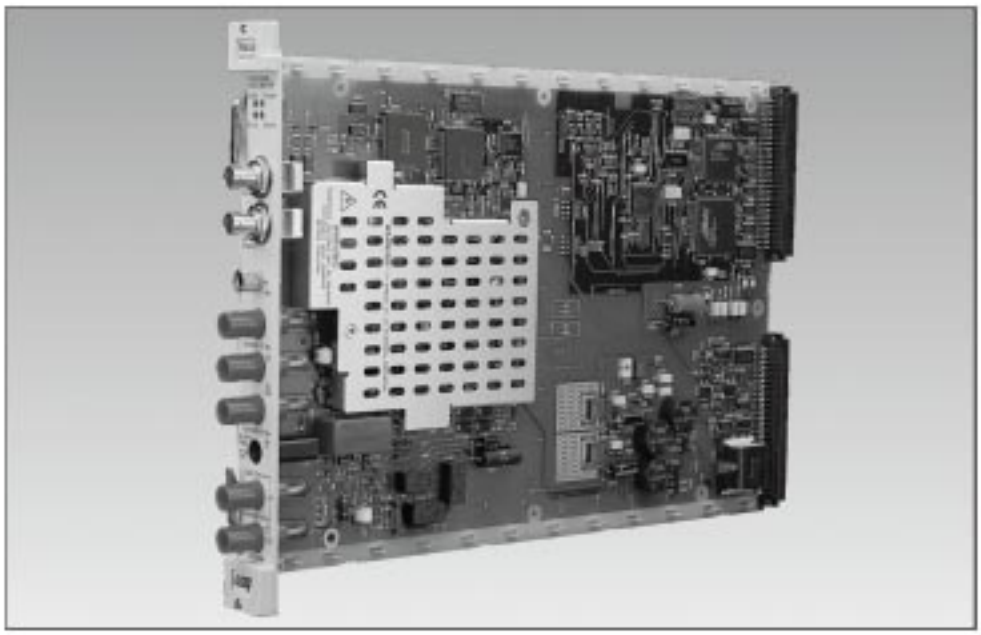
PRODUCT INFORMATION

6.5 Digit Digital Multimeter
Model 4152A



- **"Test System" Multimeter Supports Limit Testing, Averaging, Math and Vector Operations**
- **Measures AC and DC Voltages and Currents, 2/4 Wire Ohms, 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***

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

Advanced Features for High "Test System" Throughput
The Model 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
Racal Instruments provides LabWindows/CVI, and LabVIEW instrument drivers as well as a VXI*plug&play* Install Disk for the WIN and WIN32 Frameworks which adds support for Visual Basic, C and C++, 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 scannned measurements.

4152A Specifications

DC VOLTAGE CHARACTERISTICS

Summary
Voltage (max): 300V
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
0.1V, 1V, 10V Ranges: 10MΩ or 10GΩ, selectable
100V, 300V Ranges: 10MΩ ± 1%

Input Bias Current
<30pA at 25°C

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

VDC Accuracy ± (% of reading + % of range)
(specifications are for 1 hour warm-up at 6.5 digits)

Range[2]	24 Hour[1] 23°C ± 1°C	90 Day 23°C ± 5°C	1 Year 23°C ± 5°C
100.0000mV	0.0030+0.0030	0.0040+0.0035	0.0050+0.0035
1.000000V	0.0020+0.0006	0.0030+0.0007	0.0040+0.0007
10.00000V	0.0015+0.0004	0.0020+0.0005	0.0035+0.0005
100.0000V	0.0020+0.0006	0.0035+0.0006	0.0045+0.0006
300.0000V	0.0020+0.0018	0.0035+0.0030	0.0045+0.0030

[1]Relative to calibration standards
[2]20% overrange on all ranges, except 300VDC range.

