DC - Microvoltmeter 2000

General
The microvoltmeter has a sturdy plastic case with a carrying handle which can be adjusted in 30° steps. Controls and indicators are located in a clear, logical configuration. Controls are grouped in accordance with the various functions of the unit.

Measuring Range
The microvoltmeter is a highly accurate moving coil instrument equipped both with an accumulator and a 230 V, 50-60 Hz socket for direct line connection. Two scales are provided with 10 skt and 3 skt. Fullscale ranges from 10 µV to 300 V

Polarity Indicator and Zero Adjustment
The unit features automatic polarity switching to ensure correct readings irrespective of polarity. Two LED´s on the front panel indicate the polarity of the voltage measured; a control is provided for zero adjustment on the µV-range.

Active Filters for eliminating AC-influence
The 16 Hz and 50 Hz low-pass filters can be used to eliminate interference frequencies during measurements.

Isolated Amplifier Output
An output socket for the connection of an external recorder to document the measurements is located in the front panel. A special isolating amplifier is connected to the socket to isolate it from the input circuit. Recorders with earthed inputs can therefore be used without distoring the measurement.

Power supply 230 V
Power supply either via the 220 V socket or via the built-in NiCd batteries is possible. The unit is equipped with a built-in battery charger, an automatic monitoring system and protection against excessive discharging. Both battery charging and battery charge conditions are indicated.

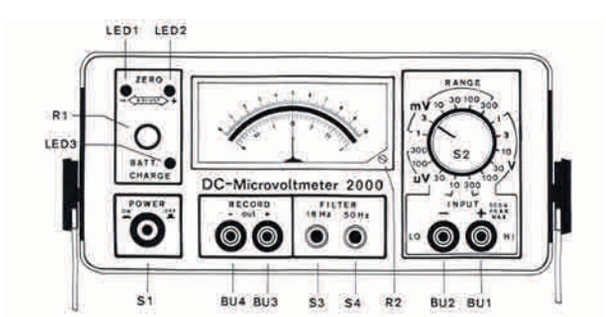
Power supply 12 V Option
A converter DC-DC with a screwed plug connecting to the rear panel is available as an optional extra for using a 12 V car battery as power supply during field measurements.

Front Panel Controls and Indication

S 1	Power - On button, with red mechanical indicator
S 2	Range selector
S 3 / 4	Filter-switch for eliminating AC influece
BU 1 / 2	Brass input sockets
BU 3 / 4	Amplifier output for external chart recorder connection Fullcsale range is transfered to 1 V
LED 1 / 2	LED to indicate input polarity
LED 3	LED-button to indicate battery charging and battery control
R 1	Zero adjuster for microvolt ranges
R 2	Mechanical zero adjustment for moving coil instrument

Technical Data

Measuring range	± 10 µV to ± 300 V
Input impedance	1 MΩ for ranges 10 µV upto 3 mV 10 MΩ for ranges 10 mV upto 300 V
Display	Analog pointer instrument with scaling factor 3 and 10 divisions
Accuracy	+/- 1.5% of full scale
Drift	+/- 0.2 µV / °C for operating temperatures from 15 up to 40°C
Series-mode rejection	16 Hz - 60 dB, 50 Hz - 80 dB
Basic pointer deflection	5 skt. on the 10 µV range
Polarity indication	LED display
Offset-control	± 45 µV
Recorder output	± 1 V to kΩ
Dimensions	105 x 230 x 230 mm
Weight	1.9 kg
Power supply	230 V line voltage or via insert NiCd-accumulator 9.6 / 1.6 Ah
Operation time	approx. 18 h non-stop operation with one accu-charge approx. 8 h by switched-on amplifier
Electric strength	max. 500 V DC or 300 V effective on all ranges



MEASURING EQUIPMENT
Handheld multimeter MODEL LC-4.5
Document No.: 11-102-R1
Sheet: 1 of 1

German Cathodic Protection

protected by GCP

Features

- DC volts for IR drop, potential & rectifier readings
- AC volts for potential & rectifier readings
- Ohms for continuity & resistance testing
- Selectable input resistance display
- Display„Freeze“ for instant off & coordinated tests
- Optional plug-in shunt for current readings
- Includes carry case with red and black test leads

GENERAL INFORMATION

Model LC-4.5 is a hand-held voltmeter to include a number of special features which facilitate corrosion and cathodic protection testing on underground structures. It is designed for field testing under almost any environmental conditions. Sealed Mil Spec. switches, sealed windows, a gasketed case and a printed circuit board with baked - on moisture and fungus resistant coating on both sides make this possible.

LCD DISPLAY: the large (0.5“) display characters are easy to read under both high and low lighting conditions and function over a wide temperature range with very little drain on the battery.

THE LC-4.5: is recommended for potential surveys, side drain measurements, surface potential surveys, IR drop measurements, checking both the AC and DC circuits of rectifiers, checking for stray or hazardous AC potentials, and checking galvanic anodes. DC current measurements require the use of an optional plug-in shunt (0-20 Amp).

THE SELECTABLE INPUT: resistance feature permits detection of high resistance in the external circuit and elimination of resulting errors in virtually all cases.

THE PUSH-TO HOLD READING: button freezes the display at any desired time, which makes the meter usable in many areas having varying stray currents. It is also useful when conducting instant-off and coordinated tests.

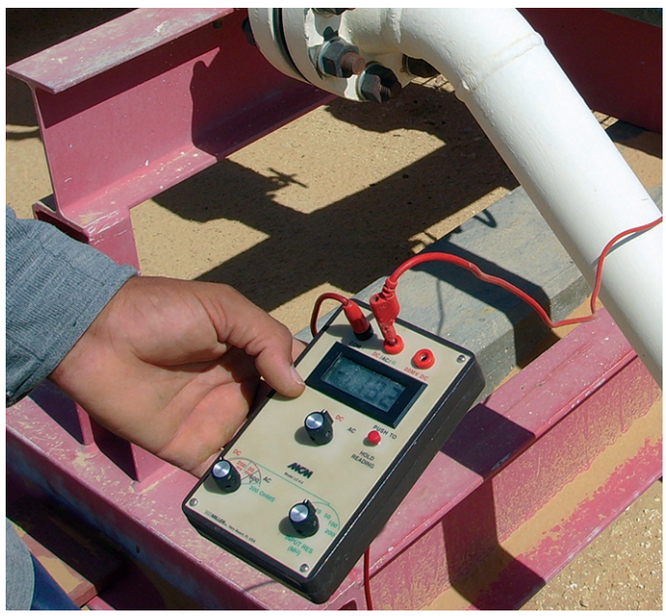
ACCESSORIES

Spare Carrying Case

Made of heavy, water resistant simulated leather, this carrying case leaves your hands free to perform tests. A quick opening snap permits ready access to the instrument, and a belt loop is included with a snap fastener.

Electrode Extension Adapter

Designed to save effort (and your back) as well as to protect you from snakes and poison ivy, the MCM electrode extension adapter firmly mates with the base of the meter by the use of Velcro® pads. The base has a threaded socket which connects to either input terminal by means of a test lead pigtail with a banana plug. Any MCM intermediate electrode extension can be screwed into the socket.



Specifications

Logic	CMOS, crystal controlled timing
Display	Liquid crystal, 3 1/2 digits, 0.5“ high
DC Volt Range	0 - 20 mV (0.01 mV resolution) 0 - 200 mV (0.1 mV resolution) 0 - 2 V (1.0 mV resolution) 0 - 200 V (0.1 V resolution)
AC Volt Range	0 - 600 V (1.0 V resolution)
Resistance Range	0 - 200 Ohms (0.1 Ω resolution)
DC Current Range	Using optional 0.001 Ω LC Shunt: 0-20 A (0.01 A resolution)
Accuracy	VDC: 1% of reading ±1 digit VAC: 3% of reading ±1 digit Ohms: 2% of reading ±1 digit
AC Rejection @ 50/60/400 Hz	20 mV range: 20 mV AC 200 mV range: 5 VAC 2 V range: 120 VAC 200 V range: 600 VAC
DC Rejection	600 VAC range: 600 VDC
Zero	Automatic
Decimal Point	Automatic; set by range switch
Polarity	Automatic; negative symbol displayed, positive assumed
Input Resistance	20 mV range; 1000 Ω. All other DCV ranges are switch selectable (10, 25, 50, 100, 200 M Ω)
Operating Temperature	+8˚F to +176˚F (-14˚C to +80˚C)
Battery	One 9V alkaline recommended
Dimensions	6-1/8 x 3-5/8 x 1-3/4“ overall (15 x 8 x 4.5 cm)
Weight	11 oz. approx. (0.312 kg)

External Shunt

Two shunts which plug directly into the 20 mV range of the LC-4 Meter are available:

- 0.00 Ω / 50A/ 1 mV = 1A (measure up to 20 A on the 20 mV range).
- 0.1 Ω / 2 A/ 100 mV= 1A (measure up to 200 mA on the 20 mV range).

Multimeter Model B3A2

Advantages

- Designed for the corrosion control industry
- Increased dependability through solid state design
- RFI shielded throughout
- Accurate, stable readings
- Active filtering for power frequency rejection
- Selectable input resistance
- Withstands the most harsh environments
- Flexible multimeter for all your corrosion tests

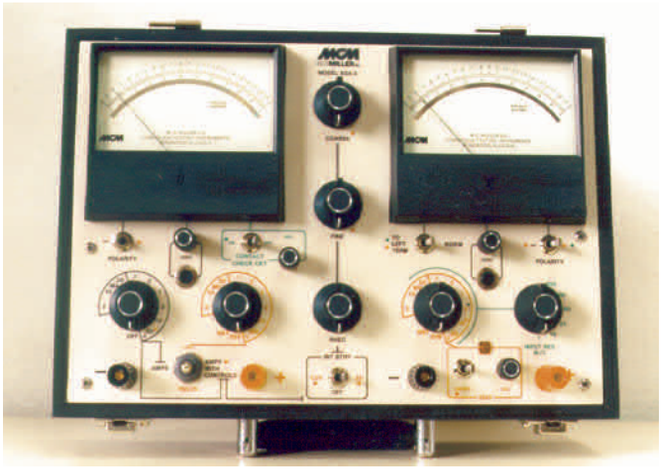
Specifications

Left meter:

- 9 DC voltage ranges, zero to full scale: 2 mV, 10 mV, 20 mV, 100 mV, 200 mV, 1 V, 2 V, 10 V, 100 V
- Minus 10% of full scale on all ranges
- Input polarity reversal switch on volts and amps ranges eliminates the need to reverse test leads
- Best resolution: 20 μV (0.00002 V) on the 2 mV range
- Input Resistance: 10 000 Ω on 2 mV and 10 mV ranges 10 MΩ on 20 mV to 100 V ranges
- Line frequency rejection: >60dB @ 60Hz
- RF rejection: > 70dB @ 1MHz
- Overload protection: 10 times full scale
- 9 DC ampere ranges, zero to full scale: 2 mA, 10 mA, 20 mA, 100 mA, 200 mA, 1 A, 2 A, 10 A, 20 A
- Minus 10% of full scale on all ranges
- Best resolution: 20 μA on the 2 mA range
- Burden voltage: 20 mV
- Overload allowed: 5 times full scale, less than 5 sec.
- Contact check: > 200 mA short circuit
- Adjustable output current supply: controllable 0 to 3 VDC and 0 to 4 A
- Control external current flow with built-in 25 W adjustable rheostats
- Read internal battery voltage directly
- Left meter switch: internally connects right meter to left terminals, enabling current and voltage to be read simultaneously

Right meter:

- 9 DC voltage ranges, zero to full scale: 2 mV, 10 mV, 20 mV, 100 mV, 200 mV, 1 V, 2 V, 10 V, 20 V
- Minus 10% of full scale on all ranges
- Input polarity reversal switch on volts
- Best resolution: 20 μV(0.00002 V) on the 2 mV range
- Input resistance: 100,000© on 2mV and 10mV ranges. selectable from 1 MΩ, 10 MΩ, 25 MΩ, 50 MΩ, 100 MΩ, 200 MΩ on 20 mV to 100 V ranges
- Line frequency rejection > 60 dB @ 60 Hz
- RF rejection > 70dB @ 1 MHz
- Bias control ± full scale, all ranges
- Overload protection 10 times full scale



General Information

- A major design achievement was to eliminate the effects of RFI, and offer accurate, repeatable readings.
- Impact resistant d'Arsonval meters with taut band movement to withstand rough handling.
- Resistant to rain, dust and temperature: - 0°F to 150°F.
- 10% up scale: -0.1, 0, 1; -.02, 0, 2: a visual prompt which indicates when the reading crosses zero.
- Knife-edge pointer with easy-to-view mirror scale.
- Accuracy: ±0.5% of full scale for all ranges.
- Tracking accuracy: ±0.5%

Applications

The B3A2 was designed specifically as a cathodic protection test instrument. In most cases it is all that is required for the test and evaluation of existing systems or design of new installation. It can be utilized in making the following tests, all of which are illustrated in the B3A2 operating manual:

- Structure-to-soil potentials
- Current measurements (direct null-amp method, 2 or 4 terminal zero resistance)
- IR drops and calibration of IR drop test stations
- Soil or water resistivity by soil box and by 4-electrode method
- Soil potential gradients
- Continuity tests
- Pipe coating resistance tests and fault surveys (over-the-ground method)
- Galvanic anode rectifier output and cathodic protection interference tests
- Duct slug survey on lead covered cables and concrete bridge deck surveys
- pH determination
- Grounding tests

German Cathodic Protection

Digital Multimeter with manual ranging MM 2

The MM 2 offers all advantages of a Digital multimeter with manual measuring range selection such as fast response time due to the manually selectable measuring ranges and easy handling due to color-marked measuring ranges.

The multimeter MM2 is provided with DC and AC voltage ranges of up to 1000 V_{DC}/750 V_{AC} as well as with DC and AC current ranges of up to 20 A. Further measuring functions are resistance measuring up to 20 MΩ as well as an acousticcontinuity and diode test.

The MM 2 has an automatic switch-off function when not in use (approx. 30 min.) and a battery low voltage indication as well.

The included protective rubber holster makes it possible to use it under roughest environmental conditions. The measuring ranges of the MM 2 are protected against overload.

Accessories for multimeter MM

Set TA2

Ø 4 mm safety measuring lead set, silicone, 6-piece, red, black, professional design, CAT III 1000 V, consisting of:
2 x Ø 4 mm safety measuring leads, silicone, L = 100 cm, 19 A
2 x fully insulated crocodile clips with toothed jaws and fine wire surface, 32 A
2 x Ø 4 mm safety test probes, 20 A

Set TA3

Ø 4 mm safety measuring lead set, silicone, 8-piece, red, black, professional design, CAT III 1000 V, consisting of:
2 x Ø 4 mm safety measuring leads, silicone, L = 100 cm, 19 A
2 x fully insulated crocodile clips with toothed jaws and fine wire surface, 32 A
2 x safety test probes with slight tip made of stainless steel, 1 A
2 x safety claw gripper with strong claws, 16 A

Display	31/2 digit LC display (1999 pixels)
DC voltage:	200 mV/2 V/20 V/200 V/1000 V
Resolution/accuracy	max. 0.1 mV/max. ± 0.5 % + 2 digit
AC voltage	200 mV/2 V/20 V/200 V/750 V
Resolution/accuracy	max. 0.1 mV/max. ± 1.3 % + 5 digit
Measuring method	RMS value
DC current	200 µA/2 mA/20 mA/200 mA/20 A
Resolution/accuracy	max. 0.1 µA/max. ± 1.0 % + 2 digit
Over voltage protection	1 A, 16 A (500 V) fuse, fast
AC current	200 µA/2 mA/20 mA/200 mA/20 A
Resolution/accuracy	max. 0.1 µA/max. ± 1.5 % + 3 digit
Over voltage protection	1 A, 16 A (500 V) fuse, fast
Measuring method	RMS value
Resistance	200 Ω/2 kΩ/20 kΩ/200 kΩ/ 2 MΩ/20 MΩ
Resolution/accuracy	max. 0.1 Ω/max. ± 0.75 % + 2 digit
Continuity test	50 Ω, acoustic: buzzer, optic: LCD
Diode test	1.5 mA
Over voltage protection	750 V effective resp. 500 V effective
Range switching	manual ranging
Over voltage category	CAT III 600 V, CAT II 1000 V
Operation temperature	0 °C to + 50 °C
Dimensions (l x w x h)	192 x 95 x 50 mm
Weight	550 g
Battery type	9 V battery IEC 6LR61
Delivery includes	multimeter, protective rubber holster, carrying case, battery, double insulated safety test leads

German Cathodic Protection

The three models of the new 170 Series are the new benchmarks for general purpose multimeters. They set the standard with a combination of precision, features, ease-of-use, safety and reliability.

