

SPECIFICATIONS

**Range:** Inductance, 0.1 microhenry to 1 henry. The range can be extended by using TYPE 1482 Standard Inductors as external standards. When the internal standard is used, the bridge will balance for storage factors between 0.06 and infinity at 1 ke.

**Accuracy:** Inductance,  $\pm(0.2\% + 0.1 \mu h)$ . The capacitance across the UNKNOWN terminals is about 90  $\mu f$ . This capacitance will increase the measured value of large inductors fractionally by the amount  $\omega^2 LC$ . At 1 ke and 1 h the increase is 0.36%.

**Frequency Range:** All calibration adjustments are made at a frequency of 1 ke. The bridge can be used at any frequency between 60 cycles and 10 kilocycles, but errors resulting from stray capacitance increase with frequency. When large values of inductance are measured with external standards, the frequency should be lowered to avoid resonance effects.

**Standards:** The standard inductor is a 1-millihenry toroid wound on a ceramic form. Resistance balance of the bridge is made by means of resistors having small residual inductances.

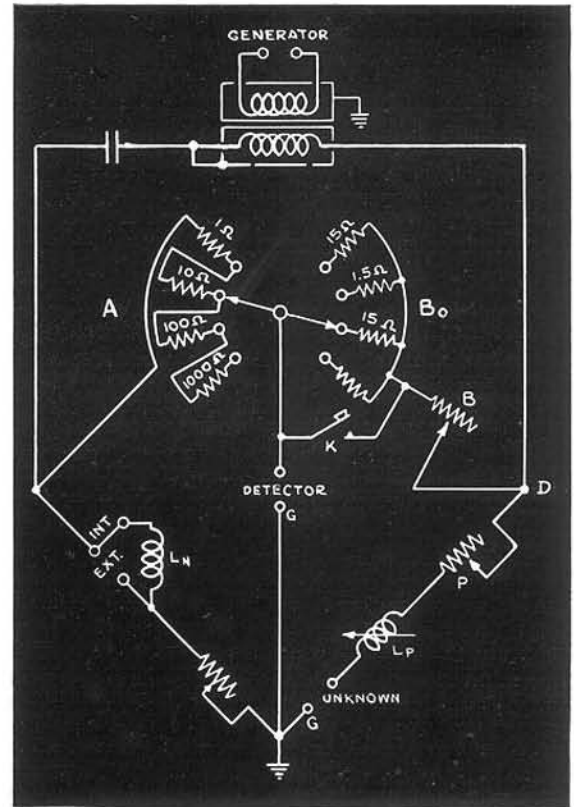
**Mounting:** The bridge is supplied in a shielded cabinet.

**Accessories Required:** Oscillator, amplifier, and earphones. TYPE 1214-A Oscillator (see page 164) and TYPE 1231-B Amplifier and Null Detector (see page 107), or the TYPE 1212-A Unit Null Detector (see page 111) are recommended.

**Accessories Supplied:** Two TYPE 274-NC Shielded Connectors.

**Dimensions:** (Length)  $17\frac{1}{2}$  x (width) 16 x (height)  $9\frac{1}{2}$  inches, over-all.

**Net Weight:** 33 pounds.



Type	Code Word	Price
667-A Inductance Bridge	AERIE	\$450.00

TYPE 1604-B COMPARISON BRIDGE



**USES:** The TYPE 1604-B Comparison Bridge is designed for the rapid testing of components at audio frequencies, by comparison with an appropriate standard. Typical measurements for which this versatile instrument is suited include: production testing of ganged potentiometers or capacitors for tracking; measurement of small values of capacitance; checking center-tapped windings for proper location of tap. In production and in the development laboratory, the bridge is useful for the rapid matching of components for use in critical circuits.

**DESCRIPTION:** This instrument is completely self-contained, consisting of a bridge circuit, an oscillator operating at 400 c, 1000 c, and 5 ke, and a sensitive cathode-ray-tube visual detector.

The bridge circuit consists basically of a pair of resistive ratio arms, with a precision

# BRIDGES

linear potentiometer providing a calibrated variation from unity. A differential capacitor across the ratio arms provides the phase-angle, or dissipation-factor, balance. Two ranges of impedance difference are provided,  $\pm 20\%$  and  $\pm 5\%$ . Provision is made for switching the point at which the bridge can be grounded, so that measurements can be made with the unknown either grounded or not, as desired.

The oscillator is a conventional R-C phase-shift oscillator which is coupled to the bridge through a shielded bridge transformer and a cathode follower. The cathode follower eliminates any reaction of the bridge back on the oscillator, while the transformer shielding prevents any unbalanced voltages from the oscillator from affecting the bridge balance. A differential capacitor is used to balance the

capacitance from the transformer shield to the ends of the shielded winding.

