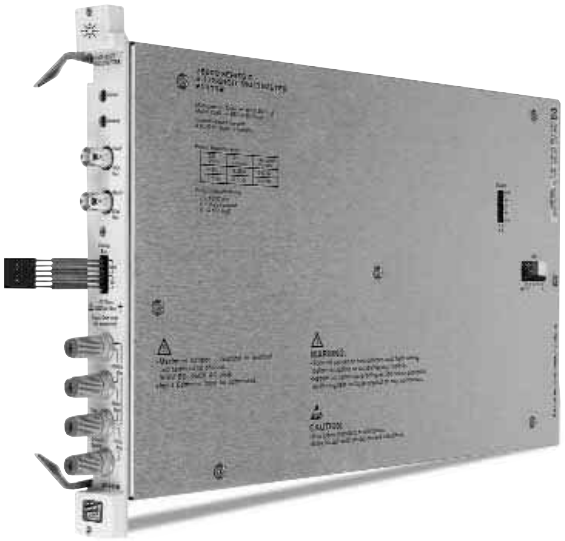
Agilent E1411B
5.5-Digit Multimeter, C-Size

Data Sheet

- **1-Slot, C-size, register based**
- **DCV, ACV, 2- & 4-wire Ω, temperature**
- **5.5-digit low-noise integrating A/D**
- **13 kHz high-speed sampling A/D**
- **Balanced differential isolated inputs**
- **Software calibration**



Description

The Agilent Technologies E1411B 5.5-Digit Multimeter is a C-size,1-slot, register-based VXI module. It is identical in electrical design to the E1326B, differing only in size. You can use the integrating A/D to make 5.5-digit, low-noise measurements, or switch to the sampling A/D to make 14-bit readings at rates up to 13 kHz.

When combined with any Agilent VXI relay or FET multiplexer, you can create a multichannel scanning multimeter. For example, by sending just one SCPI command to the E1406A, you can program the multimeter and the channels of your multiplexers all at one time. The E1411B provides flexible triggering with built-in timer pacer, also.

Product functions for this DMM include Vdc/ac, 2- and 4-wire Ω, offset-compensated Ω, thermocouples thermistors,and RTDs. This autoranging DMM is especially well suited for data acquisition and computer-aided test applications.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Reading Rate

Auto zero off, fixed range, default trigger delay, offset comp off, Sample Source "TIMER" for rates >15 readings/s.

Maximum reading rate: 13 K

Typical Reading Rates (rdgs/s)

	APERTURE						
	320 ms	**267 ms**	**20 ms**	**16.7 ms**	**2.5 ms**	**100 µs**	**10 µs**
dc voltage:	3	3.5	49	59	365	3125	13000
Four-wire resistance:	3	3.5	49	59	365	3125	13000
ac voltage:	1.3	1.4	1.9	1.9	1.9	1.9	1.9

Resolution (bits/digit)

	APERTURE						
	320 ms	**267 ms**	**20 ms**	**16.7 ms**	**2.5 ms**	**100 µs**	**10 µs**
Binary bits:	±22	±22	±20	±20	±18	±15	±14
Decimal digits:	6.5	6.5	6	6	5.5	4.5	4

Noise Rejection (dB) for DC voltage and Resistance functions.

Noise Rejection Conditions: CMR measured with 1 kΩ in both High and Low leads with a 10% imbalance. Low connted to Common at source, measured with respect to earth ground. NMR is for specified frequencies ±0.1%

