

# METRA HIT 16U

## Cable Multimeter for Measurements in Symmetrical Copper Cable Networks

3-349-227-03  
6/12.04

- **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,  $\Omega$ , 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



**DKD**  
Calibration Certificate  
included as a Standard Feature

QUALITY MANAGEMENT SYSTEM



DQS certified per  
DIN EN ISO 9001 Reg. No. 1262



### Applications

The METRA HIT 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/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.

### 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.

### IEC 61010-1, 2<sup>nd</sup> Edition

Multimeters manufactured as from 1<sup>st</sup> January, 2004 must not cause any hazards during application in any possible combination of indicated input voltages, function and range settings. Potential hazards include electric shock, fire, sparking and explosion.

### Calibration

METRA HIT 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

DIN EN 61010 Part 1: 2001/ VDE 0411-1:2002	Safety requirements for electrical equipment for measurement, control and laboratory use
DIN EN 61326 VDE 0843 Part 20	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 $\pm(\dots\% \text{ of rdg.} + \dots \text{ digit})$ at reference conditions	Overload Capacity <sup>3)</sup>		
						Value	Duration	
<b>V<sub>DC</sub></b>	30.00 mV	10 $\mu$ V	>10 G $\Omega$ // < 40 pF		0.5 + 3 <sup>4)</sup>	600 V	continuous	
	300.0 mV	100 $\mu$ V	>10 G $\Omega$ // < 40 pF		0.5 + 3			
	3.000 V	1 mV	11 M $\Omega$ // < 40 pF		0.5 + 1			
	30.00 V	10 mV	10 M $\Omega$ // < 40 pF		0.5 + 1			
	300.0 V	100 mV	10 M $\Omega$ // < 40 pF		0.5 + 1			
	600 V	1 V	10 M $\Omega$ // < 40 pF		0.5 + 1			
<b>V<sub>AC</sub></b> <sup>1)</sup>	3.000 V	1 mV	11 M $\Omega$ // < 40 pF		1.5 + 3 (> 10 digits)	DC	continuous	
	30.00 V	10 mV	10 M $\Omega$ // < 40 pF			AC eff sine		
	300.0 V	100 mV	10 M $\Omega$ // < 40 pF					
	600 V	1 V	10 M $\Omega$ // < 40 pF					
<b>V<sub>eff</sub></b> <sup>1)</sup>	3.000 V	1 mV	11 M $\Omega$ // < 40 pF		1.5 + 3 (> 10 digits)	AC eff sine	continuous	
