

Programma

TM1800™ Circuit Breaker Analyzer System



- **No limit circuit breaker testing**
- **Build the analyzer to your requirements; add new capabilities when you need them**
- **Supports all test methods — DualGround, first trip, timing & travel, DRM and vibration**
- **DualGround allows for safer and faster testing with both sides grounded**
- **Local CABA software — the common platform for all Megger breaker analyzers**
- **Full graphical display for hook-up instructions and data analysis**
- **Built-in test plans for advanced and easy testing**
- **Designed and built for every test requirement**

DESCRIPTION

The TM1800™ is the optional tool for circuit breaker maintenance, designed and built on more than 20 years' experience and more than 4,000 breaker analyzers worldwide. The modular design makes it possible to configure the TM1800 to perform any measurement on every type of circuit breaker.

The robust design utilizes powerful technology that makes circuit breaker testing accurate, powerful and still very easy. New measurement modules allow for time savings as many parameters can be measured simultaneously, eliminating the need for lengthy setup each time. DualGround™ testing uses the new Dynamic Capacitive Measurement (DCM) module, making the testing safe and fast. The DualGround allows for testing while keeping the circuit breaker grounded on both sides throughout the test, eliminating the need to lift ground connections during the timing of the breaker.

Timing M/R module uses Active Interference Suppression technology to obtain correct timing and accurate Pre-Insertion Resistance (PIR) values in high voltage substations having coupled interference currents.

The modular design allows the user to configure the TM1800 to perform the desired task. The instrument can easily be configured for more advanced analysis tools such as DRM or vibration analysis when basic timing and travel information does not provide enough data for accurate decisions to be made.

The adaptive, user-interactive software ensures repeatable and reliable tests and supports the work flow with advanced graphical help for every step including connections to breaker and analyzer. It automatically senses which modules that are installed and adopts the user interface accordingly. This Select-Connect-Inspect workflow assists users in easy steps, making testing easier to learn and perform.

The system also offers full connection capability to the local network and printers, etc.

Testing with DualGround

Electricity deregulation changes the business environment for utilities, switchgear owners and service companies. Deregulation has been shown to lead directly to increased emphasis on efficiency of operations, maintenance and service levels. Globalization of business brings new challenges and new requirements for increased emphasis on health, safety and environmental compliance. Experience has also shown demands for shorter time periods for testing, while the switchgear is less and less available to be taken out of service.

The safety aspect

Network operators and service companies need to maintain and develop their industry safety record. Eminent international bodies including the IEEE® and IEC®, National Safety agencies and Trade Unions increases the demands on safety. During deregulation, applicable safety

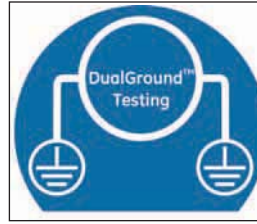
regulations have been clarified and the application of existing rules has tightened. Keeping a good safety record is becoming a crucial asset in attracting investors and customers.

The capacitive coupling from live high-voltage conductors induces harmful/lethal currents in all parallel conductors in all substations. Grounding both sides of the test object conducts the induced current to earth and provides a safe area for the test personnel. See Figures 1 and 2.

Both sides grounded

The best way to provide safety in circuit breaker testing is to keep both sides of the circuit breaker grounded throughout the test. This makes the test faster, easier and safer.

The DualGround™ testing method is available for all tests on all circuit breakers. Contact your Megger representative to discuss how this method can help you make faster and safer tests.



Equipment and methods that supports DualGround™ testing are associated with the DualGround™ symbol. This symbol certifies the use of groundbreaking technology and methods that enables a safe, fast and easy workflow with both sides grounded throughout the test.

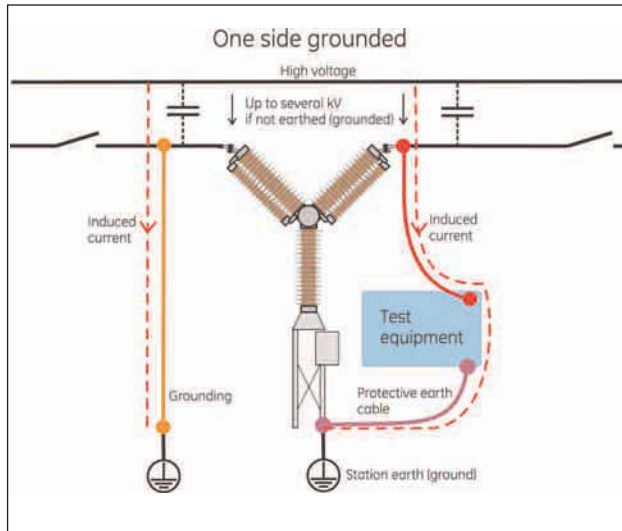


Figure 1. With only one side grounded the induced current can reach values high enough to be harmful or lethal for humans.