		APERTURE						
		320 ms	**267 ms**	**20 ms**	**16.7 ms**	**2.5 ms**	**100 µs**	**10 µs**
dc:	Common mode rejection	150 dB	150 dB	150 dB	150 dB	150 dB	150 dB	150 dB
ac (0-400):	Common mode rejection*	70 dB	70 dB	70 dB	70 dB	70 dB	70 dB	70 dB
50 Hz:	Power line cycles (NPLC)	16	–	1	–	–	–	–
	Normal mode rejection	84 dB	0 dB	60 dB	0 dB	0 dB	0 dB	0 dB
	Effective Common Mode ECMR*	154 dB	70 dB	130 dB	70 dB	70 dB	70 dB	70 dB
60 Hz:	Power line cycles (NPLCs)	–	16	–	1	–	–	–
	Normal mode (60 Hz) rejection	0 dB	84 dB	0 dB	60 dB	0 dB	0 dB	0 dB
	Effective Common Mode Rejection*	70 dB	154 dB	70 dB	130 dB	70 dB	70 dB	70 dB
400 Hz:	Power line cycles (NPLCs)	128	–	8	–	1	–	–
	Normal mode (400 Hz) rejection	84 dB	0 dB	84 dB	0 dB	60 dB	0 dB	0 dB
	Effective Common Mode ECMR*	154 dB	70 dB	154 dB	70 dB	130 dB	70 dB	70 dB

* *64 & 300 volt ranges reduced by 36 dB*

dc Voltage

Accuracy Conditions: Auto zero on,one hour warmup. Temperature within ±5°C of calibration temperature (module calibrated at 18-28°C).

		RESOLUTION vs APERTURE (Volts)		**90-DAY ACCURACY vs APERTURE ± (% of Reading + Volts)**	
Range	**Input Resistance**	**20/16.7 ms**	**10 µs**	**20/16.7 ms**	**10 µs**
125 mV	>100 MΩ	120 nV	7.6 µV	0.023% + 5 µV	0.115% + 60 µV
1 V	>100 MΩ	1.0 µV	61 µV	0.013% + 15 µV	0.1% + 200 µV
8 V	>100 MΩ	7.6 µV	488 µV	0.01% + 50 µV	0.1% + 1.5 µV
64 V	10 MΩ + 5%	61 µV	3.9 mV	0.015% + 1 mV	0.1% + 20 µV
300 V	10 MΩ + 5%	488 µV	31 mV	0.015% + 5 mV	0.1% + 80 µV

Four-Wire Resistance

Accuracy Conditions: Auto zero on, one hour warmup. Temperature within ±5°C of calibration temperature (module calibrated at 18-28°C).

Range	Source Current	Maximum Open Circuit Voltage	RESOLUTION vs APERTURE (Ω) 20/16.7 ms	RESOLUTION vs APERTURE (Ω) 10 µs	90-DAY ACCURACY vs APERTURE ± (% of Reading + Ω) 20/16.7 ms	90-DAY ACCURACY vs APERTURE ± (% of Reading + Ω) 10 µs
256 Ω	488 µA	11.5 V	250 µΩ	15 mΩ	0.035% + 10 mΩ	0.12% + 50 mΩ
2 kΩ	488 µA	11.5 V	2 mΩ	125 mΩ	0.025% + 20 mΩ	0.1% + 200 mΩ
16 kΩ	61 µA	11.5 V	15 mΩ	1 Ω	0.025% + 200 mΩ	0.1% + 2 Ω
131 kΩ	61 µA	11.5 V	125 mΩ	8 Ω	0.025% + 1 Ω	0.1% + 16 Ω
1 MΩ	7.6 µA	11.5 V	1 Ω	64 Ω	0.015% + 10 Ω	0.1% + 120 Ω

NOTE: With offset compensation on, accuracy is the same as for the voltmeter alone.

True RMS ac Voltage (ac coupled)

Crest Factor: 7 at 0% full scale; 5 at full scale. Accuracy Conditions: Sine wave inputs >0% of full scale. dc component <0% of ac component. Auto-zero on, one hour warmup. Temperature within ± 5°C of calibration temperature (module calibrated at 8-28°C).

