



Power Network Safety & Quality

Application catalogue

Power Network Safety & Quality

Introduction of covered fields

Electrical Power Plants need professional approach to minimize the possible trip-out periods, optimize power quality and maximize the safety in surrounding to ensure long-term operation without error. The

test equipment needs to be robust enough, with high immunity to electromagnetic field and noise. Test current and voltage sources must be powerful enough while meters need to be synchronized and filtered to measure satisfactory results.

Renewable Energy Power Plants in combination with existing power network platform need safety procedures and advanced test approach

like any other infrastructure and open new challenges. Several applications appeared in the area of testing the trip-out ability on live circuits at higher voltage

levels, AC and DC sources, batteries, solar panels and strings, inverters and similar. Ground impedances, lightning protection, equipotential bonding, insulation quality, voltage, current and power quality are expanding to new dimensions.

Power Production



HV substations, MV substations, Transmission lines and Distribution Power Transformers all need to be designed, installed and maintained appropriately to create safe environment and good operational

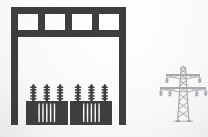
and functional safety. Insulators must protect against current leakage to ground, equipotential bonding and connectivity to earth must protect against dangerous voltage drops between exposed surfaces, and earthing systems with ground nets creates safe spread of voltage funnel. In case of a fault automatic trip-out must be guaranteed.

Industrial platforms safety and quality testing

where powerful transformers and loads impose conditions for better equalisation. Measuring equipment and methods should be ready to manage the higher cross-sections,

presence of corrosion, leakage and noise currents, harmonics and other disturbances from surrounding. Complex test equipment need to be protected in a high manner to operate without interruptions for a longer period.

Power Distribution

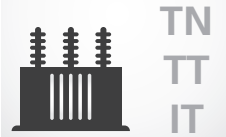


Power Transformers earthing and grounding systems are the point of connection, separation or insulation from each other for functional, operational and protective earth bonds. The installed system is the main

consideration for choosing the proper measuring method and test equipment. The strong connections and earth bonding need to be checked with adequate test currents to assure safety even in case of fault on overloaded transformers. More frequent periodical testing is strongly recommended for environments with vibrations caused by constantly changing high currents. Test methods, which enable testing under functional system without disconnection of transformers or production lines give advantages to the end user and system owner. Additional insulation analysis during remount process needs to be executed with test equipment immune to inductances, capacitances and noises from surrounding. Alternately, proper testing methods should be used to isolate equipment from excessive noise.

Power loads are connected either to TN/TT/IT earthing system and need to be continuously monitored for leakage currents or insulation failures. It makes no difference whether system

Power Transformers TN, TT, IT



is permanently installed or implemented in a portable unit (e.g. vehicles and mobile units). The test equipment needs to be robust enough: immune to electromagnetic fields, harmonics and high

frequency noise as well as to the capacitance or inductance of the load. Bigger loads (e.g. load current more than 100 A) should be tested with higher test current and four-wire test method to assure more accurate results for earth bonding and automatic trip out ability.

Power Loads TN, TT, IT



Power Network Safety & Quality

Contents

POWER NETWORK SAFETY & QUALITY

SOLUTIONS@METREL®

ACADEMY@METREL®

INSTRUMENTS FOR APPLICATIONS ON POWER NETWORK

- MI 3295 Step Contact Voltage Measuring System
- MI 3290 Earth Analyser
- MI 3252 MicroOhm 100A
- MI 3250 MicroOhm 10A
- MI 3155 EurotestXD and MI 3144 Euro Z 800 V
- MI 3280 DT Analyser
- MI 3210 TeraOhmXA 10 kV
- MI 2893 Power Master XT
- MI 3108 EurotestPV and MI 3109 EurotestPV Lite

SELECTION GUIDE BY APPLICATION

SOLUTIONS FOR FIELDS OF USE

- Powerplants, Transformers, Cables, Installations exceeding 1 kV
- Power Distribution, Substations, Transformers, Installations exceeding 1 kV

ACCESSORIES

Electrical Safety & Quality Bundle Kit Set Box Inspection - Maintenance - Service - Intervention

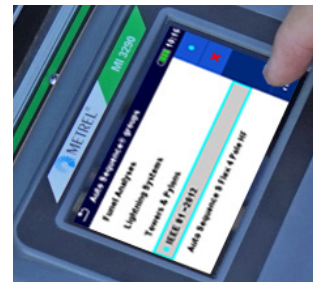
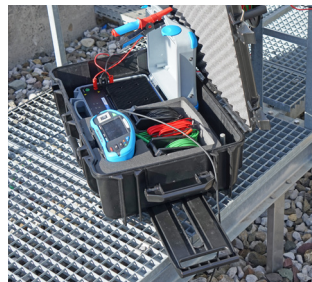
Innovative approach

Adaptable Package Kit Bundles are sets of combined tools for measuring methods tailored perfectly to customer demand. Licence and customization include appropriate accessories. The set is packed and delivered in waterproof case that eases the transport, protects the equipment and prolongs its life cycle.



AUTOSEQUENCE®

Testing procedures for Automatic Sequences can be designed on-demand. Operator can follow local rules easily and safely, never missing the goal.



Warnings & Safety Precautions

Safety precautions should be respected for any project. Safety warnings and precautions before, during and after testing procedure allow high level of protection. Regular warnings and precautions as well as standardized rules should be implemented during operation on field to automatically control the work process.



Example of safety precautions included in Metrel Earth Analyser MI 3290:

Before test:

- Wearing dielectrically rated gloves and footwear.
- Exposed test leads and electrodes are isolated from workers and public prior.
- Remote probes and test leads are under continuous observation.

Hazards during test:

- Avoid ungrounded ends of test leads.
- Surge arrester can approach line potential.
- Never disconnect the ground.
- Lightning or switching currents can be discharged into the ground.
- A system fault can occur if a surge arrester fails during testing.
- Hazard can occur when disconnecting neutral and shield wires.
- Hazard can occur due to current flow through the interconnected shield wires.
- High voltages can occur if neutrals are disconnected from energized equipment.

After test:

- All test leads promptly removed after the test is completed.

