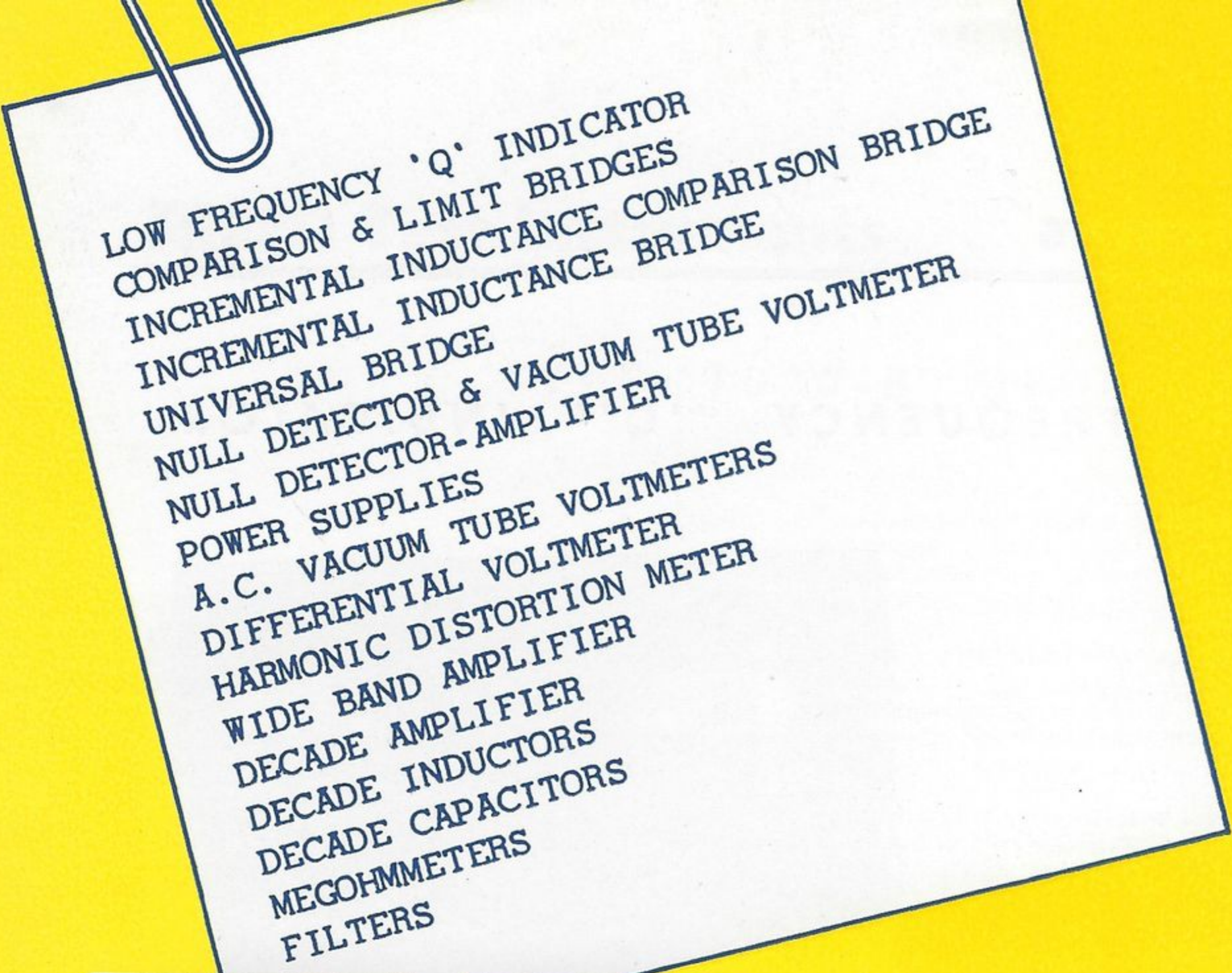




LOW FREQUENCY 'Q' INDICATOR
COMPARISON & LIMIT BRIDGES
INCREMENTAL INDUCTANCE COMPARISON BRIDGE
INCREMENTAL INDUCTANCE BRIDGE
UNIVERSAL BRIDGE
NULL DETECTOR & VACUUM TUBE VOLTMETER
NULL DETECTOR-AMPLIFIER
POWER SUPPLIES
A.C. VACUUM TUBE VOLTMETERS
DIFFERENTIAL VOLTMETER
HARMONIC DISTORTION METER
WIDE BAND AMPLIFIER
DECADE AMPLIFIER
DECADE INDUCTORS
DECADE CAPACITORS
MEGOHMMETERS
FILTERS

FREED

Precision Laboratory Test Instruments

FREED TRANSFORMER CO., INC.

1718 Weirfield St., Brooklyn (Ridgewood) 27, N. Y.

FREED Test Instruments

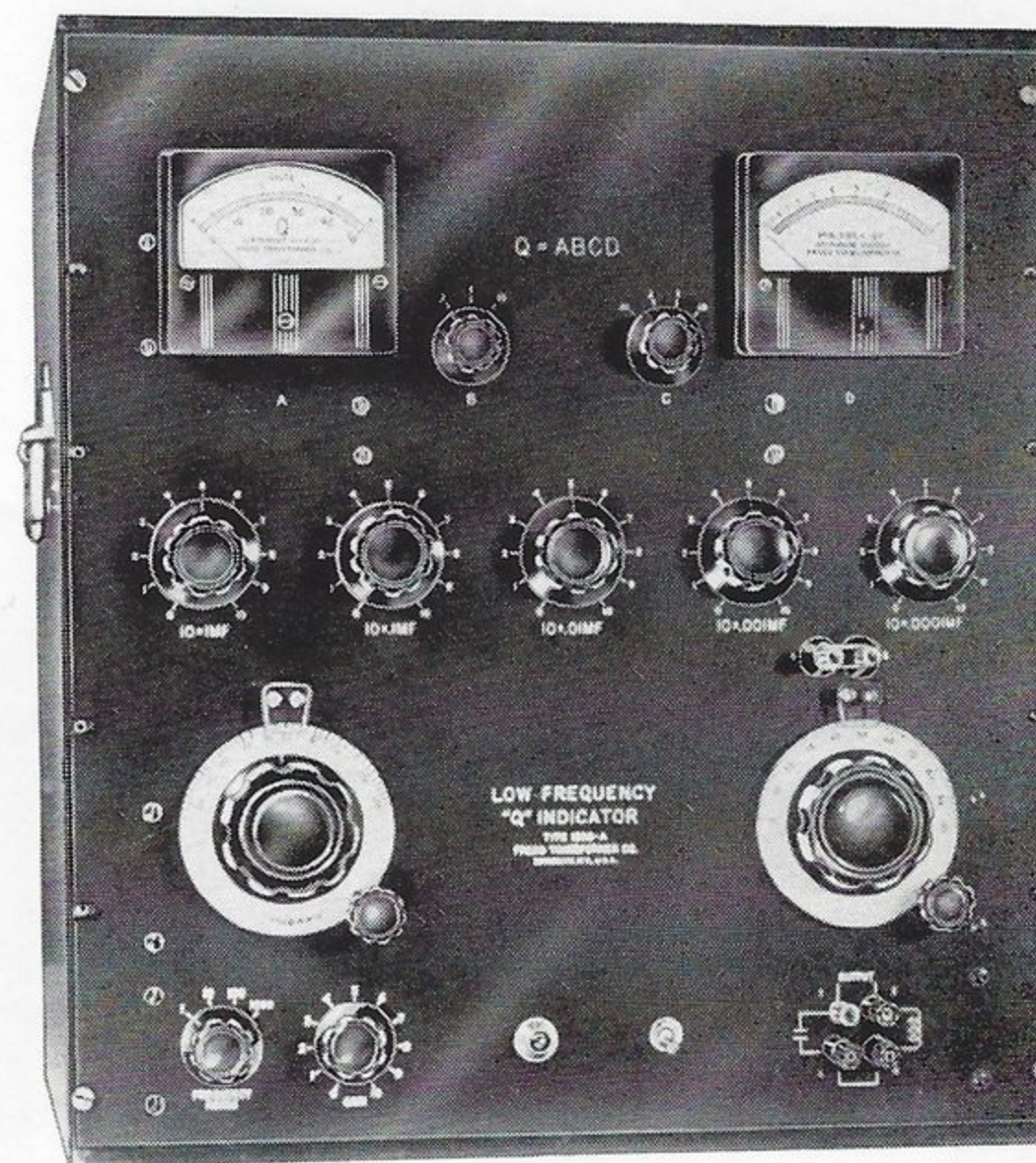
TYPE 1030-A LOW FREQUENCY "Q" INDICATOR

USES

The Type 1030-A Low Frequency "Q" Indicator measures directly the "Q" factor of coils. The instrument can also be used to measure the inductance of coils, distributed capacity, impedances, and dielectric losses. The "Q" Indicator can be used to study the magnetic properties of iron, such as stability of iron cores in function of applied voltages, and iron losses as a function of the frequency.

FEATURES

The main and essential feature of the instrument is that the "Q" factor is read directly without any complicated computations. The possibility of measuring "Q" through the whole audio and supersonic frequency range is provided. The setting up and the measuring of the "Q" of coils is practically instantaneous. The instrument is unaffected by line voltage variations, is entirely self-contained and A.C. operated. Both meters ("multiply-by" and "Q") are protected against overloads and cannot be burned out. The frequency range for "Q" measurements is 20 to 200,000 cycles. The terminals of the variable decade condensers are available directly on the front panel of the instrument. The condensers, therefore, can be used as high quality precision variable condensers. To reduce the residual capacitance a link is provided on the front panel of the instrument which disconnects all but the 100 mmfd variable air condenser. When the link is closed five decade capacitors and the air variable are connected across the condenser terminals. The R. C. Oscillator and variable impedance amplifier can be used as a separate low frequency generator with a maxi-



imum output power of five watts into a 50 ohm load. The "Q" scale is calibrated from 0 to 100. A high accuracy of measurement is obtained, since "Q" variations from 0 to 100 are read on a 4 inch meter. "Q" factors of coils can be measured with up to 100 volts across the coil, and therefore makes it possible to determine the stability and the variations of the "Q" factor of coils in function of the applied voltage. The voltage fed into the series circuit is variable from 10 volts to .01 volt.

SPECIFICATIONS

Range of "Q" Measurements: The range of "Q" factors is from 0.1 to 1000 over the frequency range from 20 to 200,000 cycles with an accuracy of 5%.

Oscillator Frequency Range: Continuously variable from 20 to 200,000 cycles in four ranges.

Frequency Accuracy: 1% under normal temperature conditions. The frequency stability is better than 2% over a long period of time.

Output Impedance and Voltage: Four output impedances are available.

- (a) 10 ohms impedance — 10 V Output Voltage
- (b) 1 ohm impedance — 1 V Output Voltage

(c) .2 ohm impedance — .1 V Output Voltage

(d) .1 ohm impedance — .01 V Output Voltage

These Impedances are measured at 50,000 cy.

Variable Condenser: The variable condenser is composed of a 10 x 1 mfd., 10 x 0.1 mfd., 10 x 0.01 mfd., 10 x 0.001 mfd. and 10 x 0.0001 mfd. decade condenser and a 100 mmfd. variable air condenser.

Power Supply: The instrument is entirely self-contained and A.C. operated. Total consumption 200 watts.

Dimension: $19\frac{1}{2}''$ W x $14\frac{1}{2}''$ D x 23'' H

Weight: 120 lbs.

FREED Test Instruments

TYPE 1020-B MEGOHMMETER



USES

The Freed Type 1020-B Megohmmeter is a self contained and A.C. operated instrument equally useful in the laboratory or for production testing of the leakage resistance of insulation materials, condensers, cables, motors and transformer windings.

FEATURES

Resistance values indicated directly on a four inch meter protected against over-load. Rapid and safe to use, test voltage removed from terminals and capacitive component discharged to ground in all positions of multiplier switch. Low resistance in series with component under test provides very short charging time for even the very largest capacitors. Calibration position provided to check accuracy of 500 volts D.C. potential.

500 volt test supply electronically regulated.

SPECIFICATIONS

Range: 1 megohm to 2,000,000 megohms in six overlapping ranges selected by a multiplier switch.

Accuracy: Plus or minus 3% on resistance values up to 100,000 megohms; plus or minus 5% from 100,000 to 2,000,000 megohms.

Voltages on Unknown: The voltage applied to the unknown terminals is 500 volts D.C. and is independent (less than 1%) of the value of the unknown.

Stability: Line voltage variations from 105-125 volts will cause less than 2% variation in the meter reading.

Power Supply: 105-125 volts A.C. 50-60 cycles 30 watts.

Dimensions: 9½ x 10½ x 8 inches.

Net Weight: 18 pounds.

TYPE 1620 MEGOHMMETER



DESCRIPTION

The instrument is a direct-reading, precision-balanced electronic ohmmeter with a variable D.C. test potential included as part of the unit. The D.C. test potential is variable from 50 to 1000 volts and is indicated by a four inch meter.

The insulation resistance is measured in six overlapping ranges and is indicated by a four inch meter, protected against overload. A relay, operated from the front panel, disconnects the high voltage from the test terminals and eliminates all danger of shock due to exposed high potential. In the standby position (when push button is released) a resistance is connected between the chassis and the high voltage terminal, so that when measuring capacitors the danger of shock is eliminated when disconnecting the component under test.

CONTROLS

1. Range selector and calibrating switch.
2. Zero adjust control for setting meter scale to infinity.
3. Push button switch for activating the relay which applies test voltage to terminals — when released, discharges capacitive component across the unknown terminals.
4. Variable D.C. adjust — for setting the D.C. test voltage at desired level.
5. A.C. on off switch.

SPECIFICATIONS

Range: .5 megohms to 4,000,000 megohms in six overlapping ranges selected by a multiplier switch.

Accuracy: Plus or minus 5%.

Voltages on Unknown: The voltage applied to the unknown terminals is continuously variable from 50 volts to 1000 volts. A 4" meter indicates the voltage applied to the unknown.

Terminals: Four terminals are provided, two for connecting the unknown, one guard and one ground.

Tube Complement 1 — 6C4, 1 — 12AU7, 1 — 0B2.

Power Supply 105-125 volts A.C.

Cabinet: 15" x 9" x 7½"

FREED Test Instruments

TYPE 1010-A COMPARISON AND LIMITED BRIDGE

USES

This instrument is a comparison and limit bridge for use in both laboratory and production testing of resistors, condensers and inductors. The manufacturer of these components can use it for production tests, the user for incoming inspection and acceptance tests. The instrument is particularly useful for laboratory work (bridge or filters) where very accurate components are required.

FEATURES

For precision and production testing, the bridge has many advantages. Power line operation and the visual indicator make the instrument completely self-contained. It can be used in noisy locations. Its small size and light weight permit the instrument to be moved easily and to be set up wherever necessary.

DESCRIPTION

The instrument is composed of an oscillator, a bridge and a selective amplifier. The oscillator output is coupled into the bridge through a shielded isolation transformer. A switch is provided which connects either a high or low impedance winding across the bridge, consisting of two fixed resistors, the unknown impedance and the standard. A variable resistor between the two fixed resistors makes it possible to read the percentage difference between the unknown and the standard on a specially calibrated dial. A high gain selective amplifier indicates the balance of the bridge. The general method of testing is the comparison of an unknown component with a standard component of the same type. Accurate percentage measurements are obtained by the use of precision components in the arms of the bridge. The use of high gain amplifier and adequate internal shielding assures a very sharp and distinct balance.

A visual null indicator, consisting of a meter used in connection with the high gain amplifier makes it possible to use the No. 1010-A Bridge as a precision limit bridge in production testing.



SPECIFICATIONS

Frequency: Three test frequencies are available: 50 or 60 cycles, 1000 cycles and 10,000 cycles.

The 50 or 60 cycles are taken from the line. The 1000 and 10,000 cycles are generated by an oscillator and are accurate to within $\pm 2\%$.

Range: Two comparison ranges are provided. 5% and 20%. The percentage difference is read directly on a calibrated dial.

Resistor Measurements: Resistors from 1 ohm to 20 megohms may be compared at 60 cycles to an accuracy of $\pm 0.1\%$.

Condenser Measurements: Condensers from 50 mmfd to 10 mfd are measured at 1000 cycles. Condensers above 10 mfd are measured at 60 cycles. Condensers below 50 mmfd may be measured if the ground-unground switch is in the unground position.

Inductor Measurements: Inductors may be measured at

60, 1000 or 10,000 cycles depending on their value. Range: 10 microhenries to 1000 henries.

Accuracy: On the 5% position the components can be adjusted to within an accuracy of $\pm 0.1\%$.

Voltage Applied to the Unknown: Two controls are provided to vary the voltage across the unknown. A special low impedance winding is used when measuring small impedances and the voltage across these may be varied from .1 to 1 volts. For higher values of impedance the voltage may be varied from .5 to 15 volts.

Power Supply: 105-125 volts; 50-60 cycles.

Tube Complement: The following tubes are required and supplied with the instrument: 1-6X4, 1-6AQ5, 1-12AX7, 2-12AU7.

Portable: Carrying cabinet of all metal construction.

Dimensions: 10 $\frac{1}{2}$ " x 12" x 12". **Net Weight:** 17 lbs.

TYPE 1870 INCREMENTAL INDUCTANCE COMPARISON BRIDGE

USES

The Freed Type 1870 is designed for rapid production testing of transformers and chokes under actual operating conditions.

The unit consists of a variable D.C. Supply (0 to 500 ma) a 60 cps. variable supply (0 to 135 volts) a comparison circuit and a vacuum tube voltmeter.

SPECIFICATIONS

Inductance Range: 25 mh to 25 h.

Deviation Range: $\pm 20\%$ with an accuracy of 1%. $\pm 50\%$ with an accuracy of 5%.

Frequency: The line frequency is used for most measurements. If another frequency is desired a jack is provided for connecting an external oscillator.

Voltage Applied to Unknown: Variable from 0 to 135 volts.

D.C. Current Range: 0 to 500 ma in four overlapping ranges, 0-5 ma, 0-25 ma, 0-100 ma, 0-500 ma.

Vacuum Tube Voltmeter: .01, .1, 1, 10, and 100 volts full scale.

Power Supply: The instrument is entirely self contained and operates on 100-125 volts, 50-60 cycles.

Dimensions: 19 $\frac{1}{2}$ " high x 22" wide x 15" deep.



