Megger

EGIL200-series

Circuit breaker analyser

User guide

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1 Introduction

1.1 Introduction

Thank you for your trust in Megger

We have the goal to always offer you a pleasant shopping experience.

EGIL200 is developed and manufactured in Sweden by knowledgeable and committed employees.
Every day, our team do their best to offer you, our products in top quality for a very affordable price and with a presice delivery.

This instruction manual contains information regarding the correct use and handling of EGIL200.

This handbook must be at hand when using the System.

Please ensure to consult the chapter 'Safety'. This chapter contains information regarding your personal safety when using the system.

Read the ensuing safety regulations attentively before using this device.

The EGIL200 is the first incarnation in a new range of circuit breaker analysers from Megger. It has been designed in close cooperation with global industry reference groups, drawing experience from the market-leading and hugely successful Megger TM series of circuit breaker analysers.

The emphasis in the development of the EGIL200 has been on ease of use, ensuring that the time spent on setting up measurements is kept to a minimum. As such, with the EGIL200, you can get your test results done in no time.

Connection to the test object has also been streamlined and with only one hook-up, all following operations or measurements can be made:

1. Timing of main and PIR contacts
2. Coil current analysis of close, open 1 and 2 coils
3. Station voltage measurements
4. Motion measurements
5. Motor current measurement

With both main instrument and accessories designed for the most demanding field conditions, the EGIL200 is your complete toolbox for daily, hassle-free circuit breaker condition assessments.

1.2 Features and benefits

The EGIL200 offers all standard measurements from IEEE C37 and IEC 62271 standards and brings high-end features from the TM series into the affordable mid-range segment:

- Offers all standard measurements based on international standards
- Intuitive and user-friendly operation – a minimum of user interventions needed from the power-up of the instrument to the documented measurement result
- Is fitted into a rugged IP67-rated case and the instrument's accessories come in an easy-to-carry backpack
- Designed for medium to high voltage circuit breakers
- One-click reporting to pdf or printed on an optional, integrated printer
- Dedicated control output for open coil 2
- Multi-functional control channels that, with only one connection, manage control pulses and can measure station voltages and coil currents
- Galvanically insulated and polarity independent auxiliary contact timing channels, automatically adapted for dry and wet contacts
- Accurate pre-insertion resistor contact timing and resistance value measurements, thanks to its patented Active Interference Suppression technology.

1.3 Company web site

Occasionally an information bulletin may be issued via the Megger web site. This may concern new accessories, new usage instructions or a software update. Please occasionally check on the Megger web site for anything applicable to your Megger instruments.

www.megger.com

1.4 Receiving instructions

This instrument has been thoroughly tested and inspected to meet rigid specifications before being shipped. It is ready for use when set up as indicated in this user manual.

Check the equipment received against the packing list to ensure that all materials are present. Notify Megger of any shortage.

Examine the instrument for damage received in transit. If damage is discovered, file a claim with the

carrier at once and notify Megger, giving a detailed description of the damage.

1.4 Service and support

For technical assistance please contact your local representative or direct your request to Megger in Sweden.

When sending the instrument, please use either the original crate or one of equivalent strength.

Add the return authorization number to the address label of the shipping container for proper identification and quicker handling.

Training

For information about training courses contact your local distributor or the Megger Sweden office.

Contact information

Internet:	www.megger.com
E-mail:	support-sweden@megger.com
Tel:	+46 8 510 195 00

2 Safety

2.1 General

- All safety and operating instructions must be read before using the product.
- All safety and operating instructions for the product must be followed.
- All safety and operating instructions must be retained for future reference.

Symbols on the instrument

Caution, refer to accompanying documents.

Caution, risk of electric shock.

Protective conductor terminal.

WEEE, Waste Electronic Equipment. Please utilise your local WEEE collection facilities in the disposition of this product and otherwise observe all applicable requirements.
The unit can also be returned to Megger at any time at no charge for the disposal.

Warning and caution notices

Warning and caution notices are used throughout this manual where applicable and should be strictly observed. These notices appear in the format shown below and are defined as follows:

Warning

Warning, as used in this manual, is defined as a condition or practice which could result in personal injury or loss of life.

Caution

Caution, as used in this manual, is defined as a condition or practice which could result in damage to or destruction of the equipment or apparatus under test.

Mains cord protective conductor

The EGIL200 is equipped with a power cord with an integral safety ground pin.

The equipment must be connected to a grounded mains outlet. Not doing so may result in fire or electric shock.

Do not damage the safety ground in any manner.

Separate ground wire

The EGIL200 case must also be grounded by the separate protective ground wire with connection to the Protective Conductor Terminal on top of the product. Check the continuity of the protective ground wire before each use. Make sure the connector is fastened properly to the EGIL200 Protective Conductor Terminal. Make sure the connection point at the ground system is fastened properly. Route the wire so that it is unlikely to be walked on or that it may loosen accidentally by someone or something moving near it.

The protective ground wire must not be loosened while any input connector is attached to the contacts of a high voltage circuit breaker, or another device being subject to inductive or capacitive coupled interference from surrounding high voltage conductors.

Placement

The EGIL200 must be situated away from any heat sources such as radiators, heat registers, stoves, or other products that produce heat. Do not place the EGIL200 in areas with excessive dust, mechanical vibration, or shock.

Do not use the EGIL200 near water.

Do not expose the EGIL200 to rain or moisture with open lid.

Do not touch the plug with wet hands. Doing so may result in electrical shock.

Accessories

Do not use any accessories/cables not recommended by the EGIL200's manufacturer as they may cause hazards.

EMC Warning

The EGIL200 generates and uses radio frequency energy. If not installed and used in accordance with this manual, it may cause interference with radio communications. The EGIL200 has been tested and found to comply with the limits for measurement equipment designed to provide reasonable protection against such interference when used in an industrial environment. Operation of the EGIL200 in a commercial or residential area is likely to cause interference, in which case, the user, at their own expense, will need to take whatever measures may be required to correct the interference.

Cables

Only use approved mains detachable cable set with the EGIL200. Main supply cables shall be rated for the maximum current for the equipment and the cable shall meet the requirements of IEC 60227 or IEC 60245. Mains supply cables certified or approved by a recognised testing authority are regarded as meeting this requirement.

Connecting cables must be routed so that they are not likely to be walked on nor pinched by items placed upon or against them. Do not pull on or tie them. Pay particular attention to the connectors.

To disconnect a cable, unlock the retainer (in case of an XLR connector), grasp the connector firmly and pull.

If an input or output cable becomes damaged, stop using it. Use of a damaged cable may result in fire or electric shock.

Power sources

Only connect the EGIL200 to an outlet protected with max 16 A overcurrent protection.

Use an easily accessible power outlet. This will ensure that you can disconnect the power quickly in case of a problem.

The EGIL200 should be operated only from the type of power source indicated on its nameplate.

Lightning

For the added protection of the EGIL200 during a lightning storm, unplug it from the AC outlet and from all cables connected to the inputs. This will prevent damage to the EGIL200 due to lightning and power supply surges.

Never touch the plug and power cord if it begins to thunder. Touching them may result in electric shock.

Cleaning

Unplug the EGIL200 before cleaning.

Do not use liquid cleaners or aerosol cleaners.

Use only a damp cloth for cleaning.

Stubborn stains may be removed with a cloth lightly dampened with a mild detergent solution.

Damaged EGIL200

Do not use the EGIL200 if the test leads appear damaged.

Do not continue using a damaged EGIL200. Using a damaged EGIL200 may result in fire or electric shock.

Do not touch a damaged LCD panel directly with bare hands. The liquid crystal, which leaks from the panel, is poisonous if it enters the eyes or mouth. If any part of the skin or body comes in direct contact with the panel, please wash thoroughly. If some physical symptoms result, please consult your doctor.

Damage requiring service: Unplug the EGIL200 from all connections and refer servicing to qualified service personnel under the following conditions:

When any connector is damaged, including mains plug.

