1SFC170020M0201 EN, REV A

Arc Guard System™ – CSU-2LV/2MV

Installation and maintenance guide

Read this first
Warning and safety

Thank you for selecting the ABB TVOC-2 Arc Guard System™. Carefully read and make sure that you understand all instructions before you mount, connect, configure the CSU-2.

This manual is intended for installation and maintenance of the CSU-2 Current Sensing Unit.

The manual is available on:

http://new.abb.com/low-voltage/products/arc-guard

- Only authorized and appropriately trained personnel are allowed to install and make the electrical connection of the Arc Guard System™ in accordance with existing laws and regulations.
- Only authorized personnel are allowed to do service and repair on the Arc Guard System.
- Unauthorized repair will affect the warranty.
- This manual is a part of the CSU-2 Current Sensing Unit. Always keep this manual available when working with the CSU-2.
- Examine the Arc Guard System™ and the package when you unpack your new product. If there are damages, please contact the transportation company or the ABB reseller/office immediately.

Safety notes

In this user manual, these symbols are used:

WARNING

General warning symbol indicates the presence of a hazard which could result in personal injury and damage to equipment or property.

WARNING

Warning symbol indicates the presence of hazardous voltage which could result in personal injury.

INFORMATION

Information sign alerts the reader to relevant facts and conditions.

Modifications to data in this manual can be applied without notice.

General safety information

WARNING

Only authorized and appropriately trained personnel are allowed to install and make the electrical connection of the Arc Guard System™ in accordance with existing laws and regulations.

WARNING

Examine the Arc Guard System™ and the package when you unpack your new product. If there are damages, please contact the transportation company or the ABB reseller/ office immediately.

WARNING

Only authorized and appropriately trained service personnel are allowed to do service and repair on the Arc Guard System. Note: unauthorized repair will affect the warranty.

Personal

Service and repair should be performed by authorized personnel only. Note that unauthorized repair affects safety and warranty.

Arc Guard System™ – CSU-2LV/2MV

Installation and maintenance guide

1 About Arc Guard System™

Arc Guard System™ quickly detects an arc and trips the incoming circuit-breaker. Using light as the main condition, Arc Guard System™ trips instantaneously. Thanks to this key functional advantage, it overrides all other protections and delays, which is crucial when reaction times need to be measured in milliseconds.

The Arc Guard System™ consists of the Arc Monitor TVOC-2, optical sensor and Current Sensing Unit CSU-2. Optical sensors used for detection of the arc and optional current sensing unit for detection of over current.

One or more current sensing units CSU-2 can be added to the system as a measure to prevent unintentional tripping from strong light, for example, the sun.

The basic function acts in three phases:

- **Detection** is light passing through an optical sensor.
- **Recognition** is the Arc Monitor determining the intensity of light and optionally Current Sensing Unit determining over current.
- **Action** is the trip contact closing.

2 Safety

2.1 Introduction

This chapter describes the safety principles and procedures to be used when working with the Arc Guard System™ or the CSU-2. It does not cover how to design for safety nor how to install safety related equipment. The chapter first presents the applicable safety standards. Finally the chapter finishes with information about how to work in a safety manner.

2.2 Applicable safety standards

2.2.1 Safety standards

The CSU-2 has improved safety to fulfill the safety standards specified in the following directives:

Table 1 Safety standards

Directive	Description
2006/95/EC	Low voltage equipment
2004/108/EC	Electromagnetic compatibility

2.2.2 Personal safety

INFORMATION

This product has been designed for environment A. Use of this product in environment B may cause unwanted electromagnetic disturbances in which case the user may be required to take adequate mitigation measures.

- Environment A relates to low-voltage nonpublic or industrial networks, locations and installations including highly disturbing sources.
- Environment B relates to low-voltage public networks such as domestic, commercial and light industrial locations, installations. Highly disturbing sources such as arc welders are not covered by this environment.

To ensure safety and quality the CSU-2 has been tested according to the following standards:

Table 2 Safety standards

Directive	Description
IEC/EN 60947-1	Low-voltage switchgear and controlgear - General
IEC/EN 60947-5-1	Low-voltage switchgear and controlgear - Control circuit devices and switching elements
IEC 61000-6-2 (2005)	Electromagnetic compatibility (EMC) - Immunity for industrial environments
IEC 61000-6-4 (2006)	Electromagnetic compatibility (EMC) - Emission standard for industrial environments
IEC 61326-1 (2005) IEC 61326-3-1	Electrical equipment for measurement and control Electrical equipment, control and laboratory use (EMC)
IEC TS 61000-6-5	Electromagnetic compatibility - immunity power stations and substation environments

2.3 Safety signs

This section specifies all dangers that may arise from performing the work detailed in the manual.

WARNING

Caution symbol indicates the presence of a hazard which could result in personal injury.

WARNING

Warning symbol indicates the presence of a hazard which could result in damage to equipment or property.

Make sure that the supply voltage has been switched off before connecting!

Working with high voltage is potentially lethal. Persons subjected to high voltage may suffer cardiac arrest, burn injuries, or other severe injuries. To avoid these hazards, do not proceed working before removing the power to the Arc Guard System.

Arc Guard System™ and CSU-2 are designed to protect people and installation equipment. Install your system components and CSU-2 before supplying power.

INFORMATION

Information sign alerts the reader to relevant facts and conditions.

2.4 Work in safety manner

Safe working methods must be used to prevent injuries. The safety equipment must not be disengaged, bypassed or in any other way modified so that the safety effect ceases.

2.4.1 Handling the CSU-2

The CSU-2 may only be used for the purposes mentioned in this manual. The CSU-2 was developed, manufactured, tested and documented in accordance with applicable safety standards. If you follow the instructions regarding safety and use as described in this manual, the product will, in the normal case, neither cause personal injury nor damage to machinery and equipment.

To avoid malfunctions or damage through improper handling, follow these instructions during transportation, installation and maintenance:

- Transport with care. Do not drop, throw, or give the CSU-2 a strong shock. It can cause breakage or failure.
- Handle with care. Do not drop, throw, or give the CSU-2 a strong shock. It can cause breakage or failure.
- The CSU-2 is installed by authorized personnel only.
- This manual is a part of the CSU-2 and should always be accessible to personnel working with this product.
- Read and understand the manual thoroughly before performing any installation or commissioning.
- CSU-2 is constantly sending light to the CSU input at the Arc Monitor during normal conditions (for safety and reliability reasons). The light might decrease over time and should be checked every year by a manual diagnostic test. See more information in chapter Maintenance and in HMI functions.
- A log is kept that indicates if the light level had decreased below a certain level. If so, the CSU-2 should be replaced within the next 6 months.
- The safety of the system will not be affected if the CSU-2 is not replaced. However, when the light level becomes too low then the Arc Monitor will recognize this as a high current situation. And then the system functions as if there was a no current condition, that is, trip on light at optical detectors only.

2.4.2 Storage

Storage in original package requires a temperature range of between, -25 C° to +70 C° (-13F to + 158F) and a humidity maximum 95%.

2.4.3 Limitation of liability

The safety information in this manual must not be considered as a guarantee from ABB that the equipment cannot cause accidents or injury, even if all the safety instructions have been observed.

2.5 Security guidelines

2.5.1 Security disclaimer

This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

2.5.2 Risk Mitigation and Secure Deployment

To prevent equipment to operate in an unsafe or undesirable manner due to malicious activities the CSU-2 unit must be positioned in a trusted network, strictly limited and in a hosted portion of a network or control system. When a Serial to Ethernet Converter is used, the user is responsible for creating a defence-in-depth protection for each network by allocating firewall solutions to the front of internal trusted networks of each network by manage firewalls, their configurations and access rules. For secure remote access, use a VPN connection with an encryption layer to create a secure channel over an insecure network. Separate the management systems and connections to separate network segments with all necessary cybersecurity features on and deny all other connectivity mechanisms from automation systems to restrict unauthorized access. The user of the product should be aware that the unsecure nature of the serial Modbus protocol exposes the communication between the product and the control system. Authentication and integrity of transmitted information is not provided by the protocol. The main security is provided through monitoring the cybersecurity, topology (asset management) and correct operation of the data networks using the cybersecurity monitoring modules and features of the firewalls and managed switches.

3 Current Sensing Unit, CSU-2

3.1 Introduction

This chapter describes the functions available in the CSU-2.
The chapter is divided in two parts:

- Overview of the CSU-2.
- Functions of the CSU-2.

3.2 Overview of CSU-2

The CSU-2 consists of:

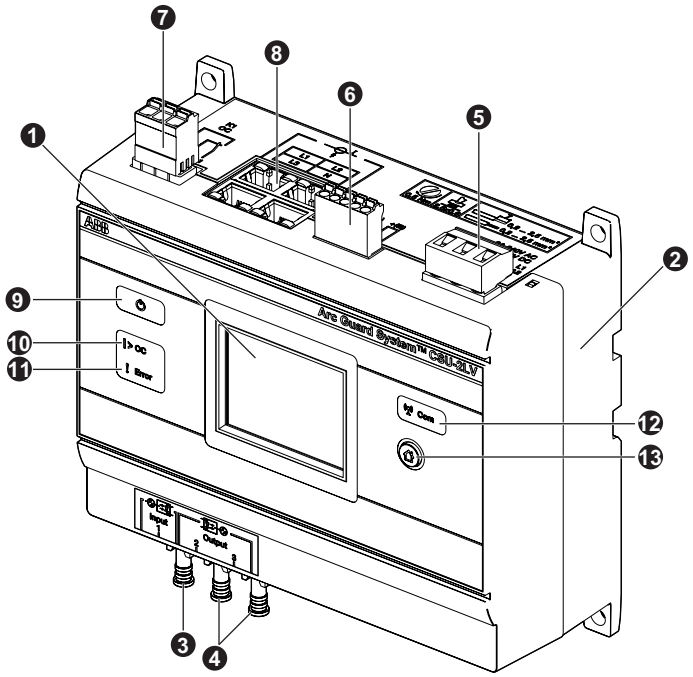


Figure 1
CSU-2 overview

Table 3 Overview of CSU-2

Number	Part	Number	Part
1	Human Machine Interface, HMI	**8**	Current sensor inputs
2	CSU-2	**9**	Power LED (Green)
3	CSU-2, Optical Input	**10**	Over Current LED (Red)
4	CSU-2/TVOC-2, Optical Outputs	**11**	Error LED (Red)
5	Power supply	**12**	Communication LED (Yellow)
6	Modbus	**13**	Home Button
7	Over current relay K1		

3.2.1 CSU-2

The Current Sensing Unit (CSU-2) is an accessory needed in specific applications where strong light is expected on a regular basis. Current Sensing Units are connected with an optical cable using a light as signal for normal current. If the connection to CSU-2 is lost an error message will appear on the TVOC-2 HMI display after 10 seconds. The safety function of the Arc Guard System™ will not be affected.

3.2.2 Human Machine Interface, HMI

The Human Machine Interface is used for all communication with the user and also to confirm any changes. The HMI has a non-erasable memory that holds trip logs and error logs even after power loss including a time stamp.

3.2.3 Current Sensor Inputs

Current sensors are connected to the CSU-2 through the four connectors. There are four inputs: L1, L2, L3, N.

3.2.4 Optical Outputs

This optical output shall be connected to the Arc Monitor or another CSU-2 unit. Light ON indicates a normal current level. If there is an ongoing over current event or an internal error the light is OFF.

3.2.5 Over Current and Current Warning

Over current occurs when the current level is above the set over current threshold level. The current warning occurs when the current level is above the set current warning threshold level. It is recommended to set the current warning threshold level to be lower than over current threshold level as in **Figure 2**. Over current provides a “fast trip”. When over current is detected, over current LED in **“Table 3 Overview of CSU-2” on page 14** is turned RED and Relay K1 is set. The current warning is not designed to provide a quick warning, only to alert the user of abnormal levels of current. Auto reset function resets the over current event after the over current level is below the set threshold level.

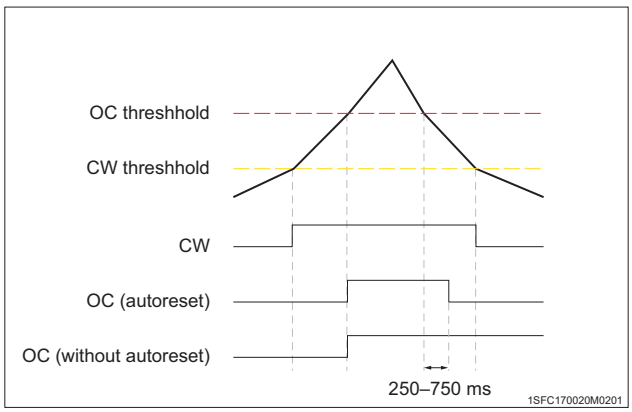


Figure 2
Over Current and Current Warning

3.2.6 Signal Relay

The Over current relay K1 is used to signal when over current occurs. The relay can be used to activate an alarm or to pass the trip information to a supervising system.

If the system is configured for manual reset, K1 is energized until the user resets in the trip notification window on the Human Machine Interface (HMI). If the system is configured for auto reset, K1 is de-energized 250-750 ms after the current level is below the set threshold level.

3.2.7 Current Sensors

The current sensors are based on the principle of the Rogowski coil. The sensors consist of an air-core winding, immune to any risk of saturation as they have no ferromagnetic core. The measurement is linear over the whole measuring range. The output signal is a voltage, which is proportional to the derivative of the current.

3.2.8 Event Logs

The event log is divided into 4 parts, “Over current”, “Current warning”, “Error”, “Parameter change”, each displaying info of their type.

Each event log holds the 10 last events of its type when each individual event log is full, the oldest event will be removed upon the arrival of a new event of that type.

The “Combined” event log will show all events sorted upon the time of occurrence, this log shows a maximum of 4 x 10 = 40 events.

Even if the internal time of the CSU-2 has been reset or changed, the events in all of the logs will always be presented in correct order after the time of occurrence.

3.2.9 Backup

CSU-2 saves all parameters internally but has no built in support for backups. To ensure that the device can be restored to a known good state, manual backup of parameters via display and or Modbus has to be performed (parameters “automatic reset”, “language” and “brightness” can not be accessed via Modbus).

3.2.10 Home button

The home button allows to:

- Navigate to home.
- Restart the setup sequence during the start-up sequence.
- Reset Current Warning. That is to say, pushing the home button, it can help you to leave Current Warning notification window.
- Wake up the screen during sleep mode.

3.2.11 LED descriptions

For LED descriptions see **“8.3.1 LED-lights” on page 73.**

4 Installation

4.1 Introduction

This chapter describes how to install the CSU-2 and set up the system.

The installation of CSU-2 is performed in steps. After finishing one step you proceed to the next one. The sequence is mandatory.

4.2 Installation procedure

WARNING

The reader should have the knowledge and follow the applicable safety laws and standards as well as local safety instructions.

Installation procedure consists of the following five steps:

- Getting started
- Mounting
- Optical connections
- Electrical connections
- Configuration

Tools required

To mount the CSU-2 the following tools are required:

- Screwdriver, 2.5 x 0.6 mm (0.98 x 0.23 inch)
- Phillips screwdriver 4.3/2
- Drill 5 mm (0.196 inch), in case of wall mounting.

4.2.1 Getting started

This section describes instructions on how to receive and check the CSU-2.

Do the following steps:

Receiving and checking

1. Turn the package with the correct side up.
2. Remove the transport casing.
3. Visually inspect the CSU-2.
4. Check that all items are included, according to the delivery document.

List of contents

Check the contents in this package as follow:

- CSU-2
- Quick installation guide
- Safety Information

INFORMATION

This package is a basic starter kit. If you need more according to your system needs then contact your local supplier.

Intermediate storage

Until the CSU-2 is mounted it should be stored in its original package.

4.2.2 Mounting CSU-2

This section describes the procedure to mount the CSU-2.

The procedure is divided into the following components:

- CSU-2
- Current Sensors

Placing CSU-2

The CSU-2 can be mounted anywhere in the switchgear, for example in the breaker cubicle or in a separate control cabinet.

Mounting CSU-2

This section describes how to mount the CSU-2 at its location.

The CSU-2 can be mounted on:

- A wall
- DIN Rail

Mounting on wall

Follow the steps below to mount the CSU-2 on the wall:

1. Predrill holes in the wall to fit screws 5M. See **Figure 3** for dimensions.
2. Place the CSU-2 on the wall.
3. Screw-in each corner of the CSU-2.
4. Use a torque wrench and torque the screws to 2.4 Nm.

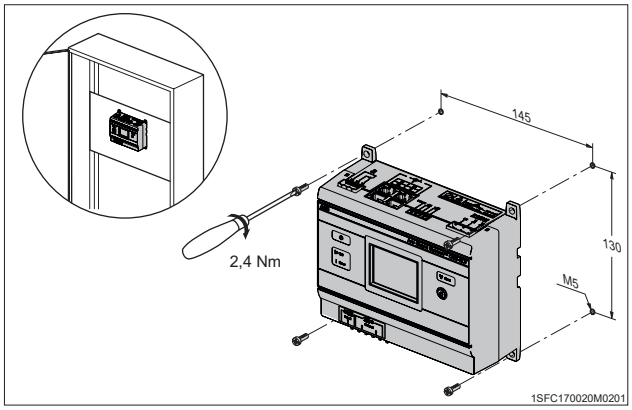


Figure 3
Mounting on wall

Mounting on a DIN rail

Follow this procedure to mount the CSU-2 on a DIN rail:

1. Hook the CSU-2 to the DIN rail.
2. Snap the CSU-2 on to the rail then release the barrier.

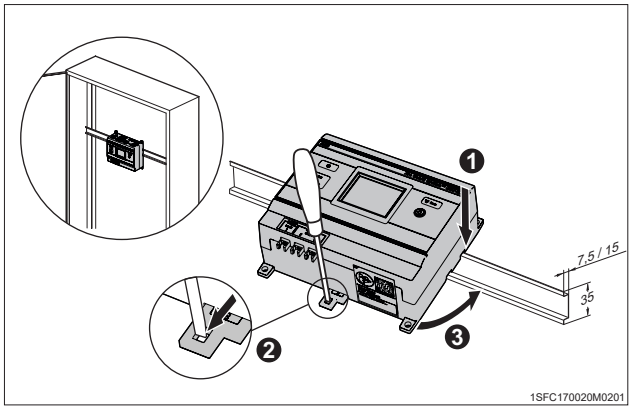


Figure 4
Mounting on DIN rail

Mounting and connecting the CSU-2 to the system

This is a summary of the complete procedure in mounting and connecting the CSU-2.