Example of standardized safety precautions - IEEE Std. 81 tm - 2012:

IEEE 81tm /5.1 SAFETY PRECAUTIONS 5.1. Ground electrode tests precautions:

- Reduced the hazards associated with handling test leads by wearing gloves and dielectrically rated footwear.
- Exposed test leads and electrodes are isolated from workers and the general public prior.
- Short test periods assured and all test leads promptly removed after the test is completed.
- Remote probes and test leads are under continuous observation.
- Ungrounded ends of test leads parallel an energized line mitigated by the physical orientation of test leads, grounding, or both.

IEEE 81tm /5.2 SAFETY PRECAUTIONS 5.2 Surge arrester ground continuity tests precautions:

- The base of the surge arrester can approach line potential. Never disconnect the ground of a surge arrester.
- Extremely high, short-duration lightning or switching currents can be discharged into the ground.
- A system fault can occur if a surge arrester fails during testing.

IEEE 81tm /5.3 SAFETY PRECAUTIONS 5.3 Neutral and shield wire ground tests procedures:

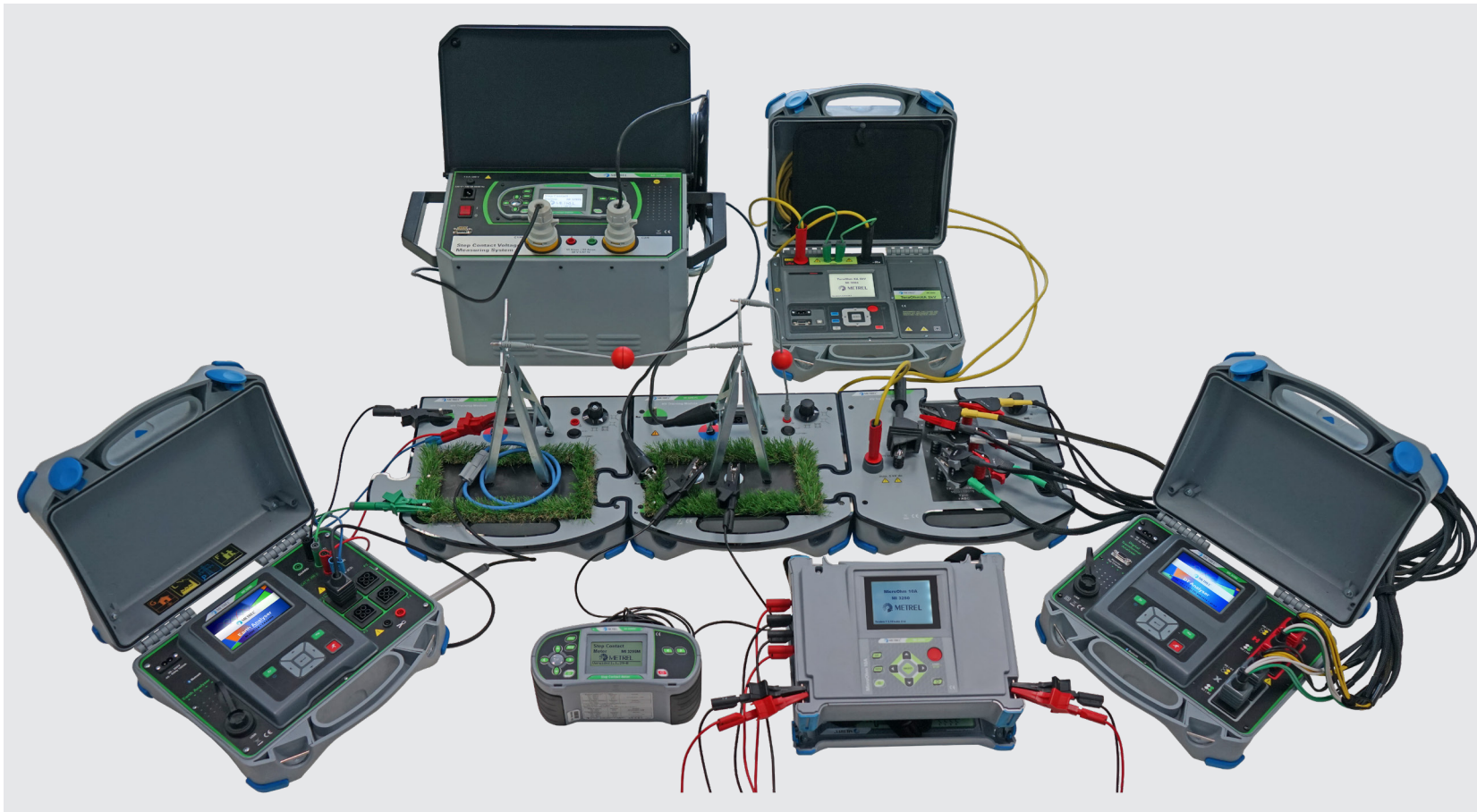
- Disconnecting neutral and shield wires can generate hazardous voltages.
- Hazard can occur whether the line is energized or not, due to current flow through the interconnected shield wires.

IEEE 81tm /5.4 SAFETY PRECAUTIONS 5.4. Equipment neutral ground test precautions:

- High voltages can occur if neutrals are disconnected from energized equipment.

Seminars and practical trainings

Seminars and practical trainings are prepared by Metrel as a package through the Power Training Modules under the Metrel Academy. All training modules are registered by the Ministry of Infrastructure (Energy Directorate) in Slovenia.



with, international standards

Registering of the module is possible:

- Through national or international institutes
- Through the Ministry of Infrastructure (Energy Directorate) in Slovenia
- Other partners: Institutes, Training centres, Electricity Safety Boards, Trainers for power network environment.

Training modules should be equipped with:

- Catalogue of Knowledge,
- A Catalogue of Exam,
- A Certificate for supplementary qualification and competences.

Certified Training Modules and Seminars are supported by the Metrel Academy. Within the Knowledge section we make recommendations and suggestions in support of national vocational qualification schemes. We can also offer training with completely new Training Modules for any new application areas.

European Qualification Certificate adjusted to the EU countries' industry standards ensures the competency of individual participants who pass the final Exam on Theoretical and Practical knowledge for the specific locally approved Training Module. It consist of:

- Know-How Package - for a Transparent Localization Process.
- Knowledge Catalogue - for the specific Training Module for modification to a local – National regulation.
- Exam's Catalogue - with the definition of the minimum level of the Entry conditions for a participant.
- Approved Certificate - approval of the obtained qualification when signed by a local authorized organization like:
 - Training organization.
 - Electrical Safety Board Organization, as for example NNELI, eTest / local – National AIE partner.

