SDRM201/202

Static and Dynamic Resistance Measurement Accessory for TM1800 / TM1700 / TM1600 / EGIL

User's Manual

Megger.

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SDRM201/202

Static and Dynamic Resistance Measurement Accessory for TM1800 / TM1700 / TM1600 / EGIL

User’s Manual

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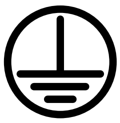
Contents

1 Safety

1.1 General

Important
Read and comply with the following instructions.
Always comply with local safety regulations.

Symbols on the instrument

	Caution, refer to accompanying documents.
	Protective conductor terminal.
	WEEE, Waste Electrical and Electronic Equipment. Please utilize 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.

1.2 Safety instructions

Read all instructions

All safety and operating instructions must be read before using SDRM201/202.

Retain all instructions

All safety and operating instructions must be retained for future reference.

Follow all instructions

All operating and usage instructions for the SDRM201/202 must be followed.

Follow the local safety regulations.

Grounding (Earthing)

Single ground system. This equipment can be used only in electrical systems with single ground. The user must verify before connecting this unit, that High Voltage Ground and Low Voltage Protective Ground create a single protective ground with no measurable voltage potential existing between these ground systems. If a voltage potential is found between the ground systems please consult local safety regulations.

Check the continuity of the protective ground wire before each use. Make sure the connector is fastened properly to the SDRM201/202 Grounding 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 disconnected 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 wires.

Fig. 1.1 Protective conductor terminal

Connections and disconnections

The SDRM201/202 is designed to handle coupled interference current from surroundings, see Figure 1.2. The protection, though, is relaying on a current path from the connected terminals to ground.

The current passing through the wires may be harmful if there is no current path to ground since, in that case, the high voltage may cause an arc or electrical shock.

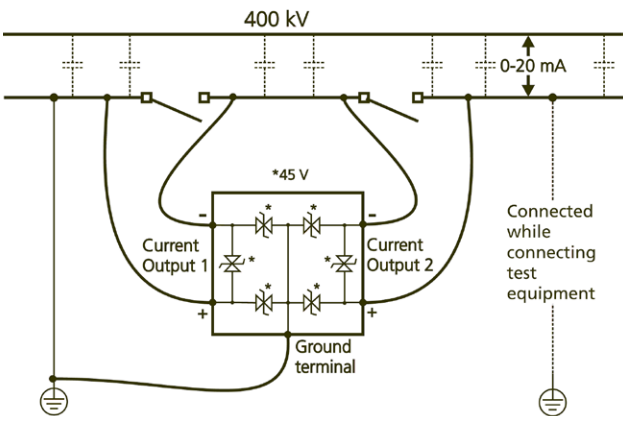


Figure 1.2. SDRM201/202 in substation environment

Before connecting or disconnecting the SDRM201/202 to/from a high voltage circuit breaker's contacts or the breaker analyzer, make sure the circuit breaker is closed and connected to ground on both sides.

The rules regarding connection to protective ground given above must be followed closely. Neglecting these rules may result in fire, electric shock, or other hazards.

The SDRM201/202 is designed to CAT I Environment – Secondary (signal level) or battery operated circuits of electronic equipment. Not connected to mains.

Do not use the SDRM201/202 to measure on circuits in measurement category II, III or IV.

Heat

The SDRM201/202 must be situated away from any heat sources such as radiators, heat registers, stoves, or other products that produce heat.

Accessories

Do not use any accessories not recommended by the SDRM201/202 manufacturer as they may cause hazards.

EMC Warning

The SDRM201/202 generates, uses, and can generate radio frequency energy. If not installed and used in accordance with this manual it may cause interference to radio communications. The SDRM201/202 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 SDRM201/202 in a commercial or residential area is likely to cause interference, at which case, the user, at his own expense, will be required to take whatever measures that may be required to correct the interference.

Cables

Do not use auxiliary equipment and/or cables not recommended by the SDRM201/202 manufacturer. In case of a need to use longer cables use the extension cable available from the SDRM201/202 manufacturer.

Power source

Only the charger supplied with the SDRM201/202 may be used for powering the unit. Not doing so may result in fire, electric shock or equipment damage.

Inputs and outputs

High current on current output terminals.

Do not apply voltage to the outputs. The current source has very low internal impedance and thus is capable of delivering high currents if externally shorted. The resultant heat can cause severe burns and is a potential fire hazard.

Lightning

For added protection for the SDRM201/202 during a lightning storm, or when it is left unattended and unused for long periods of time, unplug it from all cables connected to the inputs. This will prevent damage to the SDRM201/202 due to lightning.

Servicing

Do not attempt to service the SDRM201/202 yourself. Please refer all servicing to qualified service personnel as opening or removing covers may result in fire, electric shock or equipment damage.

Transportation

If, for some reason, you need to return your SDRM201/202, please use either the original transport box or one of equivalent strength.

Damage requiring service

Do not continue using a damaged SDRM201/202. Using a damaged SDRM201/202 may result in fire or electric shock. Unplug the SDRM201/202 from all connections and refer servicing to qualified service personnel under the following conditions:

- When any connector is damaged.
- If liquid has been spilled or objects have fallen into the SDRM201/202.
- If the SDRM201/202 does not operate normally (follow operating instructions).
- If the SDRM201/202 has been dropped or damaged in any way.
- When the SDRM201/202 exhibits a distinct change in performance. This indicates a need for service.

If the SDRM201/202 begins to emit smoke, smells like something is burning or makes strange noise, disconnect all connections immediately and contact your dealer for advice.

Cleaning

Do not use liquid cleaners or aerosol cleaners. Use only a damp cloth for cleaning. Periodically clean the SDRM201/202 with a soft cloth. Stubborn stains may be removed with a cloth lightly dampened with a mild detergent solution.

Periodically clean the area around all connectors.

Unplug the SDRM201/202 before cleaning it. Cleaning the SDRM201/202 while an input or output is being connected to a power source may result in electric shock.

1.4 Protective earthing procedure in HV environments

1. Protective earth (ground)

Connect the clamp of the protective earth cable supplied with SDRM201/202 to station earth (ground) and the other end of the cable to the terminal on SDRM201/202 marked ⏚

This connection must be done before any test cables and the mains supply cable are connected to SDRM201/202 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 fig. 1.2

2. Preparation of the CB

Before connecting or disconnecting the SDRM201/202 to a High-Voltage circuit breaker, make sure the CB is closed and earthed (grounded) on both sides according to local safety regulations.

3. Connection of test cables to the CB

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

4. Testing – Both sides grounded or single ground

SDRM201/202 and the method described below are working for both sides of the CB grounded as well as for only one side of the CB grounded. All applications described are functional for both cases. Using both sides grounded or only one is a choice for the user, the advantages and disadvantages with both ways of working is described below.

How to connect groundings to a circuit breaker is not covered in this text. This must be done according to local safety rules.

DRM

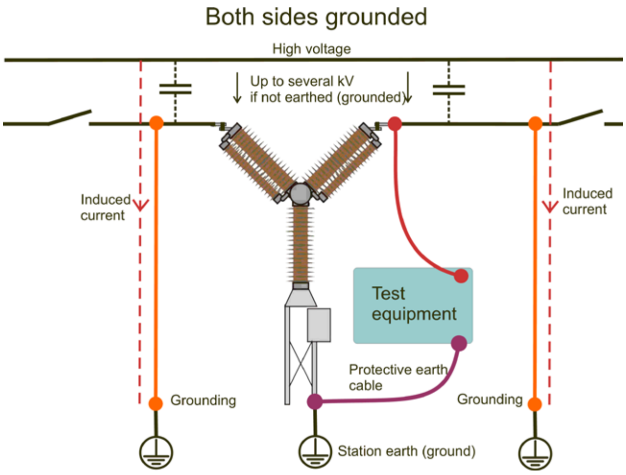
The principle for DRM is the same for testing with both sides grounded and one side grounded. With both sides grounded, DualGround™, a part of the test current will pass through the ground circuit. The inaccuracy of the resistance will therefore be greater. However, this has very limited implication for interpretation as it is the shape of the resistance graph that is important, not the absolute values. The measurement may have a lower resolution, especially if the ground connection has low resistance in comparison to the circuit breaker main and arcing contacts. In order to clearly distinguish the operation of the arcing contact the ground loop resistance should not be below the arcing contact resistance. The resistance of an arcing contact made of tungsten is normally 2 – 3 mΩ.

SRM
At static resistance measurement, SRM, the ground loop leakage current, at DualGround™, introduces an error in the measurement. The size of the error depends on the relation between the main contact resistance and the ground loop resistance.
Example: If main contact is 50 μΩ and ground loop is 10 mΩ the error will be -0.5% (the measured result is less than expected). The resistance of two grounding cables 10 m each and 95 mm^2 is around 3.6 mΩ.

DualGround – Both sides grounded

The most important advantage is improved safety but the method is also easier and will save time. The number of tasks is reduced when the ground cable does not need to be disconnected and reconnected. Permission related work that may include paper work could many times be avoided. However, the local safety regulations shall always be followed.

The disadvantage is that the measurement has a somewhat lower resolution.

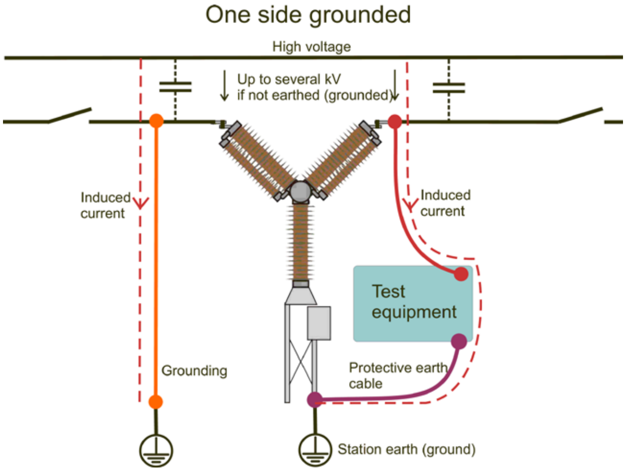


With both sides grounded the induced current will not pass through the test instrument.

Single side grounded

For cases when the ground connection has very low resistance in comparison to the CB main and arcing contacts, the resolution will be better testing with one side grounded than testing with both sides grounded.

The greatest disadvantage is the safety risk. It is recommended by standardization bodies and regulations in most countries to have both sided of the CB grounded throughout the test. Removing a ground also takes time and is in some cases only permitted by an authorized person and not by the test engineer. The CB need to be taken out of service for a longer time and the method is more complicated.



In all substations there is capacitive coupling from live high voltage conductors inducing currents in all parallel conductors. Through a disconnected circuit breaker with one side connected to earth and both disconnectors open this current can reach double digit values in mA. The Induced current is sometimes called hum current. This current can be large enough to hurt or be lethal for humans.

2 SDRM201/202 Overview

2.1 General

The DRM/SRM function enables resistance measurement on circuit breakers.

The SDRM201/202 unit is an accessory for TM1800, TM1700, TM1600 and EGIL.

The system consists of a SDRM201/202 unit with current cables and an SDRM Cable which is a small box with integrated cables for connection to the SDRM201/202 and to TM1800 or TM1700 or TM1600 or EGIL.

Note *The SDRM Cable is in three versions, one for TM1800/TM1700, one for TM1600 and one for EGIL.*

The SDRM201/202 is intended to use for both static and dynamic resistance measurements (SRM and DRM) on high voltage circuit breakers (CB) or other low resistive devices. An external instrument, TM1800, TM1700, TM1600/MA61 or EGIL, is required to measure the current and also the voltage-drop across the circuit breaker contacts. The measuring unit can thus calculate the resistance as a function of time.

In the SDRM201/202 the current is measured and represented at an output as a voltage level. Activating the TRIG IN starts operation.

Operation time is limited to 1.6 second. If the TRIG IN is deactivated before the 1.6 seconds the output current is interrupted. A number of operations can be run with short waiting intervals.

The current level is depending on the following:

- The capacitor's charging level
- The external current carrying cables' resistance (and resistance in the device under test)
- The resistance in the SDRM201/202

2.2 Front panels

SDRM201

SDRM202

1	CURRENT OUTPUT 1 negative terminal
2	CURRENT OUTPUT 1 positive terminal
3	CURRENT OUTPUT 2 negative terminal
4	CURRENT OUTPUT 2 positive terminal
	⚠ Warning High current on current out terminals
5	Protective conductor terminal ⚠ Important See section 1.4 Grounding in HW environments.
6	CIRCUIT BREAKER ANALYZER Multi-contact for connection to SDRM Cable
7	Calibration Labels Calibration is performed at factory or service center.