WARNING

Make sure that the supply voltage is switched off before mounting and connecting the CSU-2!

To mount and connect the CSU-2 do the following steps:

1. Connect optical cables (option) to current sensing units before this unit in the chain to input (1). **See: “Connecting optical cables” on page 23.**
2. Connect an optical cable to arc monitor or next CSU-2 to outputs (2 and/or 3). **See: “Connecting optical cables” on page 23.**
3. Connect electrical connections. **See: “Connecting electrical connections” on page 23.**
4. Place and mount the current sensors. This installation guide contains examples for placing the sensors and information on how to mount. **See: “Mount current sensors” on page 24.**
5. Connect current sensors to the CSU-2.
6. Supply the system with power.
7. Go through the Start-Up sequence in Human Machine Interface, HMI. **See: “4.3.1 Start-Up Sequence” on page 27.**
8. Controlling the current sensors and the system. **See: “4.3.2 Controlling” on page 28.**

Connecting optical cables

WARNING
Make sure that the supply voltage is switched off!

Follow these steps to connect the optical cables.

1. Remove the protection plug.
2. Connect optical cables to the lower left side of CSU-2.

The input 1 is for connecting a CSU-2 unit and outputs 2, 3 is for connecting the Arc monitor/Current sensing unit (TVOC-2/CSU-2).

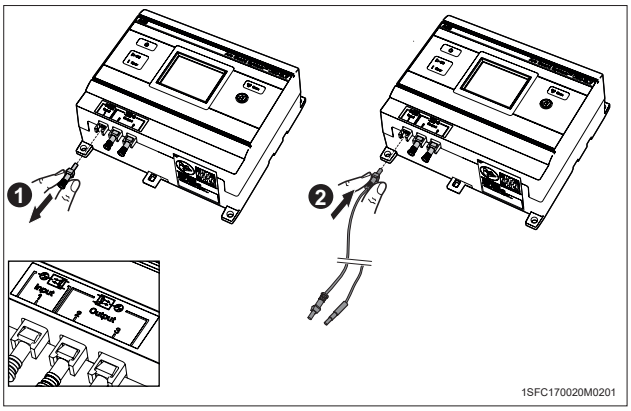


Figure 5
Connect optical cables

Connecting electrical connections

WARNING
Make sure that the supply voltage is switched off!

This section describes how to connect the electrical connections to the CSU-2 and to the Arc Guard System.

Electrical connections are:

1. Over current relay (K1 OC)
2. Modbus (DGND, -(A), +(B))
3. Current sensor inputs (I: L1, L2, L3, N)
4. Power supply (PE, N/A1, L1/A2)

The connections are on top of the CSU-2 see **Figure 6**.

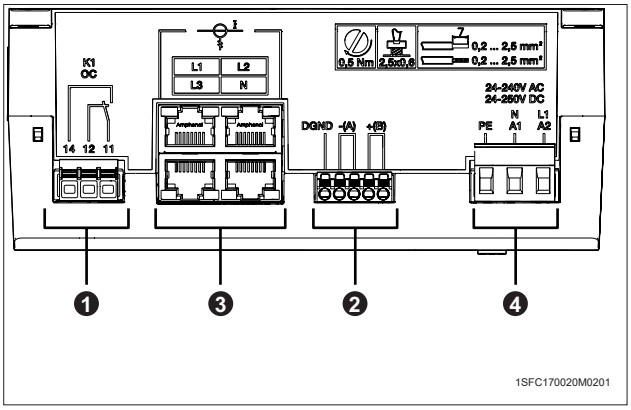


Figure 6
Electrical connections

Connecting the CSU-2

WARNING
Make sure that the supply voltage is switched off!

Connect the over current relay, see **Figure 7** and follow the steps below:

1. Connect wires for over current relay K1.
2. Cable area 0.2 - 2.5 mm² (0.078 x 0.98 inches²).
3. Connect cable for K1 to: 14,12,11.

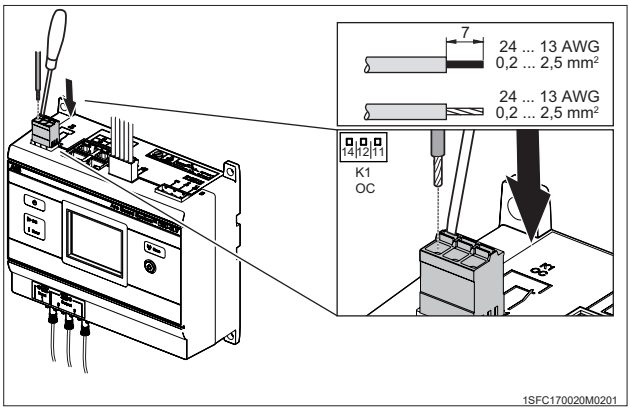


Figure 7
Connecting the over current relay

Connecting Modbus

WARNING

Make sure that the supply voltage is switched off!

Follow these steps to connect the Modbus, see **Figure 8**.

1. Connect wires for the Modbus.
2. Cable area 0.2 - 2.5 mm² (0.078 x 0.98 inches²).
3. Connect the Modbus: DGND, -(A), +(B).

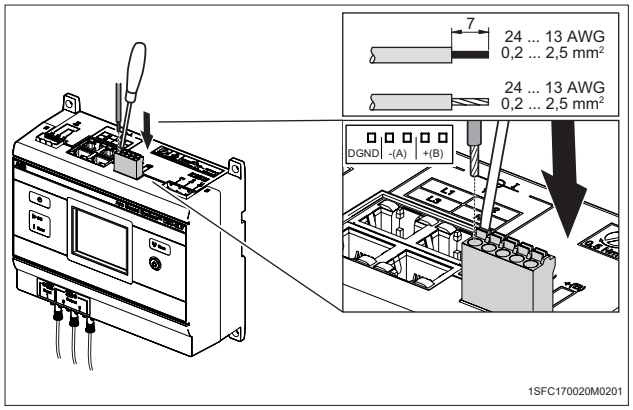


Figure 8
Connecting the Modbus

Connect Power Supply

To connect the power supply do the following steps:

1. Connect wires for power supply, use a torque of 0.5 Nm.
2. Use screwdriver 2.5 x 0.6 mm (0.98 x 0.23 inches).
3. Cable area 0.2 - 2.5 mm² (0.078 x 0.98 inch²).
4. Connect the cable for power supply 24-240V AC / 24-250V DC. See **Figure 9**.

WARNING

Always connect PE to Protective Earth!

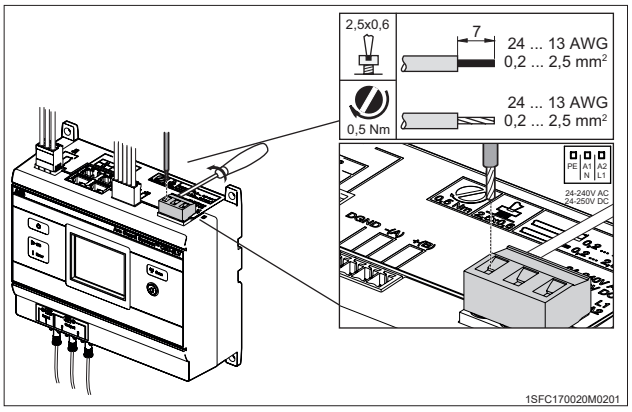


Figure 9
Connecting power supply

Mount current sensors

For the CSU-2LV, use current sensor 1SFA664005R*, see **Figure 10** and follow the steps below:

1. Turn the current sensor locking ring.
2. Open the current sensor.
3. Place and mount the current sensor.
4. Lock the current sensor.

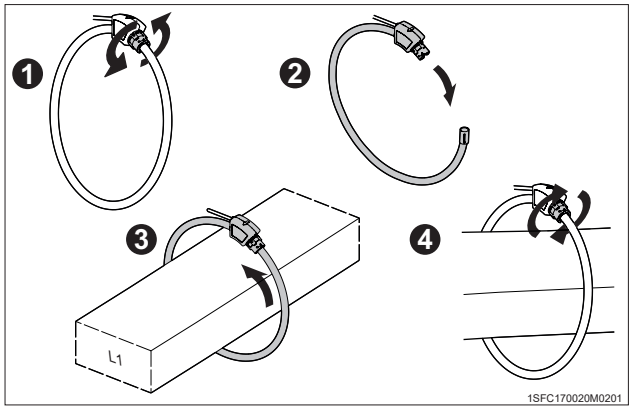


Figure 10
Current sensor 1SFA664005R*

For the CSU-2MV, use current sensors 1VL5400076V0101 or 1VL5400056V10*.

To mount current sensors 1VL5400076V0101, see **Figure 11** and follow the steps below:

1. Release the current sensor snap-lock.
2. Open the current sensor.
3. Place and lock the current sensor around the MV cable.
4. Adjust and center the current sensor to the MV cable diameter.
5. Connect the current sensor to ground.
6. Ensure the sensor stays in position with a tightening strip.

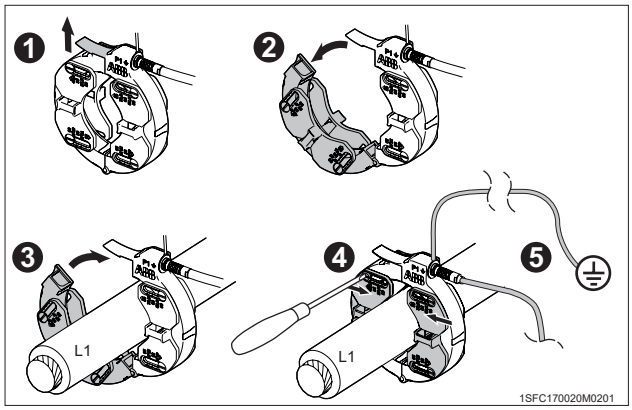


Figure 11
Current sensors 1VL5400076V0101

To mount current sensors 1VL5400056V10*, see **Figure 12** and follow the steps below:

1. Put the MV cable through the current sensor.
2. Adjust and center the current sensor to the MV cable diameter.
3. Connect the current sensor to ground.
4. Ensure the sensor stays in position with a tightening strip.

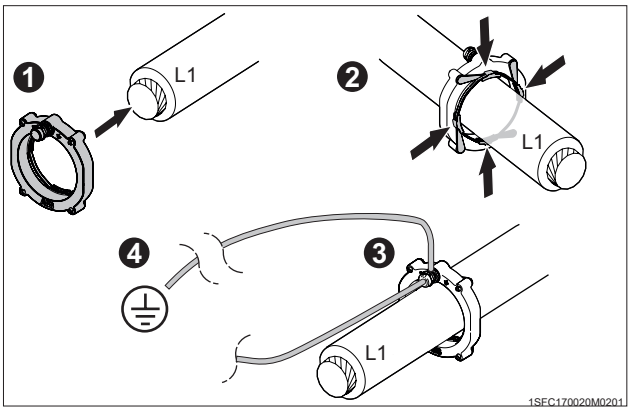


Figure 12
Current sensors 1VL5400056V10*

Connect current sensors

General: Current sensor interface according to IEC 60044-7/-8 (pin 4, 5) and IEC 91869-6/-10/-11 (pin 1, 2).

1. Place and mount the current sensors.
2. Connect the current sensors to CSU-2 inputs, L1, L2, L3 or N, depending on the configuration. See **Figure 13.**

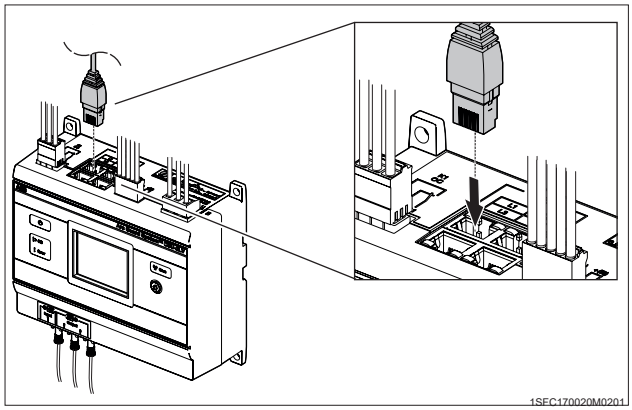


Figure 13
Connecting current sensors

4.2.3 Configurations

Power on the CSU-2

WARNING

Working with high voltage is potentially lethal.

Before switching the power supply on, follow the steps below:

1. Check your installation.
2. Check that electrical connections are orderly connected.
3. Check that the configuration is set for your system.
4. Make sure the supply voltage is according to the product marking label.
5. Make sure you do not leave any working tools in the switching gear.

The CSU-2 turns on automatically when the power is switched on. There is no ON/OFF switch.

Checking power on CSU-2

When the CSU-2 is on check the following:

- Green Power LED, see **“Table 3 Overview of CSU-2” on page 14**, on HMI is lit.
- HMI is showing text.

4.3 Setting the system

This chapter describes the eight mandatory steps to succeed in setting the system. All settings are done in the Human Machine Interface, HMI. Settings are made only with the power on.

4.3.1 Start-Up Sequence

Installation of the CSU-2 requires configuration of the system and its modules to work. This start-up is mandatory. The same start-up occurs when operating the CSU-2 for the first time and after a factory reset. The Human Machine Interface (HMI) automatically goes through the different configuration steps.

For more information, see section 5.2.

To do the Start-Up sequence follow the steps below, at all times the home button can be pressed to restart the start-up sequence:

1. Language
2. Set date
3. Set time
4. Inputs (Number of Current Sensors)
5. Correction factors (Only CSU-2MV)
6. Warning (Current Warning threshold)
7. Over Current (Over Current threshold)
8. Automatic reset
9. Daisy chain

INFORMATION

The system will not require the Start-Up sequence in the event of a power loss.

4.3.2 Controlling

INFORMATION

Do the test after installation and before the CSU-2 is used!

This test is done for each installed current sensor and the CSU-2. The test will check that the current sensor reacts to current and the HMI will display a notification window showing which current sensor that detected high current. The TVOC-2 or CSU-2 that is connected to the outputs will react on this CSU-2 signaling high current. The over current relay K1 will also be energized upon detection of high current.

Testing the installation

Connect CSU-2 to secondary testing equipment to measure the current of current sensor inputs. See **Figure 14**. Do the following steps to check the current measurement:

1. Prepare 4x shielded cables terminated with RJ45 connectors. See **Figure 15**.
2. Connect the RJ45 connectors to current sensor inputs, L1, L2, L3, N.
3. For each testing the testing sensor cable, wire 4 (blue) should go to plus (+) on the tester. Wire 5 (white/blue) should go to common (-/GND) on the tester. Wire 1, 2, 3, 6, 7 and 8 should not be connected to any. See **Figure 15**.
4. Configure all four current sensor inputs, L1, L2, L3, N, and navigate to Main / Settings / Parameters / Inputs. Select “L1 L2 L3 Neutral”.
5. Run analogue signals and compare the current signals with readings (Main / Reading) for each current sensor input.

   CSU-2LV: Input of 361 mV RMS 50 Hz corresponds to 1000 A.
   CSU-2MV: Input of 1.852 V RMS 50 Hz corresponds to 1000 A.

   Readings from HMI should be close to the current level from the tester.
6. If an over current is detected correctly and causes a trip then it should show on the HMI display as a notification window, if auto reset is not configured.
7. The notification window shows the information:
   - Over current has occurred
   - which current sensor input
   - at what time and date.
8. The TVOC-2 and/or CSU-2 that are connected to the CSU-2 should react and show that over current is detected.
9. At the notification window, If manual reset is configured, press Reset. If auto reset is configured, the notification window disappears by itself.

