

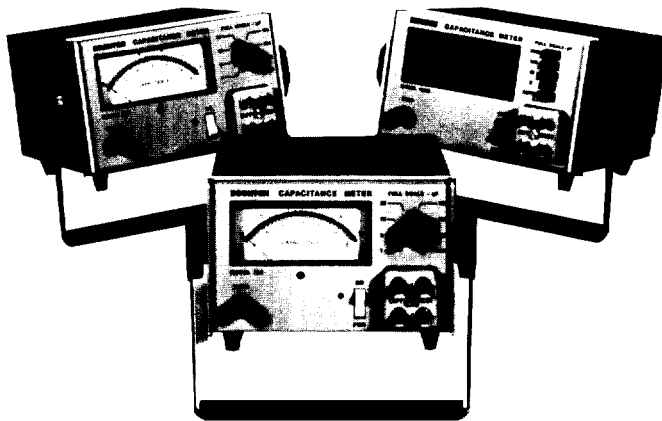
# BOONTON

## IMPEDANCE MEASURING INSTRUMENTS

### Capacitance Meters

#### Model 72 Series

- Analog Meters, Models 72B and 72C.
- Digital Meter, Model 72BD.
- Measurement range;  
Models 72B and 72C, 1 pF to 3000 pF full scale.  
Model 72BD, 2 pF to 2000 pF full scale.
- Test frequency;  
Models 72B and 72BD, 1 MHz.  
Model 72C, 100 kHz.
- 15 mV test level (Optional 100 mV on 72B and 72BD).
- $\pm 600$  V external bias capability.
- Programmable.
- DC output response time to 50  $\mu$ s.



#### Description

All Boonton capacitance meters make rapid, accurate, low test-level, three-terminal measurements of shunt capacitance. Measurements are unaffected by the shunt loss of the test component down to Q values as low as 1.

If the loss of the test component is predominantly in series, as is the case with most junction capacitance measurements, the capacitance indicated is also essentially the same as the equivalent series capacitance value, provided that the series loss does not result in a Q value below 10.

Selection of the 100 kHz Model 72C is recommended for series capacitance measurements on very low capacitance junctions where normal series loss can cause the Q of the junction capacitance to fall well below 10 at 1 MHz. In this instance, using the Model 72C takes advantage of the fact that the Q of the capacitor with series loss is inversely proportional to frequency and therefore ten times higher at 100 kHz as compared to 1 MHz.

Selection of the 1 MHz Models 72B and 72BD is recommended for most measurements where a 1 MHz test frequency is specified, but especially where the fastest DC output response is required.

#### Three-Terminal Measurements

Three-terminal input configuration is needed to accurately measure low values of capacitance in the presence of relatively large values of shunt capacitance to ground. The Model 72 Series provides two types of three-terminal input connection adapters as standard.

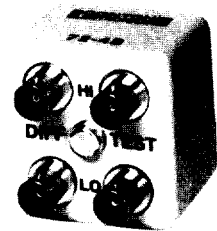
The Model 72-5C Adapter is equipped with two grip-posts, for local connection of wire-lead components to the HI and LO inputs, and a separate ground post for a shield, if required.

The Model 72-4B Adapter accepts BNC-terminated shielded cables to both the HI and LO test inputs. Because instrument accuracy is minimally affected by up to several hundred picofarads of capacitance loading from either input terminal to ground, reasonable lengths of cable may be used to connect to a remote test fixture such as a probe station.

In addition, the Model 72-4B Adapter has a second set of BNC connectors that allow relative differential measurements. For example, by connecting a suitable value capacitor to these DIFF terminals, the variance of a test capacitor can be read on lower ranges with greater resolution.



Model 72-5C



Model 72-4B

#### Phase-Sensitive Detector

All Model 72 Series instruments use a phase-sensitive detector that effectively ignores the quadrature signal associated with capacitor loss. As a result, accurate shunt capacitance measurements may be made on components whose Q is as low as 1.

#### Provision For DC Bias

DC bias up to  $\pm 600$  V may be applied to the test specimen through fused rear panel terminals from an external floating supply. This voltage appears between HI and LO posts on both the TEST and DIFF inputs, making it possible, for example, to compare the C-V characteristics of two varactors.

