

Product Datasheet - Technical Specifications



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METRAHIT | 27M, 27I and H+E CAR Milliohm Resistance Meter and Digital Multimeter, Insulation Tester and Data Logger

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- The **METRA HIT 27M** is a compact milliohm resistance meter plus multimeter and thermometer for the measurement of low-value contact resistance on aircraft outer skins (lightning protection, wick test), and for general low-resistance measurements.
- The **METRA HIT 27I** is used additionally for service and repair work performed on airplane and helicopter electrical systems (voltage, insulation, milliohm and temperature measurement). In addition to its own multimeter functions for electrical quantities, the instrument also includes a mega-ohm measuring function with insulation test voltages of 50, 100, 250 and 500 V, as well as temperature measurement with Pt100 and Pt1000 sensors.
- **METRA HIT H+E CAR** Megatester for service and repair of electric and hybrid vehicles (features and technical data identical with METRA HIT 27I)



METRA HIT 27M Features

- **All-in-one: Milliohm resistance meter, multimeter and data logger**
Compact and rugged for service under harsh conditions and laboratory use, a single device for many applications
- **Kelvin connection (4-wire measurement)**
Suppresses influence from conductor and contact resistances on measuring results
- **Measuring current can be selected according to the measuring task:**
Adaptation to various resistance measuring requirements and optimized battery service life
- **DATA Hold**
For quick, reliable measurement and storage of individual measured values, e.g. voltages at discrete cells in batteries and emergency power supplies
- **Overload protection**
Protects the instrument in the event of inadvertent connection to mains power
- **DAkkS calibration certificate as standard feature**
Reduced operating costs for use within ISO 9000 quality systems, documented traceability
- **Operation with storage batteries**
3 NiMH storage batteries are included as a standard feature.

METRA HIT 27I / METRA HIT H+E CAR Features

Includes all METRA HIT 27M functions plus:

- **Insulation resistance tester**
Testing with 50 to 500 V for components, cables and conductors, for example in aircraft and in on-board electrical systems
- **LCD panel with background illumination**
High contrast, even under adverse ambient light conditions
- **Compact and multifunctional**
Can be used advantageously in aircraft cockpits as well as in other constricted spaces, which would otherwise require the use of several individual instruments.
- **Mains power or storage battery operation**
Furnished with 3 NiMH storage batteries and a mains power battery charger as standard equipment for optimized instrument availability and low operating costs
- **DAkkS calibration certificate as standard feature**
Reduced operating costs for use within ISO 9000 quality systems, documented traceability

Special version for use in explosive atmospheres: **METRA HIT | 27EX**, see separate datasheet.

METRAHIT | 27M, 27I and H+E CAR

Milliohm Resistance Meter and Digital Multimeter, Insulation Tester and Data Logger

Applications

The METRA HIT 27 is a compact, rugged and reliable instrument, which is equally suitable for precision measuring and recording tasks in the factory, for on-site service and in the laboratory:

- Adjustment of shunts in instrumentation
- Testing of electrical connections at conductor bars for open-pit mining, in potential bonding systems, and for industrial and household applications
- Testing of cable resistance, wiring, shunt resistors in PCBs and thick-film circuits
- Measurement of contact resistance in relays, contactors and power interrupters
- Testing of resistance in fuses, as well as conductor resistance in heavy current circuits
- Testing of winding resistance in transformers, coils, small motors etc.
- Testing of discharge resistance on aircraft, and at aircraft outer skin components
- Contact resistance testing in uninterruptible power supplies
- Measurement of cell voltages, for example in on-board batteries and emergency power supplies
- Contact resistance testing at welding seams

The new **METRA HIT H+E CAR** (hybrid & E-CAR) is a measuring instrument for testing the electrical safety of electric and hybrid vehicles. It includes, among others, the following tests and measurements:

- Protection against direct contact during charging and discharging
- Protection against indirect contact during discharging (battery in the vehicle) and charging of the traction battery
- Insulation and dielectric strength (insulation resistance between all electric components of the high voltage system and the vehicle frame)
- Insulation of the battery (insulation resistance between the high voltage battery poles and the metallic tray/vehicle frame)
- Voltage of capacitors
- Protection type of electric equipment
- Testing of charging regulators
- Testing of electric motor (nominal voltage, power, speed)

General

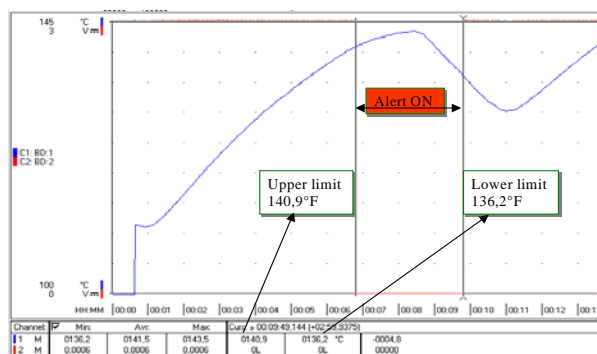
The METRA HIT 27 milliohm resistance meters are the modern alternative for the well known TH2 (Thomson) and Wh2 (Wheatstone) measuring bridges. They provide an expanded measuring range, greater accuracy and easier reading. As universal measuring and test instruments, they acquire and record values to an integrated memory module including resistance in the milliohm and micro-ohm ranges, as well as "normal multimeter resistance values" in the ohm to mega-ohm ranges by feeding a measuring current to the resistor, conductor or contact under test. The respective measuring current is determined by the rotary selector switch setting and lies within a range of 1 to 0.02 A in the milliohm ranges. The instrument also measures and records insulation resistance (METRA HIT 27I only) with test voltage selectable in steps, for example in order to test resistance in on-board electrical systems for aircraft, ocean going vessels etc., and for testing overvoltage arresters and much more.

Easy Operation

Operation is very easy. Simply connect the low-resistance device under test to the instrument with the included measurement cables, Kelvin clips or 4-pole probes (KC27), and select the ideal measuring range.

Integrated Measured Value Memory and Interface

Each METRA HIT 27 is equipped with a measured value memory module and can thus be utilized as a data logger or a recording instrument for all measuring functions. Measurement results can be transmitted to a PC either off-line via the optical interface which is furnished as standard equipment, or online with an optional bidirectional adapter. In this way, for example, characteristic voltage and temperature curves (see figure below) can be displayed and analyzed in line recorder format relative to real-time, or individual measured values, e.g. voltages for each of the cells in a storage battery, can be saved with the DATA Hold function and analyzed at a PC in tabular form.



