GOSSEN METRAWATT

METRAHIT | T-COM

Cable Multimeter for Measurements in Symmetrical Copper Cable Networks

3-349-379-03
3/5.08

- **Insulation resistance measurement** (test voltage: 100 V) with simultaneous recognition of interference voltage as well as polarity reversal for diode testing
- **Cable symmetry testing** with rapid changeover switching
- **Multifunctional multimeter** (V, Ω, F, Hz)
- **TRMS measurement**, AC and AC+DC for current and voltage
- **Low-pass filter** can be activated (200 Hz / –3 dB)
- **Direct current measurement**, 100 nA to 1 A
- **Precision temperature indication** in °C and °F for Pt100/Pt1000
- **Display**: 3¾ place, 3100 digits, illumination can be activated, analog display: linear or logarithmic for insulation measurement
- **Acoustic signals** for: continuity testing, dangerous contact voltages, exceeded overload limits
- **Min-Max value storage**
- **Data memory** and internal clock, power pack adapter socket
- **Housing** with IP 54 protection, dust and splash protected, protective rubber cover as standard feature
- **Bidirectional infrared interface** for exchanging data with a PC
- **Windows software** available as accessory for processing and graphic display of measured values via RS 232 interface
- **New housing design**, separate battery and fuse compartments, intelligent key functions with SMD button

300 V CAT III
600 V CAT II

Deutscher Kalibrierdienst DKD-K-19701
DKD
Calibration Certificate Included

Quality Management System
DQS Certified per
DIN EN ISO 9001 reg. no. 1262

Applications

The **METRAHIT** | T-COM cable multimeter is a rugged portable measuring instrument for use in the field. It is used to perform measurements for pinpointing errors in cable networks. It measures all cable and system related parameters such as voltage, current, resistance, insulation and loop resistance, capacitance and cable length. Interruption of a single core, or contact with an open-circuit core (capacitive asymmetry), is detected by means of polarity reversal and is indicated at the high-speed logarithmic bar graph display.

Features

RMS Value with Distorted Waveshape

The utilized measuring method allows for waveshape-independent TRMS measurement of periodic quantities (AC) and pulsating quantities (AC and DC) for voltage and current at up to 10 kHz.

Activatable Filter for V AC Measurements

A 200 Hz low-pass filter can be activated if required, e.g. for measurements at cables with parasitic external signals. The input signal is checked by a voltage comparator for dangerous voltages as long as the low-pass filter is activated.

Display of Negative Values at the Analog Scale

Negative values are also displayed at the analog scale for zero-frequency quantities (V DC), allowing for observation of measured quantity fluctuation around the zero-point.

Automatic/Manual Measuring Range Selection

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

Loop Impedance Measurement

Loop impedance can be measured within a range of 100 mΩ and 3.1 kΩ with a constant current of I_C = 2 mA. The threshold value for acoustic signaling is adjustable.

Fast Acoustic Continuity Test

Testing for short circuiting and interruption is possible with the selector switch in the position. The threshold value for acoustic signaling is adjustable.

Insulation Resistance Measurement with Interference Voltage Display

Whether insulation testing will be conducted between E-a, b-E or a-b can be selected by turning the selector switch to the appropriate position.

If the instrument detects interference voltage of greater than 15 V AC or 25 V DC during insulation testing, an error message is briefly displayed at the LCD panel. The instrument is then automatically switched to voltage measurement, and the currently measured voltage value is displayed.

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Error Localization (with capacitance measurement and cable length comparison)

Interruption of a single core or contact with an open-circuit core (capacitive asymmetry) can be recognized at the display by quickly reversing test voltage polarity.

The conductor is good if the bar graph lengths are the same in the a-E and b-E selector switch positions.

Cable Length Measurement

Bar graph length is directly proportional to cable length. Capacitance per meter also appears as a digital display.

