TM1800™

Circuit Breaker Analyzer System

Programma® Products

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The TM1800™ is a recently developed instrument platform for circuit breaker maintenance, based on 20 years' experience of over 4,000 delivered breaker analyzers. The modular construction makes it possible to configure the TM1800™ for measurements on all known types of breaker in operation on the world market.

The robust design contains powerful new 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.

A new type of timing channel with high analog resolution can not only measure contact timing, but also provide resistance values for series resistance and main contacts. A highly capable, easy-to-use piece of software supports everything from timing using a simple knob without the need for presettings, to advanced help functions for hooking up to the test object.

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

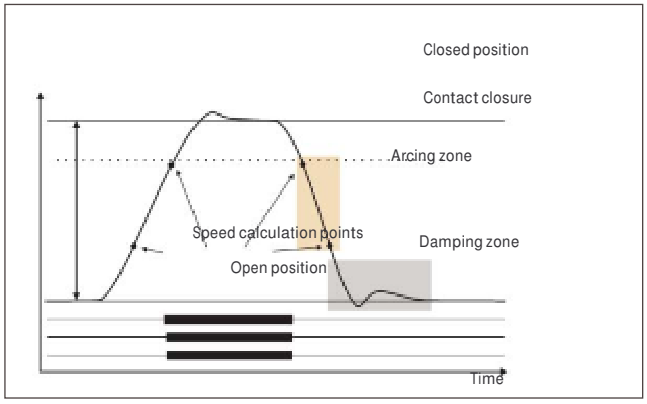
Application

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 becomes too high across one contact, and 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 50 Hz since there is always 6.67 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.

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 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 so-called 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 mechanics. 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.



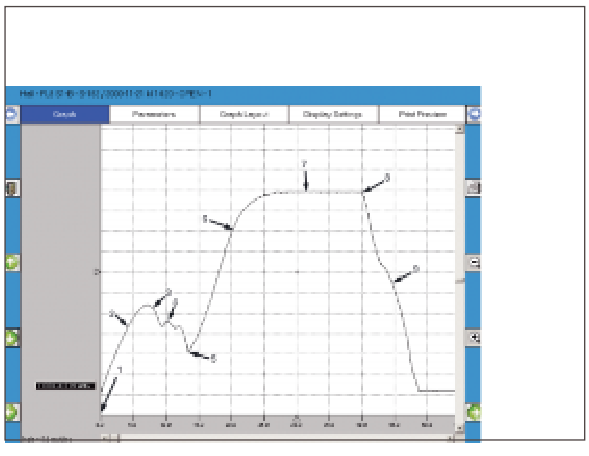
Motion Curve

Coil Currents

These can be measured on a routine basis to detect potential mechanical and/or electrical problems in actuating coils well in advance of their emergence as 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. When you apply a voltage 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 to the current proportional 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, however, that the relationship between the two current peaks varies, particularly with temperature. This also applies to the lowest tripping voltage.

Dynamic Resistance Measurement (DRM)

The main contact resistance during operation is obtained by DRM. DRM is mainly used for determination of arcing contacts shortening.



1 Trip coil energized
2-3 Armature travel
3-4 Armature operates trip latch
4-5 Armature completes its travel
5 Armature hits stop
6 Change in coil inductance
7 Proportional to DC coil resistance
8 Auxiliary contact opens
9 Current decay