METRAwin®10/METRA HIT METRAwin®10/METRA HIT (software option):

Recorded characteristic temperature curve and triggering characteristics (2-channel recording with 2 METRA HIT instruments) plus evaluation at a PC

METRAwin®10/METRA HIT Software Option

Measurement data recorded to the measured value memory module can be evaluated at a PC if required with the help of the IR interface supplied as standard equipment and a bidirectional IR adapter (BD adapter) with conversion to the RS 232 protocol. METRAwin®10/METRA HIT software (see above figure) is recommended to this end, and is suitable for display, analysis and documentation of measurement results using Windows® XP, VISTA or 7. The software is available as an accessory. User-friendly complete packages (e.g. the BD Pack or the complete METRA HIT 27 AS case) are easy to connect and install and include everything required for high performance measurement data processing.

Offset Balancing

Automatic offset balancing is provided for the lower measuring ranges. Manual offset balancing, as required with the METRA HIT 17 predecessor model, is thus no longer necessary.

Protection Against Operator Error

The METRA HIT 27 is safeguarded against erroneous short-term connection to devices under test with fault voltages of up to 600 V by means of protective devices.

Test Functions and Automatic Functions

All METRA HIT 27 instruments are equipped with diode and continuity test functions, as well as automatic and manual measuring range selection and battery shutdown.

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Protective Cover for Harsh Conditions

The device features a very compact, rugged design. Beyond this, it is protected against damage in the event of impacts or dropping

by means of a soft rubber cover with tilt stand. The rubber material also assures that the instrument does not wander if it is set up on a vibrating surface.

Characteristic Values

Measuring Function	Measuring Range	Resolution at Upper Range Limit 4% 30000 / 3% 3000 ¹⁾	Input Impedance		Intrinsic Uncertainty at Max. Resolution under Reference Conditions ±(... % rdg. + ... d)		Overload Capacity ³⁾	
			DC	AC ⁶⁾	DC	AC ⁶⁾	Value	Time
V	3 V	100 μV	2.1 MΩ	2.1 MΩ // < 50 pF	0.1 + 10 ⁴⁾	0.2 + 10 (>500 d)	600 V DC AC eff sine	Cont.
	30 V	1 mV	2.1 MΩ	2.1 MΩ // < 50 pF	0.1 + 5	0.2 + 10 (>500 d)		
	300 V	10 mV	2.1 MΩ	2.1 MΩ // < 50 pF	0.1 + 5	0.2 + 10 (>500 d)		
	600 V	100 mV	2.1 MΩ	2.1 MΩ // < 50 pF	0.1 + 5	0.2 + 10 (>500 d)		
			Open-Circuit Voltage	Measuring Current, Approx.	±(... % rdg. + ... d)			
mΩ @1A (4 L)	3 mΩ	0.001 mΩ	3.5 ... 4 V	1 A ⁷⁾	1 + 10		±0.6 V ¹¹⁾	Cont.
	30 mΩ	0.001 mΩ	3.5 ... 4 V	1 A ⁷⁾	0.5 + 10 (Valid as of 10% of R)			
	300 mΩ	0.01 mΩ	3.5 ... 4 V	1 A ⁷⁾	0.5 + 10			
mΩ (4 L)	30 mΩ	0.01 mΩ	3.5 ... 4 V	200 mA	0.25 + 10		±0.6 V ¹¹⁾ 4)	Cont.
	300 mΩ	0.01 mΩ	3.5 ... 4 V	200 mA	0.25 + 10 (Valid as of 10% of R)			
	3 Ω	0.1 mΩ	3.5 ... 4 V	20 mA	0.25 + 10			
	30 Ω	1 mΩ	3.5 ... 4 V	20 mA	0.25 + 10			
Ω (2 L)	300 Ω	10 mΩ	3.5 ... 4 V	1 mA	0.1 + 10 ⁴⁾		600 V DC AC eff sine	max. 10 s
	3 kΩ	100 mΩ	3.5 ... 4 V	100 μA	0.1 + 5 ⁴⁾			
	30 kΩ	1 Ω	3.5 ... 4 V	20 μA	0.1 + 5			
	300 kΩ	10 Ω	3.5 ... 4 V	20 μA	0.1 + 5			
	3 MΩ	100 Ω	3.5 ... 4 V	10 μA	0.1 + 5			
Ω¹⁾	300 Ω	0.1 Ω	3 V	1 mA	1 + 5			
→	3 V	0.1 mV	3 V	1 mA	1 + 5			
			Test Voltage	Measuring Current				
MΩ @ ... V	30 MΩ	0.01 MΩ	50/100/250/500 V	< 1.5 mA	2 + 10		600 V DC/AC	max. 10 s
	300 MΩ	0.1 MΩ	50/100/250/500 V		2 + 10			
	3000 MΩ ¹⁰⁾	1 MΩ	50/100/250/500 V		3 + 10			
			f_{min} ²⁾		±(... % rdg. + ... d)			
HZ	300 Hz	0.01 Hz	1 Hz		0.05 + 5 ⁵⁾		600 V AC	Cont.
	3 kHz	0.1 Hz						
	Temperature Sensor	Measuring Range	Resolution	Intrinsic Uncertainty at Max. Resolution under Reference Conditions ±(... % rdg. + ... d) ⁸⁾				
°C / °F	Pt 100 ⁹⁾	-200.0 ... +100.0 °C	0.1 °K	1 K + 5		600 V DC AC eff sine	max. 10 s	
		+100.0 ... +600.0 °C		0.5 + 5				
	Pt 1000	-200.0 ... +100.0 °C		1 K + 5				
		+100.0 ... +600.0 °C		0.5 + 5				
	Ni 100	-60.0 ... +180.0 °C		0.5 + 5				
	Ni 1000	-60.0 ... +180.0 °C		0.5 + 5				

- 1) Display: 3% places in following ranges: 3 mΩ @ 1A, 30 mΩ, Ω, MΩ@...V, a different sampling rate can also be selected in the rATE menu for saving and transmitting measured values.
- 2) Lowest measurable frequency for sinusoidal measuring signals symmetrical to the zero point
- 3) At 0° to + 40° C
- 4) ZERO is displayed for "zero balancing" function.
- 5) Range 3 V~: $U_E = 0.15V_{eff/rms} \dots 3 V_{eff/rms}$
30 V~: $U_E = 1.5V_{eff/rms} \dots 30 V_{eff/rms}$
300 V~: $U_E = 15 V_{eff/rms} \dots 300 V_{eff/rms}$
600 V~: $U_E = 300 V_{eff/rms} \dots 600 V_{eff/rms}$
For voltages > 100 V: power limiting of $1.8 \cdot 10^9 V \cdot Hz$
- 6) 20 ... 45 ... 65 Hz ... 1 kHz sine, see influences on page 4.
- 7) Pulsating measuring current with interval of $T = 1 s$
- 8) Plus sensor deviation
- 9) Temperature value is based upon the characteristic curve per EN 60751.
- 10) In the case of high resistance values of greater than 300 MΩ, the capacitive influence of the person performing the measurement or the measurement cable may distort the measured value. Use short or shielded measurement cables for this reason.
- 11) In the event of an overcharge, the integrated FF 1.6 A/1000 V fuse blows.

