

Test instruments for  
the maintenance of  
electrical power systems

**Megger**<sup>®</sup>



# New Products

## True 3-phase turns ratiometer

### TTRU3

Guaranteed  $\pm 0.05\%$  accuracy from  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$   
See page 27



TTRU3

## Static Motor Tester

### MTR105

Handheld motor tester  
See page 60



MTR105

## Thermal Camera

### TC3231

Professional infrared thermal camera  
See page 64



TC3231

## VLF test system

### VLF Sinus 62 kV

High-performance test and diagnostic system for medium voltage cables.  
See page 43



VLF Sinus 62 kV

## Portable PD detection

### PDS 62-SIN

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### ST25-30

For typical medium-voltage distribution cable fault location  
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ST25-30

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## DC diagnostic insulation testers

Regular insulation resistance testing is one of the most cost effective, non-destructive methods of identifying ageing in electrical equipment. With over 60% of equipment failures being ascribed to insulation breakdown, it is a key area to monitor. Diagnostic DC testing is probably the easiest and most convenient method of achieving this due to the small size and weight of the equipment.

### 5 kV utility insulation resistance tester S1-568

With exceptionally high noise rejection, the fast charging S1-568 offers the full gamut of automatic insulation tests with 8 mA of noise rejection, IR, timed IR, polarisation index (PI), dielectric absorption ratio (DAR), programmable Step Voltage (SS), Dielectric Discharge (DD) and ramp. The S1-568 allows the operator to control the test remotely from a computer using the 10 kV isolated USB port, to store the date and time stamped results on board or to download them in real time using Bluetooth. This is the perfect tester for the itinerant contractor as it will give results in any electrical environment.

### 10 kV utility insulation resistance tester S1-1068

With a full 8 mA of noise rejection and 4 levels of filtering the fast charging S1-1068 obtains meaningful results in extremely hostile environments. Offering the full gamut of automatic insulation tests, IR, timed IR, polarisation index (PI), dielectric absorption ratio (DAR), Step Voltage, Dielectric Discharge and

ramp, the S1-1068 allows the operator to control the test remotely from a computer using the 10 kV isolated USB port, to store the date and time stamped results on board or to download them in real time using Bluetooth. This is the perfect tester for the itinerant contractor as it will give results in any electrical environment.

### 15 kV utility insulation resistance tester S1-1568

A maximum resistance measurement of 35 TΩ and 15 kV test voltage are additional features of this instrument, which displays the same exceptionally high noise rejection as the other testers in the series. Diagnostic tests available include IR, timed IR, polarisation index (PI), dielectric absorption ratio (DAR), Step Voltage, Dielectric Discharge and ramp testing as automatic tests. The results are time and date stamped and stored on board or they can be downloaded in real-time.



## DC diagnostic insulation testers

### 5 kV general purpose insulation resistance tester MIT515

Offering CATIV safety and Megger's unique dual case design, MIT515 is an easy to operate insulation resistance tester that is very tough. Measuring up to 10 TΩ, it allows IR, timed IR, polarisation index (PI) and dielectric absorption ratio (DAR) to be measured automatically.

### 5 kV diagnostic insulation resistance tester MIT525

The MIT525 performs all the insulation tests offered by MIT515 and extends the testing capabilities to include Step Voltage, Dielectric Discharge and ramp testing. Test data can be downloaded in real-time using the 10 kV isolated USB port, or stored in the instrument's advanced memory. Smaller and lighter than its predecessors these new testers are easier to store on a van, fit in an overhead locker on an aircraft and are more convenient to carry to the job.

### 10 kV diagnostic insulation resistance tester MIT1025

The MIT1025 tests insulation to 20 TΩ at test voltages up to 10 kV. It has increased diagnostic potential over its predecessors by offering IR, timed IR, polarisation index (PI), dielectric absorption ratio (DAR), Step Voltage, Dielectric Discharge and ramp testing as automatic tests. The results are time and date stamped and stored on board or they can be downloaded in real-time.

### 15 kV diagnostic insulation tester MIT1525

Offering test voltages up to 15 kV and a maximum insulation resistance reading of 30 TΩ the MIT1525 extends the users' ability to monitor the aging of insulation. Diagnostic tests available include IR, timed IR, polarisation index (PI), dielectric absorption ratio (DAR), Step Voltage, Dielectric Discharge and ramp testing as automatic tests. The results are time and date stamped and stored on board or they can be downloaded in real-time.

		MIT515	MIT525	S1-568	MIT1025	S1-1068	MIT1525	S1-1568
<b>Test voltage</b>	15.0 kV						■	■
	10.0 kV				■	■	■	■
	5.0 kV	■	■	■	■	■	■	■
	2.5 kV	■	■	■	■	■	■	■
	1.0 kV	■	■	■	■	■	■	■
	500 V	■	■	■	■	■		
	250 V	■	■	■				
	100 V to 1 kV in 10 V steps	■	■		■		■	
	1 kV to max test voltage in 25 V steps	■	■	■	■	■	■	■
	40 V to 1 kV in 10 V steps			■		■		■
<b>Measurement</b>	Max reading	10 TΩ	10 TΩ	15 TΩ	20 TΩ	35 TΩ	30 TΩ	35 TΩ
	Min reading	10 kΩ	10 kΩ	10 kΩ	10 kΩ	10 kΩ	10 kΩ	10 kΩ
	Voltage	■	■	■	■	■	■	■
	Capacitance	■	■	■	■	■	■	■
	Leakage current	■	■	■	■	■	■	■
<b>Test types</b>	Timed insulation resistance	■	■	■	■	■	■	■
	Polarisation index	■	■	■	■	■	■	■
	Dielectric absorption index	■	■	■	■	■	■	■
	Step voltage		■	■	■	■	■	■
	Dielectric discharge		■	■	■	■	■	■
	Ramp		■	■	■	■	■	■
<b>Other feature</b>	Analogue and digital display	■	■	■	■	■	■	■
	Short circuit current	3 mA	3 mA	6 mA	3 mA	6 mA	3 mA	6 mA
	Rechargeable	■	■	■	■	■	■	■
	Timer control and display	■	■	■	■	■	■	■
	Max noise rejection	3 mA	3 mA	8 mA	3 mA	8 mA	6 mA	8 mA
	Remote control via USB port			■		■		■
	USB output		■	■	■	■	■	■
	Bluetooth output			■		■		■
<b>Software</b>	PowerDB Lite		■	■	■	■	■	

# DC highvoltage or withstand testing

## 40 kV test unit

### T99/1

The high voltage test unit is portable and powerful, able to generate a DC voltage of up to 40 kV. The T 99/1 is used for testing of cables, cable accessories, plant and installations. It can be powered from an external 12 V battery.



## 70 kV, 120 kV and 160 kV

### DC dielectric test set

### 220000 series

220000 series provides a dependable, safe, lightweight and portable DC voltage source for testing the quality and integrity of electrical power cables, cable installations, motors, switchgear, insulators, transformers and capacitors.

Each test set comes in two units, the HV unit and the controller.

220000 series has advanced performance with long-term reliability provided by filtered half-wave rectification



Model	HV tester 25 kV	T99/1	HV test set 50 kV	HPG70-K	220070	HV test set 80 kV	HV test set 110 kV
DC output	0 to 25 kV	0 to 40 kV	0 to 50 kV	0 to 70 kV	0 to 70 kV	0 to 80 kV	0 to 110 kV
Continuous output current	1.5 mA	2.5 mA	6 mA	10 mA	3.5 mA	5 mA	4 mA
Mains operation	■	■	■	■	■	■	■
Battery operation	Built-in rechargeable battery option	External battery option					
Weight	13.5 kg	15 kg	13 + 17 kg	18 + 20.5 kg	10.5 + 20 kg	13 + 18.5 kg	13 + 20 kg

Model	220123	220163	HVDC200	HVDC400	HVDC650	HVDC800
DC output	0 to 120 kV	0 to 160 kV	0 to -200 kV	0 to -400 kV	0 to -650 kV	0 to -800 kV
Continuous output current	2.5 mA	2 mA	9 mA	4 mA	3.5 mA	2 mA
Short circuit current output			300 mA	300 mA	290 mA	55 mA
Mains operation	■	■	■	■	■	■
Weight	10.5 + 30 kg	10.5 + 33 kg				

# DC highvoltage or withstand testing

## Portable high voltage test set for DC voltage testing of cable and cable installations

**HV test set 50 kV,  
HV test set 80 kV and  
HV test set 110 kV**

This range of three HV test sets is for the DC voltage testing of cables and cable installations in accordance with international standards. Each set consists of a control unit and HV unit. Because they are small and light the test sets can easily be transported and used on-site.



## Portable high voltage tester

**HV tester 25 kV**

This high-voltage generator offers a variable DC output voltage from 0 to 25 kV with an output current of 1.5 mA at the maximum voltage. It is mains or battery powered, and this combined with its low weight makes it ideal for field use. The ground safety circuit and integrated discharge enhance the operator's safety.



## 70 kV DC portable high voltage test system

**HPG70-K**

A fully insulated test set for DC testing up to 70 kV, this system is ideal for stand-alone applications. The DC voltage is obtained through a bridge rectifier which ensures a very low test voltage ripple. Moreover the DC voltage is measured on the output side thus ensuring a precise output voltage. Applications include testing of cables, switchgear, current-transformers, MV plant and components.



## High voltage DC test systems

**HVDC200, HVDC400, HVDC650 and HVDC800**

HVDC test set systems are high-performance, portable testing systems that can be used to test all kinds of components of high voltage direct current transmission in line with the applicable regulations on the generation of HVDC voltages of up to 800 kV. The modular construction permits test voltages up to 800 kV; there is a choice of polarity with a DC ripple of less than 3%.



# AC insulation testers

AC insulation testers most closely replicate the normal operating condition for a substation asset. Consequently they provide the most accurate indication of the insulation condition.

## AC high voltage test system

### T22/1

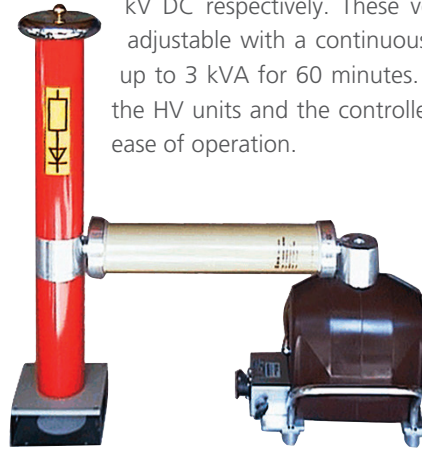
This system is of two piece design and offers continuously variable test voltages up to 75 kV. Its performance is expandable to 150 kV AC by the addition of a second transformer. It features built-in overload protection. The test set can be equipped with a rectifier accessory for DC testing up to 80 kV.



## DC and AC high voltage test system

### HPG50-D, HPG70-D and HPG80-D

These two unit test sets are capable of testing to 35 kV AC and 100 kV DC, 50 kV AC and 140 kV DC, and 58 kV AC and 150 kV DC respectively. These voltages are continuously adjustable with a continuous output of 1.2 kVA and up to 3 kVA for 60 minutes. The separation between the HV units and the controller units contribute to the ease of operation.



## DC and AC high voltage test system

### HPG50-H, HPG70-H, HPG80-H and HPG110-H



Designed on a two unit basis, these test sets are capable of testing to 35 kV AC and 50 kV DC, 50 kV AC and 70 kV DC, 58 kV AC and 80 kV d.c, and 78 kV AC and 110 kV d.c respectively. These voltages are continuously adjustable with a continuous output of 1.2 kVA and up to 3 kVA for 60 minutes.

## 100 kV 50 Hz test system

### HPA100AC and HPA130DC



Offering continuous testing with AC voltages up to 100 kV at 5 kVA, this is a powerful test set. The unit has been designed for mounting in cable test vans and can be used for testing of cable systems and for burning down high-resistance cable faults with a high breakdown voltage. The test set can be equipped with a rectifier accessory for DC testing up to 130 kV.

The noise level of the test system is below 1%, so it is also suitable as a voltage source for PD-measurements.



# AC insulation testers

## 12 kV AC Tan delta test system

### DELTA4000 series

Tough yet light and designed to work reliably in high-interference areas, like substation switchyards, Megger's DELTA4000 series diagnostic insulation systems offer time saving fully automatic power factor/tan delta measurement and tip-up testing. Also provided are facilities for full manual control including the ability to vary the applied voltage up to 12 kV during testing to cater for special testing requirements.

Accurate and dependable temperature correction, based on the actual condition of the test object, can be applied to results using a novel technique, which works with data acquired from a separate dynamic frequency response (DFR) test. Automatic detection of non-linear response, which suggests the need for further (tip-up) testing and which is often a useful indicator of incipient insulation problems, is also provided. Despite their small size and low weight, Megger's DELTA4000 series test sets offer comprehensive facilities for assessing the condition of electrical insulation in all types of high-voltage equipment, including transformers, bushings, circuit breakers, cables, lightning arrestors and rotating machinery as well as measuring the excitation current of transformer windings.

The test sets generate their own test voltage, which is independent of supply quality. A further benefit of this approach



is that it allows the test voltage to be varied in frequency from 1 Hz to 500 Hz, making the instruments even more versatile. There is the option of on-board computer or using an external computer to control the DELTA4000.

For multiple frequency tan delta measurement see FDS on pg 34.

## AC high voltage test sets

### HPA35, HPA50, HPA58 and HPA78

Capable of testing to 35 kV AC, 50 kV AC, 58 kV AC, and 78 kV AC respectively, these test sets are suitable for testing items with low capacity. They are a two piece design consisting of a control unit and a resin-cast HV unit.



#### AC and DC insulation test sets

Model	HPG50-D	HPG50-H	HPG80-D	HPG80-H	T22/1	HPG110-H	HPA100AC / HPA130DC
AC output in kV <sub>RMS</sub>	0 to 35	0 to 35	0 to 58	0 to 58	75	0 to 78	100
Expandable					150		
DC output in kV with accessories	100	50	160	80	80	110	130
Output in kVA	1.2	1.2	1.2	1.2	1	1.5	5
Weight in Kg	26 + 94	26 + 48	26 + 124	26 + 76	19 + 29	26 + 95	75 + 225

#### AC insulation test sets

Model	DELTA4310A	DELTA4110	HPA35	HPA58	HPA78	HPA100AC
AC output in kV <sub>RMS</sub>	0 to 12	0 to 12	0 to 35	0 to 58	0 to 78	0 to 100
Output in kVA	1.2	1.2	1.2	1.2	1.2	5
On-board computer	■					
Narrowband Dielectric Frequency Response	■	■				
Weight in Kg	15 + 22	14 + 22	26 + 48	26 + 76	26 + 95	75 + 225

# Low resistance testing

## 100 A highly portable micro-ohmmeter with DualGround safety

### DLRO100 Series



Weighing only 7.9 kg this battery and, or mains powered units bring real portability for field measurement of contact resistance to IEC62271-100. Rated at CAT IV 600 V and weather and dust proofed to IP54, these ohmmeters are tough. With a measurement range from 0.1  $\mu\Omega$  to 2  $\Omega$  with

a resolution of 0.1  $\mu\Omega$ , high noise immunity and smooth dc output, the DLRO100 series includes DLRO100E, DLRO100X and DLRO100H which offers all the test modes you would expect from a true micro-ohmmeter. Additional facilities include DualGround safety, internal memory, downloading, asset labelling and remote operation, depending upon model.

## 10 A micro-ohmmeter with test results storage and downloading

### DLRO10X

The DLRO10X offers a 0.1  $\mu\Omega$  resolution with a maximum capability of 2 k $\Omega$ . Fast testing ability means users can achieve results in less than 3 seconds. At only 2.5 kg it is the smallest, lightest and most sophisticated 10 A low resistance ohmmeter available making it convenient for general testing.

The DLRO10X has the capability of measuring inductive loads such as transformers and motor windings. The DLRO10X has on-board memory, RS232 download capability, maximum setting and manual or automatic range control to the features of the DLRO10. Uses easily interchangeable batteries. DLRO10X has real-time download of results and on-board storage for later download to a PC.



DLRO 10X has real-time download of results and on-board storage for later download to a PC

## Dual power 10 A micro-ohmmeter with IP rating

### DLRO10HD and DLRO10HDX

DLRO10HD is a tough low resistance ohmmeter which is designed to withstand the inclement conditions of real world testing. Rated at IP65 when the lid is closed and IP45 when operating under battery power, the DLRO10HD has a resolution of a 0.1  $\mu\Omega$ . There are also 2 power output levels to assist with condition diagnosis. One is limited to avoid heating the test sample while the other maintains a set high power output. The DLRO10HDX adds the benefit of results storage and downloading .



## 10 A Micro-ohmmeter

### DLRO10

The DLRO10 series offers a 0.1  $\mu\Omega$  resolution with a maximum capability of 2 k $\Omega$ . Fast testing ability means users can achieve results in less than 3 seconds. At only 2.5 kg the smallest, lightest and simplest-to-use 10 A low resistance ohmmeter available. Uses easily interchangeable batteries.



DLRO10 has bright 4 1/2 digit LED display making it easy to read under all lighting conditions

		DLRO10HDX	DLRO10HD	DLRO10X	DLRO10	BT51
Nominal current		Up to 10 A	Up to 10 A	Up to 10 A	Up to 10 A	Up to 2 A
No of ranges with power limited to 0.25 W		6	6	6	6	
No of higher power ranges		2	2			2
Display		LCD Backlit	LCD Backlit	LCD Backlit		
Results storage and Download		■		■		
Power supply	Mains	■	■	optional	optional	
	Rechargeable battery	■	■	■	■	■
Weight		6.7 kg	6.7 kg	2.6 kg	2.6 kg	4.5 kg

Refer table on page 13 for information on DLRO100

# Low resistance testing

## 2 A bond tester

### BT51

Low resistance ohmmeter ideally suited for bond testing applications, i.e. aircraft frames. Four terminal method of measurement ranges 0-20.00 mΩ and 0-2000 mΩ. Test current is 2A.



## Clips and leads for low resistance testing

Megger has launched a new range of duplex test leads making it possible to give customers more flexibility. One buys one set of tester end leads and attaches any of a selection of probes and clips to the tough duplex connector, one of which can house an LED indicator. Used with the DLRO10 series, the indicator will warn of connection to hazardous live voltages, indicate continuity, the completion of the test and passing or failing pre-set test limit.



## Wind turbine lightning protection test leads sets

### KC

The KC series of test leads provide a complete and convenient solution to the problem of finding reliable test leads that are long enough for testing the continuity of lightning protection conductors in wind turbines.

KC-series wind turbine test leads are available in 100 m, 50 m and 30 m versions that are equally suitable for use on site or in the manufacturing plant. All lead set versions are 10 A rated.



