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Applications of The Q Comparator

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The Q Comparator Type 265-A has been previously discussed from the standpoint of detailed description and developmental considerations in Issue Number 17 of the Notebook.[1] This article covers the many and varied production applications of the instrument. Included are the obvious applications as well as some which are specialized and tailored to specific measurement problems.

Brief Description

In a few words, the Q Comparator is a sweep-frequency Q Meter that indicates Q, L, and C in relative terms. Mechanically it comprises two units; the Oscillator-Detector Unit and the Indicator Unit (Figure 1).

When using the Q Comparator it must be remembered that the presentation is the result of sweep frequency injection. The indication may occasionally differ from a single frequency measurement. However, with the use of nominal and limit standards, this difference in indication, if any, can be reconciled. A nominal standard is defined as a component which has been selected as being the mean value to which all other units are compared. For example, if $\pm 10\%$ is the specification tolerance, a nominal standard with an absolute value known to $\pm 1\%$ would be used. In this instance, one would work to a specification tolerance of $\pm 9\%$.

Improved accuracy and better correlation can be provided by means of limit standards. These standards are used in the same way as nominal standards but are made up to provide greater accuracies within the tolerance limits than are attainable with the nominal standards.

YOU WILL FIND . . .

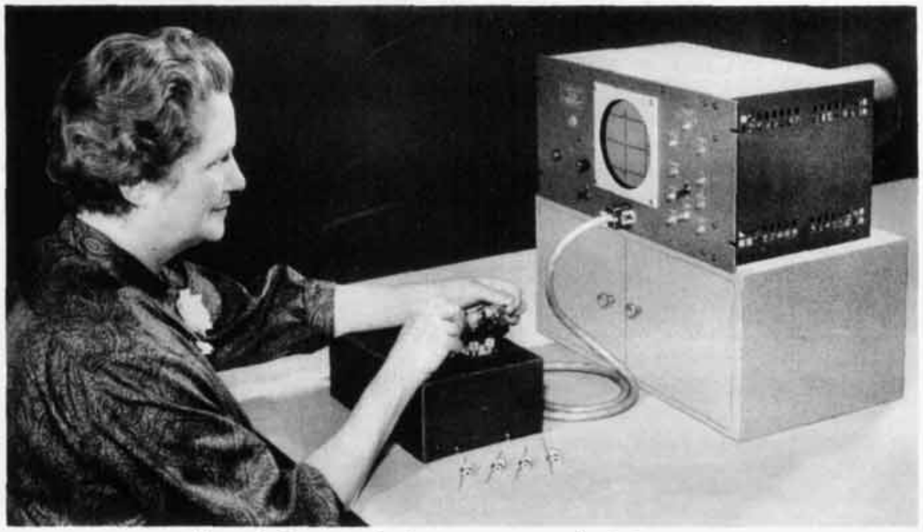

Figure 1. Operator checks components on the Q Comparator.

Purpose and Design Considerations

The purpose of the Q Comparator is the solution of quantity electrical measurements on a comparative basis with speed, ease, accuracy, and reliability. The instrument has been mechanically and electrically designed with the user in mind. First, the cost has been kept to a minimum commensurate with reliability, accuracy, readability, and minimum operator technical ability. The instrument requires a minimum amount of set-up time (about the time required to make one measurement on a Q Meter, which is a laboratory instrument for absolute measurement). Optimum simplicity, elimination of special tubes, speed of readout, and quantity testing of components and circuits were also important considerations.

Electronically and mechanically the Q Comparator has been designed to serve the following industry functions:

1. Incoming inspection.
2. Process inspection and control.
3. Quality control.

Principal of Operation

The heart of the Q Comparator is the Detector Unit or RF Unit which is shown in block diagram form in Figure 2. Once the configuration in Figure 2 is thoroughly understood, applications of the instrument will become apparent to the reader or user who has an unsolved or singular problem in the electrical measurement field. (BRC and the writer are very much interested in applications of this type and hope that the reader will not hesitate to discuss them with us.)

The motor-driven capacitor shown on the left-hand side of Figure 2 sweeps the center frequency of the oscillator. Output from the oscillator is maintained constant over the sweep-frequency range by the dynamic limiter. From this point, the RF signal is shunt fed through a small differential capacitor to the HI—L-C terminals. A so-called "infinite impedance" detector and balancing stage form a differential amplifier to drive the indicator unit. The horizontal trace is generated simultaneously by the sweep capacitor.

Set-Up Procedure

The detailed set-up procedure is given in Notebook No. 17. The production units are as described therein with one exception: the L-C ranges are $\pm 20\%$

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or ±5%.

Briefly, the nominal component is mounted in a suitable jig and connected to the terminals on the Oscillator-Detector Unit. With the intensity at maximum, the SELECTOR switch is set to CENTER Q and the CENTER Q control is adjusted to center the reference line on the face of the scope. At the same time, the TRACE WIDTH control is adjusted to bring the trace within the dotted lines on the scope face. The switch on the TRACE WIDTH control is set fully counterclockwise (±20% position) at this point. Then, with the SELECTOR set to CAL Q, the CAL Q control is adjusted to bring the reference line to the lower limit on the scope face. The SELECTOR is now set to the USE position and we are ready to set up our nomimal component.

