Agilent 4073A

Ultra Advanced Parametric Tester

Data Sheet

Contents

General Description

The Agilent 4073A Ultra Advanced Parametric Tester is designed to perform fast and precise DC measurements, capacitance measurements, Flash memory cell tests, and other high-frequency applications. The system supports up to eight Source Monitor Units (SMUs). Each SMU is self-calibrating, and can be individually configured to force either current or voltage, as well as simultaneously measure either current or voltage.

External instruments can be integrated into the system via six auxiliary input ports or 48 extended path inputs. The extended path inputs allow the user to connect external signals directly to the DUT pins. A low-leakage switching matrix connects all of the inputs to fully-guarded Kelvin output pins, which are customizable from 12 to 48 pins. One special additional pin is dedicated as a chuck connection. The 4073A also has a high-frequency switching matrix with integrated pulse generator control. The high-frequency matrix is organized as two 3×24 matrices (six inputs in total), and 1 TO 2 furnished connectors may be used on each matrix pair to create one 3×48 matrix (three inputs in total). The system also has one 1.6 A ground unit.

Agilent Technologies

General Description(continued)

Measurement functions
DC Current, DC Voltage, Capacitance and Conductance, Differential voltage and Pulse force.

DC Measurements
Spot, Sweep, Pulse Bias, and Pulse Sweep.

Measurement unit:
HRSMU (High Resolution SMU), MPSMU (Medium Power SMU and HPSMU (High Power SMU)
Measurement range:
10 fA[1] to 100 mA, 2 µV to 100 V (using the two low current SMU ports) 100 fA to 1 A[2], 2 µV to 200 V[2] (using the 6 standard SMU ports)

[1] Using HRSMU. Using MPSMU, 100 fA to 100 mA, 2 µV to 100 V

[2] Using optional HPSMU. Using MPSMU, 100 fA to 100 mA, 2 µV to 100 V

Capacitance/Conductance Measurements Using Agilent E44980A LCR Meter Option
Measurements: C/G and C/G-V

Measurement unit: Agilent E4980A LCR Meter

Measurement Frequency: 1 kHz, 10 kHz, 100 kHz, and1 MHz

Measurement range: 1 fF to 100 nF, 0.1 nS to 7.5 mS
DC Bias Voltage: ±40 V

Two Terminal Differential Voltage Measurements
Measurement unit: Agilent 3458A

Measurement range:
0.1 µV to 100 V

High-Frequency Pulse Force: PGU Option
Supported pulse generators:
Agilent 81110A and 8114A
Maximum number of installable pulse generators:
5 × 81110A
(without 8114A)
4 × 81110A
(with 1 × 8114A)
2 × 81110A
(with 2 × 8114A)
Pulse level (at open load):
±19 V (81110A),
–49.9 V to + 50 V (8114A)
Pulse period:
350 ns to 999 s (81110A)
350 ns to 999 ms (8114A)
Pulse width:
50 ns to 999 ms (81110A)
150 ns to 150 ms (8114A)
Pulse delay: 0 s to 998 ms
Transition time:
20 ns to 200 ms (81110A)
65 ns (8114A)

High-Frequency Pulse Force: HV-SPGU Option[1]
The 4073A cabinet supports a semiconductor pulse generator unit (HV-SPGU) mainframe option that contains the SPGU modules. This is mutually exclusive with the 81110A/8114A PGU option.
Maximum number of installable SPGU modules: 5
Number of channels per HV-SPGU: 2

Pulse level support: Each HV-SPGU channel supports 2-level and 3-level pulses

Pulse Level (at open load): ±40 V (at 2-level and 3-level)

Pulse Period (at 50 Ω load): 350 ns to 10 s with 10 ns resolution

Pulse Width (at 50 Ω load): 50 ns to [Period – 50 ns] with 2.5 ns[2] or 10 ns[3] resolution

Pulse Delay (at 50 Ω load); 0 s to [Period – 75 ns] with 2.5 ns[2] or 10 ns[3] resolution

Transition Time Setting Range (at 50 Ω load): 20 ns to 400 ms with 2 ns[2] or 8 ns[3] resolution

Transition Time Minimum (at 50 Ω load): 20 ns[4]; 30 ns[5]

[1] Requires Linux system controller
[2] Transition time setting ≤10 µs
[3] Transition time setting >10 µs
[4] |Vamp| ≤10 V (to 50 Ω)

[5] 10 V <|Vamp| ≤20 V (to 50 Ω)

Switching Matrix Measurement Pins
Between 12 and 48 pins

Note: One additional pin is dedicated for the prober chuck connection.

Switching Matrix Instrument Ports
Up to eight SMUs
One ground unit (GNDU)
Eight auxiliary (AUX) ports
Six high-frequency (HF) ports
48 extended paths
Pulse switch input/output ports

Switching Matrix Subsystem

Maximum DUT Pins

48 output pins plus one pin for the prober chuck connection (triaxial connector). Only the E3122A (high-resolution pin board) can be used for the 4073A (The E3121A cannot be used).

Maximum Number of Instrument Ports

SMU Ports in Testhead (Eight SMUs + one GNDU):
- Two ports for low-current measurement (Non-Kelvin)
- Four ports (Kelvin)
- Two ports (Non-Kelvin)
- One port for GNDU (Kelvin)

Auxiliary (AUX) ports:
- Eight ports for external instruments (C-Meter, digital voltmeter, etc.) 2 triaxial input ports (Force/Guard/Common, AUX ports 1 and 2)
- Four BNC two-pair input ports (Force/Common and Sense/Common, AUX ports 3 to 6)
- Two BNC input ports (Force/Common, AUX ports 7 and 8)

High Frequency (HF) ports:
- Six for pulse generator (81110A, 8114A or HV-SPGU) or other external instruments.
- HF ports 1 through 3 can access measurement pins 1 through 24, and HF ports 4 through 6 can access measurement pins 25 through 48. The user has the option of connecting any of the following HF port pairs together via a 1 TO 2 ADAPTOR in order to access all (1 through 48) measurement pins: HF ports 1 and 4, HF ports 2 and 5, and HF ports 3 and 6.