FREED Test Instruments

TYPE 1110-A INCREMENTAL INDUCTANCE BRIDGE



USES

The Incremental Inductance Bridge is designed for measuring the inductance of Iron Core components at any frequency up to 10,000 cycles. Inductors can be measured with a superimposed direct current, therefore, the bridge will measure the incremental inductance of coils. The bridge can be used for determination of storage factor, "Q", either at a given frequency in function of the applied voltage or at a given voltage in function of the applied frequency. The bridge can be used by the manufacturers of iron core components, such as filter chokes, high Q coils, and iron core audio and supersonic frequency components. Due to its very wide inductance range the instrument can be used as a general purpose laboratory inductance bridge.

SPECIFICATIONS

Inductance Ranges: One millihenry to one thousand henries in five ranges. Inductance values are read directly from a four dial decade and a multiplier switch. The last range may be extended to 10,000 henries through the use of an external resistance.

Conductance Ranges: One micromho to one mho in five ranges, read directly from a four dial decade and a multiplier switch. This conductance represents the reciprocal of the A.C. resistance of the coil.

"Q" Range: "Q" is measured as the product of Inductance (L) and Conductance (G). The range of "Q" measured on the bridge is 0.5 to 100. Measurement of inductance is independent of the values of "Q."

Accuracy: 1% through the frequency range from 60-1000 cycles 2% for frequencies from 1000 to 10,000 cycles. This accuracy is decreased for extreme positions of the multiplier. Conductance measurements 5% from 60-1000 cycles.

Frequency Range: The bridge is calibrated and adjusted at both 60 and 1000 cycles, but can be used at any frequency up to 10,000 cycles. Errors resulting from stray capacity increase with frequency. A compensated bridge with lower stray capacities is available for making more accurate inductance measurements of large inductors at higher frequencies. Order Freed Model 1110A-B.

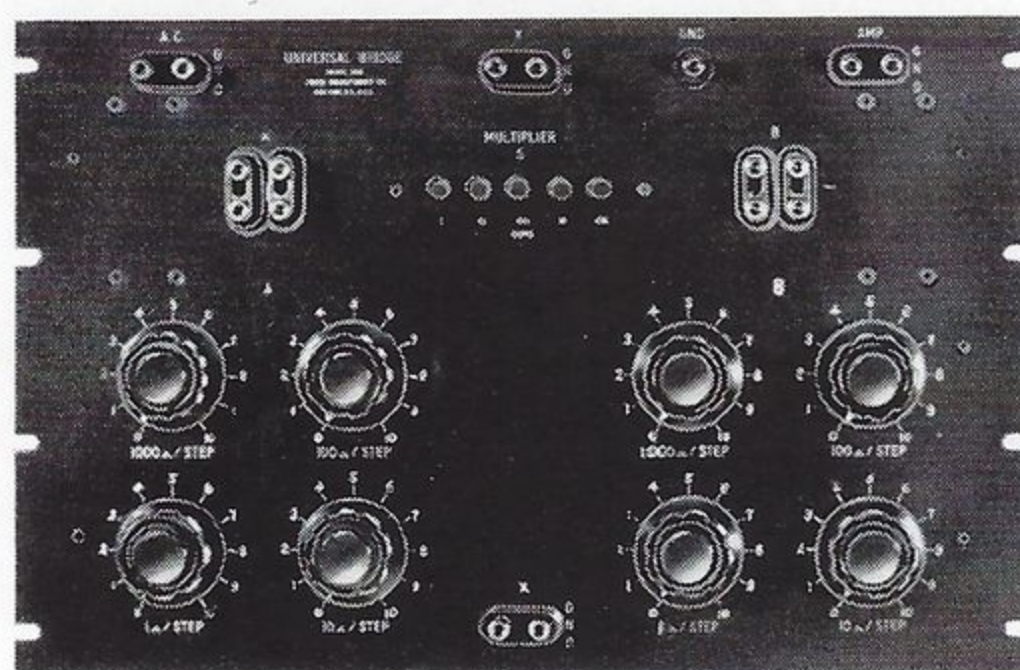
Range of Superimposed D.C.: On multiplier switch position L X 100 the D.C. is limited to 10 ma.

On the position L X 10, the D.C. is limited to 250 ma.

On all other positions the D.C. can be one ampere maximum.

Mounting: The bridge is supplied in a walnut cabinet or on special order for standard rack mounting.

	W	D	H	
Dimensions: Rack	19"	8"	14"	Net Weight: Rack, 37 lbs.
	Cabinet	21"	8"	14 5/8" Cabinet, 48 lbs.



TYPE 1150 UNIVERSAL BRIDGE

FEATURES

The Universal Bridge offers a variety of five possible bridge circuits. A wide range of capacitance, inductance, impedance, and phase angle measurement can be made throughout the frequency spectrum from 20 cycles to 20,000 cycles.

Decade resistors in the variable arms allow the unknown to be measured to four significant figures.

Operation is simple and both terminals and controls are arranged for convenience and ease of measurements.

SPECIFICATIONS

Frequency Range: The bridge can be used at frequencies from 20 cycles to 20,000 cycles.

Accuracy: All resistors of the bridge arms are adjusted to 0.1%. The absolute accuracy of measurement will depend upon the accuracy of standards used.

Inductance Range: The bridge will measure inductance of coils from 0.1 mh to 1000 henries with an accuracy of 0.5% at 1000 cycles.

Capacitance Range: Condensers from .001 mf to 1 mf can be measured to within 0.5% at 1000 cycles. Condensers below .001 mf should be measured by the substitution method.

Mounting: The bridge is supplied in a walnut cabinet or on special order for standard rack mounting.

	W	D	H	
Dimensions: Rack	19"	8"	14"	Weight: 32 lbs.
	Cabinet	21"	8"	16 5/8" Weight: 43 lbs.



TYPE 1180 A.C. SUPPLY

A valuable laboratory instrument with continuously variable output from 1/10 volt to 100 volts at 60 cycles.

Dimensions: Width 19"; Depth 5"; Height 7".

Weight: 13 1/2 lbs.

FREED Test Instruments

TYPE NO. 1170 D.C. SUPPLY

USES

The Type 1170 Power Supply is intended to be used as a dependable source of direct current for the Incremental Inductance Bridge Type No. 1110-A. The supply can also be used as a general laboratory substitute for a high voltage storage battery.

DESCRIPTION

The Type 1170 D.C. supply consists of an electronically regulated high voltage supply. Four independent control circuits provide four current ranges, namely 5 milliamperes, 25 milliamperes, 100 milliamperes and 500 milliamperes. The output current is indicated by a multirange 4" meter.

SPECIFICATIONS

Current Ranges: Four current ranges — 5, 25, 100 and 500 milliamperes.

Voltage Ranges: The maximum no load voltages corresponding to the four current ranges are the following: 500 MA — 270 volts, 100 MA — 270 volts, 25 MA — 55 volts, 5 MA — 25 volts. On both 500 MA and 100 MA range with the control set to zero, the output voltage is independent of the load.

Voltage Regulation: The unit operates from a 115 volts, 50-60 cycle line. For a line variation of plus or minus 10%, the output voltage shall not vary more than $\pm 1\frac{1}{2}\%$.

Power Consumption: Under 500 MA full load the power consumption is 360 watts. Under no load conditions the consumption is 150 watts.

Hum Level: On the 270 volt, 500 milliamperes range the hum level under full load condition is 6 millivolts which corresponds to -93 Db.



Mounting: The instrument is supplied for mounting on a 19-inch relay rack or for cabinet mounting.

Dimensions: Rack: 19" W. x 12 $\frac{3}{16}$ " D. x 12 $\frac{1}{4}$ " H. Cabinet: 21 $\frac{1}{2}$ " W. x 15" D. x 14" H.

Net Weight: Rack Mounted — 68 lbs. In Cabinet — 89 lbs.

TYPE 1210-A NULL DETECTOR AND VACUUM TUBE VOLTMETER

USES

The Type 1210-A Null Detector and Vacuum Tube Voltmeter is primarily designed for bridge measurements. The Null Detector indicates the balance of the bridge, and the Vacuum Tube Voltmeter indicates the voltage across the unknown two terminal or four terminal network. The three selective circuits provide means for sharply tuning the instrument to audio frequencies commonly used for measurements. The Vacuum Tube Voltmeter can be used as a general purpose audio Vacuum Tube Voltmeter.

DESCRIPTION

The Type 1210-A Null Detector and Vacuum Tube Voltmeter is a combination of the Model 1140 Null Detector Amplifier, and a modified Model 1060 high input impedance Vacuum Tube Voltmeter. Both instruments are independent and feed two separate 4" meters.

SPECIFICATIONS

NULL DETECTOR

Input Impedance: 1 megohm in parallel with 25 mmf.

Frequency Response: 2 db from 20 to 20,000 cycles — 5 db at 50,000 cycles.

Null Detector Sensitivity: At 1000 cycles, 100 microvolts will give a 15% meter deflection.

Selective Amplifier: 26 db second harmonic attenuation at 60, 400 and 1000 cycles. Selectivity at any other frequency between 20 cycles and 20 kc. may be obtained by connecting Freed Model 1940 to the external filter jack.

VACUUM TUBE VOLTMETER

Voltage Range: .01 volts to 100 volts in four ranges—(0.1 — 1 — 10 — 100 volts at full scale.)



Accuracy: 2% of full scale on all four ranges.

Waveform Error: The instrument is a full wave average meter and is free of turnover effects. For small amounts of distortion the accuracy of the instrument is independent of the waveform.

Frequency Range: 20 cycles to 200,000 cycles (1 db).

Input Impedance: Equivalent to 50 megohms resistance in parallel with a 25 mmf condenser.

Meter Scale: Logarithmic Voltage Scale calibrated from 1 to 10 plus a linear db scale calibrated from 0 to 20 db.

Dimensions: Rack Mounting 19" x 9" x 11 $\frac{1}{2}$ ".

Net Weight: 25 lbs.

TYPE 1140-A NULL DETECTOR-AMPLIFIER

USES

The Freed Model 1140-A Null Detector Amplifier is a sensitive null indicator for bridge measurements, providing visual null indications or aural when used in conjunction with headphones. The unit may also be used as a high gain amplifier for general laboratory work.

DESCRIPTION

Functionally the instrument consists of a high gain linear amplifier with a 30 db. input attenuator in addition to the variable gain control. A four-inch panel meter provides visual null indications, the response of the meter circuit is approximately logarithmic over a 40 db. voltage range. Resonant circuits tuned to 60, 400 and 1000 cycles limit the amplifier transmission characteristics to the three audio frequencies commonly used for bridge measurements or it may be used as a non-selective amplifier with filter "off."

SPECIFICATIONS

Input Impedance: 1 megohm in parallel with 25 mmf. **GAIN:** 98 db. with 1 megohm load (6 mmf. shunt capacity), down 1.5 db. at 25,000 cycles, down 5 db. at 50,000 cycles, down 2 db. at 20 cycles.

Null Detector Sensitivity: At 1 kc. 100 microvolts will give a 15% meter deflection.

Selective Amplifier: 26 db. second harmonic attenuation at 60, 400 and 1000 cycles. Selectivity at any other frequency between 20 cycles and 20 kc. may be obtained by connecting Freed Model 1940 to the external filter jack.

Output Impedance: Approximately 50,000 ohms.

Output Voltage: 40 volts undistorted into 1 megohm load, 10 volts into 20,000 ohms.

Power Supply: 105-125 volts, 50-60 cycles, 35 watts consumption.

Mounting: This instrument can be supplied in cabinet model (Type No. 1140-A) or in a standard relay rack mount with dust cover (Type No. 1140-AR).

Dimensions: (Type No. 1140-A) 13 $\frac{1}{2}$ " x 8 $\frac{1}{2}$ " x 10" overall (Type No. 1140-AR) 19" L. x 8 $\frac{3}{4}$ " W. x 9" D.

Weight: 24 lbs.



FREED Test Instruments

TYPE 1040 A.C.-V.T. VOLTMETER



USES

The type 1040 Vacuum Tube Voltmeter is a high impedance wide frequency range voltmeter which can be used at audio and supersonic frequencies. It is particularly recommended for (1) vibration studies involving very low frequencies, (2) frequency characteristics and gain measurements on amplifiers, (3) transmission losses on telephone circuits: filter and carrier systems up to 250,000 cycles, and (4) acoustic measurements, such as, determination of frequency response of microphones and loudspeakers. Because of the high sensitivity of the instrument, the voltmeter can be advantageously used as a null detector in A.C. bridge measurements. In addition to its use as a voltmeter, the instrument can be used as an ammeter to measure a wide range of currents by connecting it across suitable resistors. An output jack is provided so that the instrument may be used as an amplifier.

FEATURES

Because of the low input capacity, a high value of input impedance is maintained over the five ranges of the voltmeter. A balanced rectifier, a balanced D.C. amplifier circuit, and a high amount of degeneration throughout the amplifier makes it independent of line voltage variations and changes in tube characteristics. A very important feature of the instrument is the logarithmic voltage scale of the meter. With this type of scale, the percentage accuracy of reading is uniform over the entire scale. Another advantage of the logarithmic scale is that it provides a uniform decibel scale which is a very valuable feature in sound and communication measurements. A zero adjustment and full scale adjustment are provided. These two con-

trols serve for all ranges and no re-setting is necessary when switching from one range to another. The time constant of the instrument is adjusted in order to read very low frequencies of 7 to 10 cycles without any vibration of the needle. The circuit of the meter is arranged so that it cannot be burned out by any overload of the instrument. The vacuum tube voltmeter is small, compact, entirely self-contained, A.C. operated.

SPECIFICATIONS

Voltage Ranges: .001 volts to 100 volts in five ranges (.01, .1, 1, 10, and 100 volts full scale).

Accuracy: 2% of full scale on all five ranges, on sinusoidal voltages.

Waveform Error: The instrument is a peak voltmeter calibrated to read RMS values. On distorted wave-forms, the percentage deviation of the reading from RMS values may be as large as the percentage of the harmonics present.

Frequency Ranges: 10 to 250,000 cycles, .1 db. variation from 20 cycles to 150,000 cycles; .50 db. variation from 10 cycles to 200,000 cycles.

Input Impedance: Equivalent to 500,000 ohm resistance in parallel with a 15 mmf. condenser.

Stability: Effect of variation in line voltage from 100 volts to 125 volts is 1%. Effect in changes of tubes is less than .5%.

Scale: Logarithmic voltage scale calibrated from 1 to 10 plus a linear decibel scale calibrated from 0 db. to 20 db.

Meter: 4" suppressed zero 1 MA meter protected against overloads.

Power Supply: The instrument is entirely self-contained and operates on 100-125 volts, 50-60 cycles. Total consumption, 40 Watts.

Dimensions: 4 $\frac{7}{8}$ " x 5 $\frac{5}{8}$ " x 9 $\frac{7}{8}$ ".

Weight: 12 pounds.

TYPE 1060 VACUUM TUBE VOLTMETER

USES

The Type 1060 Vacuum Tube Voltmeter is a high impedance, wide frequency range voltmeter which can be used at audio and supersonic frequencies. It is particularly recommended for

1. Determining transmission losses on — telephone circuits, filter and carrier systems up to 300,000.
2. Making high impedance tuned circuit measurements where the high input resistance and low capacity of the instrument are invaluable.
3. Determining frequency characteristics and making gain measurements on amplifiers.
4. Making acoustic measurements, such as, determination of frequency response of microphones and loudspeakers.
5. Observing vibration studies involving very low frequencies.

Because of the high sensitivity of the instrument, the voltmeter can be advantageously used as a Null Detector in A.C. bridge measurements. In addition to its use as a voltmeter, the instrument can be used as an ammeter to measure a wide range of currents, by connecting it across suitable resistors.

FEATURES

Because of the low input capacity, a high value of the input impedance is maintained over the five ranges of the voltmeter. A high amount of degeneration throughout the amplifier makes it independent of line voltage variations and changes in tube characteristics. A very important feature of the instrument is the logarithmic voltage scale of the meter. With this type of scale, the percentage accuracy of reading is uniform over the entire scale. Another advantage of the logarithmic scale is that it provides a uniform decibel scale, which is a very valuable feature in sound and communication measurements. A full scale adjustment is provided. This control serves for all ranges and no re-setting is necessary when switching from one range to another. The time constant of the instrument is adjusted in order to read very low frequencies of 7 to 10 cycles without any vibration of the needle.

SPECIFICATIONS

Voltage Ranges: .001 volts to 100 volts in five ranges (.01, .1, 1, 10 and 100 volts full scale).

Waveform Error: The instrument is a full wave average meter, and is free of turnover effects. For small amounts of distortion the accuracy of the instrument is independent of the waveform.

Frequency Range: 20 cycles to 300,000 cycles.

.1 db variation from 20 to 200,000 cycles.

.5 db variation from 10 to 300,000 cycles.

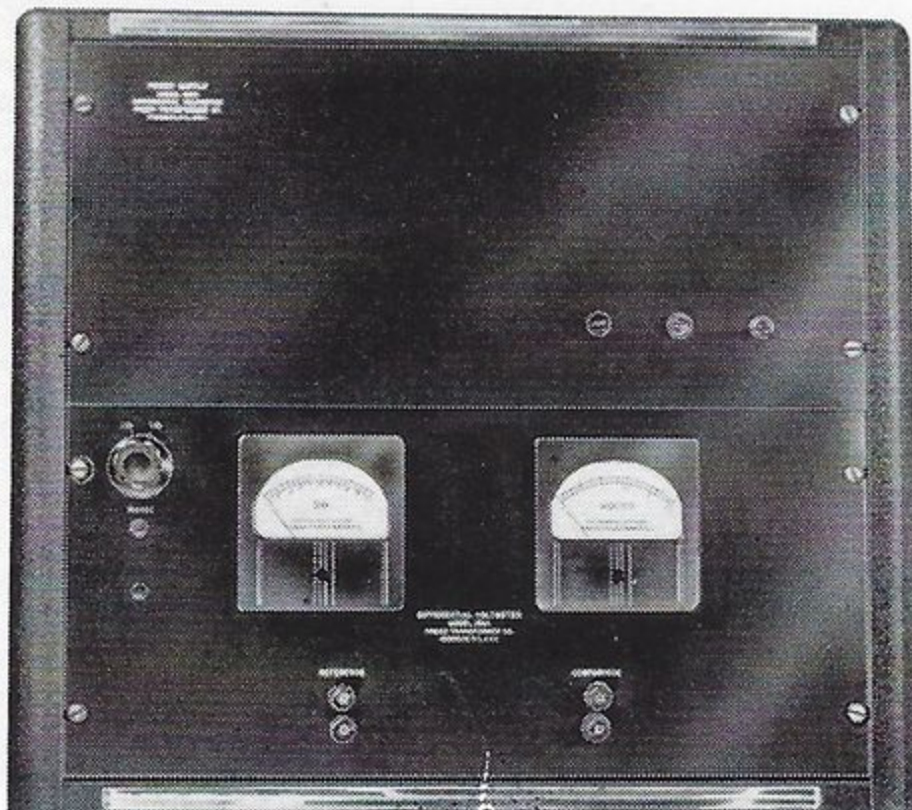
Input Impedance: Equivalent to 50 megohms resistance in parallel with a 15 mmfd condenser.