Our problem now is to find the desired reasonant point for the component involved. Generally time is saved by readjusting the CENTER Q control so that the base line is visible. The Q capacitor and oscillator frequency are then swept manually until the reasonant curve appears approximately near the center of the scope face. (The Q capacitor is adjusted from its maximum capacitance or fully counter-clockwise position.) The Q centering operation is repeated and the SET Q OF STD-COARSE control is adjusted so that the peak of the resonant curve is near the center of the scope. The dot is positioned at the peak of the resonant curve, the intensity is reduced, and the dot is focused by means of the proper controls. The SET Q OF STD-FINE control is then adjusted to center the dot vertically, and the capacitance or frequency is adjusted to center the dot horizontally.

The above procedure sets up the Q Comparator to the ranges of Q ±25% and L-C ±20% or ±5%, the latter depending upon the position of the L-C TRACE WIDTH switch. However, this is by no means the limit of accuracy or resolution. This subject will be taken up in subsequent paragraphs.

Basic Applications

Inductor testing is the primary function of the Q Comparator and is a direct measurement for values between 1 μh and 15 mh by proper selection of frequency. Indirect measurements can be extended to 0.15μh and 50 mh by utilization of series and shunt techniques. (Dot presentation permits Q measurements from 30 to 500 as specified. However, it has been found that in some cases useful curve presentations can be obtained down to Q's of 15.) The expected accuracy of indirect measurements will usually be less than that of a direct method.

Capacitor testing is the second function of the Q Comparator, and is an indirect measurement in that an external reference inductor must be used. Capacitance is virtually direct; that is, the accuracy is essentially as stipulated for inductors (for values of 500 μμf or greater) and is a function of the internal capacitance setting. By using minimum internal capacitance and maximum sweep expansion, approximately one micromicrofarad can be spread across the face of the scope. This requires a choice of the resonating inductor for minimum distributed capacitance of less than 5 μμf.

Resistance measurements are indicated on the Q scale and are indirect measurements. This means that these two resistance measurements are indicated as a change of Q with respect to the reference inductor.[2]

Specific Applications

Knowing that the Q Comparator is capable of relative measurements of the basic combinations of L, C, and R, we begin to think of other components and circuits to which it may be applied as a two-terminal indicating device. Some of these applications are listed below.

Inductance Measurements

1. Iron cores, shells, toroids and rods (powdered iron and feramic type) may be tested. Relative permeability and Q (or dissipation factor) can be determined at a single glance.
2. Inductors may be trimmed while mounted in position on the Oscillator-Detector Unit. The dot presentation greatly simplifies this operation since no judgement is required to determine the point at which a meter peaks, and the direction of the adjustment (plus or minus) is immediately indicated.
3. L-C and R-C networks can be compared, providing their impedance falls in the general range of Q Meter measurements.[3]
4. The self-resonant frequency of a coil can be determined as follows. A work coil is used to obtain the resonant peak at the nominal frequency, then the coil to be tested (coil X) is connected to the capacitor terminals. If the dot deflects vertically downward only, the resonant frequency is the same as the reference coil. If the dot deflects to the left, coil X is inductive and its resonant frequency is higher than the resonant frequency of the reference coil. If the dot deflects to the right, the resonant frequency of coil X is lower than the resonant frequency of the reference coil. The resonant frequency limits can be established by using Q Meter Type 260-A in conjunction with the limit standards.

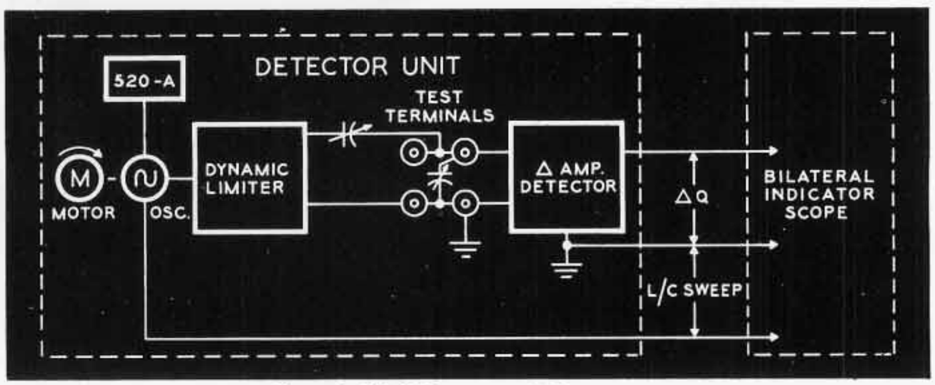


Figure 2. Block Diagram — Q Comparator.

Capacitance Measurements

1. Quartz crystals (blanks or complete assemblies) may be checked for capacitance variations as quickly as they can be inserted in the test fixture. This is performed at frequencies well below resonance.
2. Vacuum tube capacitances; i. e., grid to cathode and plate to grid (in triodes), can be compared quickly.
3. Variable capacitance diodes can be graded simultaneously for Q and capacitance at the rate of approximately

600 to 1000 an hour with simple, manually-operated fixtures.

