INSTRUCTION MANUAL

Power Factor Controller RVT

Installation and operating instructions

Instructions d'installation, d'utilisation et d'entretien

Installations und Betriebsanleitung

Instrucciones de instalación y de funcionamiento

RVT安装和操作说明

Instruções de instalação e operação

Installation and operating instructions

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Read this first

About this instruction manual

This Instruction Manual provides detailed information to help you quickly install and operate the RVT power factor controller.

Warning

Caution, risk of danger: This symbol is a warning indication to highlight some important information

Before installation and operation of the RVT controller, read the safety notices carefully. Keep it at the disposal of people in charge of installation, maintenance and operation.

Safety

The RVT complies with the European Directive LVD 2006/95/EC.

Caution, risk of electric shock: This symbol warns the reader that safety information is given and has to be taken into account

Installation, maintenance and operation of the RVT Controller must be performed by qualified electricians. Do not work under live supply conditions. For cleaning, remove the dust with a dry cloth. Do not use abrasives, solvents or alcohol. Before cleaning please turn off the power supply and voltage measurement circuit. Do not open the RVT Controller’s housing. There are no user serviceable parts inside. The RVT Controller is connected to a current transformer. Do not unplug the current transformer connections before making sure it is short-circuited or connected to another parallel load of sufficiently low impedance. Failure to do so can create dangerous over voltages. Do not use this product for any other purpose than it is designed for.

Electromagnetic compatibility

The RVT complies with the European Directive EMC 2004/108/EC.

This RVT Controller has been verified for compliance with EU (European Union) directives for EMC (electromagnetic compatibility) for operation at 50 Hz and bears the CE marking to this effect. When an apparatus is used in a system, EU directives may require that the system be verified for EMC compliance. The following guidelines are helpful in improving the EMC performance of a system: Metallic enclosures generally improve EMC performance.

1. Run cables away from apertures in the enclosure.
2. Run cables close to grounded metallic structures.
3. Use multiple ground straps for doors or other panel parts as required.
4. Avoid common ground impedances.

1 Introduction to the controller

1.1 What this chapter contains

This chapter gives a general description of the power factor controller RVT. It illustrates the basic structure of the controller, major features and the touch screen user interface of the controller.

1.2 A fully three phase individual controlled power factor controller

The RVT controller is able to fulfil power factor compensation in both balanced and unbalanced network. There are two models for RVT controllers: RVT Base Model RVT6/RVT12 and RVT Three Phase Model RVT12-3P. The Base Model is fully backward compatible to previous RVT controllers with 6 or 12 outputs, which is applicable for a balanced three phases or single phase (phase to phase) network. The Three Phase Model RVT12-3P is a more powerful version with individual phase power factor controlling functions thanks to three CT measurements for each phase. The Three Phase Model RVT12-3P has 12 outputs execution only.

The RVT can also be used for MV automatic capacitor bank. Details on how to connect RVT to a MV bank can be found in 4.3.1.1.

1.3 RVT main features

1.3.1 Power factor correction control

The RVT Power Factor Controller is the control unit of an automatic capacitor bank which is used to fulfil reactive power compensation in an installation with prevailing inductive loads.

It performs the switching of capacitors in order to reach a user-defined target cos j .

- All the switching parameters may be programmed manually or automatically (description in paragraphs 4.3.2 and 4.3.1)
- In addition to the target cos j , night target cos j and target cos j in regenerative mode may be programmed (description in paragraph 4.3.1.3).
- For the Three Phase Model RVT12-3P, the controller can be configured to switch on/off single phase capacitor in an unbalanced network. This function is used to correct the low power factor in each individual phase; for instances, power factor 0.6 in Phase1, power factor 0.8 in Phase2, power factor 0.95 in Phase3. It is very practical for some residential/commercial area where the three phase loads can be unbalanced due to many single phase loads.

1.3.2 Measurements and monitoring

- Measurements (description in paragraph 4.2).
- Protection against unexpected phenomena and/or unauthorized use (description in paragraphs 3.2.4 and 4.3.1.1.)

- Logging of data and alarm messages based on a real time clock (description in paragraphs 4.2.5 and 4.4).
- Checking and testing of relays status (description in paragraphs 4.4.2 and 4.4).
- Temperature measurements: max. 8 temperature probes can be connected in daisy chain connection (description in paragraph 4.3.1.4.3).

1.3.3 Communications

- Modbus connection (a Modbus RS485 adapter is required)
- USB connection (Compatible to USB2.0 specifications)
- Ethernet TCP/IP interface
- CAN 2.0 with extended outputs up to 32. Hardware capable in current version RVT, the software is to be implemented in the future.

Detailed information is in paragraph 4.5.

1.4 Front view and rear view

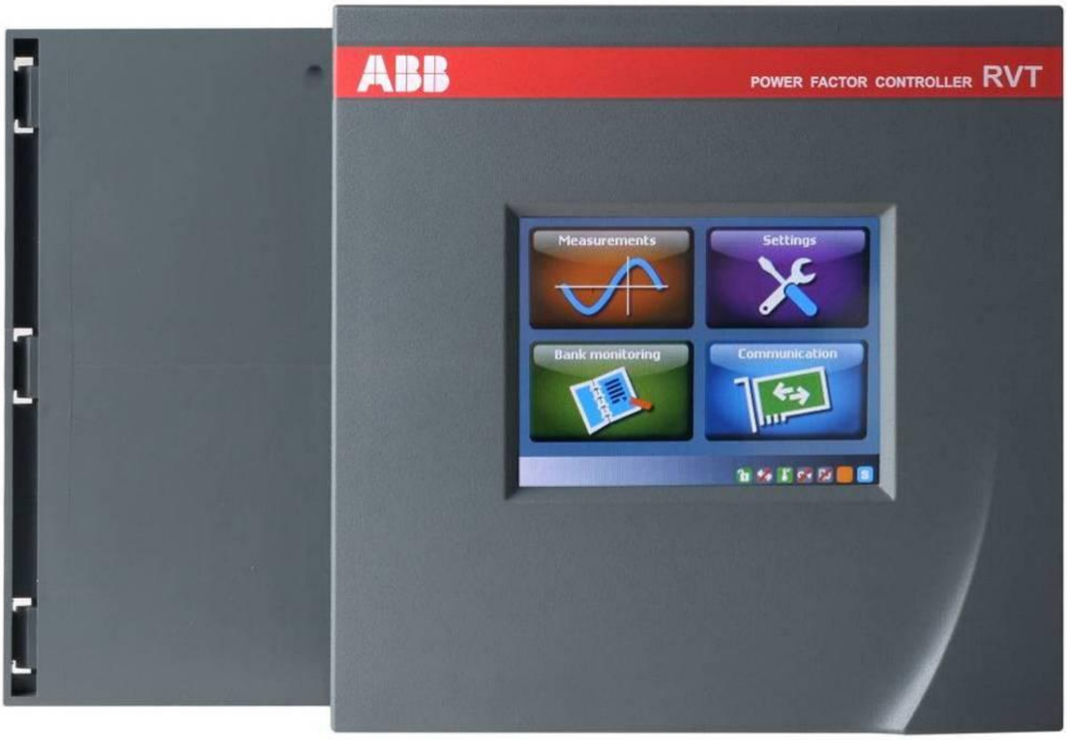


Figure 1: RVT front view

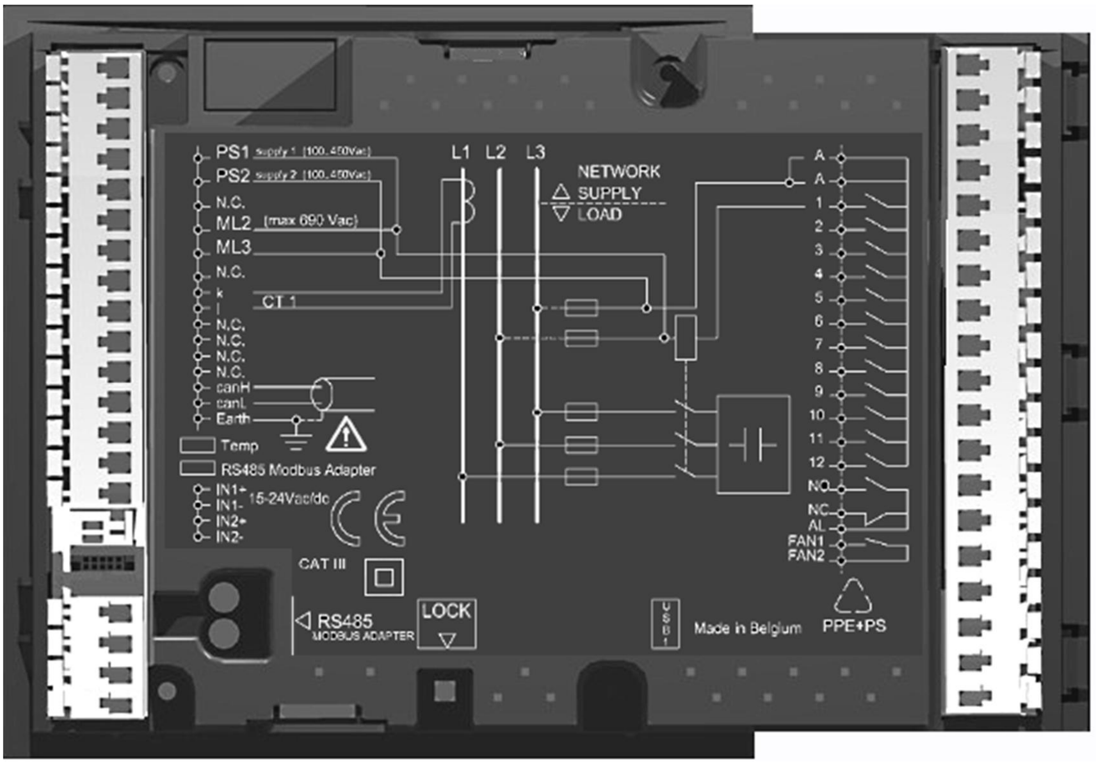


Figure 2: RVT rear View (Base Model RVT6/RVT12)

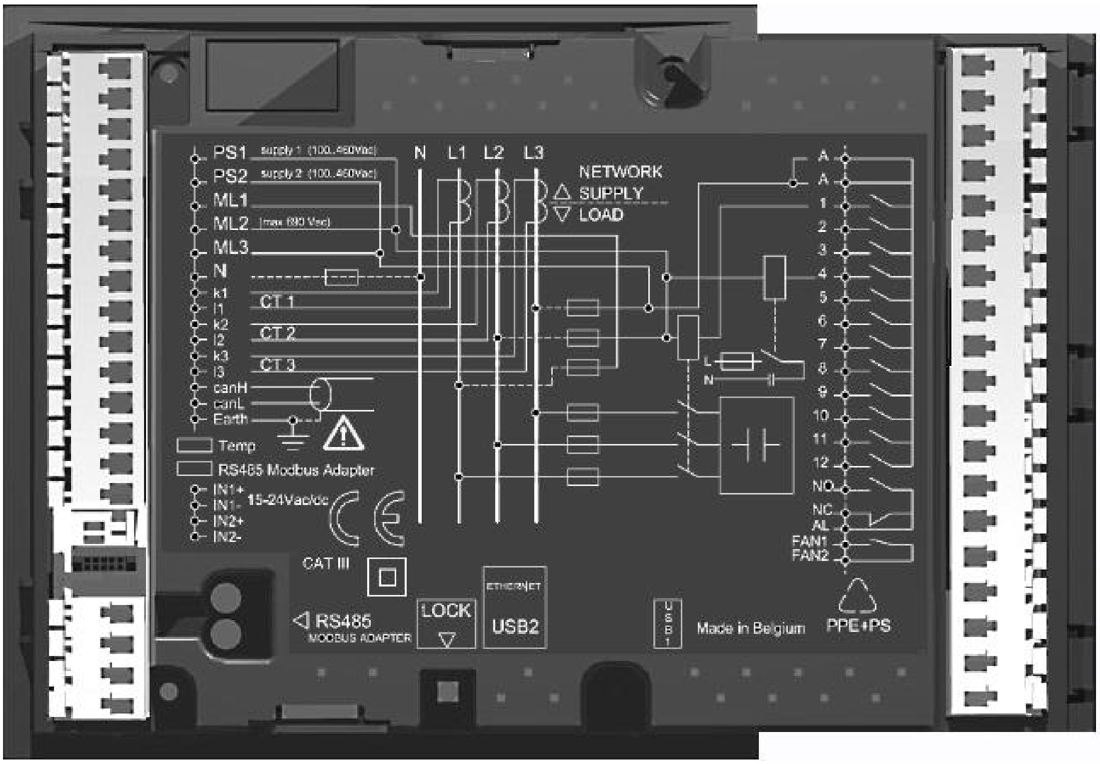


Figure 3: RVT rear View (Three Phase Model RVT12-3P)

1.5 Colorful touch screen interface

A colorful QVGA 320 x 240 pixels touch screen helps the user to operate the controller more easily. All the menu navigations, parameters settings are easy and intuitive thanks to the touch screen.

Figure 4: RVT start screen

Detailed Menu navigation can be found in Paragraph 3.2

2 Installation

2.1 What this chapter contains

This chapter gives instructions to mount the controller on the panel and explains how to make the electrical connection to the controller. The wiring diagram is shown in section 2.4.

2.2 Mounting

Please follow steps below to mount a RVT controller to a panel.

Step 1: Slide the RVT (a) perpendicularly to the Capacitor Bank Cubicle (b).
Step 2: Rotate the RVT to insert it into the Capacitor Bank Cubicle.

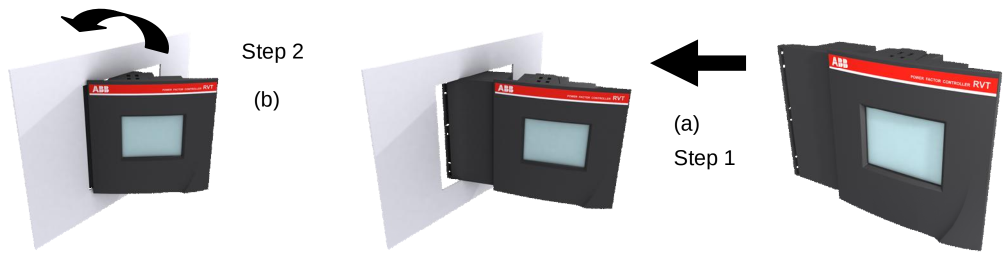


Figure 5: Mounting a RVT

Note: cut out dimensions are 138x138 mm.

Step 3: Insert the Mounting Bracket (c) in the corresponding Fixation Holes (d) of the RVT.

Step 4: Pull the Mounting Bracket backwards.

Step 5: Turn the Screw (e) into the Mounting Bracket and tighten until the RVT is secured in place.

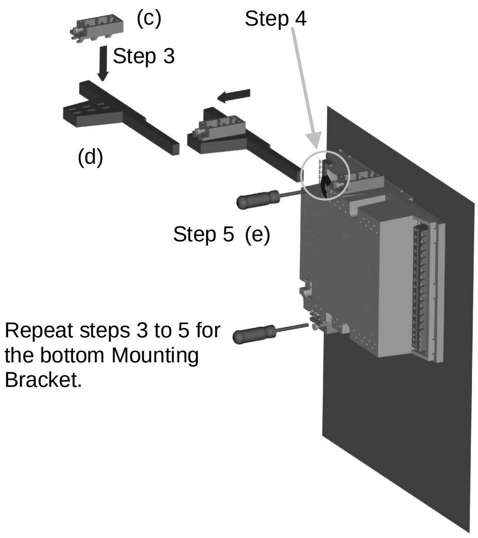


Figure 6: Mounting a RVT

2.3 Lead connections

Please follow instructions below to connect wires to the terminals on the rear side of the controller.

1. Push the lever of the connector backwards with a screwdriver.

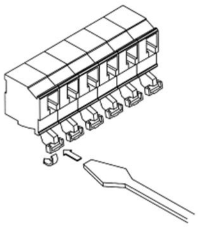


Figure 7: Lead connection

2. Insert the wire (up to 2.5 mm^2 / single core) in the corresponding connection hole while keeping the pressure on the lever.

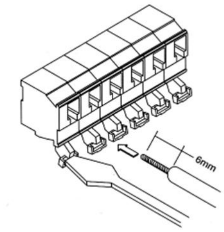


Figure 8: Lead connection

3. Release the screwdriver.

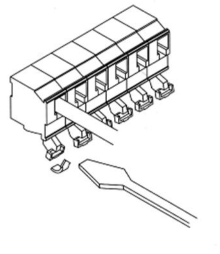


Figure 9: Lead connection

4. The wire is properly connected.

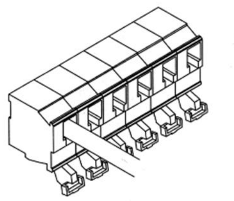


Figure 10: Lead connection

2.4 Wiring diagram

The wiring diagram shows the connection of main circuits and control circuits.

Base model RVT6 / RVT12

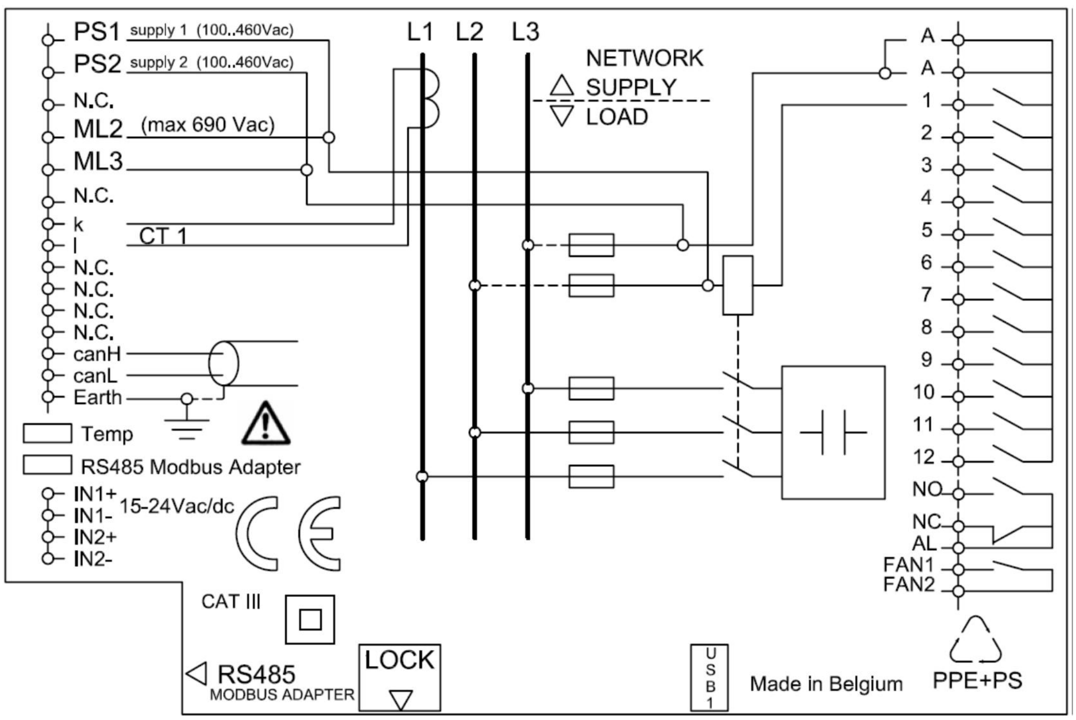


Figure 11: RVT wiring diagram (base model RVT6 / RVT12)

Three phase model RVT12-3P

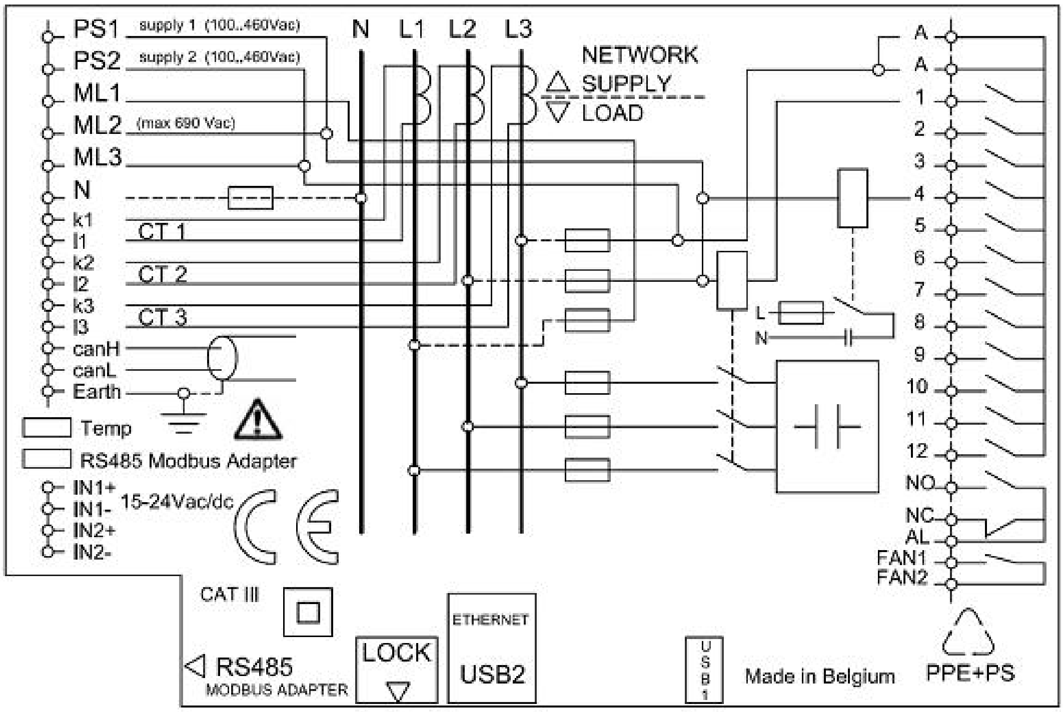


Figure 12: RVT wiring diagram (three-phase model RVT12-3P)

PS1, 2	Power supply
ML1-3	Voltage measurements
N.C.	Not connected
N	Neutral connection
k1-3, l1-3	CT connections
canH, canL	CAN bus
Earth	Grounding
Temp	Temperature probe connection
RS485 Modbus Adapter	RS485 interface
IN1+/- digital input selecting Day or Night target cos j	
IN2+/- digital input for external alarm activation	
A	Common source for output relay
1-12	Output relays
NO/NC	Output contacts of alarm relay
AL	Common source for alarm relay
FAN 1-2	FAN/warning output relay
USB	USB connection
RJ45	Ethernet connection
Lock	Hardware lock

Caution: An over-current protection is recommended in the PS1-PS2 connections: 6Arms fuses 10 X 38 gl 690V.

3 Easy start

3.1 What this chapter contains

This chapter describes briefly the quick start and automatic commissioning procedure for the controller.

3.2 Menu navigation

When the RVT is switched on power after the boot process (where the ABB logo is displayed) the start screen is the first screen which will be displayed as shown in Figure 13.

Figure 13: RVT start screen

In the center of the screen the four icons (Measurements, Settings, Bank monitoring and Communications) represent the four root-level menu.

At the bottom of the screen, the status bar shows the active capacitor steps, RVT Lock status, warnings, the control source of the RVT(by local touch screen or communications), switching on or off demand, operating mode: A (automatic mode), M (manual mode) and S (setting mode). Detailed meaning of the status icons can be found in following legends.

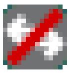
3.2.1 Legends for the touch screen icons

 …  Active (closed) output (inactive outputs are not highlighted)

 bank settings unlocked

 bank settings locked

 settings can only be done through the communication

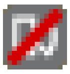
 settings can be done through the user interface or the communication

 temperature alarm (alarm relay is activated) or warning (fan / warning relay is activated)

 no temperature alarm nor warning (alarm and fan / warning relays are not activated)

warning level achieved (the fan / warning relay is activated)

 alarm activated (alarm relay is activated)

 no alarm activated (alarm relay is not activated)

 settings locked by hardware switch at the back of the controller

 settings unlocked by hardware switch at the back of the controller

 demand to switch ON step(s)

 demand to switch OFF step(s)

 no demand to switch steps

automatic mode (steps are switched automatically according settings)

manual mode (steps can be switched manually)

set mode (settings can be done)

mode change

on line help

close window

Validation

 next page

Except for the start screen, for all other RVT screens, each screen has three parts: title bar at the top, status bar at the bottom, and the setting area in the middle of the screen.

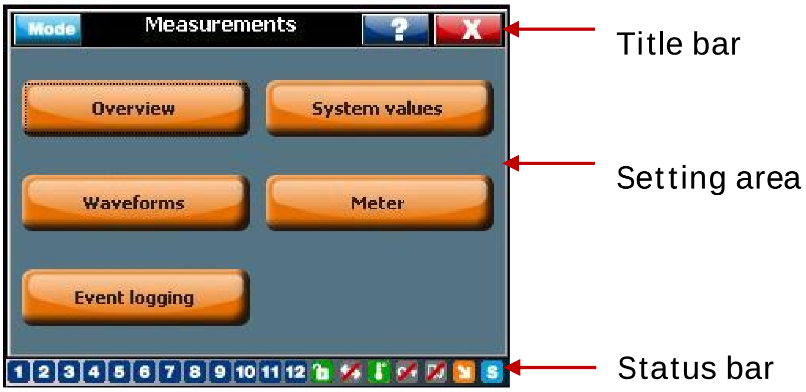


Figure 14: RVT screen composition

3.2.2 Title bar

At the left end of the title bar, the blue Mode button is used to switch between the three RVT operating modes: Automatic mode, Manual mode and Set mode. The following screen as shown in Figure 15 appears when the Mode button is clicked. When one mode is set to the RVT, for instance, the Set mode is set, the one-letter uppercase initial will be indicated at bottom right of the screen: the  at the right end of the status bar means the current mode of the RVT is in Set mode.

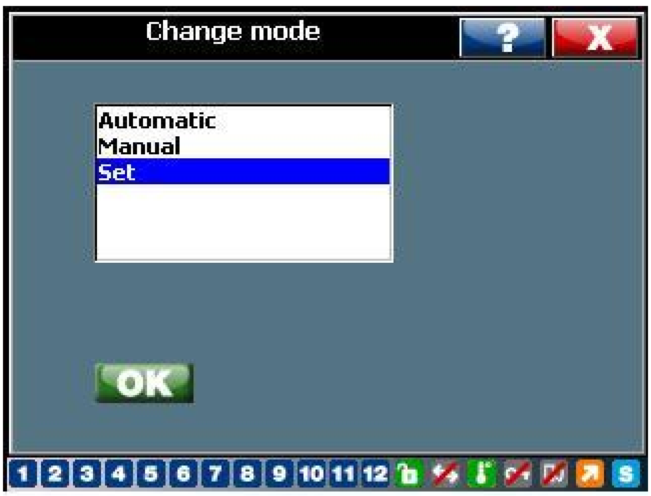


Figure 15: RVT modes switching

In the middle of the title bar, the text, like the “Measurements” in the Figure 14, displays current menu displaying in the screen.

By clicking the  question mark, a piece of relevant help information will display to aid the operator to understand and set the parameters easily. Following screen will appear after click the question mark on the Figure 15 screen:

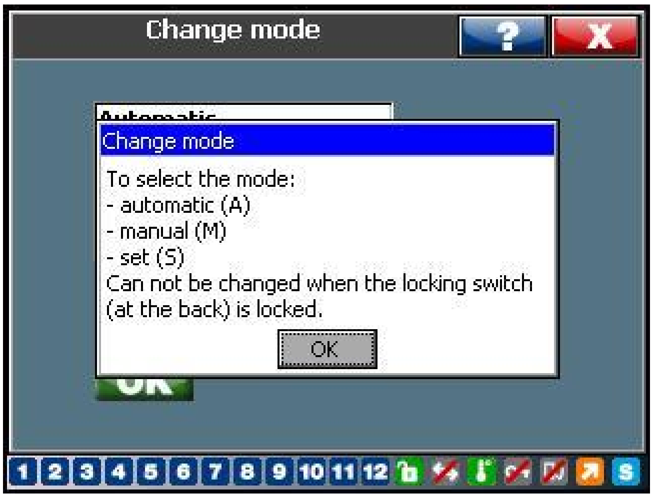


Figure 16: RVT help information

Clicking the Red Cross button at the right end of the title bar , the current active screen will be closed.

Note: The RVT returns automatically to AUTO mode when the touch screen is not touched for more than five minutes.

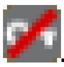
3.2.3 Setting area

The setting area consists of buttons, setting and information fields. After finishing the setting on one screen, the OK button  shall be clicked to valid the settings. In case there are more settings which cannot be displayed in one screen, the arrow button  will appear in the screen. By clicking the arrow button, the remaining settings will show in next screen.

3.2.4 Status bar

The status bar displays current active capacitor steps and the RVT status. The meaning of the status icons can be found in 3.2.1.

Hardware and software lock

RVT has both hardware and software lock. A hardware switch in blue color is located at back of the controller. When it is pressed, the RVT is locked and the icon  will appear on the status bar at the bottom of the display. When the switch is released, the same icon will turn into: . If the RVT is locked, then all bank settings are not accessible and the commissioning (both guided and auto) is disabled as well.

The icon  means the RVT bank settings are locked by software. The icon  means the RVT bank settings are unlocked by software. When the controller is locked by software, all the banking settings are protected, i.e. they are not accessible.

Description of soft lock can be found in 4.3.1.1.

3.2.5 Keyboard entry screen

All data will be entered through a keyboard interface.

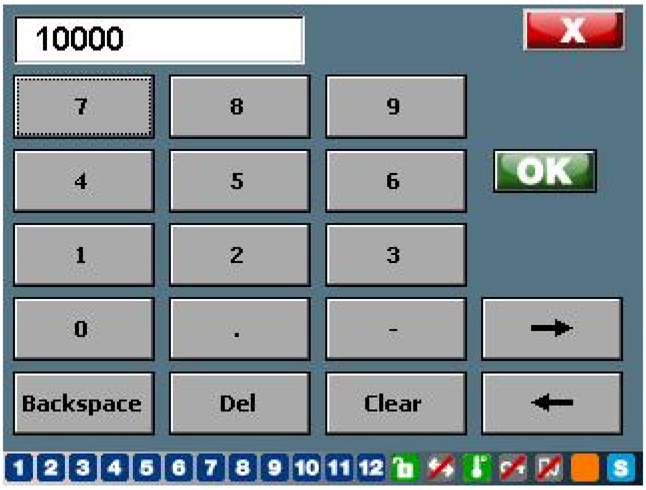
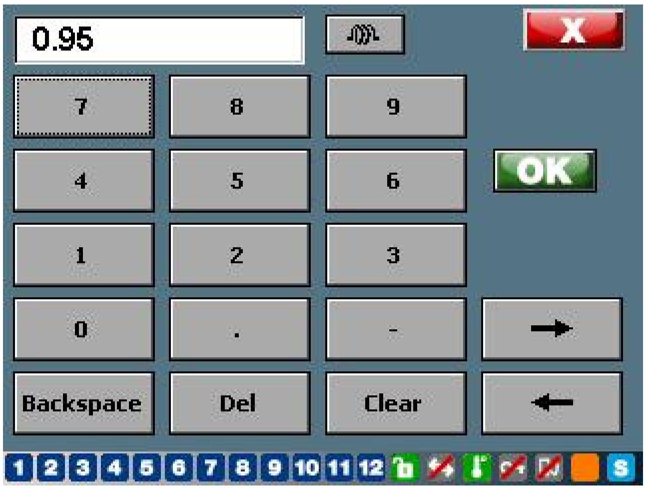


Figure 17: Keyboard entry screen

Cos j values may be entered with the (inductive) or (capacitive) symbol.



3.3 Starting the RVT

When the RVT is powered-up, the start screen as shown in Figure 13 will be displayed.

There are four big icons on the start screen: Measurements, Settings, Bank monitoring and Communication. By touching one of the four icons, next level menu contents can be easily accessed.

Five languages are presently available for the RVT controller: English, French, German, Spanish and Simplified Chinese. Following path will give you access to the language selection:

Start screen è Communication è I/O Configuration è Set language.

3.4 Automatic commissioning

Commissioning a RVT is very easy. RVT's automatic commissioning function will help a-first-time user to start a controller quickly.

3.4.1 Description

The RVT performs automatic commissioning as below:

- Automatic recognition of:

- Phase shift and rotation for each predefined type of connection
- number of outputs
- type of switching sequence

- Automatic setting of: C/k, the start current, detailed description on C/k can be found in paragraph 4.3.1.2.

3.4.2 Preparation for automatic commissioning

Required parameters during the auto commissioning process are:

- Type of connection. The type of connection defines the way of CT connections for RVT. There are total eight different types of connection for CTs, which depends on how many current measurements and how these CTs are connected. Detailed description on the type of connections can be found in paragraph 4.3.1.2.
- CT Scaling: Current Transformer ratio (for instance a 250A / 5A CT has a CT scaling of 50). More info can be found in paragraph 4.3.1.2.
- Target cos j (in paragraph 4.3.1.3.)

3.4.3 Automatic commissioning

- if you have a short-circuit on the CT's secondary winding do not forget to open it after having connected the current input of the PF Controller
- if a transformer is used for the voltage measurement, the Vscaling value needs to be changed accordingly (see paragraph 4.3.1.)

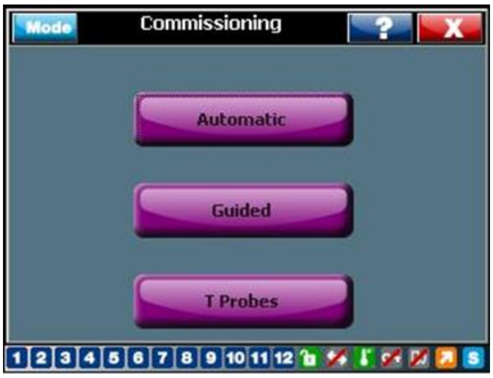
Notes: when the icon  (hardware lock) appears on the status bar at the bottom of the display, this means that the RVT is locked. The set Mode access is denied and commissioning cannot be performed until the RVT is unlocked (see description in paragraph 4.3.1.1.)

Following screenshots shows how a typical automatic commissioning takes place:

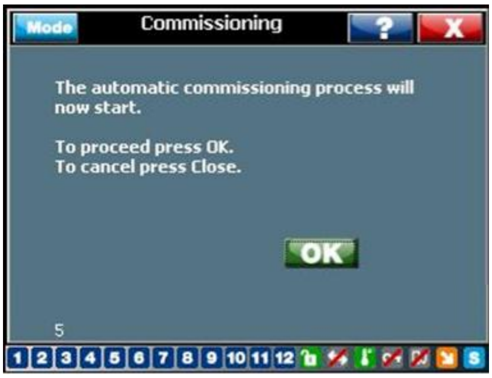
1. Start screen, Click “Settings”:

2. Click commissioning:

3. Click automatic:



4. Click OK:



5. Click OK:

6. Select type of connection (refer to Appendix7):

7. Click OK:

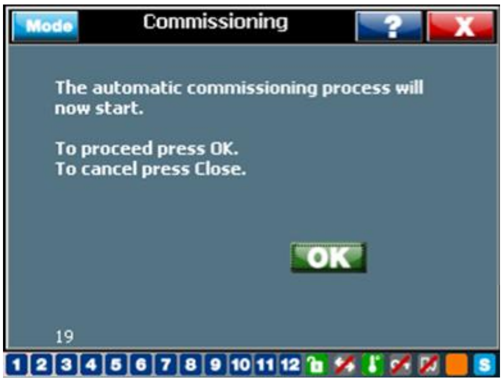
8. Lock or unlock the “Bank settings - OK:

9. Click OK:

10. Click OK:

11. Input CT scaling: 50:

12. Click OK:

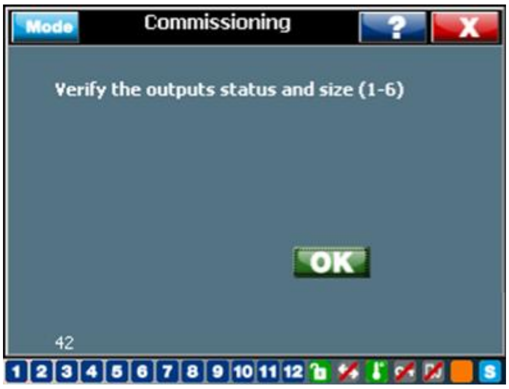


13. Click OK:

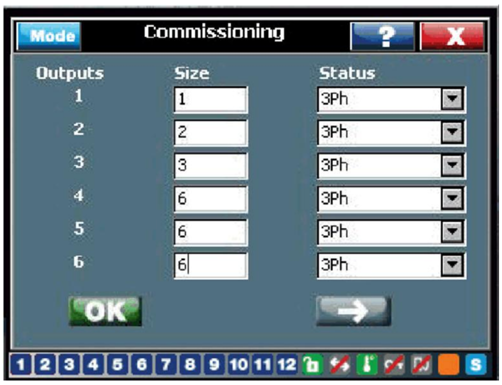
14. Click OK:

15. Click OK:

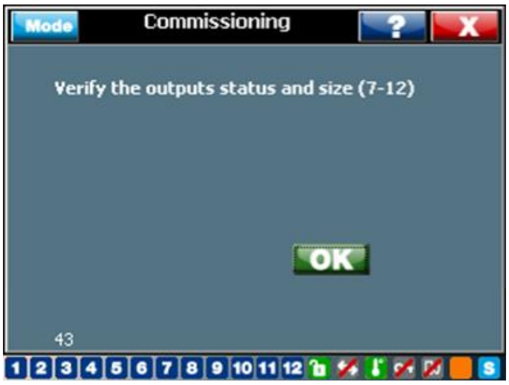
16. Click OK:



17. Click OK:



18. Click OK:



19. Click OK:

20. Click OK:

21. Automatic commissioning completed:

The above process is a typical automatic commissioning. Some setting like the CT ratio and type of connection could be different from above inputs for each installation.

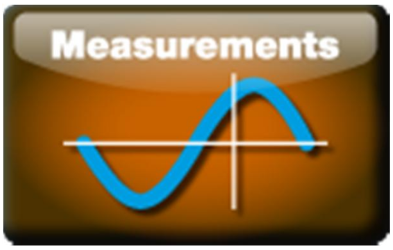
In case some errors occur during the automatic commissioning, the help info will instruct the user to identify the causes and complete the commissioning.

4 Measurements and Settings

4.1 What this chapter contains

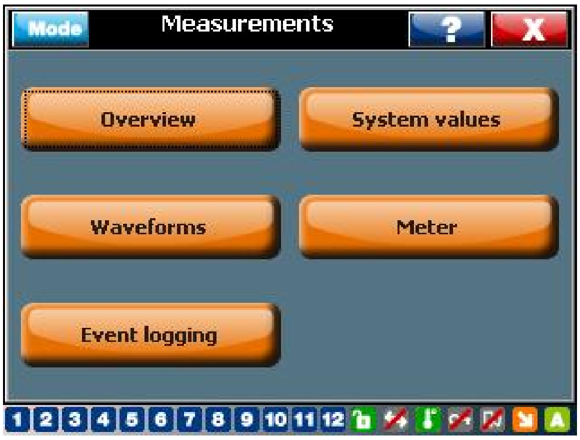
This chapter describes all the menus/submenus for measurements, settings, bank monitoring and communications settings, etc.

4.2 Measurements



This main menu allows the user to see various parameters like voltage, current, power, temperature. Five submenus are included in this main menu: Overview, System Value, Waveform, Meter and Event Logging.

RVT is very powerful in measurements and versatile on measurements display. All measurement can be shown in a table. For waveform measurements like voltage and current, a graph display is also available. A bar chart display is provided for all harmonics measurements.



Overview

The overview submenu gives a complete list of all measurements.

System Values

Network measurements like voltage, current, Power, Energy and Temperature etc. For Three Phase Model RVT12-3P, system values for each phase are available as well, for instance, the power factor for Phase 1, 2 and 3.

Waveform

System voltage and current (phase to phase or phase to neutral) can be displayed in Sine wave waveform.

Event Logging

This submenu allows the user to view the extreme values of some key parameters.

Meter

This function offers a possibility for the user to display three most concerned measurements in one screen. For instance, three line voltages can be shown in one screen in a better resolution and better view. Detailed instructions for this function can be found in 4.2.4.

4.2.1 Overview

Details on all available measurements through RVT:

Table 1: Measurements overview

Designation	Unit	Description			
Voltage			Range	Accuracy	Max value
Vrms	V	Rms Voltage	Up to 690Vac	± 1 %	10^6 V
V1	V	Rms voltage at the fundamental frequency	Up to 690Vac	± 1 %	10^6 V
Frequency	Hz	Fundamental voltage frequency	45Hz - 65Hz	± 0.5%	45Hz - 75 Hz
THDV	%	Total harmonic voltage distortion on voltage	0 - 300%	± 1 %	1000 %
V harm. Table		Voltage harmonics displayed in a table	2nd-49th	See later in this paragraph	
V harm. chart		Voltage harmonics displayed in a bar graph	2nd-49th	See later in this paragraph	
Current			Range	Accuracy	Max value
Irms	A	Rms Current	0 - 5 A	± 1 %	10^6 A
I1	A	Rms current at the fundamental frequency	0 - 5 A	± 1 %	10^6 A
THDI	%	Total harmonic current distortion on current	0 - 300%	± 1 %	1000%
I harm. table		Current harmonics displayed in a table	2nd-49th	See later in this paragraph	
I harm. chart		Current harmonics displayed in a bar graph	2nd-49th	See later in this paragraph	
Power			Range	Accuracy	Max value
Cos j		Displacement power factor	-1 è +1	± 0.02	-1 è +1
PF		Power factor	-1 è +1	± 0.02	-1 è +1
P	W	Active power	-10^9 è 10^9 W	± 2%	-10^9 è 10^9 W
Q	var	Reactive power	-10^9 è 10^9 var	± 2%	-10^9 è 10^9 var
S	VA	Apparent power	0 è 10^9 VA	± 2%	0 è 10^9 VA

Missing Q	var	Missing power to reach the pre-set alarm cos j	0 è 10^9 var	± 2%	0 è 10^9 var
Missing Steps		Missing capacitor steps to reach the pre-set alarm cos j			
Temperature (optional)			Range	Accuracy	Max value
T1-T8	°C/°F	Temperature T1-T8 (optional external probe max. up to 8)	-40°C è +105°C	± 1°C	-40°C è +150°C
Energies			Range	Accuracy	Max value
Supplied Active Energy	kWh	Active Energy to the network	0 è 10^{12}	± 3%	0 è 10^{12}
Consumed Active Energy	kWh	Active Energy to the load	0 è 10^{12}	± 3%	0 è 10^{12}
Total Active Energy	kWh	Sum of Supplied and consumed Energy	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
Inductive Reactive Energy	kvarh	Inductive Energy	0 è 10^{12}	± 3%	0 è 10^{12}
Capacitive Reactive Energy	kvarh	Capacitive Energy	0 è 10^{12}	± 3%	0 è 10^{12}
Total Reactive Energy	kvarh	Sum of inductive and capacitive Energy	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
Total Apparent Energy	kVAh	Sum of active and reactive Energy	0 è 10^{12}	± 3%	0 è 10^{12}

Notes

- All the measurements are averaged over one second
- If a transformer is used for the voltage measurement, the harmonic voltage measurements may be erroneous due to the filter behavior of the transformer. The use of a high quality transformer will minimize the error.

(1) The range values have to be multiplied by the CT ratio (Irms - I1 - P - Q - S - missing Q) and the PT ratio (Vrms - V1 - P - Q - S - missing Q).

(2) Displacement power factor or cos j : calculation based on the fundamental value of the measurements. This value is used as the reference value by Electricity Supplies Companies.

(3) Power factor: calculation based on the fundamental and harmonic values of the measurements. The power factor is always lower than or equal to the displacement power factor.

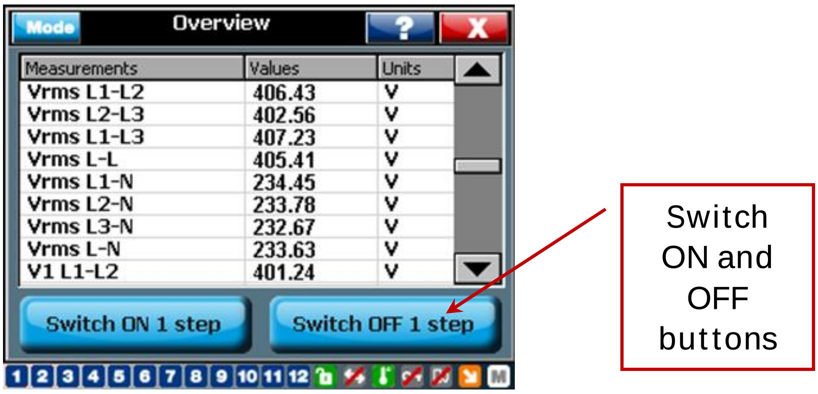
The Overview menu displays all measured items in a list.

The user may customize the display of the measurement values to his particular needs just by moving the important items in the list to a desired position.

Click on the item in the list to be moved (in the below example, the THDV L-L is chosen)

Then click on the position where the item in the list should be moved (in the example hereafter the THDV L-L is placed on the Frequency position, this one being moved automatically just below in the list)

The Overview screen is also a menu where it is possible to switch manually some steps ON and OFF. Enter the “Manual” mode by clicking the “Mode” button.



Then, “Switch ON and OFF 1 step” buttons are enabled.

Click on these buttons to switch steps manually.

Note: The RVT12-3P model will enter a new screen asking which kind of step should be (de)activated. Differences between these steps can be found in 4.3.1.1.

4.2.2 System values

The System Values menu displays all measured system values sorted by type as shown in Figure 18. For Three Phase Model RVT12-3P, the system values for each phase are included as well.

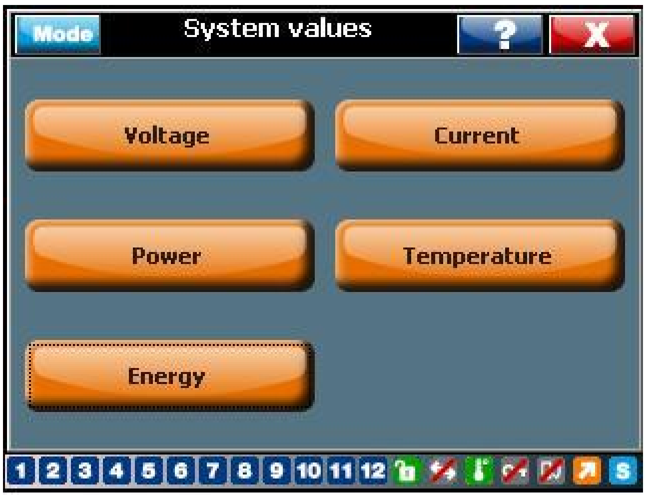
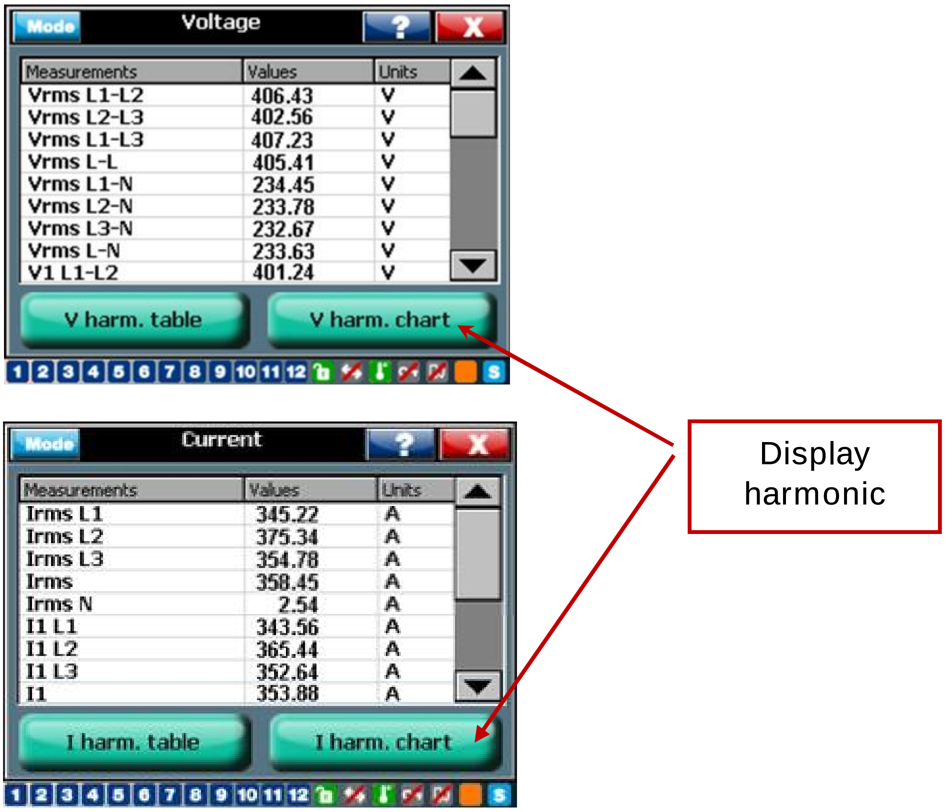


Figure 18: System values

Voltage (current) measurements



Voltage (current) harmonic chart and table

Harmonics voltage/current can be illustrated in bar chart as shown below. A scrolling bar is to choose a specific harmonic to display at the top of the screen: the harmonic order, the value and percentage against Fundamental.

For voltage and current values, the RVT is able to display the harmonics voltage and currents in table or in spectrum. Click on the "Select" button to choose which measurement is displayed in the harmonic table or chart.

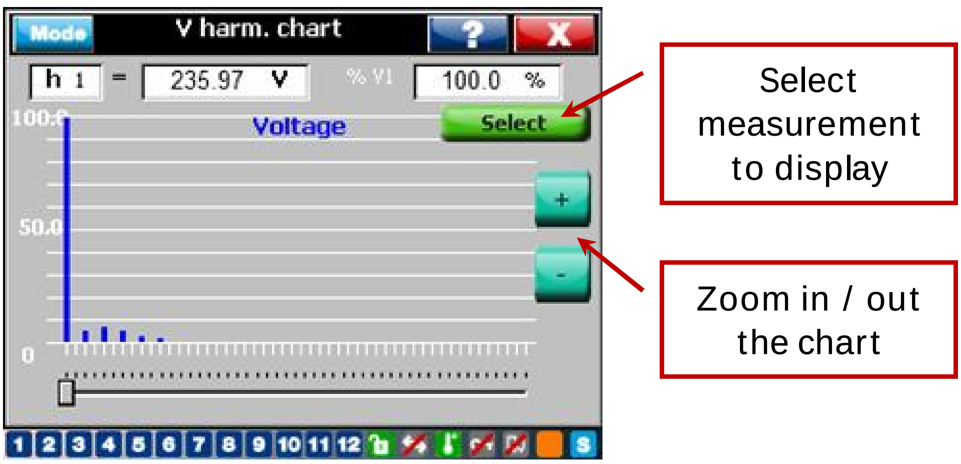
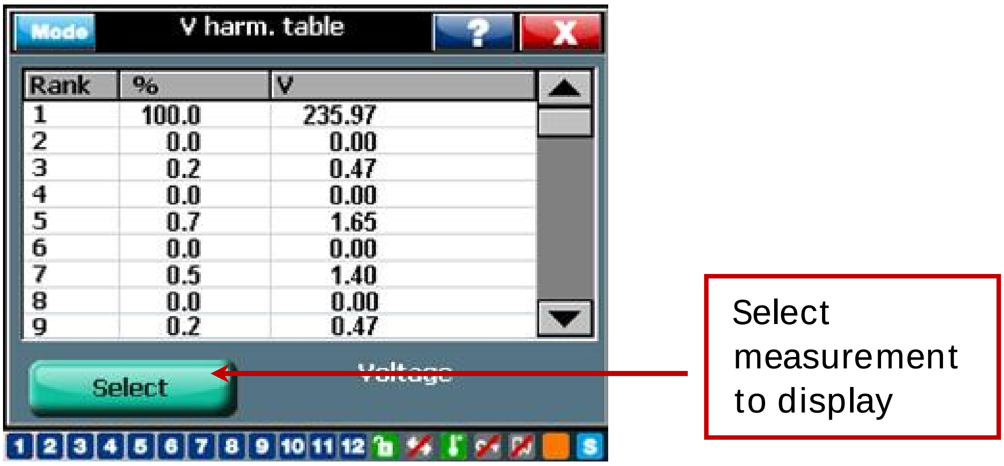


Figure 19: Harmonics voltage in chart



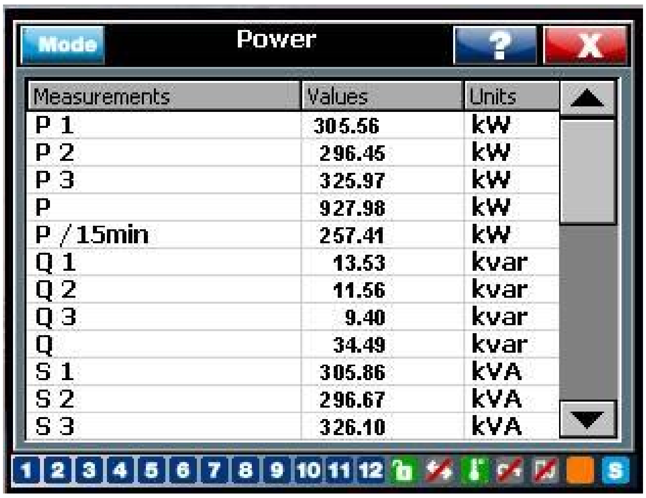
V harm. table

Rank	%	V
1	100.0	235.97
2	0.0	0.00
3	0.2	0.47
4	0.0	0.00
5	0.7	1.65
6	0.0	0.00
7	0.5	1.40
8	0.0	0.00
9	0.2	0.47

Figure 20: Harmonics voltage in table

Comment: accuracy on voltage (current) harmonic measurements: ± 1 % of Vrms (Irms)

Power, Power factor measurements



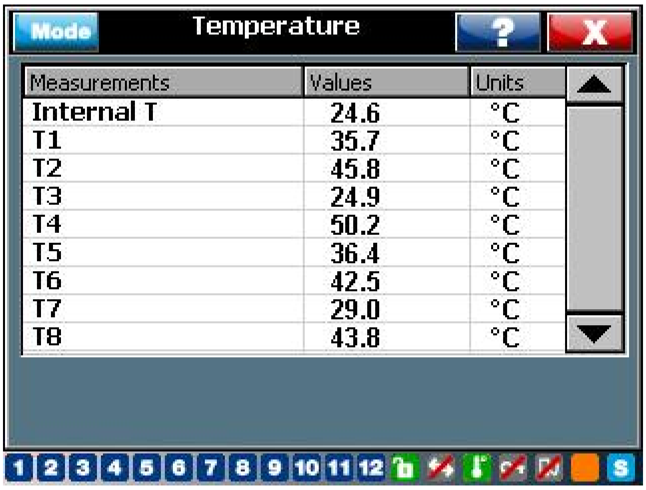
Power

Measurements	Values	Units
P 1	305.56	kW
P 2	296.45	kW
P 3	325.97	kW
P	927.98	kW
P / 15min	257.41	kW
Q 1	13.53	kvar
Q 2	11.56	kvar
Q 3	9.40	kvar
Q	34.49	kvar
S 1	305.86	kVA
S 2	296.67	kVA
S 3	326.10	kVA

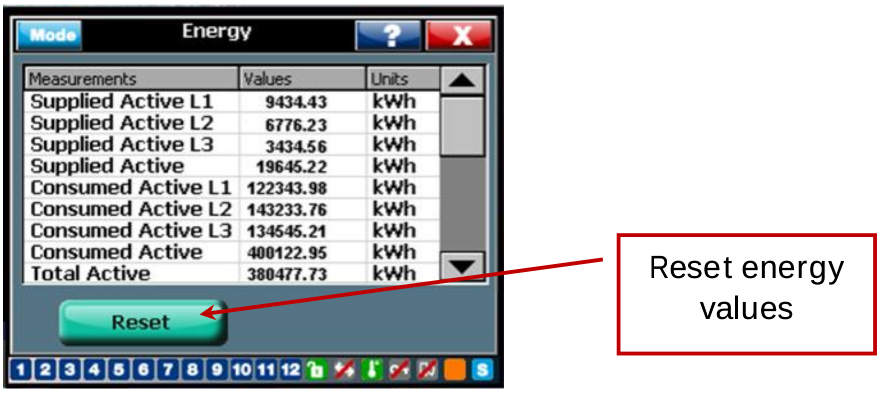
Power

Measurements	Values	Units
PF 1	0.99	
PF 2	0.99	
PF 3	0.98	
PF	1.00	
Cos φ 1	0.99	
Cos φ 2	1.00	
Cos φ 3	1.00	
Cos φ	1.00	
Missing Q1	0.00	kvar
Missing Q2	0.00	kvar
Missing Q3	0.00	kvar
Missing Q	0.00	kvar

Temperature measurements



Energy measurements



Energy measurements are only available on the RVT12-3P (the 3 phase model is equipped with a real time clock).

Energy values may be "Reset" to 0.

4.2.3 Waveform

Available voltage and current signals (depending on RVT type and connection used) and the line current can be displayed on the screen as waveforms. Figure 21 shows the voltage wave form between line and neutral.

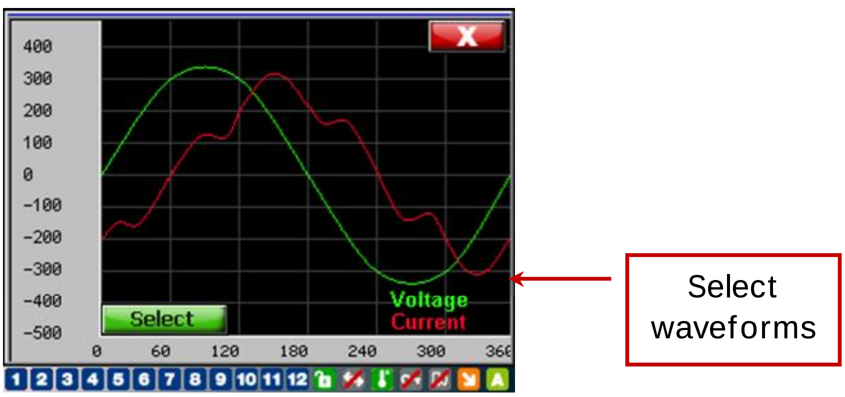


Figure 21: Voltage and current waveforms

4.2.4 Meter

This function offers the user a better view of three most interested measurements.

Click on the wanted item, and then click the “Select” button to insert values in the meter screen.

An example is shown below for three important measurements.

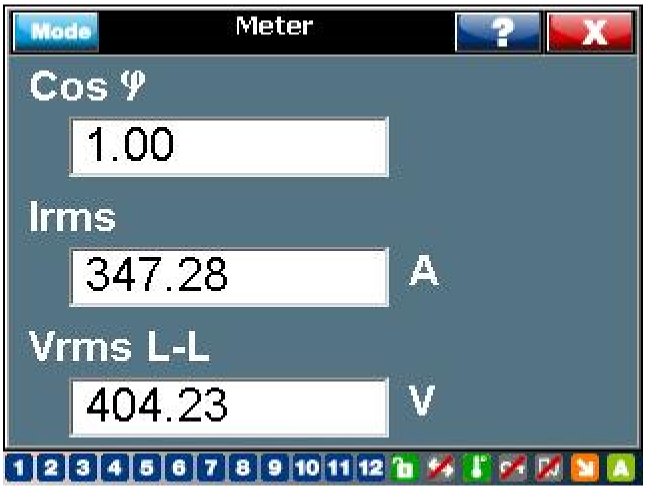


Figure 22: three measurements displayed in meter

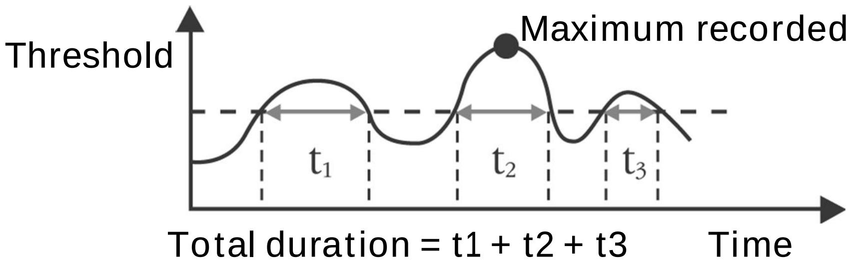
4.2.5 Event logging

Description

The event logging function allows the user to log each significant measured item (see list here below) since last clearance:

- the maximum (or minimum) value
- the duration above (or below) the threshold.

Once a threshold has been set (see example below), the RVT starts recording the maximum (or minimum) value automatically as well as the total duration until it is reset.



Recorded values

The event logging function allows the user to record the time during which a measured value exceeds a threshold and its maximum value for the following parameters : Vrms [V], Irms [A], P [kW], Q [kvar], S [kVA], THDV [%], THDI [%], missing Q [kvar], frequency* [Hz], T1* [°C or °F] to T8* [°C or °F].

* Minimum values and duration below a threshold are also recorded for the frequency and the temperatures.

Figure 23: Event logging recorded values

Example

Recording of information on Vrms.

Voltage network: 400V.

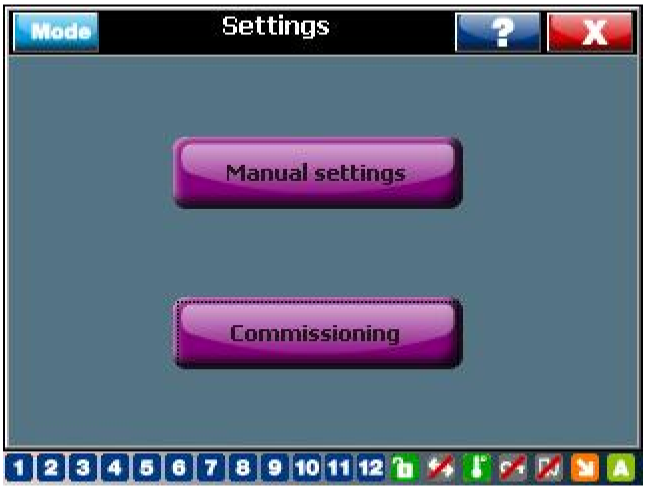
Figure 24: Event logging threshold setting - Vrms

Figure 25: Event logging threshold setting - Frequency

The recorded information (maximum value and total duration) may be cleared by selecting and validating the “Reset” button.

4.3 Settings

The main menu Settings has multi-level submenus allowing the user to program the controller as well as to do commissioning and test functions.



4.3.1 Manual settings (Set Mode)

The manual settings allow the user to access all the Bank, Installation, User settings and protection/warning configurations. The user can also restore the factory setting from this sub-menu.

Figure 26: Manual settings

Before making any settings to the controller, please make it is in Set mode. Please refer to 3.2.4 and 4.3.1.1. for the controller mode setting and locking/unlocking.

4.3.1.1 Bank settings

start->settings->manual settings->bank settings

The Bank Settings menu includes all configuration parameters related to the bank.

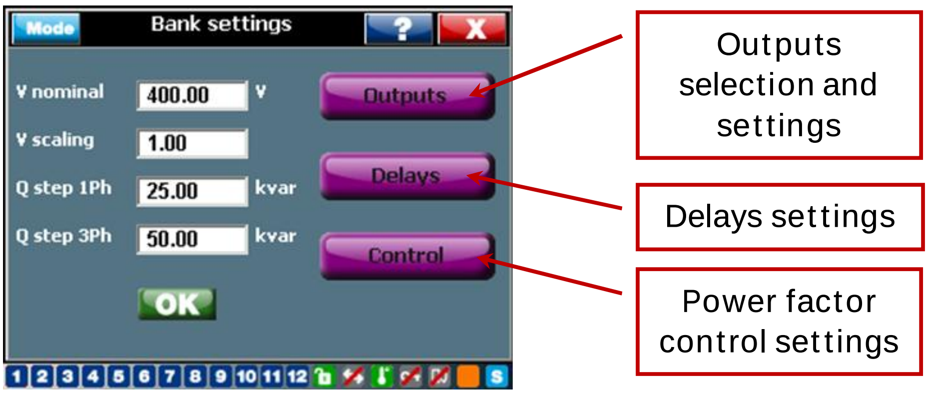


Figure 27: Bank setting

Following shows the list of bank setting parameters.

V nominal: nominal bank voltage.

When a V nominal value is entered, under-voltage and overvoltage protection levels are automatically set at 80% and 120% of V nominal.

These level values can be changed manually.

V scaling: external voltage transformer ratio.

Examples: for a 15kV/100V voltage transformer, V scaling = 150.

if no external voltage transformer is used, V scaling = 1.

This function enables the RVT to control a MV capacitor bank. A proper voltage transformer shall be connected to the measurements terminals of RVT. Then the RVT will display the MV measurement values accordingly.

Q step 1ph: the smallest step size for single phase (phase to neutral) capacitors which are used for individual phase power factor correction in an unbalanced network.

Q step 3ph: the smallest step size for three phase capacitors in a balanced network.

For the above two settings,

a) After automatic commissioning, this value will be set according to the smallest step in the capacitor bank.

b) For guided commissioning (see 4.2.2.2), this value need to be set manually.

Here is an example in a capacitor bank which has both individual phase (3 steps) and three-phase (3 steps) power factor correction:

Single phase sequence*: 1 (5kvar) 2 (10kvar) 2 (10kvar) è Q step 1ph = 5 kvar

Three phase sequence: 1 (10kvar) 2 (20kvar) 2 (20kvar) è Q step 3ph = 10 kvar

Or,

Three phase sequence: 2 (15kvar) 4 (30kvar) 5 (37.5kvar) è Q step = 7.5 kvar

*Sequence: relative reactive power value of the capacitors connected to the RVT outputs. These relative values are included between 0 and 8.

For both Base Model RVT6/RVT12 and Three Phase Model RVT12-3P, the default factory sequence is: 1:1:….:1. Customized sequence may be introduced manually.

To customize a sequence, navigate in the menu tree as following:

Start screen â Settings â Manual settings â Bank settings â Outputs.

Figure 28 shows the output 1 - 6, click the arrow button  , the next screen will display the remaining output 7-12 as shown in Figure 29.

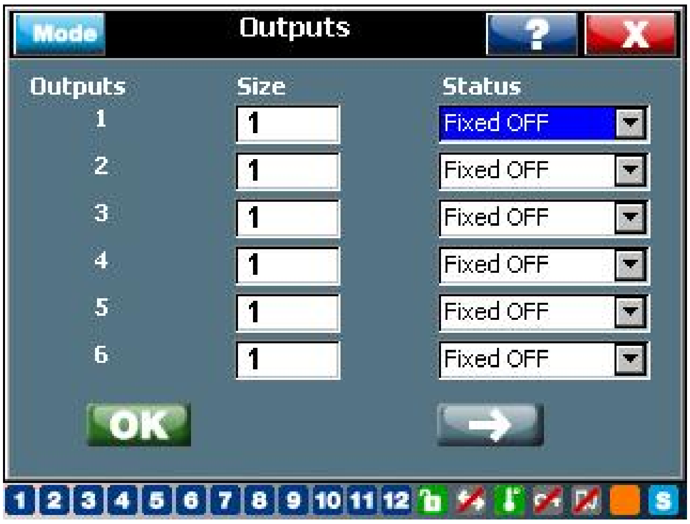


Figure 28: RVT outputs 1-6

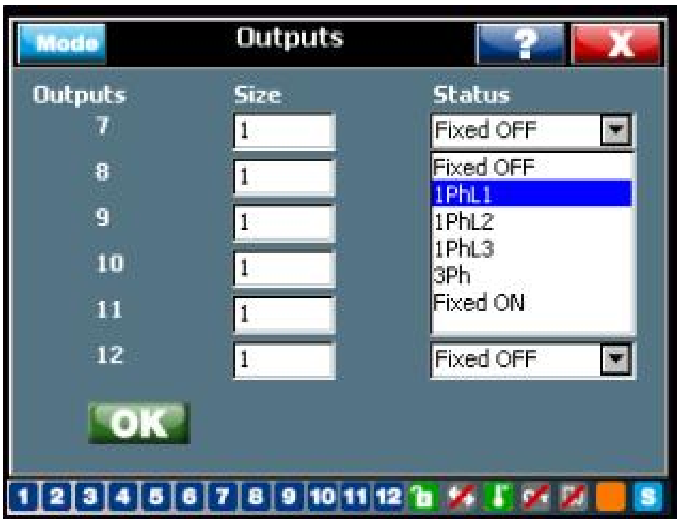


Figure 29: RVT outputs 7-12 (Three phase model RVT12-3P)

On the right of the screen, the “Status” includes six attributes of each output:

“Fixed OFF”: this output is disabled (default factory setting);

“Fixed ON”: this output is enabled (the corresponding capacitor is always connected);

“1PhL1, 1Phl2, 1PhL3”: this output controls a phase to neutral capacitor, which is at phase 1, 2 or 3 respectively.

“3Ph”: this output controls a 3 phase capacitor.

For a Base Model RVT6/RVT12, only “Fixed OFF, Fixed ON and Enabled” are available for the output status. An output need to be set “Enabled” before the controller switches on or off a capacitor.

Some typical outputs setting for Three Phase Model RVT12-3P:

Typical setting one: 12 steps of single phase (phase to neutral) capacitors:

Figure 30: Typical outputs setting 12 x 1ph (Three phase model RVT12-3P)

Typical setting two: 6 steps of three phase capacitors + 6 steps of single phase (phase to neutral) capacitors:

Figure 31: Typical outputs setting 6 x 3ph + 6 x 1ph (Three phase model RVT12-3P)

Delay

Click the button "Delay" on the screen shown in Figure 27, the user can set the bank switching delays in following screen.

Figure 32: RVT delay settings

ON-Delay:

- in normal operation, it is the time between the demand to switch ON a step and the actual switching.

- in integral operation, it is the integration time between two switching decisions.

The ON-delay is needed to allow the capacitor to discharge before switching it ON.

Caution: short delay time could cause severe damages to the bank.

OFF Delay:

- in normal operation, it is the time between the demand to switch OFF a step and the actual switching OFF.
- in integral operation, OFF-Delay is not used.

Reset Delay: the time the RVT waits before restarting bank operation after a power outage.

Click the button “Control” on the screen shown in Figure 27, the user can set the CT measurements and bank switching strategies in following screen.

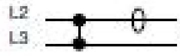
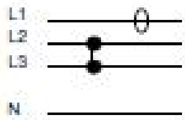
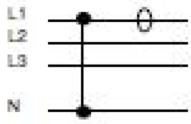
Figure 33: RVT bank control settings

1Ph/3Ph

This setting defines the type of connection for the current measurements. RVT allows eight different CT connection topologies based on the type of network (three phase three wire network, three phase four wire network or single phase network (phase to phase):

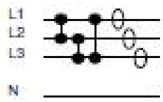
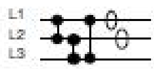
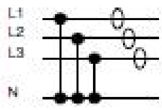
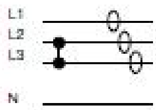
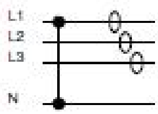
One phase current measurement (available for both base mode RVT6/12 and RVT12-3P):1Ph-1LL1, 3Ph-1LL1, 3Ph-1LN1.

Connection type

Name	Schematics
1Ph-1LL1	
3Ph-1LL1	
3Ph-1LN1	

Three phase current measurements (available only for three phase model RVT12-3P):

3Ph-3LL3, 3Ph-3LL2 (no neutral connection connected in the installation), 3Ph-3LN3, 3Ph-1LL3, 3Ph-1LN3.

3Ph-3LL3	
3Ph-3LL2	
3Ph-3LN3	
3Ph-1LL3	
3Ph-1LN3	

Detailed instruction of the connection can be found in A7. CT connection type illustration and CT wiring on the controller terminals in the appendix section at the end of this manual.

Definition of above type of connections:

3Ph – 3 LN 3

- 1: one CT connection, 2: two CTs connections, 3: three CTs connections
- LN: V measurement between L and N, LL V measurement between phases
- 1: one V measurement, 3: three V measurements
- 1Ph: single phase network (L-N or L-L), 3Ph: three phase network

NOTE: L refers to Line, N refers to Neutral

Linear / Circular (Lin./Circ. on the screen)

Linear switching follows the "first in, last out" switching principle.

Circular switching follows the “first in, first out” switching principle.

Both operations are described in the following table.

Circular switching increases the lifetime of capacitors and contactors by balancing the stress among all the outputs.

In case of “double first step” (1:1:2:2:..., 1:1:2:4:4.,...), the circularity applies to the first two outputs and also on the outputs of higher value.

Linear

	C1	C2	C3	C4	...	C11	C12
Sequence	1	1	1	1		1	1
	■	□	□	□	...	□	□
↗	■	■	□	□	...	□	□
↗	■	■	■	□	...	□	□
↘	■	■	□	□	...	□	□
↘	■	□	□	□	...	□	□

Circular

	C1	C2	C3	C4	...	C11	C12
Sequence	1	1	1	1		1	1
	■	□	□	□	...	□	□
↗	■	■	□	□	...	□	□
↗	■	■	■	□	...	□	□
↘	□	■	■	□	...	□	□
↘	□	□	■	□	...	□	□

ì Demand for adding a step

î Demand for removing a step

n Output closed
o Output open

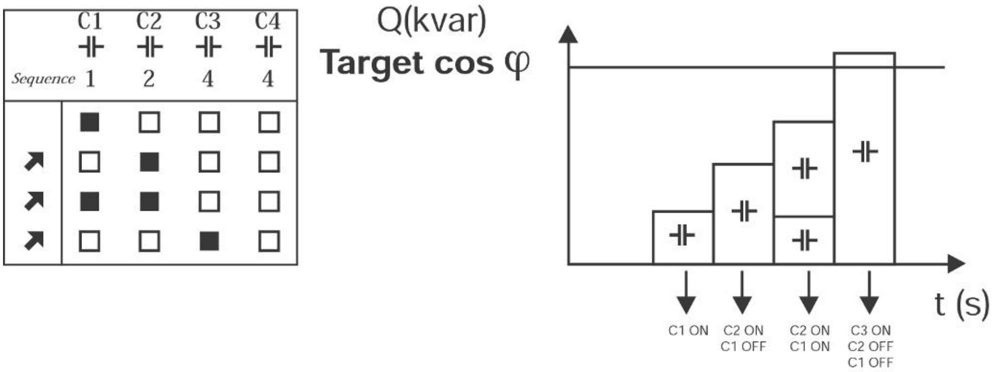
Progressive / Direct (Prog./Direct on the screen)

Progressive operation switches the steps sequentially one by one, based on ON-Delay value.

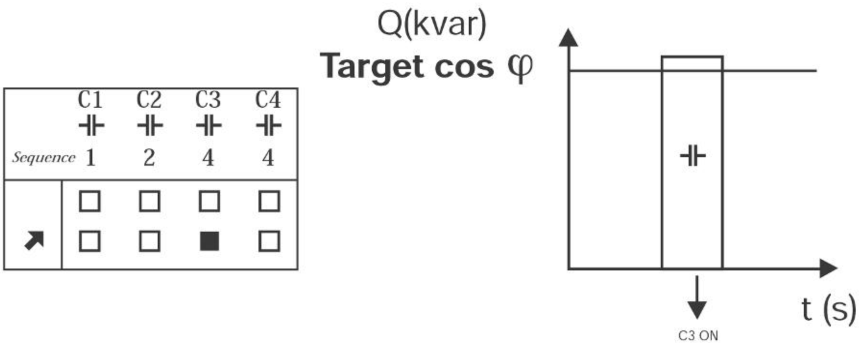
Direct operation switches the biggest steps first then the other steps with a fixed delay of 12s, to reach the target cos j faster.

The direct mode allows avoiding many useless intermediary switching.

Progressive



Direct

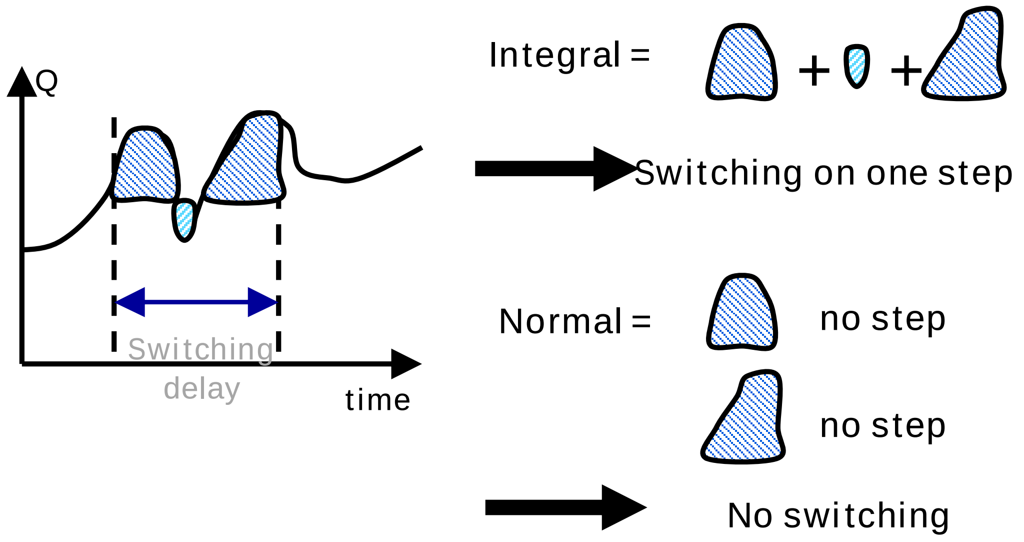


Normal / Integral (Normal/Int. on the screen)

Normal operation: switches the steps when the demand is continuously present for the whole switching delay time.

Integral operation: switches the steps according to averaged value of the requested reactive power.

Integral operation is useful for applications where the load is varying rapidly.



Bank setting protection (Software lock)

The bank settings can be protected from unauthorized access by both hardware and software. The hardware protection is described in 3.2.4. The following screen illustrates how the software lock works. The path to screen shown in Figure 34:

Start screen â Settings â Manual settings â Bank settings â Control.

Figure 34: RVT bank settings protection: not protected

To lock the bank setting, tick the “Bank settings Unlock” box, then the screen turns into following one as shown in Figure 35.

1. The bank setting fields become grey
2. “Bank settings Unlocked” became “Bank settings Locked
3. On the status bar, the soft lock icon activated: 

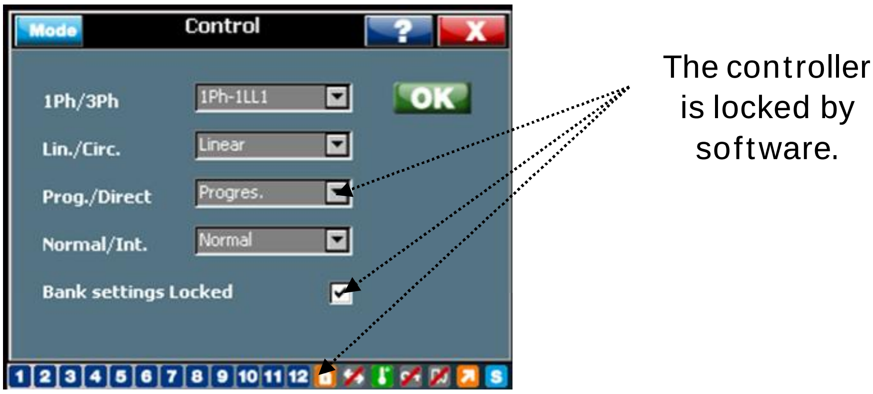


Figure 35: RVT bank settings protection: protected

4.3.1.2 Installation settings

Start screen-> Settings-> Manual settings-> installation settings

RVT installation settings give instructions on how to set CT related parameters.

Figure 36: RVT installation settings

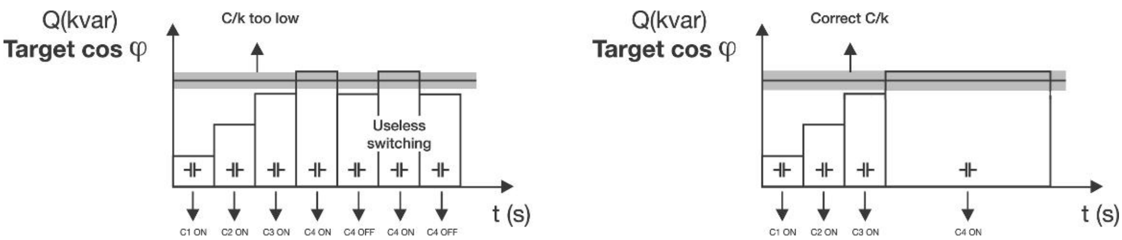
CT scaling: current transformer ratio.

Example: a 250A / 5A CT has a CT Scaling of 50.

C/k: starting current of the RVT Controller. It is usually set equal to 2/3 of the current of the capacitor step (Qstep) (see paragraph 4.3.1.1.)

It represents the threshold current value for the RVT to switch ON or OFF a capacitor step. The C/k can be programmed from 0.01 to 5.

The following example shows the effect of a too low C/k value and how it can lead to useless switching:



A too high C/k value will lead to insufficient capacitor steps being switched ON in order to reach the target cos j .

The recommended setting of C/k can be calculated by the following formula or can be read directly in the table below.

Formula

Three phase network

$$C/k = 0.67\,x\,\frac{Qstep\ x\ 1000}{\sqrt{3}\ x\ Vnom\ x\ CTscaling}$$

Single phase (L-L or L-N) network

$$C/k = 0.67\,x\,\frac{Qstep\ x\ 1000}{Vnom\ x\ CTscaling}$$

Table 2: C/k table for a 3-phase balanced 400V system

CT ratio		K	Capacitor step rating (kvar)											
			5	10	15	20	30	40	50	60	70	90	100	120
10/1	50/5	10	0.48	0.97	1.45	1.93	2.90	3.87	4.84					
20/1	100/5	20	0.24	0.48	0.73	0.97	1.45	1.93	2.42	2.90	3.38	4.35	4.84	
30/1	150/5	30	0.16	0.32	0.48	0.64	0.97	1.29	1.61	1.93	2.26	2.90	3.22	3.87
40/1	200/5	40	0.12	0.24	0.36	0.48	0.73	0.97	1.21	1.45	1.69	2.18	2.42	2.90
60/1	300/5	60	0.08	0.16	0.24	0.32	0.48	0.64	0.81	0.97	1.13	1.45	1.61	1.93
80/1	400/5	80	0.06	0.12	0.12	0.24	0.36	0.48	0.60	0.73	0.85	1.09	1.21	1.45
100/1	500/5	100	0.05	0.10	0.15	0.19	0.29	0.39	0.48	0.58	0.68	0.87	0.97	1.16
120/1	600/5	120	0.04	0.08	0.12	0.16	0.24	0.32	0.40	0.48	0.56	0.73	0.81	0.97
160/1	800/5	160	0.03	0.06	0.09	0.12	0.18	0.24	0.30	0.36	0.42	0.54	0.60	0.73
200/1	1000/5	200	0.02	0.05	0.07	0.10	0.15	0.19	0.24	0.29	0.34	0.44	0.48	0.58
300/1	1500/5	300	0.02	0.03	0.05	0.06	0.10	0.13	0.16	0.19	0.23	0.29	0.30	0.39
400/1	2000/5	400	0.01	0.02	0.04	0.05	0.07	0.10	0.12	0.15	0.17	0.22	0.23	0.29
600/1	3000/5	600	0.01	0.02	0.02	0.03	0.05	0.06	0.08	0.10	0.11	0.15	0.15	0.19

Note:

For RVT12-3P, two C/k are available: C/k 1ph and C/k 3ph; RVT6/RVT12 has only C/k available.

C/k 3ph (or C/k) is applicable for installation with one, two or three CT (three phase balanced network); C/k 1ph is applicable for installation with three CTs (unbalanced three phase network). It is assumed that, for an unbalanced three phase network, a uniform C/k 1ph is used for three individual single phase capacitor switching.

It is assumed that all CTs connected to RVT12-3P (two or three CTs under different connection types) have the same ratio. However, the minimal step for single phase capacitor and three phase capacitor could be different; this entails two different C/k values for RVT.

Phase shift (applicable to base model only): phase shift between voltage and current introduced by the measurement connection.

If the RVT is connected as shown on the connection diagram described in paragraph 2.4, the phase shift value is 90° (default setting).

For other connection, the phase shift to be programmed can be selected from the tables in the appendix A6.

Please note that the RVT can adapt automatically the phase shift during automatic commissioning.

4.3.1.3 User settings

Start screen-> Settings-> Manual settings-> user settings

User Settings allows the users to set different target power factors and alarm delays.

Figure 37: RVT user settings

Target cos **j** : target displacement power factor.

The target cos j value can be set between 0.70 inductive and 0.70 capacitive.

indicates an inductive cos j and indicates a capacitive cos j .

Night cos **j** : alternative displacement power factor (disabled by default).

Switching from the target cos j to the target night cos j is performed with an external signal applied on the external digital input IN 1 +/- (description in paragraph 2.4).

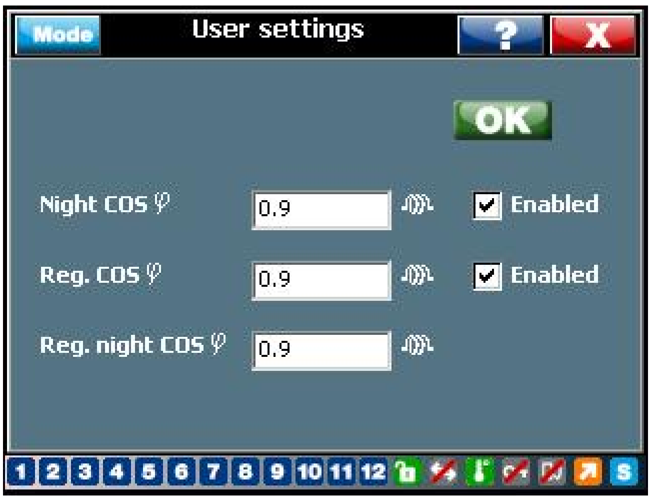


Figure 38: RVT user settings: enable night and reg. power factor

Reg. cos **j** : alternative target displacement power factor. Activated when power flow is reversed: P < 0 (disabled by default).

Alarm: alarm relay parameters can be set for the Alarm cos j condition:
The Alarm cos j condition is fulfilled when: all the capacitor steps are ON and the actual cos j value is below the alarm cos j threshold value such that at least one step is needed.

- Alarm delay: duration of alarm cos j condition before the relay closes.
- Alarm reset delay: delay time before the relay opens after the alarm condition has disappeared.
- Alarm cos j : threshold value

4.3.1.4 Protections and warnings

Start screen-> Settings-> Manual settings-> prot&warn.

RVT will activate certain actions when some system values exceeding certain thresholds. Protection level is harsher than warning ones.

Figure 39: RVT protections and warning settings

4.3.1.4.1 Protections

Figure 40: RVT protection settings

Protection levels: To set the levels of protection against under-voltage, over-voltage, prohibitive harmonics, max. Irms current protection; it also enables an external protection initiated by the opto-isolated input 2. The alarm relay provides one NO and one NC contact.

Once a protection level is reached, the following actions occur:

- all the capacitor steps are switched off
- an alarm message appears on the display
- the alarm relay is activated (NO opens / NC closes)
- the icon  is highlighted

Note: if the external input signal IN2 (description in paragraph 2.4) is activated, all capacitor steps are switched off and the Ext. prot. parameter drives the behavior of the alarm relay:

- Disconnection and alarm
- Disconnection only (no alarm)

After the event has disappeared, the RVT will restart its normal operation after a certain delay time. This delay time depends on the type of events. RVT post alarm restarting procedure is described in detail in Appendix A4.

Note: when enabled, the external protection (Ext. Prot.) may be activated by applying an external signal through the RVT digital input 2 (see paragraph 1.4).

4.3.1.4.2 Warnings

Warnings level are basically will be lower than protection levels. When a warning level is reached, following actions will occur:

- the fan/warning relay is activated: the NO contact will close
- the icon  is highlighted

Figure 41: RVT warning settings

4.3.1.4.3Temp protections

RVT provides 8 bank temperature protections by eight temperature probes. Each temperature probe protection level can be set independently. When any one of the eight the temperature protection levels is reached.

- all the capacitor steps are switched off
- an alarm message appears on the display
- the alarm relay is activated (NO opens / NC closes)
- the icons  and  are highlighted

Figure 42: RVT temperature protection settings

4.3.1.4.4Temp warnings

RVT provides 8 bank temperature warnings by eight temperature probes. Each temperature probe warning level can be set independently. When any one of the eight temperature warning level is reached.

- the fan / warning relay will be activated: the NO contact will close
- the icon  is highlighted

Figure 43: RVT temperature warning settings

Note 1: the RVT is self-protected against an internal over-temperature of 85°C. The actions described above will occur when the internal temp exceeds this protection level.

The RVT will restart automatically when the internal temperature falls back below 80°C.

Note 2: the temperature protection levels are disabled by default. When a level is entered, the RVT checks one of the eight probe connections.

4.3.1.5 Restore default settings

Start screen->Settings->Manual settings->restore default set.