- If liquid has been spilled into the EGIL200.
- If the EGIL200 has been exposed to rain or moisture.
- If the EGIL200 does not operate normally (following the operating instructions).
- If the EGIL200 has been dropped or damaged in any way.
- When the EGIL200 exhibits a distinct change in performance. This indicates a need for service.

If the EGIL200 begins to emit smoke, smells like something is burning, or makes strange noise, disconnect all power connections immediately and contact your dealer for advice.

Servicing

Do not attempt to service the EGIL200 yourself; opening or removing covers can expose you to dangerous voltage and other hazards.

Please refer all servicing to qualified service personnel.

If you attempt to service, the EGIL200 yourself, the warranty is no longer valid.

2.2 Specific instructions

Protective earthing procedure in HV environments

Protective earth (ground)

Connect the clamp of the yellow/green protective conductor supplied with the EGIL200 to the station earth (ground) and the other end of the conductor to the terminal marked on the EGIL200.

This connection must be done before any test cables and the mains supply cable are connected to the EGIL200 and this connection shall be the last connection removed. The earthing (grounding) is needed since induced current from the high-voltage circuit breaker can cause hazardous voltages. See figure 1.

Preparation of the circuit breaker

Before connecting or disconnecting the EGIL200 to a high-voltage circuit breaker, make sure the breaker is disconnected, closed and earthed (grounded) on both sides according to local safety regulations.

Connection of test cables to the circuit breaker

All connections and disconnections of cables at the circuit breaker shall be done while the breaker is disconnected, closed and grounded on both sides according to local safety regulations.

Mains supply - Voltage

The EGIL200 shall only be supplied by power according to the specifications stated at the mains inlet on EGIL200. Always connect the EGIL200 to a power outlet with protective ground.

Mains supply - Protective earth (ground)

Dangerous voltage may be present in systems that are earthed separately.

The mains cable may only be connected to a mains socket with a protective earth that is connected to nearby earth and earthed objects. Check with the nominated person in control of work activity that the systems are connected in accordance with local safety regulations. If separate earthing cannot be discounted, one of the following methods may be used on the condition that local safety regulations are observed:

- connect the earth systems temporarily
- use a (portable) electrical power source
- use an isolating transformer; the secondary side's protective earth must not be connected to the primary side's earth

Remove earthing (ground) on one side

Removing the earthing (grounding) on one side must be done in accordance with local safety rules. When only one side of the circuit breaker is connected to earth (ground), two important rules must be followed closely to protect service personnel and measuring equipment from hazardous voltages:

- The EGIL200 case must remain earthed (grounded) by the separate protective conductor
- Connections or disconnections of test cables must not be made

Inputs and outputs

Do not apply voltage to the outputs.

Do not exceed the specified input voltage limit on any of the EGIL200 inputs.

Polarity must be red to + and black to –, Timing

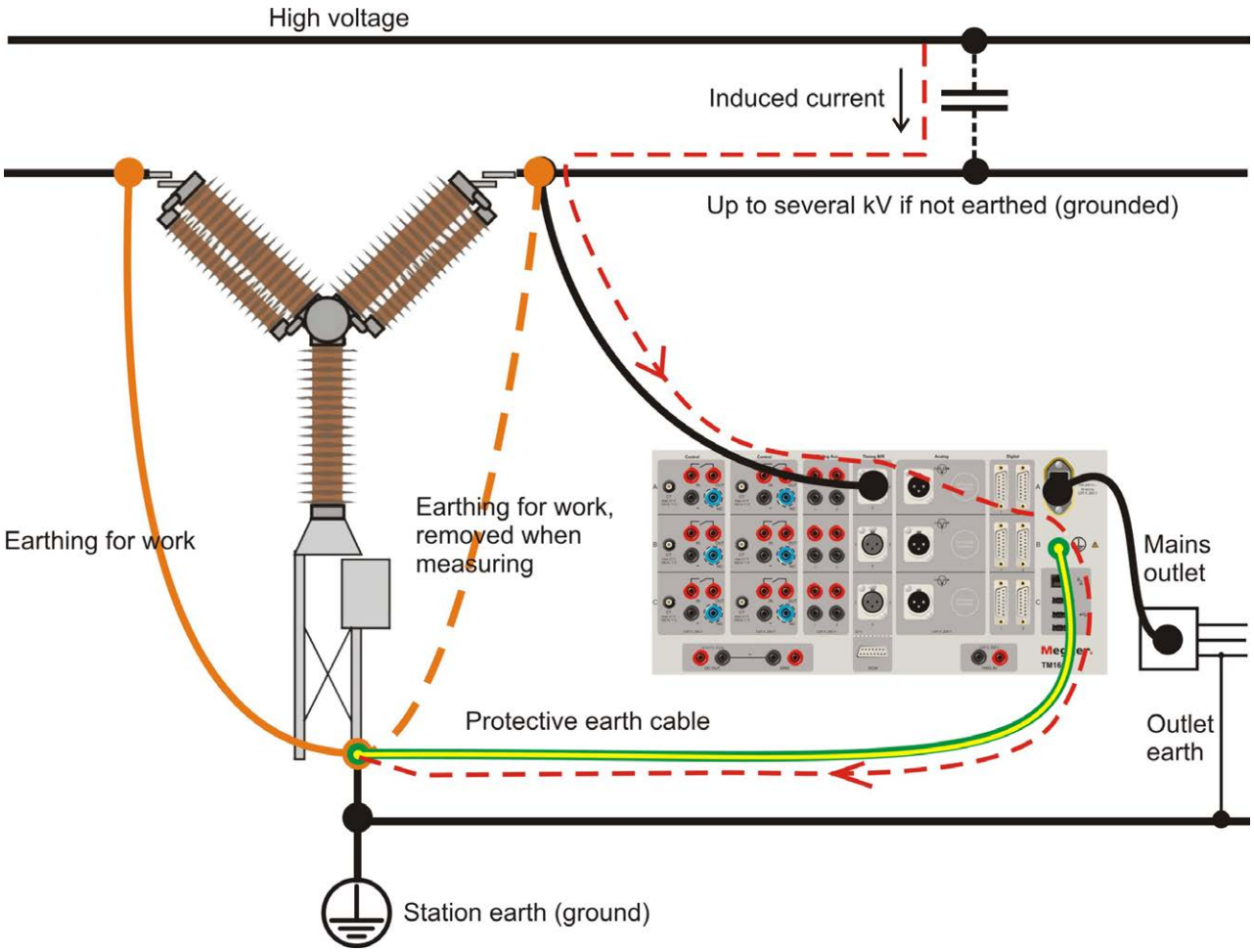


Fig 1: Earth grounding

3 Terminology

3.1 Terminolgy

Tab	The user interface is split in various screens referred to as tabs, e.g., Test tab.
Test	This term is used for the current test session. The EGIL200 always starts with a new empty test and only one test is open at a time. Tests are organised below Breakers and one Breaker can have one or more tests attached to it.
Pre-set	The current open test contains several measurements performed on the breaker, like timing and resistance. When such measurements, including all settings, are set up it is called a pre-set. This means it can easily be repeated. When performing a test all measurements will be collected in a test list, so that it contains several pre-set tests and for each of those, there can be several recordings depending on how many times the same measurement was performed.
Sequence	The sequence designated as the operation sequence for the breaker. For example, when the breaker closes, this is a 'close', 'Cls' or 'C' sequence.
Breaker	A definition of a specific circuit breaker. The breaker can be exported as a file and is stored in a list of breakers. The breaker can contain several tests performed at different points in time, so that historical measurements are available for comparison and trending.
Recording	Results from an operation. If the test is performed several times, there will be several recordings for each test. The recording contains results in the form of parameters and graphs. There can also be notes attached to each recording.
Metadata	General information about the breaker. For example, identification field, location, voltage level, test information, and more.
Test info	Information related to a test performed on a breaker, like the operator name and date. When this information is filled in, it is automatically used in the report.
Report	An output file generated with selected operations/recordings with a graph and result list, as well as metadata related to the test object and the test occasion. The report is in pdf-format.

