DISCRETE
DATABOOK

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Manufactured under one or more of the following U.S. patents: 3083262, 3189758, 3231797, 3303356, 3317671, 3323071, 3381071, 3408542, 3421025, 3426423, 3440498, 3518750, 3519897, 3557431, 3560765, 3566218, 3571630, 3575609, 3579059, 3593069, 3597640, 3607469, 3617859, 3631312, 3633052, 3638131, 3648071, 3651565, 3693248.

Introduction

National Semiconductor has added many new transistors and product families since publication of the last handbook. Many have already been widely acclaimed by users.

In addition to small signal, bipolar and field effect transistors that have been the mainstay of our catalog, there are sections for multiple bipolar, multiple field effect and power transistors. More part numbers will be added as market needs expand.

To keep current on all new National transistors please contact your National sales representative or franchised distributor and ask to be placed on the customer mailing list.

HOW TO USE THIS CATALOG

If you know the part/type number

Turn to the standard parts listing which begins on page 9 and find the desired part number. The electrical specifications page number will be shown. The list also identifies the process number from which that product is selected and the particular package code in which it is assembled. Package codes are cross-referenced to JEDEC code on page A-19.

If performance data is required, turn to the process data sheet indicated in the standard parts listing. Process data sheets are indexed in numerical order and begin on page 6-2.

Refer to the package outlines section beginning on page A-14 for complete physical dimensions.

If you know the application

Turn to the selector guide and select a potential process type. Selector guides as follows:

Refer to the process sheet which will give you the performance specifications and a reference part type.

To convert a metal can transistor to a molded epoxy type, find the equivalent part number on page 25.

To convert a TO-105/TO-106 product type to a molded epoxy type, find the correct part number on page 26.

If you are looking for a JAN/JANTX/JANTXV type, a complete product listing for bipolar and junction FET types is on page 23.

If none of the above work, refer to the Table of Contents which contains all NSC part types organized by general applications.

In desperation—call your local National representative or field office.

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2N706J	1-2	21	02
2N708	1-2	22	18
2N718	1-15	20	02
2N718A	1-15	20	02
2N722	2-8	63	02
2N743	1-2	21	18
2N744	1-2	21	18
2N753	1-2	21	18
2N760	1-11	07	02
2N760A	1-11	07	02
2N834	1-2	21	18
2N869	2-2	64	18
2N869A	2-2	64	18
2N915	1-15	23	02
2N916	1-15	23	02
2N917	1-6	43	25
2N918	1-6	43	25
2N918J	1-6	43	25
2N918JTX	1-6	43	25
2N918JTXV	1-6	43	25
2N929	1-11	07	02
2N929A	1-11	07	02
2N929J	1-11	07	02
2N929JTX	1-11	07	02
2N930	1-11	07	02
2N930A	1-11	07	02
2N930J	1-11	07	02
2N930JTX	1-11	07	02
2N956	1-15	20	02
2N981	1-11	07	02
2N995	2-2	64	18
2N995A	2-2	64	18
2N1132	2-8	63	04
2N1420	1-15	20	04
2N1566	1-15	20	04
2N1613	1-15	20	04
2N1711	1-15	20	04
2N2017	1-28	12	10
2N2102	1-28	12	10
2N2192	1-28	12	10
2N2192A	1-28	12	10
2N2193	1-28	12	10
2N2193A	1-28	12	10
2N2195	1-28	12	10
2N2195A	1-28	12	10
2N2218	1-15	20	04
2N2218J	1-15	20	04
2N2218JTX	1-15	20	04
2N2218JTXV	1-15	20	04
2N2218A	1-16	20	04
2N2218AJ	1-16	20	04
2N2218AJTX	1-16	20	04
2N2218AJTXV	1-16	20	04
2N2219	1-16	20	04
2N2219J	1-16	20	04
2N2219JTX	1-16	20	04
2N2219JTXV	1-16	20	04
2N2219A	1-16	20	04
2N2219AJ	1-16	20	04
2N2219AJTX	1-16	20	04
2N2219AJTXV	1-16	20	04
2N2221	1-16	20	02
2N2221J	1-17	20	02
2N2221JTX	1-17	20	02
2N2221JTXV	1-17	20	02
2N2221A	1-17	20	02
2N2221AJ	1-17	20	02
2N2221AJTX	1-17	20	02
2N2221AJTXV	1-17	20	02
2N2222	1-17	20	02
2N2222J	1-17	20	02
2N2222JTX	1-17	20	02
2N2222JTXV	1-17	20	02
2N2222A	1-17	20	02
2N2222AJ	1-17	20	02
2N2222AJTX	1-17	20	02
2N2222AJTXV	1-17	20	02
2N2243	1-29	12	10
2N2243A	1-29	12	10
2N2270	1-29	12	10
2N2369	1-2	21	18
2N2369A	1-2	21	18
2N2369AJ	1-2	21	02
2N2369AJTX	1-2	21	02
2N2369AJTXV	1-2	21	02
2N2453	1-51	07	30
2N2453A	1-51	07	30
2N2484	1-11	07	02
2N2484J	1-11	07	02
2N2484JTX	1-11	07	02
2N2484JTXV	1-11	07	02
2N2504	1-12	07	02
2N2509	1-11	07	02
2N2510	1-11	07	02
2N2511	1-12	07	06
2N2586	1-12	07	02
2N2604	2-6	62	06
2N2604J	2-6	62	06
2N2604JTX	2-6	62	06
2N2604JTXV	2-6	62	06
2N2605	2-6	62	06
2N2605J	2-6	62	06
2N2605JTX	2-6	62	06
2N2605JTXV	2-6	62	06
2N2639	1-51	07	30
2N2640	1-51	07	30
2N2641	1-51	07	30
2N2642	1-51	07	30
2N2643	1-51	07	30
2N2644	1-51	07	30
2N2696	2-8	63	02
2N2712	1-17	27	74
2N2714	1-18	27	74
2N2722	1-51	07	30
2N2857	1-6	42	25
2N2857J	1-6	42	25
2N2857JTX	1-6	42	25
2N2857JTXV	1-6	42	25
2N2894	2-2	64	18
2N2894A	2-2	64	18
2N2903	1-51	07	30
2N2903A	1-51	07	30
2N2904	2-9	63	04
2N2904J	2-9	63	04
2N2904JTX	2-9	63	04
2N2904JTXV	2-9	63	04
2N2904A	2-9	63	04
2N2904AJ	2-9	63	04
2N2905AJTX	2-9	63	04
2N2904AJTXV	2-9	63	04
2N2905	2-9	63	04
2N2905J	2-9	63	04
2N2905JTX	2-9	63	04
2N2905JTXV	2-9	63	04
2N2905A	2-9	63	04
2N2905AJ	2-10	63	04
2N2905AJTX	2-10	63	04
2N2905AJTXV	2-10	63	04
2N2906	2-10	63	02
2N2906J	2-10	63	02
2N2906JTX	2-10	63	02
2N2906JTXV	2-10	63	02
2N2906A	2-10	63	02
2N2906AJ	2-10	63	02
2N2906AJTX	2-10	63	02
2N2906AJTXV	2-10	63	02
2N2907	2-10	63	02
2N2907J	2-10	63	02
2N2907JTX	2-10	63	02
2N2907JTXV	2-10	63	02
2N2907A	2-10	63	02
2N2907AJ	2-11	63	02
2N2907AJTX	2-11	63	02
2N2907AJTXV	2-11	63	02
2N2913	1-51	07	30
2N2914	1-51	07	30
2N2915	1-52	07	30
2N2915A	1-52	07	30
2N2916	1-52	07	30
2N2916A	1-52	07	30
2N2917	1-52	07	30
2N2918	1-52	07	30
2N2919	1-52	07	30
2N2919A	1 52	07	30
2N2920	1-52	07	30
2N2920J	1-52	07	30
2N2920JTX	1-52	07	30
2N2920JTXV	1-52	07	27
2N2920A	1-52	07	30
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2N2974	1-53	07	08
2N2975	1-53	07	08
2N2976	1-53	07	08
2N2977	1-53	07	08
2N2978	1-53	07	08
2N2979	1-53	07	08
2N3009	1-2	22	18
2N3011	1-2	21	18
2N3012	2-2	64	18
2N3013	1-2	22	18
2N3015	1-2	25	17
2N3019	1-29	12	10
2N3019J	1-29	12	09
2N3019JTX	1-29	12	09
2N3019JTXV	1-29	12	16
2N3020	1-30	12	10
2N3053	1-30	12	10
2N3072	2-11	63	04
2N3073	2-11	63	02
2N3107	1-30	12	10
2N3108	1-30	12	10
2N3109	1-30	12	10
2N3110	1-30	14	10
2N3114	1-30	08	10
2N3115	1-18	20	02
2N3116	1-18	20	02
2N3117	1-12	07	02
2N3120	2-11	63	04
2N3121	2-11	63	02
2N3133	2-11	63	04
2N3134	2-11	63	04
2N3135	2-11	63	02
2N3136	2-11	63	02
2N3209	2-2	64	18
2N3244	2-2	70	17
2N3245	2-2	70	17
2N3246	1-12	07	02
2N3248	2-2	64	18
2N3249	2-2	64	18
2N3250	2-11	69	02
2N3250A	2-11	69	02
2N3250AJ	2-12	69	02
2N3250AJTX	2-12	69	02
2N3250AJTXV	2-12	69	02
2N3251	2-12	69	02
2N3251A	2-12	69	02
2N3251AJ	2-12	69	02
2N3251AJTX	2-12	69	02
2N3251AJTXV	2-12	69	02
2N3252	1-2	25	17
2N3253	1-3	25	17
2N3299	1-18	20	04
2N3300	1-18	20	04
2N3301	1-18	20	02
2N3302	1-18	20	02
2N3304	2-3	65	18
2N3347	2-33	62	30
2N3348	2-33	62	30
2N3349	2-33	62	30
2N3350	2-33	62	30
2N3351	2-33	62	30
2N3352	2-33	62	30
2N3390	1-18	04	74
2N3391	1-18	04	74
2N3391A	1-19	04	74
2N3392	1-19	04	74
2N3393	1-19	04	74
2N3394	1-19	04	74
2N3395	1-19	04	74
2N3396	1-19	04	74
2N3397	1-19	04	74
2N3398	1-19	04	74
2N3414	1-19	19	74
2N3415	1-19	04	74
2N3416	1-19	04	74
2N3417	1-19	04	74
2N3444	1-3	25	17
2N3451	2-3	65	18
2N3467	2-3	70	17
2N3468	2-3	70	17
2N3478	1-6	42	25
2N3498	1-30	08	10
2N3498J	1-30	08	09
2N3498JTX	1-30	08	09
2N3498JTXV	1-30	08	09
2N3499	1-30	08	10
2N3499J	1-31	08	09
2N3499JTX	1-31	08	09
2N3499JTXV	1-31	08	09
2N3500	1-31	08	10
2N3500J	1-31	08	09
2N3500JTX	1-31	08	09
2N3500JTXV	1-31	08	09
2N3501	1-31	08	10
2N3501J	1-31	08	09
2N3501JTX	1-31	08	09
2N3501JTXV	1-31	08	09
2N3502	2-12	63	04
2N3503	2-12	63	04
2N3504	2-12	63	02
2N3505	2-12	63	02
2N3545	2-3	64	18
2N3546	2-3	64	18
2N3547	2-6	62	02
2N3548	2-6	62	02
2N3549	2-6	62	02
2N3550	2-6	62	02
2N3563	1-7	43	72
2N3564	1-7	43	72
2N3565	1-12	07	72
2N3566	1-31	14	72
2N3567	1-31	14	72
2N3568	1-31	12	72
2N3569	1-31	14	72
2N3576	2-3	64	18
2N3587	1-53	07	30
2N3600	1-7	42	25
2N3605	1-3	21	74
2N3606	1-3	21	74
2N3607	1-3	21	74
2N3634	2-19	73	10
2N3634J	2-19	73	09
2N3634JTX	2-19	73	09
2N3635	2-19	73	10
2N3635	2-19	73	09
2N3635JTX	2-19	73	09
2N3636	2-19	73	10
2N3636J	2-19	73	09
2N3636JTX	2-19	73	09
2N3637	2-19	73	10
2N3637J	2-19	73	09
2N3637JTX	2-19	73	09
2N3638	2-12	63	72
2N3638A	2-13	63	72
2N3639	2-3	65	72
2N3640	2-3	65	72
2N3641	1-19	19	72
2N3642	1-19	19	72
2N3643	1-19	19	72
2N3644	2-13	63	72
2N3646	1-3	22	72
2N3662	1-7	43	74
2N3663	1-7	43	74
2N3665	1-31	12	10
2N3666	1-32	12	10
2N3678	1-19	20	04
2N3691	1-20	23	72
2N3692	1-20	23	72
2N3693	1-20	27	72
2N3694	1-20	27	72
2N3700	1-32	12	02
2N3700J	1-32	12	02
2N3700JTX	1-32	12	02
2N3700JTXV	1-32	12	02
2N3702	2-13	63	74
2N3703	2-13	63	74
2N3704	1-20	13	74
2N3705	1-20	13	74
2N3706	1-20	13	74
2N3707	1-12	07	74
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2N3742	1-32	48	10
2N3793	1-20	13	74
2N3794	1-20	13	74
2N3799	2-6	62	02
2N3800	2-34	62	08
2N3806	2-34	62	30
2N3807	2-34	62	30
2N3808	2-34	62	30
2N3809	2-34	62	30
2N3810	2-34	62	30
2N3810J	2-34	62	30
2N3810JTX	2-34	62	30
2N3810JTXV	2-34	62	30
2N3810A	2-35	62	30
2N3811	2-35	62	30
2N3811J	2-35	62	30
2N3811JTX	2-35	62	30
2N3811JTXV	2-35	62	30
2N3811A	2-35	62	30
2N3825	1-7	43	74
2N3827	1-20	27	74
2N3858	1-20	27	74
2N3858A	1-12	07	74
2N3859	1-20	27	74
2N3859A	1-12	07	74
2N3860	1-20	27	74
2N3877	1-12	07	74
2N3877A	1-13	07	74
2N3900	1-13	07	74
2N3900A	1-13	07	74
2N3901	1-13	07	74
2N3903	1-20	23	72
2N3904	1-20	23	72
2N3905	2-13	66	72
2N3906	2-13	66	72
2N3907	1-53	07	30
2N3908	1-53	07	30
2N3932	1-7	42	25
2N3933	1-7	42	25
2N3945	1-32	12	10
2N3946	1-21	23	02
2N3947	1-21	23	02
2N3962	2-6	62	02
2N3963	2-7	62	02
2N3964	2-7	62	02
2N3965	2-7	62	02
2N4013	1-4	25	02
2N4014	1-4	25	02
2N4015	2-35	62	30
2N4016	2-35	62	30
2N4017	2-35	62	30
2N4018	2-36	62	30
2N4019	2-36	62	30
2N4020	2-36	62	30
2N4021	2-36	62	30
2N4023	2-36	62	30
2N4024	2-36	62	30
2N4025	2-36	62	30
2N4030	2-20	67	10
2N4031	2-20	67	10
2N4032	2-20	67	10
2N4033	2-20	67	10
2N4036	2-20	67	10
2N4037	2-20	67	10
2N4047	1-4	25	17
2N4058	2-7	62	74
2N4059	2-7	62	74
2N4061	2-7	62	74
2N4062	2-7	62	74
2N4121	2-13	66	72
2N4122	2-13	66	72
2N4123	1-21	23	72
2N4124	1-21	23	72
2N4125	2-13	66	72
2N4126	2-13	66	72
2N4134	1-7	44	25
2N4140	1-21	19	72
2N4141	1-21	19	72
2N4142	2-13	63	72
2N4143	2-13	63	72
2N4208	2-3	65	18
2N4209	2-3	65	18
2N4234	2-20	67	10
2N4235	2-20	67	10
2N4236	2-20	67	10
2N4237	1-32	14	10
2N4248	2-7	62	72
2N4249	2-7	62	72
2N4250	2-7	62	72
2N4250A	2-7	62	72
2N4252	1-7	42	25
2N4258	2-3	65	72
2N4258A	2-3	65	72
2N4259	1-7	42	25
2N4274	1-4	21	72
2N4275	1-4	21	72
2N4286	1-13	07	74
2N4287	1-13	07	74
2N4288	2-7	62	74
2N4289	2-7	62	74
2N4290	2-13	63	74
2N4291	2-14	63	74
2N4292	1-7	43	74
2N4293	1-7	43	74
2N4294	1-4	21	74
2N4295	1-4	21	74
2N4314	2-20	67	10
2N4354	2-20	67	72
2N4355	2-20	67	72
2N4356	2-21	67	72
2N4384	1-13	07	02
2N4386	1-13	07	02
2N4400	1-21	13	72
2N4401	1-21	13	72
2N4402	2-14	63	72
2N4403	2-14	63	72
2N4409	1-13	07	72
2N4410	1-13	07	72
2N4424	1-26	04	74
2N4916	2-14	66	72
2N4917	2-14	66	72
2N4918	2-26	3C	38
2N4919	2-26	3C	38
2N4920	2-26	3C	38
2N4921	1-40	2C	38
2N4922	1-40	2C	38
2N4923	1-40	2C	38
2N4924	1-32	12	10
2N4926	1-32	48	10
2N4927	1-32	48	10
2N4944	1-26	19	72
2N4945	1-26	19	72
2N4946	1-26	19	72
2N4951	1-26	13	74
2N4952	1-26	13	74
2N4953	1-26	13	74
2N4954	1-26	13	74
2N4964	2-8	62	72
2N4965	2-8	62	72
2N4966	1-13	07	72
2N4967	1-13	07	72
2N4968	1-13	07	72
2N4969	1-26	19	72
2N4970	1-26	19	72
2N4971	2-14	63	72
2N4972	2-14	63	72
2N5022	2-4	70	17
2N5023	2-4	70	17
2N5030	1-4	21	74
2N5056	2-4	64	18
2N5057	2-4	64	18
2N5086	2-8	62	72
2N5087	2-8	62	72
2N5088	1-13	07	72
2N5089	1-13	07	72
2N5127	1-26	27	72
2N5128	1-26	19	72
2N5129	1-26	19	72
2N5130	1-7	43	72
2N5131	1-26	27	72
2N5132	1-26	27	72
2N5133	1-13	07	72
2N5134	1-4	21	72
2N5135	1-26	19	72
2N5136	1-26	19	72
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2N5180	1-7	42	25	2N6035	2-26	3J	38	2SC460	4-2	27	74
2N5189	1-4	25	17	2N6036	2-26	3J	38	2SC461	4-2	27	74
2N5190	1-40	2E	38	2N6037	1-42	2J	38	2SC463	4-2	44	25
2N5191	1-40	2E	38	2N6038	1-42	2J	38	2SC464	4-2	42	25
2N5192	1-41	2E	38	2N6039	1-42	2J	38	2SC466	4-2	42	25
2N5193	2-26	3E	38	2N6098	1-42	4A	37	2SC495	4-2	14	38
2N5194	2-26	3E	38	2N6099	1-42	4A	37	2SC535	4-2	42	74
2N5195	2-26	3E	38	2N6100	1-42	4A	37	2SC536NP	6-4	04	74
2N5209	1-14	07	72	2N6101	1-42	4A	37	2SC562	4-3	45	28
2N5210	1-14	07	72	2N6102	1-42	4A	37	2SC563	4-3	47	28
2N5219	1-27	27	72	2N6103	1-42	4A	37	2SC644	4-3	04	74
2N5220	1-27	13	72	2N6106	2-26	5E(3E)	37	2SC682	4-3	44	25
2N5221	2-14	63	72	2N6107	2-26	5E(3E)	37	2SC683	4-3	44	25
2N5222	1-7	49	71	2N6108	2-26	5E(3E)	37	2SC684	4-3	42	74
2N5223	1-27	27	72	2N6109	2-26	5E(3E)	37	2SC717	4-3	43	74
2N5224	1-5	21	72	2N6110	2-26	5E(3E)	37	2SC733	4-3	04	74
2N5225	1-27	13	72	2N6111	2-27	5E(3E)	37	2SC735	4-3	19	74
2N5226	2-14	63	72	2N6121	1-42	4E(2E)	37	2SC761	4-3	41	25
2N5227	2-8	62	72	2N6122	1-43	4E(2E)	37	2SC762	4-3	41	25
2N5232	1-14	07	74	2N6123	1-43	4E(2E)	37	2SC784	4-3	42	74
2N5232A	1-14	07	74	2N6124	2-27	5E(3E)	37	2SC785	4-3	42	74
2N5293	1-41	4E(2E)	37	2N6125	2-27	5E(3E)	37	2SC828	4-3	04	74
2N5294	1-41	4E(2E)	37	2N6126	2-27	5E(3E)	37	2SC829	4-3	23	74
2N5295	1-41	4E(2E)	37	2N6129	1-43	4E(2E)	37	2SC947	4-3	41	25
2N5296	1-41	4E(2E)	37	2N6130	1-43	4E(2E)	37	2SC1047	4-3	42	74
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2N5298	1-41	4E(2E)	37	2N6132	2-27	5E(3E)	37	2SC1205	4-4	27	74
2N5305	1-50	05	74	2N6133	2-27	5E(3E)	37	2SC1215	4-4	42	74
2N5306	1-50	05	74	2N6134	2-27	5E(3E)	37	2SC1306	4-4	35	37
2N5307	1-50	05	74	2N6288	1-43	4E(2E)	37	2SC1318	4-4	62	74
2N5308	1-50	05	74	2N6289	1-43	4E(2E)	37	2SC1335	4-4	04	74
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2N5400	2-15	74	72	2N6293	1-43	4E(2E)	37	2SC1678	4-4	35	37
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2N5493	1-41	4E(2E)	37	2N6489	2-27	5A	37	40238	1-8	42	25
2N5494	1-41	4E(2E)	37	2N6490	2-27	5A	37	40239	1-8	42	25
2N5495	1-41	4E(2E)	37	2N6491	2-27	5A	37	40240	1-8	42	25
2N5496	1-41	4E(2E)	37	2N6554	2-21	78	35	40242	1-8	42	25
2N5497	1-41	4E(2E)	37	2N6555	2-21	78	35	40243	1-8	42	25
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2N5551	1-27	16	72	2SA719	4-2	63	74	40245	1-8	42	25
2N5655	1-42	36	38	2SA738	4-2	77	38	40246	1-8	42	25
2N5656	1-42	36	38	2SC313	4-2	42	25	40314	1-33	12	10
2N5657	1-42	36	38	2SC372	4-2	27	74	40319	2-21	67	10
2N5769	1-5	21	72	2SC380	4-2	23	74	40321	1-33	48	10
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92PU45A	1-50	05	91
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92PU51A	2-21	77	91
92PU55	2-21	79	91
92PU56	2-21	79	91
92PU57	2-22	79	91
92PU100	1-34	39	91
92PU200	2-22	79	91
92PU391	1-34	48	91
92PU392	1-34	48	91
92PU393	1-34	48	91
BC107	3-2	04	02
BC107A	3-2	04	02
BC107B	3-2	04	02
BC108	3-2	04	02
BC108A	3-2	04	02
BC108B	3-2	04	02
BC108C	3-2	04	02
BC109	3-2	04	02
BC109B	3-2	04	02
BC109C	3-2	04	02
BC140	3-2	14	10
BC140-6	3-2	14	10
BC140-10	3-2	14	10
BC140-16	3-2	14	10
BC141	3-2	14	10
BC141-6	3-2	14	10
BC141-10	3-2	14	10
BC143	3-2	63	03
BC146-1	3-3	04	74
BC160	3-3	67	10
BC160-6	3-3	67	10
BC160-10	3-3	67	10
BC160-16	3-3	67	10
BC161	3-3	67	10
BC161-6	3-3	67	10
BC161-10	3-3	67	10
BC161-16	3-3	67	10
BC167	3-3	04	74
BC167A	3-3	04	74
BC167B	3-3	04	74
BC168	3-3	04	74
BC168A	3-3	04	74
BC168B	3-3	04	74
BC168C	3-4	04	74
BC169	3-4	04	74
BC169B	3-4	04	74
BC169C	3-4	04	74
BC177	3-4	71	02
BC177A	3-4	71	02
BC177B	3-4	71	02
BC177VI	3-4	71	02
BC178	3-4	71	02
BC178A	3-4	71	02
BC178B	3-4	71	02
BC179	3-4	71	02
BC179A	3-4	71	02
BC179B	3-5	71	02
BC182	3-5	04	77
BC182A	3-5	04	77
BC182B	3-5	04	77
BC182L	3-5	04	74
BC182LA	3-5	04	74
BC182LB	3-5	04	74
BC183	3-5	04	77
BC183A	3-5	04	77
BC183B	3-5	04	77
BC183C	3-5	04	77
BC183L	3-6	04	74
BC183LA	3-6	04	74
BC183LB	3-6	04	74
BC183LC	3-6	04	74
BC184	3-6	04	77
BC184B	3-6	04	77
BC184C	3-6	04	77
BC184L	3-6	04	74
BC184LB	3-6	04	74
BC184LC	3-6	04	74
BC212	3-6	63	77
BC212A	3-6	63	77
BC212B	3-6	63	77
BC212L	3-7	63	74
BC212LA	3-7	63	74
BC212LB	3-7	63	74
BC213	3-7	63	77
BC213A	3-7	63	77
BC213B	3-7	63	77
BC213C	3-7	63	77
BC213L	3-7	63	74
BC213LA	3-7	63	74
BC213LB	3-7	63	74
BC213LC	3-8	63	74
BC214	3-8	63	77
BC214A	3-8	63	77
BC214B	3-8	63	77
BC214C	3-8	63	77
BC214L	3-8	63	74
BC214LB	3-8	63	74
BC214LC	3-8	63	74
BC237-92	3-8	04	77
BC237A-92	3-8	04	77
BC237B-92	3-8	04	77
BC238-92	3-9	04	77
BC238A-92	3-9	04	77
BC238B-92	3-9	04	77
BC238C-92	3-9	04	77
BC239-92	3-9	04	77
BC239B-92	3-9	04	77
BC239C-92	3-9	04	77
BC261A	3-9	71	02
BC261B	3-10	71	02
BC262A	3-10	71	02
BC262B	3-10	71	02
BC263A	3-10	71	02
BC263B	3-10	71	02
BC307-92	3-10	71	77
BC307A-92	3-10	71	77
BC307B-92	3-10	71	77
BC308-92	3-10	71	77
BC308A-92	3-10	71	77
BC308B-92	3-11	71	77
BC308C-92	3-11	71	77
BC309-92	3-11	71	77
BC309B-92	3-11	71	77
BC309C-92	3-11	71	77
BC317	3-11	04	72
BC317A	3-11	04	72
BC317B	3-11	04	72
BC318	3-11	04	72
BC318A	3-11	04	72
BC318B	3-12	04	72
BC318C	3-12	04	72
BC319	3-12	04	72
BC319B	3-12	04	72
BC319C	3-12	04	72
BC327	3-12	67	77
BC327-10	3-12	67	77
BC327-16	3-12	67	77
BC327-25	3-12	67	77
BC328	3-12	67	77
BC328-10	3-12	67	77
BC328-16	3-12	67	77
BC328-25	3-12	67	77
BC337	3-12	14	77
BC337-10	3-12	14	77
BC337-16	3-12	14	77
BC337-25	3-12	14	77
BC338	3-13	14	77
BC338-10	3-13	14	77
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BC485B	3-13	14	77
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BC557B	3-14	71	77
BC558	3-15	71	77
BC558A	3-15	71	77
BC558B	3-15	71	77
BC558C	3-15	71	77
BC559	3-15	71	77
BC559A	3-15	71	77
BC559B	3-15	71	77
BC559C	3-15	71	77
BC560	3-15	71	77
BC560A	3-15	71	77
BC560B	3-15	71	77
BC560C	3-16	71	77
BCY56	3-16	04	02
BCY57	3-16	04	02
BCY58	3-16	04	02
BCY58-7	3-16	04	02
BCY58-8	3-16	04	02
BCY58-9	3-16	04	02
BCY58-10	3-16	04	02
BCY59	3-16	04	02
BCY59-7	3-16	04	02
BCY59-8	3-16	04	02
BCY59-9	3-16	04	02
BCY59-10	3-16	04	02
BCY70	3-17	71	02
BCY71	3-17	71	02
BCY71A	3-17	71	02
BCY72	3-17	71	02
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BD136	3-17	77	38
BD137	3-17	38	38
BD138	3-17	78	38
BD139	3-17	39	38
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BD201	3-17	4A	37
BD202	3-17	5A	37
BD233	3-17	2C	37
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BD240A	3-18	5F(3C)	37
BD240B	3-18	5F(3C)	37
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BD370A-25	3-19	78	91
BD370B	3-19	78	91
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BD370B-25	3-19	78	91
BD370C	3-19	78	91
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BD370C-16	3-19	78	91
BD370D	3-19	79	91
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BD371A	3-20	37	91
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BD371A-16	3-20	37	91
BD371A-25	3-20	37	91
BD371B	3-20	38	91
BD371B-10	3-20	38	91
BD371B-16	3-20	38	91
BD371B-25	3-20	38	91
BD371C	3-20	38	91
BD371C-6	3-20	38	91
BD371C-10	3-20	38	91
BD371C-16	3-20	38	91
BD371D	3-20	39	91
BD371D-6	3-20	39	91
BD371D-10	3-20	39	91
BD372A	3-20	78	90
BD372A-10	3-20	78	90
BD372A-16	3-20	78	90
BD372A-25	3-21	78	90
BD372B	3-21	78	90
BD372B-10	3-21	78	90
BD372B-16	3-21	78	90
BD372B-25	3-21	78	90
BD372C	3-21	78	90
BD372C-6	3-21	78	90
BD372C-10	3-21	78	90
BD372C-16	3-21	78	90
BD372D	3-21	79	90
BD372D-6	3-21	79	90
BD372D-10	3-21	79	90
BD373A	3-21	37	90
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BD373A-16	3-21	37	90
BD373A-25	3-21	37	90
BD373B	3-22	38	90
BD373B-10	3-22	38	90
BD373B-16	3-22	38	90
BD373B-25	3-22	38	90
BD373C	3-22	38	90
BD373C-6	3-22	38	90
BD373C-10	3-22	38	90
BD373C-16	3-22	38	90
BD373D	3-22	39	90
BD373D-6	3-22	39	90
BD373D-10	3-22	39	90
BD375	3-22	38	38
BD375-6	3-22	38	38
BD375-10	3-22	38	38
BD375-16	3-22	38	38
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BD376-6	3-22	78	38
BD376-10	3-22	78	38
BD376-16	3-23	78	38
BD376-25	3-23	78	38
BD377	3-23	38	38
BD377-6	3-23	38	38
BD377-10	3-23	38	38
BD377-16	3-23	38	38
BD377-25	3-23	38	38
BD378	3-23	78	38
BD378-6	3-23	78	38
BD378-10	3-23	78	38
BD378-16	3-23	78	38
BD378-25	3-23	78	38
BD379	3-23	39	38
BD379-6	3-23	39	38
BD379-10	3-23	39	38
BD379-16	3-23	39	38
BD379-25	3-24	39	38
BD380	3-24	79	38
BD380-6	3-24	79	38
BD380-10	3-24	79	38
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BD380-25	3-24	79	38
BD433	3-24	2E	38
BD434	3-24	3E	38
BD435	3-24	2E	38
BD436	3-24	3E	38
BD437	3-24	2E	38
BD438	3-24	3E	38
BD439	3-24	2E	38
BD440	3-24	3E	38
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BD442	3-25	3E	38
BD533	3-25	4E(2E)	37
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BD677	3-26	2J	38
BD677A	3-26	2J	38
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BD678A	3-26	3J	38
BD679	3-26	2J	38
BD679A	3-26	2J	38
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BF167	3-26	45	28
BF180	3-26	41	25
BF181	3-26	41	25
BF182	3-26	41	25
BF194	3-26	46	78
BF195	3-27	46	78
BF196	3-27	45	78
BF197	3-27	47	78
BF198	3-27	45	78
BF199	3-27	47	78
BF200	3-27	41	25
BF233-2	3-27	49	71
BF233-3	3-27	49	71
BF233-4	3-27	49	71
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BF240	3-27	47	78
BF241	3-27	47	78
BF254	3-27	46	78
BF255	3-27	46	78
BF257	3-27	48	10
BF258	3-27	48	10
BF259	3-28	48	10
BF457	3-28	48	38
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NA02H	5-4	60	77
NA11E	5-8	09	72
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NA12F	5-8	60	74
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NA22F	5-12	77	74
NA22H	5-12	77	77
NA22X	5-12	77	91
NA22Y	5-12	77	90
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NA31M	5-16	37	36
NA31X	5-16	37	91
NA31Y	5-16	37	90
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NA32M	5-16	77	36
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NB211X	5-48	19	91
NB211Y	5-48	19	90
NB212E	5-48	19	72
NB212F	5-48	19	74
NB212H	5-48	19	77
NB212X	5-48	19	91
NB212Y	5-48	19	90
NB213E	5-48	19	72
NB213F	5-48	19	74
NB213H	5-48	19	77
NB213X	5-48	19	91
NB213Y	5-48	19	90
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NB221X	5-48	63	91
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NB222X	5-48	63	91
NB222Y	5-48	63	90
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NB223H	5-48	63	77
NB223X	5-48	63	91
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NB312K	5-52	38	35
NB312M	5-52	38	36
NB312X	5-52	38	91
NB312Y	5-52	38	90
NB313E	5-52	38	72
NB313F	5-52	38	74
NB313H	5-52	38	77
NB313K	5-52	38	35
NB313M	5-52	38	36
NB313X	5-52	38	91
NB313Y	5-52	38	90
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NB321F	5-52	78	74
NB321H	5-52	78	77
NB321K	5-52	78	35
NB321M	5-52	78	36
NB321X	5-52	78	91
NB321Y	5 52	78	90
NB322E	5-52	78	72
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NB322H	5-52	78	77
NB322K	5-52	78	35
NB322M	5-52	78	36
NB322X	5-52	78	91
NB322Y	5-52	78	90
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PF5101	51/72	8-5	9-5
PF5102	51/72	8-5	9-5
PF5103	51/72	8-5	9-5
PN3684	52/72	8-8	9-7
PN3685	52/72	8-8	9-7
PN3686	52/72	8-8	9-7
PN3687	52/72	8-8	9-7
PN4091	51/72	8-3	9-5
PN4092	51/72	8-3	9-5
PN4093	51/72	8-3	9-5
PN4220	55/72	8-8	9-11
PN4221	55/72	8-8	9-11
PN4222	55/72	8-8	9-11
PN4223	50/72	8-5	9-2
PN4224	50/72	8-5	9-2
PN4302	52/72	8-8	9-7
PN4303	52/72	8-8	9-7
PN4304	52/72	8-8	9-7
PN4342	89/71	8-13	9-22
PN4360	89/71	8-13	9-22
PN4391	51/72	8-3	9-5
PN4392	51/72	8-3	9-5
PN4393	51/72	8-3	9-5
PN4416	50/72	8-5	9-2
PN4856	51/72	8-3	9-5
PN4857	51/72	8-3	9-5
PN4858	51/72	8-3	9-5
PN4859	51/72	8-3	9-5
PN4860	51/72	8-3	9-5
PN4861	51/72	8-3	9-5
PN5033	89/71	8-13	9-22
PN5163	50/72	8-8	9-2
TIS58	50/74	8-8	9-2
TIS59	50/74	8-8	9-2
TIS73	51/77	8-3	9-5
TIS74	51/77	8-3	9-5
TIS75	51/77	8-3	9-5
U1897E	51/72	8-3	9-5
U1898E	51/72	8-3	9-5
U1899E	51/72	8-3	9-5
U231	83/12	8-9	9-15
U232	83/12	8-9	9-15
U233	83/12	8-9	9-15
U234	83/12	8-9	9-15
U235	83/12	8-9	9-15
U257	93/24	8-10	9-28
U301	88/11	8-13	9-20
U304	88/11	8-12	9-20
U305	88/11	8-12	9-20
U306	88/11	8-12	9-20
U308	92/07	8-5	9-26
U309	92/07	8-5	9-26
U310	92/07	8-5	9-26
U312	90/07	8-5	9-24
U320	58/09	8-5	9-13
U321	58/09	8-5	9-13
U322	58/09	8-5	9-13
U401	†98/12	8-9	9-36
U402	†98/12	8-9	9-36
U403	†98/12	8-9	9-36
U404	†98/12	8-9	9-36
U405	†98/12	8-9	9-36
U406	†98/12	8-9	9-36
U421	†86/24	8-11	9-19
U422	†86/24	8-11	9-19
U423	†86/24	8-11	9-19
U424	†86/24	8-11	9-19
U425	†86/24	8-11	9-19
U426	†86/24	8-11	9-19
U430	92/24	8-10	9-26
U431	92/24	8-10	9-26

†Process in development

MIL-STD Qualifications

MIL-STD-19500 Qualifications

TYPE	DETAIL SPEC.	QUALIFICATION		
		JAN	JTX	JTXV
2N918	301	X	X	X
2N929	253	X	X	
2N930	253	X	X	
2N2218	251	X	X	X
2N2218A	251	X	X	X
2N2219	251	X	X	X
2N2219A	251	X	X	X
2N2221	255	X	X	X
2N2221A	255	X	X	X
2N2222	255	X	X	X
2N2222A	255	X	X	X
2N2369A	317	X	X	X
2N2484	376	X	X	X
2N2604	354	X	X	X
2N2605	354	X	X	X
2N2608	295	X	X	X
2N2857	343	X	X	X
2N2904	290	X	X	X
2N2904A	290	X	X	X
2N2905	290	X	X	X
2N2905A	290	X	X	X
2N2906	291	X	X	X
2N2906A	291	X	X	X
2N2907	291	X	X	X
2N2907A	291	X	X	X
2N2920	355	X	X	X
2N3019	391	X	X	X
2N3250A	323	X	X	X
2N3251A	323	X	X	X
2N3498	366	X	X	X
2N3499	366	X	X	X
2N3500	366	X	X	X
2N3501	366	X	X	X
2N3700	391	X	X	X
2N3810	366	X	X	X
2N3811	366	X	X	X
2N3823	375	X	X	X
2N4091	431	X	X	
2N4092	431	X	X	
2N4093	431	X	X	
2N4856	385	X	X	X
2N4857	385	X	X	X
2N4858	385	X	X	X
2N4859	385	X	X	X
2N4860	385	X	X	X
2N4861	385	X	X	X
2N5114	476	X	X	X
2N5115	476	X	X	X
2N5116	476	X	X	X

JANTX, TXV, NX and NXV Processing

The 100% reliability pre-conditioning on JANTX parts (vs no pre-conditioning of JAN parts) has resulted in a significant improvement in field reported failure rates.

National Semiconductor also offers JANTXV types (JANTX with 100% preseal visual inspection per MIL-STD-750 Method 2072) per the above list.

All hermetically sealed transistors in this catalog (where JANTX or JANTXV specifications do not exist) are available with TX and TXV type 100% processing as NX and NXV types respectively; e.g., NX2N4033 is 2N4033 processed per the flow plans on this page.

Production Process

- Raw Material
- Factory Processing
Visual Inspection AS1050T
- Inspection Lot Formed at
Final Assembly Operation

100% Process Conditioning

- Preseal Visual MIL-STD-750,
Method 2072 (Note 1)
- High Temp. Storage
24 Hr. 200°C
- Temp. Cycling
10 Cycles −65°C to 200°C
Min. of 15 min. in each
Extreme
- Reverse Bias Burn-In
Time and Conditions per Spec.
- Acceleration
Y_1 orientation
20,000 G min.
- Fine + Gross Hermetic
Seal Tests per spec

**100% Burn-In
(Note 3)**

- Measurement of specified
parameters per spec.
- 168 hr. Operating Life
at Max. rated conditions
- Measurement of Parameters
to determine delta per spec

Inspection Test to Verify LTPD

- Group A – Electrical
Test per Spec
- Group B
1. Environmental Testing
2. High Temp. Life
3. Steady State Operation Life
- Group C
per Spec

Note 1: JANTXV types only.

Note 2: JANTX and JANTXV types only.

Note 3: MIL-STD-19500 was under revision at the time of the publication of this document. Contact the factory for information regarding any changes made by this revision.

Bipolar Transistor and FET Dice

DICE

Standard types from National's transistor families are available in unencapsulated die form for use in hybrid circuits.

FEATURES

- 100% probed and guaranteed to 10% LTPD for key 2N parameters.
  a. BV_{CBO}, BV_{CEO}, BV_{EBO} and h_{FE} for bipolar transistors.
  b. BV_{GSS}, I_{DSS}, I_{GSS}*, R_{ON}*, Y_{fs}, $V_{GS(off)}$ for FETs.
- Minimum 60% yield to all unprobed 2N parameters.
- 100% visual inspection guaranteed to 10% LTPD for criteria equivalent to MIL-STD-883 Method 2010.
- Gold backing on all types.
- Shipment in waffle carriers.
- Die geometries shown in process section of catalog. Base Pad is identified by adjacent metallized circle on all interdigitated geometries (e.g., see Process 21).

ALL STANDARD TYPES (see index for page listing specification)

***FET NOTE:**

Leakages (I_{GSS})	$\leq$ 100 pA	10% AQL
$R_{DS(on)}$	$\leq 10\Omega$	10% AQL

Bipolar Transistor Equivalents List

METAL P/N	PLASTIC EQUIVALENT	ELECTRICAL EQUIVALENCY*	PROCESS	METAL P/N	PLASTIC EQUIVALENT	ELECTRICAL EQUIVALENCY*	PROCESS
2N697	2N4400	A	13	2N2904A	TN2904A	E	63
2N706	MPS706	E	21	2N2905	TN2905	E	63
2N708	MPS3646	N	22	2N2905A	TN2905A	E	63
2N718	2N4400	A	13	2N2906	PN2906	E	63
2N722	PN2906	N	63	2N2906A	PN2906A	E	63
2N744	PN2369	N	21	2N2907	PN2907	E	63
2N753	PN2369	N	21	2N2907A	PN2907A	E	63
2N760A	2N4409	N	07	2N3009	MPS3646	N	22
2N834	MPS834	E	21	2N3011	PN2369	N	21
2N869A	MPS3640	A	65	2N3012	MPS3640	A	65
2N915	MPS6565	A	27	2N3013	MPS3646	E	22
2N917	MPS3563	E	43	2N3019	TN3019	E	12
2N918	PN918	E	43	2N3020	TN3020	E	12
2N929	2N4409	N	07	2N3053	TN3053	E	12
2N930	PN930	E	07	2N3117	2N5210	N	07
2N956	PN2222A	N	19	2N3133	MPS3703	N	63
2N995A	MPS3640	A	65	2N3134	MPS3645	N	63
2N1132	PN2906	N	63	2N3135	MPS3703	N	63
2N1613	PN2221A	N	19	2N3136	MPS3645	N	63
2N1711	PN2222A	N	19	2N3250	2N3905	A	66
2N2218	TN2218	E	19	2N3251	2N3906	A	66
2N2218A	TN2218A	E	19	2N3300	2N4401	A	13
2N2219	TN2219	E	19	2N3301	2N4400	A	13
2N2219A	TN2219A	E	19	2N3302	2N4401	A	13
2N2221	PN2221	E	19	2N3304	MPS3639	A	65
2N2221A	PN2221A	E	19	2N3724	TN3724	E	25
2N2222	PN2222	E	19	2N3725	TN3725	E	25
2N2222A	PN2222A	E	19	2N3944	2N3903	N	23
2N2369	PN2369	E	21	2N3947	2N3904	N	23
2N2369A	PN2369A	E	21	2N3962	2N5086	N	62
2N2483	2N5209	N	07	2N3964	2N5087	N	62
2N2484	2N5210	N	07	2N3965	2N5087	N	62
2N2604	2N5086	N	62	2N4033	TN4033	E	67
2N2605	2N5086	N	62	2N4036	TN4036	E	67
2N2894	MPS3640	A	65	2N4037	TN4037	E	67
2N289A	MPS3639	A	65	2N4208	MPS3640	N	65
2N2904	TN2904	E	63	2N4209	MPS3640	N	65

*E = Exact electrical equivalent
N = Near electrical equivalent
A = Approximate equivalent
Note: On "N" and "A" categories please refer to device specification section for deviation from metal can specifications.

This list is for use when an alternative to a metal can transistor is needed.

To facilitate conversions on the most popular types National is offering the "PN" series, TO-92 devices that use the same die type and are screened to same electrical specifications. The TO-92 transistors produced by National Semiconductor are the most advanced Plastic Transistors ever manufactured. They utilize epoxy B encapsulation and a copper lead frame, to give a power dissipation of 625 mW @ T_A = 25°C. These transistors provide electrical performance and reliability equivalent to their metal can versions in most applications where T_A does not exceed 150°C.

Conversion of TO-105/TO-106 to TO-92

National has chosen to no longer produce the TO-105/106 plastic transistor line. The decision to drop this line was based on two major factors: cost and performance.

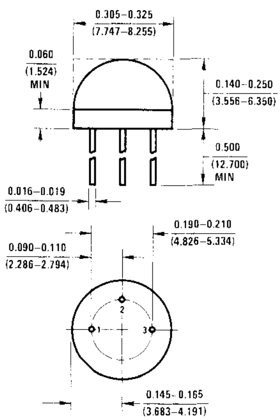
The TO-92 is the most advanced transistor offered today. With its automated assembly, it has the lowest potential cost. By contrast, the TO-105/106 is a hand-assembled product and its cost is tied to ever-increasing labor costs. One can save 20% to 50% by using TO-92 equivalents.

Our TO-92 is encapsulated in "Epoxy B" and has a copper lead frame. This is *the* superior TO-92 available today. As compared with TO-105/106, our TO-92 has better than twice the power dissipation of either package.

We have done several things in order to make this conversion as easy as possible. We are offering a series on "PN" ("PN" and "J" in FETs) part numbers that have exactly the same number as the original part; i.e., 2N3565 becomes a PN3565. These PN types use the same chip and are screened to the same electrical specification as the original part. The original parts have a pin circle, TO-106 = TO-18 and TO-105 = TO-5, so we will supply TO-92 lead formed to the appropriate configuration at no extra charge. If you enter an order to the old part number, our computer will automatically convert it to the correct PN number *with* the correct lead form; i.e., 2N3565 becomes PN3565-18. In the case of some of the less popular types, we have converted to the nearest part type using the same chip. Please use the conversion chart on the next page as a guide.

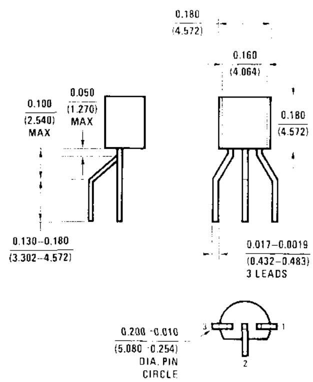
It is our intent to service our customers with the highest quality and most cost-effective product available.

TO-105

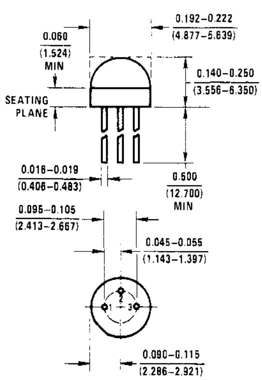


PIN	T
1	E
2	B
3	C

TO-92 Device to TO-5 Pin Circle

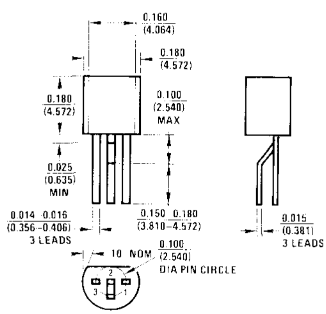


TO-106



PIN	FET	T
1	S	E
2	D	B
3	G	C

TO-92 Device to TO-18 Pin Circle



Conversion of TO-105/TO-106 to TO-92 (Continued)

Bipolar

TO-105/106	TO-92	TO-105/106	TO-92	TO-105/106	TO-92
EN2222	PN2222-18	2N3692	PN3692-18	2N4965	2N5086-18
EN2369A	PN2369A-18	2N3693	MPS3693-18	2N4966	2N5209-18
EN2484	PN2484-18	2N3694	PN3694-18	2N4967	2N5210-18
3N2907	PN2907-18	2N4121	PN4121-18	2N4968	2N5209-18
EN918	PN918-18	2N4122	PN4122-18	2N4969	PN2221-18
EN930	PN930-18	2N4140	PN4140-18	2N4970	PN2222-18
SM3904	2N3904-18	2N4141	PN4141-18	2N4971	PN2906-18
SM3906	2N3906-18	2N4142	PN4142-18	2N4972	PN2907-18
2N3563	PN3563-18	2N4143	PN4143-18	2N5127	PN5127-18
2N3564	PN3564-18	2N4248	PN4248-18	2N5128	PN5128-5
2N3565	PN3565-18	2N4249	PN4249-18	2N5129	PN5129-18
2N3566	PN3566-5	2N4250	PN4250-18	2N5130	PN5130-18
2N3567	PN3567-5	2N4250A	PN4250A-18	2N5131	PN5131-18
2N3568	PN3568-5	2N4258	PN4258-18	2N5132	PN5132-18
2N3569	PN3569-5	2N4258A	PN4258A-18	2N5133	PN5133-18
2N3638	PN3638-5	2N4274	PN4274-18	2N5134	PN5134-18
2N3638A	PN3638A-5	2N4275	PN4275-18	2N5135	PN5135-18
2N3639	PN3639-18	2N4354	PN4354-5	2N5136	PN5136-5
2N3640	PN3640-18	2N4355	PN4355-5	2N5137	PN5137-18
2N3641	PN3641-5	2N4356	PN4356-5	2N5138	PN5138-18
2N3642	PN3642-5	2N4916	PN4916-18	2N5139	PN5139-18
2N3643	PN3643-5	2N4917	PN4917-18	2N5142	PN5142-18
2N3644	PN3644-5	2N4944	PN2222A-18	2N5143	PN5143-18
2N3645	PN3645-5	2N4945	PN2222A-18	2N5910	PN5910-18
2N3646	PN3646-18	2N4946	PN2222A-18		
2N3691	PN3691-18	2N4964	MPSA70-18		

FETs

TO-106	TO-92	TO-106	TO-92	TO-106	TO-92
E100	J203-18	E300	J300-18	KE4393	PN4393-18
E101	J201-18	E304	J304-18	KE4416	PN4416-18
E102	J202-18	E305	J305-18	KE4857	PN4857-18
E103	J203-18	E308	J308-18	KE4858	PN4858-18
E108	J108-18	E309	J309-18	KE4859	PN4859-18
E109	J109-18	E310	J310-18	KE4860	PN4860-18
E110	J110-18	E311	J309-18	KE4861	PN4861-18
E111	J111-18	E312	J310-18	ITE4391	PN4391-18
E112	J112-18	KE3684	PN3684-18	ITE4392	PN4392-18
E113	J113-18	KE3685	PN3685-18	ITE4393	PN4393-18
E114	J114-18	KE3686	PN3686-18	P1086E	P1086E
E174	J174-18	KE3687	PN3687-18	P1087E	P1087E
E175	J175-18	KE4091	PN4091-18	U1897E	U1897E
E176	J176-18	KE4092	PN4092-18	U1898E	U1898E
E201	J201-18	KE4093	PN4093-18	U1899E	U1899E
E202	J202-18	KE4220	PN4220-18	2N4302	PN4302-18
E203	J203-18	KE4221	PN4221-18	2N4303	PN4303-18
E210	J210-18	KE4222	PN4222-18	2N4304	PN4304-18
E211	J211-18	KE4223	PN4223-18	2N4342	PN4342-18
E212	J212-18	KE4224	PN4224-18	2N4343	PN4343-18
E270	J270-18	KE4391	PN4391-18	2N4360	PN4360-18
E271	J271-18	KE4392	PN4392-18	2N5033	PN5033
				2N5163	PN5163

Choose The Proper FET

National Semiconductor utilizes 17 different FET geometries to cover, without compromise, the full spectrum of applications. Detailed data on each process, along with a list of all part numbers manufactured from each process, is to be found in Section 9.

To further simplify the selection procedure, the FET Family Tree is included for quick identification. After narrowing down the process types, it is suggested that the process sheets and specific part number characteristics be consulted.

FET FAMILY TREE

N-CHANNEL SINGLES

GENERAL PURPOSE AMP
- P50 – g_{fs} 3–7 mmhos, I_{DSS} 1–20 mA
- P52 – g_{fs} 0.5–3 mmhos, I_{DSS} 0.1–10 mA
- P55 – g_{fs} 0.8–5 mmhos, I_{DSS} 0.5–17 mA

RF/VHF/UHF
- P50 – G_{ps} 12 dB @ 400 MHz, g_{fs} 5.5 mmhos
- P90 – G_{pt} 11 dB @ 450 MHz, g_{fs} 8 mmhos
- P92 – G_{pg} 12 dB @ 450 MHz, g_{fs} 19 mmhos

ULTRA-LOW LEAKAGE AMP
- P50 – I_{GSS} 5 pA @ 20V, g_{fs} 3–7 mmhos
- P53 – I_{GSS} 0.3 pA @ 20V, g_{fs} 0.08–0.3 mmhos

LOW FREQ-LOW NOISE AMP
- P50 – e_n 8 nV/$\sqrt{Hz}$ @ 10 Hz, C_{is} 3 pF
- P51 – e_n 6 nV/$\sqrt{Hz}$ @ 10 Hz, g_{fs} 20 mmhos

SWITCH/CHOPPER
- P50 – r_{DS} 100–500 ohms, $I_{D(OFF)}$ 5 pA
- P51 – r_{DS} 20–100 ohms, $I_{D(OFF)}$ 15 pA
- P58 – r_{DS} 3–20 ohms, $I_{D(OFF)}$ 50 pA

P-CHANNEL SINGLES

GENERAL PURPOSE AMP
- P88 – g_{fs} 4–17 mmhos, I_{DSS} 5–90 mA
- P89 – g_{fs} 1–4 mmhos, I_{DSS} 0.3–20 mA

SWITCH/CHOPPER
- P88 – r_{DS} 50–200 ohms, $I_{D(OFF)}$ 50 pA
- P89 – r_{DS} 450 ohms, $I_{D(OFF)}$ 20 pA

N-CHANNEL DUALS

GENERAL PURPOSE
- P83 – I_G 3 pA @ 20V, g_{fs} 0.85 mmho @ 0.2 mA
- P94 – I_G 1 pA @ 35V, CMRR 125 dB

ULTRA-LOW INPUT CUR
- P84 – 1 pA @ 25V, g_{fs} 175 μmho
- P86 – I_G 0.1 pA, g_{fs} 500 μmho

WIDE BAND-LOW NOISE
- P93 – g_{fs} 6 mmhos @ 5 mA, C_{is} 4.2 pF
- P96 – g_{fs} 9 mmhos @ 2 mA, C_{is} 10 pF

LOW FREQ-LOW NOISE
- P95 – e_n 8 nV/$\sqrt{Hz}$ @ 10 Hz, g_{fs} 1–4 mmhos
- P96 – e_n 7 nV/$\sqrt{Hz}$ @ 10 Hz, g_{fs} 10–22 mmhos

All values are typical

FET Application Guide

National Semiconductor manufactures a broad line of silicon Junction Field Effect Transistors (JFETs). National's JFETs provide excellent performance in many areas such as RF amplifiers, analog switching, low input current amplifiers, low noise high impedance amplifiers and outstanding matched duals for operational amplifiers input applications.

The following FET guides enable the user to determine when to use FETs and where to look for the best choice.

POPULAR PRODUCT TYPES	2N4416, 2N5485, 6 PN4416, PN4302–4	2N4856–61, 2N4391–3 PN4856–61, PN4391–3	2N4338–41, 2N3684–7	2N4117–9, 2N3452–4 2N4117A–19A	2N3821–2, 2N4221–2 2N5457–9	2N5432–4	2N5196–9, 2N5545–7 2N3954–8	2N5902–9	U421–U426	2N5018–21, P1086–7E 2N5114–6	2N2608–9, 2N5460–62	2N5397, J300	U308–10, J308–10	2N5911–12	NDF9401–10	2N5515–24, 2N6483–5	2N5564–6	2N5561–63
PROCESS DESIGNATION	50	51	52	53	55	58	83	84	86	88	89	90	92	93	94	95	96	98
Low Current Amplifier			S	P	S		P	P	P		P				P	P		P
Low Freq Ampli ≤ 100 Hz			S		S		P			S	S				P	P		P
High Freq Ampli > 100 MHz	P											P	P	P			P	
General Purpose Amplifier	P		P		P						P							
Low Noise Amp (10 Hz $\overline{e}_n$)	S	S			S	S	P								P	P	P	P
Low Noise Amp > 50 MHz	P				S							P	P	P			P	
High Frequency Mixer	P											P	P					
Dual Diff Pair							P	P	P					P	P	S	P	P
AGC Amplifier	P				P													
Electrometer Preamp				P				P	P						P			S
Microvolt Amplifier				P				P	P						P			P
Low Leakage Diode				P														
Diff/Angle Ended Inp. Stag.							P	P	P					P	P		P	P
Active Filter	P		S		P						S							
Oscillator	P		S		P						S	P	P					
Voltage Variable Resistor	P	P	S		P					P	P							P
Hybrid Chips	P	P		P	P		P	P	P	P	P				P			
Analog/Digital Switch		P				P				P							S	S
Multiplexing	P	P			S	S				P								
Choppers		P				P				P							P	
Nixie Drivers																		
Reed Relay Replacement						P												
Sub pA Dual Diff Pair								P	P									
Sample-Hold	P	P			S				S	P								P
Buffer Interface to CMOS										P	P							
Matched Switch							S							S	S		P	P
HF ≥ 400 MHz Prime												P	P					
Current Limiter		P								P								
Current Source			P	S	P						S							

P — Prime Choice S — Secondary (Alternate) Choice

FET Application Guide (Continued)

ADVANTAGES OF USING FIELD-EFFECT TRANSISTORS

APPLICATION	ADVANTAGES	FINAL ASSEMBLY WHERE USED
DC Amplifiers	High Z_{in} Low drift duals Low noise	Transducers, military guidance systems, control systems, temp indicators, multimeters
Low frequency amplifiers	Small coupling capacitors Low noise, distortion High input impedance	Sound detection, microphones, inductive transducers, hearing aids, high impedance transducers
Operational amplifiers	Summing point essentially zero. Low device noise. Less loading of transducers	Control systems, potted op amps, test equipment, medical electronics
Medium and high frequency amplifiers	Low cross modulation Low device noise	FM tuners, communication received scope inputs, most instrumentation equipment, high impedance inputs
Mixers – 100 MHz and up	Low mixing noise Low cross modulation	FM tuners, communication receivers
Oscillators	Low drift	Transmitters, receivers, organ
Logic gates	Virtually infinite fan in Simplified circuitry Zero storage time Symmetrical	Guidance controls, computer market mini military teaching aids, traffic control, telemetry
Choppers	Zero offset Low leakage currents Simplified circuitry Eliminates input transformers	Op amp modules guidance controls instrumentation equipment
AD Converters Multiplex switching (arrays) and sample hold	Improved isolation of input and output. Zero offset. Symmetrical. Low resistance Simplified circuitry	Control system, DVM's and any read-out equipment, medical electronics
Relay contact replacement	Solid state reliability Zero offset, High isolation Symmetrical No inductive spring No contact bounce High repetition rate	Test equipment, airborne equipment instrumentation market
Voltage variable resistor	Symmetrical Solid state reliability Functions as variable resistor. Low noise. High isolation Improved resolution	Organ, tone controls, control ckts to input operational amplifiers
Current limiters Sources	Two lead simplicity Wide selection range Low voltage operation	Hybrid circuits, amplifiers, power supply protection, timing ckts, voltage regulators

JFET Cross Reference Guide

This guide contains cross reference information to more than 850 Junction FETs, including many obsolete or otherwise unavailable types. Every effort has been made to recommend a replacement FET which will plug into an existing socket and work as well as the part it replaces. Let the replacement code be your guide. If you do not find a particular part in this guide and you know its specification, you should refer to "How To Use This Catalog" in this section.

REPLACEMENT CODE

- * Identical specification and pin configuration
- ● Equal or better specification, identical pin configuration
- ■ Similar specification acceptable for all but the most critical applications, similar pin configuration
- CF Consult Factory or Local Sales Representative, available on special order
- N No equivalent process

INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER
2N2386	■	2N2608
2N2386A	■	2N4381
2N2497	■	2N5021
2N2498	■	2N5021
2N2499	■	2N4381
2N2500	■	2N4381
2N2606	N	
2N2607	N	
2N2608	*	2N2608
2N2609	*	2N2609
2N2841	N	
2N2842	N	
2N2843	■	2N5020
2N2844	■	2N5020
2N3066	●	2N4340
2N3067	●	2N4338
2N3068	■	2N4338
2N3069	*	2N3069
2N3070	*	2N3070
2N3071	*	2N3071
2N3084	■	2N4340
2N3085	●	2N4340
2N3086	■	2N4340
2N3087	●	2N4340
2N3088	■	2N4339
2N3088A	■	2N4339
2N3089	●	2N4339
2N3089A	●	2N4339
2N3277	N	
2N3278	N	
2N3328	●	2N3330
2N3329	*	2N3329
2N3330	*	2N3330
2N3331	*	2N3331
2N3332	*	2N3332
2N3365	■	2N4340
2N3366	■	2N4338
2N3367	■	2N4338
2N3368	*	2N3368
2N3369	*	2N3369
2N3370	*	2N3370
2N3376	●	2N3329
2N3378	■	2N3330
2N3380	●	2N3331
2N3382	*	2N3382
2N3384	*	2N3384
2N3386	*	2N3386
2N3436	*	2N3436
2N3437	*	2N3437
2N3438	*	2N3438
2N3452	■	2N3685
2N3453	■	2N4118
2N3454	■	2N4119
2N3455	■	2N3685
2N3456	■	2N4118
2N3457	■	2N4119
2N3458	*	2N3458
2N3459	*	2N3459
2N3460	*	2N3460
2N3574	■	2N3329
2N3575	■	2N3329
2N3578	●	2N2608
2N3684	*	2N3684
2N3684A	●	2N3684
2N3685	*	2N3685
2N3685A	●	2N3685
2N3686	*	2N3686
2N3686A	●	2N3686
2N3687	*	2N3687
2N3687A	●	2N3687
2N3819	*	2N3819
2N3820	*	2N3820
2N3821	*	2N3821
2N3822	*	2N3822
2N3823	*	2N3823
2N3824	*	2N3824
2N3909	●	2N3331
2N3909A	●	2N3331
2N3921	*	2N3921
2N3922	*	2N3922
2N3954	*	2N3954
2N3954A	*	2N3954A
2N3955	*	2N3955
2N3955A	*	2N3955A
2N3956	*	2N3956
2N3957	*	2N3957
2N3958	*	2N3958
2N3966	*	2N3966

JFET Cross Reference Guide (Continued)

INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER
2N3967	*	2N3967
2N3967A	*	2N3967A
2N3968	*	2N3968
2N3968A	*	2N3968A
2N3969	*	2N3969
2N3969A	*	2N3969A
2N3970	*	2N3970
2N3971	*	2N3971
2N3972	*	2N3972
2N3993	*	2N3993
2N3993A	*	2N3993A
2N3994	*	2N3994
2N3994A	*	2N3994A
2N4082	CF	
2N4083	CF	
2N4084	*	2N4084
2N4085	*	2N4085
2N4091	*	2N4091
2N4092	*	2N4092
2N4093	*	2N4093
2N4117	*	2N4117
2N4117A	*	2N4117A
2N4118	*	2N4118
2N4118A	*	2N4118A
2N4119	*	2N4119
2N4119A	*	2N4119A
2N4139	CF	
2N4220	*	2N4220
2N4220A	*	2N4220A
2N4221	*	2N4221
2N4221A	*	2N4221A
2N4222	*	2N4222
2N4222A	*	2N4222A
2N4223	*	2N4223
2N4224	*	2N4224
2N4302	●	PN4302
2N4303	●	PN4303
2N4304	●	PN4304
2N4338	*	2N4338
2N4339	*	2N4339
2N4340	*	2N4340
2N4341	*	2N4341
2N4342	●	PN4342
2N4343	CF	
2N4360	●	PN4360
2N4381	*	2N4381
2N4382	■	2N5115
2N4391	*	2N4391
2N4392	*	2N4392
2N4393	*	2N4393
2N4416	*	2N4416
2N4416A	*	2N4416A
2N4417	N	
2N4445	●	2N5432
2N4446	●	2N5433
2N4447	●	2N5432
2N4448	●	2N5433
2N4856	*	2N4856
2N4856A	*	2N4856A
2N4857	*	2N4857
2N4857A	*	2N4857A
2N4858	*	2N4858
2N4858A	*	2N4858A
2N4859	*	2N4859
2N4859A	*	2N4859A
2N4860	*	2N4860
2N4860A	*	2N4860A
2N4861	*	2N4861
2N4861A	*	2N4861A
2N4867	CF	
2N4867A	CF	
2N4868	CF	
2N4868A	CF	
2N4869	CF	
2N4869A	CF	
2N4881	N	
2N4882	N	
2N4883	N	
2N4884	N	
2N4885	N	
2N4886	N	
2N4977	■	2N5432
2N4978	■	2N5433
2N4979	■	2N5434
2N5018	*	2N5018
2N5019	*	2N5019
2N5020	*	2N5020
2N5021	*	2N5021
2N5033	●	PN5033
2N5045	*	2N5045
2N5046	*	2N5046
2N5047	*	2N5047
2N5078	*	2N5078
2N5103	*	2N5103
2N5104	*	2N5104
2N5105	*	2N5105
2N5114	*	2N5114
2N5115	*	2N5115
2N5116	*	2N5116
2N5163	*	2N5163
2N5196	*	2N5196
2N5197	*	2N5197
2N5198	*	2N5198
2N5199	*	2N5199
2N5245	*	2N5245
2N5246	*	2N5246
2N5247	*	2N5247
2N5248	*	2N5248
2N5265	CF	
2N5266	CF	
2N5267	CF	
2N5268	CF	
2N5269	CF	
2N5270	CF	

JFET Cross Reference Guide (Continued)

INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER
2N5277	N	
2N5278	N	
2N5358	*	2N5358
2N5359	*	2N5359
2N5360	*	2N5360
2N5361	*	2N5361
2N5362	*	2N5362
2N5363	*	2N5363
2N5364	*	2N5364
2N5391	CF	
2N5392	CF	
2N5393	CF	
2N5394	CF	
2N5395	CF	
2N5396	CF	
2N5397	*	2N5397
2N5398	*	2N5398
2N5432	*	2N5432
2N5433	*	2N5433
2N5434	*	2N5434
2N5452	*	2N5452
2N5453	*	2N5453
2N5454	*	2N5454
2N5457	*	2N5457
2N5458	*	2N5458
2N5459	*	2N5459
2N5460	*	2N5460
2N5461	*	2N5461
2N5462	*	2N5462
2N5463	N	
2N5464	N	
2N5465	N	
2N5471	■	2N5020
2N5472	■	2N5020
2N5473	■	2N5020
2N5474	■	2N5020
2N5475	■	2N5020
2N5476	■	2N5020
2N5484	*	2N5484
2N5485	*	2N5485
2N5486	*	2N5486
2N5515	*	2N5515
2N5516	*	2N5516
2N5517	*	2N5517
2N5518	*	2N5518
2N5519	*	2N5519
2N5520	*	2N5520
2N5521	*	2N5521
2N5522	*	2N5522
2N5523	*	2N5523
2N5524	*	2N5524
2N5543	N	
2N5544	N	
2N5545	*	2N5545
2N5546	*	2N5546
2N5547	*	2N5547
2N5549	●	2N5397
2N5555	*	2N5555
2N5556	*	2N5556
2N5557	*	2N5557
2N5558	*	2N5558
2N5561	*	2N5561
2N5562	*	2N5562
2N5563	*	2N5563
2N5564	*	2N5564
2N5565	*	2N5565
2N5566	*	2N5566
2N5638	*	2N5638
2N5639	*	2N5639
2N5640	*	2N5640
2N5647	■	2N3686
2N5648	■	2N3686
2N5649	■	2N3685
2N5653	*	2N5653
2N5654	*	2N5654
2N5668	*	2N5668
2N5669	*	2N5669
2N5670	*	2N5670
2N5902	*	2N5902
2N5903	*	2N5903
2N5904	*	2N5904
2N5905	*	2N5905
2N5906	*	2N5906
2N5907	*	2N5907
2N5908	*	2N5908
2N5909	*	2N5909
2N5911	*	2N5911
2N5912	*	2N5912
2N5949	*	2N5949
2N5950	*	2N5950
2N5951	*	2N5951
2N5952	*	2N5952
2N5953	*	2N5953
2N6449	N	
2N6450	N	
2N6451	CF	
2N6452	CF	
2N6453	CF	
2N6454	CF	
2N6483	*	2N6483
2N6484	*	2N6484
2N6485	*	2N6485
A5T6449	N	
A5T6450	N	
AD3954	●	2N3954
AD3954A	●	2N3954A
AD3955	●	2N3955
AD3955A	●	2N3955A
AD3956	●	2N3956
AD3957	●	2N3957
AD3958	●	2N3958
AD5905	●	2N5905
AD5906	●	2N5906
AD5907	●	2N5907

JFET Cross Reference Guide (Continued)

INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER
AD5908	●	2N5908
AD5909	●	2N5909
AD830	■	2N5906
AD831	■	2N5907
AD832	■	2N5908
AD833	■	2N5909
AD833A	■	2N5909
AD835	■	NDF9407
AD836	■	NDF9408
AD837	■	NDF9408
AD838	■	NDF9409
AD839	■	NDF9410
AD840	■	2N5520
AD841	■	2N5521
AD842	■	2N5523
AD845	■	2N5911
AD846	■	2N5912
BF244A	*	BF244A
BF244B	*	BF244B
BF244C	*	BF244C
BF245A	*	BF245A
BF245B	*	BF245B
BF245C	*	BF245C
BF246A	*	BF246A
BF246B	*	BF246B
BF246C	*	BF246C
BF247A	*	BF247A
BF247B	*	BF247B
BF247C	*	BF247C
BF256A	*	BF256A
BF256B	*	BF256B
BF256C	*	BF256C
BF264A	*	BF264A
BF264B	*	BF264B
BF264C	*	BF264C
BF264D	*	BF264D
C413N	●	2N4859
C681	■	2N4338
C681A	■	2N4338
C683	■	2N4339
C683A	■	2N4339
C685	■	2N4220
C685A	■	2N4220
CM640	■	2N4391
CM641	■	2N4391
CM642	■	2N4392
CM643	■	2N4391
CM644	■	2N4393
CM645	■	2N4392
CM646	■	2N4392
CM647	■	
CP640	●	U322
CP643	■	2N4391
CP650	●	U322
CP651	●	U320
CP652	●	U322
CP653	●	U320

INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER
E100	●	J202
E101	●	J201
E102	●	J202
E103	●	J203
E105	N	
E106	N	
E107	N	
E108	●	J108
E109	●	J109
E110	●	J110
E111	●	J111
E112	●	J112
E113	●	J113
E114	●	J114
E174	●	J174
E175	●	J175
E176	●	J176
E177	●	J177
E201	●	J201
E202	●	J202
E203	●	J203
E210	●	J210
E211	●	J211
E212	●	J212
E230	■	PN3685
E231	■	PN3684
E232	■	PN368
E270	●	J270
E271	●	J271
E300	●	J300
E304	●	J304
E305	●	J305
E308	●	J308
E309	●	J309
E310	●	J310
E311	●	J309
E312	●	J310
E400	CF	
E401	CF	
E402	CF	
E410	CF	
E411	CF	
E412	CF	
E420	■	U257
E421	■	U257
FE0654A	●	PN4416
FE0654B	●	PN4303
FE3819	●	2N3819
FE5245	●	2N5245
FE5246	●	2N5246
FE5247	●	2N5247
FE5457	●	2N5457
FE5458	●	2N5458
FE5459	●	2N5459
FE5484	●	2N5484
FE5485	●	2N5485
FE5486	●	2N5486

JFET Cross Reference Guide (Continued)

INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER
FM1100A	■	2N5906
FM1101A	■	2N5906
FM1102A	■	2N5907
FM1103A	■	2N5908
FM1104A	■	2N5909
FM105A	■	NDF9401
FM1106A	■	NDF9401
FM1107A	■	NDF9402
FM1108A	■	NDF9403
FM1109A	■	NDF9405
FM1110A	■	2N3957
FM1111A	■	2N3958
FM3954	●	2N3954
FM3954A	●	2N3954A
FM3955	●	2N3955
FM3955A	●	2N3955A
FM3956	●	2N3956
FM3957	●	2N3957
FM3958	●	2N3958
FT0654A	■	2N3824
FT0654B	■	2N3824
FT0654C	■	2N4221
FT3820	●	2N3820
IMF3954	●	2N3954
IMF3954A	●	2N3954A
IMF3955	●	2N3955
IMF3955A	●	2N3955A
IMF3956	●	2N3956
IMF3957	●	2N3957
IMF3958	●	2N3958
IT100	■	2N5115
IT101	■	2N5116
IT108	●	2N5486
IT109	●	2N5397
ITE3066	■	2N4340
ITE3067	■	2N4338
ITE3068	■	2N4338
ITE4117	●	2N4117
ITE4118	●	2N4118
ITE4119	●	2N4119
ITE4338	●	2N4338
ITE4339	●	2N4339
ITE4340	●	2N4340
ITE4341	●	2N4391
ITE4391	*	PN4391
ITE4392	*	PN4392
ITE4393	●	PN4393
ITE4416	●	PN4416
ITE4867	■	PN3686
ITE4868	■	PN3685
ITE4869	■	PN3684
J108	*	J108
J109	*	J109
J110	*	J110
J111	*	J111
J112	*	J112
J113	*	J113
J114	*	J114
J174	*	J174
J175	*	J175
J176	*	J176
J177	*	J177
J201	*	J201
J202	*	J202
J203	*	J203
J270	*	J270
J271	*	J271
J300	*	J300
J304	*	J304
J305	*	J305
J401	*	J401
J402	*	J402
J403	*	J403
J404	*	J404
J405	*	J405
J406	*	J406
J410	*	J410
J411	*	J411
J412	*	J412
J1401	*	J1401
J1402	*	J1402
J1403	*	J1403
J1404	*	J1404
J1405	*	J1405
J1406	*	J1406
KE3684	●	PN3684
KE3685	●	PN3685
KE3686	●	PN3686
KE3970	●	PN4391
KE3971	●	PN4392
KE3972	●	PN4393
KE4091	●	PN4091
KE4092	●	PN4092
KE4093	●	PN4093
KE4220	●	PN4220
KE4221	●	PN4221
KE4222	●	PN4222
KE4223	●	PN4223
KE4224	●	PN4224
KE4391	●	PN4391
KE4392	●	PN4392
KE4393	●	PN4393
KE4416	●	PN4416
KE4856	●	PN4856
KE4857	●	PN4857
KE4858	●	PN4858
KE4859	●	PN4859
KE4860	●	PN4860
KE4861	●	PN4861
KE5103	●	2N5952
KE5104	●	2N5953
KE5105	■	PN4416
MFE2000	■	2N4416
MFE2001	■	2N4416

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INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER	INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER
MFE2004	■	2N4393	NF532	●	2N3822
MFE2005	■	2N4392	NF533	●	2N3821
MFE2006	■	2N4391	NF580	●	2N5432
MFE2007	■	2N4857	NF581	●	2N5432
MFE2008	■	2N4391	NF582	●	2N5434
MFE2009	■	2N4856	NF583	●	2N5434
MFE2010	■	2N4856	NF584	●	2N5432
MFE2011	■	2N5433	NF585	●	2N5433
MFE2012	■	2N5433	NF4302	●	PN4302
MFE2093	■	2N3687	NF4303	●	PN4303
MFE2094	■	2N3686	NF4304	●	PN4304
MFE2095	■	2N3685	NF4445	●	2N5432
MFE2133	■	2N4392	NF4446	●	2N5433
MFE4007	■	2N2608	NF4447	●	2N5432
MFE4008	■	2N2608	NF4448	●	2N5433
MFE4009	■	2N3329	NF5101	*	NF5101
MFE4010	■	2N3330	NF5102	*	NF5102
MFE4011	■	2N3330	NF5103	*	NF5103
MFE4012	■	2N3331	NF5163	●	2N5163
MPF102	*	MPF102	NF5457	●	2N5457
MPF103	*	MPF103	NF5458	●	2N5458
MPF104	*	MPF104	NF5459	●	2N5459
MPF105	*	MPF105	NF5485	●	2N5485
MPF106	*	MPF106	NF5486	●	2N5486
MPF107	*	MPF107	NF5555	●	2N5555
MPF108	*	MPF108	NF5638	●	2N5638
MPF109	*	MPF109	NF5639	●	2N5639
MPF111	*	MPF111	NF5640	●	2N5640
MPF112	*	MPF112	NF5653	●	2N5653
MPF161	●	2N5461	NF5654	●	2N5654
MPF256	●	J211	NPD5564	*	NPD5564
MPF820	■	J309	NPD5565	*	NPD5565
MPF970	●	P1086E	NPD5566	*	NPD5566
MPF971	●	P1087E	NPD8301	*	NPD8301
MPF4391	*	PN4391	NPD8302	*	NPD8302
MPF4392	*	PN4392	NPD8303	*	NPD8303
MPF4393	*	PN4393	NPD9801	*	NPD9801
NDF9401	*	NDF9401	NPD9802	*	NPD9802
NDF9402	*	NDF9402	NPD9803	*	NPD9803
NDF9403	*	NDF9403	P1069E		
NDF9404	*	NDF9404	P1086E	*	P1086E
NDF9405	*	NDF9405	P1087E	*	P1087E
NDF9406	*	NDF9406	P1117E	CF	
NDF9407	*	NDF9407	P1118E	CF	
NDF9408	*	NDF9408	P1119E	CF	
NDF9409	*	NDF9409	PF510	●	PN4392
NDF9410	*	NDF9410	PF511	●	PN4392
NF500	●	2N4224	PF5101	*	PF5101
NF501	●	2N4224	PF5102	*	PF5102
NF506	●	2N3823	PF5103	*	PF5103
NF510	●	2N4092	PN3684	*	PN3684
NF520	●	2N4224	PN3685	*	PN3685
NF521	●	2N4220	PN3686	*	PN3686
NF522	●	2N4224	PN3687	*	PN3687
NF523	●	2N4220	PN4091	*	PN4091
NF530	●	2N3822	PN4092	*	PN4092
NF531	●	2N3821	PN4093	*	PN4093

JFET Cross Reference Guide (Continued)

INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER	INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER
PN4220	*	PN4220	TD5906A	■	2N5906
PN4221	*	PN4221	TD5907	■	2N5907
PN4222	*	PN4222	TD5907A	■	2N5907
PN4223	*	PN4223	TD5908	■	2N5908
PN4224	*	PN4224	TD5908A	■	2N5908
PN4302	*	PN4302	TD5909	■	2N5909
PN4303	*	PN4303	TD5909A	■	2N5909
PN4304	*	PN4304	TD5911	■	2N5911
PN4342	*	PN4342	TD5911A	■	2N5911
PN4343	■	P1087E	TD5912	■	2N5912
PN4360	*	PN4360	TD5912A	■	2N5912
PN4391	*	PN4391	TIS25	N	
PN4392	*	PN4392	TIS26	N	
PN4393	*	PN4393	TIS27	N	
PN4416	*	PN4416	TIS34	●	2N5486
PN4856	*	PN4856	TIS41	■	2N4859
PN4857	*	PN4857	TIS42	■	PN4392
PN4858	*	PN4858	TIS58	*	TIS58
PN4859	*	PN4859	TIS59	*	TIS59
PN4860	*	PN4860	TIS68	N	
PN4861	*	PN4861	TIS69	N	
PN5033	*	PN5033	TIS70	N	
PN5163	*	PN5163	TIS73	*	TIS73
SU2078	●	2N3955	TIS74	*	TIS74
SU2079	●	2N3956	TIS75	*	TIS75
SU2080			TIS78	N	
SU2081			TIS79	N	
SU2098	●	2N3954	TIS88A	●	2N5486
SU2098A	●	2N3954	U110	■	2N5020
SU2098B	●	2N3954A	U112	●	2N4381
SU2099	●	2N3955A	U114	■	2N5020
SU2099A	●	2N3955A	U133	■	2N5020
SU2365	●	U401	U146	●	2N5020
SU2365A	●	U401	U147	●	2N5020
SU2366	●	U402	U148	●	2N2608
SU2366A	●	U402	U149	●	2N2609
SU2367	●	U403	U168	●	2N2608
SU2367A	●	U403	U182	●	2N4857
SU2368	●	U404	U183	●	2N3823
SU2368A	●	U404	U184	●	2N4416
SU2369	●	U405	U197	●	2N4338
SU2369A	●	U405	U198	●	2N4340
SU2410	■	U424	U199	●	2N4341
SU2411	■	U425	U200	●	2N4393
SU2412	■	U426	U201	●	2N4392
TD5452	■	2N5452	U202	●	2N4391
TD5453	■	2N5453	U231	*	U231
TD5454	■	2N5454	U232	*	U232
TD5902	■	2N5902	U233	*	U233
TD5902A	■	2N5902	U234	*	U234
TD5903	■	2N5903	U235	*	U235
TD5903A	■	2N5903	U240	●	2N5432
TD5904	■	2N5904	U241	●	2N5433
TD5904A	■	2N5904	U242	●	2N5432
TD5905	■	2N5905	U243	●	2N5433
TD5905A	■	2N5905	U244	N	
TD5906	■	2N5906	U248	*	2N5902

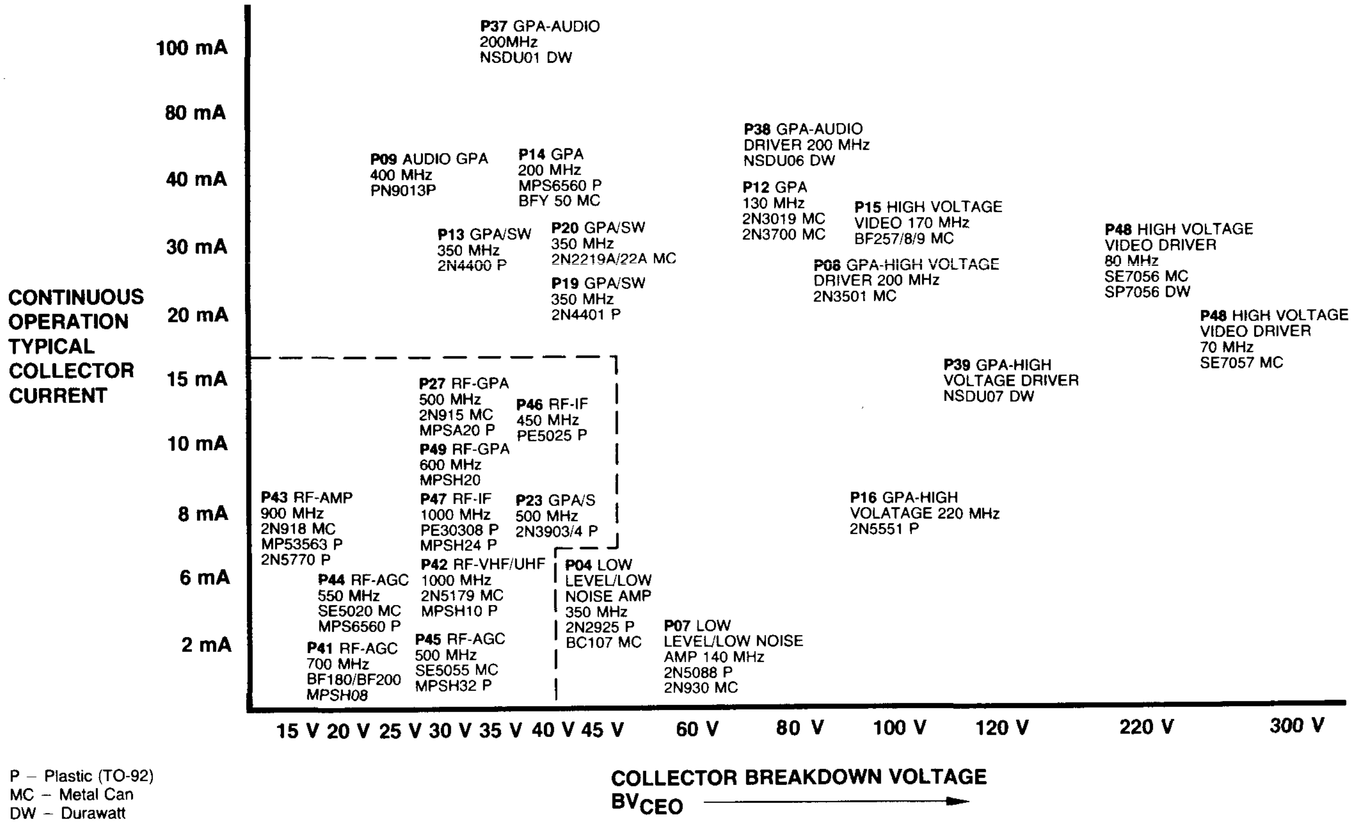
JFET Cross Reference Guide (Continued)

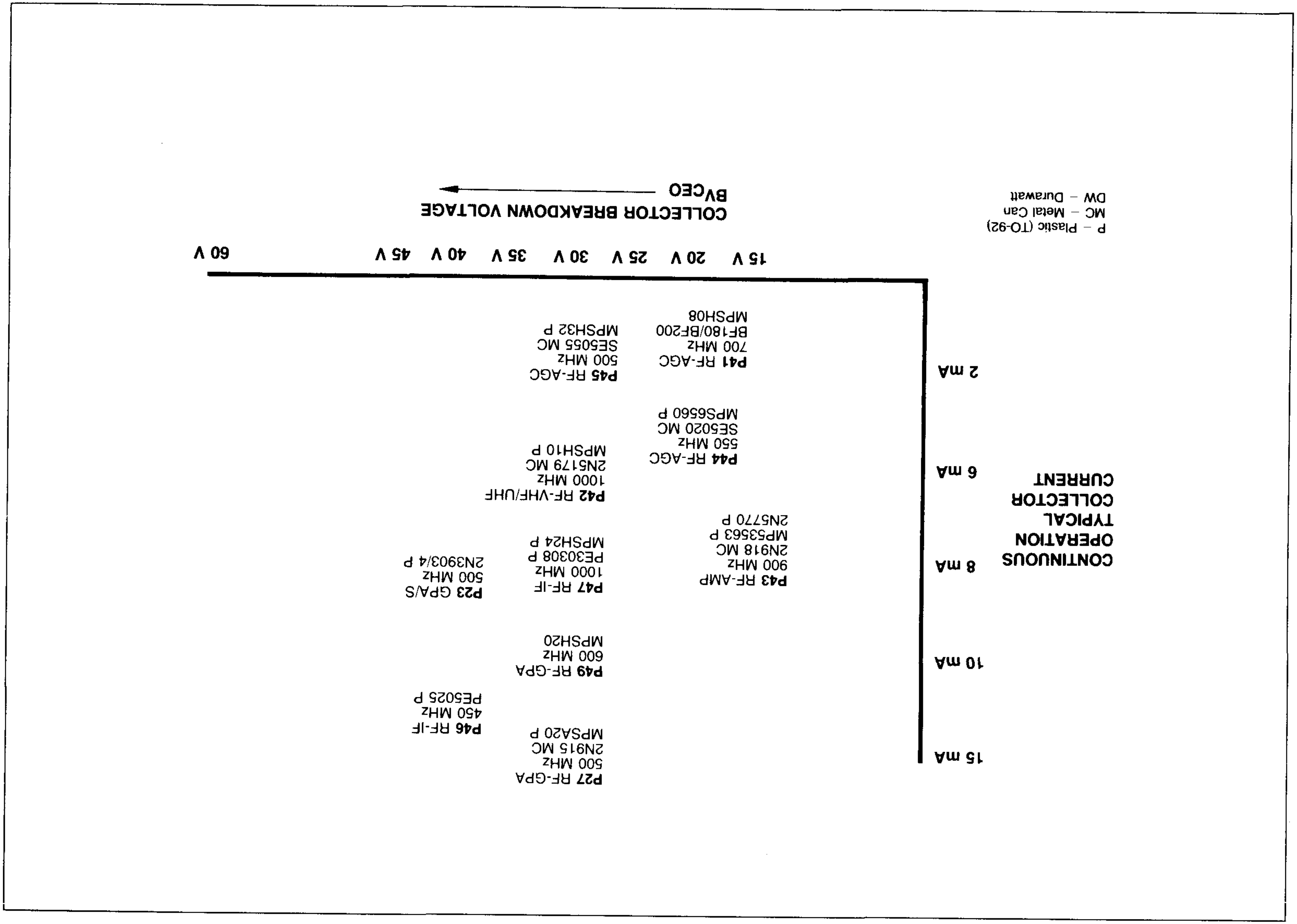
INDUSTRY TYPE NUMBER	REPLACEMENT CODE	NATIONAL PART NUMBER
U248A	*	2N5906
U249	*	2N5903
U249A	*	2N5907
U250	*	2N5904
U250A	*	2N5908
U251	*	2N5905
U251A	*	2N5909
U252	*	2N5911
U253	*	2N5912
U254	*	2N4859
U255	*	2N4860
U256	*	2N4861
U257	●	U257
U266	N	
U280	●	2N3954
U281	●	2N3954
U282	●	2N3955
U283	●	2N3955
U284	●	2N3956
U285	●	2N3957
U290	N	
U291	N	
U300	■	U304
U301	*	U301
U304	●	2N5114
U305	●	2N5116
U306	●	2N5117
U308	*	U308
U309	*	U309
U310	*	U310
U311	●	U311
U312	*	U312
U320	*	U320
U321	*	U321
U322	*	U322
U328	N	
U329	N	
U330	N	
U331	N	
U350	*	U350
U401	*	U401
U402	*	U402
U403	*	U403
U404	*	U404
U405	*	U405
U406	*	U406
U421	*	U421
U422	*	U422
U423	*	U423
U424	*	U424
U425	*	U425
U426	*	U426
U430	*	U430
U431	*	U431
U1714	●	2N4340
U1715	N	
U1837E	●	2N5486
U1897E	●	U1897E
U1898E	●	U1898E
U1899E	●	U1899E
U1994E	●	PN4416
U2047	●	PN4416
UC155	■	2N4416
UC200	■	2N4393
UC201	■	2N4416
UC210	■	2N3822
UC220	■	2N4220
UC241	■	2N3822
UC250	●	2N4391
UC251	●	2N4392
UC400	■	2N2609
UC401	■	2N5019
UC410	■	2N2609
UC420	■	2N3329
UC588	■	2N4416
UC703	■	2N3822
UC705	■	2N3824
UC707	■	2N4391
UC714	■	2N4416
UC734	■	2N4416
UC734E	■	PN4416
UC755	■	2N4391
UC756	■	2N4224
UC805	■	2N3331
UC807	■	2N4861
UC814	■	2N3331
UC851	■	2N2608
UC854	CF	
UC855	CF	
UC2139	CF	
UC2147	CF	
UC2148	CF	
UC2149	CF	
VCR2N	■	2N4092
VCR3P	■	2N5115
VCR4N	■	2N4341
VCR5P	■	2N3331
VCR7N	■	2N4119

RF Selector Guide

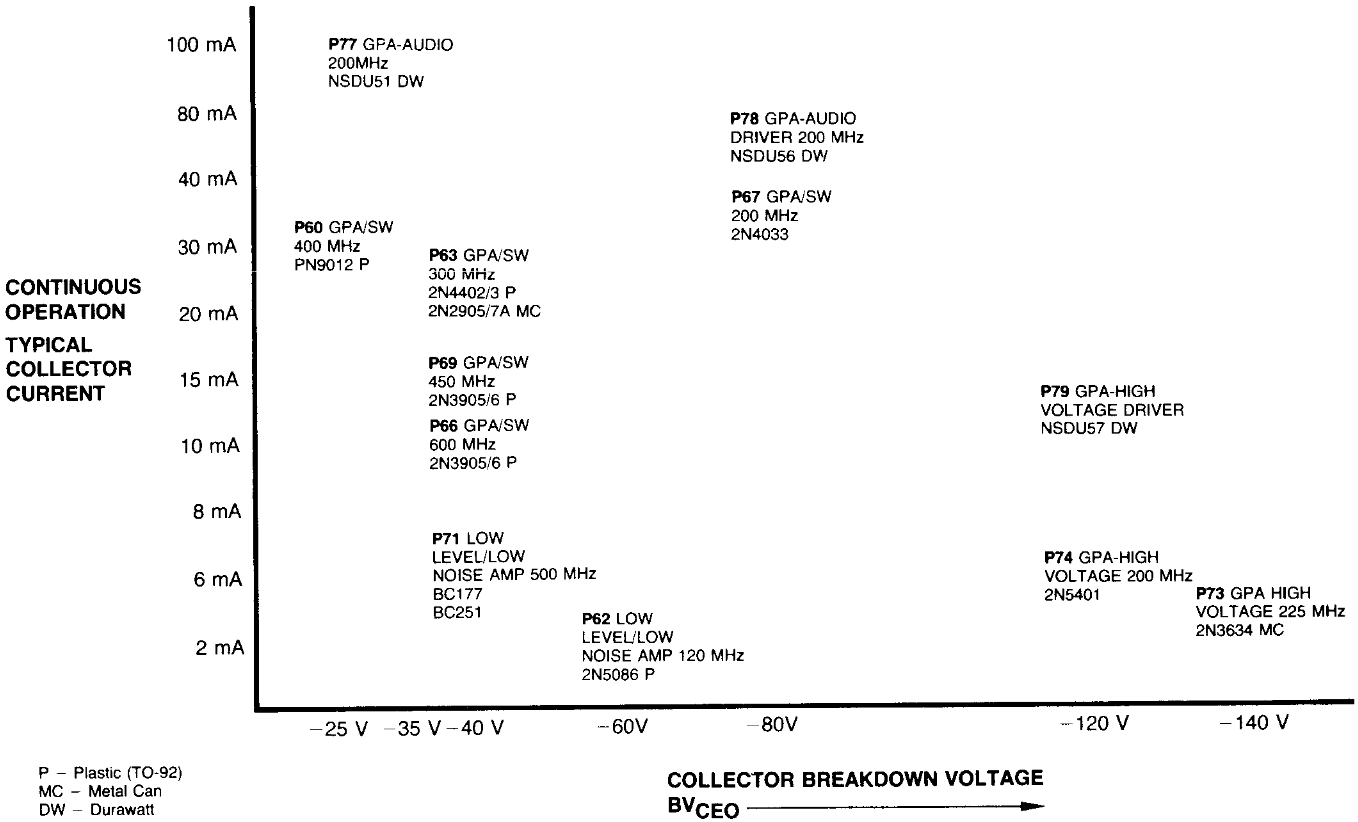
	BIPOLARS								JFET'S		
	41	42	43	44	45	46	47	49	50	90	92
Preamplifiers											
> 500 MHz	•										
> 500 MHz with AGC	•										
200–500 MHz	•	•							•	•	
200–500 MHz with AGC	•										
50–250 MHz		•		•					•	•	•
50–250 MHz with AGC	•			•							
20–120 MHz				•				•	•	•	
Mixers											
Input > 500 MHz	•										
Input 200–500 MHz		•					•		•	•	•
Input 50–250 MHz				•			•	•	•	•	
Input 20–120 MHz						•	•	•	•	•	
Loc Osc											
> 500 MHz Mech. Tuned		•	•								
> 500 MHz Varactor		•									
200–500 MHz Mech. Tuned			•				•				
200–500 MHz Varactor							•				
50–250 MHz			•				•				
20–120 MHz			•								
IF Amps											
< 75 MHz					•	•	•	•	•	•	
< 15 MHz			•			•	•		•		
< 75 MHz with AGC				•	•						
< 15 MHz with AGC				•							
< 75 MHz Last Stage						•	•	•			
< 15 MHz Last Stage						•		•	•		
Special Uses											
200–500 MHz < 1.0 mA Bias		•									
50–250 MHz < 1.0 mA Bias		•					•				
200–500 MHz 5–15 mA Linear IF		•									
50–250 MHz 5–15 mA Linear IF							•				•
< 120 MHz/20 mA Wideband RF							•				•
VHF Freq. Generator and/or Multiplier to 75 mW Levels			•								

Transistors NPN GPA Devices



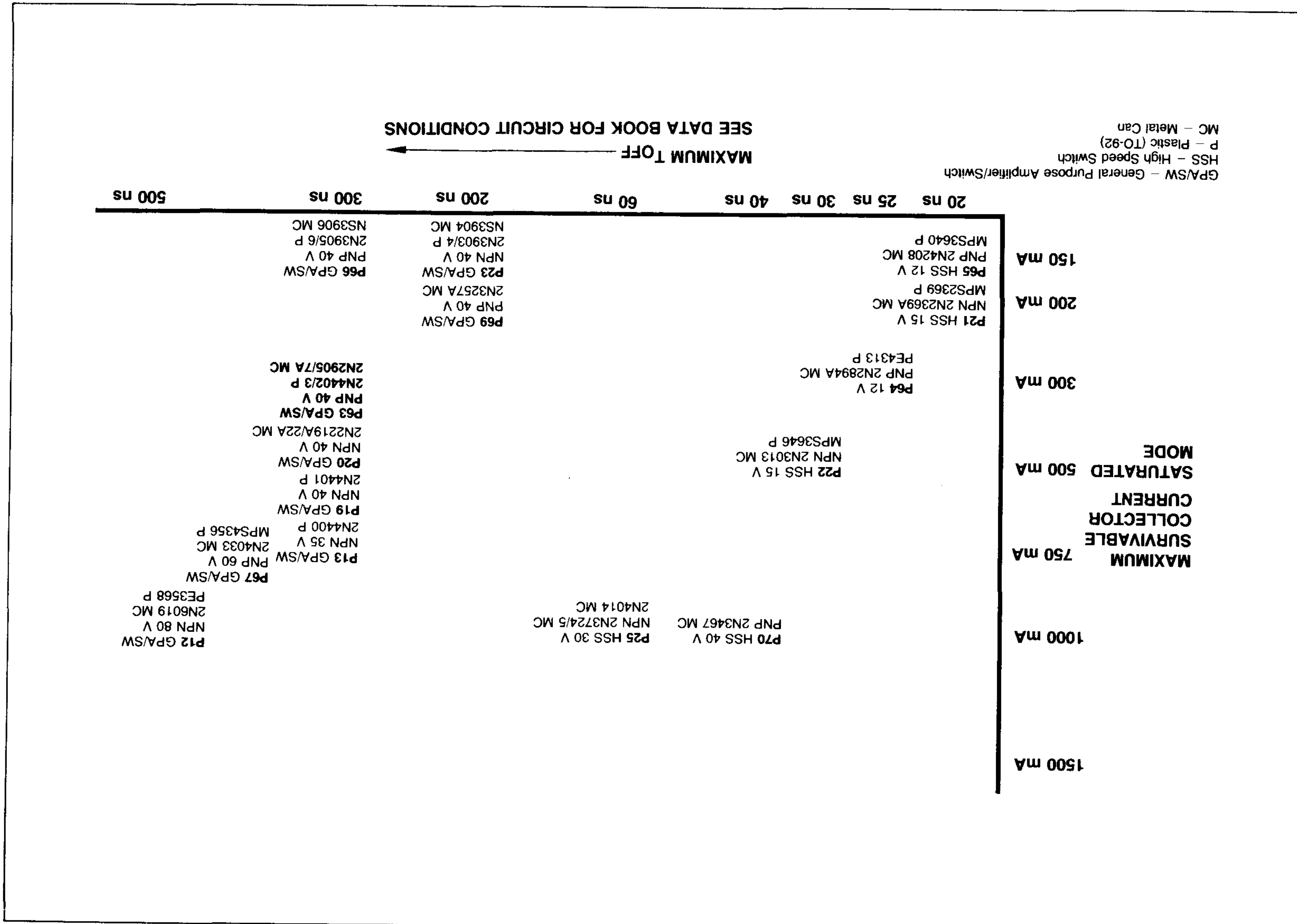

CONTINUOUS OPERATION TYPICAL COLLECTOR CURRENT
15 mA
10 mA
8 mA
6 mA
2 mA
COLLECTOR BREAKDOWN VOLTAGE
BV_{CEO}
15 V
20 V
25 V
30 V
35 V
40 V
45 V
60 V
P27 RF-GPA
500 MHz
2N915 MC
MPSA20 P
P46 RF-IF
450 MHz
PE5025 P
P49 RF-GPA
600 MHz
MPSH20
P43 RF-AMP
900 MHz
2N918 MC
MP53563 P
2N5770 P
P47 RF-IF
1000 MHz
PE30308 P
MPSH24 P
P23 GPA/S
500 MHz
2N3903/4 P
P44 RF-AGC
550 MHz
SE5020 MC
MPS6560 P
P42 RF-VHF/UHF
1000 MHz
2N5179 MC
MPSH10 P
P41 RF-AGC
700 MHz
BF180/BF200
MPSH08
P45 RF-AGC
500 MHz
SE5055 MC
MPSH32 P
P – Plastic (TO-92)
MC – Metal Can
DW – Durawatt

Transistors PNP GPA Devices



P – Plastic (TO-92)
MC – Metal Can
DW – Durawatt

Transistors for High Speed Switching



Power Transistor Selector Guide

BV_{CEO} — (Volts): 400, 300, 200, 140, 100, 80, 60, 40 (High Voltage and General Purpose; Darlington: 120, 100, 80, 60, 40; Switch Mode: 400)

			I_C	TO-92	TO-92+	TO-202	TO-126	TO-220	TO-3
HIGH VOLTAGE AND GENERAL PURPOSE	Planar	P-48	0.1A	0.6W	1.2W	10W			
	Planar	P-36	0.8A		1.2W	15W	25W		
	Planar	P-39/ P-79; P-38/ P-78; P-37/ P-77	2A	0.6W	1.2W	10W	20W		
	Epi Base Mesa	P-2C/ P-3C; P-2A	3A			15W	30W	40W	
	Epi Base Mesa	P-2E/ P-3E	5A			15W	40W	50W	
	Epi Base Mesa	P-4A/ P-5A	7A					60W	115W
	Epi Base Mesa	P-4B/ P-5B	10A					70W	150W
	Epi Base Mesa	P-4C/ P-5C	15A					75W	175W
	Epi Base Mesa	P-4G/ P-5G	20A						200W
DARLINGTON	Planar	P-05	1.5A	0.6W	1.2W	10W			
	Mesa	P-2J/ P-3J	6A				40W	50W	
	Mesa	P-4K/ P-5K	7A					60W	120W
SWITCH MODE	Triple Epi Mesa	P-8A	10A					60W	125W
	Triple Epi Mesa	P-8B P-8C	15A						175W

▨ Quote on Request

Power Transistor Part Number Listing

PART NUMBER	PACKAGE	PART NUMBER	PACKAGE	PART NUMBER	PACKAGE	PART NUMBER	PACKAGE	PART NUMBER	PACKAGE	PART NUMBER	PACKAGE	PART NUMBER	PACKAGE	PART NUMBER	PACKAGE
2N3055	TO-3	2N5880	TO-3	92PE487	92+	D41D10	TO-202	D45H2	TO-220	NSDU10	TO-202	NSP587	TO-220	TIP30	TO-220
2N3713	TO-3	2N5881	TO-3	92PE488	92+	D41D11	TO-202	D45H4	TO-220	NSDU45	TO-202	NSP588	TO-220	TIP30A	TO-220
2N3714	TO-3	2N5882	TO-3	92PE489	92+	D41D13	TO-202	D45H5	TO-220	NSDU45A	TO-202	NSP589	TO-220	TIP30B	TO-220
2N3715	TO-3	2N6034	TO-126	92PU01	92+	D41D14	TO-202	D45H7	TO-220	NSDU51	TO-202	NSP590	TO-220	TIP30C	TO-220
2N3716	TO-3	2N6035	TO-126	92PU01A	92+	D41E1	TO-202	D45H8	TO-220	NSDU51A	TO-202	NSP591	TO-220	TIP31	TO-220
2N3789	TO-3	2N6036	TO-126	92PU05	92+	D41E5	TO-202	D45H10	TO-220	NSDU52	TO-202	NSP592	TO-220	TIP31A	TO-220
2N3791	TO-3	2N6037	TO-126	92PU06	92+	D41E7	TO-202	D45H11	TO-220	NSDU55	TO-202	NSP595	TO-220	TIP31B	TO-220
2N3792	TO-3	2N6038	TO-126	92PU07	92+	D42C1	TO-202	MJE170	TO-126	NSDU56	TO-202	NSP596	TO-220	TIP31C	TO-220
2N4901	TO-3	2N6039	TO-126	92PU10	92+	D42C2	TO-202	MJE171	TO-126	NSDU57	TO-202	NSP597	TO-220	TIP32	TO-220
2N4902	TO-3	2N6053	TO-3	92PU45	92+	D42C3	TO-202	MJE172	TO-126	NSD36	TO-202	NSP598	TO-220	TIP32A	TO-220
2N4903	TO-3	2N6054	TO-3	92PU45A	92+	D42C4	TO-202	MJE180	TO-126	NSD36A	TO-202	NSP599	TO-220	TIP32B	TO-220
2N4904	TO-3	2N6055	TO-3	92PU51	92+	D42C5	TO-202	MJE181	TO-126	NSD36B	TO-202	NSP600	TO-220	TIP32C	TO-220
2N4905	TO-3	2N6056	TO-3	92PU51A	92+	D42C6	TO-202	MJE182	TO-126	NSD36C	TO-202	NSP601	TO-220	TIP41	TO-220
2N4906	TO-3	2N6099	TO-220	92PU55	92+	D42C7	TO-202	MJE340	TO-126	NSD102	TO-202	NSP602	TO-220	TIP41A	TO-220
2N4907	TO-3	2N6101	TO-220	92PU56	92+	D42C8	TO-202	MJE341	TO-126	NSD103	TO-202	NSP695	TO-220	TIP41B	TO-220
2N4908	TO-3	2N6107	TO-220	92PU57	92+	D42C9	TO-202	MJE344	TO-126	NSD104	TO-202	NSP695A	TO-220	TIP41C	TO-220
2N4909	TO-3	2N6109	TO-220	92PU391	92+	D42C10	TO-202	MJE370	TO-126	NSD105	TO-202	NSP696	TO-220	TIP42	TO-220
2N4913	TO-3	2N6111	TO-220	92PU392	92+	D42C11	TO-202	MJE371	TO-126	NSD106	TO-202	NSP696A	TO-220	TIP42A	TO-220
2N4914	TO-3	2N6121	TO-220	92PU393	92+	D42C12	TO-202	MJE520	TO-126	NSD123	TO-202	NSP697	TO-220	TIP42B	TO-220
2N4915	TO-3	2N6122	TO-220	BD344	TO-126	D43C1	TO-202	MJE521	TO-126	NSD127	TO-202	NSP697A	TO-220	TIP42C	TO-220
2N4918	TO-126	2N6123	TO-220	BD345	TO-126	D43C2	TO-202	MJE700	TO-126	NSD128	TO-202	NSP698	TO-220	TIP61	TO-220
2N4919	TO-126	2N6124	TO-220	BD346	TO-220	D43C3	TO-202	MJE701	TO-126	NSD129	TO-202	NSP698A	TO-220	TIP61A	TO-220
2N4920	TO-126	2N6125	TO-220	BD347	TO-220	D43C4	TO-202	MJE702	TO-126	NSD131	TO-202	NSP699	TO-220	TIP61B	TO-220
2N4921	TO-126	2N6126	TO-220	BD348	TO-126	D43C5	TO-202	MJE703	TO-126	NSD132	TO-202	NSP699A	TO-220	TIP61C	TO-220
2N4922	TO-126	2N6129	TO-220	BD349	TO-126	D43C6	TO-202	MJE710	TO-126	NSD133	TO-202	NSP2010	TO-220	TIP62	TO-220
2N4923	TO-126	2N6130	TO-220	BD350	TO-3	D43C7	TO-202	MJE711	TO-126	NSD134	TO-202	NSP2011	TO-220	TIP62A	TO-220
2N5067	TO-3	2N6131	TO-220	BD351	TO-3	D43C8	TO-202	MJE712	TO-126	NSD135	TO-202	NSP2020	TO-220	TIP62B	TO-220
2N5068	TO-3	2N6132	TO-220	D40C1	TO-202	D43C9	TO-202	MJE720	TO-126	NSD151	TO-202	NSP2021	TO-220	TIP62C	TO-220
2N5069	TO-3	2N6133	TO-220	D40C2	TO-202	D43C10	TO-202	MJE721	TO-126	NSD152	TO-202	NSP2090	TO-220	TIP110	TO-220
2N5190	TO-126	2N6134	TO-220	D40C3	TO-202	D43C11	TO-202	MJE722	TO-126	NSD153	TO-202	NSP2091	TO-220	TIP111	TO-220
2N5191	TO-126	2N6226	TO-3	D40C4	TO-202	D43C12	TO-202	MJE800	TO-126	NSD154	TO-202	NSP2092	TO-220	TIP112	TO-220
2N5192	TO-126	2N6227	TO-3	D40C5	TO-202	D44C1	TO-220	MJE801	TO-126	NSD202	TO-202	NSP2093	TO-220	TIP115	TO-220
2N5193	TO-126	2N6228	TO-3	D40C7	TO-202	D44C2	TO-220	MJE802	TO-126	NSD203	TO-202	NSP2100	TO-220	TIP116	TO-220
2N5194	TO-126	2N6229	TO-3	D40C8	TO-202	D44C3	TO-220	MJE803	TO-126	NSD204	TO-202	NSP2101	TO-220	TIP117	TO-220
2N5195	TO-126	2N6230	TO-3	D40D1	TO-202	D44C4	TO-220	MJE3439	TO-126	NSD205	TO-202	NSP2102	TO-220	TIP120	TO-220
2N5293	TO-220	2N6231	TO-3	D40D2	TO-202	D44C5	TO-220	MJE3440	TO-126	NSD206	TO-202	NSP2103	TO-220	TIP121	TO-220
2N5294	TO-220	2N6288	TO-220	D40D3	TO-202	D44C6	TO-220	MJ900	TO-3	NSD457	TO-202	NSP2370	TO-220	TIP122	TO-220
2N5295	TO-220	2N6290	TO-220	D40D4	TO-202	D44C7	TO-220	MJ901	TO-3	NSD458	TO-202	NSP2480	TO-220	TIP125	TO-220
2N5296	TO-220	2N6292	TO-220	D40D5	TO-202	D44C8	TO-220	MJ1000	TO-3	NSD459	TO-202	NSP2481	TO-220	TIP126	TO-220
2N5297	TO-220	2N6386	TO-220	D40D7	TO-202	D44C9	TO-220	MJ1001	TO-3	NSE457	TO-202	NSP2482	TO-220	TIP127	TO-220
2N5298	TO-220	2N6486	TO-220	D40D8	TO-202	D44C10	TO-220	MJ2801	TO-3	NSE458	TO-202	NSP2483	TO-220	TIP130	TO-220
2N5490	TO-220	2N6487	TO-220	D40D10	TO-202	D44C11	TO-220	MJ2840	TO-3	NSE459	TO-202	NSP2490	TO-220	TIP131	TO-220
2N5492	TO-220	2N6488	TO-220	D40D11	TO-202	D44C12	TO-220	MJ2841	TO-3	NSP41	TO-220	NSP2491	TO-220	TIP132	TO-220
2N5494	TO-220	2N6489	TO-220	D40D13	TO-202	D44H1	TO-220	MJ2901	TO-3	NSP41A	TO-220	NSP2520	TO-220	TIP135	TO-220
2N5496	TO-220	2N6490	TO-220	D40D14	TO-202	D44H2	TO-220	MJ2940	TO-3	NSP41B	TO-220	NSP2955	TO-220	TIP136	TO-220
2N5632	TO-3	2N6491	TO-220	D40E1	TO-202	D44H4	TO-220	MJ2941	TO-3	NSP41C	TO-220	NSP3055	TO-220	TIP137	TO-220
2N5633	TO-3	2N6548	TO-202	D40E5	TO-202	D44H5	TO-220	MJ2955	TO-3	NSP42	TO-220	NSP5974	TO-220	TN2102	92+
2N5634	TO-3	2N6549	TO-202	D40E7	TO-202	D44H7	TO-220	NCBJ14	TO-126	NSP42A	TO-220	NSP5975	TO-220	TN2218A	92+
2N5655	TO-126	2N6551	TO-202	D40N1	TO-202	D44H8	TO-220	NCBJ35	TO-126	NSP42B	TO-220	NSP5976	TO-220	TN2219	92+
2N5656	TO-126	2N6552	TO-202	D40N2	TO-202	D44H10	TO-220	NCBS14	TO-39	NSP42C	TO-220	NSP5977	TO-220	TN2219A	92+
2N5657	TO-126	2N6553	TO-202	D40N3	TO-202	H44H11	TO-220	NCBS35	TO-39	NSP105	TO-220	NSP5978	TO-220	TN2904A	92+
2N5758	TO-3	2N6554	TO-202	D40N4	TO-202	D45C1	TO-220	NCBT13	TO-92	NSP205	TO-220	NSP5979	TO-220	TN2905	92+
2N5759	TO-3	2N6555	TO-202	D40N5	TO-202	D45C2	TO-220	NCBV14	TO-202	NSP575	TO-220	SE9300	TO-220	TN2905A	92+
2N5760	TO-3	2N6556	TO-202	D40P1	TO-202	D45C3	TO-220	NCBV35	TO-202	NSP576	TO-220	SE9301	TO-220	TN3019	92+
2N5872	TO-3	2N6569	TO-3	D40P3	TO-202	D45C4	TO-220	NCBW35	TO-220	NSP577	TO-220	SE9302	TO-220	TN3020	92+
2N5873	TO-3	2N6594	TO-3	D40P5	TO-202	D45C5	TO-220	NCBX14	92+	NSP578	TO-220	SE9400	TO-220	TN3053	92+
2N5874	TO-3	92PE37A	92+	D41D1	TO-202	D45C6	TO-220	NSDU01	TO-202	NSP579	TO-220	SE9401	TO-220	TN4033	92+
2N5875	TO-3	92PE37B	92+	D41D2	TO-202	D45C7	TO-220	NSDU01A	TO-202	NSP580	TO-220	SE9402	TO-220	TN4036	92+
2N5876	TO-3	92PE37C	92+	D41D4	TO-202	D45C8	TO-220	NSDU02	TO-202	NSP581	TO-220	TIP29	TO-220	TN4037	92+
2N5877	TO-3	92PE77A	92+	D41D5	TO-202	D45C9	TO-220	NSDU05	TO-202	NSP582	TO-220	TIP29A	TO-220		
2N5878	TO-3	92PE77B	92+	D41D7	TO-202	D45C10	TO-220	NSDU06	TO-202	NSP585	TO-220	TIP29B	TO-220		
2N5879	TO-3	92PE77C	92+	D41D8	TO-202	D45H1	TO-220	NSDU07	TO-202	NSP586	TO-220	TIP29C	TO-220		

92+ Power Transistor Reference Guide

PART NUMBER NPN	PART NUMBER PNP	V_{CEO} (V)	I_C (A)	h_{FE} MIN	h_{FE} MAX	@ I_C (mA)	@ V_{CE} (V)	MAX $V_{CE(SAT)}$ (V)	@ I_C (mA)	P_D (W)	f_T (MHz)	PROCESS (NPN/PNP)
TN2219		30	0.5	100	300	150	10	0.4	150	1.2	250	19
				30		500	10					
TN3724		30	1	60	150	100	1	0.2	100	1.2	300	25
				40		300	1	0.32	300			
92PU01	92PU51	30	2	60		100	1	0.5	1000	1.2	50	37/77
				55		1000	1					
TN2218A		40	0.5	40	120	150	10	0.3	150	1.2	250	19
				25		500	10					
TN2219A	TN2905	40	0.5	100	300	150	10	0.3/0.4	150	1.2	300	19/63
				40		500	10					
TN3053	TN4037	40	1	50	250	150	10	1.4	150	1.2	100	12/63
92PU01A	92PU51A	40	2	60		100	1	0.5	1000	1.2	50	37/77
				55		1000	1					
92PU45		40	2	25k		200	5	1	200	1.2	100	05
				4k		1000	5	1.5	1000			
92PE37A	92PE77A	45	2	40		500	2	0.5	500	1.2	50	38/78
TN3725		50	1	60	150	100	1	0.4	300	1.2	300	25
				40		300						
92PU45A		50	2	25k		200	5	1	200	1.2	100	05
				4k		1000	5	1.5	1000			
	TN2904A	60	0.5	40	120	150	10	0.4	150	1.2	200	63
				40		500	10					
	TN2905A	60	0.5	100	300	150	10	0.4	150	1.2	200	63
				50		500	10					
92PE37B	92PE77B	60	2	40		500	2	0.5	500	1.2	50	38/78
92PU05	92PU55	60	2	20		500	1	0.35	250	1.2	50	39/79
TN2102	TN4036	65	1	40	120	150	10	0.5/0.65	150	1.2	60	12/67
				25		500	10					
TN3019		80	1	100	300	150	10	0.2	150	1.2	100	12
TN3020		80	1	40	120	150	10	0.2	150	1.2	100	12
	TN4033	80	1	100	300	100	5	0.15	150	1.2	150	67
92PE37C	92PE77C	80	2	40		500	2	0.5	500	1.2	50	38/78
92PU06	92PU56	80	2	20		500	1	0.35	250	1.2	50	39/79
92PU07	92PU57	100	2	20		500	1	0.35	250	1.2	50	39/79
92PE487		160	0.1	30		30	10	1	30	1.2	50	48
92PU391		200	0.1	40		10	10	2	20	1.2	50	48
92PE488		250	0.1	30		30	10	1	30	1.2	50	48
92PU392		250	0.1	40		10	10	2	20	1.2	50	48
92PE489		300	0.1	30		30	10	1	30	1.2	50	48
92PU393		300	0.1	40		10	10	2	20	1.2	50	48
92PU10		300	0.1	40		30	10	0.75	30	1.2	50	48

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PART NUMBER		I_C	V_{CEO}	h_{FE}		@		MAX		P_D	f_T	PROCESS
NPN	PNP	(A)	(V)	MIN	MAX	I_C (A)	V_{CE} (V)	$V_{CE(SAT)}$ (V)	@ I_C (A)	(W)	(MHz)	(NPN/PNP)
NSD457		0.1	160	25		0.03	10	1	0.03	1.75	50	48
NSE457		0.1	160	25		0.03	10	1	0.03	1.75	50	48
NSD458		0.1	250	25		0.03	10	1	0.03	1.75	50	48
NSE458		0.1	250	25		0.03	10	1	0.03			48
D40N1		0.1	250	30	90	0.02	10			1.3	50	48
D40N2		0.1	250	60	180	0.02	10			1.3	50	48
NSD131		0.1	250	30	90	0.03	10	1	0.02	1.75		48
NSD132		0.1	250	60	180	0.03	10	1	0.02	1.75		48
D40N3		0.1	300	30	90	0.02	10			1.3	50	48
D40N4		0.1	300	60	180	0.02	10			1.3	50	48
NSD133		0.1	300	30	90	0.03	10	1	0.02	1.75	50	48
NSD134		0.1	300	60	180	0.03	10	1	0.02	1.75	50	48
NSD459		0.1	300	25		0.03	10	1	0.03	1.75	50	48
NSE459		0.1	300	25		0.03	10	1	0.03	1.75	50	48
NSDU10		0.1	300	40		0.03	10	1.5	0.02	1.75	60	48
D40N5		0.1	375	20		0.02	10			1.3	50	48
NSD135		0.1	375	30	90	0.03	10	1	0.02	1.75	50	48
D40C1		0.5	30	10k	60k	0.2	5	1.5	0.5	1.3		05
D40C2		0.5	30	40k		0.2	5	1.5	0.5	1.3		05
D40C3		0.5	30	90k		0.2	5	1.5	0.5	1.3		05
D40C4		0.5	40	10k	60k	0.2	5	1.5	0.5	1.3		05
D40C5		0.5	40	40k		0.2	5	1.5	0.5	1.3		05
D40C7		0.5	50	10k	60k	0.2	5	1.5	0.5	1.3		05
D40C8		0.5	50	40k		0.2	5	1.5	0.5	1.3		05
D40P1		0.5	120	40		0.08	10	1	0.1	1.3	50	36
D40P3		0.5	180	40		0.08	10	1	0.1	1.3	50	36
D40P5		0.5	225	40		0.08	10	1	0.1	1.3	50	36
D40D1	D41D1	1	30	50	150	0.1	2	0.5	0.5	1.3		38/78
D40D2	D41D2	1	30	120	300	0.1	2	0.5	0.5	1.3		38/78
D40D3		1	30	290		0.1	2			1.3		38
D40D4	D41D4	1	45	50	150	0.1	2	0.5	0.5	1.3		38/78
D40D5	D41D5	1	45	120	360	0.1	2	0.5	0.5	1.3		38/78
NSD102	NSD202	1	45	50	150	0.1	5	0.2	0.1	1.75	60	37/77
NSD103	NSD203	1	45	120	360	0.1	5	0.2	0.1	1.75	60	37/77
D40D7	D41D7	1	60	50	150	0.1	2	1	0.5	1.3		38/78
D40D8	D41D8	1	60	120	360	0.1	2	1	0.5	1.3		38/78
2N6551	2N6554	1	60	80	250	0.05	1	0.5	0.25		75	38/78
D40D10	D41D10	1	75	50	150	0.1	2	1	0.5	1.3		38/78
D40D11	D41D11	1	75	120	360	0.1	2	1	0.5	1.3		38/78
D40D13	D41D13	1	75	50	150	0.1	2	1	0.5	1.3		38/78

PART NUMBER		I_C	V_{CEO}	h_{FE}		@		MAX		P_D	f_T	PROCESS
NPN	PNP	(A)	(V)	MIN	MAX	I_C (A)	V_{CE} (V)	$V_{CE(SAT)}$ (V)	@ I_C (A)	(W)	(MHz)	(NPN/PNP)
D40D14	D41D14	1	75	120	360	0.1	2	1	0.5	1.3		38/78
2N6552	2N6555	1	80	80	250	0.05	1	0.5	0.25		75	39/79
NSD104	NSD204	1	80	50	150	0.1	5	0.2	0.1	1.75	60	39/79
NSD105	NSD205	1	80	120	360	0.1	5	0.2	0.1	1.75	60	39/79
NSD106	NSD206	1	100	50	150	0.1	5	0.2	0.1	1.75	60	39/79
2N6553	2N6556	1	100	80	250	0.05	1	0.5	0.25		75	39/79
NSD36		1	150	30	300	0.1	10	0.5	0.1	1.75	10	36
NSD36A		1	200	30	300	0.1	10	0.5	0.1	1.75	10	36
NSD36B		1	250	30	300	0.1	10	0.5	0.1	1.75	10	36
NSD36C		1	300	30	300	0.1	10	0.5	0.1	1.75	10	36
NSDU01	NSDU51	2	30	60		0.1	1	0.5	1	1.75	50	37/77
NSD151		2	30	10k	250k	0.1	5	1.5	0.1	1.75	100	05
NSD153		2	30	5k		0.1	5	1.5	0.1	1.75	100	05
D40E1	D41E1	2	30	50		0.1	2	1	1	1.3		38/78
NSDU01A	NSDU51A	2	40	60		0.1	1	0.5	1	1.75	50	37/77
NSDU02	NSDU52	2	40	50	300	0.15	10	0.4	0.15	1.75	50	37/77
2N6548		2	40	15k		0.2	5	1.5	1	1.75	100	05
2N6549		2	40	25k		0.2	5	1.5	1	1.75	100	05
NSDU45		2	40	25k	150k	0.2	5	1	0.2	1.75	100	05
NSD152		2	40	10k	250k	0.1	5	1.5	1	1.75	100	05
NSD154		2	40	5k		0.1	5	1.5	1	1.75	100	05
NSDU45A		2	50	25k	150k	0.2	5	1	0.2	1.75	100	05
NSDU05	NSDU55	2	60	80		0.05	1	0.5	0.25	1.75	50	38/78
D40E5	D41E5	2	60	50		0.1	2	1	1	1.3		38/78
NSDU06	NSDU56	2	80	80		0.05	1	0.5	0.25	1.75	50	39/79
D40E7	D41E7	2	80	50		0.1	2	1	1	1.3		38/78
NSDU07	NSDU57	2	100	80		0.05	1	0.5	0.25		50	39/79
NSD123		2.2	120	40	300	0.15	10	0.4	0.15			08
D42C1	D43C1	3	30	25		0.2	1	0.5	1	1.7	50	37/77
D42C2	D43C2	3	30	40	120	0.2	1	0.5	1	1.7	50	38/78
D42C3	D43C3	3	30	40	120	0.2	1	0.5	1	1.7	50	37/77
D42C4	D43C4	3	45	25		0.2	1	0.5	1	1.7	50	37/77
D42C5	D43C5	3	45	40	120	0.2	1	0.5	1	1.7	50	37/77
D42C6	D43C6	3	45	40	120	0.2	1	0.5	1	1.7	50	37/77
D42C7	D43C7	3	60	25		0.2	1	0.5	1	1.7	50	37/77
D42C8	D43C8	3	60	40	120	0.2	1	0.5	1	1.7	50	38/78
D42C9	D43C9	3	60	40	120	0.2	1	0.5	1	1.7	50	38/78
D42C10	D43C10	3	80	25		0.2	1	0.5	1	1.7	50	38/78
D42C11	D43C11	3	80	40	120	0.2	1	0.5	1	1.7	50	38/78
D42C12	D43C12	3	80	40	120	0.2	1	0.5	1	1.7	50	38/78

Note. Preferred part types are shaded.

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PART NUMBER		I_C	V_{CEO}	h_{FE}		@		MAX $V_{CE(SAT)}$		P_D	f_T	PROCESS
NPN	PNP	(A)	(V)	MIN	MAX	I_C (A)	V_{CE} (V)	(V) @	I_C (A)	(W)	(MHz)	(NPN/PNP)
MJE3440		0.3	250	40	160	0.02	10	0.5	0.05	15	15	36
MJE3439		0.3	350	40	160	0.02	10	0.5	0.05	15	15	36
MJE341		0.5	150	25	200	0.05	10	1	0.05	20	15	36
MJE344		0.5	200	30	300	0.05	10	1	0.05	30	15	36
2N5655		0.5	250	30	250	0.1	10	1	0.1	20	10	36
MJE340		0.5	300	30	240	0.05	10			20		36
2N5656		0.5	300	30	250	0.1	10	1	0.1	20	10	36
2N5657		0.5	350	30	250	0.1	10	1	0.1	20	10	36
MJE520	MJE370	1	30	25		1	1			25		2C/3C
2N4921	2N4918	1	40	20	100	0.5	1	0.6	1	30	3	2C/3C
2N4922	2N4919	1	60	20	100	0.5	1	0.6	1	30	3	2C/3C
2N4923	2N4920	1	80	20	100	0.5	1	0.6	1	30	3	2C/3C
MJE720	MJE710	1.5	40	40		0.15	1	0.15	0.15	20		37/77
BD345	BD344	1.5	60	40	250	0.2	1	0.4	0.2	20	50	38/78
MJE721	MJE711	1.5	60	40		0.15	1	0.15	0.15	20		38/78
BD349	BD348	1.5	80	50	250	0.25	1	0.5	0.25	20	50	39/79
MJE722	MJE712	1.5	80	40		0.15	1	0.15	0.15	20		39/79
MJE180	MJE170	3	40	50	250	0.1	1	0.3	0.5	12.5	50	37/77
MJE181	MJE171	3	60	50	250	0.1	1	0.3	0.5	12.5	50	38/78
MJE182	MJE172	3	80	50	250	0.1	1	0.3	0.5	12.5	50	39/79
MJE521	MJE371	4	40	40		0.1	1			40		2C/3C
2N5190	2N5193	4	40	25	100	1.5	2	0.6	1.5	40	2	2E/3E
2N6037	2N6034	4	40	750	15k	2	3	2	2	40		2J/3J
2N5191	2N5194	4	60	25	100	1.5	2	0.6	1.5	40	2	2E/3E
MJE800	MJE700	4	60	750		1.5	3	2.5	1.5	40		2J/3J
MJE801	MJE701	4	60	750		2	3	2.8	2	40		2J/3J
2N6038	2N6035	4	60	750	15k	2	3	2	2	40		2J/3J
MJE802	MJE702	4	80	750		1.5	3	2.5	1.5	40		2J/3J
MJE803	MJE703	4	80	750		2	3	2.8	2	40		2J/3J
2N5192	2N5195	4	80	20	80	1.5	2	0.6	1.5	40	2	2E/3E
2N6039	2N6036	4	80	750	15k	2	3	2	2	40		2J/3J

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NPN	PNP	I_C (A)	V_{CEO} (V)	h_{FE} MIN	h_{FE} MAX	@ I_C (A)	@ V_{CE} (V)	MAX $V_{CE(SAT)}$ (V)	@ I_C (A)	P_D (W)	f_T (MHz)	PROCESS (NPN/PNP)
TIP61	TIP62	0.5	40	15	100	0.5	4	0.7	0.5	20	3	4F/5F
TIP61A	TIP62A	0.5	60	15	100	0.5	4	0.7	0.5	20	3	4F/5F
TIP61B	TIP62B	0.5	80	15	100	0.5	4	0.7	0.5	20	3	4F/5F
TIP61C	TIP62C	0.5	100	15	100	0.5	4	0.7	0.5	20	3	4F/5F
TIP29	TIP30	1	40	15	75	1	4	0.7	1	30	3	4F/5F
TIP29A	TIP30A	1	60	15	75	1	4	0.7	1	30	3	4F/5F
TIP29B	TIP30B	1	80	15	75	1	4	0.7	1	30	3	4F/5F
TIP29C	TIP30C	1	100	15	75	1	4	0.7	1	30	3	4F/5F
TIP110	TIP115	2	60	1000		1	4	2.5	2	50	1	4J/5J
TIP111	TIP116	2	80	1000		1	4	2.5	2	50	1	4J/5J
TIP112	TIP117	2	100	1000		1	4	2.5	2	50	1	4J/5J
	NSP2490	3	40	20	100	1	4	0.6	1	60	2	5E
NSP2520	NSP2370	3	40	40	200	0.2	4	0.7	1	40	3	4F/5F
TIP31	TIP32	3	40	10	50	3	4	1.2	3	40	3	4E/5E
NSP575	NSP576	3	45	25		1	1	0.6	1	40	3	4F/5F
NSP577	NSP578	3	60	25		1	1	0.6	1	40	3	4F/5F
	NSP2491	3	60	20	100	1	4	0.6	1	60	2	5E
TIP31A	TIP32A	3	60	10	50	3	4	1.2	3	40	3	4E/5E
NSP579	NSP580	3	80	15		1	1	0.8	1	40	3	4F/5F
TIP31B	TIP32B	3	80	10	50	3	4	1.2	3	40	3	4E/5E
NSP581	NSP582	3	100	15		1	1	0.8	1	40	3	4F/5F
TIP31C	TIP32C	3	100	10	50	3	4	0.2	3	40	3	4E/5E
D44C1	D45C1	4	30	25		0.2	1	0.5	1	30	3	4F/5F
D44C2	D45C2	4	30	40	120	0.2	1	0.5	1	30	3	4F/5F
D44C3	D45C3	4	30	40		0.2	1	0.5	1	30	3	4E/5E
NSP2480		4	40	20	100	1.5	4	0.7	1.5	60	2	4A
NSP2482		4	40	20	100	2.5	4	0.7	1.5	60	2	4A
2N5296		4	40	30	120	1	4	1	1	36	2	4E
D44C4	D45C4	4	45	25		0.2	1	0.5	1	30	3	4F/5F
D44C5	D45C5	4	45	40	120	0.2	1	0.5	1	30	3	4F/5F
D44C6	D45C6	4	45	40		0.2	1	0.5	1	30	3	4E/5E
NSP585	NSP586	4	45	25		2	2	0.8	2	40	3	4E/5E
2N6121	2N6124	4	45	25	100	1.5	2	0.6	1.5	40	2.5	4E/5E
D44C7	D45C7	4	60	25		0.2	1	0.5	1	30	3	4F/5F
D44C8	D45C8	4	60	40	120	0.2	1	0.5	1	30	3	4F/5F
D44C9	D45C9	4	60	40		0.2	1	0.5	1	30	3	4E/5E
NSP587	NSP588	4	60	25		2	2	0.8	2	40	3	4E/5E
NSP2481		4	60	20	100	1.5	4	0.7	1.5	60	2	4A
NSP2483		4	60	20	100	2.5	4	0.7	1.5	60	2	4A
2N5298		4	60	20	80	1.5	4	1	1.5	36	2	4E
2N6122	2N6125	4	60	25	100	1.5	2	0.6	1.5	40	2.5	4E/5E
2N5294		4	70	30	120	0.5	4	1	0.5	36	2	4E
D44C10	D45C10	4	80	25		0.2	1	0.5	1	30	3	4F/5F
D44C11	D45C11	4	80	40	120	0.2	1	0.5	1	30	3	4E/5E
D44C12	D45C12	4	80	40		0.2	1	0.5	1	30	3	4E/5E
NSP589	NSP590	4	80	15		2	2	0.8	2	40	3	4E/5E
2N6123	2N6126	4	80	20	80	1.5	2	0.6	1.5	40	2.5	4E/5E
NSP41	NSP42	5	40	15	75	3	4	1.5	5	50	3	4E/5E
NSP2020	NSP2010	5	40	25	125	1	4	1	3.5	80	3	4A/5A
NSP5977	NSP5974	5	40	20	120	2.5	2	0.6	2.5	75	2	4A/5A
NSP205	NSP105	5	50	26	100	2	2			50		4A/5A
NSP41A	NSP42A	5	60	15	75	3	4	1.5	5	50	3	4E/5E
NSP2021	NSP2011	5	60	25	125	1	4	1	3.5	80	3	4A/5A
NSP5978	NSP5975	5	60	20	120	2.5	2	0.6	2.5	75	2	4A/5A
NSP2100	NSP2090	5	60	750		3	3	2.5	3	70	1	4J/5J
NSP2101	NSP2091	5	60	750		4	3	2.5	4	70	1	4J/5J
TIP120	TIP125	5	60	1000		3	3	2	3	65	1	4J/5J

NPN	PNP	I_C (A)	V_{CEO} (V)	h_{FE} MIN	h_{FE} MAX	@ I_C (A)	@ V_{CE} (V)	MAX $V_{CE(SAT)}$ (V)	@ I_C (A)	P_D (W)	f_T (MHz)	PROCESS (NPN/PNP)
NSP41B	NSP42B	5	80	15	75	3	4	1.5	5	50	3	4E/5E
NSP5979	NSP5976	5	80	20	120	2.5	2	0.6	2.5	75	2	4A/5A
NSP2102	NSP2092	5	80	750		3	3	2.5	3	70	1	4J/5J
NSP2103	NSP2093	5	80	750		4	3	2.5	4	70	1	4J/5J
TIP121	TIP126	5	80	1000		3	3	2	3		1	4K/5K
NSP41C	NSP42C	5	100	15	75	3	4	1.5	5	50	3	4E/5E
TIP122	TIP127	5	100	1000		3	3	2	3		1	4K/5K
TIP41	TIP42	6	40	15	75	3	4	1.5	6	65	3	4A/5A
TIP41A	TIP42A	6	60	15	75	3	4	1.5	6	65	3	4A/5A
TIP130	TIP135	6	80	1000	15,000	4	4	2	4		1	4K/5K
TIP41B	TIP42B	6	80	15	75	3	4	1.5	6	65	3	4A/5A
TIP131	TIP136	6	80	1000	15,000	4	4	2	4		1	4K/5K
TIP41C	TIP42C	6	100	15	75	3	4	1.5	6	65	3	4A/5A
TIP132	TIP137	6	100	1000	15,000	4	4	2	4		1	4K/5K
2N6288	2N6111	7	30	30	15	3	4	1	3	40	4	4E/5E
2N5490		7	40	20	100	2	4	1	0.2	50	0.8	4E
2N5494		7	40	20	100	3	4	1	0.3	50	0.8	4E
2N6129	2N6132	7	40	20	100	2.5	4	1.4	7	50	2.5	4E/5E
2N6290	2N6109	7	50	30	150	2.5	4	1	2.5	40	4	4E/5E
2N5492		7	55	20	100	2.5	4	1	0.25	50	0.8	4E
2N6130	2N6133	7	60	20	100	2.5	4	1.4	7	50	2.5	4E/5E
2N5496		7	70	20	100	3.5	4	1	0.35	50	0.8	4E
2N6292	2N6107	7	70	30	150	2	4	1	2	40	4	4E/5E
2N6131	2N6134	7	80	20	100	2.5	4	2	7	50	2.5	4E/5E
NSP5983	NSP5980	8	40	20	120	4	2	0.6	4		2	4A/5A
2N6386		8	40	1000	20,000	3	3	2	3	40	20	4J
NSP595	NSP596	8	45	25		3	2	1	3	65	3	4E/5E
NSP695	NSP696	8	45	750		3	3	2.5	3	70	1	4J/5J
NSP695A	NSP696A	8	45	750		4	3	2.8	4	70	1	4J/5J
BD347	BD346	8	60	40	140	2	2.5	0.6	4	60	4	4A/5A
NSP597	NSP598	8	60	25		3	2	1	3	65	3	4E/5E
NSP5984	NSP5981	8	60	20	120	4	2	0.6	4		2	4A/5A
NSP697	NSP698	8	60	750		3	3	2.5	3	70	1	4J/5J
NSP697A	NSP698A	8	60	750		4	3	2.8	4	70	1	4J/5J
NSP599	NSP600	8	80	15		3	2	1	3	65	3	4E/5E
NSP5985	NSP5982	8	80	20	120	4	2	0.6	4		2	4A/5A
NSP699	NSP700	8	80	750		3	3	2.5	3	70	1	4J/5J
NSP699A	NSP700A	8	80	750		4	3	2.8	4	70	1	4J/5J
NSP601	NSP602	8	100	15		3	2	1	3	65	3	4A/5A
NSP701	NSP702	8	100	750		3	3	2.5	3	70	1	4J/5J
D44H1	D45H1	10	30	35		2	1	1	8	50	1	4A/5A
D44H2	D45H2	10	30	60		2	1	1	8	50	1	4A/5A
D44H4	D45H4	10	45	35		2	1	1	8	50	1	4A/5A
D44H5	D45H5	10	45	60		2	1	1	8	50	1	4A/5A
2N6099		10	60	20	80	4	4	2.5	10	75	0.8	4A
D44H7	D45H7	10	60	35		2	1	1	8	50	1	4A/5A
D44H8	D45H8	10	60	60		2	1	1	8	50	1	4A/5A
NSP3055	NSP2955	10	60	20	70	4	4	1.1	4		2	4A/5A
SE9300	SE9400	10	60	1000		4	3	2	4	70	1	4K/5K
2N6101		10	70	20	80	5	4	2.5	10	75	0.8	4A
D44H10	D45H10	10	80	35		2	1	1	8	50	1	4A/5A
D44H11	D45H11	10	80	60		2	1	1	8	50	1	4A/5A
SE9301	SE9401	10	80	1000		4	3	2	4	70	1	4K/5K
SE9302	SE9402	10	100	1000		4	3	2	4	70	1	4K/5K
2N6486	2N6489	15	40	20	150	5	4	1.3	5	75	5	4A/5A
2N6487	2N6490	15	60	20	150	5	4	1.3	5	75	5	4A/5A
2N6488	2N6491	15	80	20	150	5	4	1.3	5	75	5	4A/5A

Note. Preferred part types are shaded.

TO-3 Power Transistor Reference Guide

PART NUMBER		I_C	V_{CEO}	h_{FE}		@		MAX $V_{CE(SAT)}$		P_D	f_T	PROCESS
NPN	PNP	(A)	(V)	MIN	MAX	I_C (A)	V_{CE} (V)	(V) @	I_C (A)	(W)	(MHz)	(NPN/PNP)
2N5067	2N4901	5	40	20	80	1	2	0.4	1	87.5	4	4A/5A
2N4913	2N4904	5	40	25	100	2.5	2	1	2.5	87.5	4	4A/5A
2N5068	2N4902	5	60	20	80	1	2	0.4	1	87.5	4	4A/5A
2N4914	2N4905	5	60	25	100	2.5	2	1	2.5	87.5	4	4A/5A
2N5069	2N4903	5	80	20	80	1	2	0.4	1	87.5	4	4A/5A
2N4915	2N4906	5	80	25	100	2.5	2	1	2.5	87.5	4	4A/5A
2N5758	2N6226	6	100	25	100	3	2	1	3	150	1	4B/5B
2N5759	2N6227	6	120	20	80	3	2	1	3	150	1	4B/5B
2N5760	2N6228	6	140	15	60	3	2	1	3	150	1	4B/5B
2N5873	2N5871	7	60	20	100	2.5	4	1	4	115	4	4A/5A
2N5874	2N5872	7	80	20	100	2.5	4	1	4	115	4	4A/5A
2N6055	2N6053	8	60	750	18,000	4	3	2	4	100	4	4K/5K
MJ1000	MJ900	8	60	1000		3	3	2	3	90	4	4K/5K
2N6056	2N6054	8	80	750	18,000	4	3	2	4	100	4	4K/5K
MJ1001	MJ901	8	80	1000		3	3	2	3	90	4	4K/5K
	2N4907	10	40	20	80	4	4	0.75	4	150	4	5B
2N3713	2N3789	10	60	25	90	1	2	1	5	150	4	4B/5B
2N3715	2N3791	10	60	50	150	1	2	0.8	5	150	4	4B/5B
MJ2840	MJ2940	10	60	20	100	3	2			150	2	4B/5B
	2N4908	10	60	20	80	4	4	0.75	4	150	4	5B
2N5877	2N5875	10	60	20	100	4	4	1	5	150	4	4B/5B
2N3714	2N3790	10	80	25	90	1	2	1	5	150	4	4B/5B
2N3716	2N3792	10	80	50	150	1	2	0.8	5	150	4	4B/5B
	2N4909	10	80	20	80	4	4	0.75	4	150	4	5B
2N5878	2N5876	10	80	20	100	4	4	1	5	150	4	4B/5B
MJ2841	MJ2941	10	80	20	100	4	2			150	2	4B/5B
2N5632	2N6229	10	100	25	100	5	2	1	7.5	150	1	4C/5C
2N5633	2N6230	10	120	20	80	5	2	1	7.5	150	1	4C/5C
2N5634	2N6231	10	140	15	60	5	2	1	7.5	150	1	4C/5C
2N6569	2N6594	12	40	15	200	4	3			100	4	4A/5A
MJ2801	MJ2901	15	40	15	60	8	4	1.5	8	115	1	4A/5A
2N3055	MJ2955	15	60	20	70	4	4	1.1	4	115	2.5	4A/5A
2N5881	2N5879	15	60	20	100	6	4	1	7	160	4	4C/5C
BD351	BD350	15	80	20	100	6	2.5	2	6	160	4	4C/5C
2N5882	2N5880	15	80	20	100	6	4	1	7	160	4	4C/5C

Appendices

Glossary of Symbols
Package Outlines

A

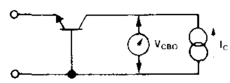
National Semiconductor

Transistor Glossary of Symbols

DC PARAMETERS

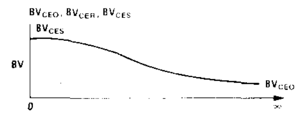
BV_{CBO} — **Collector-Base Breakdown Voltage with Emitter Open-Circuited**

The breakdown voltage of the collector-base junction, measured at a specified current, with the emitter open-circuited.



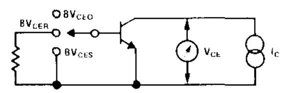
BV_{CEO} — **Collector-Emitter Breakdown Voltage with the Base Open-Circuited**

The collector-emitter breakdown voltage, measured at a specified collector current, with the base open-circuited.



BV_{CER} — **Collector-Emitter Breakdown Voltage with Resistance between Emitter and Base**

The collector-emitter breakdown voltage measured at a specified current with a specified resistance R connected between the base and the emitter.

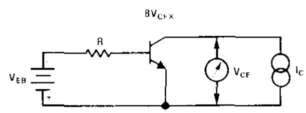


BV_{CES} — **Collector-Emitter Breakdown Voltage with Base Shorted to Emitter**

The collector-emitter breakdown, measured at a specified current, with the base shorted to the emitter.

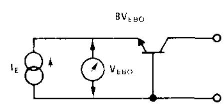
BV_{CEX} — **Collector-Emitter Breakdown Voltage at a Specified Condition**

The collector-emitter breakdown voltage measured at a specified current with the base-emitter junction forward or reverse biased by a specified voltage or current.



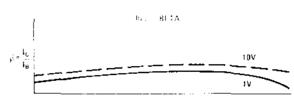
BV_{EBO} — **Emitter-Base Breakdown Voltage with Collector Open-Circuited**

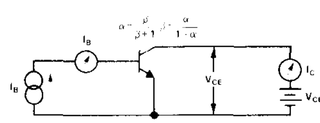
The emitter-base breakdown voltage, measured at a specified current, with the collector open-circuited.



h_{FE} — **Common-Emitter DC Current Gain**

The ratio of DC collector current to DC base current measured at a specified collector-emitter voltage and a specified collector current.

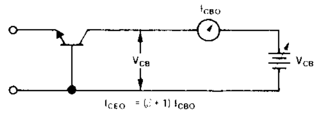




I_{CBO}

Inverse Collector-Base Current

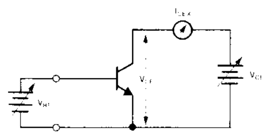
The collector-base current with the junction reverse biased by a specified voltage, with the emitter open-circuited.



I_{CEX}

Inverse Collector-Emitter Current at a Specified Condition

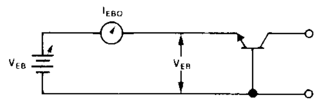
The collector-emitter current measured at a specified collector-emitter voltage with the base forward or reverse biased by a specified voltage or current.



I_{EBO}

Inverse Emitter-Base Current

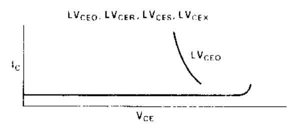
The emitter-base current with the junction reverse biased by a specified voltage with the collector open-circuited.

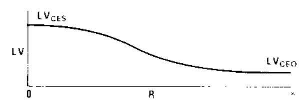


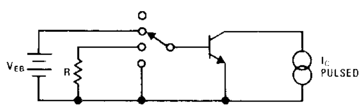
LV_{CEO}, LV_{CER}, LV_{CES}, LV_{CEX}, or, V_{CEO}(sust) V_{CER}(sust) V_{CES}(sust) V_{CEX}(sust)

Pulsed Limiting Breakdown Voltages

These are similar to the corresponding, above defined, BV parameters but are measured at a specified high current point where collector-emitter voltage is lowest. The duration of the pulse and its duty cycle must be specified. The letter L indicates LIMITING Value and is measured outside the negative resistance zone of the reverse characteristic.



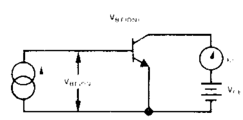


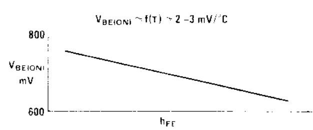


$V_{BE(ON)}$

Unsaturated Base-Emitter Voltage

The base-emitter voltage measured in the common-emitter connection at a specified collector to emitter voltage and specified collector current.



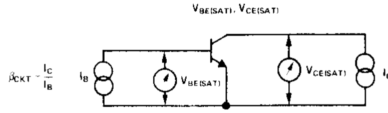


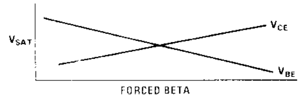
$V_{BE(SAT)}$ — **Base-Emitter Saturation Voltage**

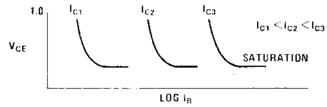
The base-emitter voltage measured in the common-emitter connection at a specified collector and base saturation currents.

$V_{CE(SAT)}$ — **Collector-Emitter Saturation Voltage**

The collector-emitter voltage measured in the common-emitter connection at specified collector and base saturation currents.







V_{RT} — **Reach Through Voltage**

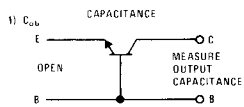
V_{PT} — **Punch Through Voltage**

The collector-base voltage above which an increase of applied voltage can be measured in the emitter-base open circuit.

SMALL SIGNAL PARAMETERS

C_{ob} — **Common-Base Output Capacitance**

The common-base output capacitance with input ac open.



C_{re} — **Common Emitter Reverse Transfer Capacitance**

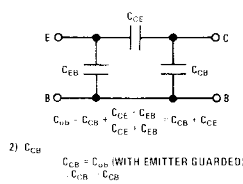
This parameter is the imaginary part of y_{re}. When $I_C = 0$, C_{re} is identical to C_{CB}.

C_{TE} — **Base-Emitter Capacitance**

The capacity of the base-emitter junction at a specified inverse voltage with the collector open.

C_{CB} — **Collector Base Capacitance**

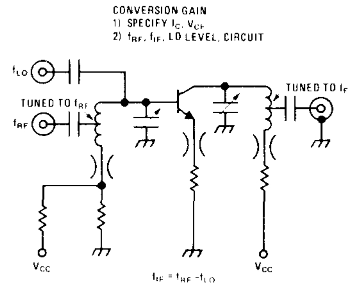
Collector Base Capacitance measured at some Specified Collector Base Voltage.



CG_e, CG_b

Conversion Gain, Common-Emitter or Common-Base

The ratio of the output power of a mixer, at one specified frequency, to its input power, at another specified frequency. This parameter is a function of oscillator injection voltage and the mixer operating point.



$f_{\alpha b}$, $f_{h_{fb}}$

Common-Base Cut Off Frequency

The frequency at which the h_{fb} (α) is reduced to 0.707 of its low frequency value.

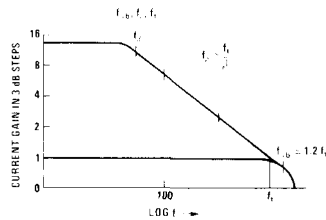
f_β, $f_{h_{fe}}$

Common-Emitter Cut Off Frequency

The frequency at which the h_{fe} (β) is reduced to 0.707 of its low frequency value.

Gain Band-Width Product

The common-emitter current gain bandwidth product in the frequency range where the current gain is falling at approximately 6 db/octave.



f_t

Maximum Frequency of Oscillation

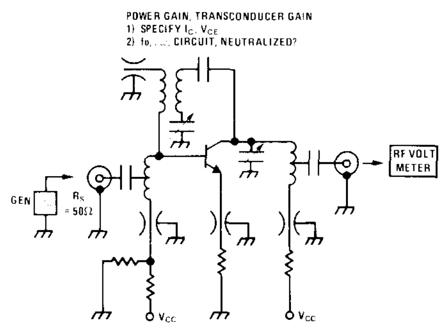
This parameter is a device figure of merit that is calculated from ft and rb'Cc.

f_{MAX} = MAX FREQUENCY OF OSCILLATION FREQUENCY AT WHICH MAG = 1

$$f_{MAX} = \sqrt{\frac{f_T}{8\pi\, rb\, Cc}} = f\sqrt{PG}$$

G_e

Common-Emitter Power Gain



C_{TE}

Common Emitter Transducer Gain

A test fixture must be specified.

$$G_{TE} = \frac{\text{POWER DELIVERED TO THE LOAD}}{\text{POWER AVAILABLE FROM THE SOURCE}}$$

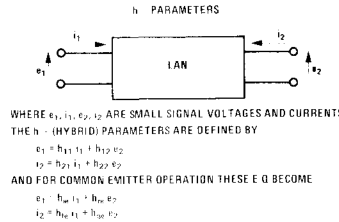
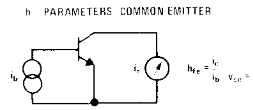
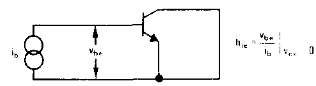
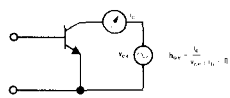
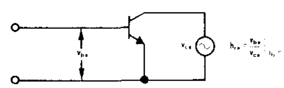
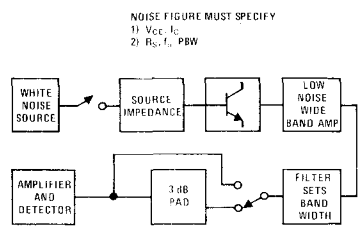
GMA

Stability Limited Gain or Gain Maximum Available

This parameter is a device figure of merit and must be calculated from the two port "y" parameters.

$$GMA = 10\ LOG \left[\frac{|Y_{fe}|}{|Y_{re}|}\left(K - \sqrt{K^2 - 1}\right)\right]$$

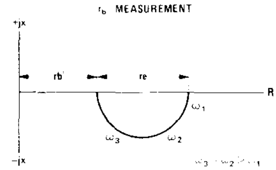
NOT DEFINED FOR K < 1

	h Parameters	
h_{fe}	**Common-Emitter Current Gain** The common-emitter forward current transfer ratio with output ac shorted. This is a complex quantity.	
h_{ie}	**Common-Emitter Input Impedance** The common-emitter input impedance with the output ac shorted. This is a complex quantity.	
h_{oe}	**Common-Emitter Output Admittance** The common-emitter output admittance with the input ac open. This is a complex quantity.	
h_{re}	**Common-Emitter Reverse Voltage Transfer Ratio** The common-emitter reverse voltage transfer ratio with input ac open. This is a complex quantity.	
MAG	**Maximum Available Gain** Device figure of merit that must be calculated from the two port "y" parameters.	$\text{MAG} = 10\ \text{LOG}\ \frac{\lvert Y_{21}\rvert^2}{4\ \text{Re}\ (Y_{11})\ \text{RE}\ (Y_{22})}$
MSG	**Maximum Stable Gain** This parameter is a device figure of merit that is calculated from the two port "y" parameters.	$\text{MSG} = 10\ \text{LOG}\ \frac{\lvert Y_{fe}\rvert}{\lvert Y_{re}\rvert}$
NF	**Noise Figure** Noise figure = 10 $\log_{10}$F, where F is the ratio of total output noise power to the output power due solely to the thermal noise of the source impedance.	

$r_{bb'}$, r_b'

Base << Spreading >> Resistance

Equivalent to the real part of h_{ie} at some specified very high frequency.



rb'Cc

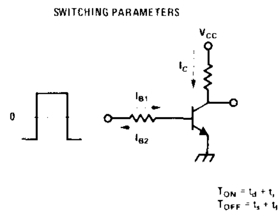
Collector Base Time Constant

This parameter is a device figure of merit and is measured in a specified test circuit.

$r_b' C_c$ = COLLECTOR BASE TIME CONSTANT SPECIFY – I_C, V_{CE}, FREQUENCY

Common-Emitter Switching Parameters

In the following, drive circuit conditions and collector circuit conditions must be specified. The transition times of the input must be negligible compared to the measured times.



t_d

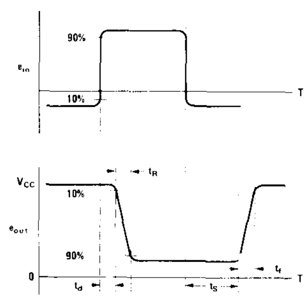
Delay Time

The time interval during turn-on from the point when the input pulse at the base *reaches 10% of its full amplitude to the* point when the collector pulse changes from 0 to 10% of its maximum amplitude.

t_r

Rise Time

The time interval during turn-on in which the collector pulse changes from 10% to 90% of its maximum amplitude.



t_s

Storage Time

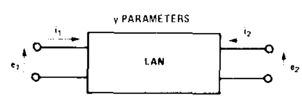
The time interval during turn-off from the point when the turn-off pulse at the base changes from 100% to 90% of its full *amplitude to the time when the collector* current has changed from 100% to 90% of its maximum amplitude.

t_f

Fall Time

The time interval during turn-off in which the collector pulse decreases from 90% to 10% of its maximum amplitude.

y Parameters



y PARAMETERS ARE DEFINED BY

$i_1 = y_{11} e_1 + y_{12} e_2$

$i_2 = y_{21} e_1 + y_{22} e_2$

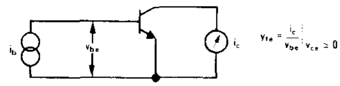
OR IN COMMON EMITTER NOTATION

$i_1 = y_{ie} e_1 + y_{re} e_2$

$i_2 = y_{fe} e_1 + y_{oe} e_2$

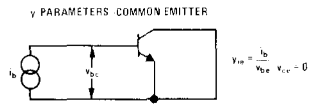
y_{fe} — **Common-Emitter Forward Transfer Admittance**

The common-emitter forward transfer admittance with output ac shorted. This is a complex quantity (g_{fe} + jb_{fe}).