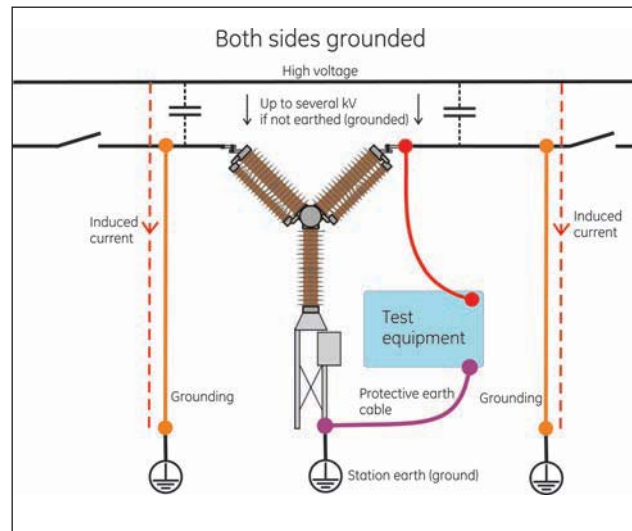


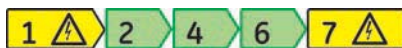
Figure 2. Testing is much safer using the DCM module and DualGround.

Test procedures – Comparison between Conventional and DualGround Testing

- 1 Site preparation (isolate work area, apply safety ground, issue permit to work)
- 2 Hook up test equipment. Issue sanction for test
- 3 Authorized person removes the ground (left out when testing with DualGround)

- 4 Perform testing
- 5 Authorized person applies ground (left out when testing with DualGround)
- 6 Cancel sanction for test. Disconnect test equipment
- 7 Site closing (cancel permit to work, disconnect ground)

Dual Ground



Two risky steps (3 & 5) in the workflow are left out and one step is made safer. Result: safer, faster and easier testing.

Conventional Testing



The following table indicates the Programma instruments that the TM1800 works in conjunction with:

Contact resistance	MJÖLNER or SDRM202
Timing	TM1800 with DCM
Motion	TM1800
Dynamic Resistance Measurement (DRM)	TM1800 with DRM1800
Vibration	CABA Win Vibration

APPLICATIONS

Timing measurements

Simultaneous measurements within a single phase are important in situations where a number of contacts are connected in series. Here, the breaker becomes a voltage divider when it opens a circuit. If the time differences are too great, the voltage can be too high across one contact. The tolerance for most types of breakers is less than 2 ms.

The time tolerance for simultaneous measurements between phases is greater for a 3-phase power transmission system running at 60 Hz since there is always 2.77 ms between zero-crossovers. Still, the time tolerance is usually specified as less than 2 ms, even for such systems. It should also be noted that breakers that perform synchronized breaking must meet more stringent requirements in both of the previously stated situations.

There are no generalized time limits for the time relationships between main and auxiliary contacts, but it is still important to understand and check their operation. The purpose of an auxiliary contact is to close and open a circuit. Such a circuit might enable a closing coil when a breaker is about to perform a closing operation and then open the circuit immediately after the operation starts, thereby preventing coil burnout.

The "a" contact must close well in advance of the closing of the main contact. The "b" contact must open when the operating mechanism has released its stored energy in order to close the breaker. The breaker manufacturer will be able to provide detailed information about this cycle.

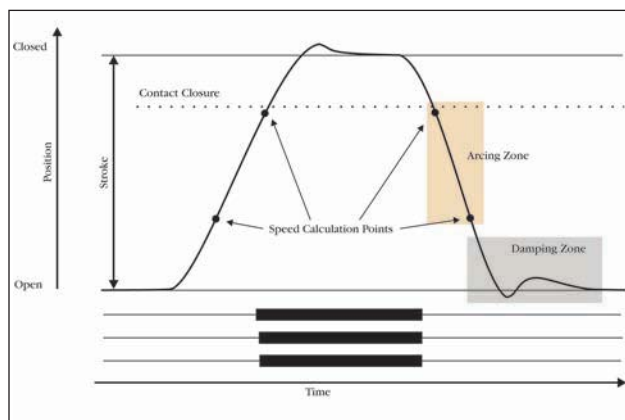


Figure 3. Motion diagram and timing graphs for a close-open operation

Motion measurements

A high-voltage breaker is designed to interrupt a specific short-circuit current, and this requires operation at a given speed in order to build up an adequate cooling stream of air, oil, vacuum or gas (depending on the type of breaker). This stream cools the electric arc sufficiently to interrupt the current at the next zero-crossover. It is important to interrupt the current in such a way that the arc will not re-strike before the breaker contact has entered the damping zone.

