

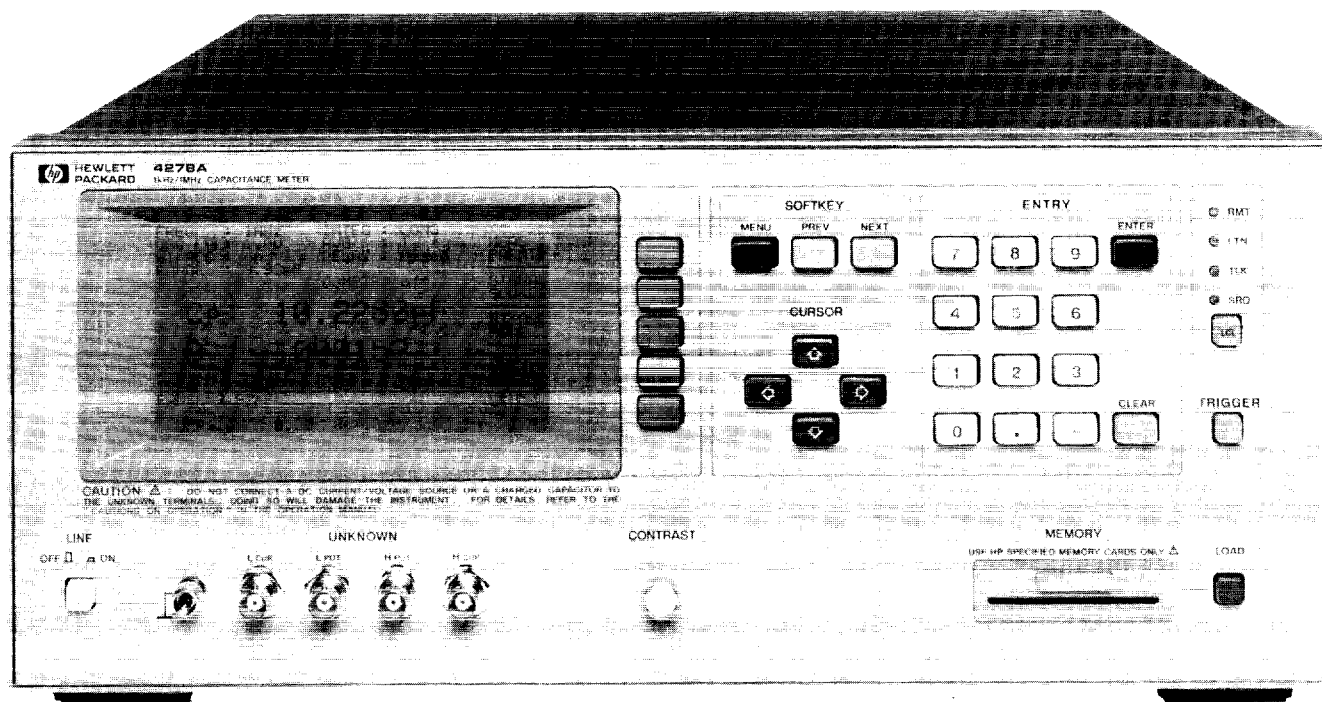
# COMPONENT MEASUREMENT

## 1 kHz / 1 MHz Capacitance Meter

Model 4278A

- Measurement Speed: 6.5ms/10ms/21ms
- Measurement Parameters: C-D•Q•ESR•G
- C-D Measurement Accuracy:  
0.07%, 0.0005(1kHz, 21ms)  
0.05%, 0.0002(1MHz, 21ms)

- High Resolution: 6 digit, D:0.00001
- Intelligent Built-in Comparator: 10-bin Sorting



HP 4278A

### Description

The HP 4278A 1kHz/1MHz Capacitance Meter is a high speed, highly reliable, precision test instrument aimed at incoming/outgoing capacitor inspection applications on the production line and in quality control. The HP 4278A will improve test efficiency by performing comparative measurements of low to medium value capacitors (up to 200  $\mu$ F—a range that covers most ceramic and film capacitors) several times faster than previously available capacitance meters.