FAR END	TESTER END	USED WITH	TEST CURRENT	SPECIAL FEATURE	LENGTH	PART NO.
Male duplex connector	2 hooks and plug	DLRO10 DLRO10X, DLRO10HD	10 A	Indicator LED in connection	1.5 m	1006-456
				Indicator LED in connection	3 m	1006-458
				Indicator LED in connection	6 m	1006-459
	2 hooks	DLRO10 DLRO10X, DLRO10HD	10 A		1.5 m	1006-452
					3 m	1006-454
					6 m	1006-455
	BT51			3 m	1007-023	
				6 m	1007-024	
	Female duplex connector with locking ring	DLRO10 DLRO10X, DLRO10HD	10 A	Lead extension	6 m	1006-460
Duplex probe	Female duplex connector with locking ring	DLRO10 DLRO10X, DLRO10HD, BT51	10 A	P and C probe spacing 6 mm	0.4 m	1006-450
Right angle duplex probe				P and C probe spacing 10 mm	0.4 m	1006-449
Concentric duplex probe				P and C probe spacing 3.8 mm	0.4 m	1006-448
Kelvin clip				Clip capacity 40 mm	0.4 m	1006-447
Kelvin clip touch proof insulated				Clip capacity 52 to 75 mm	0.4 m	1006-451
Right angle duplex probe	2 hooks	BT51	10 A	In-line duplex locking connectors	3 m	1006-442
				In-line duplex locking connector	6 m	1006-443
Duplex probe				In-line duplex locking connectors, 1 with indicator LED	1.5 m	1006-444
Kelvin clip	1 off 2 hooks and plug 1 off 2 hooks	DLRO10 DLRO10X, DLRO10HD	10 A	In-line duplex locking connectors, 1 with indicator LED	3 m	1006-462
Kelvin clip touch proof insulated				In-line duplex locking connectors, 1 with indicator LED	3 m	1006-461
Heavy duty Kelvin 10 cm g-clamp	2 spades		100 A		5 m	242104-2-16
					8 m	242104-2-16
HD 60 mm current clips and 22 mm potential clips	2 hooks	DLRO100, DLRO200, DLRO600	600 A	25 mm <sup>2</sup> csa	5 m	1008-029
				50 mm <sup>2</sup> csa	5 m	1008-028
				70 mm <sup>2</sup> csa	10 m	6220-756
				95 mm <sup>2</sup> csa	15 m	6220-757

# Contact resistance testing

For testing circuit breaker contact resistance in compliance with IEC62271-100, specialist low resistance testers are used with a high output current. For this and other applications that require a higher test current, Megger offers an extensive range of testers that will fit your testing regime.



## Testing with DualGround™

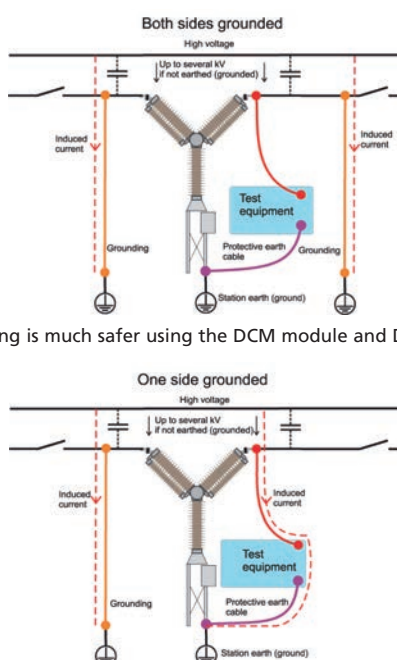
Deregulation changed the business environment for utilities, switchgear owners and their service companies. It has increased the emphasis on efficiency of operation, maintenance and service levels. Likewise the internationalisation of the business has brought new challenges by increasing the emphasis on health and safety and environmental compliance.

Experience has shown that the switch gear is less able to be taken out of service for testing. And when it is, it is available for shorter periods. Network operators and service companies are under continued pressure to maintain and improve their safety record. Safety organisations and labour organisations rightly increase their demands for safe working practices. Deregulation has led to the codification of safe working and the increasing tightening of regulation. Having a good safety record is a crucial asset to attract investment.

In all substations the capacitive coupling from live high voltage conductors induces dangerous currents in parallel conductors. Grounding both sides of the equipment under test will lead the induced currents to earth, providing a safe area for the test personnel.

Testing is much safer using the DCM module and DualGround.

With only one side grounded the induced current can reach values high enough to be harmful or lethal for humans.



Testing is much safer using the DCM module and DualGround.

With only one side grounded the induced current can reach values high enough to be harmful or lethal for humans.

## 100 A, highly portable micro-ohmmeter with DualGround safety



### DLRO100E, DLRO100X and DLRO100H



Weighing only 7.9 kg this battery and, or mains powered units bring real portability for field measurement of contact resistance to IEC62271-100. Rated at CAT IV 600 V and weather and dust proofed to IP54, these ohmmeters are tough.

With a measurement range from 0.1  $\mu\Omega$  to 2  $\Omega$  with a resolution of 0.1  $\mu\Omega$ , high noise immunity and smooth dc output,

the DLRO100 series offers all the test modes you would expect from a true micro-ohmmeter. Additional facilities include DualGround safety, internal memory, downloading, asset labelling and remote operation, depending upon model.

## Hand-held 200 A micro-ohmmeter MOM2



Weighing just 1 kg, the MOM2 micro-ohmmeter from Megger is capable of carrying out tests at currents up to 220 A and can output 100 A for 3 s. With a measurement range of 1  $\mu\Omega$  to 1  $\Omega$ , this makes it a convenient and time saving alternative.

Operating from rechargeable batteries which give 2,000 measurements per charge, allows a full day's testing to be completed.

The MOM2 is suitable for a range of applications, including testing busbar and cable joints, and carrying out contact resistance measurements on low-, medium- and high-voltage circuit breakers. Circuit breaker tests performed with the instrument conform fully to IEC and IEEE standards.



# Contact resistance testing

## 600 A and 200 A micro-ohmmeter

### DLRO600 and DLRO200

Provides the operator with high resolution, 0.1  $\mu\Omega$ , portable method of performing on-site low resistance measurements. The test current is variable from 10 A to 600 A or 200 A respectively, in 1 A steps, enabling the user to perform all the required tests with a single instrument. The unit can be used to test circuit breaker contact resistance to IEC 62271-100, switch contacts, busbars, joints, splices, fuses and rail bonds. The full keyboard makes labelling and storing of results quick and easy.



DLRO600 measures resistances between 0.1  $\mu\Omega$  and 1  $\Omega$ , at high currents. It can provide test currents from 10 amps up to 600 amps subject to the load resistance and supply voltage. It is ideal for testing busbars

A large liquid crystal display provides all the information needed to perform a test; all test parameters and measurement results are displayed.

## 600 A and 200 A micro-ohmmeter

### MOM600 and MOM200



Both these low resistance ohmmeters have a measurement range up to 2 m $\Omega$  with a resolution of 1  $\mu\Omega$ . They offer a choice of maximum current of 600 A and 200 A and the MOM200 weighs as little as 14 kg.

## 600 A low resistance ohmmeter

### MOM690A

Offering a test current from 0 to 600 A DC the MOM690A has a measurement range up to 200 m $\Omega$  with a resolution of 1  $\mu\Omega$ . The MOM690A can be programmed to perform an individual test or an entire series and store the results. There is an AC output for quick and easy demagnetization of CTs.



## 600 A and 200 A

### micro-ohmmeter with DualGround safety



### MJÖLNER600 and MJÖLNER200



By being able to operate with both sides of the circuit breaker earthed, Mjölner adds a new level of safety to the tester of CBs.

The ripple free DC test current can be varied from 5 A to 600 A or 200 A, depending on model, with a maximum continuous current of 300 A or 100 A respectively.

The measuring range is up to 1  $\Omega$  with a resolution as low as 0.1  $\mu\Omega$  depending on the resistance being measured. Equipped

with a USB port for downloading of data the Mjölner series of products can add a further level of safety for the operator by being remotely controlled.

For measurement of	DLR0600	DLRO200	MOM 690A	MOM 600A	MOM 200A	MJÖLNER 600	MJÖLNER 200	MOM2	DLRO100E	DLRO100X	DLRO100H
Test currents	10 A-600 A	10 A-200 A	0-600 A	0-600 A	0-200 A	5 A-600 A	5 A-200 A	50 A -220 A	10 A - 100A	10 A - 100A	10 A - 100A
Current steps	1 A	1 A				1 A	1 A		1 A	1 A	1 A
Max. test time at continuous	>60 sec	>10 min	10 sec	15 sec	20 sec	15 sec	2 min	3 sec - discharging	10 min	10 min	10 min
Measurement range	0.1 $\mu\Omega$ -999.9 m $\Omega$	0.1 $\mu\Omega$ -999.9 m $\Omega$	0-200 m $\Omega$	0-1999 $\mu\Omega$	0-19.99 m $\Omega$	0-999.9 m $\Omega$	0-999.9 m $\Omega$	0-1000 m $\Omega$	0.1 $\mu\Omega$ - 1.999 $\Omega$	0.1 $\mu\Omega$ - 1.999 $\Omega$	0.1 $\mu\Omega$ - 1.999 $\Omega$
Best resolution	0.1 $\mu\Omega$	0.1 $\mu\Omega$	1.0 $\mu\Omega$	1.0 $\mu\Omega$	1.0 $\mu\Omega$	0.1 $\mu\Omega$	0.1 $\mu\Omega$	1.0 $\mu\Omega$	0.1 $\mu\Omega$	0.1 $\mu\Omega$	0.1 $\mu\Omega$
Ripple free DC						■	■		■	■	■
DualGround						■	■			■	■
Remote control						■	■				■
Built-in printer						■	■				
Result storage	■	■						■		■	■
Downloading to PC	■	■	■			■	■	■		■	■
Power supply											
Mains		■	■	■	■	■	■	■	■	■	■
Rechargeable battery									optional	optional	optional
Weight	14.5 kg	14.5 kg	23.7 kg	24.7 kg	14.6 kg	13.8 kg	13.8 kg	1.0 kg	7.0/7.9 kg	7.0/7.9 kg	7.0/7.9 kg

# Circuit breaker analyser systems

IEC62271-100 recommends that contact travel and speed are tested, as well as closing and opening times, resistance of the main contacts and synchronisation of the contact operation.

As circuit breakers are electro mechanical devices, both the electrical and mechanical operation should be tested. It is essential that circuit breakers operate correctly when the protection systems detect a fault to avoid catastrophic failure. Megger offers a full suite of circuit breaker analysis tools to help ensure they do.

## Circuit breaker analyser system with DualGround safety for multiple-breaks-per-phase systems.



### TM1800



The modular design makes it possible to configure the TM1800 for measurements on all known types of circuit breakers in operation on the world market. The robust design product contains powerful technology that streamlines circuit breaker testing. Sophisticated measurement modules enable great time savings as many parameters can be measured simultaneously, eliminating the need for new setup each time. The circuit breaker can be grounded on both sides throughout all tests including timing due to the patented DCM module. DualGround™ testing makes the testing safe and time saving.

## Circuit breaker analyser with DualGround safety for two breaks per phase systems.



### TM1700 series



The TM1700 takes much of the technology from the top of the line version TM1800 and is limited to timing of 6 main contacts. TM1700 comes in five models starting from PC-remote controlled to fully stand-alone. One important feature is the test wizard that quickly guides the operator through the test setup. All inputs and outputs on the instrument are designed to withstand the challenging environment in high voltage substations and industrial environments.

# Circuit breaker analyser systems

## Load tap changer testing power supply

### LTC135



An accessory to Megger's extensive range of circuit breaker analysers, LTC135 makes it possible to obtain a deeper knowledge of the working of tap changers by recording dynamic voltage and resistance.

## Power supply voltage tester

### B10E



A useful power supply unit providing a controllable DC power source to breaker coils and spring-charging motors. Since this power is unaffected by load and virtually ripple-free, it is ideal for minimum pick-up and under voltage tests that are stated in the international standard IEC 62271-1.

## Accessories

### Vibration kit

Includes SCA606, CABA Win vibration software and one vibration channel.



### SSR kit

Synchronised switching relay test kit for TM1800 including accessories, software and cables.



### Transducers

There is a range of linear and rotary transducers available, in both digital and analogue forms.

### Current sensor

100 A AC/DC clamp for first trip analysis.

## Vacuum interrupter tester

### VIDAR

- Low weight and small size
- Fast test and easy to use
- Immediate pass/fail feedback
- 10-60 kV DC test voltage



VIDAR tests vacuum in circuit breaker chambers using DC voltage. When AC is used, the capacitive component of the current flowing through the chamber must be tested. With DC, this is eliminated. The resistive component of the leakage current is very small compared with the capacitive component, because of the high dielectric strength of the chamber. The DC flashover voltage is equal to the peak AC voltage. Testing can be completed in a few minutes.

## Circuit breaker analyser for single break per phase systems

### EGIL



Designed using the experience gained from our larger instruments, the EGIL is intended for gang operated breakers with one break per phase. Its size and simplicity makes it attractive to smaller power plants and maintenance departments. Now can be used with SDRM.



# Circuit breaker analyser systems

## Static and Dynamic Resistance

### SDRM202

- Accurate DRM results through high current supply  
2 x 200 A
- Fast charge – minimum waiting intervals
- Low weight, 4.3 kg incl. cables



DRM was introduced by Megger to assess the condition of the contacts and the arcing contact length in SF<sub>6</sub> Circuit Breakers. The SDRM202 is the 3rd generation and is based on the Megger patented super cap technology which offers high current from an extremely light weight package. The capacitors charge from completely drained to full in about 2 minutes which practically removes waiting time between measurements. The SDRM202 is put close to the interrupters which saves a lot of cable weight.

SDRM is compatible with all Megger circuit breaker analysers and measures both the contact resistance during an operation (DRM) as well as the static contact resistance.

### Static resistance measurement (SRM)

A static resistance value provides a reference value for all types of electrical contacts and joints. If the contact resistance is too high this will lead to power loss and temperature rise, which often leads to serious trouble. IEC 62271-1 states that this type of resistance is to be measured using a current ranging between 50 A and the breaker's nominal current. IEEE C 37.09 specifies a minimum test current of 100 A.

Other international and national standards set forth similar guidelines in order to eliminate the risk of obtaining erroneously high values if the test current is too low.

### Dynamic resistance measurement (DRM)

A circuit breaker will have arcing contact wear by normal operation as well as when breaking short-circuit currents. If the arcing contact is too short or in bad condition, the main contact surfaces can be deteriorated by arcing, resulting in increased resistance, excessive heating and, in the worst case, explosion.

In a Dynamic Resistance Measurement the main contact resistance is measured during an open or close operation. If contact movement is recorded simultaneously, you can read the resistance at each contact position, which is used to reliably estimate the arcing contact length. The only real alternative in finding the length of the arcing contact is dismantling the circuit breaker.

A reliable DRM interpretation requires high test current and good measurement resolution.



DRM is a reliable method to estimate the length/wear of arcing contact



# Circuit breaker analyser systems

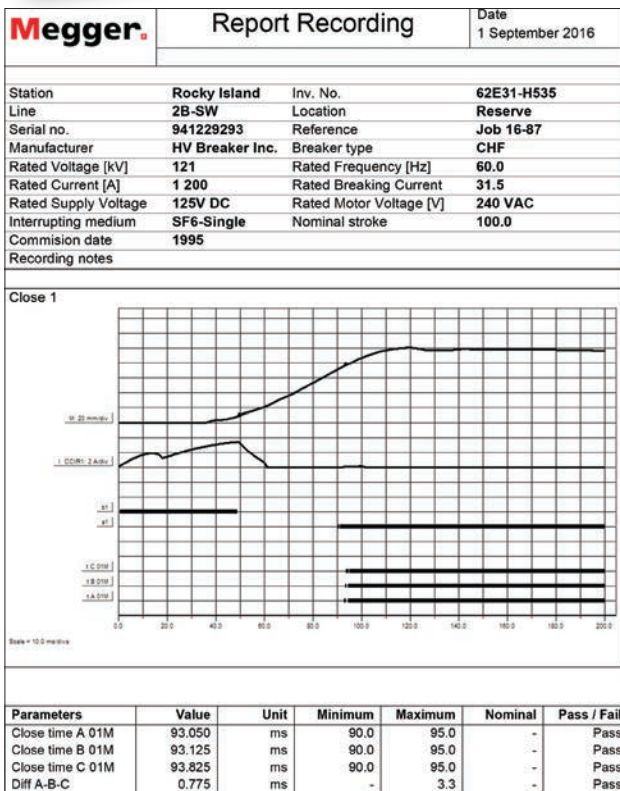
## Breaker Analyser software

### CABA Win

- Pre-defined standard test plans enable quick and easy testing
- Test Plan Editor to easily create customized test plans
- Accurate comparison with historical test results
- Convenient report generation with Word, Excel or List and Label
- Over 300 predefined calculated parameters

After connecting your breaker analyser to a computer, you can use the CABA Win software to speed up testing and improve repeatability. CABA can be used with the TM1800, TM1700 and EGIL. Results are presented on the display both graphically and in table form after each breaker operation so that you can make comparisons with limit values and previous test results.

The Test Plan Editor (TPE) lets you create individual test plans tailored to individual breakers. Timesaving conversion tables simplify the task of connecting and linking transducers to the breaker. Reports created in your own format can be obtained easily using standard field linking functions.



# Primary injection testing

Primary injection testing requires the system to be taken out of service and consequently is usually conducted during commissioning. It does however test the complete system, the current transformer, conductors, connection points, relay protection and circuit breakers.

## Primary current injection test system

### ODEN AT

The ODEN AT primary current injection test system consists of a control unit together with one, two or three current units offering an maximum output of 13 kA for one second and 3800 A continuous. There are three versions of the current unit: S, X and H. The S and X current units are identical except that the X unit has an additional 30/60 V output. The H unit is rated for even higher current. This makes an ODEN AT system very flexible. Each component is portable, and ODEN AT can be quickly assembled and connected.



The control unit has many advanced features – a measurement section that can display turns ratio as well as time, voltage and current. A second measurement channel can be used to test an additional current or voltage. Current transformer turns ratio, impedance, resistance, power, power factor ( $\cos \phi$ ) and phase angle are calculated and shown in the display. Current and voltage can be presented as percentages of nominal value. The fast-acting hold function freezes short-duration readings on the digital display; when the voltage or contact signal arrives at the stop input, the object under test interrupts the current or injection is stopped.

### Timer unit

#### TM200

This timer unit, designed for use with ODEN A and CSU600A, has the precision that makes it ideal for many substation uses.



## Primary current injection test system

### INGVAR



This 5000 A 2 piece portable system is designed for primary injection testing of protective relay equipment and circuit breakers. It is also used to test the turns ratio of current transformers and for other applications that require high variable currents.

The control unit has many advanced features including a powerful measurement section that can display turns ratio as well as time, voltage and current.

A second measurement channel can be used to test an additional current or voltage. Current transformer turns ratio, impedance, power, power factor ( $\cos \phi$ ) and phase angle are calculated and shown in the display. Current and voltage can be presented as percentages of nominal value.

### Current transformer switchbox

For use with ODEN AT the switchbox facilitates CT testing. The secondary windings of the CT are connected to the switchbox inputs and the outputs are connected to ammeter 2 of the ODEN AT. It can handle up to 5 secondary windings.



# Primary injection testing

## Current supply units

### CSU600A and CSU600AT

These high-current supply units have two main fields of application. The first is to conduct primary tests on protective relays. The second field of application involves conducting current tests on low-voltage circuit breakers and overcurrent devices.



Both outputting 600 A, the CSU60A requires the use of an external timer and ammeter, while the CSU600AT comes with built in timer and analogue ammeter that provides rough current settings quickly and easily, reducing connection time to a minimum.

## Circuit breaker and overcurrent relay test set

### MS-2A

The Megger MS-2A test set is used around the world by several thousand utility companies, industrial plants and electrical service organizations.

MS-2A is a self-contained test set that incorporates a variable high-current output and appropriate control circuitry and instrumentation for testing thermal, magnetic or solid-state motor overload relays, molded-case circuit breakers, ground-fault trip devices and overcurrent relays.



## Primary injection test Systems

### SPI225

The SPI225 is a high current primary injection test unit with the ability to perform high current commissioning test as well as test low-voltage moulded-case circuit breakers.

A single SPI225 is designed to test low-voltage moulded-case circuit breakers up to a rating of 225 A.

The Smart Touch View Interface, STVI, permits users to manually control the SPI and to perform automated testing. The SPI unit can also be controlled by a PC for testing and report generation.