4 General requirements

4.1 Environment

The system is intended for use in electrical substations where medium and high voltage circuit breakers are present. The intended use is testing of such circuit breakers and analyse the condition and performance.

4.2 Calibration

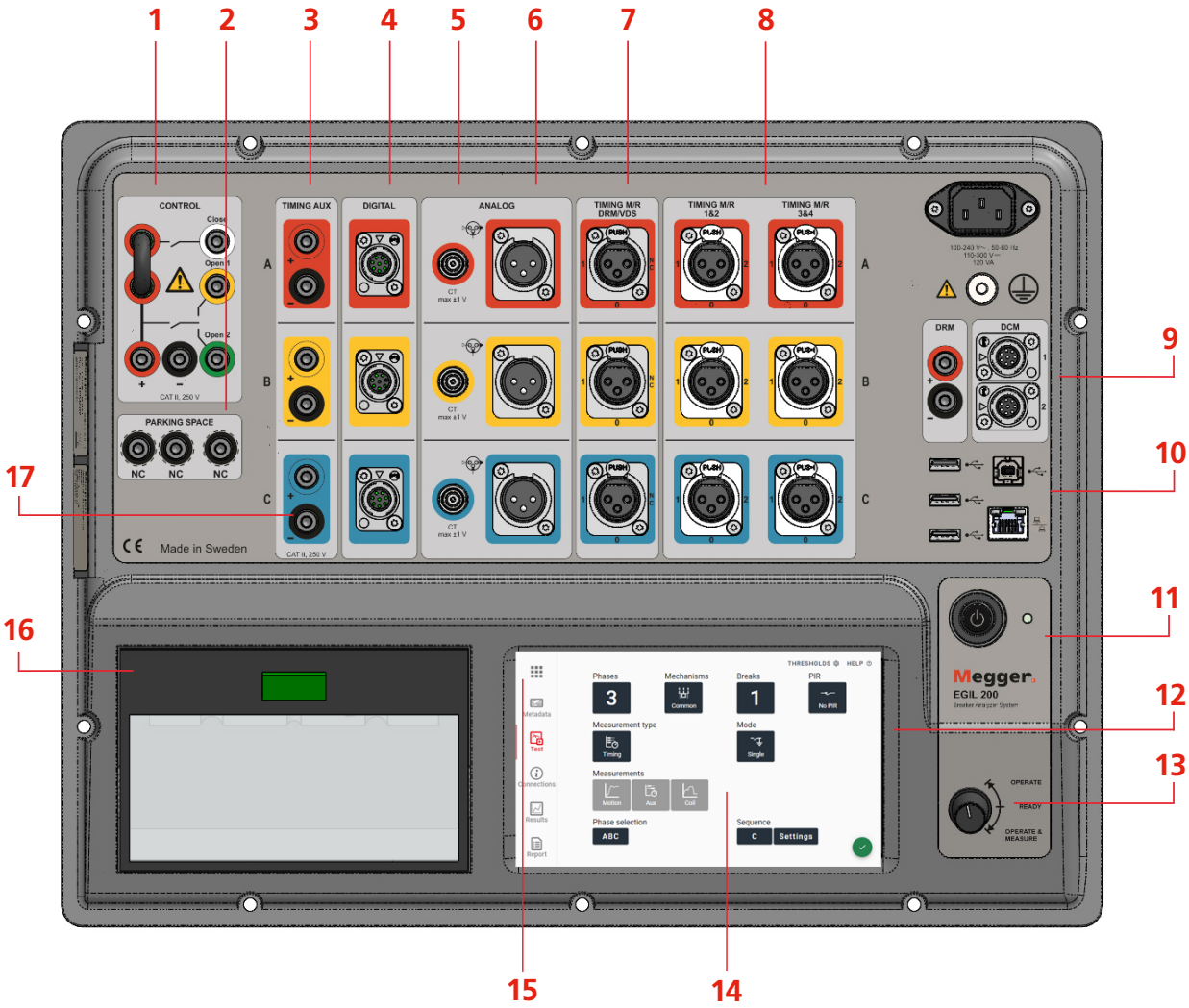
It is recommended to calibrate the EGIL200 at least once a year.

- The EGIL unit can be sent to Megger or an authorised service centre for calibration.

5 Instrument description

5.1 Instrument panel

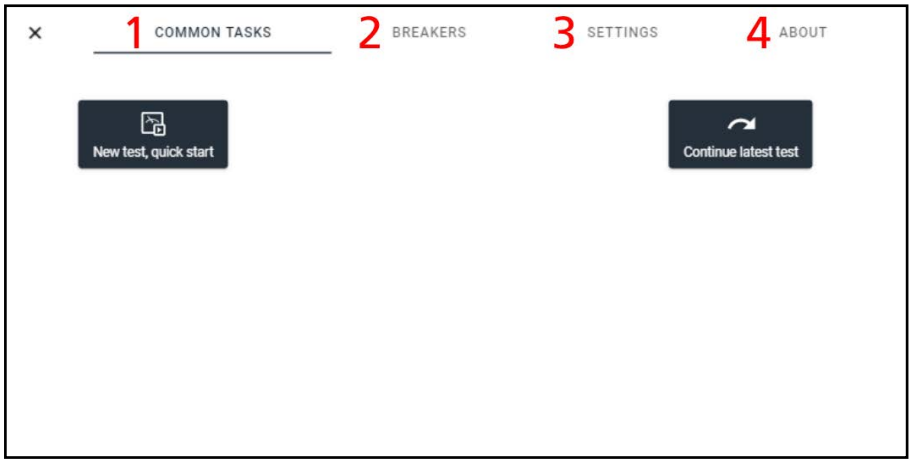
1. **CONTROL**
   Breaker control (close, open 1 and open 2)
   Station voltage and coil current measurement
2. **PARKING SPACE**
   For safe disconnection of coil circuits
3. **TIMING AUX**
   3 channels for auxiliary contact timing
4. **DIGITAL**
   3 digital inputs for incremental motion transducers
5. **1-3 BNC INPUTS**
   1-3 BNC inputs dedicated for current clamps
6. **MULTI-PURPOSE CHANNELS**
   1-3 multi-purpose analogue channels
7. **TIMING M/R, DRM/VDS**
   Timing of main and resistor contacts, DRM, SRM and VDS-timing on 1 break per phase
8. **TIMING M/R**
   Timing of main and resistor contacts on up to 4 breaks per phase
9. **DCM DualGround™ AND DRM** for future use
   Input for DualGround™ timing (opt. accessory) & DRM control output (opt. accessory)
10. **USB AND ETHERNET PORT**
    3 × USB A, 1 × USB B and 1 x RJ45
11. **ON AND OFF BUTTON**
12. **LCD SCREEN**
    7" high visibility touch screen
13. **OPERATE / MEASURE ROTARY SWITCH**
14. **ICONOGRAPHY**
    Contrast rich iconography for best visibility and understanding
15. **USER INTERFACE**
    Workflow based Metadata, test settings, connections, results, report)
16. **PRINTER**
    Optional 4" thermal printer
17. **COLOUR CODED CONNECTORS AND LEADS**
    For easy verification of connections



5.2 User interface

When starting the EGIL200, you will see it is already set up to directly run a test. The user interface is designed with a few tabs or views that follow the workflow. Begin on the 'Test' tab, then go to 'Connections', view 'Results', and create a 'Report'. The metadata information is optional and is recommended to add to get a complete report and for identification. In the menu, there are options for handling test files and settings.

