Specifications

Typical Measurement Times
HP 9000 Series 332 computer.
ASCII data transfer time is included.

HP 41420A/HP 41421B SMU
(20V/100mA range, spot measurement)
Force I or V: 3.5msec
Measure I or V: 4.0msec

HP 41425A AFU
V_T at I_0 = 1μA: 12msec

HP-IB Data Transfer Rate
ASCII format: 1300μsec/point
Binary format: 450μsec/point

Measurement Accuracy
Is specified at front panel connector terminals, referenced to SMU common, under the following conditions:

1. 23 °C ±5 °C
2. 40 minute warm-up period
3. Auto Calibration enabled
4. Kelvin connection

HP 41420A High Power Source/Monitor Unit

The HP 41420A HPSMU occupies two slots in the HP 4142B mainframe. It sources voltage and monitors current, or sources current and monitors voltage. Separate FORCE and SENSE terminals enable Kelvin connections (remote sensing).

Output/Measurement Range, Resolution and Accuracy.

Voltage Range	Set. Resolution	Meas. Resolution	Accuracy	Maximum Current
±2V	100μV	40μV	±(0.05% + 1mV)	±1A
±20V	1mV	400μV	±(0.05% + 10mV)	±1A (|V|≤14V) ±0.7A (|V|>14V)
±40V	2mV	800μV	±(0.05% + 20mV)	±350mA
±100V	5mV	2mV	±(0.05% + 50mV)	±125mA
±200V	10mV	4mV	±(0.05% + 100mV)	±50mA

Current Range	Set. Resolution	Meas. Resolution	Accuracy	Maximum Voltage
±1nA	50fA	20fA	±(1% + 6pA + 20fA × V_{OUT})	±200V
±10nA	500fA	200fA	±(1% + 15pA + 200fA × V_{OUT})	
±100nA	5pA	2pA	±(0.5% + 100pA + 2pA × V_{OUT})	
±1μA	50pA	20pA	±(0.5% + 1nA + 20pA × V_{OUT})	
±10μA	500pA	200pA	±(0.2% + 10nA + 200pA × V_{OUT})	
±100μA	5nA	2nA	±(0.2% + 100nA + 2nA × V_{OUT})	
±1mA	50nA	20nA	±(0.2% + 1μA + 20nA × V_{OUT})	
±10mA	500nA	200nA	±(0.2% + 10μA + 200nA × V_{OUT})	
±100mA	5μA	2μA	±(0.2% + 100μA + 2μA × V_{OUT})	±200V (|I|≤50mA) ±100V (|I|>50mA)
±1A	50μA	20μA	±(0.5% + 1mA + 20μA × V_{OUT})	±200V (|I|<50mA) ±100V (125mA≥|I|>50mA) ±40V (350mA≥|I|>125mA) ±20V (0.7A ≥|I|>350mA) ±14V (|I|>0.7A)

Note: V_{OUT} is the SMU output voltage in volts.

Voltage/Current Compliance
The SMU can limit output voltage or current to prevent damage to a device under test.

Compliance voltage and current resolutions are the same as the Setting Resolutions in the table above, however the maximum compliance current resolution is 1pA. The Accuracy specifications, listed in the above table, apply also to the accuracy of compliance settings.

Current Over-range
1nA–100mA range: 15% of range
1A range: 0%

Reference Data for HP 41420A

Maximum capacitive load: 1000pF
Maximum guard capacitance: 900pF
Maximum shield capacitance: 5000pF
Maximum cable resistance
FORCE terminal: 10Ω (100mA)
0.7Ω (1A)
SENSE terminal: 10Ω
Typical voltage source output resistance/current measurement input resistance (non-Kelvin connection): 0.2Ω
Typical voltage measurement input resistance/current source output resistance: ≥10^{12}Ω
Guard offset voltage: ± 1mV
Noise (typical)
(20V range, 10μA or above)
Voltage source: 0.005% of V range (rms)
Current source: 0.005% of I range (rms)
Voltage monitor: 0.01% of V range (p-p)
Current monitor: 0.05% of I range (p-p)
Output overshoot (typical)
Voltage source: 0.03% of V range
Current source: 0.03% of I range
Typical range switching transient noise
Voltage ranging: 250mV
Current ranging: 10mV
Maximum slew rate: .2V/μsec