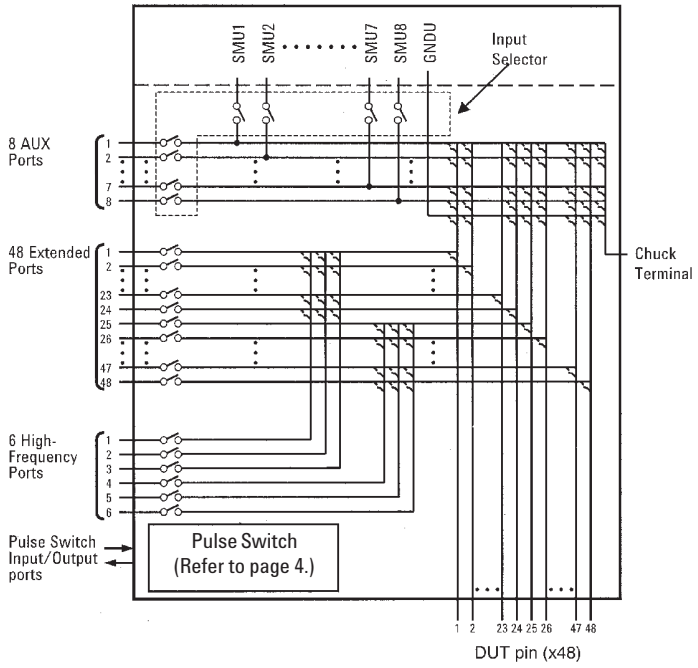
Extended path:
- 48 extended paths – The system provides one on/off relay for each path.

Pulse switch input/output ports:
- Please refer to page 4.

Maximum Voltage at Each Port

SMU port in Test Head: ±200 V

AUX port:
- ±200 V (AUX ports 1 and 2)
- ±100 V (AUX ports 3 to 8)



Testhead Circuit Diagram

HF port:
- ±100 V (between force and common of each HF port)
- ±100 V (between two of forces of all HF ports)
- ±100 V (between any force of HF ports and any force of extended paths)

Extended path:
- ±100 V (between force and common of each extended path)
- ±100 V (between any force of HF ports and any force of extended paths)

Zero reference: ±200 mV

Maximum Current, Port to DUT Pin

SMU port in Test Head:	±1.0 A
GNDU:	±1.6 A
AUX port:	±1.0 A
HF port:	±0.5 A
Extended path:	±0.5 A

Maximum Residual Resistance

Through AUX port

Low current port:	Force 1.0 Ω
Kelvin port:	Force 1.0 Ω
	Sense 2.5 Ω
Non-Kelvin port:	Force 1.0 Ω

Through HF port (supplemental characteristics): 2.0 Ω

Maximum Stray Capacitance between DUT Pins (supplemental characteristics)

3 pF

Isolation Resistance (supplemental characteristics)

Low Current (with Guard): 1×10^{15} Ω

HF Port Bandwidth (@–3dB) (supplemental characteristics)

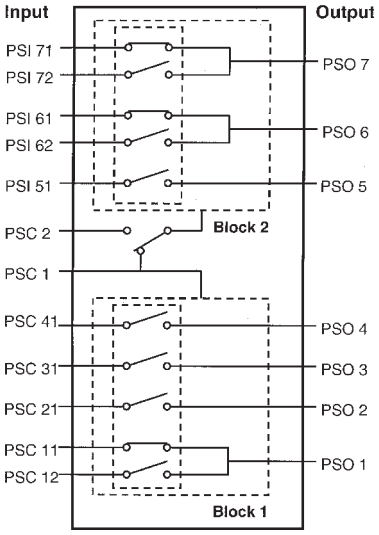
60 MHz (50 Ω load impedance: from port to DUT pin, 3 × 24 configuration)

HF Port Cross Talk Between Pins (supplemental characteristics)

±2 % (5 kΩ load impedance: from port to DUT pin, 20 ns pulse transition time)

Pulse Switch

The pulse switch includes seven semiconductor switching relays, for reliable and direct control of pulse shaping by the pulse generator or CPU. The pulse switch is integrated into the 4073A test head.



Pulse Switch

Number of Blocks

Two blocks

Number of Switches of Each Block

Block 1:

Three relays (make or break, selectable type) and 1 relay (transfer type to create multi-level pulse)

Block 2:

One relay (make or break, selectable type) and two relays (transfer type to create multi-level pulse)

Control Input Port

One input per each block (PSC1 and PSC2)

Control Method

Both the PG and CPU can control all switches. PG or CPU control is independent for every block. In the case of PG control, block 1 can be controlled by the PSC1 input, and block 2 can be controlled by either PSC1 or PSC2 (selectable).

Mode of Relay Control

Make or break, selectable type relay:

Normally open or Normally closed modes are selectable.

Transfer type relay:

Normally open and Normally closed modes are not selectable.