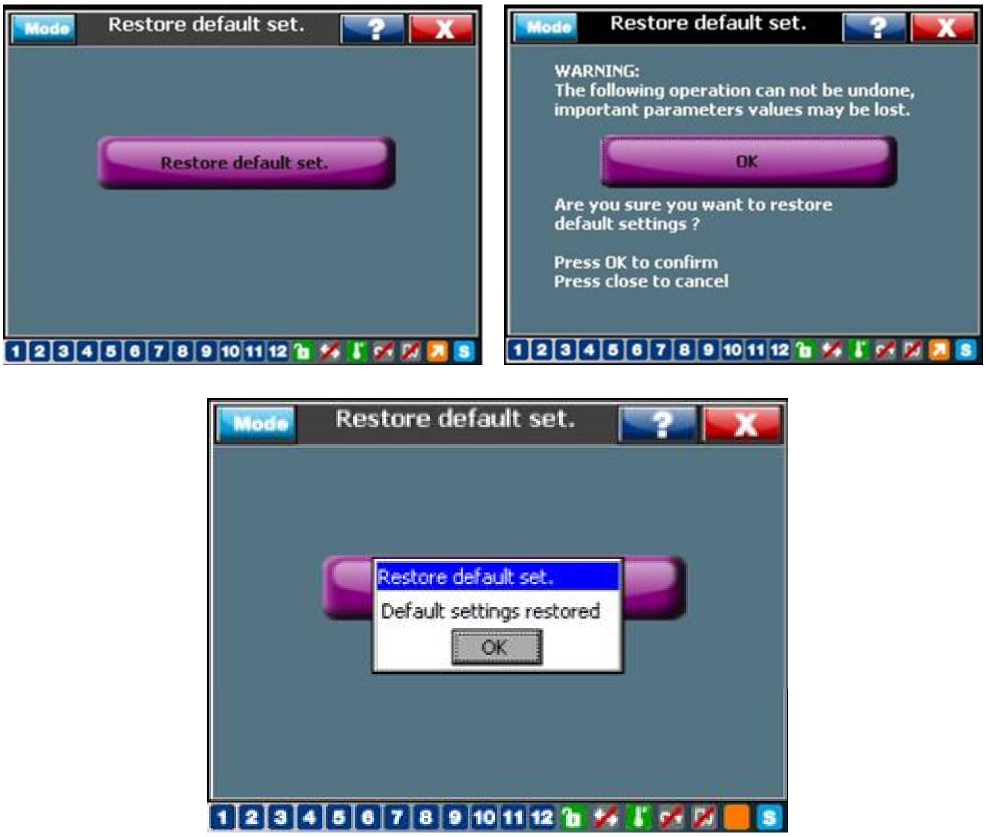


Figure 44: RVT restore default settings

By selecting and validating the “Restore default set.” item, all the values of the RVT parameters are reset to their default values (see separate document joined with the RVT), except if the bank settings item is locked, in that case the bank settings are not changed.

Warning: important parameters may be lost.

Comment: before restoring default settings, please make sure that:

- RVT is unlocked (description in paragraphs 3.2.4 and 4.3.1.1)
- RVT is in SET mode (description in paragraph 3.2.2.)

4.3.2 Commissioning (SET mode)

This sub-menu allows the user to do a complete automatic commissioning or a guided commissioning of the controller.

4.3.2.1 Automatic Commissioning

Please refer to section 3.4 for more details.

4.3.2.2 Guided Commissioning

The RVT performs a guided commissioning process. The following parameters (see table below) must be entered.

Note:

Before performing guided commissioning, please make sure that:

1. RVT is unlocked (description in paragraphs 3.2.4 and 4.3.1.1)
2. RVT is in SET mode (description in paragraph 3.2.2.)
3. if you have a short-circuit on the CT's secondary winding do not forget to open it after having connected the current input of the PF Controller.

Guided commissioning (parameters to set)

Parameter	Description
1Ph / 3Ph	Bank connection type and RVT measurement connection
Phase rotation	Check phase rotation
C.T. scaling	Current Transformer ratio.
CT redirection	Redirect CT inputs in case of CT's placed on wrong phase
Phase shift	Phase shift between voltage and current introduced by the measurement connections. The phase shift is 90° (default setting) when the RVT is connected as shown on wiring diagram (see paragraph 2.4). For other connections, please see appendix A.5.
V scaling	External voltage transformer ratio.

V nom	Nominal bank voltage.
ON-Delay OFF-Delay	Switching ON delay time. Switching OFF delay time.
Sequence	Relative reactive power value of each output.
Q step	Smallest reactive power difference between steps.
C/k	Set the starting current
Target cos j	Target displacement power factor.

4.3.2.3 T Probes commissioning

RVT can connect up to eight temperature probes in a daisy chain. Each probe needs to be commissioned as following procedures before it can be used.

Each probe has to be recognized one by one:

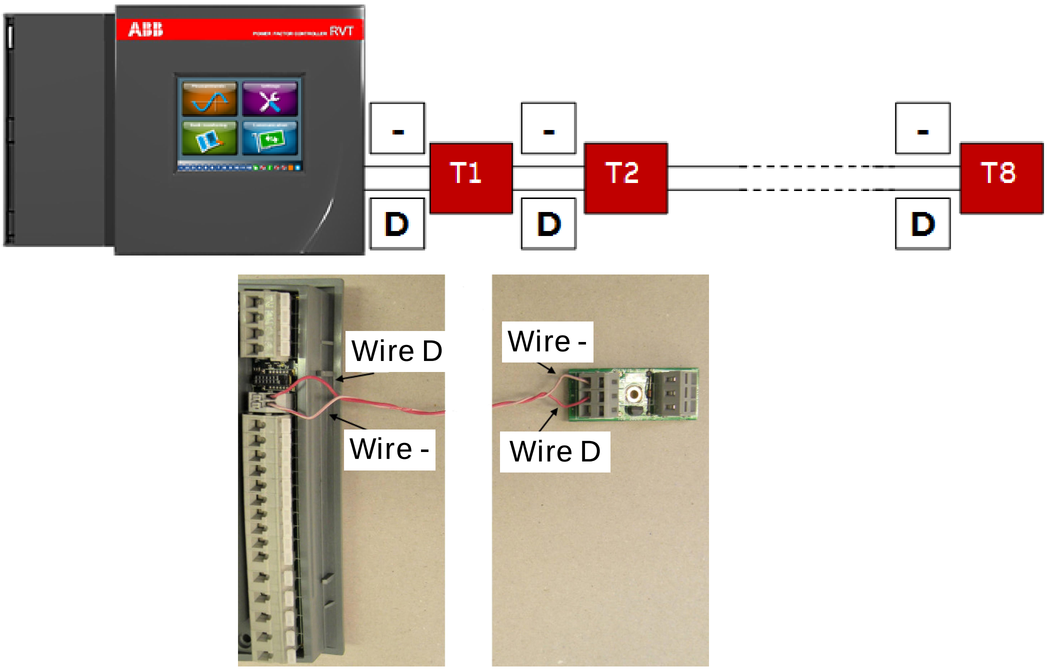
- connect the probe to the temperature probe input (one probe only)
- click on a row to assign a probe number
- click on the “Start” button
- the RVT recognize automatically the probe address
- restart the same procedure for each probe

When one of the probes has a problem, it can be cleared by clicking the clear button.

A unique address will be assigned to each activated probe after the recognition completes.

Figure 45: Temperature probe auto recognition

- Connect each probe successively :



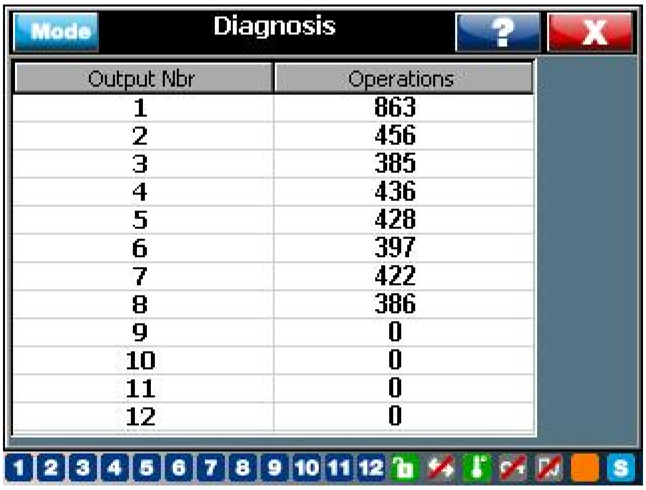
4.4 Bank Monitoring

RVT bank monitoring gives user the access to the diagnosis, alarm logging, test function and a real time clock (only the three phase model RVT12-3P has the real time clock). This makes a very helpful diagnostic tool.

Figure 46: Bank monitoring

4.4.1 Diagnosis

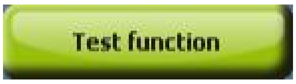
Lists the number of operations of each output capacitor relay since the RVT was manufactured.



Output Nbr	Operations
1	863
2	456
3	385
4	436
5	428
6	397
7	422
8	386
9	0
10	0
11	0
12	0

Figure 47: Bank monitoring diagnosis

4.4.2 Test function



This sub-menu allows the user to test each relay of the RVT.

Test alarm: allows testing of the alarm relay

Test fan: allows testing of the fan/warning relay

Test outputs: allows testing of each output capacitor relay (the RVT will take care of the programmed switching delays)

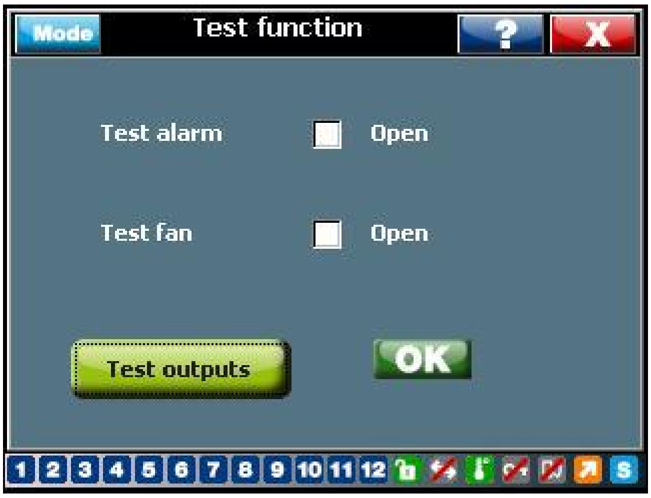


Figure 48: Bank monitoring test function

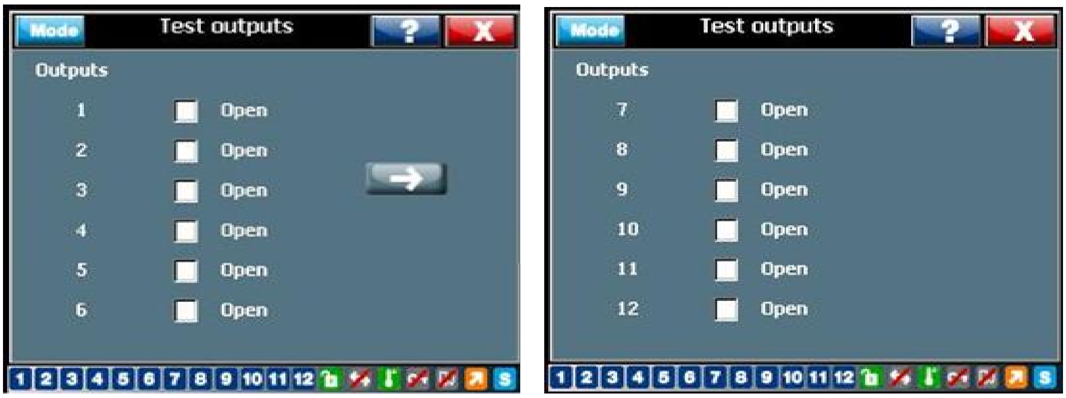
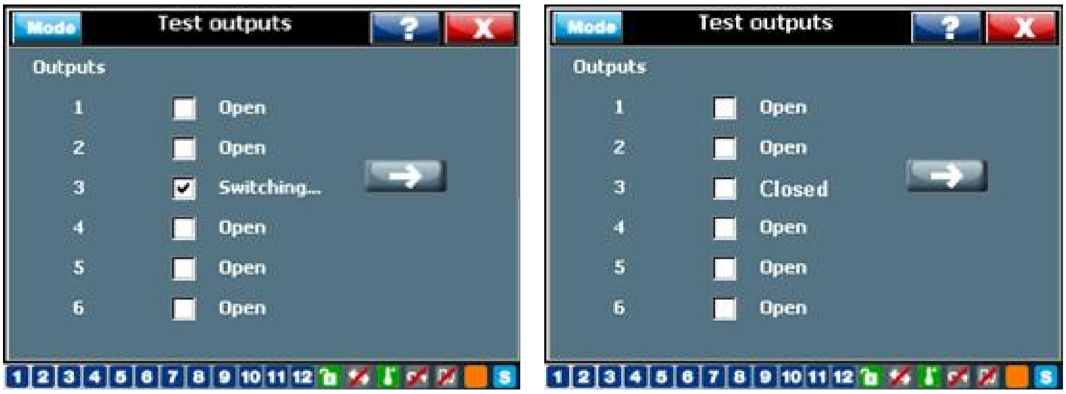


Figure 49: Bank monitoring test outputs

Click on the check box to switch ON/OFF the corresponding relay



Before proceeding to the test functions, please make sure that:

- RVT is unlocked (description in paragraphs 3.2.4 and 4.3.1.1)
- RVT is in SET mode (description in paragraph 3.2.2.)

4.4.3 Alarm logging

The alarm logging displays the last five alarm messages with a real time stamp.

Figure 50: Bank monitoring alarm logging

4.4.4 Real time clock

Figure 51: RVT real time clock

The real time clock continues to run even when the RVT is not connected to the power.

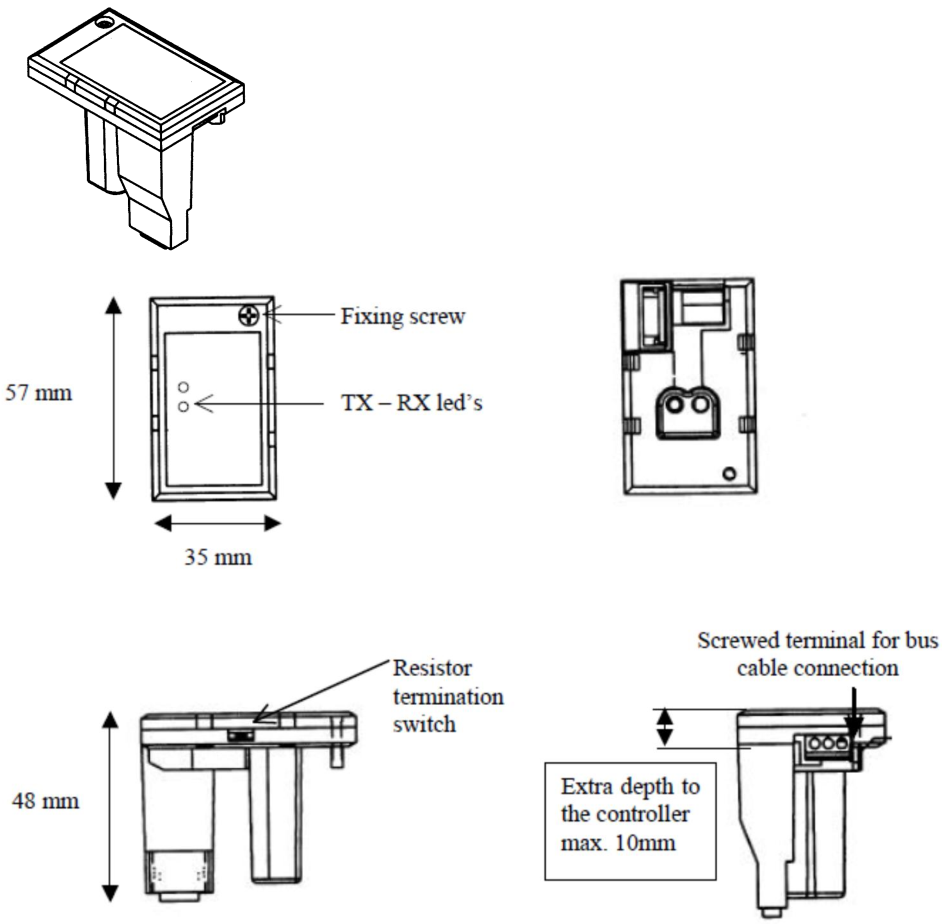
4.5 Communications

RVT provides a variety of communications methods. In this main menu, it includes the language setting, temp unit setting, screen configuration and settings for Ethernet, Modbus. More information regarding the Modbus, USB and TCP/IP protocol and programming, please refer to manual: 2GCS213013A0050_RVT communication through Modbus, USB or TCPIP protocol.

RS485 / Modbus Adapter

The Modbus adapter is an optional device for the Power Factor Controller RVT which enables the connection of the RVT to a RS485 Modbus system. The controller is considered as a slave unit in the Modbus network.

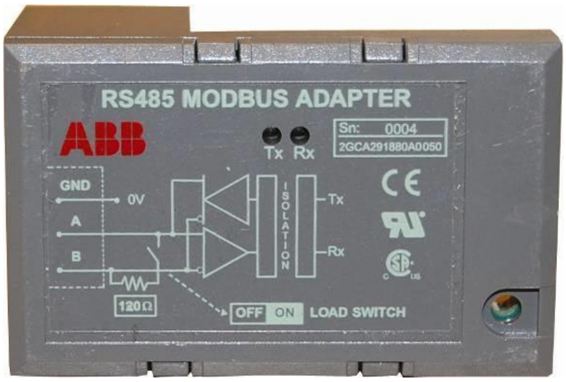
Refer to the 2GCS214013A0050-RVT Modbus RS485 adapter-User guide for more information on the RS485 Modbus Adapter.



Be careful that the RS485 MODBUS ADAPTER is the one with a GREEN text color (3.3V power supply).

The one with a WHITE text color is reserved for the old model (5V power supply).

That means: the new Modbus adapter is not compatible to the old RVT; and the old Modbus adapter cannot be connected to the new RVT (with touch screen).

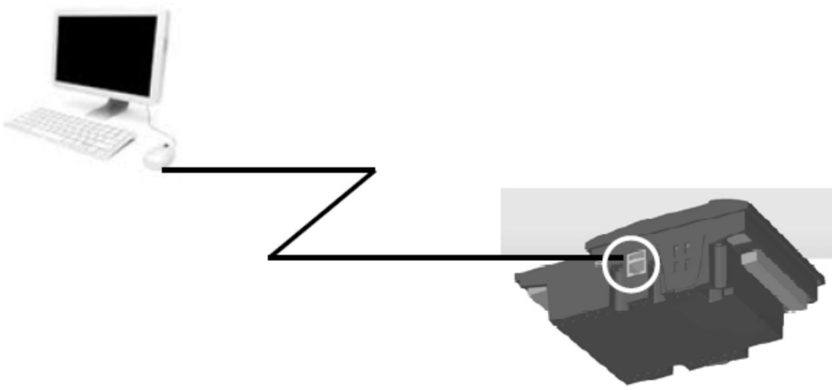


Ethernet / TCP/IP

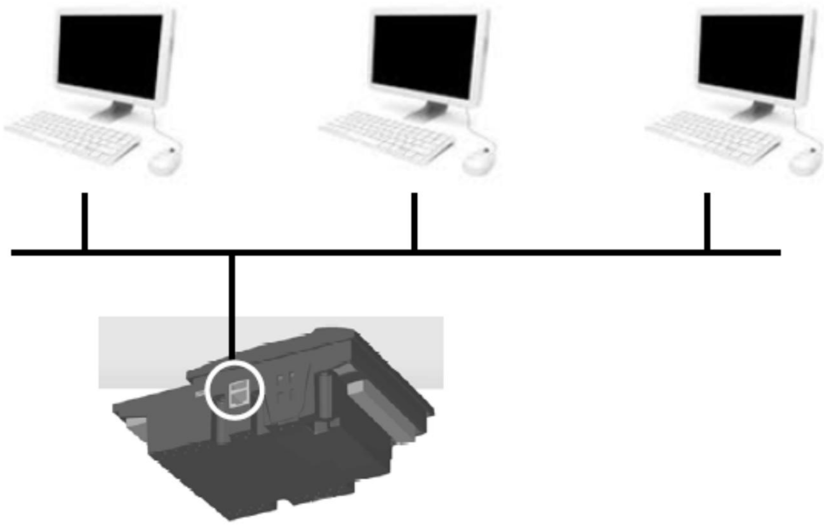
TCP/IP connections can be indifferently initiated locally or remotely.

The TCP port used by default is 4250.

The connection to the RVT is an RJ45 Cat5e Ethernet cable.



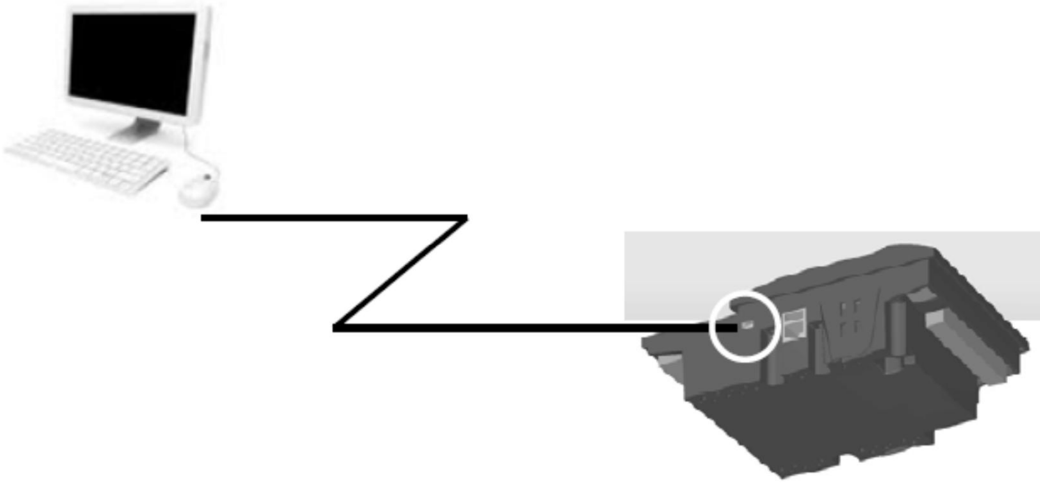
The RVT can be connected directly to a LAN or through Internet.



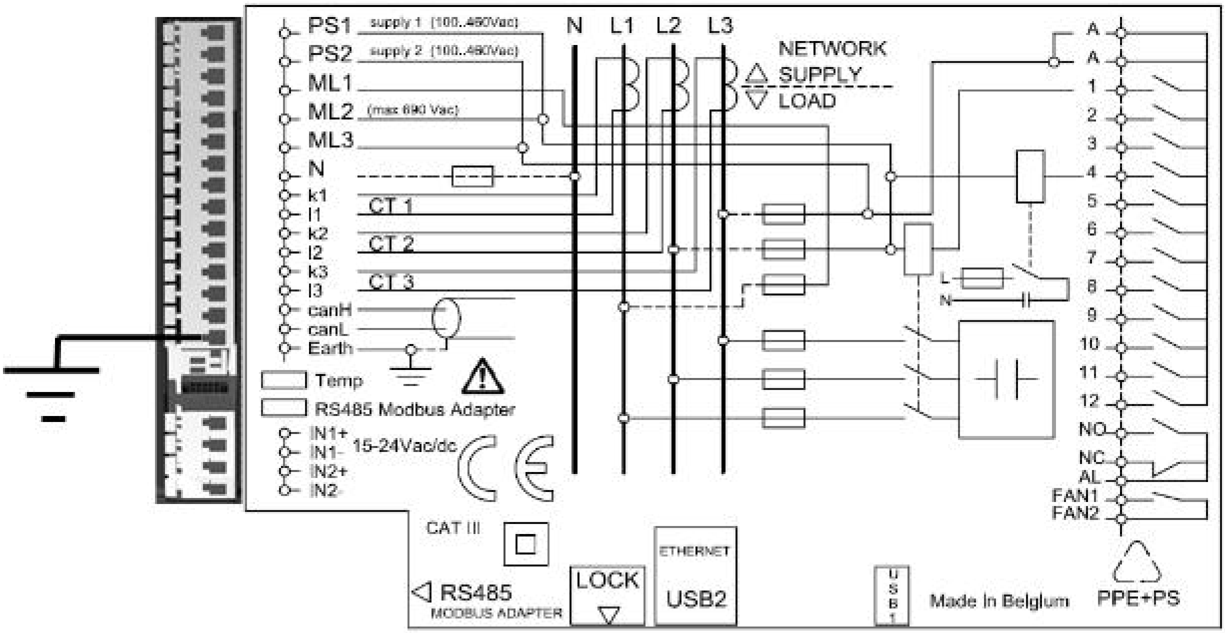
USB

The USB interface is used to present the RVT as a serial interface on its USB port.

The computer is connected through a USB-A male to USB-Mini B male.



Caution: The USB connection to the RVT is not isolated. It is mandatory to connect the protective EARTH connection when using the USB.



4.5.1 I/O configuration

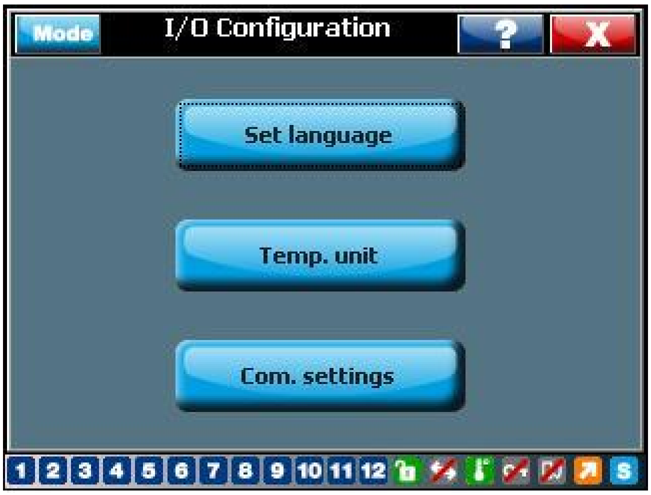


Figure 52: RVT I/O configuration

4.5.1.1 Set languages

Five different languages may be selected to dialog with the RVT.

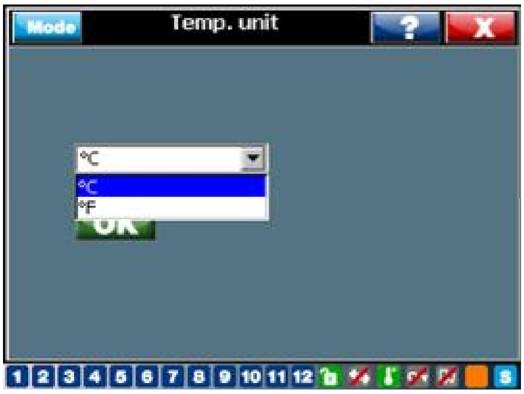
The user should come back to the main menu so that the selected language is activated.

Figure 53: RVT language selection

4.5.1.2 Temp unit

This menu provides two temperature units: Celsius and Fahrenheit.

The selected unit will be applicable in all other temperature measurements or settings.



4.5.1.3 Communications settings

Modbus and Ethernet connections have to be configured to run properly.

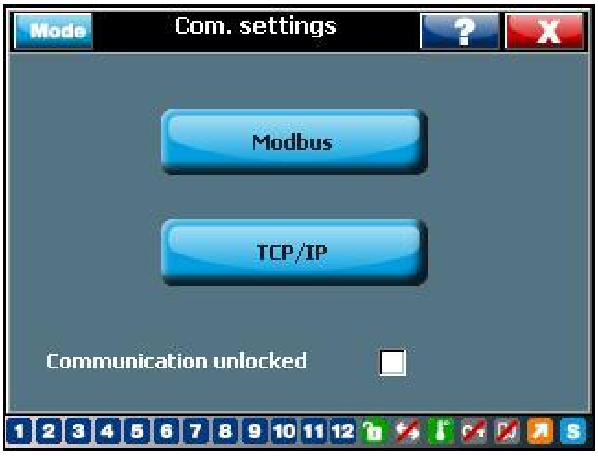


Figure 54: RVT communications protocol setting

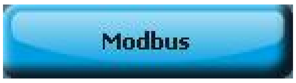


Figure 55: RVT Modbus protocol setting

The slave address is the one used by the Modbus master to address the RVT through Modbus.

Baud rate, Parity, Stop bit shall match exactly the communication settings of the Modbus master which controls the RS485 / Modbus network.

The RVT needs an IP address to be connected directly to a PC or to an Ethernet network.

This IP address may be fixed and entered manually if DHCP is disabled. The default address is 192.168.1.40.

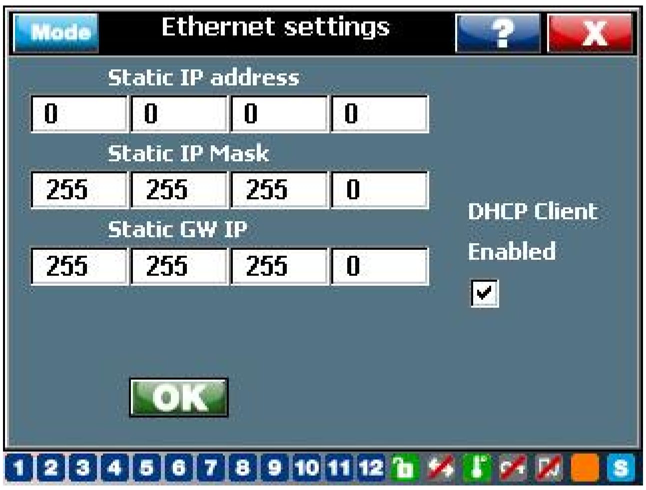
In case the IP address is given automatically by a gateway or Ethernet LAN, set DHCP to enabled.

Some examples are given below:

Example 1: The below screen shows the default settings to connect directly to a PC (note that the PC need to be configured accordingly with a fixed IP address of 192.168.1.1, Subnet mask of 255.255.255.0, DHCP disabled)

Figure 56: RVT TCP/IP protocol setting

Example 2: The below screen shows the default settings to connect to an Ethernet network (note that the PC which is also connected to the LAN has its own IP address given by the network with DHCP enabled)



Details about the communication settings can be found in the manual: 2GCS213013A0050_RVT communication through Modbus, USB or TCPIP protocol.

Reboot the RVT to initialize it with these parameters.

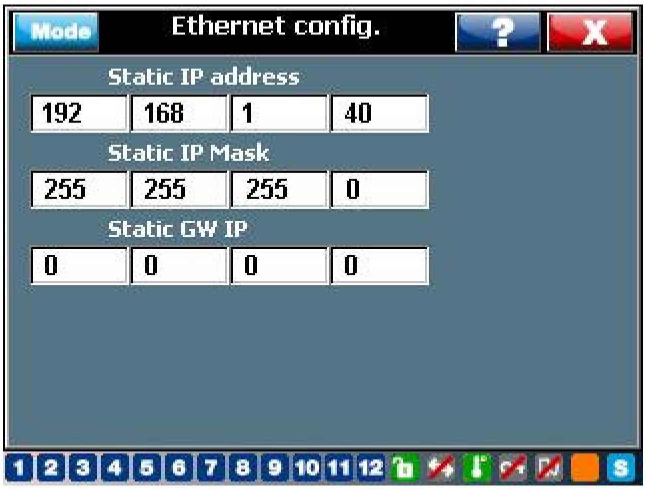
4.5.2 Ethernet configurations

This menu displays the actual RVT IP address, mask address and gateway IP address.

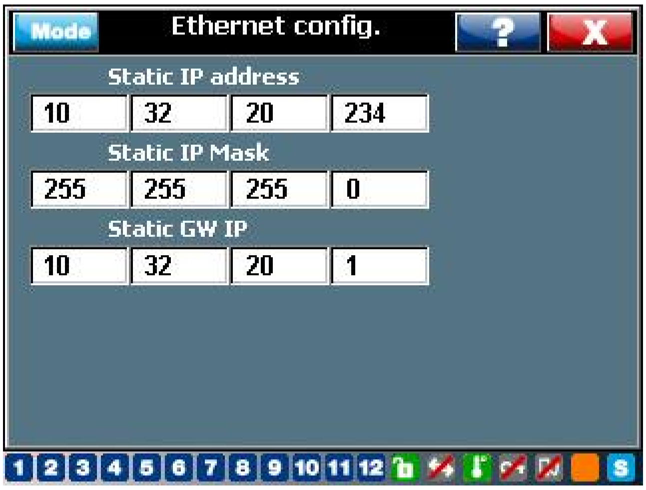
Depending on the DHCP status, the displayed data may be different.

The below screens give the result for the above Example 1 and 2:

Example 1: The below screen shows the actual IP address fixed with DHCP disabled.



Example 2: The below screen shows the actual settings resulting from the automatic IP address resolution with DHCP enabled.



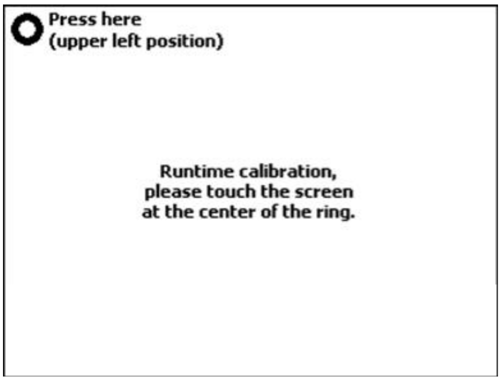
4.5.3 Screen configuration

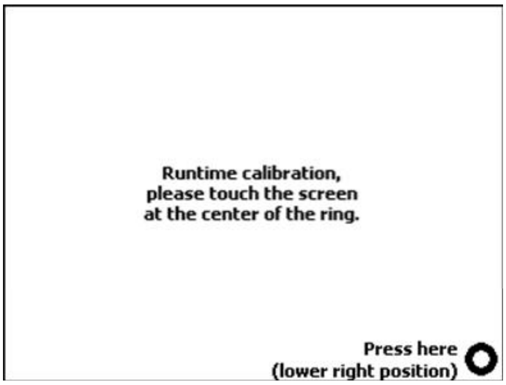
This menu helps the user to adjust the touch screen XY coordinates and the backlight brightness.

The touch screen calibration is normally not needed in a reasonable use of the screen and in standard environmental conditions.

To prevent loss of the touch screen interface, the possibility is meanwhile given to the user to manually calibrate the XY coordinates necessary to detect button activation.

Warning: Touch screen calibration has to be done carefully with a pen or a stylus in order to accurately mark and detect the calibration points!





The backlight adjustment menu set the default backlight intensity when the touch screen is used. After 10 minutes of touch screen inactivity, the backlight intensity returns to 10%.

4.5.4 About

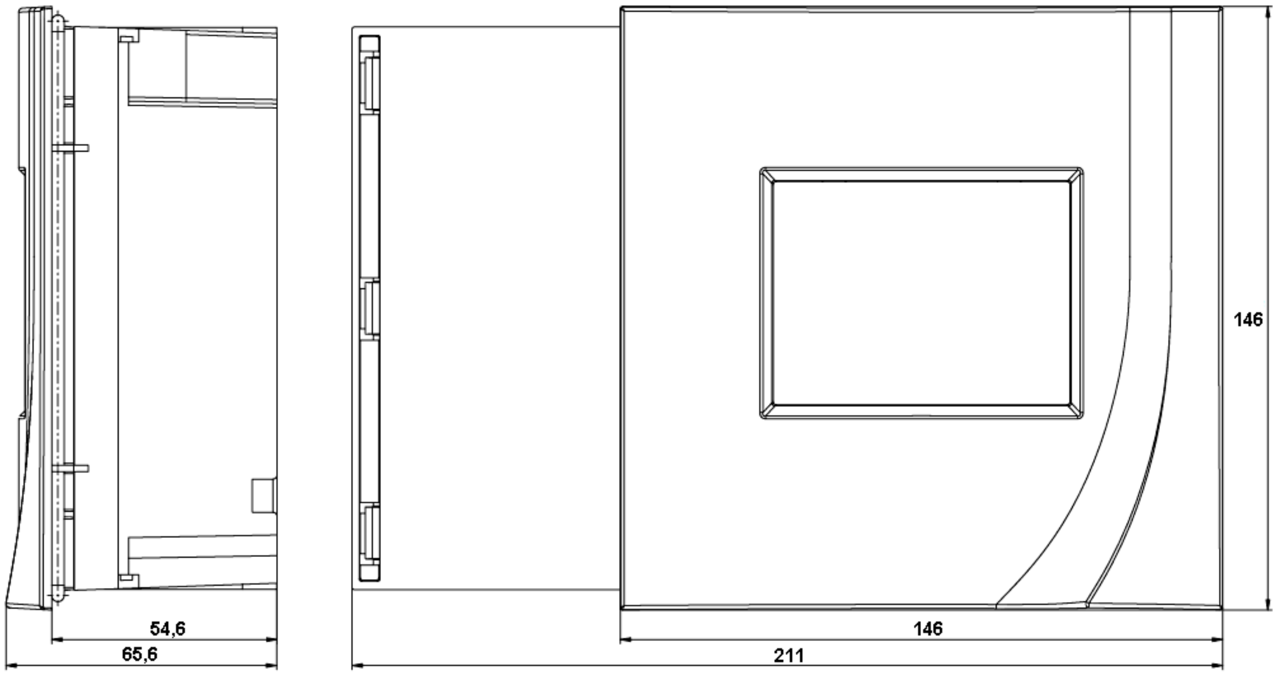
This menu gives RVT software version, serial number, article number and type.

4.5.5 Mac Address

This menu displays the RVT physical MAC address.

Appendices

A1. Dimensions



A2. Technical specifications

RVT types:

Feature	RVT 6 / RVT 12	RVT 12-3P
1 / 3 phase measurements	1 Voltage measurement input 1 Current measurement input	3 Voltage measurement inputs 3 Current measurement inputs
Real Time Clock	No	Yes
Energy Measurements	No	Yes
Ethernet connection	No	Yes
USB host connection	No	Yes
USB device connection	Yes	Yes
Digital inputs	Yes	Yes
Alarm / Fan relays	Yes	Yes
Output relays	6 or 12	12
Lock switch	Yes	Yes
RS485 Modbus connection	Yes	Yes
External temperature probes	Yes	Yes

Measuring system:

Micro-processor system for balanced three-phase/single-phase networks and unbalanced network. Individual phase power factor control is available.

Supply voltage:

From 100Vac up to 460Vac.

Consumption:

15 VA max.

Connection type:

Phase-phase or phase-neutral for balanced and unbalanced network

Voltage tolerance:

± 10% on indicated supply voltages.

Measurement category (according IEC 61010-1):

CAT III

Voltage measurement:

Up to 690Vac or higher with a voltage transformer.

Accuracy: 1% full scale

Frequency range:

45 or 65 Hz (automatic adjustments to network frequency).

Current input:

5A or 1A (RMS) (class1 C.T.).

Current input impedance:

< 0.1 Ohm.

Power outage release:

Automatic disconnection of all capacitors in case of a power outage longer than 20ms.

Number of outputs:

RVT6/RVT12 Base Model: programmable up to 6 or 12 outputs

RVT12-3P Three Phase Model: programmable up to 12 outputs

Output contact rating:

- Max. continuous current: 1.5A (ac) – 0.3A (110V dc).
- Max. peak current: 8A
- Max. voltage: 440 Vac.
- Terminal A-A are rated for a continuous current of 18A (9A/terminal).

Alarm contact rating: (voltage free contact)

- One normally closed contact and one normally open contact.
- Max. continuous current: 1.5A (ac).
- Rated voltage: 250Vac (max. breaking voltage: 440Vac).

Fan contact rating: (voltage free contact)

- Normally open contact.
- Max. continuous current: 1.5A (ac).
- Rated voltage: 250Vac (max. breaking voltage: 440Vac).

Power factor setting:

From 0.7 inductive to 0.7 capacitive.

Starting current setting (C/k):

- 0.01 to 5A.
- automatic measurement of C/k.

Switching sequences:

1:1:1:1:1:..:1 - 1:2:2:2:2:..:2 - 1:2:4:4:4:..:4

1:2:4:8:8:..:8 - 1:1:2:2:2:..:2 - 1:1:2:4:4:..:4

1:1:2:4:8:..:8 - 1:2:3:3:3:..:3 - 1:2:3:6:6:..:6

1:1:2:3:3:..:3 - 1:1:2:3:6:..:6

and any other customer programmable sequence.

10/100 Base-T Ethernet connection

Connection to a PC or a LAN through TCP/IP protocol

Electrical isolation between RVT and the RJ45 signals: 1500Vrms

Modbus baud rate:

300 - 600 - 1200 - 2400 - 4800 - 9600 - 19200 - 38400 – 57600 bps

CAN connection:

Support CAN 2.0B interface (for future use)

USB host connection:

(For future use)

USB device connection

Temperature probe input connection

Only 2 contacts using 1-wire protocol

- Parasitic supply mode (no need of external power supply)
- Connection to more nodes in a daisy chain network
- 8 temperature probes connection

- 8 meters maximum between RVT to temperature probe or between probes
- 64 meters maximum length
- Measures temperatures from -55°C to +125°C (-67°F to +257°F)
- +/-0.5°C accuracy from -10°C to +85°C
- DIN rail mounting
- Connection to the RVT using a 2 wires , twisted pair Category 1 telecommunication cable

Step configuration:

Auto, fixed, disabled.

Display:

QVGA 320 x 240 pixels colorful touch-screen.

Adjustable display backlighting

Switching time between steps:

Programmable from 1s to 18h.

Saving-function:

All programmed parameters and modes are saved in a non-volatile memory.

Auto adaptation to the connection and phase-rotation of the network.

Auto adaptation to the CT-terminals.

Power Factor correction operation is insensitive to the presence of harmonics.

Working with passive and regenerative loads (four-quadrant operation).

Operating temperature:

-20° C to 70° C.

Storage temperature:

- 30° C to 85° C.

Mounting position:

Vertical panel mounting.

Dimensions:

Front plate: 146 x 146 mm (HxW)

Rear side: 205 x 135 mm

Overall dimensions: 146 x 211 x 67 mm (HxWxD)

Cut out dimensions: 138 x 138 mm (H x W)

Weight:

650g (unpacked).

Connector:

Cage clamp type (2.5mm² single core cable).

Front plate protection:

IP 43 (IP 54 on request).

Relative humidity:

Maximum 95%; non-condensing.

CE Marked.

A3. Testing and troubleshooting

Testing

After installation of the automatic capacitor bank and programming of the switching parameters, the following tests can be performed depending on load situation.

A. No load or cos **j** = 1 or capacitive load (set desired cos **j** to 0.95 ind.)

1. Select manual mode
2. Add two or more steps.
3. Select automatic mode.

All capacitor steps must be switched off with the programmed delay time between each switching operation.

If all steps are not switched off, check the following:

- Has an inductive load been connected?
- Have the correct C/k ratio and/or step size been programmed?

(It is recommended that the C/k value be set to a value slightly higher than the calculated value)

B. Inductive load

1. Set desired cos j =1
2. Select automatic mode.

Capacitor steps will now be automatically switched on to compensate the inductive load (the controller will not switch steps if the inductive current is lower than the preset C/k value. In such a case, test according to A above).

If all steps are switched on and there is still a demand for additional steps, then check the setting of C/k.

If it is correct, then the bank is too small to compensate the cos j = 1. Select a lower value for cos j .

When one stage repeatedly switches on and off, it means the C/k is set too low (unless the load actually fluctuates periodically with a time period equal to or close to the switching delay time).

Troubleshooting

Faults	Recommended actions
The controller is connected but does not work (nothing on display)	Check the voltage setting and the fuses.
The controller does not switch on or off steps although there is a considerable variable inductive load.	Check that the controller is in automatic Mode. Check setting of phase shift and C/k. Check that the CT short-circuit bridge is removed.
The controller does not seem to activate any steps.	Wait for the delay time between switching and/or the power outage delay time.
The preset power factor is not achieved.	At low or no load, a low power factor can correspond to a very small inductive current. The corresponding capacitor steps are too large for compensation. If the average cos j over a period of time is too low, the preset cos j may be increased.
All capacitors are switched on although the required reactive power is relatively low.	Check setting of phase and C/k values.

After the automatic commissioning stops and the controller displays one of the following messages:

Messages during an automatic commissioning process	Recommended actions
Phase rotation was detected to be wrong. L2 and L3 phases will be internally inverted. Press OK to validate.	Press OK
Error: Step size too small	Adapt the step size or the CT ratio.
Error: CT not sensing any current	Check that the CT's short-circuit bridges is removed, that CT's connections are correctly wired and start the Auto commissioning again.
Error: Load changing too fast	Restart the Auto commissioning procedure under more stable conditions or set the parameters manually.
Error: Too wide phase dispersion in input nr 'X' 'Y' 'Z'	For each CT input and for each output, phase recognition is done and phase dispersion is checked. Check capacitor and contactor connections. Check capacitor currents for each phase.
Error: At least two CT input sensing the same line current	Check CT's installation
Error: No significant current in input nr 'X' 'Y' 'Z'	Check that CT's short-circuit bridge is removed , that CT's connections are correctly wired and start the Auto commissioning again
Error: Inconsistent phase shift	Check CT's connections and installation. Check capacitor and contactor connections. Check capacitor currents for each phase.

Error: Unbalanced step or CT ratio different in lines for output nr ‘A’ ‘B’ ‘C’ ‘D’…	Check that CT’s ratios are the same value. Check capacitor and contactor connections. Check capacitor currents for each phase.
Error: Too big step difference"	Check sequence and reactive power value per output.

A4. Post Alarm Restarting Procedure

Once a protection level is reached (see paragraph 4.3.1.4.1) or when the internal temperature is higher than 85°C:

- all the capacitor steps are switched off
- an alarm message appears on the LCD display
- the alarm relay opens

When the alarm condition disappears, the RVT will automatically restart.
The restarting procedure will depend on the type of event that caused the alarm, as indicated in the following table:

Event having occurred	RVT restart behavior after event has disappeared
Urms < Umin prot	- Opens alarm relay immediately - Resumes normal behavior after a time equal to ON-Delay(*)
Power outage	- Resumes normal behavior after a time equal to Reset-delay(*)
Urms > U max prot.	- Opens alarm relay immediately - Resumes normal behavior after a time equal to ON-Delay(*)
Temp internal > 85°C	- Event considered as disappeared, when Temp internal < 80°C - Opens alarm relay immediately - Resumes normal behavior after a time equal to ON-Delay(*)
One of the eight T probes temp > its max. protection level	- Opens alarm relay immediately (external optional probe T1-8) - Resumes normal behavior after a time equal to ON-Delay(*)
THDV > THDV max prot.	- Opens alarm relay immediately. - Resumes normal behavior after a time equal to ON-Delay(*). Anti-hunting protection: If the same event occurs within one hour, the RVT will resume normal operation after a time equal to 2x ON-Delay. If the same event occurs again within one hour, the restart time will be doubled to 4 x ON-Delay, and so on up to a maximum of one hour.

	This rule allows a hunting effect due to resonance phenomena to be avoided.
External input activated	- Opens alarm relay immediately. - Restart normal behavior after a time equal to ON-Delay(*).

(*) For more information regarding the Reset-Delay and ON-delay parameters, a complete description is available in paragraph 4.3.1.1.

A5. Voltage measurement and power supply connection

This appendix provides a practical way to connect voltage measurement to the RVT when it is the same as the RVT voltage supply.

Description

As shown on the Figure 57, the RVT has two terminals for its power supply and three other terminals for its voltage measurement input.

The RVT does not use its power supply voltage to perform the voltage measurement. Voltage measurement is performed only through the dedicated voltage measurement input terminals.

If the RVT auxiliary power supply and the voltage measurement signal are from the same source, a bridge between the corresponding terminals can be done:

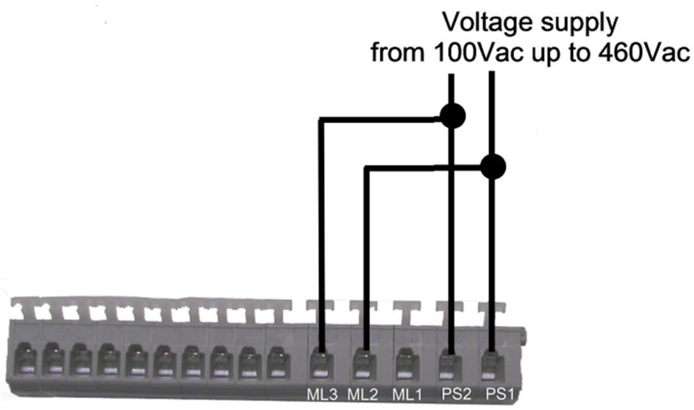


Figure 57: Terminals

Bridge connection (practical proposal)

Due to limited space, it is not possible to insert two cables in a single slot. Hence alternate methods may be used to connect two wires to a common terminal.

Several practical ways exist to perform this connection properly. One of these solutions is described on Figure 58.

On each voltage supply cable, a double entry terminal has to be used to insert a second cable needed to make the bridge.

These terminals and the corresponding crimping tool are usually available worldwide.

Please note that with these terminals, cables of same diameter have to be used. Two terminals have obviously to be used and the result is shown here below.

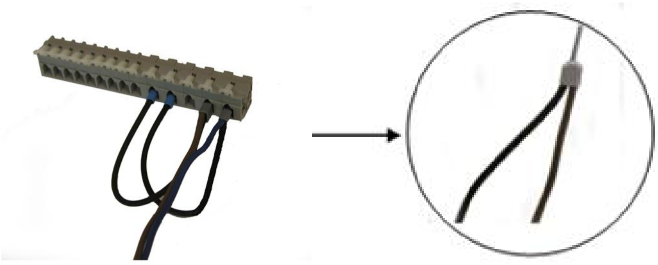
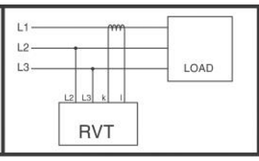
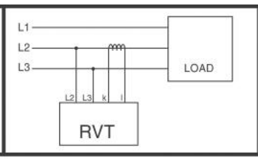
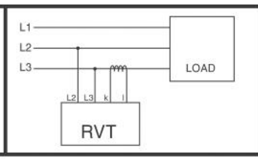
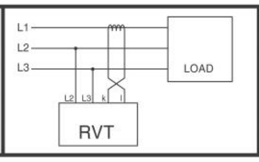
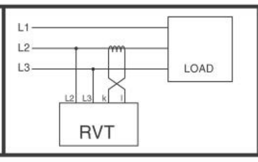
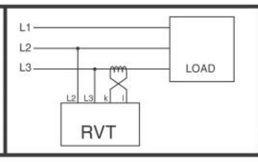


Figure 58: Bridge connection

A6. Phase shift table (applicable to Base Model)

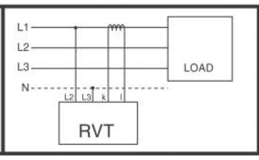
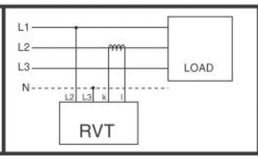
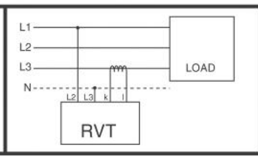
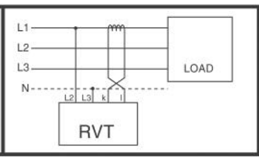
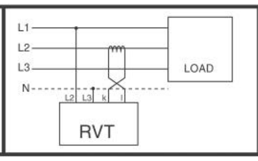
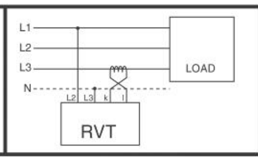
Three-phase connection (Phase to Phase)

Voltage is measured between L2 and L3

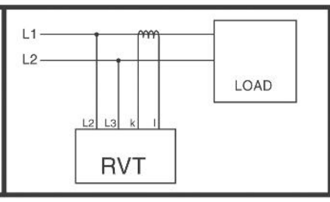
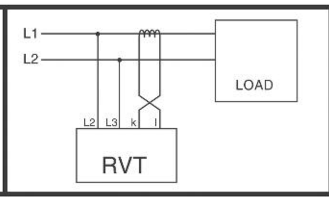
L1 Direct		90	L2 Direct		-30	L3 Direct		-150
L1 Inverted		-90	L2 Inverted		150	L3 Inverted		30

Three-phase connection (Phase to Neutral)

Voltage is measured between L1 and Neutral

L1 Direct		0	L2 Direct		-120	L3 Direct		120
L1 Inverted		180	L2 Inverted		60	L3 Inverted		-60

Single-Phase connection

L1 Direct		0	L2 Direct		180

A7. CT connection type illustration and CT wiring on the controller terminals

Connection type		RVT 12 - 3P	RVT 6 / RVT 12	Phase shift	Voltages						Currents				Compensation type		
Name	Schematics	Connection	Connection	adjustment	L12	L23	L31	L1N	L2N	L3N	L1	L2	L3	N	Full C3[1]	Full C1[2]	Mixed C3+C1
1Ph-1LL1	L2 L3	L2 L3 CT — ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	L2 L3 CT — N.C. ML2 ML3 N.C. k l N.C. N.C. N.C. N.C.	0° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	-	yes	-
3Ph-1LL1	L1 L2 L3 N	L2 L3 CT — ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	L2 L3 CT — N.C. ML2 ML3 N.C. k l N.C. N.C. N.C. N.C.	90° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	yes	-	-
3Ph-1LN1	L1 L2 L3 N	L1 N CT — ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	L1 N CT — N.C. ML2 ML3 N.C. k l N.C. N.C. N.C. N.C.	0° by default (see phase shift table)	-	-	-	Measured	-	-	Measured	-	-	-	yes	-	-
3Ph-3LL3	L1 L2 L3 N	L1 L2 L3 CT1 CT2 CT3 — ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-3LL2	L1 L2 L3	L1 L2 L3 CT1 CT2 — ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Calculated	(3)	yes	yes	yes
3Ph-3LN3	L1 L2 L3 N	L1 L2 L3 N CT1 CT2 CT3 — ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - phase rotation - CT redirection)	Calculated	Calculated	Calculated	Measured	Measured	Measured	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LL3	L1 L2 L3 N	L2 L3 CT1 CT2 CT3 — ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - CT redirection)	-	Measured	-	-	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LN3	L1 L2 L3 N	L1 N CT1 CT2 CT3 — ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - CT redirection)	-	-	-	Measured	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes

A8. Individual phase power factor control (applicable for Three Phase Model RVT12-3P)

By default only the '12 outputs' model is available for individual power factor control.

As in the base RVT, the PFC control in the three-phase RVT 12-3P is done by comparing the C/k value to the fundamental reactive current measurement.

The control is done in different ways, based on the connection type (see A7. CT connection type illustration and CT wiring on the controller terminals) and the type of the output steps (single or three phase steps).

Taking the connection type notation (please refer to A7. CT connection type illustration and CT wiring on the controller terminals)

wPh- xLyz where :

w determines a single or three phase network

x is the number of voltage measurements used

y determines Line to Line or Line to Neutral connection

z is the number of CT used

wPh-1Ly1 control type (only one CT)

Basically, if only one CT is used, the control is done according the CT in phase L1 (or the line where the CT is placed).

3Ph-xLy2 and 3Ph-xLy3 control type (2 or 3 CT)

If more than one CT is used, the control strategy follows a simple and efficient principle to be able to handle all the outputs in a comprehensive way. The following strategy is implemented:

Unbalanced network switching strategy:

Wait for the switching delay time while calculating the reactive current in phases L1, L2, and L3 according the Normal/Integral setting

Evaluation of the minimum 3 phase outputs to be switched ON or OFF

Evaluation of the single phase outputs to be switched ON or OFF

If any block of single phase outputs (already ON and to be switched ON) can be transferred to a three phase step then switch preferably a three phase output

Switch ON or OFF according the Progressive/Direct, Linear/Circular settings

Some typical examples are given hereafter:

- 12 single phase capacitors / 1 CT (1Ph-1LL1 only)

  à The control is done through the CT in the phase where it is placed

  à C/k 3Ph parameter is used for steps switching (equivalent to C/k parameter in base RVT6 or 12)

- 12 three phase capacitors / 1 CT (3Ph-1Ly1 only)

à The control is done through the CT in the phase where it is placed

à C/k 3Ph parameter is used for steps switching (equivalent to C/k parameter in base RVT6 or 12)

- 12 three phase capacitors / 2 or 3 CT's (3Ph-3LL2 or 3Ph-xLy3 only)

à The control is done through the CT1 in phase L1, CT2 in phase L2, CT3 in phase L3

à The control is done according the unbalanced network switching strategy

à The C/k 3Ph parameter is used for three phase steps switching

- 3 single phase capacitors connected between L-N / 2 or 3 CT (3Ph-3LL2 or 3Ph-xLy3 only)

à The control is done through the CT1 in phase L1, CT2 in phase L2, CT3 in phase L3

à The control is done according the unbalanced network switching strategy

à The C/k 1Ph parameter is used for single phase steps switching

- 6 three phase capacitors + 2 * 3 single phase capacitors connected between L-N / 2 or 3 CT (3Ph-3LL2 or 3Ph-xLy3 only)

à The control is done through the CT1 in phase L1, CT2 in phase L2, CT3 in phase L3

à The control is done according the unbalanced network switching strategy

à The C/k 1Ph parameter is used for single phase steps switching

à The C/k 3Ph parameter is used for three phase steps switching

A9. Recycling

This marking shown on the product or its literature, indicates that it should not be disposed with other household wastes at the end of its working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate this from other types of wastes and recycle it responsibly to promote the sustainable reuse of material resources.

Household users should contact either the retailer where they purchased this product, or their local government office, for details of where and how they can take this item for environmentally safe recycling.

Business users should contact their supplier and check the terms and conditions of the purchase contract. This product should not be mixed with other commercial wastes for disposal in accordance with the WEEE directive (waste electrical and electronic equipment).

This product does not contain any hazardous substances and complies with RoHS directive (Restriction of the Use of Certain Hazardous Substances).

Disposal of used batteries should be carried out in accordance with the national regulations for the disposal of batteries (Battery Directive).

Electronic boards should be recycled according local regulation.

Plastic enclosure and parts should be recycled separately.

This product contains a CR2032 Li-MnO2 cell battery. Do not replace the internal CR2032 lithium battery. For recycling, it can be removed for disposal after opening the plastic enclosure (4 screws at the back of the product).

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Instructions d'installation, d'utilisation et d'entretien

Table des matières

A lire en premier

A propos de ce manuel d'instructions

Ce manuel d'instructions est conçu pour vous aider à installer et utiliser rapidement les régulateurs de facteur de puissance RVT.

Avertissement

Attention, risque de danger: ce symbole est un avertissement pour attirer l'attention sur des informations importantes.

Avant l'installation et l'utilisation du régulateur RVT, lisez attentivement les instructions. Laissez ce manuel à disposition des personnes chargées de l'installation, de la maintenance et de l'utilisation.

Sécurité

Le RVT est en conformité avec la directive européenne LVD 2006/95/EC.

Attention, risque de choc électrique: ce symbole avertit le lecteur qu'une information sécurité est fournie et doit être prise en compte.

L'installation, l'entretien et l'utilisation du régulateur de facteur de puissance doivent être assurés par des électriciens qualifiés.
Ne travaillez pas sous tension.
Pour le nettoyage, enlevez la poussière à l'aide d'un chiffon sec. N'utilisez pas d'abrasif, ni solvants, ni alcool. Avant le nettoyage, veillez à toujours couper la tension d'alimentation et du circuit de mesure.
N'ouvrez pas le boîtier du régulateur de facteur de puissance. Il ne contient pas de pièces de rechange à l'intérieur.
Lorsque le régulateur de facteur de puissance est relié à un transformateur de courant, ne débranchez pas les connecteurs du transformateur de courant avant d'être sûr qu'il est court-circuité ou relié à une autre charge parallèle d'une impédance suffisamment basse.
N'utilisez pas ce produit à d'autres fins que celle pour laquelle il a été conçu.

Compatibilité électromagnétique

Ce régulateur RVT a été testé pour répondre aux directives UE (Union Européenne) de CEM (CEM 2004/108/EC) (compatibilité électromagnétique) pour un fonctionnement à 50Hz et, à cet effet, porte le label CE.

Lorsqu'un appareil est utilisé dans un système, les directives UE peuvent exiger que l'ensemble du système soit testé pour être en conformité avec les directives CEM.

Les recommandations suivantes permettent d'améliorer les caractéristiques de CEM d'un système :

En général, les boîtiers métalliques améliorent les caractéristiques de CEM.

1. Passez les câbles loin des ouvertures du boîtier.
2. Passez les câbles près des structures métalliques reliées à la terre.
3. Utilisez des tresses de masse multiples pour les portes et les autres parties du panneau, comme il est prescrit.
4. Evitez les impédances de masse de mode commun.

1 Introduction au régulateur

1.1 Que contient ce chapitre?

Ce chapitre fournit une description du régulateur du facteur de puissance de type RVT. Il illustre la structure de base du régulateur, les caractéristiques principales et l'interface utilisateur avec écran tactile du régulateur.

1.2 Un régulateur de facteur de puissance triphasé qui contrôle efficacement chaque phase individuellement

Le régulateur RVT est capable de compenser le facteur de puissance à la fois dans les réseaux équilibrés et déséquilibrés. Il existe deux modèles de régulateurs RVT : le modèle de base RVT6 / RVT12 et le modèle triphasé RVT12-3P. Le modèle de base est totalement compatible avec les régulateurs précédents à 6 ou 12 sorties. Ceux-ci sont utilisables pour un réseau équilibré triphasé ou monophasé (phase à phase). Le modèle triphasé RVT12-3P est une version plus puissante avec des fonctions de contrôle du facteur de puissance dans chaque phase individuelle grâce à trois mesures de TI pour chaque phase. Le modèle triphasé RVT12-3P est seulement disponible en version 12 sorties.

Le RVT peut aussi être utilisé pour les batteries de condensateurs MV. Les détails de connexion du RVT à une batterie MV se trouvent au paragraphe 4.3.1.1.

1.3 Caractéristiques principales du RVT

1.3.1 Contrôle de la compensation du facteur de puissance

Le régulateur du facteur de puissance RVT est l'unité de contrôle d'une batterie de compensation automatique qui est utilisé pour compenser la puissance réactive d'une installation avec en majorité des charges inductives.

Il décide de l'enclenchement de condensateurs afin d'atteindre un cos φ cible déterminé par l'utilisateur.

- Tous les paramètres d'enclenchement peuvent être programmés automatiquement ou manuellement (description aux paragraphes 4.3.2 et 4.3.1)
- En plus du cos φ cible, un cos φ cible de nuit et un cos φ cible en mode régénératif peuvent être programmés (description au paragraphe 4.3.1.3).
- Pour le modèle triphasé RVT12-3P, le régulateur peut être configuré pour enclencher / déclencher le condensateur monophasé d'un réseau non-équilibré. Cette fonction est utilisée pour corriger un mauvais facteur de puissance dans chaque phase individuelle ; par exemple, un facteur de puissance 0.6 dans la phase 1, un facteur de puissance 0.8 dans la phase 2, un facteur de puissance 0.95 dans la phase 3. C'est très utile pour certains domaines résidentiel / commercial où les charges triphasées peuvent être non-équilibrées à cause de plusieurs charges monophasées.

1.3.2 Mesures et enregistrement

- Mesures (description au paragraphe 4.2).
- Protection contre des phénomènes inattendus et/ou contre des utilisations non autorisées (description aux paragraphes 3.2.4 et 4.3.1.1.)
- Enregistrements de données et de messages d'alarme basées sur une horloge en temps réel (description aux paragraphes 4.2.5 et 4.4).
- Vérifications et tests des relais (description aux paragraphes 4.4.2 et 4.4).
- Mesures en température: max. 8 sondes de températures peuvent être connectées en série, chacune étant reliée à la précédente (description au paragraphe 4.3.1.4.3).

1.3.3 Communications

- Connexion Modbus (un adaptateur Modbus est nécessaire)
- Connexion USB (compatible avec les spécifications USB2.0)
- Interface Ethernet TCP/IP
- CAN 2.0 avec des sorties supplémentaires jusqu'à 32. C'est mécaniquement possible dans la version actuelle du RVT. Le logiciel doit être modifié dans le futur.

Le paragraphe 4.5 donne de plus amples informations.

1.4 Vues des faces avant et arrière

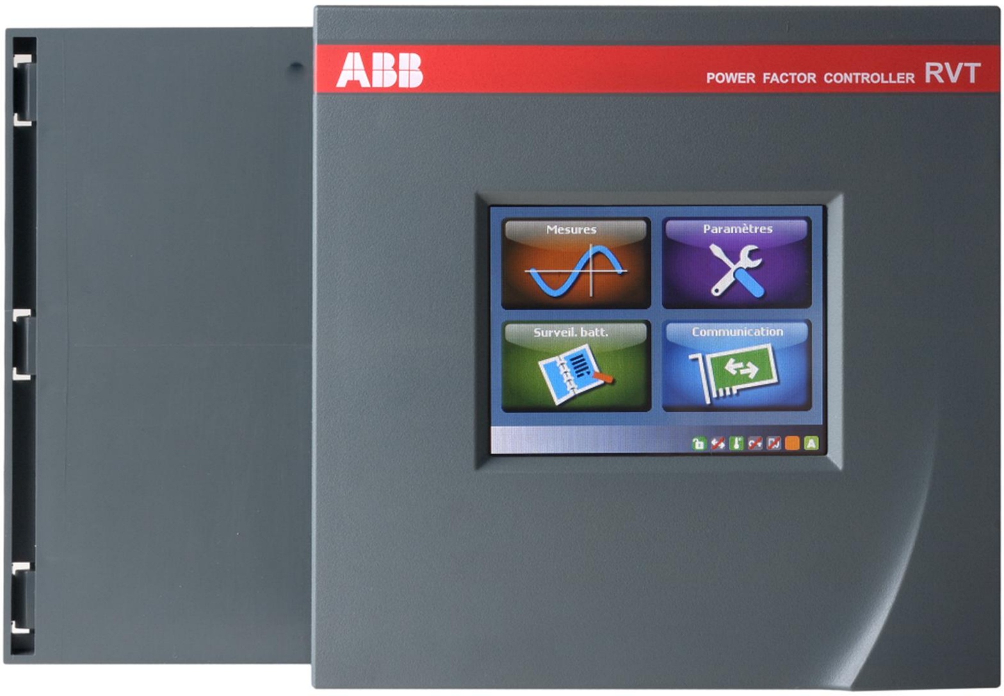


Figure 1: RVT vue avant

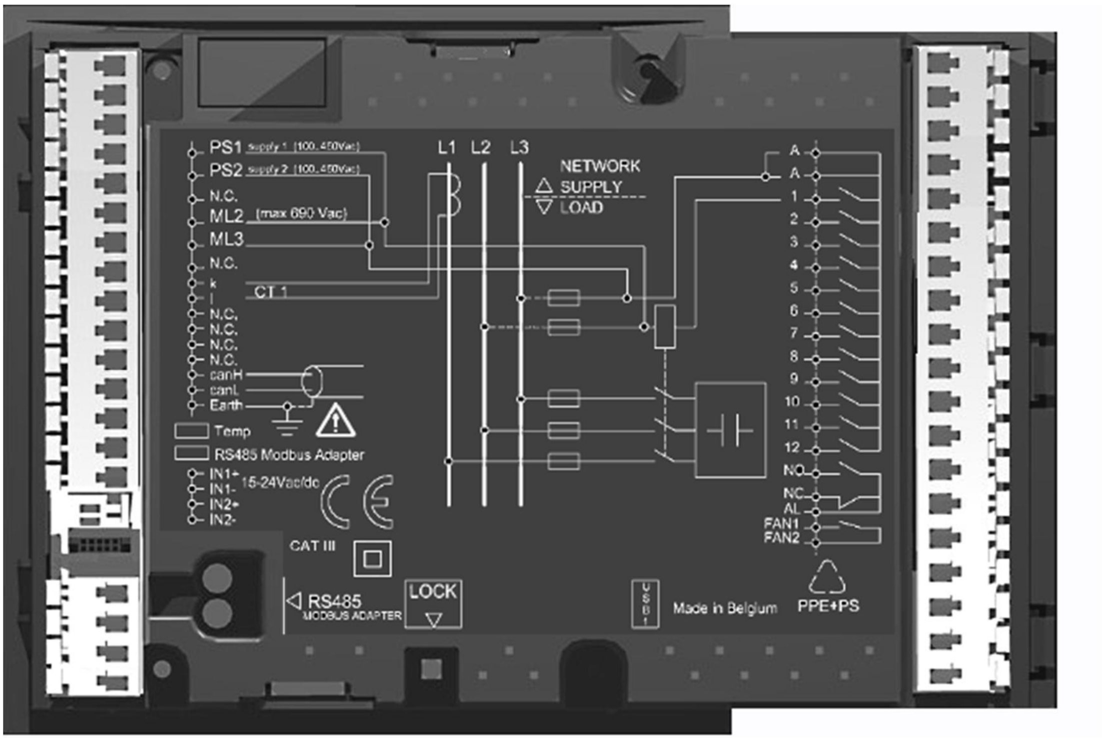


Figure 2: RVT vue arrière (modèle de base RVT6/RVT12)

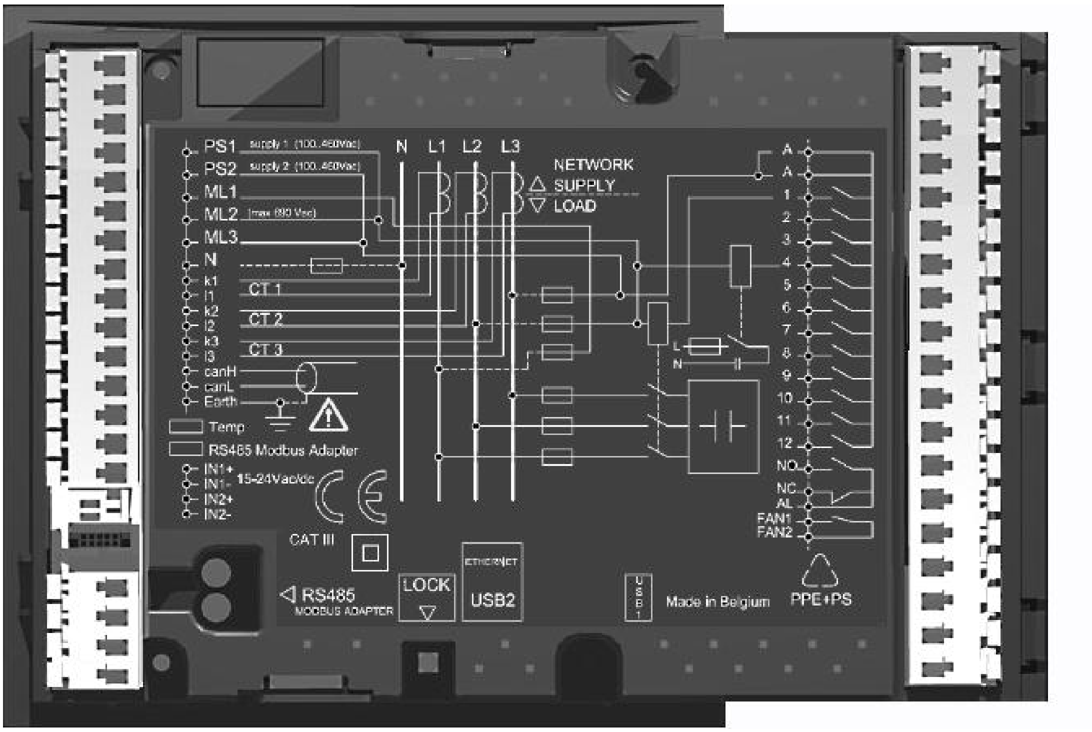


Figure 3: RVT vue arrière (modèle triphasé RVT12-3P)

1.5 Un écran tactile multicolore

Un écran tactile multicolore de type QVGA 320 x 240 pixels aide l'utilisateur à faire fonctionner le régulateur plus facilement. La navigation dans les menus et les paramétrages sont aisément réalisables avec l'écran tactile.

Figure 4: RVT écran de départ

Le menu de navigation détaillé se trouve au paragraphe 3.2

2 Installation

2.1 Que contient ce chapitre?

Ce chapitre décrit la méthode pour monter le régulateur sur le panneau et explique comment réaliser la connexion électrique vers celui-ci. Le schéma électrique est montré au point 2.4.

2.2 Fixation

Veuillez suivre les étapes ci-dessous pour monter le régulateur RVT sur le panneau.

Etape 1 : Introduisez le RVT (a) perpendiculairement dans l'armoire de la batterie automatique (b).

Etape 2 : Tourner le RVT afin de l'insérer dans l'armoire de la batterie automatique

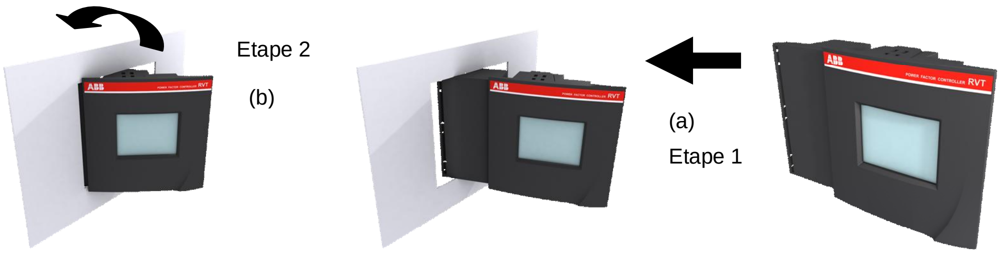


Figure 5: Fixation d'un RVT

Note: les dimensions de découpe sont 138 x 138 mm.

Etape 3 : Insérez la patte de fixation (c) dans les trous de fixation correspondants (d) du RVT.

Etape 4 : Tirez la patte de fixation vers l'arrière.

Etape 5 : Vissez la vis (e) de la patte de fixation et serrez jusqu'à ce que le RVT soit fixé.

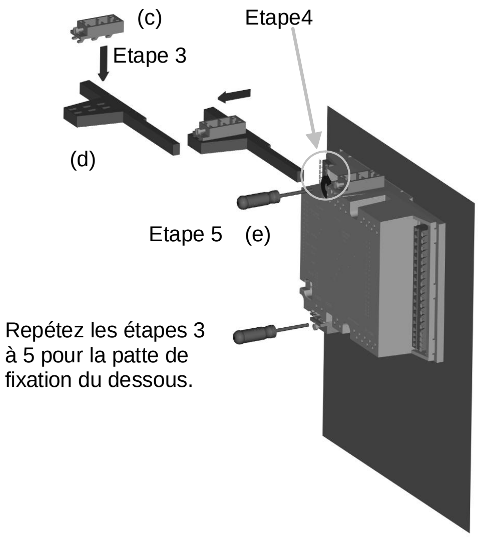


Figure 6: Montage d'un RVT

2.3 Connexion des câbles

Veuillez suivre les instructions ci-dessous pour connecter les câbles aux terminaux à l'arrière du régulateur.

1. Poussez, à l'aide d'un tournevis, sur le levier du connecteur.

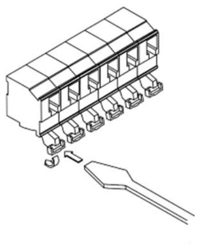


Figure 7: Connexion des câbles

2. Insérez le câble (jusqu'à 2.5 mm² / monobrin) dans le trou du connecteur correspondant tout en maintenant le levier sous pression.

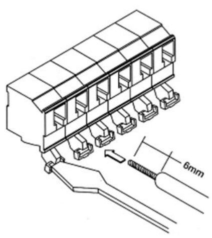


Figure 8: Connexion des câbles

3. Retirez le tournevis.

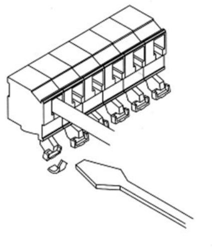


Figure 9: Connexion des câbles

4. Le câble est correctement connecté.

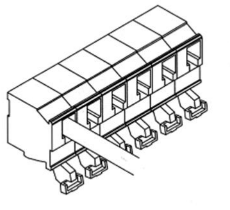


Figure 10: Connexion des câbles

2.4 Schéma électrique

Le schéma électrique montre la connexion des circuits principaux et des circuits de contrôle.

Modèle de base RVT6 / RVT12

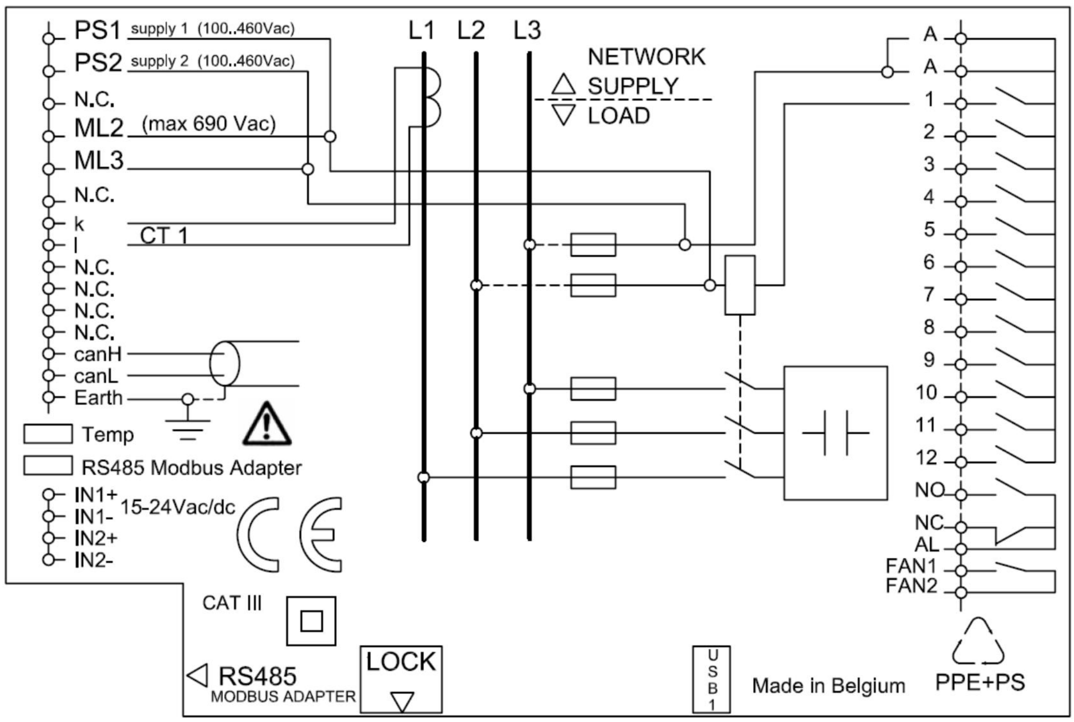


Figure 11: Schéma électrique RVT (modèle de base RVT6 / RVT12)

Modèle triphasé RVT12-3P

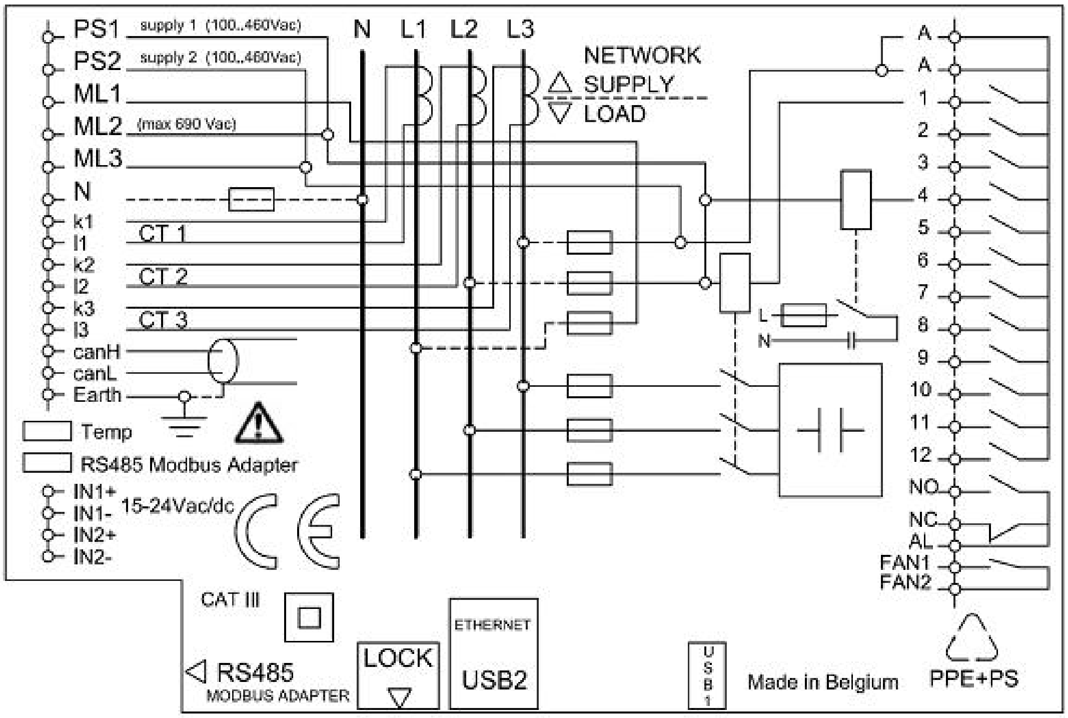


Figure 12: Schéma électrique RVT (modèle triphasé RVT12-3P)

PS1, 2	Alimentation
ML1-3	Mesures
N.C.	Non connecté
N	Connexion au neutre
k1-3, I1-3	Connexion TI
canH, canL	Bus CAN
Earth	Terre
Temp	Connexion sonde de température
RS485 Modbus Adapter	Interface RS485

IN1+/- entrée digitale sélectionnant le cos j cible jour ou nuit

IN2+/- entrée digitale pour l'activation de l'alarme externe

A	Commun des relais de sorties
1-12	Sorties
NO/NC	Contacts de sortie du relais d'alarme
AL	Source commune pour le relais d'alarme
FAN 1-2	Relais de sortie ventilateur/alerte
USB	Connexion USB
RJ45	Ethernet
Verrou	Verrou mécanique

Attention: une protection contre une surintensité est recommandée pour les alimentations PS1-PS2: 6 fusibles 10 X 38 gl 690V

3 Démarrage facile

3.1 Que contient ce chapitre?

Ce chapitre décrit brièvement le démarrage rapide et les procédures de mise en service automatique du régulateur.

3.2 Navigation dans les menus

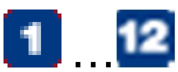
Quand le RVT est alimenté, l'écran de départ est le premier écran qui apparaîtra après le processus de démarrage (durant lequel le logo ABB s'affiche) comme montré dans la Figure 13.

Figure 13: Ecran de départ du RVT

Au centre de l'écran, les quatre boutons (Mesures, Paramètres, Surveil. Batt. et Communication) constituent le menu à quatre niveaux.

Dans le bas de l'écran, la barre de statut montrent les gradins actifs, le statut du verrou du RVT, les alarmes, le moyen de contrôler le RVT (par écran tactile ou par communication), la demande de déclenchement ou d'enclenchement, le mode de fonctionnement : A (mode automatique), M (mode manuel), et S (mode programmation). La légende ci-dessous fournit une description détaillée des icônes de statut.

3.2.1 Légendes des boutons tactiles



Sortie active (fermée) (les sorties inactives ne sont pas indiquées)

Programmation de la batterie verrouillée

Programmation de la batterie déverrouillée

La programmation peut uniquement se faire par communication

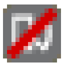

La programmation peut se faire par l'interface utilisateur ou par communication


Alarme température (le relais d'alarme est activé) ou alerte (le relais ventilateur/alerte est activé)


Pas d'alarme température ni d'alerte (les relais d'alarme et ventilateur/alerte ne sont pas activés)

Niveau d'alerte atteint (le relais ventilateur/alerte est activé)


Alarme activée (le relais d'alarme est activé)


Pas d'alarme activée (le relais d'alarme n'est pas activé)


Programmation verrouillée par un bouton mécanique au dos du régulateur


Programmation déverrouillée par un bouton mécanique au dos du régulateur


Demande d'enclencher les gradins


Demande de déclencher les gradins


Pas de demande d'enclencher les gradins

Mode automatique (les gradins sont enclenchés automatiquement en fonction de la programmation)

Mode manuel (les gradins peuvent être enclenchés manuellement)

Mode programmation (la programmation peut être faite)

Changement de mode

Aide en ligne

Fermeture de la fenêtre

Validation


Page suivante

Hormis l'écran de départ, tous les autres écrans du RVT sont constitués de trois parties : la barre de titre en haut, la barre de statut dans le bas et la zone de programmation au milieu de l'écran.

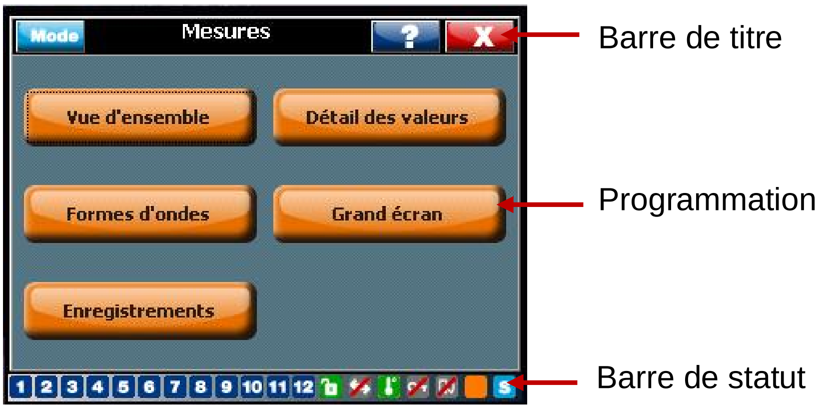


Figure 14: Composition d'un écran RVT

3.2.2 Barre de titre

Dans le coin gauche de la barre de titre, le bouton bleu Mode est utilisé pour passer d'un mode à l'autre du RVT : mode automatique, manuel et programmation. L'écran illustré par la Figure 15 apparaît quand on clique sur le bouton Mode. Quand un mode est activé, par exemple, le mode programmation, une lettre sera indiquée dans le coin inférieur droit de l'écran: le  dans le coin droit de la barre de statut signifie que le mode actuel du RVT est le mode programmation.

Figure 15: Changement de modes RVT

Au milieu de la barre de titre, le texte, comme « Mesures » dans la Figure 14, montre l'écran actuel affiché par l'écran.

En cliquant sur le point d'interrogation  , la partie concernée de l'aide sera affichée pour aider l'opérateur à comprendre et à programmer les paramètres aisément. L'écran suivant apparaîtra après avoir cliqué sur le point d'interrogation de la Figure 15.

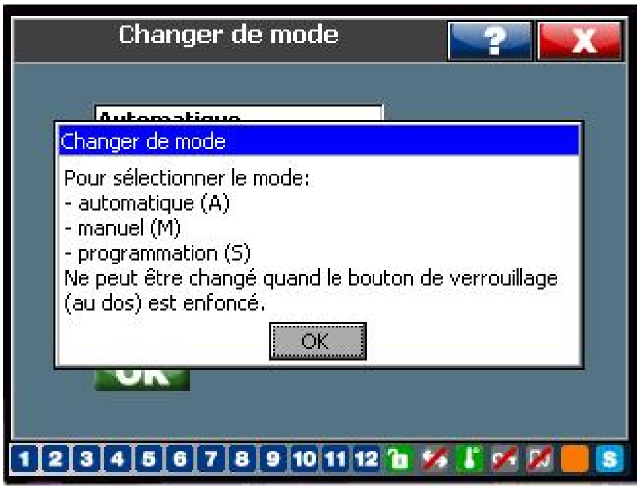


Figure 16: RVT aide

Un clic sur la croix rouge dans le coin droit de la barre de titre fermera la fenêtre active.

Note : le RVT retourne automatiquement en mode AUTO quand aucun bouton n'a plus été touché depuis plus de cinq minutes.

3.2.3 Zone de programmation

La zone de programmation est constituée de champs de boutons, de programmation et d'information. Après la programmation sur le premier écran, il faut cliquer sur le bouton pour valider les paramètres. S'il y a plus de paramètres que ce qui peut être affiché sur un écran, le bouton apparaîtra sur l'écran. Les paramètres suivants s'afficheront après un clic sur ce bouton.

3.2.4 Barre de statut

La barre de statut affiche les gradins actifs et le statut du RVT.

Verrou mécanique ou logiciel

Le RVT a à la fois un verrou mécanique et un verrou logiciel. Un bouton mécanique bleu est situé au dos du régulateur. Quand il est enfoncé, le RVT est verrouillé et l'icône apparaîtra dans la barre de statut dans le bas de l'écran. Quand le bouton est libéré, l'icône deviendra: . Si le RVT est verrouillé, les paramètres du régulateur et de la batterie ne sont pas accessibles et la mise en service (à la fois guidée et automatique) sera désactivée également.

L'icône signifie que les paramètres de la batterie sont verrouillés par le logiciel. L'icône signifie que les paramètres de la batterie sont déverrouillés par le logiciel. Quand le régulateur est verrouillé par le logiciel, tous les paramètres concernant la batterie sont protégés, c'est-à-dire non accessibles.

La description du verrou logiciel se trouve au paragraphe 4.3.1.1.

3.2.5 L'écran clavier

Toutes les données seront entrées grâce à un clavier.

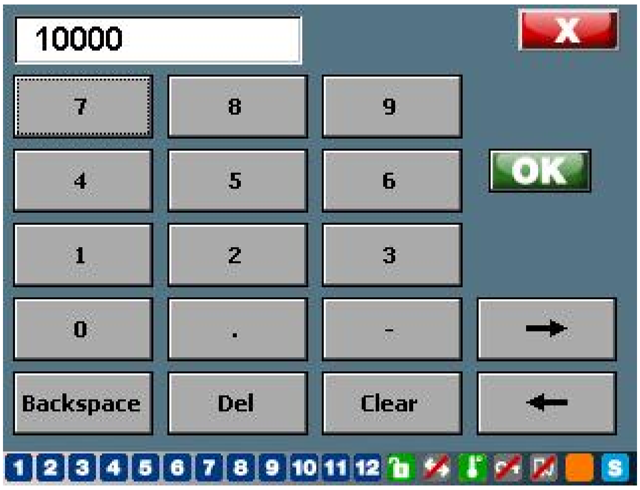
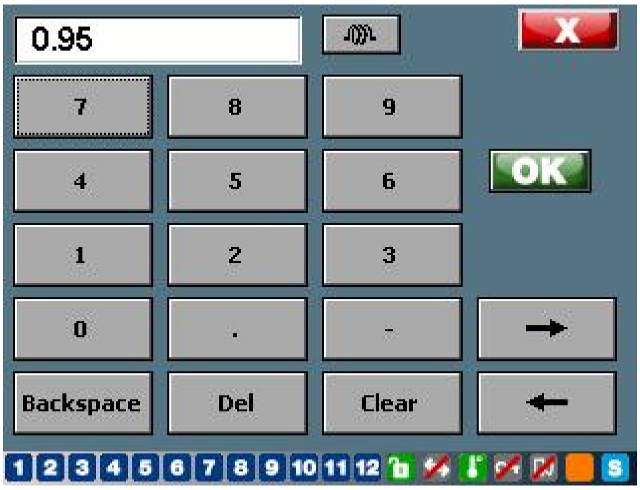


Figure 17: Clavier

Les valeurs Cos j peuvent être entrées avec les symboles  (inductif) ou  (capacitif).



