HomeGuard

USER MANUAL

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VoltGuard®

BASIC PURPOSE

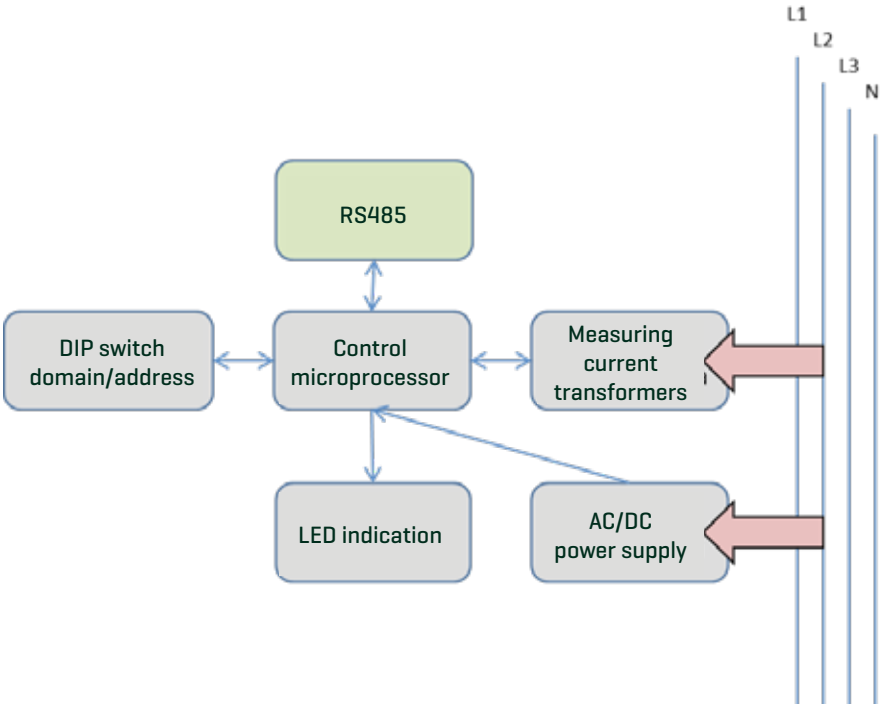
The HomeGuard residual capacity meter is a device primarily used in the VoltGuard system as the information source for regulating the charging current of the electric vehicle charging station. The meter is designed to be connected directly to the power supply circuit either next to the distribution meter or into the main switchboard of the building. It is serially connected after the distribution meter and the input circuit breaker ensuring that the measured values are the same as the values measured by the electricity meter and evaluated by the input circuit breaker trip circuit.
The main function of a residual capacity meter is, of course, to measure the flowing current with sufficient accuracy and to compare it with the set limit. The comparison result is then sent in pre-defined periods through the RS485 communication bus. The meter can send the differences between the measured and pre-set values as well as the current absolute values measured on all three phases.

MAIN FEATURES

- Direct connection of current conductors
- Maximum current of 63 A
- Current measurement accuracy up to 2%
- Internal power source 230 V AC, 50 Hz
- RS485 communication line for sending the measured data
- Compact DIN rail box dimensions
- LED status indication
- Service setting by a serial terminal

VOLTDRIVE s.r.o.,
Háj 365 (MICOS TELCOM premises), 798 12 Kralice na Hané, Czech Republic
Tel.: +420 582 307 603, Fax: +420 582 307 688
e-mail: info@voltdrive.com, www.voltdrive.com

BLOCK DIAGRAM



DESCRIPTION

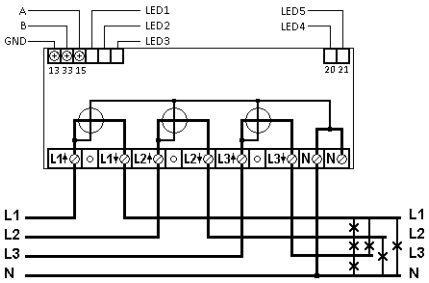
The residual capacity meter is primarily used for measuring and transmitting the amperage on three phases at the point of supply. It is connected directly to the power supply circuit, optimally as close as possible to the main circuit breaker at the distribution meter. The meter measures the flowing current using the current transformers by the A/D convertor of the control microprocessor. It neither measures the voltage nor calculates the instant power. Its output is only the effective values of the flowing current in all three phases, always measured for the period of 500ms (25 periods of network frequency).