	30.00 V	10 mV	10 M $\Omega$ // < 40 pF					
	300.0 V	100 mV	10 M $\Omega$ // < 40 pF					
	600 V	1 V	10 M $\Omega$ // < 40 pF					
<b>A</b> $\sim$ $\infty$ <sup>2)</sup>	30/100 A	10/100 mA	—		2.5 + 3 (> 10 digits)	120 A	continuous	
			open-circuit voltage					
<b><math>\Omega</math></b>	30.00 $\Omega$	10 m $\Omega$	max. 3.2 V		0.5 + 3 <sup>4)</sup>	600 V	max. 10 s	
	300.0 $\Omega$	100 m $\Omega$	max. 3.2 V		0.5 + 3			
	3.000 k $\Omega$	1 $\Omega$	max. 1.25 V		0.5 + 1			
	30.00 k $\Omega$	10 $\Omega$	max. 1.25 V		0.5 + 1			
	300.0 k $\Omega$	100 $\Omega$	max. 1.25 V		0.5 + 1			
	3.000 M $\Omega$	1 k $\Omega$	max. 1.25 V		0.6 + 1			
	30.00 M $\Omega$	10 k $\Omega$	max. 1.25 V		2.0 + 1			
<b><math>\rightarrow</math></b>	2.000 V	1 mV	max. 3.2 V		0.5 + 1			
			discharge resistance	$U_{0 \text{ max}}$				
<b>F</b>	30.00 nF	10 pF	250k $\Omega$	2.5 V	1.0 + 3 <sup>5)</sup>	600 V DC / AC eff sine	max. 10 s	
	300.0 nF	100 pF	25 k $\Omega$	2.5 V	1.0 + 3			
	3.000 $\mu$ F	1 nF	25 k $\Omega$	2.5 V	1.0 + 3			
<b>Hz</b>			$f_{\text{min}} \text{ V}_{DC}$	$f_{\text{min}} \text{ V}_{AC}$				
	300.0 Hz	0.1 Hz	1 Hz	45 Hz	0.5 + 1 <sup>6)</sup>	$\leq$ 600 V	continuous	
	3.000 kHz	1 Hz	1 Hz	45 Hz		$\leq$ 300 V		
	30.00 kHz	10 Hz	10 Hz	45 Hz	0.5 + 1 <sup>6)</sup>	$\leq$ 30 V		
100.0 kHz	100 Hz	100 Hz	100 Hz	0.5 + 1 <sup>7)</sup>				
<b><math>^{\circ}</math>C</b>	Pt 100	-200.0 ... +200.0 $^{\circ}$ C	0.1 $^{\circ}$ C	—	—	2 Kelvin + 5 digits <sup>8)</sup>	600 V	max. 10 s
		+200.0 ... +800.0 $^{\circ}$ C	0.1 $^{\circ}$ C	—	—	1.0 + 5 <sup>8)</sup>		
	Pt 1000	-100.0 ... +200.0 $^{\circ}$ C	0.1 $^{\circ}$ C	—	—	2 Kelvin + 5 digits <sup>8)</sup>		
		+200.0 ... +800.0 $^{\circ}$ C	0.1 $^{\circ}$ C	—	—	1.0 + 5 <sup>8)</sup>		
<b><math>^{\circ}</math>F</b>	Pt 100	-300.0 ... +400.0 $^{\circ}$ C	0.1 $^{\circ}$ F	—	—	4 Kelvin + 10 digits <sup>8)</sup>	600 V	max. 10 s
		+400.0 ... +999.0 $^{\circ}$ C	0.1 $^{\circ}$ F	—	—	1.0 + 10 <sup>8)</sup>		
	Pt 1000	-145.0 ... +400.0 $^{\circ}$ C	0.1 $^{\circ}$ F	—	—	4 Kelvin + 10 digits <sup>8)</sup>		
		+400.0 ... +999.0 $^{\circ}$ C	0.1 $^{\circ}$ F	—	—	1.0 + 10 <sup>8)</sup>		