3.3 Mise en route du RVT

Lorsque le RVT est alimenté, l'écran illustré par la Figure 13 s'affiche.

L'écran de départ comporte quatre gros boutons: Mesures, Paramètres, Surveillance batterie et Communication. En touchant un des quatre boutons, le menu du niveau suivant est facilement accessible.

Cinq langues sont actuellement disponibles dans le régulateur RVT: anglais, français, espagnol et chinois. Le chemin suivant vous donnera accès à la sélection des langues : Ecran de démarrage è Communication è Configuration E/S è Modifier langue.

3.4 Mise en service automatique

La mise en service d'un RVT est très facile. La fonction de mise en service automatique aidera l'utilisateur inexpérimenté à démarrer un régulateur rapidement.

3.4.1 Description

Le RVT réalise une mise en service automatique comprenant :

- la reconnaissance automatique :
  - décalage de phase et rotation des phases pour chaque type prédéfini de connexion au réseau
  - du nombre de sorties
  - de la séquence de commutation
- le calcul automatique du C/k., le courant de départ, la description détaillée du C/k se trouve au paragraphe 4.3.1.2.

3.4.2 Préparation de la mise en service automatique

Les paramètres à introduire durant la mise en service automatique sont :

- Type de connexion. Le type de connexion définit la façon dont sont réalisées les connexions du RVT. Il y a au total huit types différents de connexions TI qui dépendent du nombre de mesures de tension et courant et de la manière dont ces TI sont connectés. Une description détaillée du type de connexions se trouve au paragraphe 4.3.1.2.
- Rapport TI: le rapport du TI (par exemple un TI de 250A / 5A a un rapport TI de 50). De plus amples informations sont disponibles au paragraphe 4.3.1.2.
- Cos j cible (voir le paragraphe 4.3.1.3.)

3.4.3 Mise en service automatique

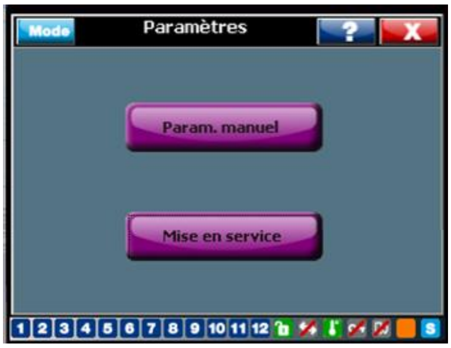
- si le secondaire du TI est court-circuité, n'oubliez pas de l'ouvrir après avoir connecté l'alimentation du régulateur
- si, pour la mesure en tension, un transformateur est utilisé, la valeur du rapport TP doit être adaptée en conséquence (voir paragraphe 4.3.1.)

Note: lorsque l'icône  (verrou mécanique) apparaît dans la barre de statut dans le bas de l'écran, cela signifie que le RVT est verrouillé. L'accès au mode SET est refusé et la mise en service ne peut pas être réalisée tant que le RVT n'est pas déverrouillé (voir description au paragraphe 4.3.1.1.).

Les écrans suivants illustrent comment se déroule une mise en service automatique typique.

1. Ecran de départ, clic sur “Paramètres”:

2. Clic sur “Mise en service”:



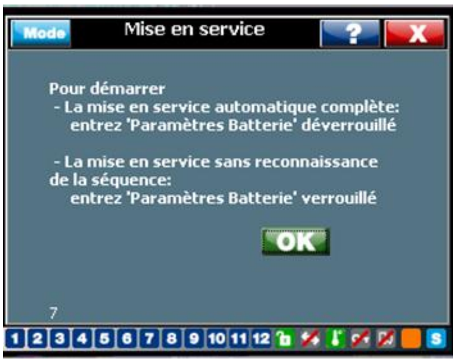
3. Clic sur “Automatique”:

4. Clic sur OK:

5. Clic OK:

6. Sélectionner le type de connexion (voir annexe 7):

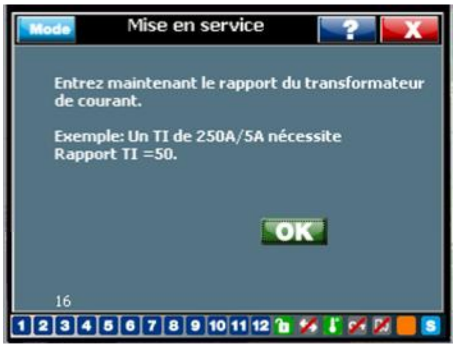
7. Clic OK:



8. Verrouiller ou déverrouiller les paramètres batterie – OK:

9. Clic OK:

10. Clic OK:



11. Rapport TI: 50:

12. Clic OK:

13. Clic OK:

14. Clic OK:

15. Clic OK:

16. Clic OK:

17. Clic OK:

18. Clic OK:

19. Clic OK:

20. Clic OK:

21. Mise en service automatique terminée:

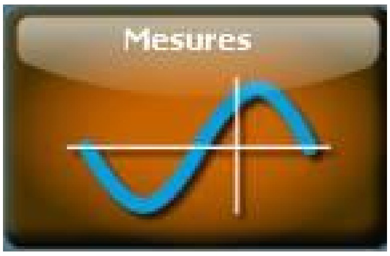
La procédure ci-dessus illustre une mise en service automatique caractéristique. Certains réglages comme le rapport du TI et le type de connexion peuvent différer des entrées
ci-dessus pour chaque installation. En cas d'erreur durant la mise en service automatique, l'aide guidera l'utilisateur pour identifier les causes et terminer la mise en service.

4 Mesures et programmation

4.1 Que contient ce chapitre?

Ce chapitre décrit tous les menus/sous-menus concernant les mesures, les paramètres, la surveillance de la batterie et les réglages de communications, etc.

4.2 Mesures



Ce menu principal permet à l'utilisateur de voir différents paramètres comme la tension, le courant, la puissance, la température. Cinq sous-menus sont inclus dans ce menu principal: Vue d'ensemble, Détail des valeurs, Formes d'ondes, Grand écran et Enregistrements.

Le RVT est très puissant en ce qui concerne les mesures et polyvalent en ce qui concerne leur affichage. Toutes les mesures peuvent être affichées sous forme de tableau. Pour les mesures en forme d'onde comme la tension et le courant, un affichage graphique est aussi disponible. Un affichage sous forme de spectre est fourni pour les mesures d'harmoniques.

Vue d'ensemble

Le sous-menu Vue d'ensemble donne la liste complète de toutes les mesures.

Détail des valeurs

Mesures du réseau comme la tension, le courant, la puissance, la température et l'énergie. Pour les modèles triphasés RVT12-3P, le détail des valeurs est disponible pour chaque phase également, par exemple le facteur de puissance pour la phase 1, 2 et 3.

Formes d'ondes

La tension du système et le courant (phase à phase ou phase à neutre) peuvent être affichées sous la forme d'une onde sinusoïdale.

Enregistrements

Ce sous-menu permet à l'utilisateur de voir les valeurs extrêmes de certains paramètres clés.

Grand écran

Cette fonction offre la possibilité à l'utilisateur de comparer les trois mesures les plus concernées en un écran. Par exemple, la tension des trois phases peut être affichée sur un écran avec une résolution et une vue meilleure. Des instructions détaillées de cette fonction se trouvent au paragraphe 4.2.4.

4.2.1 Vue d'ensemble

Détails de toutes les mesures disponibles dans le RVT:

Table 1: Vue d'ensemble des mesures

Désignation	Unité	Description			
Tension			Plage de mesure	Précision	Valeur max.
Vrms	V	Tension Rms	Jusqu'à 690Vac	± 1 %	10^6 V
V1	V	Tension Rms à la fréquence fondamentale	Jusqu'à 690Vac	± 1 %	10^6 V
Fréquence	Hz	Fréquence fondamentale	45Hz - 65Hz	± 0.5%	45Hz - 75 Hz
THDV	%	Distorsion harmonique totale de la tension	0 - 300%	± 1 %	1000 %
Tableau d'harm. V		Harmoniques en tension affichés dans un tableau	2ème – 49ème	Voir plus loin dans ce paragraphe	
Spectre d'harm.V		Harmoniques en tension affichés sous forme de spectre	2ème – 49ème	Voir plus loin dans ce paragraphe	
Courant			Plage de mesure	Précision	Valeur max.
Irms	A	Courant Rms	0 - 5 A	± 1 %	10^6 A
I1	A	Courant Rms à la fréquence fondamentale	0 - 5 A	± 1 %	10^6 A
THDI	%	Distorsion harmonique totale du courant	0 - 300%	± 1 %	1000%
Tableau d'harm.I		Harmoniques en courant affichés dans un tableau	2ème – 49ème	Voir plus loin dans ce paragraphe	
Spectre d'harm.I		Harmoniques en courant affichés sous forme de spectre	2ème – 49ème	Voir plus loin dans ce paragraphe	
Puissance			Plage de mesure	Précision	Valeur max.
Cos j		Facteur de déplacement de puissance	-1 è +1	± 0.02	-1 è +1

PF		Facteur de puissance	-1 è +1	± 0.02	-1 è +1
P	W	Puissance active	-10^9 è 10^9 W	± 2%	-10^9 è 10^9 W
Q	var	Puissance réactive	-10^9 è 10^9 var	± 2%	-10^9 è 10^9 var
S	VA	Puissance apparente	0 è 10^9 VA	± 2%	0 è 10^9 VA
Q manquant	var	Puissance manquante pour atteindre le cos j d'alarme préprogrammé	0 è 10^9 var	± 2%	0 è 10^9 var
Gradins manquants		Gradins manquants pour atteindre le cos j d'alarme préprogrammé			
Température (optionnel)			Plage de mesure	Précision	Valeur max.
T1-T8	°C/°F	Température T1-T8 (sonde de température externe jusqu'à 8 max.)	-40°C è +105°C	± 1°C	-40°C è + 150°C
Energies			Plage de mesure	Précision	Valeur max.
Energie active fournie	kWh	Energie active fournie vers le réseau	0 è 10^{12}	± 3%	0 è 10^{12}
Energie active consommée	kWh	Energie active consommée par la charge	0 è 10^{12}	± 3%	0 è 10^{12}
Energie active totale	kWh	Somme de l'énergie active fournie et consommée	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
Energie réactive inductive	kvarh	Energie réactive inductive	0 è 10^{12}	± 3%	0 è 10^{12}
Energie réactive capacitive	kvarh	Energie réactive capacitive	0 è 10^{12}	± 3%	0 è 10^{12}
Energie réactive totale	kvarh	Somme de l'énergie inductive et capacitive	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
Energie apparente totale	kVAh	Somme de l'énergie active et réactive	0 è 10^{12}	± 3%	0 è 10^{12}

NOTE:

- Toutes les mesures sont moyennées sur une seconde.
- Si un transformateur est utilisé pour la mesure de la tension, la précision des mesures des harmoniques en tension peut-être affectée par l'effet de filtre du transformateur.

  L'utilisation d'un transformateur de qualité minimisera cette erreur.

  (1) la plage de mesure doit être multipliée par le rapport TC (Irms - I1 - P - Q - S - Q manquants) et le rapport TP (Vrms - V1 - P - Q - S - Q manquants).

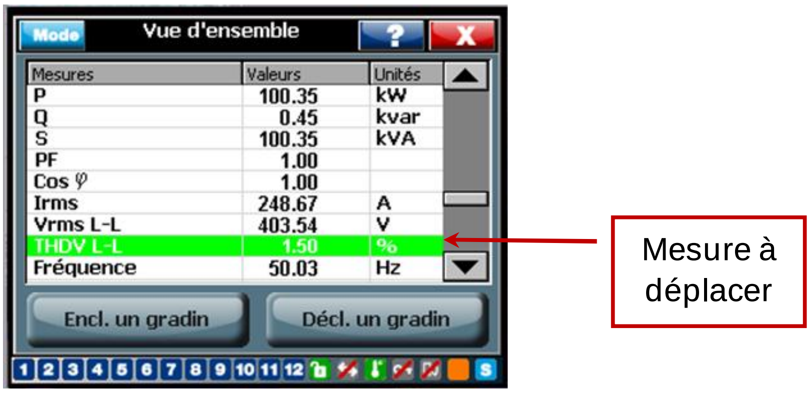
(2) Facteur de déplacement de puissance ou cos j : calcul basé sur la valeur fondamentale des mesures. Cette valeur est utilisée comme la valeur de référence par les compagnies de distribution d'électricité.

(3) Facteur de puissance: calcul basé sur les valeurs fondamentales et composantes harmoniques des mesures. Le facteur de puissance est toujours inférieur ou égal au facteur de déplacement de puissance.

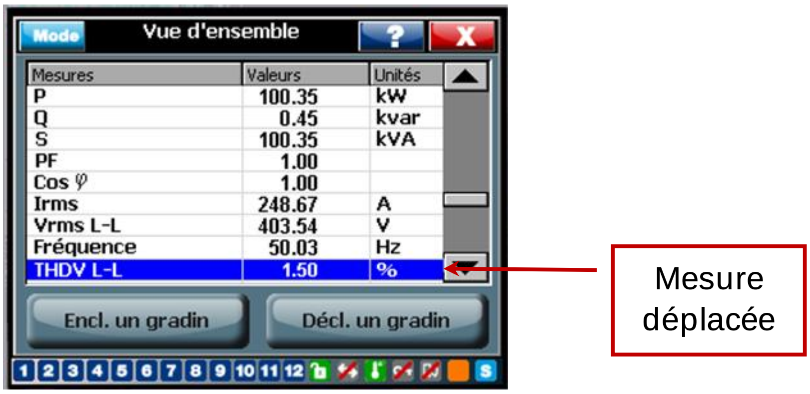
Le menu Vue d'ensemble affiche toutes les mesures dans une liste.

L'utilisateur peut personnaliser l'affichage des mesures selon ses besoins particuliers simplement en déplaçant les mesures importantes de la liste à la position souhaitée.

Il suffit de cliquer sur la mesure à déplacer (dans l'exemple ci-dessous, le THDV L-L est sélectionné).



Ensuite, cliquer sur la position où la mesure doit être déplacée (dans l'exemple ci-dessous le THDV L-L est placé à la place de la fréquence, qui est déplacée automatiquement juste en-dessous dans la liste).



Le menu Vue d'ensemble est aussi un menu où il est possible d'enclencher et déclencher manuellement certains gradins. Activer le mode « Manuel » en cliquant sur le bouton « Mode ».

Ensuite, les boutons "Encl. un gradin et Décl. un gradin » sont activés.

Cliquer sur ces boutons pour enclencher/déclencher les gradins manuellement.

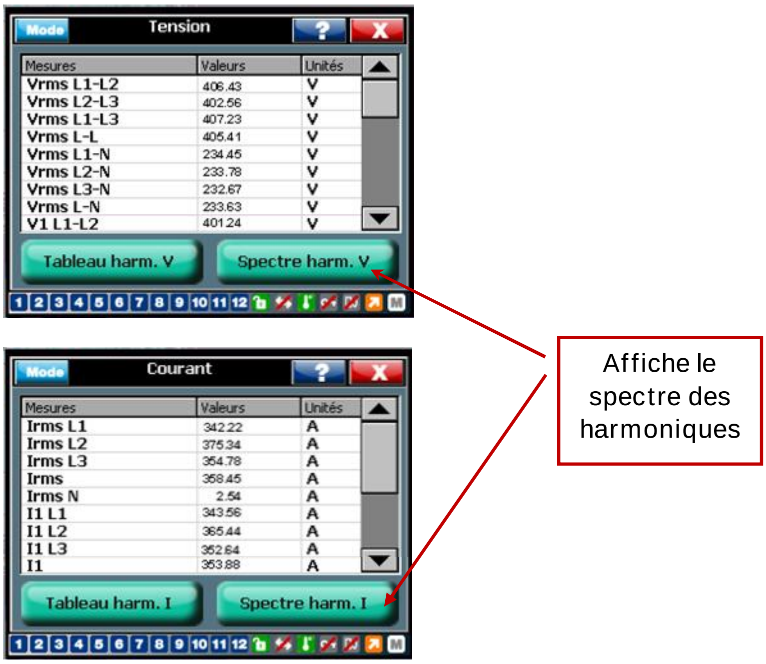
Note: le modèle RVT12-3P activera un nouvel écran demandant quel type de gradin doit être (dés)activé. Les différences entre ces gradins se trouvent au paragraphe 4.3.1.1.

4.2.2 Détail des valeurs

Le menu Détail des valeurs affiche toutes les valeurs mesurées classées par type comme illustré dans la Figure 18. Pour le modèle triphasé RVT12-3P, le détail des valeurs de chaque phase est également inclus.

Figure 18: Détail des valeurs

Mesure de la tension (courant)



Spectre et tableau du courant d'harmonique

La tension et le courant harmoniques peuvent être illustrés sous forme de spectre comme ci-dessous. Une barre de défilement permet de sélectionner une harmonique spécifique à afficher au-dessus de l'écran: l'ordre de l'harmonique, la valeur et le pourcentage en Fondamental.

Pour les valeurs de tension et de courant, le RVT est capable d'afficher la tension et le courant harmonique sous forme de tableau ou de spectre. Cliquer sur le bouton « Sélection » pour choisir quelles mesures seront affichées dans le tableau ou le spectre d'harmonique.

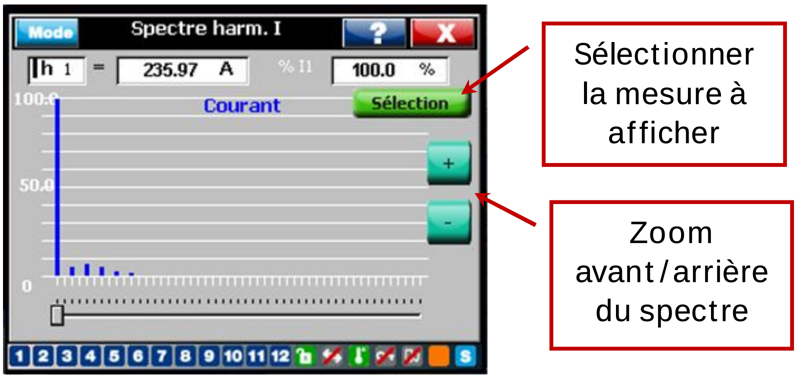


Figure 19: Spectre d'harmoniques en tension

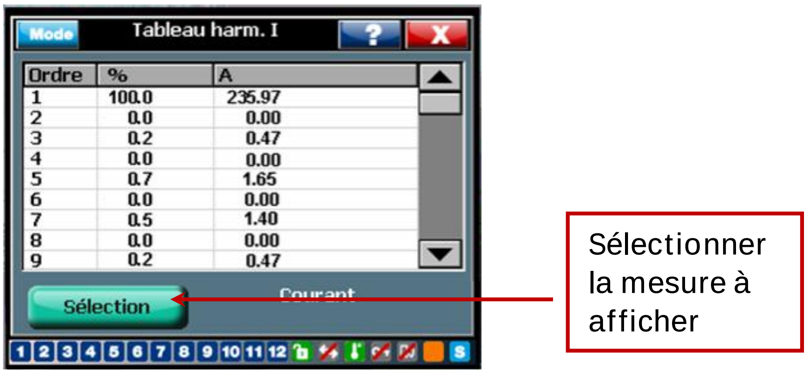
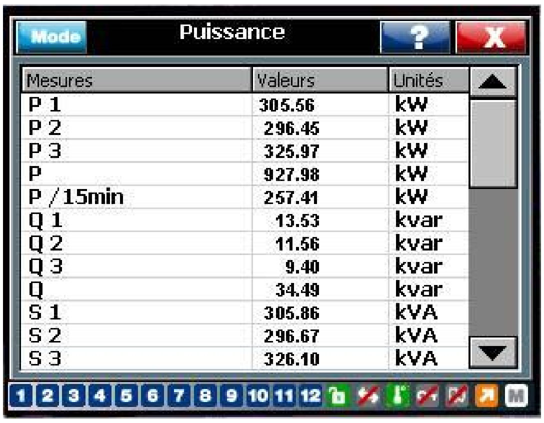
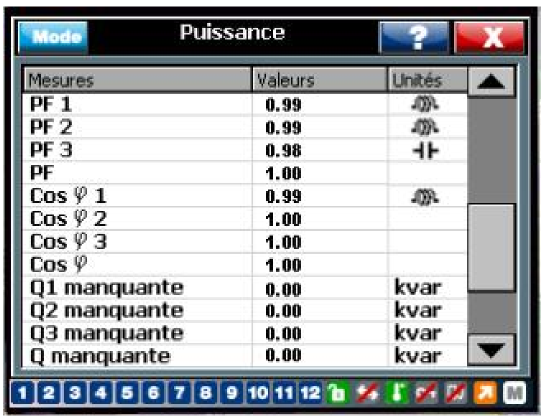


Figure 20: Tableau d'harmoniques en tension

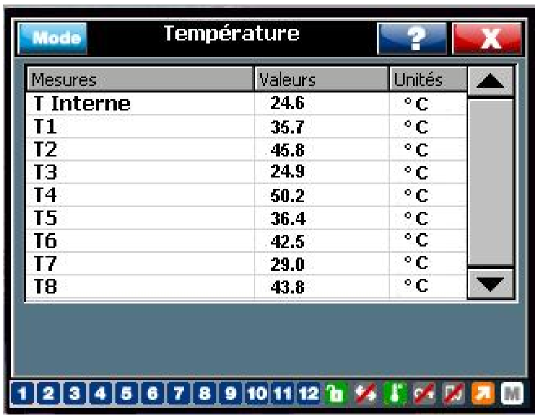
Note: précision des mesures des harmoniques en tension et en courant: ± 1 % de Vrms (Irms).

Mesures de puissance, du facteur de puissance

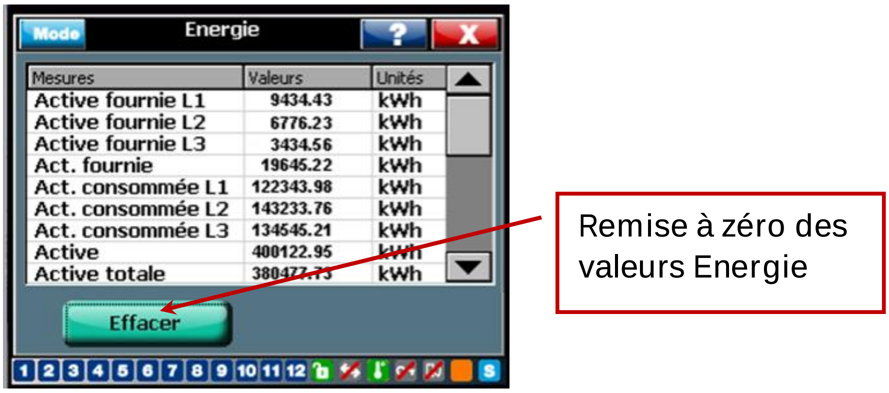




Mesures de température



Mesures d'énergie



Les mesures d'énergie sont seulement disponibles sur le RVT12-3P (le modèle triphasé est équipé d'une horloge en temps réel).

Les valeurs Energie peuvent être mises à 0.

4.2.3 Formes d'ondes

La tension disponible et les signaux de courant (selon le type de RVT et de connexion utilisée) peuvent être affichés sur l'écran sous forme d'ondes. La Figure 21 illustre la forme d'onde entre la ligne et le neutre.

Figure 21: Ondes de tension et de courant

4.2.4 Grand écran

Cette fonction permet à l'utilisateur d'avoir une meilleure vue des trois mesures les plus intéressantes.

Cliquer sur la mesure souhaitée et ensuite cliquer sur le bouton « Sélectionner » pour insérer les valeurs dans le menu ‘Grand écran’.

L’exemple ci-dessous montre trois mesures importantes.

Figure 22: Trois mesures affichées dans Enregistrements

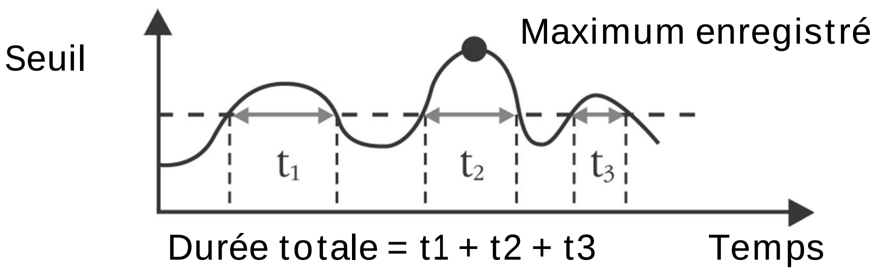
4.2.5 Enregistrements

Description

La fonction “Enregistrements” permet d’enregistrer, pour chaque paramètre significatif mesuré (voir liste ci-après) et depuis la dernière réinitialisation:

- la valeur maximale (ou minimale)
- la durée au-dessus (ou au-dessous) du seuil.

Dès qu’un seuil a été atteint (voir l’exemple ci-dessous.), le RVT commence à enregistrer la valeur maximale (ou minimale) automatiquement ainsi que la durée totale jusqu’à ce qu’une réinitialisation soit effectuée



Valeurs enregistrées

La fonction enregistrement permet d’enregistrer la durée totale pendant laquelle une valeur mesurée dépasse un seuil ainsi que la valeur maximale atteinte pour les paramètres suivants : Vrms [V], Irms [A], P [kW], Q [kvar], S [kVA], THDV [%], THDI [%], Q manquante [kvar], fréquence* [Hz], T1* [°C or °F] à T8* [°C or °F].

* Valeurs minimales et durée sous un seuil sont aussi enregistrées pour la mesure de la fréquence et de la température.

Figure 23: Enregistrement des valeurs

Exemple
Enregistrement d'information sur le Vrms.
Tension du réseau: 400V.

Figure 24: Enregistrement du seuil - Vrms

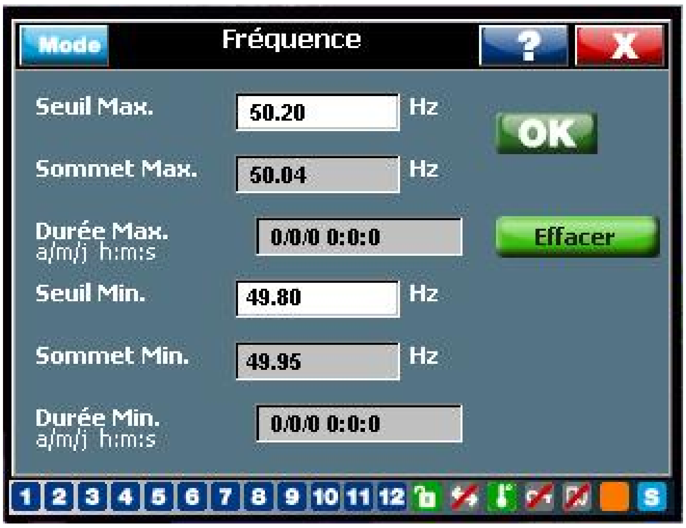
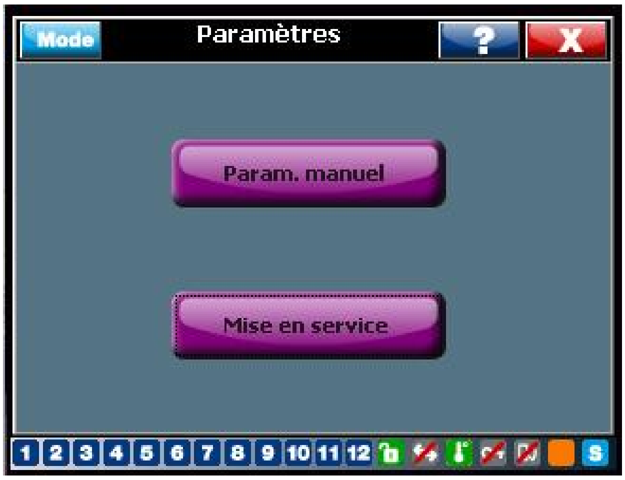


Figure 25: Enregistrement du seuil - Fréquence

Les informations enregistrées (valeur maximale et durée totale) peuvent être mises à zéro en sélectionnant et validant le bouton « Effacer ».

4.3 Paramètres

Le menu principal Paramètres possède plusieurs sous-menus permettant à l'utilisateur de programmer le régulateur mais aussi de réaliser la mise en service ou les tests.



4.3.1 Programmation manuelle (Set Mode)

La programmation manuelle permet à l'utilisateur d'accéder à tous les paramètres de la batterie, de l'installation, de l'utilisateur et de protection. L'utilisateur peut retrouver la programmation de départ à partir de ce sous-menu.

Figure 26: Paramètres manuels

Avant de programmer le régulateur, veillez à le mettre en mode SET. Veuillez-vous référez au 3.2.4 et au 4.3.1.1. pour la programmation des modes du régulateur et pour le verrouillage / déverrouillage.

4.3.1.1 Programmation de la batterie

Départ â paramètres â param. manuel â param. batterie

Le menu Param. Batterie comprend tous les paramètres relatifs à la batterie.

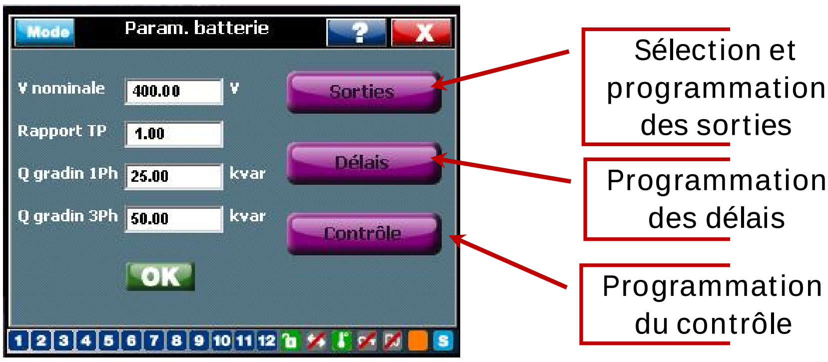


Figure 27: Programmation de la batterie

Voici la liste des paramètres de programmation de la batterie.

V nominale: tension nominale de la batterie.

Lorsqu'une valeur de Vnominale est introduite, les seuils de protections de sous-tension et de surtension sont automatiquement mis à 80% et à 120% de Vnominale. La valeur de ces seuils peut être modifiée manuellement, si nécessaire.

Rapport TP: rapport du transformateur de tension externe (pour la mesure en tension)

Exemples : pour un transformateur 15kV / 100V, rapport TP = 150.

si aucun transformateur de tension n'est utilisé, rapport TP = 1.

Cette fonction permet au RVT de contrôler une batterie de condensateurs moyenne tension. Un transformateur de tension adéquat devra être connecté aux terminaux de mesures du RVT. Le RVT affichera les mesures en moyenne tension.

Q gradin 1Ph: le plus petit gradin pour les condensateurs monophasés (phase-neutre) qui sont utilisés pour la correction du facteur de puissance d'une phase individuelle dans un réseau non-équilibré.

Q gradin 3ph: le plus petit gradin pour les condensateurs triphasés dans un réseau équilibré.

Pour les deux programmations ci-dessous,

a) Après la mise en service automatique, cette valeur sera programmée en fonction du plus petit gradin dans la batterie.

b) Pour la mise en service Guidée (voir 4.3.2.2), cette valeur doit être programmée manuellement.

Par exemple, dans une batterie qui a à la fois une correction du facteur de puissance monophasée (3 gradins) et triphasée (3 gradins):

Séquence monophasée*: 1 (5kvar) 2 (10kvar) 2 (10kvar) è Q gradin 1ph = 5 kvar

Séquence triphasée: 1 (10kvar) 2 (20kvar) 2 (20kvar) è Q gradin 3ph = 10 kvar

Ou,

Séquence triphasée: 2 (15kvar) 4 (30kvar) 5 (37.5kvar) è Q gradin = 7.5 kvar

*Séquence: valeur relative de la puissance réactive des condensateurs connectés aux sorties du RVT. Ces valeurs relatives sont comprises entre 0 et 8.

Pour les modèles de base RVT6/RVT12 et le modèle triphasé RVT12-3P, la valeur par défaut est 1:1:….:1. Une séquence personnalisée peut être introduite manuellement.

Pour personnaliser une séquence, naviguer dans le menu comme ci-dessous :

Départ â paramètres â param. manuel â param. Batterie â Sorties

La Figure 28 montre les sorties 1 - 6, cliquer sur la flèche , l'écran suivant affichera les sorties restantes 7-12 comme illustré dans la Figure 29.

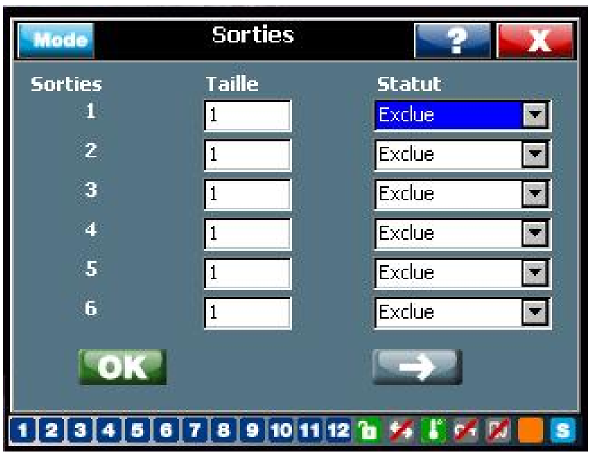


Figure 28: Sorties 1-6 RVT

Figure 29: Sorties 7-12 RVT (modèle triphasé RVT12-3P)

A la droite de l'écran, le "Statut" comprend six possibilités pour chaque sortie:

"Exclue": la sortie est désactivée (programmation par défaut);

"Fixe": la sortie est activée (le condensateur correspondant est toujours connecté);

"1PhL1, 1Phl2, 1PhL3": cette sortie contrôle un condensateur monophasé, qui est connecté aux phases 1, 2 ou 3 respectivement.

"3Ph": cette sortie contrôle un condensateur triphasé.

Pour le modèle de base RVT6/RVT12, seuls les statuts "Exclue, Fixe et Activé" sont disponibles. Une sortie doit être mise en "Activé" avant que le régulateur n'enclenche/déclenche un condensateur.

Quelques programmations de sorties courantes pour le modèle triphasé RVT12-3P:

Programmation 1: 12 gradins de condensateurs monophasés (phase-neutre):

Figure 30: Programmation courante de sortie 12 x 1ph (modèle triphasé RVT12-3P)

Programmation 2: 6 gradins de condensateurs triphasés + 6 gradins de condensateurs monophasés (phase-neutre) :

Figure 31: Programmation courante de sortie 6 x 3ph + 6 x 1ph (modèle triphasé RVT12-3P)

Délais

Après avoir cliqué sur le bouton “Délais” sur l’écran illustré par la Figure 27, l’utilisateur peut programmer les délais d’enclenchement / déclenchement de la batterie dans l’écran suivant.

Figure 32: programmation des délais du RVT

Délai encl:

- en commutation de type normal, c’est le temps entre la demande d’enclenchement d’un gradin et le déclenchement effectif.
- en commutation de type intégral, c’est le temps d’intégration entre deux décisions d’enclenchement.

Le délai d’enclenchement est nécessaire afin de permettre la décharge des condensateurs avant de les enclencher.

Attention: un délai trop court pourrait endommager la batterie.

Délai décl. :

- en commutation de type normal, c'est le temps entre la demande de déclenchement d'un gradin et le déclenchement effectif.
- en commutation de type intégral, le délai de déclenchement n'est pas utilisé.

Délai init. : le temps que le RVT attend avant le redémarrage de la batterie, suite à une mise hors tension

En cliquant sur le bouton « Contrôle » comme montré sur la Figure 27, l'utilisateur peut programmer les mesures de TI et la façon dont la batterie va commuter.

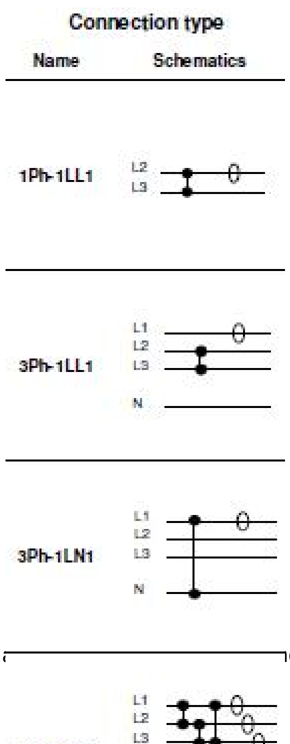
Figure 33: Programmation du contrôle de la batterie

1Ph/3Ph

Cette programmation définit le type de connexion des mesures de courant. Le RVT offre 8 différentes possibilités de connexions des TI basées sur le type de réseau (réseau triphasé trois fils, réseau triphasé quatre fils ou réseau monophasé (phase-phase)):

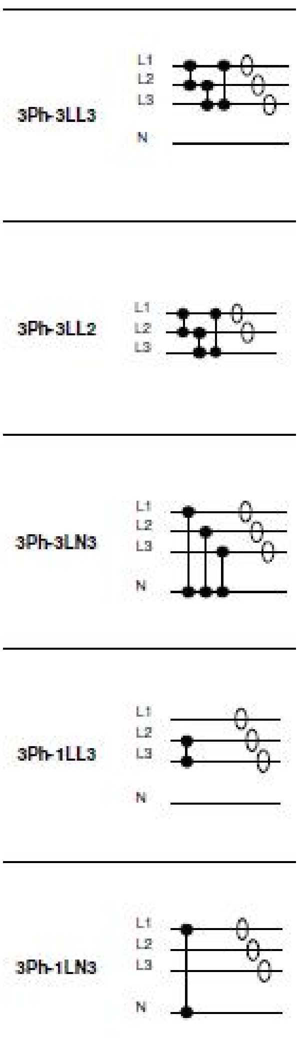
Mesures de courant une phase (disponible pour les deux modèles RVT6/12 et RVT12-3P):

1Ph-1LL1, 3Ph-1LL1, 3Ph-1LN1,



Mesures de courant triphasé (disponible seulement pour le modèle triphasé RVT12-3P):

3Ph-3LL3, 3Ph-3LL2 (pas de neutre connecté dans l'installation), 3Ph-3LN3, 3Ph-1LL3, 3Ph-1LN3.



Les instructions détaillées sur la connexion se trouvent en annexe A7. Type de connexion TI et câblage des TI sur les terminaux du régulateur à la fin du manuel.

Définition des types de connexions ci-dessus:

3Ph – 3 LN 3

1: une connexion TI, 2 : deux connexions TI, 3: trois connexions TI

LN: mesure de tension entre L et N, mesures de tension entre les phases

1: une mesure de tension, 3: trois mesures de tension

1Ph: réseau monophasé (L-N ou L-L), 3Ph: réseau triphasé

NOTE: L concerne la ligne, N concerne le neutre

Linéaire / Circulaire (Lin./Circul. sur l'écran)

La commutation linéaire suit le principe d'enclenchement/déclenchement "premier entré, dernier sorti".

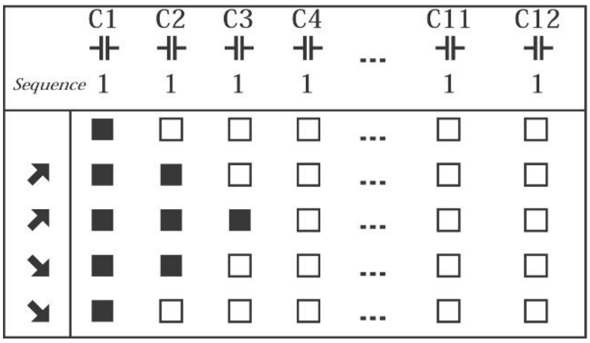
La commutation circulaire suit le principe d'enclenchement/déclenchement "premier entré, premier sorti".

Les deux principes sont décrits dans la table suivante.

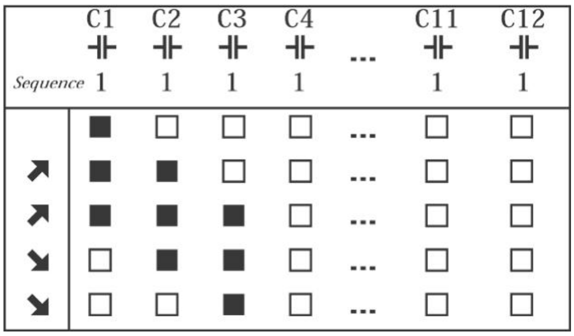
La commutation circulaire augmente la durée de vie des condensateurs et des contacteurs en répartissant les contraintes entre toutes les sorties.

En cas de double "premier gradin" (1:1:2:2:..., 1:1:2:4:4...), la commutation circulaire s'applique aux deux premières sorties et aussi aux sorties de plus haute valeur.

Linéaire



Circulaire



ì Demande pour l'ajout d'un gradin

î Demande pour l'enlèvement d'un gradin

n Sortie fermée

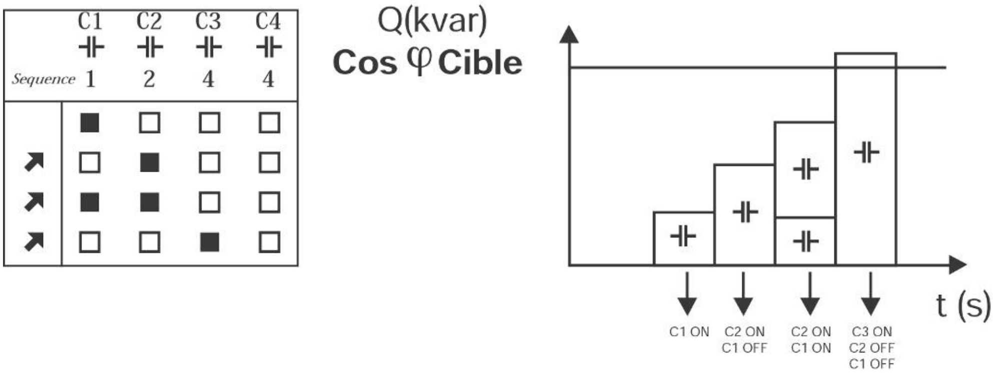
o Sortie ouverte

Progressive / Directe (Prog./Direct sur l'écran)

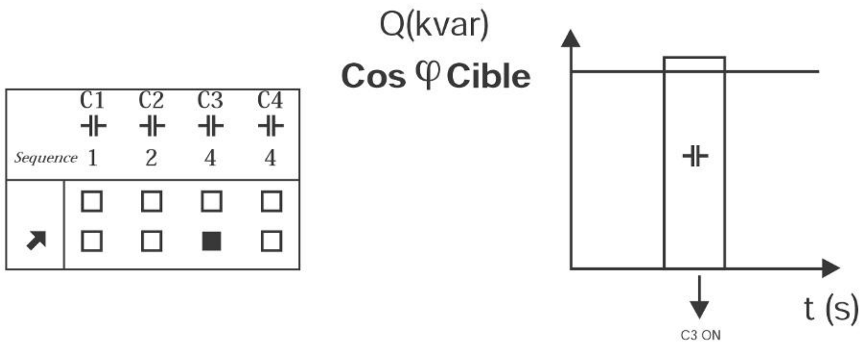
La commutation de type progressive enclenche et déclenche les gradins séquentiellement un par un, sur base de la valeur du délai d'enclenchement.

La commutation de type directe enclenche les plus grands gradins en premier lieu ensuite les autres gradins avec un délai fixe de 12s afin d'atteindre le cos j cible plus rapidement.
Elle permet d'éviter des enclenchements intermédiaires inutiles.

Progressive



Directe

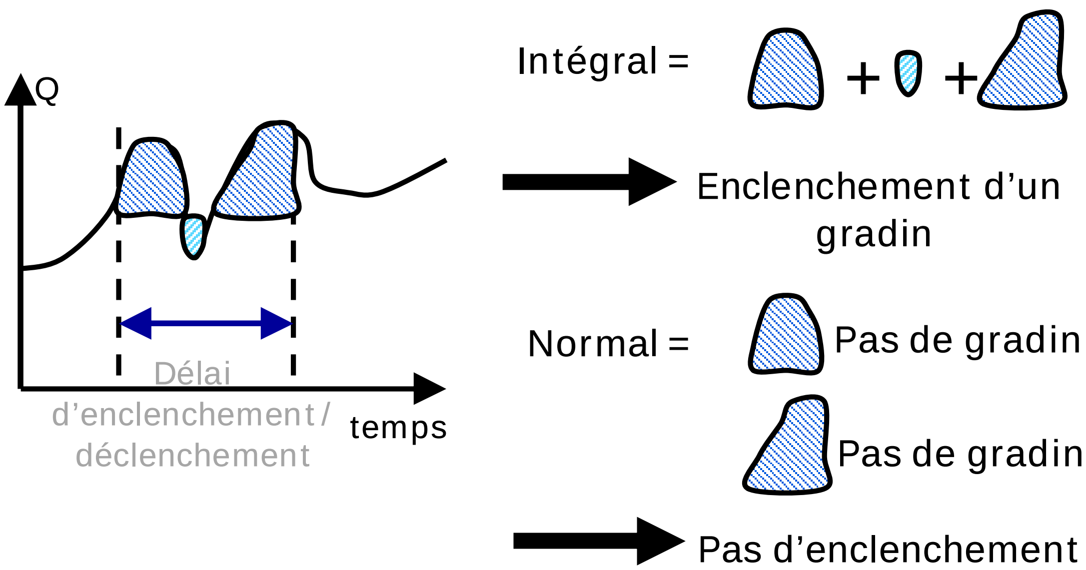


Normale / Intégrale (Normal/Int. sur l'écran)

La commutation de type normal : enclenche les gradins lorsque la demande est continuellement présente durant tout le délai d'enclenchement.

La commutation de type intégral : enclenche les gradins en fonction de la valeur moyenne de la puissance réactive demandée.

Ce type de commutation est nécessaire pour les applications où la charge varie rapidement.



Protection de la programmation batterie (verrou logiciel)

La programmation de la batterie peut être protégée contre les accès non-autorisés à la fois mécaniquement et informatiquement. La protection mécanique est décrite au 3.2.4. L'écran suivant illustre comment fonctionne le verrou logiciel. Le chemin vers l'écran est illustré par la Figure 34:

Départ â Paramètres â Param. manuel â Param. batterie â Contrôle.

Figure 34: Protection de la programmation batterie: non protégé

Pour verrouiller la programmation batterie, cocher le "Param. Batt. déverrouillé", ensuite l'écran illustré dans la Figure 35 s'affiche.

1. Les champs de programmation batterie deviennent gris
2. "Param. Batt. déverrouillé" devient "Param. Batt. verrouillé"
3. Dans la barre de statut, l'icône de verrou logiciel est activée: 

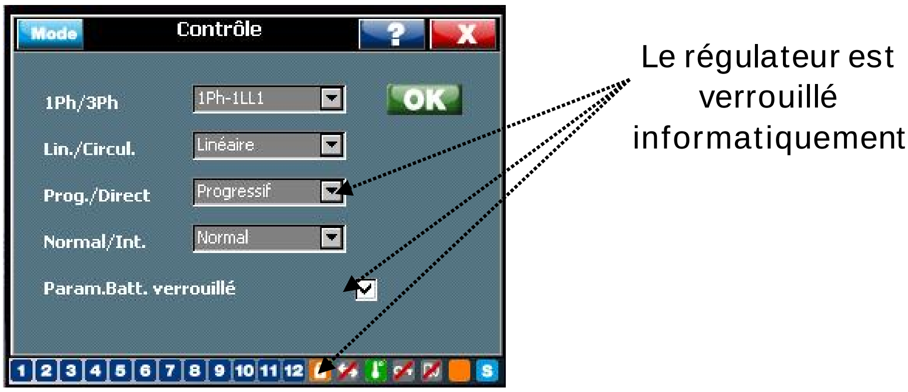


Figure 35: Protection de la programmation batterie: protégé

4.3.1.2 Paramètres d'installation

Départ â Paramètres â Param. manuel â Param. instal.

Les paramètres d'installation du RVT donnent les instructions permettant de programmer les paramètres des TI.

Figure 36: Paramètre d'installation du RVT

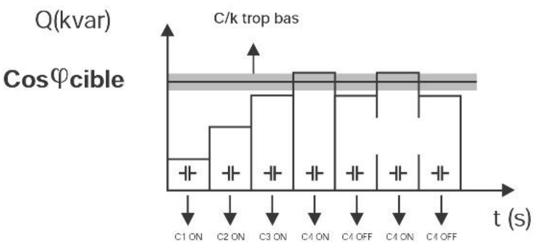
Rapport TI: rapport du transformateur de courant.

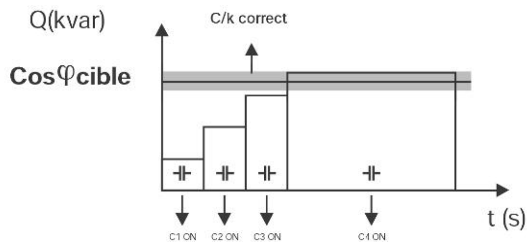
Exemple: un TI de 250A / 5A a un rapport TI de 50.

C/k : courant de démarrage du régulateur RVT. Il est usuellement fixé à une valeur égale au 2/3 du courant du gradin (Qgradin) (voir paragraphe 4.3.1.1).

Il représente la valeur du seuil en courant pour que le RVT enclenche ou déclenche un gradin. La valeur du C/k peut être programmée de 0.01 à 5.

L'exemple suivant montre l'effet d'une valeur de C/k trop basse ayant pour conséquence des commutations inutiles:





Une valeur trop élevée du C/k conduira à l'enclenchement insuffisant de gradins afin d'atteindre le cos j cible.

La valeur recommandée du C/k peut être calculée par la formule suivante ou peut être lue dans le tableau ci-après.

Formule

Réseau triphasé

$$C/k = 0.67\ x \frac{Qgradin\ x\ 1000}{\sqrt{3}\ x\ Vnom\ x\ rapport\ TC}$$

Réseau monophasé

$$C/k = 0.67\ x \frac{Qgradin\ x\ 1000}{Vnom\ x\ rapport\ TC}$$

Table 2: Tableau des valeurs C/k pour un système triphasé à 400V

Rapport TC		K	Valeur du gradin (kvar)											
			5	10	15	20	30	40	50	60	70	90	100	120
10/1	50/5	10	0.48	0.97	1.45	1.93	2.90	3.87	4.84					
20/1	100/5	20	0.24	0.48	0.73	0.97	1.45	1.93	2.42	2.90	3.38	4.35	4.84	
30/1	150/5	30	0.16	0.32	0.48	0.64	0.97	1.29	1.61	1.93	2.26	2.90	3.22	3.87
40/1	200/5	40	0.12	0.24	0.36	0.48	0.73	0.97	1.21	1.45	1.69	2.18	2.42	2.90
60/1	300/5	60	0.08	0.16	0.24	0.32	0.48	0.64	0.81	0.97	1.13	1.45	1.61	1.93
80/1	400/5	80	0.06	0.12	0.12	0.24	0.36	0.48	0.60	0.73	0.85	1.09	1.21	1.45
100/1	500/5	100	0.05	0.10	0.15	0.19	0.29	0.39	0.48	0.58	0.68	0.87	0.97	1.16
120/1	600/5	120	0.04	0.08	0.12	0.16	0.24	0.32	0.40	0.48	0.56	0.73	0.81	0.97
160/1	800/5	160	0.03	0.06	0.09	0.12	0.18	0.24	0.30	0.36	0.42	0.54	0.60	0.73
200/1	1000/5	200	0.02	0.05	0.07	0.10	0.15	0.19	0.24	0.29	0.34	0.44	0.48	0.58
300/1	1500/5	300	0.02	0.03	0.05	0.06	0.10	0.13	0.16	0.19	0.23	0.29	0.30	0.39
400/1	2000/5	400	0.01	0.02	0.04	0.05	0.07	0.10	0.12	0.15	0.17	0.22	0.23	0.29
600/1	3000/5	600	0.01	0.02	0.02	0.03	0.05	0.06	0.08	0.10	0.11	0.15	0.15	0.19

Note:

Pour RVT12-3P, deux valeurs C/k sont disponibles: C/k 1ph et C/k 3ph; le RVT6/RVT12 a une seule valeur C/k disponible.

La valeur C/k 3ph (ou C/k) est applicable pour les installations avec une, deux ou trois TC (réseau triphasé équilibré); la valeur C/k 1ph est applicable pour les installations avec trois TCs (réseau triphasé non-équilibré). On suppose que, pour un réseau triphasé non-équilibré, un C/k 1ph unique est utilisé pour trois gradins monophasés individuels.

On suppose que tous les TCs connectés au RVT12-3P (deux ou trois TCs avec des types de connexions différents) ont le même rapport. Cependant, le gradin minimal pour le condensateur monophasé et pour le condensateur triphasé peut être différent; cela entraîne deux valeurs de TC différentes pour le RVT.

Déphasage (applicable au modèle de base seulement): déphasage entre la tension et le courant introduit par la connexion de mesure.

Si le RVT est connecté comme indiqué sur le schéma électrique décrit au paragraphe 2.4, la valeur du déphasage est de 90° (valeur par défaut).
Pour d’autres connexions, la valeur du déphasage à programmer peut être sélectionnée sur base des schémas de l’annexe A6.

Veuillez noter que le RVT peut adapter automatiquement le déphasage lors de la mise en service automatique.

4.3.1.3 Paramètres de l’utilisateur

Départ â Paramètres â Param. manuel â Param. utilisat.

Les paramètres utilisateur permettent à l'utilisateur de programmer les différentes cibles de facteur de puissance et les délais des alarmes.

Figure 37: Paramètres utilisateur du RVT

Cos j cible: facteur de déplacement de puissance cible.

La valeur du cos j cible entrée peut être comprise entre 0.70 inductif et 0.70 capacitif.

indique un cos j inductif et indique un cos j capacitif.

Cos j nuit: facteur de déplacement de puissance cible secondaire (désactivé par défaut).

Le basculement du cos j cible au cos j nuit cible est réalisé en appliquant un signal sur l'entrée externe Opto1 du RVT (voir paragraphe 2.4.).

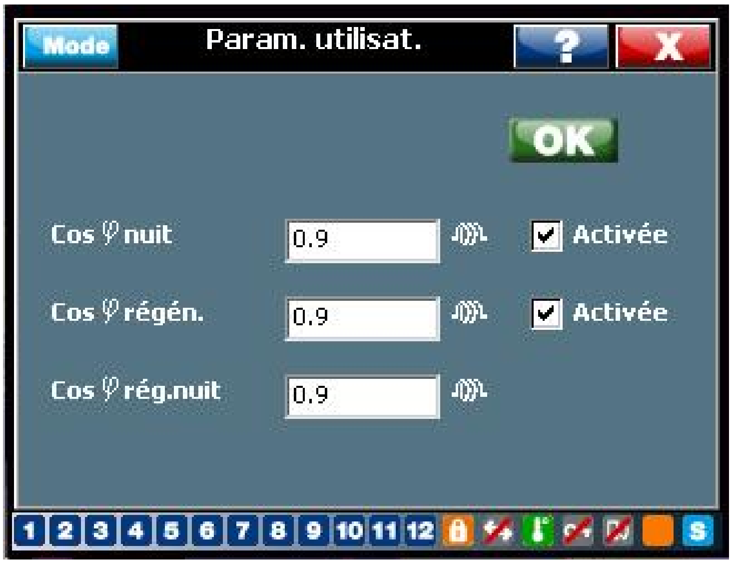


Figure 38: paramètres utilisateur du RVT: activation du facteur de puissance nuit et régén.

Cos j régen. : facteur de déplacement de puissance cible alternatif, activé lorsque le flux de puissance est inversé: P < 0. (Désactivé par défaut).

Alarme: Les paramètres relatifs au cos j alarme sont décrits ci-dessous. :
La condition d'alarme sur le cos j est remplie lorsque : tous les gradins sont enclenchés et que la valeur réelle du cos j est inférieure au seuil d'alarme cos j de telle sorte qu'au moins un gradin est nécessaire.

- Délai d'alarme: délai entre l'apparition de la condition d'alarme relative au cos j et la fermeture effective du contact d'alarme.
- Dél.fin alarme: délai entre la disparition de la condition d'alarme relative au cos j et l'ouverture du contact d'alarme.
- Cos j alarme : valeur du seuil

4.3.1.4 Protections et alertes

Départ â Paramètres â Param. manuel â Protect./Alertes

Le RVT activera certains mécanismes quand des valeurs du système dépasseront certains seuils. Le niveau des protections est plus sévère que celui des alertes.

Figure 39: programmation des protections et alertes du RVT

4.3.1.4.1 Protections

Figure 40: Programmation des protections du RVT

Seuils de protection : pour entrer les seuils de protection de sous-tension, de surtension, de taux d'harmoniques prohibitifs, de températures et pour rendre possible une alarme externe initiée par l'entrée 2 opto isolée. Le relais alarme fournit un contact NO et un contact NC.

Dès qu'un seuil de protection est atteint, les actions suivantes se produisent:

- tous les gradins sont déclenchés
- un message d'alarme apparait sur l'écran graphique
- le contact d'alarme s'ouvre (NO ouvert / NC fermé)
- l'icône  est allumée

Note: si le signal externe IN2 (description au paragraphe 2.4.) est activé, tous les gradins des condensateurs sont désactivés et le paramètre Ext. Prot. conditionne le comportement du relais d'alarme:

- Déconnexion et alarme
- Déconnexion seulement (pas d'alarme)

Lorsque l'événement a disparu, le RVT redémarre son fonctionnement normal après un certain délai.
Ce délai dépend du type d'événements. La procédure de redémarrage du RVT est décrite en détail dans l'annexe A4.

Note: lorsque l'item "prot. Externe" est activée, une protection externe peut être activée en appliquant un signal au travers de l'entrée externe 2 du RVT (voir paragraphe 1.4.)

4.3.1.4.2 Alertes

Le niveau d'alertes est plus bas que le niveau de protections. Quand un niveau d'alerte est atteint, les actions suivantes vont se produire:

- le relais ventilateur/alerte est activé: le contact NO se fermera
- l'icône  est allumée

Figure 41: programmation des alertes du RVT

4.3.1.4.3 Protections température

Le RVT fournit 8 protections de température de la batterie grâce à 8 sondes de température. Chaque niveau de protection de la sonde de température peut être programmé individuellement. Quand un de ces huit niveaux de protection de température est atteint :

- tous les gradins sont déclenchés
- un message d’alarme apparait sur l’écran graphique
- le contact d’alarme s’ouvre (NO ouvert / NC fermé)
- les icônes  et  sont allumées

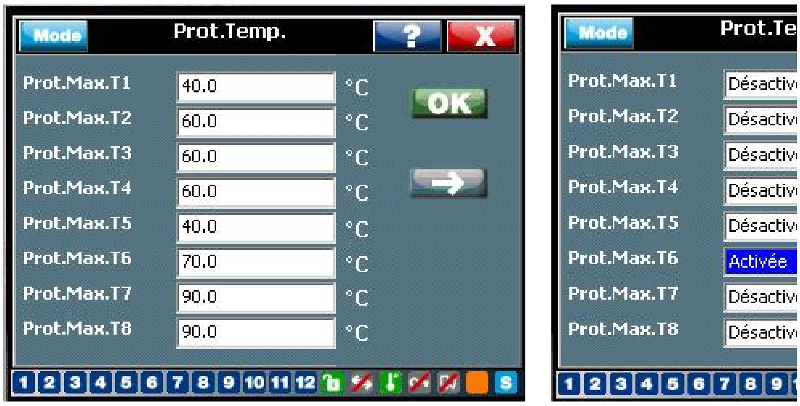


Figure 42: programmation des protections température du RVT

4.3.1.4.4Alertes température

Le RVT fournit 8 protections de température de la batterie grâce à 8 sondes de température. Chaque niveau de protection de la sonde de température peut être programmé individuellement. Quand un de ces huit niveaux de protection de température est atteint :

- le relais ventilateur / auxiliaire est activé: le contact NO se fermera
- l’icône  est allumée

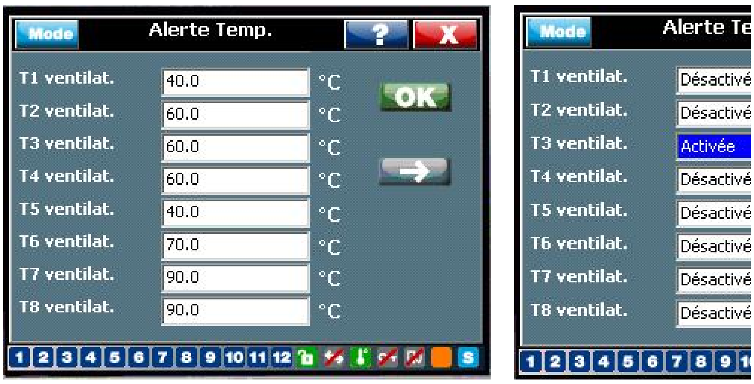


Figure 43: programmation des alarmes température du RVT

Note 1 : le RVT est auto-protégé contre une sur-température interne de 85°C. Les actions décrites ci-dessus se produisent quand la température interne dépasse le niveau de protection.

Le RVT redémarre automatiquement lorsque la température interne redescend sous 80°C.

Note 2 : la protection contre les sur-températures est désactivée par défaut. Lorsqu'un seuil est entré, le RVT vérifie les connexions des 8 sondes.

4.3.1.5 Restitution des valeurs par défaut

Départ â Paramètres â Param. manuel â Restit.par défaut

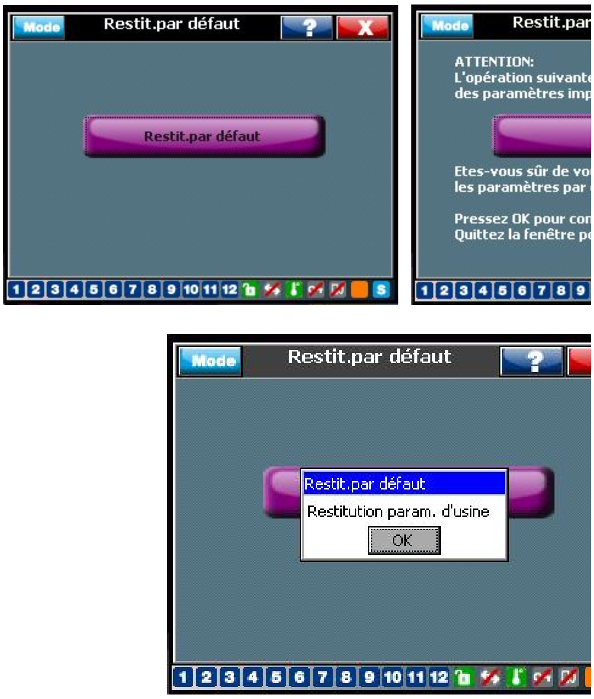


Figure 44: restitution des paramètres par défaut du RVT

En sélectionnant et validant l'item "Restit.par défaut", toutes les valeurs des paramètres du RVT sont réinitialisées à leur valeur par défaut (d'usine – voir le document séparé de ce manuel accompagnant le RVT), excepté si l'item "Param. batt." est verrouillé, auquel cas, les paramètres de la batterie ne sont pas modifiés.

Attention: des paramètres importants peuvent être perdus.

Remarque: avant de restituer les paramètres à leurs valeurs par défaut, veuillez-vous assurer que:

- le RVT est non verrouillé (description aux paragraphes 3.2.4 et 4.3.1.1)
- le RVT est en mode programmation (SET) (description au paragraphe 3.2.2.)

4.3.2 Mise en service (mode SET)

Ce sous-menu permet à l'utilisateur de faire une mise en service automatique complète ou une mise en service guidée du régulateur.

4.3.2.1 Mise en service automatique

Voir la section 3.4 pour plus d'informations.

4.3.2.2 Mise en service guidée

Le RVT Le RVT propose une mise en service guidée. Les paramètres suivants doivent être encodés (voir le tableau ci-dessous)

Note:

Avant de réaliser une mise en service guidée, veuillez-vous assurer que:

1. le RVT est déverrouillé (description aux paragraphes 3.2.4 et 4.3.1.1)
2. le RVT est en mode programmation (SET) (description au paragraphe 3.2.2.)
3. si le secondaire du TC est court-circuité, n'oubliez pas de l'ouvrir après avoir connecté l'alimentation du régulateur de facteur de puissance.

Paramètres (à régler) de la mise en service guidée

Paramètres	Description
1Ph / 3Ph	Type de connexion de la batterie et type de connexion de la mesure en tension.
Rotation de phase	Vérifier la rotation de phase
Rapport TP	Rapport du transformateur de tension externe.
Redirection des TP	Rediriger les entrées TP en cas de TP placées sur la mauvaise phase
Déphasage	Déphasage entre la tension et le courant introduit par les connexions de mesure. Le déphasage est de 90° (par défaut) lorsque le RVT est connecté comme indiqué sur le schéma électrique (voir paragraphe 2.4). Pour les autres types de connexion, veuillez-vous référer à l'annexe A5.

Rapport de transformateur	Rapport du transformateur de tension externe
V nominale	Tension nominale de la batterie.
Délai encl. Délai décl.	Délai d'enclenchement / déclenchement des gradins.
Séquence	Valeur relative de la puissance réactive connectée à chaque sortie.
Q gradin	Plus petite différence de puissance réactive entre les gradins.
C/k	Programmer le courant de départ
Cos j cible	Facteur de déplacement de puissance cible.

4.3.2.3 Mise en service des sondes de température

Le RVT peut connecter jusqu'à huit sondes de température connectées à la suite l'une de l'autre. Chaque sonde doit être mise en service selon la procédure suivante avant de pouvoir être utilisée.

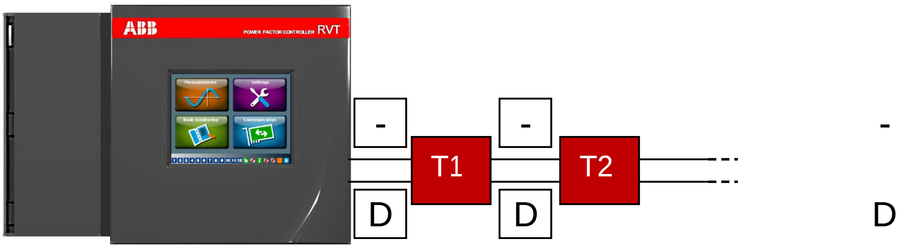
Chaque sonde doit être reconnue individuellement:

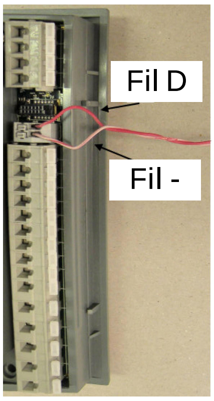
- Connecter la sonde à l'entrée « sonde de température » du RVT
- Cliquer sur la ligne pour assigner un numéro de sonde
- Cliquer sur le bouton de départ
- Le RVT reconnaît automatiquement l'adresse de la sonde
- Recommencer la même procédure pour chaque sonde

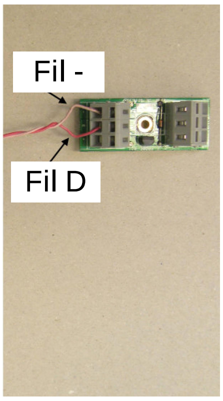
Quand une des sondes a un problème, on peut le solutionner en cliquant sur le bouton effacer. Une adresse unique sera assignée à chaque sonde activée une fois la reconnaissance terminée.

Figure 45: Auto-reconnaissance de la sonde de température

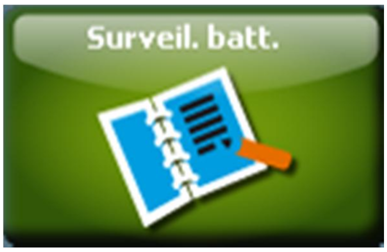
- connecter chaque sonde successivement







4.4 Surveillance batterie

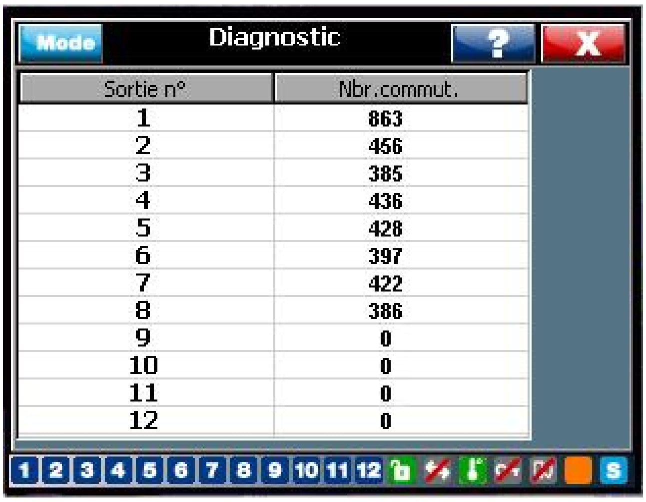


La surveillance batterie du RVT donne à l'utilisateur l'accès au diagnostic, aux alarmes enregistrées, à la fonction de test et à l'horloge. Cela en fait un outil de diagnostic très utile.

Figure 46: Surveillance batterie

4.4.1 Diagnostic

C'est la liste du nombre d'opérations de chaque contact depuis la fabrication du RVT.



Sortie n°	Nbr.commut.
1	863
2	456
3	385
4	436
5	428
6	397
7	422
8	386
9	0
10	0
11	0
12	0

Figure 47: Diagnostic

4.4.2 Fonction test

Ce sous-menu permet à l'utilisateur de tester chaque contact du RVT.

Test alarme: permet de tester le contact d'alarme

Test ventilat: permet de tester le contact du ventilateur

Test sorties: permet de tester chaque contact de sortie condensateur (le RVT tiendra compte des délais d'enclenchement et déclenchement programmés)

Figure 48: Fonction test

Figure 49: Test des sorties

Cliquer sur les cases pour enclencher / déclencher les contacts correspondants

Avant de procéder à la fonction de test, assurez-vous que:

- le RVT est déverrouillé (description aux paragraphes 3.2.4 et 4.3.1.1)
- le RVT est en mode SET mode (description au paragraphe 3.2.2.)

4.4.3 Alarmes enregistrées

L'enregistrement des alarmes affiche les cinq derniers messages d'alarmes et le temps écoulé depuis leur apparition.

Figure 50: Enregistrement des alarmes

4.4.4 Horloge

Figure 51: Horloge du RVT

L'horloge continue à fonctionner même quand le RVT n'est plus alimenté.

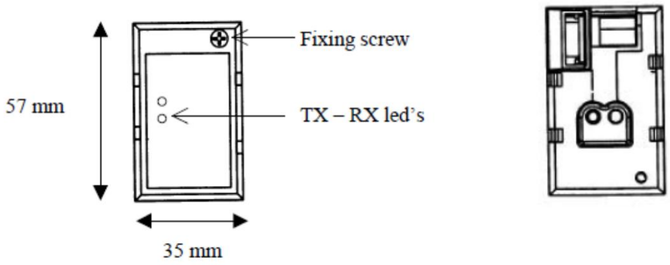
4.5 Communication

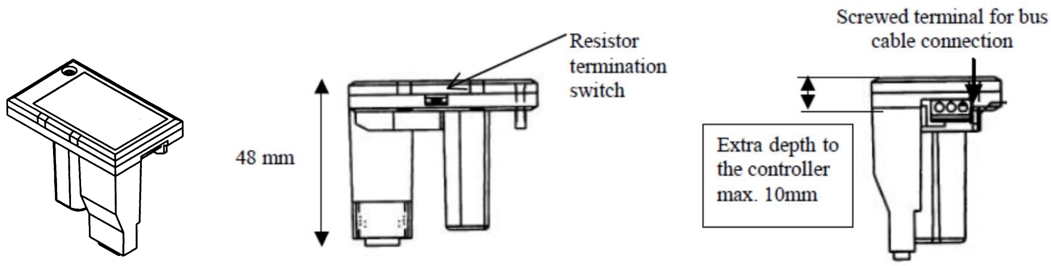
Le RVT fournit plusieurs méthodes de communication. Ce menu comprend la configuration des langues, de l'unité de température, de l'écran, de l'Ethernet et du Modbus. De plus amples informations concernant le Modbus, l'USB, le protocole TCP/IP et la programmation se trouvent dans le manuel: 2GCS213013A0050_RVT communication through Modbus, USB or TCPIP protocol.

RS485 / Adaptateur Modbus

L'adaptateur Modbus est un appareil en option du régulateur RVT qui permet la connexion du RVT à un système Modbus RS485. Le régulateur est considéré comme un esclave dans le réseau Modbus.

Référez-vous au manuel 2GCS214013A0050-RVT Modbus RS485 adapter-User guide pour de plus amples informations sur l'adaptateur Modbus RS485.





Attention: l'adaptateur Modbus RS485 est celui avec un texte de couleur VERT (alimentation 3.3V). Celui avec un texte de couleur BLANC est réservé aux anciens modèles (alimentation 5V).

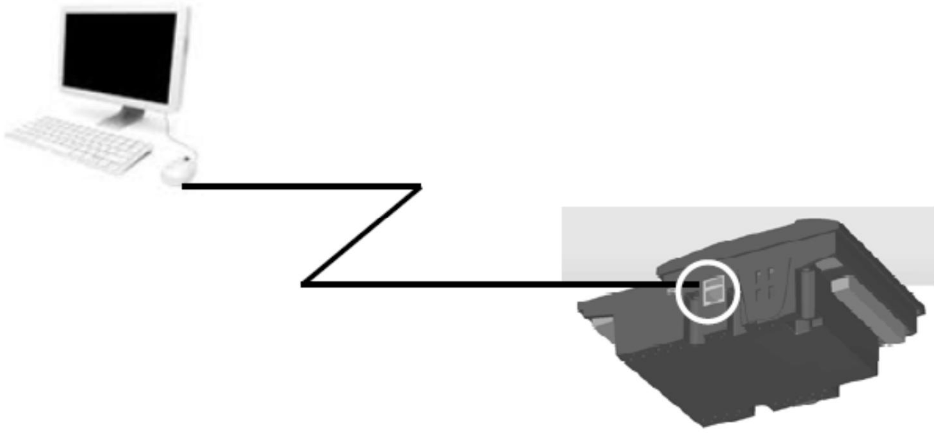
Cela signifie que le nouvel adaptateur Modbus n'est pas compatible avec l'ancien RVT. Le vieil adaptateur Modbus ne peut pas être connecté au nouvel RVT (avec écran tactile).

Ethernet / TCP/IP

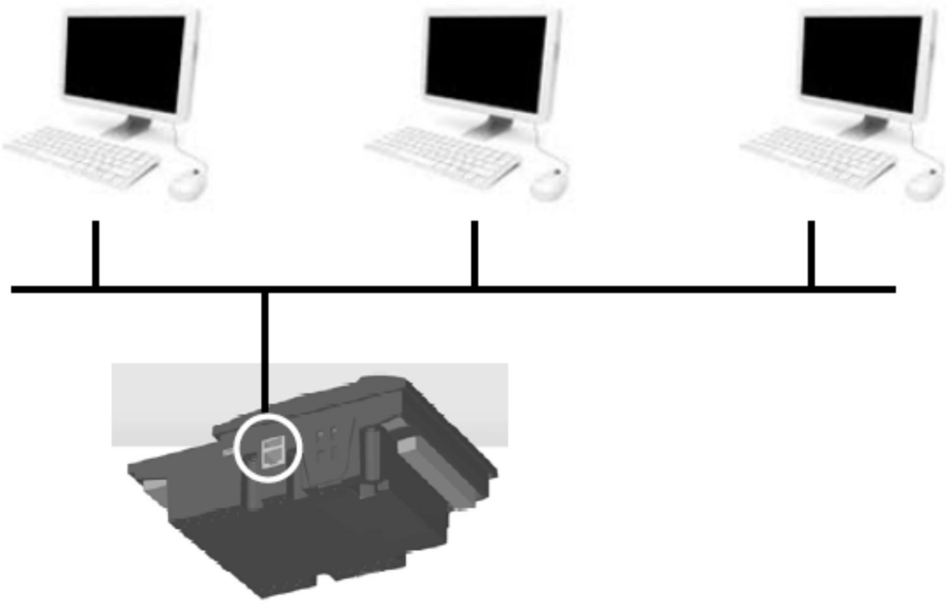
Les connexions TCP/IP peuvent être initiées soit localement soit à distance.

Le port TCP utilisé par défaut est 4250.

La connexion au RVT est un câble Ethernet RJ45 Cat5e.



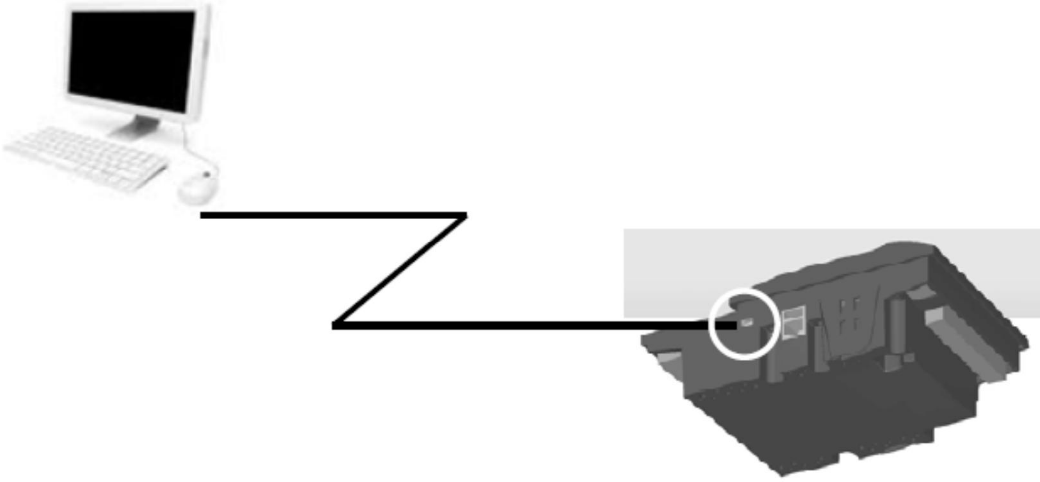
Le RVT peut être connecté directement à un LAN ou par internet.



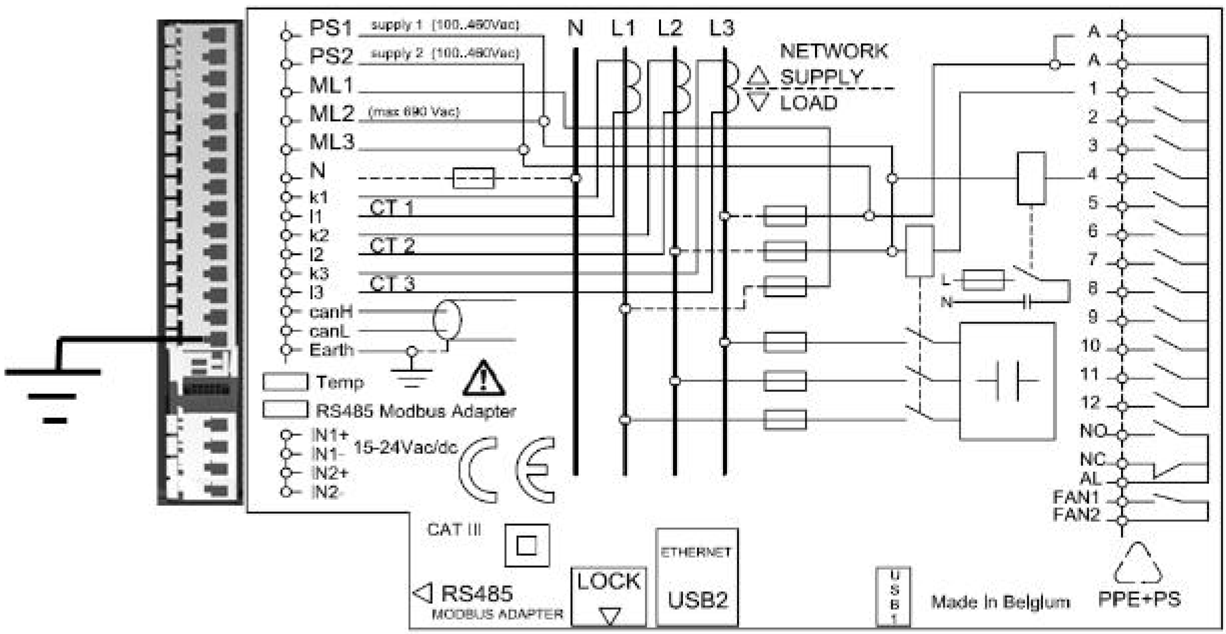
USB

L'interface USB sert à présenter le RVT comme une interface en série sur son port USB.

L'ordinateur est connecté au moyen d'un USB-A mâle à un USB-Mini B mâle.



ATTENTION: La connexion USB du RVT n’est pas isolée. Il est obligatoire de connecter la terre quand on utilise l’USB.



4.5.1 Configuration Entrée/Sortie

Figure 52: Configuration E/S du RVT

4.5.1.1 Modification des langues

Cinq différentes langues peuvent être sélectionnées pour dialoguer avec le RVT.

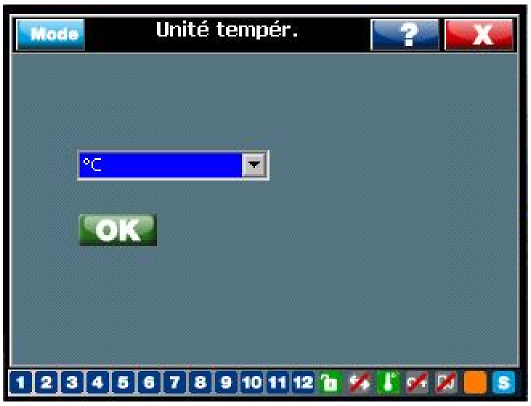
L'utilisateur doit revenir à l'écran de départ pour que la langue sélectionnée soit activée

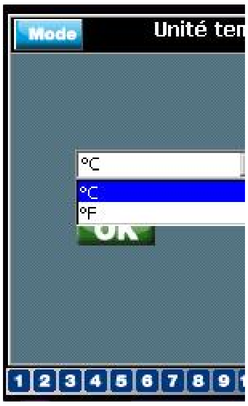
Figure 53: Sélection des langues du RVT

4.5.1.2 Unité de température

Ce menu fournit deux unités de température: Celsius et Fahrenheit.

L'unité sélectionnée sera applicable dans toutes les autres mesures ou programmations de température.





4.5.1.3 Paramètres de communication

Les connexions Modbus et Ethernet doivent être configurées pour fonctionner correctement.

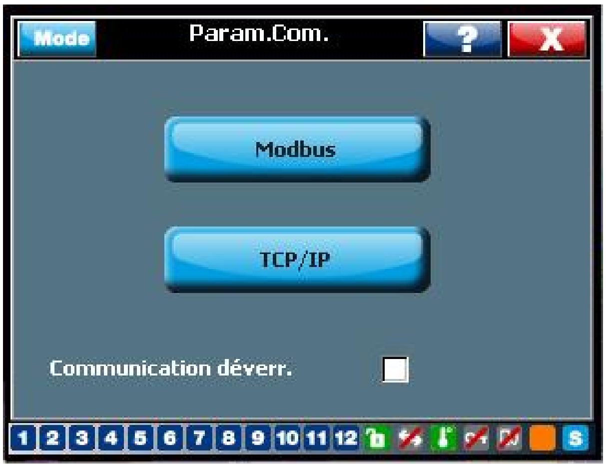


Figure 54: Programmation du protocole de communication du RVT

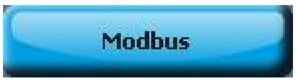


Figure 55: Programmation du protocole Modbus du RVT

L'adresse de l'esclave est celle utilisée par le maître Modbus pour communiquer avec le RVT.

Le débit en Bauds, la parité, le bit d'arrêt devront correspondre exactement aux paramètres de communication du maître Modbus qui contrôle le réseau Modbus/RS485.

Le RVT a besoin d'une adresse IP pour se connecter directement à un PC ou à un réseau Ethernet.

L'adresse IP doit être fixée ou entrée manuellement si le DHCP n'est pas actif. L'adresse par défaut est 192.168.1.40.

Dans le cas où une passerelle ou le réseau Ethernet LAN peut donner une adresse IP automatiquement, DHCP doit être programmé actif.

Exemples:

Exemple 1 : l'écran ci-dessous montre les paramètres par défaut pour une connexion directe à un PC (noter que le PC doit être configure conformément avec une adresse IP fixée 192.168.1.1, masque sous-réseau of 255.255.255.0, DHCP désactivé)

Figure 56: Programmation du protocole TCP/IP

Exemple 2: l'écran ci-dessous montre les paramètres par défaut pour se connecter à un réseau Ethernet (noter que le PC qui est également connecté à un LAN possède sa propre adresse IP donnée par le réseau avec activation du DHCP)

Les détails des paramètres de communication sont disponibles dans le manuel : 2GCS213012A0050_RVT communication through Modbus, USB or TCPIP protocol.

Redémarrez le RVT pour l'initialiser avec ces paramètres.

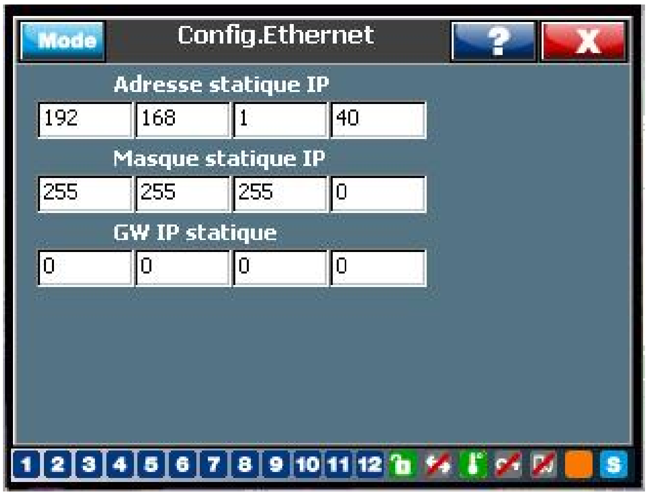
4.5.2 Configurations Ethernet

Ce menu affiche l’adresse IP, masque et GW réelle du RVT.

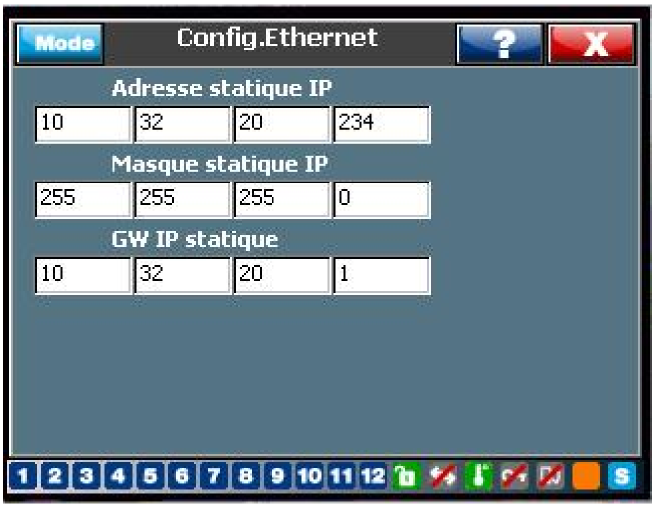
Selon le statut DHCP, les informations affichées peuvent être différentes.

L’écran ci-dessous donne le résultat pour les deux exemples ci-dessus:

Exemple 1: l’écran ci-dessous donne l’adresse IP réelle avec le DHCP désactivé.



Exemple 2: l’écran ci-dessous donne les paramètres réels avec une adresse IP automatique et le DHCP active.



Les détails des paramètres de communications se trouvent dans le manuel 2GCS213013A0050_RVT communication through Modbus, USB or TCPIP protocol.

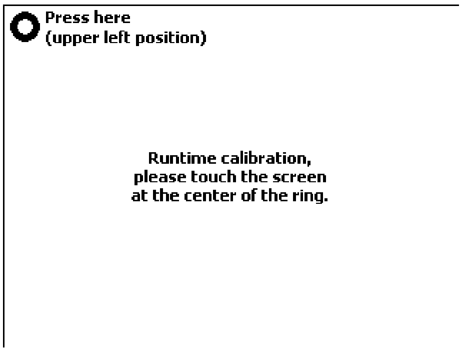
4.5.3 Configuration d’écran

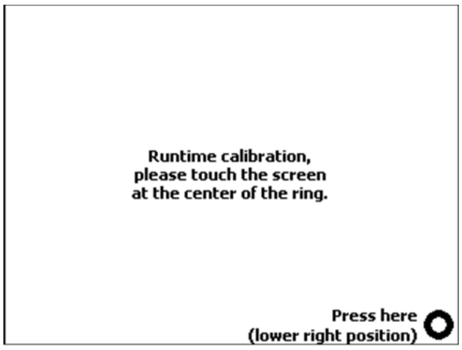
Ce menu aide l’utilisateur à ajuster les coordonnées XY de l’écran tactile ainsi que le rétro-éclairage.

La calibration de l’écran n’est normalement pas nécessaire pour une utilisation raisonnable de l’écran et dans des conditions d’environnement standards.

En cas de dérive des caractéristiques de l’écran tactile, l’utilisateur peut calibrer manuellement les coordonnées XY nécessaires pour détecter l’activation des boutons.

ATTENTION: la calibration de l’écran doit être faite avec précaution avec un bic ou un stylo afin de marquer et détecter précisément les points de calibration!