Example of coil current on circuit breaker

Modular design

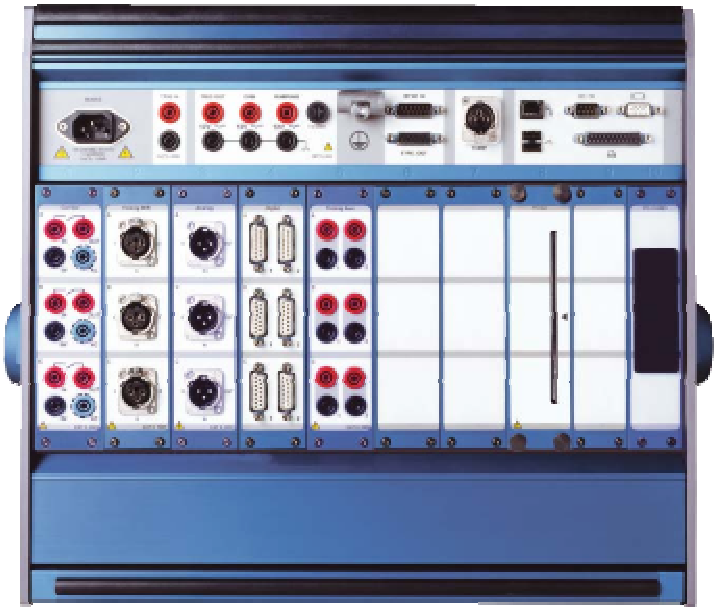
Basic Unit

TM1800™ has a modular design that makes it very flexible to user needs. You can configure the Basic Unit to a complete test set with the types of modules you need, for a specific test as-well as for general needs. The modularised design enables any user to upgrade or reconfigure the hardware for improved/new functionality.

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 a good guard to influences and even failures caused by over-voltages generated in the environment.

On the top panel of the basic unit are the following inputs and outputs:

- 8 user configurable slots for modules
- Mains input
- Trig inputs and outputs
- Outputs for warning signal
- Earth (Ground) Connection
- Communication interfaces (USB, Ethernet, RS232, LTP and VGA)



Control Module

Generates the selected circuit breaker sequences accurate and bounce-less when the TM1800 is operated. The Control Module can be configured to operate any close and trip coil to perform the programmed sequence and measure important parameters during the sequence like current, voltage, resistance and auxiliary contact timing. Two control modules can be used to control the breaker and measure coil current, control voltage, coil resistance and auxiliary contact timing for each phase on one phase operated circuit breakers.

- Three independent contact functions per module
- Pre-programmed sequences C, O, C-O, O-C, O-C-O
- All sequence settings are user configurable in CABA Local (internal software)
- Timing of a and b auxiliary contacts

Timing M/R Module

Introduces the new generation of timing measurements with an analog design that enables a more accurate and faster testing of circuit breaker parameters. The Timing M/ R module uses one hook-up for testing all the important timing parameters of an interrupter without the need of reconnections or special set-ups. One Timing M/R module will measure up to six interrupters including linear PIR contacts timing and present the result individually for each contact.

The Timing M/R also measures the voltage drop when DRM is performed without need of time consuming and hazardous reconnections since the same test leads are used for both timing and voltage measurement.

- Six channels per module
- Main contact timing
- Parallel resistor contact timing
- Resistance value of parallel resistors

Analog Module

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. With the flexible and easy to use interface it makes motion measurement of a circuit breaker like a walk in the park.

- Three channels per module
- 10 V and 24 V output
- Input range 4-20mA
- Supports industrial analog transducers

Printer Module

The Printer module offers a convenient and practical way of making printouts of test results directly from the TM1800. The printouts contain both numerical and graphical results and printer templates delivered pre-installed in the TM1800 are easy to adapt to suit specific needs for a clear and complete report of all tested parameters. Printouts can also be made on any external printer via the parallel (LPT) or the USB of TM1800.

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

Digital Module

With the Digital module motion measurement with the TM1800 system becomes even more accurate and the set-up even easier. It enables the use of incremental rotary or linear transducers, for measuring motion, velocity of circuit breakers and the damping characteristics on drive mechanisms

- Six channels per module
- Incremental transducers with resolution up to ±32000 pulses
- Built in power supply with 5 V or 12 V DC

PC-card Module

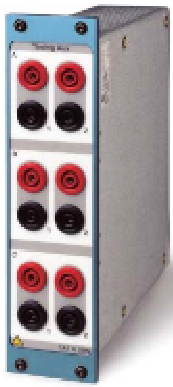
Storage of recorded data is done in the PC-card module that is delivered with every TM1800 system. This module is easily removed during transport or storage of the TM1800 to minimize the risk of data getting lost. The PC-card module comes with two standard PCMCIA slots that can be used for memory cards, w-lan etc. As an option the standard mechanical hard disk can be replaced with a flash disk that withstand higher environmental requirements when used in rougher environments or often transported. This module is always fitted into slot 10.

