





# Great reductions in meas

There is always a demand for faster production line testing, and faster test equipment is the sine qua non of reduced test times. The 3502 provides capacitance measurement in 70 ms at 1 kHz (or 80 ms at 120 Hz), greatly improving on existing test times for capacitance measurement.

The 3502 improves on existing equipment by catering for capacitance values as high as 400 mF; at the other end of its range it reaches down to 0.01 pF. It in-

cludes a comparator function for production line effectiveness. Improved protection functions guard against the eventuality of a charged capacitor being connected,

improving the resilience of the unit in combination with other test equipment.



- Dedicated capacitance tester, with dissipation (loss factor) measurement
- High-speed measurement: 70 ms (1 kHz) or 80 ms (120 Hz)
- Built-in comparator
- Dissipation indication accurate to four places of decimals
- Improved residual charge protection
- Monitoring function (applied voltage and measurement current)
- Lightweight, notebook-size unit
- Simple operation
- Key lock function
- GP-IB interface (option)

## Values measured

**Capacitance (C):** The measurement frequency is fixed at either 120 Hz or 1 kHz. At 120 Hz, electrolytic capacitors can be measured reliably, and measurement up to 400 mF is possible, while the lower ranges can provide 0.01 pF precision, and accurate measurement of very small capacitances.

**Dissipation (D):** An accurate read-out, providing four places of decimals when the averaging function is being used.

## Fast measurement for production line efficiency

Measurement times are 70 ms at 1 kHz or 80 ms at 120 Hz. Faster measurement means higher production line speed, and greater overall testing efficiency.

## Simple operation and small lightweight unit

As a dedicated capacitance tester, the notebook-sized unit has a reduced number of switches, and extremely simple operation.

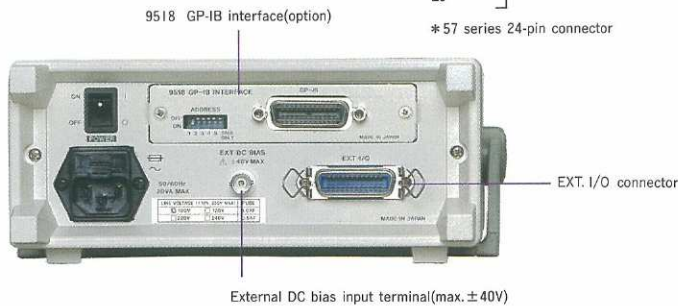


# Measurement time

## Comparator function for measuring deviations

Comparator results are shown as “Hi”, “In” or “Lo” and are also echoed as result signals from the EXT I/O connector on the rear panel. The comparator function can also be used to measure the numerical value of the deviation from a reference value.

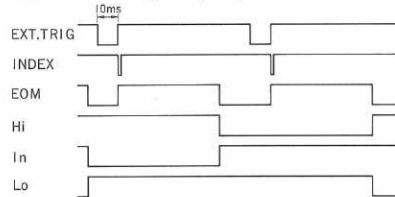
The comparator function can be used for capacitance or dissipation individually, or for both simultaneously.



## External trigger

An external trigger signal can be used to start measurement, for automated testing, and easy integration with other test equipment.

Measurement timing chart(1kHz)



\* 57 series 24-pin connector

## Backup of settings

When the unit is powered off, the current settings of measurement conditions are held in memory, and reinstated when the unit is next powered on.

## GP-IB interface (option)

This complies with IEEE 488.1-1987 and is designed with reference to IEEE 488.2-1987. Using the talk-only function, this unit can be connected directly to a printer with a listen only, without requiring a separate controller.



Printing example of talk-only function used

```
C+10.24 E-06;D+0.0012 E+00
C+10.24 E-06;D+0.0012 E+00
C+10.24 E-06;D+0.0012 E+00
C+10.24 E-06;D+0.0013 E+00
C+10.24 E-06;D+0.0012 E+00
C+10.24 E-06;D+0.0012 E+00
C+10.24 E-06;D+0.0012 E+00
```

## External on/off control of comparator function

The comparator function can be switched on and off remotely through a rear panel connection.

## EXT. I/O connector pin assignments

Pin no.	Pin no.
External DC power supply +Vin 13	1 External DC power supply +Vin
C-In 14	2 C-Hi
D - Hi 15	3 C - Lo
D - Lo 16	4 D - In
17	5(C-D) - AND
Measurement ended (EOM) 18	6 Measurement error (ER)
19	7 Analog measurement ended
20	8 (INDEX)
21	9
External trigger in * 22	10 Comparator on /off **
External supply GND in 23	11 External supply GND in
Internal DC supply COMout 24	12 Internal DC supply +Vout

\* EXT. TRIG.  
\*\* COMP. ON/OFF

## Improved residual charge protection function

If a charged capacitor is inadvertently connected, this function protects the measurement circuits from the discharge voltage.