Mounting

On the top of the box there is a fastening device used when you want to strap the SDRM201/202 to the device under test.

2.4 Cables and accessories

The SDRM Cable for TM1800/TM1700 connects SDRM201/202 to TM1800/TM1700. The SDRM Cable for TM1600 looks the same.

The SDRM Cable for EGIL.

SDRM202 Cable TM1800 / TM1700 / TM1600 – Front panel

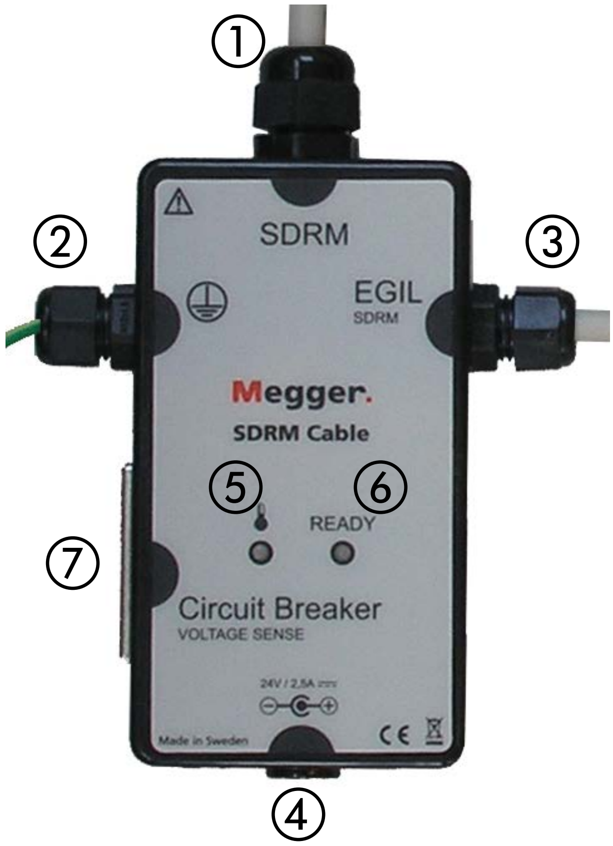
1	SDRM202 Cable lenght is 0.2 m (0.7 ft)
2	TM1800 DRM OUTPUT
3	TM1800 ANALOG INPUT I_1 and I_2
4	Input for power supply 24 V / 2.5 A
5	TEMP LED is lit when the temperature inside the box in any or both channels is too high to allow current injection.
6	READY LED is lit when both channels are ready for current injection.

TM1800 DRM OUTPUT

This input should be connected to the DRM OUTPUT on TM1800/TM1700. It is independent of the polarity and galvanic insulated from other circuits. Intended use:

- Start of the operation by changing the DC voltage level from a low level to a high level.
- Prepare for a new operation by changing the DC voltage level from a high level to a low level.

SDRM Cable EGIL – Front panel

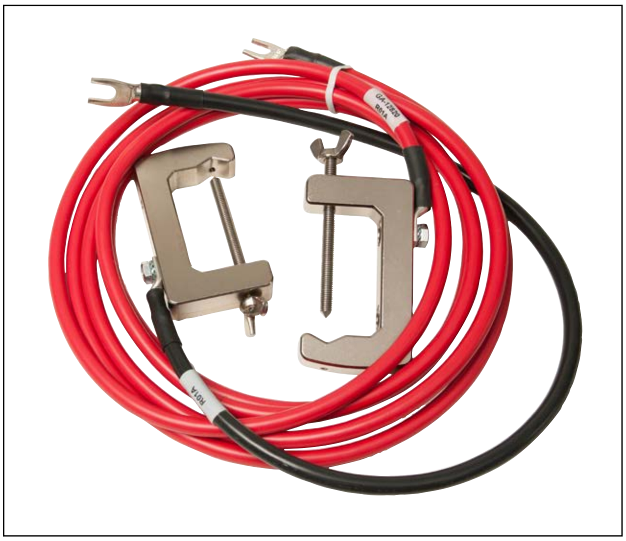


1	SDRM Cable lenght is 0.2 m (0.7 ft)
2	Protective ground (earth) cable
3	EGIL SDRM input/output (±15 V)
4	Input for power supply 24 V / 2.5 A
5	TEMP LED is lit when the temperature inside the box is too high to allow current injection.
6	READY LED is lit when ready for current injection.
7	Voltage sense input

24 VDC source

The 24 VDC source is a 60 W DC source allowing fast recharge of the SDRM201/202.

Current cables



The red current cables are 3.0 m (9.8 ft) and the black are 0.5 m (1.6 ft). For SDRM201 there is one of each.

3 DRM with TM1800/TM1700

3.1 Equipment

- TM1800/TM1700 with CABA Local R03F or later
- One control module, one Timing M/R module and one Analog module
- Timing M/R cable (voltage sense)
- Motion transducer with cable
- SDRM201/202
- Grounding cable
- Current injection cables
- SDRM Cable
- 24 V DC power source
- Optionally: SDRM201/202 extension cable 7.5 m (24.6 ft)

3.2 Preparations and hook-up

Important
Before you begin any work, read the section “1 Safety”.

TM1800/TM1700 (CABA Local) settings

1] Define a new CB or select an already existing one in the “Breaker list”.

2] Mark the breaker level of the breaker (first level below the “Circuit breaker(s)” folder in the “Breaker list”.

3] Go to “Breaker view” tab and make settings in accordance with the CB configuration.

4] Select “Measurement preferences -> Resistance” and tick the check box “Dynamic resistance (DRM)” and press <Back>.

5] Select “Motion measurement preferences menu” to make your motion measurement settings.

6] Make other necessary settings in “Breaker view” e.g. “Pulse and delay times” and “Measurement time and sample interval”.

7] Go to “Breaker list” and press <Begin new test>.

8] Make sure the correct breaker and test is marked in the “Breaker list”.

9] Navigate to the “DRM” folder, open it, and mark the operation that you wish to perform a measurement on, e.g. “CLOSE DRM A1”.

10] Press the button <Hook up diagram & transducers> to go to the “Analyzer view” tab.

11] Press the button <Select> to select appropriate transducer calibration data for the current sense of the particular SDRM201/202 and channel in use.

Note *If you have not defined the transducers you must do that first in the Transducers tab. See section “Current sense output definition” below.*

Connecting

1] Attach the motion transducer to the CB.

2] Connect the motion transducer to the channel, to which motion measurement is assigned (analog or digital).

3] Press <Select> to select appropriate transducer calibration data for the actual transducer in use. (Refer to TM1800/TM1700. User’s Manual section for transducer calibration guidance.)

Note *If you have not calibrated/defined the transducer you must do that first in the “Transducers” tab.*

Hook-up SDRM201/202 to the CB

Important
For grounding instructions, see section Safety instructions 1.3 and Protective earthing procedure in HV environments 1.4.

1] Hook up the SDRM201/202 to the CB according to the figure 3.2.1.

2] Secure the SDRM201/202 on the bushing using the strap.

3] Connect the current cables.

Note *Make sure the current cables do not form loops around the box as this may affect the measurement result.*

4] By twisting the cables as shown in the figure 3.2.2 you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

5] Connect the SDRM cable to the SDRM201/202.

6] Connect I_1 and I_2 to Analog inputs on the TM1800/TM1700.

7] Connect the DRM OUTPUT cables to the DRM output on the TM1800/TM1700.

8] Connect the power supply to the 24 V DC input and connect the power supply to the mains.

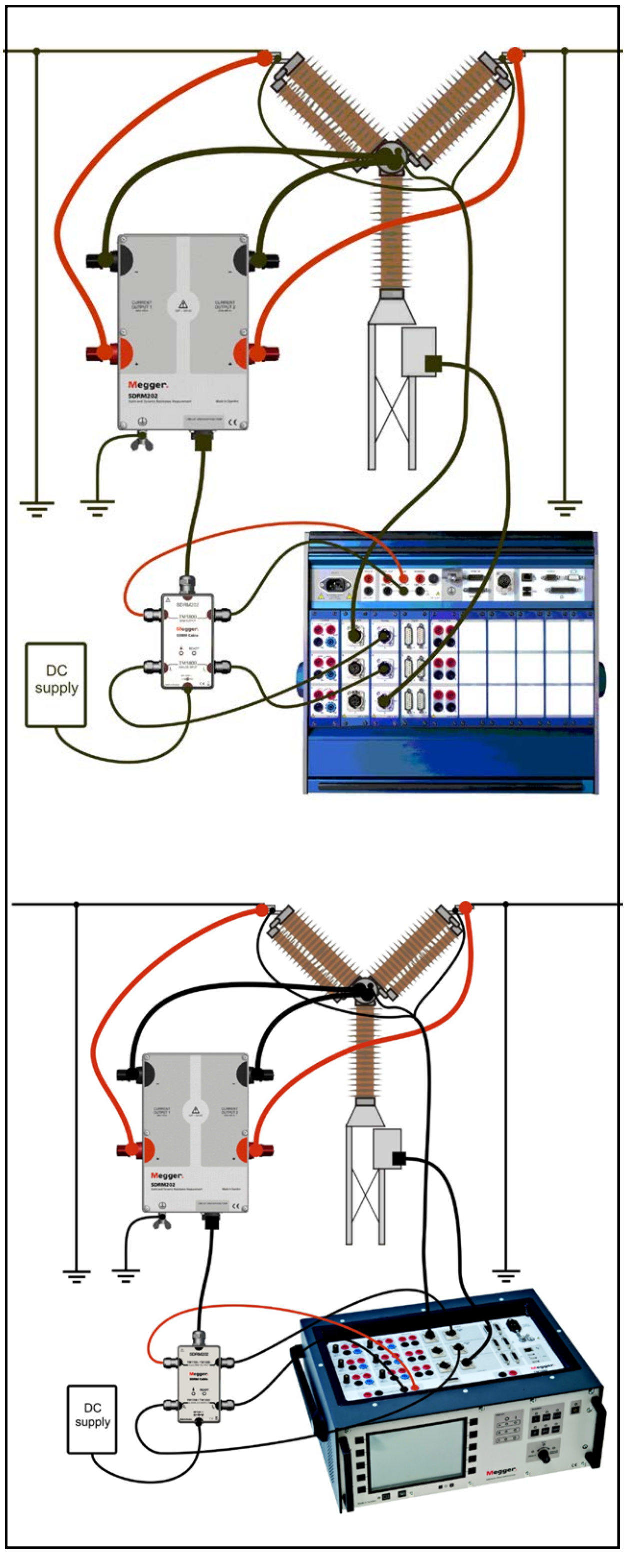


Figure 3.2.1 Figure shows hook-up with SDRM202 to TM1800 and TM1700. The SDRM201 is hooked-up the same way but with only one channel.

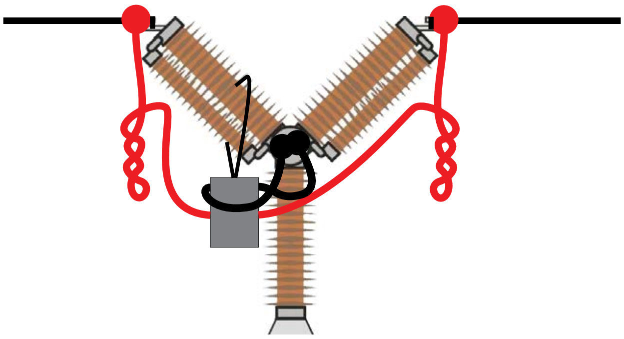


Figure 3.2.2 By twisting the current cables you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

Current sense output definition

1] Refer to TM1800/TM1700. User manuals, section "Transducers menu" for transducer definition guidance.

2] As "Transducer ID" type e.g. "SDRM201/202 S/N nnnnnnn, Ch n".

3] Set "Supply" to "Off"

4] Type "250.0" in the "Current" field.

5] For values to be entered in the "Voltage" and "Offset" fields refer to the CALIBRATION Label stuck to the SDRM201/202 box.

6] Type "VALUE" in the "Voltage" field.