Key

rdg. = reading (measured value), R = measuring range, d = digit(s),
2/4 L = 2/4-wire measurement

Applicable Regulations and Standards

IEC 61010-1 DIN EN 61010-1 VDE 0411 Part 1	Safety requirements for electrical equipment for measurement, control and laboratory use Part 1: General requirements
EN 60529 VDE 0470-1	Test instruments and test procedures Protection provided by enclosures (IP code)
DIN EN 61326-1 VDE 0843-20-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements

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Influencing Quantities and Influence Error

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range ¹	Influence Error ± (... % rdg. + d) / 10 K
Temperature	0 ... +21 °C	V DC	0.1 + 5
		V AC	0.5 + 5
		mΩ @ 1 A 4L	1 + 5
		mΩ @ 200 mA 4L	1 + 5
		300 Ω ... 300 kΩ 2L	0.2 + 5
	and +25... +40 °C	3 MΩ 2L	0.5 + 5
		30 MΩ 2L	1 + 5
		Insulation, 30 MΩ ... 3 GΩ	2 + 5
		Hz	0.1 + 5
		°C (RTD)	0.5 + 10

¹ With zero balancing

Influencing Quantity	Frequency	Measured Quantity / Measuring Range	Influence Error ¹ ± (... % rdg. + d)
Frequency V _{AC}	> 20 Hz ... 45 Hz	3 V to 600.0 V	2 + 10
	> 65 Hz ... 1 kHz		

¹ Specified error valid as of display values of 10% of the measuring range

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range ¹	Influence Error
Relative Humidity	75% 3 days instrument off	all measured quantities	1 x intrinsic error

¹ With zero balancing

Influencing Quantity	Sphere of Influence	Measuring Range	Damping ±dB
Common Mode Interference Voltage	Interference quantity max. 600 V ~ 50 Hz, 60 Hz sine	V DC	> 90 dB
		30 V ~	> 80 dB
		300 V ~	> 70 dB
		600 V ~	> 60 dB
Series Mode Interference Voltage	Interference quantity: V~, respective nominal value of the measuring range, max. 600 V ~, 50 Hz, 60 Hz sine	V =	> 60 dB
		V ~	> 60 dB

Real-Time Clock

Accuracy	±1 minute per month
Temperature Influence	50 ppm/K

Reference Conditions

Ambient temperature	+23 °C ± 2 K
Relative humidity,	40 ... 60%
Measured quantity frequency	45 ... 65 Hz
Measured quantity wave shape	Sinusoidal, deviation between RMS and rectified value < 0.1%
Storage battery voltage	3.6 V ± 0.2 V

Response Time (after manual range selection)

Measured Quantity / Measuring Range	Response Time for Digital Display	Measured Quantity Step Function	
V DC, V AC	1.5 s	from 0 to 80% of upper range limit value	
mΩ @ 1 A 4L	2 s	from ∞ to 50% of upper range limit value	
	mΩ		1.5 s
300 Ω ... 3 MΩ	2 s		
3 GΩ*	5 s		
↔ Continuity	< 50 ms		
↔	1.5 s		
°C Pt100	max. 3 s		
>10 Hz	1.5 s		from 0 to 50% of upper range limit value

* Without parallel connected capacitance

Display

LCD panel (65 mm x 30 mm) with display of up to 3 measured values, unit of measure, type of current and various special functions.

Display / char. height 7-segment characters
Main display: 12 mm
Auxiliary displays: 7 mm
Number of places 4¾ places, ≥ 30999 steps
Overflow display "OL" appears
Polarity display "-" sign is displayed if plus pole is connected to ⊥

LCD Test All display segments available during operation of the METRA HIT 27 are activated after the instrument is switched on.

Background illumination METRA HIT 27I only

Power Supply

Storage batteries 3 ea. 1.2 V/2100 mAh NiMH (AA size)
Service life with 2100 mAh NiMH storage battery set

Measuring Function	Current [mA] / 3.6 V	Operating Hours [h]
V, Hz, Ω, ↔, °C	70	30
mΩ @ 1A	700	3
mΩ @ 200mA	260	8
mΩ @ 20mA	85	24
MΩ @ ... V / 1 MΩ	100	21
Standby (MEM + clock)	0.15	approx. 1 year

Additional consumption for:

Interface operation: 0.5 mA
LCD illumination: 25 mA at 3.6 V. If voltage drops below 2.7 V, the instrument is switched off automatically.

Storage battery test ↔ is displayed automatically if storage battery voltage drops to below approx. 3.3 V

Storage battery charging with NA HIT 2x (Z218H) mains power battery charger (2100 mAh storage battery set: recharging time 20 hours)
or
with external NiMH quick charger Z206D: recharging time approx. 2 hours

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Fuses

Fuse links for all mΩ measuring ranges FF (UR) 1.6 A/1000 V AC/DC, 6.3 mm x 32 mm, 10 kA switching capacity at 1000 V AC /DC and ohmic load

Acoustic Signal For display > 610 V in 600 V range (intermittent tone, 250 ms on/off)

Electrical Safety

Safety class II per IEC/EN 61010-1:2001 /VDE 0411-1:2002

Measurement category II

Operating voltage 600 V

Fouling factor 2

Test voltage 3.5 kV~ per IEC/EN 61010-1:2001/ VDE 0411-1:2002

Electromagnetic Compatibility (EMC)

Interference emission EN 61326-1:2006 class B

Interference immunity EN 61326-1:2006
EN 61326-2-1:2006

Data Interface

With BD232 interface adapter as accessory:

Data transmission Optical via infrared light through the housing

Type RS 232 C, serial, per DIN 19241

Bidirectional baud rate (read and write)
SI232-II: all baud rates
BD232: 9600 baud