Maximum protection voltage

$$* V(V) = \sqrt{2/C}$$

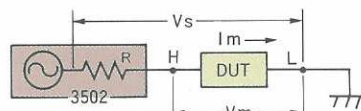
Maximum 400 V DC

C: capacitance (F)

\* Reference value

## Monitoring function

It is possible to monitor the applied voltage and measurement current.



Vs: Measurement signal level

Vm: Monitor voltage, Im: Monitor current

R: Output impedance(depends on the measurement range - 10 to 100kΩ)

DUT: Device under test

## Key lock function

This disables all the front panel keys (excluding the MANU key under external trigger operation), preventing inadvertent misoperation.

## Range of probes and test fixtures for different applications

9261 test fixture  
General-purpose four-lead fixture. The 1-meter cable length gives excellent operability.



9140 four-terminal probe  
A four-lead probe with a 1-meter cable.



9143 pincher probe  
For testing chips and other board-mounted components.



Note: Measurement range are restricted.

## Specifications

Items measured: capacitance (C) and dissipation (D)  
 Measurement circuit: series equivalent circuit or parallel equivalent circuit, manual or automatic (linked to range)  
 Measurement frequency: 120Hz or 1kHz (accuracy  $\pm 0.01\%$ )  
 Measurement signal level:  $10\mu\text{A}$ ,  $100\mu\text{A}$ ,  $1\text{mA}$ ,  $10\text{mA}$  or  $50\text{mA}$ , depending on range. 1V when open circuit.  
 Output impedance:  $100\text{k}\Omega$ ,  $10\text{k}\Omega$ ,  $1\text{k}\Omega$ ,  $100\Omega$  or  $10\Omega$ , depending on range.  
 Range switching: automatic or manual  
 Displays:  
 LED  
 C; maximum reading 4000  
 D;  $4\frac{1}{2}$  digits ( $3\frac{1}{2}$  digits at high speed)  
 Frequency monitor; 2 or 3 digits  
 Measurement terminals: Five terminals; Hc, Hp, Lp, Lc, and GUARD, BNC terminals

Residual charge protection: Maximum 400V DC (reference value)  
 Monitoring function: Applied voltage (accuracy  $\pm 3\% \pm 0.02\text{V}$ ) and measurement current (accuracy  $\pm 3\%$  rdg.  $\pm 5$  dgt.)  
 DC bias: external bias voltage  $\pm 40\text{V}$  max.  
 Trigger functions: internal (high-speed, averaging), external or manual (high-speed, averaging)  
 Zero adjustment function: short-circuit compensation and open-circuit compensation  
 Comparator: "Hi", "In" and "Lo" indications for each of capacitance and dissipation results  
 Control interface (57 series 24-pin connector, all pins isolated)  
 Outputs: C Hi, C In, C Lo, D Hi, D In, D Lo, C-D AND, INDEX (analog measurement completed), EOM (measurement completed)  
 Inputs: trigger, comparator on/off

Power supply output: internal 5V and GND  
 Power supply input: external Vcc and external common  
 Key lock function: fixes settings of all operating switches  
 Measurement times:  
 At 1kHz, 70 ms approx. (high-speed: from external trigger input to EOM output, excluding circuit settling time); for averaging processing 450 ms.  
 At 120Hz, 80 ms approx.; for averaging processing 510 ms.  
 Interfaces:  
 GP-IB interface (option)  
 Complies with IEEE 488.1-1987  
 Designed with reference to IEEE 488.2-1987  
 EXT I/O for comparator  
 Insulation resistance and withstand voltage: at least  $100\text{M}\Omega$  at 500V DC (frame to power supply); 1.5kV AC for 1 minute  
 Operating temperature range:  $0^\circ\text{C}$  to  $40^\circ\text{C}$ , maximum relative humidity 80% (no condensation)  
 Power supply: 100/120/220/240V AC  $\pm 10\%$ , 50/60Hz (specify at order)  
 Power consumption: 20VA max. (with GP-IB in use)  
 Dimensions and weight: 88mm H  $\times$  218mm W  $\times$  298mm D; 2.8kg approx. (including GP-IB)  
 Accessories: power cord, 3-pin/2-pin power adaptor, spare 1 A fuse for power supply

