

Standard Capacitance Reference or Working Standard

1409 Series

The 1409 Standard Capacitors are fixed value capacitors with very high stability for use as two, three, or five-terminal laboratory reference standards.

Typical capacitors, observed over more than 15 years, have shown random fluctuations of less than $\pm 0.01\%$ in measured capacitance with no evidence of systematic drift.

The capacitors of $\leq 1 \mu\text{F}$ consist of a silvered-mica and foil pile, spring-held in a heavy-duty metal clamping structure for mechanical stabil-

ity. The units are selected for low dissipation factor and are stabilized by heat cycling. They are housed in cast aluminum cases, along with silica gel which provides continuous dessication. These cases are sealed with high-temperature wax. A well is provided in the wall of the case for insertion of a dial-type thermometer. Three jack-top binding posts are provided on the top of the case, and removable banana plugs on the bottom, for convenient parallel connection without error.



1409 1 μF Standard Capacitor

- 0.001 μF to 1000 μF
- Excellent stability: ± 100 ppm/year
- Two-to-five terminal configuration, depending on model
- 2-terminal and 3-terminal calibrations provided, where applicable
- Use to verify meter and instrumentation calibration

Specifications

Nominal value	Model	Adjustment to nominal	Temperature coefficient (ppm/ $^{\circ}\text{C}$)	Calibration frequency	Dissipation (typical)	Stability (per year)	Max voltage		Terminals	Capacitor type
							Peak (V)	Max Frequency		
1 nF	1409-F	$\pm 0.02\%$	20	1 kHz	0.0003	± 100 ppm	500	10 kHz	2 bp's + gnd	Silvered Mica mechanically stabilized hermetically sealed
10 nF	1409-L	$\pm 0.02\%$	20	1 kHz	0.0003	± 100 ppm	500	10 kHz		
100 nF	1409-T	$\pm 0.02\%$	20	1 kHz	0.0003	± 100 ppm	500	10 kHz		
1 μF	1409-Y	$\pm 0.02\%$	20	1 kHz	0.0002	± 100 ppm	500	10 kHz	4 bp's + gnd	Metallized Polypropylene Sulfide (MPPS) hermetically sealed
10 μF	1409-10 μF	$\pm 0.04\%$	± 50	100 Hz	0.0005	± 200 ppm	22 Vrms†	1 kHz		
100 μF	1409-100 μF	$\pm 0.05\%$	± 50	100 Hz	0.001	± 500 ppm	22 Vrms†	1 kHz		
1,000 μF	1409-1000 μF	$\pm 0.4\%$	-150	100 Hz	0.001	± 500 ppm	22 Vrms†	1 kHz		
Custom	1409-X	customer-selected value and power specifications								

† Maximum allowable Vrms; subject to maximum Vdc = 50 V and max Vrms = (39000/f) for C = 10 μF ; (26000/f) for C = 19 μF ; (13000/f) for C $\leq 100\mu\text{F}$, where f = frequency (in Hz).

Calibration and Test Conditions:

Calibrated at 23 $^{\circ}\text{C}$, <50% RH, Traceable to SI

1 nF - 1 μF : Units are calibrated as both 2-terminal and as 3-terminal capacitors. For 2-terminal measurements, the LO terminal is shorted to the GND terminal. The Adjustments to Nominal specified in the table above apply to 2-terminal measurements.

10 μF - 1000 μF : Units are calibrated as 5-terminal capacitors, "series model"

Series Inductance:

for 0.01 μF - 1 μF : typically < 0.06 μH

Series Resistance:

for 0.01 μF - 0.1 μF : 0.02 Ω

for 1 μF : 0.03 Ω

Frequency Characteristics:

Varies as \sqrt{f} above 100 kHz. See figure 1.

Leakage Resistance:

5,000 ohm-Farads or 100 G Ω , whichever is less

Environment:

Operating: +10 to +40 $^{\circ}\text{C}$, <80% RH

Storage: -20 to +65 $^{\circ}\text{C}$



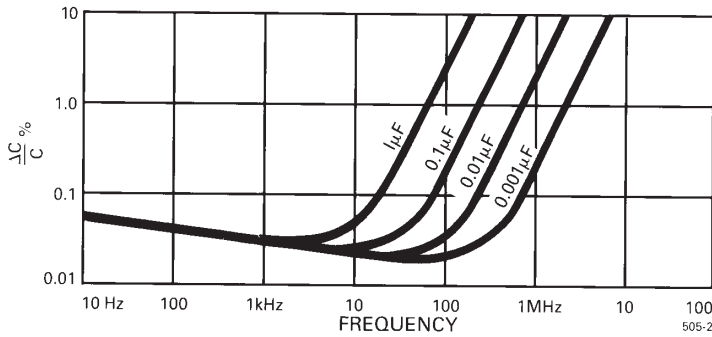


Figure 1
Change in capacitance as a function of frequency for typical 1409 Capacitors. The 1-kHz value on the plot should be used as a basis of reference in estimating frequency errors.

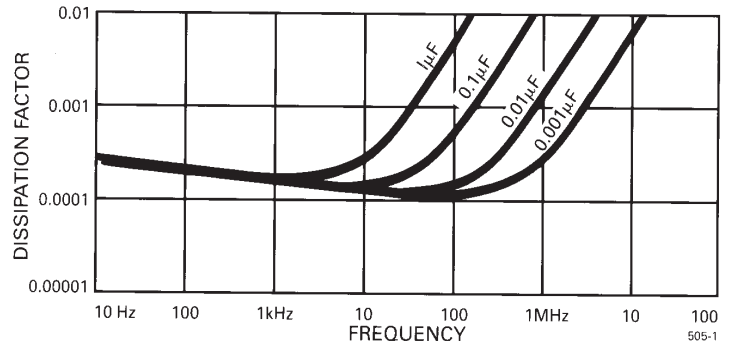
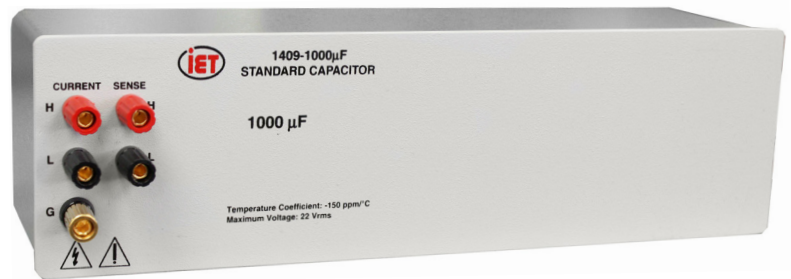


Figure 2
Dissipation factor as a function of frequency.

1409 Mechanical Information:

Values	Dimensions	Weight
1 nF - 100 nF	10.2 cm H x 8.3 cm W x 5.1 cm D (4.0" x 3.3" x 2.0")	0.6 kg (1.25 lb)
1 μF	14.3 cm H x 8.3 cm W x 6.9 cm D (5.6" x 3.2" x 2.7")	1.1 kg (2.25 lb)
10 μF - 100 μF	8.6 cm H x 10.5 cm W x 12.7 cm D (3.4" x 4.15" x 5.0")	0.73 kg (1.6 lb)
1,000 μF	31 cm W x 8.9 cm H x 10.2 cm D (12.2" x 3.5" x 4")	1.7 kg (3.8 lb)



1409 Model, 1000 μF value



Various models of 1409 Standard Capacitors

