Racal Instruments™
4152A
6.5 Digit Digital Multimeter

The Racal Instruments™ 4152A 6.5 digit Digital Multimeter (DMM) combines DC and AC current and voltage measurements as well as 2/4 wire Ω, frequency and DC ratio measurements into a one slot, C-sized VXIbus-based instrument. The 4152A includes instrument driver support for standard environments such as LabWindows™/CVI and LabVIEW™.

Key Features

- "Test system" multimeter supports limit testing, averaging, math and vector operations

- Measures AC and DC voltages and currents, 2/4 wire Ω, frequency and DC/DC ratios

- Supports scanner via VXI backplane

- Up to 65 range changes per second and 30 function changes per second

- Up to 6 readings/s at 6.5 digits, 1000 readings/s at 4.5 digits

- Driver support includes LabVIEW™, LabWindows™/CVI and VXI*plug&play*

Product Information

Advanced Features for High "Test System" Throughput

The 4152A's advanced features like limit testing, averaging, speed/resolution trade-offs, and fast function changes provide the high "test system" throughput required in today's production test environments.

The 4152A's limit testing feature supports high-speed go/no-go testing and increases throughput by reducing the need to store and retrieve data. Averaged and vector (multiple read) measurements can be made to reduce external processing and increase throughput.

By fine-tuning the measurement speed of the 4152A's continuously integrating, multi-slope A/D converter, a balance between the need for fast throughput and measurement accuracy can be reached.

For example, at 6.5 digits, the 4152A can take up to 6 readings per second with up to 0.0019% accuracy, or, at 4.5 digits, the 4152A can take up to 1000 readings per second with up to 0.012% accuracy.

Since real-world test systems sometimes require range and function changes within a test cycle, the 4152A can change ranges within a function at a rate of up to 65 per second and can change measurement functions at the rate of up to 30 per second.

Software Driver Support

We provide LabWindows™/CVI, and LabVIEW™ instrument drivers as well as a VXI*plug&play* Install Disk for frameworks based on the Microsoft Win32® application programming interface to support quick integration into the most popular software platforms for VXIbus-based test systems.

Because DMM's used in test systems often require scanned measurements, application examples are given interfacing the 4152A to Racal Instruments™ 1260 Series switching for automatic scanned measurements.

ASTRONICS
TEST SYSTEMS

Specifications

4152A measurement accuracy ±(% of reading + % of range) specifications for 1-hr warm-up at 6.5 digits

