

# METRAHIT | ENERGY

## TRMS SYSTEM Multimeter

3-349-574-03  
8/2.19

- Digital hand-held multimeter with **TRMS measurement** including: V AC TRMS, V AC+DC TRMS with a bandwidth of 100 kHz, V DC, dB, Hz (V), Hz (A),  $\Omega$ ,  $\mu\text{F}$ ,  $\text{V} \rightarrow \text{I}$ ,  $^{\circ}\text{C}/^{\circ}\text{F}$  (TC/RTD)
- **Power measurement** (W, VAR, VA, PF): active, reactive and apparent power with extreme values, power factor
- **Energy measurement** (Wh, VARh, VAh) active, reactive and apparent energy, mean power value with adjustable observation period and maximum value
- **Mains quality analysis:** recording of over and undervoltage, dips, swells, voltage peaks and transients in 0, 50 and 60 Hz systems
- **Harmonic analysis:** RMS values and distortion components up to the 15<sup>th</sup> harmonic at 16.7, 50, 60 and 400 Hz
- **Special measuring functions:** crest factor CF, conductivity nS, low resistance  $R_{\text{SL}}$ , duty cycle %, cable length km
- Resolution of 60,000 digits, **triple display**, display illumination can be activated under difficult lighting conditions
- 1 kHz / -3 dB low-pass filter can be activated
- Direct current measurement from 10 nA to 10 A, 16 A intermittently, current measurement with current transformer clamp and sensors, transformation ratio is taken into account at the display
- Large data memory for up to 300,000 measured values
- Instrument is **completely remote controllable** without activating the rotary switch or changing current sockets

### CAT IV



## Applications

The power multimeter is extremely rugged and reliable with a housing made of impact resistant ABS. With a resolution of 60,000 digits and more than 35 different measuring functions, it's been developed for professional use.

## Features

### Power and Energy Measurement

The **METRAHIT ENERGY** is a compact power meter for direct and alternating current in single-phase systems. The electrical circuit can be connected either directly, or via a current transformer. If a current transformer is connected to the multimeter (mA/A input), all current and power displays are represented with the correct value based upon the selected transformation ratio. Universal power measurement includes the following measuring functions: active, reactive and apparent power, power factor and energy.

Beyond this, the mean power value can be generated over a specified time period (e.g. 15 min.), and the corresponding maximum value can be recorded along with time of occurrence. Suitable AC current transformers with current output are listed on page 10.

Using shunt resistor **SR9800** in combination with current clamp sensor CP1800 allows for the power and energy measurement of **DC applications with high currents** as well, such as for measurements at photovoltaic systems.

### Systematic Voltage Quality Analysis

The **METRAHIT ENERGY** is equipped with a function for acquiring and recording power disturbances which is unique amongst the handheld multimeters. It allows for simultaneous, continuous recording of voltage characteristics and event-triggered recording of the following disturbances:

- Under and overvoltage with start time, duration and extreme value
- Under and overvoltage of the half-period RMS value (dips and swells) with start time, as well as min. and max. values
- Momentarily exceeded values with a duration of greater than 1 ms (peak) with time of occurrence and maximum value
- Steep transients with a rise time of 0.5 to 5 ms within a range of 200 to 1000 V including time of occurrence, relative voltage value and the previous 1 ms instantaneous value

### Harmonic Analysis

In the  $\frac{1}{\sqrt{2}}$  and current measurement (A) switch positions, harmonic analysis is performed approximately once per second using 32 sampling values per mains period (adjustable to 16.7, 50, 60 or 400 Hz).

FFT (fast Fourier transformation) makes oscillations up to the 15<sup>th</sup> harmonic available to this end. These are used to calculate the RMS values of the fundamental harmonic (HD 1) and the individual higher harmonics (HD 2 ... 15), as well as total harmonic distortion (THD). RMS values and harmonic components are displayed in each case (RMS values relative to the RMS value of the fundamental harmonic). Harmonic analysis is also available for current clamp measurement.

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### Convenient Triple Display

The momentary measured value and up to two additional values are displayed simultaneously, for example:

- Extreme value with date and time
- Frequency and RMS value of AC measuring voltage

Or in the case of power measurement:

- Momentary measured values of active power, voltage and current
- Maximum value for periodic power with date and time

### User Safety and Overload Protection

Dangerous alternating contact voltages of greater than 30 V and direct voltages of greater than 35 V are indicated visually.

Overload protection safeguards the instrument in all measuring functions for up to 600 V. Voltages of greater than 600 V and currents of greater than 10 or 16 A are indicated acoustically. Dangerous contact voltages are indicated when the 1 kHz low-pass filter has been activated.

FUSE appears at the display if the fuse for the current measuring input blows.

Switching between high and low impedance measuring functions is disabled in the event of dangerous contact voltage.

### Three Connector Jacks with Automatic Blocking Sockets (ABS) \*

All current ranges are implemented via a single connector jack which prevents any possibility of operator error. Auto-ranging is available in all current measuring ranges. Beyond this, the automatic blocking sockets prevent incorrect connection of the measurement cables, as well as selection of the wrong measured quantity. Danger to the user, the instrument and the device under test resulting from operator error is thus ruled out. Exceptions include switch positions W, Wh and A.

\* Patented (patent no. EP 1801 598 and US 7,439,725)

### RMS Value with Distorted Waveshape

The utilized measuring method allows for waveshape independent RMS measurement (TRMS AC and AC+DC) for voltage up to 100 kHz and current (up to 10 kHz and up to CF = 10).

### Activatable Filter for V AC Measurement

A 1 kHz low-pass filter can be activated if required, for example when measuring motor voltage at electronic frequency converters. The input signal is checked by a voltage comparator for dangerous voltages as long as the low-pass filter is activated. A high-voltage symbol appears at the display if dangerous voltage is present.

### Measuring of 5 V Square-Wave Signals

This function makes it possible to test circuits and transmission cables by measuring the frequency and the duty cycle of pulses with amplitudes of 2 to 5 V and frequencies of 1 Hz to 1 MHz.

