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A New System for Calibrating DME and ATC

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INTRODUCTION

With the number of jet aircraft flights continually increasing, since their inauguration in 1960, it has become necessary to augment the existing VOR (Visual Omni-Range) and ILS (Instrument Landing System) navigational aids with two new sophisticated systems; DME (Distance Measuring Equipment) and ATC (Air Traffic Control). Boonton Radio, with an established line of specialized instrumentation for the design, test, and calibration of airborne VOR and ILS equipment, and recognizing the need for the same type of instrumentation in conjunction with the DME and ATC airborne equipment, has designed the 8925A DME/ATC Test Set (Figure 1) for this purpose. A block diagram of the Test Set is shown in Figure 2.

PURPOSE OF DME AND ATC

In brief, DME provides the pilot of an aircraft with a read-out of his distance in miles from a given ground station. In addition, DME equipment, used in pairs or in conjunction with VOR equipment, can give the pilot his exact location on a continuous basis, avoiding separate measurements for triangulation and/or calculation. ATC provides ground control personnel with positive individual identification and location of aircraft within their area.

YOU WILL FIND . . .

Figure 1. Type 8925A DME/ATC Test Set

Both the DME and ATC systems function through the exchange of pulse coded information between the airborne and ground stations. The pulse coding, plus the time delays associated with transmission and reception, constitutes the information. In the case of DME, the airborne equipment interrogates the ground station which, in turn, replies. In the ATC system, the ground station interrogates the airborne equipment.

TYPE 8925A DME/ATC TEST SET

The basic concept of the 8925A Test Set was that it should be, in essence, a calibrated precisely controllable, low power, ground station. The minimum characteristics of the station were to be those as specified by the cognizant authorities for a DME and ATC ground station and for checking out airborne DME/ATC equipment.[1]

Analysis of the requirements led to the conclusion that existing "tried and proven" test instruments were available which, when assembled in building block fashion, could provide the basis of the calibrated pulsed RF source and a means of measuring the airborne transmitter peak power. With modification of some of these units, the exact requirement could be met. Having established this course, there remained to devise means of measuring the ATC airborne transmitter frequency, interconnecting the Test Set components, connecting to the equipment under test, and monitoring the various signals involved. This was accomplished by the development of two new specialized test instruments: the BRC 8905A Wavemeter to measure the transmitter frequency and the BRC 13505A Isolator-Monitor to provide the required interconnection, isolation, and monitoring facilities.

Signal Generator

The basic CW RF signal is generated by a Hewlett-Packard HO1-8614A Signal Generator. This instrument is a slightly modified version of the standard production unit. The frequency range is restricted to 950 to 1250 mc in order to optimize the characteristics over this range, and the attenuator calibration is offset to compensate for system losses. The modifications are minor and the instrument can be readily returned to its original state. The generator incorporates automatic leveling of the RF signal which permits tuning over the entire frequency range with no adjustment of level required. The attenuator dial is calibrated to read di-

1 - See References at end of article.

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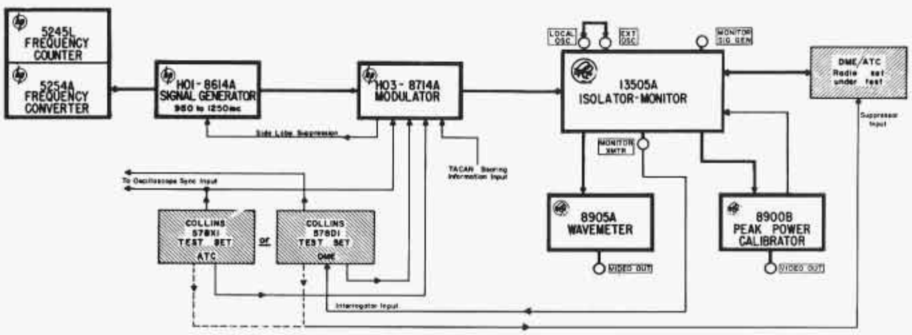