### Multi-cable high current cable sets for use with ODEN



LENGTH	IMPEDANCE (TWISTED-PAIR CABLES)	
<b>Cross section area: 240 mm<sup>2</sup> (2x120)</b> 2 x 0.5 m (1.6 ft) 2 x 1 m (3.3 ft) 2 x 1.5 m (4.9 ft) 2 x 2 m (6.6 ft)	0.21 mΩ 0.32 mΩ 0.42 mΩ 0.53 mΩ	GA-12205 GA-12210 GA-12215 GA-12220
<b>Cross section area: 360 mm<sup>2</sup> (3x120)</b> 2 x 0.5 m (1.6 ft) 2 x 1 m (3.3 ft) 2 x 1.5 m (4.9 ft) 2 x 2 m (6.6 ft)	0.18 mΩ 0.25 mΩ 0.32 mΩ 0.39 mΩ	GA-12305 GA-12310 GA-12315 GA-12320
<b>Cross section area: 480 mm<sup>2</sup> (4x120)</b> 2 x 0.5 m (1.6 ft) 2 x 1 m (3.3 ft) 2 x 1.5 m (4.9 ft) 2 x 2 m (6.6 ft)	0.16 mΩ 0.21 mΩ 0.27 mΩ 0.32 mΩ	GA-12405 GA-12410 GA-12415 GA-12420
<b>Cross section area: 720 mm<sup>2</sup> (6x120)</b> 2 x 0.5 m (1.6 ft) 2 x 1 m (3.3 ft) 2 x 1.5 m (4.9 ft) 2 x 2 m (6.56 ft)	0.14 mΩ 0.18 mΩ 0.21 mΩ 0.25 mΩ	GA-12605 GA-12610 GA-12615 GA-12620
<b>Cable set, 2 x 5 m (16 ft), 120 mm<sup>2</sup></b> Cross section area: 120 mm <sup>2</sup> Weight: 15.2 kg (33.5 lbs) Impedance: 2.2 mΩ		GA-12052
<b>Cable set, 2 x 5 m (16 ft), 25 mm<sup>2</sup></b> Cross section area: 25 mm <sup>2</sup> For the 30/60 V output of current unit X Weight: 4 kg (8.8 lbs)		GA-02052

## Protective Relay Testing

The power protection system is the guardian of the grid. It watches and safeguards via detection, automated decision-making, and (ability to) control. A protection component's intelligence to discern when an anomaly is actionable and how to react is given by component settings and system design. Proper selection and application of protection components, such as relays, directly impact their dependability to function as planned. A relay's ongoing performance is affected by the reliability and health of mechanical components (in the case of electromechanical relays), electronic circuits or components (static relays) and software (numerical relays). Testing provides a measure of a protection component(s)'s performance during commissioning and of its continued reliability throughout its use. Ultimately, testing gives assurances that vulnerabilities of the power grid and its components are not left exposed.

Given the diverse functional requirements of the grid's protection system, testing capabilities require a new level of sophisticated test hardware and software with which to analyse the entire protection system's (or individual protection component's) operation in "real life" situations. It is further necessary that these expanding testing capabilities be met with a similar improvement in the simplification of a test instrument's user interface and software control. Rest assured that every facet of relay testing, no matter the complexity, can be handled simply with the comprehensive line of relay test equipment from Megger. Moreover, whether you are testing legacy electromechanical relays or modern IEC 61850 networked devices, our rugged products output the high power you need while still being portable for real world testing.

Megger developed the first software-driven protective relay test system in 1984, and we continue to provide models ranging from computer-controlled (with comprehensive yet simple, built-in, touch screen user interfaces) to manually operated test sets in portable and



## Protective Relay Testing

laboratory styles for every relay testing need. Relay test solutions may be expensive propositions when software is charged separately but with Megger solutions, the software required to test most relays is included with the test set so you don't incur additional expenses.

Our rich legacy in manufacturing relay and primary injection test solutions is nurtured by the company's extensive relay testing experience. This experience also fuels the success of our worldwide support system – always here to help you wherever you are! As power grids get bigger and carry more power, the need for quick, reliable disconnection when faults occur becomes more urgent. The purpose of protective relay equipment is to sense fault states and trip circuit breakers. If a fault isn't corrected early, personal injuries and damage can occur.

Megger's next generation of programmable secondary relay test systems are designed specifically to test microprocessor, solid state and electromechanical relays. New generation single phase and three phase test systems with remote control facilities and analytics software can make life much easier for protection test engineers.



## Relay testing

Distribution systems are protected by increasingly complex relays which require testing. Since the 1970s the SVERKER series of relay testers has been class leaders, being small, light and simple to operate. Over the years more features have been added to enable the testing of more complex relays resulting in the variable phase shift and frequency features of the SVERKER 780. Now technology pushes the boundaries even further with the SMRT1, a revolutionary new concept in automatic relay testing, which makes high power complex testing available in a very small, extraordinarily light package.



### Relay and substation test system

#### SVERKER900

SVERKER900 is the engineer's ultimate test box that addresses the increasing need for three-phase testing capability in electrical distribution substations, renewable power generation stations and industrial applications. The intuitive user interface is presented on the LCD touch screen. It has a powerful combination of current and voltage sources and a versatility of measurement possibilities.

The SVERKER900 is specifically designed for basic, manual three-phase secondary testing of protection devices. In addition, various primary testing can be performed, since the current and voltage sources can be series- and, or parallel connected to allow for up to 105 A AC or 900 V AC output. All three current and four voltage generators can be individually adjusted with respect to amplitude, phase angle and frequency. The fourth voltage source allows for testing of numerical relays that needs a reference voltage simulating the busbar.

### Multifunction single phase relay test system

#### SVERKER750 and SVERKER780



The SVERKER750 and SVERKER780 feature many functions that make relay testing more efficient. The measurement section can display, in addition to time, voltage and current Z, R, X, S, P, Q, phase angle and  $\cos \phi$ . The voltmeter can also be used as a 2nd ammeter when testing differential relays. All values are presented on a single easy-to-read display. Directional protective equipment can be tested efficiently by means of the built-in variable voltage source.

The SVERKER780 has a continuous phase shift function and

adjustable frequency. Automatic reclosing devices can also be tested.

Both units are available in an optional impact resistant and waterproof (IP65) high density plastic-case with wheels and retractable handle.

#### SVERKER650

The SVERKER650 enjoys a well-earned reputation for reliability and convenience. Compact and powerful, it provides all of the functions needed for secondary testing of any types of single-phase protection now available. It features logical design, and it is extraordinarily easy to learn and use. Its compact design and low weight makes it extremely portable. Accessories for SVERKER650 includes a test lead set and a rugged transport case and the ACA120 voltage source which makes it easier to test directional relays.



# Relay testing

## Voltage and current source

### CSU20A



Small and light this power source is primarily intended for use with Sverker750 and Sverker780 but is in essence a multipurpose AC and DC source featuring one AC current and voltage output, a fully rectified DC output and a half wave rectified output for harmonic restraint testing.

## Variable voltage source

### ACA120

Powered by 110 V AC the ACA120 provides a variable voltage output from 0 V to 120 V for directional protection testing.



## Timer unit

### TM200

This timer unit, designed for use with SVERKER, has the precision that makes it ideal for many substation uses.



## Phase selector switch

### PSS750

Because it is a passive design, the PSS750 has many applications, any of the inputs may be used for current or voltage. It simplifies phase switching and select fault type, phase reversing and facilitates creating variable phase shift.



## Test terminal blocks

### States switches



Covers the complete area of panel connections from terminal blocks to knife switches. All products give long-term connection quality and mechanical stability. States switches are UL listed, and CSA certified.

States switches are UL listed, and CSA certified

## Automatic single phase relay test set

### SMRT1



Weighing in at only 4 kg / 8.9 lb. the SMRT1 is an amazingly powerful single-phase relay test set with one current channel and one voltage channel. The current channel is rated for 32 Amps @ 200 VA continuous and up to 60 Amps @ 300 VA for short durations. The voltage channel can provide up to 300 V @ 150 VA or can be converted to a current channel outputting up to 15 Amps maximum.

The SMRT1 is designed to operate in conjunction with any other SMRT family unit, using the Ethernet ports the SMRT1 can be daisy chained with another SMRT where voltage and current outputs will be seamlessly synchronized for testing complex relays. The SMRT1 has the ability to be manually controlled with Megger's Smart Touch View Interface™ (STVI) or by use of a laptop and Megger's Relay Test Management Software (RTMS).

## Phase angle meter

### PAM410 and PAM420

The PAM410 is a phase angle meter for use in high voltage substations and industrial locations. By switching between current and voltage, it measures the phase angle relationship between any combinations of two signals.

The PAM420 similar to the PAM410 it offers an extended range of measurements including, phase angle, voltage, current, frequency and timing.



# Multi-phase protective relay testing

Complex relays require a more flexible testing solution and Megger has a wide variety of units for these applications. The three channel SMRT46 has a class leading constant power output in a field portable case the size of a 5 kV insulation tester! The SMRT can be manually controlled using the Smart Touch View Interface or by running RTMS software from your PC. Relay Test Management Software is designed to manage all aspects of protective relay testing using the Megger SMRT family of units. Three SMRT1's can be connected together to make a full three phase unit or connecting multiple SMRT units together to create a maximum of 15 channels to test Bus Differential protection schemes. For those who prefer to have their control screen built in to the test set there is the FREJA and SMRT D models.

## Relay and test management software

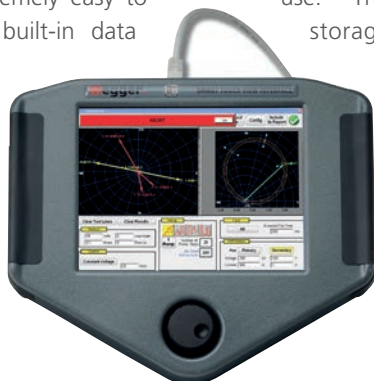
### RTMS

RTMS is not only the go-to software platform for all relay testing requirements, but is compatible across the entire Megger SMRT family of relay test systems. RTMS is a Microsoft® Windows® XP® Service Pack 3/ Vista™/7/8/10 compatible software program designed to manage all aspects of protective relay testing using the Megger SMRT family of units. The same software runs on the STVI, Smart Touch View Interface Hand-held controller and on the onboard display of the SMRT Display units. RTMS Software has two different levels, Standard and Enhanced. Standard level includes a manual test screen, Simple and Advanced Ramping, Pickup and Timing of Over Current, Under Voltage and Over Voltage relays, Directional Over Current, Sequence tests for Reclosing and Transient Earth Fault simulation, Impedance (both generic and relay specific from various manufacturer's), Three-phase Current Differential, Fault Calculator, Harmonics Generator, Symmetrical Components, Simplified Power Swing, and much more. The Enhanced level includes tests for Synchronizer, Under/Over, and  $df/dt$  (ROCOF) Frequency relay Pick-up and Timing Tests, IEEE/IEC COMTRADE Transient Waveform playback, Power Swing/Out of Step Simulator, SSI File Converter and playback, and IEC 61850 Megger GOOSE Configurator (MGC).

## Hand-held controller for SMRT, MRCT and SPI225

### STVI

Megger's second generation of the Smart Touch View Interface handheld controllers for the SMRT, MRCT and SPI225 has a large, full colour, high resolution, and high definition TFT LCD touch screen that allows the user to perform manual and automatic test without the need for a PC. Designed for ambidextrous operation, the rubber cushion grips, centrally located control knob, and touch screen makes the STVI extremely easy to use. The STVI includes non-volatile built-in data storage for saving tests and test results. Two USB ports is provided for easy transferring of test results to a USB thumb drive for saving to your PC or printing reports.



## Relay test system

### SMRT series



Powerful, tough and light in weight are the words that characterize the SMRT series of relay test systems. Housed in rugged plastic case and based on a modular design, the VIGEN (voltage and current generator) gives the SMRT relay test systems the flexibility not seen in run-of-the-mill systems. The constant power output of the Voltage-Current amplifiers (VIGEN) allows the current amplifier to deliver maximum compliance voltage to the load during the test and range changing is done automatically under load. Constant power output in many cases eliminates the need to parallel or series current channels together to test high burden relays. The SMRT provide a higher VA power output on the voltage channel at the lower critical test voltages (30 – 150V) for when the customer want to test a whole panel of relays at one time. The SMRT series of relay testers can be operated using the STVI which allows the user to perform manual, steady-state, dynamic tests and preloaded test routines for most popular relays or running a fully automatic test protocol by using a computer running the RTMS software.

**SMRT43** – Offers four voltage and three current channels.

**SMRT46** – The most popular of the products, offers four voltage and 3 current channels with the option of 6 current channels when the first three voltage channels is converted to current channels and only weighs 13 kg.

**SMRT410** – The most flexible of the range, offers up to four voltage channels and six current channels with the option of up to ten current sources when the voltage channels is converted to current channels. At less than 18 kg this test set adds greatly increased testing flexibility.



# Protective relay testing

## Relay test system

### SMRT D series

Housed in a conventional laboratory case this series of relay test systems is distinguished by the integrated touch screen, which runs RTMS software, Megger's second generation of automatic, semi-automatic or manual relay testing software. Alternatively, a SMRT D series unit can be controlled by running RTMS software on a PC.

**SMRT43D** - offering four voltage and three current channels the SMRT43D weighs a touch over 13 kg.

**SMRT46D** - offers four voltage and three current channels with the option of six current channels when the first three voltage channels is converted to current channels, yet it is the same weight as the SMRT43D.

**SMRT410D** – offers up to four voltage and six current channels with the option of up to ten current sources when the voltage channels is converted to current channels and weighs 19 kg.



### FREJA500 series

The FREJA500 series is multipurpose, lightweight, field portable relay test sets from Megger and controlled via the built-in touch-screen running the FREJA Local software. The



large, easy to read Full Color high resolution, high definition, TFT LCD touch-screen display allows the user to perform manual, steady state and dynamic testing quickly and easily. FREJA Local includes built-in preset test routines and relay test templates for automatic testing of protection relays and protection schemes. Menu screens and touch screen function buttons are provided to quickly and easily select the desired test function. Tests, and test results, can be saved in FREJA Local memory and downloaded to a USB thumb drive for test data transfer to a PC or to print test reports. For full automatic testing on a PC, each FREJA unit comes with an install version of FREJA Remote. FREJA Remote is a Microsoft® Windows® XP® Service Pack 3/ Vista™/7/8/10 compatible software program designed to manage all aspects of protective relay testing using the Megger FREJA Family of units.

**FREJA543** – offering four voltage and three current channels the SMRT43D weighs a touch over 13 kg.

**FREJA546** – offers four voltage and three current channels with the option of six current channels when the first three voltage channels is converted to current channels, the fourth voltage channel provides an AC reference/synchronizing/polarizing or a DC battery simulator voltage source.

**FREJA549** – A multi-phase test system that offers up to four voltage and six current channels with the option of up to ten current sources when the voltage channels is converted to current channels and weighs less than 20 kg.

	SMRT43	SMRT43D	FREJA543	SMRT46	SMRT46D	FREJA546	SMRT410	SMRT410D	FREJA549
Instantaneous Current per channel	45 A @ 300 VA <sub>RMS</sub>	45 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>	60 A @ 300 VA <sub>RMS</sub>
Continuous Current per channel	30 A @ 200 VA <sub>RMS</sub>	30 A @ 200 VA <sub>RMS</sub>	30 A @ 200 VA <sub>RMS</sub>	30 A @ 200 VA <sub>RMS</sub>	30 A @ 200 VA <sub>RMS</sub>	30 A @ 200 VA <sub>RMS</sub>	30 A @ 200 VA <sub>RMS</sub>	30 A @ 200 VA <sub>RMS</sub>	30 A @ 200 VA <sub>RMS</sub>
Max Voltage per channel	300 V @ 150 VA <sub>RMS</sub>	300 V @ 150 VA <sub>RMS</sub>	300 V @ 150 VA <sub>RMS</sub>	300 V @ 150 VA <sub>RMS</sub>	300 V @ 150 VA <sub>RMS</sub>	300 V @ 150 VA <sub>RMS</sub>	300 V @ 150 VA <sub>RMS</sub>	300 V @ 150 VA <sub>RMS</sub>	300 V @ 150 VA <sub>RMS</sub>
Number of Current channels	3	3	3	6	6	6	10	10	9
Number of Voltage channels	4	4	4	4	4	4	4	4	4
Number of Convertible Voltage channels	0	0	0	3	3	3	4	4	3
Control	STVI or PC	Touchscreen or PC	Touchscreen or PC	STVI or PC	Touchscreen or PC	Touchscreen or PC	STVI or PC	Touchscreen or PC	Touchscreen or PC
Case style	Tough	Lab style	Lab style	Tough	Lab style	Lab style	Tough	Lab style	Lab style
Control software	RTMS	RTMS	FREJA Local	RTMS	RTMS	FREJA Local	RTMS	RTMS	FREJA Local

# Advanced Power transformer testing

## Multifunction test system for transformers and substations

### TRAX series



- Power transformers
- Load tap-changers
- Reactors
- Instrument transformers
- Bushings
- Circuit-breakers
- Grounding systems

A multifunction system for testing transformers and other major components of the electrical supply system, TRAX 280/279 is capable of providing 800A and 2.2 kV, (2000 A and 12 kV with accessories) with an adjustable frequency range from 1 to 500 Hz. TRAX 220/219 can produce an upto 200 A AC output. The variable voltage and current levels can be generated and measure with high precision, allowing TRAX to test turns ratio, excitation current, winding and contact resistance, impedance, tan delta or power factor and various primary tests for LV, MV and HV assets.

The user interface gives full manual control; alternatively there is a selection of apps to automate testing procedures such as winding resistance, turns ratio, impedance, circuit breaker analysis etc. Tests can be reported separately or as a combined report for the asset. Only TRAX280/220 can be operated using the integrated touch screen or an external computer with a web browser.

### TRAX software

It is the software that makes the TRAX the flexible user friendly system it is. All systems are supplied with the basic software package; customers can then opt for additional packages which increase the versatility of the system by adding instrument apps.

**Advanced transformer** will add the ability to make dynamic OLTC measurements (true DRM), frequency response of stray losses (FRSL) and magnetic balance.

**Instrument transformer**, this package will enable ratio, burden, and polarity measurements for CTs and VTs. Other tests include CT winding resistance measurement and excitation curve.

**Substation**, this package adds circuit breaker analysis, primary injection timing.

**Line impedance**, together with specifically designed hardware, will add measurement of line impedance and calculation of k-factors for accurate distance relay configuration

### 2000 A current accessory for TRAX

#### TCX 200

When the high-current output of TRAX 200/219 (max 200 A) or TRAX 280/279 (max 800 A) is not sufficient, the optional accessory TCX offers currents up to 2000 A. Because it is small, the TCX unit can be placed close to the test object, thus reducing the need for long heavy current cables.

### Tan delta and capacitance accessory for TRAX

#### TDX 120

With the use of the TDX accessory, the TRAX becomes a fully automatic 12 kV tan delta or power factor test set for the condition assessment of electrical insulation in high voltage apparatus.

### 3-phase switch accessories for TRAX

#### TSX 300 and TSX 303

TSX 300 offers manual switching of phase under test. Meanwhile the TSX 303 allows the operator automatically test all windings and taps with the single climb and connection.



Learn more at [megger.com/TRAX](http://megger.com/TRAX)

# Power transformer testing

## Test van for maintenance and diagnostic testing of power transformers

### Power transformer test van

An integrated test van for the commissioning and maintenance or condition monitoring of power transformers. The heart of the system is a switch box that enables automated software-driven testing, including selection of HV and LV methods and test scheme. The results of each measurement are recorded in a report. This allows comparison with the nameplate and previous results to facilitate trending.

The software allows comparison between current measurements, previous measurements and the nameplate for trending.

Routine and advanced diagnostic techniques in accordance with IEC 60060-3, IEC 60067, IEEE C57.12.00, GOST 11677-85 and CIGRE 445 can be performed.

