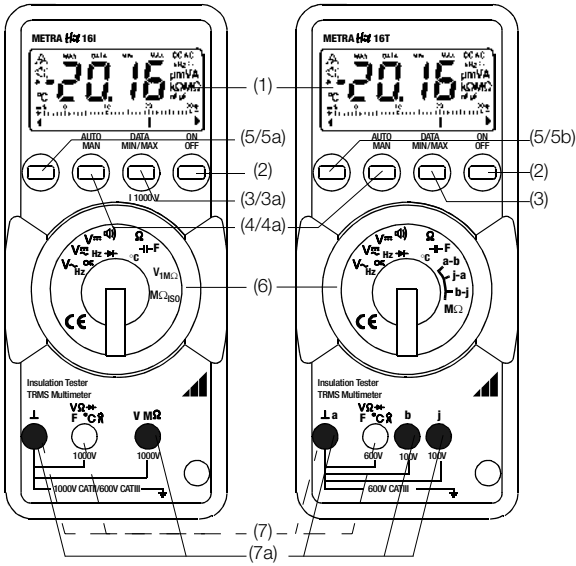
GOSSEN METRAWATT

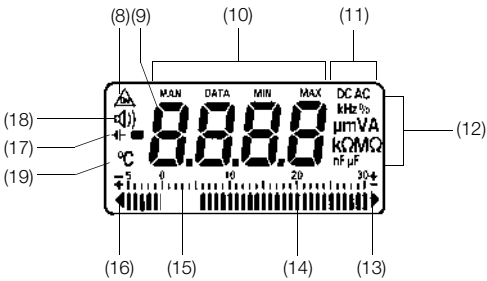
Operating Instructions

METRAHit® 16I/L/T

Analog Digital Multimeter with Insulation Measurement

3-348-892-02
5/7.02


METRA*Hit* 16I/L
METRA*Hit* 16T
(1)
(5/5a)
(5/5b)
(2)
(3)
(3/3a)
(4/4a)
(6)
(7)
(7a)
AUTO
MAN
DATA
MIN/MAX
ON
OFF
Insulation Tester
TRMS Multimeter
1000V CAT IV/600V CAT III
600V CAT III


(8)
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(17)
(18)
(19)
MAN
DATA
MIN
MAX
DC AC
kHz %
µmVA
kΩMΩ
nF µF
°C

(1) LCD
(2) ON/OFF key
(3) Function key
Storage of measurement and MIN/MAX values
(3a) Test voltage selector key
(4) Manual measuring range selection key
(4a) & (5a) Continuous operation for insulation measurement
(5) Multifunction key
(5a) Press and hold key for performance of insulation measurement
(5b) ON/OFF key for insulation measurement
(6) Measuring function selector switch
(7) Connector jacks for multimeter measurements
(7a) Connector jacks for insulation measurement
(8) Symbol for indication of continuous operation
(9) Digital display with decimal point and polarity indication
(10) Display for manual measuring range selection
and storage of measurement and MIN/MAX values
(11) DC/AC display
(12) Unit of measurement display
(13) Overrange display
(14) Analog display pointer
(15) Analog display scale
(16) Display for violation of
negative analog display range
(17) Insufficient battery voltage display
(18) Acoustic warning active display
(19) Unit of measure display, °C, for temperature measurement

Table of Contents

1 Safety Features and Precautions

You have selected an instrument which provides you with a high level of safety.
This analog-digital multimeter has been manufactured and tested in accordance with safety regulations IEC 61010–1/EN 61010–1/ VDE 0411–1 and IEC 61557/EN 61557/VDE 0413. When used for its intended purpose, safety of the operator, as well as that of the instrument, is assured. Their safety is however not guaranteed, if the instrument is used improperly or handled carelessly.
In order to maintain flawless technical safety conditions, and to assure safe use, it is imperative that you read the operating instructions thoroughly and carefully before placing your instrument into service, and that you follow all instructions contained therein.
For your safety, as well as for the protection of your instrument, the multimeter METRA*Hit*®16I/L are equipped with an automatic socket blocking device. This is coupled to the rotary switch, and only allows connection to the socket required for the selected function. It also prevents the switching of the rotary selector to disallowed functions when a measurement cable is plugged into a socket.

Observe the following safety precautions:

- The instrument may only be operated by persons who are capable of recognizing contact hazards and taking the appropriate safety precautions. Contact hazards exist anywhere, where voltages of greater than 30 V may occur (effective value).
- Avoid working alone when taking measurements which involve contact hazards. Be certain that a second person is present.
- **The maximum allowable voltage** between any given connector jack (7) and earth **is equal to 1000 V[1] cat. II or 600 V cat. III**. Overload capacities are listed in chapter 17.
- The **nominal voltage** of the system must **not exceed**
  – **600 V** between the conductor and neutral,
  – 690 V[2] between the phase conductors in 4-wire 3-phase systems,
  – or 1000 V[2] between the phase conductors in 3-wire 3-phase systems.
- Be prepared for the occurrence of unexpected voltages at devices under test (e.g. defective devices).
  For example, capacitors may be dangerously charged.
- Make certain that the measurement cables are in flawless condition, e.g. no damage to insulation, no interruptions in cables or plugs etc.
- Special care is required when measurements are made in HF electrical circuits. Dangerous pulsating voltages may be present.
- Measurements under moist ambient conditions are not allowed.
- Be absolutely certain that the **measuring ranges are not overloaded beyond their allowable capacities**. Limit values can be found in the table in chapter 17 „Characteristic Values“.

1) METRA*Hit*®16I/L only
2) METRA*Hit*®16T: up to 600 V

Meanings of Symbols on the Instrument

Warning concerning a point of danger
(Attention: observe documentation)

Earth

Continuous, doubled or reinforced insulation

VDE testing authority approval mark

CSA approval mark

Indicates EC conformity

DKD calibration certificate (red seal):

Consecutive number
German calibration service calibration laboratory
GOSSEN-METRAWATT calibration laboratory
Date of calibration (year – month)

Repair, Parts Replacement and Balancing

When the instrument is opened, voltage conducting parts may be exposed. The instrument must be disconnected from the measuring circuit for repair, replacement of parts or balancing. If repair or balancing of a live, open instrument is required, this may only be carried out by trained personnel who are familiar with the dangers involved.

Errors and Extraordinary Strains

If it may be assumed that the instrument can no longer be operated safely, it must be removed from service and secured against unintentional use.
Safe operation can no longer be relied upon,

- if the instrument demonstrates visible damage,
- if the instrument no longer functions,
- after a long period of storage under unfavorable conditions,
- after extraordinary stresses due to transport.

2 Initial Start-Up

Battery

We have already installed a 9 V flat cell battery in accordance with IEC 6 LR 61 into your instrument. The instrument is ready for operation. **Refer to chapter 18.1 „Battery“, before placing your instrument into service for the first time, or after it has been in storage.**

Switch the Instrument On

⇨ Press the “ON/OFF” key (2).
Activation is acknowledged with an acoustic signal. As long as the key remains pressed, all segments of the liquid crystal display (LCD) are active. The LCD is shown on page 2.
After the key is released, the instrument is ready for operation.
After the instrument has been switched off, it cannot be switched back on for at least 3 seconds.