Features

- True RMS voltage and current measurements
- 0.09% basic accuracy (177, 179)
- 6000 count resolution Digital display with analog bargraph and backlight (177, 179)
- Manual and automatic ranging
- Display Hold and Auto Hold
- Frequency and capacitance measurements
- Resistance, continuity and diode measurements
- Temperature measurements (179)
- Min-max-average recording
- Smoothing mode allows filtering of rapidly changing inputs
- Easy battery exchange without opening the case
- Closed case calibration through front panel
- Ergonomic case with integrated protective holster
- EN61010-1 CAT III 1000V / CAT IV 600V
- Measures twice as fast as other multimeters

Safety conformance

All inputs are protected to IEN61010-1 CAT IV 600V/CAT III 1000V. UL, CSA, TÜV listed and VDE Pending

Specifications			
Voltage DC	175 - Accuracy*		± (0.15%+2)
	177 - Accuracy*		± (0.09%+2)
	179 - Accuracy*		± (0.09%+2)
	Max. Resolution		0.1 mV
	Maximum		1000 V
Voltage AC	Accuracy*		± (1.0%+3)
	Max. Resolution	0.1 mV	
	Maximum		1000 V
Current DC	Accuracy*		± (1.0%+3)
	Max. Resolution	0.01 mA	
	Maximum		10 A
Current AC	Accuracy*		± (1.5%+3)
	Max. Resolution	0.01 mA	
	Maximum		10 A
Resistance	Accuracy*		± (0.9%+1)
	Max. Resolution	0.1 Ω	
	Maximum		50 MΩ
Capacitance	Accuracy*		± (1.2%+2)
	Max. Resolution	1 nF	
	Maximum		10,000 µF
Frequency	Accuracy*		± (0.1%+1)
	Max. Resolution	0.01 Hz	
	Maximum		100 kHz
Temperature	179 - Accuracy*	± (1.0%+10)	
	Max. Resolution	0.1°C	
	Range		-40°C/400°C
Note	* Accuracies are best accuracies for each function		

Environmental Specifications	
Operating Temperature	-10°C to +50°C
Storage Temperature	-30°C to +60°C
Humidity (Without Condensation)	0% - 90% (0°C - 35°C) 0% - 70% (35°C -50°C)

Fluke 175

Fluke 177

Fluke 179

Safety Specifications	
Overvoltage category	EN 61010-1 to 1000 V CAT III. EN 61010-1 to 600 V CAT IV.
Agency Approvals	UL, CSA, TÜV listed and VDE Pending

Mechanical & General Specifications	
Size	43 x 90 x 185 mm
Weight	420 g
Warranty	Lifetime
Battery Life	Alkaline: ~200 hours typical, without backlight

Accessories

C510 Leather Meter Case

- Oiled genuine top grain cowhide
- Rugged construction with heavy duty stitching and reinforced rivets
- Large tool belt loop and top flap to secure meter
- Holds most Fluke DMMs, Thermometers, and Process Calibrators

TLK-225 SureGrip™ Master Accessory Set

Kit includes all the SureGrip™ leads and probes in a handy roll-up pouch:

- AC220 SureGrip™ Alligator Clip Set
- AC280 SureGrip™ Hook Clip Set
- AC283 SureGrip™ Pincer Clip Set
- AC285 SureGrip™ Large Jaw Alligator Clip Set
- TP220 SureGrip™ Test Probe Set
- TL224 SureGrip™ Silicone Test Lead Set
- 6-Pocket Storage Pouch

TLK-220 US SureGrip™ Industrial Test Lead

Special value SureGrip Set for industrial applications. Includes two sizes of alligator clips and sharp test probes for reliable connections, test leads and a roomy carry case to hold and protect your meter and all your accessories. All 1000 V CAT III, 600 V CAT IV rated.

Included with set:

- AC220 Plunger Style Alligator Clips
- AC285 Large Jaw Alligator Clips
- TP220 Sharp Test Probes
- TL224 Right to Straight Test Leads
- Zippered Vinyl Carry Case with Moveable Divider

MoData 2, a computer-aided measuring system, has been developed to integrate the function and capability of several instruments used in the field of cathodic corrosion protection in one instrument only.
MoData 2 combines 4 separate measuring instruments (AC/DC voltage, current, µ-volts, resistance).
With serial interface port for connection and direct data transfer between PC and MoData2.
Provided with bar code input for automatic test point identification on site.

MoData 2, Handheld computer

Technical Data

Type	Itronix fex21
Case	Impact-resistant plastic
Size	190 x 155 x 37 mm (D x W x H)
Weight	0.8 kg
Protection class	IP 65
Screen	6.5“, 16 grayscale with backlight 640 x 240 pixel, touch screen
Keybord, waterproof	Fluorescent membrane keyboard
Operating system	Windows Handheld PC 2000
Processor	Toshiba 129 MHz
Memory	32 MB
ROM	32 MB
Interfaces	2 x 9 pin serial port, infrared interface
Modem	V34 analog (installed)
Power supply	Rechargeable lithium ion batterry Lifetime approx. 10 h
Operating temperature	-10 °C to 50 °C
Additional	Compact flash card (CF card) 64 MB installed

MoData 2, Multi task converter

Technical Data

Case	Impact-resistant plastic
Size	290 x 260 x 70 mm (D x W x H)
Weight	2.25 kg (including MoData computer)
Interfaces	2 x 9 pin serial port 12 V charging socket (with internal isolation) Terminal for synchronization or relay cable
Power supply	Rechargeable lead battery 6 V/1.3 Ah Lifetime approx. 10 h
Equipment	MoData 2 including Itronix fex21 External 230 V battery charger Synchronization cable Transfer cable User manual
Options	System carry case „Sprint“ carrying strap for maintenance „Marathon“ carrying strap for Intensive measurement External 12 V battery charger GPS antenna with integrated receiver

Measuring ranges and accuracy

The following tables contain details of the available measuring ranges, resolutions and maximum deviations.

DC voltage measurement (Channels A, B and C)

Input impedance:	> 10 MΩ	
DC voltage attenuation:	16.6 Hz / 60 dB (factor 10^3) 50.0 Hz / 100 dB (factor 10^5)	
Measuring range	Resolution	Max. deviation
± 1 V	0.1 mV	± 0.5 % ± 0.5 mV
± 10 V	1.0 mv	± 0.5 % ± 5.0 mV
± 100 V	10 mV	± 0.5 % ± 10 mV

Simultaneous measurement of 3 channels, time difference between channels < 5 ms

AC voltage measurement (Channel A)

Input impedance:	> 10 MΩ	
Measuring range	Resolution	Max. deviation
1 V eff.	0.1 mV	± 2.0 % ± 1.0 mV
10 V eff.	1.0 mv	± 2.0 % ± 10 mV
100 V eff.	10 mV	± 2.0 % ± 50 mV

Frequency range 10 Hz to 120 Hz, cut-off frequency 800 Hz (2 dB)

Micro voltage measurement (Channel A)

Input impedance:	> 10 MΩ	
AC voltage attenuation:	16.6 Hz / 60 dB (factor 10^3)	
	50.0 Hz / 100 dB (factor 10^5)	
Measuring range	Resolution	Max. deviation
± 80000 µV	1 µV	± 0.2 % ± 5.0 µV

Current measurement (Channel A)

AC voltage attenuation:	16.6 Hz / 60 dB (factor 10^3) 50.0 Hz / 100 dB (factor 10^5)		
Measuring range	Internal shunt	Resolution	Max. deviation
± 10 mA	10 Ω	1 µA	± 1.0 % ± 5 µA
± 100 mA	3 Ω	10 µA	± 1.0 % ± 20 µA

Current measurement (30 A current input)

AC voltage attenuation:	16.6 Hz / 60 dB (factor 10^3) 50.0 Hz / 100 dB (factor 10^5)		
Measuring range	Internal shunt	Resolution	Max. deviation
± 30 A	0.01 Ω	1 mA	± 1.0 % ± 3 mA

Resistance measurement

Measuring method:		Wenner; 2-pole or 4-pole		
Measuring frequency:		128 Hz		
Output voltage:		max. 2 V eff.	1 kΩ measuring range	
		max. 10 V eff.	10 kΩ measuring range	
		max. 10 V eff.	800 kΩ measuring range	
Measuring range	Resolution (4-pole)	Max. deviation		
1 kΩ	0.01 Ω	0.0 Ω - 9.9 Ω	± 1.0 %	± 0.05 Ω
	0.1 Ω	10.0 Ω - 199.9 Ω	± 1.0 %	± 0.50 Ω
	1 Ω	200 Ω - 999 Ω	± 1.0 %	± 5 Ω
10 kΩ	10 Ω	0.00 kΩ - 0.99 kΩ	± 1.0 %	± 50 Ω
	100 Ω	1.0 kΩ - 9.9 kΩ	± 1.0 %	± 100 Ω
800 kΩ	10 Ω	0.00 kΩ - 9.99 kΩ	± 1.0 %	± 0.1 kΩ
	100 Ω	10.0 kΩ - 99.9 kΩ	± 1.0 %	± 0.5 kΩ
	100 Ω	100.0 kΩ - 199.9 kΩ	± 1.0 %	± 1 kΩ
	1 kΩ	200.0 kΩ - 799.9 kΩ	± 1.0 %	± 5 kΩ

Back carrying rack „Marathon“

To ensure a problem-free measuring execution on site, the cable drum is eqipped with sliding contacts which guaranteed a simple unreeling of measuring cable without any interruption at the measuring points.
Standard cable drum with 500 m measuring cable.

MEASURING EQUIPMENT
Earth resistance and resistivity tester MRU-105

German Cathodic Protection

Document No.: 11-302-R1

Sheet: 1 of 1

General information

The MRU-105 is a portable meter for measuring earth resistance and resistivity (Wenner's method). The instrument can measure resistance with a 2, 3, or 4 poles method. The very high immunity for existing interference voltage AC + DC at which measurement is still performed: 24V (68V-p-p) but also measurement of existing interference voltage up to 40V is unique functionality of meters. Moreover meters measure the resistance of the probes and calculate automatically the error coming from probe`s resistances. The meter additionaly can be powered from Ni-MH batteries or standard C size, and the test results can be stored in the internal memory and transmitted to PC via USB-cable. Measurements can be simplified using current clamps.

- **Measurement of earthing resistance using a three- or four-pole technique**
  - selective earth resistance measurement with clamp (no influence from parallel earth; no opening of rusty junctions is needed)
  - supervision of the measurement conditions (eg. voltages, impact resistance measurement electrodes R_H i R_S and battery state/ monitor)
  - high immunity of interference voltage
- **Measurement of ground resistivity (Wenner´s method):**
  - the earth resistivity measurement with the possibility to introduce
  - the distancw between electrodes
  - automatic calculation and displaying the resistivity
- **Measurement of resistance using a two- or four-pole technique**
- **Built in battery charger**
- **Memory of 300 measurement results with the ability to transfer the data to a PC**
- **Meter meets the requirements of the standard EN61557**

- **Electric security**
  - type of insulation: double, acc. to EN 61010-1
  - measurement category: CAT III 300V acc. to EN61010-1
  - protection class: IP 54
- **Other technical data:**
  - power supply: 5 batteries LR14(C) or Ni-MH battery package
  - charge power supply: 100...250V, 50...60Hz
  - display: LCD, 20 mm high
- **Rated operational conditions:**
  - operating temperature: 0...+40°C
  - max. interference voltage AC + DC at which the measurement is still performed: 24V ($68V_{P-P}$)
  - test current for resistance value =< 100 Ω: 225mA
  - max. measured voltage: 40V
  - test current frequency: 128Hz

Standard equipment

Test lead (length: 50 m) on the reel with banana plug yellow	(WAPRZ050YEBBSZ)
Test lead (length: 25 m) on the reel with banana plug, red	(WAPRZ025REBBSZ)
Test lead with banana plug 1,2m; yellow	(WAPRZ1X2YEBB)
Test lead with banana plugs 2,2m	(WAPRZ2X2BLBB)
Pin probe with banana connector;yellow	(WASONYEOGB1)
„Crocodile" clip K01; black	(WAKROBL20K01)
Earth contact test probe (rod) 0,3m	(WASONG30)
Carrying case L2	(WAFUTL2)
Hanging straps	(WAPOZSZE1)
User Manual	
Calibration Certificate	
5 batteries LR14	

Optional Equipment

Cable for battery charger	(WAPRZLAD230)
Test wire reel	(WAPOZSZP1)
Earth contact test probe (rod) 0.8 m	(WASONG80)
Carrying case L3 for Earth contact test probe (rod) 0.8 m	(WAFUTL3)
Cramp	(WAZACIMA1)
Current clamp C-3 (=52 mm)	(WACEGC3OKR)
Ni-MH battery package 7.2 V, 3 Ah	(WAAKU05)
USB 1.1/RS232 adaptor	(WAADAUSBRS232)

Earth resistance measurement (three-, four pole method)

Measurement range acc. to IEC 61557: 0.12 Ω..20 kΩ

Range	Resolution	Accuracy
0.0.. 9.99 Ω	0.01 Ω	±(3% m.v. + 3 digits)
10.0.. 99.9 Ω	0.1 Ω	±(2% m.v. + 2 digits)
100.. 999 Ω	1 Ω	±(2% m.v. + 2 digits)
1.0..9.99 kΩ	10 Ω	±(2% m.v. + 2 digits)
10.0..20.0 kΩ	100 Ω	±(2% m.v. + 2 digits)

Earth resistance measurement using clamps

Measurement range acc. to IEC 61557: 0.16Ω..20kΩ

Range	Resolution	Accuracy
0.0.. 9.99 Ω	0.01 Ω	±(8% m.v. + 3 digits)
10.0.. 99.9 Ω	0.1 Ω	±(8% m.v. + 2 digits)
100.. 999 Ω	1 Ω	±(8% m.v. + 2 digits)
1.0..9.99 kΩ	10 Ω	±(8% m.v. + 2 digits)
10.0..20.0 kΩ	100 Ω	±(8% m.v. + 2 digits)

Ground resistivity measurement

Range	Resolution	Accuracy
0.0.. 9.99 Ω	0.01 Ω	±(3% m.v. + 3 digits)
10.0.. 99.9 Ω	0.1 Ω	±(2% m.v. + 2 digits)
100.. 999 Ω	1 Ω	±(2% m.v. + 2 digits)
1.0..9.99 kΩ	10 Ω	±(2% m.v. + 2 digits)
10.0..20.0 kΩ	100 Ω	±(2% m.v. + 2 digits)
100...999 kΩ	1 kΩ	±(2% m.v. + 2 digits)

=> m.v. = measured value

MEASURING EQUIPMENT
Earth resistance and resistivity tester MRU-120
Document No.: 11-304-R0
Sheet: 1 of 2

German Cathodic Protection

Possible measurements:

- earth resistance measurment with 3-pole,4-pole method
- selective earth resistance measurement with clamp (no influence from parallel earths; no opening of rusty junctions is needed)
- continuity of equipotential bondings and protecting conductors
- two clamps earth resistance measurement without auxiliary test probs
- earth resistivity measurement

MRU-120 allows to take the measurements of:

- earthing resistance using auxiliary electrodes
- earthing resistance using auxiliary electrodes and clamp (for measurements of multiple earthing)
- earthing resistance using double clamps (for measurement of earthing when it is impossible to use auxiliary electrodes)
- ground resistivity (Wenner method)
- measurement of continuity of equipotential bondings and protective conductors (meeting the requirements of IEC 60364-6-61:2000 6.12.2) with auto-zero function – with current 200 mA