- Two type I/II/III PCMCIA slots
- 20 GB storage capacity on built-in hard drive
- Optional: Flash disk (ordered separately)

Timing Aux Module

Expands the TM1800 system with timing inputs for measuring any auxiliary contact on the circuit breaker. It measures timing, polarity insensitive, of both dry and wet contacts for example timing of spring charging motor, anti-pump relay etc.

- Six timing inputs
- Polarity insensitive
- Dry and wet auxiliary contacts



Application examples

IMPORTANT!

Read the User's manual before using the instrument.

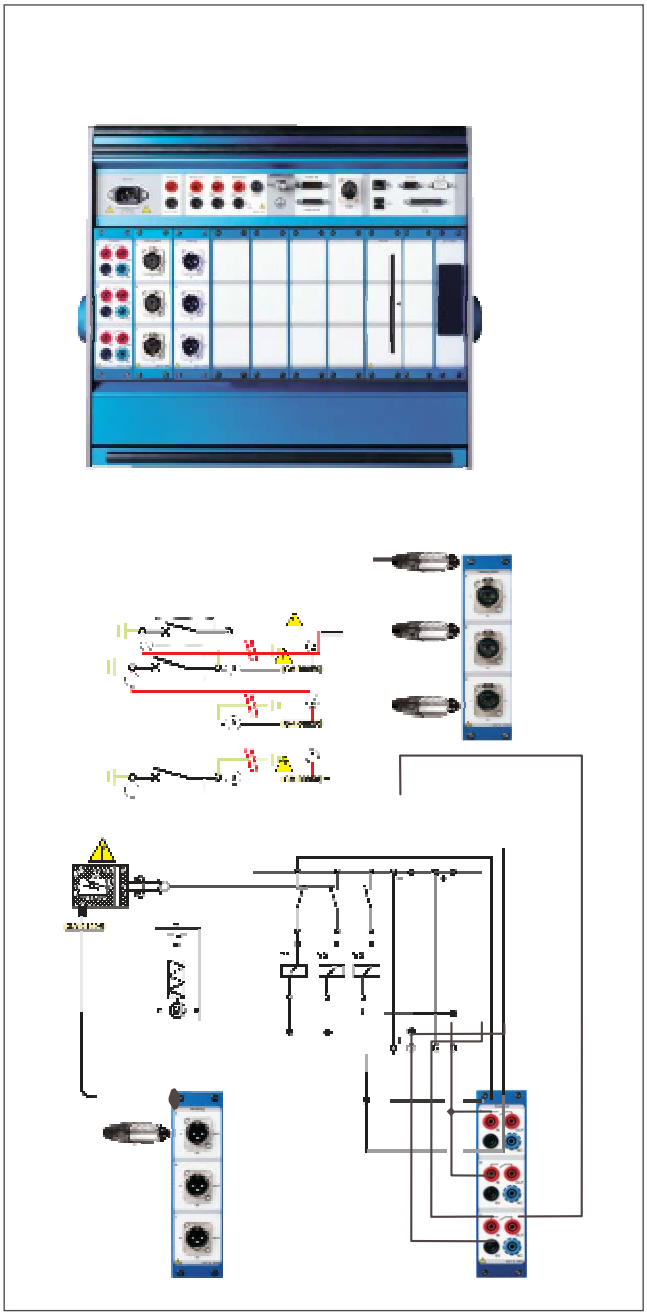
Circuit Breaker System with Common Operating Mechanism

TM1800™ Set-up for one main contact and common operating mechanism

The drawing shows an analog measurement but it can also be done with a digital module and incremental transducers. The settings in the TM1800™ system are easy to manage using the internal software (CABA Local). It offers easy access via function keys and the built-in keyboard. It comes with a track ball and large, bright screen that works as well in direct sunlight.

