
HP 4062C/F
Semiconductor Parametric Test System
HP 4062UX
Semiconductor Process Control System

System Specifications

Edition 2.0

October 1994



HP 4062UX
Semiconductor Process Control System

General Descriptions

The HP 4062C, HP 4062UX, and HP 4062F systems perform precision DC and capacitance measurements.

Measurement Functions

DC Current, DC Voltage, Capacitance, Conductance, and Pulse Force

DC Measurements

Spot, Sweep, Pulse, Pulse Sweep, and Analog Search

Switching Matrix Measurement Pins

HP 4062C/UX: Up to 96

HP 4062F: Up to 48

Switching Matrix Instrument Ports

HP 4062C/UX: 17

All ports can access all 96 measurement pins.

HP 4062F: 20

8 ports can access all 48 measurement pins, and 12 ports can access 4 measurement pins per one port.

High Resolution SMU: 1 port

Measurement Range: $\pm 20\text{fA}$ to $\pm 1\text{A}$, $\pm 40\mu\text{V}$ to $\pm 200\text{V}$

High Current SMU, Kelvin: 1 port

Measurement Range: 2pA to $\pm 1\text{A}$, $\pm 40\mu\text{V}$ to $\pm 200\text{V}$

SMU, Kelvin: 2 ports

Measurement Range: 2pA to $\pm 1\text{A}$, $\pm 40\mu\text{V}$ to $\pm 200\text{V}$

GNDU, Kelvin: 1 port

Voltage Output: 0V

VS/VMU (AUX): 4 ports (HP 4062C/UX), 3 ports (HP 4062F)

Output Range: $\pm 1\text{mV}$ to $\pm 40\text{V}$

Measurement Range: $\pm 40\mu\text{V}$ to $\pm 40\text{V}$, $\pm 4\mu\text{V}$ to $\pm 2\text{V}$ in differential voltage mode

High Frequency Ports: 12 ports (HP 4062F)

Capacitance and Conductance Measurements

CMU (HP 4280A)

Test Frequency: 1MHz

Measurement Range: 1fF to 1.2nF , 10nS to 12mS

DC Bias Voltage: $\pm 100\text{V}$

CMU (HP 4284A)

Test Frequencies: 1k , 10k , 100k , and 1MHz

Measurement Range: 1fF to 100nF , 0.1nS to 7.5mS

DC Bias Voltage: $\pm 40\text{V}$

High Frequency Pulse Force: HP 8110A

Pulse level: $\pm 19\text{V}$ (at open load)

Pulse period: 350ns to 999s

Pulse width: 50ns to 999ms

Transition time: 20ns to 200ms

SPECIFICATION INFORMATION

Hewlett-Packard warrants system performance. Accuracy is specified at $23^\circ\text{C} \pm 5^\circ\text{C}$ after calibration following at least 40 minutes warm up. The temperature change after calibration must be less than 3°C . The system calibration is performed at the measurement pins of the switching matrix.

The data marked ** in below is typical performance data and provided for reference use only. These are not warranted specifications.

Switching Matrix Subsystem

The Switching Matrix subsystem consists of a matrix and its controller(s). Three switching matrices are currently available:

HP 4085B (48 pins maximum), HP 4089B (96 pins maximum), and HP 4085F (48 pins maximum). HP 4085B and HP 4089B are for HP 4062C and UX. HP 4085F is for HP 4062F.

Maximum Number of DUT Pins

48 pins (HP 4085B/F)

96 pins (HP 4089B)

Number of Instrument Ports

HP 4062C/UX: 9 ports

4 ports for SMU's (SMU ports)

4 ports for VS/VMU and/or C meter (AUX ports)

1 port for Ground Unit (GNDU port)

HP 4062F: 20 ports

4 ports for SMU's (SMU ports)

3 ports for VS/VMU and/or C meter (AUX ports)

1 port for Ground Unit (GNDU port)

12 ports for Pulse Generator (HF ports)

Maximum Voltage Between Two Ports

$\pm 400\text{V}$ (Any two SMU ports)

$\pm 300\text{V}$ (SMU port, AUX port)

$\pm 200\text{V}$ (Any two AUX ports)

Maximum Voltage at Each Port

$\pm 200\text{V}$ (SMU ports)

$\pm 100\text{V}$ (AUX ports)

Maximum Current, Port to DUT Pin

$\pm 1.6\text{A}$ (GNDU port)

$\pm 1\text{A}$ (SMU ports)

$\pm 500\text{mA}$ (AUX ports)

Maximum Stray Capacitance Between DUT Pins: $< 6\text{pF}$ (between C meter ports)

Port Expander (HP 4062C/UX)

The Port Expander is an input multiplexer allowing additional instrumentation to be connected to the device under test (DUT). Three channel multiplexers are applied to each of the four AUX ports. The Port Expander is available only with the HP 4089B Switching Matrix.