5.2.1 Main menu



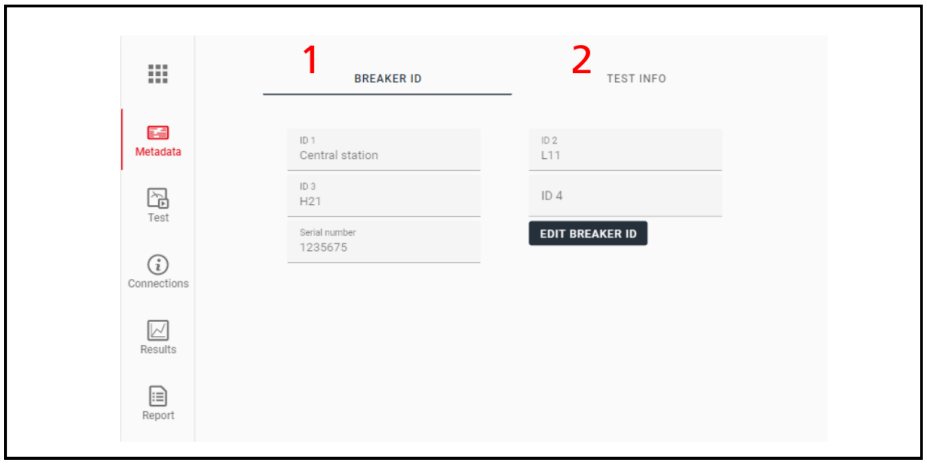
1] The first tab gives quick access to common actions, like restarting the previous test.

2] Browse the built-in storage of breakers and tests. Export, import or do other management tasks related to this storage. See section for 12.3 details.

3] Change the general settings related to the appearance and function of the EGIL200.

4] Information about current versions of the software.

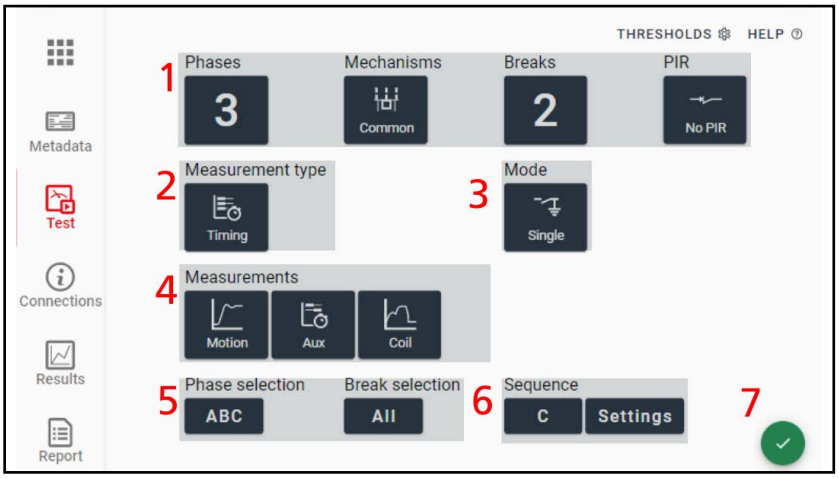
5.2.2 Metadata



1] Add information to identify what breaker the test is executed on

2] Add information about the test

5.2.3 Test



1] Select the type of breaker. The PIR option is for breakers with pre-insertion resistors, its default setting is No PIR.

2] Select what type of measurement to do. To change to other measurements, like motor current, click on this button.

3] For some measurement types, you can also select mode – e.g., how to measure.

4] The options here are to select what types of measurements should be included in the next recording.

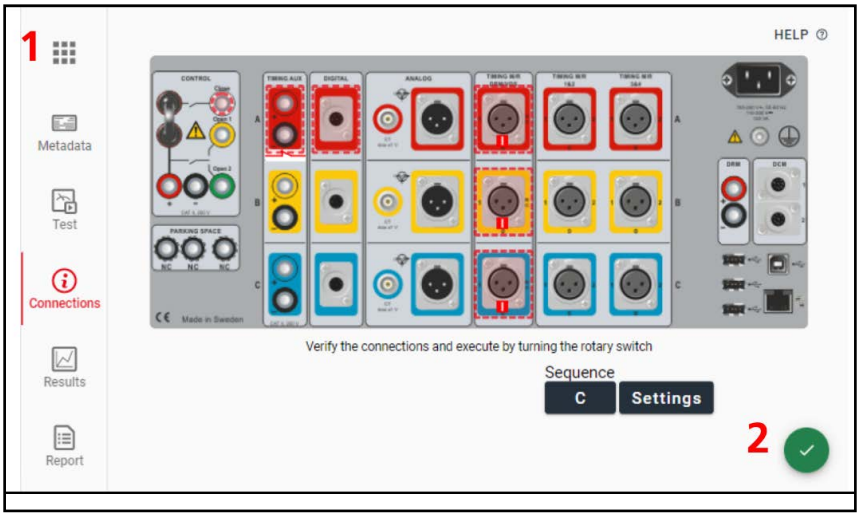
5] Optionally, you can also select what phase and breaks to measure. The default setting is for all phases and all breaks ('ABC' and 'All' respectively).

6] Select the desired operation, 'Close/Open', or a sequence. Advanced users can set pulse lengths etc. under the settings button. To measure the second trip coil, Open 2 is selected here.

7] This green tick symbol indicates that the EGIL200 is ready to perform the measurement.

Note *When this button is red, you have selected a combination which cannot be performed. Typically, this is a setup requiring more channels than what is available. For example, you cannot measure current and analogue motion at the same time with the same analogue channel.*

5.2.4 Connections



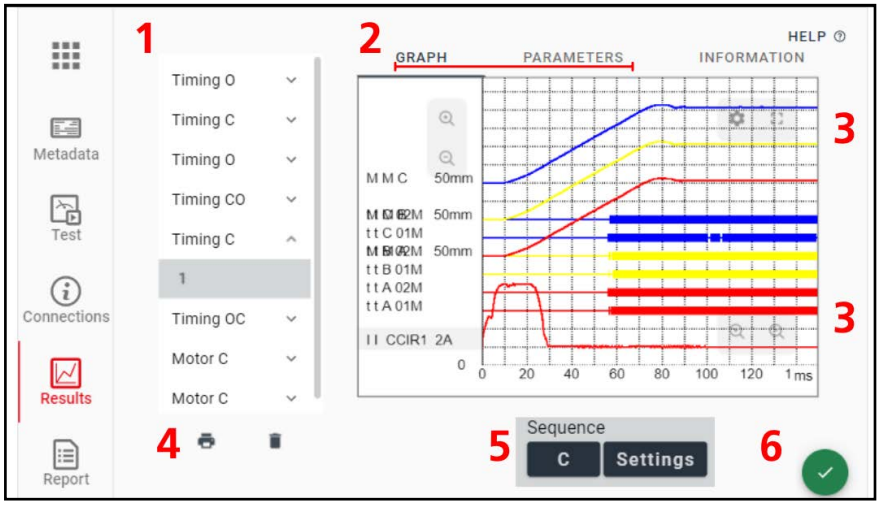
1] The top panel of the EGIL200, with all the necessary connections for the current test, is shown. Click each channel to get a detailed view of how to connect. The dashed lines indicate activated channels.

2] This green tick symbol indicates that the EGIL200 is ready to perform the test.

The 'Connections' tab is always shown when a new test is set up. Make sure to verify the connections and specify transducers if applicable. After doing so, turn the rotary switch again to confirm.

This tab is described under section 6.

5.2.5 Results



1] All measurements performed during the active session are shown in a test list and sorted per type of measurement. Below those are the corresponding recordings. These can be used as pre-set measurements: Press on the measurement to view it or to perform the same measurement again.

2] The results can be viewed as a graph or as a table of numeric parameter values.