Minimum configuration of modules for this application is:

1 Control module
1 Timing M/R module
1 Analog module



Y1 = close coil, Y2 = trip coil 1, Y3 = trip coil 2

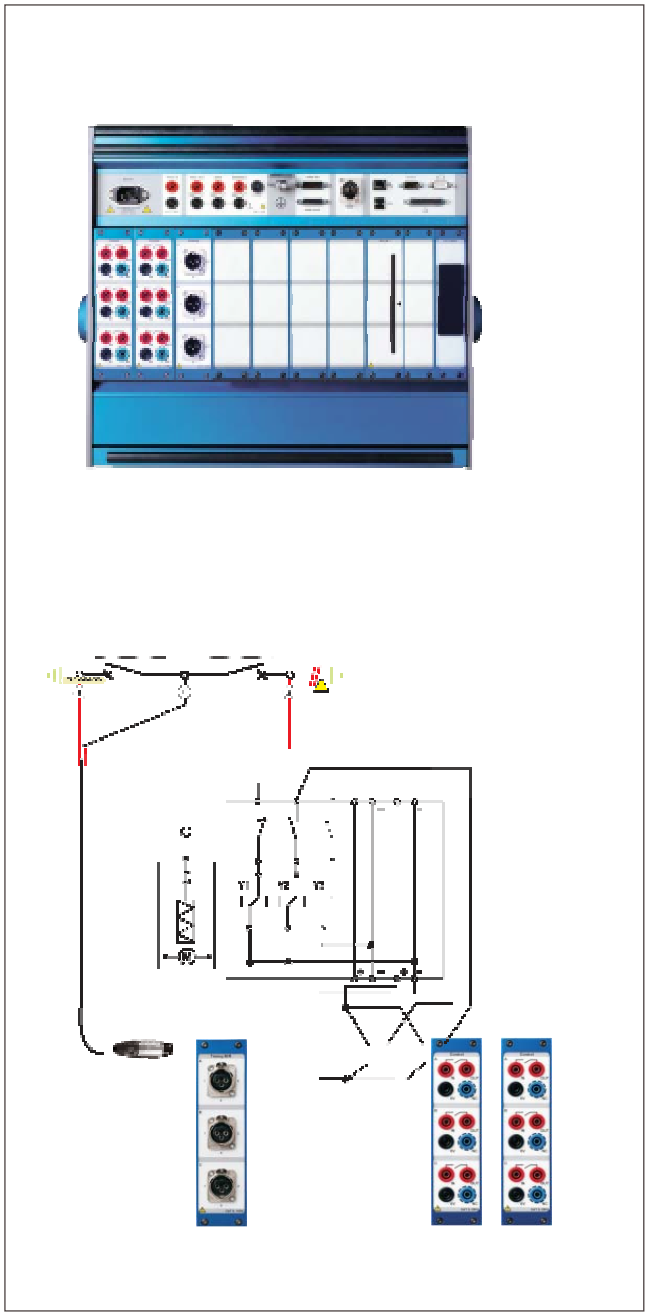
Circuit Breaker System with Separate Operating Mechanism

TM1800™ Set-up for two main contacts and one operating mechanism per pole.

Below set-up shows complete wiring for pole A. The timing hook-up for remaining pole B and C is done accordingly to pole A. Two control modules (six outputs) are needed to control each coil (Y1/Y2) for every pole. The set-up below shows the wiring of pole A. This also automatically tests timing on the auxiliary contacts that are connected in series to the coils.
Motion measurement can be added with an analog or digital module.