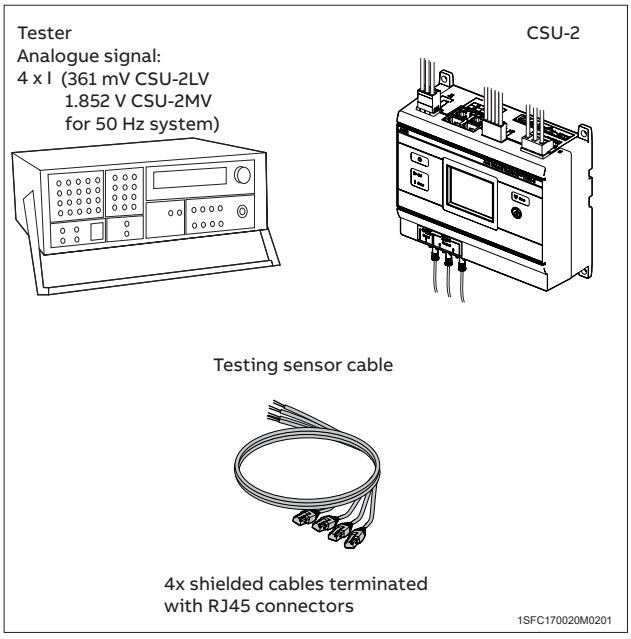


Figure 14
Test setup for CSU-2 current measurement

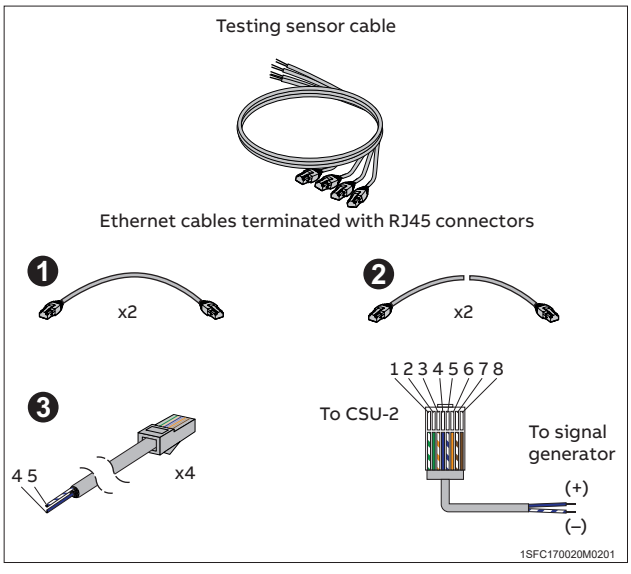


Figure 15
Testing sensor cable for CSU-2

5 Human Machine Interface (HMI)

5.1 Introduction

After power interruptions the Time and Date are set to a default value and needed to be set by the user.

The HMI is accessed through the touchscreen. In the main menu, touch the symbols to reach the subcategories.

In the subcategories, use the arrows up and down and the select button for OK.

To change a value, use the plus and minus.

This chapter consists of the following sections:

- Introduction
- Menu flow chart
- Menu description

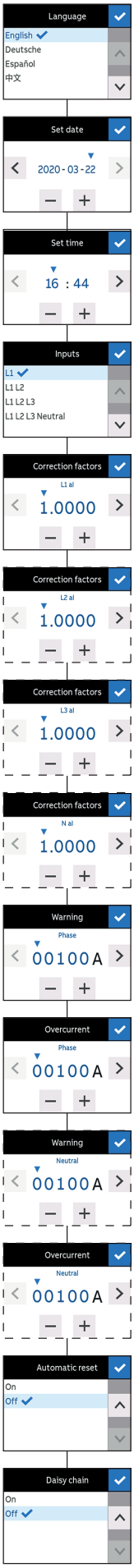
Prerequisites

WARNING

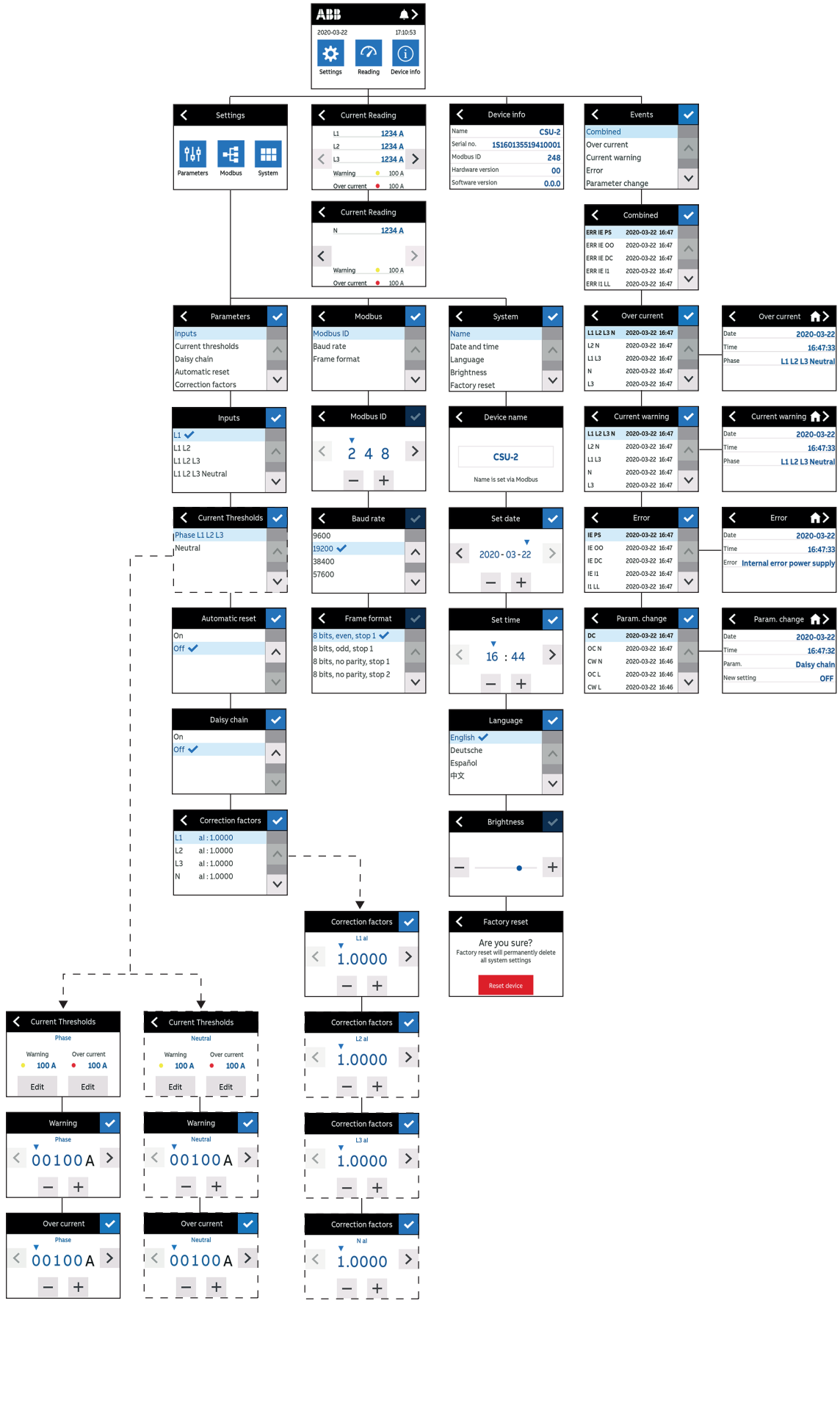
The reader should have knowledge and act according to applicable safety laws and standards as well as local safety instructions.

5.2 Menu flow chart

Startup settings



Main menu



5.3 Menu description

The main menu is structured in four head categories. Each category is divided into subcategories. Some subcategories have sub-sub categories. All categories are numbered accordingly to the structure. For more information, see **“5.2 Menu flow chart” on page 33**.

- Settings
- Reading
- Device info
- Events

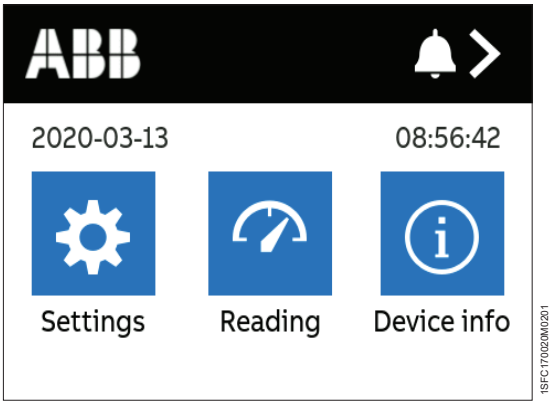


Figure 16
Main menu

5.3.1 Settings

Settings menu consists of three subcategories:

- Parameters
- Modbus
- System

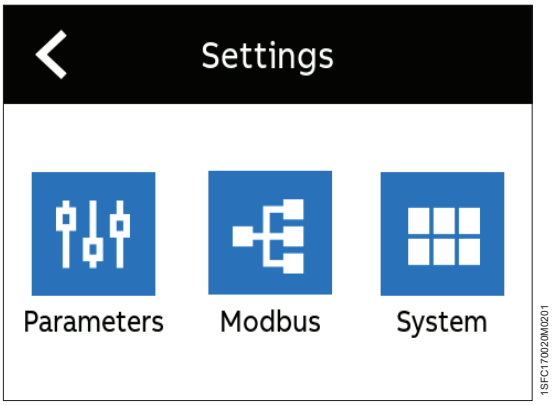


Figure 17
Settings menu

Parameters

System configuration.

- Inputs
- Current Thresholds
- Daisy chain
- Automatic reset
- Correction factors (MV version)

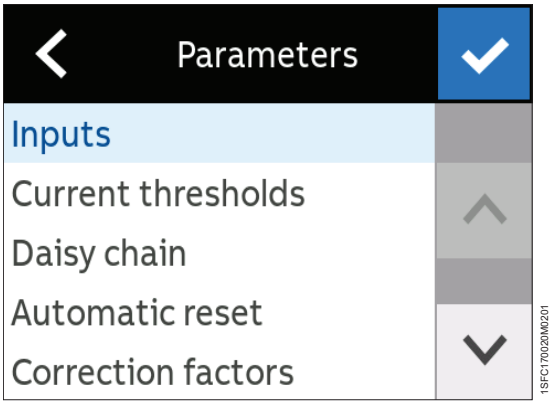


Figure 18
Parameters menu

Modbus

Network communication.

- Modbus ID
- Baud rate
- Frame format

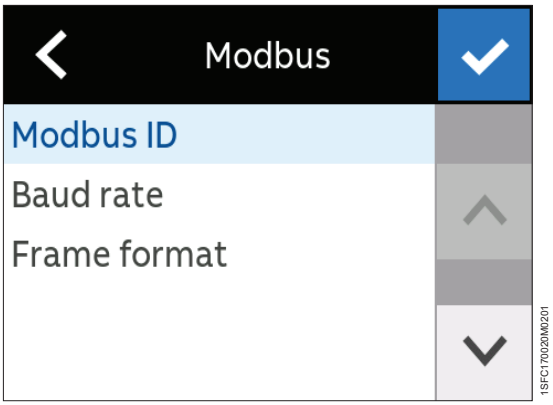


Figure 19
Modbus menu

System

System settings.

- Name
- Date and time
- Language
- Brightness
- Factory reset

5.3.2 Reading

Reading shows the current reading for L1, L2, L3 or N (depending on settings). It also shows the settings for warning and over current.

5.3.3 Device info

Device info shows information about:

- Name
- Serial number
- Modbus ID
- Hardware version
- Software version

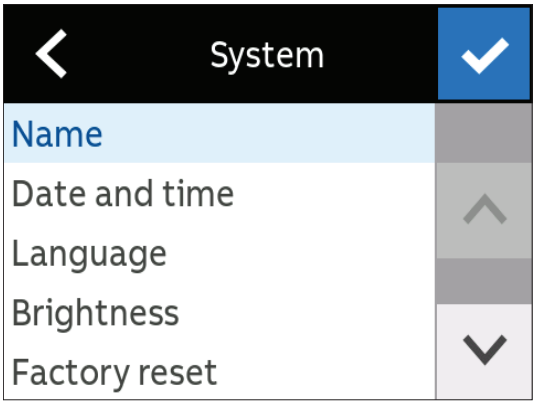


Figure 20
System menu

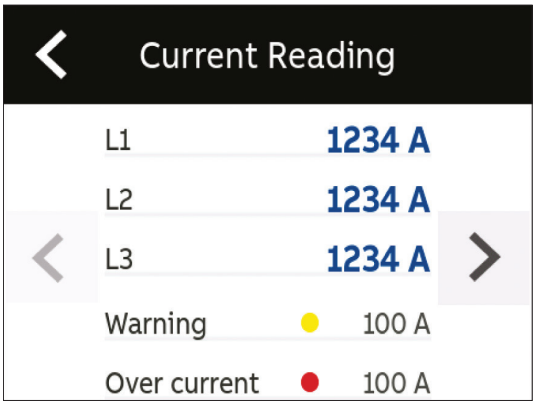


Figure 21
Current reading

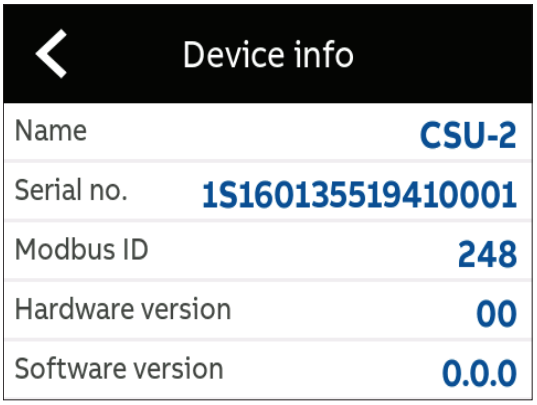


Figure 22
Device info

5.3.4 Events

Events consist of the following subcategories:

- Combined
- Over current
- Current warning
- Error
- Parameter change

Over current events

Over current detected by one or more of the connected current sensors. Each event is stored with time and information about which lines that detected the over current. The log can hold 10 events, once the log is full the oldest event will be removed upon arrival of a new event.

Current warning events

Current warning detected by one or more of the connected current sensors. Each event is stored with time and information about which lines that detected the current warning. The log holds 10 events sorted in order of arrival, once the log is full the oldest event will be removed upon arrival of a new event.

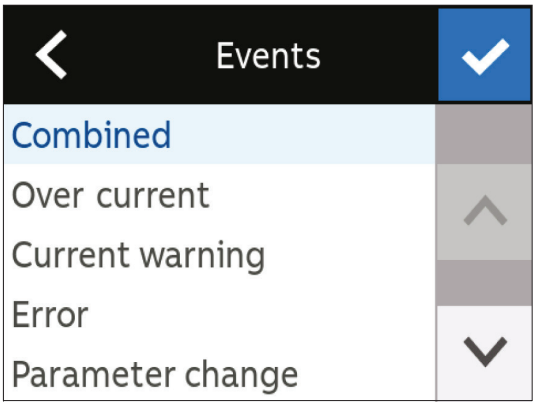


Figure 23
Events

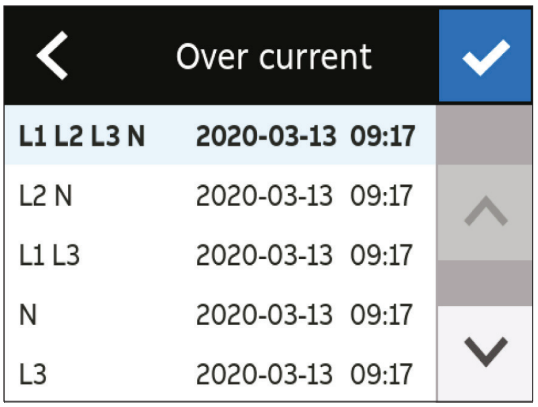


Figure 24
Current warning events

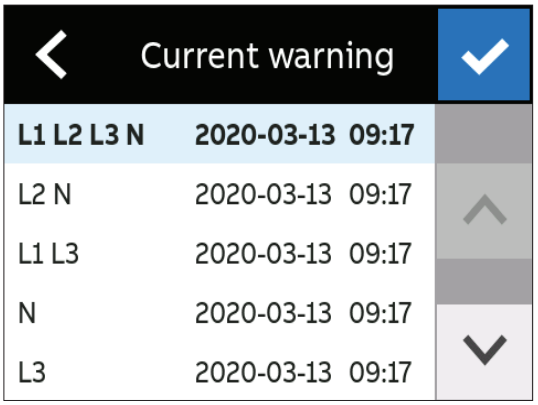


Figure 25
Over current events

Error events

The system is continuously monitored for internal and external errors. Each detected error is stored with time and name of the error. See **“Table 8 List of errors” on page 73** for a full list of possible errors. The log holds 10 events sorted in order of arrival, once the log is full the oldest event will be removed upon arrival of a new event.

Parameter change events

Changes in over current threshold, current warning threshold, phase configuration, daisy chain [on/off] and amplitude correction factor are logged in the parameter change event log. The log holds 10 events sorted in order of arrival, once the log is full the oldest event will be removed upon arrival of a new event.

Combined event log

The combined event log displays all the events of all logs. The log holds 40 events sorted in order of arrival.

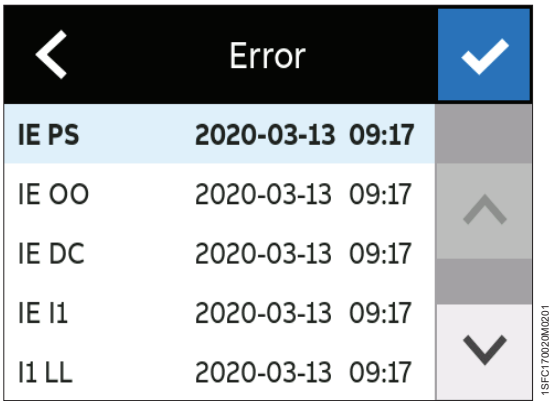


Figure 26
Error events

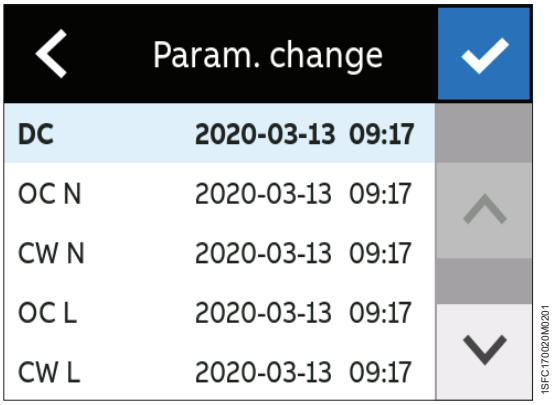


Figure 27
Parameter change events

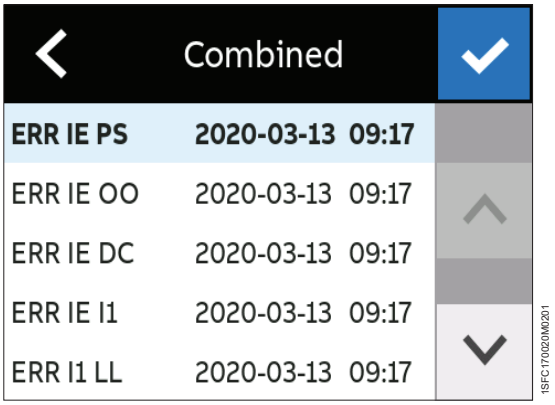


Figure 28
Common event log

6 Modbus

6.1 Introduction

This chapter covers the Modbus interface, which offers a direct connection to Modbus-RTU for the CSU-2.