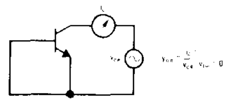
y_{ie} — **Common-Emitter Input Admittance**

The common-emitter input admittance with output ac shorted. This is a complex quantity (g_{ie} + b_{ie}).



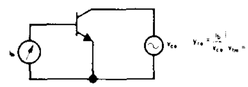
y_{oe} — **Common-Emitter Output Admittance**

The common-emitter output admittance with input ac open. This is a complex quantity (g_{oe} + jb_{oe}).



y_{re} — **Common-Emitter Reverse Transfer Admittance**

The common-emitter reverse transfer admittance with input ac shorted. This is a complex quantity (g_{re} + jb_{re}).



LARGE SIGNAL PARAMETERS

η — **Collector Efficiency**

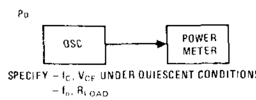
This parameter applies to oscillators and class C amplifiers, predominantly. It is defined as the ratio of RF Power Out/DC Power In.

η – COLLECTOR EFFICIENCY

$$\eta = \frac{P_O\ (RF)}{P_{IN(DC)}} = \frac{vi}{I_C \times V_{CE}}$$

P_o — **Power Out**

This parameter applies to oscillators. The units are watts and a test circuit must be specified.



THERMAL PARAMETERS

R_{TH} — **Internal Junction-to Case Thermal Resistance**

The rated increase of junction temperature with respect to the case temperature per unit of dissipated power. It is also called Thermal Resistance with infinite heat sink.

θ_{JC} — **Junction-to Case Thermal Rating**

θ_{JA} — **Junction-to Ambient Thermal Rating**

National Semiconductor

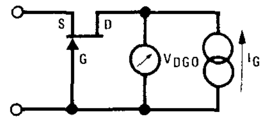
JFET Glossary of Symbols

DC PARAMETERS

BV_{DGO} (V) or BV_{GDO}

Drain-Gate Breakdown Voltage with Source Open-Circuited

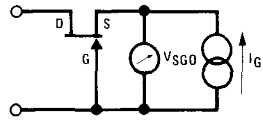
The breakdown voltage of the drain-gate junction, measured at a specified current with the source open-circuited.



BV_{SGO} (V) or BV_{GSO}

Source-Gate Breakdown Voltage with Drain Open-Circuited

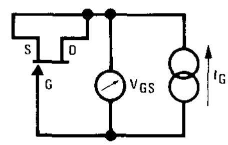
The breakdown voltage of the source-gate junction, measured at a specified current, with the drain open-circuited.



BV_{GSS} (V) or BV, $V_{(BR)GSS}$

Source-Gate Breakdown Voltage with Drain-Source Shorted

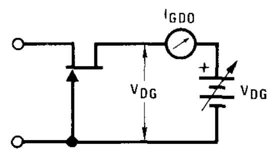
The breakdown voltage of the source-gate and drain-gate junctions, measured at a specified current with the drain-source shorted.



I_{DGO} (pA) or I_{GDO}

Drain-Gate Leakage Current, Source Open-Circuited

The leakage current of the drain-gate junction, measured at a specified voltage, with the source open-circuited.



I_D (μA) or $I_{D(ON)}$

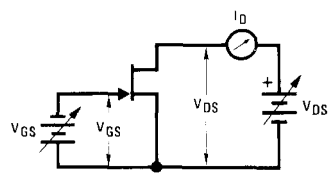
Drain ON Current

The drain current, measured at a specified drain-source voltage and gate-source voltage.

$I_{D(OFF)}$ (pA)

Drain Cutoff Current

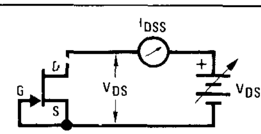
The drain cutoff current, measured at a specified drain-source voltage and gate-source voltage.



I_{DSS} (mA)

Drain Saturation Current

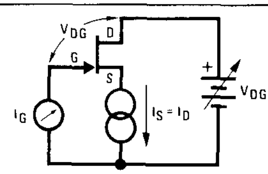
The drain current, measured at a specified drain-source voltage with the source shorted to the gate (V_{GS} = 0)



I_G (pA) or $I_{G(ON)}$

Gate Leakage Current with Drain Current Flowing

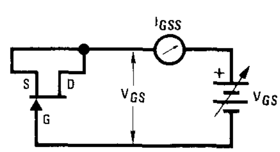
The gate leakage current, measured at a specified drain current and drain-gate voltage.

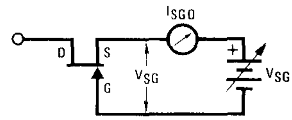
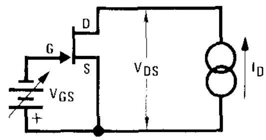
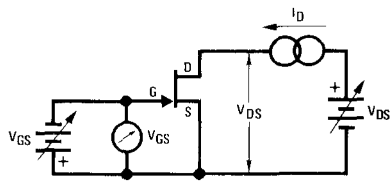
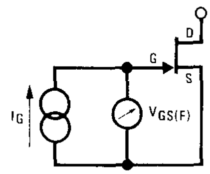
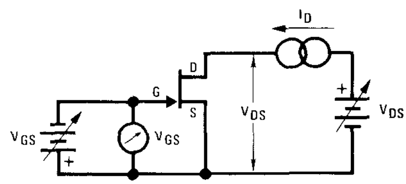


I_{GSS} (pA)

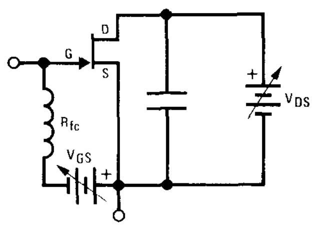
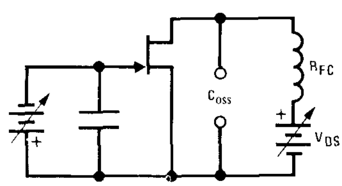
Gate-Source Reverse Leakage Current with Drain-Source Shorted

The gate-source reverse leakage current measured at a specified gate-source voltage.



Symbol	Definition	Test Circuit
I_{SGO} (pA) or I_{GSO}	**Source-Gate Reverse Leakage Current with Drain Open-Circuited** The leakage current of the source-gate junction, measured at a specified voltage, with the drain open-circuited.	
r_{DS} (Ω) or r_{ds}, R_{DS}, $r_{DS(ON)}$	**Drain-Source ON Resistance** The drain-source ON resistance, measured at a specified gate-source voltage and drain current.	
$V_{DS(ON)}$ (mV)	**Drain-Source ON Voltage** The drain-source ON voltage, measured at a specified gate-source voltage and drain current.	$r_{DS} = \frac{V_{DS}}{I_D}$
V_{GS} (V) or $V_{GS(ON)}$, V_G	**Operating Gate-Source Voltage** The gate-source voltage, measured at a specified drain current and drain-source voltage.	
$V_{GS(F)}$ (V)	**Forward Gate-Source Voltage** The forward gate-source voltage, measured at specified current.	
$V_{GS(OFF)}$ (V) or V_P	**Gate-Source Cutoff (Pinch-Off) Voltage** The gate-source cutoff voltage, measured at a specified drain current and drain-source voltage.	

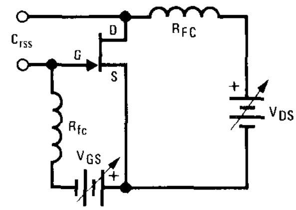
SMALL SIGNAL PARAMETERS

Symbol	Definition	Test Circuit
C_{iss} (pF) or C_{iss}, C_{gss}	**Common-Source Input Capacitance** The common-source input capacitance measured between the gate and source with the drain A–C shorted to the source at specified drain-source and gate-source voltages.	
C_{oss} (pF) or C_{os}, C_{dss}	**Common-Source Output Capacitance** The common-source output capacitance, measured between the drain and source with the source A–C shorted to the gate at specified drain-source and gate-source voltages.	

C_{rss} (pF)
or C_{rs}, C_{dg}

Common-Source Reverse Transfer Capacitance

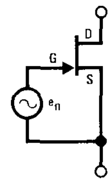
The common-source reverse transfer capacitance, measured between the drain and gate at specified drain-source and gate source voltages.



e_n (nV/$\sqrt{Hz}$)
or e_n, V_n, E_n

Equivalent Input Noise Voltage

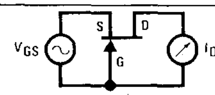
The equivalent input noise voltage per unit bandwidth, measured with the input A–C shorted to the source at a specified operating condition.



g_{fg} (mV)
or y_{fg}

Common- Gate Forward Transconductance

The common-gate forward transconductance with the output A–C shorted. This is a complex quantity (g_{fg} + jb_{fg}).



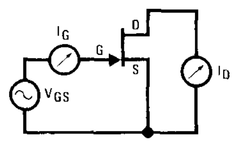
$$Y_{fg} = \frac{I_D}{V_{GS}}\bigg|_{V_{DS}=0}$$

g_{fs} (mV)
or g_m, Y_{fs}, $Re|Y_{fs}|$

Common-Source Forward Transconductance

The common source forward transconductance with the output A–C shorted. This is a complex quantity (g_{fs} + jb_{fs}).

$$Y_{fs} = \frac{I_D}{V_{GS}}\bigg|_{V_{DS}=0}$$



g_{iss} (μV)
or Y_{is}

Common-Source Input Conductance

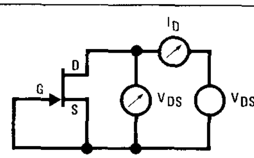
The common-source input conductance with the output A–C shorted. This is a complex quantity (g_{is} + jb_{is}).

$$Y_{is} = \frac{I_G}{V_{GS}}\bigg|_{V_{DS}=0}$$

g_{oss} (μV)
or Y_{os}

Common-Source Output Conductance

The common source output conductance with the input A–C shorted. This is a complex quantity (g_{os} + jb_{os}).



$$Y_{os} = \frac{I_D}{V_{DS}}\bigg|_{V_{GS}=0}$$

G_{pg} (dB)

Common-Gate Power Gain

The common-gate power gain is the ratio of output *power to input power.*

G_{PS} (dB)

Common-Source Power Gain

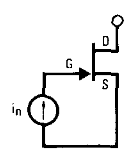
The common-source power gain is the ratio of output power to input power.

$$G_p = 10 \log_{10} \frac{P_o}{P_i}$$

i_n (pA/$\sqrt{Hz}$)

Equivalent Input Noise Current

The equivalent input noise current measured with the input open-circuited under specified operating conditions.



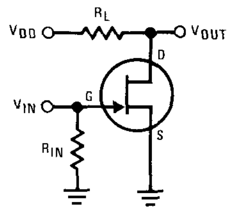
NF (dB) — **Spot Noise Figure**

Noise figure = 10 $\log_{10}$ F were F is noise factor which is the ratio of the total output noise power to the output noise power of the source. Measured at specified operating conditions and source resistance.

$$F = \frac{\text{Total Output Noise Power}}{\text{Source Output Noise Power}}$$

COMMON-SOURCE SWITCHING PARAMETERS

In the following, drive circuit conditions and drain circuit conditions must be specified. The transition times of the input must be negligible compared to the measured times.



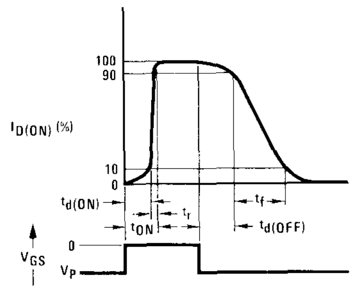
$t_{d(ON)}$ — **Turn-On Delay Time**

The time interval during turn-on from the point when the input pulse at the gate reaches 10% of its full amplitude to the point when the drain pulse changes from 0 to 10% of its maximum amplitude.

$$I_{D(ON)} = \frac{V_{DD} - V_{DS(ON)}}{R_L}$$

t_r — **Rise Time**

The time interval during turn-on in which the drain current pulse changes from 10% to 90% of its maximum amplitude.



$t_{d(OFF)}$ — **Turn-Off Delay Time**

The time interval during turn-off from the point when the turn-off pulse at the gate changes from 100% to 90% of its full amplitude to the time when the drain current has changed from 100% to 90% of its maximum amplitude.

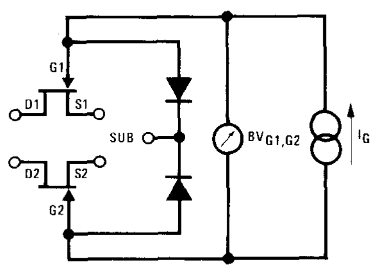
t_f — **Fall Time**

The time interval during turn-off in which the drain current pulse decreases from 90% to 10% of its maximum amplitude.

DUAL FET PARAMETERS

$BV_{G1, G2}$ (V) or BV_{G1-2} — **Gate to Gate Breakdown Voltage**

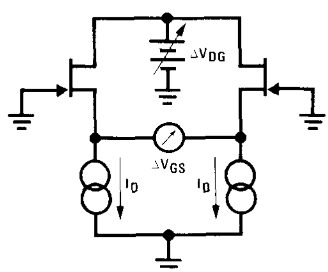
The breakdown voltage of the gate to gate junctions, measured at a specified current.



CMRR (dB) or CMR — **Common-Mode Rejection Ratio**

The common-mode rejection ratio is the ratio of the change in differential gate voltage with a change in the drain to gate voltage.

$$CMRR = 20 \log_{10} \frac{\Delta V_{DG}}{\Delta V_{os}}$$



g_{fs1-2} (%) or g_{fs1}/g_{fs2}

Common-Source Forward Transconductance Ratio (Match)

The transconductance ratio = $g_{fs1}/g_{fs2} \times 100$ (%) measured at specified drain-gate voltage and drain current.

$g_{oss\,1\text{-}2}$ (μV) or g_{os1-2}

Common-Source Output Conductance (Match)

Output conductance match = $|g_{os1} - g_{os2}|$ measured at specified drain-gate voltage and drain current.

I_{DSS1-2} (%) or I_{DS1-2}, I_{DSS1}/I_{DSS2}

Drain Saturation Current Ratio (Match)

The drain saturation current ratio = $I_{DSS1}/I_{DSS2} \times 100\%$ measured at specified drain-source voltages.

I_{G1-2} (pA)

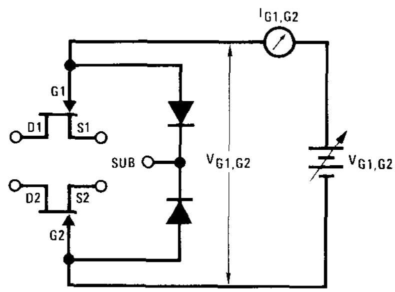
Differential Gate Leakage Current

Differential gate leakage current = $|I_{G1} - I_{G2}|$ measured at specified drain-gate voltage and drain current.

$I_{G1,\,G2}$ (pA)

Gate to Gate Reverse Leakage Current

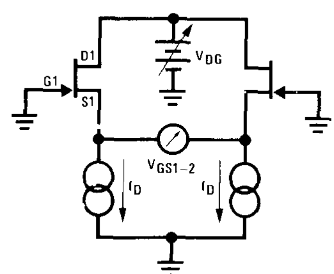
The gate to gate reverse leakage measured at a specified voltage monolithic dual with diode isolation shown.



V_{GS1-2} (mV) or ΔV_{GS}, V_{os}, $|V_{GS1} - V_{GS2}|$

Differential Gate-Source Voltage

The differential gate-source voltage, measured at a specified drain-gate voltage and drain current.

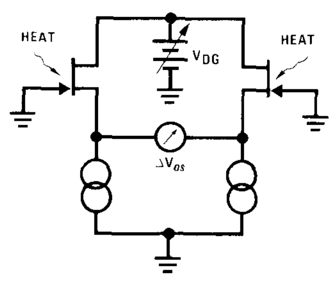


ΔV_{GS1-2} (μV/°C) or $\Delta|V_{GS1} - V_{GS2}|/\Delta T$, $\Delta V_{os}/\Delta T$

Differential Gate-Source Voltage Drift

The differential gate-source voltage drift is the change in the differential gate-source voltage with a change in device temperature at a specified operating condition.

$$\frac{\Delta V_{os}}{\Delta T} = \left| \frac{(V_{GS1} - V_{GS2})|T_1 - (V_{GS1} - V_{GS2})|T_2}{T_1 - T_2} \right|$$



National Semiconductor

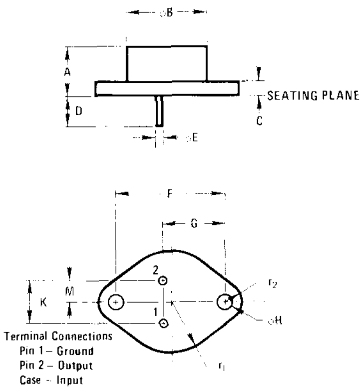
Package Outlines

Dimensions are in inches (millimeters)

Numbers in parentheses behind package titles are NS internal package codes.

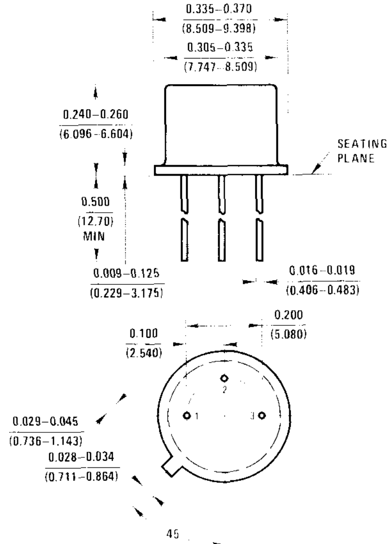
TO-3 (98)

SYMBOL	INCHES (MILLIMETERS) MIN	MAX
A	0.250 (6.35)	0.450 (11.43)
φE	0.038 (0.965)	0.043 (1.092)
φB		0.875 (22.225)
K	0.420 (10.668)	0.440 (11.176)
M	0.205 (5.207)	0.225 (5.715)
C		0.135 (3.429)
D	0.312 (7.925)	
φH	0.151 (3.835)	0.161 (4.089)
F	1.177 (29.896)	1.197 (30.404)
r_1		0.525 (13.335)
r_2		0.188 (4.775)
G	0.655 (16.637)	0.675 (17.145)



TO-5 (04)

PIN	T
1	E
2	B
3	C

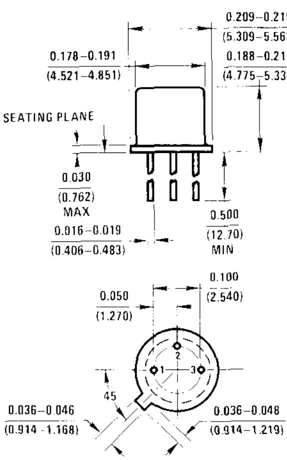


TO-18 (02, 11, 19)

PIN	T (02), (19)
1	E
2	B
3	C

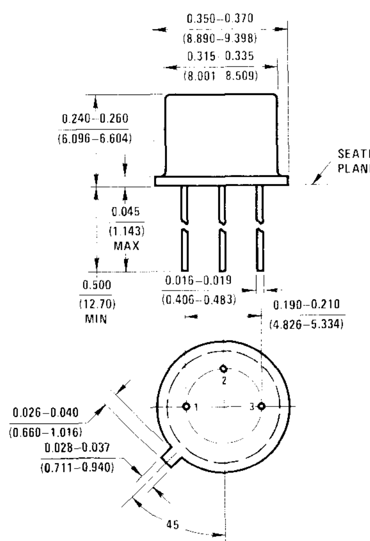
PIN	FET N (02)
1	S
2	D
3	G

PIN	FET P (11)
1	S
2	G
3	D



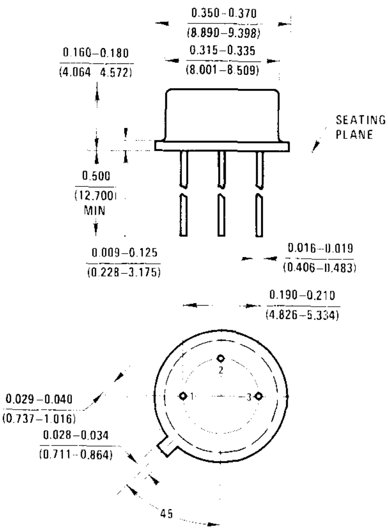
TO-39 (10, 16)*

PIN	T
1	E
2	B
3	C



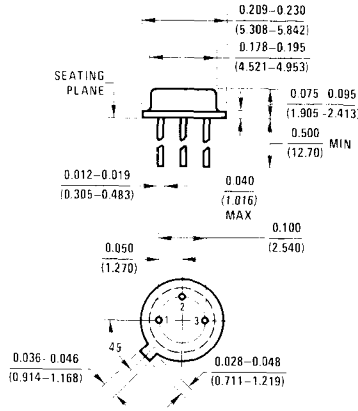
TO-39 (17) LO-PROFILE

PIN	T
1	E
2	B
3	C



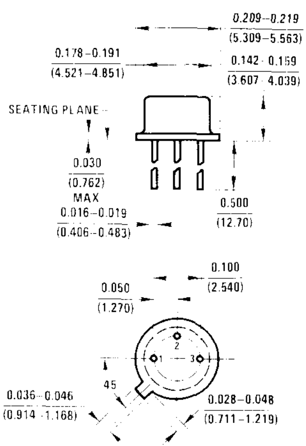
TO-46 (06)

PIN	T
1	E
2	B
3	C



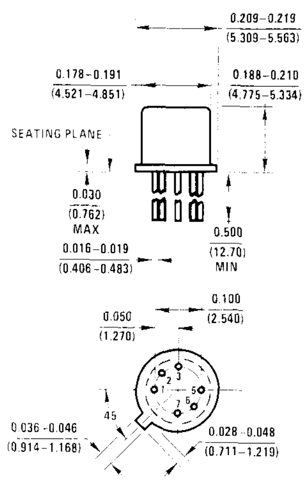
TO-52 (07, 18)

PIN	T (18)	FET (07)
1	E	S
2	B	D
3	C	G



TO-71 (08, 12)

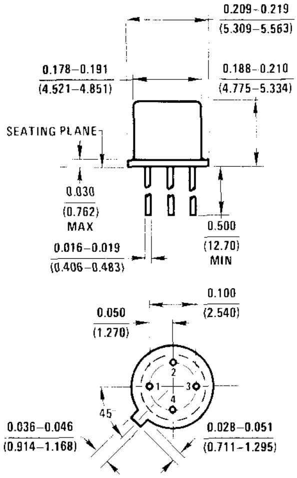
PIN	T (08)	FET (12)
1	E	S1
2	B	D1
3	C	G1
5	E	S2
6	B	D2
7	C	G2



TO-72, (23, 25, 28, 29)

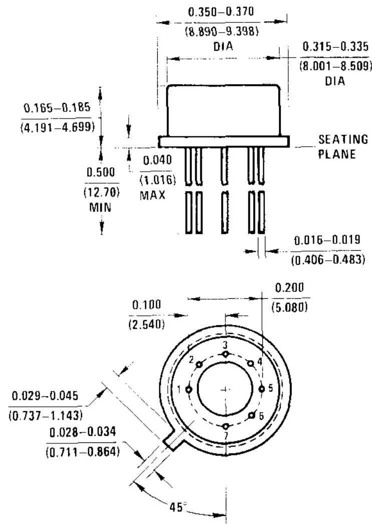
PIN	T (25)	FET N (25, 29)
1	E	S
2	B	D
3	C	G
4	GND	CASE

PIN	T (28)	FET P (23)
1	B	S
2	E	G
3	C	D
4	GND	CASE



TO-78 (24, 27)

PIN	T (27)	FET (24)
1	C	S1
2	B	D1
3	E	G1
5	E	S2
6	B	D2
7	C	G2



TO-92 (71, 72, 74, 76, 77, 78)

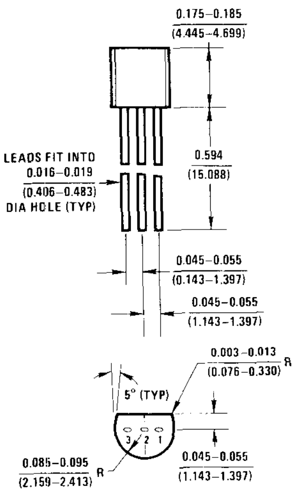
PIN	75/72 (Std)	
	T	FET
1	C	G
2	B	S
3	E	D

PIN	76/71	
	T	FET
1	C	G
2	E	D
3	B	S

PIN	74	
	T	FET
1	B	S
2	C	G
3	E	D

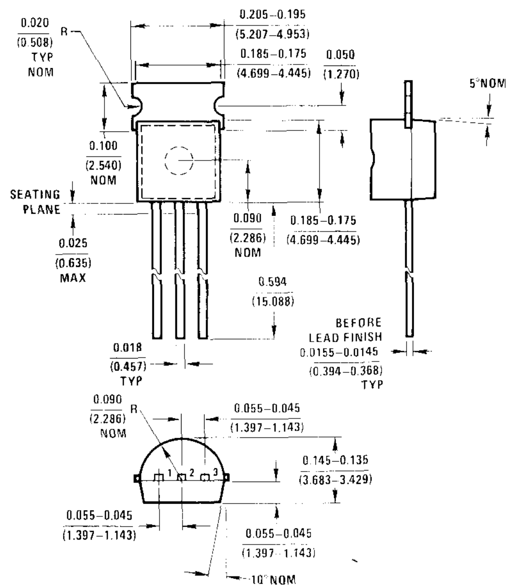
PIN	77	
	T	FET
1	E	D
2	B	S
3	C	G

PIN	78
	T
1	B
2	E
3	C



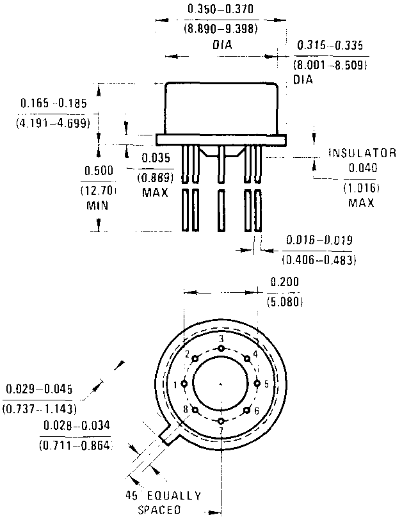
92-PLUS (90, 91)

PIN	PACKAGE 90	PACKAGE 91
1	Base	Collector
2	Collector	Base
3	Emitter	Emitter

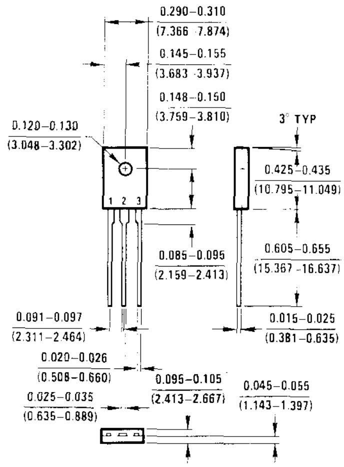


TO-99 (22)

PIN	FET
1	S
2	D
3	G
4	SUB
5	S
6	D
7	G
8	NC



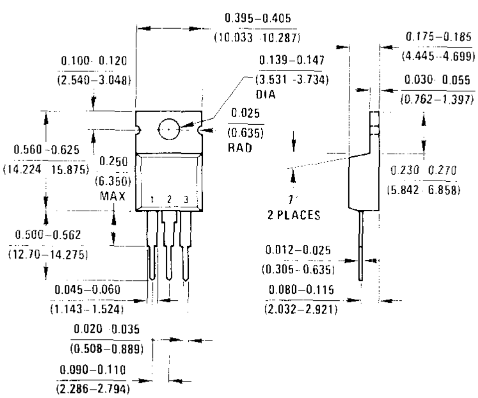
TO-126 (38)



Pin 1. Emitter
2. Collector
3. Base

When mounting the device, torque not to exceed 6.0 in lb.
If lead bending is required, use suitable clamp or other supports between transistor case and point of bend.

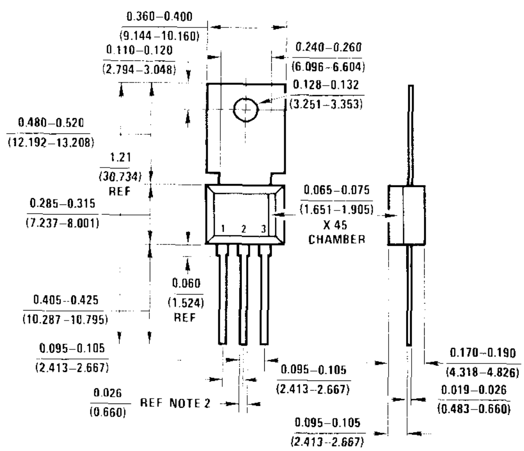
TO-220 (37)



Pin 1. Base
2. Collector
3. Emitter

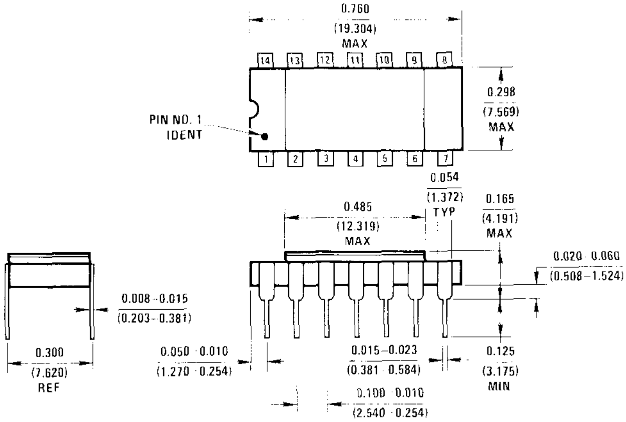
TO-202 (35, 36)

PIN	PACKAGE 35	PACKAGE 36
	T	T
1	Emitter	Emitter
2	Base	Collector
3	Collector	Base

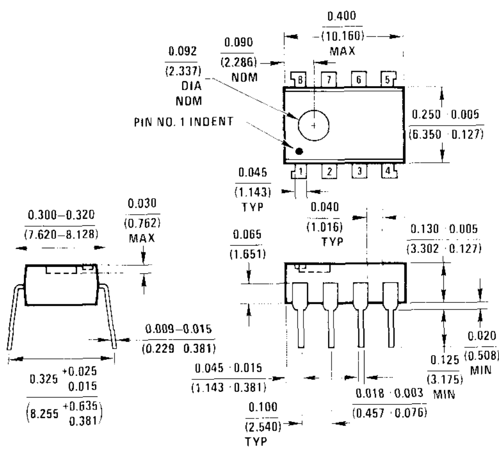


NOTES:
1. ALL DIM. ARE IN INCHES AND ARE REF. UNLESS TOLERANCED.
2. .043-.057 LEAD WIDTH WITHIN 0.100 OF BODY.

CAVITY DUAL-IN-LINE PACKAGE D (40)

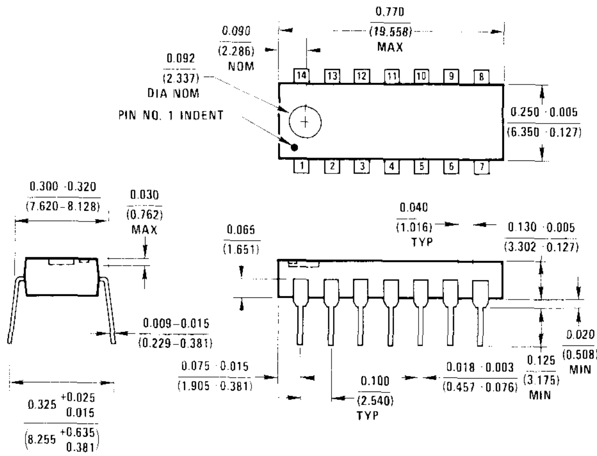


MOLDED MINI-DIP (60, 67)



PIN	60	67
1	NC	S1
2	S1	D1
3	D1	NC
4	G1	G1
5	S2	S2
6	D2	D2
7	G2	NC
8	NC	G2

MOLDED DUAL-IN-LINE PACKAGE N (39)



NS PACKAGE CODE	JEDEC CODE	NS PACKAGE CODE	JEDEC CODE
02	TO-18 Glass	37	TO-220 BCE
03	TO-5 Glass	38	TO-126 ECB
04	TO-5 Glass	39	TO-116 14-Lead M/DIP CN
05	TO-71 Diff. Amp. TO-18	40	TO-116 14-Lead Ceramic DIP CD
06	TO-46 Solid	41	TO-116 14-Lead Molded Array
07	TO-52 Solid	56	TO-100 10-Lead Header
08	TO-71 Diff. Amp. TO-18	57	TO-100 10-Lead Header
09	TO-39 Solid Kovar	58	16-Lead Side Braze DIP
10	TO-39 Solid Steel	59	16-Lead Size Braze DIP
11	TO-18 Glass SDG	60	8-Lead Molded DIP, Plastic (CN)
12	TO-71 Glass TO-18 Diff. Amp.	61	14-Lead Molded DIP, Plastic (CN)
13	TO-46 Header/TO-72 Can (4-Lead)	62	16-Lead Molded DIP, Plastic (CN)
16	TO-39 Solid Kovar	63	14-Lead Side Braze DIP
17	TO-39 Solid Steel Low Profile	64	14-Lead Side Braze DIP
18	TO-52 Glass	65	14-Lead Ceramic DIP (CJ)
19	TO-18 Solid	66	16-Lead Ceramic DIP (CJ)
22	TO-5 10-Lead	67	8-Lead Molded DIP (CN)
23	TO-72 Glass 4-Lead TO-18 SGD	69	TO-92 3-Lead Top Gate Plastic GSD
24	TO-78 Glass TO-5 Diff. Amp.	71	TO-92 BEC
25	TO-72 4-Lead TO-18 EBC	72	TO-92 EBC
27	TO-78 Diff. Amp. TO-5	74	TO-92 ECB
28	TO-72 4-Lead TO-18 BEC	75	TO-92 Faraday Shield EBC
29	TO-72 Glass TO-18 SDG 4-Lead Top Gate	76	TO-92 Faraday Shield BEC
		77	TO-92 CBE
30	TO-78 Diff. Amp. TO-5	78	TO-92 Faraday Shield CEB
31	TO-202 ECB	79	TO-92 C–E
32	TO-126 EC–	90	Mini-Watt ECB
35	TO-202 EBC	91	Mini-Watt EBC
36	TO-202 BCE	98	TO-3

Section 1

NPN Transistors

1

SATURATED SWITCHES

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA) $(I_B = \frac{I_C}{10})$	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	$t_{(off)}$ (ns) Max	Test Condition	Process No.
2N706	TO-18	25	15	5	500	15	20		10	1	0.6	0.7	0.9	10	6	200		10	75	2	21
2N706J	TO-52	25	15	5	100	15	30 20 10	120 	10 1 1	1 1 1	0.5	0.7	0.9	10	6	200	700	10	75	2	21
2N708	TO-52	40	15	5	25	20	30 15	120 	10 0.5	1 1	0.4	0.72	0.8	10	6	300		10			22
2N743	TO-52		12		1 μA	20	10 20 10	 60 	100 10 1	1 0.35 0.25		0.65	0.85 1.5	10 100	5	300		10	24	1	21
2N744	TO-52	20	12	5	1 μA	20	20 40 20	 120 	100 10 1	1 0.35 0.25		0.65	0.85 1.5	10 100	5	280		10	24	1	21
2N753	TO-52	25	15	5	500	15	40	120	10	1	0.6	0.7	0.9	10	5	200		10	75	2	21
2N834	TO-52	40		5	500	20	25		10	1	0.25		0.9	10	4	350		10	30	2	21
2N2369	TO-52	40	15	4.5	400	20	20 40	 120	100 10	2 1	0.25	0.7	0.85	10	4	500		10	18	1	21
2N2369A	TO-52	40	15	4.5	30	20	20 30 40 40	 120 	100 30 10 10	1 0.4 1 0.35	0.20 0.25 0.5	0.7	0.85 1.5 1.6	10 30 100	4	500		10	18	1	21
2N2369A J, JTX, JTXV	TO-18	40	15	4.5	400*	20	20 30 40 40	120 120 120 120	100 30 10 10	1 0.4 1 0.35	0.2 0.25 0.5	0.7	0.85 1.5 1.6	10 30 100	4	500		10	18	1	21
2N3009	TO-52	40	15	4	500*	20	15 25 30	 120	300 100 30	1 0.5 0.4	0.18 0.28 0.5	0.75	0.95 1.2 1.7	30 100 300	5	350		30	25	3	22
2N3011	TO-52	30	12	5	400*	20	12 25 30	 120	100 30 10	1 0.4 0.35	0.2 0.25 0.5	0.72	0.85 1.5 1.6	10 30 100	4	400		20	20	4	21
2N3013	TO-52	40	15	5	300*	20	15 25 30	 120	300 100 30	1 0.5 0.4	0.18 0.28 0.5	0.75	0.95 1.2 1.7	30 100 300	5	350		30	25	3	22
2N3015	TO-39	60	30	5	200	30	10 30	 120	300 150	0.7 10	0.4 1.0		1.2 1.6	150 500	8	250		50	60	5 & 6	25
2N3252	TO-39	60	30	5	500	40	25 30 30	 90 	1A 500 150	5 1 1	0.3 0.5 1.0	 0.7 	1.0 1.3 1.8	150 500 1A	12	200		50	70	7	25

SATURATED SWITCHES (Continued)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA) $(I_B = \frac{I_C}{10})$	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	$t_{(off)}$ (ns) Max	Test Condition	Process No.
2N3253	TO-39	75	40	5	500	60	20		750	5	0.35		1.0	150	12	175		50	70	7	25
							25	75	375	1	0.6	0.7	1.3	500							
							25		150	1	1.2		1.8	1A							
2N3444	TO-39	80	50	5	500	60	15		1A	5	0.35		1.0	150	12	150		50	70	7	25
							20	60	500	1	0.6		1.3	500							
							20		150	1	1.2		1.8	1A							
2N3605	TO-92 (74)		14		500	18	30		10	1	0.25		0.85	10	6	300		10	45	2	21
2N3606	TO-92 (74)		14		500	18	30		10	1	0.25		0.85	10	6	300		10	60	2	21
2N3607	TO-92 (74)		14		500	18	30		10	1	0.25		0.85	10	6	300		10	70	2	21
2N3646	Same as PN3646, see page 1-6 for explanation																				
2N3724	TO-39	50	30	6	1.7 μA	40	30		1A	5	0.32		1.1	300		300		50	60	7	25
							25		800	2				500	12						
							35		500	1	0.42	0.9	1.2								
							40		300	1	0.65		1.5	800							
							60	150	100	1											
							30		10	1	0.75		1.7	1A							
2N3724A	TO-39	50	30	6	500	40	25		1.5A	5	0.32		1.1	300	12	300		50	50	8	25
							30		1A	5				500							
							30		800	2	0.42		1.2								
							35		500	1											
							40		300	1	0.65		1.3	800					60	7	
							60	150	100	1											
							30		10	1	0.75		1.4	1A							
2N3725	TO-39	80	50	6	1.7 μA	60	25		1A	5	0.4		1.1	300	10	300		50	60	7	25
							20		800	2	0.52	0.9	1.2	500							
							35		500	1											
							40		300	1	0.8		1.5	800							
							60	150	100	1				1A							
							30		10	1	0.95		1.7								

TEST CONDITIONS:

(1) V_{CC} = 3V, I_C = 10mA, I_B^1 = 3mA, I_B^2 = 1.5mA. **(2)** V_{CC} = 3V, I_C = 10mA, I_B^1 = 3mA, I_B^2 = 1mA. **(3)** V_{CC} = 10V, I_C = 300mA, I_B^1 = I_B^2 = 30mA. **(4)** V_{CC} = 2V, I_C = 30mA, I_B^1 = I_B^2 = 3mA. **(5)** V_{CC} = 25V, I_C = 300mA, I_B^1 = I_B^2 = 30mA. **(6)** V_{CC} = 25V, I_C = 500mA, I_B^1 = I_B^2 = 50mA. **(7)** V_{CC} = 30V, I_C = 500mA, I_B^1 = I_B^2 = 50mA. **(8)** V_{CC} = 30V, I_C = 1A, I_B^1 = I_B^2 = 100mA. **(9)** V_{CC} = 3V, I_C = 10mA, I_B^1 = I_B^2 = 1mA. **(10)** V_{CC} = 10.7V, I_C = 1A, I_B^1 = I_B^2 = 100mA. **(11)** V_{CC} = 3V, I_C = 10mA, I_B^1 = I_B^2 = 3mA. **(12)** V_{CC} = 3V, I_C = 10mA, I_B^1 = I_B^2 = 3.3mA.

SATURATED SWITCHES (Continued)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA) ($I_B = \frac{I_C}{10}$)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	$t_{(off)}$ (ns) Max	Test Condition	Process No.
2N3725A	TO-39	80	50	6	500	60	20		1.5A	5	0.4		1.1	300	10			50	50	8	25
							25		1A	5	0.52		1.2	500							
							25		800	2											
							35		500	1	0.8		1.3	800							
							40		300	1											
							60	150	100	1	0.9		1.4	1A					60	7	
							30		10	1											
2N4013	TO-18	50	30	6	1.7 µA	40	30		1A	5	0.25		0.76	10	12	300		50	60	7	25
							25		800	2	0.2		0.86	100							
							35		500	1	0.32		1.1	300							
							40		300	1	0.42	0.9	1.2	500							
							60	150	100	1	0.65		1.5	800							
							30		10	1	0.75		1.7	1A							
2N4014	TO-18	80	50	6	1.7 µA	60	25		1A	5	0.25		0.76	10	10	300		50	60	7	25
							20		800	2	0.26		0.86	100							
							35		500	1	0.4		1.1	300							
							40		300	1	0.25	0.9	1.2	500							
							60	150	100	1	0.8		1.5	800							
							30		10	1	0.9		1.7	1A							
2N4047	TO-39	80	50	6	1.7 µA	60	15		1A	5	0.4		1.1	300	10	250		50	60	7	25
							15		800	2											
							20		500	1	0.52	0.9	1.2	500							
							30		300	1	0.8		1.5	800							
							40	150	100	1											
							20		10	1	0.95		1.7	1A							
2N4274	TO-92 (72)	Same as PN4274, see page 1-6 for explanation																			21
2N4275	TO-92 (72)	Same as PN4275, see page 1-6 for explanation																			21
2N4294	TO-92 (74)	30	12	4.5	400	20	20		100	2	0.25	0.6	0.9	10	5	400		10	20	1	21
							30	120	10	1											
2N4295	TO-92 (74)	40	15	5	100	20	20		100	2	0.25	0.6	0.9	10	4	500		10	15	1	21
							40	120	10	1											
2N5030	TO-92 (74)	30	12	4	250	20	30		10	1	0.25	0.72	0.87	10	4	400		10	30	9	21
2N5134	TO-92 (72)	Same as PN5134, see page 1-6 for explanation																			
2N5189	TO-39	60	35	5	500	30	15		1A	1	1.0		1.5	1A	12	250		50	70	10	25
							35		500	1											
							30		100	1											

SATURATED SWITCHES (Continued)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA) ($I_B = \frac{I_C}{10}$)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	$t_{(off)}$ (ns) Max	Test Condition	Process No.
2N5224	TO-92 (72)	25	12	5	500	15	15 40	 100	100 10	1 1	0.35		0.9	10	4	250		10	60	11	21
2N5769	TO-92 (72)	40	15	4.5	400	20	20 30 40	 120	100 30 10	1 0.4 0.35	0.2 0.25 0.5	0.7	0.85 1.5 1.6	10 30 100	4	500		10	18	1	21
2N5772	TO-92 (72)	40	15	5	500	20	15 25 30	 120	300 100 30	1 0.5 0.4	0.2 0.28 0.5	0.75	0.95 1.2 1.7	30 100 300	5	350		30	28	3	21
DH3724CD	Ceramic DIP (40)	50*	36	60	1.7 μA	40	30 35 60	 150	1A 500 100	5 1 1	0.75 0.45		1.7 1.2	500 1A	12	300		50	60	7	25
DH3724CN	Molded DIP (39)	*Electrical, same as DH3724CD*																			25
DH3725CD	Ceramic DIP (40)	80*	50	6	1.7 μA	60	25 35 60	 150	1A 500 100	5 1 1	0.95 0.52		1.7 1.2	500 1A	10	250		50	60	7	25
DH3725CN	Molded DIP (39)	Electrical, same as DH3725CD																			25
EN2369A	TO-92 (72)	Same as PN2369A, see page 1-6 for explanation																			21
MPS706	TO-92 (72)	15	15	3	500	15	20		10	1	0.6		0.9	10	6	200		10	75	11	21
MPS834	TO-92 (72)	40		5	500	20	25		10	1	0.25 0.4		0.9	10 50	4	350		10	30	2	21
MPS2369	TO-92 (72)	40*	15	4.5	400	20	20 40	 120	100 10	2 1	0.25	0.7	0.85	10	4	500		10	18	7	21
MPS2713	TO-92 (72)	18	15	5	500	18	30	90	2	4.5	0.3		1.3	50							21
MPS2714	TO-92 (72)	18	15	5	500	18	75	225	2	4.5	0.3	0.6	1.3	50							21
MPS3646	TO-92 (72)	Same as PN3646, see page 1-6 for explanation																			
PN2369	TO-92 (72)	40*	15	4.5	400	20	20 40	 120	100 10	2 1	0.25	0.7	0.85	10	4	500		10	18	1	21

TEST CONDITIONS:
(1) $V_{CC} = 3V$, $I_C = 10mA$, $I_{B1} = 3mA$, $I_{B2} = 1.5mA$. **(2)** $V_{CC} = 3V$, $I_C = 10mA$, $I_{B1} = 3mA$, $I_{B2} = 1mA$. **(3)** $V_{CC} = 10V$, $I_C = 300mA$, $I_{B1} = I_{B2} = 30mA$. **(4)** $V_{CC} = 2V$, $I_C = 30mA$, $I_{B1} = I_{B2} = 3mA$. **(5)** $V_{CC} = 25V$, $I_C = 300mA$, $I_{B1} = I_{B2} = 30mA$. **(6)** $V_{CC} = 25V$, $I_C = 500mA$, $I_{B1} = I_{B2} = 50mA$. **(7)** $V_{CC} = 30V$, $I_C = 500mA$, $I_{B1} = I_{B2} = 50mA$. **(8)** $V_{CC} = 30V$, $I_C = 1A$, $I_{B1} = I_{B2} = 100mA$. **(9)** $V_{CC} = 3V$, $I_C = 10mA$, $I_{B1} = I_{B2} = 1mA$. **(10)** $V_{CC} = 10.7V$, $I_C = 1A$, $I_{B1} = I_{B2} = 100mA$. **(11)** $V_{CC} = 3V$, $I_C = 10mA$, $I_{B1} = I_{B2} = 3mA$. **(12)** $V_{CC} = 3V$, $I_C = 10mA$, $I_{B1} = I_{B2} = 3.3mA$.

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SATURATED SWITCHES (Continued)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA) ($I_B = \frac{I_C}{10}$)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	$t_{(off)}$ (ns) Max	Test Condition	Process No.
PN2369A	TO-92 (72)	40*	15	4.5	30	20	20		100	1	0.2	0.7	0.85	10	4	500		10	18	1	21
							30		30	0.4	0.2		1.15	30							
							40	120	10	1											
							40		10	0.35	0.5		1.6	100							
PN3646	TO-92 (72)	40*	15	5	500*	20	15		300	1	0.2	0.75	0.95	30	5	350		30	28	3	22
							20		100	0.5	0.28		1.2	100							
							30	120	30	0.4	0.5		1.7	300							
PN4274	TO-92 (72)	30*	12	4.5	500	20	18		100	1	0.2	0.7	0.85	10	4	400		10	12	12	21
							30		30	0.4	0.25		1.15	30							
							35	120	10	1	0.5		1.6	100							
PN4275	TO-92 (72)	40*	15	4.5	500	20	18		100	1	0.2	0.72	0.85	10	4	400		10	12	12	21
							30		30	0.4	0.25		1.15	30							
							35	120	10	1	0.5		1.6	100							
PN5134	TO-92 (72)	20*	10	3.5	100	15	15		30	0.4	0.25	0.7	0.9	10	4	250		10	18	12	21
							20	150	10	1											

TEST CONDITIONS:
(1) V_{CC} = 3V, I_C = 10mA, I_B^1 = 3mA, I_B^2 = 1.5mA. **(2)** V_{CC} = 3V, I_C = 10mA, I_B^1 = 3mA, I_B^2 = 1mA. **(3)** V_{CC} = 10V, I_C = 300mA, I_B^1 = I_B^2 = 30mA. **(4)** V_{CC} = 2V, I_C = 30mA, I_B^1 = I_B^2 = 3mA. **(5)** V_{CC} = 25V, I_C = 300mA, I_B^1 = I_B^2 = 30mA. **(6)** V_{CC} = 25V, I_C = 500mA, I_B^1 = I_B^2 = 50mA. **(7)** V_{CC} = 30V, I_C = 500mA, I_B^1 = I_B^2 = 50mA. **(8)** V_{CC} = 30V, I_C = 1A, I_B^1 = I_B^2 = 100mA. **(9)** V_{CC} = 3V, I_C = 10mA, I_B^1 = I_B^2 = 1mA. **(10)** V_{CC} = 10.7V, I_C = 1A, I_B^1 = I_B^2 = 100mA. **(11)** V_{CC} = 3V, I_C = 10mA, I_B^1 = I_B^2 = 3mA. **(12)** V_{CC} = 3V, I_C = 10mA, I_B^1 = I_B^2 = 3.3mA.

RF AMPS AND OSCILLATORS

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob}/C_{re} (pF) Min	C_{ob}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (MHz)	Process No.
2N917	TO-72	30	15	3	1	15	20		3	1	0.5		0.87	3		3	500		4	6	60	43
2N918	TO-72	30	15	3	10	15	20		3	1	0.4		1.0	10		3	600		4	6	60	43
2N918 J, JTX, JTXV	TO-72	30	15	3	10	15	20		10	10	0.4		1.0	10		1.7	600		4	6	60	43
							20	200	3	1												
							10		500 μA	10												
2N2857	TO-72	30	15	2.5	10	15	30	150	3	1						1	1000	1900	5	4.5	450	42
2N2857 J, JTX, JTXV	TO-72	30	15	3	10	15	30	150	3	1	0.4		1.0	10		1	1000	1900	5	4.5	450	42
2N3478	TO-72	30	15	2	20	1	25	150	2	8						1	750	1600	5	4.5	200	42

RF AMPS AND OSCILLATORS (Continued)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob}/C_{re} (pF) Min	C_{ob}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (MHz)	Process No.
2N3563	TO-92 (72)	*Same as PN3563, see page 1-10 for explanation*																				43
2N3564	TO-92 (72)	Same as PN3564, see page 1-10 for explanation																				43
2N3600	TO-72	30	15	3	10	15	20	150	3	1						1	850	1500	5	4.5	200	42
2N3662	TO-92 (74)	18	12	3	500	15	20		8	10					0.8	1.7	700	2100	5	6.5	60	43
2N3663	TO-92 (74)	30	12	3	500	15	20		8	10					0.8	1.7	700	2100	5	6.5	60	43
2N3825	TO-92 (74)	30	15	4	100	15	20		2	10	0.25			2		3.5	200	800	2	5.5	1	43
2N3932	TO-72	30	20	2.5	10	15	40	150	2	8						0.55	750	1600	2	4.5	200	42
2N3933	TO-72	40	30	2.5	10	15	60	200	2	8						0.55	750	1600	2	4	200	42
2N4134	TO-72	30	30	3	50	10	25	200	4	5						0.5	350	800	4	2.5	60	44
2N4135	TO-72	30	30	3	50	10	25	200	4	5						0.5	425	800	4	5	450	44
2N4252	TO-72	30	18	4	50	15	50		2	10						0.45	600	1400	2			42
2N4259	TO-72	40	30	2.5	10	15	60	250	2	8						0.55	750	1600	2	5	450	42
2N4292	TO-92 (74)	30	15	3	500	15	20		3	1	0.6			10		3.5	600		4	6	60	43
2N4293	TO-92 (74)	30	15	3	500	15	20		3	1	0.6			10		3.5	600		4	6	60	43
2N5130	TO-92 (72)	Same as PN5130, see page 1-10 for explanation																				43
2N5179	TO-72	20	12	2.5	20	15	25	250	3	1	0.4		1.0	10		1	900	2000	5	4.5	200	42
2N5180	TO-72	30	15	2	500	8	20	200	2	8						1	650	1700	2			42
2N5222	TO-92 (71)	20	15	2	100	10	20	1500	4	10	1.0		1.2	10		1.3	450		4			49
2N5770	TO-92 (72)	30	15	4.5	10	15	50 20	200	8 3	10 1	0.4		1.0	10	0.7	1.1	90	1800	8	6	60	43
40235	TO-72	35		3	1 μA 20	35 1	40	170	1	6						0.65						42
40236	TO-72	35		3	1 μA 20	35 1	40	275	1	6						0.65						42
40237	TO-72	35		3	1 μA 20	35 1	27	275	1	6						0.8						42

RF AMPS AND OSCILLATORS (Continued)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob}/C_{re} (pF) Min	C_{ob}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (MHz)	Process No.
40238	TO-72	35		3	1 μA 20	35 1	40	170	1	6						0.65						42
40239	TO-72	35		3	1 μA 20	35 1	27	100	1	6						0.65						42
40240	TO-72	35		3	1 μA 20	35 1	27	275	1	6						0.65						42
40242	TO-72	35		3	20	1	40	170	1	6						0.65						42
40243	TO-72	35		3	20	1	40	170	1	6						0.65						42
40244	TO-72	35		3	20	1	27	170	1	6						0.65						42
40245	TO-72	35		3	20	1	70	170	1	6						0.8						42
40246	TO-72	35		3	20	1	27	170	1	6						0.65						42
EN918	TO-92 (72)	Same as PN918, see page 1-10 for explanation																				43
MPSH07	TO-92 (75)	30	30	3	50	15	20		3	10						0.3	400		3	3.2	100	41
MPSH08	TO-92 (75)	30	30	3	50	15	20		3	10						0.3	500		3	3.5	200	41
MPSH10	TO-92 (71)	30	25	3	100	25	60		4	10	0.5			4	0.35	0.65	650		4			42
MPSH11	TO-92 (76)	30	25	3	100	25	60		4	10	0.5			4	0.6	0.9	650	4				47
MPSH19	TO-92 (76)	30	25	3	100	15	45		4	10						0.65	300		4			47
MPSH20	TO-92 (71)	40	30	4	50	15	25		4	10			0.95	10		0.65	400		4			49
MPSH24	TO-92 (47)	40	30	4	50	15	30		8	10						0.36	400		8			47
MPSH30	TO-92 (71)	20	20	3	50	10	20	200	4	5	0.3		0.96	10		0.65	300	800	4	6	45	44
MPSH31	TO-92 (71)	20	20	3	50	10	20	200	4	5	0.3		0.96	10		0.65	300	800	4	6	45	44
MPSH32	TO-92 (76)	30	30	4	50	10	27	200	4	5	0.3		1.2	10		0.22	300		4			45
MPSH34	TO-92 (76)	45	45	4	50	30	15 40		20 7	2 15	0.5			20		0.32	500		15			47
MPSH37	TO-92 (71)		40	5	500	35	25		5	10	0.5			10		0.7	300		5			49

RF AMPS AND OSCILLATORS (Continued)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob}/C_{re} (pF) Min	C_{ob}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (MHz)	Process No.
MPS3563	TO-92 (72)	*Same as PN3563, see page 1-10 for explanation*																				43
MPS6507	TO-92 (72)	30*	20		5	15	25		2	10						2.5	700		10			43
MPS6511	TO-92 (72)	30*	20		50	15	25		10	10						2.5						43
MPS6539	TO-92 (71)	20	20		50	15	20		4	10						0.7	500		4	4.5	100	42
MPS6540	TO-92 (71)	30	30	4	100	25	25		2	10	0.5			10		0.65	350		2			49
MPS6541	TO-92 (72)	30*	20	4	50	15	25		4	10						1.7	600	1500	4			43
MPS6542	TO-92 (76)	30*	20		50	15	25		2	10						1.5	700		10			47
MPS6543	TO-92 (76)	35	20	3	100	25	25		4	10	0.35		0.95	10		1	750		4			47
MPS6544	TO-92 (71)	60	45	4	500	35	20		30	10	0.5			30		0.65						49
MPS6546	TO-92 (76)	35	25	3	100	25	20		2	10	0.35			10		0.45	600		2			47
MPS6547	TO-92 (76)	35	25	3	100	25	20		2	5	0.35			10		0.35	600		2			47
MPS6548	TO-92 (71)	30	25	3	100	25	25		4	10	0.5		0.95	4		0.7	650		4			42
MPS6567	TO-92 (71)		40	5	500	35	25		10	5	0.5			10		0.7						49
MPS6568A	TO-92 (71)	20	20	3	50	10	20	200	4	5	0.3		0.96	10		0.65	375	800	4	3.3	200	44
MPS6569	TO-92 (71)	20	20	3	50	10	20	200	4	5	3		0.96	10	0.25	0.5	300	800	4	6	45	44
MPS6570	TO-92 (71)	20	20	3	50	10	20	200	4	5	3		0.96	10	0.25	0.5	300	800	4	6	45	44
MRF501	TO-72	25	15	3.5	50	1	30	250	1	6							600		5			42
MRF502	TO-72	35	15	3.5	20	1	40	170	1	6							800		5			42
NSC460	TO-92 (74)	30	30	5	500	18	35	200	2	12	1.1			10		3.5				6.5	1	46
NSC461	TO-92 (74)	30	30	5	500	18	35	200	2	12	1.1			10		3.5						46

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RF AMPS AND OSCILLATORS (Continued)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob}/C_{re} (pF) Min	C_{ob}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (MHz)	Process No.
PE3100	TO-92 (76)	30*	30	3	200	30	30	225	5	10						0.8	500		5			47
PE5025	TO-92 (72)	30	30	3	50	30	20	100	10	10	0.6			20	0.6	1	300	700	10			46
PE5029	TO-92 (76)	30	30	3	200	30	30	225	5	10						0.4	500		5	6	45	47
PE5030B	TO-92 (76)	45	40	4.5	100	30	45	150	7	15	3		0.92	20 / 10	0.25	0.4	600		7			47
PE5031	TO-92 (76)	40	30	4	100	30	30	180	5	10	1			10		0.4	500		5	4.5	200	47
PN918	TO-92 (72)	30	15	3	10	15	20		3	1	0.4		1.0	10		1.7	600		4	6	60	43
PN3563	TO-92 (72)	30	15	2	50	15	20	200	8	10						1.7	600	1500	8			43
PN3564	TO-92 (72)	30	15	4	50	15	20	500	15	10	0.3		0.97	20		3.5	400	1200	15			43
PN5130	TO-92 (72)	30	12	1	50	10	15	250	8	10	0.6		1.0	10		1.7	450		8			43
PN5179	TO-92 (71)	20	15	2.5	2	15	25	250	3	1	0.4		1.0	10		1.0	900	2000	5	4.5	200	42
SE5020	TO-72	20	20	3	50	10	20	200	4	5	3.0		0.96	10	0.25	0.5	375	800	4	3.3	200	44
SE5021	TO-72	20	20	3	50	10	20	200	4	5	3.0		0.96	10	0.25	0.5	375	800	4	4	200	44
SE5022	TO-72	20	20	3	50	10	20	200	4	5	3.0		0.96	10	0.25	0.5	300	800	4			44
SE5023	TO-72	20	20	3	50	10	20	200	4	5	3.0		0.96	10	0.25	0.5	300	800	4	6	45	44
SE5024	TO-72	20	20	3	50	10	20	200	4	5	3.0		0.96	10	0.25	0.5	300	800	4	6	45	44
SE5050	TO-72	20	20	3	50	10	20	200	4	5	3.0		0.96	10	0.25	0.5	300		4	4	100	44
SE5051	TO-72	20	20	3	50	10	20	200	4	5	3.0		0.96	10	0.25	0.5	300		4			44
SE5052	TO-72	20	20	3	50	10					3.0			10			375		4	4	200	44
SE5055	TO-72	20	20	3	50	20	20	220	2	10	2.75			10	0.22		300		2	5	45	44
TIS86	TO-92 (78)	30	30		100	15	40	200	4	10	0.5			15		0.45	500		4	5	200	47
TIS87	TO-92 (78)	45	45		100	15	30	150	12	12	0.5			15		0.45	500		12			47

LOW LEVEL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Max	f_T (MHz) Min	@ I_C (mA)	NF (dB) Max	@ Freq (kHz)	Process No.
2N760	TO-18	45	45	8	200	30	76	300 (1 kHz)	1	5	1.0	0.6	1.1	10	8	50		1.0			07
2N760A	TO-18	60	60	8	100	30	76 40	333 (1 kHz)	1 10 μA	5 5	1.0		1.1	10	8	50		1.0			07
2N929	TO-18	45	45	5	10	45	 60 40	350 120	10 500 μA 10 μA	5 5 5	1.0	0.6	1.0	10	8	30		0.5	4	15.7	07
2N929 J, JTX	TO-18	60	45	6	10	45	 60 40	350 120	10 500 μA 10 μA	5 5 5	1.0	0.6	1.0	10	8	45	180	0.5	5 3 3	100 Hz 1 10	07
2N929A	TO-18	60	45	6	2	45	 60 40 25	350 120 	10 500 μA 10 μA 1 μA	5 5 5 5	0.5	0.7	0.9	10	6	45		0.5	4	10	07
2N930	TO-18	45	45	5	10	45	 150 100	600 300	10 500 μA 10 μA	5 5 5	1.0	0.6	1.0	10	8	30		0.5	3	15.7	07
2N930 J, JTX	TO-18	60	45	6	10	45	 150 100	600 300	10 500 μA 10 μA	5 5 5	1.0	0.6	1.0	10	8	45	180	0.5	5 3 3	100 Hz 1 10	07
2N930A	TO-18	60	45	6	2	45	 150 100 60	600 300 	10 500 μA 10 μA 1 μA	5 5 5 5	0.5	0.7	0.9	10	6	45		0.5	3	10	07
2N981	TO-18	80	80	8	1	30	36	100 (1 kHz)	1	5	3.0			10	5	50		1.0			07
2N2484	TO-18	60	60	6	10	45	250 200 175 100 30	 500 	1 500 μA 100 μA 10 μA 1 μA	5 5 5 5 5	0.35			1	10	15		0.05	10 3 2 3	20 Hz 200 Hz 2 15.7	07
2N2484 J, JTX, JTXV	TO-18	60	60	6	10	45	250 250 225 200 45	 500 	1 500 μA 100 μA 10 μA 1 μA	5 5 5 5 5	0.3			1	5	60	210	0.5	7.5 3 2 3	100 Hz 1 10 15.7	07
2N2509	TO-18	125	80	7	5	100	40 25		10 10 μA	5 5	1.0		0.9	5	6	45		5	7	1	07
2N2510	TO-18	100	65	7	5	80	150 75	500	10 10 μA	5 5	1.0		0.9	5	6	45		5	4	1	07

LOW LEVEL AMPS (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Max	f_T (MHz) Min	@ I_C (mA)	NF (dB) Max	@ Freq (kHz)	Process No.
2N2511	TO-18	80	50	7	5	60	240 120 80	750	10 10 μA 1 μA	5 5 5	1.0		0.9	5	6	45		5	4	1	07
2N2504	TO-46	60	45	6	2	45	 150 150 100 60	600 600 300	10 1 500 μA 10 μA 1 μA	5 5 5 5 5	0.5	0.7	0.9	10	6	45		0.5	3	10	07
2N2586	TO-18	60	45	6	2	45	 150 120 80	600 360	10 500 μA 10 μA 1	5 5 5 5	0.5	0.7	0.9	10	7	45		0.5	3 2	1 10	07
2N3117	TO-18	60	60	6	10	45	400 300 250 100	 500	1 100 μA 10 μA 1 μA	5 5 5 5	0.35			1	4.5	60		0.5	4 15	20 Hz 10 Hz	07
2N3246	TO-18	60	40	10	1	40	 400 350 300 200 150	800 600	10 1 500 μA 100 μA 10 μA 1 μA	5 5 5 5 5 5	0.5	0.7	0.9	5	5	60	180	1	2	15	07
2N3565	TO-92 (72)	Same as PN3565, see page 1-14 for explanation																			07
2N3707	TO-92 (74)	30	30	6	100	20	100	400	100 μA	5	1.0			10					5	15.7	07
2N3708	TO-92 (74)	30	30	6	100	20	45	660	1	5	1.0			10							
2N3709	TO-92 (74)		30		100	20	45	165	1	5	1.0			10							07
2N3710	TO-92 (74)	30	30	6	100	20	90	330	1	5	1.0			10							07
2N3711	TO-92 (74)	30	30	6	100	20	180	660	1	5	1.0			10							07
2N3858A	TO-92 (74)	60	60	6	500	18	60 45	120	10 1	1 1					4	90	250	2			07
2N3859A	TO-92 (74)	60	60	6	500	18	100 75	200	10 1	1 1					4	90	250	2			07
2N3877	TO-92 (74)	70	70	4	500	70	20	250	2	4.5		0.5	0.9	10							07

LOW LEVEL AMPS (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Max	f_T (MHz) Min	@ I_C (mA)	NF (dB) Max	@ Freq (kHz)	Process No.
2N3877A	TO-92 (74)	85	85	4	500	70	20	250	2	4.5		0.5	0.9	10							07
2N3900	TO-92 (74)	18	18	5	100	18	250	500	2	4.5					12						07
2N3900A	TO-92 (74)	18	18	5	100	18	250	500	2	4.5					12				5	15.7	07
2N3901	TO-92 (74)	18	18	5	100	15	350	700	2	4.5									5	15.7	07
2N4286	TO-92 (74)	30	25	6	50	25	150 100	600	1 100 μA	5 5	0.35		0.8	1	6	40		1			07
2N4287	TO-92 (74)	45	45	7	10	30	150 100	600	1 100 μA	5 5	0.35		0.8	1	6	40		1	5	15.7	07
2N4384	TO-18	40	30	5	10	30	150 120 100 60	 500 	10 1 10 μA 1 μA	5 5 5 5	0.2	0.65	0.8	10	8	30	120	0.5	2	15.7	07
2N4386	TO-18	40	30	5	10	30	120 100 40	 500	10 1 10 μA	5 5 5	0.2	0.65	0.8	10	8	30	120	0.5	3	15.7	07
2N4409	TO-92 (72)	80	50	5	10	60	60 60	400	10 1	1 1	0.2		0.8	1	12	60	300	10			07
2N4410	TO-92 (72)	120	80	5	10	100	60 60	400	10 1	1 1	0.2		0.8	1	12	60	300	10			07
2N4966	TO-92 (72)	Same as 2N5209, see page 1-14 for explanation																			07
2N4967	TO-92 (72)	Same as 2N5210, see page 1-14 for explanation																			07
2N4968	TO-92 (72)	Same as 2N5209, see page 1-14 for explanation																			07
2N5088	TO-92 (72)	35	30		50	20	300 350 300	 900	10 1 100 μA	5 5 5	0.5			10	4				3	15.7	07
2N5089	TO-92 (72)	30	25		50	15	400 450 400	 1200	10 1 100 μA	5 5 5	0.5			10	4				2	15.7	07
2N5133	TO-92 (72)																				07

LOW LEVEL AMPS (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Max	f_T (MHz) Min	@ I_C (mA)	NF (dB) Max	@ Freq (kHz)	Process No.
2N5209	TO-92 (72)	50	50		50	35	150 150 100	 300	10 1 100 μA	5 5 5	0.7			10	4	30		0.5	4	1	07
2N5210	TO-92 (72)	50	50		50	35	250 250 200	 600	10 1 100 μA	5 5 5	0.7			10	4	30		0.5	3	1	07
2N5232	TO-92 (74)		50		30	50	250	500	2	5	0.125			10	4						07
2N5232A	TO-92 (74)		50		30	50	250	500	2	5	0.125			10	4				5	1	07
EN930	TO-92 (72)	Same as PN930, see below for explanation																			07
EN2484	TO-92 (72)	Same as PN2484, see below for explanation																			07
MPSA09	TO-92 (72)	50	50		100	25	100	600	100 μA	5	0.9			10	5	600		0.5			07
MPS3707	TO-92 (72)		30		100	20	100	400	100 μA	5	1.0			10					5	15.7	07
MPS3708	TO-92 (72)		30		100	20	45	660	1	5	1.0			10							07
MPS3709	TO-92 (72)		30		100	20	45	165	1	5	1.0			10							07
MPS3710	TO-92 (72)		30		100	20	90	330	1	5	1.0			10							07
MPS3711	TO-92 (72)		30		100	20	180	660	1	5	1.0			10							07
MPS6571	TO-92 (72)	25	20	3	50	20	250	1000	100 μA	5	0.5			10	4.5	50		0.5			07
PE4010	TO-92 (72)	30	25	6	200	5	200	1000	1	10	0.35			1	4	20 60		0.05 1	3	1	07
PN930	TO-92 (72)	45	45	5	10	45	 150 100	600 300	10 500 μA 10 μA	5 5 5	1.0	0.6	1.0	10	8	30		0.5	3	15.7	07
PN2484	TO-92 (72)	60	60	6	10	45	 250 200 175 100 30	800 500 	10 1 500 μA 100 μA 10 μA 1 μA	5 5 5 5 5 5	0.35			10	6				10 3 2	100 Hz 1 10	07
PN3565	TO-92 (72)	30	25	6	50	25	150	600	1	10	0.35			1	4	40	240	1			07
PN5133	TO-92 (72)	20	18	3	50	15	60	1000	1	5	0.4			1	5	40	240	1			07

GENERAL PURPOSE AMPS AND SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N697	TO-5	60	45	5	1 μA	30	40	120	150	10	1.5		1.3	150	35	50		50				20
2N718	TO-18	60	30	5	1 μA	30	40	120	150	10	1.5		1.3	150	35	50		15				20
2N718A	TO-18	75		7	10	60	20		500	10	1.5		1.3	150	25	60		50		12	1	20
							40	120	150	10												
							35		10	10												
							20		100 μA	10												
2N915	TO-18	70	50	5	10	60	50	200	10	5	1.0		0.9	10	3.5	250		10				23
2N916	TO-18	45	25	5	10	30	50	200	10	1	0.5		0.9	10	6	300		10				23
2N956	TO-18	75	35	7	10	60	40		500	10	1.5		1.3	150	25	70		50		8	1	20
							100	300	150	10												
							75		10	10												
							35		100 μA	10												
							20		10 μA	10												
2N1420	TO-5	60	30	5	1 μA	30	100	300	150	10	1.5		1.3	150	35	50		50				20
2N1566	TO-5	80	60	5	1 μA	40	80 (1 kHz)	200	5	5	1.0			10	10	60		5				20
2N1613	TO-5	75	35	7	10	60	20		500	10	1.5		1.3	150	25	60		50		12	1	20
							40	120	150	10												
							35		10	10												
							20		100 μA	10												
2N1711	TO-5	75	35	7	10	60	40		500	10	1.5		1.3	150	25	70		50		8	1	20
							100	300	150	10												
							75		10	10												
							35		100 μA	10												
							20		10 μA	10												
2N2218	TO-5	60	30	5	10	50	20		500	10	0.4		1.3	150	8	250		20				20
							20		150	1												
							40	120	150	10	1.6		2.6	500								
							35		10	10												
							25		1	10												
							20		100 μA	10												
2N2218 J, JTX, JTXV	TO-5	60	30	5	10	50	20		500	10	0.4	0.6	1.3	150	8	250		20	250		2	20
							40	120	150	10												
							35		10	10	1.6		2.6	500								
							25		1	10												
							20		100 μA	10												

TEST CONDITIONS:

(1) I_C = 300 μA, V_{CE} = 10V, f = 1kHz. **(2)** I_C = 150mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 15mA. **(3)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(4)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(5)** I_C = 100 μA, V_{CE} = 4.5V, f = 15.7kHz. **(6)** I_C = 10mA, V_{CC} = 3V, $I_B^1 - I_B^2$ = 1mA. **(7)** I_C = 100 μA, V_{CE} = 5V, f = 15.7kHz. **(8)** I_C = 250 μA, V_{CE} = 5V, f = 10Hz–15.7kHz. **(9)** I_C = 3mA, V_{CE} = 10V, f = 1MHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 15.7kHz.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N2218A	TO-5	75	40	6	10	60	25		500	10	0.3	0.6	1.2	150	8	250		20	285		2	20
							20		150	1												
							40	120	150	10												
							35		10	10												
							25		1	10												
							20		100 μA	10												
2N2218A J, JTX, JTXV	TO-5	75	50	6	10	60	20		500	10	0.3	0.6	1.2	150	8	250		20	300		2	20
							40	120	150	10												
							40		10	10	1		2	500								
							35		1	10												
							30		100 μA	10												
2N2219	TO-5	60	30	5	10	50	30		500	10	0.4		1.3	150	8	250		20				20
							50		150	1												
							100	300	150	10	1.6		2.6	500								
							75		10	10												
							50		1	10												
							35		100 μA	10												
2N2219 J, JTX, JTXV	TO-5	60	30	5	10	50	30		500	10	0.4	0.6	1.2	150	8	250		20	250		2	20
							100	300	150	10												
							75		10	10	1.6		2.6	500								
							50		1	10												
							35		100 μA	10												
2N2219A	TO-5	75	40	6	10	60	40		500	10		0.6	1.2	150	8	300		20	285		2	20
							50		150	1			2	500								
							100	300	150	10												
							75		10	10												
							50		1	10												
							35		100 μA	10												
2N2219A J, JTX, JTXV	TO-5	75	50	6	10	60	30		500	10	0.3	0.6	1.2	150	8	250		20	300		2	20
							100	300	150	10												
							100		10	10	1		2	500								
									1	10												
									100 μA	10												
2N2221	TO-18	60	30	5	10	50	20		500	10	0.4		1.3	150	8	250		20				20
							20		150	1												
							40	120	150	10	1.6		2.6	500								
							35		10	10												
							25		1	10												
							20		100 μA	10												

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N2221 J, JTX, JTXV	TO-18	60	30	5	10	50	20		500	10	0.4	0.6	1.3	150	8	250		20	250		2	20
							40	120	150	10												
							35		10	10	1.6		2.6	500								
							25		1	10												
							20		100 μA	10												
2N2221A	TO-18	75	40	6	10	60	25		500	10	0.3	0.6	1.2	150	8	250		20	285		2	20
							40	120	150	10												
							35		10	10	1.0		2.0	500								
							25		1	10												
							20		100 μA	10												
2N2221A J, JTX, JTXV	TO-18	75	50	6	10	60	20		500	10	0.3	0.6	1.2	150	8	250		20	300		2	20
							40	120	150	10												
							40		10	10	1.0		2.0	500								
							35		1	10												
							30		100 μA	10												
2N2222	TO-18	60	30	5	10	50	30		500	10	0.4		1.3	150	8	250		20				20
							50		150	1												
							100	300	150	10	1.6		2.6	500								
							75		10	10												
							50		1	10												
							35		100 μA	10												
2N2222 J, JTX, JTXV	TO-18	60	30	5	10	50	30		500	10	0.4	0.6	1.3	150	8	250		20			2	20
							100	300	150	10												
							75		10	10	1.6		2.6	500								
							50		1	10												
							35		100 μA	10												
2N222A	TO-18	75	40	6	10	60	40		500	10	0.3	0.6	1.2	150	8	250		20	285	4	2/3	20
							50		150	1												
							100	300	150	10	1		2	500								
							75		10	10												
							50		1	10												
							35		100 μA	10												
2N2222A J, JTX, JTXV	TO-18	75	50	6	10	60	30		500	10	0.3	0.6	1.2	150	8	250		20	300		2	20
							100	300	150	10												
							100		10	10	1		2	500								
							75		1	10												
							50		100 μA	10												
2N2712	TO-92 (74)	18	18	5	500	18	75	225	2	4.5					12	80	300	2				27

TEST CONDITIONS:
(1) I_C = 300 μA, V_{CE} = 10V, f = 1kHz. **(2)** I_C = 150mA, V_{CC} = 30V, I_{B^1} = I_{B^2} = 15mA. **(3)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(4)** I_C = 300mA, V_{CC} = 25V, I_{B^1} = I_{B^2} = 30mA. **(5)** I_C = 100 μA, V_{CE} = 4.5V, f = 15.7kHz. **(6)** I_C = 10mA, V_{CC} = 3V, I_{B^1} = I_{B^2} = 1mA. **(7)** I_C = 100 μA, V_{CE} = 5V, f = 15.7kHz. **(8)** I_C = 250 μA, V_{CE} = 5V, f = 10Hz–15.7kHz. **(9)** I_C = 3mA, V_{CE} = 10V, f = 1MHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f ≈ 15.7kHz.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N2714	TO-92 (74)	18	18	5	500	18	75	225	2	4.5	0.3	0.6	1.2	50								27
2N2923	TO-92 (74)	25	25	5	100	25	90	180	2 (1 kHz)	10					10							04
2N2924	TO-92 (74)	25	25	5	100	25	150	300	2 (1 kHz)	10					10							04
2N2925	TO-92 (74)	25	25	5	100	25	235	470	2 (1 kHz)	10					10							04
2N2926	TO-92 (74)	18	18	5	500	18	35	470	2 (1 kHz)	10					10							04
2N3115	TO-18	60	20	5	25	50	40	120	150	10	0.5		1.3	150	8	250		20	500		2	20
2N3116	TO-18	60	20	5	25	50	100	300	150	10	0.5		1.3	150	8	250		20	500		2	20
2N3299	TO-5	60	30	5	10*	50	20		500	10	0.22		1.1	150	8	250		50	150		4	20
							20		150	1												
							40	120	150	10												
							35		10	10	0.6		1.5	500								
							25		1	10												
							20		100 μA	10												
2N3300	TO-5	60	30	5	10*	50	50		500	10	0.22		1.1	150	8	250		50	150		4	20
							50		150	1												
							100	300	150	10												
							75		10	10	0.6		1.5	500								
							50		1	10												
							35		100 μA	10												
2N3301	TO-18	60	30	5	10*	50	20		500	10	0.22		1.1	150	8	250		50	150		4	20
							20		150	1												
							40	120	150	10	0.6		1.5	500								
							35		10	10												
							25		1	10												
							20		100 μA	10												
2N3302	TO-18	60	30	5	10*	50	50		500	10	0.22		1.1	150	8	250		50	150		4	20
							50		150	1												
							100	300	150	10	0.6		1.5	500								
							75		10	10												
							50		1	10												
							35		100 μA	10												
2N3390	TO-92 (74)	25	25	5	100	18	400	800	2	4.5					10							04
2N3391	TO-92 (74)	25	25	5	100	18	250	500	2	4.5					10							04

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3391	TO-92 (74)	25	25	5	100	18	250	500	2	4.5					10					5	5	04
2N3392	TO-92 (74)	25	25	5	100	18	150	300	2	4.5					10							04
2N3393	TO-92 (74)	25	25	5	100	18	90	180	2	4.5					10							04
2N3394	TO-92 (74)	25	25	5	100	18	55	110	2	4.5					10							0.4
2N3395	TO-92 (74)	25	25	5	100	18	150	500	2	4.5					10							04
2N3396	TO-92 (74)	25	25	5	100	18	90	500	2	4.5					10							04
2N3397	TO-92 (74)	25	25	5	100	18	55	500	2	4.5					10							04
2N3398	TO-92 (74)	25	25	5	100	18	55	800	2	4.5					10							04
2N3414	TO-92 (74)	25	25	5	100	25	75	225	2	4.5	0.3	0.6	1.3	50								19
2N3415	TO-92 (74)	25	25	5	100	25	180	540	2	4.5	0.3	0.6	1.3	50								04
2N3416	TO-92 (74)	50	50	5	100	25	75	225	2	4.5	0.3	0.6	1.3	50								04
2N3417	TO-92 (74)	50	50	5	100	25	180	540	2	4.5	0.3	0.6	1.3	50								04
2N3641	TO-92 (72)	Same as PN3641, see page 1-22 for explanation																				19
2N3642	TO-92 (72)	Same as PN3642, see page 1-22 for explanation																				19
2N3643	TO-92 (72)	Same as PN3643, see page 1-22 for explanation																				19
2N3678	TO-5	75	55	6	10	60	25		500	10	0.4	0.6	1.2	150					250		2	20
							20		150	1												
							40	120	150	10	1.0		2.0	500								
							35		10	10												
							25		1	10												
							20		100 μA	10												

TEST CONDITIONS:

(1) I_C = 300 μA, V_{CE} = 10V, f = 1kHz. **(2)** I_C = 150mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15mA. **(3)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(4)** I_C = 300mA, V_{CC} = 25V, $I_{B1} = I_{B2}$ = 30mA. **(5)** I_C = 100 μA, V_{CE} = 4.5V, f = 15.7kHz. **(6)** I_C = 10mA, V_{CC} = 3V, $I_{B1} = I_{B2}$ = 1mA. **(7)** I_C = 100 μA, V_{CE} = 5V, f = 15.7kHz. **(8)** I_C = 250 μA, V_{CE} = 5V, f = 10Hz–15.7kHz. **(9)** I_C = 3mA, V_{CE} = 10V, f = 1MHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 15.7kHz.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3691	TO-92 (72)	Same as PN3691, see page 1-22 for explanation																				23
2N3692	TO-92 (72)	Same as PN3692, see page 1-22 for explanation																				23
2N3693	TO-92 (72)	Same as MPS3693, see page 1-24 for explanation																				27
2N3694	TO-92 (72)	Same as PN3694, see page 1-22 for explanation																				27
2N3704	TO-92 (74)	50	30	5	100	20	100	300	50	2	0.6			100	12	100		50				13
2N3705	TO-92 (74)	50	30	5	100	20	50	150	50	2	0.8			100	12	100		50				13
2N3706	TO-92 (74)	40	20	5	100	20	30	600	50	2	1.0			100	12	100		50				13
2N3721	TO-92 (74)	18	18	5	500	18	60	660 (1 kHz)	2	10					12							27
2N3793	TO-92 (74)	40	20	5	500	15	20 20 10	 120 	100 10 1	10 10 10	0.4			10	10	100	600	10				13
2N3794	TO-92 (74)	40	20	5	500	15	100 100 35	 600 	100 10 1	10 10 10	0.4			10	10	100	600	10				13
2N3827	TO-92 (74)	60	45	4	100	30	100	400	10	10					3.5	200	800	10				27
2N3858	TO-92 (74)	30	30	4	500	18	60	120	2	4.5					4	90	250	2				27
2N3859	TO-92 (74)	30	30	4	500	18	100	200	2	4.5					4	90	250	2				27
2N3860	TO-92 (74)	30	30	4	500	18	150	300	2	4.5					4	90	250	2				27
2N3903	TO-92 (72)	60	40	6			15 30 50 35 20	 150 	100 50 10 1 100 μA	1 1 1 1 1	0.2 0.3	0.6	0.85 0.95	10 50	4	250		10	225	6	6/7	23
2N3904	TO-92 (72)	60	40	6		30	30 60 100 70 40	 300 	100 50 10 1 100 μA	1 1 1 1 1	0.2 0.3	0.65	0.85 0.95	10 50	4	300		10	250	5	6/7	23

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3946	TO-18	60	40	6			20		50	1	0.2	0.6	0.9	10	4	250		10	375	5	6/7	23
							50	150	10	1												
							45		1	1	0.3		1.0	50								
							30		100 µA	1												
2N3947	TO-18	60	40	6			40		50	1	0.2	0.6	0.9	10	4	300		10	450	5	6/7	23
							100	300	10	1												
							90		1	1	0.3		1.0	50								
							60		100 µA	1												
2N4123	TO-92 (72)	40	30	5	50	20	25		50	1	0.3		0.95	50	4	250		10		6	7	23
							50	150	2	1												
2N4124	TO-92 (72)	30	25	5	50	20	60		50	1	0.3		0.95	50	4	300		10		5	7	23
							120	360	2	1												
2N4140	TO-92 (72)	Same as PN4140, see page 1-22 for explanation																				19
2N4141	TO-92 (72)	Same as PN4141, see page 1-22 for explanation																				19
2N4400	TO-92 (72)	60	40	6			20		500	2	0.4	0.75	0.95	150	6.5	200		20	255		2	13
							50	150	150	1												
							40		10	1	0.75		1.2	500								
							20		1	1												
2N4401	TO-92 (72)	60	40	6			40		500	2	0.4	0.75	0.95	150	6.5	250		20	255		2	13
							100	300	150	1												
							80		10	1	0.75		1.2	500								
							40		1	1												
							20		100 µA	1												
PN2221	TO-92 (72)	60	30	5	10	50	20		500	10	0.4		1.3	150	8	250		20				19
							20		150	1												
							40	120	150	10	1.6		2.6	500								
							35		10	10												
							25		1	10												
							20		100 µA	10												
PN2221A	TO-92 (72)	75	40	6	10	60	25		500	10	0.3	0.6	1.2	150	8	250		20	285		2	19
							20		150	1												
							40	120	150	10	1.0		2.0	500								
							35		10	10												
							25		1	10												
							20		100 µA	10												

TEST CONDITIONS:

(1) I_C = 300 µA, V_{CE} = 10V, f = 1kHz. **(2)** I_C = 150mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 15mA. **(3)** I_C = 100 µA, V_{CE} = 10V, f = 1kHz. **(4)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(5)** I_C = 100 µA, V_{CE} = 4.5V, f = 15.7kHz. **(6)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(7)** I_C = 100 µA, V_{CE} - 5V, f = 15.7kHz. **(8)** I_C = 250 µA, V_{CE} = 5V, f = 10Hz– 15.7kHz. **(9)** I_C = 3mA, V_{CE} = 10V, f = 1MHz. **(10)** I_C = 10 µA, V_{CE} = 5V, f = 15.7kHz.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
PN2222	TO-92 (72)	60	30	5	10	50	30		500	10	0.4		1.3	150	8	250		20				19
							50		150	1												
							100	300	150	10	1.6		2.6	500								
							75		10	1												
							50		1	1												
							35		100 μA	1												
PN2222A	TO-92 (72)	75	40	6	10	60	40		500	10	0.3	0.6	1.2	150	8	300		20	285		2	19
							50		150	1												
							100	300	150	10	1.0		2.0	500								
							75		10	1												
							50		1	1												
							35		100 μA	1												
PN3641	TO-92 (72)	60*	30	5	50*	50	15		500	10	0.22			150	8	250		50				19
							40	120	150	10												
PN3642	TO-92 (72)	60	45	5	50*	50	15		500	10	0.22			150	8	250		50				19
							40	120	150	10												
PN3643	TO-92 (72)	60	30	5	50*	50	20		500	10	0.22			150	8	250		50				19
							100	300	150	10												
PN3691	TO-92 (72)	35	20	4	50	15	40	160	10	1	0.7		0.9	10	3.5	200	500	10				23
PN3692	TO-92 (72)	35	20	4	50	15	100	400	10	1	0.7		0.9	10	3.5	200	500	10				23
PN3694	TO-92 (72)	45	45	4	50	30	100	400	10	1					6	200		10				27
PN4140	TO-92 (72)	60	30	5			20		500	10	0.4		1.3	150	8	250		20	310		2	19
							20		150	1												
							40	120	150	10	1.6		2.6	500								
							35		10	10												
							25		1	10												
							20		100 μA	10												
PN4141	TO-92 (72)	60	30	5			30		500	10	0.4		1.3	150	8	250		20	310		2	19
							50		150	1												
							100	300	150	10	1.6		2.6	500								
							75		10	10												
							50		1	10												
							35		100 μA	10												
PN5127	TO-92 (72)	20	12	3	50	10	15	300	2	10	0.3		1.0	10	3.5	150		2				27
PN5128	TO-92 (72)	15	12	3	50	10	35	350	50	10	0.25		1.1	150	10	200	800	50				19
							20		10	10												

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
PN5129	TO-92 (72)	15	12	3	50	10	35 20	350	50 10	10 10	0.25		1.1	150	10	200	800	50				19
PN5131	TO-92 (72)	20	15	3	50	10	35	500	10	1	1.0			10	6	100		10				27
PN5132	TO-92 (72)	20	20	3	50	10	30	400	10	10	2.0		0.9	10	3.5	200		10				27
PN5135	TO-92 (72)	30	25	4	300	15	50 15	60*	10 2	10 10	1.0		1.0	100	25	40	500	30				19
PN5136	TO-92 (72)	30	20	3	100	20	20 20	400	150 30	1 1	0.25		1.1	150	35	40	400	50				19
PN5137	TO-92 (72)	30	20	3	100	20	20 20	400	150 30	1 1	0.25		1.1	150	35	40	400	50				19
EN2222	TO-92 (72)	Same as PN2222, see page 1-22 for explanation																				19
MPSA10	TO-92 (72)		40	4	100	30	40	400	5	10					4	50		5				27
MPSA20	TO-92 (72)		40	4	100	30	40	400	5	10					4	125		5				02
MPSL01	TO-92 (72)	140	120	5	1 μA	40	50	300	10	5	0.2 0.3		1.2 1.4	10 50	8	60		10				16
MPS2711	TO-92 (72)	18	18	5	500	18	30	90	2	4.5					4							23
MPS2712	TO-92 (72)	18	18	5	500	18	75	225	2	4.5					4							23
MPS2716	TO-92 (72)	18	18	5	500	18	75	225	2	4.5					3.5							23
MPS2923	TO-92 (72)	25	25	5	500	25	90	180 (1 kHz)	2	10					12							04
MPS2924	TO-92 (72)	25	25	5	500	25	150	300 (1 kHz)	2	10					12							04
MPS2925	TO-92 (72)	25	25	5	500	25	235	470 (1 kHz)	2	10					12							04
MPS2926	TO-92 (72)	25	25	5	500	18	35 (1 kHz)	470 (5 Groups)	2	10					3.5							04
MPS3392	TO-92 (72)	25	25	5	100	18	150	300	2	4.5					10							04

TEST CONDITIONS:

(1) I_C = 300 μA, V_{CE} = 10V, f = 1kHz. **(2)** I_C = 150mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 15mA. **(3)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(4)** I_C – 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(5)** I_C = 100 μA, V_{CE} = 4.5V, f = 15.7kHz. **(6)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(7)** I_C = 100 μA, V_{CE} = 5V, f = 15.7kHz. **(8)** I_C = 250 μA, V_{CE} = 5V, f = 10Hz–15.7kHz. **(9)** I_C = 3mA, V_{CE} = 10V, f = 1MHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 15.7kHz.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
MPS3393	TO-92 (72)		25		100	18	90	180	2	4.5					3.5							04
MPS3394	TO-92 (72)		25		100	18	55	110	2	4.5					3.5							04
MPS3395	TO-92 (72)		25		100	18	150	500	2	4.5					3.5							04
MPS3396	TO-92 (72)		25		100	18	90	500	2	4.5					3.5							04
MPS3397	TO-92 (72)		25		100	18	55	500	2	4.5					3.5							04
MPS3398	TO-92 (72)		25		100	18	55	800	2	4.5					3.5							04
MPS3642	TO-92 (72)	Same as PN3642, see page 1-22 for explanation																				23
MPS3693	TO-92 (72)	45	45	4	50	35	40	160	10	10					3.5	200		10		4	9	27
MPS3694	TO-92 (72)	45	45	4	50	35	100	400	10	10					3.5	200		10		4	9	27
MPS3704	TO-92 (72)	50	30	5	100	20	100	300	50	2	0.6			100	12	100		50				13
MPS3705	TO-92 (72)	50	30	5	100	20	50	150	50	2	0.8			100	12	100		50				13
MPS3706	TO-92 (72)	40	20	5	100	20	30	600	50	2	1.0			100	12	100		50				13
MPS3721	TO-92 (72)				500	18	60	660 (1 kHz)	2	10					3.5							23
MPS3826	TO-92 (72)	60	45	4	100	30	40	160	10	10					3.5	200	800	10				23
MPS3827	TO-92 (72)	60	45	4	100	30	100	400	10	10					3.5	200	800	10				23
MPS5172	TO-92 (72)	25	25	5	100	25	100	500	10	10	0.25			10	10							04
MPS6512	TO-92 (72)	40	30	4	50	30	30 50	 100	100 2	10 10	0.5			50	3.5							23
MPS6513	TO-92 (72)	40	30	4	50	30	60 90	 180	100 2	10 10	0.5			50	3.5							23
MPS6514	TO-92 (72)	40	25	4	50	30	90 150	 300	100 2	10 10	0.5			50	3.5							23

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
MPS6515	TO-92 (72)	40	25	4	50	30	150 250	 500	100 2	10 10	0.5			50	3.5							23
MPS6520	TO-92 (72)		25	4	50	30	200 100	400	2 100 μA	10 10	0.5			50	3.5					3	10	04
MPS6521	TO-92 (72)		25	4	50	30	200 150	600	2 100 μA	10 10	0.5			50	3.5					3	10	04
MPS6530	TO-92 (72)	60	40	5	50	40	25 40 30	 120	500 100 10	10 1 1	0.5		1.0	100	5							13
MPS6531	TO-92 (72)	60	40	5	50	40	50 90 60	 270	500 100 10	10 1 1	0.3		1.0	100	5							13
MPS6532	TO-92 (72)	50	30	5	100	30	30		100	1	0.5		1.2	100	5							13
MPS6564	TO-92 (72)		45	5	500	40	25		10	5	0.5			10	4							27
MPS6565	TO-92 (72)	60	45	4	100	30	40	160	10	10	0.4			10	3.5							27
MPS6566	TO-92 (72)	60	45	4	100	30	100	400	10	10	0.4			10	3.5	200		10				27
MPS6573	TO-92 (72)		35		100	35	100 200	 500	100 μA 10	5 5	0.5			10	12	100	300	10				02
MPS6574	TO-92 (72)		35		100	35	100 (4 Groups)	300	1	5	0.5			10	12	100	300	10				02
MPS6575	TO-92 (72)		45		100	45	100 200	 500	100 μA 10	5 5	0.5			10	12	100	300	10				02
MPS6576	TO-92 (72)		45		100	45	100 (4 Groups)	300	1	5	0.5			10	12	100	300	10				02
NCBT13	TO-92 (72)	60	40	4	100	30	40		20	1	0.15			100	6	150		20				13
NS3903	TO-18	60	40	6			15 30 50 35 20	 150	100 50 10 1 100 μA	1 1 1 1 1	0.2 0.3	0.65	0.85 0.95	10 50	4	250		10	225		6	23

TEST CONDITIONS:

(1) I_C = 300 μA, V_{CE} = 10V, f = 1kHz. **(2)** I_C = 150mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 15mA. **(3)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(4)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(5)** I_C = 100 μA, V_{CE} = 4.5V, f = 15.7kHz. **(6)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(7)** I_C = 100 μA, V_{CE} = 5V, f = 15.7kHz. **(8)** I_C = 250 μA, V_{CE} = 5V, f = 10Hz–15.7kHz. **(9)** I_C = 3mA, V_{CE} = 10V, f = 1MHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 15.7kHz.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
NS3904	TO-18	60	40	6			30		100	1	0.2	0.65	0.85	10	4	300		10	250		6	23
							60		50	1												
							100	300	10	1	0.3		0.95	50								
							70		1	1												
							40		100 μA	1												
2N4424	TO-92 (74)	40	40	5	100	25	180	540	2	4.5	0.3	0.6	1.3	50								04
2N4944 2N4945 2N4946	TO-92 (72)	Same as PN2222A, see page 1-22 for explanation																				19
2N4951	TO-92 (74)	60	30	5	50	40	60	200	150	10	0.3		1.3	150	8	250		20	400		2	13
							40		10	10												
							20		1	10												
2N4952	TO-92 (74)	60	30	5	50	40	100	300	150	10	0.3		1.3	150	8	250		20	400		2	13
							75		10	10												
							50		1	10												
2N4953	TO-92 (74)	60	30	5	50	40	200	600	150	10	0.3		1.3	150	8	250		20	400		2	13
							150		10	10												
							75		1	10												
2N4954	TO-92 (74)	40	30	5	50	30	60	600	150	10	0.3		1.3	150	8	250		20	400		2	13
							40		10	10												
							20		1	10												
2N4969	TO-92 (72)	Same as PN2221, see page 1-21 for explanation																				19
2N4970	TO-92 (72)	Same as PN2222, see page 1-22 for explanation																				19
2N5127	TO-92 (72)	Same as PN5127, see page 1-22 for explanation																				27
2N5128	TO-92 (72)	Same as PN5128, see page 1-22 for explanation																				19
2N5129	TO-92 (72)	Same as PN5129, see page 1-23 for explanation																				19
2N5131	TO-92	Same as PN5131, see page 1-23 for explanation																				27
2N5132	TO-92 (72)	Same as PN5132, see page 1-23 for explanation																				27
2N5135	TO-92 (72)	Same as PN5135, see page 1-23 for explanation																				19
2N5136	TO-92 (72)	Same as PN5136, see page 1-23 for explanation																				19

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5137	TO-92 (72)	Same as PN5137, see page 1-23 for explanation																				19
2N5172	TO-92 (74)	25	25	5	100	25	100	500	10	10	0.25			10	10							04
2N5219	TO-92 (72)	20	15	3	100	10	35	500	2	10	0.4		1.0	10	4	150		10				27
2N5220	TO-92 (72)	15	15	3	100	10	30	600	50	10	0.5		1.1	150	10	100		20				13
							25		10	10												
2N5223	TO-92 (72)	25	20	3	100	10	50	800	2	10	0.7		1.2	10	4	150		10				27
2N5225	TO-92 (72)	25	25	4	300	15	30	600	50	10	0.8		1.0	100	20	50		20				13
							25		50	10												
2N5550	TO-92 (72)	160	140	6	100	100	20		50	5	0.15		1.0	10	6	100	300	10		10	8	16
							60	250	10	5												
							60		1	5	0.25		1.2	50								
2N5551	TO-92 (72)	180	160	6	50	120	30		50	5	0.15		1.0	10	6	100	300	10		8	8	16
							80	250	10	5												
							80		1	5	0.2		1.0	50								
2N5816	TO-92 (77)	50	40	5	100	25	25		500	2	0.75		1.2	500	15	100		50				13
							100	200	2	2												
TN2219	TO-92+ (91)	60	30	5	10	50	30		500	10	0.4		1.3	150	8	50		20				19
							50		150	1												
							100	300	150	10	1.6		2.6	500								
							75		10	10												
							50		1	10												
							35		0.1	10												
TN2219A	TO-92+ (91)	75	40	6	10	60	40		500	10	0.3	0.6	1.2	150	8	60		20		4	3	19
							50		150	1												
							100	300	150	10	1.0		2.0	500								
							75		10	10												
							50		1	10												
							35		0.1	10												

TEST CONDITIONS:

(1) I_C = 300 μA, V_{CE} = 10V, f = 1kHz. **(2)** I_C = 150mA, V_{CC} = 30V, $I_B{}^1 = I_B{}^2$ = 15mA. **(3)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(4)** I_C = 300mA, V_{CC} = 25V, $I_B{}^1 = I_B{}^2$ = 30mA. **(5)** I_C = 100 μA, V_{CE} = 4.5V, f = 15.7kHz. **(6)** I_C = 10mA, V_{CC} = 3V, $I_B{}^1 = I_B{}^2$ = 1mA. **(7)** I_C = 100 μA, V_{CE} = 5V, f = 15.7kHz. **(8)** I_C = 250 μA, V_{CE} = 5V, f = 10Hz–15.7kHz. **(9)** I_C = 3mA, V_{CE} = 10V, f = 1MHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 15.7kHz.

NPN Transistors

MEDIUM POWER

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N699	TO-39	120	60	5	2	60	40	120	150	10	5		1.3	150	20	50		50				12
2N2017	TO-39	60	60	8	10 μA	30	20		1A	15	2			200								12
							50	200	200 mA	10												
							20		10 mA	10												
2N2102	TO-39	120	65	7	2	60	10		1A	10	0.5		1.1	150	15	60		50		6	1	12
							25		500	10												
							40	120	150	10												
							35		10	10												
							20		0.1	10												
							10		0.01	10												
2N2192	TO-39	60	40	5	10	30	15		1A	10	0.35		1.3	150	10	50		50				12
							35		500	10												
							70		150	1												
							100	300	150	10												
							75		10	10												
							15		0.1	10												
2N2192A	TO-39	60	40	5	10	30	15	15	1A	10	0.25		1.3	150	20	50		50				12
							35		500	10												
							70		150	1												
							100	300	150	10												
							75		10	10												
							15		0.1	10												
2N2193	TO-39	80	50	8	10	60	15		1A	10	0.35		1.3	150	20	50		50				12
							20		500	10												
							30		150	1												
							40	120	150	10												
							30		10	10												
							15		0.1	10												
2N2193A	TO-39	80	50	8	10	60	15		1A	10	0.25		1.3	150	20	50		50				12
							20		500	10												
							30		150	1												
							40	120	150	10												
							30		10	10												
							15		0.1	10												
2N2195	TO-39	45	25	5	100	30	10		150	1	0.35		1.3	150	20	50		50				12
							20		150	10												
2N2195A	TO-39	45	25	5	100	30	10		150	1	0.25		1.3	150	20	50		50				12
							20		150	10												

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(sat)}$ (V) Max &	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N2243	TO-39	120	80	7	10	60	15		500	10	0.35		1.3	150	15	50		50				12
							30		150	1												
							40	120	150	10												
							30		10	10												
							15		0.1	10												
2N2243A	TO-39	120	80	7	10	60	15		500	10	0.25		1.3	150	15	50		50				12
							30		150	1												
							40	120	150	10												
							30		10	10												
							15		0.1	10												
2N2270	TO-39	60	45	7	50	60	50	200	150	10	0.9		1.2	150	15	100		50		6	1	12
							30		1	10												
2N2657	TO-39	80	50	8	100	60	15		5A	6	0.5		1.5	1A	150	20		200	1.5		2	34
							40	120	1A	2	3		2.5	5A								
2N2658	TO-39	100	80	8	100	60	15		5A	6	0.5		1.5	1A		20		200	1.5		2	34
							40	120	1A	2	3		2.5	5A								
2N2890	TO-39	100	80	5	50 µA	60	25		2A	5	0.5		1.2	1A	70	30		200	1.5		3	34
							30	90	1A	2												
							20		100	2	0.75		1.3	2A								
2N2891	TO-39	100	80	5	50 µA	60	40		2A	5	0.5		1.2	1A	70	30		200	1.5		3	34
							50	150	1A	2												
							35		100	2												
							50	300	50	10	0.75		1.3	2A								
2N3019	TO-39	140	80	7	10	90	15		1A	10	0.2		1.1	150	12	100		50		4	4	12
							50		500	10												
							100	300	150	10												
							90		10	10												
							50		0.1	10												
2N3019 J, JTX, JTXV	TO-39	140	80	7	10*	90	15		1A	10	0.2		1.1	150	12	100	400	50		4	4	12
							50	200	500	10												
							100	300	150	10	0.5			500								
							90		10	10												
							50	200	0.1	10												

TEST CONDITIONS:

(1) I_C = 300 µA, V_{CE} = 10V, f = 15.7kHz. (2) I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 100mA. (3) I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 50mA. (4) I_C = 100 µA, V_{CE} = 10V, f = 1kHz. (5) I_C = 150mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 7.5mA. (6) I_C = 30 µA, V_{CE} = 10V, f = 1kHz. (7) I_C = 150mA, V_{EB} = 2V, $I_B^1 = I_B^2$ = 15mA. (8) I_C = 500 µA, V_{CE} = 10V, f = 1kHz. (9) I_C = 2A, V_{CC} = 40V, $I_B^1 = I_B^2$ = 200mA.

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3020	TO-39	140	80	7	10	90	15		1A	10	0.2		1.1	150	12	80		50				12
							30	100	500	10												
							40	120	150	10	0.5			500								
							40	120	10	10												
							30	100	0.1	10												
2N3053	TO-39	60	40	5	250	30	50	250	150	10	1.4		1.7	150	15	100		50				12
							25		150	2.5												
2N3107	TO-39	100	60	7	10	60	40		500	10	0.25		1.1	150	20	70		50	1000	7	5/6	12
							100	300	150	1												
							35		0.1	10	1.0		2.0	1A								
2N3108	TO-39	100	60	7	10	60	25		500	10	0.25		1.1	150	20	60		50	600	7	5/6	12
							40	120	150	10												
							20		0.1	10	1.0		2.0	1A								
2N3109	TO-39	80	40	7	10*	60	40		500	10	0.25		1.1	150	25	70		50	1000	7	5/6	12
							100	300	150	1												
							35		0.1	10	1.0		2.0	1A								
2N3110	TO-39	80	40	7	10*	60	25		500	10	0.25		1.1	150	25	60		50	600	7	5/6	12
							40	120	150	1												
							20		0.1	10	1.0		2.0	1A								
2N3114	TO-39	150	150	5	10	100	30	120	30	10	1.0		0.9	50	9	40		30				08
							15		0.1	10												
2N3498	TO-39	100	100	6	50	50	15		500	10	0.2		0.8	10	10	150		20				08
							40	120	150	10	0.25		0.9	50								
							35		10	10	0.6		1.4	300								
							25		1	10												
							20		0.1	10												
2N3498	TO-39	100	100	6	50	50	15		500	10	0.2		0.8	10	10	150	800	20	1150	16	7/8	08
							40	120	150	10												
							35		10	10	0.6		1.4	300								
							25		1	10												
							20		0.1	10												
2N3498 J, JTX, JTXV	TO-39	100	100	6	50	50	15		500	10	0.2		0.8	10	10	150	800	20	1150	16	7/8	08
							40	120	150	10												
							35		10	10	0.6		1.4	300								
							25		1	10												
							20		0.1	10												
2N3499	TO-39	100	100	6	50	50	20		500	10	0.2		0.8	10	10	150		20				08
							100	300	150	10												
							75		10	10	0.25		0.9	50								
							50		1	10	0.6		1.4	300								
							35		0.1	10												

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3499 J, JTX, JTXV	TO-39	100	100	6	50	50	20		500	10	0.2		0.8	10	10	150	800	20	1150	16	7/8	08
							100	300	150	10												
							75		10	10	0.6		1.4	300								
							50		1	10												
							35		0.1	10												
2N3500	TO-39	150	150	6	50	75	15		300	10	0.2		0.8	10	8	150		20				0.8
							40	120	150	10												
							35		10	10	0.25		0.9	50								
							25		1	10	0.4		1.2	150								
							20		0.1	10												
2N3500 J, JTX, JTXV	TO-39	150	150	6	50	75	15		300	10	0.2		0.8	10	8	150	800	20	1150	16	7/8	08
							40	120	150	10												
							35		10	10	0.4		1.2	150								
							25		1	10												
							20		0.1	10												
2N3501	TO-39	150	150	6	50	75	20		300	10	0.2		0.8	10	8	150		20				08
							100	300	150	10				50								
							75		10	10	0.25		0.9	150								
							50		1	10	0.4		1.2									
							35		0.1	10												
2N3501 J, JTX, JTXV	TO-39	150	150	6	50	75	20		300	10	0.2		0.8	10	8	150	800	20	1150	16	7/8	08
							100	300	150	10												
							75		10	10	0.4		1.2	150								
							50		1	10												
							35		0.1	10												
2N3566	TO-92 (72)	Same as PN3566, see page 1-39 for explanation																				14
2N3567	TO-92 (72)	Same as PN3567, see page 1-39 for explanation																				14
2N3568	TO-92 (72)	Same as PN3568, see page 1-39 for explanation																				12
2N3569	TO-92 (72)	Same as PN3569, see page 1-39 for explanation																				14
2N3665	TO-39	120	80	10	50	60	25		500	10	0.5		1.2	150	12	60		50				12
							40	120	150	10												
							30		10	10	1.2		1.8	500								

TEST CONDITIONS:

(1) I_C = 300 μA, V_{CE} = 10V, f = 15.7kHz. **(2)** I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 100mA. **(3)** I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 50mA. **(4)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(5)** I_C = 150mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 7.5mA. **(6)** I_C = 30 μA, V_{CE} = 10V, f = 1kHz. **(7)** I_C = 150mA, V_{EB} = 2V, $I_B^1 = I_B^2$ = 15mA. **(8)** I_C = 500 μA, V_{CE} = 10V, f = 1kHz. **(9)** I_C = 2A, V_{CC} = 40V, $I_B^1 = I_B^2$ = 200mA.

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3666	TO-39	120	80	10	50	60	50		500	10	0.5		1.2	150	12	60		50				12
							100	300	150	10												
							70		10	10	1.2		1.8	500								
2N3700 J, JTX, JTXV	TO-18	140	80	7	10	90	15		1A	10	0.2		1.1	150	12	100	200	5		4	4	12
							50		500	10												
							100	300	150	10	0.5			500								
							90		10	10												
							50		1	10												
2N3700	TO-18	140	80	7	10	90	15		1A	10	0.2		1.1	150	12	100	400	50		4	4	12
							50	200	500	10												
							100	300	150	10	0.5			500								
							90		10	10												
							50	200	0.1	10												
2N3742	TO-39	300	300	7	200	200	20		50	20	0.75		1.0	10	6	60		10				48
							20	200	30	10												
							15		10	10	1.0		1.2	30								
							10		3	10												
2N3945	TO-39	70	50	8	40	60	20		500	10	1.8		1.8	500	12	60		50				12
							40	250	150	10												
							25		10	10	0.5		1.2	150								
2N4237	TO-39		40		100 µA	50	15		1A	1	0.6		1.5	1A	100	1		100				14
							30		500	4												
							30	150	250	1	0.3			500								
2N4924	TO-39	100	100	5	100	50	40	120	150	10	0.25			10	10	10	500	20				12
							35		10	10												
							25		1	10	0.4			50								
2N4926	TO-39	200	200	7	100	100	20		50	20					6	30	300	20				48
							20	200	30	10												
							15		10	10												
							10		3	10												
2N4927	TO-39	250	250	7	100	150	20		50	20					6	30	300	20				48
							20	200	30	10												
							15		10	10												
							10		3	10												
2N5148	TO-39		80		1 µA*	60	5		3A	5	0.85		1.5	200	70	50		200				34
							15		2A	5												
							30	90	1A	5	0.46		1.2	100								
							20		50	5												

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5150	TO-39		80		1 μA*	60	15		3A	5	0.46		1.2	100	70	60		200				34
							30		2A	5												
							70	200	1A	5	5.0			3A								
							50		50	5												
2N5336	TO-39		80		10 μA	80	20		5A	2	0.7		1.2	2A		30		500	2200		9	34
							30	120	2A	2												
							30		500	2	1.2		1.8	5A								
2N5338	TO-39		100		10 μA	100	20		5A	2	0.7		1.2	2A		30		500	2200		9	34
							30	120	2A	2												
							30		500	2	1.2		1.8	5A								
40314	TO-39		40		250	15	70	350	50	4	1.4			150								12
40321	TO-39		300		100	150	25	200	20	10												48
92PE37A	TO-92+ (90)		45		100	60	40		500	2	0.5			500	30	50		200				38
							40		250	2												
							25		50	2	1.0			1A								
92PE37B	TO-92+ (90)		60		100	80	40		500	2												38
							40		250	2	0.5			500	30	50		200				
							25		50	2	1.0			1A								
92PE37C	TO-92+ (90)		80		100	100	40		500	2												
							40		250	2	0.5			500	30	50		200				38
							25		50	2	1.0			1A								
92PE487	TO-92+ (90)	160	160	7	50	100	30		30	10	1.0			30	3							48
							15		10	10												
							15		1	10												
92PE488	TO-92+ (90)	250	250	7	50	200	30		30	10	1.0			30	3							48
							15		10	10												
							15		1	10												
92PE489	TO-92+ (90)	300	300	7	50	200	30		30	10	1.0			30	3							48
							15		10	10												
							15		1	10												
92PU01	TO-92+ (91)						50		1A	1	0.5			1A	30	1000		50				37
							60		100	1												
			30		100	40	55		10	1												
92PU01A	TO-92+ (91)		40		100	50	50		1A	1	0.5			1A	30	100		50				37
							60		100	1												
							55		10	1												

TEST CONDITIONS:

(1) I_C = 300 μA, V_{CE} = 10V, f = 15.7kHz. **(2)** I_C = 1A, V_{CC} = 20V, I_{B1} = I_{B2} = 100mA. **(3)** I_C = 1A, V_{CC} = 20V, I_{B1} = I_{B2} = 50mA. **(4)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(5)** I_C = 150mA, V_{CC} = 20V, I_{B1} = I_{B2} = 7.5mA. **(6)** I_C = 30 μA, V_{CE} = 10V, f = 1kHz. **(7)** I_C = 150mA, V_{EB} = 2V, I_{B1} = I_{B2} = 15mA. **(8)** I_C = 500 μA, V_{CE} = 10V, f = 1kHz. **(9)** I_C = 2A, V_{CC} = 40V, I_{B1} = I_{B2} = 200mA.

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
92PU05	TO-92+ (91)		60		100	40	20		500	1	0.35			250	30	50		200				39
							50		250	1												
							80		50	1												
92PU06	TO-92+ (91)		100		100	80	20		500	1	0.35			250	30	50		200				39
							50		250	1												
							80		50	1												
92PU10	TO-92+ (91)		300		100	200	40		30	10	0.75			30	3.5							48
							40		10	10												
							25		1	10												
92PU100	TO-92+ (91)	100	80		100	80	100	300	350	2	0.35			350	20	50		100				39
							100		10	2												
92PU391	TO-92+ (91)	200	200	6	100	160	40		10	10	2.0		2.0	20	2.5	50		10				48
							25		1	10												
92PU392	TO-92+ (91)	250	250	6	100	200	40		10	10	2.0		2.0	20	2.5	50		10				48
							25		1	10												
92PU393	TO-92+ (91)	300	300	6	100	260	40		10	10	2.0		2.0	20	2.5	50		10				48
							25		1	10												
D40D1	TO-202 (35)		30		100*	45	10		1A	2	0.5		1.5	500								38
							50	150	100	2												
D40D2	TO-202 (35)						20		1A	2	0.5		1.5	500								38
			30		100*	45	120	360	100	2												
D40D3	TO-202 (35)		30		100*	45	10		1A	2												38
							290		100	2			1.5	500								
D40D4	TO-202 (35)		45		100*	60	10		1A	2	0.5		1.5	500								38
							50	150	100	2												
D40D5	TO-202 (35)		45		100*	60	120	360	1A	2	0.5		1.5	500								38
							10		100	2												
D40D6	TO-202 (35)		60		100*	75	10		1A	2	1.0		1.5	500								38
							50	150	100	2												
D40D8	TO-202 (35)		60		100*	75	10		1A	2	1.0		1.5	500								38
							120	360	100	2												
D40D10	TO-202 (35)		75		100*	90	10		1A	2	1.0		1.5	500								38
							50	150	100	2												
D40D11	TO-202 (35)		75		100*	90	10		1A	2	1.0		1.5	500								38
							120	360	100	2												
D40D13	TO-202 (35)		75		100*	90	50	150	100	2	1.0		1.5	500								38

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
D40D14	TO-202 (35)		75		100*	90	120	360	100	2	1.0		1.5	500								38
D40E1	TO-202 (35)		30		100*	40	10 50		1A 100	2 2	1.0		1.3	1A								38
D40E5	TO-202 (35)		60		100*	70	10 50		1A 100	2 2	1.0		1.3	1A								38
D40E7	TO-202 (35)		80		100*	90	10 50		1A 100	2 2	1.0		1.3	1A								38
D40N1	TO-202 (35)		250		10 μA	250	20 30 20	 90 	40 20 4	10 10 10					3	75		20				48
D40N2	TO-202 (35)		250		10 μA	250	30 60 30	 180 	40 20 4	10 10 10					3	75		20				48
D40N3	TO-202 (35)		300		10 μA	300	20 30 20	 90 	40 20 4	10 10 10					3	75		20				48
D40N4	TO-202 (35)		300		10 μA	300	30 60 30	 180 	40 20 4	10 10 10					3	75		20				48
D40N5	TO-202 (35)		375		10 μA	300	15 20 15		40 20 4	10 10 10					3	75		20				48
D42C1	TO-202 (36)		30		1 μA*	30	10 25		1A 200	1 1	0.5		1.3	1A	30							37
D42C2	TO-202 (36)		30		1 μA*	30	20 40	 120	1A 200	1 1	0.5		1.3	1A	30							37
D42C3	TO-202 (36)		30		1 μA*	30	20 40		2A 200	1 1	0.5		1.3	1A	30							37
D42C4	TO-202 (36)		45		1 μA*	45	10 25		1A 200	1 1	0.5		1.3	1A	30							37
D42C5	TO-202 (36)		45		1 μA*	45	20 40	 120	1A 200	1 1	0.5		1.3	1A	30							37
D42C6	TO-202 (36)		45		1 μA*	45	20 40		2A 200	1 1	0.5		1.3	1A	30							37

TEST CONDITIONS:

(1) I_C = 300 μA, V_{CE} = 10V, f = 15.7kHz. **(2)** I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 100mA. **(3)** I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 50mA. **(4)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(5)** I_C – 150mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 7.5mA. **(6)** I_C = 30 μA, V_{CE} = 10V, f = 1kHz. **(7)** I_C = 150mA, V_{EB} = 2V, $I_B^1 = I_B^2$ = 15mA. **(8)** I_C = 500 μA, V_{CE} = 10V, f = 1kHz. **(9)** I_C = 2A, V_{CC} = 40V, $I_B^1 = I_B^2$ = 200mA.

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
D42C7	TO-202 (36)		60		1 μA*	60	10 25		1A 200	1 1	0.5		1.3	1A	30							38
D42C8	TO-202 (36)		60		1 μA*	60	20 40	 120	1A 200	1 1	0.5		1.3	1A	30							38
D42C9	TO-202 (36)		60		1 μA*	60	20 40		2A 200	1 1	0.5		1.3	1A	30							38
D42C10	TO-202 (36)		80		10 μA*	90	10 25		1A 200	1 1	0.5		1.3	1A	100							38
D42C11	TO-202 (36)		80		10 μA*	90	20 40	 120	1A 200	1 1	0.5		1.3	1A	100							38
D42C12	TO-202 (36)		80		10 μA*	90	20 40	 120	2A 200	1 1	0.5		1.3	1A	100							38
MPSA05	TO-92 (72)		60	4	100	60	50 50		100 10	1 1	0.25			100		100		100				12
MPSA06	TO-92 (72)		80	4	100	80	50 50		100 10	1 1	0.25			100		100		100				12
MPSA42	TO-92 (72)	300	300	8	100	200	40 40 25		30 10 1	10 10 10	0.5		0.9	20	3	50		10				48
MPSA43	TO-92 (72)	200	200	6	100	160	50 40 25	200	30 10 1	10 10 10	0.4		0.9	20	4	50		10				48
MPS6560	TO-92 (72)		25	5	100	20	50 50 35	200	500 100 10	1 1 1	0.5			500	30	60		10				14
MPS6561	TO-92 (72)		20	5	100	20	50 50 35	200	500 100 10	1 1 1	0.5			350	30	60		10				14
MRF8004	TO-39	60	30	3	10 μA	50	10		400	2					70							35
NCBS14	TO-39	60	40	4	100	30	60		20	1	0.15			100	10	125		20				14
NCBS35	TO-39		65	3	10 μA	40	30	150	100	1	0.5			1A	35	120		100				35
NCBV14	TO-202 (35)	60	40	4	100	30	75		50	1	0.4			500	100	125		50				14
NCBX14	TO-92+ (91)	60	40	4	100	30	60		20	1	0.15			100	10	125		20				14
NSD102	TO-202 (35)	60	45	5	100	60	25 40 50 40	 150	1A 500 100 10	5 5 5 5	0.2 0.4		0.9 1.2	100 500	30	60		50				37

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}^* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
NSD103	TO-202 (35)	60	45	5	100	60	30		1A	5	0.2		0.9	100	30	60		50				37
							50		500	5												
							120	360	100	5	0.4		1.2	500								
							50		10	5												
NSD104	TO-202 (35)	100	80	7	100	100	10		1A	5	0.2		0.9	100	30	60		50				39
							50	150	100	5												
							20		10	5	0.5		1.2	500								
NSD105	TO-202 (35)	100	80	7	100	100	10		1A	5	0.2		0.9	100	30	60		50				39
							120	360	100	5												
							10		10	5	0.5		1.2	500								
NSD106	TO-202 (35)	140	100	7	100	140	25		500	5	0.2		0.9	100	30	60		50				39
							50	150	100	5												
							20		10	5	0.5		1.2	500								
NSD123	TO-202 (35)	120	120	6	50	50	15		300	10	0.4		1.2	150	10							08
							40	300	150	10												
							35		10	10												
							25		1	10												
							20		1	10												
NSD131	TO-202 (35)	250	250	7	100	150	30	90	30	10	1.0		0.85	20	3							48
							15		10	10												
							15		1	10												
NSD132	TO-202 (35)	250	250	7	100	150	60	180	30	10	1.0		0.85	20	3							48
							30		10	10												
							15		1	10												
NSD133	TO-202 (35)	300	300	7	100	150	30	90	30	10	1.0		0.85	20	3							48
							15		10	10												
							15		1	10												
NSD134	TO-202 (35)	300	300	7	100	150	60	180	30	10	1.0		0.85	20	3							48
							30		10	10												
							15		1	10												
NSD135	TO-202 (35)	375	375	7	100	150	30		30	10	1.0		0.85	20	3							48
							30		10	10												
							15		1	10												
NSD457	TO-202 (35)	160	160	5	50	100	25		30	10	1.0			30								48
NSD458	TO-202 (35)	250	250	5	50	200	25		30	10	1.0			30								48

TEST CONDITIONS:

(1) $I_C = 300\ \mu A$, $V_{CE} = 10V$, $f = 15.7kHz$. **(2)** $I_C = 1A$, $V_{CC} = 20V$, $I_B^1 = I_B^2 = 100mA$. **(3)** $I_C = 1A$, $V_{CC} = 20V$, $I_B^1 = I_B^2 = 50mA$. **(4)** $I_C = 100\ \mu A$, $V_{CE} = 10V$, $f = 1kHz$. **(5)** $I_C = 150mA$, $V_{CC} = 20V$, $I_B^1 = I_B^2 = 7.5mA$. **(6)** $I_C = 30\ \mu A$, $V_{CE} = 10V$, $f = 1kHz$. **(7)** $I_C = 150mA$, $V_{EB} = 2V$, $I_B^1 = I_B^2 = 15mA$. **(8)** $I_C = 500\ \mu A$, $V_{CE} = 10V$, $f = 1kHz$. **(9)** $I_C = 2A$, $V_{CC} = 40V$, $I_B^1 = I_B^2 = 200mA$.

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(sat)}$ (V) Max &	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
NSD459	TO-202 (35)	300	300	5	50	250	25		30	10	1.0			30								48
NSD3439	TO-202 (35)		350		20 μA	300	40 30	160	20 2	10 10	0.5		1.3	50	20	15		10				36
NSD3440	TO-202 (35)		250		500 μA	200	40 30	160	20 2	10 10	0.5		1.3	50	20	15		10				36
NSD6178	TO-202 (35)		75		500 μA	80	10 40 30	 250	1A 500 50	2 2 2	0.5		1.2	500	30	50		50				38
NSD6179	TO-202 (35)		50		500 μA	60	10 40 30	 250	1A 500 50	2 2 2	0.5		1.2	500	30	50		50				38
NSDU01	TO-202 (35)	40	30	5	100	30	50 60 55		1A 100 10	1 1 1	0.5		1.2	1A	30	50		50				37
NSDU01A	TO-202 (35)	50	40	5	100	40	50 60 55		1A 100 10	1 1 1	0.5		1.2	1A	30	50		50				37
NSDU02	TO-202 (35)	60	40	5	100	40	30 50 50	 300	500 150 10	10 10 10	0.4		1.3	150	20	50		20				37
NSDU05	TO-202 (35)	60	60	4	100	60	20 50 80		500 250 50	1 1 1	0.35		250	30	50		200					38
NSDU06	TO-202 (35)	80	80	4	100	80	20 50 80		500 250 50	1 1 1	0.35		250	30	50		200					39
NSDU07	TO-202 (35)	100	100	4	100	100	20 50 80		500 250 50	1 1 1	0.35		250	30	50		200					39
NSDU10	TO-202 (35)	300	300	8	200	200	40 40 25		30 10 1	10 15 15	1.5		0.8	20	3	60		10				48
NSE180	TO-202 (36)		40		100	60	12 30 50	 250	1A 500 100	1.5 1 1	0.9 0.3		1.5	1.5A 500		50		100				37
NSE181	TO-202 (36)		60		100	80	12 30 50	 250	1A 500 10	1.5 1 1	0.9 0.3		1.5	1.5A 500		50		100				38

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
NSE457	TO-202 (36)	160	160	5	50	100	25		30	10	1.0			30								48
NSE458	TO-202 (36)	250	250	5	50	200	25		30	10	1.0			30								48
NSE459	TO-202 (36)	300	300	5	50	250	25		30	10	1.0			30								48
PN3566	TO-92 (72)	40	30	5	50	20	150 80	600	10 2	10 10	1.0			100	25	4	100	30				14
PN3567	TO-92 (72)	80	40	5	50	40	40 40	120	150 30	1 1	0.25			150	20	60	600	50				14
PN3568	TO-92 (72)	80	60	5	50	40	40 40	120	150 30	1 1	0.25			150	20	60	600	50				12
PN3569	TO-92 (72)	80	40	5	50	40	100 100	300	150 30	1 1	0.25			150	20	60	600	50				14
PN7055	TO-92 (72)	220	220	7	100	150	40 40 20		30 10 1	20 20 20	1.0		0.85	20	3.5	50		15				48
SE7055	TO-39	220	220	7	100	150	40 40 20		30 10 1	20 20 20	1.0		0.85	20	3.5	50		15				48
SE7056	TO-39	300	300	7	100	200	40 40 20		30 10 1	20 20 20	1.0		0.85	20	3	50		15				48
SV7056	TO-202 (35)	300	300	7	100	200	40 40 20		30 10 1	20 20 20	1.0		0.85	20	3	50		15				48
TN2102	TO-92+ (91)	120	65	7	10	60	10 25 40 35 20 10	 120	1A 500 150 10 0.1 0.01	10 10 10 10 10 10	0.5		1.1	150	15	60		50				12

TEST CONDITIONS:

(1) I_C = 300 μA, V_{CE} = 10V, f = 15.7kHz. **(2)** I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 100mA. **(3)** I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 50mA. **(4)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(5)** I_C = 150mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 7.5mA. **(6)** I_C = 30 μA, V_{CE} = 10V, f = 1kHz. **(7)** I_C = 150mA, V_{EB} = 2V, $I_B^1 = I_B^2$ = 15mA. **(8)** I_C = 500 μA, V_{CE} = 10V, f = 1kHz. **(9)** I_C = 2A, V_{CC} = 40V, $I_B^1 = I_B^2$ = 200mA.

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
TN3019	TO-92+ (91)	140	80	7	10	90	15		1A	10	0.2		1.1	150	12	100		50		4	1	12
							50		500	10												
							100	300	150	10	0.5			500								
							90		10	10												
							50		0.1	10												
TN3020	TO-92+ (91)	140	80	7	10	90	15		1A	10	0.2		1.1	150	12	80		50				12
							30	100	500	10												
							40	120	150	10	0.5			500								
							40	120	10	10												
							30	100	0.1	10												
TN3053	TO-92+ (91)	60	40	5	250	30	50	250	150	10	1.4		1.7	150	15	100		50				12
							25		150	2.5												

TEST CONDITIONS:
(1) I_C = 300 μA, V_{CE} = 10V, f = 15.7kHz. **(2)** I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 100mA. **(3)** I_C = 1A, V_{CC} = 20V, $I_B^1 = I_B^2$ = 50mA. **(4)** I_C = 100 μA, V_{CE} = 10V, f = 1kHz. **(5)** I_C = 150mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 7.5mA. **(6)** I_C = 30 μA, V_{CE} = 10V, f = 1kHz. **(7)** I_C = 150mA, V_{EB} = 2V, $I_B^1 = I_B^2$ = 15mA. **(8)** I_C = 500 μA, V_{CE} = 10V, f = 1kHz. **(9)** I_C = 2A, V_{CC} = 40V, $I_B^1 = I_B^2$ = 200mA.

POWER

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
2N4921	TO-126		40		100	40	10		1	1	0.6		1.3	1	100	300		0.25	2C
							20	100	0.5	1									
							40		0.05	1									
2N4922	TO-126		60		100	60	10		1	1	0.6		1.3	1	100	300		0.25	2C
							20	100	0.5	1									
							40		0.05	1									
2N4923	TO-126		80		100	80	10		1	1	0.6		1.3	1	100	300		0.25	2C
							20	100	0.5	1									
							40		0.05	1									
2N5190	TO-126		40		100	40	10		4	2	0.6			1.5		2		1	2E
							25	100	1.5	2	1.4			4					
2N5191	TO-126		60		100	60	10		4	2	0.6			1.5		2		1	2E
							25	100	1.5	2	1.4			4					

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
2N5192	TO-126		80		100	80	7 20	 80	4 1.5	2 2	0.6 1.4			1.5 4		2		1	2F
2N5293	Lead Bend + Clip TO-220		10		500†	50 (100Ω)	30	120	0.5	4	1.0			0.5		2		0.2	4E
2N5294	TO-220		70		500†	50 (100Ω)	30	120	0.5	4	1.0			0.5		2		0.2	4E
2N5295	Lead Bend + Clip TO-220		40		100	35	30	120	1	4	1.0			1		2		0.2	4E
2N5296	TO-220		40		100	35	30	120	1	4	1.0			1		2		0.2	4E
2N5297	Lead Bend + Clip TO-220		60		500†	50 (100Ω)	20	80	1.5	4	1.0			1.5		2		0.2	4E
2N5298	TO-220		60		500†	50 (100Ω)	20	80	1.5	4	1.0			1.5		2		0.2	4E
2N5490	TO-220		40		5 mA*	55	5 20	 100	6.5 2	4 4	2			6.5					4E
2N5491	Lead Form + Clip TO-220		40		5 mA*	55	5 20	 100	6.5 2	4 4	2			6.5					4E
2N5492	TO-220		55		1 mA*	70	5 20	 100	6.5 2.5	4 4	2			6.2					4E
2N5493	Lead Form + Clip TO-220		55		1 mA*	70	5 20	 100	6.5 2.5	4 4	2			6.5					4E
2N5494	TO-220		40		1 mA*	55	5 20	 100	6.5 3	4 4	2			6.5					4E
2N5495	Lead Form + Clip TO-220		40		1 mA*	55	5 20	 100	6.5 3	4 4	2			6.5					4E
2N5496	TO-220		70		1 mA*	85	5 20	 100	7 3.5	4 4	2			7					4E
2N5497	Lead Form + Clip TO-220		70		1 mA*	85	5 20	 100	7 3.5	4 4	2			7					4E

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
2N5655	TO-126		250		10	275	5 15 30 25	250	0.5 0.25 0.1 0.05	10 10 10 10	1.0 2.5 10			0.1 0.25 0.5	25	10		0.05	36
2N5656	TO-126		300		10	350	5 15 30 25	250	0.5 0.25 0.1 0.05	10 10 10 10	1.0 2.5 10			0.1 0.25 0.5	25	10		0.05	36
2N5657	TO-126		350		10	375	5 15 30 25	250	0.5 0.25 0.1 0.05	10 10 10 10	1.0 2.5 10			0.1 0.25 0.5	25	10		0.05	36
2N6037	TO-126		40		500	40	100 750 500	1500	4A 2A 0.5	3 3 3	2.0 3.0		4.0	2 4	200	25		0.75	2J
2N6038	TO-126		60		500	60	100 750 500	1500	4A 2A 0.5	3 3 3	2.0 3.0		4.0	2 4	200	25		0.75	2J
2N6039	TO-126		80		500	80	100 750 500	1500	4A 2A 0.5	3 3 3	2.0 3.0		4.0	2 4	200	25		0.75	2J
2N6098	Lead Bend + Clip TO-220		60		2 mA*	65	5 20	80	10 4	4 4	2.5			10					4A
2N6099	TO-220		60		2 mA*	65	5 20	80	10 4	4 4	2.5			10					4A
2N6100	Lead Bend + Clip TO-220		70		2 mA*	75	5 20	80	10 5	4 4	2.5			10					4A
2N6101	TO-220		70		2 mA*	75	5 20	80	10 5	4 4	2.5			10					4A
2N6102	Lead Bend + Clip TO-220		40		2 mA*	40	5 15	60	16 8	4 4	2.5			16					4A
2N6103	TO-220		40		2 mA*	40	5 15	60	16 8	4 4	2.5			16					4A
2N6121	TO-220		45		100	45	10 25	100	4 1.5	2 2	0.6 1.4			1.5 4		2.5		1	4E

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
2N6122	TO-220		60		100	60	10 25	 100	4 1.5	2 2	0.6 1.4			1.5 4		2.5		1	4E
2N6123	TO-220		80		100	80	7 20	 80	4 1.5	2 2	0.6 1.4			1.5 4		2.5		1	4E
2N6129	TO-220		40		100	40	7 20	 100	7 2.5	4 4	1.4			7					4E
2N6130	TO-220		60		100	60	7 20	 100	7 2.5	4 4	1.4			7					4E
2N6131	TO-220		80		100	80	5 20	 100	7 2.5	4 4	2.0			7					4E
2N6288	TO-220		30		100*	37.5	5 30	 150	6.5 3	4 4	1.0 2.0			3 6.5	250	4		0.5	4E
2N6289	Lead Bend + Clip TO-220		30		100*	37.5	5 30	 150	6.5 3	4 4	1.0 2.0			3 6.5	250	4		0.5	4E
2N6290	TO-220		50		100*	56	5 30	 150	6.5 3	4 4	1.0 2.0			2.5 6.5	250	4		0.5	4E
2N6291	Lead Bend + Clip TO-220		50		100*	50	5 3	 150	6.5 3	4 4	1.0 2.0			2.5 6.5	 250	4		0.5	4E
2N6292	TO-220		70		100*	75	5 30	 150	6.5 2	4 4	1.0 2.0			2 6.5	250	4		0.5	4E
2N6293	Lead Bend + Clip TO-220		70		100*	75	5 30	 150	6.5 2	4 4	1.0 2.0		 6.5	2 6.5	250	4		0.5	4E
2N6386	TO-220		40		300*	40	100 1000	 20,000	8 3	3 3	2.0 3.0			3 8	200	20		1	4J
2N6486	TO-220		40		500*	35 (100Ω)	5 20	 150	15 5	4 4	1.3 3.5			5 15					4A
2N6487	TO-220		60		500*	55 (100Ω)	5 20	 150	15 5	4 4	1.3 3.5			5 15					4A
2N6488	TO-220		80		500*	75 (100Ω)	5 20	 150	15 5	4 4	1.3 3.5			5 15					4A
D44C1	TO-220		30		10*	40	10 25		1 0.2	1 1	0.5		1.3	1	100	3		0.02	4F
D44C2	TO-220		30		10*	40	20 40	 120	1 0.2	1 1	0.5		1.3	1	100	3		0.02	4F

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
D44C3	TO-220		30		10*	40	20 40		2 0.2	1 1	0.5		1.3	1	100	3		0.02	4E
D44C4	TO-220		45		10*	55	10 25		1 0.2	1 1	0.5		1.3	1	100	3		0.02	4F
D44C5	TO-220		45		10*	55	20 40	 120	1 0.2	1 1	0.5		1.3	1	100	3		0.02	4F
D44C6	TO-220		45		10*	55	20 40		2 0.2	1 1	0.5		1.3	1	100	3		0.02	4E
D44C7	TO-220		60		10*	75	10 25		1 0.2	1 1	0.5		1.3	1	100	3		0.02	4F
D44C8	TO-220		60		10*	70	20 40	 120	1 0.2	1 1	0.5		1.3	1	100	3		0.02	4F
D44C9	TO-220		60		10*	70	20 40		2 0.2	1 1	0.5		1.3	1	100	3		0.02	4E
D44C10	TO-220		80		10*	90	10 25		1 0.2	1 1	0.5		1.3	1	100	3		0.02	4F
D44C11	TO-220		80		10*	90	20 40	 120	1 0.2	1 1	0.5		1.3	1	100	3		0.02	4E
D44C12	TO-220		80		10*	90	20 40		2 0.2	1 1	0.5		1.3	1	100	3		0.02	4E
D44H1	TO-220		30		10	30	20 35		4 2	1 1	1.0		1.5	8					4A
D44H2	TO-220		30		10	30	40 60		4 2	1 1	1.0		1.5	8					4A
D44H4	TO-220		45		10	45	20 35		4 2	1 1	1.0		1.5	8					4A
D44H5	TO-220		45		10	45	40 60		4 2	1 1	1.0		1.5	8					4A
D44H7	TO-220		60		10	60	20 35		4 2	1 1	1.0		1.5	8					4A
D44H8	TO-220		60		10	60	40 60		4 2	1 1	1.0		1.5	8					4A
D44H10	TO-220		80		10	80	20 35		4 2	1 1	1.0		1.5	8					4A
D44H11	TO-220		80		10	80	40 60		4 2	1 1	1.0		1.5	8					4A

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
MJE180	TO-126		40		0.1	60	12		1.5	1	0.3			0.500	30	50		0.05	37
							30		0.5	1	0.9		1.5	1.5					
							50	250	0.1	1	1.7		2.0	3		50		0.1	
MJE181	TO-126		60		0.1	80	12		1.5	1	0.3			0.500	30	50		0.1	38
							30		0.5	1	0.9		1.5	1.5					
							50	250	0.1	1	1.7		2.0	3					
MJE182	TO-126		80		0.1	100	12		1.5	1	0.3			0.500	30	50		0.05	39
							30		0.5	1	0.9		1.5	1.5					
							50	250	0.1	1	1.7		2.0	3		50		0.1	
MJE340	TO-126		300		100	300	30	240	0.05	10									36
MJE341	TO-126		150		300	175	20		0.15	10	1.0			0.05	15	15		0.05	36
							25	200	0.05	10									
							20		0.01	10	2.3			0.15					
MJE344	TO-126		200		100	200	30	300	0.05	10	1.0			0.05	15	15		0.05	36
MJE520	TO-126		30		100	30	25		1	1									2C
MJE521	TO-126		40		100	40	40		1	1									2C
MJE720	TO-126		40		100*	40	8		1	1	0.15			0.15					37
							20		0.5	1	0.4			0.5					
							40		0.15	1	1.0		1.3	1.5					
MJE721	TO-126		60		100*	60	8		1	1	0.15			0.15					38
							20		0.5	1	0.4			0.5					
							40		0.15	1	1.0		1.3	1.5					
MJE722	TO-126		80		100*	80	8		1	1	0.15			0.15					39
							20		0.5	1	0.4			0.5					
							40		0.15	1	1.0		1.3	1.5					
MJE800	TO-126		60		200	60	750		1.5	3	2.5			1.5					2J
MJE801	TO-126		60		200	60	750		2	3	2.8			2					2J
MJE802	TO-126		80		200	80	750		1.5	3	2.5			1.5					2J
MJE803	TO-126		80		200	80	750		2	3	2.8			2					2J
MJE3439	TO-126		350		20	360	40	160	0.02	10	0.5		1.3	0.05	10	15		0.01	36
							30		0.002	10									
MJE3440	TO-126		250		20	250	40	160	0.02	10	0.5		1.3	0.05	10	15		0.01	36
							30		0.002	10									
MRF472	TO-126		30	3	10	50	10		0.4	2					70				35
NCBJ14	TO-126	60	40	4	0.1	30	75		0.05	1	0.4			0.5	10	125		0.05	14
NCBJ35	TO-126		65	3	10	40	30	150	0.1	1	0.5			1	35	120		0.1	35
NCBW35	TO-220		65	3	10	40	30	150	0.1	1	0.5			1	35	120		0.1	35

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
NSP41	TO-220		40		400	40	15	75	3	4	1.5			5		3		0.5	4E
							30		0.3	4	1.5			5		3		0.5	4E
NSP41A	TO-220		60		400	60	30		0.3	4									
NSP41B	TO-220		80		400	80	15	75	3	4	1.5			5		3		0.5	4E
							30		0.3	4									
NSP41C	TO-220		100		400	100	15	75	3	4	1.5			5		3		0.5	4E
							15		0.3	4									
NSP205	TO-220		50		100	50	25	100	2	2									4A
NSP520	TO-220		30		100	30	25		1	1									4F
NSP521	TO-220		40		100	40	40		1	1									4F
NSP575	TO-220	45	45		100	45	25		1	1	0.6			1		3		0.5	4F
NSP577	TO-220	60	60		100	60	25		1	1	0.6			1		3		0.5	4F
NSP579	TO-220	80	80		100	80	15		1	1	0.8			1		3		0.5	4F
NSP581	TO-220	100	100		100	100	15		1	1	0.8			1		3		0.5	4F
NSP585	TO-220	45	45		100	45	25		2	2	0.8			2		3		0.25	4E
							40		0.5	2									
NSP587	TO-220	60	60		100	60	25		2	2	0.8			2		3		0.25	4E
							40		0.5	2									
NSP589	TO-220	80	80		100	80	15		2	2	0.8			2		3		0.25	4E
							30		0.5	2									
NSP595	TO-220	45	45		100	45	25		3	2	1.0			3		3		0.25	4E
							40		1	2									
NSP597	TO-220	60	60		100	60	25		3	2	1.0			3		3		0.25	4E
							40		1	2									
NSP599	TO-220	80	80		100*	80	15		3	2	1.0			3		3		0.25	4E
							30		1	2									
NSP601	TO-220		100		100	100	15		3	2	1.0			3		3		0.25	4A
							30		1	2									
NSP695	TO-220		45		200	45	750		3	3	2.5			3					4J
NSP695A	TO-220		45		200	45	750		4	3	2.8			4					4J
NSP697	TO-220		60		200	60	750		3	3	2.5			3					4J
NSP697A	TO-220		60		200	60	750		4	3	2.8			4					4J
NSP699	TO-220		80		200	80	750		3	3	2.5			3					4J
NSP699A	TO-220		80		200	80	750		4	3	2.8			4					4J
NSP701	TO-220		100		200	100	750		3	3	2.5			3					4J

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
NSP2020	TO-220		40		400	40	15 25	 125	3 1	4 4	1.0 1.5			3.5 5		3		0.5	4A
NSP2021	TO-220		60		400	60	15 20	 125	3 1	4 4	1.0 1.5			3.5 5		3		0.5	4A
NSP2100	TO-220		60		200	60	750		3	3	2.5			3					4J
NSP2101	TO-220		60		200	60	750		4	3	2.5			4					4J
NSP2102	TO-220		80		200	80	750		3	3	2.5			3					4J
NSP2103	TO-220		80		200	80	750		4	3	2.5			4					4J
NSP2480	TO-220		40		100	40	20 40	100	1.5 1	4 4	1.4 0.7			4 1.5					4A
NSP2481	TO-220		60		100	60	20 40	100	1.5 1	4 4	1.4 0.7			4 1.5					4A
NSP2482	TO-220		40		100	40	20 40	100	2.5 1	4 4	1.4 0.7			4 1.5					4A
NSP2483	TO-220		60		100	60	20 40	100	2.5 1	4 4	1.4 0.7			4 1.5					4A
NSP2520	TO-220		40		200*	40	10 40	 200	1 0.2	4 4	0.7			1					4F
NSP3054	Lead Bend + Clip TO-220		55		1 mA*	90	5 25	 100	3 0.5	4 4	1.0 6.0			0.5 3					4E
NSP3055	TO-220		60		1 mA	70	5 20	 70	10 4	4 4	1.0 8.0			4 10		2		0.5	4A
NSP4921	TO-220		40		100	40	10 20 40	 100	1 0.5 0.05	1 1 1	0.6		1.3	1		3		0.25	4F
NSP4922	TO-220		60		100	60	10 20 40	 100	1 0.5 0.05	1 1 1	0.6		1.3	1		3		0.25	4F
NSP4923	TO-220		80		100	80	10 20 40	 100	1 0.5 0.05	1 1 1	0.6		1.3	1		3		0.25	4F
NSP5190	TO-220		40		100	40	10 25	 100	4 1.5	1 1	0.6 1.4			1.5 4					4E
NSP5191	TO-220		60		100	60	10 25	 100	4 1.5	1 1	0.6 1.4			1.5 4					4E

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
NSP5192	TO-220		80		100	80	7		4	2	0.6			1.5					4E
							20	80	1.5	2	1.4			4					
NSP5977	TO-220		40		100*	60	7		5	2	1.7		2.5	5	200	2		0.5	4A
							20	120	2.5	2									
							40		0.5	2	0.6			2.5					
NSP5978	TO-220		60		100*	80	7		5	2	1.7		2.5	5	200	2		0.5	4A
							20	150	2.5	2									
							40		0.5	2	0.6			2.5					
NSP5979	TO-220		80		100*	100	7		5	2	1.7		2.5	5	200	2		0.5	4A
							20	150	2.5	2									
							40		0.5	2	0.6			2.5					
NSP5983	TO-220		40		100*	60	7		8	2	1.7		2.5	8	250	2		0.5	4A
							20	120	4	2									
							40		1	2	0.6			4					
NSP5984	TO-220		60		100*	80	7		8	2	1.7		2.5	8	250	2		0.5	4A
							20	120	4	2									
							40		1	2	0.6			4					
NSP5985	TO-220		80		100*	80	7		8	2	1.7		2.5	8	250	2		0.5	4A
							20	120	4	2									
							40		1	2	0.6			4					
TIP29	TO-220		40		200*	40	15	75	1	4	0.7			1		3		0.2	4F
							40		0.2	4									
TIP29A	TO-220		60		200*	60	15	75	1	4	0.7			1		3		0.2	4F
							40		0.2	4									
TIP29B	TO-220		80		200*	80	15	75	1	4	0.7			1		3		0.2	4F
							40		0.2	4									
TIP29C	TO-220		100		200*	100	15	75	1	4	0.7			1		3		0.2	4F
							40		0.2	4									
TIP31	TO-220		40		200*	40	10	50	3	4	1.2			3		3		0.5	4F
							25		1	4									
TIP31A	TO-220		60		200*	60	10	50	3	4	1.2			3		3		0.5	4F
							25		1	4									
TIP31B	TO-220		80		200*	80	10	50	3	4	1.2			3		3		0.5	4F
							25		1	4									
TIP31C	TO-220		100		200*	100	10	50	3	4	1.2			3		3		0.5	4F
							25		1	4									
TIP41	TO-220		40		400*	40	15	75	3	4	1.5			6		3		0.5	4A
							30		0.3	4									

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CEX}* I_{CEB}† I_{CBO} (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
TIP41A	TO-220		60		400*	60	15 30	75	3 0.3	4 4	1.5			6		3		0.5	4A
TIP41B	TO-220		80		400*	80	15 30	75	3 0.3	4 4	1.5			6		3		0.5	4A
TIP41C	TO-220		100		400*	100	15 30	75	3 0.3	4 4	1.5			6		3		0.5	4A
TIP61	TO-220		40		200*	40	15 40	100	0.5 0.05	4 4	0.7			0.5		3		0.05	4F
TIP61A	TO-220		60		200*	60	15 40	100	0.5 0.05	4 4	0.7			0.5		3		0.05	4F
TIP61B	TO-220		80		200*	80	15 40	100	0.5 0.05	4 4	0.7			0.5		3		0.05	4F
TIP61C	TO-220		100		200*	100	15 40	100	0.5 0.05	4 4	0.7			0.5		3		0.05	4F
TIP110	TO-220		60		1 mA	60	500 1000		2 1	4 4	2.5			2					4J
TIP111	TO-220		80		1 mA	80	500 1000		2 1	4 4	2.5			2					4J
TIP112	TO-220		100		1 mA	100	500 1000		2 1	4 4	2.5			2					4J
TIP120	TO-220		60		200	60	1000 1000		3 0.5	3 3	2.0 4.0			3 5					4K
TIP121	TO-220		80		200	80	1000 1000		3 0.5	3 3	2.0 4.0			3 5					4K
TIP122	TO-220		100		200	100	1000 1000		3 0.5	3 3	2.0 4.0			3 5					4K
TIP130	TO-220		60		200	60	1000 500	15,000	4 1	4 4	2.0 3.0			4 6					4K
TIP131	TO-220		80		200	80	1000 500	15,000	4 1	4 4	2.0 3.0			4 6					4K
TIP132	TO-220		100		200	100	1000 500	15,000	4 1	4 4	2.0 3.0			4 6					4K

DARLINGTON

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	Process
2N5305	TO-92 (74)				100	25	2000	20,000	2	5	1.4			200	10	60		2	05
2N5306	TO-92 (74)				100	25	7000	70,000	2	5	1.4			200	10	60		2	05
2N5307	TO-92 (74)				100	40	2000	20,000	2	5	1.4			200	10	60		2	05
2N5308	TO-92 (74)				100	40	7000	70,000	2	5	1.4			200	10	60		2	05
92PU45	TO-92+ (91)	50		12	100	30	4000 15,000 25,000		1A 500 200	5 5 5	1.5 1.0		2.0	1A 200		100		200	05
92PU45A	TO-92+ (91)	60		12	100	40	4000 15,000 25,000		1A 500 200	5 5 5	1.5 1.0		2.0	1A 200		100		200	05
D40C1	TO-202 (35)		30		500*	30	10,000	60,000	200	5	1.5		2.0	500	10				05
D40C2	TO-202 (35)		30		500*	30	40,000		200	5	1.5		2.0	500	10				05
D40C3	TO-202 (35)		30		500*	30	90,000		200	5	1.5		2.0	500	10				05
D40C4	TO-202 (35)		40		500*	40	10,000	60,000	200	5	1.5		2.0	500	10				05
D40C5	TO-202 (35)		40		500*	40	40,000		200	5	1.5		2.0	500	10				05
D40C7	TO-202 (35)		50		500*	50	10,000	60,000	200	5	1.5		2.0	500	10				05
D40C8	TO-202 (35)		50		500*	5	40,000		200	5	1.5		2.0	500	10				05
MPSA12	TO-92 (72)	20			100	15	20,000		10	5	1.0			10					05
MPSA13	TO-92 (72)	30			100	30	10,000 5,000		100 10	5 5	1.5			100		125		10	05
MPSA14	TO-92 (72)	30			100	30	20,000 10,000		100 10	5 5	1.5			100		125		10	05

DUAL DIFFERENTIAL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} Min	H_{FE} Max	@ I_C (mA)	H_{FE1}/H_{FE2} (%) Max	$V_{BE}{}^1 - V_{BE}{}^2$ (mV) Max	$\Delta V_{EE}{}^1 - V_{EE}{}^2$/$\Delta T$ ($\mu V/\Sigma$) Max	C_{ob} (pF) Max	f_t (MHz) Min	f_t (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N2453	TO-78	60	30	7	5	60	150 80	600	1 0.01	10	5 3	10	8	60		7	1	07
2N2453A	TO-78	80	50	7	5	60	150 80	600	1 0.01	10	5 3	5	4	60		4	1	07
2N2639	TO-78	45	45	5	10	45	65 55 50	300	1 0.1 0.01	10	5	10	8	80		4	2	07
2N2640	TO-78	45	45	5	10	45	65 55 50	300	1 0.1 0.01	20	10	20	8	80		4	2	07
2N2641	TO-78	45	45	5	10	45	65 55 50	300	1 0.1 0.01				8	80		4	2	07
2N2642	TO-78	45	45	5	10	45	130 110 100	300	1 0.1 0.01	10	5	10	8	80		4	2	07
2N2643	TO-78	45	45	5	10	45	130 110 100	300	1 0.1 0.01	20	10	20	8	80		4	2	07
2N2644	TO-78	45	45	5	10	45	130 110 100	300	1 0.1 0.01				8	80		4	2	07
2N2722	TO-78	45	45	5	1	30	120 100 50	250	0.1 0.01 0.001	10	5	20	6	100		4	2	07
2N2903	TO-78	60	30	7	10	50	125 60	625	1 0.1	20	10	20	8	60		7	1	07
2N2903A	TO-78	60	30	7	10	50	125 60	625	1 0.01	10	5	10	8	60		7	1	07
2N2913	TO-78	45	45	6	10	45	150 100 60	240	1 0.1 0.01				6	60		4	1	07
2N2914	TO-78	45	45	6	10	45	300 225 150	600	1 0.1 0.01				6	60		3	1	07

TEST CONDITIONS:
(1) $I_C = 10\ \mu A$, $V_{CE} = 5V$, $f = 1kHz$. **(2)** $I_C = 10\ \mu A$, $V_{CE} = 5V$, $f = 15.7kHz$. **(3)** $I_C = 100\ \mu A$, $V_{CE} = 5V$, $f = 1kHz$.

DUAL DIFFERENTIAL AMPS (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	H_{FE} Min	H_{FE} Max @	I_C (mA)	H_{FE1}/H_{FE2} (%) Max	$V_{BE}^1-V_{BE}^2$ (mV) Max	$\Delta V_{EE}^1-V_{EE}^2/\Delta T$ ($\mu V/\Sigma$) Max	C_{ob} (pF) Max	f_t (MHz) Min	f_t (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N2915	TO-78	45	45	6	10	45	150 100 60	 240	1 0.1 0.01	10	5 3 5	10	6	60		4	1	07
2N2915A	TO-78	45	45	6	10	45	150 100 60	 240	1 0.1 0.01	10	2 1.5 2	5	6	60	160	4	1	07
2N2916	TO-78	45	45	6	10	45	300 225 150	 600	1 0.1 0.01	10	3	10	6	60		3	1	07
2N2916A	TO-78	45	45	6	10	45	300 225 150	 600	1 0.1 0.01	10	2 1.5 2	5	6	60	160	3	1	07
2N2917	TO-78	45	45	6	10	45	150 100 60	 240	1 0.1 0.01	20	10 5 10	20	6	60		4	1	07
2N2918	TO-78	45	45	6	10	45	300 225 150	 600	1 0.1 0.01	20	10 5 10	20	6	60		3	1	07
2N2919	TO-78	60	60	6	2	45	150 100 60	 240	1 0.1 0.01	10	5 3 5	10	6	60		4	1	07
2N2919A	TO-78	60	60	6	2	45	150 100 60	 240	1 0.1 0.01	10	2 1.5 2	5	6	60	160	4	1	07
2N2920	TO-78	60	60	6	2	45	300 225 150	 600	1 0.1 0.01	10	5 3 5	10	6	60		3	1	07
2N2920 J, JTX, JTXV	TO-78	70	60	6	2	45	300 235 175	 600	1 0.1 0.01	10	5 3 5	10	5	60	400	3	1	07
2N2920A	TO-78	60	60	6	2	45	300 225 150	 600	1 0.1 0.01	10	2 1.5 2	5	6	60	160	3	1	07
2N2972	TO-71	45	45	6	10	45	150 100 60	 240	1 0.1 0.01				6	60		4	1	07
2N2973	TO-71	45	45	6	10	45	300 225 150	 600	1 0.1 0.01				6	60		3	1	07

DUAL DIFFERENTIAL AMPS (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} Min	H_{FE} Max	@ I_C (mA)	H_{FE1}/H_{FE2} (%) Max	$V_{BE}{}^1 - V_{BE}{}^2$ (mV) Max	$\Delta V_{EE}{}^1 - V_{EE}{}^2 / \Delta T$ (μV/Σ) Max	C_{ob} (pF) Max	f_t (MHz) Min	f_t (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N2974	TO-71	45	45	6	10	45	150 100 60	 240	1 0.1 0.01	10	5 3 5	10	6	60		4	1	07
2N2975	TO-71	45	45	6	10	45	300 225 120	 600	1 0.1 0.01	10	5 3 5	10	6	60		3	1	07
2N2976	TO-71	45	45	6	10	45	150 100 60	 240	1 0.1 0.01	20	10 5 10	20	6	60		4	1	07
2N2977	TO-71	45	45	6	10	45	300 225 120	 600	1 0.1 0.01	20	10 5 10	20	6	60		3	1	07
2N2978	TO-71	60	60	6	2	45	150 100 60	 240	1 0.1 0.01	10	5 3 5	10	6	60		4	1	07
2N2979	TO-71	60	60	6	2	45	300 225 120	 600	1 0.1 0.01	10	5 3 5	10	6	60		3	1	07
2N3587	TO-78	60	45	6	10	40	80 50	500	1 0.1	10	20	20	8	80	200	10	3	07
2N3580	TO-78	60	50	6	10	45	300 225 150 80	 600	1 0.1 0.01 0.001	10	3	5	6	60	240	3	2	07
2N3907	TO-78	60	45	6	10	45	120 70 60	 500 300	1 0.1 0.01	10	2.5 1 2	5	6	60	240	4	1	07
2N3908	TO-78	60	60	6	2	45	200 125 100 40	 300 500	1 0.1 0.01 0.001	10	2.5 1	5	6	60	240	3	1	07

TEST CONDITIONS:

(1) $I_C = 10\,\mu A$, $V_{CE} = 5V$, f = 1kHz. **(2)** $I_C = 10\,\mu A$, $V_{CE} = 5V$, f = 15.7kHz. **(3)** $I_C = 100\,\mu A$, $V_{CE} = 5V$, f = 1kHz.