The HP 4278A's standard measurement frequencies and oscillator output levels are 1kHz/1MHz and from 0.1V to 1V in 0.1V steps, respectively. The HP 4278A's ability to make precision capacitance measurements and to measure low dissipation values will give you an edge in improving the quality of your devices.

The built-in comparator function of the HP 4278A gives you the ability to sort parts into ten bins. A high speed HP-IB interface and an optional handler interface are available for combining the HP 4278A with an automatic handler and an external computer to build a total solution for automatic testing and data acquisition and analysis.

### High Speed Measurements

One of the HP 4278A's main features is its selection of high measurement speeds: 6.5ms (153 measurements/sec), 10ms (100 measurements/sec), or 21ms (47 measurements/sec), with a fast settling time. Additionally, the HP 4278A's built-in comparator and high speed HP-IB interface make it possible to construct a measurement system using an automatic handler and an external computer to minimize production test time, and, therefore, cost.

### High Accuracy and Resolution

Dissipation factor (D), the parameter measured to determine the quality of capacitors, can be measured with an accuracy of 0.0002 (1MHz) and 0.0005 (1kHz) with a resolution of 0.00001 without degrading measurement speed. The HP 4278A has high capacitance measurement accuracy, 0.05% (1MHz) and 0.07% (1kHz) with 6 full digits of resolution in all measurement ranges, 1pF to 2048 pF (1MHz), and 100pF to 100  $\mu$ F (1kHz).

The pushbutton zero adjustment function is used to compensate for stray impedance and admittance of the handler and test fixture. The auto calibration function, when used with a capacitance standard, can be used to calibrate the system up to the point of device connection.

### Intelligent Built-in Comparator

The intelligent built-in comparator gives the HP 4278A the capability to use nine sets of high and low capacitance values and one set of dissipation limits to sort capacitors into nine bins, according to their capacitance values and whether or not they meet the dissipation limits. Capacitors which are not within the capacitance limits or do not meet the dissipation limits go into the tenth or no-go bin.

All comparator settings can be controlled and monitored using an external computer, and the results of the comparisons can be transferred to a handler interface (optional). All control settings and comparator parameters can be saved on the removable EEPROM memory module (memory card) to facilitate instrument setup and to minimize the chance of an instrument setup error.

## Specifications

(refer to data sheet for complete specifications)

**Measurement Parameters:** C-D-Q-ESR-G

**Display:** Dot-matrix LCD. Displays measurement values with 4, 5, or 6 digit resolution, control settings, comparator limits, the comparator's decision, self test messages and annunciations.

**Measurement Circuit Modes:** Parallel and Series

**Test Signals:**

**Frequency:** 1kHz and 1 MHz,  $\pm 0.02\%$

**Signal Level:** 0.1 to 1 Vrms,  $\pm 10\%$  ( $C \leq 20\mu\text{F}$ ), in 0.1 Vrms steps

**Measurement Time Modes:** SHORT, MEDIUM, and LONG

**Measurement Times:**

| Mode  | SHORT | MEDIUM | LONG |
|-------|-------|--------|------|
| Time* | 6.5ms | 10ms   | 21ms |

\* Measurement time includes Settling, Integration (analog measurements), Calculation, and Comparison times.

No additional measurement time is required for measurements performed in an overload (shorted capacitor) condition.