Speed is calculated between two points on the motion curve. The upper point is defined as a distance in length, degrees or percentage of movement from a) the breaker's closed position, or b) the contact-closure or contact-separation point. The time that elapses between these two points ranges from 10 to 20 ms, which corresponds to 1-2 zero-crossovers.

The distance throughout which the breaker's electric arc must be extinguished is usually called the arcing zone. From the motion curve, a velocity or acceleration curve can be calculated in order to reveal even marginal changes that may have taken place in the breaker mechanism.

Damping is an important parameter for the high energy operating mechanisms used to open and close a circuit breaker. If the damping device does not function satisfactorily, the powerful mechanical strains that develop can shorten breaker service life and/or cause serious damage. The damping of opening operations is usually measured as a second speed, but it can also be based on the time that elapses between two points just above the breaker's open position. See Figure 3.

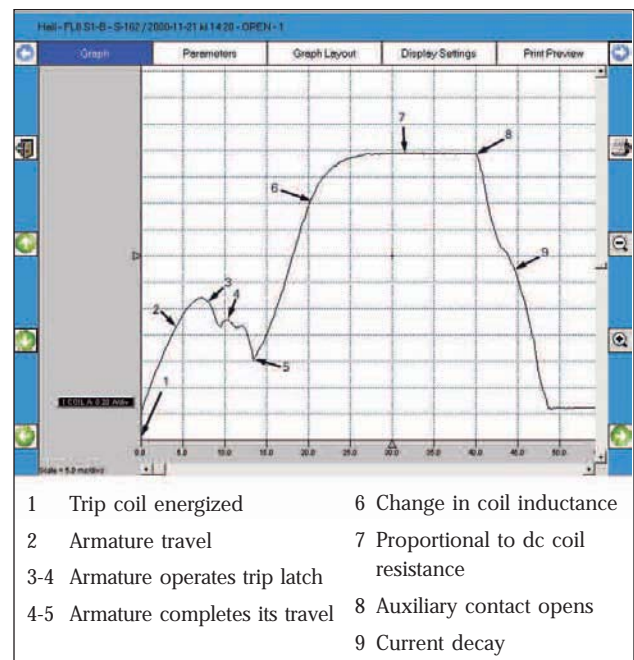


Figure 4. Example of coil current on circuit breaker

Coil currents

These can be measured on a routine basis to detect potential mechanical and/or electrical problems in actuating (trip & close) coils well in advance before developing actual faults. The coil's maximum current (if current is permitted to reach its highest value) is a direct function of the coil's resistance and actuating voltage. This test indicates whether or not a winding has been short-circuited. See Figure 4.

When a voltage is being applied across a coil, the current curve first shows a straight transition whose rate of rise depends on the coil's electrical characteristic and the supply voltage (points 1-2). When the coil armature (which actuates the latch on the operating mechanism's energy package) starts to move, the electrical relationship changes and the coil current drops (points 3-5). When the armature hits its mechanical end position, the coil current rises proportionally to the coil voltage (points 5-8). The auxiliary contact then opens the circuit and the coil current drops to zero with a current decay caused by the inductance in the circuit (points 8-9).

The peak value of the first, lower current peak is related to the fully saturated coil current (max current), and this relationship gives an indication of the spread to the lowest tripping voltage. If the coil was to reach its maximum current before the armature and latch start to move, the breaker would not be tripped. It is important to note that the relationship between the two current peaks varies, particularly with temperature. This also applies to the lowest tripping voltage.

Dynamic Resistance Measurement (DRM)

A circuit breaker will have the arcing contact wear by normal operation as well as when breaking short-circuit currents. If the arcing contact is too short or otherwise in poor condition, then the breaker soon becomes unreliable. Main contact surfaces can be deteriorated by arcing resulting in increased resistance, excessive heating and in worst-case failure.

The main contact resistance is measured dynamically over an open or close operation in DRM. With DRM measurement the arcing contact length can be reliably estimated. The only real alternative in finding the length of the arcing contact is dismantling the circuit breaker.

A reliable DRM interpretation requires high DC test current and a circuit breaker analyzer with good measurement resolution. See Figure 5.

Testing with DualGround™ is applicable.

Vibration analysis

Vibration analysis is a non-invasive method using an acceleration sensor without moving parts. The breaker can stay in service during the test. A single Open-Close operation is all that is required for the measurement. The first operation is different compared to the second and third because of corrosion and other metal to metal contact issues. Vibration is an excellent method to capture the first operation after long periods of breaker non-operation.