Additional Error With Autozero Off
100mV-100V Ranges: Add 0.002% of reading + 5µV
300V Range: Add 0.0006% of reading

Temperature Coefficient
± (% of reading + % of range)
(0°C-18°C, 28°C-55°C, after 1 hour warm-up at 6.5 digits)
100mV Range: 0.0005 + 0.0005
1V, 10V, 100V Ranges: 0.0005 + 0.0001
300V Range: 0.0005 + 0.0003

AC VOLTAGE CHARACTERISTICS

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

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

AC Filter Bandwidth
Slow: 3Hz-300kHz
Medium: 20Hz-300kHz
Fast: 200Hz-300kHz

Noise Rejection (for 1kΩ imbalance in LO lead)
AC CMRR: 70dB

Input Impedance
1MΩ ± 2% || 100pF

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

True RMS VAC Accuracy[2,4]
± (% of reading + % of range)
(1 hour warm-up, 6.5 digits, slow AC filter, sine input)

Frequency	24 Hour[1] 23°C ± 1°C	90 Day 23°C ± 5°C	1 Year 23°C ± 5°C
3-5Hz	1.00+0.02[6]	1.00+0.03[6]	1.00+0.03[6]
5-10Hz	0.35+0.02[6]	0.35+0.03[6]	0.35+0.03[6]
10Hz-20kHz	0.04+0.02[6]	0.05+0.03[6]	0.06+0.03[6]
20-50kHz	0.10+0.04	0.11+0.05	0.12+0.05
50-100kHz	0.55+0.08	0.60+0.08	0.60+0.08
100-300kHz[5]	5.00+0.50	5.00+0.50	5.00+0.50

[1]Relative to calibration standards
[2]20% overrange on all ranges, except 300VAC range which has 1% overrange.
[3]100mV to 100V range specifictions are for sine wave input >5% of range. For inputs from 1% to 5% of range and <50kHz, add 0.1% of range additional error.
[4]For 300V range, use (% reading) shown in table and multiply each (% range) x 3.
[5]300VAC range limited to 50kHz. For frequencies > 50kHz, signals must be ≤1.5x10[7]VHz
[6]For 100mV range, add 0.01% of range additional error.

Additional Low-Frequency Errors
(% reading)
(frequencies < 100Hz, slow AC filter, sine input)

Frequency	AC Filter Medium	Fast
10-20Hz	0.74	———
20-40Hz	0.22	———
40-100Hz	0.06	0.73
100-200Hz	0.01	0.22
200Hz-1kHz	0	0.18
>1kHz	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
100mV-100V Ranges: Add 0.002% of reading + 5µV
300V Range: Add 0.0006% of reading

Temperature Coefficient
± (% of reading + % of range)
(0°C-18°C, 28°C-55°C, 1 hour warm-up, 6.5 digits, slow AC filter, sine input)
3-5Hz: 0.100 + 0.003[1]
5-10Hz: 0.035 + 0.003[1]
10Hz-20kHz: 0.005 + 0.003[1]
20-50kHz: 0.011+0.005
50-100kHz: 0.060+0.008
100-300kHz: 0.200+0.020[2]

[1]For 100mV range, add 0.001% of range additional error.
[2]300VAC range limited to 50kHz. For frequencies > 50kHz, signals must be ≤1.5x10[7]VHz

DC CURRENT CHARACTERISTICS

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

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

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

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

DC Current Accuracy
± (% of reading + % of range)
(specifications are for 1 hour warm-up at 6.5 digits)

Range[2]	24 Hour[1] 23°C ± 1°C	90 Day 23°C ± 5°C	1 Year 23°C ± 5°C
10.00000mA	0.005+0.010	0.050+0.020	0.070+0.020
100.0000mA	0.01+0.004	0.040+0.005	0.070+0.005
1.000000mA	0.10+0.006	0.130+0.010	0.150+0.010
3.000000mA	0.70+0.020	0.720+0.020	0.720+0.020

[1]Relative to calibration standards
[2]20% overrange on all ranges, except 3A range.

