Ex-DM 1000

Multimeters

Users Manual

⚠ Before using, please read and observe the "User Instructions"!

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1. Introduction
Easy to operate, the ECOM Ex-DM 1000 is a compact and robust Multimeters, making it ideal for use in confined and restricted spaces within Ex-hazardous areas classified as either Zone 1 or 2 according to IEC/CENELEC (TÜV-Authorisation).

2. Safety Advice
Safe operation of the equipment is maintained providing that all instructions and warnings contained in this manual are fully observed. In case of doubt (due to translation and/or printing errors) reference should be made to the original German instruction manual.

3. Faults and Damage
If there is any reason to suspect that the safety of the unit has been affected then it must be immediately withdrawn from use and precautionary measures taken in order to prevent any further use of in the Ex-hazardous area.
It is recommended that the equipment be then sent back to the manufacturers for testing.

The safety and integrity of the unit may be compromised by, for example:

· External damage to the housing.
· Internal damage to the device is visible.
· Exposure to excessive loads.
· Incorrect storage of the unit.
· Damage sustained in transit
· Correct certification is illegible.
· Functioning errors occur
· The permitted limitations are exceeded
· Functioning errors or obvious measurement inaccuracies occur which prevent further measurement by the equipment.

4. Safety Regulations
The use of the intrinsically safe meets the requirements of the regulations providing that the user observes and applies the requirements as laid down in the regulations and that improper and incorrect use of the unit is avoided.
· Use must be restricted to specified application parameters.
· The device must not be opened within the Ex-hazardous area.
· Batteries (see technical data) must only be changed outside the Ex-hazardous area.

· The carrying of additional battery packs within the Ex-hazardous area is not permitted.
· Only type-tested batteries may be used. The use of any other type of battery is not permitted in that it will invalidate the Ex-Data certification and presents a safety risk.
· Fuse replacement within the Ex-hazardous area is not permitted.
· Only fuses provided by ECOM may be used.
· The function buttons inside the device may not be opened. Interference and/or damage to any of these elements removes the Ex-protection.
· The equipment may only be used in the Ex-hazardous area providing it is fitted in the specified accompanying holster. Particular attention must be made to ensure that the holster is completely and securely fitted.
· After using the equipment on a non-i.s. protected circuit a rest time of 3 minutes minimum duration must take place before the multimeter is taken into and/or used in an Ex-hazardous area.

5. Ex-Data
Certificate of Conformity: TÜV 01 ATEX 1658 X

Certification:  II 2 G EEx ia IIC T4

Permitted for Zone 1, Equipment group II, Gas group C hazardous gases, vapour or mist, Temperature class T4.

6. Technical Data

Ambient temperature T_a:	-20 ... +50° C	
Storage temperature:	-40 ... +60° C	
Maximum use:	Operation: 2000 m; Storage: 10.000 m	
Power supply:	9V Block type 6LR61 according to IEC (see table 9)	
Dimensions:	201 x 98 x 52 mm	
Weight:	approx. 800 g	
IP Rating:	IP 44 (with Holster)	
CE-Indicator:	CE 0102	
TÜV:	TÜV GS according to EN 61010-1	
Measuring range:	EEx ia IIC	no EEx ia IIC
Voltage:	0 - 65 V	0 - 1000 V
Current:	0 - 5A	0 - 10A
Maximum voltage between a choice of connection and mass:	1000 V RMS	
Fuse for mA or uA start:	Fuse 44/100 A, 1000 V quick	
Fuse for A start:	Fuse 11 A, 1000 V quick	
Indicator: Digital:	4000 counting rate, renewal 4/sec: (Ex-DM 1000 with 19.999 count rate using 41/2 digits)	
Indicator: Analogue:	Renewal 40/sec. Frequency: 19.999 count rate, Renewal 3/sec by >10. in addition. 4 x 32 segments (equivalent to 128).	
Temperature Coefficient:	0,05 x (given accuracy) / deg C (< 18 deg C oder > 28 deg C).	
Electromagnetic compatibility:	In a RF field of 3 V/m, General accuracy = Given accuracy + 0.4% of the range value > 800MHz (uADC) (m VAC & uAAC not given)	
Relative humidity:	0 - 80% r.H. (from 0 deg to 35 deg C)	
Battery operating time:	Approx. 400hrs (without use of backlight function).	

Measuring protected electric circuits (certificate EEx ia IIC)
Voltage-Mass (V/ ohms)

Ui = 65V	Uo = 10,4V	Co = 2,52µF
	Io = 4,1 mA	Lo = 100mH

Current-Mass (µA/mA & A)

Ii = 5A	Uo = 2,8V	Co = 1000µF
	Io = 195mA	Lo = 600µH

7. Application

7.1 Introduction

⚠ Warning

Read "Safety Information" before you use the meter.

7.2 Safety Information

Use the meter only as specified in this manual, otherwise the protection provided by the meter may be impaired.
In this manual, a **Warning** identifies conditions and actions that pose hazards to the user. A **Caution** identifies conditions and actions that may damage the meter or the equipment under test.
International symbols used on the meter and in this manual are explained in Table 1.

⚠ Warning

For your own information and safety please read and observe the Ex-safety advice on the following pages.

To avoid possible electric shock or personal injury, follow these guidelines:

- **Do not use the meter if it is damaged.**
  Before you use the meter, inspect the case.
  Look for cracks or missing plastic.
  Pay particular attention to the insulation surrounding the connectors.

- **Make sure the battery door is closed and latched before you operate the meter.**
- **Replace the battery as soon as the battery indicator ( ) appears.**
- **Remove test leads from the meter before you open the battery door.**
- **Inspect the test leads for damaged insulation or exposed metal. Check the test leads for continuity. Replace damaged test leads before you use the meter.**
- **Do not use the meter if it operates abnormally. Protection may be impaired. When in doubt, have the meter serviced.**
- **Use only a single 9 V battery, properly installed in the meter case, to power the meter.**
- **When servicing the meter, use only specified replacement parts.**

⚠ Caution

To avoid possible damage to the meter or to the equipment under test, follow these guidelines:

- **Disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.**
- **Use the proper terminals, function, and range for your measurements.**
- **Before measuring current, check the meter's fuses. (See "Testing the Fuses".)**

To protect yourself, use the following guidelines:

- Use caution when working with voltages above 30 V ac rms, 42 V ac peak, or 60 V dc. Such voltages pose a shock hazard.
- When using the probes, keep your fingers behind the finger guards.
- Connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.
- Avoid working alone.
- When measuring current, turn off circuit power before connecting the meter in the circuit. Remember to place the meter in series with the circuit.

7.3 Your Meter's Features

Tables 2 through 5 briefly describe your meter's features and give page numbers where you can find more detailed information about the features.

Table 1. International Electrical Symbols

~	AC (Alternating Current)	⏚	Earth ground
⎓	DC (Direct Current)	⏛	Fuse
≂	AC or DC	CE	Conforms to European Union directives
⚠	Refer to the manual for information about this feature.	⧈	Double or amplify insulation
⊟	Battery		
TÜV PRODUCT SERVICE GS geprüfte Sicherheit	Inspected and licensed by TÜV Product Services.		

Table 2. Inputs

Terminal	Description	Page
A	Input for 0 A to 10.00 A current measurements	23
mA μA	Input for 0 μA to 400 mA current measurements	23
COM	Return terminal for all measurements	--
V Ω ⊣◀	Input for voltage, continuity, resistance, diode, capacitance, frequency, and duty cycle measurements	V: 15 Ω: 18 ⊣◀ : 22 ⊣(:20 Frequency: 25 Duty cycle: 27

Table 3. Rotary Switch Positions

Switch Position	Function	Page
Ṽ	AC voltage measurement	15
V̿	DC voltage measurement	15
mV̿	400 mV dc voltage range	15
))) Ω ⊣(	))) Continuity test	16
	Ω Resistance measurement	18
	⊣(Capacitance measurement	20
⊣◀	Diode test	22
mA A	DC or AC current measurements from 0 mA to 10.00 A	23
μA	DC or AC current measurements from 0 μA to 4000 μA	23

Table 4. Pushbuttons

Button	Function	Button Function	Page
(Blue button)	))) Ω ⊣⊢	Selects capacitance.	20
	mA/A, µA	Switches between dc and ac current.	23
	Power-up	Disables automatic power-off feature.	14
MIN MAX	Any switch position	Starts recording of minimum and maximum values. Steps the display through MIN, MAX, AVG (average), and present readings.	29
	Power-up	Enables high-accuracy 1-second response time for MIN MAX recording.	29
RANGE	Any switch position	Switches between the ranges available for the selected function. To return to autoranging, hold the button down for 1 second.	See ranges in specifications.
		Manually selecting a range causes the meter to exit the Touch Hold®, MIN MAX, and REL (relative) modes.	
	Power-up	For servicing purposes only.	- -
HOLD	Any switch position	Touch Hold captures the present reading on the display. When a new, stable reading is detected, the meter beeps and displays the new reading.	31
	MIN MAX recording	Stops and starts recording without erasing recorded values.	29
	Frequency counter	Stops and starts the frequency counter.	25