Electric security:
- type of insulation double, according to EN 61010-1 and IEC 61557
- measurement category CAT IV 300V acc. to EN 61010-1
- protection class acc. to EN 60529 IP54

Rated operational conditions:
- operation temperature -10...+50°C
- storage temperature -20...+70°C
- humidity 20...80%

Other technical data:
- LCD display graphic, backlighted
- interface USB, wireless
- number of measurements carried out of set of batteries > 500
- warranty 24 months

Measurement of interference voltage

Range	Resolution	Accuracy
0...100 V	1 V	±(2% m.v + 3 digits)

• singnalling overvoltage 24 V or 40 V rms
• measurement for DC and AC 45…65 Hz

Measurement of continuity of equipotential bondings and protective conductors (R_{cont}) measurement range to IEC61557-5: **0.24 Ω...19.9 kΩ**

Range	Resolution	Accuracy
0.00 Ω...19.99 Ω	0.01 Ω	±(2% m.v + 2 digits)
20.0 Ω...199.9 Ω	0.1 Ω	
200 Ω...1999 Ω	1 Ω	
2.0 kΩ ... 9.99 kΩ	0.01 kΩ	±(5% m.v + 2 digits)
10.0 kΩ ...19.9 kΩ	0.1 kΩ	

- voltage on open terminals: <24 Vrms but >4 Vrms
- measurement current: under short circuit >200 mA
- frequency of measurement current: 125 (for networks 50 Hz) or 150Hz (for networks 60 Hz), possible choice of measurement frequency in menu
- auto-zero function measurement leads

Measurement of earthing resistance (method 3- and 4-pole)
measurement range to IEC61557-5: **0.30 Ω...19.9 kΩ**

Range	Resolution	Accuracy
0.00 Ω...19.99 Ω	0.01 Ω	±(2% m.v + 2 digits)
20.0 Ω...199.9 Ω	0.1 Ω	
200 Ω...1999 Ω	1 Ω	
2.0 kΩ ... 9.99 kΩ	0.01 kΩ	±(5% m.v + 4 digits)
10.0 kΩ ...19.9 kΩ	0.1 kΩ	

• measurement current: under short circuit >200 mA
• voltage on open terminals: selectable <25 V AC or <50 V AC,
• frequency of measurement current: 125 (for networks 50 Hz) or 150 Hz (for 60 Hz)

Measurement of resistance of auxiliary electrodes R_H and R_S

Range	Resolution	Accuracy
0 Ω...999 Ω	1 Ω	±(5% (R_S+R_E+R_H) + 8 digits)
1.0 kΩ ... 9.99 kΩ	0.01 kΩ	
10.0 kΩ ...19.9 kΩ	0.1 kΩ	

Measurement of multiple earthing resistance with using the clamp and auxiliary electrodes (3p + clamp)
measurement range to IEC61557-5: **0,44Ω...1999Ω**

Range	Resolution	Accuracy
0.00 Ω...19.99 Ω	0.01 Ω	±(8% w.m. + 3 digits)
20.0 Ω...199.9 Ω	0.1 kΩ	
200 Ω...1999 Ω	1 kΩ	

• selectable <25 V AC or <50 V AC
• measurement current: under short circuit > 200 mA
• frequency of measurement current: 125 (for networks 50 Hz) or 150 Hz (for 60 Hz

Measurement of ground resistivity
Measurement method: Wenner, $\rho=2\pi LR_E$

Range	Resolution	Accuracy
0.0 Ω...199.9 Ω	0.01 Ω	depending on measurement accuracy R_E with 4p method but not less than ± 1 digit
200 Ω...1999 Ω	0.1 Ω	
2.0 kΩ ... 19.99 kΩ	1 Ω	
20.0 kΩ ... 99.99 kΩ	0.01 kΩ	
100 kΩ ...999 kΩ	0.1 kΩ	

L= distance between probes: 1...50 m

Measurement of multiple earthing resistance with using double clamps

Range	Resolution	Accuracy
0.00 Ω...19.99 Ω	0.01 Ω	±(10% m.v + 3 digits)
20.0 Ω...149.9 Ω	0.1 Ω	±(20% m.v + 3 digits)

• frequency of measurement current 125 (for networks 50 Hz) or 150 Hz (for networks 60 Hz)

Standard accessories of the meter MRU-120

- Test lead with banana plug; 1.2 m; red	WAPRZ1X2REBB
- Test lead with banana plugs 2.2 m; black	WAPRZ2X2BLBB
- Test lead on a reel with banana plugs; 25 m red	WAPRZ025REBBSZ
- Test lead on a reel with banana plugs; 25 m blue	WAPRZ025BUBBSZ
- Test lead on a reel with banana plugs; 50 m yellow	WAPRZ050YEBBSZ
- USB transmission cable	WAPRZUSB
- Pin probe with banana plug; yellow	WASONYEOG1
- Earth contact test probe (rod); 0.30 m	WASONG30
- Carrying case L2	WAFUTL2
- Ni-MH battery package 4.8 V 3 Ah	WAAKU03
- Crocodile clip K01; black	WAKROBL20K01
- Power supply adaptor Z7	WAZASZ7
- Cable for battery charger	WAPRZLAD230
- Hanging straps	WAPOZSZEKPL
- Calibration certificate issued by calibration laboratory	

Optional accessories of the meter MRU-120

- Earth contact test probe (rod); 0.80 m	WASONG80
- Test lead with banana plugs 2 m (N-1)	WAPRZ002DZBB
- Carrying case L3	WAFUTL3
- Current clamp C-3 (Ø=52 mm)	WACEGC3OKR
- Current clamp N-1 (Ø=52 mm)	WACEGN1BB
- Akumulator Ni-MH 4.8V 4.2Ah	WAAKU07
- Battery case LR14 (size C)	WAPOJ1
- USB radio interface	WAADAUSBOR1
- Crocodile clip K02; red	WAKRORE20K02
- Cramp	WAZACIMA1
- Software for creation of documentation from electrical measurements „PE4”	WAPROSONPE4
- Charger for battery loading from the socket of car lighter (12V)	WAPRZLAD12SAM

UNITEST TELARIS® Earth

Key Functions

- Earth resistance measurement
- Specific earth resistance measurement

General Information

- The integrated constant current measurement principle allows the application in sandy as well in rocky environments
- Monitoring and display of auxiliary earth and probe resistances
- Displays of the actual test current
- Automatic and manual and frequency selection for noise reduction
- Test voltage preselection
- Clear and large LCD providing the user with an optimum visual indication of both test values and limits
- Auto power off

Special Features

- Earth resistance measurement 2/3 and 4-pole
- Specific earth resistance measurement in compliance with the Wenner principle

Scope of supply

1 pc UNITEST TELARIS Earth
2 pc Test leads
2 pc Crocodile clamps
1 pc Protective Holster
1 pc Carrying Case
6 pc Batteries 1.5 V, IEC LR6
1 pc Instruction Manual

Accessories

Professional Carrying Case, Cat. No. 1229
Earth Accessory-Set, Cat. No. 1189

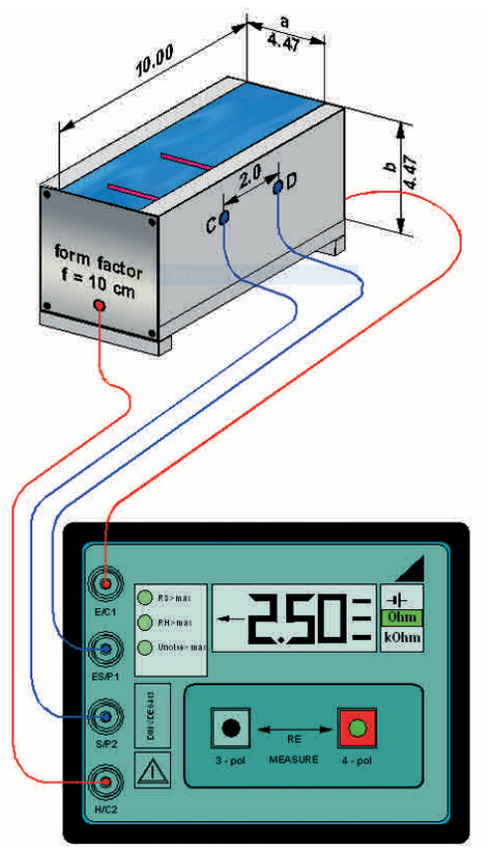
Order information

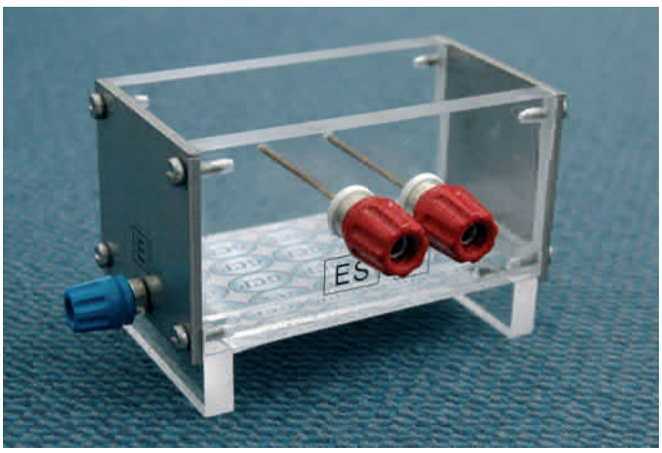
Description	Cat. No.
UNITEST TELARIS Earth	**8986**
Professional Carrying Case	**1229**
Earth Accessory-Set	**1189**

Technical data

Display	3 Digit; LCD; 1999 Digits
Duration of measurement	3 - 5 s
Measurement principle	Current-Voltage measurement
Measurement voltage	25/50 V selection
Current/power consumption	approx. 10 mA/0.1 W max. 500 mA briefly, during measurement
Measurement current	max. 12 mA
Frequency (f1/f2)	127 Hz / 140 Hz, selectable
Measurement method	2 pole / 3 pole / 4 pole
Earth resistance RE	0.05 - 2.00 Ω ±(4% + 0.1 Ω)
Earth resistance RE	2 - 1999.9 Ω ±(4% + 2 Digit)
Earth resistance RH, RS	0.1 - 50 kΩ ±(10% + 3 Digit)
I M	0.1 - 13 mA ±(10% + 3 Digit)
Nominal use range:	
Correct polarity	for 3/4 pole measurements
Noise voltage	0...5 V, max. 10% of meas. voltage
aux. earth (RH), probe res. (RS)	max. 50 kΩ
Ratio RH/RE	max. 1000/1
Ratio RS/RE	max. 10000/1
Earth resistance (RE)	max. 2 kΩ
Reference range:	
Correct polarity	for 3/4 pole measurements
Noise voltage	0 V
aux. earth (RH), probe res. (RS)	max. 2 kΩ
Auto power off	after approx. 5 min
Power supply	6 x 1.5 V, IEC LR6 (Mignon/Size AA)
Low Bat at	6.6 V ± 5% (OFF at 6.1 V ± 5%)
Battery life	approx. 1 year for normal use
Dimension (L x W x D)	235 x 105 x 68 mm
Weight	approx. 640 g (incl. 6 batteries)
Environmental conditions:	
Temperature range / humidity	0°C...40°C / max. 80% at -10...40°C
Ref. temperature range	+17°C...27°C
Storage temperature range	-20°C...+60°C
Casing	Protection class II
Built in accordance with	IEC 61557-5, DIN VDE 0413-5
Overvoltage category	CAT III / 300 V against ground
Pollution degree	2
Protection class	I I
Protection degree	I P 50
Height above MSL	up to 2000 m

Measuring arrangement, soil box with earthing tester





The soil box can be used for the measurement of specific resistivity of electrolytes ie. soil sample, water and conducting fluids.

The specific resistivity is measured by using a normal 4 -terminal earth resistance meter in accordance with Wenner´s 4 - electrode method.

The soil box consists of a plastic container with metal end plates for passing current through the soil sample packed into the box and potential terminals permitting measurement of voltage drop across a section of the soil sample,

The dimensions of the box and position of electrodes are designed so that resistivity of electrolyte sample in the box is obtained by multiplying the resistance value in Ohm indicated by the meter by the form factor (printed on box).

The test sample should be filled up to the top of the box. The soil samples should be carefully filled and compacted to ensure proper contact with the plates and rod electrodes and also to remove air bubbles and voids.

The test box method gives very accurate results for fluids but the value measured for soil samples may differ from those measured at actual site due to variations of natural conditions including moisture, compaction, void ratio, particle size etc..

CALCULATION OF FORM FACTOR (f)
$f = \frac{a \times b}{C\ D} = \frac{4.47\ cm \times 4.47\ cm}{2.0\ cm} = 10\ cm$

SPECIFIC SOIL RESISTIVITY (*p*)
p **= R x f**

Example:

Soil box filled with salty liquid

Indicated R = 2.5 Ω

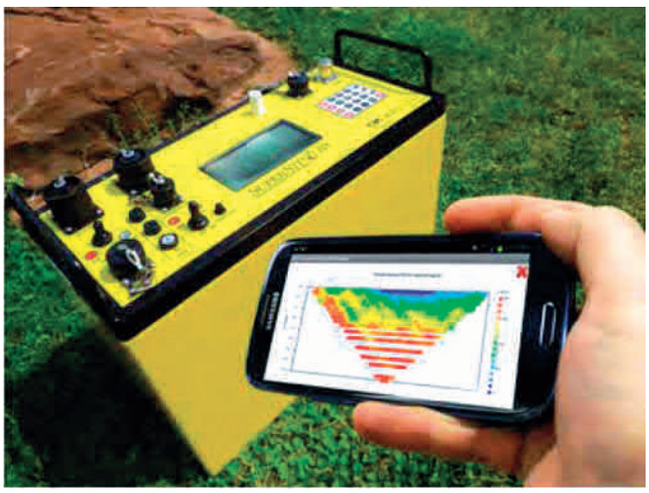
SPECIFIC SOIL RESISTIVITY (*p*)

p **= R x f = 2.5 Ω x 10 cm**

p **= 25 Ω cm**

Dimensions

Length	Height	Depth	Weight
168 mm	55 mm	60 mm	0.38 kg



Super Sting™ Wi-Fi® - Geo-electrical Imaging System

The SuperSting™ with Wi-Fi® is a portable resistivity, induced polarization (IP), and self-potential (SP) instrument with memory storage and user-defined measure cycles. It provides the highest accuracy and lowest noise levels in the industry. The instrument comes in two versions: the single-channel version R1 and the eight-channel version R8. The R8 measures up to 8 channels simultaneously for each current injection, making it up to 8 times faster than the R1 model. Both models exhibit the accuracy, reliability and ruggedness that all Advanced Geosciences instruments are known for.

The instrument uses a built-in power transmitter and can be used for traditional vertical electrical sounding (VES), mise-a-la-masse measurements, or multi-electrode electrical tomography in 2D, 3D and 4D (time lapse). Other applications include borehole-to-borehole tomography and underwater measurements in rivers, lakes, dams and the sea to investigate bottom conditions.

Geo-electrical Imaging with Android™ App & Wi-Fi®

New mobility allows you to send data immediately to your processing center from the comfort of your vehicle up to 100 meters away (depending on terrain and atmospheric conditions). You no longer need to monitor imaging surveys from the instrument in the field. Using Android™ mobile 7-inch or 10-inch tablets or phones, you can check the electrodes for contact resistance and at the same time control the SuperSting™ while reviewing data in real time in both numerical and color plots.

Accessories

- The SuperSting™ comes with a built-in 200 W transmitter. A series of external high-power, 5-15 kW, transmitters are available for deep IP surveys.
- AGI's **EarthImager**™ inversion software for 1D, 2D and 3D data processing.
- **SuperSting™ Remote** for resistivity, IP and SP time monitoring in remote & hard-to-access areas.
- Cables for land, borehole and underwater surveys.
- Electrode streamers for towed marine surveys.
- Stainless steel electrodes, non-polarizable electrodes and patented graphite electrodes.
- Manual single conductor cables on reel.