Maximum Voltage

±60 V (between force and common of each switch)

±60 V (between PSI 21 and PSO 2, between PSI 31 and PSO 3, between PSI 41 and PSO 4, between PSI 51 and PSO 5)

±60 V between PSI 11 (or PSI 12) and PSO 1,
between PSI 11 and PSI 12,
between PSI 61 (or PSI 62) and PSO 6,
between PSI 61 and PSI 62,
between PSI 71 (or PSI 72) and PSO 7,
between PSI 71 and PSI 72)

Maximum Current

±0.4 A (from input to output)

Residual Resistance (supplemental characteristics)

Nominal 2 Ω (from IN to OUT)

OFF Capacitance (supplemental characteristics)

80 pF (between IN and OUT: Vin–Vout = 0 V)

100 pF (force <-> common @ output of make or break, selectable type relay: Vin–Vout = 0 V)

Operating Time of Switching (supplemental characteristics)

Max. 2 ms

DC Measurement Subsystem: SMU (Source and Monitor Unit)

Voltage Source/Monitor Range, Resolution, and Accuracy using HRSMU

Full Scale Voltage Range	Force Resolution	Measure Resolution: High Speed	Measure Resolution: Precision	Measure Accuracy	Force Accuracy
±2 V	100 µV	100 µV	2 µV	a: 0.02% b: 0.025% c: Rmat × Io	a: 0.03% b: 0.035% c: Rmat × Io
±20 V	1 mV	1 mV	20 µV	a: 0.02% b: 0.015% c: Rmat × Io	a: 0.03% b: 0.02% c: Rmat × Io
±40 V	2 mV	2 mV	40 µV		
±100 V	5 mV	5 mV	100 µV		

Voltage Source/Monitor Range, Resolution, and Accuracy using MPSMU and HPSMU

Full Scale Voltage Range	Force Resolution	Measure Resolution: High Speed	Measure Resolution: Precision	Force Accuracy	Measure Accuracy
±2 V	100 µV	100 µV	2 µV	a: 0.05% b: 0.05% c: Rmat × Io	a: 0.04% b: 0.04% c: Rmat × Io
±20 V	1 mV	1 mV	20 µV		
±40 V	2 mV	2 mV	40 µV		
±100 V	5 mV	5 mV	100 µV		
±200 V[1]	10 mV	10 mV	200 µV		a: 0.045% b:0.04% c: Rmat × Io

Force Accuracy is calculated as follows:
±(a % of output setting value + b% of output voltage range + c) (V)
Measure Accuracy is calculated as follows:
±(a % of measure value + b% of measurement voltage range + c) (V)
Io = Output Current, Rmat = Residual Resistance of Switching Matrix Force Port
Note: Rmat is different at each port. When using prober chuck connection pin, add 0.1 Ω to Rmat.
Low Current Port (SMU1 and SMU2): 1.0 Ω
Kelvin Port: (SMU3 to SMU6); 3 mΩ
Non-Kelvin Port (SMU7 and SMU8): 1.0 Ω
[1]Using HPSMU

Current Source/Monitor Range, Resolution, and Accuracy using HRSMU connected to SMU1 and SMU2 ports

Full Scale Current Range	Force Resolution	Measure Resolution: High Speed	Measure Resolution: Precision	Force Accuracy	Measure Accuracy
±100 mA	5 µA	5 µA	100 nA	a:0.12 % b: 0.05 + 0.0001 × Vo % c: 0	a: 0.1 % b: 0.04 + 0.0001 × Vo % c: 0
±10 mA	500 nA	500 nA	10 nA	a: 0.06 % b: 0.04 + 0.0001 × Vo % c: 0	a: 0.06% b: 0.03 + 0.0001 × Vo % c: 0
±1 mA	50 nA	50 nA	1 nA	a: 0.06 % b: 0.05 + 0.0001 × Vo% c: 0	a: 0.06% b: 0.04 + 0.0001 × Vo % c: 0
±100 µA	5 nA	5 nA	100 pA	a: 0.07 % b: 0.04 + 0.0001 × Vo % c: 0	a: 0.06% b: 0.035 + 0.0001 × Vo % c: 0
±10 µA	500 pA	500 pA	10 pA	a: 0.07 % b: 0.05 + 0.0001 × Vo % c: 0	a: 0.06% b: 0.04 + 0.0001 × Vo % c: 0
±1 µA	50 pA	50 pA	1 pA	a: 0.12 % b: 0.04 + 0.0001 × Vo % c: 0	a: 0.12% b: 0.035 + 0.0001 × Vo % c: 0
±100 nA	5 pA	5 pA	100 fA	a: 0.12 % b: 0.05 + 0.0001 × Vo % c: 1 fA/V × Vo	a: 0.12% b: 0.04 + 0.0001 × Vo % c: 1 fA/V × Vo
±10 nA	500 fA	500 fA	10 fA	a: 1 % b: 0.05 + 0.0001 × Vo % c: 3 pA + 1 fA/V × Vo	a: 1% b: 0.04 + 0.0001 × Vo % c: 3 pA + 1 fA/V × Vo
±1 nA	50 fA	50 fA	10 fA	a: 1% b: 0.07 + 0.0001 × Vo % c: 3 pA + 1 fA/V × Vo	a: 1% b: 0.04 + 0.0001 × Vo % c: 3 pA + 1 fA/V × Vo
±100 pA	5 fA	5 fA	2 fA	a: 4 % b: 0.4 + 0.0001 × Vo % c: 500 fA + 1 fA/V × Vo	a: 4% b: 0.12 + 0.0001 × Vo % c: 500 fA + 1 fA/V × Vo
±10 pA	1 fA	2 fA	1 fA	a: 4 % b: 4.0 + 0.0001 × Vo % c: 500 fA + 1 fA/V × Vo	a: 4% b: 1.0 + 0.0001 × Vo % c: 500 fA + 1 fA/V × Vo

DC Measurement Subsystem (continued)

Current Source/Monitor Range, Resolution, and Accuracy using an MPSMU connected ports SMU1 and SMU2