Stability: Effect of variation in line voltage from 100 volts to 125 volts is less than 2%. Effect in changes of tubes is less than $\frac{1}{2}$ %.



FREED Test Instruments

TYPE 1560 DIFFERENTIAL VOLTMETER



USES

The Freed Type 1560 difference voltmeter has been designed to measure difference in voltage levels as low as .05 db. It is extremely useful when checking response and attenuation of filters, transformers and amplifiers. Because of its excellent stability and high sensitivity the type 1560 difference voltmeter may also be used to observe drift in amplifiers meters and filters.

SPECIFICATIONS

Difference Voltage: 0.01 db to 1 db., 0.1 db, 1 db full scale.
Accuracy: .01 db.
Frequency Range: 30 cps to 200,000 cps.
Input Impedance: 1 megohm.
Reference Voltage: 2 volts monitored by vacuum tube volt meter on 4" meter scale.
Scale: Calibrated in db. 4" meter protected against overload.
Power Supply: The instrument operates from a 100 to 125 volt 50 to 60 cycle line.

TYPE 1580 DB DECADE AMPLIFIER

USES

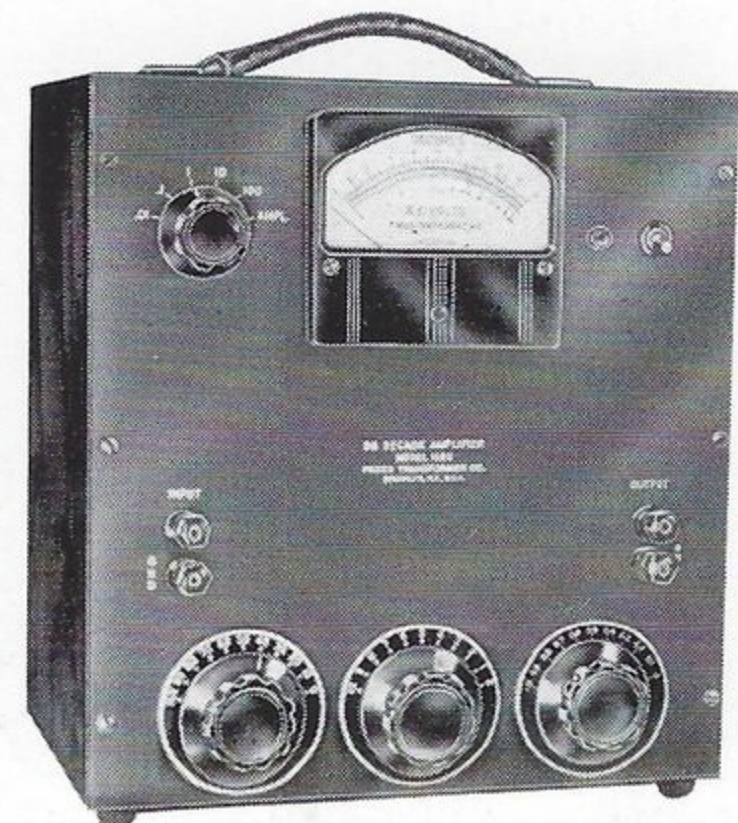
The Freed Type 1580 db Decade Voltmeter is intended to be used as a dependable means of measuring transformer turns ratio, and transformer, filter or amplifier attenuation. These measurements may be made to an accuracy of .1 db.

DESCRIPTION

Functionally, the instrument consists of a high impedance input cathode follower, a precision 6-step attenuator, a preamplifier, three db decade attenuators (10 db/step, 1 db/step and 0.1 db/step.) A high amount of degeneration throughout the amplifier makes it independent of line voltage variations and changes in tube characteristics. The 4" meter is protected against overload.

SPECIFICATIONS

Voltage Ranges: 0.001 to 100 volts in five ranges (0.01, 0.1, 1, 10 and 100 volts full scale).
Accuracy: 2% of full scale on all ranges.
Waveform Error: The instrument is a full wave average meter and is free of turnover effects.
Frequency Range: 20 cycles to 200,000 cycles.
Input Impedance: Equivalent to 50 megohms resistance in parallel with 25 mmfd condenser.
Meter: 4" meter protected against overload.
DB Attenuators: Three ten position db attenuators (10 db/step, 1 db/step and 0.1 db/step).
Dimensions: 11" x 12" x 10½".



TYPE 1570 COMPARISON BRIDGE

USES

The Type 1570 is a direct reading comparison bridge which may be used to compare a wide range of inductors. The per cent difference between the standard and unknown component is indicated quickly and accurately on a 5" meter. The instrument may be calibrated to indicate inductance directly.

Two deviation ranges are provided: $\pm 5\%$ and $\pm 20\%$. On the 5% range, units can be compared to an accuracy of $\pm 0.1\%$.

DESCRIPTION

For precision and production testing the direct reading comparison bridge has many advantages. The unit is entirely self contained and A.C. operated. By providing a minimum of operating controls the unit has been designed to be used by even the most inexperienced operators. The per cent deviation is indicated quickly and accurately on a 5" meter.

SPECIFICATIONS

Deviation Range: $\pm 5\%$ and $\pm 20\%$ indicated on a 5" meter.
Accuracy: $\pm 0.1\%$.
Test Frequency: 1000 cycles.
Inductance Range: 1 mh to 10 h.



FREED Test Instruments

TYPE 1940 INTERSTAGE FILTER

USES

This filter may be used with the Freed Type 1140-A null detector and Type 1210-A null detector VTVM or similar amplifiers. It can be set to any one of 7 fixed frequencies to reduce noise and harmonics when making bridge measurements.

DESCRIPTION

The filters are parallel resonant circuits, and are designed to be used in the plate circuit of the amplifier. D.C. current through the inductor is limited to 3 ma. Terminals are provided for connecting an external capacitor to tune to any frequency between 20 cps and 20 kc.

FEATURES

1. Each of 7 tuned frequencies is quickly available.
2. Any resonant frequency between 20 cps and 20 kc can be obtained with external capacitors.
3. Sharp anti resonant tuning.
4. Can be used directly in plate circuit.



SPECIFICATIONS

Frequencies: 100 cps, 200 cps, 500 cps, 800 cps, 1200 cps, 2000 cps and 10 kc adjusted to an accuracy of $\pm 2\%$. Discrimination vs. 2nd harmonic approximately 23 db.

Terminals: Shielded cord and plug for connection to null detector. Binding posts for connecting external capacitors.

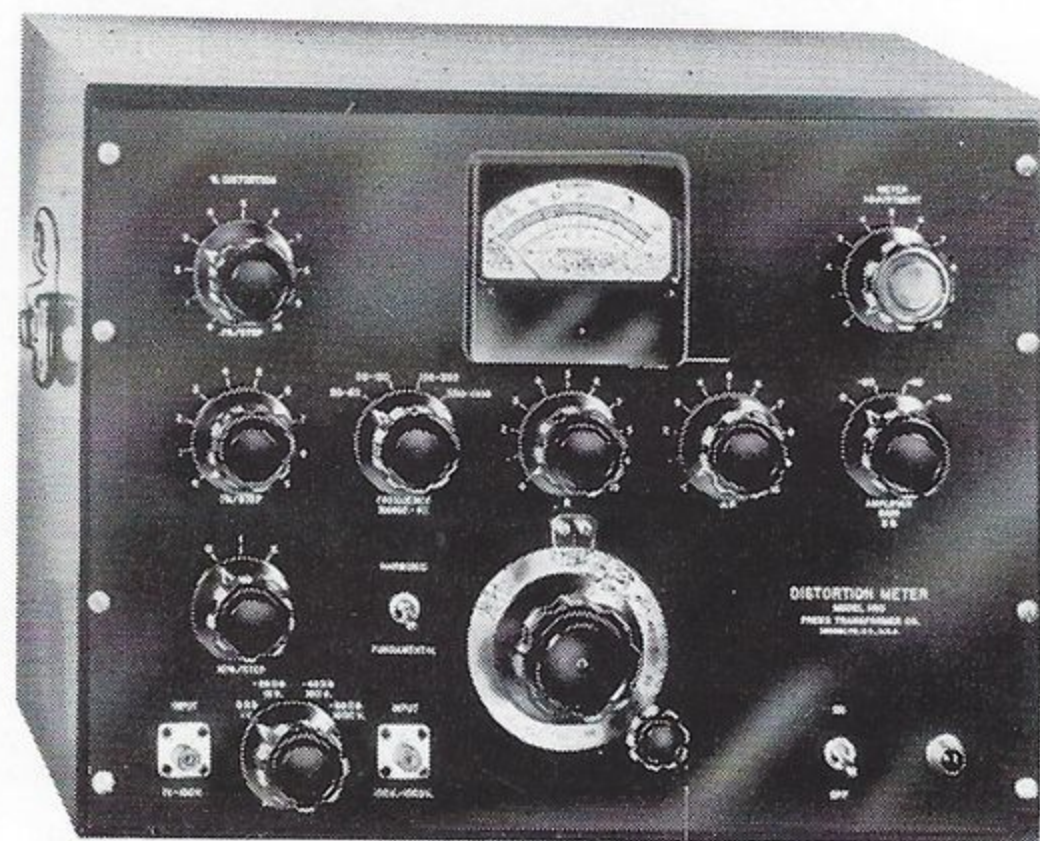
Dimensions: 6" x 6" x 6".

SERIES 1950 NULL "T" FILTERS

The Freed Series 1950 Null T networks consist of two resistance capacitance networks, whose outputs completely cancel each other at the balance frequency. They may be used as rejection networks particularly at low frequencies where LC filters become excessively large.

Standard models are available for 30, 60 and 120 cycles in a wide range of impedances. Each network will give a minimum of 50 db attenuation of the null frequency.

The null frequency is adjusted to a tolerance of $\pm 2\%$.



TYPE 1410 DISTORTION ANALYZER

USES

The Type 1410 Distortion Meter may be used in the laboratory or in production testing of receivers, amplifiers and oscillators.

DESCRIPTION

The instrument consists of a capacitive input attenuator, a low impedance output preamplifier, a null T network and a high gain vacuum tube voltmeter.

The signal to be measured is applied to the capacitive input attenuator, which reduces it sufficiently so that it may be fed into a three stage distortionless amplifier. The output impedance of this amplifier is 1 ohm due to the high amount of inverse feed back applied. In order to prevent the amplifier from being driven into non-linearity, a monitoring circuit is included in the instrument.

The attenuated signal is fed into a null T network which completely eliminates the fundamental. The residual signal consists wholly of harmonics and noise, and this is measured by the vacuum tube voltmeter.

The null T network is now switched out of the circuit and the signal level is attenuated by a calibrated resistive divider. When the voltmeter indicates the same level as the level of harmonics, the divider reads the percentage distortion directly.

FEATURES

The high sensitivity of the instrument permits measurements to be made on signals as low as 0.2 volts to an accuracy of 0.1%. Signals as high as 1000 volts may be applied to the input terminals directly.

The frequency range of the instrument is 20 kc to 1 mc. in 10 overlapping ranges. Frequencies up to 3 mc. are passed without attenuation by the amplifier circuits, so that distortion measurements can be made on fundamental frequencies up to 1 mc.

An isolation transformer and line filter provided with the instrument prevent any feedback through the power line.

SPECIFICATIONS

Frequency Range: 20 kc to 1 mc.

Input Impedance: 500,000 ohms shunted by 70 mmfd. (plus capacity of input cable) on all ranges but the 0.1 volt range. The shunt capacity on this range is 800 mmfd.

Accuracy: Harmonic Distortion can be measured accurately to 0.1%.

Sensitivity: Distortion levels of 0.1% can be read accurately for a signal input as low as 0.2 volts. Maximum input signal is 1000 volts rms.

Elimination Characteristics: Eliminates fundamental completely while attenuating second harmonic approximately 3%.

Power Supply: 105-125 volts, 50-60 cycles.

Dimensions: 19 $\frac{3}{4}$ " x 16 $\frac{3}{4}$ " x 15 $\frac{3}{4}$ ".

Net Weight: 60 pounds.

FREED Test Instruments

FREED DECADE CAPACITORS

Freed decade capacitors are high quality capacitors designed for use in wave filters, tuned circuits and equalizers for audio and supersonic frequencies where a rather large variable capacitance is desired. Their stability, accuracy and low dissipation factor make them especially useful during the preliminary design period when capacitance values are determined experimentally.

Each decade is variable from 0 to 10 by use of 11 position selector switch. The losses in the switches and mountings are kept low by the use of special low loss, impregnated switch wafers. A positive detent mechanism allows the switch to be set accurately. The accuracy is $\pm 1\%$ at frequency of 1 kc.

No. 1415 is a 1 mfd/step mylar capacitor. Total capacitance 10 mfd.

No. 1416 is a 0.1 mfd/step polystyrene capacitor. Total capacitance is 1 mfd.

No. 1417 is a .01 mfd/step polystyrene capacitor. Total capacitance is 0.1 mfd.

No. 1418 is a .001 mfd/step polystyrene capacitor. Total capacitance is .01 mfd.

No. 1419 is a 100 mmfd/step mica capacitor. Total capacitance is .001 mfd.

No. 1250 is a three section decade capacitor. The type 1416, 1417 and 1418 are assembled together in a single wooden cabinet to give a total capacity of 1.110 mfd in .001 mfd steps.

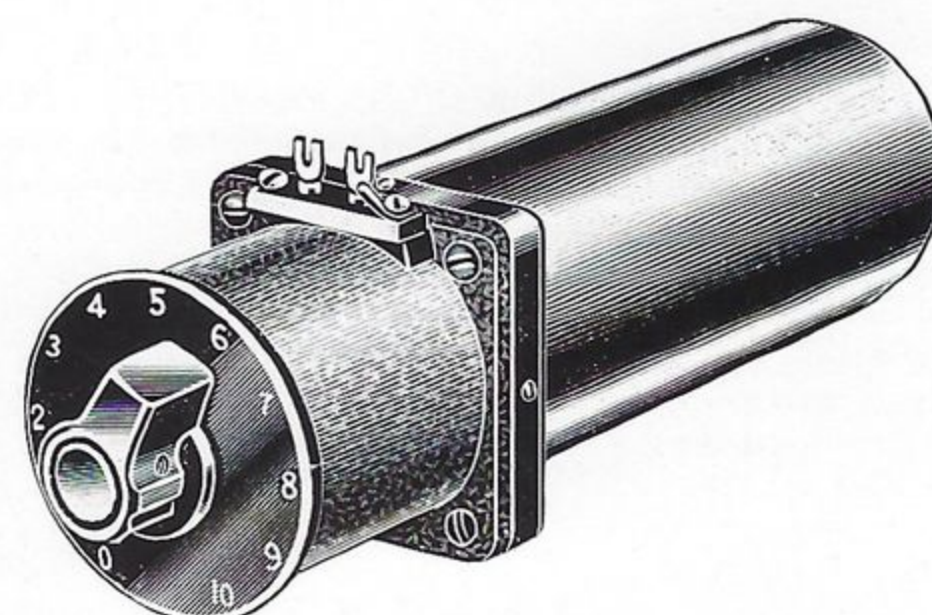
No. 1350 is a five section decade capacitor. The type 1415, 1416, 1417 and 1418 are mounted on one panel with a 1000 mmfd precision air variable condenser.

No. 1351 is a six section decade capacitor. The type 1415, 1416, 1417, 1418 and 1419 are mounted on one panel with a 100 mmfd precision variable condenser. The 100 mmfd may be used singly in which case the stray capacity is less than 10 mmfd or it may be used in conjunction with the other decades by simply closing a shorting link.

The capacity is continuously variable from 10 mmfd to 11.11 mfd in 100 mmfd steps with $\pm 1\%$ accuracy.

The maximum voltage that may be applied to these decades is 500 D.C. working volts.

The dissipation factor of the polystyrene units when measured at 1 kc. is less than .0002. The dissipation factor of the 1 mfd/step decade (mylar) is less than .005.



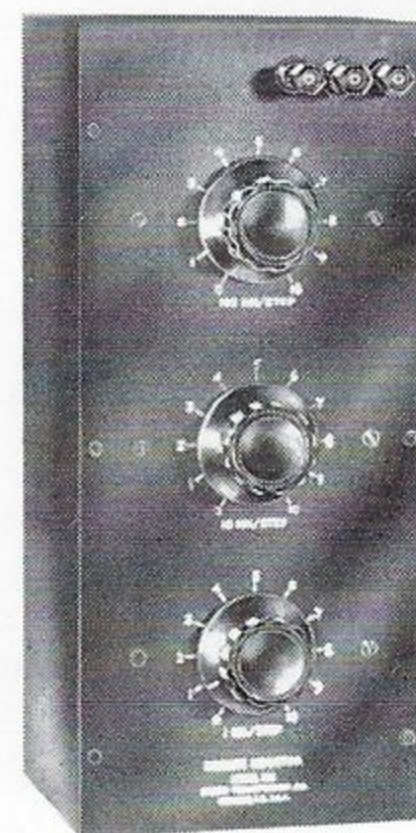
No. 1415

No. 1416

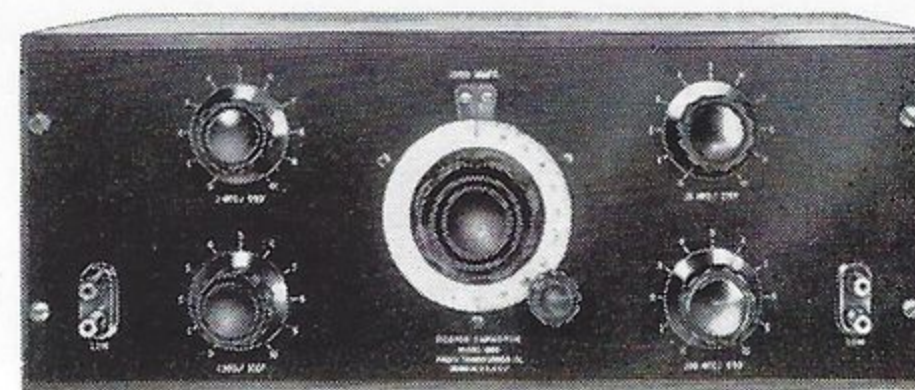
No. 1417

No. 1418

No. 1419



No. 1250



No. 1350

No. 1351

FREED Test Instruments

FREED DECADE INDUCTORS

Primarily designed for use in wave filters, tuned circuits and equalizers for audio and supersonic frequencies. The stability, accuracy and high value of "Q" makes these Decade Inductors invaluable laboratory instruments.