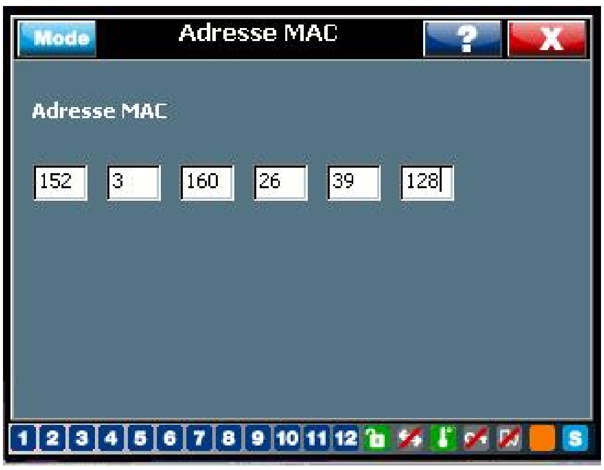
Le menu de réglage du rétro-éclairage programme l’intensité lumineuse par défaut quand l’écran tactile est utilisé. Après 10 minutes sans toucher l’écran tactile, l’intensité lumineuse revient à 10%.

4.5.4 A propos

Ce menu affiche la version du logiciel, le numéro de série, le numéro d'article et le type du RVT.

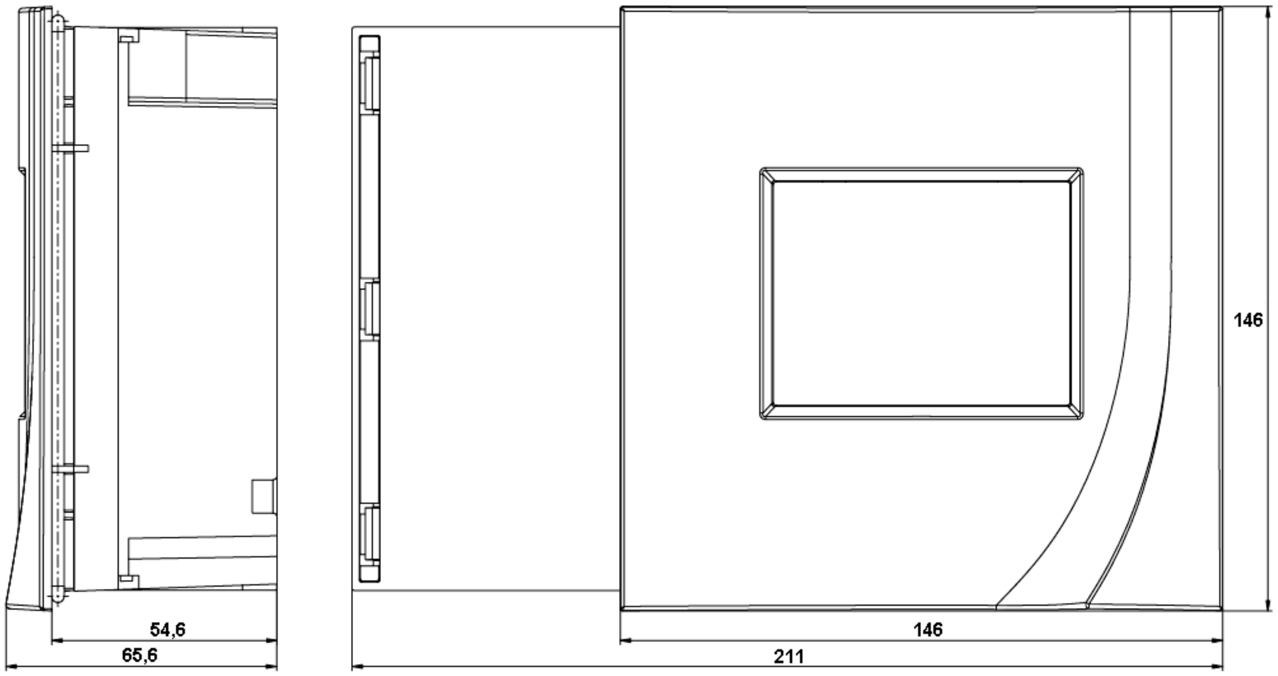
4.5.5 Adresse Mac

Ce menu affiche l'adresse MAC physique du RVT.



Annexes

A1. Dimensions



A2. Spécifications techniques

Types de RVT:

Fonctionnalité	RVT 6 / RVT 12	RVT 12-3P
Mesures 1 / 3 phase	1 entrée mesure de tension 1 entrée mesure de courant	3 entrées mesure de tension 3 entrées mesure de courant
Horloge	Non	Oui
Mesures d’énergie	Non	Oui
Connexion Ethernet	Non	Oui
Connexion hôte USB	Non	Oui
Connexion périphérique USB	Oui	Oui
Entrées digitales	Oui	Oui
Relais alarme/ventilateur	Oui	Oui
Relais sortie	6 ou 12	12
Verrou	Oui	Oui
Connexion Modbus RS485	Oui	Oui
Sondes de température externes	Oui	Oui

Système de mesure:

Système à micro-processeur pour réseaux monophasés/triphasés équilibrés ou réseaux déséquilibrés. Le contrôle du facteur de puissance peut se faire par phase individuelle.

Tension d'alimentation:

De 100Vac à 460Vac

Consommation:

15 VA max.

Type de connexion:

Phase-phase ou phase-neutre pour réseau équilibré ou déséquilibré

Plage de tolérance:

+/- 10% sur les tensions d'alimentation indiquées.

Catégorie de mesure (selon IEC 61010-1) : CAT III

Mesure de tension:

Jusqu'à 690Vac ou plus haut avec un transformateur de tension.

Précision:

1% fond d'échelle

Plage de fréquence:

45 ou 65 Hz (ajustement automatique à la fréquence du réseau).

Entrée en courant:

5A ou 1A (RMS) (T.C. de classe 1).

Impédance de l'entrée de courant:

<0.1 Ohm.

Coupure de réseau:

En cas de coupure de réseau supérieure à 20ms, le régulateur déconnecte automatiquement les condensateurs.

Nombre de sorties:

RVT6/RVT12 modèle de base: programmable de 6 à 12 sorties

RVT12-3P modèle triphasé: programmable jusqu'à 12 sorties

Caractéristiques des contacts de sortie:

- Courant nominal permanent: 1.5A (ac) – 0.3A (110V dc).
- Courant de crête maximum: 8A.
- Tension maximum: 440 Vac.
- Les sorties A-A sont dimensionnées pour un courant permanent de 18A (9A/contact).

Caractéristiques du contact d’alarme: (contact libre de potentiel)

- Un contact normalement fermé et un contact normalement ouvert.
- Courant nominal permanent: 1.5A (ac).
- Tension: 250Vac (tension de coupure max. : 440Vac).

Caractéristiques du contact de ventilateur : (contact libre de potentiel)

- Contact normalement ouvert.
- Courant nominal permanent: 1.5A (ac).
- Tension: 250Vac (tension de coupure max.: 440Vac).

Paramétrage du facteur de puissance:

De 0.7 inductif à 0.7 capacitif.

C/k:

- De 0.01 à 5A.
- Ajustement automatique.

Séquences d’enclenchement:

1:1:1:1:1:.. :1 - 1:2:2:2:2:.. :2 - 1:2:4:4:4:.. :4

1:2:4:8:8:.. :8 - 1:1:2:2:2:.. :2 - 1:1:2:4:4:.. :4

1:1:2:4:8:.. :8 - 1:2:3:3:3:.. :3 - 1:2:3:6:6:.. :6

1:1:2:3:3:.. :3 - 1:1:2:3:6:.. :6

ainsi que toutes autres séquences (personnalisable).

Connexion Ethernet 10/100 Base-T:

Connexion à un PC ou à un LAN au moyen du protocole TCP/IP

Isolation électrique entre le RVT et les signaux RJ45: 1500Vrms

Modbus débit en bauds:

300 - 600 - 1200 - 2400 - 4800 - 9600 - 19200 - 38400 – 57600

Connexion CAN:

Interface support CAN 2.0B (pour utilisation future)

Connexion de l’entrée pour la sonde de température:

Seulement 2 contacts utilisant le protocole 1-wire.

- Alimentation parasitaire (pas besoin d’une alimentation externe)
- Connexion de nœuds supplémentaires en chaîne
- Connexion de 8 sondes de température
- 8 mètres maximum entre le RVT et la sonde de température ou entre les sondes
- Longueur maximum de 64 mètres

- Mesure les températures de -55°C à +125°C (-67°F à +257°F)
- Précision de +/-0.5°C de -10°C à +85°C
- Montage en rail DIN
- Connexion au RVT avec deux fils, un câble de télécommunication de Catégorie 1 pair torsadé

Configuration des gradins:

Automatique, fixe, désactivé.

Affichage:

Ecran tactile multicolore QVGA 320 x 240 pixels.

Rétro-éclairage ajustable

Temps de commutation entre gradins:

Programmable de 1 seconde à 18 heures.

Fonction de sauvegarde:

Tous les paramètres programmés et les modes sont sauvés dans une mémoire non volatile.

Adaptation automatique au sens de rotation des phases et à la connexion du transformateur de courant.

Adaptation automatique des sorties TI.

La mesure de la puissance réactive nécessaire à la compensation du facteur de puissance est insensible à la présence d'harmoniques.

Travaille en mode passif et régénératif (fonctionnement en quatre quadrants).

Température de fonctionnement:

De -20° C à 70° C.

Température de stockage:

De - 30° C à 85° C.

Montage: en position verticale.

Dimensions:

Face avant: 146 x 146 mm (HxW)

Face arrière: 205 x 135 mm

Dimensions totales: 146 x 211 x 67 mm (HxWxD)

Dimensions de découpe: 138 x 138 mm (H x W)

Poids:

650 g (non emballé).

Connecteur:

Type “Cage Clamp” (câble mono-brin 2.5mm²).

Protection face avant:

IP 43 (IP54 sur demande).

Humidité relative:

Maximum 95%; non-condensant.

Marquage CE.

A3. Test et détection de pannes

Tests

Après l’installation de la batterie automatique de condensateurs et la programmation des paramètres du RVT, les tests suivants peuvent être effectués en fonction de la charge active.

A. Pas de charge ou cos j = 1 ou charge capacitive (entrer le cos j cible à 0.95 inductif)

1. Sélectionnez le mode manuel
2. Ajoutez 2 gradins ou plus.
3. Sélectionnez le mode automatique

Tous les gradins doivent se déclencher avec un délai entre chaque gradin égal au temps de déclenchement programmé.

Si tous les gradins ne se sont pas déclenchés, vérifiez les points suivants:

- Est-ce qu’une charge inductive a été connectée?
- Est-ce que le bon rapport C/k et/ou la valeur de gradin a (ont) été bien programmée(s)? (Il est recommandé de régler la valeur du C/k légèrement supérieure à la valeur calculée).

B. Charge inductive

1. Entrez le cos j cible à 1
2. Sélectionnez le mode automatique

Les gradins vont être maintenant automatiquement enclenchés afin de compenser la charge inductive. (Le régulateur ne réagira pas si le courant inductif est inférieur à la valeur C/k programmée. Dans ce cas, réalisez les tests selon A).

Si tous les gradins sont enclenchés et qu’il y a toujours une demande pour des gradins supplémentaires, alors vérifiez la programmation de la valeur C/k. Si cette valeur est correcte, alors la valeur de la puissance réactive que peut fournir la batterie est trop faible pour compenser jusqu’à une valeur de cos j = 1. Sélectionnez une valeur de cos j cible plus basse.

Lorsqu’un gradin est enclenché et déclenché de manière répétitive, cela signifie que la valeur C/k programmée est trop faible (à moins que la charge varie réellement de manière périodique avec un délai égal au temps de commutation).

Détection de pannes

Problème	Action(s) recommandée(s)
Le régulateur est connecté mais ne fonctionne pas (rien sur l'écran)	Vérifiez la tension et les fusibles.
Le régulateur n'enclenche ni ne déclenche des gradins bien qu'il y ait une charge inductive variable considérable.	Vérifiez que le régulateur est en mode automatique (AUTO). Vérifiez la valeur du déphasage et la valeur du C/k. Vérifiez que le pontage en court-circuit du T.C. est enlevé
Le régulateur ne semble enclencher aucun gradin.	Attendez le délai d'enclenchement entre chaque enclenchement et/ou le délai de réinitialisation après une mise hors tension.
Le cos j cible n'est pas atteint.	A faible charge ou hors charge, un faible facteur de puissance peut correspondre à un très petit courant inductif. Le gradin correspondant est trop important par rapport à la demande. Si le cos j moyen sur une période de temps est trop bas, le cos j cible peut être augmenté.
Tous les gradins sont enclenchés bien que la demande en puissance réactive est relativement basse.	Vérifiez la programmation de la rotation des phases et de la valeur du C/k.

Après l'arrêt de la mise en service automatique, le régulateur affiche un des messages suivants :

Messages lors d'une mise en service automatique	Action(s) recommandée(s)
La rotation de phase est détectée mauvaise. Les phases L2 et L3 seront inversées automatiquement. Pressez OK pour valider	Pressez OK.
Erreur: taille de gradin trop petite	Adaptez la taille du gradin ou le rapport du TI.
Erreur: le TI ne détecte aucun courant	Vérifiez que le pont de court-circuit du TI est retiré, que les connections du TI sont correctement soudées et redémarrez la mise en service automatique.
Erreur: la charge change trop rapidement	Redémarrez la procédure de mise en service automatique avec des conditions plus stables ou programmez les paramètres manuellement.
Erreur: Trop grande dispersion de phase dans l'entrée n° 'X' 'Y' 'Z'	Pour chaque entrée de TI et pour chaque sortie, la reconnaissance de phase est faite et la dispersion de phase est vérifiée. Vérifiez les connections des condensateurs et des contacteurs. Vérifiez les courants des condensateurs pour chaque phase.
Erreur: Au moins 2 TI mesurent le même courant de ligne	Vérifiez l'installation des TI.

Erreur: Pas assez de courant dans l'entrée n° 'X' 'Y' 'Z'	Vérifiez que le pont de court-circuit du TI est retiré, que les connections du TI sont correctement soudées et redémarrez la mise en service automatique.
Erreur: Déphasage inconsistant	Vérifiez les connections des TI et l'installation. Vérifiez les connections des condensateurs et des contacteurs. Vérifiez les courants des condensateurs pour chaque phase.
Erreur: Gradin déséquilibré ou rapport de TI différent détecté pour les sorties n° 'A' 'B' 'C' 'D'...	Vérifiez que les rapports des TI ont la même valeur. Vérifiez les connections des condensateurs et des contacteurs. Vérifiez les courants des condensateurs pour chaque phase.
Erreur: Trop grande différence de gradins	Vérifiez la séquence et la valeur de la puissance réactive par sortie.

A4. Procédure de redémarrage après disparition d'une alarme

Dès qu'un seuil de protection est atteint (voir paragraphe 4.3.1.4.1) ou lorsque la température interne est supérieure à 85°C:

- tous les gradins sont déclenchés,
- un message d'alarme apparait sur l'écran graphique,
- le contact d'alarme se ferme,

Lorsque la condition d'alarme disparait, le RVT redémarre automatiquement.
La procédure de redémarrage dépend du type d'événement qui a provoqué l'alarme, comme cela est décrit dans le tableau ci-dessous:

Evénement	Comportement lors du redémarrage du RVT après disparition de l'événement
Urms < prot. Umin	- Ouvre le contact d'alarme immédiatement - Reprend un comportement normal après un délai égal au délai d'enclenchement (délai encl.) (*)
Mise hors tension	- Reprend un comportement normal après un délai égal au délai d'initialisation (délai init.) (*)
Urms > prot. Umax	- Ouvre le contact d'alarme immédiatement - Reprend un comportement normal après un délai égal au délai d'enclenchement (délai encl.) (*)
Temp interne > 85°C	- L'événement est considéré comme fini lorsque Temp interne < 80°C - Ouvre le contact d'alarme immédiatement - Reprend un comportement normal après un délai égal au délai d'enclenchement (délai encl.) (*)
Une des huit sondes de température T > son niveau de protection max.	- Ouvre le relai d'alarme immédiatement (sonde de température externe en option T1-8)

	- Reprend un comportement normal après un délai égal au délai d'enclenchement (délai encl.) (*)
THDV > prot. THDV max	- Ouvre le contact d'alarme immédiatement - Reprend un comportement normal après un délai égal au délai d'enclenchement (délai encl.) (*). Protection contre les phénomènes de battement : Si le même événement se produit dans l'heure, le RVT reprendra son comportement normal après un temps égal à 2x le délai d'enclenchement (délai encl.). Si le même événement se produit à nouveau dans l'heure, le temps avant le redémarrage sera doublé, soit 4 x le délai d'enclenchement (délai encl.), et ainsi de suite jusqu'à un maximum d'une heure. Cette règle permet d'éviter tout phénomène de battement qui serait dû à un phénomène de résonance.
Entrée externe active	- Ouvre le contact d'alarme immédiatement - Reprend un comportement normal après un délai égal au délai d'enclenchement (délai encl.) (*)

(*) Pour plus d'informations concernant le délai d'initialisation (délai init.) et le délai d'enclenchement (délai encl.), une description complète se trouve au paragraphe 4.3.1.1.

A5. Connexions de l'alimentation et de la mesure en tension

Cette annexe donne une façon pratique de connecter la mesure en tension au RVT lorsqu'elle est identique à la tension d'alimentation du RVT.

Description

Comme indiqué sur la Figure 57, le RVT a deux terminaux pour son alimentation en tension et trois autres terminaux pour la mesure de la tension.
Le RVT n'utilise pas son alimentation en tension afin de réaliser la mesure de tension. La mesure en tension est réalisée uniquement via les terminaux de la mesure en tension.
Lorsque l'alimentation en tension du RVT et la mesure de la tension ont la même source, un pontage entre les terminaux correspondants peut être réalisé:

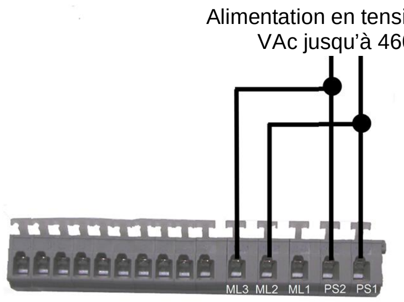


Figure 57:Terminaux

Réalisation du pontage (proposition pratique)

Etant donné l'espace limité, il n'est pas possible d'insérer deux câbles dans un seul terminal. En conséquence, différentes méthodes peuvent être utilisées afin de connecter deux fils à un même terminal.

Plusieurs solutions pratiques existent pour réaliser cette connexion correctement. Une de ces solutions est décrite sur la Figure 58.

Sur chaque câble d'alimentation en tension, un connecteur à double entrée doit être utilisé afin d'insérer un second câble nécessaire pour réaliser le pontage.

Les connecteurs proposés et la pince nécessaire pour les fixer sont généralement disponibles dans le monde entier.

Veuillez noter qu'avec ces connecteurs, des câbles de même diamètre doivent être utilisé. Deux connecteurs doivent être logiquement utilisés et le résultat est montré ci-dessous.

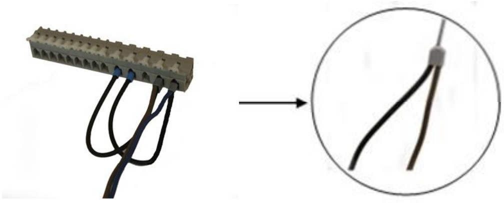
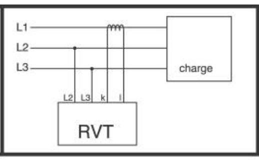
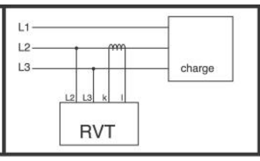
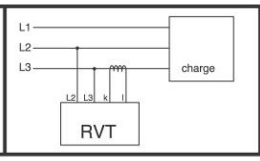
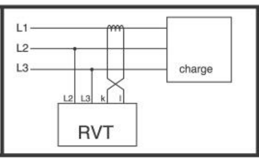
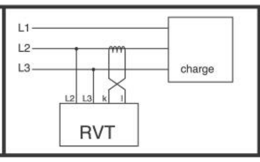
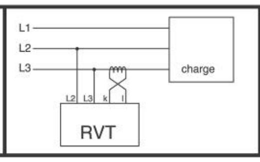


Figure 58: Pontage

A6. Tableau des connexions et déphasages associés (applicable au modèle de base)

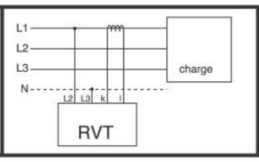
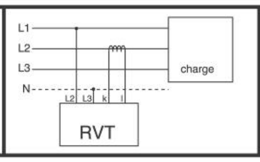
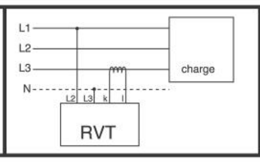
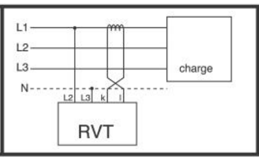
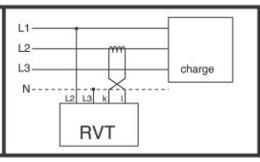
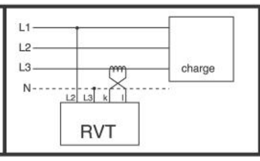
Connexion triphasée (phase - phase)

La tension est mesurée entre L2 et L3

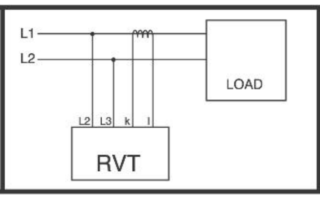
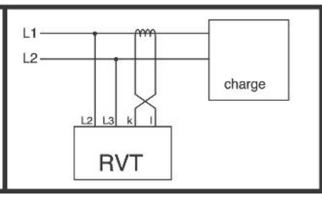
L1 Directe		90	L2 Directe		-30	L3 Directe		-150
L1 Inversée		-90	L2 Inversée		150	L3 Inversée		30

Connexion triphasée (phase - neutre)

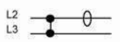
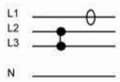
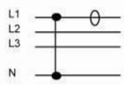
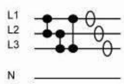
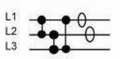
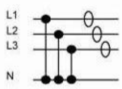
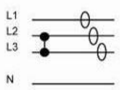
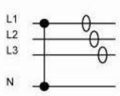
La tension est mesurée entre L1 et le neutre

L1 Directe		0	L2 Directe		-120	L3 Directe		120
L1 Inversée		180	L2 Inversée		60	L3 Inversée		-60

Connexion monophasée

L1 Directe		0	L2 Directe		180

A7. Type de connexion TI et câblage des TI sur les terminaux du régulateur

Connection type		RVT 12 - 3P	RVT 6 / RVT 12	Phase shift	Voltages						Currents				Compensation type		
Name	Schematics	Connection	Connection	adjustment	L12	L23	L31	L1N	L2N	L3N	L1	L2	L3	N	Full C3[1]	Full C1[2]	Mixed C3+C1
1Ph-1LL1		L2, L3, CT — ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	L2, L3, CT — N.C., ML2, ML3, N.C., k, l, N.C., N.C., N.C., N.C.	0° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	-	yes	-
3Ph-1LL1		L2, L3, CT — ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	L2, L3, CT — N.C., ML2, ML3, N.C., k, l, N.C., N.C., N.C., N.C.	90° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	yes	-	-
3Ph-1LN1		L1, N, CT — ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	L1, N, CT — N.C., ML2, ML3, N.C., k, l, N.C., N.C., N.C., N.C.	0° by default (see phase shift table)	-	-	-	Measured	-	-	Measured	-	-	-	yes	-	-
3Ph-3LL3		L1, L2, L3, CT1, CT2, CT3 — ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-3LL2		L1, L2, L3, CT1, CT2 — ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Calculated	(3)	yes	yes	yes
3Ph-3LN3		L1, L2, L3, N, CT1, CT2, CT3 — ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - phase rotation - CT redirection)	Calculated	Calculated	Calculated	Measured	Measured	Measured	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LL3		L2, L3, CT1, CT2, CT3 — ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - CT redirection)	-	Measured	-	-	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LN3		L1, N, CT1, CT2, CT3 — ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - CT redirection)	-	-	-	Measured	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes

A8. Contrôle du facteur de puissance phase par phase individuellement (valable pour le modèle triphasé RVT12-3P)

Par défaut, seul le modèle « 12 sorties » est disponible pour le contrôle du facteur de puissance individuel.

Comme dans le RVT de base, la compensation du facteur de puissance se fait en comparant la valeur de C/k à la mesure du courant réactif fondamental.

Le contrôle se fait de différentes façons en fonction du type de connexion (voir A7. Type de connexion TI et câblage des TI sur les terminaux du régulateur) et du type de gradins de sortie (gradins mono ou triphasés).

En se référant au type de connexion (voir A7. Type de connexion TI et câblage des TI sur les terminaux du régulateur) :

wPh- xLyz où :

w signifie un réseau mono ou triphasé

x est le nombre de mesures de tension

y signifie une connexion ligne à ligne ou ligne à neutre

z est le nombre de TI utilisés

Type de contrôle wPh-1Ly1 (uniquement un TI)

Pour résumer, si seul un TI est utilisé, le contrôle se fait en fonction du TI en phase L1 (ou la ligne où le TI est placé).

Type de contrôle 3Ph-xLy2 et 3Ph-xLy3 (2 ou 3 TI)

Si plus d'un TI est utilisé, la stratégie de contrôle suit un principe simple et efficace pour permettre de traiter toutes les sorties de façon complète. La stratégie suivante est implémentée:

Stratégie d'enclenchement d'un réseau non équilibré*:*

Attente du délai d'enclenchement et calcul du courant réactif dans les phases L1, L2, et L3, en fonction du paramètre Normal / Intégral.

Evaluation des sorties triphasées à enclencher ou à déclencher au minimum

Evaluation des sorties monophasées à enclencher ou à déclencher

Si un bloc de sorties monophasées (déjà enclenchées et à enclencher) peut être transféré vers un gradin triphasé, la préférence est donnée à l'enclenchement du gradin triphasé

Enclencher ou déclencher en fonction des paramètres Progressif / Direct, Linéaire / Circulaire

Quelques exemples représentatifs sont fournis ci-dessous:

- 12 condensateurs monophasés/ 1 TI (1Ph-1LL1 uniquement)

à Le contrôle se fait au travers du TI dans la phase où il est placé à Le paramètre C/k triphasé est utilisé pour l'enclenchement des gradins (équivalent au paramètre C/k pour les RVT de base 6 ou 12)

- 12 condensateurs triphasés / 1 TI (3Ph-1Ly1 uniquement)

à Le contrôle se fait au travers du TI dans la phase où il est placé

à Le paramètre C/k triphasé est utilisé pour l'enclenchement des gradins (équivalent au paramètre C/k pour les RVT de base 6 ou 12)

- 12 condensateurs triphasés / 2 ou 3 TI (3Ph-3LL2 or 3Ph-xLy3 uniquement)

à Le contrôle se fait au travers du TI1 dans la phase 1, du TI2 dans la phase 2, du TI3 dans la phase 3

à Le contrôle se fait en fonction de la stratégie d'enclenchement d'un réseau non équilibré

à Le paramètre C/k triphasé est utilisé pour l'enclenchement des gradins triphasés

- 3 condensateurs monophasés connectés entre L-N / 2 ou 3 TI (3Ph-3LL2 ou 3Ph-xLy3 uniquement)

à Le contrôle se fait au travers du TI1 dans la phase 1, du TI2 dans la phase 2, du TI3 dans la phase 3

à Le contrôle se fait en fonction de la stratégie d'enclenchement d'un réseau non équilibré

à Le paramètre C/k monophasé est utilisé pour l'enclenchement des gradins monophasés

- condensateurs triphasés + 2*3 condensateurs monophasés connectés entre L-N / 2 ou 3 TI (3Ph-3LL2 or 3Ph-xLy3 only)

à Le contrôle se fait au travers du TI1 dans la phase 1, du TI2 dans la phase 2, du TI3 dans la phase 3

à Le contrôle se fait en fonction de la stratégie d'enclenchement d'un réseau non équilibré

à Le paramètre C/k monophasé est utilisé pour l'enclenchement des gradins monophasés

à Le paramètre C/k triphasé est utilisé pour l'enclenchement des gradins triphasés

A9. Recyclage

Ce symbole visible sur le produit ou sa documentation indique qu'il ne doit pas être jeté avec les autres déchets ménagers à la fin de sa durée de vie. Pour prévenir les dommages possibles sur l'environnement ou la santé humaine suite au dépôt incontrôlé de déchets, veuillez le séparer des autres types de déchets et le recycler de façon responsable afin de promouvoir la réutilisation durable des ressources matérielles.

Les particuliers sont invités à contacter le distributeur leur ayant vendu le produit ou auprès de leur bureau administratif local pour savoir où et comment ils peuvent recycler leur produit.

Les professionnels sont invités à contacter leur fournisseur et vérifier les termes et conditions du contrat d'achat. Ce produit ne doit pas être mélangé avec d'autres déchets commerciaux en conformité avec la directive WEEE (waste electrical and electronic equipment).

Ce produit ne contient aucune substance dangereuse et est conforme avec la directive RoHS (Restriction of the Use of Certain Hazardous Substances).

L'élimination des piles usagées doit être effectuée en conformité avec la réglementation nationale sur l'élimination des piles (Battery Directive).

Les cartes électroniques doivent être recyclées selon la réglementation locale.

Les boîtiers en plastique et autres pièces doivent être recyclés séparément.

Ce produit contient une pile CR2032 Li-MnO2. Cette batterie ne peut pas être remplacée. Pour le recyclage, la batterie peut être retirée et jetée après l'ouverture du boîtier en plastique (4 vis au dos du produit).

A10. Additional provision on Open Source Software:

The product contains – in part – some free software (software licensed in a way that ensures your freedom to run, copy, distribute, study, change and improve the software). The following products are concerned : Linux-2.6.30.1 which is subject to "GNU General Public License", Version 2, busybox-1.15.3 which is subject to "GNU General Public License", Version 2, dropbear-0.48.1 which is subject to "GNU General Public License", Version 2, iana-etc-2.20 which is subject to "GNU General Public License", Version 2, mtd-utils-1.2.0 which is subject to "GNU General Public License", Version 2, u-boot-1.3.4 which is subject to "GNU General Public License", Version 2, ifplugd-0.28 which is subject to "GNU General Public License", Version 2, AT91Bootstrap1.9 which is subject to "GNU General Public License", Version 2, and uClibc v 0.9.29 which is subject "GNU Lesser General Public License", Version 2.1,(purchaser or user shall not be prohibited to modify libraries provided under Lesser General Public License (version 2.1) and/or to reverse engineer such libraries for debugging such modifications).

These software products which are free (i.e., freedom-respecting – see http://www.gnu.org/philosophy/free-sw.html for more details) software programs developed by the Free Software Foundation, a separate not-for-profit organization. If we distributed any of these free software programs to you, we want you to know that you were granted a license to that software under the terms of either the GNU General Public

License or GNU Lesser General Public License (“Licenses”; copies of which are available from http://www.gnu.org/licenses/licenses.html). The Licenses allow you to freely copy modify and redistribute those softwares. Those softwares are available on http://search-ext.abb.com/LibraryDownloadManager/Default.aspx?resource=http://www05.abb.com/global/scot/scot209.nsf/veritydisplay/96797337ffab5ad0c12578b0003db334/$file/2GCS705011A0050_RVT%20OSS%20software.zip

Installations und Betriebsanleitung

Inhalt

Bitte zuerst lesen

Zu diesem Handbuch

Dieses Handbuch wurde so gestaltet, daß es Ihnen hilft, den RVT-Blindleistungsregler schnell zu installieren und in Betrieb zu nehmen.

Warnung

Achtung, Gefahr: Dieses Symbol ist ein Warnhinweis, der auf wichtige Informationen aufmerksam macht

Lesen Sie diese Anleitung vor der Installation und Inbetriebnahme des RVT- insbesondere die Sicherheitshinweise - bitte sorgfältig durch. Halten Sie diese Anleitung jederzeit für alle Personen bereit, die mit der Installation, Wartung und dem Betrieb betraut Sind.

Sicherheit

Der RVT erfüllt die europäische Richtlinie LVD 2006/95/EG.

Achtung, Gefahr durch elektrischen Strom: Dieses Symbol warnt, wenn Sicherheitsinformationen gegeben werden, die unbedingt beachtet werden müssen

Die Installation, Wartung und der Betrieb des RVT-Blindleistungsreglers darf nur durch entsprechend qualifizierte Elektrofachkräfte vorgenommen werden.Führen Sie keinerlei Arbeiten bei angelegter Spannung aus.Bei Staubablagerung mit einem trockenen Tuch reinigen. Kein Scheuermittel, Lösungsmittel oder Alkohol verwenden.Öffnen Sie nicht das Gehäuse des RVT-Blindleistungsreglers. Im Gehäuseinneren befinden sich keine wartungsfähigen Teile.Schalten Sie die Stromversorgung ab, bevor Sie die Sicherung ersetzen.Der RVT-Blindleistungsregler wird an einem Stromwandler („CT“ für Current Transformer) angeschlossen. Trennen Sie den Anschluß an dem Stromwandler nicht, solange Sie nicht sichergestellt haben, daß dieser kurzgeschlossen oder an eine andere parallele Last mit ausreichend geringer Impedanz angeschlossen ist. Die Nichtbeachtung dieses Hinweises kann gefährliche Überspannungen zur Folge haben.Verwenden Sie dieses Produkt nicht für einen anderen als den ursprünglich vorgesehenen Zweck

Elektromagnetische Verträglichkeit

Dieser Blindleistungsregler wurde auf seine Konformität mit den EG-Richtlinien für Elektromagnetische Verträglichkeit (EMV 2004/108/EC) für den Betrieb bei 50Hz geprüft und entsprechend mit dem CE-Zeichen versehen.

Wenn ein Gerät in ein System eingesetzt wird, können EG-Richtlinien möglicherweise erfordern, daß das gesamte System auf seine Konformität hinsichtlich der EMV zu prüfen ist.Durch Berücksichtigung folgender Richtlinien kann die EMV-Verträglichkeit eines Systems verbessert werden: Metallgehäuse verbessern generell die EMV-Verträglichkeit.

1. Führen Sie Kabel abseits von Öffnungen im Gehäuse.

2. Führen Sie Kabel nahe an geerdeten Metallteilen entlang.

3. Setzen Sie je nach Bedarf mehrfache Erdungslaschen für Türen und andere Gehäuseteile ein.

4. Vermeiden Sie Erdungsübergangswiderstände

1 Grundsätzliches über den Regler

1.1 Inhalt dieses Abschnittes

In diesem Kapitel wird eine allgemeine Beschreibung des RVT-Blindleistungsreglers gegeben. Es werden die grundlegende Struktur des Reglers, seine Hauptkennzeichen und sein berührungsempfindliches Bedienfeld erläutert.

1.2 Ein leistungsstarker, individuell steuerbarer Drehstrom-Blindleistungsregler

Der RVT leistet eine Kompensation des Leistungsfaktors in symmetrisch wie in unsymmetrisch belasteten Netzen. Der RVT-Leistungsregler ist in zwei verschiedenen Modellen lieferbar: dem RVT-Grundmodell RVT6/RVT12 und dem RVT-Drehstrom-Modell RVT12-3P. Das Grundmodell ist vollständig rückwärtskompatibel zu vorherigen RVT-Reglern mit 6 oder 12 Ausgängen, was für ein symmetrisch belastetes Drehstromnetz oder ein Einphasennetz (Phase-Phase) zutrifft. Das Drehstrom-Modell RVT12-3P ist eine leistungsstärkere Ausführung mit Funktionen zur individuellen Leistungsfaktorregelung dank dreier Strommessungen für jede Phase. Das Drehstrom-Modell RVT12-3P gibt es nur mit 12 Ausgängen.

Der RVT kann auch als automatische Blindleistungs-Kompensationsanlage eingesetzt werden. Genaue Angaben zum Anschluss des RVT an eine Kompensationsanlage finden Sie unter 4.3.1.1.

1.3 RVT Hauptkennzeichen

1.3.1 Regelung des Leistungsfaktor

Der RVT-Blindleistungsregler ist die Steuereinheit einer automatischen Blindleistungs-Kompensationsanlage, der die reaktive Leistungskompensation in einer Anlage mit vorwiegend induktiven Lasten übernimmt. Er steuert das Schalten der Kondensatorstufen mit Blick auf die Einhaltung eines benutzerseitig eingestellten cos j -Sollwertes.

- Alle Schaltparameter können automatisch oder manuell programmiert werden (Erläuterung in den Abschnitten 4.3.2 und 4.3.1)
- Zusätzlich zum cos j -Sollwert (HT) können der NT cos j -Sollwert (Nachteinstellung) und der cos j -Sollwert für Generatorbetrieb (Wirkleistungsrückspeisung) programmiert werden (Erläuterung in Abschnitt 4.3.1.3).
- Beim Drehstrom-Modell RVT12-3P kann der Regler für das Schalten einphasiger Kondensatorstufen in einem unsymmetrisch belasteten Netz programmiert werden. Diese Funktion dient dazu, einen geringen Leistungsfaktor in jeder Phase einzeln zu korrigieren; zum Beispiel den Leistungsfaktor 0,6 in Phase 1, den Leistungsfaktor 0,8 in Phase 2 und den Leistungsfaktor 0,95 in Phase 3. Dies ist

sehr vorteilhaft in Wohn- und Gewerbegebieten, wo die Drehstromlast aufgrund vieler einphasiger Lasten unsymmetrisch sein kann.

1.3.2 Messwerte und Überwachung

- Messungen (Erläuterung in Abschnitt 4.2).
- Schutz gegen unerwartete Phänomene und/oder unbefugte Benutzung (Erläuterung in den Abschnitten 3.2.4 und 4.3.1.1.
- Speicherung von Messwerten und Alarmmeldungen basierend auf einer Echtzeituhr (Erläuterung in den Abschnitten 4.2.5 und 4.4).
- Überwachung und Prüfung des Stufenausgänge (Erläuterung in den Abschnitten 4.4.2 und 4.4).
- Temperaturmessungen: Maximal acht Temperaturfühler können in Reihe geschaltet werden (Beschreibung in Abschnitt 4.3.1.4.3).

1.3.3 Kommunikation

- Modbus-Anschluss (ein Modbus RS485-Adapter ist erforderlich)
- USB-Anschluss (kompatibel zu USB 2.0 Spezifikationen)
- TCP/IP-Netzwerkschnittstelle
- CAN 2.0 mit bis zu 32 erweiterten Ausgängen. Die Hardware kann dies in der aktuellen Ausführung des RVT, die Software wird in der Zukunft implementiert.
- Genaue Informationen in Abschnitt 4.5.

1.4 Vorder- und Rückansicht

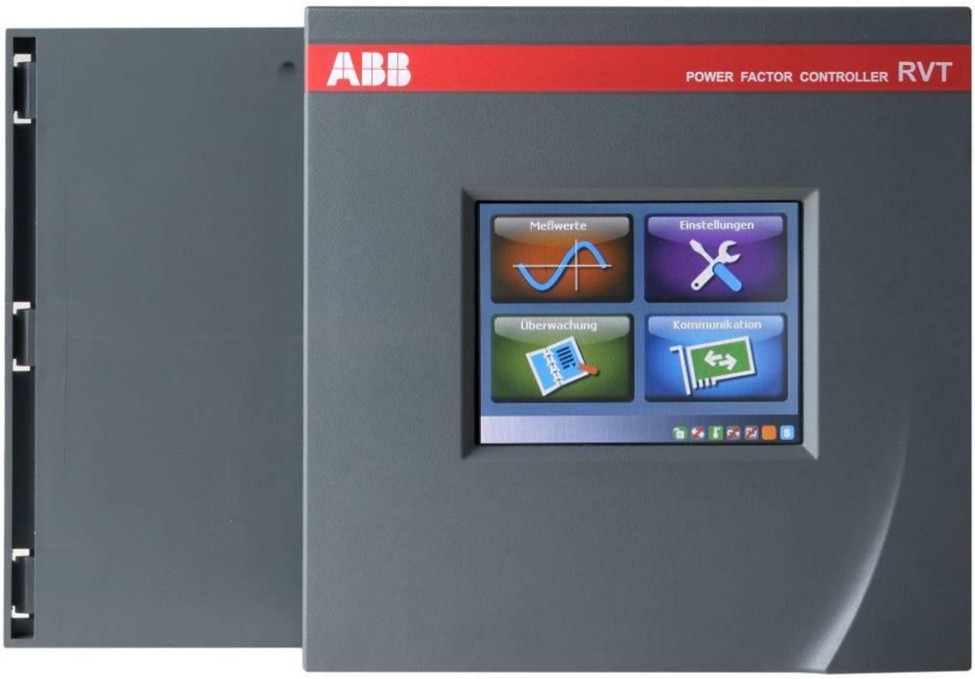


Abbildung 1: RVT Vorderansicht

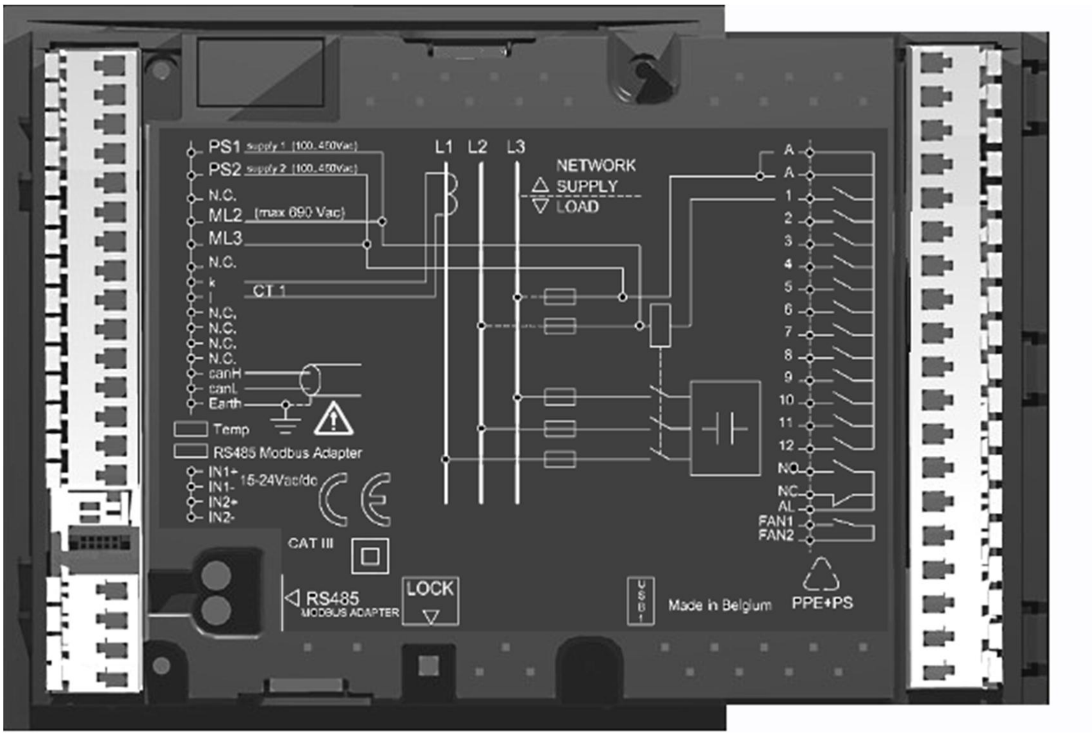


Abbildung 2: RVT Rückansicht (Grundmodell RVT6/RVT12)

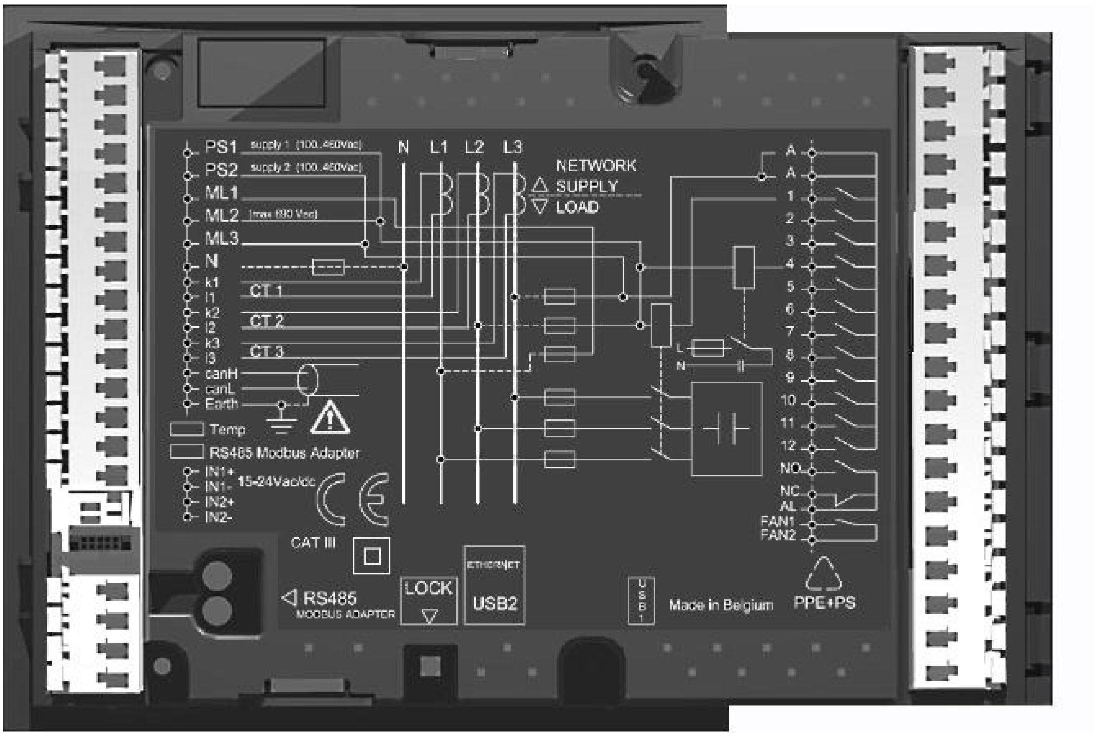


Abbildung 3: RVT Rückansicht (Drehstrom-Modell RVT12-3P)

1.5 Farbiges Touchscreen-Bedienfeld

Ein farbiger Touchscreen mit einer Auflösung von 320 x 240 Pixel hilft dem Benutzer, den Regler leichter zu bedienen. Menüs und Parametereinstellungen lassen sich so leicht und intuitiv erreichen.

Abbildung 4: RVT Startbildschirm

Eine Übersicht der Menünavigation finden Sie in Abschnitt 3.2.

2 Installation

2.1 Inhalt dieses Abschnitts

Dieser Abschnitt beschreibt den Einbau des Reglers in die Anlagenfront und die Erstellung der elektrischen Anschlüsse. Das Anschlussschema wird in Abschnitt 2.4. beschrieben.

2.2 Montage

Bitte folgen Sie den unten aufgeführten Schritten, um einen RVT-Leistungsregler an ein Bedienfeld anzuschließen.

Schritt 1: Schieben Sie den RVT (a) seitlich in das Kondensatoranlagengehäuse (b).

Schritt 2: Drehen Sie den RVT, um diesen in das Kondensatoranlagengehäuse einzusetzen.

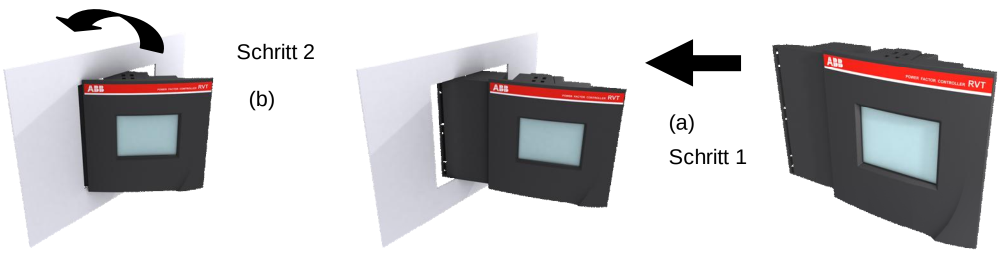


Abbildung 5: Montage eines RVT

Hinweis: Grösse des Montageausschnitts 138x138 mm.

Schritt 3: Setzen Sie den Befestigungshalter (c) in die entsprechenden Befestigungsöffnungen (d) des RVT ein.

Schritt 4: Ziehen Sie den Befestigungshalter nach hinten.

Schritt 5: Setzen Sie die Schraube (e) in den Befestigungshalter ein, und ziehen Sie diese an, bis der RVT fest sitzt.

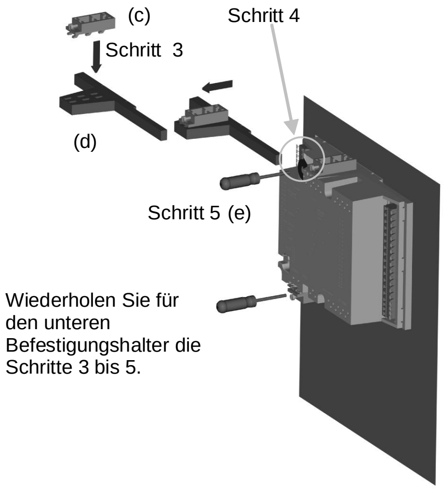


Abbildung 6: Montage eines RVT

2.3 Leitungsanschluss

Bitte folgen Sie der Anleitung unten, um Drähte an den Klemmen auf der Rückseite des Reglers anzubringen.

1. Drücken Sie den Hebel der Verbindungsklemme mit einem Schraubendreher nach hinten.

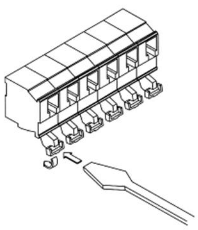


Abbildung 7: Leitungsanschluss

2. Setzen Sie den Anschlußdraht (bis zu 2,5 mm2 / Einzelader) in die entsprechende Verbindungsklemme ein, während Sie den Druck auf den Hebel beibehalten.

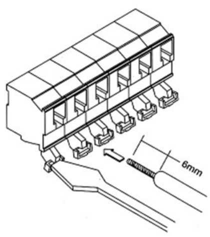


Abbildung 8: Leitungsanschluss

3. Entfernen Sie den Schraubendreher.

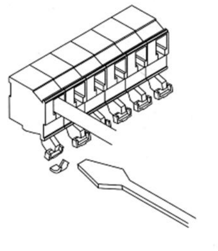


Abbildung 9: Leitungsanschluss

4. Der Anschlussdraht ist korrekt verbunden.

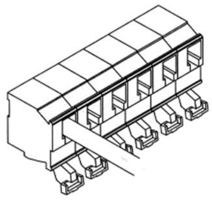


Abbildung 10: Leitungsanschluss

2.4 Verdrahtungsplan

Der Verdrahtungsplan verdeutlicht den Anschluss der Haupt- und der Steuerleitungen.

Grundmodell RVT6 / RVT12

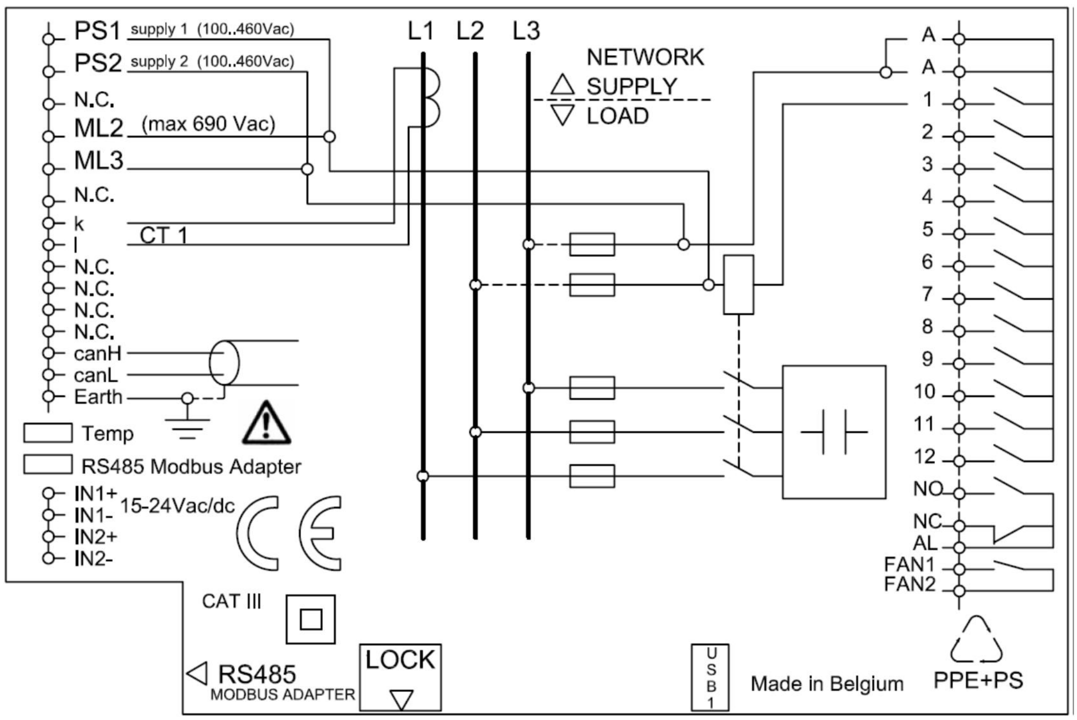


Abbildung 11: RVT Verdrahtungsplan (Grundmodell RVT6 / RVT12)

Drehstrom-Modell RVT12-3P

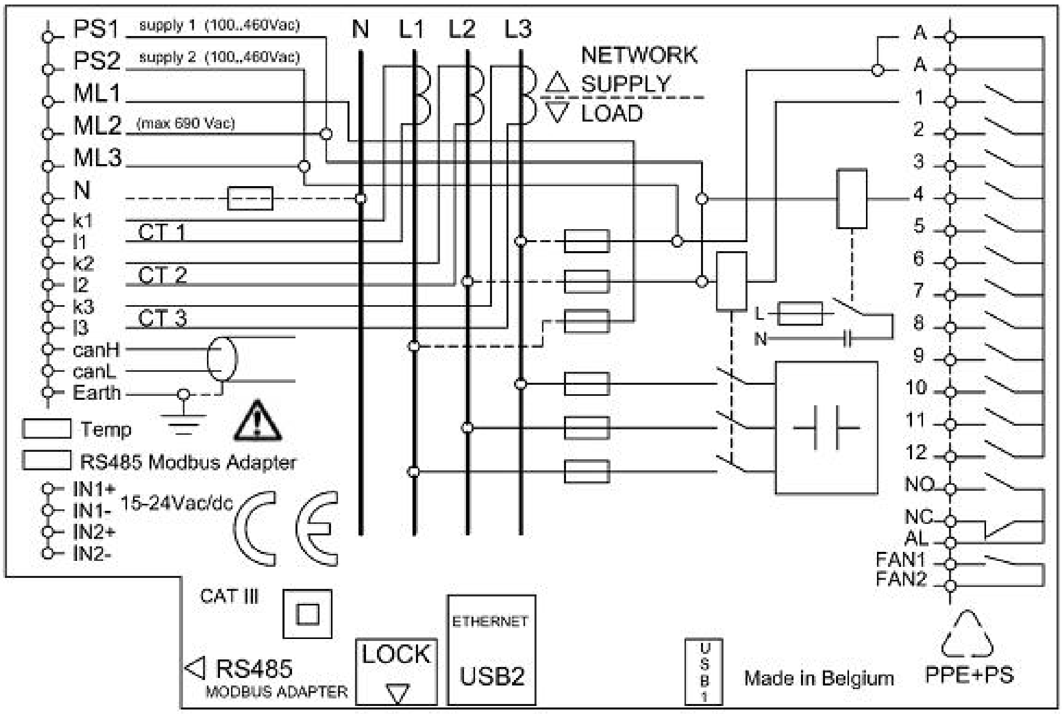


Abbildung 12: RVT Verdrahtungsplan (Drehstrom-Modell RVT12-3P)

PS1, 2	Spannungsversorgung
ML1-3	Spannungsmessung
N.C.	Nicht angeschlossen
N	Nullanschluss
k1-3, l1-3	Stromwandler
canH, canL	CAN-Bus
Erde	Erde
Temp	Verbindung Temperaturfühler
RS485 Modbus-Adapter	RS485-Schnittstelle

IN1+/- Digitaler Eingang wählt zwischen Tag- und Nachteinstellung des cos-Sollwerts j

IN2+/- Digitaler Eingang zur Aktivierung eines externen Alarms

A	Gemeinsame Leitung für Ausgangsrelais
1-12	Ausgangsrelais
NO/NC	Ausgangskontakte des Alarmrelais
AL	Gemeinsame Leitung für Alarmrelais
FAN 1-2	Lüfter / warnungrelais
USB	USB-Anschluss
RJ45	Netzwerkanschluss
Lock	Hardware-Sperre

Achtung: Ein Überstromschutz wird für die PS1-PS2-Verbindungen empfohlen: Sicherungen mit 6A 10 X 38 gl 690V.

3 Einfacher Start

3.1 Inhalt dieses Abschnitts

Dieser Abschnitt beschreibt die Schnellstartfunktion und die Selbstprogrammierung des Reglers.

3.2 Menü-Navigation

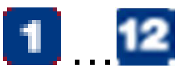
Wenn der RVT eingeschaltet wird das System gestartet und das ABB-Logo angezeigt. Danach erscheint als erstes der Startbildschirm wie in Abbildung 13.

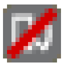
Abbildung 13: RVT Startbildschirm

Die vier Symbole in der Mitte des Bildschirms (Messwerte, Einstellungen, Anlagenüberwachung und Kommunikation) stellen die vier Hauptmenüs dar.

Die Statusleiste unten im Bildschirm zeigt die aktiven Kondensatorstufen, den RVT-Sperrstatus, Warnhinweise, die Steuerungsquelle des RVT (lokaler Touchscreen oder Kommunikationsverbindung), Anforderung zum Ein- oder Ausschalten, Betriebsart: A (Automatisch), M (Manuell) und S (gemäß Einstellungen). Die genaue Bedeutung der Statussymbole können Sie den folgenden Beschreibungen entnehmen.

3.2.1 Legende zu den Symbolen des Touchscreens

	Aktiver Ausgang (Eingeschaltet) (inaktive Ausgänge sind nicht hervorgehoben)
	Anlageneinstellungen nicht gesperrt
	Anlageneinstellungen gesperrt
	Einstellungen können nur über die Kommunikationsverbindung vorgenommen werden

	Einstellungen sind über das Bedienfeld oder die Kommunikationsverbindung möglich
	Temperaturalarm (Alarmrelais aktiviert) oder Warnung (Lüfter- / warnungrelais aktiviert)
	Kein Temperaturalarm und keine Warnung (Alarm- und Lüfter- / warnungrelais nicht aktiviert)
	Warnstufe erreicht (Lüfter- / warnungrelais aktiviert)
	Alarm aktiviert (Alarmrelais aktiviert)
	Kein Alarm aktiviert (Alarmrelais nicht aktiviert)
	Einstellungen sind durch Hardware-Schalter auf der Rückseite des Reglers gesperrt
	Einstellungen sind durch Hardware-Schalter auf der Rückseite des Reglers entsperrt
	Anforderung zum Einschalten einer / mehrerer Stufen
	Anforderung zum Ausschalten einer / mehrerer Stufen
	Keine Anforderungen zum Schalten von Stufen
	Automatische Betriebsart (Stufen werden gemäß Einstellungen automatisch geschaltet)
	Manuelle Betriebsart (Stufen können manuell geschaltet werden)
	Betriebsart Einstellungen (Einstellungen können vorgenommen werden)
	Ändern der Betriebsart
	Online-Hilfe
	Fenster schließen
	Bestätigung
	Nächste Seite

Mit Ausnahme des Startbildschirms sind alle RVT-Bildschirme in drei Bereiche unterteilt: Titelleiste oben, Statusleiste unten und Einstellungsbereich in der Mitte des Bildschirms.

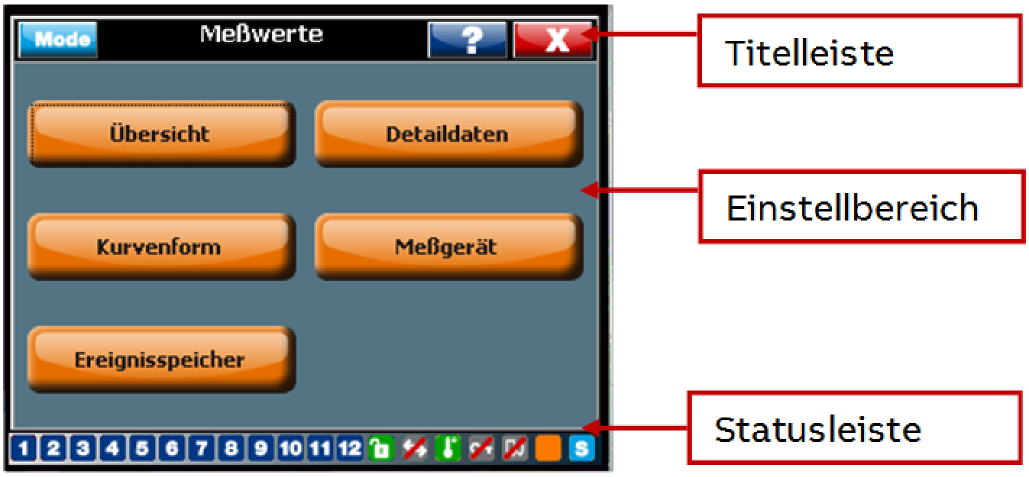


Abbildung 14: RVT Bildschirmaufbau

3.2.2 Titelleiste

Die blaue Schaltfläche "Mode" am linken Ende der Titelleiste dient zum Umschalten zwischen den drei Betriebsarten des RVT: Automatische Betriebsart, manuelle Betriebsart und Betriebsart Einstellungen. Wenn diese Schaltfläche geklickt wird erscheint der Bildschirm wie in Abbildung 15 dargestellt. Bei der Einstellung einer Betriebsart für den RVT, wird der entsprechende Großbuchstabe rechts unten im Bildschirm angezeigt: das  am rechten Ende der Statusleiste bedeutet, dass die aktuelle Betriebsart des RVT die Betriebsart Einstellungen (engl. "Set") ist.

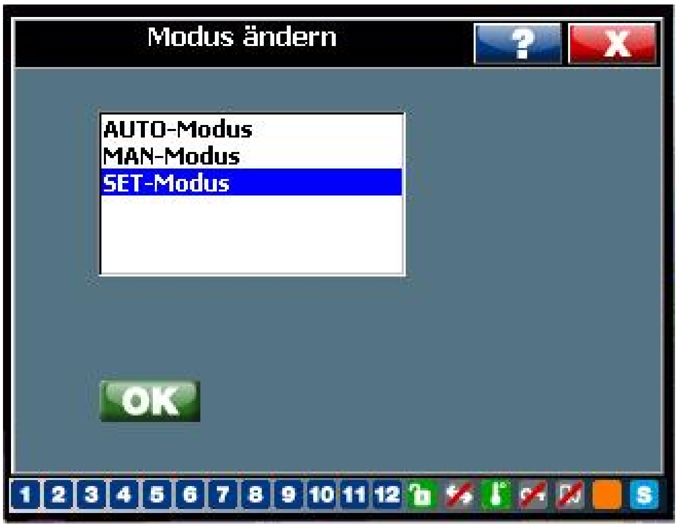


Abbildung 15: Umschalten der RVT-Betriebsarten

In der Mitte der Titelleiste gibt ein Text - wie in Abbildung 14 "Messwerte" - den Namen des aktuell angezeigten Menüs an.

Mit Klick auf das  Fragezeichen wird dem Bediener eine entsprechende Hilfe-Information angezeigt, damit er die Parameter problemlos einstellen kann. Nach Klick auf das Fragezeichen im Bildschirm in Abbildung 15 erscheint das folgende Fenster:

Abbildung 16: RVT Hilfe-Information

Durch Klick auf das rote Kreuz am rechten Ende der Titelleiste  wird der Bildschirm geschlossen.

Hinweis: Der RVT geht automatisch in die Betriebsart AUTO, wenn der Touchscreen länger als fünf Minuten nicht bedient wird.

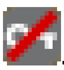
3.2.3Einstellungen

Im Bereich Einstellungen werden Schaltflächen, die Einstellungen und Informationsfelder angezeigt. Nachdem alle Einstellungen in einem Bildschirm vorgenommen wurden, werden diese durch Klick auf  bestätigt und übernommen. Falls es weitere Einstellungen gibt, die nicht auf einem Bildschirm angezeigt werden können, erscheint ein Pfeil  auf dem Bildschirm. Durch Klick auf den Pfeil werden weitere Einstellungen angezeigt.

3.2.4 Statusleiste

Die Statusleiste zeigt die derzeitig aktiven Kondensatorstufen und den Status des RVT an. Die Bedeutung der Symbole ist in 3.2.1 beschrieben.

Hardware- und Software-Sperre

Der RVT verfügt über eine Hardware- und eine Software-Sperre. Der Hardware-Schalter in blauer Farbe befindet sich auf der Rückseite des Reglers. Wenn dieser eingedrückt ist, ist der RVT gesperrt und das entsprechende Symbol  erscheint in der Statusleiste unten in der Anzeige. Wenn der Schalter nicht eingedrückt ist, ändert sich dieses Symbol in: . Wenn der RVT gesperrt ist, kann auf keine Anlageneinstellungen zugegriffen werden und auch die Inbetriebnahme (sowohl geführte als auch automatisch) ist nicht möglich.

Das Symbol  bedeutet, dass die Anlageneinstellungen des RVT durch die Software gesperrt sind. Das Symbol  bedeutet, dass die Anlageneinstellungen des RVT durch die Software entsperrt sind. Wenn der Regler über die Software gesperrt ist, sind alle Anlageneinstellungen geschützt, also nicht zugänglich.

Eine Beschreibung der Software-Sperre finden Sie unter 4.3.1.1.

3.2.5Tastatureingabe-Bildschirm

Alle Daten können über einen einfach zu nutzenden Bildschirm eingegeben werden.

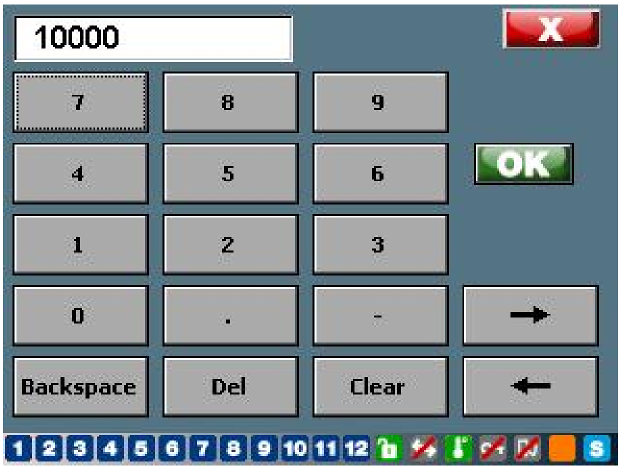
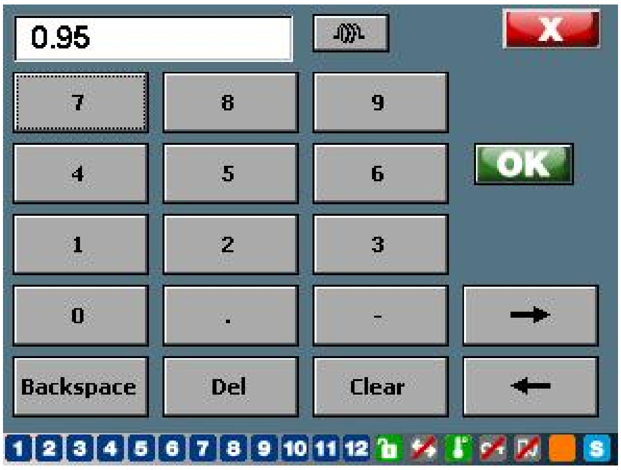


Abbildung 17: Tastatureingabe-Bildschirm

Cos j -Werte können mit den Symbolen (induktiv) und eingegeben (kapazitiv) werden.



3.3 Den RVT starten

Wenn der RVT eingeschaltet wird, erscheint als erstes der Startbildschirm wie in Abbildung 13 angezeigt.

Auf dem Startbildschirm werden vier Symbole angezeigt: Messwerte, Einstellungen, Anlagenüberwachung und Kommunikation. Durch Berührung eines der Symbole wird das entsprechende Untermenü angezeigt.

Die Bedienung des RVT-Reglers ist zurzeit in fünf verschiedenen Sprachen möglich: Englisch, Französich, Deutsch, Spanisch und Chinesisch. Über den folgenden Weg erreichen Sie das Sprachauswahlmenü:

Startbildschirm è Kommunikation è I/O Konfiguration è Sprache einstellen.

3.4 Automatische Inbetriebnahme

Die Inbetriebnahme eines RVT ist sehr einfach. Die automatische Inbetriebnahme-Funktion des RVT unterstützt einen Erstbenutzer dabei, den Regler schnell und einfach zu starten

3.4.1Beschreibung

Der RVT nimmt eine automatische Inbetriebnahme vor, einschließlich:

- automatischer Erkennung der:
    - Phasenlage und Drehfeld für jeden vordefinierten Verbindungstyp
    - Anzahl der verwendeten Ausgänge,
    - Art der Schaltfolge (Wichtungen).
- automatische Einstellung von: - C/k-Werte, Schaltschwelle des RVT; eine genaue Beschreibung des C/k finden Sie in Abschnitt 4.3.1.2.

3.4.2 Vorbereitung einer automatischen Inbetriebnahme

Die vereinfachte Inbetriebnahme erfordert nur die Festlegung folgender Parameter:

- Art der Verbindung. Die Art der Verbindung definiert, in welcher Weise die Stromwandlerverbindungen für den RVT hergestellt werden. Es gibt insgesamt acht verschiedene Verbindungsarten für Stromwandler, abhängig von der Anzahl der Strommessungen und davon, wie die Stromwandler angeschlossen sind. Eine genaue Beschreibung der Verbindungsarten finden Sie im Abschnitt 4.3.1.2.
- Iprim/Isek: derzeitiges Stromwandlerübersetzungsverhältnis (ein Stromwandler 250A / 5A beispielsweise weist ein Iprim/Isek von 50 auf). Weitere Informationen finden Sie in Abschnitt 4.3.1.2.
- Ziel-cos j (in Abschnitt 4.3.1.3.)

3.4.3 Automatische Inbetriebnahme

- Vergessen Sie nicht, falls auf der Sekundärseite des Stromwandlers (CT) eine Kurzschlußbrücke vorhanden ist, diese nach dem Anschließen an den Stromeingang des Reglers wieder zu öffnen.
- Wenn ein Transformator (PT) für die Spannungsmessung verwendet wird, muß das Übersetzungsverhältnis Uprim/Usek entsprechend angepaßt werden (vgl. Abschnitt 4.3.1.)

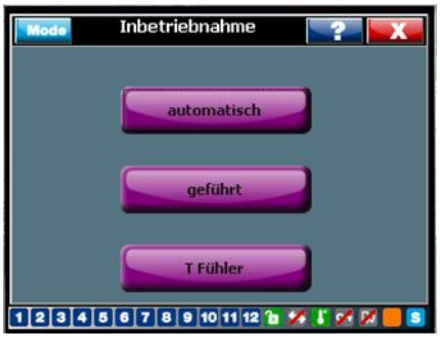
Kommentar: Wenn in der oberen linken Displayecke das Symbol  angezeigt wird, bedeutet dies, daß der RVT verriegelt ist. Der Zugriff auf die Betriebsart SET wird verweigert und die Inbetriebnahme kann nicht durchgeführt werden, bevor der RVT nicht entriegelt wurde (vgl. die Erläuterung in Abschnitt 4.3.1.1.).

In den folgenden Bildschirmfotos wird gezeigt, wie die automatische Inbetriebnahme durchgeführt wird:

1. Startbildschirm, Klick auf “Einstellungen”:

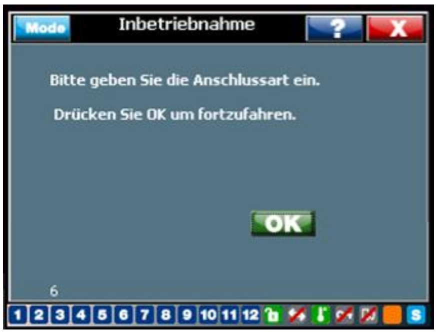
2. Klick auf Inbetriebnahme:

3. Klick auf automatisch:



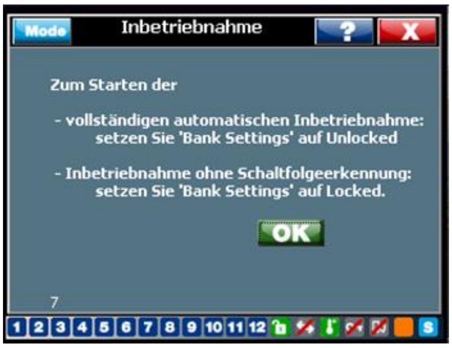
4. Klick auf OK:

5. Klick auf OK:



6. Verbindungsart auswählen (vgl.anhang 7):

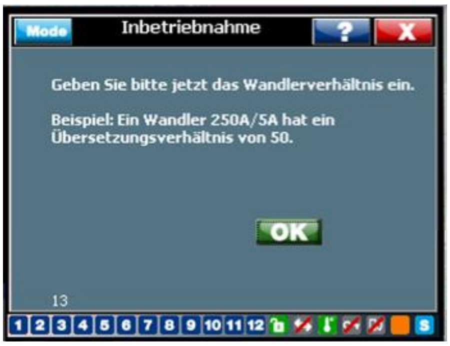
7. Klick auf OK:



8. Sperren bzw. entsperren parametereingabe – OK:

9. Klick auf OK:

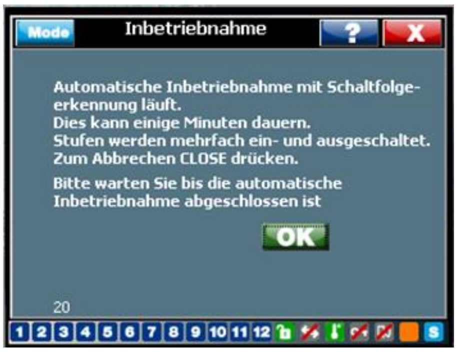
10. Klick auf OK:



11. Eingabe Iprim / Isek : 50:

12. Klick auf OK:

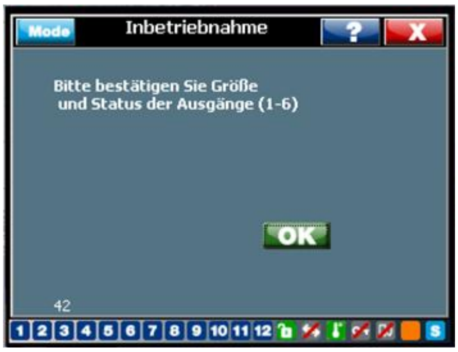
13. Klick auf OK:



14. Klick auf OK:

15. Klick auf OK:

16. Klick auf OK:



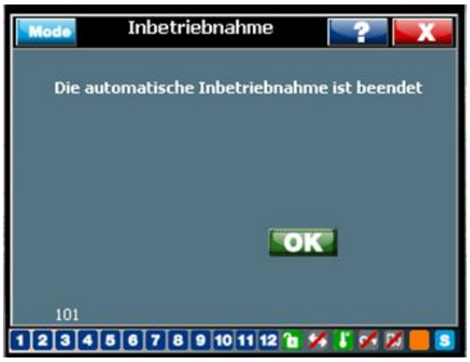
17. Klick auf OK:

18. Klick auf OK:

19. Klick auf OK:

20. Klick auf OK:

21. Inbetriebnahme abgeschlossen:



Der oben dargestellte Vorgang ist eine typische automatische Inbetriebnahme. Einige Einstellungen wie Wandlerübersetzung und Verbindungstyp sind von der Installation abhängig und können vom obigen Beispiel abweichen.

Falls bei der automatischen Inbetriebnahme Fehler auftreten, wird der Benutzer in einer Hilfe angewiesen, die Ursachen hierfür zu finden und die Inbetriebnahme abzuschließen.

4 Messungen und Einstellungen

4.1 Inhalt dieses Abschnitts

Dieser Abschnitt beschreibt alle verfügbaren Menüs/ Untermenüs für Messungen, Programmierung, Anlagenüberwachung etc.

4.2 Messungen

Dieses Hauptmenü zeigt dem Anwender verschiedene Parameter wie Spannung, Strom, Leistung, Temperatur. Von diesem Hauptmenü aus erreichen Sie fünf Untermenü: Übersicht, Detaildaten, Funktion, Messgerät und Ereignisspeicher.

Der RVT ist sehr leistungsfähig hinsichtlich der Messmöglichkeiten und vielseitig in der Darstellung der Werte. Alle Messwerte können in einer Tabelle angezeigt werden. Für Messwerte von Funktionen wie Spannung und Strom kann auch ein Diagramm angezeigt werden. Die Messwerte für Oberschwingungen werden als Balkendiagramm angezeigt.

Übersicht

Das Untermenü Übersicht zeigt die komplette Liste aller Messwerte an.

Detaildaten

Netz-Messwerte wie Spannung, Strom, Leistung, Energie und Temperatur usw. Beim Drehstrom-Modell RVT12-3P sind Detaildaten für jede Phase abrufbar, zum Beispiel der Leistungsfaktor für Phase 1, 2 und 3.

Funktion

Anlagenspannung und Strom (Phase-Phase oder Phasen-Nulleiter) kann als Sinuswelle angezeigt werden.

Ereignisspeicher

In diesem Untermenü kann der Benutzer ungewöhnliche Werte bestimmter Schlüsselparameter einsehen.

Messgerät

Diese Funktion bietet dem Benutzer die Möglichkeit, die drei wichtigsten Messwerte gleichzeitig anzuzeigen. So können zum Beispiel die Spannung der drei Leitungen gleichzeitig und mit einer besseren Auflösung angezeigt werden. Eine genaue Beschreibung dieser Funktion finden Sie in 4.2.4.

4.2.1Übersicht

Details zu allen vom RVT gelieferten Messwerten:

Tabelle 1: Messwerte Übersicht

Bezeichnung	Einheit	Beschreibung			
Spannung			Bereich	Genauigkeit	Max. Anzeigewert
Urms	V	Effektivspannung	Bis zu 690 VAC	± 1 %	$9x10^{6}$ V
U1	V	Effektivwert der Spannungs-Grundschwingung	Bis zu 690 VAC	± 1 %	$9x10^{6}$ V
f	Hz	Grundsschwingungsfrequenz	45Hz - 65Hz	± 0.5%	45Hz - 75 Hz
THDU	%	Gesamtverzerrung der Spannung	0 - 300%	± 1 %	1000 %
Uh-Tabelle		Tabelle der Oberschwingungsspannungen	2. – 49.	vgl. weitere Abschnitte	
Uh-Diagramm		Balkendiagramm der Oberschwingungsspannungen	2. – 49.	vgl. weitere Abschnitte	
Storm			Bereich	Genauigkeit	Max. Anzeigewert
Irms	A	Effektivstrom	0 - 5 A	± 1 %	$9x10^{6}$ A
I1	A	Effektivwert der Strom-Grundschwingung	0 - 5 A	± 1 %	$9x10^{6}$ A
THDI	%	Gesamtverzerrung des Stromes	0 - 300%	± 1 %	1000%
Ih-Tabelle		Tabelle den Oberschwingungsströme	2. – 49.	vgl. weitere Abschnitte	
Ih-Diagramm		Balkendiagramm Oberschwingungsströme	2. – 49.	vgl. weitere Abschnitte	
Leistung			Bereich	Genauigkeit	Max. Anzeigewert
Cos j		Verschiebungsfaktor	-1 - +1	± 0.02	-1 - +1
		Leistungsfaktor	-1 - +1	± 0.02	-1 - +1

P	W	Wirkleistung	-10^{9} è 10^{9} W	± 2%	-10^{9} è 10^{9} W
Q	var	Blindleistung	-10^{9} è 10^{9} var	± 2%	-10^{9} è 10^{9} var
S	VA	Scheinleistung	0 è 10^{9} VA	± 2%	0 è 10^{9} VA
Delta Q	var	Mehrbedarf an Komp.-Leistung zur Vermeidung des cosj -Alarmes	0 è 10^{9} var	± 2%	0 è 10^{9} var
Fehlende Stufen		Mehrbedarf an Kondensatorstufen zur Vermeidung des cosj -Alarmes			
Temperatur (optional)			Bereich	Genauigkeit	Max. Anzeigewert
T1-T8	°C oder °F	Temperatur T1-T8 (externer Temperaturfühler als Option, max. bis zu 8)	-40°C è + 105°C	± 2°C	-40°C è + 150°C
Energien			Bereich	Genauigkeit	Max. Anzeigewert
Gelieferte Wirkenergie	kWh	Wirkenergie ins Netz	0 è 10^{12}	± 3%	0 è 10^{12}
Verbrauchte Wirkenergie	kWh	Wirkenergie zur Last	0 è 10^{12}	± 3%	0 è 10^{12}
Gesamte Wirkenergie	kWh	Summe der gelieferten und der verbrauchten Energie	-10^{12} è 10^{12}	± 3%	$-^{1012}$ è 10^{12}
Induktive Blindenergie	kvarh	Induktive Energie	0 è 10^{12}	± 3%	0 è 10^{12}
Kapazitive Blindenergie	kvarh	Kapazitive Energie	0 è 10^{12}	± 3%	0 è 10^{12}
Gesamte Blindenergie	kvarh	Summe der induktiven und der Kapazitiven Energie	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
Gesamte Scheinenergie	kVAh	Summe der Wirk-und Blindenergie	0 è 10^{12}	± 3%	0 è 10^{12}

- Alle Messungen stellen Durchschnittswerte über einen Zeitraum von 1 Sekunde dar.
- Wenn ein Spannungswandler (Transformator) für die Spannungsmessung verwendet wird, können die Messungen der Oberschwingungsspannung aufgrund des Filterverhaltens des Transformators fehlerhaft sein. Durch Einsatz eines hochwertigen Spannungswandlers läßt sich dieser Fehler auf ein Minimum verringern

(1) Die Bereichswerte müssen mit dem CT-Verhältnis (Irms - I1 – P – Q – S – missing Q) und dem PT-Verhältnis (Urms - U1 - P - Q – S - missing Q) multipliziert werden.

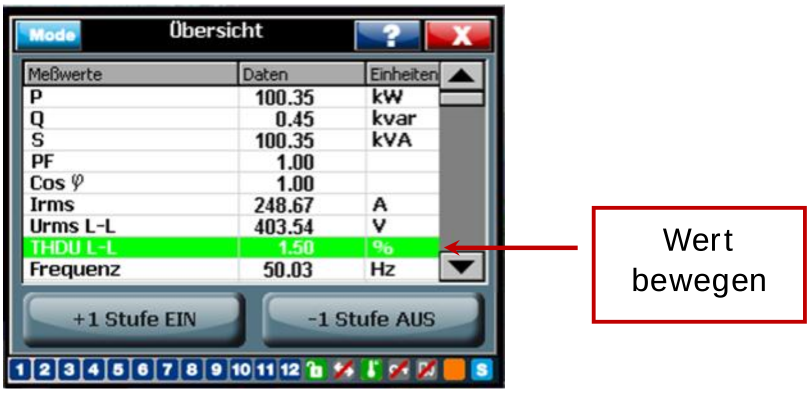
(2) Verschiebungsfaktor oder cos j : die Berechnung beruht auf den Grundschwingungen der Meßwerte. Dieser Wert wird als Referenzwert von den Energieversorgungsunternehmen herangezogen.

(3) Leistungsfaktor: die Berechnung beruht auf der Grund- und den Oberschwingungen der Meßwerte. Der Leistungsfaktor ist grundsätzlich kleiner oder gleich dem Verschiebungsfaktor.

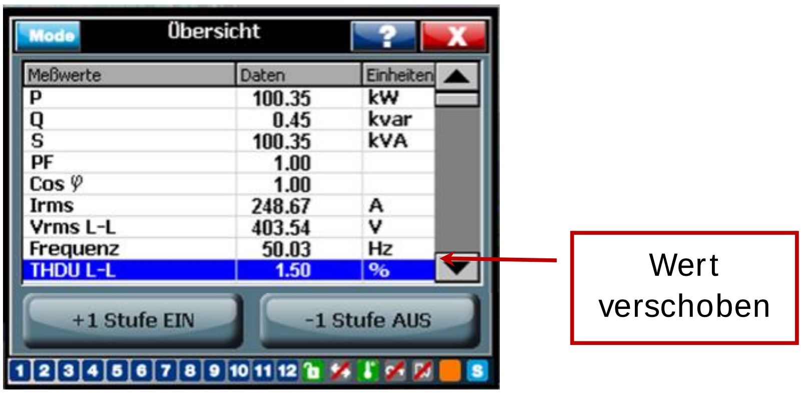
Das Menü Übersicht zeigt alle Messwerte in einer Liste.

Der Benutzer kann die Anzeige der Messwerte auf seine speziellen Bedürfnisse anpassen, indem er die wichtigen Werte in der Liste an die gewünschte Position rückt.

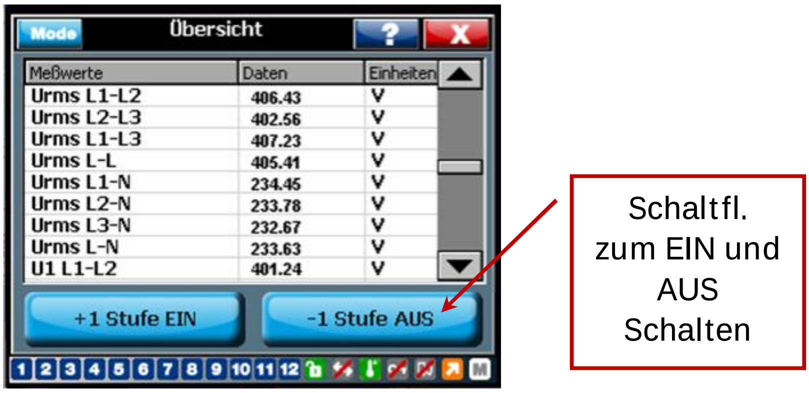
Klicken Sie auf einen Wert in der Liste, um ihn zu bewegen (im Beispiel unten ist der Wert THDU L-L gewählt)



Klicken Sie dann auf die Position, an die der Wert in der Liste bewegt werden soll (im folgenden Beispiel wird der Wert THDU L-L an die Position der Frequenz verschoben, wobei dieser Wert automatisch nach unten rückt)



Die Übersicht ist auch ein Menü, in dem einige Schritte manuell ein- und ausgeschaltet werden können. Gehen Sie in die Betriebsart "Manuell", indem Sie die “Mode”-Taste drücken.



Die Schaltflächen „+1Stufe EINschalten“ und „-1 Stufe AUSschalten“ sind jetzt verfügbar.

Klicken Sie Sie auf diese Schaltflächen, um Stufen manuell zu schalten.

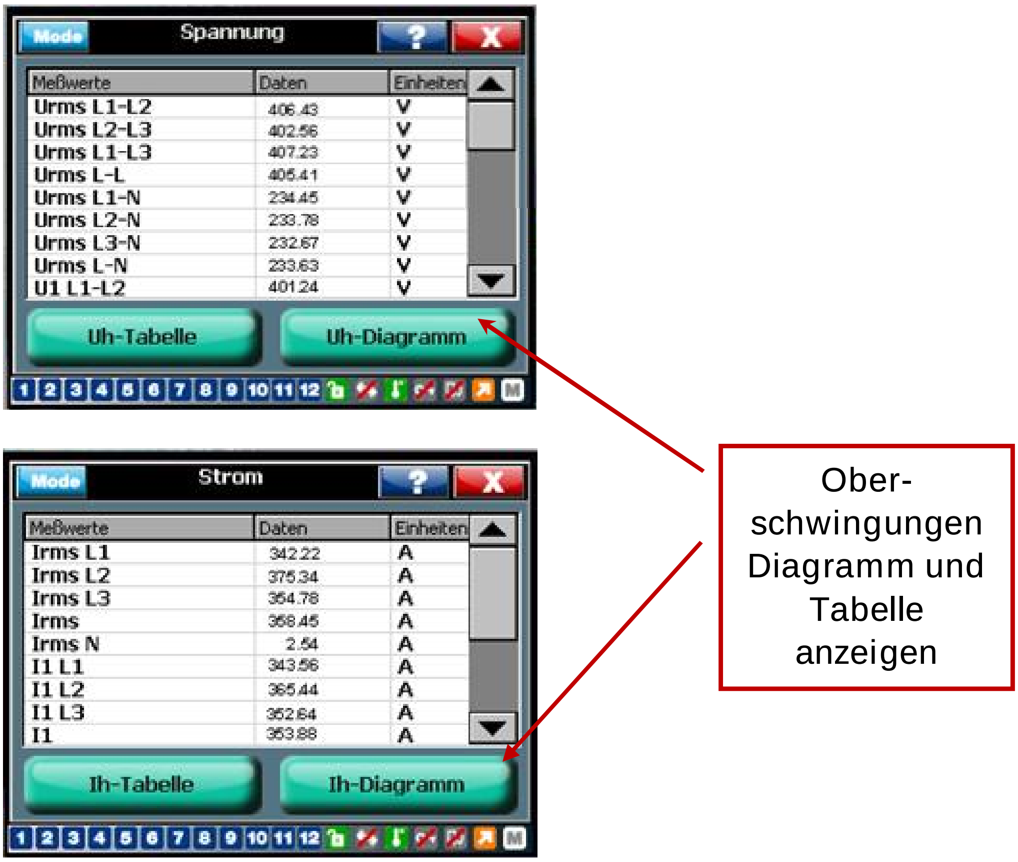
Hinweis: Das Modell RVT12-3P zeigt einen neuen Bildschirm an, in dem Sie gefragt werden, welche Art von Schritt (de)aktiviert werden soll. Unterschiede in den Stufen Sind in 4.3.1.1. beschrieben.

4.2.2 Detaildaten

Das Menü Detaildaten zeigt alle gemessenen Anlagenwerte sortiert nach Art wie in Abbildung 18 dargestellt. Beim Drehstrom-Modell RVT12-3P werden auch die Detaildaten für jede einzelne Phase angezeigt.