When used in the VoltGuard system, you have to set the comparative value in the meter, from which the meter will subtract the measured value and send the difference between the values to the charging station control unit. The principle of the function is to provide the charging station control unit with information on residual current (power) at the point of supply, and the control unit then sets the maximum possible charging current of the electric vehicle. This ensures that the maximum consumed current of the charging station never exceeds the currently available current and the main circuit breaker does not turn off. The goal is to charge electric vehicles with the maximum available current without limiting ordinary household operation.

The meter is calibrated at a rated current of 20 A ensuring its accuracy over the entire range is better than 2% of the range. The meter transmits the differences between the set limit and the measured current for each phase using the RS485 serial line and uses the VoltGuard system proprietary protocol. With special setting, the meter can also transmit absolute values of the measured current, so it can perform the functions of a communicating current meter. The communication protocol for connecting into the system will be provided on request by the manufacturer. The meter can be connected to the charging station control unit directly using the RS485 line or the PLC communication modems, which are also part of the VoltGuard system. In both cases the meter is the master module and sends data periodically to the serial line; therefore no other communication is supported on that line.

CONNECTION DIAGRAM AND LED INDICATION

CONNECTION DIAGRAM:



LED INDICATION

The device can work in two modes:

- **Normal measuring** – measuring of the currents on the input and sending information about measuring results.
- **Calibration** – the calibration constant is calculated according to the measured values and known amperage and the output information is then recalculated according to this calibration constant.

The selection of the mode is done by the "DIP Start Calibration" jumper and is indicated by LED (Led4 – Blue). The jumper is open in the "Normal measuring" mode. To do the calibration, you have to connect the jumper on Pins 1 and 2 and wait for the calibration result indicated by either red LED (ERROR) of green LED (OK).
Once the power supply is on, the orange LED indicator "LED Power" automatically turns on. Next, the device checks the status of the "DIP Start Calibration" connection pin. If Pin 1 and 2 are connected, the device goes into the "Calibration" mode; otherwise it remains in the "Normal measuring" mode.

The meaning of the LED indication is described in the following table:

LED	"Calibration" mode	"Normal measuring" mode
LED1 (Orange)	LED is on = Power On	
LED2 (Blue)	Blinking (5 Hz)	Blinking 2 Hz
LED3 (Green)	Calibration completed OK.	In case the LED3, LED4 and LED5 are on, LED2 also stops blinking and turns only on = logical error of the internal status machine or problems with writing calibration constants to FLASH memory (readback error).
LED4 (Blue)	LED is off, calibration in progress; LED is on, calibration is completed, waiting for opening the "DIP Start Calibration" jumper – calibration result shown by LED3 or LED5	
LED5 (Red)	Calibration completed with error – the process needs to be repeated	

CONFIGURATION

SERIAL PARAMETERIZATION TERMINAL

The text console enables more extensive setting of the device (current meter) than with the DIP switch (see the introductory image). The device goes into the Text Console mode when the DIP7 switch is switched. Once the power supply is on, the module automatically sends the basic menu.

Connection

RS485 connection parameters: 9600, 8n1
The control terminal uses the RS485 interface in the semi-duplex mode. Once the power supply is on, the module automatically sends the basic menu. In case the terminal is connected after the power supply on the modules is on, the menu is sent immediately after ENTER is pressed again.