Note: Electrical discharge and high frequency interference can cause incorrect displays, and may block the measuring sequence. To reset, switch the instrument off, and then back on. If this procedure is unsuccessful, briefly disconnect the battery from the contact terminals.

Before opening the instrument, disconnect it from the measuring circuit and refer to chapter 18 „Maintenance“!

Automatic Shut-Off

The instrument is switched off automatically if the measurement value remains constant for a period of approximately 10 minutes (measurement value fluctuation ≤ ±2 digits), and if none of the keys or the rotary switch are activated during this time.

Disabling Automatic Shut-Off

The instrument can also be switched to “CONTINUOUS ON”. Simultaneously press the ON/OFF key (2) and the yellow multifunction key (5) when switching the instrument on. The “CONTINUOUS ON” function is indicated at the LCD with the ⚠ symbol.

Switching the Instrument Off

Press the “ON/OFF” key (2).

3 Selection of Measurement Functions and Measuring Ranges

METRA*Hit*®16I/L: The socket blocking device only allows for connection to the jacks which are required for the selected function.

3.1 Automatic Range Selection

The multimeter is equipped with automatic measuring range selection for all measuring ranges, except for 30 mV ⎓ and 300 mV ⎓. This automatic feature is active as soon as the instrument is switched on. The instrument automatically selects the measuring range which provides optimum resolution for the measured quantity.

The previously selected voltage measuring range remains active after switching to the frequency measuring mode.

The instrument is automatically switched to:

– the next highest range	at	± (3099 digits + 1 digit)
– the next lowest range	at	± (240 / 280 digits – 1 digit)

3.2 Manual Measuring Range Selection

The automatic measuring range feature can be deactivated and the ranges can be manually selected and locked in according to the following table.

The manual mode is deactivated by pressing and holding key 4 (approx. 1s), by activating the rotary switch (6) or by switching the instrument off, and back on again.

When the instrument is switched back to automatic range selection in the 30 mV ⎓ or 300 mV ⎓ ranges, the 3 V ⎓ range is activated.

⇩ AUTO/ MAN (4)	Function	Acknowledge: Display	Acknowledge: Acoust. Signal
Brief	Manual Mode Active: selected measuring range is fixed	MAN (10)	1 x
Brief	switching sequence for: V ⎓ : 3 V → 30 V → 300 V → 1000 V[1] → 30 mV → 300 mV → 3 V → ... V ∼/⎓: 3 V → 30 V → 300 V → 1000 V[1] → 3 V → ... Ω : 30 MΩ → 30 Ω → 300 Ω → 3 kΩ → 30 kΩ → 300kΩ → 3 MΩ → 30 MΩ ... F : 30 nF[2] → 300 nF → 3 µF → 30 µF[2] → 30 nF[2] ... Hz : 300 Hz → 3 kHz → 30 kHz → 100 kHz →300 Hz ...	MAN (10)	1 x
Long	Return to Automatic Range Selection	—	2 x

1) METRA*Hit*®16T: 600 V

2) METRA*Hit*®16I/L only

4 LCD Display

4.1 Digital Display

The digital display (9) shows the measurement value with correct decimal point and sign. The selected unit of measure (12) and the current type (11) are also displayed. A minus sign appears in front of the value for zero-frequency quantities, if the positive pole of the measured quantity is applied to the "⊥" input. "OL" is displayed if an upper range limit of 3099 is exceeded (within ⇥| range: 1999). The digital display is refreshed twice per second for the measurement of V and Ω.

4.2 Analog Display

The analog display with pointer demonstrates the dynamic characteristics of a moving coil mechanism and is refreshed 20 times per second for V and Ω measurements. The analog display is especially advantageous for the observation of measurement value fluctuations and for balancing.
The analog display has its own polarity indicator. The negative range of the analog scale (15) includes 5 graduations for the measurement of zero-frequency quantities, so that fluctuations around zero can be observed. If the measurement value exceeds the display range the triangle at the left side (16) is first displayed, and then, after about 0.7 s, polarity at the analog display is reversed. Overranging (> 3099 digit, or > 1999 in the ⇥| range) is indicated with the triangle at the right side (13).

5 Measurement Value Storage, "DATA"

Measurement values can be automatically "frozen" with the DATA function. This can be especially useful when contacting the measuring point with the test probes requires your full attention. After the measurement value has been acquired and the appropriate "condition" has been fulfilled according to the following table, the measured quantity is frozen at the digital display and an acoustic signal sounds. The test probes can now be removed from the measuring point and the measurement value can be read from the digital display (9). If the measurement value lies below the limit value shown in the table, the instrument is reactivated for the storage of a new value.
The DATA function has no effect on the analog display, from which you can continue to read the current measurement value. However, when the digital display has been frozen, the decimal point can no longer be shifted. Thus if automatic measuring range selection has been activated, you are no longer able to determine which measuring range is active for the analog display. Manual measuring range selection is disabled, as long as the DATA function is active.

Function DATA	⇩ DATA MIN/MAX (3)	Condition		Reaction at Instrument		
		Measuring Range	Meas. Value Limits (digits)	Display Value Digital	Display DATA	Acoustic Signal
Activate	brief				blinks	1 x
Store		V ≃ [2] Ω F, Hz	>280 <OL >280	is displayed	is displayed	1 x
Reactivate [1]		V ≃ [2] Ω F, Hz	<280 OL <280	stored meas. value	blinks	
Cancel	long			is deleted	is deleted	2 x

[1] Reactivation when actual value falls below prescribed limit value

[2] Except for 30 mV and 300 mV ranges

The DATA function is deactivated if you press an hold key 3 (approx. 1 s), if the rotary switch (6) is activated or if the instrument is switched off and back on again.

6 Minimum and Maximum Value Storage

Minimum and maximum values which occur at the measuring instrument input after the MIN/MAX function has been activated can be “frozen”. The most important application for this function is the determination of minimum and maximum values for long-term observation of measured quantities.

MIN/MAX has no effect on the analog display, from which you can continue to read the current measurement value.

Apply the desired quantity to the instrument and select the measuring range before activating the MIN/MAX function.

If the function has been activated, measuring range selection can only be accomplished manually. However, this causes the deletion of currently stored minimum and maximum values.

The MIN/MAX function is deactivated by pressing and holding key 3 “long” (approx. 1 s), by turning the rotary switch (6) or by switching the instrument off and back on again.

Function MIN/MAX	⇓ DATA MIN/MAX (3)	Meas. Range	MIN and MAX Measurement Values	Reaction at Instrument		
				Display		Acoustic Signal
				Value digital	MIN MAX	
1. Activate and Store	2 x short, 30 mV/ 300 mV and °C : 1 x short	V ≃ Ω F, Hz, °C, °F	are stored	current meas. value	MIN and MAX blink	1 x
2. Store and Display	short	V ≃ Ω F, Hz, °C, °F	storage continues in background, new MIN and MAX values are displayed	stored MIN value	MIN	1 x
	short			stored MAX value	MAX	1 x
3. Return to 1.	short	same as 1.	same as 1. stored values are not deleted	same as 1.	same as 1.	1 x
Cancel	long		are deleted	is deleted	is deleted	2 x

7 Voltage Measurement

⇨ Set the rotary switch (6) to V ∼ , V ⎓ or V ⎓ depending upon the voltage to be measured.
⇨ Connect the measurement cables as shown. The "⊥" jack should be grounded.