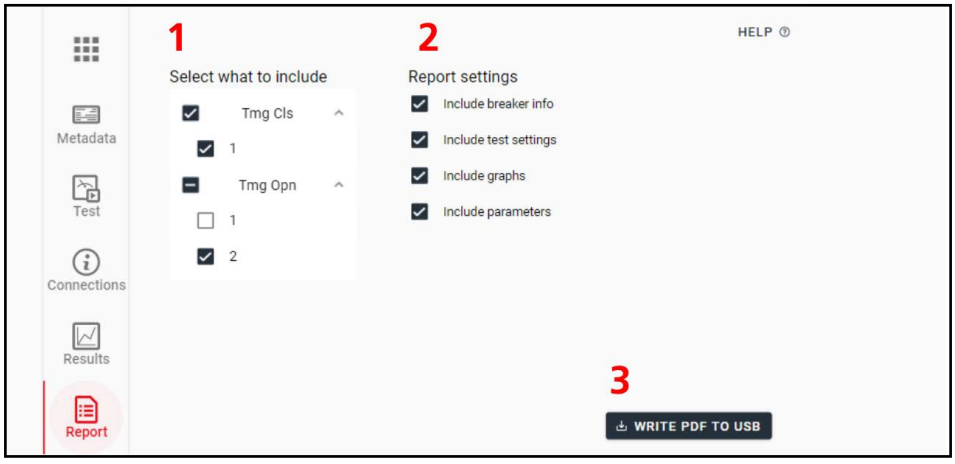
3] The graph window can be panned and scrolled by swiping the touch screen. For adjusting the amplitude of a graph or the time scale, use +/- symbols in the graph window. All graph settings can also be accessed via the gear icon. There is also a button to show the graph and parameters in full screen view.

4] To quickly print the active recording, just press the printer icon. The results will be printed on the built-in printer (optional).

5] To directly perform a new type of operation sequence in the active test, use the sequence button. It is also possible to return to the 'Test' tab to get full flexibility.

6] This green tick symbol indicates that the EGIL200 is ready to perform the test.

5.2.6 Reports



1] Select what recordings to include in the pdf report

2] Choose what content to include in the report.

3] **Write the pdf report to a USB memory stick.** In section 8, there is more information about reporting and handling test results. Note also that general information about the test, like breaker identification and the name of the operator, can be entered in the 'Metadata' tab.

5.3 Accessories

5.3.1 Included accessories

The included accessories vary between models, so please see the data sheet when ordering for a complete list.

There are a variety of accessories for circuit breaker testing, these are presented in the EGIL200 data sheet and the circuit breaker testing catalogue.

All models include the recommended accessories for standard tests with the number of cables needed for the selected model, except if you select the option of "no included accessories" when ordering.

5.3.2 Timing cables

GA-00850

Timing M/R cable

For 2 breaks/phase

- XLR3 male to banana connector, 5 m (16.4 ft)
- Length of the split portion (retractable sock), 2.4 m (8 ft) to 3.8 m (12 ft)

GA-00851

Timing M/R extension cable

- XLR3 male to XLR3 female, 10 m (32.8 ft)

GA-00853

Timing M/R medium voltage cable

- 3 x XLR3 male to banana, 3 m (9.8 ft),
- Length of the split portion 5 m (1.6 ft)

GA-00854

Timing M/R high voltage cable

For 1 breaks/phase

- XLR3 male to banana, 5 m (16.4 ft),
- Length of the split portion (retractable sock), 2.4 m (8 ft) to 3.8 m (12.5 ft)

GA-00871

Timing AUX cable

- 6 banana test leads in a common sleeve, 5 m (16.4 ft),
- Length of the split portion, 0.5 m (1.6 ft).
- Includes connection adapters

5.3.3 Other accessories

KD-03040

Timing M/R clamp

- Banana connector and strain relief

GA-01005

Analog cable

- Screened cable
- XLR3 female to XLR3 male, 10 m (32,8 ft)

GD-30225

Lead and accecory bag

- Lead and accessory bag with backpack straps and hand straps.
- Variable height through zipper solution.
- Dimensions 580 x 355 x 165/228 mm (23" x 14" x 6.5"/9")

Thermal printing paper

- Only for models with printer

Other material included in delivering

- Ground lead 2.5/5 m
- Ethernet cable 5 m
- USB cable 3 m
- USB memory stick
- Lead ties
- Power cable
- User's manual

5.4 Optional software

The EGIL200 has a modular software where available functions vary depending on the available license. All models can be upgraded at any later time, pending the compatibility of the hardware.

For details regarding software options and packages, see the EGIL200 data sheet.

Note *This user guide might describe more functionality than what is available in the model you possess.*

6 Settings

To change setting of the EGIL200, open the main menu and select the ‘Settings’ tab.

Here, settings for language, time/date, and font sizes/ colours can be set.

Please note that date and time can be set automatically when connected to a network.

6.1 Test settings

Settings related to a specific test are set per each test in the ‘Test’ tab. These settings include, for example, calculation points for speed and other settings that are specific to the breaker under test

6.2 Export log

Press ‘Export’ log to save a log file to a USB memory stick. This is useful in case of support or service as the file contains internal logs of the system. For a normal user, these files have no purpose.

7 Workflow

To provide a better overview of a typical workflow, the work can be split into five categories that follow the typical order in the graph above.
The following chapters describe each of the steps.

8 Preparation and safety

General

Make sure to read and understand the 'specific instructions' in section 2.2

Follow procedures to take the circuit breaker out of service

The correct and safe procedures to take a circuit breaker out of service vary between countries and the rules set up by, e.g., the owner of the substation or the contractor performing the work.

Always follow the rules set up locally at the substation where the test takes place.

Other preparations

It is a good practice to make a plan for what tests are to be performed.

Check that all necessary cables and accessories are available.

If an earlier measurement is available, you can download it to the EGIL200 to make it even easier to set up as well as to quickly do comparisons.

Check where auxiliary power and earthing connections are available.Circuit diagrams for the connection to the circuit breaker are recommended as understanding the correct way to connect to the breaker is important – there are differences in how breakers are wired.

9 Select test and measurement

9.1 General

The user interface is built around ease of use. To quickly start a test, the first step is to select what to test. On the start screen, first select a few key parameters of the breaker: number of phases, number of breaks per phase, type of mechanism, and if pre-insertion resistor contacts (PIR) are present.

Then proceed by selecting what you would like to measure. The most typical or common measurement type is timing. For some measurement types, you can also select a mode. For timing, the most commonly used mode is 'Single' grounded. You can also select what additional measurements you want to include. It is common to measure coil current and motion.

In the following sections the various test types and modes are described in detail. If you already are familiar with this, skip to section 10.

9.2 Timing

General about the test

Timing is the most central test when analysing a circuit breaker. It measures the operating time of the main contacts and supplies several parameters, like opening time and synchronisation between phases and breaks.

Single grounded mode

In this mode measurements are performed with the circuit breaker grounded in one side which allows timing of main and pre-insertion resistor (PIR) contacts as well as resistance value measurement of the PIR.

Dual ground mode (DCM)

For increased safety, Megger recommends testing with both sides grounded. In general, timing measurements are difficult to make with both sides of a circuit breaker grounded, so to achieve reliable measurements, this is done with Megger's patented technology DualGround™ (DCM – Dynamic Capacitance Measurement).

Please note that DualGround mode does neither offer timing of pre-insertion resistor (PIR) contacts nor PIR value measurement. DCM is an optional function and requires an external module and corresponding software package.

Voltage detection system (VDS) mode

Many medium-voltage circuit breakers placed indoors have so-called Voltage Detection System (VDS) outlets mounted on the front panel. Main contact timing can be performed via these outlets, by determining the contact status based on the presence or no presence of voltage. In this case, the circuit breaker is energised, but typically with no current running. VDS is an optional function and requires the corresponding software package.

Motion measurement

A high-voltage breaker is designed to interrupt a short-circuit current in a controlled manner. This puts great demands on the mechanical performance of all components in the interrupter chamber as well as the operating mechanism. It has to operate at a specific speed in order to build up adequate pressure to allow for cooling stream of air, oil, or gas (depending on the type of breaker) to extinguish the arc that is generated after the contact separation until the next zero crossing. It is important to interrupt the current to prevent a re-strike. This is accomplished by making sure that the contacts move apart far enough from each other before the moving contact has entered the so-called damping zone.

Motion is measured using a transducer connected to the contact linkage system or to the operating mechanism. The transducers are either digital or analogue. They can be of linear or rotary type and measure relative or absolute values.