Features

- The 8-channel instrument (R8) is designed for large surveys when time is of the essence.
- The single-channel unit (R1) is designed for smaller surveys when speed of survey is less important.
- Used for resistivity and IP imaging in 2D, 3D and 4D.
- Borehole-to-borehole, and borehole-to-surface measurements.
- Underwater measurements in fresh and salt water.
- Deep IP mineral exploration using the external power transmitter PowerSting™ (5 - 15 kW).
- Ground water exploration.
- Geotechnical investigation for depth to bedrock, cavity detection, stratigraphy and more.

SuperSting™ with Android™ AppSuperSting™ with Android™ App

Geo-electrical Instrument for Resistivity/IP/SP Tomography

- Gives you freedom in the field to move away from the instrument and still be in contact to control and monitor the data acquisition.
- Data quality analysis in real time.
- Review the data as a pseudo section or cross-plot of transmitter and receiver pairs.
- Review IP curves in real time.
- Android™ devices can serve as easily replaceable, upgradable display and control devices.
- Data can be emailed and backed up to cloud servers in real time for enhanced data security and faster reporting.

Key Features of the SuperSting™ Manager App

- You have all important information about each data point immediately available by touch screen.
- The electrodes for each data point are highlighted in case a survey needs to be paused and restarted to fix a loose electrode and thus save important time in the field while improving data quality.
- A floating window displays apparent resistivity, voltageRx/currentTx, voltageRx, currentTx, voltageTx, power, % error, command line number and the channels used.
- The contact resistance data is now saved in a separate file documenting this primary data quality control condition along the line.

What if my Android™ device gets lost or runs out of power?

- Your data is safe because it is saved both on the SuperSting™ instrument and on the Android™ device.

- The survey will continue localy on the SuperSting™ and can be fully controlled from the standard SuperSting™ keypad.

What happens if I get out of Wi-Fi® range?

- The Wi-Fi® max range is 100 meter depending on terrain, atmosphere etc. The SuperSting™ will continue to measure even if the Android™ device gets outside the range. As soon as the device returns within range the SuperSting™ App reconnects and continues all functions as before without losing any data.

SuperSting with Wi-Fi

AVAILABLE AS EIGHT- OR SINGLE-CHANNEL MEMORY EARTH RESISTIVITY, SP & IP METER

TECHNICAL SPECIFICATION

SuperSting:

Measurement modes	Apparent resistivity, resistance, induced polarization (IP), SP & battery voltage.
Measurement range	+/- 10Vp-p.
Measuring resolution	Max. 30 nV, depends on voltage level.
Screen resolution	4 digits in engineering notation.
Transmitter	200 W internal transmitter; external 5 kW, 10 kW and 15 kW transmitters are also available (see separate brochure for specications).
Output current	1 – 2,000 mA continuous, measured to high accuracy.
Output voltage	800 Vp-p, actual electrode voltage depends on transmitted current & ground resistivity.
Input channels	Two models are available; 8 channel & single channel.
Input gain ranging	Automatic, always uses full dynamic range of receiver.
Input impedance	>150 MΩ
SP compensation	Automatic cancellation of SP voltages during resistivity measurement. Constant & linearly varying SP cancels completely.
Type of IP measurement	Time domain chargeability (M), six time slots measured & stored in memory.
IP current transmission	ON+/OFF/ON-/OFF.
IP time cycles	0.5 s/1 s/2 s/4 s/8 s.
Measure cycles	Running average of measurement displayed after each cycle. Automatic cycle stop when reading errors fall below user-set limit or user-set max cycles are done.
Resistivity time cycles	Basic measure time is 0.2/0.4/0.8/1.2/3.6/7.2 or 14.4 s as selected by user via keyboard. Auto-ranging & commutation adds about 1.4 s.
Signal processing	Continuous averaging after each complete cycle. Noise errors calculated & displayed as percentage of reading. Reading displayed as resistance (ΔV/I) & apparent resistivity (Ωm). Apparent resistivity is calculated using user entered electrode array coordinates.
Noise suppression	Better than 100 dB at f>20 Hz. Better than 120 dB at power line frequencies (16 2/3, 20, 50 and 60 Hz) for measurement cycles of 1.2 s & above.
Total accuracy	Better than 1% of reading in most cases (lab measurements). Field measurement accuracy depends on ground noise & resistivity. The instrument will calculate & display running estimate of measuring accuracy.
System calibration	Calibration is done digitally by the microprocessor based on correction values stored in memory.
Supported congurations	In manual mode; resistance, Schlumberger, Wenner, dipole-dipole, pole-dipole, pole-pole. In automatic mode; any conguration can be programmed.
Operating system	Stored in re-programmable flash memory. New version can be downloaded from the AGI web site & stored in the flash memory.
Data storage	Full resolution reading average & error are stored along with user entered coordinates & time of day for each measurement. Data is automatically stored in a job oriented file system.
Data display	Apparent resistivity (m), current intensity (mA), & measured voltage (mV) are displayed & stored in memory for each measurement. Data can also be displayed on an Android device in real time as bright color pseudosections, IP curves, transmitter/receiver plot, contact resistance measurements & more.
Memory capacity	Virtually unlimited data storage in real time on controlling Android device. The internal SuperSting memory can store more than 79,000 measurements (resistivity mode) & more than 26,000 measurements in combined resistivity/IP mode.
Data transmission	Data can be instantaneously transferred from the Android device by email or by le transfer from the Android device USB port. RS-232C channel available to dump data from the instrument to a Windows type computer on user command.
Automatic multi-electrodes	The SuperSting is designed to run dipole-dipole, pole-dipole, pole-pole, gradient, Wenner and Schlumberger surveys including roll-along surveys completely automatically with the patented (Pat.# 6,404,203) Dual Mode Automatic Multi-electrode system or a passive electrode cable system. The SuperSting can run any other electrode array by using user programmed command files. These are ASCII files that can be created using a regular text editor. The command files are uploaded to the SuperSting RAM memory & can at any time be recalled & run as a survey.
User controls	20 key tactile, weatherproof keyboard with numeric entry keys & function keys. On/off switch. Measure button, integrated within main keyboard. LCD night light switch (push to light). Keyboard and LCD are mirrored to an Android™ device using Wi-Fi® technology for easy remote control of the SuperSting.
Display	Graphics LCD display (16 lines x 30 characters) with nightlight. Android mobile phone screen & 7” or 10” Android tablet bright color AMOLED display.
Power supply, field	12V or 2x12V DC external power, connector on front panel. Optional AC/DC power supply & motor generator.
Power supply, office	DC power supply.
Operating time	Depends on survey conditions & size of battery used. Internal circuitry in auto mode adjusts current to save energy.
Operating temperature	-20 to +50°C when controlled by your Android device (phone or tablet). The instrument LCD screen fades out at -5°C, but the instrument continues to function normally contolled by your Android phone, kept warm in your pocket.
Weight	10.9 kg (24 lb.)
Dimensions	Width 184 mm (7.25“); length 406 mm (16“) & height 273 mm (10.75“).

SuperSting Manager App:

Device	Used with various Wi-Fi capable Android devices such as mobile phones, 7-inch & 10-inch tablets. Recommended for tablets; the App may not render properly on all handset devices.
Android™ version	3.2 -4.4
Functions	All functions performed using the SuperSting's keypad can be performed using the App's GUI with the exception of baud rate setting.
Real time quality assurance	Color pseudo-section plot, transmitter/receiver pair plot, IP curve plot, contact resistance test results, real time data review.
Data storage	Data storage on Android devices is typically in Gigabyte range, meaning essentially unlimited storage space is available.
Data transfer	Data transfer by email or by file transfer from the Android device USB port.
Wi-Fi range	Up to 100 m, depending on terrain & atmospheric conditions.

AGI EarthImager 1D	Win10 Win8.1 Win7	Use **EarthImager 1D** to interpret 1D vertical electrical sounding (VES) resistivity curves created with Schlumberger, Wenner and dipole-dipole electrode arrays.
AGI EarthImager 2D	Win10 Win8.1 Win7	The **EarthImager 2D** is used to interpret 2D resistivity profiles created with any electrode array, recorded with electrodes in one plane, i.e. on a line on the surface, between two or more parallell bore holes, or between bore hole and surface. Any array or mixed data from Schlumberger, pole-pole, pole-dipole, dipole-dipole or Wenner electrode arrays are possible to invert. A special „Survey Planner" allows the user to enter a geological model and run a virutal survey and then invert the virtual data to see if the objective of the survey can be met. **Extra modules available:** **The 2D time lapse module**, is used when information about resistivity changes in the ground is needed. Some common situations include potential leakage from landfills, industrial sites, etc. Other monitoring situations include fracture tracing by injection of a conductive solution such as a salt solution. Other possible monitoring situations include saltwater intrusion in coastal areas, remediation progress at environmental sites, groundwater recharge, infiltration studies, to see how the ground is „wetted" or how the ground dries up after a rain storm. **The Continuous resistivity profiling (CRP) module**, is used to invert data with large number of electrode positions, like marine CRP surveys or certain roll-along files.
AGI EarthImager 3D	Win10 Win8.1 Win7	**EarthImager 3D** will automatically determine a three dimensional resistivity model for the subsurface using the data obtained from a 3D electrical imaging survey with the electrodes arranged in boreholes and/or on the surface and presents a 3D volume of inverted resistivity data with advanced volume rendering technique. The final resistivity or IP image-volume can be rotated in any orientation, zoomed in and out, and translated to anywhere inside the image window in order to see the volume of interest in detail. Colors representing areas of less interest can be made transparent so that the shape of a pollution plume, for example, can be visible. With EarthImager 3D, resistivity inversion can be as easy as two steps: Read Data and Start Inversion with only a few mouse clicks. **Extra modules available:** **The 3D time lapse module**, is used when information about resistivity changes in the ground is needed. Some common situations include potential leakage from landfills, industrial sites, etc. Other monitoring situations include fracture tracing by injection of a conductive solution such as a salt solution. Other possible monitoring situations include saltwater intrusion in coastal areas, remediation progress at environmental sites, groundwater recharge, infiltration studies, to see how the ground is „wetted" or how the ground dries up after a rain storm. **The 64-bit parallel processing module**, is used to invert data with large number of electrode positions and number of data. It can access the total RAM space available on the machine as well as all cpu cores.

SuperSting Swift Dual Mode (US Patent 6,404,203) Electrode Switches

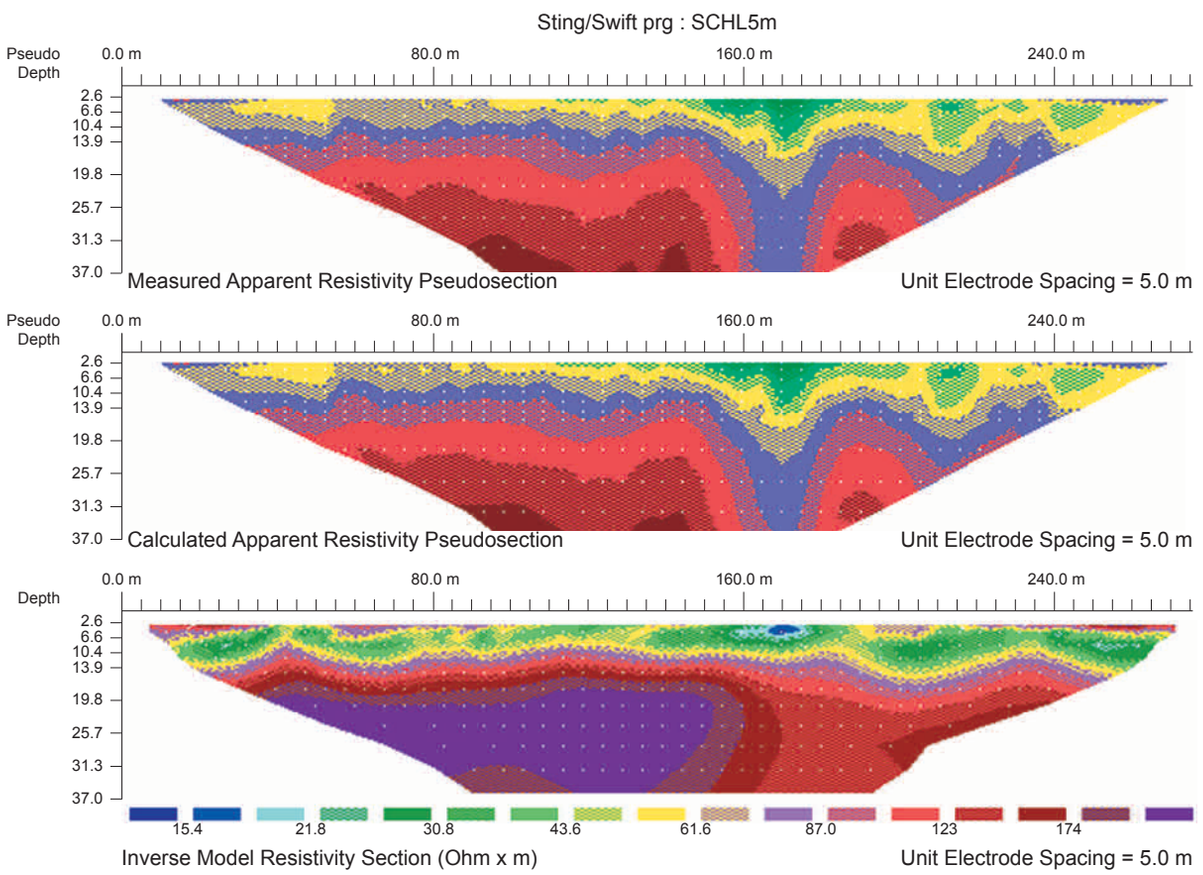
The Swift dual mode electrode switches facilitate automatic induced polarization measurement in a multi-electrode array using stainless steel stakes for current injection and non-polarizable (porous pot) electrodes for the potential measurements. The electrode switch can operate either as a dual mode electrode with separate current injection and potential measurement or in mono mode where both current injection and potential measurement occurs through the stainless steel stake. The electrode switches have been re-designed in order to reduce the size of the electrode switch. On one side of the electrode switch is a miniature banana jack where the non-polarizable electrode is connected when the electrode is used in dual mode. When the banana jack is not in use, it is covered by a plug to prevent dirt and moisture to enter the jack.

EarthImager 2D

AGI EarthImager 2D is a Windows based computer program that interprets two-dimensional (2D) electrical resistivity and induced polarization (IP) data and produces inverted resistivity and IP sections that reveal the sought-after target and subsurface geology. EarthImager turns the complicated resistivity data inversion into a simple step wise process, i.e., reading a data file, running the inversion and plotting the figurs for a report. EarthImager also presents a long list of options for advanced users.

EarthImager supports all Windows true type fonts and Windows 24-bit true color. Hardware accelerated graphics powered by OpenGL leads to fast graphics on the screen and export of report ready plots. The graphical user interface allows browsing of the processing results from one parameter to another and one iteration to another. There are multiple visualization options such as 3D volumes with variable opacity and color scale so that the viewer can see inside a subsurface volume.

Supersting wi-fi fast and easy electrical imaging



MiniSting

Earth Resistivity/IP Meter

- 4-pin Wenner Soil Test (ASTM G57)
- IEEE Fall of Potential
- Vertical Electrical Sounding (VES)

The MiniSting is a high powered resistivity & IP meter especially designed for manual resistivity jobs like electrical grounding-grid testing, the IEEE fall-off-potential method, ASTM G57 soil resistivity test using the Wenner four electrode method, survey for corrosion control, electrical surveys with the four electrode method (vertical electrical sounding or profiling).

The MiniSting is pre-programmed for Wenner, Schlumberger, dipole-dipole, pole-dipole, pole-pole, mise-a-la-masse, SP, resistance and azimuthal surveys in the manual measurement mode.

Recorded data is saved in the internal memory and at a convenient time downloaded to a computer for further processing. Our utility sofware „the Administrator“ is included with the MiniSting as well as a serial download cable. The Administrator software is used for data down-load.