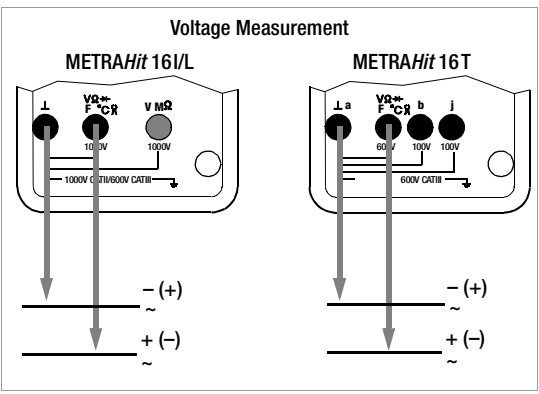
Note!
The 30 mV ⎓ and 300 mV ⎓ meas. ranges can only be selected manually with the "AUTO/MAN" key (4)! In the 1000 V[1)] range, an intermittent acoustic signal sounds alarm if the measurement value exceeds the measuring range upper limit value.

Zero Balancing in the 30 mV ⎓ Measuring Range

Zero balancing is accomplished in the 30 mV ⎓ range as follows:
⇨ Connect the measurement cables to the instrument, and connect the free cable ends to one another.
⇨ Briefly press the multifunction key (5) after the measuring range has been selected.

The instrument acknowledges zero balancing with an acoustic signal and "OO.OO" (+ 1 digit) appears at the LCD with a blinking decimal point. The voltage which was displayed at the moment the key was activated serves as a reference value (max. ±200 digits). It is automatically subtracted from subsequently measured values.

Zero balancing can be deleted:
– by pressing and holding the multifunction key (5), after which deletion is acknowledged with a twice repeated acoustic signal.
– by switching the instrument off.



7.1 METRA*Hit*®16I/L: 1 MΩ Input Impedance

The measuring instrument is equipped with a $V_{1M\Omega}$ selector switch position with an input impedance of approx. 1 MΩ specifically for electricians. This reduces incorrect measurement results caused by capacitive coupling during voltage measurement in electrical power networks to a minimum.

7.2 METRA*Hit*®16T: Terminal Assignments

Caution!
No connections may be made to **jacks b and j**, in order to avoid potential transfer from the ⊥ jack.

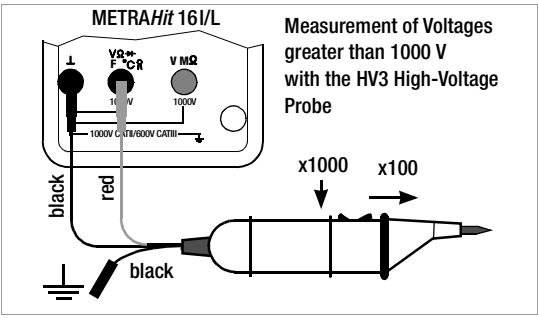
1) METRA*Hit*®16T: 600 V

7.3 Transient Overvoltages

The METRA*Hit*®16I/L and T multimeters are protected against transient overvoltages of up to 6 kV with a rise time of 1.2 and a decay time of 50 µs. Due to the fact that overvoltages of greater duration can be expected when performing measurements, for example in power supply networks or at transformers and motors, we recommend our KS30 measuring adapter for such cases. It provides for protection against transient overvoltages of up to 6 kV with a rise time of 10 and a decay time of 1000 µs. Continuous loading capability is equal to 1200 V_{eff}.
When using the measuring adapter KS30 the additional measurement is about approx. –2%.

7.4 Measurement of Voltages Greater than 1000 V

Voltages of greater than 1000 V can be measured with a high-voltage probe, e.g. HV3 or HV30 from GOSSEN METRAWATT GMBH. The bonding terminal must be grounded for measurements of this type, and all required safety precautions must be observed!



Measurement of Voltages greater than 1000 V with the HV3 High-Voltage Probe

7.5 Duty Cycle Measurement with METRA*Hit*®16L

With a duty cycle measurement, you can determine the ratio of pulse duration to cycle time of regularly recurring square-wave signals.

- ⇨ Set the function selector switch to V ⎓/Hz/% or V~/Hz/%.
- ⇨ Connections are made in the same way as for voltage measurement.
- ⇨ Briefly press the yellow multi-function pushbutton twice. The meter switches to duty cycle measurement. The duty cycle – that is the percentage pulse duration of a signal – is displayed on the LCD in %.

$$\text{Duty cycle (\%)} = \frac{\text{Pulse duration}}{\text{Cycle duration}} \bullet 100$$

Notes

The applied frequency must remain constant during the duty cycle measurement.

Repeated brief pressing of the yellow multi-function pushbutton changes the measuring functions in the following order: Voltage → frequency → duty cycle → voltage → ....

8 Resistance Measurement

⇨ Be certain that the device under test is voltage-free. Extraneous voltages distort the measurement results!
⇨ Set the rotary switch (6) to "Ω".
⇨ Connect the DUT as shown.

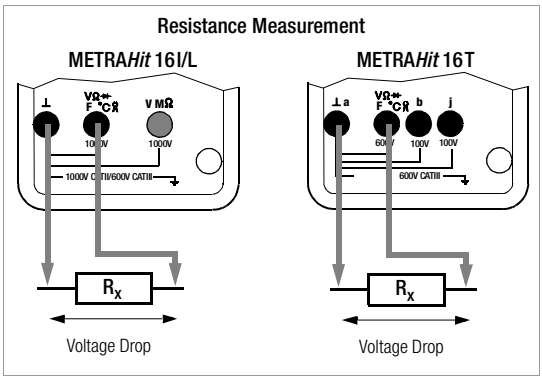
Zero Balancing in the 30 Ω Measuring Range

Cable and transition resistance can be eliminated with zero balancing for measurements of small resistance values in the in 30 Ω range:

⇨ Connect the measurement cables to the instrument, and connect the free cable ends to one another.
⇨ Briefly press the multifunction key (5).
The instrument acknowledges zero balancing with an acoustic signal and "OO.OO" (+1 digit) appears at the LCD with blinking decimal point. The resistance which was measured at the moment the key was activated serves as a reference value (max. 200 digits). It is automatically subtracted from subsequently measured values.

Zero balancing can be deleted:

– by pressing and holding the multifunction key (5), after which deletion is acknowledged with a twice repeated acoustic signal.
– by switching the instrument off.



See chapter 14 and chapter 15 for insulation resistance measurement.

9 Alternating Current Measurement with the WZ12B Clip-On Current Transformer

The rotary selector can be switched to the ⌁ position for measurements with a clip-on current transformer. The measurement value is displayed directly in A when the WZ12B clip-on transformer is used.

⇨ Read the operating instructions for the WZ12B.
⇨ Turn the selector switch (6) to ⌁ and briefly press the yellow multifunction key.
⇨ Connect the measurement cables to jacks "⊥" and ⌁.

