USER MANUAL

ARD-IT30

Digital Multimeter / Insulation Tester

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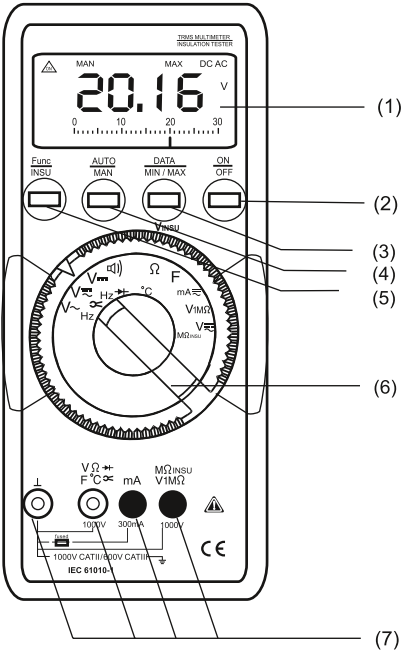
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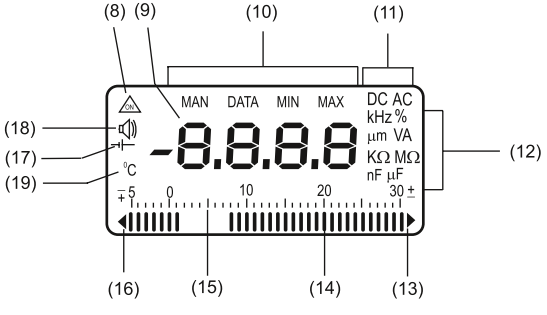
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1.0 Parts Identification Diagram

(1) Liquid Crystal Display (LCD)
(2) ON/OFF pushbutton
(3) Data hold and MIN/MAX
(4) Manual range selection
(5) Multifunction
(6) Function selector switch
(7) Terminal sockets
(8) Continuously on
(9) Digits, decimal points, polarity
(10) Manual range selection data HOLD and MIN/MAX storage
(11) Selected function
(12) Unit of measured quantity
(13) Overrange indication for positive analog range
(14) Pointer for analog indication
(15) Scale for analog indication
(16) Overrange indication for negative analog range
(17) Low battery indication
(18) Beeper indication
(19) Display °C for temperature measurement range

2.0 Safety Features and Precautions

This meter is manufactured and tested in compliance with the safety standard IEC 61010-1 :2001/ DIN EN61010 -1 :2001 and IEC61557.However, the safety of both the user and the instrument cannot be guaranteed in the event of incorrect operation or negligent handling.

To maintain the safe and proper condition of the meter and to ensure safe operation, it is absolutely necessary to carefully and completely read these operating instructions before use.

For user safety and protection, this multimeter is fitted with an Automatic terminal Blocking System (ABS). It is coupled with the function selector switch which blocks the terminal sockets not necessary for measurement.

Intended Use

- Use the instrument only as intended under the specified environmental and electrical operating conditions. Do not use in explosion prone environments.
- Before using the instrument to determine that a circuit is not hazardous, live test the viability of the measurement by checking a known voltage of similar magnitude.
- Use only correct fuses supplied by the manufacturer.
- Use only proper accessories supplied by the manufacturer.
- When the battery symbol is displayed, the instrument may measure incorrectly.
- Measurements of components within circuits may produce incorrect results.
- Do not use the instrument in the 30 mA and 300 mA ranges when measuring the current of electronic circuits.
- Ensure that the test object is discharged after performing an insulation resistance measurement.

Observe the following safety precautions:

- The meter must only be operated by persons who understand the danger of shock hazards and know how to apply safety precautions. Shock hazards exist anywhere, where voltages of more than 30 V (TRMS)may occur.
- Operators must use individual protective equipment if hazardous live parts of installation could be accessible.
- Avoid working alone in shock hazardous environment while carrying out measurement
- Keep hands/fingers behind the edge that separates rotating jaws with hand held part (22). This is the limit of the hand held part during measurement.
- The maximum allowable voltage between any terminal sockets (7) and earth is 1000 V.
- Take in to account that unexpected voltages can occur at devices under test (e.g. defective devices). For example, capacitors can be dangerously charged.
- Verify that test leads are in good condition prior to each use, e.g. no cracked insulation, no open circuits in the leads or connectors.
- The meter must not be used for measurements on circuits with corona discharge (high voltage).
- Be particularly careful when measurements are made in high-frequency electrical circuits. Dangerous voltages may be present.

- Measurements under moist ambient conditions are not permitted.
- Do not exceed permissible overload limits of the measuring rangers. Limit values can be found in chapter 17.
- Adherence to the instructions in this manual is crucial for maintaining the safety features of the digital multimeter.

Cat I	Measurements in electrical circuits which are not directly connected to the mains: for example electrical systems in motor vehicles and aircraft, batteries, etc.
Cat II	Measurements in electrical which are electrically connected o the low-voltage mains:with plugs, e.g. at home, in the office or laboratory, etc.
Cat III	Measurements in building installations, stationary power consumers, distributor terminals, devices connected permanently to the distributor.
Cat IV	Measurements at power sources for low-voltage installations, meters, mains terminals, primary over voltage protection devices.

Table 1: Safety Category Ratings per IEC61010

	AC - Alternating Current		See explanation in manual
	DC - Direct Current		Double insulation Protection Class II
	Either AC or DC		Fuse
	Ground		

Table 2: International Symbols

3.0 Initial Start-Up

Batteries

The meter includes six (6) 1.5 V (AAA) batteries according to IEC 6 LR 03. Before using the meter for the first time or after storage, refer to Chapter 18.1 "Batteries."

Switching the Meter ON

Press the "ON/OFF" pushbutton (2). Switch "ON" is acknowledged by a sound signal. All segments of the liquid crystal display (LCD) will appear.

NOTE: Electrical discharge and high frequency interference can cause incorrect displays, and may block the measuring sequence. To reset, switch the meter off and back on. If this procedure is unsuccessful, check the battery connections.

