

TECHNICAL MANUAL
CALIBRATION PROCEDURE
FOR
LCR METER
878B, 879B

(B & K PRECISION)



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LCR METER
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1 CALIBRATION DESCRIPTION:*Table 1.*

Test Instrument (TI) Characteristics	Performance Specifications	Test Method																																
Frequency	Range: P/N 878B, 120 Hz to 1 kHz; * ¹ P/N 879B, 100 Hz to 10 kHz * ¹ Accuracy: $\pm 0.02\%$ of actual output frequency	Compare to an Electronic Counter																																
Inductance	Range: 0 to 1000 H Accuracy: $\pm(\% \text{ rdg} + \text{dgts})$	Compare to a known Inductance																																
<u>100 Hz</u> * ² /120 Hz																																		
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See footnotes at end of Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method	
Capacitance/Dissipation	Range: 0 to 20 mF Accuracy: \pm (% rdg + dgts)	Compare to a known Capacitance	
	<u>100 Hz *²/120 Hz</u>		
<u>Range (F)</u>	<u>Cx Accuracy</u>	<u>DF (Dx <0.5) *³</u>	<u>Mode</u>
20 m	8% + 3 dgts	8% + 50 dgts	Series
4000 μ	2% + 2 dgts	2% + 50 dgts	Series
400 μ	0.7% + 2 dgts	0.7% + 50 dgts	Series
40 μ	0.5% + 1 dgt	0.5% + 50 dgts	Series
4000 n	0.5% + 1 dgt	0.5% + 50 dgts	---
400 n	0.5% + 2 dgts	0.5% + 50 dgts	---
40 n	0.7% + 1 dgt	0.7% + 50 dgts	Parallel
4 n	2.5% + 2 dgts	2.5% + 50 dgts	Parallel
	<u>1 kHz</u>		
<u>Range (F)</u>	<u>Cx Accuracy</u>	<u>DF (Dx <0.5)</u>	<u>Mode</u>
1000 μ	3.7% + 3 dgts	3.7% + 50 dgts	Series
400 μ	2% + 2 dgts	2% + 50 dgts	Series
40 μ	0.7% + 2 dgts	0.7% + 50 dgts	Series
4000 n	0.5% + 1 dgt	0.5% + 50 dgts	Series
400 n	0.5% + 2 dgts	0.5% + 50 dgts	---
40 n	0.5% + 2 dgts	0.5% + 50 dgts	---
4000 p	0.7% + 2 dgts	0.7% + 50 dgts	Parallel
400 p	2.5% + 2 dgts	2.5% + 50 dgts	Parallel
	<u>10 kHz *²</u>		
<u>Range (F)</u>	<u>Cx Accuracy</u>	<u>DF (Dx <0.5) *³</u>	<u>Mode</u>
100 μ	3.9% + 5 dgts	3.9% + 50 dgts	Series
40 μ	3.7% + 3 dgts	3.7% + 50 dgts	Series
4000 n	0.7% + 2 dgts	0.7% + 50 dgts	Series
400 n	0.5% + 2 dgts	0.5% + 50 dgts	Series
40 n	0.5% + 1 dgt	0.5% + 50 dgts	---
4000 p	0.5% + 2 dgts	0.5% + 50 dgts	---
400 p	0.7% + 2 dgts	0.7% + 50 dgts	Parallel
40 p	2.5% + 2 dgts	2.5% + 50 dgts	Parallel
ESR * ²	Range: 0 to 1000 Ω Accuracy: \pm (% rdg + dgts)	Compare a known Resistance	
	<u>100 Hz/120 Hz/ 1 kHz/10 kHz</u>		
<u>Range (Ω)</u>	<u>Accuracy</u>	<u>Mode</u>	
1000	0.5% + 2 dgts	Series	
100	0.5% + 2 dgts	Series	
10	0.7% + 2 dgts	Series	
1	2.0% + 2 dgts	Series	

See footnotes at end of Table.

Table 1. (Cont.)