Figure 2. Block Diagram — Type 8925A DME/ATC Test Set

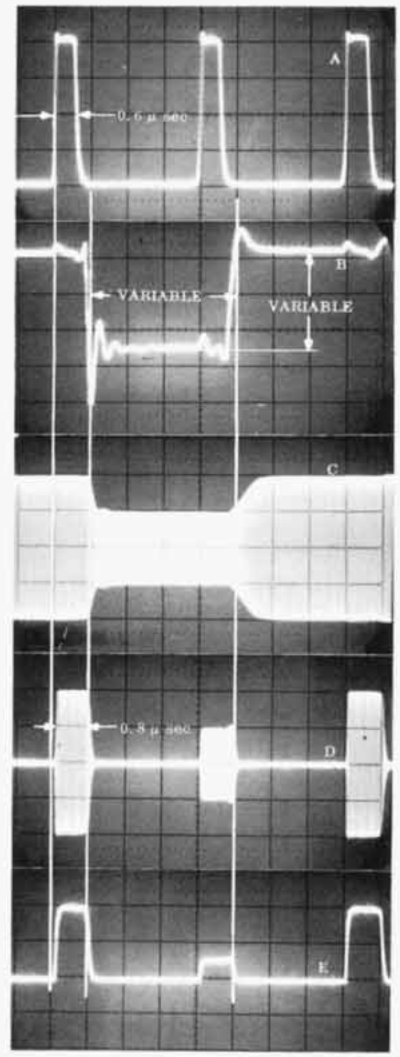
rectly the system output into 50 ohms over the range of −10 to −120 dbm. The generator contains an internal modulator which employs PIN diodes as essentially resistive modulator elements. The frequency controls permit adjustment to within 50 kc as the frequency is simultaneously monitored and displayed by an -hp 5245L Frequency Counter in combination with a 5254A (3.0 Gc) Frequency Converter.

Modulator

The RF output of the Signal Generator is fed to an -hp- HO3-8714A solid state Modulator. Like the modulator in the Signal Generator, this instrument employs electrically controlled PIN diodes mounted in a strip transmission line. Modulation is accomplished by varying the attenuation of the strip line. The HO3-8714A is an extensively modified version of the -hp- 8714A. Special front panel controls and connectors are provided and special pulse shaping circuitry is included. The pulse shaping circuitry is necessary to compensate for the inherently fast PIN diode switching time (of the order of 10 ns), permitting the RF envelope to closely reproduce the video modulating signals. The linearity of the modulator is approximately ±5% over the upper 30 db of the dynamic range. This method of post generation modulation is essentially independent of frequency and, in actual use, when set at one frequency, will hold across the entire frequency range of 950 to 1250 mc.

The video signals required to actuate the HO3-8714A Modulator are derived from equipment external to the 8925A Test Set, such as the Collins 578D-1 Test Set (DME) or 578X-1 Test Set (ATC). These units provide pulse coded video signals which simulate DME/ATC ground emission information as regards to pulse spacing, repetition rate, number of pulses, and, to some extent, pulse shape.

In the case of ATC, it is required that the second pulse of a train of two or three pulses be varied in amplitude from +1 to −10 db relative to the amplitude of the first pulse. The special circuitry within the HO3-8714A Modulator provides this capability by generating a video gate (Figure 3B), which is related in time to the second pulse of the video pulse train and adjustable in amplitude by means of a front panel control. This video gate pulse is returned to the modulator in the HO1-8614A Signal Generator where it effectively modulates the RF signal upward or downward the desired amount (Figure 3C). The generator output, then, is modulated by the HO3-8714A which turns completely on for each pulse (Figure 3D). The resulting pulse amplitudes are determined by the previously modulated generator output. The linearity of the HO3-8714A internal circuitry is such that the front panel control is calibrated in 0.5 db increments over the range of +1 to −10 db and is accurate to ±0.5 db. It is apparent that in order to permit the upward modulation, it is necessary to bias the modulator within the generator to some level below the full on condition. The bias which is derived from the HO3-8714A Modulator, can be made to vary the RF output over a range of several db by means of a control available at the front panel. In practice, the level which is set corresponds to the Test Set calibrated CW output.



(A) VIDEO SIGNAL APPLIED TO HO3-8714A MODULATOR

(B) VIDEO GATE GENERATED BY HO3-8714A MODULATOR AND APPLIED TO HO1-8614A SIGNAL GENERATOR

(C) HO1-8614A SIGNAL GENERATOR RF OUTPUT (VIEWED USING 13505A ISOLATOR-MONITOR HETERODYNE MONITOR)

(D) TEST SET RF OUTPUT (VIEWED USING 13505A HETERODYNE MONITOR)

(E) TEST SET RF OUTPUT (VIEWED USING 13505A DIODE MONITOR)

Figure 3. Generation of ATC Ground Station Signal (Time Axis 1 Microsecond per Centimeter)

While the DME system does not require any differences of relative pulse amplitudes, a closely allied system, TACAN (Tactical Air Navigation) does. The 8925A Test Set has provided means to simulate both. See Figs. 4 and 5. TACAN utilizes the basic DME pulse coded signal but, in addition, requires up to 55% amplitude modulation of the pulse train with a composite signal comprised of 15 cps and 135 cps sine waves. This AM provides bearing information.