FREQUENCY RANGE 30 TO 2000 CYCLES

Q = 50 @ 200 CYCLES

†*Type 1164 Decade Inductor — 111 Henry total in steps of .1 Henry.

FREQUENCY RANGE 100 TO 2000 CYCLES

Q = 80 @ 500 CYCLES

†Type 1341 Decade Inductor — 100 Henry total in steps of 10 Henry.

FREQUENCY RANGE 500 TO 20,000 CYCLES

Q = 60 @ 1000 CYCLES

†Type 1160 Decade Inductor — 11.1 Henry total in steps of 0.01 Henry.

†Type 1163 Decade Inductor — 1.11 Henry total in steps of 0.001 Henry.

††Type 1260 Decade Inductor — 11.11 Henry total in steps of 0.001 Henry.

FREQUENCY RANGE 500 TO 20,000 CYCLES

Q = 160 @ 1000 CYCLES

†Type 1220 Decade Inductor — 0.01 Henry total in steps of 0.001 Henry.

†Type 1230 Decade Inductor — 0.1 Henry total in steps of 0.01 Henry.

†Type 1240 Decade Inductor — 1 Henry total in steps of 0.1 Henry.

†Type 1270 Decade Inductor — 10 Henry total in steps of 1 Henry.

†Type 1280 Decade Inductor — 1.11 Henry total in steps of 0.001 Henry.

††Type 1290 Decade Inductor — 11.11 Henry total in steps of 0.001 Henry.

†Type 1310 Decade Inductor — 11.1 Henry total in steps of 0.01 Henry.

FREQUENCY RANGE 500 TO 50,000 CYCLES

Q = 200 @ 10,000 CYCLES

†Type 1161 Decade Inductor — 1.11 Henry total in steps of .001 Henry.

FREQUENCY RANGE 10,000 TO 300,000 CYCLES

Q = 200 @ 100,000 CYCLES

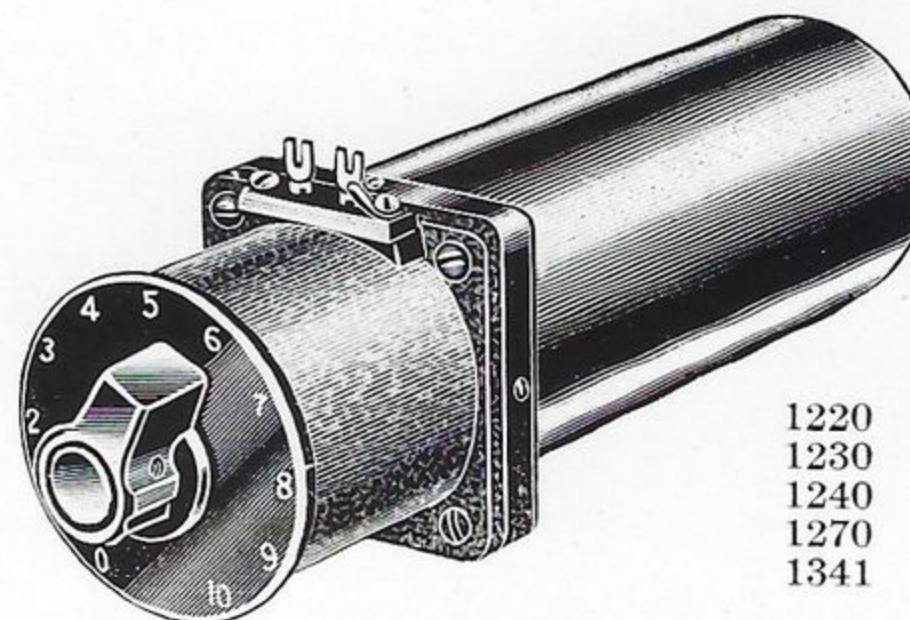
†Type 1162 Decade Inductor — 0.111 Henry total in steps of .1 Millihenry.

ACCURACY OF INDUCTANCE

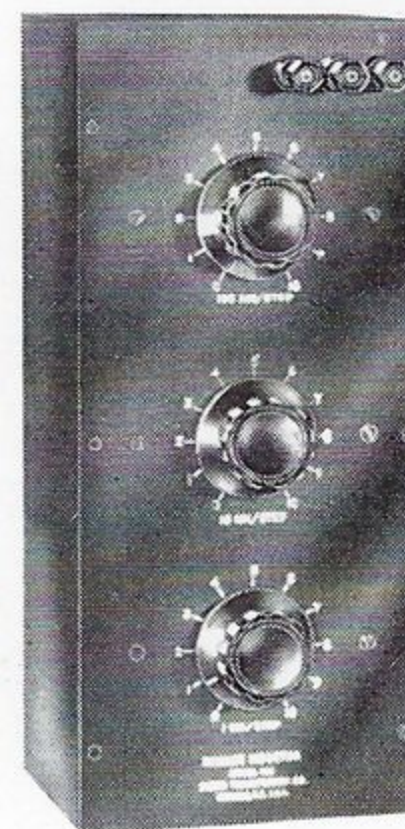
Inductance per Step	1 mh	10 mh	100 mh	1 h
Accuracy	±2%	±1%	±0.5%	±0.25%

*Type 1164 Decade Inductor is wound on a special nickel alloy core.

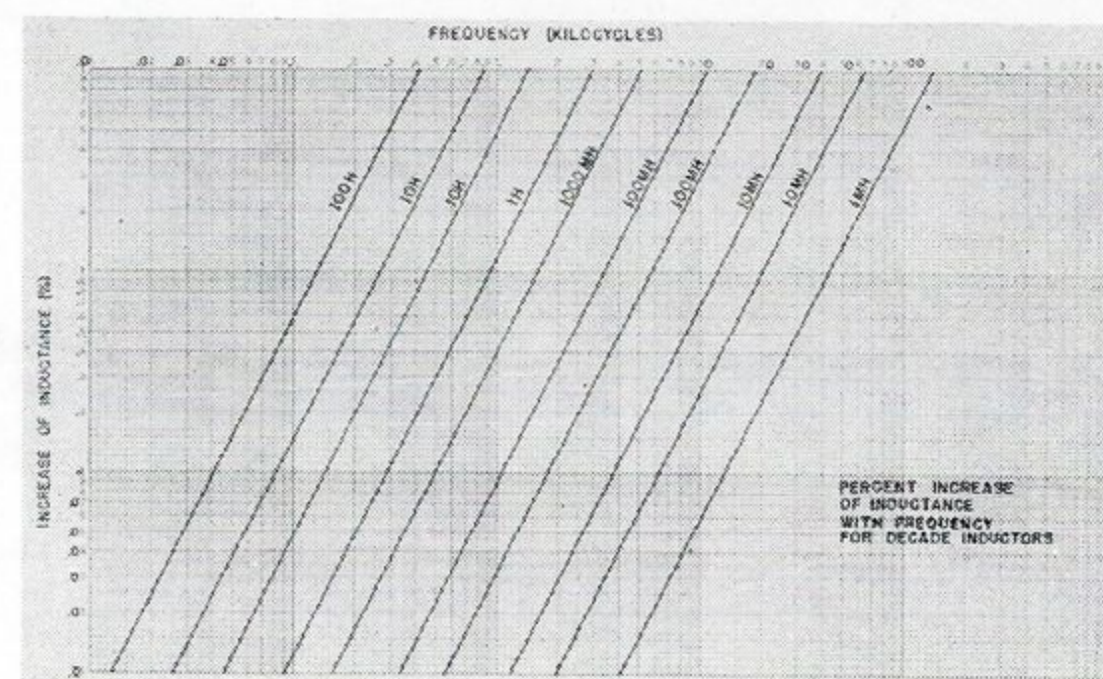
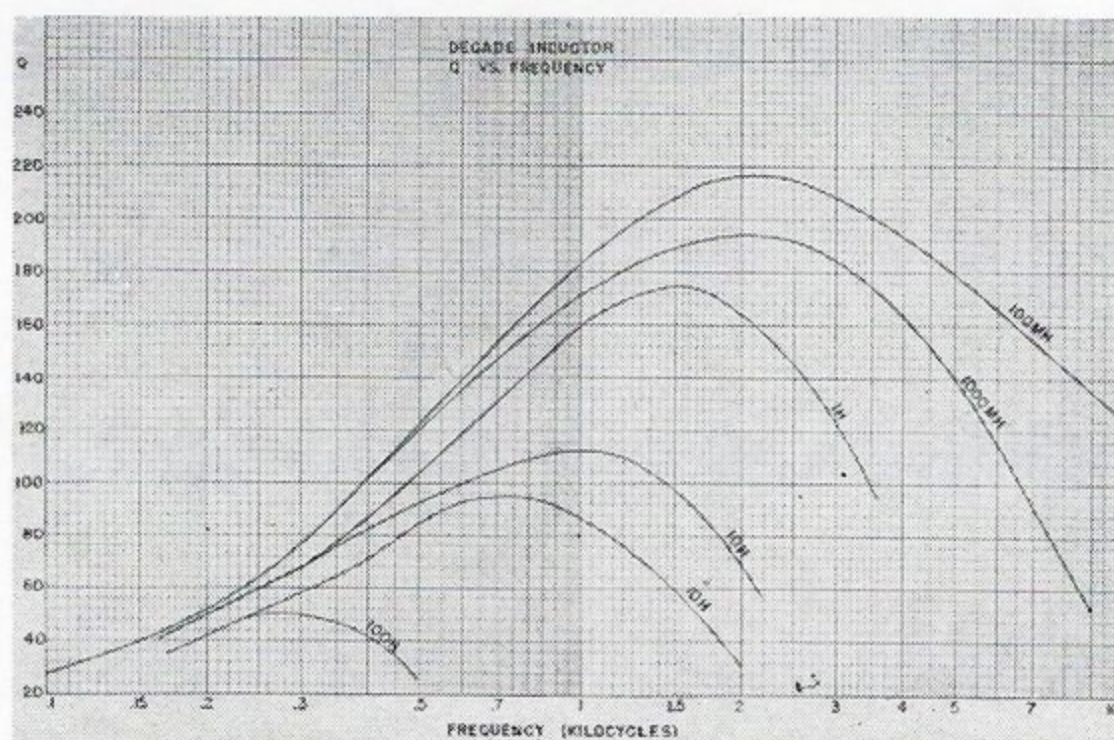
†Single Decade Unit. ††Three Decade Unit. †††Four Decade Unit.



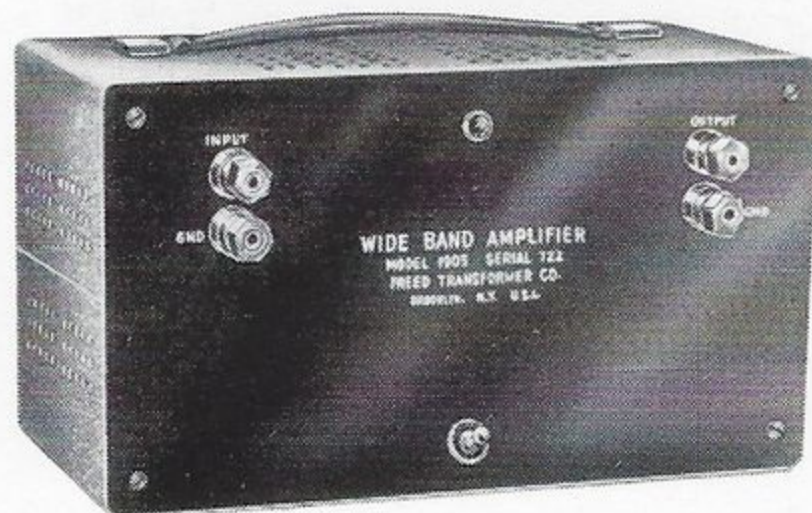
1220
1230
1240
1270
1341



1160
1161
1162
1163
1164
1280
1310



TYPE 1905 WIDE-BAND AMPLIFIER



This amplifier is particularly valuable for filter work where the output of the test oscillator is inadequate for the required signal voltage levels. It is extremely stable and will deliver 15 volts to a 600 ohm load at very low distortion over a wide range of frequencies.

SPECIFICATIONS

Frequency Response: 10 cycles to 3.5 Mc. ±2 db.

20 cycles to 2.5 Mc. ±.5 db.

Output Voltage: 15 volts across 600 ohm load.

30 volts across 10,000 ohm load.

Distortion: Less than .2% total harmonic at rated output.

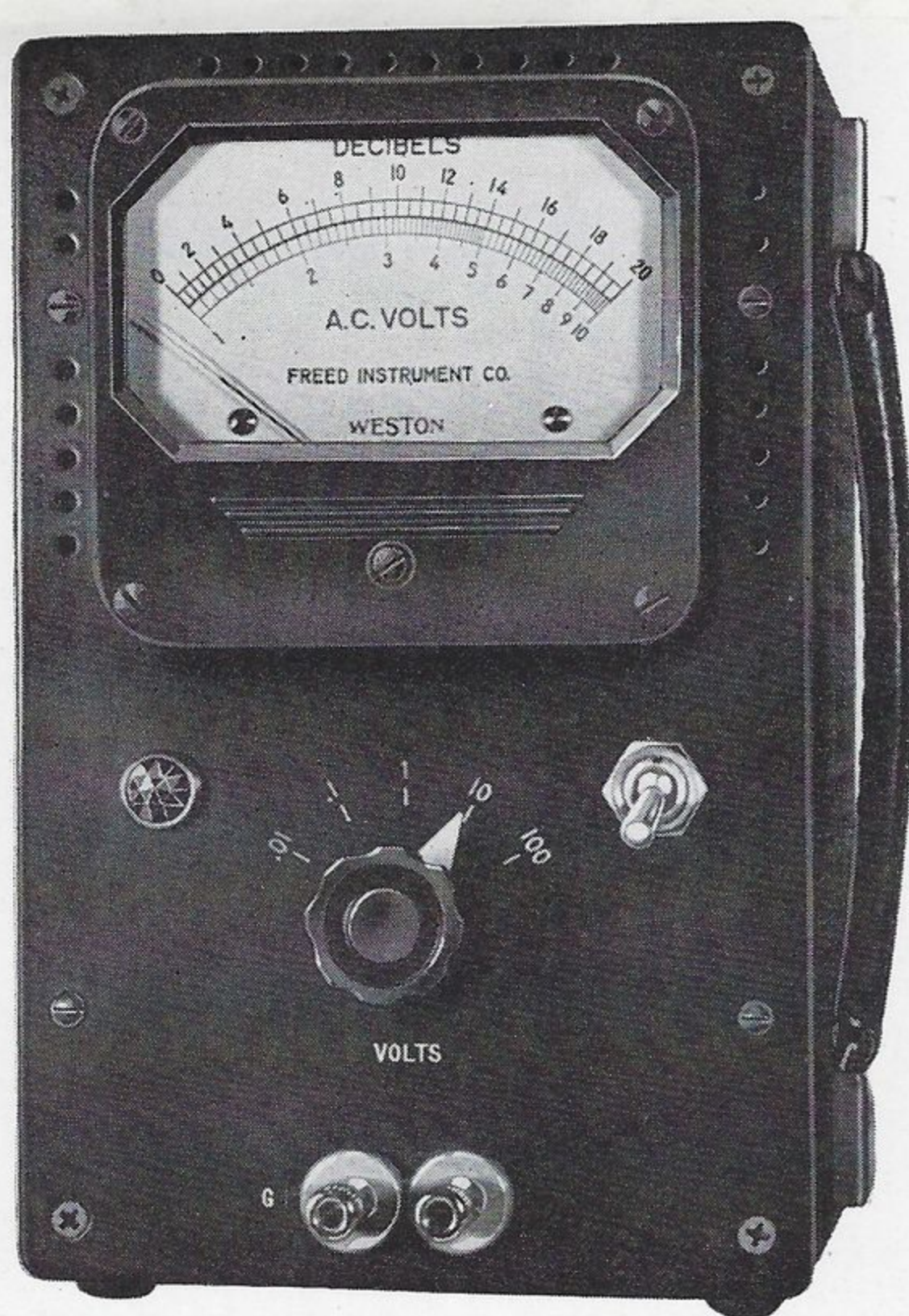
Voltage Gain: 15 db.

Source Impedance: 600 ohm.

Load Impedance: 600 ohm minimum.

Power Supply: Self-contained, 105-125 volts, 50-60 cycle input.

Dimensions: 5½" x 9¾" x 4¾"



FREED

Vacuum Tube Type

VOLTMETER

TYPE No. 1040

Uses: The type 1040 Vacuum Tube Voltmeter is a high impedance wide frequency range voltmeter which can be used at audio and supersonic frequencies. It is particularly recommended for (1) vibration studies involving very low frequencies, (2) frequency characteristics and gain measurements on amplifiers, (3) transmission losses on telephone circuits: filter and carrier systems up to 200,000 cycles, and (4) acoustic measurements, such as, determination of frequency response of microphones and loudspeakers. Because of the high sensitivity of the instrument, the voltmeter can be advantageously used as a null detector in D.C. bridge measurements. In addition to its use as a voltmeter, the instrument can be used as an ammeter to measure a wide range of currents by connecting it across suitable resistors.

Description

The instrument is composed of a high impedance precision five step attenuator, an R.C. coupled multistage amplifier, a balanced rectifier, a balanced D.C. amplifier, and a special meter in which the deflection is proportional to the logarithm of the current through it. A high amount of degeneration is used in both the A.C. and D.C. amplifiers. The switching from one voltage range to another is accomplished in the input circuit.

Features

Because of the low input capacity, a high value of input impedance is maintained over the five ranges of the voltmeter. A balanced rectifier, a balanced D.C. amplifier circuit, and a high amount of degeneration throughout the amplifier makes it independent of line voltage variations and changes in tube characteristics. A very important feature of the instrument is the logarithmic voltage scale of the meter. With this type of scale, the percentage accuracy of reading is uniform over the entire scale. Another advantage of the logarithmic scale is that it provides a uniform decibel scale which is a very valuable feature in sound and communication measurements. A zero adjustment and full scale adjustment is provided. These two controls serve for all ranges and no re-setting is necessary when switching from one range to another. The time constant of the instrument is adjusted in order to read very low frequencies of 7 to 10 cycles without any vibration of the needle. The circuit of the meter is arranged so that it can not be burned out by any overload of the instrument. The vacuum tube voltmeter is small, compact, entirely self contained, and A.C. operated.

Specifications

VOLTAGE RANGES: .001 volts to 100 volts in five ranges (.01, .1, 1, 10, and 100 volts full scale).

ACCURACY: 2% on full scale on all five ranges, on sinusoidal voltages.

WAVEFORM ERROR: The instrument is a peak voltmeter calibrated to read RMS values. On distorted waveforms, the percentage deviation of the reading from RMS values may be as large as the percentage of the harmonics present.