Full Scale Current Range	Force Resolution	Measure Resolution: High Speed	Measure Resolution: Precision	Force Accuracy	Measure Accuracy
±100 mA	5 µA	5 µA	100 nA	a: 0.12% b: 0.1 + 0.0005 × Vo % c: 0	a: 0.1% b: 0.05 + 0.0005 × Vo % c: 0
±10 mA	500 nA	500 nA	10 nA		
±1 mA	50 nA	50 nA	1 nA		
±100 µA	5 nA	5 nA	100 pA		
±10 µA	500 pA	500 pA	10 pA		
±1 µA	50 pA	50 pA	1 pA	a: 0.2% b: 0.1 + 0.0005 × Vo % c: 0.02 pA/V × Vo	a: 0.2% b: 0.05 + 0.0005 × Vo % c: 0.02 pA/V × Vo
±100 nA	5 pA	5 pA	100 fA		
±10 nA	500 fA	500 fA	10 fA	a: 1% b: 0.1 + 0.0005 × Vo % c: 3 pA + 0.02 pA/V × Vo	a: 1% b: 0.1 + 0.0005 × Vo % c: 3 pA + 0.02 pA/V × Vo
±1 nA	50 fA	50 fA	10 fA		

Note: The HPSMU cannot be connected to SMU1 and SMU2 ports.
Current measurement accuracy of the SMU may be affected by electromagnetic field strength over 3 V/m at a frequency of 26 MHz to 1 GHz.

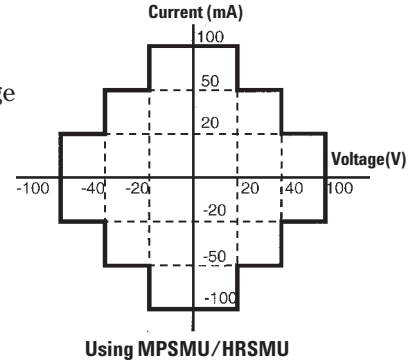
Current Source/Monitor Range, Resolution, and Accuracy using an MPSMU or HPSMU connected to the SMU3 through SMU8 ports

Full Scale Current Range	Force Resolution	Measure Resolution: High Speed	Measure Resolution: Precision	Force Accuracy	Measure Accuracy
±1 A[1]	50 µA	50 µA	1 µA	a: 0.5 % b: 0.1 + 0.0005 × Vo% c: 0	a: 0.5 % b: 0.05 + 0.0005 × Vo % c: 0
±100 mA	5 µA	5 µA	100 nA	a: 0.12 % b: 0.1 + 0.0005 × Vo % c: 0	a: 0.1 % b: 0.05 + 0.0005 × Vo % c: 0
±10 mA	500 nA	500 nA	10 nA		
±1 mA	50 nA	50 nA	1 nA		
±100 µA	5 nA	5 nA	100 pA		
±10 µA	500 pA	500 pA	10 pA		
±1 µA	50 pA	50 pA	1 pA	a: 0.2 % b: 0.1 + 0.0005 × Vo % c: 300 pA + 10 pA/V × Vo	a: 0.2 % b: 0.05 + 0.0005 × Vo % c: 300 pA + 10 pA/V × Vo
±100 nA	5 pA	5 pA	100 fA		
±10 nA[2]	500 fA	500 fA	10 fA	a: 1% b: 0.1 + 0.0005 × Vo % c: 303 pA + 10 pA/V × Vo	a: 1 % b: 0.1 + 0.0005 × Vo % c: 303 pA + 10 pA/V × Vo
±1 nA[2]	50 fA	50 fA	10 fA		

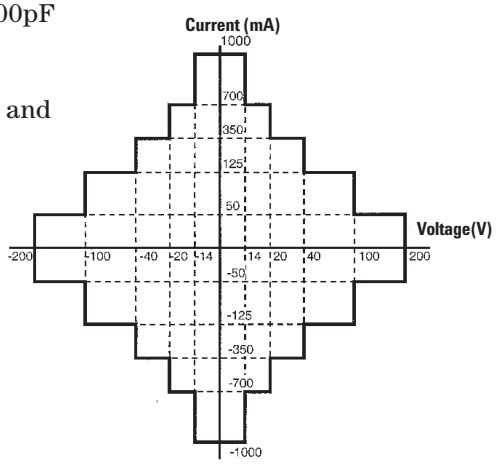
Force Accuracy is calculated as follows: ±(a % of output setting value + b% of output current range + c) (A)
Measure Accuracy is calculated as follows: ±(a % of measured value + b% of current measurement range + c) (A)
Note: The HPSMU can only be connected to the SMU3 and SMU4 ports.
Note: Current measurement ccuracy of the SMU may be affected by electromagnetic field strength over 3 V/m at a frequency of 26 MHz to 1 GHz.
[1] Using HPSMU, [2] Suplemental characteristics when using the SMU3 to SMU8 ports
Vo = Output voltage

Maximum Output Voltage/Current

Over Current Range:
15% of range (0% for 100 mA range of MPSMU/HRSMU, 0% for 1 A range of HPSMU, 5% for 10 pA/100 pA range of HRSMU)
Over Voltage Range:
V Force: % of range
V Measure: 10% of range (0% for 100 V range of MPSMU, 0% for 200 V range of HPSMU)
Current Compliance Setting Range:
1 pA to maximum current
Accuracy of converse polar current limit: [3]
±2% of range (100 nA to 1 A ranges)
±10% of range (10 pA to 10 nA ranges)
Maximum Capacitive Load: ≤1000pF
Maximum Allowable Guard Capacitance:
250 pF (between signal line and guard line outside of matrix)
Maximum Slew Rate: 0.2 V/µs



Using MPSMU/HRSMU



Using HPSMU

SMU configuration

Minimum configuration:
One HRSMU and two MPSMUs (default configuration)

A maximum of two HRSMUs can be installed and connected only to the SMU1 and SMU2 ports. A maximum of two HPSMUs can be installed and connected only to the SMU3 and SMU4 ports. The first HPSMU must be connected to SMU3 and the second to SMU4. The default configuration of the 4073A has one HRSMU (connected to the SMU2 port) and two MPSMUs (connected to the SMU3 and SMU4 ports). The following tables indicate the installation order for additional SMUs.