4. Rapid relative dielectric constant measurements can be made when it is necessary to check for statistical or control purposes.[4]
5. When the dielectric constant of a material is constant, the Q Comparator can be used to indicate relative thickness. A fixture described in Notebook No. 8 could be used for this purpose.[4] The accuracy required will determine how elaborate the fixture must be and what is required to prepare the specimen for thickness and dielectric measurements.
6. Relative moisture measurements of materials can be made. Since the Q Comparator uses an instantaneous two-dimensional presentation, relative loss or resistance is always indicated, even in low-loss materials. If the material is hygroscopic and subjected to a controlled environmental humidity, two indications will be observed. Water, which has a dielectric constant of approximately 80, will theoretically effect the nominal dielectric constant of the material when it is dry. This will be observed as plus C on the indicator for materials with low dielectric constants. However, since the effect of moisture on the loss factor or Q is usually many times the effect on the dielectric constant, a decrease in Q will be much more obvious and would be an indication of the moisture content.

Statistical Studies

After a nominal coil has been set up as previously described, the dot will move on the scope face in accordance with the per cent variations of L and Q of the coils tested. This information is not only useful to an inspection department, but can also be utilized by production engineering groups in specifying manufacturing tolerances. For example, a new component, let's say a small choke coil, is contemplated as an addition to a line of products. This component is first designed in the engineering department. Several preproduction samples are made and checked in the laboratory. The next step is to prepare a pilot production run of a few hundred coils. These can be checked and graded on the Q Comparator in approximately fifteen minutes by a non-technical operator. This statistical information, together with a count for each grade, is then fed back to engineering and tolerance distribution curves, similar to those in Figure 3, are plotted and analyzed. In our example,

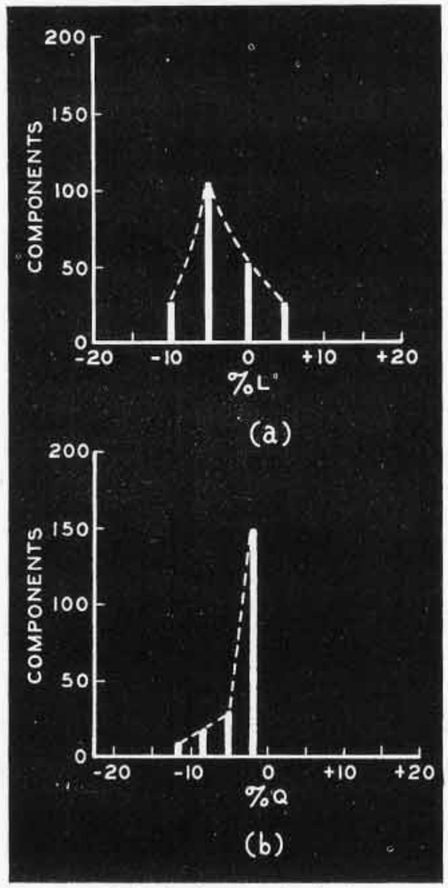


Figure 3. Typical tolerance distribution curves for analyzing pilot and production component runs.

curve (a) in Figure 3 indicates that the inductance is averaging approximately 5% below the expected normal. It is immediately evident that action should be taken to move this distribution curve toward the zero point, or to adjust the specifications. This unexpected picture prompts us to ask, "Why the difference between the prototype and the pilot run?" Possible answers might be differences in coil form diameter, wire spacing, lead mounting, and lead dress. These effects can be checked by controlled production runs, analyzed as above.

Another story is told by the Q Comparator as shown in Figure 3. Here Q behaves virtually the same as the prototype with a few miscellaneous deviations from the proposed nominal value. Greater yield will result if a few simple precautions are taken which are suggested by the curve. Since the Q readings are predominatly below the standard, one would expect, for example, that the difficulty is an erratic tensioning system, defective forms, contaminated coatings, or a hygroscopic problem.

In the above example we have dealt with a case where the components or its specifications may be altered as the result of a statistical study. A similar method can be used to grade components to cover a range of cataloged values when the absolute value is difficult to control. For example, suppose it is desired to grade capacitor diodes over a range of 5 to 30 $\mu\mu f$ in 5 $\mu\mu f$ steps. The circuit in Figure 4 would be used to connect the component to the Q Comparator and to provide the proper bias voltage. A nominal value CN would be set up as follows. Assume C equals 25 $\mu\mu f$. If we set one half C equal to 20% (the maximum range of the Q Comparator) we can compute the set up for our desired display of 5 to 30 $\mu\mu f$. If $\frac{CN}{5} = 12.5\ \mu\mu f$, then $x = 62.5\ \mu\mu f$ nominal capacitance. We now refer to our reactance charts to determine the frequency and inductance required for these conditions. One hundred microhenries at 2 megacycles is one possible combination of frequency and inductance that will be satisfactory. Using this as a starting point, the frequency and internal capacitance can be adjusted to place the limits exactly as desired, and the CRT screen on the Q Comparator can be calibrated in 5 $\mu\mu f$ steps.

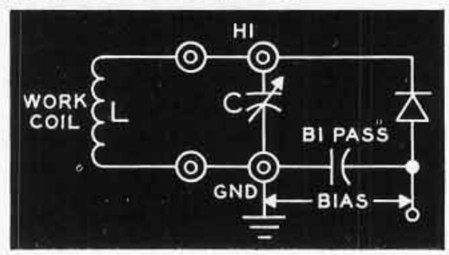


Figure 4. Circuit connections for checking capacitor diodes on the Q Comparator.