FREQUENCY RANGES: 10 to 200,000 cycles, .1 db. variation from 20 cycles to 150,000 cycles; .50 db. variation from 10 cycles to 200,000 cycles.

INPUT IMPEDANCE: Equivalent to 500,000 ohm resistance in parallel with a 15 MMF. condenser.

STABILITY: Effect of variation in line voltage from 100 volts to 125 volts is 1%. Effect in changes of tubes is less than .5%.

TEMPERATURE AND HUMIDITY EFFECTS: Over the normal range of temperature and humidity variation (65 degrees F to 95 degrees F, 0 to 95% relative humidity), the accuracy is substantially unaffected by temperature and humidity conditions.

SCALE: Logarithmic voltage scale calibrated from 1 to 10 plus a linear decibel scale calibrated from 0 db. to 20 db.

METER: 4" suppressed zero 1 MA. meter protected against overloads.

TUBES: The following tubes are required and supplied with the instrument:

3—6AU6	1—6X4
2—6C4	1—0A2
1—6AL5	1—6-8 Volt Pilot Lamp

POWER SUPPLY: The instrument is entirely self contained and operates on 100-125 volts, 50-60 cycles. Total consumption 40 Watts.

DIMENSIONS: 4 $\frac{7}{8}$ " High 5 $\frac{5}{8}$ " Wide 8 $\frac{7}{8}$ " Long

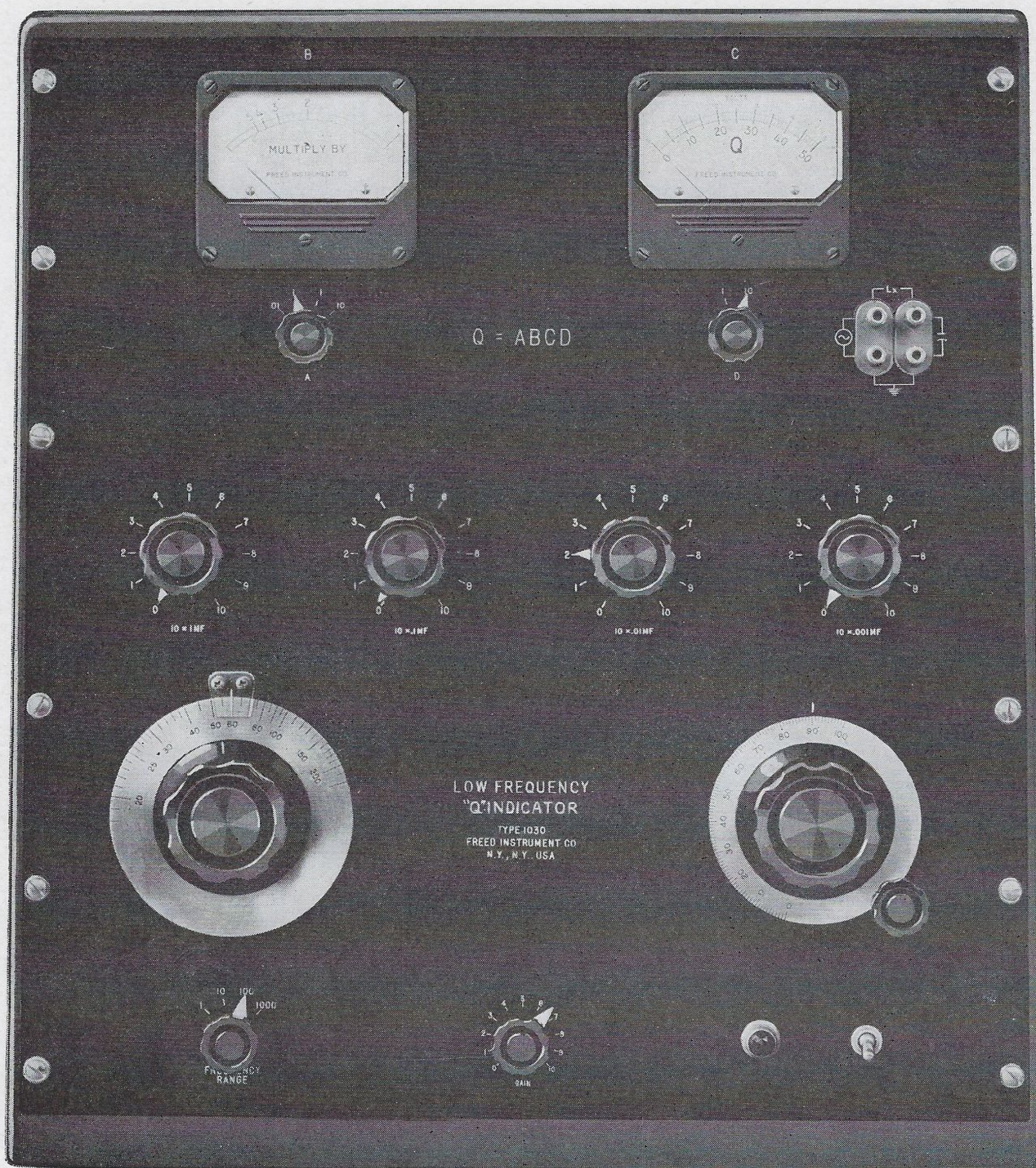
WEIGHT: 12 pounds

PRICE: \$195.00—F.O.B. New York, N. Y.

FREED TRANSFORMER COMPANY, Inc.

Instruments Division

72 SPRING STREET, NEW YORK 12, NEW YORK



FREED LOW FREQUENCY "Q" INDICATOR
Type No. 1030

Specifications

RANGE OF "Q" MEASUREMENTS: The range of "Q" factors is from .5 to 500 over the frequency range from 50 to 50,000 cycles. The accuracy of "Q" measurement is approximately 5% for frequencies up to 50,000 cycles.

OSCILLATOR FREQUENCY RANGE: Continuously variable from 20 to 200,000 cycles in four ranges.

FREQUENCY ACCURACY: 1% under normal temperature conditions. The frequency stability is better than 2% over a long period of time.

VARIABLE IMPEDANCE AMPLIFIER: Wide band amplifier with less than 10% voltage variation from 50 to 50,000 cycles.

WAVE FORM: Under normal operating conditions the harmonic distortion is 1% at 50 cycles. The distortion decreases when the frequency increases.

OUTPUT IMPEDANCE AND VOLTAGE: Four output impedances are available.

- (a) 10 ohms impedance— 10 V Output Voltage
- (b) 1 ohm impedance— 1 V Output Voltage
- (c) .2 ohm impedance— .1 V Output Voltage
- (d) .1 ohm impedance—.01 V Output Voltage

Those Impedances are measured at 50,000 cy.

VARIABLE CONDENSER: The variable condenser consists of a 10 x 1 MF high quality oil filled paper condenser decade, a 10 x .1 MF mica condenser decade, a 10 x .01 MF mica condenser decade, a 10 x .001 mica condenser decade, and a 1000 micromicrofarad air variable condenser.

ACCURACY OF ADJUSTMENT: The 10 x 1 MF decade is adjusted within .5% of the nominal capacitance value. All mica condensers are adjusted to within 1% or 10 micromicrofarads, whichever is larger. The value of the total variable capacitors at its terminals is determined by the effective zero capacitance of the whole unit which is made up of the true zero capacitance and the mutual capacitance between units. The value of the effective zero capacitance is 100 micromicrofarads.

TEMPERATURE COEFFICIENT: The temperature coefficient of the 10 x 1 MF decade is less than 1% for a temperature variation from minus 50°C to plus 50°C. The temperature coefficient of the mica decades is less than plus .01% per degree centigrade between 10 degrees and 50 degrees centigrade.

FREQUENCY CHARACTERISTICS: All condensers are adjusted to their nominal value 1000 cycles and at 25 degrees centigrade. The effective terminal capacitance of the mica decade and the air variable condenser is essentially constant up to one megacycle. The 10 x 1 MF paper decade shows a slight increase in capacity at 50 cycles.

POWER FACTOR: The losses in the switches and mountings are kept very low by the use of special low loss, impregnated

ceramic switch wafers. The power factor of the paper decade condenser is .06% per 1 microfarad at 1000 cycles. The power factor of mica decades is of the order of .01% at 1000 cycles. At 100,000 cycles the power factor decreases to about .005%. The losses in the variable air condenser are negligible at the frequencies used.

MAXIMUM VOLTAGE: The maximum peak voltage the condensers will safely withstand is 500 volts for all but the first decade which will withstand 200 volts. As the frequency of the applied voltage increases, the losses in the 10 x 1 MF decade, and 10 x .1 MF decade increase. It is therefore recommended that the 10 x 1 MF decade be used up to 1000 cycles only. Similarly the 10 x .1 MF decade should be used up to 5000 cycles only.

THE "MULTIPLY-BY" VACUUM TUBE VOLTMETER: Gain 40db. Frequency response .1db. from 50 to 50,000 cycles. This Amplifier determines four multiplying factors: .01, .1, 1, and 10. A four inch meter in the output of the amplifier, calibrated in inverse voltage, determines an additional multiplying factor from 1 to 5. The magnitude of the total multiplying factor is from .01 to 50. The Vacuum Tube Voltmeter is unaffected by line voltage variations.

"Q" READING VACUUM TUBE VOLTMETER: Input impedance 100 megohms. Frequency response .1db. from 50 to 50,000 cycles. Total sensitivity is 5 volts or 50 volts selected by a rotary switch in the input of the amplifier. This two position attenuator determines the multiplying factor of 1 or 10. A four inch meter in the output of the amplifier is calibrated in voltage or "Q". The voltage calibration is from 0 to 5. The "Q" calibration is from 0 to 50. The Vacuum Tube Voltmeter is unaffected by line voltage variations.

TEMPERATURE AND HUMIDITY EFFECTS: Over the normal range of temperature and humidity variation (65 degrees F to 95 degrees F, 0 to 95% relative humidity the accuracy is substantially unaffected by temperature and humidity conditions. An excessive increase in temperature may necessitate the zero and full scale readjustment of the meter.

POWER SUPPLY: The instrument is entirely self-contained and A.C. operated. Total consumption 200 watts.

TUBES: The following tubes are required and are supplied with the instrument:

2—Type 6H6 Metal	4—Type 6SH7 Metal
2—Type 6L6 GT	2—Type 5V4 G
2—Type 6J5 Metal	1—Type VR150
3—Type 6SN7 GT	1—6 Watt 115 Volt Mazda
3—Type 6SJ7 Metal	1—6-8 Volt Pilot Light
1—Type 6V6 GT	

	W.	D.	H.
Dimension	19 1/2"	14 1/2"	23"
Weight	120 lbs.		

FREED TRANSFORMER COMPANY, Inc.
Instruments Division
72 SPRING STREET, NEW YORK 12, NEW YORK

FREED LOW FREQUENCY "Q" INDICATOR Type No. 1030

Uses

The Type 1030 Low Frequency "Q" Indicator measures directly the "Q" factor of coils. The instrument can also be used to measure the inductance of coils, distributed capacity, impedances, and dielectric losses. The "Q" Indicator can be used to

study the magnetic properties of iron, such as stability of iron cores in function of applied voltages, and iron losses as a function of the frequency.

Description

The Type 1030 Low Frequency "Q" Indicator consists of five essential elements:

- (1) R. C. Low Frequency Oscillator.
- (2) Low distortion, high stability, variable impedance amplifier.
- (3) High quality variable condenser.
- (4) Vacuum tube type voltmeter of a special design, which measures the voltage across the circuit composed of the inductor and variable condenser. This amplifier determines the "multiply-by" factor. A four step rotary switch in the input of the amplifier varies simultaneously the gain of the amplifier and the output impedance, and the voltage of the amplifier, (2), and therefore determines four multiplying factors: .01, .1, 1, 10. A four inch meter in the output of the vacuum tube voltmeter, calibrated in inverse voltage, determines a second multiplying factor, 1 to 5.

- (5) High stability, high input impedance vacuum tube type voltmeter, which measures the voltage developed across the variable condenser directly in terms of "Q", or in terms of voltage. A two step attenuator in the input of the vacuum tube voltmeter determines either the 5 volt or 50 volt sensitivity of the amplifier and establishes two multiplying factors, 1 or 10.

The procedure of measuring the "Q" consists of connecting the inductor in series with the variable condenser, setting the oscillator at the desired frequency, adjusting the variable condenser until a maximum is read on the voltmeter calibrated directly in terms of "Q". When this maximum is obtained the "Q" of the coil is given directly as the product of the "Q" voltmeter indication and the "multiply-by" factors. The magnitude of the "multiply-by" factor varies from .01 to 500, while the "Q" varies from either 0 to 50, or 0 to 500, which corresponds to 5 volts or 50 volts across the coil.

Features

The main and essential feature of the instrument is that the "Q" factor is read directly without any complicated computations. The possibility of measuring "Q" through the whole audio and supersonic frequency range is provided. The setting up and the measuring of the "Q" of coils is practically instantaneous. The instrument is unaffected by line voltage variations, is entirely self-contained and A. C. operated. Both meters ("multiply-by" and "Q") are protected against overloads and cannot be burned out. The effective frequency range for "Q" measurements is 50 to 50,000 cycles. Due to the fact that the R. C. Oscillator frequency range is from 20 to 200,000 cycles, comparative "Q" Measurements can be made below 50 cycles and above 50,000 cycles. Since the "Q" factor appears as a relative quantity, i.e., a ratio of two voltages, the tracking of the two meters is such that a reasonably good accuracy of "Q" fac-

tors is obtained for frequencies above 50,000 cycles. The terminals of the variable decade condensers are available directly on the front panel of the instrument and can therefore be used as a high quality precision variable condenser. The R. C. Oscillator and variable impedance amplifier can be used as a separate low frequency generator with a maximum output power of two watts in a 50 ohm load. The "Q" scale is calibrated from 0 to 50. A high accuracy of measurement is obtained, since for any position of the multipliers, a total of "Q" variation from 0 to 50 is read on a 3 inch scale. "Q" factors of coils can be measured with up to 50 volts across the coil, and therefore makes it possible to determine the stability and the variations of the "Q" factor of coils in function of the applied voltage. The voltage fed into the series circuit is variable from 10 volts to .01 volt.

FREED No. 1020 MEGOHMMETER



USES

The measurement of leakage resistance of insulating materials, condensers, cables, motor and transformer windings.

SPECIFICATIONS

The instrument is a precision balanced electronic ohmmeter.

The high voltage potential necessary for insulation measurements is included in the instrument. An exceptionally wide range of resistances can be measured on the six overlapping ranges. A zero adjustment is provided for setting all the six ranges in a single operation. The resistance is read directly on a 4" meter scale. The meter is protected against overloads.

A relay operated from the front panel disconnects the high

voltage from the binding posts and this eliminates all danger of shock due to exposed high voltage potential.

In the stand by position, the relay connects a high resistance between the high voltage binding posts and the chassis (ground) thus eliminating the danger of shock when measuring the leakage resistance of condensers.

The instrument is self contained, completely AC operated and has electronically regulated high voltage supplies.

DESCRIPTION

Range: 1 megohm to 1,000,000 megohms in six overlapping ranges.

Accuracy: Plus or minus 3% on the first four ranges; plus or minus 8% on the last two ranges.

Temperature and Humidity Effect: The accuracy of the instrument is substantially independent of temperature and relative humidity variations within the normal range.

Stability: A plus or minus 10% variation in the line voltage causes less than a 1% variation in the meter reading.

Voltage on the Unknown: The voltage applied to the unknown is 500 volts and is independent (less than 1%) of the values of the unknown.

Tubes: The following tubes are required and supplied with the instrument:

2—6C6	1—VR75
2—6SH7	1—1-V
1—VR105	1—6X5

Power Supply: 105 to 125 volts AC 50 or 60 cycles. Power Consumption—32 watts.

Cabinet: Portable and of all metal construction.

Dimensions: 9½" x 10½" x 8".

Net Weight: 21 lbs.

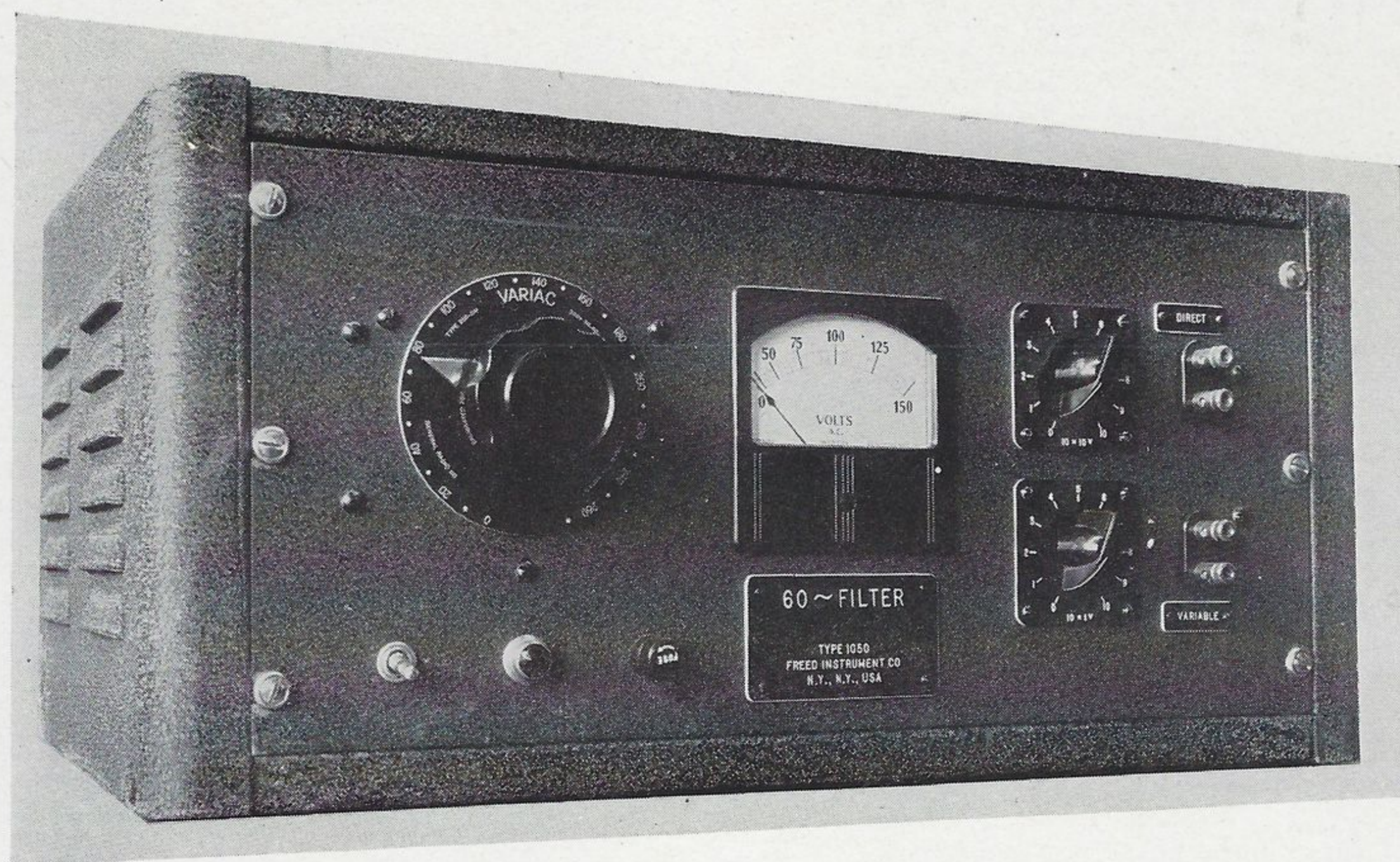
PRICE \$237.00 F.O.B. New York.

