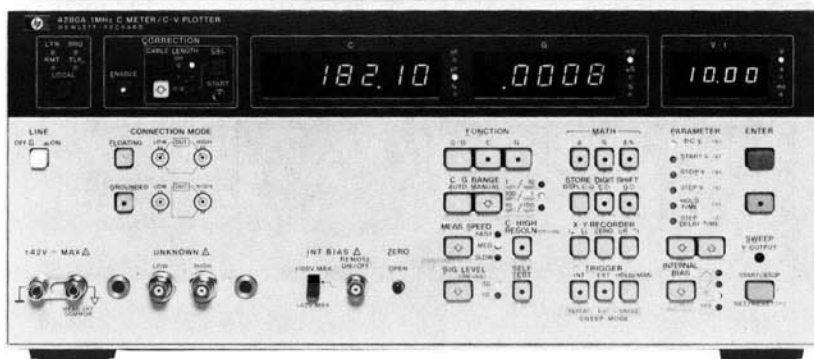


# COMPONENT & SEMICONDUCTOR MEASUREMENT

## 1 MHz C Meter/C-V Plotter

### Model 4280A

- Built-in sweepable dc bias source and timer for C-V (Capacitance-Voltage)/C-t (Capacitance-Time) measurements
- High speed C-t measurements with minimum measurement interval of 10 ms (10  $\mu$ s if an external pulse generator is used)
- Basic C/G measurement accuracy: 0.1%
- Test lead extension up to 5 m
- 5½-digit display resolution (option) for C measurement



### Description

HP's Model 4280A 1 MHz C Meter/C-V Plotter measures the capacitance and conductance of semiconductor devices and materials as functions of applied voltage (C-V) or time (C-t). The 4280A consists of 1) a precision 1 MHz C-G meter, 2) a programmable dc bias source that can be swept in staircase fashion, and 3) accurate timing control.

### C-V and C-t Measurements

The 4280's internal dc bias source has a range of 0 V to  $\pm 100$  V with 1 mV resolution on the most sensitive range. Various measurement parameters for C-V and C-t measurements—hold time (bias pulse width) and step delay time (measurement interval)—can be manually set from the front panel. Or these parameters can be set under program control via the HP-IB. Settable range for C-t measurement interval is 10 ms to 32s with a best case resolution of 10  $\mu$ s. If an external pulse generator is used, however, measurement intervals as short as 10  $\mu$ s can be set. Up to 9999 readings can be set for a C-t measurement. These capabilities make it possible for the 4280A to measure the C-t characteristics of virtually any device.

### High Speed C-t Measurement

A special sampling integration technique employed in the 4280A provides measurement intervals as short as 10  $\mu$ s using an external pulse generator, such as the HP 8112A or 8160A, to provide the bias pulse. Short measurement interval makes the 4280A applicable to Deep Level Transient Spectroscopy (DLTS) measurements, which are commonly used to analyze the physical characteristics of semiconductors.

### Precision, High Resolution Measurements

The 4280A measures capacitances up to 1.900 nF, over three ranges, with 0.001 pF resolution on the most sensitive range. Conductance up to 12 mS can be measured with a maximum resolution of 10  $\mu$ S.

C and G measurements are made at 1 MHz. AC signal level is selectable between 10 mVrms or 30 mVrms, suitable for semiconductor measurements. Basic measurement accuracy is 0.1%. Maximum display resolution is 4½ digits. With Option 001, however, display resolution for capacitance is 5½ digits.

The accuracy and resolution of the 4280A satisfy the stringent requirements of laboratory and R and D measurements, which require the detection of minute changes in device characteristics.

### Probed Measurements On Wafers

HP's 4280A has an automatic error correction function that makes

it possible to use test leads up to 5 m long. And the 4280A can measure either floating or grounded devices. Thus, the 4280A can be connected to a wafer prober and still provide stable, accurate C and G measurements.

### Easy, Low Cost Systemization

HP-IB is standard on the 4280A. So, a process evaluation system or a lab automation system capable of evaluating the physical characteristics of semiconductor devices can be easily constructed.

The 4280A is equipped with analog outputs to allow users to plot device characteristics on an X-Y recorder or large screen display.