Function	Range[2]	Frequency, Burden Voltage, Test Current	24 Hour[1] 23° C ±1° C	90 Day 23° C ±5° C	1 Year 23°C ±5° C	Temperature Coefficient 0° C to 18° C 28° C to 55° C
DC Voltage	100.0000 mV		0.0030+0.0030	0.0040+0.0035	0.0050+0.0035	0.0005+0.0005
	1.000000 V		0.0020+0.0006	0.0030+0.0007	0.0040+0.0007	0.0005+0.0001
	10.00000 V		0.0015+0.0004	0.0020+0.0005	0.0035+0.0005	0.0005+0.0001
	100.0000 V		0.0020+0.0006	0.0035+0.0006	0.0045+0.0006	0.0005+0.0001
	300.0000 V		0.0020+0.0018	0.0035+0.0030	0.0045+0.0030	0.0005+0.0003
Resistance[3]	100.0000 Ω	1 mA	0.0030+0.0030	0.008+0.004	0.010+0.004	0.0006+0.0005
	1.000000 kΩ	1 mA	0.0020+0.0005	0.008+0.001	0.010+0.001	0.0006+0.0001
	10.00000 kΩ	100 µA	0.0020+0.0005	0.008+0.001	0.010+0.001	0.0006+0.0001
	100.0000 kΩ	10 µA	0.0020+0.0005	0.008+0.001	0.010+0.001	0.0006+0.0001
	1.000000 MΩ	5 µA	0.002+0.001	0.008+0.001	0.010+0.001	0.0010+0.0002
	10.0000 MΩ	500 nA	0.015+0.001	0.035+0.001	0.054+0.001	0.0030+0.0004
	100.0000 MΩ	500 nA ‖ 10 mΩ	0.300+0.010	0.8+0.010	0.8+0.010	0.1500+0.0002
DC Current	10.00000 mA	<0.1 V	0.005+0.010	0.050+0.020	0.70+0.020	0.005+0.0020
	100.0000 mA	<0.6 V	0.01+0.004	0.040+0.005	0.070+0.005	0.006+0.0005
	1.000000 A	<1 V	0.10+0.006	0.130+0.010	0.150+0.010	0.005+0.0010
	3.000000 A	<2 V	0.70+0.020	0.720+0.020	0.720+0.020	0.005+0.0020
True RMS AC Voltage[4]	100.0000 mV	3 Hz to 5 Hz	1.00+0.03	1.00+0.04	1.00+0.04	0.100+0.004
	100.0000 mV	5 Hz to 10 Hz	0.35+0.03	0.35+0.04	0.35+0.04	0.035+0.004
	100.0000 mV	10 Hz to 20 kHz	0.04+0.03	0.05+0.04	0.06+0.04	0.005+0.004
	100.0000 mV	20 kHz to 50 kHz	0.10+0.05	0.11+0.05	0.12+0.05	0.011+0.005
	100.0000 mV	50 kHz to 100 kHz	0.55+0.08	0.60+0.08	0.60+0.08	0.060+0.008
	100.0000 mV	100 kHz to 300 kHz	5.00+0.50	5.00+0.50	5.00+0.50	0.020+0.020
	1.000000 V to 300.000 V[5]	3 Hz to 5 Hz	1.00+0.02	1.00+0.03	1.00+0.03	0.100+0.003
	1.000000 V to 300.000 V[5]	5 Hz to 10 Hz	0.35+0.02	0.35+0.03	0.35+0.03	0.035+0.003
	1.000000 V to 300.000 V[5]	10 Hz to 20 kHz	0.04+0.02	0.05+0.03	0.06+0.03	0.005+0.003
	1.000000 V to 300.000 V[5]	20 kHz to 50 kHz	0.10+0.04	0.11+0.05	0.12+0.05	0.011+0.005
	1.000000 V to 300.000 V[5]	50 kHz to 100 kHz	0.55+0.08	0.60+0.08	0.60+0.08	0.060+0.008
	1.000000 V to 300.000 V[5]	100 kHz to 300 kHz[6]	5.00+0.50	5.00+0.50	5.00+0.50	0.200+0.020
True RMS AC Current[4]	1.000000 A	3 Hz to 5 Hz	1.05+0.04	1.05+0.04	1.05+0.04	0.100+0.006
	1.000000 A	5 Hz to 10 Hz	0.35+0.04	0.35+0.04	0.35+0.04	0.035+0.006
	1.000000 A	10 Hz to 1 kHz	0.15+0.04	0.15+0.04	0.15+0.04	0.015+0.006
	1.000000 A	1 kHz to 50 kHz	0.40+0.04	0.40+0.04	0.40+0.04	0.015+0.006
	3.000000 A	3 Hz to 5 Hz	1.70+0.06	1.70+0.06	1.70+0.06	0.100+0.006
	3.000000 A	5 Hz to 10 Hz	0.95+0.06	0.95+0.06	0.95+0.06	0.035+0.006
	3.000000 A	10 Hz to 1 kHz	0.75+0.06	0.75+0.06	0.75+0.06	0.015+0.006
	3.000000 A	1 kHz to 50 kHz	1.00+0.06	1.00+0.06	1.00+0.06	0.15+0.06

Specifications

Note: The Astronics Test Systems policy is one of continuous development and improvement. Consequently, the equipment may vary in detail from the description and specifications in this publication.

