

METRAHit® 16U

Cable Multimeter for Measurements in Symmetrical Copper Cable Networks

3-349-227-03
4/8.02

- **Insulation resistance measurement** (test voltage: 100 V) with simultaneous recognition of interference voltage and polarity reversal for diode testing
- **Cable symmetry testing** by means of rapid changeover switching
- **Multifunctional multimeter** (V, Ω, F, Hz)
- **AC and AC+DC TRMS measurement**
- **Scaled current measurement** from 10 mA to 100 A with accessory clip-on current sensor
- **Precision temperature meter** °C, °F, for Pt100 and Pt1000 sensors
- **Display illumination** can be activated
Analog display: linear or logarithmic for insulation measurement
- **Acoustic signals** for:
 - Continuity testing
 - Dangerous contact voltages
 - Violation of overload limits
- **Storage of min/max values**
- **Housing** in IP54, protective rubber cover as standard equipment
- **Windows software** (accessory) for processing and graphic representation of measured values via RS232 interface



Applications

The METRAHit® 16U cable multimeter is a rugged portable measuring instrument for use in the field. It is used to perform measurements for pinpointing errors in copper cable networks. Interruption of a single core, or contact with an open-circuit core (capacitive asymmetry) is recognized at the rapid logarithmic bar graph display through the use of polarity reversal.

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

In order to be able to observe fluctuations of the measured quantity at the zero point, negative values are also displayed at the analog scale for zero-frequency quantities (V DC).

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® 16U multimeters are shipped with DKD calibration certificates which also includes insulation resistance measurement.

Guarantee

3 years material and workmanship.

Standards for Use as Insulation Measuring Instrument

IEC 61010-1 EN 61010, Part 1 VDE 0411-1	Safety requirements for electrical equipment for measurement, control and laboratory use
IEC/EN 61326	Electrical equipment for control technology and laboratory use – EMC requirements
EN 60529 VDE 0470, Part 1	Test instruments and test procedures – Degrees of protection provided by enclosures (IP code)
TS 0293/96	Technical specifications set forth by Deutsche Telekom – Cable multimeters for measurements in symmetrical copper cable networks

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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⁾	600 V	continuous	
	300.0 mV	100 μV	>10 GΩ // < 40 pF		0.5 + 3			
	3.000 V	1 mV	11 MΩ // < 40 pF		0.5 + 1			
	30.00 V	10 mV	10 MΩ // < 40 pF		0.5 + 1			
	300.0 V	100 mV	10 MΩ // < 40 pF		0.5 + 1			
	600 V	1 V	10 MΩ // < 40 pF		0.5 + 1			
V_{AC} ¹⁾	3.000 V	1 mV	11 MΩ // < 40 pF		1.5 + 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					
	600 V	1 V	10 MΩ // < 40 pF					
V_{TRMS} ¹⁾	3.000 V	1 mV	11 MΩ // < 40 pF		1.5 + 3 (> 10 digits)			
	30.00 V	10 mV	10 MΩ // < 40 pF					
	300.0 V	100 mV	10 MΩ // < 40 pF					
	600 V	1 V	10 MΩ // < 40 pF					
A ~ ∞ ²⁾	30/100 A	10/100 mA	—		2.5 + 3 (> 10 digits)	120 A	continuous	
			open-circuit voltage	U _{0 max}				
Ω	30.00 Ω	10 mΩ	max. 3.2 V		0.5 + 3 ⁴⁾	500 V	max. 10 s	
	300.0 Ω	100 mΩ	max. 3.2 V		0.5 + 3			
	3.000 kΩ	1 Ω	max. 1.25 V		0.5 + 1			
	30.00 kΩ	10 Ω	max. 1.25 V		0.5 + 1			
	300.0 kΩ	100 Ω	max. 1.25 V		0.5 + 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		0.5 + 1			
			discharge resistance	U _{0 max}				
F	30.00 nF	10 pF	250kΩ	2.5 V	1.0 + 3 ⁵⁾	500 V DC / AC eff sine	max. 10 s	
	300.0 nF	100 pF	25 kΩ	2.5 V	1.0 + 3			
	3.000 μF	1 nF	25 kΩ	2.5 V	1.0 + 3			
Hz			f _{min} V _{DC}	f _{min} V _{AC}				
	300.0 Hz	0.1 Hz	1 Hz	45 Hz	0.5 + 1 ⁶⁾	≤ 600 V	continuous	
	3.000 kHz	1 Hz	1 Hz	45 Hz		≤ 300 V		
	30.00 kHz	10 Hz	10 Hz	45 Hz	0.5 + 1 ⁷⁾	≤ 30 V		
100.0 kHz	100 Hz	100 Hz	100 Hz					
°C	Pt 100	-200.0 ... +200.0 °C	0.1 °C	—	—	2 Kelvin + 5 digits ⁸⁾	500 V	max. 10 s
		+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	max. 10 s
		+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) Range⁶⁾ 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

