

METRAHit® 16I and 16T

Analog-Digital Multimeter with Insulation Measurement

3-348-972-03
2/3.99

- Insulation resist. measurement: 16I: 500 V/1000 V, 16T: 100 V
- Multifunctional multimeter (V, Ω , μ F, Hz)
- AC and AC+DC TRMS measurement
- Input resistance for voltage measurement adjustable between 10 M Ω and 1 M Ω
- Scaled current measurement from 10 mA to 100 A with accessory clip-on current sensor
- Precision temperature meter, °C or °F, for Pt100 and Pt1000 sensors
- Acoustic signals for:
 - Continuity testing
 - Dangerous contact voltages
 - Violation of overrange limits
 - Falling below generally valid limit values for insulation resistance measurement
- Storage of min/max values
- Rugged, reliable design, protective rubber cover as standard equipment and ABS (Automatic Blocking System for 16I)
- Windows software for graphic representation of measurement values and calibration via accessory RS232 interface



Multimeter with Insulation Measurement

METRAHit® 16I and 16T multimeters allow for insulation resistance measurement with a test voltage of 500 V or 1000 V for the METRAHit® 16I, or 100 V for the METRAHit® 16T in addition to multimeter functions. The METRAHit® 16I includes the V_{1M Ω} selector switch position. Capacitive DUTs can be discharged with this function, and display errors due to capacitive coupling during voltage measurements can be curtailed.

RMS Value with Distorted Waveform

The measuring process allows for TRMS measurement independent of the waveform for periodic quantities (AC) and pulsating quantities (AC and DC).

Display of Negative Values at the Analog Scale

Negative values are also displayed at the analog scale for zero-frequency quantities, so that fluctuations of the measured quantity at the zero point can be observed.

Automatic Measurement Value Storage

The stabilized measurement value is automatically retained by the DATA HOLD function. A patented process assures that the actual measurement value is stored rather than a random value, even when rapid changes to the measured quantity occur. The stored measurement value appears at the digital display. The display of current measurement values is continued at the analog scale.

Automatic/Manual Measuring Range Selection

Quantities to be measured are selected with the rotary switch. The measuring range can either be matched automatically to the measurement value, or selected manually.

Calibration

METRAHit® 16I and 16T multimeters are shipped with DKD calibration certificates. In addition to standard electrical quantities, our DKD calibration laboratory is also accredited for high value resistance of up to 30 G Ω /1000 V.

Multimeters can be re-calibrated in our DKD calibration laboratory after expiration of the customer selected calibration interval (manufacturer recommended interval of 1 year).

Guarantee

3 years material and workmanship.

Applicable Regulations and Standards

IEC 61010-1 EN 61010 Part 1 VDE 0411-1	Safety regulations for electrical measuring, regulating, control, and laboratory devices
DIN 43751	Digital measuring instruments
EN 50081 Part 1	Generic standard for interference emission; residential, business and light industry
EN 50082 Part 1	Generic standard for interference immunity; residential, business and light industry
VDI/VDE 3540	Reliability of measuring, control and regulating devices
EN 60529 VDE 0470 Part 1	Test instruments and test procedures – Protection provided by enclosures (IP code)
EN 61557-1 VDE 0413 Part 1 EN 61557-2 VDE 0413 Part 2	Devices for testing, measuring or monitoring protective safety measures – Insulation resistance