CSU-2 will behave as a slave. This means all communication will be performed by a master device on the same Modbus system. Mostly this will be a PLC. This manual explains how to install the CSU-2 to your Modbus system.

6.2 References

[1] http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf (2012)

[2] http://www.modbus.org/docs/Modbus_over_serial_line_V1_02.pdf (2006)

[3] https://www.modbusdriver.com/modpoll.html

6.3 Quick start-up

To start-up the Modbus connection, do the following steps:

1. Make sure your Modbus master has been installed to the system.
2. The CSU-2 will be delivered with the following configuration:
   - baud rate 19200
   - parity even
   - stop bits 1
   - Modbus ID 248*

   *Modbus ID 248 is not a valid id for a Modbus system but is used to indicate that the communication is disabled, needs to be changed to get communication to work.
3. Physically connect the system to the Modbus network.
4. Test communication between your master and the CSU-2.

6.4 Installation

6.4.1 General

Modbus RTU is a 2-wire, RS485-based field bus communication system for parameter value exchange. The implementation of the Modbus interface is based on standards [1] and [2].

6.4.2 Connector

The supplied Modbus connector has the following pin configuration:

Table 4 Modbus connector

Terminal	EIA/TIA-485 name	ITr/IDv	Description
+(B)	B/B’	D1	Transceiver terminal 1 Terminator 1 input*
-(A)	A/A’	D0	Transceiver terminal 0 Terminator 2 input*
DGND	C/C’	Common	Signal common

* If the device is connected as first or last device in a multi-drop system, a 120Ω terminator resistor should be installed between terminator inputs (A) and (B).

6.4.3 Cables

Recommended cable: Belden 3105A (AWG22).

6.4.4 Termination

For the best quality of data transfer, Modbus should be terminated correctly.

The following figure shows the Modbus installation:

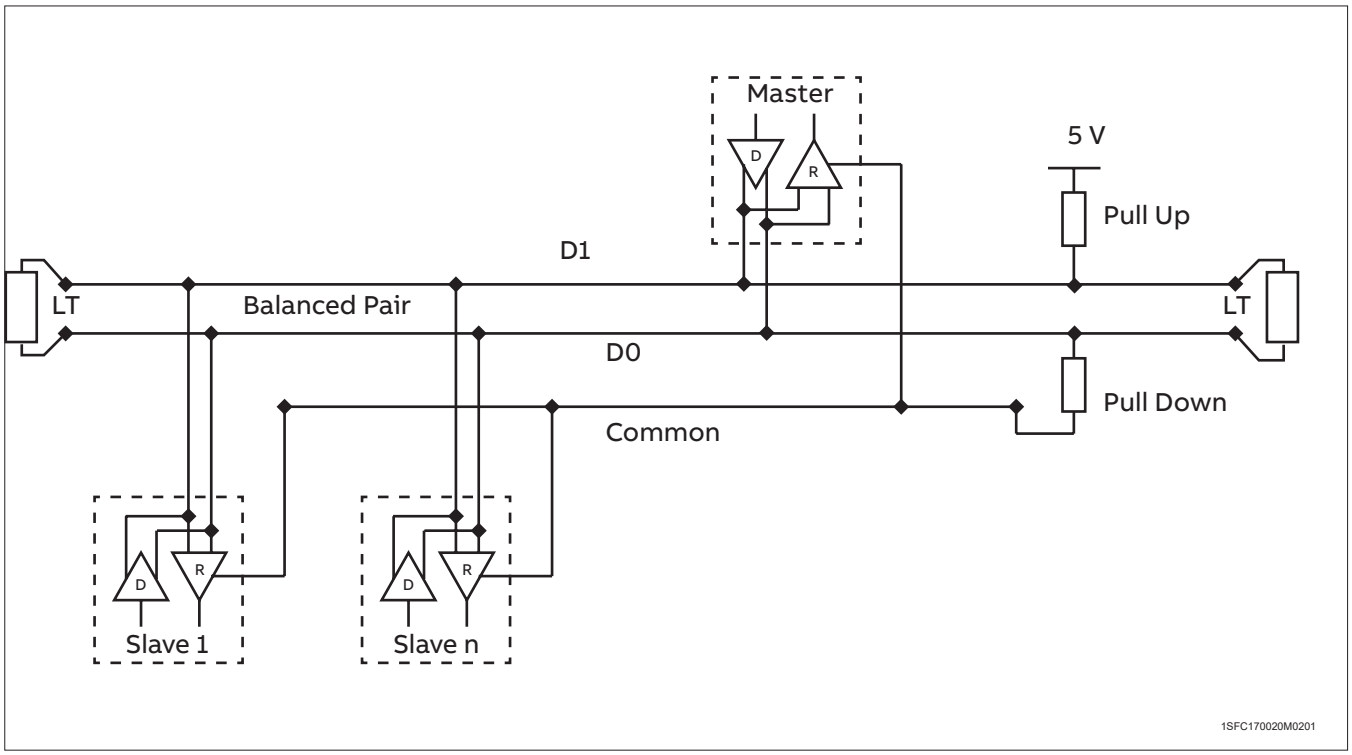


Figure 29
Modbus termination

6.4.4.1 Termination resistors

A 120Ω resistor is added in parallel with the CSU-2 B+ and A- terminals if it is installed as the first or last device on the network. For this purpose, there are double terminals for +(B) and -(A) connections.

6.4.4.2 Pull-up / pull-down resistors

When the Modbus network is not being actively driven by a device, the bus line is in an undefined state. Bias resistors should then be used to obtain a defined voltage potential on the data lines. The bias resistors act for data line B (D1) as pull-up resistors against 5V and for data line A (D0) as pull-down resistors against GND.

The following devices usually have built-in bias resistors:
- Modbus masters
- Gateways
- Repeaters

6.5 Configuration

Modbus configuration is done via the HMI.

Access the Modbus configuration page by first selecting Settings on the Main page.

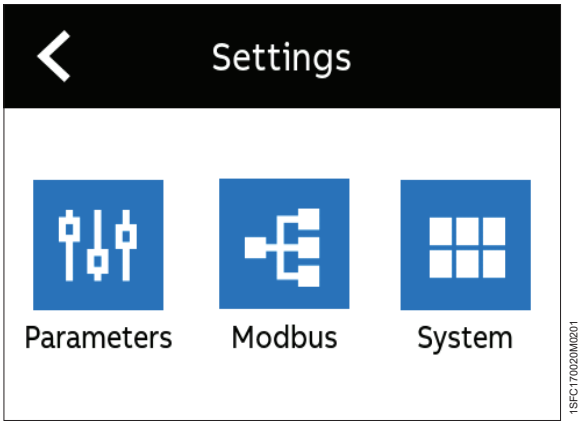


Figure 30
Settings menu

In the sub-menu for Modbus, configure Modbus ID, Baud rate and Frame format.

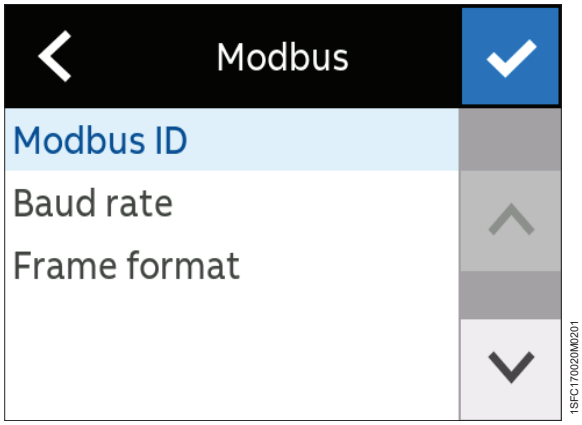


Figure 31
Settings menu

Select Modbus ID according to the existing network. On delivery the default value for Modbus ID is 248.

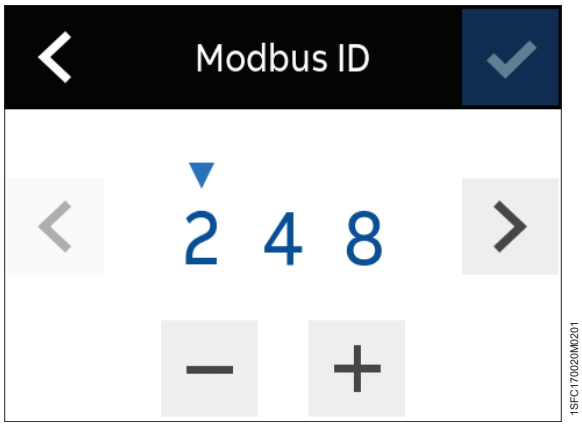


Figure 32
Settings menu

Select Baud rate according to the existing network. On delivery the default value for Baud rate is 19200.

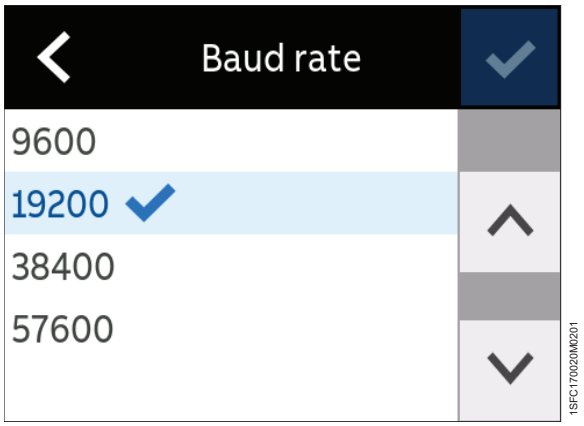


Figure 33
Settings menu

Select Frame format according to the existing network. On delivery the default value for Frame format is 8 bits, even, stop 1.

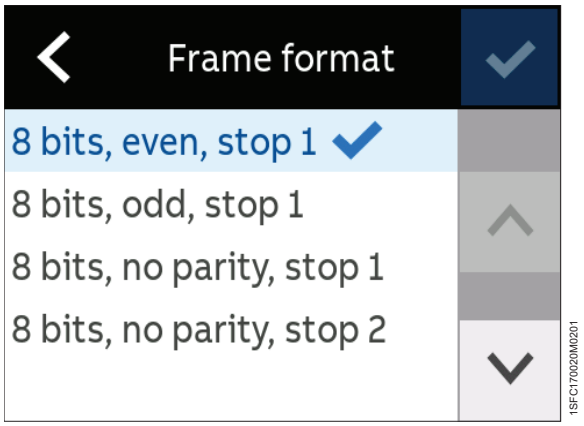


Figure 34
Settings menu

6.6 Functional description

The information found here is the basic information needed for the installation of CSU-2 in a Modbus system.

6.6.1 Implementation class

The physical and data link layers are implemented conforming to the “basic slave” implementation class as described in document [2] “MODBUS over Serial Line specification and implementation guide V1.02”. The following options have been implemented:

Table 5 Modbus Parameters

General settings		
Parameter	**Options**	**Remarks**
Addressing	address configurable 1-248 (default 248)	When set to 248, the communication is disabled.
Baud rate	9600 19200 (default) 38400 57600	
Selectable frame formats	8 bits, even parity, 1 stop bit (default) 8 bits, odd parity, 1 stop bit 8 bits, no parity, 1 stop bit 8 bits, no parity, 2 stop bits	
Electrical interface	RS485 2W cabling	

6.6.2 Supported Modbus functions

This section describes the supported Modbus function codes.

6.6.2.1 Read Registers (03, 04)

Both function 03, Read Holding Registers and function 04, Read Input Registers, can be used. The addresses are the same.

Table 6 Read Exceptions

Possible exception responses		
Code	**Name**	**Meaning**
02	ILLEGAL_DATA_ADDRESS	Address refers to a register that is not available or not readable.

6.6.2.2 Write Registers (16)

Function 16, Write Multiple Registers, are supported.

Table 7 Write Exceptions

Possible exception responses		
Code	**Name**	**Meaning**
02	ILLEGAL_DATA_ADDRESS	Address refers to a register that is not available or not readable.
03	ILLEGAL_DATA_VALUE	The value written is not permitted for this register.

6.6.2.3 Available registers

Modbus registers are numbered from 1 to 65536. In a Modbus PDU (Protocol Data Unit) these registers are addressed from 0 to 65535.

The following table lists the available parameters. More details about the data format can be found in **"6.6.3 Register data format" on page 49**.

Modbus registers

Parameter name	Access	Register Number		Remark
		Hex	Dec	
SYSTEM_STATUS	R	100	0x64	System status
ACTIVE_ERRORS	R	101	0x65	Active errors
L1_RMS	R	102	0x66	L1 RMS current
L2_RMS	R	103	0x67	L2 RMS current
L3_RMS	R	104	0x68	L3 RMS current
N_RMS	R	105	0x69	N RMS current
OC_INPUT_INFO_1	R	106	0x6A	Over current 1 input info
OC_YEAR_MONTH_1	R	107	0x6B	Over current 1 year/month
OC_DATE_HOUR_1	R	108	0x6C	Over current 1 date/hour
OC_MINUTE_SECOND_1	R	109	0x6D	Over current 1 minute/second
OC_INPUT_INFO_2	R	110	0x6E	Over current 2 input info
OC_YEAR_MONTH_2	R	111	0x6F	Over current 2 year/month
OC_DATE_HOUR_2	R	112	0x70	Over current 2 date/hour
OC_MINUTE_SECOND_2	R	113	0x71	Over current 2 minute/second
OC_INPUT_INFO_3	R	114	0x72	Over current 3 input info
OC_YEAR_MONTH_3	R	115	0x73	Over current 3 year/month
OC_DATE_HOUR_3	R	116	0x74	Over current 3 date/hour
OC_MINUTE_SECOND_3	R	117	0x75	Over current 3 minute/second
OC_INPUT_INFO_4	R	118	0x76	Over current 4 input info
OC_YEAR_MONTH_4	R	119	0x77	Over current 4 year/month
OC_DATE_HOUR_4	R	120	0x78	Over current 4 date/hour
OC_MINUTE_SECOND_4	R	121	0x79	Over current 4 minute/second
OC_INPUT_INFO_5	R	122	0x7A	Over current 5 input info
OC_YEAR_MONTH_5	R	123	0x7B	Over current 5 year/month
OC_DATE_HOUR_5	R	124	0x7C	Over current 5 date/hour
OC_MINUTE_SECOND_5	R	125	0x7D	Over current 5 minute/second
OC_INPUT_INFO_6	R	126	0x7E	Over current 6 input info
OC_YEAR_MONTH_6	R	127	0x7F	Over current 6 year/month
OC_DATE_HOUR_6	R	128	0x80	Over current 6 date/hour
OC_MINUTE_SECOND_6	R	129	0x81	Over current 6 minute/second
OC_INPUT_INFO_7	R	130	0x82	Over current 7 input info
OC_YEAR_MONTH_7	R	131	0x83	Over current 7 year/month
OC_DATE_HOUR_7	R	132	0x84	Over current 7 date/hour
OC_MINUTE_SECOND_7	R	133	0x85	Over current 7 minute/second
OC_INPUT_INFO_8	R	134	0x86	Over current 8 input info
OC_YEAR_MONTH_8	R	135	0x87	Over current 8 year/month
OC_DATE_HOUR_8	R	136	0x88	Over current 8 date/hour
OC_MINUTE_SECOND_8	R	137	0x89	Over current 8 minute/second
OC_INPUT_INFO_9	R	138	0x8A	Over current 9 input info
OC_YEAR_MONTH_9	R	139	0x8B	Over current 9 year/month
OC_DATE_HOUR_9	R	140	0x8C	Over current 9 date/hour
OC_MINUTE_SECOND_9	R	141	0x8D	Over current 9 minute/second
OC_INPUT_INFO_10	R	142	0x8E	Over current 10 input info
OC_YEAR_MONTH_10	R	143	0x8F	Over current 10 year/month
OC_DATE_HOUR_10	R	144	0x90	Over current 10 date/hour
OC_MINUTE_SECOND_10	R	145	0x91	Over current 10 minute/second