Ambient Conditions

Accuracy range 0 °C ... +40 °C

Operating temp. -10 °C ... +50 °C

Storage temperature -25 °C ... +70 °C (w/o storage batteries)

Relative humidity 40% ... 60%,
no condensation allowed

Elevation to 2000 m

Deployment Indoors only, except within specified ambient conditions

Mechanical Design

Protection Housing: IP 54, connector jacks: IP 20

Extract from table on the meaning of IP codes

IP XY (1 st digit X)	Protection against foreign object entry	IP XY (2 nd digit Y)	Protection against the penetration of water
0	not protected	0	not protected
2	≥ 12.5 mm dia.	2	vertically falling drops with enclosure tilted 15°
4	≥ 1.0 mm dia.	4	splashing water
5	dust protected	5	water jets

Dimensions 84 mm x 195 mm x 35 mm

Weight approx. 420 gr. with storage batteries
(without GH18 protective rubber cover)

Standard Equipment

METRA HIT 27M (M227A) including

- 1 GH18 protective rubber cover with carrying strap
- 3 size AA NiMH storage batteries
- 1 KS17-S measurement cable set
- 1 abbreviated operating instructions
- 1 operating instructions D/GB/F
- 1 DAkkS calibration certificate

METRA HIT 27I (M227B) including

- 1 GH18 protective rubber cover with carrying strap
- 3 size AA NiMH storage batteries
- 1 NA HIT 27 mains power battery charger
- 1 KS17-S measurement cable set
- 1 set of Kelvin clips KC4 (1 set = 2 each)
- 1 abbreviated operating instructions
- 1 operating instructions D/GB/F
- 1 DAkkS calibration certificate

METRA HIT 27AS (M227C) avionics set consisting of

- 1 METRA HIT 27I
- 1 GH18 protective rubber cover with carrying strap
- 3 size AA NiMH storage batteries
- 1 NA HIT 27 mains power battery charger
- 1 KS17-S measurement cable set
- 1 set of Kelvin clips KC4 (1 set = 2 each)
- 1 set of Kelvin probes KC27 (1 set = 2 each)
- 1 HC30 hard case
- 1 abbreviated operating instructions
- 1 operating instructions D/GB/F
- 1 adapter USB-HIT including USB cable and system software METRAwin®10/METRA HIT on CD-ROM
- 1 DAkkS calibration certificate



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METRA HIT 27I Set Set (M227S) consisting of

- 1 **METRA HIT 27I**
- 1 protective rubber cover green
- 3 size AA NiMH storage batteries
- 1 NA HIT 27 mains power battery charger
- 1 KS17-2 measurement cable set
- 1 set of Kelvin clips KC4 (1 set = 2 each)
- 1 HC30 hard case
- 1 abbreviated operating instructions
- 1 operating instructions D/GB/F
- 1 DAkkS calibration certificate

METRA HIT H+E CAR (M227T) including

- 1 protective rubber cover orange
- 3 size AA NiMH storage batteries
- 1 NA HIT 27 mains power battery charger
- 1 abbreviated operating instructions
- 1 operating instructions D/GB/F
- 1 DAkkS calibration certificate

METRA HIT H+E CAR Set (M227U) consisting of

- 1 **METRA HIT H+E CAR**
- 1 orange protective rubber cover
- 3 size AA NiMH storage batteries
- 1 NA HIT 27 mains power battery charger
- 1 abbreviated operating instructions
- 1 operating instructions in German/English/French
- 1 DAkkS calibration certificate
- 1 orange hybrid test case kit with
 - 1 pair of fused test probes
 - 1 pair of lantern fronted probes
 - 1 pair of measuring cables (2 meters long)
 - 1 pair of Kelvin measuring cables with crocodile clips

Accessories

Hybrid Diagnostic-Kit (Z227U) consisting of

- 1 orange hard case
- 1 pair of fused test probes red/black 1000 V CAT III
- 1 pair of lantern fronted probes red/black 1000 V CAT II/CAT III
- 1 pair of measuring cables red/black 1000 V CAT III
- 1 pair of Kelvin measuring cables with crocodile clips inserts for additional accessories



ADK Automotive Diagnostic Kit (Z227T) consisting of

- 1 hard case in black, large set of flexible adapter cables (heat resistant silicon cables with 4 mm safety right angle plug on one side and individual automotive flat and round connectors, male or female type, on the other side, 35 cm long)
- 1 Cord Pro cable extension on cable reel, black, 6 meters long
- 1 pair of needle-shaped test probes, angled, red/black
- 1 pair of test probes, red/black
- 2 pair of T-Sockets, red/black
- 4 miniature slim test probes (Back Probing Probes Mini)
- 1 pair of measuring cables 1.2 meters, red/black
- 1 long reach cable piercer, red/black
- 1 standard cable piercer, red/black
- 1 pair of crocodile clips, red/black



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Accessories

(See also table "Order Information" below)

The following accessories, some of which are included as standard equipment, are recommended for use with the METRA HIT 27 or METRA HIT H+E CAR respectively:

Mains power battery charger with broad range input

NA HIT 2x (Z218H): AC 90 ... 250 V DC 5 V
600 V CAT IV, 1000 V CAT III

NA HIT 27 (Z218I): AC 90 ... 250 V DC 5 V
600 V CAT II



NiMH quick charger Z206D

Microprocessor-controlled quick charging unit for 1 to 4 NiMH or NiCd storage batteries, AA or AAA type (micro and/or mignon) with a 100 ... 240 V AC power supply unit and 10 ... 15 V DC motor vehicle charging cable.

Milliohm Measurement with Type KC4 Kelvin Clips

Kelvin clips are suitable for establishing contact between the METRA HIT 27 and low-resistance devices under test. They compensate for influence resulting from cable and contact resistance. The KC4 set includes two clips with insulated, twist-resistant jaws and good clamping action. They can be used for establishing contact with very fine wires, up to rails and rods with a maximum diameter of 15 mm. 4-pole connection is highly advisable for the measurement of values of less than 30 Ω.



Milliohm Measurement with Type KC27 Kelvin Probe

Same usage as KC4, but with two spring loaded steel tips for piercing insulation coatings (e.g. on the outer skin of aircraft) and oxide layers (e.g. at oxidized battery contacts), in order to assure good contact for milliohm measurements, as well as for current and voltage measurements.



Temperature Measurement with Z3409 / Current Measurement with CP330

The Z3409 is just one of many temperature sensors which can be selected from a wide ranging product spectrum. For further information regarding temperature and current sensors, as well as other accessories, please refer to our "Measuring Instruments and Testers" catalog or visit www.gossen-metrawatt.com



Z3409

CP330

Ever-Ready Cases and Hard Cases

The following hard-shell cases are available:

HC20 with space for one METRA HIT and accessories.