Test Instrument (TI) Characteristics	Performance Specifications	Test Method		
Resistance/Impedance	Range: 0 to 10 M Ω Accuracy: \pm (% rdg + dgts)	Compared to a known Resistance		
	<u>100 Hz</u> ^{*2} / <u>120 Hz/1 kHz/10 kHz</u> ^{*2}			
	<u>Range (Ω)</u> <u>R/Zx Accuracy</u> <u>ϕ Accuracy</u> ^{*2, *3} <u>Mode</u>			
	10 M	5.5% + 3 dgts	$\pm 3.2^\circ$	Parallel
	4000 k	2.5% + 2 dgts	$\pm 1.5^\circ$	Parallel
	400 k	0.7% + 2 dgts	$\pm 0.4^\circ$	Parallel
	40 k	0.5% + 2 dgts	$\pm 0.3^\circ$	---
	4000	0.5% + 2 dgts	$\pm 0.3^\circ$	---
	400	0.5% + 2 dgts	$\pm 0.3^\circ$	Series
	40	0.7% + 2 dgts	$\pm 0.4^\circ$	Series
	4	2.0% + 2 dgts	$\pm 1.2^\circ$	Series

*¹ 120 Hz test setting = 120.048 Hz actual frequency.

*² P/N 879B only.

*³ Implicitly Calibrated.

2 EQUIPMENT REQUIREMENTS:

Noun	Minimum Use Specifications	Calibration Equipment	Sub- Item
2.1 ELECTRONIC COUNTER	Range: 100 Hz to 10 kHz Accuracy: ± 50 ppm of rdg	Agilent 53132A	
2.2 INDUCTANCE STANDARD	Range: 100 mH Accuracy: $\pm 0.15\%$ of AFPSL Certified Value	Gen-Rad 1482L	
2.3 STANDARD CAPACITOR KIT	Range: 300 pF to 1 μ F Accuracy: $\pm 0.126\%$ of Certified Values	Arco SS-32	
2.4 DECADE RESISTOR	Range: 3 Ω to 9 M Ω Accuracy: $\pm 0.126\%$ of setting	Gen Rad 1433H	
2.5 STANDARD RESISTOR SET	Range: 1 Ω to 100 k Ω Accuracy: AFPSL Certified Values @ 10 kHz: 1 Ω , $\pm 0.5\%$ of value; 10 Ω to 100 k Ω , $\pm 0.13\%$ of value	Hewlett-Packard 42030A	

Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.6 CAPACITANCE BRIDGE	Range: 1 μ F @ 10 kHz Accuracy: \pm 0.18% of rdg	Andeen-Hagerling AH2700A	

3 PRELIMINARY OPERATIONS:

3.1 Review and become familiar with the entire procedure before beginning the Calibration Process.



Unless otherwise designated, and prior to beginning the Calibration Process, ensure that all test equipment voltage and/or current outputs are set to zero (0) or turned off, where applicable. Ensure that all equipment switches are set to the proper position before making connections or applying power. If not strictly observed, could result in injury to, or death of, personnel or long term health hazards.

3.2 Connect test equipment to appropriate power source. Set all POWER switches to ON and allow warm-up as required by manufacturer.

3.3 Connect TI to appropriate power source. Press TI POWER button to ON and allow a 30 minute warm-up period.

3.4 Using the Capacitance Bridge, measure and record the Standard Capacitor Kit 1 μ F value at 10 kHz (879B only).

3.5 Perform only those portions of the Calibration Process that pertain to the TI being calibrated.

4 CALIBRATION PROCESS:

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met, before proceeding.

4.1 FREQUENCY CALIBRATION:

4.1.1 Connect test leads to TI + and - terminals and the Electronic Counter CHANNEL 1 Input connector, observing polarity. Use adapters and connectors as required.

4.1.2 Set the Electronic Counter controls as required to measure frequency.

4.1.3 Press TI FREQ key as required to select the first applicable value listed in the Applied column of Table 2.

4.1.4 The Electronic Counter must indicate within the corresponding values listed in the Limits column of Table 2.

4.1.5 Repeat steps 4.1.3 and 4.1.4 for the remaining applicable values listed in the Applied column of Table 2.

Table 2.

TI	Applied (Hz)	Limits (Hz)
878B	120 *	120.024 to 120.072
	1000	999.8 to 1000.2
879B	100	99.980 to 100.020
	120 *	120.024 to 120.072
	1000	999.8 to 1000.2
	10 k	9.998 to 10.002 k

* Actual output frequency is 120.048 Hz.