The MiniSting has a built in re-chargeable NiMH battery with power sufficient for one day of manual surveying. The instrument is delivered with a battery charger.

Key Benefits

- High Powered
- Compact size with built in battery
- Rugged construction
- Easy to use menu driven system
- Versatile instrument for different survey configurations

TECHNICAL SPECIFICATION

Measurement modes	Apparent resistivity, resistance, voltage (SP), induced polarization (IP), battery voltage.
Measurement range	400 kohms to 0.1 milliohms (resistance) 0-500 V full scale voltage autoranging
Measuring resolution	Max 30 nV, depends on voltage level
Screen resolution	4 digits in engineering notation.
Output current	1-2-5-10-20-50-100-200-500 mA
Output voltage	The user can switch between high and low voltage limit for the transmitter (800 Vp-p or 320 Vp-p voltage limit). Actual electrode voltage depends on transmitted current and ground resistivity.
Input gain ranging	Automatic, always uses full dynamic range of receiver.
Input impedance	>20 Mohms
Input voltage	Max 500 V
SP compensation	Automatic cancellation of SP voltages during resistivity measurement. Constant and linearly varying SP cancels completely.
Type of IP measurement	Time domain chargeabilitiy (M), six time slots measured and stored in memory.
IP current transmission	ON+, OFF, ON-, OFF
IP cycle times	1 s, 2 s, 4 s and 8 s
Measure cycles	Running average of measurement displayed after each cycle. Automatic cycle stops when reading errors fall below user set limit or user set max cycles are done.
Cycle times	Basic measure time is 1.2, 3.6, 7.2 or 14.4 s as selected by user via keyboard. autoranging and commutation adds about 1.4 s.
Signal processing	Continuous averaging after each complete cycle. Noise errors calculated and displayed as percentage of reading. Reading displayed as resistance (dV/I) and apparent resistivity (ohmm). Resistivity is calculated using user entered electrode distances.
Noise suppression	Better than 100 dB at f>20 Hz. Better than 120 dB at power line frequencies (16 2/3, 20, 50 & 60 Hz).
Total accuracy	Better than 1% of reading in most cases (lab measurements). Field measurement accuracy depends on ground noise and resistivity. Instrument will calculate and display running estimate of measuring accuracy.
System calibration	Calibration is done digitally by the microprocessor based on correction values stored in memory.
Supported configurations	Resistance, Schlumberger, Wenner, dipole-dipole, pole-dipole, pole-pole, azimuthal, mise-a-la-masse, SP (absolute) and SP (gradient).
Data storage	Full resolution reading average and error are stored along with user entered coordinates and time of day for each measurement. Storage is effected automatically.
Memory capacity	More than 3000 measuring points can be stored in internal memory.
Data transmission	RS-232C channel included to dump data from instrument to PC on user command
User controls	20 key tactile, weather proof keyboard with numeric entry keys and function keys. On/Off switch Measure button, integrated within main keyboard. LCD night light switch (push to illuminate).
Display	Alphanumeric LCD display (4 lines x 20 characters) with night light.
Connectors	4 banana plug, pole screws for current and potential electrodes. 10-pole KPT connector for external power, RS-232C and synchronization connections.
Power supply	12V, 4.5 Ah NiMH built-in rechargeable battery. External power connector on front panel, the instrument automatically selects external battery if present.
Operating time	Depends on conditions, internal circuitry in auto mode adjusts current to save energy. At 20 mA output current and 10 kW electrode resistance more than 2000 cycles are available from a fully charged battery pack.
Battery charger	Dual stage charger with switchable input (115/230 V AC @ 50/60 Hz
Weight	6.6 kg (14.5 lb.)
Dimensions	Width 255 mm (10“), length 255 mm (10“) and height 123 mm (5“).

German Cathodic Protection

Digital Current Clamp Meter for DC and AC currents measurements

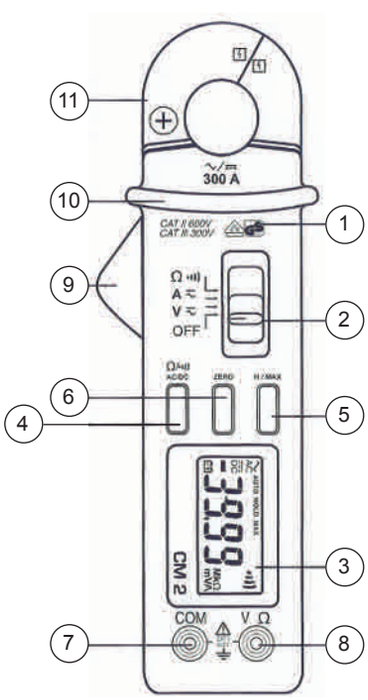
The Digital Current Clamp Meter CM 2 combines the advantages of a Digital Multimeter with a current Clamp Meter. The 3 3/4 digit LC display offers a resolution of 3999 pixels and allows the recording of the measured value and the maximum value in all measuring ranges by means of the H/MAX button.

The CM 2contains DC and AC current ranges up to 300 A and because of its maximum measurement resolution of 10 mA it is ideally suitable for measuring smaller current ranges. The optimum zero setting for the direct current range can be set to the ZERO button.

Additionally the CM 2 reads direct voltage and alternating voltage up to 600 V, resistance up to 40 MΩ and it has an acoustic continuity test. All the ranges are protected against overload.

Relative measurements (differential measurements) can be made via ZERO button in voltage and current range.

The CM 2has a battery low voltage indication and an auto-shut off function when not in use (approx. 30 min.).



1 Housing
2 Sliding switch for selecting the required functions
3 Digital display (liquid-crystal type)
4 Function button
5 HOLD/MAX button
(hold function and automatic peak-value storage)
6 ZERO button (zero setting button)
for zero adjustment in current measurement
7 COM socket: joint socket for voltage and resistance measurements and continuity test, marked black
8 V-Ω socket (positive): joint socket for voltage and resistance measurements and continuity test, marked red
9 Opening lever, for opening and closing the current prongs
10 Prong guard, protects user from accidental contact with conductor
11 Measurement prongs, for inserting and gripping the single conductor containing AC current

Display	33/4 digit LC display (3999 pixels)
DC voltage:	400 mV/4 V/40 V/400 V/600 V
Resolution/accuracy	max. 100 µV/max. ± 0.5 % + 2 digit
AC voltage	400 mV/4 V/40 V/400 V/600 V
Resolution/accuracy	max. 100 µV/max. ± 1.5 % + 5 digit
Measuring method	RMS value
DC current	40 A, 200 A, 300 A
Resolution/accuracy	max. 10 mA/max. ± 1.0 % + 2 digit
AC current	40 A, 200 A, 300 A
Resolution/accuracy	max. 10 mA/max. ± 1.0 % + 3 digit
Measuring method	RMS value
Resistance	400 Ω/4 kΩ/40 kΩ/400 kΩ/ 4 MΩ/40 MΩ
Resolution/accuracy	max. 100 mΩ/max. ± 0.9 % + 3 digit
Continuity test	50 - 300 Ω, acoustic: buzzer, optic: LCD
Over voltage protection	600 V effective, 400 A effective
Range switching	autoranging
Jaw opening	max. 25 mm
Over voltage category	CAT III 300 V, CAT II 600 V
Operation temperature	0 °C to + 50 °C
Dimensions (l x w x h)	192 x 66 x 27 mm
Weight	205 g
Battery type	2 micro batteries 1.5 V IEC 6LR03/AA
Delivery includes	Current clamp meter carrying case, set of batteries, double insulated safety test leads

MiniLog2 Datalogger and GPS Time Switch for CP

2-Channels (DC + AC = 4 values) · Microvolt · AC Filter · max. 1,000 measurements / sec. · 1,300,000 Values (4 MByte)
GPS Time Switch 15 A relay · Li-Ion battery for 1 month cont. switching · DCVG + CIPS with GPS · Waterproof IP68

General

The new MiniLog2 is a waterproofed universal measuring instrument with LCD and keyboard designed for CP measurement tasks. Used in data logger mode, the MiniLog2 samples for both channels DC and AC simultaneously. In interrupter mode, the built-in relay swiches fully GPS synchronized for interrupting not only rectifiers, but coupons for IR-free potentials. Finally with survey mode, the MiniLog2 is able to make DCVG and CIPS surveys while storing the GPS position for every measuring point taken.

Datalogger with Microvolt Measurement

Two channel sampling, each with DC and AC measurement, resulting in 4 values simultaneous measured per sample.
Both DC channels got microvolt resolution and have active filters built-in to prevent low AC frequency interference. The MiniLog2 is able to sample up to 1 300 000 values.
This results in up to 20 min. sampling even when measuring in “High-Speed mode” (= 1,000 measurements / second). The built-in USB connector allows galvanically isolated data transfer via a USB.

Miniaturised GPS Interrupter with Rechargeable Battery

The MiniLog2 has a mechanical 15A/60V relay built-in for switching of rectifiers, flanges and coupons. Optionally a version with built-in electronic relay 30A/60V is available.
Via the keyboard and the LCD a switching cycle resolution of 0.1s is configurable by the user. In addition, night and weekend savings are selectable. The rechargeable Li-Ion battery allows GPS synchronised switching for 30 days without recharging. For fixed installations in rectifier housings an USB mains supply and fix mount can be used. To increase the switching power even more, miniaturised external slave relays for MiniLog2 are available with 50 A and 100 A.

Coupon Measurement with MiniCoup

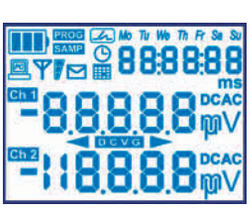
For measuring IR-free potentials on a coupon, MiniLog2 can sample and interrupt simultaneously.
For accurate sampling of the complete off depolarisation curve, MiniLog2 is able to measure 1000 samples/s for one channel for up to 20 min. time.
Optionally with the „MiniCoup“ adapter and its built-in 10 Ohm shunt, the MiniLog2 samples every second for up to 24h. By just connecting pipe, electrode and coupon with the adapter sockets, On and Off potential and DC and AC current are collected simultaneously.

GPS Synchronisation and GPS Position

The optional Garmin GPS receiver allows synchronisation of the MiniLog2 time and date. Using the MiniLog2 as data logger in DCVG survey mode, the GPS positions are automatically stored beside each value.

DCVG and CIPS survey with Google® Maps presentation

Like with an analogue multimeter, MiniLog2 shows the DCVG voltage difference in a bar graph for quick recognition. With a simple press of the „OK“-button mounted on the electrode, the DCVG value and the related GPS position are stored and the survey continues. In the same way potential (CIPS) and/ or voltage gradient measurements can be done.
The survey path and the defects can be directly presented with Google Maps and the WinLog 2.0 software.



Technical data

Measuring channels:	2 (DC+AC parallel = 4 values)
Measuring range and resolution:	± 100 mV / 1 µV (only DC) ± 10 V / 0.1 mV (DC+AC) ± 100 V / 1 mV (DC+AC)
Input impedance:	10 MΩ (for microvolt 250 KΩ)
Maximum sampling rate:	1,000 samples / second 10 samples / second (with filter)
Lowpass filters:	16.6 Hz > 60 dB (factor 1,000) 50.0 Hz > 100 dB (factor 10,000)
Recording capacity:	1,300,000 sampling values and 10,000 DCVG/CIPS measurements
Switching cycle:	In 0.1s steps, user configurable
Synchronization:	GPS and manual or external (Master / Sleeve)
Switching power:	Mechanic relay 60 V / 15 A Electronic relay 60 V / 30 A
Power supply:	Lithium-ion battery 3.6 V / 1,900 mAh charged with USB power supply
Time accuracy:	< 10 ms / 24h with GPS synchronisation
Battery time:	Datalogger mode: 10 days with 0.5s sampling rate 20 weeks with 60s sampling rate Interrupter mode: 30 days with 4/2 and GPS DCVG / CIPS: 20 hours with GPS position
Dimension:	148 x 68 x 42 mm
Weight:	350 g

LS100 - Electronic Powerswitch 100 Ampere

Powerswitch with electronic relay. Build for usage in combination with a switcher. (For example with *MiniLog2*)
The LS100 is intended for switching of CP rectifiers, flanges, soutirages and drainages.
Easy to install with no need for checking the switching polarity, as the LS100 switches polarity independent.

Technical data LS100

Housing:	Metal with built-in heat distribution plates
Switching Power:	100 A (100 V DC / 70 V AC)
Operating Temperature:	-20°C up to 60°C
Dimensions:	W 125 x H 75 x D 160 mm (incl. 30 mm pole clamps)
Weight:	1.25 kg
Item No.:	140211

WinLog 2.0 Data Logger Software

The software WinLog 2.0 for the evaluation of data loggings is especially designed for the new MiniLog2.

Beside the easy transfer of the samplings via USB to the PC, the WinLog 2.0 software supports 4 channel data evaluation with statistic (max, min and median building) and comprehensive printing features.

For the DCVG and CIPS evaluation WinLog 2.0 with an internet connection allows the instant presentation of the survey path together with the location of the defects.