Modbus registers

Parameter name	Access	Register Number		Remark
		Hex	Dec	
ERROR_ACTIVATE_YEAR_MONTH_1	R	146	0x92	Error 1 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_1	R	147	0x93	Error 1 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_1	R	148	0x94	Error 1 activate time minute/second
ERROR_ACTIVATE_YEAR_MONTH_2	R	149	0x95	Error 2 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_2	R	150	0x96	Error 2 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_2	R	151	0x97	Error 2 activate time minute/second
ERROR_ACTIVATE_YEAR_MONTH_3	R	152	0x98	Error 3 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_3	R	153	0x99	Error 3 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_3	R	154	0x9A	Error 3 activate time minute/second
ERROR_ACTIVATE_YEAR_MONTH_4	R	155	0x9B	Error 4 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_4	R	156	0x9C	Error 4 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_4	R	157	0x9D	Error 4 activate time minute/second
ERROR_ACTIVATE_YEAR_MONTH_5	R	158	0x9E	Error 5 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_5	R	159	0x9F	Error 5 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_5	R	160	0xA0	Error 5 activate time minute/second
ERROR_ACTIVATE_YEAR_MONTH_6	R	161	0xA1	Error 6 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_6	R	162	0xA2	Error 6 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_6	R	163	0xA3	Error 6 activate time minute/second
ERROR_ACTIVATE_YEAR_MONTH_7	R	164	0xA4	Error 7 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_7	R	165	0xA5	Error 7 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_7	R	166	0xA6	Error 7 activate time minute/second
ERROR_ACTIVATE_YEAR_MONTH_8	R	167	0xA7	Error 8 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_8	R	168	0xA8	Error 8 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_8	R	169	0xA9	Error 8 activate time minute/second
ERROR_ACTIVATE_YEAR_MONTH_9	R	170	0xAA	Error 9 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_9	R	171	0xAB	Error 9 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_9	R	172	0xAC	Error 9 activate time minute/second
ERROR_ACTIVATE_YEAR_MONTH_10	R	173	0xAD	Error 10 activate time year/month
ERROR_ACTIVATE_DATE_HOUR_10	R	174	0xAE	Error 10 activate time date/hour
ERROR_ACTIVATE_MINUTE_SECOND_10	R	175	0xAF	Error 10 activate time minute/second
CW_INPUT_INFO_1	R	176	0xB0	Current warning 1 input info
CW_YEAR_MONTH_1	R	177	0xB1	Current warning 1 year/month
CW_DATE_HOUR_1	R	178	0xB2	Current warning 1 date/hour
CW_MINUTE_SECOND_1	R	179	0xB3	Current warning 1 minute/second
CW_INPUT_INFO_2	R	180	0xB4	Current warning 2 input info
CW_YEAR_MONTH_2	R	181	0xB5	Current warning 2 year/month
CW_DATE_HOUR_2	R	182	0xB6	Current warning 2 date/hour
CW_MINUTE_SECOND_2	R	183	0xB7	Current warning 2 minute/second
CW_INPUT_INFO_3	R	184	0xB8	Current warning 3 input info
CW_YEAR_MONTH_3	R	185	0xB9	Current warning 3 year/month
CW_DATE_HOUR_3	R	186	0xBA	Current warning 3 date/hour
CW_MINUTE_SECOND_3	R	187	0xBB	Current warning 3 minute/second
CW_INPUT_INFO_4	R	188	0xBC	Current warning 4 input info
CW_YEAR_MONTH_4	R	189	0xBD	Current warning 4 year/month
CW_DATE_HOUR_4	R	190	0xBE	Current warning 4 date/hour
CW_MINUTE_SECOND_4	R	191	0xBF	Current warning 4 minute/second
CW_INPUT_INFO_5	R	192	0xC0	Current warning 5 input info
CW_YEAR_MONTH_5	R	193	0xC1	Current warning 5 year/month
CW_DATE_HOUR_5	R	194	0xC2	Current warning 5 date/hour
CW_MINUTE_SECOND_5	R	195	0xC3	Current warning 5 minute/second
CW_INPUT_INFO_6	R	196	0xC4	Current warning 6 input info
CW_YEAR_MONTH_6	R	197	0xC5	Current warning 6 year/month
CW_DATE_HOUR_6	R	198	0xC6	Current warning 6 date/hour

Modbus registers

Parameter name	Access	Register Number		Remark
		Hex	Dec	
CW_MINUTE_SECOND_6	R	199	0xC7	Current warning 6 minute/second
CW_INPUT_INFO_7	R	200	0xC8	Current warning 7 input info
CW_YEAR_MONTH_7	R	201	0xC9	Current warning 7 year/month
CW_DATE_HOUR_7	R	202	0xCA	Current warning 7 date/hour
CW_MINUTE_SECOND_7	R	203	0xCB	Current warning 7 minute/second
CW_INPUT_INFO_8	R	204	0xCC	Current warning 8 input info
CW_YEAR_MONTH_8	R	205	0xCD	Current warning 8 year/month
CW_DATE_HOUR_8	R	206	0xCE	Current warning 8 date/hour
CW_MINUTE_SECOND_8	R	207	0xCF	Current warning 8 minute/second
CW_INPUT_INFO_9	R	208	0xD0	Current warning 9 input info
CW_YEAR_MONTH_9	R	209	0xD1	Current warning 9 year/month
CW_DATE_HOUR_9	R	210	0xD2	Current warning 9 date/hour
CW_MINUTE_SECOND_9	R	211	0xD3	Current warning 9 minute/second
CW_INPUT_INFO_10	R	212	0xD4	Current warning 10 input info
CW_YEAR_MONTH_10	R	213	0xD5	Current warning 10 year/month
CW_DATE_HOUR_10	R	214	0xD6	Current warning 10 date/hour
CW_MINUTE_SECOND_10	R	215	0xD7	Current warning 10 minute/second
ERROR_TYPE_1	R	216	0xD8	Error 1 type
ERROR_YEAR_MONTH_1	R	217	0xD9	Error 1 year/month
ERROR_DATE_HOUR_1	R	218	0xDA	Error 1 date/hour
ERROR_MINUTE_SECOND_1	R	219	0xDB	Error 1 minute/second
ERROR_TYPE_2	R	220	0xDC	Error 2 type
ERROR_YEAR_MONTH_2	R	221	0xDD	Error 2 year/month
ERROR_DATE_HOUR_2	R	222	0xDE	Error 2 date/hour
ERROR_MINUTE_SECOND_2	R	223	0xDF	Error 2 minute/second
ERROR_TYPE_3	R	224	0xE0	Error 3 type
ERROR_YEAR_MONTH_3	R	225	0xE1	Error 3 year/month
ERROR_DATE_HOUR_3	R	226	0xE2	Error 3 date/hour
ERROR_MINUTE_SECOND_3	R	227	0xE3	Error 3 minute/second
ERROR_TYPE_4	R	228	0xE4	Error 4 type
ERROR_YEAR_MONTH_4	R	229	0xE5	Error 4 year/month
ERROR_DATE_HOUR_4	R	230	0xE6	Error 4 date/hour
ERROR_MINUTE_SECOND_4	R	231	0xE7	Error 4 minute/second
ERROR_TYPE_5	R	232	0xE8	Error 5 type
ERROR_YEAR_MONTH_5	R	233	0xE9	Error 5 year/month
ERROR_DATE_HOUR_5	R	234	0xEA	Error 5 date/hour
ERROR_MINUTE_SECOND_5	R	235	0xEB	Error 5 minute/second
ERROR_TYPE_6	R	236	0xEC	Error 6 type
ERROR_YEAR_MONTH_6	R	237	0xED	Error 6 year/month
ERROR_DATE_HOUR_6	R	238	0xEE	Error 6 date/hour
ERROR_MINUTE_SECOND_6	R	239	0xEF	Error 6 minute/second
ERROR_TYPE_7	R	240	0xF0	Error 7 type
ERROR_YEAR_MONTH_7	R	241	0xF1	Error 7 year/month
ERROR_DATE_HOUR_7	R	242	0xF2	Error 7 date/hour
ERROR_MINUTE_SECOND_7	R	243	0xF3	Error 7 minute/second
ERROR_TYPE_8	R	244	0xF4	Error 8 type
ERROR_YEAR_MONTH_8	R	245	0xF5	Error 8 year/month
ERROR_DATE_HOUR_8	R	246	0xF6	Error 8 date/hour
ERROR_MINUTE_SECOND_8	R	247	0xF7	Error 8 minute/second
ERROR_TYPE_9	R	248	0xF8	Error 9 type
ERROR_YEAR_MONTH_9	R	249	0xF9	Error 9 year/month
ERROR_DATE_HOUR_9	R	250	0xFA	Error 9 date/hour

Modbus registers

Parameter name	Access	Register Number		Remark
		Hex	Dec	
ERROR_MINUTE_SECOND_9	R	251	0xFB	Error 9 minute/second
ERROR_TYPE_10	R	252	0xFC	Error 10 type
ERROR_YEAR_MONTH_10	R	253	0xFD	Error 10 year/month
ERROR_DATE_HOUR_10	R	254	0xFE	Error 10 date/hour
ERROR_MINUTE_SECOND_10	R	255	0xFF	Error 10 minute/second
PARAM_CHANGE_ID_1	R	256	0x100	Param. changed 1 id
PARAM_CHANGE_VALUE_1	R	257	0x101	Param. changed 1 value
PARAM_CHANGE_YEAR_MONTH_1	R	258	0x102	Param. changed 1 year/month
PARAM_CHANGE_DATE_HOUR_1	R	259	0x103	Param. changed 1 date/hour
PARAM_CHANGE_MINUTE_SECOND_1	R	260	0x104	Param. changed 1 minute/second
PARAM_CHANGE_ID_2	R	261	0x105	Param. changed 2 id
PARAM_CHANGE_VALUE_2	R	262	0x106	Param. changed 2 value
PARAM_CHANGE_YEAR_MONTH_2	R	263	0x107	Param. changed 2 year/month
PARAM_CHANGE_DATE_HOUR_2	R	264	0x108	Param. changed 2 date/hour
PARAM_CHANGE_MINUTE_SECOND_2	R	265	0x109	Param. changed 2 minute/second
PARAM_CHANGE_ID_3	R	266	0x10A	Param. changed 3 id
PARAM_CHANGE_VALUE_3	R	267	0x10B	Param. changed 3 value
PARAM_CHANGE_YEAR_MONTH_3	R	268	0x10C	Param. changed 3 year/month
PARAM_CHANGE_DATE_HOUR_3	R	269	0x10D	Param. changed 3 date/hour
PARAM_CHANGE_MINUTE_SECOND_3	R	270	0x10E	Param. changed 3 minute/second
PARAM_CHANGE_ID_4	R	271	0x10F	Param. changed 4 id
PARAM_CHANGE_VALUE_4	R	272	0x110	Param. changed 4 value
PARAM_CHANGE_YEAR_MONTH_4	R	273	0x111	Param. changed 4 year/month
PARAM_CHANGE_DATE_HOUR_4	R	274	0x112	Param. changed 4 date/hour
PARAM_CHANGE_MINUTE_SECOND_4	R	275	0x113	Param. changed 4 minute/second
PARAM_CHANGE_ID_5	R	276	0x114	Param. changed 5 id
PARAM_CHANGE_VALUE_5	R	277	0x115	Param. changed 5 value
PARAM_CHANGE_YEAR_MONTH_5	R	278	0x116	Param. changed 5 year/month
PARAM_CHANGE_DATE_HOUR_5	R	279	0x117	Param. changed 5 date/hour
PARAM_CHANGE_MINUTE_SECOND_5	R	280	0x118	Param. changed 5 minute/second
PARAM_CHANGE_ID_6	R	281	0x119	Param. changed 6 id
PARAM_CHANGE_VALUE_6	R	282	0x11A	Param. changed 6 value
PARAM_CHANGE_YEAR_MONTH_6	R	283	0x11B	Param. changed 6 year/month
PARAM_CHANGE_DATE_HOUR_6	R	284	0x11C	Param. changed 6 date/hour
PARAM_CHANGE_MINUTE_SECOND_6	R	285	0x11D	Param. changed 6 minute/second
PARAM_CHANGE_ID_7	R	286	0x11E	Param. changed 7 id
PARAM_CHANGE_VALUE_7	R	287	0x11F	Param. changed 7 value
PARAM_CHANGE_YEAR_MONTH_7	R	288	0x120	Param. changed 7 year/month
PARAM_CHANGE_DATE_HOUR_7	R	289	0x121	Param. changed 7 date/hour
PARAM_CHANGE_MINUTE_SECOND_7	R	290	0x122	Param. changed 7 minute/second
PARAM_CHANGE_ID_8	R	291	0x123	Param. changed 8 id
PARAM_CHANGE_VALUE_8	R	292	0x124	Param. changed 8 value
PARAM_CHANGE_YEAR_MONTH_8	R	293	0x125	Param. changed 8 year/month
PARAM_CHANGE_DATE_HOUR_8	R	294	0x126	Param. changed 8 date/hour
PARAM_CHANGE_MINUTE_SECOND_8	R	295	0x127	Param. changed 8 minute/second
PARAM_CHANGE_ID_9	R	296	0x128	Param. changed 9 id
PARAM_CHANGE_VALUE_9	R	297	0x129	Param. changed 9 value
PARAM_CHANGE_YEAR_MONTH_9	R	298	0x12A	Param. changed 9 year/month
PARAM_CHANGE_DATE_HOUR_9	R	299	0x12B	Param. changed 9 date/hour
PARAM_CHANGE_MINUTE_SECOND_9	R	300	0x12C	Param. changed 9 minute/second
PARAM_CHANGE_ID_10	R	301	0x12D	Param. changed 10 id
PARAM_CHANGE_VALUE_10	R	302	0x12E	Param. changed 10 value

Modbus registers

Parameter name	Access	Register Number		Remark
		Hex	Dec	
PARAM_CHANGE_YEAR_MONTH_10	R	303	0x12F	Param. changed 10 year/month
PARAM_CHANGE_DATE_HOUR_10	R	304	0x130	Param. changed 10 date/hour
PARAM_CHANGE_MINUTE_SECOND_10	R	305	0x131	Param. changed 10 minute/second
SW_VERSION_XXYY	R	306	0x132	SW version XX YY
SW_VERSION_ZZ	R	307	0x133	SW version ZZ
HW_VERSION	R	308	0x134	HW version
SERIAL_NO_1_2	R	309	0x135	Serial number, letter 1 and 2
SERIAL_NO_3_4	R	310	0x136	Serial number, letter 3 and 4
SERIAL_NO_5_6	R	311	0x137	Serial number, letter 5 and 6
SERIAL_NO_7_8	R	312	0x138	Serial number, letter 7 and 8
SERIAL_NO_9_10	R	313	0x139	Serial number, letter 9 and 10
SERIAL_NO_11_12	R	314	0x13A	Serial number, letter 11 and 12
SERIAL_NO_13_14	R	315	0x13B	Serial number, letter 13 and 14
SERIAL_NO_15_16	R	316	0x13C	Serial number, letter 15 and 16
SERIAL_NO_17	R	317	0x13D	Serial number, letter 17
MODBUS_TOGGLE_REGISTER	R	318	0x13E	Modbus toggle register
MODBUS_FAILURE_REGISTER	R	319	0x13F	Modbus failure register
NO_OF_CRC_ERRORS	R	320	0x140	Number of CRC errors
EKIP_DEVICE_ID	R	321	0x141	EKIP device ID
MODBUS_DEVICE_ID	R	322	0x142	Modbus device ID
MODBUS_BAUD_RATE	R	323	0x143	Modbus baud rate
MODBUS_FRAME_FORMAT	R	324	0x144	Modbus frame format
EMPTY_REGISTER_1	R	325	0x145	Empty register 1
EMPTY_REGISTER_2	R	326	0x146	Empty register 2
EMPTY_REGISTER_3	R	327	0x147	Empty register 3
EMPTY_REGISTER_4	R	328	0x148	Empty register 4
EMPTY_REGISTER_5	R	329	0x149	Empty register 5
OVER_CURRENT_THRESHOLD_3P	RW	330	0x14A	Over current RMS threshold phases
OVER_CURRENT_THRESHOLD_N	RW	331	0x14B	Over current RMS threshold neutral
CURRENT_WARNING_THRESHOLD_3P	RW	332	0x14C	Current warning RMS threshold phases
CURRENT_WARNING_THRESHOLD_N	RW	333	0x14D	Current warning RMS threshold neutral
INPUT_CONFIGURATION	RW	334	0x14E	Input configuration
DAISY_CHAIN_STATUS	RW	335	0x14F	Daisy chain status
SYSTEM_YEAR_MONTH	RW	336	0x150	System year/month
SYSTEM_DATE_HOUR	RW	337	0x151	System date/hour
SYSTEM_MINUTE_SECOND	RW	338	0x152	System minute/second
UNIT_NAME_1_2	RW	339	0x153	Unit name, letter 1 and 2
UNIT_NAME_3_4	RW	340	0x154	Unit name, letter 3 and 4
UNIT_NAME_3_4	RW	341	0x155	Unit name, letter 5 and 6
UNIT_NAME_7_8	RW	342	0x156	Unit name, letter 7 and 8
UNIT_NAME_9_10	RW	343	0x157	Unit name, letter 9 and 10
UNIT_NAME_11_12	RW	344	0x158	Unit name, letter 11 and 12
UNIT_NAME_13_14	RW	345	0x159	Unit name, letter 13 and 14
UNIT_NAME_15_16	RW	346	0x15A	Unit name, letter 15 and 16
RESET_OVER_CURRENT	RW	347	0x15B	Reset over current
RESET_CURRENT_WARNING	RW	348	0x15C	Reset current warning
CORRECTION_FACTOR_L1	RW	349	0x15D	Correction factor L1
CORRECTION_FACTOR_L2	RW	350	0x15E	Correction factor L2
CORRECTION_FACTOR_L3	RW	351	0x15F	Correction factor L3
CORRECTION_FACTOR_N	RW	352	0x160	Correction factor N

6.6.3 Register data format

This section describes details about the data format for selected registers. Read or read/write rights of the register are specified with (R) and (RW) respective.

6.6.3.1 System status

The actual state of the system.

SYSTEM_STATUS 0x64 (R)

Bit	15–4	3	2	1	0
	-	Current warning	In startup sequence	Error	Over current

6.6.3.2 Modbus status

Toggle register

Alternates between 0 and 1 each read.