4.1.6 Disconnect test leads from the Electronic Counter.

4.2 INDUCTANCE CALIBRATION:

4.2.1 Press TI L/C/R/ or L/C/R/Z button as required to select L and the FREQ button as required to select 1 kHz.

4.2.2 Short test leads connected to TI and press TI REL/CAL button.

4.2.3 Connect TI + and - terminals to the Inductance Standard.

4.2.4 The TI must indicate the Inductance Standard Certified Value listed on the AFPSL Report of Measurement within $\pm(0.5\%$ of Certified Value + 1 dgt).

4.2.5 Disconnect test setup.

4.3 CAPACITANCE AND DISSIPATION CALIBRATION:

4.3.1 Press TI LCR or L/C/R/Z button as required to select C.

4.3.2 Connect TI + and - terminals to the Standard Capacitor Kit adapter bar.

4.3.3 Press TI REL/CAL button.

4.3.4 Insert the appropriate capacitors into the Standard Capacitor Kit adapter bar to obtain the first value listed in the Applied column of Table 3.

4.3.5 Press TI FREQ button to select the first value listed in the Frequency column of Table 3.

4.3.6 The TI must indicate within the corresponding values listed in the Limits column of Table 3.

4.3.7 Repeat steps 4.3.4 through 4.3.6 for each remaining value listed in the Frequency and Applied columns of Table 3.

Table 3.

Range (F)	Frequency (Hz)	Applied (F)	Limits (F)
400 p	1 k	300 p	292.48 to 307.52 p
4000 p		3 n	2.9788 to 3.0212 n
40 n		30 n	29.848 to 30.152 n
400 n		300 n	298.48 to 301.52 n
4000 n		1 μ	0.9949 to 1.0051 μ
	100 *	1 μ	0.9949 to 1.0051 μ
	120	1 μ	0.9949 to 1.0051 μ

* P/N 879B only

4.3.8 For TI P/N 879B, continue with step 4.3.9, otherwise proceed to step 4.3.11.

4.3.9 Press TI FREQ button to select 10 kHz.

4.3.10 The TI must indicate the Standard Capacitor Kit 1 μ F value recorded in step 3.4 within $\pm(0.7\% \text{ rdg} + 2 \text{ dgts})$.

4.3.11 Insert the appropriate capacitors into the Standard Capacitor Kit adapter bar to obtain 90 nF.

4.3.12 Connect TI + and - terminals, the Capacitor Kit adapter bar and the Decade Resistor in series.

4.3.13 Set the Decade Resistor for 702 Ω .

4.3.14 Press TI FREQ button to select 1kHz.

4.3.15 Press TI D/Q/ ϕ /ESR button to select D on the secondary display.

4.3.16 The TI secondary display must indicate within .3930 to .4070.

4.3.17 Disconnect test leads from the Standard Capacitor Kit adapter bar and Decade Resistor.

4.4 RESISTANCE/IMPEDANCE CALIBRATION:

4.4.1 Press TI L/C/R or L/C/R/Z button as required to select R.

4.4.2 Short TI test leads and press the REL/CAL button.

4.4.3 Connect TI + and - terminals to the Decade Resistor.

4.4.4 Set the Decade Resistor for the first value listed in the Applied column of Table 4.

4.4.5 Press TI FREQ button to select the first value listed in the Frequency column of Table 4.

4.4.6 The TI must indicate within the corresponding values listed in the Limits column of Table 4.

4.4.7 Repeat steps 4.4.4 through 4.4.6 for each remaining value listed in the Frequency and Applied columns of Table 4.

Table 4.