Table 4. Pushbuttons (cont)

Button	Function	Button Function	Page
☼	Any switch position	Turns the backlight on and off.	--
		Hold the yellow button down for one second to enter the 4-1/2 digit mode. To return to the 3-1/2 digit mode, hold the button down only until all display segments turn on (about one second).	28
)))))	Continuity))))Ω⊣⊢	Turns the continuity beeper on and off.	16
	MIN MAX recording	switches between 250 µs and 100 ms or 1 s response times.	29
	Power-up	Disables the beeper for all functions.	- -
REL Δ (Relative mode)	Any switch position	Stores the present reading as a reference for subsequent readings. The display is zeroed, and the stored reading is subtracted from all subsequent readings.	31
Hz	Any switch position	Starts the frequency counter.	25
		Press again to enter duty cycle mode.	27
	Power-up	Provides >4000 MΩ input impedance for the 400 mV dc range.	--

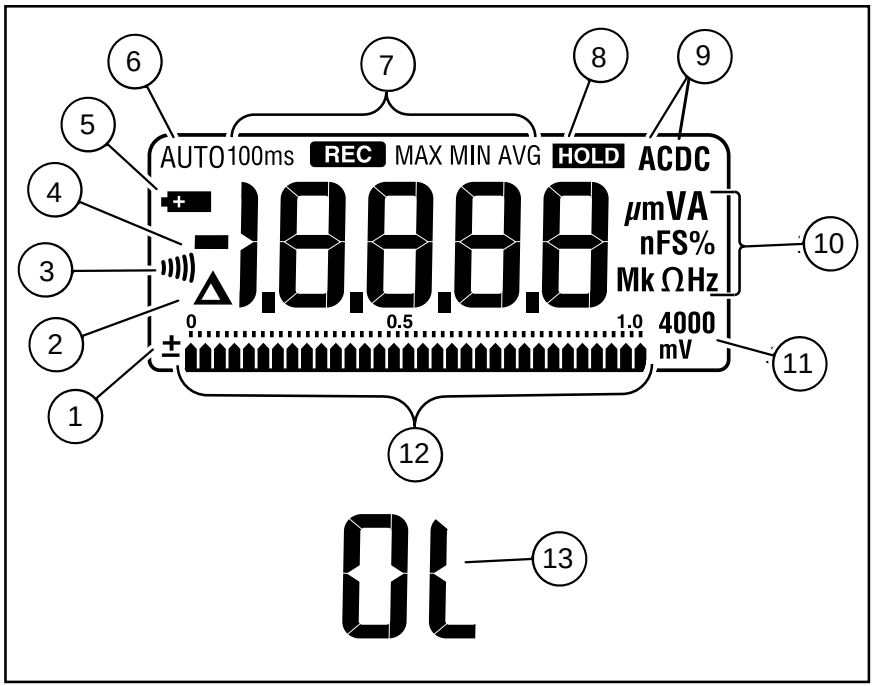


Figure 1. Display Features

Table 5. Display Features

Number	Feature	Indication	Page
①	±	Polarity indicator for the analog bar graph.	28
②	△	Relative (REL) mode is active.	31
③	)))))	The continuity beeper is on.	16
④	−	Indicates negative readings. In relative mode, this sign indicates that the present input is less than the stored reference.	31
⑤		The battery is low. ⚠ **Warning: To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator appears. ()**	31
⑥	**AUTO**	The meter is in autorange mode and automatically selects the range with the best resolution.	--
⑦	**100 ms REC MAX MIN AVG**	Indicators for minimum-maximum recording mode.	29
⑧	**HOLD**	Touch Hold is active.	31
⑨	**AC DC**	Indicator for ac or dc voltage or current. AC voltage and current is displayed as an rms (root mean square) value.	15,23

Table 5. Display Features (continued)

Number	Feature	Indication	Page
⑩	**A, μA, mA**	A: Amperes (amps). The unit of current. μA: Microamp. 1 x 10^{-6} or 0.000001 amperes. mA: Milliamp. 1 x 10^{-3} or 0.001 amperes.	23
	V, mV	V: Volts. The unit of voltage. mV: Millivolt. 1 x 10^{-3} or 0.001 volts.	15
	μF, nF	F: Farad. The unit of capacitance. μF: Microfarad. 1 x 10^{-6} or 0.000001 farads. nF: Nanofarad. 1 x 10^{-9} or 0.000000001 farads.	20
	nS	S: Siemen. The unit of conductance. nS: Nanosiemen. 1 x 10^{-9} or 0.000000001 siemens.	20
	%	Percent. Used for duty cycle measurements.	27
	Ω, MΩ, kΩ	Ω: Ohm. The unit of resistance. MΩ: Megohm. 1 x 10^{6} or 1,000,000 ohms. kΩ: Kilohm. 1 x 10^{3} or 1000 ohms.	18
	Hz, kHz, MHz	Hz: Hertz. The unit of frequency. kHz: Kilohertz. 1 x 10^{3} or 1000 hertz. MHz: Megahertz. 1 x 10^{6} or 1,000,000 hertz.	25

Table 5. Display Features (continued)

Number	Feature	Indication	Page
(11)	**4000 mV**	Displays the currently selected range.	See specifications for ranges for each function.
(12)	Analog bar graph	Provides an analog indication of the present inputs.	28
(13)	OL	The input (or the relative value when in relative mode) is too large for the selected range. For duty cycle measurements OL is displayed when the input signal stays high or low.	Duty cycle: 27

7.4 Power-Up Options

Holding a button down while turning the meter on activates a power-up option. Table 4 includes the power-up options available. These options are also listed on the back of the meter.

7.5 Automatic Power-Off

The meter automatically turns off if you do not turn the rotary switch or press a button for 30 minutes. To disable automatic power-off, hold down the blue button while turning the meter on. Automatic power-off is always disabled in MIN MAX recording mode.

7.6 Input Alert™ Feature

If a test lead is plugged into the **mA/µA** or **A** terminal, but the rotary switch is not correctly set to the **mA/µA** or **A** position, the beeper warns you by making a chirping sound. This warning is intended to stop you from attempting to measure voltage, continuity, resistance, capacitance, or diode values when the leads are plugged into a current terminal. Placing the probes across (in parallel with) a powered circuit when a lead is plugged into a current terminal can damage the circuit you are testing and blow the meter's fuse. This can happen because the resistance through the meter's current terminals is very low, so the meter acts like a short circuit.

7.7 Making Measurements

The following sections describe how to take measurements with your meter.

7.8 Measuring AC and DC Voltage

Voltage is the difference in electrical potential between two points. The polarity of ac (alternating current) voltage varies over time, while the polarity of dc (direct current) voltage is constant over time. The meter presents ac voltage values as rms (root mean square) readings. The rms value is the equivalent dc voltage that would produce the same amount of heat in a resistance as the measured sinewave voltage. Ex-DM 1000 feature true rms readings, which are accurate for other wave forms (with no dc offset) such as square waves, triangle waves, and staircase waves.

The meter's voltage ranges are 400 mV, 4 V, 40 V, 400 V, and 1000 V. To select the 400 mV dc range, turn the rotary switch to mV.

To measure ac or dc voltage, set up and connect the meter as shown in Figure 2.

The following are some tips for measuring voltage:

· When you measure voltage, the meter acts approximately like a 10 MΩ (10,000,000 Ω) impedance in parallel with the circuit. This loadingceffect can cause measurement errors in high-impedance circuits. In most cases, the error is negligible (0.1% or less) if the circuit impedance is 10 kΩ (10,000 Ω) or less.

· For better accuracy when measuring the dc offset of an ac voltage, measure the ac voltage first. Note the ac voltage range, then manually select a dc voltage range equal to or higher than the ac range. This procedure improves the accuracy of the dc measurement by ensuring that the input protection circuits are not activated.

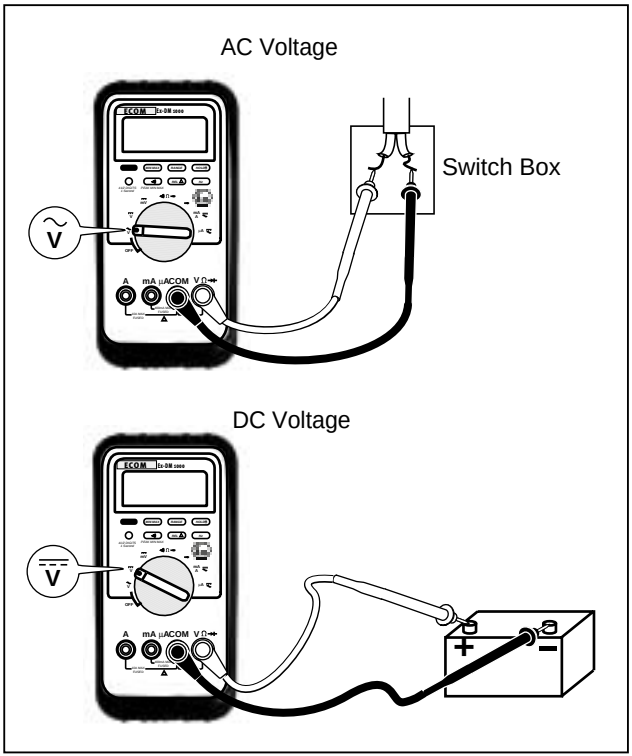


Figure 2. Measuring AC and DC Voltage

7.9 Testing for Continuity

Caution

To avoid possible damage to the meter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before testing for continuity.

