



FERRIS

FERRIS INSTRUMENT COMPANY

Boonton, N. J.

MADE IN U. S. A.

## GENERAL CATALOG

### FOREWORD

THE Ferris organization was founded by Malcolm Ferris, one of the leading pioneers in the electronic field. It specializes in the design, development and production of the finest precision test-equipment for radio and radar use.

Ferris instruments, originally designed for electronic research laboratories, are utilized today in all branches of the industry. The exactness, versatility and reliability of Ferris instruments have made them a "must" in all leading laboratories throughout the world, and have convinced highgrade electronic manufacturers of their necessity in production, testing and servicing.

All Ferris products are built of carefully selected materials and components, assembled with precision, and individually hand-calibrated. Ferris engineers and instrument makers are especially trained in the development and production of the best in electronic equipment.

The instruments illustrated in this brief catalog are the result of countless hours of experimentation. The Ferris staff is constantly searching for improved circuits and designs; changes are made as soon as new and better techniques are developed to the point of usefulness. From long experience with test equipment, and from the many reports received from laboratories and manufacturers regarding the performance of such instruments, the Ferris company is fully qualified to make special instruments to solve almost every problem of electronic research and manufacturing.

Test equipment can be furnished from our many standard types, or made according to specifications. Such apparatus includes low, high, very high and ultra high frequency Signal Generators, Noise and Field Strength Meters, Microvolters, and Frequency Calibrators.

Should you be interested in any of the instruments described herein, or in modifications, we suggest that you contact us directly by mail or in person, in order that your particular requirements can be met with equipment best suited to your needs.

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Many of the instruments shown in this catalog employ a 30 ohm transmission line output cable terminated in 30 ohms, thereby providing a regulation characteristics of a supply of 15 ohms or less. Because of the low output impedance of these generators they rate high in terms of so-called available power.

In addition to this low output impedance, several of the instruments have a three ohm tap on the output terminating resistance, thereby providing a stiff three ohm source not easily upset by the application of various loads. This feature is of considerable importance when it is desired to inject a known voltage into a tuned circuit or loop and determine the Q or effective voltage gain.

Many signal generators are made with relatively high impedance output and their use is limited to particular types of service. Ferris Signal Generators, however, are designed for low output impedance even though this involves R.F. power, and the output impedance can readily be built up to match almost any condition.

Ferris has produced many special signal generators not shown in this catalog. These include crystal controlled signal generators which are useful as secondary frequency standards as well as establishing known signal strengths.

The crystal controlled signal generator has found considerable favor in the communications field for servicing mobile radio receivers as employed by police, taxicabs and telephone services. Another application of the crystal controlled generator, such as the Model 43-B, lies in the maintenance of aircraft equipment both for communication and instrument landing systems.

It is also anticipated that there will be an ever increasing demand for signal generators for television applications where the exact frequency is established by crystals either directly or indirectly.

An example of the latter is the Model 50-A Signal Generator shown in this catalog.

A special signal generator for a particular application will frequently save time and do a more satisfactory job.

If your requirements fall into this category you are invited to consult with Ferris engineers regarding your problem.



## SIGNAL GENERATOR SECTION

**R**ADIO FREQUENCY signal generators as shown in this catalog fall into three groups or classifications, namely:

1. Precision Laboratory Standards
2. General Purpose Laboratory Generators
3. Production Type Signal Generators

**PRECISION LABORATORY STANDARDS:** Instruments in this class have features not found in those of the other two groups. Chief among these features is the employment of tuned modulated R.F. amplifiers and, in some instances, a buffer stage providing isolation from the oscillator and preventing frequency modulation when the final amplifier is modulated. The use of a modulated amplifier also prevents reaction of the output controls on the oscillator frequency and permits modulation percentages up to 100% with low distortion. This high percentage modulation is often useful in determining ultimate performance of radio receivers and is practically impossible to obtain in directly modulated oscillators without excessive distortion.

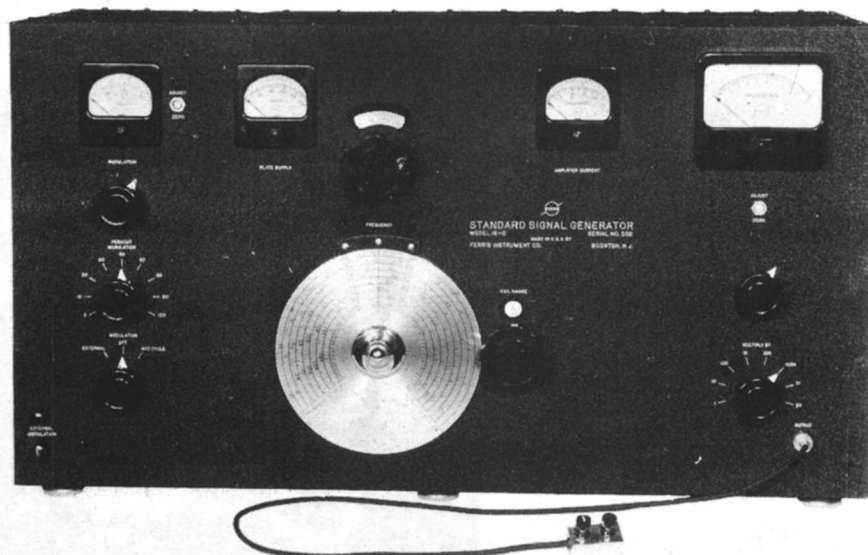
Other features of the precision standards are greater frequency stability obtained through the use of line voltage regulators, temperature compensation, and the employment of stable components. Frequency controls are provided with high ratios to permit precise setting and variation. In many instances the output meter is individually calibrated to provide the highest degree of accuracy and, in general, no expense is spared to obtain the ultimate in performance.

**GENERAL PURPOSE LABORATORY GENERATORS:** These instruments are sufficiently accurate for

most laboratory work and are convenient because of their small size and self-contained nature. Because of size limitations they are usually of the modulated oscillator type and as such, are limited in percentage modulation to from 30% to 50%. Instruments in the V.H.F. and U.H.F. range are subject to various degrees of frequency modulation for which allowance must be made in checking receiver performance. The unmodulated performance of these small generators is exceptionally good, however, and accurate measurements may be made without difficulty.

**PRODUCTION TYPE SIGNAL GENERATORS:** Generators falling in this class are, for the most part, fixed selectable frequency instruments which provide several pre-adjusted frequencies for quick factory checking. Their accuracy is sufficient to maintain performance standards to a commercially acceptable level and their cost is comparatively low. They also find use in spot frequency applications as used in communication and aircraft systems.

**GENERAL SIGNAL GENERATOR INFORMATION:** Radio frequency signal generators are characterized by their frequency range, type, and extent of modulation, voltage output and effective output impedance. In the description of the signal generators in this catalog, the frequency range of each instrument is clearly stated as well as its modulation capabilities. The range of output voltage available is also given as well as the effective output impedance. As in any other type of generator, it is desirable to supply as low an output impedance as possible so that the regulation or variation in output voltage with various loads on the generator is minimized.



MODEL 16-C

**T**HE Model 16-C Standard Signal Generator has been designed for the most exacting requirements of the radio receiver engineer.

In order to obtain the reliability, accuracy, and convenience so essential to the highest type of development laboratory work, many departures from conventional construction have been made which include a master oscillator, buffer amplifier, and final amplifier type of circuit, with modulation applied only to the final amplifier, thus eliminating frequency modulation and reaction of output controls on frequency; a three gang precision variable condenser, fitted with a split worm gear drive, providing a 30 foot scale length with negligible backlash, permitting accurate setting of small frequency increments for selectivity analysis; a direct reading dial, separately engraved with a scale for each range; an attenuator employing the Ferris transmission line output system to eliminate lead set-up errors at high frequencies.

Additional output cables are available for use with this Signal Generator at a slight additional cost such as the Model FAW-2 output cable and three terminal box with space for the insertion of a dummy antenna capacitor.

There is also the Model FAW-38 output cable which includes a terminal box with a termination having a 3 ohm tap.

A three foot cable, Model FAW-50 with a Jones plug on either end may be obtained which permits the use of the Model 448-A isolation output box including a 4 mfd. condenser for preventing A.C. or D.C. up to 200 volts from entering the generator.

These items are described in detail under the section of this catalog devoted to Miscellaneous.

#### 16-C Specifications

**Frequency range:** 50 Kcs. to 28 Mcs. covered in eight self-contained ranges.

**Dial system:** By means of a vernier dial system, a linear scale of 3000 divisions is provided. In addition to calibration charts for the eight individual bands there is a direct reading, hand-calibrated engraved scale for each range.

**Accuracy of Calibration:** .5% for the direct reading

scales and .1% for the tabulated data furnished.

**Output voltage:** Continuously variable from .1 micro-volt to 2 volts.

**Output system:** Consists of a variable input to a low resistance attenuator and a patented Ferris-type terminated transmission line, input to the attenuator being read directly by means of a vacuum tube voltmeter.

**Modulation:** The modulation system consists of a built-in audio amplifier, whose output is arranged to modulate the final r.f. amplifier. With a small fraction of a watt input to external binding posts, it is possible to secure 100% modulation with low distortion. A modulation metering system is provided to read modulation depth from 5% to 100%. A built-in 400 cycle audio oscillator is also provided and is capable of modulating the generator to 100%. In addition to the 400 cycle internal modulation, 1000 cycle modulation can be had upon special order.

**General:** Modulation of the final amplifier removes all possibility of frequency modulation. By careful shielding and r.f. filters, the stray fields have been reduced to a negligible magnitude.

**Power supply:** The standard power supply furnished with the Model 16-C is designed for a 115 volt, 60 cycle power line. In order to minimize errors due to line voltage fluctuations, a voltage regulator is incorporated in this power unit. To minimize acoustical noise, the power supply is built in two separate units. A power supply for other voltages and frequencies may be secured on special order.

**Accessories:** The accessories consist of ten mounted calibration charts, termination transmission line, spare output vacuum tube voltmeter tube, and the necessary interconnecting and power line connection cables.

**Dimensions:** Width 31 inches, Height 17½ inches, Depth 13½ inches including controls.

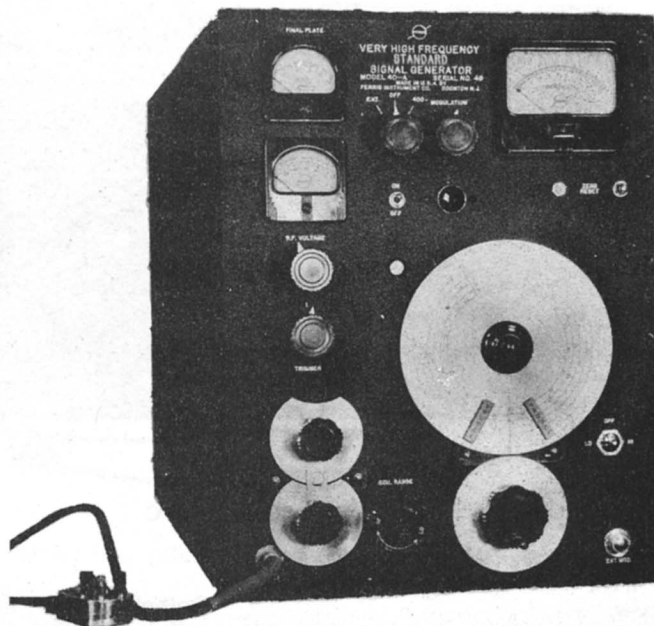
**Net Weight:** Exclusive of Power Supply 115 lbs.  
Weight of Power Supply and Regulator 54 lbs.

**Shipping Weight:** Exclusive of Power Supply 235 lbs.  
Weight of Power Supply and Regulator 110 lbs.  
Normal shipment in two cases.

Oscillator,  
Buffer,  
Modulated-  
Amplifier,  
Construction  
Giving  
Freedom  
from  
Frequency-  
Modulation

Precision  
Very High  
Frequency  
Generator

—  
20 mc.  
to  
250 mc.



#### MODEL 40-A VERY-HIGH-FREQUENCY STANDARD SIGNAL GENERATOR

THE Model 40-A V.H.F. Standard Signal Generator was designed as a companion unit to the Model 16-C and as such extends the field of precision measurements up to 250 megacycles. Like the 16-C, it incorporates a master oscillator, buffer amplifier, and final amplifier, permitting modulation up to 100% with freedom from frequency modulation.

The total range of from 20 Mc. to 250 Mc. is covered in six bands with a total of eighteen coils arranged in triple turret fashion and actuated by a special range selector mechanism in which the final positioning of the coil in use free from movements of the external control.

The tuning condensers are of a new type having great mass and rigidity which contributes to stable performance. They are motor driven with separate motors for left and right rotation and in addition to the main direct calibrated frequency dial, there is a vernier dial with a ratio of 180 to 1 for band spread work.

Output is continuously variable from less than one microvolt to one volt over the entire range and appears at the three foot triple shielded terminated cable. The terminated cable has a characteristic impedance of 30 ohms and is terminated in a three terminal output box having a 30 ohm network with a three ohm tap delivering one-tenth voltage with high regulation.

A dual cascade resistance type step attenuator with interlock controls is employed in conjunction with an R.F. control on the large output meter for intermediate values.

Internal modulation at 400 cycles up to 100% is obtained from a modulation unit with a filter to reduce

the harmonic content to a negligible value. Provision is made for external modulation up to 10,000 cycles by the application of approximately 3 volts at 500 ohms. The same modulation control and meter functions on the externally applied signal.

The power supply is external to minimize heating and vibration and in addition to the electronically regulated supply a separate line voltage regulator is furnished.

#### 40-A Specifications

**Frequency range:** 20 to 250 Mc. in six self-contained bands.

**Dial system:** Direct reading frequency dial in addition to vernier with 180 to 1 reduction. Charts are also furnished in addition to direct calibration.

**Output voltage:** From .1 microvolt to 1 volt.

**Output system:** Variable input to resistance type step attenuator and terminated 30 ohm output cable.

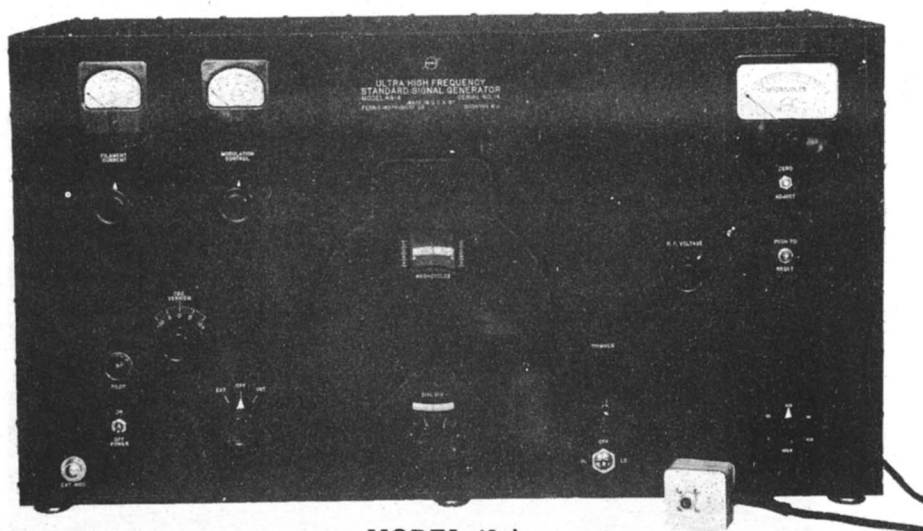
**Modulation:** Internal modulation at 400 cycles up to 100% read directly on modulation meter with provision for external modulation up to 10 Kc.

**Dimensions:** Width 16¼ inches, Height, 21½ inches, Depth 37 inches including controls.

**Net Weight:** Exclusive of Power Supply 230 lbs.  
Weight of Power Supply and Regulator 80 lbs.

**Shipping Weight:** Exclusive of Power Supply 350 lbs.  
Weight of Power Supply and Regulator 200 lbs.  
Packed in two wooden cases.





MODEL 48-A

**T**HE Ferris Model 48-A U.H.F. Standard Signal Generator is a precision laboratory instrument covering the range from 200 to 500 mc in a single band. This instrument employs a powerful resonant line oscillator (for frequency stability) to which is weakly coupled a modulated r.f. amplifier thereby avoiding frequency modulation.

The tuning mechanism is motor driven and the main dial, which is hand calibrated, makes four complete revolutions over the range. A spiral scale on the dial with window follower prevents confusion in reading as only the correct frequency is visible. Trimmer adjustments are provided for band spread work.

Output of the signal generator is at the end of a three-foot cable terminated in 30 ohms (effective value) with a 3 ohm tap. Maximum output is 100,000 microvolts or one-tenth of this value at the tap. Attenuation is by means of a decade resistance type attenuator in conjunction with a silver ribbon inductive potentiometer and calibrated output meter for continuous variation between steps.

Modulation system consists of a built-in audio amplifier, whose output is arranged to modulate the r.f. amplifier to 100% with low distortion. A separate modulation meter is provided to read the percentage modulation from either an internal 400 cycle oscillator or external source up to 10,000 cycles. Arrangements may be made for special types of modulation if desired. A continuously variable control is provided to adjust the percentage modulation from either the internal or 500 ohm external source.

The power supply consists of two separate units to avoid excessive heating or vibration of the generator. One unit is for the "A" supply to the oscillator which is D.C. to prevent hum modulation and the other unit is an electronically regulated "B" supply.

As a further protection against line voltage variation an external power supply regulator is also furnished.

#### 48-A Specifications

**Frequency range:** 200 to 500 megacycles in one continuous band.

**Tuning system:** Resonant line oscillator and coaxial type R.F. amplifier operated by lead screw.

**Dial system:** Motor driven main dial makes 4 complete revolutions and has direct reading spiral scale plus 100 division calibration scale. Vernier dial on main dial with 100 to 1 ratio and also separate oscillator vernier dial.

**Output voltage:** Continuously variable from 0.1 microvolt to 0.1 volt.

**Output system:** Consists of variable input to resistance type step attenuator and triple shielded three foot output cable terminated with coaxial type output box with High and Low tap. Cable is 30 ohms characteristic impedance and "Low" tap is 3 ohms (effective value) giving high regulation.

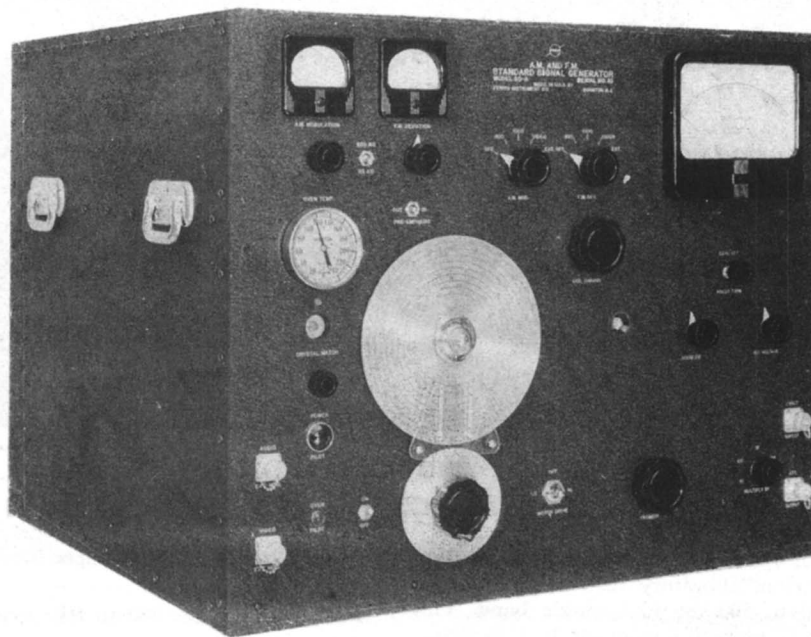
**Modulation:** Includes internal modulation unit at 400 cycles capable of 100% modulation of R.F. amplifier. Modulator unit has filter to reduce harmonic content to negligible value. Modulation read direct on meter and provision for external modulation up to 10 Kc. with approximately six volts at 500 ohms applied to jack on front panel.

**Power supply:** Two power supply units are furnished together with a separate line voltage regulator. Standard power supplies are for 115 volts, 60 cycles with other voltages and frequencies on special order.

**Dimensions:** Width 35½ inches, Height 19½ inches, Depth 17½ inches including controls.

**Net Weight:** Exclusive of Power Supplies 170 lbs.  
Weight of Power Supplies and Regulator 120 lbs.

**Shipping Weight:** Exclusive of Power Supplies 250 lbs.  
Weight of Power Supplies and Regulator 200 lbs.  
Normally packed in 2 wood cases.



### FERRIS MODEL 50-A AM AND FM STANDARD SIGNAL GENERATOR

THE Model 50-A was designed to meet the demand for a precision instrument to cover the requirements of television, frequency modulation and the communication field in the frequency range of from 5 to 250 megacycles. In order to meet the demands of such service provision is made for sine wave modulation up to 100% and frequency modulation up to 250 kilocycles deviation.

Both amplitude and frequency modulation may be obtained simultaneously, if desired. Internal amplitude modulation at fixed frequencies of 400 and 1,000 cycles and external modulation up to 15,000 cycles is provided for. In addition, a separate built in video amplifier allows pulse or television signals to be applied.

Frequency modulation from an internal source of 400, 1,000 or 10,000 cycles is furnished with external modulation capability up to 20,000 cycles. The F.M. modulator is of the push pull type giving symmetrical deviation by reason of balanced reactance tubes. The relationship of the F.M. oscillator to a crystal controlled fixed oscillator is indicated by a tuning meter with a manual adjustment on the front panel to match the F.M. to the fixed oscillator.

Basically, the instrument includes the F.M. oscillator operating at the relatively low frequency of 5 megacycles matched against a temperature controlled crystal oscillator. The F.M. oscillator is multiplied in frequency 36 times to provide a frequency modulated signal at 180 megacycles which in turn beats with a local variable oscillator giving a different frequency which is filtered and amplified by suitable tuned circuits and tubes. The local variable oscillator is contained in a temperature controlled oven and has regulated plate and heater supply voltages in order to secure the high degree of frequency stability required for high frequency mixing.

Output from the mixer is applied to a double tuned filter and then fed to an R.F. amplifier which serves as an amplitude modulator at both audio and video frequencies.

Plate modulation of the R.F. amplifier is employed at audio frequencies and grid modulation at video frequencies. The

R.F. amplifier covers the range of from 5 to 250 megacycles and acts as a frequency multiplier on the higher frequencies.

A maximum R.F. output of 1.2 volts is available at the lower frequencies and .12 volt at the high frequencies. This output is obtained by plugging a non terminated 30 ohm cable into the upper output receptacle associated directly with the meter which has a black and a red scale. The black scale registers up to 1.2 volts and the red scale up to .12 volt as obtained at the higher frequencies. For lower output levels a second receptacle following the step attenuator is used. This receptacle is located directly below the first and uses a terminated 30 ohm cable. Coaxial type dummy antennas are furnished to permit matching the generator and load impedances.

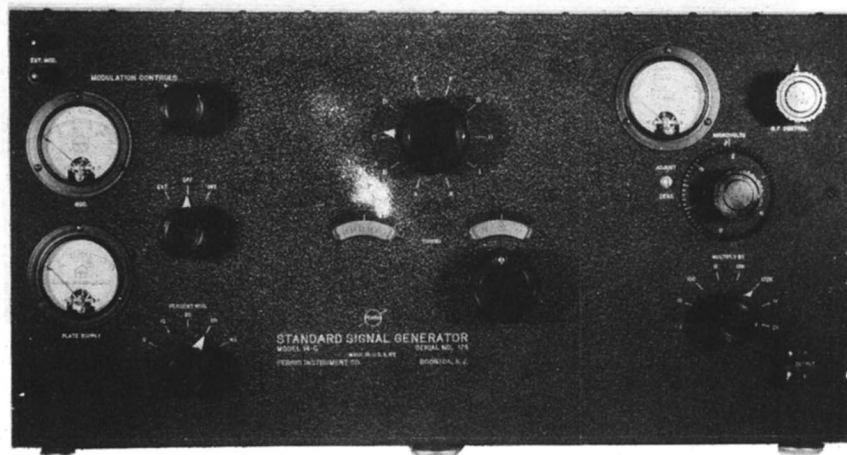
An exceptionally large output meter is used to indicate between steps on the attenuator and a smooth R.F. control is obtained through the use of a silver ribbon inductive potentiometer.

Other features include two modulation meters to indicate amplitude and frequency modulation simultaneously and a temperature gauge to show oven temperature. Motor drive on the frequency dial is a convenience in tuning and a trimmer adjustment permits accurate alignment of the modulated amplifier.

The deviation meter indicates up to 250 kc or 25 kc full scale by a selective switch thereby giving nearly full scale reading of 30% modulation of 75 kc deviation as established by I.R.E. standards. Pre-emphasis may be thrown in or out of circuit as desired.

A separate regulated power supply unit including line voltage regulator is furnished with the unit and, although normally furnished for 115 volt 60 cycle operation may be obtained for other frequencies and voltages at a nominal price increase.

The generator, exclusive of power supply, weighs approximately 250 lbs. and is 23 inches high by 28 inches wide by 27 inches deep. Four sturdy handles are provided for transporting the unit and internal rubber shock mounting is included.



### MODEL 14-C

THE Model 14-C Standard Signal Generator has been designed primarily for use in the development laboratories of radio receiver manufacturers.