Abbreviated Technical Data, WZ12B

Measuring Range	10 mA ... 100 A
Frequency Range	50 ... 500 Hz
Transformation Ratio	1 mV/10 mA

10 Diode and Continuity Testing

⇨ Be certain that the device under test is voltage-free. Extraneous voltages distort the measurement results!
⇨ Set the rotary switch (6) to ⊣▸.
⇨ Connect the DUT as shown.

Conducting Direction and Short-Circuit

The instrument displays forward voltage in volts. As long as the voltage drop does not exceed the maximum display value of 1.999 V, you can test several elements connected in series, or reference diodes with small reference voltages.

Reverse Direction or Interruption

The measuring instrument indicates overflow “OL”.

Note!
Resistors and semiconductor paths connected in parallel to the diode distort measurement results!

Diode and Continuity Testing with Acoustic Signal

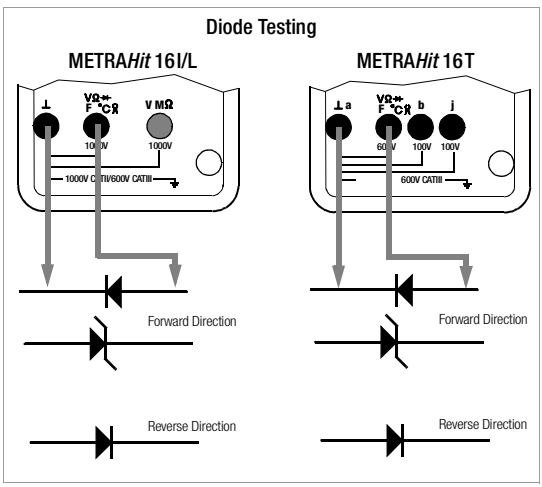
If the “acoustic signal” function is activated, the instrument generates a continuous tone for displayed values between 0 and 1 V, or for < 250 Ω.

Acoustic Signal ON (default condition)

After the “diode and continuity testing” function has been activated with the selector switch (6), the acoustic signal is always activated. The 🔊 symbol (18) is simultaneously displayed at the LCD. Repeated brief activation of the multifunction key (5) switches the acoustic signal alternately on and off.

Acoustic Signal OFF

⇨ Briefly press the multifunction key (5).
Deactivation is acknowledged with an acoustic signal. The 🔊 symbol (18) disappears from the LCD. By pressing and holding the key, the acoustic signal is always activated, which is acknowledged with a twice repeated acoustic signal.



11 Capacitance Measurement

⇨ Be certain that the device under test is voltage-free. Extraneous voltages distort the measurement results!
⇨ Set the rotary switch (6) to “F”.
⇨ Connect the (discharged!) DUT to the “⊥” and “F” jacks with measurement cables.

Note!
For polarized capacitors, the “–” pole must be connected to the “⊥” jack.
Resistors and semiconductor paths connected in parallel to the capacitor distort measurement results!

Zero Balancing in the 30 nF Measuring Range

The inherent capacitance of the instrument and the capacitance of the cables can be eliminated with zero balancing for the measurement of small capacitive values in the 30 nF range:
⇨ Connect the measurement cables to the instrument without a DUT.
⇨ Briefly press the multifunction key (5).
The instrument acknowledges zero balancing with an acoustic signal and “OO.OO” (+1 digit) is displayed with blinking decimal point. The capacitance which was measured at the moment the key was activated serves as a reference value (max. 200 digits). It is automatically subtracted from subsequently measured values.

Zero balancing can be deleted:
– by pressing and holding the multifunction key (5), after which deletion is acknowledged with a twice repeated acoustic signal.
– by switching the instrument off.

12 Frequency Measurement

Frequency measurement is possible in all voltage measuring ranges in the AC and DC operating modes.
⇨ Set the rotary switch (6) to V ∼ or V ⎓.
⇨ Apply the measured quantity in the same fashion as for voltage measurement.
Observe footnote 4) on page 21.
⇨ Briefly press the multifunction key (5).
The instrument switches to frequency measurement, and the frequency is displayed at the LCD.
The lowest measurable frequencies and maximum allowable voltages can be found in chapter 17 „Characteristic Values“.

Switching between Voltage and Frequency Measurement

Repeated brief activation of the yellow multifunction key (5) causes continuous alternation in the following sequence:
voltage → frequency → voltage → ....
You can switch from frequency measurement directly back to voltage measurement by:
– pressing and holding the yellow multifunction key (5). This is acknowledged by the instrument with a twice repeated acoustic signal. The voltage measuring range which was last selected remains active.
– activating the function selector switch (6).

13 Temperature Measurement

Temperature can be measured in °C or °F with the help of Pt 100 and Pt 1000 temperature sensors.

⇨ Set the rotary switch (6) to "Ω".
⇨ Connect the sensor to the multimeter measurement jacks (7).
⇨ Press the yellow multifunction key (5) once for display in °C, twice for display in °F, and three times for the compensation of measurement cable resistance.
The instrument switches to temperature measurement and automatically recognizes the sensor type (Pt 100 or Pt 1000).
The measured temperature value is displayed. The temperature unit of measure is only displayed for °C.

☞ **Note!**
The cable resistance for GOSSEN METRAWATT GMBH accessory temperature sensors is automatically taken into consideration during this measurement.
Switching to temperature measurement is disabled if the 30 Ω resistance measurement range has been activated!

Compensation of Sensor Cable Resistance of up to 20 Ω

Cable resistance values which differ from those of GOSSEN METRAWATT GMBH sensor cables can be compensated for up to a value of 20 Ω as follows:

⇨ Press the multifunction key repeatedly, until the current cable resistance value is displayed.
The resistance value is then displayed at the LCD, which will be used for automatic compensation after the temperature measuring range has been activated.
⇨ Correction resistance can be adjusted as follows:
Press the DATA-MIN/MAX key (3) to increase the value, or the AUTO/MAN key (4) to reduce the value. The value is changed by one digit each time the key is pressed. Continuous, rapid changing occurs if the key is pressed and held.
⇨ Briefly press the yellow multifunction key (5) again.
The measured temperature is displayed at the LCD. The blinking decimal point indicates that you have entered a correction value for cable resistance. The correction value remains until the instrument has been switched off.
⇨ Each time the yellow multifunction key (5) is activated, the display switches from °C, to °F and to the cable resistance correction value.

The temperature measurement function can be exited by:
– pressing and holding the yellow multifunction key (5), which is acknowledged by a twice repeated acoustic signal,
– by switching the instrument off.

☞ **Note!**
Use only the multimeter which will also be used for temperature measurement for the determination of cable resistance. Otherwise you cannot be certain that measurement error is held within the guaranteed range.

14 Insulation Resistance Measurement with the METRA*Hit*®16 I/L

14.1 Preparation for Measurement

Note!
Insulation resistance may only be measured at voltage-free objects.
When measuring high-ohmic insulation resistances do not touch the measurement cables.

⇨ Set the rotary switch to "V1MΩ".
⇨ Connect the measurement cables to the two jacks which have been released by the automatic blocking system.

This selector switch position provides for the measurement of interference voltage.

⇨ Turn the rotary switch to "$M\Omega_{ISO}$" when the device under test is voltage-free.

Note!
Position $M\Omega_{ISO}$ may only be selected for insulation resistance measurement. Any inadvertently applied interference voltage, however, is displayed in this position.