HC30 with space for 2 METRA HIT instruments, one 2-channel PC recording system with software, adapter, cable and accessories.

F836 imitation leather carrying pouch for one METRA HIT and accessories (dimensions: 175 x 210 x 75 mm)

F840 imitation leather carrying pouch for two METRA HIT instruments, 2 adapters and accessories (dimensions: 305 x 285 x 70 mm)



HC20

HC30



F836



F840 (with sample contents)

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Cordura belt pouch HitBag

for multimeters of the METRA HIT and METRAport series



Recording System with BD Pack

This option includes all additionally required hardware and software components for creating a PC supported measuring and recording system together with the METRA HIT 27. A full version of METRAWin®10/METRA HIT is included with this package, which can be run with Windows XP, VISTA or 7 (see figure on page 2).



USB-HIT Interface Adapter

Regarding its functions, this adapter conforms to the BD232 interface adapter, except that the bidirectional transmission takes place between the IR and USB interface.

It is not possible to establish a multi-channel system with this adapter.



Current Measuring Accessories								
All current sensors and transformers are equipped with a connector cable (1.2 to 1.5 m long) with 4 mm safety banana plugs								
Type	Designation	Measuring Range	Meas. Category	Max. Wire Dia.	Transformation Ratio	Frequency Range	Intrinsic Error ±(% rdg. + ...)	Article Number
AC/DC Current Sensors with Voltage Output								
CP30	DC/AC clip-on current sensor, with battery mode (30 h)	5 mA ... 30 A (DC / AC pk)	300 V / CAT III	25 mm	100 mV/A	DC...20 kHz (-3 dB)	1 % + 2 mA	Z201B
CP330	DC/AC clip-on current sensor, with 2 measuring ranges, battery mode (50 h)	0,5 ... 30 A 5 ... 300 A (DC / AC rms)	300 V / CAT III	25 mm	10 mV/A; 1 mV/A	DC...20 kHz (-3 dB)	1 % + 50 mA 1 % + 100 mA	Z202B
CP1100	DC/AC clip-on current sensor, with 2 measuring ranges, battery mode (50 h)	0,5 ... 100 A 5 ... 1000 A (DC / AC rms)	300 V / CAT III	32 mm	10 mV/A; 1 mV/A	DC...20 kHz (-1dB)	1 % + 100 mA 1 % + 500 mA	Z203B
CP1800	DC/AC current clamp sensor, with 2 measuring ranges, battery mode (50 h)	Range: 0.5 ... 125 A Range: 5 ... 1250 A (DC / AC rms)	300 V / CAT III	32 mm	10 mV/A, 1 mV/A	DC ... 20 kHz (-1 dB)	1% + 100 mA 1% + 500 mA	Z204A
Z13B	Clip-on current sensor with 2 measuring ranges, battery mode (50 h)	0.2 ... 40 A~/60 A-, 0.5 ... 400 A~/600A-	300 V / CAT IV	50 mm	10 mV / A, 1 mV / A	<u>DC ... 65 Hz</u> ... 10 kHz	1.5% + 0.5 A 2.5%	Z13B
AC Current Sensors with Voltage Output								
WZ12B	Clip-on current sensor	10 mA~ ... 100 A~	300 V / CAT III	15 mm	0.1 mV / mA	<u>45 ... 65</u> ... 500 Hz	1.5% + 0.1 mA	Z219B
WZ12C	Clip-on current sensor with 2 measuring ranges	1 mA~ ... 15 A~, 1 ... 150 A~	300 V / CAT III	15 mm	1 mV / mA, 1 mV / A	<u>45 ... 65</u> ... 400 Hz	3% + 0.15 mA, 2% + 0.1 A	Z219C
WZ11B	Clip-on current sensor with 2 measuring ranges	0.5 ... 20 A~, 5 ... 200 A~	600 V / CAT III	20 mm	100 mV / A, 10 mV / A	<u>30... 48... 65</u> ... 500 Hz	1 ... 3%	Z208B
Z3512A	Clip-on current sensor with 4 measuring ranges	1 mA ... 1/10 A~ 100/1000 A~	600 V / CAT III	52 mm	1 V/A, 100 mV/A, 10 mV/A, 1 mV/A	<u>10... 48... 65</u> ... 3 kHz	0.5 ... 3%, 0.2 ... 1%	Z225A

METRAHIT | 27M, 27I and H+E CAR Milliohm Resistance Meter and Digital Multimeter, Insulation Tester and Data Logger

Order Information

Description	Type	Article Number
Milliohm resistance meter and multimeter with memory ¹	METRA HIT 27M	M227A
Insulation tester, milliohm resistance meter and multimeter with memory ¹	METRA HIT 27I	M227B
Avionics set ¹	METRA HIT 27AS	M227C
Megatester Hybrid & E-CAR Set for measurements on electric and hybrid vehicles ²	METRA HIT 27I SET	M227S
Megatester for Hybrid & E-CARs for measurements on electric and hybrid vehicles ²	METRA HIT H+E CAR	M227T
Megatester Hybrid & E-CARs Set for measurements on electric and hybrid vehicles ²	METRA HIT H+E CAR SET	M227U
Hardware Accessories		
Mains power battery charger AC 90...250 V DC 5 V 600 V CAT IV, 1000 V CAT I II	NA HIT 2x	Z218H
Mains power battery charger AC 90 ... 250 V DC 5 V, 600 V CAT II	NA HIT 27	Z218J
NiMH quick charger w/o storage batteries	Z206D	Z206D
Fuses for all mΩ measuring ranges	FF (UR) 1.6 A/ 1000 V AC/DC	Z109C
Kelvin clips (1 set = 2 each) for 4-pole connection of low-resistance DUTs, cable length: 120 cm	KC4	Z227A
Kelvin probes (1 set=2 each) with double steel tips for 4-pole connection of low resistance DUTs	KC27	Z227B
Cable set with 2 mm diameter steel tips and 120 cm cable, 1000 V CAT II	KS17-S	Z110H
Pt100 temperature sensor, -40 ... 600 °C for surface and immersion measurements	Z3409	GTZ3409000R0001
Pt1000 temperature sensor, -20 ... +220 °C for measurement in household appliances, as well as in gases and liquids, 3.2 mm diameter stainless steel immersion tube	TF220	Z102A
Hybrid Diagnostic-Kit ²	KS-H&E	Z227U
ADK Automotive Diagnostic Kit ²	KS-ADK	Z227T
Transport Accessories		
Imitation leather carrying pouch for METRA HIT	F829	GTZ3301000R0003
Cordura belt pouch for multimeters of the METRA HIT series	HitBag	Z115A
Magnetic holder and belt strap for METRAHIT Multimeter with Rubber Holster	HIT-Clip	Z117A
Imitation leather ever-ready case with cable compartment	F836	GTZ3302000R0001
Ever-ready case for 2 METRA HITs, 2 adapters and accessories	F840	GTZ3302001R0001
Hard case for one METRA HIT and accessories	HC20	Z113A
Hard case for two METRA HITs and accessories	HC30	Z113B