FREED TRANSFORMER COMPANY, INC.

72-78 SPRING STREET

NEW YORK 12, N. Y.

FREED No. 1050 — 60 CYCLE FILTER



U S E S

The calibration of instruments, where the form factor of the applied voltages is important (AC voltmeters and vacuum tube voltmeters).

The measurement of harmonic distortion of amplifiers, transformers and tubes.

D E S C R I P T I O N

The instrument is composed of a constant voltage transformer, a variac, a 60 cycle low pass filter, a decade attenuator and a 1% AC voltmeter.

The constant voltage transformer makes the instrument independent of the line variations.

The variac makes the instrument extremely flexible, since any voltage value can be obtained.

The decade attenuator makes it possible to vary the output voltage from 0 to 110 volts in increments of 1 volt.

The 1% AC voltmeter measures the AC voltage in the output of the filter.

The instrument is self contained and AC operated.

S P E C I F I C A T I O N S

Frequency: 60 cycles.

Stability: There is less than 1% variation in output voltage for a plus or minus 10% variation in line voltage.

Output Impedance: 600 ohms unbalanced to ground.

Load Impedance: Where the filter is used without the attenuator the optimum matching impedance is 600 ohms.

When the filter is used with the attenuator the load impedance should be high (grid of a tube) or not less than 100,000 ohms.

Output Voltage and Power: When used directly, the open circuit voltage is 150 volts.

With matched load (600 ohms) the maximum power is 20 watts.

When used with the attenuator the maximum voltage is 150 volts.

Output Control: The output voltage is made continuously variable by the use of the variac or made variable in steps by the use of the two attenuators.

Waveform: The harmonic distortion is less than .5% in full load conditions.

Temperature and Humidity Effects: The instrument is not affected by wide variations of temperature and humidity.

Power Supply: 105-125 volts 60 cycles. The total power consumption is 60 watts.

Mounting: The instrument is mounted on a standard 19" panel and is supplied with a portable streamlined all metal cabinet.

Dimensions: 10½" x 14½" x 22".

Net Weight: 75 lbs.

PRICE \$225.00 F.O.B. New York.

FREED TRANSFORMER COMPANY, INC.

72-78 SPRING STREET

NEW YORK 12, N. Y.

FREED COMPARISON and LIMIT BRIDGE Type No. 1010

USES

This instrument is a comparison and limit bridge for use in both laboratory and production testing of resistors, condensers and inductors. The manufacturer of these components can use it for production tests, the user for incoming inspection and acceptance tests. The instrument is particularly useful for laboratory work (bridge or filters) where very accurate components are required.



FEATURES

For precision and production testing, the bridge has many advantages. Power line operation and the visual indicator make the instrument completely self-contained. It can be used in noisy locations. Its small size and light weight permit the instrument to be moved easily and to be set up wherever necessary.

DESCRIPTION

The instrument is composed of an oscillator, a bridge and an amplifier. The oscillator feeds the frequencies into a bridge consisting of 2 fixed resistors, the unknown impedance and the standard. A variable resistor connected between the 2 fixed resistors makes it possible to read the percentage difference between the unknown and the standard, on a specially calibrated dial. A high gain amplifier indicates the balance of the bridge. The general method of testing is the comparison of an unknown component with a standard component of the

same type. Accurate percentage measurements are obtained by the use of precision components in the arms of the bridge. The use of high gain amplifier and adequate internal shielding assures a very sharp and distinct balance.

A visual null indicator, consisting of a 500 microampers-meter and used in connection with the high gain amplifier makes it possible to use the No. 1010 Bridge as a precision limit bridge in production testing.

SPECIFICATIONS

1—FREQUENCY: Three frequencies are available 50 to 60 cycles, 1000 cycles, and 10,000 cycles.

The 50 or 60 cycles are taken from the line.

The 1000 and 10,000 cycles are generated by an oscillator and are accurate to within 10%.

2—RANGE: Two comparison ranges are provided 10% and 20%. They are selected by a rotary switch. In the 10% position the percentage is read directly on a calibrated dial. In the 20% position the reading of the dial is multiplied by two.

3—RESISTOR MEASUREMENTS: Resistors from 10 ohms up to 1 megohms are measured by the comparison method at 60 cycles. Resistors of greater value than 1 megohm can be measured by using the instrument as a limit bridge.

4—CONDENSER MEASUREMENTS: Condensers from 500 micromicrofarads up to 10 microfarads are measured by the comparison method at 1000 cycles. Condensers above 10 microfarads are measured by the comparison method at 60 cycles.

Small condensers 500 micromicrofarads to 25 micromicrofarads are measured at 1000 cycles, with the instrument used as a limit bridge.

5—INDUCTOR MEASUREMENTS: Inductors can be measured at 60 cycles, 1000 cycles or 10,000 cycles depending upon their values.

Ranges:

L—100Hy to 1 Hy	F— 60 cycles
L— 1Hy to .01 Hy	F— 1,000 cycles
L—.01Hy to .1mHy	F—10,000 cycles

6—ACCURACY: On the 10% position the components can be adjusted to within an accuracy of .5%.

Components to be adjusted to $\pm 10\%$ accuracy should be tested on the 20% position.

7—VOLTAGE APPLIED TO THE UNKNOWN: The voltage impressed across the unknown terminals varies with the absolute value of the unknown. The maximum voltage is 15 volts. The minimum voltage is .5 volts.

8—POWER SUPPLY: 105 to 125 volts, 50-60 cycles. The power consumption is 40 watts.

9—CONTROLS:

- (a) Oscillator Controls—Frequency selector switch and output level control.
- (b) Bridge Controls—Main percentage dial, "C balance," Range selector, 3 position switch (balance, 10% and 20%).
- (c) Null Indicator Controls—5 step attenuator for the adjustment of the gain of the amplifier. Screw head adjustment for the zero of the vacuum tube volt meter.

10—ACCESSORIES SUPPLIED: Spare fuses and Pilot lamps.

11—VACUUM TUBES: All are supplied with the instrument.
1 - 6X5 1 - 6SL7 1 - 6J5 1 - 6V6 2 - 6SJ7

12—PORTABLE: Carrying cabinet of all metal construction.

13—NET WEIGHT: 15½ lbs.

14—DIMENSIONS: 10½" x 8¾" x 12".

PRICE \$150.00 F.O.B. New York.

FREED TRANSFORMER COMPANY, INC.

72-78 SPRING STREET

NEW YORK 12, N. Y.

Equipment

1. A.C. Bridges for Inductance Measurements with or without superimposed D.C.
2. Breakdown Voltage Testers
3. Comparison and Limit Bridge
4. D.B. Decade Amplifiers
5. Low Frequency "Q" Indicator
6. Megohmmeter
7. Null Indicator Amplifiers
8. Sixty Cycle Filter
9. Special Regulated Power Supplies
10. Transmission Measuring Apparatus
11. Vacuum Tube Voltmeters

Power Components

1. High Voltage Plate Transformers
2. Filament Transformers
3. Power Transformers
4. Vibrator Transformers
5. Filter Chokes
 - a. Smoothing Chokes
 - b. Swinging Chokes
6. Power Transformers for C.R.O. Tubes
7. Saturable Reactors

The high voltage plate transformers, filament transformers and power transformers can be supplied for frequencies from 25 cps. to 3000 cps.

The activity of the laboratory of the FREED TRANSFORMER CO., INC. is devoted to research and development work in audio, supersonic and carrier systems and in the communications field.

The company will accept this type of work on either a consulting or development order basis.

Audio and Supersonic Frequency Components in the Frequency Range from 10 to 200,000 Cps.

1. Input Transformers
2. Interstage Transformers
3. Driver Transformers
4. Output Transformers
5. Modulation Transformers
6. Hybrid Transformers
7. Bridging Transformers
8. Oscillator Transformers
9. High "Q" Coils
10. Equalizers
11. Wave Filters
 - a. Low Pass Filters
 - b. High Pass Filters
 - c. Band Pass Filters
 - d. Band Elimination Filters
12. Pulse Transformers
13. Blocking Oscillator Transformers
14. Phase Shift Chokes or Transformers

Television Components

1. Vertical Deflection Transformers
2. Horizontal Deflection Transformers
3. Focusing Coils (Assembly)
4. Ion Trap Coils (Assembly)
5. Horizontal and Vertical Blocking Oscillator Transformers

FREED TRANSFORMER COMPANY, INC.

72-78 SPRING STREET

NEW YORK 12, N. Y.

PRICE LIST

Freed No.	Page	List Price	Freed No.	Page	List Price	Freed No.	Page	List Price
F-110	7	\$ 5.10	F-410A	1	\$ 5.85	603	2	\$ 1.40
111	7	6.05	411A	1	5.85	604	2	1.40
112	7	4.35	412A	1	6.30	605	2	1.45
113	7	4.35	413A	1	6.90	606	2	1.45
114	7	6.85	414A	1	7.30	607	2	1.45
115	7	6.85	415A	1	7.60	608	2	1.45
116	7	8.00	416A	1	7.90	609	2	1.75
117	7	8.00	417A	1	7.55	610	2	1.40
118	7	8.00	418A	1	8.75	611	2	1.40
119	7	8.75	419A	1	8.30	612	2	1.40
120	7	8.75	420A	1	10.20	613	2	1.45
121	7	9.50	421A	1	9.10	614	2	1.45
122	7	9.50	422A	1	10.90	615	2	2.55
123	7	21.90	423A	1	12.00	616	2	2.40
124	7	6.85	424A	1	12.45	617	2	2.40
125	7	6.05	410	1	4.50	618	2	2.40
126	7	5.85	411	1	4.50	619	2	2.40
127	7	5.85	412	1	4.55	F-620	3	\$ 3.15
128	7	4.35	413	1	5.10	621	3	3.05
129	7	5.35	414	1	5.75	622	3	3.05
130	7	21.90	415	1	6.00	623	3	3.05
131	7	7.30	416	1	6.35	624	3	3.05
F-150	10	\$11.65	417	1	5.75	625	3	3.25
151	10	11.65	418	1	7.05	626	3	3.40
152	10	11.65	419	1	6.50	627	3	3.25
153	10	14.60	420	1	8.70	628	3	4.95
154	10	11.65	421	1	7.15	629	3	4.60
155	10	11.65	422	1	9.40	630	3	4.95
156	10	11.65	423	1	10.15	631	3	4.95
157	10	14.60	424	1	10.90	632	3	4.95
158	10	11.65	F-450	2	\$ 4.25	633	3	5.70
F-210	5	\$ 2.05	451	2	4.60	634	3	5.85
211	5	2.90	425	2	5.30	635	3	5.85
212	5	3.25	453	2	6.00	636	3	7.30
213	5	2.05	454	2	6.50	637	3	7.30
214	5	2.90	F-500	9	\$ 3.75	638	3	7.30
215	5	3.25	501	9	3.75	639	3	9.90
216	5	4.25	502	9	4.00	640	3	4.95
217	5	5.60	503	9	4.75	641	3	5.70
218	5	2.05	504	9	3.75	642	3	5.85
219	5	2.90	505	9	4.25	643	3	7.30
220	5	3.25	506	9	5.10	644	3	7.30
221	5	4.25	507	9	5.10	645	3	1.95
222	5	5.60	508	9	3.35	646	3	2.10
223	5	3.25	509	9	3.45	647	3	3.00
224	5	5.75	510	9	4.80	648	3	3.00
225	5	9.10	511	9	4.80	649	3	2.55
F-300	6	\$ 2.25	512	9	3.65	F-700	4	\$11.00
301	6	2.90	513	9	3.05	701	4	11.25
302	6	4.25	514	9	3.65	702	4	11.25
303	6	2.25	515	9	3.65	703	4	20.30
304	6	4.25	F-550	8	\$ 3.15	704	4	11.25
305	6	5.35	551	8	3.15	705	4	20.30
306	6	5.75	552	8	3.40	706	4	36.50
307	6	4.60	553	8	4.10	750	4	5.70
308	6	5.40	554	8	3.15	751	4	5.70
309	6	6.00	555	8	3.65	752	4	5.70
310	6	7.40	556	8	4.50	753	4	11.40
311	6	3.40	557	8	4.50	754	4	11.40
312	6	9.10	558	9	2.60	F-900	5	\$ 8.40
313	6	9.10	559	8	2.70	901	5	9.55
314	6	1.40	560	8	4.25	902	5	12.15
315	6	1.40	561	8	4.25	903	5	15.20
316	6	1.40	562	8	3.05	904	5	18.25
317	6	1.45	563	8	3.05	905	5	24.30
318	6	1.45	564	8	3.05	906	5	30.75
319	6	2.00	565	8	3.05	907	5	45.65
320	6	2.70	F-600	2	\$ 1.40	920	5	9.10
321	6	2.00	601	2	1.40	921	5	13.00
			602	2	1.40	922	5	32.85
						923	5	40.00

FREED TRANSFORMER CO., INC.

1718 Weirfield St., Brooklyn (Ridgewood) 27, N.Y.

PRESENTS A GROUP OF LABORATORY TEST INSTRUMENTS of the Highest Quality

TYPE NO. 1030 LOW FREQUENCY "Q" INDICATOR

The Type 1030 Low Frequency "Q" Indicator measures directly the "Q" factor of coils. The instrument can also be used to measure the inductance of coils, distributed capacity, impedances, and dielectric losses. The "Q" Indicator can be used to study the magnetic properties of iron, such as stability of iron cores in function of applied voltages, and iron losses as a function of the frequency.

The main and essential feature of the instrument is that the "Q" factor is read directly without any complicated computations. The possibility of measuring "Q" through the whole audio and supersonic frequency range is provided. The setting up and the measuring of the "Q" of coils is practically instantaneous. The instrument is unaffected by line voltage variations, is entirely self-contained and A.C. operated. The effective frequency range for "Q" measurements is 50 to 50,000 cycles. Due to the fact that the R.C.



Oscillator frequency range is from 20 to 200,000 cycles, comparative "Q" Measurements can be made below 50 cycles and above 50,000 cycles. Since the "Q" factor appears as a relative quantity, i.e., a ratio of two voltages, the tracking of the two meters is such that a reasonably good accuracy of "Q" factors is obtained for frequencies above 50,000 cycles. The R.C. Oscillator and variable impedance amplifier can be used as a separate low frequency generator with a maximum output power of five watts into a 50 ohm load. A high accuracy of measurement is obtained, since for any position of the multipliers, a total of "Q" variation from 0 to 50 is read on a 4 inch meter. "Q" factors of coils can be measured with up to 50 volts across the coil, and therefore makes it possible to determine the stability and the variations of the "Q" factor of coils in function of the applied voltage. The voltage fed into the series circuit is variable from 10 volts to 0.01 volt.

SPECIFICATIONS

Range of "Q" Measurements: The range of "Q" factors is from 0.5 to 500 over the frequency range from 50 to 50,000 cycles. The accuracy of "Q" measurement is approximately 5% for frequencies up to 50,000 cycles.

Oscillator Frequency Range: Continuously variable from 20 to 200,000 cycles in four ranges.

Frequency Accuracy: 1% under normal temperature conditions. The frequency stability is better than 2% over a long period of time.

Output Impedance and Voltage: Four output impedances are available.

- (a) 10 ohms impedance — 10 V Output Voltage
- (b) 1 ohm impedance — 1 V Output Voltage

(c) 0.2 ohm impedance — 0.1 V Output Voltage

(d) 0.1 ohm impedance — 0.01 V Output Voltage

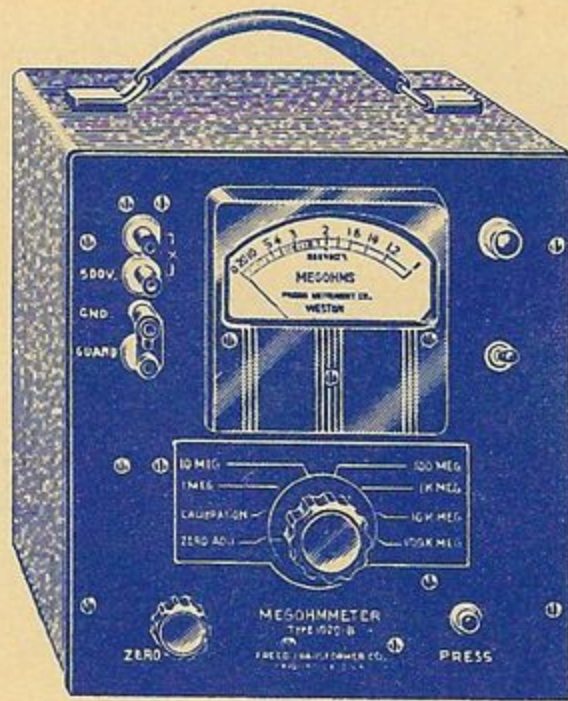
Those Impedances are measured at 50,000 cy.

Variable Condenser: The variable condenser is composed of a 10 x 1 mf., 10 x 0.1 mf., 10 x 0.01 mf., 10 x 0.001 mf. decade condenser and a 0.001 mf. variable air condenser.

Power Supply: The instrument is entirely self-contained and A.C. operated. Total consumption 200 watts.

Dimension 19 1/2" x 14 1/2" x 23"
Weight 120 lbs.

TYPE 1020-B MEGOHMMETER



The Freed Type 1020-B Megohmmeter is a self contained and a-c operated instrument equally useful in the laboratory or for production testing of the leakage resistance of insulation materials, condensers, cables, motors and transformer windings.

Resistance values indicated directly on a four inch meter protected against over-load.

Rapid and safe to use, test voltage removed from terminals and capacitive component discharged to ground in all positions of multiplier switch.

Low resistance in series with component under test provides very short charging time for even the very largest capacitors. Calibration position provided to check accuracy of 500 volts d-c potential. 500 volt test supply electronically regulated.