The design of this instrument has proven so satisfactory that it is in constant demand. The simplicity and convenience of operation and the ease with which it is possible to make accurate measurements on all types of radio receivers are mainly due to one or more of the following features. Output up to 2 volts across LOW RESISTANCE (never over 20 ohms); tuning condenser with worm gear drive, and scale length over 30 feet (3,000 divisions, each approximately  $\frac{1}{8}$  inch wide); direct reading system of modulation measurement; built in coils to cover 75 to 30,000 kilocycles; separate power unit (so that the instrument can be operated from the AC line, yet can be operated from batteries if this ever becomes desirable.)

### MODEL 14-D SIGNAL GENERATOR

Due to repeated requests, the Model 14-C has been made available with the same output system including a large output meter and terminated transmission line as used on the Model 16-C. When supplied with these additional features the instrument is known as the Model 14-D and the cost is somewhat increased.

The advantages of the transmission line output and increased accuracy at the higher frequencies will be appreciated by those who employ this generator in the range from 10 to 30 megacycles.

Many of the features of the 14-D, including the terminated line, can be applied to Model 14-C instruments

now in the field. If you now have a 14-C, correspondence is invited concerning adding these features to your instrument.

### 14-C Specifications

**Frequency range:** 75 to 30,000 kilocycles covered in 10 self-contained coil ranges.

**Dial system:** By means of a vernier dial system, a linear scale of 3,000 divisions is provided.

**Accuracy of calibration:** 5%

**Output voltage:** Continuously variable from .2 microvolt to 2 volts.

**Output system:** Slidewire and step attenuator. Maximum output appears across a resistance of 20 ohms.

**Modulation:** Internal 400 cycle audio oscillator. Direct reading percentage modulation meter is provided. Modulation up to 40%.

**General:** By careful shielding and r.f. filters, the stray fields have been reduced to a negligible magnitude.

**Power supply:** The standard power supply furnished is designed for 115 volt 60 cycle operation and is furnished as a separate unit. This instrument may be operated from an external battery.

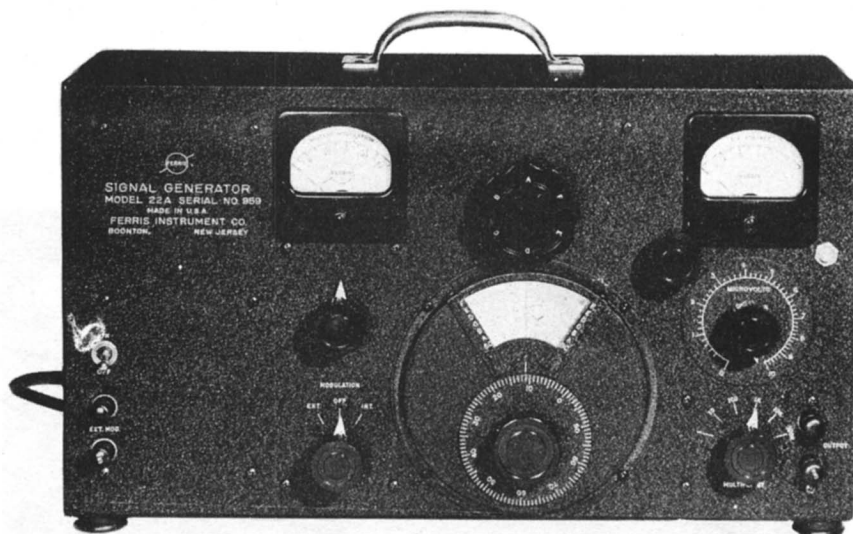
**Dimensions:** Width  $26 \frac{1}{4}$  inches, Height 14 inches, Depth  $13 \frac{1}{2}$  inches including controls.

**Net Weight:** Including Power Supply 82 lbs.

**Shipping Weight:** Including Power Supply 180 lbs.

Normal shipment in one case.





MODEL 22-A

THE Model 22-A Signal Generator is a small but versatile unit for general radio laboratory use, where convenience of operation and adaptability to a wide variety of measurements are more important than the extreme precision found only in large expensive instruments. Careful, painstaking design has made it possible to offer in the Model 22-A, a very high order of capability and performance at a price which is very low for this class of instrument. Among the important features of the Model 22-A Signal Generator are a direct reading, individually calibrated dial on tuning condenser and gear driven reduction drive, giving a total scale length of approximately four feet, thus making it possible to set small frequency increments for selectivity measurements. Direct reading modulation system, including meter calibrated directly in percentage modulation, which is in the modulation circuit at all times, 400 cycle internal modulation to 50% with provision for external modulation for fidelity measurements. All units contained within one case, including the regulated plate power supply unit for AC line operation.

Early investigations showed that an inexpensive type of master oscillator circuit using an untuned amplifier stage could not give the high output voltage and freedom from radio frequency harmonics that was desired in the 22-A, and the properly built master oscillator circuit, with tuned buffer and amplifier stages, is practical only for quite expensive instruments. For this reason, a modulated oscillator type of circuit has been used, and it has been found possible, by very careful design of the circuit and use of somewhat unusual constants, to obtain as good performance as regards linearity, stability and frequency modulation as could be obtained with an inexpensive master oscillator. The result in an instrument in which the frequency modulation is so low that no difficulty will be encountered in making selectivity measurements of any of the usual types of receivers. Further, the high value of maximum output voltage, appearing across a relatively low generator impedance, makes possible many tests of AVC overload image ratio and stage gain which are impossible, or at any rate, seriously handicapped by a low maximum output voltage. While not a really "high power" generator, the Model 22-A is nevertheless definitely out of the "low power" class.

#### 22-A Specifications

**Frequency range:** 85 kilocycles to 25 megacycles covered in six self-contained ranges.

**Dial system:** Each range has an individually hand calibrated scale. Additional slow motion dial for selectivity measurements giving scale spread of 4 feet in each range.

**Accuracy of calibration:** Direct reading dial is accurate to plus or minus 1%.

**Output voltage:** Continuously variable from .2 microvolt to 1 volt.

**Output system:** Calibrated potentiometer continuously variable and step attenuator. Maximum output of 1 volt appears across a generator resistance of 100 ohms.

**Modulation:** Internal and external modulation continuously variable to 50% with modulating meter calibrated directly in percentage of modulation.

**General:** Special modulated oscillator circuit designed to give low frequency modulation. The stray fields have been reduced to a negligible magnitude by careful shielding and R.F. filters.

**Power supply:** The standard power supply furnished with this instrument is designed for 115 volts, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Accessories:** Selectivity data for 600, 1000 and 1400 kilocycles.

**Dimensions:** Width 18 ¼ inches, Height 10 ½ inches, Depth 8 inches including controls.

**Net Weight:** 26 lbs.

**Shipping Weight:** 31 lbs., packed in 1 carton.

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Should you be interested in any of the instruments described herein, or in modifications, we suggest that you contact us directly by mail or in person, in order that your particular requirements can be met with equipment best suited to your needs.

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In addition to this low output impedance, several of the instruments have a three ohm tap on the output terminating resistance, thereby providing a stiff three ohm source not easily upset by the application of various loads. This feature is of considerable importance when it is desired to inject a known voltage into a tuned circuit or loop and determine the  $Q$  or effective voltage gain.

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Other features of the precision standards are greater frequency stability obtained through the use of line voltage regulators, temperature compensation, and the employment of stable components. Frequency controls are provided with high ratios to permit precise setting and variation. In many instances the output meter is individually calibrated to provide the highest degree of accuracy and, in general, no expense is spared to obtain the ultimate in performance.

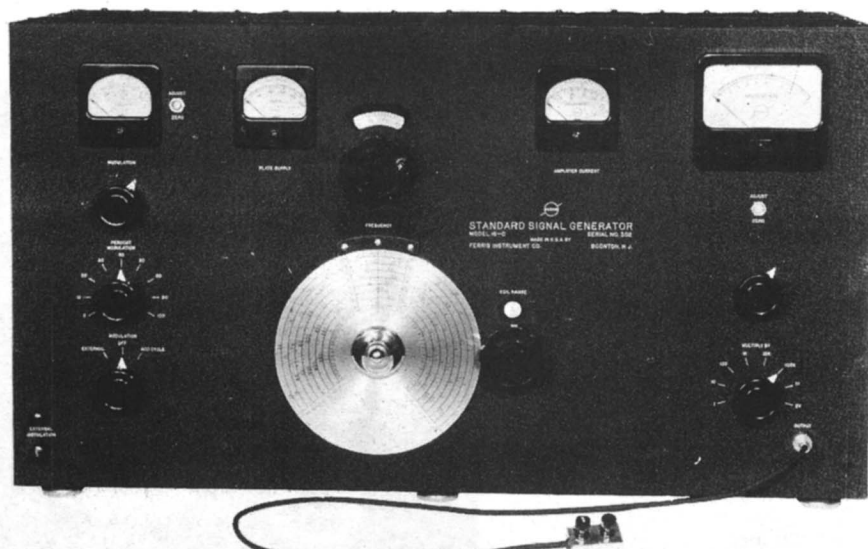
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MODEL 16-C

**T**HE Model 16-C Standard Signal Generator has been designed for the most exacting requirements of the radio receiver engineer.

In order to obtain the reliability, accuracy, and convenience so essential to the highest type of development laboratory work, many departures from conventional construction have been made which include a master oscillator, buffer amplifier, and final amplifier type of circuit, with modulation applied only to the final amplifier, thus eliminating frequency modulation and reaction of output controls on frequency; a three gang precision variable condenser, fitted with a split worm gear drive, providing a 30 foot scale length with negligible backlash, permitting accurate setting of small frequency increments for selectivity analysis; a direct reading dial, separately engraved with a scale for each range; an attenuator employing the Ferris transmission line output system to eliminate lead set-up errors at high frequencies.

Additional output cables are available for use with this Signal Generator at a slight additional cost such as the Model FAW-2 output cable and three terminal box with space for the insertion of a dummy antenna capacitor.

There is also the Model FAW-38 output cable which includes a terminal box with a termination having a 3 ohm tap.

A three foot cable, Model FAW-50 with a Jones plug on either end may be obtained which permits the use of the Model 448-A isolation output box including a 4 mfd. condenser for preventing A.C. or D.C. up to 200 volts from entering the generator.

These items are described in detail under the section of this catalog devoted to Miscellaneous.

#### 16-C Specifications

**Frequency range:** 50 Kcs. to 28 Mcs. covered in eight self-contained ranges.

**Dial system:** By means of a vernier dial system, a linear scale of 3000 divisions is provided. In addition to calibration charts for the eight individual bands there is a direct reading, hand-calibrated engraved scale for each range.

**Accuracy of Calibration:** .5% for the direct reading

scales and .1% for the tabulated data furnished.

**Output voltage:** Continuously variable from .1 micro-volt to 2 volts.

**Output system:** Consists of a variable input to a low resistance attenuator and a patented Ferris-type terminated transmission line, input to the attenuator being read directly by means of a vacuum tube voltmeter.

**Modulation:** The modulation system consists of a built-in audio amplifier, whose output is arranged to modulate the final r.f. amplifier. With a small fraction of a watt input to external binding posts, it is possible to secure 100% modulation with low distortion. A modulation metering system is provided to read modulation depth from 5% to 100%. A built-in 400 cycle audio oscillator is also provided and is capable of modulating the generator to 100%. In addition to the 400 cycle internal modulation, 1000 cycle modulation can be had upon special order.

**General:** Modulation of the final amplifier removes all possibility of frequency modulation. By careful shielding and r.f. filters, the stray fields have been reduced to a negligible magnitude.

**Power supply:** The standard power supply furnished with the Model 16-C is designed for a 115 volt, 60 cycle power line. In order to minimize errors due to line voltage fluctuations, a voltage regulator is incorporated in this power unit. To minimize acoustical noise, the power supply is built in two separate units. A power supply for other voltages and frequencies may be secured on special order.

**Accessories:** The accessories consist of ten mounted calibration charts, termination transmission line, spare output vacuum tube voltmeter tube, and the necessary interconnecting and power line connection cables.

**Dimensions:** Width 31 inches, Height 17½ inches, Depth 13½ inches including controls.

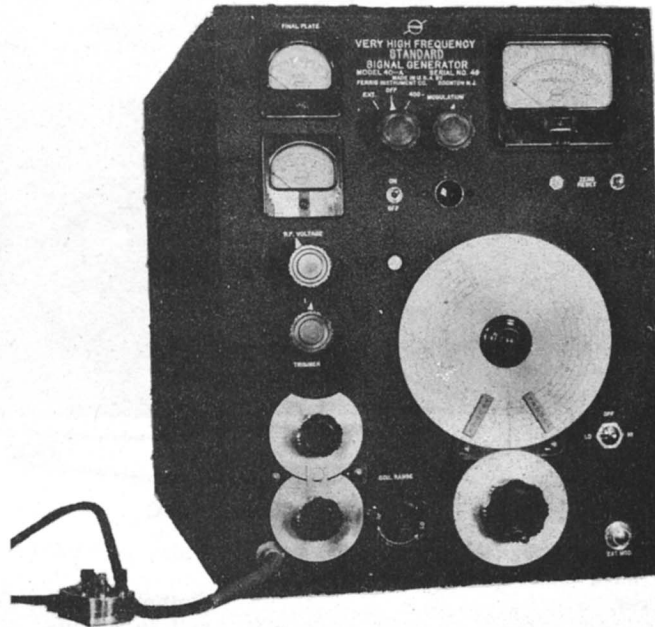
**Net Weight:** Exclusive of Power Supply 115 lbs.  
Weight of Power Supply and Regulator 54 lbs.

**Shipping Weight:** Exclusive of Power Supply 235 lbs.  
Weight of Power Supply and Regulator 110 lbs.  
Normal shipment in two cases.

Oscillator,  
Buffer,  
Modulated-  
Amplifier,  
Construction  
Giving  
Freedom  
from  
Frequency-  
Modulation

Precision  
Very High  
Frequency  
Generator

20 mc.  
to  
250 mc.



### MODEL 40-A VERY-HIGH-FREQUENCY STANDARD SIGNAL GENERATOR

**T**HE Model 40-A V.H.F. Standard Signal Generator was designed as a companion unit to the Model 16-C and as such extends the field of precision measurements up to 250 megacycles. Like the 16-C, it incorporates a master oscillator, buffer amplifier, and final amplifier, permitting modulation up to 100% with freedom from frequency modulation.

The total range of from 20 Mc. to 250 Mc. is covered in six bands with a total of eighteen coils arranged in triple turret fashion and actuated by a special range selector mechanism in which the final positioning of the coil in use free from movements of the external control.

The tuning condensers are of a new type having great mass and rigidity which contributes to stable performance. They are motor driven with separate motors for left and right rotation and in addition to the main direct calibrated frequency dial, there is a vernier dial with a ratio of 180 to 1 for band spread work.

Output is continuously variable from less than one microvolt to one volt over the entire range and appears at the three foot triple shielded terminated cable. The terminated cable has a characteristic impedance of 30 ohms and is terminated in a three terminal output box having a 30 ohm network with a three ohm tap delivering one-tenth voltage with high regulation.

A dual cascade resistance type step attenuator with interlock controls is employed in conjunction with an R.F. control on the large output meter for intermediate values.

Internal modulation at 400 cycles up to 100% is obtained from a modulation unit with a filter to reduce

the harmonic content to a negligible value. Provision is made for external modulation up to 10,000 cycles by the application of approximately 3 volts at 500 ohms. The same modulation control and meter functions on the externally applied signal.

The power supply is external to minimize heating and vibration and in addition to the electronically regulated supply a separate line voltage regulator is furnished.

#### 40-A Specifications

**Frequency range:** 20 to 250 Mc. in six self-contained bands.

**Dial system:** Direct reading frequency dial in addition to vernier with 180 to 1 reduction. Charts are also furnished in addition to direct calibration.

**Output voltage:** From .1 microvolt to 1 volt.

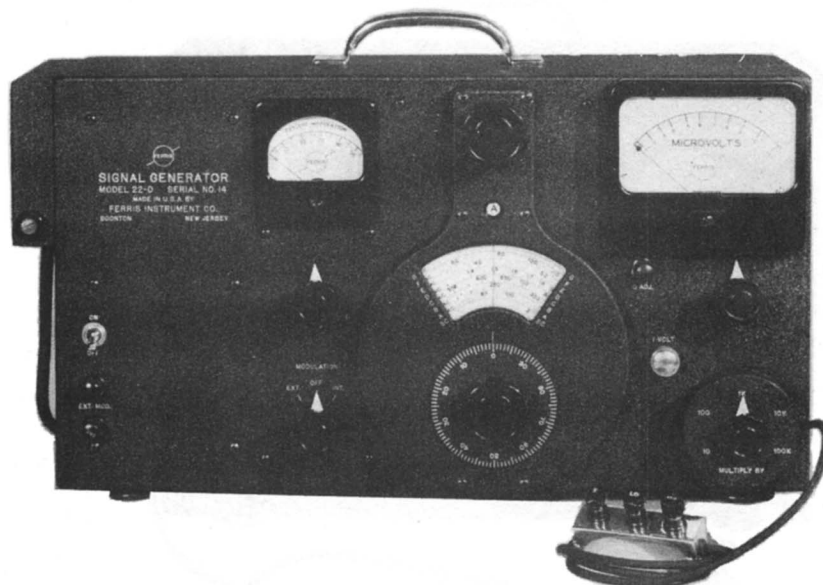
**Output system:** Variable input to resistance type step attenuator and terminated 30 ohm output cable.

**Modulation:** Internal modulation at 400 cycles up to 100% read directly on modulation meter with provision for external modulation up to 10 Kc.

**Dimensions:** Width 16¼ inches, Height, 21½ inches, Depth 37 inches including controls.

**Net Weight:** Exclusive of Power Supply 230 lbs.  
Weight of Power Supply and Regulator 80 lbs.

**Shipping Weight:** Exclusive of Power Supply 350 lbs.  
Weight of Power Supply and Regulator 200 lbs.  
Packed in two wooden cases.



## MODEL 22D SIGNAL GENERATOR

THE Model 22-D Signal Generator is similar in many respects to the popular Model 22-A Signal Generator, but has many additional desirable characteristics.

These include:

1. A frequency range of from 85 kc to 40 mc.
2. Two terminated 30 ohm output cables.
3. Ferris high frequency step attenuator.
4. Large output meter with special scale eliminating calibrated potentiometer.
5. Only two output controls, simplifying operation.
6. Exceptional shielding with additional line filtering to minimize leakage.
7. Output voltage up to 1 volt at low impedance.

The Model 22-D retains all of the desirable features of the 22-A such as direct reading frequency dial with engraved vernier for bandwidth measurements, modulation meter reading up to 50% with provision for external modulation, and internal modulation at 400 cycles.

The use of two output cables is a distinct innovation in this instrument. One of these cables, which is detachable, plugs into the 1 volt output jack and is equipped with a two terminal output box with a 30 ohm termination. This cable delivers a calibrated output as per meter reading of from 0.1 to 1.0 volt.

The second cable, permanently attached to the instrument, is for voltages up to 0.1 volt and includes a three terminal output box having a 30ohm termination resistor with a 3 ohm tap.

The first cable with the high voltage output and small output box is useful for stage gain measurements and the second cable with its 3 ohm output impedance may be used for measuring resonant rise or Q of tuned circuits or loops as well as receiver sensitivity.

## 22-D SPECIFICATIONS

**Frequency range:** 85 kilocycles to 40 megacycles in seven ranges.

**Dial System:** Each range has an individually hand calibrated scale. Additional slow motion dial for selectivity measurements, giving scale spread of 4 feet in each range.

**Accuracy of calibration:** Direct reading dial is accurate to 1%.

**Output voltage:** Continuously variable from 0.1 microvolt to 1 volt.

**Output system:** Large calibrated scale output meter giving direct reading from 0.1 to 1.0 volt and, through Ferris block type attenuator, multiplying ranges down to 10 microvolts full scale on high tap or 1 microvolt on low output tap. All outputs at end of 30 ohm terminated cables.

**Modulation:** Internal and external modulation continuously variable to 50% with modulating meter calibrated directly in percentage of modulation.

**General:** Special modulated oscillator circuit designed to give low frequency modulation. The stray fields have been reduced to a negligible magnitude by careful shielding and R.F. filters including extra line filters.

**Power supply:** The standard power supply furnished with this instrument is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Accessories:** Selectivity data for 600, 1000 and 1400 kilocycles.

**Dimensions:** Width 19¼ inches, Height 10½ inches, Depth 8 inches including controls.

**Net Weight:** 28 lbs.

**Shipping Weight:** 34 lbs., packed in 1 carton.





MODEL 18-B

**T**HE Model 18-B Microvolter is a compact, portable signal generator covering the important very high frequency portion of the radio spectrum, providing means for making accurate measurements of receiver sensitivity up to 150 megacycles.

It includes a specially designed oscillator and attenuator system to give proper operation at high frequencies, and an output coupling system of a type without which, reliable measurements at these frequencies are impossible. The output voltage of the microvolter appears not at the conventional place on the generator case, but at two binding posts located on a small box at the end of a three foot flexible cable. This permits inserting the voltage at the exact point desired, thus eliminating the large errors which are unavoidable with ordinary connecting lead arrangements. This is a feature originated and patented by Malcolm Ferris.

The flexible output cable is a true transmission line, properly terminated with resistors at both ends; its transmission loss is compensated for in the calibration so that the voltage appearing at its outer end is correct. Since without this line the voltage would be incorrect, it was made a permanent, non-removable part of the microvolter.

A rugged silver ribbon inductive potentiometer is the input to the attenuator. This arrangement provides a long-life control which holds its calibration and is very satisfactory for use in the very-high frequency region. The dials of the attenuation system are calibrated to be direct-reading in voltage over the range from 100,000 microvolts down to well below one microvolt.

The radio frequency oscillator uses a type 955 acorn tube, and the structure of same is carefully arranged to keep connections short so as to obtain proper operation at the high frequencies. Coil ranges are changed from the front panel, using the well-known Ferris drum type coil system, in which the coils rotate into position to contact the springs which connect them to the remainder of the circuit. The rotating drum contains three coils regularly supplied with the instrument, covering the range 20 to 100 megacycles. Space is provided

in the drum for a fourth coil, which can be either higher or lower in frequency than the standard coils.

#### 18-B Specifications

**Frequency range:** 20 to 100 megacycles in three coil ranges. Additional coils to cover the lower frequency range of 3.5 to 20 megacycles in four additional coils or an extra coil to extend the upper range to 150 megacycles may be secured. Coil drum in instrument has room for only four coils at any time. Extra drum with four mounted coils is available and may be quickly interchanged.

**Dial system:** Planetary drive type, calibrated for 270 degrees straight line frequency type tuning condenser. Separate calibration curve for each coil furnished in instruction book.

**Output voltage:** Continuously variable from a fraction of a microvolt to 100,000 microvolts.

**Output system:** Calibrated inductive potentiometer and step attenuator with Ferris type transmission line, output voltage appearing between two binding posts at the end of a 3 foot flexible 30 ohm cable attached permanently to the instrument.

**Modulation:** Internal 400 cycle audio oscillator adjusted for approximately 30% modulation. A switch is provided so that the modulation may be shut off when desired. On special order provision for external modulation may be secured.

**General:** The shielding and filtering of the microvolter is so complete that no difficulty will ordinarily be encountered with the most sensitive high frequency receivers.

**Power supply:** The standard power supply furnished with the Model 18-B is designed for 115 volt 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Dimensions:** Width 14 ½ inches, Height 10 ½ inches, Depth 8 inches including controls.

**Net Weight:** 16 lbs.

**Shipping Weight:** 22 lbs., packed in 1 carton.



MODEL 18-C MICROVOLTER

THE Model 18-C Microvolter is a compact, portable signal generator covering the important very high frequency portion of the radio spectrum, providing means for making accurate measurements of receiver sensitivity up to 175 megacycles.

It includes a specially designed oscillator and attenuator system to give proper operation at high frequencies, and an output coupling system of a type without which, reliable measurements at these frequencies are impossible. The output voltage of the microvolter appears not at the conventional place on the generator case, but at two binding posts located on a small box at the end of a three foot flexible cable. This permits inserting the voltage at the exact point desired, thus eliminating the large errors which are unavoidable with ordinary connecting lead arrangements. This is a feature originated and patented by Malcolm Ferris.

The flexible output cable is a true transmission line, properly terminated with resistors at both ends; its transmission loss is compensated for in the calibration so that the voltage appearing at its outer end is correct. Since without this line the voltage would be incorrect, it was made a permanent, non-removable part of the microvolter.

This instrument may also be obtained under special order with removable cable as shown in photograph of the 18-FS or large output box (see 18-D photo).

A rugged silver ribbon inductive potentiometer is the input to the attenuator. This arrangement provides a long-life control which holds its calibration and is very satisfactory for use in the very-high frequency region. The dials of the attenuation system are calibrated to be direct-reading in voltage over the range from 100,000 microvolts down to well below one microvolt.

The radio frequency oscillator uses a type 955 acorn tube, and the structure of same is carefully arranged to keep connections short so as to obtain proper operation at the high frequencies. Coil ranges are changed from the front panel, using the well-known Ferris drum type coil system, in which the coils rotate into position to contact the springs which connect them to the remainder of the circuit.

#### 18-C Specifications

**Frequency range:** 5 to 175 megacycles in seven self-contained bands as follows:

5 to	8.5 megacycles
8 to	15 megacycles
14 to	26 megacycles
25 to	42 megacycles
40 to	75 megacycles
70 to	130 megacycles
125 to	175 megacycles

**Dial system:** Planetary drive dial having a vernier ratio of 5 to 1. The dial is engraved in 150 divisions over 270 degrees.

**Output voltage:** Continuously variable from a fraction of a microvolt to 100,000 microvolts.

**Output system:** Calibrated silver ribbon inductive potentiometer and step attenuator with patented Ferris type transmission line, with voltage appearing between two binding posts at the end of a 3 foot flexible cable which is a permanent part of the instrument. A shielded high voltage output connection is provided for convenience, but no accuracy can be guaranteed at this position because the value of the output voltage will depend upon the means of coupling and load of the external circuit. The peak output voltage from this connection may reach as high as 2 volts.