**Measurement Range**

| Measurement Parameter | 1 KHz                                  | 1 MHz Normal Mode<br>1 MHz High Accuracy                                     |
|-----------------------|----------------------------------------|------------------------------------------------------------------------------|
| C                     | 0.001 pF to 200.000 $\mu\text{F}$      | 0.00001 pF to 1280.00 pF<br>0.00001 pF to 2663.00 pF                         |
| DF                    | 0.00001 to 9.99999                     | 0.00001 to 9.99999<br>0.00001 to .999999                                     |
| Q                     | 0.1 to 99999.9                         | 0.1 to 99999.9<br>20 to 99999.9                                              |
| G                     | 0.00001 $\mu\text{S}$ to 9.99999S      | 0.00001 $\mu\text{S}$ to 9.99999 mS<br>0.00001 $\mu\text{S}$ to 9.99999 mS   |
| ESR                   | 0.00001 $\Omega$ to 9.99999 M $\Omega$ | 0.001 $\Omega$ to 999.999 K $\Omega$<br>0.001 $\Omega$ to 999.999 K $\Omega$ |

1. 1kHz Normal Mode: 7 decade ranges 100pF to 100 $\mu\text{F}$  full scale. 100% overranging on all ranges, (max. 200000 counts) when  $D \leq 0.5$ .
2. 1MHz Normal Mode: 11 binary ranges, 1pF to 1024pF full scale. 25% overranging on all ranges, when  $D \leq 1$ .
3. 1MHz High Accuracy Mode: Measurement range is  $\pm 30\%$  of the user defined nominal value, maximum 2048pF. When  $D \leq 0.05$ .

## Measurement Accuracy

It is specified at the UNKNOWN terminals and at the end of standard 1 or 2 meter test leads under the following conditions. Refer to data sheet for details.

1. Warm Up Time:  $\geq 10$  minutes.
2. Ambient Temperature is  $23 \pm 5^\circ\text{C}$  and variance is less than  $0.2^\circ\text{C}/\text{minute}$ .
3. Test signal level is set to 1 Vrms.
4. Test cable length is 0, 1, or 2 meters (HP 16048A/B/D).
5. Zero OPEN/SHORT compensation has been performed.
6.  $D \leq 0.05$  for 1MHz High Accuracy Mode.  
 $D \leq 0.1$  for 1kHz and 1MHz Normal Modes.
7. Accuracies are only valid when the measured value is equal to full scale of each range.
8. Accuracy stated in the tables is given for MEDIUM (upper) and LONG (lower) integration times.
9. Accuracy equations are read as follows:  
C:  $\pm$  (% of reading + % of full scale)  
D:  $\pm$  (% of reading + absolute D value)  
(C:  $\pm$  (% of reading + absolute C value) for Table 3)

**Table 1 1kHz Measurement Accuracy**

| C range                  | C                              | D                                |
|--------------------------|--------------------------------|----------------------------------|
| 100 $\mu\text{F}$        | 0.13% + 0.3%<br>0.07% + 0.025% | 0.13% + 0.003<br>0.065% + 0.0025 |
| 100pF - 10 $\mu\text{F}$ | 0.1% + 0.05%<br>0.05% + 0.025% | 0.1% + 0.001<br>0.05% + 0.0005   |

**Table 2 1MHz Normal Mode Measurement Accuracy**

| C range      | C                             | D                             |
|--------------|-------------------------------|-------------------------------|
| 256 - 1024pF | 0.2% + 0.02%<br>0.1% + 0.02%  | 0.2% + 0.002<br>0.1% + 0.0005 |
| 4 - 128pF    | 0.2% + 0.02%<br>0.05% + 0.02% |                               |
| 2pF          | 0.2% + 0.03%<br>0.05% + 0.03% | 0.2% + 0.004<br>0.1% + 0.001  |
| 1pF          | 0.2% + 0.06%<br>0.05% + 0.06% |                               |

**Table 3 1MHz High Accuracy Mode Measurement Accuracy**

| Nominal C + Open Circuit C | C                                   | D                |
|----------------------------|-------------------------------------|------------------|
| 1024 - 2048pF              | 0.11%<br>0.11%                      | 0.0007<br>0.0004 |
| 256 - 1024pF               | 0.11%<br>0.07%                      | 0.0007<br>0.0003 |
| 4 - 256pF                  | 0.11%<br>0.05%                      | 0.0007<br>0.0002 |
| 2 - 4pF                    | 0.1% + 0.0004pF<br>0.06% + 0.0004pF | 0.0008<br>0.0003 |
| 0 - 2pF                    | 0.1% + 0.0004pF<br>0.08% + 0.0004pF | 0.0016<br>0.0006 |