Metrel Academy

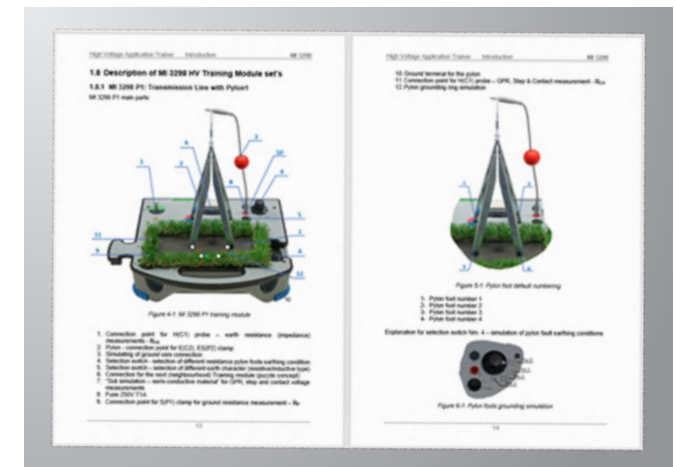
has put out a comprehensive list of training sessions in order to help you master the latest measurement and testing technologies.

Modules:

- Earth/ground network impedance analysis
- Power generator, transformer and coils
- Insulating material analysis

All modules are supported with handbooks, posters, charts, presentations, exercises, catalogue of knowledge and catalogue of exams. Approved certificates may be issued when localizing modules to meet the required country's regulation.

Both training modules offer simple error simulation, thus enabling trainees to practice troubleshooting procedures.



Instruments for applications on Power Network

MI 3295 Step Contact Voltage Measuring System

Ground Network Impedances, Earth Surface Potentials & GPR & Fault Simulated Step & Contact & Touch Voltages, Pylons

The measurement of grounding and earthing, resistances and impedances, low frequency response on earth faults, high frequency response on switching manoeuvre or lightning strike, sweep frequency graphs for earthing systems analysis, soil resistivity and the GPR analysis of voltage drops around objects ensure the safety in the surrounding area of any power plant, substation, transmission or distribution line, transformer, pylon, antenna tower and object in the common environment.

The MI 3295 Step/Contact Voltage Measuring System is a voltage measuring system intended for testing and verification of protective earthing of power stations, substations and other power systems. It is one of the smallest solutions on the market but cleverly designed to balance between safety, powerful generator (up to 55 A) and special technology

to eliminate the earth noise current even in low power operating mode in the range of mA. It utilizes a SELV voltage of only 55 V to perform the tests, reducing the risk of injury to people or livestock when testing in populated area. Test results can be interpreted and recalculated at the test site online, to "live" earth fault or lightning strike simulation. The measurement of earth

resistance, soil resistivity and the analysis of voltage drop around objects ensure the safety in the surrounding area the earth fault or lightning strike.

The system consists of Station (MI 3295S) for current generation and autonomous Volt-Meter (MI 3295M). Due to high test current (up to 55 A) and effective

noise filtering the MI 3295M ensures very accurate and stable measurements (resolution down to 10 μ V). Few voltmeters can be used simultaneously for faster measurements and analysis of voltage distribution around tested object. Test results and parameters could be saved in the instrument's memory for further downloading, analysis and test report printing with the PC software HVLink PRO.

MEASURING FUNCTIONS

- Step voltage;
- Contact voltage;
- Specific earth resistance;
- Earth resistance.



MI 3290 Earth Analyser

Ground Network Impedances, Earth Surface Potentials & GPR & Fault Simulated Step & Contact & Touch Voltages, Pylons

The measurement of earth resistance, soil resistivity and the analysis of voltage drop around objects ensure the safety in the surrounding area for the event of an earthing fault or lightning strike.



MI 3290 Earth Analyser is remarkable set of “all in one” solution for earthing and grounding measurement and analyses. MI 3290 includes all known measuring methods in single portable box – Sweep frequency generator, HF 25 kHz generator, Lightning strike pulse generator, Step / Contact / Touch and GPR Voltage funnel research tool, Pylon legs with Flex Clamps testing for mono and multiple-leg towers, including classic measurement methods 2 / 3 / 4 wire, selective one clamp and two clamp methods and additionally new exclusive approaches to saving

measure-ment time and reduce complexity.

- Excellent immunity even against changing earth currents.
- Very sensitive and autonomous Step Volt-meter with high resolution and stability down to 10µV
- Synchronized Volt-meter and generator eliminates the need for long wires
- More Volt-meters can operate simultaneously with single generator
- Low weight
- High safety due to low output voltage (55 V)
- Downloadable test results and parameters directly to the PC with the help of the professional software MESM for further analyse

MI 3290 Earth Analyser is a portable, battery or mains powered test instrument with excellent IP protection (IP 54 open case), intended for measurement of earth resistance, specific earth resistance and earth potential of various energetic and non-energetic objects. Battery operated MI 3290 Earth Analyser enables testing and analysing without the need of external power, easing approach to the testing site without heavy test equipment and generators. High electrical noise immunity makes this instrument best suited for industrial environments. Instrument is available in multiple sets which are a combination of different accessories and measurement functions.

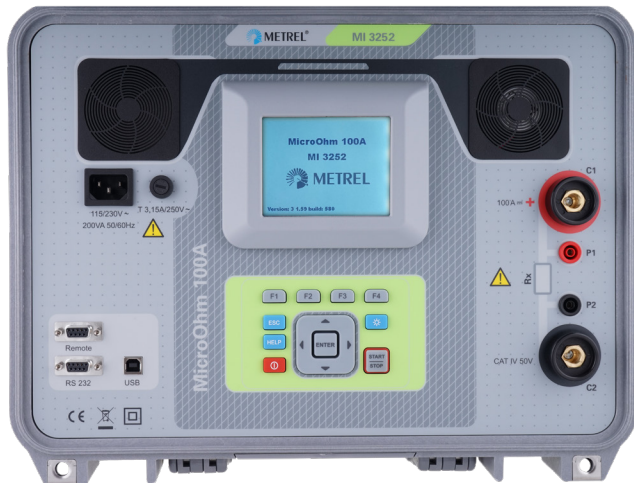
MEASURING FUNCTIONS

- Earth Resistance 2,3,4 -pole (frequency sweep or fixed one: 55 Hz - 15 kHz);
- Selective Earth Resist (1 x iron clamp);
- Earth Resistance (2 x iron clamps);
- Specific Earth Resistance (Wenner and Schlumberger method);
- HF-Earth Resistance (25 kHz, acc. to IEEE_Std 81);
- Earth Resistance of mono pylons with 5 m flex clamp (1 x A 1487);
- Earth Resistance of multi-leg pylons with up to four flex clamps (up to 4 x A 1487);
- Current measurement (Iron, flex clamps);
- Low Ohm measurement 7 mA and 200 mA;
- Earth Potential;
- Step and contact measurements;
- Impulse Earth measurement 10/350 µs.