Basic menu

In case the terminal is connected after the power supply is on, the menu is sent immediately after pressing ENTER. The menu enables the selection of options. The selection is done by entering numbers in square brackets and pressing ENTER. In case you select a wrong option, the menu is automatically displayed again. You can use this feature when the display terminal is not ready after the power supply is on, i.e. after pressing ENTER the menu is displayed again. The basic menu is displayed as follows:

----- Current Measurement Terminal -----
[1] Display settings
[2] Change settings
[3] Save settings
[4] Reload saved settings
Selection :

Option: [1] Display settings

This option displays the current setting selected by the DIP switch and also the setting stored internally in the device. The selected items in this option are:

- Source – the item sent in the output packet – see above.
- Calibration current – the current value of the calibration current used by the FW for calculating calibration constants.
- Tracked phases – the values of 001, 010, 011, 100, 101, 110, 111 (first phase 0/1, second phase 0/1, third phase 0/1) – it determines which phases are used for determining the maximum consumed current and is used for calculating the residual capacity.
- Up step – step up integers between 1and 9 (currently hard-set on 5 with the meaning of addition 1/5 residual capacity), for garages the value will be 1.
- Number of Chargers – integers between 0 and 99.

The items are listed as follows:

> Circuit breaker size:
>> HW switch: 32
>> Settings: 16
> Number of chargers (Number+1):
>> HW switch: 0;
>> Settings: 0
> Source (packet): 0.
> Typical installation (switch): 0
> Calibration current: 12.9 A.
> Tracked phases: 7.
> Up step: 5
> Safe region [%]: 5.

----- Current Measurement Terminal -----
[1] Display settings
[2] Change settings
[3] Save settings
[4] Reload saved settings
Selection :

Option: [2] Change settings

To change the items you can select the following options (their meaning is described above):

> Change:
[1] Circuit breaker capacity
[2] Number of chargers
[3] Source (packet)
[4] Tracked phases
[5] Safe region
[e] Exit
Selection :

These options enable setting the relevant values, supposing that the meaning of the numbers is as follows:

- Option 1 : an integer between 1 and 99, unit – A.
- Option 2 : an integer between 0 and 99, providing that 0 means that at least one charger is connected to the device, i.e. the final number of chargers is "the entered number" + 1.
- Option 3 : a character that will be entered into the sent packet.
- Option 4 : a number between 1 and 7 that determines the tracked phases. Binary encoded as follows:
  - 4 = 100 first phase tracked
  - 2 = 010 second phase tracked
  - 1 = 001 third phase tracked
  - 6 = 110 first and second phase tracked
  - 3 = 011 second and third phase tracked
  - 5 = 101 first and third phase tracked
  - 7 = 111 all phases tracked

Option: [3] Save settings

The last option enables saving the master module setting to the internal memory. This setting is then loaded once the power supply is on. The result of the option is either ok or fail. The result fail means the processor internal memory error, i.e. the written data do not match the read data.

Selection :'4
> saving ....
> ok.

----- Current Measurement Terminal -----
[1] Display settings
[2] Change settings
[3] Save settings
[4] Reload saved settings
Selection :

Option: [4] Reload saved settings

The console mode can be terminated in two ways, by:

- Switching the DIP switch to the relevant position – the device will start using the changed setting values.
- Selecting Option no. 4 – the setting stored in the FLASH memory is loaded before leaving the console mode.

CALIBRATION

The procedure for initiation of the calibration mode:

- Turn on the device in the measuring mode ("DIP Start Calibration" jumper is open) – LED2 blinks slowly, the other LED indicators are off.
- Set the calibration current of 20A effective for all 3 phases (the easiest way is to use one calibration source serially connected across all three inputs).
- Connect the "DIP Start Calibration" jumper - LED2 blinks quickly, the other LED indicators are off.
- Wait until LED4 is on – LED4 is on, LED2 blinks quickly, and simultaneously either LED2 is on (calibration result OK) or LED5 is on (calibration completed with ERROR, the process needs to be repeated).
- Open the "DIP Start Calibration" jumper – LED3 and LED4 turn off, LED5 and LED2 blink slowly

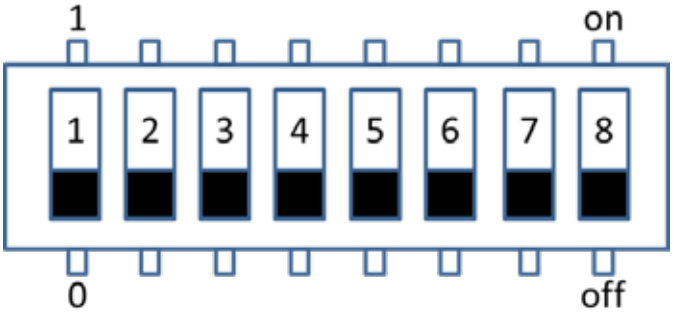
Note: the device is calibrated during the manufacturing process and it is not advisable for the end user to change the setting. Changing the calibration may result in resetting the device parameters unsuitable for the target application.