HP 41421B Medium Power Source/Monitor Unit

The HP 41421B MPSMU requires one slot in the HP 4142B mainframe. It sources voltage and monitors current, or sources current and monitors voltage. Separate FORCE and SENSE terminals enable Kelvin connections (remote sensing).

Output/Measurement Range, Resolution and Accuracy.

Voltage Range	Set. Resolution	Meas. Resolution	Accuracy	Maximum Current
±2V	100μV	40μV	±(0.05% + 1mV)	±100mA
±20V	1mV	400μV	±(0.05% + 10mV)	
±40V	2mV	800uV	±(0.05% + 20mV)	±50mA
±100V	5mV	2mV	±(0.05% + 50mV)	±20mA

Current Range	Set. Resolution	Meas. Resolution	Accuracy	Maximum Voltage
±1nA	50fA	20fA	±(1% + 6pA + 20fA × V_{OUT})	±100V
±10nA	500fA	200fA	+(1% + 15pA + 200fA × V_{OUT})	
±100nA	5pA	2pA	±(0.5% + 100pA + 2pA × V_{OUT})	
±1μA	50pA	20pA	±(0.5% + 1nA + 20pA × V_{OUT})	
±10μA	500pA	200pA	±(0.2% + 10nA + 200pA × V_{OUT})	
±100μA	5nA	2nA	±(0.2% + 100nA + 2nA × V_{OUT})	
±1mA	50nA	20nA	±(0.2% + 1μA + 20nA × V_{OUT})	
±10mA	500nA	200nA	±(0.2% + 10μA + 200nA × V_{OUT})	
±100mA	5μA	2μA	±(0.2% + 100μA + 2μA × V_{OUT})	±100V (|I|≤20mA) ±40V (50mA≥|I|>20mA) ±20V (|I|>50mA)

Note: V_{OUT} is the SMU output voltage in volts.

Specifications

Voltage/Current Compliance
Same as the HP 41420A HPSMU

Current Over-range
1nA–10mA range: 15% of range
100mA range: 0%

Reference Data for HP 41421B

Same as the HP 41420A HPSMU

HP 41422A High Current Source/Monitor Unit

The HP 41422A HCU occupies two slots and operates in pulse mode only. It sources voltage and monitors current, or sources current and monitors voltage. Separate FORCE and SENSE terminals enable Kelvin connections (remote sensing).

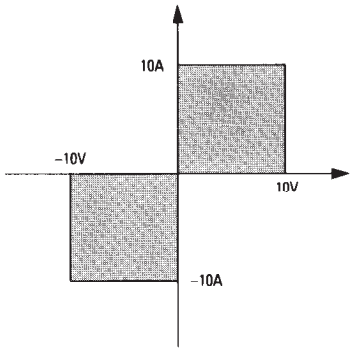
Output/Measurement Range, Resolution and Accuracy. (PULSE ONLY)

Voltage Range	Set. Resolution	Meas. Resolution	Accuracy	Maximum Current
± 2V	200μV	40μV	± (0.5% + 10mV)	± 10A (Unipolar)
± 20V (± 10V max.)	2mV	400μV	± (0.5% + 100mV)	

Current Range	Set. Resolution	Meas. Resolution	Accuracy	Maximum Voltage
± 1mA	100nA	20nA	± (0.5% + 2μA + 100nA × V_{OUT})	± 10V (Unipolar)
± 10mA	1μA	200nA	± (0.5% + 20μA + 1μA × V_{OUT})	
± 100mA	10μA	2μA	± (0.5% + 200μA + 10μA × V_{OUT})	
± 1A	100μA	20μA	± (1% + 2mA + 100μA × V_{OUT})	
± 10A	1mA	200μA	± (2% + 20mA + 1mA × V_{OUT})	

Note: V_{OUT} is the HCU output voltage in volts.
Pulse is unipolar (voltage and current are the same polarity).
Pulse base value is fixed to 0 volts.