Automatic Storage of Measured Values

The DATA HOLD function automates the storage of measured values after they have settled in. A patented process assures that random values are not saved to memory in the case of rapidly changing measured quantities, but rather the actual measured value. The stored measured value appears at the digital display. The analog display continues to read out the current measured value.

Overload Protection

The instrument is safeguarded for up to 600 V in all measuring functions by overload protection. Voltage of greater than 600 V and current of greater than 1 or 1.6 A are indicated acoustically. FUSE appears at the display if the fuse for the current measuring input blows.

IEC 61010-1, 2nd Issue

Multimeters manufactured as of 1 January 2004 may not be the source of any possible hazard, regardless of the utilized combination of input voltages, function settings and range selections. Possible hazards include electrical shock, fire, sparking and explosion.

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 can be deactivated by switching the instrument to continuous operation.

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). Interface protocol and device driver software for LabVIEW® (National Instruments™) are available upon request.

DKD calibration certificate

METRAHIT | T-COM cable multimeters are furnished with an internationally valid DKD calibration certificate (recognized by EA and ILAC). After the specified calibration interval has elapsed (recommended interval: 1 to 3 years), the multimeters can be inexpensively recalibrated in our own DKD calibration laboratory.

Voluntary Manufacturer's Guarantee

36 months for materials and workmanship
1 to 3 years for calibration (depending upon application)

Applicable Regulations and Standards

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

Included

1 cable multimeter
1 protective rubber cover
1 F836 ever-ready case
1 KS21T cable set (CAT II/150 V) consisting of:
1 two-conductor measurement cable (yellow/blue), 2 meters long with test probes, 1 earth terminal cable (black), 2 meters long with test probe
1 condensed operating instructions, English/German
1 CD ROM (contents: amongst other topics multilingual operating instructions and data sheet)
1 DKD calibration certificate with calibration report
2 batteries, 1.5 V, type AA, installed