While the 8925A Test Set is capable of providing full TACAN RF signals, there is no currently available single source of synchronized pulse and sine wave signals. However, the video TACAN signal may be simulated by using an audio oscillator (such as the -hp- 200CD) in conjunction with the Collins 578D-1. The upward modulation requires that the HO3-8714A Modulator be biased to a level, in the absence of AM, some 4 db below the full on condition. The bias is derived internal to the Modulator and, as in the ATC case, a control available at the front panel permits variation of the RF output over a range of several db. In practice, this is set to a level corresponding to the Test Set calibrated CW output.

Another control, available at the front panel of the HO3-8714A Modulator, permits variation of the Test Set CW output signal over a range of several db. This allows ease of recalibration after extended periods of use.

Isolator-Monitor

The simulated ground station RF signal is fully generated at this point. The BRC 13505A Isolator-Monitor connects the RF signal to the airborne instrument under test and monitors the signal for measurement purposes. In the normal mode of operation, the incoming RF signal is passed through a low attenuation path (approximately 1 db) of a properly terminated four-port circulator, through a coaxial switch electrically actuated from the front panel, to the output connector. It is the signal level at this connector for which the HO1-8614A Signal Generator attenuator is calibrated. A cable from this point to the antenna jack of the receiver/transmitter under test completes the path. The transmitter signal, generally of high peak power (up to 2000 watts), returns by way of the same route, but is isolated from the equipment preceding the 13505A by the 30 db minimum insertion loss of the circulator in this direction. Some of the transmitter signal is available at the remaining two ports of the circulator, and, after suitable attenuation, is brought out at the 13505A front panel for frequency and power measurements.

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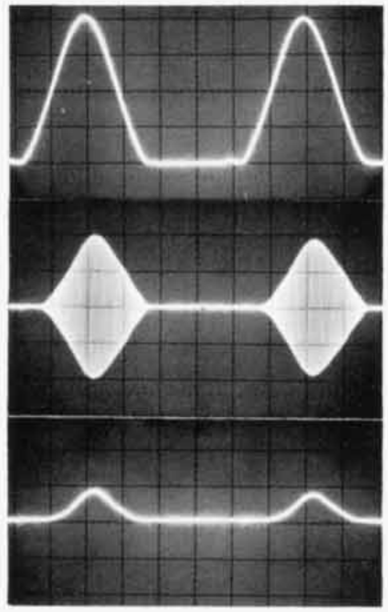

(A) VIDEO SIGNAL APPLIED TO HO3-8714A MODULATOR
(B) TEST SET RF OUTPUT (VIEWED USING 13505A HETERODYNE MONITOR)
(C) TEST SET RF OUTPUT (VIEWED USING 13505A DIODE MONITOR)

Figure 4. Generation of DME Ground Station Signal (Time Axis 2 Microseconds per Centimeter)

When the 13505A is used as a monitor, the test signal is diverted from the output connector by means of the coaxial switch and routed to the monitoring circuits. Because the load is removed from the antenna jack of the transmitter under this condition of operation, a pair of interlock terminals are provided on the 13505A rear panel which may be used to automatically de-energize the transmitter, if so desired. Two monitoring modes are available by operation of the front panel switch: a linear heterodyne mixer and a diode detector.

When the 13505A is operated as a heterodyne monitor, the signal from an internal oscillator operating at 1025 mc is mixed with the test signal and the difference frequency (IF), either plus or minus, is delivered to an amplifier. The combined circuitry has a bandwidth, at the 3 db points, of approximately 10 mc. The 1025 mc frequency was chosen because it lies between the frequencies of the middle DME ground station channels (channels 61, 62, and 63) and the ATC beacon frequency of 1030 mc. Thus, the difference frequency in either case will fall within the pass band of the amplifier. Best results are obtained, naturally, when the IF frequency is centered in the amplifier pass band. Actually, a region of about 4 mc in range gives equally good results due to the presence in the mixer output of vestigal sidebands which extend far beyond the amplifier frequency limits. This being the case, if the IF frequency is not centered within the amplifier pass band, the sidebands which are not passed on one side of the IF frequency are, in part, made up for by the additional sidebands passed on the other side of the IF frequency. This, in effect, increases the apparent bandwidth of the mixer-amplifier combination. The output of the heterodyne monitor is available at the 13505A front panel for viewing on a suitable oscilloscope (such as the -hp- 175A). A minimum of 1v peak to peak is obtained when the Test Set signal is