MODBUS_TOGGLE_REGISTER 0x13E (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Toggle bit

Failure register

Register ID of the last failed Modbus request.

MODBUS_FAILURE_REGISTER 0x13F (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Register ID															

CRC errors

Number of Modbus RTU CRC errors.

NBR_OF_CRC_ERRORS 0x140 (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Number of errors															

6.6.3.3 Active errors

Currently active errors, bit is set if error is active.

ACTIVE_ERRORS 0x65

Bit	15–10	9	8	7	6	5	4	3	2	1	0
	-	Internal error power supply	Internal error optical output	Internal error daisy chain	Internal error input 1	Input 1 low light	Input 1 no light	Rogowski coil N	Rogowski coil L3	Rogowski coil L2	Rogowski coil L1

Activation times for active errors register. If an error is inactive, the time is for the last time the error occurred. If error never has occurred the register is set to 0xFFFF.

Parameter name	Register access	Remark
ERROR_ACTIVATE_YEAR_MONTH_1	0x92 (R)	Rogowski coil L1
ERROR_ACTIVATE_YEAR_MONTH_2	0x95 (R)	Rogowski coil L2
ERROR_ACTIVATE_YEAR_MONTH_3	0x98 (R)	Rogowski coil L3
ERROR_ACTIVATE_YEAR_MONTH_4	0x9B (R)	Rogowski coil N
ERROR_ACTIVATE_YEAR_MONTH_5	0x9E (R)	Input 1 no light
ERROR_ACTIVATE_YEAR_MONTH_6	0xA1 (R)	Input 1 low light
ERROR_ACTIVATE_YEAR_MONTH_7	0xA4 (R)	Internal error input 1
ERROR_ACTIVATE_YEAR_MONTH_8	0xA7 (R)	Internal error daisy chain
ERROR_ACTIVATE_YEAR_MONTH_9	0xAA (R)	Internal error optical output
ERROR_ACTIVATE_YEAR_MONTH_10	0xAD (R)	Internal error power supply

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Years since 2000								Month (1 - 12)							

Parameter name	Register access	Remark
ERROR_ACTIVATE_DATE_HOUR_1	0x93 (R)	Rogowski coil L1
ERROR_ACTIVATE_DATE_HOUR_2	0x96 (R)	Rogowski coil L2
ERROR_ACTIVATE_DATE_HOUR_3	0x99 (R)	Rogowski coil L3
ERROR_ACTIVATE_DATE_HOUR_4	0x9C (R)	Rogowski coil N
ERROR_ACTIVATE_DATE_HOUR_5	0x9F (R)	Input 1 no light
ERROR_ACTIVATE_DATE_HOUR_6	0xA2 (R)	Input 1 low light
ERROR_ACTIVATE_DATE_HOUR_7	0xA5 (R)	Internal error input 1
ERROR_ACTIVATE_DATE_HOUR_8	0xA8 (R)	Internal error daisy chain
ERROR_ACTIVATE_DATE_HOUR_9	0xAB (R)	Internal error optical output
ERROR_ACTIVATE_DATE_HOUR_10	0xAE (R)	Internal error power supply

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Date (1 - 31)								Hour (0 - 23)							

Parameter name	Register access	Remark
ERROR_ACTIVATE_MINUTE_SECOND_1	0x94 (R)	Rogowski coil L1
ERROR_ACTIVATE_MINUTE_SECOND_2	0x97 (R)	Rogowski coil L2
ERROR_ACTIVATE_MINUTE_SECOND_3	0x9A (R)	Rogowski coil L3
ERROR_ACTIVATE_MINUTE_SECOND_4	0x9D (R)	Rogowski coil N
ERROR_ACTIVATE_MINUTE_SECOND_5	0xA0 (R)	Input 1 no light
ERROR_ACTIVATE_MINUTE_SECOND_6	0xA3 (R)	Input 1 low light
ERROR_ACTIVATE_MINUTE_SECOND_7	0xA6 (R)	Internal error input 1
ERROR_ACTIVATE_MINUTE_SECOND_8	0xA9 (R)	Internal error daisy chain
ERROR_ACTIVATE_MINUTE_SECOND_9	0xAC (R)	Internal error optical output
ERROR_ACTIVATE_MINUTE_SECOND_10	0xAF (R)	Internal error power supply

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Minute (0 - 59)								Second (0 - 59)							

6.6.4 RMS currents

Parameter name	Register access	Remark
L1_RMS	0x66 (R)	
L2_RMS	0x67 (R)	
L3_RMS	0x68 (R)	
N_RMS	0x69 (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	RMS value in Ampere															

6.6.4.1 Over current events

The 10 last over current events in chronological order, newest event on index #1.

One or more phases and/or neutral that triggered the event. If event never has occurred the register is set to 0xFFFF.

Parameter name	Register access	Remark
OC_INPUT_INFO_1	0x6A (R)	
OC_INPUT_INFO_2	0x6E (R)	
OC_INPUT_INFO_3	0x72 (R)	
OC_INPUT_INFO_4	0x76 (R)	
OC_INPUT_INFO_5	0x7A (R)	
OC_INPUT_INFO_6	0x7E (R)	
OC_INPUT_INFO_7	0x82 (R)	
OC_INPUT_INFO_8	0x86 (R)	
OC_INPUT_INFO_9	0x8A (R)	
OC_INPUT_INFO_10	0x8E (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	**N**	**L3**	**L2**	**L1**

Activation times for over current events. If event never has occurred the register is set to 0xFFFF.

Parameter name	Register access	Remark
OC_YEAR_MONTH_1	0x6B (R)	
OC_YEAR_MONTH_2	0x6F (R)	
OC_YEAR_MONTH_3	0x73 (R)	
OC_YEAR_MONTH_4	0x77 (R)	
OC_YEAR_MONTH_5	0x7B (R)	
OC_YEAR_MONTH_6	0x7F (R)	
OC_YEAR_MONTH_7	0x83 (R)	
OC_YEAR_MONTH_8	0x87 (R)	
OC_YEAR_MONTH_9	0x8B (R)	
OC_YEAR_MONTH_10	0x8F (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Years since 2000								Month (1 - 12)							

Parameter name	Register access	Remark
OC_DATE_HOUR_1	0x6C (R)	
OC_DATE_HOUR_2	0x70 (R)	
OC_DATE_HOUR_3	0x74 (R)	
OC_DATE_HOUR_4	0x78 (R)	
OC_DATE_HOUR_5	0x7C (R)	
OC_DATE_HOUR_6	0x80 (R)	
OC_DATE_HOUR_7	0x84 (R)	
OC_DATE_HOUR_8	0x88 (R)	
OC_DATE_HOUR_9	0x8C (R)	
OC_DATE_HOUR_10	0x90 (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Date (1 - 31)								Hour (0 - 23)							

Parameter name	Register access	Remark
OC_MINUTE_SECOND_1	0x6D (R)	
OC_MINUTE_SECOND_2	0x71 (R)	
OC_MINUTE_SECOND_3	0x75 (R)	
OC_MINUTE_SECOND_4	0x79 (R)	
OC_MINUTE_SECOND_5	0x7D (R)	
OC_MINUTE_SECOND_6	0x81 (R)	
OC_MINUTE_SECOND_7	0x85 (R)	
OC_MINUTE_SECOND_8	0x89 (R)	
OC_MINUTE_SECOND_9	0x8D (R)	
OC_MINUTE_SECOND_10	0x91 (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Minute (0 - 59)								Second (0 - 59)							

6.6.4.2 Current warning events

The 10 last current warning events in chronological order, newest event on index #1.

One or more phases and/or neutral that triggered the event. If event never has occurred the register is set to 0xFFFF.

Parameter name	Register access	Remark
CW_INPUT_INFO_1	0xB0 (R)	
CW_INPUT_INFO_2	0xB4 (R)	
CW_INPUT_INFO_3	0xB8 (R)	
CW_INPUT_INFO_4	0xBC (R)	
CW_INPUT_INFO_5	0xC0 (R)	
CW_INPUT_INFO_6	0xC4 (R)	
CW_INPUT_INFO_7	0xC8 (R)	
CW_INPUT_INFO_8	0xCC (R)	
CW_INPUT_INFO_9	0xD0 (R)	
CW_INPUT_INFO_10	0xD4 (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	**N**	**L3**	**L2**	**L1**

Activation times for over current events. If event never has occurred the register is set to 0xFFFF.

Parameter name	Register access	Remark
CW_YEAR_MONTH_1	0xB1 (R)	
CW_YEAR_MONTH_2	0xB5 (R)	
CW_YEAR_MONTH_3	0xB9 (R)	
CW_YEAR_MONTH_4	0xBD (R)	
CW_YEAR_MONTH_5	0xC1 (R)	
CW_YEAR_MONTH_6	0xC5 (R)	
CW_YEAR_MONTH_7	0xC9 (R)	
CW_YEAR_MONTH_8	0xCD (R)	
CW_YEAR_MONTH_9	0xD1 (R)	
CW_YEAR_MONTH_10	0xD5 (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Years since 2000								Month (1 - 12)							

Parameter name	Register access	Remark
CW_DATE_HOUR_1	0xB2 (R)	
CW_DATE_HOUR_2	0xB6 (R)	
CW_DATE_HOUR_3	0xBA (R)	
CW_DATE_HOUR_4	0xBE (R)	
CW_DATE_HOUR_5	0xC2 (R)	
CW_DATE_HOUR_6	0xC6 (R)	
CW_DATE_HOUR_7	0xCA (R)	
CW_DATE_HOUR_8	0xCE (R)	
CW_DATE_HOUR_9	0xD2 (R)	
CW_DATE_HOUR_10	0xD6 (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Date (1 - 31)								Hour (0 - 23)							

Parameter name	Register access	Remark
CW_MINUTE_SECOND_1	0xB3 (R)	
CW_MINUTE_SECOND_2	0xB7 (R)	
CW_MINUTE_SECOND_3	0xBB (R)	
CW_MINUTE_SECOND_4	0xBF (R)	
CW_MINUTE_SECOND_5	0xC3 (R)	
CW_MINUTE_SECOND_6	0xC7 (R)	
CW_MINUTE_SECOND_7	0xCB (R)	
CW_MINUTE_SECOND_8	0xCF (R)	
CW_MINUTE_SECOND_9	0xD3 (R)	
CW_MINUTE_SECOND_10	0xD7 (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Minute (0 - 59)								Second (0 - 59)							

6.6.4.3 Error events

The 10 last error events in chronological order, newest event on index #1.

ID	Error
0	Rogowski coil L1
1	Rogowski coil L2
2	Rogowski coil L3
3	Rogowski coil N
4	Optical input no light
5	Optical input low light
6	Internal error optical input
7	Internal error daisy chain
8	Internal error optical output
9	Internal error power supply

Parameter name	Register access	Remark
ERROR_TYPE_1	0xD8 (R)	
ERROR_TYPE_2	0xDC (R)	
ERROR_TYPE_3	0xE0 (R)	
ERROR_TYPE_4	0xE4 (R)	
ERROR_TYPE_5	0xE8 (R)	
ERROR_TYPE_6	0xEC (R)	
ERROR_TYPE_7	0xF0 (R)	
ERROR_TYPE_8	0xF4 (R)	
ERROR_TYPE_9	0xF8 (R)	
ERROR_TYPE_10	0xFC (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	ID			

Activation times for over error events. If event never has occurred the register is set to 0xFFFF.

Parameter name	Register access	Remark
ERROR_YEAR_MONTH_1	0xD9 (R)	
ERROR_YEAR_MONTH_2	0xDD (R)	
ERROR_YEAR_MONTH_3	0xE1 (R)	
ERROR_YEAR_MONTH_4	0xE5 (R)	
ERROR_YEAR_MONTH_5	0xE9 (R)	
ERROR_YEAR_MONTH_6	0xED (R)	
ERROR_YEAR_MONTH_7	0xF1 (R)	
ERROR_YEAR_MONTH_8	0xF5 (R)	
ERROR_YEAR_MONTH_9	0xF9 (R)	
ERROR_YEAR_MONTH_10	0xFD (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Years since 2000								Month (1 - 12)							

Parameter name	Register access	Remark
ERROR_DATE_HOUR_1	0xDA (R)	
ERROR_DATE_HOUR_2	0xDE (R)	
ERROR_DATE_HOUR_3	0xE2 (R)	
ERROR_DATE_HOUR_4	0xE6 (R)	
ERROR_DATE_HOUR_5	0xEA (R)	
ERROR_DATE_HOUR_6	0xEE (R)	
ERROR_DATE_HOUR_7	0xF2 (R)	
ERROR_DATE_HOUR_8	0xF6 (R)	
ERROR_DATE_HOUR_9	0xFA (R)	
ERROR_DATE_HOUR_10	0xFE (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Date (1 - 31)								Hour (0 - 23)							

Parameter name	Register access	Remark
ERROR_MINUTE_SECOND_1	0xDB (R)	
ERROR_MINUTE_SECOND_2	0xDF (R)	
ERROR_MINUTE_SECOND_3	0xE3 (R)	
ERROR_MINUTE_SECOND_4	0xE7 (R)	
ERROR_MINUTE_SECOND_5	0xEB (R)	
ERROR_MINUTE_SECOND_6	0xEF (R)	
ERROR_MINUTE_SECOND_7	0xF3 (R)	
ERROR_MINUTE_SECOND_8	0xF7 (R)	
ERROR_MINUTE_SECOND_9	0xFB (R)	
ERROR_MINUTE_SECOND_10	0xFF (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Minute (0 - 59)								Second (0 – 59)							

6.6.4.4 Parameter change events

The 10 last parameter change events in chronological order, newest event on index #1. If event never has occurred the register is set to 0xFFFF.

ID	Parameter
0	First setup done
1	Modbus id
2	Modbus baud rate
3	Modbus frame format
4	Inputs
5	Over current threshold phase
6	Over current threshold neutral
7	Current warning threshold phase
8	Current warning threshold neutral
9	Daisy chain
10	K1 reset
11	Language
12	Brightness

Parameter name	Register access	Remark
PARAM_CHANGE_ID _1	0x100 (R)	
PARAM_CHANGE_ID _2	0x105 (R)	
PARAM_CHANGE_ID _3	0x10A (R)	
PARAM_CHANGE_ID _4	0x10F (R)	
PARAM_CHANGE_ID _5	0x114 (R)	
PARAM_CHANGE_ID _6	0x119 (R)	
PARAM_CHANGE_ID _7	0x11E (R)	
PARAM_CHANGE_ID _8	0x123 (R)	
PARAM_CHANGE_ID _9	0x128 (R)	
PARAM_CHANGE_ID _10	0x12D (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	**ID**			

Setting of the changed parameter, possible setting values:

ID	Parameter	Setting	Values
0	First setup	0	(Not done)
		1	(Done)
1	Modbus id	0-248	
2	Modbus baud rate	0	(9600)
		1	(19200)
		2	(38400)
		3	(57600)
3	Modbus frame format	0	(8 bits, even parity, 1 stop bit)
		1	(8 bits, odd parity, 1 stop bit)
		2	(8 bits, no parity, 1 stop bit)
		3	(8 bits, no parity, 2 stop bit)
4	Inputs	0	(L1)
		1	(L1 L2)
		2	(L1 L2 L3)
		3	(L1 L2 L3 Neutral)
5	Over current threshold phase	CSU-2LV: 250–12000 [A] CSU-2MV: 100–12000 [A]	
6	Over current threshold neutral	CSU-2LV: 250–12000 [A] CSU-2MV: 100–12000 [A]	
7	Current warning threshold phase	CSU-2LV: 250–12000 [A] CSU-2MV: 100–12000 [A]	
8	Current warning threshold neutral	CSU-2LV: 250–12000 [A] CSU-2MV: 100–12000 [A]	
9	Daisy chain	0 (On) – 1 (Off)	
10	K1 reset	0 (Manual) – 1 (Auto)	
11	Language	0 - 3	
12	Brightness	0 – 100 [%]	

Parameter name	Register access	Remark
PARAM_CHANGE_VALUE_1	0x101 (R)	
PARAM_CHANGE_VALUE _2	0x106 (R)	
PARAM_CHANGE_VALUE _3	0x10B (R)	
PARAM_CHANGE_VALUE _4	0x110 (R)	
PARAM_CHANGE_VALUE _5	0x115 (R)	
PARAM_CHANGE_VALUE _6	0x11A (R)	
PARAM_CHANGE_VALUE _7	0x11F (R)	
PARAM_CHANGE_VALUE _8	0x124 (R)	
PARAM_CHANGE_VALUE _9	0x129 (R)	
PARAM_CHANGE_VALUE _10	0x12E (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								Setting							

Activation times for parameter change events. If event never has occurred the register is set to 0xFFFF.