Section 2

PNP Transistors

2

SATURATED SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N869	TO-52	25		5	10	15	20	120	10	5	1.0		1.0	10	9	100		10				64
2N869A	TO-52	25	18	5	10	15	25		100	1	0.15	0.78	0.98	10	6	400		10	80		1	64
							40	120	30	0.5												
							30		10	0.3												
							40	120	10	5	0.2	0.85	1.2	30								
2N995	TO-52	20	15	4	5	15	35	140	20	1	0.2		0.95	20	10	100		10				64
2N995A	TO-52	20	15	4	5	15	25		100	1	0.2		0.95	20	6	100		10	90		2	64
							25		50	1												
							25		20	1	0.5		1.7	100								
							35	140	1	1												
2N2894	TO-52	12	12	4	10*	6	25		100	1	0.15	0.78	0.98	10	6	400		30	90		2	64
							40	150	30	0.5	0.2	0.85	1.2	30								
							30		10	0.3	0.5		1.7	100								
2N2894A	TO-52	12	12	4.5	50*	10	30		100	1	0.13	0.78	0.92	10	4.5	800		30	25		3	64
							40	120	30	0.5	0.19	0.85	1.15	30								
							30		10	0.3	0.45	1	1.5	100								
							20		1	0.5												
2N3012	TO-52	12	12	4	80*	6	20		100	1	0.15	0.78	0.98	10	6	400		30	75		2	64
							30	120	30	0.5	0.2	0.85	1.2	30								
							25		10	0.3	0.5		1.7	100								
2N3209	TO-52	20	20	4	80*	10	15		100	1	0.15	0.78	0.98	10	5	400		30	90		2	64
							30	120	30	0.5	0.2	0.85	1.2	30								
							20		10	3	0.6		1.7	100								
2N3244	TO-39	40	40	5	50	30	25		750	5	0.3		1.1	150	25	175		50	185		4	70
							50	150	500	1												
							60		150	1	0.5	0.75	1.5	500								
2N3245	TO-39	50	50	5	50	50	20		1A	5	0.35		1.1	150	25	150		50	165		4	70
							30	90	500	1	0.6	0.75	1.5	500								
							35		150	1	1.2		2	1A								
2N3248	TO-52	15	12	5			25		100	1	0.125	0.6	0.9	10	8	250		20	100		5	64
							35		50	1												
							50		10	1	0.25	0.7	1.1	50								
							50		1	1												
							50	150	0.1	1	0.4		1.3	100								
2N3249	TO-52	15	12	5			35		100	1	0.125	0.6	0.9	10	8	300		20	100		5	64
							75		50	1												
							100		10	1	0.25	0.7	1.1	50								
							100		1	1												
							100	300	0.1	1	0.45		1.3	100								

SATURATED SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3304	TO-52	6	6	4	10*	3	20 30 15	 120 	50 10 1	1 0.3 0.5	0.15 0.16 0.5	0.7 0.8 	0.8 1 1.5	1 10 50	3.5	500		10	60		7	65
2N3451	TO-52	6	6	4	10*	3	20 30	 120	50 10	1 0.3	0.16 0.5	0.8	1.0 1.5	10 50	5.5	500		10	60		7	65
2N3467	TO-39	40	40	5	100	30	40 40 40	 120 	1 500 150	5 1 1	0.3 0.5	 0.8	1.0 1.2	150 500	25	175		50	90		4	70
2N3468	TO-39	50	50	5	100	30	20 25 25	 75 	1 500 150	5 1 1	0.35 0.6	 0.8	1.0 1.2	150 500	25	150		50	90		4	70
2N3545	TO-52	20	20	5	10	10	30 35 40 30	 120 	100 50 10 1	1 1 1 1	0.2 0.3 0.5	0.6	0.85 1.1 1.3	10 50 100	8	250		10	90		8	64
2N3546	TO-52	15	12	4.5	10	10	15 25 30 20	 120 	100 50 10 1	1 1 1 1	0.15 0.25 0.5	0.7 0.8	0.9 1.3 1.6	10 50 100	6	700		10	30		9	64
2N3576	TO-52	20	15	5	10	15	10 40	 120	100 10	1 0.5	0.15 0.5	0.75	0.95 1.1	10 100	4.5	400		10	50		5	64
2N3639	TO-92 (72)	Same as PN3639, see page 2-5 for explanation																				65
2N3640	TO-92 (72)	Same as PN3640, see page 2-5 for explanation																				65
2N4208	TO-52	12	12	4.5	10*	6	30 30 15	 120 	50 10 1	1 0.3 0.5	0.13 0.15 0.5	 0.8 	0.8 0.95 1.5	1 10 50	3	700		10	20		5	65
2N4209	TO-52	15	15	4.5	10*	8	40 50 35	 120 	50 10 1	1 0.3 0.5	0.15 0.18 0.6	 0.8 	0.8 0.95 1.5	1 10 50	3	850		10	20		5	65
2N4258	TO-92 (72)	Same as PN4258, see page 2-5 for explanation																				65
2N4258A	TO-92 (72)	Same as PN4258A, see page 2-5 for explanation																				65

TEST CONDITIONS:
(1) $I_C = 30mA$, $V_{CC} = 3V$, $I_B^1 = 3mA$, $I_B^2 = 1.5mA$. **(2)** $I_C = 30mA$, $V_{CC} = 3V$, $I_B^1 = I_B^2 = 1.5mA$. **(3)** $I_C = 30mA$, $V_{CC} = 3V$, $I_B^1 = I_B^2 = 3mA$. **(4)** $I_C = 500mA$, $V_{CC} = 30V$, $I_B^1 = I_B^2 = 50mA$. **(5)** $I_C = 10mA$, $V_{CC} = 3V$, $I_B^1 = I_B^2 = 1mA$. **(6)** $I_C = 10mA$, $V_{CC} = 1.5V$, $I_B^1 = I_B^2 = 1mA$. **(7)** $I_C = 10mA$, $V_{CC} = 1.5V$, $I_B^1 = I_B^2 = 500\mu A$. **(8)** $I_C = 10mA$, $V_{CC} = 2V$, $I_B^1 = I_B^2 = 1mA$. **(9)** $I_C = 50mA$, $V_{CC} = 3V$, $I_B^1 = I_B^2 = 5mA$. **(10)** $I_C = 1A$, $V_{CC} = 30V$, $I_B^1 = I_B^2 = 100mA$.

SATURATED SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5022	TO-39	50	50	5	100*	30	25		1A	5	0.2		1.0	100	25	170		50	90		4	70
							25	100	500	1	0.4	0.8	1.4	500								
							15		100	1	0.8		1.75	1A								
2N5023	TO-39	30	30	5	100*	20	40		1A	5	0.17		1.0	100	25	200		50	90		4	70
							40	100	500	1	0.35	0.8	1.4	500								
							30		100	1	0.7		1.75	1A								
2N5056	TO-52	15	15	4.5	50*	10	20		100	1	0.13	0.72	0.92	10	4.5	600		30	35		3	64
							30	100	30	0.5	0.19	0.8	1.15	30								
							20		10	0.3												
							12		1	0.5	0.45	0.95	1.5	100								
2N5057	TO-52	15	15	4.5	50*	10	30		100	1	0.13	0.72	0.92	10	4.5	800		30	35		3	64
							40	100	30	0.5	0.19	0.8	1.15	30								
							30		10	0.3	0.45	0.95	1.5	100								
							20		1	0.5												
2N5140	TO-92 (72)	Same as PN5140, see page 2-5 for explanation																				65
2N5771	TO-92 (72)	15	15	4.5	10	8	40		50	1.0	0.15		0.8	1	3	850		10	20		6	65
							50	120	10	0.3	0.18	0.8	0.95	10								
							35		1	0.5	0.6		1.5	50								
2N5910	TO-92 (72)	Same as PN5910, see page 2-5 for explanation																				65
DH3467CD	Ceramic DIP (40)	40	40	5	100	30	40		1A	5	1.0		1.6	1A	25	175		50	90		4	70
							40	120	500	1	0.5	0.8	1.2	500								
							40		150	1	0.3		1.0	150								
DH3467CN	Molded DIP (39)	40	40	5	100	30	40		1A	5	1.0		1.6	1A	25	175		50	90		4	70
							40	120	500	1	0.5	0.8	1.2	500								
							40		150	1	0.3		1.0	150								
DH3468CD	Ceramic DIP (40)	50	50	5	100	30	20		1A	5	1.2		1.6	1A	25	150		50	90		4	70
							25	75	500	1	0.6	0.8	1.2	500								
							25		150	1	0.35		1.0	150								
DH3468CN	Molded DIP (39)	50	50	5	100	30	20		1A	5	1.2		1.6	1A	25	150		50	90		4	70
							25	75	500	1	0.6	0.8	1.2	500								
							25		150	1	0.35		1.0	150								
MPS3639	TO-92 (72)	Same as PN3639, see page 2-5 for explanation																				65
MPS3640	TO-92 (72)	Same as PN3640, see page 2-5 for explanation																				65

SATURATED SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
NS3762	TO-39	40	40	5			30		1.5A	5	0.9		1.4	1A	18	180		50	115		10	70
							30	120	1A	1.5	0.5		1.2	500								
							35		500	1	0.22		1.0	150								
							40		150	1	0.15		0.8	10								
							35		10	1												
NS3763	TO-39	60	60	5			20		1.5A	5	0.9		1.4	1A	18	180		50	115		10	70
							20	80	1A	1.5	0.5		1.2	500								
							35		500	1	0.22		1.0	150								
							40		150	1	0.15		0.8	10								
							35		10	1												
PN3639	TO-92 (72)	6	6	4	10*	3	20		50	1.0	0.16	0.8	1.0	10	3.5	300		10	60		7	65
							30	120	10	0.3	0.5		1.5	50								
PN3640	TO-92 (72)	12	12	4	10*	6	20		50	1.0	0.2	0.8	1.0	10	3.5	300		10	75		7	65
							30	120	10	0.3	0.6		1.5	50								
PN4258	TO-92 (72)	12	12	4.5	10*	6	30		50	1	0.15	0.7	0.95	10	3	700		10	20		6	65
							30	120	10	3												
							15		1	0.5	0.5		1.5	50								
PN4258A	TO-92 (72)	12	12	4.5	10*	6	30		50	1	0.15	0.7	0.95	10	3	700		10	18		6	65
							30	120	10	3												
							15		1	0.5	0.5		1.5	50								
PN5140	TO-92 (72)	5	5	4	50*	3	20	40	10	1	0.2		1.2	10	5	400		10	20		6	65
											0.75			50								
PN5910	TO-92 (72)	20	20	4.5	10*	10	30		50	1	0.15	0.75	0.95	10	3	700		10	20		6	65
							30	120	10	0.3												
							15		1	0.5	0.5		1.5	50								

TEST CONDITIONS:

(1) I_C = 30mA, V_{CC} = 3V, I_B^1 = 3mA, I_B^2 = 1.5mA. **(2)** I_C =30mA, V_{CC} = 3V, I_B^1 = I_B^2 = 1.5mA. **(3)** I_C = 30mA, V_{CC} = 3V, I_B^1 = I_B^2 = 3mA. **(4)** I_C = 500mA, V_{CC} = 30V, I_B^1 = I_B^2 = 50mA. **(5)** I_C = 10mA, V_{CC} = 3V, I_B^1 = I_B^2 = 1mA. **(6)** I_C = 10mA, V_{CC} = 1.5V, I_B^1 = I_B^2 = 1mA. **(7)** I_C = 10mA, V_{CC} = 1.5V, I_B^1 = I_B^2 = 500 μA. **(8)** I_C = 10mA, V_{CC} = 2V, I_B^1 = I_B^2 = 1mA. **(9)** I_C = 50mA, V_{CC} = 3V, I_B^1 = I_B^2 = 5mA. **(10)** I_C = 1A, V_{CC} = 30V, I_B^1 = I_B^2 = 100mA.

LOW LEVEL AMPS

Type No.	Case Style	VCBO (V) Min	VCEO (V) Min	VEBO (V) Min	ICBO (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (kHz)	Process No.
2N2604	TO-46	60	45	6	10	45		350	10	5	0.5	0.7	0.9	10	6	30		0.5	4	1	62
							60		0.5	5											
							40	120	0.01	5											
2N2604 J, JTX, JTXV	TO-46	80	60	6	10	50	60	350	10	5	0.5	0.7	0.9	10	6	30	140	0.5	3	1	62
							60		0.5	5											
							40	120	0.01	5											
2N2605	TO-46	60	45	6	10	45		600	10	5	0.5	0.7	0.9	10	6	30		0.5	3	1	62
							150		0.5	5											
							100	300	0.01	5											
2N2605 J, JTX, JTXV	TO-46	70	60	6	10	50		600	10	5	0.5	0.7	0.9	10	6	30	140	0.5	3	1	62
							150		0.5	5											
							100	300	0.01	5											
2N3547	TO-18	60	60	6	25	45	75		10	5	1.0		1.0	10	8	45		1	5	1	62
							100	500	1	5											
							60		0.1	5											
2N3540	TO-18	60	45	6	10	45		600	10	5	1.0		1.0	10	8	60	150	1	4	1	62
							150		0.1	5											
							100	300	0.01	5											
2N3549	TO-18	60	60	6	10	45		800	10	5	1.0		1.0	10	8	60	150	1	4	1	62
							200		1	5											
							150		0.1	5											
							100	500	0.01	5											
2N3550	TO-18	60	45	8	1	45		800	10	5	0.5	0.7	0.9	5	8	60	150	1	4	1	62
							300		1	5											
							250		0.1	5											
							200	600	0.01	5											
							125		0.001	5											
2N3799	TO-18	60	60	5	10	50	300		0.1	5	0.25		0.8	1	4	30		0.5	1.5	1	62
							300	900	0.5	5											
							300		0.1	5	0.2		0.7	0.1							
							225		0.01	5											
							75		0.001	5											
2N3962	TO-18	60	60	6	10	50	90		50	5	0.25		0.9	10	6	40	160	0.5	3	1	62
							100		10	5											
							100	450	1	5	0.4		0.95	50							
							100		0.1	5											
							100	300	0.01	5											
							60		0.001	5											

LOW LEVEL AMPS (Continued)

Type No.	Case Style	VCBO (V) Min	VCEO (V) Min	VEBO (V) Min	ICBO (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (kHz)	Process No.
2N3963	TO-18	80	80	6	10	70	90 100 100 100 100 60	 450 300 	50 10 1 0.1 0.01 0.001	5 5 5 5 5 5	0.25 0.4		0.9 0.95	10 50	6	40	160	0.5	3	1	62
2N3964	TO-18	45	45	6	10	40	180 200 250 250 250 180	 600 500 	50 10 1 0.1 0.01 0.001	5 5 5 5 5 5	0.25 0.4		0.9 0.95	10 50	6	50	160	0.5	2	1	62
2N3965	TO-18	60	60	6	10	50	180 200 250 250 250 180	 600 500 	50 10 1 0.1 0.01 0.001	5 5 5 5 5 5	0.25 0.4		0.9 0.95	10 50	6	50	160	0.5	2	1	62
2N4058	TO-92 (74)	30	30	6	100	20	100	400	0.1	5	0.7			10					5	1	62
2N4059	TO-92 (74)	30	30	6	100	20	45	660	1	5	0.7			10							62
2N4061	TO-92 (74)	30	30	6	100	20	90	330	1	5	0.7			10							62
2N4062	TO-92 (74)	30	30	6	100	20	180	660	1	5	0.7			10							62
2N4248	TO-92 (72)	Same as PN4248, see page 2-8 for explanation																			62
2N4249	TO-92 (72)	Same as PN4249, see page 2-8 for explanation																			62
2N4250	TO-92 (72)	Same as PN4250, see page 2-8 for explanation																			62
2N4250A	TO-92 (72)	Same as PN4250A, see page 2-8 for explanation																			62
2N4288	TO-92 (74)	30	25	6	50	25	75 150 100	 600 	10 1 0.1	5 5 5	0.35		0.8	1	8	40		1			62
2N4289	TO-92 (74)	60	45	7	10	45	75 150 100	 600 	10 1 0.1	5 5 5	0.35		0.8	1	8	40		1	4	1	62

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LOW LEVEL AMPS (Continued)

Type No.	Case Style	VCBO (V) Min	VCEO (V) Min	VEBO (V) Min	ICBO (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (kHz)	Process No.
2N4964	TO-92 (72)	Same as MPSA70, see below for explanation																			62
2N4965	TO-92 (72)	Same as 2N5086 , see below for explanation																			62
2N5086	TO-92 (72)	50	50		50	35	150 150 150	 500	10 1 0.1	5 5 5	0.3			10	4	40		0.5	3	1	62
2N5087	TO-92 (72)	50	50		50	35			10 1 0.1	5 5 5	0.3			10	4	40		0,5	2	1	62
2N5227	TO-92 (72)	30	30	3	100	10	50 30	700	2 0.1	10 10	0.4		1.0	10	5	100		10			62
MPSA70	TO-92 (72)		40	4	100	30	40	400	5	10	0.25			10	4	125		5			62
MPS6523	TO-92 (72)		25	4	50	20	300 150	600	2 0.1	10 10	0.5			50	4				3	1	62
PN4248	TO-92 (72)	40	40	5	10	40	50		0.1	5	0.25			10	6						62
PN4249	TO-92 (72)	60	60	5	10	40	100	300	0.1	5	0.25			10	6				3	1	62
PN4250	TO-92 (72)	40	40	5	10	40	250	700	0.1	5	0.25			10	6				2	1	62
PN4250A	TO-92 (72)	60	60	5	10	50	250	700	0.1	5	0.25			10.	6				2	1	62

GENERAL PURPOSE AMPS AND SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
2N722	TO-18	50	35	5	100	30	30 25	90	150 5	10 10	1.5		1.3	150	45	60		50				63
2N1132	TO-5	50	35	2	100	30	30 25	90	150 5	10 10	1.5		1.3	150	45	60		50				63
2N2696	TO-18	25	25		25	10	20 30	 130	300 50	2 1	0.25 1.0		1.1 2.0	50 300	20	100		50	170		1	63

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ Max	V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
2N2904	TO-5	60	40	5	20	50	20		500	10	0.4		1.3	150	8	200		50	100		2	63
							40	120	150	10												
							35		10	10	1.6		2.6	500								
							25		1	10												
							20		0.1	10												
2N2904 J, JTX, JTXV	TO-5	60	40	5	20	50	20		500	10	0.4		1.3	150	8	200		50	175		2	63
							40	120	150	10												
							35		10	10	1.6		2.6	500								
							25		1	10												
							20		0.1	10												
2N2904A	TO-5	60	60	5	10	50	40		500	10	0.4		1.3	150	8	200		50	100		2	63
							40		150	10												
							40		10	10	1.6		2.6	500								
							40	120	1	10												
							40		0.1	10												
2N2904A J, JTX, JTXV	TO-5	60	60	5	10	50	40		500	10	0.4		1.3	150	8	200		50	175		2	63
							40		150	10												
							40		10	10	1.6		2.6	500								
							40	120	1	10												
							40		0.1	10												
2N2905	TO-5	60	40	5	20	50	30		500	10	0.4		1.3	150	8	200		50	100		2	63
							100	300	150	10												
							75		10	10	1.6		2.6	500								
							50		1	10												
							35		0.1	10												
2N2905 J, JTX, JTXV	TO-5	60	40	5	20	50	30		500	10	0.4		1.3	150	8	200		50	200		2	63
							100	300	150	10												
							75		10	10	1.6		2.6	500								
							50		1	10												
							35		0.1	10												
2N2905A	TO-5	60	60	5	10	50	50		500	10	0.4		1.3	150	8	200		50	100		2	63
							100	300	150	10												
							100		10	10	1.6		2.6	500								
							100		1	10												
							75		0.1	10												

TEST CONDITIONS:

(1) I_C = 300mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 30mA. **(2)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(3)** I_C = 300mA, V_{CC} = 15V, $I_B^1 = I_B^2$ = 30mA. **(4)** I_C = 300mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 30mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 100Hz. **(7)** I_C = 30 μA, V_{CE} = 5V, f = 1kHz. **(8)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 250 μA, V_{CE} = 5V, f = 1kHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 50mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 5mA. **(12)** I_C = 150mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 15mA. **(13)** I_C = 50mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 5mA.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
2N2905A J, JTX, JTXV	TO-5	60	60	5	10	50	50		500	10					8	200		50	200		2	63
							100	300	150	10	0.4		1.3	150								
							100		10	10												
							100		1	10	1.6		2.6	500								
							75		0.1	10												
2N2906	TO-18	60	40	5	20	50	20		500	10	0.4		1.3	150	8	200		50	100		2	63
							40	120	150	10												
							35		10	10	1.6		2.6	500								
							25		1	10												
							20		0.1	10												
2N2906 J, JTX, JTXV	TO-18	60	40	5	20	50	20		500	10	0.4		1.3	150	8	200		50	175		2	63
							40	120	150	10												
							35		10	10	1.6		2.6	500								
							25		1	10												
							20		0.1	10												
2N2906A	TO-18	60	60	5	10	50	40		500	10	0.4		1.3	150	8	200		50	100		2	63
							40	120	150	10												
							40		10	10	1.6		2.6	500								
							40		1	10												
							40		0.1	10												
2N2906A J, JTX, JTXV	TO-18	60	60	5	10	50	40		500	10	0.4		1.3	150	8	200		50	175		2	63
							40	120	150	10												
							40		10	10	1.6		2.6	500								
							40		1	10												
							40		0.1	10												
2N2907	TO-18	60	40	5	20	50	35		500	10	0.4		1.3	150	8	200		50	100		2	63
							100	300	150	10												
							75		10	10	1.6		2.6	500								
							50		1	10												
							35		0.1	10												
2N2907 J, JTX, JTXV	TO-18	60	40	5	20	50	30		500	10	0.4		1.3	150	8	200		50	200		2	63
							100	300	150	10												
							75		10	10	1.6		2.6	500								
							50		1	10												
							35		0.1	10												
2N2907A	TO-18	60	60	5	10	50	50		500	10	0.4		1.3	150	8	200		50	100		2	63
							100	300	150	10												
							100		10	10	1.6		2.6	500								
							100		1	10												
							75		0.1	10												

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
2N2907A J, JTX, JTXV	TO-18	60	60	5	10	50	50 100 100 100 75	 300 	500 150 10 1 0.1	10 10 10 10 10	0.4 1.6		1.3 2.6	150 500	8	200		50	200		2	63
2N3072	TO-5	60	60	4	10*	30	15 30	 130	300 50	2 1	0.25 1.0		1.2 2.0	50 300	10	130		50	100		3	63
2N3073	TO-18	60	60	4	10*	30	15 30	 130	300 50	2 1	0.25 1.0		1.2 2.0	50 300	10	130		50	100		3	63
2N3120	TO-5	45	45	4	10*	30	15 30	 130	300 50	2 1	0.25 1.0		1.2 2.0	50 500	10	130		50	100		4	63
2N3121	TO-18	45	45	4	10*	30	15 30	 130	300 50	2 1	0.25 1.0		1.2 2.0	50 500	10	130		50	100		4	63
2N3133	TO-5	50	35	4	50	30	10 40 25	 120 	150 150 1	1 10 10	0.6		1.5	150	10	200		50	150		2	63
2N3134	TO-5	50	35	4	50	30	50 100 50	 300 	150 150 1	1 10 10	0.6		1.5	150	10	200		50	150		2	63
2N3135	TO-18	50	35	4	50	30	25 40 10	 120 	150 150 1	1 10 10	0.6		1.5	150	10	200		50	150		2	63
2N3136	TO-18	50	35	4	50	30	25 100 50	 300 	150 150 1	1 10 10	0.6		1.5	150	10	200		50	157		2	63
2N3250	TO-18	50	40	5			15 50 45 40	 150 	50 10 1 0.1	1 1 1 1	0.25 0.5	0.6	0.9 1.2	10 50	6	250		10	225	6	5/6	69
2N3250A	TO-18	60	60	5			15 50 45 40	 150 	50 10 1 0.1	1 1 1 1	0.25 0.5	0.6	0.9 1.2	10 50	6	250		10	225	6	5/6	69

TEST CONDITIONS:

(1) I_C = 300mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 30mA. **(2)** I_C = 150mA, V_{CC} = 6V, $I_{B1} = I_{B2}$ = 15mA. **(3)** I_C = 300mA, V_{CC} = 15V, $I_{B1} = I_{B2}$ = 30mA. **(4)** I_C = 300mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 30mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_{B1} = I_{B2}$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 100Hz. **(7)** I_C = 30 μA, V_{CE} = 5V, f = 1kHz. **(8)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 250 μA, V_{CE} = 5V, f = 1kHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 50mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 5mA. **(12)** I_C = 150mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15mA. **(13)** I_C = 50mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 5mA.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
2N3250A	TO-18	60	60	5			15		50	1	0.2	0.6	0.9	10	6	250		10	225	6	5/6	69
J, JTX, JTXV							50	150	10	1												
							45		1	1												
							40		0.1	1	0.5		1.2	50								
2N3251	TO-18	50	40	5			30		50	1	0.25	0.6	0.9	10	6	300		20	250	6	5/6	69
							100	300	10	1												
							90		1	1												
							80		0.1	1	0.5		1.2	50								
2N3251A	TO-18	60	60	5			30		50	1	0.25	0.6	0.9	10	6	300		10	250	6	5/6	69
							100	300	10	1	0.5		1.2	50								
							90		1	1												
							80		0.1	1												
2N3251A	TO-18	60	60	5			30		50	1	0.25	0.6	0.9	10	6	300	900	10	250	6	5/6	69
J, JTX, JTXV							100	300	10	1	0.5		1.2	50								
							90		1	1												
							80		0.1	1												
2N3502	TO-5	45	45	5	10	30	50		500	10	0.25		1.0	50	8	200		50	100	4	4/7	63
							100	300	150	10												
							140		10	10	0.4		1.3	150								
							135		1	10	1		2	300								
							120		0.1	10												
							80		0.01	10	1.6		2	500								
2N3503	TO-5	60	60	5	10	50	50		500	10	0.25											
							100	300	150	10			1	50	8	200		50	100	4	4/7	63
							140		10	10	0.4		1.3	150								
							135		1	10	1		2	300								
							120		0.1	10												
							80		0.01	10	1.6		2	500								
2N3504	TO-18	45	45	5	10	30	50		500	10	0.25		1	50	8	200		50	100	4	4/7	63
							100	300	150	10												
							140		10	10	0.4		1.3	150								
							135		1	10												
							120		0.1	10	1.6		2	500								
							80		0.01	10												
2N3505	TO-18	60	60	5	10	50	100	300	150	10	0.25		1	50	8	200		50	100	4	4/7	63
							115	300	50	1												
							140		10	10	0.4		1.3	150								
							135		1	10	1		2	300								
							120		0.1	10	1.6		2	500								
2N3638	TO-92 (72)	Same as PN3638, see page 2-16 for explanation																				63

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
2N3638A	TO-92 (72)	Same as PN3638A, see page 2-17 for explanation																				63
2N3644	TO-92 (72)	Same as PN3644, see page 2-17 for explanation																				63
2N3702	TO-92 (74)	40	25	5	100	20	60	300	50	5	0.25			50	12	100		50				63
2N3703	TO-92 (74)	50	30	5	100	20	30	150	50	5	0.25			50	12	100		50				63
2N3905	TO-92 (72)	40	40	5			15		100	1	0.25	0.65	0.85	10	4.5	200		10	260	5	5/8	66
							30		50	1												
							50	150	10	1	0.4		0.95	50								
							40		1	1												
							30		0.1	1												
2N3906	TO-92 (72)	40	40	5			30		100	1	0.25	0.65	0.85	10	4.5	250		10	300	4	5/8	66
							60		50	1												
							100	300	10	1	0.4		0.95	50								
							80		1	1												
							60		0.1	1												
2N4121	TO-92 (72)	Same as PN4121, see page 2-17 for explanation																				66
2N4122	TO-92 (72)	Same as PN4122, see page 2-17 for explanation																				66
2N4125	TO-92 (72)	30	30	4	50	20	25		50	1	0.4		0.95	50	4.5	200		10		5	8	66
							50	150	2	1												
2N4126	TO-92 (72)	25	25	4	50	20	60		50	1	0.4		0.95	50	4.5	250		10		4	8	66
							120	360	2	1												
2N4142	TO-92 (72)	Same as PN4142, see page 2-17 for explanation																				63
2N4143	TO-92 (72)	Same as PN4143, see page 2-17 for explanation																				63
2N4290	TO-92 (74)	30	20	5	500	20	50	300	100	10	0.4		1.5	100	10	100		10				63
							40		10	10												
							20		0.1	10												

TEST CONDITIONS:
(1) $I_C = 300mA$, $V_{CC} = 10V$, $I_B^1 = I_B^2 = 30mA$. **(2)** $I_C = 150mA$, $V_{CC} = 6V$, $I_B^1 = I_B^2 = 15mA$. **(3)** $I_C = 300mA$, $V_{CC} = 15V$, $I_B^1 = I_B^2 = 30mA$. **(4)** $I_C = 300mA$, $V_{CC} = 30V$, $I_B^1 = I_B^2 = 30mA$. **(5)** $I_C = 10mA$, $V_{CC} = 3V$, $I_B^1 = I_B^2 = 1mA$. **(6)** $I_C = 100\ \mu A$, $V_{CE} = 5V$, f = 100Hz. **(7)** $I_C = 30\ \mu A$, $V_{CE} = 5V$, f = 1kHz. **(8)** $I_C = 100\ \mu A$, $V_{CE} = 5V$; f = 1kHz. **(9)** $I_C = 250\ \mu A$, $V_{CE} = 5V$, f = 1kHz. **(10)** $I_C = 10\ \mu A$, $V_{CE} = 5V$, f = 1kHz. **(11)** $I_C = 50mA$, $V_{CC} = 30V$, $I_B^1 = I_B^2 = 5mA$. **(12)** $I_C = 150mA$, $V_{CC} = 30V$, $I_B^1 = I_B^2 = 15mA$. **(13)** $I_C = 50mA$, $V_{CC} = 10V$, $I_B^1 = I_B^2 = 5mA$.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
2N4291	TO-92 (74)	40	30	6	200	30	100 50 30	300	100 10 0.1	10 10 10	0.4		1.5	100	10	100		10				63
2N4402	TO-92 (72)	40	40	5			20 50 50 30	 150	500 150 10 1	2 2 1 1	0.4 0.75	0.7	0.95 1.3	150 500	10	150		20	255		4	63
2N4403	TO-92 (72)	40	40	5			20 100 100 30 60	 300	500 150 10 1 0.1	2 2 1 1 1	0.4 0.75	0.75	0.95 1.3	150 500	10	200		20	255		4	63
2N4916	TO-92 (72)	Same as PN4916, see page 2-18 for explanation																				66
2N4917	TO-92 (72)	Same as PN4917, see page 2-18 for explanation																				66
2N4971	TO-92 (72)	Same as PN2906, see page 2-16 for explanation																				63
2N4972	TO-92 (72)	Same as PN2907, see page 2-16 for explanation																				63
2N5138	TO-92 (72)	Same as PN5138, see page 2-18 for explanation																				66
2N5139	TO-92 (72)	Same as PN5139, see page 2-18 for explanation																				66
2N5142	TO-92 (72)	Same as PN5142, see page 2-18 for explanation																				63
2N5143	TO-92 (72)	Same as PN5143, see page 2-18 for explanation																				63
2N5221	TO-92 (72)	15	15	3	100	10	30 30	600	50 10	10 10	0.5		1.1	150	15	100		20				63
2N5226	TO-92 (72)	25	25	4	300	15	30 25	600	50 10	10 10	0.8		1.0	100	20	50		20				63
2N5356	TO-92 (74)	25	25	4	100	25	40	120	50	1	0.25			50	8							63
2N5355	TO-92 (74)	25	25	4	100	25	100	300	50	1	0.25			50	8							63
2N5365	TO-92 (74)	40	40	4	100	40	20 40 32	 120	300 50 2	5 1 1	0.25 1.0		1.1 2.0	50 300	8							63

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ Max	V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
2N5366	TO-92 (74)	40	40	4	100	40	40 100 80	 300 	300 50 2	5 1 1	0.25 1.0		1.1 2.0	50 300	8							63
2N5400	TO-92 (72)	130	120	5	100	100	40 40 30	 180 	50 10 1	5 5 5	0.2 0.5		1.0 1.0	10 50	6	100	400	10		8	9	74
2N5401	TO-92 (72)	160	150	5	50	120	50 60 50	 240 	50 10 1	5 5 5	0.2 0.5		1.0 1.0	10 50	6	100	300	10		8	9	74
2N5817	TO-92 (77)	50	40	5	100	25	25 100	 200	500 2	2 2	0.75		1.2	500	15	100		50				63
EN2907	TO-92 (72)	Same as PN2907, see page 2-16 for explanation																				63
MPSL51	TO-92 (72)	100	100	4	1 μA	50	40	250	50	5	0.25 0.3		1.2 1.2	10 50	8	60		10				74
MPS3638	TO-92 (72)	*Same as PN3638, see page 2-16 for explanation*																				63
MPS3638A	TO-92 (72)	Same as PN3638A, see page 2-17 for explanation																				63
MPS3644	TO-92 (72)	Same as PN3644, see page 2-17 for explanation																				63
MPS3645	TO-92 (72)	Same as PN3645, see page 2-17 for explanation																				63
MPS3702	TO-92 (72)	40	25	5	100	20	60	300	50	5	0.25			50	12	100		50				63
MPS3703	TO-92 (72)	50	30	5	100	20	30	150	50	5	0.25			50	12	100		50				63
MPS6516	TO-92 (72)	40	40	4	50	30	30 50	 100	100 2	10 10	0.5			50	4							66
MPS6517	TO-92 (72)	40	40	4	50	30	60 90	 180	100 2	10 10	0.5			50	4							66
MPS6518	TO-92 (72)		40	4	500	30	90 150	 300	100 2	10 10	0.5			50	4							66
MPS6522	TO-92 (72)		25	4	50	20	200 100	400 	2 0.1	10 10	0.5			50	4					3	10	66

TEST CONDITIONS:

(1) I_C = 300mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 30mA. **(2)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(3)** I_C = 300mA, V_{CC} = 15V, $I_B^1 = I_B^2$ = 30mA. **(4)** I_C = 300mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 30mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 100Hz. **(7)** I_C = 30 μA, V_{CE} = 5V, f = 1kHz. **(8)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 250 μA, V_{CE} = 5V, f = 1kHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 50mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 5mA. **(12)** I_C = 150mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 15mA. **(13)** I_C = 50mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 5mA.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
MPS6533	TO-92 (72)	40	40	4	50	30	25		500	10	0.5		1.0	100	6							63
							40	120	100	1												
							30		10	1												
MPS6534	TO-92 (72)	40	40	4	50	30	50		500	10	0.3		1.0	100	6							63
							90	270	100	1												
							60		10	1												
MPS6535	TO-92 (72)	30	30	4	100	20	30		100	1	0.5		1.2	100	6							63
NS3905	TO-18	40	40	5			15		100	1	0.25	0.65	0.85	10	4.5	200		10	260	5	5/8	66
							30		50	1												
							50	150	10	1	0.4		0.95	50								
							40		1	1												
							30		0.1	1												
NS3906	TO-18	40	40	5			30		100	1	0.25	0.65	0.85	10	4.5	250		10	300	4	5/8	66
							60		50	1												
							100	300	10	1	0.4		0.95	50								
							80		1	1												
							60		0.1	1												
PN2906	TO-92 (72)	60	40	5	20	50	20		500	10	0.4		1.3	150	8	200		50	100		2	63
							40	120	150	10												
							35		10	10	1.6		2.6	500								
							25		1	10												
							20		0.1	10												
PN2906A	TO-92 (72)	60	60	5	10	50	40		500	10	0.4		1.3	150	8	200		50	100		2	63
							40	120	150	10												
							40		10	10	1.6		2.6	500								
							40		1	10												
							40		0.1	10												
PN2907	TO-92 (72)	60	40	5	20	50	30		500	10	0.4		1.3	150	8	200		50	100		2	63
							100	300	150	10												
							75		10	10	1.6		2.6	500								
							50		1	10												
							35		0.1	10												
PN2907A	TO-92 (72)	60	60	5	20	50	50		500	10	0.4		1.3	150	8	200		50	100		2	63
							100	300	150	10												
							100		10	10	1.6		2.6	500								
							100		1	10												
							75		0.1	10												
PN3638	TO-92 (72)	25	25	4	35*	15	20		300	2	0.25		1.1	50	20	100		50	170		1	63
							20		50	1												
							30		10	10	1.0	0.8	2.0	300								

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
PN3638A	TO-92 (72)	25	25	4	25*	15	20		300	2	0.25		1.1	50	10	150		50	170		1	63
							100		50	1												
							100		10	10	1.0	0.8	2.0	300								
							80		1	10												
PN3644	TO-92 (72)	45	45	5	35*	30	20		300	2	0.25		1.0	50	8	200		20	100		4	63
							100	300	150	10												
							80	240	50	1	0.4		1.3	150								
							100		10	10												
							80		1	10	1.0	0.8	2.0	300								
							40		0.1	10												
PN3645	TO-92 (72)	60	60	5	35*	50	20		300	2	0.25		1.0	50	8	200		20	100		4	63
							100	300	150	10												
							80	240	50	1	0.4		1.3	150								
							100		10	10												
							80		1	10	1.0	0.8	2.0	300								
							40		0.1	10												
PN4121	TO-92 (72)	40	40	5	25*	30	15		50	1	0.13		0.75	1	4.5	400		10	150	4	11/8	66
							70	200	10	1	0.14	0.7	0.9	10								
							60		1	1	0.3		1.1	50								
							40		0.1	1												
PN4122	TO-92 (72)	40	40	5	25*	30	30		50	1	0.13		0.75	1	4.5	450		10	150	4	11/8	66
							150	300	10	1												
							150		1	1	0.14	0.7	0.9	10								
							100		0.1	1	0.3		1.1	50								
PN4142	TO-92	60	40	5			20		500	10	0.4		1.3	150	8	200		50	100		12	63
							20		150	1												
							40	120	150	10	1.6		2.6	500								
							35		10	10												
							25		1	10												
							20		0.1	10												
PN4143	TO-92 (72)	60	40	5			30		500	10	0.4		1.3	150	8	200		50	100		12	63
							50		150	1												
							100	300	150	10	1.6		2.6	500								
							75		10	10												
							50		1	10												
							35		0.1	10												

TEST CONDITIONS:

(1) I_C = 300mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 30mA. **(2)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(3)** I_C = 300mA, V_{CC} = 15V, $I_B^1 = I_B^2$ = 30mA. **(4)** I_C = 300mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 30mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 100Hz. **(7)** I_C = 30 μA, V_{CE} = 5V, f = 1kHz. **(8)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 250 μA, V_{CE} = 5V, f = 1kHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 50mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 5mA. **(12)** I_C = 150mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 15mA. **(13)** I_C = 50mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 5mA.

GENERAL PURPOSE AMPS AND SWITCHES (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Min	Test Condition	Process No.
PN4916	TO-92 (72)	30	30	5	25*	15	15	200	50	1	0.13		0.75	1	4.5	400		10	150	4	13/8	66
							70		10	1	0.14	0.7	0.9	10								
							60		1	1	0.3	0.75	1.1	50								
							40		0.1	1												
PN4917	TO-92 (72)	30	30	5	25*	15	30		50	1	0.13		0.75	1	4.5	450		10	150	4	13/8	66
							150	300	10	1	0.14	0.7	0.9	10								
							150		1	1	0.3	0.75	1.1	50								
							100		0.1	1												
PN5138	TO-92 (72)	30	30	5	50	20	50		10	10	0.3		1.0	10	7	30		0.5				66
							50		1	10												
							50	800	0.1	10												
PN5139	TO-92 (72)	20	20	5	50*	15	15		50	10	0.2	0.7	1.0	10	5	300		10	200		13	66
							40		10	1												
							40		1	10												
							30		0.1	10	0.5	0.75	1.25	50								
PN5142	TO-92 (72)	20	20	4	50*	12	15		300	10	0.5		1.5	50	10	100		50	200		1	63
							30		50	1	0.2	0.8	2.5	300								
PN5143	TO-92 (72)	20	20	4	50*	12	15		300	10	0.5		1.5	50	10	100		50	200		1	63
							30		50	1	0.2	0.8	2.5	300								
TN2905	TO-92+ (91)	60	40	5	20	50	30		500	10	0.4		1.3	150	8	200		50	100		2	63
							100	300	150	10												
							75		10	10	1.6		2.6	500								
							50		1	10												
							35		0.1	10												
TN2905A	TO-92+ (91)	60	60	5	10	50	50		500	10	0.4		1.3	150	8	200		50	100		2	63
							100	300	150	10												
							100		10	10	1.6		2.6	500								
							100		1	10												
							75		0.1	10												

TEST CONDITIONS:
(1) I_C = 300mA, V_{CC} = 10V, I_{B1} = I_{B2} = 30mA. **(2)** I_C = 150mA, V_{CC} = 6V, I_{B1} = I_{B2} = 15mA. **(3)** I_C = 300mA, V_{CC} = 15V, I_{B1} = I_{B2} = 30mA. **(4)** I_C = 300mA, V_{CC} = 30V, I_{B1} = I_{B2} = 30mA. **(5)** I_C = 10mA, V_{CC} = 3V, I_{B1} = I_{B2} = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 100Hz. **(7)** I_C = 30 μA, V_{CE} = 5V, f = 1kHz. **(8)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 250 μA, V_{CE} = 5V, f = 1kHz. **(10)** I_C = 10 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 50mA, V_{CC} = 30V, I_{B1} = I_{B2} = 5mA. **(12)** I_C = 150mA, V_{CC} = 30V, I_{B1} = I_{B2} = 15mA. **(13)** I_C = 50mA, V_{CC} = 10V, I_{B1} = I_{B2} = 5mA.

MEDIUM POWER

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3634	TO-39	140	140	5	100	100	25		150	10	0.3		0.8	10	10	150		30	600	3	1/2	73
							50	150	50	10												
							50		10	10	0.5	0.65	0.9	50								
							45		1	10												
							40		0.1	10												
2N3634 J, JTX	TO-39	140	140	5	100	100	30		150	10	0.3		0.8	10	10	150	800	30	600	3	1/2	73
							50	150	50	10												
							50		10	10	0.6	0.65	0.9	50								
							45		1	10												
							25		0.1	10												
2N3635	TO-39	140	140	5	100	100	50		150	10	0.3		0.8	10	10	200		30	600	3	1/2	73
							100	300	50	10												
							100		10	10	0.5	0.65	0.9	50								
							90		1	10												
							80		0.1	10												
2N3635 J, JTX	TO-39	140	140	5	100	100	60		150	10	0.3		0.8	10	10	200	850	30	600	3	1/2	73
							100	300	50	10												
							100		10	10	0.6	0.65	0.9	50								
							90		1	10												
							55		0.1	10												
2N3636	TO-39	175	175	5	100	100	25		150	10	0.3		0.8	10	10	150		30	600	3	1/2	73
							50	150	50	10												
							50		10	10	0.5	0.65	0.9	50								
							45		1	10												
							40		0.1	10												
2N3636 J, JTX	TO-39	175	175	5	100	175	30		150	10	0.3		0.8	10	10	150	800	30	600	3	1/2	73
							50	150	50	10												
							50		10	10	0.6	0.65	0.9	50								
							45		1	10												
							25		0.1	10												
2N3637	TO-39	175	175	5	100	100	50		150	10	0.3		0.8	10	10	200		30	600	3	1/2	73
							100	300	50	10												
							100		10	10	0.5	0.65	0.9	50								
							90		1	10												
							80		0.1	10												
2N3637 J, JTX	TO-39	175	175	5	100	175	60		150	10	0.3		0.8	10	10	200	850	30	600	3	1/2	73
							100		50	10												
							100	300	10	10	0.6	0.65	0.9	50								
							90		1	10												
							55		0.1	10												

TEST CONDITIONS:
(1) I_C = 50mA, V_{CC} = 100V, $I_{B}^1 = I_{B}^2$ = 5mA. **(2)** I_C = 500 μA, V_{CE} = 10V, f = 1kHz. **(3)** I_C = 500mA, V_{CC} = 30V, $I_{B}^1 = I_{B}^2$ = 50mA. **(4)** I_C = 150mA, V_{CC} = 30V, $I_{B}^1 = I_{B}^2$ = 15mA. **(5)** I_C = 100 μA, V_{CC} = 10V, f = 1kHz.

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N4030	TO-39	60	60	5	50	50	15		1A	5	1.0			1A	20	100	400	50	400		3	67
							25		500	5	0.5			500								
							40		100	5	0.15		0.9	150								
							30	120	0.1	5												
2N4031	TO-39	80	80	5	50	60	10		1A	5	0.5			500	20	100	400	50	400		3	67
							25		500	5	0.15		0.9	150								
							40	120	100	5												
							30		0.1	5												
2N4032	TO-39	60	60	5	50	50	40		1A	5	1			1A	20	150	500	50	400		3	67
							70		500	5	0.5			500								
							100	300	100	5	0.15		0.9	150								
							75		0.1	5												
2N4033	TO-39	80	80	5	50	60	25		1A	5	0.5			500	20	150	500	50	400		3	67
							70		500	5	0.15		0.9	150								
							100	300	100	5												
							75		0.1	5												
2N4036	TO-39	90	65	7	20	60	20		500	10	0.6		1.4	150	30	60		50	700		4	67
							40	140	150	10												
							20		0.1	10												
2N4037	TO-39	60	40	7	250	60	50	250	150	10	1.4			150	30	60		50				67
							15		1	10												
2N4234	TO-39		40		100 μA	40	10		1A	1	0.6		1.5	1A	100	3		100				67
							20		500	1												
							30	150	250	1												
							40		100	1												
2N4235	TO-39		60		100 μA	60	10		1A	1	0.6		1.5	1A	100	3		100				67
							20		500	1												
							30	150	250	1												
							40		100	1												
2N4236	TO-39		80		100 μA	80	10		1A	1	0.6		1.5	1A	100	3		100				67
							20		500	1												
							30	150	250	1												
							40		100	1												
2N4314	TO-39	90	65		250	60	50	250	150	10	1.4			150	30	60		50				67
							15		1	10												
2N4354	TO-92 (72)	Same as PN4354, see page 2-25 for explanation																				67
2N4355	TO-92 (72)	Same as PN4355, see page 2-25 for explanation																				67

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N4356	TO-92 (72)	Same as PN4356, see page 2-25 for explanation																				67
2N6554	TO-202 (35)	60	60	5	100	40	25		500	1	1.0			1A	18	75	250	100				78
							60		250	1												
							80	300	50	1												
							60		10	1	0.5			250								
2N6555	TO-202 (35)	80	80	5	100	60	25		500	1	1.0			1A	18	75	250	100				78
							60		250	1												
							80	300	50	1												
							60		10	1	0.5			250								
2N6556	TO-202 (35)	100	100	5	100	80	25		500	1	1.0			1A	18	75	250	100				78
							60		250	1												
							80	300	50	1												
							60		10	1	0.5			250								
40319	TO-39		40		250	15	35	200	50	4	1.4			150								67
92PE77A	TO-92+ (90)		45		100	60	25		500	2	0.5			500	30	50		200				78
							40		250	2												
							40		50	2	1.0			1A								
92PE77B	TO-92+ (90)		60		100	80	25		500	2	0.5			500	30	50		200				78
							40		250	2												
							40		50	2	1.0			1A								
92PE77C	TO-92+ (90)		80		100	100	25		500	2	0.5			500	30	50		200				78
							40		250	2												
							40		50	2	1.0			1A								
92PU51	TO-92+ (91)		30		100	40	50		1A	1	0.5			1A	30	50		50				77
							60		100	1												
							55		10	1												
92PU51A	TO-92+ (91)		40		100	50	50		1A	1	0.5			1A	30	50		50				77
							60		100	1												
							55		10	1												
92PU55	TO-92+ (91)		60		100	40	20		500	1	0.35			250	30	50		200				79
							50		250	1												
							80		50	1												
92PU56	TO-92+ (91)		80		100	60	20		500	1	0.35			250	30	50		200				79
							50		250	1												
							80		50	1												

TEST CONDITIONS:
(1) I_C = 50mA, V_{CC} = 100V, $I_B^1 = I_B^2$ = 5mA. (2) I_C = 500 μA, V_{CE} = 10V, f = 1kHz. (3) I_C = 500mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 50mA. (4) I_C = 150mA, V_{CC} = 30V, $I_B^1 = I_B^2$ = 15mA. (5) I_C = 100 μA, V_{CC} = 10V, f = 1kHz.

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
92PU57	TO-92+ (91)		100		100	80	20 50 80		500 250 50	1 1 1	0.35			250	30	50		200				79
92PU200	TO-92+ (91)	100	80		100	80	100 100	300	350 10	2 2	0.35			350	20	500		100				79
D41D1	TO-202 (35)		30		100*	45	10 50	 150	1A 100	2 2	0.5		1.5	500								78
D41D2	TO-202 (35)		30		100*	45	20 120	 300	1A 100	2 2	0.5		1.5	500								78
D41D4	TO-202 (35)		45		100*	60	10 50	 150	1A 100	2 2	0.5		1.5	500								78
D41D5	TO-202 (35)		45		100*	60	20 120	 360	1A 100	2 2	0.5		1.5	500								78
D41D7	TO-202 (35)		60		100*	75	10 50	 150	1A 100	2 2	1.0		1.5	500								78
D41D8	TO-202 (35)		60		100*	75	20 120	 360	1A 100	2 2	1.0		1.5	500								78
D41D10	TO-202 (35)		75		100*	90	10 50	 150	1A 100	2 2	1.0		1.5	500								78
D41D11	TO-202 (35)		75		100*	90	20 120	 360	1A 100	2 2	1.0		1.5	500								78
D41D13	TO-202 (35)		75		100*	90	50	150	100	2	1.0		1.5	500								78
D41D14	TO-202 (35)		75		100*	90	120	360	100	2	1.0		1.5	500								78
D41E1	TO-202 (35)		30		100*	40	10 50		1A 100	2 2	1.0		1.3	1A								78
D41E5	TO-202 (35)		60		100*	70	10 50		1A 100	2 2	1.0		1.3	1A								78
D41E7	TO-202 (35)		80		100*	90	10 50		1A 100	2 2	1.0		1.3	1A								78
D43C1	TO-202 (36)		30		1 μA*	30	10 25		1A 200	1 1	0.5		1.3	1A	30							77
D43C2	TO-202 (36)		30		1 μA*	30	20 40	 120	1A 200	1 1	0.5		1.3	1A	30							77
D43C3	TO-202 (36)		30		1 μA*	30	20 40		2A 200	1 1	0.5		1.3	1A	30							77
D43C4	TO-202 (36)		45		1 μA*	45	10 25		1A 200	1 1	0.5		1.3	1A	30							77

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
D43C5	TO-202 (36)		45		1 μA*	45	20 40	 120	1A 200	1 1	0.5		1.3	1A	30							77
D43C6	TO-202 (36)		45		1 μA*	45	20 40		2A 200	1 1	0.5		1.3	1A	30							77
D43C7	TO-202 (36)		60		1 μA*	60	10 25		1A 200	1 1	0.5		1.3	1A	30							78
D43C8	TO-202 (36)		60		1 μA*	60	20 40	 120	1A 200	1 1	0.5		1.3	1A	30							78
D43C9	TO-202 (36)		60		1 μA*	60	20 40		2A 200	1 1	0.5		1.3	1A	30							78
D43C10	TO-202 (36)		80		10 μA*	90	10 25		1A 200	1 1	0.5		1.3	1A	100							78
D43C11	TO-202 (36)		80		10 μA*	90	20 40	 120	1A 200	1 1	0.5		1.3	1A	100							78
D43C12	TO-202 (36)		80		10 μA*	90	20 40	 120	2A 200	1 1	0.5		1.3	1A	100							78
MPSA55	TO-92 (72)		60	4	100	60	50 50		100 10	1 1	0.25			100		50		100				67
MPSA56	TO-92 (72)		80	4	100	80	50 50		100 10	1 1	0.25			100		50		100				67
MPS4354	TO-92 (72)	Same as PN4354, see page 2-25 for explanation																				67
MPS4355	TO-92 (72)	Same as PN4355, see page 2-25 for explanation																				67
MPS4356	TO-92 (72)	Same as PN4356, see page 2-25 for explanation																				67
MPS6562	TO-92 (72)			5	100	20	50 50 35	200 	500 100 10	1 1 1	0.5			500	30	60		10				67
MPS6563	TO-92 (72)			5	100	20	50 50 35	200 	350 100 10	1 1 1	0.5			350	30	60		10				60
NSD202	TO-202 (35)	60	45	5	100	60	25 40 50 40	 150 	1A 500 100 10	5 5 5 5	0.2 0.4		0.9 1.2	100 500	30	60		50				77

TEST CONDITIONS:

(1) I_C = 50mA, V_{CC} = 100V, $I_B{}^1 = I_B{}^2$ = 5mA. **(2)** I_C = 500 μA, V_{CE} = 10V, f = 1kHz. **(3)** I_C = 500mA, V_{CC} = 30V, $I_B{}^1 = I_B{}^2$ = 50mA. **(4)** I_C = 150mA, V_{CC} = 30V, $I_B{}^1 = I_B{}^2$ = 15mA. **(5)** I_C = 100 μA, V_{CC} = 10V, f = 1kHz.

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
NSD203	TO-202	60	45	5	100	60	30		1A	5	0.2		0.9	100	30	60		50				77
	(35)						50		500	5												
							120	360	100	5												
							50		10	5	0.4		1.2	500								
NSD204	TO-202	100	80	7	100	100	10		1A	5	0.2		0.9	100	30	60		50				79
	(35)						50	150	100	5												
							20		10	5	0.5		1.2	500								
NSD205	TO-202	100	80	7	100	100	10		1A	5	0.2		0.9	100	30	60		50				79
	(35)						120	360	100	5												
							20		10	5	0.5		1.2	500								
NSD206	TO-202	140	100	7	100	140	25		500	5	0.2		0.9	100	30	60		50				79
	(35)						50	150	100	5												
							20		10	5	0.5		1.2	500								
NSD6180	TO-202		75		500	80	10		1A	2	0.5		1.2	500	30	50		50				78
	(35)						40	250	500	2												
							30		50	2												
NSD6181	TO-202		50		500	60	10		1A	2	0.5		1.2	500	30	50		50				78
	(35)						40	250	500	2												
							30		50	2												
NSDU51	TO-202	40	30	5	100	30	50		1A	1	0.7			1A	30	50		50				77
	(35)						60		100	1												
							55		10	1												
NSDU51A	TO-202	50	40	5	100	40	50		1A	1	0.7			1A	30	50		50				77
	(35)						60		100	1												
							55		10	1												
NSDU52	TO-202	60	40	5	100	40	30		500	10	0.4		1.3	150	20	150		20				77
	(35)						50	300	150	10												
							50		10	10												
NSDU55	TO-202	60	60	4	100	60	20		500	1	0.35			250	30	50		200				78
	(35)						50		250	1												
							80		50	1												
NSDU56	TO-202	80	80	4	100	80	20		500	1	0.35			250	30	50		200				79
	(35)						50		250	1												
							80		50	1												
NSDU57	TO-202	100	100	4	100	100	20		500	1	0.35			250	30	50		200				79
	(35)						50		250	1												
							80		50	1												
NSE170	TO-202		40		100	60	12		1.5A	1	0.9		1.5	1.5A		50		100				77
	(36)						30		500	1												
							50	250	100	1	0.3			500								

MEDIUM POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
NSE171	TO-202 (36)		60		100	80	12		1.5A	1	0.9		1.5	1.5A		50		100				78
							30		500	1												
							50	250	100	1	0.3			500								
PN4354	TO-92 (72)	60	60	5	50	50	30		500	10	0.15		0.9	150	30	100	500	50	400	3	3/5	67
							40		100	10												
							50	500	10	10	0.5		1.1	500								
							40		1	10												
							25		0.1	10												
PN4355	TO-92 (72)	60	60	5	50	50	75		500	10	0.15		0.9	150	30	100	500	50	400	3	3/5	67
							75		100	10												
							100	400	10	10	0.5		1.1	500								
							75		1	10												
							60		0.1	10												
PN4356	TO-92 (72)	80	80	5	50	50	30		500	10	0.15		0.9	150	30	100	500	50	400	3	3/5	67
							40		100	10												
							50	250	10	10	0.5		1.1	500								
							40		1	10												
							25		0.1	10												
TN4036	TO-92+ (91)	90	65	7	20	60	20		500	10	0.65		1.4	150	30	60		50	700		4	67
							40	140	150	10												
							20		0.1	10												
TN4037	TO-92+ (91)	60	40	7	250	60	50	2	150	10	1.4			150	30	60	100	50				67
							15		1	10												

TEST CONDITIONS:

(1) I_C = 50mA, V_{CC} = 100V, $I_B{}^1 = I_B{}^2$ = 5mA. **(2)** I_C = 500 μA, V_{CE} = 10V, f = 1kHz. **(3)** I_C = 500mA, V_{CC} = 30V, $I_B{}^1 = I_B{}^2$ = 50mA. **(4)** I_C = 150mA, V_{CC} = 30V, $I_B{}^1 = I_B{}^2$ = 15mA. **(5)** I_C = 100 μA, V_{CC} = 10V, f = 1kHz.

POWER

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CEX}† (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
2N4918	TO-126		40		100	40	10 20 40	100	1 0.5 0.05	1 1 1	0.6		1.3	1	100	3		0.25	3C
2N4919	TO-126		60		100	60	10 20 40	 100	1 0.5 0.05	1 1 1	0.6		1.3	1	100	3		0.25	3C
2N4920	TO-126		80		100	80	10 20 40	 100	1 0.5 0.05	1 1 1	0.6		1.3	1	100	3		0.25	3C
2N5193	TO-126		40		100	40	10 25	 100	4 1.5	2 2	0.6 1.2			1.5 4		2		1	3E
2N5194	TO-126		60		100	60	10 25	 100	4 1.5	2 2	0.6 1.2			1.5 4		2		1	3E
2N5195	TO-126		80		100	80	7 20	 80	4 1.5	2 2	0.6 1.2			1.5 4		2		1	3E
2N6034	TO-126		40		500	40	100 750 500	 15,000	4 2 0.05	3 3 3	2.0 3.0		 4.0	2 4	200	25		0.75	3J
2N6035	TO-126		60		500	60	100 750 500	 15,000	4 2 0.5	3 3 3	2.0 3.0		 4.0	2 4	200	25		0.75	3J
2N6036	TO-126		80		500	80	100 750 500	 15,000	4 2 0.5	3 3 3	2.0 3.0		 4.0	2 4	200	25		0.75	3J
2N6106	TO-220 Lead Form + Clip		70		100†	75	5 30	 150	6.5 2	4 4	1.0 2.0			2 6.5	250	10		0.5	5E
2N6107	TO-220		70		100†	75	5 30	 150	6.5 2	4 4	1.0 2.0			2 6.5	250	10		0.5	5E
2N6108	TO-220 Lead Form + Clip		50		100†	56	5 30	 150	6.5 2.5	4 4	1.0 2.0			2.5 6.5	250	10		0.5	5E
2N6109	TO-220		50		100†	56	5 30	 150	6.5 2.5	4 4	1.0 2.0			2.5 6.5	250	10		0.5	5E
2N6110	TO-220 Lead Form + Clip		30		100†	37.5	5 30	 150	6.5 3	4 4	1.0 2.0			3 6.5	250	10		0.5	5E

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CEX}† (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
2N6111	TO-220		30		100†	37.5	5 30	 150	6.5 3	4 4	1.0 2.0			3 6.5	250	10		0.5	5E
2N6124	TO-220		45		100	45	10 25	 100	4 1.5	2 2	0.6 1.4			1.5 4		2.5		1	5E
2N6125	TO-220		60		100	60	10 25	 100	4 1.5	2 2	0.6 1.4			1.5 4		2.5		1	5E
2N6126	TO-220		80		100	80	7 20	 80	4 1.5	2 2	0.6 1.4			1.5 4		2.5		1	5E
2N6132	TO-220		40		100	40	7 20	 100	7 2.5	4 4	1.4			7		2.5		1	5E
2N6133	TO-220		60		100	60	7 20	 100	7 2.5	4 4	1.4			7		2.5		1	5E
2N6134	TO-220		80		100	60	5 20	 100	7 2.5	4 4	2.0			7		2.5		1	5E
2N6489	TO-220		40		500†	45	5 20	 150	15 5	4 4	1.3 3.5			5 15		5		1	5A
2N6490	TO-220		60		500†	65	5 20	 150	15 5	4 4	1.3 3.5			5 15		5		1	5A
2N6491	TO-220		80		500†	85	5 20	 150	15 5	4 4	1.3 3.5			5 15		5		1	5A
D45C1	TO-220		30		10*	40	10 25		1 0.2	1 1	0.5		1.3	1	125	3		0.02	5F
D45C2	TO-220		30		10*	40	20 40	 120	1 0.2	1 1	0.5		1.3	1	125	3		0.02	5F
D45C3	TO-220		30		10*	40	20 40		2 0.2	1 1	0.5		1.3	1	125	3		0.02	5E
D45C4	TO-220		45		10*	55	10 25		1 0.2	1 1	0.5		1.3	1	125	3		0.02	5F
D45C5	TO-220		45		10*	55	20 40	 120	1 0.2	1 1	0.5		1.3	1	125	3		0.02	5F
D45C6	TO-220		45		10*	55	20 40		2 0.2	1 1	0.5		1.3	1	125	3		0.02	5E
D45C7	TO-220		60		10*	70	10 25		1 0.2	1 1	0.5		1.3	1	125	3		0.02	5F

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CEX}† (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
D45C8	TO-220		60		10*	70	20		1	1	0.5		1.3	1	125	3		0.02	5F
							40	120	0.2	1									
D45C9	TO-220		60		10*	70	20		2	1	0.5		1.3	1	125	3		0.02	5E
							40		0.2	1									
D45C10	TO-220		80		10*	90	10		1	1	0.5		1.3	1	125	3		0.02	5F
							25		0.2	1									
D45C11	TO-220		80		10*	90	20		1	1	0.5		1.3	1	125	3		0.02	5E
							40	120	0.2	1									
D45C12	TO-220		80		10*	90	20		2	1	0.5		1.3	1	125	3		0.02	5E
							40		0.2	1									
D45H1	TO-220		30		10	30	20		4	1	1.0		1.5	8					5A
							35		2	1									
D45H2	TO-220		30		10	30	40		4	1	1.0		1.5	8					5A
							60		2	1									
D45H4	TO-220		45		10	45	20		4	1	1.0		1.5	8					5A
							35		2	1									
D45H5	TO-220		45		10	45	40		4	1	1.0		1.5	8					5A
							60		2	1									
D45H7	TO-220		60		10	60	20		4	1	1.0		1.5	8					5A
							35		2	1									
D45H8	TO-220		60		10	60	40		4	1	1.0		1.5	8					5A
							60		2	1									
D45H10	TO-220		80		10	80	20		4	1	1.0		1.5	8					5A
							35		2	1									
D45H11	TO-220		80		10	80	40		4	1	1.0		1.5	8					5A
							60		2	1									
MJE170	TO-126		40		0.1	60	12		1.5	1	1.7		2.0	3	50	50		0.1	77
							30		0.5	1	0.9		1.5	1.5					
							50	250	0.1	1	0.3			0.5					
MJE171	TO-126		60		0.1	80	12		1.5	1	1.7		2.0	3	50	50		0.1	78
							30		0.5	1	0.9		1.5	1.5					
							50	250	0.1	1	0.3			0.5					
MJE172	TO-126		80		0.1	100	12		1.5	1	1.7		2.0	3	50	50		0.1	79
							30		0.5	1	0.9		1.5	1.5					
							50	250	0.1	1	0.3			0.5					
MJE370	TO-126		30		100	30	25		1	1									3C
MJE371	TO-126		40		100	40	40		1	1									3E
MJE700	TO-126		60		200	60	750		1.5	3	2.5			1.5		1		1.5	3J

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CEX}† (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
MJE701	TO-126		60		200	60	750	2	3	2.8				2		1		1.5	3J
MJE702	TO-126		60		200	60	750		1.5	3	2.5			1.5		1		1.5	3J
MJE703	TO-126		80		200	80	750		2	3	2.8			2		1		1.5	3J
MJE710	TO-126		40		100†	40	8 20 40		1 0.5 0.15	1 1 1	1.0 0.4 0.15		1.3	1.5 0.5 0.15					77
MJE711	TO-126		60		100†	60	8 20 40		1 0.5 0.15	1 1 1	1.0 0.4 0.15		1.3	1.5 0.5 0.15					78
MJE712	TO-126		80		100†	80	8 20 40		1 0.5 0.15	1 1 1	1.0 0.4 0.15		1.3	1.5 0.5 0.15					79
NSP42	TO-220		40		400*	40	15 30	75	3 0.3	4 4	1.5			5		3		0.5	5E
NSP42A	TO-220		60		400*	60	15 30	75	3 0.3	4 4	1.5			5		3		0.5	5E
NSP42B	TO-220		80		400*	80	15 30	75	3 0.3	4 4	1.5			5		3		0.5	5E
NSP42C	TO-220		100		400*	100	15 30	75	3 0.3	4 4	1.5			5		3		0.5	5E
NSP105	TO-220		50		100	50	25	100	2	2									5A
NSP370	TO-220		30		100	30	25		1	1									5F
NSP371	TO-220		40		100	40	40		1	1									5F
NSP576	TO-220	45	45		100	45	25		1	1	0.6			1		3		0.5	5F
NSP578	TO-220	60	60		100	60	25		1	1	0.6			1		3		0.5	5F
NSP580	TO-220	80	80		100	80	15		1	1	0.8			1		3		0.5	5F
NSP582	TO-220	100	100		100	100	15		1	1	0.8			1		3		0.5	5F
NSP586	TO-220	45	45		100	45	25 40		2 0.5	2 2	0.8			2		3		0.25	5E
NSP588	TO-220	60	60		100	60	20 40		2 0.5	2 2	0.8			2		3		0.25	5E
NSP590	TO-220	80	80		100	80	15 30		2 0.5	2 2	0.8			2		3		0.25	5E
NSP596	TO-220	45	45		100	45	25 40		3 1	2 2	1.0			3		3		0.25	5E
NSP598	TO-220	60	60		100	60	25 40		3 1	2 2	1.0			3		3		0.25	5E

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CEX}† (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
NSP600	TO-220	80	80		100	80	15 30		3 1	2 2	1.0			3		3		0.25	5E
NSP602	TO-220		100		100	100	15 30		3 1	2 2	1.0			3		3		0.25	5E
NSP692	TO-220		45		200	45	750		3	3	2.5			3		1		3	5J
NSP696A	TO-220		45		200	45	750		4	3	2.8			4		1		3	5J
NSP698	TO-220		60		200	60	750		3	3	2.5			3		1		3	5J
NSP698A	TO-220		60		200	60	750		4	3	2.8			4		1		3	5J
NSP700	TO-220		80		200	80	750		3	3	2.5			3		1		3	5J
NSP700A	TO-220		80		200	80	750		4	3	2.8			4		1		3	5J
NSP702	TO-220		100		200	100	750		3	3	2.5			3		1		3	5J
NSP2010	TO-220		40		400	40	15 25	 125	3 1	4 4	1.5 1.0			5 3.5		3		0.5	5A
NSP2011	TO-220		60		400	60	15 25	 125	3 1	4 4	1.5 1.0			5 3.5		3		0.5	5A
NSP2090	TO-220		60		200	60	750		3	3	2.5			3		1		3	5J
NSP2091	TO-220		60		200	60	750		4	3	2.5			4		1		3	5J
NSP2092	TO-220		80		200	80	750		3	3	2.5			3		1		3	5J
NSP2093	TO-220		80		200	80	750		4	3	2.5			4		1		3	5J
NSP2370	TO-220		40		200†	40	10 40	 200	1 0.2	4 4	0.7			1		3		0.5	5F
NSP2490	TO-220		40		200†	40	8 20	 100	3 1	4 4	1.2 0.6			3 1		3		0.5	5E
NSP2491	TO-220		60		200†	60	8 20	 100	3 1	4 4	1.2 0.6			3 1		3		0.5	5E
NSP2955	TO-220		60		100	70	5 20	 70	10 4	4 4	8.0 1.1			10 4		2		0.5	5A
NSP3740	TO-220 Lead Bend + Clip		60		100	60	10 20 30 40	 100	1 0.5 0.25 0.1	1 1 1 1	0.6			1	100	3		0.1	5F
NSP3741	TO-220 Lead Bend + Clip		80		100	80	10 20 30 40	 100	1 0.5 0.25 0.1	1 1 1 1	0.6			1	100	3		0.100	5F

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CEX}† (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
NSP4918	TO-220		40		100	40	10 20 40	100	1 0.5 0.05	1 1 1	0.6		1.3	1		3		0.25	5F
NSP4919	TO-220		60		100	60	10 20 40	100	1 0.5 0.05	1 1 1	0.6		1.3	1		3		0.25	5F
NSP4920	TO-220		80		100	80	10 20 40	100	1 0.5 0.05	1 1 1	0.6		1.3	1		3		0.25	5F
NSP5193	TO-220		40		100	40	10 25	100	4 1.5	2 2	1.4 0.6			4 1.5		2		1	5E
NSP5194	TO-220		60		100	60	10 25	100	4 1.5	2 2	1.4 0.6			4 1.5		2		1	5E
NSP5195	TO-220		80		100	80	70 20	80	4 1.5	2 2	1.4 0.6			4 1.5		2		1	5E
NSP5974	TO-220		40		100†	60	7 20 40	120	5 2.5 0.5	2 2 2	1.7 0.6		2.5	5 2.5	300	2		0.5	5A
NSP5975	TO-220		60		100†	80	7 20 40	120	5 2.5 0.5	2 2 2	1.7 0.6		2.5	5 2.5	300	2		0.5	5A
NSP5976	TO-220		80		100†	100	7 20 40	120	5 2.5 0.5	2 2 2	1.7 0.6		2.5	5 2.5	300	2		0.5	5A
NSP5980	TO-220		40		100†	60	7 20 40	120	8 4 1	2 2 2	1.7 0.6		2.5	8 4	350	2		0.5	5A
NSP5981	TO-220		60		100†	80	7 20 40	120	8 4 1	2 2 2	1.7 0.6		2.5	8 4	350	2		0.5	5A
NSP5982	TO-220		80		100†	100	7 20 40	120	8 4 1	2 2 2	1.7 0.6		2.5	8 4	350	2		0.5	5A
TIP30	TO-220		40		200*	40	15 40	75	1 0.2	4 4	0.7			1		3		0.2	5F
TIP30A	TO-220		60		200*	60	15 40	75	1 0.2	4 4	0.7			1		3		0.2	5F
TIP30B	TO-220		80		200*	80	15 40	75	1 0.2	4 4	0.7			1		3		0.2	5F

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POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CEX}† (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
TIP30C	TO-220		100		200*	100	15 40	75	1 0.2	4 4	0.7			1		3		0.2	5F
TIP32	TO-220		40		200*	40	10 25	50	3 1	4 4	1.2			3		3		0.5	5F
TIP32A	TO-220		60		200*	60	10 25	50	3 1	4 4	1.2			3		3		0.5	5F
TIP32B	TO-220		80		200*	80	10 25	50	3 1	4 4	1.2			3		3		0.5	5F
TIP32C	TO-220		100		200*	100	10 25	50	3 1	4 4	1.2			3		3		0.5	5F
TIP42	TO-220		40		400*	40	15 30	75	3 0.3	4 4	1.5			6		3		0.5	5A
TIP42A	TO-220		60		400*	60	15 30	75	3 0.3	4 4	1.5			6		3		0.5	5A
TIP42B	TO-220		80		400*	80	15 30	75	3 0.3	4 4	1.5			6		3		0.5	5A
TIP42C	TO-220		100		400*	100	15 30	75	3 0.3	4 4	1.5			6		3		0.5	5A
TIP62	TO-220		40		200*	40	15 40	100	0.5 0.05	4 4	0.7			0.5		3		0.05	5F
TIP62A	TO-220		60		200*	60	15 40	100	0.5 0.05	4 4	0.7			0.5		3		0.05	5F
TIP62B	TO-220		80		200*	80	15 40	100	0.5 0.05	4 4	0.7			0.5		3		0.05	5F
TIP62C	TO-220		100		200*	100	15 40	100	0.5 0.05	4 4	0.7			0.5		3		0.05	5F
TIP115	TO-220		60		1 mA	60	500 1000		2 1	4 4	2.5			2					5J
TIP116	TO-220		80		1 mA	80	500 1000		2 1	4 4	2.5			2					5J
TIP117	TO-220		100		1 mA	100	500 1000		2 1	4 4	2.5			2					5J
TIP125	TO-220		60		200	60	1000 1000		3 0.5	3 3	4.0 2.0			5 3					5K
TIP126	TO-220		80		200	80	1000 1000		3 0.5	3 3	4.0 2.0			5 3					5K
TIP127	TO-220		100		200	100	1000 1000		3 0.5	3 3	4.0 2.0			5 3					5K

POWER (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CEX}† (μA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ (V) Min	$V_{BE(SAT)}$ (V) Max	@ I_C (A)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process
TIP135	TO-220		60		200	60	1000 500	15,000	4 1	4 4	3.0 2.0			6 4	200				5K
TIP136	TO-220		80		200	80	1000 500	15,000	4 1	4 4	3.0 2.0			6 4	200				5K
TIP137	TO-220		100		200	100	1000 500	15,000	4 1	4 4	3.0 2.0			6 4	200				5K

DUAL DIFFERENTIAL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} Min	H_{FE} Max	@ I_C (mA)	$H_{FE}1/H_{FE}2$ (%) Max	$V_{BE}1 - V_{BE}2$ (mV) Max	$\Delta V_{BE}1 - V_{BE}2 / \Delta T$ (μV/°C) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	No. Process
2N3347	TO-78	60	45	6	10	45	60 40	 300	1 0.01	10	5	10	6	60	240	4	1	62
2N3348	TO-78	60	45	6	10	45	60 40	 300	1 0.01	20	10	20	6	60	240	4	1	62
2N3349	TO-78	60	45	6	10	45	60 40	 300	1 0.01	40	20	40	6	60	240	4	1	62
2N3350	TO-78	60	45	6	10	45	150 100	 300	1 0.01	10	5	10	6	60	240	4	1	62
2N3351	TO-78	60	45	6	10	45	150 100	 300	1 0.01	20	10	20	6	60	240	4	1	62
2N3352	TO-78	60	45	6	10	45	150 100	 300	1 0.01	40	20	40	6	60	240	4	1	62
2N3726	TO-78	45	45	5	10	30	115 135 120 80	 350	50 1 0.1 0.01	10	5	20	8	200	600	4	2	62
2N3727	TO-78	45	45	5	10	30	115 135 120 80	 350	50 1 0.1 0.01	10	2.5	10	8	200	600	4	2	62

TEST CONDITIONS:
(1) $I_C = 10\,\mu A$, $V_{CE} = 5V$, f = 15.7kHz. **(2)** $I_C = 30\,\mu A$, $V_{CE} = 5V$, f = 1kHz. **(3)** $I_C = 100\,\mu A$, $V_{CE} = 10V$, f = 1kHz. **(4)** $I_C = 20\,\mu A$, $V_{CE} = 5V$, f = 1kHz.

DUAL DIFFERENTIAL AMPS (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	H_{FE} Min	H_{FE} Max @	I_C (mA)	$H_{FE}1/H_{FE}2$ (%) Max	$V_{BE}1 - V_{BE}2$ (mV) Max	$\Delta V_{BE}1 - V_{BE}2 / \Delta T$ ($\mu V/°C$) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	No. Process
2N3800	TO-71	60	60	5	10	50	125		10				4	100	500	3	4	62
							150	450	1									
							150	450	0.5									
							150	450	0.1									
							100		0.01									
2N3806	TO-78	60	60	5	10	50	125		10				4	100	500	3	3	62
							150	450	1									
							150	450	0.5									
							150	450	0.1									
							100		0.01									
2N3807	TO-78	60	60	5	10	50	250		10				4	100	500	1.5	3	62
							300	900	1									
							300	900	0.5									
							300	900	0.1									
							225		0.01									
2N3808	TO-78	60	60	5	10	50	125		10	20	5	20	4	100	500	3	3	62
							150	450	1									
							150	450	0.5									
							150	450	0.1									
							100		0.01									
2N3809	TO-78	60	60	5	10	50	250		10	20	5	20	4	100	500	1.5	3	62
							300	900	1									
							300	900	0.5									
							300	900	0.1									
							250		0.01									
2N3810	TO-78	60	60	5	10	50	125		10	10	3	10	4	100	500	3	3	62
							150	450	1									
							150	450	0.5									
							150	450	0.1									
							100		0.01									
2N3810 J, JTX, JTXV	TO-78	60	60	5	10	50	125		10	10	5	10	5	100	500	3	3	62
							150	450	1									
							150	450	0.5									
							150	450	0.1									
							100		0.01									

DUAL DIFFERENTIAL AMPS (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} Min	H_{FE} Max	@ I_C (mA)	H_{FE}^1/H_{FE}^2 (%) Max	$V_{BE}^1 - V_{BE}^2$ (mV) Max	$\Delta V_{BE}^1 - V_{BE}^2 / \Delta T$ ($\mu V/^\circ C$) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	No. Process
2N3810A	TO-78	60	60	5	10	50	125 150 150 150 100	 450 450 450 	10 1 0.5 0.1 0.01	5	1.5	5	4	100	500	3	3	62
2N3811	TO-78	60	60	5	10	50	250 300 300 300 225	 900 900 900 	10 1 0.5 0.1 0.01	10	3	10	4	100	500	1.5	3	62
2N3811 J, JTX, JTXV	TO-78	60	60	5	10	50	250 300 300 300 225	 900 900 900 	10 1 0.5 0.1 0.01	10	3	10	5	100	500	1.5	3	62
2N3811A	TO-78	60	60	5	10	50	250 300 300 300 225	 900 900 900 	10 1 0.5 0.1 0.01	5	1.5	5	4	100	500	1.5	3	62
2N4015	TO-78	60	60	5	10	50	115 135 120 80	 350 	50 1 0.1 0.01	10	5	20	8	200	600	4	2	62
2N4016	TO-78	60	60	5	10	50	115 135 120 80	 350 	50 1 0.1 0.01	10	2.5	10	8	200	600	4	2	62
2N4017	TO-78	80	80	6	10	70	90 100 100 100 100 60	 500 350 	50 10 1 0.1 0.01 0.001				6	40	160	3	4	62

TEST CONDITIONS:
(1) $I_C = 10\,\mu A$, $V_{CE} = 5V$, f = 15.7kHz. **(2)** $I_C = 30\,\mu A$, $V_{CE} = 5V$, f = 1kHz. **(3)** $I_C = 100\,\mu A$, $V_{CE} = 10V$, f = 1kHz. **(4)** $I_C = 20\,\mu A$, $V_{CE} = 5V$, f = 1kHz.

DUAL DIFFERENTIAL AMPS (Continued)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	H_{FE} Min	H_{FE} Max @	I_C (mA)	$\frac{H_{FE}{}^1}{H_{FE}{}^2}$ (%) Max	$V_{BE}{}^1 - V_{BE}{}^2$ (mV) Max	$\frac{\Delta V_{BE}{}^1 - V_{BE}{}^2}{\Delta T}$ (µV/°C) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	No. Process
2N4018	TO-78	60	60	6	10	50	90 100 100 100 100 60	 600 500 	50 10 1 0.1 0.01 0.001				6	40	160	3	4	62
2N4019	TO-78	45	45	6	10	30	180 200 250 250 250 180	 600 500 	50 10 1 0.1 0.01 0.001				6	50	160	2	4	62
2N4020	TO-78	45	45	6	10	30	180 200 250 250 250 180	 600 500 500 	50 10 1 0.1 0.01 0.001	20	5	20	6	50	160	2	4	62
2N4021	TO-78	60	60	6	10	50	90 100 100 100 100 60	 500 400 350 	50 10 1 0.1 0.01 0.001	20	5	20	6	40	160	3	4	62
2N4023	TO-78	45	45	6	10	30	180 200 250 250 250 180	 600 500 500 	50 10 1 0.1 0.01 0.001	10	3	10	6	50	160	2	4	62
2N4024	TO-78	60	60	6	10	50	90 100 100 100 100 60	 500 400 350 	50 10 1 0.1 0.01 0.001	10	3	10	6	40	160	3	4	62
2N4025	TO-78	60	60	6	10	50	180 200 250 250 250 180	 600 550 500 	50 10 1 0.1 0.01 0.001	10	3	10	6	50	160	2	4	62

TEST CONDITIONS:
(1) I_C = 10 µA, V_{CE} = 5V, f = 15.7kHz. **(2)** I_C = 30 µA, V_{CE} = 5V, f = 1kHz. **(3)** I_C = 100 µA, V_{CE} = 10V, f = 1kHz. **(4)** I_C = 20 µA, V_{CE} = 5V, f = 1kHz.

Section 3

Pro Electron Series

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Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC107	TO-18	50	45	6	15*	50	40 125 40	 500* 	0.01 2 0.01	5 5 5	0.6 0.2	0.55	0.7*	100 10 2	4.5	150		10		10	1	04
BC107A	TO-18	50	45	6	15*	50	125	260*	2	5	0.6 0.2	0.55	0.7*	100 10 2	4.5	150		10		10	1	04
BC107B	TO-18	50	45	6	15*	50	40 240	 500*	0.01 2	5 5	0.6 0.2	0.55	0.7*	100 10 2	4.5	150		10		10	1	04
BC108	TO-18	30	20	5	15*	30	40 125	 900*	0.01 2	5 5	0.6 0.2	0.55	0.7*	100 10 2	4.5	150		10		10	1	04
BC108A	TO-18	30	20	5	15*	30	40 125	 260*	0.01 2	5 5	0.6 0.2	0.55	0.7*	100 100 2	4.5	150		10		10	1	04
BC108B	TO-18	30	20	5	15*	30	40 240	 500*	0.01 2	5 5	0.6 0.2	0.55	0.7*	100 10 2	4.5	150		10		10	1	04
BC108C	TO-18	30	20	5	15*	30	40 450	 900*	0.01 2	5 5	0.6 0.2	0.55	0.7*	100 10 2	4.5	150		10		10	1	04
BC109	TO-18	30	20	5	15*	30	100 240	 900*	0.01 2	5 5	0.6 0.2	0.55	0.7*	100 10 2	4.5	150		10		4	1	04
BC109B	TO-18	30	20	5	15*	30	100 240	 500*	0.01 2	5 5	0.6 0.2	0.55	0.7*	100 10 2	4.5	150		10		4	1	04
BC109C	TO-18	30	20	5	15*	30	100 450	 900*	0.01 2	5 5	0.6 0.2	0.55	0.7*	100 10 2	4.5	150		10		4	1	04
BC140	TO-39	80*	40	7	100*	60	40	250	100	1	1.0		1.8*	1A	25	50		50	850		2	14
BC140-6	TO-39	80*	40	7	100*	60	40	100	100	1	1.0		1.8*	1A	25	50		50	850		2	14
BC140-10	TO-39	80*	40	7	100*	60	63	160	100	1	1.0		1.8*	1A	25	50		50	850		2	14
BC140-16	TO-39	80*	40	7	100*	60	100	250	100	1	1.0		1.8*	1A	25	50		50	850		2	14
BC141	TO-39	100*	60	7	100*	60	40	250	100	1	1.0		1.8*	1A	25	50		50	850		2	14
BC141-6	TO-39	100*	60	7	100*	60	40	100	100	1	1.0		1.8*	1A	25	50		50	850		2	14
BC141-10	TO-39	100*	60	7	100*	60	63	160	100	1	1.0		1.8*	1A	25	50		50	850		2	14
BC143	TO 5	60	60	5	50	40	20		200	2	1.5		1.5	500 200	20	60		50			2	63

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC146-1	TO-92 (74)	20	20	4	50	40	100 80	 200	2 0.2	1 0.2	1.5		1.5	500 200	20	60		50			2	04
BC146-2	TO-92 (74)	20	20	4	50	40	140 140	 350	2 0.2	1 0.2	1.5		1.5	500 200	20	60		50			2	04
BC146-3	TO-92 (74)	20	20	4	50	40	280 280	 550	2 0.2	1 0.2	1.5		1.5	500 200	20	60		50			2	04
BC160	TO-39	40*	5	40	100	40	40	250	100	1	1.0		1.7*	1A	30	50		50	650		2	67
BC160-6	TO-39	40*	5	40	100	40	40	100	100	1	1.0		1.7*	1A	30	50		50	650		2	67
BC160-10	TO-39	40*	5	40	100	40	63	160	100	1	1.0		1.7*	1A	30	50		50	650		2	67
BC160-16	TO-39	40*	5	40	100	40	100	250	100	1	1.0		1.7*	1A	30	50		50	650		2	67
BC161	TO-39	60*	5	60	100	60	40	250	100	1	1.0		1.7*	1A	30	50		50	650		2	67
BC161-6	TO-39	60*	5	60	100	60	40	100	100	1	1.0		1.7*	1A	30	50		50	650		2	67
BC161-10	TO-39	60*	5	60	100	60	63	160	100	1	1.0		1.7*	1A	30	50		50	650		2	67
BC161-16	TO-39	60*	5	60	100	60	100	250	100	1	1.0		1.7*	1A	30	50		50	650		2	67
BC167	TO-92 (74)	60*	45	6	15*	50	110 125	 500*	2 2	5 5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC167A	TO-92 (74)	60*	45	6	15*	50	110 125	260* 	2 2	5 5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC167B	TO-92 (74)	60*	45	6	15*	50	110 240	500* 	2 2	5 5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC168	TO-92 (74)		20	5	15*	30	110 125	 900*	2 2	5 5	0.2 0.6	 0.55	 0.70*	10 100 2	4.5	150		10		10	1	04
BC168A	TO-92 (74)		20	5	15*	30	110 125	 260*	2 2	5 5	0.2 0.6	 0.55	 0.70*	10 100 2	4.5	150		10		10	1	04
BC168B	TO-92 (74)		20	5	15*	30	110 240	 500*	2 2	5 5	0.2 0.6	 0.55	 0.70*	10 100 2	4.5	150		10		10	1	04

TEST CONDITIONS:

(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_B^1 = 50mA, I_B^2 = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_B^1 = 3mA, I_B^2 = 1mA. **(16)** I_C = 100mA, I_B^1 = 40mA, I_B^2 = 20mA.

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Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC168C	TO-92 (74)		20	5	15*	30	110 450	 900*	2 2	5 5	0.2 0.6	 0.55	 0.70*	10 100 2	4.5	150		10		10	1	04
BC169	TO-92 (74)		20	5	15*	30	110 240	 900*	2 2	5 5	0.2 0.6	 0.55	 0.70*	10 100 2	4.5	150		10		4	1	04
BC169B	TO-92 (74)		20	5	15*	30	110 240	 500*	2 2	5 5	0.2 0.6	 0.55	 0.70*	10 100 2	4.5	150		10		4	1	04
BC169C	TO-92 (74)		20	5	15*	30	110 450	 900*	2 2	5 5	0.2 0.6	 0.55	 0.70*	10 100 2	4.5	150		10		4	1	04
BC177	TO-18	50	45	5	100	20	110 125	 500*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		10	1	71
BC177A	TO-18	50	45	5	100	20	110 125	 260*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		10	1	71
BC177B	TO-18	50	45	5	100	20	110 240	 500*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		10	1	71
BC177VI	TO-18	50	45	5	100	20	110 75	 150*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		10	1	71
BC178	TO-18	30	25	5	100	20	110 125	 900*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		10	1	71
BC178A	TO-18	30	25	5	100	20	110 125	 260*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		10	1	71
BC178B	TO-18	30	25	5	100	20	110 240	 500*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		10	1	71
BC179	TO-18	25	20	5	100	20	110 125	 900*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		4	1	71
BC179A	TO-18	25	20	5	100	20	110 125	 260*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		4	1	71

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max @	V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	Max	@ I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC179B	TO-18	25	20	5	100	20	110 240	 500*	2 2	5 5	0.18		0.78 0.75* 1.0*	10 2 100	4.5	150		10		4	1	71
BC182	TO-92 (77)	60	50	5	15	50	40 80 125	 500*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC182A	TO-92 (77)	60	50	5	15	50	40 80 125	 260*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC182B	TO-92 (77)	60	50	5	15	50	40 80 240	 500*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC182L	TO-92 (74)	60	50	5	15	50	40 80 125	 500*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC182LA	TO-92 (74)	60	50	5	15	50	40 80 125	 260*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC182LB	TO-92 (74)	60	50	5	15	50	40 80 240	 500*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC183	TO-92 (77)	45	30	5	15	30	40 80 125	 900*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC183A	TO-92 (77)	45	30	5	15	30	40 80 125	 260*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC183B	TO-92 (77)	45	30	5	15	30	40 80 240	 500*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC183C	TO-92 (77)	45	30	5	15	30	40 80 450	 900*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04

TEST CONDITIONS:
(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_B^1 = 50mA, I_B^2 = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_B^1 = 3mA, I_B^2 = 1mA. **(16)** I_C = 100mA, I_B^1 = 40mA, I_B^2 = 20mA.

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Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC183L	TO-92 (74)	45	30	5	15	30	40 80 125	 900*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC183LA	TO-92 (74)	45	30	5	15	30	40 80 125	 260*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC183LB	TO-92 (74)	45	30	5	15	30	40 80 240	 500*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC183LC	TO-92 (74)	45	30	5	15	30	40 80 450	 900*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		10	1	04
BC184	TO-92 (77)	45	30	50	15	30	100 130 240	 900*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		4	1	04
BC184B	TO-92 (77)	45	30	50	15	30	100 130 240	 500*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		4	1	04
BC184C	TO-92 (77)	45	30	50	15	30	100 130 450	 900*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		4	1	04
BC184L	TO-92 (74)	45	30	50	15	30	100 130 240	 900*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		4	1	04
BC184LB	TO-92 (74)	45	30	50	15	30	100 130 240	 500*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		4	1	04
BC184LC	TO-92 (74)	45	30	50	15	30	100 130 450	 900*	0.01 100 2	5 5 5	0.6 0.25	 0.55	1.2 0.70*	100 10 2	5	150		10		4	1	04
BC212	TO-92 (77)	60	50	5	15	30	 60	 400*	 2	 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		10	1	63
BC212A	TO-92 (77)	60	50	5	15	30	 100	 300*	 2	 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		10	1	63
BC212B	TO-92 (77)	60	50	5	15	30	 200	 400*	0.01 100 2	 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		10	1	63

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	$V_{BE(SAT)}$ & $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ & $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC212L	TO-92	60	50	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(74)						60	300	2	5	0.25			10								
							60*		2	5		0.6	0.72*	2								
BC212LA	TO-92	60	50	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(74)						60		2	5	0.25			10								
							100	300*	2	5		0.6	0.72*	2								
BC212LB	TO-92	60	50	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(74)						60		2	5	0.25			10								
							200	400*	2	5		0.6	0.72*	2								
BC213	TO-92	45	30	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(77)						60		2	5	0.25			10								
							80	600*	2	5		0.6	0.72*	2								
BC213A	TO-92	45	30	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(77)						60		2	5	0.25			10								
							100	300*	2	5		0.6	0.72*	2								
BC213B	TO-92	45	30	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(77)						60		2	5	0.25			10								
							200	400*	2	5		0.6	0.72*	2								
BC213C	TO-92	45	30	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(77)						60		2	5	0.25			10								
							350	600*	2	5		0.6	0.72*	2								
BC213L	TO-92	45	30	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(74)						80	400	2	5	0.25			10								
							80*		2	5		0.6	0.72*	2								
BC213LA	TO-92	45	30	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(74)						80		2	5	0.25			10								
							100	300*	2	5		0.6	0.72*	2								
BC213LB	TO-92	45	30	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
	(74)						80		2	5	0.25			10								
							200	400*	2	5		0.6	0.72*	2								

TEST CONDITIONS:

(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_B^1 = 50mA, I_B^2 = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_B^1 = 3mA, I_B^2 = 1mA. **(16)** I_C = 100mA, I_B^1 = 40mA, I_B^2 = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC213LC	TO-92 (74)	45	30	5	15	30	40 80 350	 600*	0.01 2 2	5 5 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		10	1	63
BC214	TO-92 (77)	45	30	5	15	30	40 80 140	 600*	0.01 2 2	5 5 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		2	1	63
BC214A	TO-92 (77)	45	30	5	15	30	40 80 100	 300*	0.01 2 2	5 5 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		2	1	63
BC214B	TO-92 (77)	45	30	5	15	30	40 80 200	 400*	0.01 2 2	5 5 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		2	1	63
BC214C	TO-92 (77)	45	30	5	15	30	40 80 350	 600*	0.01 2 2	5 5 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		2	1	63
BC214L	TO-92 (74)	45	30	5	15	30	100 140 120 140*	 400	0.01 2 100 2	5 5 5 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		2	1	63
BC214LB	TO-92 (74)	45	30	5	15	30	100 140 120 200	 400*	0.01 2 100 2	5 5 5 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		2	1	63
BC214LC	TO-92 (74)	45	30	5	15	30	100 140 120 350	 600*	0.01 2 100 2	5 5 5 5	0.6 0.25	 0.6	1.1 0.72*	100 10 2	10	200		10		2	1	63
BC237-92	TO-92 (77)	50	45	6	50	20	100 140 120 125	 500*	0.01 2 100 2	5 5 5 5	0.25	 0.55	0.77* 0.6 0.70*	10 100 2	4.5					10	1	04
BC237A-92	TO-92 (77)	50	45	6	50	20	100 140 120 125	 500*	0.01 2 100 2	5 5 5 5	0.25	 0.55	0.77* 0.6 0.70*	10 100 2	4.5					10	1	04
BC237B-92	TO-92 (77)	50	45	6	50	20	100 140 120 240	 500*	0.01 2 100 2	5 5 5 5	0.25	 0.55	0.77* 0.6 0.70*	10 100 2	4.5					10	1	04

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC238-92	TO-92 (77)	30	20	5	50	20	100		0.01	5	0.25		0.77*	10	4.5					10	1	04
							140		2	5			0.6	100								
							120		100	5												
							125	900*	2	5		0.55	0.70*	2								
BC238A-92	TO-92 (77)	30	20	5	50	20	100		0.01	5	0.25		0.77*	10	4.5					10	1	04
							140		2	5			0.6	100								
							120		100	5												
							125	260*	2	5		0.55	0.70*	2								
BC238B-92	TO-92 (77)	30	20	5	50	20	100		0.01	5	0.25		0.77*	10	4.5					10	1	04
							140		2	5			0.6	100								
							120		100	5												
							240	500*	2	5		0.55	0.70*	2								
BC238C-92	TO-92 (77)	30	20	5	50	20	100		0.01	5	0.25		0.77*	10	4.5					10	1	04
							140		2	5			0.6	100								
							120		100	5												
							450	900*	2	5		0.55	0.70*	2								
BC239-92	TO-92 (77)	30	20	5	50	20	100		0.01	5	0.25		0.77*	10	4.5					4	1	04
							140		2	5			0.6	100								
							120		100	5												
							240	900*	2	5		0.55	0.70	2								
BC239B-92	TO-92 (77)	30	20	5	50	20	100		0.01	5	0.25		0.77*	10	4.5					4	1	04
							140		2	5			0.6	100								
							120		100	5												
							240	500*	2	5		0.55	0.70	2								
BC239C-92	TO-92 (77)	30	20	5	50	20	100		0.01	5	0.25		0.77*	10	4.5					4	1	04
							140		2	5			0.6	100								
							120		100	5												
							450	900*	2	5		0.55	0.70	2								
BC261A	TO-18		45		50	45	100		0.01	5	0.25		0.9	10	4.5					6	3	71
							140		2	5	0.6			100								
							120		100	5												
							125	260*	2	5												

TEST CONDITIONS:

(1) I_C = 200 µA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 5mA. **(3)** I_C = 200 µA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 µA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(10)** I_C = 200 µA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(13)** I_C = 10 µA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_B^1 = 50mA, I_B^2 = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_B^1 = 3mA, I_B^2 = 1mA. **(16)** I_C = 100mA, I_B^1 = 40mA, I_B^2 = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC261B	TO-18		45		50	45	100		0.01	5	0.25		0.9	10						6	3	71
							140		2	5	0.6			100								
							120		100	5												
							240	500*	2	5												
BC262A	TO-18		20	5	50	20	100		0.01	5	0.25		0.9	10						6	3	71
							140		2	5												
							120		100	5												
							125	260*	2	5	0.6			100								
BC262B	TO-18		20	5	50	20	100		0.01	5	0.25		0.9	10						6	3	71
							140		2	5												
							120		100	5												
							240	500*	2	5	0.6			100								
BC263A	TO-18		20	5	50	20	100		0.01	5	0.25		0.9	10						2.5	3	71
							140		2	5												
							120		100	5												
							125	260*	2	5	0.6			100								
BC263B	TO-18		20	5	50	20	100		0.01	5	0.25		0.9	10						2.5	3	71
							140		2	5												
							120		100	5												
							240	500*	2	5	0.6			100								
BC307-92	TO-92 (77)	50	45	5	100	20	100		0.01	5	0.18		0.78	10						10	1	71
							140		2	5			1.0*	100								
							120		100	5												
							75	500*	2	5			0.75*	2								
BC307A-92	TO-92 (77)	50	45	5	100	20	100		0.01	5	0.18		0.78	10						10	1	71
							140		2	5			1.0*	100								
							120		100	5												
							125	260*	2	5			0.75*	2								
BC307B-92	TO-92 (77)	50	45	5	100	20	100		0.01	5	0.18		0.78	10						10	1	71
							140		2	5			1.0*	100								
							120		100	5												
							240	500*	2	5			0.75*	2								
BC308-92	TO-92 (77)	30	25	5	100	20	100		0.01	5	0.18		0.78	10						10	1	71
							140		2	5			1.0*	100								
							120		100	5												
							125	900*	2	5			0.75*	2								
BC308A-92	TO-92 (77)	30	25	5	100	20	100		0.01	5	0.18		0.78	10						10	1	71
							140		2	5			1.0*	100								
							120		100	5												
							125	260*	2	5			0.75*	2								

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC308B-92	TO-92 (77)	30	25	5	100	20	100		0.01	5	0.18		0.78	10						10	1	71
							140	400	2	5			1.0*	100								
							120		100	5												
							240	500*	2	5			0.75*	2								
BC308C-92	TO-92 (77)	30	25	5	100	20	100		0.01	5	0.18		0.78	10						10	1	71
							140	400	2	5			1.0*	100								
							120		100	5												
							450	900*	2	5			0.75*	2								
BC309–92	TO-92 (77)	25	20	5	100	20	100		0.01	5	0.18		0.78	10						4	1	71
							140	400	2	5			1.0	100								
							120		100	5												
							125	900*	2	5			0.75	2								
BC309B-92	TO-92 (77)	25	20	5	100	20	100		0.01	5	0.18		0.78	10						4	1	71
							140		2	5			1.0	100								
							120		100	5												
							240	500*	2	5			0.75	2								
BC309C-92	TO-92 (77)	25	20	5	100	20	100		0.01	5	0.8		0.78	10						4	1	71
							140	400	2	5			1.0	100								
							120		100	5												
							450	900*	2	5			0.75*	2								
BC317	TO-92 (72)	50	45	6	30	20	110	450	2	5	0.2		0.77*	10	4					6	1	04
							125	500*	2	5	0.5			100								
												0.57	0.72*	2								
BC317A	TO-92 (72)	50	45	6	30	20	110	220	2	5	0.2		0.77*	10	4					6	1	04
							125	260*	2	5	0.5			100								
												0.57	0.72*	2								
BC317B	TO-92 (72)	50	45	6	30	20	200	450	2	5	0.2		0.77*	10	4					6	1	04
							240	500*	2	5	0.5			100								
												0.57	0.72*	2								
BC318	TO-92 (72)	30	20	5	30	20	110	800	2	5	0.2		0.77*	10	4					6	1	04
							125	900*	2	5	0.5			100								
												0.57	0.72*	2								
BC318A	TO-92 (72)	30	20	5	30	20	110	220	2	5	0.2		0.77*	10	4					6	1	04
							125	260*	2	5	0.5			100								
												0.57	0.72*	2								

TEST CONDITIONS:

(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_B^1 = 50mA, I_B^2 = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_B^1 = 3mA, I_B^2 = 1mA. **(16)** I_C = 100mA, I_B^1 = 40mA, I_B^2 = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	V_{BE} Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC318B	TO-29 (72)	30	20	5	30	20	200 240	450 500*	2 2	5 5	0.2 0.5	0.57	0.77* 0.72*	10 100 2	4					6	1	04
BC318C	TO-92 (72)	30	20	5	30	20	100 450 450	800 900*	0.01 2 2	5 5 5	0.2 0.5	0.57	0.77* 0.72*	10 100 2	4					6	1	04
BC319	TO-92 (72)	30	20	5	30	20	40 200 240	800 900*	0.01 2 2	5 5 5	0.2 0.5	0.57	0.77* 0.72*	10 100 2	4					4	1	04
BC319B	TO-92 (72)	30	20	5	30	20	200 240	450 500*	2 2	5 5	0.2 0.5	0.57	0.77* 0.72*	10 100 2	4					4	1	04
BC319C	TO-92 (72)	30	20	5	30	20	100 420 450	800 900*	0.01 2 2	5 5 5	0.2 0.5	0.57	0.77* 0.72*	10 100 2	4					4	1	04
BC327	TO-92 (77)	50†	45	5	100†	45	40 100	600	300 100	1 1	0.7		12*	500 300	4					4	1	67
BC327-10	TO-92 (77)	50†	45	5	100†	45	40 63	160	300 100	1 1	0.7		1.2*	500 300	4					4	1	67
BC327-16	TO-92 (77)	50†	45	5	100†	45	40 100	250	300 100	1 1	0.7		1.2*	500 300	4					4	1	67
BC327-25	TO-92 (77)	50†	45	5	100†	45	40 160	400	300 100	1 1	0.7		1.2*	500 300	4					4	1	67
BC328	TO-92 (77)	30†	25	5	100†	25	40 100	600	300 100	1 1	0.7		1.2	500 300	4					4	1	67
BC328-10	TO-92 (77)	30†	25	5	100†	25	40 63	160	300 100	1 1	0.7		1.2	500 300	4					4	1	67
BC328-16	TO-92 (77)	30†	25	5	100†	25	40 100	250	300 100	1 1	0.7		1.2	500 300	4					4	1	67
BC328-25	TO-92 (77)	30†	25	5	100†	25	40 160	400	300 100	1 1	0.7		1.2	500 300	4					4	1	67
BC337	TO-92 (77)	50†	45	5	100†	45	40 100	600	300 100	1 1	0.7		1.2*	500 300	4					4	1	14
BC377-10	TO-92 (77)	50†	45	5	100†	45	40 63	160	300 100	1 1	0.7		1.2*	500 300	4					4	1	14
BC337-16	TO-92 (77)	50†	45	5	100†	45	40 100	250	300 100	1 1	0.7		1.2*	500 300	4					4	1	14
BC337-25	TO-92 (77)	50†	45	5	100†	45	40 160	400	300 100	1 1	0.7		1.2*	500 300	4					4	1	14

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC338	TO-92	30†	25	5	100†	25	40		300	1	0.7			500	4					4	1	14
	(77)						100	600	100	1			1.2*	300								
BC338-10	TO-92	30†	25	5	100†	25	40		300	1	0.7			500	4					4	1	14
	(77)						63	160	100	1			1.2*	300								
BC338-16	TO-92	30†	25	5	100†	25	40		300	1	0.7			500	4					4	1	14
	(77)						100	250	100	1			1.2*	300								
BC338-25	TO-92	30†	25	5	100†	25	40		300	1	0.7			500	4					4	1	14
	(77)						160	400	100	1			1.2*	300								
BC485	TO-92	45	45	5	100	30	15		1A	5	0.5		1.2	500	4					4	1	14
	(77)						40		10	2			.12*	300								
							60	400	100	2												
BC485A	TO-92	45	45	5	100	30	15		1A	5	0.5		1.2	500	4					4	1	14
	(77)						40		10	2			1.2*	300								
							100	250	100	2												
BC485B	TO-92	45	45	5	100	30	15		1A	5	0.5		1.2	500	4					4	1	14
	(77)						40		10	2			1.2*	300								
							160	400	100	2												
BC485L	TO-92	45	45	5	100	30	15		1A	5	0.5		1.2	500	4					4	1	14
	(77)						40		10	2			1.2*	300								
							60	150	100	2												
BC547	TO-92	50	45	6	10	20					0.25		0.77*	10	4.5					10	1	04
	(77)										0.6			100								
							125	500*	2	5		0.55	0.70*	2								
BC547A	TO-92	50	45	6	10	20					0.25		0.77*	10	4.5					10	1	04
	(77)										0.6			100								
							125	260*	2	5		0.55	0.70*	2								
BC547B	TO-92	50	45	6	10	20					0.25		0.77*	10	4.5					10	1	04
	(77)										0.6			100								
							240	500*	2	5		0.55	0.70*	2								
BC547C	TO-92	50	45	6	10	20					0.25		0.77*	10	4.5					10	1	04
	(77)										0.6			100								
							450	900*	2	5		0.55	0.70*	2								

TEST CONDITIONS:
(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f =1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_B^1 = 50mA, I_B^2 = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_B^1 = 3mA, I_B^2 = 1mA. **(16)** I_C = 100mA, I_B^1 = 40mA, I_B^2 = 20mA.

Pro Electron Series

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	(V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC548	TO-92 (77)	30	20	5	10	20	125	900*	2	5	0.25 0.6	0.55	0.77* 0.70*	10 100 2	4.5					10	1	04
BC548A	TO-92 (77)	30	20	5	10	20	125	260*	2	5	0.25 0.6	0.55	0.77* 0.70*	10 100 2	4.5					10	1	04
BC548B	TO-92 (77)	30	20	5	10	20	240	500*	2	5	0.25 0.6	0.55	0.77* 0.70*	10 100 2	4.5					10	1	04
BC548C	TO-92 (77)	30	20	5	10	20	450	900*	2	5	0.25 0.6	0.55	0.77* 0.70*	10 100 2	4.5					10	1	04
BC549	TO-92 (77)	30	20	5	10	20	240	900*	2	5	0.25 0.6	0.55	0.77* 0.70	10 100 2	4.5					4	1	04
BC549B	TO-92 (77)	30	20	5	10	20	240	500*	2	5	0.25 0.6	0.55	0.77* 0.70	10 100 2	4.5					4	1	04
BC549C	TO-92 (77)	30	20	5	10	20	450	900*	2	5	0.25	0.55	0.77* 0.70	10 100 2	4.5					4	1	04
BC550	TO-92 (77)	50	45	5	10	45	240	900*	2	5	0.25 0.6	0.55	0.77* 0.70	10 100 2						3	1	04
BC550B	TO-92 (77)	50	45	5	10	45	240	500*	2	5	0.25 0.6	0.55	0.77* 0.70	10 100 2						3	1	04
BC550C	TO-92 (77)	50	45	5	10	45	450	900*	2	5	0.25 0.6	0.55	0.77* 0.70	10 100 2						3	1	04
BC557	TO-92 (77)	50	45	5	100	20	75	260*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						10	1	71
BC557A	TO-92 (77)	50	45	5	100	20	125	260*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						10	1	71
BC557B	TO-92 (77)	50	45	5	100	20	240	500*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						10	1	71

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC558	TO-92 (77)	30	25	5	100	20	75	500*	2	5	0.3 0.65	0.6	0.82* 0.75	10 100 2						10	1	71
BC558A	TO-92 (77)	30	25	5	100	20	125	260*	2	5	0.3 0.65	0.6	0.82* 0.75	10 100 2						10	1	71
BC558B	TO-92 (77)	30	25	5	100	20	240	500*	2	5	0.3 0.65	0.6	0.82* 0.75	10 100 2						10	1	71
BC558C	TO-92 (77)	30	25	5	100	20	450	900*	2	5	0.3 0.65	0.6	0.82* 0.75	10 100 2						10	1	71
BC559	TO 92 (77)	25	20	5	100	20	125	500*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						4	1	71
BC559A	TO-92 (77)	25	20	5	100	20	125	260*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						4	1	71
BC559B	TO-92 (77)	25	20	5	100	20	240	500*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						4	1	71
BC559C	TO-92 (77)	25	20	5	100	20	450	900*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						4	1	71
BC560	TO-92 (77)	50	45	5	100	45	125	500*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						2	1	71
BC560A	TO-92 (77)	50	45	5	100	45	125	260*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						2	1	71
BC560B	TO-92 (77)	50	45	5	100	45	240	500*	2	5	0.3 0.65	0.6	0.82* 0.75*	10 100 2						2	1	71

TEST CONDITIONS:
(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_B^1 = 50mA, I_B^2 = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_B^1 = 3mA, I_B^2 = 1mA. **(16)** I_C = 100mA, I_B^1 = 40mA, I_B^2 = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC560C	TO-92 (77)	50	45	5	100	45	 450	 900*	 2	 5	0.3 0.65	 0.6	0.82* 0.75*	10 100 2						2	1	71
BCY56	TO-18	45	45	5	100	20	40 100 125 40	 450 500* 	10 2 2 0.01	5 5 5 5		0.6	0.7*	2						5	1	04
BCY57	TO-18	25	20	5	100	20	200 200 240 100	 800 900* 	10 2 2 0.01	5 5 5 5		0.6	0.7*	2						5	1	04
BCY58	TO-18		32	7	10†	32	40 80 125	 1000 700*	100 10 2	1 1 5	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800	6	4/1	04
BCY58-7	TO-18		32	7	10†	32	40 80 125	 1000 250*	100 10 2	1 1 5	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800	6	4/1	04
BCY58-8	TO-18		32	7	10†	32	40 80 175	 1000 350*	100 10 2	1 1 5	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800	6	4/1	04
BCY58-9	TO-18		32	7	10†	32	40 80 250	 1000 500*	100 10 2	1 1 5	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800	6	4/1	04
BCY58-10	TO-18		32	7	10†	32	40 80 350	 1000 700*	100 10 2	1 1 5	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800	6	4/1	04
BCY59	TO-18		45	7	10†	45	40 80 125	 1000 700*	100 10 2	1 1 5	0.35 0.7	0.6 0.55	0.85 0.75 0.7*	10 1.2 2	6 100	125		10	800	6	4/1	04
BCY59-7	TO-18		45	7	10†	45	40 80 125	 1000 250*	100 10 2	1 1 5	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800	6	4/1	04
BCY59-8	TO-18		45	7	10†	45	40 80 175	 1000 350*	100 10 2	1 1 5	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6 100	125		10	800	6	4/1	04
BCY59-9	TO-18		45	7	10†	45	40 80 250	 1000 500*	100 10 2	1 1 5	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800	6	4/1	04
BCY59-10	TO-18		45	7	10†	45	40 80 350	 1000 700*	100 10 2	1 1 5	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800	6	4/1	04

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	HFE h_{fe} 1 kHz* Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BCY70	TO-18	50	40	5	10	40	40		0.1	1	0.25	0.6	0.9	10	6	250		10	420	6	5/6	71
							45		1	1												
							50		10	1												
							15		50	1	0.5		1.2	50								
BCY71	TO-18	45	45	5	500	45	40		0.01	1	0.25	0.6	0.9	10	6	200		10		2	6	71
							80		0.1	1												
							90		1	1												
							100	600	10	1	0.5		1.2	50								
BCY71A	TO-18	45	45	5	500	45	40		0.01	1	0.25	0.6	0.9	10	6	300		10	420	2	6	71
							80		0.1	1												
							90		1	1												
							100	600	10	1	0.5		1.2	50								
BCY72	TO-18	25	25	5	500	20	40		1	1	0.25			10	6	200		10	420	6	5/6	71
							50		10	1	0.5		1.2	50								
BD135	TO-126	45	45	5	100	30	25		500	2	0.5		1.0*	500		50		50	420	6	5/6	37
							40	250	50	2												
BC136	TO-126	45	45	5	100	30	25		500	2	0.5		1.0*	500		50		50				77
							40	250	50	2												
BD137	TO-126	60	60	5	100	30	25		500	2	0.5		1.0*	500		50		50	420	6	5/6	38
							40	160	50	2												
BD138	TO-126	60	60	5	100	30	25		500	2	0.5		1.0*	500		50		50				78
							40	160	50	2												
BD139	TO-126	80	80	5	100	30	25		500	2	0.5		1.0*	500		50		50	420	6	5/6	39
							40	160	50	2												
BD140	TO-126	80	80	5	100	30	25		500	2	0.5		1.0*	500		50		50	420	6	5/6	79
							40	160	50	2												
BD201	TO-220	60	45	5	10 μA	40	30		3A	2	1.0		1.5*	3A		3		300	420	6	5/6	4A
							30		1A	2												
							75	235	500	1												
BD202	TO-220	60	45	5	10 μA	40	30		3A	2	1.0		1.5*	3A		3		300	420	6	5/6	5A
							30		1A	2												
							75	235	500	1												
BD233	TO-126	45	45		100 μA	45	25		1A	2	0.6		1.3*	1A		3		250	420	6	5/6	2C
							40		150	2												

TEST CONDITIONS:

(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B{}^1 = I_B{}^2$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B{}^1 = I_B{}^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B{}^1 = I_B{}^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_B{}^1 = I_B{}^2$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B{}^1 = I_B{}^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B{}^1 = I_B{}^2$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, $I_B{}^1$ = 50mA, $I_B{}^2$ = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, $I_B{}^1$ = 3mA, $I_B{}^2$ = 1mA. **(16)** I_C = 100mA, $I_B{}^1$ = 40mA, $I_B{}^2$ = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BD234	TO-126	45	45		100 μA	45	25 40		1A 150	2 2	0.6		1.3*	1A		3		250	420	6	5/6	3C
BD235	TO-126	60	60		100 μA	60	25 40		1A 150	2 2	0.6		1.3*	1A		3		250	420	6	5/6	2C
BD236	TO-126	60	60		100 μA	60	25 40		1A 150	2 2	0.6		1.3*	1A		3		250	420	6	5/6	3C
BD237	TO-126	80	80		100 μA	80	25 40		1A 150	2 2	0.6		1.3*	1A		3		250	420	6	5/6	2C
BD238	TO-126		80		100 μA	80	25 40		1A 150	2 2	0.6		1.3*	1A		3		250	420	6	5/6	3C
BD239	TO-220		45		200 μA*	45	15 40		1A 200	4 4	0.7		1.3*	1A		3		200	420	6	5/6	4F(2C)
BD239A	TO-220		60		200 μA*	60	15 40		1A 200	4 4	0.7		1.3*	1A		3		200	420	6	5/6	4F(2C)
BD239B	TO-220		80		200 μA*	80	15 40		1A 200	4 4	0.7		1.3*	1A		3		200	420	6	5/6	4F(2C)
BD239C	TO-220		100		200 μA*	100	15 40		1A 200	4 4	0.7		1.3*	1A		3		200	420	6	5/6	4F(2C)
BD240	TO-220		45		200 μA*	45	15 40		1A 200	4 4	0.7		1.3*	1A		3		200	420	6	5/6	5F(3C)
BD240A	TO-220	80	60		200 μA*	60	15 40		1A 200	4 4	0.7		1.3*	1A		3		200	420	6	5/6	5F(3C)
BD240B	TO-220	80	80		200 μA*	80	15 40		1A 200	4 4	0.7		1.3*	1A		3		200	420	6	5/6	5F(3C)
BD240C	TO-220	80	100		200 μA*	100	15 40		1A 200	4 4	0.7		1.3*	1A		3		200	420	6	5/6	5F(3C)
BD241	TO-220	80	45		200 μA*	45	10 25		3A 1A	4 4	1.3		1.8*	3A		3		500	420	6	5/6	4F(2C)
BD241A	TO-220	80	60		200 μA*	60	10 25		3A 1A	4 4	1.3		1.8*	3A		3		500	420	6	5/6	4F(2C)
BD241B	TO-220	80	80		200 μA*	80	10 25		3A 1A	4 4	1.3		1.8*	3A		3		500	420	6	5/6	4F(2C)
BD241C	TO-220	80	100		200 μA*	100	10 25		3A 1A	4 4	1.3		1.8*	3A		3		500	420	6	5/6	4F(2C)
BD242	TO-220	80	45		200 μA*	45	10 25		3A 1A	4 4	1.2		1.8*	3A		3		500	420	6	5/6	5E(3E)
BD242A	TO-220	80	60		200 μA*	60	10 25		3A 1A	4 4	1.2		1.8*	3A		3		500	420	6	5/6	5E(3E)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	$V_{BE(SAT)}$ & $V_{BE(ON)}$* (V) Min	V_{BE} (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BD242B	TO-220	80	80		200 μA*	80	10 25		3A 1A	4 4	1.2		1.8*	3A	3	3		500	420	6	5/6	5E(3E)
BD242C	TO-220	80	100		200 μA*	100	10 25		3A 1A	4 4	1.2		1.8*	3A		3		500	420	6	5/6	5E(3E)
BD370A	TO-92+ (91)	80	45		100	45	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370A-10	TO-92+ (91)	80	45		100	45	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370A-16	TO-92+ (91)	80	45		100	45	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370A-25	TO-92+ (91)	80	45		100	45	25 160	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370B	TO-92+ (91)	80	60		100	60	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370B-10	TO-92+ (91)	80	60		100	60	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370B-16	TO-92+ (91)	80	60		100	60	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370B-25	TO-92+ (91)	80	60		100	60	25 160	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370C	TO-92+ (91)	80	80		100	80	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370-6	TO-92+ (91)	80	80		100	80	25 40	 100	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370C-10	TO-92+ (91)	80	80		100	80	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370C-16	TO-92+ (91)	80	80		100	80	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD370D	TO-92+ (91)	80	100		100	80	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	79
BD370D-6	TO-92+ (91)	80	100		100	80	25 40	 100	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	79

TEST CONDITIONS:

(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_B^1 = I_B^2$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_B^1 = 50mA, I_B^2 = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_B^1 = 3mA, I_B^2 = 1mA. **(16)** I_C = 100mA, I_B^1 = 40mA, I_B^2 = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	V_{BE} Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BD370D-10	TO-92+ (91)	80	100		100	80	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	79
BD371A	TO-92+ (91)	80	45		100	45	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371A-10	TO-92+ (91)	80	45		100	45	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371A-16	TO-92+ (91)	80	45		100	45	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371A-25	TO-92+ (91)	80	45		100	45	25 160	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371B	TO-92+ (91)	80	60		100	60	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371B-10	TO-92+ (91)	80	60		100	60	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371B-16	TO-92+ (91)	80	60		100	60	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371B-25	TO-92+ (91)	80	60		100	60	25 160	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371C	TO-92+ (91)	80	80		100	80	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371C-6	TO-92+ (91)	80	80		100	80	25 40	 100	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371C-10	TO-92+ (91)	80	80		100	80	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371C-16	TO-92+ (91)	80	80		100	80	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD371D	TO-92+ (91)	80	100		100	100	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	39
BD371D-6	TO-92+ (91)	80	100		100	100	25 40	 100	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	39
BD371D-10	TO-92+ (91)	80	100		100	100	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	39
BD372A	TO-92+ (90)	80	45		100	45	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372A-10	TO-92+ (90)	80	45		100	45	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372A-16	TO-92+ (90)	80	45		100	45	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	V_{BE} Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BD372A-25	TO-92+ (90)	80	45		100	45	25 160	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372B	TO-92 (90)	80	60		100	60	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372B-10	TO-92 (90)	80	60		100	60	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372B-16	TO-92 (90)	80	60		100	60	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372B-25	TO-92 (90)	80	60		100	60	25 160	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372C	TO-92+ (90)	80	80		100	80	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372C-6	TO-92+ (90)	80	80		100	80	25 40	 100	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372C-10	TO-92+ (90)	80	80		100	80	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372C-16	TO-92+ (90)	80	80		100	80	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	78
BD372D	TO-92+ (90)	80	100		100	100	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	79
BD372D-6	TO-92+ (90)	80	100		100	100	25 40	 100	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	79
BD372D-10	TO-92+ (90)	80	100		100	100	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	79
BD373A	TO-92+ (90)	80	45		100	45	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373A-10	TO-92+ (90)	80	45		100	45	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373A-16	TO-92+ (90)	80	45		100	45	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373A-25	TO-92+ (90)	80	45		100	45	25 160	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38

TEST CONDITIONS:

(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_{B1} = I_{B2}$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_{B1} = I_{B2}$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_{B1} = I_{B2}$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_{B1} = I_{B2}$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_{B1} = 50mA, I_{B2} = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_{B1} = 3mA, I_{B2} = 1mA. **(16)** I_C = 100mA, I_{B1} = 40mA, I_{B2} = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BD373B	TO-92+ (90)	80	60		100	60	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373B-10	TO-92+ (90)	80	60		100	60	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373B-16	TO-92+ (90)	80	60		100	60	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373B-25	TO-92+ (90)	80	60		100	60	25 160	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373C	TO-92+ (90)	80	80		100	80	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373C-6	TO-92+ (90)	80	80		100	80	25 40	 100	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373C-10	TO-92+ (90)	80	80		100	80	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373C-16	TO-92+ (90)	80	80		100	80	25 100	 250	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	38
BD373D	TO-92+ (90)	80	100		100	100	25 40	 400	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	39
BD373D-6	TO-92+ (90)	80	100		100	100	25 40	 100	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	39
BD373D-10	TO-92+ (90)	80	100		100	100	25 63	 160	500 100	2 1	0.7		1.2*	1A	30	50		200	420	6	5/6	39
BD375	TO-126	50	45		2 μA	45	20 40	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD375-6	TO-126	50	45		2 μA	45	20 40	 100	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD375-10	TO-126	50	45		2 μA	45	20 63	 160	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD375-16	TO-126	50	45		2 μA	45	20 100	 250	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD375-25	TO-126	50	45		2 μA	45	20 150	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD376	TO-126	50	45		2 μA	45	20 40	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78
BD376-6	TO-126	50	45		2 μA	45	20 40	 100	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78
BD376-10	TO-126	50	45		2 μA	45	20 63	 160	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	V_{BE} Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BD376-16	TO-126	50	45		2 μA	45	20 100	 200	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78
BD376-25	TO-126	50	45		2 μA	45	20 150	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78
BD377	TO-126	75	60		2 μA	60	20 40	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD377-6	TO-126	75	60		2 μA	60	20 40	 100	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD377-10	TO-126	75	60		2 μA	60	20 63	 160	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD377-16	TO-126	75	60		2 μA	60	20 100	 250	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD377-25	TO-126	75	60		2 μA	60	20 150	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	38
BD378	TO-126	75	60		2 μA	60	20 40	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78
BD378-6	TO-126	75	60		2 μA	60	20 40	 100	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78
BD378-10	TO-126	75	60		2 μA	60	20 63	 160	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78
BD378-16	TO-126	75	60		2 μA	60	20 100	 250	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78
BD378-25	TO-126	75	60		2 μA	60	20 150	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	78
BD379	TO-126	100	80		2 μA	80	20 40	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	39
BD379-6	TO-126	100	80		2 μA	80	20 40	 100	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	39
BD379-10	TO-126	100	80		2 μA	80	20 63	 160	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	39
BD379-16	TO-126	100	80		2 μA	80	20 100	 250	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	39

TEST CONDITIONS:
(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, I_{B}^{1} = I_{B}^{2} = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, I_{B}^{1} = I_{B}^{2} = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, I_{B}^{1} = I_{B}^{2} = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, I_{B}^{1} = I_{B}^{2} = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, I_{B}^{1} = I_{B}^{2} = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, I_{B}^{1} = I_{B}^{2} = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_{B}^{1} = 50mA, I_{B}^{2} = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_{B}^{1} = 3mA, I_{B}^{2} = 1mA. **(16)** I_C = 100mA, I_{B}^{1} = 40mA, I_{B}^{2} = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BD379-25	TO-126	100	80		2 µA	80	20 150	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	39
BD380	TO-126	100	80		2 µA	80	20 40	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	79
BD380-6	TO-126	100	80		2 µA	80	20 40	 100	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	79
BD380-10	TO-126	100	80		2 µA	80	20 63	 160	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	79
BD380-16	TO-126	100	80		2 µA	80	20 100	 250	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	79
BD380-25	TO-126	100	80		2 µA	80	20 150	 375	1A 150	2 2	1.0		1.5*	1A	30	50		200	420	6	5/6	79
BD433	TO-126	22†	22	5	100 µA	22	50 85 40	 475 	2A 500 10	1 1 5	0.5		1.1*	2A		3		250	420	6	5/6	2E
BD434	TO-126	22†	22	5	100 µA	22	50 85 40	 475 	2A 500 10	1 1 5	0.5		1.1*	2A	30	3		250	420	6	5/6	3E
BD435	TO-126	32†	32	5	100 µA	32	50 85 40	 475 	2A 500 10	1 1 5	0.5		1.1*	2A	30	3		250	420	6	5/6	2E
BD436	TO-126	32†	32	5	100 µA	32	50 85 40	 475 	2A 500 10	1 1 5	0.5		1.1*	2A	30	3		250	420	6	5/6	3E
BD437	TO-126	45†	45	5	100 µA	45	40 40 30	 236 	2A 500 10	1 1 5	0.6		1.2*	2A	30	3		250	420	6	5/6	2E
BD438	TO-126	45†	45	5	100 µA	45	40 40 30	 236 	2A 500 10	1 1 5	0.6		1.2*	2A	30	3		250	420	6	5/6	3E
BD439	TO-126	60†	60	5	100 µA	60	25 40 20	 236 	2A 500 10	1 1 5	0.8		1.5*	2A	30	3		250	420	6	5/6	2E
BD440	TO-126	60†	60	5	100 µA	60	25 40 20	 236 	2A 500 10	1 1 5	0.8		1.5*	2A	80	3		250	420	6	5/6	3E
BD441	TO-126	80†	80	5	100 µA	80	15 40 15	 236 	2A 500 10	1 1 5	0.8		1.5*	2A	30	3		250	420	6	5/6	2E

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BD442	TO-126	80†	80	5	100 μA	80	15		2A	1	0.8		1.5*	2A	30	3		250	420	6	5/6	3E
							40	236	500	1												
							15		10	5												
BD533	TO-220	80†	45	5	100 μA	45	25		2A	2	0.8		1.5*	2A	30	3		250	420	6	5/6	4E
							40		500	2												
							20		10	5												
BD534	TO-220	80†	45	5	100 μA	45	25		2A	2	0.8		1.5*	2A	30	3		250	420	6	5/6	5E
							40		500	2												
							20		10	5												
BD535	TO-220	80†	60	5	100 μA	60	25		2A	2	0.8		1.5*	2A	30	3		250	420	6	5/6	4E
							40		500	2												
							20		10	5												
BD536	TO-220	80†	60	5	100 μA	60	25		2A	2	0.8		1.5*	2A	30	3		250	420	6	5/6	5E
							40		500	2												
							20		10	5												
BD537	TO-220	80†	80	5	100 μA	80	15		2A	2	0.8		1.5*	2A	30	3		250	420	6	5/6	4E
							40		500	2												
							15		10	5												
BD538	TO-220	80†	80	5	100 μA	80	15		2A	2	0.8		1.5*	2A	30	3		250	420	6	5/6	5E
							40		500	2												
							15		10	5												
BD633	TO-220	45	45	5	200 μA†	45	25		1A	2	0.6		1.3*	1A	30	3		250	420	6	5/6	4F
							40		25	2												
BD634	TO-220	45	45	5	200 μA†	45	25		1A	2	0.6		1.3*	1A	30	3		250	420	6	5/6	5F
							40		25	2												
BD635	TO-220	60	60	5	200 μA†	60	25		1A	2	0.6		1.3*	1A	30	3		250	420	6	5/6	4F
							40		25	2												
BD636	TO-220	60	60	5	200 μA†	60	25		1A	2	0.6		1.3*	1A	30	3		250	420	6	5/6	5F
							40		25	2												
BD637	TO-220	100	80	5	200 μA†	100	25		1A	2	0.6		1.3*	1A	30	3		250	420	6	5/6	4F
							40		25	2												
BD638	TO-220	100	80	5	200 μA†	100	25		1A	2	0.6		1.3	1A	30	3		250	420	6	5/6	5F
							40		25	2												

TEST CONDITIONS:

(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_{B1} = I_{B2}$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_{B1} = I_{B2}$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, $I_{B1} = I_{B2}$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_{B1} = I_{B2}$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_{B1} = 50mA, I_{B2} = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_{B1} = 3mA, I_{B2} = 1mA. **(16)** I_C = 100mA, I_{B1} = 40mA, I_{B2} = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	V_{BE} Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BD675	TO-126		45		200 μA	45	750		1.5A	3	2.5		2.5*	1.5A		1		1.5A				2J
BD675A	TO-126		45		200 μA	45	750		2A	3	2.8		2.5*	2A		1		1.5A				2J
BD676	TO-126		45		200 μA	45	750		1.5A	3V	2.5		2.5*	1.5A		1		1.5A				3J
BD676A	TO-126		45		200 μA	45	750		2A	3V	2.8		2.5*	2A		1		1.5A				3J
BD677	TO-126		60		200 μA	60	750		1.5A	3V	2.5		2.5*	1.5A		1		1.5A				2J
BD677A	TO-126		60		200 μA	60	750		2A	3V	2.8		2.5*	2A		1		1.5A				2J
BD678	TO-126		60		200 μA	60	750		1.5A	3V	2.5		2.5*	1.5A		1		1.5A				3J
BD678A	TO-126		60		200 μA	60	750		2A	3V	2.8		2.5*	2A		1		1.5A				3J
BD679	TO-126		80		200 μA	80	750		1.5A	3V	2.5		2.5*	1.5A		1		1.5A				2J
BD679A	TO-126		80		200 μA	80	750		2A	3V	2.8		2.5*	2A		1		1.5A				2J
BD680	TO-126		80		200 μA	80	750		1.5A	3V	2.5		2.5*	1.5A		1		1.5A				3J
BD680A	TO-126		80		200 μA	80	750		2A	3V	2.8		2.5*	2A		1		1.5A				3J
BD681	TO-126		100		200 μA	100	750		1.5A	3V	2.5		2.5*	1.5A		1		1.5A				2J
BD682	TO-126		100		200 μA	100	750		1.5A	3V	2.5		2.5*	1.5A		1		1.5A				3J
BD733	TO-220	25	25	5	200 μA†	25	50 40		2A 20	1 4	0.6		1.1*	2A		1		1.5A				4F
BD734	TO-220	25	25	5	200 μA†	25	50 40		2A 20	1 4	0.6		1.1*	2A		1		1.5A				5E
BD735	TO-220	35	35	5	200 μA†	35	40 40		2A 20	1 4	0.6		1.1*	2A		1		1.5A				4F
BD736	TO-220	35	35	5	200 μA†	35	40 40		2A 20	1 4	0.6		1.1*	2A		1		1.5A				5E
BD737	TO-220	45	45	5	200 μA†	45	40 40		2A 20	1 4	0.8		1.1*	2A		1		1.5A				4F
BD738	TO-220	45	45	5	200 μA†	45	40 40		2A 20	1 4	0.8		1.1*	2A		1		1.5A				5E
BF167	TO-72 (28)	40	30	4	100†	30	26		4	10			0.84*	4								45
BF180	TO-72 (25)	30	20	3	100	20	13 6		2 12	10 7												41
BF181	TO-72 (25)	30	20	3	100	20	13 6		2 12	10 7												41
BF182	TO-72 (25)	25	20	3	100	20	10 6		2 12	10 7												41
BF194	TO-92 (78)	Same as BF254, see page 3-27 for explanation																				46

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BF195	TO-92 (78)	Same as BF255, see below for explanation																				46
BF196	TO-92 (78)	Same as BF198, see below for explanation																				45
BF197	TO-92 (78)	Same as BF199, see below for explanation																				47
BF198	TO-92 (78)	40	30	4	100	40	26 6		4 12	10 7			0.85*	4								45
BF199	TO-92 (78)	40	25	4	100	40	38 6		7 12	10 7						1100 typ		7				47
BF200	TO-72 (25)	30	20	3	100	40	15 6		3 12	10 7												41
BF233-2	TO-92 (71)	30	30	4	100	10	40 6	70	1 12	10 7		0.65	0.74*	1	1.0	150		1				49
BF233-3	TO-92 (71)	30	30	4	100	10	60 6	100	1 12	10 7		0.65	0.74*	1	1.0	150		1				49
BF233-4	TO-92 (71)	30	30	4	100	10	90 6	150	1 12	10 7		0.65	0.74*	1	1.0	150		1				49
BF233-5	TO-92 (71)	30	30	4	100	10	140 6	220	1 12	10 7		0.65	0.74*	1	1.0	150		1				49
BF240	TO-92 (78)	40	40	4	100	20	67 6	222	1 12	10 7		0.65	0.74*	1	0.34			1		3.5	7	47
BF241	TO-92 (78)	40	40	4	100	20	36 6	125	1 12	10 7		0.65	0.74*	1	0.34			1		3.5	7	47
BF254	TO-92 (78)	30	20	5	100	20	67 6	220	1 12	10 7		0.65	0.74*	1	0.34			1		3.5	7	46
BF255	TO-92 (78)	30	20	5	100	20	35 6	125	1 12	10 7		0.65	0.74*	1	0.34			1		3.5	7	46
BF257	TO-39	160	160	5	50	100	25 6		30 12	10 7	1.0	0.65	0.74*	30	0.34			1		3.5	7	48
BF258	TO-39	250	250	5	50	200	25 6		30 12	10 7	1.0	0.65	0.74*	30	0.34			1		3.5	7	48

TEST CONDITIONS:

(1) $I_C = 200\,\mu A$, $V_{CE} = 5V$, f = 1kHz. **(2)** $I_C = 100mA$, $V_{CC} = 20V$, $I_B^1 = I_B^2 = 5mA$. **(3)** $I_C = 200\,\mu A$, $V_{CE} = 2V$, f = 1kHz. **(4)** $I_C = 100mA$, $V_{CC} = 10V$, $I_B^1 = I_B^2 = 10mA$. **(5)** $I_C = 10mA$, $V_{CC} = 3V$, $I_B^1 = I_B^2 = 1mA$. **(6)** $I_C = 100\,\mu A$, $V_{CE} = 5V$, f = 1kHz. **(7)** $I_C = 1mA$, $V_{CE} = 10V$, f = 200kHz. **(8)** $I_C = 1mA$, $V_{CE} = 5V$, f = 1kHz. **(9)** $I_C = 150mA$, $V_{CC} = 6V$, $I_B^1 = I_B^2 = 15mA$. **(10)** $I_C = 200\,\mu A$, $V_{CE} = 5V$, f = 1kHz. **(11)** $I_C = 150mA$, $V_{CC} = 10V$, $I_B^1 = I_B^2 = 75mA$. **(12)** $I_C = 300mA$, $V_{CC} = 25V$, $I_B^1 = I_B^2 = 30mA$. **(13)** $I_C = 10\,\mu A$, $V_{CE} = 5V$, f = WB. **(14)** $I_C = 500mA$, $V_{CC} = 25V$, $I_B^1 = 50mA$, $I_B^2 = 25mA$. **(15)** $I_C = 10mA$, $V_{BE} = 2V$, $I_B^1 = 3mA$, $I_B^2 = 1mA$. **(16)** $I_C = 100mA$, $I_B^1 = 40mA$, $I_B^2 = 20mA$.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max @	V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(SAT)}$ (V) Max &	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	V_{BE} Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BF259	TO-39	300	300	5	50	250	25		30	10	1.0	0.65	0.74*	30	0.34			1		3.5	7	48
							6		12	7												
BF457	TO-126	160	160	5	50	100	25		30	10	1.0	0.65	0.74*	30	0.34			1		3.5	7	48
							6		12	7												
BF458	TO-126	250	250	5	50	200	25		30	10	1.0	0.65	0.74*	30	0.34			1		3.5	7	48
							6		12	7												
BF459	TO-126	300	300	5	50	250	25		30	10	1.0	0.65	0.74*	30	0.34			1		3.5	7	48
							6		12	7												
BFX13	TO-18	20	15	5	50	15	10		100	2	0.2		0.78	1	6	150		10		10	8	66
							50	250	10	0.35	0.25	0.7	0.9	10								
							18		1	2	1.5		1.5	100								
BFX29	TO-5	20	15	5	50	50	40		150	10					12	100		50	150		9	63
							50		50	10	0.4		1.3	150								
							50		10	10			0.9	30								
							40		1	10												
							20		0.1	10												
BFX30	TO-5	65	65	5	50	50	10		150	0.4					12				290		4	63
							20		50	0.4			0.9	30								
							50	200	10	0.4			1.3	150								
							40		1	0.4												
BFX37	TO-18	60	60	6	20†	50	100		10	5	0.4		1.0	50	6	40		0.5		3	10	62
							100		1	5												
							0.85		0.1	5	0.25		0.9	10								
							70	300	0.01	5												
BFX65	TO-18	45	45	6	10*	40	100		10	5	0.25		0.9	10	6.5					3	10	62
							100		1	5												
							100		0.1	5												
							40		0.01	5												
BFX84	TO-39	45	45	6	500	100	15		1A	10	0.15		1.2	10	12	50		50	360		9	14
							20		500	10	0.35		1.3	150								
							30		150	10	1.0		1.5	500								
							20		10	10	1.6		2.0	1A								
BFX85	TO-39	45	45	6	50	80	15		1A	10	0.15		1.2	10	12	50		50	360		9	14
							30		500	10	0.35		1.3	150								
							70		150	10	1.0		1.5	500								
							50		10	10	1.6		2.0	1A								
BFX86	TO-39	45	45	6	50	30	15		1A	10	0.15		1.2	10	12	50		50	360		9	14
							30		500	10	0.35		1.3	150								
							70		150	10	1.0		1.5	500								
							50		10	10	1.6		2.0	1A								

Type No.	Case Style	V_{CES}^* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}^* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}^*$ (V) Min	V_{BE} Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BFX87	TO-5	45	50	6	50	40	25		500	10	0.4		1.3	150	12	100		50	150		9	63
							40		150	10			0.9	30								
							40		10	10												
							40		1	10												
BFX88	TO-5	45	40	6	50	30	25		500	10	0.4		1.3	150	12	100		50	150		9	63
							40		150	10			0.9	30								
							40		10	10												
							40		1	10												
BFY72	TO-5	50	28	5	20†	40	15		500	10	0.7		1.6	500	8	250		50	170		12	20
							45	150	150	10												
							30		10	10	0.25		1.2	150								
							20		1	10												
							15		0.1	10												
BFY76	TO-18	45	45	6	20†	30	140		1	5	0.35			1	6	12		0.05		4	13	07
							80		0.5	5												
							30	200	0.01	5		0.5	0.75*	0.1								
BSX21	TO-18	45	80	6	40 μA	120	20		4	3			0.9*	4		60		4				07
BSX45-6	TO-39	80†	40	7	10†	60	40	100	100	1			2.0	1A	20	60		50	650		11	14
											1.0			500								
BSX45-10	TO-39	80†	40	7	10†	60	63	160	100	1			2.0	1A	20	60		50	650		11	14
											1.0			500								
BSX45-16	TO-39	80†	40	7	10†	60	100	250	100	1			2.0	1A	20	60		50	650		11	14
											1.0			500								
BSX46-6	TO-39	100†	60	7	10†	60	40	100	100	1			2.0	1A	25	60		50	650		11	14
											1.0			500								
BSX46-10	TO-39	100†	60	7	10†	60	63	160	100	1			2.0	1A	25	60		50	650		11	14
											1.0			500								
BSX46-16	TO-39	100†	60	7	10†	60	100	250	100	1			2.0	1A	25	60		50	650		11	14
											1.0			500								
BSX48	TO-18	50	25	5	120	50	17		100	1	1.5		1.5	500	6	250		30	110		14	20
BSX88	TO-52	40	15	5	25	20	30	120	10	1	0.4	0.72	0.8	10	6	300		10	75		15	21
							15		0.5	1												

TEST CONDITIONS:
(1) I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, I_{B1} = I_{B2} = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, I_{B1} = I_{B2} = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, I_{B1} = I_{B2} = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} = 6V, I_{B1} = I_{B2} = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, I_{B1} = I_{B2} = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, I_{B1} = I_{B2} = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_{B1} = 50mA, I_{B2} = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_{B1} = 3mA, I_{B2} = 1mA. **(16)** I_C = 100mA, I_{B1} = 40mA, I_{B2} = 20mA.

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} h_{fe} 1 kHz* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	$V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BSY38	TO-52	20	12	5	100	20	15	45	100	1	0.6		1.5	100	5	200		10	45		16	21
							30	60	10	0.35	0.25	0.7	0.85	10								
BSY39	TO-52	20	12	5	100	20	20	70	100	1	0.6		1.5	100	5	200		10	45		16	21
							40	120	10	0.35	0.25	0.7	0.85	10								
BSY51	TO-5	60	25	5	100	30	20	70	100	1	1.0		1.3	150	9	130		50	45		16	20
							40	120	150	10												
BSY52	TO-5	60	25	5	100	30	20	70	100	1	1.0		1.3	150	9	130		50	45		16	20
							100	300	150	10												
BSY53	TO-5	75	30	7	10	60	20		500	10	0.6		1.3	150	9	150		50	45		16	20
							40	120	150	10	2.0			500								
							35		10	10												
							20		0.1	10												
BSY54	TO-5	75	30	7	10	60	40		500	10	0.6		1.3	150	9	150		50	45		16	20
							100	300	150	10	2.0			500								
							75		10	10												
							35		0.1	10												
BSY95A	TO-52	20	15	5	50	16	50	200	10	0.35	0.35	0.67	0.87	10	6	200		10	50		16	21
							30		1	0.35												

TEST CONDITIONS:

(1) I_C = 200 μA, V_{CE} 5V, f = 1kHz. **(2)** I_C = 100mA, V_{CC} = 20V, $I_B^1 = I_B^2$ = 5mA. **(3)** I_C = 200 μA, V_{CE} = 2V, f = 1kHz. **(4)** I_C = 100mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 10mA. **(5)** I_C = 10mA, V_{CC} = 3V, $I_B^1 = I_B^2$ = 1mA. **(6)** I_C = 100 μA, V_{CE} = 5V, f = 1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 200kHz. **(8)** I_C = 1mA, V_{CE} = 5V, f = 1kHz. **(9)** I_C = 150mA, V_{CC} 6V, $I_B^1 = I_B^2$ = 15mA. **(10)** I_C = 200 μA, V_{CE} = 5V, f = 1kHz. **(11)** I_C = 150mA, V_{CC} = 10V, $I_B^1 = I_B^2$ = 75mA. **(12)** I_C = 300mA, V_{CC} = 25V, $I_B^1 = I_B^2$ = 30mA. **(13)** I_C = 10 μA, V_{CE} = 5V, f = WB. **(14)** I_C = 500mA, V_{CC} = 25V, I_B^1 = 50mA, I_B^2 = 25mA. **(15)** I_C = 10mA, V_{BE} = 2V, I_B^1 = 3mA, I_B^2 = 1mA. **(16)** I_C = 100mA, I_B^1 = 40mA, I_B^2 = 20mA.

Section 4

JEIDA Series

4

JEIDA SERIES

Type No.	Case Style	V_{CES}† V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}† I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2SA719	TO-92 (74)	30	25	5	100	20	40 60	 340	500 150	10 10	0.6		1.5	500		200		50				63
2SA738	TO-126	25	25	5	20 μA	25	20 35	 320	1.5A 500	2 2	1.0		 1.5*	2A 1.5A								77
2SC313	TO-72 (25)	30	19	2	500	10	35	120	10	10	1.0			20	2	600		10				42
2SC372	TO-92 (74)	35	30	4	500	18	200	400	2	12	0.4			10	3.5	80		1				04
2SC380	TO-92 (74)	35	30	4	500	18	40	240	2	12	1.3			10	3.2	400		1				23
2SC385	TO-92 (74)	30	15	3	500	15	20		8	3					1.5	600		8				43
2SC387	TO-92 (74)	30	15	3	500	15	20		8	3	0.6		1.2	10	1.5	650		8				43
2SC388	TO-92 (74)	25	25	3	25	10	20	200	12.5	12.5	0.2		1.5	15	2	300		12.5				46
2SC394	TO-92 (74)	35	30	4	500	18	40 16	240	2 0.1	12 10					3.5	100		1				23
2SC398	TO-72 (25)	20	20	3	50	10	20	200	4	5					0.5	250		4		4.5	1	44
2SC399	TO-72 (25)	20	20	3	50	10	20	200	4	5					0.5	250		4		5.0	1	44
2SC454	TO-92 (74)	30	30	5	500	18	100	320	2	12	0.5		 0.32*	1 2	3.5					25	2	27
2SC458	TO-92 (74)	30	30	5	500	18	100	500	2	12	0.5		 0.75*	1 2	3.5					10	2	27
2SC460	TO-92 (74)	30	30	5	500	18	35	200	2	12	1.1		 0.75*	1 2	3.5					6.5	3	27
2SC461	TO-92 (74)	30	30	5	500	18	35	200	2	12	1.1		0.75*	2 1	3.5							27
2SC463	TO-72 (25)	35	35	4	100	10	30	150	2	10	0.2			10	0.6					4	4	44
2SC464	TO-72 (25)	30	19	2	500	10	20*		1	6	1.0			20	2.0	600		10				42
2SC466	TO-72 (25)	30	19	2	500	10	20*		1	6	1.0			20	2.0	600		10				42
2SC495	TO-126	70	50	5	1 μA	30	40	240	50	2	0.8		1.1*	500	10	50		10				14
2SC535	TO-92 (74)	30	20	4	500	10	35	200	1	6					1.2	450		1		5.5	5	42
2SC536	TO-92 (74)	40	30	5	1 μA	35	60	960	1	6												04

JEIDA SERIES (Continued)

Type No.	Case Style	V_{CES}^* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}^* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	H_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}^*$ (V) Min	V_{BE} Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2SC562	TO-72 (28)	40	30	4	1 μA	10	26		4	10					0.22	220	500	4				45
2SC563	TO-72 (28)	40	25	4	10 μA	40	38		7	10					0.32	360	820	5				47
2SC644	TO-92 (74)	30	25	5	1 μA	40	90	700	2	5										5	6	04
2SC682	TO-72 (25)	20	20	3	100	10	20	200	2	10						400		2				44
2SC683	TO-72 (25)	20	20	3	100	10	20	200	2	10					0.6	400		2		4	4	44
2SC684	TO-92 (74)	30	19	2			40		10	10	1.0			20	2	900		10				42
2SC717	TO-92 (74)	30	19	2	500	10	40		1	6	1.0			20	2	600		10				43
2SC733	TO-92 (74)	35	30	5	100	18	70	700	2	6	0.3			10		80		1		10	2	04
2SC735	TO-92 (74)	35	30	5	100	18	25 70	 400	400 100	5 1	 0.25			 100								19
2SC761	TO-72 (25)	30	20	3			25		2	10						450	950	2				41
2SC762	TO-72 (25)	30	20	3			22		2	10						450	770	2				41
2SC784	TO-92 (74)	40	30	4	500		18	25	140	1	6				0.9					6	5	42
2SC785	TO-92 (74)	40	30	4	500	18	25	140	1	6					0.9							42
2SC828	TO-92 (74)	30	25	5	1 μA	10	65	700	2	5												04
2SC829	TO-92 (74)	30	20	5	1 μA	10	40	500	1	10					1.6							23
2SC947	TO-72 (25)	25	20	3			10		2	10					0.3	400	1000	3				41
2SC1047	TO-92 (74)	30	20	3			40	500	1	6					1.0	450		1				42
2SC1117	TO-72 (25)	20	20	3			60	320	2	10					45	600		2		7	4	41

TEST CONDITIONS:

(1) V_{AG} = 1.4V, V_{CC} = 12V, f = 200MHz. (2) I_C = 0.1mA, V_{CE} = 6V, f = 1kHz. (3) I_C = 2mA, V_{CE} = 6V, f = 1MHz. (4) I_C = 2mA, V_{CC} = 10V, f = 200MHz. (5) I_C = 1mA, V_{CE} = 6V, f = 100MHz. (6) I_C = 0.2mA, V_{CE} = 5V, f = 0.1kHz. (7) I_C = 1mA, V_{CE} = 10V, f = 5MHz.

JEIDA SERIES (Continued)

Type No.	Case Style	V_{CES}* V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CES}* I_{CBO} (nA) Max	@ V_{CB} (V)	H_{FE} h_{fe} 1 kHz* Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(SAT)}$ (V) Max	& $V_{BE(SAT)}$ $V_{BE(ON)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2SC1205	TO-92 (74)	30	30	5	500	18	35	200	2	12	1.1		 0.75*	1 2	3.5							27
2SC1215	TO-92 (74)	30	20	3	100	10	25		2	10			0.72*	2	1.5	650		10				42
2SC1306	TO-220	65		4	10 μA	40	30	150	500	10	0.6			1A	30	200		150				35
2SC1335*	TO-92 (74)	30	30	5	500	18	160	1200	2	12	0.5		 0.75*	10 2	3.5					6	2	04
2SC1342	TO-92 (74)	30	20	4	500	10	35	200	1	6	1.2			10	1.5	150		1		8.5	5	23
2SC1344	TO-92 (74)	30	30	5	500	18	160	1200	2	12	0.5		0.75*	2 10	3.5					8	2	04
2SC1359	TO-92 (74)	30	20	5	100	10	50	220	1	10					1.5	150		1		4	7	23
2SC1678	TO-220	65		4	10 μA	30	15 10		500 1.5A	5 5	1.0			500	45	100		100				35
2SC1318*	TO-92 (74)	60	50	5	100	20	40 60	 340	500 15.0	10 10	0.6		1.5	500		200		50				62
CS9011	TO-92 (72)		18	3	50	18	29	280	1	5												27
CS9012	TO-92 (72)		25	3			64	202	5	1	1.0			250								60
CS9013	TO-92 (72)		25	3			64	202	5	1	1.0			250								09
CS9014	TO-92 (72)		18	3	50	18	60	1000	1	5	0.5			1								04
CS9015	TO-92 (72)		18	3	50	18	60	1000	1	5	0.5			1								71
CS9016	TO-92 (72)		20	3	50	18	29	146	1	5	3		1	10								44
CS9018	TO-92 (72)		12	2	50	15	29	198	1	5	0.6			10								43

TEST CONDITIONS:
(1) V_{AG} = 1.4V, V_{CC} = 12V, f = 200MHz. **(2)** I_C = 0.1mA, V_{CE} = 6V, f = 1kHz. **(3)** I_C = 2mA, V_{CE} = 6V, f = 1MHz. **(4)** I_C = 2mA, V_{CC} = 10V, f = 200MHz. **(5)** I_C = 1mA, V_{CE} = 6V, f = 100MHz. **(6)** I_C = 0.2mA, V_{CE} = 5V, f = 0.1kHz. **(7)** I_C = 1mA, V_{CE} = 10V, f = 5MHz.

Section 5

NA/NB/NR Series

5

National Semiconductor

NA/NB TRANSISTOR SERIES SELECTION GUIDE

GENERAL DESCRIPTION

The NA series of transistors are complementary power series which provide minimum collector saturation voltages at low drive conditions and feature matched HFE, guaranteed V_{BE} (on), V_{BE} (sat), V_{CE} (sat), etc, for estimating circuit performance at limit conditions. They are ideal for use with the NB series in complementary audio power amplifier applications. In addition, the collector breakdown voltages range from 20 to 60 Volts, which allows great flexibility in other power applications, such as converters/inverters, servo amplifiers, etc. The NB series of transistors are complementary general-purpose devices which cover a wide range of applications from low-noise equalizer preamplifiers to 1.5 Amp class B drivers. This series provides low leakage, low V_{CE} (sat), high HFE and three different types of collector breakdown voltages (35, 50 and 65 Volts) for multi-purpose usage and total flexibility.