SPECIFICATIONS

Range: 1 megohm to 2,000,000 megohms in six overlapping ranges selected by a multiplier switch.

Accuracy: Plus or minus 3% on resistance values up to 100,000 megohms; plus or minus 5% from 100,000 to 2,000,000 megohms.

Voltages on Unknown: The voltage applied to the unknown terminals is 500 volts d-c and is independent (less than 1%) of the value of the unknown.

Stability: Line voltage variations from 105-125 volts will cause less than 2% variation in the meter reading.

Power Supply: 105-125 volts A.C. 50-60 cycles 30 watts.

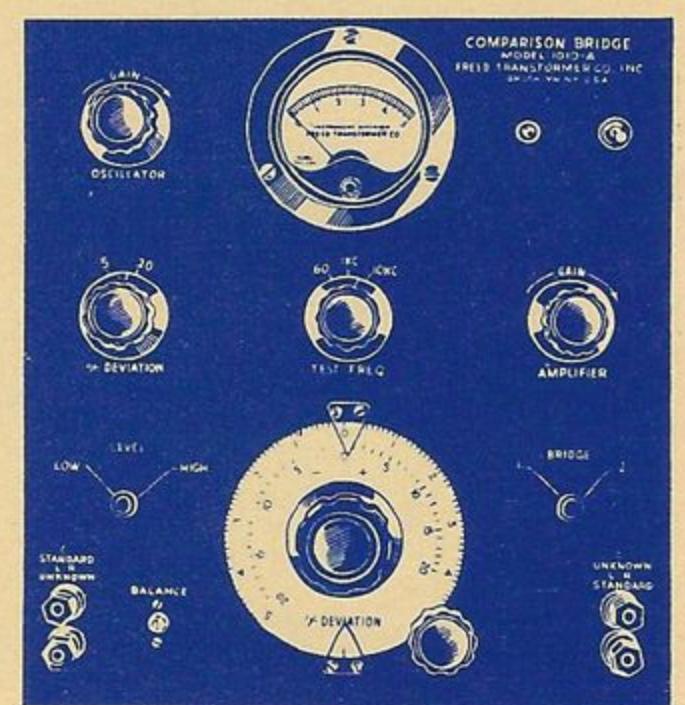
Dimensions: 9 1/2 x 10 1/2 x 8 inches.

Net Weight: 18 pounds.

NO. 1010A COMPARISON AND LIMIT BRIDGE

This instrument is a Comparison and Limit Bridge for use in both laboratory and production testing of resistors, condensers and inductors. The manufacturer of these components can use it for production tests, the user for incoming inspection and acceptance tests. The instrument is particularly useful for laboratory work (bridge or filters) where very accurate components are required.

For precision and production testing, the bridge has many advantages. Power line operation and the visual indicator make the instrument completely self-contained. It can be used in noisy locations. Its small size and light weight permit the instrument to be moved easily and to be set up wherever necessary.



SPECIFICATIONS

Frequency: Three frequencies are available: 50 to 60 cycles, 1,000 cycles and 10,000 cycles. The 50 or 60 cycles are taken from the line. The 1,000 and 10,000 cycles are generated by an oscillator and are accurate to within $\pm 2\%$.

Range: Two comparison ranges are provided: 5% and 20%. The percentage difference is read directly on a calibrated dial.

Resistor Measurements: 1 ohm to 10 megohms.

Condenser Measurements: 10 mmfd to 1000 mf.

Inductor Measurements: 10 microhenries to 1,000 henries.

Accuracy: On the 5% position the components can be adjusted to within an accuracy of $\pm 0.1\%$.

Voltage Applied to the Unknown: Two controls are provided to vary the voltage across the unknown. A special low impedance winding is used when measuring small impedances and the voltage across these may be varied from 0.1 to 1 volts. For higher values of impedance the voltage may be varied from 0.5 to 15 volts.

Power Supply: 105-125 volts; 50-60 cycles.

Tube Complement: The following tubes are required and supplied with the instrument: 1-6X4, 1-6AQ5, 2-12AX7, 12AU7.

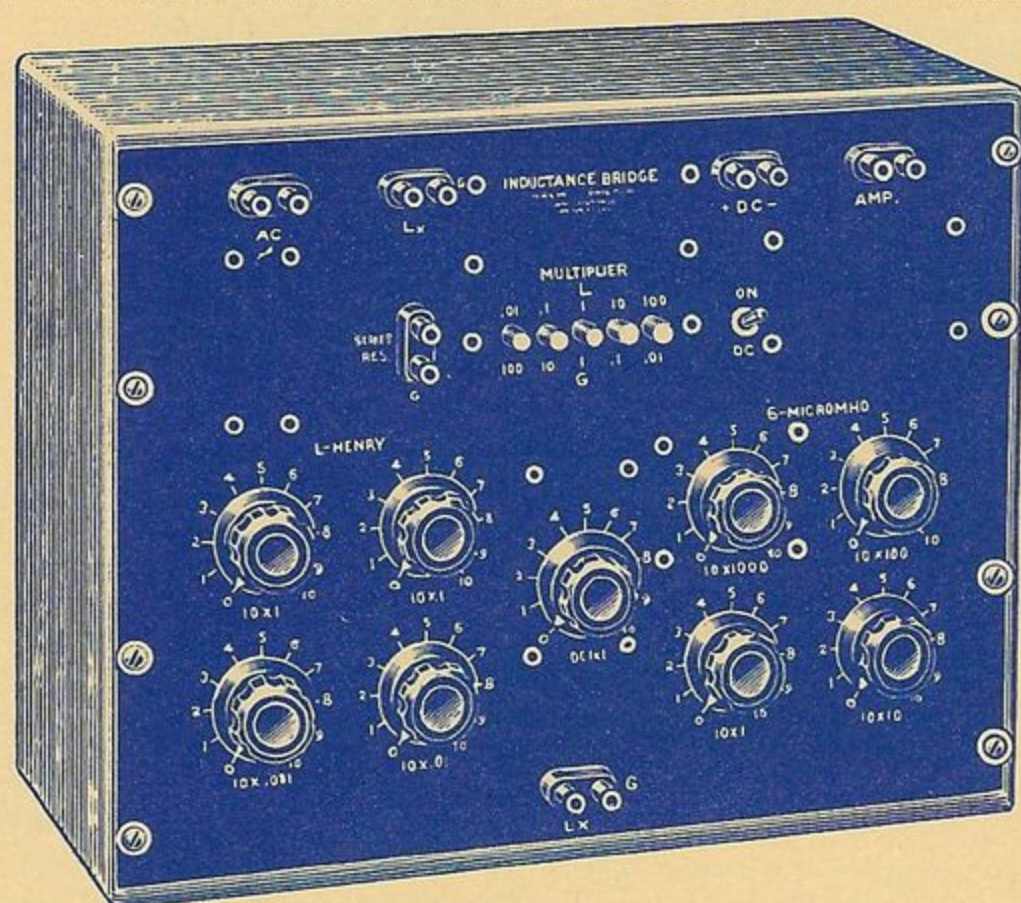
Portable: Carrying cabinet of all metal construction.

Dimensions: 11" x 12" x 10 1/2".
Net Weight: 17 pounds.

FREEED

A.C. BRIDGES

TYPE 1110-A INCREMENTAL INDUCTANCE BRIDGE



Frequency Range: The bridge is calibrated and adjusted at both 60 and 1000 cycles, but can be used at any frequency up to 10,000 cycles. Errors resulting from stray capacity increase with frequency. Coils having a high inductance should be measured at a low frequency to avoid resonance effect.

The Incremental Inductance Bridge is designed for measuring the inductance of Iron Core components at any frequency up to 10,000 cycles. Inductors can be measured with a superimposed direct current, therefore, the bridge will measure the incremental inductance of coils. The bridge can be used for determination of storage factor, "Q", either at a given frequency in function of the applied

SPECIFICATIONS

Inductance Ranges: One millihenry to one thousand henries in five ranges. Inductance values are read directly from a four dial decade and a multiplier switch. The last range may be extended to 10,000 henries through the use of an external resistance.

Conductance Ranges: One micromho to one mho in five ranges, read directly from a four dial decade and a multiplier switch. This conductance represents the reciprocal of the A.C. resistance of the coil.

Range of Superimposed D.C.: On multiplier switch position L X 100, the D.C. is limited to 10ma. On the position L X 10, the D.C. is limited to 250 ma. On all other positions the D.C. can be one ampere maximum.

voltage or at a given voltage in function of the applied frequency. The bridge can be used by the manufacturers of iron core components, such as filter chokes, high Q coils, and iron core audio and supersonic frequency components. Due to its very wide inductance range the instrument can be used as a general purpose laboratory inductance bridge.

"Q" Range: "Q" is measured as the product of Inductance (L) and Conductance (G). The range of "Q" measured on the bridge is 0.5 to 100. Measurement of inductance is independent of the values of "Q".

Accuracy: 1% through the frequency range from 60-1000 cycles 2% for frequencies from 1000 to 10,000 cycles. This accuracy is decreased for extreme positions of the multiplier. Conductance measurements 5% from 60-1000 cycles.

Mountings: The bridge is supplied in a walnut cabinet or on special order for standard rack mounting.

Dimensions: Rack: 19" x 8" x 14"
Cabinet: 21" x 8" x 14 1/8"

Net Weight: Rack—37 lbs.; Cabinet—48 lbs.

TYPE NO. 1170 D.C. SUPPLY



The Type 1170 Power Supply is intended to be used as a dependable source of direct current for the Incremental Inductance Bridge Type No. 1110A. The supply can also be used as a general laboratory substitute for a high voltage storage battery.

The Type 1170 D.C. supply consists of an electronically regulated high voltage supply. Four independent control circuits provide four current ranges, namely 5 milliamperes, 25 milliamperes, 100 milliamperes and 500 milliamperes. The output current is indicated by a multirange 4" meter.

SPECIFICATIONS

Current Ranges: Four current ranges—5-25-100 and 500 milliamperes.

Voltage Ranges: The maximum no load voltage corresponding to the four current ranges are the following: 500MA — 270 volts, 100 MA — 270 volts, 25 MA — 55 volts, 5 MA — 25 volts. On both 500 MA and 100 MA ranges with the control set to zero, the output voltage is independent of the load.

Voltage Regulation: The unit operates from a 115 volts, 50-60 cycle line. For a line variation of plus or minus 10%, the output voltage shall not vary more than $\pm 1\frac{1}{2}\%$.

Power Consumption: Under 500 MA full load the power consumption is 360 watts. Under no load conditions the consumption is 150 watts.

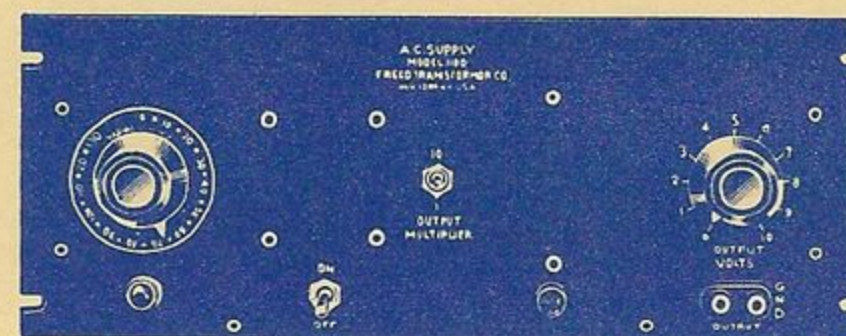
Hum Level: On the 270 volt, 500 milliamperere range the hum level under full load condition is 6 millivolts which corresponds to -93 Db.

Mounting: The instrument is supplied for mounting on a 19 inch relay rack or for cabinet mounting.

Dimensions: Rack: 19" W. x 12 3/16" D. x 12 1/4", Cabinet: 21 1/2" W. x 15" D. x 14" H.

Net Weight: In Cabinet — 89 lbs. Rack Mounted — 68 lbs.

NO. 1180 A.C. SUPPLY



A valuable laboratory instrument with continuously variable output from 1/10 volt to 100 volts at 60 cycles.

Dimensions: Width—19";
Depth 5"; Height 7"

Weight: 13 1/2 pounds.

MODEL 1040 A.C.-V.T. VOLTMETER

The type 1040 Vacuum Tube Voltmeter is a high impedance wide frequency range voltmeter which can be used at audio and supersonic frequencies. It is particularly recommended for (1) vibration studies involving very low frequencies, (2) frequency characteristics and gain measurements on amplifiers, (3) transmission losses on telephone circuits: filter and carrier systems up to 250,000 cycles, and (4) acoustic measurements such as, determination of frequency response of microphones and loudspeakers. Because of the high sensitivity of the instrument, the voltmeter can be advantageously used as a null detector in A.C. bridge measurements. In addition to its use as a voltmeter, the instrument can be used as an ammeter to measure a wide range of currents by connecting it across suitable resistors.



FEATURES

Because of the low input capacity, a high value of input impedance is maintained over the five ranges of the voltmeter. A balanced rectifier, a balanced D.C. amplifier circuit, and a high amount of degeneration throughout the amplifier makes it independent of line voltage variations and changes in tube characteristics. A very important feature of the instrument is the logarithmic voltage scale of the meter. With this type of scale, the percentage accuracy of reading is uniform over the entire scale. Another advantage of the logarithmic scale is that it provides a uniform decibel scale which is a very valuable feature in sound and communication measurements. A zero adjustment and full scale adjustment are provided. These two controls serve for all ranges and no re-setting is necessary when switching from one range to another. The time constant of the instrument is adjusted in order to read very low frequencies of 7 to 10 cycles without any vibration of the needle. The circuit of the meter is arranged so that it can not be burned out by any over load of the instrument. The vacuum tube voltmeter is small, compact, entirely self-contained, A.C. operated.

SPECIFICATIONS

Voltage Ranges: 0.001 volts to 100 volts in five ranges (0.01, 0.1, 1.0, 10, and 100 volts full scale).

Accuracy: 2% on full scale on all five ranges, on sinusoidal voltages.

Waveform Error: The instrument is a peak voltmeter calibrated to read RMS values. On distorted waveforms, the percentage deviation of the reading from RMS values may be as large as the percentage of the harmonics present.

Frequency Ranges: 10 to 200,000 cycles, 0.1 db. variation from 20 cycles to 150,000 cycles; 0.50 db. variation from 10 cycles to 200,000 cycles.

Input Impedance: Equivalent to 500,000 ohm resistance in parallel with a 15 MMF. condenser.

Stability: Effect of variation in line voltage from 100 volts to 125 volts is 1%. Effect in changes of tubes is less than 0.5%.

Scale: Logarithmic voltage scale calibrated from

1 to 10 plus a linear decibel scale calibrated from 0 db. to 20 db.

Meter: 4" suppressed zero 1 MA meter protected against overloads.

Power Supply: The instrument is entirely self-contained and operates on 100-125 volts, 50-60 cycles. Total consumption, 40 watts.

Dimensions: 4 7/8" High x 5 5/8" Wide x 9 7/8" Long.
Weight: 12 pounds.

& ACCESSORIES FREED

TYPE 1150 UNIVERSAL BRIDGE

FEATURES

The Universal Bridge offers a variety of five possible bridge circuits. A wide range of capacitance, inductance, impedance, and phase angle measurement can be made throughout the frequency spectrum from 20 cycles to 20,000 cycles. By using decade resistors in the variable arms the unknown can be measured to four significant figures.

Operation is simple and both terminals and controls are arranged for convenience and ease of measurements.

SPECIFICATIONS

Frequency Range: The bridge can be used at frequencies from 20 cycles to 20,000 cycles.

Accuracy: All resistors of the bridge arms are adjusted to 0.1%. The absolute accuracy of measurement will depend upon the accuracy of standards used.

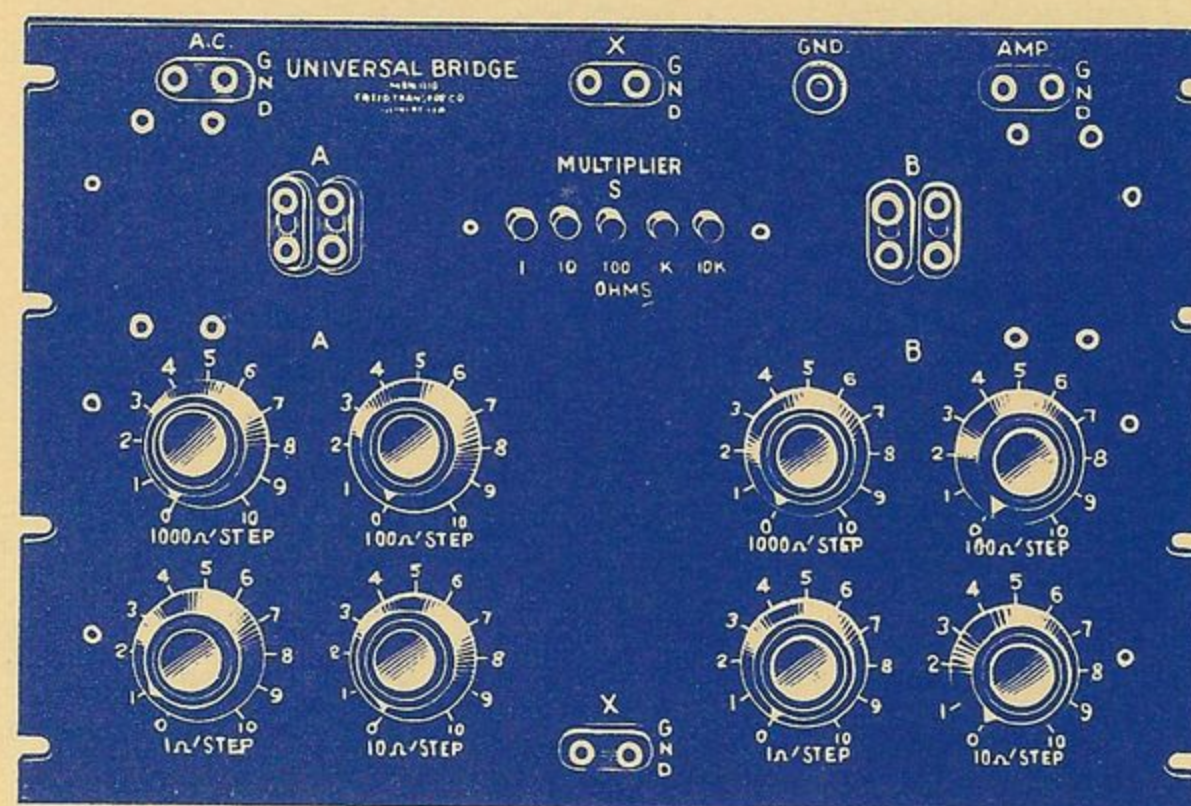
Inductance Range: The bridge will measure inductance of coils from 0.1 mh to 1000 henries with an accuracy of 0.5% at 1000 cycles.