**Modulation:** Internal 400 cycle and 1000 cycle modulation adjusted for approximately 30%. Provision for external modulation connection, requiring approximately 30 volts to modulate 30%. A fourth position is provided on the modulation selector switch for a pure carrier.

**General:** The shielding and filtering of the units of the microvolter is so complete that no difficulty will ordinarily be encountered in making sensitivity measurements on even the most sensitive very-high frequency receivers, and it will in most cases be impossible to detect leakage or stray voltages except by a very careful test with pick-up devices located quite close to the microvolter case.

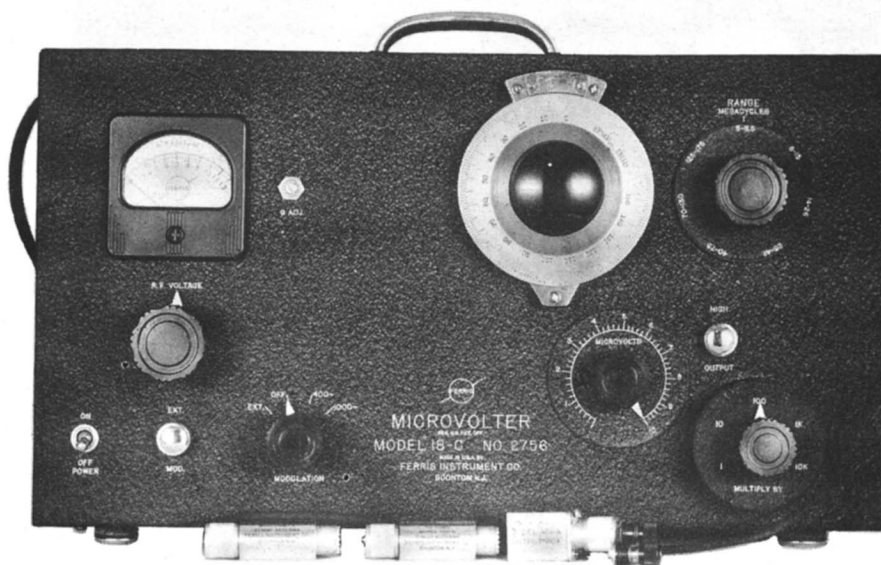
**Power supply:** The standard power supply of the VR 90 regulated type is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Accessories:** Mounted calibration chart, calibration curves for each coil range and instruction book.

**Dimensions:** Width 18 inches, Height 10½ inches, Depth 8 inches including controls.

**Net Weight:** 26 lbs.

**Shipping Weight:** 31 lbs., packed in one carton.



### MODEL 18-C MICROVOLT WITH A FERRIS 451-A OUTPUT BOX

THE Model 18-C Microvolter, shown in the above photograph, is equipped with the Ferris 451-A Coaxial Type Output Box which is available at a slight additional cost. This type of output box has the advantages that not only are the two binding posts shown in the photograph provided in the form of a removable adapter but also it permits easy insertion of various value coaxial type dummy antennas. Two of the Ferris Model 440-A Dummy Antennas are pictured above and were provided to permit the customer to raise the normal output impedance of the microvolter from 15 ohms to 52 or 95 ohms respectively.

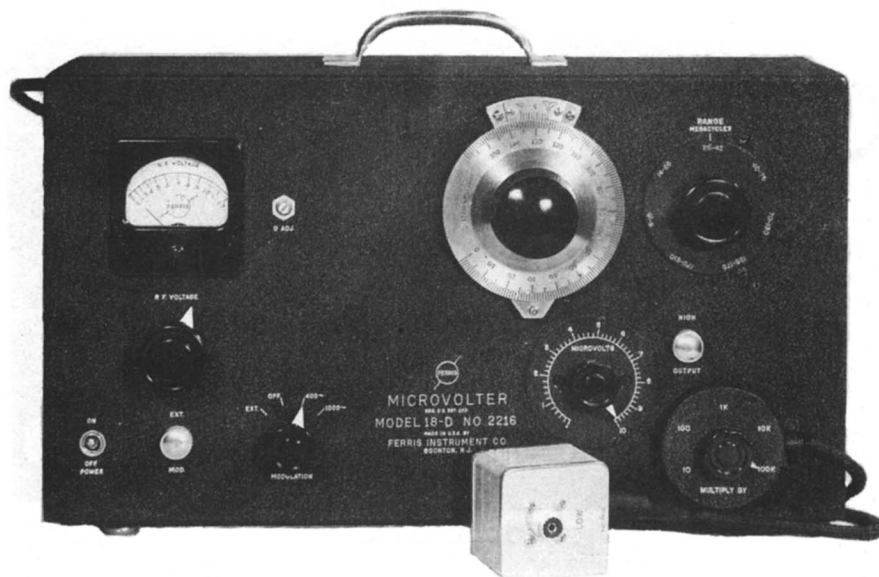
In other words, the two dummy antennas shown have internal resistance values of 37 and 80 ohms which,

when added to the internal resistance of the generator, match the instrument to either a 52 ohm or 95 ohm load.

Both the Model 451-A Output Box and Model 440-A Dummy Antennas are shown with standard type AN fittings but either or both may be obtained with type N or BNC connectors as specified.

The Model 451-A Output Box is available for use on any of the Ferris Standard Signal Generators equipped with an output cable as well as the Model 18-C shown in the photograph.

Correspondence is invited to provide the type of termination best suited for customer requirements,



MODEL 18-D MICROVOLT

THE Model 18-D Microvolter is similar to the Model 18-C described elsewhere in this catalog except it covers the frequency range from 8 to 210 megacycles.

Normally, this instrument is equipped with a standard two terminal output box as furnished with the 18-C, but at a slight additional cost, the coaxial type termination (shown in the photograph) may be obtained.

This coaxial termination has a low impedance output tap of three ohms in addition to the terminating resistance of thirty ohms. The low output tap delivers 10% of the voltage of the high output tap (on the reverse side of the box) but has the advantage of a very stiff voltage supply not easily upset by the application of ordinary external loads.

The coaxial termination (known as the Model 441 V.H.F. and U.H.F. Output Box) works out particularly well when used in conjunction with the Model 440-A Coaxial Type Dummy Antenna described elsewhere in this catalog.

With the exception of the frequency range of the Model 18-D Microvolter and the coaxial output termination (when specified) the other features are identical to the Model 18-C.

#### 18-D Specifications

**Frequency range:** 8 to 210 megacycles in seven self-contained bands as follows:

- 8 to 15 megacycles
- 14 to 26 megacycles
- 25 to 42 megacycles
- 40 to 42 megacycles
- 70 to 130 megacycles
- 125 to 175 megacycles
- 170 to 210 megacycles

**Dial system:** Planetary drive dial having a vernier ratio of 5 to 1. The dial is engraved in 150 divisions over

270 degrees.

**Output voltage:** Continuously variable from a fraction of a microvolt to 100,000 microvolts.

**Output system:** Calibrated silver ribbon inductive potentiometer and step attenuator with patented Ferris type transmission line, with voltage appearing between two binding posts at the end of a three foot flexible cable which is a permanent part of the instrument. A shielded high voltage output connection is provided for convenience, but no accuracy can be guaranteed at this position because the value of the output voltage will depend upon the means of coupling and load of the external circuit. The peak output voltage from this connection may reach as high as 2 volts.

**Modulation:** Internal 400 cycle and 1000 cycle modulation adjusted for approximately 30%. Provision for external modulation connection, requiring approximately 30 volts to modulate 30%. A fourth position is provided on the modulation selector switch for a pure carrier.

**General:** The shielding and filtering of the units of the microvolter is so complete that no difficulty will ordinarily be encountered in making sensitivity measurements on even the most sensitive very-high-frequency receivers, and it will in most cases be impossible to detect leakage or stray voltages except by a very careful test with pick-up devices located quite close to the microvolter case.

**Power supply:** The standard power supply of the AB-3 regulated type is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Accessories:** Mounted calibration chart, calibration curves for each coil range and instruction book.

**Dimensions:** Width 18 inches, Height 10½ inches, Depth 8 inches, including controls.

**Shipping Weight:** 31 lbs., packed in one carton.





## MODEL 18-FS

### MICROVOLT

THE Model 18-FS Microvolter closely resembles the Model 18-C except for the fact that the range is from 14 to 235 megacycles made possible by a change in the oscillator tube.

Normally the Model 18-FS is furnished with the standard 30 ohm terminated cable as shown on the Model 18-C but when so specified the type 83-1R receptacle may be obtained together with a detachable 30 ohm cable with termination.

It should be noted that a 30 ohm load, as supplied by this cable, is required for correct output. However, it is possible to apply a dummy antenna, similar to the 440-A Dummy Antenna shown in this catalog, but with a shunt as well as series resistor, to this receptacle and thereby build up the impedance of the generator to match any desired load.

This feature may also be applied to the Models 18-C and 18-D Microvolter and correspondence with our engineering department is invited regarding this feature.

At a slight additional cost the Model 18-FS may also be obtained with provision for applying external pulse modulation. This modification consists of providing a detachable input cable and switching means to transfer from regular sine wave modulation of 30% to 100% pulse modulation.

An external pulse generator capable of supplying approximately 10 milliamperes at 200 is required for pulse modulation. This external source replaces the normal plate supply to the 18-FS oscillator tube and for best results the external source should have as low an output impedance as practical to minimize the effect of capacity loading of the input cable and oscillator.

#### 18-FS Specifications

**Frequency range:** 14 to 235 megacycles in seven self-contained bands as follows:

14 to 26 megacycles	125 to 175 megacycles
25 to 42 megacycles	170 to 200 megacycles
40 to 75 megacycles	195 to 235 megacycles
70 to 130 megacycles	

**Dial system:** Planetary drive dial having a vernier ratio of 5 to 1. The dial is engraved in 150 divisions over 270 degrees.

**Output voltage:** Continuously variable from a fraction of a microvolt to 100,000 microvolts.

**Output system:** Calibrated silver ribbon inductive potentiometer and step attenuator with patented Ferris type transmission line, with voltage appearing between two binding posts at the end of a 3 ft. flexible cable which is a permanent part of the instrument. A shielded high voltage output connection is provided for convenience but no accuracy can be guaranteed at this position because the value of the output voltage will depend upon the means of coupling and load of the external circuit. The peak output voltage from this connection may reach as high as 2 volts.

**Modulation:** Internal 400 cycle and 1000 cycle modulation adjusted for approximately 30%. Provision for external modulation connection, requiring approximately 30 volts to modulate 30%. A fourth position is provided on the modulation selector switch for a pure carrier.

**General:** The shielding and filtering of the units of the microvolter is so complete that no difficulty will ordinarily be encountered in making sensitivity measurements on even the most sensitive very-high-frequency receivers, and it will in most cases be impossible to detect leakage or stray voltages except by a very careful test with pick-up devices located quite close to the microvolter case.

**Power supply:** The standard power supply of the OB-3 regulated type is designed for 115 volts, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Accessories:** Mounted calibration chart, calibration curves for each coil range and instruction book.

**Dimensions:** Width 18 inches, Height 10 1/2 inches, Depth 8 inches, including controls.

**Net Weight:** 26 lbs.

**Shipping Weight:** 31 lbs., packed in one carton.



MODEL 44-A

### MICROVOLT F.M. CONVERTER

FOR those who already own a Ferris Model 18-C, 18-D or 18-FS Microvolter the Model 44-A Converter offers a means of converting these instruments to meet the demands of frequency modulation economically.

Basically, the Model 44-A includes a fixed frequency F.M. oscillator multiplied to 180 megacycles where it is mixed with a variable frequency of from 55 to 175 mc from a Ferris Model 18 Microvolter producing a beat frequency of from 5 to 125 mc.

This beat frequency from the mixer is passed through a tuned circuit to an output meter and attenuator which delivers a "High" output to a 50 ohm type "N" receptacle. This output is attenuated by a step attenuator and the lower calibrated output appears at a second type "N" receptacle. The impedance of both "High" and "Low" output taps is established at 50 ohms and may be raised to any higher level by the use of a suitable dummy antenna such as the Ferris Model 440-A.

The local FM oscillator of the Model 44-A Converter may be internally modulated at 400 or 1,000 cycles up to 250 kc deviation and the amount of deviation is registered by a suitable modulation meter. Pre-emphasis may be introduced when desired and provision is made for external modulation.

As the two beating oscillators, that is, the local oscillator and the second oscillator, supplied by the external Model 18 Microvolter, are isolated from the output system there is no change in the frequency of the output as the level is varied. This results in an improvement in the performance characteristics of the Model 18 and this advantage will be appreciated either with or without modulation.

Curves are supplied indicating the correct setting of the National dial for various output frequencies. Additional curves show the difference frequency to which the Model 18 Microvolter should be adjusted to produce this output frequency. Charts are also furnished which provide calibration data at fixed intervals.

### 44-A Specifications

**Frequency range:** 5 to 125 mc in seven bands when used with proper signal source.

**Dial system:** Planetary drive dial having a vernier ratio of 5 to 1. The dial is engraved in 150 divisions over 270 degrees.

**Output voltage:** Continuously variable from a fraction of a microvolt to 100,000 microvolts.

**Output system:** Variable metered input to resistance type step attenuator with 50 ohm effective output impedance.

**Modulation:** Internal frequency modulation at 400 and 1000 cycles up to 250 kc deviation with provision for external modulation up to 10,000 cycles. Both internal and external modulation indicated by meter. Standard pre-emphasis may be switched in when desired.

**External generator:** This converter is made for use with a second signal generator or microvolter capable of supplying approximately 1 volt over the range of from 55 to 175 mc. Such signal may be obtained from the "High" output jack of a Ferris Model 18-C, 18-D or 18-FS Microvolter.

**Power supply:** The standard power supply of the N.R. regulated type is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Accessories:** Mounted calibration charts, calibration curves for each coil range and instruction book.

**Dimensions:** Width 22 inches, Height 13  $\frac{3}{4}$  inches, Depth, 10 inches.

**Net Weight:** 35 lbs.

**Shipping Weight:** 40 lbs., packed in one carton.



**THE FERRIS MODEL 44-B**  
**LOW FREQUENCY CONVERTER**

**Purpose:**

The Ferris Model 44-B low frequency converter is an accessory for use with any signal generator capable of supplying approximately one volt at frequencies from 100 to 150 kilocycles. This input signal is converted by the 44-B to an audio plus output ranging from approximately 20 cycles per second to 50 kilocycles.

The output covers from one microvolt to 10 volts and is continuously adjustable over this range by means of a step attenuator and calibrated output meter.

In addition to delivering this output range the Model 44-B may be used as a signal generator calibrator to identify 100 kc intervals up to approximately 10 mc. At frequencies below 1 mc 50 kc intervals are also apparent.

**Description:**

The Model 44-B includes a 100 kc crystal controlled oscillator, mixer, and two stage amplifier. Means are provided following the mixer to filter out the 100 kc component leaving the difference frequency between 100 kc and the input frequency. The dial calibration of the signal generator used with the 44-B provides an indication of the output frequency and the crystal oscillator in the 44-B gives an accurate check on the signal generator calibration.

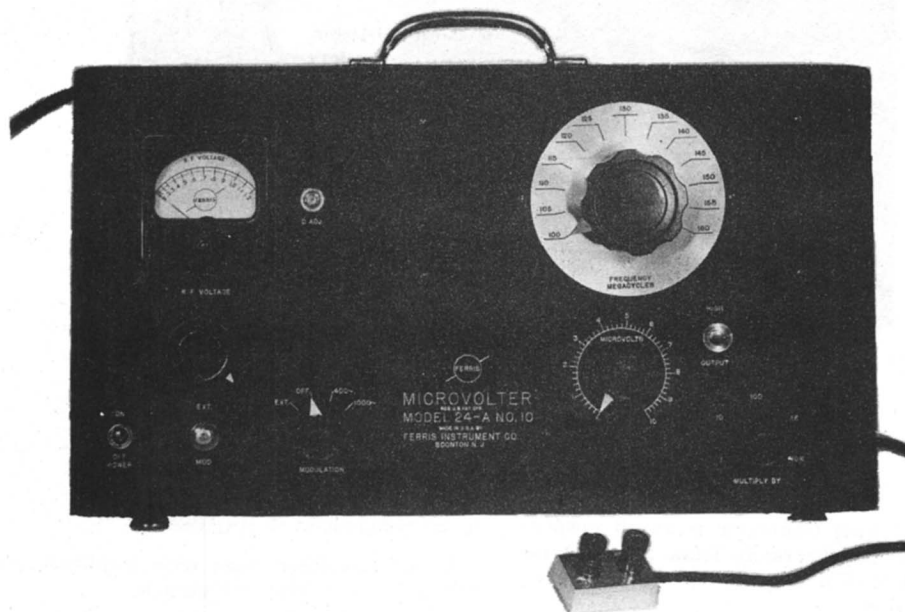
A switch is provided in the Model 44-B to shift from "Converter" to "Calibrator" operation. In the "Con-

verter" position the output of the 44-B connects to the output meter and attenuation system and a 100 kc filter is inserted in the crystal oscillator output.

In the "Calibrator" position the output of the 44-B connects to a head phone jack and the harmonics of the crystal oscillator are emphasized. The continuously variable output control is active in both the "Converter" and "Calibrator" position but the output meter and step attenuator only function in the "Converter" position.

The output impedance of the Model 44-B is approximately 20,000 ohms at the 10 volt position of the step attenuator, 2000 ohms at the 1 volt position and progressively reduces to only 10 ohms at the three lowest steps of the attenuator. With the exception of the second harmonic of the output frequency all other harmonics are less than 1%. Other spurious responses, chief of which is a tweet at 50 kc output, are below 5%. For distortion measurements of audio systems an external filter is recommended for use with the Model 44-B.

Although rated up to 50 k: the Model 44-B gives rated output up to approximately 60 kc and, in many instances, serves to extend the range of such instruments as the Ferris Model 16-C Signal Generator down to 20 cycles. The Model 44-B includes its own power supply and is normally designed to operate on a 50/60 cycle 115 volt supply. Special instruments for operation at the other supply voltages are available.



### MODEL 24-A

**T**HE Model 24-A Microvoltmeter was developed to meet the demand for a spot frequency signal generator at V.H.F. up to 160 megacycles.

This instrument not only meets the demand for a reliable production test instrument for V.H.F. receivers, but also can be employed to check band pass characteristics by a proper selection of frequencies on either side of the center.

Fifteen frequencies within the range of from 10 to 160 megacycles are available from this instrument. By the use of rigid coil construction and high shunt capacitors, very stable frequencies have been obtained without the use of crystal control.

Although confined to 30% audio frequency amplitude modulation, this instrument may be used to make sensitivity tests on new television receivers. Frequencies for the I.F. and allocated television channels may be secured if desired.

The instrument employs a 6J4 tube as a strong and stable oscillator capable of delivering ample power at low plate voltage. Provision is made by trimmers to adjust the frequency approximately plus or minus 2% of established values.

#### 24-A Specifications

**Frequency range:** The choice of 15 frequencies in the range of 10 to 160 megacycles, exact frequencies being specified by customer.

**Dial system:** Fifteen position rotatable control.

**Output voltage:** Continuously variable from 2 to 100,000 microvolts.

**Output system:** Calibrated silver ribbon inductive potentiometer and step attenuator. Output appears at end of 3 foot transmission line cable terminated in 30 ohms. High output connection available not calibrated.

**Modulation:** Internal 400 cycle and 1,000 cycle modulation adjusted for approximately 30% with provision for external modulation.

**General:** The shielding and filtering of the units in this microvoltmeter is so complete that no difficulty will ordinarily be encountered in making sensitivity measurements on even the most sensitive very high frequency receivers, and it will in most cases be impossible to detect leakage or stray voltages except by a very careful test with pick-up devices located quite close to the microvoltmeter case.

**Power supply:** The standard power supply of the regulated type is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Dimensions:** Width 18 inches, Height 10 1/2 inches, Depth 8 inches, including controls.

**Net Weight:** 22 lbs.

**Shipping Weight:** 30 lbs., packed in 1 carton.





**MODEL 24-B**

### **AM AND FM SIGNAL GENERATOR**

**T**HE Model 24-B Signal Generator is an all purpose instrument for use in the range from 5 to 220 mc with internal AM and FM modulation and provision for external modulation.

Primarily, the instrument is designed for production checking of FM and television receivers although it will also be found very useful in laboratory and service work.

Although it covers the entire range from 5 to 220 mc the RF amplifier is limited to seven spot frequencies in this range which are established by seven pairs of coils mounted in two easily removable coil drums thereby permitting additional spot frequencies if required.

Basically, the instrument consists of a fixed oscillator which may be frequency modulated when desired, followed by a doubler and a mixer tube.

At the mixer the signal is mixed with a variable oscillator which produces beat frequencies from 5 to 110 mc. The mixer output is tuned to any one of seven frequencies in this range by pretuned coils mounted on one of the coil drums previously mentioned. This is followed by an RF stage having seven similar coils on a second drum which, in turn, feed the output attenuator system.

The RF stage may be amplitude modulated up to 50% allowing both FM and AM simultaneously if desired.

In addition to the standard amplitude modulation of the final stage by plate modulation a video signal may be applied to the grid of this tube for pulse and picture work.

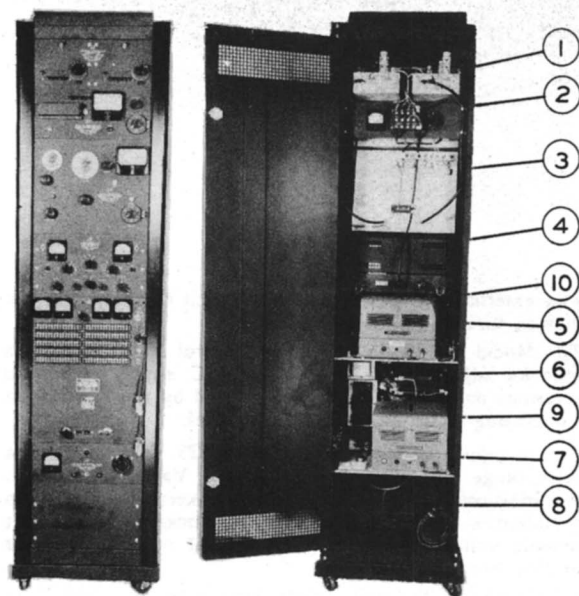
The modulation level is registered by a modulation meter which may be switched to either the AM or FM modulator. Continuously variable separate controls permit the establishment of any AM modulation level up to 50% and any FM deviation level from 0 to 250 kc.

#### **24-B Specifications**

1. Any seven spot frequencies in the range of 5 to 220 mc available.
2. Easily changed coil drums to provide seven addi-

tional frequencies if specified.

3. RF amplifier stage with amplitude plate modulation and video grid modulation.
4. Amplitude modulation from internal or external source to 50%.
5. Frequency modulation from internal or external source to 250 kc deviation.
6. Built-in video amplifier for external pulse or picture modulation.
7. Manual adjustment of frequency by main dial to plus or minus 2%.
8. Internal adjustment of frequencies in coil drums to plus or minus 10%.
9. Modulation meter registers both AM modulation and FM deviation.
10. Separate manual modulation controls for AM and FM.
11. Individual audio oscillators for internal AM and FM modulation.
12. Internal modulation at 400 and 1000 cycles with provision for external modulation.
13. Direct current on FM oscillator and modulator tube heaters to prevent hum modulation.
14. Output continuously variable from 0.1 microvolt to 1.1 volts.
15. Four inch output meter in conjunction with decade step attenuator.
16. Type "N" connectors for output and external modulation application.
17. 50 ohm output impedance plus coaxial dummy antenna.
18. Extra power supply filter plus exceptional shielding to prevent leakage.
19. Dimensions: 30" wide, 14" high, 10" deep.
20. Weight: 45 lbs. including built-in dual power supply.



REAR VIEW

#### FERRIS MODEL 45-D TEST ASSEMBLY

The Ferris Model 45-D Assembly is intended, primarily, for testing and calibrating radio receivers used in the aircraft "Instrument Landing System" (ILS). Typical receivers for this purpose include:

1. Localizer Receiver BC-733-D.
2. Glide Path Receivers R89/ARN-5, R89/ARN-5A and R89B/ARN-5.
3. Marker Receivers RC-193A and RC-193A2.

In addition, some provisions are made for meeting demands of future receivers of these general types.

#### General Description

The Model 45-D Assembly consists of a group of units mounted either on or in a cabinet rack. These units are described briefly under the above heading and later in detailed descriptions of individual units. A list of the various units included in the assembly follows:

1. Models 45-5A and 45-6A Crystal Controlled Oscillators combined in a single unit.
2. Model 45-9A Signal Generator Unit.
3. Model 45-1A R.F. Oscillator-Amplifier.
4. Model 45-2A Audio Modulator.
5. Model 45-11A Test Panel.
6. Model E-28-10 Nobatron Power Supply.
7. Model 45-10-A Line Voltage Control Panel.
8. Model 40-45U1 Power Supply Unit.
9. Riverbank 90 cycle Tuning Fork Unit.
10. Riverbank 150 cycle Tuning Fork Unit.

Continuing with the brief description of these units and their function, the Model 45-1A R.F. Oscillator-Amplifier consists of a final modulated R.F. amplifier stage, variable oscillator, vacuum tube diode voltmeter and attenuator system. Characteristics of this unit are:

1. Frequency range 75 mc to 150 mc.
2. Modulations from Model 45-2A source up to 95 percent.
3. Modulation capability from 30 to more than 11,000 cycles as described in detail in another section.
4. Output attenuator calibrated from less than 1 to 100,000 microvolts.
5. Provision for driving the final modulated amplifier from either the continuously variable oscillator, which is a part of this unit, or from crystal controlled oscillators, Models 45-5A and 45-6A.