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Characteristic Values

Meas. Function (input)	Measuring Range		Resolution at Upper Range Limit	Input impedance		Intrinsic Error under Reference Conditions			Overload Capacity [2]	
						± (... % rdg. + ... d)	± (... % rdg. + ... d)	± (... % rdg. + ... d)		
				⎓	~ / ≂	⎓	~ [1], [11]	≂ [1], [11]	Value	Time
V (a)	300.0	mV	100 µV	9 MΩ	9 MΩ // < 50 pF	0.5 + 3 [10]	1.5 + 3 (> 300 d)	1.5 + 3 (> 300 d)	600 V DC AC RMS Sine [6]	Cont.
	3.000	V	1 mV	9 MΩ	9 MΩ // < 50 pF	0.5 + 1	1.5 + 3 (> 30 d)	1.5 + 3 (> 100 d)		
	30.00	V	10 mV	9 MΩ	9 MΩ // < 50 pF	0.5 + 1				
	300.0	V	100 mV	9 MΩ	9 MΩ // < 50 pF	0.5 + 1				
	600	V	1 V	9 MΩ	9 MΩ // < 50 pF	0.5 + 1				
				Voltage drop at approx. range limit						
						⎓	~ [1], [11]	≂ [1], [11]		
A (E)	300.0	µA	100 nA	18 mV	18 mV	0.5 + 5	1.5 + 5 (> 100 d)	1.5 + 5 (> 100 d)	0.3 A	Cont.
	3.000	mA	1 µA	160 mV	160 mV	0.5 + 3	1.5 + 5 (> 30 d)	1.5 + 5 (> 100 d)		
	30.00	mA	10 µA	32 mV	32 mV					
	300.0	mA	100 µA	320 mV	320 mV					
	1.000	A	1 mA	600 mV	600 mV	0.5 + 5			1.6 A	5 min.
	Factor: 1:1/10/100/1000		Input	Input impedance		⎓	~ [1], [11]	≂ [1], [11]		
A (a)	0.3/3/300	A	300 mV	Voltage measurement input approx. 9 MΩ (V socket)		0.5 + 3	1.5 + 3 (> 300 d)	1.5 + 3 (> 300 d)	Measurement input	
	3/30/300/3k	A	3 V				1.5 + 3 (> 30 d)	1.5 + 3 (> 100 d)	600 V TRMS	Max. 10 s
	30/300/3k/30k	A	30 V			Plus clip-on current sensor error				
				Open-circuit voltage	Meas. current at range limit	± (... % rdg. + ... d)				
Ω (a)	300.0	Ω	100 mΩ	< 1.4 V	Approx. 250 µA	0.5 + 3 with ZERO function active			600 V DC AC RMS Sine	Max. 10 s
	3.000	kΩ	1 Ω	< 1.4 V	Approx. 160 µA	0.5 + 1				
	30.00	kΩ	10 Ω	< 1.4 V	Approx. 28 µA	0.5 + 1				
	300.0	kΩ	100 Ω	< 1.4 V	Approx. 2.9 µA	0.5 + 1				
	3.000	MΩ	1 kΩ	< 1.4 V	Approx. 0.31 µA	0.5 + 1				
	30.00	MΩ	10 kΩ	< 1.4 V	Approx. 33 nA	2.0 + 5				
R_{SL}	300.0	Ω	100 mΩ	Approx. 13 V	Approx. 2 mA const.	3 + 5				
	3.000	kΩ	1 Ω	Approx. 13 V		3 + 5				
	300.0	Ω	100 mΩ	Approx. 13 V		2 + 5				
	5.1	V [3]	1 mV	Approx. 13 V		2 + 5				
				Discharge resistance	$U_{0\ max}$	± (... % rdg. + ... d)				
F (a)	30.00	nF	10 pF	10 MΩ	0.7 V	1 + 6 [4] with ZERO function active			600 V DC AC RMS Sine	Max. 10 s
	300.0	nF	100 pF	1 MΩ	0.7 V	1 + 6 [4]				
	3.000	µF	1 nF	100 kΩ	0.7 V	1 + 6 [4]				
	30.00	µF	10 nF	12 kΩ	0.7 V	1 + 6 [4]				
	300.0	µF	100 nF	3 kΩ	0.7 V	5 + 6 [4]				
					f_{min} [5]	± (... % rdg. + ... d)				
Hz (V)/ Hz (A)	300.0	Hz	0.1 Hz		1 Hz	0.5 + 1 [8]			Hz (V) [6]; Hz (A) [6]: 600 V Hz (A): [7]	Max. 10 s
	3.000	kHz	1 Hz							
	30.00	kHz	10 Hz		10 Hz					
Hz (V)	300.0	kHz	100 Hz		100 Hz					
						± (... % rdg. + ... d) [9]				
°C	Pt100	– 200.0 ... +200.0 °C	0.1 °C			2 K + 5			600 V DC/AC RMS Sine	Max. 10 s
		+200.0 ... +850.0 °C				1 + 5				
	Pt1000	– 150.0 ... +200.0 °C				2 K + 5				
		+200.0 ... +850.0 °C				1 + 5				

[1] 15 ... 45 ... 65 Hz ... 10 (5) kHz sine. For influence see page 4.
[2] At 0 to + 40° C
[3] Display of up to max. 5.1 V, "OL" in excess of 5.1 V.
[4] Applies to measurements at film capacitors
[5] Lowest measurable frequency for sinusoidal measuring signals symmetrical to the zero point
[6] Overload capacity of the voltage measurement input: power limiting: frequency x voltage max. 6×10^6 V x Hz: e.g. max. 600 V 1 kHz
[7] Overload capacity of the current measurement input: See current measuring ranges for maximum current values.
[8] Input sensitivity, sinusoidal signal, 10% to 100% of the voltage or current measuring range; limitation: up to 30% of the range at up to 100 kHz in the mV measuring range, 50% of the range at up to 300 kHz, 30% of the range in the 1 A measuring range. The voltage measuring ranges with max. 30 kHz apply in the A measuring range.
[9] Plus sensor deviation
[10] With ZERO function active
[11] With short circuited terminal tips
Exception: residual value of 1 to 10 digits, in the mV/µA range, 1 to 35 digits as zero point due to the TRMS converter