Abbildung 18: Detaildaten

Spannungs- (Strom-) Messwerte



Spannung (Strom) Oberschwingungen Diagramm und Tabelle

Oberschwingungsspannungen/-ströme können wie unten dargestellt als Balkendiagramm angezeigt werden. Eine Scrollleiste dient dazu, eine bestimmte Oberschwingung auszuwählen, die oben am Bildschirmrand angezeigt wird: die Ordnungszahl, der Wert und der Prozentanteil von der Grundfrequenz.

Für Spannungs- und Stromwerte kann der RVT die Oberschwingungsspannungen und -ströme in einer Tabelle oder einem Spektrum anzeigen. Klicken Sie auf die Schaltfläche “Auswahl”, um anzugeben, welcher Messwert in der Tabelle oder im Diagramm angezeigt werden soll.

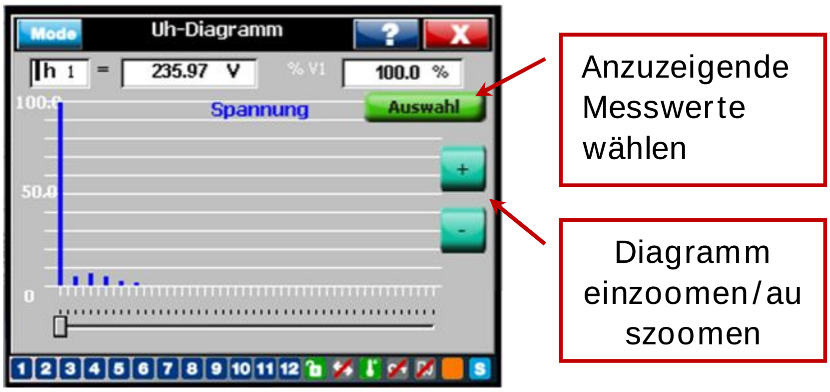


Abbildung 19: Oberschwingungsspannung in Diagramm

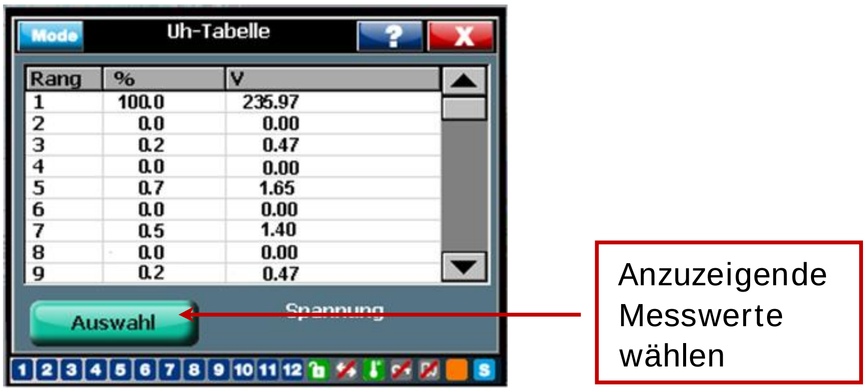
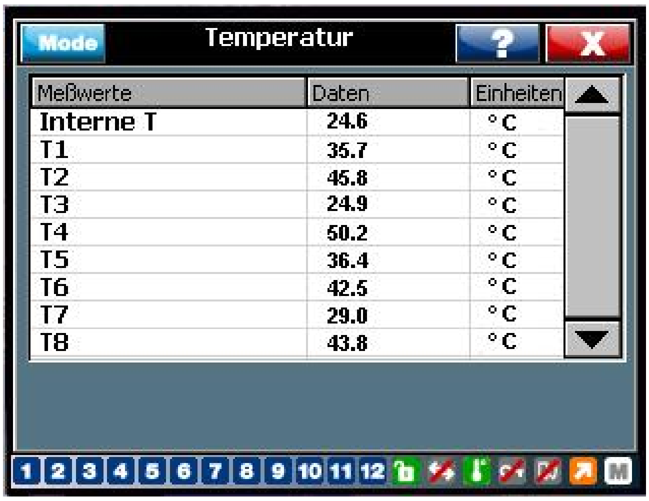


Abbildung 20: Oberschwingungsspannung in Tabelle

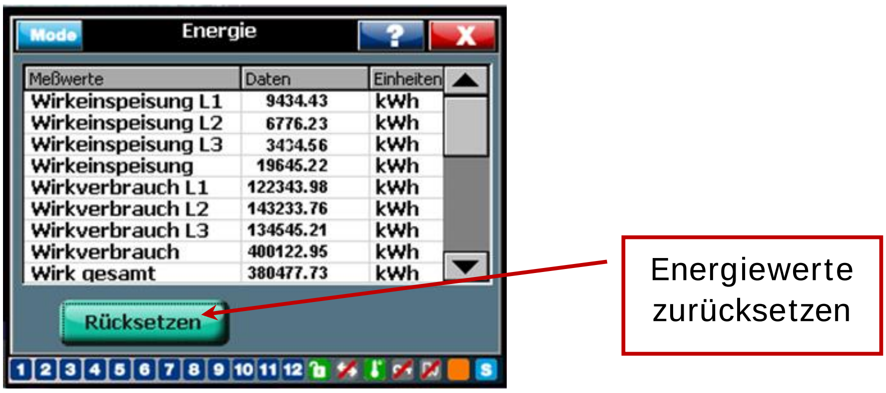
Anmerkung: Genauigkeit bei Messungen von Oberschwingungsspannung(-strom): ± 1 % of Urms (Irms)

Leistung, Leistungsfaktormessungen

Temperaturmessungen



Energiemessungen



Energiemessungen können nur mit dem RVT12-3P durchgeführt werden (das Drehstrom-Modell ist mit einer Echtzeituhr ausgestattet).

Energiewerte können auf 0 zurückgesetzt werden.

4.2.3 Wellenform

Verfügbare Spannungs- und Stromsignale (abhängig von RVT-Typ und Anschluß) und der Phasenstrom können als Wellenform auf dem Display angezeigt werden. Abbildung 21 zeigt die Spannungsfunktion zwischen Leiter und Nulleiter.

Abbildung 21: Spannung und Stromfunktionen

4.2.4 Messgerät

In der großen Anzeige sind die drei wichtigsten Messwerte für Benutzer am besten zu sehen.

Klicken Sie auf den gewünschten Wert und klicken Sie dann auf die Schaltfläche“Auswahl”, um Werte in die Messgeräte-Ansicht einzufügen.

Unten wird ein Beispiel mit drei wichtigen Messwerten angezeigt.

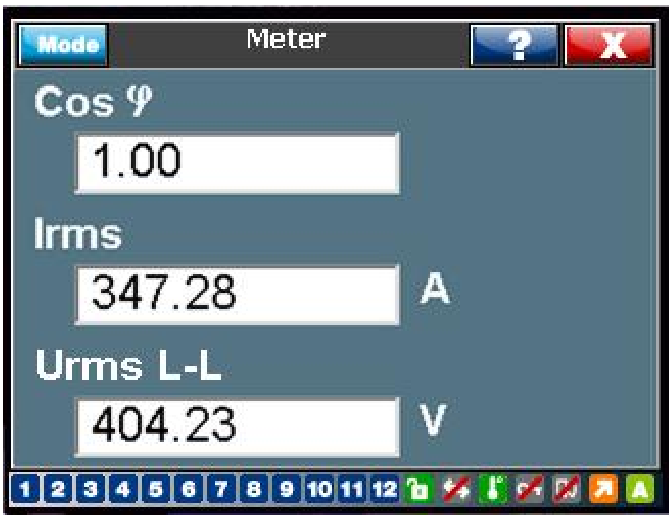


Abbildung 22: drei Messwerte in der Messgerät-Ansicht

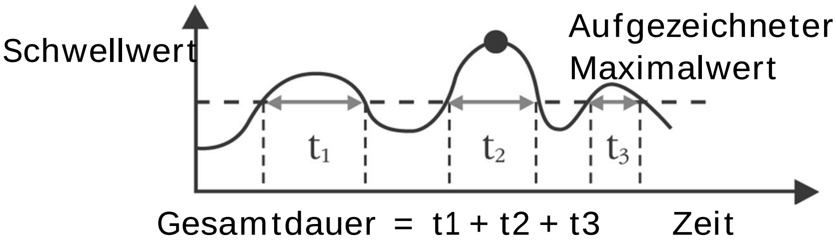
4.2.5 Ereignisspeicher

Beschreibung

Die Ereignisspeicherfunktion ermöglicht dem Benutzer für alle bedeutenden Meßwerte (vgl. dazu die nachstehende Aufstellung) und seit der letzten Speicherlöschung die Speicherung folgender Werte:

- den höchsten (bzw. niedrigsten) aufgetretenen Wert,
- die über (bzw. unter) dem Schwellwert liegende Dauer.

Im Anschluß an die Einstellung eines Schwellwertes (vgl. das Beispiel unten) beginnt der RVT automatisch, die Höchstwerte (bzw. Niedrigstwerte) sowie die jeweilige Gesamtdauer der Schwellwertüberschreitung bis zur nächsten Speicherrückstellung zu speichern.



Aufzeichnung

Die Ereignisspeicherfunktion ermöglicht dem Benutzer die Aufzeichnung der Dauer, während der ein Meßwert den Schwellwert überschreitet, sowie dessen Höchstwert, für folgende Parameter: Urms[V], Irms[A], P[kW], Q[kvar], S[kVA], THDU[%], THDI[%], Delta Q[kvar], Frequenz* [Hz], T1* [°C oder °F] bis T8* [°C oder °F].* Niedrigstwerte und die Dauer der Unterschreitung eines Schwellwertes werden für die Frequenz und die Temperaturen ebenfalls aufgezeichnet.

Abbildung 23: Ereignisspeicher aufgezeichnete Werte

Beispiel

Aufzeichnung der Urms-Meßwerte. Netzspannung: 400 V.

Abbildung 24: Ereignisspeicher Schwellwert-Einstellung - Urms

Abbildung 25: Ereignisspeicher Schwellwert-Einstellung - Frequenz

Die aufgezeichnete Information (Höchstwert und Gesamtdauer) kann mit der Schaltfläche Rücksetzen auf 0 gestellt werden.

4.3 Einstellungen

Das Hauptmenü Einstellungen hat verschiedene Untermenüs, über die der Benutzer den Regler programmieren kann sowie eine Inbetriebnahme und Funktionstests durchführen kann.

4.3.1Handeinstellung (Betriebsart Einstellungen)

Über die Handeinstellung hat der Benutzer Zugriff auf alle Einstellungen der Anlage, Benutzereinstellungen und Schutz-/Warnkonfigurationen. Von diesem Untermenü aus können auch die Werkseinstellungen wieder hergestellt werden.

Abbildung 26: Handeinstellung

Bevor irgendwelche Einstellungen vorgenommmen werden, vergewissern Sie sich, dass sich der Regler in der Betriebsart Einstellungen befindet. Beachten Sie hierzu bitte 3.2.4 und 4.3.1.1. zur Umschaltung der Betriebsart und das Sperren/Entsperren des Geräts.

4.3.1.1 Anlagendaten

Start->Einstellungen->Handeinstellungen->Anlagendaten

Das Menü „Anlagendaten“ beinhaltet alle mit der Kompensationsanlage zusammenhängenden Konfigurationsparameter.

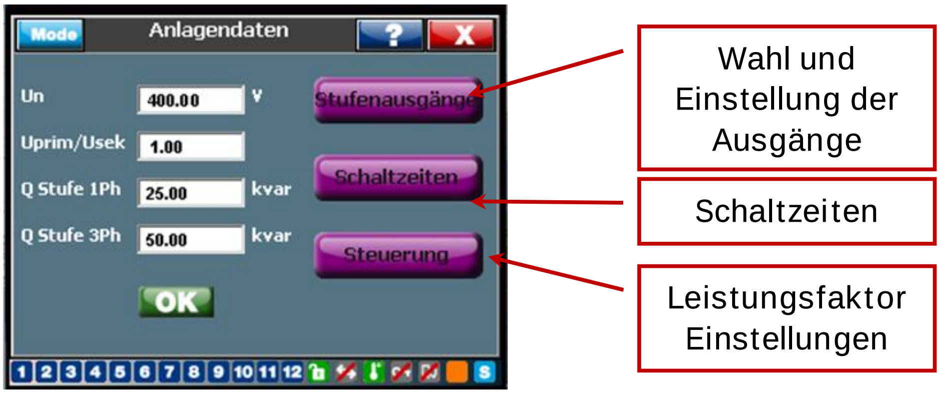


Abbildung 27: Anlagendaten

Im Folgenden wird eine Liste der Anlagenparameter angezeigt.

Un: Anlagen-Nennspannung.

Wenn die Nennspannung geändert wird, werden der Unter- und Überspannungsschutz automatisch auf 80% bzw. 120% von Un eingestellt. Diese Schutzeinsstellungen können von Hand geändert werden.

Uprim / Usek: Spannungswandler-Übersetzungsverhältnis

Beispiel: Für einen Spannungswandler 15kV / 100V: Uprim / Usek = 150.

Wenn kein Spannungswandler verwendet wird: Uprim / Usek = 1.

Diese Funktion ermöglicht es, eine MS-Kondensatorbank mit einem RVT zu regeln. Ein geeigneter Spannungswandler muß mit den Meßeingängen des RVT verbunden werde, der Regler zeigt dann die MS-seitigen Meßwerte an.

Q Stufe 1-phasig: geringste Stufengröße für Einphasennetz (Phasen-Nulleiter)-Kondensatoren, die für die Leistungsfaktorkompensation einer einzelnen Phase in einem unsymmetrisch belasteten Netz verwendet werden.

Q Stufe 3-phasig: geringste Stufengröße für Drehstromkondensatoren in einem symmetrisch belasteten Netz.

Für die beiden obigen Einstellungen:

a) Nach einer automatischen Inbetriebnahme wird dieser Wert entsprechend der kleinsten Stufen in der Kompensationsanlage eingestellt.

b) Bei der geführten Inbetriebnahme (siehe 4.2.2.2) muss dieser Wert manuell eingestellt werden.

Zum Beispiel in einer Kompensationsanlage mit sowohl Einzelphasen- (3 Stufen) als auch Dreiphasen- (3 Stufen) Leistungsfaktorkompensation:

Einphasen Schaltfolge*: 1 (5 kvar) 2 (10 kvar) 2 (10 kvar) è Q Stufe 1-phasig = 5 kvar

Dreiphasen Schaltfolge: 1 (10 kvar) 2 (20 kvar) 2 (20 kvar) è Q Stufe 3-phasig = 10 kvar

Oder,

Dreiphasen Schaltfolge: 2 (15 kvar) 4 (30 kvar) 5 (37,5 kvar) è Q Stufe = 7,5 kvar

*Schaltfolge: Wichtung der von den Stufenausgängen geschalteten Kondensatorleistungen. Diese relativen Werte liegen zwischen 0 und 8.

Für beide Modelle, das Grundmodell RVT6/RVT12 und das Drehstrom-Modell RVT12-3P ist die werksseitig voreingestellte Schaltfolge: 1:1:….:1. Eine andere Schaltfolge kann manuell eingegeben werden.

Um eine eigene Schaltfolge anzugeben, folgen Sie im Menü den folgenden Unterpunkte:

Startbildschirm â Einstellungen â Handeinstellungen â Anlagendaten â Stufenausgänge.

Abbildung 28 zeigt die Ausgänge 1 - 6, klicken Sie auf den Pfeil , um in die verbleibenden Ausgänge 7-12 angezeigt zu bekommen, wie in Abbildung 29 zu sehen.

Abbildung 28: RVT Ausgänge 1-6

Abbildung 29: RVT Ausgänge 7-12 (Drehstrom-Modell RVT12-3P)

Rechts auf dem Bildschirm werden unter “Status” sechs Attribute jedes Ausgangs aufgeführt:

“Fest AUS”: Dieser Ausgang ist deaktiviert (Werkseinstellung);

“Fest EIN”: Dieser Ausgang ist aktiviert (der entsprechende Kondesator ist immer verbunden);

“1PhL1, 1Phl2, 1PhL3”: Dieser Ausgang steuert einen Phasen-Nulleiter-Kondensator, der an Phase 1, 2 oder 3 ist.

“3Ph”: Dieser Ausgang steuert einen 3-Phasen-Kondensator.

Beim Grundmodell RVT6/RVT12 stehen nur “Fest AUS", "Fest AN" und "Aktiviert” zur Verfügung. Ein Ausgang muss auf “Aktiviert” gesetzt werden, bevor der Regler einen Kondensator ein- oder ausschaltet.

Einige typische Ausgangseinstellungen für das Drehstrom-Modell RVT12-3P:

Typische Einstellung eins: 12 Stufen mit Einphasenkondensatoren (Phase-N-Leiter) Kondensatoren:

Abbildung 30: Typische Ausgangseinstellungen 12 x 1ph (Drehstrom-Modell RVT12-3P)

Typische Einstellung zwei: 6 Stufen mit Dreiphasenkondensatoren + 6 Stufen mit Einphasenkondensatoren (Phase-Neutralleiter):

Abbildung 31: Typische Ausgangseinstellungen 6 x 3ph + 6 x 1ph (Drehstrom-Modell RVT12-3P)

Schaltzeiten

Mit Klick auf die Schaltfläche “Schaltzeiten” im Bildschirm gezeigt in Abbildung 27 kann der Benutzer im Folgebildschirm die Einschaltverzögerung für die Anlage eingeben.

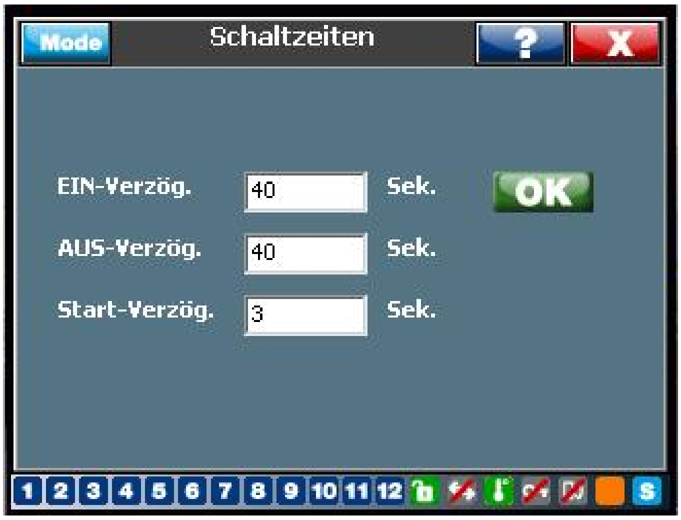


Abbildung 32: RVT Einstellen der Schaltzeiten

EIN-Verzögerung:

- bei normaler Messung muß über diese Zeit dauernd eine Anforderung bestehen, um Stufen zuzuschalten.
- bei integraler Messung ist dies die Integrationsdauer zwischen zwei Schaltentscheidungen.

Die Einschaltverzögerung ist erforderlich, damit sich die Kondensatoren vor dem Wiederzuschalten sicher entladen können.

Warnung: eine zu kurze Einschaltverzögerung kann die Anlage nachhaltig beschädigen

AUS-Verzögerung:

- bei normaler Messung muß über diese Zeit dauernd eine Anforderung bestehen, um Stufen abzuschalten.
- bei integraler Messung wird die Ausschaltverzögerung nicht verwendet.

Start-Verzögerung: die Zeit, die der RVT abwartet, bevor er den Regelbetrieb nach einem Spannungsausfall wieder aufnimmt.

Mit Klick auf die Schaltfläche “Steuerung” im Bildschirm gezeigt in Abbildung 27 kann der Benutzer im Folgebildschirm die Einstellungen für die Stromwandler-Messungen und die Schaltstrategien für die Anlage eingeben.

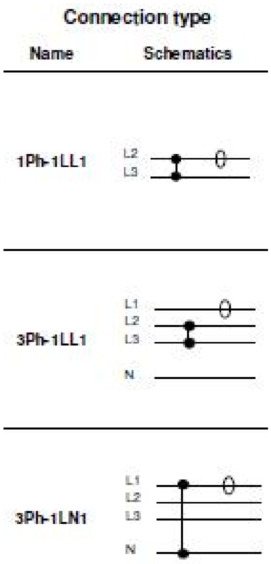
Abbildung 33: RVT Einstellung der Anlagensteuerung

1Ph / 3Ph

Diese Einstellung gibt die Art der Verbindung für die Strommessungen an. Der RVT erlaubt acht verschiedene Stromwandler-Verbindungstopologien je nach Art des Netzes (Dreiphasen-Drei Leitungen, Dreiphasen-Vier Leitungen oder einphasig (Phase-Phase) :

Einphasige Strommessung (Beim Basismodell RVT6 / 12 und beim RVT12-3P):

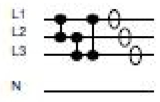
1Ph-1LL1, 3Ph-1LL1, 3Ph-1LN1,



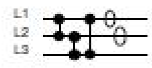
Dreiphasige Strommessung (Nur beim Dreiphasenmodell RVT12-3P):

3Ph-3LL3, 3Ph-3LL2 (Bei diesem Anschlußtyp darf kein N-Leiter vorhanden sein), 3Ph-3LN3, 3Ph-1LL3, 3Ph-1LN3.

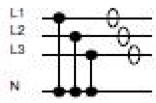
3Ph-3LL3



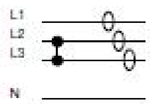
3Ph-3LL2



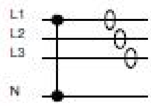
3Ph-3LN3



3Ph-1LL3



3Ph-1LN3



Die Verbindungstypen sind beschrieben in A7. Abbildung der Stromwandler-Verbindungstypen und Stromwandler-Verdrahtung an den Regleranschlüssen im Anhang am Ende dieser Anleitung.

Definition der oben genannten Verbindungsarten:

3Ph – 3 LN 3

- 3: 1: ein Stromwandleranschluß, 2: zwei Stromwandleranschlüsse, 3: drei Stromwandleranschlüsse
- LN: LN: Spannungsmessung zwischen Phase und N
LL: Spannungsmessung zwischen 2 Phasen
- 3: 1: Spannungsmesung einphasig, 3: Spannungsmessung dreiphasig
- 3Ph: 1Ph: Einphasiges Netz (L-N oder L-L), 3Ph: Dreiphasennetz

Bitte beachten: L steht für Phase, N für Neutralleiter

Linear / Kreis (Lin./Circ. auf dem Bildschirm)

Lineare Schaltung erfolgt nach dem Schaltungsprinzip „first in, last out".

Kreis-Schaltung erfolgt nach dem Schaltprinzip „first in, first out".

Die beiden Vorgänge sind in der nachstehenden Tabelle beschrieben.

Die Kreisschaltung verlängert die Lebensdauer der Kondensatoren und Kontakte, indem die Belastungen auf alle Ausgänge ausgewogen verteilt werden.

Bei „Double First Step"-Schaltfolgen (1:1:2:2:..., 1:1:2:4:4.,...) wirkt die Kreisschaltung auf die ersten beiden Ausgänge und die höchstgewichteten Ausgänge.

Linear

	C1	C2	C3	C4	...	C11	C12
Schaltfolge	1	1	1	1		1	1
	■	□	□	□	...	□	□
↗	■	■	□	□	...	□	□
↗	■	■	■	□	...	□	□
↘	■	■	□	□	...	□	□
↘	■	□	□	□	...	□	□

Kreis

	C1	C2	C3	C4	...	C11	C12
Schaltfolge	1	1	1	1		1	1
	■	□	□	□	...	□	□
↗	■	■	□	□	...	□	□
↗	■	■	■	□	...	□	□
↘	□	■	■	□	...	□	□
↘	□	□	■	□	...	□	□

ì Anforderung für das Einschalten einer Stufe

î Anforderung für das Abschalten einer Stufe

n Ausgangskontakt geschlossen

o Ausgangskontakt offen

Progressiv / Direkt (Prog./Direct auf dem Bildschirm)

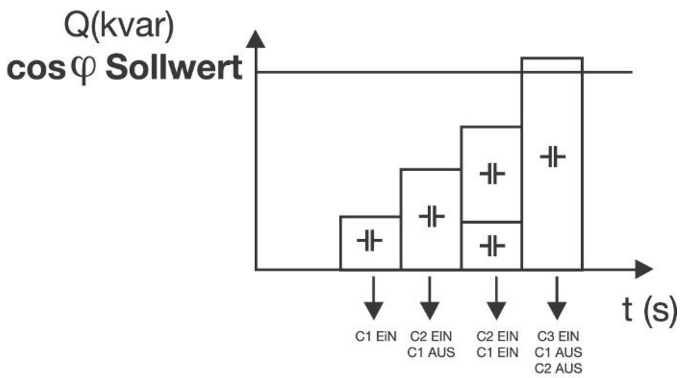
Beim progressiven Schalten wird Stufe für Stufe einzeln gemäß der ON-delay-Zeit geschaltet.

„Direct operation“ schaltet zuerst die größtmöglichen Stufen und dann kleinere mit einer festen Verzögerung von 12 s um den Ziel cos j schnellstmöglich zu erreichen.

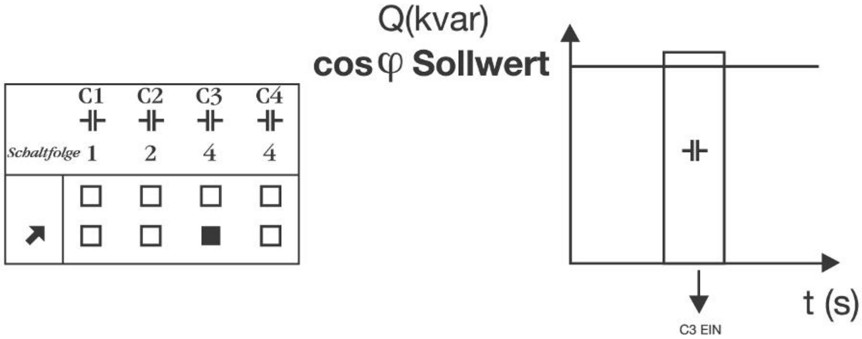
Das direkte Schalten vermeidet zahlreiche unnötige Zwischenschritte.

Progressiv

	C1	C2	C3	C4
Schaltfolge	1	2	4	4
	■	□	□	□
↗	□	■	□	□
↗	■	■	□	□
↗	□	□	■	□



Direkt

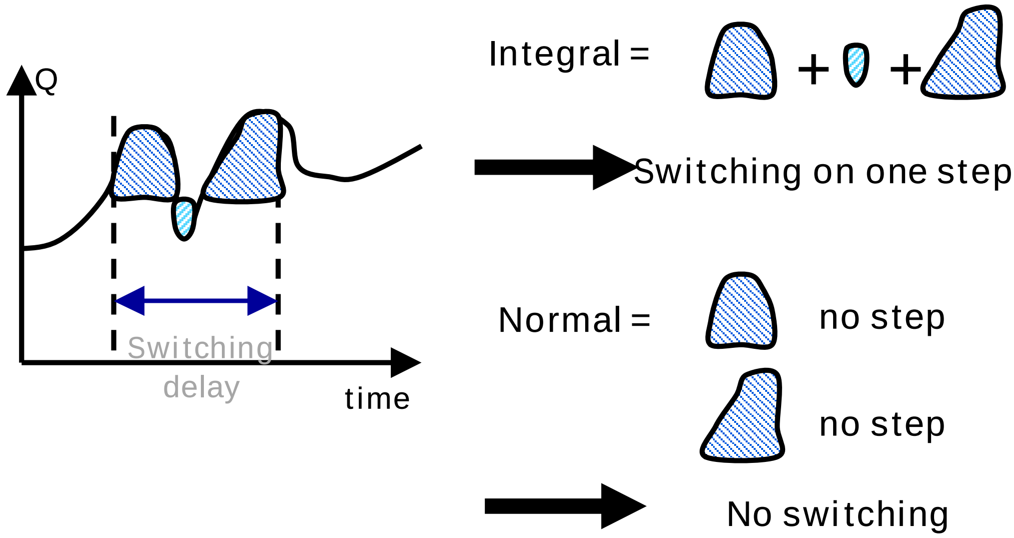


Normal / Integral (Normal/Int. auf dem Bildschirm)

Bei der normalen Meßmethode schalten Stufen, wenn die Schaltanforderung während der gesamten Verzögerungszeit ständig anliegt.

Bei der integralen Meßmethode schalten Stufen entsprechend dem Mittelwert des während der Verzögerungszeit erfaßten Änderungsbedarfs.

Die integrale Methode empfiehlt sich für Anwendungen mit sich schnell und häufig ändernden Lasten.



Schutz vor Änderung der Anlageneinstellungen (Software-Sperre)

Die Anlageneinstellung kann gegen einen unauthorisierten Zugriff sowohl per Hardware als auch per Software geschützt werden. Die Hardware-Sperre wird in 3.2.4 beschrieben. Im folgenden Bildschirm wird gezeigt, wie die Software-Sperre funktioniert. Dies ist der Pfad zum Bildschirm in Abbildung 34:

Startbildschirm â Einstellungen â Handeinstellungen â Anlagendaten â Steuerung.

Abbildung 34: RVT Schutz der Anlageneinstellungen: nicht geschützt

Um die Anlageneinstellungen zu schützen, klicken Sie in das Kästchen hinter “Parametereingabe frei”; die Bildschirmanzeige ändert sich dann wie in Abbildung 35.

1. Die Einstellungsfelder sind jetzt ausgegraut
2. “Parametereingabe frei” wird zu “Parametereingabe gesperrt"
3. In der Statusleiste ist das Symbol für das Softlock aktiviert: 

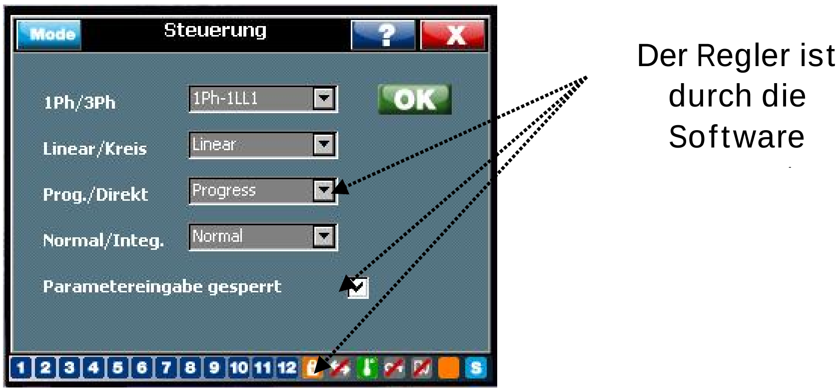


Abbildung 35: RVT Schutz der Anlageneinstellungen: geschützt

4.3.1.2 Anschlussdaten

Startbildschirm-> Einstellungen-> Handeinstellungen-> Anschlussdaten

Die RVT-Anschlussdaten geben an, wie die Stromwandlerparameter eingestellt werden.

Abbildung 36: RVT-Anschlussdaten

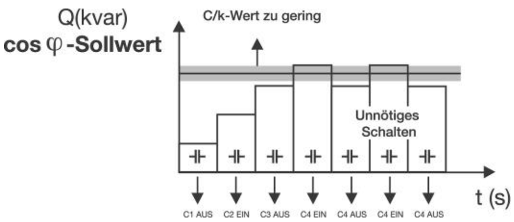
Iprim / Isek: Stromwandlerübersetzungsverhältnis (wird auch mit k bezeichnet)

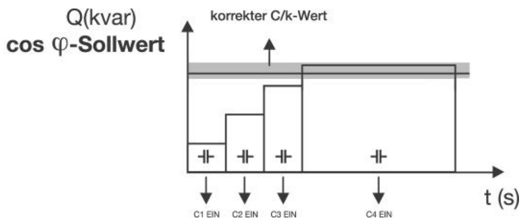
Beispiel: ein Stromwandler 250 A / 5 A weist einen Wert k = Iprim / Isek von 50 auf.

C / k-Wert: Schaltschwelle des RVT-Blindleistungsreglers. Diese beträgt üblicherweise 2 / 3 des Stromes der Kondensatorstufe (Q Stufe) auf der Sekundärseite des Wandlers (Erläuterung in Abschnitt 4.3.1.1).

Der C / k-Wert beschreibt die Ansprechschwelle des RVT für das Ein- und Ausschalten von Kondensatorstufen. Der C / k-Wert kann zwischen 0.01 und 5 programmiert werden.

Das nachstehende Beispiel zeigt die Auswirkungen eines zu geringen C / k-Wertes und wie sich daraus unerwünschtes Pendelschalten ergeben kann:





Ein zu hoher C / k-Wert führt (insbesondere in Niederlastzeiten) zu unnötig großen Regelabweichungen vom voreingestellten cos j -Sollwert.

Die empfohlene C / k-Einstellung kann anhand der nachstehenden Formel errechnet oder unmittelbar der nachstehenden Tabelle entnommen werden.

Formel:

Drehstromnetz

$$C/k = 0.67 \; x \; \frac{QStufe \; (Kvar) \; x \; 1000}{\sqrt{3} \; x \; U_N \; (V) x \; K}$$

Einphasenstromnetz

$$C/k = 0.67 \; x \; \frac{QStufe \; x \; 1000}{U_N \; (V) x \; K}$$

Table 2: Tabelle für Drehstromnetz 400V

CT-Verhältnis		K	Kondensatorstufen (kvar)											
			5	10	15	20	30	40	50	60	70	90	100	120
10/1	50/5	10	0.48	0.97	1.45	1.93	2.90	3.87	4.84					
20/1	100/5	20	0.24	0.48	0.73	0.97	1.45	1.93	2.42	2.90	3.38	4.35	4.84	
30/1	150/5	30	0.16	0.32	0.48	0.64	0.97	1.29	1.61	1.93	2.26	2.90	3.22	3.87
40/1	200/5	40	0.12	0.24	0.36	0.48	0.73	0.97	1.21	1.45	1.69	2.18	2.42	2.90
60/1	300/5	60	0.08	0.16	0.24	0.32	0.48	0.64	0.81	0.97	1.13	1.45	1.61	1.93
80/1	400/5	80	0.06	0.12	0.12	0.24	0.36	0.48	0.60	0.73	0.85	1.09	1.21	1.45
100/1	500/5	100	0.05	0.10	0.15	0.19	0.29	0.39	0.48	0.58	0.68	0.87	0.97	1.16
120/1	600/5	120	0.04	0.08	0.12	0.16	0.24	0.32	0.40	0.48	0.56	0.73	0.81	0.97
160/1	800/5	160	0.03	0.06	0.09	0.12	0.18	0.24	0.30	0.36	0.42	0.54	0.60	0.73
200/1	1000/5	200	0.02	0.05	0.07	0.10	0.15	0.19	0.24	0.29	0.34	0.44	0.48	0.58
300/1	1500/5	300	0.02	0.03	0.05	0.06	0.10	0.13	0.16	0.19	0.23	0.29	0.30	0.39
400/1	2000/5	400	0.01	0.02	0.04	0.05	0.07	0.10	0.12	0.15	0.17	0.22	0.23	0.29
600/1	3000/5	600	0.01	0.02	0.02	0.03	0.05	0.06	0.08	0.10	0.11	0.15	0.15	0.19

Hinweis:

Beim RVT12-3P sind zwei C/k-Werte möglich: C/k 1ph und C/k 3ph; beim RVT6/RVT12 ist nur C/k möglich.

C/k 3ph (oder C/k) trifft auf Anlagen mit ein, zwei oder drei Stromwandler zu (symmetrisch belastetes Drehstromnetz); C/k 1ph ist für Anlagen mit drei Stromwandlern (unsymmetrisch belastetes Drehstromnetz). Es wird angenommen, dass für ein unsymmetrisch belastetes Drehstromnetz ein einheitlicher C/k 1ph für das Schalten drei einzelner einphasiger Kondensatorstufen eingesetzt werden (Alle Einphasenstufen müssen gleichgroß sein).

Es wird angenommen, dass alle mit dem RVT12-3P verbundenen Stromwandler (zwei oder drei Stromwandler mit verschiedenen Verbindungsarten) das gleiche Stromwandlerübersetzungsverhältnis haben. Die geringste Stufe für einphasige Kondensatorstufe und dreiphasige Kondensatorstufe könnte jedoch unterschiedlich sein; hieraus ergeben sich zwei verschiedene C/k-Werte für RVT.

Phasenlage (Nur beim Grundmodell): Phasendifferenz zwischen Spannung und Strom, die durch die Wahl der Meßanordnung bewirkt wird.

Wenn der RVT wie auf dem in Abschnitt 2.4, beschriebenen Schaltbild angeschlossen ist, beträgt diese Phasenverschiebung 90° (Voreinstellung).

Für andere Anschlüsse kann die zu programmierende Phasenverschiebung den Tabellen in Anlage A6 entnommen werden.

Berücksichtigen Sie dabei bitte, daß der RVT die Phasenlage bei der automatischen Inbetriebnahme selbständig anpassen kann.

4.3.1.3 Benutzereinstellungen

Startbildschirm-> Einstellungen-> Handeinstellungen-> Benutzereinstellungen

Die Benutzereinstellungen ermöglichen es den Benutzern, verschiedene Sollwerte für Leistungsfaktoren und Alarm-Verzögerungen anzugeben.

Abbildung 37: RVT Benutzereinstellungen

Ziel-cos j : Sollwert des Verschiebungsfaktors (Regelungsziel).

Der cos j -Sollwert kann zwischen 0,70 induktiv und 0,70 kapazitiv eingestellt werden.

zeigt einen induktiven cos j -Wert, einen kapazitiven cos j -Wert an.

NT cos j : alternativer Verschiebungsfaktor für die Tag/Nacht-Umschaltung (voreinstellungsmäßig deaktiviert).

Die Umschaltung vom Ziel-cos j auf den NT cos j -(Niedertarif) erfolgt durch ein externes Signal, das am Eingang OPTO1 (Erläuterung in Abschnitt 2.4) angelegt wird.

Abbildung 38: RVT Benutzereinstellungen: NT und Gen. Verschiebungsfaktor aktivieren

Gen. cos **j** : alternativer Verschiebungsfaktor für netzparallen Generatorbetrieb. Wird bei Wirkleistungsrückspeisung P < 0 wirksam. (voreinstellungsmäßig deaktiviert).

Alarm: Menü zur Einstellung der Parameter zur Beschreibung der Bedingungen für einen cos j -Alarm. Die Bedingung für einen cos j Alarm ist erfüllt, wenn: alle Kondensatorstufen eingeschaltet sind und der gegenwärtige Wert für cos j unter dem vorgegebenen Schwellwert für Alarm-cos j liegt und somit mindestens eine weitere Stufe erforderlich ist.

- Alarmverzögerung: Mindestdauer der Alarmbedingung, bis der Meldekontakt geschlossen wird.
- Rückstellungsverzögerung: die Dauer, bevor sich der Meldekontakt nach Ende der Alarmbedingung wieder öffnet.
- Alarm-cos j -Schwellwert: threshold value

4.3.1.4 Schutz und Warnungen

Startbildschirm-> Einstellungen-> Handeinstellungen-> Schutz/Warnungen

Der RVT kann beim Überschreiten bestimmter Grenzwerte vorgegebene Aktionen durchführen. Der Schutzlevel reagiert dabei stärker als bei Warnungen.

Abbildung 39: RVT Einstellungen Schutz und Warnungen

4.3.1.4.1 Schutzfunktionen

Abbildung 40: RVT Einstellung der Schutzfunktionen

Schutz: Einstellung der Auslösewerte zum Schutz gegen Unterspannung, Überspannung, unzulässigen THDU, Übertemperatur und für die Aktivierung eines externen Schutzes initiiert durch den opto-isolierten Eingang 2. Das Alarmrelais hat einen NO- und einen NC-Kontakt.

Sobald ein Auslösewert erreicht ist, erfolgen die nachstehenden Aktionen:

- alle Kondensatorstufen werden abgeschaltet
- auf dem Display wird eine Alarmmeldung angezeigt
- das Alarmrelais ist aktiviert (NO geöffnet / NC geschlossen)
- das Symbol  wird hervorgehoben

Hinweis: Wenn der das externe Eingangssignal IN2 (Beschreibung in Abschnitt 2.4.) angelegt wird werden alle Stufen abgeschaltet und der Parameter „Externer Schutz“ aktiviert den Alarmkontakt:

- Abschaltung und Alarm
- Nur Abschaltung (kein Alarm)

Trifft die Auslösebedingung nicht mehr zu, nimmt der RVT nach Ablauf einer Verzögerungszeit die Reglertätigkeit wieder auf. Die Verzögerungszeit hängt von der Art der Störung ab. Der Neuanlauf nach einer Alarmauslösung ist im Anhang A4 eingehend erläutert.

Hinweis : wenn aktiviert, kann die externe Fehlerüberwachung (Ext. Schutz) durch Anlegen eines Signals an den RVT-Eingang OPTO2 (vgl. Abschnitt 1.4) die Funktion auslösen.

4.3.1.4.2 Warnungen

Bei Warnungen wird grundsätzlich weniger stark reagiert, als bei Verletzungen der Schutzstufe. Wenn eine Warnstufe erreicht wird, werden die folgenden Aktionen durchgeführt:

- wird das Lüfter- / warnungrelais aktiviert: wird der NO-Kontakt geschlossen
- Das Symbol  wird hervorgehoben

Abbildung 41: RVT Warneinstellungen

4.3.1.4.3Temperatur-Schutz

Der RVT bietet acht Temperaturschutzvorrichtungen mittels acht Temperaturfühlern. Die Schutzstufe kann für jeden Temperaturfühler einzeln eingestellt werden. Wenn eine der acht Temperatur-Schutzstufen verletzt wird

- werden alle Kondensatoren abgeschaltet
- erscheint eine Alarmmeldung in der Anzeige
- wird das Alarmrelais aktiviert (NO geöffnet / NC geschlossen)
- un die Symbole  und  leuchten auf

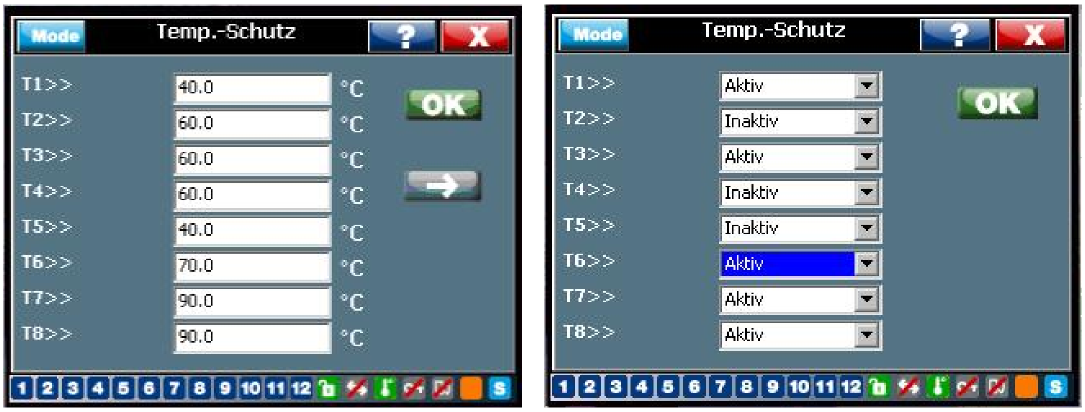


Abbildung 42: RVT Einstellung der Temperatur-Schutzfunktionen

4.3.1.4.4Temperatur-Warnungen

Der RVT bietet acht Temperatur-Warnungen mittels acht Temperaturfühlern. Die Warnstufe kann für jeden Temperaturfühler einzeln eingestellt werden. Wenn eine der acht Temperatur-Warnungen ausgegeben wird

- wird das Lüfter- / warnungrelais aktiviert: wird der NO-Kontakt geschlossen
- Das Symbol  wird hervorgehoben

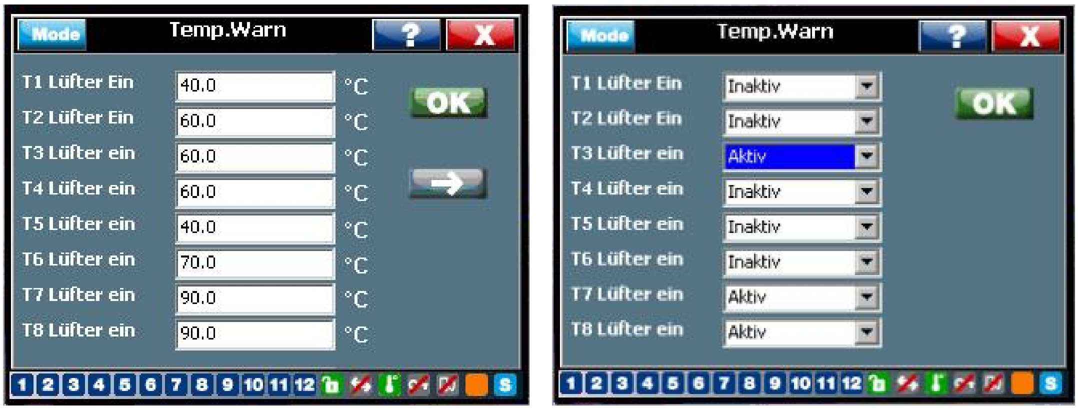


Abbildung 43: RVT Temperatur-Warneinstellungen

Hinweis 1: der RVT ist mit einem Eigenschutz gegen Innentemperaturen über 85°C ausgestattet. Bei Überschreitung dieses Wertes wird die beschriebene Aktion ausgelöst wenn die Innentemperatur dieser Schutzschwelle überschreitet. Der RVT nimmt den Betrieb automatisch wieder auf, sobald die Innentemperatur unter 80°C abgefallen ist.

Hinweis 2: der Schutz gegen Übertemperatur ist voreinstellungsmäßig deaktiviert. Wenn ein Grenzwert eingegeben wird überprüft der RVT den Temperaturfühler.

4.3.1.5 Grundeinstellungen wiederherstellen

Startbildschirm-> Einstellungen-> Handeinstellungen-> Grundeinstellung

Abbildung 44: RVT Grundeinstellungen wiederherstellen

Durch Aufruf und Bestätigung der Funktion „Rücksetzen aller Parameter auf die Grundeinstellungen“ (Menü-Punkt „Grundeinstellung“) werden alle Werte der RVT-Parameter auf deren Voreinstellungswerte zurückgesetzt (vgl. das dem RVT beiliegende separate Dokument). Dies gilt nicht, wenn die Einstellung der Anlagenparameter gesperrt ist. In diesem Fall bleiben die Anlagenparameter unverändert.

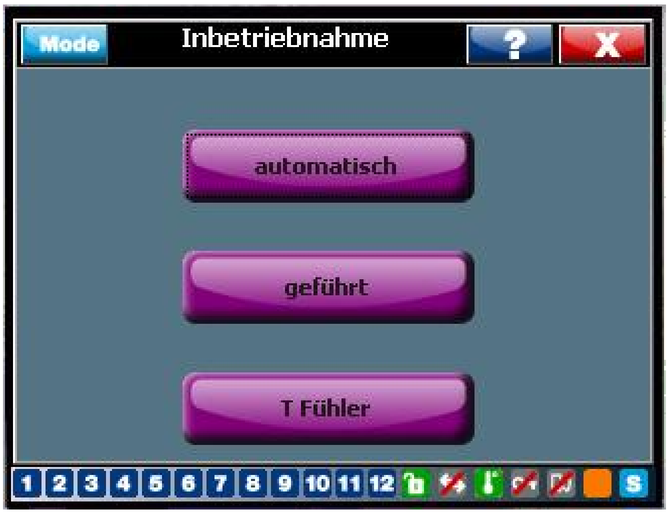
Warnung: Dabei können wichtige Parameter unwiederbringlich gelöscht werden.

Anmerkung: Stellen Sie vor einer Rückstellung auf die Grundeinstellungen folgendes sicher:

- daß der RVT entriegelt ist (Erläuterung in Abschnitten 3.2.4 und 4.3.1.1)
- daß sich der RVT im SET-Modus befindet (Erläuterung in Abschnitt 3.2.2.)

4.3.2 Inbetriebnahme (SET-Modus)

Mit diesem Untermenü kann der Anwender eine automatische Selbstprogrammierung oder eine geführte manuelle Programmierung des Reglers durchführen.



4.3.2.1 Einfache Inbetriebnahme

Beziehen Sie sich bitte auf die vollständige Erläuterung in Abschnitt 3.4.

4.3.2.2 Geführte Inbetriebnahme

Der RVT führt Sie schrittweise durch die Liste der einzustellenden Parameter. Die folgenden Parameter (siehe nachstehende Tabelle) müssen Sie eingegeben.

Anmerkungen:

Stellen Sie vor der geführten Inbetriebnahme sicher, daß:

1. der RVT entriegelt ist (Erläuterung in Abschnitt 3.2.4 und 4.3.1.1).

2. der RVT sich im SET-Modus befindet (Erläuterung in Abschnitt 3.2.2).

3. Vergessen Sie nicht, wenn der Stromwandler sekundärseitig kurzgeschlossen ist, die Kurzschlußbrücke wieder zu öffnen, nachdem Sie den Stromeingang des Reglers angeschlossen haben.

Bei der geführten Inbetriebnahme einzugegebende Parameter

Parameter	Beschreibung
1Ph / 3Ph	Anschlußkonfiguration der Anlage und der RVT-Meßeingänge.
Phasenverschiebung	Kontrolle der Phasenverschiebung
Iprim / Isek	Stromwandlerübersetzungsverhältnis
Stromwandler Umlenkung	Lenkt Stromwandlereingänge um, wenn der Stromwandler an die falsche Phase angeschlossen ist
Phasenlage	Durch die Anschlußkombination bedingte Phasendifferenz zwischen Strom und Spannung. Die Voreinstellung 90° gilt für einen Anschluß entsprechend dem Regler-Schaltbild (vgl. Abschnitt 2.4) zu. Andere Anschlußarten: s. Anhang A5.
Uprim / Usek	Übersetzungsverhältnis für einen externen Spannungstransformator.
Un	Anlagen-Nennspannung
EIN-Verzög. AUS-Verzög.	Einschaltverzögerung Ausschaltverzögerung
Schaltfolge	Wichtung (Wertigkeit)der Stufenausgänge
Q Stufe	Leistung der kleinsten Stufe (Stufenleistung entsprechend der Wichtung 1)
C / k	Einstellen der Schaltschwelle
Ziel-cos j	Sollwert für den Verschiebungsfaktor.

4.3.2.3 T-Fühlererkennung

An den RVT können bis zu acht Temperaturfühler (in Reihe geschaltet) angeschlossen werden. Jeder Fühler muss vor der Verwendung folgendermaßen in Betrieb genommen werden.

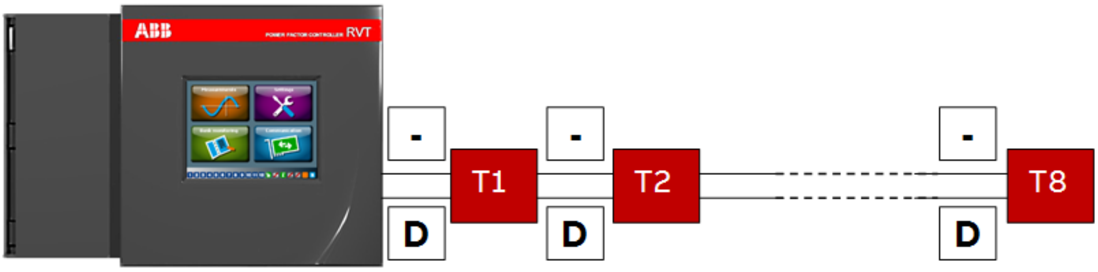
Jeder Fühler muss einzeln erkannt werden:

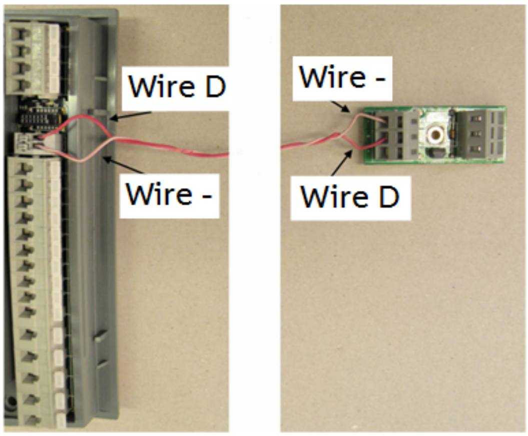
- Schließen Sie den Fühler an einen Eingang für Temperaturfühler an (jeweils nur ein Fühler)
- Klicken Sie auf die Zeile, um eine Fühlernummer zuzuweisen
- Klicken Sie auf die Schaltfläche “Start”
- Der RVT erkennt automatisch die Fühleradresse
- Führen Sie diesen Vorgang für jeden Fühler durch

Wenn einer der Fühler ein Problem hat, kann er mit der Schaltfläche "Löschen" gelöscht werden.

Nach einer erfolgreichen Erkennung wird jedem aktivierten Fühler eine eindeutige Adresse zugewiesen.

Abbildung 45: T-Fühler-Erkennung





4.4 Überwachung

Unter Überwachung kann der Benutzer Schaltspiele, den Alarmspeicher, Testfunktionen und eine Echtzeituhr aufrufen (Nur das Dreiphasenmodell RVT12-3P hat eine Echtzeituhr). Hierdurch stehen ihm sinnvolle Diagnosemöglichkeiten zur Verfügung.

Abbildung 46: Überwachung

4.4.1 Schaltspiele

Gibt die Anzahl der Schaltspiele für alle Ausgangskondensatorrelais seit der Herstellung des RVT an.

Ausgang	Anzahl
1	863
2	456
3	385
4	436
5	428
6	397
7	422
8	386
9	0
10	0
11	0
12	0

Abbildung 47: Schaltspiele

4.4.2 Testfunktionen

In diesem Untermenü ermöglicht dem Benutzer die Überprüfung jedes einzelnen Ausgangsrelais des RVT.

Alarmtest: ermöglicht das Testen des Alarmrelais

Lüftertest: ermöglicht das Testen des Lüfterrelais.

Test der Stufenausgänge: ermöglicht das Testen jedes einzelnen Stufenausganges. (Der RVT überwacht die programmierten Verzögerungszeiten)

Abbildung 48: Überwachung Testfunktion

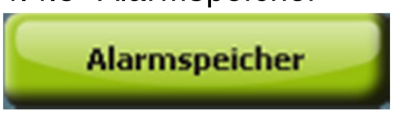
Abbildung 49: Test der Stufenausgänge

Klicken Sie die Kästchen an um das entsprechende Relais ein- oder auszuschalten

Bevor Sie mit den Testfunktionen fortfahren, stellen Sie sicher, dass:

- der RVT entsperrt ist (Beschreibung in den Abschnitten 3.2.4 und 4.3.1.1)
- der RVT sich in der Betriebsart Einstellungen befindet (Beschreibung in Abschnitt 3.2.2.)

4.4.3 Alarmspeicher



Der Alarmspeicher zeigt die letzten fünf Alarmmeldungen einschließlich des Zeitpunkts an.

Abbildung 50: Alarmspeicher

4.4.4 Echtzeituhr

Abbildung 51: RVT Echtzeituhr

Die Echtzeituhr des RVT läuft weiter, auch wenn das Gerät nicht angeschlossen ist.

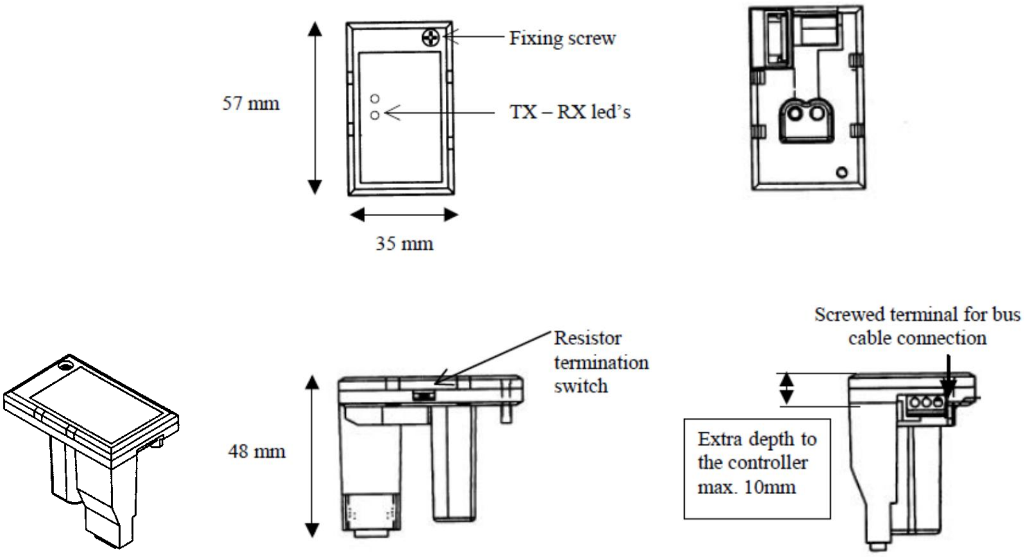
4.5 Kommunikation

Der RVT bietet verschiedene Kommunikationmöglichkeiten. Von diesem Hauptmenü aus erhalten Sie Zugriff auf die Sprachenwahl, die Einstellungen der Temperatureinheit, die Bildschirmkonfiguration sowie Einstellungen für Netzwerk und Modbus. Weitere Informationen zu Modbus-, USB- und TCP/IP-Protokoll und deren Programmierung finden Sie im Handbuch: 2GCS213013A0050_RVT Kommunikation über Modbus-, USB- oder TCPIP-Protokoll.

RS485 / Modbus-Adapter

Der Modbus-Adapter ist ein optionales Gerät für den RVT-Blindleistungsregler, der den Anschluss des RVT an ein RS485 Modbus-System ermöglicht. Der Regler wird im Modbus-Netz als Slave-Einheit angesehen.

Beachten Sie die 2GCS214013A0050-RVT Modbus RS485-Adapter Benutzeranleitung für weitere Informationen zum RS485 Modbus-Adapter.



Beachten Sie, dass der RS485 MODBUS-ADAPTER durch die GRÜNE Textfarbe gekennzeichnet ist (3,3V Stromversorgung).

Der mit WEISSER Textfarbe gekennzeichnete ist für das alte Modell (5V Stromversorgung) reserviert.

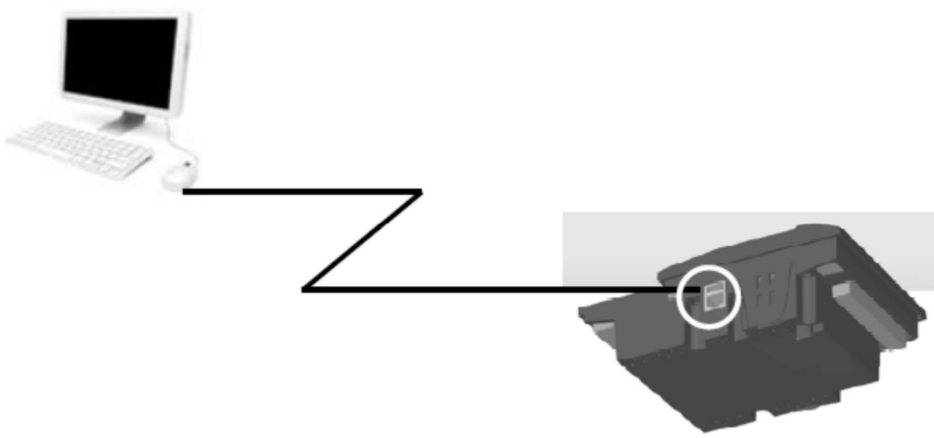
Dies bedeutet: Der neue Modbusadapter ist nicht kompatibel mit dem alten RVT; der alte Modbusadapter funktioniert nicht mit dem neuen RVT (mit Touchscreen).

Netzwerk / TCP/IP

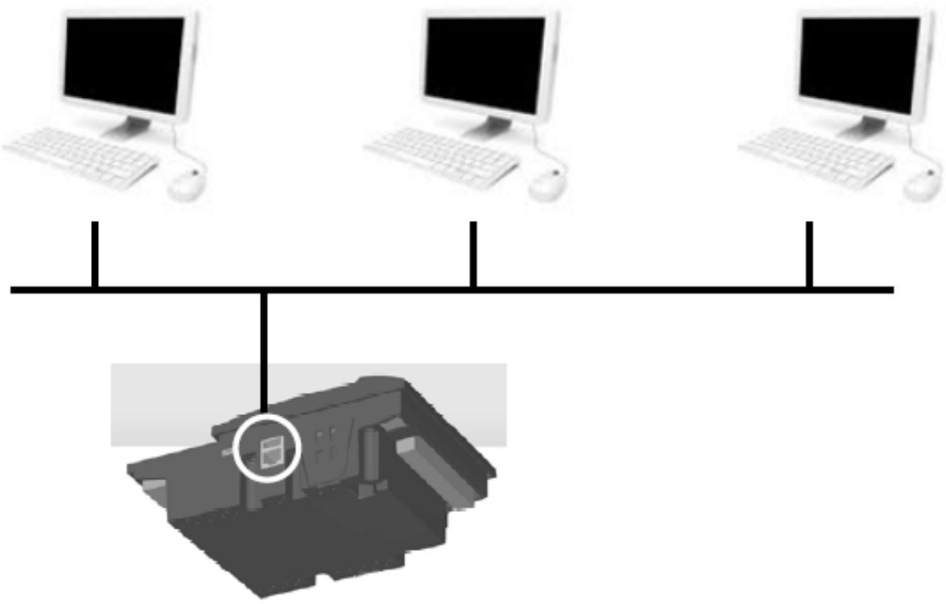
TCP/IP-Verbindungen können lokal oder über Fernverbindungen hergestellt werden.

Der standardmmäßig verwendete TCP-Port ist 4250.

Der Anschluss am RVT erfolgt über ein RJ45 Cat5e Netzwerkkabel.



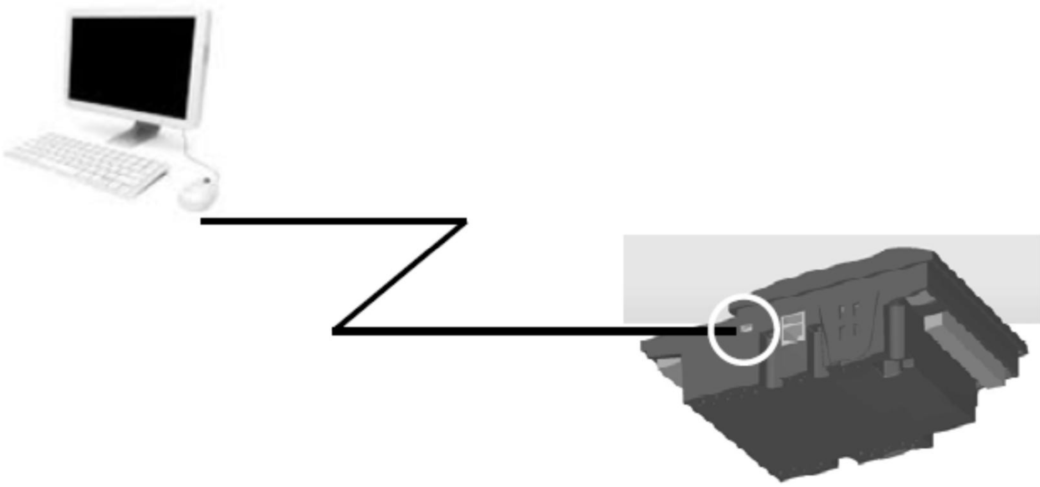
Der RVT kann direkt über das LAN oder über das Internet verbunden werden



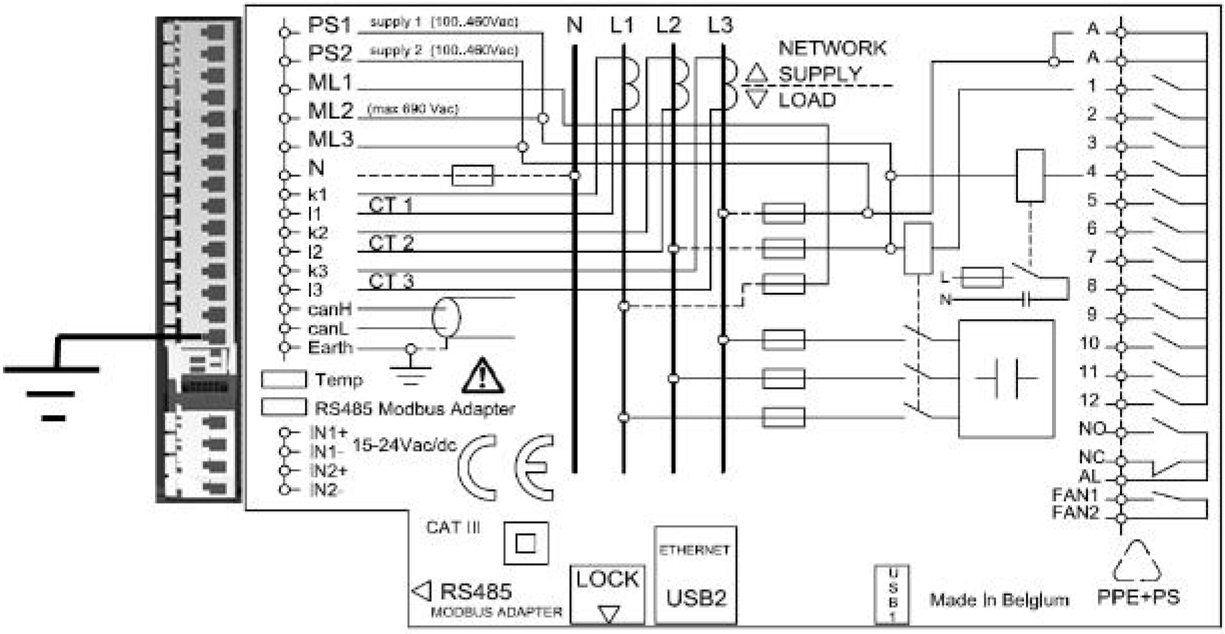
USB

Die USB-Schnittstelle dient dazu, den RVT mit einer seriellen Schnittstelle an seinem USB-Port auszustatten.

Ein Computer wird über einem USB-A Stecker auf USB-Mini B Stecker angeschlossen



Achtung: Der USB-Anschluss zum RVT ist nicht isoliert. Es ist zwingend notwendig die Erdung anzuschließen, wenn der USB-Anschluss verwendet wird.



4.5.1 I/O Konfiguration

Abbildung 52: RVT I/O Konfiguration

4.5.1.1 Sprachenwahl

Es stehen fünf verschiedene Bediensprachen für den RVT zur Auswahl.

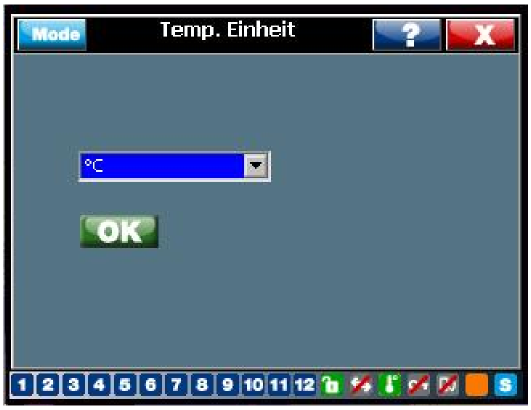
Der Benutzer muss zum Hauptmenü zurückkehren, damit die gewählte Sprache verwendet wird.

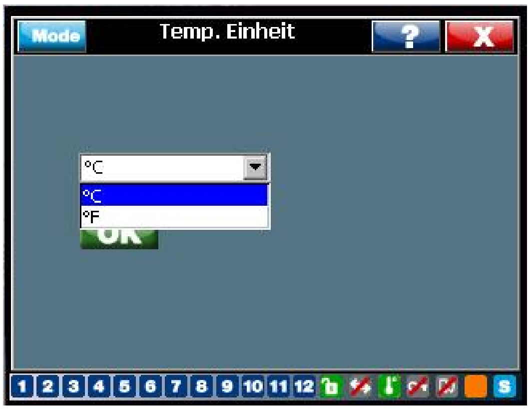
Abbildung 53: RVT Sprachauswahl

4.5.1.2 Temperatureinheit

Hier kan zwischen zwei Temperatureinheiten gewählt werden: Celsius und Fahrenheit.

Die gewählte Einheit wird für alle Temperaturmessungen und Einstellungen verwendet.

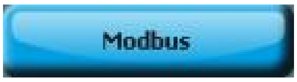




4.5.1.3 Allgemeine Einstellungen

Modbus- und Netzwerkverbindungen müssen konfiguriert werden.

Abbildung 54: RVT Einstellung des Kommunikationsprotokolls



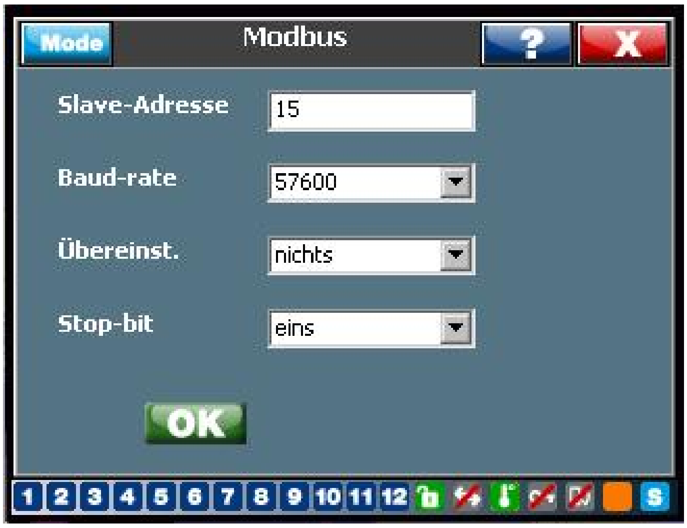


Abbildung 55: RVT Einstellung des Modbus-Protokolls

Die Slave-Adresse wird vom Modbus-Master verwendet, um den RVT über Modbus anzusprechen.

Baudrate, Übereinst. und Stop-bit müssen übereinstimmen mit den Kommunikationseinstellungen des Modbus Masters, der das RS485 / Modbus Netzwerk steuert.

Der RVT braucht eine IP-Adresse, um sich direkt mit einem PC oder einem Netzwerk zu verbinden.

Diese IP-Adresse kann fest vergeben und eingetragen werden, wenn DHCP deaktiviert ist. Die Standardadresse ist 192.168.1.40.

Wenn die IP-Adresse von einem Gateway oder im LAN automatisch vergeben wird, stellen Sie DHCP auf aktiviert.

Es folgen einige Beispiele:

Beispiel 1: Im Bildschirm unten werden die Grundeinstellungen angezeigt, um sich direkt mit einem PC zu verbinden (beachten Sie, dass beim PC hierbei die feste IP-Adresse 192.168.1.1, Subnet-Maske 255.255.255.0 und DHCP deaktiviert angegeben wurde).

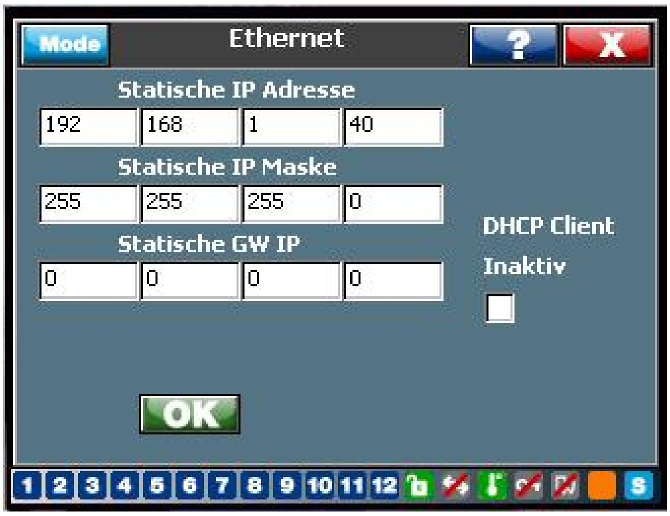


Abbildung 56: RVT TCP/IP-Protokolleinstellungen

Beispiel 2: Im Bildschirm unten werden die Grundeinstellungen angezeigt, um sich mit einem Netzwerk zu verbinden (beachten Sie, dass der PC, der ebenfalls mit dem LAN verbunden ist, seine eigene IP-Adresse über DHCP erhalten hat)

Weitere Informationen zu Kommunikation Sie im Handbuch: 2GCS213013A0050_RVT communication through Modbus, USB or TCPIP protocol.

Starten Sie den RVT, um es mit diesen Parametern zu initialisieren.

4.5.2 Ethernet Konfiguration

In diesem Menü werden die gegenwärtige IP-Adresse, die IP-Maske und die Gateway-IP des RVT angezeigt.

Je nach DHCP-Status kann die angezeigte Information unterschiedlich sein.

In den Bildschirmen unten werden die Ergebnisse der Beispiele 1 und 2 angezeigt:

Beispiel 1: Der folgende Bildschirm zeigt die feste IP-Adresse bei abgeschaltetem DHCP.

Beispiel 2: Der folgende Bildschirm zeigt die Einstellungen an, die sich bei einer automatischen Adressvergabe durch DHCP ergeben.

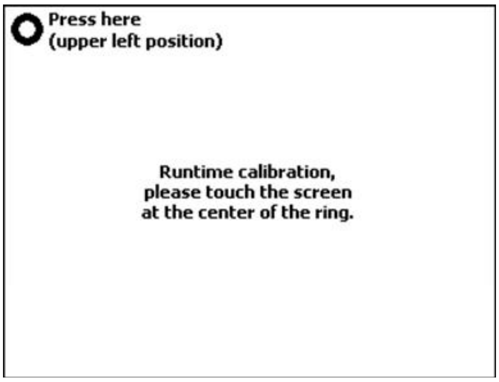
4.5.3 Screen Konfiguration

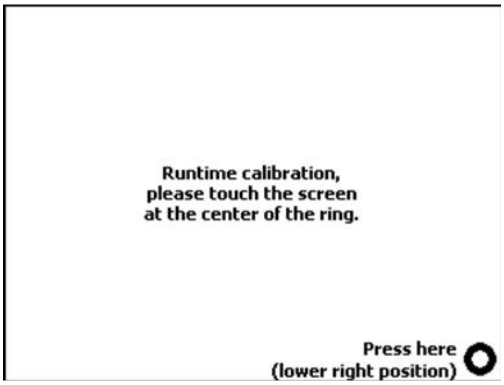
Über dieses Menü kann der Benutzer die XY-Koordinaten und die Helligkeit der Hintergrundbeleuchtung des Touchscreens einstellen.

Eine Kalibrierung des Touchscreens ist i.d.R. bei einer normalen Nutzung des Touchscreens unter normalen Bedingungen nicht notwendig.

Um einen Ausfall der Touchscreen-Bedienschnittstelle zu verhindern, hat der Benutzer die Möglichkeit zur manuellen Kalibrierung der XY-Koordinaten, die dazu dienen, die Bedienung der Schaltflächen zu erkennen.

Warnung: Die Kalibrierung des Touchscreens muss vorsichtig mit einem Stift durchgeführt werden, damit die Kalibrierpunkte präzise erkannt werden!





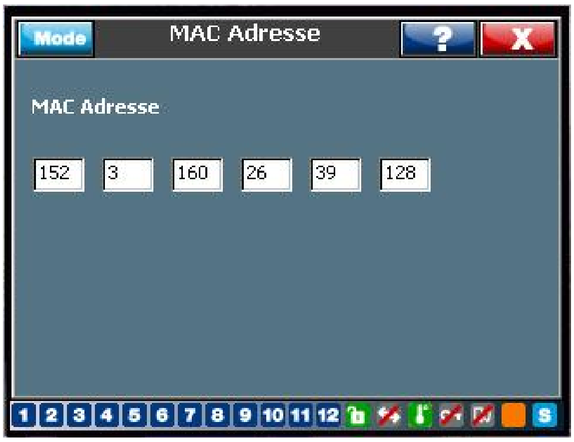
Im Menü zur Einstellung der Hintergrundbeleuchtung kann die Helligkeit der Hintergrundbeleuchtung eingestellt werden, wenn der Touchscreen verwendet wird. Wenn der Touchscreen für 10 Minuten nicht verwendet wird, wird die Helligkeit der Hintergrundbeleuchtung auf 10% abgesenkt.

4.5.4 Über

In diesem Menü werden Softwareversion, Seriennummer, Artikelnummer und Typ des RVT angegeben.

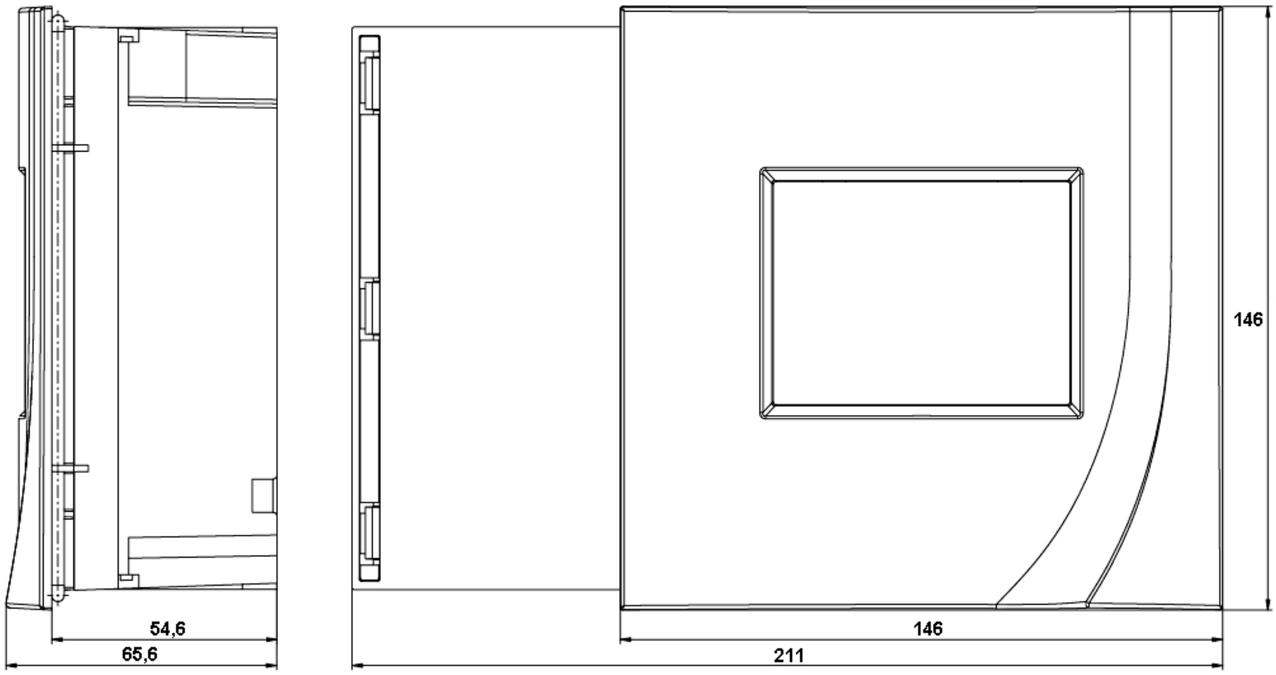
4.5.5 Mac Adresse

In diesem Menü wird die physikalische MAC-Adresse des RVT angezeigt.



Anhang

A1. Abmessungen



A2. Technische Daten

RVT Modelltypen:

Funktion	RVT 6 / RVT 12	RVT 12-3P
1- oder 3-Phasenmessung	1 Eingang zur Spannungsmessung 1 Eingang zur Strommessung	3 Eingänge zur Spannungsmessung 3 Eingänge zur Strommessung
Echtzeituhr	Nein	Ja
Energiemessungen	Nein	Ja
Netzwerkanschluss	Nein	Ja
USB-Host-Anschluss	Nein	Ja
USB-Geräte-Anschluss	Ja	Ja
Digitale Eingänge	Ja	Ja
Alarm- / Lüfterrelais	Ja	Ja
Ausgangsrelais	6 oder 12	12
Sperrschalter	Ja	Ja
RS485 Modbus-Anschluss	Ja	Ja
Externe Temperaturfühler	Ja	Ja

Meßsystem:

Microprozessorsystem für symmetrische Dreiphasen- / Einphasennetze und für unsymmetrische Netze. Individuelle Leistungsfaktorregelung in jeder Phase ist möglich.

Betriebsspannung:

von 100 VAC bis 460 VAC

Leistungsaufnahme:

max. 15 VA.

Verbindungsart:

Phase-Phase oder Phase-Neutralleiter für symmetrische und unsymmetrische Netze

Spannungstoleranz:

± 10 % der angegebenen Betriebsspannung.

Messkategorie (nach IEC 61010-1):

CAT III

Spannungsmessung:

bis 690 VAC, darüber hinaus mit einem Spannungswandler (Transformator)

Genauigkeit: 1 % der Anzeigeskala

Frequenzbereich:

45 oder 65 Hz (automatische Netzfrequenzabstimmung)

Stromeingang:

5 A oder 1 A (RMS) (Stromwandler Klasse 1)

Stromeingangsimpedanz:

<0,1 Ohm

Abschaltung bei Spannungsausfall:

automatische Abschaltung aller Stufen bei Spannungsausfall von mehr als 20 ms

Anzahl der Ausgänge:

RVT6/RVT12 Grundmodell: programmierbar für bis zu 6 Ausgänge

RVT12-3P Drehstrom-Modell: programmierbar für bis zu 12 Ausgänge

O Kontaktbelastbarkeit:

- max. Dauerstrom: 1,5 A (AC) – 0,3 A (110 VDC)
- max. Spitzenstrom: 8 A
- max. Spannung: 440 VAC.
- Anschlüsse A-A sind auf einen Dauerstrom von 18A (9A pro Anschluss) ausgelegt.

Alarmkontakt: (potentialfreier Kontakt)

- Ein normalerweise geschlossener Kontakt und ein normalerweise geöffneter Kontakt.
- max. Dauerstrom: 1,5 A (AC)
- Nennspannung: 250 VAC (Abschaltvermögen: 440 VAC)

Lüfterkontakt: (potentialfreier Kontakt)

- Schließer
- max. Dauerstrom: 1,5 A (AC).
- Nennspannung: 250 VAC (Abschaltvermögen: 440 VAC)

Leistungsfaktoreinstellung:

0,7 induktiv bis 0,7 kapazitiv

C/k-Werteinstellung:

0,01 bis 5 A

automatische C/k-Erkennung

Schaltfolgen:

1:1:1:1:1:..:1 - 1:2:2:2:2:..:2 - 1:2:4:4:4:..:4

1:2:4:8:8:..:8 - 1:1:2:2:2:..:2 - 1:1:2:4:4:..:4

1:1:2:4:8:..:8 - 1:2:3:3:3:..:3 - 1:2:3:6:6:..:6

1:1:2:3:3:..:3 - 1:1:2:3:6:..:6

oder eine beliebige, frei programmierbare Schaltfolge

10/100 Base-T Ethernet-Anschluss

Anschluss an einen PC oder ein LAN über TCP/IP-Protokoll

Elektrische Isolierung zwischen RVT und den RJ45-Signalen: 1500 Urms

Modbus Baudrate:

300 - 600 - 1200 - 2400 - 4800 - 9600 - 19200 - 38400 – 57600 bps

CAN-Verbindung:

Unterstützt die CAN 2.0B-Schnittstelle (für zukünftige Verwendung)

USB-Host-Anschluss:

(für zukünftige Verwendung)

USB-Geräte-Anschluss

Anschluss für Temperaturfühler

Nur zwei Kontakte über 1-Wire-Protokoll

- Keine externe Spannungsversorgung notwendig
- Anschluss an weitere Nodes über Reihenschaltung

- 8 Temperaturfühler insgesamt
- Maximal 8 Meter Abstand zwischen RVT und Temperaturfühler oder zwischen den Fühlern
- Maximal 64 Meter Länge
- Temperaturmeßbereich von -55°C bis +125°C (-67°F bis +257°F)
- +/-0.5°C Genauigkeit von -10°C bis +85°C
- Montage auf Hutprofilschiene
- Anschluß an den RVT mit verdrillter Zweidraht-Leitung

Stufenrelais-Konfiguration:

Automatisch, fest EIN (Dauerstufe), fest AUS (deaktiviert)

Anzeige:

QVGA 320 x 240 Pixel farbiger Touchscreen.

Einstellbare Hintergrundbeleuchtung

Schaltverzögerungszeiten:

programmierbar von 1 Sek. bis 18 Std.

Parameterspeicherung:

Alle programmierten Parameter und Betriebsarten werden in einem nichtflüchtigen Speicher abgelegt.

Automatische Einstellung auf die Phasenfolge des Netzes und der Phasenlage des Stromwandlers

Blindleistungsregelung unempfindlich gegenüber selbst hohen Oberschwingungsbelastungen

Regelung bei Wirkleistungsbezug wie auch Wirkleistungsrückspeisung (Vierquadrantenbetrieb)

Betriebstemperatur:

-20°C bis +70°C

Lagertemperatur:

- 30°C bis +85°C

Montageposition:

Vertikaler Schaltschrankeinbau

Abmessungen:

Frontplatte: 146 x 146 mm (HxB)

Rückseite: 205 x 135 mm

Gesamtabmessungen: 146 x 211 x 67 mm (HxBxT)

Montageausschnitt: 138 x 138 mm (H xB)

Gewicht:

650g (ohne Verpackung).

Anschlüsse:

Klemmen für 2,5 mm2 Einzeladerleitungen

Schutzklasse der Frontplatte:

IP 43 (IP 54 auf Anfrage)

Relative Luftfeuchtigkeit:

Max. 95 %; nicht kondensierend

CE-Zeichen.

A3. Prüfung und Störungsbehebung

Prüfung

Nach Installation der Blindleistungsregelanlage und Programmierung der Reglerparameter können, abhängig von der Lastsituation, die nachstehenden Prüfungen durchgeführt werden.

A. Keine Last oder cos j = 1 oder kapazitive Last (Einstellung des cos j -Sollwerts auf 0,95 induktiv)

1. Wählen Sie den MAN-Modus (Manueller Betrieb).
2. Schalten Sie zwei oder mehr Stufen ein.
3. Wählen Sie den AUTO-Modus (Automatischer Betrieb).

Alle Kondensatorstufen müssen unter Einhaltung der programmierten Verzögerungszeit zwischen den einzelnen Schaltvorgängen abgeschaltet werden.

Falls nicht alle Stufen abgeschaltet werden, überprüfen Sie die folgenden Punkte:

- Wurde inzwischen eine induktive Last zugeschaltet?
- Wurde der korrekte C/k-Wert bzw. die richtige Stufengröße und die richtigen Wandlerübersetzungsverhältnisse programmiert?(Es wird empfohlen, den C/k-Wert etwas höher als den errechneten Wert zu einzustellen.)

B. Induktive Last

1. Stellen Sie den Ziel-cos j = 1 ein.
2. Wählen Sie den AUTO-Modus (Automatischer Betrieb).

Die Kondensatorstufen werden nun automatisch eingeschaltet, um die induktive Last zu kompensieren. (Der Regler schaltet keine Stufen, falls der induktive Strom kleiner als der C/k-Wert ist. In solchen Fällen prüfen Sie wie unter A. beschrieben).

Falls alle Stufen eingeschaltet sind und immer noch ein Bedarf an weiteren Kondensatorstufen besteht, so prüfen Sie die Einstellung des C/k-Wertes. Ist dieser

Wert korrekt, so ist die Kondensatoranlage zu klein, um cos j = 1 zu erreichen. Wählen Sie einen kleineren Wert für cos j .

Schaltet eine Leistungsstufe wiederholt ein- und aus, so bedeutet dies, daß der C/k-Wert zu klein gewählt ist (Ausnahme: die Last variiert regelmäßig mit derselben Zeitperiode wie die Schaltverzögerung).

Störungsbehebung

Störung	Empfohlene Maßnahme
Der Regler ist angeschlossen, funktioniert jedoch nicht (keine Anzeige auf dem Display). Der Regler schaltet die Stufen nicht ein oder aus, obwohl eine bedeutende variable, induktive Last anliegt.	Überprüfen Sie die Spannungsversorgung und die Sicherungen. Überprüfen Sie, ob sich der Regler im AUTO-Modus (Automatik) befindet. Überprüfen Sie die Einstellung der Phasenlage und des C/k-Wertes. Überprüfen Sie, ob die Kurzschlußbrücke am Stromwandler entfernt wurde.
Der Regler scheint keine Stufe zu aktivieren.	Warten Sie die Verzögerungszeit zwischen den Schaltvorgängen und/oder die Startverzögerung bei einem Spannungsausfall ab.
Der voreingestellte Leistungsfaktor wird nicht erreicht.	Bei geringer oder keiner Last kann ein niedriger Leistungsfaktor einem sehr geringen induktiven Strom entsprechen. Die Kondensatorstufen sind für eine genauere Kompensation zu groß. Falls der Mittelwert des Leistungsfaktors cos j über längere Zeit zu niedrig ist, sollte der cos j -Sollwert möglicherweise erhöht werden.

Die automatische Inbetriebnahme wird unterbrochen, und auf der Anzeige des Reglers werden folgende Meldungen ausgegeben:

Messages during an automatic commissioning process	Empfohlene Maßnahme
Das gemessenene Drehfeld ist falsch. Die Phasen L2 und L3 werden intern getausch. Mit OK bestätigen.	Press OK
Fehler: Stufe zu klein	Adapt the step size or the CT ratio.
Fehler: Wandler erfasst keine Strom	Check that the CT's short-circuit bridges is removed, that CT's connections are correctly wired and start the Auto commissioning again.
Fehler: Last variiert zu schnell	Restart the Auto commissioning procedure under more stable conditions or set the parameters manually.
Fehler: Zu grosse Phasenstreuung in Eingang Nr 'X' 'Y' 'Z'	For each CT input and for each output, phase recognition is done and phase dispersion is checked. Check capacitor and contactor connections. Check capacitor currents for each phase.
Fehler: Mindestens zwei Wandler erfassen denselben Phasenstrom	Check CT's installation

Fehler: Kein signifikanter Strom in Eingang Nr ‘X’ ‘Y’ ‘Z’	Check that CT’s short-circuit bridge is removed , that CT’s connections are correctly wired and start the Auto commissioning again
Fehler: Inconsistente Phasenverschiebung	Check CT’s connections and installation. Check capacitor and contactor connections. Check capacitor currents for each phase.
Fehler: Unsymmetrische Stufe oder Wandlerverhältnis in den Phasen unterschidelich bei Ausgang Nr ‘A’ ‘B’ ‘C’ ‘D’…	Check that CT’s ratios are the same value. Check capacitor and contactor connections. Check capacitor currents for each phase.
Fehler: Zu grosse Unterschiede zwischen Stufen	Check sequence and reactive power value per output.