## Measurement ranges and accuracy

Standard measurement conditions:  $23^\circ\text{C} \pm 5^\circ\text{C}$ , maximum 80% R.H. (no condensation). Wait 30 minutes after powering on, then carry out zero adjustment (outside  $0^\circ\text{C}$  to  $40^\circ\text{C}$  the tolerances are doubled); figures are for dissipation  $D \leq 0.1$ , using a 9261 test fixture.  
 When  $D \geq 0.1$ , the accuracy tolerance for capacitance is multiplied by  $\sqrt{1+Dx^2}$ , and the tolerance for D is multiplied by  $\sqrt{1+Dx}$ , where Dx is the displayed value for D.

Range	1kHz	40.00pF	400.0pF	4.000nF	40.00nF	400.0nF	4.000μF
Range	120Hz	400.0pF	4.000nF	40.00nF	400.0nF	4.000μF	40.00μF
Equivalent circuit							
Output impedance	100 kΩ		10kΩ	1kΩ	100Ω	10Ω	
Measurement signal	1V						
Display range for capacitance (auto)	0 ~ 4000		280 ~ 4000				
Display range for dissipation (auto)	Averaging processing 0.0001 to 1.9999 (high-speed measurement 0.001 to 1.999)						
Capacitance accuracy *	1kHz	$\pm 4\%$ rdg. $\pm 50$ dgt.	$\pm 0.5\%$ rdg. $\pm 4$ dgt.	$\pm 0.3\%$ rdg. $\pm 4$ dgt.			$\pm 0.5\%$ rdg. $\pm 4$ dgt.
	120Hz		$\pm 1\%$ rdg. $\pm 4$ dgt.				
Dissipation accuracy **	1kHz	$\pm 4\%$ rdg. $\pm (50 + 5000/Cx)$ dgt.	$\pm 0.5\%$ rdg. $\pm (5 + 2000/Cx)$ dgt.	$\pm 0.3\%$ rdg. $\pm (4 + 1000/Cx)$ dgt.			$\pm 0.5\%$ rdg. $\pm (5 + 2000/Cx)$ dgt.
	120Hz		$\pm 0.5\%$ rdg. $\pm (10 + 2000/Cx)$ dgt.				
Equivalent circuit (auto)							

\* Table shows capacitance accuracy when using averaging. For high-speed measurement, multiply margin by 3.

Cm indicates capacitance (mF)

\*\* Dissipation accuracy:

When using averaging, multiply reading by 10 (resolution 0.0001).

For high-speed measurement, multiply reading by 4 (resolution 0.001).

Cx indicates measured value of C.

## Optional accessories

9261 test fixture

9140 four-terminal probe

9143 pincher probe

9518 GP-IB interface \*

9151-02 GP-IB connector cable (2m)

9151-04 GP-IB connector cable (4m)

\* Please note that the 9518 is designed for (easy) user fitting. Even when ordered together with the 3502, it will be shipped in a separate carton.

Range	1kHz	400.0nF	4.000μF	40.00μF	400.0μF	4.000mF	40.00mF
Range	120Hz	4.000μF	40.00μF	400.0μF	4.000mF	40.00mF	400.0mF
Equivalent circuit							
Output impedance	100kΩ	10kΩ	1kΩ	100Ω	10Ω		
Measurement signal	$10\mu\text{A}$	$100\mu\text{A}$	1mA	10mA	50mA		
Display range for capacitance (auto)	280 ~ 4000						
Display range for dissipation (auto)	Averaging processing 0.0001 to 1.9999 (high-speed measurement 0.001 to 1.999)						
Capacitance accuracy *	1kHz	$\pm 0.3\%$ rdg. $\pm (5 + Cx/200)$ dgt.		$\pm 1\%$ rdg. $\pm (5 + Cx/200)$ dgt.	$\pm (3 + 1.2 \times Cm)\%$ rdg. $\pm 10$ dgt.		
	120Hz				$\pm (3 + 0.12 \times Cm)\%$ rdg. $\pm 10$ dgt.		
Dissipation accuracy **	1kHz	$\pm 0.3\%$ rdg. $\pm (5 + Cx/200)$ dgt.		$\pm 1.0\%$ rdg. $\pm (5 + Cx/200)$ dgt.	$\pm ((\text{The value of } C \times 10) + 20)$ dgt.		
	120Hz						

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