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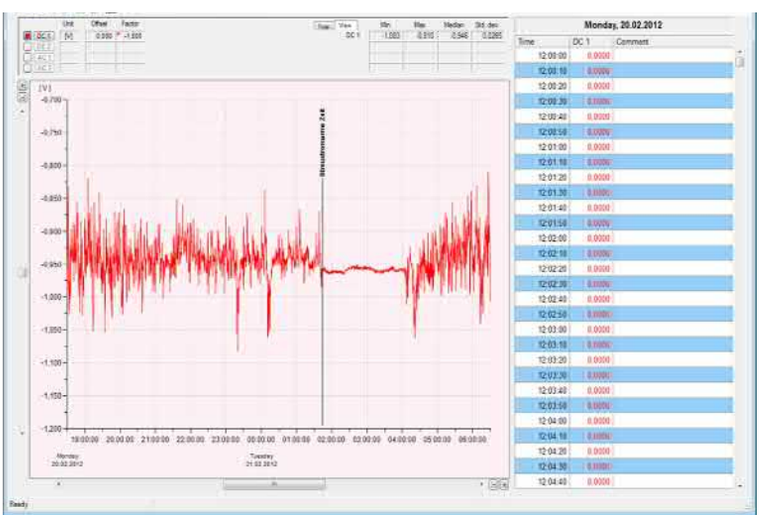
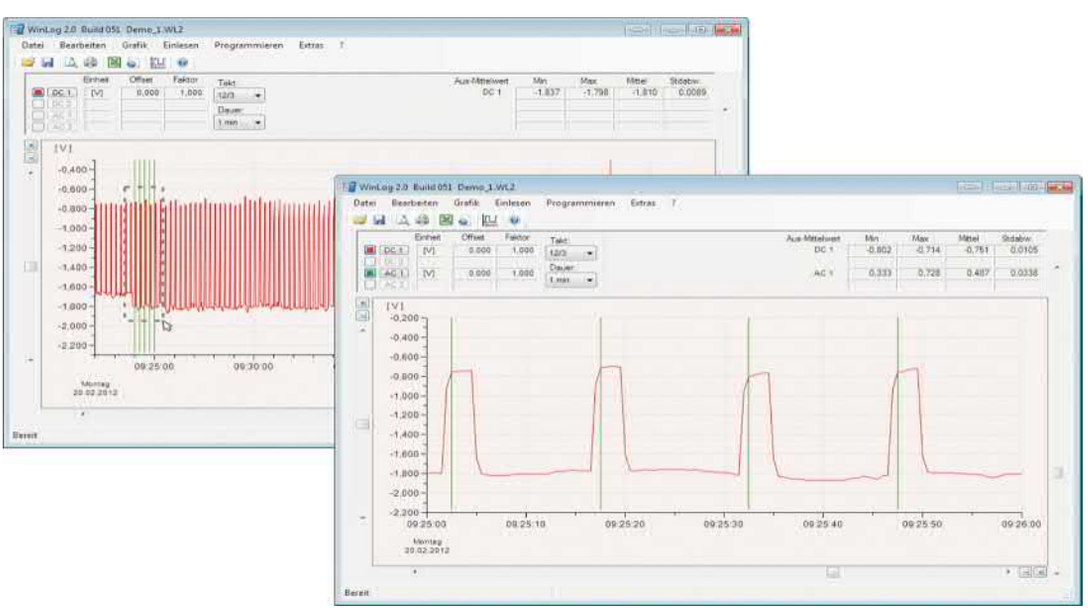
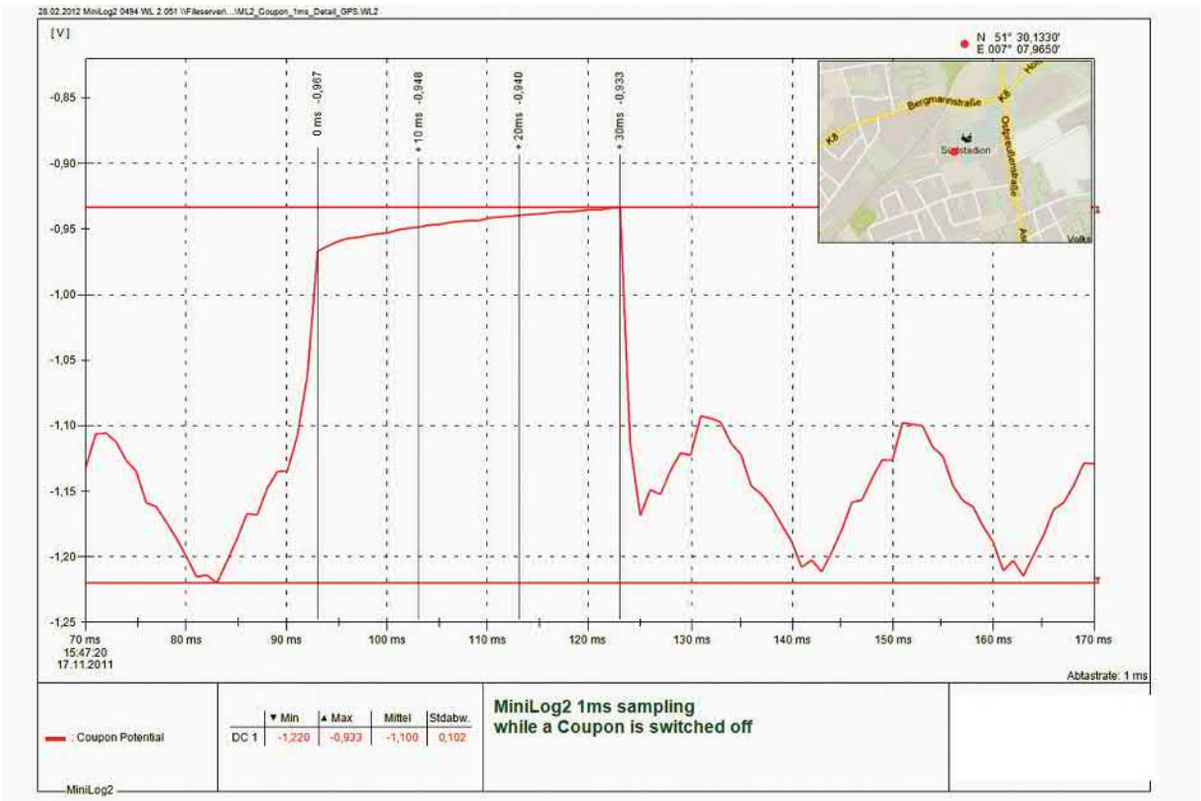
WinLog 2.0 works with Windows® XP, Vista and Windows®7 (32/64 Bit)



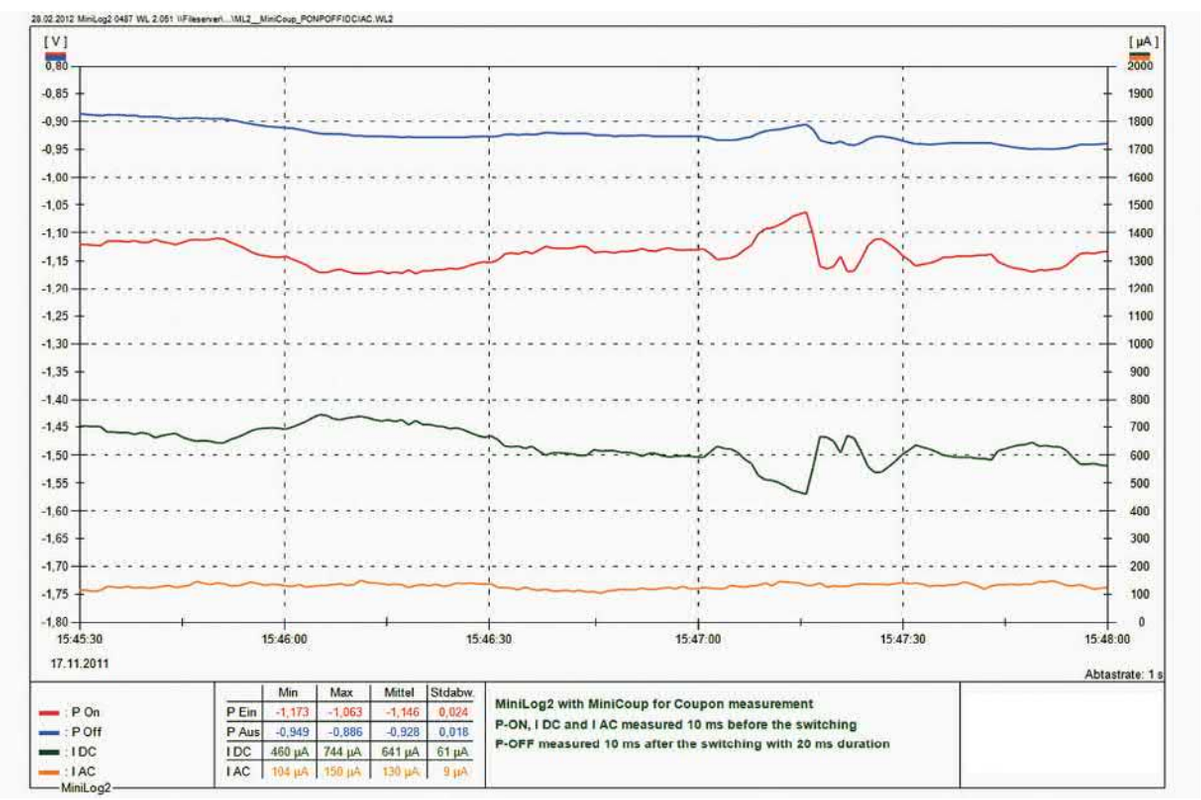
Stray current sampling during 24 hours



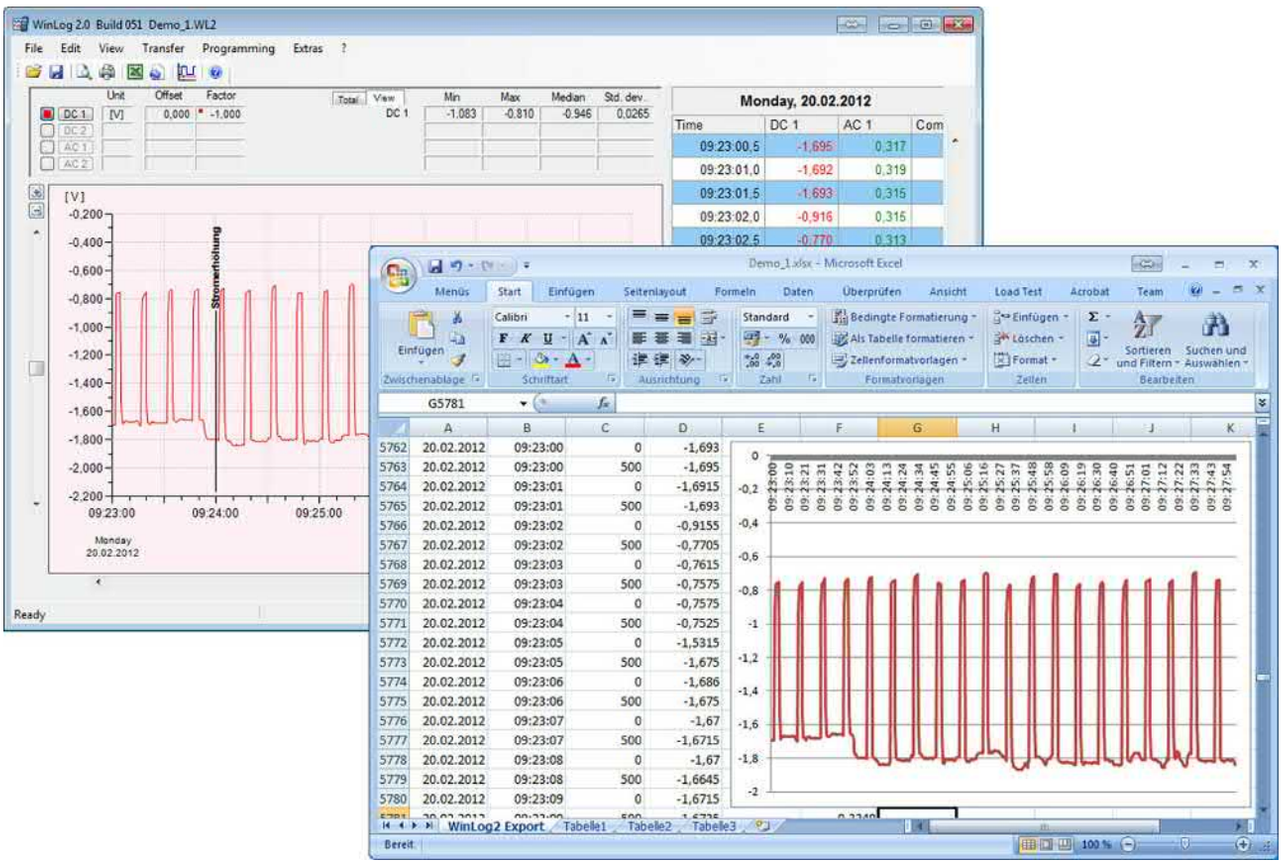
Median values of the Off-Potential with a screen mouse zoom



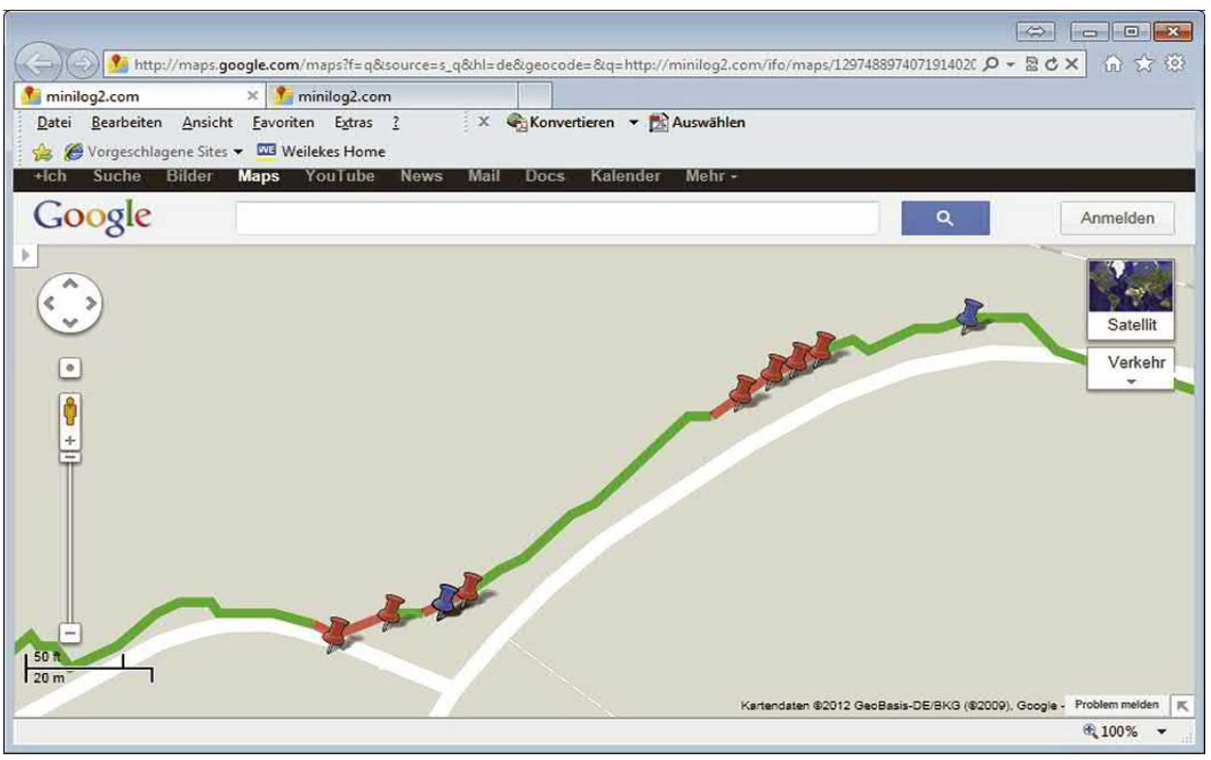
Print: Coupon switching with 1 ms sampling rate



Print: 24 hours coupon measurement with P_{ON} + P_{OFF} + I_{DC} + I_{AC}



Built-in export feature for Microsoft® Excel®



DCVG measurement export to Google® Maps for defect localization

A new dimension in pipe location

Locating underground pipelines and cables is a matter of precision. The more accurate the measurement, the lower the risk of digging up the wrong spot. Performance, practical handling and simple operation are just as important for fast and efficient work.
Likewise, reliability, versatility and a sturdy design are also essenial for obtaining measuring safely in difficult conditions and in-accessible environments. The UT 930 systems is up to any locating task.

Cutting-edge technology for outstanding performance

The system feature a multitude of frequencies, extremely long battery life, surprisingly simple operation and, above all, versatile functionality – allowing you to master any work challenge.

The **UT 930 R** receiver offers seven different frequencies and is combined with the **UT 935 TX** 5 Watt generator.

The possibilities of the system are phenomenal:
find the optimal frequency instantly, connect two pipes at the same time or locate very long sections of pipe. Accurately locate pipes in difficult environments and all weathers, or reliably determine the depth of the pipe.

Operation made easy

Use the **UT 930** systems without extensive training. The receivers and generators have a logical operating concept. The structured menus on the receiver and generator screens show both intelligible symbols and textual information, and thus reliably guide you to successful location.

Comfortable

The balanced receivers fit nicely into the hand, ensuring ergonomic carrying comfort and effortless work.

The right frequency for every task

Adjust the **UT 930** system to your needs. There are seven frequencies available for the receiver and generator.
The desired frequencies can be enabled or disabled directly in the devices.
However, if a frequency is missing, you can install it yourself in the receiver and generator using the UT configurator software. This ensures your **UT 930** meets your personal requirements.

Reliable depth measurement

If the receiver is directly above a pipe, the depth of the pipe is determined automatically. The calculated value is the distance between the bottom edge of the receiver and the centre of the pipe.
The highly sensitive aerials in the receivers ensure above average location success rates and exceptionally attainable depths.

Brilliant display
The display is perfectly legible at all times, even in the brightest sunshine or in the dark. The clear and coherent layout of directional arrows and measurements makes work easier and reliably guides you to your objective.

Maximum availability
Benefit from extremely long operating times: 30 hours for the UT 930 R receivers, 100 hours for the UT 935 TX generators. High quality batteries maximise the availability of the devicesand mean that you can work without interruption and independently of external power sources.

Receicer	**UT 930 R**
Suitable generator	**UT 935 TX**
Number of frequencies	**7**
Individual frequencies possible	**X**
Passive location (current/radio)	**X**
Automatic mode (auto gain)	**X**

Generator	**UT 935 TX**
Suitable receiver	**UT 930 R**
Output power	**max. 5 W**
Frequencies	**7**

Pack contents
UT 830 R receiver
UT 830 R receiver bag
UT 830 TR transmitter
UT 830 T transmitter bag
UT 830 cable set
Earthing spike

For more information, please refer to the offers.