Range (RMS)	Input Impedance	Frequency	RESOLUTION vs APERTURE (Volts) 320/267 ms	RESOLUTION vs APERTURE (Volts) 10 µs	90-DAY ACCURACY vs APERTURE ± (% of Reading + Volts) 320/267 ms	90-DAY ACCURACY vs APERTURE ± (% of Reading + Volts) All other apertures
87.5 mV	>100 MΩ, <100 pF	20-50 Hz	30 nV	7.6 µV	2.175% +200 µV	2.175% +1 mV
		50 Hz-1 kHz			0.675% +200 µV	0.675% +200 µV
		5-10 kHz			3.175% +200 µV	3.175% +200 µV
700 mV	>100 MΩ, <100 pF	20-50 Hz	0.24 µV	61 µV	2.125% +1.5 mV	2.125% +8 mV
		50 Hz-1 kHz			0.625% +1.5 mV	0.625% +1.5 mV
		1-5 kHz			0.625% +1.5 mV	0.625% +1.5 mV
		5-10 kHz			3.125% +1.5 mV	3.125% +1.5 mV
5.6 V	>100 MΩ, <100 pF	20-50 Hz	2.0 µV	488 µV	2.125% +15 mV	2.125% +80 mV
		50 Hz-1 kHz			0.625% +15 mV	0.625% +15 mV
		1-5 kHz			1.125% +15 mV	1.125% +15 mV
		5-10 kHz			10.125% +15 mV	10.125% +15 mV
44.8 V	10 MΩ ± 5%, <100 pF	20-50 Hz	15 µV	3.9 mV	2.125% +100 mV	2.125% + 500 mV
		50 Hz-1 kHz			0.625% +100 mV	0.625% +100 mV
		1-5 kHz			1.125% +100 mV	1.125% +100 mV
		5-10 kHz			10.125% +100 mV	10.125% +100 mV
300 V	10 MΩ ± 5%, <100 pF	20-50 Hz	122 µV	31 mV	2.125% + 500 mV	2.125% + 2.5 V
		50 Hz-1 kHz			0.625% + 500 mV	0.625% + 500 mV
		1-5 kHz			1.125% + 500 mV	1.125% + 500 mV
		5-10 kHz			10.125% + 500 mV	10.125% + 500 mV

Timing/Synchronization

Timer/pacer
Timer range: 76 µs to 65.5 ms
Resolution: 2 µs

Programmable delay
Delay range: 40 µs to 16 s
Resolution: 2 µs

External trigger
Minimum pulse width: 100 ns
Maximum trigger rate: 5 kHz (Trigger Condition, negative edge; Fixed range,10 µs aperture)

Isolation

450 Vpk between any terminal and chassis.

dc Voltage Accuracy with Relay Multiplexers

Range	20/16.7 ms	10 µs	20/16.7 ms	10 µs
125 mV	0.023%+9 µV	0.115%+64 µV	0.023%+55 µV	0.115%+110 µV
1 V	0.013%+19 µV	0.1%+204 µV	0.013%+65 µV	0.1%+250 µV
8 V	0.01%+54 µV	0.1%+1.5 mV	0.01%+100 µV	0.1%+1.55 mV
64 V	0.015%+1 mV	0.1%+20 mV	0.015%+1.05 mV	0.1%+20 mV
300 V	0.015%+5 mV	0.1%+80 mV	0.015%+5.05 mV	0.1%+80 mV

Accuracy Conditions: Auto zero on, one hour warmup. Temperature within ±5°C of calibration temperature (module calibrated at 8-28°C).

True RMS ac Voltage (ac coupled)with Relay Multiplexers

1-5 kHz and 5-10 kHz frequencies (all apertures) when using Relay Multiplexers (E1343A, E1345A, E1346A, or E1347A).
Add 0.2% to the ac Voltage specifications.

Strain Measurements with Strain Relay Multiplexers

All measurements are made using the MEAS command.

NOTE: The Agilent E1406A command module and embedded controllers provide units conversion; if the E1411B is register programmed, your program must make the units conversion.