Minimum configuration of modules for this application is:

2 Control modules
1 Timing M/R module



Y1 = close coil, Y2 = trip coil 1, Y3 = trip coil 2

Specifications TM1800

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	0 °C to +50 °C (32 °F to +122 °F) -20 °C to +50 °C (-4 °F to +122 °F), with flash disk
Storage & transport	-55 °C to +70 °C (-67 °F to +158 °F)
Humidity	5% – 95% RH, non-condensing

CE-marking

EMC	EMC Directive 89/336/EEC am. by 91/263/EEC, 92/31/EEC and 93/68/EEC
LVD	Low Voltage Directive 73/23/ EEC am. by 93/68/EEC

Basic unit

General

Mains input (nominal)	100 – 240 V AC, 50 / 60 Hz
Power consumption (max)	250 VA
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 inaccuracy	±0.1 ms
Voltage mode	
Input range	0 – 250 V AC / DC
Threshold level	User configurable in software in steps of 1 V
Contact mode	
Open circuit voltage	35 V DC ±20%
Short circuit current	10 – 40 mA
Threshold level	1 – 2 kΩ

External outputs

General

No. of channels	3, (TRIG OUT, DRM, WARNING)

TRIG OUT

Switch	Electronic
Pulse duration	1 – 999 ms, user configurable in steps of 1 ms
Inaccuracy	±0.1 ms
Voltage mode	
Open circuit voltage	12 V DC ±5%
Voltage at 0.5 A	9 V DC ±10%
Max. short circuit current	1.5 A
Contact mode	
Max. switching currrent	0.5 A at 12 V and resistive load
Voltage drop at 0.5 A	4.5 V DC ±10%
Max. short circuit current	1.5 A

DRM

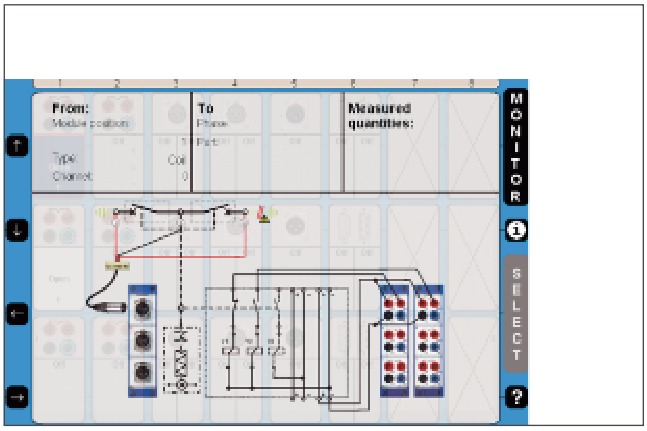
Switch	Relay
Voltage mode	
Open circuit voltage	12 V DC ±5%
Voltage at 0.5 A	11 V DC ±10%
Max short circuit current	1.5 A

WARNING

Switch	Relay
Pre-operation warning	0 – 999 s, user configurable in steps of 1 s
Voltage mode	
Output Voltage	12 V DC ±10%
Short circuit protection	Fuse 1 A DC fast acting type (F1H250V)
Contact mode	
Max. switching currrent	1 A at 12 V and resistive load

External temperature sensor (optional accessory)

Range	-20 °C to +50 °C (-4 °F to +122 °F)
Resolution	0.5 °C (0.9 °F)



When on site doing the hook-up, you can get help on how to connect by pressing the i-button.