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Characteristic Values

Measuring Function	Measuring Range	Resolution	Input Impedance		Digital Display Inherent Deviation ±(...% of rdg. + ... digit) at reference conditions	Overload Capacity ³⁾		
						Value	Duration	
V_{DC}	30.00 mV	10 μV	>10 GΩ // < 40 pF		0.5 + 3 ⁴⁾	1200 V ¹¹⁾	continuous	
	300.0 mV	100 μV	>10 GΩ // < 40 pF		0.5 + 3			
	3.000 V	1 mV	11 MΩ // < 40 pF		0.25 + 1			
	30.00 V	10 mV	10 MΩ // < 40 pF		0.25 + 1			
	300.0 V	100 mV	10 MΩ // < 40 pF		0.25 + 1			
	1000 ⁹⁾ V	1 V	10 MΩ // < 40 pF		0.35 + 1			
V_{AC} ¹⁾	3.000 V	1 mV	11 MΩ // < 40 pF		1.0 + 3 (> 10 digits)	DC AC eff sine	continuous	
	30.00 V	10 mV	10 MΩ // < 40 pF					
	300.0 V	100 mV	10 MΩ // < 40 pF					
	1000 ⁹⁾ V	1 V	10 MΩ // < 40 pF					
V_{eff} ¹⁾	3.000 V	1 mV	11 MΩ // < 40 pF		1.0 + 3 (> 10 digits)	DC AC eff sine	continuous	
	30.00 V	10 mV	10 MΩ // < 40 pF					
	300.0 V	100 mV	10 MΩ // < 40 pF					
	1000 ⁹⁾ V	1 V	10 MΩ // < 40 pF					
A_{AC} ²⁾	30/100 A	10/100 mA	—		2.5 + 3 (> 10 digits)	120 A	continuous	
			open-circuit voltage					
Ω	30.00 Ω	10 mΩ	max. 3.2 V		0.5 + 3 ⁴⁾	500 V DC AC eff sine	10 min.	
	300.0 Ω	100 mΩ	max. 3.2 V		0.5 + 3			
	3.000 kΩ	1 Ω	max. 1.25 V		0.4 + 1			
	30.00 kΩ	10 Ω	max. 1.25 V		0.4 + 1			
	300.0 kΩ	100 Ω	max. 1.25 V		0.4 + 1			
	3.000 MΩ	1 kΩ	max. 1.25 V		0.6 + 1			
	30.00 MΩ	10 kΩ	max. 1.25 V		2.0 + 1			
→	2.000 V	1 mV	max. 3.2 V		0.25 + 1			
			discharge resistance	U _{0 max}				
F	30.00 ¹⁰⁾ nF	10 pF	250kΩ	2,5 V	1.0 + 3 ⁵⁾	500 V DC / AC eff sine	10 min.	
	300.0 nF	100 pF	250kΩ	2,5 V	1.0 + 3			
	3.000 μF	1 nF	25 kΩ	2,5 V	1.0 + 3			
	30.00 ¹⁰⁾ μF	10 nF	25 kΩ	2,5 V	3.0 + 3			
			f _{min} V _{DC}	f _{min} V _{AC}				
Hz	300.0 Hz	0.1 Hz	1 Hz	45 Hz	0.5 + 1 ⁶⁾	≤ 1200 V	continuous	
	3.000 kHz	1 Hz	1 Hz	45 Hz				
	30.00 kHz	10 Hz	10 Hz	45 Hz				
	100.0 kHz	100 Hz	100 Hz	100 Hz				0.5 + 1 ⁷⁾
°C	Pt 100	-200.0 ... +200.0 °C	0.1 °C	—	—	2 Kelvin + 5 digits ⁸⁾	500 V DC AC eff sine	10 min.
		+200.0 ... +800.0 °C	0.1 °C	—	—	1.0 + 5 ⁸⁾		
	Pt 1000	-100.0 ... +200.0 °C	0.1 °C	—	—	2 Kelvin + 5 digits ⁸⁾		
		+200.0 ... +800.0 °C	0.1 °C	—	—	1.0 + 5 ⁸⁾		
°F	Pt 100	-300.0 ... +400.0 °C	0.1 °F	—	—	4 Kelvin + 10 digits ⁸⁾	500 V DC AC eff sine	10 min.
		+400.0 ... +999.0 °C	0.1 °F	—	—	1.0 + 10 ⁸⁾		
	Pt 1000	-145.0 ... +400.0 °C	0.1 °F	—	—	4 Kelvin + 10 digits ⁸⁾		
		+400.0 ... +999.0 °C	0.1 °F	—	—	1.0 + 10 ⁸⁾		

¹⁾ TRMS measurement

²⁾ Measurement with type WZ12B clip-on current sensor

³⁾ At -20 °C ... +40 °C

⁴⁾ Without zero setting + 35 digits

⁵⁾ Without zero setting + 50 digits

^{6),7)} Range ⁶⁾ 3 V ≅: U_E = 1.5 V_{eff/rms} ... 100 V_{eff/rms} ⁷⁾ U_E = 2.5 V_{eff} ... 30 V_{eff}

⁶⁾ 30 V ≅: U_E = 15 V_{eff/rms} ... 300 V_{eff/rms} ⁷⁾ U_E = 25 V_{eff} ... 30 V_{eff}