MEASURING

The device goes into the measuring mode automatically after the power source is on and also after the "DIP Start Calibration" jumper is open when leaving the calibration mode. The meter performs the following operations in the measuring mode:

- Checks if the "DIP Start Calibration" jumper is closed and eventually goes into the calibration mode.
- Reads the DIP switch setting and saves the data.
- Performs the measurements.
- Sends the measurements and settings to the RS485 output.

DIP SWITCH SETTING



The ON position on the DIP switch is interpreted as switched on (log.1), the opposite position as switched off (log.0). In the position of logical 1, the switch on the DIP switch is switched on.

DIP position	Designation	Function
1	LSB circuit breaker	Used for calculating the remaining current available on the circuit breaker: Setting: Circuit breaker capacity **0**: 10, **1**: 16, **2**: 20, **3**: 25, **4**: 32, **5**: 40, **6**: 50, **7**: 63
2	Circuit breaker	
3	MSB circuit breaker	
4	Output packet type	**1**: short option – circuit breaker capacity **0**: long option – measured currents
5	NumOfSlaves LSB	The setting is reflected in the output packet, the NumOfSlaves field and also the calculation of the remaining circuit breaker capacity – see below. The value 0 means one slave, i.e. the number of connected chargers is (NumOfSlaves + 1) or the setting NumOfSlaves=(number of chargers – 1)
6	NumOfSlaves MSB	
7	Console mode	**1**: The device does not transmit data but enables setting the device through the text console. **0**: The device does not transmit the set data.
8	Typical installation	**1**: The device is in the typical installation mode. **0**: The device runs according to the settings available through the text console.

COMMUNICATION

The setting of the RS485 serial channel is 9600, 8n1.
The device accepts the communication packet on its input with the following options.

A. Short option – remaining circuit breaker capacity

STX	SOURCE	DEST	NUM OF SLAVES	CMD	DELKA	DATA	DATA	DATA	SUMA	ETX
0x02	'0' + Source	'0'	'0' + Domain DIP	'A'	3	'0'	'0'	'0'	SUMA	0x03

The variables are only the following fields:
- Source - '0' character + DIP switch value.
- NumOfSlaves - '0' character + DIP switch value. It is the number of connected chargers – the meaning of calculation is described in the table explaining the meaning of the DIP switches.
- DATA - three characters, where '123' means free capacity 12.3 A.

B. Long option – currents measured on each input

STX	SOURCE	DEST	NUM OF SLAVES	CMD	DELKA	Ch0	Ch1	Ch2	SUMA	ETX
0x02	'0' + Source	'0'	'0' + Domain DIP	'A'	9	'0' '0' '0'	'0' '0' '0'	'0' '0' '0'	SUMA	0x03

The variables are only the following fields:
- Source - '0' character + DIP switch value.
- NumOfSlaves - '0' character + DIP switch value. It is the number of connected chargers – the meaning of calculation is described in the table explaining the meaning of the DIP switches.
- DATA - three groups of three characters, where '123' means input current 12.3 A.

Relation between field variables and device setting

The values of the Source and NumOfSlaves fields vary according to the setting of the DIP8 "Typical installation" switch.
The values entered into the output packet are as follows:

Parameter	"Typical installation" mode	"Console setting" mode
Source	Nothing is added. Character "0" is sent.	See Source setting
NumOfSlaves	The value read from the DIP5-6 switches is added, i.e. the final sent value is "0", "1", "2" or "3".	See NumOfSlaves setting

TYPE DESIGNATION AND ORDER CODE

HomeGuard	HG	xx	yy.	zz
HW modification				
FW modification				
Internal setting				

INSTALLATION AND SOLVING OPERATIONAL PROBLEMS

DIN RAIL INSTALLATION

The device is mounted onto the DIN rail in a standard way and is fixed by two plastic locks. The installation and maintenance must be carried out by a competent person with relevant electrical qualifications, who informs the operator about the conditions for safe operation.