MI 3252 MicroOhm 100A Equipotential & Connectivity

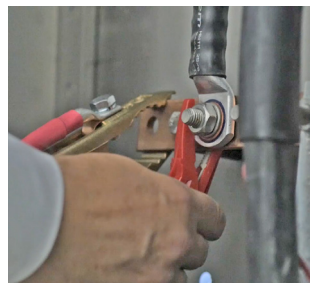
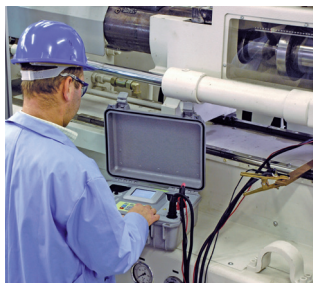
The equipotential bonding and connectivity of conductors with larger cross-section, parallel connected bars and metal strips are hard to prove without a powerful, accurate and precise measuring system.



The MI 3252 MicroOhm 100A is just what is needed to show reliable and stable results with resolution of 1 nΩ. The MI 3252 MicroOhm 100A is portable low resistance ohmmeter used for measuring low contact resistances of circuit breakers, switches and busbar joints using test current from 100 mA to 100 A. 4-wire Kelvin measuring method ensures very high result accuracy (0.25%) and eliminates test leads resistance. MI 3252 could be powered from mains or internal rechargeable battery. PC software HVLink PRO supplied as a standard accessory enables results downloading, analysis, export and printing of test reports/results.

MEASURING FUNCTIONS

- Resistance measurement with adjustable test current (100 mA ... 100 A);
- Voltage drop measurement.



MI 3250 MicroOhm 10A Equipotential & Connectivity

MI 3250 is intended to perform measurements on industrial applications, inductive mode of operation enables measurements on inductive loads and/or transformer coils.



The MI 3250 MicroOhm 10A is portable low resistance ohmmeter used for measuring low resistances of circuit breakers and switches, busbars, cable joints, small to medium sized transformers and motor windings for industrial application, etc., with test current up to 10 A and resolution up to 0.1 μΩ. Used 4-wire Kelvin testing method together with automatic bidirectional procedure ensure high accuracy (0.25%) and eliminates test lead resistance. MI 3250 could be powered from mains or internal rechargeable battery. Results are stored on the instrument and could be downloaded to PC with software HVLink PRO, supplied as a part of standard set. HVLink PRO enables measurement results analyse as well as printing of test reports/results.

MI 3155 EurotestXD and MI 3144 Euro Z 800 V

Short Circuit Currents, Hot Factor evaluation, Automatic Tripout Ability Live Transformer's Impedance & Fault Currents, Transformer protection, maintenance troubleshooting

The MI 3155 EurotestXD is the flagship of Metrel Electrical Installation Safety portfolio. It is a most versatile installation tester, designed specifically for testing in industry, offering every test from basic insulation, line/loop impedance and continuity to multiple option for earth analysis and various additional

measurements. Its ergonomic design, an intuitive colour user interface and advanced software features; like predefined AUTOSEQUENCES®, customized AUTOSEQUENCES®, multilevel programmable location structure and complementary PC software allows easily and reliably instrument use.

MI 3155 together with **MI 3144 Euro Z 800V impedance adapter** is a professional portable high current Hi Precision 4-wire 300A Line / Loop Impedance Tester intended for power utilities and maintenance engineers. It is the most powerful Industrial tester in ranges up to 800V / 16 ... 400 Hz and DC networks with Earth Leakage Relay trip-out testing, 4-wire Partial & Path Resistances dR 300A testing.



MEASURING FUNCTIONS

- Live Transformer's Impedance Measurement with 4-Wire Test;
- Hi-precision Short Circuit Current evaluation with Calculated Hot factor;
- 3-wire test of PE (RPE function) without extension lead conductor;
- Autotest insulation function between L-N, N-PE and L-PE (R ISO ALL function);
- 4 - wire continuity test;
- Insulation resistance with DC voltage from 50 V to 2500 V and PI, DAR calculation;
- Varistor test;
- Continuity of PE conductors with 200 mA DC test current with polarity change;
- Continuity of PE conductors with 7 mA test current without RCD tripping;
- 2-wire and 3-wire loop impedance (L-PE) measurement with Trip Lock RCD function;
- Touch voltage / Contact voltage measurement with external P/S probe.
- 2-wire and 3-wire line impedance (L-L, L-N) measurement;
- 1-phase / 3-phase TRMS voltage and frequency measurements;
- Line, loop and RCD measurements at frequency range 16 ... 400 Hz;
- Phase sequence;
- Power and THD measurement (up to the 12th harmonic);
- RCD testing (general and selective, type AC, A, F, B, B+, MI RCD, EV RCD, PRCD, PRCD-K, PRCD-S);
- Earth resistance (3-wire and 2-clamps method);
- Specific earth resistance with Ro-adapter (option);
- TRMS leakage and load currents (option);
- First fault leakage current (ISFL);
- Testing of Insulation Monitoring Devices (IMDs);
- Machine mode support with time discharge;
- Illumination (option);
- High resolution Loop impedance (mΩ) (option);
- EVSE (Electrical Vehicle Supply Equipment) support (option);
- Determining location of cables (option);
- QR and/or barcode scanner support (option).



