

High Accuracy Capacitance Substituter

HACS-Z Series

The HACS-Z Decade Capacitance System is capable of meeting exacting requirements for fixed or adjustable calibration capacitance or any applications requiring precise stable capacitance values. It provides a wide range of capacitance in increments as low as 1 pF and a total capacitance of up to 10,000 μ F. With its high-quality, tight-tolerance capacitors, it is an ideal part of a test or calibration system.



*HACS-Z Capacitance Substituter:
6-decade, 1 pF through 0.1 μ F*

Features:

- High accuracy: 0.05%
- Low zero capacitance: <0.1 pF
- Trimmable capacitors for lower decades
- 3-Terminal shielded construction for low values
- 5-Terminal construction for high values
- Excellent stability - 100 ppm/year
- Excellent TC - begins at 20 ppm/ $^{\circ}$ C

See Also:

- For GenRad version - **1413 Series**
- For Programmable version - **PCS Series**

SELECTION OF VARIOUS HACS-Z MODELS



*HACS-Z High-Capacitance Substituter:
4-decade, 1 μ F through 1000 μ F steps*



*HACS-Z Capacitance Substituter:
9-decade, 10 pF through 1000 μ F steps*



IET LABS, INC. in the **GenRad** Tradition
534 Main Street, Westbury, NY 11590

TEL: (516) 334-5959 • (800) 899-8438 • FAX: (516) 334-5988

www.ietlabs.com

SPECIFICATIONS: LOW VALUES

Zero capacitance

≤0.1 pF maximum capacitance obtained with all dials set to zero

Temperature coefficient

<20 ppm/°C

Insulation resistance

>50,000 MΩ

Environmental conditions

Operating conditions: 10°C to 40°C

Storage conditions: -40°C to 70°C

Shielding

Double-shielded construction; see below.

Connection to capacitor

Two bnc connectors labeled **HI** and **LO** are located on the front panel.



HACS-Z Capacitance Substituter:
6-decade, 1 pF through 0.1 μF

Capacitance per step	Total decade capacitance	Accuracy*	Stability	Max Voltage	Dissipation factor*	Capacitor type
HACS-Z-1pF Variable Decade	1 pF+	±0.1 pF	±(100 ppm + 0.1 pF) per year	500 V peak max up to 10 kHz	<0.003 typical	Air Capacitors
1 pF	10 pF	<0.002			Position 1: <0.002 All others: <0.001	
10 pF	100 pF	±(0.05%+0.5 pF)			Position 1: <0.001 Position 2: <0.0005 All others: <0.0003	Silvered mica Mechanically stabilized Hermetically sealed
100 pF	1 nF				<0.0003	
1,000 pF	10 nF				<0.0003	
0.01 μF	100 nF				<0.0003	
0.1 μF	1 μF				<0.0004	



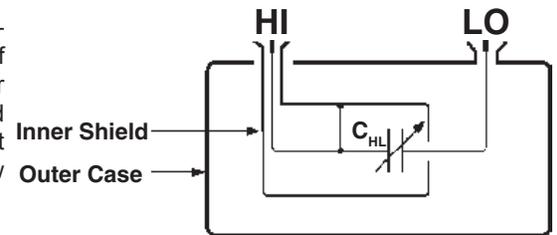
HACS-Z Variable decade:
1 pF+, plugs into the main unit, adds continuous 0-1pF parallel capacitance

*1 kHz, 3-terminal measurement; series model; 1 Vrms, 23°C; traceable to SI
No zero-subtraction required