Communication interfaces

PC-card	Type I/II/III PCMCIA cards, 5 V supply
USB	Universal Serial Bus ver. 1.1
Ethernet	100 base-Tx Fast Ethernet
Printer port	LTP, Multi-mode parallel (ECP/EPP/SPP) 25-pin D-sub female
Serial port	RS232, 9-pin D-Sub male
External screen	SVGA, up to 800 x 600 at 24 bit color, 32 MB SDRAM

HMI, Human-Machine interface

Operating system	Windows XP Embedded
CABA Local	Circuit breaker analyzing software
Available languages	English, German
Display	Transreflecting to increase visibility in direct sunlight
Diagonal size	21 cm (8")
No. of pixels	800 x 600 (W x H)
Display mode	256k colour
Luminance	350 cd/m^2
Keyboard	Built-in trackball and mouse buttons

Modules

Control module

General

No. of channels	3
Time base inaccuracy	±0.01% of reading ±1 sample interval
Min. resolution	0.1 ms
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. continuous current	15 A AC / DC
Max current	60 A AC / DC during 100 ms with intermittence of 5%
Short circuit protection	15 A DC
Duration	1 ms – 1000 s, user configurable in steps of 1 s
Delay	0 – 999 s, user configurable in steps of 1 s

Current measuremen

Measurement range	0 – 60 A AC / DC
Resolution	3 mA (6 mA at data compression)
Inaccuracy	±2% of reading ±0.1% of range

Voltage measurement

Measurement range	0 – 250 V AC / DC
Resolution	20 mV (40 mV at data compression)
Inaccuracy	±1% of reading ±0.1% of range

Auxiliary contact status/resistance

Open circuit voltage	25 – 35 V DC
Short circuit current	10 – 40 mA
Status threshold	Open > 10 kΩ > closed
Resistance range	0 – 10 kΩ
Resolution	100 mΩ at 100 Ω, 5 Ω at 10 kΩ
Inaccuracy	±2% of reading ±0.2% of range

Timing M/R module

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 Data compression is available at sample rates up to 20 kHz
Weight	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 cicuit 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 – 10 kΩ
Inaccuracy	±10% of reading ±0.1% of range

Voltage measurement

Measurement ranges	±50 V_{peak}, ±15 V_{peak}, ±0.5 V_{peak}
Resolution	2 mV, 0.5 mV, 20 µV (4 mV, 1 mV, 40 µV at data compression)
Inaccuracy	±1% of reading ±0.1% of range

Analog module

General

No. of channels	3
Time base inaccuracy	±0.01% of reading ±1 sample interval
Min. resolution	0.025 ms
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 – 30 mA

Current measurement

Measurement range	0 – 20 mA DC
Resolution	0.35 µA (0.7 µA at data compression)
Inaccuracy	±1% of reading ±0.1% of range

Voltage measurement

Input voltage range	0 – 250 V AC / DC
Measurement ranges	±10 V DC, 0 – 250 V AC / DC
Resolution	0.3 mV, 13 mV (0.6 mV, 26 mV at data compression)
Inaccuracy	
250 V range	±1% of reading ±0.1% of range
10 V range	±0.1% of reading ±0.01% of range

Digital module

General

No. of channels	6
Supported types	Incremental transducers, RS422
Time base inaccuracy	±0.01% of reading ±1 sample interval
Min. resolution	0.05 ms
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 input

Range	±32000 pulses
Resolution	1 pulse
Inaccuracy	±1 pulse

Timing Aux module

General

No. of channels	6
Time base inaccuracy	±0.01% of reading ±1 sample interval
Min. resolution	0.05 ms
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
Inaccuracy	±0.5 V

Contact mode

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

Printer module

General

Printer type	Thermal printer
Paper type	Thermal 114 mm
Printing speed	50 mm/s (400 dotlines/s)
Horizontal resolution	8 dots/mm
Vertical resolution	8 dots/mm
Storage and transport temperature	-20 °C to +60 °C (-4 °F to +140 °F)
Weight	0.8 kg (1.8 lbs)

Ordering information

TM1800	**Art. No.**
Complete with: CABA Local Transport case USB Memory	
TM1800, Basic Unit	**CG-19090**
TM1800, Basic Unit, with Flashdisk	**CG-19091**