7] Type "OFFSET" in the "Offset" field.

8] Repeat step 2 to 7 for channel 2.

Note *If the value is negative you need to place the cursor in the middle of the field to be able to type a minus sign.*

3.3 Measurement

1] Connect the breaker's close and trip circuits to corresponding output of the TM1800/TM1700 control inputs. Refer to TM1800/TM1700 User manuals.

2] Make sure the correct operation is selected in the "Breaker list" tab

3] Wait until the ready LED on the SDRM Cable comes on.

4] Turn the OPERATE / MEASURE rotary switch to initiate operation and recording.

Note *SRM, DRM and Timing can be done using the same hook-up.*

3.4 Disconnecting

Important
Disconnecting should be done in the following order.

1] Ground the circuit breaker on both sides.

2] Disconnect the power supply from the mains.

3] Disconnect the power supply from the 24 V DC input.

4] Disconnect the DRM OUTPUT cables from the DRM output on the TM1800/TM1700.

5] Disconnect I_1 and I_2 to Analog inputs on the TM1800/TM1700.

6] Disconnect the SDRM cable from the SDRM201/202.

7] Disconnect the current cables.

8] Loosen the SDRM201/202 strap from the bushing.

4 SRM with TM1800/TM1700

4.1 Equipment

- **TM1800/TM1700** with CABA Local R03F or later
- One Timing M/R module and one Analog module
- Timing M/R cable (voltage sense)
- SDRM201/202
- Grounding cable
- Current injection cables
- SDRM201/202 Cable
- 24 VDC power source
- Optionally: SDRM extension cable 7.5 m (24.6 ft)

4.2 Preparations and hook-up

Important
Before you begin any work, read the section "1 Safety".

TM1800/TM1700 (CABA Local) settings

1] Define a new CB or select an already existing one in the "Breaker list".

2] Mark the breaker level of the breaker (first level below the "Circuit breaker(s)" folder in the "Breaker list".

3] Go to "Breaker view" tab and make settings in accordance with the CB configuration.

4] Select "Measurement preferences -> Resistance" and tick the check box "Static resistance (SRM)" and press <Back>.

5] Go to "Breaker list" and press <Begin new test>.

6] Make sure the correct breaker and test is marked in the "Breaker list".

7] Navigate to the "SRM" folder, open it, and mark the operation that you wish to perform a measurement on, e.g. "CLOSE SRM A".

8] Press the button <Hook up diagram & transducers> to go to the "Analyzer view" tab.

9] Press the button <Select> to select appropriate transducer calibration data for the current sense of the particular SDRM201/202 and channel in use.

Note *If you have not defined the transducers you must do that first in the Transducers tab. See section "Current sense output definition" below.*

Hook-up SDRM201/202 to the CB

Important
For grounding instructions, see section Safety instructions 1.3 and Protective earthing procedure in HV environments 1.4.

1] Hook up the SDRM201/202 to the CB according to figure 4.2.1

2] Secure the SDRM201/202 on the bushing using the strap.

3] Connect the current cables.

Note *Make sure the current cables do not form loops around the box as this may affect the measurement result.*

4] By twisting the cables as shown in the figure 4.2.2 you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

5] Connect the SDRM cable to the SDRM201/202.

6] Connect I_1 and I_2 to Analog inputs on the TM1800/TM1700.

7] Connect the DRM OUTPUT cables to the DRM output on the TM1800/TM1700.

8] Connect the power supply to the 24 V DC input and connect the power supply to the mains.

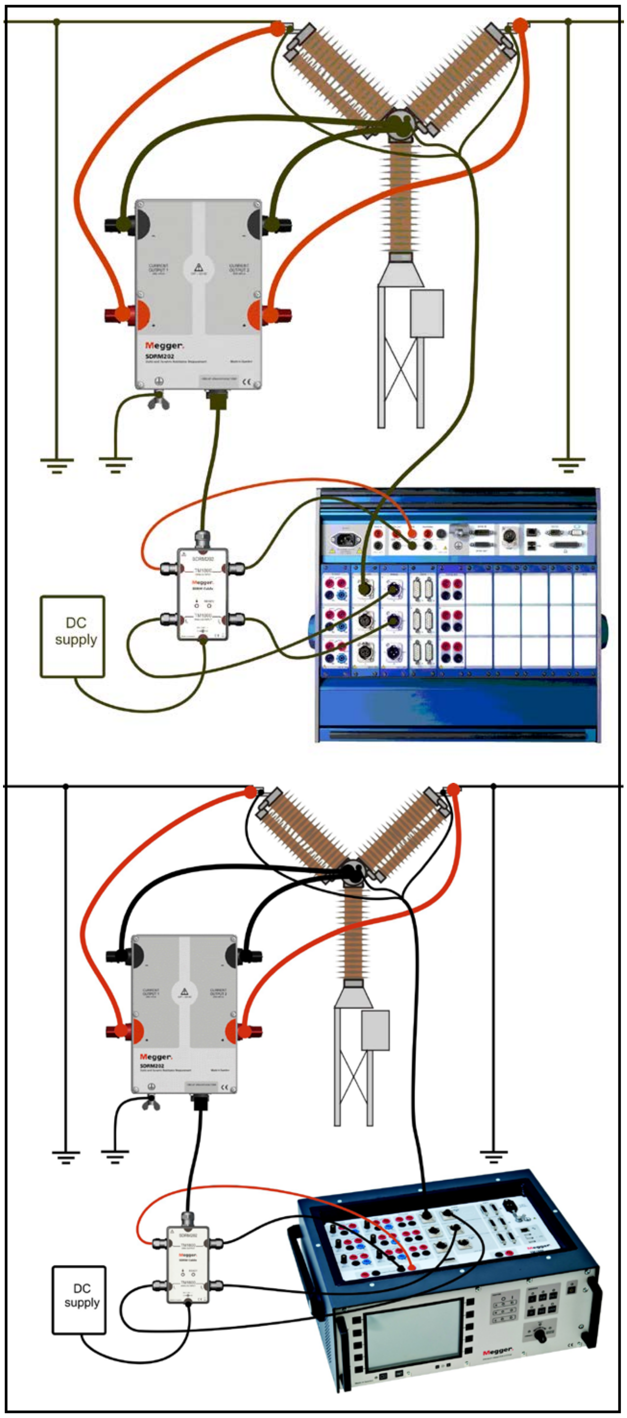


Fig. 4.2.1 Figure shows hook-up with SDRM202. The SDRM201 is hooked-up the same way but with only one channel.

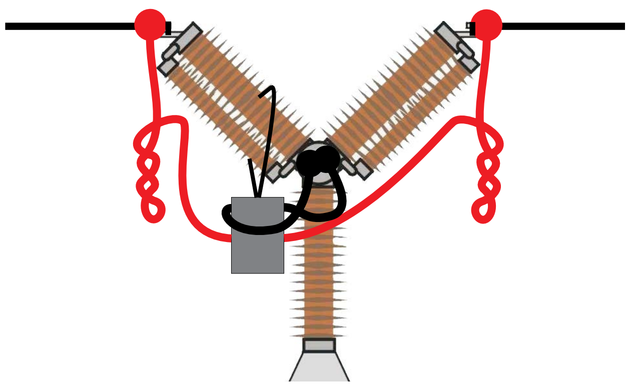


Fig. 4.2.2 By twisting the current cables you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

Current sense output definition

1] Refer to TM1800/TM1700 User manuals section "Transducers menu" for transducer definition guidance.

2] As "Transducer ID" type e.g. "SDRM201/202 S/N nnnnnnn, Ch n".

3] Set "Supply" to "Off"

4] Type "250.0" in the "Current" field.

5] For values to be entered in the "Voltage" and "Offset" fields refer to the CALIBRATION Label stuck to the SDRM201/202 box.

6] Type "VALUE" in the "Voltage" field.

7] Type "OFFSET" in the "Offset" field.

8] Repeat step 2 to 7 for channel 2.

Note *If the value is negative you need to place the cursor in the middle of the field to be able to type a minus sign.*

4.3 Measurement

1] Connect the breaker's close and trip circuits to corresponding output of the TM1800/TM1700 control inputs. Refer to TM1800/TM1700 User manuals

2] Make sure the breaker is in closed position

3] Make sure the correct operation (SRM) is selected in the "Breaker list" tab

4] Wait until the ready LED on the SDRM Cable comes on.

5] Turn the OPERATE / MEASURE rotary switch to initiate operation and recording.

Note *At repeated use wait 2 minutes between operations to avoid degradation due to temperature increase.*

SRM, DRM and Timing can be done using the same hook-up.

4.4 Disconnecting

Important
Disconnecting should be done in the following order.

1] Ground the circuit breaker on both sides.

2] Disconnect the power supply from the mains.

3] Disconnect the power supply from the 24 V DC input.

4] Disconnect the DRM OUTPUT cables from the DRM output on the TM1800/TM1700.

5] Disconnect I_1 and I_2 to Analog inputs on the TM1800/TM1700.

6] Disconnect the SDRM cable from the SDRM201/202.

7] Disconnect the current cables.

8] Loosen the SDRM201/202 strap from the bushing.

5 DRM with TM1600/MA61/ CABA Win

5.1 Equipment

Note *By using the optional accessory SDRM Cable for TM1600, it is possible to perform the same measurements with TM1600/MA61 as with TM1800/TM1700.*

- TM1600 / MA61
- Computer with CABA Win installed
- At least 3 analog channels for one break/phase and 5 channels for two breaks/phase
- Timing cables and adapters (banana to XLR, GA-00040)
- Motion transducer with cable
- SDRM201/202
- Protective earth cable
- Current injection cables
- SDRM Cable for TM1600
- 24 V DC power source
- Optionally: SDRM extension cable 7.5 m (24.6 ft)

5.2 Preparations and hook-up

Important
Before you begin any work, read the section “1 Safety”.

CABA Win settings

1] Define a new CB or select an already existing one in the “Breaker list”.

2] Make sure you have marked the breaker level of the breaker (first level below the “Circuit breaker(s)” folder in the “Breaker list”.

3] Go to “Required settings” tab and make settings in accordance with the CB configuration.

4] Press “Select test plan” and select a test plan containing DRM measurement.

5] Select “Measurement preferences” tab to make your motion measurement settings.

6] Make other necessary settings e.g. “Measurement time”.

7] Press <Save>.

8] Press <New test> to create a new test.

9] Make sure the correct breaker and test is marked in the “Breaker list”.

10] Navigate to the test menu and mark the operation that you wish to perform a measurement on, e.g. “CLOSE DRM PHASE A”.

11] Press the “New recording”.

12] Mark an item in the “Transducer selection” list and press <Select> button to select appropriate transducer calibration data for the actual transducer in use.

Note *If you have not calibrated / defined the transducer you must do that first in the “Transducer list” dialogue. See section “Current and voltage sense output definition” .*

13] After selected all transducers press "OK" to show the "Connection list".

Note *Standard test plans in CABA Win are designed for one break at a time. Here is described how to measure two breaks at a time.*

Connecting

Attach the motion transducer to the breaker

Connect the motion transducer to the channel, to which motion measurement is assigned

Hook up the SDRM201/202 to the CB

Important
For grounding instructions, see section Safety instructions 1.3 and Protective earthing procedure in HV environments 1.4.

Hook up SDRM201/202 to the CB

1] Hook up the SDRM201/202 to the CB, see example in figure 5.2.1.

2] Secure the SDRM201/202 on the bushing using the strap.

3] Connect the current cables.

Note *Make sure the current cables do not form loops around the box as this may affect the measurement result.*

4] By twisting the cables as shown in figure 5.2.2 you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

5] Connect the SDRM cable to the SDRM201/202.

6] Connect I_1 and/or I_2 to the inputs on MA61 assigned for current measurement.

7] Connect the TRIG cables to the terminals on the TM1600.

8] Make an interconnection between TRIG and TRIG OUT (short cable).

9] Connect the power supply to the 24 V DC input and connect the power supply to the mains.