Vs = 5 V Power Supply/Gage Factor = 2

		18-20°C		Temp. Coefficient	
		με%	**%e**	**με%**	**%e**
Relays	Quarter	25.8	0.023	1.96	0.006
	Half	33.2	0.023	0.23	0.006
	Full	16	0.023	0.053	0.006
FETs	Quarter	353	0.023	103	0.006
	Half	169	0.023	50.7	0.006
	Full	83.8	0.023	25.3	0.006

Vs = 1 V Power Supply/Gage Factor = 2

		18-20°C		Temp. Coefficient	
		με%	**%e**	**με%**	**%e**
Relays	Quarter	25.8	0.023	1.96	0.006
	Half	5.39	0.023	0.23	0.006
	Full	2.07	0.023	0.053	0.006
FETs	Quarter	52.9	0.023	12	0.006
	Half	18.9	0.023	5.27	0.006
	Full	8.85	0.023	2.57	0.006

Vs = 0.1 V Power Supply/Gage Factor = 2

		18-20°C		Temp. Coefficient	
		με%	**%e**	**με%**	**%e**
Relays	Quarter	81.3	0.023	1.96	0.006
	Half	33.2	0.023	0.23	0.006
	Full	16	0.023	0.053	0.006
FETs	Quarter	353	0.023	103	0.006
	Half	169	0.023	50.7	0.006
	Full	83.8	0.023	25.3	0.006

Four-Wire Resistance with Relay Multiplexers

Accuracy Conditions: Auto zero on, one hour warmup, temperature within ±5°C of calibration temperature (module calibrated at 18-28°C).

NOTE: With offset compensation on, accuracy is the same as for the voltmeter alone.

	90-DAY ACCURACY vs APERTURE ±(% of reading + Ω) E1326B & E1345A/47A	
Range	**20/16.7 ms**	**10 µs**
256 Ω	0.035%+18.2 mΩ	0.12%+58.2 mΩ
2 kΩ	0.025%+28.2 mΩ	0.1%+208 m Ω
16 kΩ	0.025%+266 m Ω	0.1%+2.1 Ω
131 kΩ	0.025%+1.1 Ω	0.1%+16.1 Ω
1 MΩ	0.025%+10.5 Ω	0.1%+121 Ω

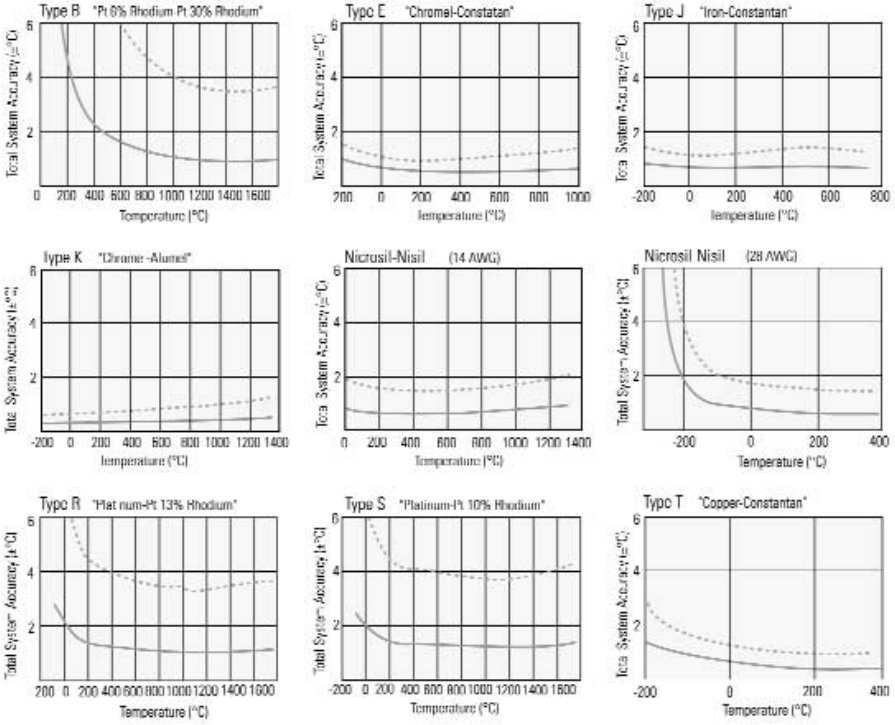
NOTE: Accuracy data includes all errors contributed by the multimeter, analog bus ribbon cables, multiplexer, and transducer linearization (if applicable). The accuracies do not include transducer accuracy errors.