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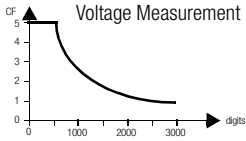
Insulation Measurement

Measuring Function Switch Position	Measuring Range	Resolution	Inherent Deviation of Digital Display at Reference Conditions
$U_{Interf}/M\Omega_{ISO}^{1)}$	0 ... 110 V \approx	0,1 V	$\pm(3\% \text{ of rdg.} + 10 \text{ d})$
$M\Omega_{ISO}$ ($U_N = 100 \text{ V}$)	0.000 ... 0.310 $M\Omega^{2)}$	1 $k\Omega$	$\pm(3\% \text{ of rdg.} + 5 \text{ d})$
	0.280 ... 3.100 $M\Omega$	1 $k\Omega$	$\pm(3\% \text{ of rdg.} + 2 \text{ d})$
	02.80 ... 3.100 $M\Omega$	10 $k\Omega$	
	028.0 ... 310.0 $M\Omega$	100 $k\Omega$	

¹⁾ Recognition of interference voltage ²⁾ Where $R < 100 \text{ k}\Omega$, FEHL is displayed first.

Measuring 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 Capacity Value	Overload Capacity Time
$U_{Interf}/M\Omega_{ISO}$	—	—	—	—	$U > 110\text{V}$	110 V \approx	cont.
$M\Omega_{ISO}$	100 V	max. 130 V	$> 1.0 \text{ mA}$	$< 1.5 \text{ mA}$	$U > 110\text{V}$	100 V \approx	10 s

Influencing Quantities and Influence Errors

Influenc. Quantity	Sphere of Influence	Meas. Quantity/ Measuring Range	Influence Error ¹⁾ $\pm(\dots \% \text{ of rdg.} + \dots \text{ digit})$
Temperature	0 °C ... +21 °C and +25 °C ... +40 °C	30/300 mV \approx	1.0 + 3
		3 ... 300 V \approx	0.15 + 1
		600 V \approx	0.2 + 1
		V \sim	0.4 + 2
		30 $\Omega^{2)}$	0.15 + 2
		300 Ω	0.25 + 2
		3 $k\Omega$... 3 $M\Omega$	0.15 + 1
		30 $M\Omega$	1.0 + 1
		30 nF ²⁾ ... 3 μF	2 + 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
		$M\Omega_{ISO}$	1.0 + 2
Frequency of Meas. Quantity	15 Hz ... < 30 Hz 30 Hz ... < 45 Hz > 65 Hz ... 400 Hz > 400 Hz ... 1 kHz	3 ... 600 V \sim	1.0 + 3
			0.5 + 3
			2.0 + 3
			3.0 + 3
Waveform of Meas. Quantity	crest factor CF > 3 ... 5	V $\sim^{4)}$	$\pm 1\% \text{ of rdg.}$
			$\pm 3\% \text{ of rdg.}$
³⁾ The allowable crest factor CF for the periodic quantity to be measured depends upon the displayed value: 			

¹⁾ For temperature: indicated error values apply per 10 K change in temperature.

For frequency: indicated error values valid as of a display of 300 digits.

²⁾ With zero setting

³⁾ For unknown waveform (CF > 2): Measure with manual range selection.

⁴⁾ Except for sinusoidal waveforms

Influencing Qty.	Influence Range	Measuring Ranges	Influence Error
Battery Voltage	$\pm^{1)}$... < 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 $k\Omega$... 30 $M\Omega$	± 3 digits
		$M\Omega_{ISO}$	± 2 digits
		nF, μF	± 1 digit
Relative Humidity	75%, 3 days, device off	V \approx , Ω , $M\Omega_{ISO}$, $M\Omega$	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 \pm symbol.