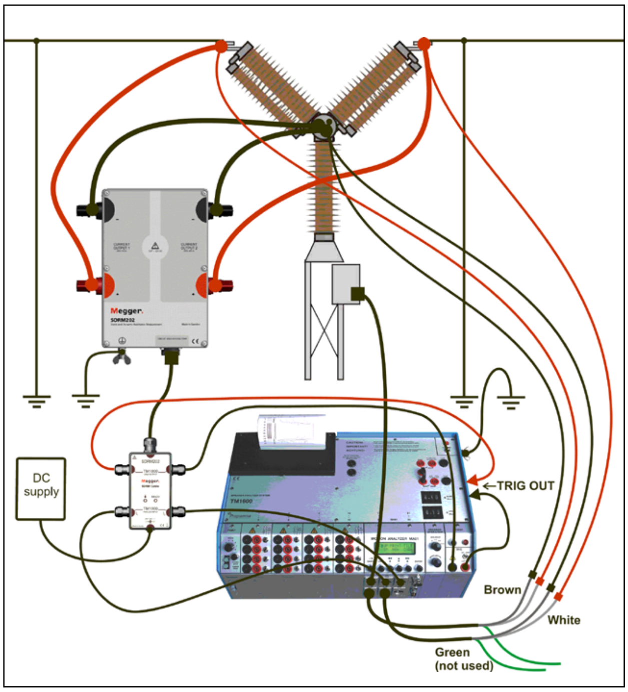


Fig 5.2.1 Hook up example. Figure shows hook-up with SDRM202. The SDRM201 is hooked-up the same way but with only one channel.

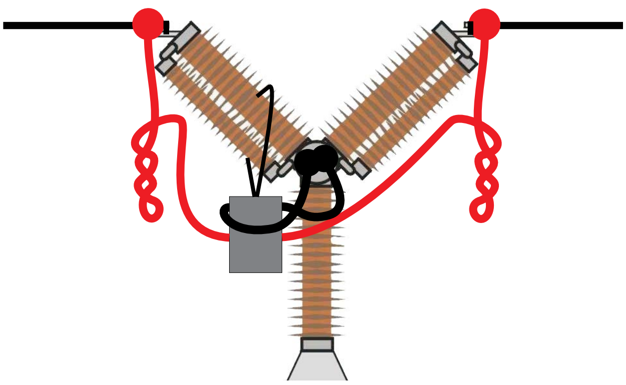


Fig 5.2.2 By twisting the current cables you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

Current and voltage sense output definition

1] Refer to CABA Win User's Manual section "6.5 Transducer calibration" for transducer definition guidance.

2] As "Transducer ID" type e.g. "SDRM201/202 S/N nnnnnnn Ch n".

3] For the Current sense output (current transducer) type "250.0" in the "Current" field. For value to be entered in the "Voltage" field refer to the CALIBRATION Label stuck to the SDRM201/202 box. Type "VALUE"/10 (divided by ten) in the "Voltage" field.

4] For the Voltage sense output (voltage transducer) type "1.0" in the "Actual voltage" field and type "1.0" in the "Voltage" field.

5] Repat step 2 to 3 for channel 2.

5.3 Measurement

1] Connect the breaker's close and trip circuits to corresponding output of the TM1600 top panel. Refer to TM1600 User's manual.

2] Set the TM1600 mode selector TRIG to contact position (downward).

3] Press the Measurement button in the Connection list dialogue in CABA Win.

4] Make sure that the correct operation sequence is selected and that the appropriate delay time, if applicable, is set.

5] Wait until the TM1600 LED "READY" comes on.

6] Wait until the ready LED on the SDRM Cable comes on.

7] Turn the START rotary switch to initiate operation and recording.

Note *The current pulse is maximum 1.6 seconds.*

Classical timing measurement using resistor contact mode on TM1600 does not work properly while SDRM201/202 is hooked up.

5.4 Disconnecting

Important
Disconnecting should be done in the following order.

1] Ground the circuit breaker on both sides.

2] Disconnect the power supply from the mains.

3] Disconnect the power supply from the 24 V DC input.

4] Disconnect the TRIG cables from the terminals on the TM1600 .

5] Disconnect I_1 and I_2 from the inputs on MA61.

6] Disconnect the SDRM cable from the SDRM201/202.

7] Disconnect the current cables.

8] Loosen the SDRM201/202 strap from the bushing.

6 SRM with TM1600/MA61/ CABA Win

6.1 Equipment

By using the optional accessory SDRM Cable for TM1600, it is possible to perform the same measurements with TM1600/MA61 as with TM1800.

- TM1600 / MA61
- Computer with CABA Win installed
- At least 2 analog channels for one break/phase and 4 channels for two breaks/phase.
- Timing cables and adapters (banana to XLR, GA-00040)
- SDRM201/202
- Protective earth cable
- Current injection cables
- SDRM Cable for TM1600
- 24 V DC power source
- Optionally: SDRM extension cable 7.5 m (24.6 ft)

6.2 Preparations and hook-up

Important
Before you begin any work, read the section "1 Safety".

CABA Win settings

1] Define a new CB or select an already existing one in the "Breaker list".

2] Make sure you have marked the breaker level of the breaker (first level below the "Circuit breaker(s)" folder in the "Breaker list".

3] Go to "Required settings" tab and make settings in accordance with the CB configuration.

4] Press "Select test plan" and select a test plan containing SRM measurement.

5] Make other necessary settings e.g. "Measurement time".

6] Press <Save>.

7] Press <New test> to create a new test.

8] Make sure the correct breaker and test is marked in the "Breaker list".

9] Navigate to the test menu and mark the operation that you wish to perform a measurement on, e.g. "SRM PHASE A"

10] Press the "New recording".

11] Mark an item in the "Transducer selection" list and press <Select> button to select appropriate transducer calibration data for the actual transducer in use.

Note *If you have not calibrated / defined the transducer you must do that first in the "Transducer list" dialogue. See section below "Current and voltage sense output definition" .*

12] After selected all transducers press "OK" to show the "Connection list".

Note *Standard test plans in CABA are designed for one break at a time. Here is described how to measure two breaks at a time.*

Connecting

Hook up the SDRM201/202 to the CB, see below.

Important
For grounding instructions, see section Safety instructions 1.3 and Protective earthing procedure in HV environments 1.4.

Hook up SDRM201/202 to the CB

1] Hook up the SDRM201/202 to the CB, see example in figure 6.2.1.

2] Secure the SDRM201/202 on the bushing using the strap.

3] Connect the current cables.

Note *Make sure the current cables do not form loops around the box as this may affect the measurement result.*

4] By twisting the cables as shown in figure 6.2.2 you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

5] Connect the SDRM cable to the SDRM201/202.

6] Connect I_1 and/or I_2 to the inputs on MA61 assigned for current measurement.

7] Connect the TRIG cables to the terminals on the TM1600.

8] Make an interconnection between TRIG and TRIG OUT (short cable).

9] Connect the power supply to the 24 V DC input and connect the power supply to the mains.

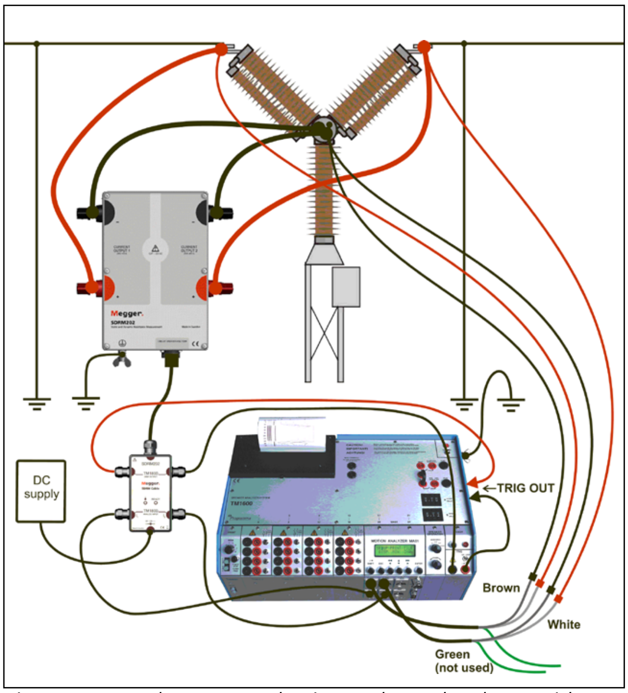


Fig. 6.2.1 Hook up example.Figure shows hook-up with SDRM202. The SDRM201 is hooked-up the same way but with only one channel.

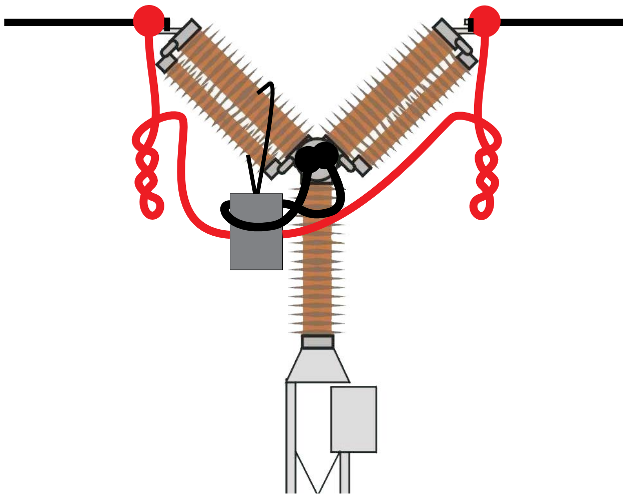


Fig. 6.2.2 By twisting the current cables you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

Current and voltage sense output definition

1] Refer to CABA Win User's Manual section "6.5 Transducer calibration" for transducer definition guidance.

2] As "Transducer ID" type e.g. "SDRM20X S/N nnnnnnn Ch n".
a) For the Current sense output (current transducer) type "250.0" in the "Current" field.
b) For value to be entered in the "Voltage" field refer to the CALIBRATION Label stuck

to the SDRM201/202 box. Type “VALUE”/10 (divided by ten) in the “Voltage” field.

3] As transducer ID type e.g. “SRM20X EGIL SRM/X”
For the Voltage sense output (voltage transducer) type “1.0” in the “Actual voltage” field and type “1.0” in the “Voltage” field.

4] Repeat step 2 to 3 for channel 2.

6.3 Measurement

1] Park the breaker’s close and trip circuits at the BLIND TERMINALS on the TM1600 top panel

2] Set the TM1600 mode selector TRIG to contact position (downward).

3] Press the Measurement button in the Connection list dialogue in CABA Win

4] Make sure that the circuit breaker is in closed position

5] Wait until the TM1600 LED “READY” comes on.

6] Wait until the ready LED on the SDRM Cable comes on.

7] Turn the START rotary switch to initiate operation and recording.

Note *The current pulse is maximum 1.6 seconds.*

At repeated use wait 2 minutes between operations to avoid degradation due to temperature increase.

Classical timing measurement using resistor contact mode on TM1600 does not work properly while SDRM201/202 is hooked up.

6.4 Disconnecting

Important
Disconnecting should be done in the following order.

1] Ground the circuit breaker on both sides.

2] Disconnect the power supply from the mains.

3] Disconnect the power supply from the 24 V DC input.

4] Disconnect the TRIG cables from the terminals on the TM1600 .

5] Disconnect I_1 and I_2 from the inputs on MA61.

6] Disconnect the SDRM cable from the SDRM201/202.

7] Disconnect the current cables.

8] Loosen the SDRM201/202 strap from the bushing.

7 DRM with TM1600/MA61 stand alone

7.1 Equipment

By using the optional accessory SDRM Cable for TM1600, it is possible to perform the same measurements with TM1600/MA61 as with TM1800

- TM1600 / MA61
- At least 3 analog channels
- Motion transducer with cable
- Timing cables and adapters (banana to XLR, GA-00040)
- SDRM201/202
- Protective earth cable
- Current injection cables
- SDRM Cable for TM1600
- 24 V DC power source
- Optionally: SDRM extension cable 7.5 m (24.6 ft)

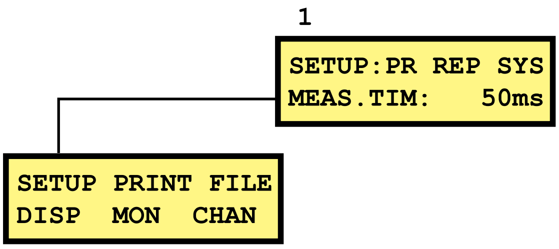
7.2 Preparations and hook-up

Important
Before you begin any work, read the section "1 Safety".