A4. Neuanlauf nach Alarmbedingung

Wenn der Auslösewert einer Schutzeinstellung erreicht wird (vgl. Abschnitt 4.3.1.4.1), oder wenn die Innentemperatur 85°C überschreitet:

- alle Kondensatorstufen werden abgeschaltet,
- auf dem Display wird eine Alarmmeldung angezeigt,
- der Alarmkontakt öffnet sich

Nach Aufhebung der Alarmbedingung nimmt der RVT den Betrieb automatisch wieder auf. Der Neuanlauf hängt von der Art der Alarmursache wie in der nachstehenden Tabelle dargestellt ab:

Vorkommnis	RVT-Neuanlauf nach Aufhebung des Alarmereignisses
Unterspannung: U unter U<<	- Kontakt des Alarmrelais öffnet sich sofort. - Rückkehr auf Normalverhalten nach einer der EINschaltverzögerung entsprechenden Zeit(*)
Spannungsausfall	- Rückkehr auf Normalverhalten nach einer der Start-Verzögerung entsprechenden Zeit(*)
Überspannung: U über U>>	- Kontakt des Alarmrelais öffnet sich sofort. - Rückkehr auf Normalverhalten nach einer der EINschaltverzögerung entsprechenden Zeit(*)
Temp intern > 85°C	- Ereignis als aufgehoben betrachtet, wenn Temp intern < 80°C - Kontakt des Alarmrelais öffnet sich sofort. - Rückkehr auf Normalverhalten nach einer der EINschaltverzögerung entsprechenden Zeit (*)
Bei einer der acht T-Fühlern ist Temp > Eingestellter Schutzschwellwert	- Kontakt des Alarmrelais öffnet sich sofort (externer Temperaturfühler T1-8 als Option) - Rückkehr auf Normalverhalten nach einer der EINschaltverzögerung entsprechenden Zeit (*)
Spannungsverzerrung zu hoch: THDU über THDU>>	- Kontakt des Alarmrelais öffnet sich sofort. - Rückkehr auf Normalverhalten nach einer der EINschaltverzögerung entsprechenden Zeit (*).

	„Anti-hunting“-Schutz: Tritt das gleiche Ereignis innerhalb von 1 Stunde erneut ein, nimmt der RVT den Normalbetrieb erst nach doppelter EINschaltverzögerungwieder auf. Tritt das gleiche Ereignis innerhalb von 1 Stunde dann wieder ein, wird die Wiederanlaufzeit vervierfacht, usw. bis zu einer maximalen Wiederanlaufzeit von einer Stunde.Dieser Vorgang vermeidet einen „Hunting-Effekt“ aufgrund von Resonanzphänomenen.
Externer Eingang aktiviert	- Kontakt des Alarmrelais öffnet sich sofort. - Rückkehr auf Normalverhalten nach einer der EINschaltverzögerung entsprechenden Zeit (*).

(*) Beziehen Sie sich für nähere Angaben zur Start-Verzögerung und EINschaltverzögerung auf die eingehenderen Erläuterungen in Abschnitt 4.3.1.1.

A5. Spannungsmessung und Netzanschluß

Dieser Zusatzt ermöglicht einen praktischen Weg die Spannungsmessung des RVT mit dem Netzanschluß zu realisieren.

Beschreibung

Wie in Abbildung 57 gezeigt, hat der RVT zwei Anschlüsse für seine Stromversorgung und drei weitere Anschlüsse als Eingänge für die Spannungsmessung.

Der RVT verwendet nicht die Energieversorgung für die Bildung der Meßspannung. Die Spannungsmessung wird nur mit den eingens dafür vorgesehenen Klemmen für die Spannungsmessung durchgeführt.

Wenn die RVT Versorgungsspannung und das Spannungsmesssignal von der selben Quelle kommen, kann eine Brücke zwischen den betroffenen Klemmen gelegt werden.

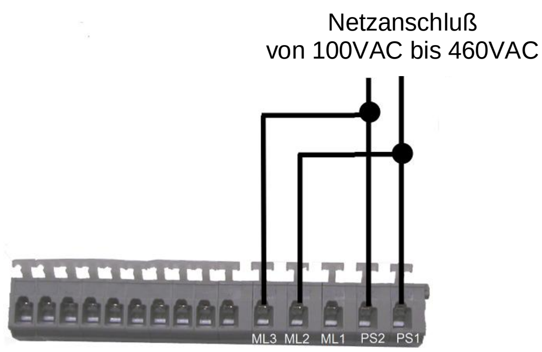


Abbildung 57: Anschlüsse

Praktischer Vorschlag für die Brücke zur Spannungsmessung

Wegen des geringen Platzes ist es nicht möglich zwei Leitungen unter einen Kontakt zu klemmen. Deshalb wechselt man auf Methoden welche zwei Leitungen mit einem Kontakt ermöglichen.

Es gibt verschiedene praktische Möglichkeiten die Verbindung herzustellen. Eine Möglichkeit beschreibt die Abbildung 58.

An jeder Einspeiseleiitung wird eine zweite Leitung als Brücke mit einer Zwillingsaderendhülse gecrimpt.

Diese Zwillingsaderendhülsen und das dazugehörige Crimpwerkzeug ist weltweit erhältlich.

Bitte beachten Sie, dass Sie Leitungen mit demselben Querschnitt verwenden. Es sind offemsichtlich nur zwei Zwillingsaderendhülsen für das dargestellte Ergebnis in erforderlich.

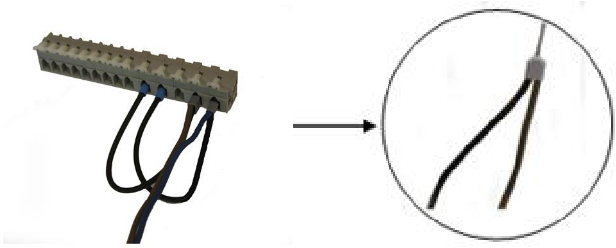
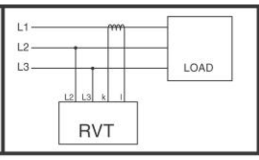
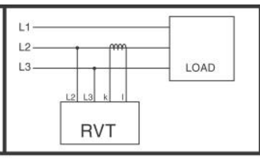
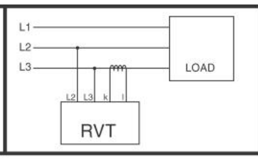
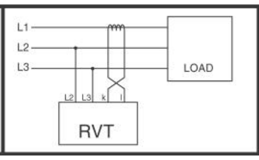
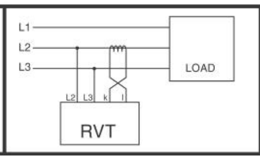
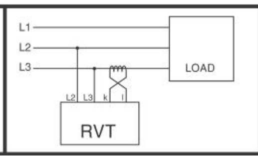


Abbildung 58: Brücke

A6. Phasenkorrekturtabelle (beim Grundmodell)

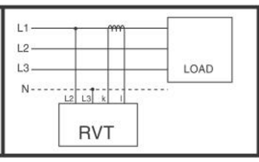
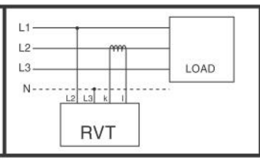
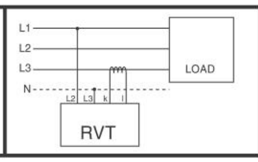
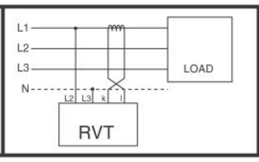
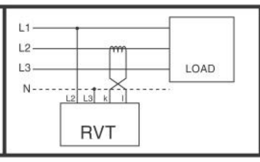
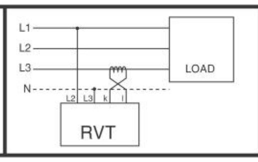
3-phasige Kompensationsanlage

Die Spannung wird zwischen L2 und L3 gemessen.

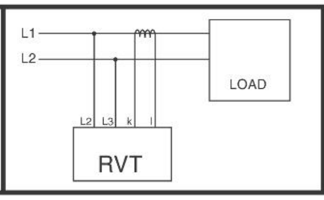
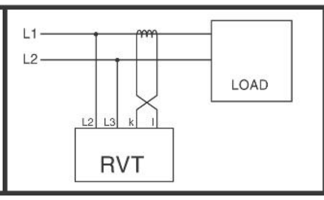
L1 Direkt		90	L2 Direkt		-30	L3 Direkt		-150
L1 Invertiert		-90	L2 Invertiert		150	L3 Invertiert		30

3-phasige Kompensationsanlage

Die Spannung wird zwischen L1 und Neutralleiter gemessen.

L1 Direkt		0	L2 Direkt		-120	L3 Direkt		120
L1 Invertiert		180	L2 Invertiert		60	L3 Invertiert		-60

1-phasige bzw. 2-phasige Kompensationsanlage

L1 Direkt		0	L2 Direkt		180

A7. Abbildung der Stromwandler-Verbindungstypen und Stromwandler-Verdrahtung an den Regleranschlüssen

Connection type		RVT 12 - 3P	RVT 6 / RVT 12	Phase shift	Voltages						Currents				Compensation type		
Name	Schematics	Connection	Connection	adjustment	L12	L23	L31	L1N	L2N	L3N	L1	L2	L3	N	Full C3[1]	Full C1[2]	Mixed C3+C1
1Ph-1LL1	L2 L3	L2, L3, CT ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	L2, L3, CT N.C., ML2, ML3, N.C., k, l, N.C., N.C., N.C., N.C.	0° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	-	yes	-
3Ph-1LL1	L1 L2 L3 N	L2, L3, CT ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	L2, L3, CT N.C., ML2, ML3, N.C., k, l, N.C., N.C., N.C., N.C.	90° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	yes	-	-
3Ph-1LN1	L1 L2 L3 N	L1, N, CT ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	L1, N, CT N.C., ML2, ML3, N.C., k, l, N.C., N.C., N.C., N.C.	0° by default (see phase shift table)	-	-	-	Measured	-	-	Measured	-	-	-	yes	-	-
3Ph-3LL3	L1 L2 L3 N	L1, L2, L3, CT1, CT2, CT3 ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-3LL2	L1 L2 L3	L1, L2, L3, CT1, CT2 ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Calculated	(3)	yes	yes	yes
3Ph-3LN3	L1 L2 L3 N	L1, L2, L3, N, CT1, CT2, CT3 ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - phase rotation - CT redirection)	Calculated	Calculated	Calculated	Measured	Measured	Measured	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LL3	L1 L2 L3 N	L2, L3, CT1, CT2, CT3 ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - CT redirection)	-	Measured	-	-	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LN3	L1 L2 L3 N	L1, N, CT1, CT2, CT3 ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - CT redirection)	-	-	-	Measured	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes

A8. Individuelle Leistungsfaktorkompensation (beim Drehstrom-Modell RVT12-3P)

Standardmäßig sind nur Modelle mit 12 Ausgängen verfügbar für voneinander unabhängige Leistungsfaktorregelung in jeder Phase.

Wie im Grundmodell des RVT erfolgt die Leistungsfaktorregelung auch beim Drehstrom-Modell RVT 12-3P durch einen Vergleich des C/k-Werts mit dem gemessenen Grundschwingungsblindstrom.

Die Regelung erfolgt unterschiedlich je nach Anschlußtyp (siehe A7. Abbildung der Stromwandler-Verbindungstypen und Stromwandler-Verdrahtung an den Regleranschlüssen) und der Art der angeschlossenen Stufen (Ein- oder dreiphasig).

Zur Erklärung der Anschlußtypbezeichnung (siehe A7. Abbildung der Stromwandler-Verbindungstypen und Stromwandler-Verdrahtung an den Regleranschlüssen)

wPh- xLyz ·wobei:

w ein Ein oder dreiphasiges Netz anzeigt

x die Anzahl der Spannungsmessungen ist

y den Anschluß Phase-Phase oder Phase-N angibt

z die Anzahl der Stromwandler ist

wPh-1Ly1 Anschlußtyp (nur ein Stromwandler)

Falls nur ein Stromwandler angeschlossen ist erfolgt die Regelung gemäß der Last in L1 (bzw. der Phase in der der Stromwandler liegt).

3Ph-xLy2 und 3Ph-xLy3 Anschlußtyp (2 oder 3 Stromwandler)

Falls mehr als ein Stromwandler angeschlossen ist erfolgt die Regelung gemäß einer einfachen und effektiven Strategie um die Stufen sinnvoll zu nutzen. Die Strategie ist:

Regelstrategie bei unsymmetrischem Netz:

Abwarten der Schaltverzögerungszeit und dabei die Blindströme in den Phasen L1, L2 und L3 gemäß der Einstellung Normal/Integral berechnen.

Bestimmung der minimalen Anzahl zu schaltender Dreiphasenstufen.

Bestimmung der zu schaltenden Einphasenstufen.

Falls eine Gruppe von Einphasenstufen (bereits EIN bzw. soll EIN geschaltet werden) durch eine Dreiphasenstufe ersetzt werden kann wird bevorzugt die Dreiphasenstufe geschaltet..

EIN- und AUSschalten erfolgt gemäß den Vorgaben Progressive/Direct, Linear/Circular.

Eingie typische Beispiele:

12 Einphasenstufen / 1 Wandler (Nur 1Ph-1LL1)

à Die Regelung erfolgt gemäß der Last in der Phase des Stromwandlers à Der C/k 3Ph Parameter wird für das Schalten der Stufen genutzt (Äquivalent zum C/k Parameter in den Grundversionen RVT6 oder 12)

12 Dreiphasenkondensatoren / 1 Wandler (Nur 3Ph-1Ly1)

à Die Regelung erfolgt gemäß der Last in der Phase des Stromwandlers

à Der C/k 3Ph Parameter wird für das Schalten der Stufen genutzt (entspricht dem C/k Parameter in den Grundversionen RVT6 oder 12)

12 Dreiphasenkondensatoren / 2 oder 3 CT's (3Ph-3LL2 oder 3Ph-xLy3)

à Die Regelung erfolgt gemäß der Last in L1, der Last in L2 und der Last in L3

à Die Regelung erfolgt nach der "Regelstrategie bei unsymmetrischem Netz"

à Der C/k 3Ph Parameter wird für das Schalten der Dreiphasenstufen genutzt

4 * 3 Einphasenkondensatoren zwischen L und N / 2 oder 3 Stromwandler

(3Ph-3LL2 oder 3Ph-xLy3)

à Die Regelung erfolgt gemäß der Last in L1, der Last in L2 und der Last in L3

à Die Regelung erfolgt nach der "Regelstrategie bei unsymmetrischem Netz"

à Der C/k 1Ph Parameter wird für das Schalten der Einphasenstufen genutzt

6 Dreiphasenkondensatoren + 2 * 3 Einphasenkondensatoren zwischen L und N / 2 oder 3 CT (3Ph-3LL2 oderr 3Ph-xLy3)

à Die Regelung erfolgt gemäß der Last in L1, der Last in L2 und der Last in L3

à Die Regelung erfolgt nach der "Regelstrategie bei unsymmetrischem Netz"

à Der C/k 1Ph Parameter wird für das Schalten der Einphasenstufen genutzt

à Der C/k 3Ph Parameter wird für das Schalten der Dreiphasenstufen genutzt

A9. Recycling

Die Markierungen auf dem Produkt und in der Dokumentation zeigen an, daß das Gerät am Ende seiner Lebensdauer nicht mit normalem Haushaltsmüll entsorgt werden sollte. Um mögliche Umwelt- und Gesundheitsschäden durch unkontrollierte Abfallbeseitigung zu vermeiden zich führen Sie es bitte einer verantwortungsvollen Materialtrennung und Entsorgung zu.

Privatkunden sollten entweder den Verkäufer oder die zuständige lokale Behörde kontaktieren um zu erfahren, wie das Produkt sicher und umweltfreundlich recycelt werden kann.

Gewerbliche Kunden sollten ihren Lieferanten kontaktieren und die Regelungen des Kaufvertrages über die Entsorgung prüfen. Das Produkt sollte nicht mit anderem gewerblichen Abfall vermischt werden in Übereinstimmung mit der WEEE-Richtlinie (waste electrical and electronic equipment).

In diesem Produkt sind keine Gefahrstoffe enthalten und entspricht den RoHS-Richtlinie (Restriction of the Use of Certain Hazardous Substances).

Die Entsorgung von Batterien muß in Übereinstimmung mit den nationalen Regelungen für die Batterieentsorgung erfolgen (Battery Directive).

Elektronikplatinen sollten in Übereinstimmung mit den nationalen Regelungen wiederverwertet werden.

Gehäuse und andere Kunststoffteile sollten separat wiederverwertet werden.

In diesem Produkt ist eine CR2032 LIMnO2-Batteriezelle enthalten. Ersetzen Sie nicht die interne Lithiumbatterie CR2032. Sie kann nach Öffnen des Gehäuses zur Entsorgung entfernt werden (4 Schrauben auf der Geräterückseite).

A10. Additional provision on Open Source Software:

The product contains – in part – some free software (software licensed in a way that ensures your freedom to run, copy, distribute, study, change and improve the software). The following products are concerned : Linux-2.6.30.1 which is subject to "GNU General Public License", Version 2, busybox-1.15.3 which is subject to "GNU General Public License", Version 2, dropbear-0.48.1 which is subject to "GNU General Public License", Version 2, iana-etc-2.20 which is subject to "GNU General Public License", Version 2, mtd-utils-1.2.0 which is subject to "GNU General Public License", Version 2, u-boot-1.3.4 which is subject to "GNU General Public License", Version 2, ifplugd-0.28 which is subject to "GNU General Public License", Version 2, AT91Bootstrap1.9 which is subject to "GNU General Public License", Version 2, and uClibc v 0.9.29 which is subject "GNU Lesser General Public License", Version 2.1,(purchaser or user shall not be prohibited to modify libraries provided under Lesser General Public License (version 2.1) and/or to reverse engineer such libraries for debugging such modifications).

These software products which are free (i.e., freedom-respecting – see http://www.gnu.org/philosophy/free-sw.html for more details) software programs developed by the Free Software Foundation, a separate not-for-profit organization. If we distributed any of these free software programs to you, we want you to know that you were granted a license to that software under the terms of either the GNU General Public License or GNU Lesser General Public License (“Licenses”; copies of which are available from http://www.gnu.org/licenses/licenses.html). The Licenses allow you to freely copy modify and redistribute those software. Those software are available on http://search-ext.abb.com/LibraryDownloadManager/Default.aspx?resource=http://www05.abb.com/global/scot/scot209.nsf/veritydisplay/96797337ffab5ad0c12578b0003db334/$file/2GCS705011A0050_RVT%20OSS%20software.zip

Instrucciones de instalación y de funcionamiento

Contenido

Leer esto primero

Sobre este manual de instrucciones

Este manual de instrucciones está destinado a ayudarle a instalar y manejar con rapidez el Regulador RVT.

Advertencia

Precaución, riesgo de peligro: Este símbolo es una indicación de advertencia para resaltar cierta información importante

Antes de proceder a la instalación y al manejo del Regulador RVT, lea cuidadosamente el aviso de seguridad. Manténgalo a disposición de las personas que están a cargo de la instalación, del mantenimiento y del manejo.

Seguridad

El sistema RVT cumple la Directiva Europea LVD 2006/95/CE.

Precaución, riesgo de descarga eléctrica: Este símbolo advierte al lector de que se proporciona información de seguridad y que se debe tener en cuenta

La instalación, el mantenimiento y el manejo del Regulador RVT deberán ser realizados por electricistas calficados.

No trabaje bajo tensión.

Para limpiar el polvo utilice un paño seco. No utilice abrasivos, disolventes o alcohol. Antes de proceder a limpiar desconecte el suministro eléctrico y el circuito de medida de tensión.

No abra la carcasa del Regulador RVT. En su interior no hay elementos de servicio a las que el usuario deba acceder.

Desconectar la tensión antes de sustituir algún fusible.

El Regulador RVT va conectado a un transformador de corriente. No desenchufar las conexiones del transformador de corriente antes de asegurarse de que está cortocircuitado o conectado a otra carga en paralelo que tenga una impedancia suficientemente baja. De no proceder así pueden crearse sobretensiones peligrosas.No utilizar este producto para ningún otro fin que el previsto.

Compatibilidad electromagnética

El sistema RVT cumple la Directiva Europea EMC 2004/108/CE.

El Regulador RVT cumple con la normativa de la Unión Europea referente a la CEM (compatibilidad electromagnética) para su funcionamiento a 50 Hz y lleva la marca CE indicándolo.

Cuando un aparato se utiliza en un sistema, las directivas de la UE pueden exigir que se compruebe que el sistema cumple con la CEM. Las siguientes instrucciones resultan útiles para mejorar las prestaciones de CEM del sistema.

Los encerramientos metálicos en general mejoran las prestaciones de CEM.

1. Efectuar el tendido de los cables lejos de las aperturas del encerramiento.

2. Efectuar el tendido de los cables próximo a las estructuras metálicas de puesta a tierra.

3. Utilizar varios cables de puesta a tierra para los puertos y otros paneles que lo requieran.

4. Evitar impedancias de masa comunes.

1 Introducción al regulador

1.1 Contenido del capítulo

Este capítulo describe el regulador RVT. Ilustra la estructura básica del regulador, las funciones principales y la interfaz de usuario con pantalla táctil del regulador.

1.2 Un potente regulador de factor de potencia con control en las tres fases individualmente

El regulador RVT puede realizar la compensación del factor de potencia tanto en red equilibrada como desequilibrada. Hay dos modelos de reguladores RVT: Modelo base RVT RVT6/RVT12 y modelo trifásico RVT RVT12-3P. El modelo base es totalmente compatible con reguladores RVT anteriores con 6 o 12 salidas, lo cual es aplicable para una red equilibrada trifásica o monofásica (fase a fase). El modelo trifásico RVT12-3P es una versión más potente con funciones de control del factor de potencia de fase individual gracias a tres mediciones CT para cada fase. El modelo trifásico RVT12-3P tiene ejecución de 12 salidas solamente.

El RVT se puede utilizar también para batería de condensadores automática en MV. Se ofrece información detallada sobre cómo conectar el RVT a una batería en MV en 4.3.1.1.

1.3 Funciones principales del RVT

1.3.1 Control de corrección del factor de potencia

El regulador de factor de potencia RVT es la unidad de control de una batería de condensadores automática que se utiliza para realizar la compensación de potencia reactiva en una instalación con cargas inductivas preponderantes. Realiza la conmutación de los condensadores con el fin de conseguir un cos j determinado definido por el usuario.

- Todos los parámetros de conmutación se pueden programar de forma automática o manual (descripción en los párrafos 4.3.2 y 4.3.1)
- Además del cos j deseado, se pueden programar un cos j nocturno deseado y un cos j deseado en modo regenerativo (descripción en el párrafo 4.3.1.3).
- En el modelo trifásico RVT12-3P, el regulador se puede configurar para activar y desactivar un condensador monofásico en una red desequilibrada. Esta función se utiliza para corregir el factor de baja potencia en cada fase; por ejemplo, el factor de potencia 0.6 en Fase1, factor de potencia 0.8 en Fase2, factor de potencia 0.95 en Fase3. Resulta muy práctico en ciertas áreas residenciales y comerciales donde las cargas trifásicas se pueden desequilibrar debido a muchas cargas monofásicas.

1.3.2 Mediciones y supervisión

- Mediciones (descripción en el párrafo 4.2).

- Protección contra fenómenos imprevistos y/o uso no autorizado (descripción en los párrafos 3.2.4 y 4.3.1.1.
- Registro de mensajes de alarmas y datos basado en un reloj de tiempo real (descripción en los párrafos 4.2.5 y 4.4).
- Comprobación y ensayo del estado de los relés (descripción en los párrafos 4.4.2 y 4.4).
- Mediciones de temperatura: es posible conectar un máximo de 8 sondas de temperatura en conexión en cadena tipo margarita (descripción en el párrafo 4.3.1.4.3).

1.3.3 Comunicaciones

- Conexión Modbus (se requiere un adaptador Modbus RS485)
- Conexión USB (compatible con especificaciones USB2.0)
- Interfaz TCP/IP Ethernet
- CAN 2.0 con salidas ampliadas hasta 32. Capacidad de hardware en la versión actual de RVT; el software se implementará en el futuro.

Se proporciona información detallada en el párrafo 4.5.

1.4 Vista frontal y vista posterior

Figura 1: RVT vista frontal

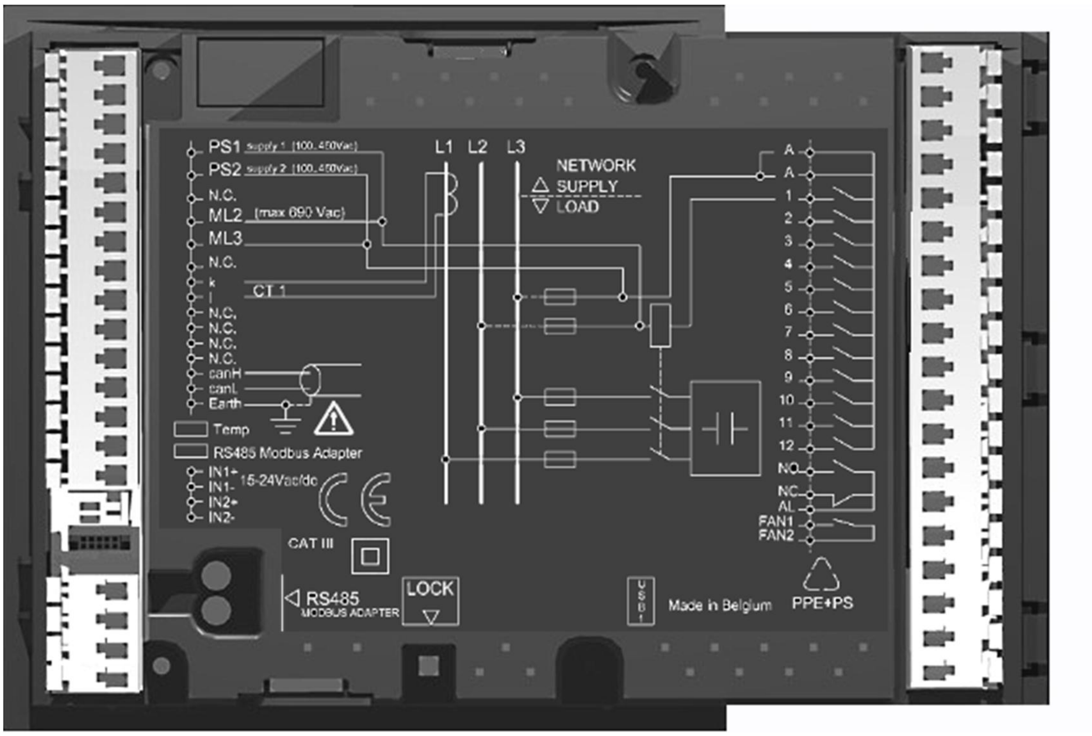


Figura 2: RVT vista posterior (modelo base RVT6/RVT12)

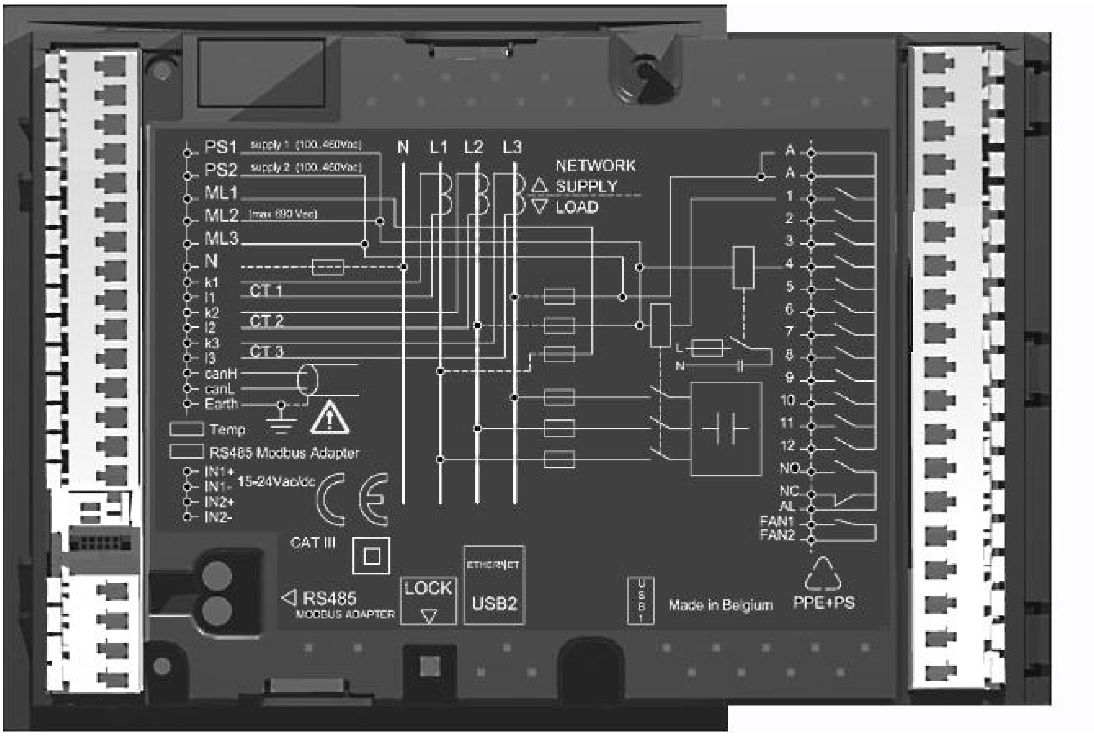


Figura 3: RVT vista posterior (modelo trifásico RVT12-3P)

1.5 Interfaz de pantalla táctil en color

Una pantalla táctil en color QVGA de 320 x 240 píxeles permite al usuario utilizar el regulador con mayor facilidad. Todos los ajustes de parámetros y navegación por los menús se realizan de forma fácil y sencilla gracias a la pantalla táctil.

Figura 4: Pantalla de inicio de RVT

Se ofrece información detallada sobre la navegación por los menús en el párrafo 3.2.

2 Instalación

2.1 Contenido del capítulo

Este capítulo describe el proceso de montaje del regulador en el panel y como realizar su conexionado eléctrico. El diagrama de cableado se explica en la sección 2.4.

2.2 Montaje

Realizar los pasos que se indican a continuación para montar un regulador RVT en un panel.

Paso 1: Deslizar el RVT(a) perpendicularmente respecto al Armario de la Batería de Condensadores (b).Paso 2: Girar el RVT para introducirlo en el Armario de la Batería de Condensadores.

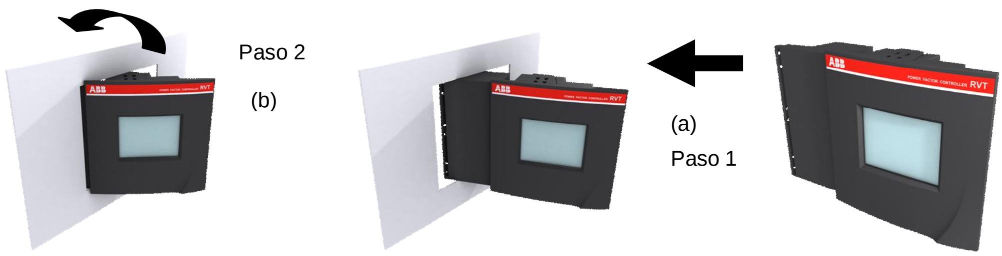


Figura 5: Montaje de un RVT

Nota: Las dimensiones del calado en puerta son 138x138 mm.

Paso 3: Introducir en el Soporte de montaje (c) en los correspondientes Agujeros de fijación (d) del RVT.

Paso 4: Tirar hacia atrás del Soporte de montaje.

Paso 5: Enroscar el Tornillo (e) en el Soporte de montaje y apretarlo hasta que el RVT quede seguro en su sitio.

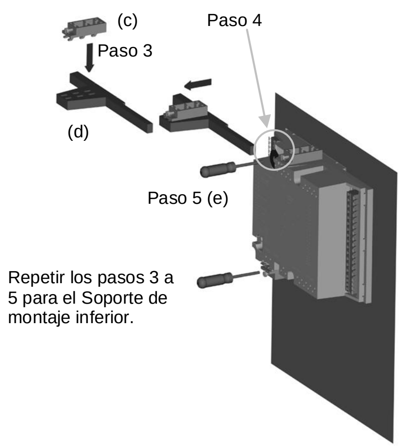


Figura 6: Montaje de un RVT

2.3 Conexionado de cables

Siga las instrucciones que se indican a continuación para conectar cables a los terminales de la parte trasera del regulador.

1. Empuje hacia atrás con un destornillador la palanca del conector.

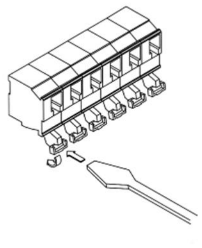


Figura 7: Conexión de cables

2. Introduzca el hilo (hasta 2,5 mm^2/núcleo único) en el agujero de conexión correspondiente manteniendo la presión sobre la palanca.

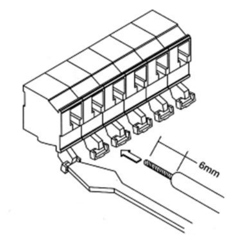


Figura 8: Conexión de cables

3. Suelte el destornillador.

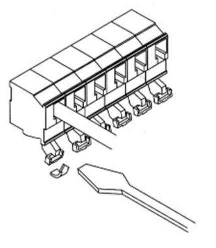


Figura 9: Conexión de cables

4. El hilo ha quedado debidamente conectado.

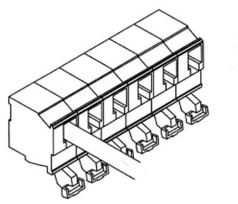


Figura 10: Conexión de cables

2.4 Esquema de cableado

En el esquema de cableado se muestra la conexión de los circuitos principales y de control.

Modelo base RVT6/RVT12

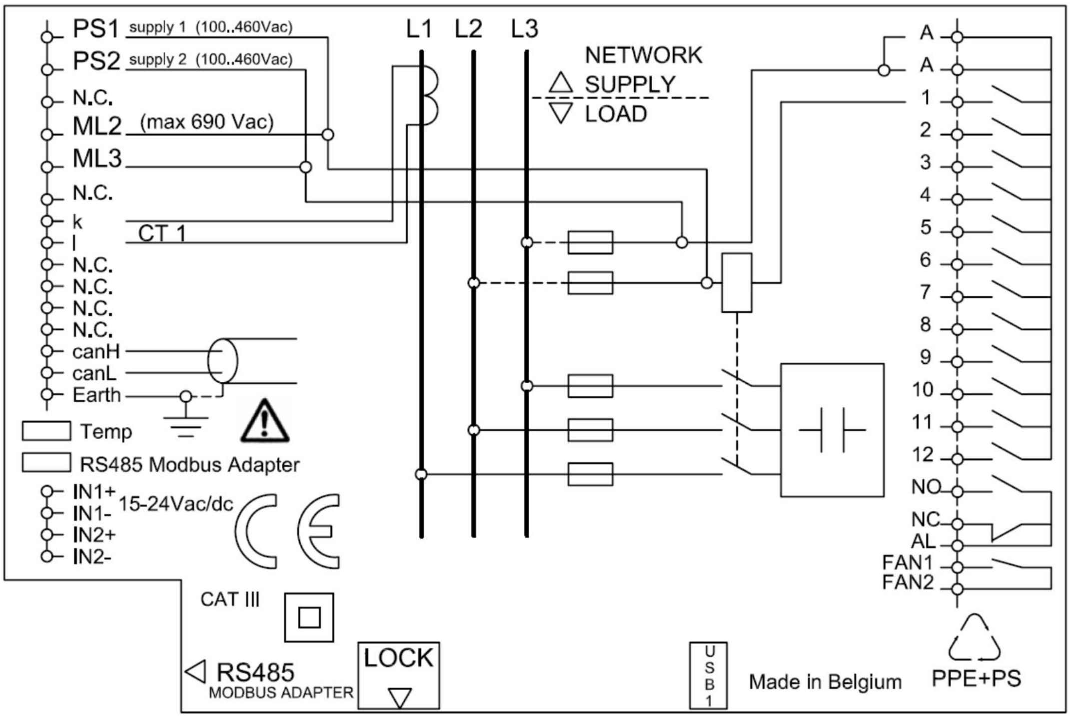


Figura 11: Esquema de cableado del RVT (modelo base RVT6/RVT12)

Modelo trifásico RVT12-3P

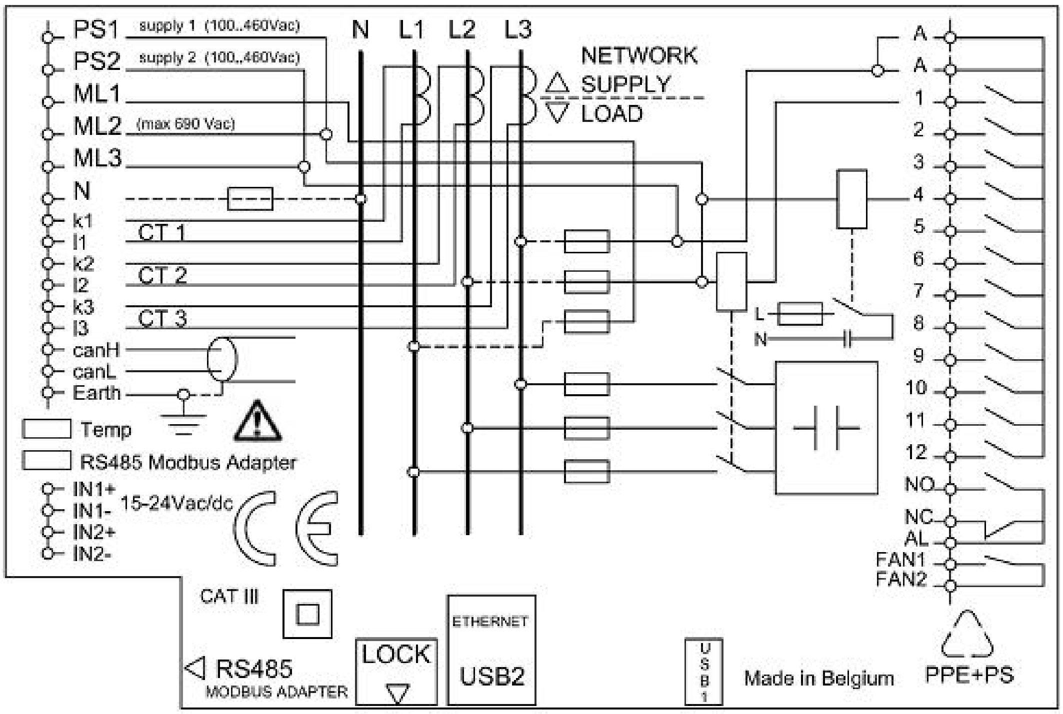


Figura 12: Esquema de cableado del RVT (modelo trifásico RVT12-3P)

PS1, 2	Fuente de alimentación
ML1-3	Medición de Tensión
N.C.	No está conectado
N	Conexión del Neutro
k1-3, l1-3	Transformador de corriente
canH, canL	Bus CAN
Conexión a tierra	Tierra
Temperatura	Conexión de sondas de temperatura
Adaptador Modbus RS485	Interfaz RS485

Entrada digital IN1+/- de selección de cos j objetivo de día o noche

Entrada digital IN2+/- para activación de alarma externa

A	Alimentación común de los relés de salida
1-12	Salidas
NO/NC	Contactos de salida del relé de alarma
AL	Fuente común para relé de alarma
FAN 1-2	Relé de salida advertencia / Ventilador
USB	Conexión USB
RJ45	Conexión Ethernet
Bloqueo	Bloqueo del hardware

Precaución: Se recomienda una protección contra sobrecarga en las conexiones PS1-PS2: fusibles 6Arms 10 X 38 gl 690V.

3 Fácil comienzo

3.1 Contenido del capítulo

Este capítulo describe brevemente la puesta en marcha rápida y en modo automático del controlador.

3.2 Navegación por los menús

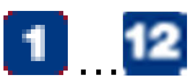
Cuando el RVT se enciende luego de proceso de arranque (donde se muestra el logo de ABB), la pantalla de inicio es la primera que aparece como se muestra en la Figura 13.

Figura 13: Pantalla de inicio de RVT

En el centro de la pantalla, los cuatro iconos (Mediciones, Parámetros, Control batería y Comunicación) representan los cuatro menús de nivel raíz.

En la parte inferior de la pantalla, la barra de estado muestra los pasos del condensador activo, el estado de bloqueo del RVT, advertencias, la fuente de control del RVT (mediante pantalla táctil local o comunicación), demanda de encendido o apagado, modo de funcionamiento: A (modo automático), M (modo manual) y S (modo de ajuste). En la siguiente simbología se indica el significado detallado de los iconos de estado.

3.2.1 Simbología de los iconos de la pantalla táctil



salida activa (cerrada) (las salidas inactivas no aparecen resaltadas)

ajustes de la batería desbloqueados

ajustes de la batería bloqueados

los ajustes sólo se pueden realizar a través de la comunicación

los ajustes se pueden realizar a través de la interfaz de usuario o la comunicación

alarma de temperatura (el relé de alarma se activa) o advertencia (el relé del ventilador/advertencia se activa)

ninguna alarma de temperatura ni advertencia (los relés de alarma y del ventilador/advertencia no se activan)

nivel de advertencia alcanzado (el relé del ventilador/advertencia se activa)

alarma activada (el relé de alarma se activa)

ninguna alarma activada (el relé de alarma no se activa)

ajustes bloqueados mediante el interruptor de hardware de la parte trasera del regulador

ajustes desbloqueados mediante el interruptor de hardware de la parte trasera del regulador

demanda para activar pasos

demanda para desactivar pasos

ninguna demanda para conmutar pasos

modo automático (los pasos se conmutan automáticamente según los ajustes)

modo manual (los pasos se pueden conmutar manualmente)

Modo Modificar (es posible realizar ajustes)

cambio de modo

ayuda en línea

cerrar ventana

Validación

página siguiente

Excepto la pantalla de inicio, en todas las demás pantallas del RVT, cada pantalla tiene tres partes: barra de título en la parte superior, barra de estado en la parte inferior y área de ajuste en el centro de la pantalla.

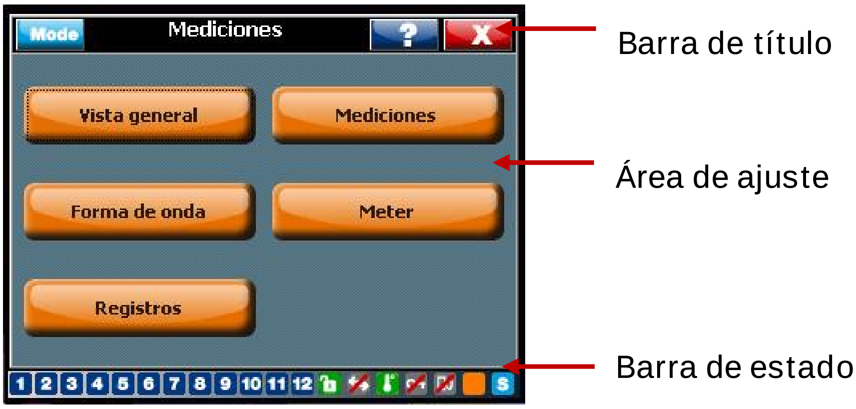


Figura 14: Composición de la pantalla del RVT

3.2.2 Barra de título

En el extremo izquierdo de la barra de título, el botón azul de modo se utiliza para cambiar entre los tres modos de funcionamiento del RVT: Modo Automático, Manual y Modificar. Como se muestra en la Figura 15, aparece la siguiente pantalla cuando se hace clic en el botón de modo. Cuando se define un modo en el RVT, por ejemplo, el modo Modificar, se mostrará la inicial de una letra en mayúsculas en la parte inferior derecha de la pantalla: la letra  del extremo derecho de la barra de estado indica que el modo actual del RVT es Modificar.

Figura 15: Conmutación de modos del RVT

En el medio de la barra de título, el texto "Mediciones", como se muestra en la Figura 14, muestra el menú actual que aparece en la pantalla.

Al hacer clic en el signo de interrogación , aparecerá la información de ayuda correspondiente para que el operario entienda y establezca los parámetros fácilmente. La siguiente pantalla aparecerá tras hacer clic en el signo de interrogación en la pantalla, tal como se ve en la Figura 15:

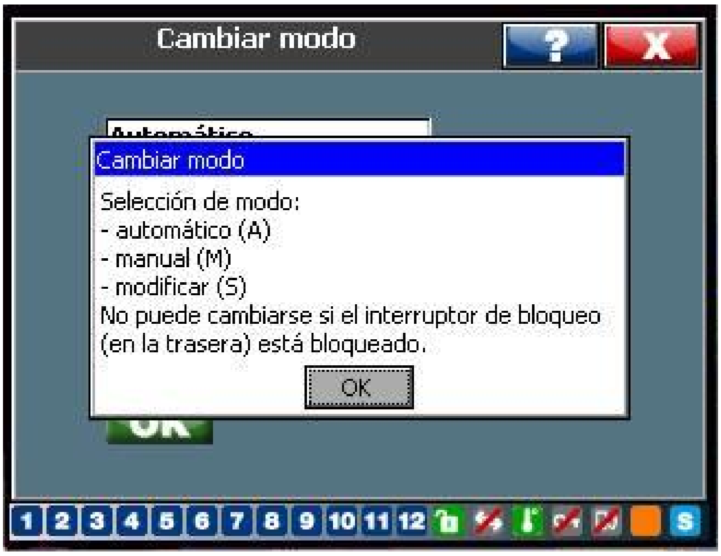


Figura 16: Información de ayuda del RVT

Al hacer clic en el botón de la cruz roja del extremo derecho de la barra de título , se cerrará la pantalla actualmente activa.

Nota: El RVT vuelve automáticamente al modo AUTO cuando la pantalla táctil no se toca durante más de cinco minutos.

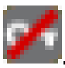
3.2.3 Área de ajuste

El área de ajuste consta de botones y campos de ajuste e información. Tras finalizar el ajuste en una pantalla, se deberá hacer clic en el botón OK  para validar los ajustes. Si hay más ajustes que no se puedan mostrar en una pantalla, aparecerá el botón de flecha  en la pantalla. Al hacer clic en el botón de flecha, los ajustes restantes aparecerán en la pantalla siguiente.

3.2.4 Barra de estado

La barra de estado muestra pasos activos de la batería de condensadores y el estado del RVT.

Bloqueo de hardware y software

El RVT dispone de bloqueo de hardware y de software. Hay un interruptor de hardware de color azul en la parte trasera del regulador. Cuando se pulsa, el RVT se bloquea y el icono  aparece en la barra de estado de la parte inferior de la pantalla. Cuando el interruptor se libera, el mismo icono se transforma en . Si el RVT se bloquea, no se podrá acceder a ningún ajuste de la batería y la puesta en marcha (tanto guiada como automática) se desactivará también.

El icono  significa que los ajustes de la batería del RVT están bloqueados mediante el software. El icono  significa que los ajustes de la batería del RVT están desbloqueados mediante el software. Cuando el regulador se bloquea mediante el software, todos los ajustes de la batería quedan protegidos, es decir, no es posible acceder a ellos.

Se puede consultar una descripción del bloqueo de software en 4.3.1.1.

3.2.5 Pantalla de introducción mediante teclado

Todos los datos se pueden introducir mediante una pantalla de fácil uso

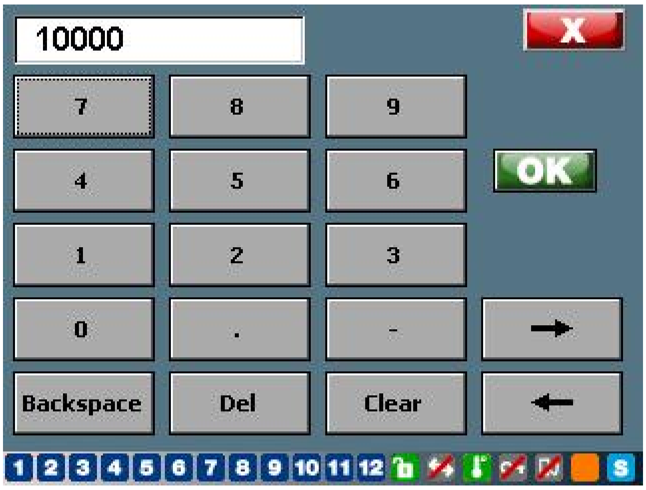
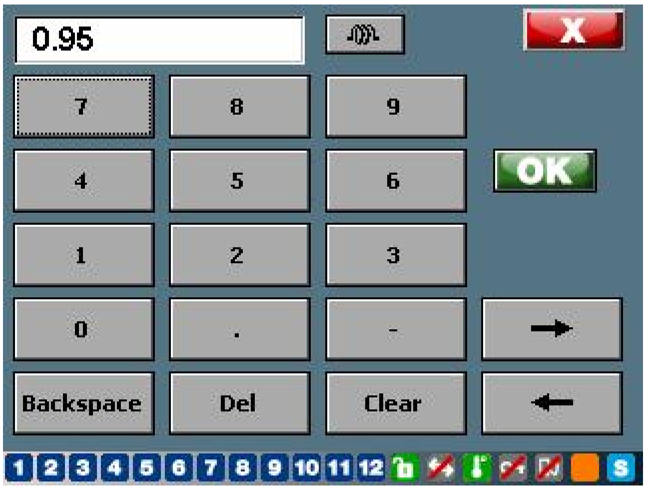


Figura 17: Pantalla de introducción mediante teclado

Los valores de cos j se pueden introducir con el símbolo (inductivo) o (capacitivo).



3.3 Puesta en marcha del RVT

Cuando el RVT se enciende, aparece la pantalla de inicio que se muestra en la Figura 13.

Hay cuatro iconos grandes en la pantalla de inicio: Mediciones, Parámetros, Control batería y Comunicación. Al tocar uno de los cuatro iconos, se puede acceder fácilmente al contenido del menú del siguiente nivel.

Se encuentran disponibles cinco idiomas para el regulador RVT: inglés, francés, alemán, español y chino simplificado. La siguiente ruta proporciona acceso a la selección de idioma:

Pantalla de inicio è Comunicación è Configuración E/S è Ajuste de idioma.

3.4 Puesta en marcha automática

La puesta en marcha de un RVT es muy fácil. La función de puesta en marcha automática del RVT facilitará a un usuario principiante a poner un regulador en funcionamiento rápidamente.

3.4.1 Descripción

El RVT lleva a cabo automáticamente la puesta en marcha incluyendo:

- reconocimiento automático de:
    - secuencia de fase y rotación para cada tipo de conexión predefinida
    - número de salidas
    - Tipo de Secuencia de Conmutación
- ajuste automático: C/k, corriente de arranque; se puede consultar una descripción detallada sobre C/k en el párrafo 4.3.1.2.

3.4.2 Preparación para la puesta en marcha automática

A continuación se indican los parámetros necesarios durante el proceso de puesta en marcha automática:

- Tipo de conexión. El tipo de conexión define cómo se conectan CT para el RVT. Hay en total ocho tipos distintos de conexiones para CT, que dependen del número de mediciones de corriente y de cómo se conecten estos CT. Se puede consultar una descripción detallada del tipo de conexiones en el párrafo 4.3.1.2.
- Relación TC: Relación del Transformador de Corriente (por ejemplo un transformador de corriente de 250A/5A tiene una relación TC de 50). Se puede obtener más información en el párrafo 4.3.1.2.
- Cos j deseado (en el párrafo 4.3.1.3.)

3.4.3 Puesta en marcha automática

- si ha cortocircuitado el secundario del TC no olvide abrirlo después de haber conectado la entrada de corriente al Regulador de FP
- si se utiliza un transformador para medir la tensión es necesario modificar el valor de la relación V correspondientemente (véase el párrafo 4.3.1.)

Notas: cuando aparece el icono  (bloqueo del hardware) en la barra de estado de la parte inferior de la pantalla, significa que el RVT está bloqueado. Se deniega el acceso al ajuste de modo y la puesta en marcha no se podrá realizar hasta que el RVT se desbloquee (consultar la descripción en el párrafo 4.3.1.1).

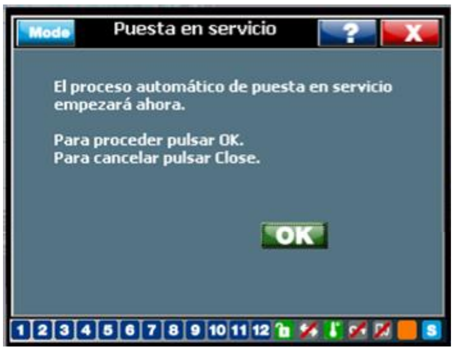
Las siguientes capturas de pantalla muestran cómo se realiza una puesta en marcha automática:

1. Pantalla de Inicio, Click "Parámetros":

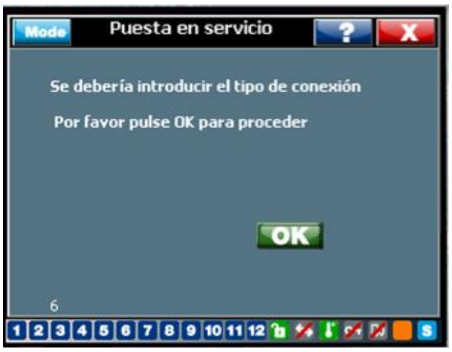
2. Click Puesta en servicio:

3. Click automático:

4. Click OK:



5. Click OK:

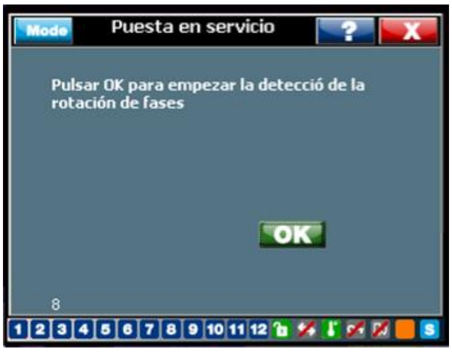


6. Seleccionar tipo de conexión (Anexo 7):

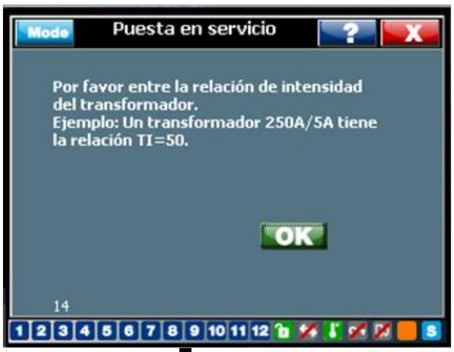
7. Click OK:

8. Bloquear o desbloquear los banco de registros – OK:

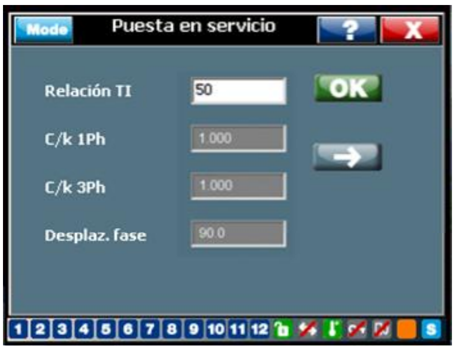
9. Click OK:



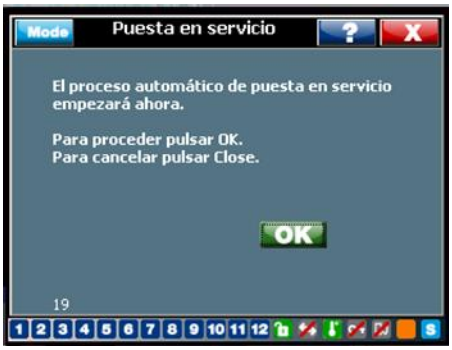
10. Click OK:



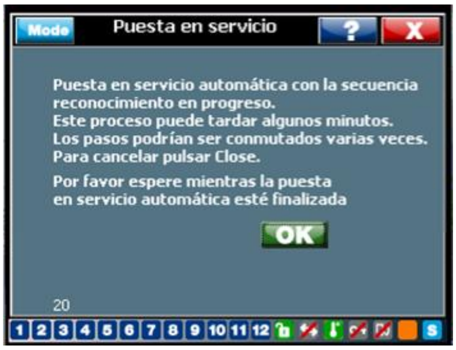
11. Ingresar la Relación del TC: 50:



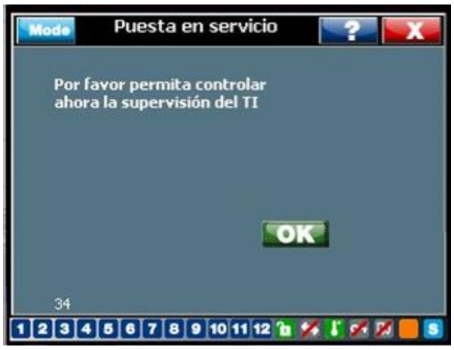
12. Click OK:



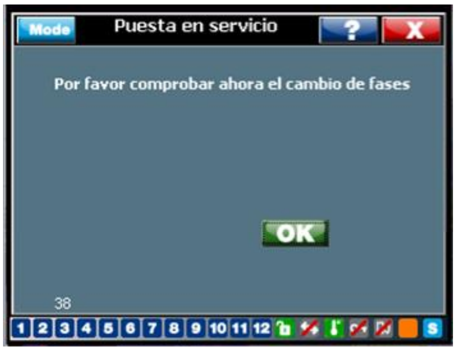
13. Click OK:



14. Click OK:



15. Click OK:



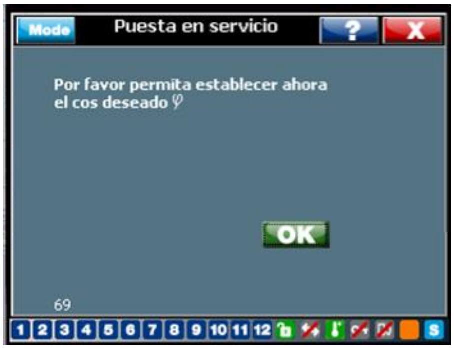
16. Click OK:

17. Click OK:

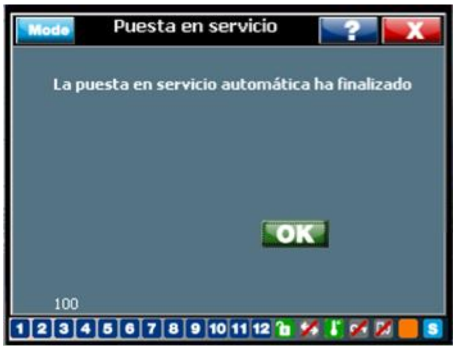
18. Click OK:

19. Click OK:

20. Click OK:



21. Puesta en servicio auto. Completada:



El anterior proceso corresponde a una puesta en marcha automática habitual. Algunos parámetros como la relación de TC y el tipo de conexión pueden ser diferentes a lo ingresado líneas arriba, dependiendo de cada instalación.

Si se producen errores durante la puesta en marcha automática, la información de ayuda proporcionará instrucciones al usuario para identificar las causas y finalizar la puesta en marcha.

4 Mediciones y Parámetros

4.1 Contenido del capítulo

Este capítulo describe todos los menús disponibles para lecturas, ajustes, monitorización de la batería, etc.

4.2 Mediciones

Este menú principal permite al usuario ver distintos parámetros como tensión, corriente, potencia y temperatura. Se incluyen cinco submenús en este menú principal: Vista general, Mediciones, Forma de onda, Meter y Registros.

El RVT es muy potente en las mediciones y versátil en la presentación de dichas mediciones. Todas las mediciones se pueden mostrar en una tabla. Para mediciones de forma de onda como la tensión y la corriente, también se encuentra disponible una presentación gráfica. Se proporciona una presentación de gráfico de barras para todas las mediciones de armónicos.

Vista general

El menú de Vista general presenta todos los elementos medidos en forma de lista.

Mediciones

Mediciones de red como la tensión, corriente, potencia, energía y temperatura, etc. En el modelo trifásico RVT12-3P, se encuentran disponibles también los valores de sistema de cada fase, por ejemplo, el factor de potencia de la fase 1, 2 y 3.

Forma de onda

La tensión y la corriente del sistema (fase a fase o fase a neutro) se pueden visualizar en forma de onda sinusoidal.

Registros

Este submenú permite al usuario ver los valores extremos de algunos de los parámetros clave.

Meter

Esta función permite al usuario mostrar tres mediciones en una pantalla. Por ejemplo, se pueden mostrar tres tensiones de línea en una pantalla con mejor resolución y vista. Instrucción detallada de esta function se puede encontrar en 4.2.4

4.2.1 Vista general

Detalles de todas las mediciones disponibles mediante el RVT:

Tabla 1: Vista general de mediciones

Designación	Unidad	Descripción			
Tensión			Gama	Precisión	Valor máx. presentado
Vef	V	Tensión eficaz	Hasta 690Vac	± 1 %	10^6 V
V1	V	Tensión eficaz a la frecuencia fundamental	Hasta 690Vac	± 1 %	10^6 V
Frecuencia	Hz	Frecuencia de la tensión fundamental	45Hz - 65Hz	± 0.5%	45Hz – 75Hz
THDV	%	Distorsión armónica total de la tensión	0 - 300%	± 1 %	1000 %
Tabla arm. V		Armónicos de tensión presentados en forma de tabla	2-49	Véase más adelante en este párrafo	
Gráf. arm. V		Armónicos de tensión presentados en forma de gráfico de barras	2-49	Véase más adelante en este párrafo	
Corriente			Gama	Precisión	Valor máx. presentado
Ief	A	Corriente eficaz	0 - 5 A	± 1 %	10^6 A
I1	A	Corriente eficaz a la frecuencia fundamental	0 - 5 A	± 1 %	10^6 A
THDI	%	Distorsión armónica total de la corriente	0 - 300%	± 1 %	1000%
Tabla arm. I		Armónicos de corriente presentados en forma de tabla	2-49	Véase más adelante en este párrafo	
Gráf. arm. I		Armónicos de corriente presentados en forma de gráfico de barras	2-49	Véase más adelante en este párrafo	
Potencia			Gama	Precisión	Valor máx. presentado

Cos j		Factor de potencia de desplazamiento	-1 - +1	± 0.02	-1 - +1
PF		Factor de potencia	-1 - +1	± 0.02	-1 - +1
P	W	Potencia activa	-10^9 è 10^9 W	± 2%	-10^9 è 10^9 W
Q	var	Potencia reactiva	-10^9 è 10^9 W	± 2%	-10^9 è 10^9 W
S	VA	Potencia aparente	-10^9 è 10^9 W	± 2%	-10^9 è 10^9 W
Ausencia Q	var	Falta de potencia para alcanzar la alarma preajustada cos j	-10^9 è 10^9 W	± 2%	-10^9 è 10^9 W
Pasos ausentes		Pasos de condensador que faltan para alcanzar la alarma reajustada cos j			
Temperatura (opcional)			Gama	Precisión	Valor máx. presentado
T1-T8	°C / °F	Temperatura T1-T8 (sonda externa opcional hasta 8 máx.)	-40°C è + 105°C	± 2°C	-40°C è + 150°C
Energías			Gama	Precisión	Valor máx. presentado
Energía activa suministrada	kWh	Energía activa a la red	0 è 10^{12}	± 3%	0 è 10^{12}
Energía activa consumida	kWh	Energía activa a la carga	0 è 10^{12}	± 3%	0 è 10^{12}
Energía activa total	kWh	Suma de energía suministrada y consumida	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
Energía reactiva inductiva	kvarh	Energía inductiva	0 è 10^{12}	± 3%	0 è 10^{12}
Energía reactiva capacitiva	kvarh	Energía capacitiva	0 è 10^{12}	± 3%	0 è 10^{12}
Energía reactiva total	kvarh	Suma de energía inductiva y capacitiva	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
Energía aparente total	kVAh	Suma de energía activa y reactiva	0 è 10^{12}	± 3%	0 è 10^{12}

NOTAS:

- Todas las mediciones están promediadas a lo largo de un segundo
- Si utiliza un transformador para la medición de la tensión, la medición de la tensión armónica puede ser errónea debido al comportamiento de filtro que realiza el transformador. El empleo de un transformador de alta calidad reducirá al mínimo el error.

  (1) los valores de la gama deberán ser multiplicados por la relación TC (Irms - I1 - P - Q - S - Ausencia Q) y la relación PT (Vrms - V1 - P - Q - S - Ausencia Q).

  (2) Factor de potencia de desplazamiento o cos j : cálculo basado en el valor fundamental de las mediciones. Este valor se utiliza como valor de referencia por las compañías de suministro de electricidad.

  (3) Factor de potencia: cálculo basado en los valores fundamental y armónico de las mediciones. El factor de potencia es siempre inferior o igual al factor de potencia de desplazamiento.

El menú Vista general muestra todos los elementos medidos en una lista.

El usuario puede personalizar la presentación de los valores de medición según desee con sólo desplazar los elementos importantes de la lista a la posición correcta.

Hacer clic en el elemento de la lista que se desee desplazar (en el ejemplo siguiente, se ha elegido el elemento THDV L-L).

A continuación, hacer clic en la posición a la que se debe desplazar el elemento de la lista (en el ejemplo siguiente, el elemento THDV L-L se sitúa en la posición Frecuencia, desplazándose automáticamente justo debajo en la lista).

La pantalla Vista general es también un menú en el que es posible activar y desactivar manualmente algunos pasos. Entrar en el modo “Manual” haciendo clic en el botón “Modo”.

A continuación, se activan los botones de activación y desactivación de un paso.

Hacer clic en estos botones para conmutar pasos manualmente.

Nota: El modelo RVT12-3P mostrará una nueva pantalla en la que se pregunta qué tipo de paso se debe (des)activar. Diferencias entre estos pasos pueden encontrarse en 4.3.1.1.

4.2.2 Valores del sistema

El menú Mediciones muestra todos los valores de sistema medidos ordenados por tipo como se muestra en la Figura 18. En el modelo trifásico RVT12-3P, también se incluyen los valores de sistema de cada fase.

Figura 18: Mediciones

Mediciones de Tensión - Corriente

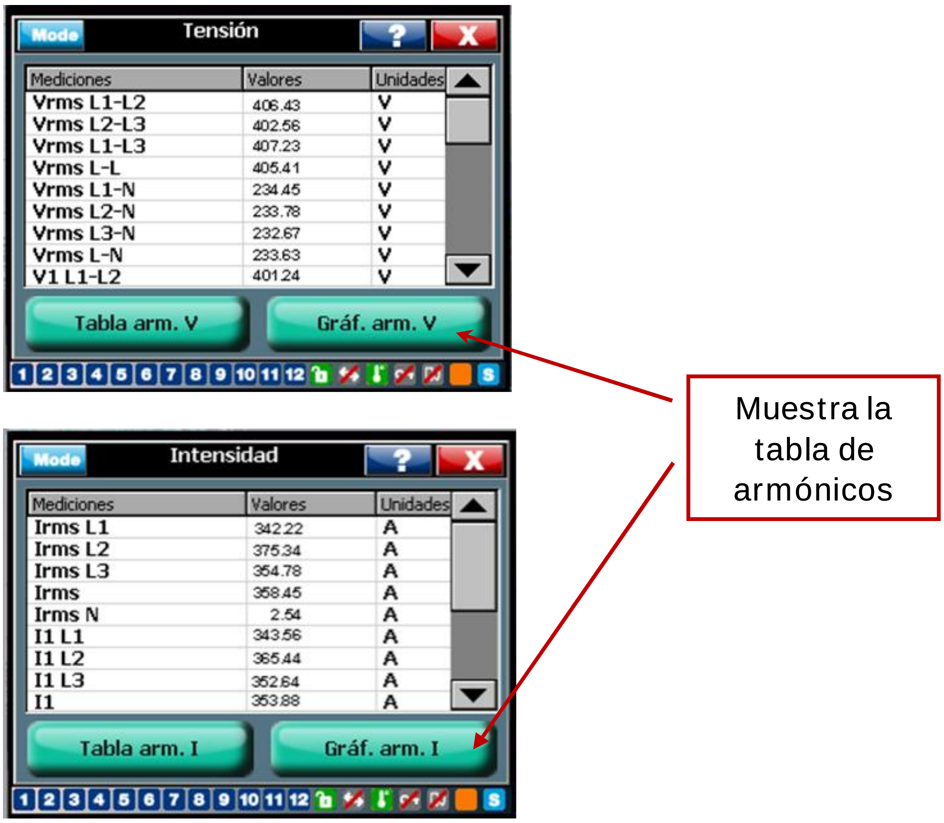


Gráfico y tabla de armónicos de tensión (corriente)

La tensión/corriente de armónicos se puede ilustrar en un gráfico de barras como se muestra a continuación. Una barra de desplazamiento permite elegir un determinado armónico para mostrarlo en la parte superior de la pantalla: orden de armónico, valor y porcentaje frente a Fundamental.

Para los valores de tensión e corriente, el RVT puede mostrar la tensión y la corriente de los armónicos en una tabla o en un espectro. Hacer clic en el botón “Selección” para elegir la medición que se desee visualizar en la tabla o gráfico de armónicos.

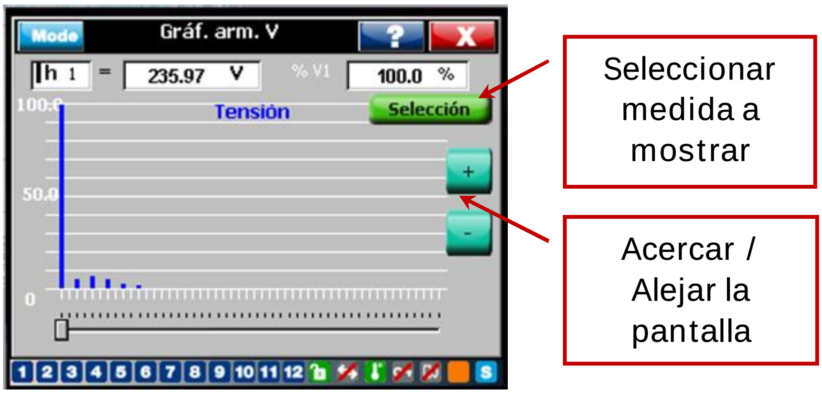
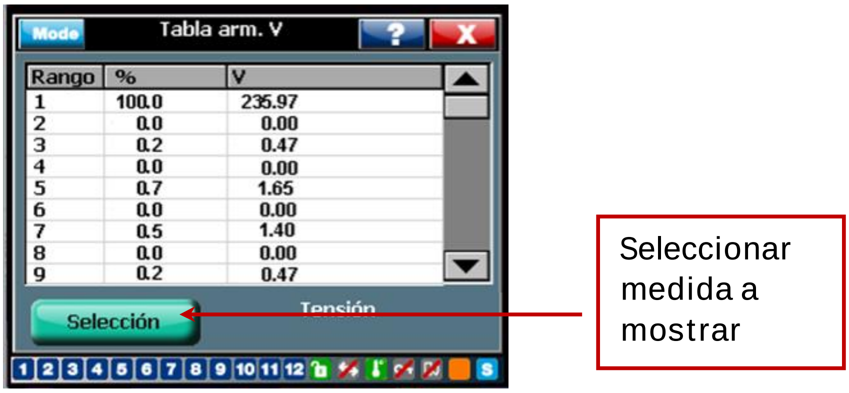


Figura 19: Tensión de armónicos en gráfico



Rango	%	V
1	100.0	235.97
2	0.0	0.00
3	0.2	0.47
4	0.0	0.00
5	0.7	1.65
6	0.0	0.00
7	0.5	1.40
8	0.0	0.00
9	0.2	0.47

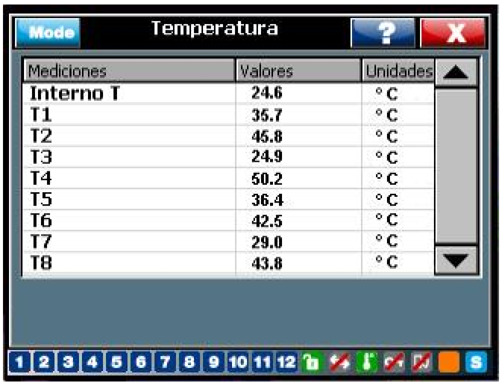
Figura 20: Tensión de armónicos en tabla

Comentario: precisión de las mediciones de armónicos de tensión (corriente): ± 1 % de Vrms (Irms)

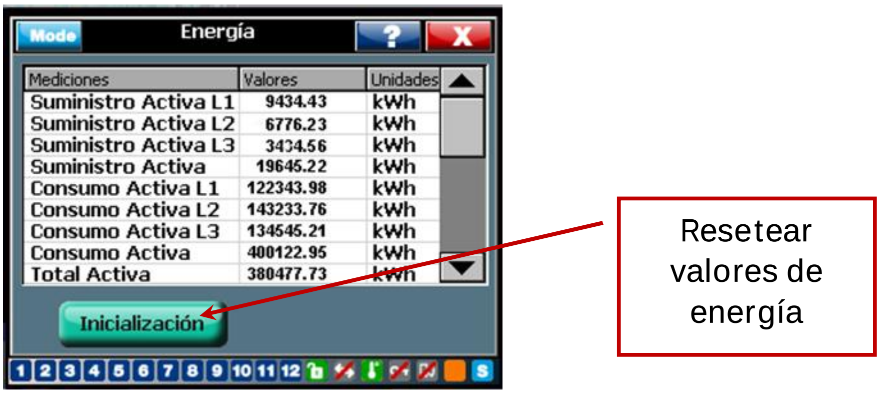
Mediciones del factor de potencia, potencia

Mediciones	Valores	Unidades
P 1	305.56	kW
P 2	296.45	kW
P 3	325.97	kW
P	927.98	kW
P /15min	257.41	kW
Q 1	13.53	kvar
Q 2	11.56	kvar
Q 3	9.40	kvar
Q	34.49	kvar
S 1	305.86	kVA
S 2	296.67	kVA
S 3	326.10	kVA

Mediciones de temperatura



Mediciones de energía



Las mediciones de energía sólo se encuentran disponibles en el modelo RVT12-3P (el modelo trifásico está equipado con un reloj de tiempo real).

Los valores de energía se pueden restaurar a 0.

4.2.3 Forma de onda

Disponible señales de voltage y corriente de línea (dependiendo del tipo de RVT y la conexión usada) puede mostrarse en la pantalla como forma de onda. Figura 21 muestra la forma de onda de tensión entre línea y neutro.

Figura 21: Formas de onda de tensión y corriente

4.2.4 Meter

La pantalla grande ofrece al usuario una vista mejorada de las tres mediciones más interesantes.

Hacer clic en el elemento deseado y, a continuación, en el botón “Selección” para insertar valores en la pantalla Meter.

Debajo se muestra un ejemplo correspondiente a tres mediciones importantes.

Figura 22: tres mediciones mostradas en Meter

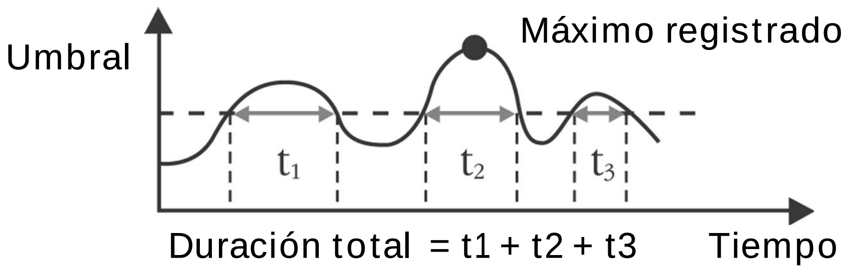
4.2.5 Registros

Descripción

La función de registro de eventos le permite al usuario registrar para cada elemento medido significativo (véase la lista inferior) y desde la última vez que se borró:

- el valor máximo (o mínimo)
- la duración por encima (o por debajo) del umbral.

Una vez que se haya establecido un umbral (véase el ejemplo siguiente) el RVT comienza a registrar automáticamente el valor máximo (o mínimo) así como la duración total hasta que se efectúe un reset.



Valores registrados

La función de registro de eventos le permite al usuario registrar el tiempo durante el cual un valor medido rebasa un determinado umbral así como su valor máximo para los parámetros siguientes: Vef [V], Ief [A], P [kW], Q [kvar], S [kVA], THDV [%], THDI [%], Ausencia Q [kvar], frequencia*, [Hz], T1*[°C o °F] to T8* [°C o °F].

* Para la frecuencia de temperaturas se registra también los valores mínimos y la duración por debajo de un umbral.

Figura 23: Valores grabados de registro de eventos

Ejemplo

Registro de información en Vef.

Tensión de la red: 400V.

Figura 24: Ajuste del umbral de registro de eventos - Vrms

Figura 25: Ajuste del umbral de registro de eventos - Frecuencia

La información registrada (valor máximo y duración total) se puede borrar seleccionando y validando la posición “Inicialización”.

4.3 Parámetros

El menú principal Parámetros cuenta con submenús de varios niveles que permiten al usuario programar el regulador, así como utilizar funciones de puesta en marcha y prueba.

4.3.1 Ajuste manual (modo Modificar)

Los ajustes manuales permiten al usuario acceder a todos los ajustes de la batería, instalación y usuario, así como a configuraciones de protección y advertencia. El usuario también puede restaurar al ajuste de fábrica mediante este submenú.

Figura 26: Ajuste manual

Antes de realizar ajustes en el regulador, se debe comprobar que se encuentra en el modo Modificar. Consultar 3.2.4 y 4.3.1.1 con respecto al bloqueo/desbloqueo y al ajuste del modo del regulador.

4.3.1.1 Ajustes de batería

inicio->parámetros->ajustes manual->ajustes bateria

El menú de Ajustes batería incluye los parámetros de configuración relacionados con la batería.

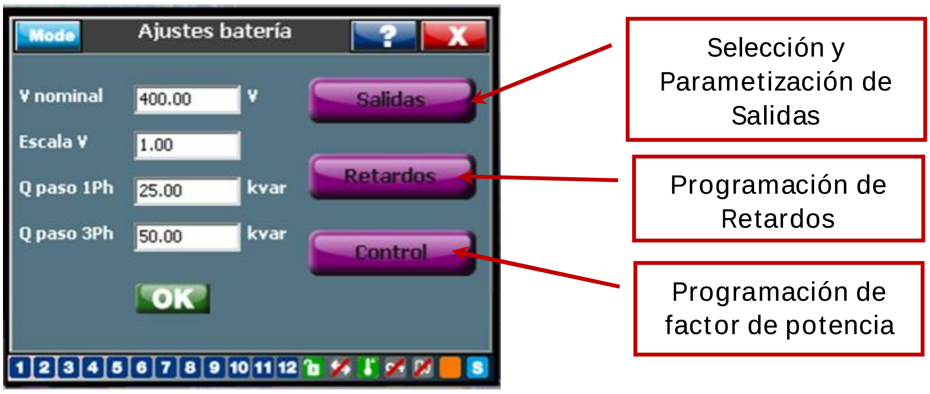


Figura 27: Ajustes bateria

A continuación se muestra la lista de parámetros de ajuste de la batería.

V nominal: tensión nominal de la batería.

Cuando se introduce un valor Vnom los niveles de protección, de falta de tensión y de sobretensión se ponen automáticamente en el 80% y 120% de Vnom. Los valores de estos niveles se pueden modificar manualmente.

Escala V: relación del transformador de tensión exterior.

Ejemplos:

Para un transformador de tensión de 15kV/100V el valor de relación V = 150.

Si no se utiliza ningún transformador de tensión exterior, relación V = 1

Esta función permite al RVT controlar un banco de condensadores en MV. Un transformador de tensión propiamente dimensionado será conectado a los terminales de medición del RVT. Luego, el RVT va a mostrar la medida en MV correspondiente.

Q paso 1ph: tamaño de paso más pequeño para condensadores monofásicos (fase a neutro) que se utilizan para corrección del factor de potencia de fase individual en una red desequilibrada.

Q paso 3ph: tamaño de paso más pequeño para condensadores trifásicos en una red equilibrada.

Para los dos ajustes anteriores,

a) Tras la puesta en marcha automática, este valor se establecerá según el paso más pequeño de la batería de condensador.

b) Para la puesta en marcha guiada (consultar 4.2.2.2), este valor se debe establecer manualmente.

Por ejemplo, en una batería de condensador que tenga tanto corrección del factor de potencia de fase individual (3 pasos) como trifásica (3 pasos):

Secuencia monofásica*: 1 (5kvar) 2 (10kvar) 2 (10kvar) è Q paso 1ph = 5 kvar

Secuencia trifásica: 1 (10kvar) 2 (20kvar) 2 (20kvar) è Q paso 3ph = 10 kvar

O

Secuencia trifásica: 2 (15kvar) 4 (30kvar) 5 (37,5kvar) è Q paso = 7,5 kvar

Secuencia: valor relativo reactivo de los condensadores conectados a las salidas del RVT. Estos valores relativos están incluidos entre 0 y 8.

Tanto para el modelo base RVT6/RVT12 como para el trifásico RVT12-3P, la secuencia predeterminada de fábrica es: 1:1:….:1. Las secuencias personalizadas se pueden introducir manualmente.

Para personalizar una secuencia, se debe navegar por el árbol de menús de la siguiente forma:

inicio->parámetros->ajustes manual->ajustes bateria ->salidas

La Figura 28 muestra la salida 1 - 6; hacer clic en el botón de flecha . La siguiente pantalla mostrará la salida restante 7-12 como se indica en la Figura 29.

Figura 28: RVT salidas 1-6

Figura 29: RVT salidas 7-12 (modelo trifásico RVT12-3P)

En el lado derecho de la pantalla, en el “Estado” se incluyen seis atributos de cada salida:

“Fijo OFF”: esta salida está desactivada (ajuste predeterminado de fábrica);

“Fijo ON”: esta salida está activada (el condensador correspondiente está siempre conectado);

“1PhL1, 1Phl2, 1PhL3”: esta salida controla un condensador fase a neutro, que se encuentra en la fase 1, 2 o 3 respectivamente.

“3Ph”: esta salida controla un condensador trifásico.

Para un modelo base RVT6/RVT12, sólo se encuentran disponibles “Fijo OFF, Fijo ON y Activado” para el estado de la salida. Es preciso definir una salida como “Activado” para que el regulador active o desactive un condensador.

A continuación se indican algunos ajustes habituales de las salidas para el modelo trifásico RVT12-3P:

Ajuste habitual uno: Condensadores fase a neutro 12 pasos monofásicos

Figura 30: Ajuste habitual de las salidas 12 x 1ph (modelo trifásico RVT12-3P)

Ajuste habitual dos: Condensadores trifásicos 6 pasos + condensadores fase a neutro 6 pasos

Figura 31: Ajuste habitual de las salidas 6 x 3ph + 6 x 1ph (modelo trifásico RVT12-3P)

Retardos

Hacer clic en el botón “Retardos” en la pantalla mostrada en la Figura 27. El usuario puede fijar los retardos de la batería en la siguiente pantalla.

Figura 32: Retardos del RVT

Retardo de conexion:

- Durante el funcionamiento normal es el tiempo que transcurre entre la demanda de conectar un escalón y la conmutación efectiva.
- El funcionamiento integral es el tiempo integrado entre dos decisiones de conmutación.

El Retardo de CONEXION es necesario para permitirle al condensador descargar antes de CONECTARLO.

Advertencia: un tiempo de retardo demasiado corto podría causar daños a la batería.

Retardo de desconexion:

- En funcionamiento normal es el tiempo que transcurre entre la demanda de DESCONECTAR un escalón y la desconexión efectiva.
- En operación integral, no se utiliza el Retardo de DESCONEXION.

Retardo inicio: tiempo que espera el RVT antes de reiniciar el funcionamiento de la batería después de un corte de corriente.

Control

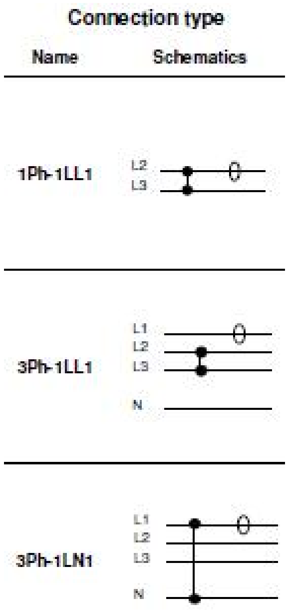
Hacer clic en el botón “Control” en la pantalla mostrada en la Figura 27. El usuario puede definir las mediciones de CT y las estrategias de conmutación de la batería en la siguiente pantalla.

Figura 33: Ajustes de control de la batería del RVT

1Ph/3Ph

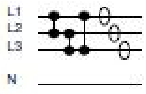
Este ajuste define el tipo de conexión correspondiente a las mediciones de corriente. El RVT admite ocho topologías distintas de conexión de CT en función del tipo de red (red trifásica de tres cables, red trifásica de cuatro cables o red monofásica (fase a fase):

Medición de corriente monofásica (disponible para ambos modelos RVT6/12 y RVT12-3P) 1Ph-1LL1, 3Ph-1LL1, 3Ph-1LN1,

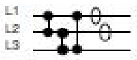


Mediciones de corriente trifásica (disponible solo para el modelo trifásico RVT12-3P) 3Ph-3LL3, 3Ph-3LL2 (no conexión del neutro conectada en la instalación), 3Ph-3LN3, 3Ph-1LL3, 3Ph-1LN3.

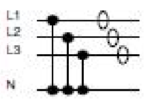
3Ph-3LL3



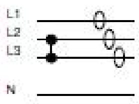
3Ph-3LL2



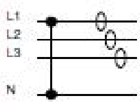
3Ph-3LN3



3Ph-1LL3



3Ph-1LN3



Instrucciones detalladas de la conexión se pueden encontrar en A7. Ilustración del tipo de conexión de CT y cableado de CT en los terminales del regulador. En el apéndice al final de este manual se muestra la imagen del tipo de conexión del TC y el cableado del TC a los terminales del regulador.

Definición de los anteriores tipos de conexiones:

3Ph – 3 LN 3

1: un TC conectado, 2: dos TC conectados, 3: tres TC conectados.

LN: Medición de Tensión entre L y N, LL Medición de Tensión entre fases

1: una medición de tensión, 3: tres mediciones de tensión

1Ph: Sistema Monofásico (L-N or L-L), 3Ph: Sistema Trifásico

NOTA: L se refiere a Línea, N se refiere a Neutro

Lineal / Circular

Conmutación lineal, sigue el principio de conmutación “primero que entra, último que sale”.

Conmutación circular, sigue el principio de conmutación “primero que entra, primero que sale”.

Ambas operaciones se describen en la tabla siguiente.

La conmutación circular incrementa la vida útil de los condensadores y contactores al equilibrar los esfuerzos entre todas las salidas. La circularidad se aplica a las dos primeras salidas y también a las salidas de valor superior.

En el caso de “primer paso doble” (1:1:2:2:…, 1:1:2:4:4.,…), la circularidad se aplica a las dos primeras salidas y también en las salidas de valor más alto.

Lineal

	C1	C2	C3	C4	...	C11	C12
Secuencia	1	1	1	1		1	1
	■	□	□	□	...	□	□
↗	■	■	□	□	...	□	□
↗	■	■	■	□	...	□	□
↘	■	■	□	□	...	□	□
↘	■	□	□	□	...	□	□

Circular

	C1	C2	C3	C4	...	C11	C12
Secuencia	1	1	1	1		1	1
	■	□	□	□	...	□	□
↗	■	■	□	□	...	□	□
↗	■	■	■	□	...	□	□
↘	□	■	■	□	...	□	□
↘	□	□	■	□	...	□	□

ì Demanda de añadir un escalón
î Demanda de eliminar un escalón

n Salida cerrada

o Salida abierta

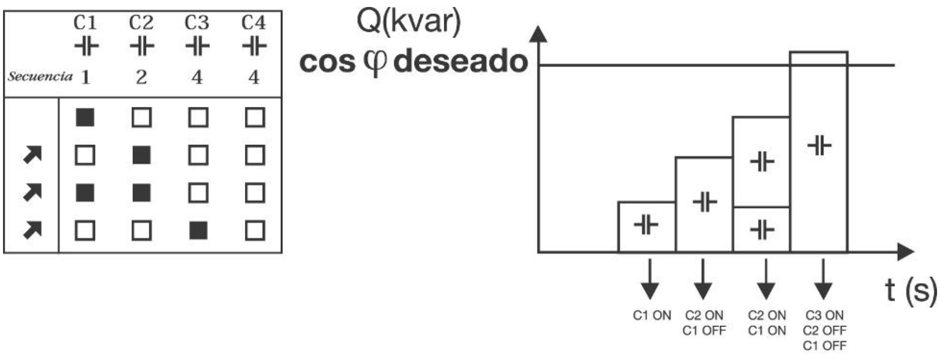
Progresivo / Directo

El funcionamiento Progresivo va conmutando los escalones secuencialmente uno a uno basado en el tiempo de inserción. (ON-Delay).

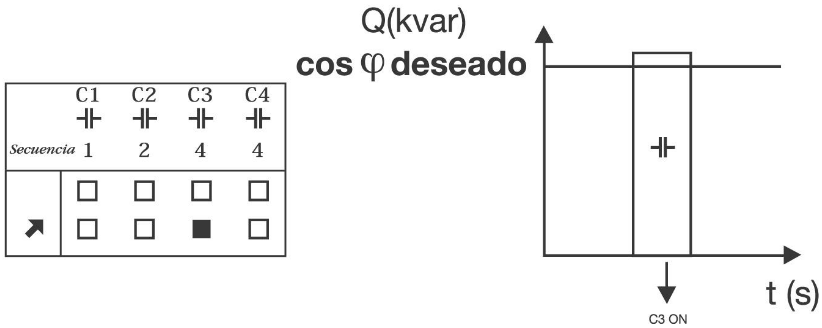
La operación directa conmuta el paso más grande primero, luego el resto de pasos con un retardo fijo de 12 s. hasta alcanzar el cosj objetivo más rápido.