### Fast Acoustic Continuity Test

Testing for short circuiting and interruption is possible with the selector switch in the  $\Omega$  position. The threshold value for acoustic signaling can be set to 1, 10, 20 ... 500  $\Omega$  in 10 ohm steps.

### Automatic / Manual Measuring Range Selection

Measured quantities are selected by means of a rotary switch and a function key. The measuring range is automatically matched to the measured values. The measuring range can also be selected and locked manually with a key.

### Peak Value Monitoring for Automatic and Manual Measuring Range Selection

The peak value is measured in addition to RMS measurement in the V / A DC, AC and AC+D functions, as well as for power measurement. If the peak value exceeds the valid range of the corresponding measuring path, the instrument is switched up one range, even if the displayed RMS measured value has not yet reached the threshold value. If the momentary measuring range is manually locked, (-)OL appears to indicate the peak value.

This assures that measurement only takes place in the permissible range for these functions (e.g. during measurement of a signal with a high crest factor or measurement of the DC component of high AC+DC voltages).

### Measurement with Current Transformer Clamps and Sensors

Current transformer clamps and sensors are used for current measurements without interrupting the circuit under test, and for high amperages (> 16 A). All E series multimeters offer convenient measurement with current clamps. The measured current value is automatically calculated for the user with the help of the adjustable clamp factor.

### Automatic Storage of Measured Values \*

The DATA function automatically saves the digitally displayed measured value after settling in. Acoustic signaling is also used to indicate whether the new measured value deviates from the initial reference value less or more than 0.1% of the measuring range.

\* Patented

### Storage of Min-Max Values

Comparable to the slave-pointer function of an analog instrument, the device saves the highest and lowest measured values after the Min-Max function has been activated or reset. These extreme values and their time stamps can be queried at the display.

### Memory Mode Operation

The METRAHIT ENERGY is equipped with a quartz-movement synchronized measurement data memory (2048 kB), which has enough capacity for up to 300,000 measured values depending upon configuration. This allows for use of the instrument as an autonomous real-time data logger.

Measurement data recording is executed either:

- In a time controlled fashion with an adjustable sampling interval within a range of 0.5 ms (for V/A DC only) to 9 hours
- Dependent upon measured value in the event of exceeded limit/delta value
- Automatically after stabilization of the measuring value
- As an individual measured value by pressing a key

Memory content can be read out from a PC with the help of the USB X-TRA adapter, as well as analyzed and documented with METRAWIN 10 evaluation software.

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### Battery Charging Status – Power Saving Circuit

The battery charging status is indicated by means of four symbols.

The device is switched off automatically if the measured value remains unchanged for a period of between 10 and 59 minutes (adjustable), and if none of the controls are activated during this time (automatic shutdown is deactivated for power and energy measurement as well as for power quality analysis).

Automatic shutdown can be disabled by switching the instrument to continuous operation.

The standby mode for the infrared interface can be deactivated.

### Protective Cover for Harsh Conditions

The instrument is protected against damage in the event of impacts or dropping by means of a soft rubber cover with tilt stand and test probe holder. The rubber material also assures that the instrument does not wander if it is set up on a vibrating surface.

### Infrared Data Interface

The device can be remote configured, and momentary and saved measurement data can be read out via the bidirectional infrared interface. The USB X-TRA interface adapter and **METRAwin 10** software are required to this end (see accessories). An interface protocol and device drivers for LabVIEW® (National Instruments™) are available upon request.

### DAkKS Calibration Certificate

Each multimeter is individually adjusted, subjected to final inspection and calibrated. Adherence to the specification is confirmed by means of the included DAkKS calibration certificate, which is valid worldwide (recognized by EA and ILAC). After the specified calibration interval has elapsed (recommended interval: 1 to 3 years), the multimeters can be recalibrated at any time in our own DAkKS calibration laboratory.

### Applicable Regulations and Standards

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

### Scope of Delivery

- 1 multimeter
- 1 KS29 safety measurement cable set consisting of 3 measuring cables (1 black, 1 blue, 1 red) with 90° offset safety plugs, test probes and 3 safety caps for CAT IV, 1000 V CAT II 16 A / 600 V CAT IV 1 A
- 2 batteries, 1.5 V, type AA
- 1 DAkKS calibration certificate
- 1 rubber holster
- 1 condensed operating instructions\*, English/German


\* Detailed operating instructions are available for download on the Internet at [www.gossenmetrawatt.com](http://www.gossenmetrawatt.com)

### Extended, Voluntary Manufacturer's Guarantee

36 months for materials and workmanship

1 to 3 years for calibration (depending upon application)

### Functions Overview

Function	
Power measurement	W (Var, VA, PF)
Energy measurement	Wh (varh, VAh)
Energy recording	DC / AC events
Power disturbance recording	PQ
Harmonic Analysis	 V, A
Voltage (Ri ≥ 17 MΩ)	V <sub>DC</sub>
Voltage (Ri ≥ 9 MΩ)	V <sub>AC</sub> TRMS
Voltage (Ri ≥ 9 ... 17 MΩ)	V <sub>AC+DC</sub> TRMS
Crest factor (1 ≤ CF ≤ 11)	✓
Frequency in Hz with V <sub>AC</sub>	... 300 kHz
Low-pass filter	1 kHz with V <sub>AC</sub>
Bandwidth for V <sub>AC+DC</sub> or V <sub>AC</sub>	100 kHz
Pulse frequency in MHz at 5V TTL	1 Hz...1 MHz
Duty cycle as %	2.0% ... 98%
Voltage level measurement in dB	✓
Resistance	Ω
Conductivity	nS
Low resistance measurement with I <sub>CONST</sub> = 3 mA	R <sub>SL</sub>
Continuity test with I <sub>CONST</sub> = 1 mA	✓
Diode test with I <sub>CONST</sub> = 1 mA	✓
Temperature measurement °C/°F with T <sub>C</sub>	Type K
Temp. measurement °C/°F R <sub>TD</sub>	Pt100/Pt1000
Capacitance measurement in F	✓
Cable length in m	✓
Current	A <sub>DC</sub> A <sub>AC</sub> TRMS A <sub>AC+DC</sub> TRMS
Bandwidth for A <sub>AC+DC</sub> or A <sub>AC</sub>	10 kHz
Frequency in Hz for A <sub>AC</sub>	... 60 kHz
Current clamp measurement with adjustable transformation ratio	∞ mV / A ∞ mA / A
Relative value measurement (reference value measurement) ΔREL	✓
Zero point	✓
Data logger function <sup>1</sup> (memory)	16 MBit
Min / Max / data hold	✓
IR interface (38.4 kBd)	✓
Power pack socket	✓
Rubber holster	✓
Fuse	10 A / 1000 V
Protection	IP 52
Measuring category	600 V CAT III 300 V CAT IV
DAkKS calibration certificate	✓