⁶⁾ 300 V ≅: U_E = 150 V_{eff/rms} ... 1000 V_{eff/rms} —

⁸⁾ Without probe

⁹⁾ METRAHit® 16T: 600 V

¹⁰⁾ METRAHit® 16I only

¹¹⁾ METRAHit® 16T: 720 V

METRAHit® 16I and 16T Analog-Digital Multimeter with Insulation Measurement

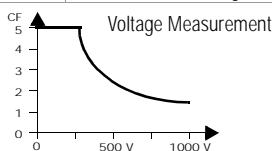
Insulation Measurement

Measuring Function Switch Position	Measuring Range	Resolution	Digital Display Inherent Deviation at Reference Conditions	
16I	V _{1MΩ}	0 ... 1000 V \approx	1 V ±(1% of rdg. + 10 d)	
	MΩ _{ISO}	0 ... 1000 V \approx	1 V ±(1% of rdg. + 10 d)	
	MΩ _{ISO} (U _N = 500 V)	0.100 ... 1.600 MΩ	1 kΩ	±(3% of rdg. + 2 d)
		01.40 ... 16.00 MΩ	10 kΩ	
014.0 ... 160.0 MΩ		100 kΩ		
0140 ... 1600 MΩ	1 MΩ			
16T	MΩ _{ISO} (U _N = 1000 V)	0.100 ... 3.100 MΩ	1 kΩ	±(3% of rdg. + 2 d)
		02.80 ... 31.00 MΩ	10 kΩ	
		028.0 ... 310.0 MΩ	100 kΩ	
		0280 ... 3100 MΩ	1 MΩ	
16T	MΩ (U _N = 100 V)	0 ... 100 V \approx	0.1 V	±(1% of rdg. + 10 d)
		000.0 ... 310.0 kΩ	0.1 kΩ	±(3% of rdg. + 10 d)
		0.280 ... 3.100 MΩ	1 kΩ	±(3% of rdg. + 2 d)
		02.80 ... 3.100 MΩ	10 kΩ	
		028.0 ... 310.0 MΩ	100 kΩ	

Meas. Function Switch Position	Nom. Voltage U _N	Open-Circuit Voltage U _o	Nom. Current I _N	Short-Circuit Current I _k	Acoustic Signal at	Overload Value	Capacity Duration
16I	V _{1MΩ}	—	—	—	U > 1000 V	1200 V \approx	cont.
	MΩ _{ISO}	—	—	—	U > 50 V	1200 V \approx	max. 1 min.
	MΩ _{ISO}	500 V	< 1.15 x U _N	> 1.0 mA	< 2.5 mA	R _x < 1 MΩ	
		1000 V	< 1.15 x U _N	> 1.0 mA	< 2.5 m A	R _x < 2 MΩ	1200 V \approx
16T	MΩ	—	—	—	U > 50 V	250 V \approx	cont.
	MΩ	100 V	< 1.15 x U _N	> 1.0 mA	< 1.5 mA	R _x < 1 MΩ	250 V \approx max. 1 min.

Influencing Quantities and Influence Errors

Influenc. Quantity	Sphere of Influence	Meas. Quantity/ Measuring Range	Influence Error ¹⁾ ±(... % of rdg. + ... digit)
Temperature	0 °C ... +21 °C and +25 °C ... +40 °C	30/300 mV \approx	1.0 + 3
		3 ... 300 V \approx	0.15 + 1
		1000 V ⁵⁾ \approx	0.2 + 1
		V \sim	0.4 + 2
		30 Ω ²⁾	0.15 + 2
		300 Ω	0.25 + 2
		3 kΩ ... 3 MΩ	0.15 + 1
		30 MΩ	1.0 + 1
		30 nF ²⁾ ... 3 μF	0.5 + 2 ⁶⁾
		30 μF	2.0 + 2
		Hz	0.5 + 1
		- 200 ... + 200 °C	0.5 K + 2
		+ 200 ... + 800 °C	0.5 + 2
		- 300 ... + 400 °F	1.0 K + 4
		+ 400 ... + 999 °F	0.5 + 2
Frequency of Meas. Quantity	15 Hz ... < 30 Hz 30 Hz ... < 45 Hz > 65 Hz ... 400 Hz > 400 Hz ... 1 kHz	3 ... 1000 V ⁵⁾ \sim	1.0 + 3
			0.5 + 3
			2.0 + 3
			3.0 + 3
Waveform of Meas. Quantity	crest factor CF 1 ... 3 > 3 ... 5	V \sim ⁴⁾	±1 % of rdg.
			±3 % of rdg.
3)	The allowable crest factor CF for the periodic quantity to be measured depends upon the displayed value:		



