



Specifications

Measurement Parameters and Modes: Series or parallel L and Q, series or parallel C and D, series C and ESR, or parallel C and parallel equivalent R. Continuous-repetitive, single, or averaged (set of 10) measurements; start button initiates single or averaged measurements. Keyboard selection of these and all measurement conditions.

Main Displays: MEASURE FUNCTION (3 selections): Value display is LED-type numerical readout with automatically positioned decimal points and illumination of units; five digits for LC (99999) and simultaneously four digits for D Q ESR (9999). Delta-percent display is percentage difference between LC measurement and previously stored nominal value. Bin number display shows the bin assignment of the measured device. (Refer to "sorting", below.) ENTER FUNCTION: Display shows comparator bin limits, nominal values, and test frequency.

Measurements Rates: 0.5, 2, 3, and 8 measurements/second (except 6.5 max if test frequency < 710 Hz). Keyboard selections are: extended accuracy, slow, medium, fast.

Test Frequencies: Keyboard selection by entering any desired frequency; the Digibridge responds by selecting nearest one of 254 frequencies between 234.37 Hz and 20 kHz, inclusive. Selected value is automatically displayed. Available frequencies are: $f = (60/n) \pm .01\%$, where n is an integer that satisfies $3 \leq n \leq 256$, and f is expressed in kHz.

Applied Voltage: HIGH: 1.0 V rms, open ckt. LOW: 0.25 V rms, open ckt. (Source impedance depends on range; see para 3.5.) CONSTANT HIGH: 1.0 V rms across DUT, with autoranging, if DUT impedance > 25 Ω (for low-loss reactive DUT). CONSTANT LOW: 0.25 V rms, similarly. VOLTAGE ACCURACY: +20% (for f = 1 kHz), or $\pm 30\%$ (for f \neq 1 kHz).

Ranges: Automatic ranging for best accuracy; autorange can be inhibited by keyboard selection. Four basic ranges (best accuracy, see table) each covering a factor of about 16 in impedance, for each parameter. Automatic extensions to min and max, as tabulated.

Control Functions: ENTER: For keyboard entry of numbers for nominal value, bin limits, or test frequency. MEASURE: for keyboard entry of all other measurement conditions, and to enable measurement and display of results.

DUT Connection: 4-terminal (Kelvin) at built-in test fixture for radial-lead or axial-lead parts. Optional extender cable.

Zeroing and Recalibration: "Zero" capacitance of test fixture, cable, etc. is stored at keyboard command and automatically eliminated from DUT measured values. Recalibration requires only connection of 4 known capacitors and appropriate keyboard commands; recommended recalibration interval is 1 year.

RANGES OF MEASUREMENT AT 1 kHz*

Parameter	Minimum	Basic Ranges	Maximum
L	.00001 mH	1.0 mH to 64 H	9999.9 H
C (with D)	00.001 pF	400 pF to 25 μ F	9999.9 μ F
C (with ESR)	.00001 nF	0.4 nF to 25 μ F	9999.9 μ F
$\Delta\%$ (of LC)	0.0001%	(fully automatic)	99999%
Q (with L)	.0001	(fully automatic)	999.9
D (with C)	.0001	(fully automatic)	999.9
D (ext acc)	0001 ppm	(fully automatic)	9999 ppm
ESR (with C)	.0001 Ω	(fully automatic)**	9999 k Ω

* For any other measurement frequency, each table entry with units of inductance or capacitance must be divided by a scale factor equal to frequency in kHz.

** For D \geq 1, basic ranges of R: 6.25 Ω to 400 k Ω .

Accuracy: BASIC (not including range extensions): For L, $\pm .04\%$; C, $\pm .02\%$; Q, $\pm .0002 [1 + (1+Q)Q]$; D, ± 100 ppm (for D < 9999 ppm); ESR, $\pm .02\% \pm 1$ count. BASIC-ACCURACY TEST CONDITIONS: 1 kHz, autoranging, extended accuracy, non-constant high test voltage, DUT impedance within basic ranges (approx 6 Ω to 400 k Ω), with small quadrature component (< 10% of main component), temperature 23°C. GENERAL: (Basic accuracies here include range extensions; refer to table.)

L accuracy = \pm (L basic accuracy) (N) (1 + 1/Q) \pm (.02% of reading) \pm T;

C accuracy = \pm (C basic accuracy) (N) (1 + D) \pm T;

R accuracy (for D \geq 1) = \pm (R basic accuracy) (N) (1 + 1/D) \pm (1 count) \pm T;

R accuracy (for D < 1) = $\pm .02\%$ of R value (KM) (1 + 1/D) \pm (1 count) \pm U;

Q accuracy (extended acc selected) = $\pm .0002 [1 + (1+Q)Q]$ (K) (M) \pm t;

Q accuracy (slow, med, or fast) = $\pm .0001 [1 + 2(1+Q)Q]$ (K) (M) \pm t;

D accuracy (extended acc selected) = \pm (100 ppm) (K) (M) \pm t;