A Speed Fixture

Since speed of measurement is a basic advantage of the Q Comparator, we would naturally look for means to utilize its potential. Figure 5 shows a manually-operated fixture designed to minimize handling and loading time, thereby speeding up component testing. This jig, or one constructed along similar lines, permits the checking of 500 to 1000 pieces per hour.

To go further, the Q Comparator can be used as the nucleous of an automated high volume testing system. For example, the component jig could be hopper fed and motor driven, and a photo electric system could be used to reject out of tolerence components. The potential volume with such a system would be limited only by the feed system.

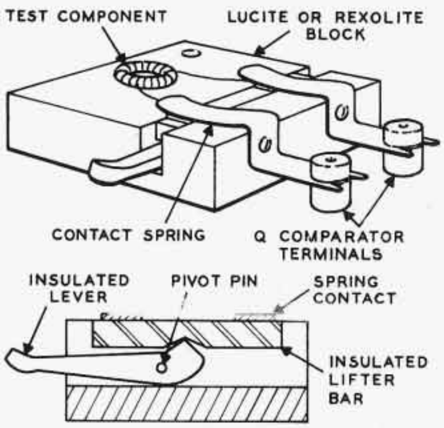


Figure 5. A manually-operated fixture designed to speed up component testing on the Q Comparator.

Capacitors As Calibration Standards

Capacitors are available in virtually limitless values and increments and in tolerence ranges which are adequate for use as standards.

It is obvious that these capacitors can be used to calibrate discrete increments, but not so obvious is the fact that the same scheme can be applied to coil testing. The first step is to measure the resonating capacitance on a Q Meter Type 260-A for the nominal standard. Let us assume the capacitance is 100 $\mu\mu$f. Since L and C bear the same relationship with respect to the resonant frequency, 5% L equals 5% C within the specified limits. If we wish to calibrate the 5% range in 1% increments, 1 $\mu\mu$f increments will be required. The nominal inductance standard is set up on the Q Comparator with 5 $\mu\mu$f external capacitance and 95 $\mu\mu$f internal capacitance. The 5 $\mu\mu$f capacitance is removed in 1 $\mu\mu$f steps to calibrate the —L range and an additional capacitance of 5 $\mu\mu$f is removed in 1 $\mu\mu$f steps to calibrate the +L range. This operation may be performed extremely rapidly.

Summary

The Q Comparator is a unique instrment specifically designed for high speed production testing of components and networks in the RF range from 200 kc to 70 mc. Offering instantaneous and simultaneous readout of both Q and L-C, operation is extremely simple, and speed of measurement is limited only by the rate at which test components can be fed to the measuring circuit.

References

(1) Wachter, James E., "A Q Comparator", BRC Notebook No. 17, Spring 1958.
(2) Cook, Lawrence O., "A Versatile Instrument — "The Q Meter", BRC Notebook No. 4, Winter 1955.
(3) Riemenschneider, Norman L., "The RX Meter or the Q Meter?", BRC Notebook No. 16, Winter 1958.
(4) Riemenschneider, Norman L., "Measurement of Dielectric Materials and Hi Q Capacitors with the Q Meter", BRC Notebook No. 8, Winter 1956.

Typical Performance Data for the Type 225-A Signal Generator

CHANNING S. WILLIAMS, *Production Engineer*

The development of the General Purpose Signal Generator Type 225-A is covered in detail in Notebook No. 21.[1] The catalog specifications define the limit performance capabilities quite completely. However, the collection of data from additional instruments in production more clearly defines the *typical* levels of performance. This article describes the performance levels of seven typical instruments and is written for the guidance of the user who is interested in characteristics not usually specified. It should be noted that, while the data given in this article is typical, it in no way modifies the calalog specifications.

Radio Frequency Characteristics

Frequency stability is defined as the maximum percentage frequency excursion during a stated time interval. For example, the long-term stability specified in the catalog for 1 hour (after a 2-hour warm up) is 0.01% of the carrier frequency or less.

Warm Up Time

A typical instrument achieved the above defined stability in ½ hour at 10 mc, 1 hour at 80 mc, ½ hour at 160 mc, and ½ hour at 320 mc. Warm up time did not exceed 1 hour at any frequency.

[1]Gorss, Charles G., "A General Purpose Precision Signal Generator", BRC Notebook No. 21, Spring 1959.

Long-term Stability

After 2 hours warm up, RF drift for 1 hour typically varies from 0.001% to 0.005% of the operating frequency. The sample stability tape (Figure 1) shows rapid adjustment during the first ½ hour. Drift during succeeding hours is progressively smaller down to the minute changes caused by line variations, FM due to noise, etc. Final stability may take 10 hours to achieve and has been as good as 300 cycles per hour at 100 mc.

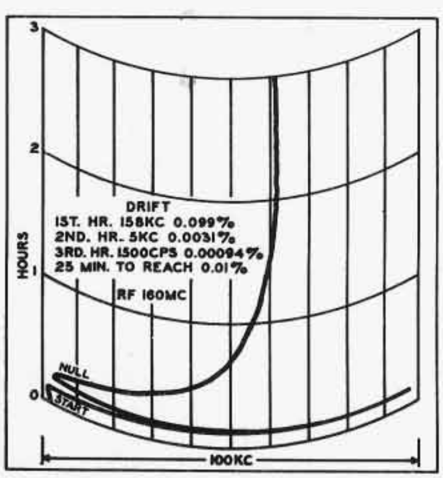


Figure 1. A graphic record of the long-term RF stability of the 225-A.