Description	Type	Article Number
Accessories for Operation with PCs		
Single-channel pack consisting of BD232 bidirectional interface adapter, cable, METRAwin [®] 10/ METRA HIT software and installation instructions	BD-Pack 1	Z215A
Bidirectional interface adapter	BD232	GTZ3242100R0001
RS232 interface cable, 2 m long (included with Z3231)	Z3241	GTZ3241000R0001
METRAwin [®] 10/METRA HIT software update and installation instructions	Z3240	GTZ3240000R0001
Bidirectional interface adapter IR/USB for METRA HITs	USB-HIT	Z216A

¹ standard equipment see page 5

² standard equipment see page 6

METRAHIT | 27M, 27I and H+E CAR **Milliohm Resistance Meter and Digital Multimeter,** **Insulation Tester and Data Logger**

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

METRA HIT | 27EX

Milliohmmeter

for Use in Potentially Explosive Atmospheres

3-349-335-03
6/8.14

Compact milliohmmeter for the measurement of low value contact resistance in potentially explosive atmospheres, for example at contacts inside aircraft fuel tanks (bonding test), as well as for general low value resistance measurements inside and outside of potentially explosive atmospheres, for example on aircraft outer skins (lightning protection and wick test)

- **Measuring ranges:** 30 mΩ, 300 mΩ, 3 Ω, 30 Ω
- **Resolution:** 10 μΩ
- **Measuring method:** Kelvin connection (4-wire measurement)
- **DATA Hold memory:** 1200 measured values
- **EX designation:** Ex II 2 G Ex ia IIA T4 Gb
- **Prototype test certificate:** INERIS 05ATEX0040
- **DAkKS calibration certificate**
- **Included accessories:** Kelvin probe, Kelvin clip, batteries, protective rubber holster, hard case
- **Guarantee:** 3 years material and workmanship, 1 to 3 years for calibration (depending upon application)



Features

- **Indicator Displays**
LCD panel: 4¾-place display for measured values, two auxiliary displays for special functions, background illumination, LCD test and overload display
2 LEDs : red and green, for evaluating contact quality
- **Kelvin Connection (4-wire measurement)**
 Suppresses influence from conductor and contact resistance on measuring results
- **Offset Balancing**
 In the lower measuring ranges an automatic offset balancing is conducted by thermovoltage compensation.
- **DATA Hold**
 For quick, reliable measurement and storage of individual measured values
- **Auto-Ranging**
 The instrument is equipped with automatic and manual measuring range selection
- **Power Supply**
 The instrument is operated with two Ex approved batteries. Power management: If none of the keys are actuated for a lengthy period of time, the milliohmmeter is shut down automatically. The instrument is also shut down automatically if the minimum voltage required to perform the selected measurement is fallen short of.
- **Protective Cover for Harsh Conditions**
 The device features a very compact, rugged design. Beyond this, it is protected against damage in the event of impacts or dropping by means of a soft protective rubber holster with tilt stand. The rubber material also assures that the instrument does not wander if it is set up on a vibrating surface.

Applications

The **METRA HIT | 27EX** is a compact, rugged and reliable instrument, which is equally suitable for precision measuring and recording tasks in the factory, for on-site service and in the laboratory. The instrument is certified for use in potentially explosive atmospheres in accordance with Ex II 2 G Ex ia IIA T4 Gb.

- Adjustment of shunts in instrumentation
- Testing of electrical connections at conductor bars for open-pit mining, in potential bonding systems, in industry and in household applications
- Testing of cable resistance, wiring, shunt resistors in PCBs and thick-film circuits
- Measurement of contact resistance in relays, contactors and power interrupters
- Testing of resistance in fuses, as well as conductor resistance in power current circuits
- Testing of coil resistance in transformers, coils, small motors etc.
- Testing of discharge resistance on aircraft, and at aircraft outer skin components
- Contact resistance testing in uninterruptible power supplies
- Contact resistance testing at welding seams

General

The **METRA HIT | 27EX** milliohm resistance meter is the modern alternative to the well known TH2 (Thomson) and Wh2 (Wheatstone) measuring bridges. It provides an expanded measuring range, greater accuracy and easier reading. As a universal measuring instrument, it acquires resistance values by feeding a test current through the respective resistor, conductor or contact, and records them to its integrated memory module.

Easy Operation

Operation is very easy. Simply connect the low-resistance device under test to the instrument with the included measurement cables, Kelvin clip or 4-pole probe, and select the ideal measuring range.

Integrated Measured Value Memory and Interface

The **METRA HIT | 27EX** is equipped with a measured value memory module and can be utilized as a data logger or a recording instrument. Measurement results can be transmitted to a PC either off-line via the optical interface which is furnished as standard equipment, or online with an optional bidirectional adapter. In this way, characteristic curves can be displayed and analyzed in line recorder format relative to real time, or individual measured values can be saved with the DATA Hold function and analyzed at a PC in tabular form.

METRAwin10/METRAHit Software Option

Measurement data recorded to the measured value memory module can be evaluated at a PC if required with the help of the IR interface supplied as standard equipment and a bidirectional IR adapter (BD adapter) with conversion to the RS 232 protocol.

METRAwin10/METRAHit software is recommended to this end, which is suitable for display, analysis and documentation of measurement results using Windows XP, VISTA or 7. The software is available as an accessory. User-friendly complete packages (e.g. the BD Pack) are easy to connect and install and include everything required for high performance measurement data processing.