MI 3280 DT Analyser

Transformer Ratio and TAP changer Testing, Windings Resistance, Transformer protection, Maintenance & Troubleshooting

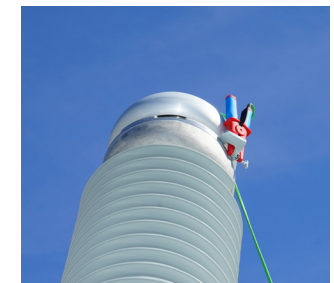
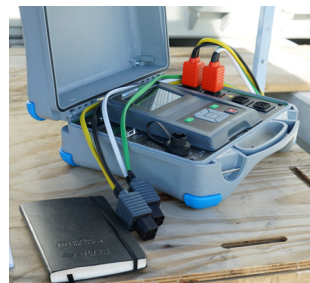
Safe and efficient operation of an electrical system relies on good connectivity between conductors, joints, busbars, switches and components on the way from the power source to the load. Loop impedance testing is one of the best options for finding the cause of losses, high voltage drops, faults on live circuits

and bad contacts. The MI 3280 Digital Transformer Analyser is powerful single and three phases solution for automatic testing of any vector group of LV and MV transformers. Beside transformer turn ratio test, MI 3280 allows also measurement of transformer winding resistance, which could be periodically performed to inspect the transformer condition.

The MI 3280 Digital Transformer Analyser is a portable, battery (Li-ion) operated test instrument intended for transformers turn ratio diagnosing, phase deviation, excitation current and winding resistance measurements of single and three phase CT, VT transformers and power transformers. It offers excellent IP protection (IP 65 case closed, IP 54 case open) for operating in harsh environments. Colour LCD touchscreen enables straight forward operation with included help screens and readable results. Test results could be saved to the instrument's memory and transferred either to PC or Android device with the standardly supplied software via Bluetooth interface or USB cable. PC software offers also creation of test structures, AUTOSEQUENCE editor and report creation.

MEASURING FUNCTIONS

- Turn ratio measurement of single and three phase CT, VT and power transformers;
- Phase deviation between high voltage and low voltage winding;
- Excitation current;
- Winding resistance measurement of single and three phase transformers.



MI 3210 TeraOhmXA 10 kV

HV Insulation Analyzing

Characteristics of insulation tend to change through the time, normally getting worse through ageing. Various physical phenomena's (like temperature, dirt, humidity, mechanical and electrical stresses, high-energy radiation, etc) have a big influence on insulation characteristics.

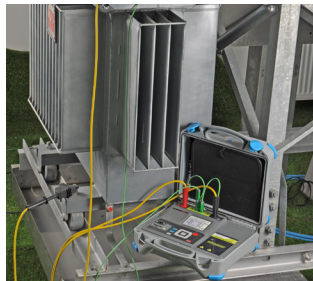


Safety, operability, and reliability are the most important parameters of an electrical device or system containing insulation and this is the reason why insulation must be regularly measured. Insulation is measured in the production phase of electrical device and also later, during maintenance works or repair.

MI 3210 TeraOhm XA 10 kV is a portable, battery or mains powered test instrument with excellent IP protection (IP65), intended for diagnosing of Insulation Resistance by using high DC test voltages of up to 10 kV. Because of its robustness (CAT IV/600 V protection) and high immunity to radiated RF fields it is well suited for industrial or another noise-heavy environment. The voltage can be adjusted in 50 V or 100 V steps and timers for measurements are programmable. The charging rate for capacitive load is $< 3 \text{ s} / \mu\text{F}$ at 10 kV, discharging is automatically after performed test. Results can be viewed on the instrument in numeric or graphical form or transferred to a PC using standardly included PC software. Available interfaces are USB, RS232 and Bluetooth.

MEASURING FUNCTIONS

- Insulation Measurements up to 20 TΩ;
- Diagnostic Tests (PI, DAR, DD);
- Step Voltage Test;
- Withstanding Voltage Test (DC) up to 10 kV;
- Voltage and frequency measurement up to 550 V TRMS.
- Capacitance.



MI 2893 Power Master XT

Energy, Power, Current, Voltage Quality & Energy Reports, Analyse of Events & Waveforms & Harmonics & Flickers & Disturbances & Transients

Power quality is a major strategic issue in the open electricity market economy. It refers to the ability of electrical equipment to consume the energy being supplied to it. Power quality issues include:

- Harmonics influences
- Low power factor
- Voltage instability and
- Imbalance impact on the efficiency of electrical equipment

Systematic and constant approach to the power quality monitoring issues include:

- Easy identification and elimination of problems on the utilities or customer's installation
- Preventative action by early location of potential sources of disturbances or failures
- Optimization of the power network based on measured Power Quality parameters

Including consequences:

- Energy usage and cost is too high
- Maintenance cost is too high
- Equipment failure and instability

Energy management is an important and critical consideration for any business. With the proper energy management, you can achieve better business results through:

- Reduce the maintenance costs of equipment
- Using more effective equipment
- Shift your energy use to the period, when energy is at lower tariff (rate)
- Improve your business result by keeping track on your energy use

Power quality be considered as part of any energy management strategy.

The MI 2893 is the top of the line Class A power quality analyzers intended for usage in different type of installations. It has a large easy-to-read graphical colour display. Simply by connecting to the system, it detects and graphically displays harmonics, phasors, flickers, waveform and transient anomalies in the installation as well as other recorded data and events. The instrument is designed for a long term recording as well as for troubleshooting power quality problems. The handy Quick Set buttons allow faster data overview for troubleshooting. Advanced PC software package PowerView3 enables detailed analysis of recorded data, direct local or remote reading from the micro SD memory card, analysis of long term records and automatic creation of professional test report according national and international standards, like EN 50160, IEEE 519 etc..

MEASURING FUNCTIONS

- Voltage: TRMS, peak, crest factor (4-channels);
- Current: TRMS, peak, crest factor (4-channels);
- Power (active, reactive, apparent);
- Power measurements fully compliant with IEEE 1459 (active, non-active, fundamental, harmonics, inter-harmonics, load unbalance) and classic (vector or arithmetic) method;
- VFD (Variable Frequency Drives),
- 400 Hz;
- Unbalance, flicker measurement;
- Harmonic and inter-harmonic analysis up to 50th harmonics, THD & TID & TDD measurement;
- Energy (active, apparent, reactive, generated, consumed);
- Capturing and recording of power supply events (shutdowns, interruptions, swells, dips);
- Inrush currents monitoring and recording;
- Waveform/inrush displaying, snapshot and recording;
- Transients recording with the 1 MHz sampling frequency;
- Efficiency measurements for PV installations;
- Power quality analysis according to EN 50160, IEEE 519;
- Recording up to 7 adjustable alarms;
- Temperature measurement;
- Power factor/ tg fi.