Temperature

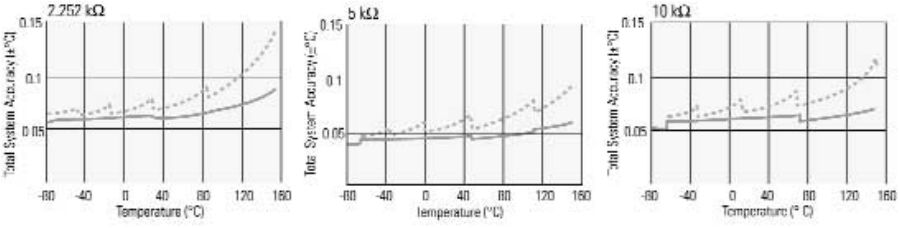
The temperature accuracy graphs (below) include instrument and firmware linearization errors. The linearization algorithm used is based on the ITS-90 standard transducer curves. Add your transducer accuracy to determine total measurement error.

NOTE: The E1406A command modules and Agilent embedded VXI controllers provide units conversion; if the E1411B is register-programmed, your program must make the necessary units conversion.

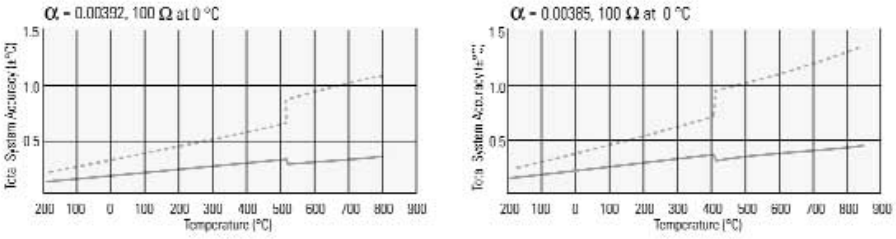
Thermocouple: (E1411B Multimeters and E1347A / E1476A TC MUX)
16 ms aperture (1 PLC): - - - - - - -
100 µs aperture: ———



Thermistors: (E1411B Multimeters and E1345A/E1347A/E1476A MUXs)
4-wire Ω:
16 ms aperture (1 PLC): - - - - - - -
100 µs aperture: ———



RTDs: (E1411B Multimeters and E1345A / E1476A MUXs)
4-wire Ω:
16 ms aperture (1 PLC): - - - - - - -
100 µs aperture: ———



Functions

I_{dc}:	—
I_{ac}:	—
Frequency:	—
Period:	—
Temp.:	T_m T_c RTD

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	Not specified
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	Yes, shared memory available with E1406A SCPI driver
VXI buses:	TTL Trigger Bus

Instrument Drivers

See the Agilent Technologies Website
(http://www.agilent.com/find/inst_drivers)
for driver availability and downloading

Command module firmware:	Downloadable
Command module firmware rev:	A.02
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXI*plug&play* Win Framework:	Yes
VXI*plug&play* Win 95/NT Framework:	Yes
VXI*plug&play* HP-UX Framework:	No

Module Current

	I_{pm}	I_{dm}
+5 V:	0.2	0.01
+12 V:	0.55	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling Slot

Watts/slot:	8.50
ΔP mm H_2O:	0.14
Air Flow liter/s:	0.71

Ordering Information

Description	Product Number
5.5-Digit Multimeter, High-Accuracy, C-Size	E1411B
Service Manual	E1411B 0B3
Japan - Japanese Localization	E1411B ABJ
ANSI Z540 Compliant Calibration	E1411B A6J

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