Poro Test 7 - High voltage porosity detection

Reliable porosity detection

For all insulating coatings on metal such as:

- coatings on oil, gas or water pipelines
- linings of tubes, vessels or storage tanks
- protective coatings on hulls, oil tanks, vessels, pipelines including fittings
- enamel, epoxy and plastics coatings

Porosity detection and corrosion control

Flaws in protective coatings such as pores, cracks and fissures, if undetected, may impair the corrosion resistance of a product. The PoroTest 7 has been specifically designed for non-destructive porosity testing of such coatings, based on automatic test voltage control specific to the thickness of material to be tested and vice versa. The major fields of application of the PoroTest 7 range from vendor inspection to quality assurance in corrosion protection.

Test principle and field of application

Designed for detecting flaws and pores, the PoroTest 7 can be used for testing all insulating coatings on conductive substrates such as steel, Aluminium, etc.
The test instrument consists of a high voltage probe with an integrated high voltage generator and a test electrode, which is simply connected to the probe. The control unit features a digital display and control pad. The control unit housing is fully portable and made of rugged ABS plastic with an integrated handle. The high voltage probe and control
unit are connected via a rugged cable. To detect porosity, the appropriate test voltage specific to the material thickness is set on the control unit which applies, when activated, a spark discharge at the moment a material flaw is detected.
In addition to the spark discharge, flaws are indicated by a visible and audible signal and counted. Typical applications: Testing linings and coatings applied on ducts, pipes, hulls, oil and storage tanks, enamel, paint, rubber and bitumen linings, vessels and tanks, GFK and other plastics materials.

Features

- Powerful and versatile gauge with new ergonomic design making it ideal for on-site testing
- Light-weight and hand-held test electrodes provide convenient operation
- User-friendly key-pad layout with menu driven operation
- Test method conforms to DIN 55 670
- 15 sensitivity settings
- Pre-set test voltages specific to material thickness
- Backlit display to indicate current test voltage, number of pores and material thickness
- High voltage probe with equipment-on and pore indicator (red LED)
- Residual voltage indicator
- Power supply: AC operated or battery operated via integrated storage battery (C-cells)
- Low-battery indicator

Product advantages

- Quick detection of local flaws in the insulating material being tested.
- Reliable detection of flaws according to the test conditions described in the DIN 55 670 standard
- Additional safety feature through residual voltage indicator
- New compact and ergonomic design, extremely light-weight and handy for easy handling
- Broad range of electrodes are available for a wide range of applications
- Optimum test voltage setting ensures safe testing without damaging the material being tested
- Variable test voltages
- Precise and stable test voltage settings achieved through electronic control
- No separate gauge required for measuring the current test voltage at the search electrode
- Test voltage directly indicated on the instrument's digital display
- User-selectable menu language: German, English, French and Spanish. Others available upon request.

Variable high voltage probes

Non-destructive porosity detection requires adapted high voltages covering different ranges. The versatile PoroTest 7 offers 2 types of high voltage probes, which are interchangeable with the control unit. The test electrode of your selection directly plugs to the high voltage probe. The specific high voltage setting is entered on the control unit's touch pad and is displayed on the digital display and monitored via the electronic control. The PoroTest 7 is designed for safe use, the high voltage probes are designed and engineered to be insulated and absolutely risk free to the operator. Electrical safety conforms to the German standard VDE 0411, part 1: Both, the maximum discharge rate as well as the probe voltage never exceed the limit values as set forth in the safety standard.

- High voltage probe, model P 7: 0.5…7 kV
- High voltage probe, model P 35: 6…35 kV
- Accuracy of voltage setting: ± (0.1 kV + 3% of reading)

Test principle

When scanning the high voltage search electrode smoothly over the surface, flaws are detected through spark discharge to the conductive substrate.
Test voltage can be adjusted from 500 Volt to 35.000 Volt. The instrument has been designed for testing insulating materials from approx. 30 microns to 11.3 mm (1 mils … 444 mils) thickness.

Adapted search electrodes

A comprehensive selection of special test electrodes are available, such as:

- Rolling spring or ring electrodes for outside-tube testing
- Brush electrodes for inside or outside pipe and tube testing
- Sweeper electrodes for large surfaces of coatings made from plastics, enamel or rubber
- Silicon-rubber electrodes for sensitive surfaces

Even complex shapes such as accoutrements or fittings can be tested confidently with specially designed adaptor brush electrodes.

Compact and convenient design

The PoroTest 7 is a powerful tool for porosity detection and includes the following items:

- Rugged plastics carrying case
- Control unit with integrated storage battery
- Connecting cable probe-control unit
- High voltage probe
- Metal sweeper electrode
- Silicon-rubber electrode, 200 mm (0.7 ft) width
- Earthing magnet
- Earthing clamp
- Equipotential cable, 5 m (16 ft) length
- Power cable
- Shoulder belt

Recommended accessories

- Aluminium case
- Brush electrodes
- Rolling spring electrodes
- Ring electrodes
- Right-angle electrodes (max. 500 mm/20” width)
- 3-pin plug, cable-free, directly plugs into the integrated signal contact (make contact)
- Earthing rod
- Earthing/equipotential cable, 10 m (32 ft) length
- Connecting cable for control unit and high voltage probe in special lengths: 5 m (16 ft), 10 m (32 ft)
- Non-destructive coating thickness gauge, helps you to adjust test voltage specific to coating thickness

High voltage probe P 7 or P 35

Due to the characteristic dielectric strengths of different materials, they require different ranges of test voltages. To meet the requirements of such different applications, two high voltage probe models are available:

- **P 7** for thin coatings starting from 30 microns (1 mils) such as condenser or packaging films, paints, enamels
- **P 35** for thick coatings ranging from 1.4 mm (55 mils) thickness and more such as protective linings in pipelines

Further gauges from our range of products:

- Coating thickness gauges
- Wall thickness gauges
- Gloss meters
- Hardness and roughness gauges
- Continuous measuring systems for flat films and sheets
- Continuous pinhole detection systems for flat films and sheets

Technical specification

High voltage probe	P 7	P 35
Operating range	0.5 ... 7 kV	6 ... 35 kV
Coating thickness	0.03 mm .... 1.7 mm 1 mils ... 67 mils	1.4 mm ... 11.3 mm 55 mils ... 444 mils
Voltage	DC	
Test voltage indication	LC-Display, 3-digit	
Accuracy of voltage setting	± (0.1 kV + 3 % of reading)	
Dimension of voltage probe	274 mm x 63 mm (L x dia.)	
Weight of voltage probe	550 g	
Dimension of control unit	225mm x 150 mm x 85 mm (L x W x H)	
Weight of control unit	1 400 g	
Alarm signal	90 dB, 0.1 s/Pore, continuous in case of short circuit	
Signal output	potential free, U_{max}: 100 V, I_{max}: 0.4 A	
Storage battery	4 C-cells, IEC LR 14, 3.5 Ah, NiMH, replaceable	
Storage battery life	P 7 approx. 20 h	P 35 approx. 10 h
Storage battery charging time	4 hrs quick charge	
Mains voltage	110 to 230 V, 50/60 Hz, automatic switch	
Operating temperature	0° ... 50° C	
Humidity	avoid dew on the surface (refer to DIN 55 670)	
Standards	DIN 55 670, DIN 50 191 (VDE 0104), DIN EN 611010/Part 1	

ISOTEST 4S - Porosity Testing of Coatings

Application

ISOTEST 4S is indispensable in the area of passive corrosion protection.

Non-destructive high voltage testing of the most diverse coatings and corrosion protection materials has proved itself again and again over long periods of time. The test, prescribed by many works' specifications and Standards, has made a successful contribution, within the framework of quality control to reducing stoppalte times and avoiding interruptions to production and subsequent repair costs.

Coating thicknesses from a few hundred micrometres to several millimetres can be tested for pores, cracks or scarcely discernible transport damage by means of short high voltage impulses. The short action time of the impulses, which treats the material gently, makes it possible to test with reserves of energy, which, in turn, guarantees the stability of the selected test voltage even with dirty or damp surfaces.

Defective areas can be clearly distinguished, whether it be with externally or internally coated tubes, rubber coated containers, seams in plastic, fully coated fittings or machine parts ... everywhere where non conductive coatings are overlaid an conductive materials (e.g. metal, wet concrete) or where non conductive coatings have an underlay of conductive materials (e.g. plastic seams in tubing or containers).

Benefits at a glance

- Microprocessor controlled test instrument
- Fully adjustable test voltage
- Patented automatic regulation
- Power reserves for the highest requirements
- Graduated voltage adjustment
- Adjustable sensitivity (switch)
- Separate high voltage pushbotton

ISOTEST 4S stands for:

- Robust construction for using at construction sites
- Testing of dyrty, damp and even slightly conductive surfaces
- Rapid battery change - on site
- Three earthing possibilities, including capacitance
- Testing of fully insulated objects
- Emergency off safety mode via switch
- No static charge when testing
- Automatic earth monitoring
- Minimal loading on material by using short test impulses
- Can be carried with shoulder strap and abdominal belt

Accessories

A large number of accessories are available for a wide range of applications. Test electrodes for the most diverse shapes of object and coatings are complemented by components for the using of different earthing possibilities including capacitance earthing.

The full-trimmed brush electrodes and the spiral electrodes are impressively robust and hard wearing. All electrodes can be easily swapped even with older versions of ISOTEST.
Our expert service personnel are always available to advise you on the choice of the right accessory for your application - especially for less common uses of the equipment.

Whether testing internally, in manholes, with completely coated components or on oversized tubing, the ISOTEST accessory programme has the right tool.

Service - Calibration

ISOTEST instruments will be delivered with a traceable calibration together with a certificate. A clearly visible seal make keeping to the recommended inspection easier. The data can also be accessed through the menu.

Revisions in the course of technical progress reserved.

Technical data

Voltage range	10-25 kV, 5 kV steps
Voltage selection	graduated switch
Voltage form	unipolar impulses
Impulse duration	< 10 µs
Voltage supply	rechargeable battery 6 V, 4.5 Ah, separate compartment
Size and weight of battery	(90 x 45 x 120) mm, 0,9 kg
Operating time	up to 9 hours
Size and weight w/o battery	(220 x 256 x 88) mm, < 3 kg
Alarm signal	approx. 86 dB, 3.5 kHz
Connecting cable to test probe	1.5 m
Relevant standards and DVGW process sheets	DIN (55670, 28055, 30670) DIN (4681, 28063) DIN EN 14330 (iV) DVGW 462/I, W400-2

The 3110 handheld meters provide reliable measurements under difficult conditions both in the Lab and in the field.

- Robust silicone keypad with sealed surface – 100 % waterproof and easy to clean
- Tangible button click - for ease of use
- Built-in calibration timer - for accurate measurements

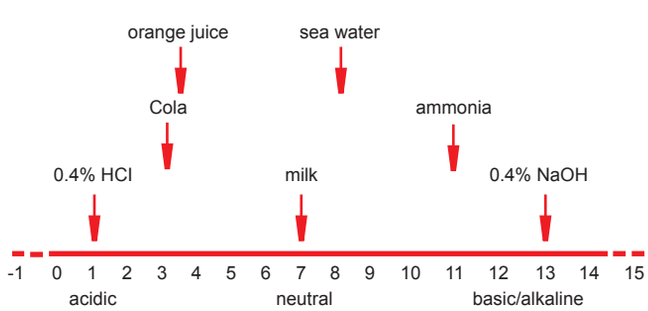
pH-Value

The water molecule has the property of dissociating into two ionic components in aqueous solutions.

$$H_2O \leftrightarrow H^+ + OH^-$$

The H^+ ion is termed hydrogen ion or proton, the OH^- ion hydroxide ion.

The pH value describes the activity of hydrogen ions in aqueous solutions on a scale of -1 to 15. Based on this scale, liquids are characterised as being acidic, alkaline or neutral: a solution which is neither acidic or alkaline is neutral. This corresponds to a value of 7 on the scale. Acidity indicates a higher activity of hydrogen ions and a pH value lower than 7. Alkaline solutions are characterised by a lower hydrogen ion activity or higher hydroxide ion activity, respectively and a pH value above 7. The graph below uses examples to illustrate the pH scale.



The pH scale is logarithmic. A difference of one pH unit represents a tenfold, or ten times increase or reduction of hydrogen ion activity in the solution. This explains how a solution's aggressiveness increases with the distance from the neutral point.
The pH value can be measured using electrochemical measuring systems, litmus paper, indicators and colorimeters. Of these methods, electrochemical sensors provide the most accurate results.
The pH electrode is an electrochemical sensor which consists of a measuring electrode and a reference electrode. The measuring electrode is made of special glass which, due to its surface properties, is particularly sensitive to hydrogen ions. It is filled with a buffer solution which has a pH value of 7.

Technical data

Dimension	approx. 180 x 80 x 55 mm
Weight	approx. 0.4 kg
Type of protection	IP 67
Electrical safety	Protective class III
Test certificates	CE
Storage temperature	-25 °C .... +65 °C
Operation temperatur	-10 °C .... +55 °C
Power supply	Four 1.5 V AA batteries
Battery life time	2500 hours
Sensor input resistance	> 5 x 10^{12} Ohm
Sensor input current	< 1 x 10^{-12} A

Measuring ranges, resolution

Variable	Measuring range	Resolution
pH	-2.0...+20.0	0.1
pH	-2.00...+20.00	0.01
pH	-2.000...+19.999	0.001
U [mV]	-1200.0...+1200.0	0.1
U [mV]	-2000...+2000	1
T [°C]	-5.0...+105.0	0.1
T [°F]	23.0...+266	0.1

Manual temperature input

Variable	Range	Increment
T_{manual} [°C]	-25...+130	1
T_{manual} [°F]	-13...+221.0	1

Accuracy (± 1 digit)

Variable	Accuracy	Temp. of test sample
pH / range*		
-2.0...+20.0	±0.1	+15 °C...+35 °C
-2.00...+20.00	±0.01	+15 °C...+35 °C
-2.000...+19.999	±0.005	+15 °C...+35 °C
U [mV] / range		
-2000...+2000	±1	+15 °C...+35 °C
-1200.0...+1200.0	±0.3	+15 °C...+35 °C
T [°C] / temp. sensor		
NTC 30	±0.1	
PT 1000	±0.1	

** when measuring in a range of ± 2 pH around the calibration point*

When placing the pH electrode into a test solution, the change in voltage is measured by the electrode by comparing the measured voltage to the stable reference electrode. This change is recorded by the meter and converted into the pH value displayed.

METRISO PRIME
High-Voltage Insulation Tester
for battery or hand crank generator operation

- Broad measuring range from 10 kΩ to 1 TΩ
- Easy to read logarithmic display
- Test voltages:
  100 V, 250 V, 500 V, 1000 V, 1500 V, 2000 V, 2500 V, 5000 V
- Measurement to 2000 V in accordance with DIN VDE 0413
- Measuring range: 100 kΩ to 100 MΩ (1000 V)
- Voltage measurement to 2000 V DC and AC
- Guard terminal eliminates surface current
- 5 m extension cable as accessory equipment
- Power supply with batteries or hand crank generator (optional)

Applications
Insulation measurement for cables, motors etc.

Test voltages to 5000 V

This instrument is suited for the non-destructive measurement of installation resistance in electrical systems at machines, transformers and cables, as well as within the electrical equipment with eight selectable test voltages up to 5 kV.

Voltage measurement to 2000 V

With the voltage measuring ranges, test objects can be checked for the absence of voltage in network of up to 2 kV. This is important for insulation resistance measurement, because extraneous voltages distort measurement results.

Discharge of capacitive devices under test

Capacitive devices under test such as cables and coils, which might be discharged to test voltage, are discharged by the instrument. The drop in voltage can be observed at the needle gauge.

Measurements in accordance with EN 61557 part 1 and 2 (VDE 0413)

Measuring current is equal to 1 mA at a test voltage of 100 V, 250 V, 500 V and 1000 V.