<sup>1</sup> 16 Mbit = 2048 kByte = up to 300,000 measured values, sampling rate adjustable from 0.5 second to 9 hours

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## TRMS SYSTEM Multimeter

### Characteristic Values

Meas. Function	Measuring Range	Resolution at Upper Range Limit		Input impedance		Intrinsic Uncertainty at Ref. Cond. for High Resolution (59,999 digits)			Overload Capacity <sup>2</sup>		
		60,000	6,000	$\equiv$	$\sim / \approx$	$\pm(\dots \% \text{ rdg.} + \dots \text{ d})$	$\pm(\dots \% \text{ rdg.} + \dots \text{ d})$	$\pm(\dots \% \text{ rdg.} + \dots \text{ d})$	Value	Time	
<b>V</b>	60 mV	1 $\mu$ V				0.02 + 15 with ZERO	$\sim$	$\approx$	600 V DC AC TRMS sine	Max. 10 s  Cont.	
	600 mV	10 $\mu$ V		$\geq 17 \text{ M}\Omega$	$\geq 9 \text{ M}\Omega // < 50 \text{ pF}$	0.02 + 15 with ZERO	0.2 + 30	1 + 30			
	6 V	100 $\mu$ V		$\geq 17 \text{ M}\Omega$	$\geq 9 \text{ M}\Omega // < 50 \text{ pF}$	0.02 + 15	0.2 + 30	1 + 30			
	60 V	1 mV		$\geq 17 \text{ M}\Omega$	$\geq 9 \text{ M}\Omega // < 50 \text{ pF}$	0.02 + 15	0.2 + 30	1 + 30			
	600 V	10 mV		$\geq 17 \text{ M}\Omega$	$\geq 9 \text{ M}\Omega // < 50 \text{ pF}$	0.02 + 15	0.2 + 30	1 + 30			
<b>Display range where reference voltage <math>U_{REF} = 0.775 \text{ V}</math></b>											
<b>dB</b>	0.6 ... 600 V-		0.01 dB	-48 dB ... +58 dB		Intrinsic uncertainty			600 V DC AC TRMS sine	Cont.	
<b>A</b>	<b>Voltage drop at approx. range limit</b>										
	600 $\mu$ A	10 nA		60 mV	60 mV	0.1 + 20	0.5 + 25	1.0 + 30	0.7 A	Cont.	
	6 mA	100 nA		160 mV	160 mV	0.05 + 20	0.5 + 25	1.0 + 30			
	60 mA	1 $\mu$ A		180 mV	180 mV	0.05 + 20	0.5 + 25	1.0 + 30			
	600 mA	10 $\mu$ A		250 mV	250 mV	0.1 + 20	0.5 + 25	1.0 + 30			
	6 A	100 $\mu$ A		360 mV	360 mV	0.2 + 30	0.5 + 25	1.0 + 30			
	10 A	1 mA		600 mV	600 mV	0.2 + 30	0.5 + 25	1.0 + 30			
								10 A: $\leq 5 \text{ min}^{10}$ 16 A: $\leq 30 \text{ s}^{10}$			
<b>A <math>\succ</math></b>	Factor: 1:1/10/100/1000		<b>Input</b>		<b>Input impedance</b>		See A $\sim$ current measuring range for specification Plus current transformer clamp error See voltage measuring range V DC, AC, AC+DC <sup>1</sup> for specifications Plus Current clamp sensor error			Measurement input 0.7 A continuous 10 A: 5 min	
	0.06, 0.6, 6, 60 A	60 mA	3 $\Omega$								
	0.6, 6, 60, 600 A	600 mA	0.4 $\Omega$								
<b>A <math>\succ</math></b>	6, 60, 600, 6000 A		6 A		60 m $\Omega$		Refer to A DC, AC, AC+DC <sup>1</sup> current measuring ranges for specifications Current measuring range 600 $\mu$ A plus error CP1800 plus 0.5 %			Measurement input 600 V RMS max. 10 s	
	0.6, 6, 60, 600 A		600 mV		Voltage measurement input (V jack) Ri = 9 M $\Omega$						
	6, 60, 600, 6000 A		6 V		60 V						
<b>A <math>\succ</math> with SR9800</b>	6/60/600/6000A		6 V at adapter SR9800		Current measuring input (socket A) with adapter SR9800: Ri = 10 k $\Omega$					Measurement input 600 V RMS max. 10 s	
<b><math>\Omega</math></b>	<b>Open-circuit voltage</b> Meas. current at range limit										
	600 $\Omega$	10 m $\Omega$		< 1.4 V	Approx. 250 $\mu$ A	$\pm(\dots \% \text{ rdg.} + \dots \text{ d})$			600 V DC AC TRMS sine	Max. 10 s	
	6 k $\Omega$	100 m $\Omega$		< 1.4 V	Approx. 60 $\mu$ A	0.1 + 5 with ZERO function active					
	60 k $\Omega$	1 $\Omega$		< 1.4 V	Approx. 7 $\mu$ A	0.1 + 5					
	600 k $\Omega$	10 $\Omega$		< 1.4 V	Approx. 0.8 $\mu$ A	0.2 + 5					
	6 M $\Omega$	100 $\Omega$		< 1.4 V	Approx. 180 nA	0.5 + 5					
	60 M $\Omega$	1 k $\Omega$		< 1.4 V	Approx. 15 nA	2.0 + 10 (battery operation)					
600 nS	0.1 nS		< 1.4 V	0.45 $\mu$ A	2 + 10 (as of 3% MR)						
<b>RSL</b>	60 $\Omega$	001 $\Omega$		9 V	Approx. 3 mA	1 + 5 with ZERO function active					
<b><math>\rightarrow</math></b>	600 $\Omega$	—	0.1 $\Omega$	Approx. 3.2 V	Approx. 1 mA const.	1 + 5 with ZERO function active					
<b><math>\rightarrow</math></b>	6.0 V <sup>3</sup>	—	1 mV	Approx. 9 V	Approx. 1 mA const.	0.5 + 3					
<b>F</b>	<b>Discharge resist. <math>U_0 \text{ max}</math></b>										
	60 nF	—	10 pF	1 M $\Omega$	0.7 V	$\pm(\dots \% \text{ rdg.} + \dots \text{ d})$			600 V DC AC TRMS sine	Max. 10 s	
	600 nF	—	100 pF	100 k $\Omega$	0.7 V	1 + 10 <sup>4</sup> with ZERO function active					
	6 $\mu$ F	—	1 nF	12 k $\Omega$	0.7 V	1 + 6 <sup>4</sup>					
	60 $\mu$ F	—	10 nF	12 k $\Omega$	0.7 V	1 + 6 <sup>4</sup>					
	600 $\mu$ F	—	100 nF	3 k $\Omega$	0.7 V	5 + 6 <sup>4</sup>					
						$f_{min}^5$					
<b>Hz (V)</b>	600.00 Hz	0.01 Hz				$\pm(\dots \% \text{ rdg.} + \dots \text{ d})$			Hz (V) <sup>6</sup> , Hz(A $\succ$ ) <sup>6</sup> , 600 V Hz (A): <sup>7</sup>	Max. 10 s	
<b>Hz (A)</b>	6.0000 kHz	0.1 Hz				0.05 + 5 <sup>8</sup>					
<b>Hz (A<math>\succ</math>)</b>	60.0000 kHz	1 Hz		Input impedance, V jack: Ri = 9 M $\Omega$	1 Hz	As of 15% MR for U $\geq 0.18 \text{ V}$					
<b>Hz (V)</b>	300.00 kHz	10 Hz			10 Hz						
<b>MHz</b>	600 Hz ... 1 MHz	0.01 ... 100 Hz			1 ... 100 Hz	0.05 + 5			600 V	Max. 10 s	
<b>%</b>	2.0 ... 98 %	—	0.01%	15 Hz ... 1 kHz		0.1 MR + 10 d					
	5.0 ... 95%	—	0.01%	1 kHz ... 10 kHz		0.1 MR per kHz + 10 d					
	10 ... 90%	—	0.01%	10 kHz ... 50 kHz		0.1 MR per kHz + 10 d					
<b><math>^{\circ}\text{C}/^{\circ}\text{F}</math></b>	$\pm(\dots \% \text{ rdg.} + \dots \text{ d})$										
	Pt100	-200.0 ... +850.0 $^{\circ}\text{C}$	0.1 $^{\circ}\text{C}$				0.3 + 10 <sup>9</sup>			600 V DC/AC RMS sine	Max. 10 s
	Pt1000	-150.0 ... +850.0 $^{\circ}\text{C}$					0.3 + 10 <sup>9</sup>				
	K (NiCr-Ni)	-250.0 ... -150 $^{\circ}\text{C}$					1.0% + 2.0 K <sup>9</sup>				
	-150 $^{\circ}\text{C}$ ... +1372.0 $^{\circ}\text{C}$					1.0% + 0.5 K <sup>9</sup>					