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

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Insulation Resistance Measurement (a-b, a-E, b-E)

Measuring Function Switch Setting	Measuring Range	Resolution	Digital Display Intrinsic Error under Reference Conditions
$U_{interference}/M\Omega_{ISO}$ [1]	6 ... 110 V ≂	0.1 V	±(3% rdg. + 30 d)
$M\Omega_{ISO}$ (U_N = 100 V)	5 ... 310.0 kΩ [2]	0.1 kΩ	±(3% rdg. + 5 d)
	0,280 ... 3.100 MΩ	1 kΩ	
	02,80 ... 31.00 MΩ	10 kΩ	±(5% rdg. + 5 d)
	028,0 ... 310.0 MΩ	100 kΩ	

1) Recognition of interference voltage
2) Where R < 100 kΩ, FEHL is displayed first.
Restriction: 250 ... 310,0 kΩ with external power supply unit.

Measuring Function Switch Setting	Nom. Voltage U_N	Open-Circuit Voltage U_o	Nom. Current I_N	Short-Circuit Current I_k	Acoustic Signal for	Overload Capacity Value	Overload Capacity Time
$U_{interference}/M\Omega_{ISO}$	—	—	—	—	U > 110 V	110 V≂	Cont.
$M\Omega_{ISO}$	100 V	Max. 120 V	> 1.0 mA	< 1.2 mA	U > 110 V	100 V≂	10 s

Influencing Quantities and Influence Error

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range [1]	Influence Error (...% rdg. + ... d) / 10 K
Temperature	0° C ... +21° C and +25° C ... +40° C	V ⎓	0.2 + 5
		V ∼	0.4 + 5
		300 Ω ... 3 MΩ	0.5 + 5
		30 MΩ	1 + 5
		mA/A ⎓	0.5 + 5
		mA/A ≂	0.8 + 5
		30 nF ... 300 µF	1 + 5
		Hz	0.2 + 5
		°C/°F (Pt100/Pt1000)	0.5 + 5

1) With zero balancing

Influencing Quantity	Measured Qty. / Measuring Range		Sphere of Influence	Intrinsic error [3] ±(... % rdg. + ... d)
Frequency	V_{AC} [2]	300 mV ... 300 V	> 15 Hz ... 45 Hz	3 + 5 > 300 digits
			> 65 Hz ... 10 kHz	
		600 V	> 65 Hz ... 5 kHz	3 + 5 > 60 digits
	A_{AC}	300 µA ... 1 A	> 15 Hz ... 45 Hz	3 + 10 > 300 digits
			> 65 Hz ... 10 kHz	
	A_{AC+DC}	300 µA ... 1 A	> 15 Hz ... 45 Hz	3 + 30 > 300 digits
			> 65 Hz ... 10 kHz	
	A_{AC} ⩙	300 mV / 3 V / 30 V	>65 Hz ... 10 kHz	3 + 5 > 300 digits

2) Power limiting: frequency x voltage max. 6 x 10^6 V x Hz
3) The accuracy specification is valid as of a display value of 10% to 100% of the measuring range for both measuring modes with the TRMS converter in the A AC and A (AC+DC) ranges.

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range	Influence Error [5]
Crest Factor CF	1 ... 3	V ∼, A ∼	± 1% rdg.
	> 3 ... 5		± 3% rdg.