1) TRMS measurement

2) Measurement with type WZ12B clip-on current sensor

3) At -20  $^{\circ}$ C ... +40  $^{\circ}$ C

4) Without zero setting + 35 digits

5) Without zero setting + 50 digits

6),7) Range <sup>6)</sup> 3 V  $\approx$ :  $U_E = 1.5 V_{\text{eff/rms}} \dots 100 V_{\text{eff/rms}}$  <sup>7)</sup>  $U_E = 2.5 V_{\text{eff}} \dots 30 V_{\text{eff}}$

<sup>6)</sup> 30 V  $\approx$ :  $U_E = 15 V_{\text{eff/rms}} \dots 300 V_{\text{eff/rms}}$  <sup>7)</sup>  $U_E = 25 V_{\text{eff}} \dots 30 V_{\text{eff}}$

<sup>6)</sup> 300 V  $\approx$ :  $U_E = 150 V_{\text{eff/rms}} \dots 600 V_{\text{eff/rms}}$

8) Without probe

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## Cable Multimeter for Measurements in Symmetrical Copper Cable Networks

### Insulation Measurement

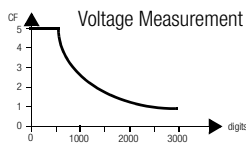
Measuring Function Switch Position	Measuring Range	Resolution	Inherent Deviation of Digital Display at Reference Conditions
$U_{\text{Interf}}/M\Omega_{\text{ISO}}^{1)}$	0 ... 110 V $\approx$	0.1 V	$\pm(3\% \text{ of rdg.} + 10 \text{ d})$
$M\Omega_{\text{ISO}}$ ( $U_N = 100 \text{ V}$ )	0.005 ... 0.310 $M\Omega$ $^{2)}$	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 $\Omega$	

<sup>1)</sup> Recognition of interference voltage <sup>2)</sup> 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
$U_{\text{Interf}}/M\Omega_{\text{ISO}}$	—	—	—	—	$U > 110\text{V}$	110 V $\approx$	cont.
$M\Omega_{\text{ISO}}$	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 <sup>1)</sup> $\pm(\dots \% \text{ of rdg.} + \dots \text{ digit})$
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 $\Omega$	0.25 + 2
		3 k $\Omega$ ... 3 M $\Omega$	0.15 + 1
		30 M $\Omega$	1.0 + 1
		30 nF $^{2)}$ ... 3 $\mu\text{F}$	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
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 1 ... 3 > 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:	



- <sup>1)</sup> For temperature: indicated error values apply per 10 K change in temperature.  
<sup>2)</sup> For frequency: indicated error values valid as of a display of 300 digits.  
<sup>3)</sup> With zero setting  
<sup>4)</sup> For unknown waveform (CF > 2): Measure with manual range selection.  
<sup>5)</sup> 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 $\approx$	$\pm 2$ digits
		V $\sim$	$\pm 4$ digits
		30 $\Omega$ /300 $\Omega$ /°C/°F	$\pm 4$ digits
		3 k $\Omega$ ... 30 M $\Omega$	$\pm 3$ digits
		$M\Omega_{\text{ISO}}$	$\pm 2$ digits
		nF, $\mu\text{F}$	$\pm 1$ digit
Relative Humidity	75%, 3 days, device off	V $\approx$ , $\Omega$ , $M\Omega_{\text{ISO}}$ , M $\Omega$	1x inherent deviation
		Hz, °C, °F	$\pm 1$ digit
DATA	—	V $\approx$	$\pm 2$ digits
MIN / MAX	—	V $\approx$	$\pm 2$ digits

<sup>1)</sup> 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 $\approx$	$> 120 \text{ dB}$
		3 V $\sim$ , 30 V $\sim$	$> 80 \text{ dB}$
		300 V $\sim$ 600 V $\sim$ $^{5)}$	$> 70 \text{ dB}$ $> 60 \text{ dB}$
Series-Mode Interference Voltage	interference V $\sim$ , respective meas. range nom. value, max. 600 V $\sim$ 50 Hz, 60 Hz sine	V $\approx$	$> 50 \text{ dB}$
		V $\sim$	$> 110 \text{ dB}$

### 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 $\Omega$ ... 3 M $\Omega$	1.5 s	2 s	from $\infty$ to 50 % of upper range limit
30 M $\Omega$	4 s	5 s	
$\rightarrow$	0.7 s	1.5 s	
nF, $\mu\text{F}$ , °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	40 % ... 60 %
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  $M\Omega_{\text{ISO}}$ ):  
 $\approx 5 \dots 0 \dots \pm 30$  with 35 scale graduations for  $\approx$ , 0 ... 30 with 30 scale graduations for all other ranges  
Logarithmic ( $M\Omega_{\text{ISO}}$  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 $\Omega$ : 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 "L"
Measurement Rate	2 measurements per second, for $\Omega$ and °C: 1 measurement per second

### Electrical Safety

Protection Class	II per EN 61010-1:2001/VDE 0411-1:2002
Measuring Category	II
Nominal Voltage	600 V
Fouling Factor	2
Test Voltage	3.5 kV $\sim$ per EN 61010-1:2001/VDE 0411-1:2002

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## Cable Multimeter for Measurements in Symmetrical Copper Cable Networks

### 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) <sup>2)</sup>
V $\overline{\text{---}}$			500 <sup>1)</sup>	
V $\sim$			100 <sup>1)</sup>	
$M_{ISO}$	100 V	1 M $\Omega$	50	
	100 V	100 k $\Omega$		3000

<sup>1)</sup> Multiply hours by 0.7 for interface operation, and by 0.2 with illumination

<sup>2)</sup> Battery depletion warning: automatic display of the  $\text{+}$  symbol if battery voltage falls below 7 V.