MI 3108 EurotestPV and MI 3109 EurotestPV Lite

Energy, Power, Current, Insulation resistance, Continuity, Line & Loop impedance, RCD testing, Earth resistance

Photovoltaic installation consists of an arrangement of several components, including solar panels, a AC/DC inverter, cabling and other electrical accessories to set up a working system. To ensure calculated the reimbursement of investment (ROI), a photovoltaic system should operate on the maximum efficiency and whole

system should be maintained appropriately to create safe environment and proper operation.

Systematic and constant approach of the photovoltaic parameters include:

- Easy identification and problem eliminations on the PV installation
- Preventative maintenance by the early location of potential sources of disturbances or failures
- Optimization of the power network based on power quality parameters

The MI 3108 EurotestPV is a combination of photovoltaic and electrical installations safety tester. Complete testing of electrical installations in accordance with EN 61557 standards is enabled and in addition all necessary tests required on single and three photovoltaic (PV) installations could be performed. These include all tests as required by EN 62446, but also I - U characteristic, calculation of STC values as required by EN 61829 and power measurements on Inverter's DC and AC sides by using Metrel power quality analysers (MI 2893/MI 2892/MI 2885). MI 3108 is designed for demanding instrument disconnection from the PV installation in case of failure in the instrument work conditions (up to 1000 V, with 15 A DC). Photovoltaic Safety Probe for A 1385 ensures safety disconnection and improves operator safety during performed measurements.

MEASURING FUNCTIONS

Photovoltaic installations:

Measurements on the DC side of PV inverter:

- Voltage, current, power;
- Uoc (Open Circuit Voltage) and Isc (Short Circuit Current);
- I - U curve of PV modules and strings;
- Irradiance;
- Module temperature.

Measurements on AC side of PV inverter:








- Voltage, current, power;
- Efficiency of PV module, inverter, PV system calculation.

Electrical installations:

- Insulation resistance;
- Continuity of PE conductors;
- Line impedance;
- Loop impedance (sub-functions with high current and without RCD tripping);
- RCD testing (type AC, A and B);
- Earth resistance;
- AC current (load and leakage);
- TRMS voltage, frequency, phase sequence;
- Power, energy, harmonics.



Selection guide by application

LOCATION	Application	Earthing & Grounding testers				Installation testers		
		MI 3295S Step Contact Voltage	MI 3295M Volt-meter	MI 3290 Earth Analyser	MI 3123 Earth / Clamp	MI 3152 EurotestXC	MI 3155 EurotestXD	MI 3144 Euro Z 800 V
								
EARTH / GROUND NETWORK IMPEDANCE	Specific Earth Resistance, Resistivity Werner method	•		•	•	•	•	
	Specific Earth Resistance, Resistivity Schlumberger method			•				
	Earth Resistance of large earthing systems and Surrounding	•		•				
	Earth Impedance at Low frequencies	•		•	•	•	•	
	Earth Impedance at kHz and sweep/graphs			•				
	Fault Simulated Step and Contact Voltages	•	•	•				
	Earth Surface Potentials	•	•	•				
	Voltage Funels GPR & Underground Nets	•	•	•				
	Earth resistances and impedance on Pylons and Transmission Lines	•		•	•			
	Pylon Selective legs & Monotowers, PGWT			•				
BONDING AND EQUILIZING, CONTACTS AND JOINTS HI VOLTAGE INSULATION	Earthing of Remote container with Antenna Towers	•		•	•			
	Lightning Protection & Varistors and Surge protection			•		•	•	
	Equipotential Bonding and Continuity Testing					•	•	
	High Current Partial Earth Bonding Resistance dR 300A with Flex Clamps					•	•	•
	Micro Ohm Testing of Contacts, and Joints and Switches							
	Insulation Resistance Analysing, PI, DAR and DD Indexes							
	Insulation of long cables & Transformers & High Capacitive Loads							
	Insulators and Cable Heads Testing with Steps							
	Insulated and Semiconductive Floors and Walls							
	Surge Protection Devices testing							
POWER GENERATORS AND TRANSFORMERS	Insulation of Transformers and Generators Windings							
	Transformer Ratio Analysing and Tap Evaluation							
	Winding Resistance testing							
	Automatic Tripout Ability on LV side of Power Transformer					•	•	•
	Live Transformer's Impedance and Fault Currents with Hot Factor					•	•	•
	Wind Generator Transformer Testing					•	•	•
	Photo Voltaic Generator Testing					•	•	•
	Fault Currents with ELR and Fuse Characteristics evaluation					•	•	•
POWER QUALITY AND ENERGY MANAGEMENT	Class A Voltage Quality report on LV and MV stations							
	Power Quality and Energy Report							
	Recording of Functional Procedures							
	Transients recording of Switching maneuvers							
	Asymetry and Overheating Prediction							
	Mains signalling Evaluation							
	Flickers Tracking							

**Conductivity & Equipotential Bonding
testers**

**Insulation & Leakage
testers**

**Transformer ratio &
TAP changer testers**

**Power Quality
testers**

MI 3252
MicroOhm 100A



MI 3250
MicroOhm 10A



MI 3242
MicroOhm 2A



MI 3210
TeraOhmXA 10 kV



MI 3205
TeraOhmXA 5 kV



MI 3201
TeraOhm 5 kV Plus



MI 3280
Digital transformer
analyser



MI 2893
Power MasterXT



MI 2892
Power Master



MI 2885
Energy Master



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Solutions for Fields of use

Powerplants, Transformers, Cables, Installations exceeding 1 kV



REFERENCES:

- Nuclear powerplants
- Thermal powerplants
- Hydro powerplants

SOLUTIONS FOR FIELDS OF USE:

Earthing & Grounding

- MI 3290 Earth Analyser
- MI 3295S Step Contact Voltage Measuring System
- MI 3295M Volt-meter