- Software control and reporting
- High voltage and low voltage leads are shared among different instruments
- DC Winding resistance / Tap Changer Test
- Turns ratio and vector group verification
- Capacitance and dissipation factor / power factor
- Excitation current
- Insulation Resistance

The screenshot displays the software interface for transformer testing. It includes a top section for test parameters like OIL TEMP, IMPEDANCE, WEATHER, and TANK TYPE. Below this is a table for test settings (PRIMARY, RESONANT, TEST FREQUENCY) and a section for test results. The results are organized into two main tables: 'TRANSFORMER OVERALL TEST SET UP' and 'TRANSFORMER OVERALL TEST RESULTS'. The results table contains columns for Test No., Insulation, Test Voltage, Test Lead Connections, Test HV, Capacitance, Dissipation Factor, and IR. A legend at the bottom explains the symbols used in the test results, such as 'G' for Good, 'D' for Deteriorated, and 'I' for Investigate.

Test No.	Insulation	Test Voltage	Test Lead Connections	Test HV	Capacitance	Dissipation Factor	IR				
1	C <sub>10</sub> = C <sub>10</sub>	0.00	H1 L1 G1	0.00	9.139 20	0.26	0.000	28.7150	0.0048	G	
2	C <sub>10</sub>	0.00	H1 L1 G1	0.00	2.267 13	0.34	0.18	0.000	7.1863	0.1723	G
3	C <sub>10</sub>	0.00	H1 L1 G1	0.00	6.051 05	0.29	0.24	0.000	21.4239	0.0506	G
4	C <sub>10</sub> = C <sub>10</sub>	0.00	H1 L1 G1	0.00	6.862 07			0.000	21.8276	0.0326	Valid
5	C <sub>10</sub> = C <sub>10</sub>	0.00	H1 L1 G1	0.00	14.037 27	0.31	0.28	0.000	44.0979	1.3816	G
6	C <sub>10</sub>	0.00	H1 L1 G1	0.00	7.164 04	0.32	0.30	0.000	32.0082	0.7910	G
7	C <sub>10</sub>	0.00	H1 L1 G1	0.00	6.862 58	0.29	0.23	0.000	21.6274	0.6312	G
8	C <sub>10</sub>	0.00	H1 L1 G1	0.00	6.863 23			0.000	21.5297	0.6300	Valid
9	C <sub>10</sub>	0.00	H1 L1 G1	0.00				0.000			G
10	C <sub>10</sub>	0.00	H1 L1 G1	0.00				0.000			G



# Power Transformer testing

Power transformers are one of the most critical and expensive assets in a substation. If a large transformer fails it will be a major problem for the asset owner. It will be expensive to repair or replace and there may not be a replacement of the required type available at short notice. Extending transformer life and predicting failure is becoming increasingly important to asset owners and managers. Luckily, Megger can help. Megger's transformer test equipment is tough, light and with all the functionality you need.

## Tan delta test system

### DELTA4000

The DELTA4000 Series is a fully automatic 12 kV insulation power factor/dissipation factor (tan delta) test set designed for condition assessment of electrical insulation in high voltage apparatus such as transformers, bushings, circuit breakers, cables, lightning arresters and rotating machinery. In addition to performing insulation power factor tests, the DELTA4000 Series can be used to measure the excitation current of transformer windings as well as to perform automatic tip-up tests and HV turns-ratio testing (an optional TTR capacitor is available).

The test set is designed to provide a comprehensive AC insulation diagnostic test, including Narrowband Dielectric Frequency Response (NB DFR). The high power variable frequency design generates its own test signal independent of line frequency quality and the hardware design uses the latest technology available for digital filtering of the response signal. As a result, the DELTA4000 Series produces reliable results and stable readings in the shortest time with the highest accuracy, even in high interference substations.

The DELTA4000 Series operates with PowerDB software for automatic testing and reporting or with Delta Control software for real-time manual testing. Measurements include voltage, current, power (loss), tan delta, inductance, power factor and capacitance. The test results are automatically stored in the computer and can also be downloaded directly to USB storage or a printer. DELTA4110 test set is to be used with an external computer (not included) while the DELTA4310A test set comes with an onboard computer.



## Capacitance and dissipation factor bridge

### CDAX605



CDAX605 can be used as part of a customised tan delta solution with an external power source or generator. It is a precision instrument using a combination of bridge and direct (vector) measurements and is capable of measuring capacitive, resistive and inductive loads.

CDAX605 is designed for laboratory, production line or field testing of electrical equipment insulation and insulating materials as well as e.g. calibration of CCVTs and other ratio devices. A test set with unique high accuracy for the most demanding applications.

## Single-phase turns ratio testers

### TTR100-1

The latest TTR available from Megger is the TTR100-1, a handheld, robust, lightweight and battery operated instrument. This TTR will complement several existing Megger transformer test products and will offer functions, such as winding resistance and polarity. These functions, as well as the phase angle measurement function, can be switched off when not required. With a turn ratio of 20,000:1, the TTR100-1 offers the highest turns ratio accuracy in the industry of 0.1%. The TTR100-1 features special software capabilities.



# Transformer testing

## True 3-phase turns ratiometer

### TTRU3



The NEW Megger TTRU3 transformer turns ratiometer uses a revolutionary design to perform a complete series of measurements on a transformer, including 3Ø step up turns ratio testing (patent pending). 3Ø voltage output offers numerous advantages to testing with today's busy schedules.

The TTRU3 is an important tool for determining the mechanical condition of transformers. All ratio tests are performed in one instrument, with only one 3Ø lead-set connection. The TTRU3 utilizes the latest 7 in. (180 mm) color touch display, as well as an optional printer so results are never lost. This is complimented with remote control which can be operated from a PC, as well as the ability to download results to a USB memory device.

## Step-up transformer

### MAGNUS

MAGNUS permits the preparation of excitation curves for CTs, to demagnetize their cores and turns ratio tests on voltage transformers. It can deliver 1 A at 2.2 kV. for rapid testing.



## Current transformer tester

### MRCT

This tough, portable unit is used to perform demagnetization, ratio, saturation, winding resistance, polarity, phase deviation, and insulation tests on current transformers. The MRCT automatically calculates ratio errors, saturation curves, and knee points.

The MRCT provides automatic testing of single and multi ratio CTs, reducing testing time and increasing productivity. The MRCT will directly connect to multi ratio CT's and perform all tests – saturation, ratio and polarity, winding resistance and insulation – on all taps with the push of a button and without changing leads. Their are the options of DC excitation techniques for CT with knee points up to 30 kV and an integrated VT/CVT tester.



The MRCT can be controlled via Megger's Smart Touch View Interface (STVI) controller or from a PC running Power DB software.

## Current transformer and Voltage transformer tester

### MVCT

The MVCT test set is a lightweight, robust, portable unit capable of testing both current and voltage transformers. At less than 20 lb (10Kg) the MVCT is a highly portable unit that also offers accuracy in testing. Capable of performing saturation, ratio, polarity, winding resistance, and insulation tests on current transformers, it can also be used for testing metering and protection class voltage/potential transformers.



The MVCT provides a microprocessor controlled variable voltage and current output along with precision instrumentation for automatically testing single and multi-ratio CTs and VT's. The MVCT makes testing CTs easy. It will directly connect to multi ratio CT's and perform all tests – saturation, ratio and polarity, winding resistance, and insulation – on all taps with the push of a button and without changing leads. This greatly reduces testing time.

The MVCT can be controlled via its large, full color, high resolution, sunlight readable TFT LCD touch screen display. This interface allows the user to perform manual and automatic testing quickly.

# Power transformer testing

## Automated six-winding transformer ohmmeter

### MTO300 and MTO330



The MTO300 series saves time by testing all six windings without having to disconnect and reconnect leads; combined with the simultaneous winding magnetization method this gives fast and reliable measurements even on large transformers with delta

configuration on the low voltage side. A built-in circuit restores the transformer core to a demagnetised state after testing, before being returned to service or can be used to prepare the transformer for SFRA.

Safety is maintained by the discharge function which automatically discharges the item under test should a lead disconnect, the power fail or at the end of the test.

MTO300 series test leads are the same as TTR300 series of three-phase turns ratio instrument thus eliminating additional connecting time for the additional measurements.

**MTO330:** This fully automatic transformer ohmmeter has an on-board computer running Power DB Onboard. This permits test result storage and certification as well as the opportunity control other Megger transformer test products.

**MTO300:** Basic 3-phase transformer ohmmeter requires a PC running Power DB Lite (supplied), or Megger transformer product with on-board computer.

## 6 A two winding transformer ohmmeter

### MTO106

The MTO106 transformer ohmmeter is an easy-to-use, line-operated instrument specifically designed for safe and accurate field measurement of winding resistance in smaller transmission and distribution transformers. It has dual channels with max 6 A current output. It's measurement range and accuracy suited to provide accurate information about the vast majority of power transformers, reactors and instrument transformers. The test current can be manually set in five different ranges to fit transformers of various sizes.



## 10 A two winding transformer ohmmeter

### MTO210



A two channel transformer ohmmeter MTO210 outputs a dc test current of up to 10 A. With a range from 1  $\mu\Omega$  to 2 k $\Omega$ , it offers a measurement accuracy of 0.25 %. Test results can be stored on

board and downloaded for analysis. A built-in circuit restores the transformer core to a demagnetised state after testing, before being returned to service or can be used to prepare the transformer for SFRA. The high speed discharge circuit protects the operator.

## 50 A two winding transformer ohmmeter

### MTO250



Designed for larger transformers up to 1000 MVA, MTO250, 2 channel transformer ohmmeter, outputs a test current up to 50 A. This makes the testing of larger transformers significantly faster. It can be used to assess the performance of make-before-break transitions in load tap changers too. Test results can be stored on board and downloaded for analysis. A built-in circuit restores the transformer core to a demagnetised state after testing, before being returned to service or can be used to prepare the transformer for SFRA. The high speed discharge circuit protects the operator.

# Power transformer testing

## 3-phase ratio and winding resistance analyser

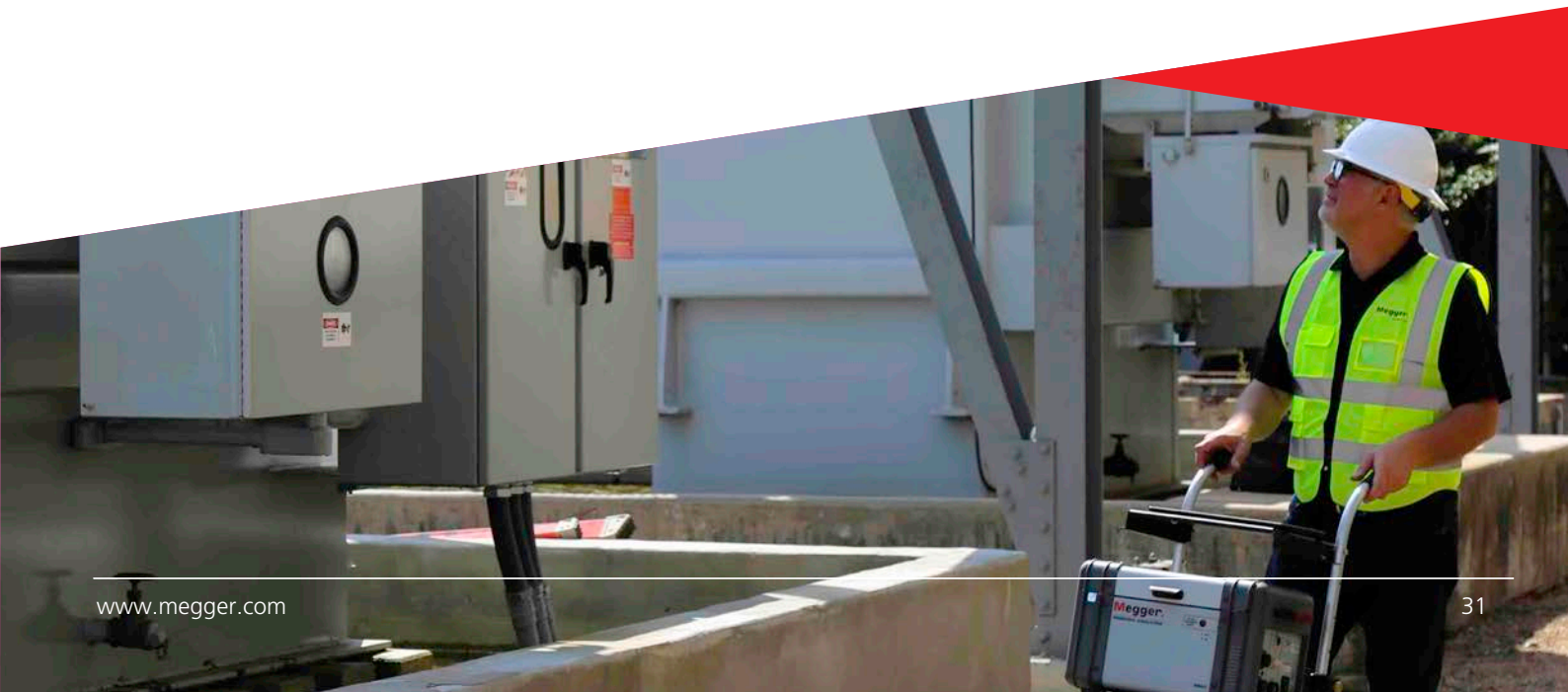
### MWA300 series

The MWA 300 transformer winding analyser is an advanced test system that can test all sizes and types of transformer, with and without OLTC tap changers. It delivers greater productivity due to its portability and by reduced set up time. The MWA will perform the following tests: ratio, phase deviation, polarity, excitation current, winding resistance, demagnetization, and make/break transition monitoring. Built to test transformers in the harshest of environments, the MWA performs well in high noise conditions.

The MWA300 outputs to PowerDB as a single software platform saving time with a single set-up and one easy-to-read report



		MT0106	MTO210	MTO250	MTO300	MTO330A	MWA300	MWA330A
Maximum windings connected		2	2	2	6	6	6	6
Max DC test current in A		6	10	50	10	10	10	10
Interface	Direct digital read out	■	■	■				
	PC Control			■	■	■	■	■
	PC on-board					■		■



# Transformer oil testing

## Dielectric strength testing

Oil is an efficient coolant with a high flash point and high dielectric strength when used as an insulator in transformers. The insulation properties can change due to oxidation, acids, sludge, gas and water absorption. These changes can be monitored using a dielectric Megger oil test set.

### 60 kV, 80 kV and 100 kV automatic laboratory oil test sets

#### OTS60AF, OTS80AF and OTS100AF

Designed for Laboratory use, these instruments measure the dielectric strength of mineral, ester and silicon insulating oils. With re-thought out ergonomics, the vessels and chambers are particularly easy to drain and clean out. The screw adjusted electrodes have a unique mechanism to lock precisely the electrode gap. The detection circuit offers direct measurement of both voltage and current and the system has an ultra fast HV switch off time of less than 10  $\mu$ s to reduce oil deterioration.

Each instrument has a large, bright, coloured screen to make user interface intuitive. To assist with the labelling of results files and recording of comments there is a phone-like 12 key alphanumeric pad.

The products can be configured to meet the testing requirements of the laboratory.



### Oil tan delta test set

#### OTD



A new addition to the comprehensive range of Megger Oil Test Sets, the OTD measures Tan Delta, resistivity and relative permittivity of insulating oils. As well as international set of standards, the OTD supports up to six customer configurable test sequences.

Productivity in the laboratory is maximised, with the focus on reducing the test cycle time by fan cooling and inductive heating, together with an oil drain facility, negating the need to move the oil vessel.

### Karl Fischer testing

Karl Fischer testing uses the titration method to measure the amount of water in fluids such as insulating oil. It has become a standard test done on transformer insulating oil.

### Variable specific gravity moisture in oil test set

#### KF-LAB



Easy to use test set that titrates for specific gravities between 0.60 and 1.40. Designed specifically for laboratory use, the KF-LAB is mains powered only.

### Portable moisture in insulating oil test set

#### KF875

Optimised for oils with an SG of 0.875, the KF875 is easy to use, portable one button test set with integral printer. Can be powered from mains, internal rechargeable battery or car battery. Ideal for on site use.



# Transformer oil testing

## 60 kV and 80 kV portable automatic oil test sets

### OTS60PB and OTS80PB



Weighing in at only 16 kg the OTS60PB is the lightest, most portable oil test set available. Meanwhile the OTS80PB is the most flexible test set because it offers more power in a test set which weighs less than 21 kg. Featuring the same easy-empty vessel and quick-drain chamber design as the laboratory models, the large, bright, colour screens are easy to read in sun light. Features like the electrode precision lock and ultra fast HV switch off time are particularly important for instruments that may not be used in the ideal environment. The OTSPBs can be configured to match the users needs. 60 kV manual oil test set.

## 60 kV semi automatic oil test set

### OTS60SX

Light semi-automatic 60 kV oil dielectric strength test set which is simple to use and can be powered from a range of mains supplies.



## Digital voltage checker for oil test sets up to 80 kV and 100 kV

### VCM80D and VCM100D

Designed for checking the output voltage of the OTS AF and OTS PB test sets, these checkers show the output voltage in digital read out and this can be compared with the instrument reading.



## OTS super-user kit

Offer 2 sizes of test chamber and a selection of electrode and impeller types.



# Power transformer testing

Frequency Response Analysis (FRA) applies a variable signal to the transformer and monitors its response. This can be compared to a reference which can reveal a wide range of faults.

Dielectric Frequency Response (DFR) also known as FDS (Frequency domain spectroscopy) is the most powerful tool for assessing the moisture in the oil and cellulose components of power transformers. Because it scans the dielectric losses in the system across a spectrum of frequencies and then compares them to a modelled curve, results are independent of temperature.

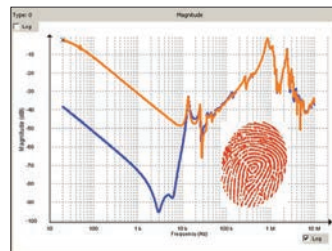
## Sweep frequency response analyser controlled by PC

### FRAX101

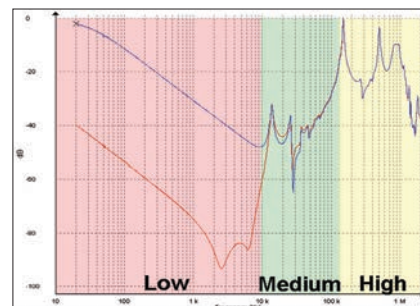
- Highest accuracy and dynamic range in the industry
- Complies with and exceeds international standards for sweep frequency measurements
- Smallest and most rugged sweep frequency analyser on the market
- Extensive file import-export capabilities including CIGRE and xml formats



SFRA is a method for assessing whether or not a transformer has been subject to mechanical damage, for example when moved or from a lightning strike. FRAX101 and its software on a PC allows repeatable fingerprinting of transformers so that a scan can be run whenever it experiences a traumatic event such as transportation, severe fault or overhaul, allowing it to go back on line faster. Ideally a transformer is fingerprinted at birth, but now is a good time so any future problems can be diagnosed. Compatible with all international standards for SFRA, FRAX101 can be battery powered and has wireless communication with a computer.



Collecting fingerprint data using Frequency response analysis (FRA) is an easy way to detect electro-mechanical problems in power transformers and an investment that will save time and money



## Sweep frequency response analyser

### FRAX150

Like FRAX101 the FRAX150 offers all the benefits of SFRA for diagnosis of damage to transformers, but it is built into a tough carry case which includes an on-board computer making it even more transportable. There is a large bright screen to make it comfortable to use even in bright sun light. Data can be stored on the hard-drive and can be downloaded using the galvanically isolated USB port.



# Power transformer testing

## Insulation diagnostic analyser

### IDAX300 and IDAX350

- State-of-the-art measurement of moisture content, tan delta / power factor and oil conductivity using DFR (Dielectric Frequency Response)
- Easy-to-use: Software with automated measurement flow and analysis of test results  
“Traffic light” interpretation of test results
- Dedicated test procedures for power transformers, bushings and current transformers
- Automated individual temperature correction (ITC) for accurate comparison with reference data/tests
- Reliable measurements even in high-interference environments



A reliable and accurate method for assessment of the condition of the insulating components of transformers and bushings, IDAX300 exploits FDS techniques and state-of-the-art software to make a transformer moisture assessment in less than 18 minutes. It measures capacitances and tan delta or power factor of the insulation between the transformer windings at multiple frequencies and plots the resultant curve. Comparing this measured curve with a modelled one allows calculate the moisture content.