NA – APPLICATIONS

- 0.1 to 25 Watts fully complementary audio power amplifiers
- Converters/Inverters
- Power control circuits
- Switching/linear regulators
- High current switching circuits
- Servo amplifiers

NB – APPLICATIONS

- Low noise equalizer preamplifiers
- Class A general purpose amplifiers
- Class B drivers
- Oscillators
- Control/Switching circuits
- Display/line drivers
- Servo amplifiers

NA SERIES – – COMPLEMENTARY POWER TRANSISTORS

device types and ratings

PART # NPN	PART # PNP	AVAILABLE PACKAGES	V_{CE} (max) VOLTS	I_C (max) AMPS	HFE	DESCRIPTION
NA01	NA02	TO-92	20	0.8	Matched	0.8A complementary power transistors
NA11	NA12	TO-92	20	1.0	Matched	1.0A complementary power transistors
NA21	NA22	TO-92, TO-92 PLUS	20	1.5	Matched	1.5A complementary power transistors
NA31	NA32	TO-92 PLUS, TO-202	30	2.0	Matched	2.0A complementary power transistors
NA41	NA42	TO-126, TO-220	30	2.5	Guaranteed min	2.5A complementary power transistors
NA51	NA52	TO-126, TO-220	45	3.5	Guaranteed min	3.5A complementary power transistors
NA61	NA62	TO-126, TO-220	45	4.5	Guaranteed min	4.5A complementary power transistors
NA71	NA72	TO-126, TO-220	60	3.5	Guaranteed min	3.5A complementary power transistors

NB SERIES – – GENERAL PURPOSE COMPLEMENTARY TRANSISTORS

device types and ratings

PART # NPN	PART # PNP	AVAILABLE PACKAGES	V_{CE} (max) VOLTS	I_C (max) AMPS	V_{CE} (sat) max	V_{CE} (sat) Ic/Ib (mA)	DESCRIPTION
NB011	NB021	TO-92	35	0.03	0.3	10/0.5	30mA general purpose transistors
NB012	NB022	TO-92	50	0.03	0.3	10/0.5	30mA general purpose transistors
NB013	NB023	TO-92	35	0.03	0.3	10/0.5	30mA low noise transistors
NB014	NB024	TO-92	50	0.03	0.3	10/0.5	30mA low noise transistors
NB111	NB121	TO-92	35	0.1	0.3	40/0.8	100mA general purpose transistors
NB112	NB122	TO-92	50	0.1	0.3	40/0.8	100mA general purpose transistors
NB113	NB123	TO-92	65	0.1	0.3	40/0.8	100mA general purpose transistors
NB211	NB221	TO-92, TO-92 PLUS	35	0.5	0.4	100/2	500mA medium current drivers
NB212	NB222	TO-92, TO-92 PLUS	50	0.5	0.4	100/2	500mA medium current drivers
NB213	NB223	TO-92, TO-92 PLUS	65	0.5	0.4	100/2	500mA medium current drivers
NB311	NB321	TO-92, TO-92 PLUS, TO-202	35	1.5	0.5	300/10	1.5A complementary power drivers
NB312	NB322	TO-92, TO-92 PLUS, TO-202	50	1.5	0.5	300/10	1.5A complementary power drivers
NB313	NB323	TO-92, TO-92 PLUS, TO-202	65	1.5	0.5	300/10	1.5A complementary power drivers

COMPLEMENTARY AUDIO AMPLIFIER CROSS REFERENCE CHARTS

AUDIO OUTPUT POWER — — Battery operated "OTL" amplifiers

OPERATING CONDITIONS	(1) OUTPUT POWER minimum	@ 10% THD typical	RECOMMENDED OUTPUT DEVICES	RECOMMENDED DRIVER DEVICES
6 Volts/8Ω single-bootstrapping		380 mW	NA01 / NA02	NB111 / NB121
6 Volts/8Ω single-bootstrapping	380 mW	480 mW	NA11 / NA12	NB111 / NB121
6 Volts/4Ω single-bootstrapping	680 mW	850 mW	NA21 / NA22	NB111 / NB121
6 Volts/4Ω double-bootstrapping	920 mW	1.0 W	NA21 / NA22	NB111 / NB121
9 Volts/8Ω single-bootstrapping	800 mW	1.0 W	NA21 / NA22	NB111 / NB121
9 Volts/4Ω single-bootstrapping	1.4 W	1.8 W	NA21 / NA22	NB111 / NB121
9 Volts/4Ω double-bootstrapping	1.9 W	2.2 W	NA21 / NA22	NB111 / NB121
14 Volts/8Ω single-bootstrapping	2.0 W	2.3 W	NA21 / NA22	NB111 / NB121
14 Volts/4Ω single-bootstrapping	3.8 W	4.2 W	NA31 / NA32	NB211 / NB221

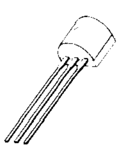
AUDIO OUTPUT POWER — — AC operated "OTL" amplifiers

OUTPUT POWER (min) @ 10% THD	LOAD IMPEDENCE	(2) REQUIRED SUPPLY VOLTAGE (min)	RECOMMENDED OUTPUT DEVICES	RECOMMENDED DRIVER DEVICES
3 Watts	8Ω	15	NA31 / NA32	NB211 / NB221
4 Watts	8Ω	17	NA31 / NA32	NB211 / NB221
6 Watts	8Ω	20	NA41 / NA42	NB211 / NB221
8 Watts	8Ω	23	NA51 / NA52	NB212 / NB222
12 Watts	8Ω	27	NA51 / NA52	NB312 / NB322
15 Watts	8Ω	32	NA71 / NA72	NB312 / NB322
18 Watts	8Ω	35	NA71 / NA72	NB313 / NB323
24 Watts	8Ω	40	NA71 / NA72	NB313 / NB323
3 Watts	4Ω	11	NA31 / NA32	NB211 / NB221
4 Watts	4Ω	13	NA31 / NA32	NB211 / NB221
6 Watts	4Ω	16	NA41 / NA42	NB211 / NB221
8 Watts	4Ω	18	NA51 / NA52	NB211 / NB221
12 Watts	4Ω	20	NA51 / NA52	NB311 / NB321
15 Watts	4Ω	23	NA61 / NA62	NB312 / NB322
18 Watts	4Ω	26	NA61 / NA62	NB312 / NB322
24 Watts	4Ω	30	NA61 / NA62	NB312 / NB322

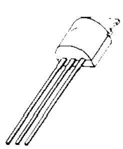
NOTES : (1) Minimum Output Power levels shown are obtained by considering transistor parameter variations only, and do not include external component value tolerances.
(2) Voltage drops across emitter ballest resistors of the output devices are not included as part of the minimum required supply voltages; voltages specified are dc and under full load condition.

PACKAGE OUTLINES

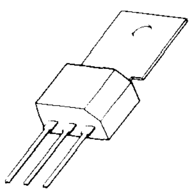
TO-92



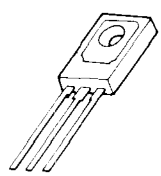
TO-92 PLUS™



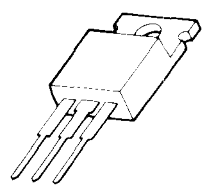
TO-202



TO-126



TO-220



NA01(NPN) NA02(PNP) 800mA complementary power transistors

features

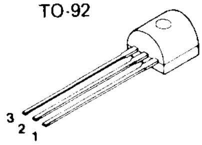
- 20 Volt/800 mA Amp rating
- Low V_{CE} (sat) and V_{BE} (sat) characteristics at I_C = 500 mA, I_B = 50 mA
- Guaranteed V_{BE} (on) characteristics at low current for stable biasing
- Matched HFE groupings for complementary applications
- "Epoxy B" packaging concept for excellent reliability

applications

- 0.2 to 1 Watt audio power amplifiers
- Medium power switching circuits
- Converter/Inverter circuits
- Circuits for toys

1 package and lead coding

TO-92



PACKAGE CODE TO-92	LEAD 1	LEAD 2	LEAD 3
E	E	B	C
F	E	C	B
H	C	B	E

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V_{DC}
Collector-Base Voltage	V_{CB}	25	V_{DC}
Emitter-Base Voltage	V_{EB}	5.0	V_{DC}
Collector Current (continuous)	I_C (max)	800	mA
Power Dissipation (T_A = 25°C)	P_D		
TO-92		0.6	W
Power Dissipation (T_C = 25°C)	P_D		
TO-92		1.0	W
Thermal Resistance			
TO-92	θ_{JA}	208	°C/W
	θ_{JC}	125	°C/W
Temperature, Junction and Storage	T_j, T_{stg}	–55 to + 150	°C

3 ordering information

NA0XXX

- POLARITY: "1" for NPN, "2" for PNP
- PACKAGE/LEAD CODE: refer to 1
- HFE GROUPING: refer to 5

4 electrical characteristics $T_C = 25°C$

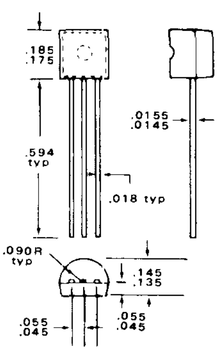
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	$I_C = 1$ mA	20			V
BV_{CBO}	Collector-Base Breakdown Voltage	$I_C = 100\mu A$	25			V
BV_{EBO}	Emitter-Base Breakdown Voltage	$I_E = 10\mu A$	5			V
I_{CEO}	Collector-Emitter Leakage Current	$V_{CE} = 15V$			100	μA
I_{CBO}	Collector-Base Leakage Current	$V_{CB} = 20V$			1	μA
V_{BE} (on)	Base-Emitter Voltage	$I_C = 10$ mA, $V_{CE} = 3V$	630	680	730	mV
V_{BE} (sat)	Base-Emitter Saturation Voltage	$I_C = 400$ mA, $I_B = 10$ mA		0.9	1.0	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	$I_C = 400$ mA, $I_B = 10$ mA		0.3	0.5	V
Cob	Collector Output Capacitance	$V_{CB} = 10V$, f = 1 MHz				
	NPN types			4.5		pF
	PNP types			7.0		pF
ft	Current Gain Bandwidth Product	$I_C = 100$ mA, $V_{CE} = 3V$	50	200		MHz

5 HFE groupings

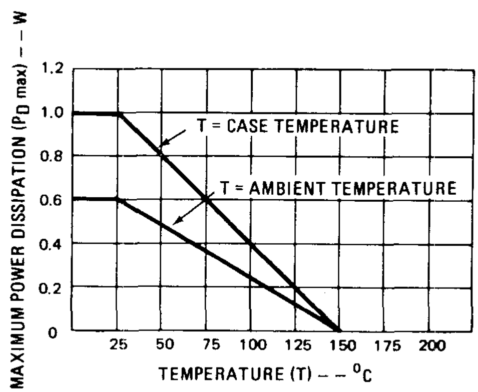
GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
G	DC Current Gain	$I_C = 100$ mA, $V_{CE} = 3V$	68	85	110	1:1.6
H	DC Current Gain	$I_C = 100$ mA, $V_{CE} = 3V$	100	127	160	1:1.6
I	DC Current Gain	$I_C = 100$ mA, $V_{CE} = 3V$	140	180	240	1:1.6
J	DC Current Gain	$I_C = 100$ mA, $V_{CE} = 3V$	200	260	350	1:1.6
X	DC Current Gain	$I_C = 100$ mA, $V_{CE} = 3V$	30	58	110	1:3.5
Y	DC Current Gain	$I_C = 100$ mA, $V_{CE} = 3V$	100	190	350	1:3.5

6 physical dimensions

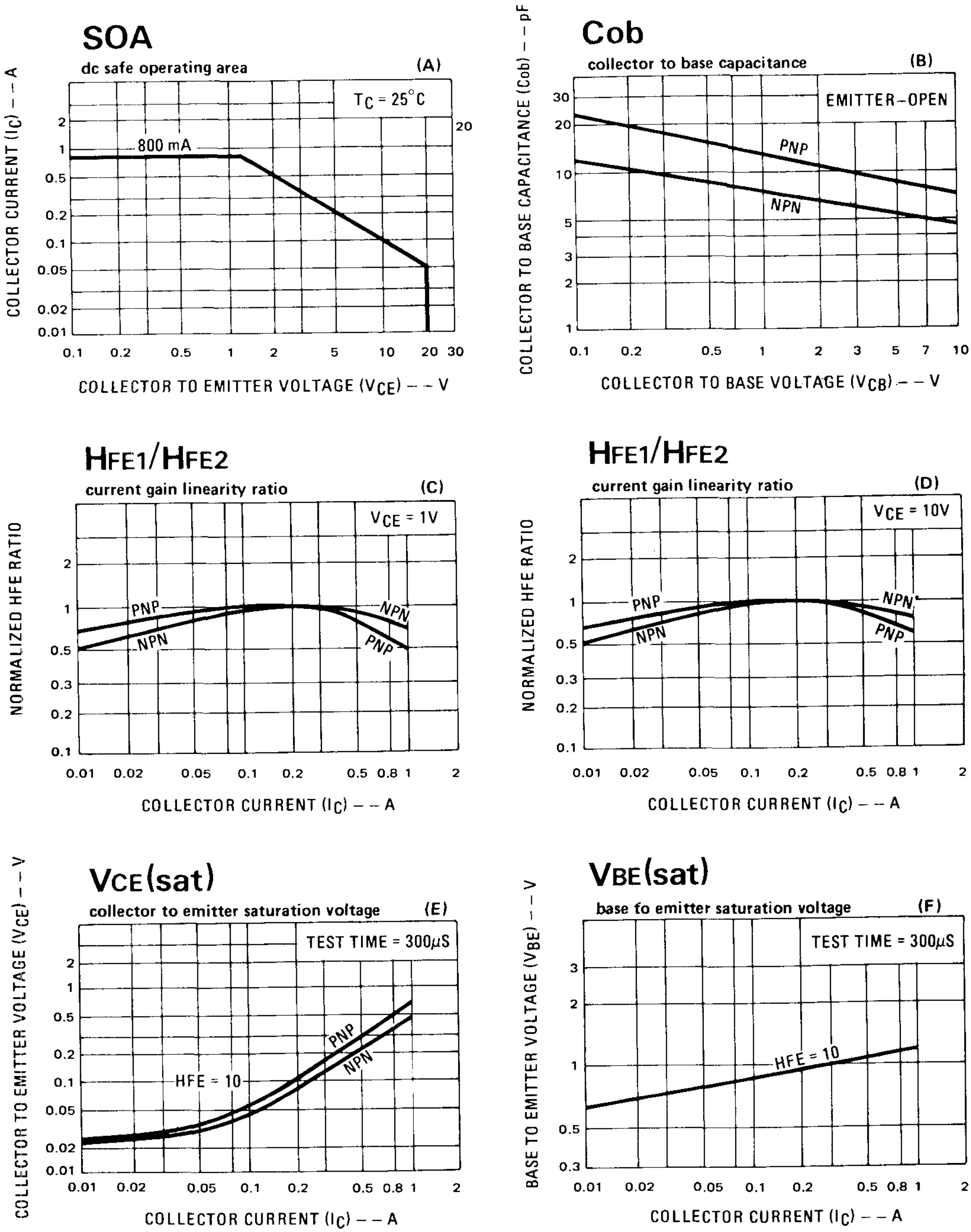
TO-92



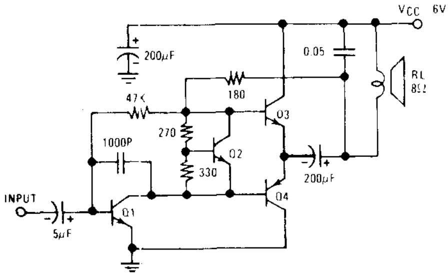
7 max power dissipation



8 typical performance characteristics

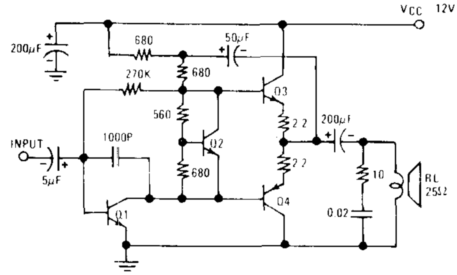


9 typical applications



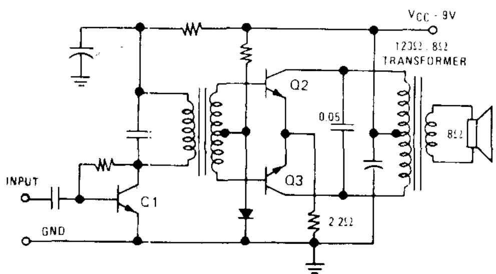
Q1 NB111EH/J Q3 NA01EG/J
Q2 NR001E Q4 NA01EG/J

Figure A. 380mW 6V/8Ω OTL Amplifier



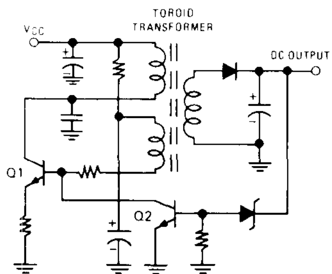
Q1 NB111EH/J Q3 NA01EG/J
Q2 NR001E Q4 NA01EG/J

Figure B. 650mW 12V/25Ω OTL Amplifier



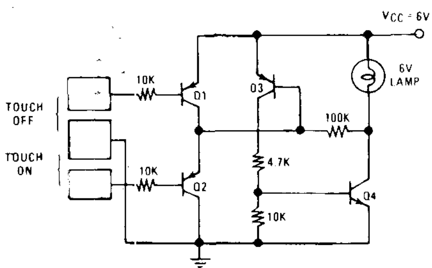
Q1 NB111EH/J Q2 NA01EG/J Q3 NA01EG/J

Figure C. 1.2W Audio Amplifier



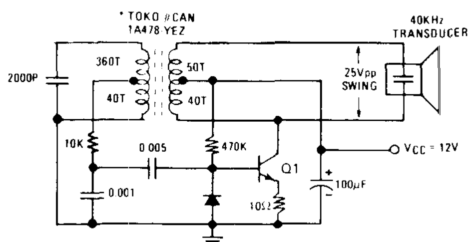
Q1 NA01EX Q2 NB111EY

Figure D. Typical Converter Circuit



Q1 NB021EY Q3 NB021EY
Q2 NB021EY Q4 NA01EX

Figure E. Touch-on/Touch-off Electronic Switch



Q1 NA01EX

Figure F. 40KHz Ultrasonic Transmitter

National Semiconductor

NA11 (NPN) NA12 (PNP) 1 Amp complementary power transistors

features

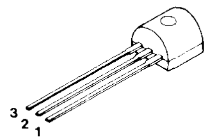
- 20 Volt/1 Amp rating
- Low V_{CE} (sat) and V_{BE} (sat) characteristics at I_C = 400 mA, I_B = 10 mA
- Guaranteed V_{BE} (on) characteristics at low current for stable biasing
- Matched HFE groupings for complementary applications
- "Epoxy B" packaging concept for excellent reliability

applications

- 0.2 to 1 Watt audio power amplifiers
- Medium power switching circuits
- Converter/Inverter circuits
- Circuits for toys

1 package and lead coding

TO-92



PACKAGE CODE TO-92	LEAD 1	2	3
E	E	B	C
F	E	C	B
H	C	B	E

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V_{DC}
Collector-Base Voltage	V_{CB}	25	V_{DC}
Emitter-Base Voltage	V_{EB}	5.0	V_{DC}
Collector Current (continuous)	I_C (max)	1.0	A
Power Dissipation (T_A = 25°C)	P_D		
TO-92		0.6	W
Power Dissipation (T_C = 25°C)	P_D		
TO-92		1.0	W
Thermal Resistance			
TO-92	θ_{JA}	208	°C/W
	θ_{JC}	125	°C/W
Temperature, Junction and Storage	Tj, Tstg	–55 to + 150	°C

3 ordering information

NA1XXX

- POLARITY: "1" for NPN, "2" for PNP
- PACKAGE/LEAD CODE: refer to 1
- HFE GROUPING: refer to 5

4 electrical characteristics $T_C = 25°C$

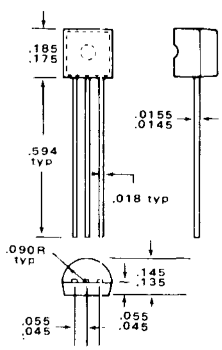
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	I_C = 1 mA	20			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100μA	25			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 10μA	5			V
I_{CEO}	Collector-Emitter Leakage Current	V_{CE} = 15V			100	μA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 20V			1	μA
V_{BE} (on)	Base-Emitter Voltage	I_C = 10 mA, V_{CE} = 3V	630	680	730	mV
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 500 mA, I_B = 50 mA		0.95	1.5	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 500 mA, I_B = 50 mA		0.2	0.5	V
Cob	Collector Output Capacitance NPN types PNP types	V_{CB} = 10V, f = 1 MHz		 4.5 7.0		 pF pF
ft	Current Gain Bandwidth Product	I_C = 100 mA, V_{CE} = 3V	50	200		MHz

5 HFE groupings

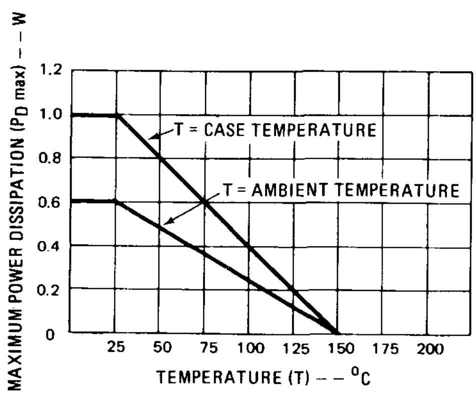
GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
G	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	68	85	110	1:1.6
H	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	100	127	160	1:1.6
I	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	140	180	240	1:1.6
J	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	200	260	350	1:1.6
X	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	30	58	110	1:3.5
Y	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	100	190	350	1:3.5

6 physical dimensions

TO-92



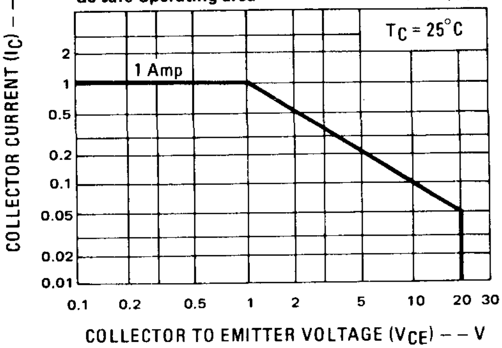
7 max power dissipation



8 typical performance characteristics

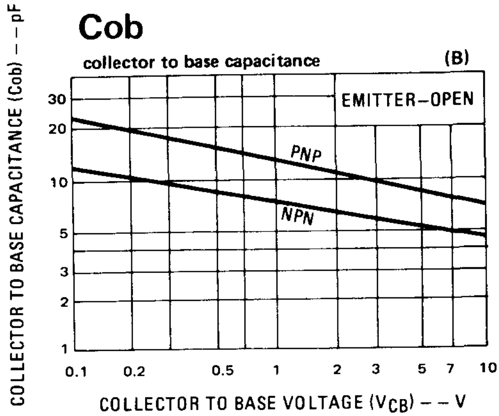
SOA

dc safe operating area (A)



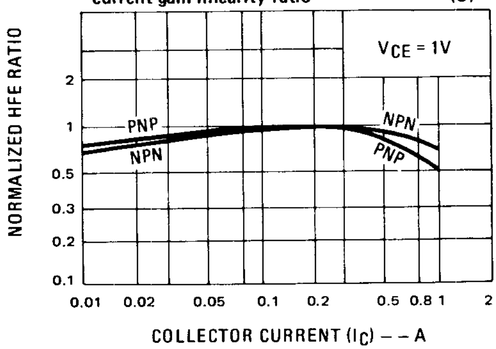
Cob

collector to base capacitance (B)



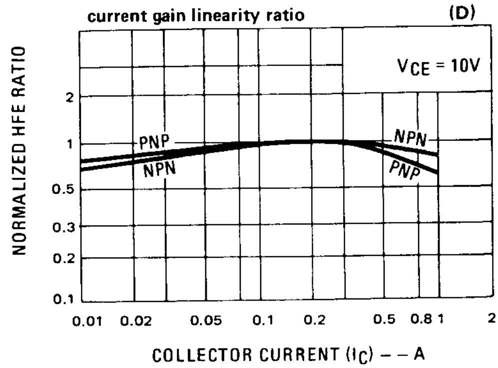
HFE1/HFE2

current gain linearity ratio (C)



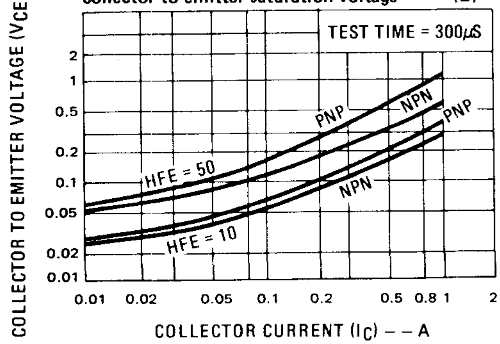
HFE1/HFE2

current gain linearity ratio (D)



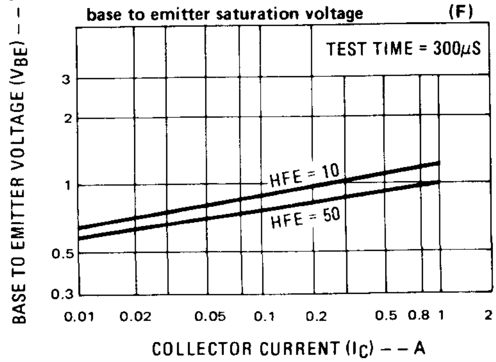
VCE(sat)

collector to emitter saturation voltage (E)

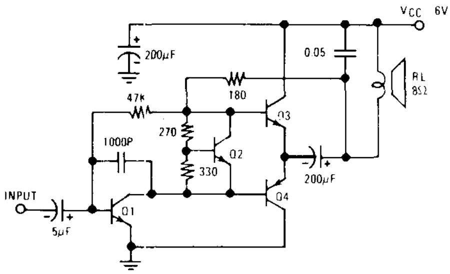


VBE(sat)

base to emitter saturation voltage (F)

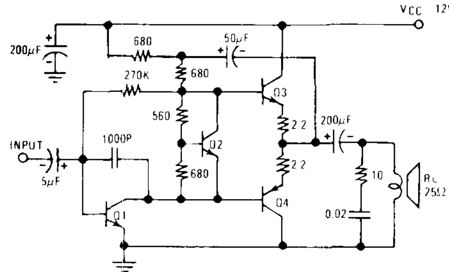


9 typical applications



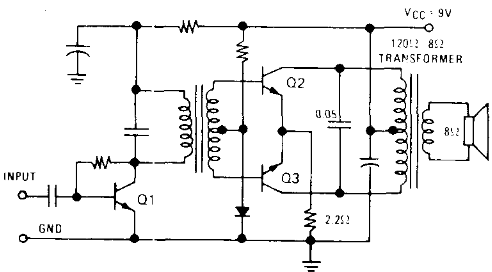
Q1 NB111EH/J Q3 NA11EG/J
Q2 NR001E Q4 NA12EG/J

Figure A. 380mW 6V/8Ω OTL Amplifier



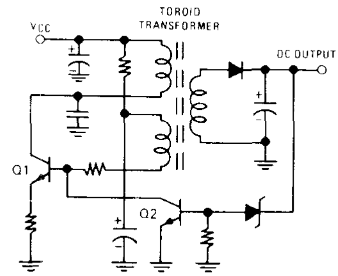
Q1 NB111EH/J Q3 NA11EG/J
Q2 NR001E Q4 NA12EG/J

Figure B. 650mW 12V/25Ω OTL Amplifier



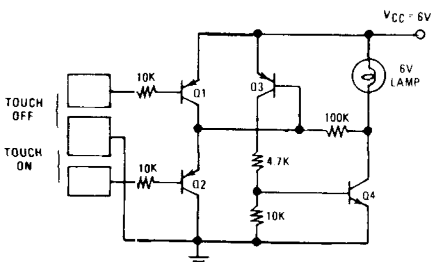
Q1 NB111EH/J Q2 NA11EG/J Q3 NA11EG/J

Figure C. 1.2W Audio Amplifier



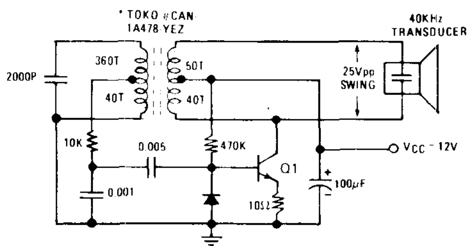
Q1 NA11EX Q2 NB111EY

Figure D. Typical Converter Circuit



Q1 NB021EY Q3 NB021EY
Q2 NB021EY Q4 NA11EX

Figure E. Touch-on/Touch-off Electronic Switch



Q1 NA11EX

Figure F. 40KHz Ultrasonic Transmitter

National Semiconductor

NA21 (NPN) NA22 (PNP) 1.5 Amp complementary power transistors

features

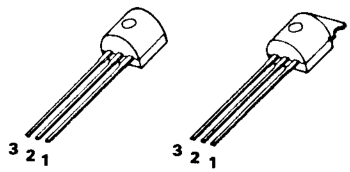
- 20 Volt/1.5 Amp rating
- 1.2 Watts practical power dissipation (TO-92 PLUS™)
- Low V_{CE} (sat) and V_{BE} (sat) characteristics at I_C = 700 mA, I_B = 14 mA
- Guaranteed V_{BE} (on) characteristics at small current for stable biasing
- Matched HFE groupings for complementary applications
- "Epoxy B" packaging concept for excellent reliability

applications

- 0.5 — 2 Watt audio power amplifiers
- Medium power switching circuits
- Converter/Inverter circuits
- Toy circuits

1 package and lead coding

TO-92 TO-92 PLUS™



PACKAGE CODE		LEAD		
TO-92	TO-92 PLUS	1	2	3
E	X	E	B	C
F	Y	E	C	B
	Z	B	C	E
H		C	B	E

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CE}	20	V_{DC}
Collector-Base Voltage	V_{CB}	25	V_{DC}
Emitter-Base Voltage	V_{EB}	5.0	V_{DC}
Collector Current (continuous)	I_C (max)	1.5	A
Power Dissipation (T_A = 25°C)	P_D		
TO-92		0.6	W
TO-92 PLUS		0.75	W
Power Dissipation (T_C = 25°C)	P_D		
TO-92		1.0	W
TO-92 PLUS		2.5	W
Thermal Resistance			
TO-92	θ_{JA} / θ_{JC}	208/125	°C/W
TO-92 PLUS	θ_{JA} / θ_{JC}	167/50	°C/W
Temperature, Junction and Storage	Tj, Tstg	−55 to + 150	°C

3 ordering information

N A 2 X X X

- POLARITY: "1" for NPN, "2" for PNP
- PACKAGE/LEAD CODE: refer to 1
- HFE GROUPING: refer to 5

4 electrical characteristics $T_C = 25°C$

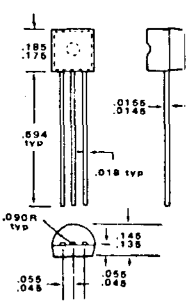
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	I_C = 1 mA	20			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100μA	25			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 10 μA	5			V
I_{CEO}	Collector-Emitter Leakage Current	V_{CE} = 15V			100	μA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 20V			1	μA
V_{BE} (on)	Base-Emitter Voltage	I_C = 10 mA, V_{CE} = 3V	630	680	730	mV
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 700 mA, I_B = 14 mA		0.9	1.0	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 700 mA, I_B = 14 mA				
	NPN types			0.35	0.5	V
	PNP types			0.65	1	V
C_{ob}	Collector Output Capacitance	V_{CB} = 10V, f = 1 MHz				
	NPN types			0.45		pF
	PNP types			0.7		pF
f_t	Current Gain Bandwidth Product	I_C = 100 mA, V_{CE} = 3V	50	200		MHz

5 HFE groupings

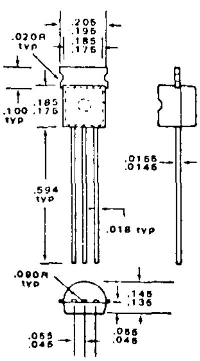
GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
G	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	68	85	110	1:1.6
H	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	100	127	160	1:1.6
I	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	140	180	240	1:1.6
J	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	200	260	350	1:1.6
X	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	30	58	110	1:3.5
Y	DC Current Gain	I_C = 100 mA, V_{CE} = 3V	100	190	350	1:3.5

6 physical dimensions

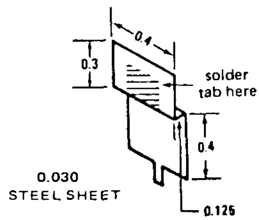
TO-92



TO-92 PLUS



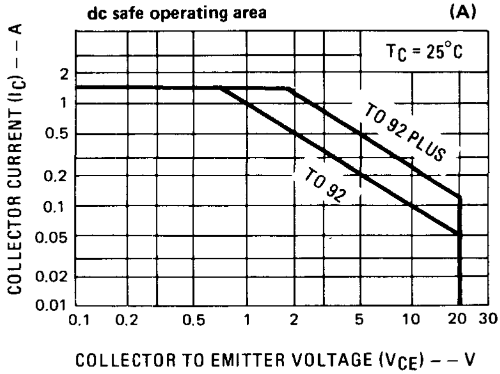
7 heatsink information



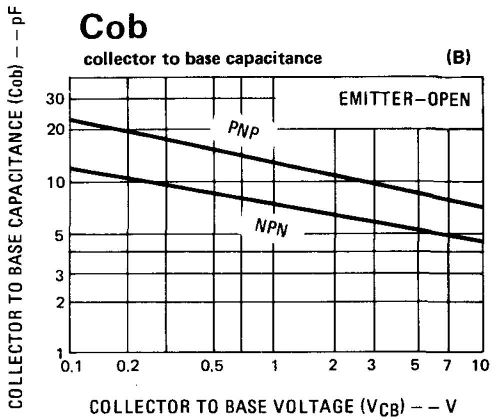
- TO-92 PLUS package with heat-sink shown on right permits 1.6 Watts power dissipation and combined Thermal Resistance θ_{JA} = 78°C/W. If used without heatsink and PCB land area at collector lead > 1 sq. inch, P_D = 1.2W.

8 typical performance characteristics

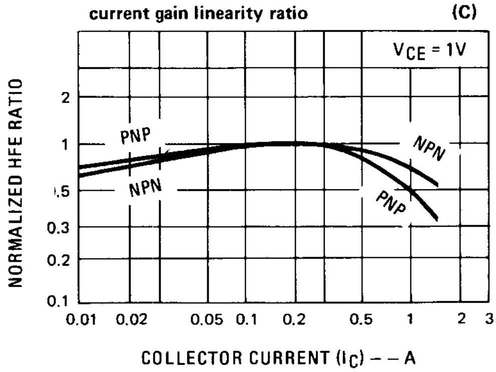
SOA
dc safe operating area (A)



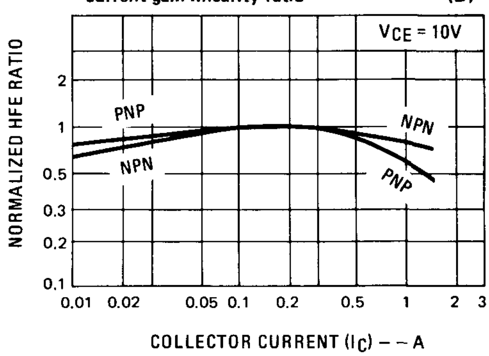
Cob
collector to base capacitance (B)



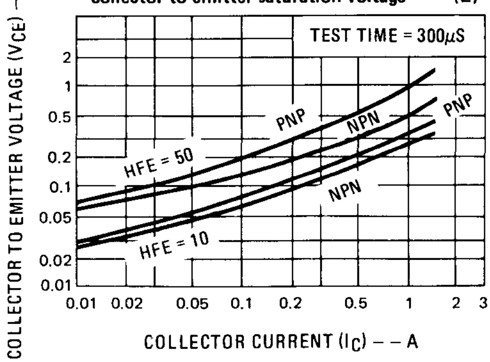
HFE1/HFE2
current gain linearity ratio (C)



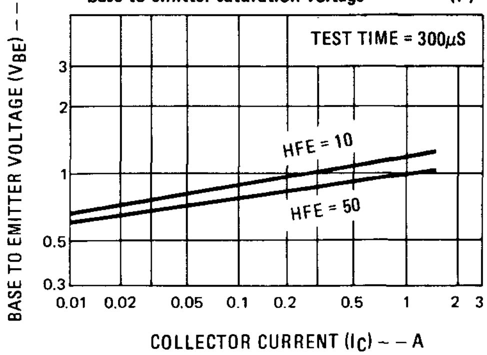
HFE1/HFE2
current gain linearity ratio (D)



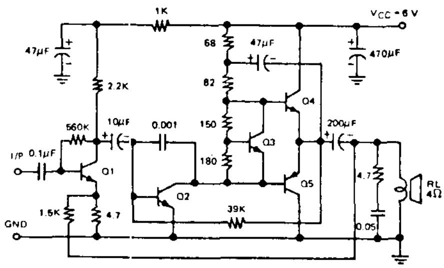
VCE(sat)
collector to emitter saturation voltage (E)



VBE(sat)
base to emitter saturation voltage (F)

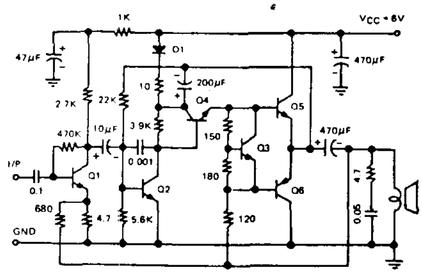


9 typical applications



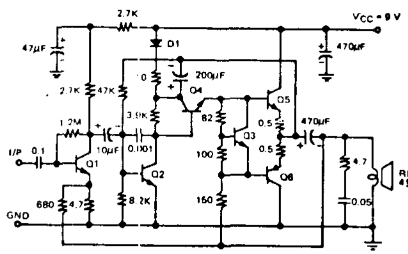
Q1 NB01'EY Q3 NR001E Q5 NA22EG/J
Q2 NB11'EH/J Q4 NA21EG/J

Figure A. 700mW 6V/4Ω OTL Amplifier



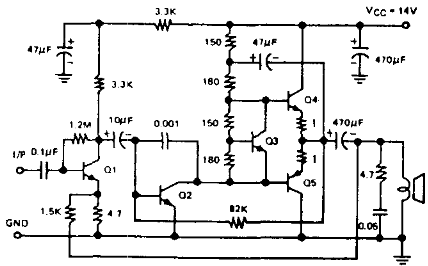
Q1 NB011EY Q3 NR001E Q5 NA21EG/J
Q2 NB011EY Q4 NB111EY Q6 NA22EG/J

Figure B. 950mW 6V/4Ω OTL Amplifier



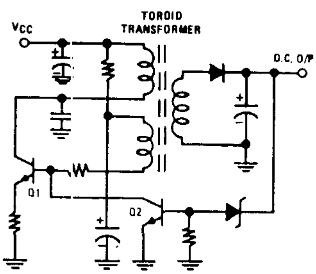
Q1 NB011EY Q3 NR001E Q5 NA21EG/J
Q2 NB011EY Q4 NB111EY Q6 NA22EG/J

Figure C. 2W 9V/4Ω OTL Amplifier



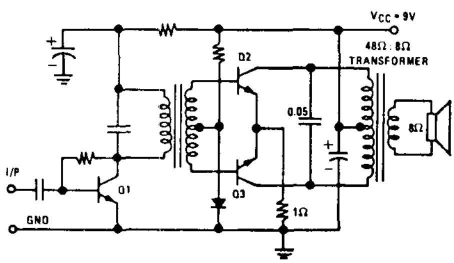
Q1 NB011EY Q3 NR001E Q5 NA22EG/J
Q2 NB111EH/J Q4 NA21EG/J

Figure D. 2.2W 14V/8Ω OTL Amplifier



Q1 NA21EX Q2 NB111EY

Figure E. Typical Convertor Circuit



Q1 NB111E Q2 NA21Y G/J Q3 NA21Y G/J

Figure F. 2W Audio Amplifier

National Semiconductor

NA31 (NPN) NA32 (PNP) 2 Amp complementary power transistors

features

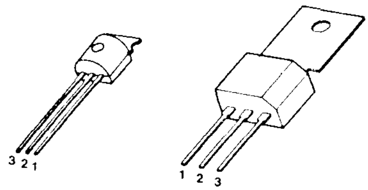
- 30 Volt/2 Amp rating
- 1.2 Watts practical power dissipation (TO-92 PLUS™)
- 1.75 Watts free air power dissipation (TO-202)
- Low $V_{CE(sat)}$ and $V_{BE(sat)}$ characteristics at I_C = 1.2A, I_B = 30 mA
- Matched HFE groupings for complementary applications
- "Epoxy B" *packaging concept* for excellent reliability

applications

- 4-Watt audio power amplifiers
- Medium power switching circuits
- Converter/Inverter circuits
- TV receivers

[1] packages and lead coding

TO-92 PLUS ™ TO-202



PACKAGE CODE		LEAD		
TO-92 PLUS	TO-202	1	2	3
X	K	E	B	C
Y	L	E	C	B
Z	M	B	C	E

[2] maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V_{DC}
Collector-Base Voltage	V_{CB}	35	V_{DC}
Emitter-Base Voltage	V_{EB}	5.0	V_{DC}
Collector Current (continuous)	I_C (max)	2.0	A
Power Dissipation (T_A = 25°C)	P_D		
TO-92 PLUS		0.75	W
TO-202		1.75	W
Power Dissipation (T_C = 25°C)	P_D		
TO-92 PLUS		2.5	W
TO-202		10	W
Thermal Resistance			
TO-92 PLUS	θ_{JA}/θ_{JC}	167/ 50	°C/W
TO-202	θ_{JA}/θ_{JC}	72/ 12.5	°C/W
Temperature, Junction and Storage	T_j, T_{stg}	−55 to + 150	°C

[3] ordering information

N A 3 X X X

- POLARITY: "1" for NPN, "2" for PNP
- PACKAGE/LEAD CODE: refer to [1]
- HFE GROUPING: refer to [5]

4 electrical characteristics $T_C = 25°C$

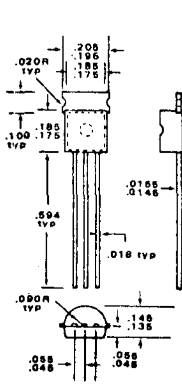
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	I_C = 1 mA	30			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100 μA	35			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 10 μA	5			V
I_{CEO}	Collector-Emitter Leakage Current	V_{CE} = 25V			100	μA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 30V			1	μA
$V_{BE(on)}$	Base-Emitter Voltage	I_C = 15 mA, V_{CE} = 5V	600	650	700	mV
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	I_C = 1.2A, I_B = 30 mA		0.95	1.2	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C = 1.2A, I_B = 30 mA		0.5	1	V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	I_C = 1.2A, I_B = 120 mA		1.0	1.4	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C = 1.2A, I_B = 120 mA		0.25	0.5	V
C_{ob}	Collector Output Capcitance NPN types PNP types	V_{CB} = 10V, f = 1 MHz		 10 17		 pF pF
f_t	Current Gain Bandwidth Product	I_C = 300 mA, V_{CE} = 5V	20			MHz

5 HFE groupings

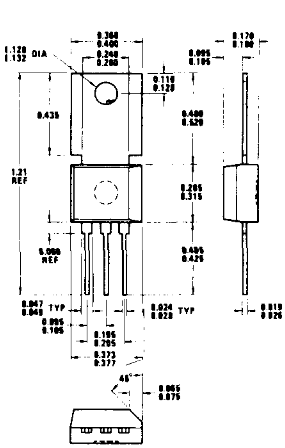
GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
G	DC Current Gain	I_C = 300 mA, V_{CE} = 5V	68	85	110	1:1.6
H	DC Current Gain	I_C = 300 mA, V_{CE} = 5V	100	127	160	1:1.6
I	DC Current Gain	I_C = 300 mA, V_{CE} = 5V	140	180	240	1:1.6
J	DC Current Gain	I_C = 300 mA, V_{CE} = 5V	200	260	350	1:1.6
X	DC Current Gain	I_C = 300 mA, V_{CE} = 5V	30	58	110	1:3.5
Y	DC Current Gain	I_C = 300 mA, V_{CE} = 5V	100	190	350	1:3.5

6 physical dimensions

TO-92 PLUS

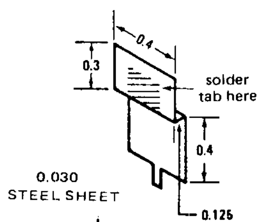


TO-202

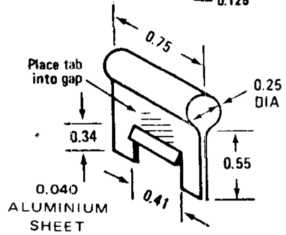


7 heatsink information

- TO-92 PLUS package with heatsink shown on right permits 1.6 Watts power dissipation and combined Thermal Resistance θ_{JA} = 78°C/W. If used without heatsink and PCB land area at collector lead > 1 sq. inch, P_D = 1.2W.

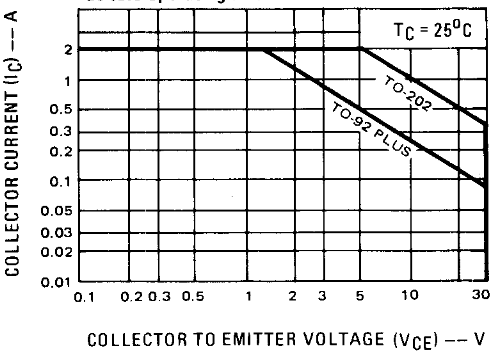


- TO-202 package with heatsink shown on right permits 3 Watts P_D and θ_{JA} = 42°C/W.

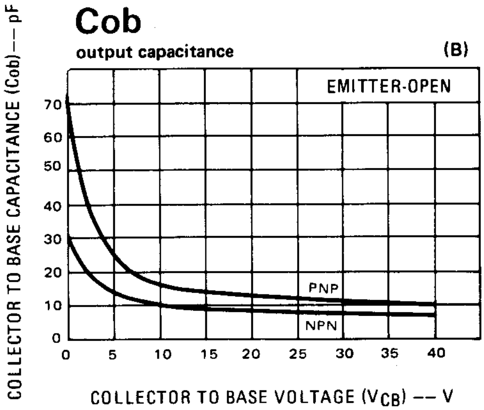


8 typical performance characteristics

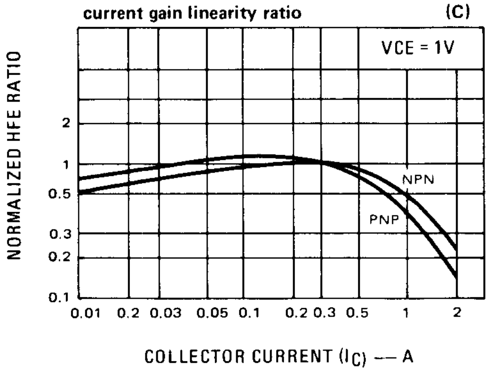
SOA
dc safe operating area (A)



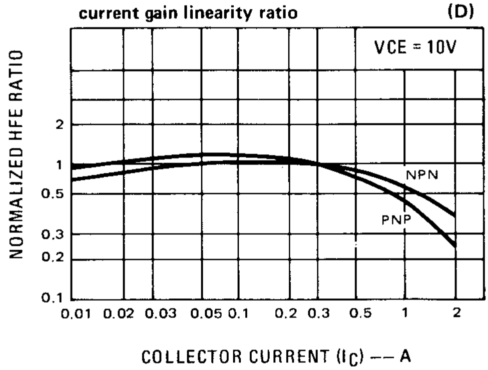
Cob
output capacitance (B)



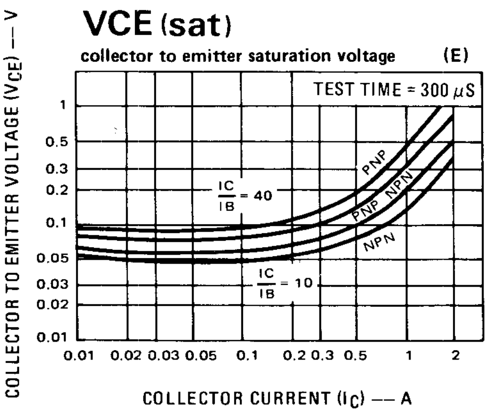
HFE1/HFE2
current gain linearity ratio (C)



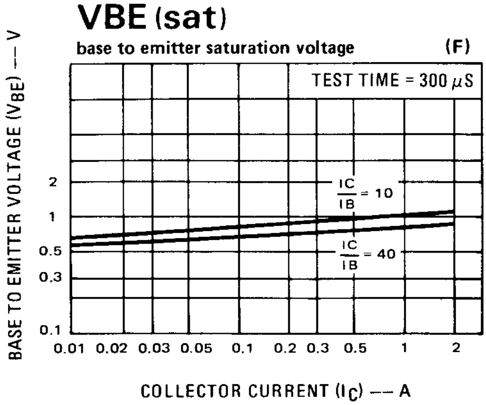
HFE1/HFE2
current gain linearity ratio (D)



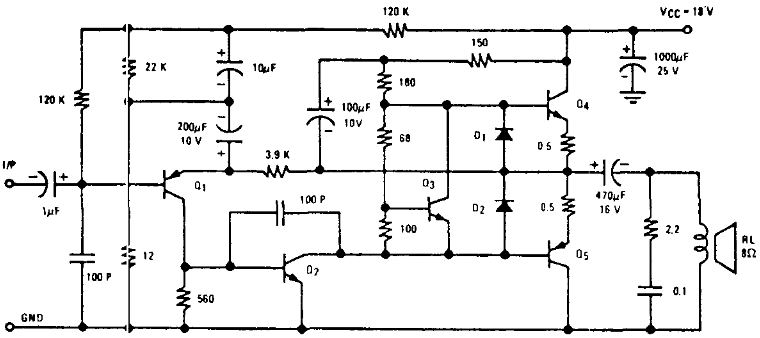
VCE (sat)
collector to emitter saturation voltage (E)



VBE (sat)
base to emitter saturation voltage (F)

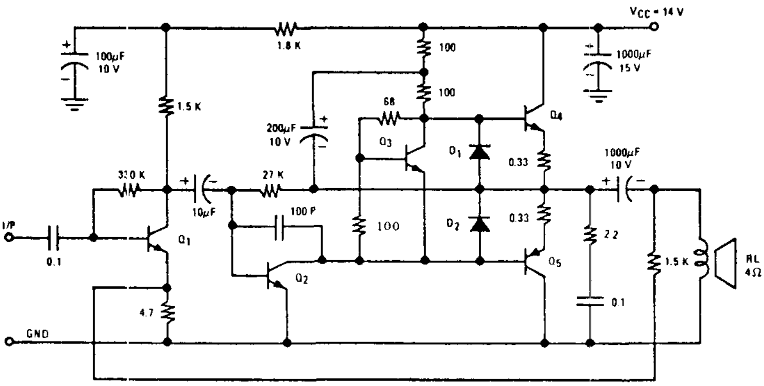


9 typical applications



Q1	NB021EY
Q2	NB211EY
Q3	NR001E
Q4	NA31YG/I
Q5	NA32YG/I

Figure A. 4 Watt/ 8 Ohm OTL Amplifier



Q1	NB011EU
Q2	NB211EH/J
Q3	NR001E
Q4	NA31YG/I
Q5	NA32YG/I

Figure B. 4 Watt/ 4 Ohm OTL Amplifer

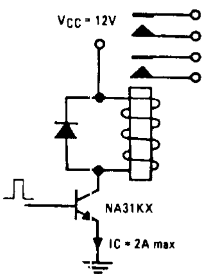


Figure C. Relay Driver

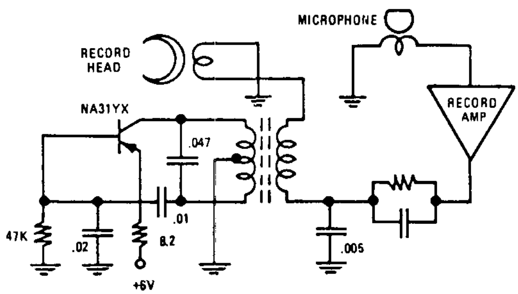


Figure D. Cassette Bias Oscillator

National Semiconductor

NA41 (NPN) NA42 (PNP) 2.5 Amp complementary power transistors

features

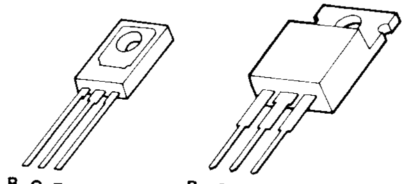
- 30 Volt/2.5 Amp rating
- Available in TO-126 and TO-220 packages
- Low V_{CE} (sat) and V_{BE} (sat) characteristics at I_C = 1.6 A, I_B = 40 mA
- Matched HFE groupings for complementary applications
- "Epoxy B" packaging concept for excellent reliability

applications

- 4 to 7 Watt, 4 or 8 Ohm audio power amplifiers
- High current switching circuits
- Converter/Inverter circuits
- TV receivers

1 packages and lead coding

TO-126 TO-220



PACKAGE CODE	
TO 126	TO 220
U	W

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CE}	30	V_{DC}
Collector-Base Voltage	V_{CB}	35	V_{DC}
Emitter-Base Voltage	V_{EB}	4	V_{DC}
Collector Current (continuous)	I_C (max)	2.5	A
Power Dissipation (T_A = 25°C)	P_D		
TO-126		1.7	W
TO-220		1.8	W
Power Dissipation (T_C = 25°C)	P_D		
TO-126		25	W
TO-220		25	W
Thermal Resistance			
TO-126	θ_{JA}/θ_{JC}	73.5/5	°C/W
TO-220	θ_{JA}/θ_{JC}	69.4/5	°C/W
Temperature, Junction and Storage	Tj, Tstg	−55 to + 150	°C

3 ordering information

N A 4 X X X

- POLARITY: "1" for NPN, "2" for PNP
- PACKAGE/LEAD CODE: refer to 1
- HFE GROUPING: refer to 5

4 electrical characteristics $T_C = 25°C$

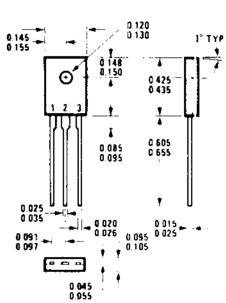
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CER}	Collector-Emitter Sustaining Voltage	I_C = 10 mA, R = 1K	30			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100μA	35			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 100μA	4			V
I_{CER}	Collector-Emitter Leakage Current	V_{CE} = 20V, R = 1K			500	μA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 25V			200	μA
V_{BE} (on)	Base-Emitter Voltage	I_C = 10 mA, V_{CE} = 10V	510	590	670	mV
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 1.6A, I_B = 40 mA			1.2	V
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 1.6A, I_B = 160 mA			1.4	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 1.6A, I_B = 40 mA			1.2	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 1.6A, I_B = 160 mA			0.6	V
Cob	Collector Output Capacitance	V_{CB} = 10V, f = 1 MHz				
	NPN types			35		pF
	PNP types			65		pF

5 HFE groupings

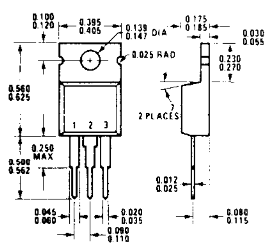
GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
G	DC Current Gain	I_C = 300 mA, V_{CE} = 10V	68	85	110	1:1.6
H	DC Current Gain	I_C = 300 mA, V_{CE} = 10V	100	127	160	1:1.6
I	DC Current Gain	I_C = 300 mA, V_{CE} = 10V	140	180	240	1:1.6
X	DC Current Gain	I_C = 300 mA, V_{CE} = 10V	30	58	110	1:3.5
Y	DC Current Gain	I_C = 300 mA, V_{CE} = 10V	100	190	350	1:3.5

6 physical dimensions

TO-126



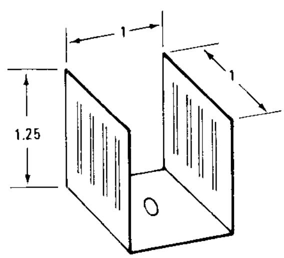
TO-220



7 heatsink information

The TO-126 and TO-220 packages used with heatsink shown below permits about 8.7 Watts Power Dissipation and θ_{CA} = 9.4°C/W.

0.05 inch aluminium sheet

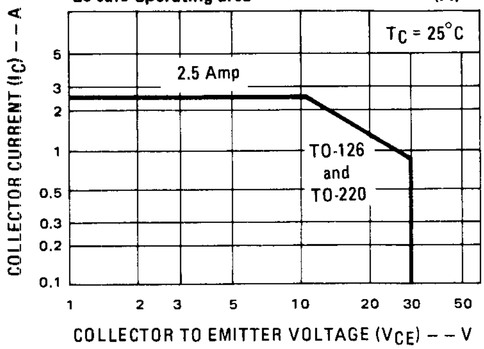


Mount transistor under heatsink and apply thermally conductive compound between contact surfaces.

8 typical performance characteristics

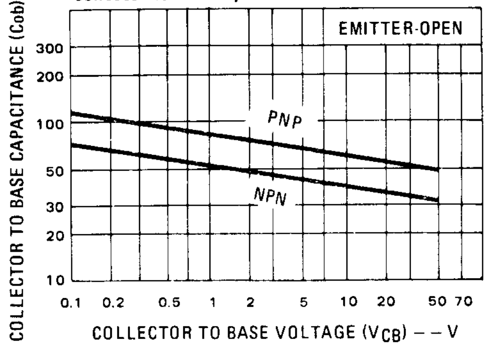
SOA

dc safe operating area (A)



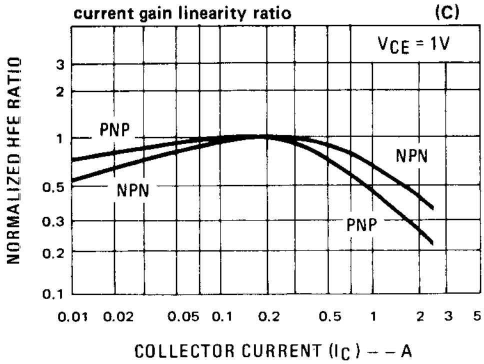
Cob

collector to base capacitance (B)



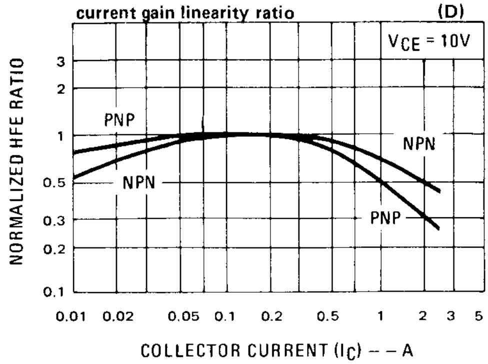
HFE1/HFE2

current gain linearity ratio (C)



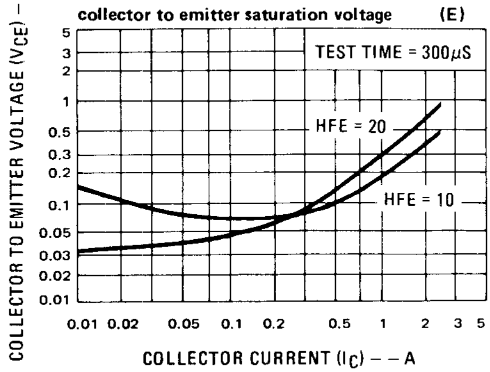
HFE1/HFE2

current gain linearity ratio (D)



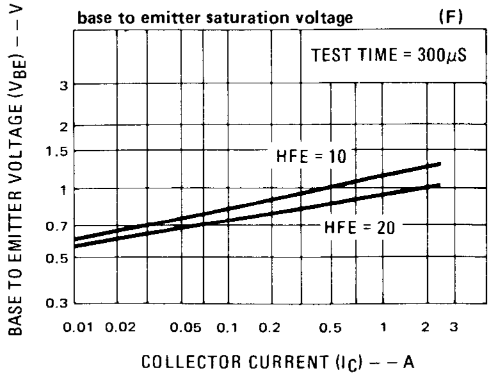
VCE(sat)

collector to emitter saturation voltage (E)

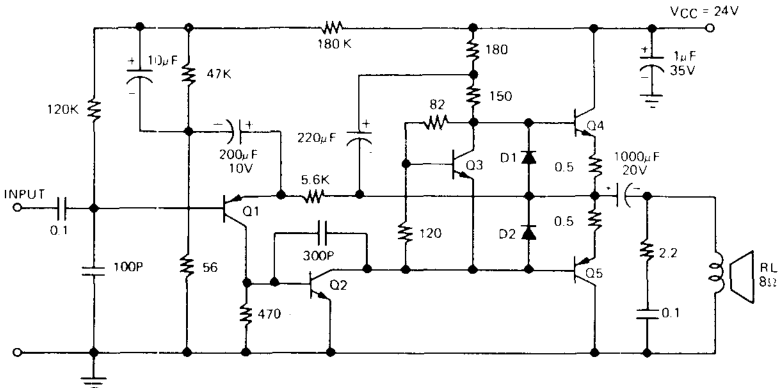


VBE(sat)

base to emitter saturation voltage (F)

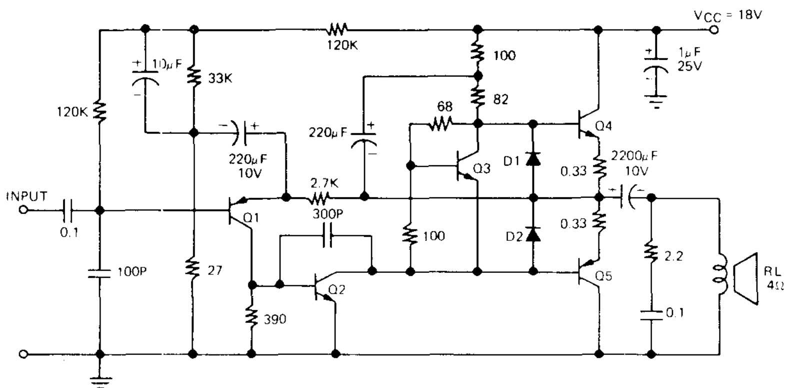


9 typical applications



Q1	NB021EY
Q2	NB211YY
Q3	NR001E
Q4	NA41U
Q5	NA42U

Figure A. 6 Watt, 8 Ohm OTL Amplifier



Q1	NB021EY
Q2	NB211YY
Q3	NR001E
Q4	NA41U
Q5	NA42U

Figure B. 6 Watt, 4 Ohm OTL Amplifier

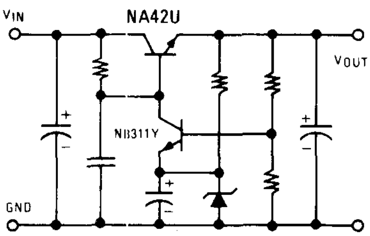


Figure C. Linear Regulator Circuit

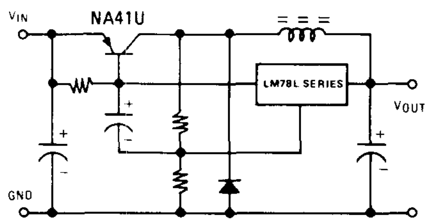


Figure D. Switching Regulator Circuit

National Semiconductor

NA51(NPN) NA52(PNP) 3.5 Amp complementary power transistors

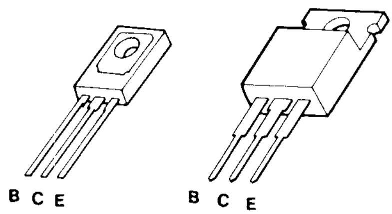
features

- 45 Volt/3.5 Amp rating
- Available in TO-126 and TO-220 packages
- Low V_{CE} (sat) and V_{BE} (sat) characteristics at I_C = 2A, I_B = 80 mA
- Guaranteed V_{CE} (sat) and V_{BE} (sat) at I_C = 3A, I_B = 160 mA for improved short-circuit protection design in audio amplifier
- "Epoxy B" packaging concept for excellent reliability

applications

- 6 to 14 Watt, 4 or 8 Ohm audio power amplifier
- High current switching circuits
- Converter/Inverter circuits
- TV receivers

1 packages and lead coding



PACKAGE CODE	
TO 126	TO 220
U	W

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CE}	45	V_{DC}
Collector-Base Voltage	V_{CB}	50	V_{DC}
Emitter-Base Voltage	V_{EB}	4	V_{DC}
Collector Current (continuous)	I_C (max)	3.5	A
Power Dissipation (T_A = 25°C)	P_D		
TO-126		1.8	W
TO-220		2.0	W
Power Dissipation (T_C = 25°C)	P_D		
TO-126		30	W
TO-220		30	W
Thermal Resistance			
TO-126	θ_{JA}/θ_{JC}	69.4/4.17	°C/W
TO-220	θ_{JA}/θ_{JC}	62.5/4.17	°C/W
Temperature, Junction and Storage	Tj, Tstg	−55 to + 150	°C

3 ordering information

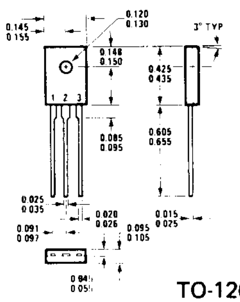
N A 5 X X

- POLARITY (first X): "1" for NPN, "2" for PNP
- PACKAGE/LEAD CODE (second X): refer to 1

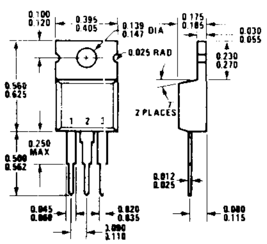
4 electrical characteristics $T_C = 25°C$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CER}	Collector-Emitter Sustaining Voltage	I_C = 10 mA, R = 1K	45			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100μA	50			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 100μA	4			V
I_{CER}	Collector-Emitter Leakage Current	V_{CE} = 35V, R = 1K			1	mA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 40V			0.5	mA
V_{BE} (on)	Base-Emitter Voltage	I_C = 15 mA, V_{CE} = 10V	520	600	680	mV
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 2A, I_B = 80 mA			1.3	V
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 3A, I_B = 160 mA			1.6	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 2A, I_B = 80 mA			1.5	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 3A, I_B = 160 mA			5	V
HFE_1	DC Current Gain	I_C = 500 mA, V_{CE} = 10V	30	100		ratio
Cob	Collector Output Capacitance NPN types PNP types	V_{CB} = 10V, f = 1 MHz		 35 65		 pF pF

5 physical dimensions



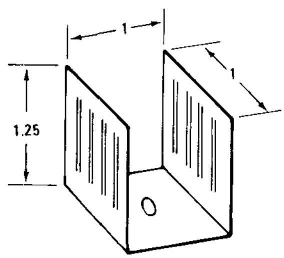
TO-126



TO-220

6 heatsink information

The TO-126 and TO-220 packages used with heatsink shown below permits about 9.2 Watts power dissipation and θ_{CA} = 9.4°C/W.



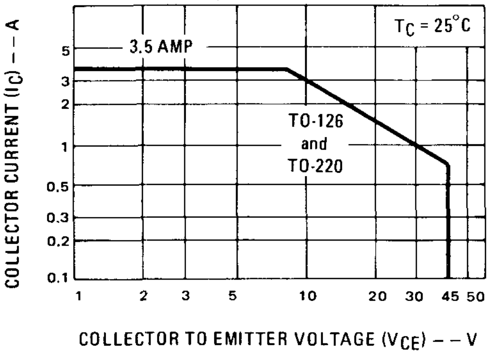
0.05 inch aluminium sheet

Mount transistor under heatsink and apply thermally conductive compound between contact surfaces.

7 typical performance characteristics

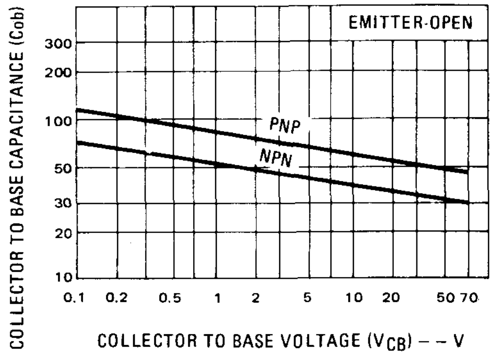
SOA

dc safe operating area **(A)**



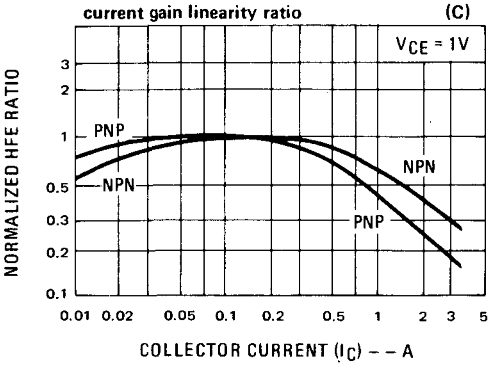
Cob

collector to base capacitance **(B)**



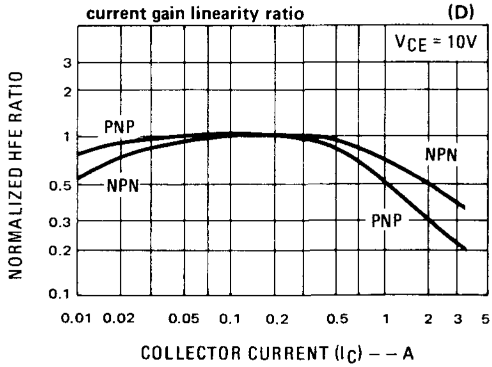
HFE1/HFE2

current gain linearity ratio **(C)**



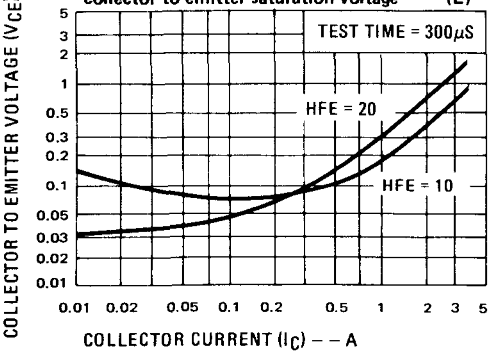
HFE1/HFE2

current gain linearity ratio **(D)**



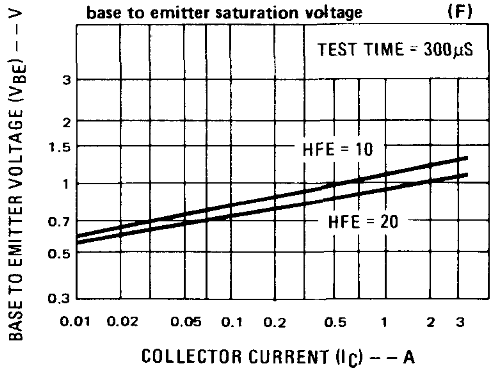
VCE(sat)

collector to emitter saturation voltage **(E)**

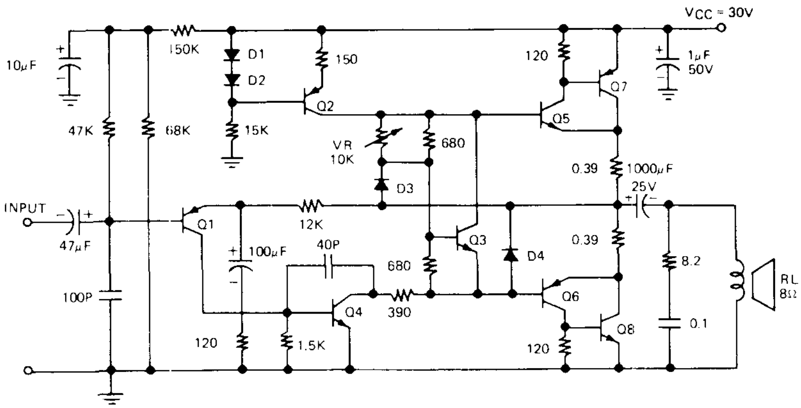


VBE(sat)

base to emitter saturation voltage **(F)**

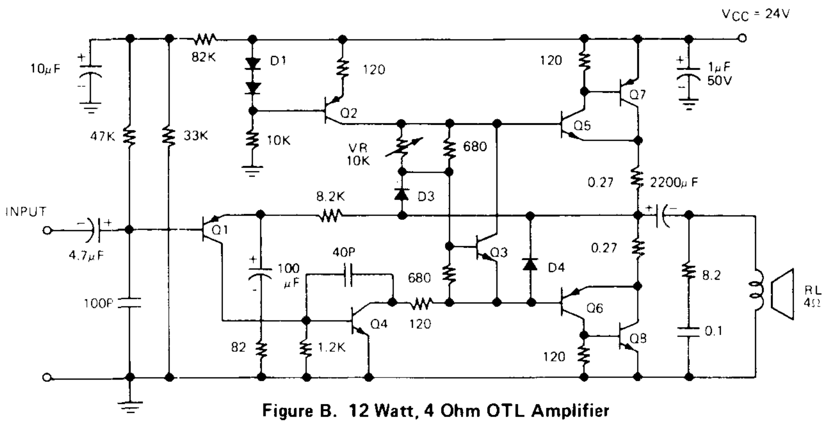


8 typical applications



Q1	NB021EY
Q2	NB122EY
Q3	NR001E
Q4	NB112EY
Q5	NB312E
Q6	NB322E
Q7	NA52W
Q8	NA51W

Figure A. 12 Watt, 8 Ohm OTL Amplifier



Q1	NB021EY
Q2	NB122EY
Q3	NR001E
Q4	NB112EY
Q5	NB312E
Q6	NB322E
Q7	NA52W
Q8	NA51W

Figure B. 12 Watt, 4 Ohm OTL Amplifier

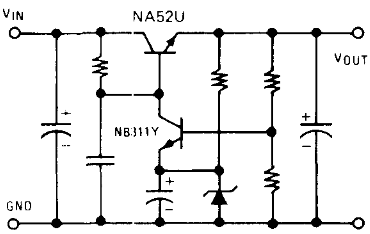


Figure C. Linear Regulator Circuit

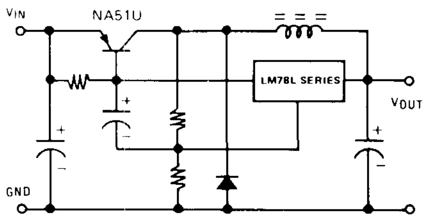


Figure D. Switching Regulator Circuit

National Semiconductor

NA61 (NPN) NA62 (PNP) 4.5 Amp complementary power transistors

features

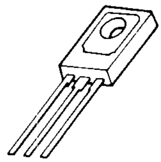
- 45 Volt/4.5 Amp rating
- Available in TO-126 and TO-220 packages
- Low V_{CE} (sat) and V_{BE} (sat) characteristics at I_C = 3A, I_B = 150 mA
- Guaranteed V_{CE} (sat) and V_{BE} (sat) at I_C = 4.5A, I_B = 300 mA for improved short-circuit protection design in audio amplifiers
- "Epoxy B" packaging concept for excellent reliability

applications

- 10 to 25 Watt, 4 Ohm audio power amplifiers
- High current switching circuits
- Converter/Inverter circuits
- TV receivers

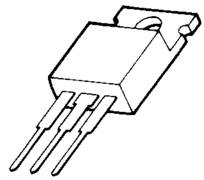
[1] packages and lead coding

TO-126



B C E

TO-220



B C E

PACKAGE CODE	
TO 126	TO 220
U	W

[2] maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CE}	45	V_{DC}
Collector-Base Voltage	V_{CB}	50	V_{DC}
Emitter-Base Voltage	V_{EB}	4	V_{DC}
Collector Current (continuous)	I_C (max)	4.5	A
Power Dissipation (T_A = 25°C)	P_D		
TO-126		1.8	W
TO-220		2.0	W
Power Dissipation (T_C = 25°C)	P_D		
TO-126		40	W
TO-220		40	W
Thermal Resistance			
TO-126	θ_{JA}/θ_{JC}	69.4/3.125	°C/W
TO-220	θ_{JA}/θ_{JC}	62.5/3.125	°C/W
Temperature, Junction and Storage	Tj, Tstg	–55 to + 150	°C

[3] ordering information

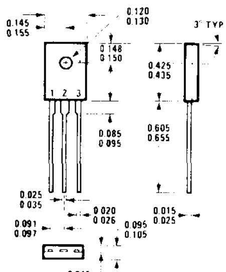
NA6XX

- First X — POLARITY: "1" for NPN, "2" for PNP
- Second X — PACKAGE/LEAD CODE, refer to [1]

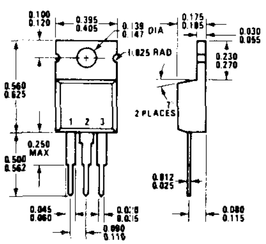
4 electrical characteristics $T_C = 25°C$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CER}	Collector-Emitter Sustaining Voltage	I_C = 10 mA, R = 1K	45			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100μA	50			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 100μA	4			V
I_{CER}	Collector-Emitter Leakage Current	V_{CE} = 35V, R = 1K			2	mA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 40V			1	mA
V_{BE} (on)	Base-Emitter Voltage	I_C = 20 mA, V_{CE} = 10V	520	600	680	mV
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 3A, I_B = 150 mA			1.5	V
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 4.5A, I_B = 300 mA			2	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 3A, I_B = 150 mA			2	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 4.5A, I_B = 300 mA			5	V
HFE	DC Current Gain	I_C = 500 mA, V_{CE} = 10V	30	100		ratio
Cob	Collector Output Capacitance NPN types PNP types	V_{CB} = 10V, f = 1 MHz		 40 70		 pF pF

5 physical dimensions



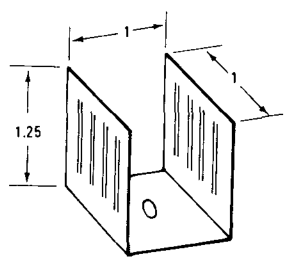
TO-126



TO-220

6 heatsink information

The TO-126 and TO-220 packages used with heatsink shown below permits about 10 Watts power dissipation and θ_{CA} = 9.4°C/W.

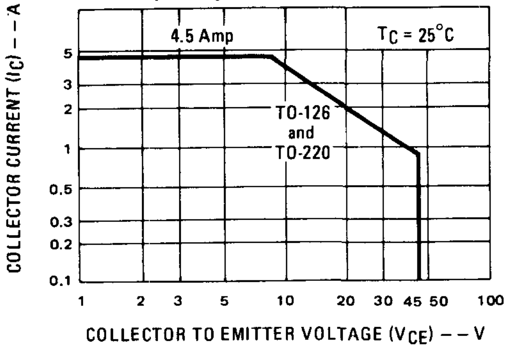


0.05 inch aluminium sheet

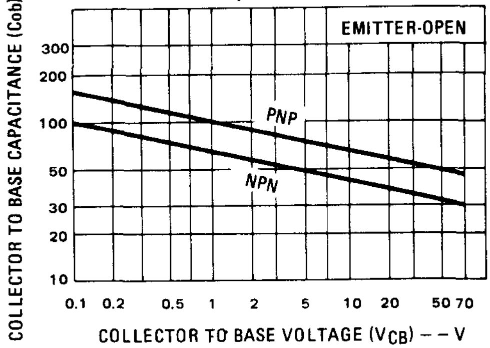
Mount transistor under heatsink and apply thermally conductive compound between contact surfaces.

7 typical performance characteristics

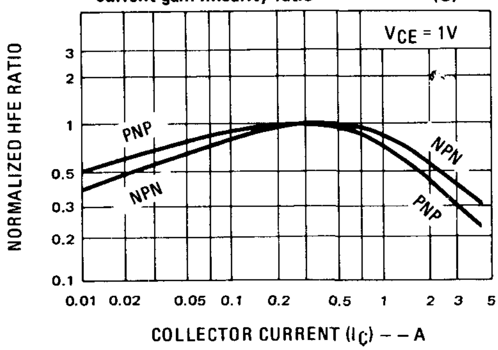
SOA
dc safe operating area (A)



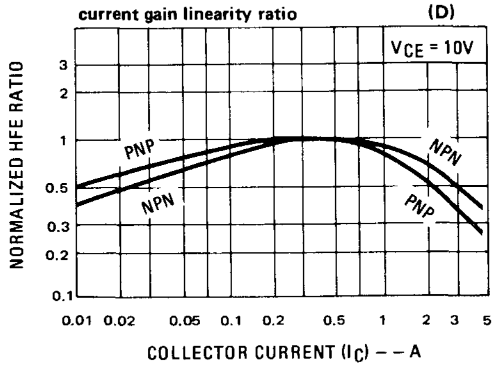
Cob
collector to base capacitance (B)



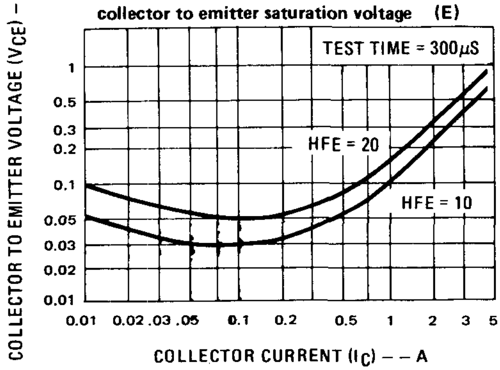
HFE1/HFE2
current gain linearity ratio (C)



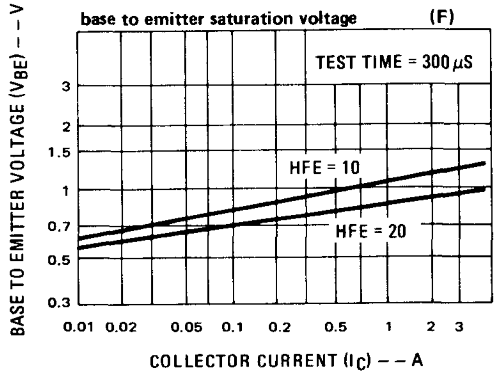
HFE1/HFE2
current gain linearity ratio (D)



VCE(sat)
collector to emitter saturation voltage (E)



VBE(sat)
base to emitter saturation voltage (F)



8 typical applications

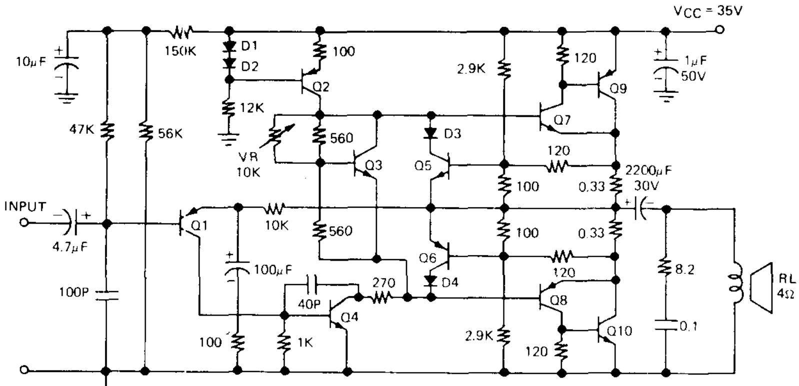


Figure A. 25 Watt OTL Amplifier

Q1	NB022EY
Q2	NB123EY
Q3	NR001E
Q4	NB113EY
Q5	NB111EY
Q6	NB121EY
Q7	NB313Y
Q8	NB323Y
Q9	NA62W
Q10	NA61W

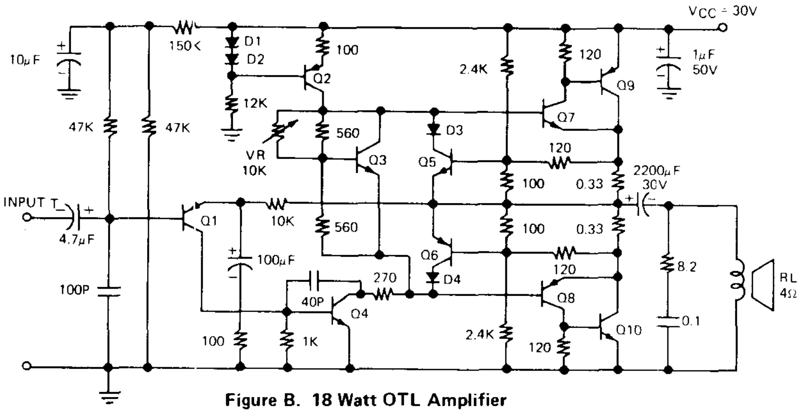


Figure B. 18 Watt OTL Amplifier

Q1	NB022EY
Q2	NB122EY
Q3	NR001E
Q4	NB112EY
Q5	NB111EY
Q6	NB121EY
Q7	NB313Y
Q8	NB323Y
Q9	NA62W
Q10	NA61W

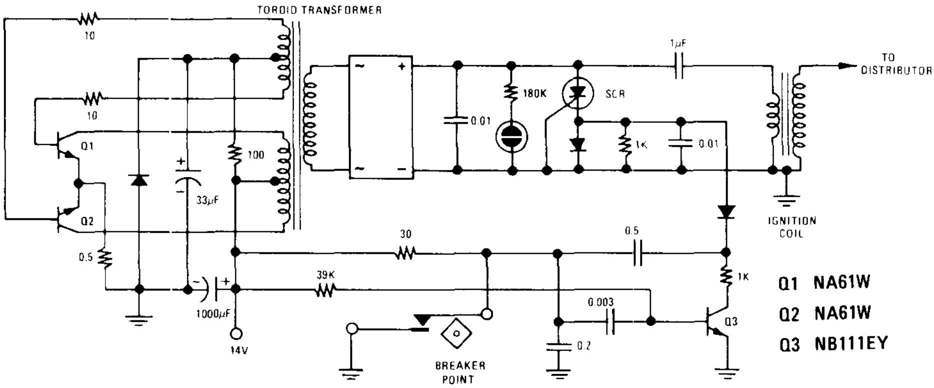


Figure C. Capacitor Discharge Ignition System

Q1	NA61W
Q2	NA61W
Q3	NB111EY

National Semiconductor

NA71 (NPN) NA72 (PNP) 3.5 Amp complementary power transistors

features

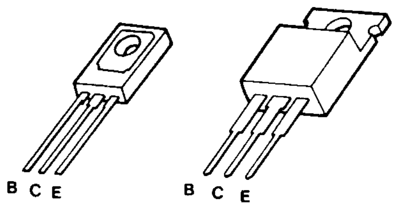
- 60 Volt/3.5 Amp rating
- Available in TO-126 and TO-220 packages
- Low V_{CE} (sat) and V_{BE} (sat) characteristics at $I_C = 2$ A, $I_B = 100$mA
- Guaranteed V_{CE} (sat) and V_{BE} (sat) at $I_C = 3$A, $I_B = 200$mA for improved short circuited protection design in audio amplifiers
- "Epoxy B" packaging concept for excellent reliability

applications

- 10–25 Watt 8 Ohm audio power amplifiers
- High current switching circuits
- Converter/Inverter circuits
- TV receivers

1 packages and lead coding

TO-126 TO-220



PACKAGE CODE	
TO 126	TO 220
U	W

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CE}	60	V_{DC}
Collector-Base Voltage	V_{CB}	65	V_{DC}
Emitter-Base Voltage	V_{EB}	4	V_{DC}
Collector Current (continuous)	I_C (max)	3.5	A
Power Dissipation ($T_A = 25°C$)	P_D		
TO-126		1.8	W
TO-220		2.0	W
Power Dissipation ($T_C = 25°C$)	P_D		
TO-126		40	W
TO-220		40	W
Thermal Resistance			
TO-126	θ_{JA}/θ_{JC}	69.4/3.125	°C/W
TO-220	θ_{JA}/θ_{JC}	62.5/3.125	°C/W
Temperature, Junction and Storage	Tj, Tstg	–55 to + 150	°C

3 ordering information

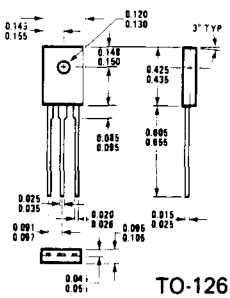
NA7XX

- POLARITY: "1" for NPN, "2" for PNP
- PACKAGE/LEAD CODE: refer to 1

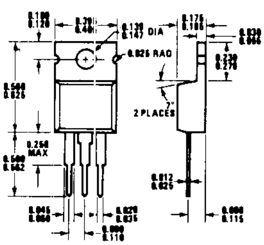
4 electrical characteristics $T_C = 25°C$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CER}	Collector-Emitter Sustaining Voltage	I_C = 10 mA, R = 1K	60			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100 μA	65			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 100 μA	4			V
I_{CER}	Collector-Emitter Leakage Current	V_{CE} = 50V, R = 1K			2	mA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 55V			1	mA
V_{BE} (on)	Base-Emitter Voltage	I_C = 20 mA, V_{CE} = 10V	520	600	680	mV
V_{BE} (sat)	Base -Emitter Saturation Voltage	I_C = 2A, I_B = 100 mA			1.5	V
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 3A, I_B = 200 mA			2	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 2A, I_B = 100 mA			2	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 3A, I_B = 200 mA			5	V
HFE_1	DC Current Gain	I_C = 500 mA, V_{CE} = 10V	30	100		ratio
C_{ob}	Collector Ouput Capacitance	V_{CB} = 10V, f = 1 MHz				
	NPN types			40		pF
	PNP types			70		pF

5 physical dimensions



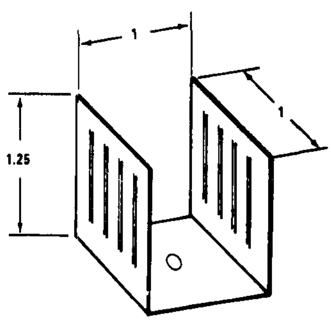
TO-126



TO-220

6 heatsink information

The TO-126 and TO-220 packages used with heatsink shown below permits about 10 Watts power dissipation and θ_{CA} = 9.4°C/W.



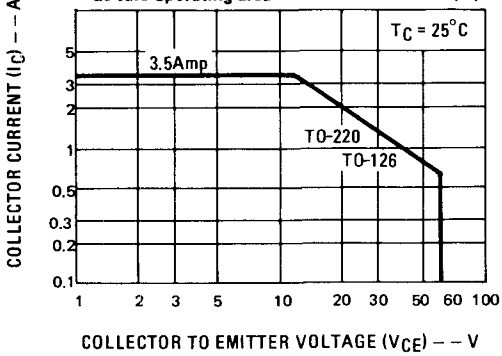
0.05 inch aluminium sheet

Mount transistor under heatsink and apply thermally conductive compound between contact surfaces.

7 typical performance characteristics

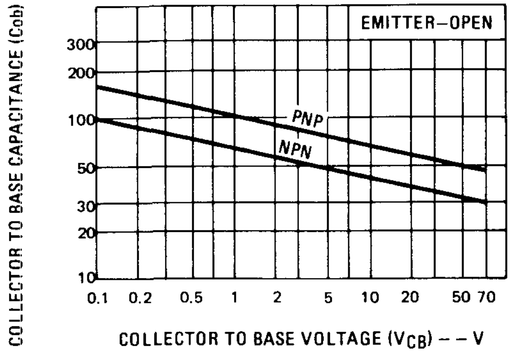
SOA

dc safe operating area (A)



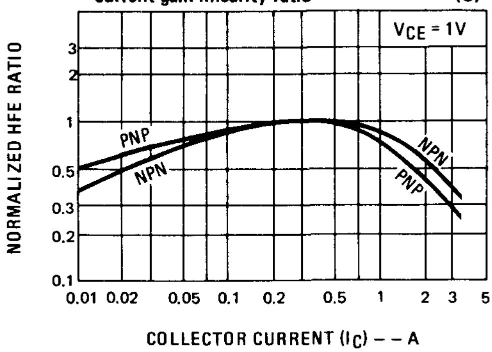
Cob

collector to base capacitance (B)



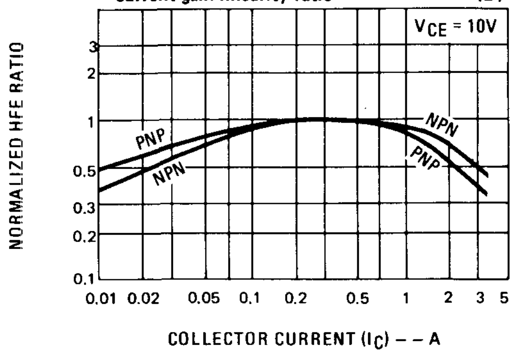
HFE1/HFE2

current gain linearity ratio (C)



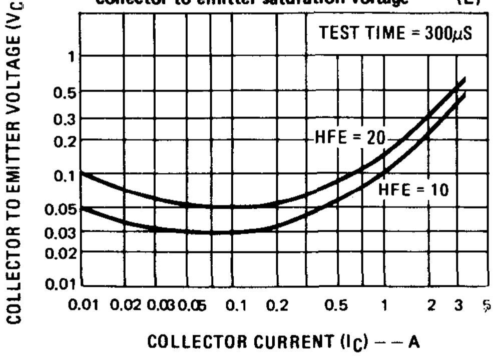
HFE1/HFE2

current gain linearity ratio (D)



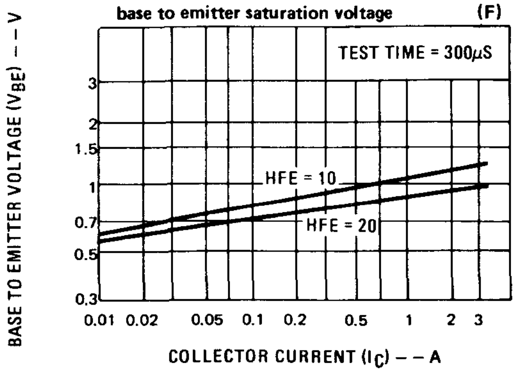
VCE (sat)

collector to emitter saturation voltage (E)

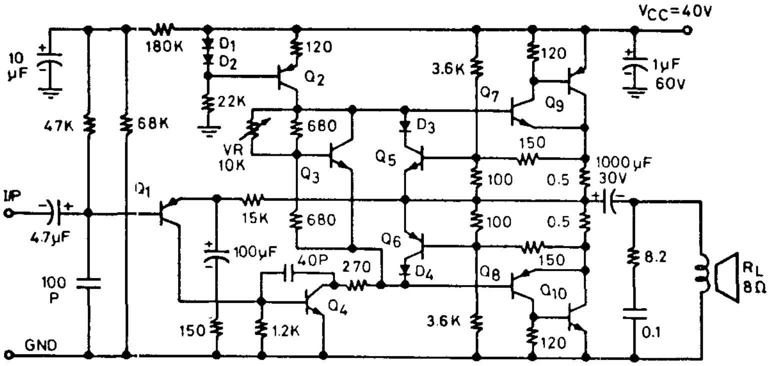


VBE (sat)

base to emitter saturation voltage (F)

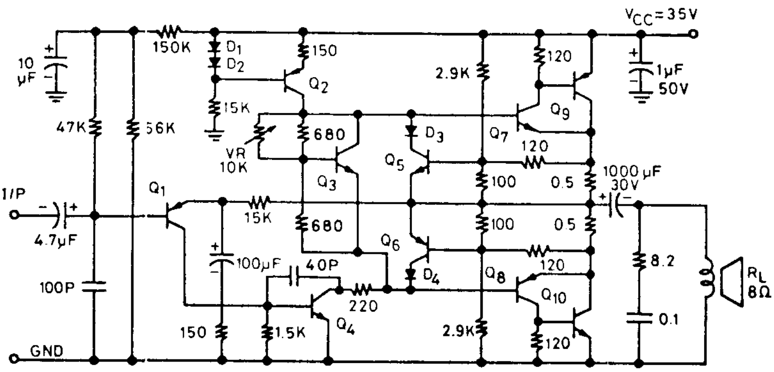


8 typical applications



Q1	NB022EY
Q2	NB123EY
Q3	NR001E
Q4	NB113EY
Q5	NB111EY
Q6	NB121EY
Q7	NB313Y
Q8	NB323Y
Q9	NA72W
Q10	NA71W

Figure A. 25 Watt OTL Amplifier



Q1	NB022EY
Q2	NB123EY
Q3	NR001E
Q4	NB113EY
Q5	NB111EY
Q6	NB121EY
Q7	NB313Y
Q8	NB323Y
Q9	NA72W
Q10	NA71W

Figure B. 18 Watt OTL Amplifier

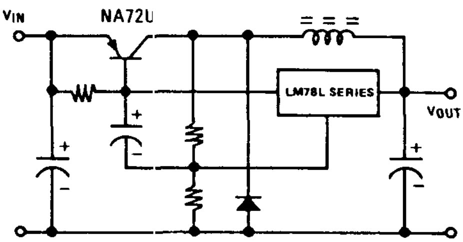


Figure C. Switching Regulator Circuit

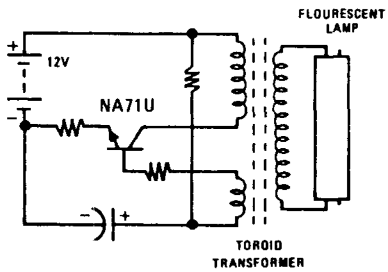


Figure D. Battery Lantern Circuit

National Semiconductor

NB011, 012 (NPN) NB021, 022 (PNP) 30mA general purpose transistors

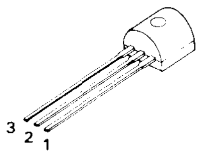
features

- 35 to 50 Volt at 30 mA collector ratings
- 300 mV guaranteed V_{CE} (sat) characteristics at I_C = 10 mA and I_B = 0.5 mA
- Matched HFE groupings for complementary applications
- "Epoxy B" packaging concept for excellent reliability

applications

- Small signal amplifier circuits
- Equalizer preamplifiers
- Low current switching circuits
- TV receivers

1 package and lead coding



PACKAGE CODE TO-92	LEAD 1	2	3
E	E	B	C
F	E	C	B
H	C	B	E

2 maximum ratings

PARAMETER	SYMBOL	NB011 NB021	NB012 NB022	UNIT
Collector-Emitter Voltage	V_{CEO}	35	50	V_{DC}
Collector-Base Voltage	V_{CB}	40	55	V_{DC}
Emitter-Base Voltage	V_{EB}	5	5	V_{DC}
Collector Current (continuous)	I_C (max)	30	30	mA_{DC}
Power Dissipation (T_A = 25°C)	P_D	0.6	0.6	W
Power Dissipation (T_C = 25°C)	P_D	1.0	1.0	W
Thermal Resistance	θ_{JA}	208	208	°C/W
	θ_{JC}	125	125	°C/W
Temperature, Junction and Storage	Tj, Tstg	−55 to + 150	−55 to + 150	°C

3 ordering information

NBOXXXX

- POLARITY "1" for NPN "2" for PNP
- VOLTAGE RATING refer to 2
- PACKAGE/LEAD CODE refer to 1
- HFE GROUPING refer to 5

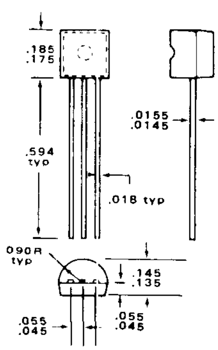
4 electrical characteristics $T_C = 25°C$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	$I_C = 1$ mA				
	NB011/021		35			V
	NB012/022		50			V
BV_{CBO}	Collector-Base Breakdown Voltage	$I_C = 100\mu A$				
	NB011/021		40			V
	NB012/022		55			V
BV_{EBO}	Emitter-Base Breakdown Voltage	$I_E = 10\mu A$	5			V
I_{CEO}	Collector-Emitter Leakage Current	$V_{CE} = 30V$ NB011/021			1	μA
		45V NB012/022			1	μA
I_{CBO}	Collector-Base Leakage Current	$V_{CB} = 35V$ NB011/021			0.1	μA
		50V NB012/022			0.1	μA
I_{EBO}	Emitter-Base Leakage Current	$V_{EB} = 4V$			0.1	μA
V_{BE} (sat)	Base-Emitter Saturation Voltage	$I_C = 10$ mA, $I_B = 0.5$ mA		0.75	0.95	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	$I_C = 10$ mA, $I_B = 0.5$ mA		0.1	0.3	V
Cob	Collector Output Capacitance	$V_{CB} = 10V$, f = 1 MHz				
	NPN types			2		pF
	PNP types			3		pF
ft	Current Gain Bandwidth Product	$I_C = 1$ mA, $V_{CE} = 5V$	50	120		MHz

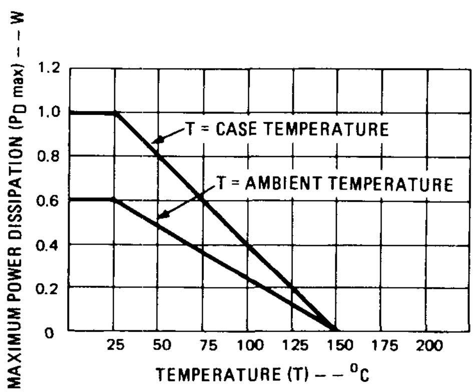
5 HFE groupings

GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
I	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	140	180	240	1:1.6
J	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	200	260	350	1:1.6
K	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	300	380	500	1:1.6
L	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	450	580	750	1:1.6
T	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	100	150	240	1:2.4
U	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	200	320	500	1:2.4
V	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	450	700	1100	1:2.4
Y	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	100	190	350	1:3.5
Z	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	300	580	1100	1:3.5

6 physical dimensions



7 max power dissipation

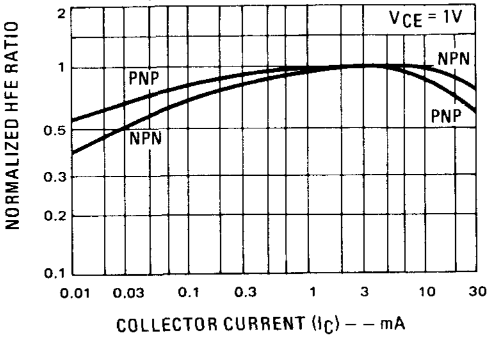


5

8 typical performance characteristics

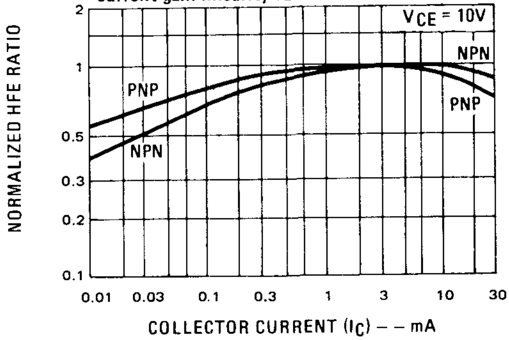
HFE1/HFE2

current gain linearity ratio (A)



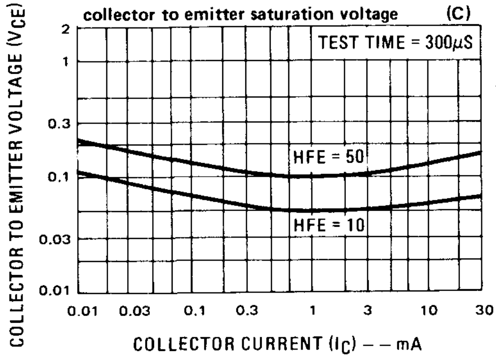
HFE1/HFE2

current gain linearity ratio (B)



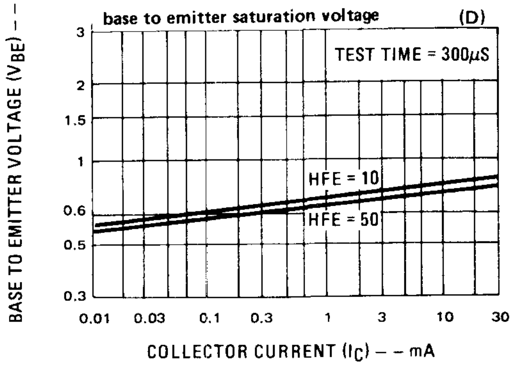
VCE (sat)

collector to emitter saturation voltage (C)



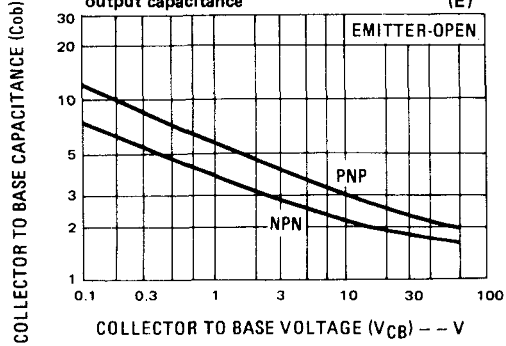
VBE(sat)

base to emitter saturation voltage (D)



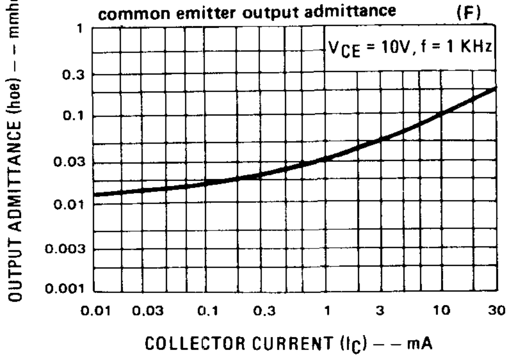
Cob

output capacitance (E)

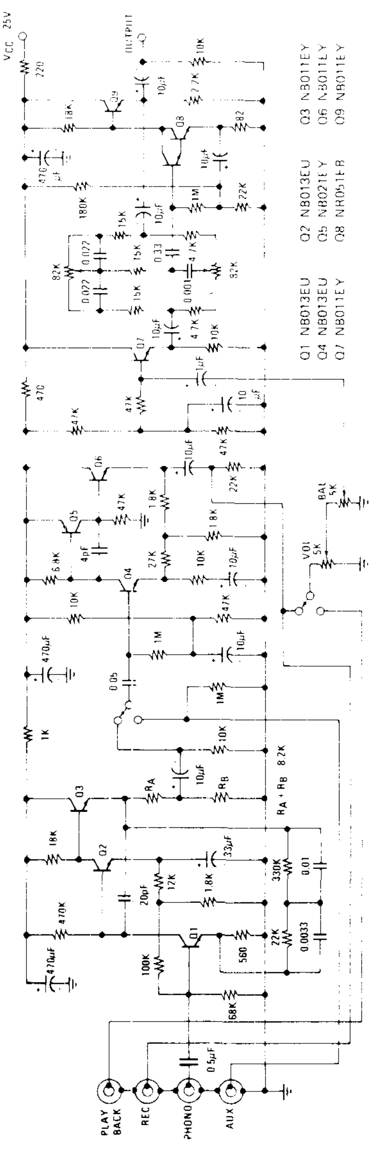


hoe

common emitter output admittance (F)

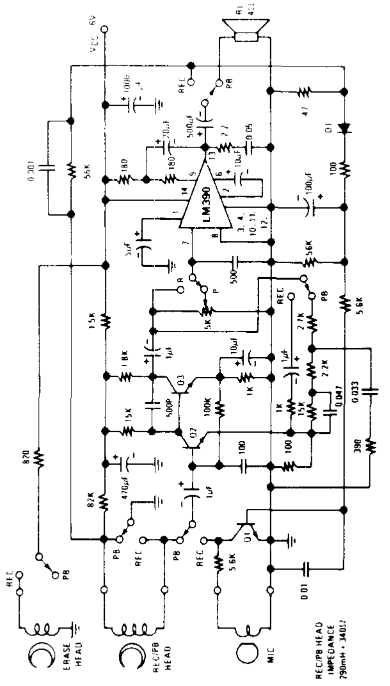


9 typical applications



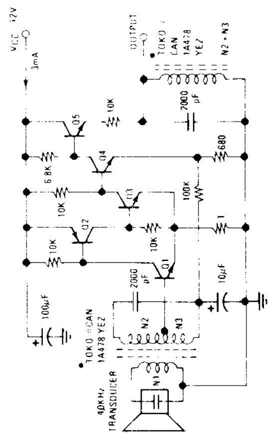
Q1 NB013EU　Q2 NB013EU　Q3 NB011EY
Q4 NB013EU　Q5 NB021EY　Q6 NB011EY
Q7 NB011EY　Q8 NB051EB　Q9 NB011EY

Figure A. High Quality Preamplifier with Tone Control Circuit



Q1 NR041E　Q2 NB013EU　Q3 NB011EY

Figure B. Battery Operated Recording/Playback Cassette Circuit



Q1 NB013EY
Q2 NB023EY
Q3 NB011EY
Q4 NB011EY
Q5 NB011EY

- Gain = 60K V/V
- Input impedance = 1K Ohm
- Output noise = 10mV rms

*L = 8mH
Qμ = 50
N1 = 40T
N2 = 360T
N3 = 40T

Figure C. High Gain Ultrasonic Amplifier

National Semiconductor

NB013, 014 (NPN) NB023, 024 (PNP) 30mA low noise transistors

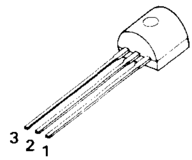
features

- 35 to 50 Volt at 30mA collector ratings
- 300mV guaranteed V_{CE} (sat) characteristics at I_C = 10mA and I_B = 0.5mA
- 1dB typical wide-band Noise Figure
- "Epoxy B" packaging concept for excellent reliability

applications

- Low noise amplifier circuits
- Equalizer preamplifiers

[1] package and lead coding



PACKAGE CODE TO-92	LEAD 1	2	3
E	E	B	C
F	E	C	B
H	C	B	E

[2] maximum ratings

PARAMETER	SYMBOL	NB013 NB023	NB014 NB024	UNIT
Collector-Emitter Voltage	V_{CEO}	35	50	V_{DC}
Collector-Base Voltage	V_{CB}	40	55	V_{DC}
Emitter-Base Voltage	V_{EB}	5	5	V_{DC}
Collector Current (continuous)	I_C (max)	30	30	mA_{DC}
Power Dissipation (T_A = 25°C)	P_D	0.6	0.6	W
Power Dissipation (T_C = 25°C)	P_D	1.0	1.0	W
Thermal Resistance	θ_{JA}	208	208	°C/W
	θ_{JC}	125	125	°C/W
Temperature, Junction and Storage	Tj, Tstg	−55 to + 150	−55 to + 150	°C

[3] ordering information

NB0XXXX

- POLARITY — "1" for NPN, "2" for PNP
- VOLTAGE RATING — refer to [2]
- PACKAGE/LEAD CODE — refer to [1]
- HFE GROUPING — refer to [5]

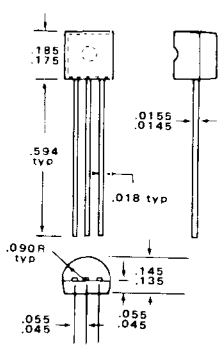
4 electrical characteristics $T_C = 25°C$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	I_C = 1 mA				
	NB013/023		35			V
	NB014/024		50			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100μA				
	NB013/023		40			V
	NB014/024		55			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 10μA	5			V
I_{CEO}	Collector-Emitter Leakage Current	V_{CE} = 30V NB013/023			1	μA
		45V NB014/024			1	μA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 35V NB013/023			50	nA
		50V NB014/024			50	nA
I_{EBO}	Emitter-Base Leakage Current	V_{EB} = 4V			0.1	μA
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 10 mA, I_B = 0.5 mA		0.75	0.95	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 10 mA, I_B = 0.5 mA		0.1	0.3	V
Cob	Collector Output Capacitance	V_{CB} = 10V, f = 1 MHz				
	NPN types			2		pF
	PNP types			3		pF
ft	Current Gain Bandwidth Product	I_C = 1 mA, V_{CE} = 5V	50	120		MHz
NF	Noise Figure	I_C = 10μA, V_{CE} = 5V, R_S = 10 K, BW = 15.7 KHz		1	4	dB

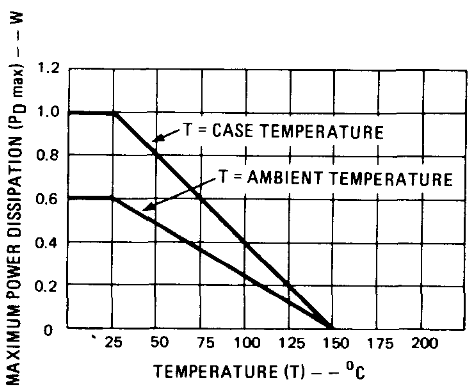
5 HFE groupings

GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
I	DC Current Gain	I_C = 100μA, V_{CE} = 5V	140	180	240	1:1.6
J	DC Current Gain	I_C = 100μA, V_{CE} = 5V	200	260	350	1:1.6
K	DC Current Gain	I_C = 100μA, V_{CE} = 5V	300	380	500	1:1.6
L	DC Current Gain	I_C = 100μA, V_{CE} = 5V	450	580	750	1:1.6
T	DC Current Gain	I_C = 100μA, V_{CE} = 5V	100	150	240	1:2.4
U	DC Current Gain	I_C = 100μA, V_{CE} = 5V	200	320	500	1:2.4
V	DC Current Gain	I_C = 100μA, V_{CE} = 5V	450	700	1100	1:2.4
Y	DC Current Gain	I_C = 100μA, V_{CE} = 5V	100	190	350	1:3.5
Z	DC Current Gain	I_C = 100μA, V_{CE} = 5V	300	580	1100	1:3.5

6 physical dimensions



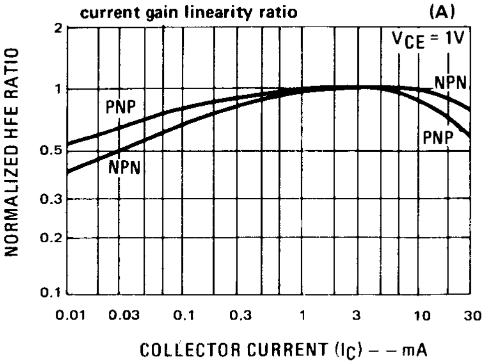
7 max power dissipation



8 typical performance characteristics

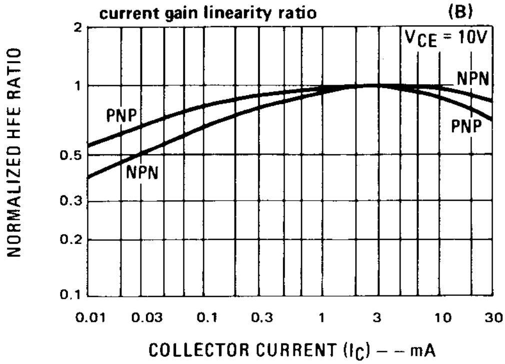
HFE1/HFE2

current gain linearity ratio (A)



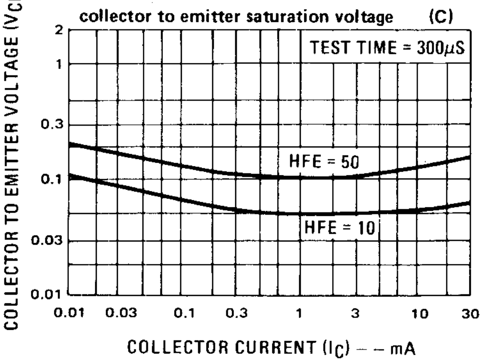
HFE1/HFE2

current gain linearity ratio (B)



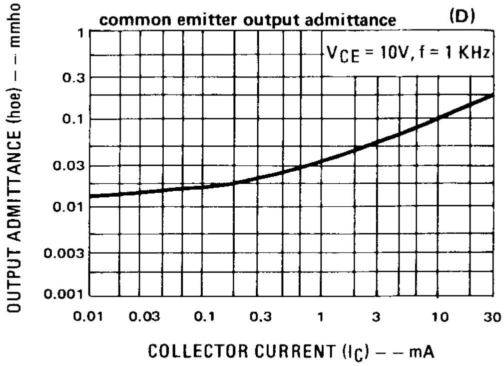
VCE(sat)

collector to emitter saturation voltage (C)



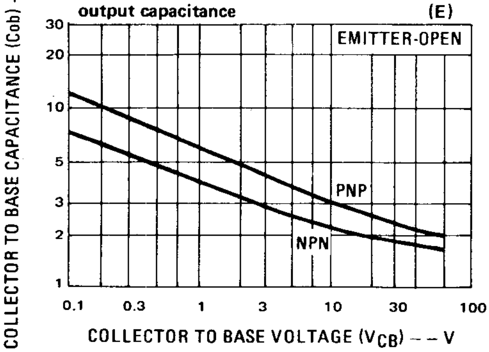
hoe

common emitter output admittance (D)



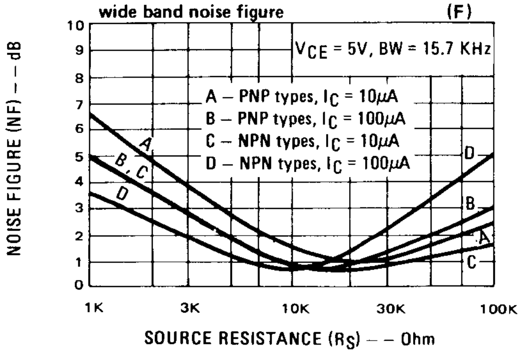
Cob

output capacitance (E)



NF

wide band noise figure (F)



9 typical applications

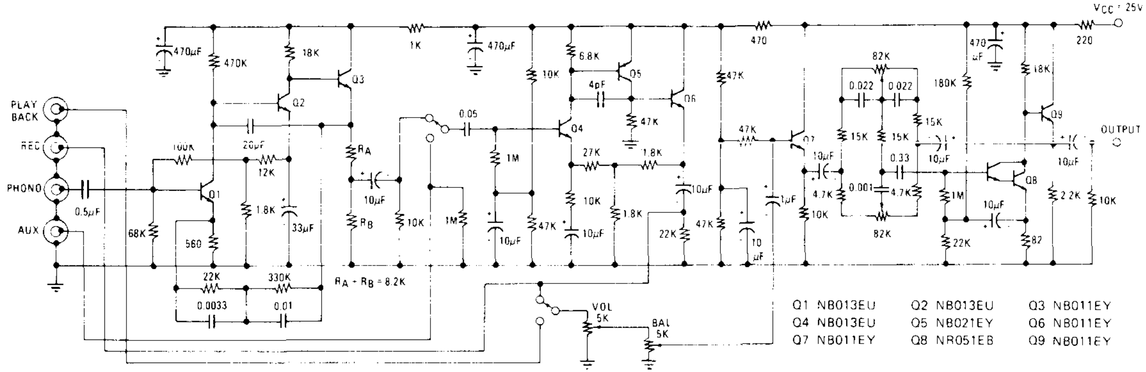
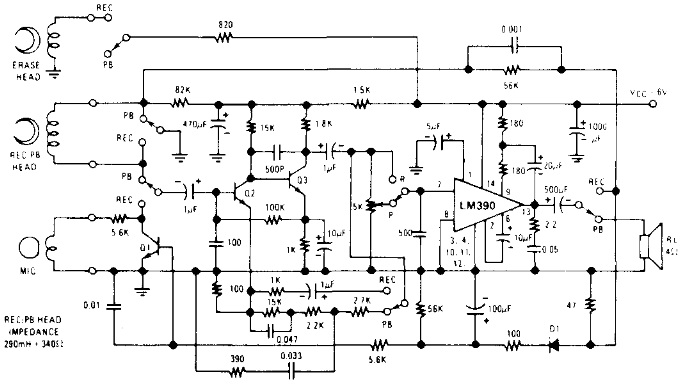
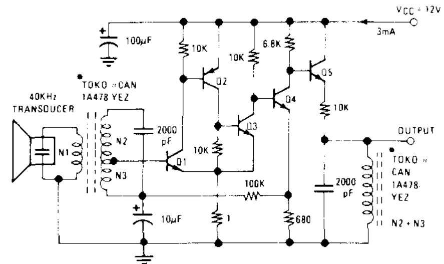


Figure A. High Quality Preamplifier with Tone Control Circuit



Q1 NR041E Q2 NB013EU Q3 NB011EY

Figure B. Battery Operated Recording/Playback Cassette Circuit



Q1 NB013EY	◆ Gain = 60K V/V	• L = 8mH
Q2 NB023EY	◆ Input impedance	Qμ = 50
Q3 NB011EY	= 1K Ohm	N1 = 40T
Q4 NB011EY	◆ Output noise	N2 = 360T
Q5 NB011EY	= 10mV rms	N3 = 40T

Figure C. High Gain Ultrasonic Amplifier

National Semiconductor

NB111,112,113(NPN) NB121,122,123(PNP) 100mA general purpose transistors

features

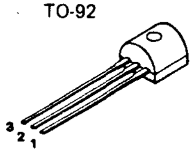
- 35 to 65 Volt at 100mA collector ratings
- 300mV guaranteed V_{CE} (sat) characteristics at I_C = 40mA and I_B = 0.8mA
- Matched HFE groupings for complementary applications
- "Epoxy B" packaging concept for excellent reliability

applications

- Small signal amplifier circuits
- Medium current level switching circuits
- LED drivers
- TV receivers

[1] package and lead coding

TO-92



PACKAGE CODE TO-92	LEAD 1	2	3
E	E	B	C
F	E	C	B
H	C	B	E

[2] maximum ratings

PARAMETER	SYMBOL	NB111 NB121	NB112 NB122	NB113 NB123	UNIT
Collector-Emitter Voltage	V_{CEO}	35	50	65	V_{DC}
Collector-Base Voltage	V_{CB}	40	55	70	V_{DC}
Emitter-Base Voltage	V_{EB}	6	6	6	V_{DC}
Collector Current (continuous)	I_C (max)	100	100	100	mA_{DC}
Power Dissipation (T_A = 25°C)	P_D	0.6	0.6	0.6	W
Power Dissipation (T_C = 25°C)	P_D	1.0	1.0	1.0	W
Thermal Resistance	θ_{JA}	208	208	208	°C/W
	θ_{JC}	125	125	125	°C/W
Temperature, Junction and Storage	T_j, T_{stg}	−55 to + 150	−55 to + 150	−55 to + 150	°C

[3] ordering information

NB1XXXX

- POLARITY: "1" for NPN, "2" for PNP
- VOLTAGE RATING: refer to [2]
- PACKAGE/LEAD CODE: refer to [1]
- HFE GROUPING: refer to [5]

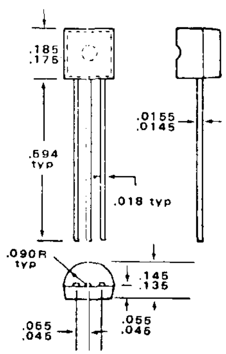
4 electrical characteristics $T_C = 25°C$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	I_C = 1 mA				
	NB111/121		35			V
	NB112/122		50			V
	NB113/123		65			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100μA				
	NB111/121		40			V
	NB112/122		55			V
	NB113/123		70			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 10μA	6			V
I_{CEO}	Collector-Emitter Leakage Current	V_{CE} = 30V NB111/121			1	μA
		45V NB112/122			1	μA
		60V NB113/123			1	μA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 35V NB111/121			0.1	μA
		50V NB112/122			0.1	μA
		65V NB113/123			0.1	μA
I_{EBO}	Emitter-Base Leakage Current	V_{EB} = 5V			0.1	μA
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	I_C = 40 mA, I_B = 0.8 mA		0.8	0.95	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C = 40 mA, I_B = 0.8 mA		0.15	0.3	V
H_{FE1}	DC Current Gain	I_C = 100μA, V_{CE} = 5V	50			ratio
Cob	Collector Ouput Capacitance	V_{CB} = 10V, f = 1MHz				
	NPN types			2		pF
	PNP types			3		pF
ft	Current Gain Bandwidth Product	I_C = 15 mA, V_{CE} = 5V	100			MHz

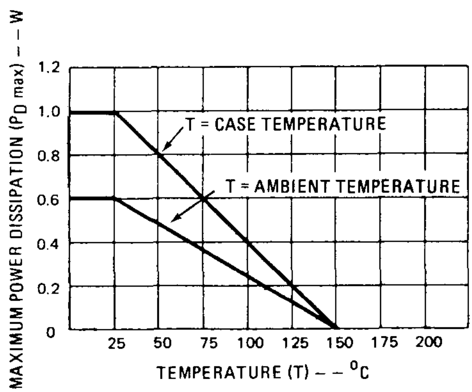
5 HFE groupings

GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
H	DC Current Gain	I_C = 15 mA, V_{CE} = 5V	100	127	160	1:1.6
I	DC Current Gain	I_C = 15 mA, V_{CE} = 5V	140	180	240	1:1.6
J	DC Current Gain	I_C = 15 mA, V_{CE} = 5V	200	260	350	1:1.6
Y	DC Current Gain	I_C = 15 mA, V_{CE} = 5V	100	190	350	1:3.5

6 physical dimensions

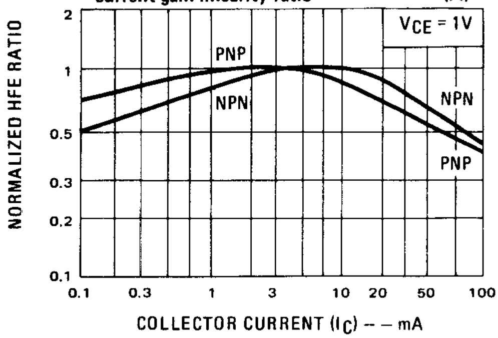


7 max power dissipation

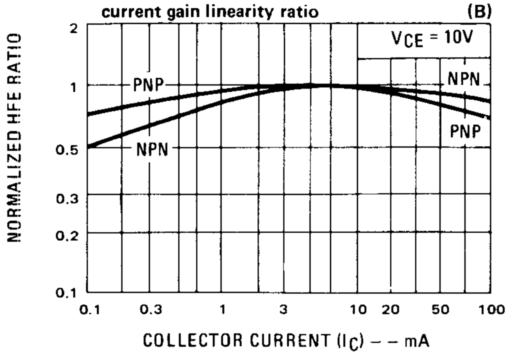


8 typical performance characteristics

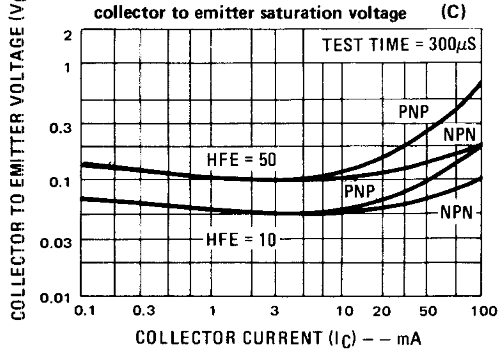
HFE1/HFE2
current gain linearity ratio (A)



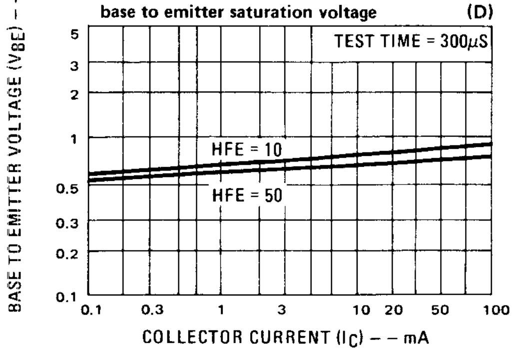
HFE1/HFE2
current gain linearity ratio (B)



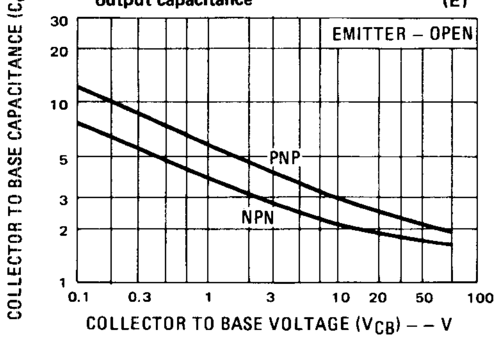
VCE(sat)
collector to emitter saturation voltage (C)



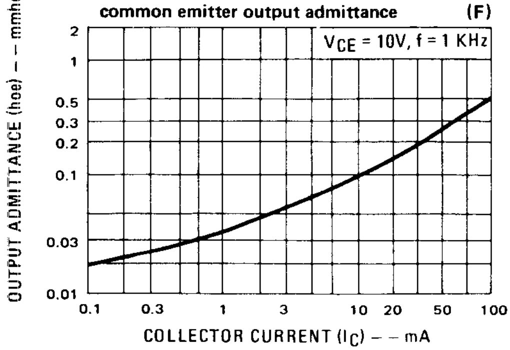
VBE(sat)
base to emitter saturation voltage (D)



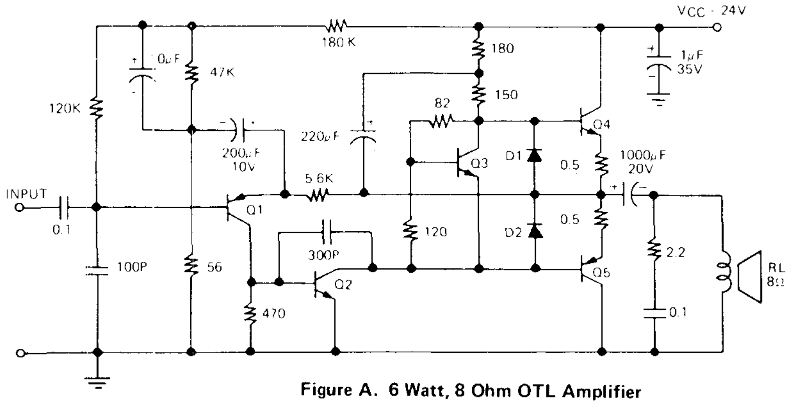
Cob
output capacitance (E)



hoe
common emitter output admittance (F)

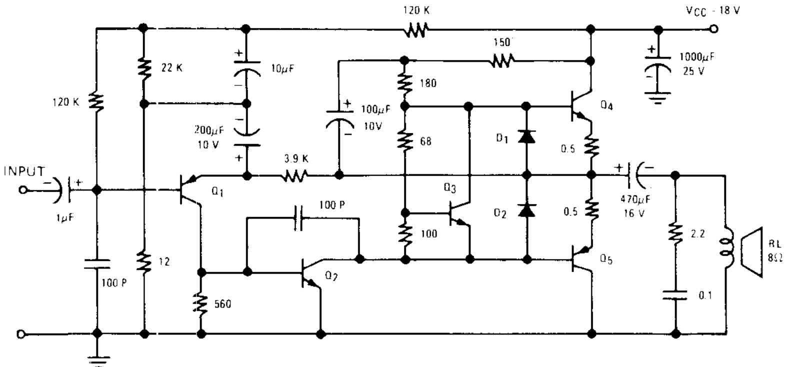


9 typical applications



Q1	NB021EY
Q2	NB211YY
Q3	NR001E
Q4	NA41U
Q5	NA42U

Figure A. 6 Watt, 8 Ohm OTL Amplifier



Q1	NB021EY
Q2	NB211EY
Q3	NR001E
Q4	NA31YG/I
Q5	NA32YG/I

Figure B. 4 Watt, 8 Ohm OTL Amplifier

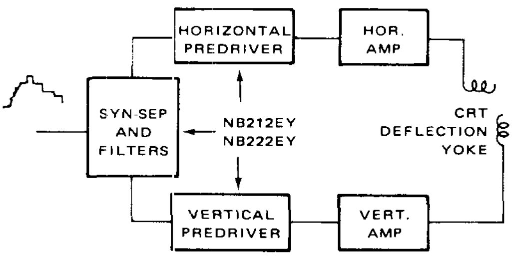


Figure C. TV processor/predriver applications

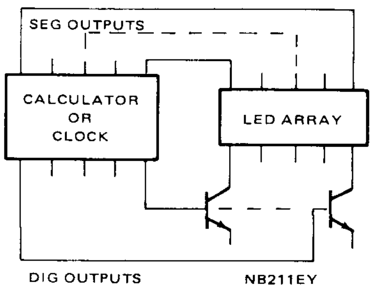


Figure D. Calculator/Clock driver application

National Semiconductor

NB211,212,213(NPN) NB221,222,223(PNP) 500mA medium current driver transistors

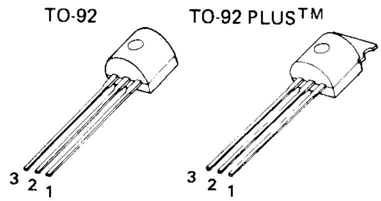
features

- 35 to 65 Volt at 500 mA collector ratings
- 1.2 Watts practical power dissipation (TO-92 PLUS™)
- 400 mV guaranteed V_{CE} (sat) characteristics at I_C = 100 mA and I_B = 2 mA
- Matched HFE groupings for complementary applications
- "Epoxy B" packaging concept for excellent reliability

applications

- 4 to 6 Watt amplifier class A drivers
- Medium current level switching circuits
- LED drivers
- TV receivers

1 package and lead coding



PACKAGE CODE TO-92	PACKAGE CODE TO-92 PLUS	LEAD 1	LEAD 2	LEAD 3
E	X	E	B	C
F	Y	E	C	B
	Z	B	C	E
H		C	B	E

2 maximum ratings

PARAMETER	SYMBOL	NB211 NB221	NB212 NB222	NB213 NB223	UNIT
Collector-Emitter Voltage	V_{CEO}	35	50	65	V_{DC}
Collector-Base Voltage	V_{CB}	40	55	70	V_{DC}
Emitter-Base Voltage	V_{EB}	6.0	6.0	6.0	V_{DC}
Collector Current (continuous)	I_C (max)	500	500	500	mA
Power Dissipation (T_A = 25°C)	P_D				
TO-92		0.6	0.6	0.6	W
TO-92 PLUS		0.75	0.75	0.75	W
Power Dissipation (T_C = 25°C)	P_D				
TO-92		1.0	1.0	1.0	W
TO-92 PLUS		2.5	2.5	2.5	W
Thermal Resistance					
TO-92	θ_{JA}/θ_{JC}	208/125	208/125	208/125	°C/W
TO-92 PLUS	θ_{JA}/θ_{JC}	167/50	167/50	167/50	°C/W
Temperature, Junction and Storage	Tj, Tstg	−55 to +150	−55 to +150	−55 to +150	°C

3 ordering information

NB2XXXX

- POLARITY: "1" for NPN, "2" for PNP
- VOLTAGE RATING: refer to 1
- PACKAGE/LEAD CODE: refer to 2
- HFE GROUPING: refer to 5

4 electrical characteristics $T_C = 25°C$

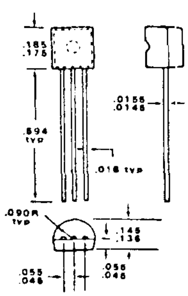
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	$I_C = 1$ mA				
	NB211/221		35			V
	NB212/222		50			V
	NB213/223		65			V
BV_{CBO}	Collector-Base Breakdown Voltage	$I_C = 100\mu A$				
	NB211/221		40			V
	NB212/222		55			V
	NB213/223		70			V
BV_{EBO}	Emitter-Base Breakdown Voltage	$I_E = 10\mu A$	6			V
I_{CEO}	Collector-Emitter Leakage Current	$V_{CE} = 30V$ NB211/221			10	μA
		45V NB212/222			10	μA
		60V NB213/223			10	μA
I_{CBO}	Collector-Base Leakage Current	$V_{CB} = 35V$ NB211/221			0.5	μA
		50V NB212/222			0.5	μA
		65V NB213/223			0.5	μA
I_{EBO}	Emitter-Base Leakage Current	$V_{EB} = 5V$			0.1	μA
V_{BE} (sat)	Base-Emitter Saturation Voltage	$I_C = 100$ mA, $I_B = 2$ mA		0.8	0.95	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	$I_C = 100$ mA, $I_B = 2$ mA		0.2	0.4	V
H_{FE1}	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	30			ratio
Cob	Collector Output Capacitance	$V_{CB} = 10V$, f = 1 MHz				
	NPN types			3.5		pF
	PNP types			4.5		pF
ft	Current Gain Bandwidth Product	$I_C = 20$ mA, $V_{CE} = 5V$	50			MHz

5 HFE groupings

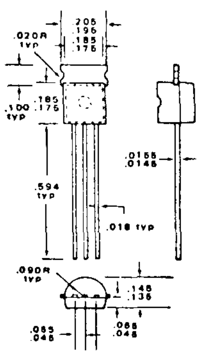
GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
G	DC Current Gain	$I_C = 30$ mA, $V_{CE} = 5V$	68	85	110	1:1.6
H	DC Current Gain	$I_C = 30$ mA, $V_{CE} = 5V$	100	127	160	1:1.6
I	DC Current Gain	$I_C = 30$ mA, $V_{CE} = 5V$	140	180	240	1:1.6
J	DC Current Gain	$I_C = 30$ mA, $V_{CE} = 5V$	200	260	350	1:1.6
X	DC Current Gain	$I_C = 30$ mA, $V_{CE} = 5V$	30	58	110	1:3.5
Y	DC Current Gain	$I_C = 30$ mA, $V_{CE} = 5V$	100	190	250	1:3.5

6 physical dimensions

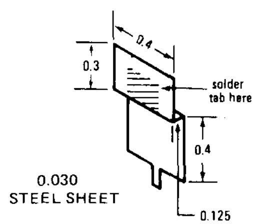
TO-92



TO-92 PLUS



7 heatsink information

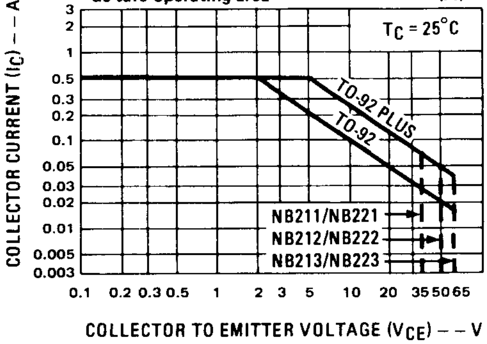


- TO-92 PLUS package with heat-sink shown on right permits 1.6 Watts power dissipation and combined Thermal Resistance $\theta_{JA} = 78°C/W$. If used without heatsink and PCB land area at collector lead > 1 sq. inch, $P_D = 1.2W$.