Number of Inputs: 12

SMUs: 2 ports

Measurement Range

$\pm 2\text{pA}$ to $\pm 1\text{A}$, $\pm 40\mu\text{V}$ to $\pm 100\text{V}$

Capacitance Measurement: 2 ports

HP 4280A and HP 4284A can be used.

AUX: 8 ports

Source Range: $\pm 1\text{mV}$ to $\pm 40\text{V}$

Measurement Range: $\pm 40\mu\text{V}$ to $\pm 40\text{V}$

$\pm 4\mu\text{V}$ to $\pm 2\text{V}$ in differential voltage mode

Maximum Voltage at Each Port: $\pm 100\text{V}$

Maximum Current, Port to DUT Pin

$\pm 500\text{mA}$ (C meter ports, AUX ports)

$\pm 1\text{A}$ (SMU ports)

Maximum Stray Capacitance Between DUT Pins: $< 6\text{pF}$ (between C meter ports)

High Frequency Cable Adapter (HP 4062F)

The High Frequency Cable Adapter includes four switching relays allowing reliable and direct control by the HP 8110A pulse generator. The High Frequency Cable Adapter is available only with HP 4085F Switching Matrix.

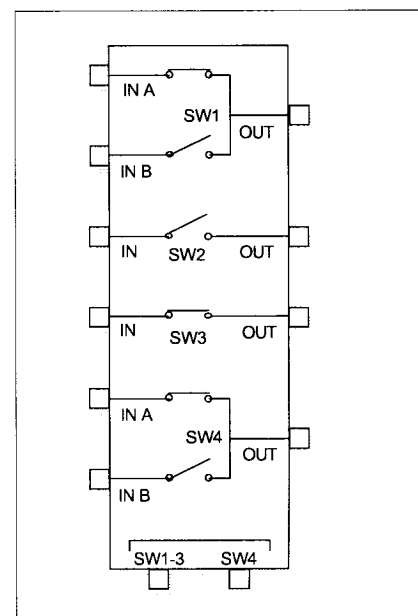


Figure 1. Cable Adapter

Switch 1 (Semiconductor Relay):

Relay Type: Transfer

Load Voltage (Peak AC): 60V

Continuous Load Current: 0.4A

Switch 2,3 (Semiconductor Relay):

Relay Type: Make or Break, selectable

Load Voltage (Peak AC): 60V

Continuous Load Current: 0.4A

Switch 4 (Reed Relay)

Relay type: Transfer

Load voltage (DC): 200V

Continuous Load Current: 1A

All relays can be controlled by one output channel of any HP 8110A's output channels.

Operate time of switching (common to all switches): 2ms (max.)

DC Measurement Subsystem

The DC measurement subsystem consists of the HP 4142B mainframe and plug-in modules. This modular design allows many possible configurations depending upon the application. A standard general purpose configuration includes three HP 41421B SMU's, one HP 41420A SMU, one HP 41424A VS/VM, and one HP 41425A AFU. A total of 8 slots are available.

Note: The HP 41420A SMU requires two slots.

The following pages outline the force/measure specifications of the HP 4142B when used with the Switching Matrix Subsystem. The HP 4142B can source up to a maximum of 32 at any one time. The individual SMU power limitations are also specified.

SMU Port #1: High Resolution Port

This port is optimized for low current measurements and is non-Kelvin.

Voltage Source Monitor Range, Resolution, and Accuracy (at HP 4085B/F pins)

Full Scale V Range	Resolution Force/Meas.	Accuracy ±(%reading+range+volt)
±2V	100µV/40µV	±(0.05%+0.05% +0.5Ω×I _o +100µV)
±20V	1mV/400µV	±(0.05%+0.05%+0.5Ω×I _o)
±40V	2mV/800µV	
±100V	5mV/2mV	
±200V ¹	10mV/4mV	

I_o=Output Current

0.5Ω×I_o is voltage error due to non-Kelvin cable loss in HP 4085B/F 48-pin Switching Matrix.

Voltage Source/Monitor Range, Resolution and Accuracy (at HP 4089B pins)

Full Scale V Range	Resolution Force/Meas.	Accuracy ±(%reading+range+volt)
±2V	100µV/40µV	±(0.05%+0.05% +0.6Ω×I _o +100µV)
±20V	1mV/400µV	±(0.05%+0.05%+0.6Ω×I _o)
±40V	2mV/800µV	
±100V	5mV/2mV	
±200V ¹	10mV/4mV	

I_o=Output Current

0.6Ω×I_o is voltage error due to non-Kelvin cable loss in HP 4089B 96-pin Switching Matrix.

*1: HP 41420A SMU only.