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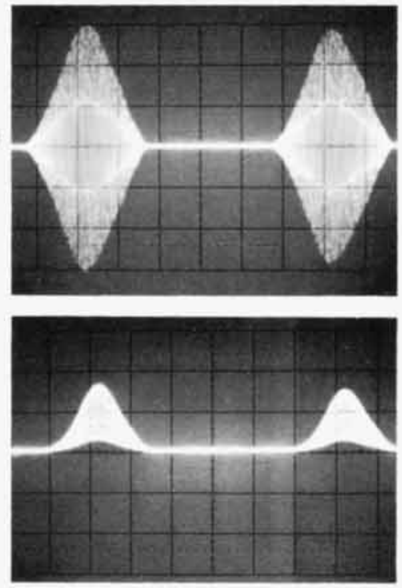

(A) VIEWED USING 13505A HETERODYNE MONITOR
(B) VIEWED USING 13505A DIODE MONITOR

Figure 5. Simulated TACAN Ground Station Signal (Approx. 45% AM — Time Axis 2 Microseconds per Centimeter)

−10 dbm, and the presentation is linear within ±0.5 db over the range of test signal levels of +4 to −10 dbm. This provides an accurate means of relative amplitude measurements such as are required for setting the ATC side lobe suppression pulse and the percent amplitude modulation of the TACAN signal.

The bandwidth of the heterodyne monitor is more than adequate for making pulse shape measurements of the DME (or TACAN) pulses, which have rise and fall times of 2.5 μs nominally. However, in the case of ATC pulses, which may have rise and fall times of 50 ns, an error of up to +40% could result. For accurate measurement of the ATC pulse shape, it is recommended that a sampling type oscilloscope (such as the -hp- 185B) be used to directly observe the 8925A DME/ATC Test Set output signal.

It should be mentioned, that, due to the frequency independence of the PIN modulator units, pulse settings made using the heterodyne monitor (that is with the HO1-8614A Signal Generator tuned to the restricted band of frequencies which provide a heterodyne signal), will remain constant at any other frequency to which the generator is set. Nevertheless, should it be desired to employ the heterodyne principle at any other frequency, provision is made on the back panel of the 13505A Isolator-Monitor for the substitution of an external oscillator (capable of 60 mw output power) for the internal oscillator. Also, the internal oscillator is capable of being tuned over a small range of approximately ±5mc by a control available at the 13505A back panel.

When operating the 13505A as a diode monitor, the internal oscillator is turned off and the mixer then becomes a diode detector with an output amplified by the same amplifier discussed previously. A minimum of +0.1v peak is obtained at the 13505A front panel for a Test Set signal of −10 dbm at any frequency within the range of the Test Set. As with most diode detectors, the output is not a linear presentation and care must be exercised when using it for making measurements. (See Fig. 6). The relationship between the diode monitor output and the Test Set RF signal may be readily examined by varying the Signal Generator attenuator in fixed amounts and noting the corresponding changes in the diode monitor output amplitude. While it is not as accurate as the heterodyne monitor, the diode monitor does provide a rapid means of making relative measurements at any frequency within the range of the Test Set. This signal is also used when calibrating the overall DME system (including the 578D-1 video modulator) delay.

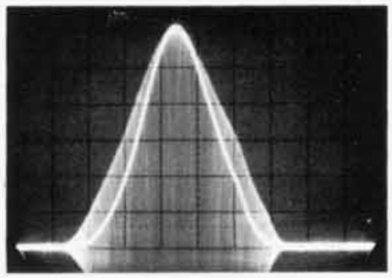

Figure 6. Comparison of Diode Monitor and Heterodyne Monitor Displays of the Same RF Signal (Time Axis 1 Microsecond per Centimeter)

With the 13505A operating in the normal mode, portions of the transmitter power are available at the front panel Wavemeter and Pwr Meter connectors. The amounts of power available are controlled by the inclusion of fixed precision attenuators within the 13505A.

Peak Power Calibrator

A BRC 8900B Peak Power Calibrator is connected to the Pwr Meter output of the 13505A. This is a production unit specially calibrated to account for variations in attenuation in the system (including cables) preceding it. The unit will read peak power of 100 to 2000 watts over the frequency range of 960 to 1215 mc to an accuracy of ±1.2 db. The accuracy of measurement may be improved to ±0.6 db with special calibration. Should measurement of other power ranges be desired, it may be accomplished by changing the fixed attenuation within the 13505A. This would be handled on a special order basis. For peak powers in excess of 2000 watts, the user may, with some degradation of accuracy, insert additional attenuation between the 13505A and 8900B, external to the system.