Continuity is the presence of a complete path for current flow. The continuity test features a beeper that sounds if a circuit is complete. The beeper allows you to perform quick continuity tests without having to watch the display.

To test for continuity, set up the meter as shown in Figure 3.

Press))))) to turn the continuity beeper on or off.

The continuity function detects intermittent opens and shorts lasting as little as 1 millisecond (0.001 second). These brief contacts cause the meter to emit a short beep.

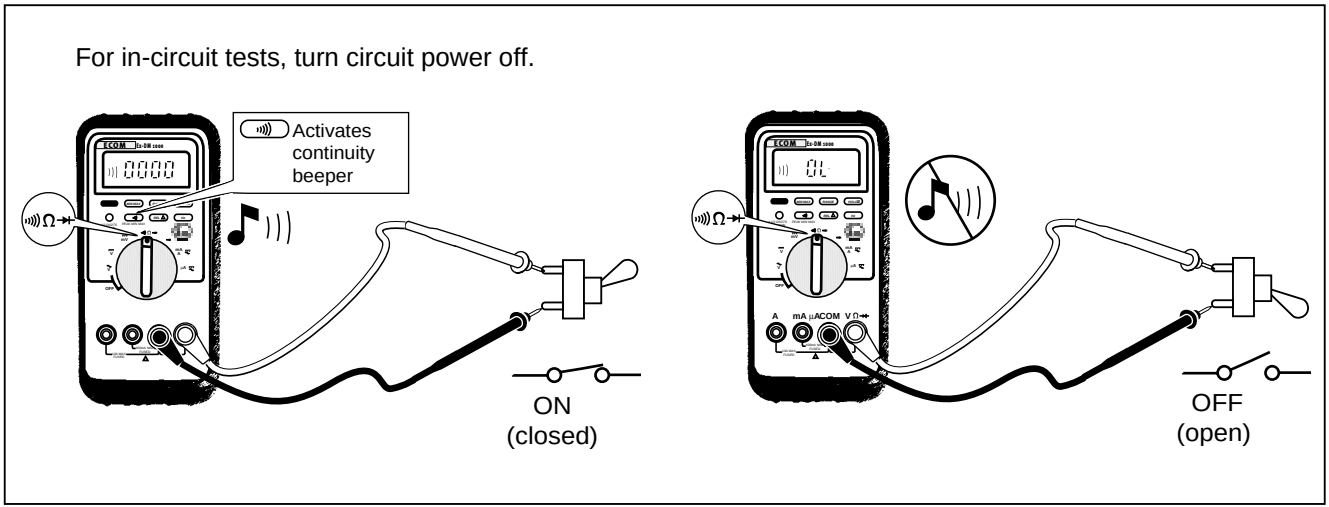


Figure 3. Testing for Continuity

7.10 Measuring Resistance

Caution

To avoid possible damage to the meter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before measuring resistance.

Resistance is an opposition to current flow. The unit of resistance is the ohm (Ω). The meter measures resistance by sending a small current through the circuit. Because this current flows through all possible paths between the probes, the resistance reading represents the total resistance of all paths between the probes.

The meter's resistance ranges are 400 Ω, 4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, and 40 MΩ.

To measure resistance, set up the meter as shown in Figure 4.

The following are some tips for measuring resistance:

- Because the meter's test current flows through all possible paths between the probe tips, the measured value of a resistor in a circuit is often different from the resistor's rated value.

- The test leads can add 0.1 Ω to 0.2 Ω of error to resistance measurements. To test the leads, touch the probe tips together and read the resistance of the leads. If necessary, you can use the relative (REL) mode to automatically subtract this value.

- The resistance function can produce enough voltage to forward-bias silicon diode or transistor junctions, causing them to conduct. To avoid this, do not use the 40 MΩ range for in-circuit resistance measurements.

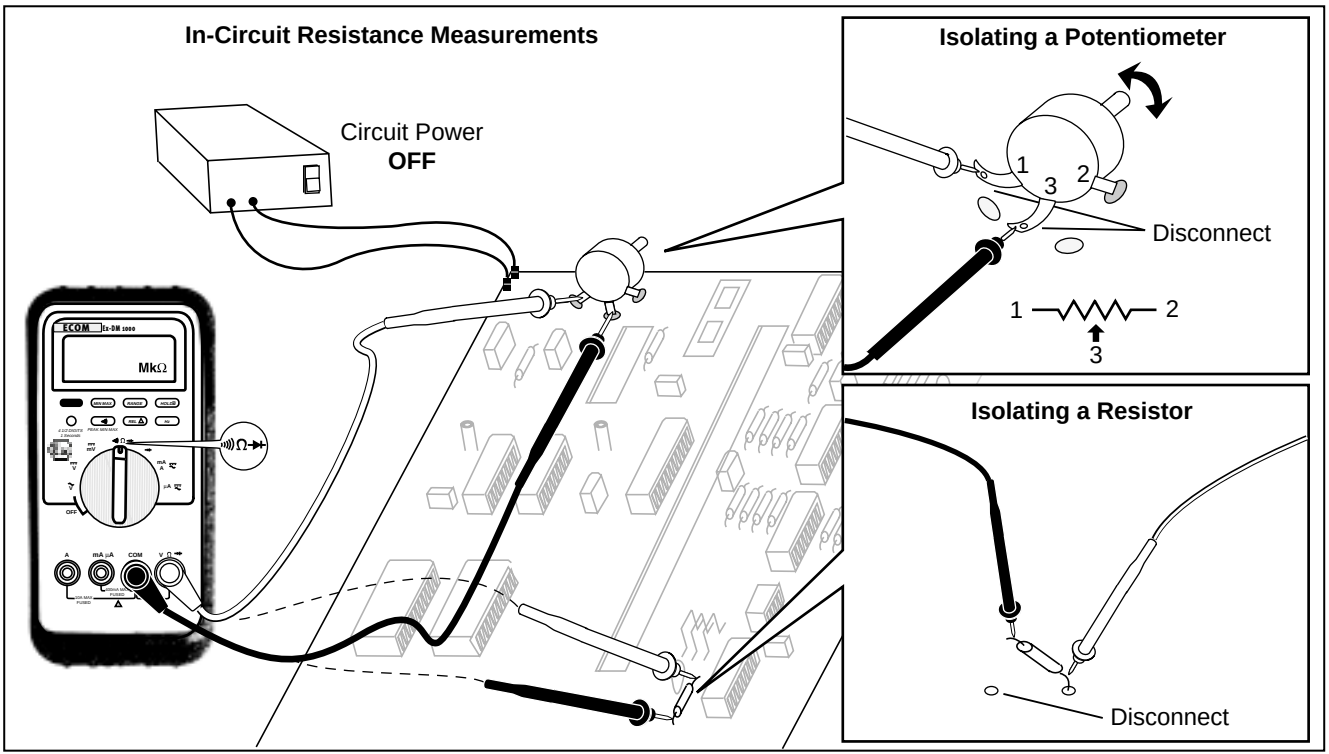


Figure 4. Measuring Resistance

7.11 Using Conductance for High Resistance or Leakage Tests

Conductance, the inverse of resistance, is the ability of a circuit to pass current. High values of conductance correspond to low values of resistance.

The unit of conductance is the Siemen (S). The meter's 40 nS range measures conductance in nanosiemens (1 nS = 0.000000001 Siemens). Because such small amounts of conductance correspond to extremely high resistance, the nS range lets you determine the resistance of components up to 100,000 MΩ, or 100,000,000,000 Ω (1/1 nS = 1,000 MΩ).

To measure conductance, set up the meter as shown for measuring resistance (Figure 4); then press RANGE until the nS indicator appears on the display.

The following are some tips for measuring conductance:

· High-resistance readings are susceptible to electrical noise. To smooth out most noisy readings, enter the MIN MAX recording mode; then scroll to the average (AVG) reading.

· There is normally a residual conductance reading with the test leads open. To ensure accurate readings, use the relative (REL) mode to subtract the residual value.

7.12 Measuring Capacitance

⚠ Caution

To avoid possible damage to the meter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before measuring capacitance.
Use the dc voltage function to confirm that the capacitor is discharged.

Capacitance is the ability of a component to store an electrical charge. The unit of capacitance is the farad (F).
Most capacitors are in the nanofarad to microfarad range.

The meter measures capacitance by charging the capacitor with a known current for a known period of time, measuring the resulting voltage, then calculating the capacitance. The measurement takes about 1 second per range. The capacitor charge can be up to 1.2 V.

The meter's capacitance ranges are 5 nF, 0.05 µF, 0.5 µF, and 5 µF.

To measure capacitance, set up the meter as shown in Figure 5.

The following are some tips for measuring capacitance:

· To speed up measurements of similar values, press RANGE to manually select the proper range.