Two separate bias voltages may be applied between HI and ground and LO and ground. This is convenient when making small-signal capacitance measurements on transistors because it allows separate bias on both test terminals, or either HI or LO post to be at DC ground.

#### DC Output

A fast responding, high-level DC output, proportional to the capacitance display, is available on the rear panel of all Model 72 Series instruments. Option -05A shortens the output response time to 50  $\mu$ s for the Models 72B and 72BD and to 200  $\mu$ s for the 72C.

#### System Applications

All three models have remote control capabilities of capacitance ranging via TTL logic inputs. In addition, the digital Model 72BD allows control of autorange, hold and trigger and has serial BCD outputs as standard, and parallel BCD outputs as an option. Autoranging capability is standard on the 72BD.

A Model 10A-03 Bus Interface Unit is available to adapt the Model 72BD to the IEEE-488 data bus. A separate 8" x 10" x 3" cabinet is cabled directly to a rear panel connector and allows the 72BD to be addressed as either a listener or a talker. All functions, except zeroing, can then be under the direction of a remote controller.

## IMPEDANCE MEASURING INSTRUMENTS

### Capacitance Meters Model 72 Series (Continued)

#### Specifications

MODEL:	Analog 72C	Analog 72B	Digital 72BD
Test Frequency:	100 kHz.	1 MHz.	1 MHz.
Test Level:	15 mV.	15 mV.	15 mV.
Ranges:	1 pF to 3000 pF fs in a 1-3-10 sequence.		2 pF to 2000 pF fs in a decade sequence.
Accuracy: Q > 5	1-1000 pF fs, $\pm(0.5\% \text{ rdg} + 0.5\% \text{ fs})$ . Add 0.005 pF for 1 and 3 pF ranges. 3000 pF, $\pm(1\% \text{ rdg} + 0.5\% \text{ fs})$ .	1 pF fs, $\pm(0.5\% \text{ rdg} + 0.01 \text{ pF})$ . 3-1000 pF, $\pm(0.5\% \text{ rdg} + 0.5\% \text{ fs})$ . 3000 pF, $\pm(1\% \text{ rdg} + 0.5\% \text{ fs})$ .	2 pF fs, $\pm(0.25\% \text{ rdg} + 0.01 \text{ pF})$ . 20, 200 pF, $\pm(0.25\% \text{ rdg} + 0.2\% \text{ fs})$ . 2000 pF, $\pm(0.4\% \text{ rdg} + 0.2\% \text{ fs})$ .
Q = 1 to 5	1-1000 pF fs, $\pm(1\% \text{ rdg} + 0.5\% \text{ fs})$ . Add 0.005 pF for 1 and 3 pF ranges. 3000 pF, $\pm(2\% \text{ rdg} + 0.5\% \text{ fs})$ .	1 pF fs, $\pm(1\% \text{ rdg} + 0.01 \text{ pF})$ . 3-1000 pF, $\pm(1\% \text{ rdg} + 0.5\% \text{ fs})$ . 3000 pF, $\pm(2\% \text{ rdg} + 0.5\% \text{ fs})$ .	2 pF fs, $\pm(0.5\% \text{ rdg} + 0.01 \text{ pF})$ . 20, 200 pF, $\pm(0.5\% \text{ rdg} + 0.2\% \text{ fs})$ . 2000 pF, $\pm(2\% \text{ rdg} + 0.2\% \text{ fs})$ .
Temp. Effect:	21°C to 25°C, 0%. 18°C to 30°C, 0.2% rdg. 10°C to 40°C, 0.5% rdg.		
Differential Measurements:	Maximum capacitance on DIFF terminals for specified accuracy is fs value of range in use.		Same as 72B/C. No differential measurements with autorange.
Capacitive Loading:	LO post to ground, 500 pF maximum, all ranges. HI post to ground as follows: 1 pF, 3 pF fs: 200 pF max., 0.5% rdg effect.* 10-3000 pF, 500 pF max., 0.25% rdg effect.* *Decreases proportionally with capacitive loading.		