<sup>1</sup> Specified accuracy valid as of 1% of measuring range for AC, and 3% for AC+DC. See frequency influence on page 6.

<sup>2</sup> At 0  $^{\circ}$  ... + 40  $^{\circ}\text{C}$

<sup>3</sup> Display of up to max. 6.0 V, "OL" in excess of 5.1 V.

<sup>4</sup> Applies to measurements at film capacitors during battery operation

<sup>5</sup> Lowest measurable frequency for sinusoidal measuring signals symmetrical to the zero point

<sup>6</sup> Overload capacity of the voltage measurement input: power limiting: frequency x max. voltage  $6 \times 10^6 \text{ V} \times \text{Hz}$  for U > 100 V

<sup>7</sup> Overload capacity of the current measurement input: see current measuring ranges for max. current values

<sup>8</sup> Input sensitivity, sinusoidal signal, 10% to 100% MR (mV range: as of 30%)

<sup>9</sup> Plus sensor deviation for measurement with external reference temperature, plus  $\pm 2 \text{ K}$  for internal reference temperature

<sup>10</sup> Off-time > 30 min. and  $T_A \leq 40 \text{ }^{\circ}\text{C}$

**Key:** d = digit(s), MR = measuring range, rdg. = reading (measured value)

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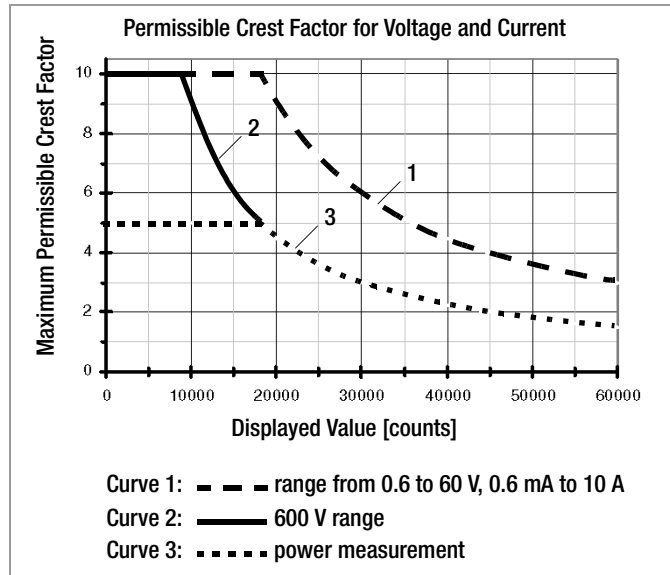
## TRMS SYSTEM Multimeter

