



1633-A Incremental-Inductance Bridge

- direct reading at 9 frequencies in series L and R or Q
- 0.2 μ H to 1000 H
- 20 Hz to 20 kHz
- accuracy $\pm 1\%$
- apply up to 1250 V and 50 A, ac and dc
- numerous safety features

The 1633-A was designed primarily for measuring inductance and loss of transformers, chokes, and similar components at very high levels of ac and dc excitation and over a wide frequency range. Easy to operate and flexible in application, it can also measure other nonlinear elements such as Zener diodes, rectifiers, thermistors, and lamps. The bridge contains a highly selective nine-frequency detector for effective harmonic rejection and can be supplied complete with high-power ac and dc supplies as the Type 1630 Inductance-Measuring Assembly.

The incremental-inductance bridge uses a circuit that incorporates active elements* in stable operational am-

plifiers. Although large signal and bias levels may be applied to the unknown inductor, this circuit keeps signals in the bridge small, minimizes corrections, and eliminates sliding balance. Current and voltage in the unknown inductor are nearly identical in magnitude and waveform to those applied at the GENERATOR terminals. In many instances measurements can be made on the inductor while it is actually operating in your circuit.

Up to 7 amperes rms (combined ac and dc) can be passed through the inductor during measurement, up to 50 amperes if you use the 1633-P1 Range-Extension Unit. The impressed voltage can be as high as 1250 volts. Two power supplies are available, a dc supply and a variable-frequency oscillator, which are designed specifically for use with the bridge. Most conventional power supplies are not suitable.

The internal detector is highly selective at nine frequencies between 50 Hz and 15.75 kHz. Owing to high detector sensitivity and low noise, measurements can be made at excitation levels below one volt on the highest inductance ranges and 10 millivolts on the lowest range.

* H. P. Hall, R. G. Fulks, "The Use of Active Devices in Precision Bridges," *Electrical Engineering*, May 1962.

SPECIFICATIONS

Ranges and Accuracy:

Measurement	Frequency	Full-Scale Ranges						Lowest Scale Division	Accuracy
		a	b	c	d	e	f		
Inductance	50, 60, 100, 120 Hz	10 mH	100 mH	1 H	10 H	100 H	1000 H	20 μ H	$\pm(1\%$ of reading or 0.1% of full scale)
	400, 800, 1000 Hz	1 mH	10 mH	100 mH	1 H	10 H	100 H	2 μ H	$\pm(2\pi fR_L/100 Q_L) \%^*$, $\pm 2\%$ above 10 kHz
	10, 15.75 kHz	100 μ H	1 mH	10 mH	100 mH	1 H	10 H	0.2 μ H	or $\pm 3\%$ above 15.75 kHz
Resistance	All	10 Ω	100 Ω	1 k Ω	10 k Ω	100 k Ω	1 M Ω	10 m Ω	$\pm(2\%$ of reading or 0.1% of full scale) $\pm \frac{4\pi fR_L Q_L}{100} \%^*$
Q		∞ to 1, direct reading at above frequencies Largest scale reading: 1000						0.9	1/Q accuracy = $\pm 2\% \pm 0.001 \pm 0.0005 fR_L Q_L^*$
Max rms volts		12.5	125	1250	1250	1250	1250		
Min rms volts for 1% accuracy (internal detector)	50, 60 Hz	0.025	0.25	2.5	2.5	2.5	2.5		
	1 kHz	0.006	0.06	0.6	0.6	0.6	0.6		
Max rms amperes**		7	7	7	2	0.7	0.2		
with extension unit†		50	50	50					

* The frequency-error term is 5 times larger on highest L range.

** Max rms current = $\sqrt{I_{dc}^2 + I_{ac}^2}$

† 1633-P1 Range-Extension Unit contains a 0.1- Ω resistor, which you connect externally to shunt R_s (on the 3 lowest bridge ranges). Inductance and resistance values are reduced by a factor of 10.

Generator: External only (not supplied). For optimum performance when dc bias is used, ac supply must be able to withstand large dc currents in output circuit, and dc supply large ac currents. For dc bias, use 1265-A Adjustable DC Power Supply, 200 W; over the audio-frequency range, use 1308-A Audio Oscillator and Power Amplifier, 200 VA.

Detectors: INTERNAL: Selectively tuned to 50, 60, 100, 120, 400, 800 Hz, 1, 10, and 15.75 kHz; response varies < 3 dB for frequency components within $\pm 1\%$ of the nominal. Response at 2nd harmonic is typically 50 dB lower. EXTERNAL: Use the 1232-A Tuned Amplifier and Null Detector, which is tunable continuously, 20 Hz to 20 kHz.

Available: 1633-P1 Range-Extension Unit, 1232-A Tuned Amplifier and Null Detector, 1308-A Audio Oscillator and Power Amplifier.

Power: 105 to 125 V or 210 to 250 V, 50 to 60 Hz, ≈ 6 W.

Mechanical: Rack-bench cabinet. DIMENSIONS (wxhxd): Bench, 19x12.75x10.25 in. (483x324x260 mm); rack, 19x12.25x8.75 in. (483x311x222 mm). WEIGHT: 31 lb (14 kg) net, 48 lb (22 kg) shipping.

Description	Catalog Number
1633-A Incremental-Inductance Bridge	
115-V Bench Model \diamond	1633-9801
115-V Rack Model	1633-9811
230-V Bench Model	1633-9802
230-V Rack Model	1633-9812

1265-A Adjustable DC Power Supply

The 1265-A supplies dc bias for the 1633-A Incremental-Inductance Bridge. Its characteristics include wide ranges of current and voltage, a passive low-impedance output circuit that will pass high alternating currents, and a choice of voltage or current regulation.

The instrument has four voltage ranges and four current ranges and will deliver its maximum rated power of 200 watts to 8, 80, or 800 ohms. Range switches are interlocked to prevent most likely overload situations. In addition, electronic circuit prevents damage from overload.



SPECIFICATIONS

Full-Scale Output Ranges: 12.5, 40, 125, 400 V dc; 0.16, 0.5, 1.6, 5 A dc; in any combination up to 200 W.

Meters: Voltage and current; ranges switch with output ranges.

Overload Protection: Overload circuit trips at approx $1\frac{1}{2}$ times full-scale current.

Regulation: VOLTAGE OR CURRENT: 0.2% for 10% line-voltage change; 1% for 100% load change. SPEED OF RESPONSE: Approx 0.1 second.

Hum Level (rms): For 60-Hz operation, approx 70 dB below full-scale dc output (55 dB on 5-A ranges); for 50-Hz operation, 6 dB higher.

Power: 105 to 125 V or 210 to 250 V, 50 or 60 Hz, 380 W at rated load. (Specify if for 50 Hz.)

Mechanical: Rack-bench cabinet. DIMENSIONS (wxhxd): Bench, 19x7.5x17.25 in. (483x190x438 mm); rack, 19x7x15 in. (483x178x381 mm). WEIGHT: 70 lb (32 kg) net, 124 lb (57 kg) shipping.

Description	Catalog Number
1265-A Adjustable DC Power Supply	
115-V Models	
60-Hz, Bench	1265-9801
60-Hz, Rack	1265-9811
50-Hz, Bench	1265-9803
50-Hz, Rack	1265-9813
230-V Models	
60-Hz, Bench	1265-9802
60-Hz, Rack	1265-9812
50-Hz, Bench	1265-9804
50-Hz, Rack	1265-9814

\diamond Federal stock numbers are listed before the Index.