Short-term Stability

The short-term stability, as specified in the catalog, is 0.001% or less of the carrier frequency for a 5-minute interval after a 2-hour warm up. This stability varies from 0.0001% to 0.00075% of the operating frequency. After 10 hours warm up, the frequency change at 100 mc has been as low as 80 cps for 5-minutes or 0.00008% of the operating frequency.

While measuring short-term stability, sudden perturbations in frequency occurred which displayed steep slopes. These are caused by noise from the oscillator tubes. Note in Figure 2 that the *total excursion* is minute in each case, even though the rate of change may be rapid.

Stability After Operating Controls

During normal operation of a signal generator the frequency controls may be set for one frequency and then changed to another. In a wide range, continuously tunable oscillator, there are many factors which affect the temperature of frequency determining elements. Most important among these factors is the dc power through the tube and the RF current in the inductor. These values are affected by several factors: oscillator efficiency, which is a function of the tank circuit impedance for fixed operating conditions; the amount of feedback, which is also a function of frequency; the operating point of a self-biased oscillator, which is dependant on the foregoing; and the tightness of coupling to the load, which varies from range to range. Any change which affects the level of operation will require some definite time to stabilize, due to the thermal capacity of the parts involved. We may define the point where stabilization occurs as the start of the first 5-minute interval where the change in frequency is less than 0.001% of the operating frequency. Table 1 shows a summary of data for tuning changes of approximately 10% and 20% of the carrier frequency. It should not be assumed that a change of 20% will take twice as long to stabilize as a change of 10%. For 31% of the carrier frequencies tested for stabilization, the instrument "stabilized" as defined above, within ½ minute.

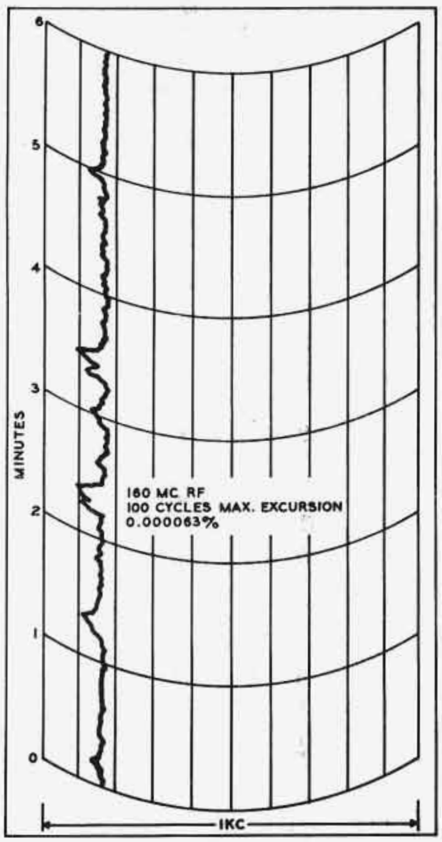


Figure 2. A graphic record of the short-term RF stability of the 225-A.

TABLE 1

Time Required to Stabilize to 0.001% of the Carrier Frequency for 5 Minutes

Range	Frequency	Maximum Minutes for 10% RF Change	Maximum Minutes for 20% RF Change
1	10mc	9	13
2	35mc	10.5	7
3	68mc	13.8	13.8
4	110mc	4.3	6.2
5	230mc	4.3	4.0
6	270mc	5	2.31
Average of all readings		2.64	6.15

Data from a typical instrument indicates that, when operating the Range Switch, an average of 7.7 minutes is required to stabilize to within 0.01% of operating frequency for 1 hour, and 17 minutes to stabilize to within 0.001% of operating frequency for 5 minutes. The longest stabilization time is required by range three, which requires 15 minutes to stabilize within 0.01% for 1 hour, and 35 minutes to stabilize within 0.001%, for 5 minutes.

For convenience in specifying changes in frequency which occur when varying the RF level control, the 10% and 20% marks on the meter were selected as RF level reference points. For the change in RF level with the frequency dial set near the low frequency end, an average change for all 6 ranges was 0.0016% of the carrier frequency. Near mid range the average for all ranges was 0.0022%, and at the high frequency end, the average for all ranges was 0.007%. A maximum change of 0.018% of the operating frequency occured at 19 mc on range 1. From 10 to 90 mc, an increase in RF level caused an increase in operating frequency. The change occured in less than 5 seconds at all points. Of course, this change is generally unimportant to the user since all calibrations have been made with the RF level set to red line, where the instrument should be used.

If operation of the generator requires frequent adjustment of the attenuator near the 100,000 microvolt level, it is convenient to compensate for the loading effect of the piston on the output tank circuit. Compensation may be achieved by detuning the amplifier trimmer slightly counterclockwise, until variation in the attenuator setting causes no visible change in the RF level meter indication. (Compensation will be accompanied by a slight increase in residual FM.)