### Crest Factor CF

Measuring range:  $1.0 \leq CF \leq 11.0$ ; resolution: 0.1

Typical (not specified) maximum deviation:

Frequency	$CF \leq 3.0$	$3.0 < CF \leq 5.0$	$5.0 < CF \leq 10.0$
10 to 70 Hz	$\pm 0.2$	$\pm 0.2$	$\pm 0.5$
70 to 440 Hz	$\pm 0.2$	$\pm 0.5$	Not valid
440 Hz to 1 kHz	$\pm 0.5$	Not valid	Not valid
> 1 kHz	Not valid	Not valid	Not valid



Above figure: Influence of Crest Factor on Display Range

Additional error caused by the signal's crest factor:

$\geq 1.5 < CF \leq 3$  1% rdg.  
 $\geq 3 < CF \leq 5$  3% rdg.

### Power Measurement (measuring ranges for a current clamp factor of 1) – Single-Phase Measurement for Direct and Alternating Current

Measuring Function	Measuring Range	Resolution at Upper Range Limit	Overload capacity at 0 ... +40 °C	
			Value	Time
W, VAR, VA	360 $\mu$ W	10 nW	V: 600 V A: 10 A DC AC TRMS sine	V continuous 10 A: 5 min. <sup>2)</sup> 16 A: 30 s <sup>2)</sup>
	3. mW	100 nW		
	36 mW	1 $\mu$ W		
	360 mW	10 $\mu$ W		
	3. W	100 $\mu$ W		
	36 W	1 mW		
	360 W	10 mW		
	600 W	100 mW		
	3.6 kW	100 mW		
	6 kW	1 W		
	36 kW <sup>1)</sup>	1 W		
	360 kW <sup>1)</sup>	10 W		
3600 kW <sup>1)</sup>	100 W			

<sup>1)</sup> Ranges achieved with current clamp only

<sup>2)</sup> Off-time > 30 min. and  $T_A \leq 40$  °C

### Intrinsic Uncertainty and Frequency Influence for Power and Energy Measurement

Measured Quantity	Measuring Range	Intrinsic Uncertainty (... % rdg + ... d)		
		DC	10 Hz to 65 Hz	65 Hz ... 1 kHz
Voltage, auxiliary display	$U \geq 0.1 \times U_{max}$ and $U \geq 0.15$ V	$0.5 + 10$	$0.3 + 10$	$0.4 + 10$ <sup>1</sup>
Current, auxiliary display	$I \geq 0.01 \times I_{max}$	$0.2 + 5$	$0.1 + 5$	$0.9 + 10$
Power factor		1 d	1 d	1 d <sup>1</sup>
Apparent power		$1.0 + 20$	$0.4 + 20$	$1.3 + 20$ <sup>1</sup>
Active power	IPFI $\geq 0.4$ IPFI $< 0.4$	$1.0 + 20$ —	$0.4 + 20$ $1.0 + 20$	$1.5 + 20$ <sup>1</sup> $3.0 + 20$ <sup>1</sup>
Reactive power	IPFI $\leq 0.8$	—	$1.0 + 20$	$3.0 + 20$ <sup>1</sup>

<sup>1</sup> Not valid for mV range.

### Display range

- Voltage and current: 6000 digits
- Apparent, reactive and active power: 36,000 digits
- Power factor: 100 digits

Intrinsic error: stable sinusoidal voltage, stable sinusoidal current, mean voltage value: max. 10% of amplitude.  $U > 10\%$  of the upper range limit is usually the case during normal operation due to auto-ranging, except in the smallest range. Bandwidth up to 1 kHz; signal components of higher frequency are clipped by input filters.

**Note:** Power is measured with a separate measurement circuit: As a result, specified accuracies for voltage and current measurement do not correspond with the specified values for the respective measuring functions. Principally, DC voltage linearity is only assured with voltages of  $\geq 0.15$  V or  $\geq 10\%$  of the upper range limit.

Additional deviation for U, I during power measurement with higher crest factor,  $f = 0 \dots 65$  Hz:

CF  $\leq 2$ : -0.3% rdg., CF = 3: -0.9% rdg.,  
 CF = 4: -1.5% rdg., CF = 5: -2.5% rdg.

### Square-wave signal, 10 to 65 Hz to U or I:

Additional intrinsic uncertainty of +0% / -0.7% rdg.

### Mains Monitoring / Mains Disturbance Recording

Type of Disturbance	Measuring Range	Resolution (display)	Intrinsic Uncertainty under Reference Conditions with Fixed Frequency of 50/60 Hz	Pulse Time
Over/undervoltage	6 ... 600 V	60,000 digits		
Dip/swell	6 ... 600 V	6000 digits	1% rdg. + 1% MR	$\geq 1$ half-period
Peak	6 ... 600 V	6000 digits	1% rdg. + 2% MR	$\geq 1$ ms
Transient	200 ... 1000 V*	10 V	$\pm 50$ V	0.5 ... 5 $\mu$ s

\* Absolute value of the transients is limited to approximately 1000 V by input protection.

### Internal Clock

Time format DD.MM.YYYY hh:mm:ss  
 Resolution 0.1 s  
 Accuracy  $\pm 1$  minute per month  
 Temperature influence 50 ppm per K

### Reference Conditions

Ambient temperature  $+23$  °C  $\pm 2$  K  
 Relative humidity 40 ... 75%  
 (no condensation allowed)  
 Meas. quantity frequency 45 ... 65 Hz  
 Meas. quantity waveform Sine  
 Battery voltage 2.0 V ... 3.2 V