In making a power measurement, the 8900B basically compares the demodulated pulse envelope of the signal to be measured and the output from an internal dc reference supply. A mechanical chopper permits both signals to be viewed simultaneously using a suitable oscilloscope (-hp-175A). The dc reference is adjusted, by means of a front panel control, to be equal in amplitude to the demodulated pulse. The resulting dc reference is indicated on the front panel meter, which is calibrated to read peak RF power. Provision is made for readily recalibrating the instrument against an external bolometer or calorimeter.

The 8900B also provides a means for monitoring the transmitter output pulses. The demodulated pulse is brought to a back panel connector through a two-stage emitter follower. By means of intercabling, this signal is available at the Xmtr. Monitor connector on the front panel of the 13505A for monitoring purposes, and, in the case of DME, as the demodulated transmitter interrogation signal required by the 578D-1 for distance measurement.

Wavemeter

The BRC 8905A Wavemeter is connected to the Wavemeter connector on the front panel of the 13505A and is used to measure the frequency of the pulsed output signal of the ATC transmitter. The instrument is composed of a transmission type tuneable wavemeter and associated metering circuitry. The front panel meter indicates a peak reading when the cavity is tuned to the incoming frequency. This frequency can be read to within ±0.5 mc directly from a dial calibrated in 0.5 mc increments from 1070 to 1110 mc. The sensitivity of the unit is adjusted for individual Test Set losses, so that meter indications are obtained for any ATC transmitter signal within the specified frequency range and within the peak power limits of 250 to 1000 watts. A video output is provided whereby the detected cavity output may be monitored with a suitable oscilloscope for frequency measurements of signals having peak power as low as 10 watts.

Interconnecting Cables

Because the calibration of the 8925A DME/ATC Test Set takes into account all the known system losses and the many interfaces which exist, the over-all system accuracy is dependent upon all critical interconnecting cables remaining in their proper locations. To insure this, all cables and their associated connectors are color coded.

CONCLUSION

The 8925A is the most complete and universal Test Set available for the checking of DME and ATC airborne equipment and, because of its building block construction, is readily adaptable to many special applications. Its high degree of stability and continuous frequency tuning are highly desirable features when regarded in the light of possible future expansion of the DME system; i.e., channel splitting.

The Test Set is the result of a Hewlett-Packard corporate effort and the responsible groups are deserving of recognition. Individual instruments which form part of the Test Set and the divisions responsible for their development are listed below.

Instrument		*-hp- Division*
5245L	Electronic Counter	Frequency and Time Division
5254A	Frequency Converter	Frequency and Time Division
HO1-8614A	Signal Generator	Microwave Division
HO3-8714A	Modulator	Microwave Division
13505A	Isolator-Monitor	Boonton Radio Division
8900B	Peak Power Calibrator	Boonton Radio Division
8905A	Wavemeter	Boonton Radio Division

REFERENCES

1 - *Air Traffic Control Transponder, ARINC Characteristic No. 532C, Mar. 1, 1961.*

2 - *Airborne Distance Measuring Equipment (DME) ARINC Characteristic No. 521D, Nov. 1, 1963.*

3 - *Minimum Performance Standards Airborne Distance Measuring Equipment (DMET) Operating within the Radio Frequency Range of 960-1215 Megacycles, RTCA Paper 167-59/DO-99, Sept. 8, 1959.*

4 - *Minimum Performance Standards Airborne ATC Transponder Equipment, RTCA Paper 181-61/DO-112, Dec. 14, 1961.*

X-Y Plotting with the Types 202H and J FM-AM Signal Generators

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INTRODUCTION

A rear panel jack on the Types 202H and 202J FM-AM Signal Generators provides a means for introducing an external dc voltage to control the output frequency over a limited range. The jack permits direct coupling, at low rates, to the reactance tube modulator in the generator. This feature, together with the improved linearity, automatic leveling, and low FM noise characteristics of these generators, opens the door to applications new to the FM signal generator art.

Two major areas of application which make use of the direct-couple feature of the 202H and J signal generators will be discussed in this article. One area deals with tests and measurements that can be made with the signal generator connected with an X-Y Plotter. The other area of application involves tests and measurements that can be made with the signal generator connected in an automatic frequency control setup or system.

X-Y PLOTTER APPLICATION

The aforementioned features of the 202H and J signal generators, together with the advantages of the X-Y Plotter; i.e., large display, extremely good linearity, permancy, and reproducibility, make these instruments an excellent combination. In this application, sweep widths from a few kc to 1 mc are possible. This pair of instruments, plus a 207H Univerter and a 230A Power Amplifier used as a doubler, yields a potential frequency range of 100 kc to 500 mc for the applications to be discussed in this article.