8 typical performance characteristics

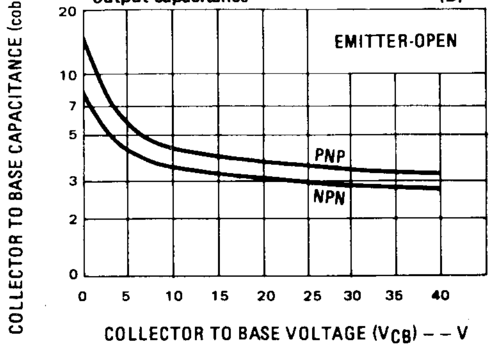
SOA

dc safe operating area (A)



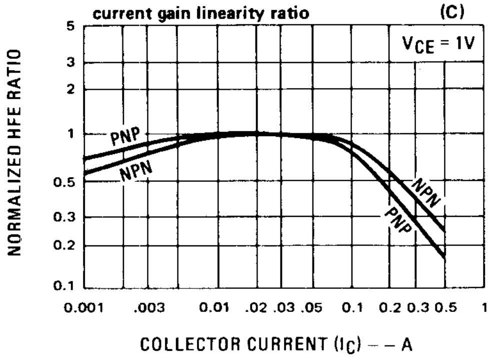
Cob

output capacitance (B)



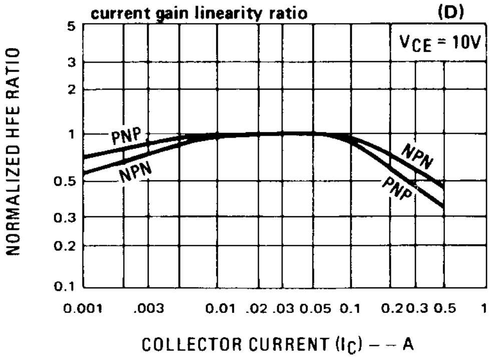
HFE1/HFE2

current gain linearity ratio (C)



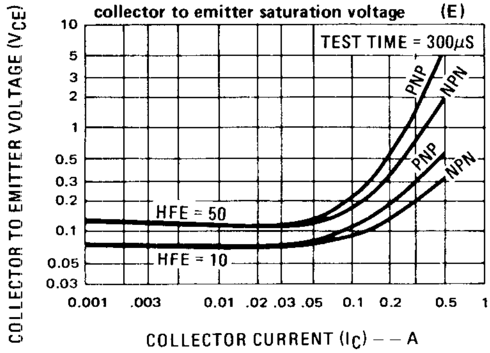
HFE1/HFE2

current gain linearity ratio (D)



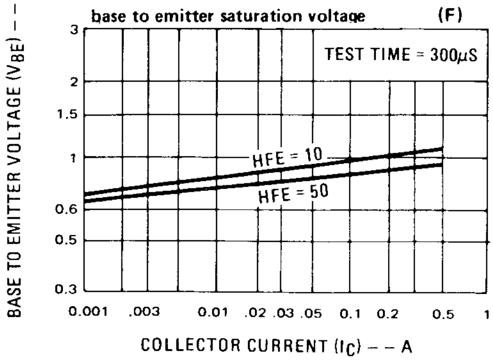
VCE (sat)

collector to emitter saturation voltage (E)

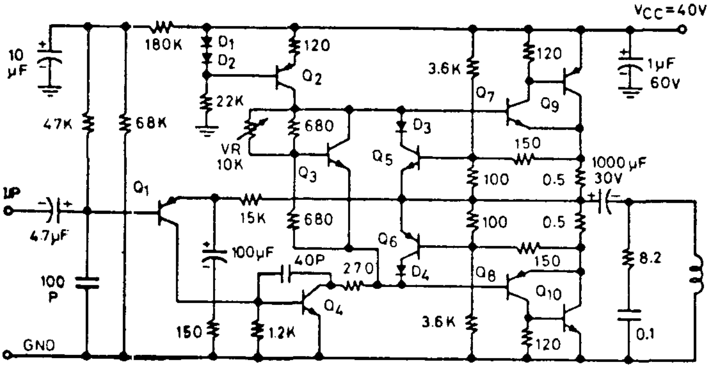


VBE (sat)

base to emitter saturation voltage (F)

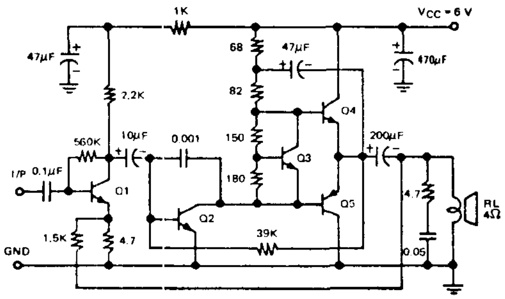


9 typical applications



Q1	NB022EY
Q2	NB123EY
Q3	NR001E
Q4	NB113EY
Q5	NB111EY
Q6	NB121EY
Q7	NB313Y
Q8	NB323Y
Q9	NA72W
Q10	NA71W

Figure A. 25 Watt OTL Amplifier



Q1	NB011EY
Q2	NB111EH/J
Q3	NR001
Q4	NA21EG/J
Q5	NA22EG/J

Figure B. 700mW 6V/4Ω OTL Amplifier

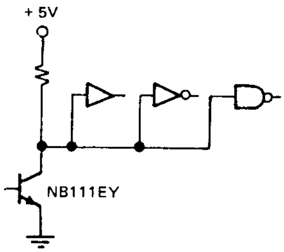


Figure C. High fan-out TTL driver

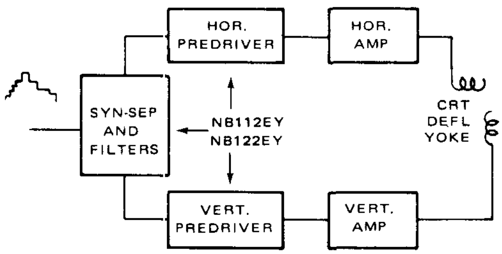


Figure D. TV processor/predriver applications

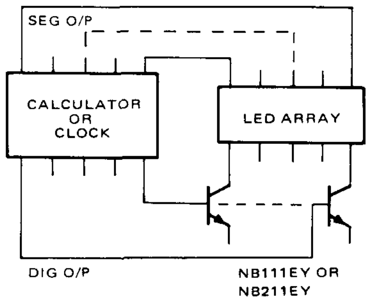


Figure E. Calculator/Clock driver application

National Semiconductor

NB311, 312, 313 (NPN) NB321, 322, 323 (PNP) 1.5Amp complementary power drivers

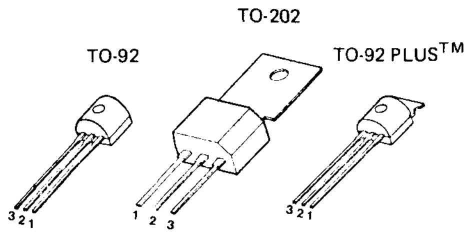
features

- 35 to 65 Volt at 1.5 Amp collector ratings
- Low V_{CE} (sat) and V_{BE} (sat) characteristics with I_C = 300 mA and I_B = 10 mA drive
- Available in TO-92, TO-92 PLUSTM and TO-202 packages
- "Epoxy B" packaging concept for excellent reliability

applications

- Driver stages in high-power audio amplifiers
- Medium-power switching circuits
- Converter/inverter circuits
- TV receivers

[1] packages and lead coding



PACKAGE CODE			LEAD		
TO-92	TO-92 PLUS	TO-202	1	2	3
E	X	K	E	B	C
F	Y	L	E	C	B
	Z	M	B	C	E
H			C	B	E

[2] maximum ratings

PARAMETER	SYMBOL	NB311 NB321	NB312 NB322	NB313 NB323	UNIT
Collector-Emitter Voltage	V_{CEO}	35	50	65	V_{DC}
Collector-Base Voltage	V_{CB}	40	55	70	V_{DC}
Emitter-Base Voltage	V_{EB}	6	6	6	V_{DC}
Collector Current (continuous)	I_C	1.5	1.5	1.5	A_{DC}
Power Dissipation (T_A = 25°C)	P_D				
TO-92		0.6	0.6	0.6	W
TO-92 PLUS		0.75	0.75	0.75	W
TO-202		1.75	1.75	1.75	W
Power Dissipation (T_C = 25°C)	P_D				
TO-92		1.0	1.0	1.0	W
TO-92 PLUS		2.5	2.5	2.5	W
TO-202		10	10	10	W
Temperature, Junction and Storage	T_j, T_{stg}	−55 to +150	−55 to +150	−55 to +150	°C

[3] ordering information

N B 3 X X X

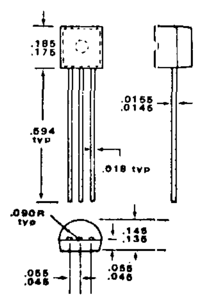
- POLARITY: "1" for NPN, "2" for PNP
- VOLTAGE RATING: refer to [2]
- PACKAGE/LEAD CODE: refer to [1]

[4] electrical characteristics $T_C = 25^oC$

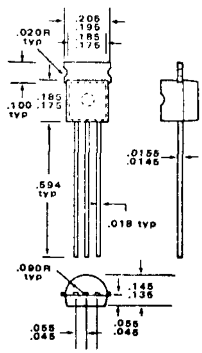
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	I_C = 1 mA				
	NB311/321		35			V
	NB312/322		50			V
	NB313/323		65			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100 μA				
	NB311/321		40			V
	NB312/322		55			V
	NB313/323		70			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 10 μA	6			V
I_{CEO}	Collector-Emitter Leakage Current	V_{CE} = 30V NB311/321			50	μA
		45V NB312/322			50	μA
		60V NB313/323			50	μA
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 35V NB311/321			0.5	μA
		50V NB312/322			0.5	μA
		65V NB313/323			0.5	μA
I_{EBO}	Emitter-Base Leakage Current	V_{EB} = 5V			0.5	μA
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	I_C = 300 mA, I_B = 10 mA		0.9	1	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C = 300 mA, I_B = 10 mA		0.15	0.5	V
H_{FE1}	DC Current Gain	I_C = 1 mA, V_{CE} = 10V	30			
H_{FE2}	DC Current Gain	I_C = 100 mA, V_{CE} = 10V	50			
C_{ob}	Collector Output Capacitance	V_{CB} = 10V, f = 1 MHz				
	NPN types			10		pF
	PNP types			17		pF
f_t	Current Gain Bandwidth Product	I_C = 100 mA, V_{CE} = 10V	20			MHz

[5] physical dimensions

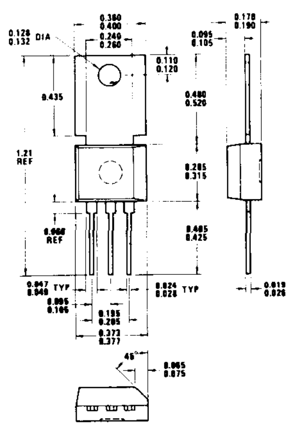
TO-92



TO-92 PLUS

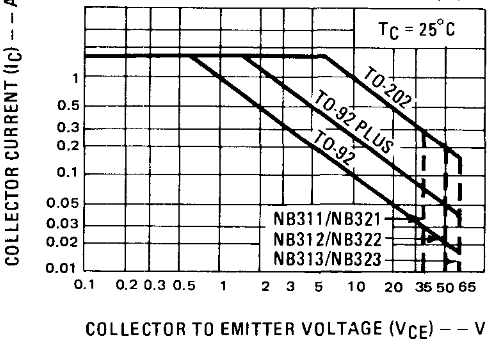


TO-202

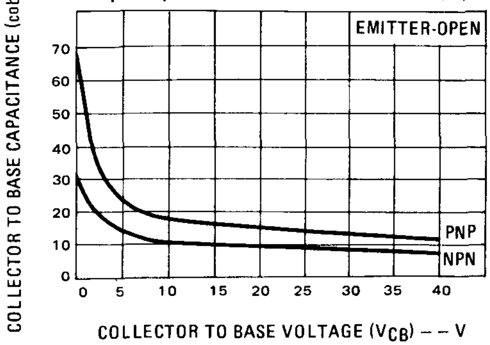


6 typical performance characteristics

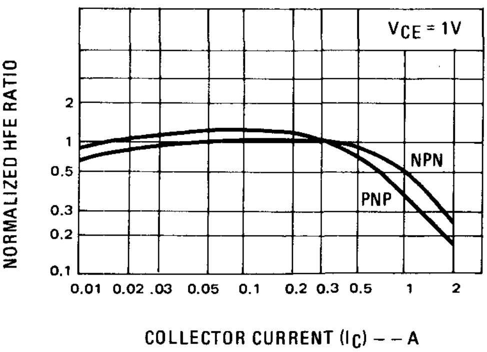
SOA
dc safe operating area (A)



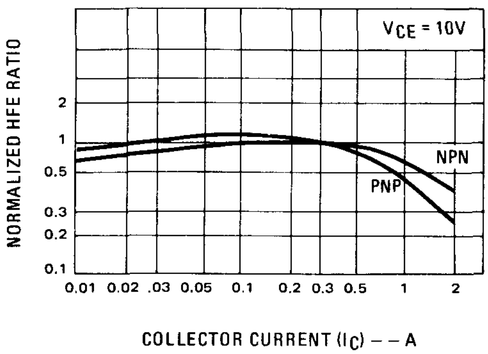
Cob
output capacitance (B)



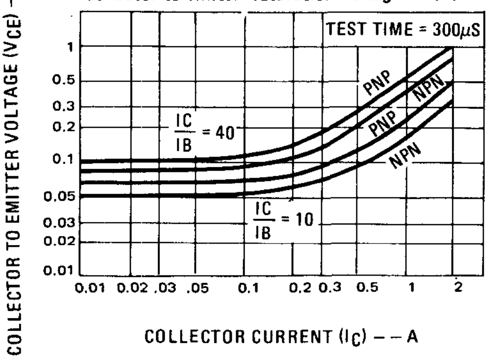
HFE1/HFE2
current gain linearity ratio (C)



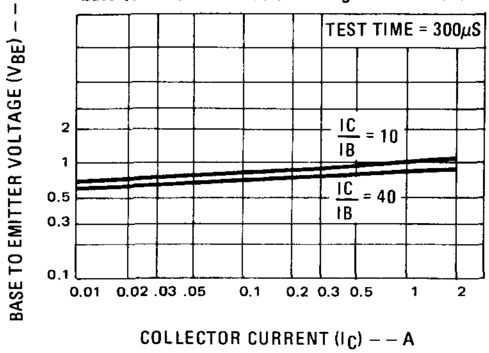
HFE1/HFE2
current gain linearity ratio (D)



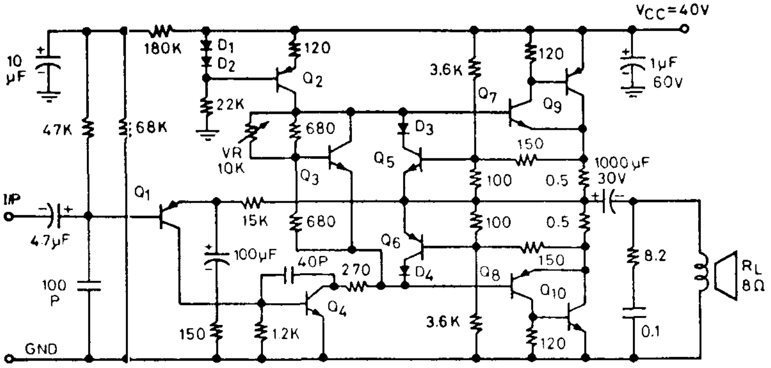
VCE(sat)
collector to emitter saturation voltage (E)



VBE(sat)
base to emitter saturation voltage (F)

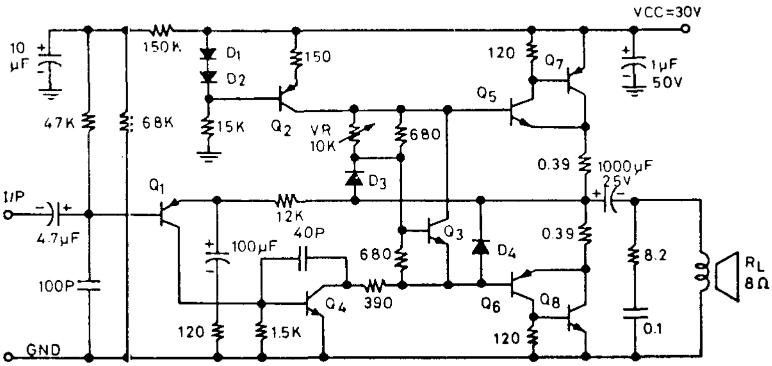


7 typical applications



Q1	NB022EY
Q2	NB123EY
Q3	NR001E
Q4	NB113EY
Q5	NB111EY
Q6	NB121EY
Q7	NB313Y
Q8	NB323Y
Q9	NA72W
Q10	NA71W

Figure A. 25 Watt OTL Amplifier



Q1	NB021EY
Q2	NB122EY
Q3	NR001E
Q4	NB112EY
Q5	NB312E
Q6	NB322E
Q7	NA52W
Q8	NA51W

Figure B. 12 Watt OTL Amplifier

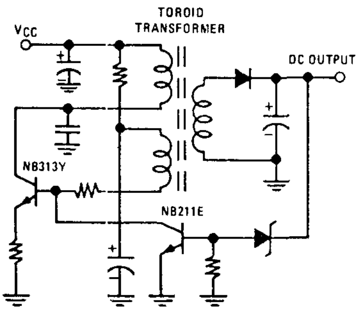


Figure C. Typical Converter Circuit

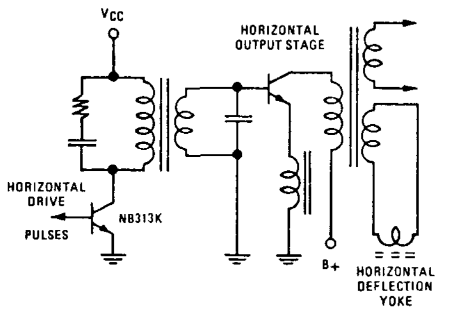


Figure D. Typical TV Horizontal Driver Application

National Semiconductor

NR421(NPN) VHF amplifier/FM converter transistor

features

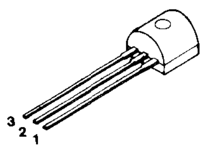
- 0.65pF typical feedback capacitance for excellent RF stability
- Guaranteed collector-base time constant and RF output resistance
- 150mV typical V_{CE} (sat) characteristics at I_C = 10 mA, and I_B = 0.5 mA
- 2 dB typical noise figure at 200 MHz
- "Epoxy B" packaging concept for excellent reliability

applications

- VHF RF amplifiers/converters
- CB radios
- Low-power RF oscillators

1 package and lead coding

TO-92



PACKAGE CODE TO-92	LEAD 1	2	3
D	B	E	C
F	E	C	B

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V_{DC}
Collector-Base Voltage	V_{CB}	35	V_{DC}
Emitter-Base Voltage	V_{EB}	3	V_{DC}
Collector Current (continuous)	I_C (max)	30	mA_{DC}
Power Dissipation (T_A = 25°C)	P_D	0.6	W
Power Dissipation (T_C = 25°C)	P_D	1.0	W
Thermal Resistance	θ_{JA}	208	°C/W
	θ_{JC}	125	°C/W
Temperature, Junction and Storage	Tj, T_{stg}	–55 to + 150	°C

3 ordering information

NR421XX

- First X: PACKAGE/LEAD CODE — refer to 1
- Second X: HFE GROUPING — refer to 5

4 electrical characteristics $T_C = 25°C$

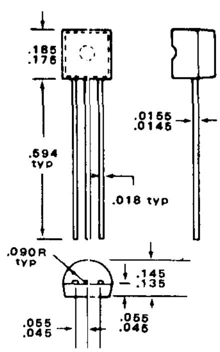
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	I_C = 1 mA	30			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100μA	35			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 10μA	3	5.5		V
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 30V			0.1	μA
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 10 mA, I_B = 0.5 mA		830	950	mV
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 10 mA, I_B = 0.5 mA		150	300	mV
Ccb	Common Emitter Collector Feedback Capacitance	V_{CB} = 10V, f = 1 MHz		0.65	0.9	pF
Cob	Collector Output Capacitance	V_{CB} = 10V, f = 1 MHz		0.9	1.3	pF
rb'Cc	Collector Base Time Constant	I_C = 2 mA, V_{CE} = 5V		8	20	pS
Roep	Common Emitter Output Resistance	I_C = 2 mA, V_{CE} = 5V f = 200 MHz	5			KOhm
ft	Current Gain Bandwidth Product	I_C = 2 mA, V_{CE} = 5V	450	700		MHz

5 HFE groupings

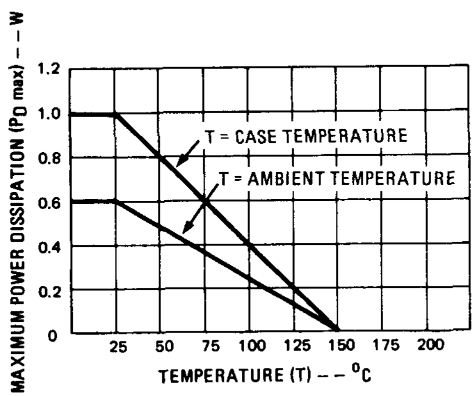
GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
E	DC Current Gain	I_C = 2 mA, V_{CE} = 5V	30	38	50	1:1.6
F	DC Current Gain	I_C = 2 mA, V_{CE} = 5V	45	58	75	1:1.6
G	DC Current Gain	I_C = 2 mA, V_{CE} = 5V	68	85	110	1:1.6
H	DC Current Gain	I_C = 2 mA, V_{CE} = 5V	100	127	160	1:1.6
R	DC Current Gain	I_C = 2 mA, V_{CE} = 5V	20	32	50	1:2.4
S	DC Current Gain	I_C = 2 mA, V_{CE} = 5V	45	70	110	1:2.4
T	DC Current Gain	I_C = 2 mA, V_{CE} = 5V	100	150	240	1:2.4

6 physical dimensions

TO-92

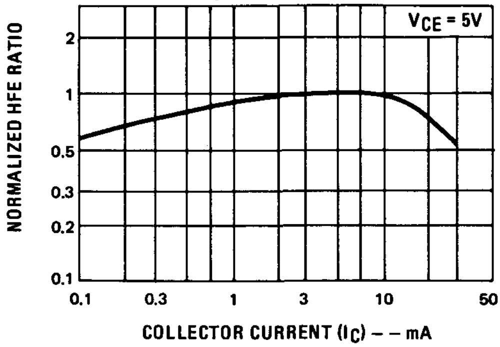


7 max power dissipation

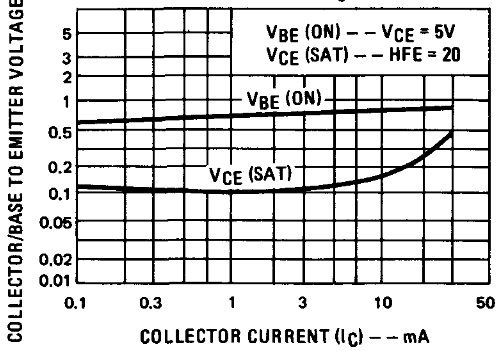


8 typical performance characteristics

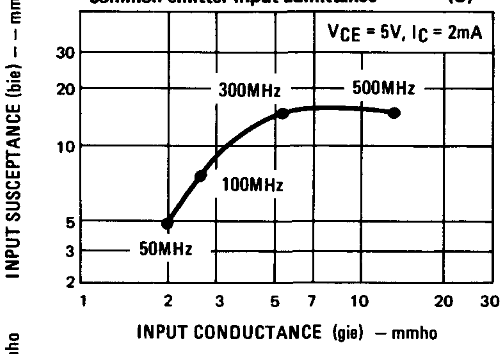
HFE1/HFE2
current linearity ratio (A)



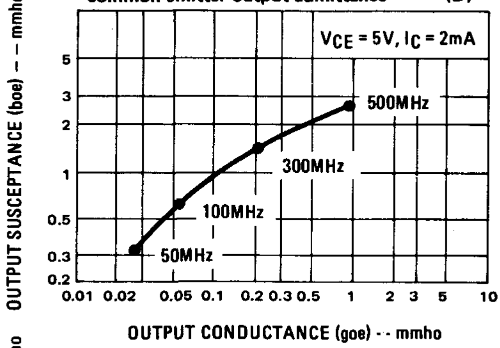
VCE(sat)/VBE(on)
collector/base to emitter voltage (B)



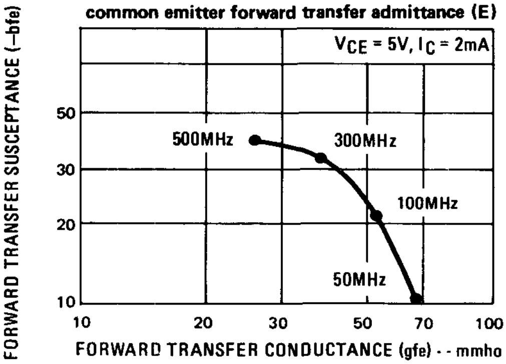
Yie
common emitter input admittance (C)



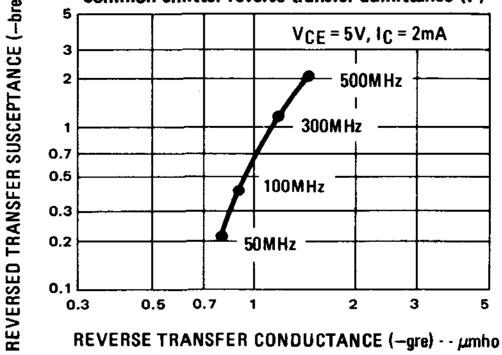
Yoe
common emitter output admittance (D)



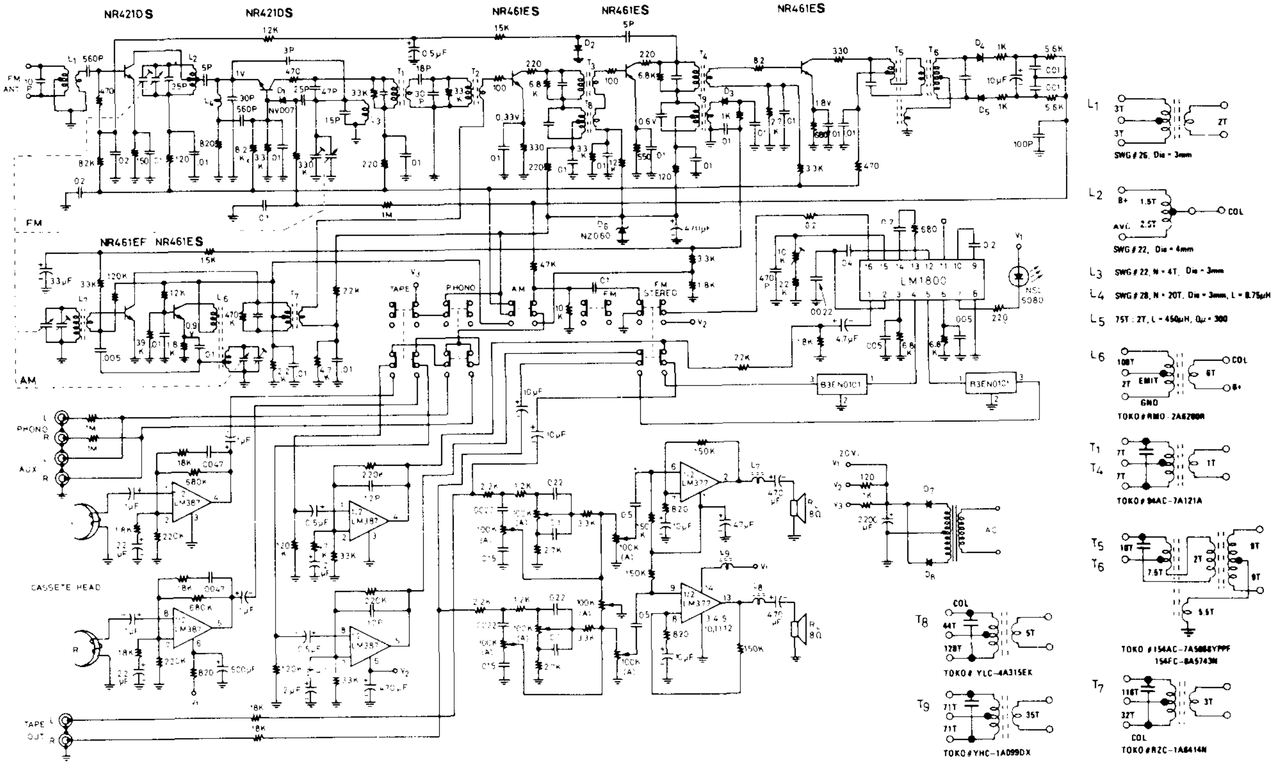
Yfe
common emitter forward transfer admittance (E)



Yre
common emitter reverse transfer admittance (F)



9 typical applications



FM performance (88–108 MHz)

- 30dB quieting sensitivity: 2μV
- limiting sensitivity: 7μV
- AM rejection: 40dB
- AFC holding range: 800KHz
- stereo separation: 40dB

AM performance (525–1650 KHz)

- maximum sensitivity: 100μV/M
- 20dB quieting sensitivity: 280μV/M
- selectivity ±10KHz: –28dB
- AGC figure of merit: 52dB
- overload distortion: 3%

AUDIO performance

- 10% THD output power: 3W + 3W
- frequency response: 50Hz – 15KHz
- channel separation: 45dB
- tone control range: ±10dB
- typical system dist: 0.5%

Figure A. AM/FM/Cassette Home Stereo Circuit

National Semiconductor

NR431(NPN) HF amplifier/FM converter transistor

features

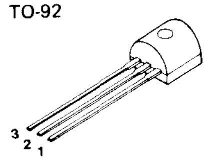
- 1.1pF typical collector feedback capacitance
- 5K Ohm minimum RF output resistance at 100 MHz
- 150mV typical V_{CE} (sat) characteristics at I_C = 10 mA, and I_B = 0.5 mA
- "Epoxy B" packaging concept for excellent reliability

applications

- High frequency amplifiers/converters
- CB radios
- Low power RF oscillators

1 package and lead coding

TO-92



PACKAGE CODE TO-92	LEAD 1	LEAD 2	LEAD 3
E	E	B	C
F	E	C	B
H	C	B	E

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	15	V_{DC}
Collector-Base Voltage	V_{CB}	18	V_{DC}
Emitter-Base Voltage	V_{EB}	3	V_{DC}
Collector Current (continuous)	I_C (max)	30	mA_{DC}
Power Dissipation (T_A = 25°C)	P_D	0.6	W
Power Dissipation (T_C = 25°C)	P_D	1.0	W
Thermal Resistance	θ_{JA}	208	°C/W
	θ_{JC}	125	°C/W
Temperature, Junction and Storage	T_j, T_{stg}	−55 to + 150	°C

3 ordering information

NR431XX

- First X: PACKAGE/LEAD CODE — refer to 1
- Second X: HFE GROUPING — refer to 5

4 electrical characteristics $T_C = 25°C$

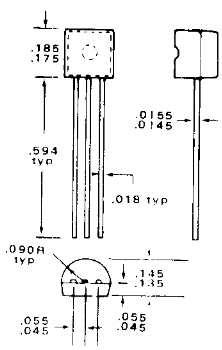
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	$I_C = 1$ mA	15			V
BV_{CBO}	Collector-Base Breakdown Voltage	$I_C = 100\mu A$	18			V
BV_{EBO}	Emitter-Base Breakdown Voltage	$I_E = 10\mu A$	3	5.6		V
I_{CBO}	Collector-Base Leakage Current	$V_{CB} = 15V$			0.1	μA
V_{BE} (sat)	Base-Emitter Saturation Voltage	$I_C = 10$ mA, $I_B = 0.5$ mA		830	950	mV
V_{CE} (sat)	Collector-Emitter Saturation Voltage	$I_C = 10$ mA, $I_B = 0.5$ mA		150	300	mV
Ccb	Common Emitter Collector Feedback Capacitance	$V_{CB} = 10V$, f = 1 MHz		1.1	1.4	pF
Cob	Collector Output Capacitance	$V_{CB} = 10V$, f = 1 MHz		1.4	1.7	pF
Roep	Common Emitter Output Resistance	$I_C = 1mA, V_{CE} = 5V$ f = 100 MHz	5			KOhm
ft	Current Gain Bandwidth Product	$I_C = 1mA, V_{CE} = 5V$	350	600		MHz

5 HFE groupings

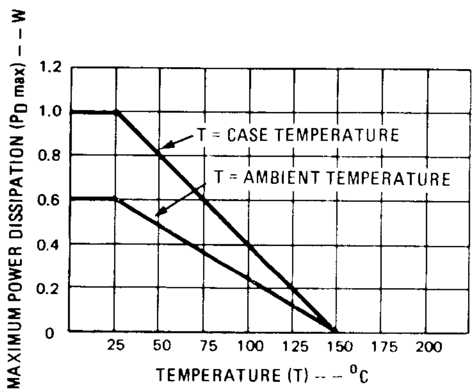
GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
E	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	30	38	50	1:1.6
F	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	45	58	75	1:1.6
G	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	68	85	110	1:1.6
R	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	20	32	50	1:2.4
S	DC Current Gain	$I_C = 1$ mA, $V_{CE} = 5V$	45	70	110	1:2.4

6 physical dimensions

TO-92

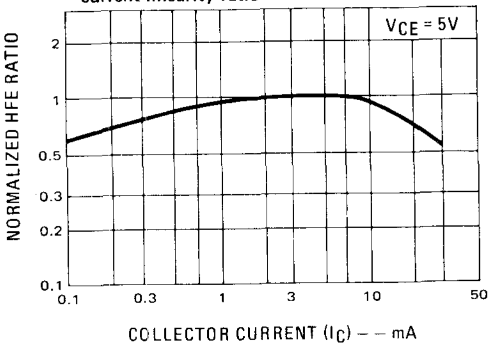


7 max power dissipation

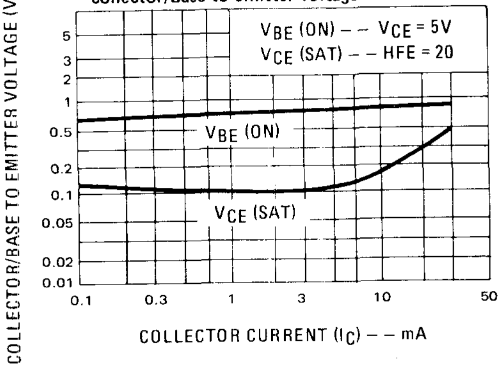


8 typical performance characteristics

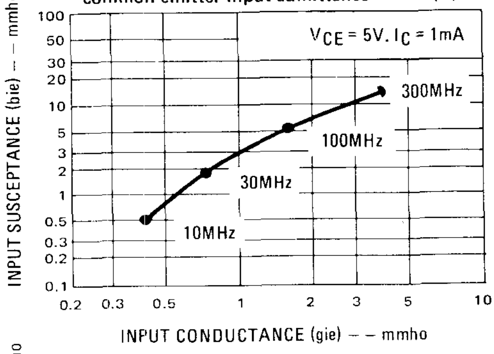
HFE1/HFE2
current linearity ratio (A)



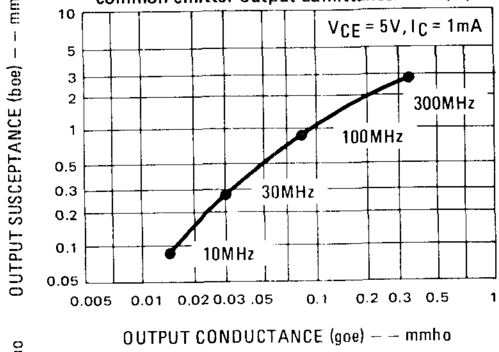
VCE(sat)/VBE(on)
collector/base to emitter voltage (B)



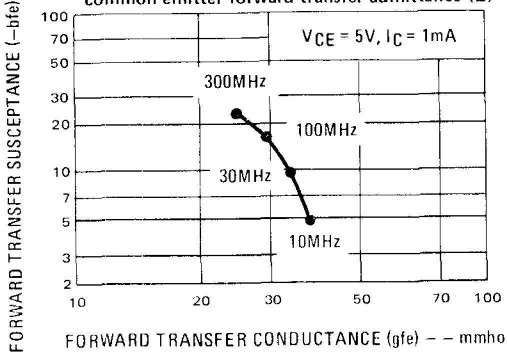
Yie
common emitter input admittance (C)



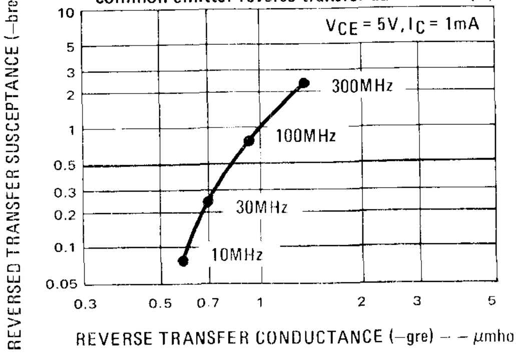
Yoe
common emitter output admittance (D)



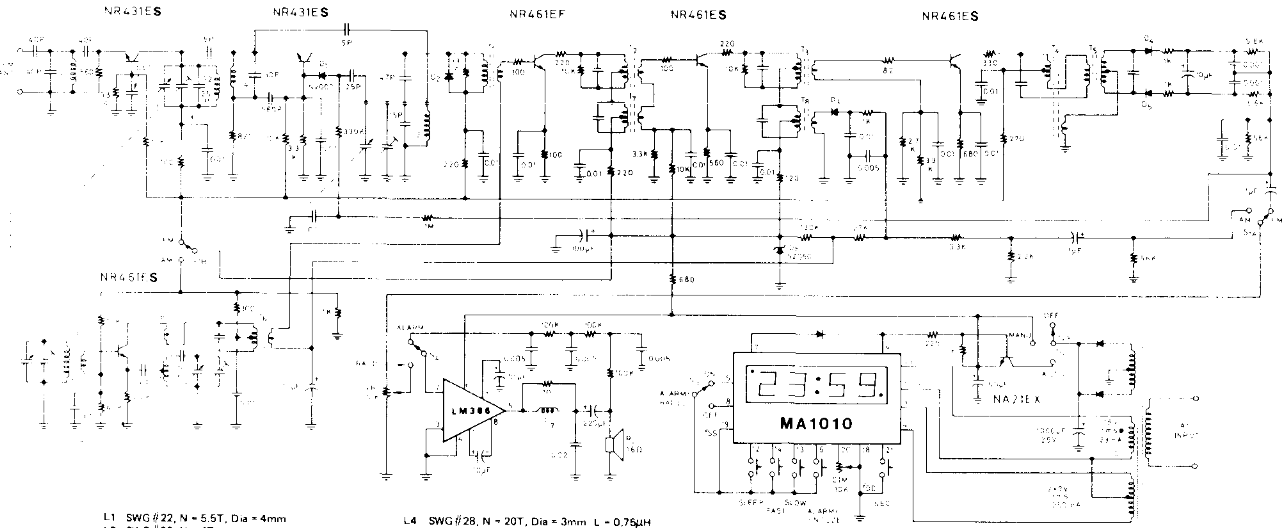
Yfe
common emitter forward transfer admittance (E)



Yre
common emitter reverse transfer admittance (F)

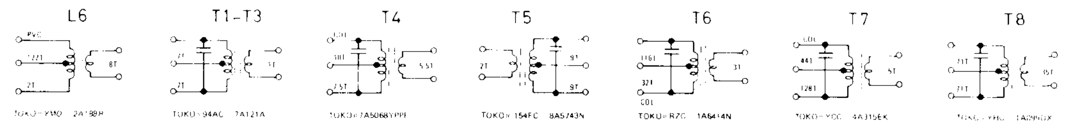


9 typical applications



L1 SWG#22, N = 5.5T, Dia = 4mm
L2 SWG#22, N = 4T, Dia = 4mm
L3 SWG#22, N = 4T, Dia = 3mm

L4 SWG#28, N = 20T, Dia = 3mm L = 0.75μH
L5 95T : 8T, L = 600μH, Qμ = 300
L7 N = 1.5T, PHILIPS #4312–020–34401



FM performance (88–108 MHz)	
● 30dB quieting sensitivity:	5μV
● limiting sensitivity:	20μV
● AM rejection:	40dB
● AFC holding range:	800KHz
● Bandwidth:	180KHz

AM performance (525–1650 KHz)	
● maximum sensitivity:	100μV/M
● 20dB quieting sensitivity:	280μV/M
● selectivity ± 10KHz:	–28dB
● AGC figure of merit:	40dB
● overload distortion:	6%

AUDIO performance	
● gain at 1 KHz:	200
● 10% THD output power:	900mW
● frequency response:	70Hz – 12KHz
● typical system dist:	0.8%
● alarm tone frequency:	600Hz

Figure A. AM/FM clock radio

National Semiconductor

NR461(NPN) low-noise RF/IF transistor

features

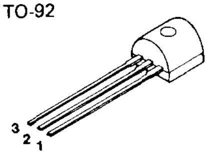
- Low Ccb for excellent RF stability
- High Roep for simplified RF coupling designs
- 70mV typical V_{CE} (sat) characteristics at I_C = 10 mA, and I_B = 0.5 mA
- 1.1 dB typical noise figure at 1 MHz
- "Epoxy B" packaging concept for excellent reliability

applications

- MW/SW/CB radios
- 0.1 to 50 MHz frequency converters
- 455KHz to 10.7 MHz IF stages
- Low-power RF oscillators

1 package and lead coding

TO-92



PACKAGE CODE TO-92	LEAD 1	2	3
E	E	B	C
F	E	C	B
H	C	B	E

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V_{DC}
Collector-Base Voltage	V_{CB}	35	V_{DC}
Emitter-Base Voltage	V_{EB}	4	V_{DC}
Collector Current (continuous)	I_C (max)	30	mA_{DC}
Power Dissipation (T_A = 25°C)	P_D	0.6	W
Power Dissipation (T_C = 25°C)	P_D	1.0	W
Thermal Resistance	θ_{JA}	208	°C/W
	θ_{JC}	125	°C/W
Temperature, Junction and Storage	Tj, Tstg	−55 to + 150	°C

3 ordering information

NR461XX

- First X: PACKAGE/LEAD CODE — refer to 1
- Second X: HFE GROUPING — refer to 5

4 electrical characteristics $T_C = 25°C$

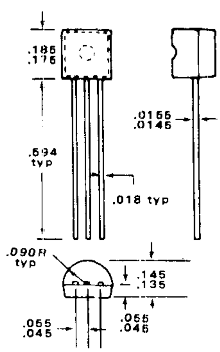
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	I_C = 1 mA	30			V
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 100μA	35			V
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E = 10μA	4	5.5		V
I_{CBO}	Collector-Base Leakage Current	V_{CB} = 30V			0.1	μA
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C = 10 mA, I_B = 0.5 mA		760	950	mV
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C = 10 mA, I_B = 0.5 mA		70	300	mV
Ccb	Common Emitter Collector Feedback Capacitance	V_{CB} = 10V, f = 1 MHz		0.9	1.1	pF
Roep	Common Emitter Output Resistance	I_C = 1 mA, V_{CE} = 5V				
		f = 455 KHz	100			KOhm
		f = 10.7 MHz	20			KOhm
ft	Current Gain Bandwidth Product	I_C = 1 mA, V_{CE} = 5V	180	300		MHz

5 HFE groupings

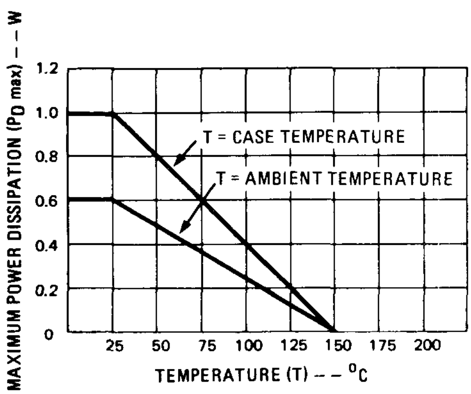
GROUPING	PARAMETER	CONDITIONS	MIN	TYP	MAX	RATIO
E	DC Current Gain	I_C = 1 mA, V_{CE} = 5V	30	38	50	1:1.6
F	DC Current Gain	I_C = 1 mA, V_{CE} = 5V	45	58	75	1:1.6
G	DC Current Gain	I_C = 1 mA, V_{CE} = 5V	68	85	110	1:1.6
H	DC Current Gain	I_C = 1 mA, V_{CE} = 5V	100	127	160	1:1.6
R	DC Current Gain	I_C = 1 mA, V_{CE} = 5V	20	32	50	1:2.4
S	DC Current Gain	I_C = 1 mA, V_{CE} = 5V	45	70	110	1:2.4
T	DC Current Gain	I_C = 1 mA, V_{CE} = 5V	100	150	240	1:2.4

6 physical dimensions

TO-92



7 max power dissipation

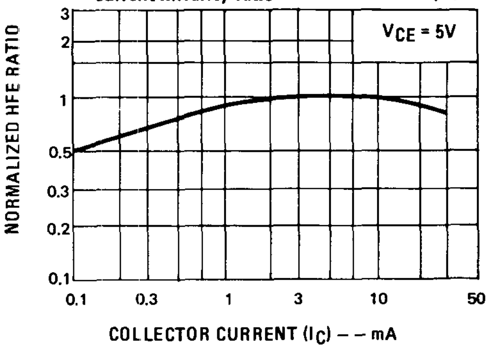


5

8 typical performance characteristics

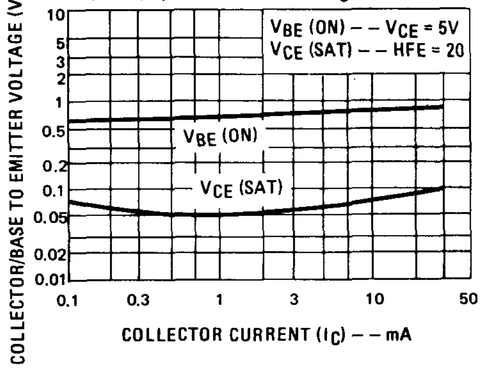
HFE1/HFE2

current linearity ratio (A)



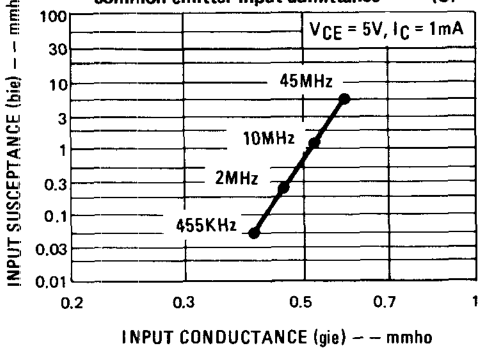
VCE(sat)/VBE(on)

collector/base to emitter voltage (B)



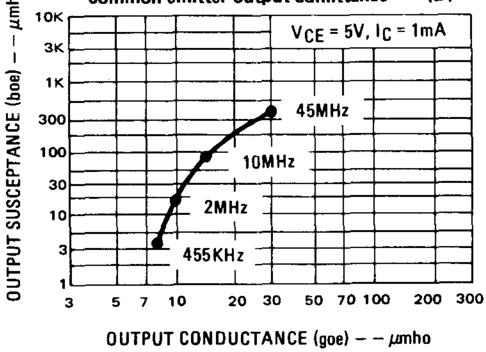
Yie

common emitter input admittance (C)



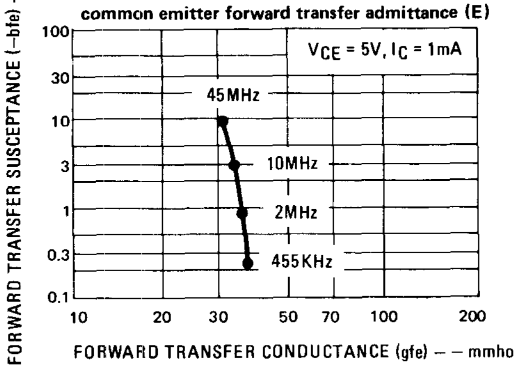
Yoe

common emitter output admittance (D)



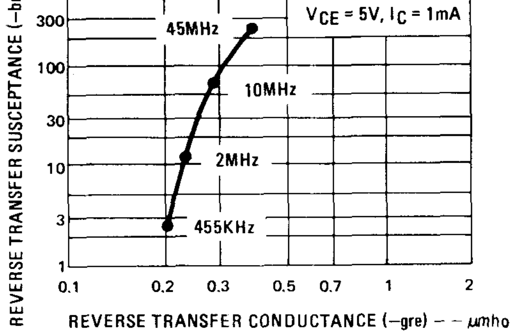
Yfe

common emitter forward transfer admittance (E)

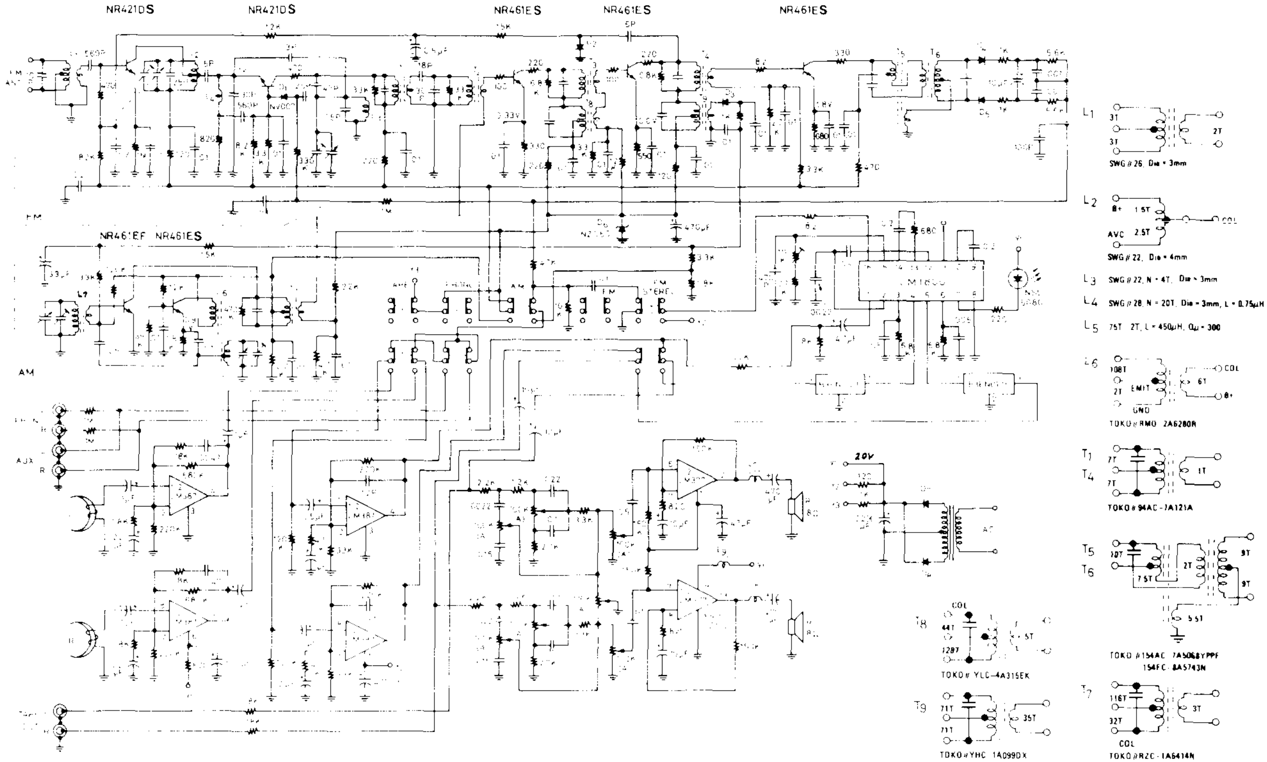


Yre

common emitter reverse transfer admittance (F)



9 typical applications



FM performance (88–108 MHz)

- *30dB quieting sensitivity* 2μV
- limiting sensitivity: 7μV
- AM rejection: 40dB
- AFC holding range: 800KHz
- stereo separation: 40dB

AM performance (525–1650 KHz)

- *maximum sensitivity:* 100μV/M
- 20dB quieting sensitivity: 280μV/M
- selectivity ±10KHz: −28dB
- AGC figure of merit: 52dB
- overload distortion: 3%

AUDIO performance

- *10% THD output power:* 3W + 3W
- frequency response: 50Hz – 15KHz
- channel separation: 45dB
- tone control range: ±10dB
- typical system dist: 0.5%

Figure A. AM/FM/Cassette Home Stereo Circuit

5

National Semiconductor

NR041(NPN) low-level signal switching transistor

features

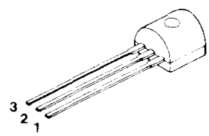
- 40mV guaranteed V_{CE} (sat) characteristics at I_C = 1mA and I_B = 0.1mA
- Linear collector characteristics
- 1dB typical wide-band Noise Figure
- "Epoxy B" packaging concept for excellent reliability

applications

- ALC device for CB microphone circuits
- Cassette circuits
- Audio signal switches
- Envelope modulators for musical equipment

1 package and lead coding

TO-92



PACKAGE CODE TO-92	LEAD 1	2	3
E	E	B	C
F	E	C	B
H	C	B	E

2 maximum ratings

PARAMETER	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V_{DC}
Collector-Base Voltage	V_{CB}	20	V_{DC}
Emitter-Base Voltage	V_{EB}	5	V_{DC}
Collector Current (continuous)	I_C (max)	30	mA_{DC}
Power Dissipation (T_A = 25°C)	P_D	0.6	W
Power Dissipation (T_C = 25°C)	P_D	1.0	W
Thermal Resistance	θ_{JA}	208	°C/W
	θ_{JC}	125	°C/W
Temperature, Junction and Storage	Tj, Tstg	– 55 to +150	°C

3 ordering information

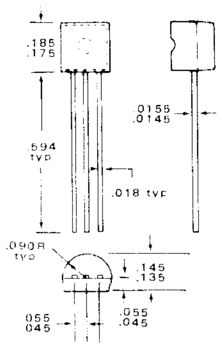
NR041X

↑ PACKAGE/LEAD CODE refer to 1

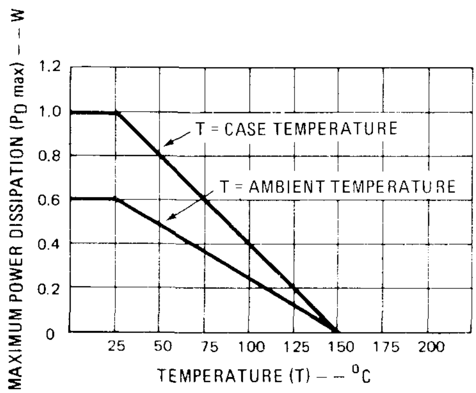
4 electrical characteristics $T_C = 25°C$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BV_{CEO}	Collector-Emitter Sustaining Voltage	$I_C = 1$ mA	20			V
BV_{CBO}	Collector-Base Breakdown Voltage	$I_C = 100\mu A$	20			V
BV_{EBO}	Emitter-Base Breakdown Voltage	$I_E = 10\mu A$	5			V
I_{CEO}	Collector-Emitter Leakage Current	$V_{CE} = 15V$			1	μA
I_{CBO}	Collector-Base Leakage Current	$V_{CB} = 15V$			50	nA
I_{EBO}	Emitter-Base Leakage Current	$V_{EB} = 4V$			0.1	μA
V_{BE} (sat)	Base-Emitter Saturation Voltage	$I_C = 1$ mA, $I_B = 0.1$ mA		0.65	0.8	V
V_{CE} (sat)	Collector-Emitter Saturation Voltage	$I_C = 1$ mA, $I_B = 0.1$ mA		25	40	mV
Cob	Collector Output Capacitance	$V_{CB} = 10V$, f = 1 MHz		2		pF
NF	Noise Figure	$I_C = 10\mu A$, $V_{CE} = 5V$ $R_S = 10K$, BW = 15.7 KHz		1		dB

5 physical dimensions



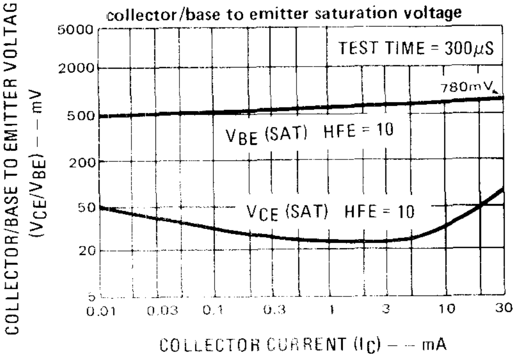
6 max power dissipation



7 typical performance characteristics

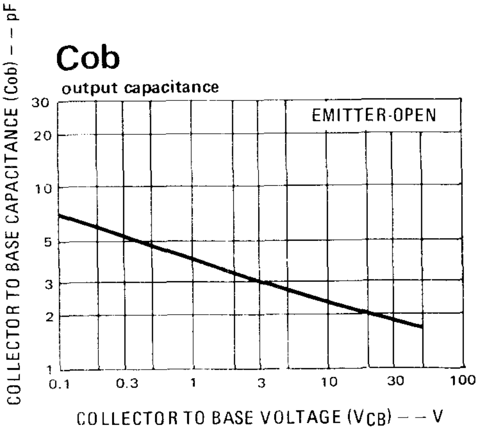
VCE(sat)/VBE(sat)

collector/base to emitter saturation voltage



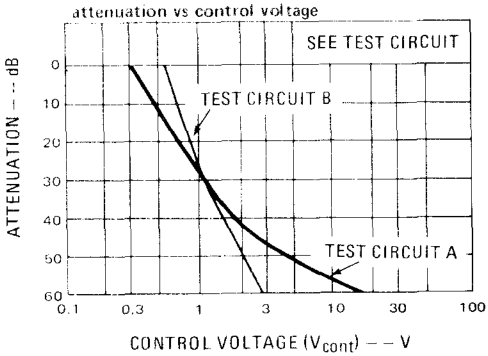
Cob

output capacitance



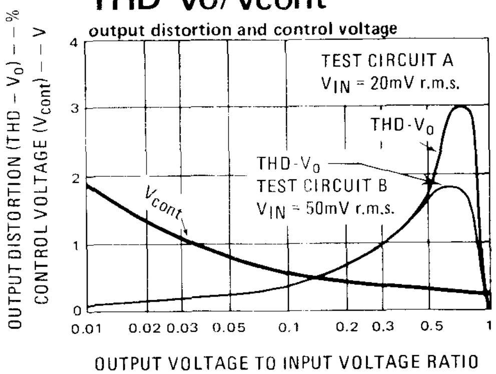
Attenuation

attenuation vs control voltage



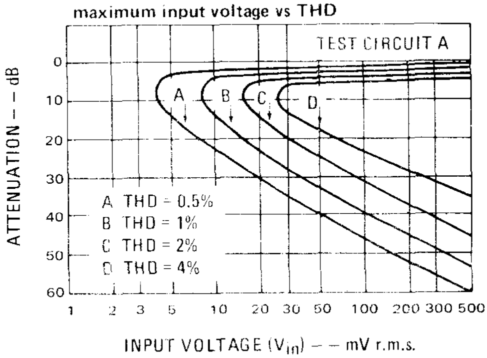
THD-Vo/Vcont

output distortion and control voltage

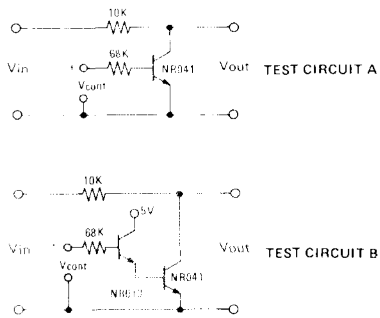


Dynamic range

maximum input voltage vs THD



Test circuits



NOTE: ATTENUATION = $20 \log_{10} \frac{Vout}{Vin}$

8 typical applications

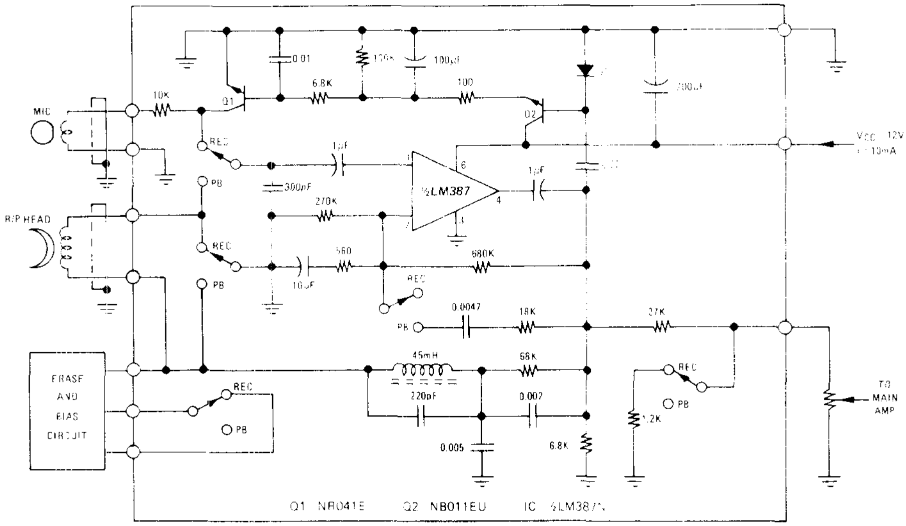


Figure A. 60dB ALC Range Record/Playback Preamplifier

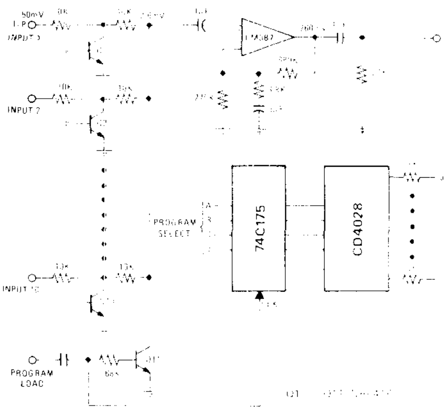


Figure B. 10 Channel Program Selector

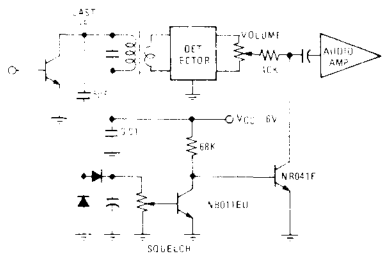


Figure C. Squelch Circuit

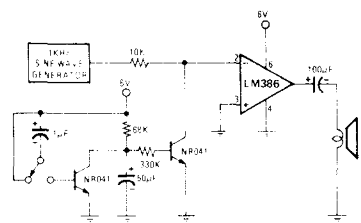


Figure D. Ringing Tone Generator

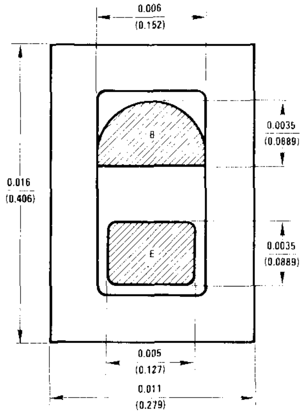
Section 6

Process Characteristics Double-Diffused Epitaxial Transistors

6

National Semiconductor

Process 02 NPN Small Signal



DESCRIPTION

Process 02 is a non-overlay double diffused, silicon device.

APPLICATION

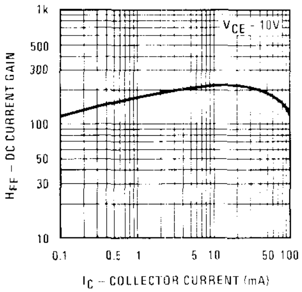
An economical device, good for all-around applications from DC to low radio frequencies. Ideal for use in audio, radio and television applications.

PRINCIPAL DEVICE TYPES

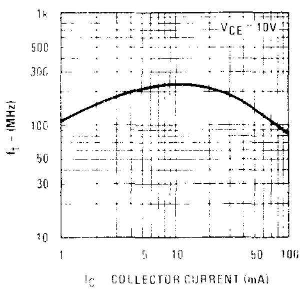
TO-92: MPS-A20
MPS-6573-6

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	$I_C = 1$ mA, $I_B = 0$	40			V
BV_{EBO}	$I_E = 100\ \mu A$, $I_C = 0$	4.0			V
I_{CBO}	$V_{CB} = 30V$, $I_E = 0$		100		nA
H_{FE}	$I_C = 5$ mA, $V_{CE} = 10V$	40	400		
$V_{BE(ON)}$	$I_C = 5$ mA, $V_{CE} = 10V$			0.85	V
$V_{CE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA			0.25	V
f_t	$I_C = 5$ mA, $V_{CE} = 10V$, f = 100 MHz	125			MHz
C_{ob}	$V_{CB} = 10V$, $I_E = 0$, f = 100 kHz			4.0	pF

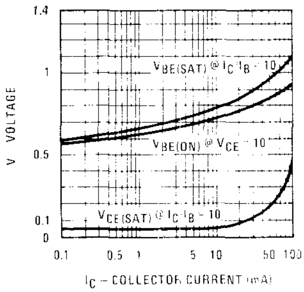
DC Current Gain vs
Collector Current



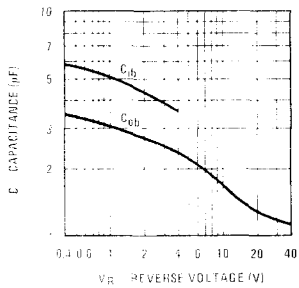
Bandwidth Product vs
Collector Current



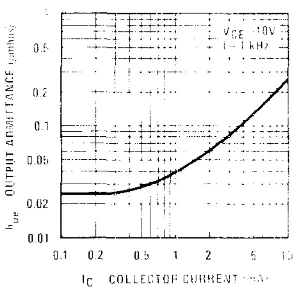
Saturation and ON Voltages



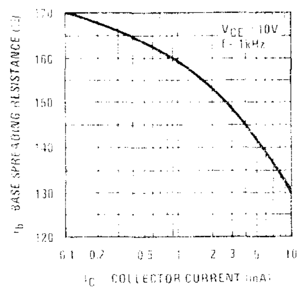
Capacitance vs Reverse
Voltage



Output Admittance vs
Collector Current

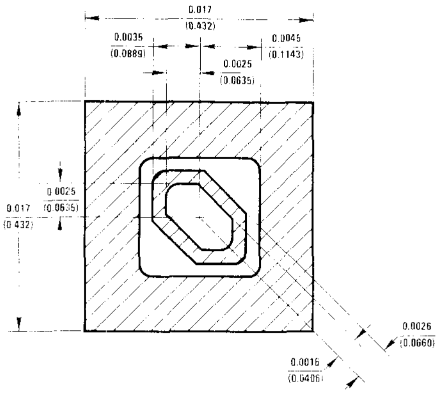


Base Spreading Resistance
vs Collector Current



National Semiconductor

Process 04 NPN Small Signal



DESCRIPTION

Process 04 is a non-overlay double diffused silicon epitaxial device. Complement to Process 71.

APPLICATION

This device was designed for low noise, high gain, general purpose amplifier application. From 1 μA to 100 mA collector current.

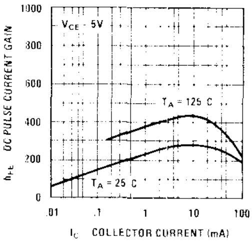
PRINCIPAL DEVICE TYPES

TO-18	BC107 Series
TO-92 (ECB)	2N2923 Series
TO-92 (EBC)	MPS2923 Series

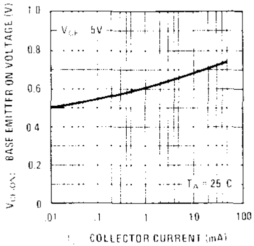
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_{CE} = 5V f = 1 kHz, R_S = 2k		2.0	4.0	dB	TO-18
C_{ob}	V_{CB} = 10V, f = 1 MHz		3.2	3.5	pF	TO-18
C_{ib}	V_{EB} = 0.5V, f = 1 MHz		7.6	8.5	pF	TO-18
f_T	V_{CE} = 5V, I_C = 10 mA	150	350		MHz	
h_{FE}	V_{CE} = 5V, I_C = 100 μA	50	250	500		
h_{FE}	V_{CE} = 5V, I_C = 2 mA	50	250	750		
h_{FE}	V_{CE} = 5V, I_C = 100 mA	75	250	300		
h_{FE}	V_{CE} = 1V, I_C = 100 mA	30	100	150		
$V_{CE(sat)}$	I_C = 10 mA, I_B = 1 mA		0.040	0.080	V	
$V_{CE(sat)}$	I_C = 100 mA, I_B = 10 mA		0.120	0.180	V	
$V_{BE(sat)}$	I_C = 10 mA, I_B = 1 mA		0.75	0.85	V	
$V_{BE(sat)}$	I_C = 100 mA, I_B = 10 mA		0.89	0.95	V	
BV_{CBO}	I_C = 10 μA	50	40	120	V	
BV_{CEO}	I_C = 10 mA	20	45	55	V	
BV_{EBO}	I_E = 10 μA	7.0			V	
I_{CBO}	V_{CB} = 40V			10	NA	
I_{EBO}	V_{EB} = 4V			10	NA	

Process 04

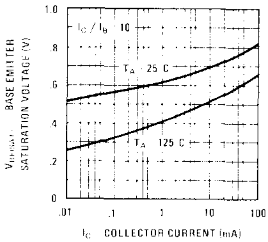
Pulsed DC Current Gain vs *Collector Current*



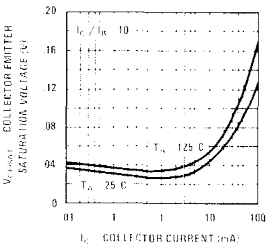
Base-Emitter On Voltage vs Collector Current



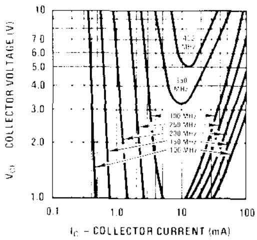
Base-Emitter Saturation Voltage vs Collector Current



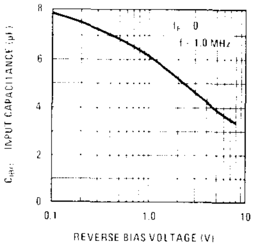
Collector-Emitter Saturation Voltage vs Collector Current



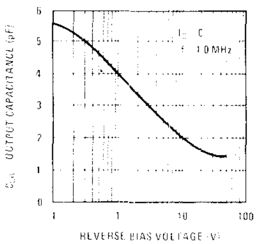
Contours of Constant Gain Bandwidth Product (F_T)



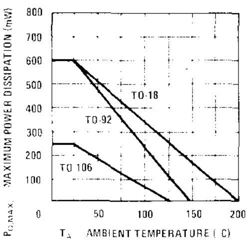
Input Capacitance vs Reverse Bias Voltage



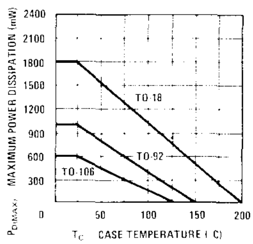
Output Capacitance vs Reverse Bias Voltage



Maximum Power Dissipation vs Ambient Temperature

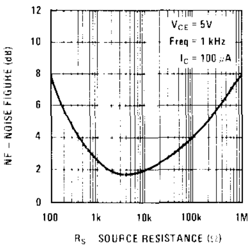


Maximum Power Dissipation vs Case Temperature

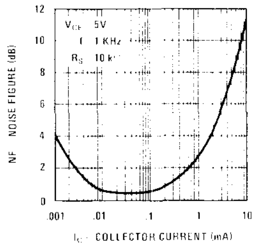


Process 04

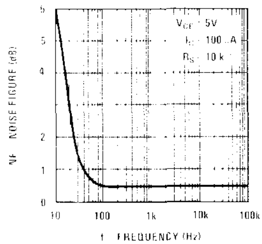
Noise Figure vs Source Resistance



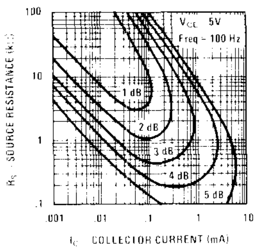
Noise Figure vs Collector Current



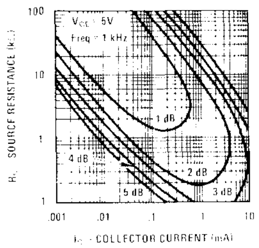
Noise Figure vs Frequency



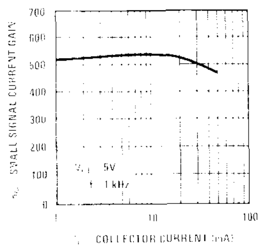
Contours of Constant Narrow Band Noise Figure



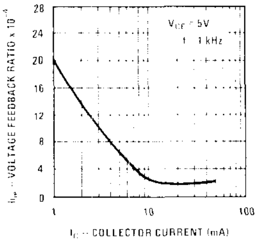
Contours of Constant Narrow Band Noise Figure



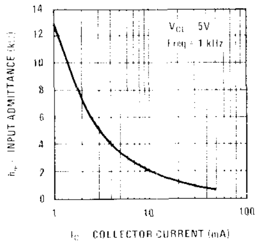
Small Signal Current Gain



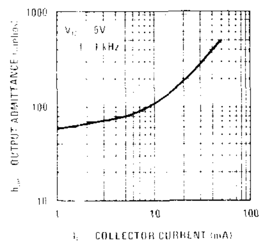
Voltage Feedback Ratio



Input Admittance

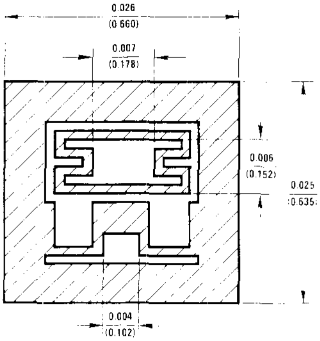


Output Admittance



National Semiconductor

Process 05 NPN Darlington



DESCRIPTION

Process 05 is a monolithic double diffused, silicon epitaxial Darlington.

APPLICATION

This device is designed for applications requiring extremely high current gain at collector currents to 1 Amp.

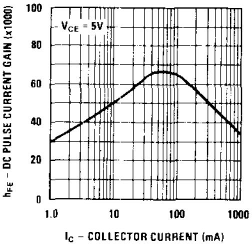
PRINCIPAL DEVICE TYPES

TO-92, MPS-A12 (EBC), 2N5306 (ECB)

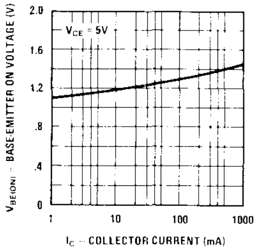
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	I_C = 1 mA, V_{CE} = 5V, R_S = 100 k, f = 1 kHz		2		dB	
C_{cb}	V_{CB} = 10V, I_E = 0, f = 1 MHz		4	8	pF	
h_{FE}	I_C = 10 mA, V_{CE} = 5V I_C = 100 mA, V_{CE} = 5V	5,000 5,000	50,000 100,000	200,000 250,000		
$V_{CE(SAT)}$	10 mA, 0.01 mA 100 mA, 0.1 mA			1.0 1.5	V	
$V_{BE(ON)}$	10 mA, 5V 100 mA, 5V		1.2 1.25	1.4 2.0	V	
h_{FE}	I_C = 10 mA, V_{CE} = 5.0V, f = 1 kHz		80,000			
BV_{CES}	I_C = 100 μA	30	40	50	V	
I_{CES}	V_{CE} = 15V, V_{BE} = 0			100	nA	
I_{CBO}	V_{CB} = 15V, I_E = 0			100	nA	
I_{EBO}	V_{EB} = 10V, I_C = 0			100	nA	

Process 05

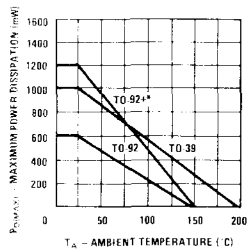
DC Pulse Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current

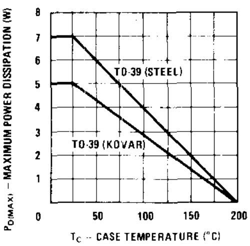


Maximum Power Dissipation vs Ambient Temperature

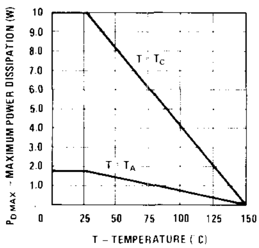


*One square inch of copper run

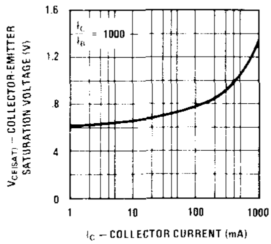
Maximum Power Dissipation vs Case Temperature



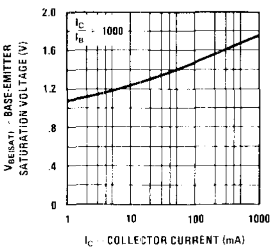
Maximum Power Dissipation TO-202 vs Case and Ambient Temperature



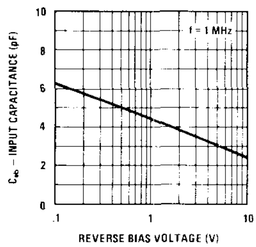
Collector-Emitter Saturation Voltage vs Collector Current



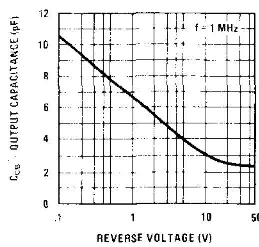
Base-Emitter Saturation Voltage vs Collector Current



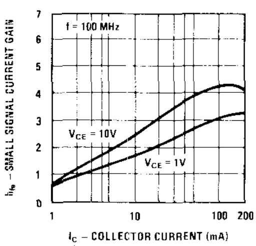
Input Capacitance vs Reverse Bias Voltage



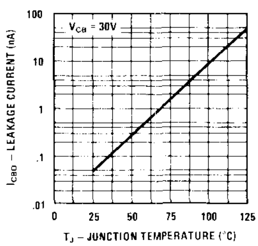
Output Capacitance vs Reverse Bias Voltage



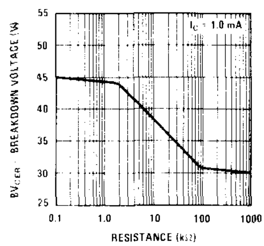
Small Signal Current Gain vs Collector Current



Collector-Base Diode Reverse Current vs Temperature

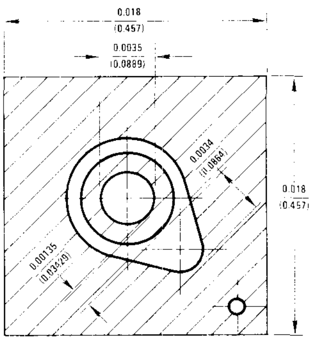


Collector-Emitter Breakdown Voltage vs Resistance



National Semiconductor

Process 07 NPN Small Signal



DESCRIPTION

Process 07 a nonoverlay, double diffused, silicon epitaxial device. Complement to Process 62.

APPLICATION

This device was designed for low noise, high gain general purpose amplifier applications. From 1 μA to 25 mA collector current.

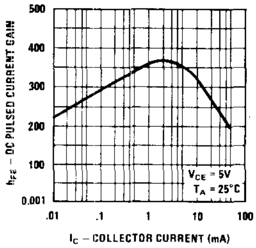
PRINCIPAL DEVICE TYPES

TO-18	2N930
TO-92	2N5088 (EBC), 2N3392 (ECB)

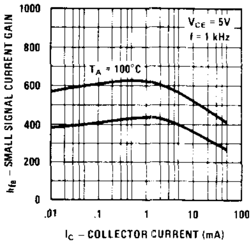
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	$I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_S = 10k$, $f = 100\ Hz$, $P_{BW} = 20\ Hz$		3	10	dB	
NF (spot)	$I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_S = 10k$, $f = 1\ kHz$ $P_{BW} = 200\ Hz$		1	3	dB	
NF (spot)	$I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_S = 10k$, $f = 10\ kHz$, $P_{BW} = 2\ kHz$		1	3	dB	
NF (wide band)	$I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_S = 10k$, $P_{BW} = 15.7\ kHz$		1	3	dB	
h_{fe}	$I_C = 500\ \mu A$, $V_{CE} = 5V$, $f = 20\ MHz$	5	7			
C_{cb}	$V_{CB} = 5V$		1.7	2.5	pF	TO-18
C_{eb}	$V_{EB} = 0.50V$		4.5	6.0	pF	TO-18
h_{FE}	$I_C = 1\ \mu A$, $V_{CE} = 5V$	35	170	450		
h_{FE}	$I_C = 10\ \mu A$, $V_{CE} = 5V$	45	230	670		
h_{FE}	$I_C = 100\ \mu A$, $V_{CE} = 5V$	60	300	830		
h_{FE}	$I_C = 500\ \mu A$, $V_{CE} = 5V$	65	335	950		
h_{FE}	$I_C = 1\ mA$, $V_{CE} = 5V$	70	350	1000		
h_{FE}	$I_C = 10\ mA$, $V_{CE} = 5V$	65	320	900		
$V_{CE(SAT)}$	$I_C = 1\ mA$, $I_B = 0.10\ mA$		0.06	0.10	V	
$V_{CE(SAT)}$	$I_C = 10\ mA$, $I_B = 1\ mA$		0.08	0.15	V	
$V_{BE(SAT)}$	$I_C = 1\ mA$, $I_B = 0.1\ mA$		0.65	0.75	V	
$V_{BE(SAT)}$	$I_C = 10\ mA$, $I_B = 1\ mA$		0.70	0.85	V	
BV_{CEO}	$I_C = 10\ mA$	60	80	100	V	
BV_{CBO}	$I_C = 100\ \mu A$	60			V	
BV_{EBO}	$I_C = 10\ \mu A$	8			V	
I_{CBO}	$V_{CB} = 45V$			10	nA	
I_{EBO}	$V_{EB} = 4V$			10	nA	

Process 07

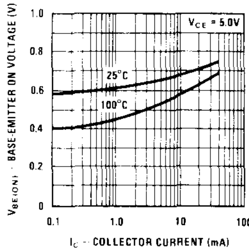
Pulsed DC Current Gain vs Collector Current



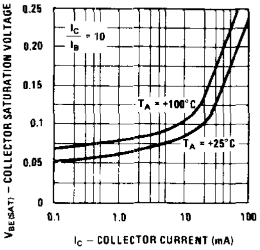
Small Signal Current Gain vs Collector Current



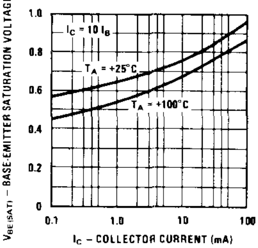
Base-Emitter On Voltage vs Collector Current



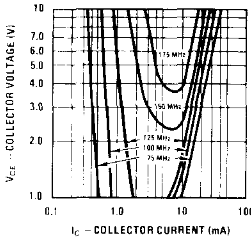
Collector Saturation Voltage vs Collector Current



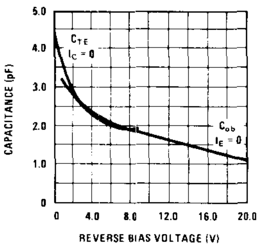
Base-Emitter Saturation Voltage vs Collector Current



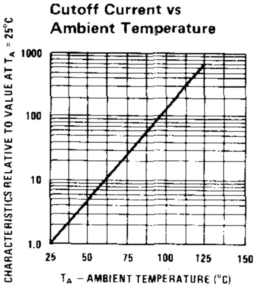
Contours of Constant Gain Bandwidth Product (f_T)



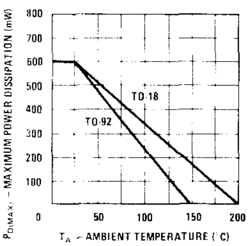
Input and Output Capacitance vs Reverse Bias Voltage



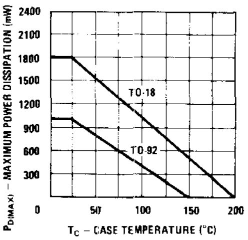
Normalized Collector Cutoff Current vs Ambient Temperature



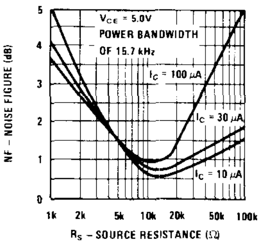
Maximum Power Dissipation vs Ambient Temperature



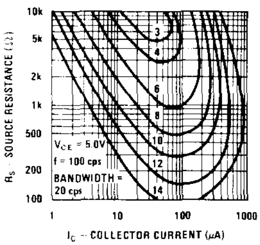
Maximum Power Dissipation vs Case Temperature



Wide Band Noise Figure vs Source Resistance

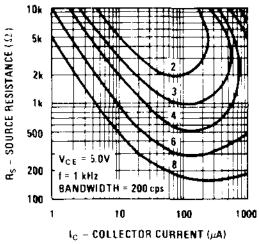


Contours of Constant Narrow Band Noise Figure

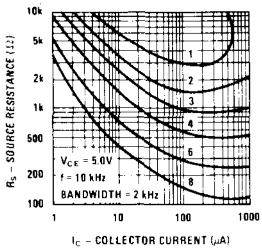


Process 07

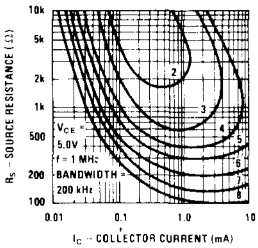
Contours of Constant Narrow Band Noise Figure



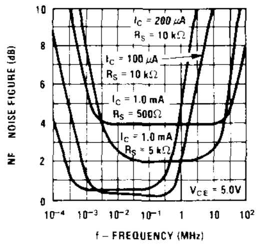
Contours of Constant Narrow Band Noise Figure



Contours of Constant Narrow Band Noise Figure



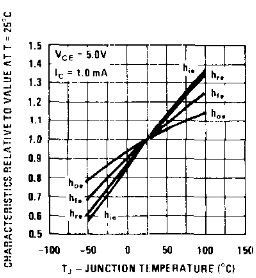
Noise Figure vs Frequency

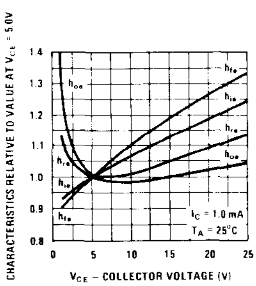


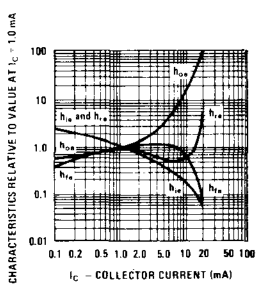
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	15	kΩ	I_C = 1.0 mA V_{CE} = 5.0V
h_{oe}	Output Conductance	15	μmho	I_C = 1.0 mA V_{CE} = 5.0V
h_{re}	Voltage Feedback Ratio	425	$\times 10^{-6}$	I_C = 1.0 mA V_{CE} = 5.0V
h_{fe}	Small Signal Current Gain	400		I_C = 1.0 mA V_{CE} = 5.0V
h_{ib}	Input Resistance	27	ohms	I_C = 1.0 mA V_{CB} = 5.0V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

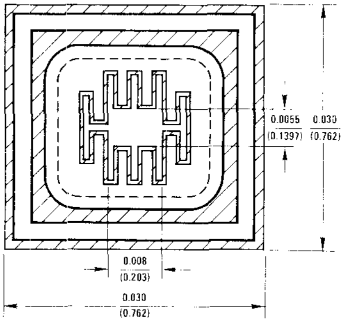






National Semiconductor

Process 08 NPN High Voltage



DESCRIPTION

Complements Process 73.

APPLICATION

This device was designed as a general purpose amplifier and switch for applications requiring high line voltages.

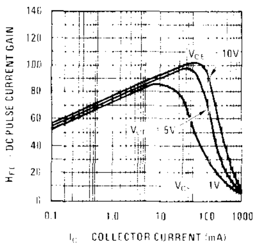
PRINCIPAL DEVICE TYPES

TO-39 2N3501

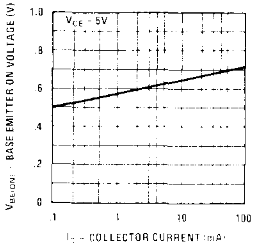
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C = 10 mA	100	160	185	V	
BV_{CBO}	I_C = 10 μA	100			V	
BV_{EBO}	I_E = 10 μA	6			V	
I_{CBO}	V_{CB} = 50V			50	nA	
I_{EBO}	V_{EB} = 4V			25	nA	
h_{FE}	I_C = 0.1 mA, V_{CE} = 10V	20	40			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	25	70			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	35	95			
h_{FE}	I_C = 150 mA, V_{CE} = 10V	40	100	300		
h_{FE}	I_C = 300 mA, V_{CE} = 10V	15	40			
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.25	0.4	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.9	1.2	V	
C_{OB}	V_{CB} = 10V		7.5	10	pF	
C_{IB}	V_{EB} = 0.5V		65	80	pF	
f_T	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	150	200		MHz	

Process 08

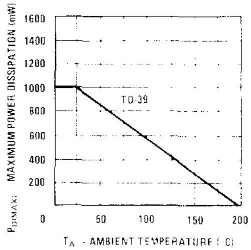
DC Pulsed Current Gain vs Collector Current



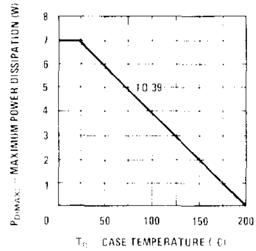
Base-Emitter On Voltage vs Collector Current



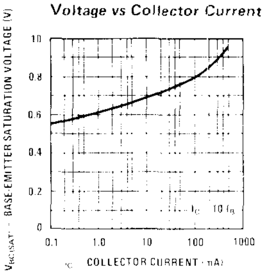
Maximum Power Dissipation vs Ambient Temperature



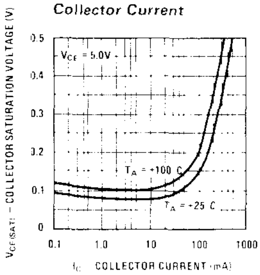
Maximum Power Dissipation vs Case Temperature



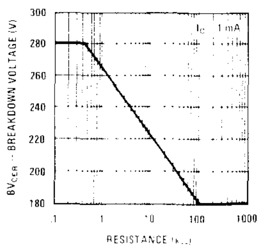
Base-Emitter Saturation Voltage vs Collector Current



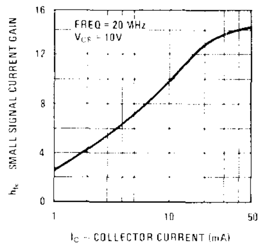
Collector-Emitter Saturation Voltage vs Collector Current



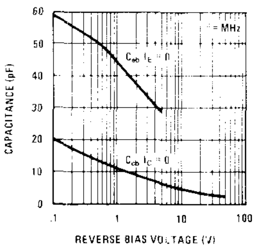
Collector-Emitter Breakdown Voltage With Resistance Between Emitter and Base



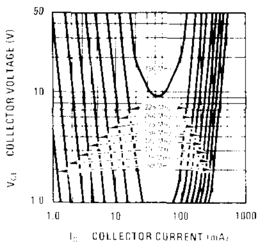
Small Signal Current Gain vs Collector Current



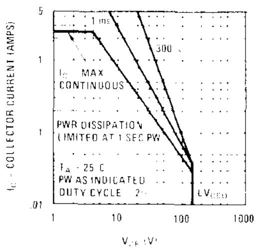
Input and Output Capacitance vs Reverse Bias Voltage



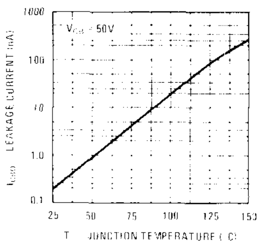
Collector-Emitter Voltage vs Collector Current



Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink

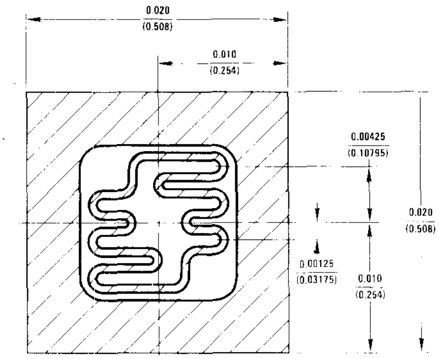


Collector-Base Diode Current vs Temperature



National Semiconductor

Process 09 NPN Medium Power



DESCRIPTION

Process 09 is a nonoverlay double diffused silicon epitaxial device.

APPLICATION

This device was designed for general purpose audio amplifier applications at collector currents to one Amp.

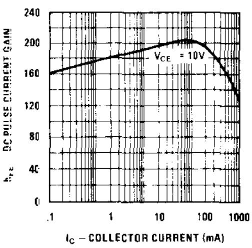
PRINCIPAL DEVICE TYPES

TO-92 CS9013

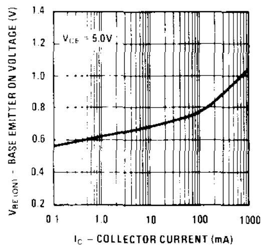
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{OB}	$V_{CB} = 10V$		5	10	pF	
C_{IB}	$V_{EB} = .5V$		25	35	pF	
NF	$V_{CE} = 10V$, $I_C = 1$ mA		1.0		dB	
f_T	$R_S = 1k$, $f = 1$ kHz $V_{CE} = 10V$, $I_C = 100$ mA		400		MHz	
h_{FE}	$V_{CE} = 1.0V$, $I_C = 1$ mA	50	170	290		
h_{FE}	$V_{CE} = 1.0V$, $I_C = 50$ mA	60	200	350		
h_{FE}	$V_{CE} = 1.0V$, $I_C = 500$ mA	50	160	280		
h_{FE}	$V_{CE} = 1.0V$, $I_C = 1A$	35	120	200		
$V_{CE(SAT)}$	$I_C = 150$ mA, $I_B = 15$ mA		0.09		V	
$V_{CE(SAT)}$	$I_C = 500$ mA, $I_B = 50$ mA		0.24		V	
$V_{BE(SAT)}$	$I_C = 150$ mA, $I_B = 15$ mA		0.86		V	
$V_{BE(SAT)}$	$I_C = 500$ mA, $I_B = 50$ mA		1.0		V	
BV_{CBO}	$I_C = 100\ \mu A$		100			
BV_{CEO}	$I_C = 10$ mA	20	25	30		
BV_{EBO}	$I_E = 1\ \mu A$		7.5			
I_{CBO}	$V_{CB} = 40V$			50	nA	
I_{EBO}	$V_{EB} = 4.0V$			50	nA	

Process 09

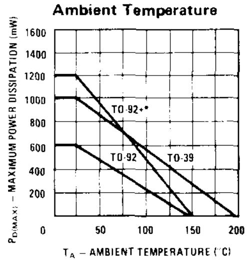
DC Pulse Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current

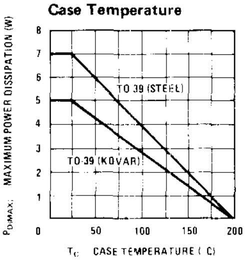


Maximum Power Dissipation vs Ambient Temperature

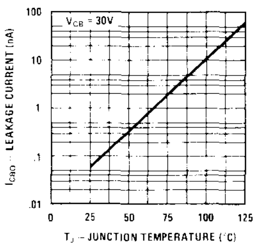


*One square inch of copper run

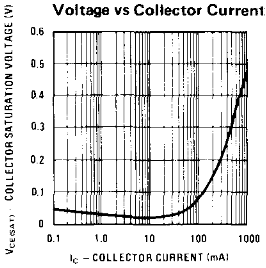
Maximum Power Dissipation vs Case Temperature



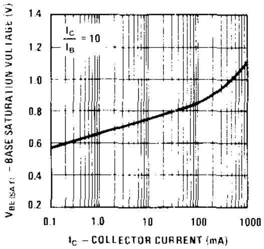
Collector-Base Diode Reverse Current vs Temperature



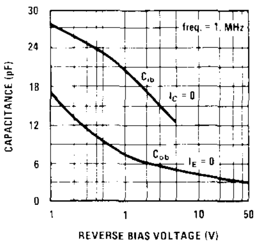
Collector-Emitter Saturation Voltage vs Collector Current



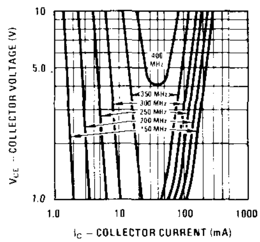
Base-Emitter Saturation Voltage vs Collector Current



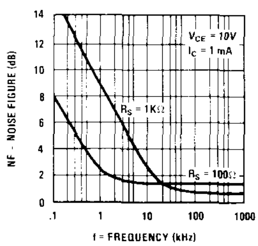
Capacitance vs Reverse Bias Voltage



Contours of Constant Gain Bandwidth Product (f_T)

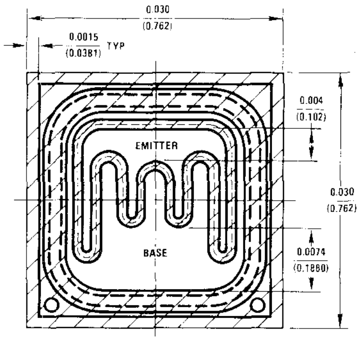


Noise Figure vs Frequency



National Semiconductor

Process 12 NPN Medium Power



DESCRIPTION

Process 12 is a nonoverlay, double diffused silicon epitaxial device. Complement to Process 67.

APPLICATION

This device was designed for general purpose medium power amplifiers and switches requiring collector currents up to 1 amp and collector voltages between 80 and 140 volts.

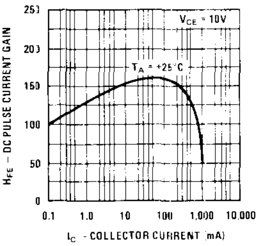
PRINCIPAL DEVICE TYPES

TO-92	MPSA05
TO-39	2N3019
TO-202	NSD106
TO-92+	TN3019, TN3020

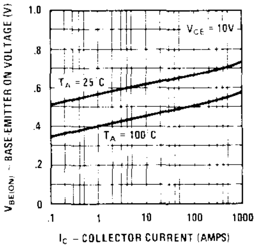
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		50	60	ns	Fig. I
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		400	500	ns	
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	4.0	6.5			
C_{cb}	V_{CB} = 10V		6.5	10	pF	TO-39
C_{eb}	V_{EB} = 0.5		50	60	pF	
NF	I_C = 100 μA, V_{CE} = 10V, R_S = 1k f = 1 kHz, PBW = 200 Hz		1.5	4	dB	
h_{FE}	I_C = 100 μA, V_{CE} = 10V	20	100			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	30	130			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	40	150			
h_{FE}	I_C = 150 mA, V_{CE} = 10V	40	170	300		
h_{FE}	I_C = 500 mA, V_{CE} = 10V	30	130			
h_{FE}	I_C = 1A, V_{CE} = 10V	20	40			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.1	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.25	0.5	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.82	0.90	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.0	1.20	V	
BV_{CEO}	I_C = 10 mA	65	80	100	V	
BV_{CBO}	I_C = 100 μA	120			V	
BV_{CES}	I_C = 10 μA	120			V	
BV_{EBO}	I_C = 10 μA	7			V	
I_{CBO}	V_{CB} = 90V			50	nA	
I_{EBO}	V_{EB} = 5V			50	nA	

Process 12

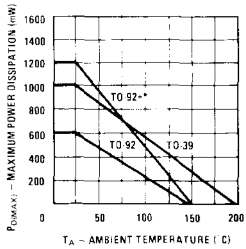
Pulsed DC Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current

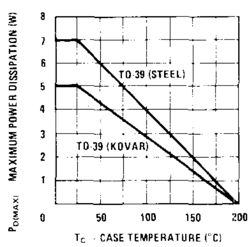


Maximum Power Dissipation vs Ambient Temperature

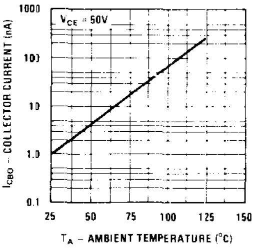


*One square inch of copper run

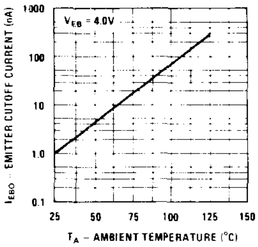
Maximum Power Dissipation vs Case Temperature



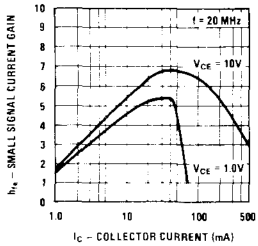
Collector Reverse Current vs Ambient Temperature



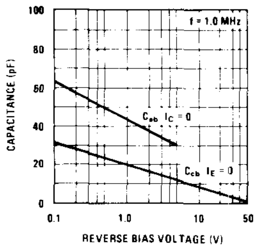
Emitter Cutoff Current vs Ambient Temperature



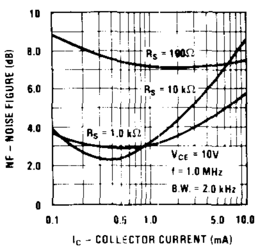
Small Signal Current Gain at 20 MHz



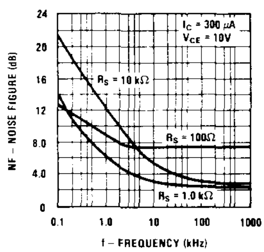
Collector-Base and Emitter Base Capacitance vs Reverse Bias Voltage



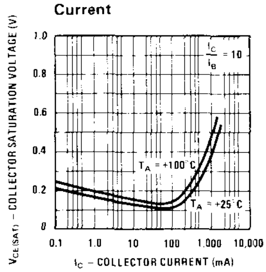
Noise Figure vs Collector Current



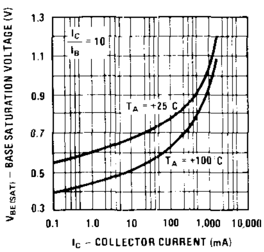
Noise Figure vs Frequency



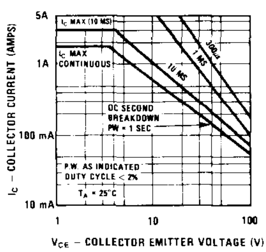
Collector Saturation Voltage vs Collector Current



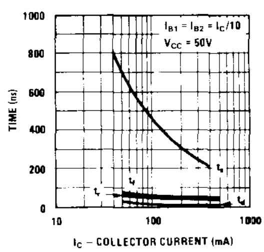
Base Saturation Voltage vs Collector Current



Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink

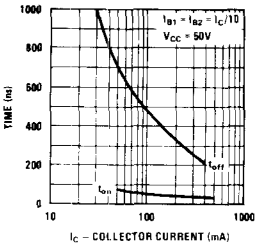


Switching Times vs Collector Current

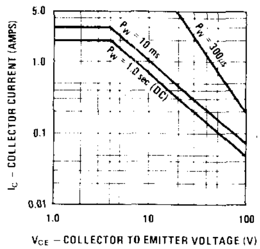


Process 12

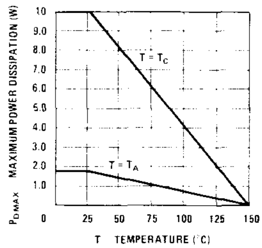
Turn On and Turn Off Times vs Collector Current



Safe Operating Area TO-202



Maximum Power Dissipation TO-202 vs Case and Ambient Temperature



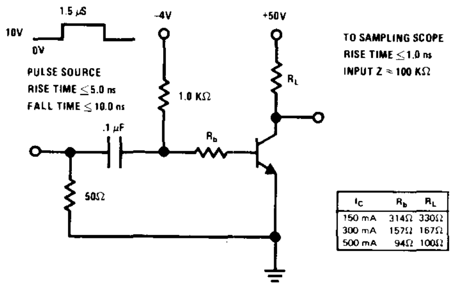
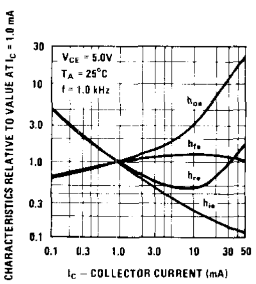


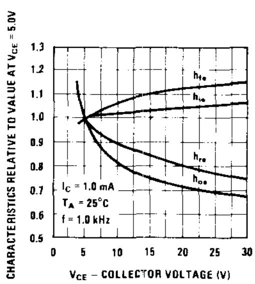
FIGURE 1. t_{on}, t_{off} Test Circuit

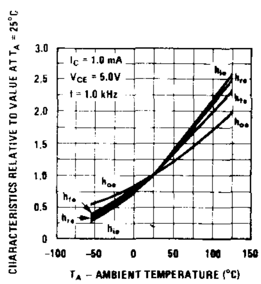
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	3000	ohms	I_C = 1.0 mA	V_{CE} = 5.0V
h_{oe}	Output Conductance	8.0	μmhos	I_C = 1.0 mA	V_{CE} = 5.0V
h_{re}	Voltage Feedback Ratio	2.1	$x10^{-4}$	I_C = 1.0 mA	V_{CE} = 5.0V
h_{fe}	Small Signal Current Gain	100		I_C = 1.0 mA	V_{CE} = 5.0V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

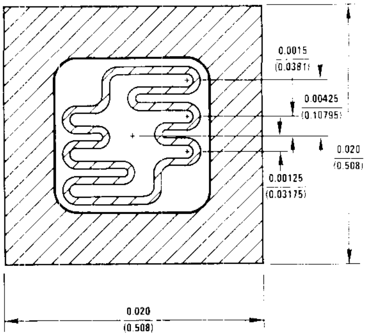






National Semiconductor

Process 13 NPN Medium Power



DESCRIPTION

Process 13 is a nonoverlay. Complement to Process 63.

APPLICATION

These devices were designed for use as medium power amplifiers and switches requiring collector currents of .1 mA to one Amp.

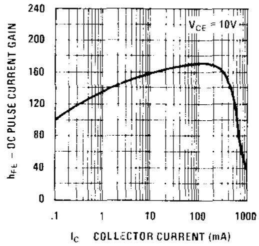
PRINCIPAL DEVICE TYPES

TO-92 2N4401 (EBC), 2N3704 (ECB)

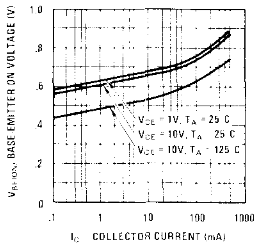
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns	
h_{fe}	I_C = 20 mA, V_{CE} = 10V, f = 100 MHz	1.8	2.5			
NF (spot)	I_C = 100 μA, V_{CE} = 10V R_S = 1 kΩ, f = 1 kHz, PBW = 200 Hz		1.2	4.0	dB	
C_{ob}	V_{CB} = 10 V		4.5		pF	
C_{ib}	V_{EB} = .5V		22		pF	
h_{FE}	V_{CE} = 1.0V, I_C = 100 μA	15	80	150		
h_{FE}	V_{CE} = 1.0V, I_C = 1.0 mA	25	110	250		
h_{FE}	V_{CE} = 1.0V, I_C = 10 mA	35	135	300		
h_{FE}	V_{CE} = 1.0V, I_C = 150 mA	40	140	300		
h_{FE}	V_{CE} = 1.0V, I_C = 500 mA	25	100	200		
h_{FE}	V_{CE} = 5.0V, I_C = 1A	15	45	75		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.1	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.26	0.36	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.87	0.97	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.0	1.2	V	
BV_{CBO}	I_C = 1.0 μA	60	100	140	V	
BV_{CES}	I_C = 10 μA	60			V	
BV_{CEO}	I_C = 10 mA	30	40	55	V	
BV_{EBO}	I_E = 1.0 μA	6.0			V	
I_{CBO}	V_{CB} = 40V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 13

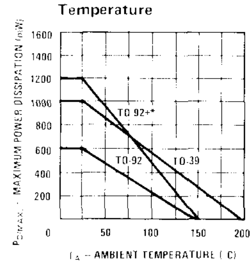
DC Pulse Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current

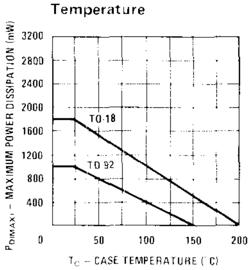


Maximum Power Dissipation vs Ambient Temperature

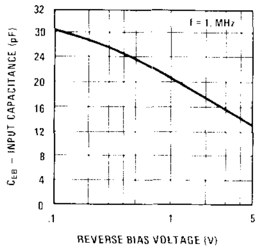


*One square inch of copper run

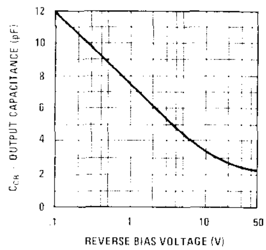
Maximum Power Dissipation vs Case Temperature



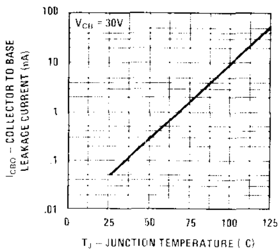
Input Capacitance vs Reverse Bias Voltage



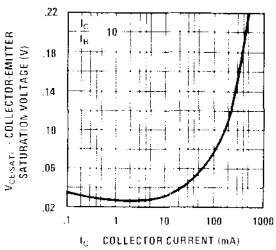
Output Capacitance vs Reverse Bias Voltage



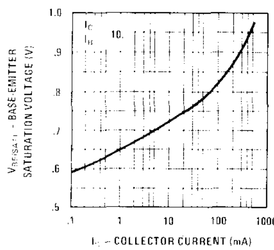
Collector to Base Diode Reverse Current vs Temperature



Collector-Emitter Saturation Voltage vs Collector Current

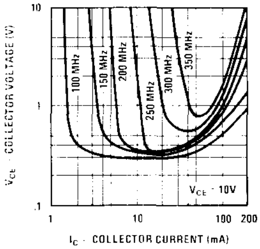


Base-Emitter Saturation Voltage vs Collector Current

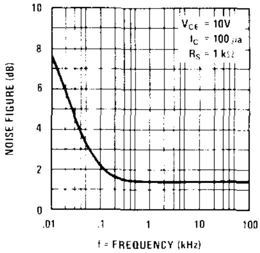


Process 13

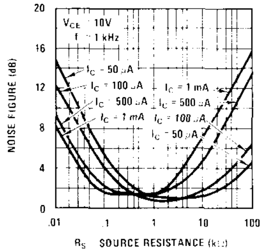
Contours of Constant Gain Bandwidth Product (f_t)



Noise Figure vs Frequency



Noise Figure vs Source Resistance

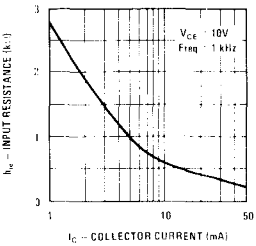


SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

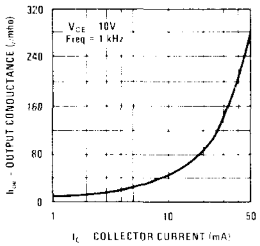
SYMBOL	CHARACTERISTIC	TYP	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	600	ohms	I_C = 10 mA, V_{CE} = 10V
h_{oe}	Output Conductance	50	μmhos	I_C = 10 mA, V_{CE} = 10V
h_{fe}	Small Signal Current Gain	170		I_C = 10 mA, V_{CE} = 10V
h_{re}	Voltage Feedback Ratio	120	$\times 10^{-6}$	I_C = 10 mA, V_{CE} = 10V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

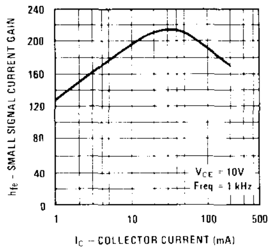
Small Signal Input Resistance vs Collector Current



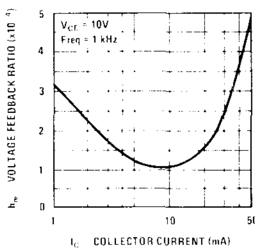
Small Signal Output Conductance vs Collector Current



Small Signal Current Gain vs Collector Current

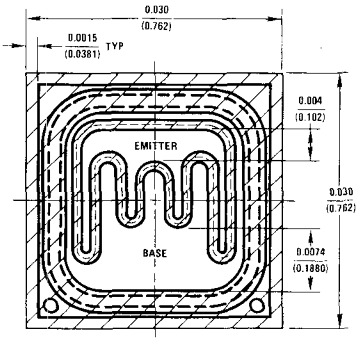


Small Signal Voltage Feedback Ratio vs Collector Current



National Semiconductor

Process 14 NPN Medium Power



DESCRIPTION

Process 14 is a nonoverlay double diffused silicon epitaxial device. Complement to Process 67.

APPLICATION

This device was designed for general purpose audio amplifier applications at collector currents to 500 mA.

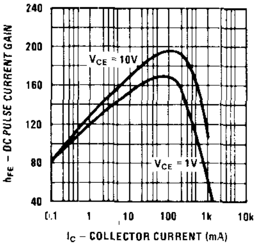
PRINCIPAL DEVICE TYPES

TO-39 BFY50
TO-92 MPS6560

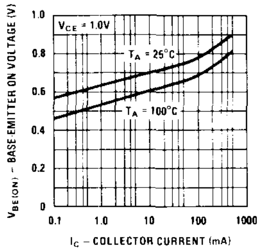
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{ob}	$V_{CB} = 10V$		8	10	pF	
C_{ib}	$V_{EB} = 0.5V$		55	65	pF	
h_{fe}	$I_C = 50$ mA, $V_{CE} = 10V$, f = 20 MHz	5	10			
h_{FE}	$I_C = 0.1$ mA, $V_{CE} = 1V$	20	60			
h_{FE}	$I_C = 1$ mA, $V_{CE} = 1V$	20	80			
h_{FE}	$I_C = 10$ mA, $V_{CE} = 1V$	20	100	400		
h_{FE}	$I_C = 150$ mA, $V_{CE} = 1V$	45	160	300		
h_{FE}	$I_C = 500$ mA, $V_{CE} = 1V$	20	70			
$V_{CE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.04	0.10	V	
$V_{CE(SAT)}$	$I_C = 150$ mA, $I_B = 10$ mA		0.10	0.15	V	
$V_{BE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.70	0.90	V	
$V_{BE(SAT)}$	$I_C = 150$ mA, $I_B = 10$ mA		0.80	1.0	V	
BV_{CEO}	$I_C = 1$ mA	40	50	60	V	
BV_{CBO}	$I_C = 100\ \mu A$	80			V	
BV_{EBO}	$I_E = 10\ \mu A$	7			V	
I_{CBO}	$V_{CB} = 30$			50	nA	
I_{EBO}	$V_{EB} = 3$			50	nA	

Process 14

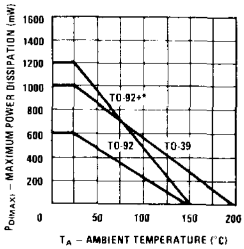
DC Pulse Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current

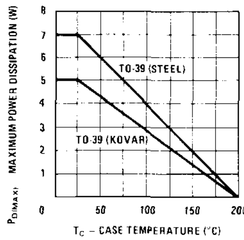


Maximum Power Dissipation vs Ambient Temperature

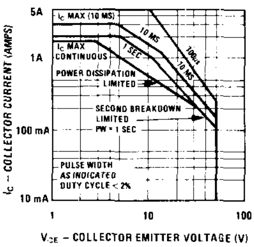


*One square inch of copper run

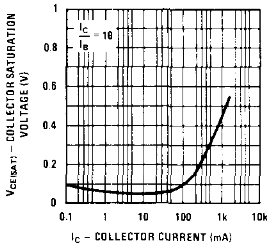
Maximum Power Dissipation vs Case Temperature



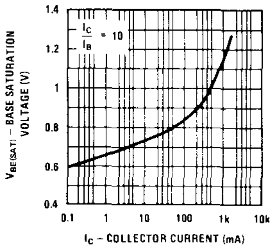
Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink



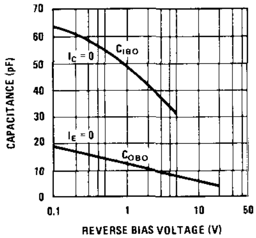
Collector-Emitter Saturation Voltage vs Collector Current



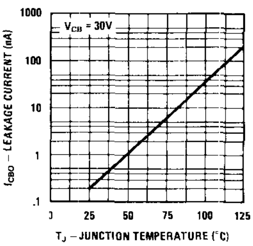
Base-Emitter Saturation Voltage vs Collector Current



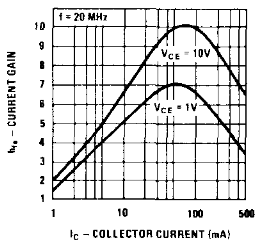
Capacitance vs Reverse Bias Voltage



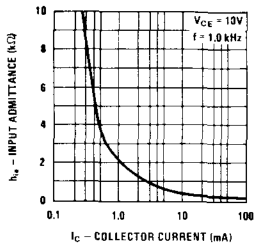
Collector-Base Diode Reverse Current vs Temperature



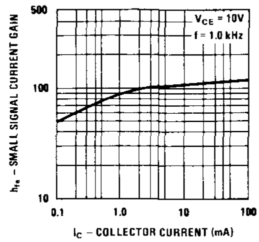
Small Signal Current Gain At 20 MHz vs Collector Current



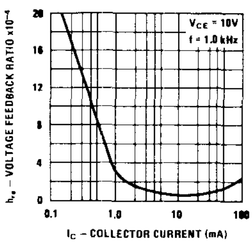
Input Admittance



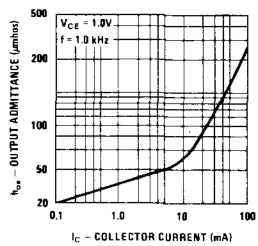
Small Signal Current Gain



Voltage Feedback Ratio

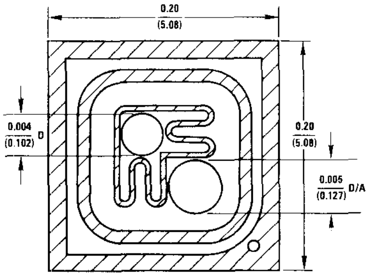


Output Admittance



National Semiconductor

Process 16 NPN High Voltage



DESCRIPTION

Process 16 is a nonoverlay, double diffused, epitaxial silicon device.

APPLICATION

This device was designed for general purpose high voltage amplifiers and gas discharge display driving.

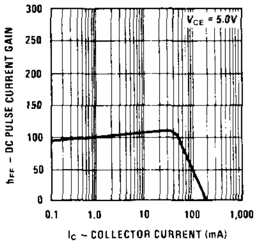
PRINCIPAL DEVICE TYPES

TO-92 2N5551

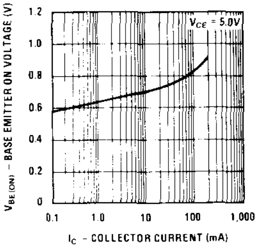
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 1.0 mA	100	155	180	V
BV_{CBO}	I_C = 100 μA	120			V
BV_{EBO}	I_E = 10 μA	6			V
I_{CBO}	V_{CB} = 120V		0.5	50	nA
I_{EBO}	V_{EB} = 4.0V		0.3	50	nA
h_{FE}	I_C = 1.0 mA, V_{CE} = 5.0V	50	105	300	
h_{FE}	I_C = 10 mA, V_{CE} = 5.0V	50	132	300	
h_{FE}	I_C = 50 mA, V_{CE} = 5.0V	20	60		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1.0 mA		0.07	0.15	V
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5.0 mA		0.12	0.25	V
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1.0 mA		0.75	1.0	V
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.83	1.2	V
f_T	I_C = 10 mA, V_{CE} = 10V, f = 100 MHz	100	220	300	MHz
C_{ob}	V_{CB} = 10V		2.67	6.0	pF
C_{cb}	V_{CB} = 10V		2.53	4.0	pF
C_{ib}	V_{EB} = 0.5V		17	30	pF

Process 16

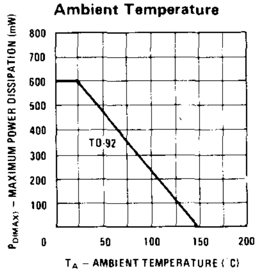
DC Pulse Current Gain
vs Collector Current



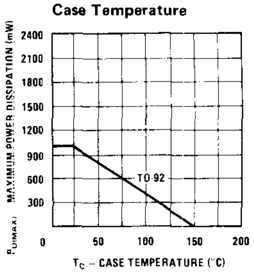
Base-Emitter on Voltage
vs Collector Current



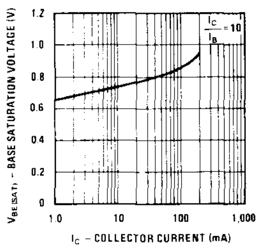
Maximum Power
Dissipation vs
Ambient Temperature



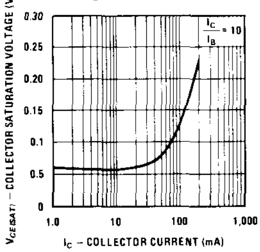
Maximum Power
Dissipation vs
Case Temperature



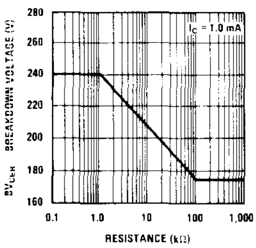
Base-Emitter Saturation
Voltage vs Collector Current



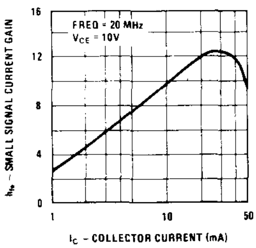
Collector-Emitter Saturation
Voltage vs Collector Current



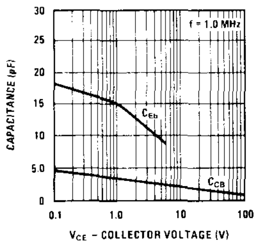
Collector-Emitter
Breakdown Voltage With
Resistance Between
Emitter-Base



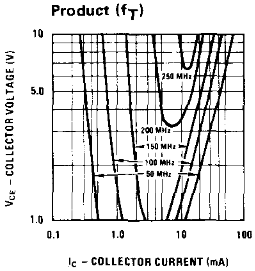
Small Signal Current Gain
vs Collector Current



Input and Output
Capacitance vs Reverse
Bias Voltage

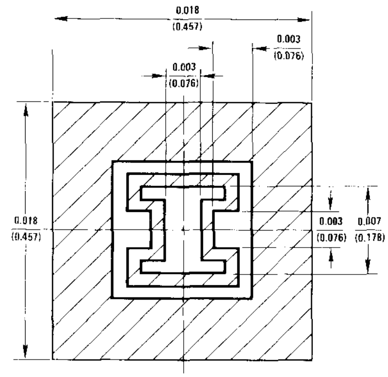


Contours of Constant
Gain Bandwidth
Product (f_T)



National Semiconductor

Process 19 NPN Medium Power



DESCRIPTION

Process 19 is nonoverlay double diffused, gold doped, silicon epitaxial device. Complement to Process 63.

APPLICATION

These devices were designed for use as medium power amplifiers and switches requiring collector currents of 0.1 to 500 mA.

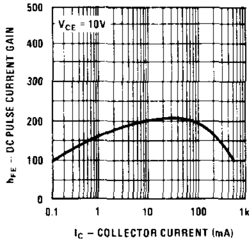
PRINCIPAL DEVICE TYPES

TO-92 PN2222

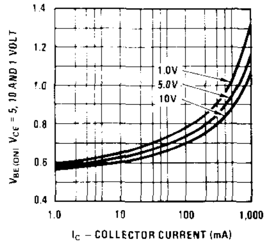
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns	
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2.5	3.5			
C_{cb}	V_{CB} = 10V		3.0	6.0	pF	
C_{cb}	V_{EB} = 0.5V		18	25	pF	
NF (spot)	I_C = 100 μA, V_{CE} = 10V R_S = 1 kΩ, f = 1 kHz, PBW = 200 Hz		1.2	4.0	dB	
h_{FE}	I_C = 100 μA, V_{CE} = 10V	20	100			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	30	160			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	40	200	300		
h_{FE}	I_C = 150 mA, V_{CE} = 10V	45	180	540		
h_{FE}	I_C = 500 mA, V_{CE} = 10V	25	90			
h_{FE}	I_C = 1A, V_{CE} = 10V	15	30			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.12	0.50	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.35	1.0	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.90	1.2	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.1	1.5	V	
BV_{CEO}	I_C = 10 mA	30	50	60	V	
BV_{CBO}	I_C = 100 μA	45			V	
BV_{CES}	I_C = 10 μA	45		85	V	
BV_{EBO}	I_E = 10 μA	6			V	
I_{CBO}	V_{CB} = 60V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 19

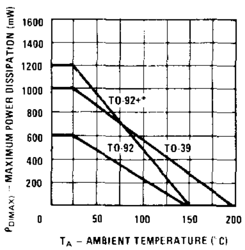
DC Pulse Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current

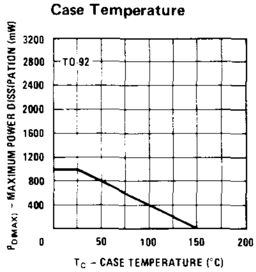


Maximum Power Dissipation vs Ambient Temperature

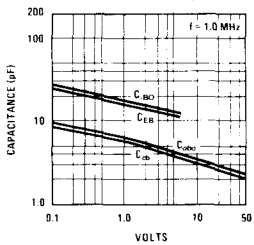


*One square inch of copper run

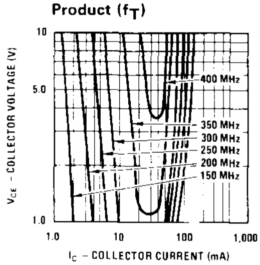
Maximum Power Dissipation vs Case Temperature



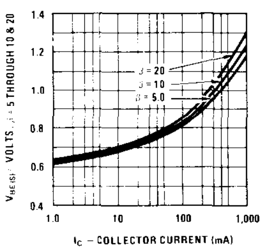
Emitter Transition and Output Capacitance vs Reverse Bias Voltage



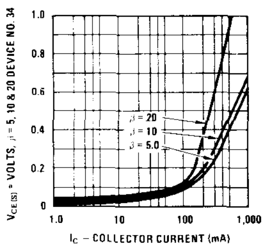
Contours of Constant Gain Bandwidth Product (f_T)



Base-Emitter Saturation Voltage vs Collector Current

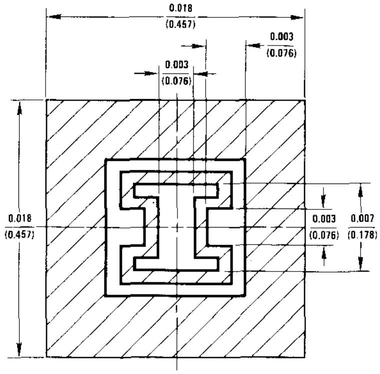


Collector-Emitter Saturation Voltage vs Collector Current



National Semiconductor

Process 20 NPN Medium Power



DESCRIPTION

Process 20 is nonoverlay double diffused, gold doped, silicon epitaxial device. Complement to Process 63.

APPLICATION

These devices were designed for use as medium power amplifiers and switches requiring collector currents of 0.1 to 500 mA.

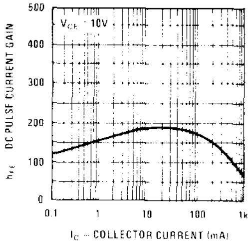
PRINCIPAL DEVICE TYPES

TO-5	2N2219A
TO-18	2N2222A
TO-92	MPS3642
TO-105	2N3643
TO-106	2N4141

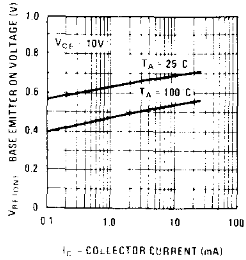
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns	
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2.5	3.5			
C_{cb}	V_{CB} = 10V		3.0	6.0	pF	
C_{ib}	V_{EB} = 0.5V		19	25	pF	
NF (spot)	I_C = 100 μA, V_{CE} = 10V R_S = 1 kΩ, f = 1 kHz, PBW = 200 Hz		1.2	4.0	dB	
h_{FE}	I_C = 100 μA, V_{CE} = 10V	30	100			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	40	195			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	50	240	500		
h_{FE}	I_C = 150 mA, V_{CE} = 10V	50	180	500		
h_{FE}	I_C = 500 mA, V_{CE} = 10V	30	90			
h_{FE}	I_C = 1A, V_{CE} = 10V	15	30			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.12	0.50	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.35	1.0	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.90	1.2	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.00	1.5	V	
BV_{CEO}	I_C = 10 mA	40			V	
BV_{CBO}	I_C = 100 μA	70			V	
BV_{EBO}	I_E = 10 μA	6			V	
I_{CBO}	V_{CB} = 60V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 20

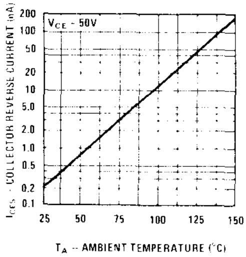
DC Pulse Current Gain vs Collector Current



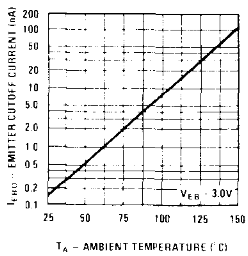
Base-Emitter On Voltage vs Collector Current



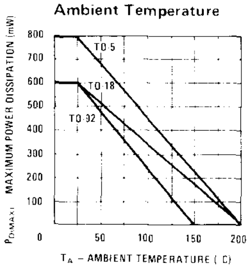
Collector Reverse Current vs Ambient Temperature



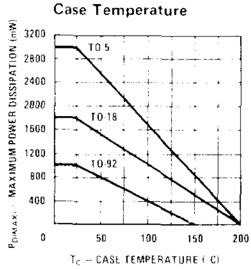
Emitter Cutoff Current vs Ambient Temperature



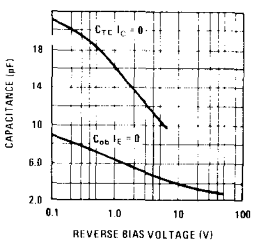
Maximum Power Dissipation vs Ambient Temperature



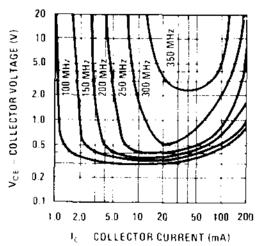
Maximum Power Dissipation vs Case Temperature



Emitter Transition and Output Capacitance vs Reverse Bias Voltage

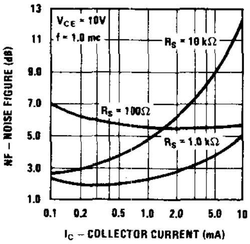


Contours of Constant Gain Bandwidth Product (f_T)

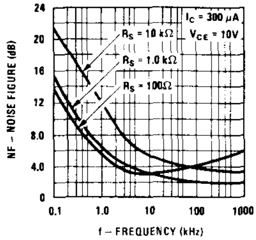


Process 20

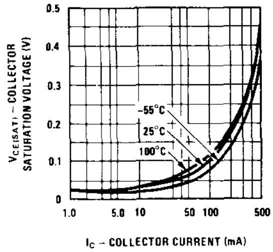
Noise Figure vs Collector Current



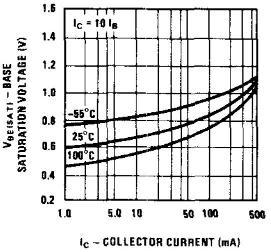
Noise Figure vs Frequency



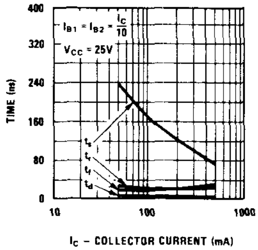
Collector Saturation Voltage vs Collector Current



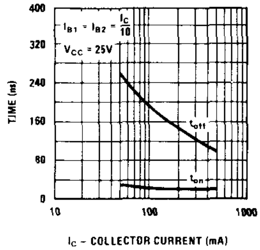
Base Saturation Voltage vs Collector Current



Switching Times vs Collector Current



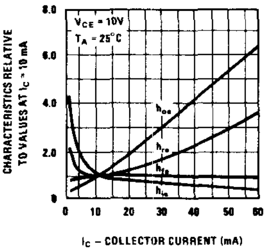
Turn On and Turn Off Times vs Collector Current

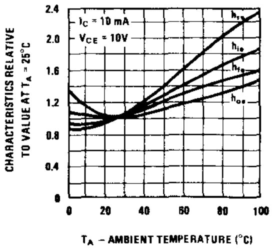


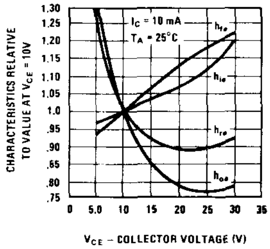
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	700	ohms	I_C = 10 mA V_{CE} = 10V
h_{oe}	Output Conductance	120	μmhos	I_C = 10 mA V_{CE} = 10V
h_{fe}	Small Signal Current Gain	240		I_C = 10 mA V_{CE} = 10V
h_{re}	Voltage Feedback Ratio	460	$x10^{-6}$	I_C = 10 mA V_{CE} = 10V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

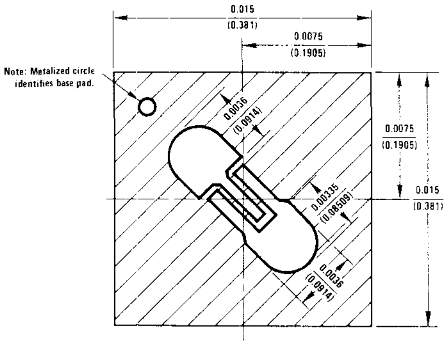






National Semiconductor

Process 21
NPN High Speed Switch



DESCRIPTION

Process 21 is an overlay, double diffused, gold doped silicon epitaxial device. Complement to Process 65.

APPLICATION

This device was designed for high speed saturated switching at collector currents of 10 to 100 mA.

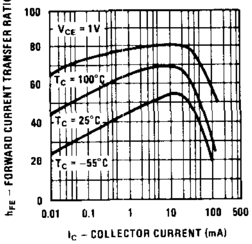
PRINCIPAL DEVICE TYPES

TO-18	2N2369A
TO-92	MPS2369 (EBC)

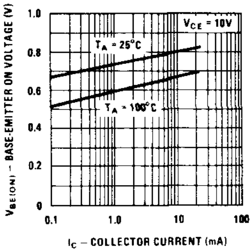
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_s	$I_{B1} = I_{B2} = I_C = 10$ mA		7	13	ns	Fig. 1
t_{on}	$I_C = 10$ mA, $I_{B1} = 3$ mA		9	12	ns	Fig. 2
t_{off}	$I_C = 10$ mA, $I_{B2} = 1.50$ mA		10	18	ns	Fig. 2
h_{fe}	$I_C = 10$ mA, $V_{CE} = 10$V, f = 100 MHz	5.0	6.5			
C_{cb}	$V_{CB} = 5$V		2.0	4.0	pF	TO-18
C_{eb}	$V_{EB} = 0.5$V		4.0	5.0	pF	TO-18
h_{FE}	$I_C = 1$ mA, $V_{CE} = 1$V	30	65	150		
h_{FE}	$I_C = 10$ mA, $V_{CE} = 1$V	30	70	150		
h_{FE}	$I_C = 50$ mA, $V_{CE} = 1$V	25	55	150		
h_{FE}	$I_C = 100$ mA, $V_{CE} = 1$V	20	30	150		
h_{FE}	$I_C = 10$ mA, $V_{CE} = 0.35$V	30	65	150		
h_{FE}	$I_C = 30$ mA, $V_{CE} = 0.4$V	30	60	150		
$V_{CE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.15	0.2	V	
$V_{CE(SAT)}$	$I_C = 100$ mA, $I_B = 10$ mA		0.35	0.5	V	
$V_{BE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.80	0.85	V	
$V_{BE(SAT)}$	$I_C = 100$ mA, $I_B = 10$ mA		1.0	1.5	V	
BV_{CEO}	$I_C = 10$ mA	12	15	19	V	
BV_{CBO}	$I_C = 10\ \mu$A	50	55	60	V	
BV_{EBO}	$I_E = 10\ \mu$A	4.5			V	
I_{CBO}	$V_{CB} = 25$V			50	nA	
I_{EBO}	$V_{EB} = 3$V			50	nA	

Process 21

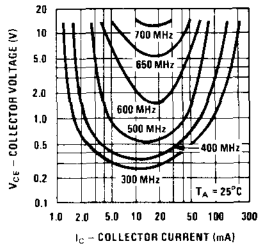
Pulse DC Current Gain vs Collector Current



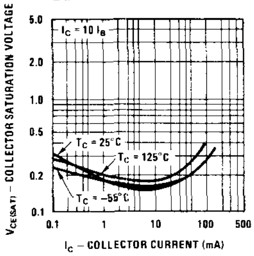
Base-Emitter On Voltage vs Collector Current



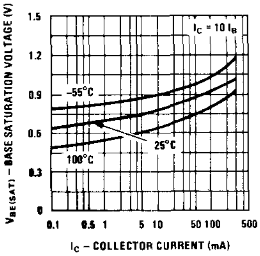
Contours of Constant Gain Bandwidth Product (f_T)



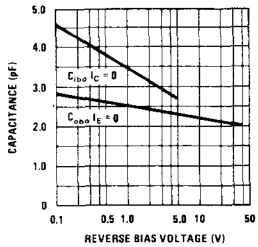
Collector Saturation Voltage vs Collector Current



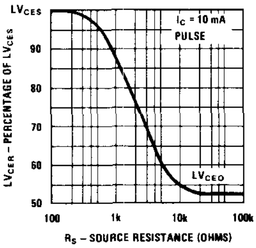
Base Saturation Voltage vs Collector Current



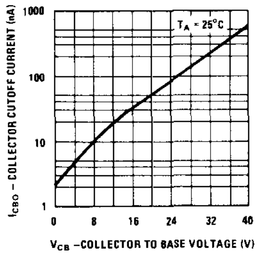
Emitter Transition and Output Capacitances vs Reverse Bias Voltage



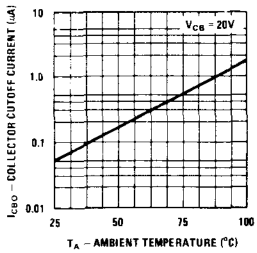
Lower Limiting Voltage vs Source Resistance



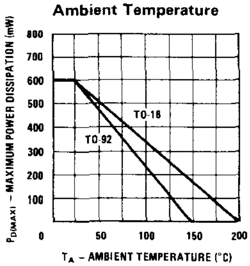
Collector Cutoff Current vs Reverse Bias Voltage



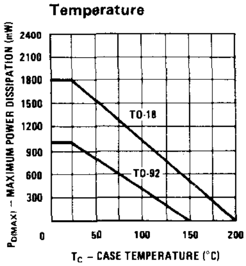
Collector Cutoff Current vs Ambient Temperature



Maximum Power Dissipation vs Ambient Temperature

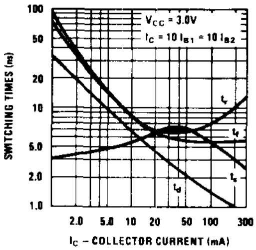


Maximum Power Dissipation vs Case Temperature

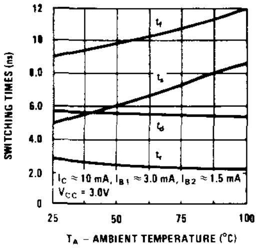


Process 21

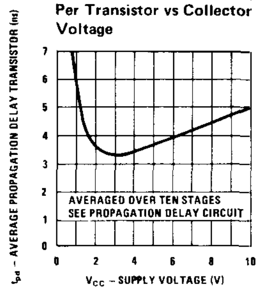
Switching Times vs Collector Current



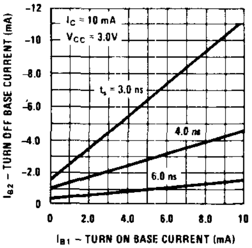
Switching Times vs Ambient Temperature



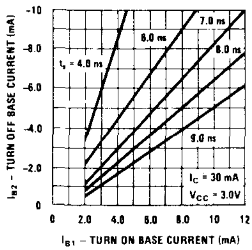
Average Propagation Delay Per Transistor vs Collector Voltage



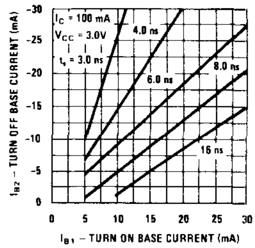
Storage Time vs Turn On and Turn Off Base Currents



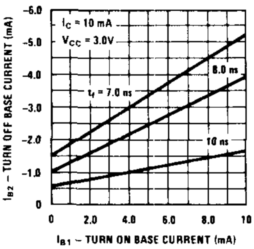
Storage Time vs Turn On and Turn Off Base Currents



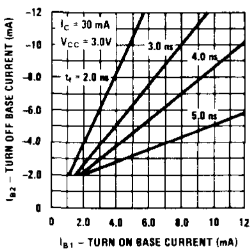
Storage Time vs Turn On and Turn Off Base Currents



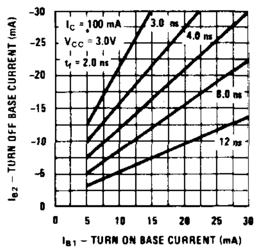
Fall Time vs Turn On and Turn Off Base Current



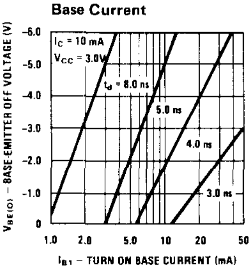
Fall Time vs Turn On and Turn Off Base Currents



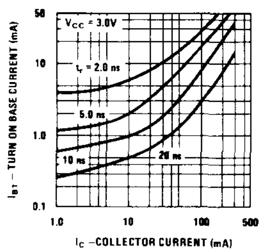
Fall Time vs Turn On and Turn Off Base Currents



Delay Time vs Base Emitter Off Voltage and Turn On Base Current



Rise Time vs Turn On Base Current and Collector Current



Process 21

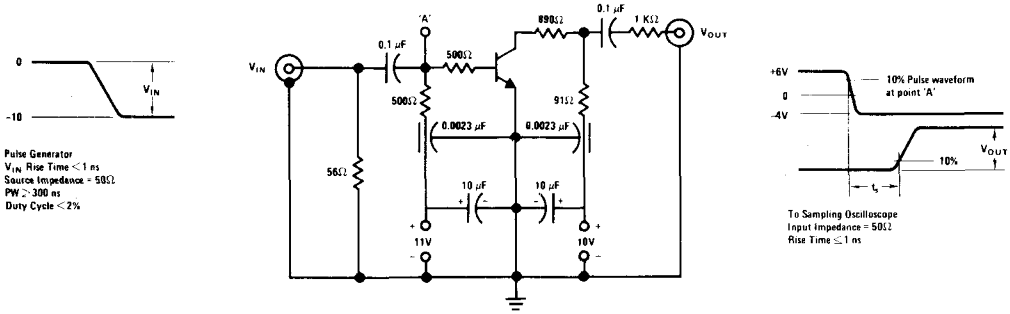


FIGURE 1. Charge Storage Time Measurement Circuit

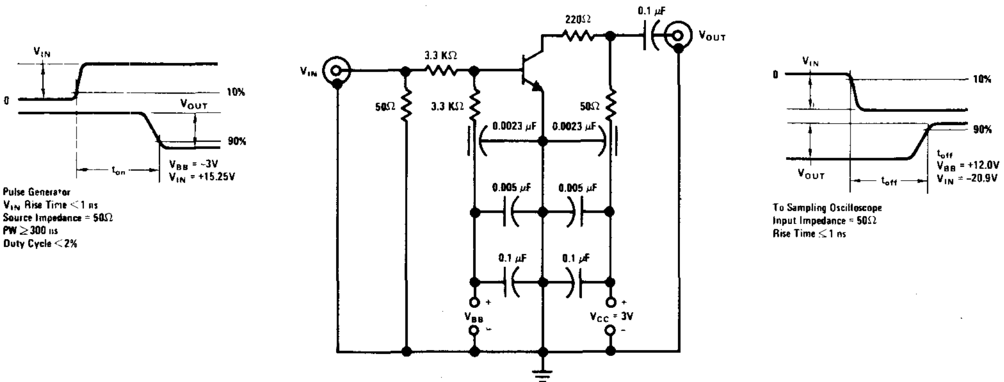
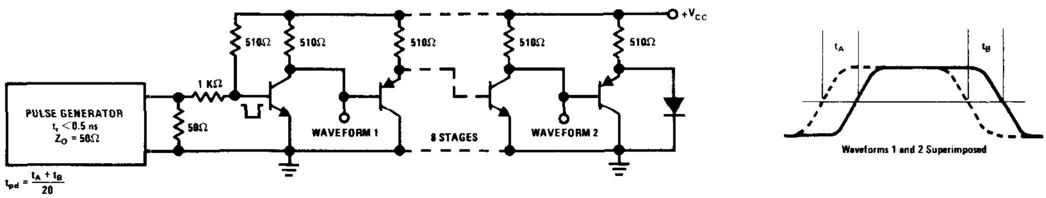


FIGURE 2. t_{on}, t_{off} Measurement Circuit



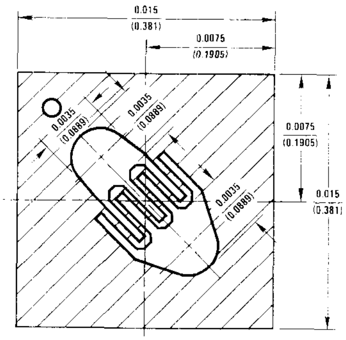
$t_{pd} = \frac{t_A + t_B}{20}$

t_{pd} = Average Propagation per Transistor

FIGURE 3. Circuit For Measurement of Propagation Delay

National Semiconductor

Process 22 NPN Small Signal



DESCRIPTION

Process 22 is an overlay, double diffused, gold doped silicon epitaxial device. Complement to Process 64.

APPLICATION

This device was designed for high speed logic and core driver applications to 300 mA.

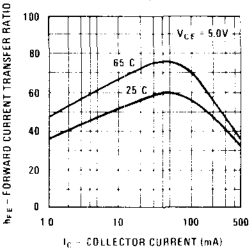
PRINCIPAL DEVICE TYPES

TO-52	2N3013
TO-92	2N5772

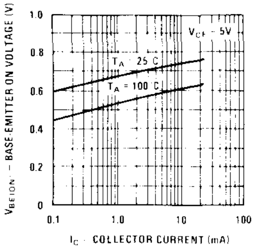
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_s	I_C = 10 mA, I_{B1} = I_{B2} = 10 mA		12	18	ns	Fig. 1
t_{on}	I_C = 300 mA, I_{B1} = I_{B2} = 30 mA		10	18	ns	Fig. 2
t_{off}	I_C = 300 mA, I_{B1} = I_{B2} = 30 mA		18	30	ns	
C_{ob}	V_{CB} = 5V		3.2	5.0	pF	TO-18
C_{ob}	V_{EB} = 0.5V		6.2	8.0	pF	TO-18
h_{fe}	I_C = 30 mA, V_{CE} = 10V, f = 100 MHz	3.5	7.0	10		
h_{FE}	V_{CE} = 1V, 10 mA	20	50	150		
h_{FE}	V_{CE} = 1V, I_C = 30 mA	20	50	150		
h_{FE}	V_{CE} = 1V, I_C = 100 mA	20	48	150		
h_{FE}	V_{CE} = 1V, I_C = 300 mA	15	30	120		
h_{FE}	V_{CE} = 0.4V, I_C = 30 mA	20	50	150		
h_{FE}	V_{CE} = 0.5V, I_C = 100 mA	20	50	150		
$V_{CE(SAT)}$	I_C = 30 mA, I_B = 3 mA		0.14	0.20	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.20	0.28	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.40	0.50	V	
$V_{BE(SAT)}$	I_C = 30 mA, I_B = 3 mA		0.80	0.95	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.92	1.2	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA		1.1	1.7	V	
BV_{CBO}	I_C = 100 μA	40	50		V	
BV_{CEO}	I_C = 10 mA	15	18		V	
BV_{EBO}	I_E = 100 μA	5.0	5.7		V	
I_{CBO}	V_{CB} = 20V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 22

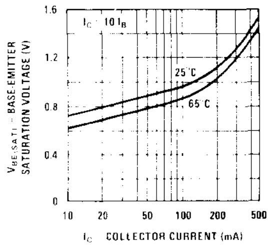
DC Pulse Current Gain vs Collector Current



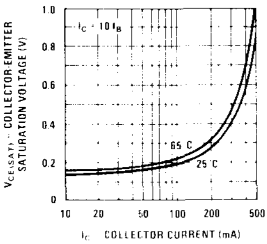
Base-Emitter On Voltage vs Collector Current



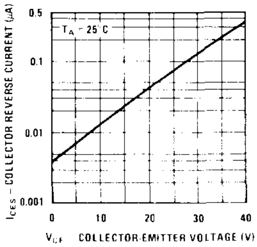
Base Saturation Voltage vs Collector Current



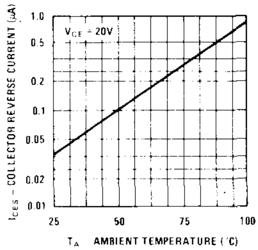
Collector Saturation Voltage vs Collector Current



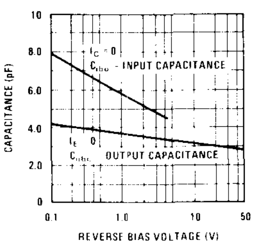
Collector Reverse Current vs Reverse Bias Voltage



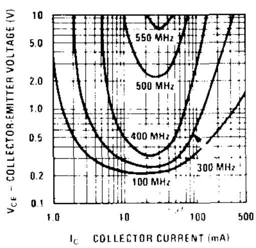
Collector Reverse Current vs Ambient Temperature



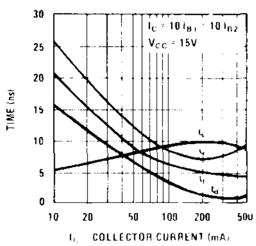
Input and Output Capacitance vs Reverse Bias Voltage



Contours of Constant Gain Bandwidth Product (f_T)

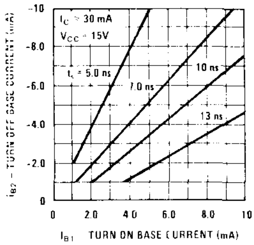


Switching Times vs Collector Current

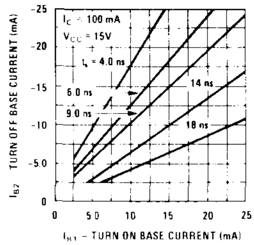


Process 22

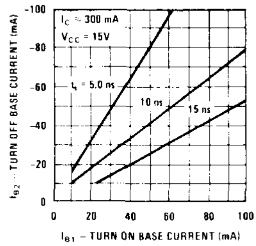
Storage Time vs Turn On and Turn Off Base Currents



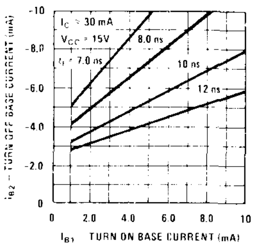
Storage Time vs Turn On and Turn Off Base Currents



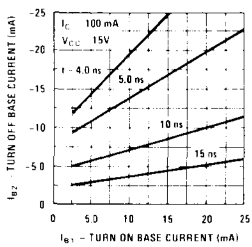
Storage Time vs Turn On and Turn Off Base Currents



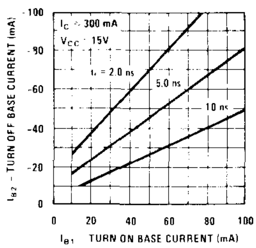
Fall Time vs Turn On and Turn Off Base Currents



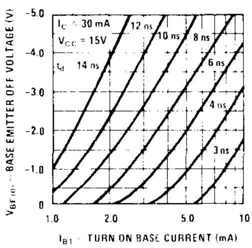
Fall Time vs Turn On and Turn Off Base Currents



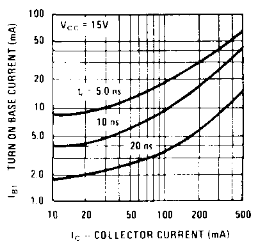
Fall Time vs Turn On and Turn Off Base Currents



Delay Time vs Base Emitter Off Voltage and Turn On Base Current

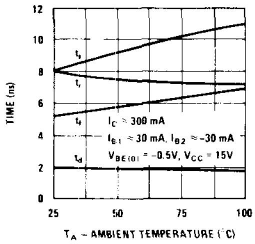


Rise Time vs Collector and Turn On Base Currents

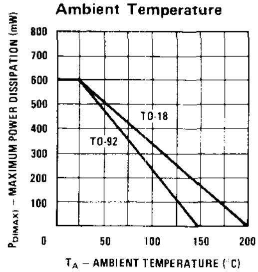


Process 22

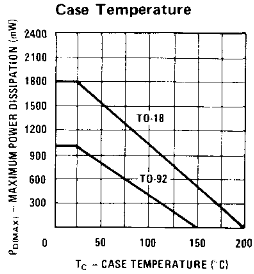
Switching Times vs Ambient Temperature



Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



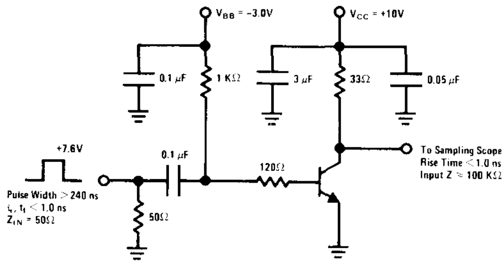


FIGURE 1. t_{on}, t_{off} Test Circuit

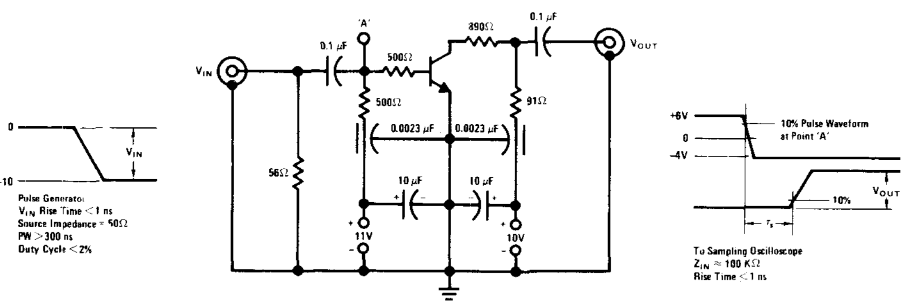
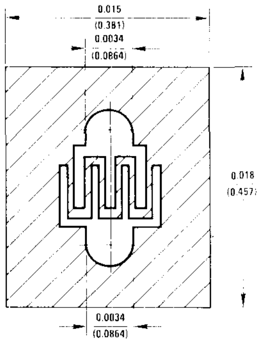


FIGURE 2. Charge Storage Time Measurement Circuit

National Semiconductor

Process 23 NPN Small Signal



DESCRIPTION

Process 23 is an overlay, double diffused gold doped silicon epitaxial device. Complement to Process 66.

APPLICATION

This device is designed as general purpose amplifier and switch. The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier.

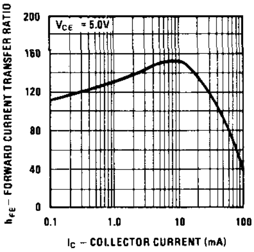
PRINCIPAL DEVICE TYPES

TO-18 NS3904
TO-92 2N3904

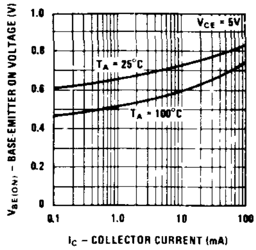
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		30	70	ns	Fig. 1
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		150	250	ns	Fig. 2
C_{ob}	V_{CB} = 5V, f = 1 MHz		2.7	4.0	pF	TO-18
C_{ib}	V_{EB} = 0.5V, f = 1 MHz		5.5	8.0	pF	TO-18
NF	V_{CE} = 5V, I_C = 100 μA, R_S = 1 kΩ, P_{BW} = 15.7 kHz		2.0	5.0	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 20V, f = 100 MHz	2.0	5.0	7.0		
h_{FE}	I_C = 100 μA, V_{CE} = 5V	40	100	300		
h_{FE}	I_C = 1 mA, V_{CE} = 5V	70	150	300		
h_{FE}	I_C = 10 mA, V_{CE} = 5V	50	150	350		
h_{FE}	I_C = 50 mA, V_{CE} = 5V	30	120	200		
h_{FE}	I_C = 100 mA, V_{CE} = 5V	20	50	100		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.07	0.10	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.70	0.80	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.10	0.15	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.75	0.85	V	
BV_{CBO}	I_C = 10 μA	60	90	120	V	
BV_{CEO}	I_C = 1 mA	30	40	50	V	
BV_{EBO}	I_C = 10 μA	6.0		8.0	V	
I_{CBO}	V_{CB} = 25V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 23

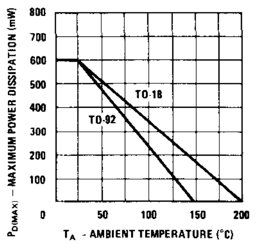
Pulsed DC Current Gain vs Collector Current



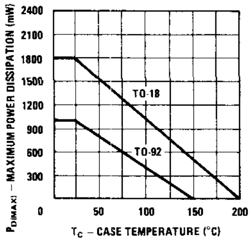
Base-Emitter On Voltage vs Collector Current



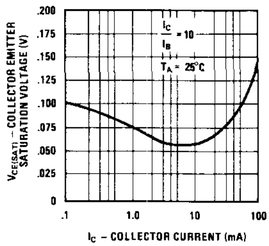
Maximum Power Dissipation vs Ambient Temperature



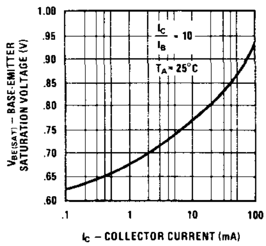
Maximum Power Dissipation vs Case Temperature



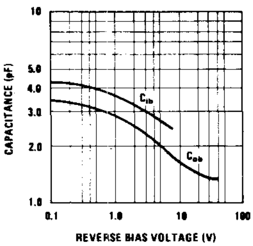
$V_{CE(SAT)}$ vs I_C



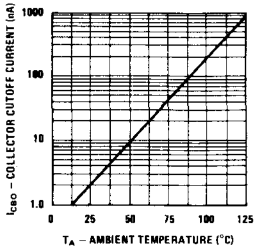
$V_{BE(SAT)}$ vs I_C



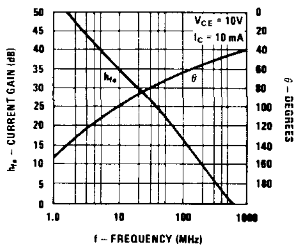
Capacitance vs Reverse Bias Voltage



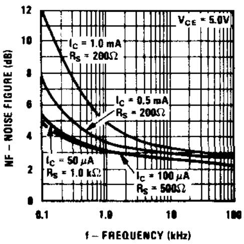
Collector Cutoff Current vs Ambient Temperature



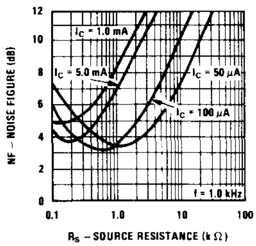
Current Gain and Phase Angle vs Frequency



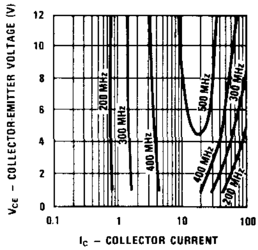
Noise Figure vs Frequency



Noise Figure vs Source Resistance



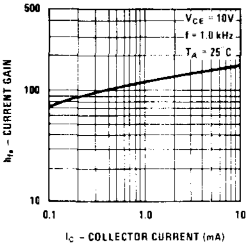
Contours of Constant Gain Bandwidth Product (f_T)



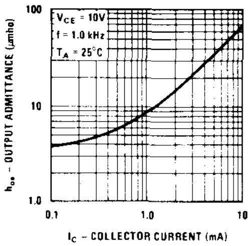
Process 23

h PARAMETERS (V_{CE} = 10 V_{DC}, f = 1.0 kHz, T_A = 25°C)

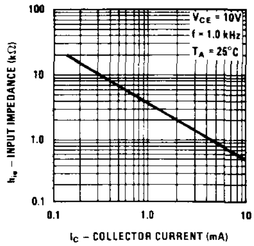
Current Gain



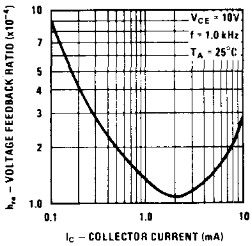
Output Admittance



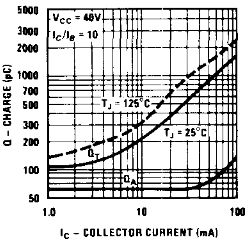
Input Impedance



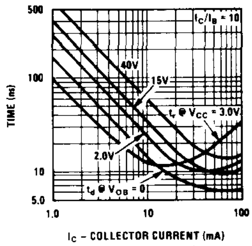
Voltage Feedback Ratio



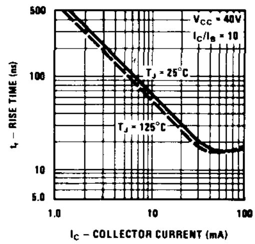
Charge Data



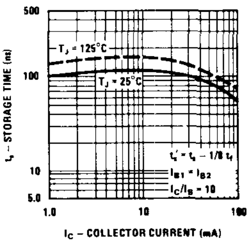
Turn On Time



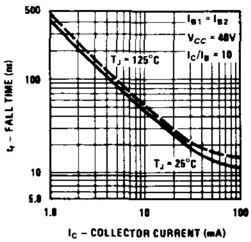
Rise Time



Storage Time



Fall Time



TRANSIENT CHARACTERISTICS (–T_J = 25°C --- T_J = 125°C)

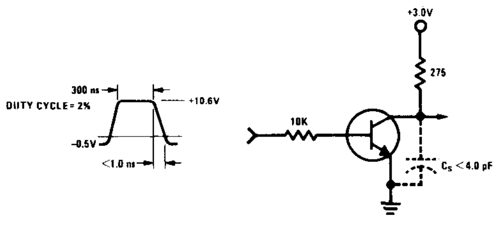


FIGURE 1. Delay and Rise Time Equivalent Test Circuit

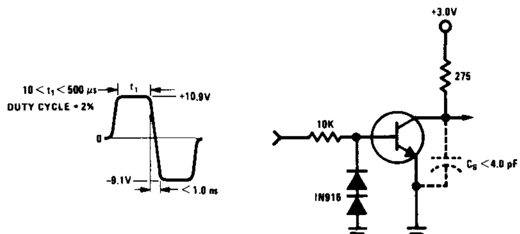
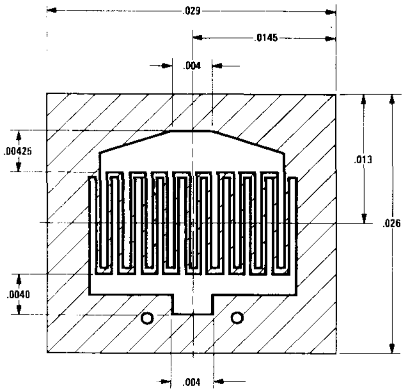


FIGURE 2. Storage and Fall Time Equivalent Test Circuit

National Semiconductor

Process 25 NPN Memory Driver



DESCRIPTION

Process 25 is an overlay double diffused, gold doped silicon epitaxial device. Complement to Process 70.

APPLICATION

This device was designed for high speed core driver applications.

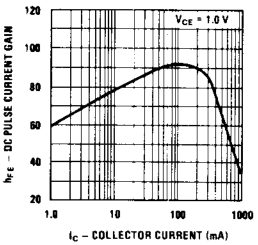
PRINCIPAL DEVICE TYPES

TO-18	2N4014
TO-39	2N3725
TO-92+	TN3725

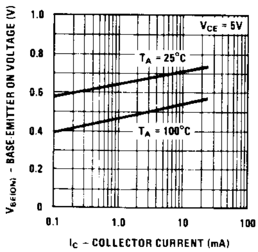
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 500 mA, I_{B1} = 50 mA		12	35	ns	Fig. 1
t_{off}	I_C = 500 mA, I_{B2} = 50 mA		50	60	ns	Fig. 1
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 100 MHz	2.5	4.25			
C_{cb}	V_{CB} = 10V		5.5	10	pF	
C_{eb}	V_{EB} = 0.5V		45	55	pF	
h_{fe}	I_C = 10 mA, V_{CE} = 1V	40	60	120		
h_{fe}	I_C = 100 mA, V_{CE} = 1V	45	90	150		
h_{fe}	I_C = 300 mA, V_{CE} = 1V	35	65	120		
h_{fe}	I_C = 500 mA, V_{CE} = 1V	25	50	100		
h_{fe}	I_C = 800 mA, V_{CE} = 1V	20	28	40		
h_{fe}	I_C = 1A, V_{CE} = 1V	15	25	35		
h_{fe}	I_C = 800 mA, V_{CE} = 2V	25	38	60		
h_{fe}	I_C = 1A, V_{CE} = 5V	25	40	60		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.155	0.20	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.155	0.20	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.240	0.40	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.350	0.50	V	
$V_{CE(SAT)}$	I_C = 800 mA, 80 mA		0.50	0.80	V	
$V_{CE(SAT)}$	I_C = 1A, I_B = 100 mA		0.70	1.20	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.66	0.70	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.77	0.85	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.88	1.20	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.95	1.20		
$V_{BE(SAT)}$	I_C = 800 mA, I_B = 80 mA		1.10	1.50	V	
$V_{BE(SAT)}$	I_C = 1A, I_B = 100 mA		1.18	1.70	V	
BV_{CEO}	I_C = 10 mA	40	45	50	V	
BV_{CBO}	I_C = 100 μA	80	100	130	V	
BV_{EBO}	I_C = 10 μA	6.0			V	
I_{CBO}	V_{CB} = 40V			1.0	μA	
I_{EBO}	V_{EB} = 4V			1.0	μA	

Process 25

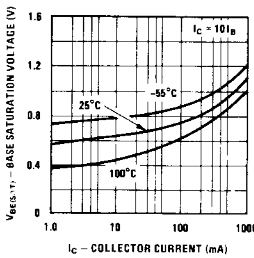
DC Pulse Current Gain vs Collector Current



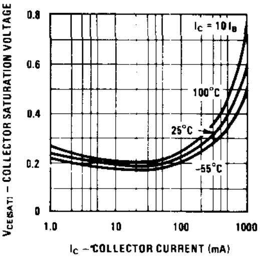
Base-Emitter On Voltage vs Collector Current



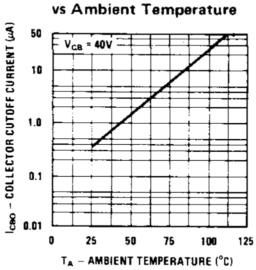
Base Saturation Voltage vs Collector Current



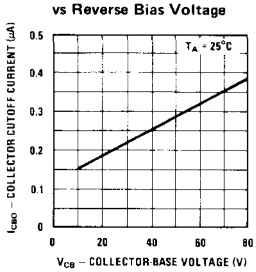
Collector Saturation Voltage vs Collector Current



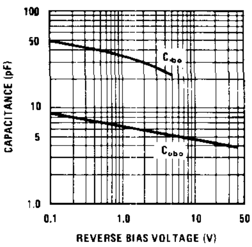
Collector Cutoff Current vs Ambient Temperature



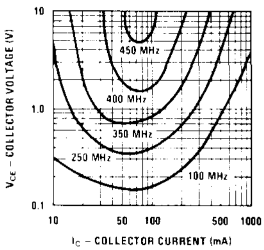
Collector Cutoff Current vs Reverse Bias Voltage



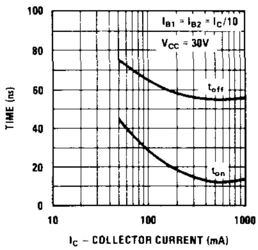
Input and Output Capacitance vs Reverse Bias



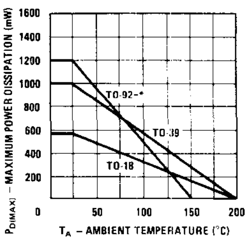
Contours of Constant Bandwidth Product (f_T)



Turn On and Turn Off Times vs Collector Current

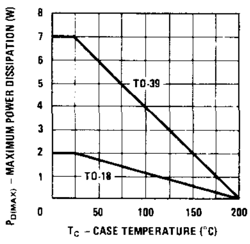


Maximum Power Dissipation vs Ambient Temperature

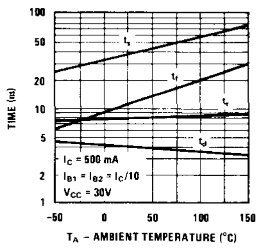


*One square inch of copper run

Maximum Power Dissipation vs Case Temperature

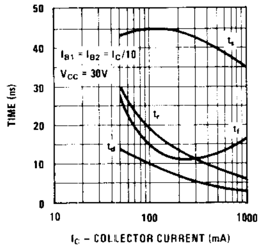


Switching Times vs Ambient Temperature

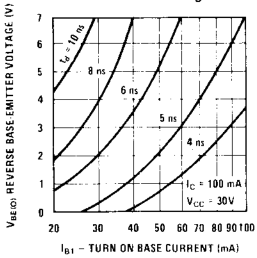


Process 25

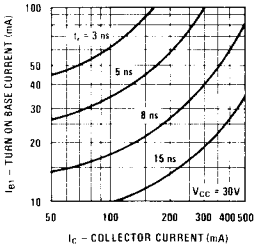
Switching Times vs Collector Current



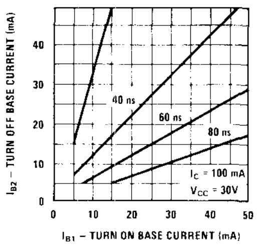
Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



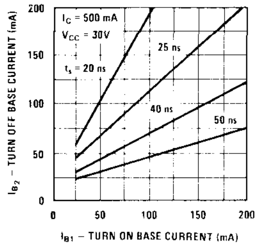
Rise Time vs Collector and Turn On Base Currents



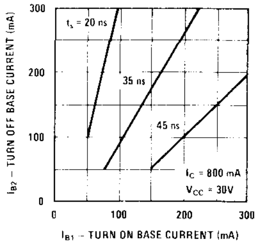
Storage Time vs Turn On and Turn Off Base Currents



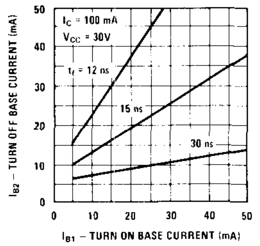
Storage Time vs Turn On and Turn Off Base Currents



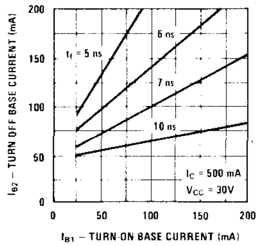
Storage Time vs Turn On and Turn Off Base Currents



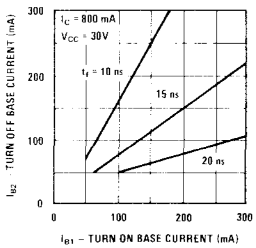
Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



SWITCHING TIME TEST CIRCUIT

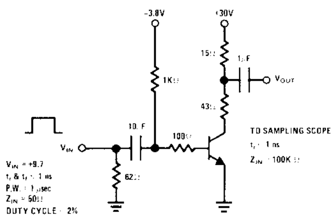
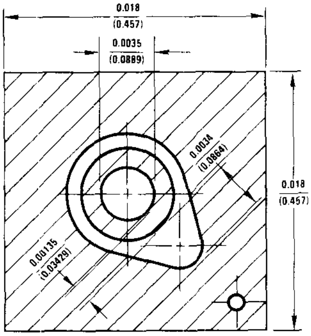


FIGURE 1. $I_C \approx 500$ mA, $I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA

National Semiconductor

Process 27 NPN Small Signal



DESCRIPTION

Process 27 is a nonoverlay, double diffused, silicon epitaxial device. Complement to Process 69.

APPLICATION

This device is designed for general purpose amplifier and switch applications, useful from audio to RF frequencies.

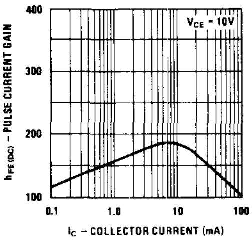
PRINCIPAL DEVICE TYPES

TO-18	2N915
TO-92	MPSA20 (EBC)

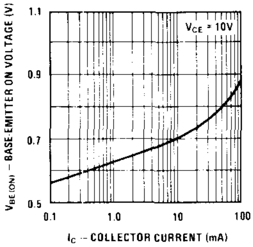
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (wide band)	V_{CE} = 5, I_C = 100 μA, f_{BW} = 15.7 kHz		1.5		dB	
NF (spot)	V_{CE} = 5V, I_C = 100 μA, f = 1 kHz, R_S = 1k		1.5	3.0	dB	
C_{cb}	V_{CB} = 10V, f = 1 MHz		2.0	2.5	pF	TO-18
C_{ob}	V_{CB} = 10V, f = 1 MHz		2.5	3.0	pF	TO-18
C_{ib}	V_{EB} = 0.50V, f = 1 MHz		5.5	7.0	pF	TO-18
f_T	V_{CE} = 10V, I_C = 10 mA	100	500		MHz	
t_{on}	V_{CE} = 10V, I_C = 10 mA, I_{B1} = 1 mA	30	40	50	ns	
t_{off}	V_{CE} = 10V, I_C = 10 mA, I_{B2} = 1 mA	400	600	700	ns	
h_{FE}	V_{CE} = 10V, I_C = 100 μA	40	115	340		
h_{FE}	V_{CE} = 10V, I_C = 1 mA	50	150	450		
h_{FE}	V_{CE} = 10V, I_C = 10 mA	62	185	560		
h_{FE}	V_{CE} = 10V, I_C = 50 mA	45	130	400		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.055	0.10	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.770	1.0	V	
BV_{CBO}	I_C = 100 μA	50	70		V	
BV_{CEO}	I_C = 10 mA	30	45	60	V	
BV_{EBO}	I_E = 10 μA	5.0	6.5		V	
I_{CBO}	V_{CB} = 40			50	nA	
I_{EBO}	V_{EB} = 4.0			50	nA	

Process 27

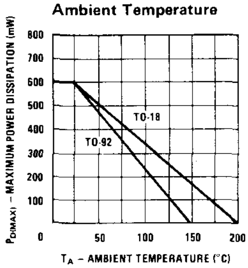
DC Pulse Current Gain vs Collector Current



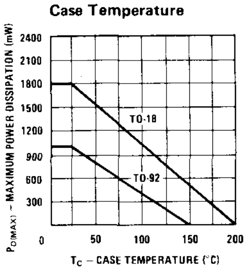
Base-Emitter On Voltage vs Collector Current



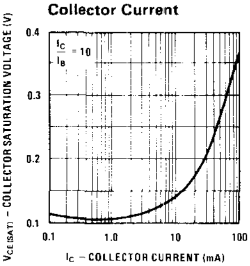
Maximum Power Dissipation vs Ambient Temperature



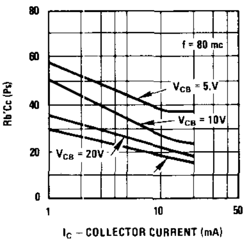
Maximum Power Dissipation vs Case Temperature



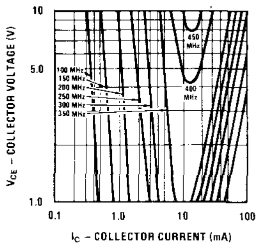
Collector-Emitter Saturation Voltage vs Collector Current



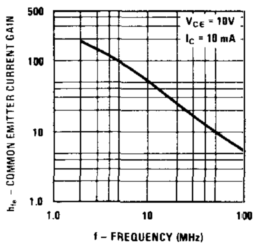
Rb'Cc vs Collector Current



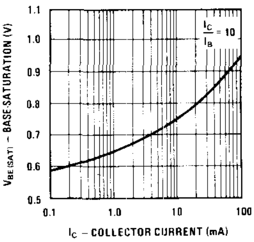
Small Signal Current Gain vs Collector Current



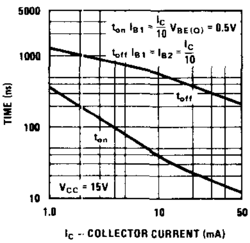
Small Signal Current Gain vs Frequency



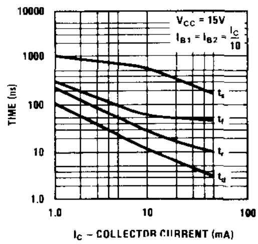
Base Saturation Voltage vs Collector Current



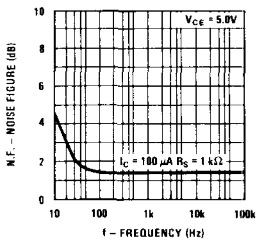
t_{on} And t_{off} vs Collector Current



Switching Times vs Collector Current

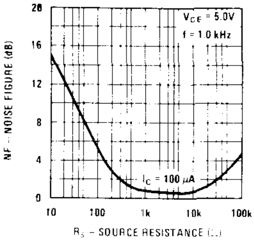


Noise Figure vs Frequency

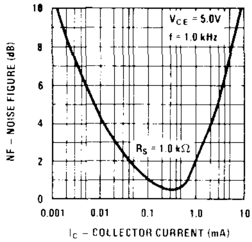


Process 27

Noise Figure vs Source Resistance

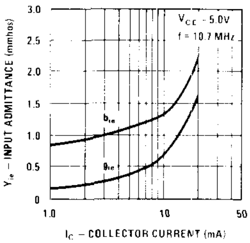


Noise Figure vs Collector Current

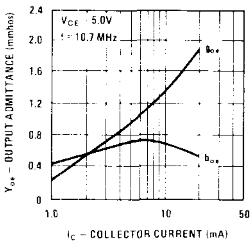


COMMON EMITTER Y PARAMETERS

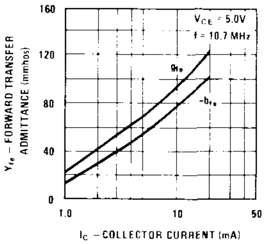
Input Admittance vs Collector Current



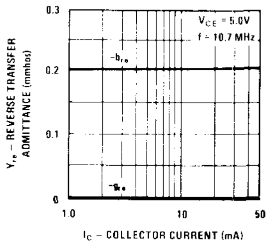
Output Admittance vs Collector Current



Forward Transfer Admittance vs Collector Current

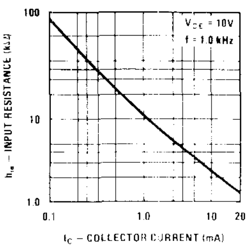


Reverse Transfer Admittance vs Collector Current

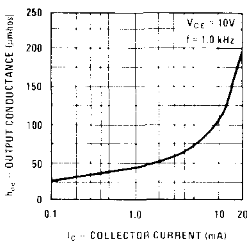


COMMON EMITTER H PARAMETERS

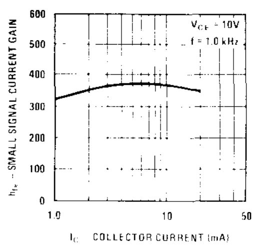
Small Signal Input Resistance vs Collector Current



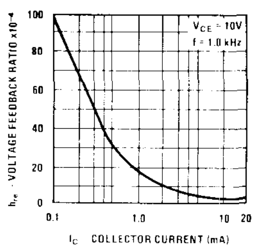
Small Signal Output Conductance vs Collector Current



Small Signal Current Gain vs Collector Current

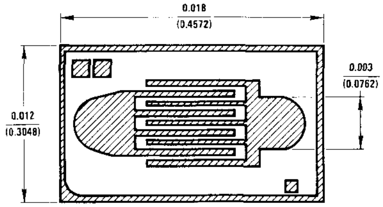


Small Signal Voltage Feedback Ratio vs Collector Current



National Semiconductor

Process 29 NPN HF Amp



DESCRIPTION

Process 29 is an overlay double diffused, silicon epitaxial device.