Automatic Power-Off

The meter turns off automatically when the measured value remains constant (variations of the measured value (± 2 digits) for 10 minutes and when neither a pushbutton nor the function selector switch is operated during that time. It remains on, however, when a current measuring range is selected and a measured value of >30 digits is displayed.

Preventing Automatic Power-Off

In order to prevent automatic turn-off, select "continuously on" mode by pressing the yellow multifunction pushbutton (5) and the ON/OFF pushbutton (2) together. The function "continuously on" is shown on the LCD by the symbol "⚠ON" (8).

Turning the Meter OFF

Press the ON/OFF pushbutton (2).

4.0 Function and Range Selection

The function selector switch (6) is coupled with the Automatic terminal Blocking System (ABS) which allows access only to two correct sockets for each function. Prior to switching to the "mA" functions or from the "mA" functions, remove the test lead from the corresponding socket. When the test leads are plugged-in, the terminal blocking systems prevents accidental switching to non-permissible functions.

4.1 Switching the DC Current Measuring Ranges

300 µA, 30 mA, 300 mA

The current measuring ranges mentioned above are not automatically selected when the meter is switched ON. The above ranges can only be selected manually with "AUTO/MAN" key.

NOTE: Automatic turn-off is inactive on all current measuring ranges when the measured value display exceeds 30 digits. Set the function selector switch (6) to the desired position.

4.2 Autoranging

This multimeter features autoranging for all measuring ranges with the exception of the 30 mV ⎓ and 300mV⎓ ranges. Autoranging is automatically selected after turning the multimeter on. According to the measured quantity applied, the multimeter automatically selects the measuring range which gives the best resolution. When switching to frequency measurement and ratio measurement, the previously selected voltage measuring range is maintained.

The meter switches automatically:

- To the next highest range at ± 3099 digits + 1 digit.
- To the next lowest range at 240/280 digits - 1 digit .
- From the 300 mA⎓ to the 3 mA⎓ range.

4.3 Manual Range Selection

Autoranging can be turned off and ranges selected manually according to table 3.

Manual mode is switched off when AUTO/MAN pushbutton (4) is pressed for approximately 1 second, when function selector is operated, or when meter is turned off and on again.

When switching back to autoranging from 30 mV ⎓ or 300 mV ⎓ ranges, 3 V ⎓ is automatically selected.

AUTO/ MAN	Function	Acknowledgment	
		Display	Sound Signal
Short	Manual Operation ON: User range is fixed Switching sequence at:	MAN (10)	1X
Short	V ⎓: 3V → 30V → 300V → 1000V → 30mV → 300V → 3V ... V~/≋: 3V → 30V → 300V → 1000V → 3V... mA⎓: 300µA → 3mA → 30mA → 300mA →300µA ⏀: 30A → 300A → 30A... Ω: 30MΩ → 30Ω → 300Ω → 3kΩ → 30kΩ → 300kΩ → 3MΩ →.30MΩ... F: 30nF →300nF → 3µF → 30µF → 30nF → Hz: 300Hz → 3KHz → 30KHz →100KHz → 300Hz...	MAN (10)	1X
Long	Return to autoranging	—	2X

Table 3

5.0 Liquid Crystal Display (LCD)

5.1 Digital Display

The digital display (9) shows the measurement value, decimal point, and sign. The selected measuring unit (12) and function (11) are displayed. When measuring DC quantities minus sign appears in front of the digits, if the positive pole of the measurement magnitude is applied to the "⊥" input terminal. "OL" appears if the measuring range upper limit 3099 (on the range ⟶|⟵ : 1999) is exceeded. The digital display is updated 2.8 times per second. The sub digital display (14) shows the measured value. With V, A, and Ω measurements, the digital display is updated 2 times per second.

5.2 Analog Indication

The analog indication with pointer presentation gives the dynamic response of a moving-coil movement and is updated 20 times per second, when measuring V, A and Ω. Analog indication is of particular advantage when observing variations of measured values and for calibration procedures.

The analog indicator has its own polarity indication. When measuring DC quantities, the analog scale (15) has a negative range of 5 scale divisions so that variations of the measured values around "zero"can be observed exactly. When the measured value exceeds the range of indication, the left triangle (16) is shown before the polarity of the analog indicator switches over after approximately 0.7s.The overrange is indicated by the right triangle (13) when measured value is > 3099 digits (on the range ⟶|⟵ : 1999).

5.3 Display with Backlight

This instrument is provided with a selectable backlight for taking measurements in poor lighting conditions.

Switching the Backlight On

Press the AUTO/MAN and DATA/MIN/MAX keys simultaneously.

Switching the Backlight Off

Press the AUTO/MAN and DATA/MIN/MAX keys simultaneously.

6.0 DATA Hold Function

The DATA function allows to automatically hold the measured values. This is particularly useful, for instance, when connecting the probes to the measuring point requires full attention. When the measured value is applied and the "condition" according to table 4 is met, the meter holds the measured value on the digital display and emits a sound signal.

The probes can now be removed from the measuring point and the measured value on the digital display (9) can be read. When the measured value falls below the limit specified in table 4, the meter is reactivated for a new storage.

The analog indication is not influenced by the DATA hold, The actual measured value can still be noted / read. Note that with a held digital display, the location of the decimal point is also held. With autoranging selected, the measuring range of the analog indicator is no longer known.

Table 4

Function DATA	↓ Data MIN/MAX (3)	Condition		Meter Acknowledgment		
				Display		Sound Signal
		Measuring Ranges	Limit of Measured Values	Meas. Value Digital	DATA	
1. Activate	Short	—	—	—	Flashes	1X
2. Store		V≂ 2) A≂ Ω, F, Hz, %	>280 >24 OL <280	Displayed	Displayed	1X
3. Reactive 1)		V≂ 2) A≂ Ω, F, Hz, %		Stored measured value	Flashes	1X
Reset	Long			Cleared	Cleared	2X

1. Reactivated by falling below the specified limits of the measured value.
2. With the exception of the ranges of 30 mV and 300 mV.