Temperature Coefficient
± (% of reading + % of range)
(0°C-18°C, 28°C-55°C, after 1 hour warm-up at 6.5 digits)
10mA Range: 0.005 + 0.0020
100mA Range: 0.006 + 0.0005
1A Range: 0.005 + 0.0010
3A Range: 0.005 + 0.0020

4152A Specifications

AC CURRENT CHARACTERISTICS

Summary

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

Measurement Method

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

Shunt Resistance

0.1Ω

Input Protection

3A, 250V fuse (externally accessible)

Burden Voltage

1A Range: $<1V_{rms}$
3A Range: $<3V_{rms}$

True RMS Current Accuracy[2,4]

±(% of reading + % of range)
(1 hour warm-up, 6.5 digits, slow AC filter, sine input)

Frequency	24 Hour[1] 23°C ± 1°C	90 Day 23°C ± 5°C	1 Year 23°C ± 5°C
3-5Hz	1.05+0.04	1.05+0.04	1.05+0.04
5-10Hz	0.35+0.04	0.35+0.04	0.35+0.04
10Hz-1kHz	0.15+0.04	0.15+0.04	0.15+0.04
1-50kHz	0.40+0.04	0.40+0.04	0.40+0.04

[1]Relative to calibration standards
[2]20% overrange on all ranges, except 3A range which has 1% overrange.
[3]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. 300V 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.
[4]Accuracy for 1A range given. For 3A range, add 0.60+0.02 to table values and an extra 0.05+0.00 between 3-5Hz.

Low-Frequency & Crest Factor Errors

See VAC section

Temperature Coefficient[2]

±(% of reading + % of range)
(0°C-18°C, 28°C-55°C, 1 hour warm-up, 6.5 digits, slow AC filter, sine input)

3-5Hz: 0.100 + 0.006
5-10Hz: 0.035 + 0.006
10Hz-1kHz: 0.015 + 0.006
1-50kHz: 0.015+0.006[1]

[1]For 3A range, add 0.135+0.00 additional error.
[2]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. 300V 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.

RESISTANCE CHARACTERISTICS

Summary

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

Measurement Method

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

Lead Resistance (max)

100Ω Range: 10% of range per lead
Other Ranges: 1kΩ per lead

Input Protection

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

Test Current

100Ω, 1kΩ Range: 1mA
10kΩ Range: 100µA
100kΩ Range: 10µA
1MΩ Range: 5µA
10MΩ Range: 500nA
100MΩ Range: 500nA || 10MΩ

Ohms Accuracy±(% of reading + % of range)

(specifications are for 1 hour warm-up at 6.5 digits)

Range[2]	24 Hour[1] 23°C ± 1°C	90 Day 23°C ± 5°C	1 Year 23°C ± 5°C
100.0000Ω	0.0030+0.0030	0.008+0.004	0.010+0.004
1.000000kΩ	0.0020+0.0005	0.008+0.001	0.010+0.001
10.00000kΩ	0.0020+0.0005	0.008+0.001	0.010+0.001
100.0000kΩ	0.0020+0.0005	0.008+0.001	0.010+0.001
1.000000MΩ	0.002+0.001	0.008+0.001	0.010+0.001
10.00000MΩ	0.015+0.001	0.035+0.001	0.054+0.001
100.0000MΩ	0.300+0.010	0.8+0.010	0.8+0.010

[1]Relative to calibration standards
[2]Specifications are for 4-wire Ω function, or 2-wire Ω using Math Null. Without Math Null, add 0.2Ω additional error in 2-wire Ω function.

Temperature Coefficient[1]

±(% of reading + % of range)
(0°C-18°C, 28°C-55°C, after 1 hour warm-up at 6.5 digits)

100Ω Range: 0.0006 + 0.0005
1kΩ, 10kΩ, 100kΩ Ranges: 0.0006 + 0.0001
1MΩ Range: 0.0010 + 0.0002
10MΩ Range: 0.0030 + 0.0004
100MΩ Range: 0.1500 + 0.0002

[1]Specifications are for 4-wire Ω function, or 2-wire Ω using Math Null. Without Math Null, add 0.2Ω additional error in 2-wire Ω function.

FREQUENCY AND PERIOD

Summary

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

Measurement Method

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

Voltage Ranges

$100mV_{rms}$ to $300V_{rms}$, auto or manual.

Gate Time

10ms, 100ms or 1s

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.

Frequency and Period Accuracy[2]

(% of reading)
(1 hour warm-up, 6.5 digits)

Frequency	24 Hour[1] 23°C ± 1°C	90 Day 23°C ± 5°C	1 Year 23°C ± 5°C
3-5Hz	0.10	0.10	0.10
5-10Hz	0.05	0.05	0.06
10Hz-40Hz	0.03	0.03	0.03
40Hz-300kHz	0.006	0.01	0.01

[1]Relative to calibration standards
[2]20% overrange on all ranges, except 300VAC range which has 1% overrange.