· To improve the accuracy of measurements less than 5 nF, use the relative (REL) mode to subtract the residual capacitance of the meter and leads.

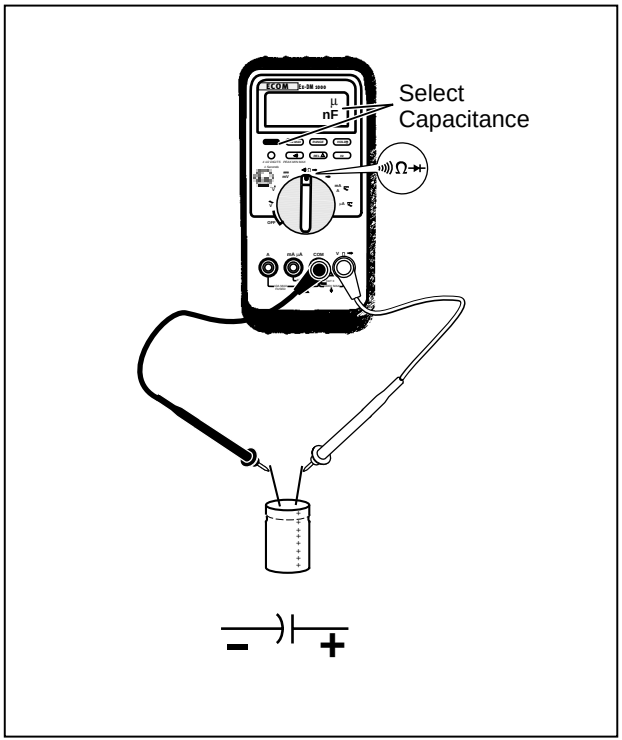


Figure 5. Measuring Capacitance

· To estimate capacitance values above 5 µF, use the current supplied by the meter's resistance function, as follows:

1. Set up the meter to measure resistance.

2. Press RANGE to select a range based on the value of capacitance you expect to measure (refer to Table 6.)

3. Discharge the capacitor.

4. Place the meter's leads across the capacitor; then time how long it takes for the display to reach OL.

5. Multiply the charge time from step 4 by the appropriate value in the µF/second of Charge Time column in 6. The result is the estimated capacitance value in microfarads (µF).

Table 6. Estimating Capacitance Values Over 5 Microfarads

Expected Capacitance	Suggested Range*	µF/second of Charge Time
Up to 10 µF	4 M	0,3
11 µF bis 100 µF	400 k	3
101 µF bis 1000 µF	40 k	30
1001 µF bis 10.000 µF	4 k	300
10.000 µF bis 100.000 µF	400 Ω	3000

*These ranges keep the full-charge time between 3.7 seconds and 33.3 seconds for the expected capacitance values. If the capacitor charges too quickly for you to time, select the next higher resistance range.

7.13 Testing Diodes

Caution

To avoid possible damage to the meter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before testing diodes.

Use the diode test to check diodes, transistors, silicon controlled rectifiers (SCRs), and other semiconductor devices. This function tests a semiconductor junction by sending a current through the junction, then measuring the junction's voltage drop. A good silicon junction drops between 0.5 V and 0.8 V.

To test a diode out of a circuit, set up the meter as shown in Figure 6. For forward-bias readings on any semiconductor component, place the red test lead on the component's positive terminal and place the black lead on the component's negative terminal.

In a circuit, a good diode should still produce a forward-bias reading of 0.5 V to 0.8 V; however, the reverse-bias reading can vary depending on the resistance of other pathways between the probe tips.

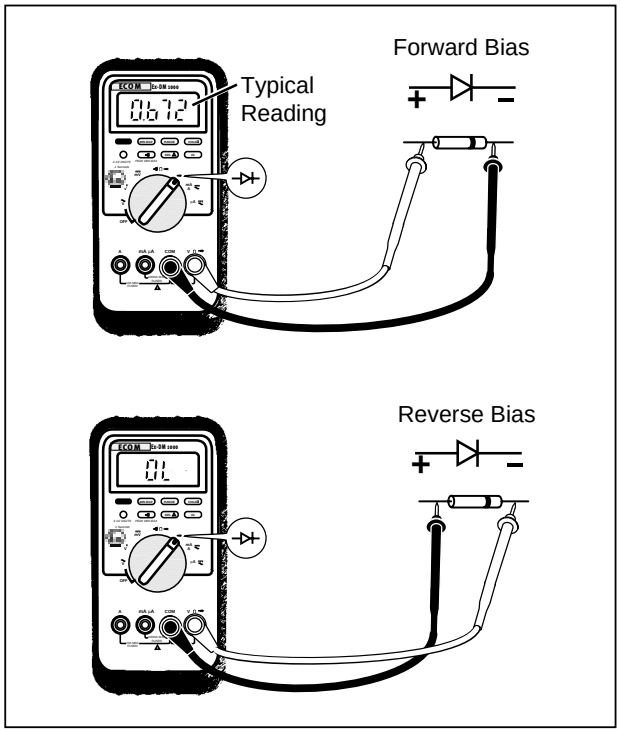


Figure 6. Testing a Diode

7.14 Measuring AC or DC Current

⚠Warning

Never attempt an in-circuit current measurement where the open-circuit potential to earth is greater than 1000 V. You may damage the meter or be injured if the fuse blows during such a measurement.

Caution

To avoid possible damage to the meter or to the equipment under test, check the meter's fuses before measuring current.
Use the proper terminals, function, and range for your measurement. Never place the probes across (in parallel with) any circuit or component when the leads are plugged into the current terminals.

Current is the flow of electrons through a conductor. To measure current, you must break the circuit under test, then place the meter in series with the circuit.

The meter's current ranges are 400 µA, 4000 µA, 40 mA, 400 mA, 4000 mA, and 10 A. AC current is displayed as an rms value.

To measure current, refer to Figure 7 and proceed as follows:

1. **Turn off power to the circuit. Discharge all high-voltage capacitors.**

2. Insert the black lead into the COM terminal. For currents between 4 mA and 400 mA, insert the red lead into the mA/µA terminal. For currents above 400 mA, insert the red lead into the A terminal.

Note

To avoid blowing the meter's 400 mA fuse, use the mA/ µA terminal only if you are sure the current is less than 400 mA.

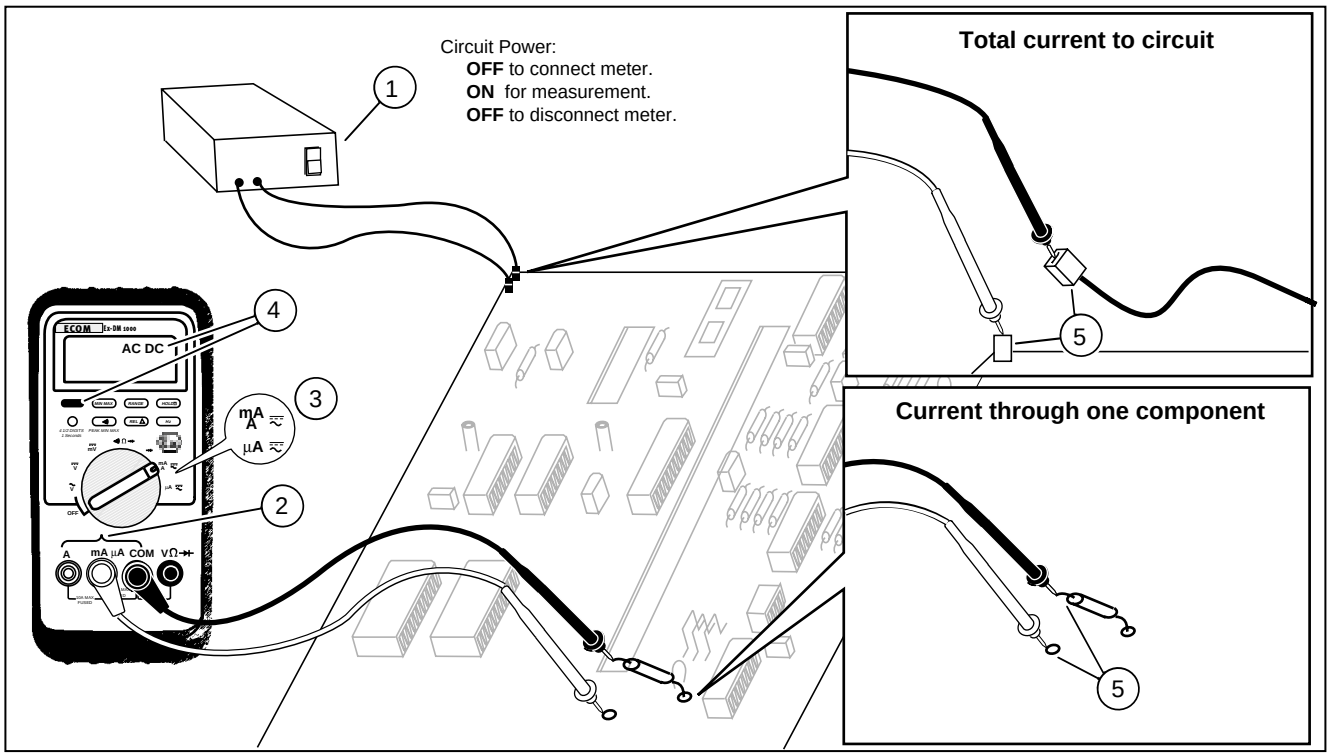


Figure 7. Measuring Current

3. If you are using the A terminal, set the rotary switch to mA/A. If you are using the mA/µA terminal, set the rotary switch to mA for currents below 4000 µA (4 mA), or mA/A for currents above 4000 µA.