D accuracy (slow, med, or fast) = $\pm .0001 [1 + 2(1+D)D]$ (K) (M) \pm t;

where N and M depend on meas rate, voltage, frequency, and range, as tabulated in para 3.3 of this manual (values are $1 \leq N \leq 63$ and $1 \leq M \leq 88$, each being close to 1 for test conditions close to those given above for basic accuracy; T, t, and U are negligible for temperature within $\pm 2^\circ$ C of calibration temperature (23°C) and relative humidity < 60% (see below); "1 count" is 1 increment in least significant digit of the Q D ESR display (example, .05% for a display of 2000). K is 1 in basic ranges and increases linearly with LC accuracy in range extensions, as shown on graphs in para 3.3. NORMAL ENVIRONMENTAL TERMS (for 0° to 50°C and relative humidity < 60%); T = (5 ppm/°C) (ambient temp - 23°C), typical; t = [(2 + 3f) ppm/°C] (ambient temp - 23°C), typical; U is typically: (100 t/D) % of R value (express both t and D in ppm); f = frequency in kHz. SIMILAR TERMS FOR MAX RECOMMENDED CONDITIONS (50°C, 85% R H):

T = 30 ppm/°C (ambient temp - 23°C), typical;

t = [(20 + 20f) ppm/°C] (ambient temp - 23°C), typical.

BASIC ACCURACY AT 1 kHz*

Parameter and Range	Accuracy in Low Extension	Basic Range Corner	Accuracy in Basic Range (% of Reading)	Basic Range Corner	Accuracy in High Extension (% of Reading)
L range 4	±0.0002 mH	1 mH	±.02%	16 mH	±(L/800 mH)%**
3	±0.0032 mH~	16 mH		250 mH	±(L/12.5 H)%**
2	±0.05 mH~	250 mH		4000 mH	±(L/200 H)%**
1	±0.8 mH~	4 H		64 H	±(L/3200 H)%
C range 1	±.08 pF	400 pF	±.02%	6400 pF	±(C/320 nF)%
2	±1.28 pF**	6.4 nF		100 nF	±(C/5 μF)%~
3	±20 pF**	100 nF		1600 nF	±(C/80 μF)%~
4	±320 pF**	1.6 μF		25 μF	±(C/1250 μF)%
The following applies only if D ≥ 1 (i.e., the DUT is a resistor).					
R range 4	±1.25 mΩ	6.25 Ω	±0.2%	100 Ω	±(R/5 kΩ)**
3	±20 mΩ~	0.1 kΩ		1.6 kΩ	±(R/80 kΩ)**
2	±0.32 Ω~	1.6 kΩ		25 kΩ	±(R/1.25 MΩ)**
1	±5 Ω~	25 kΩ		400 kΩ	±(R/20 MΩ)

*For any other measurement frequency, each table entry with units of inductance or capacitance must be divided by a scale factor equal to test frequency in kHz.

** Autoranging avoids these extensions unless constant test voltage has been selected, in which case they are used to a maximum of ±.08%. (Thus the "worst case" is a factor of 4 above basic-range accuracy.) Measurement of large L at high frequency may require use of range-2 high extension to avoid LC resonance effect on range 1; refer to para 3.12.

~ Autoranging avoids these extensions.

Bias: Internal voltage source -2 V ± 10%, on-off switch.

Supplementary displays: Main display category, measurement rate, measurement voltage, function, mode, if frequency not 1 kHz, if range held, if parallel equivalent circuit, and if remote control.

Sorting: Limit comparator sorts vs a Q D ESR limit and up to 8 pairs of LC limits into 10 bins, conveniently defined by keyboard entries. GO/NO-GO is indicated, whether bin number or measured value is selected as main display.

Interface option: 2 ports (1 with choice of 2 modes); a 24-pin connector for each port. IEEE-488 INTERFACE PORT: Functions are SH1, AH1, T5, L4, SR1, RL2, PPO, DC0, DT1, C0. Refer to IEEE Standard 488-1973. Switch selection between 2 modes as follows. TALKER-LISTENER MODE: Input commands from system controller can disable keyboard and program all functions (except switching bias voltage and performing full recalibration); any or all measurement results are available as outputs. TALKER-ONLY MODE: Measured results are always output, for use in systems without controllers. HANDLER INTERFACE PORT: 1 input (start signal), 2 output (status signals), and set of 10 output lines (sorting data); active-low logic; for input, logic low is 0.0 to +0.4 V (current is 0.4 mA max) and logic high is +2.4 V to +5.0 V; for outputs, open-collector drivers each rated at +30 V max, 40 mA max (sink), at this port only. (External power supply and pullup resistors are required.)

Environment: OPERATING: Temperature, 0 to 50°C; Relative humidity, 0 to 85%. STORAGE: -40 to 75°C. CALIBRATION TEMPERATURE: 23°C.

Supplied: Axial-lead test-fixture adaptors, condensed operating instruction card, instruction manual, and power cord for 125-V ac line.

Line Voltage and Power: 90 to 125 V or 180 to 250 V, 50 to 60 Hz. Either range of voltage selected by rear-panel switch. 40 W max, 30 W typical.

Mechanical: Bench mounting. DIMENSIONS: (wxhxd): 375x112x343 mm (14.8x4.4x13.5 in.). WEIGHT: 6 kg (13 lb) net, 10 kg (22 lb) shipping.

Description	Catalog Number
1688 Precision LC Digibridge®	
Standard Model	1688-9700
With Interface Option	1688-9701
Extender Cable (for test fixture)	1688-9600

Patent applied for.