DOUBLE SHIELDED CONSTRUCTION

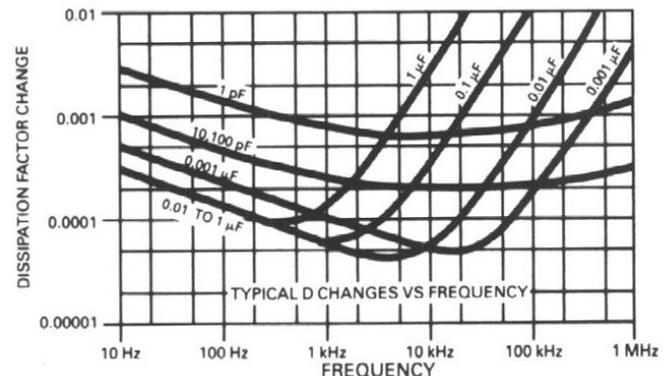
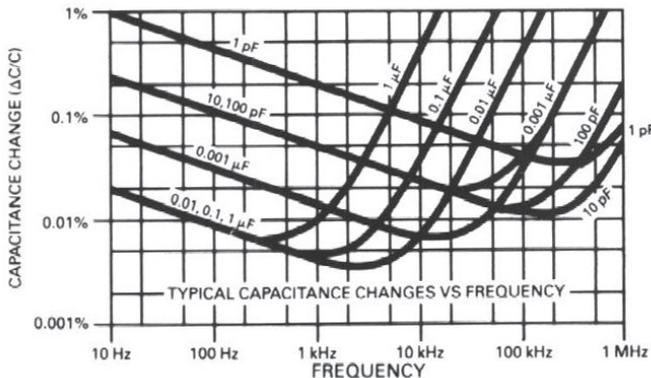
The shielding is divided into two different parts: an inner shield that minimizes the low terminal-to-guard capacitance, and an outer shield (the case) that minimizes the detector input capacitance and noise.

The outer shell of the **HI** connector is connected to the switch shaft. The outer shell of the **LO** connector is connected to the outer case. When these two shields are connected together, the HACS-Z becomes an excellent 3-terminal capacitance substituter with low zero capacitance.



Double Shielded Construction

FREQUENCY CHARACTERISTICS



SPECIFICATIONS: HIGH VALUES

Zero capacitance

≤0.5 pF maximum capacitance obtained with all dials set to zero;
5-terminal measurement

Temperature coefficient

-50 ppm/°C

Insulation resistance

>50,000 MΩ

Environmental conditions

Operating conditions: 10°C to 40°C

Storage conditions: -40°C to 70°C

Connection to capacitor

Five 5-way binding posts labeled **HI CURRENT**, **LO CURRENT**, **HI SENSE**, **LO SENSE** and **GND** are located on the front panel. Special wiring and low-resistance conductors in this 4-terminal connection circuit minimize dissipation and parasitic inductance, and improve frequency characteristics. To use as a 2-terminal capacitor, connect to only the two **SENSE** terminals.



HACS-Z High-Capacitance Substituter:
4-decade, 1 μF through 1000 μF steps

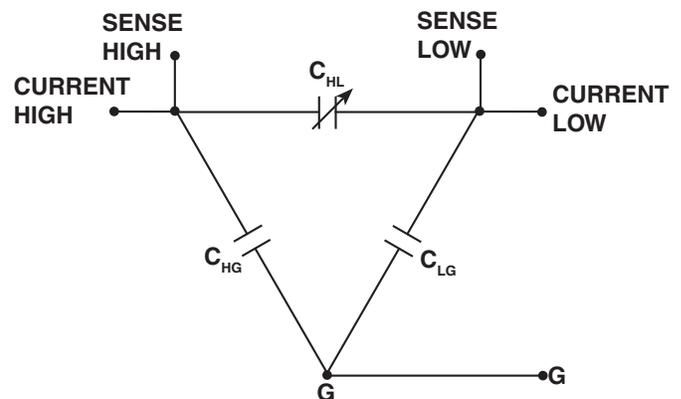
Capacitance per step	Total decade capacitance	Max Voltage	Accuracy*	Test Frequency	Stability	Dissipation factor	Capacitor type
1 μF	10 μF	50 V peak max	±0.05%	1 kHz	±200 ppm/year	<0.0005	Sealed metallized polypropylene sulfide (MPPS)
10 μF	100 μF	(Vdc+Vac) or Vac <22 V				<0.002	
100 μF	1,000 μF	50 V peak max 25 V peak max	±0.5%	100 Hz	±500 ppm/year	<0.02	Polyphenylene
1,000 μF	10 mF		±1%			-	Electrolytic**
			±10%		-	-	