The IDAX350 incorporates an on-board PC for results analysis and reporting with-in the enclosure.

## High voltage amplifier for IDAX300

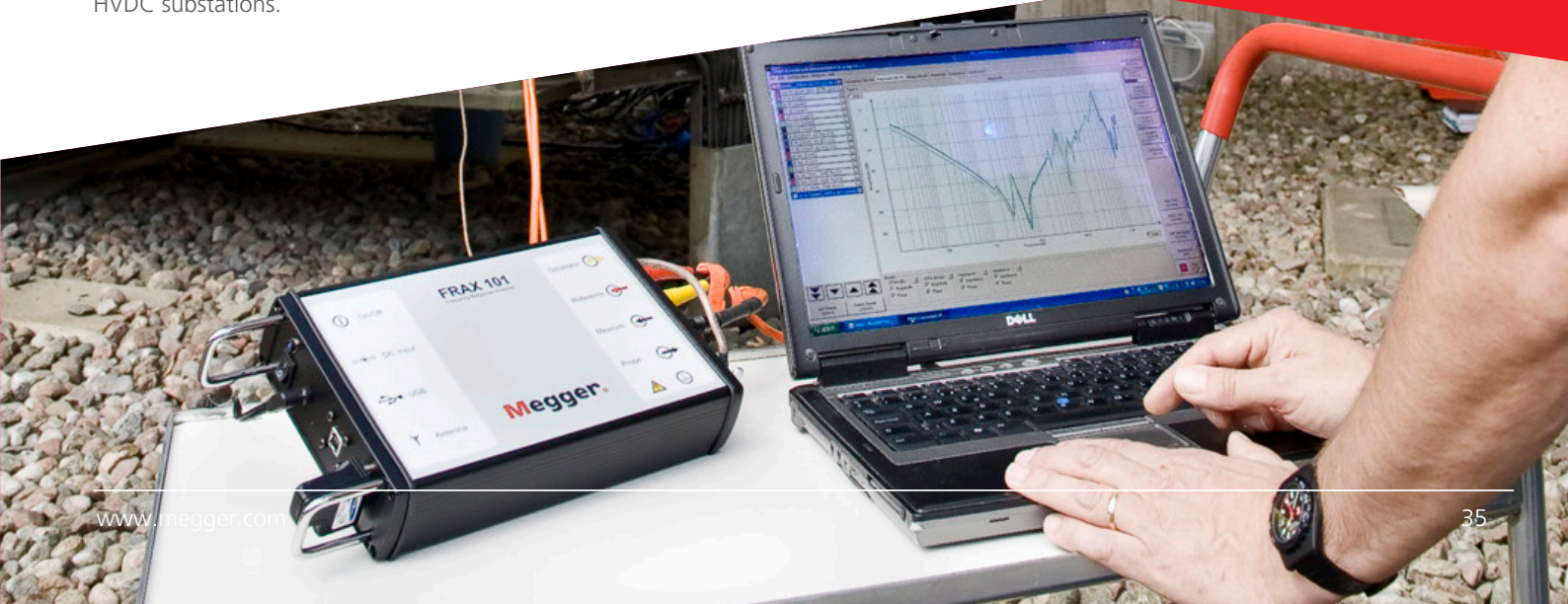
### VAX020

- True and proven DFR/FDS technology for highest performance
- High voltage amplifier enables IDAX measurements at 2 kV test voltage
- Large frequency range, DC to 1 kHz
- Compact design, weight only 4.4 kg

VAX020 expands the IDAX300 test voltage range from 200 V to 2 kV. This improves the capability to perform accurate measurements in extreme high interference environments e.g. HVDC substations.



Besides 50/60 Hz capacitance and dissipation factor (power factor) measurements, the application gives valuable information about the general condition of any high voltage insulation by measuring its dielectric response. The technique is also capable of assessing the moisture content in oil/paper insulation systems.





**Power Diagnostix offers a wide range of partial discharge testing and monitoring systems for MV and HV applications**

# Partial Discharge Testing by Power Diagnostix



Power Diagnostix offers instruments for partial discharge (PD) measurement and monitoring (ICM™ Technology), loss factor (LF/DF) measurement devices, fiber optic analog and digital signal transmission systems, high voltage test and control systems and cabinets, plus many other tools for high voltage diagnostic applications. Beside all these special products for quality control and life cycle assessment of insulation materials and components, Power Diagnostix also provides services, expertise, and training seminars in this special subject.

Power Diagnostix is now a part of the Megger group.

## Transformers

Partial discharge measurements on power and distribution transformers are a proven tool to identify and locate insulation defects within windings, instrument transformers, bushings, tap changers, or other accessories. Besides providing the required equipment for factor acceptance testing (FAT), Power Diagnostix offers a wide range of instruments for onsite investigations and for continuous online monitoring. Such offline or online measurements in the field generally serve as an in-depth verification of an initial trigger by a PD-monitoring system or suspicious dissolved gas analysis results, and can provide essential information about ongoing deterioration of components of the active part and bushings, for instance. Currently, offline partial discharge testing in the field after commissioning of new units is an emerging trend, and already proved to be very effective to detect assembling or processing deficiencies. The permanent PD-surveillance of transformers in the grid is these days a proven technology to prevent unforeseen outages or irreparable damage. Accurate monitoring of phase resolved PD-patterns and alarm thresholds are the required indicators to monitor in order to avoid a breakdown or system failure.

## Cables

Polyethylene is a 'non-forgiving' insulation system. Thus, close attention must be paid to partial discharge activity during factory testing, commissioning, and service. On-site measurement techniques have to cover the needs of an aging polymeric cable distribution net as well as an increasing application of polyethylene extra high voltage cables.

## Rotating Machines

The epoxy-mica stator winding insulation system of rotating machines "forgiving" insulation system. Due its dielectric stability, partial discharge activity acts as an indicator for a variety of defect mechanisms. Besides the normal thermal ageing, further problems, such as end winding contamination, bar or overhang vibrations, deterioration of grading layers, loose wedges or large internal delaminations are common practice and can be classified by analysis of the phase resolved pattern properties. Partial discharge testing and monitoring on generators and large motors offers a detailed stator winding condition assessment. This helps avoiding unplanned outages as well as scheduling efficient maintenance turn arounds.

## Switchgear (GIS/GIL)

Besides factory partial discharge testing for quality assurance, field-testing becomes increasingly important for gas-insulated equipment. For the field applications UHF and acoustic detection methods complement the low frequency detection according to the IEC60270.

Power Diagnostix range of instruments cover the entire needs of partial discharge testing on gas-insulated substation equipment from acceptance testing and commissioning to maintenance and monitoring.

**Learn more about the complete range of products offered by Power Diagnostix at [www.pdix.com](http://www.pdix.com)**

# Partial discharge testing

## Advanced Partial Discharge Detector

### ICMsystem Generation 5

The ICMsystem Generation 5 is part of the Power Diagnostix ICM series of digital partial discharge detectors. The ICMsystem is a powerful, versatile instrument for evaluating the condition of medium and high voltage insulation. The ICMsystem Generation 5 is usable over a range of frequencies of applied voltage, including power system frequency (50/60 Hz) and VLF (0.1 Hz).

The ICMsystem Generation 5 provides high-resolution digital PD patterns for classification of defects in high voltage insulation systems.

The multi-channel version of the ICMsystem is specifically designed to meet the requirements of partial discharge acceptance tests on large power transformers. The instrument builds on the acquisition core of the standard ICMsystem. However, by introducing an individual amplifier plug-in board for each channel, true parallel acquisition of the discharge magnitude of up to ten channels is achieved. The instrument can be equipped with optional features like RIV or acoustic PD measurement. Using the ICMsystem Generation 5 greatly simplifies partial discharge acceptance tests on large power transformers.

With the true parallel acquisition of the partial discharge activity on up to 10 channels, the overall testing period is substantially shortened. In acceptance test mode, the software shows up to 10 meter displays, each indicating PD level, voltage, and frequency of the specific channel.



*ICMsystem with nine and ten channels*

## Digital Partial Discharge Detector

### ICMcompact

The ICMcompact is part of the ICM series of digital partial discharge detectors. The ICMcompact is a compact, stand-alone instrument for evaluating the condition of medium and high voltage insulation. It is often used in quality assurance and quality control tests in manufacturing.

The easy portability, simple operation, and flexibility of the ICMcompact make it a good choice for routine PD testing in a variety of utility and industrial applications.



## Partial Discharge Measurement Device

### AIAcompact

The AIAcompact is a portable unit for in-service acoustic and electric (UHF) partial discharge measurements on gas-insulated switchgear (GIS), transformers, and cable accessories. The instrument is fitted with a battery pack for independent operation up to 3 hours. It adapts to a variety of piezo-electric acoustic sensors and is supplied with a versatile sensor fixture. Additionally, the AIAcompact allows partial discharge measurements on external UHF sensors.

Offering easy-to-use acoustic partial discharge analysis of gas-insulated switchgear (GIS) and other high voltage equipment plus the optional analysis on embedded or external UHF sensors makes the AIAcompact the ideal solution for convenient in-service substation condition assessment.

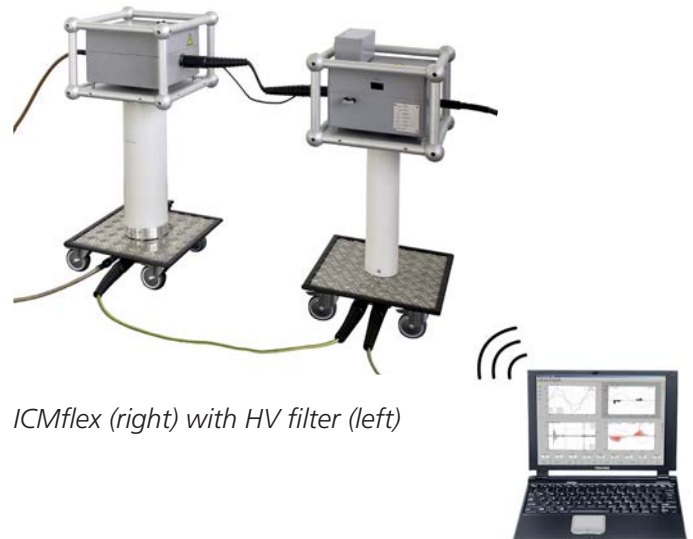


## Partial Discharge Measurement System

### ICMflex

The ICMflex offers inherent operator safety and greatly simplifies distribution class cable testing and other field tasks involving partial discharge and tan delta testing. The instrument is mainly used for on-site testing, but can be used in laboratories and work shops as well.

Using wireless Bluetooth or fiber optic technology the ICMflex and partial discharge analyzer family increases operator's safety and greatly simplifies off-line testing and analysis of distribution class cables and rotating machine stator windings.



ICMflex (right) with HV filter (left)

## Partial Discharge Monitoring on GIS Systems

### GISmonitor

The GISmonitor Portable is a portable unit for partial discharge measurements on gas-insulated switchgear (GIS) caused by hopping particles, floating potentials, cracks in insulators or spacers, or other degradation in the insulation system. The instrument offers parallel real time PD acquisition on up to 40 channels. To eliminate disturbance signals from the measurement, the instrument can be connected to a disturbance antenna that provides a gating signal.



# Partial discharge testing

## Partial Discharge Monitoring Device

### ICMmonitor

The ICMmonitor is part of the Power Diagnostix ICMseries of digital partial discharge detectors. It is a compact, stand-alone instrument for evaluating the condition of medium and high voltage insulation. A built-in four-, or eight-channel multiplexer offers scanning of three-phase systems or multiple sensors. It is used principally for permanent, continuous on-line monitoring of rotating machines, cable systems, power transformers, and gas-insulated switch gear (GIS).

## High power test & diagnostics combination for MV cables

### TDS NT series

Network operators can now get faster and significantly more reliable information about the quality and the condition of their cables. For the first time, it has become possible to immediately locate faults in underground cables during the actual PD measurement. With the 50/60 Hz Slope Technology a withstand test with VLF cosine-rectangular voltage (VLF CR) and PD diagnosis with damped alternating voltage (DAC) is combined in one unit, the TDS NT series. This allows an efficient and integrated solution for precise inventory of the network infrastructure. Important to mention is that the PD measurement data, gained with the VLF CR or with the DAC test voltage, can be compared directly with the 50 / 60 Hz network voltage. This facilitates reliable decision making.

Apart from PD diagnostics the TDS NT series can also be used for simple VLF withstand testing, DC testing, sheath testing and sheath fault pinpointing. Making it a universal system for both cable testing and diagnostics. The TDS series are available in two versions, 40 and 60 kV.



## Test and diagnostic system for high-voltage cables

### HV DAC200 and HV DAC300



The HV DAC-300 and HV DAC-200 apply damped AC voltage techniques to the cable installation, as part of a maintenance regime or the commissioning of new high voltage cables up to 230 kV. HV DAC systems can easily identify, evaluate and locate partial discharge faults in cable insulation and cable accessories of all types in both new and aged high voltage power cables.

## PD diagnostic system for medium voltage cables

### MV DAC-30

The MV DAC-30 unit can identify, evaluate and locate partial discharge in both cable insulation and accessories according to IEC 60270 and IEEE 400.3/4. One of the major benefits of the DAC waveform is the similarity with the 50/60 Hz power frequency. Data can directly be correlated and decisions can be made, this in contrary to VLF Sine 0.1 Hz, over here it is not possible.

One of the unique features of the MV DAC-30 is that the HV unit consists of a voltage source with an internal PD detector. Unlike with other PD measurement systems, the cable under test is the only accessible live component when testing with the MV DAC30, making it much safer.





# Partial discharge testing

## Handheld online PD substation surveying system

### UHF PD Detector

The UHF PD Detector is the ideal tool for quick, non-invasive surveys in MV and HV substations and should be part of the toolkit for all maintenance and service teams. Due to its high measurement bandwidth, the UHF method provides accurate local online partial discharge (PD) measurements on HV components such as cable end-terminations, surge arrestors, voltage transformers and isolators.



MV switchgear surveys can also be carried out using radio frequencies in combination with TEV and HFCT sensors. The phase resolved PD pattern (PRPD) display helps to identify type of defect and, importantly, differentiate the noise from the PD signal. Noise can affect PD readings, leading to a false interpretation of the results and unnecessary component replacement. The noise handling capability of the Megger UHF PDD ensures a true reading of PD, eliminating false positives, so that only failing components are identified for replacement.

## High power test and diagnostics combination for MV cables

### TDM 45 series

TDM 45 series is a revolutionary breakthrough in testing and diagnostics of MV cables. The patented concept addresses the utilities increasing need for flexibility in use of test and measuring equipment based on the type of application.

The modular concept allows the engineer to individually setup the unit based on the type of job that needs to be executed, e.g. for tanDelta diagnostics, PD diagnostics or VLF withstand testing. The TDM 45 series is available in eight variants; upgrades are possible without sending the unit back to the factory.



## Portable PD detection and localization system

### PDS 62-SIN

Apart from PD couplers which are suited for all types of excitation voltages Megger also offers PD couplers which are suited for VLF sinusoidal only. The PDS 62-SIN has been designed for all Megger VLF sinusoidal testers up to 62 kVpeak. With its weight of 14.5 kg the PDS 62-SIN is the lightest PD measuring unit on the market.



## Medium voltage switchgear substation surveying system

### PD Scan

The PD Scan is a handheld, pre-screening tool suitable for on-line detection of PD activity in MV cables and plant. PD activity is widely regarded as an indication of incipient faults in the insulation and seen as one of the best 'early warning' indicators of the deterioration of medium and high voltage insulation. Faults in MV plant are in most cases cost expensive. A breakdown in e.g. a termination can lead to damage of the entire cubicle. In addition faults in MV plant can lead to long outage times. With help from the PD scan such faults can be prevented.

The intuitive operating system and the large touchscreen color display makes it one of the most user-friendly handheld online PD units in the market.



## Partial Discharge Diagnostics

### PDS60

The PDS60 PD module works together with the VLF 45 Sinus as well the TDS60 VLF Rectangular and 50Hz Slope voltage sources to perform PD diagnostics on cables using the latest automatic analysis algorithms.



# VLF insulation testing of cables

Very Low Frequency (VLF) 0.1 Hz testing is used on XLPE cables as an alternative to DC testing to prevent polarisation and premature damage to the insulation. It is designed to identify weak spots due to electrical trees in the insulation.

Cosine rectangular 0.1 Hz systems have been developed to meet international standards such as IEC HD 620/621 and IEEE 400. The benefit of the cosine rectangular waveform is that you can test longer cables to the standards of 0.1 Hz.

Many of our VLF test systems also feature dc and pulsed dc outputs to enable sheath testing, and sheath fault pin-pointing using the ESG NT.

## VLF and DC cable 20 kV post repair cable tester

### Easytest 20 kV

The Easytest is a simplified version of the standard cosine rectangular VLF test.

Typically, a test is performed in accordance with company specifications after repairs or after a new cable has been installed.



## 28 kV, 40 kV and to 60 kV VLF cosine rectangular waveform test systems

### VLF CR 28 kV, VLF CR 40 kV Basis, VLF CR 40 kV Plus, VLF CR 60 kV Basis and VLF CR 60 kV Plus



The portable VLF CR systems VLF CR 28 ... 60 kV are high power test sets that allow standard compliant testing at 0.1Hz. Aside from cable and sheath testing, the test systems can also be used for precise pinpointing of sheath faults. The VLF CR 28 is suited for cables rated up to 15 kV, the VLF CR 40 up to 23 kV and the VLF CR 60 up to 36 kV.

## High power VLF test systems

### VLF CR 60 HP, VLF CR 80 Base and VLF CR 80 Plus

The VLF CR systems VLF CR 60-HP and VLF CR-80 are high power test sets that allow standard compliant testing at 0.1Hz of very long cables (up to 33 km at maximum test voltage). These units are ideally suited, if installed in a container, for offshore windfarm testing (36 kV class up to 3 U<sub>0</sub>, and 66 kV class up to 2 U<sub>0</sub>).



## VLF test system with 50 Hz slope technology

### TDS40 and TDS60

Offering 40 or 60 kV output at 0.1 Hz with rising and falling edge shape equivalent to the 50 Hz slope, these test systems are built in two parts to make them more transportable. They also output damped ac and dc to the nominal voltage and can be used for sheath testing.



# VLF insulation testing of cables

## 34 kV sine wave VLF test system

### VLF sinus 34 kV



The VLF Sine 34 kV is a compact, robust and portable VLF sine wave test system for medium voltage cables. With its output voltage of 34 kV<sub>peak</sub> it is ideally suited to perform withstand testing on cables rated up to 15 kV. For diagnostic applications it is suited for cables up to the 23 kV class.

### Tan delta attachment



Megger provides three solutions for tanDelta diagnostics, the external tanDelta attachment is a high precise unit which functions with all Megger VLF testers. In addition Megger also provides VLF units with internal tanDelta facility, the VLF Sinus 45-TD/TDM45-P-TD and the VLF Sinus 62-TD/ TDM62-P-TD.

## 45 kV sine wave VLF test system

### VLF sinus 45 kV

The VLF Sine 45 kV, with optional integrated tanDelta, is a compact system for commissioning and condition analysis of medium-voltage cables. With its output voltage of 45 kV<sub>peak</sub> it is ideally suited to perform withstand testing on cables rated up to 25 kV. For diagnostic applications it is suited for cables up to the 36 kV class.