Range (Ω)	Applied (Ω)	Frequency (Hz)	Limits (Ω)
4	3	120	2.9398 to 3.0602
40	30		29.788 to 30.212
400	300		298.48 to 301.52
4000	3 k		2.9848 to 3.0152 k
40 k	30 k		29.848 to 30.152 k
400 k	300 k		297.88 to 302.12 k
4000 k	3 M		2.9248 to 3.0752 M
10 M	9 M		8.502 to 9.498 M
	9 M	100 *	8.502 to 9.498 M
	9 M	1 k	8.502 to 9.498 M

* P/N 879B only

4.4.8 For TI P/N 879B, continue with step 4.4.9, otherwise proceed to step 4.4.18.

4.4.9 Press TI D/Q/ ϕ /ESR button to select ESR.

4.4.10 Set the Decade Resistor for 900 Ω .

4.4.11 The TI display must indicate within 895.3 to 904.7 Ω .

4.4.12 Press TI the FREQ button to select 10 kHz.

4.4.13 Connect TI + and - terminals to the Standard Resistor short and press the REL/CAL button, remove the short.

4.4.14 Connect TI + and - terminals to the first Standard Resistor listed in the Applied column of Table 5. Use adapters and connectors as necessary.

4.4.15 The TI display must indicate within the corresponding values listed in the Limits column of Table 5.

4.4.16 Disconnect Standard Resistor.

4.4.17 Repeat steps 4.4.14 through 4.4.16 for each remaining value listed in the Applied column of Table 5.

Table 5.

Range	Applied (Ω)	Limits (Ω)
4	1	0.9798 to 1.0202
40	10	9.928 to 10.072
400	100	99.48 to 100.52
4000	1000	0.9948 to 1.0052 k
40 k	10 k	9.948 to 10.052 k
400 k	100 k	99.28 to 100.72 k

4.4.18 Set all POWER switches to OFF or STBY. Disconnect and secure all equipment.

CALIBRATION PERFORMANCE TABLE

4.1 FREQUENCY CALIBRATION:

<u>TI</u>	<u>Applied (Hz)</u>	<u>Limits (Hz)</u>
878B	120 *	120.024 to 120.072
	1000	999.8 to 1000.2
879B	100	99.980 to 100.020
	120 *	120.024 to 120.072
	1000	999.8 to 1000.2
	10 k	9.998 to 10.002 k

* Actual output frequency is 120.048 Hz.

4.2 INDUCTANCE CALIBRATION:

<u>Range (mH)</u>	<u>Applied (mH)</u>	<u>Limits (mH)</u>
400	100	99.49 to 100.51

4.3 CAPACITANCE AND DISSIPATION CALIBRATION:

<u>Range (F)</u>	<u>Frequency (Hz)</u>	<u>Applied (F)</u>	<u>Limits (F)</u>
400 p	1 k	300 p	292.48 to 307.52 p
4000 p		3 n	2.9788 to 3.0212 n
40 n		30 n	29.848 to 30.152 n
400 n		300 n	298.48 to 301.52 n

CALIBRATION PERFORMANCE TABLE (Cont.)

4.3 CAPACITANCE AND DISSIPATION CALIBRATION: (Cont.)

<u>Range (F)</u>	<u>Frequency (Hz)</u>	<u>Applied (F)</u>	<u>Limits (F)</u>
4000 n	1 k	1 μ	0.9949 to 1.0051 μ
	100 *	1 μ	0.9949 to 1.0051 μ
	120	1 μ	0.9949 to 1.0051 μ
	10 k *	1 μ	0.9928 to 1.0072 μ
Select D on secondary display	1 k	90 n with 702 Ω in series	.3930 to .4070

* P/N 879B only

4.4 RESISTANCE/IMPEDANCE CALIBRATION:

<u>Range (Ω)</u>	<u>Applied (Ω)</u>	<u>Frequency (Hz)</u>	<u>Limits (Ω)</u>
4	3	120	2.9398 to 3.0602
40	30		29.788 to 30.212
400	300		298.48 to 301.52
4000	3 k		2.9848 to 3.0152 k
40 k	30 k		29.848 to 30.152 k
400 k	300 k		297.88 to 302.12 k
4000 k	3 M		2.9248 to 3.0752 M
10 M	9 M		8.502 to 9.498 M
	9 M	100 *	8.502 to 9.498 M
	9 M	1 k	8.502 to 9.498 M
Select ESR *	900		895.3 to 904.7
4 *	1	10 k	0.9798 to 1.0202
40 *	10		9.928 to 10.072
400 *	100		99.48 to 100.52
4000 *	1000		0.9948 to 1.0052 k
40 k *	10 k		9.948 to 10.052 k
400 k *	100 k		99.28 to 100.72 k

* P/N 879B only