Activating the HOLD Function

Momentarily pres the HOLD key. As long as the data HOLD function is active, manual range selection is not available.

To switch off the HOLD function:

- Press the HOLD pushbutton for approximately 1s.
  - This is acknowledged by 2 sound signals.
- Operate the function switch.
- Turn the multimeter off and on again.

7.0 MIN/MAX Function

With the MIN/MAX function, you can hold the minimum and maximum measured value which was applied to the input of the multimeter after activating MIN/MAX function. The most important application is the determination of the minimum and the maximum value for long-term monitoring of measured parameters. The actual measured value can still be noted/read during this feature. Apply the measured quantity to the meter and select the measuring range prior to activating the MIN/MAX function. With the function activated, you can select the measuring ranges only manually, if you switch to another range, the stored MIN/MAX values are cleared.

Function MIN/MAX	Data MIN/MAX (3)	Measuring Ranges	Measured Values MIN/MAX	Meter Acknowledgment		
				Display		Sound Signal
				Meas. Value Digital	MIN/ MAX	
1. Activate and Store	2x short, 30mV/300mV and °C 1xshort	V⎓ 2) A⎓ Ω, F, Hz, %	Stored	Actual measured value	MIN and MAX flash	1X
2. Store and Display	Short	V⎓ 2) A⎓ Ω, F, Hz, %	Storage continued in the background. New MIN/MAX displayed	Stored MIN value	MIN	1X
	Short			Stored MAX value	MAX	
3. Return to 1	Short	Same as 1	Same as 1. Stored values are not cleared	Same as 1	Same as 1	1X
Reset	Long		Cleared	Cleared	Cleared	2X

Table 5

The MIN/MAX function is switched OFF, when the MIN/MAX pushbutton (3) is pressed for approximately 1 s, or when the function selector switch (6) is operated, or when the meter is turned OFF and ON again.

8.0 Voltage Measurement

According to the voltage to be measured, set the function selector switch (6) to V~, V⎓ or V⎓. Connect the test leads as shown in figure 1. The "⊥" socket should be connected to the lowest potential ground available.

NOTE: The 30 mV "DC" and 300 mV "DC" measuring ranges can only be selected with the AUTO/MAN pushbutton (4). On the 1000V range, an intermittent sound signal warns when the measured value exceeds the upper range limit.

ATTENTION: Ensure current measuring range (mA) is not selected for voltage measurement.

Zero Adjustment on the 30 mV ⎓ Measuring Range

Connect the test leads to the meter and join the free ends. Select the measuring range, then press the multifunction pushbutton (5). The meter acknowledges "zero" setting with a sound signal. The LCD shows "00.00" (+1 digit) and the decimal point flashes. The displayed voltage at the instant the pushbutton is pressed is used as a reference value (max ±200 digits) and is automatically deducted from the values measured thereafter.

To clear the zero adjustment, perform one of the following:

- Press and hold the yellow multifunction button.
  - This is acknowledged by a sound signal.
- Turn the multimeter off and on again.

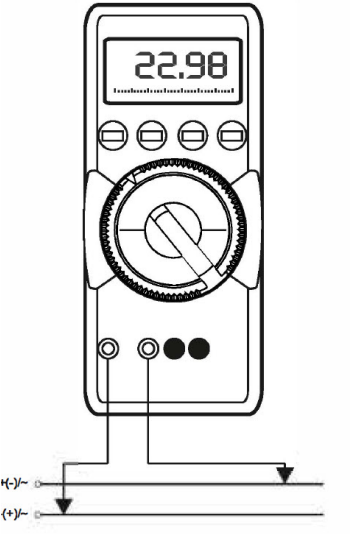

Fig. 1 Voltage measurement

9.0 Current Measurement

- Disconnect the power supply to the circuit being measured and/or to the load, and discharge all capacitors within that circuit.
- Select the DC current measuring ranges as described in section 4.1
- With the function selector mA = for currents<300 mA. When measuring current of unknown magnitude, select the highest measuring range first.
- Select the function corresponding to the measured quantity by briefly pressing the yellow multi-function pushbutton (5). Each time the pushbutton is pressed, alternate switching takes place between DC and (DC + AC).
  The change-over is acknowledged by a sound signal. The symbols DC and AC (11) are displayed as per selected function on the LCD. When selecting a range with the function selector switch (6), the DC+AC function is always set by default. When pressing the yellow multifunction pushbutton (5) for a long time, the multimeter always switches back to DC + AC and acknowledges this by two sound signals.
- Connect the multimeter in series with the load, as shown in figure 2. Ensure that the connections are tight (without contact resistance).

Notes on Current Measurement:

- The multimeter must be used only in the power systems, where the current circuit is protected by a fuse or a circuit breaker of 2 A and when the nominal voltage of the system does not exceed 1000V AC/DC
- Make the measuring circuit connections mechanically strong and secure so that they do not accidentally open. The conductor cross sections and connection points should be designed to avoid excessive heating.
- On the 300 mA an Intermittent sound signal warns you, when the measured value exceeds the upper range limit.
- The current measuring ranges up to 300 mA are protected to a short circuit current of 25 A by a fuse 1.6 A/ 1000V AC/DC in conjunction with power diodes. The cut-out capacity of the fuse is 10 kA at a rated voltage of 1000 V AC/DC and ohmic load.
- A blown fuse is signaled on the LCD the instant a measured quantity having a voltage of more than 4 V is applied to the corresponding connection sockets. Then, the digital display (9) shows the word "FUSE."
- After a fuse has blown, eliminate the cause of the overload before using the meter again .
- Replacement of the fuses is described in chapter 18.
- The voltage drop in 30 mA and 300 mA ranges is significant and may result in improper operation of electronic circuit connected in series.