Capacitance Range: Condensers from 0.001 mf to 1 mf can be measured to within 0.5% at 1000 cycles. Condensers below 0.001 mf should be measured by the substitution method.

Mounting: The bridge is supplied in a walnut cabinet or on special order for standard rack mounting.

Dimensions: 19" x 8 1/2" x 14"

Weight: 32 lbs.



MODEL 1140A NULL DETECTOR-AMPLIFIER



The Freed Model 1140A Null Detector Amplifier is a sensitive null indicator for bridge measurements, providing visual null indications or aural when used in conjunction with headphones. The unit may also be used as a high gain amplifier for general laboratory work.

DESCRIPTION

Functionally the instrument consists of a high gain linear amplifier with a 30 db. input attenuator in addition to the variable gain control. A four inch panel meter provides visual null indications, the response of the meter circuit is approximately logarithmic over a 40 db. voltage range.

SPECIFICATIONS

Input Impedance: 1 megohm in parallel with 25 mmf. GAIN: 98 db. with 1 megohm load (6 mmf. shunt capacity), down 1.5 db. at 25,000 cycles, down 5 db. at 50,000 cycles, down 2 db. at 20 cycles.

Null Detector Sensitivity: At 1 Kc. 100 microvolts will give a 15% meter deflection.

Selective Amplifier: 23 db. second harmonic attenuation at 60, 400 and 1000 cycles.

Output Impedance: Approximately 50,000 ohms.

Output Voltage: 40 volts undistorted into 1 megohm load, 10 volts into 20,000 ohms.

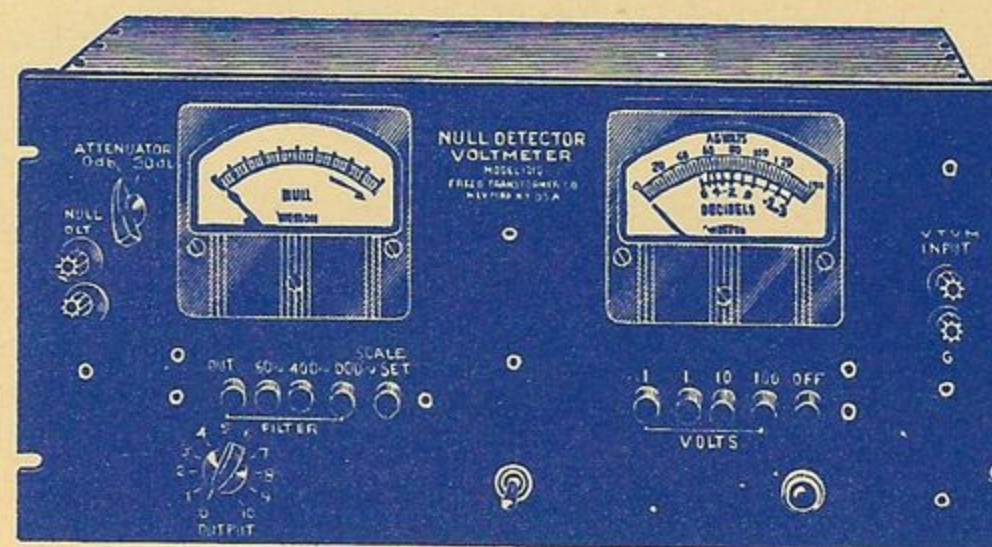
Power Supply: 105-125 volts, 50-60 cycles, 35 watts consumption.

Mounting: This instrument can be supplied in cabinet model (Type No. 1140A) or in a standard relay rack mount with dust cover (Type No. 1140AR).

Dimensions: (Type No. 1140A) 13 1/2" x 8 1/2" x 10" overall; (Type No. 1140AR) 19" L. x 7" W. x 9" D.

Weight: 24 lbs.

NO. 1210 NULL DETECTOR AND VACUUM TUBE VOLTMETER



The Type 1210 Null Detector and Vacuum Tube Voltmeter is primarily designed for bridge measurements. The Null Detector indicates the balance of the bridge, and the Vacuum Tube Voltmeter indicates the voltage across the unknown two terminal or four terminal

network. The three selective circuits provide means for sharply tuning the instrument to audio frequencies commonly used for measurements. The Vacuum Tube Voltmeter can be used as a general purpose audio Vacuum Tube Voltmeter.

DESCRIPTION

The Type 1210 Null Detector and Vacuum Tube Voltmeter is a combination of the Model 1140A Null Detector Amplifier and a modified model 1060 high input im-

pedance Vacuum Tube Voltmeter. Both instruments are independent and feed two separate 4" meters.

SPECIFICATIONS

NULL DETECTOR

Input Impedance: 1 megohm in parallel with 25 mmf.

Frequency Response: 2 Db from 20 to 20,000 cycles — 5 Db at 50,000 cycles.

Null Detector Sensitivity: At 1000 cycles, 100 microvolts will give a 15% meter deflection.

Selective Amplifier: 23 Db second harmonic attenuation at 60 cycles, 400 cycles and 1000 cycles.

VACUUM TUBE VOLTMETER

Voltage Ranges: 0.01 volts to 100 volts in four ranges — (0.1 — 1 — 10 — 100 volts at 3/4 of scale.)

Accuracy: 2% of full scale on all four ranges.

Waveform Error: The instrument is a full wave average meter and is free of turnover effects. For small amounts of distortion the accuracy of the instrument is independent of the waveform.

Frequency Range: 20 cycles to 20,000 cycles (1 Db).

Input Impedance: Equivalent to 50 megohms resistance in parallel with a 15 mmf condenser.

Meter Scale: Voltage scale calibrated from 0 to 150. Decibel scale calibrated from -6 Db to +3 Db.

Dimensions: Rack Mounting 19" x 9" x 11 1/2".
Net Weight: 25 Lbs.

MODEL 1060 A.C.-V.T. VOLTMETER

A 50 Megohm input impedance wide frequency range voltmeter which can be used at audio and supersonic frequencies.

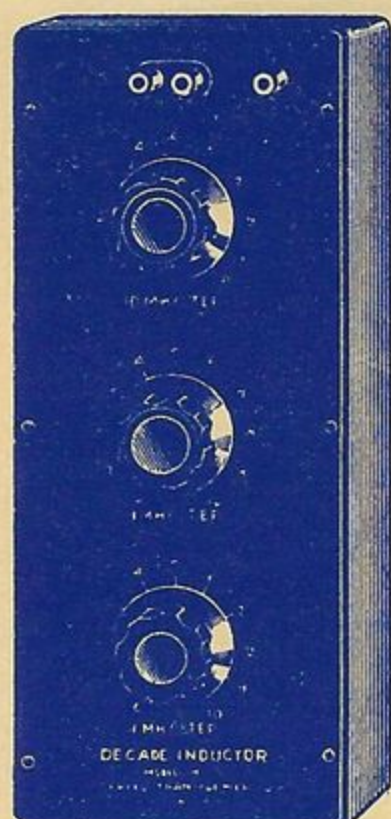
Particularly recommended for: (1) Vibration studies involving very low frequencies. (2) Frequency characteristics and gain measurements on amplifiers. (3) Transmission losses on telephone carrier systems.

High input resistance together with the small input capacity makes the instrument invaluable for high impedance tuned circuit measurements at audio and supersonic frequencies.



DECADE INDUCTORS

Primarily designed for use in wave filters, tuned circuits and equalizers for audio and supersonic frequencies. The stability, accuracy and high value of "Q" makes these Decade Inductors invaluable laboratory instruments.



3 DECADE INDUCTOR

No. 1160

10 x 1. HY Steps
10 x 0.1 HY Steps
10 x 0.01 HY Steps
500-15,000 Cycles

No. 1161

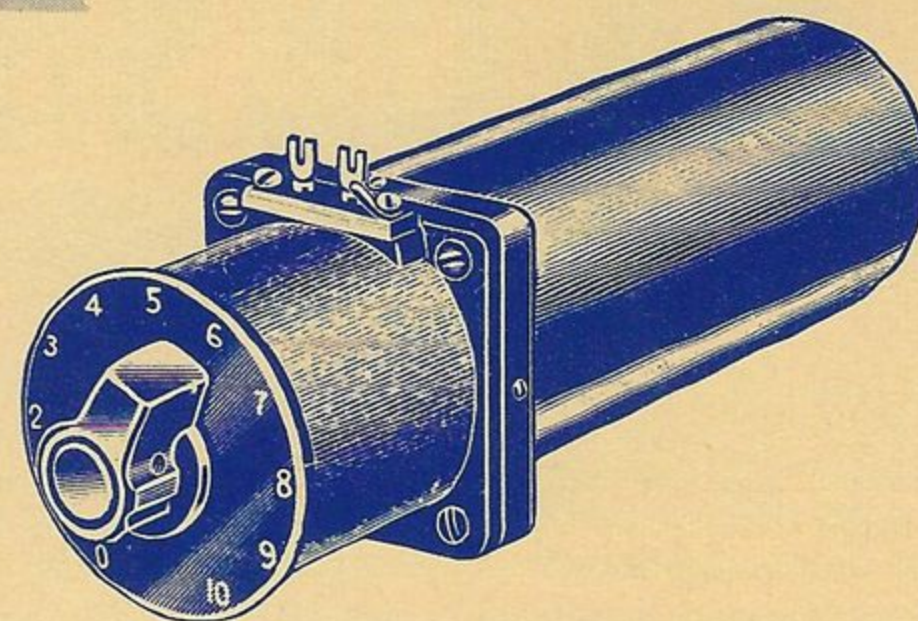
10 x 0.1 HY Steps
10 x 0.01 HY Steps
10 x 0.001 HY Steps
2000-50,000 Cycles

No. 1162

10 x 0.01 HY Steps
10 x 0.001 HY Steps
10 x 0.0001 HY Steps
10,000-300,000 Cycles

No. 1164

10 x 10 HY Steps
10 x 1 HY Steps
10 x 0.1 HY Steps
30-2,000 Cycles



SINGLE DECADE INDUCTOR

No. 1163 — 3 Unit Decade Inductor
10 x 0.1 HY, 10 x 0.01 HY, 10 x 0.001 HY.
Frequency Range, 500-15,000 cycles.
Q = 60 @ 1,000 cycles.

No. 1280 — 3 Unit Decade Inductor
10 x 0.1 HY, 10 x 0.01 HY, 10 x 0.001 HY.
Frequency Range, 500-15,000 cycles.
Q = 160 @ 1,000 cycles.

No. 1310 — 3 Unit Decade Inductor
10 x 1 HY, 10 x 0.1 HY, 10 x 0.01 HY.
Frequency Range, 500-15,000 cycles.
Q = 160 @ 1,000 cycles.

No. 1342 — 3 Unit Decade Inductor
10 x 10 HY, 10 x 1 HY, 10 x 0.1 HY.
Frequency Range, 200-2,000 cycles.
Q = 80 @ 500 cycles.

No. 1260 — 4 Unit Decade Inductor
10 x 1 HY, 10 x 0.1 HY, 10 x 0.01 HY,
10 x 0.001 HY.
Frequency Range, 500-15,000 cycles.
Q = 60 @ 1,000 cycles.

No. 1290 — 4 Unit Decade Inductor
10 x 1 HY, 10 x 0.1 HY, 10 x 0.01 HY,
10 x 0.001 HY.
Frequency Range, 500-15,000 cycles.
Q = 160 @ 1,000 cycles.

No. 1270 — 10 x 1 HY.
Frequency Range, 500-15,000 cycles.
Q = 160 @ 1,000 cycles.

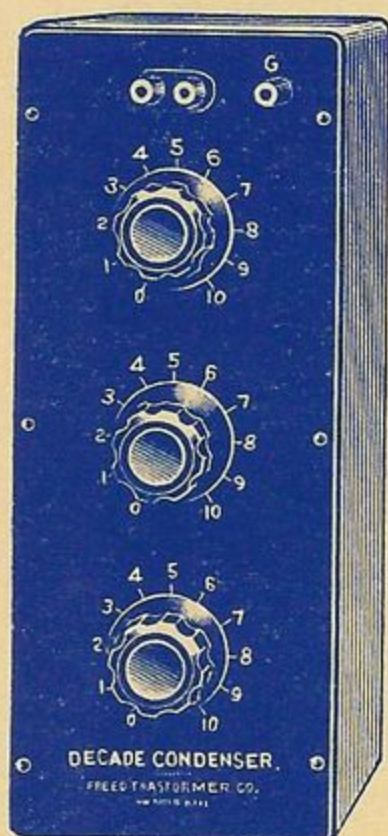
No. 1240 — 10 x 0.1 HY.
Frequency Range, 500-15,000 cycles.
Q = 160 @ 1,000 cycles.

No. 1230 — 10 x 0.01 HY.
Frequency Range, 500-15,000 cycles.
Q = 160 @ 1,000 cycles.

No. 1220 — 10 x 0.001 HY.
Frequency Range, 500-15,000 cycles.
Q = 160 @ 1,000 cycles.

No. 1341
Decade Inductor, 10 x 10 HY.
Frequency Range, 200-2,000 cycles.
Q = 80 @ 500 cycles.

NO. 1250 DECADE CONDENSER



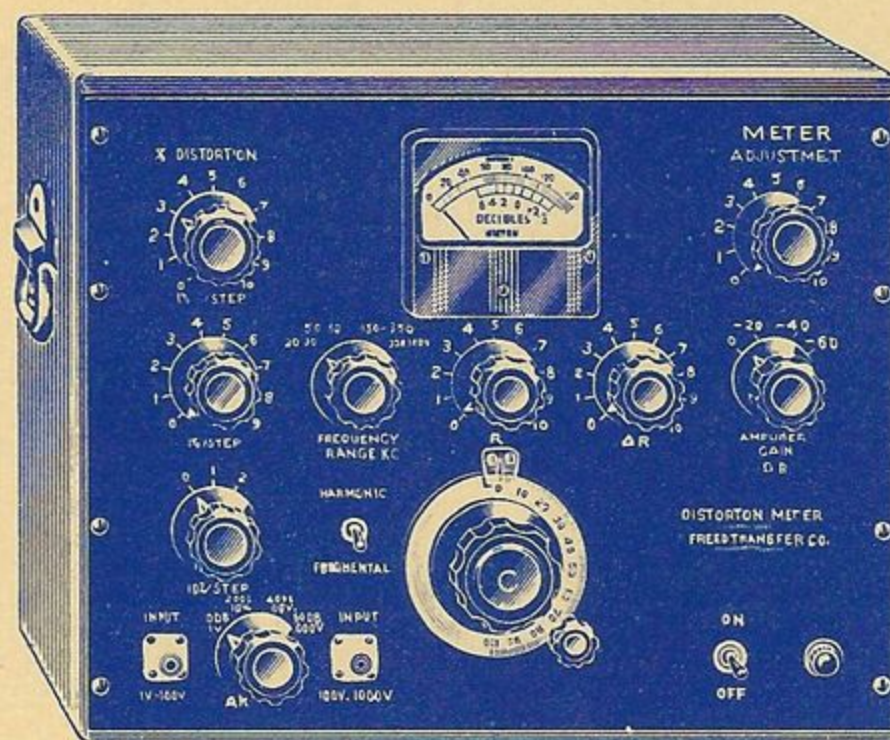
High quality Decade Condenser designed for use in Wave Filters, Tuned Circuits and Equalizers for Audio and Supersonic Frequency.

The stability, accuracy and low dissipation factor make this Condenser an invaluable laboratory instrument. 1.110 mf in 0.001 mf steps $\pm 1\%$ accuracy. Maximum Voltage 500 peak.

Dimensions: Width 6"; Depth 4 1/2"
Height 13 3/4"

Weight: 8 pounds.

NO. 1410 HARMONIC DISTORTION METER FOR CARRIER FREQUENCIES



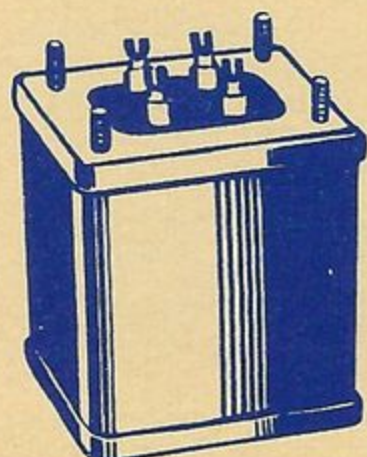
Frequency range 20,000 cycles to one megacycle. Harmonic distortion range from 1/10% to 30%. Maximum input voltage 1,000 volts. The instrument is self-contained and A.C. operated.

Dimensions: Width 19 1/2";
Height 15";
Depth 10 1/4";

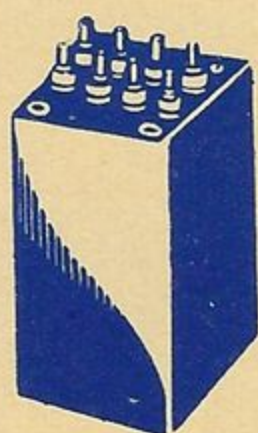
Weight: 45 pounds.

Commercial Transformers TO SUIT EVERY REQUIREMENT

Military Transformers To meet MIL-T-27 & ANE-19 Specifications



HIGH FIDELITY TRANSFORMERS
1/2 DB 20 CPS TO 30 KC



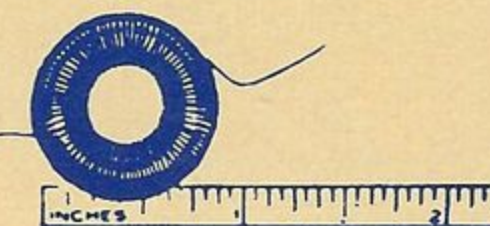
HERMETICALLY SEALED COMPONENTS
TO MEET MIL-T-27 SPECS.



TOROIDAL INDUCTORS
60 CPS TO 1 MC



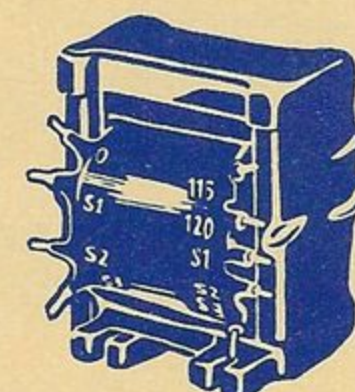
SUB MINIATURE
HERMETICALLY SEALED
COMMUNICATION
COMPONENTS



MINIATURE INDUCTORS
1000 CPS TO 100 KC



SLUG TUNED
COMPONENTS



FREEDSEAL TREATMENT
ANE-19 SPECS.

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