Modules

Control Module Including 3 cable sets, 5 m (16 ft), GA-00877	**CG-19030**
Timing M/R Module Including 3 cable sets, 5 m (16 ft) total length, 1.5 m (4.9 ft) spread, GA-00850	**CG-19080**
Analog Module Including 3 cable sets, 10 m (33 ft), GA-01005	**CG-19000**
Digital Module	**CG-19040**
Timing Aux Module Including 3 cable sets, 5 m (16 ft), GA-00870	**CG-19060**
Printer Module Including paper spool, GC-00040	**CG-19050**

Optional accessories

See section “Circuit breaker testing accessories”

Circuit Breaker Testing Accessories

Item	Description	TM1800	TM1600	EGIL	Art. No.
CABA – Software					
CABA Win	Breaker analysis software, incl. Ethernet cross-over cable	X			**CG-8000X**
	Breaker analysis software, incl. fiberoptics and USB interface		X		**BL-8203X**
	Breaker analysis software, incl. RS232 cable			X	**BL-8204X**
CABA Win upgrade	Upgrade	X	X	X	**CG-8010X**
Transducers – Linear					
TLH 500	500 mm (20") travel Incl. cable 0.5 m (20")	X	X	X	**XB-30020**
LWG 225	225 mm (9") travel Incl. cable 0.5 m (20")	X	X	X	**XB-30117**
TS 150	150 mm (5.9") travel Incl. cable 1.0 m (39")	X	X	X	**XB-30030**
TS 25	25 mm (1") travel Incl. cable 1.0 m (39")	X	X	X	**XB-30033**
The above transducers are also available in many other lengths, please contact GE Energy for more information.					
Transducers – Rotary					
Analog					
Novotechnic IP6501	Incl. cable 1 m (39"), 6 mm Flex coupling, Hexagon wrench	X	X	X	**XB-31010**
Digital					
Baumer BDH16.05A3600-LO-B	Incl. cable 10 m (33ft), 10/6 mm Flex coupling, Hexagon wrench	X			**XB-39130**
Transducer mounting kits – Universal					
Rotary transducer mounting kit	For transducers XB-31010 and XB-39130	X	X	X	**XB-51010**
Universal transducer mounting kit	For linear and rotary transducers	X	X	X	**XB-51020**
Transducer mounting kits – Circuit breaker specific					
LTB Kit (ABB)	Incl. mounting kit XB-51010, Software conversion table BL-8730X	X	X		**XB-61010**
HPL/BLG Kit (ABB)	Incl. mounting kit XB-51010, Software conversion table BL-8720X	X	X		**XB-61020**
Ready-to-use kits – Rotary					
Analog					
1-phase kit	Incl. transducer XB-31010, mounting kit XB-51010	X	X	X	**XB-71010**
3-phase kit	Incl. 3 x 1-pase kits XB-71010	X	X		**XB-71013**
Digital					
1-phase kit	Incl. transducer XB-39130, mounting kit XB-51010	X			**XB-71020**
3-phase kit	Incl. 3 x 1-pase kits XB-71020	X			**XB-71023**
Accessories for transducer mounting					
Universal support		X	X	X	**XB-39029**
Switch magnetic base		X	X	X	**XB-39013**
Cables					
Cable reel 20 m (65.5 ft), 4 mm stackable safety plugs	Black	X	X	X	**GA-00840**
	Red	X	X	X	**GA-00842**
	Yellow	X	X	X	**GA-00844**
	Green	X	X	X	**GA-00845**
	Blue	X	X	X	**GA-00846**
Timing cable sets	The cable sets consist of 8 cables with clamps and 4 mm stackable safety plugs				
	8 x 5 m, (16.4 ft)		X		**GA-00231**
	8 x 10 m, (32.8 ft)		X		**GA-00241**
	8 x 15 m, (49.2 ft)		X		**GA-00251**
Cable reel	Cable reel and multi-connector for 4 timing channels Note: without cable		X		**BL-90060**
Extension cable	Cable for cable reel BL-90060. Specify length when ordering		X		**03-10070**
Extension cable XL	10 m (32.8 ft), for time measurement of main contacts			X	**GA-00150**
Open analog cable	For customized analog transducer connection	X	X	X	**GA-01000**
XLR to 4 mm safety plugs	For customized analog transducer connection	X	X	X	**GA-00040**
Digital transducer extension cable	10 m (33 ft)	X			**GA-00888**
Open digital cable	For customized digital transducer connection	X			**GA-00885**