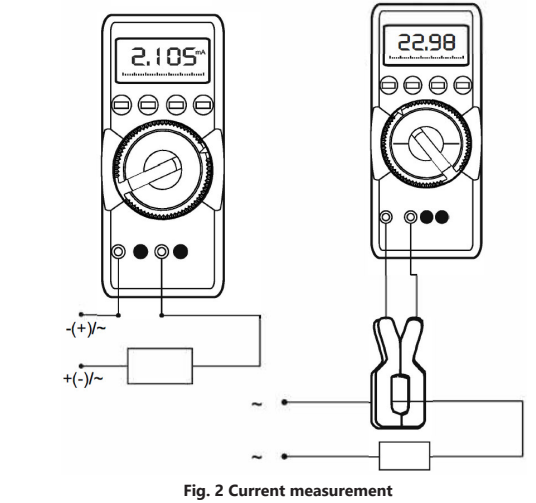

Fig. 2 Current measurement

9.1 AC Current Measurement w/ Clip-on Current Transformer ⫘

- Current to voltage clamp with ratio 10 mA:1 mV is used to measure the current up to 300 A AC with this function.
- Set rotary knob at position V(DC+AC) .Press multifunction (Yellow)key until a sound beep is heard. This will enter "Measurement with clip-on transformer" mode.
- Connect Clamp Output probes to "⊥" and "⫘" input terminal of this meter.
- It has two ranges i.e. 30.00 A and 300.0A. Measurement is possible with both auto ranging and manual ranging.

10.0 Resistance Measurement

- Verify that the device under test is electrically dead. External voltages would falsify the measured result.
- Set the function selector switch (6) to "Ω."
- Connect the device under test as shown in figure 3.

Zero Adjustment on the 30Ω Measurement Range

When measuring small resistance values on the 30Ω range, you can eliminate the resistance of the leads and contact resistance by zero adjustment.

- Connect the test leads to the multimeter and join the free ends.
- Briefly press the yellow multi-function pushbutton (5).The meter acknowledges zero adjustment by a sound signal, the LCD shows "00.00"(+1digit), and the decimal point flashes. The resistance measured at the instant the pushbutton is pressed is used as a reference value (max. 200 digits). It is automatically deducted from the values measured thereafter.

The clear the zero adjustment, perform one of the following:

- Press and hold the yellow multifunction button.
  - This is acknowledged by two sound signals.
- Turn the multimeter off and on again.

11.0 Diode and Continuity Test

- Verify that the device under test is electrically dead. External voltages would falsify the measured results.
- Set the function selector switch (6) to "".
- Connect the device under test as shown in figures 4 and 5.

The multimeter displays the forward voltage in Volts. As long as the voltage drop does not exceed the maximum display value of 1.999V, you can also rest several series-connected elements or reference diodes with small reference voltage. Reverse direction or open circuit: The multimeter indicates overrange "OL."

NOTE: Resistors and semiconductor junction in parallel with the diode falsify the measured results.

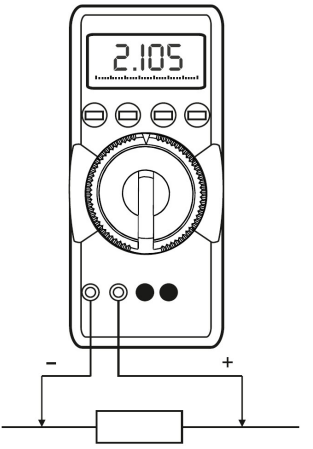

Fig. 3 Resistance measurement

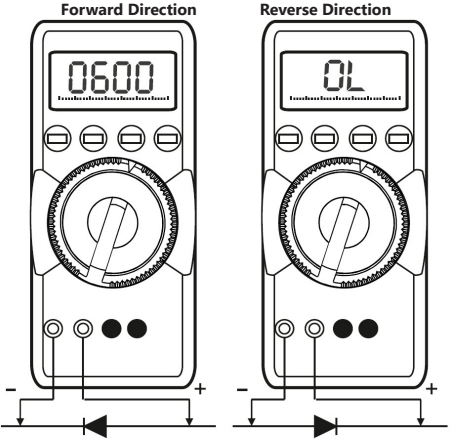

Fig. 4 Diode Test

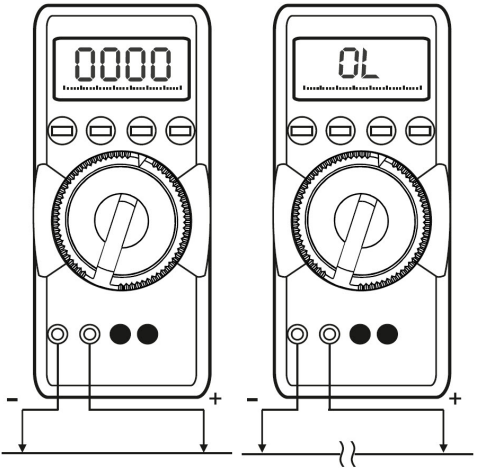

Fig. 5 Continuity Test

Diode Test and Continuity with Beeper

With the "🔊" function selected, the meter emits a continuous sound signal on the range 0 to approximately 0.7 V.

To Switch the Beeper On:

- Briefly press the yellow multifunction button (5).
- The multimeter acknowledges turn-on with a sound signal. The symbol "🔊" (18) appears on the LCD.

To Switch the Beeper Off:

- Briefly press the yellow multifunction button (5) again.
- The multimeter acknowledges turn-off with a sound signal. The symbol "🔊" (18) disappears from the LCD.

When selecting the function "Diode test and continuity test" with the function selector switch (6), the beeper is always switched ON. Repealed brief pressing of the multifunction pushbutton (5) alternately switches the beeper off and on. When pressing the pushbutton for a long lime, the beeper is always switched ON. This is acknowledged by the beeper sounding twice.

12.0 Capacitance Measurement

- Verify that the device under test is electrically dead. External voltages would falsify the measured results.
- Set the function selector switch (6) to 'F'
- Connect the (discharged) device under test to the "⊥" and "F" socket via test lead.