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## TRMS SYSTEM Multimeter

### Influencing Quantities and Influence Error

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range	Influence Error per 10 K $\pm(\dots\% \text{ rdg.} + \dots \text{ d})$
Temperature	0 °C ... +21 °C and +25 °C ... +40 °C	60 mV $\overline{\text{---}}$ <sup>1</sup>	0.2 + 5
		600 mV ... 600 V $\overline{\text{---}}$	0.1 + 5
		600 mV $\overline{\text{---}}$	0.3 + 20
		V $\sim$ , 6 ... 600 V $\overline{\text{---}}$	0.2 + 10
		600 $\Omega$ ... 60 M $\Omega$ , nS	0.2 + 5
		A $\overline{\text{---}}$ , $\sim$ , $\overline{\text{---}}$	0.2 + 10
		60 nF ... 6 $\mu$ F, km	1 + 5
		60, 600 $\mu$ F	3 + 5
		Hz, dB	0.2 + 10
		Diode measurement	0.3 + 5
		RSL measurement	1 + 10
		Pt100 / Pt1000	0.5 + 10
		Type K thermocouple <sup>1</sup>	0.2 + 10
		Power measurement: V	0.3 + 10
		Power measurement: A	0.2 + 5
		W, VA, Wh, VAh	0.5 + 10

<sup>1</sup> The 60 mV DC range and thermocouple measurement are sensitive to temperature fluctuation: For this reason, specified values are not valid 30 until minutes after ambient temperature has stabilized.

Influencing Qty.	Meas. Quantity / Measuring Range	Sphere of Influence	Intrinsic Uncertainty <sup>3</sup> $\pm(\dots\% \text{ rdg.} + \dots \text{ d})$
Frequency	600.00 mV	> 15 Hz ... 45 Hz	3 + 30
		> 65 Hz ... 1 kHz	2 + 30
		> 1 kHz ... 20 kHz	3 + 30
		> 20 kHz ... 100 kHz <sup>4</sup>	3.5 + 30 <sup>4</sup>
	6.0000 V ... 60.00 V	> 15 Hz ... 45 Hz	2 + 30
		> 65 Hz ... 1 kHz	1 + 30
		> 1 kHz ... 20 kHz	3 + 30
		> 20 kHz ... 100 kHz <sup>4</sup>	3.5 + 30 <sup>4</sup>
	600.00 V <sup>2</sup>	> 15 Hz ... 45 Hz	2 + 30
		> 65 Hz ... 1 kHz	1 + 30
600.00 $\mu$ A ... 10.0000 A	> 1 kHz ... 20 kHz	3 + 30	
	> 65 Hz ... 10 kHz	3 + 25	

<sup>2</sup> Power limiting: frequency x voltage max.  $6 \times 10^6 \text{ V} \times \text{Hz}$  for  $U > 100 \text{ V}$

<sup>3</sup> The accuracy specification for frequency response is valid as of a display value of 10% of the measuring range for both measuring modes with the TRMS converter in the A AC and A (AC+DC) ranges.

<sup>4</sup> Frequency response up to 100 kHz, > 60 kHz plus 5%

Influencing Quantity	Sphere of Influence	Measured Quantity	Influence Error
Relative humidity	75%	V, A, $\Omega$ , F, Hz, dB, °C	1 x intrinsic uncertainty
	3 days instrument off		
Battery voltage	2.0 ... 3.2 V	V, A, $\Omega$ , F, Hz, dB, °C	Included in intrinsic uncertainty

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range	Damping
Common mode interference voltage	Interference quantity max. 600 V $\sim$ 50 Hz ... 60 Hz, sine	V $\overline{\text{---}}$	> 120 dB
		6 V $\sim$ , 60 V $\sim$	> 80 dB
		600 V $\sim$	> 70 dB
Series-mode interference voltage	Interference quantity V $\sim$ , respective nominal value of the measuring range, max. 600 V $\sim$ , 50 Hz ... 60 Hz, sine	V $\overline{\text{---}}$	> 50 dB
		Interference quantity max. 600 V $\text{---}$	> 100 dB

### Response Time (after manual range selection)

Measured Quantity / Measuring Range	Digital Display Response Time	Measured Quantity Jump Function
V $\overline{\text{---}}$ , V $\sim$ , dB AV $\overline{\text{---}}$ , A $\sim$	1.5 s	From 0 to 80% of upper range limit value
600 $\Omega$ ... 6 M $\Omega$	3 s	From $\infty$ to 50% of upper range limit value
nS, R <sub>SL</sub>	3 s	
60 M $\Omega$	8 s	
Continuity (acoustic signal)	< 50 ms	
°C (Pt100)	Max. 3 s	
$\rightarrow$	1.5 s	From 0 to 50% of upper range limit value
60 nF ... 600 $\mu$ F	Max. 2 s	
> 10 Hz	1.5 s	

### Data Interface


Type	Optical via infrared light through the housing
Data transmission	Serial, bidirectional (not IrDa compatible)
Protocol	Device specific
Baud rate	38,400 baud
Functions	<ul style="list-style-type: none"> <li>Select/query measuring functions and parameters</li> <li>Query momentary measurement data</li> <li>Read out stored measurement data</li> </ul>

The USB X-TRA plug-in interface adapter (see accessories) is used for adaptation to the PC's USB port.

### Internal Measured Value Storage

Memory capacity	16 MBit for approx. 300,000 measured values with indication of date and time
-----------------	--

### Power Supply

Battery	2 each 1.5 V AA batteries, alkaline manganese per IEC LR6 (2 each 1.2 V NiMH rechargeable batteries also possible)
Service life	With alkaline manganese: approx. 120 hrs.
Battery indicator	Battery capacity display with battery symbol in 4 segments:  . Querying of momentary battery voltage via menu function.
Power OFF function	The multimeter is switched off automatically: <ul style="list-style-type: none"> <li>When battery voltage drops below approx. 2.0 V</li> <li>If none of the keys or the rotary switch are activated for an adjustable duration of 10 to 59 min. and the multimeter is not in the continuous operation mode (assuming the instrument is not set to power measurement or mains analysis)</li> </ul>
Power pack socket	If the NA X-TRA power pack has been plugged into the instrument, the batteries are disconnected automatically. Rechargeable batteries can only be recharged externally. Power pack voltage: 5.1 V $\pm$ 0.2 V

# METRAHIT | ENERGY

## TRMS SYSTEM Multimeter

### Display



Transreflective LCD panel (65 x 36 mm) with display of up to 3 measured values, unit of measure, type of current and various special functions.