The analysis compares the vibration time series with earlier taken reference. The vibration method detects faults that can hardly be indicated with conventional methods. But if conventional data such as contact time, travel curve, coil current and voltage are available in addition to the vibration data even more precise condition assessment is possible. The vibration data is stored together with available conventional data.

The Vibration method is published in CIGRÉ and IEEE® papers. Vibration can be performed under very safe conditions for the test technician as both sides can be grounded throughout the test. Also less climbing is required since no access to the breaker contact system is needed, the acceleration sensor is easily mounted on the breaker.

Testing with DualGround™ is applicable.

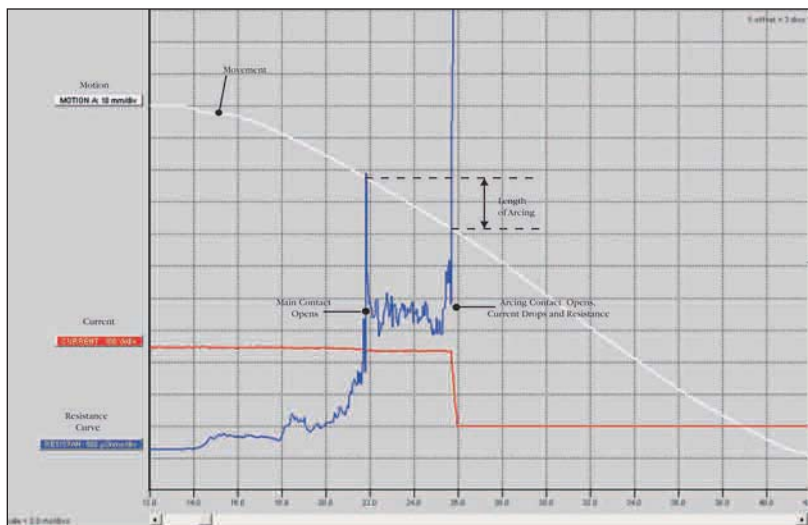


Figure 5. DRM is a reliable method to estimate the length/wear of the arcing contact. The DRM1800 provides high current and the TM1800 gives an accurate measurement with very good resolution. Besides, it is possible to use DualGround testing.

Select – Connect – Inspect

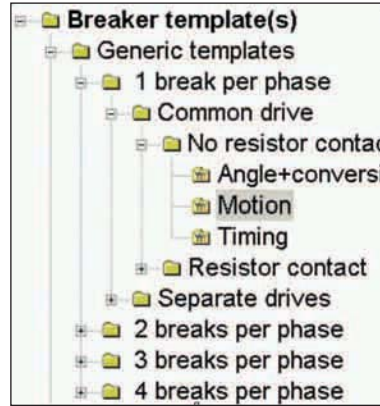
Working with TM1800 means fast, safe and easy testing. Testing is done with a three-step process.

1. Select a suitable template from the template library depending on number of contacts per phase, motion or not, resistor contacts and more.
2. Connect the test leads according to the graphical help screen.
3. Turn the “Measure” knob. The measurement is performed, analyzed and the results will be displayed on the screen. Magnification and compare functions are available.

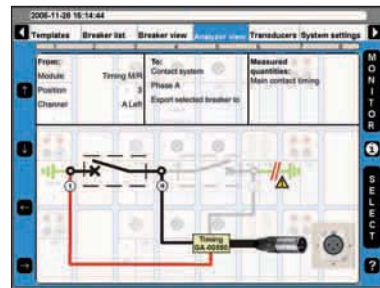
For more advanced setup there is still the opportunity to control all the details in the measurement. The large number of general purpose templates cover most circuit breakers found throughout the world. It is also possible to select a custom template with special adaptations. The user can edit templates with assistance from customer support. This is a very powerful tool to customize TM1800 for fast, safe and easy work according to the user’s needs in every detail.

It is possible to print a test report, either from the TM1800 built in printer module or using CABA Win on a PC.

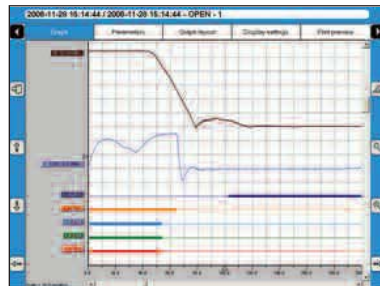
CABA Win allows the user to perform a more advanced analysis of the data. CABA Win is also the archive for common test data.



Select
Select the template suitable for the test and circuit breaker from the library.



Connect
Connect test leads and cables according to display. Separate help screen per cable.