The auxiliary equipment required depends on the specific test to be made. This equipment will be listed as each application is discussed.

The major areas of X-Y Plotter application are receiver testing and narrow-band filter testing.

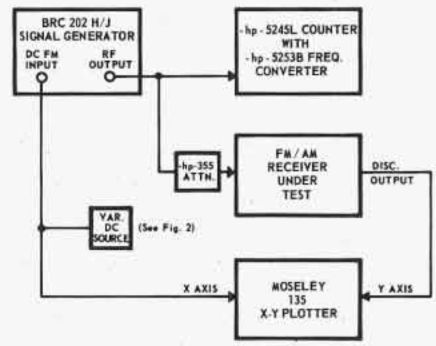

Figure 1. Setup for Checking Discriminator Output vs. Frequency

Receiver Testing

Receiver tests that can be made to advantage with the 202H/J and X-Y Plotter are as follows:

1. Selectivity or bandwidth versus frequency and input.

2. Discriminator output versus frequency.

3. AGC or detector voltage versus input level or overload characteristics.

4. Audio/video output versus input level.

5. Audio/video fidelity or response versus level.

The first tests to be discussed will be those tests which use a minimum of equipment; i.e., selectivity or bandwidth versus frequency and RF input level, and discriminator output versus frequency. If it is assumed that the receiver to be tested is in the range of the 202H and J, the connections and equipment are shown in Fig. 1. The Plotter may be a Moseley Type 2D, 135, etc. The Y axis input to the Plotter is connected to the AM detector, limiter grid, or discriminator output. The X axis input is connected to the variable dc source. The simplest form of variable dc is a multi-turn variable potentiometer of approximately 10,000 ohms and two 6-volt batteries connected as shown in Fig. 2. This supply will produce approximately 600 kc sweep on the

202H low band, and about 1200 kc on the 202H high band and the 202J. Reference to the dc FM input curve (Fig. 3) will indicate how to optimize this sweep if necessary. (A function generator, such as the -hp- 202A, could be used in place of the dc source described above.) With the equipment connected as shown in Fig. 1, typical curves, such as those shown in Figs 4 and 5 can be plotted.

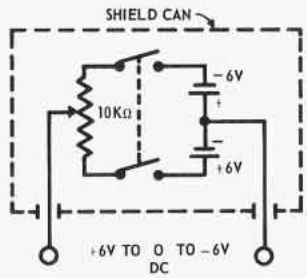

Figure 2. Variable DC Source Using Multi-turn Variable Potentiometer

Calibration of Scales

Before the data in the plotted curves can be of value, the X and Y axes must be calibrated. The vertical scale can usually be read directly, using the indicated sensitivity on the Y amplifier controls. If more precise calibration is necessary, an -hp- 412A DC Voltmeter may be used in shunt with the Y terminals.

The horizontal X axis may be calibrated in a number of ways, depending upon the accuracy required and the equipment available. The curve in Fig. 3 could be plotted as a function of the X input sensitivity, as indicated by the calibration on the X amplifier controls. A much more precise method, however, utilizes a crystal calibrator or an -hp- 5243L or 5245L counter with an -hp- 5253B Converter plug-in. Fig. 1 shows the setup using the counter. Note that additional attenuators are necessary if continuous frequency monitoring is desirable. This enables the counter to operate at a reasonable level with the 202H and J. The Type 202JA has 50 mv available for continuous monitoring.

It is good practice to calibrate the frequency or X axis beginning at the most important point, usually the center, peak, or zero crossing, depending upon the curve being plotted. There are a number of choices in the method of marking. Two possibilities are given below.

1. Retrace the curve with "pen up" and mark a vertical line at the desired frequency increments, using the Y axis "Zero" control and the "pen up/down" control. This procedure produces a trace marked as shown in Fig. 4.

2. After checking that the reference point is at the desired location, reduce the Y signal to zero. Sweep the signal generator through the same limits and mark the desired increments with a vertical line, using the Y axis "Zero" control. This procedure produces a trace calibration as shown in Fig. 4.