MA61 settings

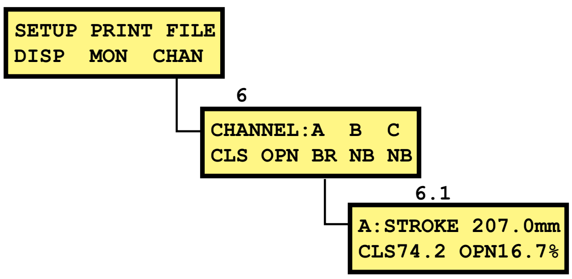
1] MA61 channel disposition:
 a. Channel A: Motion
 b. Channel B: Voltage sense
 c. Channel C: Current sense

2] Menu 1: Select a measurement time that corresponds to the breaker's operation time. The shorter measurement times the better resolution of the recording.



3] Menu 6: Set channel A in BR mode and B and C in NB mode.

4] Menu 6.1: Do all settings shown below. Enter nominal stroke for the breaker.



5] Menu 6.2: Channel B.

```
6
CHANNEL:A  B  C
CLS OPN BR NB NB

    6.2
    B: 0/+1 Z+0000mV
    +1000.000 mV /V
```

Note *The measuring range can be either 0/+1 or 0/+4. The first choise gives higher resolution ande the second higher resistance range.*

Current channel – scaling

To get the appropriate scaling for the current channel do as follows.

1] Locate the CALIBRATION label stuck to the SDRM201/202 box.

2] Put the "VALUE" for the SDRM201/202 channel in use into the formula below as the "VALUE" variable.
SCALE FACTOR = 250 / VALUE x 10000

3] Type the "SCALE FACTOR" value into menu 6.2, lower row. (The value should be around 250).

4] Enter the "OFFSET" from SDRM201/202's CALIBRATION Label, into menu 6.2 upper row after the "Z". Remember to change the sign if the value is negative.

```
6
CHANNEL:A  B  C
CLS OPN BR NB NB

    6.2
    C: 0/+1 Z+0000mV
    +0250.000  A /V
```

Connecting

1] Attach the motion transducer to the breaker.

2] Connect the motion transducer to the channel, to which motion measurement is assigned.

3] Hook up the SDRM201/202 to the CB, see below.

Important
For grounding instructions, see section 1.3 For grounding instructions, see section Safety instructions 1.3 and Protective earthing procedure in HV environments 1.4 .

Hook up SDRM201/202 to the CB

1] Hook up the SDRM201/202 to the CB, see example in figure 7.2.1.

2] Secure the SDRM201/202 on the bushing using the strap.

3] Connect the current cables.

Note *Make sure the current cables do not form loops around the box as this may affect the measurement result.*

4] By twisting the cables as shown in the figure 7.2.2 you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

5] Connect the SDRM cable to the SDRM201/202

6] Connect the channel in use I_1 or I_2 to the input on MA61 assigned for current measurement.

7] Connect the TRIG cables to the terminals on the TM1600.

8] Make an interconnection between TRIG and TRIG OUT (short cable).

9] Connect the power supply to the 24 V DC input and connect the power supply to the mains.

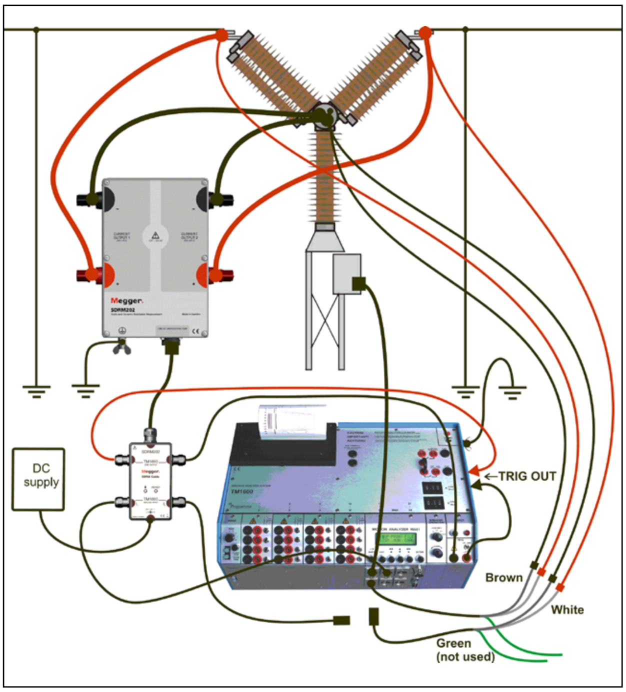


Fig. 7.2.1 Hook up example. Figure shows hook-up with SDRM202. The SDRM201 is hooked-up the same way but with only one channel.

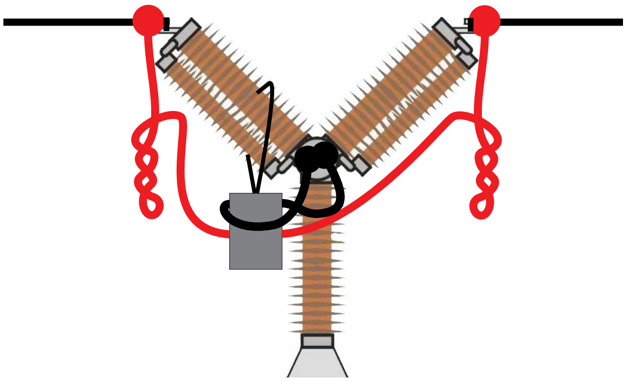


Fig. 7.2.2 By twisting the current cables you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

Tip
MA61 can only make a recording for one break at a time. To test break number two switch current sense channel and voltage sense channel.

7.3 Measurement

1] Connect the breaker's close and trip circuits to corresponding output of the TM1600 top panel. Refer to TM1600 User's manual.

2] Record close and open position. Refer to TM1600/MA61 User's manual.

```
SETUP PRINT FILE
DISP  MON   CHAN
```

6

```
CHANNEL:A   B   C
CLS OPN BR  NB  NB
```

3] Set the TM1600 mode selector TRIG to contact position (downward).

4] Make sure that the correct operation sequence is selected and that the appropriate delay time, if applicable, is set.

5] Wait until the ready LED on the SDRM Cable comes on.

6] Press READY button and wait until the TM1600 LED "READY" comes on.

7] Turn the START rotary switch to initiate operation and recording.

Note *The current pulse is maximum 1.6 seconds.*

Classical timing measurement using resistor contact mode on TM1600 does not work properly while SDRM201/202 is hooked up.

7.4 Disconnecting

Important
Disconnecting should be done in the following order.

1] Ground the circuit breaker on both sides.

2] Disconnect the power supply from the mains.

3] Disconnect the power supply from the 24 V DC input.

4] Disconnect the TRIG cables from the terminals on the TM1600 .

5] Disconnect I_1 and I_2 from the inputs on MA61.

6] Disconnect the SDRM cable from the SDRM201/202.

7] Disconnect the current cables.

8] Loosen the SDRM201/202 strap from the bushing.

8 SRM with TM1600/MA61 stand alone

8.1 Equipment

By using the optional accessory SDRM Cable for TM1600, it is possible to perform the same measurements with TM1600/MA61 as with TM1800

- TM1600 / MA61
- At least 2 analog channels
- Timing cables and adapters (banana to XLR, GA-00040)
- SDRM201/202
- Protective earth cable
- Current injection cables
- SDRM Cable for TM1600
- 24 VDC power source
- Optionally: SDRM extension cable 7.5 m (24.6 ft)

8.2 Preparations and hook-up

Important
Before you begin any work, read the section “1 Safety”.

MA61 settings

1] MA61 channel disposition:
a. Channel A: Voltage sense
b. Channel B: Current sense

2] Menu 1: Select a measurement time that corresponds to the breaker’s operation time. The shorter measurement times the better resolution of the recording.

```
1
SETUP:PR REP SYS
MEAS.TIM:    50ms

SETUP PRINT FILE
DISP  MON  CHAN
```

3] Menu 6.2: Channel A.

```
6
CHANNEL:A  B  C
CLS OPN NB NB NB

6.2
B: 0/+1 Z+0000mV
+1000.000 mV /V
```

Note *The measuring range can be either 0/+1 or 0/+4. The first choise gives higher resolution ande the second higher resistance range.*

Current channel – scaling

To get the appropriate scaling for the current channel do as follows.

1] Locate the CALIBRATION label stuck to the SDRM201/202 box.

2] Put the “VALUE” for the SDRM201/202 channel in use into the formula below as the

"VALUE" variable
SCALE FACTOR = 250 / VALUE x 10000

3] Type the "SCALE FACTOR" value into menu 6.2, lower row. (The value should be around 250).

4] Enter the "OFFSET" from SDRM201/202's CALIBRATION Label, into menu 6.2 upper row after the "Z". Remember to change the sign if the value is negative.

6
```
CHANNEL:A   B   C
CLS  OPN  BR  NB  NB
```

6.2
```
C:  0/+1  Z+0000mV
+0250.000   A  /V
```

Connecting

Hook up the SDRM201/202 to the CB, see below.

Important
For grounding instructions, see section Safety instructions 1.3 and Protective earthing procedure in HV environments 1.4 .

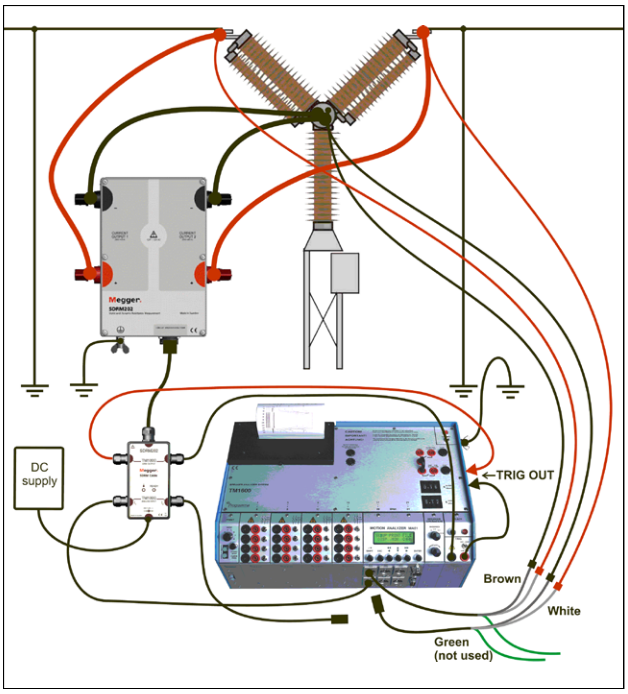


Fig. 8.2.1 Hook up example. Figure shows hook-up with SDRM202. The SDRM201 is hooked-up the same way but with only one channel.

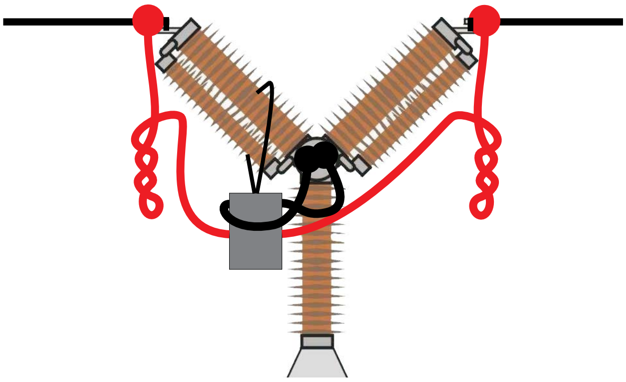


Fig. 8.2.2 By twisting the current cables you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

Hook up SDRM201/202 to the CB

1] Hook up the SDRM201/202 to the CB, see example in figure 8.2.1.

2] Secure the SDRM201/202 on the bushing using the strap

3] Connect the current cables.

Note *Make sure the current cables do not form loops around the box as this may affect the measurement result.*

4] By twisting the cables as shown in the figure 8.2.2 you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

5] Connect the SDRM cable to the SDRM201/202.

6] Connect the channel in use I_1 or I_2 to the input on MA61 assigned for current measurement.

7] Connect the TRIG cables to the terminals on the TM1600.

8] Connect the power supply to the 24 V DC input and connect the power supply to the mains.

Tip
MA61 can only make a recording for one break at a time. To test break number two switch current sense channel and voltage sense channel.

8.3 Measurement

1] Park the breaker's close and trip circuits at the BLIND TERMINALS on the TM1600 top panel

2] Set the TM1600 mode selector TRIG to contact position (downward).