If an interference voltage of > 50 V is present within the system, insulation resistance measurement is disabled. The interference voltage is displayed at the LCD. If a voltage of greater than 1000 V has been applied, this is indicated additionally with an acoustic signal.

High-Voltage!

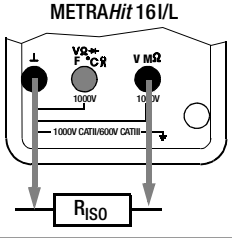
Do not touch the conductive ends of the test probes after insulation resistance measurement has been activated at the instrument.
A current with a value of 2.5 mA (limited by the instrument) may flow over your body, and although this is not life endangering, the electric shock is distinctly perceptible.
If you are taking a measurement at a capacitive DUT, for example a cable, it may be charged with as much as 1000 V, depending upon the selected nominal voltage. Touching the DUT after measurement may be life endangering in such cases!

Test Voltage Selection: 500 V or 1000 V

⇨ If the I 1000 V key is briefly activated, the currently selected test voltage is displayed.
⇨ In order to select the other value, press and hold the I 1000 V key until the other value is displayed and acknowledged with an acoustic signal.

Insulation Resistance Measurement

METRA*Hit* 16 I/L



14.2 Insulation Resistance Measurement

⇨ For insulation resistance measurement, press and hold the yellow multifunction key until the display has stabilized. Insulation resistance measurement is ended when the key is released.

An insulation resistance of less than 1 MΩ with a test voltage of 500 V, or less than 2 MΩ with a test voltage of 1000 V is indicated with an acoustic signal.

Automatic measuring range selection is active for insulation resistance measurement. Their is no provision for the manual selection of the measuring range.

Note!

The instrument's batteries are rapidly depleted during insulation resistance measurement. Only press and hold the mutlifunction key as long as is necessary to take the reading. Continuous measurement as described below should only be performed if absolutely necessary.
Use only alkali-manganese batteries in accordance with IEC 6 LR61.

Continuous Measurement

⇨ Activation: Press and hold the yellow multifunction key and simultaneously press the AUTO/MAN key until acknowledgement is indicated with an acoustic signal.

⇨ Deactivation: Briefly press the yellow multifunction key.

14.3 Conclusion of Measurement and Discharging

After the measurement has been completed, any residual voltage is displayed which may be caused by conductor capacitance.

⇨ Discharge the DUT by turning the selector switch to the $V_{1M\Omega}$ position. Contact with the DUT must be maintained. The reduction in voltage can be observed directly at the LCD.
Do not disconnect the DUT until voltage has dropped to below 25 V!

14.4 Evaluation of Measurement Values

In order to assure that insulation resistance does not violate lower limit values as prescribed by DIN VDE requirements, the instrument's intrinsic and influence errors must be taken into consideration.

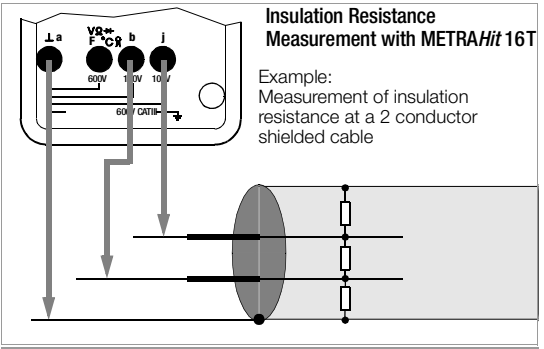
The minimum values for insulation resistance can be determined with the following table, which must be displayed under consideration of maximum operating error for the METRA*Hit*®16I/L (under nominal conditions of use) in order to assure that the required limit values are not violated.

Limit Value in MΩ	Min. Display in MΩ
0.1	0.11
0.2	0.22
0.5	0.55
1	1.1
2	2.2
5	5.5
10	11
20	22
50	55
100	110
200	220
500	550
1000	1100
2000	2200

15 Insulation Resistance Measurement at Telecommunications Equipment with the METRA*Hit*® 16T

Three jacks, a, b and j, have been provided for measurement at telecommunications equipment with two conductors and shield. Insulation testing between a and b, j and a or b and j can be selected with the function selector switch.

⇨ Connect the measuring cables to jacks a, b and j.



Insulation Resistance Measurement with METRA*Hit* 16T

Example:
Measurement of insulation resistance at a 2 conductor shielded cable

Caution!

Do not touch the conductive ends of the test probes after insulation resistance measurement has been activated at the instrument.
If at all possible, only plug in the measurement cable which is actually required for testing: loose test probes or cable ends represent a safety hazard. A current with a value of 1.5 mA (limited by the instrument) may flow over your body, and although this is not life endangering, the electric shock is distinctly perceptible.
If you are taking a measurement at a capacitive DUT, for example a cable, it may be charged with as much as 100 V. Touching the DUT after measurement may be life endangering in such cases!

⇨ Turn the selector switch to MΩ_a-b, then to MΩ_j-a and finally to MΩ_b-j, in order to display possible interference voltage for all three possible conductor pair combinations.

Note!

Insulation resistance may only be measured at voltage-free objects.

If an interference voltage of > 50 V is present within the system, insulation resistance measurement is disabled. The interference voltage is displayed at the LCD. If a voltage of greater than 310 V has been applied, this is indicated additionally with an acoustic signal.

⇨ To activate insulation resistance measurement: Briefly press the yellow multifunction key. Insulation resistance for the currently selected conductor pair is displayed. Insulation resistance values of less than 1 MΩ are indicated with an acoustic signal.
⇨ Turn the selector switch to MΩ_a-b, then to MΩ_j-a and finally to MΩ_b-j, in order to perform the desired test.

Automatic measuring range selection is active for insulation resistance measurement. Their is no provision for the manual selection of the measuring range.

Conclusion of Measurement and Discharging

⇨ Briefly press the yellow multifunction key.
After the measurement has been completed, any residual voltage is displayed which may be caused by conductor capacitance. The 100 kΩ internal resistance provides for quick discharging. Contact with the DUT must be maintained. The reduction in voltage can be observed directly at the LCD. **Do not disconnect the DUT until voltage has dropped to below 25 V!**

☞ **Note!**
The instrument's batteries are rapidly depleted during insulation resistance measurement. Deactivate insulation resistance measurement between measurements. Use only alkali-manganese batteries in accordance with IEC 6 LR61.

15.1 Evaluation of Measurement Values

In order to assure that insulation resistance does not violate lower limit values as prescribed by national requirements, the instrument's intrinsic and influence errors must be taken into consideration. The minimum values for insulation resistance can be determined with the table in chapter 14.4 which must be displayed under consideration of maximum operating error for the METRA*Hit*®16T (under nominal conditions of use) in order to assure that the required limit values are not violated.

16 RS232C Interface

The multimeters are equipped with an serial infrared interface for the transmission of measurement data to computer systems. The measurement values are optically transmitted through the housing to an interface adapter via infrared light, which can be plugged onto the multimeter. Data are then transmitted to the computer by means of a RS232 cable.

Activating the Interface

⇨ Press the "ON/OFF" (2) and "DATA-MIN/ MAX" (3) keys simultaneously when switching the instrument on.
After the interface has been activated, automatic shut-off is disabled for the instrument. This is indicated at the LCD (1) with the blinking symbol (8).
The "DATA" function cannot be activated.