6. The output of the Model 45-1A appears in a coaxial receptacle but, by means of dual dummy antennas (supplied), may be applied to a receiver having a 95 ohm dual balanced input.

The Model 45-2A unit supplies the audio power necessary to modulate the Models 45-1A and 45-9A R.F. Amplifiers. This audio unit also filters, amplifies and meters the output from the 90 and 150 cycle tuning fork oscillators and generates the output frequencies of 400, 1300 and 3000 cycles for modulation of the final R.F. amplifiers. External audio frequencies over the range from 30 to 11,000 cycles may be applied to this unit for the same purpose.

Any of the above frequencies are available individually or the 90 and 150 cycles simultaneously as well as individually. Provision is made for accurately determining the equality of the 90 and 150 cycles by a center point galvanometer and individually by a direct reading modulation meter.

A control is provided for simultaneously increasing the level of one frequency while decreasing the other so that either the 90 or 150 cycles will predominate by 1.5, 3, 4 or 6 db.

The Models 45-5A and 45-6A are crystal controlled oscillators including multiplying stages for energizing the final R.F. amplifier of the Model 45-1A unit. Unless otherwise specified, the 45-5A unit delivers the crystal controlled frequencies of 108.3 mc, 109.5 mc, 109.9 mc and 110.3 mc. The 45-6A unit delivers the single frequency of 75 mc, unless otherwise specified. The basic crystals supplied are of much lower frequency than the final output because of the frequency multiplying stages employed. (36 times for the 5A and 27 times for the 6A).

The Model 45-9A is a complete crystal controlled signal generator except for the plate power to the final R.F. amplifier which is supplied by the Model 45-2A Audio Modulator. Provision is made for four crystal controlled frequencies and, normally, three crystals are supplied with the unit resulting in output frequencies of 332.6 mc, 333.8 mc and 335.0 mc. Because of the multiplying stages in this unit the actual crystals are one sixty-fourth of the output frequencies.

Modulation up to 95 percent is supplied by the Model 45-2A unit and includes all audio frequencies mentioned in connection with this audio modulator.

Output is from less than 1 to 100,000 microvolts as indicated by output meter and step attenuator. Termination is in a coaxial fitting to which may be applied dual Model 440-C and 440-D Dummy Antennas (furnished) for supplying a receiver with a 95 ohm dual balanced input.

The Model 40-45U1 power supply unit furnishes plate voltage for the Models 45-1A, 45-2A, 45-5A and 45-6A units. These plate voltages are regulated and are normally adjusted to 100 and 250 volts at the power supply.

The Model 45-10A Test Panel is optional equipment and provides ready means for testing and calibrating the ILS receivers mentioned previously. The test panel includes meters for indicating the supply voltage of either 12 or 24 volts D.C. required to operate the receivers and various other meters and lights to indicate their performance.

Actually, in addition to the voltmeter indicating the magnitude of the supply voltage, there is a D.C. zero-center microammeter (to read crosspointer current) 150-0-150 ua. A third meter is for reading the A.V.C. current (0 to 10 milliamperes) and the fourth meter reads flag alarm current from 0 to 500 microamperes.

A multi-position switch is provided for selecting one of six localizer or glide path channels.

Three pilot lights having a purple, amber and white jewel are located in the top center of the test panel for indication of marker beacon receiver operation. These are in addition to the two pilot lights in the upper right hand corner of the test panel having red and green jewels for indicating either 24 or 12 volt operation respectively.

Five rows of terminals are supplied for applying cables required by the various receivers. Each row includes 30 terminals and the five rows are connected in parallel and wired in

accordance with the wiring diagram. Seven of the 30 terminals are spares to accommodate new facilities which may be developed.

A toggle switch for controlling marker beacon sensitivity and a headphone jack for testing audio signals from the receivers completes the test panel.

The Model E-28-10 Nobatron furnishes 24 volts D.C. for operation of 24 volt receivers through the test panel or functions as a battery charger for testing 12 volt receivers. Provision is made by a panel within the rack cabinet for switching the Nobatron from direct 24 volt connection to the test panel or to connection, through a limiting charging resistor, to the external 12 volt battery. This allows the battery to be charged while being used, in which event, it acts to regulate the 12 volt supply. For 24 volt operation no battery is required as, under these conditions, the Nobatron has its own regulator.

Actual output voltage of the Nobatron may be adjusted by a control on the front of the instrument and the resultant voltage indicated by the voltmeter on the test panel. Twelve volt operation should not be attempted without first connect-

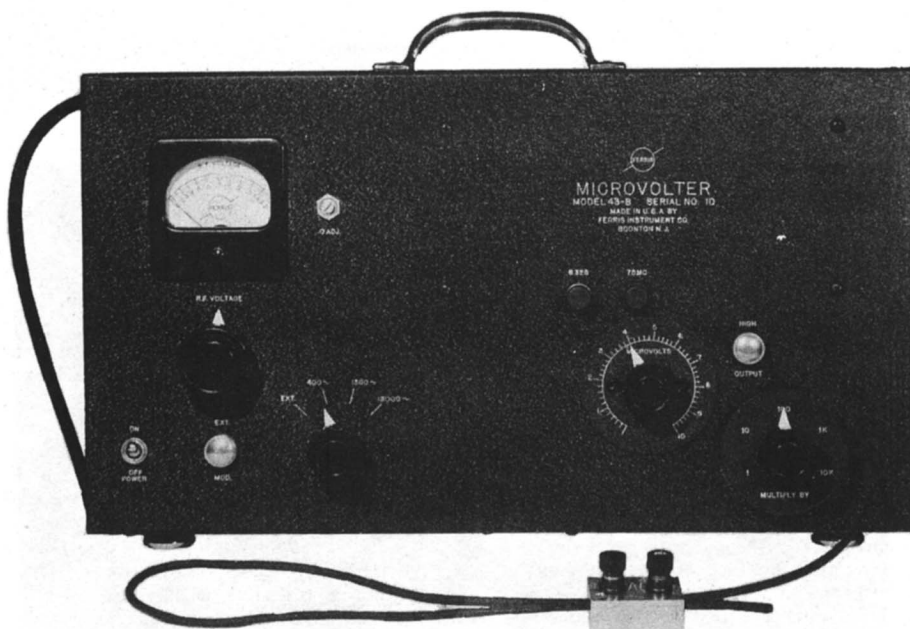
ing an external twelve volt battery to limit the output of the Nobatron through the charging resistor.

The Model 45-10A Line Voltage Control Panel includes a Variac for adjusting the value of the A.C. supply voltage to the various units to 115 volts as indicated by the red line on the indicating meter mounted on this panel.

Actual supply voltages from 105 to 125 volts or even a greater range are taken care of by this Variac adjustment. The variac controls all supply voltages except the supply to the Nobatron which has its own adjustment. Unlike most automatic voltage regulators, this manual regulator permits operation from 48 to 62 cycles.

In addition to the units which have been described there is included in the 45-D Assembly a grid current meter for indicating the activity of the crystals and multipliers in the Models 45-5A and 45-6A units. This meter is mounted on a panel inside the rack cabinet at the top of the assembly and means are provided on the panel for switching the meter to various points in the circuit.

This general description covers the main functions and features of the various units.



### THE FERRIS MODEL 43-B MICROVOLTER

**T**HE Model 43-B Microvolter is a special purpose instrument particularly suited for checking aircraft marker beacon receivers operating on 75 mc. The instrument delivers two crystal controlled frequencies, namely, 6.325 and 75 megacycles with internal modulation at 30% on three audio frequencies.

These modulating frequencies are 400, 1300 and 3000 cycles and provision is made for the application of an external modulating voltage. Modulation is applied to the R.F. amplifier stage and has no effect on the carrier frequency.

Two crystals are employed having fundamental frequencies of 6.325 and 3.125, respectively, the former being employed in an oscillator which feeds the modulated R. F. amplifier direct and the latter is multiplied in frequency 24 times before being applied to the amplifier.

An output of from one microvolt to 0.1 volt is obtained at the end of a three foot 30 ohm terminated

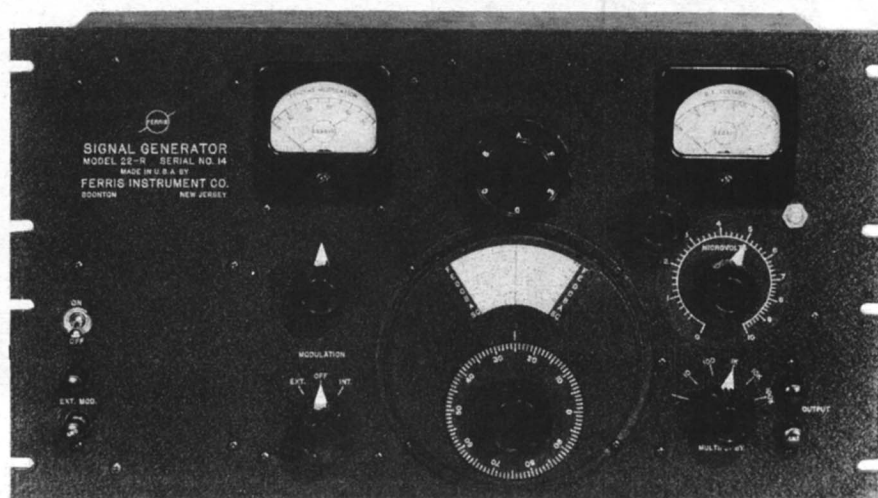
output cable. A shielded high voltage output connection is also provided for convenience, but this output connection is not calibrated and may reach as high as 2 volts depending upon connected loads.

The two carrier frequencies are selected by interlocked push buttons on the front of the instrument and are adjusted to exact frequency by screw driver adjustments accessible through the back of the instrument. These are normally set at the factory but can be compared with harmonics of W.W.V. at any time.

All units within the case are thoroughly shielded and leakage is kept down to a negligible amount and in most cases cannot be detected even with the most sensitive receivers.

The power supply is regulated and maintains practically constant voltage over the input range of from 105 to 130 volts, 60 cycles. Supplies for other frequencies may be obtained on special order.





### INSTRUMENTS FOR RACK MOUNTING

**M**ANY of the instruments shown in this catalog may be obtained with a front panel adapted for rack mounting. Typical of this construction is the Model 22-R, shown above, which is essentially a Model 22-A Signal Generator constructed for rack mountings.

The front panel is made of  $\frac{1}{8}$ " thick aluminum and the rear of the instrument is completely shielded by an aluminum case.

Panel measurement on the 22-R is 9" wide by 10  $\frac{1}{2}$ " high with mounting slots spaced 1  $\frac{3}{4}$ " and multiples thereof.

Practically any of the Model 22 Series are available with this rack mounting feature at only a slight increase in cost. The Model 18 Series, Model 20-A and 20-B and the Crystal Calibrators may also be obtained with this provision for rack mounting. Your inquiry invited.



**FERRIS MODEL 52-A**  
**U.H.F. STANDARD SIGNAL GENERATOR**

**T**HE Ferris Model 52-A Standard Signal Generator was designed to meet the demand for a suitable instrument for television development and testing in the U.H.F. range from 450 to 900 megacycles. In many respects it follows the pattern of lower frequency Ferris Signal Generators in method of operation and manipulation. Particular care has been taken in this instrument to minimize undesired frequency modulation and reaction of output controls on the high frequency. In addition, the output frequency is stabilized by a unique arrangement of line oscillator and the use of direct current for the heater supply of the oscillator tube.

This arrangement utilizes a basic oscillator operating at one half the output frequency feeding a dual tuned multiplier operating at the output frequency. The lower frequency oscillator provides improved stability and permits modulation of the tuned multiplier without frequency shift.

The maximum output of the 52-A is 0.1 volt at 30 ohms impedance and the lower levels from less than 1 microvolt to 10,000 microvolts are available at 15 ohms output impedance. Two dummy antennas are provided to raise the lower output impedance to either 50 ohms coaxial or 300 ohms dual.

Internal amplitude modulation up to 50% at 400 and 1000 cycles is included with provision for external modulation up to 10,000 cycles. Modulation percentages are read on a separate modulation meter.

The output system includes a four inch output meter with calibrated scale and a decade step attenuator. As

mentioned previously, the output impedance from 10,000 to 100,000 microvolts is 30 ohms and is taken from a separate output receptacle. Lower values are obtained from a second receptacle following the step attenuator which feeds a terminated output cable. Special compensation is used in the resistance type attenuator to preserve accuracy at the higher frequencies.

The power supply is built into the Model 52-A providing a compact self-contained instrument which may easily be transported.

#### Specifications

**Frequency range:** 450 to 900 megacycles

**Tuning System:** Resonant line oscillator.

**Dial System:** Lead screw vernier giving 40 to 1 ratio with respect to main dial.

**Output Voltage:** Continuously variable from 0.1 microvolt to 0.1 volt.

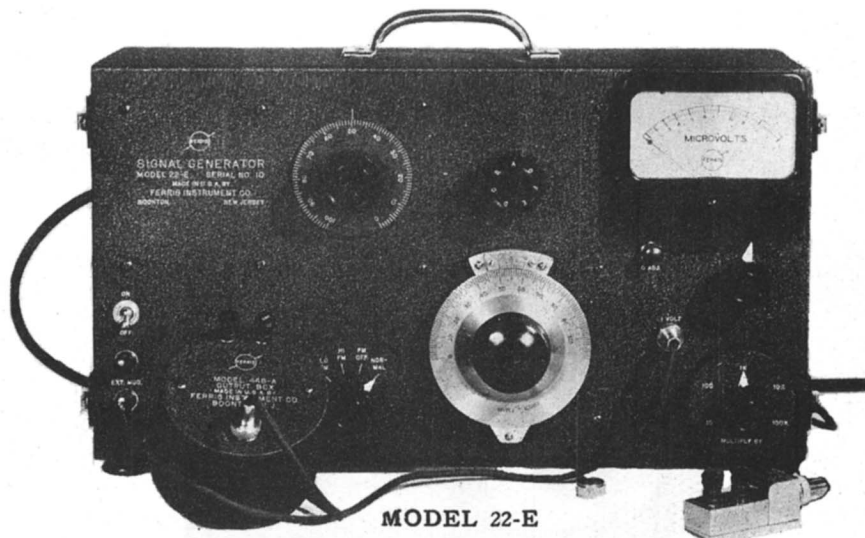
**Output System:** Dual output receptacles providing high output at 30 ohms impedance and up to 10,000 microvolts at 15 ohms.

**Modulation:** Amplitude modulation up to 50% at 400 and 1000 cycles with provision for external modulation to 10,000 cycles.

**Accessories:** Two output cables and two dummy antennas.

**Power Supply:** Built in 60 cycles, 115 volts, unless otherwise specified.

**Dimensions:** Width 12 inches, Height 16 inches, Depth 21 inches including controls.



**A**NOTHER feature, requested by the customer, is the removable box (Model 449-A) and isolation output box (Model 448-A) attached to the signal generator by a removable cable (Model FAW-50) with a plug either end.

These items may be used with many of the other signal generators such as the Models 16-C, 14-D, 22-A and 22-D.

The Model 449-A two terminal output includes a 30 ohm terminating resistor and may be used to replace the two terminal box ordinarily connected permanently to these instruments.

The removable feature makes it possible to substitute the Model 448-A isolation output box which includes a 4 mfd capacitor in addition to the 30 ohm terminating resistor to prevent damage to the signal generator or termination where it is liable to have line voltage applied as in testing ac-dc receivers and the like.

Many of these features may be incorporated in Ferris signal generators now in use. Your inquiry as to how

you may obtain greater use of instruments now in your possession is invited.

### SPECIAL PURPOSE INSTRUMENTS AND ACCESSORIES

**I**N addition to the standard line of instruments shown in this catalog Ferris is also always pleased to give consideration to customers' special requirements as typified by the Model 22-E Signal Generator shown above.

This particular special model is a low frequency F.M. generator equipped with such features as removable front cover to protect the front of the instrument when it is desired to carry the unit to various locations. Provision is made in the cover to store the instruction book and calibration charts, as shown.

This cover is a new feature and can be applied to the Models 22-A, 22-D or the Model 18 Series. The cover is held to the generator by four draw bolts and makes a neat carrying package as can be seen below.



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## CRYSTAL CALIBRATOR SECTION

**T**HE frequency calibration of those signal generators that are not crystal controlled is subject to some variation with temperature tubes, etc., although this effect may be minimized by proper design.

There is a need, in any laboratory engaged in extensive radio design, for more exact frequency standards than can readily be obtained with ordinary tuned circuits. This need may be met by crystal controlled secondary standards that can be adjusted to exact frequency by comparison with the signals transmitted by the Bureau of Standards Radio Station WWV.

These crystal controlled secondary standards are extensively employed in the calibration of Ferris Signal Generators and have been made available to provide means for checking and maintaining such calibration.

Harmonics of the crystal controlled oscillator in the calibrator provides a vast number of frequencies from a single crystal. Multivibrators subdivide the frequencies adding further to the number of frequencies available.

In the Ferris crystal calibrators described in this catalog three crystal controlled oscillators are provided which may be used individually or simultaneously, resulting in hundreds of established accurate frequencies.

Means are provided in the calibrators to mix or beat the locally generated frequencies against an external signal and the resultant audio beat note is amplified by a built-in audio amplifier so it may be heard in pair of headphones.

The internally generated r.f. voltages from the crystal controlled oscillators are available across the terminals on the front panel for the operation of some external device as well as for heterodyning with any other r.f. voltage applied. The instrument can therefore be used for calibrating directly any receiver designed for C.W. reception.

When employed at V.H.F. or U.H.F. the response of the instrument to the higher harmonics may be extended considerably by the use of external resonant lines or tuned circuits at the input terminals.





**MODEL 33-A**

**T**HE Ferris Model 33-A Calibrator is a small, portable, line-operated unit which supplies hundreds of standard frequencies covering the entire useful radio frequency range. The standard frequencies are the fundamental and harmonic output of the stabilized crystal-controlled oscillators, and each is accurate to within 0.01 per cent, a degree of accuracy which makes the instrument useful for all ordinary laboratory and production checking and calibrating purposes.

It is intended primarily for the checking and calibration of all types of laboratory oscillators, signal generators, microvolts, Q-Meters, bridge drivers, etc., and has been designed to afford the greatest possible speed and convenience of operation when used with such sources of r.f. voltage. No additional equipment other than a pair of headphones is needed and the light weight and portability adapt it to many laboratory uses for which a larger, precision frequency standard would be unsatisfactory.

The standard frequencies are generated by three crystal-controlled oscillators having fundamentals of 100, 1,000 and 10,000 kilocycles per second. The harmonics are in general useful up to about the 30th or 40th, while under some conditions they can be used up to the 100th or even the 200th. In addition to the oscillators, with their rather widely spaced points, there is a multivibrator circuit by means of which the frequency intervals can be still further subdivided, down to 10 kc or even 5 kc intervals. The multivibrator is controlled (locked) by the 100 kc oscillator, and is set to give a fundamental frequency of 50, 25, 20 or 10 kc selected by means of a panel switch. The harmonics of the multivibrator are in general useful up to about 3,000 kc, and in some cases can be detected and used up as far as 20,000 kc.

The hundreds of standard frequencies thus generated appear at the terminals which are located on the panel of the Calibrator and are available either for the opera-

tion of some external device such as a receiver, or for beating (heterodyning) with any other r.f. voltage impressed on the terminals by an external source such as a signal generator. For the detection of these beats there is provided a self-contained detector and two-stage audio amplifier, the detector input also being bridged across the panel terminals of the Calibrator. The beats between the external voltage and the internal standards will be audible in headphones connected to the output of the audio amplifier, which is connected to a headphone jack located on the front panel of the Calibrator. A gain control is provided for the adjustment of the audio level in the phones.

### 33-A Specifications

**Fundamental Crystal Frequencies:** 100, 1,000 and 10,000 kc.

**Harmonics of 10 mc. Crystal:** Up to 20th approximately.

**Harmonics of 1 mc. Crystal:** Up to 50th approximately.  
**Harmonics of 100 kc. Crystal:** Up to 100th approximately.

**Multivibrator Frequencies:** 10, 20, 25 and 50 kc.

**Harmonics of Multivibrator:** Up to 3,000 kc. approximately.

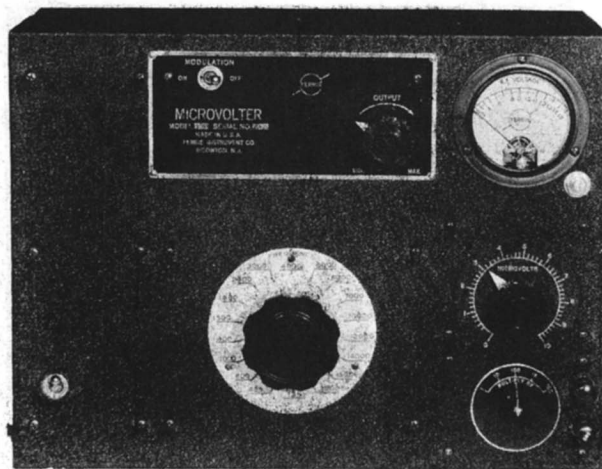
**R.F. Input Voltage Required:** Approximately 0.1 volt.

**Power Supply:** The standard power supply furnished with this instrument is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Dimensions:** Width 12¾ inches, Height 10½ inches, Depth 7½ inches, including controls.

**Net. Weight** 16 lbs.

**Shipping Weight:** 21 lbs., packed in 1 carton.



### MODEL 20-A-1

**T**HIS type Microvolter is an inexpensive and simplified instrument designed for operation by the average factory personnel for testing radio receivers in the production line.

Instead of the usual coil-switch and variable condenser, eighteen fixed frequencies are provided, any one of which can be chosen by means of the selector switch on the front panel. This arrangement greatly speeds up testing as no calibration or curves are needed and only one motion is necessary to set to any desired frequency. The choice of eighteen frequencies within the range 150 to 20,000 kilocycles can be supplied.

An unusual circuit arrangement, employing a master oscillator with an untuned amplifier, is used to make this feature possible without undue complication.

Means are provided to allow the change of the original specified frequencies by plus or minus 2%.

When ordering instruments of this type be sure to specify frequencies required. Eighteen frequencies must be in range of 150 to 20,000 kilocycles.

#### 20-A-1 Specifications

**Frequency range:** The choice of 18 frequencies in the

range of 150 to 20,000 kilocycles, exact frequencies being specified by customer.

**Dial system:** Eighteen position continuously rotatable control.

**Output voltage:** Continuously variable from .2 microvolt to 100,000 microvolts.

**Output system:** Calibrated potentiometer and step attenuator. Maximum output appears across resistance of 100 ohms.

**Modulation:** Internal 400 cycle audio oscillator. On special order 1000 cycles modulation and provision for external modulation may be secured.

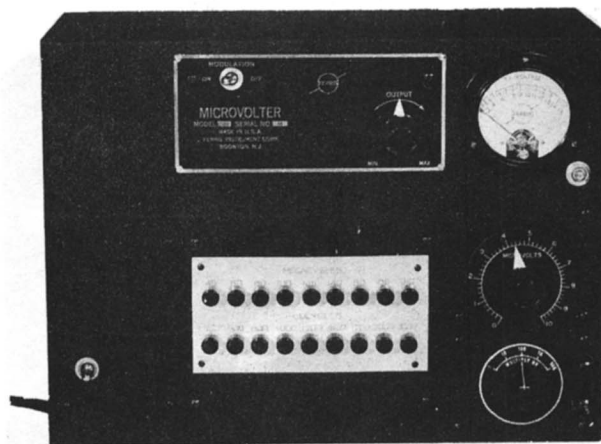
**General:** By careful shielding and r.f. filters, the stray fields have been reduced to a negligible magnitude.

**Power supply:** The standard power supply furnished is designed for 115 volt 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Dimensions:** Width 14 inches, Height 10 ½ inches.  
Depth 7 ½ inches, including controls.

**Net Weight** 20 lbs.

**Shipping Weight:** 26 lbs., packed in 1 carton.



### MODEL 20-B

**T**HE Model 20-B Microvolter is similar to the Model 20-A-1 except that push buttons are used to select any one of the eighteen fixed frequencies supplied with this instrument.

As in the case of the 20-A-1, the eighteen frequencies must be within the range of from 150 to 20,000 kilocycles.

The Model 20-B with its push button type of selector switch has the feature that any frequency may be selected without going through the sequence established with a rotary switch as used in the Model 20-A-1.

The eighteen frequencies may be varied plus or minus 2% by means of trimmer adjustments accessible from the rear of the instrument. These adjustments are clearly indicated by a card within the instrument which may be transferred to the outside of the case when desired.

#### 20-B Specifications

**Frequency range:** The choice of 18 frequencies in the range of 150 to 20,000 kilocycles, exact frequencies being specified by customer.

**Dial system:** Any one of 18 frequencies are selected by

a system of interlocked push buttons releasing all but the button depressed.

**Output voltage:** Continuously variable from .2 microvolt to 100,000 microvolts.

**Output system:** Calibrated potentiometer and step attenuator. Maximum output appears across resistance of 100 ohms.

**Modulation:** Internal 400 cycle audio oscillator. On special order 1000 cycles modulation and provision for external modulation, may be secured.

**General:** By careful shielding and r.f. filters, the stray fields have been reduced to a negligible magnitude.

**Power supply:** The standard power supply furnished is designed for 115 volt 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Dimensions:** Width 14 inches, Height 10 ½ inches, Depth 7 ½ inches including controls.