Influencing Quantity	Influence Range	Measuring Ranges	Damping
Common-Mode Interference Voltage	interference max. 600 V \sim 50 Hz, 60 Hz sine	V \approx	> 120 dB
		3 V \sim , 30 V \sim	> 80 dB
		300 V \sim 600 V $\sim^{5)}$	> 70 dB > 60 dB
Series-Mode Interference Voltage	interference V \sim , respective meas. range nom. value, max. 600 V \sim 50 Hz, 60 Hz sine	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 $M\Omega$	1.5 s	2 s	from ∞ to 50 % of upper range limit
30 $M\Omega$	4 s	5 s	
\rightarrow	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 $\pm 2 \text{ K}$
Relative Humidity	45 % ... 55 %
Measured Quantity Frequency	45 Hz ... 65 Hz
Measured Quantity Waveform	sine
Battery Voltage	8 V $\pm 0.1 \text{ V}$

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

Linear (ranges other than $M\Omega_{ISO}$):
 $\mp 5 \dots 0 \dots \pm 30$ with 35 scale graduations for all other ranges
Logarithmic ($M\Omega_{ISO}$ range):
 $\dots \leq 0.3 \dots 3 \dots 30 \dots 300$
 bar graph instead of pointer

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 \triangleq 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 °C: 1 measurement per second

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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 Nominal Current (1 mA) ²⁾
V $\overline{\text{---}}$			500 ¹⁾	
V \sim			100 ¹⁾	
M_{ISO}	100 V	1 M Ω	50	
	100 V	100 k Ω		3000

¹⁾ Multiply hours by 0.7 for interface operation, and by 0.2 with illumination

²⁾ Battery depletion warning: automatic display of the + symbol if battery voltage falls below 7 V.

Electrical Safety

Protection Class II per IEC 1010-1:1990, IEC 1010-1/A2: 1995
EN 61010-1:1993, EN 61010-1 / A2:1995

Overvoltage Category II
Nominal Voltage 600 V
Fouling Factor 2
Test Voltage 3.7 kV \sim per IEC 61010-1/EN 61010-1

EMC

Product standard EN 61326:2002
EN 61326:2002

Interference Emission EN 55022: 1998 – class B

Interference Immunity EN 61000-4-2: 1995
– 4 kV/8 kV contact/atmosph. discharge
– power feature A
EN 61000-4-3: 1996+A1: 1998
– 3 V/m
– power feature B

Ambient Conditions

Operating Temp. $-10\text{ }^{\circ}\text{C} \dots +50\text{ }^{\circ}\text{C}$
Storage Temperature $-25\text{ }^{\circ}\text{C} \dots +70\text{ }^{\circ}\text{C}$ (without battery)
Relative Humidity $\leq 75\%$, no condensation allowed
Elevation to 2000 m
Deployment indoors; outdoors: only in the specified ambient conditions

Interface

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

Mechanical Design

Protection case: IP 54, connector jacks: IP 20
Dimensions 84 mm x 195 mm x 35 mm
Weight approx. 0.35 kg with battery

Standard Equipment

- 1 METRAHit® 16U cable multimeter
- 1 GH18 protective rubber cover with carrying strap
- 1 KS21T cable set (CAT II/150 V) consisting of one 2-conductor measurement cable (yellow/blue), 2 m long with 4 mm banana plug and sliding sleeve, 1 earth terminal cable (black), 2 m long with 4 mm banana plug and sliding sleeve
- 1 Operating instructions
- 1 DKD calibration certificate with calibration report
- 1 9 V battery, installed

Recommended Accessories

KS17T safety cable set

Order Information

Designation	Type	Article Number
Cable multimeter, see included standard equipment above	METRAHit® 16U	M216U
Safety cable set consisting of 2 CAT III/1000 V safety measurement cables, 3 test probes and 1 alligator clip	KS17T	Z110T
Cable set, see description above	KS21T	Z110U
Single-channel memory pack with SI232-II memory adapter, cable and METRAwin® 10/METRAHit® software	1-CH. Pack	GTZ 3231 020 R0001
4-channel memory pack with four SI232-II memory adapters, cable and METRAwin® 10/METRAHit® software	4-CH. Pack	GTZ 3234 020 R0001
Memory adapter for KMM 2002	SI232-II ^{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, $-40 \dots +600\text{ }^{\circ}\text{C}$	Z3409	GTZ 3409 000 R0002
Pt1000 temperature sensor for measurements in gases and liquids, $-50 \dots +220\text{ }^{\circ}\text{C}$ (for service applications on household appliances)	TF220	Z102A
Pt100 oven sensor, $-50 \dots +550\text{ }^{\circ}\text{C}$	TF550	GTZ 3408 000 R0001
10 adhesive PT100 temperature sensors, from $-50 \dots +550\text{ }^{\circ}\text{C}$	TS-Chipset	GTZ 3406 000 R0001
Ri adapter: 200 k Ω /230 V	R200K	Z101A
Protective rubber cover and carrying strap	GH18	GTZ 3212 000 R0001
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 \dots 100 A, 1 mV/10 mA, jaw opening: 15 mm dia.	WZ12B ^{D)}	Z219B

^{D)} Data Sheet available

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