* 5-terminal measurement; series model; 1 Vrms, 23°C; traceable to SI; No zero-subtraction required

**For this option, add -EC at the end of part number



HACS-Z Capacitance Substituter:
4-decade, 1 μF through 1000 μF steps with electrolytic capacitor option



HACS-Z Model as a 4 or 5-terminal capacitor
You may use this as a 2-terminal capacitor, by connecting to only the two **SENSE** terminals



ORDERING INFORMATION

STANDARD MODELS

Models	Total capacitance	No. of decades	Resolution
HACS-Z-A-3E-1pF	1,110 pF	3	1 pF
HACS-Z-A-3E-10pF	11,100 pF	3	10 pF
HACS-Z-A-3E-100pF	111,000 pF	3	100 pF
HACS-Z-A-3E-1nF	1.11 μF	3	1 nF
HACS-Z-A-3E-10nF	11.1 μF	3	10 nF
HACS-Z-A-3E-100nF	111 μF	3	100 nF
HACS-Z-A-3E-1μF	1,110 μF	3	1 μF
HACS-Z-A-3E-10μF	11,100 μF	3	10 μF
HACS-Z-A-4E-1pF	11,110 pF	4	1 pF
HACS-Z-A-4E-10pF	0.1111 μF	4	10 pF
HACS-Z-A-4E-100pF	1.111 μF	4	100 pF
HACS-Z-A-4E-1nF	11.11 μF	4	1 nF
HACS-Z-A-4E-10nF	111.1 μF	4	10 nF
HACS-Z-A-4E-100nF	1,111. μF	4	100 nF
HACS-Z-A-4E-1μF	11,110 μF	4	1 μF
HACS-Z-A-5E-1pF	0.111 11 μF	5	1 pF
HACS-Z-A-5E-10pF	1.111 1 μF	5	10 pF
HACS-Z-A-5E-100pF	11.111 μF	5	100 pF
HACS-Z-A-5E-1nF	111.11 μF	5	1 nF
HACS-Z-A-5E-10nF	1,111.1 μF	5	10 nF
HACS-Z-A-5E-100nF	11,111 μF	5	100 nF

Models	Total capacitance	No. of decades	Resolution
HACS-Z-A-6E-1pF	1.111 11 μF	6	1 pF
HACS-Z-A-6E-10pF	11.111 1 μF	6	10 pF
HACS-Z-A-6E-100pF	111.111 μF	6	100 pF
HACS-Z-A-6E-1nF	1,111.11 μF	6	1 nF
HACS-Z-A-6E-10nF	11,111.1 μF	6	10 nF
HACS-Z-A-7E-1pF	11.111 11 μF	7	1 pF
HACS-Z-A-7E-10pF	111.111 1 μF	7	10 pF
HACS-Z-A-7E-100pF	1, 111.111 μF	7	100 pF
HACS-Z-A-7E-1nF	11,111.11 μF	7	1 nF
HACS-Z-A-8E-1pF	111.111 11 μF	8	1 pF
HACS-Z-A-8E-10pF	1,111.111 1 μF	8	10 pF
HACS-Z-A-8E-100pF	11,111.111 μF	8	100 pF
HACS-Z-A-9E-1pF	1,111.111 11 μF	9	1 pF
HACS-Z-A-9E-10pF	11,111.111 1 μF	9	10 pF
HACS-Z-A-10E-1pF	11,111.111 11 μF	10	1 pF

Options

- RM: Rack mount version
- RO: Rear output version
- EC: electrolytic capacitors in the 1,000 μF decade

HACS-Z-1pF

Variable air-capacitor decade that attaches to the main unit for resolution finer than 1 pF

OPTIONAL MODELS

In order to satisfy any requirement for a HACS-Z Series capacitor, generate a part number from the chart below.