**Net Weight:** 20 lbs.

**Shipping Weight:** 26 lbs., packed in one carton.



### THE FERRIS MODEL 67-A PICK UP LOOP TUNER AND AMPLIFIER

**General:** In response to many requests the Ferris Instrument Company has developed a loop accessory for field strength measurements. Although primarily designed for use with the Ferris Model 32 Radio Noise and Field Strength Meters this loop tuner is not confined to such use and may be employed with any suitable receiver covering the frequency range of from 150 to 350 kc. and 550 to 20,000 kc.

**Description:** Briefly, the FERRIS MODEL 67-A PICK UP LOOP TUNER AND AMPLIFIER consists of a tapped eight turn loop approximately eight inches in diameter and completely shielded against electrostatic pickup. Taps are provided to permit the use of either one or four turns in addition to the eight turns employed at the lower frequencies. The loop is tuned to the desired frequency by means of a variable capacitor in conjunction with proper loading coils for the desired range. Actually, five ranges are provided as tabulated below:

Range	Frequency	Loop Turns
X	150— 350 kc	8
A	550— 1,550 kc	8
B	1,550— 4,000 kc	4
C	4,000—10,000 kc	1
D	10,000—20,000 kc	1

A three ohm resistor is placed in series with the loop across which a local signal from a suitable generator may be impressed to equal the signal picked up. The three ohm resistor is part of a 10 to 1 step down attenuator built into the loop base. A signal generator, such as the Ferris Model 22-D, having a three ohm output tap is recommended for use in conjunction with this loop tuner.

The loop tuner also includes a low output impedance triode amplifier requiring an external source of 6 volts and 135 volts for excitation. This source may be obtained from a 6 volt battery and vibrator supply, Ferris Model 32-U2, for portable use, or a 110 volt power supply unit, such as the Ferris Model 32-U1, where line voltage is available. A slight modification of these

power supply units is required for use with the loop tuner.

In actual operation, the Model 67-A Loop Tuner is tuned to the desired signal frequency in combination with the Model 32 or other suitable receiver. The loop is rotated for maximum signal pick up and the output meter reading noted. Rotate the loop for minimum pick up and introduce a signal from a local signal generator to give equivalent output reading. The signal generator output level reading is then multiplied by a factor taken from the curves supplied with the instrument to give the true field strength. The multiplying factor is based upon the effective height of the loop at the particular frequency being used.

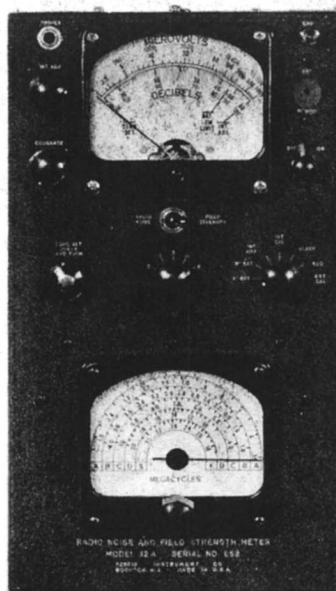
Briefly this instrument has increased sensitivity made possible by an additional tube and includes a five microvolt full scale position plus the 1,000 and 100,000 microvolt full scale positions in the Model 32-A. On the five microvolt scale the automatic volume control action has been eliminated although on the other two positions the a.v.c. is retained to preserve logarithmic scales.

Also simultaneous audio reception with noise reading has been provided by using a separate diode for audio and noise respectively.

Calibration of the instrument in the field is maintained by the use of an internal shot noise generator for which curves are supplied. This form of calibration is only approximate but is usually sufficiently accurate for all practical purposes. For greater accuracy particularly on the five microvolt scale a signal generator such as the Ferris Model 22-A is recommended for calibration purposes.

Because of the fact that the life of the small battery pack supplied with the 32-A is comparatively short, the Model 32-B is furnished with the large battery pack (32BP2) having longer life, as standard equipment. The smaller light weight pack (32BP1) may be obtained on special request.





**MODEL 32-A**

**T**HE first compact, portable and accurate instrument of its kind. Universally applicable in field, laboratory and shop for measurements of carrier voltages and fields, noise voltages and fields, signal to noise ratio, voltages on lines and conductors, antenna field patterns, noise output and acceptance rating of electrical appliances, filter characteristics, localization of noise sources and interference reduction means.

The Model 32-A provides means for measuring quickly and accurately all kinds of radio interference fields. Among possible sources of such interference are ignition systems of automobiles, airplanes, and other gas engine equipment, sparking at the commutator of electric motors, oil burner ignition systems, defective power transformers and leakage from power lines to ground due to defective insulation.

It may also be used for localizing the source of radio noise, for determining the presence of standing waves on power lines, and for measuring the ratio of desired radio signal strength to unwanted noise voltage.

The Model 32-A provides a convenient, portable instrument for radio field surveys when the extreme accuracy of the larger, more expensive field strength measuring equipment is not required.

The Model 32-A has been designed to be light in weight yet rugged, for portability. It is equally at home in the field, shop, or on the laboratory bench. Operates in any position from a wide variety of power supplies.

This microvolter is the first really practical instrument of its kind, bringing to the field of radio micro-voltage measurement a new conception of compactness, convenience and versatility, in a finely designed and finished instrument. It has been engineered to give the greatest accuracy possible in a light portable design, and combines ease and rapidity of operation with complete adaptability to a wide variety of measurements. The design of the instrument is such as to make possible its use with very little more trouble than is experienced when using an ordinary indicating meter.

The unique operating convenience of this instrument

is obtained by the use of direct-reading scales throughout. The tuning dial is graduated in megacycles, while the output meter scale gives directly in microvolts the value of the voltage applied to the input.

The input of the Model 32-A will fall into two general classes. In the first, the instrument is considered merely as the two-terminal voltmeter that it actually is, and is used as such to measure voltages existing between any two points. These two points may be the two sides of a line, line to ground, a machine frame to ground, etc.

The second class of measurement is the determination of field intensities, either of noise or of c.w. carrier. For this use an antenna of known effective height is plugged into the antenna jack of the Noise Meter, the instrument case providing the counterpoise.

### 32-A Specifications

**Frequency range:** 150 to 350 kc. and 550 to 20,000 kc. in five bands.

**Voltage range:** 1 to 100,000 microvolts.

**Field Intensity range.** With standard antenna, 2 to 200,000 microvolts.

**Standard Time Constants:** Charge 10 milliseconds, discharge 600 milliseconds.

**Sensitivity:** 1 to 1,000 microvolts and 100 to 100,000 microvolts in two ranges.

**Calibrating Source:** Internal shot noise diode.

**Power Supply:** Normally supplied with small 32-BP1 dry battery pack. Large battery pack, A.C. power pack, and vibrator packs available.

**Accessories:** Supplied with 41 inch telescoping rod antenna having one-half meter effective height. All other accessories including 32-XA2 Dummy Antenna and 32-XA6 Hand Exploring Prod additional.

**Dimensions:** Width 7 inches, Height 13¼ inches. Depth 12 inches, including cover.

**Net Weight:** 22 lbs.

**Shipping Weight:** 28 lbs., packed in 1 carton



#### MODEL 34-A

**T**HIS is a small portable secondary frequency standard suitable for laboratory and production checking and calibrating.

It contains three crystal-controlled oscillators having fundamental frequencies of 1 megacycle, 5 megacycles and 10 megacycles; all being capable of being adjusted to exact frequency. The harmonics of these oscillators are useful as frequencies well over 500 megacycles. At 500 megacycles every one megacycle point may be easily identified and at lower frequencies the 500 kilocycles points may be heard.

The families of standard frequencies generated by the oscillators of the Calibrator all appear at the two binding posts located on the left hand edge of the front panel. They may be fed to any external device, such as a radio receiver, and they are also available for beating (heterodyning) with any other source of radio frequency voltage which may be connected to these terminals. The Calibrator is provided with a self-contained detector and two stage audio amplifier, whose input is also bridged across the Calibrator external terminals, for the detection of any such beats. The output of the audio amplifier is connected to a phone jack.

The crystal oscillators may be tuned to exact frequency by means of coarse adjustments which may be reached with a screwdriver through holes in the back cover, and fine adjustments

located on the front panel.

These adjustments make it possible to set the frequency while beating the crystals against a radio receiver tuned to receive the Bureau of Standards radio station WWV.

The power supply has a OD-3 tube for the regulation of the B voltage and is normally furnished for operation on 115 volts, 60 cycles. Other voltages and frequencies can be furnished on special order.

#### 34-A Specifications

**Fundamental Crystal Frequencies:** 1, 5 and 10 mc.

**Harmonics of 10 mc. Crystal:** Up to 500 mc., approximately.

**Harmonics of 5 mc. Crystal:** Up to 500 mc. approximately.

**Harmonics of 1 mc. Crystal:** Up to 500 mc. approximately.

**R.F. Input Voltage Required:** 0.1 to 1.0 Volt.

**Power Supply:** The standard power supply furnished with this instrument is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Dimensions:** Width 14½ inches, Height 10½ inches, Depth 7½ inches, including controls.

**Net Weight:** 16 lbs.

**Shipping Weight:** 21 lbs., packed in 1 carton.

## RADIO NOISE METER SECTION

THE measurement of radio noise interference is of considerable importance to the radio industry. Standards for the performance of radio noise meters have been established both here and abroad and instruments for this purpose are manufactured with due regard to such standards.

Radio noise may radiate as radio waves, exist in the form of induction fields, or be conducted along wires or other structures. Noise meters as described in this catalog have rod antennas for intercepting the radio waves, small loops or prods for exploring the induction fields, and dummy antenna adapters for measurement of conducted noise voltages.

The radio noise meter is essentially a sensitive radio receiver provided with a meter for indicating the output of the receiver and means for definitely establishing its sensitivity.

The smaller type portable instruments operate from either dry battery packs or interchangeable power packs either A.C. or storage battery supplied. These portable instruments employ a so-called shot noise generator for establishing proper sensitivity and the output meter reads directly in microvolts impressed on the input terminals.

In addition to radio noise measurements, field strengths of broadcasting stations and other radio signals within the frequency range of the instrument may be determined by the radio noise meter. For this reason the instruments are called Radio Noise and Field Strength Meters. Switching means provided on the front of the instrument change the time constant associated with the meter indicating circuit when used for radio noise or field strength.

When employed for field strength measurement the instrument indicates the average value and is independent of modulation. In the radio noise position, however, indications approach the peak or quasi peak value de-

pending upon the character of the noise.

Means are provided within the instruments for extending the range by fixed attenuation steps at the head of the receiver. Additional attenuation steps may be obtained by the use of multipliers plugged into the unit as an accessory.

A list of various accessories which are available to extend the usefulness of Ferris Noise Meters is given elsewhere in this catalog together with an explanation of their purpose.

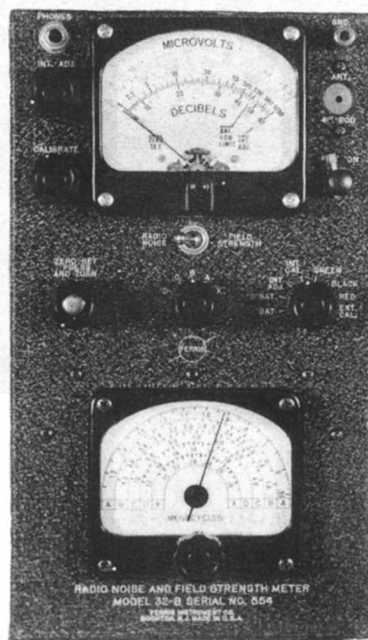
Noise Meters are calibrated with a standard signal generator and in the case of the Models 32-A and 32-B, this calibration is given in the form of curves for each instrument.

Normally, this calibration will hold over a period of several months providing the batteries are maintained at proper operating voltage. A new calibration is advisable about every six months, however, to compensate for tube and other changes.

This recalibration may be done with a standard signal generator such as the Ferris Model 22-A, using a dummy antenna. The bias batteries in the instrument should be replaced before calibration.

Ferris maintains a calibration service for those who do not wish to make their own calibration. This service includes a thorough check of the instrument as well as new calibration curves and prompt return of the instrument is assured.

As new methods of measuring radio noise are evolved often times additional features are required in the instruments. In so far as is possible, it is the Ferris policy to incorporate such change in existing instruments in the field in order that the owner of a Ferris instrument will obtain the greatest service and satisfaction from his investment.



**MODEL 32-B**

**T**HE Model 32-B Radio Noise and Field Strength Meter is similar to the Model 32-A with several additional features.

Briefly this instrument has increased sensitivity, made possible by an additional tube and includes a five microvolt full scale position plus the 1,000 and 100,000 microvolt full scale positions in the Model 32-A. On the five microvolt scale the automatic volume control action has been eliminated although on the other two positions the a.v.c. is retained to preserve logarithmic scales.

Also simultaneous audio reception with noise reading has been provided by using a separate diode for audio and noise respectively.

Calibration of the instrument in the field is maintained by the use of an internal shot noise generator for which curves are supplied. This form of calibration is only approximate but is usually sufficiently accurate for all practical purposes. For greater accuracy particularly on the five microvolt scale a signal generator such as the Ferris Model 22-A is recommended for calibration purposes.

Because of the fact that the life of the small battery pack supplied with the 32-A is comparatively short, the Model 32-B is furnished with the large battery pack (32BP2) having longer life, as standard equipment. The smaller light weight pack (32BP1) may be obtained on special request.

#### **32-B Specifications**

**Frequency range:** 150 to 350 kc. and 550 to 20,000 kc. in five bands.

**Voltage range:** 0.5 to 100,000 microvolts.

**Field Intensity range:** With standard antenna, 1 to 200,000 microvolts.

**Standard Time Constants:** Charge 10 milliseconds, discharge 600 milliseconds.

**Sensitivity:** 0.5 to 5 microvolts, 1 to 1,000 microvolts and 100 to 100,000 microvolts in three ranges.

**Calibrating source:** Internal shot noise diode.

**Power supply:** Normally supplied with large 32-BP2 dry battery pack. Smaller pack A.C. power pack, or vibrator packs available.

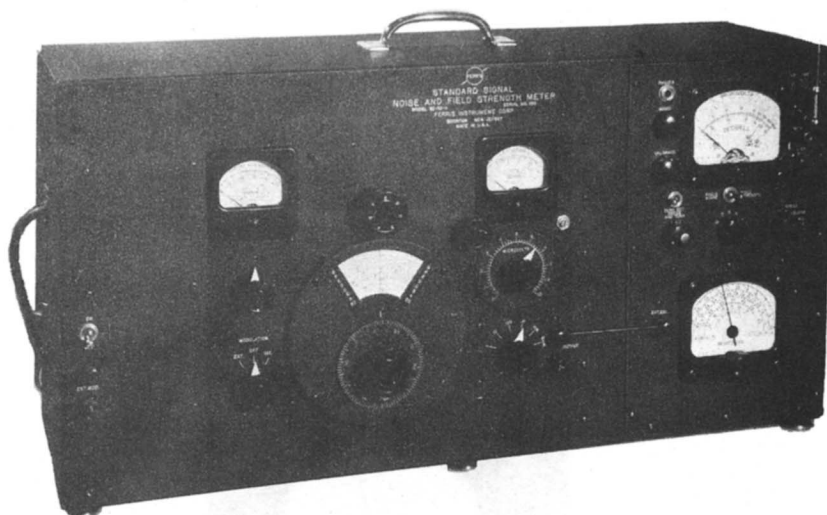
**Accessories:** Supplied with 41 inch telescoping rod antenna having one-half meter effective height. All other accessories, including 32-XA2 Dummy Antenna and 32-XA6 Hand Loop Exploring Prod, additional.

**Dimensions:** Width 7 inches, Height 13¼ inches, Depth 14½ inches, including cover.

**Net Weight:** 32 lbs.

**Shipping Weight:** 38 lbs, packed in 1 carton.





### MODEL 22-32-B

THE Ferris Model 22-32-B Standard Signal Noise and Field Strength Meter is, as the name implies, a combination of the 22-A Standard Signal Generator and the Model 32-B Radio Noise and Field Strength Meter, modified. The instrument operates from 115 volts, 60 cycles and is recommended where extreme portability is not of paramount importance.

This combination of the 22-A and 32-B provides an instrument covering the range from 150 to 350 and 550 to 20,000 kilocycles and is known as the Model 22-32-B Standard Signal Noise and Field Strength Meter.

The sensitivity of the 22-32-B is such that full scale deflection of the meter may be obtained on a signal strength of five microvolts. The meter is provided with three scales having ranges of 0-5, 0-1,000, and 0-100,000 microvolts. A built in dummy antenna makes a direct reading of line noise possible without the use of an accessory and of course the signal generator is available for calibration of the instrument at all times which may be done much more easily and quickly than heretofore.

The meter may be switched to give readings under three conditions, namely:

1. For measurement of Field Strength in the second detector diode circuit.
2. For measurement of Radio Noise in the second detector diode circuit with a 10/600 time constant.
3. For measurement of audio response at the output of a built-in power out-put tube as employed in the conventional radio receiver.

When employed as a Field Strength Meter the Signal Generator may be made to beat with the incoming signal thereby establishing exact frequency as well as intensity.

Output terminals from the Standard Signal Generator are brought out on the front panel so the Signal Generator alone may be used for other types of measurement work such as receiver sensitivity, etc.

### 22-32-B Specifications

#### Noise Meter Section

**Frequency range:** 150 to 350 kc. and 550 to 20,000 kc. in five bands.

**Voltage range:** 0.5 to 100,000 microvolts.

**Field Intensity range:** With standard antenna, 1 to 200,000 microvolts.

**Standard Time Constants:** Charge 10 milliseconds, discharge 600 milliseconds.

**Sensitivity:** 0.5 to 5 microvolts, 1 to 1,000 microvolts and 100 to 100,000 microvolts in three ranges.

**Calibrating source:** Associated 22-A Signal Generator.  
**Power supply:** The standard power supply furnished with this instrument is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

#### Signal Generator Section

**Frequency range:** 85 kc. to 25 mc. covered in six self-contained ranges.

**Dial system:** Each range has an individually hand-calibrated scale. Additional slow motion dial for selectivity measurements, giving scale spread of 4 feet in each range.

**Accuracy of calibration:** Direct reading dial is accurate to plus or minus 1%.

**Output voltage:** Continuously variable from .2 microvolt to 1 volt.

**Output system:** Calibrated potentiometer and step attenuator.

**Modulation:** Internal 400 cycle and external to 10 kc. continuously variable to 50% with direct reading modulation meter.

**Power supply:** As above

**Dimensions:** Width 28 inches, Height 14½ inches.

Depth 9½ inches, including controls.

**Net Weight:** 47 lbs.

**Shipping Weight:** 126 lbs., packed in 1 wooden case.



## RADIO NOISE and FIELD STRENGTH METERS

### FERRIS MODELS 64-AB and 64-BC

THE Ferris Models 64-AB and 64-BC Radio Noise and Field Strength Meters have been designed to conform with tentative standards set up by a Joint Coordination Committee EEI NEMA and RMA and by the American Standards Association in the early part of 1950.

The Model 64-AB covers from 15 kc. to 2000 kc. and the 64-BC from 150 kc. to 25 mc. Both instruments have double intermediate frequencies thereby permitting continuous coverage over their respective ranges. They have all the features of the widely used Ferris Models 32-A and 32-B Radio Noise and Field Strength Meters plus several additions which widen the scope of radio noise measurements.

These additions to the new Ferris instruments include some features not required by the new tentative standards but which help in improving and maintaining the accuracy of the instruments. For example, means are included for adjusting the "A" and "B" voltages to a fixed value as indicated by a separate meter on the instrument panel. This insures uniform performance over the entire life of the batteries with constant surveillance of the battery voltage of either "A" or "B" supply while making measurements.

A built-in dummy antenna obviates the need for an accessory when making conducted voltage measure-

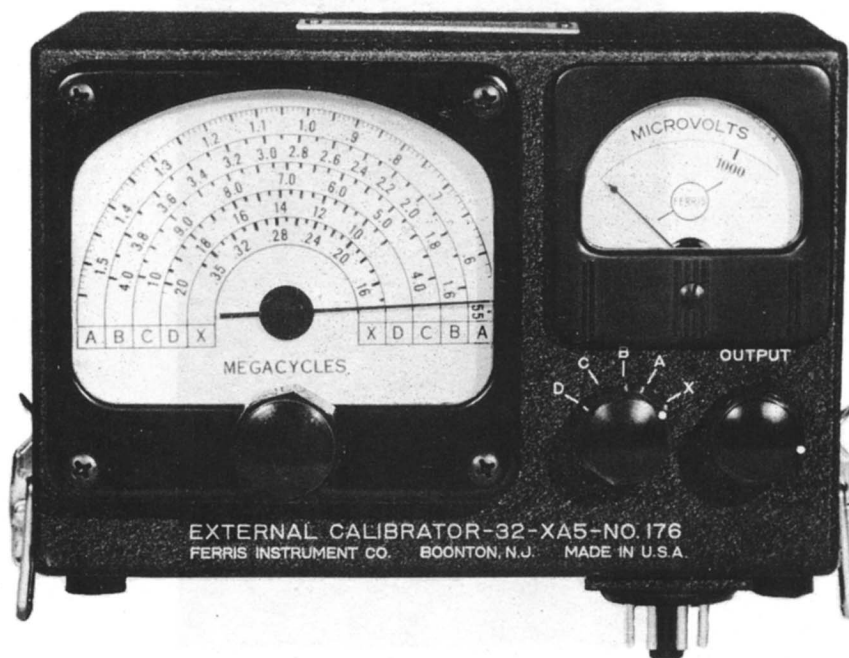
ments and provision is made for the attachment of loop antennas which are furnished in an accessory kit. A  $\frac{1}{2}$  meter effective height rod antenna is included with the instrument for the measurement of radiated radio noise or field strengths.

Provision is made within the instrument for self-contained dry batteries and also for the use of either AC operated or 6 volt storage battery operated power packs. These packs are part of the accessory kit and may be used either externally or to replace the batteries within the instrument.

The response of the instrument includes the average, quasi peak and peak readings as prescribed by the new specifications and also includes the earlier 10-600 millisecond time constants used in the Ferris Models 32-A and 32-B Noise Meters.

In addition to the meter response of the instrument provision is made for the attachment of an external recorder, cathode-ray oscillograph or head phones with separate receptacles or jacks for each.

The Models 64-AB and 64-BC are approximately 19 inches high by 10 inches wide by 12 inches deep and weigh approximately 32 pounds including dry batteries. A removable carrying cover protecting the face of the instrument during transportation is also furnished.



#### MODEL 32-XA5 EXTERNAL CALIBRATOR

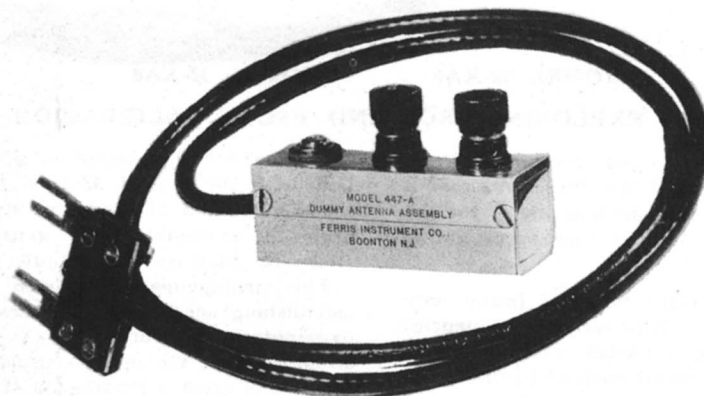
THE Model 32-XA5 External Calibrator shown above, is for use with either the Model 32-A or Model 32-B Noise Meters. This Calibrator is in reality a small, self-contained battery operated signal generator, delivering a constant output level of 1,000 microvolts as indicated by a small meter on the front of the instrument. It covers the same range as the Noise Meters, namely 150 to 350 and 550 to 20,000 kc. in five bands and fastens to the end of the Noise Meter by draw bolts making a rigid combination.

Connections to the Noise Meter are automatically made to a socket accessible by removing a plug in the

Noise Meter case. The combination of the external calibrator and noise meter provides greater accuracy than possible with the internal shot noise generator, particularly on the higher frequencies where the shot noise output is limited. Its use is also desirable for field strength measurements, not only because of greater accuracy, but also because it supplies the same type of c.w. signal as the transmitting station.

Dimensions: Width 7 inches, Height 5 inches.  
Depth 7 inches including controls.

Shipping Weight: 7½ lbs., packed in 1 carton.



#### MODEL 447-A DUMMY ANTENNA ASSEMBLY

THE Model 447-A Dummy Antenna Assembly shown above was designed in accordance with the I.R.E. Standards for Radio Receiver Testing in the range from 500 Kc. to 30 Mc.

This dummy antenna includes a combination of inductance, capacitance and resistance so arranged that it presents a capacity reactance at the lower frequencies and practically pure resistance above 10 megacycles.

Specifically it consists of a 20 micro-henry inductance shunted by a 400 mmfd. capacitor in series with a 400 ohm resistor. This network is in turn placed in series

with a 200 mmfd. capacitor giving the characteristics mentioned above.

The particular Model shown (447-A) is for use with the Ferris Model 22-A Signal Generator. As can be seen, it includes a three foot cable with forked terminals for connection to the 22-A signal generator binding posts.

Other models are available employing the same output box and cable, but with different terminal arrangements such as a plug for the Model 16-C. In ordering this accessory, the model signal generator with which the dummy antenna is to be used should be specified.





MODEL 32-XA6

MODEL 32-XA8

### HAND LOOP EXPLORING PROD AND PROBE CALIBRATION COIL

**T**HE Model 32-XA6 Hand Loop Exploring Prod, shown above, may be plugged into the 32-A or 32-B Noise Meters instead of the rod antenna and is for the purposes of locating noise sources and investigating induction fields.