## 62 kV sine wave VLF test system

### VLF sinus 62 kV

The VLF Sine 62 kV, with optional integrated tanDelta, is the smallest and lightest system on the market with internal tanDelta measurement. With its output voltage of 62 kV<sub>peak</sub> it is ideally suited to perform withstand testing on cables rated up to 36 kV. For diagnostic applications it is suited for cables up to the 45 kV class.



MODEL		EASYTEST 20 KV	VLF CR 28 KV	VLF CR 40 KV BASIS	VLF CR 40 KV PLUS	VLF CR 60 KV BASIS	VLF CR 60 KV PLUS	VLF CR 60 KV HP
Test voltage	Vlf Test Voltage	0 ... 20 kV peak	0 ... 28 kV eff	0 to 40 kV eff	0 to 40 kV eff	0 to 60 kV eff	0 to 60 kV eff	0 to 60 kV rms
	Frequency	0.01 to 0.1 Hz	0.1 Hz	0.1 Hz	0.1 Hz	0.1 Hz	0.1 Hz	0.1 Hz
	Wave Form	Simplified Cosine Rectangular	Cosine Rectangular	Cosine Rectangular	Cosine Rectangular	Cosine Rectangular	Cosine Rectangular	Cosine Rectangular
Testing cable capacitance (at max. voltage)		0,5µF (0.1 Hz)/	5µF (0.01 Hz)	2.4 µF	4.8 µF	1 µF	2 µF	6.5 µF
	DC	0 ... 20 kV	0 to -28 kV	0 to -40 kV	0 to ±40 kV	0 to -60 kV	± 0 to ±60 kV	0 to ±60 kV
Output current measurement		0 ... 50 mA	0 to 12 mA	0 to 7 mA	0 to 7 mA	0 to 5 mA	0 to 5 mA	0 to 17 mA
Sheath testing		0 to 5 kV or 0 to 10 kV	2 to 10 kV	2 to 10 kV	2 to 10 kV	2 to 10 kV	2 to 10 kV	0 to 10 kV
Sheath pinpointing	Test voltage	0 to 5 kV or 0 to 10 kV	2 to 10 kV	2 to 10 kV	2 to 10 kV	2 to 10 kV	2 to 10 kV	0 to 10 kV
	Pulse rate	01:03	1:3, 1:4 or 1:9	1:3, 1:4 or 1:9	1:3, 1:4 or 1:9	1:3, 1:4 or 1:9	1:3, 1:4 or 1:9	1:3, 1:5 or 1:9
Weight		17 kg	25 + 25 kg	55 + 48 kg	55 + 48 kg	85 + 48 kg	85 + 48 kg	380 kg

MODEL		VLF CR 80 KV BASE	VLF CR 80 KV PLUS	TDS40	TDS60	VLF SINUS 34 KV	VLF SINUS 45 KV	VLF SINUS 62 KV
Test voltage	Vlf Test Voltage	0 To 80 Kv Rms	0 To 80 Kv Rms	3 to 40 kV rms	3 to 60 kV rms	0 to 34 kV peak	0 to 45 kV peak	to 562 kV peak
	Frequency	0.1 Hz	0.1 Hz	VLF 0.1 Hz DAC 50 to 300 Hz	VLF 0.1 Hz DAC 50 to 300 Hz	0.01 to 0.1 Hz	0.01 to 0.1 Hz	0.01 to 0.1Hz
	Wave Form	Cosine Rectangular	Cosine Rectangular	50 Hz slope	50 Hz slope	Sine	Sine	Sine
Testing cable capacitance (at max. voltage)		2.0 µF	2.5 µF	up to 4.8 µF	50 Hz slope	0.6 µF(0.1 Hz)/	0.6 µF	1 µF @ 0.1Hz 5 µF @ 0.01Hz
	DC	0 to - 80 kV	0 to ± 80 kV	DAC 5 µF	DAC 2 µF	0 to ± 34 kV	0 to ± 45 kV	0 to ± 62 kV
Output current measurement		-12.5 mA	±12.5 mA	7 mA	5 mA	0 to 14 mA	0 to 20 mA	0 to 40 mA
Sheath testing		0 to 10 kV	0 to 10 kV	3 to 10 kV	3 to 10 kV	0 to 5 kV or 0 to 10 kV	0 to 5 kV, 10 kV, 20 kV	0 to 5 / 10 / 20 kV
Sheath pinpointing	Test voltage	0 to 10 kV	0 to 10 kV	3 to 10 kV	3 to 10 kV	0 to 5 kV or 0 to 10 kV	0 to 5 kV, 10 kV, 20 kV	0 to 5 / 10 / 20 kV
	Pulse rate	1:3, 1:5 or 1:9	1:3, 1:5 or 1:9	1:3, 1:5 or 1:9	1:3, 1:5 or 1:9	1:3 or 1:4	1:3 or 1:4	1:3 or 1:4
Weight		380 kg	380 kg	55 + 48 kg	85 + 48 kg	25 kg	50 kg	60 kg

# Cable test vans

The family of Megger Cable Test Vans was specifically developed with the demanding needs of our international customers in mind; may it be service contractors, utilities or research facilities. Our test vans are delivering superior performance, ergonomics, user-friendliness, reliability in the field and optimum speed on all 5 continents and even in difficult environmental conditions.

Embodied into this unique test van concept are the requirements and the field experience of many end users. The result is a system which sets a new benchmark for cable fault location and cable diagnostics performance, empowering you to keep the power on.

## Variant

The Variant system is a manually operated, modern, modular system. It can be customized for cable fault location as a single- or three-phase system controlled by a Teleflex VX.

The Variant system provides all the high voltage prelocation techniques for cable fault location. It can also be set up for cable testing and diagnostics providing a complete solution for customers working with underground cable systems. There are two versions available for DC testing: 80 kV and 110 kV.

- **Modular design, variably expandable**
- **Reliable due to redundant system architecture**
- **easyGO® user interface**
- **ARM® multi-shot prelocation**
- **Powerful 0.1 Hz VLF test up to 18  $\mu$ F**
- **Autonomous operation with Li-Ion battery power**



Learn more at  
[www.cabletestvan.com](http://www.cabletestvan.com)

# Cable test vans

## Complete test and fault location system suitable for installation into compact vans

### City Series – Compact City and Centrix City

The City van systems are the most versatile solution for cable testing, cable diagnostics and cable fault location where a small vehicle is a necessity. It is ideal for use in city areas with narrow pedestrian zones and minimal parking spaces. For fault location applications the van is equipped with an SPG 40 fault locator; for testing and diagnostics, the TDM 45 can also be installed.

The City series includes all the safety features implemented in the large cable test systems and is easy to use. The easyGO operation philosophy enables even inexperienced users to efficiently carry out cable checks, fault location and diagnostics.



- Tailored to fit to small vehicles
- Easy operation in restricted spaces
- Centrally controlled, fully automatic system with intuitive user interface
- Fully integrated PD coupler
- Cost-effective modular system architecture
- Highest safety standard



# Cable test vans

**Fully integrated single or three-phase diagnosis or cable fault location van**

## Centrix 2.0 system

The Centrix 2.0 system is the most sophisticated system available in the market, combining both

cable fault location and cable testing and diagnostics technologies into one integrated van-mounted solution. The system's operation is fully automatic and based on the well-known easyGO user Interface.

Centrix 2.0 is available as single- and three-phase version and may be configured with every high voltage prelocation method there is, including ARM Multishot, ARM Burning, ICE, Decay, Decay plus and IFL.

All accessories for tracing/line location, fault pinpointing and cable identification are also included. The Centrix system may be customised as a complete cable testing and diagnostics solution which provides market-leading capabilities for VLF testing, tanDelta measurement and partial discharge analysis, as well as DC testing up to 80 kV. Centrix comes with an impressive set of safety features, undoubtedly making it the safest system in the market. It is the most versatile and most reliable all-in-one solution for predictive, preventive and corrective maintenance. With its onboard database, remote control function and GPS mapping, data management and fault locating is as convenient and as accurate as it gets.

- **Made in Germany – high build quality**
- **Intuitive easyGO® operation using a touch display**
- **Cable diagnostics with 50/60 Hz slope technology**
- **Highest standard of safety with SafeDischarge technology**
- **Remote control of important system functions**
- **Breakdown phase detection for three-phase cable testing**
- **System powered by Li-Ion battery**



# Cable test vans

## System R 30 fault location system for all applications

The R 30 is suitable for challenging medium voltage and high voltage applications, thanks to its robust HV DC source, and its superior energy discharge capabilities. The system is controlled with the single rotary knob easyGO interface of the Teleflex VX.

A number of high end options are available, e.g. DC test and Decay prelocation modules up to 150 kV and even 400 kV for UHV transmission cables. The R 30 also offers surge generator options up to 100 kV, as well as ARM up to 50 kV and ICE up to 80 kV.

VLF testing can be carried out up to 70 kVRMS with a testable cable capacity of 5  $\mu\text{F}$  @ 0.1 Hz to provide a flexible, powerful solution for cable testing. Additional diagnostic equipment can be included, and fault conditioning can be achieved with a 15 kV / 25 A burner. Motorised HV switches, digital interfaces and extensive safety systems provide the highest standard of personal safety for the operator and protection to the equipment during operation.

The R30 discharge capabilities of up to 220 kJ are essential for safe operation on long cables and offshore applications and, and are unmatched in the industry.



**Learn more at**  
**[www.cabletestvan.com](http://www.cabletestvan.com)**



# Time domain reflectometry

## Advanced portable reflectometer for fault location systems

### Teleflex VX

Teleflex VX is especially designed to capture the rapid events encountered during fault location in power cables. The new hardware with significantly improved specification such as sampling frequency, pulse width and pulse amplitude, offers a longer range, higher resolution and above all, improved measurement.

When used with a surge generator the DeltaU trigger technology always provides the perfect trigger timing. The ARMslide records 15 traces in one shot and allows the selection of the best trace, especially for wet and long cables. The ProRange function allows a range-based gain adjustment, displaying distant reflections with the same amplitude as those from short distances. With its large bright colour display Teleflex VX is operated using standard jog dial rotary controller, common to the Teleflex range.



The USB interface permits a very easy data transfer either as PDF files, as data set to the Winkis database software, or directly to a printer.

## Three-phase time domain reflectometer

### MTDR300

The 3-phase MTDR300 has a range from 100 m to 55 km is designed to rapidly and accurately pre-locate faults in power cable networks. Operation is via a single jog-dial and an easy-to-use menu with pull-downs. All the operator has to do is select the operation and click to confirm.

The MTDR300 is available as part of a Megger CFL or PFL system and as a stand-alone unit, housed in a rugged field proven case.



## Portable reflectometer for fault location systems

### Teleflex SX

With a range of between 20 m to 160 km Teleflex SX is a powerful TDR. It is easily operated using the touch screen and control knob and it automatically analyses the trace to give the cable end and fault distance indication. It supports all existing pre-location technologies and is compatible with all HV fault location systems.



## Overhead line testing system

This interface permits a Teleflex reflectometer to be safely attached to overhead lines by earthing any dangerous induced voltages. By measuring the impedance changes, it can detect breaks, short circuits and branches off the line, smaller changes in impedance such as poor connections, faulty insulators and changes in cross section and sags in the line.

## Single channel LV cable fault locator

### TDR1000/3P

A very capable TDR for identifying and locating faults on metallic cables. The TDR1000 is suitable for use on both dead and live cables without a blocking filter, up to CATIII 150 V phase-to-earth. Using a 2 ns pulse the TDR1000/3P's near end performance is exceptional while offering a maximum range of 5 km.





# Time domain reflectometry

## Dual channel LV cable fault locator

### TDR2050

Offering a CATIV 600 V safety rating, the TDR2050 is perfect for chasing down fault on power circuits such as street lighting. It is IP54 rated. The step function trace improves the near-end performance of the TDR2050 as it prevents the trailing edge of the pulse masking faults. Other features are Auto-find taking you to the major events on the cable, Find-end function identifies the end of the cable and measures its length. Distance dependant gain is a major benefit in long cable performance.



Model	Teleflex VX-P	Teleflex SX	Teleflex LX	MTR300	TDR2050	TDR1000/3P
Range	20m to 1280 km	20 m to 160 km	20 m to 160 km	55 km	0.5 m to 20 km	0.5 m to 5 km
Output pulse	30 to 160 V	5 to 50 V	10 to 50 V	25 V	20 V	5 V
Pulse width	20 ns to 10 $\mu$ s	20 ns to 10 $\mu$ s	20 ns to 10 $\mu$ s	50 ns to 10 $\mu$ s	min 2 ns	2 ns to 4 $\mu$ s
Velocity factor range	3 to 50 %	3 to 50 %	3 to 50 %	30 to 99 %	20 to 99%	20 to 99%
Resolution	0.1 m	0.1 m	0.1 m	0.82 m	0.1 m	0.1 m
Weight	20 kg	10 kg	10 kg	6.7 kg	1.7 kg	0.6 kg
Interface with HV prelocator	■	■		■		

## Why CATIV?

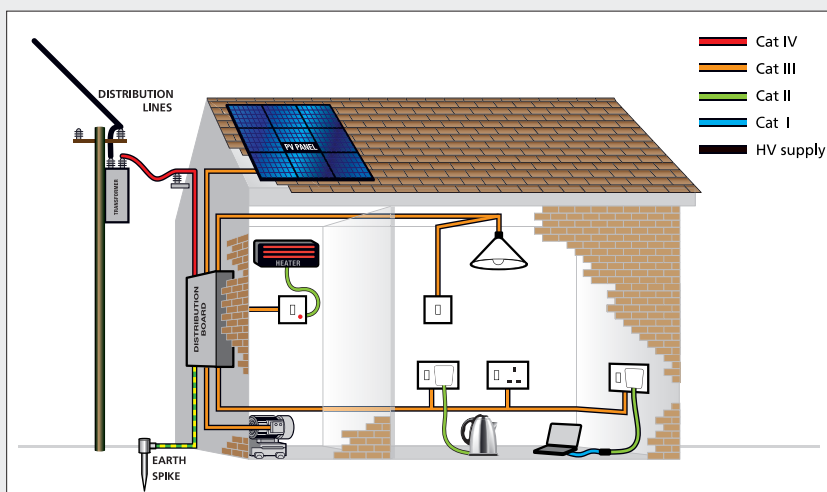
A distant lightning strike can produce a transient of several kV on the supply. That transient lasts for a few tens of microseconds and is likely to do little damage.

The problem is that it may initiate an arc and this arc then presents a low impedance path for current from the mains supply. Often, that supply can deliver 1000 A or more before the breaker or other protective device operates. In that time, the amount of energy liberated is enough to start a fire or even cause an explosion. If the arc is within a test instrument there is a high probability that you will be injured or worse!

The solution is simple – design the instruments with protection and internal clearances that are large enough to prevent transients from establishing an arc and along with appropriate protection devices. Guidance to this is given in IEC61010 in order to comply with category ratings defined in IEC60664.

In practice, transients are damped quite quickly as they pass through a typical distribution system. As you can see from the diagram CATIV is recommended for use outside and to the consumer unit.

Using an instrument with a higher installation category rating does not alone create a safer working environment. You should always follow correct work practices to keep you and others safe.



# Cable fault location systems

The fundamental objective of any cable fault location system is to provide quick, effective, accurate and safe fault location, resulting in reduced system outages and "Customer Minutes Lost". Megger's fault location systems help you quickly find the location of the underground fault.

## Highly portable fault location system

### EZ-Thump12

Weighing less than 33 kg the EZ-Thump12 is the most portable fault location systems on the market. It utilises the "Easy Go" test system, which is easy to operate, interprets the results and requires minimal training to find faults. On-board is a TDR with a 7.6 km range and arc reflection at 12 kV for pre-locating. For pinpointing, EZ-Thump offers a surge energy of 500 j, DC testing for breakdown detection and insulation resistance measurement. The unit is operated from line or the internal battery. It can fit in the boot of a car, making it ideal for a flexible, quick response fault finding strategy.



### EZ-Thump3

The new dual-stage 3 kV EZ-Thump is the first of its kind in the entire market. It's portable, compact and lightweight, battery and AC line operated cable fault location systems specifically designed for fault locating of shielded and unshielded low voltage power cables. Due to its portable, robust and (wet) outdoor-capable enclosure, it's ideally suited for all typical fault locating operations on LV cables either in industrial applications up to 3 kV, street light fault locating or fault locating of LV power circuits in the utility industry.



The EZT3DV2 model is the only dual-stage 3 kV unit in the market which addresses LV cables with either 600 V or 1000 V ratings and a max permissible test level of 3 U<sub>0</sub> (1.8 kV or 3 kV).

## 20 kV fault location system

### PFL22M1500

This tough portable system offers cable and fault diagnosis, pre-location, fault conditioning and pin-pointing using the acoustical method. There is a 20 kV output for insulation testing and proof / burn. The surge energy is 1550 J at 8 or 16 kV. The TDR has a range of 50 m to 55 km.



## Portable cable fault locating system

### ST16

This neat, compact system can be powered by on-board batteries or main supply. It utilises the "Easy Go" test system, which is easy to operate, interprets the results and requires minimal training to find faults. Proof test at 8 or 16 kV, surge energy 1500 J, features ICE, ARC reflection (ARM), decay and sheath test modes.



### ST25-30

The SMART THUMP ST25-30 Portable Cable Fault Locating System provides safe, efficient and extremely easy-to-use solutions for quickly identifying, prelocating and pinpointing various types of cable faults for power cables. The ST25-30 is developed to meet the requirements for typical medium-voltage distribution cable fault location markets from 11 to 35 kV system voltage.



## Traditional surge wave generators

### SWG

Surge wave generators are the main component of cable fault location. They are used for both pinpointing and prelocation in combination with an ARM filter and reflectometer.



## Fault location systems for MV networks

### SFX12 and SFX16

A pair of mobile fault locating systems offering up to 12 kV, 1100 J or 16 kV, 2000 J surge energy respectively. They are controlled using the well-renowned built-in Teleflex SX TDR.

# Cable fault location systems

## 8, 16 and 32 kV fault location system

### SFX32



SFX32 is a mobile system for testing and fault locating on low and medium voltage cables as the test and surge voltages can be up to 32 kV. The Short Period Arc Reflection Method is used for pre-location of high resistance faults up to 32 kV while low resistance faults can be located with the Teleflex TFX-SX TDR module without recourse to high voltage methods. The burning of faults is possible at all voltage levels by short-term burning. 1750 Joules with a vehicle mounted option of 3500 J of surge energy provide the necessary high power for fast and accurate pinpointing cable faults by the acoustic method.

## 8 kV fault locating system

### SFX8-1000

With an output surge of 1000 J and voltages of up to 8 kV SFX8-1000 is the perfect for finding faults on low and medium voltage cables. For pre-location ARM, ICE modes can be used with the TDR having a maximum range of 160 km. The pre-location unit TeleflexSX can be battery operated and stand alone or integrated with the surge unit on the wheeled mounting frame.



## Mobile cable testing and fault location system

### SFX40

The SFX40 is a mobile, multi-functional system for testing, pre-location, pinpointing and converting cable faults in low and medium voltage networks. The system is controlled directly via the connected TFX-SX reflectometer or the integrated control panel. All functions of the system can be easily performed using the selector knob. With DC output up to 40 kV and surge energies of 1000 J or 2000 J this is a powerful system yet the integrated safety system ensures the highest degree of safety is guaranteed.



## 5 kV fault locating system

### SFX5-1000

This portable system is used for cable testing, fault conditioning, pre- and pinpoint location of faults in low voltage distribution systems. With an output of up to 5 kV, the unit can supply up to 1000 J.