NOTE: Connect polarized capacitors with the "—" pole to the "⊥" socket. Resistors and semiconductor junction in parallel with the capacitor falsify the measured results.

Zero Adjustment on the 30 nF Measuring Range

When measuring small capacitance values on the 30 nF range, the internal resistance of the multimeter and the capacitance of the leads can be eliminated by zero adjustment.

- Connect the test leads to the meter without device under test.
- Briefly press the yellow multi-function pushbutton (5) displaying"00.00"(+1 digit) on the LCD and by a flashing decimal point. The capacitance measured at the instant the pushbutton is pressed is used as reference value (max. 200 digits). It is automatically deduced from the values measured thereafter.

The clear the zero adjustment, perform one of the following:

- Press and hold the yellow multifunction button.
  - This is acknowledged by two sound signals.
- Turn the multimeter off and on again.

13.0 Frequency Measurement

Frequency measurement is possible on all voltage measuring ranges in AC and DC modes.

- Set the function selector switch (6) to V~, V-.
- Connections are made the same way as for voltage measurement.
- Briefly press the yellow multi-function pushbutton (5). The multimeter switches to frequency measurement. The frequency is displayed on the LCD.

See chapter 17 for the lowest measurable frequencies and the maximum permissible voltages.

Changing between voltage, frequency, and duty cycle measurement

Repeated brief pressing of the yellow multi-function button (5) changes the measuring function in the following order:

Voltage → Frequency → Duty cycle → Voltage

To switch to voltage measurement from frequency or duty cycle measurement, perform one of the following:

- Press and hold the yellow multifunction button.
  - This is acknowledged by two sound signals.
  - The voltage measuring range last selected is maintained.
- Operate the function selector switch(6).

14.0 Duty Cycle Measurement

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

- Set the function selector switch (6) to V~ or V⎓
- Connections are made in the same way as for voltage measurement Briefly press the yellow multifunction pushbutton (5) 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 %.

$$\text{Duty cycle (\%)} = \frac{\text{pulse duration}}{\text{cycle duration}} \text{ X } 100$$

NOTE: Input applied frequency must remain constant during the duty cycle measurement. Change-over between voltages,frequency and duty cycle factor measurement is done as described in the preceding section.

15.0 Temperature Measurement

The Clamp 300A/ 1000A allows you to measure temperature with Pt100 and Pt1000 temperature sensors in the range from - 200 (-100) °C to 850°C.

- Set the function selector switch (6) to"Ω "
- Connect the sensor to the two terminals.
- Briefly press the yellow multifunction pushbutton(5). The multimeter switches to temperature measurement, automatically detects the connected sensor (Pt100 to Pt1000), and shows the measured temperature in °C on the digital display.

NOTE: It is not possible to switch over to temperature measurement when the 30Ω resistance range is selected.

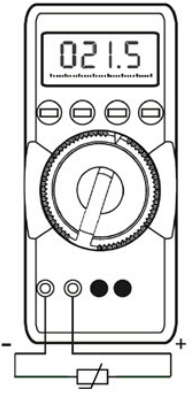

Fig. 6 Insulation Temperature Measurement

Sensor Lead Resistance up to 50Ω

Lead resistance of sensors having a value differing from that of company sensors can be considered up to a value of 50Ω as follows:

- Briefly press the yellow multi-function pushbutton (5) again. The LCD now displays the resistance value which the multimeter automatically considers after selecting the temperature measuring range. We can recognize that this is the resistance correction value on the temperature measuring range. The “°C” character is simultaneously shown on the display.
- Set the lead resistance correction value as follows:
- Press the DATA-MIN/MAX pushbutton (3) to increment the value, or the AUTO/MAN pushbutton(4) to decrement the value. Each time the pushbutton is briefly pressed, the value changes by one digit.
- Briefly press the yellow multifunction pushbutton (5) again. The LCD displays the measured temperature. The flashing decimal point shows you that we have entered a correction value for the lead resistance The correction value is retained as long as multimeter is switched on.
- Each time the yellow multifunction pushbutton (5) is briefly pressed, the display changes between measured temperature and correction value of the lead resistance.

To exit the temperature measurement function:

- Press and hold the yellow multifunction button.
  - This is acknowledged by two sound signals.
- Change the function selector switch.

NOTE: For the lead resistance, the actual value measured on the meter should be taken as correction value and not any specified value.

16.0 Insulation Resistance Measurement

16.1 Before Measurement

ATTENTION: Insulation resistance of only 'voltage free objects' can be measured. Do not touch measuring probes.

- Select the V1MΩ function using rotary switch.
- Connect the measuring probes to "⊥" and "V1MΩ' input terminals. This function provides way to measure interference voltage. It also provides discharge path of 1 Mohm to charge present on measuring objects.
- Turn the rotary switch to "MΩINSU' when device under measurement is voltage-free.
- This position by default reads interference voltage. If this voltage is >50 V, insulation resistance measurement is disabled.

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

16.2 Selecting Test Voltage: 50V, 100V, 250V, 500V, or 1000V

- If VINSU key is briefly activated, currently selected test voltage is displayed.
- Default values is 500 V. To select other value press and hold VINSU key until other voltage is displayed. This is confirmed with a sound beep signal.

16.3 Insulation Resistance Measurement

- Press and hold multifunction (yellow) key until display has stabilized. Insulation measurement is stopped when multifunction 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. There is no provision for the manual selection of measuring range.

NOTE: The instrument batteries are rapidly depleted during insulation resistance measurement. Only press and hold the multifunction key as long as is necessary to take the reading. Continuous measurement as described below should only be performed if absolutely necessary. Use only Alkaline manganese batteries in accordance with IEC6 Lr03.

Continuous Measurement

Activation: Press and hold multifunction (yellow) key and simultaneously press AUTO/MAN key until a beep is heard.

16.4 After Insulation Measurement

- Voltage displayed after measurement is the voltage present on the device under test (DUT) due to conductor capacitance.
- Discharge the device under test (DUT) by turning the function selector switch to "V1MΩ'.
- Contact with DUT must be maintained. Reduction of voltage can be observed directly on LCD .