4. To measure ac current, press the blue button.

5. Break the circuit path to be tested. Touch the black probe to the more negative side of the break; touch the red probe to the more positive side of the break. Reversing the leads will produce a negative reading, but will not damage the meter.

6. Turn on power to the circuit; then read the display. Be sure to note the unit given at the right side of the display (µA, mA, or A).

7. Turn off power to the circuit and discharge all high-voltage capacitors. Remove the meter and restore the circuit to normal operation.

The following are some tips for measuring current:

· If the current reading is 0 and you are sure the meter is set up correctly, test the meter's fuses as described under "Testing the Fuses".

· A current meter drops a small voltage across itself, which might affect circuit operation. You can calculate this burden voltage using the values listed in the specifications in Table 14.

7.15 Measuring Frequency

Frequency is the number of cycles a signal completes each second. The meter measures the frequency of a voltage or current signal by counting the number of times the signal crosses a threshold level each second.

Table 7 summarizes the trigger levels and applications for measuring frequency using the various ranges of the meter's voltage and current functions.

To measure frequency, connect the meter to the signal source; then press (Hz). Pressing ( ) switches the trigger slope between + and -, as indicated by the symbol at the left side of the display (refer to Figure 8 under "Measuring Duty Cycle"). Pressing (HOLD) stops and starts the counter.

The meter autoranges to one of five frequency ranges: 199.99 Hz, 1999.9 Hz, 19.999 kHz, 199.99 kHz, and greater than 200 kHz. For frequencies below 10 Hz, the display is updated at the frequency of the input. Between 0.5 Hz and 0.3 Hz, the display may be unstable. Below 0.3 Hz, the display shows 0.000 Hz.

The following are some tips for measuring frequency:

· If a reading shows as 0 Hz or is unstable, the input signal may be below or near the trigger level. You can usually correct these problems by selecting a lower range, which increases the sensitivity of the meter. In the $\tilde{\tilde{V}}$ function, the lower ranges also have lower trigger levels.

· If a reading seems to be a multiple of what you expect, the input signal may be distorted. Distortion can cause multiple triggerings of the frequency counter. Selecting a higher voltage range might solve this problem by decreasing the sensitivity of the meter. You can also try selecting a dc range, which raises the trigger level. In general, the lowest frequency displayed is the correct one.

Table 7. Functions and Trigger Levels for Frequency Measurements

Function	Range	Approximate Trigger Level	Typical Application
$\tilde{V}$	4 V, 40 V, 400 V, 1000 V	0 V	Most signals.
$\tilde{V}$	400 mV	0 V	High-frequency 5 V logic signals. (The dc-coupling of the $\overline{\tilde{V}}$ function can attenuate high-frequency logic signals, reducing their amplitude enough to interfere with triggering.)
$\overline{\tilde{V}}$	400 mV	40 mV	Refer to the measurement tips given before this table.
$\overline{\tilde{V}}$	4 V	1,7 V	5 V logic signals (TTL).
$\overline{\tilde{V}}$	40 V	4 V	Automotive switching signals.
$\overline{\tilde{V}}$	400 V	40 V	Refer to the measurement tips given before this table.
$\overline{\tilde{V}}$	1000 V	400 V	
	Frequency counter characteristics are not specified for these functions.		
A~	All ranges	0 A	AC current signals.
μ**A**⎓		400 μA	Refer to the measurement tips given before this table.
mA⎓		40 mA	
A⎓		4 A	

7.16 Measuring Duty Cycle

Duty cycle (or duty factor) is the percentage of time a signal is above or below a trigger level during one cycle (Figure 8). The duty cycle mode is optimized for measuring the on or off time of logic and switching signals. Systems such as electronic fuel injection systems and switching power supplies are controlled by pulses of varying width, which can be checked by measuring duty cycle.

To measure duty cycle, set up the meter to measure frequency; then press Hz a second time. As with the frequency function, you can change the slope for the meter's counter by pressing .

For 5 V logic signals, use the 4 V dc range. For 12 V switching signals in automobiles, use the 40 V dc range. For sine waves, use the lowest range that does not result in multiple triggering. (Normally, a distortion-free signal can be up to ten times the amplitude of the selected voltage range.)

If a duty cycle reading is unstable, press MIN MAX; then scroll to the AVG (average) display.

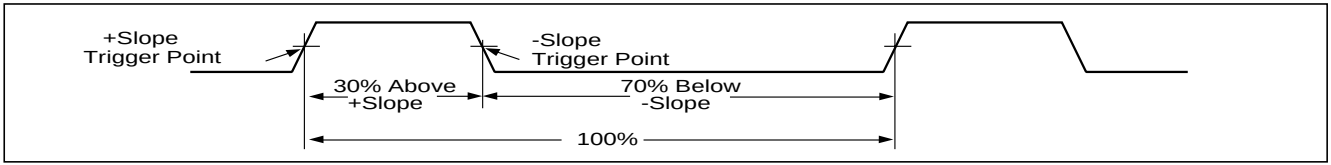


Figure 8. Components of Duty Cycle Measurements

7.17 Determining Pulse Width

For a periodic waveform (its pattern repeats at equal time intervals), you can determine the amount of time that the signal is high or low as follows:

1. Measure the signal's frequency.

2. Press (Hz) a second time to measure the signal's duty cycle. Press ( )))) to select a measurement of the signal's positive or negative pulse. (Refer to Figure 8.)

3. Use the following formula to determine the pulse width:

$$\text{Pulse Width (in seconds)} = \frac{\%\ \text{Duty Cycle} \div 100}{\text{Frequency}}$$

7.18 Analog Bar Graph

The analog bar graph functions like the needle on an analog meter, but without the overshoot. The bar graph is updated 40 times per second. Because the graph responds 10 times faster than the digital display, it is useful for making peak and null adjustments and observing rapidly changing inputs.

7.19 Bar Graph

Ex-DM 1000 bar graph consists of 32 segments. The position of the pointer on the display represents the last three digits of the digital display. For example, for inputs of 500 Ω, 1500 Ω, and 2500 Ω, the pointer is near 0.5 on the scale. If the last three digits are 999, the pointer is at the far right of the scale. As the digits increment past 000, the pointer wraps back to the left side of the display. The polarity indicator at the left of the graph indicates the polarity of the input.

7.20 4-1/2 Digit Mode

On a Ex-DM 1000 meter, pressing the yellow button for one second causes the meter to enter the high-resolution, 4-1/2 digit mode. Readings are displayed at 10 times the normal resolution with a maximum display of 19.999 counts. The display is updated once per second. The 4-1/2 digit mode works in all modes except capacitance and the 250 µs and 100 ms MIN MAX modes.

To return to the 3-1/2 digit mode, press the yellow button only until all of the display segments turn on (about one second).

7.21 MIN MAX Recording Mode

The MIN MAX mode records minimum and maximum input values. When the inputs go below the recorded minimum value or above the recorded maximum value, the meter beeps and records the new value. This mode can be used to capture intermittent readings, record maximum readings while you are away, or record readings while you are operating the equipment under test and cannot watch the meter. MIN MAX mode can also calculate an average of all readings taken since the MIN MAX mode was activated. To use MIN MAX mode, refer to the functions in Table 8.

Response time is the length of time an input must stay at a new value to be recorded. A shorter response time captures shorter events, but with decreased accuracy. Changing the response time erases all recorded readings. Ex-DM 1000 has 1 second, 100 millisecond, and 250 µs (peak) response times. The 250 µs response time is indicated by "1 ms" on the display.

The 100 millisecond response time is best for recording power supply surges, inrush currents, and finding intermittent failures. This response time follows the update time of the analog display.

The high-accuracy 1 second response time has the full accuracy of the meter and is best for recording power supply drift, line voltage changes, or circuit performance while line voltage, temperature, load, or some other parameter is being changed.

The true average value (AVG) displayed in the 100 ms and 1 s modes is the mathematical integral of all readings taken since you started recording. The average reading is useful for smoothing out unstable inputs, calculating power consumption, or estimating the percent of time a circuit is active.

Table 8. MIN MAX Functions

Button	MIN MAX Function
MIN MAX	Enter MIN MAX recording mode. The meter is locked in the range displayed before you entered MIN MAX mode. (Select the desired measurement function and range before entering MIN MAX.) The meter beeps each time a new minimum or maximum value is recorded.
MIN MAX (While in MIN MAX mode)	Scroll through minimum (MIN), maximum (MAX), and average (AVG) values.
 PEAK MIN MAX	Select 100 ms or 250 µs response time. (The 250 µs response time is indicated by "1 ms" on the display.) Stored values are erased. The present and AVG (average) values are not available when 250 µs is selected.
HOLD	Stop recording without erasing stored values. Press again to resume recording.
MIN MAX (hold for 1 second)	Exit MIN MAX mode. Stored values are erased. The meter stays in the selected range.
Hold down MIN MAX while turning the meter on	Select 1 s high-accuracy response time. See text under "MIN MAX Recording Mode" for more explanation. MIN MAX readings for the frequency counter are recorded only in the high-accuracy mode.