Current Source/Monitor Range, Resolution, and Accuracy

Full Scale I Range	Resolution Force/Meas.	Accuracy ±(%reading+range+amp)
±1A ¹	50µA/20µA	±[0.5%+(0.1+0.002×V _o)%]
±100mA	5µA/2µA	±[0.2%+(0.1+0.002×V _o)%]
±10mA	500nA/200nA	
±1mA	50nA/20nA	
±100µV	5nA/2nA	
±10µV	500pA/200pA	±[0.5%+(0.1+0.002×V _o)%]
±1µV	50pA/20pA	
±100nA	5pA/2pA	
±10nA ²	500fA/200fA	
±[1%+(0.002×V _o)%+15pA]		
±1nA ²	50fA/20fA	±[1%+(0.002×V _o)%+8pA]

V_o=Output voltage

*1: HP 41420A SMU only.

*2: Current measurement resolution of 200fA/20fA in the 10nA/1nA ranges are obtained when the HP 4142B integration time is set to LONG.

Maximum Output Power: 2W

Voltage Source Output/Current Measurement Input Resistance

≤0.5Ω (HP 4085B/F), ≤0.6Ω (HP 4089B)

Current Source Output/Voltage Measurement Input Resistance: ≥10¹²Ω

Output Terminals

Force, Guard (non-Kelvin)

SMU Port #2: High Current Port

This port is optimized for high current measurements using the HP 41420A SMU.

Voltage Source/Monitor Range, Resolution, and Accuracy

Full Scale V Range	Resolution Force/Meas.	Accuracy ±(%reading+range+volt)
±2V	100µV/40µV	±(0.05%+0.05% +2.5mΩ×I _o +100µV)
±20V	1mV/400µV	±(0.05%+0.05%+2.5mΩ×I _o)
±40V	2mV/800µV	
±100V	5mV/2mV	
±200V ¹	10mV/4mV	

I_o=Output Current

2.5mΩ×I_o is voltage error due to SMU leakage when current exceeds 100mA.

Current Source/Monitor Range, Resolution, and Accuracy

Full Scale I Range	Resolution Force/Meas.	Accuracy ±(%reading+range+amp)
±1A ^{*1}	50µA/20µA	±[0.5%+(0.1+0.002×V _o)%]
±100mA	5µA/2µA	±[0.2%+(0.1+0.002×V _o)%]
±10mA	500nA/200nA	
±1mA	50nA/20nA	
±100µA	5nA/2nA	
±10µA	500pA/200pA	±[0.2%+(0.1+0.003×V _o)%]
±1µA	50pA/20pA	±[0.5%+(0.01×V _o)%+2nA]
±100nA	5pA/2pA	±[0.5%+(0.1×V _o)%+1nA]

V_o=Output voltage

10nA and 1nA ranges are available but are not specified.

*1: HP 41420A only.

Maximum Output Power: 14W

Current Source Output/Voltage Measurement Input Resistance: ≥10¹⁰Ω

Output Terminals

Force, Sense, Guard (Kelvin)

SMU Ports #3 and #4: Normal Port

Both the HP 41420A and HP 41421B can be used with these ports.

Voltage Source/Monitor Range, Resolution, and Accuracy (at HP 4085B/F)

Full Scale V Range	Resolution Force/Meas.	Accuracy ±(%reading+range+volt)
±2V	100µV/40µV	0A≤I _o ≤0.1A: ±(0.05%+0.05%+100µV)
		0.1A<I _o ≤0.5A: ±(0.05%+0.05%+100µV +40mΩ×I _o) [*]
		0.5A<I _o ≤1A: ±(0.05%+0.05%+100µV +200mΩ×I _o)
		1A<I _o ≤0.1A: ±(0.05%+0.05%)
±20V	1mV/400µV	0.1A<I _o ≤0.5A: ±(0.05%+0.05%+40mΩ×I _o) [*]
		0.5A<I _o ≤1A: ±(0.05%+0.05% +200mΩ×I _o)
		1A<I _o ≤0.1A: ±(0.05%+0.05%)
		1A<I _o ≤0.1A: ±(0.05%+0.05%)
±40V	2mV/800µV	±(0.05%+0.05%)
±100V	5mV/2mV	
±200V ²	10mV/4mV	

I_o=Output Current

Voltage Source/Monitor Range, Resolution and Accuracy (at HP 4089B pins)

Full Scale V Range	Resolution Force/Meas.	Accuracy ±(%reading+range+volt)
±2V	100µV/40µV	±(0.05%+0.05%+2.5mΩ×I _o +100µV)
±20V	1mV/400µV	±(0.05%+0.05%+2.5mΩ×I _o)
±40V	2mV/800µV	
±100V	5mV/2mV	
±200V ²	10mV/4mV	

I_o=Output Current

2.5mΩ×I_o is voltage error due to SMU leakage when current exceeds 100mA.