3] Make sure that the circuit breaker is in closed position

4] Wait until the ready LED on the SDRM Cable comes on.

5] Press READY button and wait until the TM1600 LED "READY" comes on.

6] Turn the START rotary switch to initiate operation and recording.

7] Read the resistance value in the display menu (DISP). Place the cursor on the "A" in the upper left corner and toggle using up/down arrow button until "R" is displayed.
The resolution is 0.1 mΩ.

Note *The current pulse is maximum 1.6 seconds.*

At repeated use wait 2 minutes between operations to avoid degradation due to temperature increase.

Classical timing measurement using resistor contact mode on TM1600 does not work properly while SDRM201/202 is hooked up.

8.4 Disconnecting

Important
Disconnecting should be done in the following order.

1] Ground the circuit breaker on both sides.

2] Disconnect the power supply from the mains.

3] Disconnect the power supply from the 24 V DC input.

4] Disconnect the TRIG cables from the terminals on the TM1600 .

5] Disconnect I_1 and I_2 from the inputs on MA61.

6] Disconnect the SDRM cable from the SDRM201/202.

7] Disconnect the current cables.

8] Loosen the SDRM201/202 strap from the bushing.

9 DRM / MOTION with EGIL / CABA Win

9.1 Equipment

- EGIL SDRM (BM-19095)
- Computer with CABA Win R03A or later installed
- Motion transducer with cable
- SDRM201/202
- Protective earth cable
- Current injection cables
- Voltage sense cables
- SDRM Cable for EGIL
- 24 VDC power source
- Optionally: SDRM extension cable 7.5 m (24.6 ft)

9.2 Preparations and hook-up

Important
Before you begin any work, read the section "1 Safety"

CABA Win settings

1] Define a new CB or select an already existing one in the "Breaker list"

2] Make sure you have marked the breaker level of the breaker (first level below the "Circuit breaker(s)" folder in the "Breaker list"

3] Go to "Required settings" tab and make settings in accordance with the CB configuration.

4] Press <Select test plan> and select a test plan designated for EGIL containing DRM measurement.

5] Select "Measurement preferences" tab to make your motion measurement settings.

6] Make other necessary settings e.g. "Measurement time"

7] Press <Save>

8] Press <New test> to create a new test.

9] Make sure the correct breaker and test is marked in the "Breaker list"

10] Navigate to the test menu and mark the operation that you wish to perform a measurement on, e.g. "CLOSE DRM PHASE A"

11] Press <New recording>

12] Mark an item in the "Transducer selection" list and press <Select> button to select appropriate transducer calibration data for the actual transducer in use.

13] After selected all transducers press "OK" to show the "Connection list"

Note *If you have not calibrated / defined the transducers you must do that first in the "Transducer list" dialogue. See section "Transducer definition" below.*

Connecting

1] Attach the motion transducer to the breaker.

2] Connect the motion transducer to the MOTION channel.

3] Hook up the SDRM201/202 to the CB, see below.

Important
For grounding instructions, see section Safety instructions 1.3 and Protective earthing procedure in HV environments 1.4.

Hook up SDRM201/202 to the CB

1] Hook up the SDRM201/202 to the CB according to the picture below.

2] Secure the SDRM201/202 on the bushing using the strap.

3] Connect the current cables for CURRENT OUTPUT 1.

4] Connect the voltage sense leads closer to the interrupter related to the current cables. Connect black "V sense -" to the negative side and red "V sense +"to the positive side.

5] Connect the 10 m (32.8 ft) extension cable to the voltage sense cable.

6] Connect the XLR connector from the voltage sense extension cable to the SDRM cable "Circuit Breaker VOLTAGE SENSE" input.

7] To reduce disturbances minimize the magnetic window created by the cables loop and the interrupter by twisting the cables as shown in the picture below.

8] Connect the SDRM cable to the SDRM201/202.

9] Fasten the ground cable from the SDRM cable to EGIL's grounding screw.

10] Connect the seven pin XLR connector to EGIL's SDRM terminal.

11] Connect the power supply to the 24 V DC input and connect the power supply to the mains.

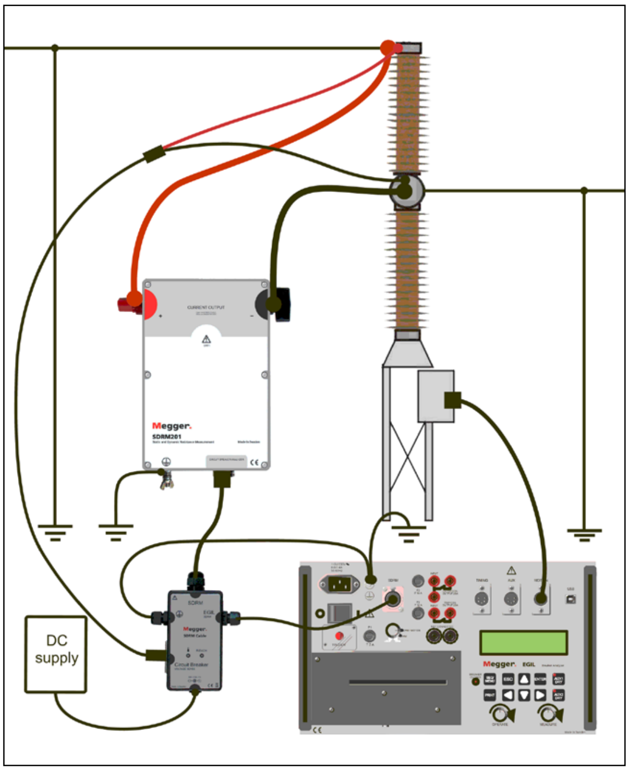


Fig. 9.2.1 Hook up example with SDRM201.An SDRM202 can also be used but then using only channel 1.

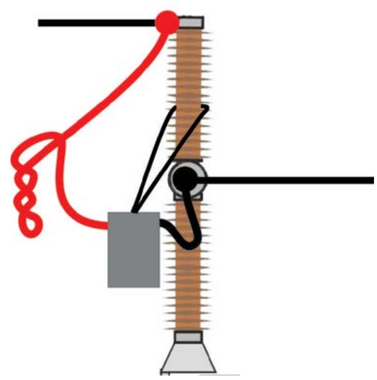


Fig. 9.2.2 By twisting the current cables you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

Transducer definition

Different selections of the SDRM mode switch on EGIL require different transducer definitions. For DRM / MOTION mode a motion and a resistance transducer are required, for SRM and DRM mode a current and a voltage transducer are required.

1] Refer to CABA Win User's Manual section "6.5 Transducer calibration" for transducer definition guidance.

2] Resistance transducer used in DRM / MOTION mode: As "Transducer ID" type e.g. "SDRM20X EGIL DRM/MTN". Type "36.0" in the "Resistance" field and type 2048.0 in the "Voltage" field.

3] Current transducer used in SRM and DRM mode: As "Transducer ID" type e.g. "SDRM20X S/N nnnnnnn Ch1". Type "250.0" in the "Current" field. For value to be entered in the "Voltage" field refer to the CALIBRATION label stuck to the SDRM201/202 box. Type "VALUE" / 5 (divided by 5) in the "Voltage" field.

4] Voltage transducer used in SRM mode: As "Transducer ID" type e.g. "SDRM20X EGIL SRM". Type "1.0" in the "Actual voltage" field and type "10.0" in the "Voltage" field.

5] Voltage transducer used in DRM mode: As "Transducer ID" type e.g. "SDRM20X EGIL DRM". Type "1.0" in the "Actual voltage" field and type "1.0" in the "Voltage" field.

9.3 Measurement

1] Connect the breaker's close and trip circuits to corresponding output of the EGIL's top panel. Refer to EGIL User's manual

2] Turn the "SDRM" mode switch on EGIL to "DRM / MOTION" position

3] Click the Measurement button in the Connection list dialogue in CABA Win

4] Make sure that the correct operation sequence is selected and that the appropriate delay time, if applicable, is set.

5] Wait until the ready LED on the SDRM Cable is lit.

6] Turn the MEASURE rotary switch to initiate operation and recording.

Note *The current pulse is maximum 1.6 seconds*

Note *To perform a standard measurement, i.e. using coil current and motion channels in the standard way, the SDRM Cable has to be disconnected from EGIL*

9.4 Disconnecting

Important
Disconnecting should be done in the following order.

1] Ground the circuit breaker on both sides.

2] Disconnect the power supply from the mains.

3] Disconnect the power supply from the 24 V DC input.

4] Disconnect the SDRM cable from EGIL

5] Disconnect the SDRM cable from the SDRM201/202.

6] Disconnect the voltage sense cables.

7] Disconnect the current cables.

8] Loosen the SDRM201/202 strap from the bushing.

10 SRM with EGIL / CABA Win

10.1 Equipment

- EGIL SDRM (BM-19095)
- Computer with CABA Win R03A or later installed
- SDRM201/202
- Protective earth cable
- Current injection cables
- Voltage sense cables
- SDRM Cable for EGIL
- 24 VDC power source
- Optionally: SDRM extension cable 7.5 m (24.6 ft)

10.2 Preparations and hook-up

Important
Before you begin any work, read the section “1 Safety”.

CABA Win settings

1] Define a new CB or select an already existing one in the “Breaker list”.

2] Make sure you have marked the breaker level of the breaker (first level below the “Circuit breaker(s)” folder in the “Breaker list”.

3] Go to “Required settings” tab and make settings in accordance with the CB configuration.

4] Press <Select test plan> and select a test plan designated for EGIL containing SRM measurement.

5] Make other necessary settings e.g. “Measurement time”.

6] Press <Save>.

7] Press <New test> to create a new test.

8] Make sure the correct breaker and test is marked in the “Breaker list”.

9] Navigate to the test menu and mark the operation that you wish to perform a measurement on, e.g. “SRM PHASE A”

10] Press the <New recording>.

11] Mark an item in the “Transducer selection” list and press <Select> button to select appropriate transducer calibration data for the actual transducer in use.

12] After selected all transducers press “OK” to show the “Connection list”

Note *If you have not calibrated / defined the transducers you must do that first in the “Transducer list” dialogue. See section “Transducer definition” below.*

Hook up SDRM201/202 to the CB

Important
For grounding instructions, see section Safety instructions 1.3 and Protective earthing procedure in HV environments 1.4.

1] Hook up the SDRM201/202 to the CB according to the picture below

2] Secure the SDRM201/202 on the bushing using the strap

3] Connect the current cables for CURRENT OUTPUT 1

4] Connect the voltage sense leads closer to the interrupter related to the current cables. Connect black “V sense -” to the negative side and red “V sense +”to the positive side.

5] Connect the 10 m (32.8 ft) extension cable to the voltage sense cable.

6] Connect the XLR connector from the voltage sense extension cable to the SDRM cable “Circuit Breaker VOLTAGE SENSE” input.

7] To reduce disturbances minimize the magnetic window created by the cables loop and the interrupter by twisting the cables as shown in the picture below

8] Connect the SDRM cable to the SDRM201/202

9] Fasten the ground cable from the SDRM cable to EGIL’s grounding screw.

10] Connect the seven pin XLR connector to EGIL’s SDRM terminal

11] Connect the power supply to the 24 V DC input and connect the power supply to the mains.

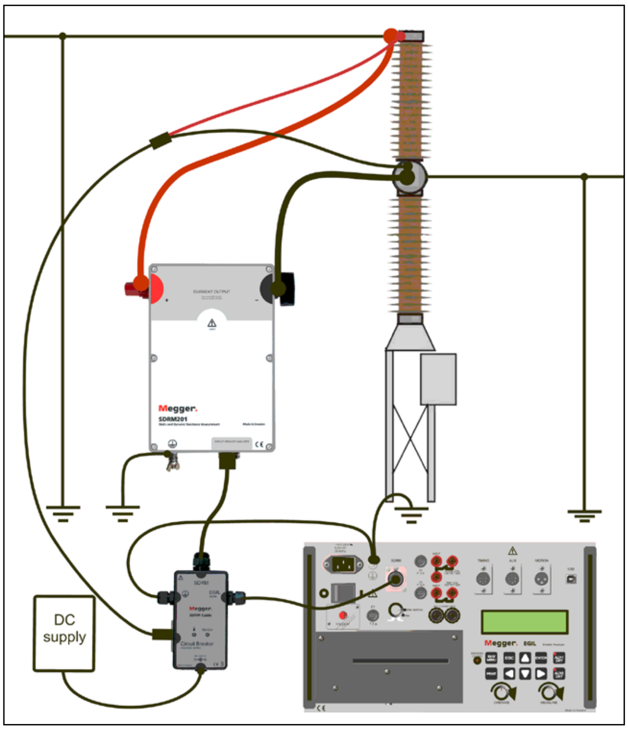


Fig. 10.2.1 Hook up example with SDRM201. An SDRM202 can also be used but then using only channel 1.