**Trigger Modes:** Internal, External, or Manual

**Measurement Terminals:** Four-terminal pair, guarded

**Cable Length Compensation:** 0, 1, or 2m

**Compensation Function**

**Zero OPEN/SHORT:** Compensation range:  $R \leq 20\Omega$ ,  $G \leq 20\mu\text{S}$ , and unlimited C and L.

**Standard:** Improves measurement accuracy by using a standard capacitor as a reference.

**Offset:** Arithmetic correction of measurement data.

**Comparator:** Ten-bin sorting for capacitance, and go/no-go testing for D, Q, ESR, and G.

**Sorting Modes:** Sequential sorting into un-nested bands with absolute limits, and tolerance sorting into nested bands with absolute or percent limits.

**Self Test:** Checks the HP 4278A's basic operation.

**Memory Card:** External memory for storing and recalling control settings and comparator limits.

## General Specifications

**Operating Temperature and Humidity:**  $0-55^\circ\text{C}$ , 95% RH @  $40^\circ\text{C}$   
**Power:** 100, 120, 220VAC  $\pm 10\%$ , 240VAC  $+5 -10\%$ , 48-66Hz, 200VA max.

**Dimensions (in mm):** Approximately 426(W) by 177(H) by 498(D)

**Weight:** Approximately 10kg (22lb., standard)

## Reference Data

**Stability:** LONG integration and constant operating temperature.

C  $\leq 0.01\%/ \text{day}$

D  $\leq 0.0001/\text{day}$

**Temperature Coefficient:** LONG integration and  $12 \pm 5^\circ\text{C}$ .

C  $\leq 0.01\%/^\circ\text{C}$ ; 1kHz and 1MHz.

D  $\leq 0.0001/\text{C}$ ; 1kHz and 1MHz Normal Mode.

D  $\leq 0.00004/\text{C}$ ; 1MHz High Accuracy Mode.

**HP-IB Data Output Speed:** Maximum 100 bytes/ms, typically 3ms for handshake, depending on the system controller.

## Accessories Available

|                                                          |        |
|----------------------------------------------------------|--------|
| HP 16270A: Memory Card Set                               | \$275  |
| HP 16334A: Tweezer-type Test Fixture for Chip Components | \$430  |
| HP 16047A: Direct-coupled Test Fixture                   | \$265  |
| HP 16047C: Test Fixture                                  | \$305  |
| HP 16048A: Test Leads, BNC (1m)                          | \$325  |
| HP 16048B: Test Leads, SMC (1m)                          | \$325  |
| HP 16048D: Test Leads, BNC (2m)                          | \$420  |
| HP 16380A: Standard Capacitor Set                        | \$2955 |
| HP 16380C: Standard Capacitor Set                        | \$4500 |

Refer to page 279.

## Ordering Information

|                                                                                                                                                     |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| HP 4278A 1kHz/1MHz Capacitance Meter                                                                                                                | \$7130 |
| Opt W30: 3-year hardware support                                                                                                                    | \$180  |
| Opt 001: 1kHz test frequency only                                                                                                                   | -\$750 |
| Opt 002: 1MHz test frequency only                                                                                                                   | -\$330 |
| Opt 003: 1% frequency shift: prevents possible test signal interference when component test contacts are located close to those of other test units | \$0    |
| Opt 009: Delete Manual                                                                                                                              | -\$30  |
| Opt 101: HP-IB compatibility                                                                                                                        | \$224  |
| Opt 201: Handler Interface                                                                                                                          | \$255  |
| Opt 202: Handler Interface                                                                                                                          | \$270  |
| Opt 301: Scanner Interface                                                                                                                          | \$540  |

Fast-ship product, see page 766.