Current Source/Monitor Range, Resolution, and Accuracy

Full Scale I Range	Resolution Force/Meas.	Accuracy $\pm(\% \text{reading} + \% \text{range} + \text{amp})$
$\pm 1\text{A}^*$	50 μA /20 μA	$\pm[0.5\% + (0.1 + 0.002 \times V_o)\%]$
$\pm 100\text{mA}$	5 μA /2 μA	
$\pm 10\text{mA}$	500nA/200nA	$\pm[0.2\% + (0.1 + 0.002 \times V_o)\%]$
$\pm 1\text{mA}$	50nA/20nA	
$\pm 100\mu\text{A}$	5nA/2nA	$\pm[0.2\% + (0.1 + 0.003 \times V_o)\%]$
$\pm 10\mu\text{A}$	500pA/200pA	
$\pm 1\mu\text{A}$	50pA/20pA	$\pm[0.5\% + (0.01 \times V_o)\% + 2\text{nA}]$
$\pm 100\text{nA}$	5pA/2pA	$\pm[0.5\% + (0.1 \times V_o)\% + 1\text{nA}]$

*2: HP 41420A only.

V_o = Output voltage

10nA and 1nA ranges are available but are not specified.

Maximum Output Power: 2W

Current Source Output/Voltage Measurement Input Resistance: $\geq 10^{10}\Omega$

Output Terminals: Force, Sense, Guard (Kelvin)

SMU Ports: Expander Port

Both the HP 41420A and HP 41421B can be used with these ports.

Voltage Source/Monitor Range, Resolution, and Accuracy (at HP 4089B pins with Port Expander)

Full Scale V Range	Resolution Force/Meas.	Accuracy $\pm(\% \text{reading} + \% \text{range} + \text{volt})$
$\pm 2\text{V}$	100 μV /40 μV	$\pm(0.05\% + 0.05\% + 1.3\text{m}\Omega \times I_o + 180\mu\text{V})$
$\pm 20\text{V}$	1mV/400 μV	
$\pm 40\text{V}$	2mV/800 μV	$\pm(0.05\% + 0.05\% + 1.3\text{m}\Omega \times I_o)$
$\pm 100\text{V}$	5mV/2mV	
$\pm 200\text{V}^*$	10mV/4mV	

I_o = Output Current

*3: Maximum Voltage is 100V.

1.3m $\Omega \times I_o$ is voltage error due to non-Kelvin cable loss in HP 4089B 96-pin Switching Matrix with Port Expander.

Current Source/Monitor Range, Resolution, and Accuracy
Same as SMU Port #3 and #4.

Specifications Common to All SMUs

Compliance Setting, Current and Voltage

Range:

$I_p\text{A} \leq \text{Current limit} \leq \text{Max. current}$
 $\text{Voltage limit} \leq \text{Max. voltage}$

Accuracy: +V with +I (quadrant I)
-V with -I (quadrant III)

Same as programmed current or voltage

+V with -I (quadrant IV)
-V with +I (quadrant II)

$\pm 2\%$ of range (100 nA to 1 A ranges)
 $\pm 10\%$ of range (1 nA and 10 nA ranges)

Current Over-range

1nA to 100mA range: 15% of range

1A range: 0%

Voltage Source/Monitor Range and Max. Current

Full Scale V Range	Max. Current HP 41420A	HP 41421B
$\pm 2\text{V}$	1.0A	100mA
$\pm 20\text{V}$	1.0A ($\leq 14\text{V}$)	100mA
	0.7A ($\leq 20\text{V}$)	
$\pm 40\text{V}$	350mA	50mA
$\pm 100\text{V}$	125mA	20mA
$\pm 200\text{V}$	50mA	-

Current Source/Monitor Range and Max. Voltage

Full Scale I Range	Max. Voltage HP 41420A	HP 41421B
$\pm 1\text{A}$	14V ($\leq 1\text{A}$)	-
	20V ($\leq 0.7\text{A}$)	
	40V ($\leq 350\text{mA}$)	
	100V ($\leq 125\text{mA}$)	
	200V ($\leq 50\text{mA}$)	
$\pm 100\text{mA}$	100V ($\leq 100\text{mA}$)	20V ($\leq 100\text{mA}$)
	200V ($\leq 50\text{mA}$)	40V ($\leq 50\text{mA}$)
		100V ($\leq 20\text{mA}$)
$\pm 10\text{mA}$		
$\pm 1\text{nA}$	200V	100V

Voltage Source

Voltage sources are connected to the DUT through the AUX ports on the Switching Matrix. These sources can also be used to measure current. Specifications are given at the Switching Matrix DUT pins.

Note: Specifications also apply when used with a Port Expander.

VS Output range, Resolution, and Accuracy

Full Scale V Range	Resolution	Accuracy	Max. Current
$\pm 20\text{V}$	1mA	0.1% + 10mV	100mA
$\pm 40\text{V}$	2mA	0.1% + 20mV	20mA

VS Current Monitor range, Resolution, and Accuracy

Full Scale I Range	Resolution	Accuracy	Voltage Range
$\pm 20\text{mA}$	20 μA	3% + 200 μA	40V
$\pm 40\text{mA}$	100 μA	3% + 1mA	20V

Output Terminal: Force, Guard

Voltage Monitor VM

Voltage monitors are connected to the DUT through the AUX ports on the Switching Matrix. These monitors can be used to provide differential voltage measurements. Specifications are given at the Switching Matrix DUT pins.