Model	EZ-THUMP3	EZ-THUMP4	EZ-THUMP12	SFX8-1000	ST16	PFL22 -M1500	SFX5-1000	SFX12	SFX16	SFX32	SFX40
<b>Max output voltage</b>	1.5 to 3 kV	0 to 4 kV	0 to 12 kV	2, 4 and 8 kV	8 and 16 kV	10 and 20 kV	5 kV	12 kV	16 kV	0 to 30 kV	40 kV
<b>Surge energy output</b>	500 J	500 J	500 J	1000 J	1500 J	1500 J	1000 J	1100 J	200 J	1750 J	1000 J
<b>TDR range</b>	7.6 km	7.6 km	7.6 km	160 km	7.5 km	55 km	160 km	160 km	160 km	160 km	160 km
<b>Pre-location method</b>	ARM	■	■	■	■	■	■	■	■	■	■
	ICE				■	■	■	■	■	■	■
	Decay							■	■	■	■
	Insulation						■				■
<b>Fault conditioning</b>				■	■	■	■	■	■	■	■
<b>Proof/burn</b>				■	■	■	■	■	■	■	■
<b>Pin-pointing</b>	■	■	■	■	■	■	■			■	■
<b>Sheath fault</b>				■	■	■	■	■	■	■	■
<b>Mains operation</b>	■	■	■	■	■	■	■	■	■	■	■
<b>Battery operation</b>	■	■	■		■						
<b>Width</b>	355 mm	355 mm	355 mm	530 mm	500 mm	536 mm	520 mm	800 mm	800 mm	800 mm	520 mm
<b>Weight</b>	33 kg	33 kg	33 kg	90 kg	135 kg	131 kg	60 kg	135 kg	135 kg	140 kg	116 kg

# Underground cable fault pin-pointing

These are used in conjunction with a surge generator or sheath fault locator pulsed energy source to find the exact location of a fault.

## Pinpointing with magnetic-acoustic surge wave receiver

### digiPhone+

Hear just what you need to hear during pinpointing operations thanks to the noise cancelling technology of the digiPhone+. New audio-feedback technology uses acoustic and magnetic detection to pinpoint underground cable faults accurately and reliably. The digiPhone+ works by measuring the energy around an underground fault.

It measures distance by timing between the electromagnetic "flash" and the seismic (or acoustic) jolt created at the moment of flashover, similar to the time difference between a flash of lightning and a thunder crack.



## Combination system for pinpointing and sheath fault location

### digiPhone+ NT set

Megger has combined the two systems digiPhone+ and ESG NT in one device: the digiPhone+ NT Set.

The acoustic-magnetic cable fault pinpointing and step voltage pinpointing of cable sheath faults can be done easily, quickly, and reliably.

The operating mode switches automatically by identifying the selected sensor.



## High voltage bridge for fault location in long cables

### HVB10



HVB10 is a highly accurate HV bridge designed to prelocate cable and sheath faults, perform sheath testing and pinpoint sheath faults, especially on long high voltage cables.

With its high resolution, intermittent fault detection function, and load adaptation for faster cable charging, the HVB10 is the ideal tool for finding sheath faults early and accurately by identifying poor cable

laying practices and checking contractor work before connecting to the utility's network.

The HVB10 prelocates core-to-core and core-to-screen faults, but it also provides the sheath fault location functions from the MFM10, sheath testing, prelocation and pinpointing with pulsed DC, and optional audio frequency operation.

# Cable sheath fault location

## Battery operated sheath fault location system

### MFM10

Sheath faults can occur due to poor cable laying or damage during installation. A sheath fault may not be detected until the cable is already in operation, and at this point they can become real cable faults later down the cable's lifecycle. It is therefore important to identify and address these faults as quickly as possible before they can become real faults.

The fully automatic MFM10 is a testing device for the prelocation and pinpointing of cable sheath faults. The unit works with the easyGO principle, which gives the operator a fast, easy and reliable tool to evaluate this kind of fault. The unit includes evaluation of measured data to interpret the fault location. It also has voltage

drop and bipolar prelocation methods to ensure that external galvanic and thermoelectric influences are eliminated, which increases the accuracy and quality of the measurement.



## Digital earth fault locator

### ESG NT

The earth fault locator ESG NT is used for the high accuracy pinpointing of a sheath fault. The easy-to-use instrument utilizes a bright, sun readable TFT color display.

A fully automatic calibration keeps the display always at zero. The integrated noise suppression eliminates all influences by DC, railway currents, industrial plants and high resistive soil environment.

With two earth rods, the ground step voltage potential is measured and the direction towards the fault is indicated by the display.



# Cable route tracing and identification

## Cable location system

### Ferrolux FLG10 and FLG50



The FERROLUX® System provides solutions to a wide variety of problems for operators of power and telecommunication cable systems and public utility companies. The FERROLUX® Audio Frequency System can be used for pipelines and cable tracing, cable selection and location of cable faults.

The FERROLUX® combines the location techniques (identification of the direction of the signal flow) and audio-frequency methods in one instrument.

## Utility services detection and location system EasyLoc

The Easyloc is a fast and simple to operate system for the detection and tracing of undergrounded cable and pipe systems. The Easyloc receiver shows the signal level received and marks the maximum. The operators can work with the audio signal and the visual confirmation at all times.



Depth measurements can be obtained at the push of a button, identifying the selected sensor.

## Phase verification system

### PVS100i

Whether you are restructuring a network, planning new network systems or performing switching operations, precise phase identification is essential for the safe and reliable operation of a network.

The PVS 100i assists you in checking the phase quickly and precisely. It helps you to avoid faulty switching, eliminates safety risks, reduces operation expenses, prevents a one-sided load of the network and improves the service.

The PVS 100i system not only offers energy providers safety-related advantages but also economic benefits, making it an essential piece of equipment.



## Cable Identifier

### CI/LCI

The CI & LCI are cable identifiers that single out a specific cable in a trench within a group. The consequences of cutting the wrong cable can be fatal. The CI will safely identify a de-energized primary HV cable within a group of energized or de-energized cables. The LCI will also identify the cable on energized low voltage cables. The transmitter sends a pulsed signal, which the CI and LCI use to detect the correct cable. Pulsing the signal allows the operator to distinguish between their signal and background noise. The receiver uses green LEDs to clearly confirm the correct cable, which is generally accompanied by maximum signal strength. This double confirmation provides the user with maximum confidence in the result. The transmitter can operate on 120 VAC or internal battery. The standard combination kit (for HV & LV cables) includes a 6" flexible clip-on probe, and two touch sensors for all applications where a clip-on cannot be used.



## Phase identification in earthed and shorted MV cables

### PIL8

The Phase Identification System PIL 8 permits a fast and safe phase determination at the jointing location during the mounting of medium voltage cables.

The VDE regulations stipulate that if for the purpose of a phase identification in medium voltage cables it is necessary to disconnect the earthing and shortcircuiting for the duration of the measurement, othersuitable safety measures have to be implemented.

The PIL 8 unit meets this requirement, inasmuch as its application eliminates the need of disconnecting the short-circuiting and earthing circuit.



## DETEX

The Detex range of testers is ideal for determining the presence of voltage, be it phase to earth or phase to phase. A verification unit is available to ensure safe operation. Voltage detectors are suitable for voltages from 2.3 kV to 550 kV.



# Power quality testing

With the increased sophistication of electrical and electronic equipment, and new micro generation systems being added to the grid, there is now more than ever attention being paid to the quality of supply. Power quality surveys on electrical noise, lamp flicker, load balancing, power factor correction and motor in-rush studies can all be carried out with Megger power quality analysers.

## Power quality analysis system

### MPQ1000



The MPQ1000 handheld power quality analyzer has features which make it ideal for troubleshooting, compliance testing and energy audits. Auto CT identification eliminates potential errors due to wrong CT range settings. The analyzer will automatically identify the CT and verify it is connected correctly. This means you can be confident you will have the correct data.

You can create your own company standard templates that can be stored and compared, as well as check your results against compliance standards. This saves time, effort and costs, making your entire testing process more efficient. The software automatically creates custom configurations based on the issue you are troubleshooting, whether it be equipment tripping out, transformer or motor issues, EN50160 analysis or general PQ analysis. This ensures the analyzer will capture the power quality phenomenon that causes those problems. You do not have to be a PQ expert to carry out a comprehensive analysis.

- **Auto CT identifies the current clamp that is connected to the analyzer as well as the range to which the CT is set.**
- **Configuration verification which identifies and notifies you if the product has been connected incorrectly.**
- **On-board data analysis which can compare results against canned or custom standards. Create your own templates for internal your company standards.**
- **SD Card Support, USB Card Support, USB Communications as well as Ethernet connections, making it versatile.**

## Impedance meter

### NIM1000

The impedance meter NIM1000 measures the loop impedance to detect malfunctions in the LV grid at an early stage.

The NIM1000 triggers load-sensitive and neutral faults, detects weak contacts, and exposes hidden flaws. Depending on the grounding conditions of the tested grid, a multi-phase measurement calculates the impedance of the neutral conductor to detect defects that can cause severe safety issues. NIM1000 is a versatile device. It measures the current capacity under real-life conditions, determines the voltage dip resulting from a given load, and performs tests on cables, power supply lines, and busbars. Those tests help determine the correct dimensioning of the installations, ensure a consistently good power quality, and prevent downtimes.



### MPQ2000



The MPQ2000 portable power quality analyser has features which make it ideal for testing power quality in any environment, including rugged, weatherproof hardware, and the ability to power off Phase A or auxiliary power.

But the hardware is not all it's about – behind the sturdy exterior is an intelligence that is focused on minimizing errors and making your testing more efficient, with industry-leading software that enables you to quickly and easily analyse your results.

- **Power off Phase A or auxiliary, allowing it to be used anywhere**
- **Weather proof to NEMA 4 standard for use in any environment**
- **Auto CT identifies the current that the instrument is connected to and it's range**
- **Configuration verification which highlights if the product has been connected incorrectly**
- **On-board data analysis which can compare results against compliance standards, including setting templates for internal company standards**

	MPQ1000	MPQ2000
Voltage inputs	4 with common neutral	4 isolated channels
Current inputs	4	5
Battery powered	■	■
Powered off of A phase		■
Case type	Hand held	Weather-proof
Weight in kg	1.8	2.3

# Earth or ground testers

Earth or ground resistance testing - One of the most important considerations in an electrical system is the resistance of the earth for reliable operation and safety. Whether you are doing a ground resistivity survey to plan the location of a substation or testing an earth electrode Megger has an earth tester suitable for the job. Megger has more than 50 years' experience of designing and building earth resistance testers. The latest generation is CATIV rated, and have tough moulded cases. Variable test frequency keeps noise down, reliability up.

## Advanced Earth Tester

### DET2/3



The DET2/3 is a robust and compact automatic earth (ground) test instrument designed to measure earth electrode resistance and soil resistivity. For use on large or more complex earth systems, which include communications earth systems and difficult test environments, it can be used to test in accordance with BS

7430 (earthing / grounding), BS-EN-62305 (Lightning Protection), BS-EN-50122-1 (Railway Applications), and IEEE Standard 81.

The DET2/3 can provide a live trace of its measurements, which graphically shows the amount of noise from the system under test - a powerful diagnostic tool for the expert earth (ground) test engineer. Test frequency, test current and filtering can be quickly and easily adjusted so that adverse conditions, which can influence the test, can be overcome, and a wide band of test current frequencies, with a resolution of 0.5 Hz, can be used to eliminate errors caused by noise in the earth.

The DET2/3 also includes an automatic frequency selection feature that scans for frequencies with the lowest noise level and then runs a test at that frequency. The selected test current frequency, test current level and the increased filtering option are stored in memory for use in subsequent tests. Use of the latest processors and a large internal memory allows for immediate calculations of resistivity (Wenner or Schlumberger method) and the ability to save a complete days' worth of test results. Test result data can be downloaded directly through a USB flash drive or straight to a Windows PC running PowerDB™ software.

## Earth Test Kit



The Megger Earth Test Kit (ETK models) are designed to be as practical as possible. Housed in a holdall, the kits are stored neatly, well protected and easy to transport. Much care has been taken to produce

a variety of kits to meet needs. In use the test leads are fitted and retained on reels with smooth action.

## Earth ground testers

### DET3 and DET4

- All models include these features
- Extra large selector switch
- Extra large, clear display for easier operation in outdoor conditions
- Simple one button operation
- Battery powered with a bar graph that updates battery strength
- Noise reduction up to 40 V peak to peak
- Safety rating of CATIV 100 V
- IP54 rated (water/dust ingress) for extra protection in harsh conditions

**DET3TD** - offers a complete kit for customers wishing to conduct earth electrode testing using the two and three pole techniques.

**DET3TC** - when used with the optional ICLAMP allows fall of potential testing using the ART technique without needing to disconnect the electrode under test.

**DET4TD2** - is a complete earth testing kit for users needing the flexibility to use either the two and three pole electrode techniques or the four pole soil resistivity test.

**DET4TR2** - is similar to DET4TD2, with the added advantage of using rechargeable batteries. You can also get an adaptor to charge your tester from your vehicle.

**DET4TC2** - is a four pole tester with extended resistance range and variable test frequency. Use it for ART testing, two or three pole testing, four pole resistivity testing and stakeless testing.

DET4TC2 comes as a bare tester or in a full kit

**DET4TCR2** - is similar to DET4TC2, with the added advantage of using rechargeable batteries. You can also get an adaptor to charge your tester from your vehicle.

**Each instrument includes everything you need to test:** Comes complete with test leads, stakes, batteries, calibration certificate and rugged polypropylene carry case.





# Earth or ground testers

## Earth resistance clamp testers

### DET14C and DET24C

Earth resistance clamp testers are suitable for measuring earth resistance of installations such as buildings, pylons and RF transmitter sites and for inspection of lightning protection systems.

- Elliptical clamp shape improves access to earth cables and straps up to 50 mm
- Low maintenance flat jaw interface
- Measures ground resistance from 0.05 Ω to 1500 Ω
- Measures true RMS ground leakage current from 0.5 mA rms to 35 A rms
- Automatically self calibrates
- High and low alarms
- Memory and Bluetooth downloading
- CAT IV 600 V safety rating



## Professional earth test kit

Megger's Professional Earth Test Kit is designed to be as practical as possible. Housed in a tough polyethylene carry case, the kit is stored neatly, well-protected and easy to transport. In use the reels are fitted and retained on the spike handles, simply run out the test lead to the instrument and plug in, plug the other end directly into the spike, and test. When the test is complete, unplug the test leads and wind them in, whilst still on the spike.

- Ideal for use with whole range of Megger earth testers
- 4 wires on easy-wind reels make it quick to get testing and quick to pack away again
- 1 croc clip test wire
- Fibre-glass measuring tape to assist accuracy depth
- Auger style spikes make it easy to deploy and to check
- Tough easy store case



	DET2/2	DET2/3	DET4TCR2	DET4TC2	DET4TR2	DET4TD2	DET3TC	DET3TD	DET14C	DET24C
<b>Test techniques available</b>										
4 pole resistivity test	■	■	■	■	■	■				
3 pole electrode test	■	■	■	■	■	■	■	■		
3 pole electrode test with ART		■	■	■			■			
2 pole electrode test	■	■	■	■	■	■	■	■		
Stakeless test		■	■	■					■	■
<b>Power</b>										
Rechargeable	■	■	■		■					
Dry cells				■		■	■	■	■	■
<b>Warnings</b>										
Excessive noise	■	■	■	■	■	■	■	■		
Potential spike resistance high	■	■	■	■	■	■	■	■		
Current spike resistance high	■	■	■	■	■	■	■	■		
<b>Resistance range</b>	0.010 Ω-19.99 k Ω	0.001 Ω to 20.00 k Ω	0.01 Ω-200 k Ω	0.01 Ω-200 k Ω	0.01 Ω-20 k Ω	0.01 Ω-20 k Ω	0.01 Ω-2.0 k Ω	0.01 Ω-2.0 k Ω	0.05 Ω-1.50 k Ω	0.01 Ω-1.50 k Ω
<b>Resolution</b>	0.0 01 Ω	0.0 01 Ω	0.01 Ω	0.01 Ω	0.01 Ω	0.01 Ω	0.01 Ω	0.01 Ω	0.01 Ω	0.01 Ω
<b>Earth current range</b>										
0.00 mA to 2 A		■								
0.02 mA to 35 A									■	■
0.5 mA to 19.9 A			■	■			■			
<b>Test frequency</b>	105 Hz-160 Hz	10 Hz to 200 Hz in steps of 0.5 Hz	94 Hz, 105 Hz, 111 Hz, 128 Hz	94 Hz, 105 Hz, 111 Hz, 128 Hz	128 Hz	128 Hz	128 Hz	128 Hz	1500 Hz	1500 Hz
<b>Noise rejection 40 V peak to peak</b>	■	■	■	■	■	■	■	■		
<b>Test results storage</b>		■							■	■
<b>Downloadable test results</b>		■								■
<b>Supplied with basic test lead set</b>		■	■	■	■	■	■	■		
<b>IEC61010-1 safety rating</b>	CAT III 300 V	CAT IV 300 V	CAT IV 100 V	CAT IV 100 V	CAT IV 100 V	CAT IV 100 V	CAT IV 100 V	CAT IV 100 V	CAT IV 600 V	CAT IV 600 V
<b>Weatherproof and dust proof to</b>	IP54	IP54	IP54	IP54	IP54	IP54	IP54	IP54	IP30	IP30
<b>Supplied with Power DB earth testing forms</b>		■	■	■	■	■				

# Battery testing

With the increasing dependency of back-up systems on battery strings, and the escalating cost of replacing batteries, instrumentation and software systems that can measure, trend and manage the life-cycle of cells is a cost effective option. There are two methodologies for testing batteries; the first, impedance testing is an on line test and can be performed frequently to identify individual weak cells before they fail. The second, battery discharge test is, normally, an off-line test and tests the actual output of the whole battery under load conditions. This will show what will actually happen if the battery is required to take the load. Most battery systems are floating and have earth leakage monitors and trips if there is an earth fault. The Battery Ground Fault Tracer allows you to trace a faulty circuit easily in a complex floating system.

## Battery impedance test equipment

### BITE3

- Determines health of lead-acid cells
- Automatically detects cells and straps without programming
- Test parallel strings without sectionalizing
- Measures float current as well as ripple current.
- Built in spectrum analyzer for locating faulty chargers.
- View results on screenharsh conditions

The BITE3 will measure changes in a battery's internal chemistry due to aging effects. These effects can be caused by plate corrosion, plate shedding, plate sulfation, dry out, negative plate depolarization and more. The BITE3's auto cell strap detection means no complicated programming. Just enter a string name and the BITE3 does the rest. It tests parallel strings without the need of segmentation.

The BITE3 is ideal for parallel strings. It's the perfect tool for telecom applications. The BITE3 measures cell impedance, cell voltage, inter-cell connection resistance and ripple current. The BITE3 also measures float current. This allows you to detect conditions that can lead to a thermal runaway. The built-in spectrum analyzer allows you to determine the source of the ripple current by examining its frequency.

## DC earth fault locator

### Geolux GL660-1

For fault location in isolated, earth free DC battery systems as used in railway signalling, hospitals and power plants etc. the GL660 directly connects to the faulty line with live voltages up to 660 V, and generates a low frequent pulsed signal which allows the tracing by a specific receiver along the faulty line to the fault position.

A single earth fault will cause no service interruption however with the occurrence of a second earth fault there is a high risk of partial or complete breakdown of the installation, consequently any earth fault must be located and repaired as fast as possible. The GL660-1 can locate faults up to 150 kΩ even in noisy environments and without the need to switch off the system.



BITE3 determines the health of lead-acid cells up to 2000 Ah by taking measurements of the most important battery parameters



## Battery Load Units

### TORKE910, TORKE930 and TORKE950

TORKE™900 series is used to perform load or discharge testing, which is the only way to determine battery systems actual capacity. Together with the optional cell voltage logger, BVM, connected directly to the TORKE 900, it becomes a complete, stand-alone, discharge test system.