The amplifier tank will now have more capacitance than at peak (i. e., will be tuned lower in frequency than the peak). Since the piston loop is in effect a shorted turn which will decrease the inductance of the amplifier tank when coupled closer to it, increased coupling will move the peak of the amplifier resonance curve up in frequency. Therefore, a judicious detuning of the amplifier will allow these two effects to nearly cancel, thus eliminating apparent reaction on the red line reading as the output is varied.

With the attenuator compensated as described in the preceeding paragraph, there was less than 50 cycles frequency change as a result of varying the attenuator from 20,000 microvolts to 100,000 microvolts over the full range of the instrument. When the attenuator was uncompensated the change in frequency due to loading was of similar magnitude.

The detenting resettability, or change of operating frequency, when moving the Range Selector to a high cam position between ranges momentarily and resetting to the same range, is less than 0.01% of the operating frequency when detenting from either side and about 0.006% when detenting from one side. Variation in frequency caused by "rocking" the Range Selector within the detent was less than 0.006% for all frequencies.

Ambient Temperature

An ambient temperature change for a typical instrument caused a 0.03% frequency change per degree centigrade at 320 mc and a 0.006% frequency change per degree centigrade at 20 mc. Frequency stability for a 5-volt line change was 25 cycles at 10 mc and 500 cycles at 320 mc. All frequency changes occurred in less than ½ minute.

Amplitude Modulation Characteristics

One of the characteristics measured during the data taking process was incidental FM due to 30% AM. The method described below was used to measure incidental FM, residual FM, and desired FM. The test set up, shown in Figure 3, is actually a wide band receiver employing a descriminator with very good AM rejection. Limiting is achieved in the H-P 500B frequency meter. The input to this frequency meter must be sufficient to saturate it. The other instruments used are typical of many that will do the job. The audio amplifier used was a 2% instrument covering 10 to

150,000 cps. The local oscillator is another Type 225-A Signal Generator. The local oscillator is set at 100,000 microvolts and the output of the generator under test is set at 20,000 to 50,000 microvolts. This difference is necessary to insure linear operation of the mixer. The setup used permits the reading of deviations of less than 100 cycles. Vertical deflection represents deviation.

To measure the incidental FM, which we define as frequency deviation due to amplitude modulation, the generator under test is modulated 30% with 1000 cps and the scope pattern is measured from peak to peak (less the width of the trace). With no modulation, the indication then represents residual FM from all sources other than AM. A typical 225-A Signal Generator exhibits 400 to 800 cycles incidental FM at 18 mc and even less at other frequencies. For example, 200 to 350 cycles incidental FM is exhibited at 160 mc.

The incidental FM due to 30% AM, as measured on a typical instrument for audio frequencies of 400, 1000, 4000, and 10,000 cps at carrier frequencies up to 20 mc, showed no dependance on modulating frequency.

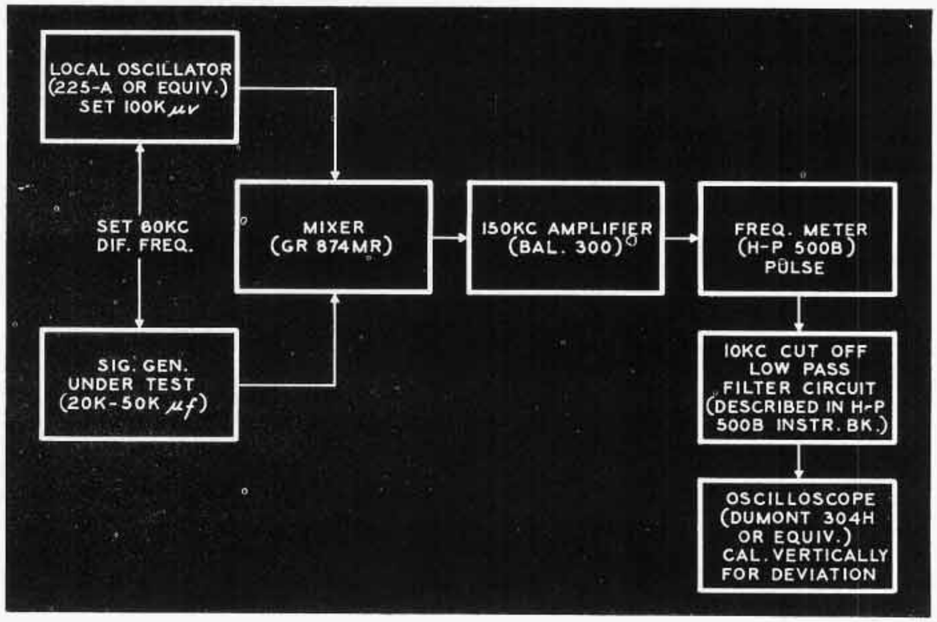


Figure 3. Test set up for measuring incidental FM on the 225-A.