HCU Output and Measurement Range



Voltage/Current Compliance
The HCU can limit output voltage or current to prevent damage to a device under test. Compliance voltage and current resolutions are the same as the Setting Resolutions in the table above, however the maximum compliance current resolution is 1μA. The Accuracy specifications, listed in the above table, apply also to the accuracy of compliance settings.

Current Over-range
1mA–1A range: 15% of range
10A range: 0%

Pulse Settings and Accuracy
Single pulse width: 100μsec–1msec
(100μs resolution)
Dual pulse width: 100μsec–800μsec
(100μs resolution)
Maximum pulse duty cycle:
1mA–1A range: 10%
10A range: 1%
Maximum pulse power: 100mJ

Hold time accuracy: 0.5% ± 1msec
Delay time accuracy: 0.5% ± 1msec
Pulse period accuracy: 0.5% ± 100μsec
Pulse width accuracy: 0.5% ± 20μsec

Reference Data for HP 41422A

Maximum capacitive load: 3.5nF
Maximum inductive load: 1μH on 10A range
Maximum cable resistance
FORCE terminal: 150mΩ @ 10V,10A
SENSE terminal: 10Ω
Maximum cable inductance
FORCE terminal: 200nH max
Noise (typical)
Voltage source: 0.01% of V range (rms)
Current source: 0.1% of I range (rms)
Voltage monitor: 0.02% of V range (p-p)
Current monitor: 0.2% of I range (p-p)
Maximum slew rate: 0.3V/μsec

HP 41423A High Voltage Source/Monitor Unit

The HP 41423A HVU occupies two slots in the HP 4142B mainframe. It sources voltage and monitors current, or sources current and monitors voltage.

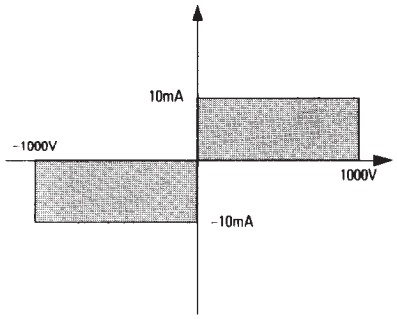
Output/Measurement Range, Resolution and Accuracy.

Voltage Range	Set. Resolution	Meas. Resolution	Accuracy	Maximum Current
± 100V	10mV	2mV	± (0.5% + 0.5V)	± 10mA (Unipolar)
± 200V	20mV	4mV	± (0.5% + 1V)	
± 500V	50mV	10mV	± (0.5% + 2.5V)	
± 1000V	100mV	20mV	± (0.5% + 5V)	

Current Range	Set. Resolution	Meas. Resolution	Accuracy	Maximum Voltage
± 100nA	50pA	2pA	± (1% + 1nA)	± 1000V (Unipolar)
± 1μA	500pA	20pA	± (1% + 10nA)	
± 10μA	5nA	200pA	± (1% + 100nA)	
± 100μA	50nA	2nA	± (1% + 1μA)	
± 1mA	500nA	20nA	± (1% + 10μA)	
± 10mA	5μA	200nA	± (1% + 100μA)	

Note: Unipolar output means non-zero crossing.
In pulse mode the output may be offset with a base value.

HVU Output and Measurement Range



Voltage/Current Compliance
The HVU can limit output voltage or current to prevent damage to a device under test.

Compliance voltage and current resolutions are the same as the Setting Resolutions in the table above, however the maximum compliance current resolution is 2pA. The Accuracy specifications, listed in the above table, apply also to the accuracy of compliance settings.