El modo directo permite evitar numerosas conmutaciones intermedias inútiles

Progresivo



Directo

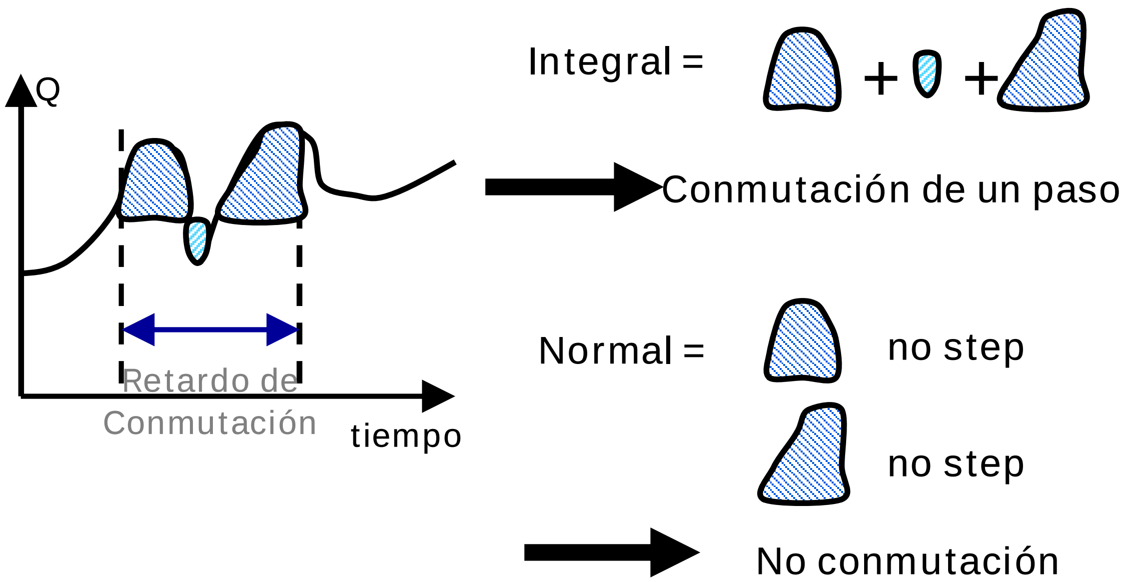


Normal / Integral

Funcionamiento Normal: conmuta los escalones cuando la demanda está presente continuamente durante todo el intervalo de conmutación.

Funcionamiento Integral: conmuta los escalones de acuerdo con el valor promediado de la potencia reactiva requerida.

El funcionamiento integral es útil para aplicaciones en las que la carga varíe con rapidez.



Protección del ajuste de la batería (bloqueo de software)

El ajuste de la batería se puede proteger contra el acceso no autorizado mediante hardware y mediante software. La protección de hardware se describe en 3.2.4. En la siguiente pantalla se ilustra cómo funciona el bloqueo de software. La ruta a la pantalla se muestra en la Figura 34.

inicio->parámetros->ajustes manual->ajustes bateria ->control

Figura 34: Protección de los ajustes de la batería del RVT: no protegidos

Para bloquear el ajuste de la batería, marque la casilla "Banco de registros desbloqueado"; a continuación, la pantalla cambia a la siguiente como se muestra en la Figura 35.

1. Los campos de ajuste de la batería aparecen en gris
2. "Banco de registros desbloqueado" pasa a ser "Banco de registros bloqueado"
3. En la barra de estado, se activa el icono de bloqueo de software: 

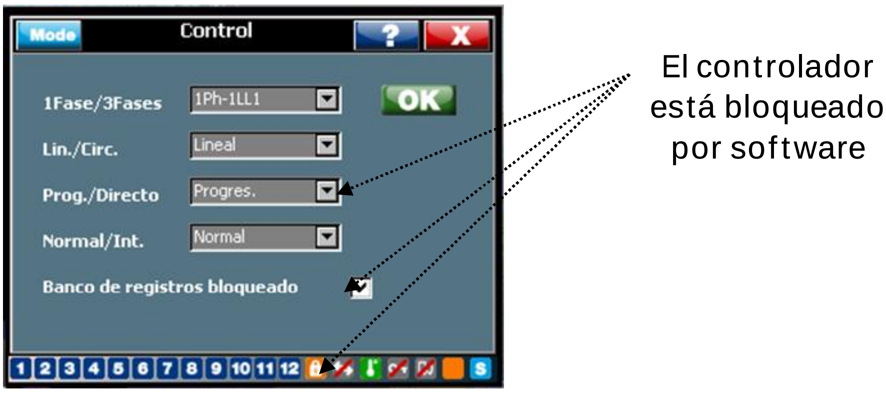


Figura 35: Protección de los ajustes de la batería del RVT: protegidos

4.3.1.2 Ajustes instalación

inicio->parámetros->ajustes manual->ajustes instalación

Los ajustes de instalación del RVT proporcionan instrucciones sobre cómo establecer los parámetros relacionados con CT.

Figura 36: RVT ajustes instalación

Relación TC: relación del transformador de corriente.

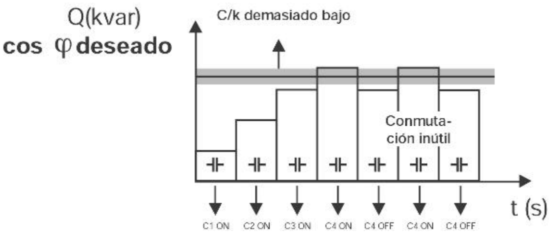
Ejemplo: un transformador de corriente de 250A/5A tiene una relación TC de 50.

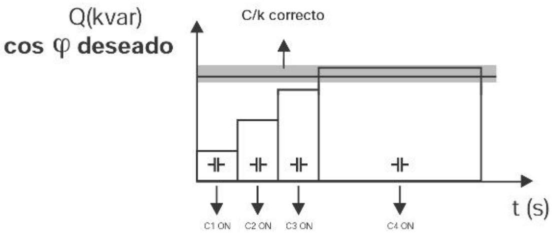
C/k: corriente de arranque del Regulador RVT. Generalmente se hace igual a 2/3 de la corriente del escalón de condensadores (Qescalón) (descripción en el párrafo 4.3.1.1.)

Representa el valor del corriente umbral para que el RVT CONECTE o DESCONECTE un escalón de condensadores.

El valor C/k se puede programar de 0,1 hasta 5.

El siguiente ejemplo muestra el efecto de un valor C/k demasiado bajo y como puede dar lugar a conmutaciones inútiles.





Un valor C/k demasiado alto dará lugar a que se conecte un número de condensadores insuficiente para alcanzar el cos j deseado.

El ajuste recomendado de C/k se puede calcular por la siguiente fórmula o se puede ver directamente en la tabla siguiente.

Fórmula

Red trifásica:

$$C/k = 0.67\ x\ \frac{Qescalón\ x\ 1000}{\sqrt{3}\ x\ Vnom\ x\ Relación\ TI}$$

Red monofásica:

$$C/k = 0.67\ x\ \frac{Qe}{Vno}$$

Tabla 2: C/k para un sistema trifásico de 400V

Relación IT		K	Escalón nominal del condensador (kvar)											
			5	10	15	20	30	40	50	60	70	90	100	120
10/1	50/5	10	0.48	0.97	1.45	1.93	2.90	3.87	4.84					
20/1	100/5	20	0.24	0.48	0.73	0.97	1.45	1.93	2.42	2.90	3.38	4.35	4.84	
30/1	150/5	30	0.16	0.32	0.48	0.64	0.97	1.29	1.61	1.93	2.26	2.90	3.22	3.87
40/1	200/5	40	0.12	0.24	0.36	0.48	0.73	0.97	1.21	1.45	1.69	2.18	2.42	2.90
60/1	300/5	60	0.08	0.16	0.24	0.32	0.48	0.64	0.81	0.97	1.13	1.45	1.61	1.93
80/1	400/5	80	0.06	0.12	0.12	0.24	0.36	0.48	0.60	0.73	0.85	1.09	1.21	1.45
100/1	500/5	100	0.05	0.10	0.15	0.19	0.29	0.39	0.48	0.58	0.68	0.87	0.97	1.16
120/1	600/5	120	0.04	0.08	0.12	0.16	0.24	0.32	0.40	0.48	0.56	0.73	0.81	0.97
160/1	800/5	160	0.03	0.06	0.09	0.12	0.18	0.24	0.30	0.36	0.42	0.54	0.60	0.73
200/1	1000/5	200	0.02	0.05	0.07	0.10	0.15	0.19	0.24	0.29	0.34	0.44	0.48	0.58
300/1	1500/5	300	0.02	0.03	0.05	0.06	0.10	0.13	0.16	0.19	0.23	0.29	0.30	0.39
400/1	2000/5	400	0.01	0.02	0.04	0.05	0.07	0.10	0.12	0.15	0.17	0.22	0.23	0.29
600/1	3000/5	600	0.01	0.02	0.02	0.03	0.05	0.06	0.08	0.10	0.11	0.15	0.15	0.19

Nota:

Para el modelo RVT12-3P, hay dos C/k disponibles: C/k 1ph y C/k 3ph; el modelo RVT6/RVT12 sólo dispone de C/k.

C/k 3ph (o C/k) es aplicable para una instalación con uno, dos o tres TC (red trifásica equilibrada); C/k 1ph es aplicable para una instalación con tres TC (red trifásica desequilibrada). Se asume que, para una red trifásica desequilibrada, se utiliza un C/k 1ph uniforme para conmutación de tres condensadores monofásicos individuales.

Se asume que todos los TC conectados al RVT12-3P (dos o tres TC en tipos distintos de conexión) tienen la misma relación. No obstante, el paso mínimo para condensador monofásico y condensador trifásico podría ser distinto; esto implica dos valores de C/k distintos para el RVT.

Desplaz. Fase (aplicable a modelo básico solamente): desfase entre la tensión y la corriente introducida por la conexión de medida.

Si el RVT está conectado tal como se indica en el esquema de conexión descrito en el párrafo 2.4. el valor del desfase es de 90°C (ajuste por defecto).

Para otras conexiones, el desfase a programar se seleccionará de las tablas del anexo A6.

Por favor tener en cuenta que el RVT puede adaptar automáticamente el desfase durante la puesta en marcha automática

4.3.1.3 Ajustes usuario

inicio->parámetros->ajustes manual->ajustes usuario

Los ajustes de usuario permiten al usuario establecer distintos factores de potencia objetivo y retardos de alarma.

Figura 37: Ajustes de usuario del RVT

Cos j objetivo: factor de potencia de desplazamiento deseado.

El valor de cos j deseado se puede ajustar entre 0,70 inductivo y 0,70 capacitivo.

indica un cos j inductivo y indica un cos j capacitivo.

Cos j nocturno: factor de potencia de desplazamiento alternativo (inhabilitado por defecto).

La conmutación del cos j deseado al cos j nocturno deseado se realiza mediante una señal exterior aplicada a la entrada exterior Opto1 (descripción en el párrafo 2.4).

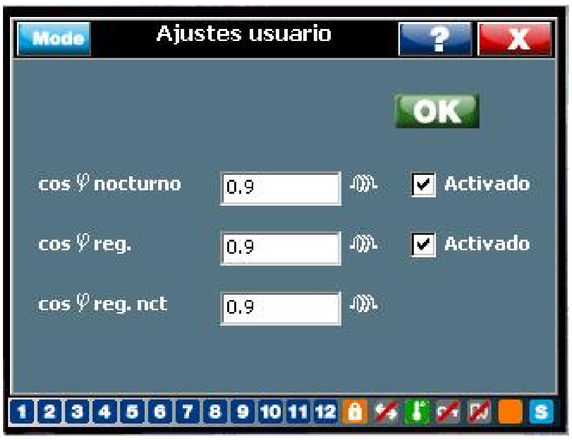


Figura 38: RVT ajustes usuario: activación del factor de potencia nocturno y reg.

Cos j reg.: el factor de potencia de desplazamiento deseado alternativo. Activado cuando se invierte el flujo de fuerza: P < 0 (inhabilitado por defecto).

Alarma: Los parámetros de relé de alarma se pueden ajustar para la condición cos j .La condición cos j se cumple cuando: todos los escalones de condensadores estén conectados y el valor actual de cos j esté por debajo del valor umbral de cos j alarma de manera que por lo menos se necesita un escalón.

- Retardo de alarma: duración de una condición de cos j alarma antes de que se cierre el relé.
- Retardo rearme alarma: tiempo de retardo antes de que se abra el relé una vez que haya desaparecido la condición de alarma.
- Alarma cos j : valor umbral.

4.3.1.4 Protecciones/avisos

Inicio->parámetros->ajustes manual->protecciones/avisos

El RVT activará ciertas acciones cuando determinados valores de sistema superen ciertos umbrales. El nivel de protección es más estricto que los de advertencia.

Figura 39: RVT protecciones/avisos

4.3.1.4.1 Protecciones

Figura 40: Protecciones del RVT

Niveles de protección: Para establecer los niveles de protección contra subtensión, sobretensión, THDv máx., protección contra corriente Irms máxima; también activa una protección externa iniciada por la entrada 2 optoaislada. El relé de alarma proporciona un contacto NO y otro NC.

Una vez alcanzado un nivel de protección, se producen las siguientes acciones:

- todos los pasos del condensador se desactivan
- aparece un mensaje de alarma en la pantalla
- el relé de alarma se activa (NO se abre/NC se cierra)
- el icono  aparece resaltado

Nota: Si la señal externa IN2 (descrita en el párrafo 2.3) está activa, todos los pasos de capacitores son retirados y el parámetro de Prot. Externa dirige el comportamiento de la alarma:

- Desconexión y alarma
- Desconexión solamente (sin alarma)

Una vez que el evento desaparece, el RVT reiniciará su regulación tras un determinado espacio de tiempo de retardo. Este tiempo de retardo depende del tipo de evento. El procedimiento de reinicio de la alarma posterior del RVT se describe detalladamente en el anexo A4.

Nota 1: si está habilitada, la recepción exterior (Ext. Prot.) se puede activar aplicando una señal exterior a través de la entrada OPTP2 del RVT (véase párrafo 1.4).

4.3.1.4.2 Avisos

Los niveles de aviso son básicamente inferiores a los niveles de protección 1. Cuando se alcanza un nivel de aviso, se producen las siguientes acciones:

- el relé del ventilador/advertencia se activa: el contacto NO se cerrará
- el icono  aparece resaltado

Figura 41: Avisos del RVT

4.3.1.4.3Prot. Temp.

El RVT proporciona 8 protecciones de temperatura de la batería mediante ocho sondas de temperatura. Es posible establecer independientemente cada nivel de protección de la sonda de temperatura. Cuando se alcanza uno de los ocho niveles de protección de temperatura.

- todos los pasos del condensador se desactivan
- aparece un mensaje de alarma en la pantalla
- el relé de alarma se activa (NO se abre/NC se cierra)
- los iconos  y  aparecen resaltados

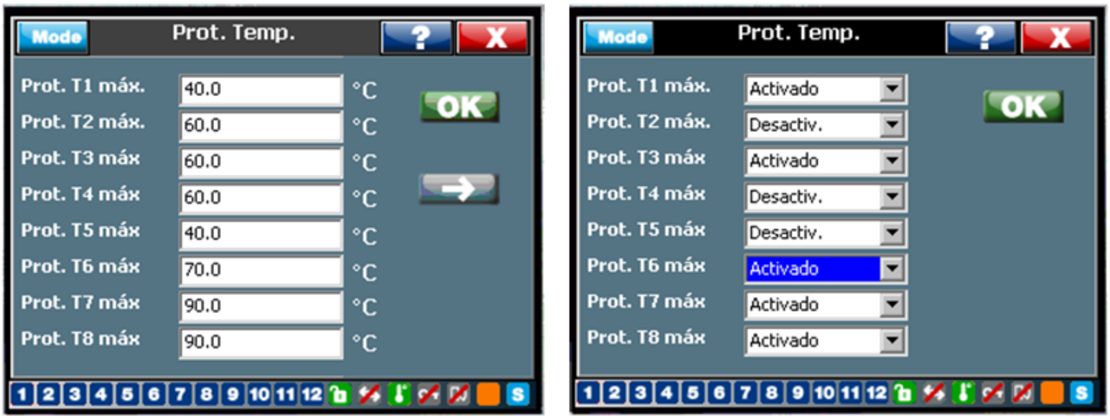


Figura 42: Ajustes de protección de temperatura del RVT

4.3.1.4.4Aviso de Temp.

El RVT proporciona 8 avisos de temperatura de la batería mediante ocho sondas de temperatura. Es posible establecer independientemente cada nivel de aviso de la sonda de temperatura. Cuando se alcanza uno de los ocho niveles de aviso de temperatura.

- el relé del ventilador/advertencia se activa: el contacto NO se cerrará
- el icono  aparece resaltado

Figura 43: Ajustes de aviso de temperatura del RVT

Nota 1: el RVT está autoprotegido contra una sobretemperatura interna de 85°C. Se producirán las acciones antes descritas cuando la temperatura interna exceda el nivel de protección.

El RVT se reinicia automáticamente cuando la temperatura interna haya descendido por debajo de 80°C.

Nota 2: los niveles de protección de temperatura quedan inhabilitados por defecto. Cuando se introduce un nivel, el RVT comprueba la conexión de la sonda.

4.3.1.5 Restablecer los ajustes por defecto

inicio->parámetros->ajustes manual->restaurar predet.

Figura 44: Ajustes de restauración de valores predeterminados del RVT

Al seleccionar y validar el elemento “Restaurar ajustes por defecto”, todos los valores de los parámetros del RVT se reponen en sus valores por defecto (véase el documento independiente anexo al RVT), excepto si está bloqueado el elemento de ajuste de la batería en cuyo caso no se cambian los ajustes de la batería.

Advertencia: Pueden perderse parámetros importantes.

Comentario: antes de restablecer los ajustes por defecto, asegúrese de que:

- el RVT está desbloqueado (descripción en los párrafos 3.2.4 y 4.3.1.1)
- el RVT está en modo Modificar (descripción en el párrafo 3.2.2.)

4.3.2 Puesta en servicio (modo Modificar)

Este sub-menú permite al usuario realizar una completa puesta en servicio automática o guiada del regulador.

4.3.2.1 Puesta en marcha fácil

Por favor véase la descripción completa en el párrafo 3.4.

4.3.2.2 Puesta en marcha guiada

El RVT lleva a cabo un proceso de puesta en marcha guiada. Es preciso introducir los parámetros requeridos (véase la tabla siguiente).

Comentario:

antes de efectuar la puesta en marcha guiada, asegúrese de que:

1. el RVT está desbloqueado (descripción en los párrafos 3.2.4 y 4.3.1.1)
2. el RVT está en modo Modificar (descripción en el párrafo 3.2.2.)
3. si tiene cortocircuitado el secundario del TC no olvide abrirlo después de haber conectado la entrada de corriente del Regulador PF.

Parámetro de puesta en marcha guiada

Parámetro	Descripción
Monofásico/Trifásico	Tipo de conexión de la batería y conexión de medición RVT.
Rotación de fase	Comprobación de la rotación de fase
Relación T	Relación del transformador de corriente.
Redirección de TC	Redirección de entradas de CT en el caso de que los TC se encuentren en una fase incorrecta
Escalón Q	Desfase entre suspensión de corriente introducida por las conexiones de medición. El desfase es de 90° (ajuste por defecto) cuando el RVT está conectado tal como se muestra en el esquema de cableado (véase párrafo 2.4). Para otras conexiones, por favor véase el anexo A.5
Relación V	Relación del transformador de tensión exterior.
V nom	Tensión nominal de la batería.

Retardo ON	Tiempo de retardo de activación.
Retardo OFF	Tiempo de retardo de desactivación.
Secuencia:	Valor relativo de la potencia reactiva de cada salida.
Q paso	Diferencia de potencia reactiva más pequeña entre pasos.
C/k	Ajuste de la corriente de puesta en marcha
Cos j deseado	Factor de potencia de desplazamiento deseado.

4.3.2.3 Puesta en marcha de las sondas T

El RVT permite conectar hasta ocho sondas de temperatura en cadena tipo margarita. Cada una de las sondas se debe poner en marcha según los siguientes procedimientos para poder utilizarlas.

Cada sonda se debe reconocer una a una:

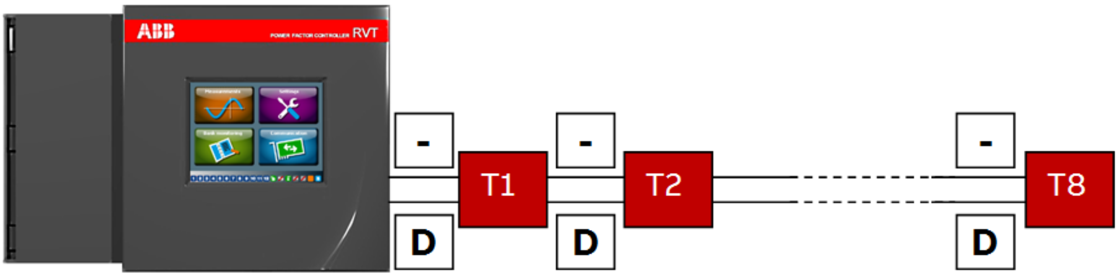
- conectar la sonda a la entrada de sonda de temperatura (una sonda solamente)
- hacer clic en una fila para asignar un número de sonda
- hacer clic en el botón “Empezar”
- el RVT reconoce automáticamente la dirección de la sonda
- realizar el mismo procedimiento para cada sonda

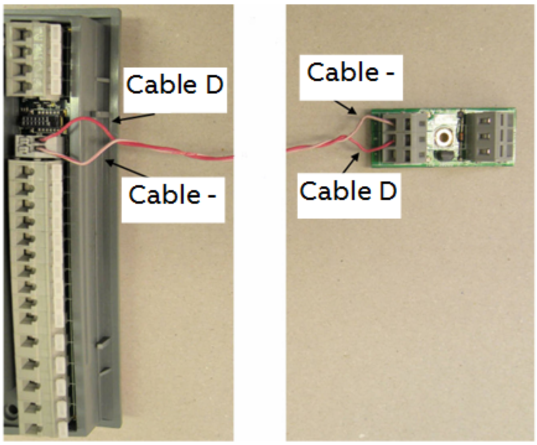
Si alguna de las sondas presenta algún problema, se podrá borrar haciendo clic en el botón Borrar.

Se asignará una dirección única a cada sonda activada tras realizarse el reconocimiento.

Figura 45: Reconocimiento automático de la sonda de temperatura

- Conectar cada sonda sucesivamente:





4.4 Control de la batería

La función de control de la batería del RVT permite al usuario acceder a diagnósticos, registro de alarmas, función de prueba y a un reloj de tiempo real (solo el modelo trifásico RVT12-3P tiene el reloj en tiempo real). Por ello, resulta ser una herramienta de diagnóstico muy útil.

Figura 46: Control batería

4.4.1 Diagnóstico

Relaciona el número de operaciones de cada relé de condensadores de salida desde que se fabricó el RVT.

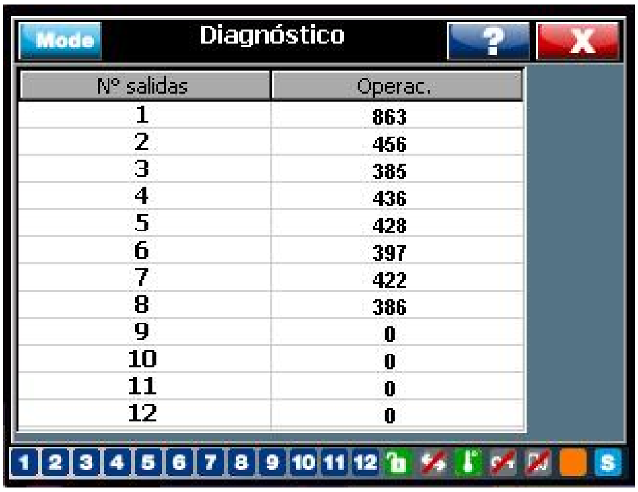


Figura 47: Diagnóstico de la batería

4.4.2 Comprobar función

Este sub-menú le permite al usuario comprobar cada uno de los relés del RVT.

Prueba alarma: permite probar el relé de alarma

Prueba ventilador: permite probar el relé del ventilador/ advertencia

Prueba salidas: permite probar cada una de las salidas de los relés de condensadores. (El RVT va a encargarse de los retardos de conmutación programado)

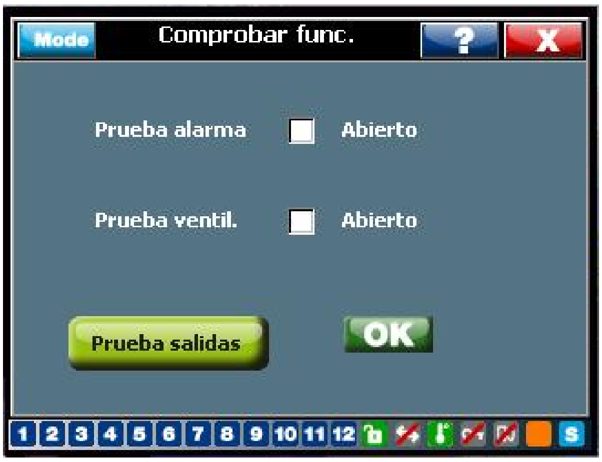


Figura 48: Función de prueba de control de la batería

Figura 49: Salidas de prueba de control de la batería

Hacer clic en la casilla de verificación para activar o desactivar el relé correspondiente

Antes de proceder a las funciones de prueba, asegúrese de que:

- el RVT está desbloqueado (descripción en los párrafos 3.2.4 y 4.3.1.1)
- el RVT está en Modo Modificar (descripción en el párrafo 3.2.2.)

4.4.3 Histórico alarma

El registro de alarmas muestra los cinco últimos mensajes de alarma con grabación de tiempo real.

Figura 50: Control batería histórico alarma

4.4.4 Reloj de tiempo real

Figura 51: Reloj de tiempo real de RVT

El reloj de tiempo real sigue en funcionamiento incluso cuando el RVT no recibe alimentación.

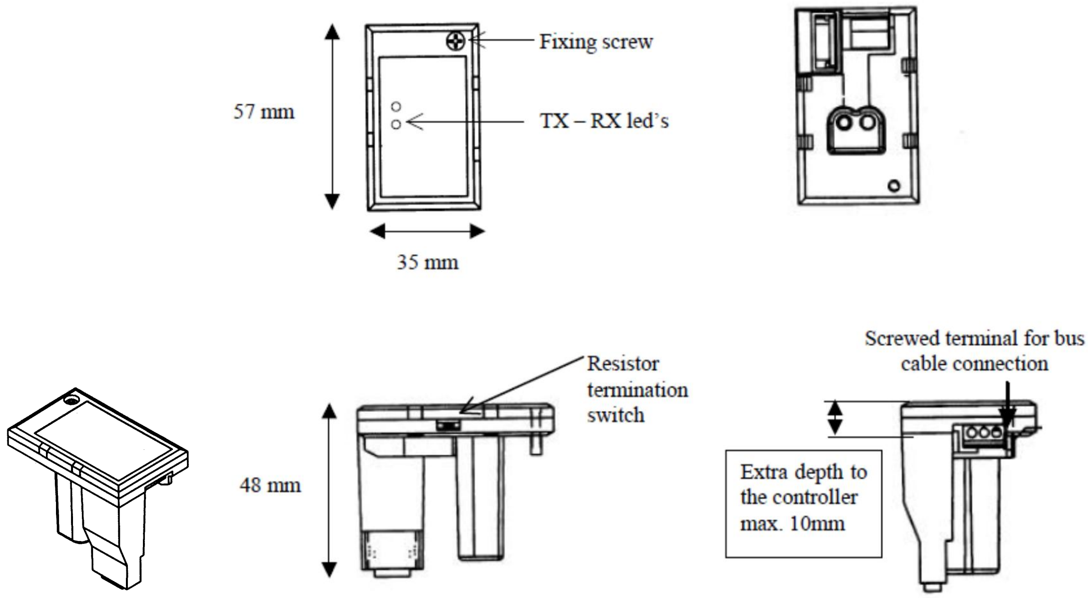
4.5 Comunicación

El RVT proporciona varios métodos de comunicación. En este menú principal, se incluye el ajuste de idioma, el ajuste de la unidad de temperatura, la configuración de la pantalla y ajustes de Ethernet, Modbus. Para obtener más información sobre el protocolo TCP/IP, Modbus y USB y la programación, consultar el manual: 2GCS213013A0050_RVT, comunicación a través de protocolo TCPIP, Modbus o USB.

Adaptador RS485/Modbus

El adaptador Modbus es un dispositivo opcional para el regulador de factor de potencia RVT que permite conectar el RVT a un sistema RS485 Modbus. El regulador se considera una unidad secundaria en la red Modbus.

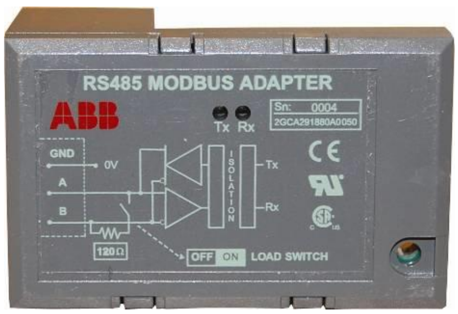
Consultar la guía del usuario del adaptador Modbus RS485 2GCS214013A0050-RVT para obtener más información sobre el adaptador RS485 Modbus.



Se debe tener en cuenta que el adaptador RS485 MODBUS es el que tiene el texto de color VERDE (verde) (suministro de alimentación de 3,3 V).

El que tiene el texto de color BLANCO (blanco) está reservado para el modelo antiguo (suministro de alimentación de 5 V).

Esto significa: El Nuevo Adaptador Modbus no es compatible con el antiguo RVT; y el antiguo adaptador Modbus no podrá conectarse al nuevo RVT (con pantalla táctil).

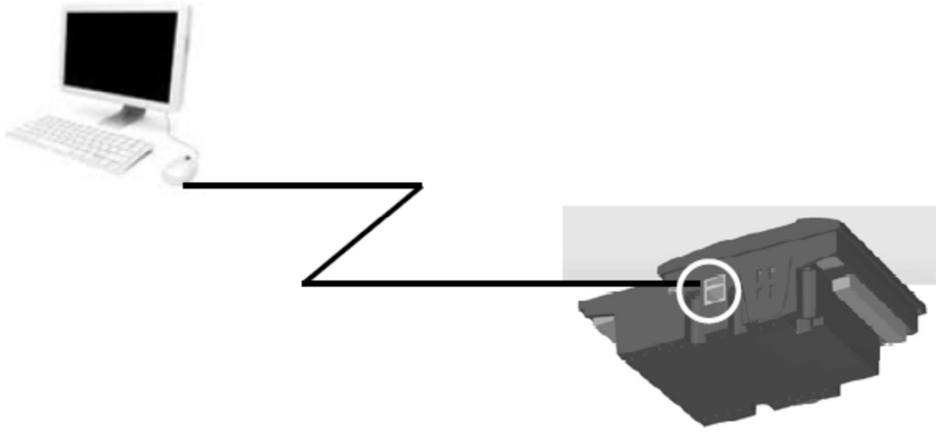


Ethernet / TCP/IP

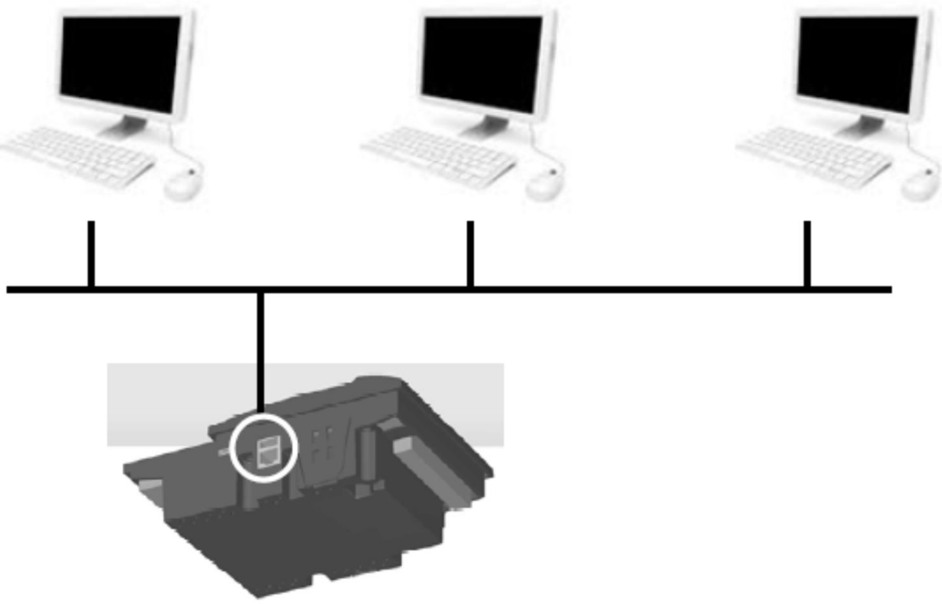
Las conexiones TCP/IP se pueden iniciar indiferentemente de forma local o remota.

El puerto TCP que se utiliza de forma predeterminada es el 4250.

La conexión al RVT se realiza con un cable Ethernet RJ45 Cat5e



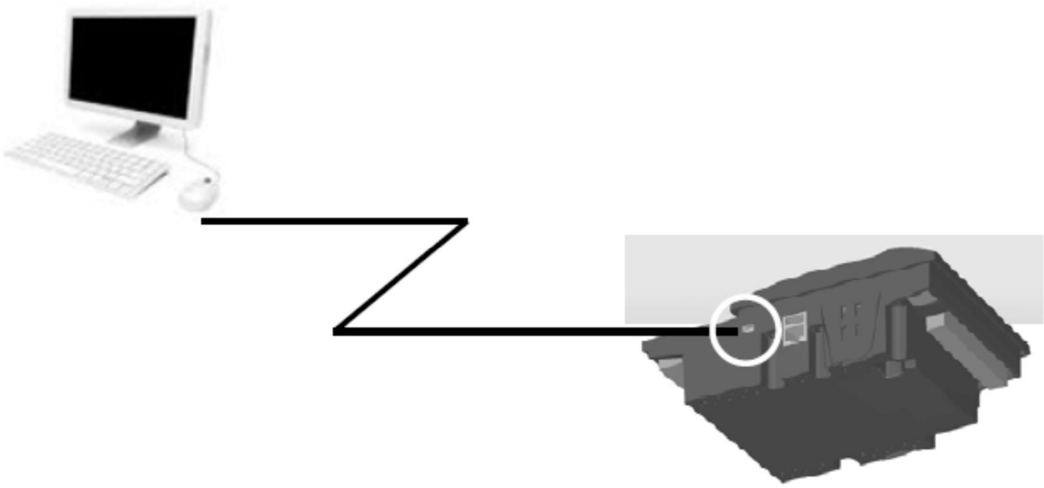
El RVT se puede conectar directamente a una LAN o a través de Internet



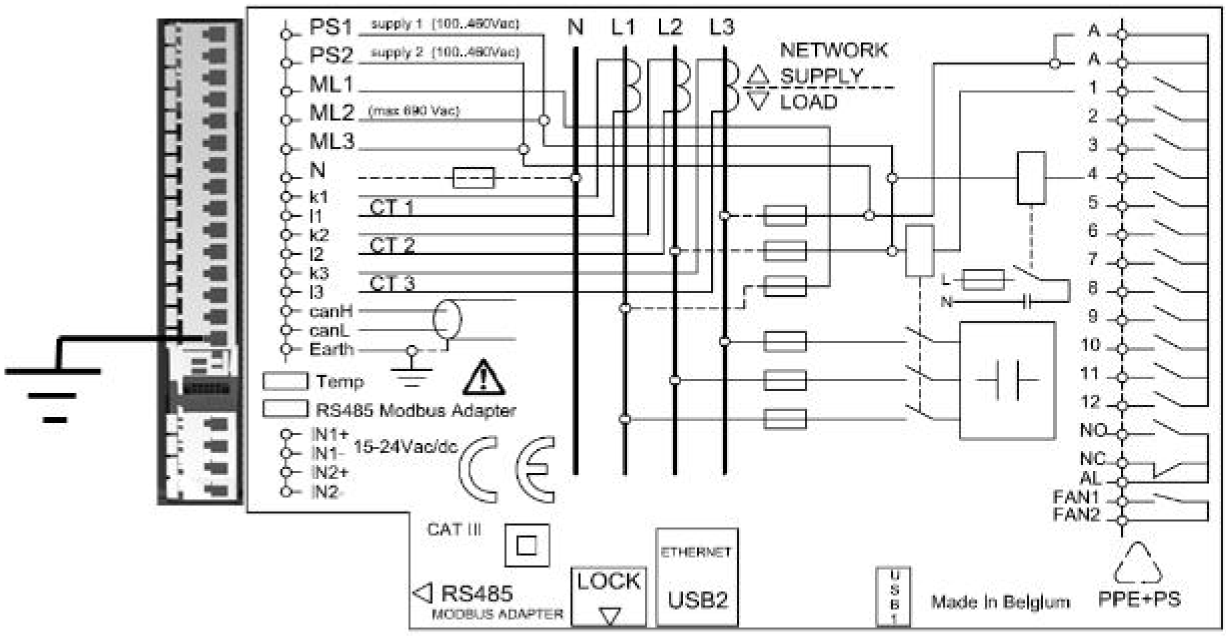
USB

La interfaz USB se utiliza para presentar el RVT como una interfaz serie en su puerto USB.

El ordenador se conecta mediante una conexión macho USB-A a macho USB-Mini B



Precaución: La conexión USB al RVT no está aislada. Es obligatorio conectar la conexión a TIERRA de protección cuando se utiliza el sistema USB.



4.5.1 Configuración E/S

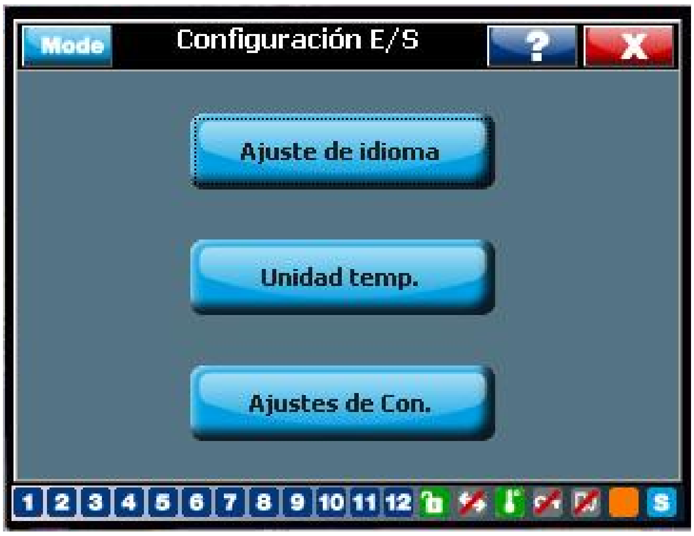


Figura 52: RVT Configuración E/S

4.5.1.1 Ajuste de idioma

Se pueden seleccionar cinco idiomas distintos para el RVT.

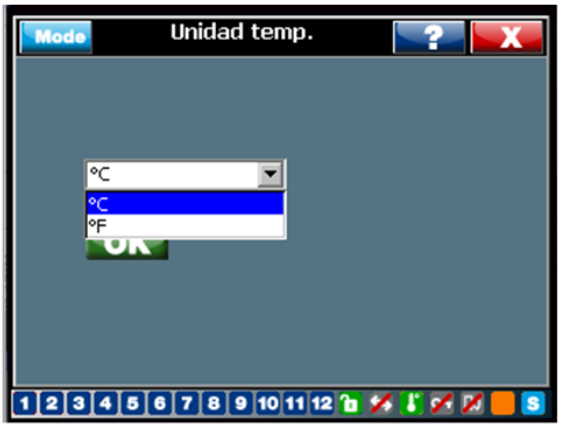
El usuario debe regresar al menú principal para que el idioma seleccionado surta efecto.

Figura 53: RVT ajuste d'idioma

4.5.1.2 Unidad Temp.

Este menú proporciona dos unidades de temperatura: Celsius y Fahrenheit.

La unidad seleccionada será aplicable en todas las demás mediciones o ajustes de temperatura.



4.5.1.3 Ajustes de con.

Es preciso configurar las conexiones Modbus y Ethernet para que funcionen correctamente.

Figura 54: Ajuste del protocolo de comunicaciones del RVT

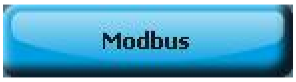


Figura 55: Ajuste del protocolo Modbus del RVT

La dirección secundaria es la que utiliza el Modbus principal para gestionar el RVT a través de Modbus.

Los parámetros de comunicación de velocidad en baudios, paridad y bits de parada deben coincidir exactamente con los ajustes de comunicación del Modbus principal que controla la red RS485/Modbus.

El RVT necesita una dirección IP para conectarse directamente a un PC o a una red Ethernet.

Esta dirección IP puede ser fija e introducirse manualmente si DHCP está desactivado. La dirección predeterminada es 192.168.1.40.

Si la dirección IP se proporciona de forma automática mediante una puerta de enlace o una LAN Ethernet, DHCP se deberá activar.

A continuación se proporcionan algunos ejemplos:

Ejemplo 1: En la siguiente pantalla se muestran los ajustes predeterminados para conectarse directamente a un PC (el PC se debe configurar en consecuencia con la dirección IP fija 192.168.1.1, máscara de subred 255.255.255.0, DHCP desactivado).

Figura 56: Ajuste del protocolo TCP/IP del RVT

Ejemplo 2: En la siguiente pantalla se muestran los ajustes predeterminados para conectarse a una red Ethernet (el PC que se conecta también a la LAN tiene su propia dirección IP proporcionada por la red con DHCP activado).

Para obtener más información sobre la comunicación, consultar el manual: 2GCS213013A0050_ RVT communication through Modbus, USB or TCPIP protocol.

Reinicie el RVT para iniciar con estos parámetros.

4.5.2 Configuraciones de Ethernet

Este menú muestra la dirección IP real del RVT, la dirección de máscara y la dirección IP de la puerta de enlace.

Los datos mostrados pueden variar según el estado de DHCP.

En las siguientes pantallas se muestra el resultado de los anteriores ejemplos 1 y 2:

Ejemplo 1: En la siguiente pantalla se muestra la dirección IP fija real con DHCP desactivado.

Ejemplo 2: En la siguiente pantalla se muestran los ajustes reales resultantes de la resolución de dirección IP automática con DHCP activado.

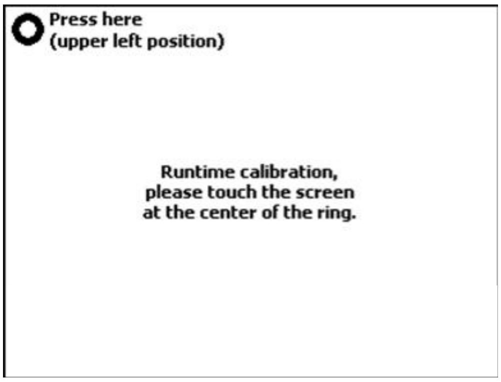
4.5.3 Configuración de la pantalla

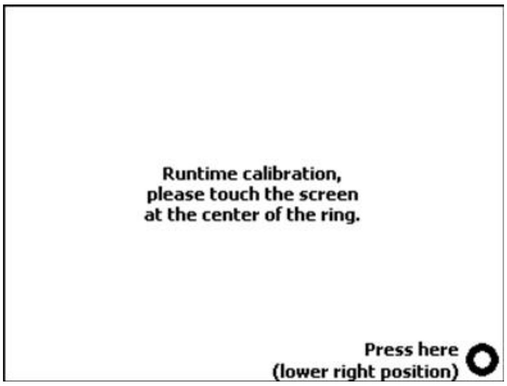
Este menú permite al usuario ajustar las coordenadas XY de la pantalla táctil, así como el brillo de la luz posterior.

Normalmente no es necesario realizar la calibración de la pantalla táctil si se utiliza de forma razonable y en condiciones ambientales estándar.

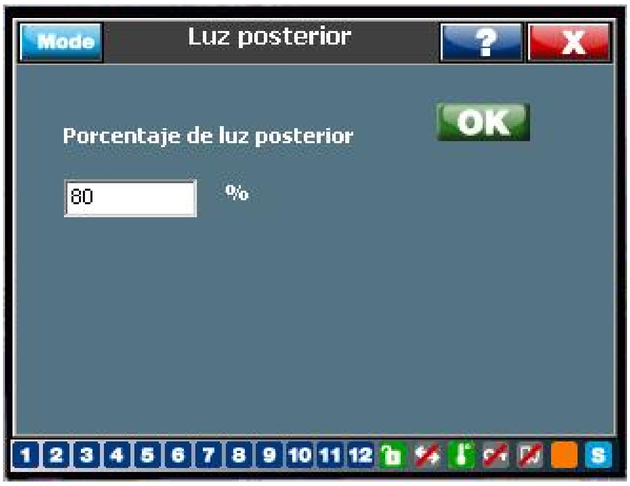
Para evitar pérdidas de la interfaz de la pantalla táctil, el usuario puede calibrar manualmente las coordenadas XY necesarias para detectar la activación de los botones.

Advertencia: La calibración de la pantalla táctil se debe realizar cuidadosamente con un bolígrafo o un estilete para marcar y detectar con precisión los puntos de calibración.





El menú de ajuste de la luz posterior permite fijar la corriente predeterminada de la luz posterior al utilizar la pantalla táctil. Tras 10 minutos de inactividad de la pantalla táctil, la corriente de la luz posterior vuelve al 10%.



4.5.4 A cerca de

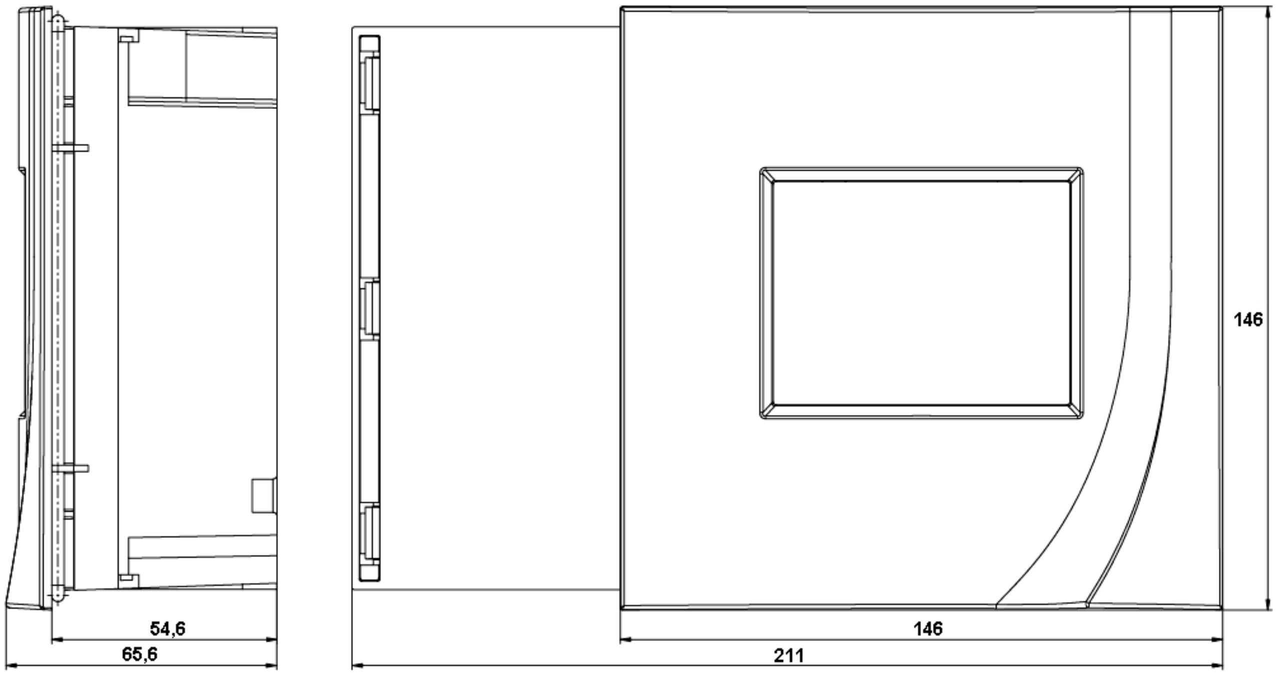
Este menú proporciona la versión de software del RVT, el número de serie, el número de artículo y el tipo.

4.5.5 Dirección Mac

Este menú muestra la dirección MAC física del RVT.

Anexos

A1. Dimensiones



A2. Especificaciones técnicas

Tipos de RVT:

Función	RVT 6 / RVT 12	RVT 12-3P
Mediciones monofásicas/trifásicas	1 entrada de medición de tensión 1 entrada de medición de corriente	3 entradas de medición de tensión 3 entradas de medición de corriente
Reloj de tiempo real	No	Sí
Mediciones de energía	No	Sí
Conexión Ethernet	No	Sí
Conexión de host USB	No	Sí
Conexión de dispositivo USB	Sí	Sí
Entradas digitales	Sí	Sí
Relés de alarma/ventilador	Sí	Sí
Relés de salida	6 o 12	12
Interruptor de bloqueo	Sí	Sí
Conexión de RS485 Modbus	Sí	Sí
Sondas de temperatura externa	Sí	Sí

Sistema de medición:

Sistema de microprocesador para redes equilibradas trifásicas/monofásicas y red desequilibrada. Se encuentra disponible control del factor de potencia de fase individual.

Tensión de alimentación:

Desde 100Vac a 460Vac.

Consumo:

15 VA máx.

Tipo de conexión:

Entre fases o entre fase y neutro para red equilibrada y desequilibrada

Tolerancia de tensión:

+/- 10% de la tensión de alimentación indicada

Categoría de medición (según IEC 61010-1):

CAT III

Medición de la tensión:

Hasta 690Vac o superior con un transformador de tensión.

Precisión: 1% de final de escala.

Gama de frecuencias:

45 ó 65 Hz (ajustes automáticos a la frecuencia de la red).

Corriente de entrada:

5A ó 1A (Valor eficaz) (TC Clase 1).

Impedancia de la Corriente de entrada:

< 0,1 Ohmios.

Disparo por falta de Corriente:

Desconexión automática de todos los condensadores en el caso de un corte de corriente de más de 20 ms.

Número de salidas:

Modelo base RVT6/RVT12: programable hasta 6 o 12 salidas

Modelo trifásico RVT12-3P: programable hasta 12 salidas

Valor asignado de los contactos de salida:

- Máxima corriente de forma continua 1.5 A (ac) – 0.3 A (110 V dc)
- Corriente máxima de pico: 8 A
- Tensión máxima: 440 Vac
- Los terminales A-A están asignados para una corriente de forma continua de 18 A (9A/terminal).

Valor asignado del contacto de alarma: (contacto exento de tensión)

- Un contacto normalmente cerrado y un contacto normalmente abierto.
- Máxima corriente de forma continua: 1.5 A (ac)
- Tensión asignada: 250 Vac (tensión de ruptura máxima: 440 Vac)

Valor asignado del contacto del ventilador: (contacto exento de tensión)

- Contacto normalmente abierto.
- Corriente de forma continua máxima: 1.5 A (ac)
- Tensión asignada: 250 Vac (tensión de rotura máxima: 440 Vac)

Ajuste de factor de potencia:

De 0.7 inductivo a 0.7 capacitivo.

Ajuste de la corriente de arranque (C/k):

- 0.01 a 5 A.
- medición automática de C/k.

Secuencias de conmutación:

1:1:1:1:1:..:1 - 1:2:2:2:2:..:2 - 1:2:4:4:4:..:4

1:2:4:8:8:..:8 - 1:1:2:2:2:..:2 - 1:1:2:4:4:..:4

1:1:2:4:8:..:8 - 1:2:3:3:3:..:3 - 1:2:3:6:6:..:6

1:1:2:3:3:..:3 - 1:1:2:3:6:..:6

y cualquier otra secuencia programable por el cliente.

Conexión 10/100 Base-T Ethernet

Conexión a un PC o una LAN mediante protocolo TCP/IP

Aislamiento eléctrico entre el RVT y las señales RJ45: 1500 Vrms

Modbus baudios:

300 - 600 - 1200 - 2400 - 4800 - 9600 - 19200 - 38400 – 57600 bps

Conexión CAN:

Compatible con interfaz CAN 2.0B (para uso futuro)

Conexión de host USB:(Para uso futuro)

Conexión de dispositivo USB

Conexión de entrada de sondas de temperatura

Sólo 2 contactos utilizando protocolo de 1 cable

- Modo de suministro parásito (no se necesita suministro de alimentación externo)
- Conexión a más nodos en una red en cadena tipo margarita
- Conexión de 8 sondas de temperatura

- 8 metros máximo entre el RVT y la sonda de temperatura o entre sondas
- Longitud máxima de 64 metros
- Medición de temperatura desde -55°C hasta 125°C (-67°F a 257°F)
- Precisión de +/-0.5°C desde -10°C hasta +85°C
- Montaje en riel DIN
- Conexión al RVT usando 2 alambres, un par de cables de telecomunicación de Categoría 1 entrelazados

Configuración de pasos:

Automática, fija, desactivada.

Pantalla:

Pantalla táctil en color QVGA de 320 x 240 píxeles.

Luz posterior de la pantalla ajustable

Tiempo de conmutación entre escalones:

Programable desde 1 s a 18 h.

Función de guardar:

Todos los parámetros y modos programados se guardan en una memoria no volátil.

Autoadaptación a la rotación de la fase de la red y a los terminales del TC.

La operación de corrección del factor de potencia es insensible a la presencia de armónicos.

Trabajo con cargas pasivas y regenerativas (funcionamiento en cuatro cuadrantes).

Temperatura de funcionamiento:

-20° C a 70° C.

Temperatura de almacenamiento:

- 30° C a 85° C.

Posición de montaje:

Montaje en panel vertical.

Dimensiones:

Placa frontal: 146 x 146 mm (altura x anchura)

Parte trasera: 205 x 135 mm

Dimensiones generales: 146 x 211 x 67 (altura x anchura x profundidad)

Dimensiones del cut out: 138 x 138 mm (altura x anchura)

Peso: 650g (desembalados).

Conector:

Tipo de mordaza de jaula (2,5 mm² cable de un sólo núcleo)

Protección de la placa frontal:

IP 43 (IP54 bajo demanda).

Humedad relativa:

Máximo 95%m, sin condensación.

Marcado CE.

A3. Prueba y localización de averías

Pruebas

Después de la instalación la batería automática de condensadores y la programación de los parámetros de conmutación se pueden realizar las siguientes pruebas según la situación de la carga:

A. Sin carga o cos j = 1 o carga capacitiva (poner el cos deseado en 0,95 ind.)

1. Seleccione el modo manual.
2. Añada dos o más escalones.
3. Seleccione el modo automático.

Todos los escalones de los condensadores deberán quedar desconectados dentro del tiempo de retardo programado entre cada operación de conmutación.

Si no se desconectan todos los escalones, compruebe lo siguiente:

- Se ha conectado una carga inductiva?
- Se ha programado la relación C/k correcta y/o el tamaño de escalón correcto? (se recomienda que el valor C/k se ajuste a un valor ligeramente superior a los calculados)

B. Carga inductiva

1. Ponga el valor deseado de cos j = 1
2. Seleccione modo automático.

Los distintos escalones del condensador se irán conectando automáticamente para compensar la carga inductiva. (el Regulador no irá conmutando escalones si la corriente inductiva es inferior al valor C/k preajustado. En este caso compruebe según A lo anterior).

Si se han conectado todos los escalones y sigue habiendo demanda de escalones adiciones, compruebe los ajustes de C/k.

Si es correcto, entonces la batería es demasiado pequeña para compensar el cos j = 1. Seleccione un valor inferior para cos j .

Si uno de los escalones se conecta y desconecta repetidas veces significa que C/k está ajustado a un valor demasiado bajo (a menos que la carga de hecho esté fluctuando periódicamente por un período de tiempo igual o próximo al tiempo de retardo de conmutación).

Localización de averías

Fallo	Acción recomendada
El Regulador está conectado pero no funciona (no hay nada en la pantalla).	Comprobar los ajustes de tensión y los fusibles.
El Regulador no conecta o desconecta escalones a pesar de que hay una carga inductiva variable considerable	Comprobar que el Regulador está en modo automático.Comprobar los ajustes de desfase y C/k. Comprobar que se ha quitado la brida de cortocircuito del TC
El Regulador no parece activar ningún escalón.	Esperar el tiempo de retardo entre conmutación y/o el tiempo de retardo de corte de corriente
No se ha alcanzado el factor de potencia preajustado.	Con una carga bajo o nula, un factor de potencia bajo puede corresponder a una corriente inductiva muy pequeña. Los correspondientes escalones de condensadores son demasiado grandes para compensar. Si el cos j medio a lo largo de un período de tiempo es demasiado bajo, se puede incrementar el cos j preajustado.
Todos los condensadores están conectados a pesar de que la potencia reactiva requerida es relativamente baja.	Comprobar los ajustes de los valores de fase y C/k.

La puesta en marcha automática se detiene y el Regulador presenta una de los mensajes siguientes:

Mensajes durante una programación automática	Acciones Recomendadas
Se ha detectado la rotación de fases equivocada. Las fases L2 y L3 serán invertidas internamente. Pulsar OK para validar.	Presione OK
Error: Tamaño del paso demasiado pequeño	Ajuste el tamaño de paso o la relación del TC
Error: El TI no recibe ninguna intensidad	Revisar que el puente cortocircuitando el TC ha sido removido, que las conexiones del TC estén correctamente cableadas y comenzar la programación automática de nuevo.
Error: Carga cambiante demasiado rápida	Reinicie la programación automática bajo condiciones más estables o programe los parámetros manualmente.
Error: Dispersión de fase demasiado ancha en la\nentrada nr ‘X’ ‘Y’ ‘Z’	Para cada entrada del TC y para cada salida, ya se ha realizado reconocimiento y distorsión de fase. Revisar las conexiones del condensador y contactor. Revisar las corrientes de cada fase del condensador.
Error: Al menos dos TI detectados en la entrada en la misma línea de corriente	Revisar la instalación del TC.
Error: Intensidad insignificante en la entrada nr‘X’ ‘Y’ ‘Z’	Revisar que el puente cortocircuitando el TC ha sido removido, que las conexiones del TC estén correctamente cableadas y comenzar la programación automática de nuevo.

Error: Retraso de fase incoherente	Revisar la conexión e instalación de los TC's. Revisar las conexiones del condensador y contactor. Revisar las corrientes de cada fase del condensador.
Error: Paso desequilibrado o relación de TI diferente en líneas para la salida nr ‘A’ ‘B’ ‘C’ ‘D’...	Revisar que la relación de los TC's sean del mismo valor. Revisar las conexiones del condensador y contactor. Revisar las corrientes de cada fase del condensador.
Error: Diferencia de pasos demasiado grande	Revisar secuencia y potencia reactiva por cada paso.

A4. Procedimiento de reinicio después de la alarma

Una vez que se haya alcanzado el nivel de protección (véase el párrafo 4.3.1.4.1) o cuando la temperatura interna es superior a 85°C:

- todos los escalones de condensadores se desconectan,
- en la pantalla del LCD aparece un mensaje de alarma,
- se cierra el relé de alarma,

Cuando desaparece la situación de alarma el RVT se reinicia automáticamente.El procedimiento de reinicio dependerá del tipo de evento que provocó la alarma tal como se indica en la tabla siguiente:

Evento que se ha producido	Comportamiento de reinicio del RVT una vez que ha desaparecido el evento
Uef < Umín prot.	- Abre inmediatamente el relé de alarma - Reanuda el comportamiento normal después de un tiempo igual al retardo de marcha(*)
Corte de corriente	- Reanuda el comportamiento normal después de un tiempo igual al retardo de rearme(*)
Uef > U máx prot.	- Abre inmediatamente el relé de alarma - Reanuda el comportamiento normal después de un tiempo igual al retardo de marcha(*)
Temp interna > 85°C	- Se considera que ha desaparecido el evento cuando es Temp interna < 80°C - Abre inmediatamente el relé de alarma - Reanuda el comportamiento normal después de un tiempo igual al retardo de marcha(*)
Una de las ocho sondas de temperatura T > su protección máx.	- Abre el relé de alarma inmediatamente (sonda opcional externa T1-8) - Reanuda el comportamiento normal tras un tiempo igual a Retardo ON(*)
THDV > THDV máx prot.	- Abre inmediatamente el relé de alarma - Reanuda el comportamiento normal después de un tiempo igual al retardo de marcha(*)

	Protección contra seguimiento: Si el mismo elemento se produce antes de transcurrida una hora el RVT reanuda el funcionamiento normal después de tiempo igual a 2 veces el retardo de marcha. Si el mismo evento vuelve a producirse dentro del plazo de una hora, el tiempo de reinicio se duplicará pasando a ser de 4 veces el retardo de marcha, y así sucesivamente hasta el máximo de una hora. Esta regla permite evitar un efecto de seguimiento debido a fenómenos de resonancia
Entrada exterior activada	- Abre inmediatamente el relé de alarma - Reanuda el comportamiento normal después de un tiempo igual al retardo de marcha(*)

(*) Para más información relativa al retardo de rearme o a los parámetros de retardo de MARCHA, puede encontrase una descripción completa en el párrafo 4.3.1.1.

A5. Conexión de la medida de tensión y de la alimentación

Este anexo muestra una forma práctica de conectar la medida de tensión al RVT cuando es la misma que la alimentación del RVT.

Descripción

Como se muestra en la Figura 57, el RVT tiene tres terminales para su alimentación y dos terminales más para la entrada de medida de tensión.

El RVT no utiliza su alimentación para realizar la medida de tensión. La medida de tensión solo se realiza a través de los terminales de entrada destinados a ello.

Si la alimentación del RVT y la señal para la medida de la tensión provienen de la misma fuente, se puede hacer un puente entre los terminales correspondientes:

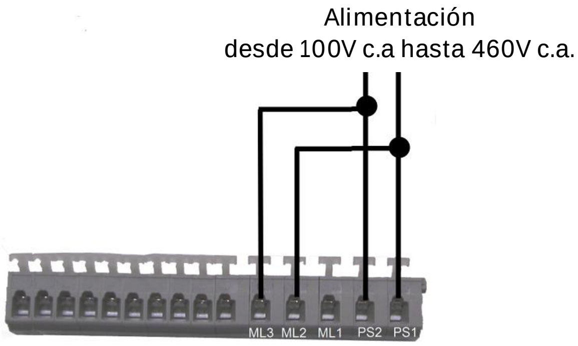


Figura 57: Terminales

Conexión del puente (propuesta práctica)

A causa de la limitación de espacio, no es posible insertar dos cables en la misma ranura. Sin embargo, se pueden utilizar métodos alternativos para conectar dos cables a un terminal común.

Existen varias maneras prácticas de realizar esta conexión adecuadamente. En la Figura 58 se describe una de estas soluciones.

Estos terminales y la correspondiente herramienta de prensar se pueden encontrar en cualquier lugar del mundo.

Se debe tener en cuenta que con estos terminales se deben usar cables de igual diámetro. Obviamente se deben usar dos terminales con el resultado que se muestra abajo.

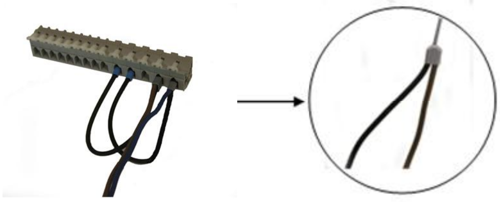
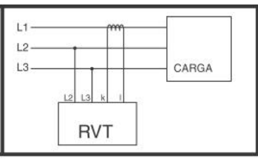
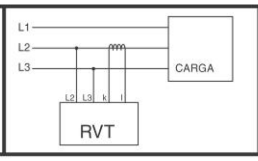
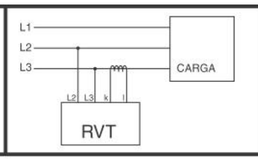
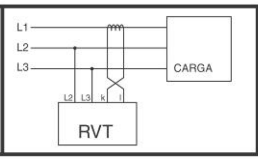
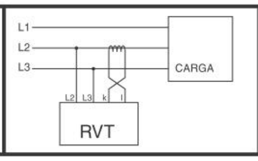
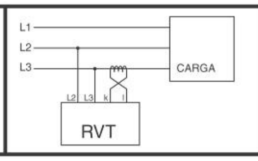


Figura 58: Conexión del puente

A6. Tabla de desfase (aplicable al modelo básico)

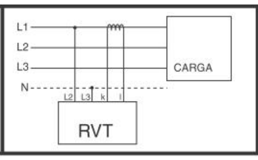
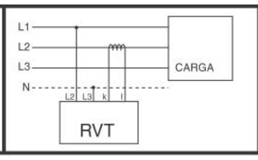
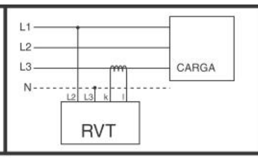
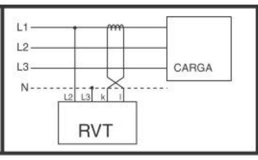
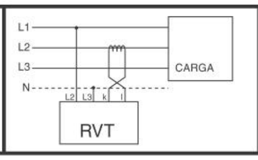
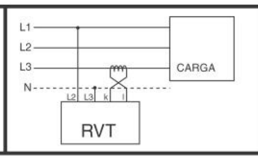
Conexión trifásica (Fase con fase)

La tensión se mide entre L2 y L3

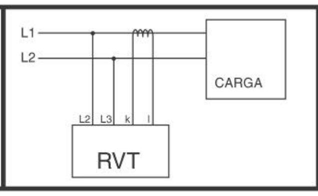
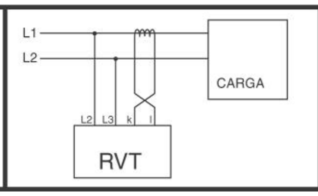
L1 Directa		90	L2 Directa		-30	L3 Directa		-150
L1 Invertida		-90	L2 Invertida		150	L3 Invertida		30

Conexión trifásica (Fase a neutro)

Las tensión se mide entre L1 y neutro

L1 Directa		0	L2 Directa		-120	L3 Directa		120
L1 Invertida		180	L2 Invertida		60	L3 Invertida		-60

Conexión monofásica

L1 Directa		0	L2 Directa		180

A7. Ilustración del tipo de conexión de CT y cableado de CT en los terminales del regulador

Connection type		RVT 12 - 3P	RVT 6 / RVT 12	Phase shift	Voltages						Currents				Compensation type		
Name	Schematics	Connection	Connection	adjustment	L12	L23	L31	L1N	L2N	L3N	L1	L2	L3	N	Full C3[1]	Full C1[2]	Mixed C3+C1
1Ph-1LL1	L2 L3	L2, L3, CT: ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	L2, L3, CT: N.C. ML2 ML3 N.C. k l N.C. N.C. N.C. N.C.	0° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	-	yes	-
3Ph-1LL1	L1 L2 L3 N	L2, L3, CT: ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	L2, L3, CT: N.C. ML2 ML3 N.C. k l N.C. N.C. N.C. N.C.	90° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	yes	-	-
3Ph-1LN1	L1 L2 L3 N	L1, N, CT: ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	L1, N, CT: N.C. ML2 ML3 N.C. k l N.C. N.C. N.C. N.C.	0° by default (see phase shift table)	-	-	-	Measured	-	-	Measured	-	-	-	yes	-	-
3Ph-3LL3	L1 L2 L3 N	L1, L2, L3, CT1, CT2, CT3: ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-3LL2	L1 L2 L3	L1, L2, L3, CT1, CT2: ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Calculated	(3)	yes	yes	yes
3Ph-3LN3	L1 L2 L3 N	L1, L2, L3, N, CT1, CT2, CT3: ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - phase rotation - CT redirection)	Calculated	Calculated	Calculated	Measured	Measured	Measured	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LL3	L1 L2 L3 N	L2, L3, CT1, CT2, CT3: ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - CT redirection)	-	Measured	-	-	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LN3	L1 L2 L3 N	L1, N, CT1, CT2, CT3: ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - CT redirection)	-	-	-	Measured	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes

A8. Control del factor de potencia de fase individual (aplicable al modelo trifásico RVT12-3P)

De forma predeterminada, sólo se encuentra disponible el modelo de "12 salidas" para corrección de factor de potencia individual.

Como en el RVT básico, el control de PFC del RVT 12-3P trifásico se realiza comparando el valor de C/k con la medición de corriente reactiva fundamental.

El control se hace de diferentes formas, basado en el tipo de conexión (ver A7. Ilustración del tipo de conexión de CT y cableado de CT en los terminales del regulador) y el tipo de paso de conmutación. (monofásico o trifásico)

Tomando en cuenta la denominación del tipo de conexión (por favor referirse A7. Ilustración del tipo de conexión de CT y cableado de CT en los terminales del regulador)

wPh- xLyz donde :

w determina el tipo de red trifásica o monofásica.

x es el número de medición de voltage usado.

y determina la conexión Línea a Línea o Línea a Neutro

z es el número de CT usado.

wPh-1Ly1 tipo de control (solo un CT)

Basicamente, si solo un CT es usado, el control se hace de acuerdo al CT en fase L1 (o la línea en donde el CT es instalado).

3Ph-xLy2 and 3Ph-xLy3 tipo de control (2 o 3 CT)

Si más de un CT es usado, la estrategia de control sigue un simple y eficiente principio para ser capaz de manejar todas las salidas de una manera comprensiva. La estrategia siguiente se ha implementado:

Estrategia de conmutación en una red desbalanceada:

Espera por el retardo de conmutación mientras calcula la corriente reactiva en la fase L1, L2 y L3 de acuerdo al seteo Normal / Integral.

Evaluación de las salidas trifásica mínimas para conmutar ON – OFF.

Evaluación de las salidas monofásica para conmutar ON – OFF.

Si algún paso monofásico (estando ya ON y por conmutar a ON) puede ser cambiado a un paso monofásico, entonces conmutar preferentemente el paso trifásico.

Conmutar ON o OFF de acuerdo a la programación Progresivo/directo, Lineal/ Circular.

Algunos ejemplos típicos se dan a continuación:

- 12 pasos monofásicos / 1 CT (1Ph-1LL1 solamente)

  à El control se hace a través del CT en la fase donde es montado.

  à El parámetro C/k 3Ph es usado para la conmutación de pasos (equivalente al parámetro C/k en los modelos RVT6 o 12)

- 12 pasos trifásicos / 1 CT (3Ph-1Ly1 solamente)

à El control se hace a través del CT en la fase donde es montado.

à El parámetro C/k 3Ph es usado para la conmutación de pasos (equivalente al parámetro C/k en los modelos RVT6 o 12)

- 12 capacitores trifásicos / 2 o 3 CT's (3Ph-3LL2 o 3Ph-xLy3 solamente)

à El control se hace a través de CT1 en la fase L1, CT2 en la fase L2, CT3 en la fase L3

à El control se hace de acuerdo a la estrategia de conmutación de una red desbalanceada

à El parámetro C/k 3Ph se usa en la conmutación de los pasos trifásicos.

- 3 pasos monofásicos conectados entre L-N / 2 o 3 CT (3Ph-3LL2 o 3Ph-xLy3 solamente)

à El control se hace a través de CT1 en la fase L1, CT2 en la fase L2, CT3 en la fase L3

à El control se hace de acuerdo a la estrategia de conmutación de una red desbalanceada

à El parámetro C/k 1Ph se usa para la conmutación de pasos monofásicos.

- capacitores trifásicos + 2 * 3 pasos monofásicos conectados entre L-N / 2 o 3 CT (3Ph-3LL2 o 3Ph-xLy3 solamente)

à El control se hace a través de CT1 en la fase L1, CT2 en la fase L2, CT3 en la fase L3

à El control se hace de acuerdo a la estrategia de conmutación de una red desbalanceada

à El parámetro C/k 1Ph se usa para la conmutación de pasos monofásicos.

à El parámetro C/k 3Ph se usa en la conmutación de los pasos trifásicos.

A9. Reciclaje

Esta marca en el producto o en el material, indica que no deberá eliminarse junto con otros residuos domésticos al final de su vida útil. Para evitar los posibles daños al medio ambiente o la salud humana que representa la eliminación incontrolada de residuos, separe este producto de otros tipos de residuos y reciclar de forma responsable para promover la reutilización sostenible de los recursos materiales.

Los usuarios particulares pueden contactar con el establecimiento donde adquirieron el producto, o con las autoridades locales, para informarse sobre cómo y dónde pueden llevarlo para el reciclaje ecológico y seguro.

Los usuarios comerciales pueden contactar con su proveedor y comprobar los términos y condiciones del contrato de compra. Este producto no debe ser mezclado con otros residuos comerciales de acuerdo con la Directiva WEEE (waste electrical and electronic equipment).

Este producto no contiene sustancias peligrosas y cumple con la directiva RoHS (Restriction of the Use of Certain Hazardous Substances).

La eliminación de las baterías usadas deben llevarse a cabo de conformidad con la normativa nacional para la eliminación de las baterías (Battery Directive).

Los módulos electrónicos deben ser reciclados, según la regulación local.

Caja de plástico y las piezas se reciclan por separado

Este producto contiene una batería de CR2032 Li-MnO2. No sustituya la interna batería de litio CR2032. Puede ser retirados para su eliminación después de abrir la caja de plástico (4 tornillos en la parte posterior del producto)

A10. Additional provision on Open Source Software:

The product contains – in part – some free software (software licensed in a way that ensures your freedom to run, copy, distribute, study, change and improve the software). The following products are concerned : Linux-2.6.30.1 which is subject to "GNU General Public License", Version 2, busybox-1.15.3 which is subject to "GNU General Public License", Version 2, dropbear-0.48.1 which is subject to "GNU General Public License", Version 2, iana-etc-2.20 which is subject to "GNU General Public License", Version 2, mtd-utils-1.2.0 which is subject to "GNU General Public License", Version 2, u-boot-1.3.4 which is subject to "GNU General Public License", Version 2, ifplugd-0.28 which is subject to "GNU General Public License", Version 2, AT91Bootstrap1.9 which is subject to "GNU General Public License", Version 2, and uClibc v 0.9.29 which is subject "GNU Lesser General Public License", Version 2.1,(purchaser or user shall not be prohibited to modify libraries provided under Lesser General Public License (version 2.1) and/or to reverse engineer such libraries for debugging such modifications).

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RVT安装和操作说明

目录

前言

关于本使用手册的简介

本使用手册所提供的详细信息旨在帮助您快速安装和操作 RVT 功率因数控制器。

警示

小心，危险警示标志。

在安装和操作 RVT 控制器之前，应仔细阅读安全注意事项。本手册供安装、维护和操作人员参考。

安全性

本 RVT 控制器符合欧盟 LVD（低电压）指令 2006/95/EC 要求。

小心触电安全提示。

RVT 控制器必须由合格的电工技师进行安装、维护和操作。切勿带电操作。清洁时，请用干布擦拭灰尘。切勿使用研磨剂、溶剂或酒精。清洁前，请先关掉电源，断开电压测量电路。切勿打开 RVT 控制器外壳。仪器内部没有可供用户使用的零件。本 RVT 控制器可连接到电流互感器上。在尚未确定其已短路或已并联至另一个阻抗够低的负载之前，请勿拔掉电流互感器的接线。否则将会产生危险的高压。请勿将本产品用于其设计功能之外的任何其他用途。

电磁兼容性

本 RVT 符合欧盟电磁兼容指令 2004/108/EC。

这款 RVT 控制器经过鉴定，符合 EU（欧盟）有关操作于 50 赫兹时的 EMC（电磁兼容）规定，为此而标注 CE 标志。当一个系统采用某件仪器时，欧盟指令要求该系统必须经过电磁兼容性的鉴定。下列指南有助于改善一个系统的电磁兼容性：

1. 金属外壳可以普遍改善电磁兼容性。

2. 电缆须远离外壳的孔隙。

3. 电缆须贴近接地的金属结构。

4. 根据需要，在门板或其他面板零件上使用多重接地母线。避免共同接地阻抗。

1 控制器入门介绍

1.1 本章内容概述

本章对于功率因数控制器 RVT 进行概括性说明。 其中介绍了控制器的基本结构、主要功能以及控制器的触摸屏用户界面。

1.2 一款功能强大的可共补/分补的功率因数控制器

RVT 控制器能够在三相平衡与不平衡的负荷中实现功率因数补偿。本系列产品有两种型号的 RVT 控制器：

基本型号：RVT6（六路输出）和 RVT12（十二路输出）

三相型号：RVT12-3P（仅有 12 路输出规格）

基本型号兼容于以往的 RVT 控制器，该款适用于平衡三相或单相（相对相）负荷无功补偿。RVT12-3P 三相型号具备三相电压和电流测量，是一款可实现共补和分补的功率因数控制器。

该 RVT 亦可用于中压电容柜的控制。有关 RVT 与中压电容柜的说明，参见 4.2.1.1。

1.3 RVT 主要特点

1.3.1 功率因数控制

RVT 功率因数控制器是一个自动投切电容柜（或电抗器）的控制单元，适用于感性（或容性）负载现场的无功补偿。为了达到用户设定的目标 cos j 值，自动控制电容器的投入和切除。

- 所有参数均可通过手动或自动方式设置（参见 4.2.2 和 4.2.1）。
- 除了目标 cos j 值以外，还可设置夜间目标 cos j 值和再生模式中的目标 cos j 值（参见 4.2.1.3）。
- RVT12-3P （可分补型号控制器）能够通过参数配置，在不平衡的负荷中投入/切除单相电容。这项功能可用来矫正单独各相的低功率因数； 譬如，L1 相的功率因素为 0.6、L2 相的功率因素为 0.8、L3 相的功率因素为 0.95。这对于单相负载较普遍而导致三相负载不平衡的住宅/商业区负荷来说非常实用。

1.3.2 测量和监测

- 强大的数据测量功能（参见 4.1 款）。
- 参数设置保护，以防意外现象发生和/或未经授权的使用（参见 3.1.4 和 4.2.1.1 款）。

- 基于实时时钟事件记录和报警信息（参见 4.1.5 和 4.3 款）。

- 检查和测试每个输出端口状态（参见 4.3.2 和 4.3 款）。

- 温度测量：可通过菊链连接多达 8 个温度探头（参见 4.2.1.4.3 款）。

1.3.3 通信设置

- 兼容 Modbus 通信协议（需要 Modbus RS485 适配器）

- USB 接口（兼容 USB2.0）

- 以太网 TCP / IP 接口

- 通过 CAN 2.0 可配置多达 32 个可扩展型输出通道。当前型号的 RVT 仅有硬件实现，软件需待将来版本实施。

详情参阅 4.4 。

1.4 前视图与后视图

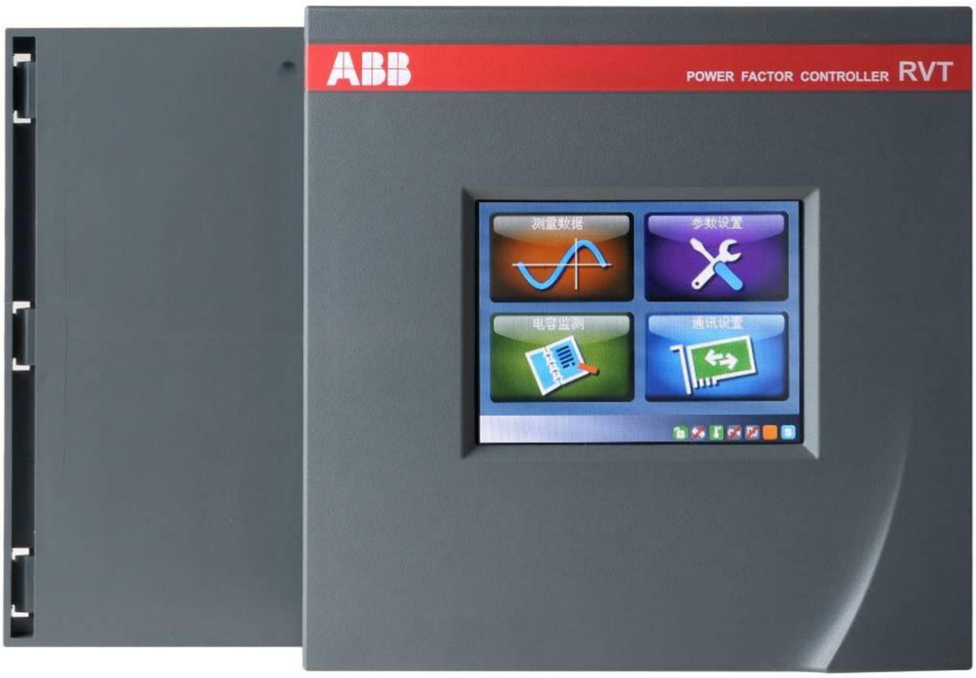


图 1：RVT 前视图

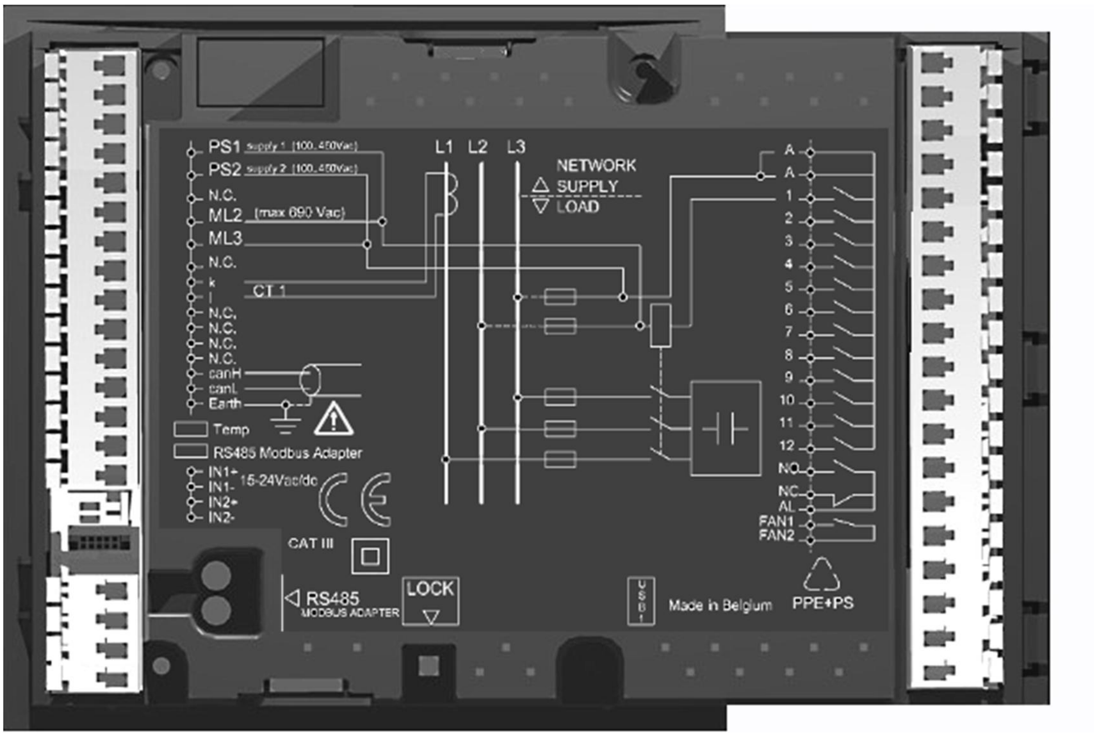


图 2：RVT 后视图（RVT6/RVT12 基本型号）

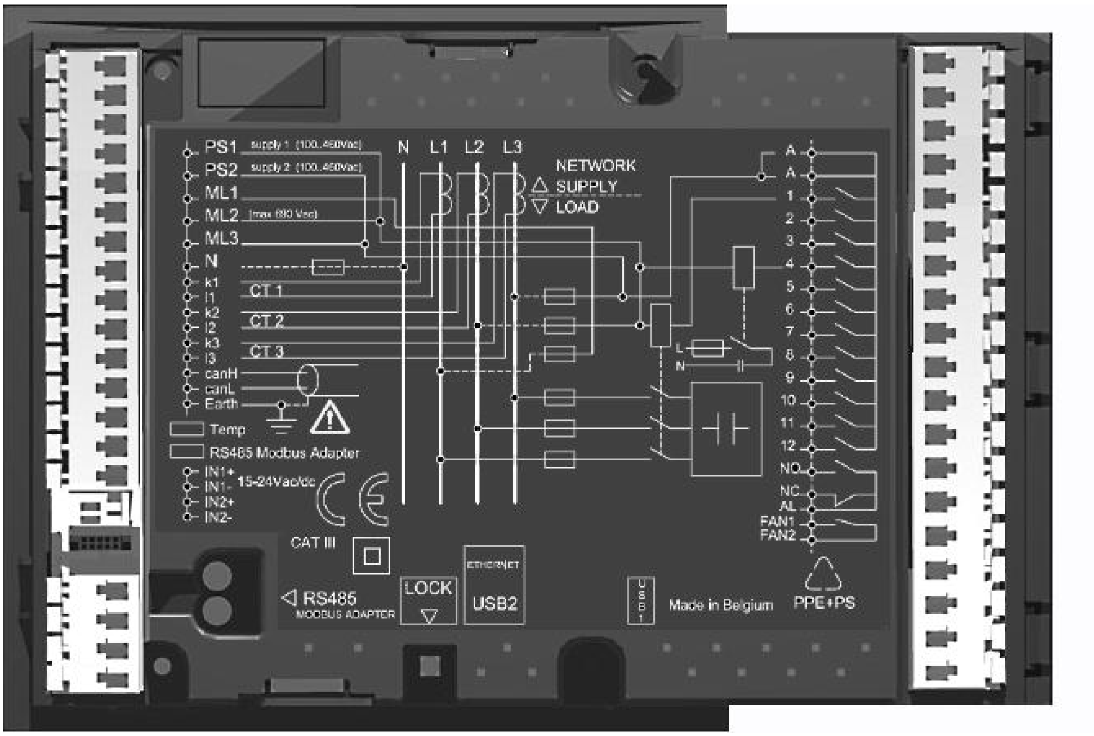


图 3：RVT 后视图（RVT12-3P 三相型号）

1.5 彩色触摸屏界面

QVGA 320 x 240 像素的彩色触摸屏可以帮助用户较为方便地操作控制器。触摸屏操作让菜单导航、参数设置都相当简单而直观。

图 4：RVT 启动界面

菜单导航的详细信息可参阅 3.1。

2 安装

2.1 本章内容概述

本章阐述了将控制器嵌装于面板上的流程，并介绍了控制器电气连接的方法。接线图如 2.3 部分所示。

2.2 嵌装

请按照以下步骤，将 RVT 控制器嵌装于电容柜面板之上。

第 1 步：将 RVT (a) 以垂直电容柜面板滑入电容柜的柜体 (b) 开孔内。第 2 步：转动 RVT，将其嵌入电容柜的柜体开孔内。

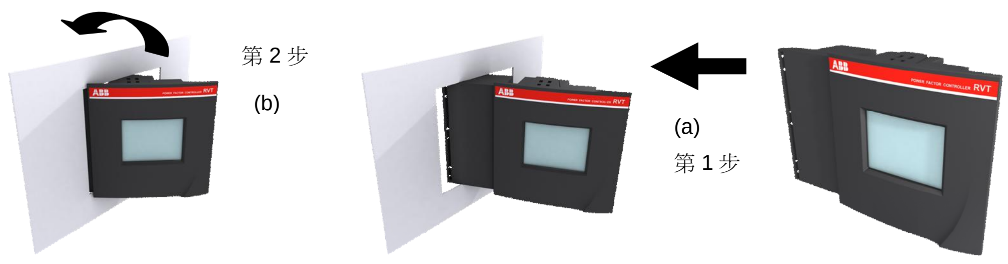


图 5：嵌装 RVT

备注：嵌入式开孔尺寸为 138 x 138 毫米。

第 3 步：将安装支架 (c) 插入 RVT 对应的固定孔 (d) 内。

第 4 步：将安装支架向后拉动。

第 5 步：将螺钉 (e) 拧入安装支架并旋紧，直至 RVT 紧固安装于柜体面板上。

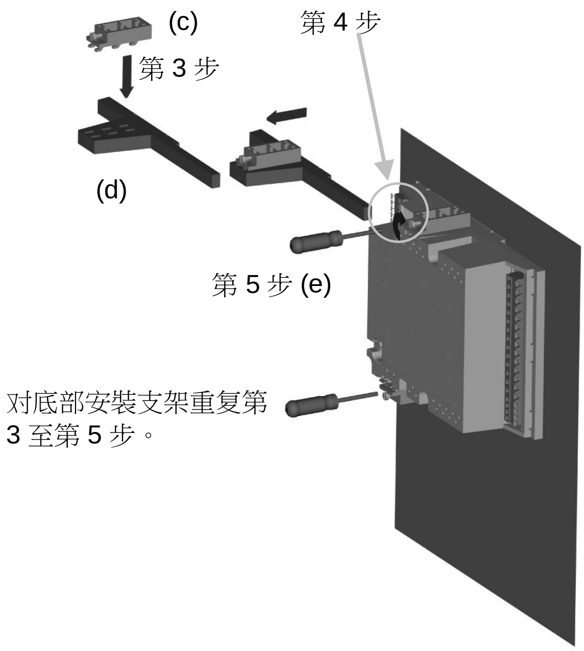


图 6：嵌装 RVT

2.3 导线连接

请按照下列说明将导线连接到控制器背面的端子。

1. 用一把螺丝刀将接线器夹杆向后压。

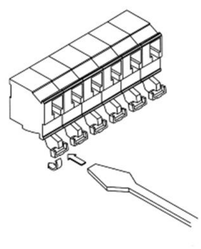


图 7：导线连接

2. 在压住夹杆的同时，将线缆（规格为 2.5 mm2 / 单芯）插入对应的连接孔内。

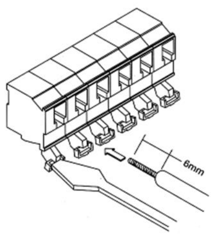


图 8：导线连接

3. 松开螺丝刀。

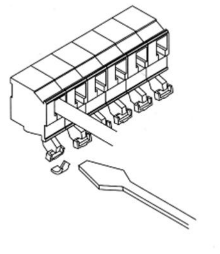


图 9：导线连接

4. 正确完成接线。

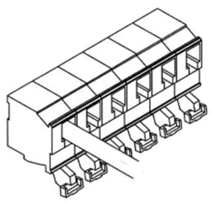


图 10：导线连接

2.4 接线图

该接线图显示了主电路和控制电路的连接方式。

RVT6/RVT12 基本型号

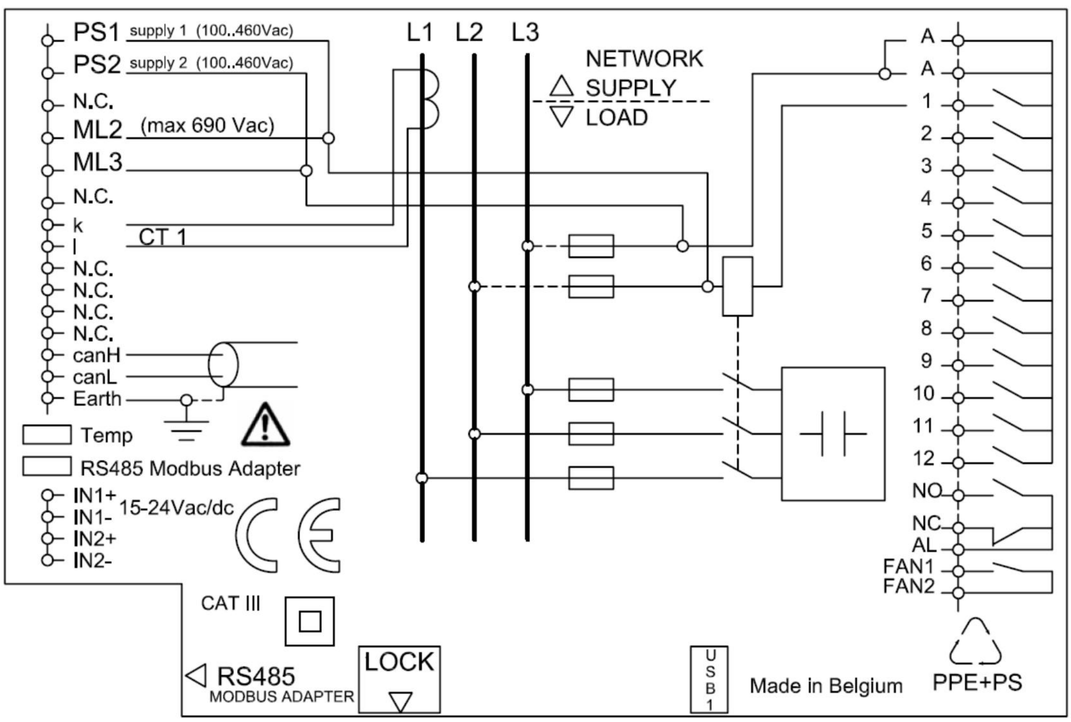


图 11：RVT 接线图（RVT6/RVT12 基本型号）

RVT12-3P 三相型号

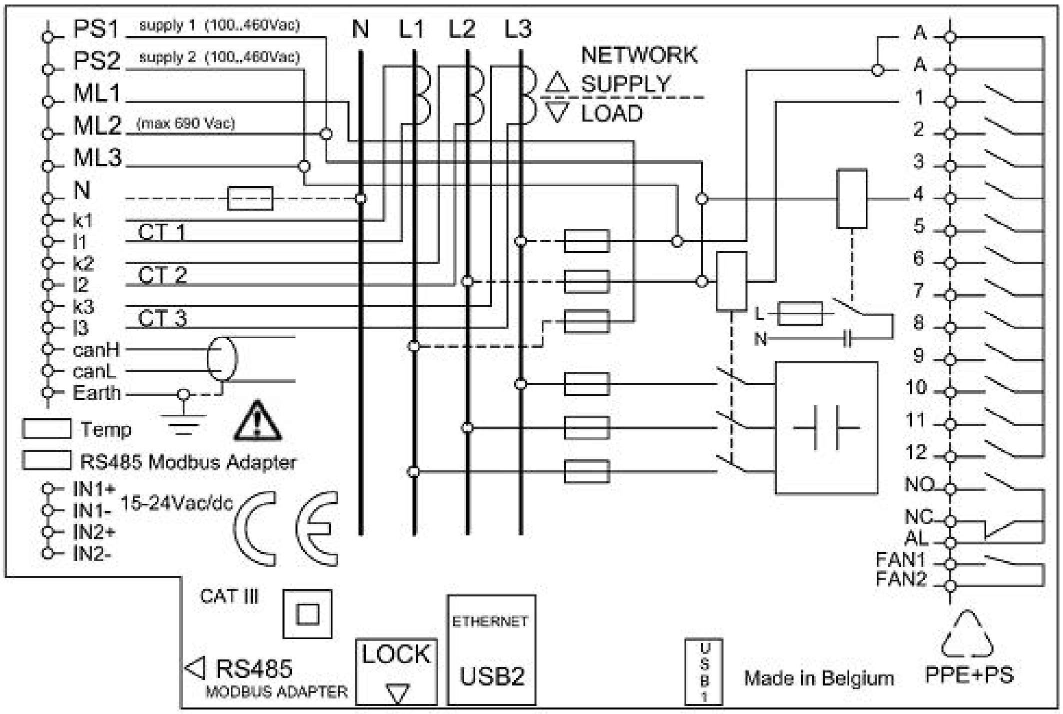


图 12：RVT 接线图（RVT12-3P 三相型号）

PS1、2	电源
ML1-3	电压测量
N	中线连接
k1-3、l1-3	CT 连接
canH、canL	CAN 总线
Earth	接地线
Temp	温度探头连接
RS485 Modbus Adapter	RS485 Modbus 接口
IN1+/-	夜间目标 cos j 的数字输入端
IN2+/-	外部报警信号的数字输入端
A	输出继电器的共源
1-12	输出继电器
NO/NC	报警继电器的输出触点
AL	报警继电器共源
FAN 1-2	风扇（报警）继电器
USB	USB 连接
RJ45	以太网连接
LOCK	硬件上锁