The Loop consists of several turns of heavy wire forming a rigid coil and is tuned broadly to frequencies up to 3.5 mcs. by means of a switch which connects various capacity values to a circuit coupled to the Loop.

A 10 mmfd. dummy antenna capacitor is included which preserves alignment of the noise meter input circuit and the 8 foot flexible cable attached to the probe permits considerable exploring latitude.

The exploring prod or probe coil is directional which assists in locating the source of noise as well as the plane of the field. Ordinarily the Model 32-XA6 Hand Loop Exploring Prod is used only for locating noise sources and some idea of the magnitude of the noise from the meter reading.

If, however, the exploring prod is used in conjunction with the Model 32-XA8 Probe Calibration Coil, the combination of prod and noise meter may be calibrated by a suitable signal generator to serve as yardsticks of arbitrary but definite values.

This arrangement has been found very useful in establishing acceptable noise levels for such devices as dynamotors and various electrical appliances. In such an application the prod is usually placed in a position to give as great a reading on the noise meter as possible after the sensitivity has been established by means of the probe calibration coil and a signal generator.

Calibration figures are supplied with the probe calibration coil indicating the microvolts required for a fixed noise meter output and the calibration control is adjusted to obtain this reading.

Model 32-XA6—Net Weight: 1 lb.

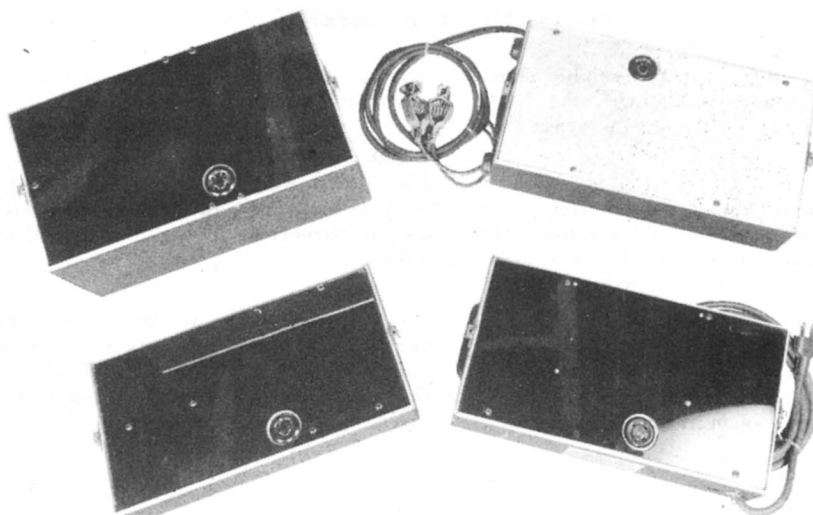
Shipping Weight: 4 lbs., packed in 1 carton.

Model 32-XA8—Net Weight 1¼ lbs.

Shipping Weight: 4 lbs., packed in 1 carton.

32-BP2

32-U2



32-BP1

32-U1

### POWER PACKS FOR MODEL 32 NOISE METER

**F**IVE different types of power supply packs are available for use with the Models 32-A and 32-B Noise Meters.

These consist of two types of dry cell battery packs, a 115 volt, 60 cycle rectifier pack and two vibrator packs for storage battery operation.

The small 32-BP1 battery pack is standard equipment furnished with the Model 32-A Noise Meter. It is very light and suited for portable use and has a battery life of approximately 20 hours.

The larger 32-BP2 pack is standard equipment with the Model 32-B Noise Meter and has a battery life of

approximately 50 hours. This pack is interchangeable on either noise meter with the 32-BP1 pack.

For continuous service, where a 110 volt power source is available, the Model 32-U1 Rectifier Pack is recommended. This pack is normally built for 60 cycles, but 25 cycle packs may be secured on special order.

Where a 110 volt source is not available and continuous operation is required, the Model 32-U2 or 32-U3 Vibrator Pack is more economical than dry cell operation, although not as portable. The 32-U2 pack is for 6 volt storage battery operation and the 32-U3 is for 12 volt storage battery operation.



### FERRIS CENTRALIZED SYSTEM TERMINATION UNITS

FERRIS Signal Generators are widely used for the development of radio receivers in the laboratory. In some instances the signal generator is also employed for production testing.

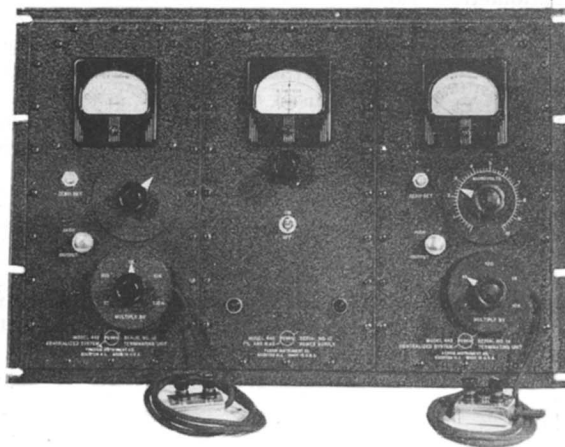
Many manufacturers of radio receivers, however, prefer to employ a centralized system using crystal controlled main oscillators which are considered easier to maintain where a large number of test positions are involved.

It is, of course, still desirable that the same type of output system be employed in the test position as in the signal generator used for the receiver development and there has consequently been a considerable demand for Ferris type attenuators, vacuum tube voltmeters, and the like in production testing.

Such an assembly is now offered in the form of a "Centralized System Terminating Unit," a description of which follows:

The Ferris Centralized System Terminating Unit is made in three types or ranges depending upon the frequencies involved. The Model 442-A is for the low frequency range from 50 kc. to 30 mc. and the Model 443-A is intended for the range from 30 to 150 mc. A third, Model 444-A, is recommended for the range from 30 to 300 mc.

These units are mounted upon an aluminum panel (black wrinkle finished and engraved) measuring 6 inches wide by 12 inches high by  $\frac{3}{32}$  inch thick. A  $\frac{1}{2}$  inch flange is included in these dimensions allowing easy installation in a suitable rack or frame.



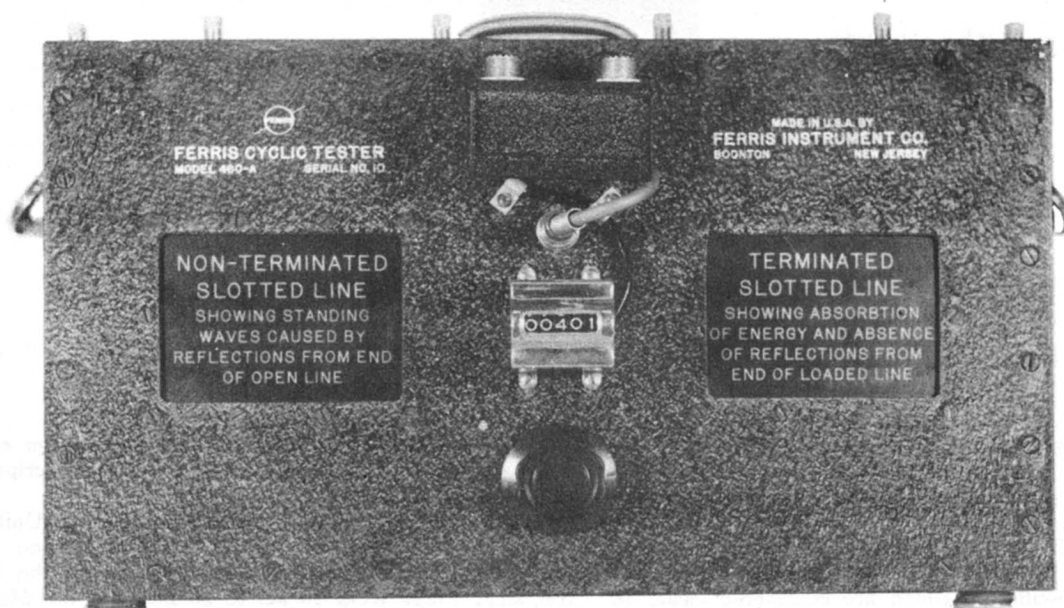
EACH unit is thoroughly shielded and includes a step attenuator, diode voltmeter, zero set control, R.F. output meter and suitable calibrated potentiometer for the frequency range involved. The selector switch for various frequencies is not included as this is a variable factor, which, it is felt, can best be handled by a separate panel assembly.

Ferris is prepared to advise and, if desired, to supply this additional panel, built to the requirements of the number of frequencies involved and other pertinent factors.

In the 444-A unit, a large output meter is employed with an individually calibrated scale in lieu of the calibrated potentiometer.

All of the units are designed to deliver a maximum of 0.1 volt across a 30 ohm terminated output transmission line. A high output jack, giving non-calibrated output of from 0.5 to 1 volt, is also included. Normally, the terminated transmission line is furnished with a two terminal output box, although a three terminal box with provision for the dummy antenna is available on special request.

In addition to the R. F. supply to the unit, a source of six volts direct current is required for the diode meter and zero set adjustment. This may be obtained from a storage battery, or rectifier unit, which is common to all positions. Only approximately 60 m.a. is required for each unit. A Model 445-A Filament and Bias Supply is available for this purpose.



### MODEL 460-A CYCLIC TESTER

THE Ferris Model 460-A Cyclic Tester was developed for use in the Ferris Laboratories for life testing various devices such as potentiometers, variable condensers and mechanical drive units as well as for demonstration purposes.

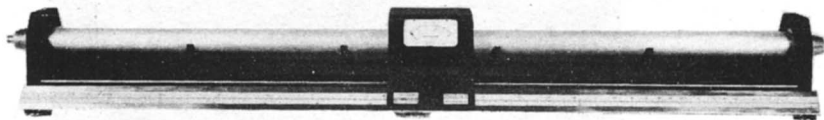
Briefly, the tester consists of two separate A. C. motors for rotating a series of shafts, first in one direction and then in the other, for a pre-set number of revolutions or time, as desired. In addition, 6 volts D.C. is supplied during one direction of travel for actuating a relay, electrical counter, or other device requiring not more than  $\frac{1}{2}$  ampere.

There are three shafts available for a take off of mechanical rotation. These three shafts rotate at 60 RPM, 6 RPM and 0.6 RPM with a torque of 25 inch lbs. on the 6 RPM shaft and correspondingly more

or less on the 0.6 and 60 RPM shafts.

A chain sprocket with twenty feet of ladder chain is provided for use on the 6 RPM shaft which permits operation of a mechanically remote device. The internal switch, which reverses the motors, may also be used to control associated lamps or other 110 volt A.C. operated devices up to 2 amperes. For heavier loads an external relay, operated from the 6 volt D.C. source, may be used.

The time of a complete reversal cycle may be adjusted from six seconds to three minutes and special attachments may be secured upon request. These special attachments may take the form of a commutator which will permit a sequence of operations during the time cycle.



## MODEL 446-A

### SLOTTED MEASURING LINE

THE measurement of impedances at very high and ultra high frequencies may often be accomplished by the use of a short length of transmission line with provision for measuring the amplitude and position of standing waves caused by the character of the load attached to the transmission line. Not only is it possible to determine the amplitude of the load impedance but also its phase angle which indicates the capacitive inductive or resistive nature of the load. For convenience in making observations of the amplitude and position of standing waves on such a line the Ferris Instrument Company has made available the Slotted Measuring Line shown above.

The Ferris Model 446-A Slotted Measuring Line consists of a 5 foot length of silver-plated brass tubing, having a 2 inch inside diameter, enclosing a coaxial inner conductor of seven-eighths inch outside diameter thereby forming a transmission line having a characteristic impedance of approximately 50 ohms. A slot in the outer tube permits the insertion of a high resistance probe consisting of a crystal rectifier, load resistance, and specially calibrated sensitive meter for determining the presence and relative amplitude of standing waves along the line. A removable dual scale is provided along the entire length of the line for indicating the position of the probe and the meter is calibrated in percentage thereby providing a direct reading of the standing wave ratio.

The removable dual scale which has upper and lower graduations indicates the frequency of the supplied R.F. voltage on the upper section and the phase angle of the load at some specific frequency normally 110 Mcs. on the lower section. With this arrangement the measuring line may first be used for determining the frequency of the R.F. supply and then, after this supply

is adjusted to 110 Mcs. as indicated by the line, the lower scale showing the angle of the load impedance is used. A standard coaxial connector is used to feed the energy to the line and the load end is provided with screw terminals to minimize lead lengths.

For proper operation the Ferris Model 446-A Slotted Measuring Line requires a source of high frequency normally 110 Mcs. capable of delivering a level of 0.5 volt into a 50 ohm load. Such a source may conveniently be obtained from a Ferris Model 18-C, 18-D or 18-FS Microvolter using the "High Output" jack. The frequency of the supply may be adjusted to coincide with the frequency scale on the measuring line and the amplitude set so that the maximum reading on the probe indicator reads 100%.

Special models of the Slotted Measuring Line are available on request. For example, longer lines up to 15 feet in three 5 foot sections, may be obtained. The longer lines are provided with continuous low loss centering insulation and having additional supports on the outer conductor.

Other forms of probes with amplifiers may also be secured as well as special fittings for adapting the line to specific requirements.

Correspondence and consultation is invited on measuring lines to meet your particular needs.

Dimensions: Width 64 inches, Height 8 inches,  
Depth 9 inches, including controls.

Net Weight: 50 lbs.

Shipping Weight: 125 lbs., packed in 1 wooden case.





MODEL 400

#### FERRIS TYPE 400 CONVERTER

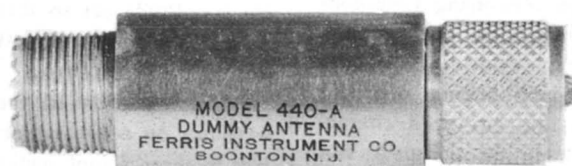
THE type 400 series of converters was developed due to repeated requests for a vibrator type converter which would permit our various instruments to be worked from a storage battery. Existing equipment of this type which has been available, has not been sufficiently filtered and shielded to obtain the required low noise level for many of the tests which are made with our equipment.

These converters furnish 115 volts, 60 cycle power from a storage battery. The 6 volt, Model 406, supplies 80 watts and the 12 volt, Model 412, furnishes 100 watts of A.C. power. They are exceptionally well shielded and filtered so that they are free from interference on

all radio frequencies. Extra heavy battery leads and battery clips are furnished so as to keep the supply voltage drop to a minimum. A fuse, accessible from the outside, is included in the supply circuit as well as a pilot light to indicate when the power is "on."

The overall dimensions of these converters are  $14\frac{3}{4}" \times 10\frac{3}{4}" \times 9\frac{3}{8}"$ , while the actual dimensions of the case are  $12" \times 10" \times 9\frac{3}{8}"$ . The weight is approximately 25 pounds.

These converters make it possible to use standard 115 volt, 60 cycle laboratory equipment in field trucks and other locations where commercial power is not available.



MODEL 440-A

#### DUMMY ANTENNA

THE Model 440-A Dummy Antenna is intended for use at V.H.F. and U.H.F. and consists of a selected resistor placed in a metal container with a standard male coaxial fitting on one end and a female fitting on the other. Normally, it is supplied with a 50 ohm resistor selected for best high frequency characteristics. The outer sheath of the container may be easily removed and other resistance values substituted. In order to insure short lead lengths and good connections, the resistor is soldered in place.

This Dummy Antenna is particularly suited for use with the Model 441 V.H.F. and U.H.F. coaxial type

output box as supplied with the Model 48-A signal generator and available for other signal generators on special order.

When used with the Model 441 Output Box, the dummy antenna may be attached to either the "High" or "Low" output tap as desired. The use of this combination on the "Low" output tap is particularly suitable as the loading effect of the dummy antenna and receiver is negligible on this tap.

Other uses of this item will be readily apparent to anyone working at V.H.F. and U.H.F. as the construction is particularly suited for placing in series with coaxial lines equipped with standard fittings.



**MODEL 451-A  
OUTPUT BOX**

FOR those who prefer a coaxial type termination instead of the two binding posts normally furnished with the Model 18 Series Microvolters, the Model 451-A Output Box, shown above is available at a slight additional cost.

This output box includes the 30 ohm termination required for the output cable and provides a ready means for employing the 440-A Dummy Antenna with its easily changed resistance values. With this combination it is a simple matter to match the 15 ohm

effective output impedance of the generator to any higher value.

It is also possible to apply the FAU-257-A Connector Plug, as shown in the photograph of the Model 450-B Signal Generator Amplifier, thereby giving, in effect, the two terminal output connection normally supplied with the Model 18.

This output box is available for use on new instruments or may be readily attached to microvolters now in use. Correspondence on this item is invited.



**MODEL 450-B  
SIGNAL GENERATOR AMPLIFIER**

YOUR attention is called to a new Ferris product which may be of use to you in extending the usefulness of present signal generators.

This product, which is known as the Model 450-B Signal Generator Amplifier, is a broad band untuned amplifier covering the range of from 100 kc to 20 mc and delivering approximately 15 volts of R.F. when supplied with an input of 1 volt.

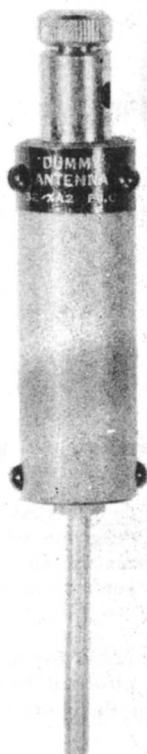
The amplifier is particularly useful in coupling the signal generator to radio frequency bridges, oscilloscopes, etc., where a high voltage R.F. supply is frequently desirable. It has a resistive output impedance of 500 ohms, a flat response to 4 mc, and is down 0.6

db at 10 mc, 2.8 db at 15 mc and 6.0 db at 20 mc open circuit voltage.

With a 500 ohm resistive load the output is approximately 7.5 volts out for 1 volt input and is flat to 15 mc, and only down 2.0 db at 20 mc.

The amplifier includes its own regulated power supply with two regulator tubes and employs three 6AG7 wide band amplifier tubes.

Recommended applications of the amplifier include attachment to Ferris Signal Generators, such as the Models 16-C, 14-C, 22-A, 22-D, 20-A, and 20-B. In the case of the last two models, which normally deliver 0.1 volt, the output is raised to 1.5 volts.



#### MODEL 32-XA2 DUMMY ANTENNA

THE Model 32-XA2 Dummy Antenna converts either the Model 32-A or 32-B Noise Meter into a micro-voltmeter for measuring conducted noise voltages such as on low voltage power lines, motors, generators, dynamotors and other electrical appliances. It is also employed in series with a signal generator for calibrating the noise meter from an external source.

Actually, it consists of a low loss capacitor adjusted to exactly 10 mmfd, including the miscellaneous capacity of its terminals which consist of a plug for insertion into the noise meter and a binding post for attaching a wire leading to the device under test.

**Model 32-XA7 Shielded Dummy Antenna:**

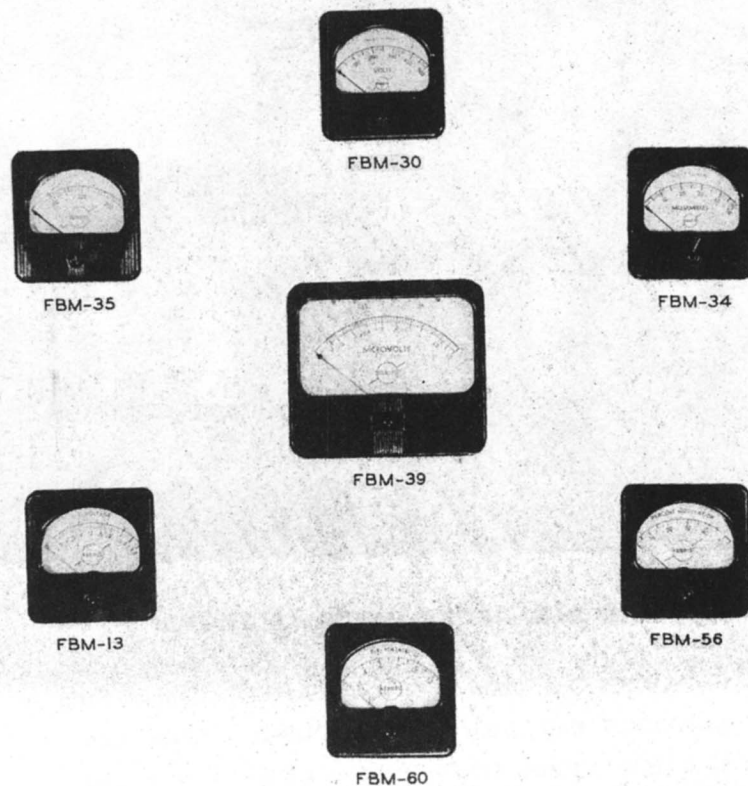


#### MODEL 32-XA4 EXTERNAL MULTIPLIER

The Model 32-XA7 Shielded Dummy Antenna is similar to the 32-XA2 except it is shielded for use in locations where a strong field exists in addition to conducted noise. It includes a shielded lead for connecting to the device under test or to a signal generator and may be used interchangeably with the 32-XA2 with the added advantage of complete shielding.

##### **Model 32-XA3 and 32-XA4 External Multipliers:**

These external multipliers extend the maximum voltage range of the 32-A or 32-B ten and one hundred times respectively. In other words, with the Model 32-XA3 plugged in series with the noise meter antenna, voltages up to one volt may be measured, and with the 32-XA4, the range is extended to 10 volts.



### SPECIAL FERRIS METERS

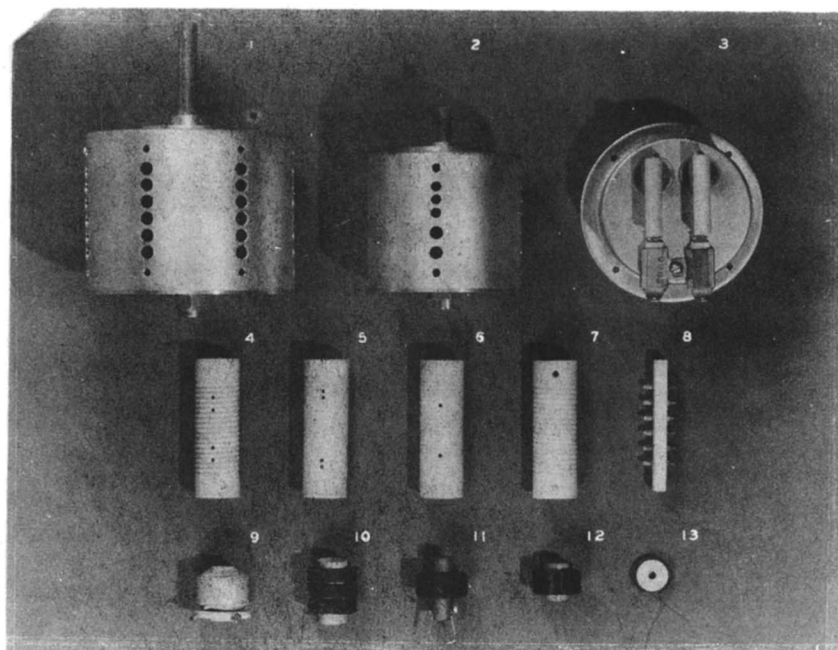
THE accuracy of any instrument such as a signal generator depends to a large extent upon the meter employed. Ferris instruments use meters built to special specifications for the type of service they perform.

In the above photograph a typical group of Ferris meters is shown. The three top and center meters will be recognized by many as those employed in the Model 16-C Signal Generator.

The output meter, FBM-13 is used in the Model 18 Series Microvolts, the FBM-56 and FBM-60 will be found in the Model 22-A.

These meters, and many others, are available for service on Ferris instruments as well as for other miscellaneous applications. Brief specifications are shown in table form below:

Model No.	Type	Range	Size	Use
FBM-35	dc Micrometer	0-100 ua	3 inch	Modulation 16C
FBM-30	dc Voltmeter	0-500 Volts	3 inch	Plate E 16C
FBM-34	dc Milliammeter	0-50 ma	3 inch	Plate I 16C
FBM-39	dc Microammeter	0-100 ua	4 inch	Output 16C
FBM-13	dc Microammeter	0-50 ua	3 inch	Output 18C
FBM-60	dc Microammeter	0-100 ua	3 inch	Output 22A
FBM-56	dc Voltmeter	0-15 Volts	3 inch	Modulation 22A



### MISCELLANEOUS PARTS AS SHOWN

1—FAU-228 Coil Drum	8—FAHE-37 Contact Strip
2—FAU-227 Coil Drum	9—FLR-20 Choke Coil
3—FAM-4 Meter Shield	10—FLR-13 Choke Coil
4—FEC-23 Coil Form	11—FLR-6 Choke Coil
5—FEC-24 Coil Form	12—FLR-16 Choke Coil
6—FEC-26 Coil Form	13—FLR-12 Choke Coil
7—FEC-21 Coil Form	

1. The FAU-228 Coil Drum is employed in the Model 22-A Signal Generator for arranging the six range coils in turret fashion. The drum is equipped with a  $\frac{3}{8}$ " bakelite shaft extending  $1\frac{3}{4}$ " beyond the face of the drum and has a bearing nut on the other end for a  $\frac{1}{2}$ " hole.

2. The FAU-227 Coil Drum is employed in the Model 18-B Microvolter for arranging either three or four coils in turret fashion. The drum is equipped with a  $\frac{1}{4}$ " bakelite shaft extending  $\frac{3}{4}$ " beyond the face of the drum and has a bearing nut on the other end for a  $\frac{1}{2}$ " hole.