- For temperature: indicated error values apply per 10 K change in temperature.
- For frequency: indicated error values valid as of display of 300 digits.
- With zero setting
- For unknown waveform (CF > 2): Measure with manual range selection.
- Except for sinusoidal waveforms
- METRAHit®16T: 600 V
- METRAHit®16T: 2 + 2

Measuring Function	U _N	Nominal Range of Use	Operating Error
16I	500 V	100 kΩ ... 1600 MΩ	± 10%
	1000 V	100 kΩ ... 3100 MΩ	
16T	100 V	100 kΩ ... 310 MΩ	± 10%

Influencing Qty.	Influence Range	Measuring Ranges	Influence Error
Battery Voltage	⚡ ¹⁾ ... < 7.9 V > 8.1 V ... 10.0 V	V \approx	±2 digits
		V \sim	±4 digits
		30 Ω/300 Ω/°C/°F	±4 digits
		3 kΩ ... 30 MΩ	±3 digits
		MΩ _{ISO} , MΩ	±2 digits
		nF, μF	±1 digit
Relative Humidity	75%, 3 days, device off	V \approx , Ω, MΩ _{ISO} , MΩ	1x inherent deviation
		Hz, °C, °F	±1 digit
DATA	—	V \approx	±2 digits
MIN / MAX	—	V \approx	±2 digits

¹⁾ As of display of the ⚡ symbol.

Influencing Quantity	Influence Range	Measuring Ranges	Damping
Common-Mode Interference Voltage	interference max. 1000 V \sim 50 Hz, 60 Hz sine	V \approx	> 120 dB
		3 V \sim , 30 V \sim	> 80 dB
		300 V \sim	> 70 dB
Series-Mode Interference Voltage	interference V \sim , respective meas. range nom. value, max. 1000 V \sim , 50 Hz, 60 Hz sine	1000 V \sim	> 60 dB
		V \approx	> 50 dB
		V \sim	> 110 dB

Response Time (after manual range selection)

Measured Qty./ Meas. Range	Response Time		Measured Quantity Jump Function
	Analog Display	Digital Display	
V \approx , V \sim	0.7 s	1.5 s	from 0 to 80 % of upper range limit
30 Ω ... 3 MΩ	1.5 s	2 s	from ∞ to 50 % of upper range limit
		30 MΩ	
⚡	0.7 s	1.5 s	
nF, μF, °C, °F		max. 1... 3 s	from 0 to 50 % of upper range limit
300 Hz, 3 kHz		max. 2 s	
30 kHz		max. 0.7 s	

Reference Conditions

Ambient Temp.	+23 °C ±2 K
Relative Humidity	45 % ... 55 %
Measured Quantity	
Frequency	45 Hz ... 65 Hz
Measured Quantity	
Waveform	sine
Battery Voltage	8 V ±0.1 V

Display

LCD display field (65 mm x 30 mm) with analog and digital display including display of unit of measure, voltage type and various special functions.

Analog

Display	LCD scale with pointer
Scale Length	55 mm for V \approx ; 47 mm in all other ranges
Scaling	± 5 ... 0 ... ±30 with 35 scale graduations for \approx , 0 ... 30 with 30 scale graduations for all other ranges

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Polarity Display with automatic reversal
 Overflow Display with triangle
 Measurement Rate 20 measurements per second,
 for Ω : 10 measurements per second

Digital

Display/Char. Height 7 segment characters / 15 mm
 Number of Places $3\frac{3}{4}$ places \approx 3100 steps
 Overflow Display "OL" is displayed
 Polarity Display "-" sign is displayed with plus pole at "1"
 Measurement Rate 2 measurements per second,
 for Ω and $^{\circ}\text{C}$: 1 measurement per second

Power Supply

Battery 9 V flat cell battery;
 alkali-manganese cell per IEC 6 LR 61
 Autom. Shut-Down if measurement value remains constant
 and no operating elements are activated
 for approx. 10 minutes. Can also be
 switched to continuous operation.

