

# Standard Capacitance Reference or Working Standard

## 1409 Series

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Highly stable cost-effective capacitance standards with low temperature coefficient, low losses and a wide range of values.

- 0.001  $\mu\text{F}$  to 1000  $\mu\text{F}$
- $\pm 0.01\%$ /year stability
- Verify meter and instrumentation calibration
- Two-to-five terminal configuration, depending on model



Model 1409 Standard Capacitance

### SPECIFICATIONS

Calibration Accuracy: 100 ppm for 1 nF; 0.01% for 1  $\mu\text{F}$  and under; 0.04% for 100  $\mu\text{F}$  and under; and 0.4% for 1000  $\mu\text{F}$ ;

At test frequency of 1 kHz for up to 5  $\mu\text{F}$ ; 100 Hz for over 5  $\mu\text{F}$ .

2-terminal and 3-terminal measurements are provided.

Stability: <0.01% per year.

Temperature Coefficient: 20 ppm/°C for 1  $\mu\text{F}$  and under;  
-50 ppm/°C for capacitance to 190  $\mu\text{F}$ ;  
-150 ppm/°C for 1000  $\mu\text{F}$ .

Operating Temperature: 10°C to 50°C.

Dissipation Factor: 0.01  $\mu\text{F}$  - 1  $\mu\text{F}$ ; 0.0003 at 1 kHz;  
10  $\mu\text{F}$ ; 0.0005; 100  $\mu\text{F}$ ; 0.001;  
1000  $\mu\text{F}$ ; 0.002 at 100 Hz and 120 Hz; 0.02 at 1 kHz.

Series Inductance: Typically < 0.06  $\mu\text{H}$ , 0.01  $\mu\text{F}$  - 1  $\mu\text{F}$ .

Series Resistance at 1 MHz: 0.02  $\Omega$ , 0.01  $\mu\text{F}$  - 0.1  $\mu\text{F}$ ; 0.03  $\Omega$ , 1  $\mu\text{F}$ .

Frequency Characteristics: Varies as  $\sqrt{f}$  above 100 kHz. See figure 1.

Leakage Resistance: 5,000 ohm-Farads or 100 G $\Omega$ , whichever is less.

Max Voltage: See table.

Test Conditions: (100 Hz, 120 Hz and 1 kHz at 23°C; < 1  $\mu\text{F}$ ; 5 - terminal measurement for values 1  $\mu\text{F}$ , 1 MHz or other available.

Capacitor Type: Hermetically sealed silvered mica for 100 pF to 1  $\mu\text{F}$ ; hermetically sealed polystyrene for 10  $\mu\text{F}$ ; hermetically sealed polycarbonate for >10  $\mu\text{F}$ .

Terminals: Three binding posts, for values up to 1  $\mu\text{F}$ ;  
five binding posts, for values over 1  $\mu\text{F}$ .

Dimensions:

-F/L/T: 10.2 cm H x 8.3 cm W x 5.1 cm D  
(4.0" x 3.3" x 2.0")

-Y: 14.3 cm H x 8.3 cm W x 6.9 cm D  
(5.6" x 3.2" x 2.7")

-10  $\mu\text{F}$ /100  $\mu\text{F}$ : 86 cm H x 10.5 cm W x 12.7 cm D  
(3.4" x 4.15" x 5.0")

-1000  $\mu\text{F}$ : 8.6 cm H x 30.5 cm W x 8.9 cm D  
(3.4" x 12" x 3.5")

Weight: -F/L/T: ~ 0.6 kg (1.25 lb.)

-Y: ~ 1.1 kg (2.25 lb.)

-10  $\mu\text{F}$ /100  $\mu\text{F}$ : ~ 0.4 kg (0.8 lb.)

-1000  $\mu\text{F}$ : ~ 2 kg (4.5 lb.)

Model	Value	Adjustment Accuracy	Dissipation Factor (typical)	Maximum Voltage** (V)
1409-F	1 nF	$\pm 0.02\%$	0.0003	500
1409-L	10 nF	$\pm 0.02\%$	0.0003	500
1409-T	100 nF	$\pm 0.02\%$	0.0003	500
1409-Y	1 $\mu\text{F}$	$\pm 0.02\%$	0.0003	500
1409-10 $\mu\text{F}$	10 $\mu\text{F}$	$\pm 0.04\%$	0.0005	44 Vrms+
1409-100 $\mu\text{F}$	100 $\mu\text{F}$	$\pm 0.05\%$	0.001	22 Vrms+
1409-1000 $\mu\text{F}$	1000 $\mu\text{F}$	$\pm 0.4\%$	0.001	22 Vrms+
1409-X	Custom	*	*	*

+ Maximum allowable Vrms; subject to maximum Vdc = 50 V and max Vrms = (39000/f) for C = 10  $\mu\text{F}$ ; (26000/f) for C = 19  $\mu\text{F}$ ; (13000/f) for C  $\geq$  100  $\mu\text{F}$ ; (9500/f) for C  $\geq$  1000  $\mu\text{F}$ , where f = frequency (in Hz).

\* Depends on Custom value

\*\* Peak up to 10 kHz.



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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.

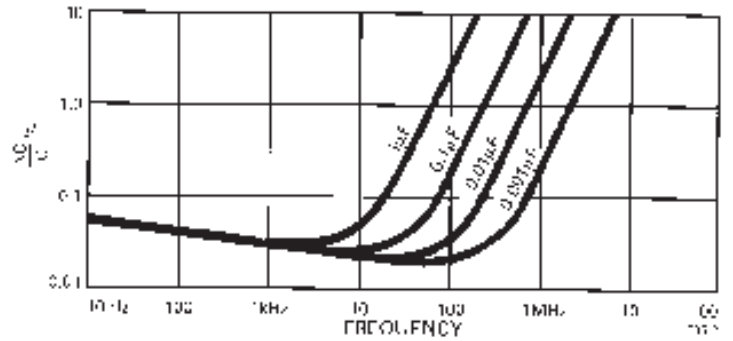
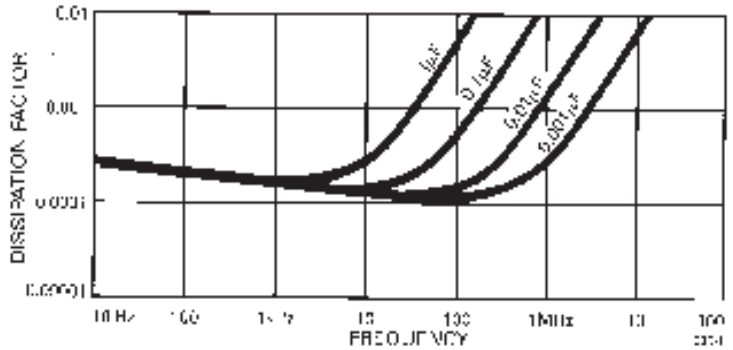


Figure 2  
Dissipation factor as a function of frequency.



### ORDERING INFORMATION

1409-9706	1409-F,	0.001 $\mu$ F
1409-9712	1409-L,	0.01 $\mu$ F
1409-9720	1409-T,	0.1 $\mu$ F
1409-9725	1409-Y,	1.0 $\mu$ F

1409-9730	1409,	10 $\mu$ F
1409-9735	1409,	100 $\mu$ F
1409-9740	1409,	1000 $\mu$ F
1409-9740	1409,	Custom Value