4152A measurement accuracy ±(% of reading + % of range) specifications for 1-hr warm-up at 6.5 digits – continued from pg. 2

Function	Range	Frequency, Burden Voltage, Test Current	24 Hour 23° C ±1° C	90 Day 23° C ±5° C	1 Year 23°C ±5° C	Temperature Coefficient 0° C to 18° C 28° C to 55° C
Frequency and Period	100 mV to 300 V	3 Hz to 5 Hz	0.1	0.1	0.1	0.005
	100 mV to 300 V	5 Hz to 10 Hz	0.05	0.05	0.06	0.005
	100 mV to 300 V	10 Hz to 40 Hz	0.03	0.03	0.03	0.001
	100 mV to 300 V	40 Hz to 300 kHz	0.006	0.01	0.01	0.001

Notes:

1 Relative to calibration standards

2 20% overrange on all ranges, except 200 VDC and 3 A range, which have a 1% overrange

3 Specifications are for 4-wire Ω function, or 2-wire Ω using Math Null, add 0.2 Ω additional error in 2-wire Ω function.

4 100 mV to 100 V range specifications are for sine wave input >5% of range. For inputs from 1% to 5% of range and <50 kHz, add 0.1% of range additional error. For 50 kHz to 100 kHz, add 0.13% additional error. 300 V range specifications are for sinewave input >15% of range. For inputs from 3% to 15% of range and >50 kHz, add 0.30% of kHz, add 0.40% of range additional error.

5 For 300 V range, use (% reading) shown in table and multiply each (% range) x 3.

6 300 VAC range limited to 50 kHz. For frequencies >50 kHz, signals must be ≤1.5 x 10^7 VHz.

DC Voltage Characteristics

Summary

- Voltage (max): 300 V
- Voltage Accuracy: ± 0.0019%

Measurement Method

- Continuously integrating, multi-slope III A/D converter

A/D Linearity

- 0.0002% of reading + 0.0001% of range

Input Resistance

- 0.1 V, 1 V, 10 V Ranges: 10 MΩ or 10 GΩ, selectable
- 100 V, 300 V Ranges: 10 MΩ ±1%

Input Bias Current

- <30 pA at 25° C

Input Protection

- 300 VDC/300 V_{rms} on all ranges

Additional Error With Autozero Off

- 100 mV to 100 V Ranges: Add 0.002% of reading + 5 mV
- 300 V Range: Add 0.0006% of reading

AC Voltage Characteristics

Summary

- Voltage (max): 300 V_{rms}
- Voltage Accuracy: ±0.07%

Measurement Method

- AC-coupled True RMS – measures the AC component of the input with up to 300 VDC of bias on any range (Max AC+DC = 300 V_{rms})

AC Filter Bandwidth

- Slow: 3 Hz to 300 kHz
- Medium: 20 Hz to 300 kHz
- Fast: 200 Hz to 300 kHz

Noise Rejection (for 1 kΩ imbalance in LO lead)

- AC CMRR: 70 dB

Input Impedance

- 1 MΩ ±2% || 100 pF

Input Protection

- 300 VDC/300 V_{rms} on all ranges

Additional Low-Frequency Errors (% reading)

(frequencies <100 Hz, slow AC filter, sine input)

AC Filter

Frequency	Medium	Fast
10 to 20 Hz	0.74	—
20 to 40 Hz	0.22	—
40 to 100 Hz	0.06	0.73
100 to 200 Hz	0.01	0.22
200 Hz to 1 kHz	0	0.18
>1 kHz	0	0

Additional Crest Factor Errors (Crest factor range: % of reading add'l error)

- 1-2: 0.05% of reading
- 2-3: 0.15% of reading
- 3-4: 0.30% of reading
- 4-5: 0.40% of reading

Additional Error With Autozero Off

- 100 mV to 100 V Ranges: Add 0.002% of reading + 5 µV
- 300 V Range: Add 0.0006% of reading

DC Current Characteristics

Summary

- Current (max): 3 A
- Current Accuracy: ±0.015%

Shunt Resistance

- 10 mA, 100 mA Ranges: 5 Ω
- 1 A, 3 A Ranges: 0.1 Ω

Input Protection

- 3 A, 250 V fuse (externally accessible)