Additional Low-Frequency Errors

(% of reading)
(input >100mV. For mV input, multiply % of reading error x 10)

Frequency	6.5 Digits	5.5 Digits	4.5 Digits
3-5Hz	0	0.12	0.12
5-10Hz	0	0.17	0.17
10-40Hz	0	0.2	0.2
40-100Hz	0	0.06	0.21
100-300Hz	0	0.03	0.21
300Hz-1kHz	0	0.01	0.07
>1kHz	0	0	0.02

Temperature Coefficient[1]

±(% of reading + % of range)
(0°C-18°C, 28°C-55°C, 1 hour warm-up, 6.5 digits, slow AC filter, sine input)

3-5Hz: 0.005
5-10Hz: 0.005
10Hz-40Hz: 0.001
40Hz-300kHz: 0.001

[1]20% overrange on all ranges, except 300VAC range which has 1% overrange.

DC-DC RATIO CHARACTERISTICS

Measurement Method

Input HI-LO/Reference HI-LO (apply "reference HI-LO" signal to Ohms 4-wire sense terminals.

Input Signal Range

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

DC-DC Ratio Accuracy

(Input Accuracy[1]) + (Reference Accuracy[2])

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

SYSTEM CONSIDERATIONS

Settling Considerations

Reading settling times are affected by source impedance, cable dielectric characteristics, and input signal changes.

Measurement Considerations

Racal Instruments recommends the use of Teflon® or other high impedance, low-dielectric absorption wire insulation for these measurements.

Teflon is a registered trademark of E.I. duPont deNemours and Co.

DCV, DCI and Ω Reading Speeds

(readings speeds for 60Hz and[50Hz] 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 300V range: use 0.003% of range for 5.5 digits and 0.030% of range for 4.5 digits. For all ranges: add 20µV for DC Volts, 4µA for DC current, or 20mΩ 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: <30ms
Internal Trigger Rate (max): 1000/s
External Trigger Rate to Memory (max): 1000/s

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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: <0.8s
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: 1kHz max
External: Front Panel BNC, 1kHz max
VXI Backplane: TTLTrg0-7
Software: *TRG, WS Trigger Cmd.

Trigger Delay

Range: 0-3600 seconds
Resolution: 2ms

VM (Voltmeter) Complete Out

Front Panel: BNC
VXI Backplane: TTLTrg0-7

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: 10MΩ or 10GΩ, selectable
Protection: 300VDC/300V_{rms}

Resistance (2-wire)

Connectors: Copper Alloy Banana Jacks (Hi/Lo)
Protection: 300VDC/300V_{rms}

Current

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

Resistance (4-wire)

Connectors: Copper Alloy Banana Jacks (Ω4W Sense Hi/Lo)
Protection: 300VDC/300V_{rms}

VXIbus INTERFACE DATA

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

Software Compliance

SCPI 1993, IEEE488.2

Drivers

LabVIEW, LabWindows/CVI, VXI *plug&play* (WIN, WIN95, WIN NT Frameworks)

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

Cooling (10°C Rise)

0.80 l/s @ 0.05mmH_2O

Peak Current & Power Consumption

	+24	+12	+5	-2	-5.2	-12	-24
I_{Pm}(A)	0.0	0.7	0.2	0.0	0.0	0.0	0.0
I_{Dm}(A)	0.0	0.06	0.1	0.0	0.0	0.0	0.0

Total Power: 9.4 Watts

ENVIRONMENTAL

Temperature

Operating: 0°C-55°C
Storage: -40°C-70°C

Humidity (non-condensing)

<40°C: 65%[1]

[1]RH > 65% may necessitate recalibration

Overvoltage

Category 1 (1500V peak max impulse)

Weight

2lbs. 10oz. (1.2kg)

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

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

ORDERING INFORMATION

Model	Description	Part Number
4152A	6.5 Digit Digital Multimeter	407654

The Racal policy is one of continuous development and consequently the equipment may vary in detail from the description and specification in this publication.

RACAL INSTRUMENTS

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