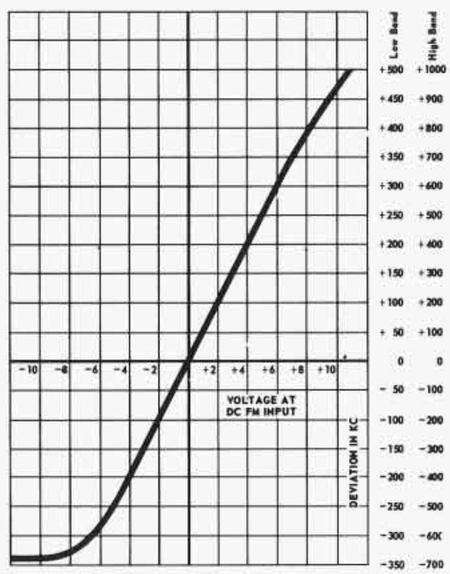

Figure 3. DC FM Input Curve

AUTOMATIC FREQUENCY CONTROL APPLICATION

Since it is possible to feed a dc signal into the reactance tube modulator directly through the DC FM INPUT jack, this dc signal might easily be an error signal which is a function of some reference frequency. This arrangement, shown in block diagram form in Fig. 6, is helpful in reducing the frequency drift per hour of the 202H and J signal generators by a significant factor. Frequency stability of 0.001% per hour is easily obtainable with this setup. This improved stability is valuable in the testing of narrow band (about 10 kc) systems where drift is a problem. System frequency can also be measured more precisely on a continuous basis with this method, utilizing a frequency counter connected as shown in Fig. 6. At this point, it is well to point out that the AFC correction is not instantaneous. In fact, there is a time constant of approximately one-half second, so that short-term frequency changes, such as FM modulation rates, are not cancelled out by the AFC loop. This permits all of the standard tests to be performed while the long-term drift is corrected.

Phase Locking

A slight modification in the area of the DC FM INPUT circuit will per-

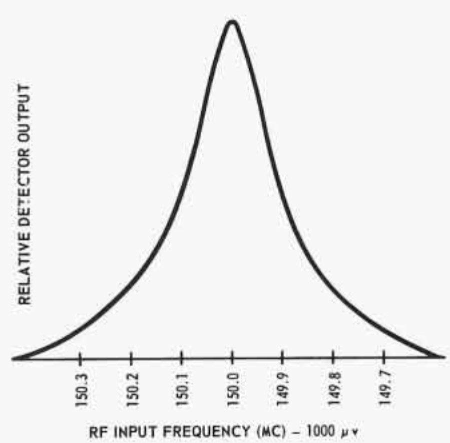

Figure 5. Overall Receiver Selectivity Curve

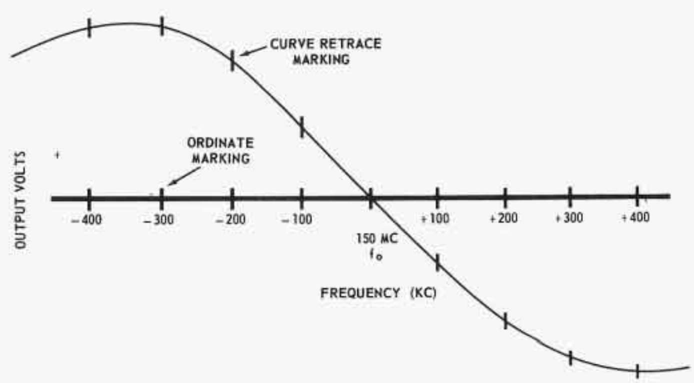

Figure 4. Discriminator Output vs. Frequency Curve

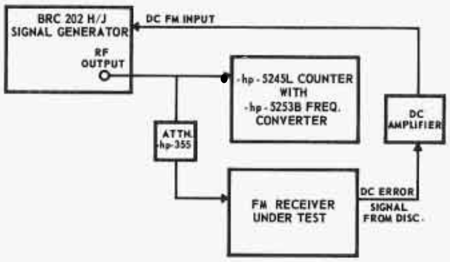

Figure 6.
Setup for Automatic Frequency Control

mit phase locking, to a suitable reference, of the 202H and J signal generators. This could considerably reduce phase noise in critical applications, but the FM function would be cancelled out by the phase lock loop. Frequency stability in this case would be that of the reference.