One HRSMU and no HPSMU installed in addition to MPSMUs

Port Number	Installed SMU	Installation order for additional SMUs
1	MPSMU	2
2	MPSMU	Default
3	HRSMU	Default
4	MPSMU	Default
5	MPSMU	1
6	MPSMU	3
7	MPSMU	4
8	MPSMU	5

Two HRSMUs and no HPSMUs installed in addition to MPSMUs

Port Number	Installed SMU	Installation order for additional SMUs
1	HRSMU	Optional HRSMU
2	HRSMU	Default
3	MPSMU	Default
4	MPSMU	Default
5	MPSMU	1
6	MPSMU	2
7	MPSMU	4
8	MPSMU	5

Two HRSMU and one HPSMU installed in addition to MPSMUs

Port Number	Installed SMU	Installation order for additional SMUs
1	MPSMU	1
2	HRSMU	Default
3	HPSMU	Optiona HPSMU
4	MPSMU	Default
5	MPSMU	Default
6	MPSMU	2
7	MPSMU	3
8	MPSMU	4

Two HRSMUs and one HPSMU installed in addition to MPSMUs

Port Number	Installed SMU	Installation order for additional SMUs
1	HRSMU	Optional HRSMU
2	HRSMU	Default
3	HPSMU	Optional HPSMU
4	MPSMU	Default
5	MPSMU	Default
6	MPSMU	1
7	MPSMU	2

One HRSMU and two HPSMUs installed in addition to MPSMUs

Port Number	Installed SMU	Installation order for additional SMUs
1	MPSMU	Default
2	HRSMU	Default
3	HPSMU	Optional HPSMU
4	HPSMU	Optional HPSMU
5	MPSMU	Default
6	MPSMU	1
7	MPSMU	2

Two HRSMUs and two HPSMUs installed in addition to MPSMUs

Port Number	Installed SMU	Installation order for additional SMUs
1	HRSMU	Optional HRSMU
2	HRSMU	Default
3	HPSMU	Optional HPSMU
4	HPSMU	Optional HPSMU
5	MPSMU	Default
6	MPSMU	Default

DC Mearurement Subsystem: Ground Unit (GNDU)

This unit is used for ground when making measurements.
Output Voltage: 0 V
Maximum Current: ±1.6 A
Offset Voltage: ±200 µV
Maximum Capacitance Load (Supplemental Characteristics):
1 µF

DC Measurement Subsystem: Digital Volt Meter (Agilent 3458A)

Voltage Measurement Range, Resolution, and Accuracyv(at number of Power Line Cycles ≥1)

Full-Scale Voltage Range	Resolution	Accuracy (% of reading + volt)
0.1 V	0.1 µV	0.01% + 100 µV
1 V	1 µV	0.01% + 100 µV
10 V	10 µV	0.01% + 200 µV
100 V	100 µV	0.02% + 1 mV

Capacitance Measurement Subsystem: Agilent E4980A LCR Meter

Accuracy is specified between any two output pins except chuck connection pin.
Measurement range:
1 fF to 1.2 nF and 10 nS to 7.5 mS (1 MHz)
1 fF to 10 nF and 1 nS to 6.3 mS (100 kHz)
1 fF to 100 nF and 0.1 nS to6.3 mS (10 kHz)
10 fF to 100 nF and 0.1 nS to 0.63 mS (1 kHz)
Measurement frequency:
1 kHz, 10 kHz, 100 kHz, and 1 MHz
DC Bias Voltage: ±40V
Measurement speed:
MEDIUM or LONG
Note: Above specifications are valid after calibration data measurement and offset cancel.

Full-Scale Voltage Range	Force Accuracy ±(% of reading % of range + volt)
±40 V	0.1% + 10 mV

DC Bias Range and Accuracy
Accuracy is specified between CMH and CML pins.
Test signal level: 30 mV (rms)
Bias Current Isolation Function:
OFF