3. The FAM-4 Meter Shield includes a meter filter for excluding V.H.F. from the meter consisting of two feed through condensers, two r.f. chokes and two feed-a-long condensers. The shield has an inside diameter of  $2\frac{1}{8}$ " and a useable depth of  $1\frac{1}{4}$ ".

4. The FEC-23 Coil Form is a ceramic tube  $\frac{7}{8}$ " O.D. by  $\frac{5}{8}$ " I.D. by  $2\frac{3}{4}$ " overall length. It is threaded for a central section of  $1\frac{3}{4}$ " at 10 threads to the inch. Two mounting holes  $2\frac{1}{4}$ " between centers are provided as well as four lead wire holes as shown.

5. The FEC-24 Coil Form is similar to the FEC-23 just described except that it has no threads.

6. The FEC-26 is also similar to FEC-23 except that

it has 30 threads per inch for a distance of 1".

7. The FEC-21 is similar to the FEC-23 except that it has left hand threads and no lead wire holes.

8. The FAHE-37 Contact Strip is a ceramic strip  $2\frac{5}{8}$ " long by  $\frac{1}{2}$ " wide by  $\frac{1}{4}$ " thick. It is equipped with six solid silver contacts and mounts with two threaded holes on  $2\frac{5}{16}$ " centers.

9. The FLR-20 Choke Coil is a heavy duty R.F. choke wound with No. 18 DCC wire on a ceramic form and has an inductance of approximately 50 micro-henries.

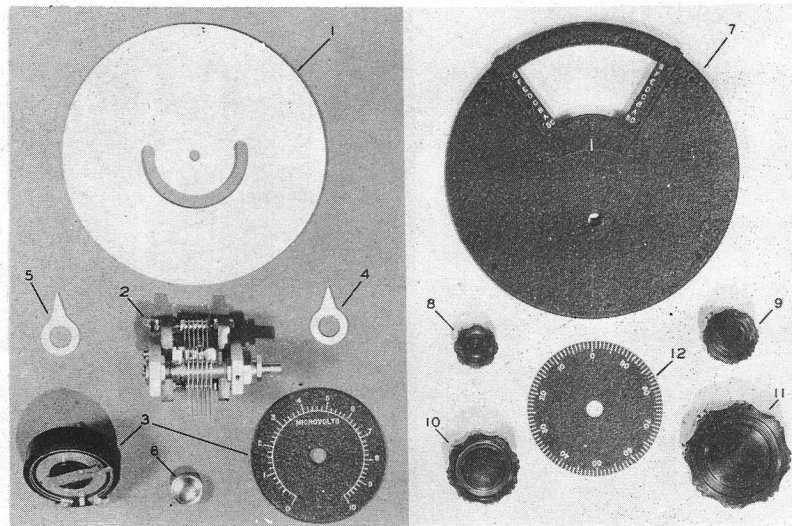
10. The FLR-13 Choke Coil is a triple section R.F. choke wound with No. 26 D.S.C. wire on a wooden bobbin and has an inductance of approximately 1000 micro-henries.

11. The FLR-6 Choke Coil is wound with No. 36 S.S.C. wire on an impregnated paper form and has an inductance of approximately 50 milli-henries.

12. The FLR-16 Choke Coil is wound with No. 36 S.S.E. wire on a wooden bobbin and has an inductance of approximately 35 milli-henries.

13. The FLR-12 Choke Coil is wound with No. 36 D.S.C. wire on a ceramic button and has an inductance of approximately 200 micro-henries.





MISCELLANEOUS PARTS AS SHOWN

- 1—FKE-3 Blank Dial
- 2—FACV-6 Variable Condenser
- 3—FRV-37 Calibrated Potentiometer
- 4—FKK-51 Knob Pointer (short)
- 5—FKK-21 Knob Pointer (long)
- 6—FQP-36 Jack Cover
- 7—FAU-226 Dial Cover and Bezel
- 8—FKK-12 Molded Knob
- 9—FKK-31 Molded Knob
- 10—FKK-39 Molded Knob
- 11—FKK-34 Molded Knob
- 12—FKG-8 Engraved Dial

1. The FKE-3 Blank Dial is the same as used in the 22-A Signal Generator except it is furnished without marking of any kind. The dial is  $\frac{3}{32}$ " thick aluminum,  $5\frac{3}{8}$ " diameter with a  $\frac{1}{4}$ " center hole and is painted on one side only with white pyralin paint which will readily take black India ink.

2. The FACV-6 Variable Condenser is of the straight line frequency type particularly designed for high frequencies. It employs a heavy  $2" \times \frac{3}{4}"$  aluminum channel frame with  $\frac{1}{4}"$  mykroy supports for the stator plates. End play can be taken up by an end bearing adjustment and the condenser is supported by a single shoulder nut which does not place strain on the assembly. The rotor shaft is pigtailed to eliminate noise and when equipped with the standard number of 12 stator and 12 rotor plates the condenser has a maximum capacity of 60 mmfds. and a minimum of 8 mmfds.

3. The FRV-37 Calibrated Potentiometer is employed in the Model 22-A and is individually calibrated with a special engraved dial for each unit. It is wire wound non-inductively and tapered throughout its entire length. Similar appearing calibrated potentiometers are

the FRV-64 for the 20-A and the FRV-66 for the 22-D.

4 and 5. These are FKK-51 and FKK-21, white celluloid Knob Pointers for use with the FKK-12 and FKK-31 Molded Knobs. The FKK-51 pointer has a  $\frac{1}{2}"$  hole and measures  $\frac{7}{8}"$  from the center of the hole to the tip of the pointer. The FKK-21 also has a  $\frac{1}{2}"$  hole but measures  $1"$  to the tip. These pointers can be easily applied to the shoulder on the brass inserts in the knob.

6. This Jack Cover FQP-36 fits a S-101-D Jones socket and prevents leakage from the signal generator when the jack is not used.

7. FAU-226 Dial Cover is used on the 22-A in conjunction with FKE-3 dial. The dial cover includes a bezel which may be obtained either with or without engraved letters.

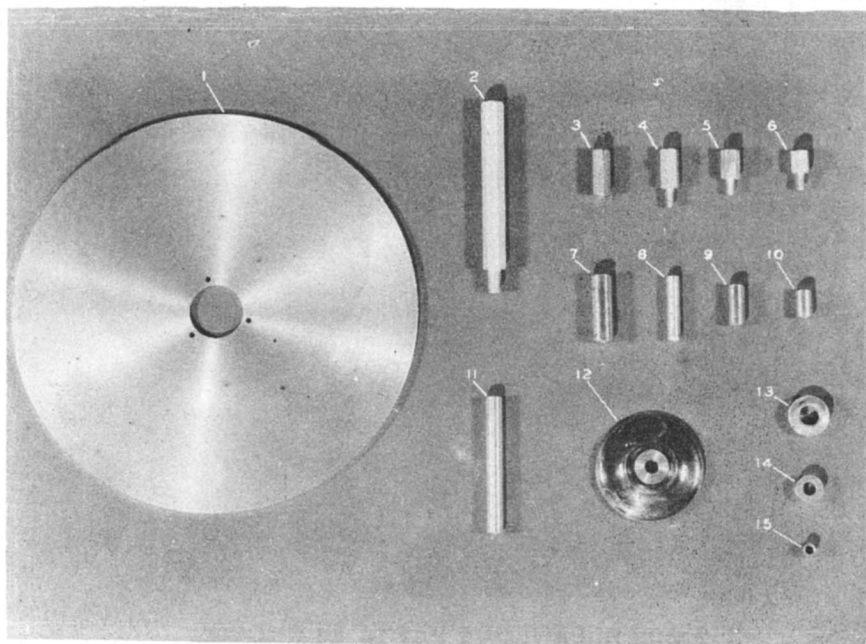
8. FKK-12 is a molded bakelite knob having a maximum diameter of  $1"$ , height  $\frac{5}{8}"$ , and brass insert with  $\frac{1}{4}"$  hole  $\frac{1}{16}"$  deep with two No. 6-32 set screws at right angles.

9. FKK-31 Molded Knob,  $1\frac{1}{4}"$  maximum diameter,  $1\frac{5}{8}"$  height overall, brass insert  $\frac{1}{4}"$  hole with shoulder for knob pointer. Two No. 8-32 screws.

10. FKK-39 Molded Knob,  $1\frac{5}{8}"$  maximum diameter,  $1\frac{1}{16}"$  height overall, brass insert  $\frac{1}{4}"$  hole with shoulder for knob pointer. Two No. 8-32 set screws.

11. FKK-34 Molded Knob,  $2\frac{3}{8}"$  maximum diameter,  $1\frac{1}{16}"$  height overall, brass insert  $\frac{1}{4}"$  hole. Two No. 8-32 set screws.

12. The FKG-8 Engraved Dial is  $3"$  in diameter by  $\frac{1}{16}"$  thick with either a  $\frac{3}{8}"$  or  $\frac{1}{2}"$  hole as requested. When supplied with the  $\frac{1}{2}"$  hole the dial may be easily applied to either the FKK-12 or FKK-31 Molded Knobs. There are 100 graduations engraved on the dial with numerals every ten graduations.



MISCELLANEOUS PARTS AS SHOWN

- 1—FKE-12 Dial
- 2—FQT-95 Stud
- 3—FQT-70 Spacer Post
- 4—FQT-84 Stud
- 5—FQT-21 Stud
- 6—FQT-6 Stud
- 7—FQT-50 Spacer Post
- 8—FQT-48 Spacer Post
- 9—FQT-23 Spacer Post
- 10—FQT-38 Spacer Post
- 11—FQT-40 Spacer Post
- 12—FOM-21 Dial Hub
- 13—FOM-2 Hub
- 14—FOM-23 Collar
- 15—FQT-44 Spacer Post

1. The FKE-12 Dial is the same as used on the 16-C Signal Generator except it is without marking of any kind. The dial is  $\frac{1}{8}$ " thick aluminum,  $7\frac{1}{2}$ " diameter with a 1" center hole and three smaller holes for mounting the FOM-21 dial hub.

2. The FQT-95 Stud is made from  $\frac{3}{8}$ " hexagon aluminum alloy and is  $3\frac{5}{8}$ " long overall including a  $\frac{1}{4}$ -20 x  $\frac{1}{8}$ " threaded extension and tapped  $\frac{1}{4}$ -20 x  $\frac{3}{4}$ " deep at the other end.

3. The FQT-70 Spacer Post is made from  $\frac{5}{16}$ " hexagon aluminum alloy and is  $\frac{7}{8}$ " long and tapped No. 10-32 for its entire length.

4. The FQT-84 Stud is made from  $\frac{5}{16}$ " hexagon brass stock and is  $1\frac{1}{8}$ " overall including a No. 6-32 x  $\frac{3}{8}$ " threaded extension, and is tapped No. 6-32 x  $\frac{3}{8}$ " deep at the other end.

5. The FQT-21 Stud is made from  $\frac{5}{16}$ " hexagon brass stock plated and is  $\frac{7}{8}$ " long overall including a No. 6-32 x  $\frac{5}{16}$ " threaded extension and is tapped No. 6-32 x  $\frac{1}{8}$ " deep at the other end.

6. The FQT-6 Stud is made from  $\frac{5}{16}$ " hexagon brass stock plated and is  $\frac{3}{4}$ " long over all including a No. 6-32 x  $\frac{5}{16}$ " threaded extension and is tapped No. 6-32 x  $\frac{1}{4}$ " deep at the other end.

7. The FQT-50 Spacer Post is made from  $\frac{3}{8}$ " diameter brass stock plated and is  $1\frac{1}{4}$ " long tapped No. 8-32 x  $\frac{1}{2}$ " deep at each end.

8. The FQT-48 Spacer Post is made from  $\frac{1}{4}$ " diameter aluminum alloy and is  $1\frac{3}{16}$ " long tapped No. 6-32 x  $\frac{3}{8}$ " deep at each end.

9. The FQT-23 Spacer Post is made from  $\frac{5}{16}$ " diameter brass stock plated and is  $\frac{3}{4}$ " long tapped No. 6-32 for its entire length.

10. The FQT-38 Spacer Post is made from  $\frac{5}{16}$ " diameter brass stock plated and is  $\frac{1}{2}$ " long tapped No. 6-32 for its entire length.

11. The FQT-40 Spacer Post is made from  $\frac{5}{16}$ " diameter aluminum alloy and is  $2\frac{1}{2}$ " long tapped No. 6-32 x  $\frac{1}{2}$ " deep at each end.

12. The FOM-21 Dial Hub is made particularly for use with the FKE-12 Dial and is nickel plated brass 2" maximum diameter with a  $\frac{1}{4}$ " center hole. It is machined with recess for cap and extension having two No. 8-32 set screws and pilot hole for taper pin.

13. The FOM-2 Hub is made from  $\frac{3}{8}$ " diameter aluminum alloy and is  $\frac{3}{8}$ " long overall with a  $\frac{1}{2}$ " diameter by  $\frac{1}{8}$ " shoulder. The hub is made to fit a  $\frac{3}{8}$ " diameter shaft.

14. The FOM-23 Collar is made from  $\frac{1}{2}$ " diameter brass stock plated and is  $\frac{1}{4}$ " long with a  $\frac{1}{4}$ " hole. Provision is made for a No. 8-32 set screw.

15. The FQT-44 Spacer Post is made from  $\frac{1}{4}$ " diameter brass stock plated. It is  $\frac{1}{4}$ " long and has clearance for a No. 6 screw.



### THE FERRIS MODEL 18-H MICROVOLT

**T**he Model 18 H Microvolter has a frequency range of from 450 to 950 megacycles, with provisions for 30% internal amplitude modulation at 1,000 cycles.

This instrument employs the Ferris Hinge Type Tuner, which provides a smooth variation of frequency over the range of the instrument.

A variable output from less than one to more than 100,000 microvolts is available. The instrument has a resistance type step attenuator using high frequency resistors and a new variable output box giving continuous variation between steps. This is a new feature which avoids reaction on the oscillator, thereby eliminating frequency shift with output adjustment.

Effective output impedance is 50 ohms from a type "N" receptacle mounted on the output box, which in turn is permanently fastened to the front of the instrument. The output level is established by the output meter reading, multiplied by the setting of the step attenuator and output box control. The meter reading is normally maintained at a fixed value of 1.0 microvolts.

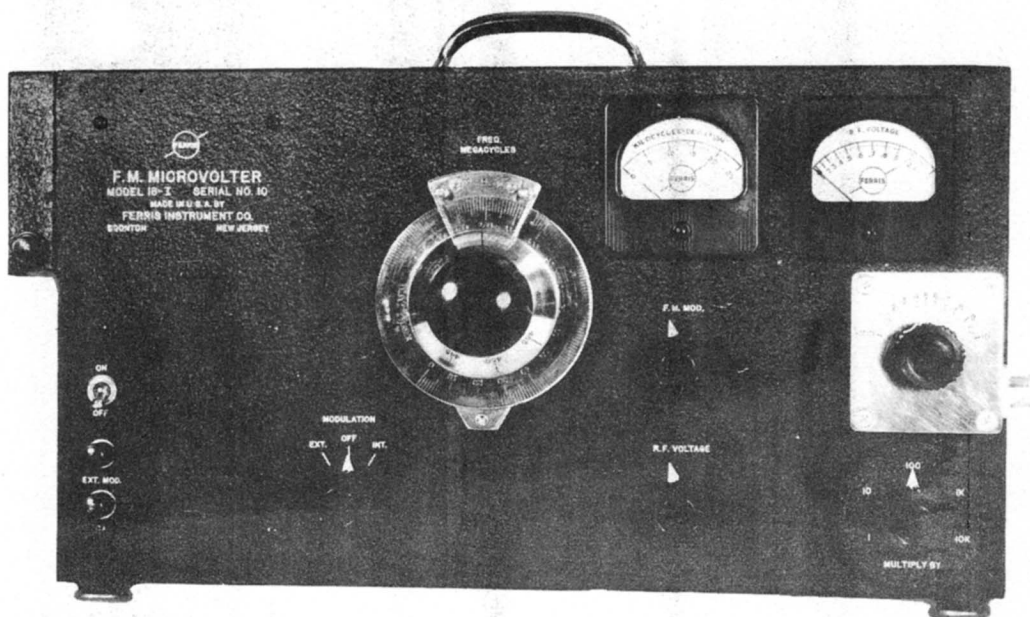
The internal modulation, which has a fixed value of 30% at 1,000 cycles, may be switched on at will. Provision is also made for applying external modulation up to 10,000 cycles.

This instrument employs plate voltage modulation on the oscillator resulting in some degree of frequency variation, as well as amplitude modulation. Data is supplied indicating the amount of frequency modulation present over the range of the instrument.

The frequency range is spread over a 50 division 180 degree dial with a vernier ratio of 100 to 1. Vernier markings on the control knob dial afford a total of 5,000 divisions over the frequency range or about 5 divisions per megacycle at the most crowded section of the dial.

Direct frequency readings on the main dial are furnished in addition to charts, which indicate correct frequencies to  $\pm 0.5\%$ .

The instrument is housed in an aluminum case measuring 19 $\frac{1}{4}$  inches wide by 10 $\frac{1}{2}$  inches high and 11 inches deep. The net weight is approximately 30 lbs.



### THE FERRIS MODEL 18-I FM MICROVOLT

The Model 18-I FM Microvolter has a frequency range of from 445 to 475 megacycles, with provisions for internal frequency modulation up to 25 kilocycles deviation at 1,000 cycles modulating frequency.

This instrument employs a resonant line oscillator of high stability encased in a very thick aluminum box to minimize microphonic effects. Tuning over the range is accomplished by capacity variation at the end of the line and uses no moving contacts.

A variable output from less than one to more than 100,000 microvolts is available. The instrument has a resistance type step attenuator, using high frequency resistors and a new variable output box giving continuous variation between steps. This is a new feature which avoids reaction on the oscillator, thereby eliminating frequency shift with output adjustment.

Effective output impedance is 50 ohms from a type "N" receptacle, mounted on the output box, which in turn is permanently fastened to the front of the instrument. The output level is established by the output

meter reading multiplied by the setting of the step attenuator and output box control. The meter reading is normally maintained at a fixed value of 1.0 microvolt.

The FM deviation is read on a separate meter and is continuously variable up to 25 kc. deviation. Provision is made for applying external modulation up to 10,000 cycles.

The frequency range is spread over a 150 division National dial, incorporating a direct reading frequency calibration in addition to the regular vernier scale which can be read to 0.1 division. This is equivalent to approximately 20 kilocycles, or about .005% of the carrier frequency.

Charts are furnished in addition to the direct reading dial calibration for accurate setting of frequency to within 0.1% and the direct reading dial is within 0.3%.

The instrument is housed in an aluminum case measuring 19¼ inches wide by 10½ inches high and 10 inches deep. The net weight is approximately 31 lbs.





### THE FERRIS MODEL 22 G SIGNAL GENERATOR

**T**he Model 22-G Signal Generator is a low frequency instrument covering a range of from 15 kilocycles to 4.0 megacycles. Output levels of from 1 microvolt to 100,000 microvolts are available at 3 ohms output impedance and from 10 microvolts to 1 volt at 15 ohms.

A resistance type decade attenuator is employed in combination with a calibrated four inch output meter. The dual meter scale and step attenuator are marked in both microvolts and db for those who prefer working in decibels.

Incidentally, the Ferris Model 22-D may also be obtained with this dual marking upon special request. As the db figures are based on decibels above a 1 microvolt level, the output arrangement as outlined above is employed.

Internal amplitude modulation up to 50% at 400 cycles is included with provision for external modulation. The percentage modulation is indicated on a separate meter.

The total frequency range is covered in six overlapping bands, with a direct reading frequency dial individually calibrated on each instrument.

The Model 22-G employs a modulated oscillator, but at the frequency range of this instrument, any frequency

modulation is negligible. An all aluminum black wrinkle finished case minimizes weight.

#### 22-G Specifications

**Frequency Range:** 15 kilocycles to 4 megacycles in six ranges.

**Dial System:** Each range has an individually hand calibrated scale. Additional slow motion dial for selectivity measurements, giving scale spread of 4 feet in each range.

**Accuracy of Calibration:** Direct reading dial is accurate to 1%.

**Output Voltage:** Continuously variable from 1 microvolt to 1 volt.

**Output System:** Large dual scale output meter, plus Ferris block type decade resistance attenuator with tapped output box on end of three foot cable.

**Modulation:** Internal and external up to 50% with modulation meter calibrated to read percent modulation.

**New Feature:** Output levels calibrated in both microvolts and decibels above 1 microvolt.

**Dimensions:** Width 18¼ inches, Height 10½ inches, Depth 8 inches.

**Net Weight:** 28 lbs.

**Shipping Weight:** 34 lbs. packed in 1 carton.





## THE FERRIS MODEL 24-C CRYSTAL CONTROLLED SIGNAL GENERATOR

The Model 24-C Crystal Controlled Signal Generator is designed to furnish seven fixed crystal controlled frequencies in the range of from 200 to 2,000 kc. for the purpose of accurate alignment of I. F. and R. F. circuits for automobile and standard home broadcast receivers. It also serves as a standard to set manually adjusted fixed frequency signal generators, such as the Ferris Model 20 Microvolter, on exact frequency.

The Model 24-C includes provision for 30% internal amplitude modulation at both 400 and 1,000 cycles, as well as external modulation up to 3,500 cycles. Output levels from 1 to 100,000 microvolts are available at an output impedance of 15 ohms.

Modulation in the Model 24-C is applied to an R. F. amplifier, thereby avoiding frequency modulation. When employing external modulation sources, the percentage modulation may be increased to nearly 100% by the application of sufficient modulating voltage.

Both the crystals and associated coils may be easily changed for various frequencies in the operating range. The crystals are plugged into ceramic sockets and have shunt trimmer capacitors to adjust them to exact frequencies.

Output level on the meter is adjusted by an R. F. control and additional attenuation is obtained by a decade step attenuator. The output appears at the end of a three-foot terminated cable and includes an

output box with binding post for flexible application to either I. F. or R. F. circuits.

The instrument is housed in a black wrinkle finish aluminum case.

### 24-C Specifications

**Frequency range:** Seven spot frequencies from 200 to 2,000 kilocycles.

**Frequency selector:** Single knob with easily read aluminum scale.

**Output voltage:** Continuously variable from 1 to 100,000 microvolts.

**Output system:** Calibrated meter and step attenuator. Output appears at end of 3-foot transmission line cable. High output connection, approximately 0.7 volt, not calibrated.

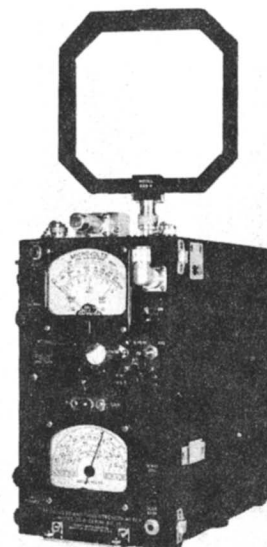
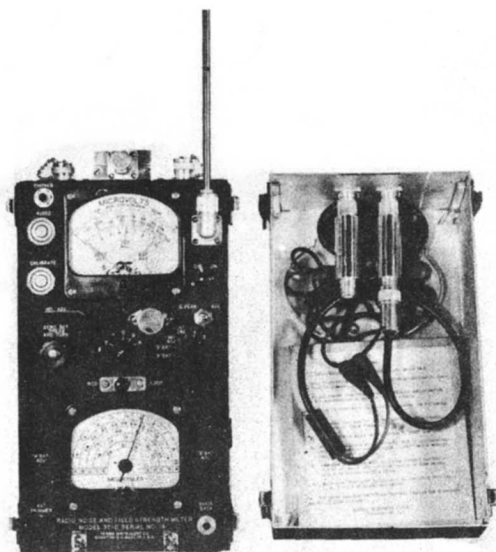
**Modulation:** Internal 400 cycle and 1,000 cycle modulation with provision for external modulation.

**Power supply:** The standard power supply of the regulated type is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Dimensions:** Width, 18 inches. Height, 10½ inches. Depth, 8 inches including controls.

**Net weight:** 22 lbs.

**Shipping weight:** 30 lbs. packed in 1 carton.



### THE FERRIS MODEL 32-D RADIO NOISE AND FIELD STRENGTH METER

The Ferris Model 32-D Radio Noise and Field Strength Meter is for the purpose of measuring the intensity of radio frequency fields in space, or it may also be used as a two terminal radio frequency voltmeter to measure levels from 1 microvolt to 1 volt over the frequency range of from 550 kilocycles to 25 megacycles.

For field strength measurements in free space, either the rod antenna furnished with the instrument may be used or any one of five available accessory loops, required to cover the five bands, or complete frequency range of the instrument.

Radio frequency measurements of communication signals may be made with the instrument as well as measurements of various disturbances which may interfere with such communication. These disturbances are often referred to as radio frequency noise and may originate in electrical devices such as ignition systems, motors, dynamotors, electric razors and other appliances. Transmission lines with leaky insulators may also be detected and measured with the instrument.

In order to minimize such interference caused by various electrical devices, it is now customary to measure the intensity of the radio frequency disturbance and apply corrective measures, such as filters or shielding to prevent excessive radiation. The Model 32-D is particularly well suited to this type of measurement and is the result of many years experience with similar instruments, such as the Ferris Models 32-A and 32-B Radio Noise and Field Strength Meters, which have been used extensively by both military and civilian agencies.