### Background Illumination

LED fiber-optic background illumination is switched off approx. 1 minute after it has been activated. If necessary, automatic deactivation of background illumination can be disabled with the appropriate parameter setting or via the interface.

### Digital

Display / char. height	7-segment characters Main display: 13 mm Auxiliary displays: 7.5 mm
Number of places	60,000 counts/steps
Overflow display	"OL" is displayed as of 61,000 + 1 digits
Polarity display	"-" sign is displayed if plus pole is connected to "⊥"
Sampling rate	10 or 40 measurements per second with the Min-Max function except for the capacitance, frequency, duty cycle and power measuring functions, 2000 measurements per second for fast DC measurement
Refresh rate	V (DC, AC+DC), A, Ω, →+, EVENTS AC/DC, count 2 per second Hz, °C (Pt100, Pt1000) 1 to 2 per second °C (J, K) 0.5 per second

### Acoustic Signals

For voltage	Intermittent signal at above 600 V
For current	Intermittent signal at above 10 A Continuous signal at above 16 A

### Fuse

Fuse link	FF (UR) 10 A/1000 V AC/DC, 10 mm x 38 mm, breaking capacity of at least 30 kA at 1000 V AC/DC, protects the current measurement input in the 600 μA to 10 A ranges
-----------	---

### Electrical Safety

Per IEC 61010-1:2010/VDE 0411-1:2011

Protection class	II	
Measuring category	CAT III	CAT IV
Operating voltage	600 V	300 V
Pollution degree	2	
Test voltage	5.2 kV~	

### Electromagnetic Compatibility (EMC)

Interference emission	EN 61326-1: 2013, class B
Interference immunity	EN 61326-1: 2013 EN 61326-2-1: 2013

### Ambient Conditions

Accuracy Range	0 °C to +40 °C
Op. temp. range $T_A$	-10 °C to +50 °C*
Storage temp. range	-25 °C to +70 °C (without batteries)
Relative humidity	40 to 75 %, no condensation allowed
Elevation	To 2000 m
Deployment	Indoors, except within specified ambient conditions

\* Exception: measurement of current > 10 to 16 A, operation at up to 40 °C

### Mechanical Design

Housing	Impact resistant plastic (ABS)
Dimensions	200 x 87 x 45 mm (without rubber holster)
Weight	Approx. 0.4 kg with batteries
Protection	Housing: IP 52

Table Excerpt Regarding 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 Penetration by Water
5	Dust protected	2	Dripping (at angle of 15°)

# METRAHIT | ENERGY

## TRMS SYSTEM Multimeter

### Accessories

#### NA X-TRA Power Pack (90 ... 250 V AC / 5 V DC)

Power pack for battery-saving mains operation, for continuous measurement using multimeters with internal memory

- Broad range input, 50/60 Hz
- Measuring category: CAT IV at 600 V



#### PMA16 Power Measuring Adapter

The adapter is used for safe, trouble-free measurement of current consumption (up to 16 A) at earthing contact plugs, as well as for connecting the voltage path to the **METRAHIT ENERGY** for power measurement.



### Accessories for Operation at a PC

#### Interface Adapter for USB Connection

The following functions can be executed with the USB X-TRA bidirectional interface adapter:

- Configure the **METRAHIT** multimeter from a PC.
- Transmit live measurement data to the PC.
- Read data out of memory from the **METRAHIT ENERGY**.

The adapter does not require a separate power supply. Its baud rate is 38,400 baud.

A CD ROM is included which contains current drivers for Windows operating systems.



### METRAwin<sup>®</sup>10/METRAHit<sup>®</sup> Software

METRAwin<sup>®</sup>10/METRAHit<sup>®</sup>PC software is a multilingual, measurement data logging program for recording, visualizing, evaluating and documenting measured values with reference to time from **METRAHIT** E series multimeters.

Communication between the PC and the measuring instrument(s) is established via available interface adapters.

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

- **Device Parameters 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.
  - Measuring channels Up to 10
  - Start recording Manual, triggered by measured value, time triggered
  - Recording mode
    - > Time controlled with a sample 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

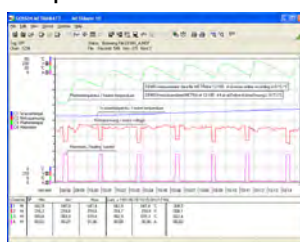
\* Depending upon device type, measuring function, number of measuring channels and communication mode (e.g. via modem), sample intervals of less than 1 second cannot be used.

- **Reading Out and Visualizing Stored Data**

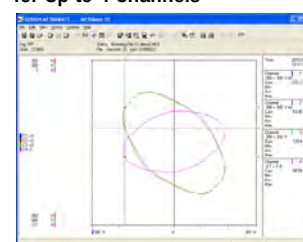
If supported by the device: read-in and display of offline data recorded to device memory

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



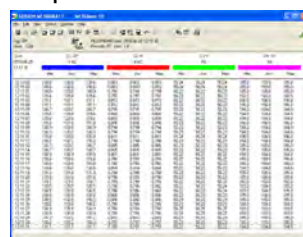
#### XY Recorder Display for Up to 4 Channels



#### Multimeter Display for Up to 4 Channels



#### Tabular Display for Up to 10 Channels



### System Requirements

METRAwin 10 (from version 5.3) can be run on IBM compatible PCs with Microsoft Windows<sup>®</sup> 7, 8 or 10.