C/G Measurement Range, Resolution, and Accuracy

Frequency	C Range	C Accuracy % of reading + % of range	G Range	G Accuracy % of reading + % of range
1 MHz	10 pF [1]	0.8% + [1.0 + (0.6 × Gm^2/63 µS)]%	63 µS[1]	0.8% + [1.0 + (0.6 × Cm^3/10 pF)]%
	100 pF	0.8% + [0.3 + (0.6 × Gm/630 µS)]%	630 µS	0.8% + [0.3 + (0.6 × Cm/100 pF)]%
	1 nF	1.5% + [0.2 + (1.7 × Gm/6.3 mS)]%	6.3 mS	1.3% + [0.2 + (2.2 × Cm/1 nF)]%
100 kHz	10 pF [1]	0.4% + [1.0 + (0.3 × Gm/6.3 µS)]%	6.3 µS[1]	0.4% + [1.0 + (0.4 × Cm/10 pF)]%
	100 pF	0.3% + [0.3 + (0.3 ´ Gm/63 µS)]%	63 µS	0.3% + [0.3 + (0.3 × Cm/100 pF)]%
	1 nF	0.3% + [0.2 + (0.4 × Gm/630 µS)]%	630 µS	0.3% + [0.2 + (0.4 × Cm/1 nF)]%
	10 nF	0.5% + [0.2 + 1.0 × (Gm/6.3 mS)]%	6.3 mS	0.7% + [0.2 + (0.8 × Cm/10 nF)]%
10 kHz	100 pF	0.3% + [0.2 + (0.3 × Gm/6.3 µS)]%	6.3 µS	0.3% + [0.2 + (0.3 × Cm/100 pF)]%
	1 nF	0.3% + [0.1 + (0.3 × Gm/63 µS)]%	63 µS	0.3% + [0.1 + (0.3 × Cm/1 nF)]%
	10 nF	0.3% + [0.1 + (0.3 × Gm/630 µS)]%	630 µS	0.3% + [0.1 + (0.3 × Cm/10 nF)]%
	100 nF	0.3% + [0.1 + (1.0 × Gm/6.3 mS)]%	6.3 mS	0.7% + [0.1 + (0.7 × Cm/100 nF)]%
1 kHz	100 pF [1]	0.4% + [0.5 +(0.4 × Gm/0.63 µS)]%	0.63 µS[1]	0.4% + [0.5 + (0.4 × Cm/100 pF)]%
	1 nF	0.3% + [0.1 + (0.3 × Gm/6.3 µS)]%	6.3 µS	0.3% + [0.1 + (0.3 × Cm/1 nF)]%
	10 nF	0.3% + [0.1 + (0.3 × Gm/63 µS)]%	63 µS	0.3% + [0.1 + (0.3 × Cm/10 nF)]%
	100 nF	0.3% + [0.1 + (0.3 × Gm/630 µS)]%	630 µS	0.3% + [0.1 + (0.3 × Cm/100 nF)]%

[1]Supplemental Characteristics
[2]Gm = Measured conductance
[3]Cm = Measured capacitance

Note: Accuracy is specified between any DUT pins. Stray capacitance between force and guard must be under 5 pF.
Frequency accuracy: ±0.1%; Test signal level: 30 mV_{rms} ± 5 mV_{rms}
When measurement speed is set to SHORT, add 0.25% to the % of reading and 0.1% to the % of range.
When Open/Short calibrations at the DUT pins are carried out, accuracy is the same as in the above table. (Note that the length of cable from the output pins must be less than 1 meter, and capacitance to guard must be under 100 pF.)

Pulse Force Unit: PGU Option

Supported Pulse Generators:
81110A and 8114A

Maximum Number of Installable Pulse Generators:
81110A × 5 (without 8114A)
81110A × 4 (with 8114A × 1)
81110A × 2 (with 8114A × 2)

Pulse Force Mode
Pulse Signal:
2-level and 3-level output
Burst Count:
10^9 (max.) or infinite

Output mode
Normal mode or Pattern mode

Normal mode
All pulse generators (up to 5) can force synchronously.

Pattern mode
All pulse generators except the master pulse generator can force synchronously (more

accurate pulse width and pulse delay than normal mode).

Note: Agilent 8114A does not support pattern mode.

Load impedance

999 kΩ (default), selectable from 2.5 Ω to 999 kΩ (81110A)
999 kΩ (default), selectable from 10 Ω to 999 kΩ (8114A)

Pulse Setting Range

Pulse Period

Normal mode
81110A:
Range: 350 ns to 999 s
Resolution: 4 digits (min. 100 ps)
8114A:
Range: 350 ns to 999 ms
Resolution: 3 digits (min. 1 ns)
Pattern mode
81110A:
Range: 120 µs to 999 s
Resolution: 4 digits (min. 100 ns)
8114A:
Range: 120 ns to 999 ms
Resolution: 3 digits (min. 1 µs)

Pulse Width

Normal mode
81110A:
Range: 50 ns to 999 ms
Resolution: 3.5 digits (min. 50 ps)
8114A:
Range: 150 ns to 150 ms
Resolution: 3 digits (min. 1 ns)
Pattern mode
81110A in the master unit
Range: 50 ns to 999 ms
Resolution: 3 digits (min. 100 ps)
8114A in the master unit
Range: 150 ns to 150 ms
Resolution: 3 digits (min. 1 ns)
81110A in slave units
Range: 100 ns to 999 ms
Resolution:
1×10^{-n} (at $1000 \times 10^{-n} < T \leq 4000 \times 10^{-n}$)
2×10^{-n} (at $4000 \times 10^{-n} < T \leq 8000 \times 10^{-n}$)
2.5×10^{-n} (at $8000 \times 10^{-n} < T \leq 10000 \times 10^{-n}$)
T means the maximum value of (pulse width + delay time) among all the channels. For example, if T is 250 µs, then according to the above table, the resolution is 0.1 µs (1×10^{-7}) because $T = 250 \times 10^{-6} = 2500 \times 10^{-7}$.

Pulse Delay

Normal mode
81110A Range: 0 to 998 ms
Resolution: 3.5 digits (min. 5 ps)
8114A Range: 0 to 998 ms
Resolution: 3 digits (min. 10 ps)
Pattern mode
Range: 0 to 998 ms
Resolution:
81110A and 8114A in the master unit
3 digits (min. 10 ps)
81110A in slave units
1×10^{-n} (at $1000 \times 10^{-n} < T \leq 4000 \times 10^{-n}$)
2×10^{-n} (at $4000 \times 10^{-n} < T \leq 8000 \times 10^{-n}$)
2.5×10^{-n} (at $8000 \times 10^{-n} < T \leq 10000 \times 10^{-n}$)
T means pulse period specified in the Force_pg subprogram. If not specified, T is the maximum value of 1.1 × (pulse width + delay time + 30 ns) among all specified PGs.