VM Measurement Range, Resolution, and Accuracy

Full Scale V Range	Resolution	Accuracy
$\pm 2\text{V}$	40 μV	0.05% + 1.1mV
$\pm 20\text{V}$	400 μV	0.05% + 10mV
$\pm 40\text{V}$	800 μV	0.05% + 20mV

VM Differential Measurement Range, Resolution, and Accuracy

Full Scale V Range	Resolution	Accuracy	Max. Common Voltage
$\pm 0.2\text{V}$	4 μV	0.2% + 0.5mV + 2.5 $\mu\text{V} \times V_{in}$	40V
$\pm 2\text{V}$	40 μV	0.1% + 2.1mV + 25 $\mu\text{V} \times V_{in}$	40V

V_{in} = common voltage (actual offset voltage applied to both pins)

Input Terminals: Sense, Guard

VM Measurement Range, Resolution, and Accuracy (when HP 41424A is used with Port Expander)

Full Scale V Range	Resolution	Accuracy
$\pm 2\text{V}$	40 μV	0.05% + 1.18mV
$\pm 20\text{V}$	400 μV	0.05% + 10mV
$\pm 40\text{V}$	800 μV	0.05% + 20mV

VM Differential Measurement Range, Resolution, and Accuracy (when HP 41424A is used with Port Expander)

V Range	Resolution	Accuracy	Max. Common Voltage
$\pm 0.2\text{V}$	4 μV	0.2% + 0.76mV + 2.5 $\mu\text{V} \times V_{in}$	40V
$\pm 2\text{V}$	40 μV	0.1% + 2.1mV + 25 $\mu\text{V} \times V_{in}$	40V

V_{in} = common voltage (actual offset voltage applied to both pins)

Input Terminals: Sense, Guard

Pulse Measurement Function

Pulsed measurement can be performed using SMUs or VS units.

Modes

Pulsed spot, pulsed sweep, pulsed bias with sweep

Pulse Width

1ms to 50ms, 0.1ms resolution

Pulse Cycle (pulse repetition time)

10ms to 500ms, 0.1ms resolution

Hold time Setting Range

0ms to 655.35s, 10ms resolution

Pulse Voltage Force Range

2V to 200V

Pulse Current Force Range

10nA to 1A

Ground Unit

Using a Kelvin connection, this unit forces a DUT pin to ground making all measurements relative to that reference. This provides better circuit stability and noise immunity.

Current Range: $\pm 1.6\text{A}$

Offset Voltage: $\pm 1\text{mV}$

Analog Feedback Unit

The AFU searches for a target current or voltage on one SMU by controlling (sweeping) the output voltage of another SMU.

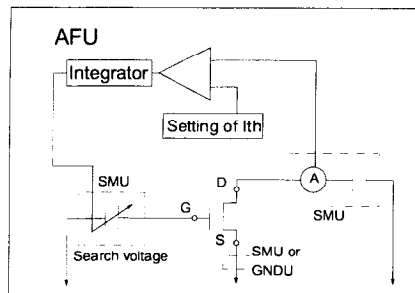


Figure 2. AFU Block Diagram

Monitor SMU

Setting Range and Resolution:

See SMU specifications

Setting Accuracy:

SMU accuracy +0.1% setting value
+ 0.1% SMU range

Search SMU

Search Voltage Range:

2V, 20V, 100V, and 200V

200V range is only available when using
the HP 41420A.

Search Voltage Slow Rate Range:

0.5mV/ms to 50V/ms

Search Voltage Slow Rate Resolution:

1/100 of slow rate range

Feedback Integration Time Range:

50μs to 500ms

Feedback integration time Resolution:

1/10 of range

Capacitance/Conductance Measurement Subsystem

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

These are specifications of the HP 4280A when used with the Switching Matrix Subsystem.

Test Frequency: 1MHz ± 0.01%

OSC Level

30 mVrms (±10%) or 10 mVrms(±10%)

Display Resolution: 4 1/2 digits max.

C-t Measurement

Time Interval: 60ms to 32s

Pulse Width Setting Range: 10ms to 32s

C/G Measurement Range, Resolution, and Accuracy

Range	Accuracy
10pF**/	0.8% + (0.7 + 1.5 × Gm/100μS)%
100pS**	1.5% + (0.7 + 0.2 × Cm/10pF)%
100pF/	0.5% + (0.1 + 1.5 × Gm/1000μS)%
1000pS	1.5% + (0.2 + 0.2 × Cm/100pF)%
1000pF/	1.5%*4 + (0.2 + 3.5 × Gm/10mS)%
10mS	3.5% + (0.4 + 0.5 × Cm/1000pF)%

Gm is measured conductance. Cm is measured capacitance. Maximum count is 12000 (120% of full scale.)

