

## 1417 Series

The 1417 Four-Terminal Capacitance Standard consists of a 1  $\mu\text{F}$  standard capacitor and two precise inductive voltage dividers used to scale the value of the 1  $\mu\text{F}$  capacitor up to 1 F in decade steps. This arrangement provides accuracy and stability unattainable with very high-value true capacitors.

### Features:

- A laboratory standard
- Standard for dissipation factor
- Calibration of LCR meters and other instruments
- Working standard
- Calibration of multimeters
- Capacitance measurement functions
- 1  $\mu\text{F}$  to 1 F in decade steps
- 3 Frequencies 100, 120 and 1000 Hz
- 0.25% direct-reading capacitance accuracy
- 0.1% or better ratio accuracy
- Dissipation - factor standard



Model 1417 Capacitance Standard

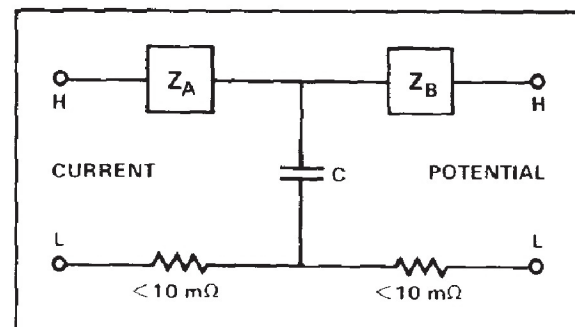
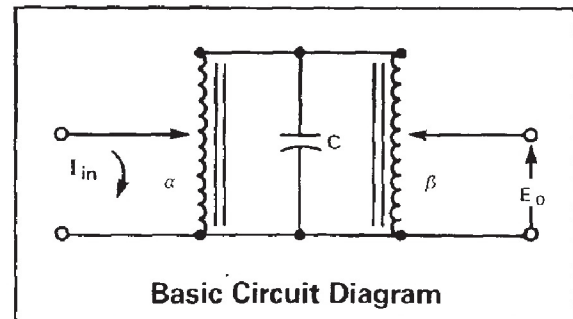
In addition to the seven direct-reading capacitance values, an infinite number of intermediate or higher capacitance values can be obtained by using external capacitors. An external capacitor is simply connected to the 1417's external standard terminals, either directly or in parallel with a 1  $\mu\text{F}$  internal standard, and the resulting capacitance is scaled in value by the 1417's inductive voltage dividers.

The direct - reading accuracy of the 1417 is  $\pm 0.25\%$  plus ratio accuracy at test frequencies of 100, 120, or 1000 Hz. Since the 1417 scaling ratios are precise and repeatable, better accuracy can be obtained by measuring the actual value of the internal 1  $\mu\text{F}$  standard or of an external standard before scaling.

The 1417 also serves as a standard of dissipation factor (D). The dissipation factor of the 1417 is intentionally set to 0.01 at test frequencies of 100, 120 and 1000 Hz. Basic D accuracy at these frequencies is  $\pm 0.001$ .

The 1417 may also be used as a two-terminal capacitance standard when higher D values can be tolerated. In a two-terminal configuration, D is less than 1 for capacitance values up to 1000  $\mu\text{F}$  at frequencies below 150 Hz. This feature allows the 1417 to be used in calibrating the higher capacitance ranges of popular universal or RLC bridges.

One additional feature of importance is that all the 1417's parameters are measurable (without) disassembly) so, in effect, its ultimate accuracy depends on the accuracy of the external measurement equipment.



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### SPECIFICATIONS

Capacitance Value	Ratio Accuracy		D Accuracy		Approximate Terminal Impedance		E Max* (Vrms) *DC Voltage cannot be applied
	100 & 120 Hz	1 kHz	100 & 120 Hz	1 kHz	ZA ( $\Omega$ )	ZB ( $\Omega$ )	
(Internal Standard)							
1 $\mu$ F	-----	-----	$\pm 0.001$	$\pm 0.001$	0.03	0.03	20
10 $\mu$ F	0.02%	0.04%	$\pm 0.001$	$\pm 0.001$	7.0	15.5	6
100 $\mu$ F	0.02%	0.04%	$\pm 0.001$	$\pm 0.001$	3.1	6.4	2
1 mF	0.02%	0.06%	$\pm 0.001$	$\pm 0.002$	1.1	2.2	0.8
10 mF	0.03%	0.2%	$\pm 0.001$	$\pm 0.005$	0.37	0.72	0.5
100 mF	0.1%	-----	$\pm 0.003$	-----	0.13	0.23	0.25
1 F	0.25%	-----	$\pm 0.01$	-----	0.04	0.05	0.06

#### Capacitance:

Internal Standard: 1  $\mu$ F in 7-switch-selected decade values  
External Standard: Indicated capacitance, multiplied by C ext/ $\mu$ F.

**Capacitance Accuracy, Direct-Reading:** 0.25% plus ratio accuracy at 100 Hz, 120 Hz and 1 kHz, 20 to 25°C, with low applied voltage (< 1/4 Emax) using internal standard and a proper four-terminal measurement. (May also be used as a two-terminal standard, with a D < 1 and a capacitance change from the four-terminal value of < 0.5% up to 1 mF at 120 Hz or less).

**Capacitance Ratio:** Accuracy see table above.

**Dissipation Factor:** 0.01 at 100 Hz, 120 Hz and 1 kHz. For D accuracy, see table.

**Terminal Impedance:** See figure and table (approximate values given).

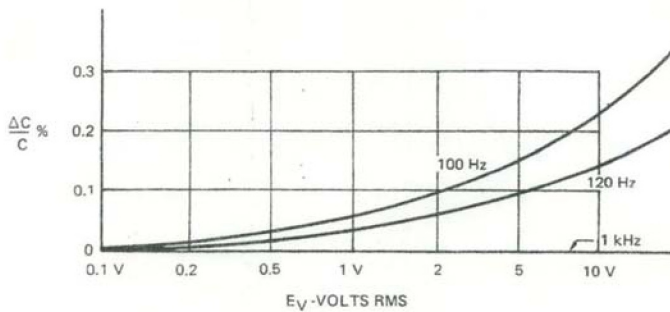
**Temperature Coefficient:** Approximately -140ppm/°C.

**Voltage Characteristic:** Approximately +0.3 % change from 0 V to E max (see table) at 100 Hz. Less at higher frequencies.

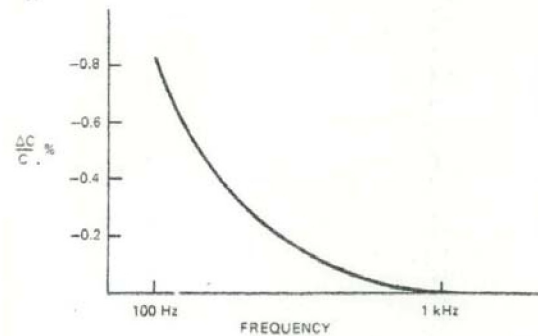
**Mechanical:** Bench cabinet

**Dimensions:** 14.7 cm H x 21.5 cm W x 13.2 cm D (5.9" x 8.5" x 5.25").

**Weight:** 2.7 kg (6 lb.) net, 5 kg (11 lb.) shipping.



Capacitance Change versus Voltage



Capacitance Change versus Frequency

### ORDERING INFORMATION

1417-9700 Four-Terminal Capacitance Standard