ATTENTION: Do not disconnect DUT until voltage has dropped below 25V.

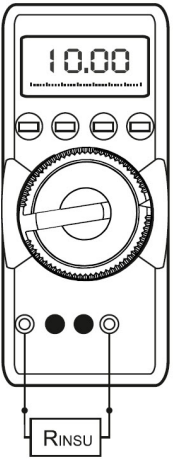

Fig. 7 Insulation Resistance Measurement

16.5 Evaluation of Measurement Values

To assure that insulation resistance does not violate lower limit values, the instrument's intrinsic and influence errors must be taken into consideration.

The minimum values of insulation resistance can be determined by table 6, which must be displayed under consideration of maximum operating error for this meter (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	Limit Value in MΩ	Min. Display in MΩ
0.1	0.11	20	22
0.2	0.22	50	55
0.5	0.55	100	110
1	1.1	200	220
2	2.2	500	550
5	5.5	1000	1100
10	11	2000	2200

Table 6

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17.0 Specifications

Measurement Function	Measuring Range	Resolution	Input Impedance
V⎓	30.00 mV	10 µV	> 10G Ω// < 40pF
	300.0 mV	100 µV	> 10G Ω// < 40pF
	3.000 V	1 mV	11 MΩ// < 40pF
	30.00 V	10 mV	10 MΩ< 40pF
	300.0 V	100 mV	10 MΩ< 40pF
	1000 V	1 V	10 MΩ< 40pF
V~	3.000 V [1]	1 mV	11 MΩ// < 40pF
	30.00 V [1]	10 mV	10 MΩ< 40pF
	300.0 V [1]	100 mV	10 MΩ< 40pF
	1000 V [1]	1 V	10 MΩ< 40pF
V≂	3.000 V [1]	1 mV	11 MΩ// < 40pF
	30.00 V [1]	10 mV	10 MΩ< 40pF
	300.0 V [1]	100 mV	10 MΩ< 40pF
	1000 V [1]	1 V	10 MΩ< 40pF
			Voltage Drop Approx
A⎓	300.0 µA	100 nA	15 mV
	3.000 mA	1 µA	150 mV
	30.00 mA	10 µA	650 mV
	300.0 mA	100 µA	1 V
A~	30.00 A [2]	10 mA	—
	300.0 A [2]	100 mA	—
A≂	3.000 mA [1]	1 µA	150 mV
	300.0 mA [1]	100 µA	1 V
			No Load Voltage
Ω	30.00 Ω	10 m	max. 3.2 V
	300.0 Ω	100 m	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

1) TRMS measurement

2) Measurement with clip-on current sensor with ration 1 mV/10 mA

3) At 0 to 40°C

4) With zero adjustment. Without zero adjustment: +35 digits

Measurement Function	Variation [1] ±(% of RDG+digits)	Overload Capacity [3]	
		Overload Value	Overload Duration
V⎓	0.5 + 3 [4]	1000 V DC AC eff/rms sine wave	Cont.
	0.5 + 3		
	0.25 + 1		
	0.25 + 1		
	0.25 + 1		
	0.25 + 1		
V~	1.0 + 3 (>10 digits)		
V⎓~	1.0 + 3 (>10 digits)		
A⎓	0.5 + 5 (>10 digits)	0.36 A	
	0.5 + 2		
	0.5 + 5 (>10 digits)		
	0.5 + 5		
A~	0.5 + 5		Cont.
	0.5 + 5		
A⎓~	1.5 + 4 (>10 digits)	12 A	10 min.
	1.5 + 4 (>10 digits)		
Ω	1.5 + 4 (>10 digits).5 + 3 [4]	1000 V DC AC eff/rms sine wave	Max. 10s
	0.5 + 3		
	0.4 + 1		
	0.4 + 1		
	0.4 + 1		
	0.6 + 1		
	2.0 + 1		
"→|←"	0.25 + 1		

Measurement Function	Measuring Range		Resolution	Discharge Resistance	$U_{0\ max}$
F	30.00 nF		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		10 nF	25 kΩ	2.5 V
				fmin V⎓	fmin V~
Hz	300.0 Hz		0.1 Hz	1 hz	45 Hz
	3.000 Hz		1 Hz	1 Hz	45 Hz
	30.00 Hz		10 Hz	10 Hz	45 Hz
	100.0 kHz		100 Hz	100 Hz	100 Hz
%	2.0 to 98.0%		0.1°C%	2 Hz	—
°C	-200°C to 200°C		0.1°C	—	—
	200°C to 850°C		0.1°C	—	—
	pt 100 pt 1000	-100°C to 200°C	0.1°C	—	—
		200°C to 850°C	0.1°C	—	—

Measurement Function	Measuring Range	Overload Capacity [1]	
		Overload Value	Overload Duration
F	1.0 + 3 [2]	1000 V DC/AC eff/rms sine	Max 10s
	1.0 + 3		
	1.0 +3		
	3.0 + 3		
Hz	0.5 + 1 [3]	≤3 kHz; 1000 V ≤3 kHz; 300 V ≤100 kHz 20 V	Cont.
%	2Hz ... 1 kHz ± 5 digits [4] 1kHz ... 10 kHz; ±5 Digit/kHz [4]		
°C	2 Kelvin + 5 digits [5]	1000 V DC/AC eff/rms sine	Max 10s
	1.0 + 5 [5]		
	2 Kelvin + 2 digits [5]		
	1.0 + 2 [5]		

1) At 0° to 40°C

2) With zero adjustment; without zero adjustment + 50 digits

3) Range: 3 V≂: UE = 1.5 V eff/rms to 100 V eff/rms
30 V≂: UE = 15 V eff/rms .. 300 V eff/rms
300 V≂:UE = 150 V eff/rms .. 1000 V eff/rms

4) On the range 3 V⎓, square-wave signal positive on one side 5 to 15 V, f = const., not 163.84 Hz or integral multiple.