TABLE 2

Range	RF	Deviation Cycles	1000 cps Modulation RMS Voltage	Limiting Factor		
1	10.7	1,740	25	10% Dist.		
2	21	2,170	20	10% Dist.		
2	30	7,550	26	10% Dist.		
3	40	4,360	24	10% Dist.		
4	70	11,000	24	10% AM		
4	92	22,300	26	10% Dist.		
4	100	25,000	24	10% Dist.		
					For 5,000 ~ Deviation	
					RMS Voltage	Resistor*
5	148	7,750	20	10% Dist.	13.7 Volts	
5	155	6,900	18	10% Dist.	12.8	
5	165	10,300	21	10% Dist.	10.6	
5	170	7,050	16	10% Dist.	12.6	
5	174	9,650	19	10% Dist.	10.2	
5	185	22,100	23	10% Dist.	5.3	4,700 Ohms**
5	205	22,100	20	10% Dist.	4.7	5,600
5	216	15,050	17	10% Dist.	5.7	3,900
5	220	25,800	21.5	10% Dist.	4.1	6,800
					For 75,000 ~ Deviation	
					RMS Voltage	Resistor*
6	450	181,000	24	10% Dist.	10 Volts	1,000 Ohms**
6	455	263,000	25	10% Dist.	7.1	2,200
6	460	188,000	16.5	10% AM	6.6	2,700
6	465	211,000	16.5	10% Dist.	5.9	3,300
6	470	460,000	23.5	10% Dist.	3.8	8,200

*Resistor connecting internal oscillator to FM audio input.
**Recovered audio distortion less than 4%.

Frequency Modulation Characteristics

Although the instrument was basically designed for amplitude modulation, provision has been made for frequency modulation from an external source. The resulting FM is useful over the 160 to 500 mc portion of the range.

The audio response of the FM channel is down 3 db at 400 and 12,000 cps. It is also possible to obtain narrow deviation FM from the internal modulation oscillator by connecting a resistor from the AM external modulation binding post to the FM binding post. Use of a resistor as low as 1000 ohms for this purpose will not significantly increase the distortion on the modulating signal. See Table 2 for typical deviations obtainable with different resistor values.

Modulating Oscillator

Output from the internal audio oscillator is available at the AM binding post when the AM Selector is in either the 400 or 1000 cps position. This output is approximately 12 volts RMS and typically has 0.6% distortion with no external load. The distortion of the modulating oscillator in a typical instrument, when grounded externally through 3300 Ω, is 0.9%.

Pulse On-Off Ratio

The generator output may be pulsed by applying a pulse to the AM modulation terminals with the AM level control in Pulse position. Typical DC pulse on-off ratio for —10 volts bias is given below.

10 mc	40 db
15 mc	36 db
150 mc	25 db
700 mc	24 db
450 mc	22 db

Conclusion

The Type 225-A Signal Generator is a truly general purpose generator, providing exceptionally low incidental FM and excellent frequency stability. It is hoped that this additional information regarding the performance of the instrument will prove valuable to the user and increase the utility of his 225-A Signal Generator.

MEET OUR REPRESENTATIVES
EDWARD A. OSSMANN AND ASSOC., INC.

Edward A. Ossmann and Assoc., Inc. has sold and serviced BRC instruments in the Upstate New York area, continuously since 1947. The Company maintains its headquarters in Rochester, with branch offices in Syracuse and Binghamton.

Edward Ossmann, founder of the Company, obtained his EE degree from Manhattan College in 1943. After serving successively as Test Engineer for General Electric Co. and Engineering Manager with the DuMont Laboratories, Mr. Ossmann entered the field of Sales representation in 1946. This was the beginning of a career which was to see his organization progress from a one-man effort to the 23-employee organization it is today.

After the untimely death of Mr. Ossmann in 1959, Mr. Roy Smart, who had joined the organization early that year, became a Director of the Company, and serves now as Vice-President and General Manager. Mr. Smart, a native of England, moved to Toronto, Canada in 1947. He held the post of Works Manager for the Instrument Division of Ferranti Electric, Ltd. from that year until 1954, when he became Manager of the Canadian Division of Helipot Corp. He held the latter position until 1955 when he joined the Ossmann organization.

Sales Manager of the Company is Mr. John Jordan who joined the organization in 1958, bringing with him years of experience as Electronic Engineer with Bell Aircraft and Area Sales Manager with Motorola.

The Company established their headquarters in a new building in Rochester in 1955. Over 6000 square feet in area, the building comprises complete office, service, and warehouse facilities. The main functions of accounting and clerical services are carried out at this location, although both the Syracuse and Binghamton branches are equipped to process and expedite customer orders. All locations have TWX and Western Union service and are in constant communication with the Company's principal factories.

All of the instruments sold by the Company are serviced by Brighton Electronic Laboratories, a Division of Edward A. Ossmann and Assoc. This group is completely equipped to provide calibration and repair service on all BRC instruments.

Edward A. Ossmann & Assoc. headquarters in Rochester, N. Y.

Edward A. Ossmann and Assoc. has endeavored over the years to sell and service only the finest precision electronic instrumentation. It is their firm belief that initial sale of an instrument represents only a small part of their obligation to their customers. To assist in the selection of proper instrumentation for each individual application, and to provide quick and reliable repair service to insure that the instruments they sell continue to fulfill the customer's needs is, they believe, their primary objective.

BRC is proud of its association with Edward A. Ossmann and Assoc. and is grateful for the record of dependable service this Company has rendered to our many customers in the Upstate New York area.

SERVICE NOTE
Checking RX Meter Calibration

The following techniques are given as an aid to those persons responsible for the maintenance and calibration of the RX Meter Type 250-A. It is not intended that the methods described be used to establish absolute calibration of the instrument, but rather, to provide an approximate or relative check as well as an indication of a change in calibration. In many cases, the techniques described will obviate the need for returning to the factory instruments which are thought to be performing improperly.