TORKE930 is used for battery systems ranging from 12 to 300 V and TORKE950 ranging upto 500 V, often encountered in switchgear and similar equipment. The high discharge capacity of TORKE gives the opportunity to shorten the test time. Discharging can take place at up to 220 A, and if higher current is needed, two or more TORKE units or extra load units, TXL, can be linked together. Tests can be conducted at constant current, constant power, constant resistance or in accordance with a pre-selected load profile. Testing can also be carried out without disconnecting the battery from the equipment it serves. Via a DC clamp-on probe, TORKE measures the total battery current while regulating it at a constant level. Battery systems can be plus or minus grounded or free floating.



	TORKE950	TORKE930	TORKE910
Maximum discharge current	220 A	220 A	110 A
Voltage	500 V	300 V	300 V
BVM functionality	2 strings of 120	2 strings of 120	
Charging measurement	■	■	
Full report functionality	■	■	

## Battery voltage monitoring

### BVM series

BVM is a battery voltage measurement device that is used for the capacity testing of large battery banks. When used in conjunction with TORKE unit, and test data management software, the BVM enables the user to perform a completely automated battery bank capacity test, according to IEC test method. The test also meet NERC/FERC requirements.



## Digital hydrometer



For determining the specific gravity of flooded cells, electrolyte is simply drawn in and the specific gravity and temperature are determined in five seconds. It provides memory for both temperature and specific gravity for eight tests of 256 cells each. The stored data can be easily downloaded into any PC.



## Battery extra load

### TXL

For use with the TORKE testers which controls the test, the extra load units allow the battery to be discharged at a greater rate.

## Battery testing software

### TORKE Viewer

TORKE Viewer can be used to edit and print out reports

# Rotating machine testing

Baker Instruments' motor test equipment are the industry-leading suite of products for detecting weaknesses and faults in the insulation systems of electric motors, generators and coils. Employing both low-voltage and high-voltage tests – such as Baker's signature surge test - these essential troubleshooting and predictive maintenance tools allow maintenance professionals to assess any need to maintain or replace specific motors and generators that support their business. Equally at home in the motor repair shop or on a plant floor, these testers ensure that the electrical condition of your rotating machinery is understood.

## Static Motor Analyzer

### Baker AWA-IV



The Baker AWA-IV automatically performs repeatable, user-programmable tests to thoroughly assess the strength of a motor's insulation and circuit. In fact, it is the only high-voltage test instrument that a user can program to perform a specific

set of insulation tests prior to being in the field, and then use as programmed in the field. The AWA-IV is also used to assure quality of motor rebuilds or new production motors before they are placed into service. Available models: 2kV, 4kV, 6kV, 12kV and 12kV High Output

Test types: resistance, megohm, DA, PI, DC step voltage, DChiPot, Surge (IEEE and IEC compliant)

## Static Motor Analyzer

### Baker DX

The Baker DX can find early indications of insulation weaknesses and faults in windings, between phases, coil-to-coil and in groundwall insulation. It can identify if contamination is impacting insulation strength, and detect motor circuit problems such as feed cable insulation weakness, motor imbalances, open circuits or high resistance.

Available models: 4kV, 6kV, 6kV High Output, 12kV, 12kV High Output, 15kV and DX15A armature tester

Test types (some tests require optional upgrades): resistance, capacitance,

inductance, megohm, DA, PI, DC step voltage, DChiPot, Surge (IEEE and IEC compliant), partial discharge (PD) on surge



## Static Motor Tester

### MTR105

The MTR105 is a dedicated Static Motor Tester with Megger's tried and trusted suite of insulation resistance tests (IR), plus all the great traditional features and reliability of Megger's testers. The MTR105 takes the test abilities of Megger's

proven IR test instruments adding DLRO four wire Kelvin low resistance test, inductance and capacitance tests to provide a versatile motor tester, all packaged in a robust hand held instrument, which up to now has simply not been available. Additionally the MTR105 incorporates temperature measurement and compensation (for IR tests), motor direction of rotation plus supply phase rotation tests. These new test abilities make the MTR105 a real world, versatile, hand held motor test instrument. The MTR105 comes in an over-moulded case, providing increased protection and robustness, achieving an IP54 weatherproof rating.



## On-Line Motor Analysis System

### Baker NetEP

The Baker NetEP is a permanently-installed, fully automated machine system monitoring solution. It continuously acquires health and performance data on up to 32 electric motors and the rotating machine systems they operate. With the Baker NetEP, maintenance professionals can safely gather performance data on critical motors around the clock, 365 days a year, from the convenience and safety of a central office. The system helps reduce costly unplanned downtime by providing information that improves maintenance decision making and planning. The dashboard display of the NetEP's associated software indicates motors which are in an alarm condition.



# Rotating machine testing

## Dynamic Motor Analyzer

### Baker EXP4000



The Baker EXP4000 monitors an on-line motor's voltages and currents to separate mechanical and electrical issues that may be present in a motor-machine system. By monitoring many different parameters and using advanced software algorithms, the EXP4000 is designed to pinpoint challenges across the system, including those with the power supply, variable-frequency drive, the motor, and the load placed on the motor.

Test domains: Power quality, machine performance, current, spectrum, torque, variable-frequency drives, continuous monitoring, transient analysis (e.g. startup), motor efficiency

The Baker EP1000 Dynamic Motor Link can be installed in motor control cabinets (MCC) to provide a permanent, rapid-hookup port for the EXP4000.

## Power Packs

### Baker PPX power packs

For high-voltage motors and generators, and large form-wound coils, the Baker PPX series extends HiPot and surge test voltages up to 40kV. The Power Packs are designed to be used in conjunction with a Baker AWA-IV (6kV or 12kV)\*, or a Baker DX.

Available models: 30kV, 40kV. 30A model includes armature test feature.

\* PPX40 is not compatible with AWA-IV.



# Testing data management software

## PowerDB

### Do you have problems managing test data?

Once tests have been done on site there is the issue of recording and managing the data. This may have been recorded by a number of field engineers or 3rd party contractors. How do you correlate all this data and store it so that it can be used efficiently for maintenance or referenced for auditing?

PowerDB software allows the user to manually enter test results into specifically designed forms for testing substation assets such as transformers, CTs, batteries and relays. It allows the user to quickly and easily enter the test results straight into a unique test data form on a laptop.

This form can then be sent over the internet to be synchronized with the PowerDB database, which stores and manages the data so that it can be easily referenced.

PowerDB is specifically designed for storing and managing data from commissioning and maintenance, including analysis and trending of test results.

PowerDB can then quickly create entire test documentation packages that include test reports, comment and deficiency summaries, table of contents and field service reports.

If IT implementation is a problem, PowerDB can even host your data on a dedicated server, to reduce reliance on company IT systems.

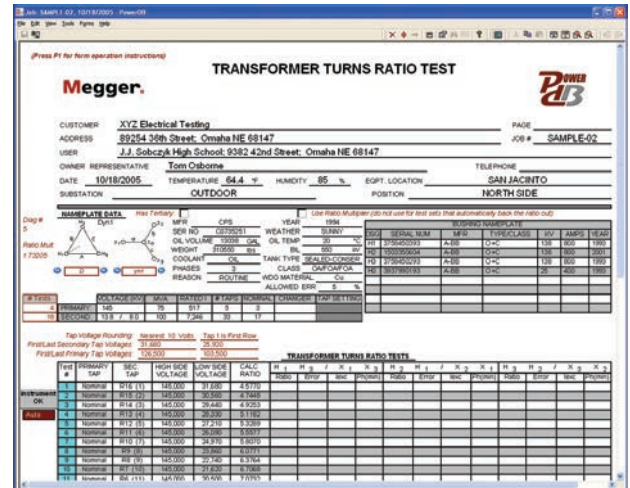
This economic software package has been designed for Utilities, OEMs, HV contractors, maintenance, service and commissioning companies. In fact, anyone involved in substation asset testing.

### PowerDB's test forms are designed to be used with each of the following assets:

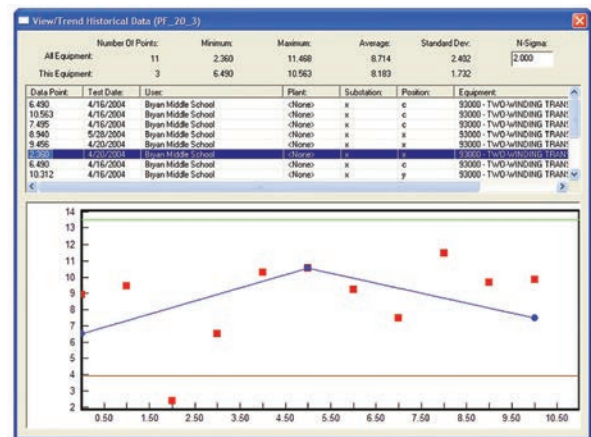
- Batteries
- Insulation Fluids
- Cables
- Loadbreak Switches
- Circuit Breakers
- Motor Control
- Coordination Data
- Power Factor Tests
- Disconnects
- Relays
- Generators
- Switchboards
- Ground Fault Tests
- Transfer Switches
- Ground Mat/Grid Tests
- Watthour Meters
- Instrument Transformers
- Transducers
- Power Transformers

### Easier Management of Test Data

PowerDB offers a straightforward approach to data management. The basic step in creating this user-friendly package was to make test data entry screens and printed forms identical. Users will appreciate that what they see on the screen is what they will get in the printed version. PowerDB simplifies testing and data management by allowing users to deliver reports electronically. The



software will execute several tasks including equation calculations, temperature, correction factors and charting.



PowerDB helps predict possible equipment failure by trending results, which can be stored in PowerDB or imported from other software. This makes transitions to PowerDB easy.

Industry standard test forms are not always what a company needs. So PowerDB software allows the user to customize forms. With a drag and drop feature anyone, even those without database experience, can create a form simply by dragging and dropping in tables, text boxes, images, charts and more, to create a customized form. And, with VBScript, calculations can be defined, tables looked

# Testing data management software



up, and it can even interact with other applications. One time definition of common items can be used to put logos, headers and footers on every page or in many multiple forms. One change

will automatically update every form the common item is used in.

## Built-in Report Flexibility

PowerDB can create reports in one step, with customisable sorting of the order of test forms. Forms can be removed, and page numbering will be automatically adjusted. In a single print job, supplementary reports can also be printed at the same time as the primary report. The supplementary reports, including comment and deficiency summary reports, open up the data and information for all of the equipment tested on one job. Finally, all of the information can be generated for the on-demand world using the optional PowerDB Web server. All of the user's important information is published to the Web and can be accessed from anywhere in the world.

## Computerized Maintenance Management System Support

Many electrical utilities and other company operations have invested in sophisticated CMMS systems, such as Digital Inspection's Cascade and MRO Software's MAXIMO. However, due to test instrument specific software packages and handwritten test results, these firms often struggle to get test data into their systems. One electric utility even referred to getting data into the CMMS as 'feeding the monster'.

## PowerDB's speciality is 'feeding the monster'!

PowerDB allows you to link easily with the CMMS system so that the system can pre-populate the PowerDB equipment database, send PowerDB all work orders, add forms based on the job plans, and even return the measurement points, obtained from a multitude of test sets, back to the CMMS system.

**Furthermore, Megger will work directly with your CMMS personnel to integrate your data into your internal CMMS system.**

There are three ways to document testing using the PowerDB software. First and foremost, data fields can be filled in using manual entry, standardizing the reporting of test results. Second, forms can be filled in using other applications, including Megger's AVTS, entering data into the fields using information stored in the other applications. Finally, the software can communicate directly with test and measurement equipment produced by Megger.

## Simplifying the compilation and reporting process

The new PowerDB software package eliminates many common paperwork and recording problems. With the software, the number of man-hours devoted to preparing reports will be minimal. The user can customize the reports to be what a job requires but will not have to write the report, which is automatically generated by the software. Included in the reports are a table of contents, data sheets, as well as comment and deficiency summaries. PowerDB even comes with a built-in spell check.

Automatically generated professional reports means that a testing company, for instance, is able to complete jobs faster and in a more efficient manner. PowerDB is well-suited for technicians who prefer to spend a minimum amount of time writing reports and want a more concise way to process data.

Electronic records of test data can create a couple of different problems for companies and utilities. While many electronic records are hard to locate due to the vast amount of records kept on one system PowerDB makes it easier. By using its relational database it is much easier to find present and past records. And, because it has multiple safe guards, PowerDB prevents lost data. By saving documents that are in progress to multiple places, the problem of lost data is eliminated. PowerDB also synchronizes the date to several machines, meaning that a single crash does not create a costly loss of data.

# Low voltage testing

Electrical contractors throughout the world depend on hand-held test equipment to ensure installations are safe and function correctly. Count on Megger to produce tough machines that are designed to surpass the requirements of wiring regulations.

## Thermal Camera TC3231

The Megger TC3231 offers a professional infrared 32 x 31 pixels image thermometer with a 2.2 inch (55.88 mm) colour TFT LCD display. Quick, accurate readings are possible; covering a wide range of surface temperature measurements. The product combines the convenience of an infrared thermometer with the visual advantage of a thermal imager providing a troubleshooting camera with infrared heat map. The TC3231 features a range of selectable thermal image colour palette display options along with high / low user preset temperature alarms. For convenience, background temperature is also user selectable. An easy to use image blending function is also featured; the camera takes an aligned visible, non-infrared, image, together with a full infrared image. The 2 pictures are then blended and can be adjusted between 0 to 100%. This makes identifying problems and pinpointing their location far easier. As well as centre spot temperature measurement, the camera also offers simultaneous hot and cold spot tracking, with resultant values and location updated continuously on the display. Up to 6000 images can be saved on the included micro SD memory card which can be downloaded to a PC via the USB interface in BMP file format. An SD card adapter is also provided for file transfer directly to a computer if required.



## LTW425



Measuring loop impedance to 3 decimal places make this 2-wire non-tripping loop tester highly desirable. This feature means that contractors can use this instrument to make measurement close to the source of supply. It calculates the PFC and PSSC value up to 40 kA. See also NIM1000 on page 55.

## LTW300 Series

2-wire non-tripping loop testers that makes loop impedance testing clear and obvious what is being tested. Unlike three-wire loop testing it makes it possible should no neutral be present. With auto-start the LTW300s will calculate and display the PFC and PSSC value at the press of a button up to 20 kA.



## Residual current device testers

### RCDT300 series

This tester is built on the same case as the tough LTW series, they are easy to use with no buried functions. It tests all RCDs from 10 mA to 1000 mA, and can offer the auto RCD test as well as ramp testing.



## Earth loop impedance testers

### LT300



A high current loop tester that is ideal for industrial applications with 50 V to 500 V and 16 Hz to 400 Hz operational range. LT300 offers users the assurance of a CAT IV rating.



# Low voltage testing

## Multimeters

### AVO800 series



Specifically designed for the electrical engineer and profession electrician, this range of tough, high quality series of multimeters offers the perfect selection of functions required. Useful innovations such as the high and low impedance switching allow a quick and safe method to identify capacitive coupled, ghost, voltage. The introduction of the dual sensitivity non-contact voltage detector helps you identify a live circuit at a distance and then to pinpoint the exact conductor or circuit. The AVO830 with CATIV 600V application and

AVO835 with CATIII 1000V application are multimeters which offer phase sequence detection to prevent miss connection and the consequent damage to motors and generators. These functions are in addition to the fact that this range offers a 10,000 count display with a basic accuracy of 0.01% accuracy, and shuttered 4mm inputs to ensure that the right connections are made every time.

### AVO210



A CATII 600 V multimeter that offers auto ranging with a manual over-ride. These low cost meters are great value.

## Clampmeters

### DCM series



A choice of 4 clamp meters and a fork multimeter for use during the installation, maintenance and checking of electrical systems and equipment.

Our selection of clamp meters gives the option of measuring currents between 10 A and 1.5 kA. The forked multimeter and DCM1500 offer CAT IV safety.

### DCM305E



The DCM305E is a specialist clamp for earth leakage detection and diagnosis. With a 10  $\mu$ A resolution it can make fault finding surprisingly quick and easy. The instrument has six ranges: 6 mA, 60 mA, 600 mA, 6 A, 60 A, 100 A with a minimum resolution of 0.001 mA on the 6 mA range. Either auto or manual ranging can be selected.

## Isolation test kits

### TPT320 and MPU690



These CATIV 1000 V 2-pole tester indicate the presence of voltage using either an LED array or an LCD screen. The MPU690 proving unit confirms the correct functioning before and after proving that the circuit is not live.

## Portable appliances testing

A range of testers are offered for in-service inspection and testing of electrical equipment in accordance with the IEE code of practice.

### PAT100 series

Offers truly simple PAT testing with a hand-held, battery operated tester.



### PAT300 series

Designed for those who want to conduct the regime but do not need to store the results on the machine.



### PAT400 series

Offers a sophisticated tester with on-board asset database for high speed testing, and data download for certification.



## Multifunction installation tester

### MFT series

Offering insulation resistance, continuity, earth loop impedance, RCD and earth electrode testing all in one tester. They are ideal for installation testing and periodic inspection of low voltage domestic, commercial and industrial systems. The top of the range models offer Bluetooth connectivity for paperless certification and the a full range of earth electrode tests.



# Combined insulation and continuity testers

## Pocket sized insulation and continuity tester

### MIT200 series



The MIT200 series are CATIII 600 V tested offering 250, 500 and 1000 V test voltages and have applications in electrical contracting, on domestic and industrial systems, as well as site maintenance and service departments. They are small and light making them ideal for those engineers that need to carry them for extended periods.

## Insulation resistance and continuity testers for industrial maintenance

### MIT400/2 Series

Recently updated and including stabilised test voltage control, MIT400/2 series testers offer CATIV 600 V safety in a convenient easy to hold format. It is a classic 2 wire low voltage insulation and continuity instrument.



MIT400/2 series are true diagnostic instruments measuring insulation resistance up to 200 GΩ, they measure insulation deterioration long before most testers even offer a reading. They offer functions such as TRMS voltage measurement, polarisation index (PI), dielectric absorption ratio (DAR) and capacitance measurement. These diagnostic tests make it ideal for engineers working in industrial maintenance, allowing them to trend motor performance, and give them more solid evidence when taking a motor out of service.

## Insulation resistance and continuity testers for electricians

### MIT300 series



Tough enough to soak up the treatment meted out to testers on site, the MIT300 series offer CATIV 300 V safety with flexibility. The MIT300 comes in five versions from a basic two-test voltages digital tester to a downloading three-test voltages tester.

Each of the digital versions of MIT300 series offers the Megger analogue arc technology, while for those who like a classical insulation and continuity tester there is an analogue instrument. This series of testers is characterised by its case design which is particularly tough and has a cover to protect the screen.

## Insulation resistance and continuity testers for telecommunications

### MIT480/2 Series

Designed for the telecommunications industry, the MIT480/2 series testers are 3-wire testers consequently the connection is made once and then the measurement are made by switching between the pairs at the instrument.

This convenience has found application among electrical contractors who limit their insulation testing to 500 V.

With stabilised insulation test voltage, MIT480/2 series offers variable insulation test voltages from 10 V to 500 V, and full CATIV 600 V safety.



# Combined Insulation and continuity testers

## Hand-held insulation and continuity tester for higher voltage applications

### MIT2500

This tough CATIV 600 V tester designed for industrial maintenance and electrical contractors offers a lot of power in a very small and convenient package, performing insulation tests with a test voltage up to 2500 V, and measuring insulation resistance up to 200 GΩ.

This tester is a 3-wire tester using the well-established Megger guard terminal technology to ensure that surface leakage is discounted when making a measurement.



	MIT200	MIT300	MIT400/2	MIT480/2
Voltage range	Up to 1000 V	Up to 1000 V	Up to 1000 V	Up to 500 V
Test Range	1000 MΩ	1000 MΩ	200 GΩ	100 GΩ
Voltage Measurement		600 V	600 V	600 V
On board Memory				■
IP54		■	■	■
Rechargeable batteries		■		Only available in MIT 485/2
Safety	CAT III	CAT III	CAT IV	CAT IV



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