5) Without sensor

Reference Conditions

Ambient temperature	23°C ± 2 K
Relative humidity	45% to 55% RH
Frequency of measured quantity	45 Hz to 65 Hz
Waveform of measured quantity	Sinusoidal
Battery voltage	8V ± 0.1V

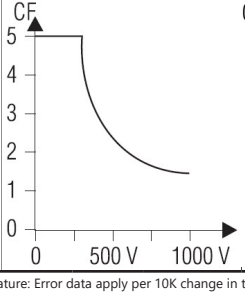
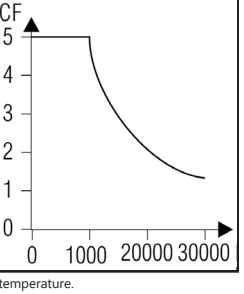
Insulation Resistance Measurement

Measurement Function	Measuring Range	Resolution	Variation ±(% of RDG+digits)
V1MΩ	0 TO 1000 VAC/VDC	1 V	1 + 10
MΩINSU@1000V	0 TO 1000 VAC/VDC	` V	1 + 10
MΩINSU UN=50 V	0.100 to 1.600 MΩ 01.40 to 10.00 MΩ 014.0 to 155.0 MΩ	1 KΩ 10 KΩ 100 KΩ	5 + 15
MΩINSU UN=100 V	0.100 to 3.100 MΩ 02.80 to 31.00 MΩ 028.0 to 310.0 MΩ	1 KΩ 10 KΩ 100 KΩ	5 + 15
MΩINSU UN=250 V	0.100 to 0.800 MΩ 00.70 to 08.00 MΩ 007.0 to 080.0 MΩ 0070 to 0800 MΩ	1 KΩ 10 KΩ 100 KΩ 1MΩ	3 + 10
MΩINSU UN=500 V	0.100 to 1.600 MΩ 1.40 to 16.00 MΩ 014.0 to 160.0 MΩ 0140 to 1600 MΩ	1 KΩ 10 KΩ 100 KΩ 1MΩ	3 + 10
MΩINSU UN=1000 V	0.100 to 3.100 MΩ 02.80 to 31.00 MΩ 028.0 to 310.0 MΩ 0280 to 3100 MΩ	1 KΩ 10 KΩ 100 KΩ 1MΩ	3 + 10

Measurement Function	Nominal Voltage U_N	Open Circuit Voltage	Nominal Current	Short-Circuit Current
MΩINSU	50 V	<1.25 x U_N	>1.0 mA	<2.5 mA
	100 V	<1.25 x U_N	>1.0 mA	<2.5 mA
	250 V	<1.15 x U_N	>1.0 mA	<2.5 mA
	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

Measurement Function	Nominal Voltage V_N	Acoustic Signal	Overload Capacity	
			Value	Duration
V1MΩ	—	V_N>1000 V	1000 V≂≅	Continuous
MΩINSU	1000 V	R_X<2MΩ	1000 V≂≅	max. 10s
	500 V	R_X<1MΩ	1000 V≂≅	max. 10s
	250 V	R_X<0.5MΩ	1000 V≂≅	max. 10s
	100 V	R_X<0.2MΩ	1000 V≂≅	max. 10s
	50 V	R_X<0.1MΩ	1000 V≂≅	max. 10s

Influence Quantities and Variations

Influence Quality	Range of Influence		Measured Quantity/ Measuring Range	Variation [1] ±(% of RDG+digits)
Temperature	0 °C +21 °C and +25 °C to +40°C		30/300 mVDC	1.0+3
			3 to 300 VDC	0.15+1
			1000 VDC	0.2+1
			VAC	0.4+2
			300 µA [2] 300 mA AC	0.5+1
			A AC/DC	0.75+3
			30 Ω [2]	0.15+2
			300 Ω	0.25+2
			3 KΩ to 3 MΩ	0.15+1
			30 MΩ	1.0+1
			30 nF[2] to 3µF	0.5+2
			30µF	2.0+2
			Hz	0.5+1
			%	± 5 digits
			-200 to 200°C	0.5K+2
			200 to 850°C	0.5+2
			MΩINSU	0.25+2
Frequency of the measured quantity	15 Hz to <30 Hz		3 to 1000 VAC	1.0+3
	30 Hz to <45 Hz			0.5+3
	>65 Hz to 400 Hz			2.0+3
	400 Hz to 1kHz		30to 300 VAC	3.0+3
				3.0+7
	15 Hz to <30 Hz		A AC/DC	1.0+3
	30 Hz to <45 Hz			0.5+3
	>65 Hz to <1 kHz			3.0+3
Waveform of the measured Quantity [3]	Crest factor CF	1 to 3	VAC4) [4], AAC/DC [4]	±1% of rdg.
		>3 to 5		±3% of rdg.
	The permissible crest factor CF of the AC quantity to be measured function of the displayed value			
	Voltage Measurement		Current Measurement	
				

1) With temperature: Error data apply per 10K change in temperature.
With frequency: Error data apply to a display from 300 digits onwards

2) With zero adjustment

3) With unknown waveform (crest factor CF > 2), measure with manual range selection

4) With the exception of sinusoidal waveform.

Influence Quality	Range of Influence	Measured Quantity/ Measuring Range	Variation [1] ±(% of RDG+digits)
Battery Voltage	⊣⊢ [1] to <7.9 V >8.1 V to 10.0 V	V⎓	±2 digits
		V~	±4 digits
		A⎓	±4 digits
		A~	±6 digits
		30Ω / 300Ω / °C	±4 digits
		3 kΩ to 30 MΩ, MΩINSU	±3 digits
		nF, µF	±1 digit
		Hz	±1 digit
		%	±1 digit
Relative Humidity	75%% 3 days Meter off	V≂,	1 x intrinsic error
		A≂	
		Ω	
		F	
		Hz	
		°C	
DATA	—	%	± 1 digit
MIN/MAX	—	V≂, A≂,	± 2 digits

1) After the "⊣⊢" symbol is displayed.