5) Except for sinusoidal waveshape

Influencing Quantity	Sphere of Influence	Measured Quantity	Influence Error
Relative humidity	75% 3 days instrument off	V, A, Ω, F, Hz, °C	1 x intrinsic error
Battery voltage	1.8 to 3.6 V	ditto	Included in intrinsic error

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range	Damping
Common mode interference voltage	Interference quantity max. 600 V ∼	V ⎓	> 120 dB
	Interference quantity max. 600 V ∼ 50 Hz ... 60 Hz, sine	3 V ∼, 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 ⎓	> 50 dB
	Interference quantity max. 600 V —	V ∼	> 110 dB

Response Time (after manual range selection)

Measured Quantity / Measuring Range	Response Time, Digital Display	Measured Quantity Waveshape
V ⎓, V ∼ A ⎓, A ∼	1.5 s	from 0 to 80% of upper range limit value
300 Ω ... 3 MΩ	2 s	from ∞ to 50% of upper range limit value
30 MΩ	5 s	
Continuity	< 50 ms	
°C (Pt 100)	Max. 3 s	
⇻	1.5 s	
30 nF ... 300 µF	Max. 5 s	from 0 to 50% of upper range limit value
>10 Hz	1.5 s	

Reference Conditions

Ambient temperature	+23° C ±2 K
Relative humidity	40% … 75%
Measured qty. frequency	45 Hz … 65 Hz
Measured qty. waveshape	Sine
Battery voltage	3 V ±0.1 V

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	40 to 75%, no condensation allowed
Elevation	to 2000 m
Deployment	Indoors, except within specified ambient conditions

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Display

LCD panel (65 x 36 mm) with analog and digital display including unit of measure, type of current and various special functions

Background illumination

Background illumination is switched off approximately 1 minute after it has been activated.

Analog

Display	LCD scale with bar graph or pointer, depending upon the selected parameter setting
Scaling	Linear (ranges other than $M\Omega_{ISO}$): ∓ 5 ... 0 ... ±30 with 35 scale divisions for ⎓ , 0 ... 30, with 30 scale divisions in all other ranges Logarithmic $M\Omega_{ISO}$ range): … ≤ 0.3 … 3 … 30 … 300, bar graph instead of pointer
Polarity display	With automatic switching
Overflow display	With the ▶ symbol
Sampling rate	40 measurements per second and display refresh

Digital

Display / char. height	7-segment characters / 15 mm
Number of places	3¾ place ≙ 3100 steps
Overflow display	"OL" is displayed for ≥3100 digits
Polarity display	"–" (minus sign) is displayed if plus pole is connected to "⊥"
Sampling rate	10 and 40 measurements per second with the Min-Max function except in the capacitance, frequency and keying ratio measuring functions
Refresh Rate	2 times per second, every 500 ms

Electrical Safety

Safety class	II per EN 61010-1:2001/VDE 0411-1:2002	
Measuring category	II	III
Nominal voltage	600 V	300 V
Pollution degree	2	
Test voltage	3.5 kV~ per EN 61010-1:2001/VDE 0411-1:2002	

Fuses

Fuse link	FF 1.6 A/700 V AC/DC; 6.3 mm x 32 mm; switching capacity: 50 kA at 700 V AC/DC; protects the current measurement input in the 300 µA through 1 A ranges

Power Supply

Battery	2 ea. 1.5 V mignon cell (2 ea. size AA), alkaline manganese per IEC LR6
Service life	With alkaline manganese: approx. 200 hrs. (without $M\Omega_{ISO}$ meas.)
Battery test	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: – If battery voltage falls below approx. 1.8 V – If none of the keys or the rotary switch are activated for an adjustable duration of 10 to 59 minutes, and the multimeter is not in the continuous operation mode
Power pack socket	If the power pack has been plugged into the instrument, the installed batteries are disconnected automatically. Rechargeable batteries can only be recharged externally.