Accessory Interface Packs

Interface adapters without memory provide for the transmission of measurement data from up to two multimeters to a PC.
Memory adapters also allow for on-site storage of measurement data without a PC, and stored data can be subsequently uploaded to a PC. Up to 10 multimeters can be interconnected off-line for the establishment of a high performance, multiple measuring system. On-line connection of up to six multimeters to a PC via memory adapters is also possible (single-channel memory pack or 4-channel memory pack).
All interface packs include adapters, connector cables and "METRAwin 10" data logging and analysis software with operating instructions.

17 Characteristic Values

Meas. Function	Meas. Range	Resolution	Input Impedance
V ⎓	30.00 mV	10 µV	>10 GΩ // < 40 pF
	300.0 mV	100 µV	>10 GΩ // < 40 pF
	3.000 V	1 mV	11 MΩ // < 40 pF
	30.00 V	10 mV	10 MΩ // < 40 pF
	300.0 V	100 mV	10 MΩ // < 40 pF
	1000[3] V	1 V	10 MΩ // < 40 pF
V ~ [1]	3.000 V	1 mV	11 MΩ // < 40 pF
	30.00 V	10 mV	10 MΩ // < 40 pF
	300.0 V	100 mV	10 MΩ // < 40 pF
	1000[3] V	1 V	10 MΩ // < 40 pF
V ≂ [1]	3.000 V	1 mV	11 MΩ // < 40 pF
	30.00 V	10 mV	10 MΩ // < 40 pF
	300.0 V	100 mV	10 MΩ // < 40 pF
	1000[3] V	1 V	10 MΩ // < 40 pF
Ã ~ [2]	30/100 A	10/100mA	—
			open-circuit voltage
Ω	30.00 Ω	10 mΩ	max. 3.2 V
	300.0 Ω	100 mΩ	max. 3.2 V
	3.000 kΩ	1 Ω	max. 1.25 V
	30.00 kΩ	10 Ω	max. 1.25 V
	300.0 kΩ	100 Ω	max. 1.25 V
	3.000 MΩ	1 kΩ	max. 1.25 V
	30.00 MΩ	10 kΩ	max. 1.25 V
→+	2.000 V	1 mV	max. 3.2 V

Meas. Function		Measuring Range	Resolution		Discharge Resistance	$U_{0\,max}$
F		30.00 nF[4]	10	pF	250 kΩ	2.5 V
		300.0 nF	100	pF	250 kΩ	2.5 V
		3.000 µF	1	nF	25 kΩ	2.5 V
		30.00 µF[4]	10	nF	25 kΩ	2.5 V
					f_{min} V ⎓	f_{min} V ~
Hz		300.0 Hz	0.1	Hz	1 Hz	45 Hz
		3.000 kHz	1	Hz	1 Hz	45 Hz
		30.00 kHz	10	Hz	10 Hz	45 Hz
		100.0 kHz	100	Hz	100 Hz	100 Hz
% [5]		2,0 ... 98,0 %	0,1	Hz	1 Hz	—
°C	Pt 100	– 200.0 ... + 200.0 °C	0.1	°C	—	—
		+ 200.0 ... + 800.0 °C	0.1	°C	—	—
	Pt 1000	– 100.0 ... + 200.0 °C	0.1	°C	—	—
		+ 200.0 ... + 800.0 °C	0.1	°C	—	—
°F	Pt 100	– 300.0 ... + 400.0 °C	0.1	°F	—	—
		+ 400.0 ... + 999.0 °C	0.1	°F	—	—
	Pt 1000	– 145.0 ... + 400.0 °C	0.1	°F	—	—
		+ 400.0 ... + 999.0 °C	0.1	°F	—	—

1) True RMS measurement (TRMS)
2) Measurement with WZ12B
3) METRA*Hit*®16T: 600 V
4) METRA*Hit*®16I/L only
5) METRA*Hit*®16L only

Meas. Function	Measuring Range	Digital Display Intrinsic Error ±(...% of rdg.+... digit) at reference conditions	Overload Capacity [1] Value	Duration
V ⎓	30.00 mV	0.5 + 3 [2]	1000 V [7] DC AC rms sine	cont.
	300.0 mV	0.5 + 3		
	3.000 V	0.25 + 1		
	30.00 V	0.25 + 1		
	300.0 V	0.25 + 1		
	1000 V	0.35 + 1		
V ~	3.000 V	1.0 + 3 (> 10 digits)		
	30.00 V			
	300.0 V			
	1000 V			
V ⎓~	3.000 V	1.0 + 3 (> 10 digits)		
	30.00 V			
	300.0 V			
	1000 V			
A ~ ⎓	100 A	2.5 + 3 (> 10 digits)	120 A	cont.
Ω	30.00 Ω	0.5 + 3 [2]	500 V DC AC rms sine	max. 10 s
	300.0 Ω	0.5 + 3		
	3.000 kΩ	0.4 + 1		
	30.00 kΩ	0.4 + 1		
	300.0 kΩ	0.4 + 1		
	3.000 MΩ	0.6 + 1		
	30.00 MΩ	2.0 + 1		
→|←	2.000 V	0.25 + 1		

Meas. Function	Measuring Range		Digital Display Intrinsic Error ±(...% of rdg.+... digit) at reference conditions	Overload Capacity [1] Value	Duration
F		30.00 nF	1.0 + 3 [3]	500 V DC / AC rms sine	max. 10 s
		300.0 nF	1.0 + 3		
		3.000 µF	1.0 + 3		
		30.00 µF	3.0 + 3		
Hz		300.0 Hz	0,5 + 1 [4]	≤ 1000 V [7]	cont.
		3.000 kHz			
		30.00 kHz	0,5 + 1 [4]	≤ 300 V	
		100.0 kHz	0,5 + 1 [5]	≤ 30 V	
% [8]	V ⎓	2,0... 98,0%	1 Hz ... 1 kHz: ±5 Digit 1 kHz ... 5 kHz: ±5 Digit/kHz	see Hz	
°C	Pt 100	– 200.0 ... + 200.0 °C	2 Kelvin + 5 digits [6]	500 V DC AC rms sine	max. 10 s
		+ 200.0 ... + 800.0 °C	1.0 + 5 [6]		
	Pt 1000	– 100.0 ... + 200.0 °C	2 Kelvin + 5 digits [6]		
		+ 200.0 ... + 800.0 °C	1.0 + 5 [6]		
°F	Pt 100	– 300.0 ... + 400.0 °C	4 Kelvin + 10 digits [6]	500 V DC AC rms sine	max. 10 s
		+ 400.0 ... + 999.0 °C	1.0 + 10 [6]		
	Pt 1000	– 145.0 ... + 400.0 °C	4 Kelvin + 10 digits [6]		
		+ 400.0 ... + 999.0 °C	1.0 + 10 [6]		

[1] at –20 °C ... +40 °C

[2] Without zero setting: +35 digits, [3] Without zero setting: +50 digits

[4], [5] Range
3 V ⎓: [4] U_E = 1,5 V_{rms} ... 100 V_{rms} [5] U_E = 2,5 V_{rms} ... 30 V_{rms}
30 V ⎓: [4] U_E = 15 V_{rms} ... 300 V_{rms} [5] U_E = 25 V_{rms} ... 30 V_{rms}
300 V ⎓: [4] U_E = 150 V_{rms} ...1000 V_{rms} —

[6] without probe, [7] METRA*Hit*®16T: 600 V

[8] On the range 3 V ⎓, square-wave signal positive on one side 5 ... 15 V or 5 ... 15 V AC, f = const., not 163.84 Hz or integral multiple.