Inspect
Turn the knob and the measurement is displayed on the screen ready for inspection.

FEATURES AND BENEFITS

- Circuit breaker analyzer test set TM1800 performs timing, travel and motion tests, dynamic and static resistance measurement and coil current measurements.
- Light and portable TM1800 unit with user configurable modules to suit different demands, testing and applications.
- Built in PC with keyboard and mouse, HDD module with removable hard drive to store more than 1000 test results.
- Quick and easy testing — simply a turn of “Measure” knob provides instant graphical results and measurements.
- All testing done with same connections — save “out of service” time of circuit breaker and less physical labor for operator as no need of reconnecting the unit for different tests.
- Dual ground testing — safest way of testing by grounding both sides of the circuit breakers.

- CABA local circuit breaker analyzing software — pre-defined and custom based circuit breaker templates, connection diagram through graphical help screen.
- Active Interference Suppression technique used for correct timing and accurate PIR values in high voltage substations having coupled interference currents.
- Unique DMC measuring technology — Dynamic Capacitive Measurement for dual ground testing.
- Data back up and transfer through USB and Ethernet communication.
- Print a graphical and tabular test report through printer module or CABA win software on a PC.
- CABA Win software — used for advanced data analysis, reporting and data management.
- Multiple language support — English, French, German, Spanish, Swedish

SPECIFICATIONS

GENERAL

Specifications are valid after 30 minutes warm up time. System time base drift 0.001% per year. Specifications are subject to change without notice.

Environment

Application field

For use in high-voltage substations and industrial environments.

Temperature

Operating: -10°C to +50°C (+14°F to +122°F)
Storage & transport: -55°C to +70°C (-67°F to +158°F)
Humidity: 5% - 95% RH, non-condensing

CE-marking

LVD Low Voltage Directive 73/3/EEC am. by 93/68/EEC

EMC EMC Directive 89/336/EEC am. by 91/263/EEC, 92/31/EEC and 93/68/EEC

MODULAR DESIGN OF THE TM1800

BASIC UNIT, Cat. No. CG-19090

The modularized design makes it very flexible to user needs and enables reconfiguration for new demands and upgrade with new functionality. The user can configure TM1800 to a complete test set based upon user specific need. The firmware, CABA Local, guides the user to efficient circuit breaker testing.

All inputs and outputs on the TM1800 and the modules are designed to withstand the harsh environment in high-voltage substations and industrial environments.

With built-in protection circuits and software-designed protection the TM1800 has built-in suppression to protect against failures caused by over-voltages generated in the substations and high-voltage environments.

The HDD module is a part of the basic unit and contains the hard drive with all data and software setup. It can easily be removed and changed.



Some of the key features of configurable TM1800 unit are:

- Eight user configurable slots for modules
- Temperature sensor connection
- Quick backup on USB device
- Trigger inputs and outputs
- Outputs for warning signal
- Earth (Ground) connection
- Communication interfaces (USB, Ethernet, etc)

BASIC UNIT SPECIFICATIONS

Power supply (nominal) 100-240 V AC, 50/60 Hz
Power consumption 250 VA (max)
Dimensions 515 x 173 x 452 mm (20.3" x 6.8" x 17.8")
Weight 15.5 kg (34.2 lbs)

External Input

Trig in

Time accuracy: ±0.1 ms
Voltage mode
 Input range: 0 to 250 V AC/DC
 Threshold level: user configurable in software steps of 1 V
Contact mode
 Open circuit voltage: 35 V DC ±20%
 Short circuit current: 10 to 40 mA
 Threshold level: 1 - 2 kΩ

External Output

Trig out

Number of channels: 3 (Trig Out, DRM, Warning)
Pulse duration: 1-999 ms, user configurable in steps of 1 ms
Voltage mode
 Open circuit voltage: 12 V DC ±5%
 Voltage at 0.5A: 9 V DC ±10%
 Max short circuit current: 1.5 A
Contact mode
 Max switching current: 0.5 A at 12 V and resistive load
 Voltage at 0.5A: 9 V DC ±10%
 Max short circuit current: 1.5 A

DRM (for DRM1800 only)

Warning

Relay: for lamp or horn
Pre-operation warning: 0 0 999 s, user configurable in steps of 1 s

Voltage mode

Output voltage: 12 V DC ±10%
 Voltage at 0.5A: 9 V DC ±10%
 Short circuit current: Fuse 1 A DC fast acting type (F1H250V)

Contact mode

Max switching current: 1 A at 12 V and resistive load

Communication Interface

USB Ver. 1.1
Ethernet 100 base-Tx Fast Ethernet
External screen SVGA, up to 800 x 600 at 24 bit color, 32 MB SDRAM

HMI, Human-Machine Interface

CABA Local Circuit breaker analyzing software
Languages English, French, German, Spanish, Swedish
Display Transreflecting to increase visibility in direct sunlight
Diag. Size 21 cm (8")
Keyboard Built-in

CONTROL MODULE, Cat. No. CG-19030

The control module controls the operation of the circuit breaker. Various circuit breaker operation sequences can be performed accurately and without any bounce.