Conductivity & Equipotential Bonding

- MI 3252 MicroOhm 100A

Insulation & Leakage

- MI 3210 TeraOhm XA 10kV

Transformers & Windings & Tripout Ability

- MI 3280 DT Analyser
- MI 3155 EurotestXD
- MI 3144 Euro Z 800 V

Power Quality

- MI 2893 Power Master XT
- MI 2892 Power Master

Solutions for Fields of use

Powerplants, Transformers, Cables, Installations exceeding 1 kV



REFERENCES:

- Solar Powerplants
- Wind turbine Powerplants

SOLUTIONS FOR FIELDS OF USE:

Earthing & Grounding

- MI 3290 Earth Analyser
- MI 3295S Step Contact Voltage Measuring System
- MI 3295M Volt-meter

Conductivity & Equipotential Bonding

- MI 3252 MicroOhm 100A

Insulation & Leakage

- MI 3210 TeraOhm XA 10kV

Transformers & Windings & Tripout Ability

- MI 3155 EurotestXD
- MI 3144 Euro Z 800 V

Power Quality

- MI 2893 Power Master XT
- MI 2892 Power Master

Photovoltaic Systems

- MI 3108 EurotestPV
- MI 3109 EurotestPV Lite
- A 1378 EurotestPV Remote

Multimeters & Clamps

- MD 9070 Insulation/continuity Digital Multimeter
- MD 9050 TRMS Heavy Duty Industrial Digital Multimeter
- MD 116 Non Contact Voltage Detector

Solutions for Fields of use

Power Distribution, Substations, Transformers, Installations exceeding 1 kV



REFERENCES:

- MV Substation
- Power Distribution Substation
- Industrial Switchyard Distribution Platform

SOLUTIONS FOR FIELDS OF USE:

Earthing & Grounding

- MI 3290 Earth Analyser
- MI 3295S Step Contact Voltage Measuring System
- MI 3295M Volt-meter

Conductivity & Equipotential Bonding

- MI 3252 MicroOhm 100A

Insulation & Leakage

- MI 3210 TeraOhm XA 10kV
- MD 9272 Leakage Clamp TRMS Meter with Power Functions

Transformers & Windings & Tripout Ability

- MI 3280 DT Analyser
- MI 3155 EurotestXD
- MI 3144 Euro Z 800 V

Power Quality

- MI 2893 Power Master XT
- MI 2892 Power Master

Solutions for Fields of use

Power Distribution, Substations, Transformers, Installations exceeding 1 kV



REFERENCES:

- Monotowers 700 kV, 400 kV, 200 kV, 100 kV, 36 kV, 20 kV, 10 kV, 1 kV, 700 V, 400 V
- Switchyards – Industrial
- Surrounding Areas – Industry
- Surrounding Areas – Public

SOLUTIONS FOR FIELDS OF USE:

Earthing & Grounding

- MI 3290 Earth Analyser
- MI 3295S Step Contact Voltage Measuring System
- MI 3295M Volt-meter

Insulation & Leakage

- MI 3210 TeraOhm XA 10kV
- MD 9272 Leakage Clamp TRMS Meter with Power Functions

Transformers & Windings & Tripout Ability

- MI 3280 DT Analyser
- MI 3155 EurotestXD
- MI 3144 Euro Z 800 V

Power Quality

- MI 2893 Power Master XT
- MI 2885 Energy Master

Accessories

Featured accessories









Photo	Part number	Description	MI 3295S Step Contact Voltage Measuring System	MI 3290 Earth Analyzer	MI 3252 MicroOhm 100A	MI 3250 MicroOhm 10A	MI 3280 DT Analyzer	MI 3155 EurotestXD	MI 3152 EurotestXC	MI 3144 Euro Z 800 V	MI 3210 TeraOhm XA 10kV	MI 2893 Power Master XT
	MI 3295M	Volt-meter for measuring Step & Contact voltages with resolution of 10 µV	•	•								
	A 1587	Flex current clamp 3000/300/30 A	•	•								
	S 2053	Step voltage test plates	•	•						•		
	A 1353	Step voltage probes (25 kg)	•	•								
	A 1529	Current earth spike (90 cm)	•	•								
	A 1528	Potential earth spoike (42 cm)	•	•						•		
	A 1629	Potential earth spike (60 cm)	•	•								
	A 1325	Current test lead (shielded), 50 m, black, 10 mm ² , with crocodile clip, on wheel	•									









Photo	Part number	Description	MI 3295S Step Contact Voltage Measuring System	MI 3290 Earth Analyzer	MI 3252 MicroOhm 100A	MI 3250 MicroOhm 10A	MI 3280 DT Analyzer	MI 3155 EurotestXD	MI 3152 EurotestXC	MI 3144 Euro Z 800 V	MI 3210 TeraOhm XA 10kV	MI 2893 Power Master XT
	A 1392	Current test lead, 10 m, black, 10 mm ² , with crocodile clip	•									
	A 1508	Shielded test lead 75 m on reel	•									
	A 1530	G clamp	•	•						•		
	A 1487	Flexible current clamp, 50 A, 5 m	•									
	A 1509 A 1510 A 1525	Test lead 50 m on cable reel; black green blue	•	•						•		
	A 1526 A 1527	Test leed 5 m on holder; blue red	•	•								
	A 1595	Large test crocodile, black								•		
	A 1596	Large test crocodile, red								•		









Photo	Part number	Description	MI 3295 Step Contact Voltage Measuring System	MI 3290 Earth Analyzer	MI 3252 MicroOhm 100A	MI 3250 MicroOhm 10A	MI 3280 DT Analyzer	MI 3155 EurotestXD	MI 3152 EurotestXC	MI 3144 Euro Z 800 V	MI 3210 TeraOhm XA 10kV	MI 2893 Power Master XT
	A 1620	Test lead 5 m, black										•
	A 1621	Test lead 20 m, black										•
	A 1640	Test lead 20 m, red, 1.5 mm2										•
	A 1608	Test lead 20 m, green										•
	A 1654	Test lead on cable reel, 50 m, red, 1.5 mm2, extendable										•
	A 1660	Extension test leads on reel, 75 m, red, green, 2.5 mm2	•									•
	A 1661	Jumbo case mount for A 1660	•									•
	A 1597	Human body resistance probe										•