Influence Quality	Range of Influence	Measuring Ranges	Attenuation
Common Mode Interference Voltage	Noise quantity max. 1000 V~	V⎓	>120 dB
	Noise quantity max. 1000 V~ 50 Hz 60 Hz sinusoidal	3 V~, 30 V~, 300 V~	>70 dB
		1000 V~	>60 dB
Normal Mode Interference Voltage	Noise quantity V~ value of the measuring range at a time max. 1000 V~ , 50 Hz, 60 Hz sinusoidal	V⎓	>50 dB
	Noise quantity max. 1000 V-	V~	>110 dB

Display

Liquid crystal display section with analog indication and digital display and with display of the unit of measured quantity, function and various special functions.

Analog

Indication	LCD scale with pointer
Scale length	55mm on VDC and ADC, 47mm on all other ranges
Graduation	± 5 to to ±30 w/ 35 scale divisions DC, 0 to 30 w/ 25 scaled divisions on all other ranges
Polarity indication	Automatic change-over
Overrange indication	Triangle (13)
Sampling rate	20 reading/s Ω: 10 readings/s

Digital

Main display character height	7-segment digits - 15mm
Number of digits	3-3/4 digit 3100 counts
Overflow display	"OL"
Polarity display	"-" sign is displayed when positive pole is at "⊥"
Sampling rate	2 readings/s Ω and °C: 1 reading/s

Power Supply

Battery	1.5V X 6 (AAA size) alkaline-manganese cell according to IEC 6 LR 03	
Service Life	Without backlight on using alkaline-manganese cell:	
	approx. 600 hours on:	VDC, ADC
	approx. 240 hours on:	VAC, AAC
	approx. 800 measurements for MISO	@ 1000 V
	approx. 800 measurements for MISO	@ 50 V, 100 V, 250 V, 500 V
	When operating with interface:	times x 0.7
Battery test	Automatic display of "⊣-" symbol when battery voltage drops below approx. 7V	

Electromagnetic Capability

Emission	EN 61326 : Class B	
Immunity	IEC 61000-4-2	8 kV atmosphere discharge 4 kV contact discharge
	IEC 61000-4-3	3 V/m

Safety	IEC 61010-1-2010-06	
Protection class	II as per EN 61010-1	
Overvoltage Category	III	IV
Nominal Voltage	1000 V	600 V
Pollution Degree	2	2
Measuring category	CAT IV 600V CAT III 1000V	

Fuses

Fuses for up to 300 mA	FF (UR) 1.6 A/ 1 OOOV AC/DC; 6.3mm X 32mm; rating 10 kA with 1000VAC/DC and ohmic load; in conjuction with power diodes, protects all current measuring ranges upto 300mA.

Measured quantity/ measured range	Response Time		Transient response for step function of the measured quantity
	Analog indication	Digital display	
V⎓, V~, A~, A≂	0.7s	1.5s	0 to 80% of upper range limit
30Ω to 3MΩ	1.5s	2s	0 to 50% of upper range limit
30MΩ	4s	5s	
"⟶⊢"	0.7s	1.5s	
nF, µF, °C	—	Max. 1 to 3s	0 to 50% of upper range limit
300 Hz to 3 KHz	—	Max. 2s	
30 to 100 KHz	—	Max 0.7s	
% (1 Hz)	—	Max 9s	
% (>1Hz)	—	Max 2.5s	

Environmental Conditions

Functional temperature range	-10 to 50°C [14 to 122°F]
Storage temperature range	-25 to 70°C [-13 to 158°F] (w/o batteries)
Climatic class	2z/-10/50/70/75 % with reference to VDI/VDE 3540
Altitude	up to 2000m

Mechanical Configuration

Dimensions	3.3 x 7.6 x 1.3 in [84 x 195 x 35 mm]
Weight	13.7 oz [390g] including battery

18.0 Maintenance

ATTENTION: Disconnect the meter from the measuring circuit before replacing the battery.

18.1 Batteries

Before initial start-up, or after storage of your instrument, make sure that no leakage has occurred at the instrument battery. Repeat this inspection at regular intervals.

If battery leakage has occurred, electrolyte from the battery must be carefully and completely removed and a new battery must be installed, before the instrument can be placed back into operation.

If the "⊣⊢" symbol appears in the LCD display, replace the battery as soon as possible. You can continue to take measurements, but reduced measuring accuracy may result.

The multimeter operates with six (6) 1.5V (AAA) batteries according to IEC6 LR03.

Replacing the Batteries

- Place the multimeter on its face, loosen the two screws on the rear and remove the lower part of the case, lifting it from the bottom. The lower and the upper part of the case are fixed together at the top on the front by means of wedges.
- Remove all six batteries from the battery holder.
- Place six new batteries into battery holder with correct polarities.
- Replace the lower part of the case. Start at the top on the front and take care that the wedges are properly engaged at this point.
- Tighten the lower part with the two screws.

18.2 Fuses

A blown fuse is signaled on the LCD display the instant a measured quantity having a voltage of more than 4 V is applied to the corresponding connection sockets. Then, the digital display (9) shows "FUSE." The 1.6 A protects all other current measuring ranges. All other measuring ranges continue to function.

When a fuse blows, first eliminate the cause of the overload before using the multimeter again.

Fuse Replacement

- Open the multimeter same as for battery replacement
- Remove the blown fuse, e.g. with the aid of a probe and replace it with a new one

Permissible Types

- For current measuring ranges up to 300 mA:
  FF (UR) 1.6 A/ 1000 V AC/DC; (10 KA); 6.3 mm x 32 mm

ATTENTION: Absolutely verify that only the specified fuse is installed. If a fuse of other cut-out capacity other nominal current or other switching capacity is used, a dangerous situation exists, and there is danger of damaging protective diodes, resistors or other components. The shorting of the fuse holder is not permissible.

18.3 Case

Special maintenance of the case is not required. Take care that the surface between the connection sockets is clean. For cleaning take a moist cloth. Avoid scrubbing.

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