For those who have had occasion to use either the Models 32-A or 32-B Noise Meters, the additional features incorporated in the new Model 32-D will be readily apparent. These additional features include the following:

1. Modern miniature type tubes are used throughout.
2. Both filament and plate voltages are indicated, with adjustments provided to keep them constant.
3. The frequency range is continuous from 550 kilocycles to 25 megacycles.
4. Provision is made for the use of either rod or loop antennas, the latter being optional.
5. A separate antenna trimmer permits peaking of either rod or loop antenna.
6. The time constant of the weighting circuit has been changed to 1 millisecond charge time and 600 milliseconds discharge time in the quasi peak position thereby increasing response to certain types of radio noise.
7. Means are provided to read peak voltages by use of an external slideback unit.
8. The audio response has been greatly increased to facilitate peak readings.
9. An audio output control is included with a separate receptacle for attaching a scope in order to observe

the audio envelope.

10. A multivibrator is used for internal purposes, which gives greatly increased readings at higher frequencies, resulting in improved accuracy.
11. Provision is made for attaching a 1 milliampere recorder or remote indicator, which may be used simultaneously with the instrument meter.
12. The deep cover allows room for the following accessories, which are included with the instrument:
  - a. Rod antenna and stub.
  - b. Pair of headphones.
  - c. Dummy antenna.
  - d. Fifty Ohm Matching Impedance.
  - e. Input Cable.
  - f. Calibration Charts.
13. As a two terminal voltmeter, radio frequency levels of from 1 microvolt to 1 volt may be measured using the dummy antenna.
14. Large bias cells having longer life are included in the power supply packs where they are more conveniently accessible.

The Model 32-D is normally supplied with a dry battery pack, making it a completely portable instrument. A Model 32-U4 Rectifier Pack is available as an accessory for use on a 115 volt a.c. power supply. This pack may be clipped on in place of the battery pack and is more economical to use where conditions permit.

Other available accessories include a Model 32-XA9 Slidebacker for measuring peak response and a Model 32-XA12 Loop Probe, two inches in diameter.

#### 32-D Specifications

**Frequency Range:** 550 kc. to 25 mc. in five bands.

**Voltage Range:** 1 microvolt to 1 volt.

**Field Intensity Range:** With rod antenna, 2 microvolts to 2 volts.

**Standard Time Constants:** Charge 1 millisecond. Discharge 600 milliseconds.

**Sensitivity:** 1 to 10 microvolts, 5 to 1,000 microvolts, 100 to 10,000 microvolts and 10,000 microvolts to 1 volt. Total of 4 ranges.

**Calibrating Source:** Internal multivibrator.

**Power Supply:** Normally supplied with battery pack, with AC rectifier pack or storage battery packs available.

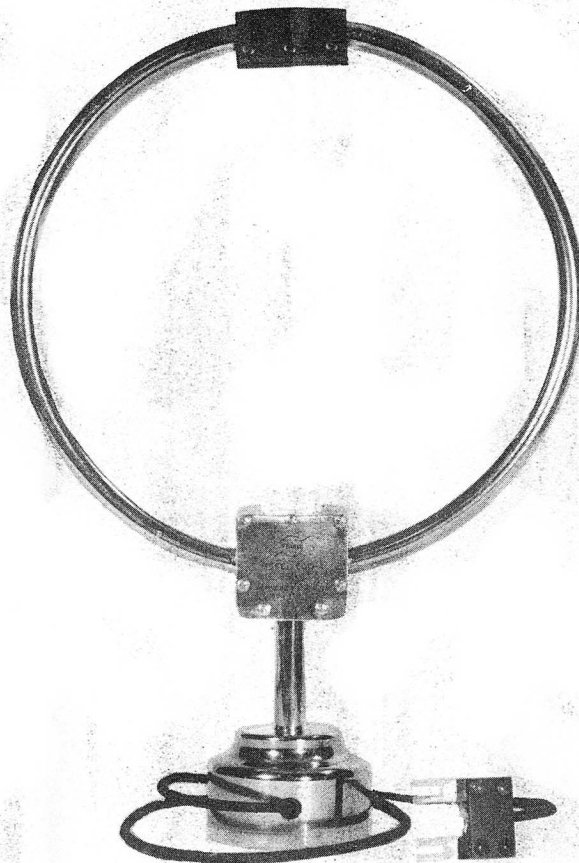
**Accessories:** Supplied with 41 inch telescoping rod antenna plus stub, pair headphones, dummy antenna, 50 ohm matching impedance, input cable, and calibration charts.

**Accessories Available:** AC rectifier pack, storage battery packs, loop antennas, loop probe, and peak reading slidebacker.

**Carrying Dimensions:** Width 7 inches. Depth 14½ inches. Height 17½ inches including cover.

**Net Weight:** 40 lbs.

**Shipping Weight:** 50 lbs. packed in 1 carton.



### THE FERRIS MODEL 500-A SIGNAL GENERATOR LOOP

**T**he Model 500-A Signal Generator Loop is designed for use with any Signal Generator, such as the Ferris Model 16-C, 22-A or 22-D for the purpose of establishing a known field for testing such items as loop receivers, field strength meters, etc.

The loop consists of two turns on a ten inch diameter and double shielded to minimize electrostatic effects. Series resistors in the base of the loop maintain substantially constant current through the loop over its operating range of from 100 KC to 5 MC.

Values are chosen for these resistors such as to establish a field of one tenth of the signal generator output reading at a distance of 24 inches from the center of the loop. Thus, a reading of 10,000 microvolts on the signal generator will create a field intensity of 1,000 microvolts per meter at the loop of a receiver under test, providing the receiver loop is placed 24 inches from the signal generator loop and in the same flat plane.

The field intensity varies inversely as the cube of the

distance between the two loops so the field created at distances other than 24 inches can be readily calculated.

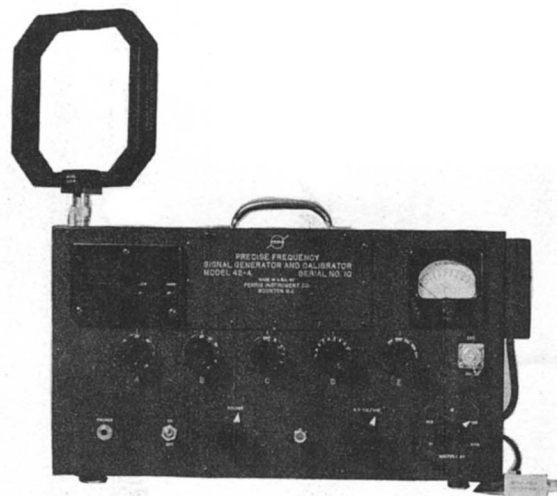
The field intensity is practically constant over the range of from 100 KC. to 2 MC., but falls off to 90% of this value at 5 MC., introducing a 10% error at this highest frequency. For most practical purposes, this error is inconsequential when making field measurements in this region.

The standard Model 500-A Loop is fed from the signal generator by a flexible coaxial cable, with its outer shield grounded to the loop shield and signal generator ground terminal, such as available with standard unbalanced output signal generators.

This cable is supplied with a suitable connection for any specific standard signal generator so it is necessary to specify the model of the generator when ordering the loop.

A heavy base holds the loop in an upright position when placed on a table or other flat surface.





## THE FERRIS MODEL 42-A

### PRECISE FREQUENCY SIGNAL GENERATOR AND CALIBRATOR

#### INTRODUCTION:

The demands for a high degree of radio frequency accuracy are gradually increasing due to the need of making the most effective use of the available spectrum. This is particularly true in the radio communications field where the channel widths are receiving close scrutiny with the thought of further narrowing, possibly with the use of single side band transmission, etc. The secondary crystal controlled standards often require checks against a higher primary standard to maintain the degree of precision required. Radio transmissions from the National Observatories offer the most precise standards available to most laboratories. It is the aim of this new instrument to promote greater use of this primary frequency standard by supplying several keyed frequencies above and below the transmitted signal in a very convenient and useful manner.

#### DESCRIPTION:

The Ferris Model 42-A Precise Frequency Signal Generator and Calibrator employs a new concept of obtaining and maintaining frequency precision by reason of a built in radio receiver tuned to the National Bureau of Standards Station WWV. The instrument may be used in areas where the field strength at 5 megacycles from WWV is 10 microvolts per meter or more, with a signal to noise ratio of at least two to one.

Ordinarily, the signal is picked up by a loop antenna mounted directly on the instrument, although provision is also made to introduce the signal by transmission line from an outdoor antenna when desirable.

The Model 42-A includes a crystal controlled 1 megacycle oscillator, a harmonic of which may be beat with the signal from WWV and the crystal oscillator adjusted for zero beat. The audible beat note may be heard from a loud speaker mounted in the instrument or from plugged in headphones. As a signal generator, the basic 1 mc. crystal frequency, plus various higher harmonics, are available.

These frequencies are metered and attenuated to provide any desired output level from 1 to 100,000 microvolts. The following frequencies are available for use in this manner as a result of multipliers:

1 Megacycle	30 Megacycles
2 Megacycles	40 Megacycles
3 Megacycles	50 Megacycles
4 Megacycles	60 Megacycles
5 Megacycles	80 Megacycles
10 Megacycles	90 Megacycles
20 Megacycles	100 Megacycles

As all of these frequencies stem from the basic 1 mc. crystal controlled oscillator, they have the same percentage frequency accuracy as the crystal which in turn may be kept on exact frequency by zero beating with WWV.

Provision is made in the Model 42-A to beat the above fixed frequencies and their harmonics with various external signals for calibration purposes and the resultant beat notes may be heard in the instrument loud speaker or plugged in headphones. This results in a highly accurate calibrator which may be used to establish innumerable fixed frequency points up to 1,000 megacycles or the 10th harmonic of the 100 mc. output.

Thus, the instrument may be used to accurately establish the frequency of a continuously variable signal generator at various intervals which lie close to the desired operating point. Intervals of 0.5 mc. may be identified up to approximately 20 mc. and 1 mc. intervals up to 100 mc., providing the strength of the unknown external signal is 0.1 volt or more. Comparisons of frequencies corresponding to the direct output of the 42-A can be made with external signal levels as low as 1,000 microvolts.

The Model 42-A may also be used as a termination unit to meter and attenuate an external signal source such as from a shielded oscillator, providing the strength of the oscillator is approximately 1 volt or more at 50 ohms load impedance. It can, therefore, be seen that the frequency of such a shielded laboratory oscillator can first be accurately established by the 42-A, and then it may be used as a standard signal generator by employing the termination feature.

For those located in areas not covered by WWV, but served by standard signals of other frequencies, special versions of the Model 42-A may be obtained to order.

#### 42-A Specifications

**Frequency range:** Fourteen fixed frequencies available as a signal generator in range from 1 to 100 mc. Higher harmonics to 1,000 mc. available as calibrator.

**Dial system:** Frequencies selected by switches, except for direct reading dial in range from 50 to 100 mc.

**Output voltage:** Continuously variable from one to 100,000 microvolts.

**Output system:** Variable metered input to resistance type step attenuator with 50 ohm effective output impedance.

**Calibrator range:** 1 mc. intervals to 100 mc. Harmonics produce higher frequencies to 1,000 mc.

**Power supply:** The standard power supply of the regulated type is designed for 115 volt — 50-60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

**Accessories:** Loop antenna and instruction book.

**Dimensions:** Width 18 inches. Height 10½ inches without loop. Depth 8 inches including controls.

**Net weight:** 26 lbs.

**Shipping weight:** 32 lbs. packed in one carton.



## THE FERRIS MODEL 44-C COMMUNICATIONS F.M. CONVERTER

The Ferris Model 44-C Communications F. M. Converter covers a frequency range of from 200 to 500 kc. and 2 to 55 mc., with F. M. deviation values up to 125 kc. It is designed to operate in conjunction with any suitable external variable oscillator or signal generator capable of supplying approximately 0.7 volt over a frequency range of from 65 to 120 mc. unmodulated.

The Model 44-C is useful in the alignment of the low frequency I. F. transformers and discriminators found in many communication receivers such as those using 290 and 455 kc., as well as other frequencies between 2 and 55 mc. The deviation is sufficient to act as a sweep frequency generator for communication systems and internal modulation frequencies of 60 and 120 cycles are supplied for this purpose. In addition, a variable phase output voltage at 60 cycles is also furnished for the horizontal sweep of the oscilloscope.

Basically, the Model 44-C includes a 5 mc. oscillator frequency modulated by push-pull reactance tubes, giving symmetrical swings each side of a center frequency established by comparison with a 5 mc. crystal controlled oscillator. The 5 mc. F.M. oscillator is multiplied in frequency up to 120 mc., where it is mixed with the variable external source to produce a difference frequency equal to the output of the converter. The output is metered and attenuated to allow levels from 1 to 100,000 microvolts to be selected.

The frequency calibration of the instrument depends upon the calibration of the external variable source as the output frequency is the difference between this source and 120 mc., which is accurately established. Thus, an external source of 115 mc. produces an output frequency, after the built-in mixer, of 120 minus 115 mc. or 5 mc. This mixer output is broadly tuned by the National vernier dial on the converter. Curves are supplied showing the setting of this dial for various output frequencies as well as the correct frequency for the external source.

For difference frequencies below 500 kc., it is important that the external variable oscillator have high stability and complete freedom from hum modulation. A companion unit oscillator having the necessary re-

quirements is available for use with the 44-C. This item, which is known as the Ferris Model 44-D Unit Oscillator, has a frequency range of from 120.0 to 120.5 mc., which produces a difference frequency of from 0 to 500 kilocycles. Of course, when the unit is used with the Model 44-C, the useful F.M. modulated range is from 200 to 500 kc.

### 44-C Specifications

**Frequency range:** 200 to 500 kc. and 2 to 55 mc. in seven bands when used with suitable external generator.

**Dial system:** Planetary drive dial having vernier ratio of 5 to 1. The dial is engraved with 150 divisions over 270 degrees.

**Output voltage:** Continuously variable from 1 to 100,000 microvolts.

**Output system:** Variable metered input to resistance type step attenuator with 50 ohm effective output impedance.

**Modulation:** Internal frequency modulation at 60 and 120 cycles up to 125 kc. deviation, with provision for external modulation up to 10,000 cycles. Both internal and external modulation indicated by meter with dual range.

**Sweep voltage:** Supplies variable phase 60 cycle sine wave for horizontal deflection of scope.

**External generator:** This converter is made for use with a second signal generator or unmodulated oscillator capable of supplying approximately 0.7 volt over the range from 65 to 120 mc. Such a signal may be obtained from Ferris Microvolts such as the Models 18-C, 18-D or 18-FS or sections of the required external signal from the Model 44-D Unit Oscillator.

**Power supply:** The standard power supply of the regulated type is designed for 115 volt, 60 cycle operation. Supplies for other frequencies and voltages may be secured on special order.

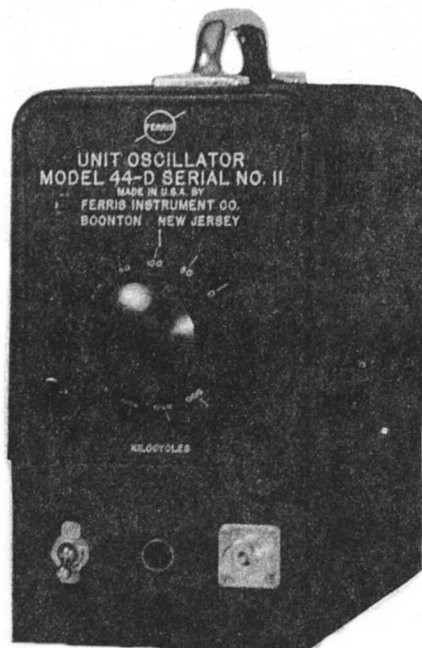
**Accessories:** Mounted calibration charts, calibration curves for each coil range and instruction book.

**Dimensions:** Width, 26 inches. Height, 12½ inches. Depth, 11 inches including controls.

**Net weight:** 40 lbs.

**Shipping weight:** 120 lbs. packed in one wooden case.





## THE FERRIS MODEL 44-D UNIT OSCILLATOR

The Model 44-D Unit Oscillator is particularly designed for use with the Model 44-C Communications F. M. Converter. It has a frequency range of from 120 to 120.5 megacycles which, when mixed with the 120 mc. F. M. signal of the 44-C, produces a difference frequency of from 0 to 500 kc.

A high order of stability and freedom from incidental A. M. or F. M. modulation characterize the Model 44-D Unit Oscillator. This requirement is achieved by the use of an exceptionally well-filtered and regulated plate supply to the type 6AF4A oscillator tube.

Means are provided to "O" set the Model 44-D to exactly 120 mc. by a small knob on the front of the instrument. The main dial then registers the departure or difference frequency up to 500 kilocycles. This range provides frequencies for aligning the intermediate transformers and discriminators of the average communications receiver when the unit is used in conjunction with the Model 44-C Communications F. M. Converter.

The Model 44-D is considerably less expensive than a suitable signal generator for use with the Model

44-C, as well as providing a small compact package. It is furnished with a coaxial cable for connection to the 44-C. Modifications of the Model 44-D for covering frequencies other than from 120 to 120.5 mc. may be obtained on special order.

### 44-D Specifications

**Frequency range:** 120 to 120.5 mc. producing a difference frequency of 0 to 500 kc. when used with the Model 44-C.

**Dial system:** Direct reading planetary type vernier dial calibrated in difference frequencies from 0 to 500 kc.

**Output voltage:** Approximately 1 volt into a 100 ohm load.

**Power supply:** Built-in power supply for use on 115 volts, 50-60 cycles. Other supply voltages and frequencies available on special order.

**Dimensions:** Width, 5 inches. Height, 11 inches. Depth 12 inches.

**Net weight:** 12 lbs.

**Shipping weight:** 17 lbs. packed in one carton.



### FERRIS MODEL 52-D UHF STANDARD SIGNAL GENERATOR

THE Ferris Model 52-D Standard Signal Generator covers the frequency range from 460 to 960 megacycles, and may be used for general purpose testing and development work in this range. It has several features which overcome defects of lower priced instruments and still the cost is less than half that of the so-called precision laboratory class.

For example, the instrument employs a tuned radio frequency amplifier which permits amplitude modulation with negligible frequency modulation, and prevents reaction of the output controls on the oscillator frequency.

Both the oscillator and amplifier operate on fundamental frequencies and each employs a new hinge type tuner of high stability. This tuner affords coverage of the entire range without resort to switching either inductance or capacity.

The output of the Model 52-D is adjustable from 1 to 100,000 microvolts at an output impedance of 50 ohms unbalanced to ground from a type N receptacle on the front panel. Various coaxial type dummy antennas and cables are available, according to customer's specification, if desired.

Internal amplitude modulation at 400 and 1,000 cycles is included with provision for external modulation up to 10,000 cycles. Modulation percentages are read on a separate modulation meter.

The output system includes a four inch output meter with calibrated scale and a decade step attenuator. This attenuator is of special construction and employs coated resistors having excellent high frequency characteris-

tics. Provision is made to check the response of the output meter against a regulated low frequency voltage with means for correction of the meter indication if required on the front panel.

Dual regulated power supplies isolate the oscillator and amplifier with both heater and plate regulation on the oscillator unit. Unless otherwise specified, the Model 52-D is for use on 105-130 volts 60 cycle AC only.

A similar companion instrument, identical in appearance with all the features of the 52-D, but with a frequency range of from 230 to 480 megacycles, is also available. This lower frequency instrument is known as the Ferris Model 52-C Standard Signal Generator.

#### 52-D Specifications

**Frequency range:** 460 to 960 megacycles.

**Tuning system:** New hinge type tuners oscillator and amplifier.

**Dial system:** Worm gear with 100 to 1 ratio with respect to 180 degree main dial.

**Output voltage:** Continuously adjustable from 1 to 100,000 microvolts.

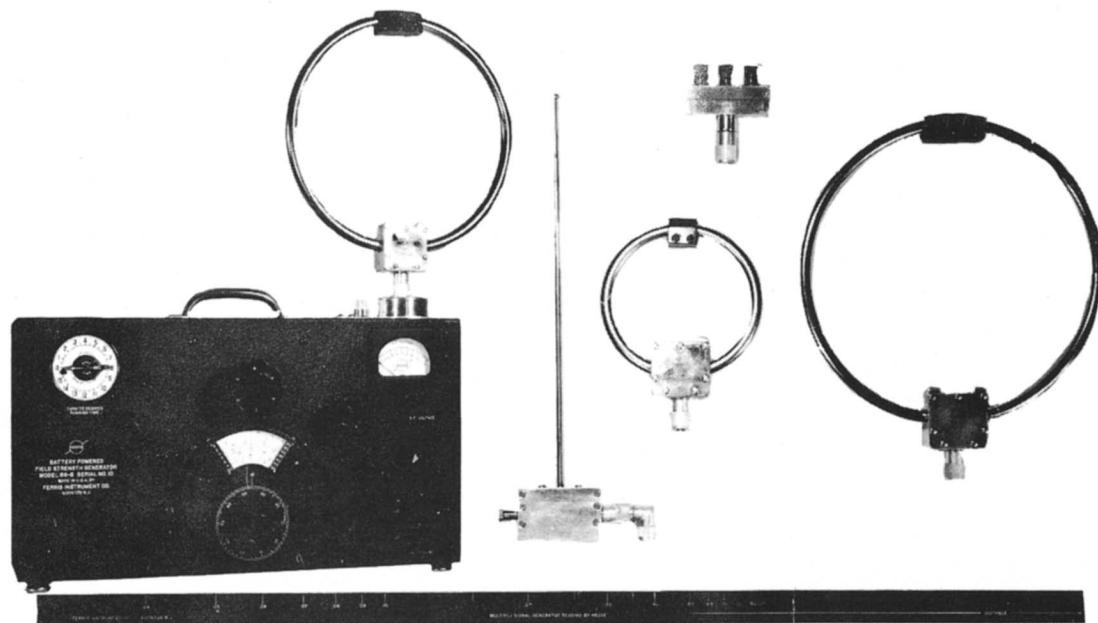
**Output impedance:** 50 ohms unbalanced from type N receptacle on front panel.

**Modulation:** Amplitude modulation up to 50% at 400 and 1,000 cycles with provision for external modulation to 10,000 cycles.

**Power supply:** Built in 105-130 volts at 60 cycles unless otherwise specified.

**Dimensions:** Width 12 inches. Height 16 inches. Depth 21 inches including controls.

**Net Weight:** 62 lbs



### THE FERRIS MODEL 66-B FIELD STRENGTH GENERATOR

**T**HE Ferris Model 66-B Field Strength Generator is essentially a battery operated signal generator with provision for plugging in various transmitting loops for the purpose of creating a known field strength at established distances. This known field strength may be used for testing the sensitivity of loop type receivers, calibrating field strength meters, and numerous other applications. The instrument has a frequency of from 85 kc to 25 mc, and is capable of establishing known field strengths up to 10,000 microvolts per meter at a distance of 24 inches from the transmitting loops, or 100,000 microvolts at approximately 11 inches.

In addition to the transmitting loops, a three terminal output box is provided, with proper terminating resistors, to form a balanced output signal generator for conductive measurements. When this three terminal box is used, in place of the loops, output levels up to 100,000 microvolts per side are obtainable at an output of 15 ohms to ground from each side of the balanced line. The available balanced output from the two outer terminals ranges up to 200,000 microvolts at 30 ohms.

The use of balanced transmitting loops eliminates the error frequently encountered when a measuring loop is connected to a standard signal generator having an unbalanced output. By making the instrument self contained with an internal battery power supply a truly portable instrument is provided for field use. This arrangement also eliminates error due to a common power supply or ground loop.

A two turn loop with a 10 inch diameter is used to cover the range from 85 kc to 1 mc, and a single loop of 10 inches diameter covers from 500 kc to 5 mc. Another single turn loop with a 5 inch diameter is employed from 4 to 25 mc. All of these loops are double shielded and incorporate proper resistance networks in the base to establish correct current through the loop over its working range.

The loops may be rotated at any angle with respect to the instrument and locked in any desired position. Provision is made to insert a yardstick in the loop to determine the distance between transmitting and receiving loops.

The instrument employs six bands with a direct reading hand calibrated dial with vernier reduction for making selectivity measurements. This reduction results in a spread of approximately 4 feet of scale on the 3 inch vernier dial for each band.

In order to provide the balanced output, two separate step attenuators ganged together and two ganged calibrated potentiometers are employed, thus preserving a balanced output from the oscillator. This arrangement results in a single knob control for the calibrated potentiometer and a single knob for the step attenuator, and for all practical purposes the manipulation of the output adjustment is similar to that of the well-known Ferris Model 22-A Signal Generator.

Only one tube is used in the instrument, which makes for long operating life for the ample size batteries in the instrument. The R.F. control on the plate supply battery uses the minimum of plate current necessary to obtain standard output at any particular frequency. As a further safeguard insuring long battery life, a "Mark Time" switch is incorporated in the instrument, which automatically cuts off battery consumption within 15 minutes in the event that the device is inadvertently left on.

#### 66-B Specifications

**Frequency range:** 85 kilocycles to 25 megacycles covered in six self-contained ranges.

**Dial system:** Each range has an individually hand calibrated scale. Additional slow motion dial for selectivity measurements giving scale spread of 4 feet in each range.

**Accuracy of calibration:** Direct reading dial is accurate to plus or minus 1%.

**Output voltage:** Output balance to ground from 1 microvolt to 100,000 microvolts each side to ground.

**Output impedance:** 15 ohms each side to ground or 30 ohms overall with three binding post attachment.

**Output system:** Calibrated output meter and decade step attenuator.

**Power Supply:** From internal batteries. Requires two 6 volt lantern type batteries and two 45 volt "B" batteries.

**Accessories:** Includes three terminal output box for signal generator use. Three loops required to cover full range as desired.

**Dimensions:** Width 18¼ inches, Height 12 inches without loop. Depth 8 inches including controls.

Net Weight: 26 lbs.