For details on how to connect, follow the instructions in the user interface, see section 5.2.4

Settings for motion measurement:

- Select contact and/or mechanism with the toggle buttons. The 'Motion' button turns black to indicate that the measurement is active.
- Depending on the transducer at hand, select digital or analogue, then select absolute or relative measurement
- At absolute measurement linear or rotary transducer must be chosen
- At relative measurement the nominal stroke of the circuit breaker contacts must be entered
- Set calculation points for close and open speed

Auxiliary contacts measurement

There are no general time limits for the time relationships between the 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 auxiliary contacts are of three types: A (NO), B (NC) and Wiper (temporary). Type A is following the position of the main contacts and type B is in the opposite position. The Wiper type makes a temporary closure during both close and open operation. Auxiliary contacts are sometimes also used to convey different dynamic properties of the circuit breaker, such as speed and damping. The results from timing these contacts can be used to adjust the circuit breaker. There are also auxiliary contacts used for interlocking, such as spring charge indication, hydraulic pressure, SF6 density monitor, X/Y-relay, and anti-pump relay.

Coil current measurement

When a trip coil is first energised, current flows through its windings. The magnetic lines of force in the coil magnetize the iron core of the armature, in effect, inducing a force in the armature. The current flowing through the trip coil increases to the point where the force exerted on the armature is sufficient to overcome the combined forces of gravity and friction, which may be exerted pulling it through the trip coil core. 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. 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. In some cases, it is also of interest to measure DC voltage sagging during coil operation. The voltage going to the coil will vary during operation. This change will influence the coil current, the armature release time and finally, the contact timing.

Settings for coil current measurement

- To measure coil current first enable it by clicking the Coil button and checking the box that enables the measurement. The Coil button turns black to indicate that the measurement is active.
- To measure coil current, first enable it by clicking the 'Coil' button and checking the toggle button that enables the measurement. The 'Coil' button turns black to indicate that the measurement is active.
- Select 'Internal' to measure using the internal sensor in the control channel of the EGIL200, or select 'Clamp' to measure using a current clamp and analogue channel.
- Select 'Summary' to get a combined coil current for all phases and 'Individual' to get the coil current for each phase individually. Note that the number of channels in the product model at hand might limit what selections are possible. If 'Internal' is selected as measurement source in the step above, only 'Summary' will be possible unless each phase is measured separately.
- •Connect according to the instructions in the user interface under the 'Connections' tab,see section 5.2.4

■ Pre-insertion resistor (PIR) measurement

If the circuit breaker has pre-insertion resistors, make this selection before starting the test (see page 8). Timing of resistor contacts are made simultaneously with the main contacts. The resistance value will be part of the resulting parameters. Please note that PIR measurements only apply to measurements in single grounded mode.

9.3 Static resistance

9.3.1 General about static resistance tests

With a static resistance test, the resistance of the breaker's main contact is measured. The value of this test is to determine that the main contacts have not deteriorated and have too high a resistance. A resistance that has too high a value can result in over heating during operation. The test is conducted by injecting a DC current through the main contact system when the circuit breaker is closed. By measuring the voltage drop, the resistance can be calculated. The value of the main contact resistance reflects the condition of the conducting parts.

9.3.2 Manual mode

When performing this test in a manual mode, the EGIL200 will present several input fields for the manual input of resistance values. Use any available device that can measure resistance in the needed range and type in the measured values manually.

9.3.3 SDRM mode

In this mode, the EGIL200 will be setup to use SDRM202 units to automatically measure the resistance values and populate the test parameters.

SDRM is an optional function and requires external modules and corresponding software package.

9.4 Motor current

The energy storage spring of a circuit breaker is tensioned with an electric motor whose supply current is measured during the entire tensioning process. The current signature gives important information about possible fatigue of the spring or increased mechanical resistance due to lubrication or corrosion issues, as well as the total charging time. Since spring charging takes several seconds, the measurement time in the system can be set from 5 to 50 seconds. For independent pole operated breakers each current can be measured individually or all together as a summary measurement. The latter is more applicable when the phases are charged sequentially. The result of motor current measurement will occur as a graph and will have a few parameters e.g., spring charge motor run time and peak current (inrush current excluded).

Motor current measurement is only applicable on spring drives.

9.5 Minimum pickup voltage

In this test, you determine the minimum voltage at which the breaker is able to operate. It is a measure of how much force is needed to move the coil armature. In this test, you are not interested in contact timing parameters, only whether the breaker operates or not. You start on a low voltage sending a control pulse to the breaker. If not operating, you increase the voltage with, say, 5 V and try again, and so on. Once the breaker has operated, you note the voltage at which operation occurred. Next time maintenance is done, you can compare your results with the old test value to determine changes.

9.6 Dynamic resistance measurement (DRM)

Tests are conducted by injecting DC current through the breaker main contact and measuring the voltage drop and current while the breaker is operating. The breaker analyser then calculates and plots resistance as a function of time. If contact movement is recorded simultaneously, you can read the resistance at each contact position. This method is used for contact diagnosis and in particular for assessment of the arcing contact.

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. In SF6 breakers, the arcing contact is commonly made of wolfram (tungsten). This contact is burned off and becomes shorter for each interruption of load current.

DRM is an optional function and requires external modules and corresponding software package.

9.7 First trip

A good and time-efficient way to check the condition of a circuit breaker is to document its behaviour at the first open operation after it has been idle for long time. The measurements and connections to the circuit breaker are carried out while it is still in service. All connections are made inside the control cabinet.

First trip is an optional function and requires the corresponding software package.

9.8 Zero-voltage test

This test examines the behaviour of certain circuit breakers with functionality to handle loss of auxiliary voltage by means of a specific zero-voltage relay. It measures the time until the circuit breaker opens in the case of loss of auxiliary voltage.

A zero voltage test is an optional function and requires the corresponding software package.

9.9 Running the test

After selecting what to test, turn the rotary switch in the unit's panel to execute the test. Alternatively, skip to the 'Connection' screen using the touch screen. Now you will be presented with a connection diagram as described in chapter 5.2.4.

9.9.1 Limitations

The EGIL presents very many measuring types and modes. The product is also available in various configurations with various numbers of measurement channels. This means that not all selections will be possible to execute. In the case that the amount of measurement channels available are insufficient, a red indicator will appear. Make changes in 'Setup' to be able to continue.

9.10 Settings

The EGIL200 is designed to start up with default values to minimise time to set up tests. In this chapter, those settings are described in detailed as a reference to users who need to adjust the test setup.

9.10.1 Phase selection

The phase selection makes it possible to select what phase is currently being tested. The typical setup is to test all phases at the same time, so the default setting is ABC.

For example, in case the number of measurement channels is insufficient, or due to any other practical reason, each phase could be tested individually. In this case, first select 'A' to test the first phase. Then run the test again while having selected 'B'. And lastly, run a third test with 'C' selected. As a final step phase discrepancy can be determined by measuring all three phases together with Break selection set to 'Across' which means that one channel is connected across all contacts in each phase. Each phase will then deliver its closing and opening times according to the definitions in international standards, that are, last contact to close and first contact to open.

9.10.2 Break selection

Similarly, to phase selection, it is possible to select and test the breaks of the breaker in various ways. The default setting is 'All', where each break is tested individually in the same recording, and the results will contain a time for each break as well as the combined time.

To obtain the important parameters for time difference between contacts within each phase all contacts need to be measured at the same time. If this is not possible due to insufficient number of measurement channels it is recommended to split the timing measurements by phase. See previous section for more information.

For certain measurement methods, for example DRM, there might be necessary to run the test break by break due to insufficient number of measurement channels. In such case set Phase selection to an individual phase and Break selection to an individual break.