# METRAHIT | ENERGY TRMS SYSTEM Multimeter

## Order Information

Designation	Type	Article Number
Professional, digital TRMS multimeter with power measurement. Triple digital display with a resolution of 60,000 digits. Multimeter functions: voltage and current (DC and TRMS AC and AC+DC), frequency, resistance, diode, temperature, power, energy and power quality, data logger and IR interface. Scope of delivery includes DAKKS calibration certificate, set of measurement cables KS29 and rubber holster	METRAHIT ENERGY	M249A
<b>Accessories for operation at a PC</b>		
IR-USB bidirectional interface adapter	USB X-TRA	Z216C
METRAwin 10 software	METRAwin 10	GTZ3240000R0001
<b>Accessories for temperature measurement with resistance thermometer</b>		
Pt100 temperature sensor for surface and immersion measurements, -40 ... +600 °C	Z3409	GTZ3409000R0001
Pt1000 temperature sensor for measurement in gases and liquids, -50 ... +220 °C	TF220	Z102A
Pt100 oven sensor, -50 ... +550 °C	TF550	GTZ3408000R0001
Ten adhesive Pt100 temperature sensors, -50 ... +550 °C	TS Chipset	GTZ3406000R0001
<b>Replacement fuse</b>		
Fuses (pack of 10)	FF (UR) 10 A / 1000 V AC/DC	Z109L
<b>Adapter</b>		
Power measuring adapter	PMA16	Z228A
Power pack	NA X-TRA	Z218G
Shunt resistor SR9800 (specified with 600 V CAT III) transforms the output voltage of current clamp sensors into current. This allows for the power and energy measurement of DC applications with high currents as well, such as for measurements at photovoltaic systems. The shunt resistor is connected in the current path between current clamp sensor (accessory CP1800) and mA/VA input of the multimeter to this end. *	SR9800	Z249A
Set consisting of: 1 x METRAHIT ENERGY, 1 x current sensor CP1800, 1 x shunt resistor SR9800, 1 x hard case HC30	METRAHIT ENERGY DC-Power Set	M249D
Rubber holster and carrying strap	GH X-TRA	Z104C

\* will only be supported as of firmware version 2.00.

## Transport Accessories

**HitBag Cordura Belt Pouch** for METRA HIT multimeters (with/without rubber holster) and METRAport



**HC30 Hard Case** for two multimeters (with/without rubber holster) and accessories



**F836 Ever-Ready Case** for multimeter and accessories



**F829 Ever-Ready Case** for multimeter (with/without rubber holster) and accessories



Designation	Type	Article Number
Imitation leather carrying pouch for METRA HIT and METRAmax	F829	GTZ3301000R0003
Cordura belt pouch for METRA HIT series multimeters and METRAport	HitBag	Z115A
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

For additional information regarding accessories please refer to:

- Measuring Instruments and Testers catalog
- [www.gossenmetrawatt.com](http://www.gossenmetrawatt.com)

# METRAHIT | ENERGY

## TRMS SYSTEM Multimeter

Accessories for Current and Power Measurement									Suitable for measuring:	
All current sensors and transformers are equipped with a terminal with 4 mm safety banana plugs.									Power	Current
Type	Designation	Measuring Range	Meas. Category	Max. Cable Diameter	Transformation Ratio	Frequency Range	Intrinsic Uncertainty $\pm$ (% rdg. + ...)	Article Number		
<b>DC/AC Current Sensors with Voltage Output</b>										
CP30	DC-AC current sensor clamp with battery operation (30 h)	5 mA to 30 A (DC / AC pk)	300 V CAT III	25 mm	100 mV/A	DC...20 kHz (-3dB)	1 % +2 mA	Z201B		●
CP330	DC-AC current sensor clamp with 2 measuring ranges, battery operation (50 h)	Range: 0.5 ... 30 A Range: 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 current sensor clamp with 2 measuring ranges, battery operation (50 h)	Range: 0.5 ... 100 A Range: 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	● *	●
<b>AC Current Sensors with Voltage Output</b>										
WZ12B	AC current sensor clamp	10 mA~ ... 100 A~	300 V CAT III	15 mm	100 mV/A	<u>45 ... 65</u> ... 500 Hz	1.5 % + 0.1 mA	Z219B		●
WZ12C	AC current sensor clamp 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	AC current sensor clamp 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	AC current sensor clamp with 4 measuring ranges	1 mA ... 1/10/100/ 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		●
METRA-FLEX3000	Flexible AC current sensor with 3 measuring ranges, battery operation (2000 h)	0,5 ... 30 A, 0,5 ... 300 A, 5 ... 3000 A	1000 V CAT III 600 V CAT IV	176 mm	100 mV/A, 10 mV/A, 1 mV/A	10 Hz ... 20 kHz	1% + 0.1 A 1% + 0.1 A 1% + 1 A	Z207E		●
METRA-FLEX 300M	Flexible AC miniature current sensor with 3 measuring ranges, battery operation (150 h)	0,5 ... 30 A, 0,5 ... 300 A, 5 ... 3000 A	1000 V CAT III 600 V CAT IV	50 mm	1 V/A, 100 mV/A, 10 mV/A	20 Hz ... 100 kHz	1% + 0.2 A 1% + 0.2 A 1% + 1 A	Z207J		●
<b>AC Current Transformer with Current Output</b>										
WZ12A	AC current transformer clamp	15 ... 180 A~	300 V CAT III	15 mm	1 mA/A	<u>45 ... 65</u> ... 400 Hz	3%	Z219A	●	●
WZ12D	AC current transformer clamp	30 mA ... 150 A~	300 V CAT III	15 mm	1 mA/A	<u>45 ... 65</u> ... 500 Hz	2.5 % + 0.1 mA	Z219D	●	●
WZ11A	AC current transformer clamp	1 ... 200 A~	600 V CAT III	20 mm	1 mA/A	<u>48 ... 65</u> ... 400 Hz	1 ... 3%	Z208A	●	●
Z3511	AC current transformer clamp	4 ... 500 A~	600 V CAT III	30 x 63 mm	1 mA/A	<u>48 ... 65</u> ... 1 kHz	3 % + 0.4 A	GTZ351100 0R0001	●	●
Z3512	AC current transformer clamp	0.5 ... 1000 A~	600 V CAT III	52 mm	1 mA/A	<u>30...48...65</u> ... 5 kHz	0.5% ... 0.7%	GTZ351200 0R0001	●	●
Z3514	AC current transformer clamp	1 ... 2000 A~	600 V CAT III	64 x 150 mm	1 mA/A	<u>30...48...65</u> ... 5 kHz	0.5% + 0.1 A	GTZ351400 0R0001	●	●

● With adjustable transformation ratio of 1 to 1, 10, 100 or 1000

\* with shunt resistor SR9800

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