Applicable Regulations and Standards

IEC/EN 61 010-1:2010 VDE 0411-1:2011	Safety requirements for electrical equipment for measurement, control and laboratory use
EN 60529 VDE 0470, part 1	Test instruments and test procedures Degrees of protection provided by enclosures (IP code)
DIN EN 61 326-1 VDE 0843-20-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements
DIN EN 60079-0:2013 VDE 170-01	Electrical apparatus for explosive gasatmosphere, general requirements
DIN EN 60079-11:2012 VDE 170-7	Explosive atmosphere

Included

- 1 **METRA HIT | 27EX**
- 1 GH18 protective rubber holster (blue) including carrying strap
- 8 Ex approved batteries
- 1 KC27 Kelvin probe (1 ea. – not a set)
- 1 KC4 Kelvin clip (1 ea. – not a set)
- 1 HC30 hard case
- 1 DAkKS calibration certificate
- 1 Ex certificate: INERIS 05ATEX0040
- 1 set operating instructions

Characteristic Values

Measuring Function	Measuring Range	Resolution at Upper Range Limit 4% 30000 / 3% 3000 ¹⁾	Open-Circuit Voltage, Approx.	Meas. Current, Approx.
mΩ (4 L)	30 mΩ	0.01 mΩ	4 ... 6 V	100 mA
	300 mΩ	0.01 mΩ		100 mA
	3 Ω	0.1 mΩ		10 mA
	30 Ω	1 mΩ		10 mA

- ¹⁾ Display
 4 $\frac{3}{4}$ -place in the 300 mΩ, 3 Ω and 30 Ω ranges
 3 $\frac{3}{4}$ -place in the 30 mΩ range
 A different sampling rate and can also be selected in the rAtE menu for saving and transmitting measured values.

Measuring Function	Intrinsic Error at Max. Resolution under Reference Conditions ±(% rdg. + ... d)	Overload Capacity ²⁾		
		Value	Time	
mΩ (4 L)	30 mΩ	±0.6 V ³⁾	Continuous	
	300 mΩ			2 + 20
	3 Ω			1 + 20 ⁴⁾
	30 Ω			1 + 10

- ²⁾ At 0 ° ... + 40 °C
³⁾ The integrated 500 mA / 600 V~ fuse blows in the event of overloading (terminals I+, I-).
⁴⁾ Valid as of 10% of measuring range

Key

rdg. = reading (measured value), d = digit(s), 4 L = 4-wire measurement

Influencing Quantities and Influence Error

Influencing Quantity	Sphere of Influence	Measuring Range ¹⁾	Influence Error ± (... % rdg. + d)/10 K
Temperature	0 ... +21 °C and +25 ... +40 °C	mΩ, Ω	1 + 10

- ¹⁾ With zero balancing

Influencing Quantity	Sphere of Influence	Measuring Range ¹⁾	Influence Error
Relative Humidity	90% 3 days instrument off	All measuring ranges	1 x intrinsic error

- ¹⁾ With zero balancing

Real-Time Clock

Accuracy ±1 minute per month
 Temperature influence 50 ppm/K

Reference Conditions

Ambient temperature +23 °C ±2 K
 Relative humidity 40 ... 60%
 Battery voltage 5.0 V ±0.1 V

Response Time

Response Time (after manual range selection)

Measuring Range	Response Time Digital Display	Measured Quantity Waveshape
mΩ, Ω	1.5 s	From ∞ to 50% of upper range limit value

- * Without parallel connected capacitance

for Use in Potentially Explosive Atmospheres

Indicator Displays

LCD panel (65 x 30 mm) with display of up to 2 measured values, unit of measure and various special functions.

Display / char. height 7-segment characters
 Main display: 12 mm
 Auxiliary displays: 7 mm

Number of places 4¾-place \geq 30,999 steps

Overflow display "D. L" appears

LCD Test All display segments available during operation of the instrument are activated after it is switched on.

Background illumination can be switched on and off

OK LED (green) lights up to indicate good contact at the measuring point

Error LED (red) lights up to indicate interrupted test current (invalid measurement, poor contact when „D. L“ appears)

Power Supply

Batteries 4 x 1,5 V PhilipsLonglife R6L4B (AA-Size)

Service life

Measuring Function	Number of measurements *
mΩ at 100 mA	> 500
Ω at 10 mA	> 800

* 1 measuring cycle = 5 s

Additional consumption for:
 Interface operation: 0.5 mA
 LCD illumination: 40 mA at 6 V
 Battery test mΩ range at 100 mA:
 Automatic display of the \rightarrow symbol when battery voltage falls below approx. 4.6 V. Instrument is shut down at less than 4.3 V.

Fuses


Fuse link
 F1 for mΩ / Ω ranges 500 mA / 600 V AC, switching capacity: 60 A at 600 V AC
 F2 for batteries 250 mA / 125 V AC EX

Electrical Safety

Safety class II per IEC/EN 61010-1:2010 /VDE 0411-1:2011

Measuring category 50 V CAT I

Pollution degree 2

EX designation CE 0080
 II 2 G Ex ia IIA T4 Gb
 Ex = type tested
 II = device group
 2 = device category
 G = atmosphere (gas)
 Ex = conforms with European Ex standards
 ia = explosion protection (intrinsically safe)
 IIA = explosion group
 T4 = temperature class
 Gb = Equipment Protection Level (EPL)

Tamb. = -10 °C ... +50 °C
 (Tamb. = ambient temperature)

Prototype test certificate INERIS 05ATEX0040
 INERIS = test and certification authority
 05 = year
 ATEX = directive (atmosphere, explosive)
 0040 = test report no. 40

Electromagnetic Compatibility (EMC)

Interference emission/
 Interference immunity EN 61326:2006 Tab A1

Data Interface

Data transmission (data transfer) Bidirectional, optical via infrared light through the housing (read data and configure parameters)

With interface adapter as accessory
 BD232 IR to RS 232C, serial, per DIN 19241, can be cascaded for multi-channel operation

USB-HIT IR to USB 1.1 / USB 2.0, single-channel operation

Baud rate (MM ↔ PC) 9600 baud

Ambient Conditions

Accuracy range 0 °C ... +40 °C
 Operating temp. range -10 °C ... +50 °C
 Storage temp. range -25 °C ... +70 °C (without batteries)
 Relative humidity 45% ... 90%, no condensation allowed
 Elevation to 2000 m

Mechanical Design

Protection IP 54

Table Excerpt Regarding Significance of the IP Code

IP XY (1 st digit X)	Protection against penetration by solid particles	IP XY (2 nd digit Y)	Protection against penetration by water
5	dust protected	4	Splashing water

Dimensions 84 x 195 x 35 mm
 Weight Approx. 380 g with batteries (without GH18 protective rubber holster)

METRA HIT | 27EX

Milliohmmeter

for Use in Potentially Explosive Atmospheres

Accessories

(See also table below: "Order Information")

The following accessories, some of which are included as standard equipment, are recommended for use with the **METRA HIT | 27EX**:

Milliohm Measurement with KC4 Kelvin Clips

Kelvin clips are suitable for establishing contact between the **METRA HIT | 27EX** and low-resistance devices under test. They compensate for influence resulting from cable and contact resistance. The KC4 set includes two clips with insulated, twist-resistant jaws and good clamping action. They can be used for establishing contact with very fine wires, right on up to rails and rods with a maximum diameter of 15 mm.