Photo	Part number	Description	MI 3295 Step Contact Voltage Measuring System	MI 3290 Earth Analyzer	MI 3252 MicroOhm 100A	MI 3250 MicroOhm 10A	MI 3280 DT Analyzer	MI 3155 EurotestXD	MI 3152 EurotestXC	MI 3144 Euro Z 800 V	MI 3210 TeraOhm XA 10kV	MI 2893 Power Master XT
	A 1022	Earth test rod, 2 pcs		•					•	•		•
	S 1072	Continuity test lead with crocodile clip		•			•					
	A 1615	Kelvin test lead (Red/ black - yellow) with Metrel crocodiles; 2.5 m / 5 m					•					
	A 1616	Kelvin test lead (Red/ white - green) with Metrel crocodiles; 2.5 m / 5 m					•					
	A 1617	Kelvin test lead (Gray/ black - yellow) with Metrel crocodiles; 2.5 m / 5 m					•					
	A 1618	Kelvin test lead (Gray/ white - green) with Metrel crocodiles; 2.5 m / 5 m					•					
	S 2046	100A Current test lead with insulated crocodiles, 5 m, 25 mm2			•							
	A 1333	Resistor Shunt, 750 Ω			•	•						









Photo	Part number	Description	MI 3295S Step Contact Voltage Measuring System	MI 3290 Earth Analyzer	MI 3252 MicroOhm 100A	MI 3250 MicroOhm 10A	MI 3280 DT Analyzer	MI 3155 EurotestXD	MI 3152 EurotestXC	MI 3144 Euro Z 800 V	MI 3210 TeraOhm XA 10kV	MI 2893 Power Master XT
	S 2052	100 A test leads with crocodile clip			•							
	A 1383	Temperature probe with 3 m cable				•						
	A 1169	Fast battery charger				•		•				•
	A 1160	Fast battery charger				•		•				•
	A 1110	Three phase adapter						•	•			
	A 1111	Three phase adapter with switch						•	•			
	A 1391	AC/DC current clamp						•	•			
	A 1105	Barcode scanner						•	•			









Photo	Part number	Description	MI 3295S Step Contact Voltage Measuring System	MI 3290 Earth Analyzer	MI 3252 MicroOhm 100A	MI 3250 MicroOhm 10A	MI 3280 DT Analyzer	MI 3155 EurotestXD	MI 3152 EurotestXC	MI 3144 Euro Z 800 V	MI 3210 TeraOhm XA 10kV	MI 2893 Power Master XT
	A 1653	QR / Barcode scanner (Bluetooth)										•
	A 1314	Plug commander							•	•		
	A 1172 A 1173	Luxmeter sensor, type B (A 1172) type C, PS/2 (A 1173)							•	•		
	A 1199	Ro-adapter							•	•		
	A 1201	Insulated rod for continuity measurement							•	•		
	A 1198	Magnetic contact probe							•	•		•
	S 2058	Insulation test plates							•	•		•
	S 2029	10 kV shielded test lead, 8m										•


























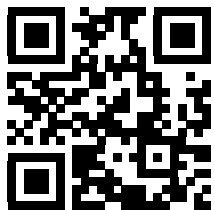
Photo	Part number	Description	MI 3295S Step Contact Voltage Measuring System	MI 3290 Earth Analyzer	MI 3252 MicroOhm 100A	MI 3250 MicroOhm 10A	MI 3280 DT Analyzer	MI 3155 EurotestXD	MI 3152 EurotestXC	MI 3144 Euro Z 800 V	MI 3210 TeraOhm XA 10kV	MI 2893 Power Master XT
	S 2030	10 kV shielded test lead, 15m										
	S 2036	HV crocodile clip										
	A 1532	EVSE adapter										
	A 1567	4400 mAh battery pack										
	A 1568	8800 mAh battery pack										
	A 1593	Large Kelvin test crocodile										
	A 1597	HB probe										
	A 1609	Flex clamp, 30/300/3000A, fi=54 cm, 5 m cable length										
	A 1281	Iron current clamp 0,5/5/100/1000 A/ 1 V, with jaw opening: 5.2 cm;Max. conductor size < 50 mm, 1.5m cable length										

Photo	Part number	Description	MI 3295S Step Contact Voltage Measuring System	MI 3290 Earth Analyzer	MI 3252 MicroOhm 100A	MI 3250 MicroOhm 10A	MI 3280 DT Analyzer	MI 3155 EurotestXD	MI 3152 EurotestXC	MI 3144 Euro Z 800 V	MI 3210 TeraOhm XA 10kV	MI 2893 Power Master XT
	A 1227	Flex clamp, 30/300/3000A, fi=14 cm, 1.5m cable length										
	MI 3144	Euro Z 800 V impedance adapter										
	A 1501 A 1502 A 1445	1-phase flexible smart current clamps 30/300/3000A/1V phi 7cm/14cm/19cm										
	A 1503 A 1446	1-phase flexible smart current clamps 60/600/6000A/1V phi 27cm"										
	A 1588	1-phase iron smart current clamps 0.5/5/50A jaw opening 4 cm; max. conductor size < 5 cm / 5 cm										
	A 1648	Current clamp A 1281 extension cable, 5m										
	A 1019	1000 A/1 V current clamp										
	A 1018	1000 A/1 V low range, leakage current clamp, 3.5 m length										

Notes

Photo	Part number	Description	MI 3295 Step Contact Voltage Measuring System	MI 3290 Earth Analyzer	MI 3252 MicroOhm 100A	MI 3250 MicroOhm 10A	MI 3280 DT Analyzer	MI 3155 EurotestXD	MI 3152 EurotestXC	MI 3144 Euro Z 800 V	MI 3210 TeraOhm XA 10kV	MI 2893 Power Master XT
	A 1391 PQA A 1636	AC/DC iron current clamp 40/300A/1V // DC 2000A AC 1000A jaw opening 2.5cm // 7.3 cm; max. conductor size < 2.2 cm // 6.8 cm"										•
	A 1355	GPS synchronization unit										•
	A 1622	3G/Wi-Fi router										•
	S 2014	Safety fuse adapter, 3 pcs										•
	S 2015	Safety flat clamp, 4 pcs										•
	A 1500 A 1565	Watterproof, IP 65 rated plastic carrying case (A1500); outdoor application - pillar mounted (A 1565)										•
	A 1577	Watterproof, IP65 rated plastic carrying case with telescopic handle and smooth running wheels										•
	A 1658	Jumbo case		•		•	•	•	•	•		•

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