Transition Time

20 ns to 200 ms (81110A)
65 ns (fixed) (8114A)

Pulse Level (at open load)

81110A:
±19 V (at 2 level)
±19 V (at 3 level)
Restriction for "3-level pulse with one PG" output mode: the sum of the absolute values of both amplitudes cannot exceed 20 V.
8114A:
–49.9 V to +50 V (at 2 level)
–49.9 V to +50 V (at 3 level)
There is no "3-level pulse with one PG" output mode on the Agilent 8114A because it has only one Output.
81110A + 8114A:
–49.9 V to +50 V (at 3 level)

Pulse Level Accuracy (at open load)

81110A level:
± ((2 % of amplitude) + 150 mV)
8114A amplitude:
± ((2 % of amplitude) + 200 mV)
8114A baseline:
± ((2 % of baseline) + (1 % of amplitude)+ 200 mV)

Pulse Shape Accuracy (at 50 Ω load impedance)

81110A width:
± (3%of setting + 2 ns) or
± (0.5%of setting + 2 ns)*
(in normal mode, width ≥50 ns)
81110A delay:
± (3%of setting + 1 ns)
± (0.5%of setting + 1 ns)*
(in normal mode, width ≥ 50 ns)
*Supplemental characteristics after timing calibration

81110A transition:
(–10%of setting) to (+10%of setting + 20 ns) (transition time ≥ 20ns)
81110A overshoot:
± (5%of amplitude + 20 mV)
(transition time ≥20 ns)
8114A width:
± (5%of setting + 3.5 ns)
(width ≥ 200 ns)
± (5%of setting + 6.0 ns)
(width ≥ 150 ns)
8114A delay:
± (5%of setting + 1 ns)
8114A transition:
65 ns ± 20 ns
8114A overshoot:
± (5%of amplitude + 50 mV)

Pulse Shape Accuracy (at 5 kΩ load impedance: reference data)

Agilent 81110A overshoot/ringing:
± (5%of amplitude + 20 mV)
8114A overshoot/ringing:
(–8% of amplitude) to (+4% of amplitude)
81110A transition time:
±(10%of setting + 5 ns)
8114A transition time:
56 ns ± 5 ns
Skew between pins: ± 10 ns

Pulse Force Unit: HV-SPGU Option[1]

Supported Pulse Generators
High-voltage semiconductor pulse generator unit (HV-SPGU) modules

Installable HV-SPGU modules: 5 (max.)

Channels per SPGU: 2

Pulse Force Mode
Pulse Signal: Each HV-SPGU channel supports 2-level and 3-level pulses

Output Mode
All pulse generator channels (up to 10) can force synchronously

HV-SPGU Output Impedance: 50 Ω

HV-SPGU Load Impedance
0.1 Ω to 10 MΩ

Pulse Setting Range

Pulse Level (at open load)
±40 V (at 2-level and 3-level)

Pulse Period (at 50 Ω load)
350 ns to 10 s, 10 ns resolution

Pulse Width (at 50 Ω load)
50 ns to [Period – 50 ns] with 2.5 ns[2] or 10 ns[3] resolution

Pulse Delay (at 50 Ω load)
0 s to [Period –75 ns] with 2.5 ns[2] or 10 ns[3] resolution

Transition Time (at 50 Ω load)
20 ns to 400 ms with 2 ns[2] or 8 ns[3] resolution

Transition Time Minimum (at 50 Ω load)
20 ns[4], 30 ns[5]

Pulse Amplitude (at open load)
0 to 80V peak-to-peak

Pulse Resolution (at open load)
0.4 mV (Vout ≤10 V)
1.6 mV (Vout >10 V)

Pulse Level Accuracy (at open load)
± (2% +150 mV)

Pulse Shape Accuracy (at 50 Ω load)
Delay: ± (3% +1 ns)
Transition Time: –5% to (+5% + 35 ns)
Overshoot/Ringing: ± (5% of amplitude +20 mV)
Skew between pins: ±10 ns

Pulse Shape Accuracy (reference data at 5 kΩ load)
Transition Time: –5% to (+5% + 35 ns)
Overshoot/Ringing: ± (5% of amplitude +20 mV)
Skew between pins: ±10 ns

[1] Requires Linux system controller
[2] Transition time setting ≤10 µs
[2] Transition time setting >10 µs
[4] |Vamp| ≤10 V (to 50 Ω)
[5] 10 V <|Vamp| ≤20 V (to 50 Ω)

System Controller

UNIX®

Supported Computers
HP Visualize workstation C3600, C3700B, C3750, C8000

Operating System
HP-UX 11i

For C3600, C3700B, C3750, BASIC/UX (C.08.04), SICL (11i-2.1) or C/ANSI C, SICL

For C8000, BASIC/UX(C.08.10), SICL (11i-2.5) or C/ANSI C, SICL

Recommended Memory: 256 MB

Required Disk
8 GB (forC3600, C3700B, C3750)
20 GB (for C8000)

Linux

Supported Computer
HP xw8400 Workstation

Operating System
RedHat Enterprise Linux WS4 Update3

BASIC/LX (12.2), SICL (3.2) or C/ANSI C, SICL

Required Memory: 1 GB

Required Disk: 20 GB

Required GP-IB Interfaces
Agilent recommends two external GP-IB interface cards for use with: One for instruments controlled by 4072A TIS commands (e.g., 3458A) and another for an automatic wafer prober.