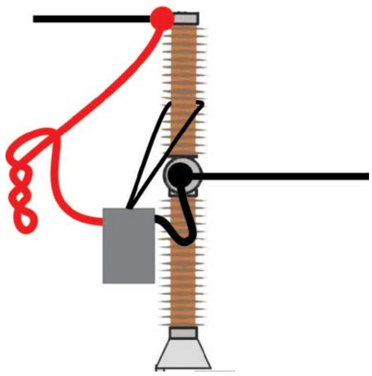


Fig. 10.2.2 By twisting the current cables you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

Transducer definition

Different selections of the SDRM mode switch on EGIL require different transducer definitions. For DRM / MOTION mode a motion and a resistance transducer are required, for SRM and DRM mode a current and a voltage transducer are required.

1] Refer to CABA Win User’s Manual section “6.5 Transducer calibration” for transducer definition guidance.

2] Resistance transducer used in DRM / MOTION mode: As “Transducer ID” type e.g. “SDRM20X EGIL DRM/MTN”. Type “36.0” in the “Resistance” field and type 2048.0 in the “Voltage” field.

3] Current transducer used in SRM and DRM mode: As "Transducer ID" type e.g. "SDRM20X S/N nnnnnnn Ch1". Type "250.0" in the "Current" field. For value to be entered in the "Voltage" field refer to the CALIBRATION label stuck to the SDRM201/202 box. Type "VALUE" / 5 (divided by 5) in the "Voltage" field.

4] Voltage transducer used in SRM mode: As "Transducer ID" type e.g. "SDRM20X EGIL SRM". Type "1.0" in the "Actual voltage" field and type "10.0" in the "Voltage" field.

5] Voltage transducer used in DRM mode: As "Transducer ID" type e.g. "SDRM20X EGIL DRM". Type "1.0" in the "Actual voltage" field and type "1.0" in the "Voltage" field.

System calibration

To achieve highest possible accuracy the system (EGIL SDRM in combination with SDRM201/202) needs to be calibrated against a reference resistor. For best result the reference resistor should be in the same range as the real test object, however, a 100 µOhm calibration shunt would be suitable in most situations.

1] Connect according to picture "A" below. Note that it is crucial for the quality of the calibration to connect groundings exactly as shown in the picture.

2] Make all preparations in CABA Win to make an SRM test, like creating breaker, selecting test plan, hooking up EGIL to PC etc.

3] Set the "SDRM" mode switch on EGIL to "SRM" position.

4] Wait until the ready LED on the SDRM Cable is lit.

5] Select an SRM operation from the SRM test menu folder in CABA Win and click "New recording".

6] Select the current and the voltage (SRM) transducer defined according to the "Transducer definition" section above.

7] Click "OK" and then "Measure".

8] Turn the MEASURE rotary switch to initiate recording.

9] Read the value of parameter number 401 in the Parameters window and make a note of it.

10] Exit the CABAANA window (result view) and click "Transducer" and "Transducer list". Select the "SDRM20X EGIL SRM, Voltage" transducer and click "Edit".

11] Take the value (including sign) from point 9 above, multiply it by 10 and then enter it into the "Offset" field. Click "OK".

12] Double-click on "End the test" at the bottom of the test menu tree and confirm that the message "Closing communication" appears.

13] Select an SRM operation from the test menu and click "New recording".

14] Select current and voltage (SRM) transducer, click "OK" and then "Measure".

15] Turn the MEASURE rotary switch to initiate recording.

16] The value of parameter number 401 in the Parameters window shall now display "0.0 mV".

17] Exit the CABAANA window.

18] Connect according to picture "B" below.

19] Make a new recording.

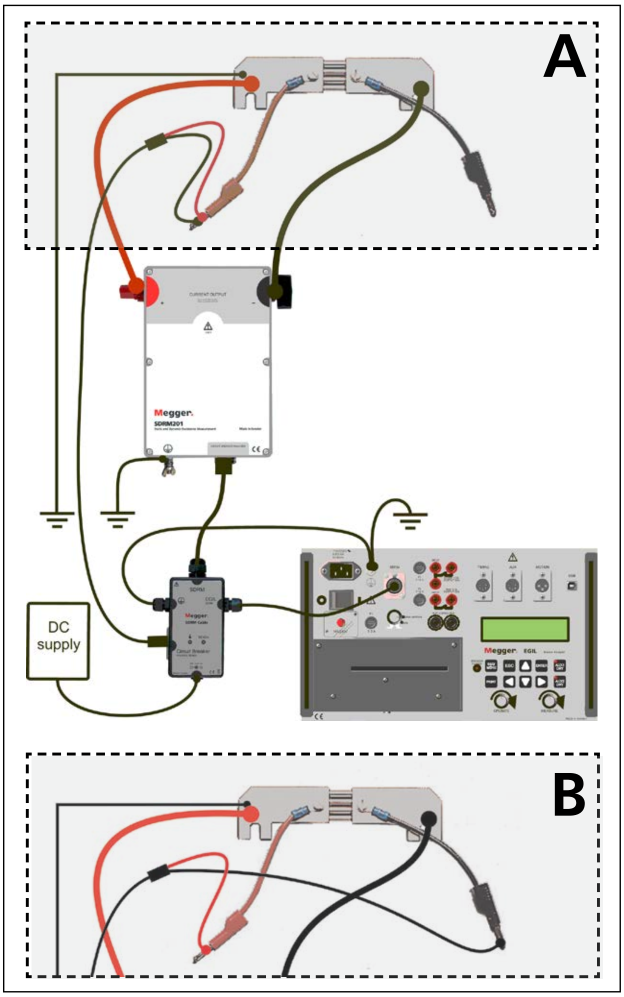
20] Read the value of parameter number 400 and compare with the value of the reference resistor. If the value is within required accuracy margin the calibration procedure is complete, if not, take a note of the value and proceed performing the steps below.

21] Exit the CABAANA window (result view) and click "Transducer" and "Transducer list". Select the "SDRM20X EGIL SRM, Voltage" transducer and click "Edit".

22] Take the value of the reference resistor, divide it by the value from point 20 above and then enter it into the "Actual voltage" field. Click "OK".

23] Double-click on "End the test" at the bottom of the test menu tree and confirm that the message "Closing communication" appears.

24] Make a new recording. Confirm that the value of parameter number 400 complies with the value of the reference resistor. If yes, the calibration procedure is complete.



The connection to the calibration shunt differ from A to B.

10.3 Measurement

1] Park the breaker's close and trip circuits at the "NOT CONNECTED" terminals on the EGIL top panel

2] Turn the "SDRM" mode switch on EGIL to "SRM" position

3] Click the Measurement button in the Connection list dialogue in CABA Win

4] Make sure that the circuit breaker is in closed position

5] Wait until the ready LED on the SDRM Cable is lit.

6] Turn the MEASURE rotary switch to initiate recording.

Note *The current pulse is maximum 1.6 seconds At repeated use wait 2 minutes between operations to avoid degradation due to temperature increase.*

Note *To perform a standard measurement, i.e. using coil current and motion channels in the standard way, the SDRM Cable has to be disconnected from EGIL*

10.4 Disconnecting

Important
Disconnecting should be done in the following order.

1] Ground the circuit breaker on both sides.

2] Disconnect the power supply from the mains.

3] Disconnect the power supply from the 24 V DC input.

4] Disconnect the SDRM cable from EGIL

5] Disconnect the SDRM cable from the SDRM201/202.

6] Disconnect the voltage sense cables.

7] Disconnect the current cables.

8] Loosen the SDRM201/202 strap from the bushing.

11 DRM with EGIL / CABA Win (U/I, no Motion)

11.1 Equipment

- EGIL SDRM (BM-19095)
- Computer with CABA Win R03A or later installed
- SDRM201/202
- Protective earth cable
- Current injection cables
- Voltage sense cables
- SDRM Cable for EGIL
- 24 VDC power source
- Optionally: SDRM extension cable 7.5 m (24.6 ft)

11.2 Preparations and hook-up

Important
Before you begin any work, read the section "1 Safety".

CABA Win settings

1] Define a new CB or select an already existing one in the "Breaker list".

2] Make sure you have marked the breaker level of the breaker (first level below the "Circuit breaker(s)" folder in the "Breaker list".

3] Go to "Required settings" tab and make settings in accordance with the CB configuration.

4] Press <Select test plan> and select a test plan designated for EGIL containing DRM measurement.

5] Make other necessary settings e.g. "Measurement time".

6] Press <Save>.

7] Press <New test> to create a new test.

8] Make sure the correct breaker and test is marked in the "Breaker list".

9] Navigate to the test menu and mark the operation that you wish to perform a measurement on, e.g. "DRM PHASE A"

10] Press the <New recording>.

11] Mark an item in the "Transducer selection" list and press <Select> button to select appropriate transducer calibration data for the actual transducer in use.

12] After selected all transducers press "OK" to show the "Connection list"

Note *If you have not calibrated / defined the transducers you must do that first in the "Transducer list" dialogue. See section "Transducer definition" below.*

Hook up SDRM201/202 to the CB

Important
For grounding instructions, see section Safety instructions 1.3 and Protective earthing procedure in HV environments 1.4.

1] Hook up the SDRM201/202 to the CB according to the picture below

2] Secure the SDRM201/202 on the bushing using the strap

3] Connect the current cables for CURRENT OUTPUT 1

4] Connect the voltage sense leads closer to the interrupter related to the current cables. Connect black “V sense -” to the negative side and red “V sense +”to the positive side.

5] Connect the 10 m (32.8 ft) extension cable to the voltage sense cable.

6] Connect the XLR connector from the voltage sense extension cable to the SDRM cable “Circuit Breaker VOLTAGE SENSE” input.

7] To reduce disturbances minimize the magnetic window created by the cables loop and the interrupter by twisting the cables as shown in the picture below

8] Connect the SDRM cable to the SDRM201/202

9] Fasten the ground cable from the SDRM cable to EGIL’s grounding screw.

10] Connect the seven pin XLR connector to EGIL’s SDRM terminal

11] Connect the power supply to the 24 V DC input and connect the power supply to the mains.

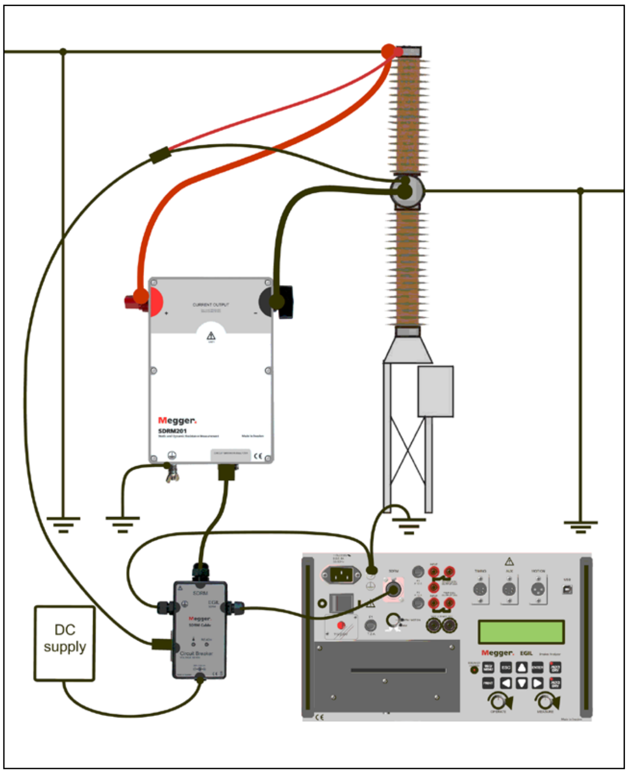


Fig. 11.2.1 Hook up example with SDRM201. An SDRM202 can also be used but then using only channel 1..