7.22 Touch Hold ® Mode

⚠ Warning

The Touch Hold mode will not capture unstable or noisy readings. Do not use Touch Hold mode to determine that circuits are without power.

The Touch Hold mode captures the present reading on the display. When a new, stable reading is detected, the meter beeps and displays the new reading. To enter or exit Touch Hold mode, press (HOLD).

7.23 Relative Mode (REL)

Selecting relative mode (REL Δ) causes the meter to zero the display and store the present reading as the reference for subsequent measurements. The meter is locked into the range selected when you pressed (REL Δ). Press (REL Δ) again to exit this mode.

8. Repairs

The general terms and conditions of ELEX V apply to repair work. The manufacturer must carry out the repair work in order to check for the safe functioning of the protective circuits.

9. Cleaning and Maintenance

The equipment should only be cleaned using a cloth or sponge dampened with water. Do not use solvents, abrasives or other cleaning solutions. It is recommended that the manufacturer tests the operation and accuracy of the equipment every 2 years.

Dirt or moisture in the terminals can affect readings and can falsely activate the Input Alert feature. Clean the terminals as follows:

1. Turn the meter off and remove all test leads.

2. Shake out any dirt that may be in the terminals.

3. Soak a new swab with a cleaning and oiling agent (such as WD-40). Work the swab around in each terminal. The oiling agent insulates the terminals from moisture-related activation of the Input Alert feature.

9.1 Replacement of batteries:

The batteries must only be changed outside the Ex-hazardous area. The use of any other type of batteries is strictly forbidden in that it will invalidate the Ex-data certification. When replacing the batteries ensure that only the type is used (see Table 9).

⚠ Warning

To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator + appears.

Replace the battery as follows (refer to Figure 10):

1. Holster remove.

2. Turn the rotary switch to OFF and remove the test leads from the terminals.

3. Remove the battery door by using a standard-blade screwdriver to turn the battery door screws one-quarter turn counterclockwise.

4. Replace the battery and the battery door. Secure the door by turning the screws one-quarter turn clockwise.

5. Holster attach.

9.2 Testing the Fuses

Before measuring current, test the appropriate fuse as shown in Figure 9. If the tests give readings other than those shown, have the meter serviced.

⚠Warning

To avoid electrical shock or personal injury, remove the test leads and any input signals before replacing the battery or fuses. To prevent damage or injury, install ONLY specified replacement fuses with the amperage, voltage, and speed ratings shown in Table 9.

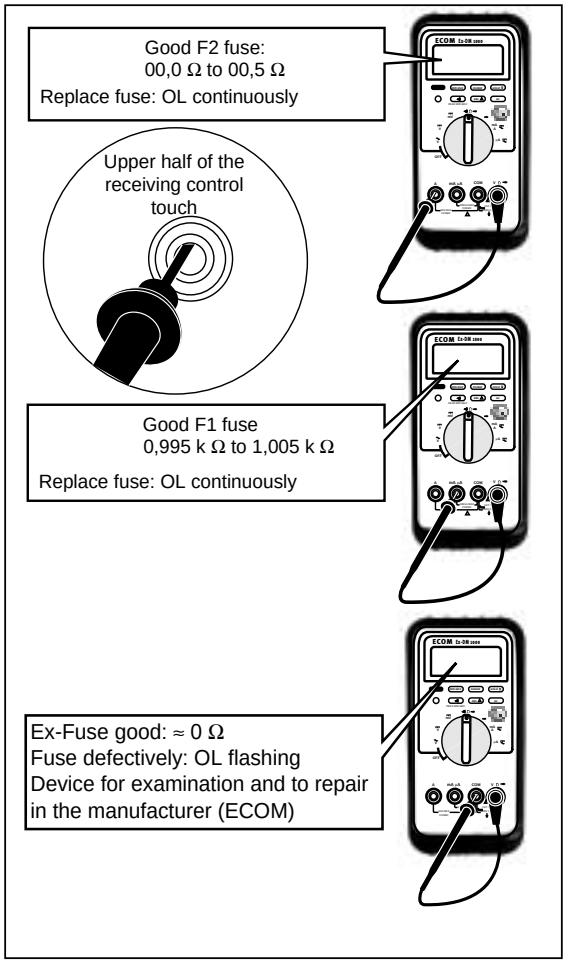


Figure 9. Testing the Current Fuses

9.3 Replacing the Fuses

- A protection change is forbidden in the ex-area.
- The spore fuses given by the manucaturer may be used excluding.
- The function keys bonded inside the device may not be removed or - raised. A damage of the gluing lead to a removal of the explosion protection
- Referring to Figure 10, examine or replace the meter's fuses as follows:

1. Remove the holster.

2. Turn the rotary switch to OFF and remove the test leads from the terminals.

3. Remove the battery door by using a standard-blade screwdriver to turn the battery door screws one-quarter turn counterclockwise.

4. Remove the three Phillips-head screws from the case bottom and turn the case over.

5. Gently lift the input terminal-end of the top case to separate the two halves of the case.

   Please Note: The softkey-keyboard in the casing and the 1000V fuse located in the top of the casing may not be taken out or removed, Interference and/or damage to any of these elements removes the Ex-protection.

6. Remove the fuse by gently prying one end loose, then sliding the fuse out of its bracket.

7. Install ONLY specified replacement fuses with the amperage, voltage, and speed ratings shown in Table 9.

8. Verify that the rotary switch and the circuit board switch are in the OFF position.

9. Replace the case top, ensuring that the gasket is properly seated and case snaps together above the LCD (item 10).

10. Reinstall the three screws and the battery door. Secure the door by turning the screws one-quarter turn clockwise.

11. Refit the holster.

***10.* GUARANTEE AND LIABILITY**

ECOM issue a guarantee of 2 years - starting from the date of delivery - for the operating and material of this product under normal operating and maintenance conditions.
This guarantee does not apply to products used improperly, altered or neglected, accidental damages or unusual operating conditions, as well as exposure to improper handling.
Guarantee claims can only be granted if the defective equipment is returned. We reserve the rights to repairs, new adjustments or exchanges of equipment.

The existing regulations are the only right to compensation and are valid exclusively in place of all other contractual or legal guarantees. ECOM takes no responsibility for special, unavoidable or consequential damage, such as losses, including the loss of data, irrelevant of whether legitimate or illegitimate handling can be traced back to violation of the guarantee. In those countries where the restriction of a legal guarantee (e.g. the exclusion or limitation of subsequent damage) is not permitted, it could be that the above mentioned limitations and exclusions are not valid for each purchase. Should any clause of this guarantee be found ineffective or unacceptable before a court, then the effectivity or enforcement of any other part of this guarantee should be unaffected by such claims.