System Software Capabilities

- System Management
- Control of subsystems (TIS Library)
- Parameter measurement utility (PARA Library)
- Off-line debugging
- Interactive Debugging Panel (IDP includes Test Algorithm Code Generating Function)
- Probing pattern generation and wafer maps display (PPG, MAP)
- Prober Control Library (Sample program): Electroglas, TEL, and TSK
- Application program (Sample program): Flash memory cell evaluation, Charge pumping method
- Automatic Diagnostics

Agilent Semiconductor Process Evaluation Core Software (SPECS)

Agilent SPECS is a test shell environment for the Agilent 4070 Series.

Input
User interaction occurs via a graphical interface with spreadsheet-like operation. Test plans require simple specifications: wafer, die, test, and probe.

Customization
Agilent supplies basic development, engineering, and operator test shell frameworks, which users can tailor or modify to create entirely new frameworks.

Analysis & Output
All data is output into a flat ASCII file which users can manipulate to allow for input into database software. In addition, the data management structure supports x-y graphs, histograms, and wafer maps.

UNIX
Users have full access to the UNIX environment from within the test shell.

Linux
Users have full access to the Linux environment from within the test shell.

General Specifications

Accuracy is specified at:
Temperature: 23° C ± 5° C
Humidity: 5% to 70% RH[1]
Warm up: at least 40 min.
Self-calibration: Within one hour after calibration
Integration Time: Medium or Long[2]

Power Requirement

Nominal Line Voltage[3]	Allowable Voltage Range	Required Maximum Current
200 Vac	180 - 220 Vac	20 A
208 Vac	188 - 228 Vac	24 A
220 Vac	198 - 242 Vac	20 A
240 Vac	216 - 252 Vac	20 A

Operating Temperature Range: 5°C to 30°C
Operating Humidity range: 5% to 70% (no condensation)
Storage Temperature Range: –20°C to 50°C (< 80% RH, no condensation)[4]
Warm up time: At least 40 minutes

[1] 5% to 60% RH (no condensation) for isolation resistance of low current port.

[2] For SMU current ranges that are less than or equal to 1 nA, the integration time must be Long (16 PLC or longer).

Note: Temperature change after calibration must be less than 3° C.

[3] Line frequency must be 48 Hz to 63 Hz.

[4] For an unpacked system, –20° C to 60 °C (< 90% RH, <12 hrs).

Regulatory and Standard Compliance:

EMC:
EMC Directive 89/336/EEC, 93/68/EEC
EN61326-1
ICES-001
AS/NZS 2064.1
Safety:
Low Voltage Directive 73/23/EEC, 93/68/EEC
EN61010-1
CSA C22.2 No.1010.1
UL3111-1
SEMI S2-0200/S8-0999

Certification marking

CE, CSA, NRTL/C, C-tick, ICES/NMB-001

Dimensions

System Cabinet:
600 mm (W) by 900 mm (D) by 1600 mm (H)
Testhead:
640 mm (W) by 642 mm (D) by 400 mm (H)

Weight

System Cabinet:
250 kg (including 3458A, 81110A × 4, 8114A and system controller)

Note: Cabinet weight approximately 4 kg less using 5 HV-SPGUs instead of 4 81110As and an 8114A.

Testhead:
70 kg (including 4 SMUs and 48 pins)

Recommended Conditions for Low Current and Low Voltage Measurements

In addition to the conditions listed in General Specifications, Agilent Technologies recommends that the following additional conditions be satisfied for measuring precise low current and low voltage with the 4073A.

Note: These conditions are not specified to guarantee a certain measurement performance.

Auto probers[5]:
TEL P8LC, P12XL
TSK UF200, UF300, UF3000
EG 5|300e
Probe cards[5]:
JEM (Japan Electronic Materials Co.)
MJC (Micronics Japan Co.)
K&S (Kulicke & Soffa Industries Inc.)
Temperature: Within ±1°C after calibration
Temperature change period: ≥10 minutes
Humidity: ≤50 %
Warm up time: ≥60 minutes
Floor vibration: ≤1 mG
Floor vibration frequency: ≥10 Hz
Air cleanliness: ≤class 10,000
Line voltage: Burst noise ≤ 1 kV, Surge noise ≤1 kV
This line voltage environment applies EN61326–1

[5] Please contact your local sales representative regarding the latest information on recommended probers and probe cards

For more information about Agilent Technologies and its products, go to **www.agilent.com**.

For more information about Agilent parametric test products, applications, and services, visit our Web site at **www.agilent.com/see/parametric** or call one of the centers listed below and ask to speak with a sales representative.

Americas

Brazil (11) 4197-3600
Canada (French) 1 877 894-4414
Canada (English) 1 800 447-8378
Mexico 33 134-5841
United States 1 800 829-4444

Asia/Asia Pacific

Australia 1 800 629-485
China 1 800 276-3059
Hong Kong 852 2599 7889
India 91/11 690-6156
Japan 0120 421-345
Malaysia 1 800 880-780
New Zealand 0 800 738 378
Philippines 1 800 1651-0135
Singapore 1 800 276-3059
South Korea 080 778-0011
Taiwan 0 800 047-662
Thailand 1 800 2758-5822

Europe

Austria (01) 25 125-7183
Belgium (0) 2 404-9380
Denmark 080301040
Finland 20 547-9999
France (0) 825 010710
Germany (0) 18 05 24-63 34
Greece 20 547-9999
Ireland 016158393
Italy 02 92 60 8333
Luxembourg (0) 2 404-9340
Netherlands (0) 20 547-9999
Poland 20 547-9999
Russia 20 547-9999
Spain 91 631 3383
Sweden 020 120-9975
Switzerland (Italian) (0) 2 92 60 8484
Switzerland (German) (0) 1 735-9300
Switzerland (French) (0) 825 010 700
United Kingdom (0) 7004 222-222

Middle East

Israel 20 547-9999

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