Low-loss Variable Air Capacitors

1422 Series

The 1422 is a stable and precise variable air capacitor intended for use as a continuously adjustable standard of capacitance. One of the most important applications is an AC bridge measurements, either as a built-in standard for substitution measurements. It is available in a variety of ranges, terminal configurations, and scale arrangements to permit selection of precisely the required characteristics.

Model 1422-D Precision Capacitor

Model 1422-CB/CL Precision Capacitor

Model 1422-CD Precision Capacitor

Features:

- A laboratory standard
- For calibrating working standards
- Working standard
- Capacitance measurement functions
- For substitution measurements
- For calibrating instrumentation
- Stability: better than 0.02% full scale per year
- Settleable to 40 ppm
- Low temperature coefficient, low losses
- Wide selection to suit needs
- 3 different models

Two-terminal - The 1422-D is a dual-range 115 pF and 1150 pF, two-terminal capacitor, direct reading in total capacitance at either range terminal to ground.

Three-terminal - The 1422-CB, 1422-CL and 1422-CD are three-terminal capacitors with shielded coaxial terminals for use in three-terminal measurements. Connection is made via GR-874 connectors. The calibrated direct capacitance is independent of terminal capacitance to ground, and losses are very low.

The 1422-CL has particularly low, constant terminal capacitance, making it suitable for measurement circuits in which high capacitance to guard cannot be tolerated.

The 1422-CD is a dual-range 1.1 pF and 11 pF, three-terminal capacitor with direct reading in total capacitance at either range terminal to low.

Construction - The capacitor assembly is mounted in a cast frame for rigidity. This frame and other critical parts are made of aluminum alloy selected to give the strength of brass with the lightness of aluminum. The plates of most models are also aluminum, so that all parts have the same temperature coefficient of linear expansion.

A worm drive is used to obtain high precision of setting. To avoid eccentricity, the shaft and the worm are accurately machined as one piece. The worm and worm wheel are also lapped into each other to improve smoothness. The dial end of the worm shaft runs n a self-aligning ball bearing, while the other end is supported by an adjustable spring mounting, which gives positive longitudinal anchoring to the worm shaft through the use of a pair sealed, self-lubricating, preloaded ball bearings. Similar pairs of preloaded ball bearings provide positive and invariant axial location for the main or rotor shaft. Electrical connection to the rotor is made by means of a silver-alloy brush bearing on a silver-overlay drum to assure a low-noise electrical contact.

Stator insulation in all models is a cross-linked thermosetting modified polystyrene having low dielectric losses and very high insulation resistance. Rotor insulation, where used (Types 1422-CB and -CL), in grade L-4 steatite, silicone treated.

Accuracy - The errors tabulated in the specifications are possible errors, i.e., the sum of error contributions from setting, adjustment, calibration, interpolation, and standards. When the capacitor is in its normal position with the panel horizontal, the actual errors are almost always smaller. The accuracy is improved when the readings are corrected using the 12 calibrated values of capacitance given on the correction chart on the capacitor panel and interpolating linearly between calibrated points. Even better accuracy can be obtained from a precision calibration of approximately 100 points on the capacitor dial, which permits correction for sight residual eccentricities of the worm drive and requires interpolation over only short intervals. This precision calibration is available for the 1422-CL model.

SPECIFICATIONS

Accuracy:	1422 Precision Capacitors Type 1422	Two-terminal Type 1422-D		Three-terminal Type 1422-CB	Three-terminal Type 1422-CL	Three-terminal Type 1422-CD	
	Capacitance Range (Min/Max)	100/1150 pF	35/115 pF	50/1100 pF	10/110 pF	0.5/11 pF	0.05/1.1 pF
	Scale, pF/Division	0.2	0.2	0.2	0.02	0.002	0.0002
	Initial Accuracy: Picofarads Direct-Reading (Adjustment): Total Capacitance	±1.5*	±0.3*	±1.5	±0.1	±0.04	±0.008
	With Corrections from Calibration Chart (supplied) Total Capacitance				0.04	±0.01	±0.002
	With Corrections from Precision Calibration (extra charge) Total Capacitance				0.01		
	Residuals (typical values): Series Inductance, µH Series Resistance, Ω at 1 MHz	0.06 0.04	0.10 0.05	0.14 0.1	0.13 0.1	0.17	0.17
	Terminal Capacitance, pF, typical high terminal to case low terminal to case	min/max scale min/max scale		36/35 58/53	34/33 58/55	min/max scale min/max scale	
	* Total capacitance is the capacitance added when the capacitor is plugged into a 777-Q3 Adapter						