Accuracy is specified at D < 1 (dissipation). Also, OSC LEVEL = 30mV and MEAS SPEED = medium. Accuracy is specified between any DUT pins. When stray capacitance to guard exceeds 5pF, add 0.08% of reading to C/G error for each 10pF increment (stray capacitance to guard).

** : Reference data.

*4: When a Port Expander is used, capacitance accuracy is specified as:
C: 1.7% + (0.2 + 3.5 × Gm/10mS)%

Internal DC Bias Range, Range Coverage, Resolution, and Accuracy

V Range	Range Coverage	Resolution	Accuracy ±(%setting+offset)
2V	±(0.000~1.999)V	1mV	±(0.2%+0.01V)
20V	±(2.00~19.99)V	10mV	±(0.1%+0.02V)
100V	±(20.0~100.0)V	100mV	±(0.1%+0.1V)

HP 4284A Precision LCR Meter

Measurement Function: Capacitance and Conductance

Measurement Range

C: 1fF to 1.2nF (1MHz)
1fF to 10nF (100kHz)
1fF to 100nF (10kHz)
10fF to 100nF (1kHz)
G: 10nS to 7.5mS (1MHz)
1nS to 6.3mS (100kHz)
0.1nS to 6.3mS (10kHz)
0.1nS to 0.63mS (1kHz)

Measurement Frequency

1k, 10k, 100k, and 1MHz

Frequency Accuracy: ±0.01%

OSC Level: 30mVrms

Capacitance Measurement Frequency, Range, and Accuracy

Frequency [Hz]	C Range [F]	Accuracy ±(%reading+range)
1M	10p**	0.8% + (1.0 + 0.6 × G/63μ)%
	100p	0.8% + (0.3 + 0.6 × G/630μ)%
	1.0n**	1.9% + (0.2 + 1.7 × G/6.3m)%
100k	10p**	0.4% + (1.0 + 0.4 × G/6.3μ)%
	100p	0.3% + (0.3 + 0.3 × G/63μ)%
	1n	0.3% + (0.2 + 0.4 × G/630μ)%
10k	10n	0.5% + (0.2 + 1.0 × G/6.3m)%
	100p	0.3% + (0.2 + 0.3 × G/6.3μ)%
	1n	0.3% + (0.1 + 0.3 × G/63μ)%
1k	10n	0.3% + (0.1 + 0.3 × G/630μ)%
	100p**	0.4% + (0.5 + 0.4 × G/0.63μ)%
	1n	0.3% + (0.1 + 0.3 × G/6.3μ)%
100n	10n	0.3% + (0.1 + 0.3 × G/63μ)%
	100n	0.3% + (0.1 + 0.3 × G/630μ)%

Conductance Measurement Frequency, Range, and Accuracy

Frequency [Hz]	G Range [S]	Accuracy ±(%reading+range)
1M	63μ**	0.8% + (1.0 + 0.6 × C/10p)%
	630μ	0.08% + (0.3 + 0.6 × C/100p)%
	6.3m**	1.3% + (0.2 + 2.2 × C/1.0n)%
100k	63μ**	0.4% + (1.0 + 0.4 × C/10p)%
	630μ	0.3% + (0.3 + 0.3 × C/100p)%
	6.3m	0.3% + (0.2 + 0.4 × C/1n)%
10k	63μ	0.7% + (0.2 + 0.8 × C/10n)%
	630μ	0.3% + (0.2 + 0.3 × C/100p)%
	6.3m	0.3% + (0.1 + 0.3 × C/1n)%
1k	630μ	0.3% + (0.1 + 0.3 × C/10n)%
	6.3m	0.7% + (0.1 + 0.7 × C/100n)%
	0.63μ**	0.4% + (0.5 + 0.4 × G/100p)%
100n	63μ	0.3% + (0.1 + 0.3 × G/1n)%
	630μ	0.3% + (0.1 + 0.3 × G/100n)%

Gμ = conductance measurement value.

Cμ = capacitance measurement value.

** : Reference data.

*5: Maximum count is 12000 (120% full scale).

Internal DC Bias Range, Resolution, and Accuracy

Signal Level: ≤ 2Vrms

Voltage Range	Resolution	Accuracy ±(%setting+offset)
±(0.000 to 4.000)V	1mV	±(0.1%+1.2mV)
±(4.002 to 8.000)V	2mV	±(0.1%+2.2mV)
±(8.005 to 20.000)V	5mV	±(0.1%+5mV)
±(20.01 to 40.000)V	10mV	±(0.1%+10mV)

HP 8110A Pulse Generator (HP 4062F)

These are specifications of the HP 8110A when used with the HP 4085F Switching Matrix.

Pulse Force Mode

Pulse Signal: 2 level and 3 level

Burst Count: 10^9 (max)

Output Mode

Normal and Pattern Mode

All pulse generators can force simultaneously in normal mode, and all pulse generator except a master pulse generator can force simultaneously in pattern mode.

Load Impedance

999k Ω (default), selectable

Pulse Setting Range

Pulse Period

Can be set automatically from pulse delay and width, or set intentionally.