APPLICATION

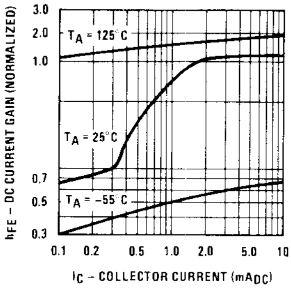
This device was designed for use in high frequency receiver front end designs requiring good NF from low driving R_S.

PRINCIPAL DEVICE TYPES

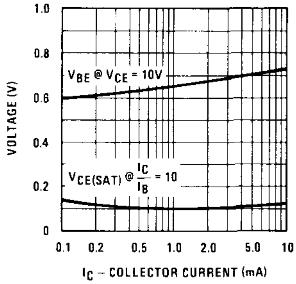
TO-92-MPS

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 1 mA	80			V
BV_{CBO}	I_C = 100 μA	80			V
BV_{EBO}	I_E = 100 μA	4.0			V
I_{CBO}	V_{CB} = 60V			50	nA
I_{EBO}	V_{EB} = 3.0V			50	nA
H_{FE}	V_{CE} = 10V, I_C = 1.5 mA	30	70	150	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.12	0.25	V
f_t	V_{CE} = 10V, I_C = 1.5 mA f = 100 MHz	80	180		MHz
C_{cb}	V_{CB} = 10V		1.0	1.6	pF
h_{oe}	I_C = 1.5 mA, V_{CE} = 10V, f = 1.0 kHz		2.0	5.0	μmho
NF	I_C = 1.5 mA, V_{CE} = 10V, R_s = 50Ω, f = 1.0 MHz		1.7	2.0	dB

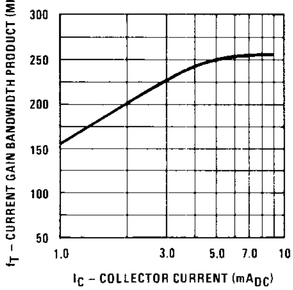
Normalized DC Current Gain



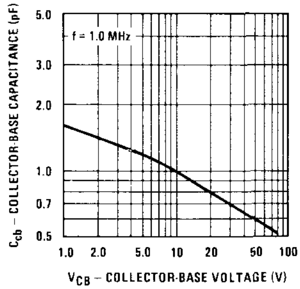
ON Voltages vs Collector Current



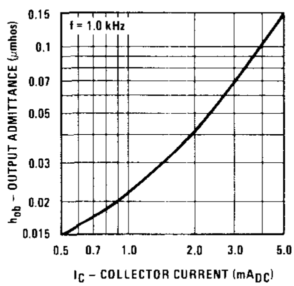
Current Gain Bandwidth Product



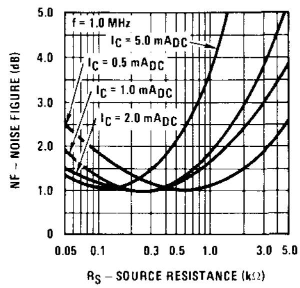
Collector-Base Capacitance vs Voltage



Output Admittance

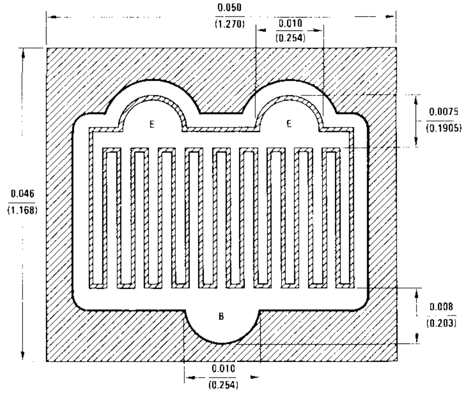


Noise Figure



National Semiconductor

Process 35
NPN RF-HF Power Amplifier



DESCRIPTION

Process 35 is a double diffused silicon epitaxial device.

APPLICATION

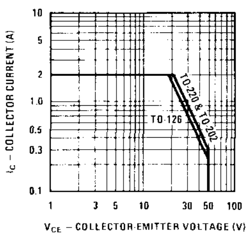
This device is designed for use in the output stage of 4W AM Citizens Band (27 MHz) transmitters with capabilities to withstand infinite VSWR at rated output.

PRINCIPAL DEVICE TYPES

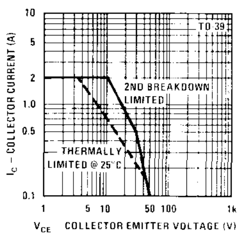
TO-39	MRF8004
TO-126	MRF472
TO-220	2SC1678

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
P_{OUT}	f = 27 MHz, I_C (Avg) = 415 mA, *(Figure 1)*	3.0	3.5		W
η	V_{CC} = 12V, P_{IN} = 0.4W	60	70		%
h_{fe}	I_C = 100 mA, V_{CE} = 5V, f = 20 MHz	6.0	12		
C_{ob}	V_{CB} = 10V		25	35	pF
H_{FE}	I_C = 100 mA, V_{CE} = 1V	30	70	150	
V_{CES}	I_C = 1.0A, I_B = 100 mA		0.2	0.5	V
BV_{CER}	I_C = 1 mA, R_{BE} = 10Ω	65			V
BV_{EBO}	I_E = 100 μA	3			V
I_{CBO}	V_{CB} = 40V			10	μA
I_{CEO}	V_{CE} = 40V'			100	μA
I_{EBO}	V_{EB} = 2.0V			10	μA
SOA	V_{CE} = 30V, t = 1 sec	500			mA

Safe Operating Area Curve

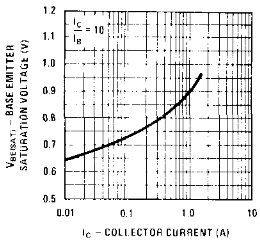


Safe Operating Area Curve

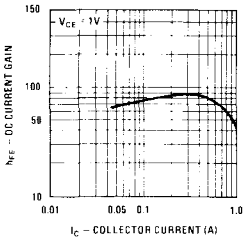


Process 35

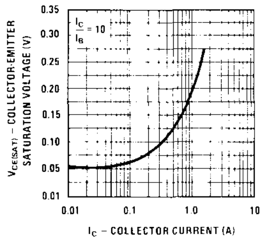
Base-Emitter Saturation Voltage vs Collector Current



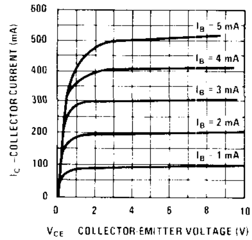
DC Current Gain vs Collector Current



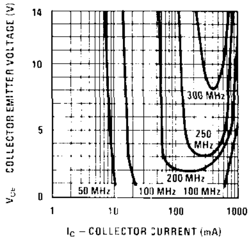
Collector-Emitter Saturation Voltage vs Collector Current



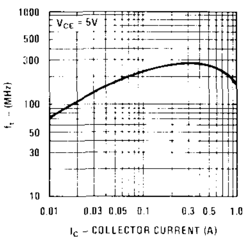
I_C vs V_{CE}



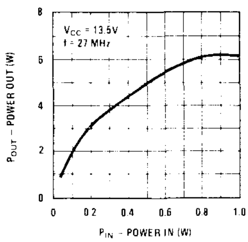
Contours of Constant Gain Bandwidth Product (f_t)



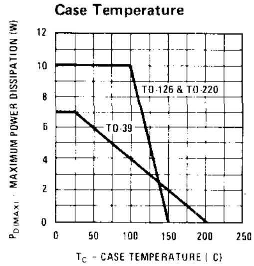
f_t vs I_C

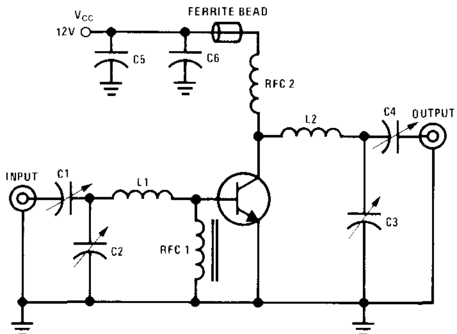


Power In vs Power Out



Maximum Power Dissipation vs Case Temperature



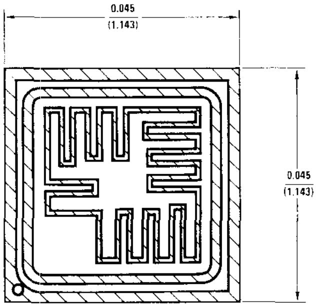


C1, C2 = 9.0–180 pF ARCO 463
C3, C4 = 5.0–80 pF ARCO 462
C5 = 0.01 μF Disc
C6 = 0.1 μF Disc
RFC 1 4 turns No. 32 enameled wire wound on Indiana General Bead No. 57-1692
RFC 2 15 μH choke, J.W. Miller #4624
L1 – 0.22 μH molded choke
L2 – 1 μH molded choke

FIGURE 1. 27 MHz Test Circuit

National Semiconductor

Process 36 NPN High Voltage Power



DESCRIPTION

Process 36 a non-overlay double-diffused silicon epitaxial device.

APPLICATION

This device is designed for use in horizontal driver, class A off-line amplifier and off-line switching applications.

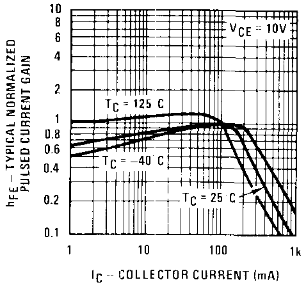
PRINCIPAL DEVICE TYPES

2N5655	MJE340	MJE343
2N5656	MJE341	MJE344
2N5657	MJE342	

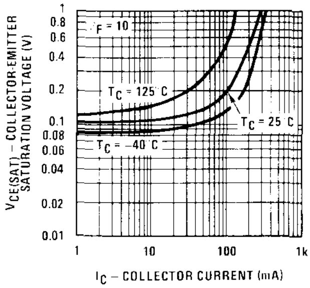
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_{CE} = 1 mA*	200	300		V
BV_{CBO}	I_{CB} = 100 μA	225	325		V
BV_{EBO}	I_{EB} = 10 μA	6			V
I_{CEO}	V_{CE} = 200V			50	μA
I_{CBO}	V_{CB} = 225V			1	μA
I_{EBO}	V_{EB} = 5V			1	μA
H_{FE}	I_C = 50 mA, V_{CE} = 10V*	25	190		
	I_C = 100 mA, V_{CE} = 10V*	30	200	300	
	I_C = 250 mA, V_{CE} = 10V*	15	60		
	I_C = 500 mA, V_{CE} = 10V*	10	25		
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA*		0.08	0.5	V
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 100 mA*		0.175	0.5	V
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 100 mA*		0.9	1.2	V
$V_{BE(ON)}$	I_C = 100 mA, V_{CE} = 10V*		0.7	1.0	V
f_t	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	10	60		MHz
C_{ob}	V_{CB} = 10V			15	pF
C_{ib}	V_{BE} = 0.5V			125	pF
I_{SB}	V_{CE} = 100V, T = 1 second	200			mA
$P_{D(MAX)}$	TO-126			25	W
	TO-202			15	W
θ_{jc}	TO-126			5.0	°C/W
	TO-202			8.33	°C/W
θ_{jA}	TO-202			69.4	°C/W

*Pulse test, pulse width = 300 μs

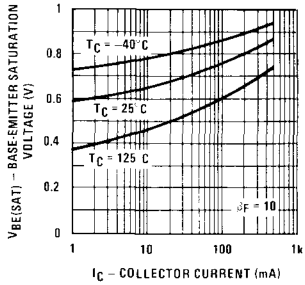
Typical Normalized Pulsed Current Gain vs Collector Current



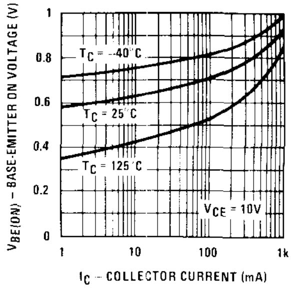
Collector-Emitter Saturation Voltage vs Collector Current



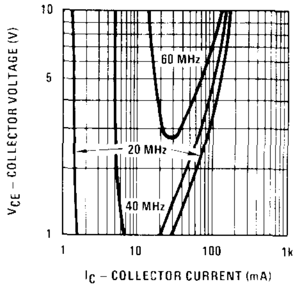
Base-Emitter Saturation Voltage vs Collector Current



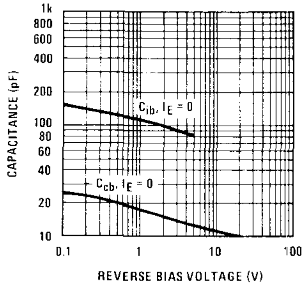
Base-Emitter ON Voltage vs Collector Current



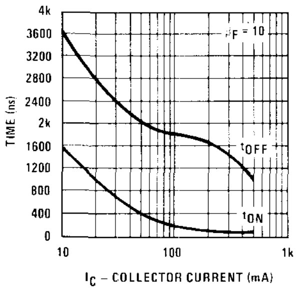
Contours of Constant Gain Bandwidth Product (f_t)



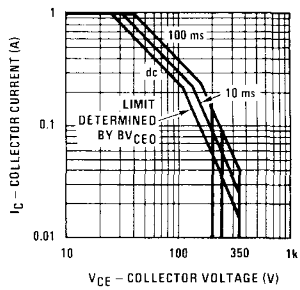
Collector-Base and Emitter-Base Capacitance vs Reverse Bias Voltage



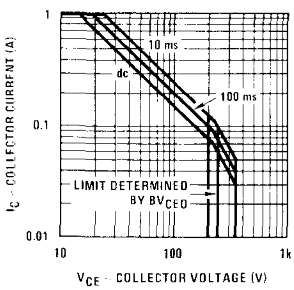
Typical Switching Time vs Collector Current



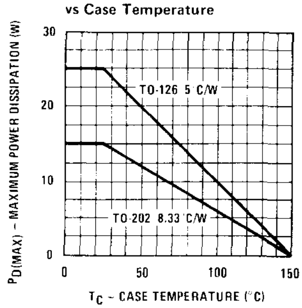
Safe Operating Area TO-126



Safe Operating Area TO-202

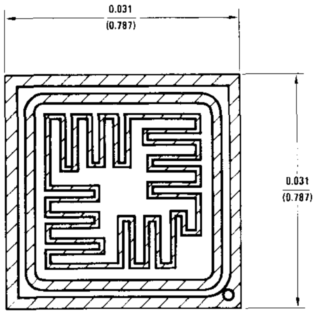


Maximum Power Dissipation vs Case Temperature



National Semiconductor

Process 37 NPN Medium Power



DESCRIPTION

Process 37 is a double diffused silicon epitaxial planar device. Complement to Process 77.

APPLICATION

This device was designed for general purpose medium power amplifiers and switching circuits that require collector currents to 1A.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 10 mA	25		45	V
BV_{CBO}	I_C = 100μA	50			V
BV_{EBO}	I_E = 100μA	5	7		V
I_{CBO}	V_{CB} = BV_{CEO}		50	500	nA
I_{EBO}	V_{EB} = 5V		0.1	100	μA
h_{FE}	I_C = 500 mA, V_{CE} = 1V	100		400	
$V_{CE(SAT)}$	I_C = 1A, I_B = 0.1A		0.2	0.5	V
$V_{BE(SAT)}$	I_C = 1A, I_B = 0.1A		0.95	1.5	V
f_T	I_C = 100 mA, V_{CE} = 10V		300		MHz
C_{OBO}	V_{CB} = 10V			20	pF

PRINCIPAL DEVICE TYPES

TO-202 (Package 35)
NSD102
NSD103
NSDU01
NSDU01A

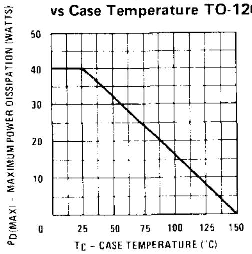
TO-202 (Package 36)
D42C1
D42C2
D42C3
D42C4
D42C5
D42C6
NSE180

92 PLUS (Package 90)
92PE37A
BD373A

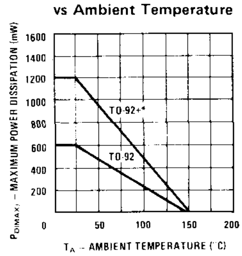
92 PLUS (Package 91)
92PU01
92PU01A

TO-126 (Package 38)
BD135

Power Dissipation vs Case Temperature TO-126

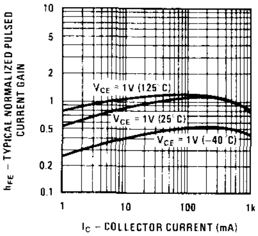


Maximum Power Dissipation vs Ambient Temperature

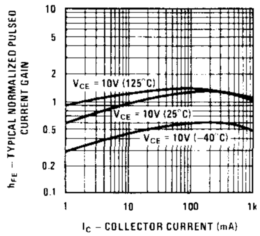


*One square inch of copper run

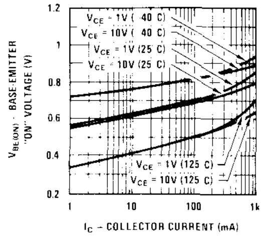
Typical Normalized Pulsed Current Gain vs Collector Current



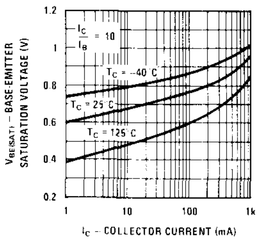
Typical Normalized Pulsed Current Gain vs Collector Current



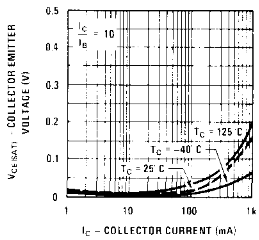
Base-Emitter "ON" Voltage vs Collector Current



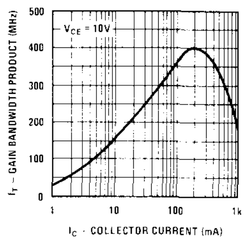
Base-Emitter Saturation Voltage vs Collector Current



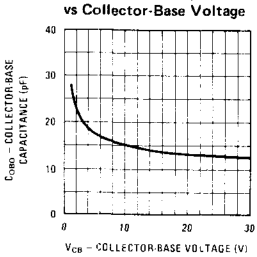
Collector-Emitter Voltage vs Collector Current



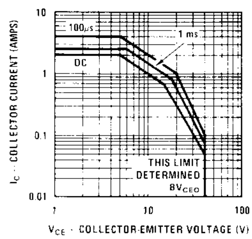
Gain Bandwidth Product vs Collector Current



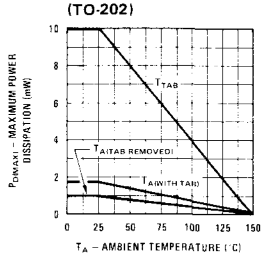
Collector-Base Capacitance vs Collector-Base Voltage



Safe Operating Area TO-202

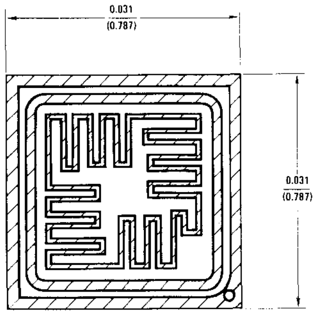


Maximum Power Dissipation vs Ambient Temperature (TO-202)



National Semiconductor

Process 38 NPN Medium Power



DESCRIPTION

Process 38 is a double diffused silicon epitaxial planar device. Complement to Process 78.

APPLICATION

This device was designed for general purpose medium power amplifier and switching circuits that require collector currents to 1A.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 10 mA	45		80	V
BV_{CBO}	I_C = 100μA	90		160	V
BV_{EBO}	I_E = 100μA	5	7		V
I_{CBO}	$V_{CB} = BV_{CEO}$		50	500	nA
I_{EBO}	V_{EB} = 5V		0.1	100	μA
h_{FE}	I_C = 100 mA, V_{CE} = 1V	150		500	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.2	0.5	V
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.8	1.4	V
f_T	I_C = 100 mA, V_{CE} = 10V		250		MHz
C_{OBO}	V_{CB} = 10V			15	pF

PRINCIPAL DEVICE TYPES

TO-202 (Package 35)
NSDU05
NSD6178
NSD6179

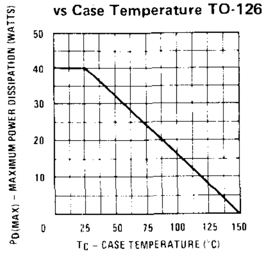
92 PLUS (Package 91)
92PU05
BD371B
BD371C

TO-202 (Package 36)
D42C7
D42C8
D42C9
NSE181

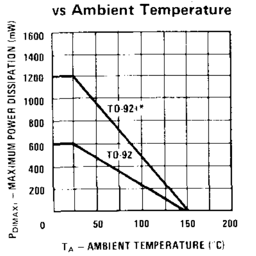
TO-126 (Package 38)
BD137

92 PLUS (Package 90)
92PE37B
BD373B
BD373C

Power Dissipation vs Case Temperature TO-126

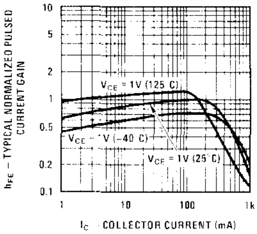


Maximum Power Dissipation vs Ambient Temperature

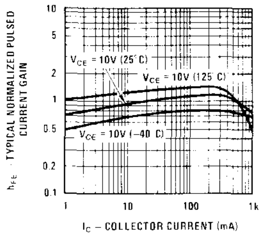


*One square inch of copper run

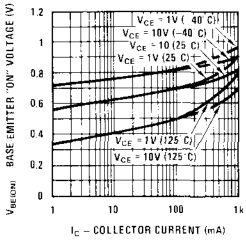
Typical Normalized Pulsed Current Gain vs Collector Current



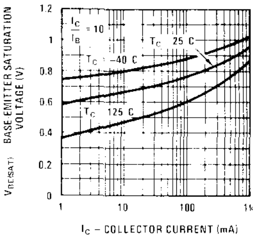
Typical Normalized Pulsed Current Gain vs Collector Current



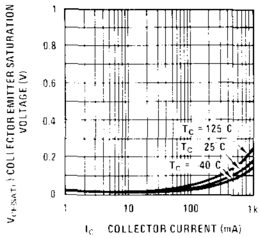
Base-Emitter "ON" Voltage vs Collector Current



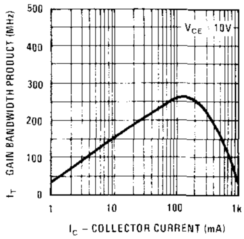
Base-Emitter Saturation Voltage vs Collector Current



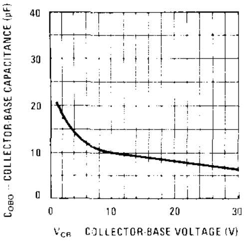
Collector-Emitter Saturation Voltage vs Collector Current



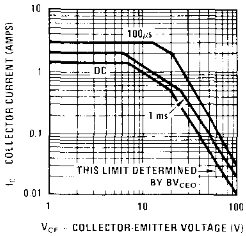
Gain Bandwidth Product vs Collector Current



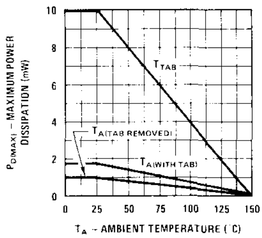
Collector-Base Capacitance vs Collector-Base Voltage



Safe Operating Area TO-202

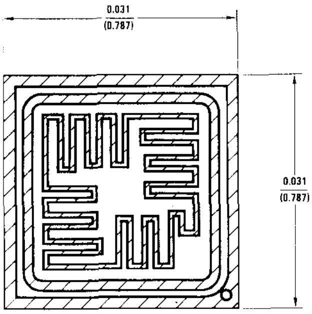


Maximum Power Dissipation vs Ambient Temperature (TO-202)



National Semiconductor

Process 39 NPN Medium Power



DESCRIPTION

Process 39 is a double diffused silicon epitaxial planar device. Complement to Process 79.

APPLICATION

This device was designed for general purpose medium power amplifier and switching circuits that require collector currents to 1A.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 10 mA	80		110	V
BV_{CBO}	I_C = 100μA	160		220	V
BV_{EBO}	I_E = 100μA	5	7		V
I_{CBO}	V_{CB} = BV_{CEO}		50	500	nA
I_{EBO}	V_{EB} = 5V		0.1	100	μA
h_{FE}	I_C = 100 mA, V_{CE} = 1V	100		350	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.2	0.5	V
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.95	1.5	V
f_T	I_C = 100 mA, V_{CE} = 10V		120		MHz
C_{OBO}	V_{CB} = 10V			12	pF

PRINCIPAL DEVICE TYPES

TO-202 (Package 35)

NSD104
NSD105
NSD106
NSDU06
NSDU07

92 PLUS (Package 90)

92PE37C
BD373D

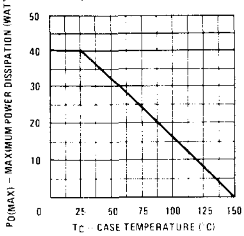
92 PLUS (Package 91)

92PU06
92PU07
BD371D

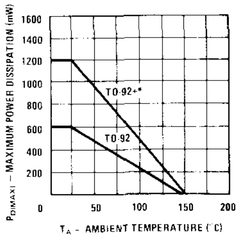
TO-126 (Package 38)

BD139

Power Dissipation vs Case Temperature TO-126

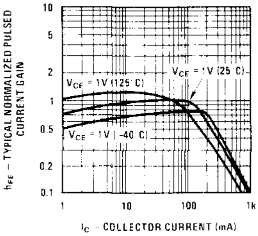


Maximum Power Dissipation vs Ambient Temperature

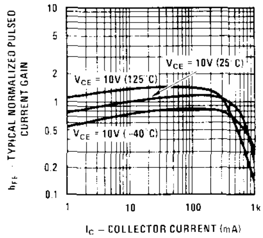


*One square inch of copper run

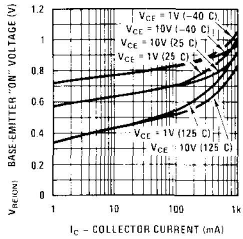
Typical Normalized Pulsed Current Gain vs Collector Current



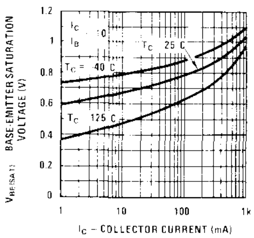
Typical Normalized Pulsed Current Gain vs Collector Current



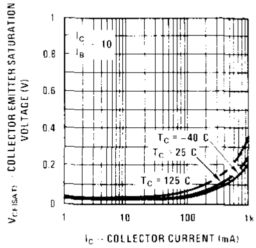
Base-Emitter "ON" Voltage vs Collector Current



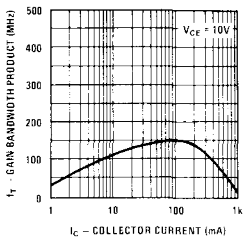
Base-Emitter Saturation Voltage vs Collector Current



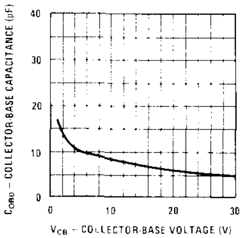
Collector-Emitter Saturation Voltage vs Collector Current



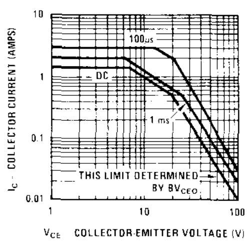
Gain Bandwidth Product vs Collector Current



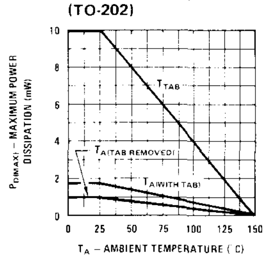
Collector-Base Capacitance vs Collector-Base Voltage



Safe Operating Area TO-202

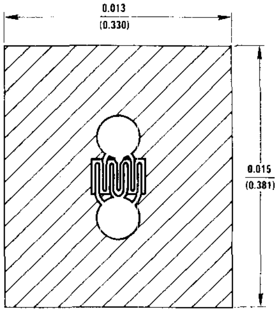


Maximum Power Dissipation vs Ambient Temperature (TO-202)

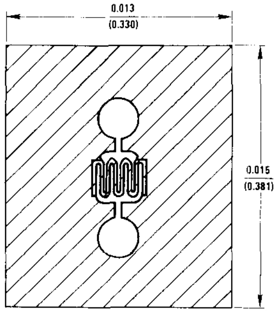


National Semiconductor

Process 41
NPN AGC-UHF, Amp Mixer



UHF (TO-72 and Micro Disc Only)



VHF (TO-92 Only)

DESCRIPTION

Process 41 is an overlay double diffused, silicon device.

APPLICATION

This device was designed for use in extremely low noise UHF/VHF preamplifiers operated common-emitter or common base, and in UHF mixers. Exhibits forward AGC characteristics between 3–10 mA.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	f = 800 MHz, V_{CB} = 10V, I_C = 2 mA, Common Base, $\|Y_S\|$ = Optimum		5.5		dB	TO-72
NF	f = 800 MHz, V_{CB} = 10V, I_C = 2 mA, Common Base, $\|Y_S\|$ = 10 ±j0 mmhos		7.0	9.5	dB	TO-72
P_G	f = 800 MHz, V_{CB} = 10V, I_C = 2 mA, Common Base, R_L = 500Ω	7.5	9.0		dB	TO-72
NF	f = 450 MHz, V_{CE} = 10V, I_C = 2 mA, Common-Emitter, R_S = 75Ω		2.0		dB	TO-72
NF	f = 200 MHz, V_{CB} = 10V, I_C = 3 mA, Common Base, R_S = 100Ω		2.5	3.0	dB	Fig. 1
P_G	f = 200 MHz, V_{CB} = 10V, I_C = 3 mA, Common Base, R_L = 1 kΩ	13	16		dB	Fig. 1
rb'Cc	f = 79.8 MHz, V_{CB} = 10V, I_C = 3 mA,		2.5	5.0	ps	TO-72
h_{fe}	f = 100 MHz, V_{CE} = 10V, I_C = 2 mA	6.0	7.5			
C_{cb}	f = 1.0 MHz, V_{CB} = 10V, I_E = 0		0.28	0.35	pF	TO-72
C_{ce}	f = 1.0 MHz, V_{CE} = 10V, I_B = 0		0.12 0.19	0.20 0.30	pF pF	TO-72 TO-92
h_{FE}	V_{CE} = 10V, I_C = 2 mA	30	75	200		
BV_{CEO}	I_C = 1 mA	30			V	
BV_{CBO}	I_C = 10 μA	30			V	
BV_{EBO}	I_E = 1 μA	3.0	4.0		V	
I_{CBO}	V_{CB} = 20V			100	nA	
I_{EBO}	V_{EB} = 2.5V			50	nA	

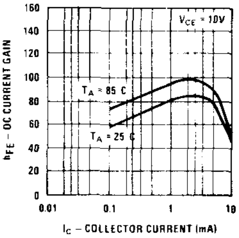
PRINCIPAL DEVICE TYPES

TO-72 (Package 25)
BF180
BF181
BF200

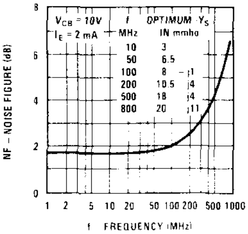
TO-92 (Package 75)
MPSH08
MPSH07

Process 41

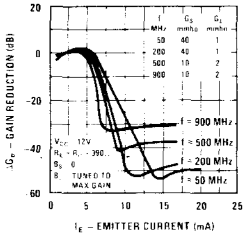
DC Pulse Current Gain vs Collector Current



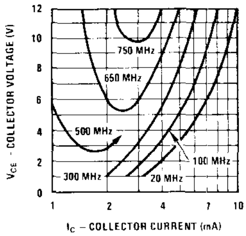
Common Base Noise Figure vs Frequency @ Optimum Source |YS|



Normalized Common Base Gain vs Emitter Current vs Operating Frequency

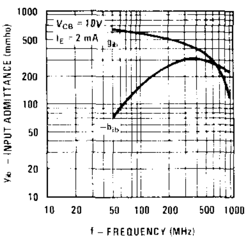


Contours of Constant Gain Bandwidth Product (f_T)

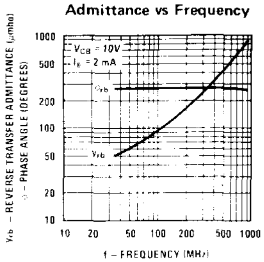


COMMON BASE Y PARAMETERS VS FREQUENCY

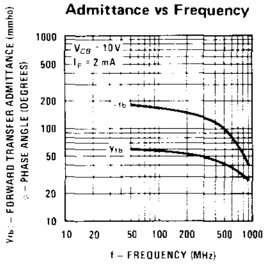
Input Admittance vs Frequency



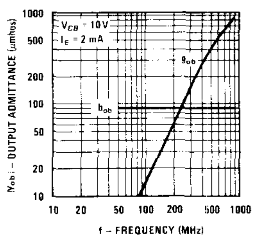
Reverse Transfer Admittance vs Frequency



Forward Transfer Admittance vs Frequency

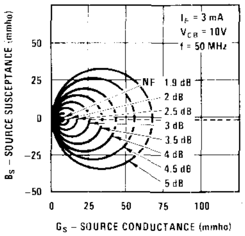


Output Admittance vs Frequency

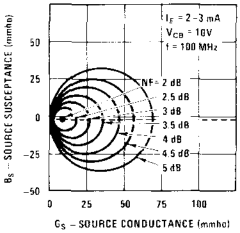


CONTOURS OF CONSTANT NOISE FIGURES

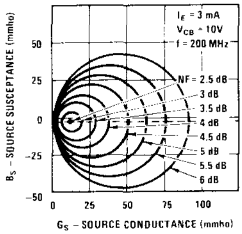
Common Base Noise Figure vs Source |YS|

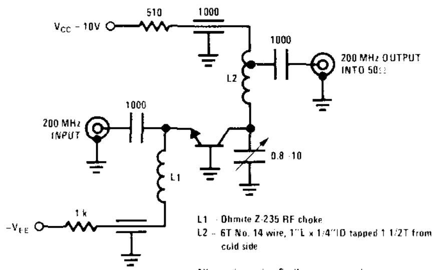


Common Base Noise Figure vs Source |YS|



Common Base Noise Figure vs Source |YS|





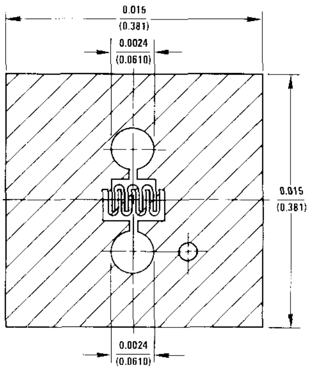
L1 – Ohmite Z-235 RF choke
L2 – 6T No. 14 wire, 1"L x 1/4"ID tapped 1 1/2T from cold side

All capacitance in pF, all resistance in ohms.
Faraday shield techniques used in pg construction

FIGURE 1. Common Base 200 MHz PG and NF Circuit

National Semiconductor

Process 42 NPN RF Amp



DESCRIPTION

Process 42 is an overlay double diffused silicon epitaxial device.

APPLICATION

This device was designed for use in low noise UHF/VHF amplifiers with collector current in the 100 μA to 10 mA range in common emitter or common base mode of operation, and low frequency drift, high output UHF oscillators.

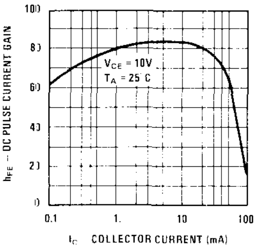
PRINCIPAL DEVICE TYPES

TO-72	2N5179
TO-92	2SC535 (ECB), MPS-H10 (BEC)

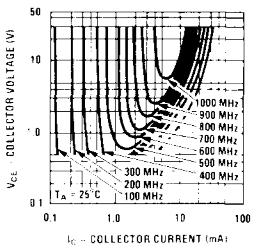
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
P_G	f = 450 MHz, V_{CE} = 10V, I_C = 2 mA	10	13		dB	Fig. 1
NF	f = 450 MHz, V_{CE} = 10V, I_C = 2 mA R_g = 50Ω		3.0	5.0	dB	Fig. 1
P_{OUT}	f = 500 MHz, V_{CB} = 15V, I_E = 8 mA	30	50		mW	TO-92 Fig. 3
P_G	f = 200 MHz, V_{CE} = 10V, I_C = 2 mA	22	27		dB	Fig. 2
NF	f = 200 MHz, V_{CE} = 10V, I_C = 2 mA R_S = 120Ω		2.0	3.5	dB	Fig. 2
h_{fe}	f = 100 MHz, V_{CE} = 10V, I_C = 5 mA	6.0	10.5	15		
rb'Cc	f = 79.8 MHz, V_{CE} = 10V, I_C = 5 mA		3.5	10	ps	TO-72
C_{cb}	f = 1.0 MHz, V_{CB} = 10V, I_E = 0		0.4	0.5	pF	TO-72
C_{ce}	f = 1.0 MHz, V_{CE} = 10V, I_B = 0		0.2	0.3	pF	TO-72
C_{eb}	f = 1.0 MHz, V_{EB} = 0.5V, I_C = 0		0.8	1.5	pF	TO-72
h_{FE}	V_{CE} = 10V, I_C = 5 mA	30	90	200		
h_{FE}	V_{CE} = 6V, I_C = 1 mA	25	75			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.07	0.2	V	
BV_{CEO}	I_C = 1 mA	20	30	40	V	
BV_{CBO}	I_C = 100 μA	35			V	
BV_{EBO}	I_E = 10 μA	4.0			V	
I_{CBO}	V_{CB} = 30V			100	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 42

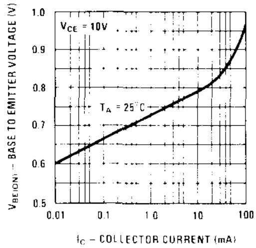
DC Pulse Current Gain vs Collector Current



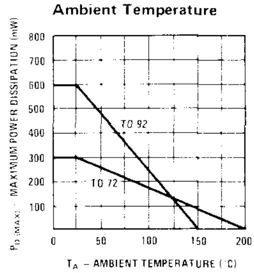
Contours Of Constant Gain Bandwidth Product (f_T)



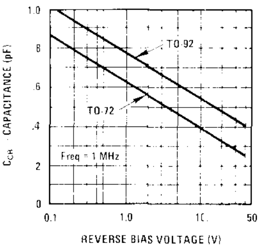
Base Emitter On Voltage vs Collector Current



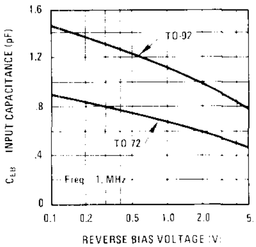
Maximum Power Dissipation vs Ambient Temperature



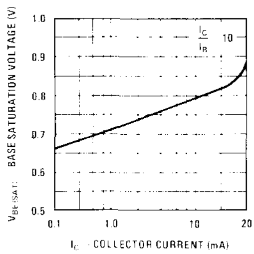
Reverse Transfer Capacitance vs Reverse Bias Voltage



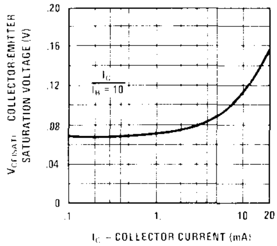
Input Capacitance vs Reverse Bias Voltage



Base-Emitter Saturation Voltage vs Collector Current

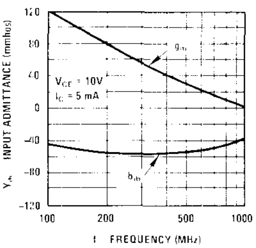


Collector-Emitter Saturation Voltage vs Collector Current

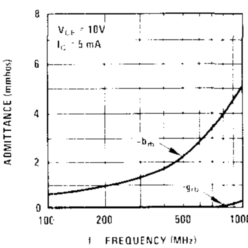


COMMON BASE Y PARAMETERS VS FREQUENCY

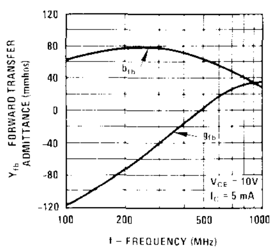
Input Admittance vs Frequency



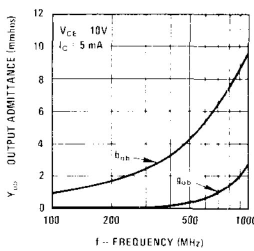
Reverse Transfer Admittance vs Frequency



Forward Transfer Admittance vs Frequency



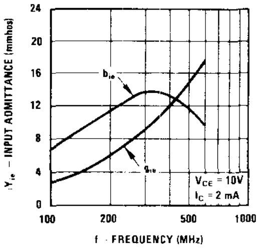
Output Admittance vs Frequency



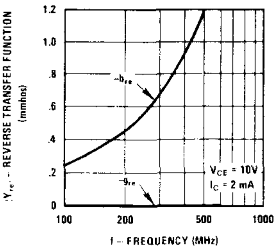
6

COMMON EMITTER Y PARAMETERS VS FREQUENCY

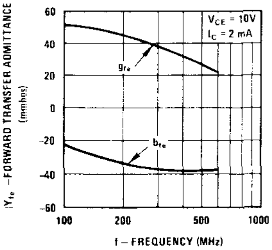
Input Admittance vs Frequency



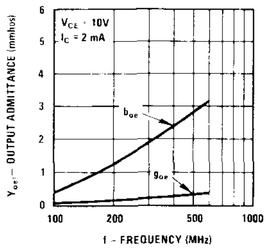
Reverse Transfer Admittance vs Frequency

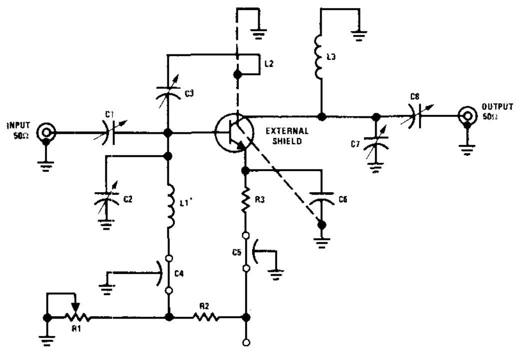


Forward Transfer Admittance vs Frequency



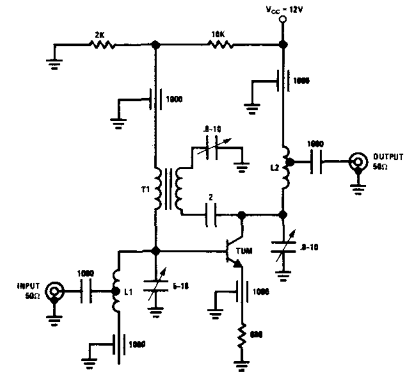
Output Admittance vs Frequency





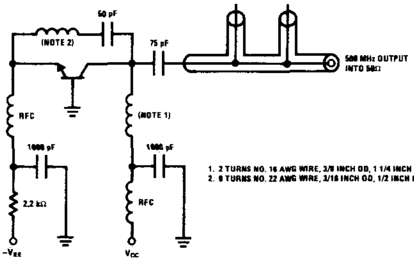
C1, C2, C3, C7, C8   0.8-10 pF VARIABLE CAPACITOR
C3 – PLASTIC TUBULAR TRIMMER CAPACITOR [ADJUSTED AND FIXED FOR A TRANSISTOR HAVING A TYPICAL VALUE OF C_{cb} (0.35 pF)]
C4   200 pF BUTTON-TYPE FEEDTHROUGH CAPACITOR
C5 – 1000 pF FEEDTHROUGH CAPACITOR
C6 – 470 pF LEADLESS CERAMIC DISC CAPACITOR
L1, L3 – 1" LENGTH OF 1/4"-DIAMETER COPPER BAR STOCK
L2 – 1/2 LOOP No. 14 AWG ENAMELED WIRE PARALLEL TO AND APPROXIMATELY 1/4" FROM L3
R1 – 5 kΩ POTENTIOMETER
R2   1.2 kΩ
R3 – 2 kΩ

FIGURE 1. Neutralized 450-MHz Gain and Noise Figure Circuit



L1 – 3T #16 WIRE, 1/2"L x 1/4"ID TAPPED 1-1/2T FROM COLD SIDE
L2 – 8T #14 WIRE, 1"L x 1/4"ID TAPPED 1-1/2T FROM COLD SIDE
T1 – PRI. 1T #18 WIRE
SEC. 1T #18 WIRE   CORE IS INDIANA GENERAL P/N F-684-03
ALL CAPACITANCE IN pF, ALL RESISTANCE IN OHMS.

FIGURE 2. Neutralized 200-MHz PF & NF Circuit

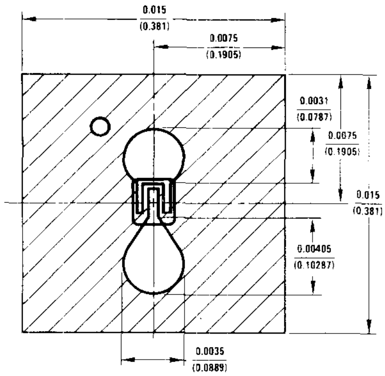


1. 2 TURNS NO. 16 AWG WIRE, 3/8 INCH OD, 1 1/4 INCH LONG.
2. 8 TURNS NO. 22 AWG WIRE, 3/16 INCH OD, 1/2 INCH LONG.

FIGURE 3. 500 MHz Oscillator Circuit

National Semiconductor

Process 43
NPN VHF/UHF Oscillator



DESCRIPTION

Process 43 is an overlay double diffused, silicon epitaxial device.

APPLICATION

This device was designed for use as RF amplifiers, oscillators and multipliers with collector current in the 1 mA to 2 mA range.

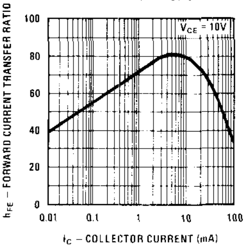
PRINCIPAL DEVICE TYPES

TO-72	2N918
TO-92	PN3563, PN5130 (EBC), 2N3663 (ECB)

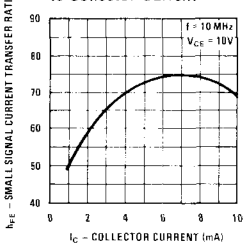
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
G_{PE}	f = 200 MHz, I_C = 5 mA, V_{CE} = 10V	15	18		dB	Neutralized
NF	f = 60 MHz, I_C = 1 mA, V_{CE} = 10V R_S = 200Ω		3.5	5.0	dB	
PO	f = 500 MHz, I_C = 8 mA, V_{CE} = 15V	20	35		mW	Fig. 1
PO	f = 900 MHz, I_C = 8 mA, V_{CE} = 15V	3.0	8.0		mW	
h_{fe}	I_C = 5 mA, V_{CE} = 10V, f = 100 MHz	6.0	9.0			
rb'Cc	f = 79.8 MHz, V_{CE} = 10V, I_E = 8 mA		10	25	ps	
C_{obo}	V_{CB} = 10V, I_E = 0		1.2	1.7	pF	
C_{eb}	V_{EB} = 0.5V, I_C = 0		1.4	2.0	pF	TO-72
h_{FE}	I_C = 1 mA, V_{CE} = 1V	25	5			
h_{FE}	I_C = 5 mA, V_{CE} = 10V	40	80	200		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.25	0.40	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA			0.95	V	
BV_{CEO}	I_C = 3 mA	15	20	24	V	
BV_{CBO}	I_C = 100 μA	30			V	
BV_{EBO}	I_E = 10 μA	4.0			V	
I_{CBO}	V_{CB} = 15V			50	nA	
I_{EBO}	V_{CB} = 3V			50	nA	

Process 43

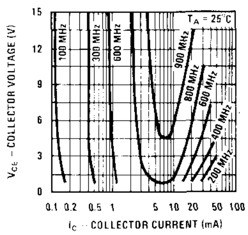
Pulsed DC Current Gain vs Collector Current



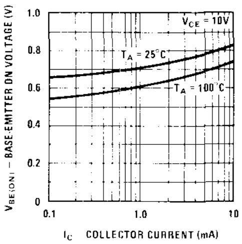
Small Signal Current Gain vs Collector Current



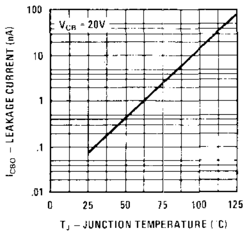
Contours of Constant Gain Bandwidth Product (f_T)



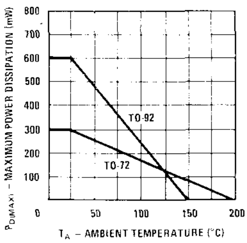
Base-Emitter On Voltage vs Collector Current



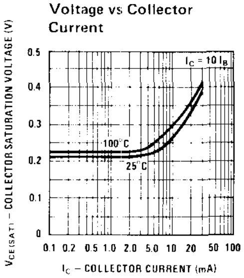
Collector-Base Diode Reverse Current vs Temperature



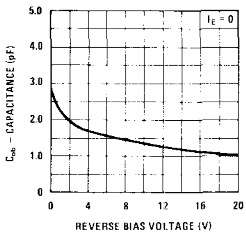
Maximum Power Dissipation vs Ambient Temperature



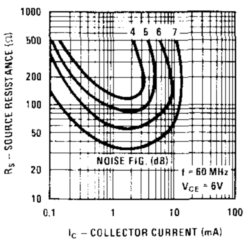
Collector Saturation Voltage vs Collector Current



Output Capacitance vs Reverse Bias Voltage



Contours of Constant Noise Figure



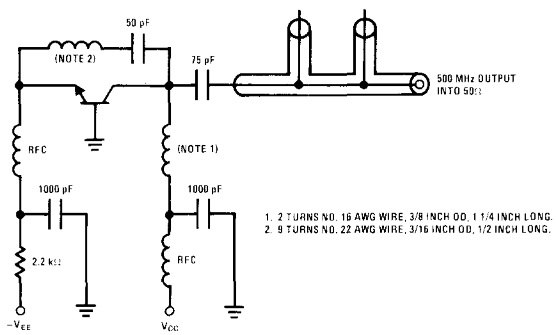
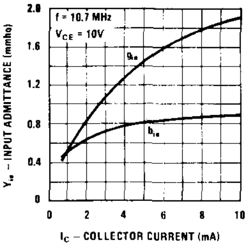


FIGURE 1. 500 MHz Oscillator Circuit

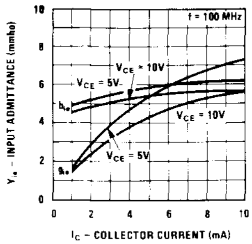
COMMON EMITTER Y PARAMETERS VS FREQUENCY

Process 43

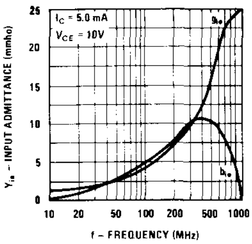
Input Admittance vs Collector Current-Output Short Circuit



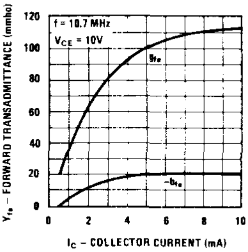
Input Admittance vs Collector Current-Output Short Circuit



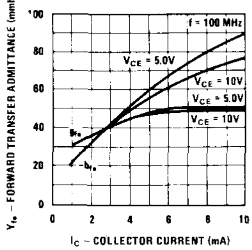
Input Admittance vs Frequency-Output Short Circuit



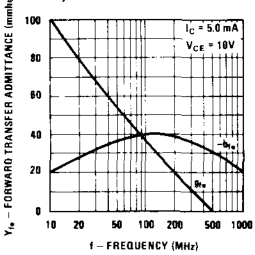
Forward Transfer Admittance vs Collector Current-Output Short Circuit



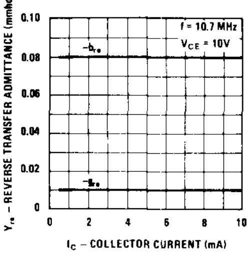
Forward Transfer Admittance vs Collector Current-Output Short Circuit



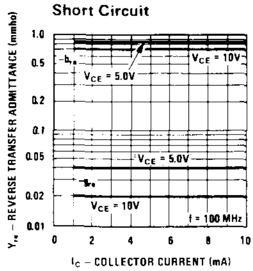
Forward Transfer Admittance vs Frequency-Output Open Circuit



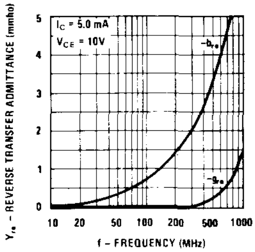
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



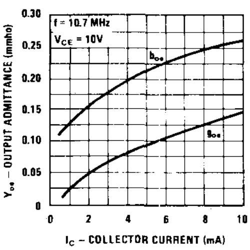
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



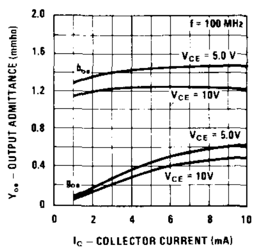
Reverse Transfer Admittance vs Frequency-Input Short Circuit



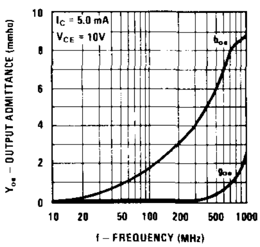
Output Admittance vs Collector Current-Input Short Circuit



Output Admittance vs Collector Current-Input Short Circuit

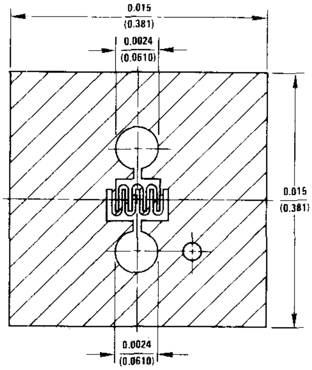


Output Admittance vs Frequency-Input Short Circuit



National Semiconductor

Process 44 NPN AGC-RF Amp



DESCRIPTION

Process 44 is an overlay double diffused, silicon device.

APPLICATION

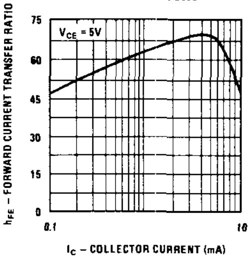
This device was designed for use as a low noise VHF amplifier with forward AGC capability.

PRINCIPAL DEVICE TYPES

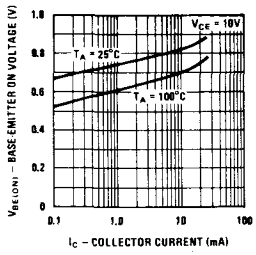
TO-72 SE5020
TO-92 MPS6568, MPS-H30 (BEC)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	f = 200 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω		2.0	3.3	dB	Fig. 1
P_G	f = 200 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω	20	24		dB	Fig. 1
NF	f = 45 MHz, I_C = 4 mA, V_{CE} = 10V, R_S = 50Ω		3.0	5.0	dB	Fig. 2
P_G	f = 45 MHz, I_C = 4 mA, V_{CE} = 10V, R_S = 50Ω	23	26		dB	Fig. 2
AGC	f = 200 MHz, V_{AGC} at 30 dB Down	4.0	4.5	5.0	V	Fig. 1
AGC	f = 45 MHz, V_{AGC} at 30 dB Down	4.3	5.0	5.6	V	Fig. 2
C_{cb}	V_{CB} = 10V, I_E = 0		0.35	0.50	pF	TO-72
			0.45	0.55	pF	TO-92
h_{fe}	V_{CE} = 10V, I_C = 4 mA, f = 100 MHz	3.75	5.5	8.0		
h_{FE}	I_C = 4 mA, V_{CE} = 5V	30	70	200		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 5 mA		1.0	2.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.85	0.95	V	
BV_{CEO}	I_C = 1 mA	30			V	
BV_{CBO}	I_C = 100 μA	30			V	
BV_{EBO}	I_E = 10 μA	4.0			V	
I_{CBO}	V_{CB} = 20V			100	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

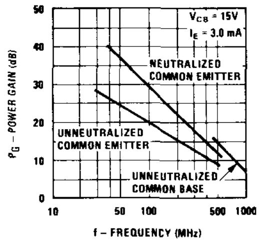
Pulsed DC Current Gain vs Collector Current



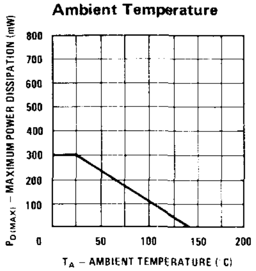
Base-Emitter On Voltage vs Collector Current



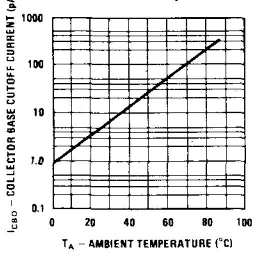
Power Gain vs Frequency



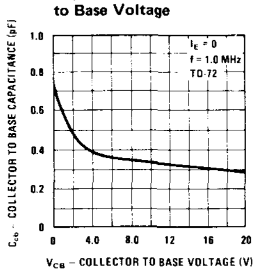
Maximum Power Dissipation vs Ambient Temperature



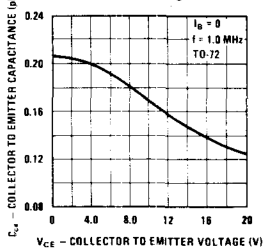
Collector Cutoff Current vs Ambient Temperature



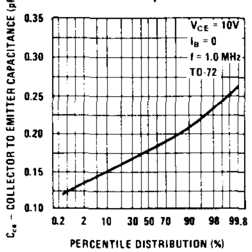
Collector to Base Capacitance vs Collector to Base Voltage



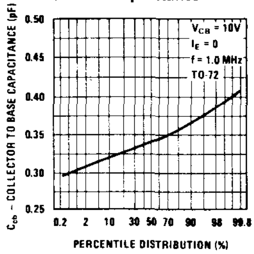
Collector to Emitter Capacitance vs Collector to Emitter Voltage



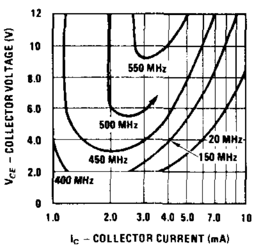
Distribution of Collector to Emitter Capacitance



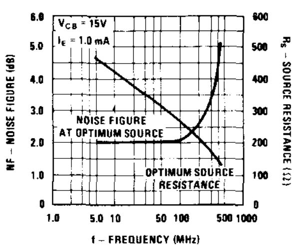
Distribution of Collector to Base Capacitance



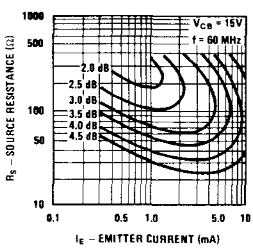
Contours of Constant Gain Bandwidth Product (f_T)



Noise Figure and Source Resistance vs Frequency



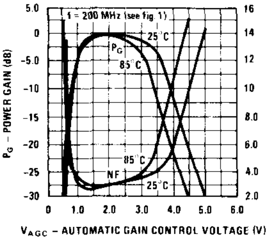
Noise Figure vs Source Resistance and Collector Current



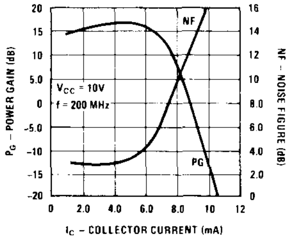
Process 44

COMMON EMITTER PERFORMANCE

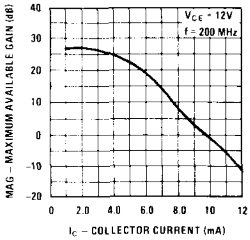
Power Gain and Noise Figure vs Automatic Gain Control Voltage



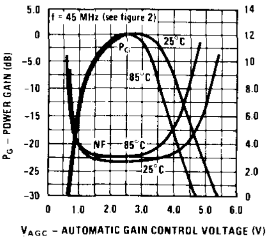
Power Gain and Noise Figure vs Collector Current



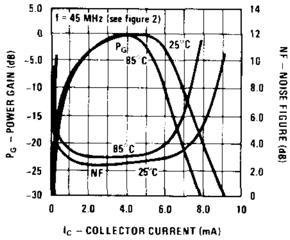
Maximum Available Gain vs Collector Current



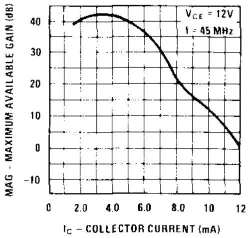
Power Gain and Noise Figure vs Automatic Gain Control Voltage



Power Gain and Noise Figure vs Collector Current



Maximum Available Gain vs Collector Current



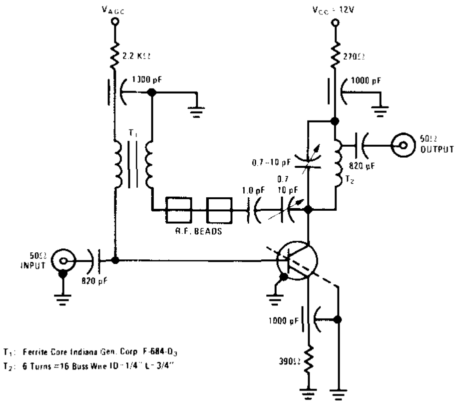


FIGURE 1. 200 MHz, AGC, Power Gain and Noise Figure Test Jig

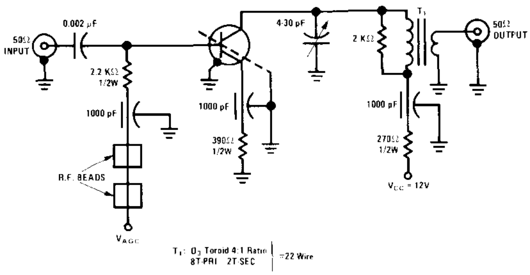
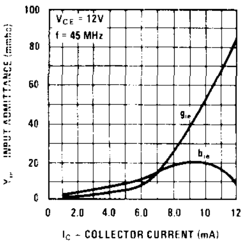


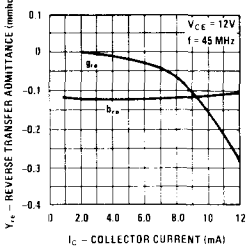
FIGURE 2. 45 MHz, AGC, Power Gain and Noise Figure Test Jig

COMMON EMITTER Y PARAMETERS VS FREQUENCY

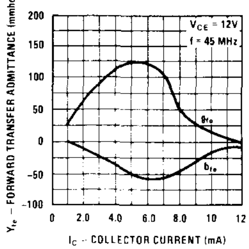
Input Admittance vs Collector Current-Output Short Circuit



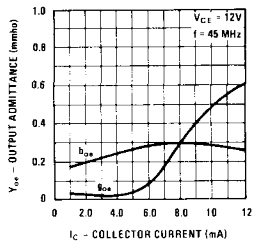
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



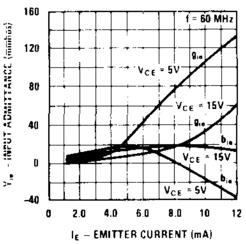
Forward Transfer Admittance vs Collector Current-Output Short Circuit



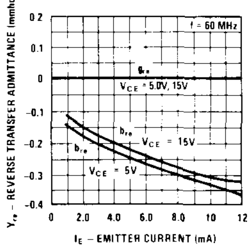
Output Admittance vs Collector Current-Input Short Circuit



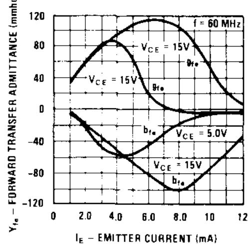
Input Admittance vs Emitter Current-Output Short Circuit



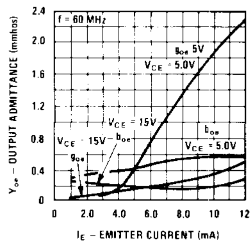
Reverse Transfer Admittance vs Emitter Current-Input Short Circuit



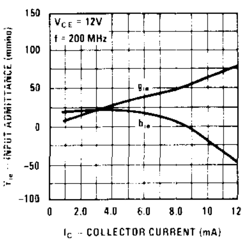
Forward Transfer Admittance vs Emitter Current-Output Short Circuit



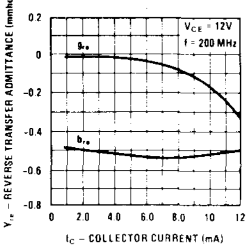
Output Admittance vs Emitter Current - Input Short Circuit



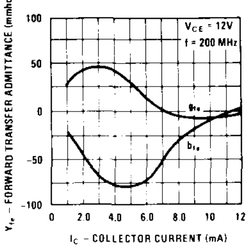
Input Admittance vs Collector Current-Output Short Circuit



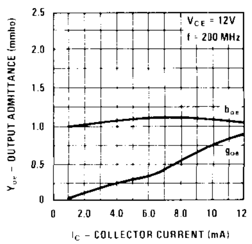
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



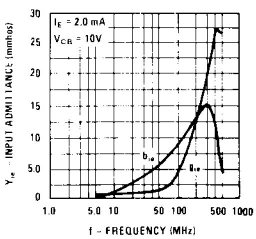
Forward Transfer Admittance vs Collector Current-Output Short Circuit



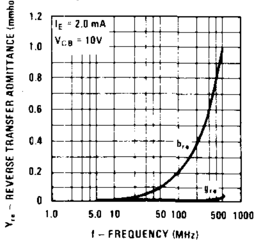
Output Admittance vs Collector Current - Input Short Circuit



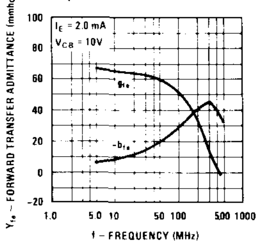
Input Admittance vs Frequency - Output Short Circuit



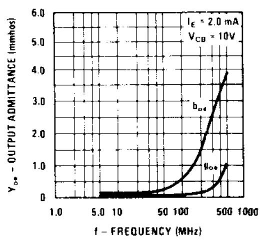
Reverse Transfer Admittance vs Frequency Output Short Circuit



Forward Transfer Admittance vs Frequency Input Short Circuit



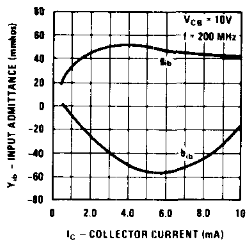
Output Admittance vs Frequency - Input Short Circuit



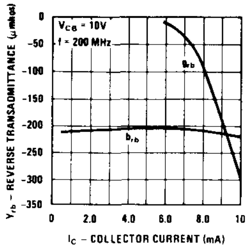
Process 44

COMMON BASE Y PARAMETERS VS FREQUENCY

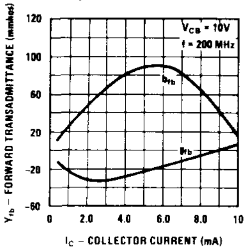
Input Admittance vs Collector Current-Output Short Circuit



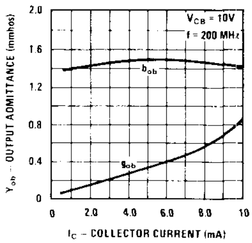
Reverse Transadmittance vs Collector Current-Input Short Circuit



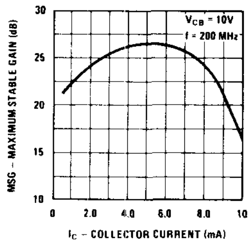
Forward Transadmittance vs Collector Current-Output Short Circuit



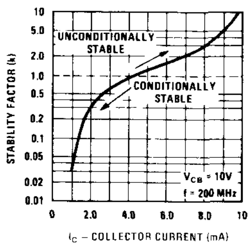
Output Admittance vs Collector Current-Input Short Circuit



Maximum Stable Gain vs Collector Current Common Base Configuration

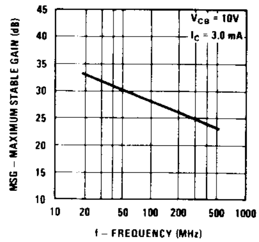


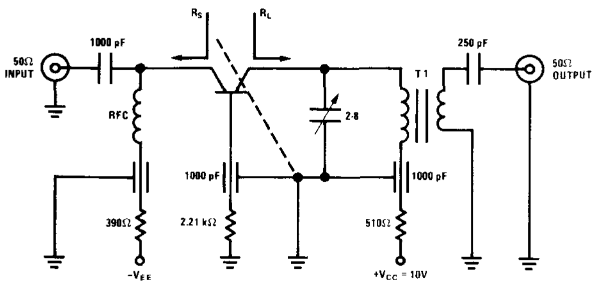
Common Base Configuration Stability Factor-k vs Collector Current



Rollett stability factor "k" is defined as: $R = \frac{2 g_{i} g_{o} - R_e (Y_f Y_r)}{|Y_f Y_r|}$

Maximum Stable Gain vs Frequency Common Base Configuration





T_1–3:1 Ratio No. 22 Bifilar on Micrometals Toroid, P/N T30-12

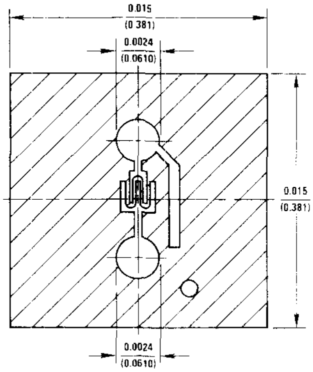
R_S = 50Ω, R_L = 2.5 kΩ

f_{bw} = 8.0 MHz

FIGURE 3. 200 MHz Common Base Power Gain, Noise Figure, Automatic Gain Control Test Circuit.

National Semiconductor

Process 45 NPN AGC-IF Amp



DESCRIPTION

Process 45 is an overlay double diffused silicon device, with a Faraday shield diffusion.

APPLICATION

This device was designed for use as a forward AGC amplifier in IF amplifiers without neutralization.

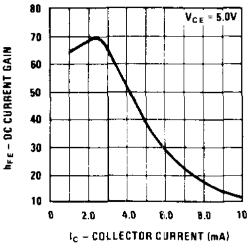
PRINCIPAL DEVICE TYPES

TO-72	SE5055 (pkg 28)
TO-92	MPS-H32 (BEC)

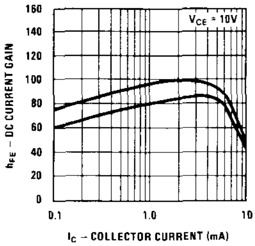
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
P_G	f = 45 MHz, V_{CE} = 10V, I_C = 3 mA, R_G = 50Ω	27.0	29.5		dB	Fig. 1
NF	f = 45 MHz, V_{CE} = 10V, I_C = 3 mA, R_G = 50Ω		2.8	5.0	dB	Fig. 1
C_{re}	V_{CB} = 10V, I_E = 0		0.13	0.22	pF	TO-72
C_{re}	V_{CB} = 10V, I_E = 0		0.20	0.30	pF	TO-92
V_{AGC}	f = 45 MHz, V_{CC} = 12V 30 dB Gain Reduction	3.8	4.4	5.0	V	Fig. 1
V_{AGC}	f = 45 MHz, V_{CC} = 12V 50 dB Gain Reduction		6.8	8.0	V	Fig. 1
h_{fe}	V_{CE} = 10V, I_C = 2 mA, f = 100 MHz	3.0	5.5			
h_{FE}	V_{CE} = 10V, I_C = 2 mA	30	80	200		
h_{FE}	V_{CE} = 10V, I_C = 10 mA	18	35			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 5 mA		1.0	2.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.92	1.0	V	
BV_{CEO}	I_C = 1 mA	30			V	
BV_{CBO}	I_C = 100 μA	30			V	
BV_{EBO}	I_E = 10 μA	4.0			V	
I_{CBO}	V_{CB} = 20V			100	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 45

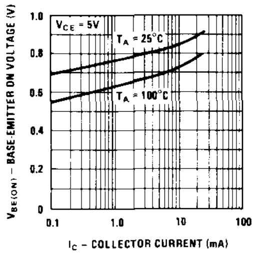
DC Current Gain vs Collector Current



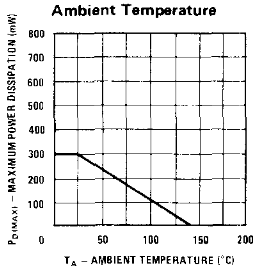
DC Pulse Current Gain vs Collector Current



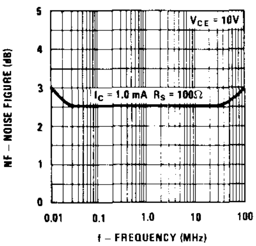
Base-Emitter On Voltage vs Collector Current



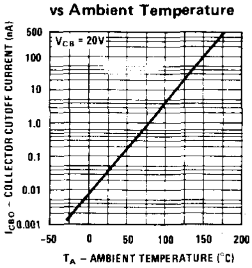
Maximum Power Dissipation vs Ambient Temperature



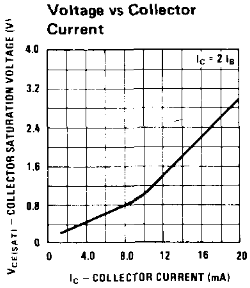
Noise Figure vs Frequency



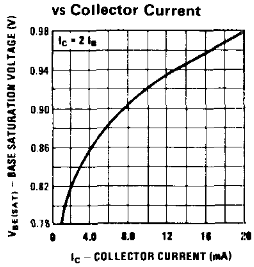
Collector Cutoff Current vs Ambient Temperature



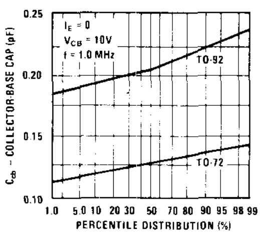
Collector Saturation Voltage vs Collector Current



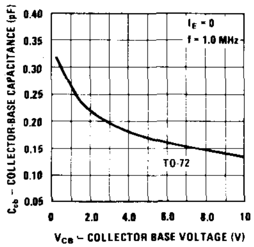
Base Saturation Voltage vs Collector Current



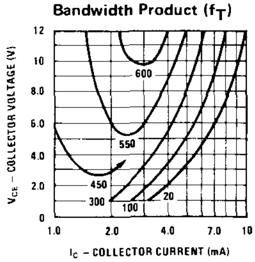
Distribution of Collector to Base Capacitance



Collector-Base Capacitance vs Collector-Base Voltage



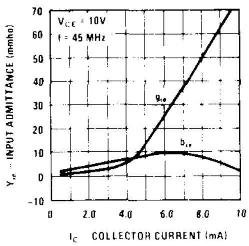
Contours of Constant Gain Bandwidth Product (f_T)



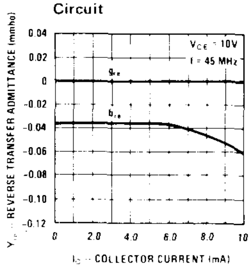
Process 45

COMMON EMITTER Y PARAMETERS VS FREQUENCY

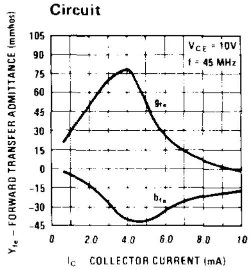
Input Admittance vs Collector Current-Output Short Circuit



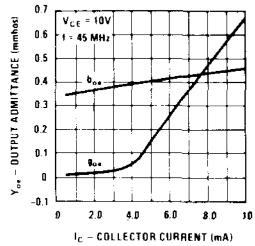
Reverse Transfer Admittance vs Collector Current—Input Short Circuit



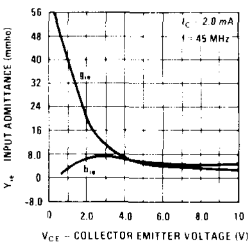
Forward Transfer Admittance vs Collector Current - Output Short Circuit



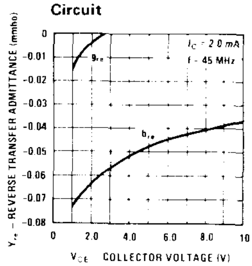
Output Admittance vs Collector Current-Input Short Circuit



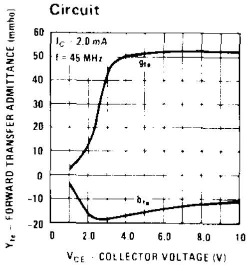
Input Admittance vs Collector Voltage-Output Short Circuit



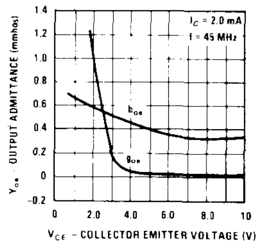
Reverse Transfer Admittance vs Collector Voltage - Input Short Circuit



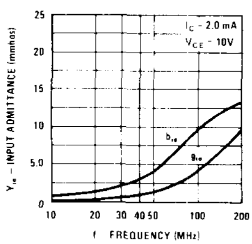
Forward Transfer Admittance vs Collector Voltage—Output Short Circuit



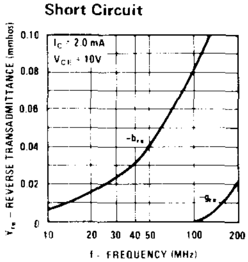
Output Admittance vs Collector Voltage-Input Short Circuit



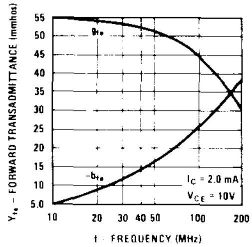
Input Admittance vs Frequency - Output Short Circuit



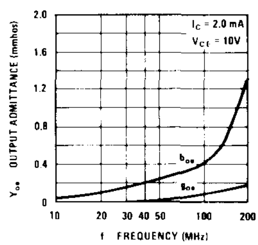
Reverse Transadmittance vs Frequency - Input Short Circuit



Forward Transadmittance vs Frequency - Output Short Circuit

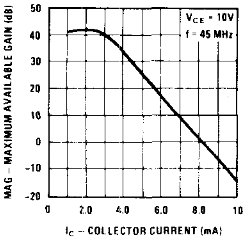


Output Admittance vs Frequency - Input Short Circuit

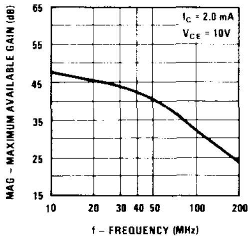


COMMON EMITTER PERFORMANCE

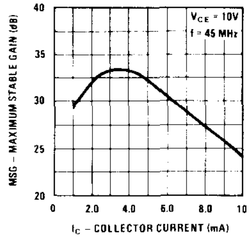
Maximum Available Gain vs Collector Current



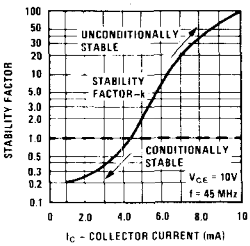
Maximum Available Gain vs Frequency



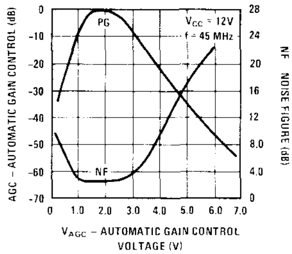
Maximum Stable Gain vs Collector Current



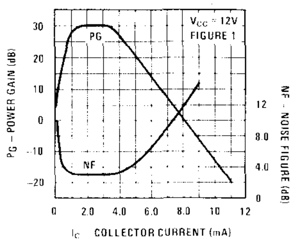
Stability Factor* vs Collector Current



Automatic Gain Control and Noise Figure vs Automatic Gain Control Voltage



Power Gain and Noise Figure vs Collector Current



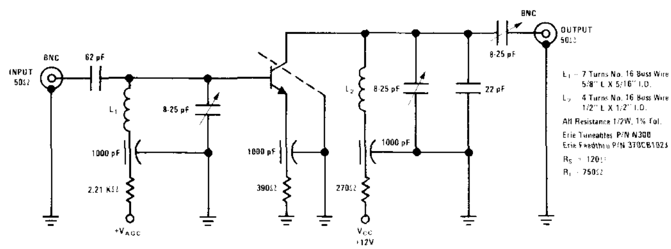
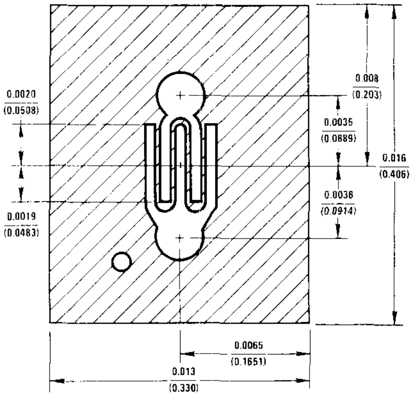


FIGURE 1. SE5055 45 MHz Gain, Noise Figure, AGC Circuit

* Rollett stability factor "k" is defined as: $R = \frac{2_{gigo} - R_e (Y_f Y_r)}{|Y_f Y_r|}$

National Semiconductor

Process 46 NPN RF-IF Amp



DESCRIPTION

Process 46 is an overlay double diffused, silicon epitaxial device.

APPLICATION

This device was designed for linear RF amplifier applications up to 100 MHz with collector current in the 1 mA to 30 mA range.

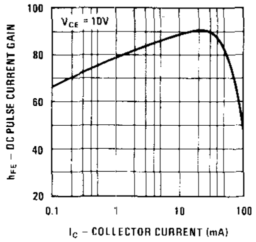
PRINCIPAL DEVICE TYPES

TO-92 ST5025

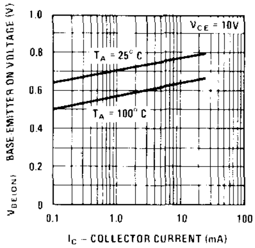
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
G_{pe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA	25	28		dB	
C_{cb}	V_{CB} = 10V		0.8	1.0	pF	TO-92
g_{oe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA			200	µmho	
h_{fe}	I_C = 10 mA, V_{CE} = 10V, f = 100 MHz	3.0	4.50			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	30	100	250		
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 1 mA		0.2	0.6	V	
BV_{CEO}	I_C = 1 mA	30	55		V	
BV_{CBO}	I_C = 100 µA	35			V	
BV_{EBO}	I_C = 10 µA	4.0			V	
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 46

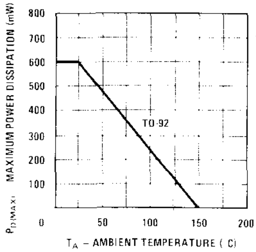
DC Pulse Current Gain vs Collector Current



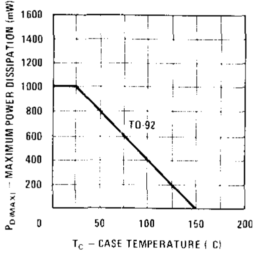
Base-Emitter On Voltage vs Collector Current



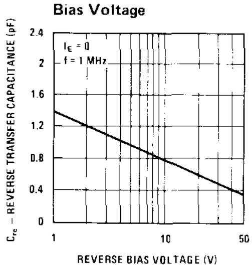
Maximum Power Dissipation vs Ambient Temperature



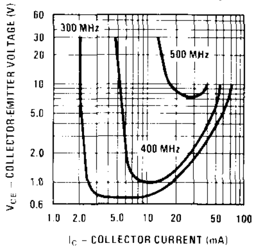
Maximum Power Dissipation vs Case Temperature



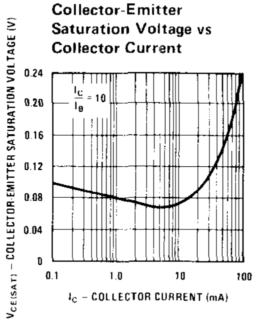
Reverse Transfer Capacitance vs Reverse Bias Voltage



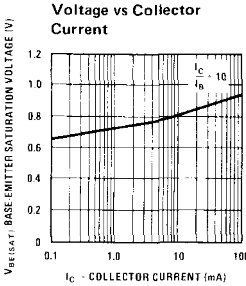
Contours of Constant Gain Bandwidth Product (f_T)



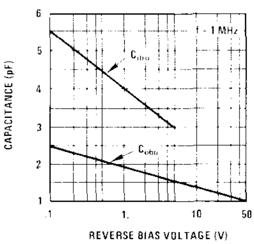
Collector-Emitter Saturation Voltage vs Collector Current



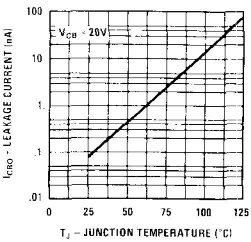
Base-Emitter Saturation Voltage vs Collector Current



Capacitance vs Reverse Bias Voltage

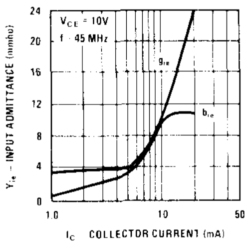


Collector-Base Diode Reverse Current vs Temperature

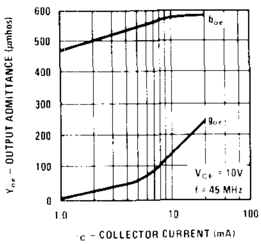


Process 46

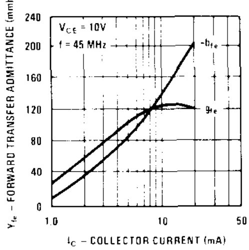
Input Admittance vs Collector Current



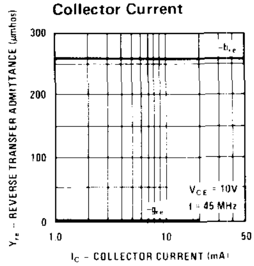
Output Admittance vs Collector Current



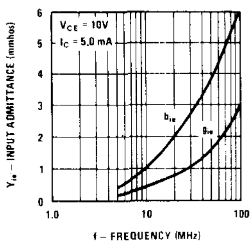
Forward Transfer Admittance vs Collector Current



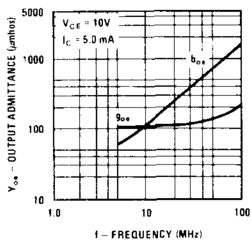
Reverse Transfer Admittance vs Collector Current



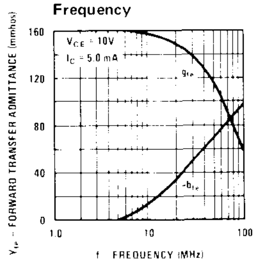
Input Admittance vs Frequency



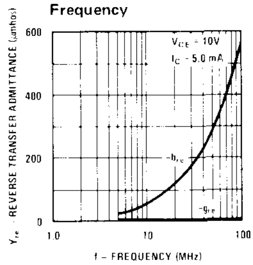
Output Admittance vs Frequency



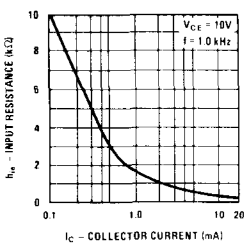
Forward Transfer Admittance vs Frequency



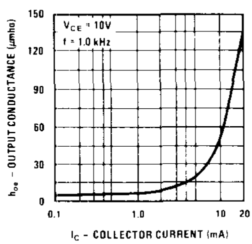
Reverse Transfer Admittance vs Frequency



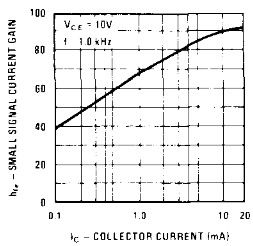
Small Signal Input Resistance vs Collector Current



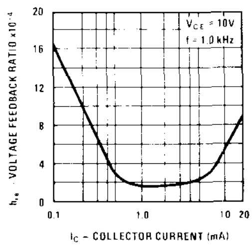
Small Signal Output Conductance vs Collector Current



Small Signal Current Gain vs Collector Current

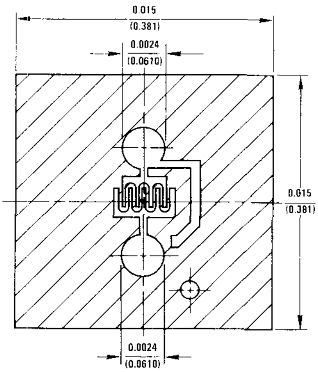


Small Signal Voltage Feedback Ratio vs Collector Current



National Semiconductor

Process 47 NPN RF-IF Amp



DESCRIPTION

Process 47 is an overlay double diffused, silicon epitaxial device, with a Faraday shield diffusion.

APPLICATION

This device was designed for common-emitter low noise amplifier and mixer applications in the 100 μA to 15 mA range to 300 MHz, and low *frequency drift common-base* VHF oscillator applications with high output levels for driving FET mixers.

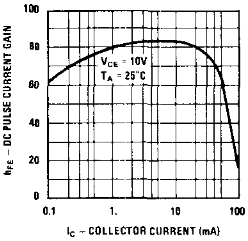
PRINCIPAL DEVICE TYPES

TO-72	SE5035
TO-92	ST5030B, MPSH24, MPSH11

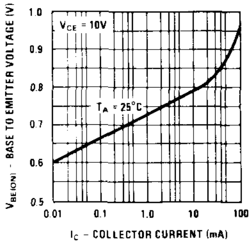
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
P_G	f = 45 MHz, V_{CE} = 10V, I_C = 4 mA	29	33		dB	Fig. 1
P_G	f = 200 MHz, V_{CE} = 10V, I_C = 2 mA	17	19.5		dB	Unneutralized Fig. 3
NF	f = 200 MHz, V_{CE} = 10V, I_C = 2 mA, R_S = 50Ω		2.0	4.0	dB	Fig. 3
rb'Cc	f = 79.8 MHz, V_{CB} = 10V, I_E = 5 mA		6.5	15.0	ps	
h_{fe}	f = 100 MHz, V_{CE} = 15V, I_C = 7 mA	6	10			
C_{ib}	V_{EB} = 0.5V, I_C = 0		2.0	3.0	pF	TO-92
C_{cb}	V_{CB} = 10V, I_E = 0	0.25	0.33	0.40	pF	TO-92
g_{oe}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA			125	μmho	
roep	f = 10.7 MHz, V_{CE} = 10V, I_C = 2 mA	100k			Ω	
h_{FE}	V_{CE} = 15V, I_C = 7 mA	40	100	200		
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 1 mA		0.3	1.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.85	0.92	V	
BV_{CEO}	I_C = 10 mA	20	30		V	
BV_{CBO}	I_C = 100 μA	35	45		V	
BV_{EBO}	I_E = 10 μA	4.0			V	
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 47

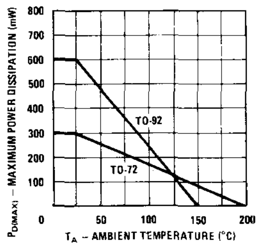
DC Pulse Current Gain vs Collector Current



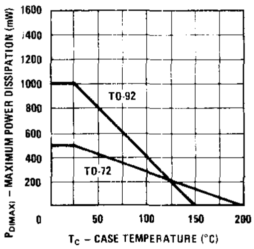
Base-Emitter On Voltage vs Collector Current



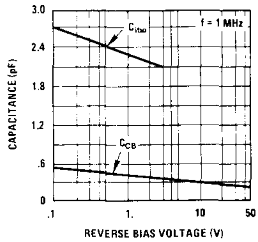
Maximum Power Dissipation vs Ambient Temperature



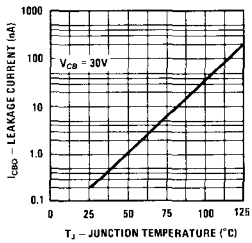
Maximum Power Dissipation vs Case Temperature



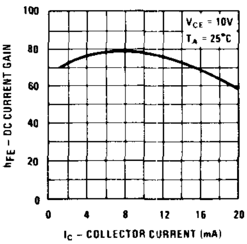
Capacitance vs Reverse Bias Voltage



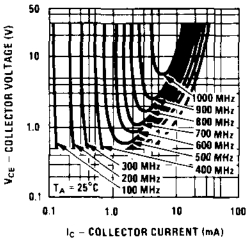
Collector-Base Diode Reverse Current vs Temperature



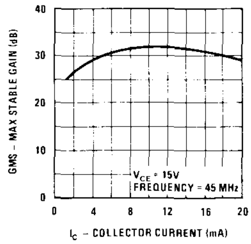
DC Current Gain vs Collector Current



Contours of Constant Gain Bandwidth Product (f_T)



Max Stable Gain vs Collector Current

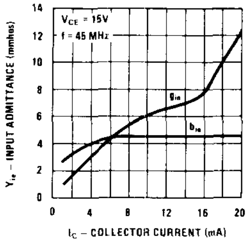


6

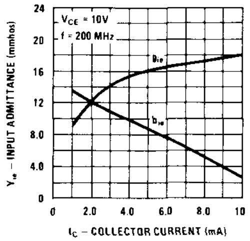
Process 47

COMMON EMITTER VS FREQUENCY Y PARAMETERS

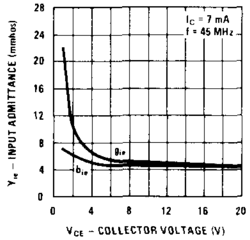
Input Admittance vs Collector Current



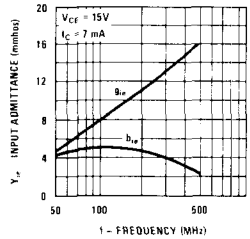
Input Admittance vs Collector Current



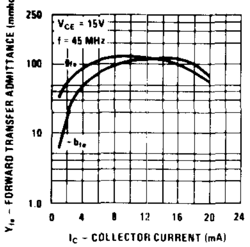
Input Admittance vs Collector Voltage



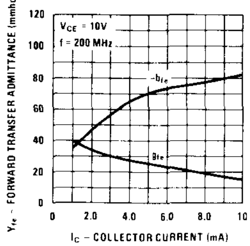
Input Admittance vs Frequency



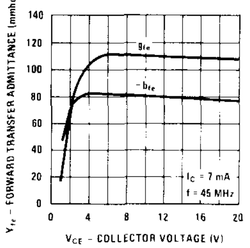
Forward Transfer Admittance vs Collector Current



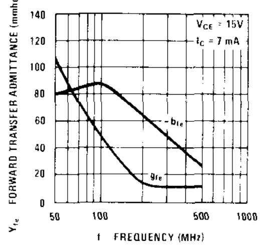
Forward Transfer Admittance vs Collector Current



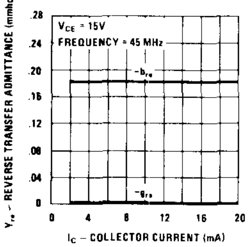
Forward Transfer Admittance vs Collector Voltage



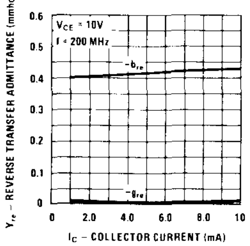
Forward Transfer Admittance vs Frequency



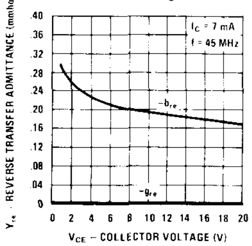
Reverse Transfer Admittance vs Collector Current



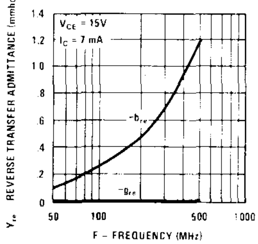
Reverse Transfer Admittance vs Collector Current



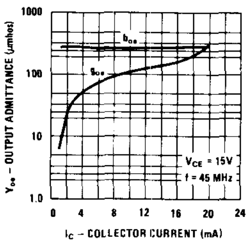
Reverse Transfer Admittance vs Collector Voltage



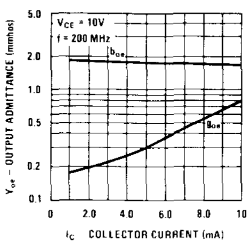
Reverse Transfer Admittance vs Frequency



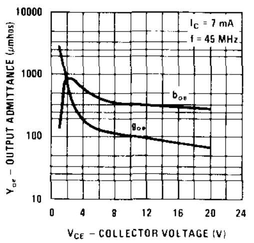
Output Admittance vs Collector Current



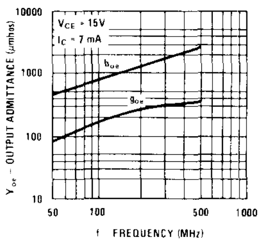
Output Admittance vs Collector Current



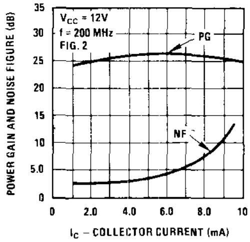
Output Admittance vs Collector Voltage



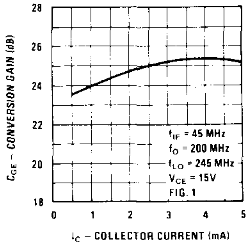
Output Admittance vs Frequency



Power Gain and Noise Figure vs Collector Current



Conversion Gain vs Collector Current



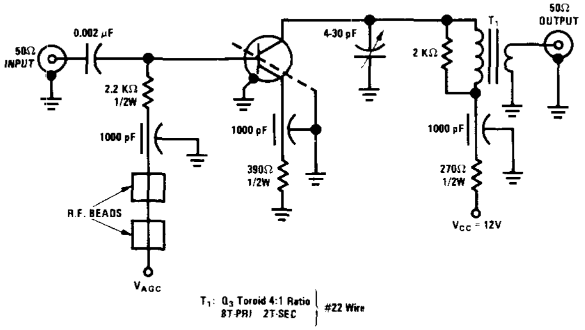


FIGURE 1. 45 MHz Power Gain Circuit

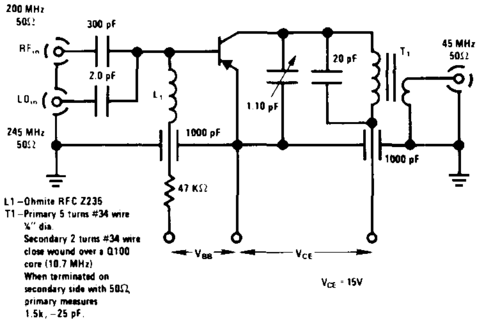


FIGURE 2. 200 MHz Conversion Gain Test Circuit

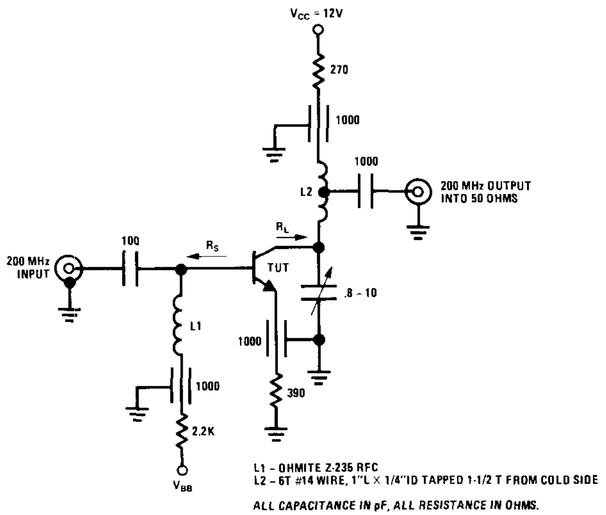
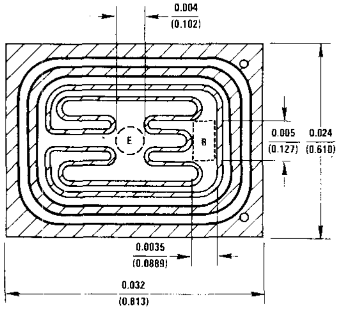


FIGURE 3. Unneutralized 200 MHz PG NF Test Circuit

National Semiconductor

Process 48
NPN High Voltage Video Output



DESCRIPTION

Process 48 is a nonoverlay triple diffused, silicon device with a field plate.

APPLICATION

This device was designed for application as a video output to drive color CRT.

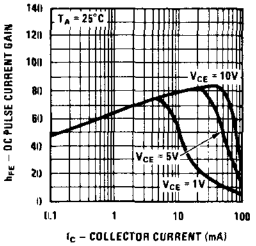
PRINCIPAL DEVICE TYPES

TO-39	SE7056
TO-202	SV7056, NSD134

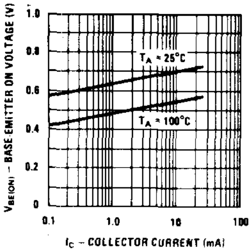
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{cb}	V_{CB} = 20 V		2.5	3.5	pF	TO-39
h_{fe}	f = 20 MHz, V_{CE} = 100 V I_C = 15 mA	2.5	4.0			
h_{fe}	I_C = 1 mA, V_{CE} = 10V	15	50			
h_{fe}	I_C = 10 mA, V_{CE} = 10V	40	80	160		
h_{fe}	I_C = 30 mA, V_{CE} = 10V	30	100			
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 2 mA		0.35	1.0	V	
$V_{BE(SAT)}$	I_C = 20 mA, I_B = 2 mA		0.74	0.85	V	
C_{eb}	V_{EB} = 0.5V		45	70	pF	
BV_{CEO}	I_C = 5 mA	220	280	320	V	
BV_{CBO}	I_C = 100 μA	320	410	470	V	
BV_{EBO}	I_E = 100 μA	7.0			V	
I_{CBO}	V_{CB} = 150V			100	nA	
I_{EBO}	V_{EB} = 6V			100	nA	

Process 48

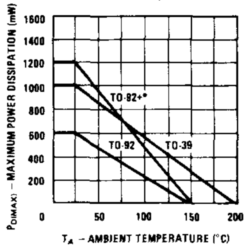
DC Pulse Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current

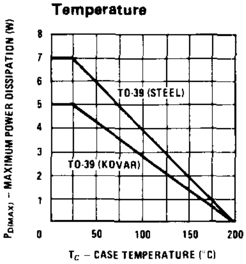


Maximum Power Dissipation vs Ambient Temperature

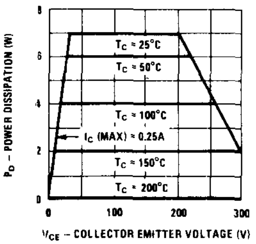


*One square inch of copper run

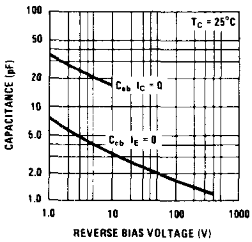
Maximum Power Dissipation vs Case Temperature



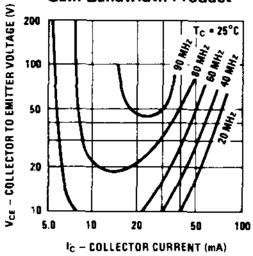
Guaranteed Maximum DC Power Dissipation vs Collector-Emitter Voltage, TO-39



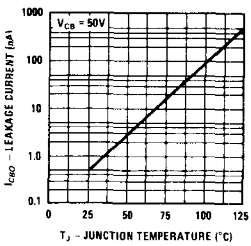
Collector to Base and Emitter to Base Capacitance vs Reverse Bias Voltage



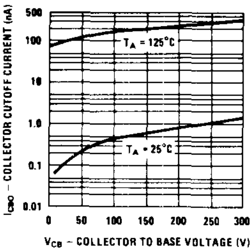
Contours of Constant Gain Bandwidth Product



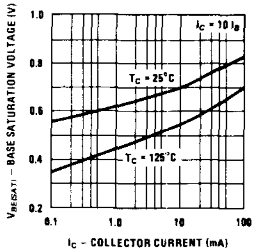
Collector-Base Diode Reverse Current vs Temperature



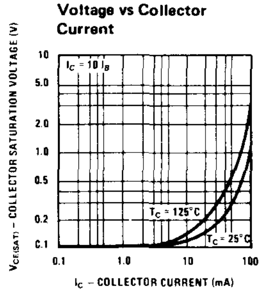
Collector Cutoff Current vs Collector Voltage



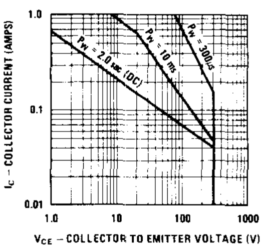
Base Saturation Voltage vs Collector Current



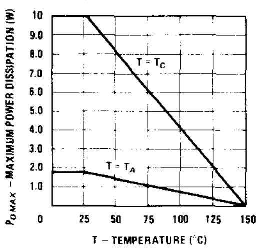
Collector Saturation Voltage vs Collector Current



Safe Operating Area, TO-202

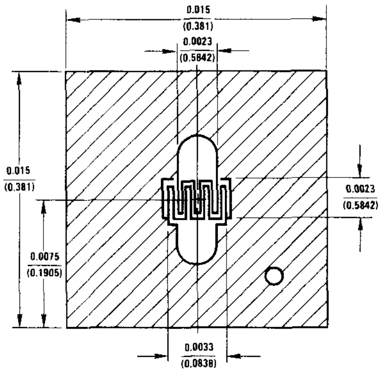


Maximum Power Dissipation TO-202 vs Case and Ambient Temperature



National Semiconductor

Process 49 NPN RF Amp



DESCRIPTION

Process 49 is an overlay double diffused silicon epitaxial device.

APPLICATION

This device was designed for general RF amplifier and mixer applications to 250 MHz with collector current in the 1 mA to 20 mA range.

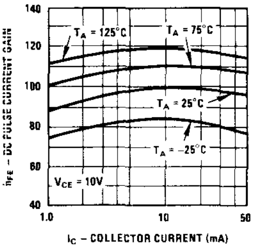
PRINCIPAL DEVICE TYPES

TO-92 (BEC) MPS6544, MPSH20

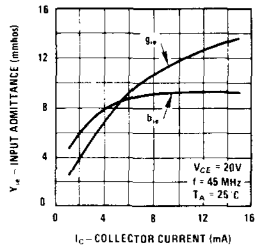
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
P_G	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA	25	30		dB	
f_t	V_{CE} = 10V, I_C = 10 mA	400	700		MHz	
rb'Cc	f = 31.9 MHz, V_{CE} = 10V, I_C = 8 mA		7.5	20.0	ps	TO-92
Ccb	f = 1.0 MHz, V_{CB} = 10V, I_E = 0		0.55	0.65	pF	TO-92
h_{FE}	V_{CE} = 10V, I_C = 10 mA	30	100	250		
h_{FE}	V_{CE} = 10V, I_C = 4 mA	30	90			
$V_{BE(ON)}$	V_{CE} = 10V, I_C = 10 mA		0.80	0.95	V	
$V_{CE(SAT)}$	I_C = 30 mA, I_C = 3 mA		0.15	0.50	V	
g_{oe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA			100	µmhos	
roep	f = 4.5 MHz, V_{CE} = 10V, I_C = 2 mA	80k			Ω	
BV_{CEO}	I_C = 1 mA	30	40	55	V	
BV_{CBO}	I_C = 100 µA	45			V	
BV_{EBO}	I_E = 10 µA	4.0			V	
I_{CBO}	V_{CB} = 30V			100	nA	
I_{EBO}	V_{EB} = 3.0V			50	nA	

Process 49

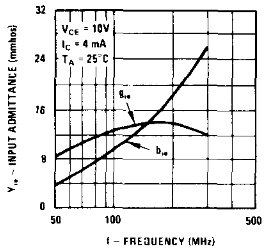
DC Pulse Current Gain vs Collector Current



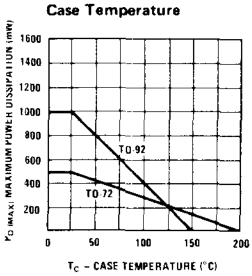
Input Admittance vs Collector Current



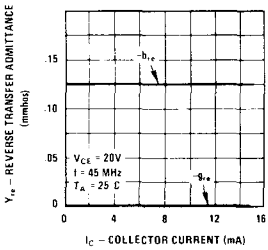
Input Admittance vs Frequency



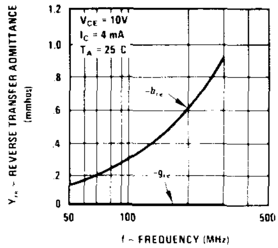
Maximum Power Dissipation vs Case Temperature



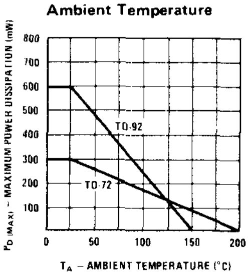
Reverse Transfer Admittance vs Collector Current



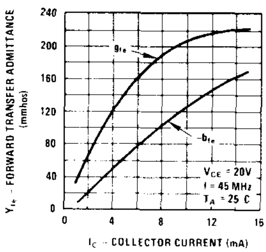
Reverse Transfer Admittance vs Frequency



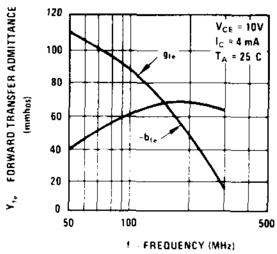
Maximum Power Dissipation vs Ambient Temperature



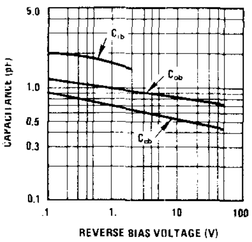
Forward Transfer Admittance vs Collector Current



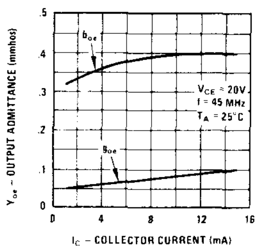
Forward Transfer Admittance vs Frequency



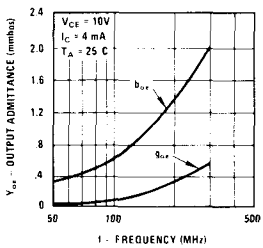
Capacitance vs Reverse Bias Voltage



Output Admittance vs Collector Current

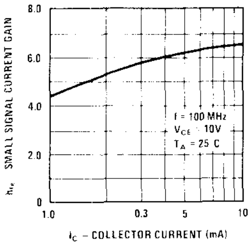


Output Admittance vs Frequency

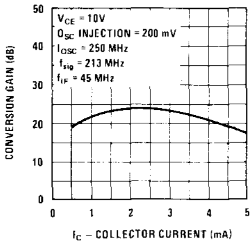


Process 49

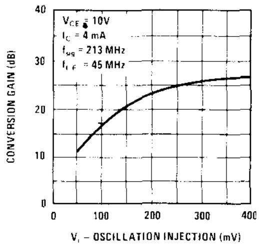
Small Signal Current Gain vs Collector Current



Conversion Gain vs Collector Current



Conversion Gain vs Oscillator Injection Level



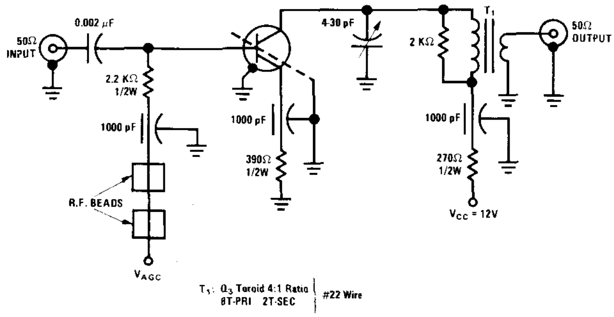


FIGURE 1. 45 MHz Power Gain Circuit

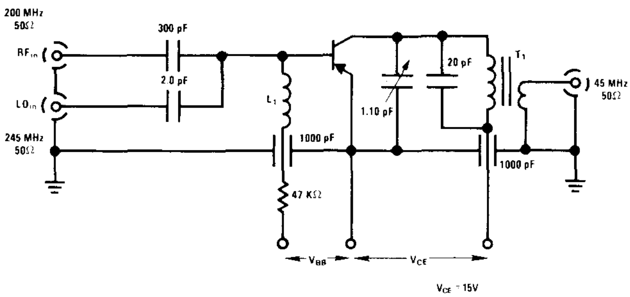
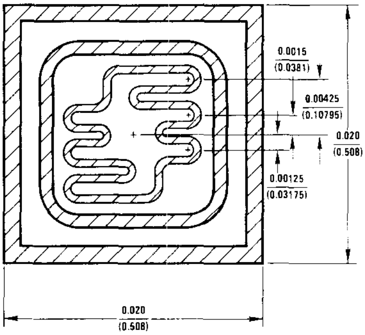


FIGURE 2. 200 MHz Conversion Gain Test Circuit

National Semiconductor

Process 60 PNP Medium Power



DESCRIPTION

Complements Process 09.

APPLICATION

These devices are designed for general purpose amplifier applications at collector currents to 500 mA.

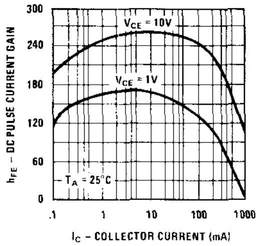
PRINCIPAL DEVICE TYPES

TO-92 MPS6563

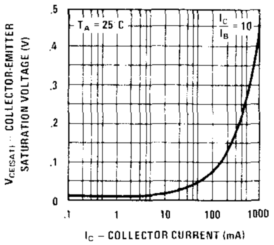
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{OB}	V_{CB} = 10V		8	12	pF	
C_{IB}	V_{EB} = 1V		22	26	pF	
NF	V_{CE} = 10V, I_C = 1 mA R_S = 1k, f = 1 kHz		0.5		dB	
f_T	V_{CE} = 10V, I_C = 100 mA		400		MHz	
h_{FE}	V_{CE} = 1V, I_C = 1 mA	55	160	325		
h_{FE}	V_{CE} = 1V, I_C = 50 mA	50	150	300		
h_{FE}	V_{CE} = 1V, I_C = 150 mA	40	125	245		
h_{FE}	V_{CE} = 1V, I_C = 500 mA	20	65	125		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.1	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.3	0.5	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.8	0.96	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.98	1.2	V	
I_{CES}	V_{CE} = 20V			100	nA	
I_{CEO}	V_{CE} = 20V			100	nA	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 10 μA	7	8		V	
BV_{CEO}	I_C = 10 mA	20	30	40	V	

Process 60

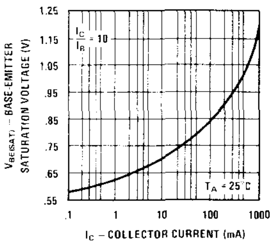
DC Pulse Current Gain vs Collector Current



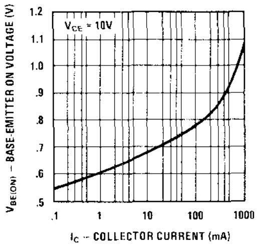
Collector-Emitter Saturation Voltage vs Collector Current



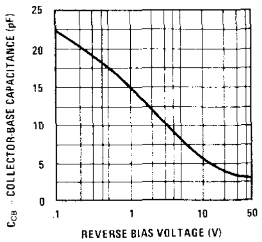
Base-Emitter Saturation Voltage vs Collector Current



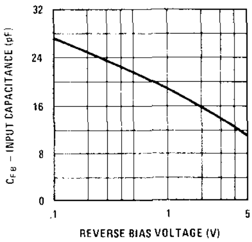
Base-Emitter On Voltage vs Collector Current



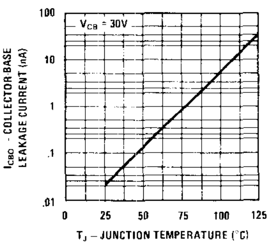
Collector-Base Capacitance vs Reverse Bias Voltage



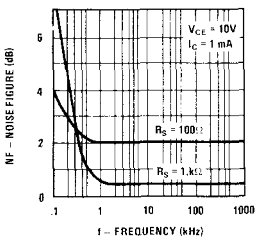
Input Capacitance vs Reverse Bias Voltage



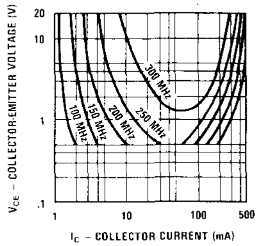
Collector-Base Diode Reverse Current vs Temperature



Noise Figure vs Frequency

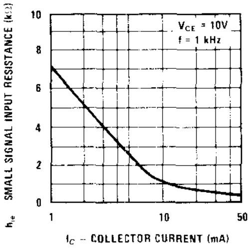


Contours of Constant Gain Bandwidth Product (f_T)

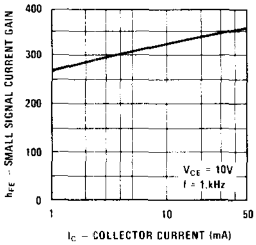


Process 60

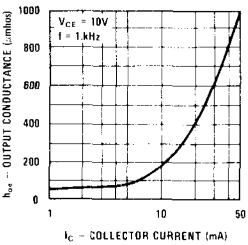
Small Signal Input Resistance vs Collector Current



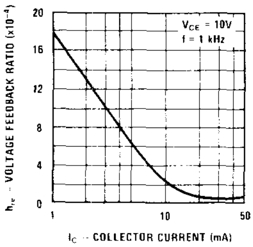
Small Signal Current Gain vs Collector Current



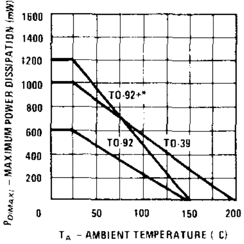
Small Signal Output Conductance vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current

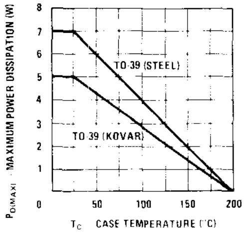


Maximum Power Dissipation vs Ambient Temperature



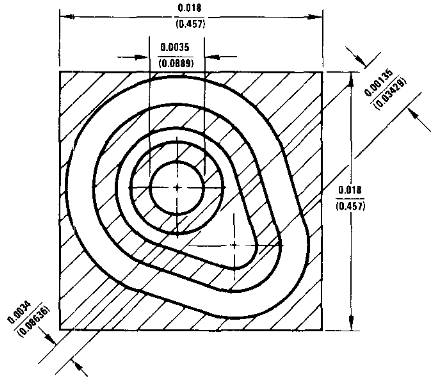
*One square inch of copper run

Maximum Power Dissipation vs Case Temperature



National Semiconductor

Process 62 PNP Small Signal



DESCRIPTION

Process 62 is a nonoverlay double diffused, silicon epitaxial device. Complement to Process 07.

APPLICATION

These devices are designed for low level, high gain, low noise general purpose amplifier applications.

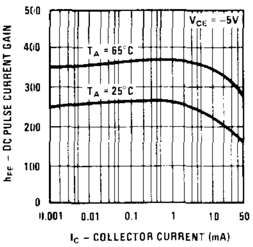
PRINCIPAL DEVICE TYPES

TO-18	2N3550
TO-46	2N2605
TO-92	2N5086 (EBC), 2N4058 (ECB)

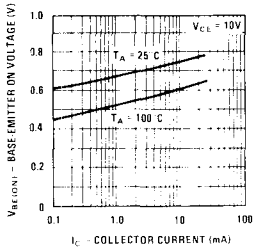
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	V_{CE} = 5V, I_C = 10 μA, R_S = 10 kΩ, P_{BW} = 15.70 kHz		1.20	3	dB	
h_{fe}	V_{CE} = 5V, I_C = 500 μA, f = 20 MHz	5	6			
C_{eb}	V_{EB} = 0.5V		6	7	pF	
C_{cb}	V_{CB} = 5V		3.5	5	pF	
h_{FE}	I_C = 10 μA, V_{CE} = 5V	50	200	400		
h_{FE}	I_C = 100 μA, V_{CE} = 5V	50	250	500		
h_{FE}	I_C = 500 μA, V_{CE} = 5V	100	260	600		
h_{FE}	I_C = 1 mA, V_{CE} = 5V	50	270	500		
h_{FE}	I_C = 10 mA, V_{CE} = 5V	50	270	500		
$V_{CE(SAT)}$	I_C = 1 mA, I_B = 0.1mA		0.05	0.10	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.08	0.12	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = 0.1 mA		0.68	0.70	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.77	0.90	V	
BV_{CEO}	I_C = 1 mA	35	65	70	V	
BV_{CBO}	I_C = 100 μA	65			V	
BV_{EBO}	I_E = 10 μA	7			V	
I_{CBO}	V_{CB} = 45V			50	nA	
I_{EBO}	V_{EB} = 5V			50	nA	

Process 62

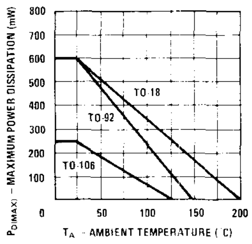
DC Pulse Current Gain vs Collector Current



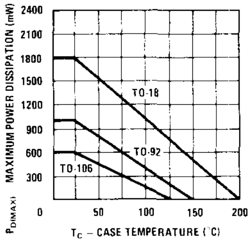
Base-Emitter On Voltage vs Collector Current



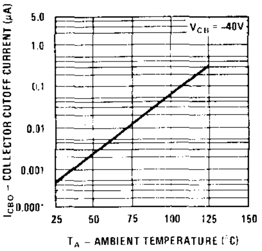
Maximum Power Dissipation vs Ambient Temperature



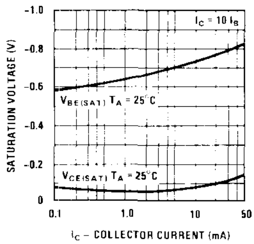
Maximum Power Dissipation vs Case Temperature



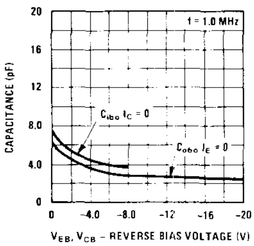
Collector Cutoff Current vs Ambient Temperature



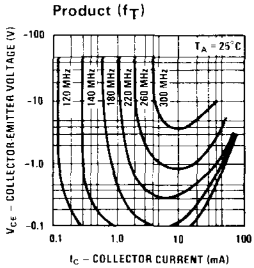
Collector and Base Saturation Voltage vs Collector Current



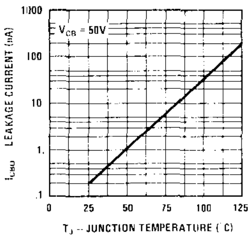
Input and Output Capacitances vs Reverse Bias Voltage



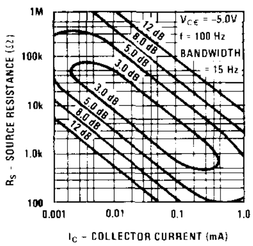
Contours of Constant Gain Bandwidth Product (f_T)



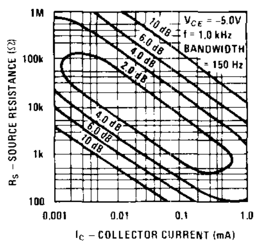
Collector-Base Diode Current vs Temperature



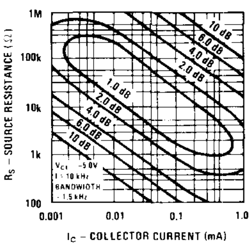
Contours of Constant Narrow Band Noise Figure



Contours of Constant Narrow Band Noise Figure

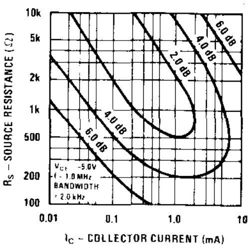


Contours of Constant Narrow Band Noise Figure

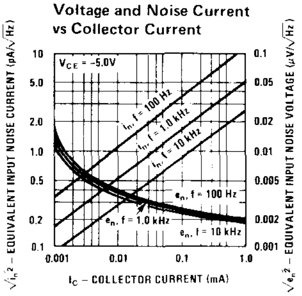


Process 62

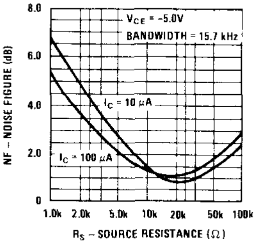
Contours of Constant Narrow Band Noise Figure



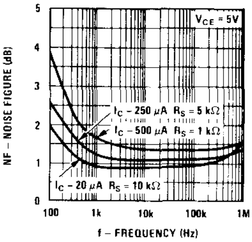
Equivalent Input Noise Voltage and Noise Current vs Collector Current



Wide Band Noise Figure vs Source Resistance



Noise Figure vs Frequency

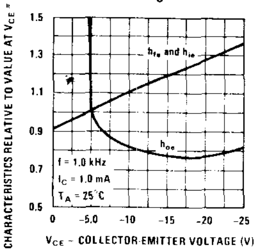


SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

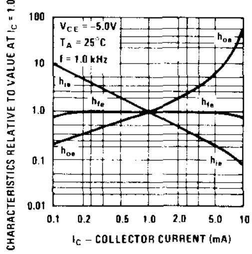
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	2.5	8.0	20	kΩ	I_C = 1.0 mA V_{CE} = -5.0V
h_{oe}	Output Conductance	5.0	19	50	μmho	I_C = 1.0 mA V_{CE} = -5.0V
h_{re}	Voltage Feedback Ratio			10	$x10^{-4}$	I_C = 1.0 mA V_{CE} = -5.0V
h_{fe}	Small Signal Current Gain	100	250	800		I_C = 1.0 mA V_{CE} = -5.0V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

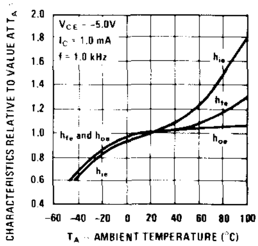
Common Emitter Characteristics vs Collector Emitter Voltage



Common Emitter Characteristics vs Collector Current

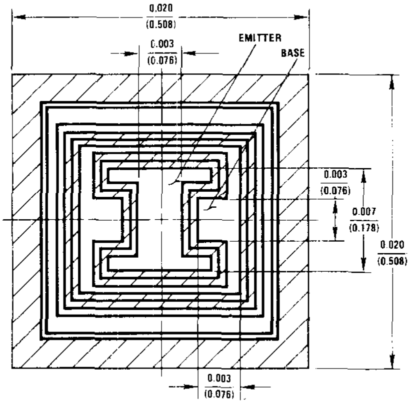


Common Emitter Characteristics vs Ambient Temperature



National Semiconductor

Process 63 PNP Medium Power



DESCRIPTION

Process 63 is a nonoverlay double diffused, silicon epitaxial device. Complement to Process 20.

APPLICATION

This device was designed for use as general purpose amplifiers and switches requiring collector currents to 500 mA.

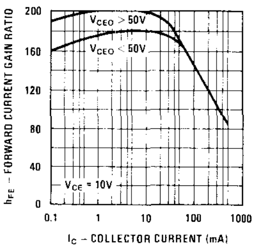
PRINCIPAL DEVICE TYPES

TO-5	2N2905A
TO-18	2N2907A
TO-92	2N4403 (EBC), 2N3702 (ECB)
TO-105	2N3645
TO-106	2N4143
TO-92+	TN2905A

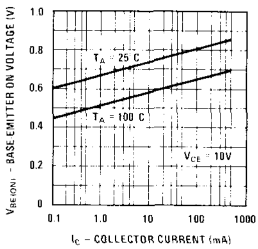
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		30	45	ns	Fig. 1
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		220	290	ns	Fig. 2
C_{cb}	V_{CB} = 10V		6	8	pF	TO-18
C_{eb}	V_{EB} = 0.50V		15	18	pF	TO-18
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	1.5	2.5			
NF (spot)	I_C = 100 μA, V_{CE} = 10V, R_S = 1k f = 1 kHz		1.5	3	dB	
h_{FE}	I_C = 1 mA, V_{CE} = 10V	50	140	400		
h_{FE}	I_C = 10 mA, V_{CE} = 10V	50	140	400		
h_{FE}	I_C = 100 mA, V_{CE} = 10V	50	95	400		
h_{FE}	I_C = 150 mA, V_{CE} = 10V	40	150	350		
h_{FE}	I_C = 500 mA, V_{CE} = 10V	40	50	200		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.25	0.40	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.60	1.00	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.90	1.3	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.10	1.6	V	
BV_{CEO}	I_C = 10 mA	35	50	65	V	
BV_{CBO}	I_C = 100 μA	45	70	95	V	
BV_{CES}	I_C = 10 μA	0.45		90	V	
BV_{EBO}	I_E = 10 μA	7			V	
I_{CBO}	V_{CB} = 40V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 63

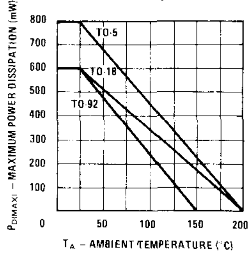
DC Pulse Current Gain vs Collector Current



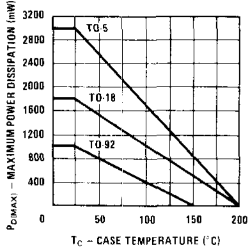
Base-Emitter On Voltage vs Collector Current



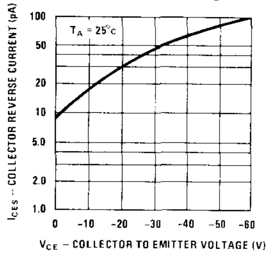
Maximum Power Dissipation vs Ambient Temperature



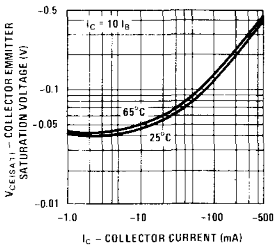
Maximum Power Dissipation vs Case Temperature



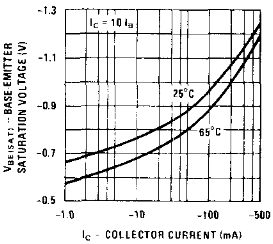
Collector Reverse Current vs Reverse Bias Voltage



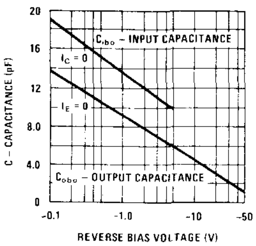
Pulsed Collector Saturation Voltage vs Collector Current



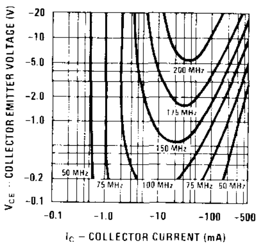
Pulsed Base Saturation Voltage vs Collector Current



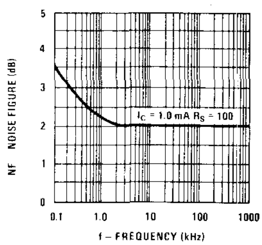
Input and Output Capacitances vs Reverse Bias Voltage



Contours of Constant Gain Bandwidth Product (f_T)

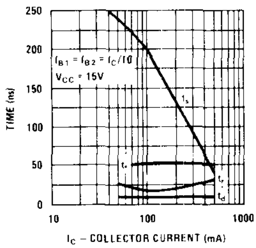


Noise Figure vs Frequency

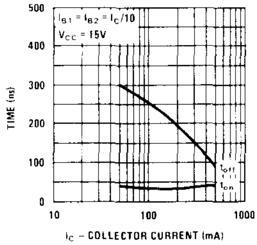


Process 63

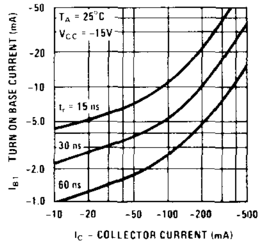
Switching Times vs Collector Current



Turn On and Turn Off Times vs Collector Current



Rise Time vs Collector and Turn On Base Currents



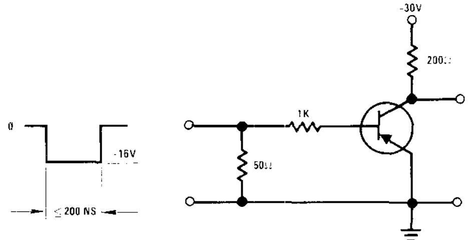


FIGURE 1. Saturated Turn-On Switching Time Test Circuit

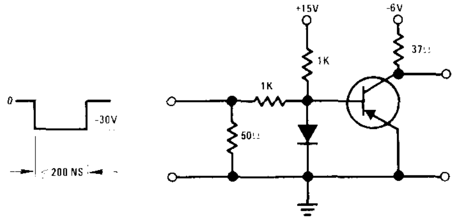
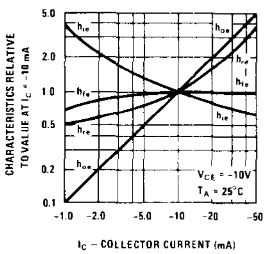


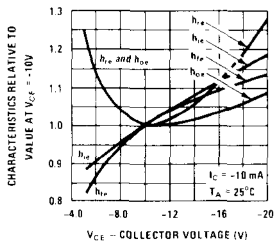
FIGURE 2. Saturated Turn-Off Switching Time Test Circuit

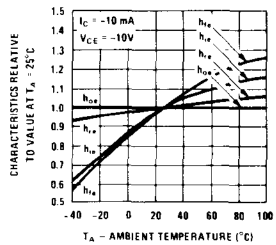
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance		480	2000	ohms	I_C = 10 mA	$V_{CE} = -10V$
h_{oe}	Output Conductance		80	1200	µmhos	I_C = 10 mA	$V_{CE} = -10V$
h_{re}	Voltage Feedback Ratio		162	1500	$x10^{-6}$	I_C = 10 mA	$V_{CE} = -10V$
h_{fe}	Small Signal Current Gain	100				I_C = 10 mA	$V_{CE} = -10V$

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

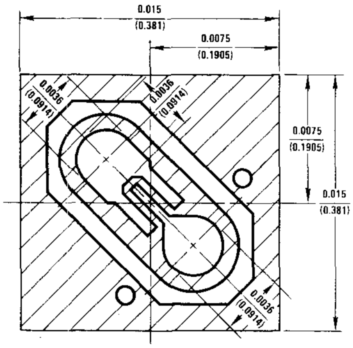






National Semiconductor

Process 64
PNP High Speed Switch



DESCRIPTION

Process 64 is an overlay double diffused, gold doped silicon epitaxial device. Complement to Process 22.

APPLICATION

This device was designed for high speed saturated switching applications at collector currents to 200 mA.

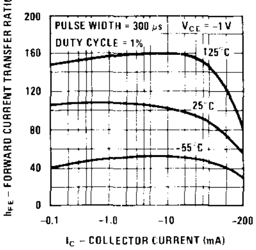
PRINCIPAL DEVICE TYPES

TO-52	2N2894A
TO-92	PN4313

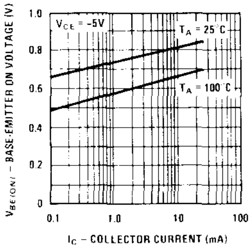
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 30 mA, I_{B1} = 3 mA		10	20	ns	Fig. 1
t_{off}	I_C = 30 mA, I_{B2} = 3 mA		21	30	ns	Fig. 1
t_s	$I_C = I_{B1} = I_{B2}$ = 10 mA		15	20	ns	
C_{ob}	V_{CE} = 5V		3.0	4.5	pF	TO-18
C_{ib}	V_{EB} = 0.5V		5.0	6.0	pF	TO-18
h_{fe}	f = 100 MHz, I_C = 30 mA, V_{CE} = 10V	8	12			
h_{FE}	I_C = 1 mA, V_{CE} = 1V	20	65			
h_{FE}	I_C = 10 mA, V_{CE} = 1V	30	95			
h_{FE}	I_C = 30 mA, V_{CE} = 1V	40	95	130		
h_{FE}	I_C = 100 mA, V_{CE} = 1V	30	85			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.08	0.15	V	
$V_{CE(SAT)}$	I_C = 30 mA, I_B = 3 mA		0.11	0.19	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.28	0.45	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.80	0.92	V	
$V_{BE(SAT)}$	I_C = 30 mA, I_B = 3 mA		0.90	1.15	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		1.10	1.50	V	
BV_{CEO}	I_C = 10 mA	12		15	V	
BV_{CBO}	I_C = 100 μA	12		15	V	
BV_{EBO}	I_E = 10 μA	4.5			V	
I_{CES}	V_{CE} = 10V			50	nA	

Process 64

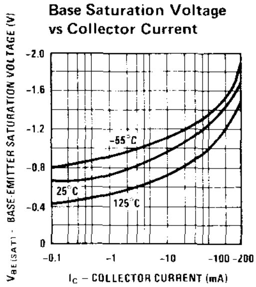
Pulsed DC Current Gain vs Collector Current



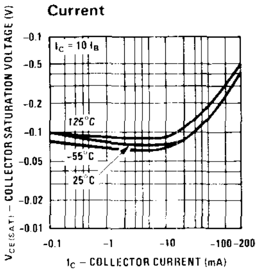
Base-Emitter On Voltage vs Collector Current



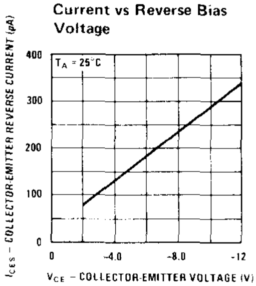
Base Saturation Voltage vs Collector Current



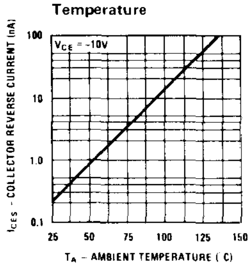
Collector Saturation Voltage vs Collector Current



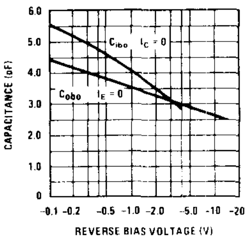
Collector-Base Reverse Current vs Reverse Bias Voltage



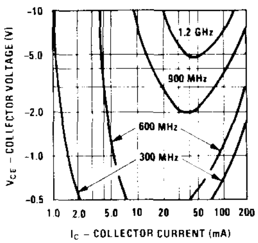
Collector-Base Diode Reverse Current vs Temperature



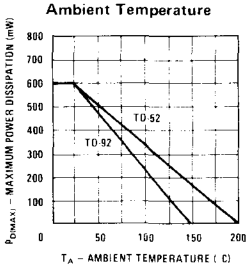
Input and Output Capacitance vs Reverse Bias Voltage



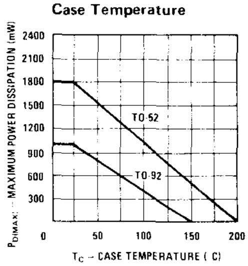
Contours of Constant Gain Bandwidth Product (f_T)



Maximum Power Dissipation vs Ambient Temperature

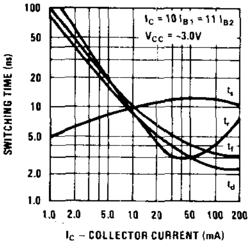


Maximum Power Dissipation vs Case Temperature



Process 64

Switching Times vs Collector Current



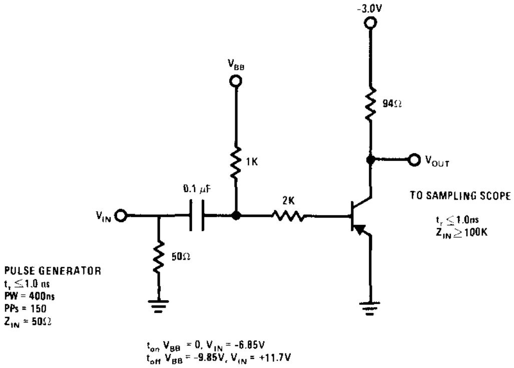
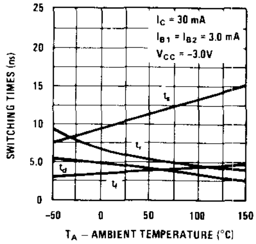
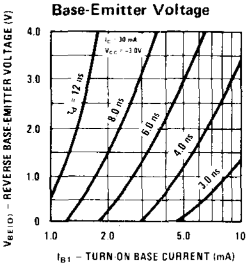


FIGURE 1. Switching Time Test Circuit

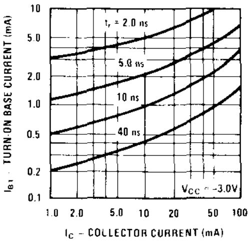
Switching Times vs Temperature



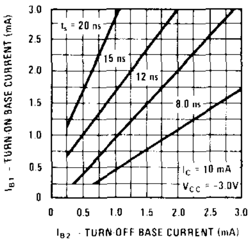
Delay Time vs Turn On Base Current and Reverse Base-Emitter Voltage



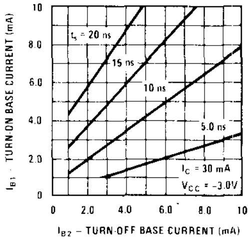
Rise Time vs Collector and Turn On Base Currents



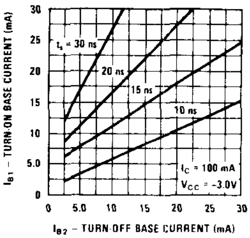
Storage Time vs Turn On and Turn Off Base Currents



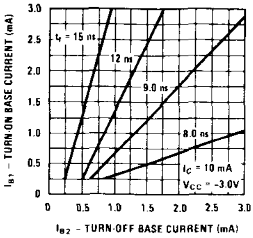
Storage Time vs Turn On and Turn Off Base Currents



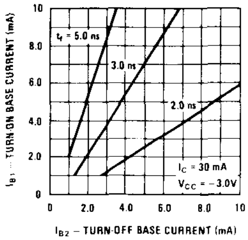
Storage Time vs Turn On and Turn Off Base Currents



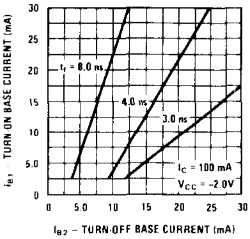
Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents

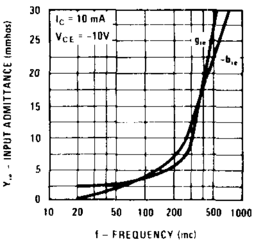


Fall Times vs Turn On and Turn Off Base Currents

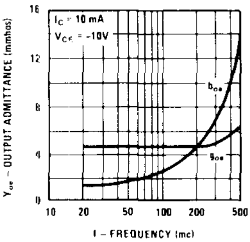


COMMON EMITTER VS FREQUENCY Y PARAMETERS

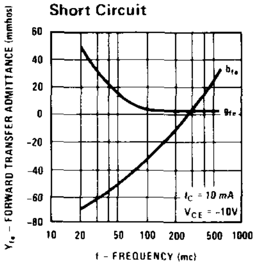
Input Admittance vs Frequency-Output Short Circuit



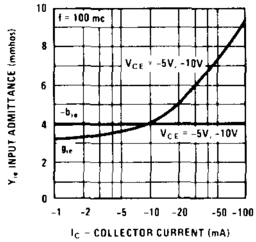
Output Admittance vs Frequency-Input Short Circuit



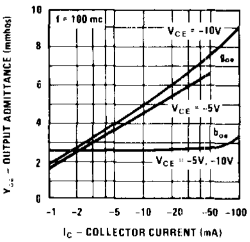
Forward Transfer Admittance vs Frequency-Output Short Circuit



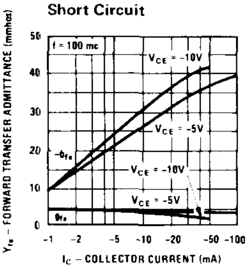
Input Admittance vs Collector Current and Voltage-Output Short Circuit



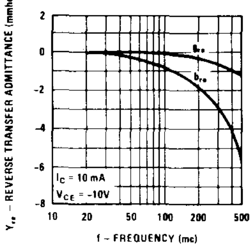
Output Admittance vs Collector Current and Voltage-Input Short Circuit



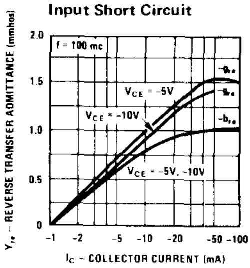
Forward Transfer Admittance vs Collector Current and Voltage-Output Short Circuit



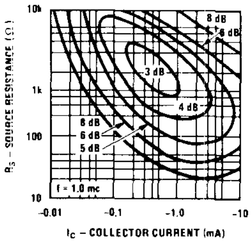
Reverse Transfer Admittance vs Frequency-Input Short Circuit



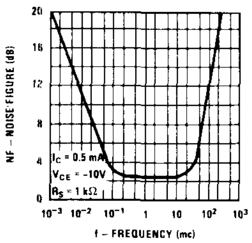
Reverse Transfer Admittance vs Collector Current and Voltage-Input Short Circuit



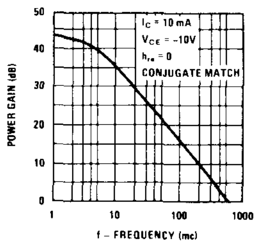
Noise Figure vs Source Resistance and Collector Current



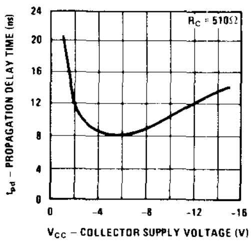
Noise Figure vs Frequency



M.A.G. vs Frequency

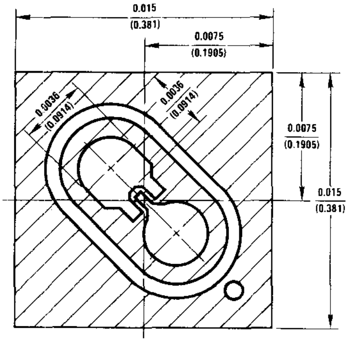


Propagation Delay Time vs Collector Supply Voltage



National Semiconductor

Process 65
PNP High Speed Switch



DESCRIPTION

Process 65 is an overlay double diffused, gold doped, silicon epitaxial device.

APPLICATION

This device was designed for very high speed saturate switching at collector currents to 50 mA.

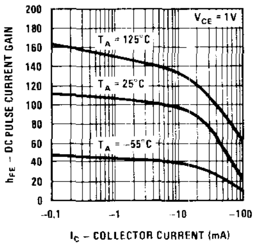
PRINCIPAL DEVICE TYPES

TO-18 2N4208
TO-92 MPS3640, 2N5771

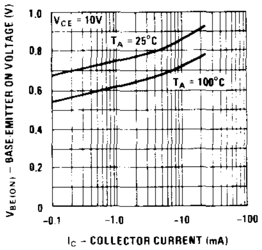
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		18	25	ns	Fig. 1
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		11	15	ns	Fig. 1
t_s	$I_C = I_{B1} = I_{B2}$ = 10 mA		15	20	ns	
C_{ob}	V_{CB} = 5V		2	3	pF	TO-18
C_{ib}	V_{EB} = .5V		2.5	3.5	pF	
h_{fe}	V_{CE} = 10V, I_C = 10 mA, f = 100 MHz	6.5	9			
h_{fe}	I_C = 1 mA, V_{CE} = 1V	20	60			
h_{fe}	I_C = 10 mA, V_{CE} = 1V	30	85	120		
h_{fe}	I_C = 50 mA, V_{CE} = 1V	20	75			
h_{fe}	I_C = 100 mA, V_{CE} = 1V	20	60			
h_{fe}	I_C = 1 mA, V_{CE} = .5V	20	60			
h_{fe}	I_C = 10 mA, V_{CE} = .3V	20	67	150		
h_{fe}	I_C = 50 mA, V_{CE} = 1.0V	20	60			
$V_{CE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.10	0.13	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.12	0.15	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.25	0.50	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.73	0.8	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.88	0.95	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		1.00	1.5	V	
BV_{CEO}	I_C = 3 mA	12	15	20	V	
BV_{CBO}	I_C = 100 μA	25	30	40	V	
BV_{EBO}	I_C = 10 μA	4.5			V	
I_{CBO}	V_{CB} = 3V			50	nA	

Process 65

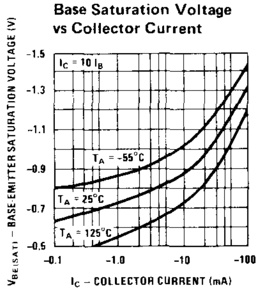
DC Pulse Current Gain vs Collector Current



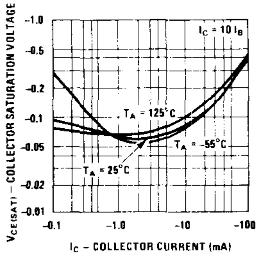
Base-Emitter On Voltage vs Collector Current



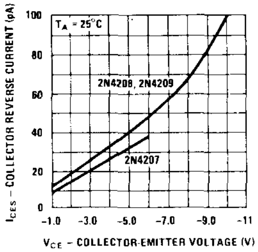
Base Saturation Voltage vs Collector Current



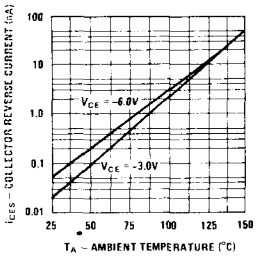
Collector Saturation Voltage vs Collector Current



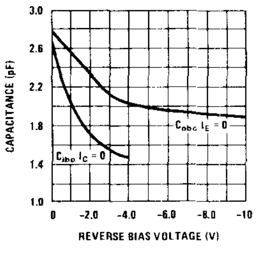
Collector Reverse Current vs Collector-Emitter Voltage



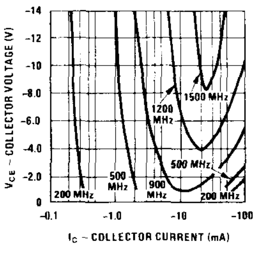
Collector Reverse Current vs Ambient Temperature



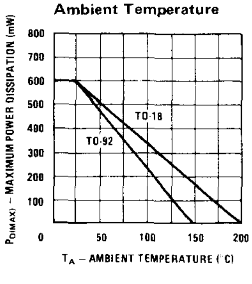
Input and Output Capacitance vs Reverse Bias Voltage



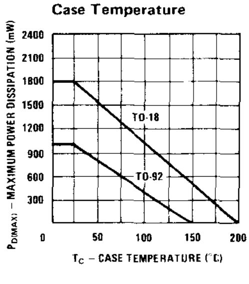
Contours of Constant Gain Bandwidth Product (f_T)



Maximum Power Dissipation vs Ambient Temperature

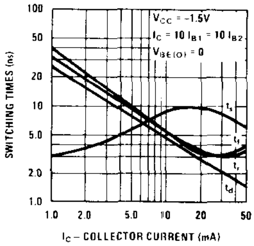


Maximum Power Dissipation vs Case Temperature

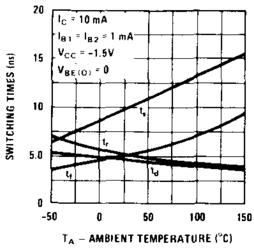


Process 65

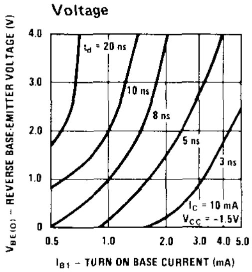
Switching Times vs Collector Current



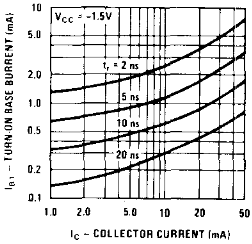
Switching Times vs Ambient Temperature



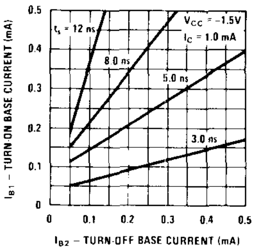
Delay Time vs Turn On Base Current and Reverse Base-Emitter Voltage



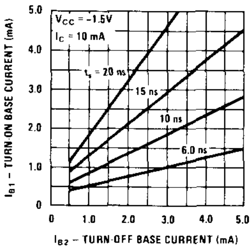
Rise Time vs Collector and Turn On Base Currents



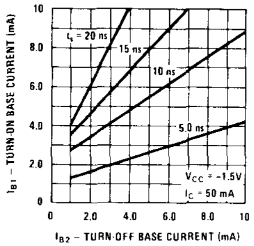
Storage Time vs Turn On and Turn Off Base Currents



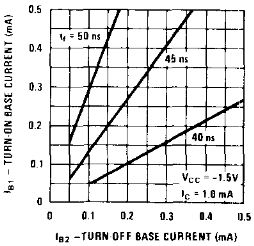
Storage Time vs Turn On and Turn Off Base Currents



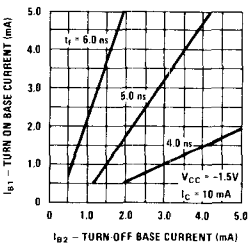
Storage Time vs Turn On and Turn Off Base Currents



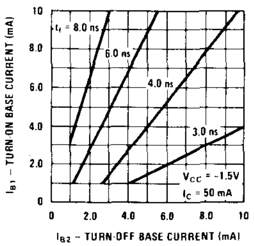
Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



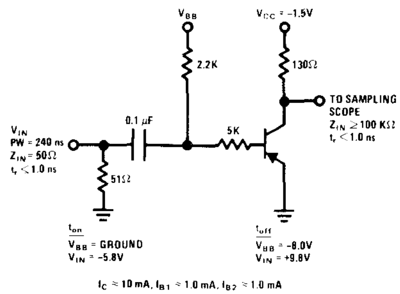
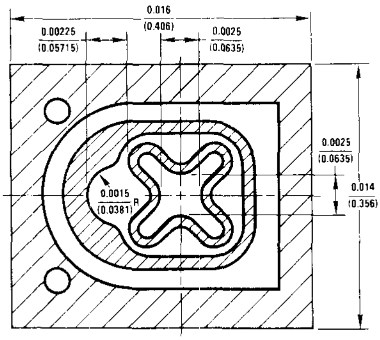


FIGURE 1. t_{on} and t_{off} Test Circuit

National Semiconductor

Process 66 PNP Small Signal



DESCRIPTION

Process 66 is a nonoverlay double diffused, gold doped, silicon epitaxial device. Complement to Process 23.