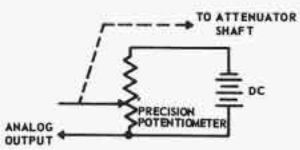

Figure 7.
Connections for Analog Output vs. Attenuator

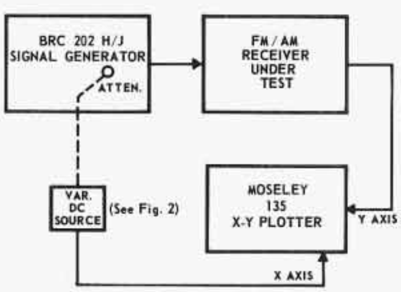

Figure 8.
Setup for Checking RF Input Level vs. Output

Output Versus RF Level

Using the equipment mentioned previously, there are other tests that can be made with the 202H and J signal generators and the X-Y Plotter. It is a simple matter to connect a double-ended precision potentiometer directly to the attenuator shaft by removing the knob. Using the circuit shown in Fig. 7, a voltage analogous to RF input or attenuation can be obtained. The equipment is connected as shown in Fig. 8. Typical curves are shown in Fig. 9. When the Y axis is a function of audio/video voltage, the "AC Voltage" position in the Type

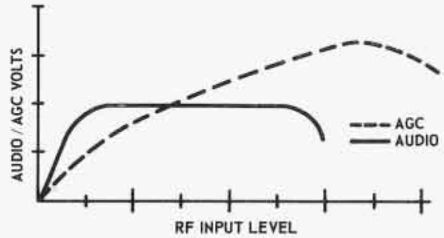

Figure 9.
Typical Output vs. RF Input Level Curves

2D Plotter may be used; otherwise, an ac to dc converter or detector must be used to obtain a dc signal proportional to the audio/video output.

Audio/Video Fidelity or Response

If an audio/video oscillator with a dc analog output is available, such as the DYMEC Model DY-207A, response curves may be plotted directly.

EASTERN SERVICE CENTER TO BE ESTABLISHED AT BRC

In order to provide improved parts and repair services for customers in the Eastern U.S., the Hewlett-Packard Company is establishing a new Eastern Regional Service Center at Boonton Radio Company in Rockaway, N. J. The new facility will provide complete parts support and an extensive factory-level instrument repair service. Parts and factory repair service will be available for all Hewlett-Packard Company equipment and for equipment manufactured by -hp-Divisions; including BRC, Dymec, Moseley, and Sanborn.

The new operation will be set up in the present BRC plant and will occupy about 25,000 square feet of space: 10,000 square feet for parts warehousing and repair areas and 1,500 square feet for administrative functions. Approximately 90 employees will be hired to handle the various administrative and technical tasks.

Manager of the new service center, under the direction of Bill Myers, BRC General Manager, will be Al Thoburn, formerly manager of the materials handling group in the Western Service Center. Service Manager will be Bob Wolfe, who served as Service Manager for RMC Sales Division in New York City. Dick Love,

Al Thoburn

Bob Wolfe

Dick Love

formerly parts manager at the Western Service Center, will be Parts Manager.

It is expected that the new service center, scheduled to begin operations on August 17, will provide even better service to all our customers in the Eastern region of the country.

ERWIN CONRAD TO BE SERVICE ENGINEER

Erwin Conrad joined BRC in January of this year as Customer Service Supervisor, replacing Ray Tatman who has been on special assignment pending his return to Corporation headquarters in Palo Alto. Erwin came to BRC from the RMC Sales Division in New York City, where he was Assistant Service Manager and had gained seven years of valuable experience in the service of Hewlett-Packard products. In his present assignment as Customer Service Supervisor, he has been responsible for all BRC factory repairs, replacement parts, and general service support.

With the establishment, in August, of the new Eastern Regional Service Center, announced in this issue, Erwin's present operation will be integrated into the service center and he will assume new duties as Service Engineer for all Boonton Radio products. In this capacity, he will be responsible for aiding in the preparation of field maintenance procedures and providing the necessary customer support and training for these instruments. His duties will also include the preparation of Service Notes and other service publications, to better enable -hp- field repair stations and customers to properly maintain BRC products.

Q CONTEST WINNER

The IEEE Show at the Coliseum in New York in March found BRC's booth bustling with contest hopefuls all determined to "out-estimate" each other in the annual BRC "Guess the Q" contest. This year's display coil was formed with heavy copper wire into a configuration not too unlike the BRC logograph. It proved challenging to the parade of booth visitors.

Bill Myers, BRC General Manager, Presents Q Meter to Contest Winner George Engert

The Q of the coil, it turns out, is 242.6. This is the "indicated Q" and represents the average of ten measurements made at 10 mc on the Type 260A Q Meter in the BRC Standards Laboratory.

Winner of the contest, with an estimate of 242.5, is George W. Engert. Project Engineer with MEPCO, Inc. in Livingston, N. J. Runners-up are Alan Budner of U. S. A. Electronic R & D Lab. (240); John Mulqueen of MEPCO, Inc. (246.5); and T. A. Metz of Polyphase Inst. Comp. (248).

Mr. Engert was awarded a factory reconditioned Type 170A Q Meter at BRC on June 17.

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