10 Connect

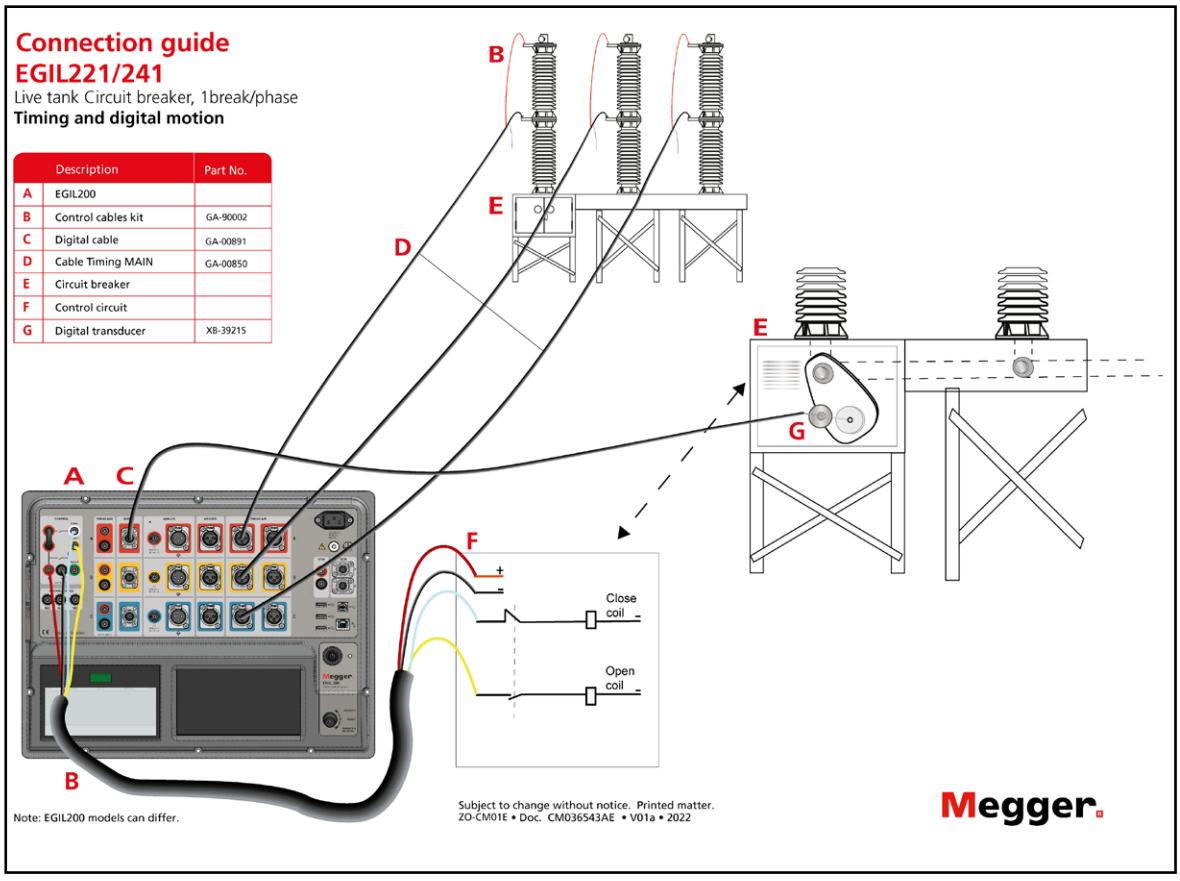
10.1 General

At this step it is time to connect test cables from EGIL200 to the circuit breaker.

IMPORTANT
Always follow the safety regulations in chapter 2.2 (Specific instructions) in this manual. Always, comply with local safety regulations.

10.2 Connection guide

As described in section 5.2.4, the instrument will provide detailed instruction on the screen for how to connect the instrument to the circuit breaker.



11 Inspect

After the test has been performed, the instrument will display the 'Results' tab, see section 5.2.5. The results are displayed in the form of a graph with curves representing the measured qualities – and a table with calculated test parameters

11.1 Test list

Each operation, defined as a specific measurement with same settings, is displayed in a list to the left of the screen. It is helpful to consider this list as a list of pre-set operations. For each such pre-set, several recording can be made. Here are some tips of what can be done from this view:

- Select an earlier recording to view and analyse.
- When another pre-set is selected, it is possible to run it again.
- Alternatively, with a pre-set selected, go to the 'Test' tab to view the settings. If the settings are changed, a new test can be run.
- It is also possible to directly perform the same pre-set test but with another breaker sequence. For example, after performing a timing test when opening a breaker, you can select a 'Close' sequence and directly run it again from this tab.
- Make a quick report of the recording, see section 12 for details.

11.2 Continue with more tests

It is very common to perform several measurements on one circuit breaker. After one measurement, select the Test tab again to continue with another measurement. A common set of (pre-set) measurements could look like this:

1] Timing open

2] Timing close

3] Motor current

4] Minimum pickup voltage

5] Static resistance

Also note that it is possible to run the same pre-set again, but with another sequence (Open, Close, Close-Open) directly from the 'Results' tab.

To summarise: All measurements are collected in the test list available in 'Results' tab. There they can be run again, or a new different measurement can be set up on the 'Test' tab.

12 Manage results and reports

There are several options for how to handle the results from measuring a circuit breaker. These options are described below.

12.1 Quick print; operation of the built-in printer

This function is only available in models with printer option.

When at the 'Results' tab, it is possible to quickly print the results of the currently viewed recording. These will be printed with a default template on the built-in 4-inch printer. Press the printer icon to get the print-out. The graph layout will be the same as shown on screen.

The printer has a status led light with the following meanings:

- Green status light on: Normal conditions
- Flashing yellow light with…
  - 2 flashes: overheating
  - 3 flashes: out of printing paper, replace with a new paper roll
  - 4 flashes: paper jammed, open lid to clear the jam

To replace the paper roll, gently press the green button upwards. When the lid is open, remove the roll and place the new roll with a few centimetres of paper sticking out when closing the lid. Note that the paper has a front and back side.

12.2 Export of test report

In the Report tab a test report can be generated directly from the touch screen. By default, all needed settings for a typical report are pre-set. So just click 'Write pdf to USB' if those settings are sufficient. To modify the report, follow the instructions below:

- Select which operations/recordings to include in the list to the left. By default, the last recording of each operation is selected. Graph layouts will be the same as last time viewed.
- Select which sections of information to include in the report.
- Under the 'Metadata' tab it is possible to add information about the test that will be included in the report.

Note Only FAT32 formatted USB memory sticks with one partition can be used. A recommended practice is to have a dedicated memory stick only for data transfer between the EGIL200 and a computer.

12.3 Understanding the breaker list and storage of results

First, note that the EGIL200 automatically and continuously saves test results in a built-in database.

The user has two recommended ways of working:

Quick test. When powering up the EGIL200 it will, for your convenience, automatically enter the test that was active when the unit was shut down. Now you can continue to make measurements where you left off or choose to start a new clean test by clicking the 'New test, quick start' button in the menu under 'Common tasks' tab. Now a new test session can begin by following the test flow described in section 5.2.3 and on. The new test is automatically attached to a new breaker having date and time as default identification. If desired identification information can be changed in the 'Metadata' tab for easier recognition.

Organising tests in breaker files. The user can also set up a breaker that corresponds to a real test asset – the breaker under test. This object and file can contain many tests performed at various occasions in time. The breaker can be exported to a compressed file format, zip, so that the unique file contains all testing history of the circuit breaker. This way of working has several advantages as it stores the complete history of the breaker in one location. The way this works is best described in a few examples, as detailed in the following sections. It is of course also possible to import a historical file from another EGIL200 or even from CABA.

12.4 Accessing and browsing the breaker list

The breaker list is found in the menu under the 'Breakers' tab. Each line in the list represents one breaker. The identification fields 'Breaker ID1-4' are used to identify them and the 'Date tested' shows the date of the latest performed test on each breaker. The identification fields can be set in the 'Metadata' tab, as described in section 5.2.1.

There are several actions that can be performed with the breaker list:

- First, pressing 'Show tests', will show all tests in the selected breaker. For more information, see the following sections.

- The 'New breaker' button will create and open a new breaker and make the EGIL200 ready to test. As a first step, the 'Metadata' tab is shown, and it is recommended to start by filling in the identification fields of the circuit breaker. Then just continue according to the test flow described in section 5.2.3 and on. Once the first recording has been performed a test is created below the new breaker.
- Pressing 'Import' gives the user the option to import a breaker file from a USB memory stick.