R_p DIAL

The Type 515-A Coaxial Adapter Kit, with its 50-ohm termination resistor, will check the R_p dial over the entire frequency range at the 50-ohm point. For checking other points on the R_p dial, stable film resistors with short and controlled lead shape and length may be connected to the RX Meter terminals and used to prepare frequency curves of R_p. This should be done after the instrument is received from the factory, or at a time when the calibration is known to be accurate. The film resistors, appropriately labeled, together with the curve data, could then serve as reference standards for the activity responsible for insuring proper operation of the instrument.

C_p DIAL

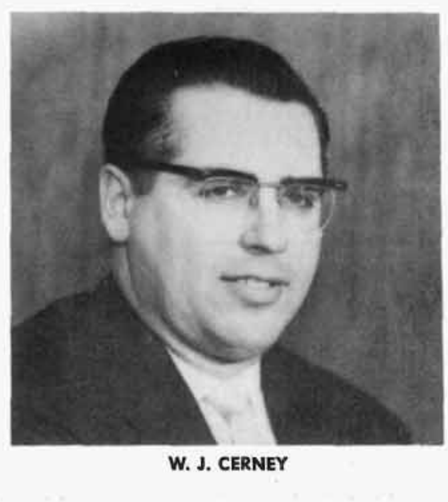
High quality capacitors with short and controlled lead shape and length may be connected to the RX Meter terminals and used to check the calibration of the C_p dial. When the instrument is known to be accurately calibrated, the capacitors are used to prepare frequency curves of C_p. The labeled capacitors, together with the curve data, are then used as reference standards for subsequent calibration checks of the C_p dial.

A precision variable capacitor may be similarly used to check the C_p dial calibration as follows.

1. Select a coil that will resonate with the precision capacitor at 120 $\mu\mu$f with the RX Meter C_p dial set to +20 $\mu\mu$f at a frequency in the lowest band, (500-1000 kc).
2. Connect the coil and the precision capacitor to the RX Meter terminals, using the shortest leads possible.
3. Set the RX Meter at zero C_p, the precision capacitor to 115 $\mu\mu$f, and adjust the frequency until a null is obtained.
4. Decrease the capacitance of the precision capacitor in the desired steps (e. g., 10 $\mu\mu$f) and readjust the RX Meter C_p dial for null.
5. Record the C_p dial readings from which a calibration curve can be prepared.

W. J. CERNEY JOINS BRC AS SALES ENGINEER

Many of our customers in the Metropolitan Philadelphia and Washington, D. C. area have already met Willard J. "Will" Cerney, recent addition to the



W. J. CERNEY

BRC Sales Engineering staff, during his visits to those areas. "Will" came to BRC from Link Aviation, Inc. where he worked with instrument trainers, simulators, and associated testing systems, and participated in that Company's training program. Before that time, he was employed by Harnishfager Corp. of Milwaukee, Wisconsin where he assisted in the setting up of a new production control system.

"Will" attended the Milwaukee School of Engineering, the University of Minnesota, and Broome Tech. in Binghamton, New York. While with the U. S. Army from 1948 to 1952, he gained experience repairing radar, navigational, and communications equipment.

During the short time he has been with BRC, "Will" has been instrumental in solving many customer problems and would welcome the opportunity to be of further service to our many customers in this area.

EDITOR'S NOTE
Q Meter Contest Winner

Again this year, the problem coil displayed at the BRC during the IRE show drew a host of hopefuls armed with slide rules, pad and pencil, and crystal balls. Viewing the "monster coil" from every conceivable angle, they slowly lapsed into a stupor, seemingly oblivious to all the commotion around them. Moments later, once again among the living, our friends began their frenzied manipulation of slide rules and delved into page after page of complicated mathematical computations. With the last stroke of the pencil their faces broke into a smile rivaling that of the cat who joined in the search for the missing canary and they quickly jotted down their estimate on the contest card. They were last seen as they disappeared into the stampeding crowd.

The coil has been measured and the story can be told. The Q of the coil, measured at 500 mc on a developmental model of the UHF Q Meter Type 280, is 395. The inductance of the coil is 9.3 mμh.

Winner of the contest and the Type 160-A Q Meter is William F. Byers of General Radio Co. in West Concord, Mass. Other contestants whose estimates are certainly worthy of note are listed below.

Estimate	
386.5	J. H. Marchese, Data Control Systems, Inc., Danbury, Conn.
386.5	E. H. Scannell, Jr., Ft. Trumbull, New London, Conn.
392	F. Haferd, North Electric, Galion, Ohio
392	J. F. Pryrt, Okonite Co., Passaic, N.J.
398	D. T. Walker National Lead Co., South Amboy, N. J.
400	J. Bullinga, National Coil Co., Sheridan, Wyo.
400	W. D. Street, Delta Coil, Inc., Paterson, N. J.
400	Vincent Vinci, Vitro Labs, W. Orange, N. J.
403	Alan Sobel, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.
405	George Kelk, George Kelk Ltd., Willowdale, Ontario, Canada
405	Harry M. Blombaum, Radio Corp. of America, Camden, N. J.

Our congratulations to Mr. Byers and sincere thanks to our many friends who visited us at the show.

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