APPLICATION

This device was designed for general purpose amplifier and switching applications at collector currents of 10 μA to 100 mA.

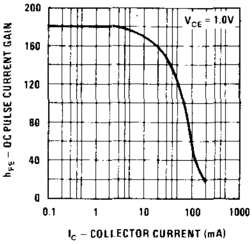
PRINCIPAL DEVICE TYPES

TO-92 2N3906

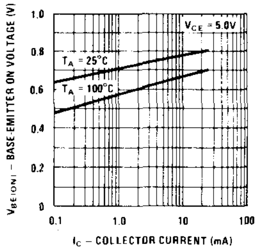
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		125	300	ns	
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		30	70	ns	
C_{ob}	V_{CB} = 5V		3.0	4.5	pF	TO-92
C_{ib}	V_{EB} = 0.5V		6.0	10.0	pF	TO-92
h_{fe}	f = 100 MHz, V_{CE} = 20V, I_C = 10 mA	2.5	6.0			
NF (wide band)	I_C = 100 μA, V_{CE} = 5V, R_S = 1 kΩ		2.0	4.0	dB	
h_{fe}	I_C = 0.1 mA, V_{CE} = 1V	40	80			
h_{fe}	I_C = 1 mA, V_{CE} = 1V	50	120			
h_{fe}	I_C = 10 mA, V_{CE} = 1V	50	150	300		
h_{fe}	I_C = 50 mA, V_{CE} = 1V	40	110			
h_{fe}	I_C = 100 mA, V_{CE} = 1V	20	40			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.07	0.25	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.12	0.40	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.75	0.85	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.85	0.95	V	
BV_{CEO}	I_C = 1 mA	30	45	60	V	
BV_{CBO}	I_C = 100 μA	45		70	V	
BV_{CES}	I_C = 10 μA	45		70	V	
BV_{EBO}	I_C = 10 μA	5.0			V	
I_{CBO}	V_{CB} = 25V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 66

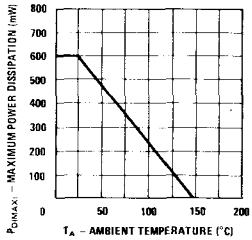
DC Pulse Current Gain vs Collector Current



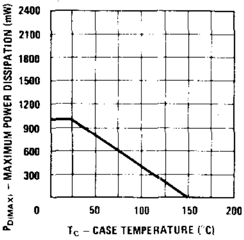
Base-Emitter On Voltage vs Collector Current



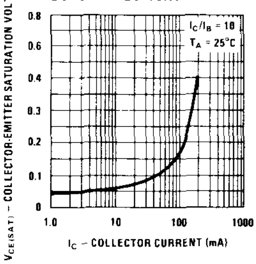
Maximum Power Dissipation vs Ambient Temperature TO-92



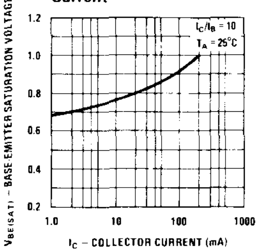
Maximum Power Dissipation vs Case Temperature TO-92



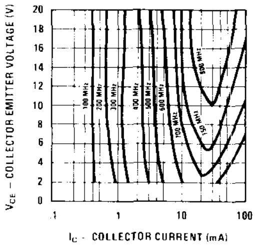
Collector-Emitter Saturation Voltage vs Collector Current



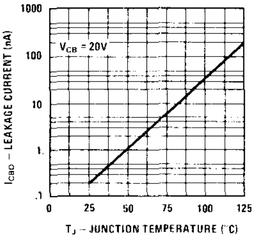
Base-Emitter Saturation Voltage vs Collector Current



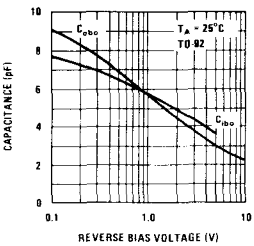
Contours of Constant Gain Bandwidth Product (f_T)



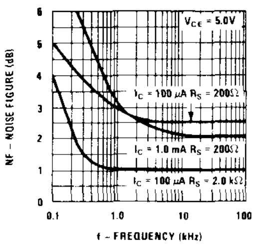
Collector-Base Diode Reverse Current vs Temperature



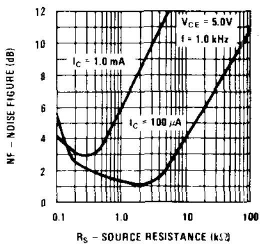
Common Base Open Circuit Input and Output Capacitance vs Reverse Bias Voltage



Noise Figure vs Frequency

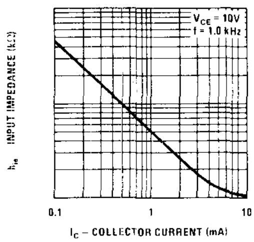


Noise Figure vs Source Resistance

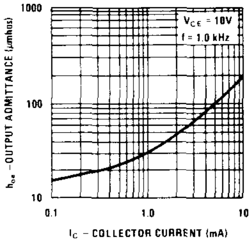


Process 66

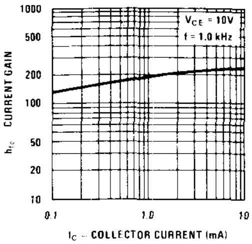
Input Impedance



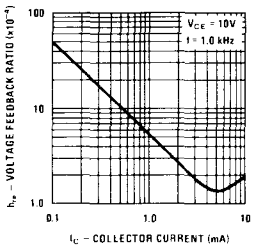
Output Admittance



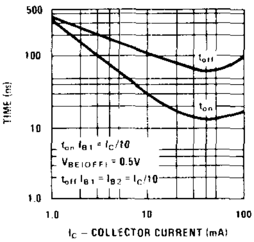
Current Gain



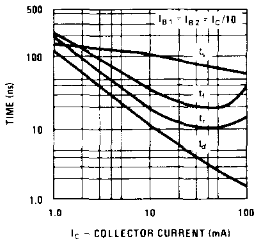
Voltage Feedback Ratio



Turn On and Turn Off Times vs Collector Current

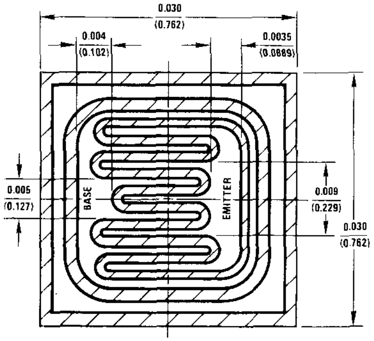


Switching Times vs Collector Current



National Semiconductor

Process 67 PNP Medium Power



DESCRIPTION

Process 67 is a nonoverlay double diffused silicon device. Complement to Process 12.

APPLICATION

This device is designed for general purpose amplifier and switching applications at currents to one amp.

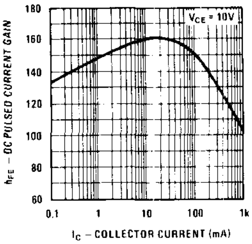
PRINCIPAL DEVICE TYPES

TO-39	2N4033
TO-92	MPS4356, MPSA55
TO-92+	TN4033

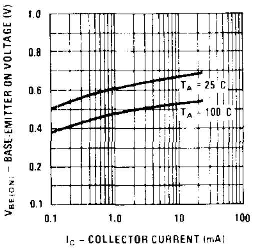
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 500 mA, I_{B1} = 50 mA	20	25	60	ns	
t_{off}	I_C = 500 mA, I_{B2} = 50 mA	200	250	400	ns	
C_{ob}	V_{CB} = 10V		11	15	pF	TO-39
C_{ib}	V_{EB} = 0.50V		65	90	pF	TO-39
h_{fe}	V_{CE} = 10V, I_C = 50 mA, f = 100 MHz	1.5	2			
NF (spot)	I_C = 100 μA, R_S = 1k, V_{CE} = 10V, f = 1 kHz		0.5	4	dB	
h_{FE}	I_C = 0.10 mA, V_{CE} = 10V	36	135			
h_{FE}	I_C = 1.0 mA, V_{CE} = 10V	40	145			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	42	160	370		
h_{FE}	I_C = 100 mA, V_{CE} = 10V	40	150	350		
h_{FE}	I_C = 500 mA, V_{CE} = 10V	35	130			
h_{FE}	I_C = 1A, V_{CE} = 10V	25	100			
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.15	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.4	0.5	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.8	1.0	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.95	1.2	V	
BV_{CEO}	I_C = 10 mA	60	80	90	V	
BV_{CBO}	I_C = 100 μA	80	120		V	
BV_{EBO}	I_E = 10 μA	6			V	
I_{CBO}	V_{CB} = 60V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 67

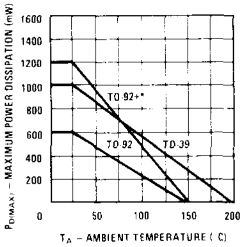
DC Pulse Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current

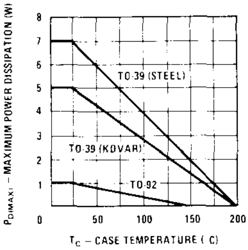


Maximum Power Dissipation vs Ambient Temperature

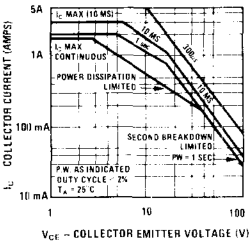


*One square inch of copper run

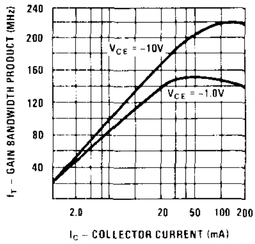
Maximum Power Dissipation vs Case Temperature



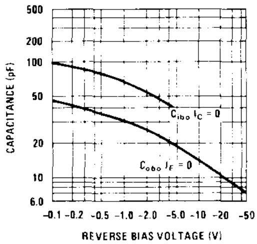
Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink



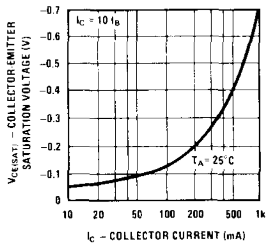
Gain Bandwidth Product vs Collector Current



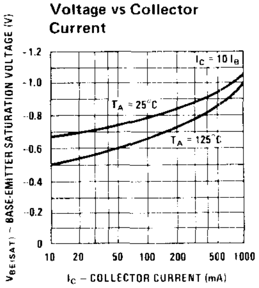
Common Base Open Circuit Input and Output Capacitance vs Reverse Bias Voltage



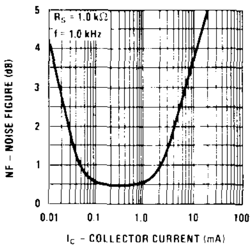
Collector-Emitter Saturation Voltage vs Collector Current



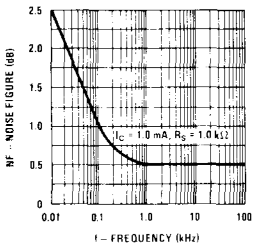
Base-Emittter Saturation Voltage vs Collector Current



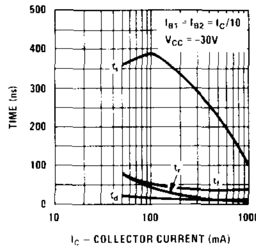
Noise Figure vs Collector Current



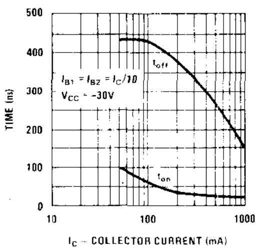
Noise Figure vs Frequency



Switching Times vs Collector Current



Turn On and Turn Off Times vs Collector Current

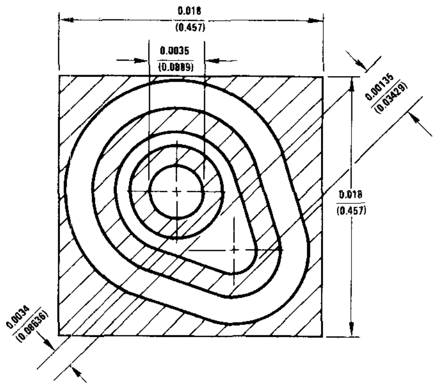


Process 67

6

National Semiconductor

Process 69 PNP Small Signal



DESCRIPTION

Process 69 is a nonoverlay double diffused, silicon epitaxial device. Complements Process 27.

APPLICATION

This device was designed for general purpose amplifier and switching applications to collector currents of 100 mA.

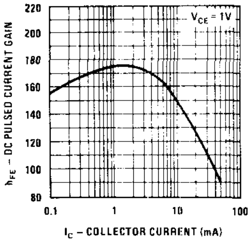
PRINCIPAL DEVICE TYPES

TO-18 2N3251A

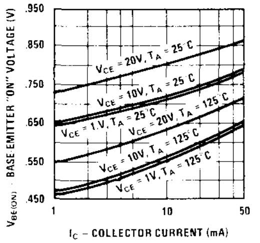
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
T_{ON}	I_C = 10 mA, I_B = 1 mA		50	70	ns	
T_{OFF}	I_C = 10 mA, I_B = 1 mA		125	225	ns	
NF	V_{CE} = 5V, I_C = 100 μA, f = 1 kHz R_S = 1 kΩ		1.7	4.5	dB	
C_{OB}	V_{CE} = 5V		4	5.0	pF	
C_{IB}	V_{EB} = 1V		6.5	8.0	pF	
f_T	V_{CE} = 20V, I_C = 10 mA	250	450		MHz	
h_{FE}	V_{CE} = 1V, I_C = 100 μA	40	150	270		
h_{FE}	V_{CE} = 1V, I_C = 1 mA	55	175	315		
h_{FE}	V_{CE} = 1V, I_C = 10 mA	50	150	270		
h_{FE}	V_{CE} = 1V, I_C = 50 mA	15	85	150		
h_{FE}	V_{CG} = 1V, I_C = 100 mA		18	35		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.15	0.25	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.25	0.50	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.74	0.90	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.90	1.20	V	
I_{CBO}	V_{CB} = 30V		1.5	50	nA	
I_{EBO}	V_{EB} = 4V		0.05	50	nA	
BV_{CBO}	I_C = 10 μA	50	70	95		
BV_{EBO}	I_C = 10 μA	5.0				
BV_{CEO}	I_C = 1 mA	40	50	60		
BV_{CES}	I_C = 10 μA		70			

Process 69

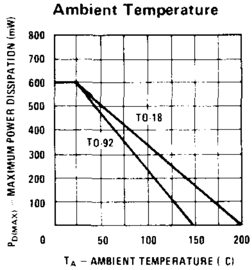
DC Pulsed Current Gain vs Collector Current



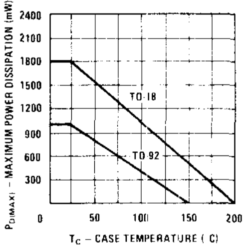
Base-Emitter On Voltage vs Collector Current



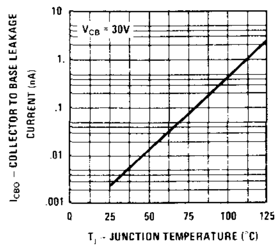
Maximum Power Dissipation vs Ambient Temperature



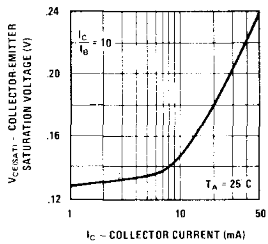
Maximum Power Dissipation vs Case Temperature



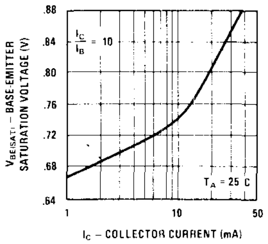
Collector-Base Diode Reverse Current vs Temperature



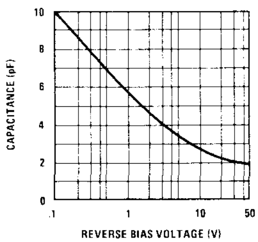
Collector-Emitter Saturation Voltage vs Collector Current



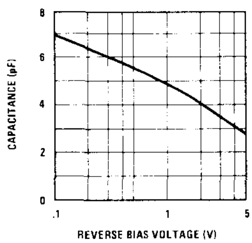
Base-Emitter On Voltage vs Collector Current



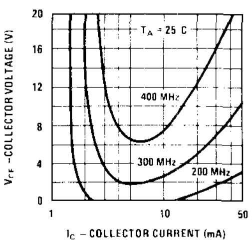
***Output Capacitance vs* Reverse Bias Voltage**



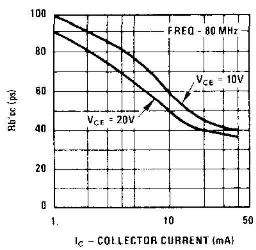
Input Capacitance vs Reverse Bias Voltage



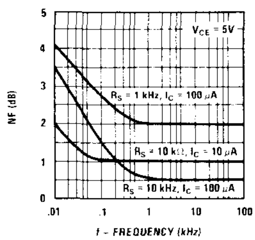
Contours of Constant Gain Bandwidth Product (f_T)



Rb'cc vs Collector Current

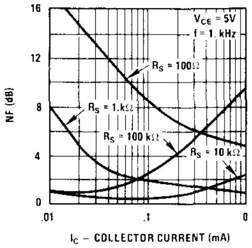


Noise Figure vs Frequency

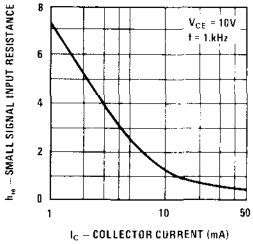


Process 69

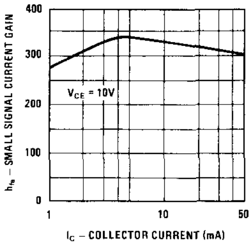
Noise Figure vs Collector Current



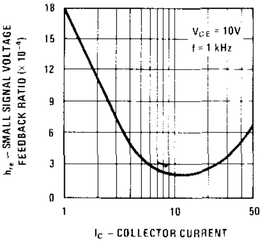
Small Signal Input Resistance vs Collector Current



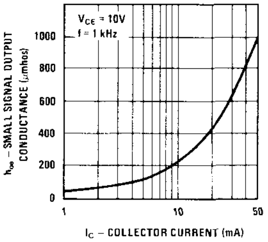
Small Signal Current Gain vs Collector Current



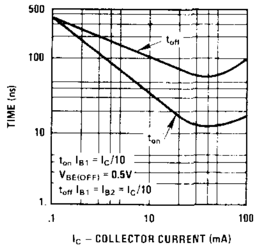
Small Signal Voltage Feedback Ratio vs Collector Current



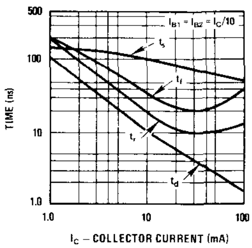
Small Signal Output Conductance vs Collector Current



Turn On and Turn Off Times vs Collector Current

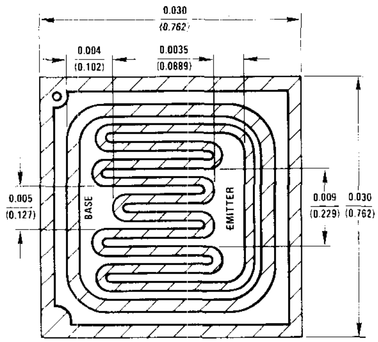


Switching Times vs Collector Current



National Semiconductor

Process 70 PNP Memory Driver



DESCRIPTION

Process 70 is a nonoverlay double diffused, gold doped, silicon epitaxial device. Complement to process 25.

APPLICATION

This device was designed primarily for high speed saturated switching applications.

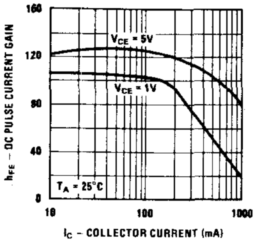
PRINCIPAL DEVICE TYPES

TO-39	2N3467
TO-92+	TN3467

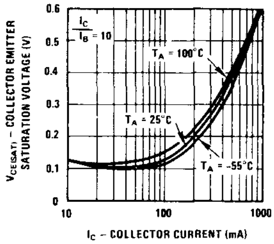
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{ON}	I_C = 500 mA, I_{B1} = 50 mA		20	40	ns	Fig. 1
t_{OFF}	I_C = 500 mA, I_{B2} = 50 mA		60	90	ns	Fig. 2
h_{fe}	I_C = 50 mA, V_{CE} = −10V, f = 100 MHz	1.75	2.9			
C_{ob}	V_{CB} = −10V		15	20	pF	
C_{ib}	V_{eb} = −0.5V		65	80	pF	
h_{FE}	I_C = 100 mA, V_{CE} = −1V	40	100	200		
h_{FE}	I_C = 500 mA, V_{CE} = −1V	40	75	120		
h_{FE}	I_C = 1 Amp, V_{CE} = −1V	40	85			
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.165	0.3	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.30	0.5	V	
$V_{CE(SAT)}$	I_C = 1 Amp, I_B = 100 mA		0.50	1.0	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.80	1.0	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.95	1.2	V	
$V_{BE(SAT)}$	I_C = 1 Amp, I_B = 100 mA		1.1	1.6	V	
BV_{CEO}	I_C = 10 mA	30	40	50	V	
BV_{CBO}	I_C = 10 μA	40	60	80	V	
BV_{EBO}	I_E = 10 μA	5	8.0		V	
I_{CBO}	V_{CB} = 30V		10	100	nA	
I_{CEX}	V_{CE} = −30V, $V_{BE(OFF)}$ = 3V		10	100	nA	
I_{bL}	V_{CE} = −30V, $V_{BE(OFF)}$ = 3V		10	120	nA	

Process 70

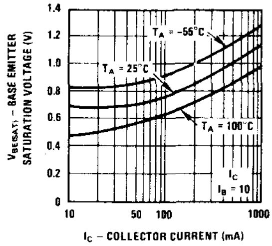
DC Pulse Current Gain vs Collector Current



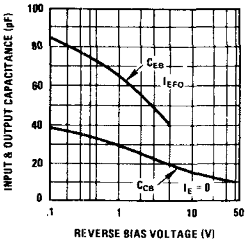
Collector-Emitter Saturation Voltage vs Collector Current



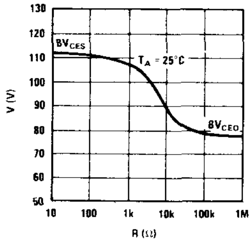
Base-Emitter Saturation Voltage vs Collector Current



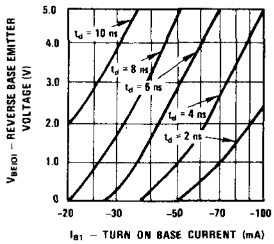
Input & Output Capacitance vs Reverse Bias Voltage



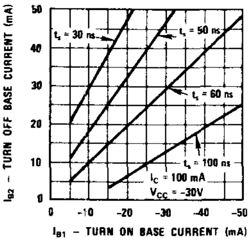
BV_{CER} vs R_{BE}
I_C = 10 mA



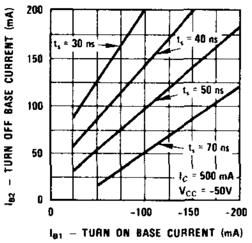
Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



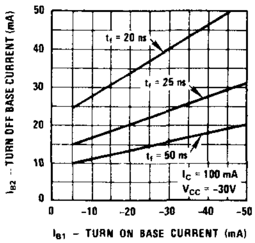
Storage Time vs Turn On and Turn Off Base Currents



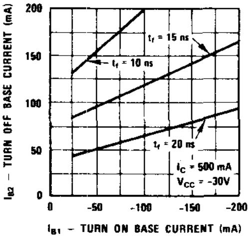
Storage Time vs Turn On and Turn Off Base Currents



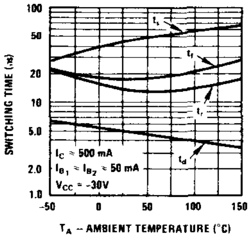
Fall Time vs Turn On and Turn Off Base Currents



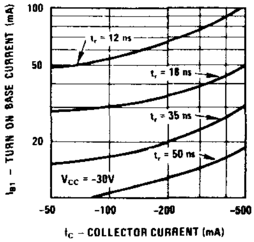
Fall Time vs Turn On and Turn Off Base Currents



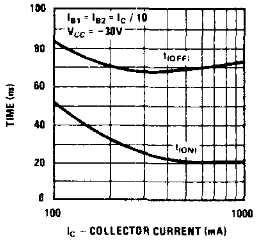
Switching Times vs Ambient Temperature



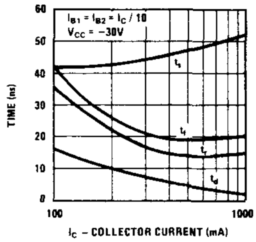
Rise Time vs Collector Current and Turn On Base Current



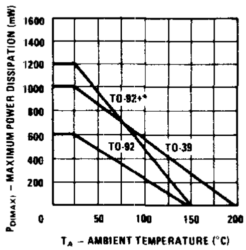
Turn On and Turn Off Times vs Collector Current



Switching Times vs Collector Current

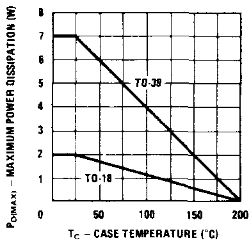


Maximum Power Dissipation vs Ambient Temperature



*One square inch of copper run

Maximum Power Dissipation vs Case Temperature



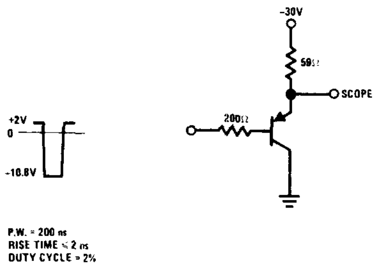


FIGURE 1. t_{on} Equivalent Test Circuit

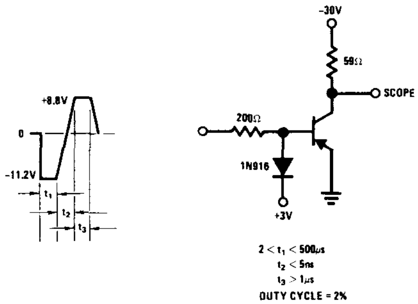
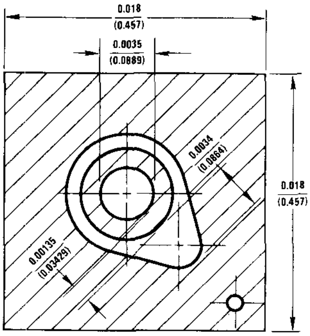


FIGURE 2. t_{off} Equivalent Test Circuit

National Semiconductor

Process 71 PNP Small Signal



DESCRIPTION

Process 71 is a nonoverlay, double diffused, silicon device. Complement to Process 04.

APPLICATION

This device was designed for general purpose amplifier applications at collector currents to 20 mA.

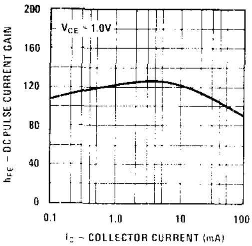
PRINCIPAL DEVICE TYPES

TO-18	BC177 Series
TO-92	BC560 Series

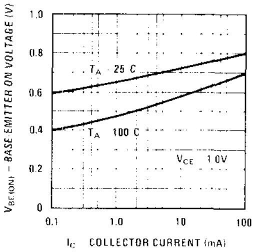
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_C = 5V, R_S = 2k, f = 1 kHz		0.5	2.50	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 5V, f = 100 MHz	3	5			
C_{ob}	V_{CB} = 10V		4	6	pF	TO-18
C_{ib}	V_{EB} = 0.50V		8	12	pF	TO-18
h_{FE}	I_C = 100 μA, V_{CE} = 5V	40	140	400		
h_{FE}	I_C = 1 mA, V_{CE} = 5V	40	140	400		
h_{FE}	I_C = 10 mA, V_{CE} = 5V	40	130			
h_{FE}	I_C = 20 mA, V_{CE} = 5V	40	125			
$V_{CE(SAT)}$	I_C = 1 mA, I_B = 0.10 mA		0.04	0.10	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.055	0.11	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = 0.10 mA		0.8	0.95	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.9	1.0	V	
BV_{CEO}	I_C = 1 mA	40	50		V	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 10 μA	5	6		V	
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 71

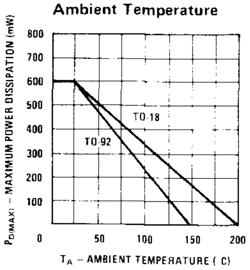
DC Pulse Current Gain vs Collector Current



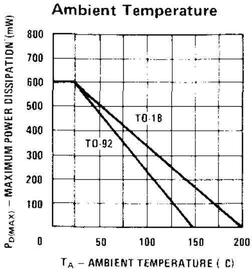
Base-Emitter On Voltage vs Collector Current



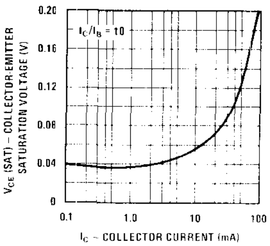
Maximum Power Dissipation vs Ambient Temperature



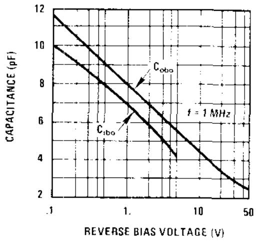
Maximum Power Dissipation vs Ambient Temperature



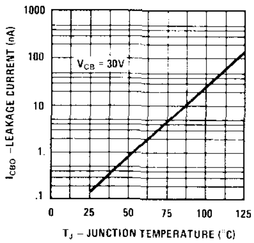
Collector-Emitter Saturation Voltage vs Collector Current



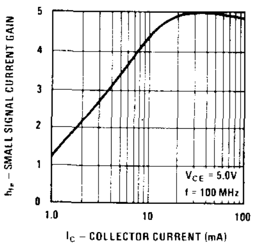
Capacitance vs Reverse Bias Voltage



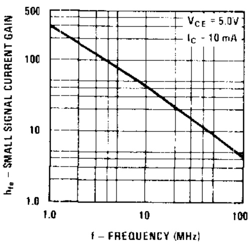
Collector-Base Diode Reverse Current vs Temperature



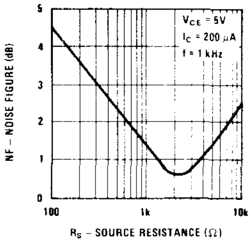
Small Signal Current Gain vs Collector Current



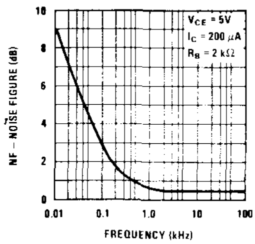
Capacitance vs Reverse Bias Voltage



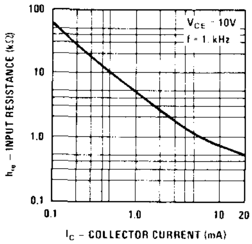
Noise Figure vs Source Resistance



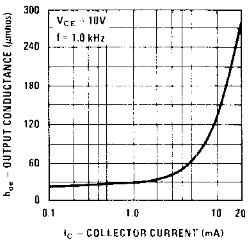
Noise Figure vs Frequency



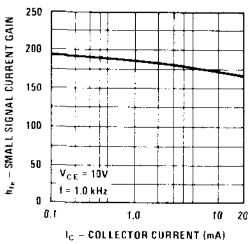
Small Signal Input Resistance vs Collector Current



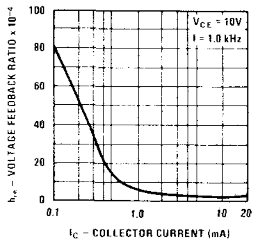
Small Signal Output Conductance vs Collector Current



Small Signal Current Gain vs Collector Current

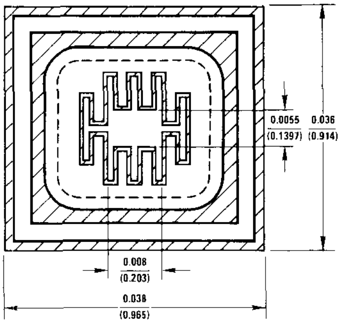


Small Signal Voltage Feedback Ratio vs Collector Current



National Semiconductor

Process 73 PNP High Voltage



DESCRIPTION

Process 73 is nonoverlay doubled diffused, silicon epitaxial device. Complement to Process 08.

APPLICATION

This device was designed as a general purpose amplifier and switch for applications requiring high line voltages.

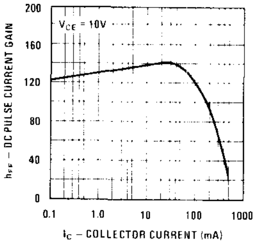
PRINCIPAL DEVICE TYPES

TO-39 2N3634
TO-92+ TN3634

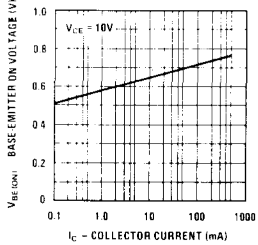
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C = 10 mA	105	160	180	V	
BV_{CBO}	I_C = 100 μA	145		250	V	
BV_{EBO}	I_E = 10 μA	5	7		V	
I_{CBO}	V_{CB} = 100V			100	nA	
I_{EBO}	V_{EB} = 3V			50	nA	
h_{FE}	I_C = 0.1 mA, V_{CE} = 10V	40	80			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	45	90			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	50	100			
h_{FE}	I_C = 50 mA, V_{CE} = 10V	55	135	270		
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.15	0.3	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.75	0.9		
C_{OB}	V_{CB} = 20V		8	10	pF	
C_{IB}	V_{EB} = 1.0V		50	75	pF	
F_T	I_C = 30 mA, V_{CE} = 30V, f = 100 MHz	150	225		MHz	

Process 73

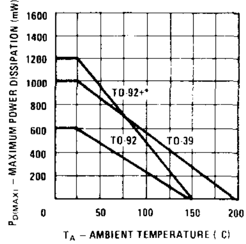
DC Pulse Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current

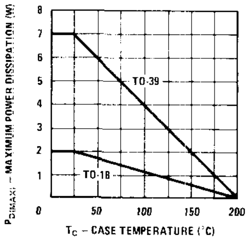


Maximum Power Dissipation vs Ambient Temperature

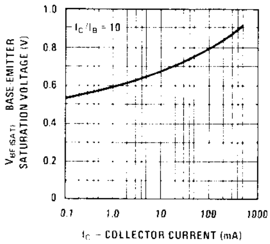


*One square inch of copper run

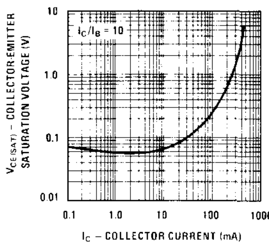
Maximum Power Dissipation vs Case Temperature



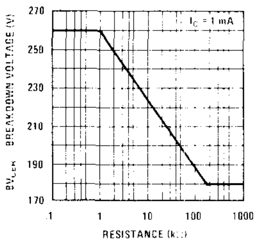
Base-Emitter Saturation Voltage vs Collector Current



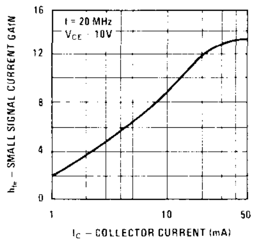
Collector-Emitter Saturation Voltage vs Collector Current



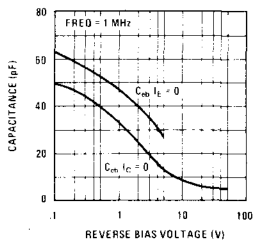
Collector-Emitter Breakdown Voltage With Resistance Between Emitter-Base



Small Signal Current Gain vs Collector Current

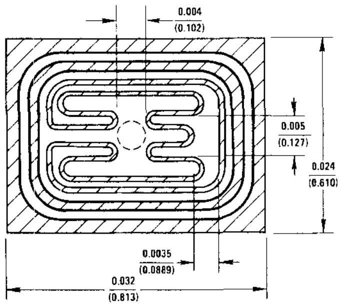


Input and Output Capacitance vs Reverse Bias Voltage



National Semiconductor

Process 74 PNP High Voltage



DESCRIPTION

Process 74 is nonoverlay double diffused, silicon epitaxial device. Complement to Process 16.

APPLICATION

This device was designed as a general purpose amplifier and switch for applications requiring high line voltages

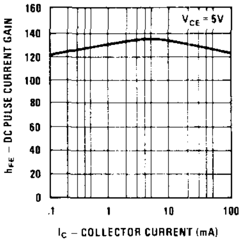
PRINCIPAL DEVICE TYPES

TO-92 2N5401, MPSL51

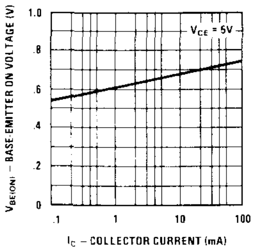
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C = 1 mA	105	170	210	V	
BV_{CBO}	I_C = 100 μA	150		275	V	
BV_{EBO}	I_E = 10 μA	6				
I_{CBO}	V_{CB} = 100V			100	nA	
I_{EBO}	V_{EB} = 3V			50	nA	
h_{FE}	I_C = 1 mA, V_{CE} = 5V	30	60			
h_{FE}	I_C = 10 mA, V_{CE} = 5V	40	150	240		
h_{FE}	I_C = 50 mA, V_{CE} = 5V	40	60			
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.18	0.25		
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.77	1.0		
C_{OB}	V_{CB} = 10V		8	12	pF	
f_T	I_C = 10 mA, V_{CE} = 10V, f = 100 MHz	100	160	300	MHz	

Process 74

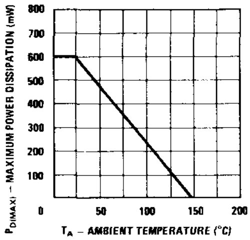
DC Pulse Current Gain vs Collector Current



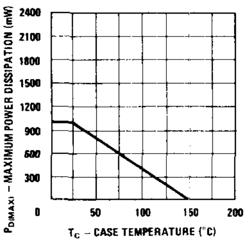
Base-Emitter On Voltage vs Collector Current



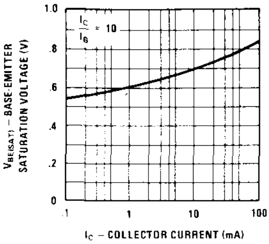
Maximum Power Dissipation vs Ambient Temperature TO-92



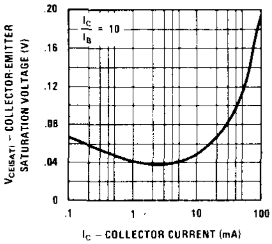
Maximum Power Dissipation vs Case Temperature TO-92



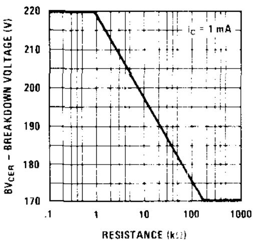
Base-Emitter Saturation Voltage vs Collector Current



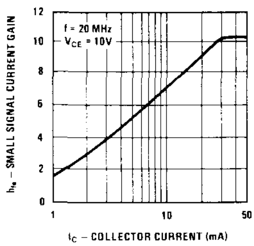
Collector-Emitter Saturation Voltage vs Collector Current



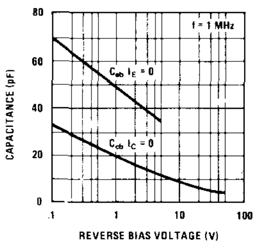
Collector-Emitter Breakdown Voltage With Resistance Between Base-Emitter



Small Signal Current Gain vs Collector Current



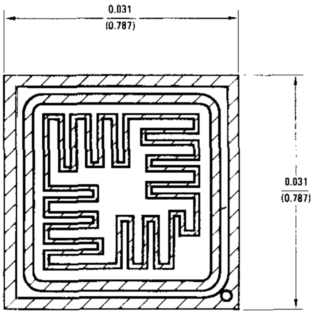
Input and Output Capacitance vs Reverse Bias Voltage



6

National Semiconductor

Process 77 PNP Medium Power



DESCRIPTION

Process 77 is a double diffused silicon epitaxial planar device. Complement to Process 37.

APPLICATION

This device was designed for general purpose medium power amplifier and switching circuits that require collector currents to 1A.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 10 mA	25		45	V
BV_{CBO}	I_C = 100μA	40			V
BV_{EBO}	I_E = 100μA	5	7		V
I_{CBO}	$V_{CB} = BV_{CEO}$		50	500	nA
I_{EBO}	V_{EB} = 5V		0.1	10C	μA
h_{FE}	I_C = 500 mA, V_{CE} = 1V	50		250	
$V_{CE(SAT)}$	I_C = 1A, I_B = 0.1A		0.3	0.5	V
$V_{BE(SAT)}$	I_C = 1A, I_B = 0.1A		1.0	1.5	V
f_T	I_C = 100 mA, V_{CE} = 10V		200		MHz
C_{OBO}	V_{CB} = 10V			20	pF

PRINCIPAL DEVICE TYPES

TO-202 (Package 35)
NSD202
NSD203
NSDU51
NSDU51A

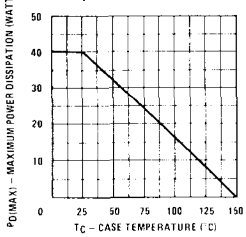
TO-202 (Package 36)
D43C1
D43C2
D43C3
D43C4
D43C5
D43C6
NSE170

92 PLUS (Package 90)
92PE77A
BD372A

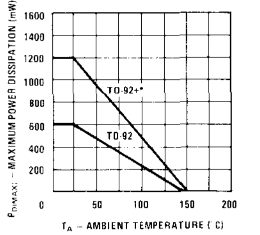
92 PLUS (Package 91)
92PU51
92PU51A
BD370A

TO-126 (Package 38)
BD136

Power Dissipation vs Case Temperature TO-126



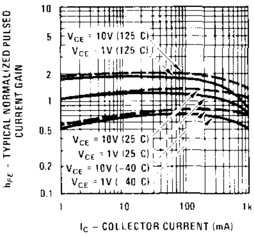
Maximum Power Dissipation vs Ambient Temperature



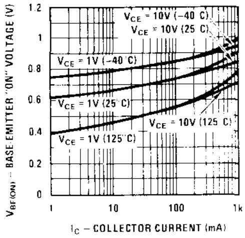
*One square inch of copper run

Process 77

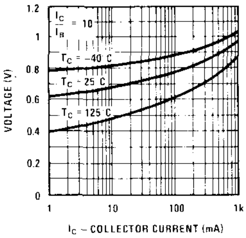
Typical Normalized Pulsed Current Gain vs Collector Current



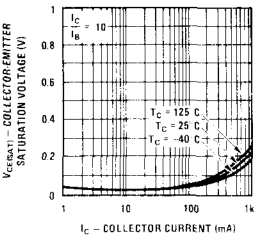
Base-Emitter "ON" Voltage vs Collector Current



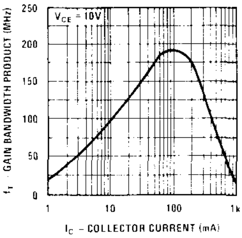
Base-Emitter Saturation Voltage vs Collector Current



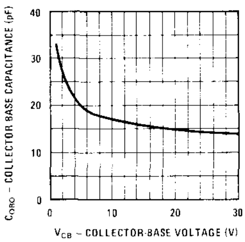
Collector-Emitter Saturation Voltage vs Collector Current



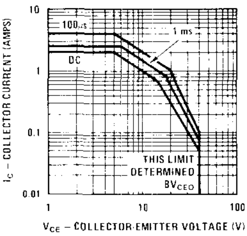
Gain Bandwidth Product vs Collector Current



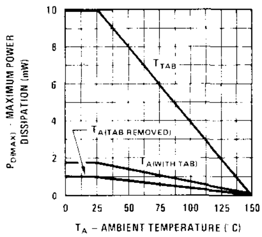
Collector-Base Capacitance vs Collector-Base Voltage



Safe Operating Area TO-202

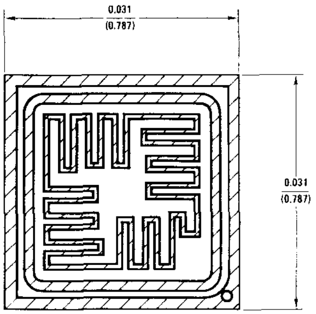


Maximum Power Dissipation vs Ambient Temperature (TO-202)



National Semiconductor

Process 78 PNP Medium Power



DESCRIPTION

Process 78 is a double diffused silicon epitaxial planar device complement to Process 38.

APPLICATION

This device was designed for general purpose medium power amplifier and switching circuits that require collector currents to 1A.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 10 mA	45		80	V
BV_{CBO}	I_C = 100μA	75		110	V
BV_{EBO}	I_E = 100μA	5	7		V
I_{CBO}	V_{CB} = BV_{CEO}		50	500	nA
I_{EBO}	V_{EB} = 5V		0.1	100	μA
h_{FE}	I_C = 100 mA, V_{CE} = 1V	50		250	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.2	0.5	V
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.95	1.4	V
f_T	I_C = 100 mA, V_{CE} = 10V	50			MHz
C_{OBO}	V_{CB} = 10V			15	pF

PRINCIPAL DEVICE TYPES

TO-202 (Package 35)

NSDU55
NSD6180
NSD6181

TO-126 (Package 38)

BD138

TO-202 (Package 36)

D43C7
D43C8
D43C9
NSE171

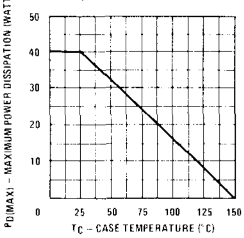
92 PLUS (Package 90)

92PE77B
BD372B
BD372C

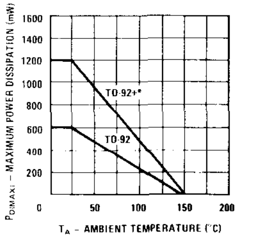
92 PLUS (Package 91)

92PU55
BD370B
BD370C

Power Dissipation vs Case Temperature TO-126



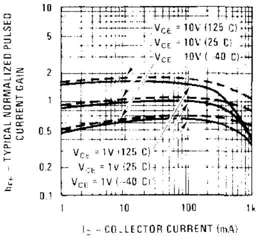
Maximum Power Dissipation vs Ambient Temperature



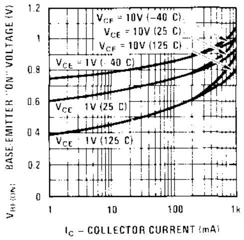
*One square inch of copper run

Process 78

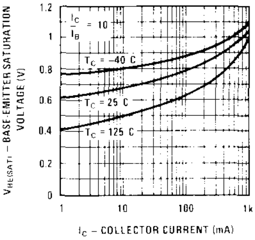
Typical Normalized Pulsed Current Gain vs Collector Current



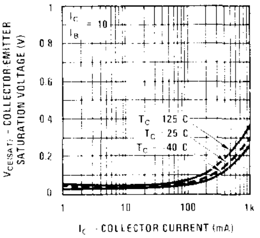
Base-Emitter "ON" Voltage vs Collector Current



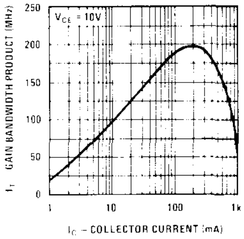
Base-Emitter Saturation Voltage vs Collector Current



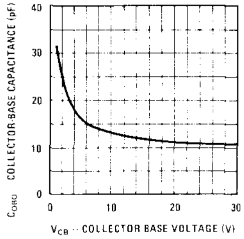
Collector-Emitter Saturation Voltage vs Collector Current



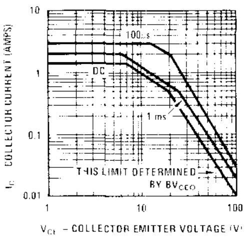
Gain Bandwidth Product vs Collector Current



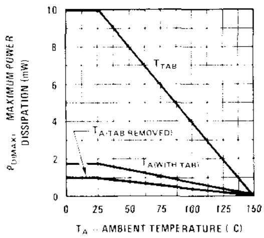
Collector-Base Capacitance vs Collector-Base Voltage



Safe Operating Area TO-202

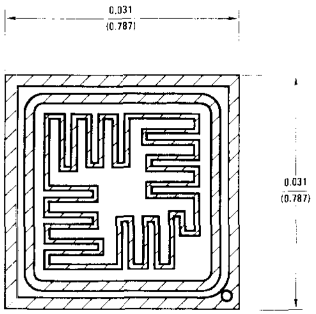


Maximum Power Dissipation vs Ambient Temperature



National Semiconductor

Process 79 PNP Medium Power



DESCRIPTION

Process 79 is a double diffused silicon epitaxial planar device complement to Process 39.

APPLICATION

This device was designed for general purpose medium power amplifier and switching circuits that require collector currents to 1A.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	$I_C = 10$ mA	80		110	V
BV_{CBO}	$I_C = 100$ μA	110		140	V
BV_{EBO}	$I_E = 100$ μA	5	7		V
I_{CBO}	$V_{CB} = BV_{CEO}$		50	500	nA
I_{EBO}	$V_{EB} = 5V$		0.1	100	μA
h_{FE}	$I_C = 100$ mA, $V_{CE} = 1V$	25		150	
$V_{CE(SAT)}$	$I_C = 500$ mA, $I_B = 50$ mA		0.2	0.5	V
$V_{BE(SAT)}$	$I_C = 500$ mA, $I_B = 50$ mA		0.9	1.4	V
f_T	$I_C = 100$ mA, $V_{CE} = 10V$	50	120		MHz
C_{OBO}	$V_{CB} = 10V$			15	pF

PRINCIPAL DEVICE TYPES

TO-202 (Package 35)

NSD204
NSD205
NSD206
NSDU56
NSDU57

92 PLUS (Package 90)

92PE77C
BD372D

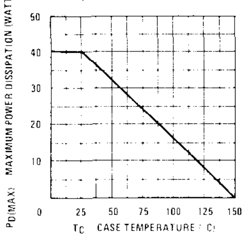
92 PLUS (Package 91)

92PU56
92PU57
BD370D

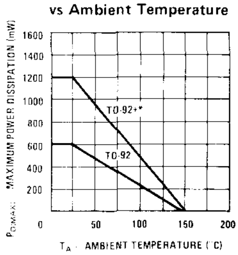
TO-126 (Package 38)

BD140

Power Dissipation vs Case Temperature TO-126



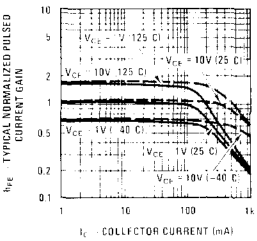
Maximum Power Dissipation vs Ambient Temperature



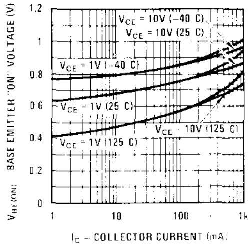
*One square inch of copper run

Process 79

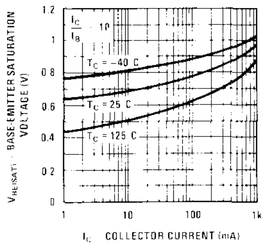
Typical Normalized Pulsed Current Gain vs Collector Current



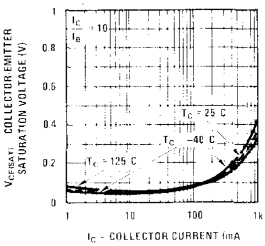
Base-Emitter "ON" Voltage vs Collector Current



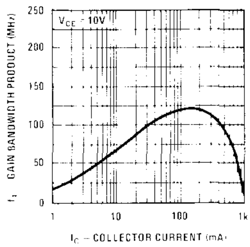
Base-Emitter Saturation Voltage vs Collector Current



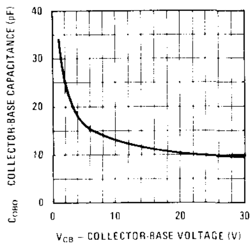
Collector-Emitter Saturation Voltage vs Collector Current



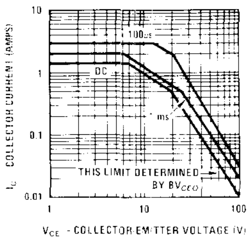
Gain Bandwidth Product vs Collector Current



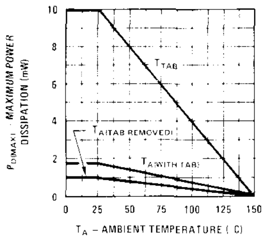
Collector-Base Capacitance vs Collector-Base Voltage



Safe Operating Area TO-202



Maximum Power Dissipation vs Ambient Temperature (TO-202)



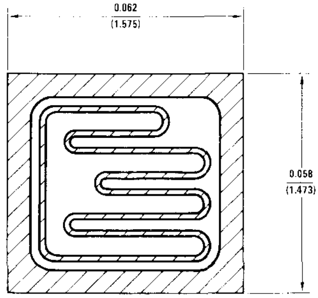
Section 7

Process Characteristics Mesa Transistors

7

National Semiconductor

Process 2C/4F NPN Epitaxial Power



DESCRIPTION

Process 2C/4F is a double epitaxial silicon mesa with diffused emitter.

APPLICATION

This device was designed for general purpose power amplifier and switching circuits where a large safe operating area is required.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 100 mA, (Note 1)	30		100	V
BV_{CBO}	I_C = 1 mA	60		200	V
BV_{EBO}	I_E = 1mA	5	8		V
I_{CEO}	V_{CE} = BV_{CEO} 10V		10	300	μA
I_{CBO}	V_{CB} = BV_{CEO}		0.1	10	μA
I_{EBO}	V_{EB} = 5V		10	100	μA
h_{FE}	I_C = 1.0A, V_{CE} = 1V, (Note 1)	15		200	
$V_{CE(SAT)}$	I_C = 2.0A, I_B = 0.3A, (Note 1)			0.5	V
$V_{BE(ON)}$	I_C = 2.0A, V_{CE} = 2.0V, (Note 1)			1.0	V
SOA	TO 220, V_{CE} = 25V t = 1 sec	1.6			A
SOA	TO-126, V_{CE} = 33.3V, t = 1 sec	0.9			A
SOA	TO-202, V_{CE} = 30V, t = 1 sec	0.4			A
f_T	I_C = 0.5A, V_{CE} = 2V	4			MHz
t_d	I_C = 1A, I_{B1} = I_{B2} = 0.1A, V_{CC} = 40V		0.05		μs
t_r	I_C = 1A, I_{B1} = I_{B2} = 0.1A, V_{CC} = 40V		0.25		μs
t_s	I_C = 1A, I_{B1} = I_{B2} = 0.1A, V_{CC} = 40V		0.75		μs
t_f	I_C = 1A, I_{B1} = I_{B2} = 0.1A, V_{CC} = 40V		0.25		μs
$P_{D(MAX)}$	TO-220	40			W
	TO-126	30			W
	TO-202	12.5			W
θ_{jc}	TO-220			3.125	°C/W
	TO-126			4.167	°C/W
	TO-202			10.0	°C/W

Note 1: Pulsed measurement = 300μs pulse width.

PRINCIPAL DEVICE TYPES

TO-220 (Package 37)

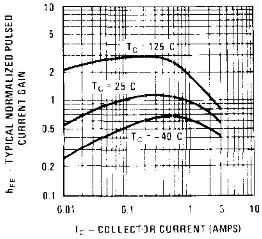
DC44C1, DC44C2, DC44C4, DC44C5, DC44C7, DC44C8, DC44C10, NSP520, NSP521, NSP4921, NSP4922, NSP4923, TIP29, TIP29A, TIP29B, TIP29C, TIP31, TIP31A, TIP31B, TIP31C, TIP61, TIP61A, TIP61B, TIP61C

TO-126 (Package 38)

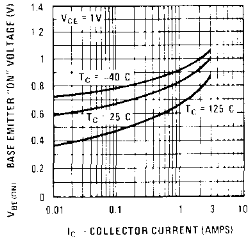
2N4921, 2N4922, 2N4923, MJE520, MJE521

Process 2C/4F

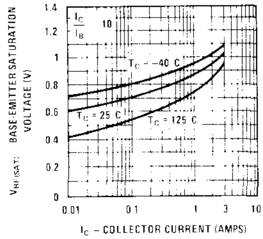
Typical Normalized Pulsed Current Gain vs Collector Current



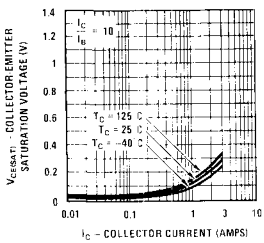
Base-Emitter "ON" Voltage vs Collector Current



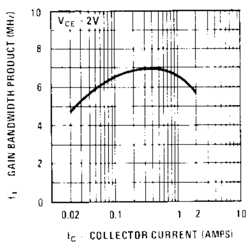
Base-Emitter Saturation Voltage vs Collector Current



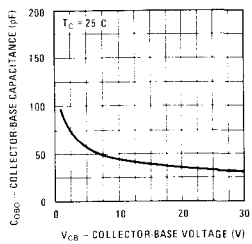
Collector-Emitter Saturation Voltage vs Collector Current



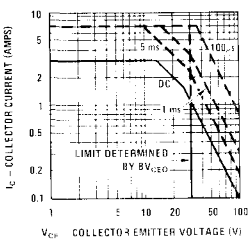
Gain Bandwidth Product vs Collector Current



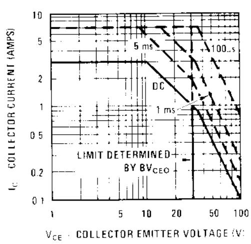
Collector-Base Capacitance vs Collector-Base Voltage



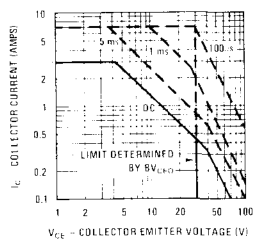
Safe Operating Area TO-220



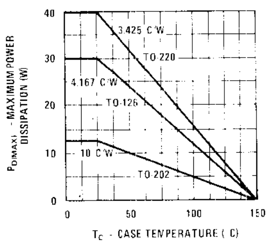
Safe Operating Area TO-126



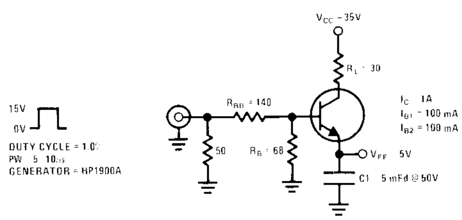
Safe Operating Area TO-202



Maximum Power Dissipation vs Case Temperature

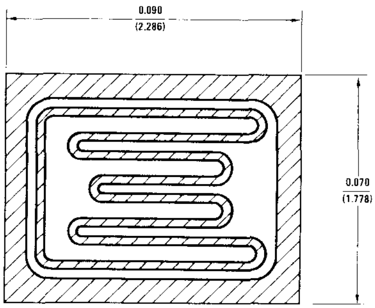


Switching Circuit



National Semiconductor

Process 2E/4E NPN Epitaxial Power



DESCRIPTION

Process 2E/4E is a double epitaxial silicon mesa with diffused emitter.

APPLICATION

This device was designed for general purpose power amplifier and switching circuits where a large safe operation area is required.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 100 mA, (Note 1)	30	60	100	V
BV_{CBO}	I_C = 1 mA	50		200	V
BV_{EBO}	I_E = 1mA	5	8		V
I_{CEO}	V_{CE} = BV_{CEO} 10V		50	300	μA
I_{CBO}	V_{CB} = BV_{CEO}		10	100	μA
I_{EBO}	V_{EB} = 5V		50	1000	μA
h_{FE}	I_C = 1.5A, V_{CE} = 20V, (Note 1)	20		200	
$V_{CE(SAT)}$	I_C = 4.0A, I_B = 0.6A, (Note 1)			0.6	V
$V_{BE(ON)}$	I_C = 4.0A, V_{CE} = 2.0V, (Note 1)			1.3	V
SOA	TO-220, V_{CE} = 33.3V, t = 1 sec	1.5			A
SOA	TO-126, V_{CE} = 33.3V, t = 1 sec	1.2			A
SOA	TO-202, V_{CE} = 30V, t = 1 sec	0.5			A
f_T	I_C = 0.5A, V_{CE} = 2V, f = 1 MHz	4			MHz
t_d	I_C = 1.0A, I_{B1} = 0.1A, I_{B2} = 0.1A, V_{CC} = 30V		0.10		μs
t_r	I_C = 1.0A, I_{B1} = 0.1A, I_{B2} = 0.1A, V_{CC} = 30V		0.25		μs
t_s	I_C = 1.0A, I_{B1} = 0.1A, I_{B2} = 0.1A, V_{CC} = 30V		0.35		μs
t_f	I_C = 1.0A, I_{B1} = 0.1A, I_{B2} = 0.1A, V_{CC} = 30V		0.23		μs
$P_{D(MAX)}$	TO-220	50			W
	TO-126	40			W
	TO-202	15			W
θ_{jc}	TO-220			2.5	°C/W
	TO-126			3.125	°C/W
	TO-202			8.33	°C/W

Note 1: Pulsed measurement = 300μs pulse width

PRINCIPAL DEVICE TYPES

TO-220 (Package 37)

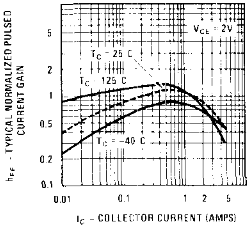
2N5293	2N5298	2N6130	2N6291	D44C9	NSP41B
2N5294	2N6121	2N6131	2N6292	D44C11	NSP41C
2N5295	2N6122	2N6288	2N6293	D44C12	NSP5190
2N5296	2N6123	2N6289	D44C3	NSP41	NSP5192
2N5297	2N6129	2N6290	D44C6	NSP41A	NSP5193

TO-126 (Package 38)

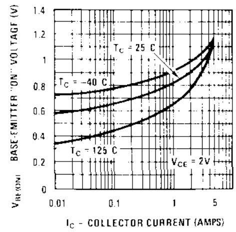
2N5190
2N5191
2N5192

Process 2E/4E

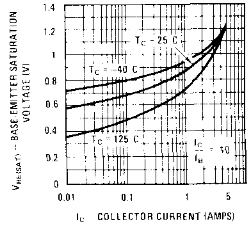
Typical Normalized Pulsed Current Gain vs Collector Current



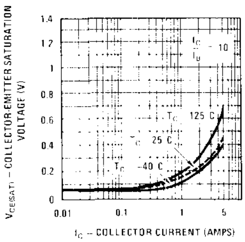
Base-Emitter "ON" Voltage vs Collector Current



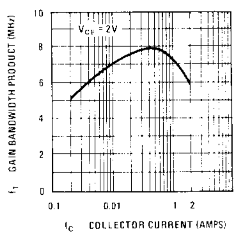
Base-Emitter Saturation Voltage vs Collector Current



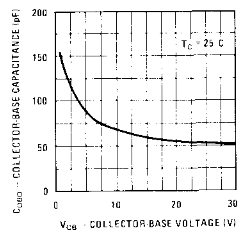
Collector-Emitter Saturation Voltage vs Collector Current



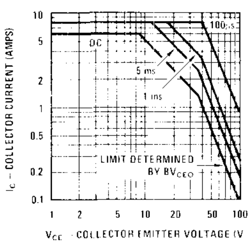
Gain Bandwidth Product vs Collector Current



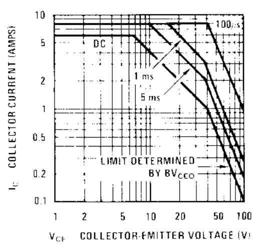
Typical Collector Capacitance vs Collector-Base Voltage



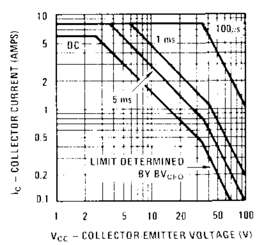
Safe Operating Area TO-220



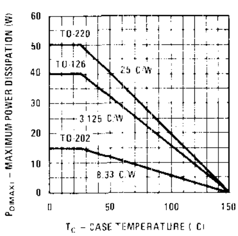
Safe Operating Area TO-126



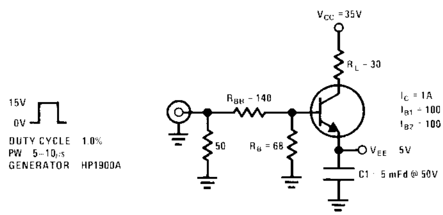
Safe Operating Area TO-202



Maximum Power Dissipation vs Case Temperature



Switching Circuit



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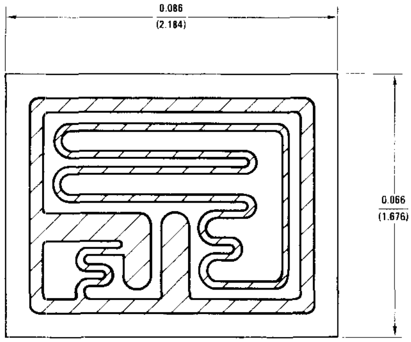
Process 2J/4J NPN Power Darlington



DESCRIPTION

Process 2J/4J is a double epitaxial silicon mesa device. Complement to Process 3J/5J.

APPLICATION

This device was designed for use in driver and output stages of complementary audio amplifier circuits. It is also well suited for solenoid driver applications.

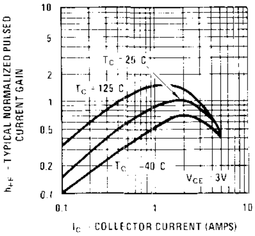
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 100 mA	30		100	V
BV_{CBO}	I_C = 100μA	50		120	V
BV_{EBO}	I_E = 2 mA	5			V
I_{CEO}	V_{CE} = 1/2 BV_{CEO}			0.5	mA
I_{CBO}	V_{CB} = BV_{CEO}			200	μA
I_{EBO}	V_{EB} = 5V			2.0	mA
h_{FE}	I_C = 2A, V_{CE} = 3V	500		15,000	
$V_{CE(SAT)}$	I_C = 5A, I_B = 2.0 mA			3.0	V
$V_{BE(ON)}$	I_C = 5A, V_{CE} = 3V			2.5	V
C_{OBO}	V_{CB} = 10V		30		pF
$\|h_{FE}\|$	I_C = 1A, V_{CE} = 3V, f = 1 MHz		9		MHz
t_{ON}	I_C = 6A, V_{CE} = 30V, *(Figure 1)*		1.25		μs
t_{OFF}	I_C = 6A, V_{CE} = 30V, *(Figure 1)*		2.75		μs
SOA	TO-220, V_{CE} = 33V, t = 1 sec	1.5			A
SOA	TO-126, V_{CE} = 33V, t = 1 sec	1.2			A
$P_{D(MAX)}$	TO-220	50			W
$P_{D(MAX)}$	TO-126	40			W
θ_{jc}	TO-220			2.5	°C/W
θ_{jc}	TO-126			3.125	°C/W

PRINCIPAL DEVICE TYPES

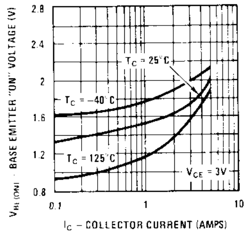
TO-220 (Package 37)
2N6386, NSP2101, TIP110, NSP2102, TIP111, NSP2103, TIP112, NSP2100

TO-126 (Package 38)
2N6037, MJE802, 2N6038, MJE803, 2N6039, MJE800, MJE801

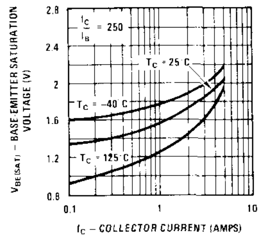
Typical Normalized Pulsed Current Gain vs Collector Current



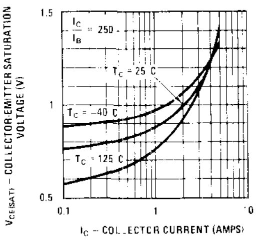
Base-Emitter "ON" Voltage vs Collector Current



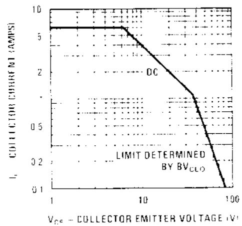
Base-Emitter Saturation Voltage vs Collector Current



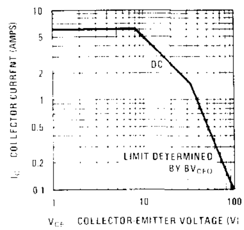
Collector-Emitter Saturation Voltage vs Collector Current



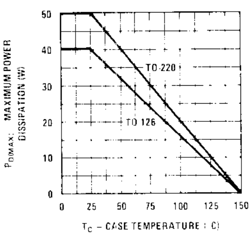
Safe Operating Area TO-126



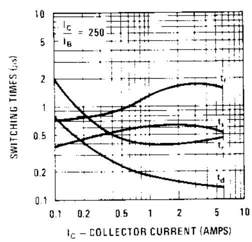
Safe Operating Area TO-220



Maximum Power Dissipation vs Case Temperature



Switching Times vs Collector Current



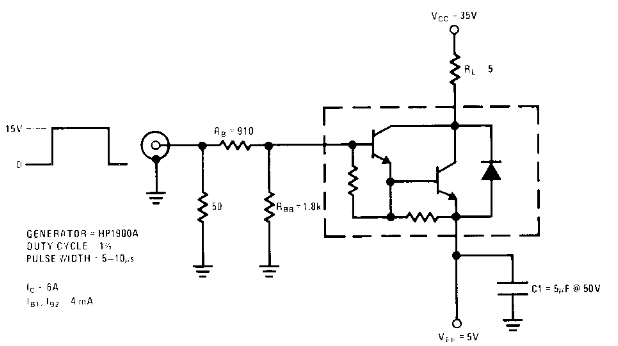
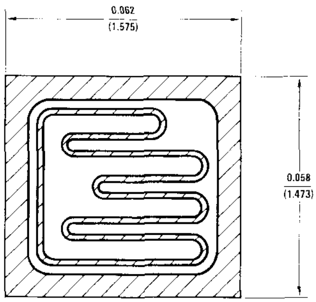


FIGURE 1

National Semiconductor

Process 3C/5F PNP Epitaxial Power



DESCRIPTION

Process 3C/5F is a double epitaxial silicon mesa with diffused emitter.

APPLICATION

This device was designed for general purpose power amplifier and switching circuits where a large safe operating area is required.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 100 mA	30		100	V
BV_{CBO}	I_C = 1 mA	50		150	V
BV_{EBO}	I_E = 1 mA	5	6.5		V
I_{CEO}	$V_{CE} = BV_{CEO} - 10V$		10	300	μA
I_{CBO}	$V_{CB} = BV_{CEO}$		0.1	10	μA
I_{EBO}	V_{EB} = 5V		10	100	μA
h_{FE}	I_C = 1.0A, V_{CE} = 1.0V	10		120	
$V_{CE(SAT)}$	I_C = 2.0A, I_B = 0.3A			0.5	V
$V_{BE(ON)}$	I_C = 2.0A, V_{CE} = 2.0V			1.1	V
SOA	TO-220, V_{CE} = 25V, t = 1 sec	1.6			A
SOA	TO-126, V_{CE} = 33.3V, t = 1 sec	0.9			A
SOA	TO-202, V_{CE} = 33.3V, t = 1 sec	0.375			A
f_T	I_C = 0.5A, V_{CE} = 2V	4			MHz
t_d			0.03		μs
t_r	I_C = 1A, $I_{B1} = I_{B2}$ = 0.1A		0.20		μs
t_s	V_{CC} = 40V		0.26		μs
t_f			0.20		μs
P_D	TO-220			40	W
	TO-126			30	W
	TO-202			12.5	W
θ_{jc}	TO-220			3.125	°C/W
	TO-126			4.167	°C/W
	TO-202			10.0	°C/W

Note 1: Pulsed measurement ≈ 300μs pulse width.

PRINCIPAL DEVICE TYPES

TO-220 (Package 37)

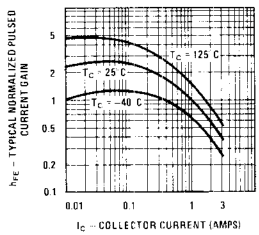
D45C1	D45C7	NSP370	TIP30	TIP32	TIP62
D45C2	D45C8	NSP4918	TIP30A	TIP32A	TIP62A
D45C4	D45C10	NSP4919	TIP30B	TIP32B	TIP62B
D45C5	D45C11	NSP4920	TIP30C	TIP32C	TIP62C

TO-126 (Package 38)

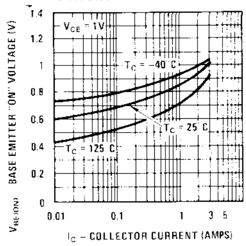
2N4918
2N4919
2N4920
MJE370

Process 3C/5F

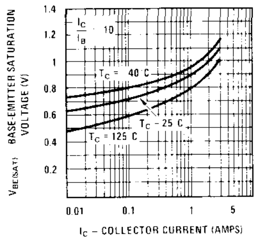
Typical Normalized Pulsed Current Gain vs Collector Current



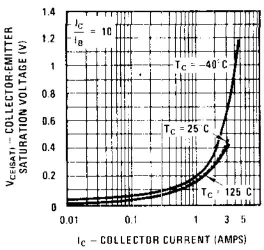
Base-Emitter "ON" Voltage vs Collector Current



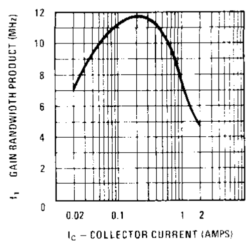
Base-Emitter Saturation Voltage vs Collector Current



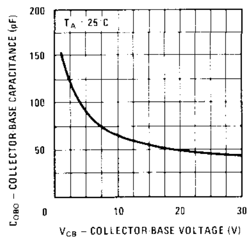
Collector-Emitter Saturation Voltage vs Collector Current



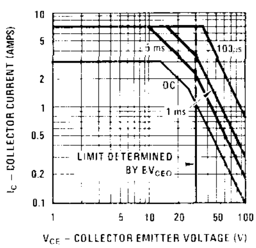
Gain Bandwidth Product vs Collector Current



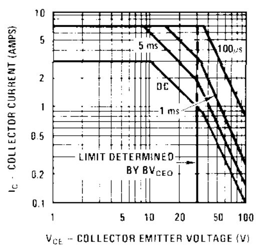
Typical Collector Capacitance vs Collector-Base Voltage



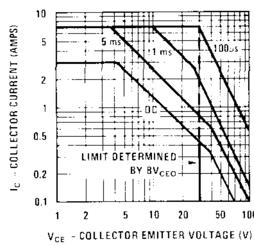
Safe Operating Area TO-220



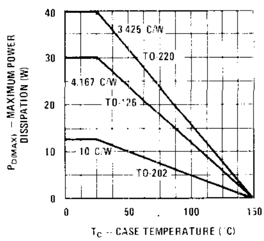
Safe Operating Area TO-126



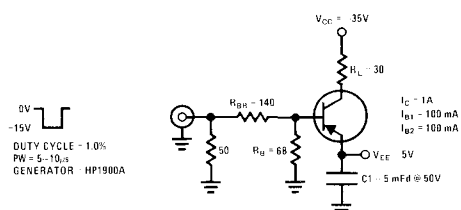
Safe Operating Area TO-202



Maximum Power Dissipation vs Case Temperature



Switching Circuit



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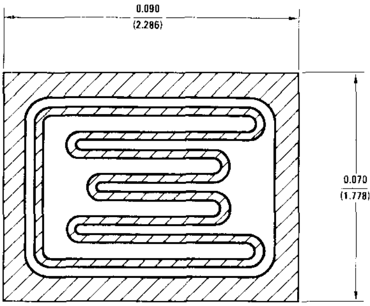
National Semiconductor

Process 3E/5E PNP Epitaxial Power



DESCRIPTION

Process 3E/5E is a double epitaxial silicon mesa with diffused emitter.

APPLICATION

This device was designed for general purpose power amplifier and switching circuits where a large safe operation area is required.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 100 mA, (Note 1)	30	60	100	V
BV_{CBO}	I_C = 1 mA	40		150	V
BV_{EBO}	I_E = 1 mA	5	8		V
I_{CEO}	$V_{CE} = BV_{CEO}$		50	300	μA
I_{CBO}	$V_{CB} = BV_{CEO}$		10	100	μA
I_{EBO}	V_{EB} = 5V		50	1000	μA
h_{FE}	I_C = 1.5A, V_{CE} = 2.0V, (Note 1)	20		170	
$V_{CE(SAT)}$	I_C = 4.0A, I_B = 0.6A, (Note 1)			0.65	V
$V_{BE(ON)}$	I_C = 4.0A, V_{CE} = 2.0V, (Note 1)			1.3	V
SOA	TO-220, V_{CE} = 33.3V, t = 1 sec	1.5			A
SOA	TO-126, V_{CE} = 33.3V, t = 1 sec	1.2			A
SOA	TO-202, V_{CE} = 33.3V, t = 1 sec	0.45			A
f_t	I_C = 0.5A, V_{CE} = 2V, f = 1 MHz	4			MHz
t_d	I_C = 1.0A, I_{B1} = 0.1A, I_{B2} = 0.1A, V_{CE} = 30V		0.10		μs
t_r	I_C = 1.0A, I_{B1} = 0.1A, I_{B2} = 0.1A, V_{CE} = 30V		0.25		μs
t_s	I_C = 1.0A, I_{B1} = 0.1A, I_{B2} = 0.1A, V_{CE} = 30V		0.40		μs
t_f	I_C = 1.0A, I_{B1} = 0.1A, I_{B2} = 0.1A, V_{CE} = 30V		0.23		μs
$P_{D(MAX)}$	TO-220 TO-126 TO-202			50 40 15	W W W
θ_{jc}	TO-220 TO-126 TO-202			2.5 3.125 8.33	°C/W °C/W °C/W

Note 1: Pulsed measurement = 300μs pulse width.

PRINCIPAL DEVICE TYPES

TO-220 (Package 37)

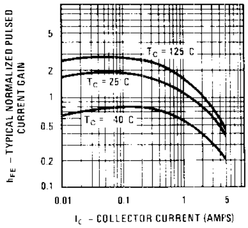
2N6106	2N6124	D45C3	NSP42B
2N6107	2N6125	D45C6	NSP42C
2N6108	2N6126	D45C9	NSP371
2N6109	2N6132	D45C12	NSP5193
2N6110	2N6133	NSP42	NSP5194
2N6111	2N6134	NSP42A	NSP5195

TO-126 (Package 38)

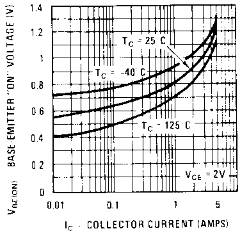
2N5193
2N5194
2N5195
MJE371

Process 3E/5E

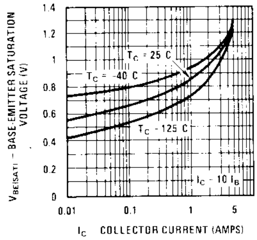
Typical Normalized Pulsed Current Gain vs Collector Current



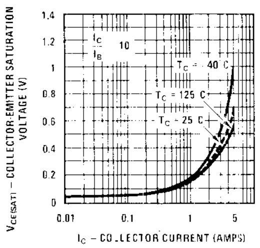
Base-Emitter "ON" Voltage vs Collector Current



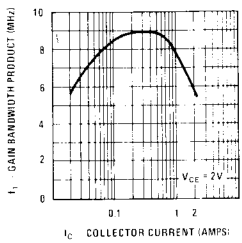
Base-Emitter Saturation Voltage vs Collector Current



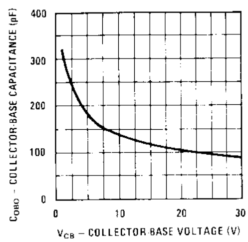
Collector-Emitter Saturation Voltage vs Collector Current



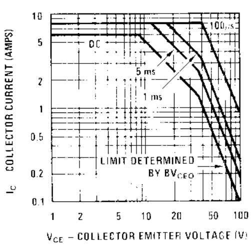
Gain Bandwidth Product vs Collector Current



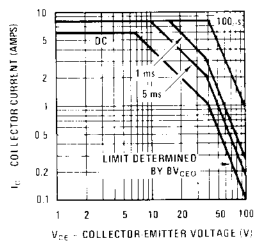
Collector-Base Capacitance vs Collector-Base Voltage



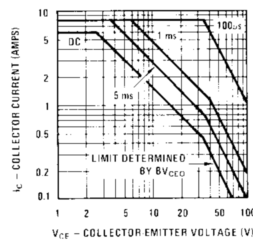
Safe Operating Area TO-220



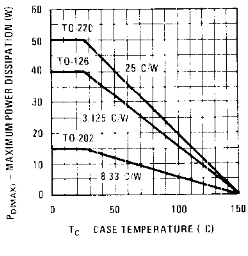
Safe Operating Area TO-126



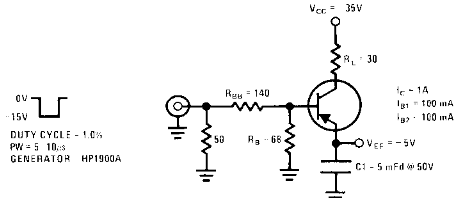
Safe Operating Area TO-202



Maximum Power Dissipation vs Case Temperature



Switching Circuit



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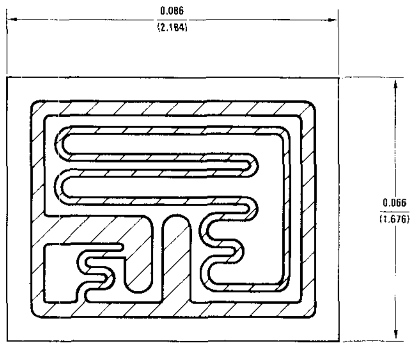
Process 3J/5J PNP Power Darlington



DESCRIPTION

Process 3J/5J is a double epitaxial silicon mesa device. Complement to Process 2J/4J.

APPLICATION

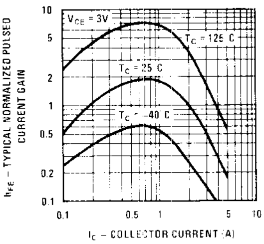
This device was designed for use in driver and output stages of complementary audio amplifier circuits. It is also well suited for solenoid driver applications.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 100 mA	30		100	V
BV_{CBO}	I_C = 100μA	5 0		120	V
BV_{EBO}	I_E = 2 mA	5			V
I_{CEO}	V_{CE} = 1/2 BV_{CEO}			0.5	mA
I_{CBO}	V_{CB} = BV_{CEO}			200	μA
I_{EBO}	V_{EB} = 5V			2.0	mA
h_{FE}	I_C = 2A, V_{CE} = 3V	500			
$V_{CE(SAT)}$	I_C = 5A, I_B = 2.0 mA			3.3	V
$V_{BE(ON)}$	I_C = 5A, V_{CE} = 3V			2.8	V
C_{OBO}	V_{CB} = 10V		35		pF
$\|h_{FE}\|$	I_C = 1A, V_{CE} = 3V, f = 1 MHz		4		
t_{ON}	I_C = 6A, V_{CE} = 30V, *(Figure 1)*		2.0		
t_{OFF}	I_C = 6A, V_{CE} = 30V, *(Figure 1)*		2.6		
$P_{D(MAX)}$	TO-220	50			W
$P_{D(MAX)}$	TO-126	40			W
θ_{jc}	TO-220			2.5	°C/W
θ_{jc}	TO-126			3.125	°C/W

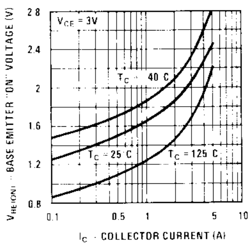
PRINCIPAL DEVICE TYPES

TO-126 (Package 38)	TO-220 (Package 37)
2N6034	TIP115
2N6035	TIP116
2N6036	TIP117
MJE700	NSP2090
MJE701	NSP2091
MJE702	NSP2092
MJE703	NSP2093

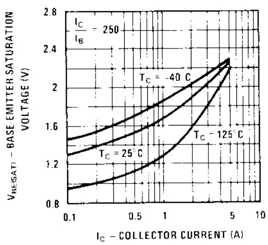
Typical Normalized Pulsed Current Gain vs Collector Current



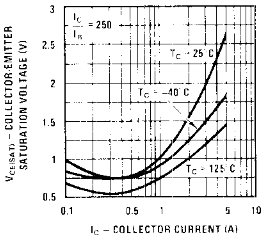
Base-Emitter "ON" Voltage vs Collector Current



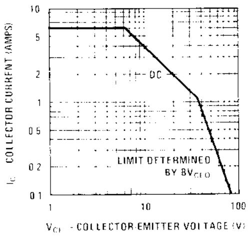
Base-Emitter Saturation Voltage vs Collector Current



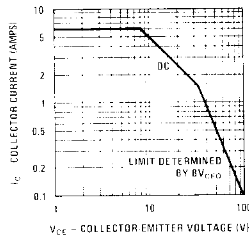
Collector-Emitter Saturation Voltage vs Collector Current



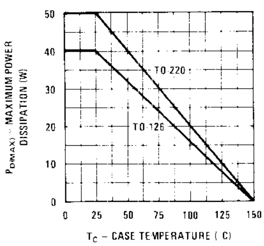
Safe Operating Area TO-126



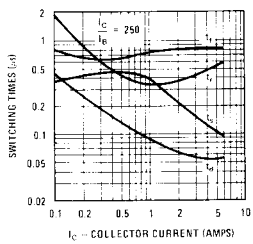
Safe Operating Area TO-220



Maximum Power Dissipation vs Case Temperature



Switching Times vs Collector Current



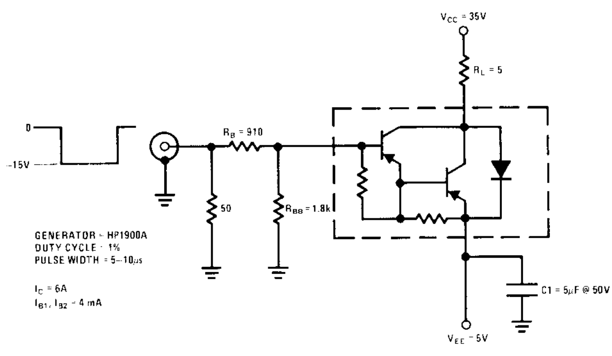
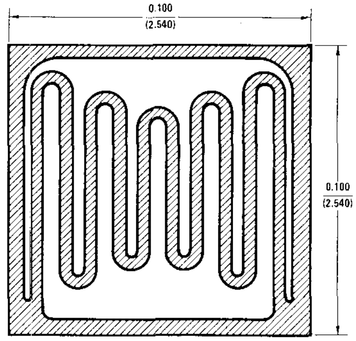


Figure 1.

National Semiconductor

Process 4A Epitaxial Power



DESCRIPTION

Process 4A is a double epitaxial silicon NPN mesa device with diffused emitter.

APPLICATION

This device was designed for general purpose power amplifier and switching circuits where a large safe operating area is required.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 200 mA, (Note 1)	40		100	V
BV_{CBO}	I_C = 1 mA	60			V
BV_{EBO}	I_E = 0.5 mA	5	7		V
I_{CEO}	$V_{CE} = BV_{CEO} - 10V$		10	200	μA
I_{CBO}	$V_{CB} = BV_{CEO} + 20V$		1	20	μA
I_{EBO}	V_{EB} = 5V		1	500	μA
h_{FE}	I_C = 2.5 A, V_{CE} = 2V	20		160	
$V_{CE(SAT)}$	I_C = 4 A, I_B = 0.4 A		0.4	0.6	V
$V_{BE(ON)}$	I_C = 5 A, V_{CE} = 2V		1.1	1.3	V
SOA	TO-3, I_C = 3 A, t = 1 sec	30			V
SOA	TO-220, I_C = 2 A, t = 1 sec	30			V
f_t	I_C = 0.5 A, V_{CE} = 5V, f = 1 MHz	2	3		
t_d	I_C = 5 A, $I_{B1} = I_{B2}$ = 0.5 A V_{CC} = 40V		0.07		μs
t_r	I_C = 5 A, $I_{B1} = I_{B2}$ = 0.5 A, V_{CC} = 40V		0.8		μs
t_s	I_C = 5 A, $I_{B1} = I_{B2}$ = 0.5 A, V_{CC} = 40V		0.4		μs
t_f	I_C = 5 A, $I_{B1} = I_{B2}$ = 0.5 A, V_{CC} = 40V		0.5		μs
$P_{D(MAX)}$	TO-3	115			W
$P_{D(MAX)}$	TO-220	60			W
θ_{jc}	TO-3			1.52	°C/W
θ_{jc}	TO 220			2.08	°C/W

Note 1: Pulsed measurement = 300 μs pulse width.

PRINCIPAL DEVICE TYPES

TO-220 (Package 37)

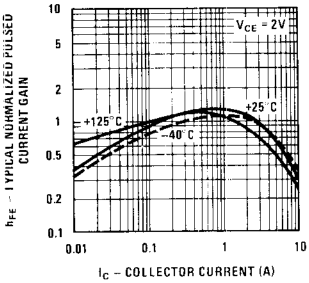
NSP5977, NSP5978, NSP5979, NSP2020, NSP2021, NSP205, NSP3055, 2N6098, 2N6099, 2N6102, 2N6103, 2N6100, 2N6101, 2N6486, 2N6487, D44H1, D44H2, D44H4, D44H5, D44H7, D44H8, D44H10, D44H11, NSP2480, NSP2481, NSP2482, NSP2483

TO-3 (Package 98)

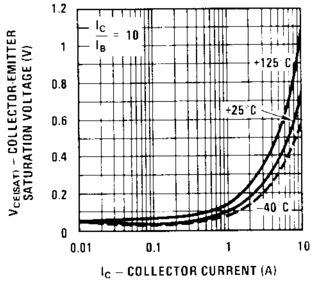
2N3055, 2N4913, 2N4914, 2N4915, 2N5067, 2N5068, 2N5069, 2N6569, MJ2801

Process 4A

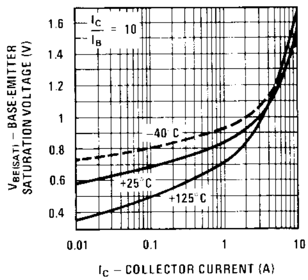
Typical Normalized Pulsed Current Gain vs Collector Current



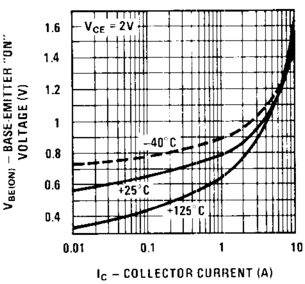
Collector-Emitter Saturation Voltage vs Collector Current



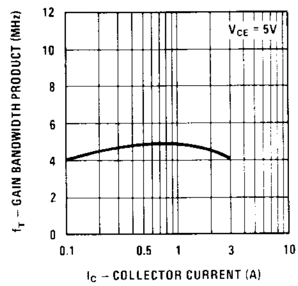
Base-Emitter Saturation Voltage vs Collector Current



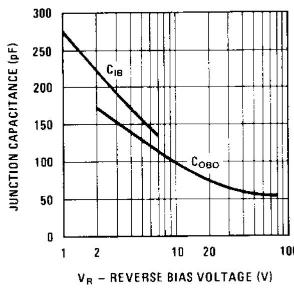
Base-Emitter "ON" Voltage vs Collector Current



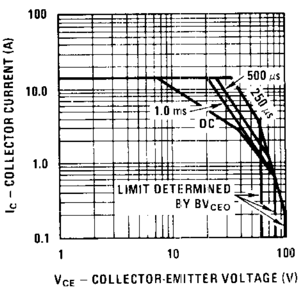
Gain Bandwidth Product vs Collector Current



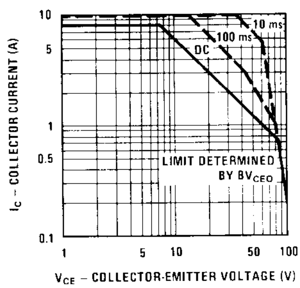
Junction Capacitance vs Reverse Bias Voltage



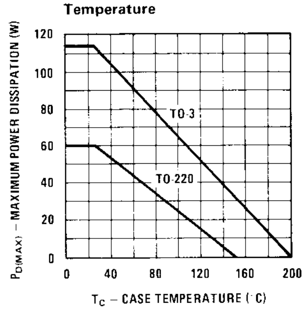
Safe Operating Area TO-3



Safe Operating Area TO-220

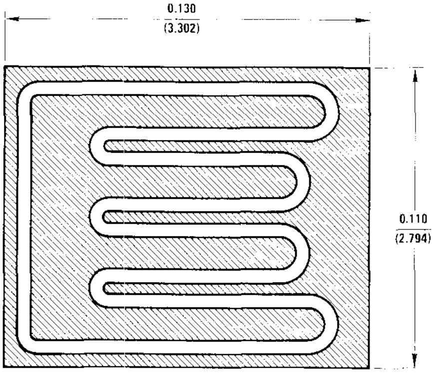


Maximum Power Dissipation vs Case Temperature



National Semiconductor

Process 4B NPN Epitaxial Power



DESCRIPTION

Process 4B is a double epitaxial silicon mesa transistor with diffused emitter.

APPLICATION

This device was designed for general purpose amplifier and switching circuits where a large safe operating area is required.

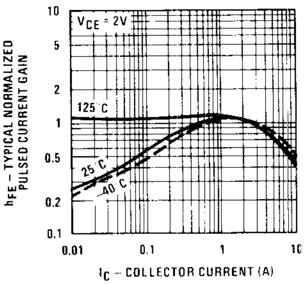
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 200 mA	60	80	150	V
BV_{CBO}	I_C = 500 μA	60			V
BV_{EBO}	I_E = 100 μA	5	7		V
I_{CEO}	V_{CE} = 30V			1	mA
I_{CEX}	V_{CE} = 60V, V_{BE} = −1.5V			0.5	mA
I_{CBO}	V_{CB} = 60V			0.5	mA
I_{EBO}	V_{EB} = 5V			1	mA
H_{FE}	I_C = 1A, V_{CE} = 2V	25			
H_{FE}	I_C = 3A, V_{CE} = 2V	15		100	
H_{FE}	I_C = 8A, V_{CE} = 4V	5			
$V_{CE(SAT)}$	I_C = 5A, I_B = 0.5A			1	V
$V_{CE(SAT)}$	I_C = 8A, I_B = 1.6A			3	V
$V_{BE(SAT)}$	I_C = 5A, I_B = 0.5A			1.6	V
$V_{BE(ON)}$	I_C = 3A, V_{CE} = 2V			1.5	V
C_{obo}	V_{CB} = 10V			300	pF
f_t	I_C = 0.5A, V_{CE} = 10V, f = 1 MHz	4			MHz
SOA	TO-3, V_{CE} = 45V t = 1 sec	3.3			A
SOA	TO-220, V_{CE} = 45V, t = 1 sec	1.55			A
$P_{D(MAX)}$	TO-3	150			W
$P_{D(MAX)}$	TO-220	70			W
θ_{jc}	TO-3			1.16	°C/W
θ_{jc}	TO-220			1.78	°C/W

PRINCIPAL DEVICE TYPES

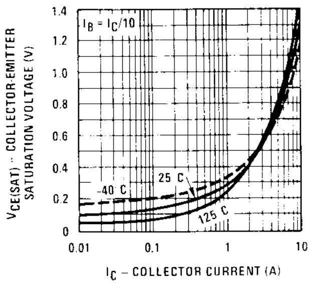
TO-3

2N3713	2N5758	2N5877
2N3714	2N5759	2N5878
2N3715	2N5760	MJ2840
2N3716		MJ2841

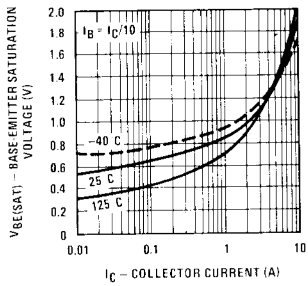
Typical Normalized Pulsed Current Gain vs Collector Current



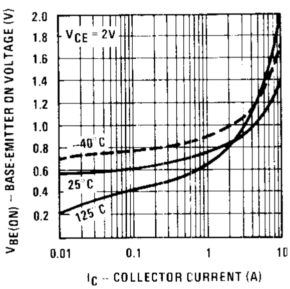
Collector-Emitter Saturation Voltage vs Collector Current



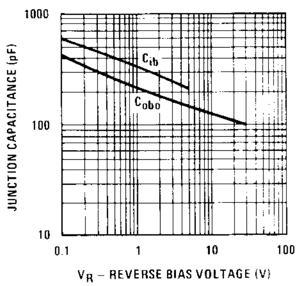
Base-Emitter Saturation Voltage vs Collector Current



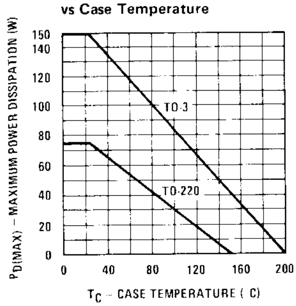
Base-Emitter ON Voltage vs Collector Current



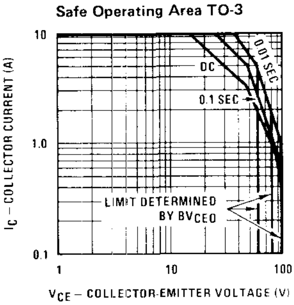
Junction Capacitance vs Reverse Bias Voltage



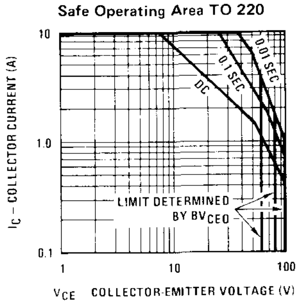
Maximum Power Dissipation vs Case Temperature



Safe Operating Area TO-3



Safe Operating Area TO 220



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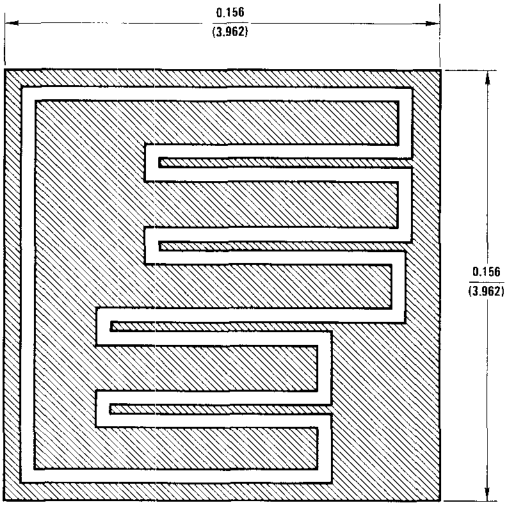
Process 4C NPN Epitaxial Power



DESCRIPTION

Process 4C is a double epitaxial silicon mesa transistor with diffused emitter.

APPLICATION

This device was designed for general purpose amplifier and switching circuits where a large safe operating area is required.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 200 mA	60	80	150	V
BV_{CBO}	I_C = 500 μA	60		100	V
BV_{EBO}	I_E = 100 μA	5			V
I_{CEX}	V_{CE} = 60V, V_{BE} = −1.5V			0.5	mA
I_{CBO}	V_{CB} = 60V			0.5	mA
I_{EBO}	V_{EB} = 5V			1.0	mA
H_{FE}	I_C = 2A, V_{CE} = 4V	35			
H_{FE}	I_C = 6A, V_{CE} = 4V	20		100	
H_{FE}	I_C = 12A, V_{CE} = 4V	5			
$V_{CE(SAT)}$	I_C = 7A, I_B = 0.7A			1	V
$V_{CE(SAT)}$	I_C = 12A, I_B = 2.4A			4	V
$V_{BE(SAT)}$	I_C = 7A, I_B = 0.7A			1.6	V
$V_{BE(ON)}$	I_C = 12A, V_{CE} = 4V			2.5	V
C_{obo}	V_{CB} = 10V			400	pF
SOA	TO-3, V_{CE} = 50V, t = 1 sec	3.0			A
f_t	I_C = 1A, V_{CE} = 10V, f = 1 MHz	4			MHz
$P_{D(MAX)}$	TO-3	175			W
$P_{D(MAX)}$	TO-220	75			W
θ_{jc}	TO-3			1.0	°C/W
θ_{jc}	TO-220			1.66	°C/W

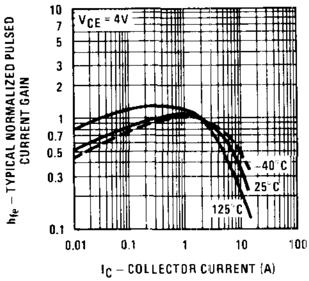
PRINCIPAL DEVICE TYPES

TO-3

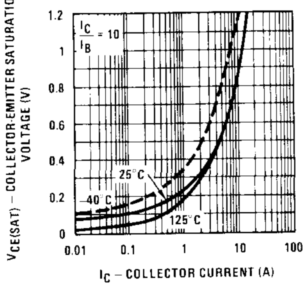
2N5632	2N5881
2N5633	2N5882
2N5634	BD351

Process 4C

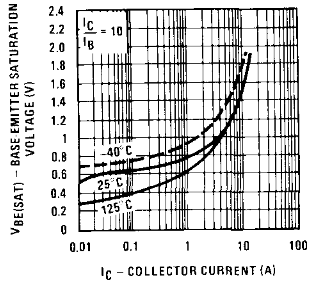
Typical Normalized Pulsed Current Gain vs Collector Current



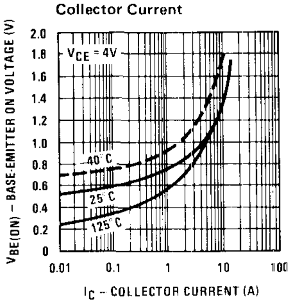
Collector-Emitter Saturation Voltage vs Collector Current



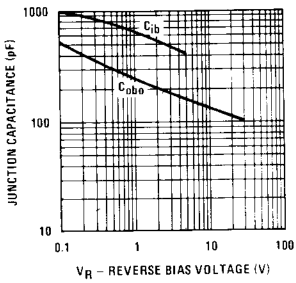
Base-Emitter Saturation Voltage vs Collector Current



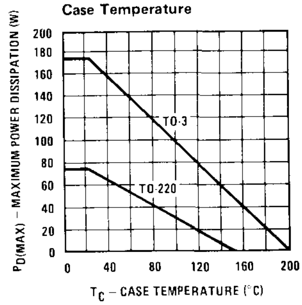
Base-Emitter ON Voltage vs Collector Current



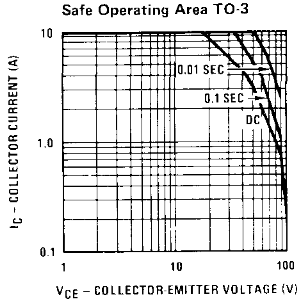
Junction Capacitance vs Reverse Bias Voltage



Maximum Power Dissipation vs Case Temperature

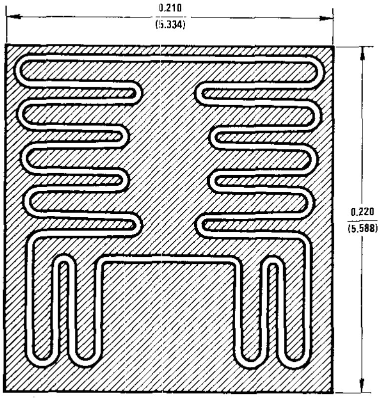


Safe Operating Area TO-3



National Semiconductor

Process 4G NPN Epitaxial Power



DESCRIPTION

Process 4G is a double epitaxial silicon mesa transistor with diffused emitter.

APPLICATION

This device was designed for general purpose amplifier and switching circuits where a large safe operating area is required.

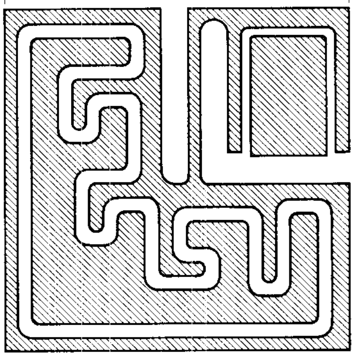
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 200 mA	60	80	150	V
BV_{CBO}	I_C = 1 mA	60			V
BV_{EBO}	I_E = 100 μA	5			V
I_{CEO}	V_{CE} = 30V			2	mA
I_{CEX}	V_{CE} = 60V, V_{BE} = −1.5V			1	mA
I_{CBO}	V_{CB} = 60V			1	mA
I_{EBO}	V_{BE} = 5V			1	mA
H_{FE}	I_C = 3A, V_{CE} = 4V	35			
H_{FE}	I_C = 10A, V_{CE} = 4V	20		100	
H_{FE}	I_C = 20A, V_{CE} = 4V	5			
$V_{CE(SAT)}$	I_C = 15A, I_B = 1.5A			1	V
$V_{CE(SAT)}$	I_C = 20A, I_B = 4A			4	V
$V_{BE(SAT)}$	I_C = 15A, I_B = 1.5A			1.8	V
$V_{BE(ON)}$	I_C = 20A, V_{CE} = 4V			2.5	V
C_{obo}	V_{CB} = 10V			500	pF
f_t	I_C = 1A, V_{CE} = 10V, f = 1 MHz	4			MHz
$P_{D(MAX)}$	TO-3	200			W
θ_{jc}	TO-3			0.875	°C/W

PRINCIPAL DEVICE TYPES

TO-3
2N5629
2N5630
2N5631
2N5885
2N5886
2N5301
2N5302
2N5303
MJ802

National Semiconductor

Process 4K NPN Epitaxial Power



DESCRIPTION

Process 4K is a double epitaxial silicon mesa Darlington transistor.

APPLICATION

The 4K was designed for general purpose amplifier and low-speed switching applications.

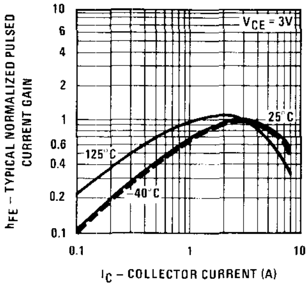
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	$I_C = 100$ mA	60	80	150	V
BV_{CBO}	$I_C = 500\ \mu A$	60			V
BV_{EBO}	$I_E = 5$ mA	5			V
I_{CEO}	$V_{CE} = 30V$			0.5	mA
I_{CEX}	$V_{CE} = 60V$, $V_{EB} = 1.5V$			0.5	mA
I_{EBO}	$V_{BE} = 5V$			2.0	mA
H_{FE}	$I_C = 4A$, $V_{CE} = 3V$	750		18000	
H_{FE}	$I_C = 8A$, $V_{CE} = 3V$	100			
$V_{CE(SAT)}$	$I_C = 4A$, $I_B = 16$ mA			2	V
$V_{CE(SAT)}$	$I_C = 8A$, $I_B = 80$ mA			3	V
$V_{BE(SAT)}$	$I_C = 8A$, $I_B = 80$ mA			4	V
$V_{BE(ON)}$	$I_C = 4A$, $V_{CE} = 3V$			2.8	V
C_{obo}	$V_{CB} = 10V$			200	pF
f_t	$I_C = 3A$, $V_{CE} = 3V$, f = 1 MHz	4			MHz
$P_{D(MAX)}$	TO-3	120			W
$P_{D(MAX)}$	TO-220	60			W
θ_{jc}	TO-3			1.66	°C/W
θ_{jc}	TO-220			2.08	°C/W

PRINCIPAL DEVICE TYPES

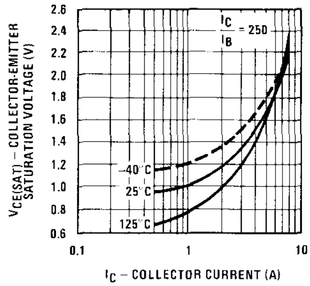
TO-3		TO-220	
2N6055	2N6385	TIP121	TIP132
2N6056	MJ1000	TIP122	SE9300
2N6383	MJ1001	TIP130	SE9301
2N6384		TIP131	SE9302

Process 4K

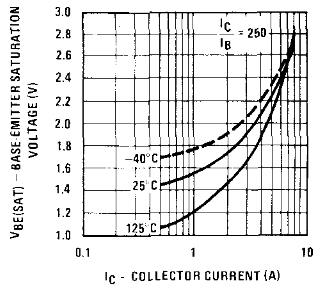
Typical Normalized Pulsed Current Gain vs Collector Current



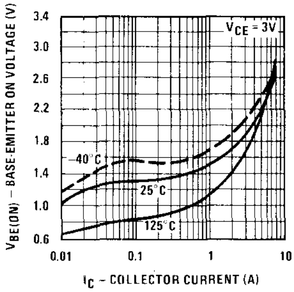
Collector-Emitter Saturation Voltage vs Collector Current



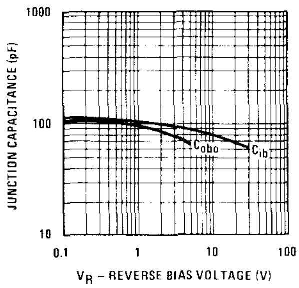
Base-Emitter Saturation Voltage vs Collector Current



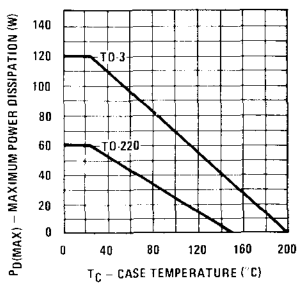
Base-Emitter ON Voltage vs Collector Current



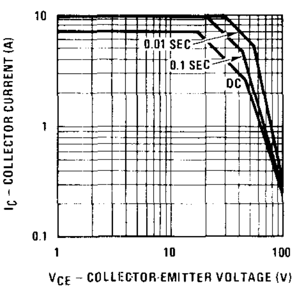
Junction Capacitance vs Reverse Bias Voltage



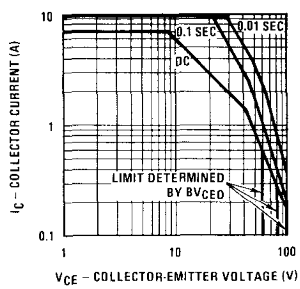
Maximum Power Dissipation vs Case Temperature

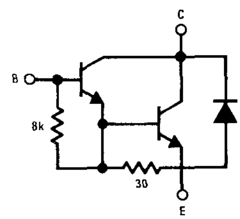


Safe Operating Area TO-3



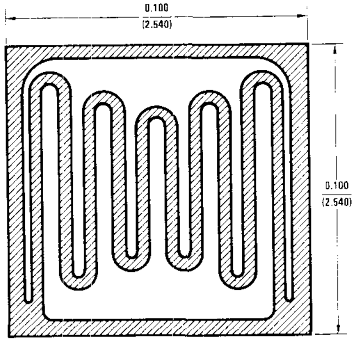
Safe Operating Area TO-220





National Semiconductor

Process 5A Epitaxial Power



DESCRIPTION

Process 5A is a double epitaxial silicon PNP mesa device with a diffused emitter.

APPLICATION

This device was designed for general purpose power amplifier and switching circuits where a large safe operating area is required.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 200 mA, (Note 1)	40		100	V
BV_{CBO}	I_C = 1 mA	60		150	V
BV_{EBO}	I_E = 0.5 mA	5	7		V
I_{CEO}	$V_{CE} = BV_{CEO} - 10V$		10	200	μA
I_{CBO}	$V_{CB} = BV_{CEO} + 20V$		1	20	μA
I_{EBO}	V_{EB} = 5V		1	500	μA
h_{FE}	I_C = 2.5 A, V_{CE} = 2V	20		200	
$V_{CE(SAT)}$	I_C = 4 A, I_B = 0.4 A		0.5	0.6	V
$V_{BE(ON)}$	I_C = 5 A, V_{CE} = 2V		1.2	1.3	V
S_{OA}	I_C = 3 A, t = 1 sec	30			V
f_t	I_C = 0.5 A, V_{CE} = 5V, f = 1 MHz	2			
t_d	I_C = 5 A, $I_{B1} = I_{B2}$ = 0.5 A V_{CC} = 40V		0.03		μs
t_r	I_C = 5 A, $I_{B1} = I_{B2}$ = 0.5 A, V_{CC} = 40V		0.27		μs
t_s	I_C = 5 A, $I_{B1} = I_{B2}$ = 0.5 A, V_{CC} = 40V		0.3		μs
t_f	I_C = 5 A, $I_{B1} = I_{B2}$ = 0.5 A, V_{CC} = 40V		0.37		μs
$P_{D(MAX)}$	TO-220	60			
θ_{jc}	TO-220			2.08	°C/W

Note 1: Pulsed measurement = 300 μs pulse width.

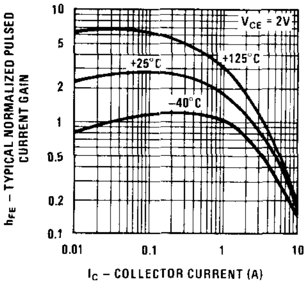
PRINCIPAL DEVICE TYPES

TO-220

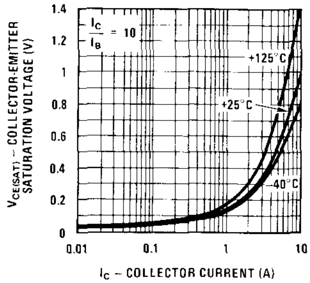
NSP5974	NSP2955	D45H4
NSP5975	2N6489	D45H5
NSP5976	2N6490	D45H7
NSP2010	2N6491	D45H8
NSP2011	D45H1	D45H10
NSP105	D45H2	D45H11

Process 5A

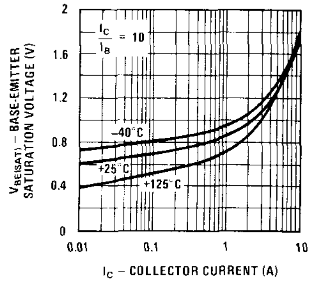
Typical Normalized Pulsed Current Gain vs Collector Current



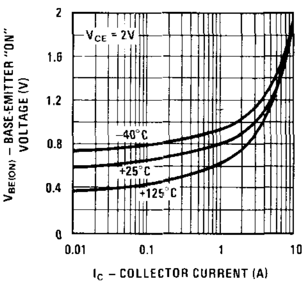
Collector-Emitter Saturation Voltage vs Collector Current



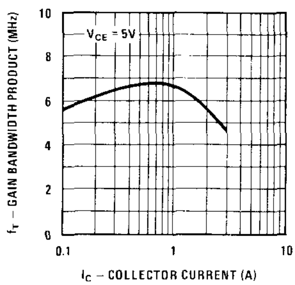
Base-Emitter Saturation Voltage vs Collector Current



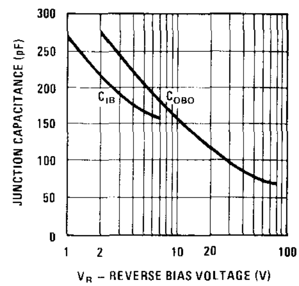
Base-Emitter "ON" Voltage vs Collector Current



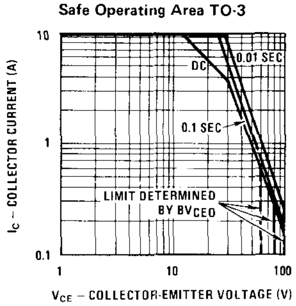
Gain Bandwidth Product vs Collector Current



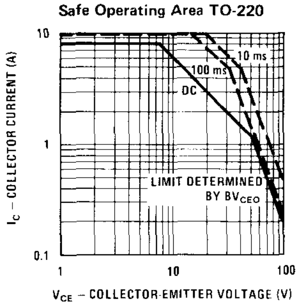
Junction Capacitance vs Reverse Bias Voltage



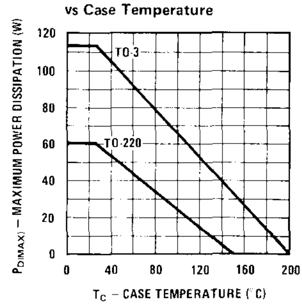
Safe Operating Area TO-3



Safe Operating Area TO-220

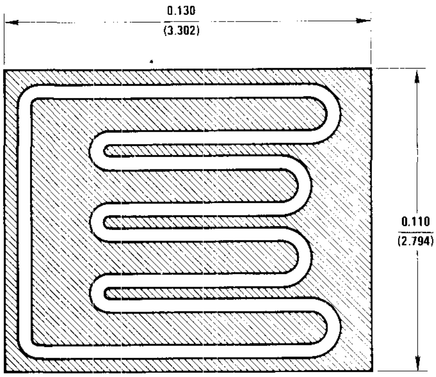


Maximum Power Dissipation vs Case Temperature



National Semiconductor

Process 5B PNP Epitaxial Power



DESCRIPTION

Process 5B is a double epitaxial silicon mesa transistor with diffused emitter.

APPLICATION

This device was designed for general purpose amplifier and switching circuits where a large safe operating area is required.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 200 mA	60	80	150	V
BV_{CBO}	I_C = 500 μA	60			V
BV_{EBO}	I_E = 100 μA	5			V
I_{CEO}	V_{CE} = 30V			2	mA
I_{CEX}	V_{CE} = 60V, V_{BE} = −1.5V			1	mA
I_{CBO}	V_{CB} = 60V			1	mA
I_{EBO}	V_{BE} = 5V			1	mA
H_{FE}	I_C = 1A, V_{CE} = 2V	25			
H_{FE}	I_C = 3A, V_{CE} = 2V	15		100	
H_{FE}	I_C = 8A, V_{CE} = 4V	5			
$V_{CE(SAT)}$	I_C = 5A, I_B = 0.5A			1	V
$V_{CE(SAT)}$	I_C = 8A, I_B = 1.6A			4	V
$V_{BE(SAT)}$	I_C = 5A, I_B = 0.5A			1.8	V
$V_{BE(ON)}$	I_C = 3A, V_{CE} = 2V			2.5	V
C_{obo}	V_{CB} = 10V			500	pF
f_t	I_C = 0.5A, V_{CE} = 10V, f = 1 MHz	4			MHz
$P_{D(MAX)}$	TO-3	150			W
$P_{D(MAX)}$	TO-220	70			W
θ_{jc}	TO-3			1.16	°C/W
θ_{jc}	TO-220			1.78	°C/W

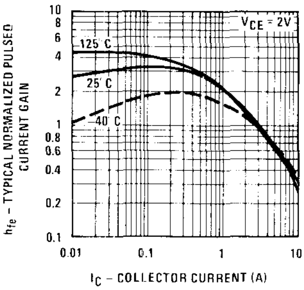
PRINCIPAL DEVICE TYPES

TO-3

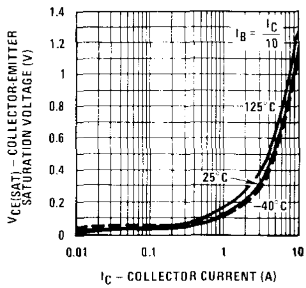
2N3789	2N4908	2N6227
2N3790	2N4909	2N6228
2N3791	2N5875	MJ2940
2N3792	2N5876	MJ2941
2N4907	2N6226	

Process 5B

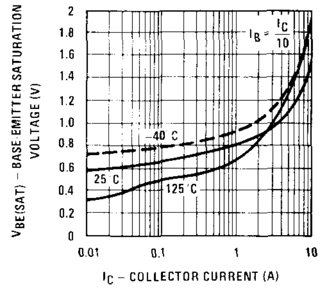
Typical Normalized Pulsed Current Gain vs Collector Current



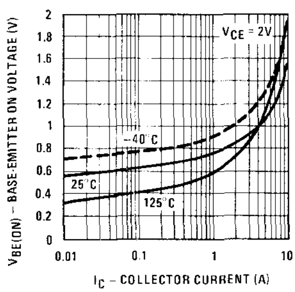
Collector-Emitter Saturation Voltage vs Collector Current



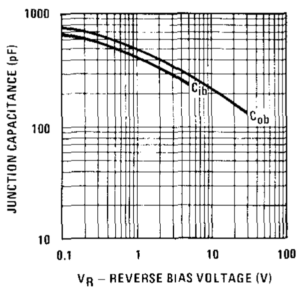
Base-Emitter Saturation Voltage vs Collector Current



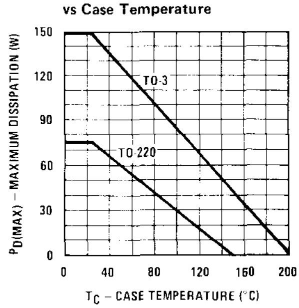
Base-Emitter ON Voltage vs Collector Current



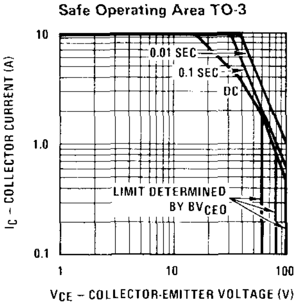
Junction Capacitance vs Reverse Bias Voltage



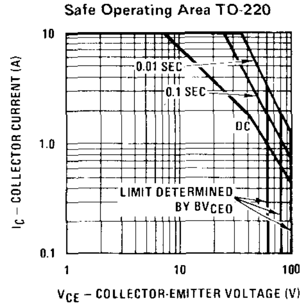
Maximum Power Dissipation vs Case Temperature



Safe Operating Area TO-3

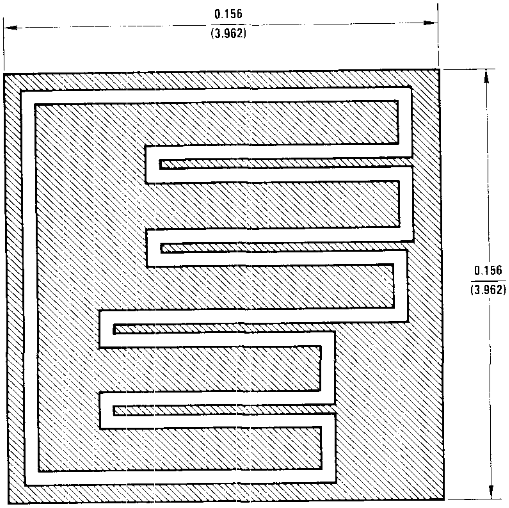


Safe Operating Area TO-220



National Semiconductor

Process 5C PNP Epitaxial Power



DESCRIPTION

Process 5C is a double epitaxial silicon mesa transistor with diffused emitter.

APPLICATION

This device was designed for general purpose amplifier and switching circuits where a large safe operating area is required.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 200 mA	60	80	150	V
BV_{CBO}	I_C = 500 μA	60		100	V
BV_{EBO}	I_E = 100 μA	5			V
I_{CEX}	V_{CE} = 60V, V_{BE} = 1.5V			0.5	mA
I_{CBO}	V_{CB} = 60V			0.5	mA
I_{EBO}	V_{EB} = 5V			1.0	mA
H_{FE}	I_C = 2A, V_{CE} = 4V	35			
H_{FE}	I_C = 6A, V_{CE} = 4V	20		100	
H_{FE}	I_C = 12A, V_{CE} = 4V	5			
$V_{CE(SAT)}$	I_C = 7A, I_B = 0.7A			1	V
$V_{CE(SAT)}$	I_C = 12A, I_B = 2.4A			4	V
$V_{BE(SAT)}$	I_C = 7A, I_B = 0.7A			1.6	V
$V_{BE(ON)}$	I_C = 12A, V_{CE} = 4V			2.5	V
C_{obo}	V_{CB} = 10V			600	pF
f_t	I_C = 1A, V_{CE} = 10V, f = 1 MHz	4			MHz
$P_{D(MAX)}$	TO-3	175			W
$P_{D(MAX)}$	TO-220	75			W
θ_{jc}	TO-3			1.0	°C/W
θ_{jc}	TO-220			1.66	°C/W

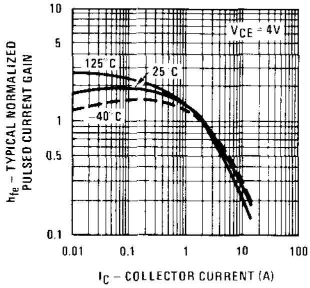
PRINCIPAL DEVICE TYPES

TO-3

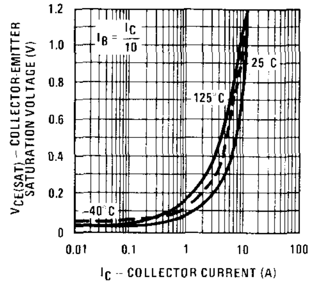
2N6229 2N5879
2N6230 2N5880
2N6231 BD350

Process 5C

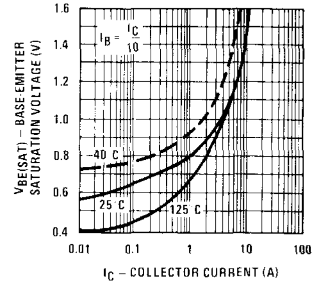
Typical Normalized Pulsed Current Gain vs Collector Current



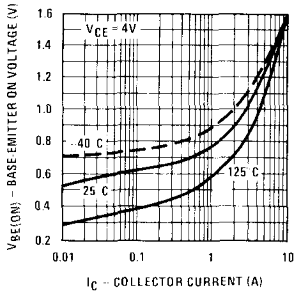
Collector-Emitter Saturation Voltage vs Collector Current



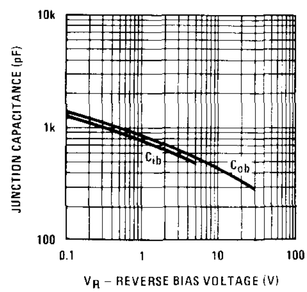
Base-Emitter Saturation Voltage vs Collector Current



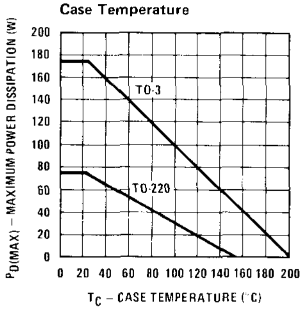
Base-Emitter ON Voltage vs Collector Current



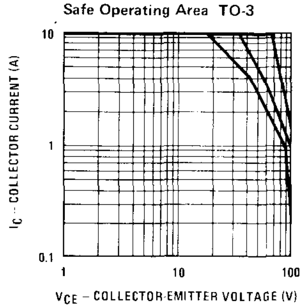
Junction Capacitance vs Reverse Bias Voltage



Maximum Power Dissipation vs Case Temperature

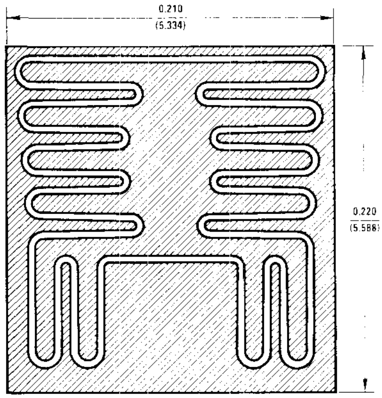


Safe Operating Area TO-3



National Semiconductor

Process 5G PNP Epitaxial Power



DESCRIPTION

Process 5G is a double *epitaxial* silicon mesa transistor with diffused emitter.

APPLICATION

This device was designed for general purpose amplifier and switching circuits where a large safe operating area is required.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 200 mA	60	80	150	V
BV_{CBO}	I_C = 1 mA	60			V
BV_{EBO}	I_E = 100 μA	5			V
I_{CEO}	V_{CE} = 30V			2	mA
I_{CEX}	V_{CE} = 60V, V_{BE} = 1.5V			1	mA
I_{CBO}	V_{CB} = 60V			1	mA
I_{EBO}	V_{EB} = 5V			1	mA
H_{FE}	I_C = 3A, V_{CE} = 4V	35			
H_{FE}	I_C = 10A, V_{CE} = 4V	20		100	
H_{FE}	I_C = 20A, V_{CE} = 4V	5			
$V_{CE(SAT)}$	I_C = 15A, I_B = 1.5A			1	V
$V_{CE(SAT)}$	I_C = 20A, I_B = 4A			4	V
$V_{BE(SAT)}$	I_C = 15A, I_B = 1.5A			1.8	V
$V_{BE(ON)}$	I_C = 20A, V_{CE} = 4V			2.5	V
C_{obo}	V_{CB} = 10V			800	pF
f_t	I_C = 1A, V_{CE} = 10V, f = 1 MHz	4			MHz
$P_{D(MAX)}$		200			W
θ_{jc}				0.875	°C/W

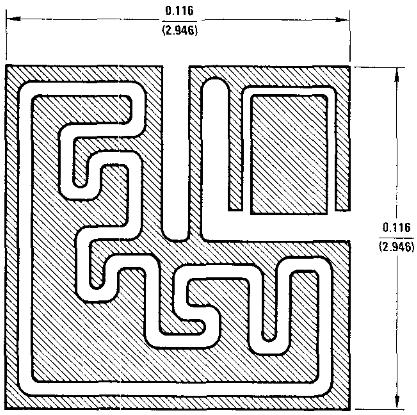
PRINCIPAL DEVICE TYPES

TO-3

2N6029
2N6030
2N6031
MJ4502

National Semiconductor

Process 5K PNP Epitaxial Power



DESCRIPTION

Process 5K is a double epitaxial silicon mesa Darlington transistor.

APPLICATION

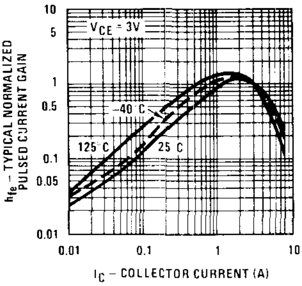
The 5K was designed for general purpose amplifier and low-speed switching applications.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	$I_C = 100$ mA	60	80	150	V
BV_{CBO}	$I_C = 500\ \mu A$	60			V
BV_{EBO}	$I_E = 5$ mA	5			V
I_{CEO}	$V_{CE} = 30V$			0.5	mA
I_{CEX}	$V_{CE} = 60V$, $V_{EB} = 1.5V$			0.5	mA
I_{EBO}	$V_{BE} = 5V$			2.0	mA
H_{FE}	$I_C = 4A$, $V_{CE} = 3V$	750		18000	
H_{FE}	$I_C = 8A$, $V_{CE} = 3V$	100			
$V_{CE(SAT)}$	$I_C = 4A$, $I_B = 16$ mA			2	V
$V_{CE(SAT)}$	$I_C = 8A$, $I_B = 80$ mA			3	V
$V_{BE(SAT)}$	$I_C = 8A$, $I_B = 80$ mA			4	V
$V_{BE(ON)}$	$I_C = 4A$, $V_{CE} = 3V$			2.8	V
C_{obo}	$V_{CB} = 10V$			300	pF
f_t	$I_C = 3A$, $V_{CE} = 3V$, f = 1 MHz	4			MHz
$P_{D(MAX)}$	TO-3	120			W
$P_{D(MAX)}$	TO 220	60			W
θ_{jc}	TO-3			1.66	°C/W
θ_{jc}	TO-220			2.08	°C/W

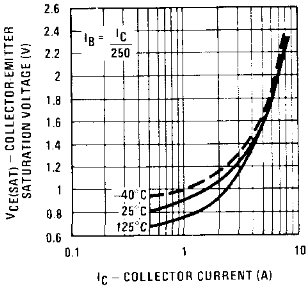
PRINCIPAL DEVICE TYPES

TO-3	TO-220	
2N6053	TIP125	TIP136
2N6054	TIP126	TIP137
MJ900	TIP127	SE9401
MJ901	TIP135	SE9402

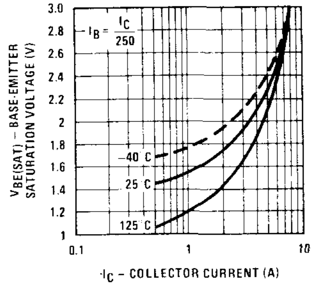
Typical Normalized Pulsed Current Gain vs Collector Current



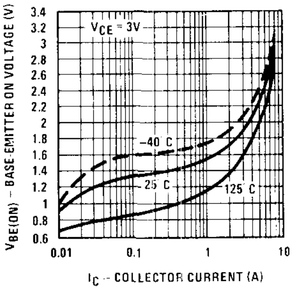
Collector-Emitter Saturation Voltage vs Collector Current



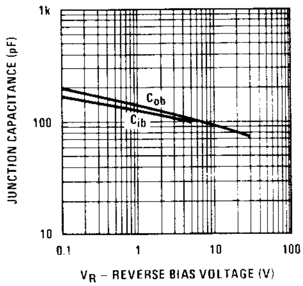
Base-Emitter Saturation Voltage vs Collector Current



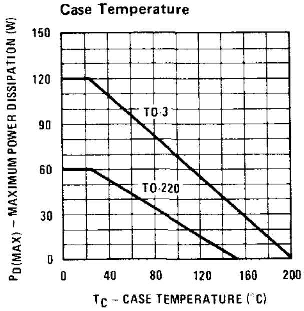
Base-Emitter ON Voltage vs Collector Current



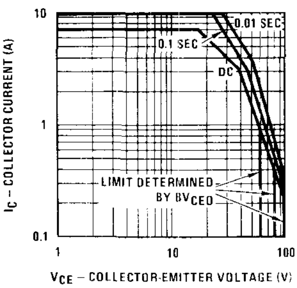
Junction Capacitance vs Reverse Bias Voltage



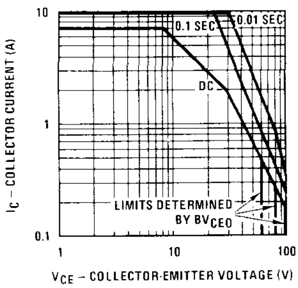
Maximum Power Dissipation vs Case Temperature

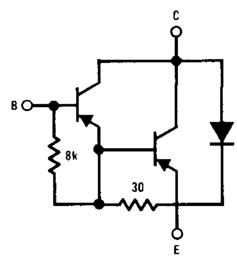


Safe Operating Area TO 3



Safe Operating Area TO-220





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Section 8

JFET Selection Guide

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N-Channel FETs

SWITCHES/CHOPPERS

Type No.	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} $*I_{DGO}$ (nA) Max	@ V_{DG} (V)	$I_{D(off)}$ (nA) Max	@ V_{DS} (V)	V_{GS} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	$r_{ds(on)}$ (Ω) Max	@ I_D (mA)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	t_{on} (ns) Max	t_{off} (ns) Max	Process No.	Pkg. No.
2N3824	TO-72	50	1	0.1	30	0.1	15	−8		8	15	.1				250		6	15	0	3	0	−8			55	25
2N3966	TO-72	30	1	1	20	0.1	10	−7	4	6	10	10	2		20	220		6	20	0	1.5	0	7			50	25
2N3970	TO-18	40	1	0.25*	20	0.25	20	−12	4	10	20	1	50	150	20	30	1	25	20	0	6	0	12	20	30	51	02
2N3971	TO-18	40	1	0.25*	20	0.25	20	12	2	5	20	1	25	75	20	60	1	25	20	0	6	0	−12	30	60	51	02
2N3972	TO-18	40	1	0.25*	20	0.25	20	−12	0.5	3	20	1	5	30	20	100	1	25	20	0	6	0	12	80	100	51	02
•2N4091	TO-18	40	1	0.2*	20	0.2	20	−12	5	10	20	1	30		20	30	1	16	20	0	5	0	−20	25	40	51	02
•2N4092	TO-18	40	1	0.2*	20	0.2	20	−8	2	7	20	1	15		20	50	1	16	20	0	5	0	−20	35	60	51	02
•2N4093	TO-18	40	1	0.2*	20	0.2	20	−6	1	5	20	1	8		20	80	1	16	20	0	5	0	−20	60	80	51	02
2N4391	TO-18	40	1	0.1	20	0.1	20	−12	4	10	20	1	50	150	20	30	1	14	20	0	3.5	0	−12	20	35	51	02
2N4392	TO-18	40	1	0.1	20	0.1	20	−7	2	5	20	1	25	75	20	60	1	14	20	0	3.5	0	−7	20	55	51	02
2N4393	TO-18	40	1	0.1	20	0.1	20	−5	0.5	3	20	1	5	30	20	100	1	14	20	0	3.5	0	−5	20	80	51	02
•2N4856	TO-18	40	1	0.25	20	0.25	15	−10	4	10	15	.5	50		15	25		18	0	−10	8	0	−10	9	25	51	02
2N4856A	TO-18	40	1	0.25	20	0.25	15	−10	4	10	15	.5	50		15	25		10	0	−10	4	0	−10	8	20	51	02
•2N4857	TO-18	40	1	0.25	20	0.25	15	−10	2	6	15	.5	20	100	15	40		18	0	−10	8	0	−10	10	50	51	02
2N4857A	TO-18	40	1	0.25	20	0.25	15	−10	2	6	15	.5	20	100	15	40		10	0	−10	3.5	0	−10	10	40	51	02
•2N4858	TO-18	40	1	0.25	20	0.25	15	−10	0.8	4	15	.5	8	80	15	60		18	0	−10	8	0	−10	20	100	51	02
2N4858A	TO-18	40	1	0.25	20	0.25	15	10	0.8	4	15	.5	8	80	15	60		10	0	10	3.5	0	10	16	80	51	02
•2N4859	TO-18	30	1	0.25	15	0.25	15	10	4	10	15	.5	50		15	25		18	0	−10	8	0	−10	9	25	51	02
2N4859A	TO-18	30	1	0.25	15	0.25	15	−10	4	10	15	.5	50		15	25		10	0	−10	4	0	10	8	20	51	02
•2N4860	TO-18	30	1	0.25	15	0.25	15	−10	2	6	15	.5	20	100	15	40		18	0	10	8	0	−10	10	50	51	02
2N4860A	TO-18	30	1	0.25	15	0.25	15	−10	2	6	15	.5	20	100	15	40		10	0	10	3.5	0	−10	10	40	51	02
•2N4861	TO-18	30	1	0.25	15	0.25	15	−10	0.8	4	15	.5	8	80	15	60		18	0	−10	8	0	10	20	100	51	02
2N4861A	TO-18	30	1	0.25	15	0.25	15	−10	0.8	4	15	.5	8	80	15	60		10	0	10	3.5	0	−10	16	80	51	02
2N5432	TO-52	25	1	0.2	15	0.2	5	−10	4	10	5	3	150		15	5	10	30	0	−10	15	0	−10	5	36	58	07
2N5433	TO-52	25	1	0.2	15	0.2	5	−10	3	9	5	3	100		15	7	10	30	0	−10	15	0	−10	5	36	58	07
2N5434	TO-52	25	1	0.2	15	0.2	5	−10	1	4	5	3	30		15	10	10	30	0	−10	15	0	−10	5	36	58	07
2N5555	TO-92	25	10	1	15	10	12	−10		(10)			15		15	150		5	15	0	1.2	0	−10	10	25	50	72

• **Note.** JAN qualified per applicable MIL-S-19500 specification.

SWITCHES/CHOPPERS (Continued)

Type No.	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	$I_{D(off)}$ (nA) Max	@ V_{DG} (V)	V_{GS} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	$r_{ds(on)}$ (Ω) Max	@ I_D (mA)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	t_{on} (ns) Max	t_{off} (ns) Max	Process No.	Pkg. No.
2N5638	TO-92	30	10	1	15	1	15	−12		(12)			50		20	30	1	10	0	−12	4	0	−12			51	72
2N5639	TO-92	30	10	1	15	1	15	−8		(8)			25		20	60	1	10	0	−12	4	0	−8			51	72
2N5640	TO-92	30	10	1	15	1	15	−6		(6)			5		20	100	1	10	0	−12	4	0	−6			51	72
2N5653	TO-92	30	10	1	15	1	15	12		(12)			40		20	50	1	10	0	12	3.5	0	12	9	15	51	72
2N5654	TO-92	25	10	1	15	10	15	8		(8)			15		20	100	1	10	0	12	3.5	0	8	14	30	51	72
J108	TO-92	25	1	3	15	3	5	−10	3	10	5	1000	80		15	8	10	t30	0	−10	t15	0	−10	t5	t36	58	72
J109	TO-92	25	1	3	15	3	5	−10	2	6	5	1000	40		15	12	10	t30	0	−10	t15	0	−10	t5	t36	58	72
J110	TO-92	25	1	3	15	3	5	−10	.5	4	5	1000	10		15	18	10	t30	0	−10	t15	0	−10	t5	t36	58	72
J111	TO-92	35	1	1	15	1	5	−10	3	10	5	1000	20		15	30	1	t10	0	−10	t5	0	−10	t13	t35	51	72
J112	TO-92	35	1	1	15	1	5	−10	1	5	5	1000	5		15	50	1	t10	0	−10	t5	0	−10	t13	t35	51	72
J113	TO-92	35	1	1	15	1	5	−10	.5	3	5	1000	2		15	100	1	t10	0	−10	t5	0	−10	t13	t35	51	72
J114	TO-92	25	1	1	15	1	5	10	3	10	5	1000	15		15	150	1	t4	0	10	t2	0	10	t6	t20	90	72
PN4091	TO-92	40	1	1*	20	1	20	−12	5	10	20	1	30		20	30		16	20	0	5	20	0	25	40	51	72
PN4092	TO-92	40	1	1*	20	1	20	−8	2	7	20	1	15		20	50		16	20	0	5	20	0	35	60	51	72
PN4093	TO-92	40	1	1*	20	1	20	−6	1	5	20	1	8		20	80		16	20	0	5	20	0	60	80	51	72
PN4391	TO-92	40	1	1	20	1	20	−12	4	10	20	1	50	150	20	30		14	20	0	3.5	0	−12	20	35	51	72
PN4392	TO-92	40	1	1	20	1	20	−7	2	5	20	1	25	75	20	60		14	20	0	3.5	0	−7	40	80	51	72
PN4393	TO-92	40	1	1	20	1	20	−5	0.5	3	20	1	5	30	20	100		14	20	0	3.5	0	−5	55	130	51	72
PN4856	TO-92	40	1	1	20	1	15	−10	4	10	15	.5	50		15	25		18	0	−10	8	0	−10	9	25	51	72
PN4857	TO-92	40	1	1	20	1	15	−10	2	6	15	.5	20	100	15	40		18	0	−10	8	0	−10	10	50	51	72
PN4858	TO-92	40	1	1	20	1	15	−10	0.8	4	15	.5	8	80	15	60		18	0	−10	8	0	−10	20	100	51	72
PN4859	TO-92	30	1	1	15	1	15	10	4	10	15	.5	50		15	25		18	0	10	8	0	10	9	25	51	72
PN4860	TO-92	30	1	1	15	1	15	10	2	6	15	.5	20	100	15	40		18	0	10	8	0	−10	10	50	51	72
PN4861	TO-92	30	1	1	15	1	15	−10	0.8	4	15	.5	8	80	15	60		18	0	10	8	0	10	20	100	51	72
TIS73	TO-92	30	1	2	15	2	15	10	4	10	15	4	50		15	25		18	0	10	8	0	10	9	25	51	77
TIS74	TO-92	30	1	2	15	2	15	10	2	6	15	4	20	100	15	40		18	0	10	8	0	10	10	50	51	77
TIS75	TO-92	30	1	2	15	2	15	10	0.8	4	15	4	8	80	15	60		18	0	10	8	0	10	20	100	51	77
U1897E	TO-92	40	1	0.2*	20				5	10	20	1	30		20	30	1	16	20	0	5	0	20	25	40	51	72
U1898E	TO-92	40	1	0.2*	20				2	7	20	1	15		20	50	1	16	20	0	5	0	20	35	60	51	72
U1899E	TO-92	40	1	0.2*	20				1	5	20	1	8		20	80	1	16	20	0	5	0	20	60	80	51	72

N-Channel FETs

RF, VHF, UHF AMPLIFIERS

Type No.	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} I_{DGO} (pA) Max	@ V_{DG} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	$R_e(Y_{fs})$ (mmho) Min	@ Freq (MHz)	$R_e(Y_{os})$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	NF (dB) @ R_G = 1k Max	Freq (MHz)	Process No.	Pkg. No.
2N3819	TO-92	25	1	2	15		8	15	2	2	20	15	1.6	100			8	15	0	4	15	0			50	74
2N3823	TO-72	30	1	0.5	20		8	15	.5	4	20	15	3.2	200	200	200	6	15	0	2	15	0	2.5	100	50	25
2N4223	TO-72	30	10	0.25	20	0.1	8	15	.25	3	18	15	2.7	200	200	200	6	15	0	2	15	0	5	200	50	25
2N4224	TO-72	30	10	0.5	20	0.1	8	15	.5	2	20	15	1.7	200	200	200	6	15	0	2	15	0			50	25
2N4416	TO-72	30	1	0.1	20		6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50	25
•2N4416A	TO-72	35	1	0.1	20	2.5	6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50	25
2N5078	TO-72	30	1	0.25	20	0.5	8	15		4	25	15	4	200	150	200	6	15	0	2	15	0	3	200	50	25
2N5245	TO-92	30	1	1	20	1	6	15	10	5	15	15	4	400	100	400	4.5	15	0	1	15	0	4	400	90	77
2N5246	TO-92	30	1	1	20	0.5	4	15	10	1.5	7	15	2.5	400	100	400	4.5	15	0	1	15	0			90	77
2N5247	TO-92	30	1	1	20	1.5	8	15	10	8	24	15	4	400	150	400	4.5	15	0	1	15	0			90	77
2N5248	TO-92	30	1	5	20	1	8	15	10	4	20	15	3	200	200	200	6	15	0	2	15	0			50	74
2N5397	TO-72	25	1	0.1	15	1	6	10	1	10	30	10	5.5	450	200	450	5	10	10m	1.2	10	10m	3.5	450	90	29
2N5398	TO-72	25	1	0.1	15	1	6	10	1	5	40	10	5.0	450	400	450	5.5	10	0	1.3	10	0	3.2	450	90	29
2N5484	TO-92	25	1	1	20	0.3	3	15	10	1	5	15	2.5	100	75	100	5	15	0	1	15	0	3	100	50	72
2N5485	TO-92	25	1	1	20	1	4	15	10	4	10	15	3	400	100	400	5	15	0	1	15	0	4	400	50	72
2N5486	TO-92	25	1	1	20	2	6	15	10	8	20	15	3.5	400	100	400	5	15	0	1	15	0	4	400	50	72
2N5668	TO-92	25	10	2	15	0.2	4	15	10	1	5	15	1	100	50	100	7	15	0	3	15	0	2.5	100	50	72
2N5669	TO-92	25	10	2	15	1	6	15	10	4	10	15	1.6	100	100	100	7	15	0	3	15	0	2.5	100	50	72
2N5670	TO-92	25	10	2	15	2	8	15	10	8	20	15	2.5	100	150	100	7	15	0	3	15	0	2.5	100	50	72
2N5949	TO-92	30	1	1	15	3	7	15	100	12	18	15	3.0	100	75	100	6	15	0	2	15	0	5	100	50	77
2N5950	TO-92	30	1	1	15	2.5	6	15	100	10	15	15	3.0	100	75	100	6	15	0	2	15	0	5	100	50	77
2N5951	TO-92	30	1	1	15	2	5	15	100	7	13	15	3.0	100	75	100	6	15	0	2	15	0	5	100	50	77
2N5952	TO-92	30	1	1	15	1.3	3.5	15	100	4	8	15	1.0	100	75	100	6	15	0	2	15	0	5	100	50	77
2N5953	TO-92	30	1	1	15	.8	3	15	100	2.5	5	15	1.0	100	50	100	6	15	0	2	15	0	5	100	50	77
J300	TO-92	25	1	0.5	15	1	6	10	1	6	30	10	4.5	.001	200	.001	5.5	10	5m	1.7	10	5m	t2	100	90	72
J304	TO-92	30	1	0.1	20	2	6	15	1	5	15	15	t4.2	400	t80	100	t3	15	0	t.8	15	0	t4	400	50	72
J305	TO-92	30	1	0.1	20	.5	3	15	1	1	8	15	t3.0	400	t80	100	t3	15	0	t.8	15	0	t4	400	50	72
J308	TO-92	25	1	1	15	1	6.5	10	1	12	60	10	8	.001	200	.001	7.5	0	−10	2.5	0	−10	t1.5	100	92	72
J309	TO-92	25	1	1	15	1	4.0	10	1	12	30	10	10	.001	200	.001	7.5	0	−10	2.5	0	−10	t1.5	100	92	72
J310	TO-92	25	1	1	15	2	6.5	10	1	24	60	10	8	.001	200	.001	7.5	0	−10	2.5	0	−10	t1.5	100	92	72

• **Note.** JAN qualified per applicable MIL-S-19500 specification.