Measuring Function	Nominal Voltage U_N	DUT Resistance	Service Life in Hours	Number of Possible Measurements with Nominal Current per VDE 0413
V ⎓			200 [1]	
V ∼			150 [1]	
MΩ	100 V	1 MΩ	50	
	100 V	100 kΩ		3000

[1] Times 0.7 for interface operation

Electromagnetic Compatibility (EMC)

Interference emission	EN 61326: May 2004, class B
interference immunity	EN 61326: May 2004, appendix E IEC 61000-4-2:Dec. 2001 Feature B: 8 kV atmospheric discharge 4 kV contact discharge IEC 61000-4-3:Dec. 2001 Feature C: 3 V/m

Data Interface

Type	Optical via infrared light through housing
Data transmission	Serial, bidirectional (not IrDa compatible)
Protocol	Device specific
Baud Rate	38,400 baud
Functions	– Select/query measuring functions and parameters – Query momentary measurement data

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

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Internal Measured Value Storage

Memory capacity	4 MBit / 540 kB for approx. 15,400 measured values with indication of date and time

Mechanical Design

Housing	Impact resistant plastic (ABS)
Dimensions	200 x 87 x 45 mm (without protective rubber cover)
Weight	Approx. 0.35 kg with batteries
Protection	Housing: IP 54 (pressure equalization by means of the housing)

Table Excerpt Regarding Significance of the IP Code

IP XY (1st digit X)	Protection against foreign object entry	IP XY (2nd digit Y)	Protection against the penetration of water
0	not protected	0	not protected
1	≥ 50.0 mm dia.	1	vertical falling drops
2	≥ 12.5 mm dia.	2	vertically falling drops with enclosure tilted 15°
3	≥ 2.5 mm dia.	3	spraying water
4	≥ 1.0 mm dia.	4	splashing water
5	dust protected	5	water jets

Order Information

Designation	Type	Article Number
Cable multimeter, see page 2 for scope of delivery	METRAHIT | T-COM	M246A
Power supply unit AC 90 ... 250 V / DC 5 V, 600 V CAT IV	NA | X-TRA	Z218G
Accessory cables and adapters		
Cable set (1 pair of measuring cables), 1.2 m, with VDE-GS mark (1000 V CAT III / 600 V CAT IV 16 A)	KS17-2	GTY 3620 034 P0002
Cable set for telecommunication applications for METRAHIT T-COM, 150 V CAT II	KS21T	Z110V
Alligator clips (1 pair) for KS17-2	KY95-1	GTZ3215000R0002
Ri adapter 200 kΩ / 230 V	R200K	Z101A
Clip-on current sensor, 10 mA … 100 A, 1 mV / 10 mA, clip opening: 15 mm dia.	WZ12B	Z219B
Accessories for Operation at a PC		
IR-USB bidirectional interface adapter	USB | X-TRA	Z216C
Software **METRAwin 10**	**METRAwin 10**	GTZ3240000R0001
Accessories for temperature measurement with resistance thermometer		
Pt100 temperature sensor for surface and emersion measurements, −40 … +600° C	Z3409	GTZ 3409 000 R0001
Pt1000 temperature sensor for measurement in gases and liquids, −50 … +220° C (for servicing household appliances)	TF220	Z102A
Pt100 oven sensor, −50 … +550 °C	TF550	GTZ 3408 000 R0001
Ten adhesive Pt100 temperature sensors, −50 … +550 °C	TS Chipset	GTZ 3406 000 R0001
Protection and transport accessories		
Imitation leather carrying pouch	F829	GTZ 3301 000 R0003
Cordura belt pouch	HitBag	Z115A
Ever-ready case for 2 instruments and accessories	F840	GTZ 3302 001 R0001
Hard case for one instrument and accessories	HC20	Z113A
Hard case for two instruments and accessories	HC30	Z113A
Replacement fuses		
Fuses (pack of 10)	FF 1.6 A / 700 V AC/DC	Z109E

For additional information regarding accessories please see:

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

GMC-I GOSSEN METRAWATT

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