### EMC

Interference Emission EN 61326:2002 class B

Interference Immunity EN 61326:2002  
IEC 61000-4-2: 1995/A1:1998  
power feature A:  
8 kV atmosph. discharge  
4 kV contact discharge  
IEC 61000-4-3:1995/A1:1998  
power feature B: 3 V/m

### 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

Dimensions 84 mm x 195 mm x 35 mm

Weight approx. 0.35 kg with battery

Protection case: IP 54, connector jacks: IP 20  
Extract from table on the significance of IP codes

IP XY (1 <sup>st</sup> digit X)	Protection against foreign object entry	IP XY (2 <sup>nd</sup> digit Y)	Protection against the penetration of water
0	not protected	0	not protected
1	$\geq 50.0$ mm dia.	1	vertically falling drops
2	$\geq 12.5$ mm dia.	2	vertically falling drops with enclosure tilted 15 $^{\circ}$
3	$\geq 2.5$ mm dia.	3	spraying water
4	$\geq 1.0$ mm dia.	4	splashing water
5	dust protected	5	water jets

### Standard Equipment

- METRA HIT 16U cable multimeter
- GH18 protective rubber cover with carrying strap
- Imitation leather ever-ready case with cable compartment (F836)
- KS21T cable set (CAT II/150 V) consisting of:  
one 2-conductor measurement cable (yellow/blue), 2 m long with probes,  
one earth terminal cable (black), 2 m long with probe
- Cable set KS17-2 consisting of:  
one pair of measurement cables with probes, 1.5 m long
- Alligator clip, black
- Operating instructions
- DKD calibration certificate with calibration report
- 9 V battery, installed

### Order Information

Designation	Type	Article Number
Cable multimeter, see incl. standard equipment above	METRA HIT 16U	M216U
Cable set consisting of 1 pair of measurement cables with probes, 1.5 m	KS17-2	GTY3620034P0002
Alligator clip (1 pair) for KS17-2	KY95-1	GTZ3215000R0002
Single-channel memory pack with SI232-II memory adapter, cable and METRAWin <sup>®</sup> 10/METRAHit <sup>®</sup> software	1-CH. Pack	GTZ 3231 020 R0001
4-channel memory pack with four SI232-II memory adapters, cable and METRAWin <sup>®</sup> 10/METRAHit <sup>®</sup> software	4-CH. Pack	GTZ 3234 020 R0001
Memory adapter	SI232-II	GTZ 3242 020 R0001
RS232 interface cable, 2 m	Z3241	GTZ 3241 000 R0001
METRAWin <sup>®</sup> 10/METRAHit <sup>®</sup> 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 R0001
Bidirectional interface adapter IR/USB for METRA HIT	USB-HIT	Z216A
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 $\Omega$ /230 V	R200K	Z101A
Clip-on current sensor 10 mA ... 100 A, 1 mV/10 mA, jaw opening: 15 mm dia.	WZ12B <sup>D)</sup>	Z219B
Imitation leather carrying pouch for METRA HIT and METRAMax	F829	GTZ 3301 000 R0003
Cordura belt pouch for multimeters of the METRA HIT and METRAport series	HitBag	Z115A
Ever-ready case for two METRA HITS, two adapters and accessories	F840	GTZ 3302 001 R0001
Hard case for one METRA HIT and accessories	HC20	Z113A
Hard case for two METRA HITS and accessories	HC30	Z113B

<sup>D)</sup> Data Sheet available

Edited in Germany • Subject to change without notice • A pdf version is available on the internet