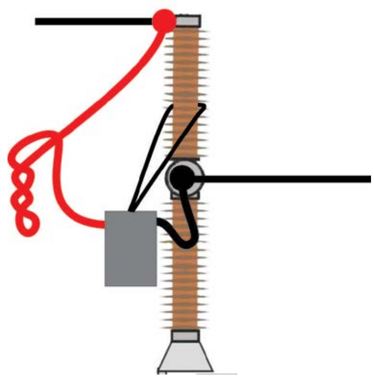


Fig. 11.2.2 By twisting the current cables you can reduce disturbances by minimizing the magnetic window created by the cable loops and the interrupter.

Transducer definition

Different selections of the SDRM mode switch on EGIL require different transducer definitions. For DRM / MOTION mode a motion and a resistance transducer are required, for SRM and DRM mode a current and a voltage transducer are required.

1] Refer to CABA Win User’s Manual section “6.5 Transducer calibration” for transducer definition guidance.

2] Resistance transducer used in DRM / MOTION mode: As “Transducer ID” type e.g. “SDRM20X EGIL DRM/MTN”. Type “36.0” in the “Resistance” field and type 2048.0 in the “Voltage” field.

3] Current transducer used in SRM and DRM mode: As “Transducer ID” type e.g. “SDRM20X S/N nnnnnnn Ch1”. Type “250.0” in the “Current” field. For value to be entered in the “Voltage” field refer to the CALIBRATION label stuck to the SDRM201/202 box. Type “VALUE” / 5 (divided by 5) in the “Voltage” field.

4] Voltage transducer used in SRM mode: As “Transducer ID” type e.g. “SDRM20X EGIL SRM”. Type “1.0” in the “Actual voltage” field and type “10.0” in the “Voltage” field.

5] Voltage transducer used in DRM mode: As “Transducer ID” type e.g. “SDRM20X EGIL DRM”. Type “1.0” in the “Actual voltage” field and type “1.0” in the “Voltage” field.

11.3 Measurement

1] Connect the breaker’s close and trip circuits to corresponding output of the EGIL’s top panel. Refer to EGIL User’s manual

2] Turn the “SDRM” mode switch on EGIL to “DRM” position

3] Click the Measurement button in the Connection list dialogue in CABA Win

4] Make sure that the correct operation sequence is selected and that the appropriate delay time, if applicable, is set.

5] Wait until the ready LED on the SDRM Cable is lit.

6] Turn the MEASURE rotary switch to initiate recording.

Note *The current pulse is maximum 1.6 seconds*

Note *To perform a standard measurement, i.e. using coil current and motion channels in the standard way, the SDRM Cable has to be disconnected from EGIL*

11.4 Disconnecting

Important
Disconnecting should be done in the following order.

1] Ground the circuit breaker on both sides.

2] Disconnect the power supply from the mains.

3] Disconnect the power supply from the 24 V DC input.

4] Disconnect the SDRM cable from EGIL

5] Disconnect the SDRM cable from the SDRM201/202.

6] Disconnect the voltage sense cables.

7] Disconnect the current cables.

8] Loosen the SDRM201/202 strap from the bushing.

12 DRM / MOTION, SRM and DRM with EGIL stand alone

DRM / MOTION, SRM and DRM are not supported by EGIL stand alone. However, it is possible to make recordings although current -, voltage- and resistance graphs will be wrongly labeled and scaled. The relations and approximate scales are shown in the table below.

SDRM mode	Channel	Measured quantity	Label in print out	Scale
DRM / MOTION	CURRENT (internal)	Resistance	I	0.64 mΩ / A
DRM / MOTION	MOTION	Motion	M	Correct
SRM	CURRENT (internal)	Current	I	5 A / A
SRM	MOTION	Voltage (1:1)	V	0.1 V / V
DRM	CURRENT (internal)	Current	I	5 A / A
DRM	MOTION	Voltage (1:1)	V	Correct

13 Dynamic Resistance Measurement (DRM)

Application and interpretation

There are several occasions where timing will not give an adequate diagnosis of a CB. By applying the methods described below the electrical distribution system's reliability is increased at the same time as assets are used during their full service life. The time consuming and expensive refurbishing of circuit breakers is also optimized.

DRM may be used for several kinds of diagnostic situations. The most common examples are:

- Measuring of operating distance between main and arcing contacts to verify arcing contact wear and/or positions.
- Timing and arcing contact length measurements on parallel contacts.
- Timing and arcing contact length measurements on breakers with both-sided grounded.
- Indicating abnormalities in contact resistance.

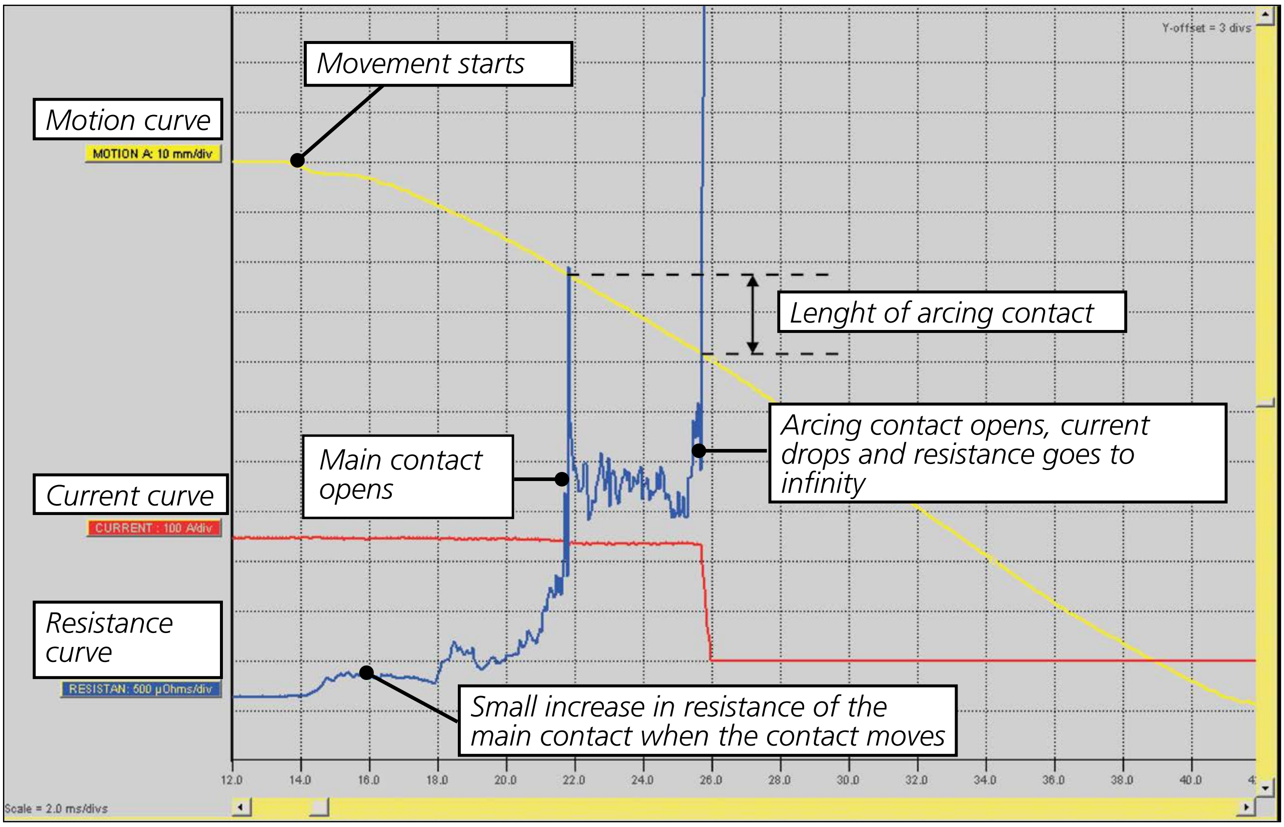


Fig. 9.1 Interpretation of DRM recording for evaluation of arcing contact length.

There are three graphs in the figure, Current (Red), Resistance (Blue) and main contact travel (White). The event is an Open operation. The current is injected and remains as long as the main or arcing contact is closed. The resistance is calculated by applying Ohms law on the voltage drop over the CB knowing the injected current. The motion is measured by a transducer applied on a moving part of the breaker and recalculating this into movement of the main contact within the CB.

14 Specifications

Specifications SDRM201/202

Inaccuracy is specified for 1 year after calibration at 22 °C to 28 °C, relative humidity 90%. Specifications are valid, after 30 minutes warm up time. Specifications are subject to change without notice.

Environment

Application field	The instrument is intended for use in high-voltage substations and industrial environments.
Installation category	CAT I
Pollution degree	2
Temperature	
Operating	-20°C to +50°C (-4°F to +122°F)
Storage & transport	-40°C to +70°C (-40°F to +158°F)
Vibration	IEC 60068-2-6 2 g for 5-500 Hz
Shock (non-operating)	IEC 60068-2-27 30 g, half-sine, 11 ms
Degree of protection	
SDRM201/202 (Box) and SDRM Cable interconnected	IP 43
SDRM Cable	IP 41
Humidity	5% – 95% RH, non-condensing

CE-marking

LVD	2006/95/EC
EMC	2004/108/EC

General

Dimensions	
SDRM201/202	160 x 240 x 90 mm (6.3”x 9.4”x 3.5”) excl. binding posts
Weight	
SDRM201	1.3 kg (2.9 lbs) 2.5 kg (5.5 lbs) incl. current cables
SDRM202	1.8 kg (4 lbs) 3.1 kg (6.8 lbs) incl. current cables
Total incl. transport case with accessories	SDRM202 11 kg (24 lbs) SDRM201 9.4 kg (20.7 lbs)
SDRM Cable TM1600/1800	0.2 m (0.7 ft), 0.5 kg (1.1 lbs)
SDRM Cable EGIL	0.2 m (0.7 ft), 0.6 kg (1.3 lbs)
Extension cable	7.5 m (24.5 ft), 0.7 kg (1.5 lbs)

Power inlet

24 V / 2.5 A

Voltage	24 V DC (max) 21 V DC (min)
Current	2.5 A (max 50% intermittence)

SDRM201/202 – Terminals

CURRENT OUTPUT terminals – and +

Open circuit	2.5 V DC (max)
Short circuit current (max)	
Instantaneous	500 A DC
After 2 seconds	150 A ±10%
Minimum current with cables	
Instantaneous	200 A DC
After 1 second	140 A DC
Overvoltage protection	45 V between terminals and between terminals and ground

Not to be connected to circuits generating peak power pulse above 1500 W (10/1000 µs)

SDRM Cable – Terminals

TM1800 / TM1700/TM1600
ANALOG INPUT terminals I_1 and I_2

Voltage (max)	12 V DC
Voltage	10 V/250 A (TM1800/TM1700) 1 V/250 A (TM1600)
Short circuit current (max)	100 mA
SRM inaccuracy	1% ±1µΩ

TM1800 / TM1700/TM1600
DRM OUTPUT terminal / TRIG terminal

Voltage	60 V DC (max)
Trig threshold	9 V (min) 10 V (max)
Trig current at trig threshold	40 mA (max)

SDRM Cable – Terminals

EGIL
SDRM terminal

Measurement ranges	
DRM / MOTION mode	0 – 32 mΩ
SRM mode	0 – 2 mΩ
DRM mode	0 – 32 mΩ
SRM inaccuracy	2% ±2 µΩ

Pin	*Signal*	*Maximum rating*
1	Current sense output	-12 V < U < 12 V -12 mA < I < 12 mA
2	Common	N/A
3	+15 V supply input	18 V DC, 100 mA DC
4	-15 V supply input	-18 V DC, -15 mA DC
5	Voltage sense output	-12 V < U < 12 V -12 mA < I < 12 mA
6	Trig input/output	15 V DC, 10 mA
7	Relay output	18 V, 90 mA

Circuit Breaker
VOLTAGE SENSE terminal

Pin	*Signal*	*Maximum rating*
1	Voltage sense + input	6.8 V, 25 mA
2,4, Shield	Protective earth ⏚	N/A
3	Voltage sense – input	0 V
5	Not connected	N/A

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- Motor & Phase Rotation Test Equipment
- Multimeters
- Oil Test Equipment
- Portable Appliance & Tool Testers
- Power Quality Instruments
- Recloser Test Equipment
- Relay Test Equipment
- T1 Network Test Equipment
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