4-pole connection is highly advisable for measuring values of less than 30 Ω .



Milliohm Measurement with KC27 Kelvin Probe

Same application as KC4, but with 2 spring-loaded steel tips each for piercing insulation coatings (e.g. on aircraft outer skins) and oxide layers (e.g. at oxidized battery contacts) in order to assure good contact for milliohm measurements.



Ever-Ready Cases and Hard Cases

The following hard-shell cases are available:

HC20 with space for one **METRA HIT |** and accessories.

HC30 with space for, for example, 2 **METRA HIT |**s, one 2-channel PC recording system with software, adapter, cable and accessories.



HitBag Cordura Belt Pouch

For **METRA HIT |**
and METRAport



for Use in Potentially Explosive Atmospheres

Accessories for Operation with PCs

Recording System with BD Pack

This option includes all additionally required hardware and software components for creating a PC supported measuring and recording system together with the **METRA HIT | 27EX**. A full version of METRAWin10/METRAHit is included with this package, which can be run with Windows XP VISTA or 7.



USB-HIT Interface Adapter

This adapter is functionally identical to the BD232 interface adapter, except that bidirectional transmission takes place between the IR and the USB interfaces in this case.

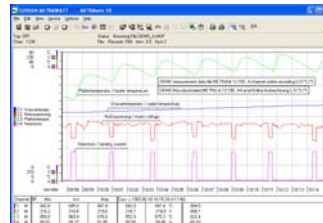


USB-Pack

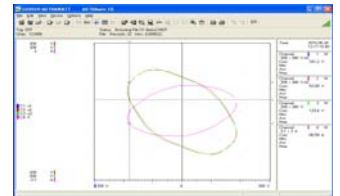
Set consisting of USB-HIT interface adapter, USB cable and METRAWin 10 / METRAHit software.

For purposes of analysis, data recorded online or read in from the device's memory can be displayed in various formats:

Y(t)-recorder display
for up to 6 channels



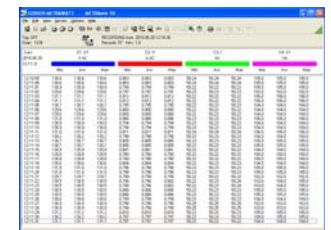
XY-recorder display
for up to 4 channels



Multimeter-display
for up to 4 channels



Tabular display
for up to 10 channels



System Requirements

METRAWin 10 (version 5.x) can be run on IBM compatible PCs with Microsoft Windows® XP, VISTA or 7.

METRAWin10/METRAHit Software

METRAWin10/METRAHit PC software is a multilingual, measurement data logging program for recording, visualizing and documenting measured values from **METRA HIT | 27EX** multimeters.

Communication between the PC and the measuring instrument(s) is established via available interfaces and memory adapters. Telephone modems can be interconnected as well.

Depending upon device type, one or several of the following operating modes are possible:

- **Device Configuration**
Remote configuration and querying of device-specific functions and parameters, for example measuring function, measuring range and memory parameters. Frequently used device settings can be saved to configuration files for easy recall.
- **Online Recording of Measurement Data**
Read-in, display and recording of momentarily measured data from the interconnected device.
 - Number of measuring channels up to 10
 - Start recording manual, triggered by measured value, time triggered
 - Recording mode > time controlled
with sampling interval of 0.05 s* ... 1 s ... 60 min
> manually controlled
> measured value controlled in event of exceeded limit/delta value
 - Recording duration max. 10 million intervals

* Depending upon device type, measuring function, number of measuring channels and communication (e.g. via modem), sample intervals of less than 1 s cannot be used.

- **Reading Out and Visualizing Stored Data**
If supported by the device: read-in and display of offline data recorded to device memory.

Milliohmmeter

for Use in Potentially Explosive Atmospheres

Order Information

Description	Type	Article Number
Special milliohmmeter for use in potentially explosive atmospheres, EX II 2G EEX ia IIA T4, incl. one Kelvin probe, one Kelvin clip and batteries in hard case HC30 with DAKKS Calibration Certificate		
Same version as above, but without particular designation; for customers from the chemical industry or aviation enterprises	METRAHIT 27EX GMC-I-Ausführung	M227F
Version for AIRBUS customers (maintenance services of airlines). The milliohmmeter is stipulated in the so-called AMM (Aircraft Maintenance Manual) for aircraft types A300..380, article numbers 97F92003500 and 97000F92001015000	METRAHIT 27EX AIRBUS-Ausführung	M227G
Hardware Accessories		
Ex approved Batteries (1 set of 4 ea.) 1,5 V Philips Longlife R6L4B (AA-Size)	BAT27	Z206F
Kelvin clips (1 set of 2 ea.) for 4-pole connection of low-resistance DUTs, cable length: 120 cm	KC4	Z227A
Kelvin probes (1 set of 2 ea.) with double steel tips for 4-pole connection of low-resistance DUTs	KC27	Z227B
Cable set with 2 mm diameter steel tips and 120 cm cable, 1000 V / CAT II	KS17-S	Z110H
Transport Accessories		
Cordura belt pouch for multimeters METRAHIT	HitBag	Z115A
Hard case for one METRAHIT and accessories	HC20	Z113A
Hard case for two METRAHITs and accessories	HC30	Z113A
Accessories for Operation at a PC		
Single-channel pack consisting of BD232 bidirectional interface adapter, cable, METRAwin10/METRAHit software and installation instructions	BD-Pack 1	Z215A
Bidirectional interface adapter	BD232	GTZ3242100R0001
RS 232 interface cable, 2 m (included with Z3231)	Z3241	GTZ3241000R0001
METRAwin10/METRAHit software update and installation instructions	Z3240	GTZ3240000R0001
IR-USB bidirectional interface adapter for METRAHIT	USB-HIT	Z216A
Set consisting of interface adapter USB-HIT, USB cable and METRAwin10/METRAHit software	USB-Pack	Z216B

For additional information regarding accessories please see:

- Measuring Instruments and Testers catalog
- www.gossenmetrawatt.com