Parameter name	Register access	Remark
PARAM_CHANGE_YEAR_MONTH_1	0x102 (R)	
PARAM_CHANGE_YEAR_MONTH_2	0x107 (R)	
PARAM_CHANGE_YEAR_MONTH_3	0x10C (R)	
PARAM_CHANGE_YEAR_MONTH_4	0x111 (R)	
PARAM_CHANGE_YEAR_MONTH_5	0x116 (R)	
PARAM_CHANGE_YEAR_MONTH_6	0x11B (R)	
PARAM_CHANGE_YEAR_MONTH_7	0x120 (R)	
PARAM_CHANGE_YEAR_MONTH_8	0x125 (R)	
PARAM_CHANGE_YEAR_MONTH_9	0x12A (R)	
PARAM_CHANGE_YEAR_MONTH_10	0x12F (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Years since 2000								Month (1 - 12)							

Parameter name	Register access	Remark
PARAM_CHANGE_DATE_HOUR_1	0x103 (R)	
PARAM_CHANGE_DATE_HOUR_2	0x108 (R)	
PARAM_CHANGE_DATE_HOUR_3	0x10D (R)	
PARAM_CHANGE_DATE_HOUR_4	0x112 (R)	
PARAM_CHANGE_DATE_HOUR_5	0x117 (R)	
PARAM_CHANGE_DATE_HOUR_6	0x11C (R)	
PARAM_CHANGE_DATE_HOUR_7	0x121 (R)	
PARAM_CHANGE_DATE_HOUR_8	0x126 (R)	
PARAM_CHANGE_DATE_HOUR_9	0x12B (R)	
PARAM_CHANGE_DATE_HOUR_10	0x130 (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Date (1 - 31)								Hour (0 - 23)							

Parameter name	Register access	Remark
PARAM_CHANGE_MINUTE_SECOND_1	0x104 (R)	
PARAM_CHANGE_MINUTE_SECOND_2	0x109 (R)	
PARAM_CHANGE_MINUTE_SECOND_3	0x10E (R)	
PARAM_CHANGE_MINUTE_SECOND_4	0x113 (R)	
PARAM_CHANGE_MINUTE_SECOND_5	0x118 (R)	
PARAM_CHANGE_MINUTE_SECOND_6	0x11D (R)	
PARAM_CHANGE_MINUTE_SECOND_7	0x122 (R)	
PARAM_CHANGE_MINUTE_SECOND_8	0x127 (R)	
PARAM_CHANGE_MINUTE_SECOND_9	0x12C (R)	
PARAM_CHANGE_MINUTE_SECOND_10	0x131 (R)	

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Minute (0 - 59)								Second (0 - 59)							

6.6.4.5 Unit information

Software version
The software version is specified with three numbers XX.YY.ZZ. The version is presented using two registers.

Parameter name	Register access
SW_VERSION_XXYY	0x132 (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Version no. XX								Version no. YY							

Parameter name	Register access
SW_VERSION_ZZ	0x133 (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								Version no. ZZ							

Hardware version
Hardware version is specified in one 8-bit number.

Parameter name	Register access
HW_VERSION	0x134 (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								Version no.							

Serial Number
Serial number is 17 letters in ASCII format, stored in 9 registers each containing ascii code for two letters.

Parameter name	Register access
SERIAL_NBR_1_2	0x135 (R)
SERIAL_NBR_3_4	0x136 (R)
SERIAL_NBR_5_6	0x137 (R)
SERIAL_NBR_7_8	0x138 (R)
SERIAL_NBR_9_10	0x139 (R)
SERIAL_NBR_11_12	0x13A (R)
SERIAL_NBR_13_14	0x13B (R)
SERIAL_NBR_15_16	0x13C (R)
SERIAL_NBR_17	0x13D (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	First letter								Second letter							

EKIP device ID
Fixed ID representing the device type for EKIP.

Parameter name	Register access
EKIP_DEVICE_ID	0x141 (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								Device id							

Modbus parameters

Parameters defining the Modbus settings.

Modbus id in range 0 – 248.

Parameter name	Register access
MODBUS_DEVICE_ID	0x142 (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								Device id							

ID	Modbus baud rate
0	(9600)
1	(19200)
2	(38400)
3	(57600)

Parameter name	Register access
MODBUS_BAUD_RATE	0x143 (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								ID							

ID	Modbus frame format
0	(8 bits, even parity, 1 stop bit)
1	(8 bits, odd parity, 1 stop bit)
2	(8 bits, no parity, 1 stop bit)
3	(8 bits, no parity, 2 stop bit)

Parameter name	Register access
MODBUS_FRAME_FORMAT	0x144 (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								ID							

Unit name

Unit name is 16 letters in ASCII format, stored in 8 registers each containing ascii code for two letters.

Parameter name	Register access
UNIT_NAME_1_2	0x153 (RW)
UNIT_NAME_3_4	0x154 (RW)
UNIT_NAME_5_6	0x155 (RW)
UNIT_NAME_7_8	0x156 (RW)
UNIT_NAME_9_10	0x157 (RW)
UNIT_NAME_11_12	0x158 (RW)
UNIT_NAME_13_14	0x159 (RW)
UNIT_NAME_15_16	0x15A (RW)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	First letter								Second letter							

6.6.4.6 Configuration parameters

Parameters defining active inputs and levels.

Input configuration

ID	Current measurement inputs
0	(L1)
1	(L1 L2)
2	(L1 L2 L3)
3	(L1 L2 L3 Neutral)

Parameter name	Register access
INPUT_CONFIGURATION	0x14E (RW)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								ID							

Correction factors

Amplitude correction factor (aI).

Range 0.9000 – 1.1000.

Representation 9000 – 11000, to get the correction factor aI, the register (reg) is divided by factor 1000 (aI = reg / 1000).

Parameter name	Register access
CORRECTION_FACTOR_L1	0x15D (RW)
CORRECTION_FACTOR_L2	0x15E (RW)
CORRECTION_FACTOR_L3	0x15F (RW)
CORRECTION_FACTOR_N	0x160 (RW)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Correction factor * 1000															

Thresholds

Over current threshold (RMS) in ampere, two threshold levels, over current and current warning, separate for phases and neutral.

Parameter name	Register access
OVER_CURRENT_THRESHOLD_3P	0x14A (RW)
OVER_CURRENT_THRESHOLD_N	0x14B (RW)
CURRENT_WARNING_THRESHOLD_3P	0x14C (RW)
CURRENT_WARNING_THRESHOLD_N	0x14D (RW)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								RMS value in ampere							

Daisy chain
Enable or disable daisy chain functionality.

ID	Current measurement inputs
0	(ON)
1	(OFF)

Parameter name	Register access
DAISY_CHAIN_STATUS	0x14F (RW)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-								ID							

6.6.4.7 Date and time
System date and time

Parameter name	Register access
SYSTEM_YEAR_MONTH	0x150 (RW)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Years since 2000								Month							

Parameter name	Register access
SYSTEM_DATE_HOUR	0x151 (RW)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Date								Hour							

Parameter name	Register access
SYSTEM_MINUTE_SECOND	0x152 (RW)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Minute								Second							

6.6.4.8 Reset

Reset of over current and current warning

ID	Command
0	(NOT_USED)
1	(RESET)

Parameter name	Register access
RESET_OVER_CURRENT	0x15B (RW)
RESET_CURRENT_WARNING	0x15C (RW)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ID

6.6.4.9 Spare

Empty registers.

Parameter name	Register access
EMPTY_REGISTER_1	0x145 (R)
EMPTY_REGISTER_2	0x146 (R)
EMPTY_REGISTER_3	0x147 (R)
EMPTY_REGISTER_4	0x148 (R)
EMPTY_REGISTER_5	0x149 (R)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

6.7 Troubleshooting

6.7.1 Visual diagnostics

The yellow Com LED flashes when a Modbus request is received.

6.7.2 Practice via modpoll [3]

Using the application modpoll [3] from a windows environment, it is easy to communicate with CSU-2. To read the status of CSU-2 unit, do the following:

1. Download modpoll from [3]
2. Connect CSU-2 to a PC with a USB-RS485 adapter
3. Configure Modbus RTU according to the existing network. In the example, we choose Modbus ID = 5, Baud rate = 19200 and Frame format is 8 bits, even, stop 1.
4. Execute modpoll from command prompt: modpoll -m rtu -0 -a 5 -r 0x64 -c 1 -t 4 -b 19200 -d 8 -s 1 -p even -l 100 COM9

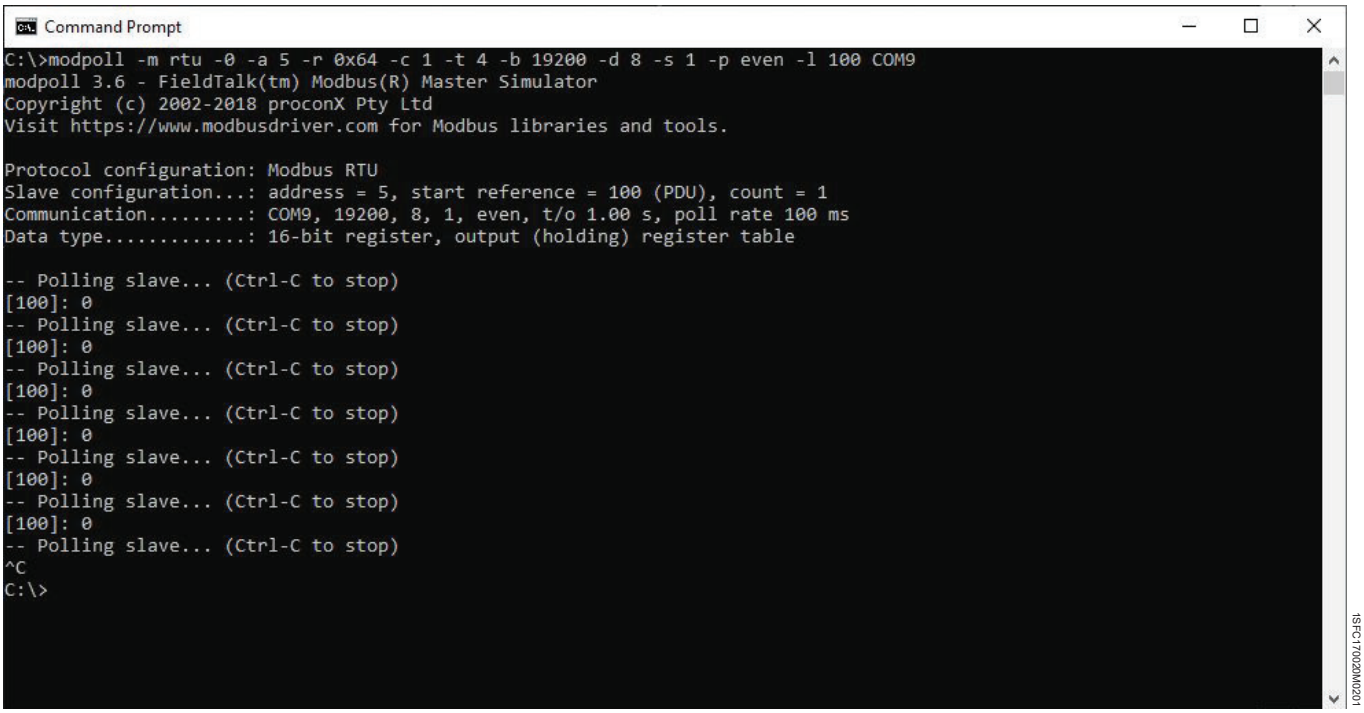


Figure 35
Example for Modbus RTU connection with modpoll as master

INFORMATION

According to **“6.6.3.1 System status” on page 49**, system status can be read with address 0x64. A USB-RS485 adapter is used for Modbus RTU communication, and it is connected to USB serial port COM9.

6.7.3 Practice via PLC

This section shows a demo about how to read system status using a Programmable logic controller (PLC). We use AC500 and Automation Builder as a development platform.

We choose the same Modbus ID, baud rate and frame format as previous practice. These settings can be configured in Modbus parameters in Automation Builder.

A build-in function block from AC500, “COM_MOD_MAST”, is used for sending/receiving Modbus telegrams via COM interface. Do the following steps to set up a program with Ladder:

- CSU2_COM: COM_MOD_MAST;
- enable: BOOL;
- READ_VALUE: ARRAY [1..15] OF UINT;
- FCT_READ_HOLDING_REGISTERS:BYTE:=3;
- NUM_VARIALBE_READ: UINT := 1;
- REGISTER_ADDRESS:BYTE:=100;
- TIMEOUT_TIME: WORD := 1000;
- SLAVE_ID: BYTE := 5;

We set up the network as following:

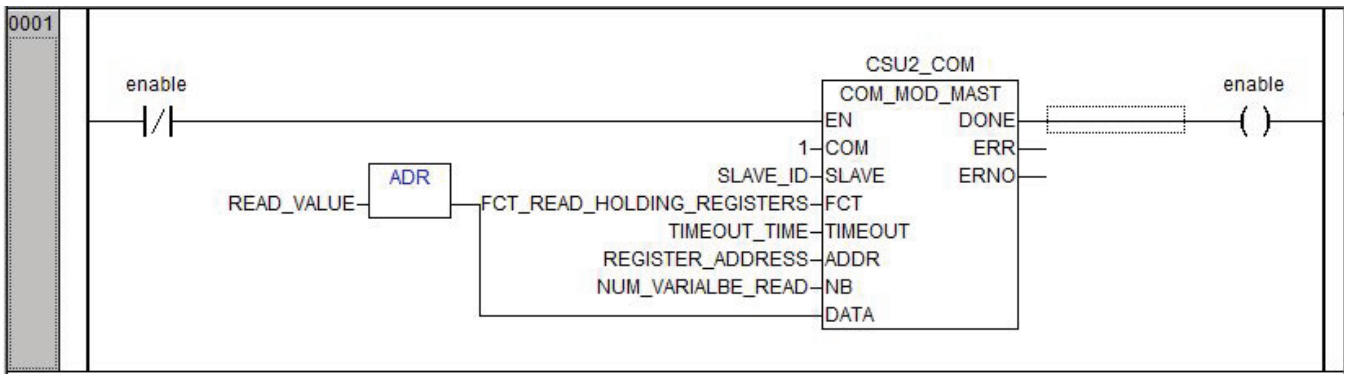


Figure 36
PLC network

Results are shown in READ_VALUE array.

7 Maintenance

7.1 Introduction

The Arc Guard System™ CSU-2 does not require any special maintenance due to that it continuously monitors itself.

For maintenance of the Arc Guard System™ see SFC170011M0201, Arc Guard System™ – TVOC-2 Installation and maintenance guide.

8 Troubleshooting

8.1 Introduction

This chapter describes how to handle events in the system and what measures to take. That includes the handling error event log, list of error codes and how to contact ABB.

8.2 Requirements

Troubleshooting should be done by authorized personnel who are familiar with the CSU-2, the setup as well as the environment where it is located.

Troubleshooting should take into consideration:

- History, including events just before an arc.
- The situation, circumstances when an arc occurred.
- Environment, temperature, vibrations, power supply, electrical/magnetic disturbances.
- How an arc is indicated and the nature of its occurrence.
- The different Arc Guard System™ CSU-2 modules and all connections.

Handling Error log

This section presents diagnostics and describes how to handle the error log. It includes view logs and error codes.

Diagnostics

The Arc Guard Systems is often operated without any personnel present. The error logging function is a way to store information about past events for future reference in order to facilitate troubleshooting. Performing diagnostics is a check on the system status and its error events.

8.3 Error events

The system is continuously monitored, error events are logged in the error event log, possible errors and actions upon them are presented in **Table 8**. The log can hold 10 events, once the log is full the oldest event will be removed upon arrival of a new event. See **“Figure 37” on page 72**.

Attending errors

The error will exist until it is attended to and proper measures are taken. To view the Error events do the steps below:

1. From the home screen, press the bell and the arrow in the top right corner to get to the events screen.
2. Select Error using down arrow and press the select button.
3. To see full event information text, select the event using up and down arrows and then press the select button.
4. In detail view, press back arrow in the upper left corner to get back to the list of error events or press the home button in the upper right corner to get back to the home screen. It is also possible to any time press the physical home button to get to the home screen.

List of errors

The errors and the descriptions are shown in **Table 8**.

INFORMATION

This is not a complete list of errors!

This list only shows some of the most simple errors in which the user may be able to take actions on their own.

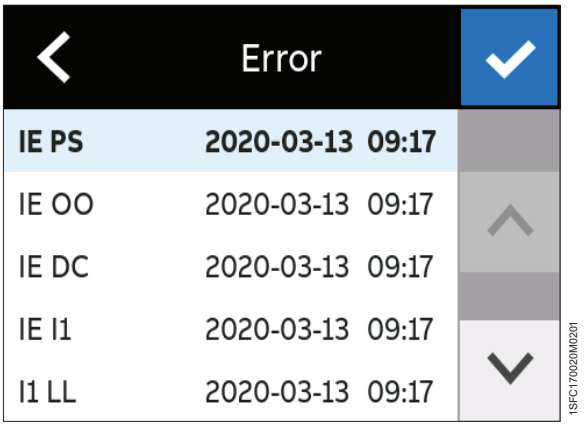


Figure 37
Error events

Table 8 List of errors

Error code	Description	Recommended actions
Ix LL	Input x low light	Degenerated LED at connected CSU-2/TVOC-2 unit. The unit in the other end should be replaced.
Ix NL	Input x no light	Make sure that light is transmitted by units connected to the optical input connector and that the optical cable is not damaged.
CS Lx/N	Current sensor Lx/N	Connect cable from current sensor.
IE PS	Internal error power supply	Check if auxiliary voltage to CSU-2 is low (>24VAC/DC), if not, it is an internal power supply error in which case CSU-2 should be replaced.
IE Ix	Internal error input x	CSU-2 should be replaced.
IE OO	Internal error optical output	
IE DC	Internal error daisy chain	

8.3.1 LED-lights

Table 9 LED on CSU-2

LED	Description	Recommended actions
Green	Power	
Red	Over current	
Red	Error	
Yellow	Communication	

Table 10 LED on current sensor inputs

LED	Description	Recommended actions
OFF	Current sensor inputs are not configured	
Flashing Green	Current sensor cable are connected and configured	
Red	Current sensor inputs are configured but not connected	Connect cables from current sensor

8.3.2 ABB support

If you have a problem with your CSU-2, contact ABB for support.