This module also measures important parameters during the test. Coil current, control voltage, coil resistance for each phase on one phase operated circuit breaker is automatically measured without any additional test lead connections. Auxiliary contact timing is measured for single operation.

- Three independent contact functions per module
- Pre-programmed sequences Close, Open, Close/Open, Open/Close, Open/Close/Open
- Timing of a and b auxiliary contacts for single operation



CONTROL MODULE SPECIFICATIONS

General

No. of channels	3
Time base Accuracy	±0.01% of reading ±1 sample interval
Max sample rate	10 kHz
Measurement time	19 s at 10 kHz sample rate, 39 s at 5 kHz sample rate, 200 s at 10 kHz sample rate using data compression
Weight	1.0 kg (2.2 lbs)

Non-bouncing switch

Max current	60 A AC/DC, pulse ≤ 100 ms
Fuse	15 A DC
Duration	User configurable in steps of 1 ms
Delay	User configurable in steps of 1 ms

Current measurement

Measurement range	0 to 60 A AC/DC
Resolution	16 bits (15 bits at data compression)
Accuracy	±2% of reading ±0.1% of range

Voltage measurement

Measurement range	0 to 250 A AC/DC
Resolution	20 mV (40 mV at data compression)
Accuracy	±1% of reading ±0.1% of range

TIMING M/R MODULE, Cat. No. CG-19080

The timing M/R module uses one hook-up for testing all the important timing parameters of a contact without the need of reconnection or special set-ups.

One timing M/R module will measure up to six contacts including linear PIR contacts.

The timing M/R module is using patented Active Interference Suppression to obtain correct timing and accurate PIR values regardless of interference in high voltage substations.

The module is equipped with three galvanically isolated XLR female connectors with built-in voltage source.

- Six channels per module
- Active Interference Suppression
- High resolution and up to 40 kHz sampling
- Main and parallel resistor contact timing
- Resistance value of parallel resistors



TIMING M/R MODULE SPECIFICATIONS

General

No. of channels	6 (2 voltage ranges per channel when used in voltage mode)
Time base inaccuracy	±0.01% of reading ±1 sample interval
Min resolution	0.05 ms
Max sample rate	40 kHz
Measurement time	16 s at 20 kHz sample rate, 32 s at 10 kHz sample rate, 200 s at 10 kHz sample rate using data compression
Weight	Data compression is available at sample rates up to 20 kHz 0.8 kg (1.8 lbs)

Timing of main and resistive contacts

Open circuit voltage 6 V or 26 V ±10% (toggling at every second sample at sample rates from 10 kHz and upwards)

Short circuit current 9.7 mA or 42 mA ±10%

Status threshold

Main: Closed < 10 Ω < open
Main and resistor: main <10 Ω <PIR < 10 kΩ < Open

PIR resistance measurement

Supported PIR types	Linear PIR
Measurement range	10 Ω to 10 kΩ
Accuracy	±10% of reading ±0.1% of range

DCM MODULE, Cat. No. CG-19190

The DCM module enables DualGround testing. This increases safety and also makes testing easier. This module uses a patented measuring technology called Dynamic Capacitive Measurement.

Each pair of a Timing M/R and DCM module provides up to six channels. Each channel requires a special DCM cable with integrated electronics.

The TM1800 system can be equipped with multiple DCM and Timing M/R module pairs that enable timing measurement on up to 18 contacts.

- Six channels per module
- Timing test using DualGround
- Safe, fast and easy testing



DCM MODULE SPECIFICATIONS

General

No. of channels 6
Weight 625 g (1.4 lbs)

Output

Voltage 0 to 5 V rms ac
Current 0 to 20 mA rms ac

ANALOG MODULE, Cat. No. CG-19000

The analog module measures any analog entity from a transducer mounted on a circuit breaker. It enables measurements of motion, speed, current, voltage, pressure, vibration etc. Motion measurements are taken with standard linear or rotary transducers, shunts and 4-20 mA transducers. High level user interface makes measurement faster and easier.

Universal transducers and specialized transducers with conversion tables are available for numerous circuit breakers.