Burden Voltage

- 10 mA Range: <0.1 V
- 100 mA Range: <0.6 V
- 1 A Range: <1 V
- 3 A Range: <3 V

AC Current Characteristics

Summary

- Current (max): 3 A_{rms}
- Current Accuracy: ±0.19%

Specifications
continued

Measurement Method
- Direct couple to the fuse and shunt
- AC coupled True RMS measurement (measures the AC component only)

Shunt Resistance
- 0.1 Ω

Input Protection
- 3 A, 250 V fuse (externally accessible)

Burden Voltage
- 1 A Range: <1 V_{rms}
- 3 A Range: <3 V_{rms}

Resistance Characteristics

Summary
- Resistance (max): 100 MΩ
- Resistance Accuracy: ± 0.0025%

Measurement Method
- Selectable 4-wire or 2-wire Ω (current source referenced to low input)

Lead Resistance (max)
- 100 Ω Range: 10% of range per lead
- Other Ranges: 1 kΩ per lead

Input Protection
- 300 VDC/300 V_{rms} on all ranges

Frequency And Period

Summary
- Voltage (max): 300 V_{rms}
- Accuracy: 0.006% of reading

Measurement Method
- Reciprocal-counting technique
- AC-coupled input using the AC voltage measurement function

Voltage Ranges
- 100 mV_{rms} to 300 V_{rms}, auto or manual

Gate Time
- 10 ms, 100 ms or 1 s

Settling Considerations
- Errors will occur when attempting to measure the frequency or period of an input following a DC offset voltage change. The input blocking RC time constant must be allowed to fully settle (up to 1 s) before the most accurate measurements are possible.

Measurement Considerations
- All frequency counters are susceptible to error when measuring low-voltage, low-frequency signals. Shielding inputs from external noise pickup is critical for minimizing measurement errors.

DC-DC Ratio Characteristics

Measurement Method
- Input HI-LO/Reference HI-LO (apply "reference HI-LO" signal to Ω 4-wire sense terminals)

Input Signal Range
- Input HI to Input LO: 100 mV to 300 V
- Reference HI to Input LO: <12 V on 100 mV to 10 V ranges (autoranged)
- Reference LO to Input LO: <2 V

DC-DC Ratio Accuracy
- (Input Accuracy[1]) + (Reference Accuracy[2])

System Considerations

Settling Considerations
- Reading settling times is affected by source impedance, cable dielectric characteristics, and input signal changes.

Measurement Considerations
- We recommend the use of Teflon® or other high impedance, low-dielectric absorption wire insulation for these measurements.

DCV, DCI and Ω Reading Speeds
(Reading speeds for 60 Hz and [50 Hz] operation, autozero off)

Digits	Readings/s	Additional Noise Error
6.5	0.6[0.5]	0% of range
6.5	6[5]	0% of range
5.5	60[50]	0.001% of range*
5.5	300	0.001% of range*
4.5	1000	0.01% of range*

* For 300 V range: use 0.003% of range for 5.5 digits and 0.030% of range for 4.5 digits. For all ranges: add 20 µV for DC Volts, 4 µA for DC current, or 20 mΩ for resistance.

DC System Speeds
(Speeds are for 4.5 digits, Delay=0, Autozero Off. Includes measurement and data over VXI backplane)
- Function Change: 30/s
- Range Change: 65/s
- Autorange Time: <30 ms
- Internal Trigger Rate (max): 1000/s
- External Trigger Rate to Memory (max): 1000/s

ACV and ACI Reading Speeds
(Maximum reading rates 0.01% of AC step additional error. Additional settling delay required when input DC level varies.)

Digits	Readings/s	AC Filter
6.5	7s/reading	Slow
6.5	1	Medium
6.5	1.6[1]	Fast
6.5	10	Fast
6.5	50[2]	Fast

[1] For External Trigger or when using default settling delay (Delay Auto)
[2] Maximum useful limit within default settling delays used.

AC System Speeds
(Maximum useful limit with default settling delays used; speeds are for 4.5 digits, delay 0, and fast AC filter.)
- Function Change: 5/s
- Range Change: 5/s
- Autorange Time: <0.8 s
- Internal Trigger Rate (max): 50/s
- External Trigger Rate to Memory (max): 50/s

Frequency and Period Reading Speeds
(Speeds are for 4.5 digits, Delay=0, and fast AC filter.)