External DC Bias:	HI to GND, $\pm 200 \text{ V max.}$ LO to GND, $\pm 400 \text{ V max.}$ HI to LO (floating supply only), $\pm 600 \text{ V max.}$ 170 mA max., 1/32 A fuse-protected.		
Display:	4½ inch taut-band meter; two linear scales. 0 to 10 (0.1 per division) and 0 to 30 (0.5 per division).		4 digit LED, 200 ms display period.
DC Output: FS Level	1 V $\pm 0.5\%$ (1 series ranges). 3 V $\pm 0.5\%$ (3 series ranges).		2 V $\pm 0.5\%$ , all ranges.
Linearity	1-300 pF fs; $\pm(0.1\% \text{ rdg} + 0.01\% \text{ fs})$ . 1000-3000 pF; $\pm(0.25\% \text{ rdg} + 0.01\% \text{ fs})$ .		2-200 pF fs; $\pm(0.1\% \text{ rdg} + 0.005\% \text{ fs})$ . 2000 pF fs; $\pm(0.25\% \text{ rdg} + 0.01\% \text{ fs})$ .
Source Resistance			
Response Time	1 ms to full accuracy. (200 $\mu\text{s}$ , option -05A).	1 ms to full accuracy. (50 $\mu\text{s}$ , option -05A).	2 ms to full accuracy. (50 $\mu\text{s}$ , option -05A).
Noise	<1.5 mV, 1 and 3 pF ranges <1.0 mV, all other ranges	<1 mV rms (<5 mV, option -05A).	<2 mV rms (<6 mV, option -05A).
Commands: Range	Logic 0 (<0.7 V) selects each range (8 lines).		Logic 0 (<0.7 V) selects each range 4 lines.
Manual Disable	Logic 0 disables front panel range switch.		
Autorange			Logic 0 selects autorange.
Hold			Logic 0 inhibits new encode cycle for delayed data transfer.
Trigger			Transition from logic 1 to logic 0 initiates encode cycle. Data available in 75 ms. Fall time < 1 $\mu\text{s}$ , width > 0.5 $\mu\text{s}$ .
Data Outputs: Digits	Bit parallel, digit serial, logic 1 true.		
Range	1, 2 code, logic 1 true.		
Encode Complete	Logic 1 to 0 transition.		
Polarity	Logic 1 indicates negative.		
Overrange	Logic 0 for >100% fs.		
Underrange	Logic 0 for <0.9% fs.		
Power Consumption:	9W; 115/230 V $\pm 10\%$ , 50 to 400 Hz.		16W; 115/230 V $\pm 10\%$ , 50 to 400 Hz.
Weight:	Net 7.2 lbs (3.3 kg).		Net 8 lbs (3.7 kg).
Dimensions:	5.2 in (13.2 cm) high, 8.3 in (21.1 cm) wide, and 12 in (30.5 cm) deep.		
Options: - 03	100 mV test level		
- 05A	200 $\mu\text{s}$ DC output response time.	50 $\mu\text{s}$ DC output response time.	
- 21	Serial-to-parallel buffered BCD data output converter.		
Accessories Furnished:	72-5C Test Post Adapter (Clips). 72-4B Test Post Adapter (BNC).		
Accessories Available:	76-3A Precision Decade Capacitor. 1 pF to 1221 pF steps. Basic accuracy of 0.1% at 1 MHz or 100 kHz. 76-2A Capacitance Standard. Values available from .01 pF to 3000 pF. Basic accuracy 0.1%. Certifiable at 1 MHz or 100 kHz. 71-1A High/Low Q Capacitance Standard. 950032 Rack Mounting Kit, Single. 950030 Rack Mounting Kit, Dual. 10A-03 IEEE-488 Bus Interface Unit. 950031 Transit Case. 950033 Interface Unit Rack Mounting Kit. Mounts 10A-03 behind left or right mounted 72BD. 950034 Interface Unit Rack Mounting Kit. Mounts two 10A-03s behind two 72BDs. 950035 Interface Unit Rack Mounting Kit. Mounts 10A-03 alongside 72BD. 960000 Extender Card		