Insulation Measurement, METRA*Hit*®16I/L / METRA*Hit*®16T

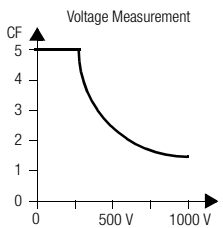
	Measurement Function Switch Setting	Measuring Range	Resolution	Digital Display Intrinsic Error at reference conditions
METRA*Hit*®16I/L	$V_{1M\Omega}$	0 ... 1000 V ⎓	1 V	±(1% of rdg. + 10 d)
	$M\Omega_{ISO}$	0 ... 1000 V ⎓	1 V	±(1% of rdg. + 10 d)
	$M\Omega_{ISO}$ (U_N = 500 V)	0.100 ... 1.600 MΩ 01.40 ... 16.00 MΩ 014.0 ... 160.0 MΩ 0140 ... 1600 MΩ	1 kΩ 10 kΩ 100 kΩ 1 MΩ	±(3% of rdg. + 2 d)
	$M\Omega_{ISO}$ (U_N = 1 000 V)	0.100 ... 3.100 MΩ 02.80 ... 31.00 MΩ 028.0 ... 310.0 MΩ 0280 ... 3100 MΩ	1 kΩ 10 kΩ 100 kΩ 1 MΩ	±(3% of rdg. + 2 d)
METRA*Hit*®16T	MΩ	0 ... 100 V ⎓	0,1 V	±(1% of rdg. + 10 d)
	MΩ (U_N = 100 V)	000.0 ... 310.0 kΩ	0,1 kΩ	±(3% of rdg. + 2 d)
		0.280 ... 3.100 MΩ 02.80 ... 31.00 MΩ 028.0 ... 310.0 MΩ	1 kΩ 10 kΩ 100 kΩ	±(3% of rdg. + 2 d)

	Meas. Function Switch Setting	Nominal Voltage U_N	Open-Circuit Voltage U_o	Nominal Current I_N	Short-Circuit Current I_k
16I/L	$V_{1M\Omega}$	—	—	—	—
	$M\Omega_{ISO}$	—	—	—	—
	$M\Omega_{ISO}$	500 V	< 1.15 x U_N	> 1.0 mA	< 2.5 mA
		1000 V	< 1.15 x U_N	> 1.0 mA	< 2.5 mA
16T	MΩ	—	—	—	—
	MΩ	100 V	< 1.15 x U_N	> 1.0 mA	< 1.5 mA

	Meas. Function Switch Setting	Nominal Voltage U_N	Acoustic Signal at:	Overload Capacity	
				Value	Duration
16I/L	$V_{1M\Omega}$	—	U > 1000 V	1000 V⎓	continuous
	$M\Omega_{ISO}$	—	U > 50 V	1000 V⎓	max. 10 s
	$M\Omega_{ISO}$	500 V	R_x < 1 MΩ	1000 V⎓	
		1000 V	R_x < 2 MΩ	1000 V⎓	
16T	MΩ	—	U > 50 V	100 V⎓	continuous
	MΩ	100 V	R_x < 1 MΩ	100 V⎓	max. 10 s

	Measuring Function	U_N	Nominal Range of Use	Operating Meas. Deviation
16I/L	$M\Omega_{ISO}$	500 V	100 kΩ ... 1600 MΩ	± 10%
		1000 V	100 kΩ ... 3100 MΩ	
16T	MΩ	100 V	100 kΩ ... 310 MΩ	± 10%

Influencing Quantities and Influence Errors

Influencing Quantity	Sphere of Influence	Measured Quantity/ Measuring Range	Influence Error [1] ±(... % of rdg. + ... digit)
Temperature	0 °C ... +21 °C and +25 °C ... +40 °C	30/300 mV ⎓	1.0 + 3
		3 ... 300 V ⎓	0.15 + 1
		1000 V[5] ⎓	0.2 + 1
		V ∼	0.4 + 2
		30 Ω [2]	0.15 + 2
		300 Ω	0.25 + 2
		3 kΩ ... 3 MΩ	0.15 + 1
		30 MΩ	1.0 + 1
		30 nF[2] ... 3 µF	0.5 + 2 [6]
		30 µF	2.0 + 2
		Hz	0.5 + 1
		%	±5 Digit
		– 200 ... + 200 °C	0.5 K + 2
		+ 200 ... + 800 °C	0.5 + 2
		– 300 ... + 400 °F	1.0 K + 4
		+ 400 ... + 999 °F	0.5 + 2
		16I: $M\Omega_{ISO}$	0.25 + 2
		16T: MΩ	0.25 + 2
Measured Quantity Frequency	15 Hz ... < 30 Hz	3 ... 1000 V[5] ∼	1.0 + 3
	30 Hz ... < 45 Hz		0.5 + 3
	> 65 Hz ... 400 Hz		2.0 + 3
	> 400 Hz ... 1 kHz		3.0 + 3
Measured Quantity Waveform [3]	crest factor CF 1 ... 3	V∼ [4]	±1 % of rdg.
	crest factor CF > 3 ... 5		±3 % of rdg.
	The allowable crest factor CF of the periodic quantity to be measured is dependent upon the displayed value: 		

1) For temperature:
Indicated error values valid per 10 K change in temperature.
For frequency: Indicated error values valid as of 300 digit display.
2) With zero setting
3) If waveform is unknown (crest factor CF > 2) measure with manual range selection.
4) Except for sinusoidal waveform
5) METRA*Hit*®16T: 600 V
6) METRA*Hit*®16T: 2+2

Influencing Quantity	Sphere of Influence	Measured Quantity/ Measuring Range	Influence Error
Battery Voltage	⊣⊢ [1] ... < 7.9 V > 8.1 V ... 10.0 V	V ⎓	±2 digits
		V ∼	±4 digits
		30 Ω/300 Ω/°C/°F	±4 digits
		3 kΩ ... 30 MΩ	±3 digits
		$MΩ_{ISO}$, MΩ	±2 digits
		nF, µF	±1 digit
		Hz	±1 digit
		%	±1 Digit
Relative Humidity	75% 3 days device off	V ≃ Ω $MΩ_{ISO}$, MΩ Hz % °C, °F	1x intrinsic error
DATA	—		±1 digit
MIN / MAX	—	V ≃	±2 digits

[1] as of display of ⊣⊢ symbol.