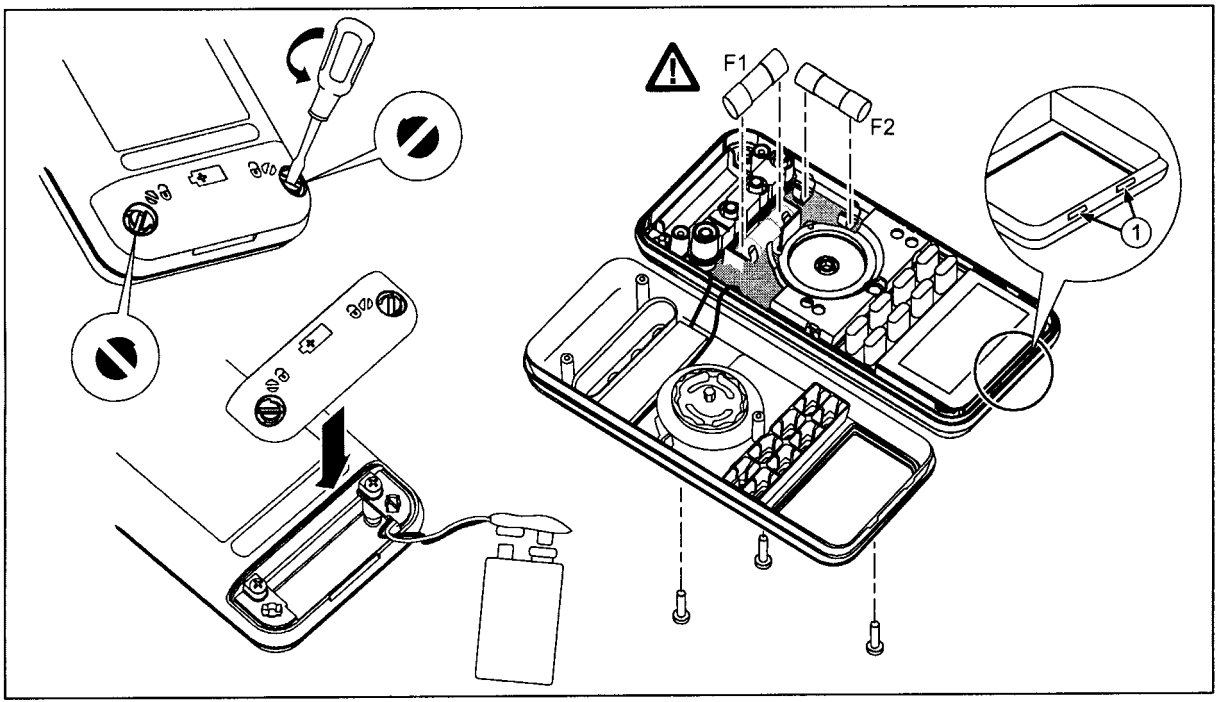


Figure 10. Battery and Fuse Replacement

Table 9. Replacement Parts

Item	Description		ECOM Part or Model Number	Quantity
BT1	Battery, 9 V 6LR 61 according to IEC		W 123	1
	Table of type-tested batteries.			
	Manufacturer	Type:		
	Varta	Alkaline No. 4822		
	Varta	Alkaline Universal No. 4022		
	Varat	Alkaline Electric Power No. 8022		
	Duracell	Alkaline		
	Duracell	Alkaline Ultra		
	Duracell	Professional Alkaline Battery Procell		
	Everady (Ralston Energy System AG)	Alkaline Energizer		
	Panasonic	Alkaline Power Line Industrial Battery		
	Daimon	Alkaline		
F1 ⚠	Fuse 0,440 A, 1000 V, FAST		F 64	1
F2 ⚠	Fuse11 A, 1000 V, FAST		F 65	1
H1	Screw, Case		DN 310	3
MP390/391	Battery cover		KT 267	1
MP1	Foot		KT 268	2
MP2	O-Ring, Input Receptacle		KT 269	1
TM 52	Users Manual: English, French, German, Dutch		PA 145	1
MP15	Ex-Holster		KT 270	1
MP22	Battery box cover		KT 271	1

⚠ To ensure safety, use specified and exact replacements only.

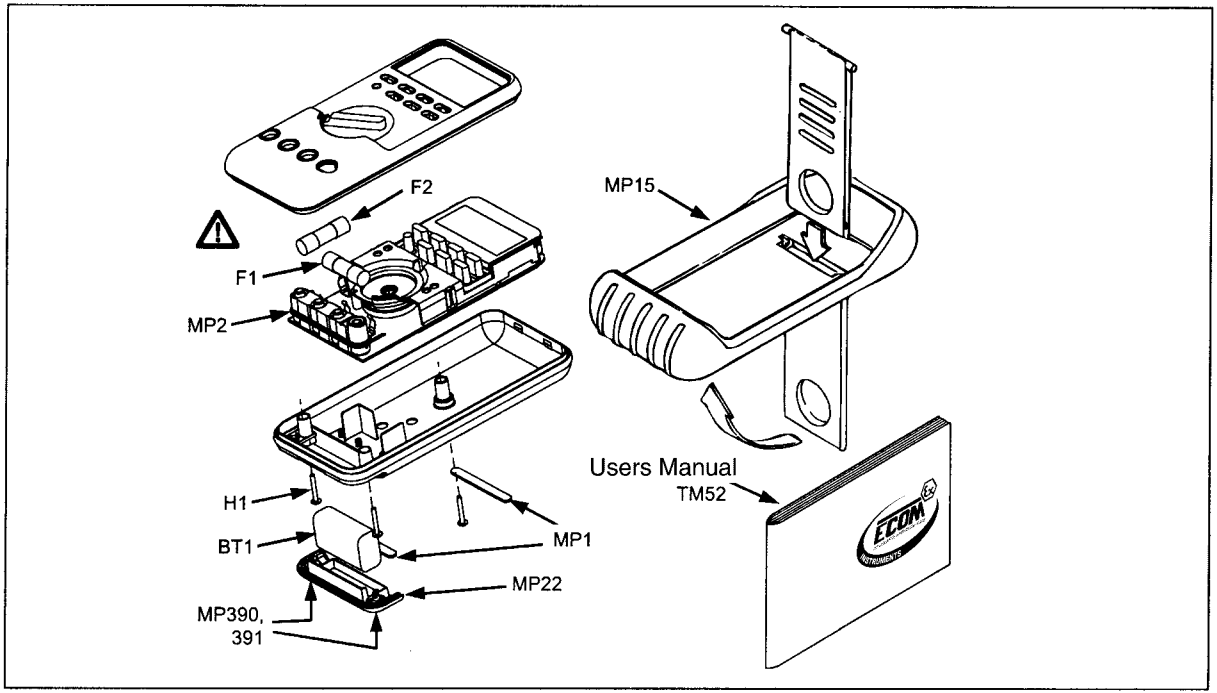


Figure 11. Replaceable Parts

Table 11. Ex-DM 1000 AC Voltage Function Specifications

Function	Range	Resolution	Accuracy[1]			
			50 Hz - 60 Hz	45 Hz - 1 kHz	1 kHz - 5 kHz	5 kHz - 20 kHz[2]
$\tilde{V}$ [3]	400.0 mV	0.1 mV	±(0.7% + 4)	±(1.0% + 4)	±(2.0% + 4)	±(2.0% + 20)
	4.000 V	0.001 V	±(0.7% + 2)	±(1.0% + 4)	±(2.0% + 4)	±(2.0% + 20)
	40.00 V	0.01 V	±(0.7% + 2)	±(1.0% + 4)	±(2.0% + 4)	±(2.0% + 20)
	400.0 V	0.1 V	±(0.7% + 2)	±(1.0% + 4)	±(2.0% + 4)[4]	unspecified
	1000 V	1 V	±(0.7% + 2)	±(1.0% + 4)[5]	unspecified	unspecified

1. Accuracy is given as ±([% of reading] + [number of least significant digits]) at 18°C to 28°C, with relative humidity up to 80%, for a period of one year after calibration. In the 4 Ω-digit mode, multiply the number of least significant digits (counts) by 10. AC conversions are ac-coupled and valid from 5% to 100% of range. The true ems responding. AC crest factor can be up to 3 at full scale, 6 at half scale. For non-sinusoidal wave forms add -(2% Rdg + 2% full scale) typical, for a crest factor up to 3.
2. Below 10% of range, add 6 counts.
3. The Ex-DM 1000 show true rms responding meters. When the input leads are shorted together in the ac functions, the meters display a reading (typically <25 counts) that is caused by internal amplifier noise. The accuracy is not significantly affected by this internal offset when measuring inputs that are within 5% to 100% of the selected range. When the rms value of the two values (5% of range and internal offset) is calculated, the effect is minimal as shown in the following example where 20.0 = 5% of 400 mV range, and 2.5 is the internal offset: RMS = SQRT[$(20.0)^2$ + $(2.5)^2$] = 20.16. If you use the REL function to zero the display when using the ac functions, a constant error that is equal to the internal offset will result.
4. Frequency range: 1 kHz to 2.5 kHz.
5. Below 10% of range, add 16 counts.

Table 12. AC Voltage Function Specifications

Function	Range	Resolution	Accuracy[1]
⎓ V	4,000 V 40,00 V 400,0 V 1000 V	0,001 V 0,01 V 0,1 V 1 V	±(0,05% + 1) ±(0,05% + 1) ±(0,05% + 1) ±(0,05% + 1)
⎓ **mV**	400,0 mV	0,1 mV	±(0,1% + 1)
Ω	400,0 Ω 4,000 kΩ 40,00 kΩ 400,0 kΩ 4,000 MΩ 40,00 MΩ	0,1 Ω 0,001 kΩ 0,01 kΩ 0,1 kΩ 0,001 MΩ 0,01 MΩ	±(0,2% + 2)[2] ±(0,2% + 1) ±(0,2% + 1) ±(0,6% + 1) ±(0,6% + 1) ±(1,0% + 3)
nS	40,00 nS	0,01 nS	unspecified

1. See the first sentence in Table 11 for a complete explanation of accuracy.
2. When using the REL Δ function to the balance of disalignment values.

Table 13. Current Function Specifications

Function	Range	Resolution	Accuracy[1,2,3]	Burden Voltage (typical)
mA **A~** (45 Hz to 2 kHz)	40.00 mA 400.0 mA 4000 mA 10.00 A[4]	0.01 mA 0.1 mA 1 mA 0.01 A	±(1.0% + 2) ±(1.0% + 2) ±(1.0% + 2) ±(1.0% + 2)	1.8 mV/mA 1.8 mV/mA 0.03 V/A 0.03 V/A
mA **A⎓**	40.00 mA 400.0 mA 4000 mA 10.00 A[4]	0.01 mA 0.1 mA 1 mA 0.01 A	±(0.2% + 4) ±(0.2% + 2) ±(0.2% + 4) ±(0.2% + 2)	1.8 mV/mA 1.8 mV/mA 0.03 V/A 0.03 V/A

1. See the first sentence in Table 11 for a complete explanation of accuracy.
2. AC conversions for Ex-DM 1000 are accoupled, true rms responding, and valid from 5% to 100% of range.
3. See note 3 in Table 11.
4. ⚠10 A continuous; 20 A for 30 seconds maximum; >10 A: unspecified.