Measuring cables with heavy-duty insulation

The measuring cables with heavy-duty insulation are permanently connected for safety and technical reasons. Possible danger caused by the unintended removal of cables is thus avoided, for example when charging occurs due to capacitive test objects.

Needle gauge with LEDs

Three LEDs arranged within the scale to make reading easier. The lamp which is assigned to the selected measuring range lights up. During the measurement sequence, the green LED indicates whether or not the battery charge is sufficient for the measurement.

Applicable Regulations and Standards

IEC 61010-1:2010 DIN EN 61010-1:2010 VDE 0411-1:2011	Safety regulations for electrical measurement, control, regulation and lab devices – General requirements
IEC 61010-031: 2002+A1:2008 DIN EN 61010-031: 2008 VDE 0411-031:2008	Safety requirements for electrical equipment for measurement, control and laboratory use. Part 031. Safety requirements for hand-held probe assemblies for electrical measurement and test
IEC61010-2-030:2010 DIN EN 61010-2- 030:2011 VDE 0411-2-030:2011	Safety requirements for electrical equipment for measurement, control and laboratory use. Part 2-030: Particular requirements for testing and measuring circuits
IEC 61557 DIN EN 61557 Part 1:2007, Part 2:2007 VDE 0413 Part 1:2007, Part 2:2008	Measuring and monitoring facilities for testing the electrical safety in lines with nominal voltages up to AC 1000 V and DC 1500 V Part 1 – General Part 2 – Insulation resistance measuring devices
IEC 61326-1:2005 DIN EN 61326-1:2006 VDE 0843-20-1:2006	Generic Emission Standard; Electrical equipment for measurement, control and laboratory use – EMC requirements Part 1 – General requirements
DIN EN 60529 VDE 0470-1:2000	Test instruments and test procedures – degree of protection provided by enclosures (IP code)

Measuring Ranges

Insulation Resistance

Scale Standard	Measuring Range	Nominal Range of Use	Nominal Test Voltage U_N/U_T	Nominal Test Current I_N/I_T	Instrinsic Uncertainty [1]	Measuring Uncertainty
1 VDE 0423	100 kΩ ... 100 MΩ	100 kΩ ... 10 MΩ	100 V 200 V 500 V 1000 V	1 mA	± 2.5%	±30% of measured value
2	10 kΩ ... 1TΩ	100 kΩ ... 100 GΩ	100/1500 V 250/2000 V 500/2500 V 1000/5000 V	1mA/0.7mA 1mA/0.5mA 1mA/0.4mA 1mA/0.1mA	± 5%	

ShortCircuit Current I_K 1.3 mA

Making Capacity for Insulation Resistance Measurement
Response Time < 100 GΩ < 3 s; > 100 GΩ < 8 s
also valid for test voltage or measuring range change

Direct and Alternating Voltage

Measuring range	Frequency	Internal resistance	Max. allowable voltage	Instrinsic error 1)
0 ... 2000 V AC/DC	15 ...5 00 Hz	5 MΩ	2200 V AC/DC max. 10 s	± 5%

Protective Devices

Terminal	Internal resistance	Max. allowable voltage	Protective device
- Measurement cable	------	to +meas. cable/ to Guard cable: 2000 V DC/AC max. 10 s	via grounded damping diodes
+ Measurement cable Insulation measurement	------	to +meas. cable/ to Guard cable: 2000 V DC/AC max. 10 s	Diodes in high-voltage cascade, PTC thermistor 2) and series resistors
Guard cable	between Guard and meas. cables 90 kΩ	to +meas. cable 2000 V DC/AC max. 10 s	PTC thermistor 2) and series resistors
Battery	------	10 V	Pole protection with diodes voltage limiting in battery charger (optional)

1) with reference to scale length 97.5 mm (100 MΩ range) or 109.8 mm (1 TΩ range)
2) PTC resistor cool-down period until start of new measurement: at least 2 minutes must be observed!

Reference Conditions

Ambient Temperature	+23 °C ±2 K
Relative Humidity	40 ... 60%
Meas. Quantity Frequency	50 Hz ±10 Hz (for voltage measurements)
Line Voltage Waveform	Sine, deviation between effective and rectified value < 1%
Battery voltage	8 V ±1%
Operating position	Horizontal

Power Supply

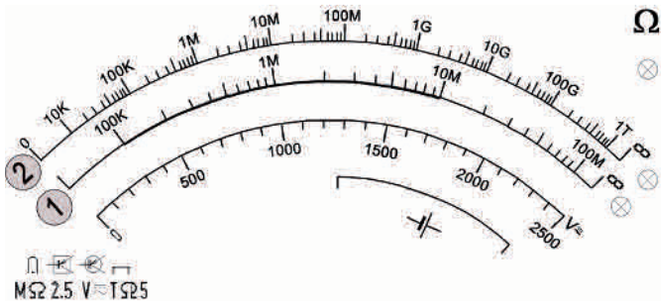
Standard or Storage Battery	6 ea. 1.5 V single cell per IEC R20 (6 x D-Size)
Working Range	6 V ... 10 V
Battery Service Life	7500 measurements for test voltage of 1000 V with meas. resistance of 1 MΩ, 15000 measurements for test voltage of 500 V with meas. resist. of 500 kΩ, measurement of 5 s – pause 25 s
Crank Generator (optional)	2 to 3 r.p.s. with moderate strength, the LED Ω signals sufficient crank frequency and consequently the validity of measuring values
Nominal Voltage	7.5 V (at approx. 2.5 r.p.s.)
Nominal Power	4 W (at approx. 2.5 r.p.s.)

Ambient Conditions

Operating Temperature	0 °C ... + 40 °C
Storage Temperature	- 20 °C ... + 60 °C (without batteries)
Relative Humidity	max. 75%, condensation must be avoided
Elevation	up to 2000 m

Display

Movement	Core-magnet moving coil mechanism
Scale length	111.5 mm (longest scale)



Electrical Safety

Protection Class	II
Test Voltage	8.5 kV~
Measuring Category	1000 V CAT II, 600 V CAT III, 300 V CAT IV
Nominal Voltage	1000 V
Open Circuit Voltage	5000 V
Contamination Degree	2

Using the test probes

Maximum rated voltage	300 V	600 V	1000 V	5000 V
Measuring category	CAT IV	CAT III	CAT II	----
With safety cap attached	■	■	----	----
Without safety cap	----	----	■	■

Electromagnetic Compatibility (EMC)

Product standard DIN EN 61326-1:2006

Interference Emission		Class
EN 55022		B
Interference Immunity	Test Value	Performance Feature
EN 61000-4-2	Contact/Air - 4 kV/8 kV	B
EN 61000-4-3	10 V/m	B

Mechanical Design

Dimensions	W x D x H: 290 mm x 250 mm x 140 mm
Weight	3.4 kg with batteries
Protection	IP 52

Extract from table on the meaning of IP codes

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

Equipment METRISO PRIME (battery operation)

1 high-voltage insulation tester with permanently connected measurement cables and test prods,
2 crocodile clips (5 kV version) and plug-in battery module including batteries
1 carrying strap
1 operating instructions

Equipment METRISO PRIME (hand crank generator operation)

1 high-voltage insulation tester with permanently connected measurement cables and test prods,
2 crocodile clips (5 kV version) and hand crank generator
1 carrying strap
1 operating instructions

Accessories

Hand Crank Generator for retrofit

Carrying Bag F2000

The test instrument, replacement batteries, guard cable, etc., can all be conveniently strored and transported with the F2000 carrying bag.

ISO-Kalibrator 1

Calibration adapter for testing the accuracy of measurement instruments for insulation resistances and low impedance resistances for test voltages up to 1000 V.

Order Information

Designation	Type	Article Number
High-voltage insulation tester **for battery operation**	METRISO PRIME	M550T
High-voltage insulation tester **for hand crank generator operation**	METRISO PRIME	M550U
Universal carrying bag for METRISO PRIME	F2000 [D)]	Z700D
2 alligator clips 1000 V CAT III / 5000 V CAT I 16 A	KY 5000A	Z580B
1 guard cable with plug and crocodile clip	Guard 5000A	Z580C
5 m extension cable	Leadex 5000	Z580D
Hand crank generator for retrofitting METRISO PRIME to hand crank generator operation	Z580A	Z580A
Set consisting of: METRISO PRIME for battery operation, F2000, KY 5000A and 5000A guard	METRISO PRIME-Set	M551T
Set consisting of: METRISO PRIME for hand crank generator operation, F2000, KY 5000A and 5000A guard	METRISO PRIME-Set	M551U
Calibration adapter for test voltages up to 1000 V	ISO-Kalibrator 1	M662A

[D)] Data sheet available

The monitoring and control schemes of cathodic protection systems require very accurate measurement of relatively very low potential differences between metallic objects and surrounding electrolytes soil or water, with respect to a standard reference electrode :
Zn, **Cu/CuSO$_4$**, **Ag/AgCl** or **MnO$_2$**

The conventional low input impedance instrument can not be relied upon to give good results in such cases. The zinc reference electrodes which have relatively longer reliable operation life than other electrodes are installed in permanent systems but the measured values are to be usually / conventionally displayed and reported in terms of potentials with respect to Cu/CuSO$_4$ or Ag/AgCl reference electrodes for easy interpretation of results.

The present practice of marking the scales for both types of reference electrodes on analog type instruments solves the problem to some extent but not at all when the low input impedance analog type instruments are replaced by high input impedance digital instruments.
The transmission of field data by long cables between local measuring points and master control station for remote monitoring and controls, makes it necessary to convert the measured low voltage signal into an equivalent low current signal to preserve its integrity. These practical considerations indicated the need of developing a potential converter which can be conveniently connected across the conventional potential measuring devices to provide the desired results.

Option

Potential Converter with integrated potential data logger

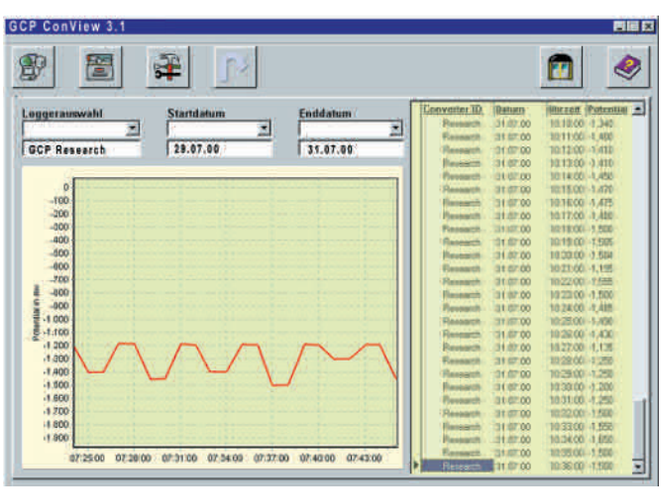
The potential converter can be optionally equiped with a one channel potential logger. The available number of selectable sampling rates in combination with the storage capacity allows short term recording as well as long term recording covering several months.
The specially designed processing software *ConView* (for Windows) enables display of stored values either graphically or as table on screen as well as print-out by printer or plotter.
The data transfer to a laptop takes place by means of an interface RS 232. Data transfer during potential logger operation mode is possible.

Recording capacity: 2 000 values

Sampling rates: 1.0 s / 1 min / 10 min / 1.0 h / 6.0 h

Technical data

Design	Plug-in or snap-on unit with separate terminals
Input	Reference electrode / cathode -4.0 V - +4.0 V DC
Output	Volts, as measured by a 10 MΩ input impedance voltmeter Volts, measured by a specified type of reference electrode : Zn, Cu/CuSO$_4$, Ag/AgCl or MnO$_2$
Output options	0 - 20 mA or 4 - 20 mA signals for transmission purposes via cable
Accuracy	< 1 %
Environmental conditions	Temperature -25°C to 60°C Installation : indoor (enclosed)
Power supply	AC 90 - 265 V, 50-60 Hz, or DC 18 - 36 V
Protection class	IP 40
Dimensions	70 x 75 x 109.5 mm



Portable reference electrodes

Portable reference electrodes are used to carry out potential measurements on all types of buried and submerged structures. The reference electrodes are made of solid copper elements which are housed in impact resistant plastic tubes.
To ensure that the copper elements remain electrically stable, copper sulfate crystals are provided with each ordered reference electrodes. The crystals surround the copper elements in the plastic tube, and when mixed with distilled water, create a super saturated solution of copper sulfate to reduce ion intermixing. A window on each cell allows the operator to observe the water level of the crystallized solution. If the level is insufficient, water and copper sulfate crystals can be simply added by removing the filling cap found on each creference electrodes.

Reference Electrode Kit Ag/AgCl
Model: RE-7AG

Dimensions of case:

270 x 180 x 85 mm (W x D x H)	Weight: 1.1 kg

Used on land with Lexan tube, CPT ceramic plug and KCL filling solution.
Used in sea water with perforated Lexan tube, brass submersible weights (any number of weights can be attached; two included in this kit) and standard 2.5 m submersible adapter (available in additional lengths).

Reference Electrode Cu/CuSO4 for use in soil
Model: CUS-01

Dimensions

Diameter: 110 mm	Height: 110 mm	Weight: 1.0 kg

Reference Electrode Cu/CuSO4 for use in soil and (with submersible adapter) for use in water
Model: MILLER RE-5

Dimensions

Diameter: 35 mm	Height: 152 mm	Weight: 0.15 kg

Accessories:
Electrode extension 760 mm long.
Submersible adapter converts electrode for use in water.
With different lead length:
(2.5 m, 7.5 m, 15 m, 30 m, or 60 m) with copper test clip attached.
Water-tight connection.

Test lead reels - „ BIGSPOOL „			
Type	Lead length	Cross-section	Colour code
SPOOLB - 50/1.00	500 m	1.0 mm^2	1 - 8
SPOOLB - 10/1.00	1000 m	1.0 mm^2	1 - 8
SPOOLB - 50/1.50	500 m	1.5 mm^2	1
SPOOLB - 10/1.50	1000 m	1.5 mm^2	1
SPOOLB - 50/2.50	500 m	2.5 mm^2	1

Colours : 1 = black, 2 = red, 3 = blue, 4 = yellow, 5 = green, 6 = violet, 7 = brown, 8 = white

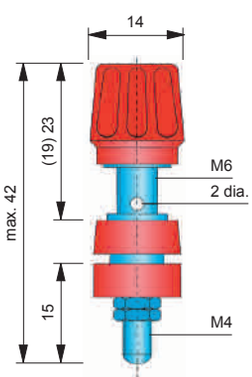
Test lead reels - „ FASTSPOOL „			
Type	Lead length	Cross-section	Colour code
SPOOLF - 25/0.75	25 m	0.75 mm^2	1 - 8
SPOOLF - 25/1.00	25 m	1.0 mm^2	1 - 8
SPOOLF - 50/0.75	50 m	0.75 mm^2	1 - 8
SPOOLF - 50/1.00	50 m	1.0 mm^2	1 - 8
SPOOLF - 10/0.75	100 m	0.75 mm^2	1 - 8
SPOOLF - 10/1.00	100 m	1.0 mm^2	1 - 8

Colours : 1 = black, 2 = red, 3 = blue, 4 = yellow, 5 = green, 6 = violet, 7 = brown, 8 = white

Needle tips

Flexible guide shaft and contact socket for plug 4 mm dia.

Colours : 1 = black, 2 = red



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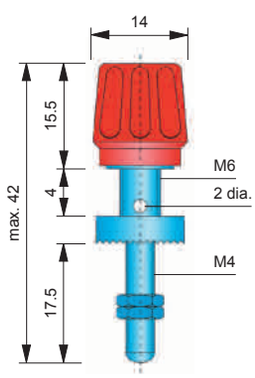

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Earthing rod for temporary measurements

Rod material:	Vanadium steel 50CrV4 Blade tanged right through the handle, chrome-plated, extremely strong
Handle:	Hardwood, clear varnished with leather cap
Total length:	390 mm
Rod length:	250 mm
Contact socket:	4 mm dia.

Earthing rod for temporary measurements

Type: D 634 145
Material : Steel, galvanised
Length : 450 mm