SWITCHING ON

The meter is powered from the L3 phase terminal and N working conductor. It automatically switches on upon connecting the N and L3 terminals, which is the minimum necessary configuration for single-phase measurement. The settings of the DIP switches can be changed without turning off the meter and the new values are immediately accepted.

CHECKING LED STATUS INDICATION

If in the Normal measuring mode, the LED1 indicator is on indicating that the module power voltage is available. The LED2 indicator blinks with a frequency of 2 Hz indicating proper functioning. The meaning of the other LED indicators and their use during the calibration process are described in the table above.

CONNECTING RS485 LINE BETWEEN METER AND PORTGUARD

The RS485 interface is used for transmitting a data frame with a period of 500ms. The RS485 communication line parameters are 9600, 8n1. The bus needs to be connected by a twisted pair. The signals on the 3-pin connector are allocated as follows:
Pin1 – signal A (rightmost)
Pin2 – signal B
Pin3 – GND

SETTING DOMAIN AND ADDRESS

The settings of the domain number and the meter address are used to identify the meter. They do not affect the meter function and are sent in a data frame through the RS-485 bus.

VoltGuard®

TECHNICAL SPECIFICATIONS

Power supply

- Rated voltage: 230 V AC
- Specified supply voltage range: 0.9 – 1.1 Un
- Rated frequency: 50 Hz
- Power supply phase: L3
- Internal consumption: < 1.2 W

Measuring

- Minimum measured current: 5 A
- Nominal current for calibration: 20 A
- Maximum measured current: 63 A
- Current difference detection period: 500 ms
- Power terminal diameter: 7.2 mm
- Maximum conductor cross section: 25 mm^2 cable, 16 mm^2 wire

Insulation parameters according to the CSN EN 60664-1/CSN EN 60664-3 standards

- Overvoltage category: III
- Pollution degree: 3
- Altitude: <2000 m

Construction parameters

- Dimensions: 107 x 91 x 71.5 mm (WxHxD)
- Weight: 350 g
- Operating temperature: between -30°C and +50°C
- Storage temperature: between -40°C and +70°C
- Installation: DIN rail

Communication

- Type: RS485 twisted pair physical layer
- Communication line parameters: 9600 baud, 8n1
- Communication line power supply: internal
- RS485 twisted pair replacement options: Voltdrive ShiftGuard PLC modems
- Communication protocol: VoltGuard system proprietary protocol, see product documentation

Type tests

- Protection class: 2
- Safety: assessed according to ČSN EN 61010-1 standard

VOLTDRIVE s.r.o.,
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e-mail: info@voltdrive.com, www.voltdrive.com

SAFETY INSTRUCTIONS

The product is capable of safe operation. The manufacturer warns of the risk of possible danger resulting from incorrect handling or incorrect use of the product:

- The installation and maintenance must be carried out by a competent person with relevant electrical qualifications, who informs the operator about the conditions for safe operation.
- The product must not be used for other than its intended purpose.
- The product must not be modified compared to its standard design.
- The product must not be operated with other voltage, current or frequency than it was produce or professionally modified for.
- The product must be placed and secured, so that it is difficult to access or inaccessible for the people without any electrical qualification, especially children.
- Before every re-commissioning, for example, after any reparation or maintenance, the protection and all safety measures must be completely restored to ensure safe operation.
- The product must not be used in conditions and environments that do not guarantee safe operation (for example, installed on a flammable surface, its cover made of flammable materials, insufficient protection against foreign body intrusion or water and other liquid ingress).

In case the user does not comply with any of the above instructions and if this noncompliance results in any defect, the manufacturer disclaims any liability for the defect.

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