Influencing Quantity	Sphere of Influence	Measuring Range	Damping
Common-Mode Interference Voltage	interference max. 1000 V ∼ [1]	V ⎓	> 120 dB
	interference max. 1000 V ∼ [1] 50 Hz, 60 Hz sine	3 V ∼, 30 V ∼	> 80 dB
		300 V ∼	> 70 dB
		1000 V ∼ [1]	> 60 dB
Series-Mode Interference Voltage	interference V ∼ , respective nom. value of meas. range, max. 1000 V ∼ [1], 50 Hz, 60 Hz sine	V ⎓	> 50 dB
	interference max. 1000 V ⎓ [1]	V ∼	> 110 dB

[1] METRA*Hit*®16T: 600 V

Response Time (after manual range selection)

Measured Qty. / Measuring Range	Response Time		Measured Quantity Jump Function
	Analog Display	Digital Display	
V ⎓ , V ∼	0.7 s	1.5 s	from 0 to 80 % of the measuring range upper limit
30 Ω ... 3 MΩ	1.5 s	2 s	from ∞ to 50 % of the measuring range upper limit
30 MΩ	4 s	5 s	
⊣◀	0.7 s	1.5 s	
nF, µF, °C, °F		max. 1... 3 s	from 0 to 50 % of the measuring range upper limit
300 Hz, 3 kHz		max. 2 s	
30 kHz		max. 0.7 s	
% (1 Hz)		max. 9 s	
% (≥ 10 Hz)		max. 2,5 s	

Reference Conditions

Ambient Temperature	+23 °C ±2 K
Relative Humidity	45 % ... 55 %
Measured Quantity Frequency	45 Hz ... 65 Hz
Measured Quantity Waveform	sine
Battery Voltage	8 V ±0.1 V

Display

LCD (65 mm x 30 mm) with analog and digital display including display of unit of measure, voltage type and various special functions.

Analog	
Display	LCD scale with pointer
Scale Length	55 mm for V ⎓ ; 47 mm for all other ranges
Scaling	∓ 5 ... 0 ... ±30 with 35 graduations for ⎓ , 0 ... 30 with 30 graduations in all other ranges
Polarity Display	with automatic reversal
Overflow Display	indicated with triangle (13)
Measurement Rate	20 measurements per second, for Ω: 10 measurements per second
Digital	
Display/Char. Height	7 segment characters / 15 mm
Places	3¾ places ≙ 3100 steps
Overflow Display	"OL" is displayed
Polarity Display	"–" sign is displayed for plus pole to "⊥"
Measurement Rate	2 measurements per second, for Ω and °C: 1 measurement per second

Power Supply

Battery 9 V flat cell battery,
alkali-manganese cell per IEC 6 LR 61

Measuring Function METRA*Hit*® 16I/L, 16T	Nominal Voltage U_N	Resistance at DUT	Service Life in Hours	Number of Possible Measurements with Nominal Current per VDE 0413 [2]
V ⎓			750 [1]	
V ∼			150 [1]	
MΩ	100 V	1 MΩ	50	
	100 V	100 kΩ		3000
$MΩ_{ISO}$	500 V	500 kΩ		600
	1000 V	1 MΩ		200

[1] Times 0.7 with active interface
[2] Battery test: automatic display of ⊣⊢ symbol when battery voltage falls below approx. 7 V

Electrical Safety

Protection Class	II per IEC 1010-1:1990, IEC 1010-1/A2:1995 EN 61010-1:1993, EN 61010-1/A2:1995	
Overvoltage Category	II [1]	III
Nominal Voltage	1000 V [1]	600 V
Pollution Degree	2	2
Test Voltage	5.55 kV~ per IEC 61010-1/EN 61010-1	

[1] METRA*Hit*®16I/L only

EMC	Electromagnetic Compatibility
Product standard	EN 61326-1: 1997 EN 61326: 1997/A1: 1998
Interference Emission	EN 55022: 1998 – Klasse B
Interference Immunity	EN 61000-4-2: 1995 – 4 kV/8 kV contact and atmospheric discharge – power feature A EN 61000-4-3: 1996+A1: 1998 – 3 V/m – power feature B

Interface

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

Ambient Conditions

Operating Temp.	–20 °C ... + 50 °C
Storage Temp.	–25 °C ... + 70 °C (without battery)
Relative Humidity	≤ 75 %, no condensation allowed
Elevation	to 2000 m
Deployment	indoors, outdoors: only in the specified ambient conditions

Mechanical Design

Protection	housing: IP 50, connector jacks: IP 20
dimensions	84 mm x 195 mm x 35 mm
weight	approx. 0.35 kg with battery

18 Maintenance

Caution!

The instrument must be disconnected the from the measuring circuit before opening to replace the battery!

18.1 Battery

Before initial start-up, or after your instrument has been in storage, make sure that no battery leakage has occurred, and inspect for battery leakage on a regular basis.
If battery leakage has occurred, the electrolyte must be completely removed with a damp cloth and a new battery must be installed, before the instrument is placed back into service.
If the ⊣⊢ symbol (17) is displayed at the LCD (1), the battery should be replaced as soon as possible. You can continue to take measurements, but the accuracy of the instrument may be negatively influenced.
The instrument is powered by a 9 V flat cell battery in accordance with IEC 6 LR 61. Use only alkali-manganese cells which comply with IEC 6 LR61.

Replacing the Battery

- ⇨ Lay the instrument onto its face, loosen the two screws at the rear panel and lift out the housing base, starting at the bottom (a). The housing base and housing top are held together with snap hooks at the top of the front panel.
- ⇨ Remove the battery from the battery compartment and carefully pull the battery from the terminal contacts.
- ⇨ Snap the terminal contacts onto a new 9 V battery and insert the battery into the battery compartment.
- ⇨ Important for reassembly: First lay the housing base into place as shown in the diagram below. Push the housing base and housing top together, first at the bottom front (a) and then at the top front (b).

- ⇨ Retighten the housing base with the two screws.
- ⇨ Please dispose of used batteries properly!

18.2 Housing

No special maintenance is required for the housing. Keep outside surfaces clean. Use a slightly dampened cloth for cleaning. Avoid the use of cleansers, abrasives or solvents.

19 Repair and Replacement Parts Service DKD Calibration Lab* and Rental Instrument Service

If required, please contact:

GOSSEN METRAWATT GMBH
Service-Center
Thomas-Mann-Strasse 20
90471 Nürnberg • Germany
Phone +49-(0)-911-8602-410/256
Fax +49-(0)-911-8602-2 53
E-Mail service@gmc-instruments.com

This address is only valid in Germany. Please contact our representatives or subsidiaries for service in other countries.

* **DKD** Calibration Laboratory for Electrical Quantities DKD–K–19701

Accredited measured quantities: direct voltage, direct current values, DC resistance, alternating voltage, alternating current values, AC active power, AC apparent power, DC power, capacitance and frequency

Guarantee: METRA*Hit*®16I/L and T

3 year guarantee for materials and workmanship.

20 Product Support

If required, please contact:

GOSSEN METRAWATT GMBH
Product Support Hotline
Phone +49-(0)-911-8602-112
Fax +49-(0)-911-8602-709
E-Mail support@gmc-instruments.com

DKD Calibration Certificate Reprints

If you need to order a reprint of the DKD calibration certificate for your instrument, please include the ID number shown in the uppermost and lowermost fields of the calibration certificate. We do not need the instrument's serial number.

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GOSSEN METRAWATT GMBH
Thomas-Mann-Str. 16-20
90471 Nürnberg • Germany
Phone+49-(0)-911-8602-0
Fax +49-(0)-911-8602-669
E-Mail info@gmc-instruments.com
www.gmc-instruments.com

Member of GMC Instruments Group GOSSEN METRAWATT