N-Channel FETs

RF, VHF, UHF AMPLIFIERS (Continued)

Type No.	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} I_{DGO} (pA) Max	@ V_{DG} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	$R_e Y_{fs}$ (mMho) Min	@ Freq (MHz)	$R_e(Y_{os})$ (μMho) Max	@ f (MHz)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	NF (dB) @ R_G = 1k Max	Freq (MHz)	Process No.	Pkg. No.
MPF102	TO-92	25	1	2	15		8	15	2	2	20	15	1.6	100	100	200	7	15	0	3	15	0			50	72
MPF106	TO-92	25	1	1	20	0.5	4	15	.5	4	10	15	2.5	0.001			5	15	0	2	15	0	4	400	50	72
MPF107	TO-92	25	1	1	20	2	6	15	.5	8	20	15	4	0.001			5	15	0	1.2	15	0	4	400	50	72
MPF108	TO-92	25	10	1	15	0.5	8	15	10p	1.5	24	15	1.6	100	200	100	6.5	15	0	2.5	15	0	3	100	50	72
PN4223	TO-92	30	1	0.25	20	0.1	8	15	1	3	18	15	2.7	200	200	200	6	15	0	2	15	0	5	200	50	72
PN4224	TO-92	30	1	0.25	20	0.1	8	15	5	2	20	15	1.7	200	200	200	6	15	0	2	15	0			50	72
PN4416	TO-92	30	1	0.1	20		6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50	72
U308	TO-52	25	1	0.15	15	1	6	10	1	12	60	10	10	0.001	150	100	5	0	10m	2.5	0	10mA	t3	450	92	07
U309	**TO-52**	**25**	**1**	**0.15**	**15**	**1**	**4**	**10**	**1**	**12**	**30**	**10**	**10**	**0.001**	**150**	**100**	**5**	**0**	**10m**	**2.5**	**0**	**10mA**	**t3**	**450**	**92**	**07**
U310	**TO-52**	**25**	**1**	**0.15**	**15**	**2.5**	**6**	**10**	**1**	**24**	**60**	**10**	**10**	**0.001**	**150**	**100**	**5**	**10**	**10m**	**2.5**	**10**	**10mA**	**t3**	**450**	**92**	**07**
U312	TO-52	25	1	0.1	15	1	6	10	1	10	30	10	6	0.001			3.8	10	10m	1.2	10	10mA	t3.5	450	90	07
U320	TO-39	20	1	3	15	2	10	5	1m	100	500	15	75	0.001			30	0	10	15	0	10	t2.5	30	58	09
U321	TO-39	25	1	3	15	1	4	5	1m	80	250	15	75	0.001			30	0	10	15	0	10	t2.5	30	58	09
U322	TO-39	25	1	3	15	3	10	5	1m	200	700	15	75	0.001			30	0	10	15	0	10	t2.5	30	58	09

N-Channel FETs

LOW FREQUENCY—LOW NOISE AMPLIFIERS

Type No.	Case Style	BV_{GSS} (V) Min	@ I_G (μA)	I_{GSS} (nA) Max	@ V_{DG} (V)	$V_{GS(OFF)}$ (V) Min	$V_{GS(OFF)}$ (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	g_{fs} (Re Y_{fs}) (mmho) Min	g_{fs} (mmho) Max	V_{DS} (V)	f (MHz)	G_{oss} (μmho) Max	V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	e_n nV/√Hz Max	@ f (Hz)	Process No.	Pkg. No.
2N4393	TO-18	40	1.0	0.1	20	0.5	3.0	20	1.0	5.0	30	20	t12		20	0.001			14	20	0	3.5	5.0(GS)	t8.0	10	51	02
2N5556	TO-72	30	10	0.1	15	0.2	4.0	15	1.0	0.5	2.5	15	1.5	6.5	15	0.001	20	15	6.0	15	0	3.0	15	35	10	50	25
2N5557	TO-72	30	10	0.1	15	0.8	5.0	15	1.0	2.0	5.0	15	1.5	6.5	15	0.001	20	15	6.0	15	0	3.0	15	35	10	50	25
2N5558	TO-72	30	10	0.1	15	1.5	6.0	15	1.0	4.0	10	15	1.5	6.5	15	0.001	20	15	6.0	15	0	3.0	15	35	10	50	25
NF5101	**TO-72**	**40**	**1**	**0.2**	**15**	**0.5**	**1.1**	**15**	**1.0**	**1.0**	**12**	**15**	**3.5**		**15**	**0.001**	**25**	**15**	**t12**	**15**	**0**	**t4**	**15**	**3.5**	**1k**	**51**	**25**
NF5102	**TO-72**	**40**	**1**	**0.2**	**15**	**0.7**	**1.6**	**15**	**1.0**	**4.0**	**20**	**15**	**7.5**		**15**	**0.001**	**25**	**15**	**t12**	**15**	**0**	**t4**	**15**	**3.5**	**1k**	**51**	**25**
NF5103	**TO-72**	**40**	**1**	**0.2**	**15**	**1.2**	**2.7**	**15**	**1.0**	**10**	**40**	**15**	**7.5**		**15**	**0.001**	**25**	**15**	**t12**	**15**	**0**	**t4**	**15**	**3.5**	**1k**	**51**	**25**
PF5101	**TO-92**	**40**	**1**	**0.2**	**15**	**0.5**	**1.1**	**15**	**1.0**	**1.0**	**12**	**15**	**3.5**		**15**	**0.001**	**25**	**15**	**t12**	**15**	**0**	**t4**	**15**	**3.5**	**1k**	**51**	**72**
PF5102	**TO-92**	**40**	**1**	**0.2**	**15**	**0.7**	**1.6**	**15**	**1.0**	**4.0**	**20**	**15**	**7.5**		**15**	**0.001**	**25**	**15**	**t12**	**15**	**0**	**t4**	**15**	**3.5**	**1k**	**51**	**72**
PF5103	**TO-92**	**40**	**1**	**0.2**	**15**	**1.2**	**2.7**	**15**	**1.0**	**10**	**40**	**15**	**7.5**		**15**	**0.001**	**25**	**15**	**t12**	**15**	**0**	**t4**	**15**	**3.5**	**1k**	**51**	**72**
PN4393	TO-106	40	1.0	0.1	20	0.5	3.0	20	1.0	5.0	30	20	t12		20	0.001			14	20	0	3.5	5.0(GS)	t8.0	10	51	72

JFET Selection Guide

N-Channel FETs

ULTRA LOW INPUT CURRENT AMPS

Transistor Type	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} I_{DGO} (pA) Max	@ V_{DG} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (μA) Min	I_{DSS} (μA) Max	@ V_{DS} (V)	G_{fs} (μmho) Min	G_{fs} (μmho) Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	e_n $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ f (Hz)	Process No.	Pkg. No.
2N4117	TO-72	40	1	10	20	0.6	1.8	10	1	30	90	10	20	210	10	3	10	3	10	0	1.5	10	0			53	25
2N4117A	TO-72	40	1	1	20	0.6	1.8	10	1	30	90	10	70	210	10	3	10	3	10	0	1.5	10	0			53	25
2N4118	TO-72	40	1	10	20	1	3	10	1	80	240	10	80	250	10	5	10	3	10	0	1.5	10	0			53	25
2N4118A	TO-72	40	1	1	20	1	3	10	1	80	240	10	80	250	10	5	10	3	10	0	1.5	10	0			53	25
2N4119	TO-72	40	1	10	20	2	6	10	1	200	600	10	100	330	10	10	10	3	10	0	1.5	10	0			53	25
2N4119A	TO-72	40	1	1	20	2	6	10	1	200	600	10	100	330	10	10	10	3	10	0	1.5	10	0			53	25

N-Channel FETs

GENERAL PURPOSE AMPS

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} I_{DGO} (nA) Max	@ V_{DG} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	G_{fs} (mmho) Min	G_{fs} (mmho) Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	e_n $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.	Pkg. No.
2N3069	TO-18	*50	1	1	30		9.5	30	1000	2	10	30	1	2.5	30	80	30	15	0	−12	1.5	30	0	125	1000	52	02
2N3070	TO-18	*50	1	1	30		4.5	30	1000	0.5	2.5	30	0.75	2.5	30	30	30	15	0	−8	1.5	30	0	125	1000	52	02
2N3368	TO-18	*40	1	5	30		11.5	20	1000	2	12	30	1	4	30	80	30	20	8	0	3	30	0			52	02
2N3369	TO-18	*40	1	5	30		6.5	20	1000	0.5	2.5	30	0.6	2.5	30	30	30	20	8	0	3	30	0			52	02
2N3370	TO-18	*40	1	5	30		3.2	20	1000	0.1	0.6	30	0.3	2.5	30	15	30	20	8	0	3	30	0			52	02
2N3436	TO-18	*50	1	0.5	30		9.8	20	1000	3	15	20	2.5	10	20	35	30	18	0	−10	6	30	0	100	1000	55	02
2N3437	TO-18	*50	1	0.5	30		4.8	20	1000	0.8	4	20	1.5	6	20	20	30	18	0	−6	6	30	0	100	1000	55	02
2N3438	TO-18	*50	1	0.5	30		2.3	20	1000	0.2	1	20	0.8	4.5	20	5	30	18	0	−4	6	30	0	100	1000	55	02
2N3458	TO-18	*50	1	0.25	30		7.8	20	1000	3	15	20	2.5	10	20	35	30	18	0	−10	5	30	0	225	20	52	02
2N3459	TO-18	*50	1	0.25	30		3.4	20	1000	0.8	4	20	1.5	6	20	20	30	18	0	−6	5	30	0	155	20	52	02
2N3460	TO-18	*50	1	0.25	30		1.8	20	1000	0.2	1	20	0.8	4.5	20	5	30	18	0	−4	5	30	0	155	20	52	02
2N3684	TO-72	50	1	0.1	30	2	5	20	1	2.5	7.5	20	2	3	20	50	20	4	20	0	1.2	20	0	150	100	52	25
2N3685	TO-72	50	1	0.1	30	1	3.5	20	1	1	3	20	1.5	2.5	20	25	20	4	20	0	1.2	20	0	150	100	52	25
2N3686	TO-72	50	1	0.1	30	0.6	2	20	1	0.4	1.2	20	1	2	20	10	20	4	20	0	1.2	20	0	150	100	52	25
2N3687	TO-72	50	1	0.1	30	0.3	1.2	20	1	0.1	0.5	20	0.5	1.5	20	5	20	4	20	0	1.2	20	0	150	100	52	25
2N3821	TO-72	50	1	0.1	30		4	15	.5	0.5	2.5	15	1.5	4.5	15	10	15	6	15	0	3	15	0	200	10	55	25
2N3822	TO-72	50	1	0.1	30		6	15	.5	2	10	15	3	6.5	15	20	15	6	15	0	3	15	0	200	10	55	25
2N3967	TO-72	30	1	0.1	20	2	5	20	1	2.5	10	20	2.5		20	35	20¶	5	20	¶	1.3	20	♠	84	100	50	25
2N3967A	TO-72	30	1	0.1	20	2	5	20	1	2.5	10	20	2.5		20	35	20¶	5	20	¶	1.3	20	♠	160	10	50	25
2N3968	TO-72	30	1	0.1	20		3	20	1	1	5	20	2		20	15	20**	5	20	**	1.3	20	†	84	100	50	25
2N3968A	TO-72	30	1	0.1	20		3	20	1	1	5	20	2		20	15	20**	5	20	**	1.3	20	†	160	10	50	25
2N3969	TO-72	30	1	0.1	20		1.7	20	1	0.4	2	20	1.3		20	5	20††	5	20	††	1.3	20	¶	84	100	50	25
2N3969A	TO-72	30	1	0.1	20		1.7	20	1	0.4	2	20	1.3		20	5	20††	5	20	††	1.3	20	¶	160	10	50	25

♠ I_D = 1 mA † I_D = 500μA ¶ I_D = 250μA δ I_D = 100μA ** I_D = 100μA †† I_D = 40μA

N-Channel FETs

GENERAL PURPOSE AMPS (Continued)

Transistor Type	Case Style	BV_{GSS} $*BV_{GDO}$ (V) Min	@ I_G (μA)	I_{GSS} I_{DGO} (nA) Max	@ V_{DG} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	G_{fs} (mmho) Min	G_{fs} (mmho) Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	e_n $\left(\frac{nV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.	Pkg. No.
2N4220	TO-72	30	10	0.1	15		4	15	.1	0.5	3	15	1	4	15	10	15	6	15	0	2	15	0			55	25
2N4220A	TO-72	30	10	0.1	15		4	15	.1	0.5	3	15	1	4	15	10	15	6	15	0	2	15	0	115	100	55	25
2N4221	TO-72	30	10	0.1	15		6	15	.1	2	6	15	2	5	15	20	15	6	15	0	2	15	0			55	25
2N4221A	TO-72	30	10	0.1	15		6	15	.1	2	6	15	2	5	15	20	15	6	15	0	2	15	0	115	100	55	25
2N4222	TO-72	30	10	0.1	15		8	15	.1	5	15	15	2.5	6	15	40	15	6	15	0	2	15	0			55	25
2N4222A	TO-72	30	10	0.1	15		8	15	.1	5	15	15	2.5	6	15	40	15	6	15	0	2	15	0	115	100	55	25
2N4338	TO-18	50	1	0.1	30	0.3	1	15	100	0.2	0.6	15	0.6	1.8	15	5	15	7	15	0	3	15	0	68	1000	52	02
2N4339	TO-18	50	1	0.1	30	0.6	1.8	15	100	0.5	1.5	15	0.8	2.4	15	15	15	7	15	0	3	15	0	68	1000	52	02
2N4340	TO-18	50	1	0.1	30	1	3	15	100	1.2	3.6	15	1.3	3	15	30	15	7	15	0	3	15	0	68	1000	52	02
2N4341	TO-18	50	1	0.1	30	2	6	15	100	3	9	15	2	4	15	60	15	7	15	0	3	15	0	68	1000	55	02
2N5103	TO-72	25	10	0.1	15	0.5	4	15	1	1	8	15	2	8	15	100	15	5	15	0	1	15	0	100	10	50	25
2N5104	TO-72	25	1	0.1	15	0.5	4	15	1	2	6	15	3.5	7.5	15	100	15	5	15	0	1	15	0	50	10	50	25
2N5105	TO-72	25	1	0.1	15	0.5	4	15	1	5	15	15	5	10	15	100	15	5	15	0	1	15	0			50	25
2N5358	TO-72	40	1	0.1	20	0.5	3	15	100	0.5	1	15	1	3	15	10	15	6	15	0	2	15	0	115	100	55	25
2N5359	TO-72	40	1	0.1	20	0.8	4	15	100	0.6	1.6	15	1.2	3.6	15	10	15	6	15	0	2	15	0	115	100	55	25
2N5360	TO-72	40	1	0.1	20	0.8	4	15	100	0.5	2.5	15	1.4	4.2	15	20	15	6	15	0	2	15	0	115	100	55	25
2N5361	TO-72	40	1	0.1	20	1	6	15	100	2.5	5	15	1.5	4.5	15	20	15	6	15	0	2	15	0	115	100	55	25
2N5362	TO-72	40	1	0.1	20	2	7	15	100	4	8	15	2	5.5	15	40	15	6	15	0	2	15	0	115	100	55	25
2N5363	TO-72	40	1	0.1	20	2.5	8	15	100	7	14	15	2.5	6	15	40	15	6	15	0	2	15	0	115	100	55	25
2N5364	TO-72	40	1	0.1	20	2.5	8	15	100	9	18	15	2.7	6.5	15	60	15	6	15	0	2	15	0	115	100	55	25
2N5457	TO-92	25	1	1	15	0.5	6	15	10	1	5	15	2	5	15	50	15	7	15	0	3	15	0			55	72
2N5458	TO-92	25	1	1	15	1	7	15	10	2	9	15	1.5	5.5	15	50	15	7	15	0	3	15	0			55	72
2N5459	TO-92	25	1	1	15	2	8	15	10	4	16	15	2	6	15	50	15	7	15	0	3	15	0			55	72
2N5556	TO-72	30	1	0.1	15	0.2	4	15	1	0.5	2.5	15	1.5	6.5	15	20	15	6	15	0	3	15	0	35	10	50	25
2N5557	TO-72	30	1	0.1	15	0.8	5	15	1	2.0	5.0	15	1.5	6.5	15	20	15	6	15	0	3	15	0	35	10	50	25
2N5558	TO-72	30	1	0.1	15	1.5	6	15	1	4	10	15	1.5	6.5	15	20	15	6	15	0	3	15	0	35	10	50	25
J201	TO-92	40	1	0.1	20	0.3	1.5	20	10	0.2	1.0	20	0.5		20	†1	20	†5	20	0	†2	20	0	†10	1k	52	72
J202	TO-92	40	1	0.1	20	0.8	4.0	20	10	0.9	4.5	20	1.0		20	†3.5	20	†5	20	0	†2	20	0	†10	1k	52	72
J203	TO-92	40	1	0.1	20	2.0	10.0	20	10	4.0	20	20	1.5		20	†10	20	†5	20	0	†2	20	0	†10	1k	52	72
J210	TO-92	25	1	0.1	15	1	3	15	1	2	15	15	4.0	12.0	15	150	15	†5	15	0	†1.5	15	0	†10	1k	90	72
J211	TO-92	25	1	0.1	15	2.5	4.5	15	1	7	20	15	7.0	12.0	15	200	15	†5	15	0	†1.5	15	0	†10	1k	90	72
J212	TO-92	25	1	0.1	15	4	6	15	1	15	40	15	7.0	12.0	15	200	15	†5	15	0	†1.5	15	0	†10	1k	90	72
MPF103	TO-92	25	1	1	15		6	15	1	1	5	15	1	5	15	50	15	7	15	0	3	15	0			55	72
MPF104	TO-92	25	1	1	15		7	15	1	2	9	15	1.5	5.5	15	50	15	7	15	0	3	15	0			55	72
MPF105	TO-92	25	1	1	15		8	15	1	4	16	15	2	6	15	50	15	7	15	0	3	15	0			55	72
MPF109	TO-92	25	10	1	15	0.2	8	15	10	0.5	24	15	0.8	6	15	75	15	7	15	0	3	15	0	115	1000	55	72

N-Channel FETs

GENERAL PURPOSE AMPS (Continued)

Transistor Type	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (µA)	I_{GSS} I_{DGO} (nA) Max	@ V_{DG} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ VDS (V)	G_{fs} (mmho) Min	G_{fs} (mmho) Max	@ V_{DS} (V)	G_{oss} (µmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	e_n $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.	Pkg. No.
MPF111	TO-92	20	10	100	10	0.5	10	10	1000	0.5	20	10	0.5		10	200	10									50	72
MPF112	TO-92	25	10	100	10	0.5	10	10	1000	1	25	10	1	7.5	10											55	72
PN3684	TO-92	50	1	1	30	2	5	20	1	2.5	7.5	20	2	3	20	50	20	4	20	0	1.2	20	0	150	20	52	72
PN3685	TO-92	50	1	1	30	1	3.5	20	1	1	3	20	1.5	2.5	20	25	20	4	20	0	1.2	20	0	150	20	52	72
PN3686	TO-92	50	1	1	30	0.6	2	20	1	0.4	1.2	20	1	2	20	10	20	4	20	0	1.2	20	0	150	20	52	72
PN3687	TO-92	50	1	1	30	0.3	1.2	20	1	0.1	0.5	20	0.5	1.5	20	5	20	4	20	0	1.2	20	0	150	20	52	72
PN4220	TO-92	30	10	1	15		4	15	1	0.5	3	15	1	4	15	10	15	6	15	0	2	15	0			55	72
PN4221	TO-92	30	10	1	15		6	15	1	2	6	15	2	5	15	20	15	6	15	0	2	15	0			55	72
PN4222	TO-92	30	10	1	15		8	15	1	5	15	15	2.5	6	15	40	15	6	15	0	2	15	0			55	72
PN4302	TO-92	30	1	1	10		4	20	10	0.5	5	20	1		20	50	20	6	20	0	3	20	0	100	1000	52	72
PN4303	TO-92	30	1	1	10		6	20	10	4	10	20	2		20	50	20	6	20	0	3	20	0	100	1000	52	72
PN4304	TO-92	30	1	1	10		10	20	10	0.5	15	20	1		20	50	20	6	20	0	3	20	0	125	1000	52	72
PN5163	TO-92	25	1	10	15	0.4	8	15	1000	1	40	15	2	9	15	200	15	12	15	0	3	15	0	50	1000	50	72
TIS58	TO-92	25	1	4	15	0.5	5	15	20	2.5	8	15	1.3	4	15			6	15	2 mA	3	15	2 mA			50	74
TIS59	TO-92	25	1	4	15	1	9	15	20	6	25	15	1.3		15			6	15	2 mA	3	15	2 mA			50	74

N-Channel FETs

GENERAL PURPOSE DUAL JFETs

Type No.	Case Style	OPERATING CONDITIONS FOR THESE CHARACTERISTICS: OP. CHAR. V_{DG} (V)	OP. CHAR. I_D (µA)	$\lvert V_{GS1-2}\rvert$ V_{OS} (mV) Max	DRIFT (µV/°C) ΔV_{GS} Max	I_G (pA) Max	G_{fs} µmhos Min	G_{fs} µmhos Max	G_{oss} (µmho) Max	CMRR (dB) Min	V_{gs} (V) Min	V_{gs} (V) Max	V_p (V) Min	V_p (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	G_{fs} (mmho) Min	G_{fs} (mmho) Max	G_{oss} (µmho) Max	I_{GSS} (pA) Max	@ V_{DG} (V)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV (V) Min	e_n (nV/$\sqrt{Hz}$) Max	@ f (Hz)	I_{DSS} Match %	G_{fs} Match %	G_{oss1-2} (µmho)	I_{G1}-I_{G2} 125°C (nA)	Process No.	Pkg. No.
2N3921	TO-71	10	700	5.0	10	250	1500		20					-3.0	1.0	10	1.5	7.5	35	1000	30	18	6.0	50	100	1.0k		5.0			83	12
2N3922	TO-71	10	700	5.0	25	250	1500		20					3.0	1.0	10	1.5	7.5	35	1000	30	18	6.0	50	100	1.0k		5.0			83	12
2N3934	TO-71	10	200	5.0	10	100	300		5.0				See 2N3954-6 as an improved replacement																			12
2N3935	TO-71	10	200	5.0	25	100	300		5.0				See 2N3954-6 as an improved replacement																			12
2N3954A	TO-71	20	200	5.0	5.0	50					0.5	4.0	1.0	4.5	0.5	5.0	1.0	3.0	35	100	30	4.0	1.2	50	150	100	5.0	3.0		10	83	12
2N3954	TO-71	20	200	5.0	10	50					0.5	4.0	1.0	4.5	0.5	5.0	1.0	3.0	35	100	30	4.0	1.2	50	150	100	5.0	3.0		10	83	12
2N3955A	TO-71	20	200	5.0	15	50					0.5	4.0	1.0	4.5	0.5	5.0	1.0	3.0	35	100	30	4.0	1.2	50	150	100	5.0	3.0		10	83	12
2N3955	TO-71	20	200	10	25	50					0.5	4.0	1.0	4.5	0.5	5.0	1.0	3.0	35	100	30	4.0	1.2	50	150	100	5.0	3.0		10	83	12
2N3956	TO-71	20	200	15	50	50					0.5	4.0	1.0	4.5	0.5	5.0	1.0	3.0	35	100	30	4.0	1.2	50	150	100	5.0	5.0		10	83	12
2N3957	TO-71	20	200	20	75	50					0.5	4.0	1.0	4.5	0.5	5.0	1.0	3.0	35	100	30	4.0	1.2	50	150	100	10	10		10	83	12
2N3958	TO-71	20	200	25	100	50					0.5	4.0	1.0	4.5	0.5	5.0	1.0	3.0	35	100	30	4.0	1.2	50	150	100	15	15		10	83	12
2N4082	TO-71	10	200	15	10	100	300		10				See 2N3954-6 as an improved replacement																			12
2N4083	TO-71	10	200	15	25	100	300		10				See 2N3954-6 as an improved replacement																			12
2N4084	TO-71	10	700	15	10	250	1500		20		0.5	4.0		3.0	1.0	10	1.5	7.5	35	1000	30	18	6.0	50	100	1.0k		5.0			83	12
2N4085	TO-71	10	700	15	25	250	1500		20					3.0	1.0	10	1.5	7.5	35	1000	30	18	6.0	50	100	1.0k		5.0			83	12

GENERAL PURPOSE DUAL JFETs (Continued)

Type No.	Case Style	OP. CHAR. V_{DG} (V)	OP. CHAR. I_D (μA)	$\vert V_{GS1-2}\vert$ V_{OS} (mV) Max	DRIFT (μV/°C) ΔV_{GS} Max	I_G (pA) Max	G_{fs} μmhos Min	G_{fs} μmhos Max	G_{oss} (μmho) Max	CMRR (dB) Min	V_{gs} (V) Min	V_{gs} (V) Max	V_p (V) Min	V_p (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	G_{fs} (mmho) Min	G_{fs} (mmho) Max	G_{oss} (μmho) Max	I_{GSS} (pA) Max	@ V_{DG} (V)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV (V) Min	$\bar{e}_n$ (nV/√Hz) Max	@ f (Hz)	I_{DSS} Match %	G_{fs} Match %	G_{oss1-2} (μmho)	$I_{G1}-I_{G2}$ 125°C (nA)	Process No.	Pkg. No.
		Operating conditions for these characteristics																														
2N5045	TO-71	15	200	5.0	67								0.5	4.5	0.5	8.0	1.5	6.0	25	250	30	8.0	4.0	50	200	10		5.0	1.0		83	12
2N5046	TO-71	15	200	10	133								0.5	4.5	0.5	8.0	1.5	6.0	25	250	30	8.0	4.0	50	200	10		10	2.0		83	12
2N5047	TO-71	15	200	15	200								0.5	4.5	0.5	8.0	1.5	6.0	25	250	30	8.0	4.0	50	200	10		20	3.0		83	12
2N5196	TO-71	20	200	5.0	5.0	15	700	1500	4.0		0.2	3.8	0.7	4.5	0.7	7.0	1.0	4.0	50	25	30	6.0	2.0	50	20	1.0k	5.0	3.0	1.0	5.0	83	12
2N5197	TO-71	20	200	5.0	10	15	700	1500	4.0		0.2	3.8	0.7	4.5	0.7	7.0	1.0	4.0	50	25	30	6.0	2.0	50	20	1.0k	5.0	3.0	1.0	5.0	83	12
2N5198	TO-71	20	200	10	20	15	700	1500	4.0		0.2	3.8	0.7	4.5	0.7	7.0	1.0	4.0	50	25	30	6.0	2.0	50	20	1.0k	5.0	5.0	1.0	5.0	83	12
2N5199	TO-71	20	200	15	40	15	700	1500	4.0		0.2	3.8	0.7	4.5	0.7	7.0	1.0	4.0	50	25	30	6.0	2.0	50	20	1.0k	5.0	5.0	1.0	5.0	83	12
2N5452	TO-71	20	200	5.0	5.0				1.0		0.2	4.2	1.0	4.5	0.5	5.0	1.0	3.0	3.0	100	30	4.0	1.2	50	20	1.0k	5.0	3.0	0.25		83	12
2N5453	TO-71	20	200	10	10				1.0		0.2	4.2	1.0	4.5	0.5	5.0	1.0	3.0	3.0	100	30	4.0	1.2	50	20	1.0k	5.0	3.0	0.25		83	12
2N5454	TO-71	20	200	15	25				1.0		0.2	4.2	1.0	4.5	0.5	5.0	1.0	3.0	3.0	100	30	4.0	1.2	50	20	1.0k	5.0	5.0	0.25		83	12
2N5545	TO-71	15	200	5.0	10	50							0.5	4.5	0.5	8.0	1.5	6.0	25	100	30	6.0	2.0	50	180	10	5.0	3.0	1.0	5.0	83	12
2N5546	TO-71	15	200	10	20	50							0.5	4.5	0.5	8.0	1.5	6.0	25	100	30	6.0	2.0	50	200	10	10	5.0	2.0	5.0	83	12
2N5547	TO-71	15	200	15	40	50							0.5	4.5	0.5	8.0	1.5	6.0	25	100	30	6.0	2.9	50			10	10	3.0	5.0	83	12
2N5561	TO-71	PROCESS IN DEVELOPMENT																														12
2N5562	TO-71																															12
2N5563	TO-71																															12
J401	8-Pin Mini-DIP																														98	60
J402																															98	60
J403																															98	60
J404																															98	60
J405																															98	60
J406																															98	60
J410	8-Pin	20	200	10	10	250	600	1200	5.0		0.3	4.0	0.5	3.5	0.5	6	1	4	20	250	20	4.5	1.2	40	50	100					98	60
J411	Mini-	20	200	25	25	250	600	1200	5.0		0.3	4.0	0.5	3.5	0.5	6	1	4	20	250	20	4.5	1.2	40	50	100					98	60
J412	DIP	20	200	40	80	250	600	1200	5.0		0.3	4.0	0.5	3.5	0.5	6	1	4	20	250	20	4.5	1.2	40	50	100					98	60
NPD8301	8-Pin	20	200	5	10	100	700	1200	5.0		0.3	4.0	0.5	3.5	0.5	6	1	4	20	100	20	4.5	1.2	40	50	100					83	67
NPD8302	Mini-	20	200	10	15	100	700	1200	5.0		0.3	4.0	0.5	3.5	0.5	6	1	4	20	100	20	4.5	1.2	40	50	100					83	67
NPD8303	DIP	20	200	15	25	100	700	1200	5.0		0.3	4.0	0.5	3.5	0.5	6	1	4	20	100	20	4.5	1.2	40	50	100					83	67
NPD9801		PROCESS IN DEVELOPMENT																													98	67
NPD9802																															98	67
NPD9803																															98	67
U231	TO-71	20	200	5.0	10	50	600		10		0.3	4.0	See 2N3954 as an improved replacement																		83	12
U232	TO-71	20	200	10	25	50	600		10		0.3	4.0	See 2N3955 as an improved replacement																		83	12
U233	TO-71	20	200	15	50	50	600		10		0.3	4.0	See 2N3956 as an improved replacement																		83	12
U234	TO-71	20	200	20	75	50	600		10		0.3	4.0	See 2N3957 as an improved replacement																		83	12
U235	TO-71	20	200	25	100	50	600		10		0.3	4.0	See 2N3958 as an improved replacement																		83	12
U401	TO-71	PROCESS IN DEVELOPMENT																													98	12
U402	TO-71																														98	12
U403	TO-71																														98	12
U404	TO-71																														98	12
U405	TO-71																														98	12
U406	TO-71																														98	12

N-Channel FETs

LOW FREQUENCY—LOW NOISE DUAL JFETs

Type No.	Case Style	OP. CHAR. V_{DG} (V)	OP. CHAR. I_D (µA)	$\|V_{GS1-2}\|$ V_{OS} (mV) Max	DRIFT (µV/°C) ΔV_{GS} Max	I_G (pA) Max	G_{fs} µmhos Min	G_{fs} µmhos Max	G_{oss} (µmho) Max	CMRR (dB) Min	V_{gs} (V) Min	V_{gs} (V) Max	V_p (V) Min	V_p (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	G_{fs} (µmho) Min	G_{fs} (µmho) Max	G_{oss} (µmho) Max	I_{GSS} (pA) Max	@ V_{DG} (V)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV (V) Min	e_n (nV/√Hz) Max	@ f (Hz)	I_{DSS} Match %	G_{fs} Match %	G_{oss1-2} (µmho)	I_{G1}-I_{G2} 125°C (nA)	Process No.	Pkg. No.
2N5515	TO-71	20	200	5.0	5.0	100	500	1000	1.0	100	0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	30	10	5.0	3.0	0.1	10	95	12
2N5516	TO-71	20	200	5.0	10	100	500	1000	1.0	100	0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	↓	10	5.0	3.0	0.1	10	95	12
2N5517	TO-71	20	200	10	20	100	500	1000	1.0	90	0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	↓	10	5.0	5.0	0.1	10	95	12
2N5518	TO-71	20	200	15	40	100	500	1000	1.0		0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	↓	10	5.0	5.0	0.1	10	95	12
2N5519	TO-71	20	200	15	80	100	500	1000	1.0		0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	↓	10	10	10	0.1	10	95	12
2N5520	TO-71	20	200	5.0	5.0	100	500	1000	1.0	100	0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	15	10	5.0	3.0	0.1	10	95	12
2N5521	TO-71	20	200	5.0	10	100	500	1000	1.0	100	0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	↓	10	5.0	3.0	0.1	10	95	12
2N5522	TO-71	20	200	10	20	100	500	1000	1.0	90	0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	↓	10	5.0	5.0	0.1	10	95	12
2N5523	TO-71	20	200	15	40	100	500	1000	1.0		0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	↓	10	5.0	5.0	0.1	10	95	12
2N5524	TO-71	20	200	15	80	100	500	1000	1.0		0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	250	30	+25	+5.0	40	↓	10	10	10	0.1	10	95	12
2N6483	TO-71	20	200	5.0	5.0	100	500	1500	1.0	100	0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	200	30	20	3.5	50	10	10	5.0	3.0	0.1	10	95	12
2N6484	TO-71	20	200	10	10	100	500	1500	1.0	100	0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	200	30	20	3.5	50	↓	10	5.0	3.0	0.1	10	95	12
2N6485	TO-71	20	200	15	25	100	500	1500	1.0	90	0.2	3.8	0.7	4.0	0.5	7.5	1.0	4.0	10	200	30	20	3.5	50	↓	10	5.0	5.0	0.1	10	95	12

N-Channel FETs

WIDE BAND—LOW NOISE DUAL JFETs

Type No.	Case Style	OP. CHAR. V_{DG} (V)	OP. CHAR. I_D (µA)	$\|V_{GS1-2}\|$ V_{OS} (mV) Max	DRIFT (µV/°C) ΔV_{GS} Max	I_G (pA) Max	G_{fs} µmhos Min	G_{fs} µmhos Max	G_{oss} (µmho) Max	CMRR (dB) Min	V_{gs} (V) Min	V_{gs} (V) Max	V_p (V) Min	V_p (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	G_{fs} (µmho) Min	G_{fs} (µmho) Max	G_{oss} (µmho) Max	I_{GSS} (pA) Max	@ V_{DG} (V)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV (V) Min	e_n (nV/√Hz) Max	@ f (Hz)	I_{DSS} Match %	G_{fs} Match %	G_{oss1-2} (µmho)	I_{G1}-I_{G2} 125°C (nA)	Process No.	Pkg. No.
2N5564	TO-71	15	2000	5.0	10		7500		45				0.5	3.0	5.0	30				100	20	12	3.0	40	50	10	5.0	5.0			96	12
2N5565	TO-71	15	2000	10	25		7500		45				0.5	3.0	5.0	30				100	20	12	3.0	40	50	10	5.0	10			96	12
2N5566	TO-71	15	2000	20	50		7500		45				0.5	3.0	5.0	30				100	20	12	3.0	40	50	10	5.0	10			96	12
2N5911	TO-78	10	5000	10	20	100	5000	10,000	100		0.3	4.0	1.0	5.0	7.0	40				100	15	5.0	1.2	25	20	10k	5.0	5.0	20	20	93	24
2N5912	TO-78	10	5000	15	40	100	5000	10,000	100		0.3	4.0	1.0	5.0	7.0	40				100	15	5.0	1.2	25	20	10k	5.0	5.0	20	20	93	24
NPD5564	8-Pin	15	2000	5.0	10		7500		45				0.5	3.0	5.0	30				100	20	12	3.0	40	50	10	5.0	5.0			96	67
NPD5565	Mini-	15	2000	10	25		7500		45				0.5	3.0	5.0	30				100	20	12	3.0	40	50	10	5.0	10			96	67
NPD5566	DIP	15	2000	20	50		7500		45				0.5	3.0	5.0	30				100	20	12	3.0	40	50	10	5.0	10			96	67
U257	TO-78	10	5000	100			5000	10,000	150				1.0	5.0	5.0	40				100	15	5.0	1.2	25	30	10k	15	15	20		93	24
U430	TO-99	10	10,000				10,000	20,000	150				1.0	4.0	12	30				150	15			25	10	100	10	10			92	24
U431	TO-99	10	10,000				10,000	20,000	150				2.0	6.0	24	60				150	15			25	10	100	10	10				

N-Channel FETs

LOW LEAKAGE—HIGH CMRR—WIDE BAND DUAL JFETs

Type No.	Case Style	OPERATING CONDITIONS FOR THESE CHARACTERISTICS: Op. Char. V_{DG} (V)	Op. Char. I_D (μA)	V_{GS1-2} V_{OS} (mV) Max	Drift (μV/°C) ΔV_{GS} Max	I_G (pA) Max	G_{fs} μmhos Min	G_{fs} μmhos Max	G_{oss} (μmho) Max	CMRR (dB) Min	V_{gs} (V) Min	V_{gs} (V) Max	V_p (V) Min	V_p (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	G_{fs} (μmho) Min	G_{fs} (μmho) Max	G_{oss} (μmho) Max	I_{GSS} (pA) Max	@ V_{DG} (V)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV (V) Min	e_n (nV/√Hz) Max	@ f (Hz)	I_{DSS} Match %	G_{fs} Match %	G_{oss1-2} (μmho)	I_{G1}-I_{G2} 125°C (nA)	Process No.	Pkg. No.
NDF9401	TO-78	20	200	5.0	5.0	5.0¶	950	2000	0.1	120	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	5.0	3.0	0.1	1.0	94	24
NDF9402	TO-78	20	200	5.0	10	5.0¶	950	2000	0.1	120	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	5.0	3.0	0.1		94	24
NDF9403	TO-78	20	200	10	10	5.0¶	950	2000	0.1	110	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	5.0	5.0	0.1	1.0	94	24
NDF9404	TO-78	20	200	15	10	5.0¶	950	2000	0.1	110	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	5.0	5.0	0.1	1.0	94	24
NDF9405	TO-78	20	200	25	25	5.0¶	950	2000	0.1	100	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	10	10	0.1	1.0	94	24
NDF9406	TO-71	20	200	5.0	5.0	5.0¶	950	2000	0.1	120	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	5.0	3.0	0.1	1.0	94	12
NDF9407	TO-71	20	200	5.0	10	5.0¶	950	2000	0.1	120	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	5.0	3.0	0.1	1.0	94	12
NDF9408	TO-71	20	200	10	10	5.0¶	950	2000	0.1	110	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	5.0	5.0	0.1	1.0	94	12
NDF9409	TO-71	20	200	15	10	5.0¶	950	2000	0.1	110	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	5.0	5.0	0.1	1.0	94	12
NDF9410	TO-71	20	200	25	25	5.0¶	950	2000	0.1	100	0.1	4.0	0.5	4.0	0.5	10				10	30	5.0	0.02	50	30	10	10	10	0.1	1.0	94	12

¶ V_{DG} = 35V

N-Channel FETs

ULTRA LOW LEAKAGE DUALS

Type No.	Case Style	OPERATING CONDITIONS FOR THESE CHARACTERISTICS: Oper. Cond. V_{DG} (V)	Oper. Cond. I_D (μA)	V_{GS1-2} V_{OS} (mV) Max	ΔV_{GS} DRIFT (μV/°C) Max	I_G (pA) Max	G_{fs} (mMho) Min	G_{oss} (μMho) Max	V_{GS} (V) Min	V_{GS} (V) Max	V_p (V) Min	V_p (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	G_{fs} (mmho) Min	G_{fs} (mmho) Max	G_{oss} (μmho) Max	I_{GSS} (pA) Max	@ V_{GS} (V)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV_{GSS} (V) Min	I_{G1}-I_{G2} @ 125°C (nA) Max	Process No.	Pkg. No.
2N5902	TO-78	10	30	5	5	3	50μ	1		4	0.6	4.5	30μ	0.5	70μ	0.25	5	5	20	3	1.5	40	2	84	24
2N5903	TO-78	10	30	5	10	3	50μ	1		4	0.6	4.5	30μ	0.5	70μ	0.25	5	5	20	3	1.5	40	2	84	24
2N5904	TO-78	10	30	10	20	3	50μ	1		4	0.6	4.5	30μ	0.5	70μ	0.25	5	5	20	3	1.5	40	2	84	24
2N5905	TO-78	10	30	15	40	3	50μ	1		4	0.6	4.5	30μ	0.5	70μ	0.25	5	5	20	3	1.5	40	2	84	24
2N5906	TO-78	10	30	5	5	1	50μ	1		4	0.6	4.5	30μ	0.5	70μ	0.25	5	2	20	3	1.5	40	0.2	84	24
2N5907	TO-78	10	30	5	10	1	50μ	1		4	0.6	4.5	30μ	0.5	70μ	0.25	5	2	20	3	1.5	40	0.2	84	24
2N5908	TO-78	10	30	10	20	1	50μ	1		4	0.6	4.5	30μ	0.5	70μ	0.25	5	2	20	3	1.5	40	0.2	84	24
2N5909	TO-78	10	30	15	40	1	50μ	1		4	0.6	4.5	30μ	0.5	70μ	0.25	5	2	20	3	1.5	40	0.2	84	24
U421	TO-78	PROCESS IN DEVELOPMENT																						86	24
U422	TO-78																							86	24
U423	TO-78																							86	24
U424	TO-78																							86	24
U425	TO-78																							86	24
U426	TO-78																							86	24

8

P-Channel FETs

SWITCHES

Transistor Type	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} I_{DGO} (nA) Max	@ V_{DG} (V)	$I_{D(off)}$ (nA) Max	@ V_{DS} (V)	V_{GS} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (μA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	r_{ds} (Ω) Max	@ I_D (mA)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	t_{on} (ns) Max	t_{off} (ns) Max	Process No.	Pkg. No.
2N3382	TO-72	30	1	15	30	2	-5	6	1	5	-5	1	3	30	10	300										88	23
2N3384	TO-72	30	1	15	30	2	-5	6	4	5	-5	1	15	30	10	180										88	23
2N3386	TO-72	30	1	15	30	2.5	-5	10	4	9.5	-5	1	15	50	10	150										88	23
2N3993	TO-72	25	1	1.2*	15	1.2	−10	10	4	9.5	−10	1	10		10	150		16	−10	0	4.5	0	10			88	23
2N3993A	TO-72	25	1	1.2*	15	1.2	−10	10	4	9.5	−10	1	10		10	150		12	−10	0	3	0	10			88	23
2N3994	TO-72	25	1	1.2*	15	1.2	−10	6	1	5.5	−10	1	2		10	300		16	−10	0	4.5	0	10			88	23
2N3994A	TO-72	25	1	1.2*	15	1.2	−10	6	1	5.5	−10	1	2		10	300		12	−10	0	3	0	10			88	23
2N5018	TO-18	30	1	2	15	10	-15	12		10	−15	1	10		20	75		45	−15	0	10	0	12	35	65	88	11
2N5019	TO-18	30	1	2	15	10	−15	7		5	-15	1	5		20	150		45	-15	0	10	0	7	90	125	88	11
•2N5114	TO-18	30	1	0.5	20	0.5	−15	12	5	10	−15	.001	30	90	18	75	1	25	−15	0	7	0	12	16	21	88	11
•2N5115	TO-18	30	1	0.5	20	0.5	−15	7	3	6	−15	.001	16	60	15	100	1	25	−15	0	7	0	7	30	38	88	11
•2N5116	TO-18	30	1	0.5	20	0.5	−15	5	1	4	−15	.001	5	25	15	150	1	25	−15	0	7	0	5	42	60	88	11
J174	TO-92	30	1	1	20	1	−15	10	5	10	−15	.01	20	100	15	85	1	11	0	10	5.5	0	10	2	5	88	74
J175	TO-92	30	1	1	20	1	−15	10	3	6	−15	.01	7	60	15	125	.5	11	0	10	5.5	0	10	5	10	88	74
J176	TO-92	30	1	1	20	1	−15	10	1	4	−15	.01	2	25	15	250	.25	11	0	10	5.5	0	10	15	15	88	74
J177	TO-92	30	1	1	20	1	−15	10	.8	2.25	−15	.01	1.5	20	15	300	.1	11	0	10	5.5	0	10	20	20	88	74
P1086E	TO-92	30	1	2	20	10	−15	10		10	−15	.01	10		15	75	1	45	−15	0	10	15	0	35	50	88	71
P1087E	TO-92	30	1	2	20	10	−15	5		5	−15	.01	5		15	150		45	15	0	10	15	0	40	75	88	71
U304	TO-18	30	1	0.5	20	0.5	-15	12	5	10	15	1	30	90	15	85		27	−15	0	7	0	12	35	35	88	11
U305	TO-18	30	1	0.5	20			7	3	4	15	1	15	60	15	110		27	−15	0	7	0	7	50	45	88	11
U306	TO-18	30	1	0.5	20			5	1	4	15	1	5	25	15	175		27	15	0	7	0	5	60	80	88	11

• Note. JAN qualified per applicable MIL-S-19500 specification

P-Channel FETs

AMPLIFIERS

Transistor Type	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} I_{DGO} (nA) Max	@ V_{DG} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (μA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	G_{fs} (mmho) Min	G_{fs} (mmho) Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	V_{DS} (V)	V_{GS} (V)	e_n $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.	Pkg. No.
•2N2608	TO-18	30	1	10	30	1	4	5	1	0.9	4.5	5	1		5			17	−5	1				125	1000	89	11
2N2609	TO-18	30	1	30	30	1	4	5	1	2	10	5	2.5		5			30	5	1				125	1000	88	11
2N3329	TO-72	20	10	10	10		5	−15	10	1	3	10	1	2	10/1mA	20	10	20	−10	1				125	1000	89	23
2N3330	TO-72	20	10	10	10		6	15	10	2	6	10	1.5	3	10/2mA	40	10	20	−10	1				125	1000	89	23
2N3331	TO-72	20	10	10	10		8	−15	10	5	15	10	2	4	10/5mA	100	10	20	−10	1				155	1000	89	23
2N3332	TO-72	20	10	10	10		6	−15	10	1	6	10	1	2.2	10/1mA	20	10	20	−10	1				65	1000	89	23
2N4381	TO-18	25	1	1	15	1	5	−15	1	3	12	15	2	6	15	75	15	20	−15	0	5	−15	0	20	1000	89	11

• Note. JAN qualified per applicable MIL-S-19500 specification

P-Channel FETs

AMPLIFIERS (Continued)

Transistor Type	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} I_{DGO} (nA) Max	@ V_{DG} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (μA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	G_{fs} (mmho) Min	G_{fs} (mmho) Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	V_{DS} (V)	V_{GS} (V)	e_n $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.	Pkg. No.
2N5020	TO-18	25	1	1	15	0.3	1.5	-15	1	0.3	1.2	15	1	3.5	15	20	15	25	-15	0	7	15	0	30	1000	89	11
2N5021	TO-18	25	1	1	15	0.5	2.5	15	1	1	3.5	15	1.5	6	15	20	15	25	-15	0	7	15	0	30	1000	89	11
2N5460	TO-92	40	10	5	20	0.75	6	-15	1	1	5	15	1	4	15	50	15	7	-15	0	2	-15	0	115	100	89	71
2N5461	TO-92	40	10	5	20	1	7.5	-15	1	2	9	15	1.5	5	15	50	15	7	-15	0	2	-15	0	115	100	89	71
2N5462	TO-92	40	10	5	20	1.8	9	-15	1	4	16	15	2	6	15	50	15	7	-15	0	2	-15	0	115	100	89	71
J270	TO-92	30	1	0.2	20	0.5	2.0	15	.001	2	15	15	6.0	15.0	15	200	15	120	15	0	15	15	0	110	1k	88	74
J271	TO-92	30	1	0.2	20	1.5	4.5	15	.001	6	50	15	8.0	18.0		500	15	120	15	0	15	15	0	110	1k	88	74
PN4342	TO-92	25	10	10	15		5.5	-10	1	4	12	10	2	6	10	75	10	20	10	0	5	10	0	80	100	89	71
PN4360	TO-92	20	10	10	15	0.7	10	-10	1	3	30	10	2	8	10	100	10	20	10	0	5	10	0	190	100	89	71
PN5033	TO-92	20	10	10	15	0.3	2.5	10	1	0.3	3.5	10	1	5	10	20	10	25	10	0	7	10	0	100	1000	89	71
U301	TO-18	40	1	0.1	20	2.5	60	-15	.001	15	60		7	11	15			20	15	7 mA	5.5	-15	5.5 mA	40	1000	88	11

Pro-Electron FETs

AMPLIFIERS

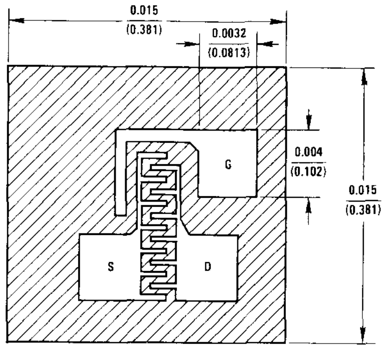
Type No.	Case Style	BV_{GSS} BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} I_{DGD} (nA) Max	@ V_{GD} (V)	V_P (V) Min	V_P (V) Max	@ V_{DS} (V)	I_D (nA)	V_{GS} (V) Min	V_{GS} (V) Max	@ V_{DS} (V)	I_D (μA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	$R_e(Y_{FS})$ (mmho) Min	$R_e(Y_{FS})$ (mmho) Max	@ f (MHz)	C_{iss} (pF) Typ	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Typ	@ V_{DS} (V)	V_{GS} (V)	NF (dB) @ R_G = 1k, e_n^* Max	Typ	f (Hz)* (MHz)	Process No.	Pkg. No.
BF244A	TO-92	30	1	5	20	.5	8	15	10	.4	2.2	15	200	2	6.5	15	3	6.5	.001	4	20	1	1.1	20	-1		1.5	100	50	74
BF244B	TO-92	30	1	5	20	.5	8	15	10	1.6	3.8	15	200	6	15	15	3	6.5	.001	4	20	1	1.1	20	-1		1.5	100	50	74
BF244C	TO-92	30	1	5	20	.5	8	15	10	3.2	7.5	15	200	12	25	15	3	6.5	.001	4	20	-1	1.1	20	1		1.5	100	50	74
BF245A	TO-92	30	1	5	20	.5	8	15	10	.4	2.2	15	200	2	6.5	15	3	6.5	.001	4	20	1	1.1	20	-1				50	77
BF245B	TO-92	30	1	5	20	.5	8	15	10	1.6	3.8	15	200	6	15	15	3	6.5	.001	4	20	-1	1.1	20	-1				50	77
BF245C	TO-92	30	1	5	20	.5	8	15	10	3.2	7.5	15	200	12	25	15	3	6.5	.001	4	20	-1	1.1	20	-1				50	77
BF246A	TO-92	25	1	5	15	.6	14.5	15	10	1.5	4.0	15	200	30	80	15	8		.001	11	15	0	3.5	15	0				51	74
BF246B	TO-92	25	1	5	15	.6	14.5	15	10	3.0	7.0	15	200	60	140	15	8		.001	11	15	0	3.5	15	0				51	74
BF246C	TO-92	25	1	5	15	.6	14.5	15	10	5.5	12	15	200	110	250	15	8		.001	11	15	0	3.5	15	0				51	74
BF247A	TO-92	25	1	5	15	.6	14.5	15	10	1.5	4.0	15	200	30	80	15	8		.001	11	15	0	3.5	15	0				51	77
BF247B	TO-92	25	1	5	15	.6	14.5	15	10	3.0	7.0	15	200	60	140	15	8		.001	11	15	0	3.5	15	0				51	77
BF247C	TO-92	25	1	5	15	.6	14.5	15	10	5.5	12	15	200	110	250	15	8		.001	11	15	0	3.5	15	0				51	77
BF256A	TO-92	30	1	5	20					.5	7.5	15	200	3	7	15	4.5		.001				.7	20	1		7.5	800	50	77
BF256B	TO-92	30	1	5	20					.5	7.5	15	200	6	13	15	4.5		.001				.7	20	-1		7.5	800	50	77
BF256C	TO-92	30	1	5	20					.5	7.5	15	200	11	18	15	4.5		.001				.7	20	-1		7.5	800	50	77
BC264A	TO-92	30	1	10	20	.5		15	10	.2	1.2	15	1000	2	4.5	15	2.5		.001	4.0	15	-1	1.2	15	-1		40*	10*	50	77
BC264B	TO-92	30	1	10	20	.5		15	10	.4	1.4	15	1500	3.5	6.5	15	3.0		.001	4.0	15	-1	1.2	15	1		40*	10*	50	77
BC264C	TO-92	30	1	10	20	.5		15	10	.5	1.5	15	2500	5.0	8.0	15	3.5		.001	4.0	15	1	1.2	15	-1		40*	10*	50	77
BC264D	TO-92	30	1	10	20	.5		15	10	.6	1.6	15	3500	7.0	12.0	15	4.0		.001	4.0	15	-1	1.2	15	-1		40*	10*	50	77

Section 9

Process Characteristics JFETs

9

Process 50 N-Channel JFET



GATE IS ALSO BACKSIDE CONTACT

DESCRIPTION

Process 50 is designed primarily for RF amplifier and mixer applications. It will operate up to 450 MHz with low noise figure and good power gain. These devices offer outstanding performance at VHF aircraft and communications frequencies. Their major advantage is low crossmodulation and intermodulation, low noise figure and good power gain. The device is also a good choice for analog switching where low capacitance is very important.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−25	−40		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0V	1.0	10	20	mA
Forward Trans-conductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0	3.0	5.5	7.0	mmhos
Forward Trans-conductance	g_{fs}	V_{DG} = 15V, I_D = 200 μA		1.1		mmhos
Reverse Gate Leakage	I_{GSS}	V_{GS} = −20V, V_{DS} = 0		−5.0	−100	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	100	175	500	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	−0.7	−3.5	−6.0	V
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 1 mA, f = 1 kHz		10		μmhos
Feedback Capacitance	C_{rss}	V_{DG} = 15V, V_{GS} = 0		0.7	0.9	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0		3.5	4.0	pF
Noise Voltage	e_n	V_{DG} = 15V, I_D = 1 mA, f = 100 Hz		8.0		nV/$\sqrt{Hz}$
Noise Figure	NF	V_{DG} = 15V, I_D = 5 mA, R_G = 1 kΩ, f = 400 MHz		2.2	4.0	dB
Power Gain	G_{PS}	V_{DG} = 15V, I_D = 5 mA, f = 400 MHz		12		dB

This process is available in the following device types. *Denotes preferred parts.

TO-72 (CASE 25)

2N3823
2N3966
2N4223
2N4224
2N4416
*2N4416A
2N5078
2N5103
2N5104
2N5105
2N5556
2N5557
2N5558

TO-92 (CASE 72)

*2N5484
*2N5485
*2N5486
2N5555
2N5668
2N5669
2N5670
*J304
*J305
PN4223
PN4224
*PN4416
PN5163
MPF102
MPF106
MPF107
MPF110
MPF111

TO-92 (CASE 74)

2N3819
2N5248
BF244A
BF244B
BF244C
TIS58
TIS59

TO-92 (CASE 77)

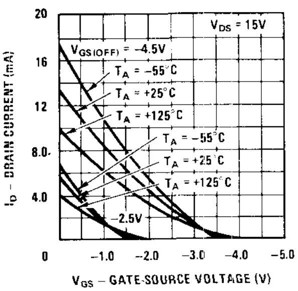
2N5949
2N5950
2N5951
2N5952
2N5953
BC264A
BC264B
BC264C
BC264D
BF245A
BF245B
BF245C
BF256A
BF256B
BF256C

QUALIFIED PER MIL-S-19500

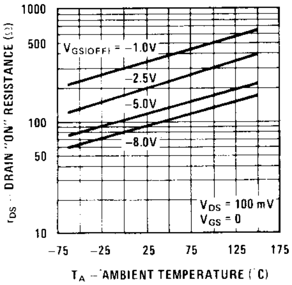
2N3823JAN, JANTX, JANTXV
2N4416AJAN, JANTX, JANTXV

Process 50

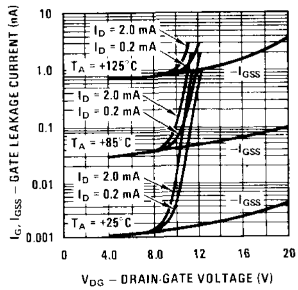
Transfer Characteristics



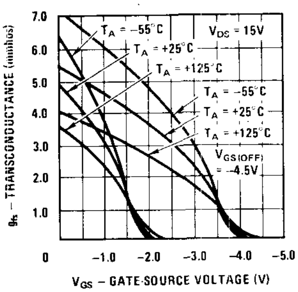
Channel Resistance vs Temperature



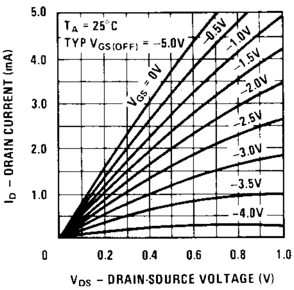
Leakage Current vs Voltage



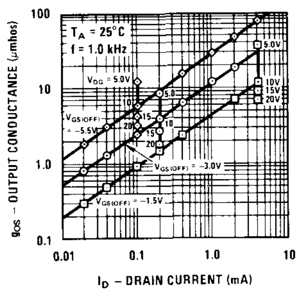
Transconductance Characteristics



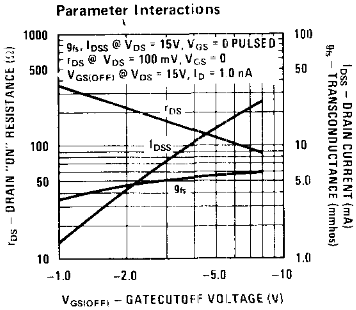
Common Drain-Source Characteristics



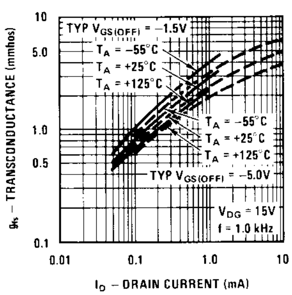
Output Conductance vs Drain Current



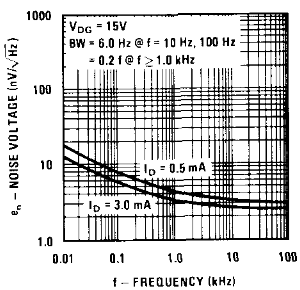
Parameter Interactions



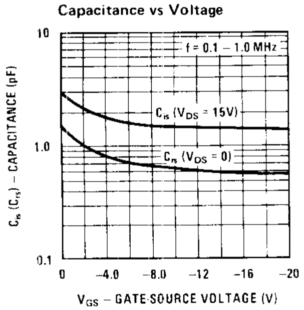
Transconductance vs Drain Current



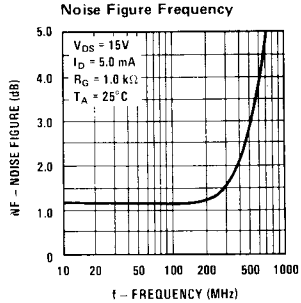
Noise Voltage vs Frequency



Capacitance vs Voltage

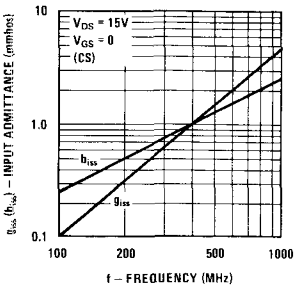


Noise Figure Frequency



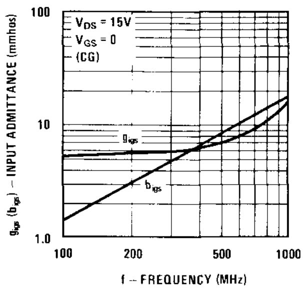
COMMON SOURCE

Input Admittance

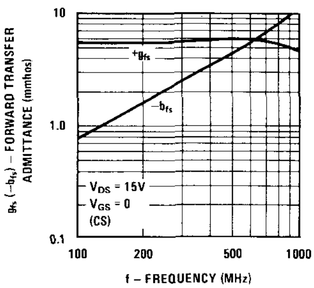


COMMON GATE

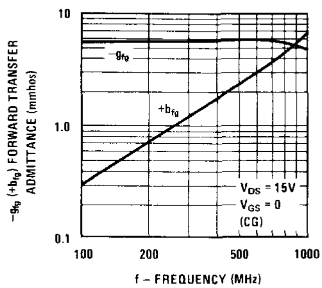
Input Admittance



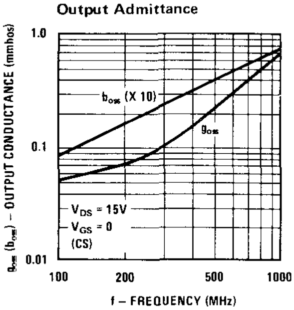
Forward Transadmittance



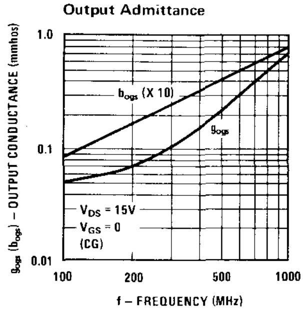
Forward Transadmittance



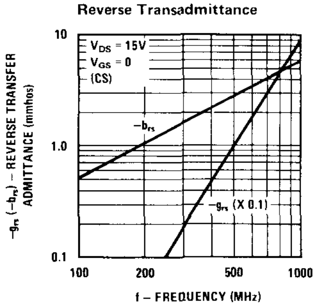
Output Admittance



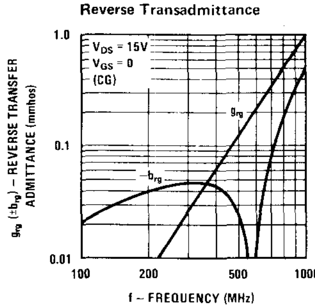
Output Admittance



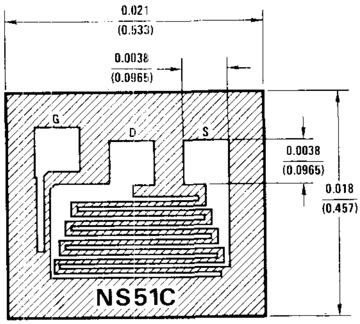
Reverse Transadmittance



Reverse Transadmittance



Process 51 N-Channel JFET



GATE IS ALSO BACKSIDE CONTACT

DESCRIPTION

Process 51 is designed primarily for electronic switching applications such as low ON resistance analog switching. It features excellent C_{iss} $R_{DS(ON)}$ time constant. The inherent zero offset voltage and low leakage current make these devices excellent for chopper stabilized amplifiers, sample and hold circuits, and reset switches. Low feedthrough capacitance also allows them to handle video signals to 100 MHz.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−30	−50		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0 Pulse Test	5.0	65	170	mA
Reverse Gate Leakage	I_{GSS}	V_{GS} = −20V, V_{DS} = 0		−15	−200	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	20	35	100	Ω
Forward Transconductance	g_{fs}	V_{DG} = 15V, I_D = 2 mA		8.5		mmhos
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 20V, I_D = 1 nA	−0.5	−4.5	−9.0	V
Drain "OFF" Current	$I_{D(OFF)}$	V_{DS} = 20V, V_{GS} = −10V		15	200	pA
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_D = 5 mA, f = 1 MHz		3.5	4.0	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, I_D = 5 mA, f = 1 MHz		12	16	pF
Noise Voltage	e_n	V_{DG} = 15V, I_D = 1 mA, f = 100 Hz		6.0		nV/√Hz
Turn-On Time	t_{on}	V_{DD} = 10V, I_D = 6.6 mA		12	20	ns
Turn-Off Time	t_{off}	V_{DD} = 10V, I_D = 6.6 mA		40	80	ns

This process is available in the following device types. *Denotes preferred parts.

TO-18 (CASE 02)

2N3970
2N3971
2N3972
*2N4091
*2N4092
*2N4093
*2N4391
*2N4392
*2N4393
*2N4856
2N4856A
*2N4857
2N4857A
*2N4858
2N4858A
2N4859
2N4859A
2N4860
2N4860A
2N4861
2N4861A

TO-72 (CASE 25)

*NF5101
*NF5102
*NF5103

TO-92 (CASE 72)

*2N5638
*2N5639
*2N5640
2N5653
2N5654
*J111
*J112
*J113
*PF5101
*PF5102
*PF5103
*PN4091
*PN4092
*PN4093
*PN4391
*PN4392
*PN4393
*PN4856
*PN4857
*PN4858
*PN4859
*PN4860
*PN4861
U1897E
U1898E
U1899E

TO-92 (CASE 74)

BF246A
BF246B
BF246C

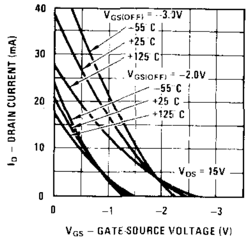
TO-92 (CASE 77)

BF247A
BF247B
BF247C
TIS73
TIS74
TIS75

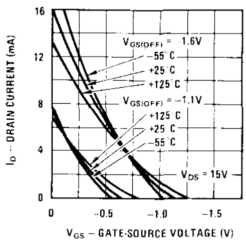
QUALIFIED PER MIL-S-19500

2N4091 JAN, JANTX
2N4092 JAN, JANTX
2N4093 JAN, JANTX, JANTXV
2N4856 JAN, JANTX, JANTXV
2N4857 JAN, JANTX JANTXV
2N4858 JAN, JANTX, JANTXV
2N4859 JAN, JANTX, JANTXV
2N4860 JAN, JANTX, JANTXV
2N4861 JAN, JANTX, JANTXV

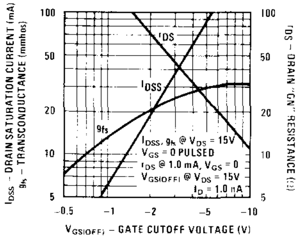
Transfer Characteristics



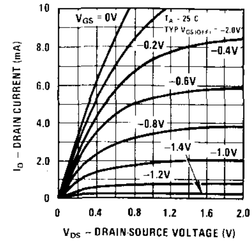
Transfer Characteristics



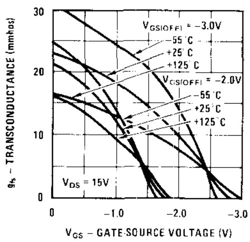
Parameter Interactions



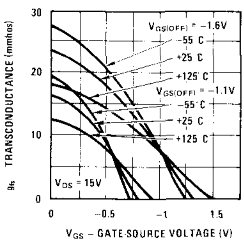
Common Drain-Source Characteristics



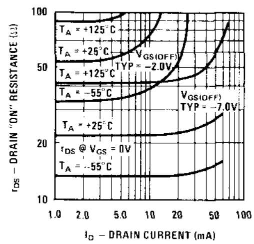
Transfer Characteristics



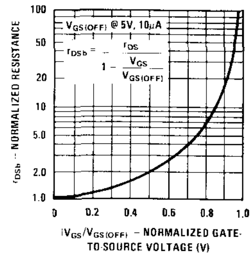
Transfer Characteristics



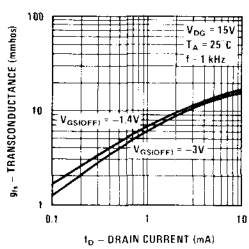
Resistance vs Drain Current



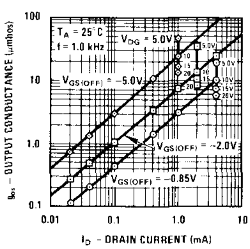
Normalized Drain Resistance vs Bias Voltage



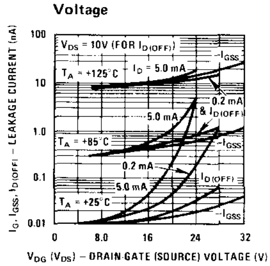
Transconductance vs Drain Current



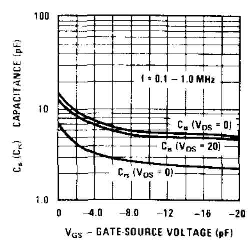
Output Conductance vs Drain Current



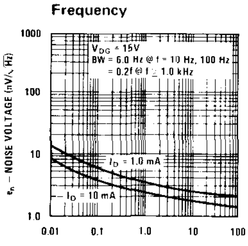
Leakage Current vs Voltage



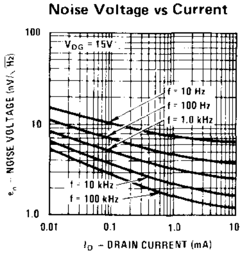
Capacitance vs Voltage



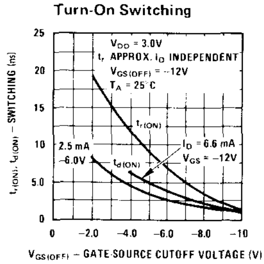
Noise Voltage vs Frequency



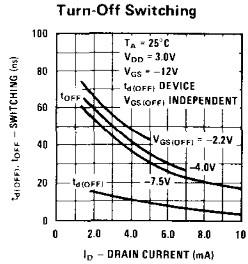
Noise Voltage vs Current



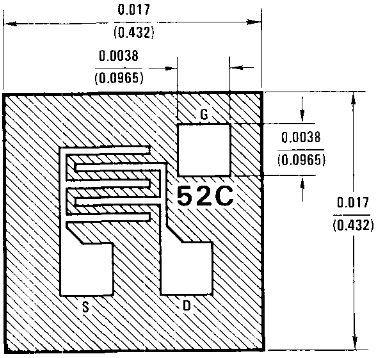
Turn-On Switching



Turn-Off Switching



Process 52 N-Channel JFET



GATE IS ALSO BACKSIDE CONTACT

DESCRIPTION

Process 52 is designed primarily for low level audio and general purpose applications. These devices provide excellent performance as input stages for piezo electric transducers or other high impedance signal sources. Their high output impedance and high voltage breakdown lend them to high gain audio and video amplifier applications. Source and drain are interchangeable.

CHARACTERISTIC	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−40	−70		V
Drain Saturation Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0V	0.2	1.5	12	mA
Forward Transconductance	g_{fs}	V_{DS} = 20V, V_{GS} = 0V	1.0	2.5	5.0	mmho
Forward Transconductance	g_{fs}	V_{DS} = 20V, I_D = 200 μA		700		μmho
Reverse Gate Leakage Current	I_{GSS}	V_{GS} = −30V, V_{DS} = 0V		−10		pA
Drain ON Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0V	250	400	2000	Ω
Gate Cutoff Voltage	$V_{GS(OFF)}, V_P$	V_{DS} = 15V, I_D = 1 nA	−0.3	1.0	−8.0	V
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 200 μA		2.0		μmho
Feedback Capacitance	C_{rss}	V_{DG} = 15V, V_{GS} = 0V, f = 1 MHz		1.3	1.8	pF
Input Capacitance	C_{iss}	V_{DG} = 15V, V_{GS} = 0V, f = 1 MHz		5	6	pF
Noise Voltage	e_n	V_{DG} = 15V, I_D = 200 μA, f = 100 Hz		10		nV/√Hz

This process is available in the following device types.
*Denotes preferred parts.

TO-18 (CASE 02)

2N3069
2N3070
2N3071
2N3368
2N3369
2N3370
2N3458
2N3459
2N3460
*2N4338
*2N4339
*2N4340
*2N4341

TO-72 (CASE 25)

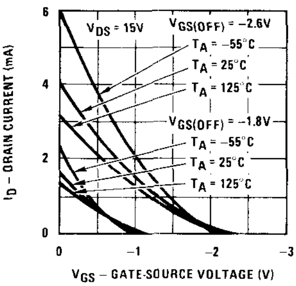
*2N3684
*2N3685
*2N3686
*2N3687
2N3967
2N3967A
2N3968
2N3968A
2N3969
2N3969A

TO-92 (CASE 72)

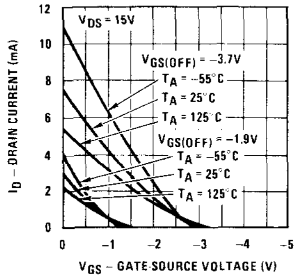
*J201
*J202
*J203
*PN3684
*PN3685
*PN3686
*PN3687
*PN4302
*PN4303
*PN4304

Process 52

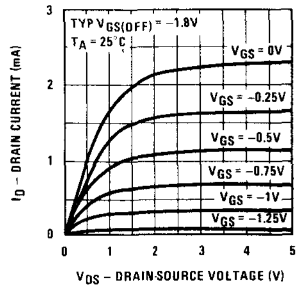
Transfer Characteristics



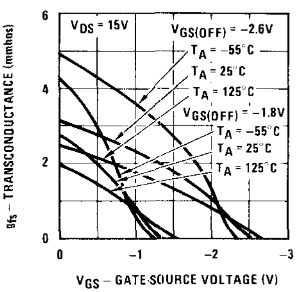
Transfer Characteristics



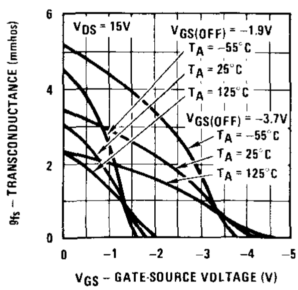
Common Drain-Source Characteristics



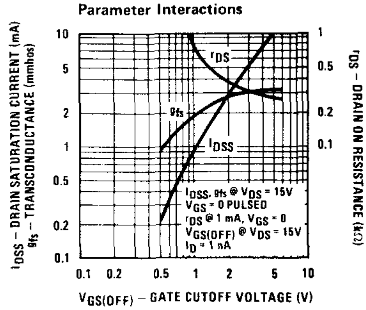
Transfer Characteristics



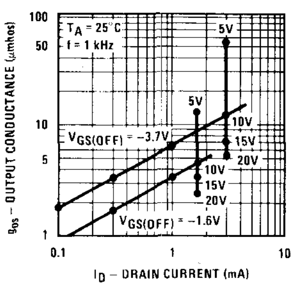
Transfer Characteristics



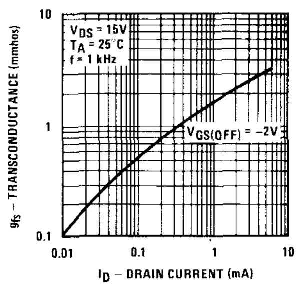
Parameter Interactions



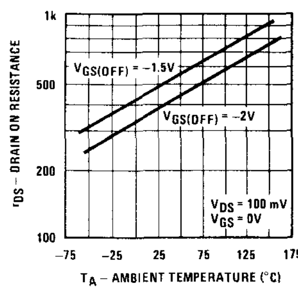
Output Conductance vs Drain Current



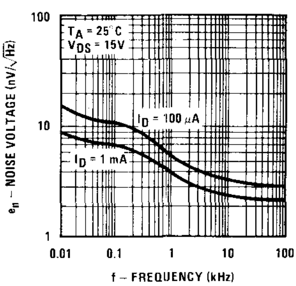
Transconductance vs Drain Current



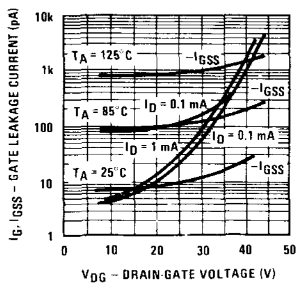
Channel Resistance vs Temperature



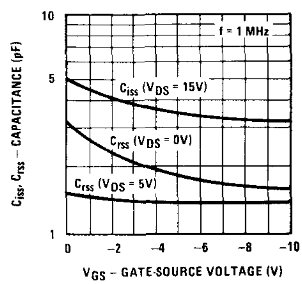
Noise Voltage vs Frequency



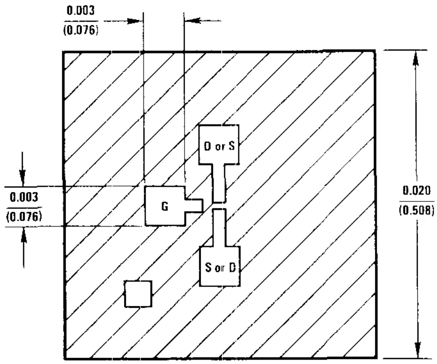
Leakage Current vs Voltage



Capacitance vs Voltage



Process 53 N-Channel JFET



GATE IS BACKSIDE CONTACT

DESCRIPTION

Process 53 is designed primarily for low current DC and audio applications. These devices provide excellent performance as input stages for sub pico-amp instrumentation or any high impedance signal sources.

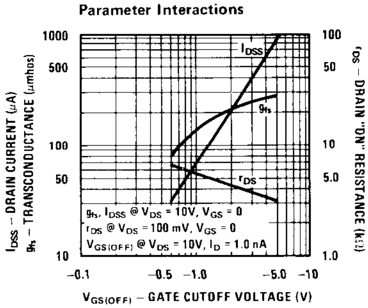
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V$, $I_G = -1\ \mu A$	−40	−60		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 10V$, $V_{GS} = 0$	0.02	0.25	1.0	mA
Forward Trans-conductance	g_{fs}	$V_{DS} = 10V$, $V_{GS} = 0$	80	250	350	µmho
Forward Trans-conductance	g_{fs}	$V_{DG} = 15V$, $I_D = 50\ \mu A$		120		µmho
Reverse Gate Leakage	I_{GSS}	$V_{GS} = -20V$, $V_{DS} = 0$		−0.3	−10	pA
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 10V$, $I_D = 1$ nA	−0.5	−2.2	−6.0	V
Feedback Capacitance	C_{rss}	$V_{DG} = 15V$, $V_{GS} = 0$, f = 1 MHz		0.85	1.0	pF
Input Capacitance	C_{iss}	$V_{DS} = 15V$, $V_{GS} = 0$, f = 1 MHz		2.0	2.5	pF
Output Conductance	g_{os}	$V_{DG} = 10V$, $I_D = 50\ \mu A$		0.9	5.0	µmhos
Noise Voltage	e_n	$V_{DG} = 10V$, $I_D = 50\ \mu A$, f = 100 Hz		45	150	$nV/\sqrt{Hz}$

This process is available in the following device types.
*Denotes preferred parts.

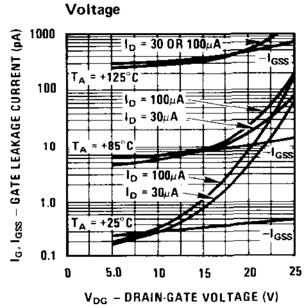
TO-72 (CASE 25)

2N4117
*2N4117A
2N4118
*2N4118A
2N4119
*2N4119A
*NF5301

Parameter Interactions

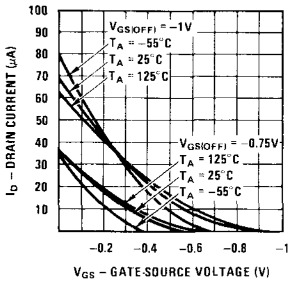


Leakage Current vs Voltage

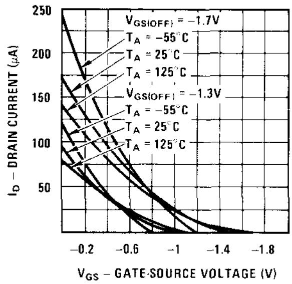


Process 53

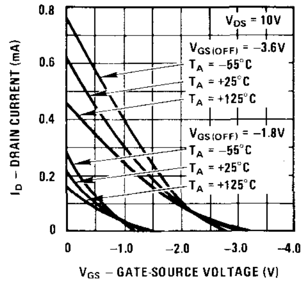
Transfer Characteristics



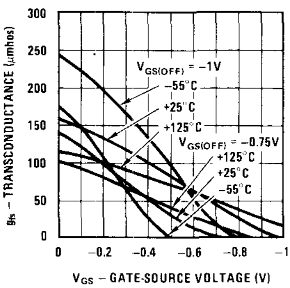
Transfer Characteristics



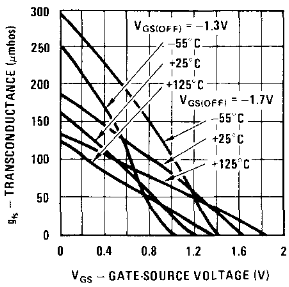
Transfer Characteristics



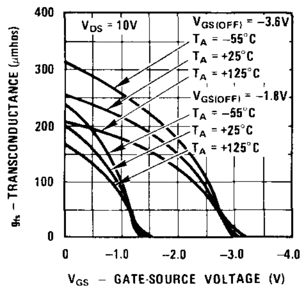
Transfer Characteristics



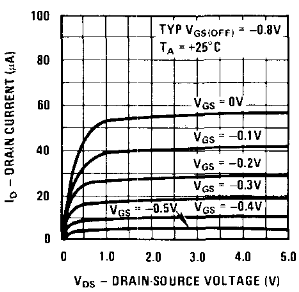
Transfer Characteristics



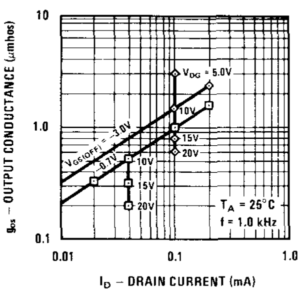
Transfer Characteristics



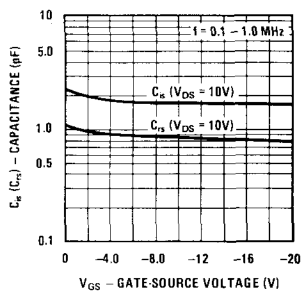
Common Drain-Source Characteristics



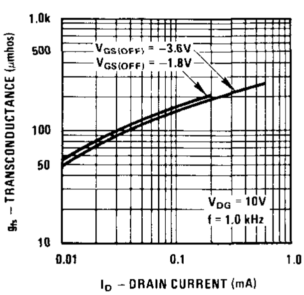
Output Conductance vs Drain Current



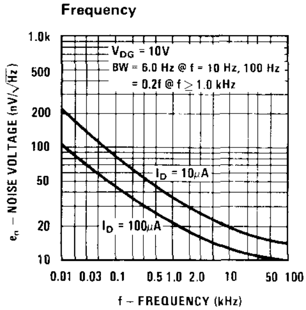
Capacitance vs Voltage



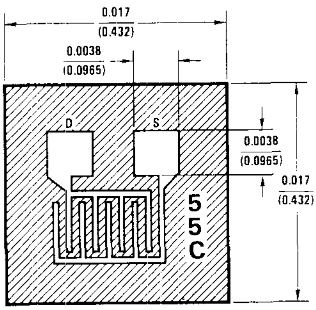
Transconductance vs Drain Current



Noise Voltage vs Frequency



Process 55 N-Channel JFET



GATE IS BACKSIDE CONTACT

DESCRIPTION

Process 55 is a general purpose low level audio amplifier and switching transistor. Wafer processing is similar to process 52 but process 55 uses a larger geometry. This results in higher Y_{fs}, I_{DSS}, and capacitance and lower $R_{DS(ON)}$. It is useful for audio and video frequency amplifiers and RF amplifiers under 50 MHz. It may also be used for analog switching applications.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−40	−70		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0	0.5	5.0	20	mA
Forward Transconductance	g_{fs}	V_{DS} = 20V, V_{GS} = 0	2.0	4.5	7.0	mmho
Forward Transconductance	g_{fs}	V_{DG} = 15V, I_D = 200 μA		1200		μmhos
Reverse Gate Leakage	I_{GSS}	V_{GS} = −30V, V_{DS} = 0		−10	−100	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	140	250	600	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 20V, I_D = 1 nA	−0.5	−2.0	−8.0	V
Feedback Capacitance	C_{rss}	V_{DG} = 15V, V_{GS} = 0, f = 1 MHz		1.5	2.0	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz		6.0	7.0	pF
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 200 μA		2		μmhos
Noise Voltage	e_n	V_{DG} = 15V, I_D = 200 μA, f = 100 Hz		10		$nV/\sqrt{Hz}$

This process is available in the following device types. *Denotes preferred parts.

TO-18 (CASE 02)

2N3436
2N3437
2N3438
*2N5361
*2N5362
*2N5363
*2N5364

TO-72 (CASE 25)

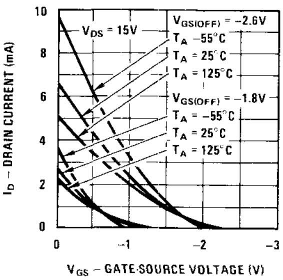
2N3821
2N3822
2N3824
2N4220
2N4220A
2N4221
2N4221A
2N4222
2N4222A
*2N5358
*2N5359
*2N5360

TO-92 (CASE 72)

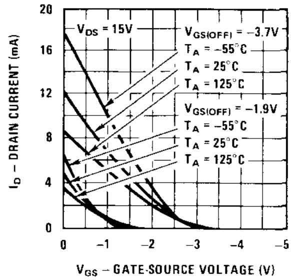
*2N5457
*2N5458
*2N5459
MPF103
MPF104
MPF105
MPF108
MPF109
MPF112
PN4220
PN4221
PN4222

Process 55

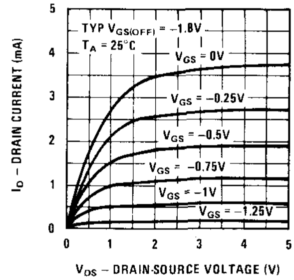
Transfer Characteristics



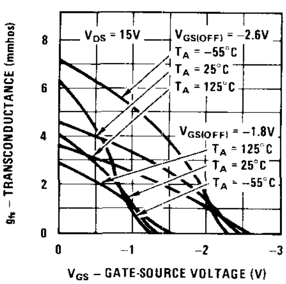
Transfer Characteristics



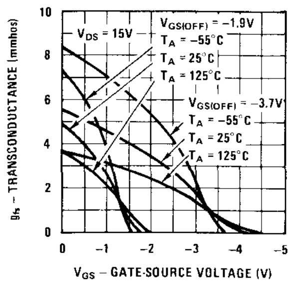
Common Drain-Source Characteristics



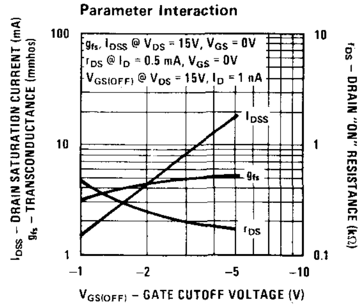
Transfer Characteristics



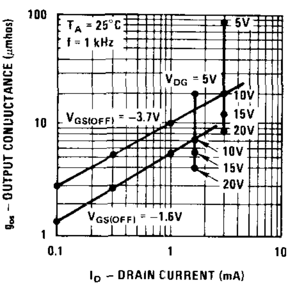
Transfer Characteristics



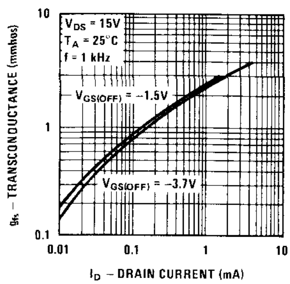
Parameter Interaction



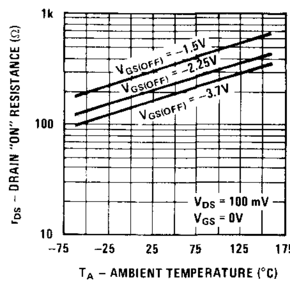
Output Conductance vs Drain Current



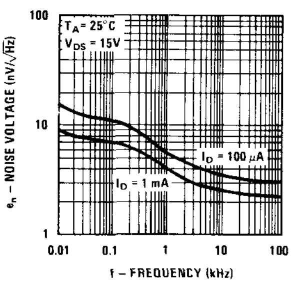
Transconductance vs Drain Current



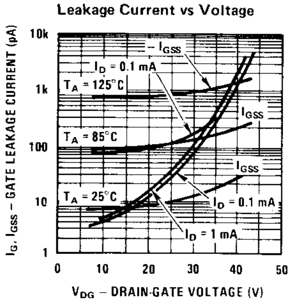
Channel Resistance vs Temperature



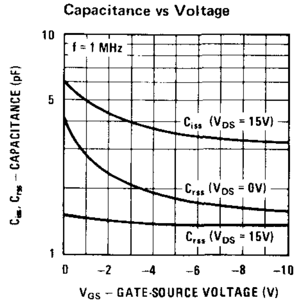
Noise Voltage vs Frequency



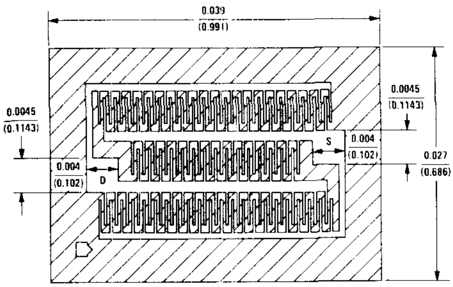
Leakage Current vs Voltage



Capacitance vs Voltage



Process 58 N-Channel JFET



GATE IS BACKSIDE CONTACT

DESCRIPTION

Process 58 was developed for analog or digital switching applications where very low $r_{DS(ON)}$ is mandatory. Switching times are very fast and $R_{DS(ON)}$ C_{iss} time constant is low. The 6Ω typical on resistance is very useful in precision multiplex systems where switch resistance must be held to an absolute minimum. With r_{DS} increasing only 0.7%/ °C, accuracy is retained over a wide temperature excursion.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−25	−30		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 5V, V_{GS} = 0 Pulse Test	100	400	1000	mA
Reverse Gate Leakage	I_{GSS}	V_{GS} = −15V, V_{DS} = 0		−50	−500	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	3.0	6.0	20	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 5V, I_D = 3 nA	−0.5	−5.0	−12	V
Drain "OFF" Current	$I_{D(OFF)}$	V_{DS} = 5V, V_{GS} = −10V		0.05	20	nA
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_D = 2 mA, f = 1 MHz		12	25	pF
Input Capacitance	C_{iss}	V_{DG} = 15V, I_D = 2 mA, f = 1 MHz		25	50	pF
Forward Transconductance	g_{fs}	V_{DG} = 10V, I_D = 2 mA		10		mmhos
Output Conductance	g_{os}	V_{DG} = 10V, I_D = 2 mA		100		μmhos
Noise Voltage	e_n	V_{DG} = 15V, I_D = 2 mA, f = 100 Hz		6.0		nV/√Hz

This process is available in the following device types. *Denotes preferred parts.

TO-39 (CASE 09)

U320
U321
U322

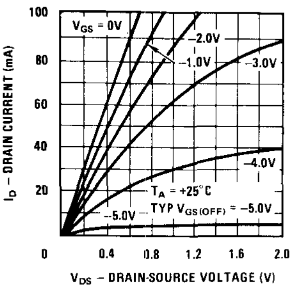
TO-52 (CASE 07)

*2N5432
*2N5433
*2N5434

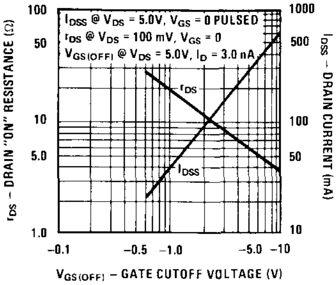
TO-92 (CASE 72)

*J108
*J109
*J110

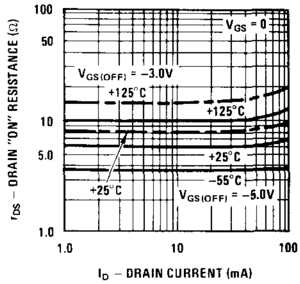
Common Drain-Source Characteristics



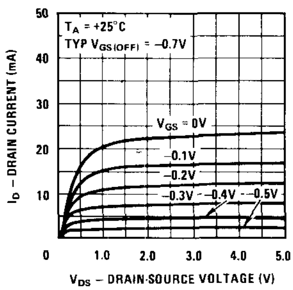
Parameter Interactions



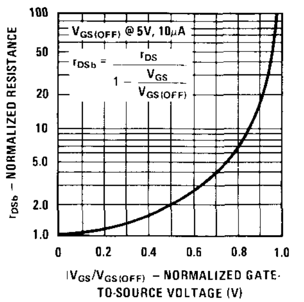
"ON" Resistance vs Drain Current



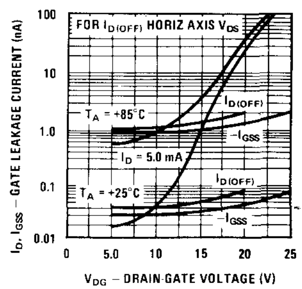
Common Drain-Source Characteristics



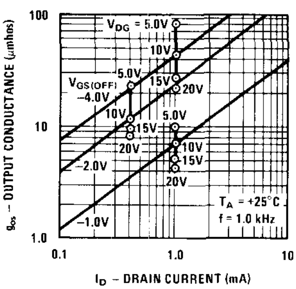
Normalized Drain Resistance vs Bias Voltage



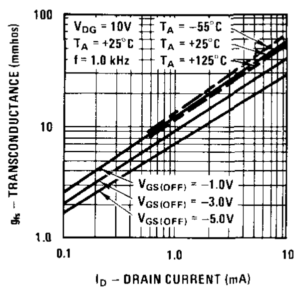
Leakage Current vs Voltage



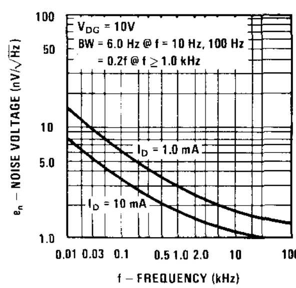
Output Conductance vs Drain Current



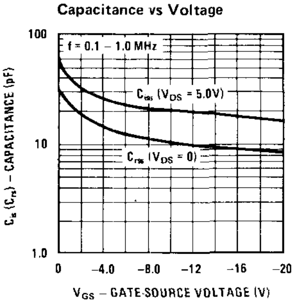
Transconductance vs Drain Current



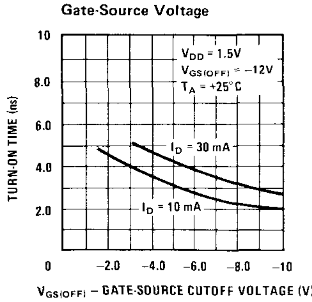
Noise Voltage vs Frequency



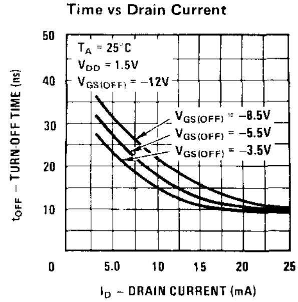
Capacitance vs Voltage



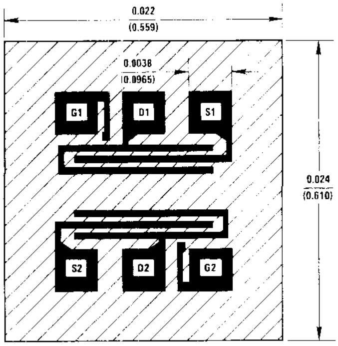
Switching Turn-On vs Gate-Source Voltage



Switching Turn-On Time vs Drain Current



Process 83 N-Channel Monolithic Dual JFET



DESCRIPTION

Process 83 is a monolithic dual JFET with a diode isolated substrate. It is intended for operational amplifier input buffer applications. Processing results in low input bias current and virtually unmeasureable offset current. Likewise matching characteristics are virtually independent of operating current and voltage, providing design flexibility. Most GP 2N types are sorted from this family.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−50	−70		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.5	2.5	8.0	mA
Forward Transconductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0	1.0	2.5	5.0	mmho
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	−0.5	−2.0	−4.5	V
Gate Current	I_G	V_{DG} = 20V, I_D = 0.2 mA		3.0	50	pA
Forward Transconductance	g_{fs}	V_{DG} = 15V, I_D = 0.2 mA	600	850		μmhos
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 0.2 mA		1.0	5.0	μmhos
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0		450		Ω
Noise Voltage	e_n	V_{DG} = 15V, I_D = 0.2 mA f = 100 Hz		10	50	$nV/\sqrt{Hz}$
Differential Match	$\lvert V_{GS1}-V_{GS2}\rvert$	V_{DG} = 15V, I_D = 0.2 mA		7.0	25	mV
Differential Match	ΔV_{GS1-2}	V_{DG} = 15V, I_D = 0.2 mA		10	50	μV/°C
Common Mode Rejection	CMRR	V_{DG} = 15V, I_D = 0.2 mA	80	95		dB
Feedback Capacitance	C_{rs}	V_{DG} = 15V, I_D = 0.2 mA, f = 1 MHz		1.0	1.2	pF
Input Capacitance	C_{is}	V_{DG} = 15V, I_D = 0.2 mA, f = 1 MHz		3.4	4.0	pF

This process is available in the following device types. *Denotes preferred parts.

TO-71 (CASE 12)

2N3921	2N5047	U233
2N3922	*2N5196	U234
*2N3954	*2N5197	U235
*2N3954A	*2N5198	
*2N3955	*2N5199	
*2N3955A	2N5452	
*2N3956	2N5453	
*2N3957	2N5454	
*2N3958	*2N5545	
2N4084	*2N5546	
2N4085	*2N5547	
2N5045	U231	
2N5046	U232	

8-Pin MiniDIP (CASE 60)

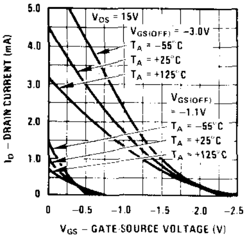
J410
J411
J412

8-Pin MiniDIP (CASE 67)

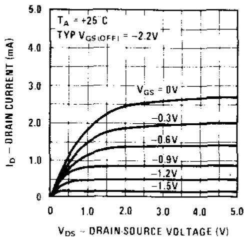
*NPD8301
*NPD8302
*NPD8303

Process 83

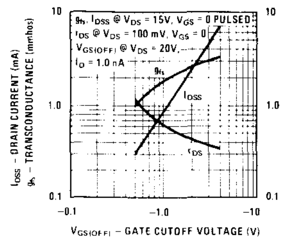
Transfer Characteristics



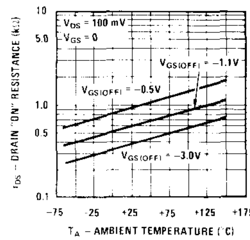
Common Drain-Source Characteristics



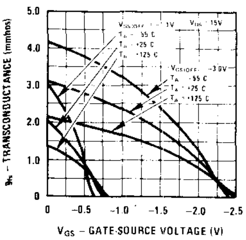
Parameter Interactions



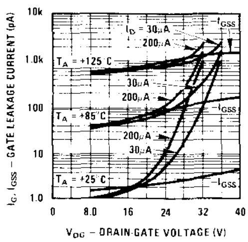
Channel Resistance vs Temperature



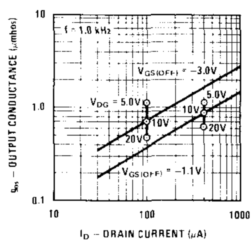
Transfer Characteristics



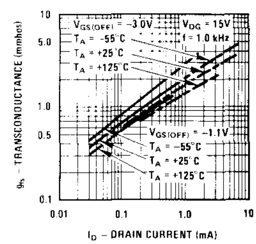
Leakage Current vs Voltage



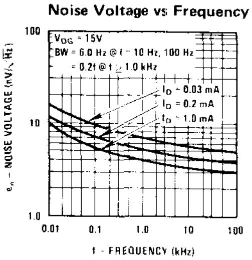
Output Conductance vs Drain Current



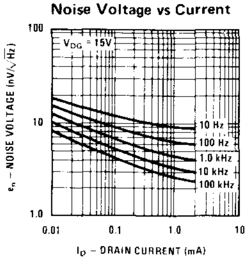
Transconductance vs Drain Current



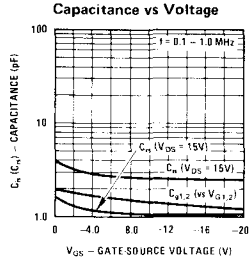
Noise Voltage vs Frequency



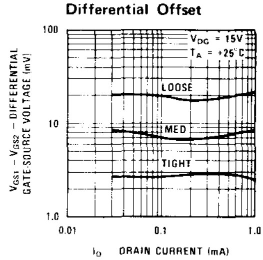
Noise Voltage vs Current



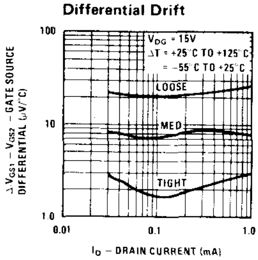
Capacitance vs Voltage



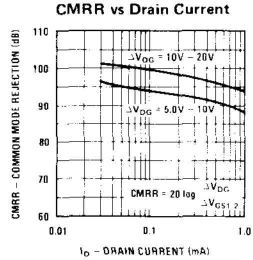
Differential Offset



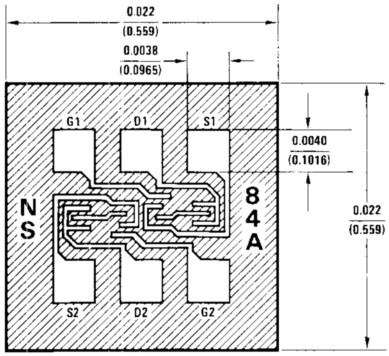
Differential Drift



CMRR vs Drain Current



Process 84 N-Channel Monolithic Dual JFET



DESCRIPTION

Process 84 is a monolithic dual JFET with a diode isolated substrate. It is designed for the most critical operational amplifier input stages or electrometer single ended preamp. Ideal for medical applications and instrumentation inputs where subpicoamp inputs are important. Device design considered high CMRR, subpicoamp leakage over wide input swings, low capacitance, and tight match over wide current range.

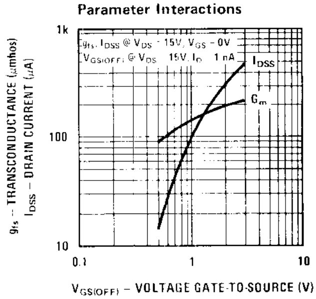
CHARACTERISTIC	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−40	−60		V
Drain Saturation Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0V	20	300	1000	μA
Forward Transconductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0V	90	180	300	μmhos
Forward Transconductance	g_{fs}	V_{DS} = 15V, I_D = 30 μA	50	120	150	μmhos
Gate Cutoff Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	0.5	2	4.5	V
Reverse Gate Leakage Current	I_{GSS}	V_{DS} = 0V, V_{GS} = −20V		1	5	pA
Gate Leakage Current	I_G	V_{DG} = 10V, I_D = 30 μA		0.5	3	pA
Feedback Capacitance	C_{rss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz		0.3	0.4	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz		2	3	pF
Noise Voltage	e_n	V_{DS} = 15V, I_D = 30 μA, f = 1 kHz		30	50	nV/√Hz
Noise Voltage	e_n	V_{DS} = 15V, I_D = 30 μA, f = 10 Hz		180		nV/√Hz
Output Conductance	g_{os}	V_{DS} = 10V, I_D = 30 μA		0.01	0.02	μmhos
Differential Gate-Source Voltage	$\|V_{GS1} - V_{GS2}\|$	V_{DS} = 10V, I_D = 30 μA		12	25	mV
Differential Gate-Source Voltage Drift	ΔV_{GS1-2}	V_{DS} = 10V, I_D = 30 μA		10	50	μV/°C
Common-Mode Rejection Ratio	CMRR	V_{DS} = 10V, I_D = 30 μA		112		dB

This process is available in the following device types. *Denotes preferred parts.

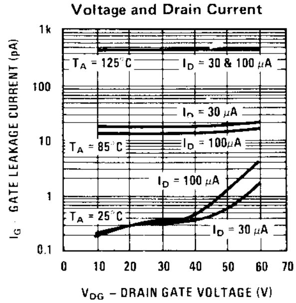
TO-78 (CASE 24)

2N5902	*2N5906
2N5903	*2N5907
2N5904	*2N5908
2N5905	*2N5909

Parameter Interactions

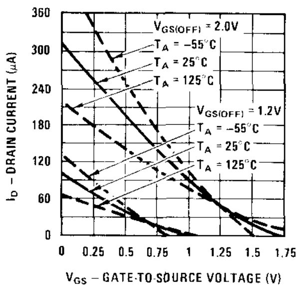


Leakage Current vs Voltage and Drain Current

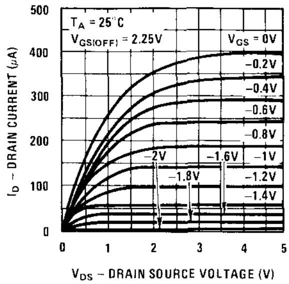


Process 84

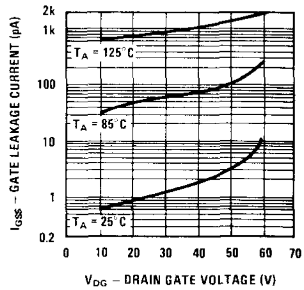
Transfer Characteristics



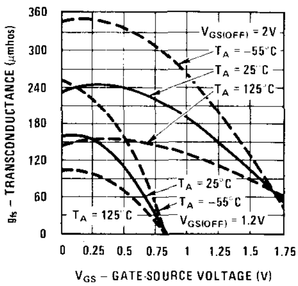
Common Drain-Source Characteristics



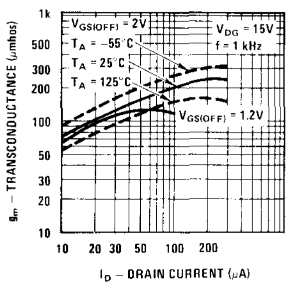
Leakage Current vs Voltage



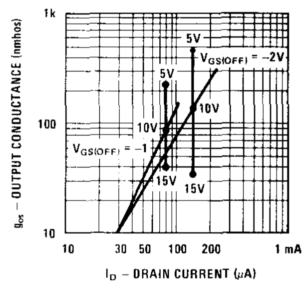
Transfer Characteristics



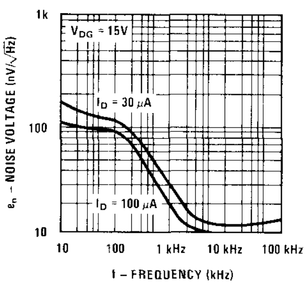
Transconductance vs Drain Current



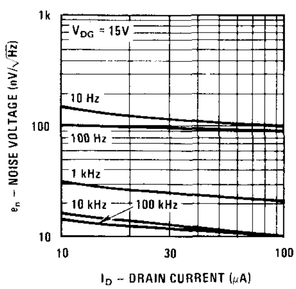
Output Conductance vs Drain Current



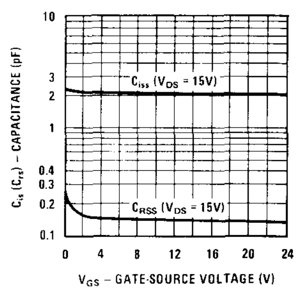
Noise Voltage vs Frequency



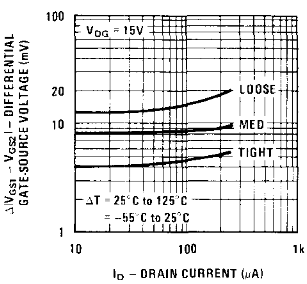
Noise Voltage vs Current



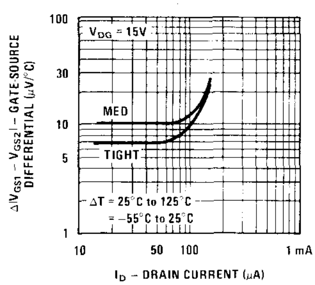
Capacitance vs Voltage



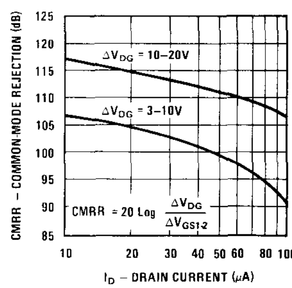
Differential Offset



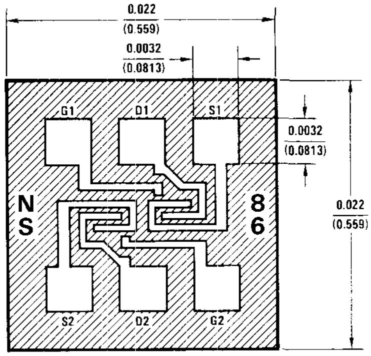
Differential Drift



CMRR vs Drain Current



Process 86 N-Channel Monolithic Dual JFET



DESCRIPTION

Process 86 is a monolithic dual JFET with a diode isolated substrate. It is intended for critical amplifier input stages requiring low noise, sub picoamp bias currents and high gain. Exacting process control results in consistent parameter distribution with tight match and low drift.

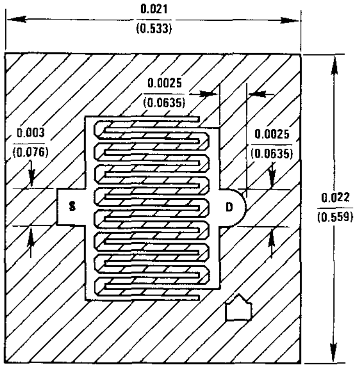
This process is available in the following device types. *Denotes preferred parts.

TO-78 (CASE 24)

U421
U422
U423
U424
U425
U426

PROCESS IN DEVELOPMENT

Process 88 P-Channel JFET



DESCRIPTION

Process 88 is designed primarily for electronic switching applications where a P channel device is desirable. Inherent zero offset voltage, low leakage and low $R_{DS(ON)}$ C_{iss} time constant make this device excellent for low level analog switching, sample and hold circuits and chopper stabilized amplifiers. This device is the complement to Process 51.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	30	40		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = −15V, V_{GS} = 0	−5.0	−30	−90	mA
Forward Trans-conductance	g_{fs}	V_{DS} = −15V, V_{GS} = 0	4.0	13	17	mmhos
Forward Trans-conductance	g_{fs}	V_{DG} = −15V, I_D = −2 mA		3.5		mmhos
Gate Leakage	I_{GSS}	V_{GS} = 20V, V_{DS} = 0		0.05	1.0	nA
"ON" Resistance	r_{DS}	V_{DS} = −100 mV, V_{GS} = 0	50	80	200	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = −15V, I_D = −1 nA	0.5	5.0	10	V
Drain "OFF" Current	$I_{D(OFF)}$	V_{DS} = −15V, V_{GS} = 10V		−0.05	−10	nA
Feedback Capacitance	C_{rss}	V_{DG} = −15V, I_D = −2 mA, f = 1 MHz		4.0	5.0	pF
Input Capacitance	C_{iss}	V_{DS} = −15V, I_D = −2 mA, f = 1 MHz		14	15	pF
Output Conductance	g_{os}	V_{DG} = −15V, I_D = −2 mA		100	300	μmhos
Noise Voltage	e_n	V_{DG} = −15V, I_D = −2 mA, f = 100 Hz		20		nV/√Hz

This process is available in the following device types. *Denotes preferred parts.

TO-18 (CASE 11)

2N2609
2N5018
2N5019
*2N5114
*2N5115
*2N5116
U301
U304
U305
U306

TO-72 (CASE 23)

2N3382
2N3384
2N3386
2N3993
2N3993A
2N3994
2N3994A

TO-92 (CASE 71)

P1086E
P1087E

TO-92 (CASE 74)

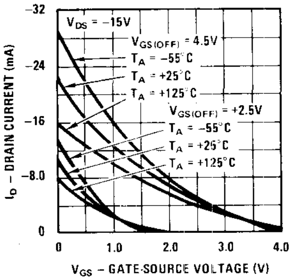
*J174
*J175
*J176
*J177
*J270
*J271

QUALIFIED PER MIL-S-19500

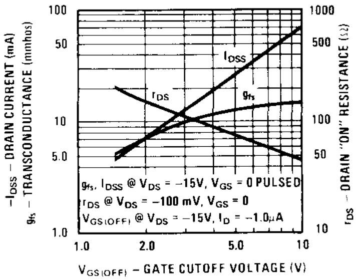
*2N5114JAN, JANTX, JANTXV
*2N5115JAN, JANTX, JANTXV
*2N5116JAN, JANTX, JANTXV

Process 88

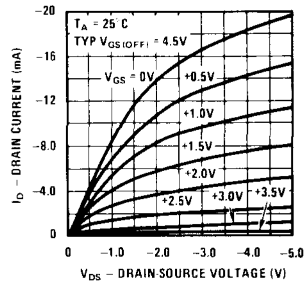
Transfer Characteristics



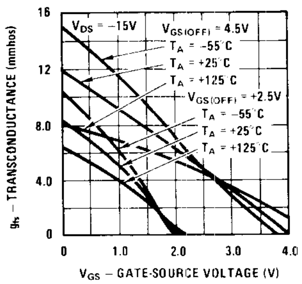
Parameter Interactions



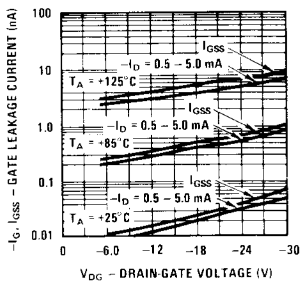
Common Drain-Source Characteristics



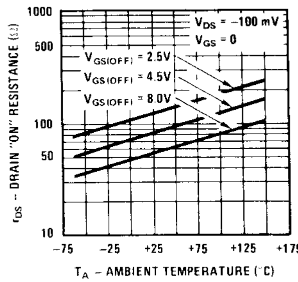
Transfer Characteristics



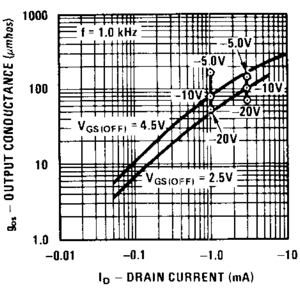
Leakage Current vs Voltage



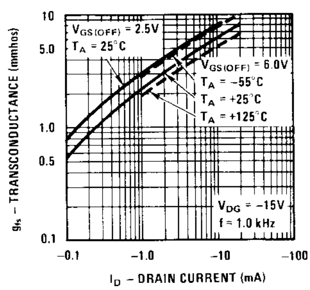
Channel Resistance vs Temperature



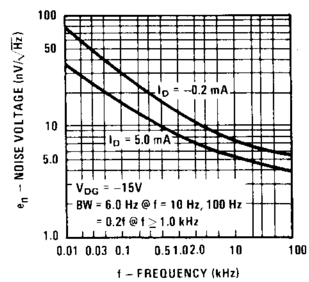
Output Conductance vs Drain Current



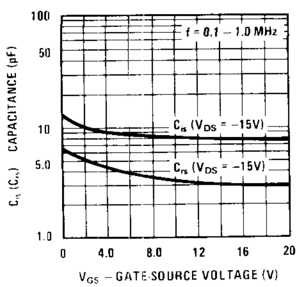
Transconductance vs Drain Current



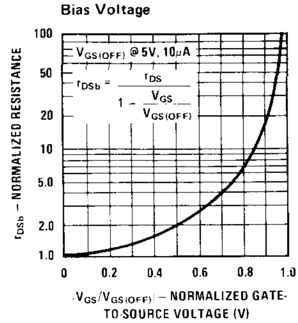
Noise Voltage vs Frequency



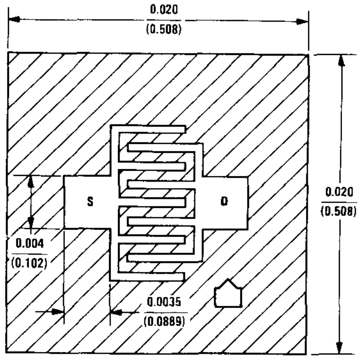
Capacitance vs Voltage



Normalized Drain Resistance vs Bias Voltage



Process 89 P-Channel JFET



GATE IS BACKSIDE CONTACT

DESCRIPTION

Process 89 is designed primarily for low level amplifier applications. This device is the complement to Process 55. Commonly used in voltage variable resistor applications.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	20	40		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = −15V, V_{GS} = 0	−0.3	−4.0	−20	mA
Forward Transconductance	g_{fs}	V_{DS} = −15V, V_{GS} = 0	1.0	2.5	4.0	mmhos
Forward Transconductance	g_{fs}	V_{DG} = −15V, I_D = −0.2 mA		700		μmhos
Gate Leakage	I_{GSS}	V_{GS} = 20V, V_{DS} = 0		0.02	1.0	nA
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = −15V, I_D = −1 nA	0.5	3.0	9.0	V
Feedback Capacitance	C_{rss}	V_{DG} = −15V, V_{GS} = 0, f = 1 MHz		2.0	2.5	pF
Input Capacitance	C_{is}	V_{DS} = −15V, I_D = −2 mA, f = 1 MHz		7.0	8.5	pF
"ON" Resistance	r_{DS}	V_{DS} = −100 mV, V_{GS} = 0		450		Ω
Output Conductance	g_{os}	V_{DG} = −15V, I_D = −0.2 mA		5.0	15	μmhos
Noise Voltage	e_n	V_{DG} = −15V, I_D = −0.2 mA, f = 100 Hz		30		$nV/\sqrt{Hz}$

This process is available in the following device types. *Denotes preferred parts.

TO-18 (CASE 11)

2N2608
2N4381
2N5020
2N5021

TO-72 (CASE 23)

2N3329
2N3330
2N3331
2N3332

TO-92 (CASE 71)

*2N5460
*2N5461
*2N5462
PN4342
PN4360
PN5033

TO-92 (CASE 74)

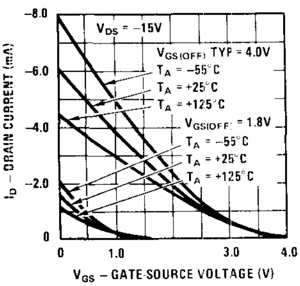
2N3820

QUALIFIED PER MIL-S-19500

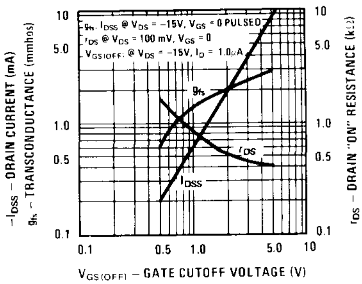
2N2608JAN

Process 89

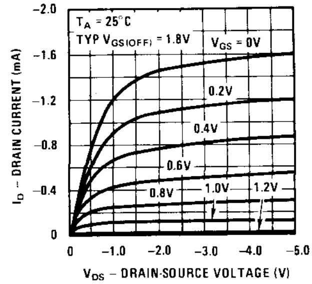
Transfer Characteristics



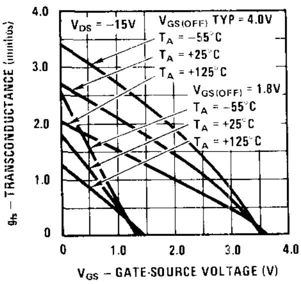
Parameter Interactions



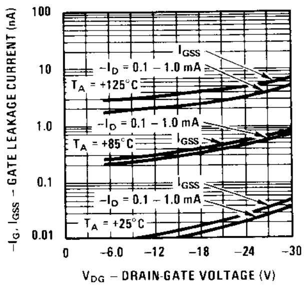
Common Drain-Source Characteristics



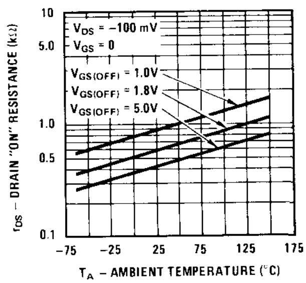
Transfer Characteristics



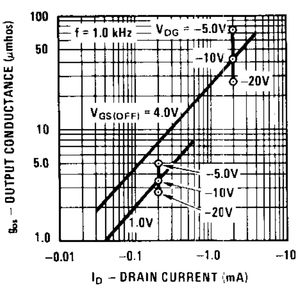
Leakage Current vs Voltage



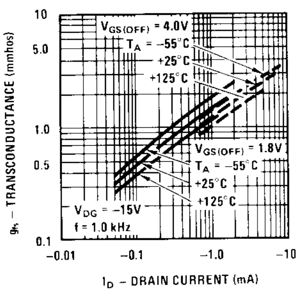
Channel Resistance vs Temperature



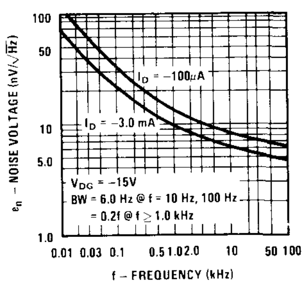
Output Conductance vs Drain Current



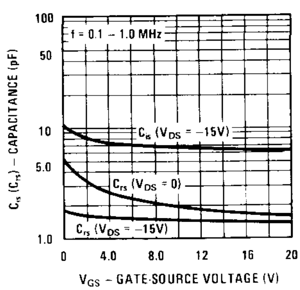
Transconductance vs Drain Current



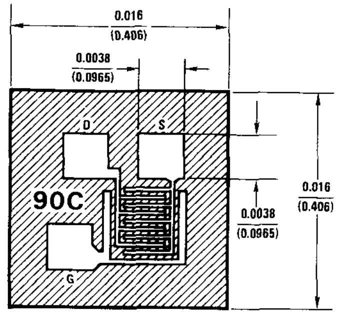
Noise Voltage vs Frequency



Capacitance vs Voltage



Process 90 N-Channel JFET



GATE IS ALSO BACKSIDE CONTACT

DESCRIPTION

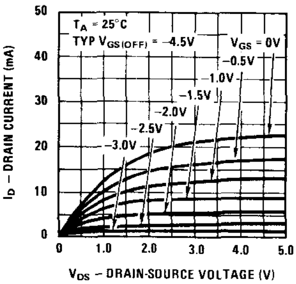
Process 90 is designed for VHF/UHF mixer/amplifier and applications where Process 50 is not adequate. Has sufficient gain and low noise, common gate configuration at 450 MHz, for sensitive receivers. The high transconductance and square law characteristics insures low crossmodulation and intermodulation distortions. Common-gate operation simplifies circuitry. Consider Process 92 for even higher performance.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V$, $I_G = -1\ \mu A$	−20	−30		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 10V$, $V_{GS} = 0$	3	18	40	mA
Forward Trans-conductance	g_{fs}	$V_{DS} = 10V$, $V_{GS} = 0$	5.5	8.0	10	mmhos
Forward Trans-conductance	g_{fs}	$V_{DS} = 10V$, $I_D = 5$ mA	4.5	5.8		mmhos
Reverse Gate Current	I_{GSS}	$V_{GS} = -15V$, $V_{DS} = 0$		−5.0	−100	pA
"ON" Resistance	r_{DS}	$V_{DS} = 100$ mV, $V_{GS} = 0$		90		Ω
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 10V$, $I_D = 1$ nA	−1.5	−3.5	−6.0	V
Output Conductance	g_{os}	$V_{DG} = 10V$, $I_D = 5$ mA		45	100	μmhos
Feedback Capacitance	C_{rs}	$V_{DG} = 10V$, $I_D = 5$ mA		1.0	1.2	pF
Input Capacitance	C_{is}	$V_{DG} = 10V$, $I_D = 5$ mA		4.0	5.0	pF
Noise Voltage	e_n	$V_{DG} = 10V$, $I_D = 5$ mA, f = 100 Hz		13		$nV/\sqrt{Hz}$
Noise Figure	NF	$V_{DG} = 10V$, $I_D = 5$ mA, f = 450 MHz		3.0		dB
Power Gain	G_{pg} (CG)	$V_{DG} = 10V$, $I_D = 5$ mA, f = 450 MHz		11		dB

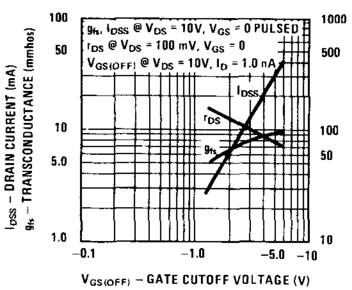
This process is available in the following device types. *Denotes preferred parts.

TO-52 (CASE 07)	TO-72 (CASE 29)	TO-92 (CASE 72)	TO-92 (CASE 77)
U312	*2N5397	J114	*2N5245
	2N5398	*J210	*2N5246
		*J211	*2N5247
		*J212	
		*J300	

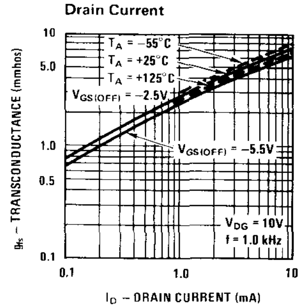
Common Drain-Source Characteristics



Parameter Interactions



Transconductance vs Drain Current

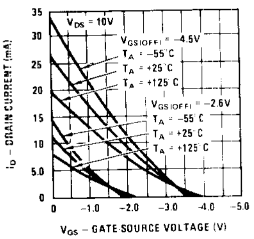


Process 90

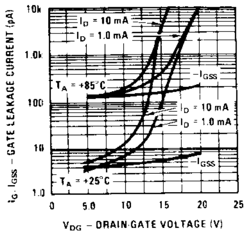
COMMON SOURCE

COMMON GATE

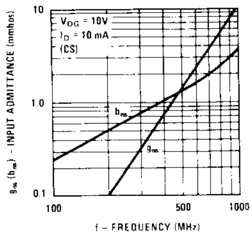
Transfer Characteristics



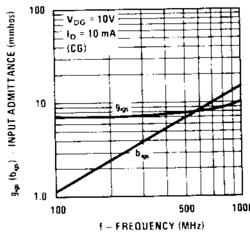
Leakage Current vs Voltage



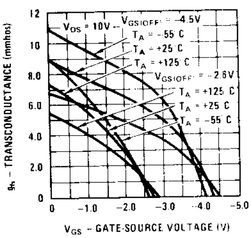
Input Admittance



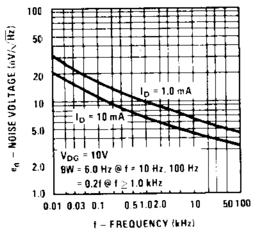
Input Admittance



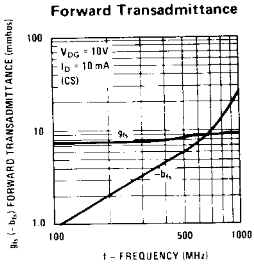
Transfer Characteristics



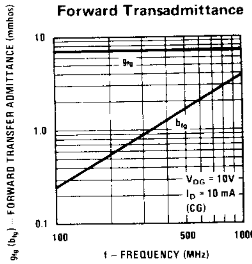
Noise Voltage vs Frequency



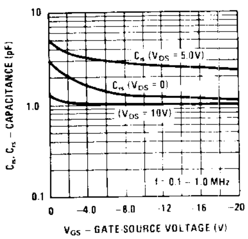
Forward Transadmittance



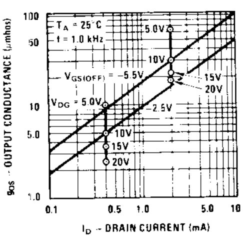
Forward Transadmittance



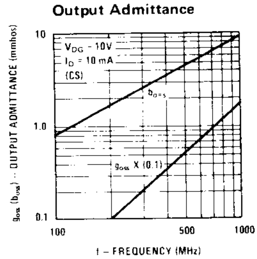
Capacitance vs Voltage



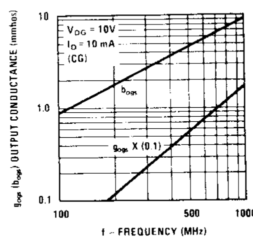
Output Conductance vs Drain Current



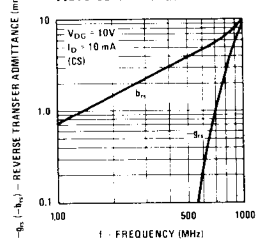
Output Admittance



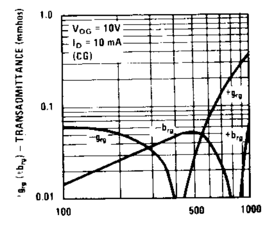
Output Admittance



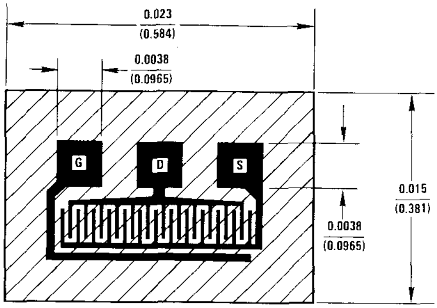
Reverse Transadmittance



Reverse Transadmittance



Process 92 N-Channel JFET



GATE IS ALSO BACKSIDE CONTACT

DESCRIPTION

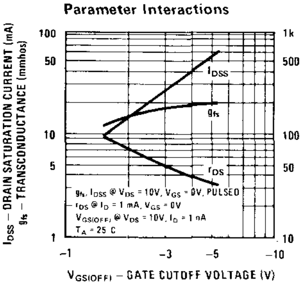
Process 92 is designed for VHF/UHF amplifier, oscillator, and mixer applications. As a common gate amplifier, 16 dB at 100 MHz and 12 dB at 450 MHz can be realized. Worst case 75 ohm input impedance provides ideal input match.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−20	−30		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 10V, V_{GS} = 0, Pulsed	10	38	80	mA
Forward Trans-conductance	g_{fs}	V_{DS} = 10V, V_{GS} = 0, Pulsed		19		mmhos
Forward Trans-conductance	g_{fs}	V_{DG} = 10V, I_D = 10 mA	10	13	18	mmhos
Reverse Gate Current	I_{GSS}	V_{GS} = −15V, V_{DS} = 0		−15	−100	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	35	45	80	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 1 nA	−1.5	−4.0	−6.5	V
Output Conductance	g_{os}	V_{DG} = 10V, I_D = 10 mA		160	250	μmhos
Feedback Capacitance	C_{gd}	V_{DG} = 10V, I_D = 10 mA, f = 1 MHz		2.0	2.5	pF
Input Capacitance	C_{gs}	V_{DG} = 10V, I_D = 10 mA, f = 1 MHz		4.1	5.0	pF
Noise Voltage	e_n	V_{DG} = 10V, I_D = 10 mA, f = 100 Hz		6.0		$nV/\sqrt{Hz}$
Noise Figure	NF	V_{DG} = 10V, I_D = 10 mA, f = 450 MHz		3.0		dB
Power Gain	G_{pg}	V_{DG} = 10V, I_D = 10 mA, f = 450 MHz		12		dB

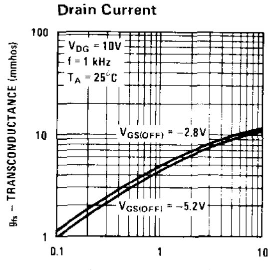
This process is available in the following device types. *Denotes preferred parts.

TO-52 (CASE 07)	TO-99 (CASE 24)	TO-92 (CASE 72)
U308	U430 } Dual	J308
*U309	U431 } Dual	*J309
*U310		*J310

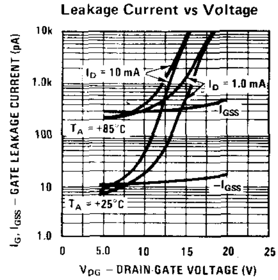
Parameter Interactions



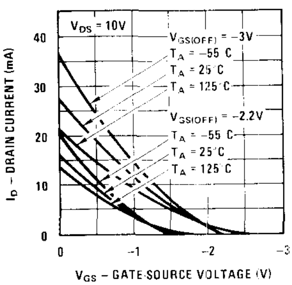
Transconductance vs Drain Current



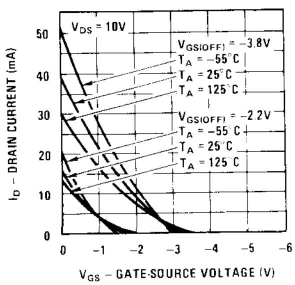
Leakage Current vs Voltage



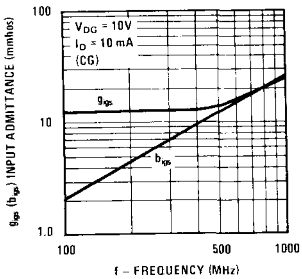
Transfer Characteristics



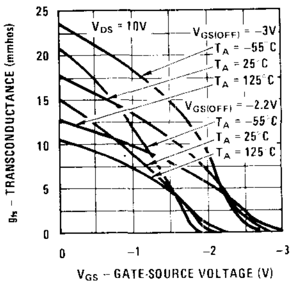
Transfer Characteristics



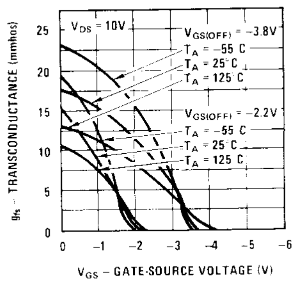
Input Admittance



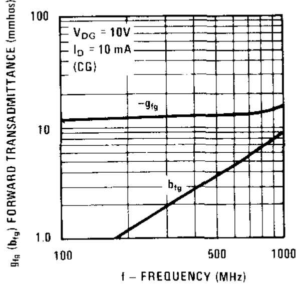
Transfer Characteristics



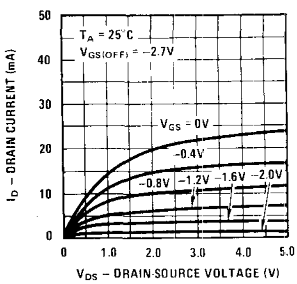
Transfer Characteristics



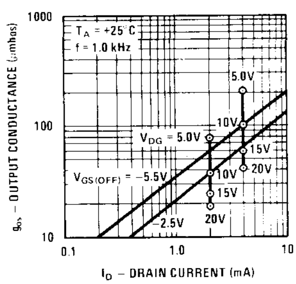
Forward Transadmittance



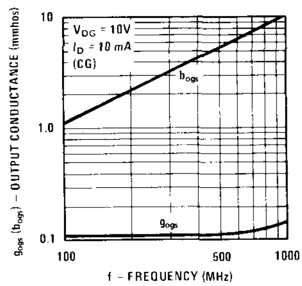
Common Drain-Source Characteristics



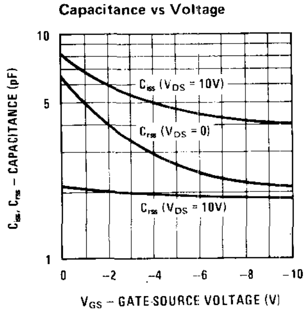
Output Conductance vs Drain Current



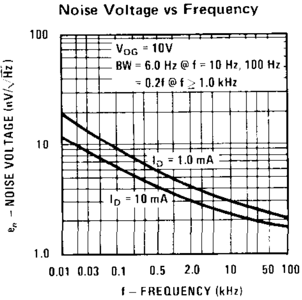
Output Admittance



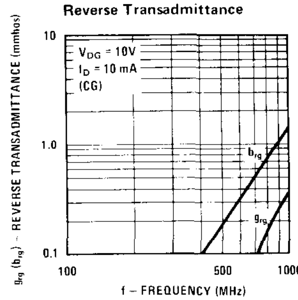
Capacitance vs Voltage



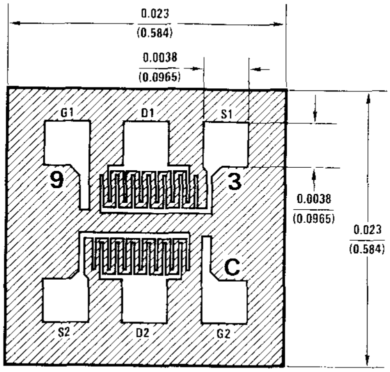
Noise Voltage vs Frequency



Reverse Transadmittance



Process 93 N-Channel Monolithic Dual JFET



DESCRIPTION

Process 93 is a monolithic dual JFET with a diode isolated substrate. It is intended for wide band, low noise, single ended video amplifier input stages, and high slew rate op amps. Monolithic structure eliminates thermal transient errors, and provides freedom to pick operating current and voltage.

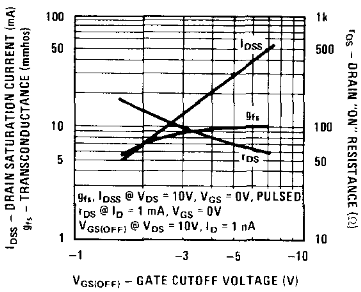
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−25	−30		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 10V, V_{GS} = 0, Pulsed	3.0	18	40	mA
Forward Transconductance	g_{fs}	V_{DS} = 10V, V_{GS} = 0, Pulsed		8.0		mmhos
Forward Transconductance	g_{fs}	V_{DG} = 10V, I_D = 5 mA	5.0	6.0	10	mmhos
Output Conductance	g_{os}	V_{DG} = 10V, I_D = 5 mA		50	100	μmhos
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 1 nA	−1.5	−3.5	−6.0	V
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0		100		Ω
Gate Current	I_G	V_{DG} = 10V, I_D = 5 mA		10	100	pA
Noise Voltage	e_n	V_{DG} = 10V, I_D = 5 mA, f = 100 Hz		9.0	30	nV/√Hz
Differential Match	$\|V_{GS1}-V_{GS2}\|$	V_{DG} = 10V, I_D = 5 mA		9.0	30	mV
Differential Match	ΔV_{GS1-2}	V_{DG} = 10V, I_D = 5 mA		15	40	μV/°C
Common Mode Rejection	CMRR	V_{DG} = 10V, I_D = 5 mA		90		dB
Feedback Capacitance	C_{rs}	V_{DG} = 10V, I_D = 5 mA, f = 1 MHz		1.0	1.2	pF
Input Capacitance	C_{is}	V_{DG} = 10V, I_D = 5 mA, f = 1 MHz		4.2	5.0	pF

This process is available in the following device types. *Denotes preferred parts.

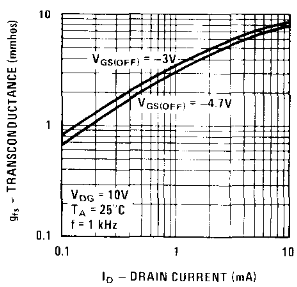
TO-78 (CASE 24)

*2N5911
*2N5912
U257

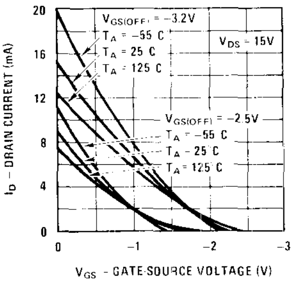
Parameter Interactions



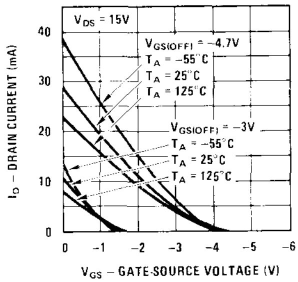
Transconductance vs Drain Current



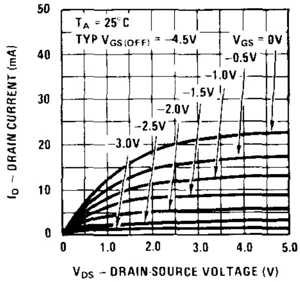
Transfer Characteristics



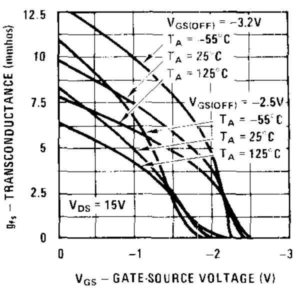
Transfer Characteristics



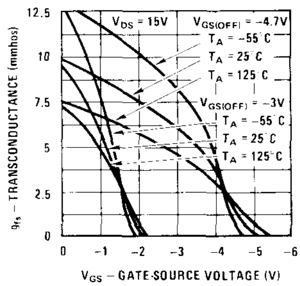
Common Drain-Source Characteristics



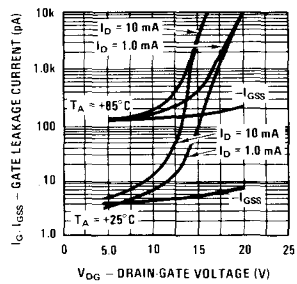
Transfer Characteristics



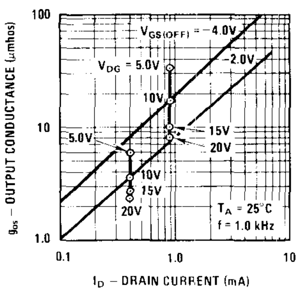
Transfer Characteristics



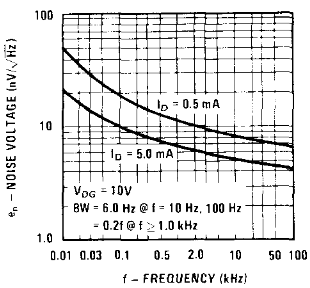
Leakage Current vs Voltage



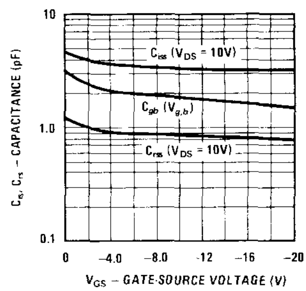
Output Conductance vs Drain Current



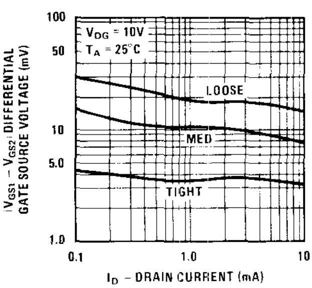
Noise Voltage vs Frequency



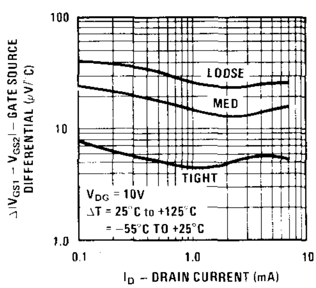
Capacitance vs Voltage



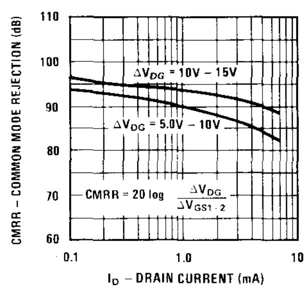
Differential Offset



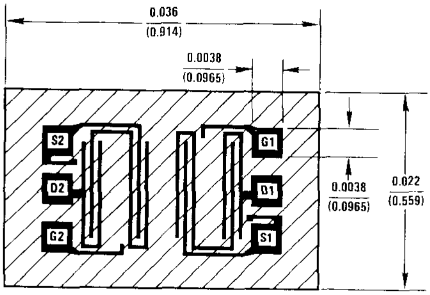
Differential Drift



CMRR vs Drain Current



Process 94 N-Channel Monolithic Dual JFET



DESCRIPTION

Process 94 is a monolithic dual JFET. It is strictly intended for operational amplifier input buffer applications. Special processing results in extremely low input bias current and virtually unmeasureable offset current. It is important to note that the <5 pico ampere bias current is measured at 35 volts. Typical CMRR is 125 dB. Performance superior to electrometer tubes can be readily achieved with low offset voltage and almost zero long term drift.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−40	−70		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.5	3.0	10	mA
Forward Transconductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0	1.5	3.5	7.0	mmho
Forward Transconductance	g_{fs}	V_{DG} = 15V, I_D = 0.2 mA	0.9	1.2	1.8	mmhos
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	−0.5	−2.0	−6.0	V
Gate Current	I_G	V_{DG} = 35V, I_D = 0.20 mA		1.0	15	pA
Feedback Capacitance	C_{rss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz		0.01	0.02	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz		4.0	5.0	pF
Noise Voltage	e_n	V_{DG} = 15V, I_D = 0.2 mA, f = 10 Hz		12	50	$nV/\sqrt{Hz}$
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 0.2 mA		<0.1		μmhos
Differential Match	$\lvert V_{GS1}-V_{GS2}\rvert$	V_{DG} = 15V, I_D = 0.2 mA		5.0	25	mV
Differential Match	ΔV_{GS1-2}	V_{DG} = 15V, I_D = 0.2 mA		6.0	50	μV/°C
Common Mode Rejection	CMRR	V_{DG} = 15V, I_D = 0.2 mA		125		dB

This process is available in the following device types.
*Denotes preferred parts.

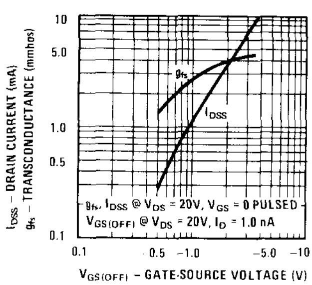
TO-71 (CASE 12)

*NDF9406
*NDF9407
*NDF9408
*NDF9409
*NDF9410

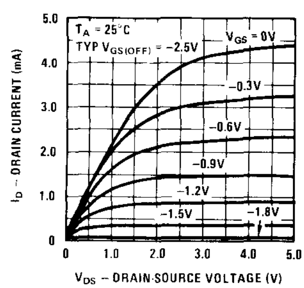
TO-78 (CASE 24)

NDF9401
NDF9402
NDF9403
NDF9404
NDF9405

Parameter Interactions

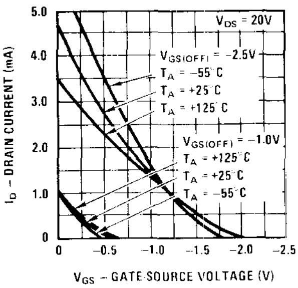


Common Drain-Source Characteristics

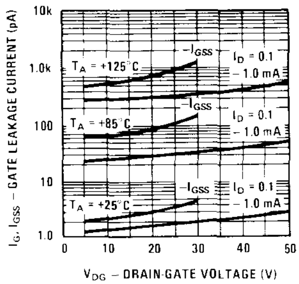


Process 94

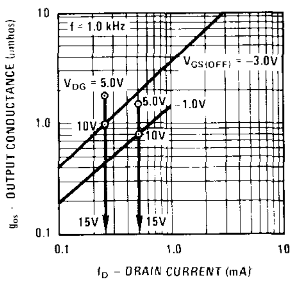
Transfer Characteristics



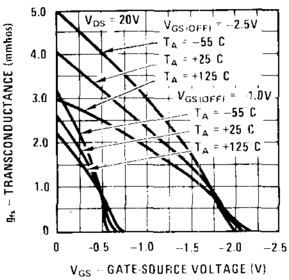
Leakage Current vs Voltage



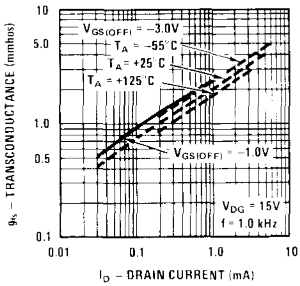
Output Conductance vs Drain Current



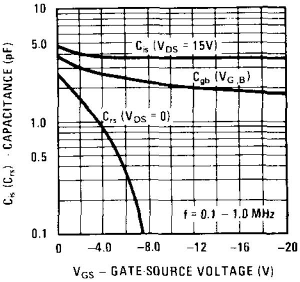
Transfer Characteristics



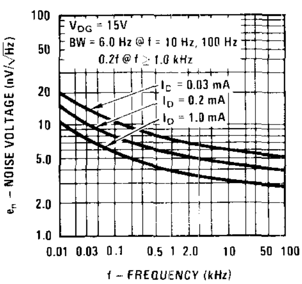
Transconductance vs Drain Current



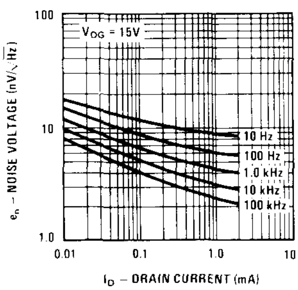
Capacitance vs Voltage



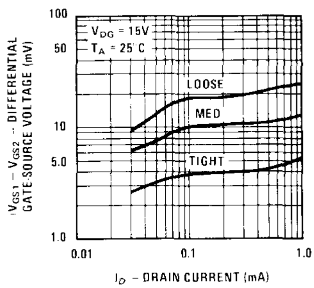
Noise Voltage vs Frequency



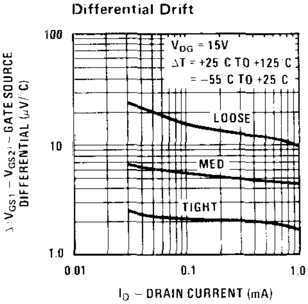
Noise Voltage vs Current



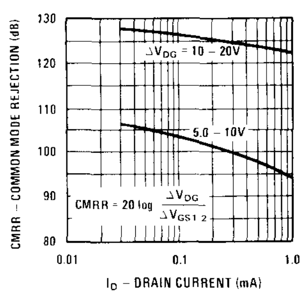
Differential Offset



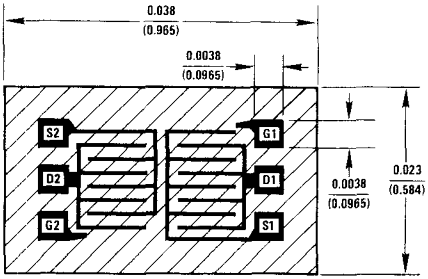
Differential Drift



CMRR vs Drain Current



Process 95 N-Channel Monolithic Dual JFET



DESCRIPTION

Process 95 is a monolithic dual JFET with a diode isolated substrate. It is intended for operational amplifier input buffer applications. Processing results in low input bias current and virtually unmeasureable offset current. Low noise voltage and high CMRR for critical I/f applications.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V$, $I_G = -1\ \mu A$	−40	−70		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 15V$, $V_{GS} = 0$	0.5	3.0	8.0	mA
Forward Transconductance	g_{fs}	$V_{DS} = 15V$, $V_{GS} = 0$	1.0	2.5	4.0	mmhos
Forward Transconductance	g_{fs}	$V_{DG} = 15V$, $I_D = 0.2$ mA	0.5	0.7		mmhos
Gate Leakage	I_{GSS}	$V_{GS} = -20V$, $V_{DS} = 0$		−5.0	−100	pA
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 15V$, $I_D = 1$ nA	−0.5	−2.5	−4.0	V
Input Capacitance	C_{iss}	$V_{DS} = 15V$, $V_{GS} = 0$, f = 1 MHz		10	14	pF
Noise Voltage	e_n	$V_{DS} = 15V$, $I_D = 0.2$ mA, f = 10 Hz		8.0	30	$nV/\sqrt{Hz}$
Noise Voltage	e_n	$V_{DS} = 15V$, $I_D = 0.2$ mA, f = 100 Hz		6.0	10	$nV/\sqrt{Hz}$
Output Conductance	g_{os}	$V_{DG} = 15V$, $I_D = 0.2$ mA		0.3	1.0	µmhos
Feedback Capacitance	C_{rss}	$V_{DS} = 15V$, $V_{GS} = 0$, f = 1 MHz		3.5	5.0	pF
Differential Match	$\|V_{GS1}-V_{GS2}\|$	$V_{DG} = 20V$, $I_D = 0.2$ mA		6.0	25	mV
Differential Match	ΔV_{GS1-2}	$V_{DG} = 20V$, $I_D = 0.2$ mA		9.0	60	µV/°C
Common Mode Rejection	CMRR	$V_{DG} = 20V$, $I_D = 0.2$ mA	86	115		dB

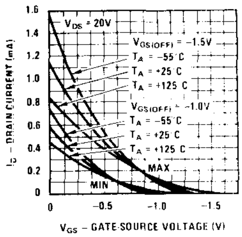
This process is available in the following device types. *Denotes preferred parts.

TO-71 (CASE 12)

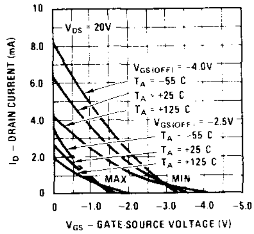
2N5515	*2N5522
2N5516	*2N5523
2N5517	*2N5524
2N5518	*2N6483
2N5519	*2N6484
*2N5520	*2N6485
*2N5521	

Process 95

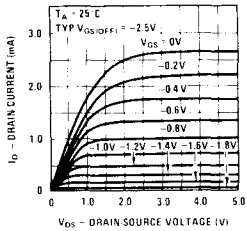
Transfer Characteristics



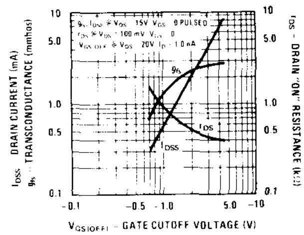
Transfer Characteristics



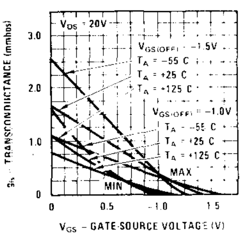
Common Drain-Source Characteristics



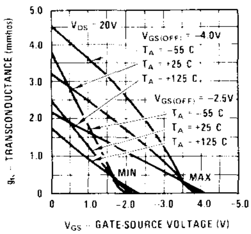
Parameter Interactions



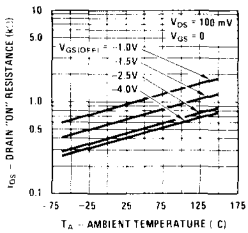
Transconductance Characteristics



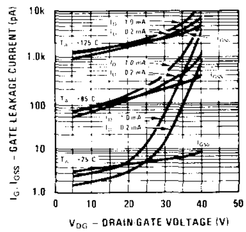
Transconductance Characteristics



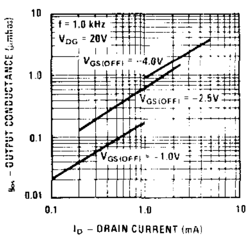
Channel Resistance vs Temperature



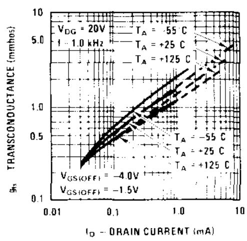
Leakage Current vs Voltage



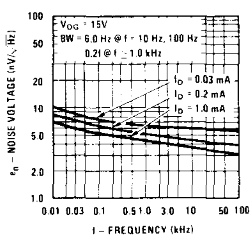
Output Conductance vs Drain Current



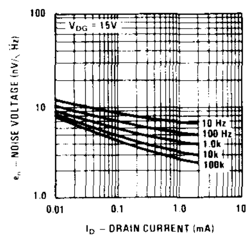
Transconductance vs Drain Current



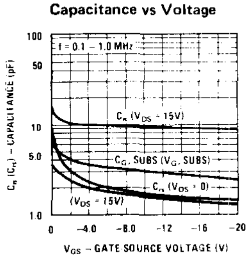
Noise Voltage vs Frequency



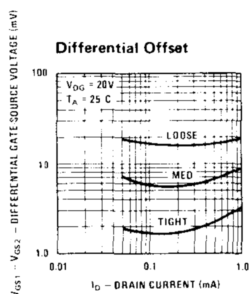
Noise Voltage vs Current



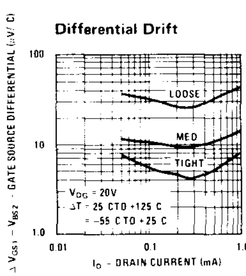
Capacitance vs Voltage



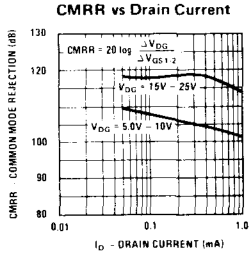
Differential Offset



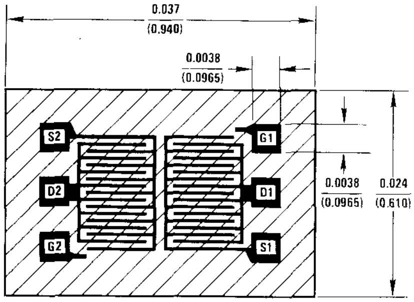
Differential Drift



CMRR vs Drain Current



Process 96 N-Channel Monolithic Dual JFET



DESCRIPTION

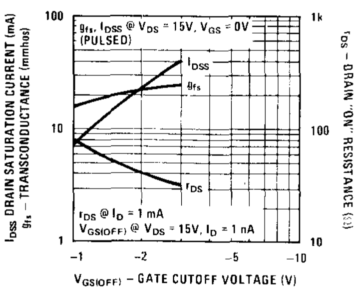
Process 96 is a monolithic dual JFET with a diode isolated substrate. It is intended for wide band, low noise, single ended video amplifier input stages. Also ideal for matched voltage variable resistor applications over 60 dB tracking range.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V$, $I_G = -1\ \mu A$	−40	−55		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 15V$, $V_{GS} = 0$	5.0	15	30	mA
Forward Transconductance	g_{fs}	$V_{DS} = 15V$, $V_{GS} = 0$	9.0	18	30	mmhos
Forward Transconductance	g_{fs}	$V_{DG} = 15V$, $I_D = 2$ mA	7.5	9.0		mmhos
Output Conductance	g_{os}	$V_{DG} = 15V$, $I_D = 2$ mA		15	45	μmhos
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 15V$, $I_D = 1$ nA		−1.8	−3.0	V
"ON" Resistance	r_{DS}	$V_{DS} = 100$ mV, $V_{GS} = 0$	35	70	120	Ω
Gate Current	I_{GSS}	$V_{GS} = -20V$, $V_{DS} = 0$		−8.0	−100	pA
Gate Current	I_G	$V_{DG} = 15V$, $I_D = 2$ mA		15	200	pA
Noise Voltage	e_n	$V_{DG} = 15V$, $I_D = 2$ mA, f = 100 Hz		4.5	10	$nV/\sqrt{Hz}$
Feedback Capacitance	C_{rs}	$V_{DG} = 15V$, $I_D = 2$ mA, f = 1 MHz		2.5	3.0	pF
Input Capacitance	C_{is}	$V_{DG} = 15V$, $I_D = 2$ mA, f = 1 MHz		10	12	pF
Differential Voltage	$\lvert V_{GS1}-V_{GS2}\rvert$	$V_{DG} = 15V$, $I_D = 2$ mA		8.0	25	mV
Differential Voltage	ΔV_{GS}	$V_{DG} = 15V$, $I_D = 2$ mA		9.0	50	μV/°C
Common Mode Rejection	CMRR	$V_{DG} = 15V$, $I_D = 2$ mA	76	95		dB

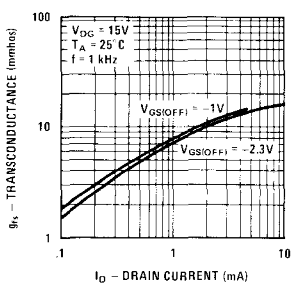
This process is available in the following device types. *Denotes preferred parts.

TO-71 (CASE 12)	8-Pin DIP (CASE 67)
*2N5564	*NPD5564
*2N5565	*NPD5565
*2N5566	*NPD5566

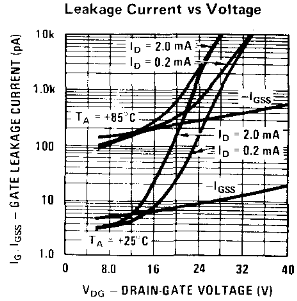
Parameter Interactions



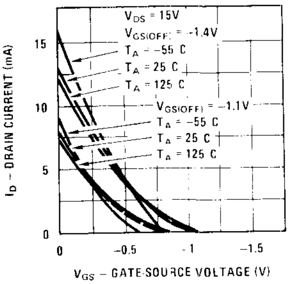
Transconductance vs Drain Current



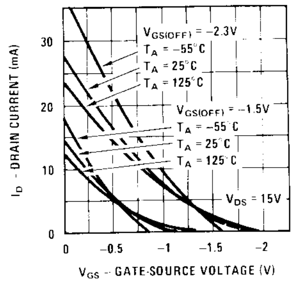
Leakage Current vs Voltage



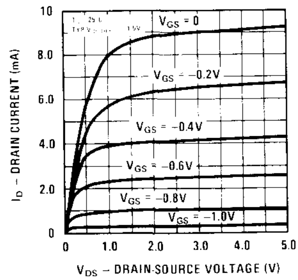
Transfer Characteristics



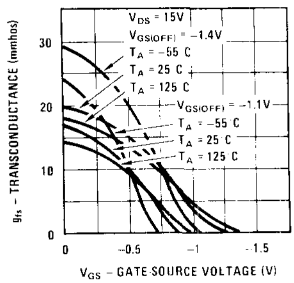
Transfer Characteristics



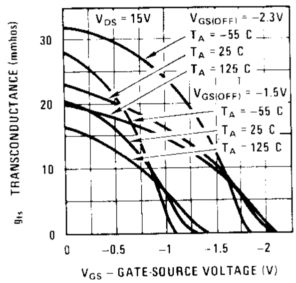
Common Drain-Source Characteristics



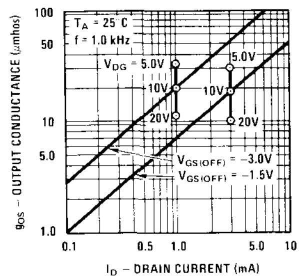
Transfer Characteristics



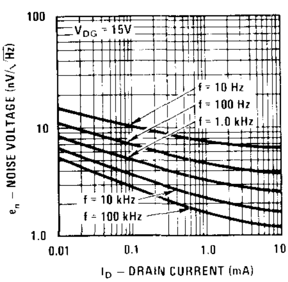
Transfer Characteristics



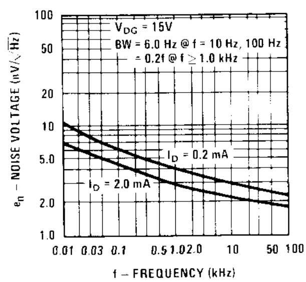
Output Conductance vs Drain Current



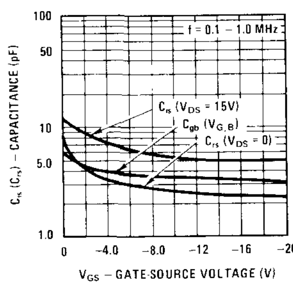
Noise Voltage vs Current



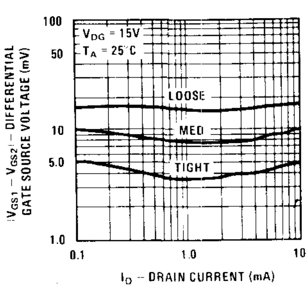
Noise Voltage vs Frequency



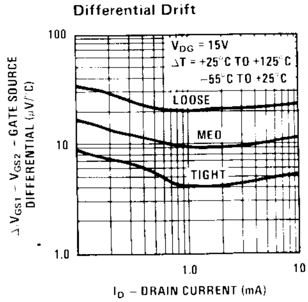
Capacitance vs Voltage



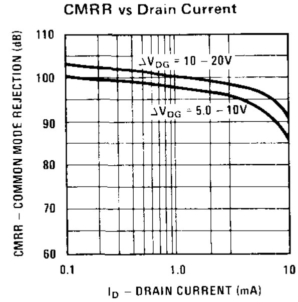
Differential Offset



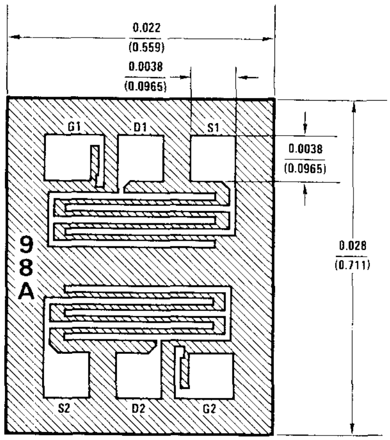
Differential Drift



CMRR vs Drain Current



Process 98 N-Channel JFET



DESCRIPTION

Process 98 is a high gain, general purpose, monolithic dual JFET with a diode isolated substrate. It is intended for amplifier input stages requiring high gain, low noise and low offset drift over temperature. Strict processing controls result in low input bias currents and virtually immeasurable offset currents. Matching characteristics are essentially independent of operating current and voltage.

This process is available in the following device types. *Denotes preferred parts.

TO-71 (CASE 12)

2N5561
2N5562
2N5563
U401
U402
U403
U404
U405
U406

8-Pin DIP (CASE 60)

J401
J402
J403
J404
J405
J406

PROCESS IN DEVELOPMENT

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