Table 13. Current Function Specifications (continued)

Function	Range	Resolution	Accuracy[1,2,3]	Burden Voltage (typical)
µA~ (45 Hz to 2 kHz)	400.0 µA	0.1 µA	±(1.0% + 2)	100 µV/µA
	4000 µA	1 µA	±(1.0% + 2)	100 µV/µA
µA⎓				
	400.0 µA	0.1 µA	±(0.2% + 4)	100 µV/µA
	4000 µA	1 µA	±(0.2% + 2)	100 µV/µA

1. See the first sentence in Table 11 for a complete explanation of accuracy.
2. AC conversions for Ex-DM 1000 are accoupled, true rms responding, and valid from 5% to 100% of range.
3. See note 3 in Table 11.

Table 14. Capacitance and Diode Function Specifications

Function	Range	Resolution	Accuracy[1]
⊣⊢	5.00 nF 0.0500 µF 0.500 µF 5.00 µF	0.01 nF 0.0001 µF 0.001 µF 0.01 µF	±(1% + 3) ±(1% + 3) ±(1% + 3) ±(1.9% + 3)
→|	3.000 V	0.001 V	±(2% + 1)

1. With a film capacitor or better, using Relative mode to zero residual. See the first sentence in Table 11 for a complete explanation of accuracy.

Table 15. Frequency Counter Specifications

Function	Range	Resolution	Accuracy[1]
Frequency (0.5 Hz to 200 kHz, pulse width >2 µs)	199.99 1999.9 19.999 kHz 199.99 kHz >200 kHz	0.01 Hz 0.1 Hz 0.001 kHz 0.01 kHz 0.1 kHz	±(0.005% + 1) ±(0.005% + 1) ±(0.005% + 1) ±(0.005% + 1) unspecified

1. See the first sentence in Table 11 for a complete explanation of accuracy.

Table 16. Frequency Counter Sensitivity and Trigger Levels

Input Range[1]	Minimum Sensitivity (RMS Sinewave)		Approximate Trigger Level (DC Voltage Function)
	5 Hz - 20 kHz	0.5 Hz - 200 kHz	
400 mV DC	70 mV (to 400 Hz)	70 mV (to 400 Hz)	40 mV
400 mV DC	150 mV	150 mV	—
4 V	0.3 V	0.7 V	1.7 V
40 V	3 V	7 V (≤140 kHz)	4 V
400 V	30 V	70 V (≤14.0 kHz)	40 V
1000 V	300 V	700 V (≤1.4 kHz)	400 V
Duty Cycle Range	**Accuracy**		
0.0 to 99.9%	Within ±(0.05% per kHz + 0.1%) of full scale for a 5 V logic family input on the 4 V dc range. Within ±((0.06 x Voltage Range/Input Voltage) x 100%) of full scale for sine wave inputs on ac voltage ranges.		

1. Maximum input for specified accuracy = 10x Range or 1000 V.

Table 17. Electrical Characteristics of the Terminals

Function	Overload Protection[1]	Input Impedance (nominal)	Common Mode Rejection Ratio (1 kΩ unbalance)		Normal Mode Rejection					
V⎓	1000 V rms	10 MΩ<100 pF	>120 dB at DC, 50 Hz or 60 Hz		>60 dB at 50 Hz or 60 Hz					
mV⎓	1000 V rms	10 MΩ<100 pF	>120 dB at DC, 50 Hz or 60 Hz		>60 dB at 50 Hz or 60 Hz					
V~	1000 V rms	10 MΩ<100 pF (ac-coupled)	>60 dB, DC to 60 Hz							
		Open Circuit Test Voltage	**Full Scale Voltage**		**Typical Short Circuit Current**					
			To 4.0 MΩ	**40 MΩ or nS**	**400 Ω**	**4 k**	**40 k**	**400 k**	**4 M**	**40 M**
Ω	1000 V rms	<1.3 V dc	<450 mV dc	<1.3 V dc	200 µA	80 µA	12 µA	1.4 µA	0.2 µA	0.2 µA
→|←	1000 V rms	<3.9 V dc	3.000 V dc		0.6 mA typical					

1. 10^6 V Hz max

Table 18. MIN MAX Recording Specifications

Nominal Response	Accuracy
100 ms to 80% (DC functions)	Specified accuracy ±12 counts for changes >200 ms in duration
120 ms to 80% (AC functions)	Specified accuracy ±40 counts for changes >350 ms and inputs >25% of range
1 s	Same as specified accuracy for changes >2 seconds in duration
250 µs	Specified accuracy ±100 counts for changes >250 µs in duration (± 250 digits typical for mV, 400 µA dc, 40 mA dc, 4000 mA dc)

11. DECLARATION OF CONFORMITY

We ***ECOM Rolf Nied GmbH, Industriestraße 2, D-97959 Assamstadt*** declare under our sole resposibility that the product Ex-DM 1000 to which this declaration relates is in accordance with the provision of the following directives

94/9/EG	Equipment and protective systems in hazardous areas
89/336/EWG	Electromagnetic compatibility
73/23/EWG	Electrical apparatus for use within certain voltage limits.

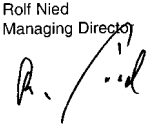
and is in conformity with the following standards or other normative documents

EN 50014: 1997	Electrical apparatus for potentially explosive atmospheres General requirements
EN 50020: 1994	Electrical apparatus for potentially explosive atmospheres Intrinsic safety “i“
EN 61010-01: 1993	Safety requirements for electrical equipment for measurement, control and laboratory use

ecom instruments GmbH

Assamstadt, November 2001

Rolf Nied
Managing Director



12. Certificate of conformity

TÜV CERT

Translation

(1) **EC TYPE-EXAMINATION CERTIFICATE**

(2) Equipment or protective system intended for use in potentially explosive atmospheres **- Directive 94/9/EC**

(3) EC-Type Examination Certificate Number

TÜV 01 ATEX 1658 X

(4)	Equipment:	Explosionproof multimeter type EX-DM 1000
(5)	Manufacturer:	ECOM Rolf Nied GmbH
(6)	Address:	D-97959 Assamstadt, Industriestraße 2

(7) This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) The TÜV Hannover/Sachsen-Anhalt e.V., TÜV CERT-Certification Body, notified body number N° 0032 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 (94/9/EC), certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in the confidential report N° 01 PX 18300.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 50 014: 1997 **EN 50 020: 1994**

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type examination certificate relates only to the design and construction of the specified equipment or protective system according to Directive 94/9/EC. Further requirements of this Directive apply to the manufacture and placing on the market of this equipment or protective system.

(12) The marking of the equipment or protective system must include the following:

Ex **II 2 G EEx ia IIC T4**

TÜV Hannover/Sachsen-Anhalt e.V.
TÜV CERT-Zertifizierungsstelle
Am TÜV 1
D-30519 Hannover

Hannover, 2001-05-28

Head of the
Certification Body

TÜV NORD

This certificate may only be reproduced without any change, schedule included.
Excerpts or changes shall be allowed by the TÜV Hannover/Sachsen-Anhalt e.V.

page 1/3

(13) **SCHEDULE**

(14) **EC-TYPE EXAMINATION CERTIFICATE N° TÜV 01 ATEX 1658 X**

(15) Description of equipment

The explosionproof multimeter type EX-DM 1000 is used for measurements at intrinsically safe and not intrinsically safe circuits.

The maximum permissible ambient temperature is +50°C.

Electrical data

Supply (internal battery): 1 pc block battery according to IEC 6LR 61, U = 9 V

Only batteries successfully type-examined according to Section 10.9 of the EN 50020:1994 are permissible. The manufacturers and the types have to be indicated in the operating instructions. It is only allowed to replace the battery outside of the hazardous area (information plate).

Measurements at intrinsically safe circuits

Measuring inputs: in type of protection "Intrinsic Safety" EEx ia IIC for the measurement at intrinsically safe circuits
Maximum values: U_i = 65 V
I_i = 5 A

Maximum output values at the voltage measuring input
U_o = 10,4 V
I_o = 4,1 mA
The effective internal capacitance and inductance are negligibly small.

Maximum output values at the current measuring inputs
U_o = 2,8 V
I_o = 195 mA
The effective internal capacitance and inductance are negligibly small.

Measurements at non intrinsically safe circuits
Measuring inputs: Maximum values: U_i = 1000 V
I_i = 10 A

(16) Test documents are listed in the test report No.: 01 PX 18300.

(17) Special conditions for safe use

After every measurement at non intrinsically safe circuits a delay time of at least three minutes has to be observed before the multimeter may be brought into the hazardous explosive area again.

The replacement of the battery and the opening of the multimeter is only allowed outside of the hazardous explosive area.

Inside of the hazardous explosive areas the multimeter may be used with the special holster bag only.

(18) Essential Health and Safety Requirements

no additional ones