Contact information
ABB AB
Control Products
SE-721 61 VÄSTERÅS, Sweden
Telephone +46 21 32 07 00
www.abb.com/lowvoltage

Providing information

To get faster support when contacting ABB support it is beneficial to be prepared to answer the following questions:

- Description of how the error occurred.
- Which Arc Guard System™ modules are used, setup and configuration.
- Readings on LEDs and display.
- Output signals.
- What is the general situation.
- Application, location, ambient conditions.
- What has happened, the situation before the error, any event that happened in connection with the error.
- Have you done troubleshooting? What did you check?
- Which are your findings?

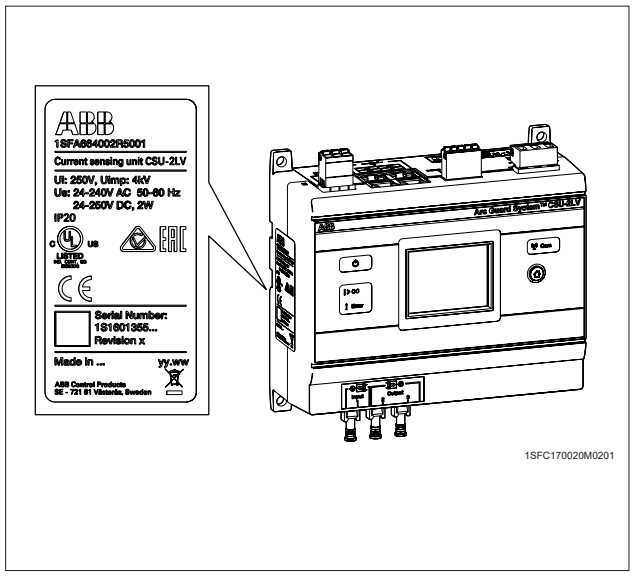


Figure 38
Serial number

INFORMATION

It is also important to know the serial number.

See label on CSU-2.

To get the CSU-2 Revision Information, **See: "5.3.3 Device info" on page 35.**

9 Technical data

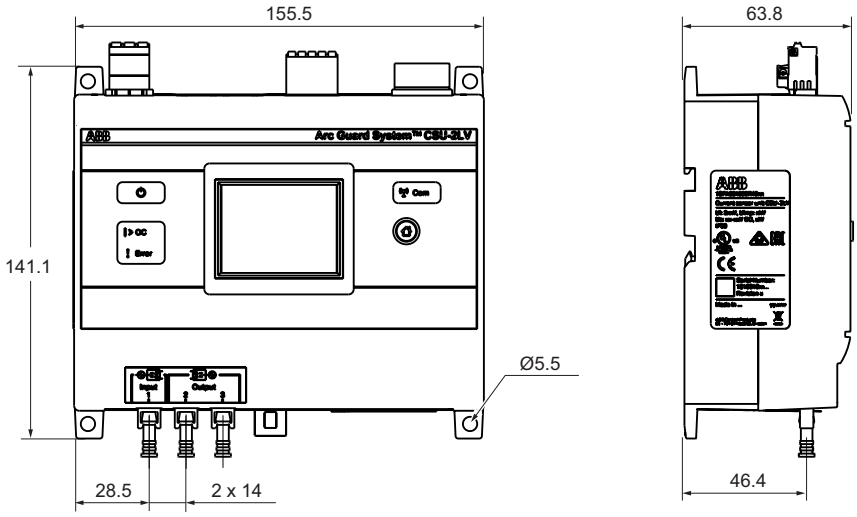
9.1 Technical data

Table 11 Technical data

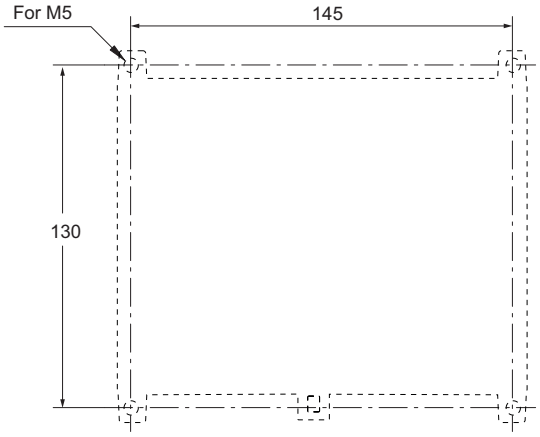
Common technical data	Overvoltage category		III		
	Pollution degreee		3		
Power supply			**CSU-2**		
	Rated supply voltage,U_S		24-240 V AC 50-60 Hz 24-250 V DC		
	U_S variation		AC - 10% - +15% DC - 25% - + 30%		
	Rated insulation voltage, U_i		250 V with reinforced insulation		
	Rated impulse withstand voltage U_{imp}		4 kV		
	Main MCB/fuse		Max. 10 A char. C/fuse 10 A gG		
	Power consumption		<2 W		
Output contacts Contact rated voltage with reinforced insulation between different contacts	Terminals	Description	U_i	U_e	U_{imp}
	11, 12, 14	K1 OC signal	250 V	250 V AC 50-60 HZ, 250 V DC	4 kV
Environmental specifications	Permissible ambient temperature in operation		- 25 to + 55 °C		
	Permissible ambient temperature in transportation and storage		- 25 to + 70°C		
	Humidity		Maximum 95%		
	Altitude		Less than 2000m above sea level.		
	Degree of protection		IP20		
Optical inputs and outputs					
	Current signal from another unit (TVOC-2 or CSU-2)		Input: 1 (optical)		
	Forward current signal to another unit (TVOC-2 and/or CSU-2)		Output: 2 & 3 (optical)		
Relay (K1)	Over current relay		1 CO gold-plated contact		
	Rated voltage		250 V AC/DC		
	Continous carry I_{th}		8 A		
	Make and carry for 3 s		8 A		
	Breaking capacity		250 V	1.5 A	AC - 15
			250 V	0.15 A	DC - 13
			110 V	0.3 A	DC - 13
			48 V	0.5 A	DC - 13
			Reinforced insulation between separate contacts.		
			I_{th} = 5 A Min switching load: 1 mA at 5 V DC with contacts not used for switching current > 0.5 A if inductive/capacitive load before.		
Settings and indications					
	Display		Color touch TFT display 320 x 480 with LED backlight		
	Buttons		1 soft key home button		
	LED signals		Power, Over current, Error, Communication, Current Sensor status		
	Settings (HMI)		Input selection, current thresholds, daisy chain on/off, automatic reset on/off, amplitude correction factors (MV version), modbus id, baud rate, frame format, date and time, language, display brightness, factory reset.		
	Display information		Over current, Current Warning, Event logs, settings, device info.		
Reaction time	Over current to optical output		<1 ms		
	Optical input to output		<0.4 ms		
Optical cable for connecting CSU to an Arc Monitor	Maximum length		30 m		

9.2 Dimensions

Current sensor unit



Drilling plan



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9.3 Applications Diagrams

9.3.1 Example 1

Example 1: Arc Guard System™ configured to trip all contacts in case of an arc and over current.

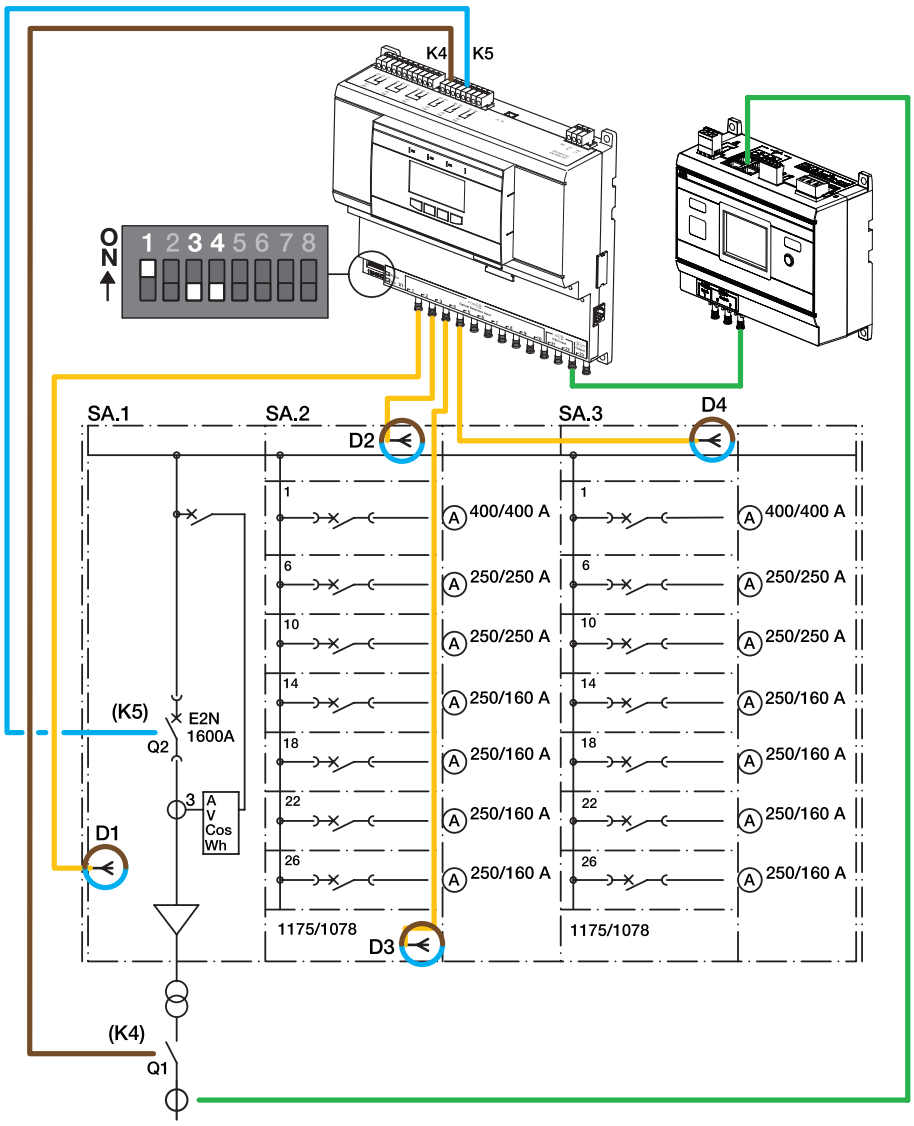

Table 12 Connection description for example 1

Connection	Description
SA...SA3	Switchgear
K4, K5	Solid state tripping contacts
Q1, Q2, Q3	Circuit-breaker
D1...D4	Detectors

9.3.2 Example 2

Example 2: Arc Guard system™ configured to trip different trip contacts depending on where the arc occurs together with over current.

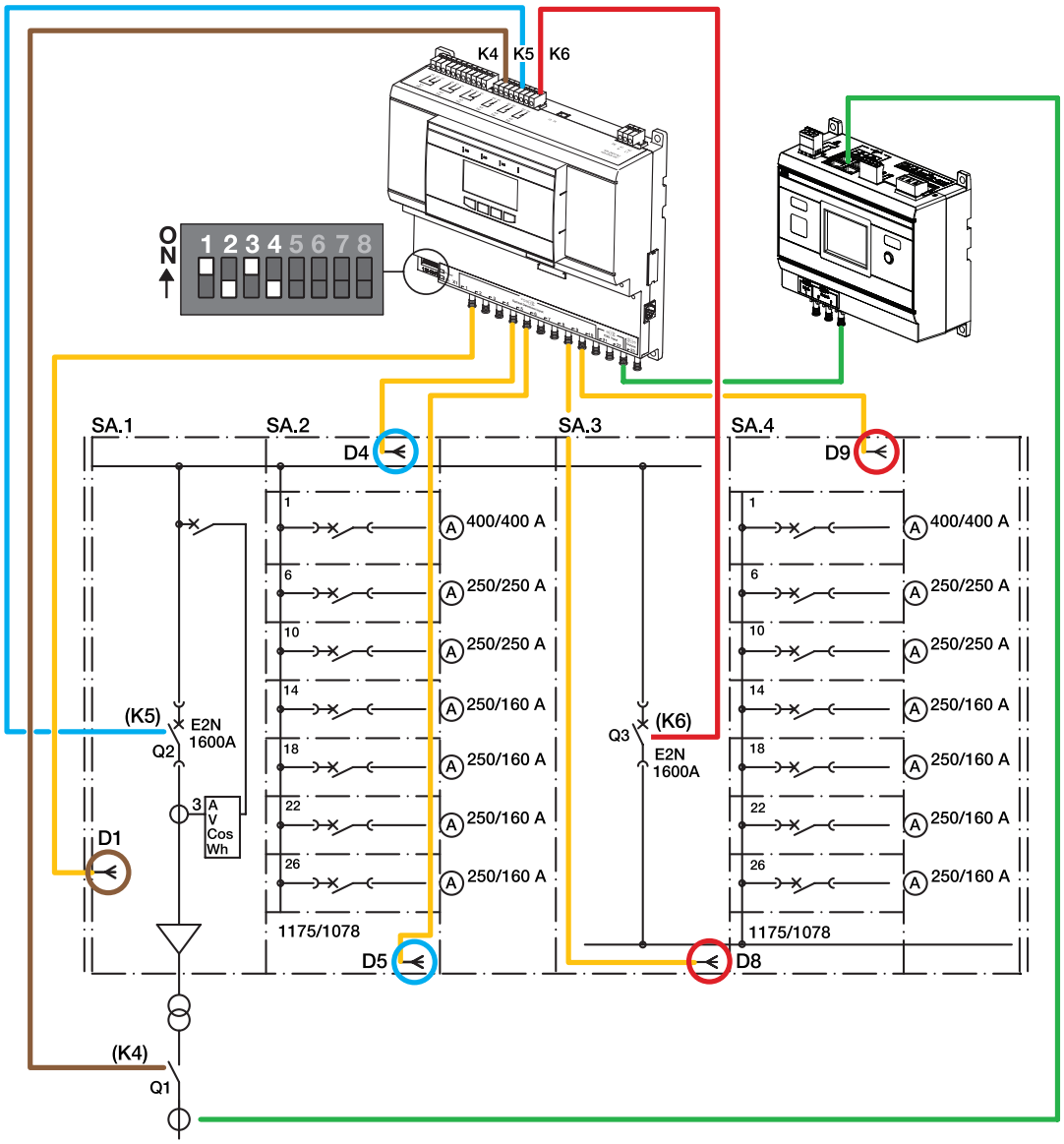

Table 13 Connection description for example 2

Connection	Description
SA...SA4	Switchgear
K4, K5, K6	Solid state tripping contacts
Q1, Q2	Circuit breaker
Q3	Bus couplar
D1...D9	Detectors

9.4 Circuit diagrams

Arc Monitor

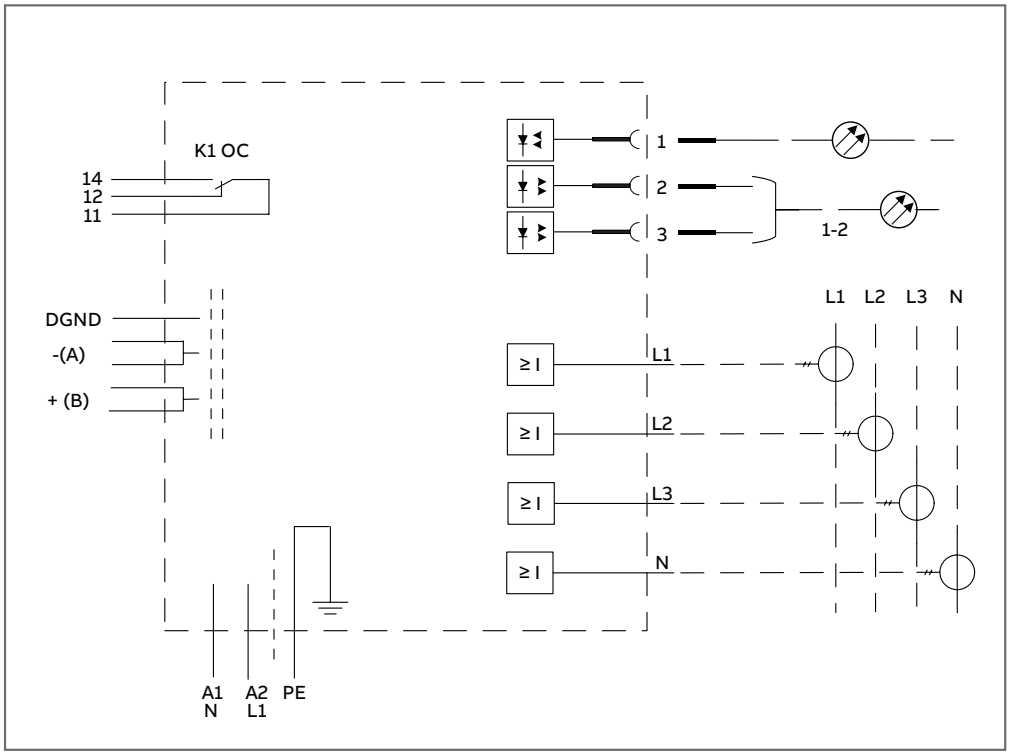

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Table 14 Terminal description for circuit diagrams

Terminals	**Description**
L1, L2, L3, N	Current transformer terminals
11,12,14	Signal Relay
K1	Over current (OC)
DGND, -(A), +(B)	Communication interface Modbus RTU
2 and 3	Output current signal to another Current Sensing Unit or Arc Monitor
1	Input current signal from another Current Sensing Unit
Power supply terminals	**Description**
A1(N) and A2(L1)	24–240 V AC, 24–250 V DC

ABB AB
Electrification Products Division
Low Voltage Products and Systems
Protection & Connection
Motorgränd 20
SE-721 61 Västerås / Sweden

You can find the address of your local sales organisation on the ABB home page.

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