Note that import is only possible if the breaker doesn't already exist in the built-in storage. In case the user needs to import the breaker again, the already existing one must be deleted or renamed.

- Pressing 'Export' gives the user the option to save the breaker file to a USB memory.

It is possible to clone a breaker, which will create a new breaker with the exact same setup. This is useful when testing several circuit breakers with the same design and test requirements.

- The 'Edit Breaker ID' button opens a dialogue box where the user can edit the identification fields of the circuit breaker.

Pressing 'Delete' will delete the breaker from the built-in storage.

- Last, pressing 'New test' will create a new test for the selected circuit breaker.

12.5 Working with an original breaker file from a computer

Users that have a central storage of breaker files in a computer, file server, asset management system, or similar, will be interested in keeping one breaker file per circuit breaker and letting all historical tests be included in that file. Such workflow is described here as an example:

- The breaker file is placed on a USB memory stick.
- In the EGIL200, open the main menu, select the 'Breakers' tab, and press 'Import'.
- Once the breaker is imported, select it and press 'New test'.
- Perform the necessary tests.

Again, open the 'Breaker' tab from the main menu. Select the breaker and press 'Export' to save it to the USB memory stick. This is now the original file, including the last performed test.

12.6 Viewing and editing test in a breaker file

In the breaker list, having selected one breaker, press 'Show tests' to view all tests saved in the selected breaker. Several actions can be taken in this view:

Select a test and press 'Delete' to delete it.

Press 'New test'. This will create a new test in the selected breaker and make the EGIL200 ready to test.

Press 'Open/View' to open the test. It will be opened in the normal interface where results can be viewed, additional measurements can be made, and a report can be created.

Press 'Edit', to add or edit information related to the test.

12.7 Compatibility

The base test data format of the breaker file is compatible with existing breaker files in CABA Win in terms of viewing and analysing results. However, some considerations must be made. This tables details the compatibility between products.

Original breaker file	Format	CABA, from version R06D	EGIL200
EGIL200	.zip	Import possible. Test results can be viewed and analysed. Test settings are not compatible i.e., test with an EGIL200 test plan cannot be performed from CABA.	An EGIL200 breaker file is compatible with any other EGIL200 versions. If the number of channels doesn't match those currently available, manual reassignment is possible.
Breaker originated in the CABA environment.	.arc	Import possible	Cannot be imported in EGIL200.
Breaker originated in the CABA environment.	.zip	Import possible.	The breaker file can be imported, and results viewed, but the tests cannot be executed again. However, a new test can be added to the same file.

Please note that product in the TM1700/1800 range and CABA are using a file format called .arc.

The EGIL200 works with .zip files. While data compatibility between the formats is retained, it is necessary to use CABA to switch between formats.

For example, a historical measurement available as a .arc file could be imported to CABA and directly exported as .zip for use in the EGIL200.

13 Specifications

SPECIFICATIONS EGIL200

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 medium and high voltage substations and industrial environments
Temperature	
Operating	-20 °C to +55 °C (-4 °F to +131 °F)
Storage & transport	-40 °C to +70 °C (-40 °F to +158 °F)
Humidity	5 % – 95 % RH, non-condensing
Altitude	
Operating	Up to 2000 m (6562 ft) max. 240 V AC / 250 V DC on mains, max. 250 V AC / 300 V DC on CONTROL and TIMING AUX inputs. Between 2000 m (6562 ft) and 5000 m (16404 ft) max. 150 V AC / DC on mains, CONTROL and TIMING AUX inputs

CE-marking

LVD	2014/35/EU
EMC	2014/30/EU
RoHS	2011/65/EU

General

Mains input (nominal)	100 – 240 V AC, 50/60 Hz, 110 – 250 V DC
Power consumption	200 VA (max.)
Dimensions	474 x 415 x 214 mm (18.7" 16.3" 8.4),
Weight	12 kg (26.5 lbs)
IP-rating (IEC 60529):	
Closed case	IP67
Open case	IP20

Display

7" (17.8 cm) LCD, Capacitive touch screen

Available languages	English, French, German, Spanish and Swedish

Communication interfaces

	3 USB A, 1 USB B
	RJ45 connector for connection to external PC
Keyboard	On-screen and optional USB keyboard

External outputs

Trig output for SDRM20X

Output voltage	12 V DC ±10 %
Short circuit protection	PTC 250 mA
Switching current	<250 mA, resistive load

Control section

General

Control pulse outputs	Close, open 1 and open 2 (Galvanically insulated from earth and each other)
Time base inaccuracy	±0.01 % of reading ±1 sample interval
Max. sample rate	40 kHz
Measurement time	36 s at 10 kHz sample rate

Non-bouncing switch

Max. current	20 A AC / DC, pulse ≤ 20 ms
Max. continuous current	5 A
Duration	User configurable in steps of 1 ms
Delay	User configurable in steps of 1 ms

Current measurement

Measurement range	±20 A
Resolution	16 bits
Inaccuracy	±2 % of reading ±0.1 % of range

Voltage measurement

Max. voltage	250 V AC, ±300 V DC
Measurement range	± 400V
Resolution	16 bit
Inaccuracy	±1 % of reading ±0.1 % of range

Timing M/R section

General

No. of channels	3,6 or 12 selectable at ordering
Time base inaccuracy	±0.01 % of reading ±1 sample interval
Min. resolution	0.05 ms
Max. sample rate	40 kHz
Measurement time	36 s at 10 kHz sample rate

Timing of main and resistor contacts

Open circuit voltage	Toggling ±12 V ±10 %
Short cicuit current	22 mA ±10 %

50/60 Hz interference suppression

Active Interference Suppression, Megger patent

Transient disturbance suppression

Smart digital filter

Status threshold

User configurable thresholds

Main	Closed < 10 Ω < Open (Factory default)
Main and resistor	Main < 10 Ω < PIR < 10 kΩ < Open (Factory default)

PIR resistance measurement

Supported PIR types	Linear PIR
Measurement range	10 Ω – 10 kΩ
Inaccuracy	±10 % of reading ±0.1 % of range

Voltage measurement (Only TIMING M/R, DRM/VDS inputs)

Measurement ranges	±50 V and ±2.5 V
Resolution	16 bits
Inaccuracy	±1 % of reading ±0.1 % of range

Analogue section

General

No. of channels	1 or 3 isolated channels
Time base inaccuracy	±0.01 % of reading ±1 sample interval
Max. sample rate	40 kHz
Measurement time	36 s at 10 kHz sample rate

Transducer resistance	500 Ω – 5 kΩ

Output

Voltage	10 V DC ±5 %
Max. output current	30 mA

Voltage measurement

Max. voltage	±10 V_{peak}
Measurement ranges	±1 V and ±10 V
Resolution	16 bits

Inaccuracy

1 V range	±0.1 % of reading ±0.1 % of range
10 V range	±1 % of reading ±0.1 % of range

External current measurement

Max. input	±1 V_{peak}
Scaling	Selectable in software

Digital section

General

No. of channels	3
Supported types	Incremental transducers, RS422
Time base inaccuracy	±0.01 % of reading ±1 sample interval
Max. sample rate	40 kHz
Measurement time	36 s at 10 kHz sample rate

Output

Voltage	12 V DC ±5 %
Max. output current	300 mA

Digital input

Range	±32000 pulses
Resolution	1 pulse
Inaccuracy	±1 pulse

Timing Aux section

General

No. of channels	3 isolated channels
Time base inaccuracy	±0.01 % of reading ±1 sample interval
Max. sample rate	40 kHz
Measurement time	36 s at 10 kHz sample rate
Max. voltage	250 V AC, ±300 V DC

Contact mode

Open circuit voltage	24 V DC ± 5 %
Short circuit current	10 mA DC ±5%
User configurable status threshold	Open < -10 V < Closed < 10 V< Open (Factory default)

Printer (optional)

Type	Thermal printer
Paper width	112 mm, 114 mm (4.41", 4.48")
Operating temperature	0 °C to +60 °C (32 °F to +140 °F)
Storage & transport	-20 °C to +70 °C (-4 °F to +158 °F)

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