- Three channels per module
- Supports industrial analog transducers



ANALOG MODULE SPECIFICATIONS

General

No. of channels 3
Time base accuracy ±0.01% of reading ±1 sample interval
Max sample rate 40 kHz
Measurement time 10 s at 40 kHz sample rate,
 20 s at 20 kHz sample rate,
 200 s at 10 kHz sample rate using data compression

Transducer

Resistance 500 Ω - 10 kΩ at 10 V output
Weight 0.8 kg (1.8 lbs)

Output

Voltage output 10 V dc ±5%, 24 V DC ±5%
Max output current 20 to 30 mA

Current measurement

Measurement range 0 to 20 mA DC
Resolution 16 bits (15 bits at data compression)
Accuracy ±1% of reading ±0.1% of range

Voltage measurement

Input voltage range 0 to 250 V AC/DC
Measurement range ±10 V dc, 0 to 250 V AC/DC
Resolution 16 bits (15 bits at data compression)
Accuracy
250 V range: ±1% of reading ±0.1% of range
10 V range: ±0.1% of reading ±0.1% of range

DIGITAL MODULE, Cat. No. CG-19040

With digital/incremental transducers motion and other measurement becomes even more accurate, faster and easier. The digital module enables use of incremental rotary or linear transducers for measurements like motion, velocity and damping characteristics of circuit breakers.

- Six channels per module
- Incremental transducers with RS422
- Up to ±32000 pulses resolution
- Up to 20 kHz sampling



DIGITAL MODULE SPECIFICATIONS

General

No. of channels 6
Supported types Incremental transducers, RS422
Time base accuracy ±0.01% of reading ±1 sample interval
Max sample rate 20 kHz
Measurement time 16 s at 20 kHz sample rate,
 32 s at 10 kHz sample rate,
 200 s at 10 kHz sample rate using data compression
Weight 0.7 kg (1.5 lbs)

Output

Voltage 5 V DC ±5% or 12 V DC ±5%
Max output current 200 mA

Digital output

Range ±32,000 pulses
Resolution 1 pulse
Accuracy ±1 pulse

TIMING AUX MODULE, Cat. No. CG-19060

The timing aux module expands the TM1800 system with timing inputs for measuring any auxiliary contact on the circuit breaker.

It measures timing of both dry and wet contacts for example timing of spring charging motor, anti-pump relay etc.

- Six channels per module
- Polarity insensitive
- Dry and wet auxiliary contacts



TIMING AUX MODULE SPECIFICATIONS

General

No. of channels	6
Time base accuracy	±0.01% of reading ±1 sample interval
Max sample rate	20 kHz
Measurement time	15 s at 20 kHz sample rate, 30 s at 10 kHz sample rate, 200 s at 10 kHz sample rate using data compression
Weight	0.8 kg (1.8 lbs)
Voltage mode	
Input voltage range	0 - 250 V AC/DC
Status threshold	±10 V
Accuracy	±0.5 V

Contact mode

Open circuit voltage	25 to 35 V
Short circuit current	10 to 30 mA
Status threshold	Closed < 100 Ω, Open > 2 kΩ

HDD MODULE

The HDD module is a special module which is a part of the basic unit. It is a data storage module.

Storage of all set up, user customization and measurement data is done in the HDD module. The module is easily replaced e.g. when different users are sharing one TM1800 and want individual setups, data and configurations.

- Change set-up, user customization, measurement data by changing HDD module



PRINTER MODULE, Cat. No. CG-19050

The Printer module offers a convenient and practical way of making printouts of test results in the field.

The printouts contain both numerical and graphical results. Pre-installed printer templates in the TM1800 are easy to adapt and provide different printout formats to suit specific needs for a comprehensive test report.

- Thermal printer sensitive line dot method
- Paper width 114 mm (4")
- Printing speed 50 mm/s (400 dot lines/s)