Stability: Capacitance change with time < 1 scale division (0.02% of full scale) per year Long-term accuracy can be estimated from the stability and the initial accuracy.

Calibration: Measured values (supplied) are obtained by comparison at 1 kHz, with working standards whose absolute values are known to and accuracy of ± (0.01% + 0.0001 pF). Each comparison is made to a precision better than ±0.01%. The values of the working standards are determined and maintained in terms of reference standards periodically calibrated by an SI. The indicated value of total capacitance of a two-terminal capacitor is the capacitance added when 1422 Capacitor is plugged into a 777-Q3 Adapter *. The uncertainty of this method to connection is approximate ± 0.03 pF.

* Gilbert Engineering Part Number 0777-9703.

Resolution: Dial can be read and set to 1/5 of a small division, i.e. to 0.004% of full scale. BACKLASH: Negligible for any setting reached consistently from lower scale readings; <0.004% of full scale, for settings reached from alternate directions.

Temperature Coefficient: Approximately +20 ppm/°C, for small temperature changes.

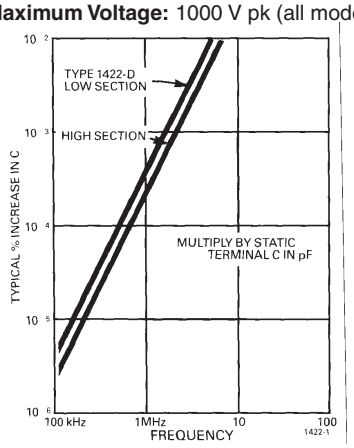
Residual Parameters: See table above. Series resistance varies as $\sqrt{f}$ for f > 100 kHz; negligible, for f < 100 kHz.

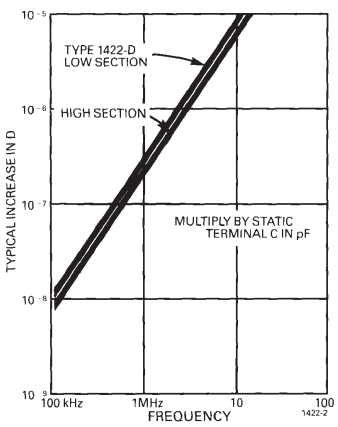
Frequency Characteristic: 2-terminal model, see Figure 1. 3-terminal models: 20 and 40 MHz (approximately) resonant frequency for 1422-CB and -CL (each section), respectively.

Dissipation Factor: 2-terminal, loss primarily in stator supports of low-loss polystyrene (the product DC = 10^{-14}), 3-terminal, estimated D < 20 x 10^{-6}.

Insulation Resistance: > 10^{12} Ω, under standard conditions (23°C, RH < 50%).

Maximum Voltage: 1000 V pk (all models)





Terminals: 2-terminal Model: Jack-top binding posts at standard (0.75 in) spacing. Rotor terminal connected to panel and shield. 3-terminal Models: Locking G874 coaxial connectors.

Mechanical: Lab-bench cabinet.

Dimensions: 17.8 cm H x 24.2 cm W x 21.5 cm D (7" x 9.5" x 8.5").

Weight: (depending on model): 4.8 to 5.7 kg (10.5 to 12.5 lb.)net, 7 kg (15 lb.) shipping.

ORDERING INFORMATION

Catalog No:	Item	Name	Calibration
1422-9704	1422-D	Precision Capacitor	12 points
1422-9916	1422-CB	Precision Capacitor	12 points
1422-9933	1422-CL	Precision Capacitor	12 points
	1422-CD	Precision Capacitor	12 points
1422-9508	1422-CLP	Precision Capacitor	~100