Intentional Mode

Normal Mode: Range: 350ns to 999s

Resolution: 4 digits, 10ps

Pattern Mode: Range: 120ps to 999s

Pulse Width

Normal Mode

Range: 50ns to 999ms

Resolution: 3 digits, 10ps

Pattern Mode

Range: 50ns to 999ms (in a master unit)
100ns to 999ms (in slave units)

Resolution: 3 digits, 10ps (in a master unit)

In slave units,

1×10^{-n} at $1000 \times 10^{-n} < Pwd \leq 4000 \times 10^{-n}$

2×10^{-n} at $4000 \times 10^{-n} < Pwd \leq 8000 \times 10^{-n}$

2.5×10^{-n} at $8000 \times 10^{-n} < Pwd \leq 10000 \times 10^{-n}$

Pulse Delay

Normal Mode

Range: 0 to 998ms

Resolution: 3 digit, 10ps

Pattern Mode

Range: 0 to 998ms

Resolution: 3 digit, 10ps (in a master unit)

In slave units,

1×10^{-n} at $1000 \times 10^{-n} < Pwd \leq 4000 \times 10^{-n}$

2×10^{-n} at $4000 \times 10^{-n} < Pwd \leq 8000 \times 10^{-n}$

2.5×10^{-n} at $8000 \times 10^{-n} < Pwd \leq 10000 \times 10^{-n}$

Transition Time: 20ns to 200ms

Pulse Level (at 999k Ω load impedance)

2 level: $\pm 19V$

3 level: $\pm 19V$ (Total amplitude is up to 20V)

Level Accuracy at 2 level

$\pm(2\% \text{ of amplitude} + 150mV)$

Pulse Accuracy (at 50 Ω load impedance)

Pulse Width

$\leq \pm 5\% \pm 1ns$ (in normal mode)

Pulse Delay

$\leq \pm 5\% \pm 1ns$ (in normal mode)

Transition Time

$\leq -10\%$ to $+10\% + 20ns$

Overshoot

$\leq \pm 5\%$ of output level $\pm 20mV$

System Controller

Supported Computers

For HP 4062C

HP 9000 Series 300 Model 310, 320, 330, 332, 340, 350, 360, 362, 370, 375 or 382

For HP 4062UX/F

HP 9000 Models 332, 360, 362, 370, 375 or 382

or

HP 9000 Model 340, 345 for diskless cluster configurations.

HP 9000 Model 745i, 747i or 725

Operating System

For HP 4062C: BASIC 6.3

For HP 4062UX/F:

Series 300:

HP-UX 9.03, HP BASIC/UX 6.3

Series 700:

HP-UX 9.05, HP BASIC/UX 7.02

Required Memory

For HP 4062C:

2MB or more

4MB or more when using the HP IMA software

For HP 4062UX/F:

32MB or more

Required Hard Disk Memory

For HP 4062C: 40 Mbyte or more

For HP 4062UX/F: 300 Mbyte or more (600Mbyte or more recommended.)

Required HP-HIL Device

HP 46084A ID module

Required HP-IB Interfaces:

Two separate HP-IB interfaces are necessary. One interface for each:

- HP 4062C/UX/F hardware

- Automatic wafer prober

Additional instruments and peripherals can be controlled using the same HP-IB card as the automatic wafer prober.

Supported HP-IB Interface

HP 98624A (for Series 300)

HP E2071B (for Series 700)

Internal HP-IB port

System Software

Standard HP 4062C/UX/F software provides the following capabilities:

- System initialization
- Control of system subsystems (Test Instruction Set)
HP BASIC/UX or C language can be used (HP 4062UX only).
- Monitor of system subsystems and measurement data (Virtual Front Panel)
- Parameter measurement utility (PARA Library)
- Offline debugging (HP 4062UX only)
- Probing pattern generation and wafer maps display (PPG, MAP)
- BSDM data format generation library (File Creation Library)
- Wafer prober control utility subprograms include Electroglas Model 1034X/2001X/2010X/3001X and APM-3000A/6000A/7000A prober control commands.
- Operational Verification Diagnostics (DIAG)
- Interactive Measurement and Analysis Software (Optional)
- Test Shell for HP 4062UX is available. (ICMS: Integrated Circuit Measurement Shell Software)

General Specifications

Operating Temperature Range

5°C to 40°C, 5% to 70% RH. Permissible change is less than 3°C after calibration.

System Calibration Cycle

Once per year.

Air Cleanliness

Better than class 100,000

Power Requirements

100V (90 - 110V), 120V (108 - 127V), 220V (198 - 242V), 240V (216 - 252V), 48-66Hz.