The detector is a three-stage, high-gain, non-linear amplifier. The highly non-linear response permits the bridge to be balanced without continual resetting of the gain control. Balance is indicated on a cathode-ray tube.

- FEATURES:**
- Rapid measurements.
  - Three measuring frequencies.
  - High accuracy.
  - Wide impedance range.
  - Requires no accessories — ready for operation when connected to power line.
  - Visual null indicator.
  - Grounded or ungrounded measurements can be made.

## SPECIFICATIONS

**Deviation Range:** For impedance difference,  $\pm 5\%$  and  $\pm 20\%$ , selected by a panel switch. For dissipation factor difference,  $\pm .006$  at 400 c,  $\pm .015$  at 1 kc,  $\pm .075$  at 5 kc.

**Impedance Range and Accuracy:** Impedances between 2  $\Omega$  and 20 M $\Omega$  can be compared. For the 5% deviation range the basic accuracy is  $\pm 0.1\%$ , but at extreme values of impedance the error is somewhat greater. The range for resistors, capacitors, and inductors for which the  $\pm 0.1\%$  accuracy applies is given in the table:

Frequency	R	L	C
400 c	2 $\Omega$ to 20 M $\Omega$	2 mh to 1500 h	100 $\mu$ f to 50 $\mu$ mf
1 kc	2 $\Omega$ to 20 M $\Omega$	1 mh to 250 h	30 $\mu$ f to 50 $\mu$ mf
5 kc	4 $\Omega$ to 2 M $\Omega$	200 $\mu$ h to 10 h	2 $\mu$ f to 50 $\mu$ mf

These ranges apply for comparison of components whose dissipation factor differences do not exceed .02. On the 20% deviation range the accuracy is  $\pm 0.5\%$  over the same impedance ranges.

**Dissipation Factor Accuracy:** The accuracy of measurement of differences of dissipation factor is:

Frequency	Accuracy
400 c	$\pm (0.0002 + 2\%$ of the impedance difference)
1 kc	$\pm (0.0005 + 2\%$ of the impedance difference)
5 kc	$\pm (0.0025 + 2\%$ of the impedance difference)

**Frequency:** Frequencies of 400 c, 1 kc and 5 kc are provided, selected by panel switch. The frequency is within  $\pm 3\%$  of the nominal value.

**Grounding:** Two ground positions are provided, one of which grounds the junction of the standard and unknown impedances. With this connection the total impedances between the high terminals and ground are compared. In the other connection the junction of the ratio arms of the bridge is grounded, leaving both terminals of the standard and unknown ungrounded. With this connection the direct impedance between terminals of a component is measured, and terminal impedances to ground, within certain limits, will not affect the bridge balance.

**Voltage Applied to Unknown:** Approximately one volt, for impedances above 500  $\Omega$ . For lower values of

impedance the voltage is decreased, corresponding to a source impedance of the order of 100  $\Omega$ .

**Zero Adjustment:** An adjustable index mark is provided with locking means so that the zero can be offset to correspond to the deviation of the standard component from the desired nominal value.

**Power Supply:** 105-125 (or 210-250) volts, 50 to 60 cycles.

**Accessories Supplied:** Line-Connector cord.

**Accessories Required:** Adjustable calibrated standards such as the TYPE 1432 Decade Resistors, TYPE 219 Decade Capacitors, and TYPE 1490 Decade Inductors may be used. Fixed standards such as the TYPE 509 Standard Capacitors, TYPE 1481 and TYPE 1482 Inductors, and TYPE 500 Resistors may also be used whenever appropriate values are available.

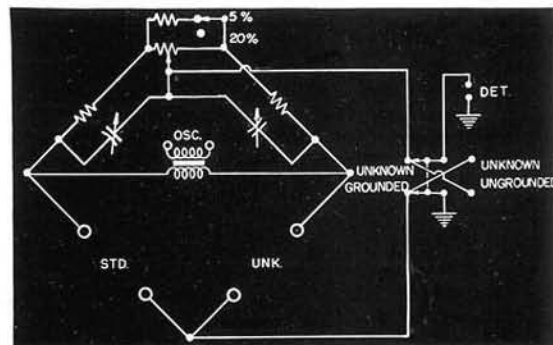
For production tests, the standard is often a component of the type to be tested, that has been measured independently or otherwise selected.

**Accessories Available:** TYPES 1231-P2 and 1231-P5 Filters (pages 108 and 109) for providing frequency discrimination.

**Mounting:** Welded aluminum cabinet.

**Dimensions:** (Width) 12 inches, (height) 14 $\frac{1}{4}$  inches, (depth) 10 inches, over-all.

**Net Weight:** 22 $\frac{1}{2}$  pounds.



Basic schematic diagram of the bridge circuit used in the TYPE 1604-B Comparison Bridge.

Type	Code Word	Price
1604-B   Comparison Bridge .....	FATTY	\$390.00

PATENT NOTICE. See Note 2, page vi.