### Specifications (refer to data sheet to complete specifications)

Measurement functions: C, C-V and C-t

Function		Available Internal dc Bias Function
Basic Function	Selection	
C	C only C-G only	OFF, $\infty$ (DC)
C-V	C-V G-V C & G-V	
C-t	C-t G-t C & G-t	, $\infty$ (DC), OFF

### C Measurement

#### Test Signal

Frequency: 1 MHz  $\pm 0.01\%$

OSC level: 30 mVrms or 10 mVrms  $\pm 10\%$

Measurement terminals: two-terminal-pair configuration (High, Low and Guard).

Connection mode: sets connection configuration between DUT (floating/grounded) and measurement circuit.

Ranging: auto or manual

#### Error Compensation

Cable length: 0 m, 1 m or 0–5 m. The standard cable (P/N 8120-4195) up to 5 m can be internally compensated.

Zero open: compensate stray capacitance and conductance at the test fixture.

External error compensation: compensate errors by external computer to eliminate other error factors not listed above.

Measurement speed: FAST, MED or SLOW

Trigger: Internal, External or Hold/Manual

Internal dc bias mode: OFF or  $\infty$  (DC)





## Measurement Range/Resolution/Accuracy

Range <sup>1</sup>	Resolution <sup>2</sup>	Max. Display <sup>3</sup>	Accuracy <sup>4</sup> ±(% of rdg + counts)	
			OSC: 30 mV	OSC: 10 mV
10 pF/100 μS	0.001 pF 0.01 μS	19.000 pF 120.00 μS	±(0.1% + 5) ±(0.2% + 5)	±(0.2% + 5) ±(0.3% + 5)
100 pF/1 mS	0.01 pF 0.1 μS	190.00 pF 1.2000 mS	±(0.1% + 3) ±(0.2% + 3)	±(0.2% + 3) ±(0.3% + 3)
1 nF/10 mS <sup>5</sup>	0.1 pF 0.001 mS	1.9000 nF 12.000 mS	±(0.1% + 3) ±(1.2% + 3)	±(0.2% + 3) ±(1.2% + 3)

<sup>1</sup> 100 pF/1 mS and 1 nF/10 mS ranges only in grounded measurement.

<sup>2</sup> When measurement speed is set to FAST (10 mV/30 mV) or MED (10 mV), resolution and Max. display become 1 digit lower (3½ digit display).

<sup>3</sup> Approx. 50 pF at 100 pF/1 mS range and 1.78 nF at 1 nF/10 mS range in grounded measurement. Error correction to offset residuals will reduce maximum value which can be measured.

<sup>4</sup> Accuracy is specified at UNKNOWN terminals and at the end of 16082A Test Leads (1 m) after warm-up ≥ 30 min., at temperature 23°C ± 5°C, zero open calibration is performed, and CORRECTION is enabled. Front panel settings are C-G, FLOATING and 0 m or 1 m (CABLE LENGTH). Some errors will be added at other settings (refer to data sheet). C accuracy is specified when D < 0.05 and G accuracy is specified when counts of C < 1/100 of range. Error double at 0°C-55°C.

<sup>5</sup> Add 0.1% of rdg for C and 0.2% of rdg for G when 16082A is used.

## C-V Measurement

**Function:** measures C-V, G-V or C & G-V characteristics using internal staircase bias.

**Measurement speed:** FAST, MED or SLOW

## C-t Measurement

**Function:** measures C-t, G-t or C & G-t characteristics using internal and/or external pulse bias source.

**Internal measurement mode:** Burst or Sampling Mode automatically selected.

**Burst mode:** apply one pulse then make repetitive measurement with specified time interval between measurements.

**Sampling mode:** repeated pulse with single samples between pulses. Delay between application of measure voltage and sample can be specified.

**Measurement speed:** FAST or MED

## DC Bias Source

**Output Mode:** (DC) or OFF

**Output Voltage Range/Resolution/Accuracy**

Voltage Range	Resolution	Accuracy* ±(% of setting + volts)
±1.999 V	1 mV	±(0.2% + 0.01 V)
±19.99 V	10 mV	±(0.1% + 0.02 V)
±100.0 V	100 mV	±(0.1% + 0.1 V)