Power Consumption

HP 4062C/UX (excluding the system controller)

6A (at 100V), 5.5A (at 120V), 3.5A (at 220, 240V)

HP 4062F (including three HP 8110A, excluding the system controller)

15A (at 100V), 13A (at 120V), 8A (at 220, 240V)

Regulatory Compliance

EMC EN 55011 Group 1, class A

EN 50082-1

Safety CSA certified

Dimensions

System Cabinet

600mm(W) × 1600mm(H) × 800mm(D)

HP 4085B/F 48-pin SWM

470mm(W) × 230mm(H) × 440mm(D)

HP 4089B 96-pin SWM

620mm(W) × 250mm(H) × 600mm(D)

Port Expander

227mm(W) × 180mm(H) × 57mm(D)

Weight

System Cabinet: approx. 230kg

HP 4085B/F 48-pin SWM: approx. 22kg

HP 4089B 96-pin SWM: approx. 55kg

Reference Data

This information is provided for your convenience. It is typical performance data and is provided for reference use only. These are not warranted specifications.

Switching Matrix Subsystem (at 23°C, 50%RH)

Command Execution Time

3.0 ms (connect relay)

Offset Voltage/Current per pin

High Resolution SMU Port: 50μV / 1pA

Other SMU Ports: 50μV / 40pA

AUX1 - 4 Ports: 50μV / 1nA

Port Exp. SMU Ports: 80μV / 40pA

Port Exp. AUX Ports: 50μV / 1nA

80μV on the capacitance measurement ports.

Isolation Between Ports

High Resolution SMU Port: $8 \times 10^{13} \Omega$

Other SMU Ports: $5 \times 10^{11} \Omega$

AUX1 - 4 Ports: $4 \times 10^8 \Omega$

Port Exp. SMU Ports: $5 \times 10^{11} \Omega$

Path to Ground Capacitance

High Resolution SMU Port: 30pF

15pF for the HP 4089B switching matrix.

Other SMU Ports: 60pF

Port Exp. SMU Ports: 60pF

Stray Capacitance Between Ports

AUX3 - 4 Ports: 4pF

Port Exp. AUX Ports: 4pF

AC Performance of the HP 4085B AUX Ports

Insertion	≤100kHz	≤1MHz	≤10MHz	
-	3	d		B
Loss (dB)				Freq.
AUX1/2	< 0.5	< 0.6	< 5.0	7.5MHz
AUX3/4	< 0.5	< 0.6	< 2.5	13MHz

Crosstalk (dB)	<10kHz	<100kHz	<1MHz
AUX1 to AUX2	< -90	< -70	< -50
AUX3 to AUX4	< -90	< -70	< -50

Risetime

40ns (AUX1 and AUX2)

10% to 90%: 30ns (AUX3 and AUX4)

AC Performance of the HP 4089B AUX Ports

Insertion	≤100kHz	≤1MHz	≤10MHz	-3dB
Loss (dB)				Freq.
AUX1/2	< 0.2	< 0.5	< 5.5	5.5MHz
AUX3/4	< 0.3	< 0.4	< 2.3	11.5MHz

Crosstalk (dB)	<10kHz	<100kHz	<1MHz
AUX1 to AUX2	< -90	< -70	< -50
AUX3 to AUX4	< -95	< -80	< -60

Risetime

60ns (AUX1 and AUX2)

10% to 90%: 35ns (AUX3 and AUX4)

Delay time: 25ns

AC Performance of the HP 4085F AUX Ports and HF Ports

AUX1 -3 Ports: same as HP 4085Bs.

HF Ports:

-3dB Freq.: 35 MHz

DC Measurement Subsystem

ALL SMUs

Maximum Slew Rate: 0.2V/μs

Maximum Capacitive Load: 1000pF

(User added capacitive load)

Maximum Allowable Guard Capacitance

100pF (User added capacitance between measurement pin and guard)

Ground Unit

Maximum Capacitive Load: 10μF

Analog Feedback Unit

Monitor Specifications

Maximum Current Setting Value: 900mA (HP 41420A)

Maximum Voltage Setting Value: 180V (HP 41420A, SMU#2)

Search Specifications

Feedback Integration Time Accuracy: 30% of setting

Start Voltage Accuracy:

0.5% of setting + 0.5% of voltage range

Stop Voltage Accuracy: 3% of range

Voltage Slew Rate Accuracy:

30% + 10% of slew rate range

Voltage Sources (VS)

Output Resistance: ≤ 2Ω, typically 1Ω

(Resistance of Vs output + cabling + switching matrix)

Maximum Capacitive Load: 10μF

(User added across Vs output)

Maximum Slew Rate: 0.2V/μs

Current Limit Accuracy: -0% + 20%

Output Noise Level: 0.005% of range (rms)

Voltage Monitors (VM)

Input Resistance: ≥ 50MΩ

Monitor Noise

0.01% of range (p-p)

0.02% of range (p-p), for VM Differential

Measurement

HP 8110A

Pulse Accuracy: (at 5kΩ load impedance)

Overshoot/Ringing: ±5%±20mV

Transition Time: ±(10%+5ns)

Pin Skew: ±10ns

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Printed in USA 10/94
5091-0803E