Meas. Function	Nom. Voltage U_N	DUT Resistance	Service Life in Hours	No. of Measurements Possible with Nom. Curr. per VDE 0413 ²⁾
V $\overline{=}$			750 ¹⁾	
V \sim			150 ¹⁾	
$M\Omega$	100 V	1 $M\Omega$	50	
	100 V	100 $k\Omega$		3000
$M\Omega_{ISO}$	500 V	500 $k\Omega$		600
	1000 V	1 $M\Omega$		200

¹⁾ Times 0.7 for interface operation

²⁾ Battery control: automatic display of the $\overline{+}$ symbol if battery voltage falls below 7 V.

Electrical Safety

Protection Class II per IEC 61010-1/EN 61010-1/
 VDE 0411-1
 Overvoltage Category II * III
 Nominal Voltage 1000 V * 600 V
 Fouling Factor 2 2
 Test Voltage 5.55 kV~ per IEC 61010-1/EN 61010-1

EMC

Emission EN 50081-1:1992/EN 55022:1987 Class B
 Immunity EN 50082-1:1992/IEC 801-2:1991
 8 kV atmospheric discharge
 IEC 801-3:1984 3 V/m
 IEC 801-4:1988 0.5 kV

Interface

Type RS232C, serial, per DIN 19241
 Data Transmission optical with infrared light
 Baud Rate 8192 bit/s

* METRAHit® 16I only

Ambient Conditions

Operating Temp. $-20^{\circ}\text{C} \dots +50^{\circ}\text{C}$
 Storage Temperature $-25^{\circ}\text{C} \dots +70^{\circ}\text{C}$ (without battery)
 Climatic Category 2Z/-10/50/70/75%
 in compliance with VDI/VDE 3540
 Relative Humidity $\leq 75\%$, no condensation allowed
 Elevation to 2000 m

Mechanical Design

Protection instrument: IP 50, connector jacks: IP 20
 Dimensions 84 mm x 195 mm x 35 mm
 Weight approx. 0.35 kg with battery

Order Information

Designation	Type	ID Number
Multimeter with insulation measurement including protective rubber cover, carrying strap and KS 17 cable set for test voltage: 500/1000 V for test voltage: 100 V	METRAHit 16I METRAHit 16T*	M216B M216A
METRAHit® 16I, HC20 carrying case, KS17 cable set, TF220 temperature sensor	METRAHit 16I-Set 1	M216E
METRAHit® 16I, HC20 carrying case, TF220 temperature sensor, WZ12B clip-on current sensor	METRAHit 16I-Set 2	M216F
Single-channel memory pack with SI232 memory adapter, cable and METRAWin®10/METRAHit® software	1-CH. Pack	GTZ 3231 020 R0001
4-channel memory pack with four SI232 memory adapters, cable and METRAWin®10/METRAHit® software	4-CH. Pack	GTZ 3234 020 R0001
Memory adapter for METRAHit®S	SI232 ^{D)}	GTZ 3242 020 R0001
2 meter long RS232 interface cable (included with Z3231)	Z3241	GTZ 3241 000 R0001
METRAWin®10/METRAHit® software update	Z3240	GTZ 3240 000 R0001
PT100 temp. sensor for surface and immersion measurements, $-40 \dots +600^{\circ}\text{C}$	Z3409	GTZ 3409 000 R0001
PT1000 temperature sensor for measurements in gases and liquids, $-50 \dots +220^{\circ}\text{C}$ (for service applications and household appliances)	TF220	Z102A
PT100 oven sensor, $-50 \dots +550^{\circ}\text{C}$	TF550	GTZ 3408 000 R0001
10 adhesive PT100 temperature sensors, from $-50 \dots +550^{\circ}\text{C}$	TS-Chipset	GTZ 3406 000 R0001
Ri adapter: 200 $k\Omega$ /230 V	R200K	Z101A
Carrying bag	F829	GTZ 3301 000 R0003
Ever-ready bag	F836	GTZ 3302 000 R0001
Hard case	HC20	Z113A
Clip-on current sensor 10 mA ... 100 A, 1 mV/10 mA, jaw opening: 15 mm dia.	WZ12B ^{D)}	Z219B

* Data Sheet available

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