\*at 23°C ± 5°C, at 0°C -55°C error doubles

## Staircase Sweep Parameter Settings (C-V Basic Function Only)

**Start/stop voltage:** 0 V-±100 V (max. 1 mV resolution)

**Step voltage:** 0 V-200 V (max. 1 mV resolution)

**Hold/step delay time (th/td):** 3 ms-650s (max. 1 ms resolution)

## Pulse Bias Parameter Settings (C-t basic function only)

**DC/pulse/measurement voltage:** 0 V-±100 V (max. 1 mV resolution)

**Number of readings:** 1-9999

**Hold time (th):** max. 10 μs resolution

**Internal bias:** 10 ms-32 s

**Ext bias slow:** 50 μs-32 s

**Ext bias fast:** 10 μs-32 s

**Delay time (td):** 10 μs-32 s (max. 10 μs resolution)

## Burst Mode

Function	Meas. Speed	Block Mode	Non Block Mode	
			Data Format	
			Binary	ASCII
C-t	FAST	10 ms-32 s	20 ms-32 s	150 ms-32 s
G-t	MED			
C & G-t	FAST	50 ms-32 s		200 ms-32 s
	MED	100 ms-32 s		250 ms-32 s

## Sampling Mode

**EXT BIAS SLOW:** 200 μs-5 s

**EXT BIAS FAST:** 10 μs-5 s

**Math functions:** displays measured C/G values as differential values (Δ), % ratio (%) or differential % (Δ%) of the reference value.

## Other

**HP-IB:** not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a measurement system.

**Data output format:** ASCII or Binary

**Block mode output:** can make C-V/t characteristics measurement and store measured data (C-V/t or G-V/t Function: 680 data, C & G-V/t Function: 400 data) into the internal data buffer. Then, packed data can be output.

## Recorder Output

**Output voltage:** ±10 V for C, G and V/t data

**Accuracy:** ±(% of output voltage + V)

**C or G:** ±(0.5% + 20 mV)

**V or t:** ±(0.15% + 40 mV)

**Selftest:** verifies normal measurement operations (not including calibration)

## Options

**Option 001:** High Resolution Offset Capacitance Measurement

**Function:** increase C measurement resolutions by one digit with offset reference value.

**C offset range:** 0 pF-1023 pF (1 pF increment). C offset value can be set by measured data or numeric key.

## General Specifications

**Operating temperature range:** 0°C to 55°C; 95% RH at 40°C

**Power requirements:** 100/120/220 V ± 10%, 240 V + 5% - 10%; 48 to 66 Hz; 140 V A max.

**Dimensions:** 426 mm W x 177 mm H x 498 mm D (16.5" x 7" x 19.5")

**Weight:** 15.3 kg (33.7 lbs)

## Accessories Furnished

**16080A:** Direct coupled test fixture

## Accessories Available

**16081A:** test leads, doubled shielded (2 m)

**16082A:** test leads, shielded (1 m)

**16083A:** Noise Clipper for pulse bias from the pulse generator

**Reference Data** (reference data are typical values given for information purpose)

**C/G measurement time:** A (+B) (+C) (+D)

	Meas. Speed	Display Parameter		
		C	G	C-G
A (Net Meas. Time)	FAST	10 ms		30 ms
	MED	40 ms	35 ms	70 ms
	SLOW	270 ms	220 ms	400 ms
B (Internal Error Compensation Time)		30 ms		60 ms
C (MATH Function Time)		10 ms		20 ms
D (Display Output Time)		10 ms		20 ms

**Residual L-R compensation:** error compensation for residual L-R (Max. 19 μH/190 Ω) is available using an external controller.

**Internal dc Characteristics of High and Low Unknown Terminals (without dc bias)**

**Maximum offset voltage:** ±1 mV

**Maximum allowable current:** 100 mA

## Internal dc Bias

**Settling time (99.9% of final value):** 0.05 × voltage swing (V) + 1.7 (ms)

**Maximum output current:** ±6 mA

**Hold time/step delay time/th/td:** 0.02% (basic accuracy)

**Response time of the EXT SLOW bias circuit (99.9% of final value):** 100 μs

## Option 001

**C offset accuracy:** ±(0.2% of reference value + 0.5 pF) can be compensated by CORRECTION ENABLE key.

## Ordering Information

**Opt 001 C-High Resolution** (field installation is not possible)

**16081A Test Leads**, 2 m double shielded, BNC

**16082A Test Leads**, 1 m, BNC

**4280A 1 MHz C Meter/C-V Plotter**

## Price

\$335

\$560

\$190

\$8380