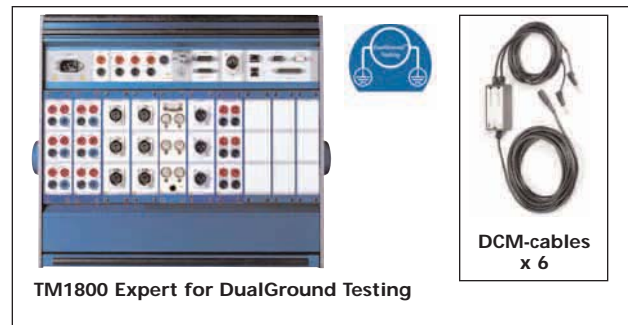
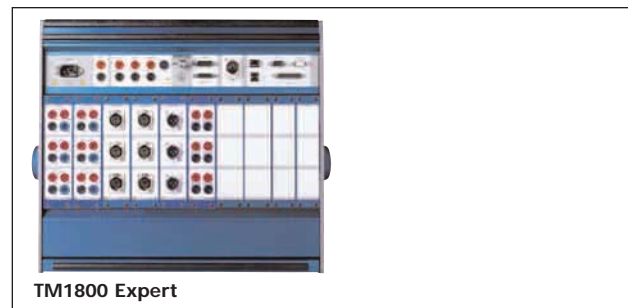
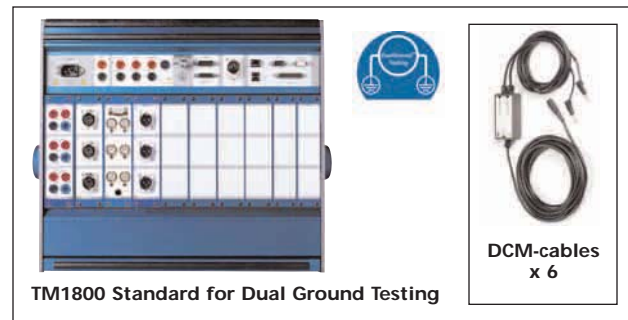
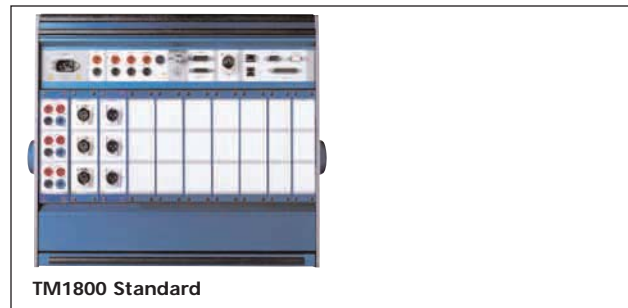
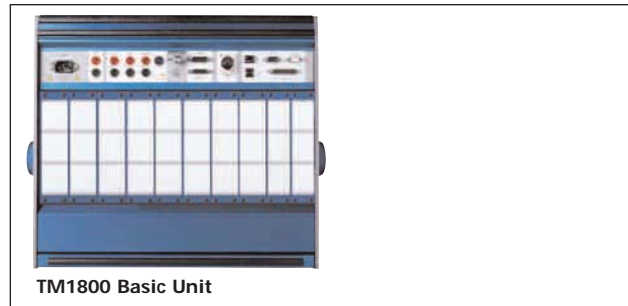


PRINTER MODULE SPECIFICATIONS

General

Printer type	Thermal printer
Paper type	Thermal 114 mm
Max sample rate	20 kHz
Storage & transport temperature	-20°C to +60°C (-4°F to +140°F)
Weight	0.8 kg (1.8 lbs)

ORDERING INFORMATION	
Item	Cat. No.
TM1800 Basic Unit Complete with: HDD module, CABA local, transport case, USB memory	CG-19090
Control Module (3 independent contacts) Including: 3 cable sets, 5 m (16 ft), GA-00877	CG-19030
Timing M/R Module (6 channels + 6 PIR) Including: 3 cable sets, 5 m (16 ft) total length, 1.5 m (4.9 ft) spread, GA-00850	CG-19080
DCM Module (3 channels) Including: 3 DCM-cables, 12 m (39 ft)	CG-19190
Analog Module (3 channels) Including: 3 cable sets, 10 m (33 ft), GA-01005	CG-19000
Digital Module (6 channels)	CG-19040
Timing Aux Module (6 channels) Including: 3 cable sets, 5 m (16 ft), GA-00870	CG-19060
Printer Module Including: paper spool, GC-00040	CG-19050
TM1800 – Configurations	
TM1800 Standard, complete with: TM1800 Basic unit, +1 Control Module, 1 Timing M/R module, 1 Analog module	CG-19290
TM1800 Standard – for DualGround testing Complete with: TM1800 Standard +1 DCM module incl. 6 DCM-cables	CG-19292
TM1800 Expert, complete with: TM1800 Standard +1 Control modules, 1 Timing M/R module, 1 Timing AUX module, CABA Win	CG-19294
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Optional accessories	
CABA Win	



UK
Archcliffe Road, Dover
CT17 9EN England
T +44 (0) 1 304 502101
F +44 (0) 1 304 207342
UKsales@megger.com

UNITED STATES
4271 Bronze Way
Dallas, TX 75237-1019 USA
T 1 800 723 2861 (USA only)
T +1 214 333 3201
F +1 214 331 7399
USsales@megger.com

OTHER TECHNICAL SALES OFFICES
Täby SWEDEN, Norristown USA,
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