Linear transducer, TLH 225

Linear transducer, TS 25

Rotary transducer, Novotechnic IP6501 (analog)

Rotary transducer, Baumer BDH (digital)

Rotary transducer mounting kit

Switch magnetic base

Cable reels, 20 m (65.5 ft), 4 mm stack-able safety plugs

Universal support

Item	Description	TM1800	TM1600	EGIL	Art. No.
Ethernet cable, network	For connection to network	X			**GA-00960**
Vibration testing					
SCA606	Signal Conditioning Amplifier. Power supply, amplifier and signal conditioning filter for vibration testing using accelerometers with built-in charge amplifiers. (Note: DTW-analysis software needed)		X		**BL-13096**
Vibration analysis software	CABA option for DTW-analysis		X		**BL-8270X**
Accelerometer	DYTRAN 3200B5		X		**XB-32010**
Synchronized Switching Relay test kit					
SSR kit incl. accessories, software and cables (delivered in transport case)	SSR kit for TM1800	X			**CG-91200**
	SSR for TM1600 (incl. VD401)		X		**BL-91200**
Dynamic resistance measurement					
DRM1000	Dynamic resistance measurement of breaker contacts. Controls injection current up to 1000 A. External supply 12 V DC. Delivered complete, including the following:		X		**BL-90041**
	• Control unit DRM1000 incl. cable KG-00702 (red) and cable KG-00706 (blue) with snap-on connectors for a sealed 12 V battery.		X		BL-90040
	• Connection box		X		BL-90035
	• Sensing cables, 2 x 2 m, (6.5 ft) with clamps for connecting the circuit breaker to the connection box		X		GA-00430
	• Transport case		X		**50-00110**
DRM for TM1800	(To be released)	X			
Current cables	100 A		X		**GA-00424**
	250 A		X		**GA-00422**
	1000 A		X		**GA-00420**
Other					
VD401	Voltage divider, ratio 400/1 (for TM1600 and EGIL with analog channel)		X	X	**BL-90070**
PIR adapter	The adapter is used to test circuit breakers with pre-insertion resistors, when the resistance is lower than 250 ∧ or higher than 3000 ∧. There are two versions:				
	PIR, 15 – 250 ∧		X		**BL-90080**
	PIR2, 90 – 4500 ∧		X		**BL-90082**
Current	AC/DC clamp/clip-on/current probe, Fluke 80i-110s				
	Current sensor kit 1 channel (Fluke 80i-110s incl. cable GA-00140)	X	X		**BL-90600**
	Current sensor kit 3 channels (Fluke 80i-110s incl. cables GA-00140)	X	X		**BL-90610**
Temperature sensor	For ambient temperature measurement (To be released)	X			
Long term monotoring	EPROM to be mounted in the TM1600				
LTM1	Starts measurement when there is a change at any of the time-measuring inputs		X		**BL-80010**
LTM2	Functions in the same way as a standard TM1600, but returns automatically to the READY state after measurement		X		**BL-80011**
Thermopaper	114 mm, 30 m		X	X	**GC-00030**
Thermopaper	114 mm, Ø 40 mm	X			**GC-00040**
Soft case		X			**GD-00340**

For more information about optional accessories please contact GE Energy.

Signal conditioning amplifier, SCA606

Cable reel, BL-90060

Extension cable XL, GA-00150

Accelerometer, Dytran 3200B5 and cable

DRM1000

Voltage divider, VD401

PIR adapter

Soft case

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