Digits	Readings/s
6.5	1
5.5	9.8
4.5	80

Frequency and Period System Speeds
- Configuration Rates: 14/s
- Autorange Time: <0.6s
- Internal Trigger Rate (max): 80/s
- External Trigger Rate to Memory(max): 80/s

Trigger Characteristics

Input Sources
- Internal: 1 kHz max
- External: Front Panel BNC, 1 kHz max
- VXI Backplane: TTLTrg0-7
- Software: *TRG, WS Trigger Cmd

Trigger Delay
- Range: 0 to 3600 seconds
- Resolution: 2 ms

VM (Voltmeter) Complete Out
- Front Panel: BNC
- VXI Backplane: TTLTrg0-7

Specifications
continued

Interface
(Single-slot, Message-based, VXIbus 1.4 Compliant)

Backplane Signal Support
• TTLTrg0-7: Trigger In, VM Complete
• Out

Status Lights
• Red: Power-On Self-Test Failure
• Red: Error(s) in error queue
• Green: Module accessed on VXIbus
• Green: Sample taken

Peak Current & Power Consumption
• Total Power: 9.4 W

	I_{PM} (A)	I_{DM} (A)
+24 V	0.0	0.0
+12 V	0.7	0.06
+5 V	0.2	0.1
-2 V	0.0	0.0
-5.2 V	0.0	0.0
-12 V	0.0	0.0
-24 V	0.0	0.0

Front Panel I/O

Trigger Input
• Connector: BNC
• Level: TTL

VM Complete Output
• Connector: BNC
• Level: TTL

Ground Connection
• Connector: Uninsulated banana jack

Voltage
• Connectors: Copper Alloy Banana Jacks (Hi/Lo)
• Impedance: 10 MΩ or 10 GΩ, selectable
• Protection: 300 VDC/300 V_{rms}

Resistance (2-wire)
• Connectors: Copper Alloy Banana Jacks (Hi/Lo)
• Protection: 300 VDC/300 V_{rms}

Current
• Connectors: Copper Alloy Banana Jacks ("I"/Lo)
• Impedance: 0.1 Ω or 5 Ω, depending on range
• Protection: 3 A/250 V fuse

Resistance (4-wire)
• Connectors: Copper Alloy Banana Jacks (Ω 4 W Sense Hi/Lo)
• Protection: 300 VDC/300 V_{rms}

Software

Software Compliance
• SCPI 1993, IEEE488.2

Drivers
• LabVIEW™, LabWindows™/CVI, VXI*plug&play* support for frameworks based on Microsoft Win32® application programming interface

Environmental

Temperature
• Operating: 0° C to 55° C
• Storage: -40° C to 70° C

Humidity (non-condensing)
• <40° C: 65%[1]
• 1RH > 65% may necessitate recalibration

Overvoltage
• Category 1 (1500 V_{pk} max impulse)

EMC (Council Directive 89/336/EEC)
• CISPR11, EN55011 Group 1 Class A,
• EN50082-1, IEC 801-2, 3, 4

Safety (Low Voltage Directive 73/23/EEC)
• EN61010-1, IEC1010-1, UL3111-1,
• CSA 22.2#1010

Mechanical

Weight
• 2 lbs 10 oz (1.2 kg)

Cooling (10° C Rise)
• 0.80 l/s @ 0.05 mm H_2O

[1] Input Accuracy = accuracy specification for the HI-LO input signal

[2] Reference Accuracy = accuracy specification for HI-LO reference input signal

The CE Mark indicates that the product has completed and passed rigorous testing in the area of RF Emissions and Immunity to Electromagnetic Disturbances, and complies with European electrical safety standards.
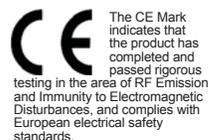
Ordering Information

407654 : Racal Instruments™ 4152A
6.5 Digit Multimeter