注意： 建议在 PS1-PS2 **连接中采用过电流保护措施：**

6Arms **保险丝** 10 x 38 gl 690V

3 轻松启动

3.1 本章内容概述

本章介绍了快速启动以及控制器的自动调试程序。

3.2 导航菜单

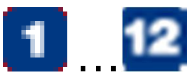
当 RVT 的电源开关被打开后，首先显示的是如图 13 所示的启动界面。

图 13： RVT 启动界面

屏幕中的四个图标代表了四个根级菜单：数据测量、参数设置、电容监测和通信设置。

在屏幕下方，状态栏显示了已投入电容段数、RVT 锁定状态、警示、RVT 的控制源（触摸屏或通信）、投入或切除要求、操作模式：A（自动模式）、M（手动模式）和 S（设定模式）。状态图标的具体含义，可参阅以下注释。

3.2.1 触摸屏图标的注释

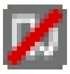
	该输出的电容已投入（未投入输出不被显示）
	电容柜设定解锁
	电容柜设定上锁
	仅能通过通信指令完成设置程序
	可以通过用户界面或通信指令完成设置程序

温度保护（报警继电器被激活）或报警（如风扇继电器被激活）

既无温度保护也无报警（报警和风扇继电器都没有被激活）

报警（如风扇继电器启动）

报警（报警继电器被激活）



无报警（报警继电器没有被激活）

硬件上锁（控制器背面）

硬件解锁（控制器背面）

投入需求

切除需求

无切换需求

自动模式（根据设置程序自动控制投切）

手动模式（可手动逐步投切各段电容）

设定模式

设定模式切换

在线帮助

关闭当前菜单

确认

下一页

除了启动界面之外，其他所有的 RVT 界面都包含三部分：顶部的标题栏、底部的状态栏、屏幕中部的设置区。

图 14：RVT 界面组成

3.2.2　标题栏

在标题栏的左端，蓝色的模式按钮可被用于切换三种 RVT 操作模式：自动模式、手动模式和设定模式。点击模式按钮后，会显示如图 15 所示的界面。当对 RVT 设置一种模式时，例如，设置设定模式，屏幕的右下角就会显示一个大写字母的缩写：位于状态栏右端的  代表 RVT 当前模式为设定模式。

图 15：RVT 模式切换

标题栏内的文字，如图 14 中的“数据测量”，显示了当前菜单。

点击  后，将会显示一条相关的帮助信息，便于操作者理解和设置参数。点击如图 15 中的问号，会出现以下界面：

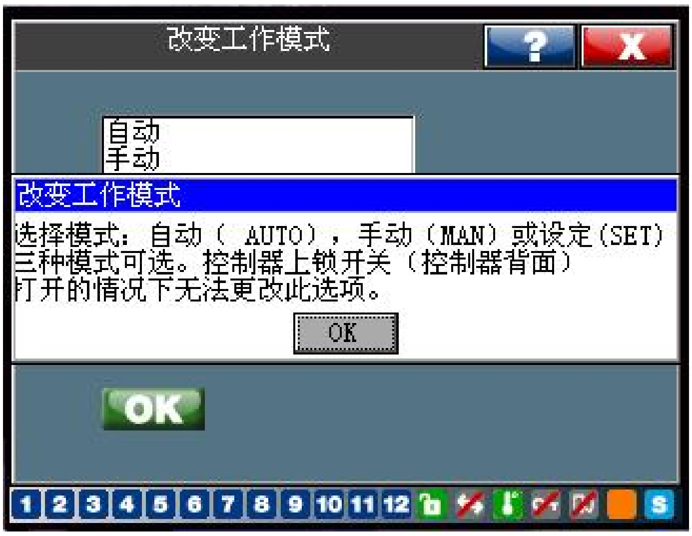


图 16：RVT 帮助信息

点击标题栏右端的红叉按钮 ，当前的操作界面将会关闭。

注意：当触摸屏幕处于非触及状态达五分钟后，RVT 将自动返回自动 (AUTO) 模式。

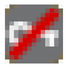
3.2.3 设定区

设定区域包括按钮、设定和相关信息。当设定一个界面后，单击 OK（确认）按钮  使设置生效。如果无法在一个屏幕中显示多项设置，界面内会出现箭头按钮 。单击箭头按钮，下一个屏幕会显示其余的设置项。

3.2.4 状态栏

状态栏显示了当前已投入电容的步数和 RVT 状态。状态图标的具体含义，可参阅 3.1.1。

硬件和软件上锁

RVT 具有硬件和软件的上锁功能。蓝色的硬件开关位于控制器背面。当按下这一开关时，RVT 即被锁定，图标  将出现在屏幕底部的状态栏。当开关被断开后，上述图标将变成：。一旦 RVT 被锁定，电容柜的所有设置项都处于拒绝访问的状态，而且调试项也被禁用（包括调试向导和自动调试）。

图标  代表 RVT 电容柜设置是被软件锁定的。图标  代表 RVT 系统设置处于软件解锁状态。当控制器被软件锁定后，电容柜的所有设置项都处于保护状态，即不能更改任何设置。

有关软件上锁详情参阅 4.2.1.1 说明。

3.2.5 键盘输入界面

所有的数据都可通过一个数字键盘输入。

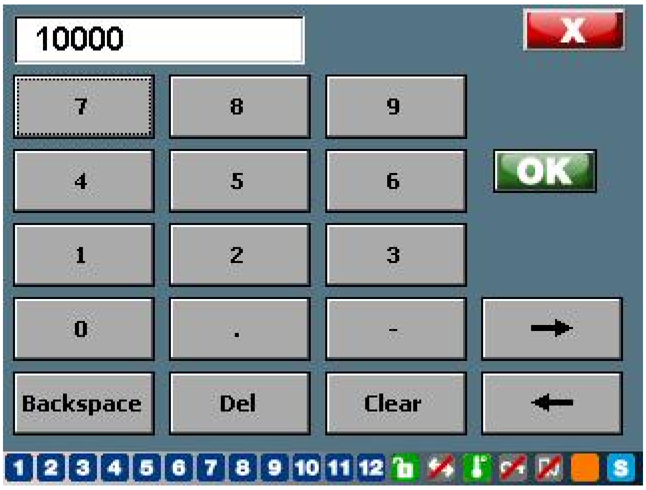
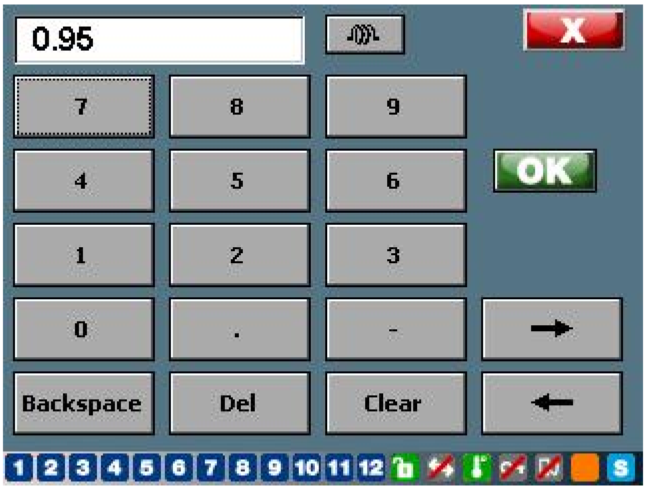


图 17：数字键盘输入界面

Cos j 值可通过 （感性）或 （容性）符号选择。



3.3 启动 RVT

当 RVT 接通电源后，将显示如图 13 所示的启动界面。

启动界面中含有四个图标：数据测量、参数设置、电容监测和通信设置。通过点击这四个图标中的其中一个，可以访问下一级菜单的内容。

目前 RVT 控制器支持五种语言：英语、法语、德语、西班牙语和简体中文。您可以通过以下路径来选择语言：

启动界面 è 通信设置 è I/O 配置 è 设置语言。

3.4 自动调试

调试 RVT 非常容易。RVT 的自动调试功能帮助即使新用户很快学会使用控制器。

3.4.1 说明

RVT 自动调试程序将会：

- 自动识别：
    - 由 CT 连接方式引入的电压电流测量相位差
    - 相序
    - 每步电容容量（自动识别三相和单相电容）
    - 投切序列
- 自动设置：C/k（启动电流），关于 C/k 的详细说明参见 4.2.1.2。

3.4.2 自动调试的准备工作

自动调试前需设置下面参数：

- 共补/分补类型。根据电流和电压测量方式的不同，总共有八种不同类型的 CT 连接方式。共补/分补类型的详细介绍参见 4.2.1.2。
- 电流互感器变比：电流互感器变比（例如，一台 250A / 5A 的电流互感器的变比值为 50）。更多信息参见 4.2.1.2。
- 目标 cos j （参见 4.2.1.3。）

3.4.3 自动调试

- 如果电流互感器二次绕组处于短路状态，当功率因数控制器的电流输入端接通以后，请勿忘记拔出二次绕组的短路片。
- 如果 RVT 用于中压电容柜的控制，电压互感器变比值需要做相应设置（参见 4.2.1。）

注意：当图标 （硬件锁）出现在屏幕底部的状态栏中时，表示 RVT 已被锁定。在解锁 RVT 之前，无法进入设定模式，也无法执行调试程序（请参见 4.2.1.1 的说明。）

以下截图为一个典型的自动调试过程：

1. 启动界面，单击参数设置：

2. 单击调试：

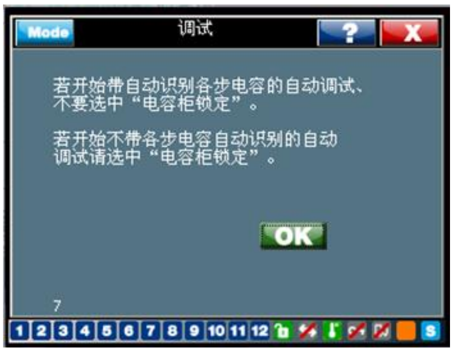
3. 单击自动调试：

4. 单击 OK（确认）：

5. 单击 OK（确认）：

6. 选择共补/分补类型 (附录)：

7. 单击 OK（确认）



8. 请选择电容柜设置解锁或锁定

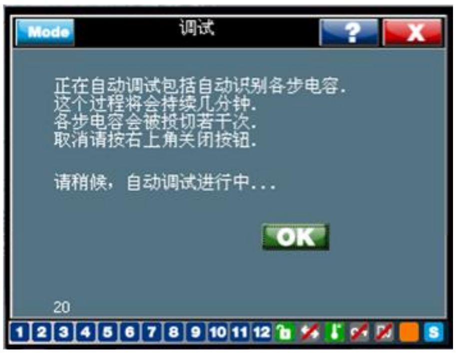
9. 单击 OK（确认）

10. 单击 OK（确认）：

11. 输入电流互感器的变比值：50：

12. 单击 OK（确认）

13. 单击 OK（确认）



14. 单击 OK（确认）

15. 单击 OK（确认）

16. 单击 OK（确认）

17. 单击 OK（确认）：

18. 单击 OK（确认）

19. 单击 OK（确认：

20. 单击 OK（确认：

21. 自动调试已完成：

以上流程是一个典型的自动调试过程。在不同现场，由于不同 CT 变比和 CT 连接类型不同，上述某些步骤设置或有差异。

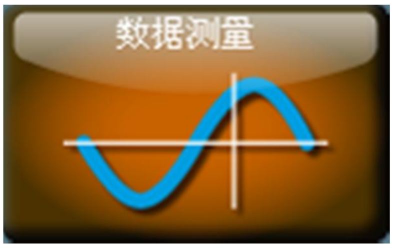
万一在自动调试中发生一些错误，帮助信息将指导用户找出原因，并完成调试。

4 数据测量和参数设置

4.1 本章内容概述

本章介绍了数据测量、参数设置、电容监测和通信设置等菜单和子菜单的信息。

4.2 数据测量



这个主菜单允许用户查看电压、电流、功率和温度等各种参数。其中包括五个子菜单：总览、系统、波形、电表和监测。

RVT 具有强大的测量功能，可显示丰富的测量项目。在总览菜单下包含所有的测量项目。对于像电压和电流这类的波形测量，还可通过图形显示，以供查阅。所有的谐波测量值均可通过频谱图显示。

总览

总览子菜单通过列表形式显示所有的测量项目。

系统数值

包括电压、电流、功率、能量和温度等参数。采用 RVT12-3P 三相型号，还可获取各单相的测量数值，例如，A,B,C 各相的功率因数。

波形

系统电压和电流（相对相或相对中性点）均可以波形显示。

监测

这个子菜单允许用户查看某些关键的参数极值。

电表

电表功能用于方便地显示三个用户最关心的参数。有关这项功能的详细说明，参见 4.1.4。

4.2.1 总览

RVT 所有测量项目：

表 1：测量总览

数据测量	**单位**	**说明**			
电压			**范围**	**误差**	**最大值**
Vrms	V	电压有效值	可达 690 Vac	± 1 %	106 V
V1	V	工频电压有效值	可达 690 Vac	± 1 %	106 V
频率	Hz	工频电压频率	45Hz - 65Hz	± 0.5%	45Hz - 75 Hz
THDV	%	总电压畸变率	0 - 300%	± 1 %	1000 %
V harm. 列表		谐波电压显示列表	2nd-49th	参阅本节后续说明	
V harm. 频谱		谐波电压频谱图	2nd-49th	参阅本节后续说明	
电流			**范围**	**误差**	**最大值**
Irms	A	电流有效值	0 - 5 A	± 1 %	10^6 A
I1	A	工频电流有效值	0 - 5 A	± 1 %	10^6 A
THDI	%	总电流畸变率	0 - 300%	± 1 %	1000%
I harm. 表		谐波电流显示列表	2nd-49th	参阅本节后续说明	
I harm. 图表		谐波电流频谱图	2nd-49th	参阅本节后续说明	
功率			**范围**	**误差**	**最大值**
Cos j (2)		工频功率因数(2)	-1 è +1	± 0.02	-1 è +1
PF (3)		功率因数 (3) （含谐波成分）	-1 è +1	± 0.02	-1 è +1
P	W	有用功率	-10^9 è 10^9 W	± 2%	-10^9 è 10^9 W

Q	var	无用功率	-10^{9} è 10^{9} var	± 2%	-10^{9} è 10^{9} var
S	VA	视在功率	0 è 10^{9} VA	± 2%	0 è 10^{9} VA
剩余需补偿 无用功	var	达到预设的报警 cos j 值之前尚需补足的无用功率	0 è 10^{9} var	± 2%	0 è 10^{9} var
需补偿的步数		达到预设的报警 cos j 值之前尚需补足的电容步数			
温度测量（需温度探头可选件）			**范围**	**误差**	**最大值**
T1-T8	°C / °F	温度 T1-T8（最多可选 8 个温度探头）	-40°C è + 105°C	± 1°C	-40°C è + 150°C
能量			**范围**	**误差**	**最大值**
回馈有功电能	kWh	负载再生的有功电能（负载到电网）	0 è 10^{12}	± 3%	0 è 10^{12}
消耗的有功电能	kWh	负载消耗的有功电能（电网到负载）	0 è 10^{12}	± 3%	0 è 10^{12}
总有功电能	kWh	回馈电能与消耗电能合计	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
感性无功电能	kvarh	感性无功电能	0 è 10^{12}	± 3%	0 è 10^{12}
容性无功电能	kvarh	容性无功电能	0 è 10^{12}	± 3%	0 è 10^{12}
总无功电能	kvarh	感性无功电能与容性无功电能的合计	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
总视在电能	kVAh	总的无功和有功电能	0 è 10^{12}	± 3%	0 è 10^{12}

注意：

- 所有项目的测量为一秒内均值。
- 如果采用电压互感器进行电压测量，该谐波电压测量将可能会由于变压器的滤波作用而导致误差。采用高品质的变压器可将误差降至最低限度。

  (1) 该范围数值必须乘以 CT 比值（Irms - I1 - P - Q - S - 剩余需补偿无用功 Q）和 PT 比值（Vrms - V1 - P - Q - S - 剩余需补偿无用功 Q）。

  (2) 工频功率因数或 cos j ：根据工频测量值计算得出。供电公司以此作为低功因罚款的依据。

(3) 功率因数：根据工频和谐波测量值计算得出。功率因数始终低于或等于工频功率因数。

总览菜单通过一份列表显示所有的测量项目。

用户可以根据需要，自行设定显示某测量值，在列表中将关心项目移至所选的位置。

单击列表中需要移动的项目（如下例所示，选择 THDV L-L）

然后在列表中点击该项目应需被移至的位置（在下一图例中，THDV L-L 被置于频率所在位置，而该项目则会如下表所示，进行顺移。）

本总览界面还可以手动投切单步电容。单击屏幕左上角“模式”mode 按钮，进入“手动”模式。

继而启用 “投入或切除一步”。

单击这些按钮，手动投切各步电容。

备注：如使用 RVT12-3P 三相型号需要选择投切的电容类型（共补或分补）。相关区别请参见 4.2.1.1。

4.2.2　系统数值

系统数值菜单分类显示所有的测量值，如图 18 所示。RVT12-3P 三相型号还可提供每相的系统值。

图 18：系统值

电压（电流）测量

电压（电流）谐波图和表

谐波电压/电流频谱图如下所示。通过滚动条可在屏幕上端选择一个特定的谐波：谐波次数、相对工频的数值和百分比。

RVT 能够通过表格或频谱显示谐波的电压和电流值。单击“请选择”按钮，可选择在谐波测量表或频谱中需要显示的测量值。

图 19： 谐波电压图

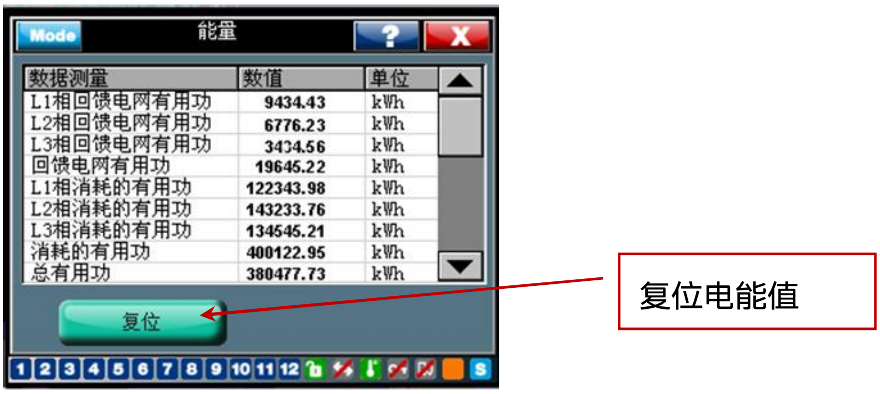
图 20：谐波电压表

注释：电压（电流）谐波测量的误差：Vrms (Irms) 为 ± 1 %

功率、功率因数测量

温度测量

电能测量



只有 RVT12-3P 具备电能测量功能（3 相型号配备实时时钟）。

电能值可以“复位”至 0。

4.2.3 波形

相间或相与中性点之间电压和电流波形 (取决于 RVT 型号和 CT 连接类型)可以在屏幕上显示。

图 21 显示了相与中性点间的电压和电流波形。

图 21： 电压和电流波形

4.2.4 电表

这一功能赋予用户更佳的观察效果，可同时查看三个最值得关注的测量项目。

单击关注的项目后，再单击“选择”按钮，最多三个测量值。

以下示例显示了三个重要的测量项目。

图 22：电表中显示的三个测量项目

4.2.5 监测

说明

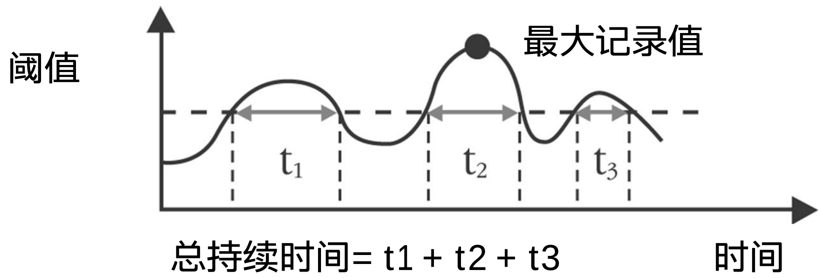
监测功能

记录每个重要的测量项目（自上次清除内容以后），参见以下列表：

- 最大（或最小）值

- 高于（或低于）阈值的持续时间。

一旦设定阈值（参见以下示例），RVT 便开始自动记录最大（或最小）值以及总的持续时间，直至执行重新设置为止。



记录值

监测功能，允许用户记录某一测量值，超过阈值的持续时间及其最大值，该功能适用于下列参数：Vrms [V]、Irms [A]、P [kW]、Q [kvar]、S [kVA]、THDV [%]、THDI [%]、 剩余需补足 Q [kvar]、频率* [Hz]、T1* [°C 或 °F] 至 T8* [°C 或 °F]。

* 频率和温度的最小值以及低于阈值的持续时间也被记录下来。

图 23：监测记录值

示例

记录电压有效值（Vrms）的信息。

系统电压：400 V。

图 24：监测阈值设置——V 有效值

图 25：监测阈值设置——频率

记录到的信息（最大值和总时间）可通过选择和确认“复位”按钮而被清除。

4.3 参数设置

主菜单设置具有的多级子菜单允许用户设置控制器以及执行调试和测试功能。

4.3.1 **手动设定值（设定模式）**

手动设置允许用户访问所有的电容柜设置、系统设置、用户设置和保护/报警配置。 用户也可以通过这个子菜单恢复出厂设置。

图 26： 手动设定值

在对控制器进行任何设置之前，请先确认进入设定模式。请参考 3.1.4 和 4.2.1.1，了解控制器的模式设置和上锁/解锁程序。

4.3.1.1 电容柜设定

启动 â 参数设置 â 手动设定值 â 电容柜设定

电容柜设定菜单包括了有关电容柜的所有配置参数。

图 27：电容柜设定

电容柜的设置参数

V nominal（**额定电压**）： 电容柜的额定电压。

当输入一个额定电压值后，欠压和过压保护值则后被自动设为额定电压的 80% 和 120%。

这些保护值可经手动更改。

V scaling（**电压比值**）：   外接电压互感器的比值。示例：一台 15kV/100V 电压互感器，V scaling = 150。

如果没有外接电压互感器，则 V scaling = 1。

这一功能可让 RVT 控制中压电容柜。连接适当的电压互感器后，RVT 即会显示相应的中压测量值。

1ph **最小单步**： 用于不平衡负荷的分补，单相（相对中性点）电容器的最小单步容量。

3ph **最小单步**：平衡负荷中的三相电容器的最小单步容量。

对于上述两项设置程序，

a) 经自动调试后，这一数值将根据电容柜的最小单步容量自动设定。

b) 在调试向导中（参见 4.2.2.2），这一数值必须手动设定。

以下是一个共补和分补投切序列的示例，包括单相分补（3 步）和三相共补（3 步）：

单相分补序列*：1 (5kvar) 2 (10kvar) 2 (10kvar) è Q step 1ph = 5 kvar

三相共补序列：1 (10kvar) 2 (20kvar) 2 (20kvar) è Q step 3ph = 10 kvar

或，

三相序列：2 (15kvar) 4 (30kvar) 5 (37.5kvar) è Q step = 7.5 kvar

***序列：**连接到 RVT 输出的各段电容器相对值。这些相对值处于 0 至 8 之间。

RVT6/RVT12 基本型号和 RVT12 - 3P 三相型号的出厂默认序列为：1:1:….:1。特定序列可以通过手动设置。

如需自定义一个序列，可参照以下导航菜单：

启动界面 â 参数设置 â 手动设置值 â 电容柜设定 â 输出步进段数。

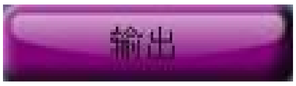


图 28 显示了 1 - 6 个输出步进，单击箭头按钮 ，下一个界面将显示其余的第 7-12 输出步进，如图 29 所示。

图 28：RVT 1-6 个输出步进

图 29：RVT7-12 输出步进（RVT12-3P 三相型号）

在屏幕的右侧，“状态”栏中对应各输出步进示有六种属性：

“切除锁定”：这个输出端被禁用（默认出厂设置）；

“投入锁定”：这个输出端被启用（相应的电容始终处于连接状态）；

“1PhL1、1Phl2、1PhL3”：这个输出端控制着一个单相分补电容器，其分别处于 L1 相、L2 相或 L3 相。

"3Ph"：这个输出端控制着一个三相共补电容器。

RVT6/RVT12 基本型号，仅具备"切除锁定、投入锁定和启用"三个输出状态。在通过控制器切换电容器之前，必须将输出端设为"启用"状态。

以下示例为 RVT12-3P 三相型号的一些典型输出情况：

典型设置之一：单相分补（相对中性点）电容器的 12 个步进：

图 30：典型输出端设置 12 x 1ph (RVT12-3P 三相型号)

典型设置之二：三相共补 6 步 + 单相分补 6 步：

图 31：典型输出端设置 6 x 3ph +6 x 1ph（RVT12-3P 三相型号）

延时

单击如图 27 所示的"延时"按钮，用户可在以下界面设置电容柜的切换延时功能。

图 32：RVT 延时设定

投入延时：

- 在正常操作中，这是控制器检测到须投入一段电容与实际投入之间的时间。
- 在积分模式操作中，这是两个投入指令之间的时间。

投入延时旨在让该电容器在投入之前先放电。

注意：	**过短延迟时间（电容放电时间）可能会导致电容柜遭受严重损害。**

切除延时：

- 在正常操作中，这是控制器检测到须切除一段电容与实际切除之间的时间。
- 在积分操作中，不使用切除延时。

复位延时：电源中断后，RVT 在重新启动电容柜操作之前的等待时间。

单击如图 27 所示的“控制”按钮，用户可在以下界面设置 RVT 共补或分补及 CT 测量连接方式。

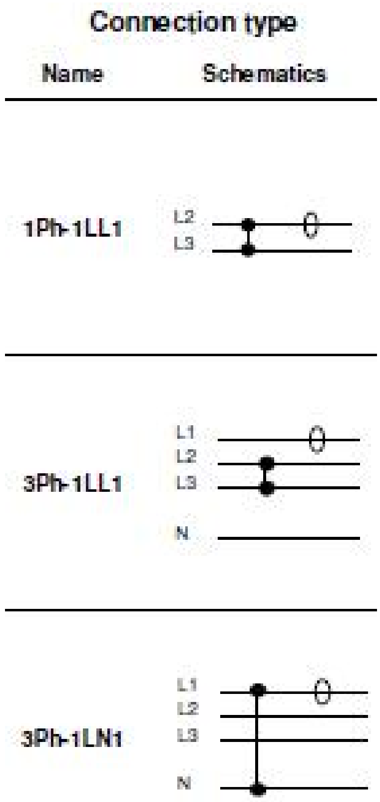
图 33：RVT 电容柜控制设定

共补/分补（仅适用于 RVT12-3P）

这项设置可设定共补/分补方式和 CT 电流测量的连接类型。 根据不同的负载连接类型和电压电流测量方法，RVT 允许八种不同的连接方式：

单相电流测量（适用于 RVT6/12 和 RVT12-3P）：

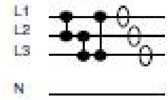
1Ph-1LL1、3Ph-1LL1 and 3Ph-1LN1:



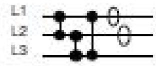
三相电流测量（仅适用于 RVT12-3P 三相型号）：

3Ph-3LL3、3Ph-3LL2(没有中性线)、3Ph-3LN3、3Ph-1LL3 and 3Ph-1LN3.

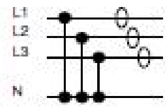
3Ph-3LL3



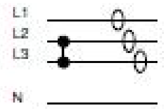
3Ph-3LL2



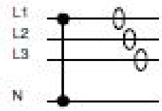
3Ph-3LN3



3Ph-1LL3



3Ph-1LN3



有关接线的详细说明，参见本手册附录的 A7. 共补/分补 CT 连接类型说明和控制器端子上的 CT 接线部分。

上述连接类型的定义如下:

3Ph – 3 LN 3

1: 有一个 CT 测量，2: 有两个 CT 测量, 3:有三个 CT 测量

LN：相对中性点之间的电压测量，LL 线电压测量

1: 1 个电压测量值，3: 三个电压测量值

1Ph：单相负荷（L-N 或 L-L），3Ph：三相负荷

备注：L 是指相，N 是指中性点。

线性 / 循环

线性投切遵循“先进后出”的投切原则。

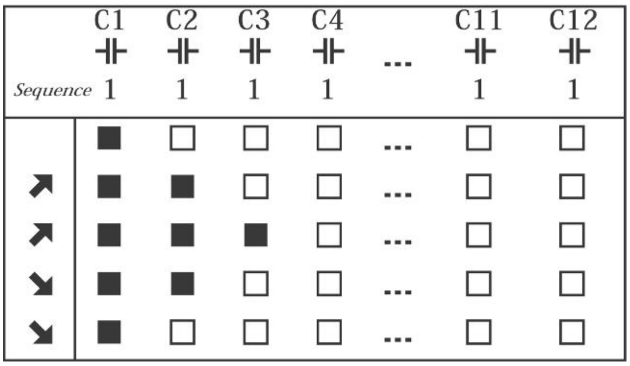
循环投切遵循“先进先出”的投切原则。

下表是对两种操作的说明。

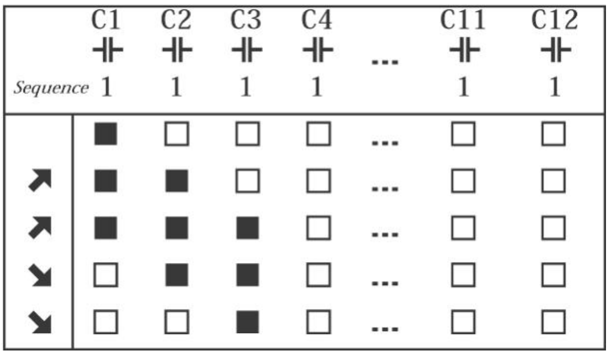
循环投切可平衡所有各段电容之间带载时间，从而延长电容器和接触器的使用寿命。

对于存在多段相同步进的投切序列(1:1:2:2:…, 1:1:2:4:4.,…)，该循环投切也同样适用于所有相同容量的各段电容之间（1:1, 2:2 and 4:4）。

线性



循环



ì 要求投入一段电容

î 要求切除一段电容

n 输出段电容触点闭合

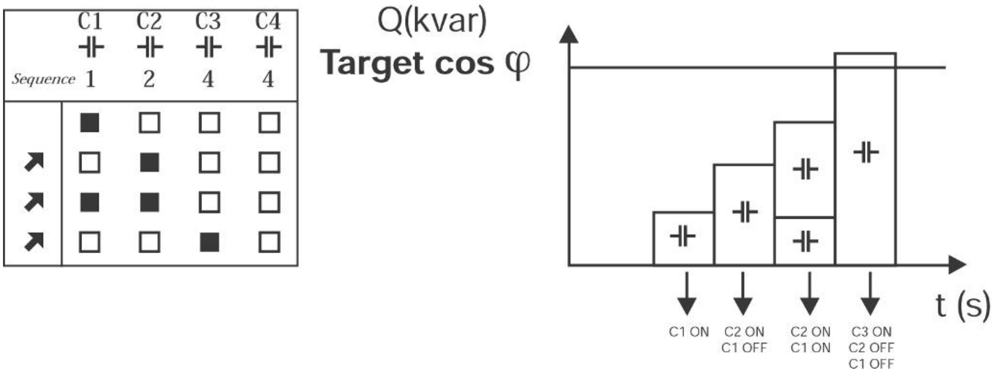
o 输出段电容触点断开

渐进/直投模式

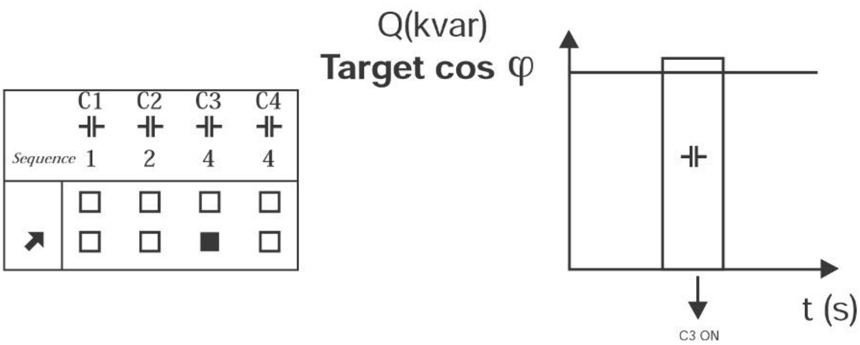
渐进式操作是按顺序基于投入延时逐一投切各段电容。

直投模式是首先投入最大一段电容；可以避免许多不必要的连续性投切操作（投切延时固定为 12 秒）。

渐进



直投

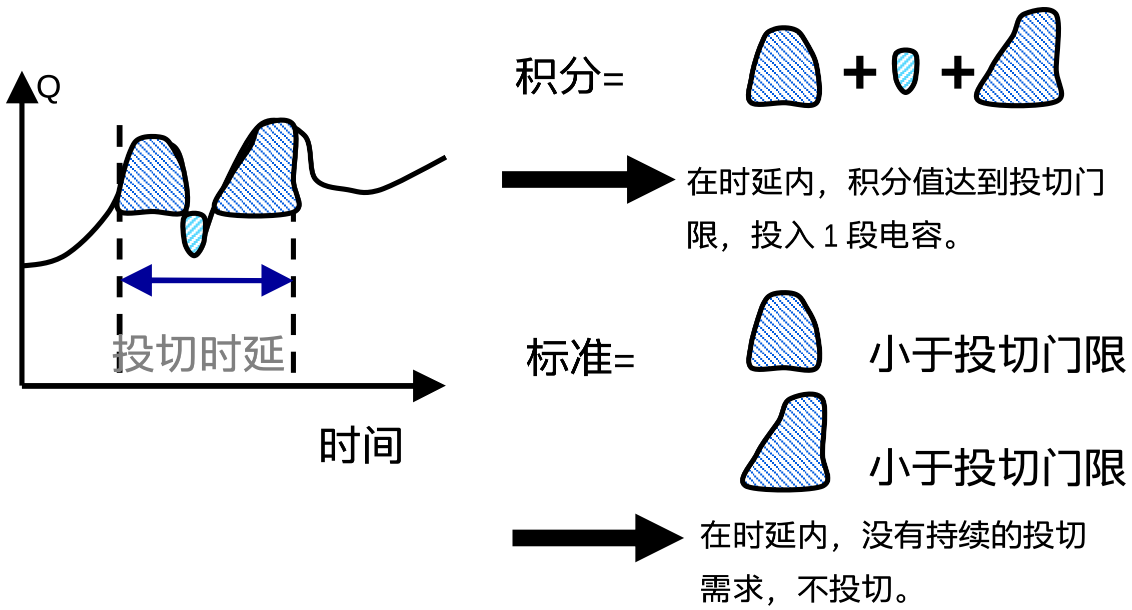


标准/积分投切模式

标准投切模式：在整个切换延迟时间段内（默认 40 秒），只有在控制器检测到持续的投切需求时才执行投切某段电容。

积分投切模式：根据无功需求在延迟时间内的对无功的积分值来判断是否投切某段电容。

积分投切模式适用于负载不断变化的情况。



电容柜设置锁定/解锁（软件上锁）

可通过硬件和软件对电容柜设定进行锁定，以防未经授权的访问。有关硬件锁定的说明，参见 3.1.4。以下界面显示了软件上锁的操作方法。访问界面的路径如下图 34 所示：

启动界面 â 参数设置 â 手动设定值 â 电容柜设定 â 控制。

图 34：RVT 电容柜设置解锁：没有锁定

如需锁定电容柜设置，先勾选“电容柜设置解锁”，界面继而转为图 35 所示。

1. 电容柜设置字段会变成灰色
2. “电容柜设置解锁”变成“电容柜设置锁定”
3. 状态栏内的软件上锁图标会被激活：

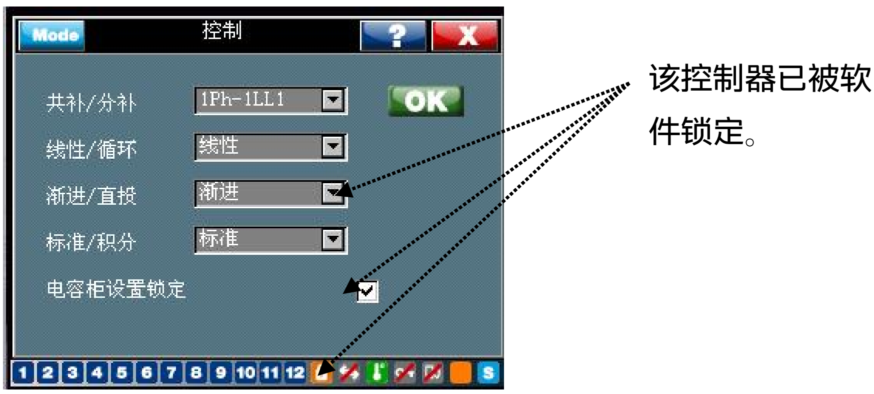


图 35：RVT 电容柜设置锁定：锁定

4.3.1.2 互感器设定

启动界面->参数设置->手动设定值->互感器设定。

RVT 互感器设定为您提供如何设置 CT 相关参数的说明。

图 36：RVT 互感器设定

电流互感器变比：电流互感器变比。

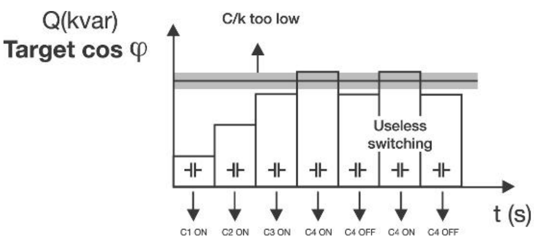
示例：一台 250A / 5A 电流互感器的变比为 50。

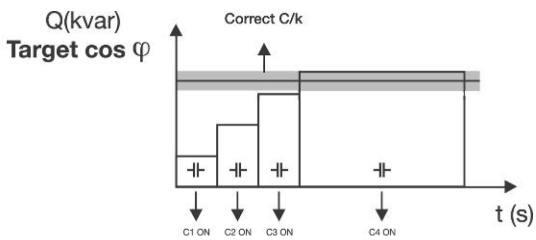
C/k：RVT 控制器的启动电流。它通常设为相当于最小步进电容器（Q 最小步进）无功电流的 2/3 (参见 4.3.1.1 的说明）。

该值代表 RVT 投入或切除一个电容器步进段数的电流阈值。C/k 值可以设定的范围在 0.01 至 5。

C/k 值需根据互感器变比和最小步进电容千乏数设定适当值；过低或过高都会导致电容柜不能达到理想补偿效果。

以下示例显示了一个过低 C/k 值的现象以及它如何导致投切震荡（反复投切电容但始终无法达到设定功率因数值的不稳定状态）。





一个过高 C/k 值将导致投入的电容器不足以达到目标 cos j （与设定目标差距较大）。

可以通过下列公式计算，或直接在下表读取需要设定的 C/k 值。

公式

三相负载

$$C/k = 0.67\,x \frac{Qstep\ x\ 1000}{\sqrt{3}\ x\ Vnom\ x\ CTscaling}$$

单相 (L-L 或 L-N) 负载

$$C/k = 0.67\,x \frac{Qstep\ x\ 1000}{Vnom\ x\ CTscaling}$$

表 2：三相平衡 400V 系统的 C/k 值设定表

电流互感器变比		K	电容器最小步进容量（千乏）											
			5	10	15	20	30	40	50	60	70	90	100	120
10/1	50/5	10	0.48	0.97	1.45	1.93	2.90	3.87	4.84					
20/1	100/5	20	0.24	0.48	0.73	0.97	1.45	1.93	2.42	2.90	3.38	4.35	4.84	
30/1	150/5	30	0.16	0.32	0.48	0.64	0.97	1.29	1.61	1.93	2.26	2.90	3.22	3.87
40/1	200/5	40	0.12	0.24	0.36	0.48	0.73	0.97	1.21	1.45	1.69	2.18	2.42	2.90
60/1	300/5	60	0.08	0.16	0.24	0.32	0.48	0.64	0.81	0.97	1.13	1.45	1.61	1.93
80/1	400/5	80	0.06	0.12	0.12	0.24	0.36	0.48	0.60	0.73	0.85	1.09	1.21	1.45
100/1	500/5	100	0.05	0.10	0.15	0.19	0.29	0.39	0.48	0.58	0.68	0.87	0.97	1.16
120/1	600/5	120	0.04	0.08	0.12	0.16	0.24	0.32	0.40	0.48	0.56	0.73	0.81	0.97
160/1	800/5	160	0.03	0.06	0.09	0.12	0.18	0.24	0.30	0.36	0.42	0.54	0.60	0.73
200/1	1000/5	200	0.02	0.05	0.07	0.10	0.15	0.19	0.24	0.29	0.34	0.44	0.48	0.58
300/1	1500/5	300	0.02	0.03	0.05	0.06	0.10	0.13	0.16	0.19	0.23	0.29	0.30	0.39
400/1	2000/5	400	0.01	0.02	0.04	0.05	0.07	0.10	0.12	0.15	0.17	0.22	0.23	0.29
600/1	3000/5	600	0.01	0.02	0.02	0.03	0.05	0.06	0.08	0.10	0.11	0.15	0.15	0.19

备注：

RVT12-3P 可提供两个 C/k 值：共补 C/k 值 和 分补 C/k 值；RVT6/RVT12 只可提供共补 C/k 值。

共补 C/k 值(RVT6/RVT12 型号只有 C/k)适用于有一个 CT,两个 CT 或三个 CT 的连接方式（适用于平衡三相负载）；分补 C/k 值适用于具有三个 CT 的连接方式（适用于三相不平衡负载）。对于不平衡的三相负载，RVT 只允许设定一个统一的分补 C/k 值（没有针对于每单相的分补 C/k 值）。

同时要求 RVT12-3P 相连的所有 CT（不同连接类型中的两个或三个 CT）具有相同的变比。然而，单相电容器和三相电容器的最小单步可能会有差异；这就需要为 RVT 提供两个不同的 C/k 值。

相位移（仅适用于基本型号）： 测量电压与电流接线之间的相位角度。

如果 RVT 按 2.3 款中的接线图指示的方式连接，相位移为 90°（默认设置）。

至于其他的接线方式，可以从附录 A6 的表格中选择需要设置的相位角度。

请注意，在自动调试中，RVT 可以自动检测并设定相位角度。

4.3.1.3　功率因数设定

启动界面->参数设置->手动设定->功率因数设定

功率因数设定允许用户设置不同的目标功率因数和报警延时功能。

图 37：RVT 功率因数设定

目标 cos j （工频）：目标功率因数。

目标 cos j 值的设定范围在感性 0.70 和容性 0.70 之间。

表示一个感性 cos j ，而 表示一个容性 cos j 。

夜间 cos j （工频）：夜间目标功率因数（出厂默认未启用，需手动激活）。

从目标 cos j 到夜间 cos j 的切换是通过外接数字输入 IN 1 +/- 的外接信号执行的（参见 2.4 的说明）。

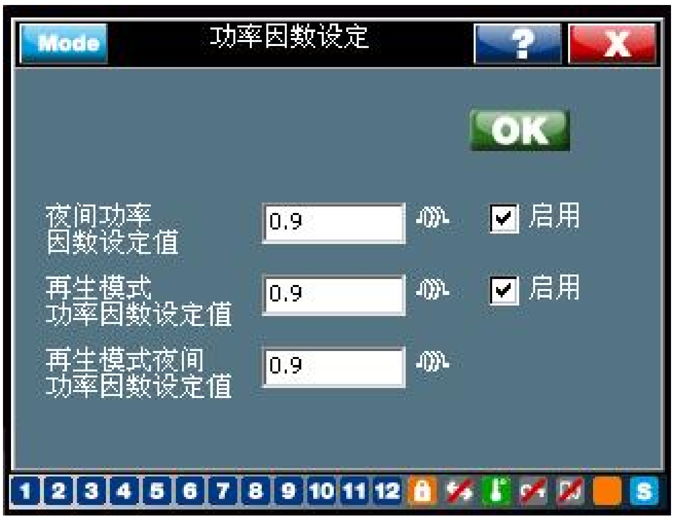


图 38：RVT 功率因数设定：启用夜间和再生负载功率因数

再生模式 cos j （工频）：再生模式下目标功率因数。在再生模式下被激活：P < 0（出厂默未启用， 需手动激活）。

报警： cos j 报警激活条件为：当各段电容器均处于投入状态，但实际 cos j 值仍低于报警 cos j 的临界值，以至于还需要至少投入一个步进段数。

- **报警延时：**到达报警 cos j 临界值条件后，距离报警继电器闭合之前的延迟时间。
- **重新设定报警延时：**在报警条件消失后，距离报警继电器正式开启之前的延迟时间。
- **报警** cos j **：**功率因数报警临界值

cos j 报警激活后, RVT 将会有以下动作:

1. 在屏幕上显示报警信息;
2. 报警继电器动作;
3. 剩余需补偿 Q (无功功率) 被记录，可在总览菜单下查询。

4.3.1.4　保护和报警

启动界面->参数设置->手动设定->保护和报警

当某些系统值超过特定的阈值时，RVT 会激活特定操作程序。保护限值的要求比报警限值更严格。

图 39：RVT 保护和报警设定

4.3.1.4.1 保护

图 40：RVT 保护设定

保护限值： 针对欠压、过压、谐波超标、最大 Irms 电流保护的情况而设置保护限值；并启用 2 个光隔离脉冲输入通道作为外接保护装置。RVT 保护动作后报警继电器 NO（常开节点） 和 NC（常闭节点）两个节点会有相应操作。

一旦达到保护限值，将会有以下操作：

- 所有电容器都将被切除
- 显示屏上出现一条警报信息
- 报警继电器被激活（NO 开启 / NC 闭合）
- 图标  显亮

备注：如果外部输入信号 IN2 (见 2.3) 有效，所有投切的电容会被切除并且报警继电器会有如下相应的动作：

- 切断所有电容器并发出警报，或者
- 只切断所有电容器不发出警报 （适用于某些风电应用或其他特殊应用）

当激活保护动作的条件消失以后，RVT 将在一定的延迟时间后，恢复正常操作。延迟时间的长短取决事件的类型。有关 RVT 保护动作后重新启动程序，参见附录 A4。

4.3.1.4.2报警

报警限值基本上都低于保护限值。当到达报警限值时，将会发生以下情况：

- 风扇继电器启动：风扇继电器常开触点 NO 闭合
- 图标  显亮

图 41：RVT 报警设定

4.3.1.4.3温度保护

RVT 支持连接八个温度探头。每个温度探头的温度保护限值都可单独进行设置。当八个温度探头中的任何一个探头达到温度保护值，

- 所有电容器都会被切除
- 显示屏中出现一条警报信息
- 报警继电器被激活（NO 开启 / NC 闭合）
- 图标  和  显亮

图 42：RVT 温度保护设定

4.3.1.4.4温度报警

RVT 通过八个温度探头设有 8 个电容柜温度报警。每个温度探头的报警温度都可单独进行设置。当八个温度探头中的任何一个探头达到报警温度时，

- 风扇继电器将被启动：NO 常开触点闭合
- 图标  显亮

图 43：RVT 温度报警设定

备注 1：当控制器内部高温超过 85°C 时，RVT 可自行实施保护。上述保护动作在内部温度超过这一保护限值时会执行。

当控制器内部温度降至 80°C 以下时，RVT 会自动恢复正常操作。

备注 2：温度保护功能出厂默认未被启用。当设定一个保护值时（启用），RVT 会自动检查是否有外接温度探头。

4.3.1.5 恢复默认值

启动界面->参数设置->手动设定->恢复默认值

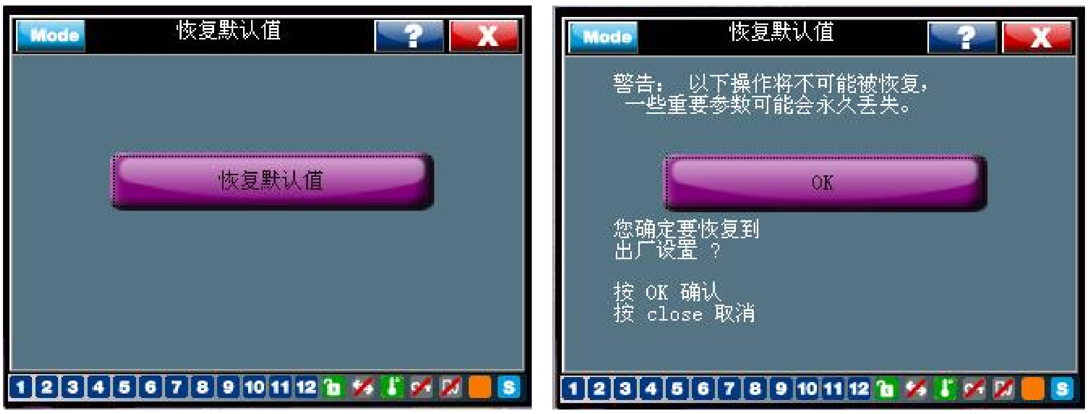


图 44：RVT 恢复默认值

除非电容柜设定项目处于锁定状态（在此情况之下，无法改变电容柜的设置项目），一般都可通过选择和确认 "恢复默认值"项目，将 RVT 的所有参数值全都复位到其默认值（参见与 RVT 有关的其他文件）。

警告：恢复默认值可能会丢失重要的以往设定好的参数。

备注：在恢复默认设置之前，请先确保：

- RVT 处于解锁状态 （详情参见 3.1.4 和 4.2.1.1)
- RVT 进入设定模式（参见 3.1.2。）

4.3.2 调试（设定模式）

这个子菜单允许用户采用控制器的自动调试或调试向导程序。

4.3.2.1　自动调试

如需了解详情，请参阅 3.3 部分。

4.3.2.2　调试向导

RVT 调试向导逐步帮助用户完成调试流程。

备注:

在开始调试向导流程之前，请确保:

1. RVT 处于解锁状态（参见 3.1.4 款和 4.2.1.1 款说明)
2. RVT 进入设定模式（参见 3.1.2 款的说明。）
3. 如果电流互感器二次绕组处于短路状态，当功率因数控制器的电流输入端接通以后，请勿忘记拔出二次绕组的短路片。

调试向导会设定的参数

参数	**说明**
共补/分补	控制器补偿方式选择
相序	检查相序
电流互感器变比	电流互感器变比值
CT 相序调整	如果 CT 相序连接错误，只需调整 CT 输入端调整相序。
相位移	电压与电流测量接线引入的相位移角度。当 RVT 是按照 2.3 中的接线图连接，相位角度为 90°（默认设定）。如需了解其他接线情况，请参阅附录 A.5。
电压测量变比	外接电压互感器的比值。
V nom（额定电压）	电容柜额定电压。
ON-Delay（投入延时）	延迟投入时间。
OFF-Delay（切除延时）	延迟切除时间。
投切序列	该 RVT 控制的各段电容千乏的相对值序列。
共补分补最小单步容量	共补（3Ph） 和分补（1Ph）单步最小容量（千乏）。
C/k （共补/分补）	设定共补/分补启动电流。
目标 cos j	工频目标功率因数。

4.3.2.3 温度探头调试

RVT 可在菊链链路中最多连接八个温度探头。每个探头在使用之前都需要按照以下程序进行调试。

逐一识别和确认每个探头（每个探头需单独进行以下识别过程）：

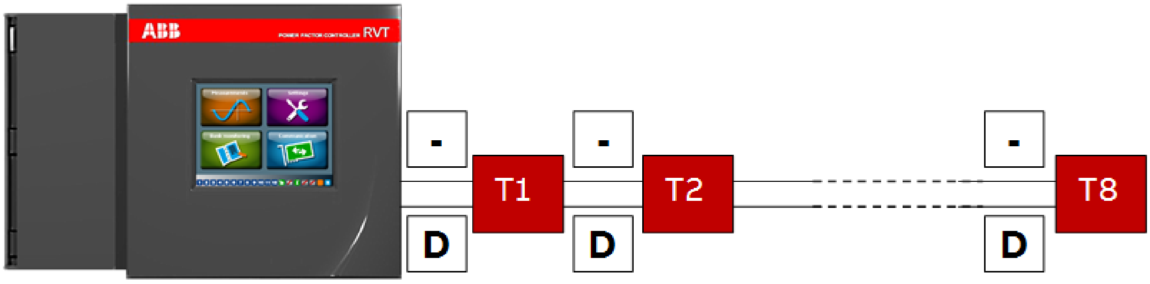
- 将该探头连接于 RVT 温度探头输入端
- 单击并指定行列中的探头编号（可任选一编号）
- 单击“开始”按钮
- RVT 自动识别探头地址（地址已被厂家固化在该探头内）
- 对其它待连接的探头重复以上操作

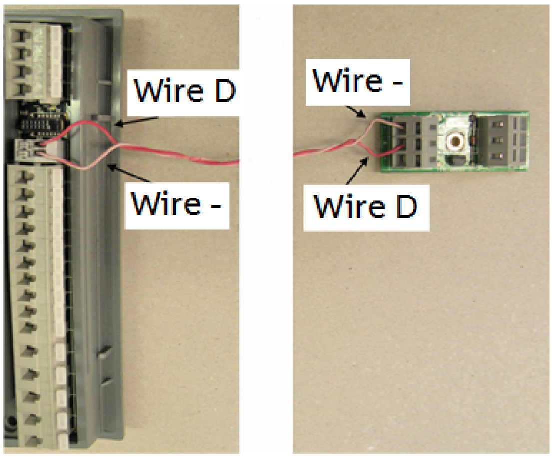
当其中一个探头出现问题时，可单击清除按钮进行清除。

完成识别程序后，每个探头都将被指定一个唯一的序号。

图 45：温度探头自动识别

- 依次连接每个探头（按编号顺序）；注意下图所示的接线方式：





4.4 电容监测

RVT 电容监测可让用户访问诊断、报警记录、测试功能和实时时钟界面（只有 RVT12-3P 三相型号具有实时时钟）。其中具备非常有用的诊断工具。

图 46：电容监测

4.4.1 诊断

记录自 RVT 出厂以来的每段电容器的操作次数。

输出步数	操作
1	863
2	456
3	385
4	436
5	428
6	397
7	422
8	386
9	0
10	0
11	0
12	0

图 47：电容监测诊断

4.4.2 测试功能

这个子菜单允许用户测试每个 RVT 的输出继电器。

测试报警：可以测试报警继电器

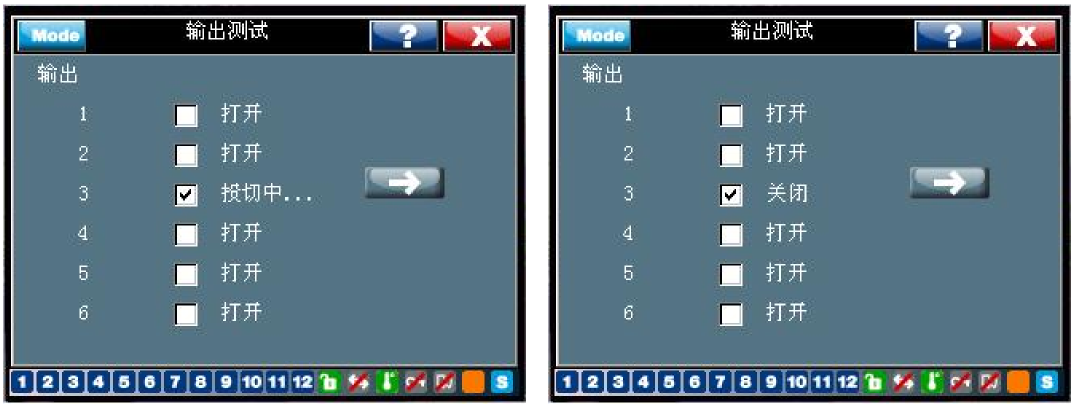
测试风扇：可以测试风扇继电器

测试输出：可以测试每个输出继电器（各段电容控制） (测试过程中投切延时由 RVT 设定)

图 48：电容监测测试功能

图 49：电容监测测试输出

单击各路输出的复选框进行打开/关闭相应的继电器的测试。



在执行测试功能之前，请确保：

- RVT 处于解锁状态（参见 3.1.4 和 4.2.1.1 说明)
- RVT 进入设定模式（参见 3.1.2 说明。）

4.4.3 **报警记录**

报警记录显示最后五条带有实时时钟的报警信息。

图 50：电容监测警报记录

4.4.4 实时时钟

图 51：RVT 实时时钟

当 RVT 的电源断开时，实时时钟仍保持正常运行。

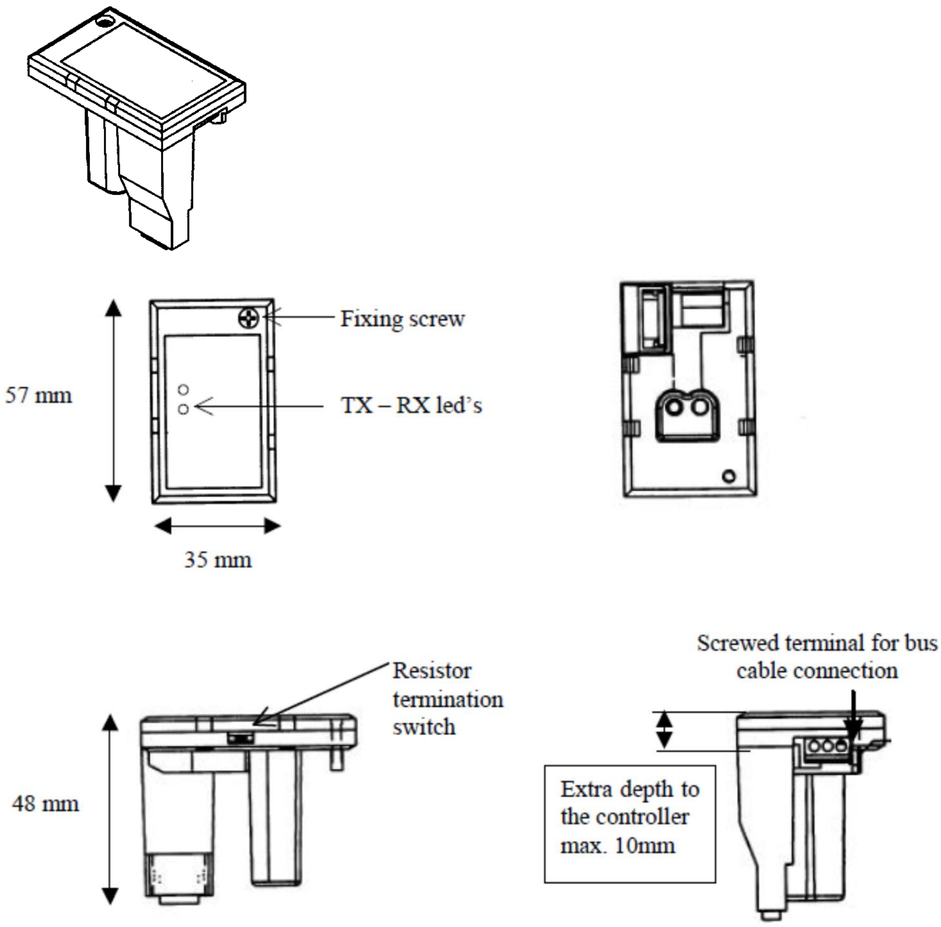
4.5 通信设置

RVT 提供多种通信方式。在这个主菜单内，包括了语言设定、温度单位设定、界面配置和以太网、Modbus 设定。更多有关 Modbus、USB 和 TCP / IP 协议和设置的信息，请参考单独通信设置手册（仅有英文版）：2GCS213013A0050_RVT communication through Modbus, USB or TCPIP protocol。

RS485 / Modbus **适配器**

Modbus 适配器是 RVT 的一个可选件，通过该选件可以将 RVT 连接到一个 Modbus 通信系统中；RVT 作为该 Modbus 通信网络中的一个从机。

如需了解 RS485 Modbus 适配器的详细信息，请参阅 2GCS214013A0050-RVT Modbus RS485 adapter-User guide （仅有英文版）。



注意：

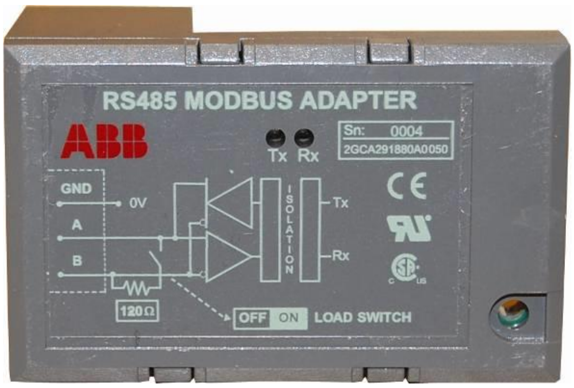
当前版本 RVT （带触摸屏）的 RS485 MODBUS 适配器（3.3V 工作电压） 与以前版本 RVTRS485 MODBUS 适配器（5V 工作电压）互不兼容。

区别方法：

新 RS485 MODBUS 适配器： 标签上文字颜色是绿色；

旧 RS485 MODBUS 适配器： 标签上文字颜色是白色。

订货物料号有新旧区别。



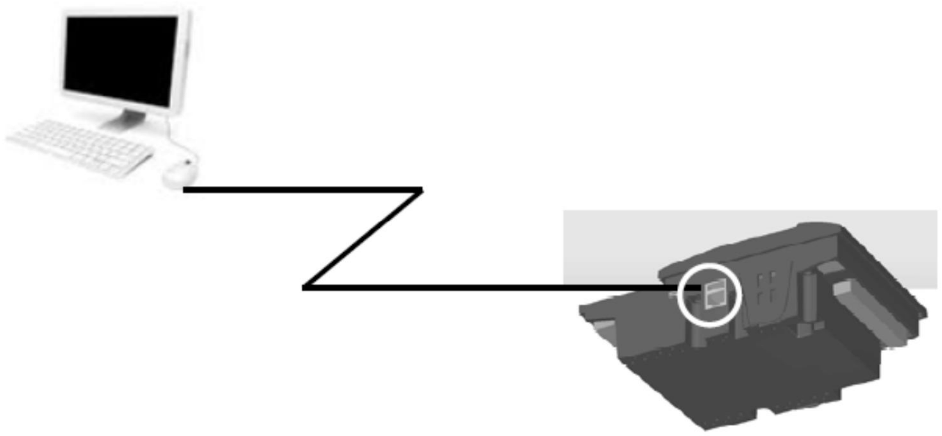
TCP / IP **协议**

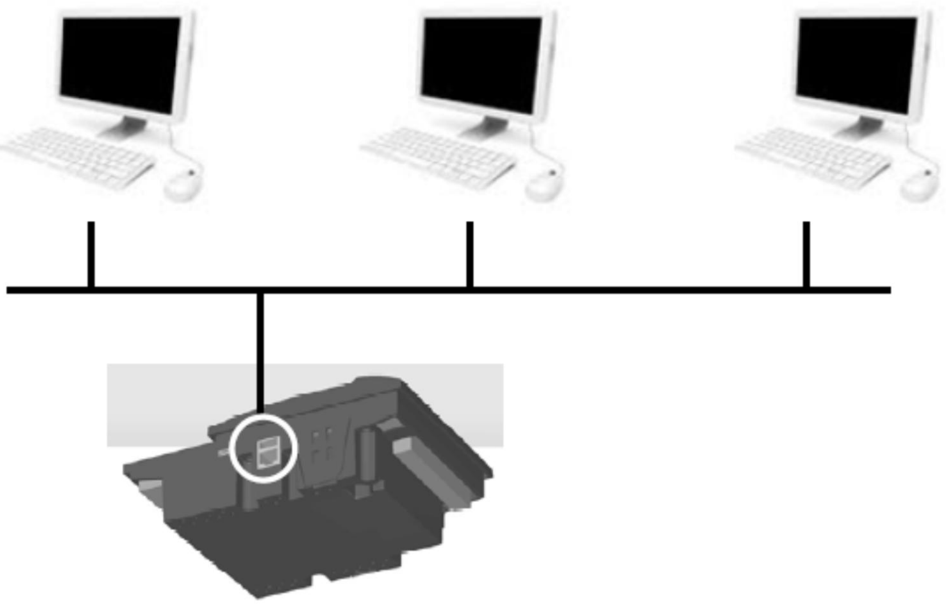
通过 RJ45 Cat5e 以太网电缆和 TCP/IP 协议可对 RVT 远程启动和监控， 比如通过互联网。 远控计算机需要安装 ABB PQ LINK 软件。

TCP 端口使用的默认值为 4250。

RJ45 Cat5e 以太网电缆：

RVT 可以直接连接到 LAN 或互联网。





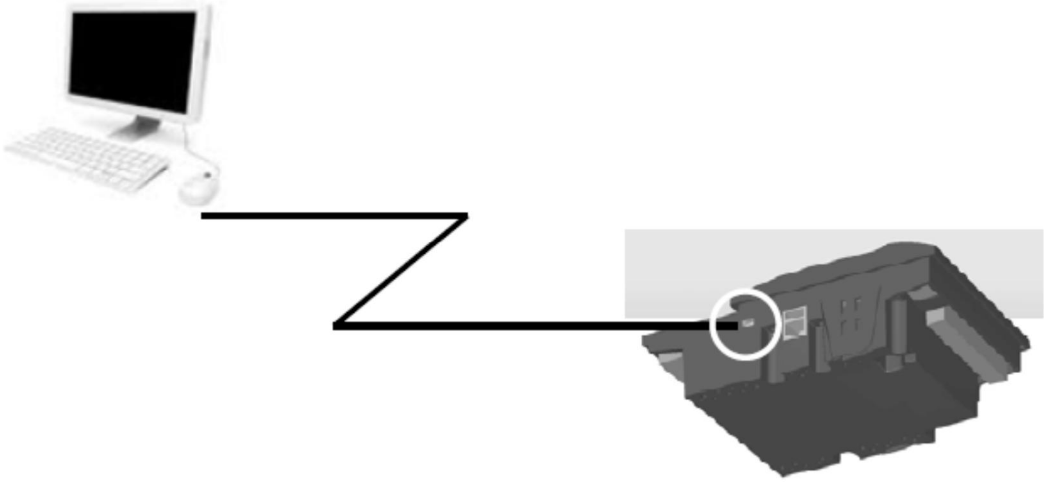
USB **连接**

RVT 配备有 USB 串行接口。

计算机是通过 USB-A 公线 至 USB-Mini B 公线与 RVT 相连。该计算机需要安装 ABB PQ LINK 软件对 RVT 进行通信和控制。

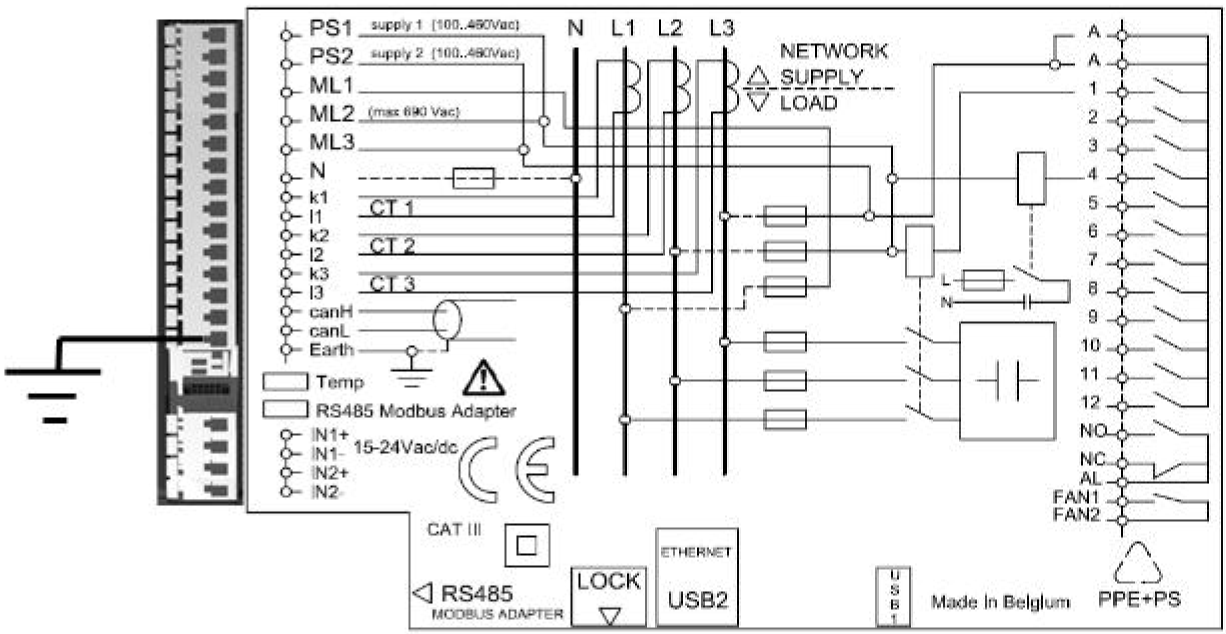
注意：

RVT 硬件上提供 A 接头和 B 接头。 当前版本 RVT 仅支持 B 接头； RVT 只能作为一台 USB 终端设备。在今后版本中 A 接头（RVT 作为 USB 主机）将会被实现。



注意： USB **端口并未隔离；**

使用 USB **时，必须确保** RVT **安全接地，如下图所示。**



4.5.1 I/O 配置

图 52：RVT 语言和通信设置

4.5.1.1 语言选择

RVT 支持五种不同语言界面。

为了激活已选语言，用户需返回根菜单（起始屏幕）。

图 53：RVT 语言选择

4.5.1.2 温度单位

此菜单提供两种温度单位：摄氏和华氏。

选定的单位将适用于所有的温度测量项目或设置项目。

4.5.1.3 通信设置

Modbus 和 TCP/IP 协议经配置才能正常运行。

图 54： RVT 通信协议设置

图 55：RVT Modbus 协议设置

从机地址是 Modbus 主站用于识别 Modbus 网络中的 RVT。

波特率、奇偶校验、停止位应完全匹配 Modbus 主站通信设置。

RVT 需要一个直接连接电脑或以太网的 IP 地址。

这个 IP 地址可以是静态地址，需手工输入（如果 DHCP 被禁用）。默认的地址是 192.168.1.40。

如果 IP 地址是通过网关或以太网自动获得，请将 DHCP 设置为启用状态。

参见以下示例：

示例 1：以下界面显示了直接连接电脑的默认设定（注意,电脑需要相应地配置一个固定的 IP 地址 192.168.1.1，子网掩码为 255.255.255.0，DHCP 未启用）。

图 56：RVT TCP/IP 协议设定

示例 2：以下界面显示了连接到以太网的默认设置（请注意，同时与 LAN 连接的电脑本身具有网络配置的 IP 地址，DHCP 已启用）

有关通信设置的详细信息，参见手册：2GCS213013A0050_RVT communication through Modbus, USB or TCPIP protocol（仅有英文版）。

要激活上述设置，需重启 RVT。

4.5.2 以太网设置

此菜单显示 RVT 的实际 IP 地址，掩码地址和网关的 IP 地址。

显示的数据会因 DHCP 的不同状态而各有差异。

以下界面提供了上述示例 1 和 2 的结果：

示例 1：以下界面显示了 DHCP 未启用时的实际 IP 地址。

示例 2：以下界面显示了 DHCP 处于启用状态时 RVT 实际获得的 IP 地址。

有关通信设置的详细信息，参见手册：2GCS213013A0050_RVT communication through Modbus, USB or TCPIP protocol（仅有英文版）。

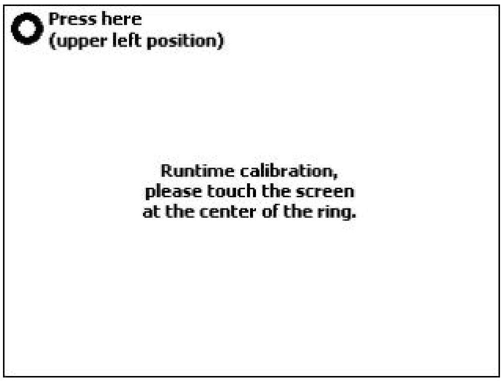
4.5.3 屏幕设置

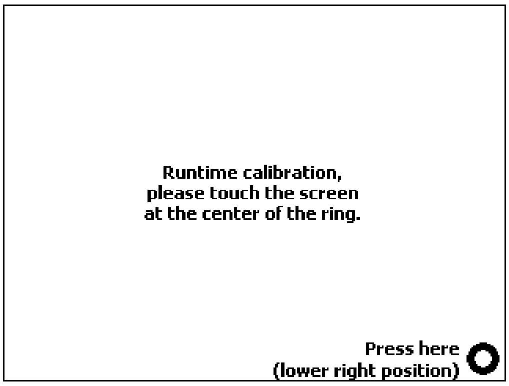
这个菜单帮助用户调整触摸屏的 XY 坐标和背光亮度。

通常情况下无需对触摸屏进行校准。出厂前已校准。

万一触摸屏出现异常，用户需自行进行如下校准。

警告：　请使用圆珠笔或触摸笔对触摸屏进行校准，以便实现最佳校准效果！





背光调整

此菜单是用以设置触摸屏的背光强度。当触摸屏处于非操作状态达 10 分钟以上，背光强度就会降至正常状态下的 10%。

4.5.4 关于

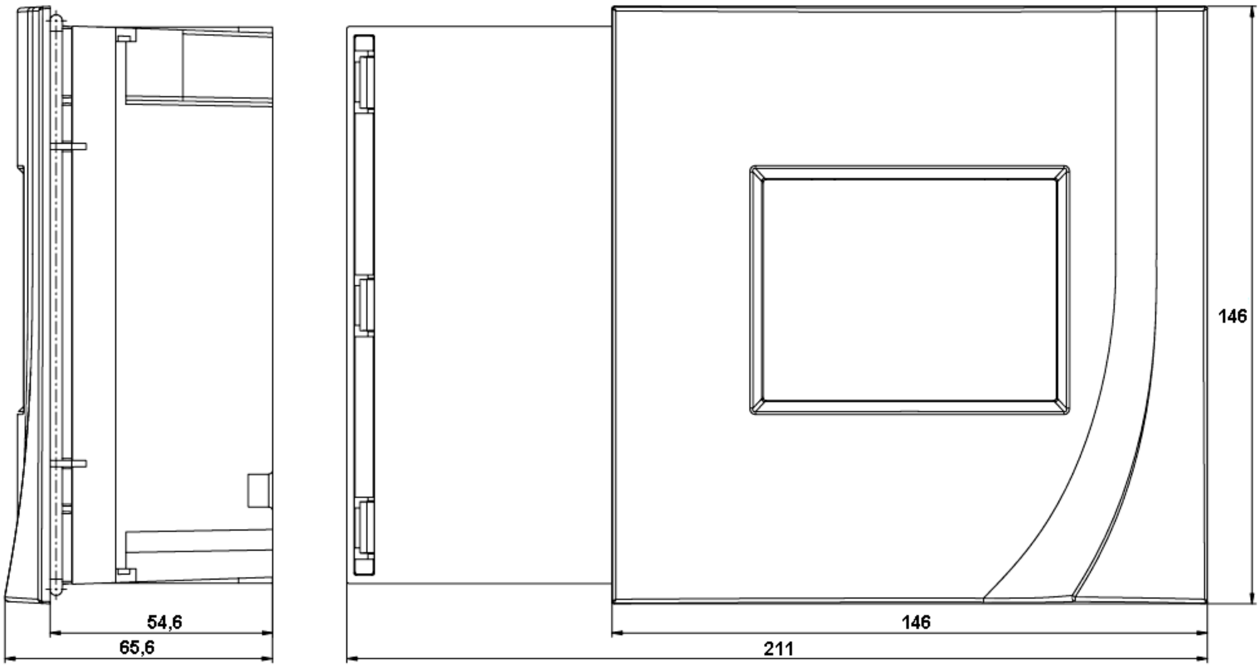
本菜单提供 RVT 软件版本、序列号、物料号和型号。

4.5.5 **显示** Mac **地址**

此菜单显示 RVT 的 MAC 硬件地址。

附录

A1. 外形尺寸



A2. 技术规格

RVT 类型：

特点	RVT6 / RVT12	RVT12-3P
电压/电流测量	1 个电压测量输入端 1 个电流测量输入端	3 个电压测量输入端 3 个电流测量输入端
实时时钟	无	有
电能测量	无	有
以太网连接	无	有
USB 主机接口	无	有
USB 设备接口	有	有
数字输入端	有	有
风扇继电器	有	有
输出继电器	6 或 12	12
上锁开关	有	有
RS485 Modbus 接口	有	有
外接温度探头	有	有

共补/分补：

适用于三相平衡和不平衡负载的功率因数三相共补和单相（相与中性线）分补。

电源电压:

100Vac 至 460Vac。

功耗：

最大值 15 VA。

接线类型：

共补/分补共八种不同的接线方式。

允许电压波动范围：

额定电源电压的 ±10%。

测量类别（符合 IEC 61010-1**）：**

CAT III

电压测量：

可达 690Vac 或经由电压互感器测量更高电压。

误差：

满量程的 1%

频率范围：

45 或 65 Hz（可自动调整至系统频率）。

输入电流：

有效值 (RMS) 5A 或 1A（1 级 C.T. ）。

输入电流的阻抗：

< 0.1 Ohm。

断电保护：

如果断电超过 20 毫秒以上，所有的电容器会自动断开连接。

输出通道数：

RVT6/RVT12 基本型号：最多可设置 6 个或 12 个输出通道

RVT12-3P 三相型号：最多可设置 12 个输出通道

输出触点额定值：

- 连续最大电流：1.5A (ac) – 0.3A (110V dc)。
- 峰值最大电流：8A
- 最高电压：440 Vac。
- A-A 端点的额定连续电流为 18A（每个端点为 9A）。

报警继电器触点额定值：（无电压触点）

- 一个常闭触点和一个常开触点。
- 连续最大电流：1.5A (ac)。
- 额定电压：250Vac（断路电压最大值：440Vac）。

风扇继电器触点额定值：（无电压触点）

- 常开触点。
- 连续最大电流：1.5A (ac)。
- 额定电压：250Vac（断路电压最大值：440Vac）。

功率因数设定范围：

感性 0.7 至容性 0.7。

启动电流设定 (C/k)**：**

- 0.01 至 5A。
- C/k 可自动识别。

部分投切序列：

1:1:1:1:1:..:1 - 1:2:2:2:2:..:2 - 1:2:4:4:4:..:4

1:2:4:8:8:..:8 - 1:1:2:2:2:..:2 - 1:1:2:4:4:..:4

1:1:2:4:8:..:8 - 1:2:3:3:3:..:3 - 1:2:3:6:6:..:6

1:1:2:3:3:..:3 - 1:1:2:3:6:..:6

以及其他用户可自行设定的投切序列。

10/100 Base-T **以太网**

通过 TCP / IP 协议连接到计算机或局域网

RVT 和 RJ45 信号之间的电气隔离值：1500Vrms

Modbus **总线波特率：**

300 - 600 - 1200 - 2400 - 4800 - 9600 - 19200 - 38400 - 57600 bps

CAN **总线连接：**

支持 CAN 2.0B 接口（仅硬件）

USB **主机连接：**

（仅硬件）

USB **设备连接**

一个 USB B 接口

温度探头

菊链连接协议

- 寄生供电模式（无需外接电源）
- 支持多个节点
- 最多可连接 8 个温度探头
- RVT 与温度探头之间或各探头之间的线长最大值为 8 米。
- 该菊链链路最大长度为 64 米
- 温度测量范围： -55°C to +125°C (-67°F to +257°F)
- 测量精度： +/-0.5°C（ -10°C to +85°C）
- 导轨式安装 （DIN 导轨）
- 所用导线： 通讯用一类(CAT 1)双绞线

输出控制：

自动、固定、禁用。

显示屏：

QVGA 320 x 240 像素的彩色触摸屏。

背光可调显示屏

投切延时设定范围：

可设置 1s 至 18h。

存储功能：

所有设定的参数设置均存储在非易失性存储器中。

自动相序调整。

自动适配 CT **连接（通过自动调试）。**

功率因数免疫与谐波干扰。

可四象限运行。

工作温度：

-20°C 至 70°C。

存储温度：

-30°C 至 85°C。

嵌装位置：

垂直面板嵌装。

尺寸：

前板：146 x 146 毫米（高 x 宽）

背面：205 x 135 毫米

总尺寸：146 x 211 x 67 毫米（高 x 宽 x 长）

开孔尺寸：138 x 138 mm (高 x 宽)

重量：

650 克（净重）。

接线端子：

笼式弹簧端子（2.5 mm^2 单芯线缆）。

前面板防护等级：

IP 43（选配 IP 54）。

相对湿度：

最大 95%，不凝结。

符合 CE **认证要求。**

A3. 测试和故障排除

电容柜功能测试

电容柜调试完成后，可根据负载状况进行下列测试程序。

A. **无负载或** cos j = 1 **或容性负载（将目标** cos j **设定为** 0.95 **感性）下**

1. 选择手动模式；
2. 添加两个或更多段电容；
3. 改到自动模式运行。

所有电容应在设定的延迟时间后逐步而被切除掉（没有容性无功需求）。

如果电容没有被切除，请做下列检查：

- 是否存在感性负载？
- 是否设置正确的 C / k 比值和/或步进容量？

（建议可将 C / k 值设定为一个略高于表 2 计算值的数值）

B. **在感性负载下**

1. 设定需要的 cos j =1。
2. 选择自动模式。

电容器将自动投入以补偿感性负载。（如果感性电流低于预设的 C / K 值，控制器将不会切入电容。在这种情况下，请根据上述 A 的方法进行该值的微调）。

如果所有电容均被投入却仍然要求额外容性无功需求，那么需要进一步检查 C / k 的设置情况。

如果 C/k 值设定正确，那么就是因为电容柜容量过小，不足以补偿至 cos j = 1。请选择一个较低的 cos j 值。

当出现投切震荡时，意味着 C/k 设定过低。（除非负载确实呈周期性波动，其周期等于或接近于切换延迟时间）。

故障排除

故障	建议采取的措施
控制器处于连接状态但不工作（显示屏中没有任何内容）。	检查电压设置和保险丝。
虽然存在一个变动很大的感性负载，控制器却仍无法投入或切除电容。	检查控制器是否处于自动模式（手动模式下不会自动投切）。 检查相移和 C/k 的设置情况。 检查 CT 短接是否已去掉。

控制器无法切换任何电容。	检查等待投切延迟时间或断电延迟时间。
无法达到预设的功率因数。	在低负载或无负载时，功率因数很低，而相对的电感性电流也非常小。相应投入的电容器对补偿额过大。如果一段时间内的平均 cos j 值过低，则需要提高预设的 cos j 值。
虽然需要的无效功率相对较低，但所有的电容器均被投入。	检查相序和 C/k 的设置情况。

自动调试结束后，控制器可能显示下列其中一条信息：

自动调试过程中可能出错信息	**建议**
相序检测出错，L1 和 L2 两相需内部调换， 按 OK 确认。	按 OK 确认。
错误提示: 步进 kvar 太小	调整步进容量或 CT 变比。
错误提示: 互感器未检测到任何电流	检查 CT 短接是否已去掉；确保 CT 连接正确和牢固。重新开始自动调试。
错误提示: 负荷变化过快	等负荷稳定后重新启动自动调试，或手动调整其他相应参数。
错误提示: 相位差过大 （检测到的三相电流相位差『标准 120 度』超标过大）	检查电容器和接触器（或其他投切装置）接线。 检查每相电容器电流。
错误提示: 至少有两个互感器在检测同一相电流	检查 CT 连接。
错误提示: 电流过小	检查 CT 短接是否已去掉；确保 CT 连接正确和牢固。重新开始自动调试。
错误提示: 相位错误	检查 CT 连接。 检查电容器和接触器（或其他切换装置）接线。 检查每相电容器电流。
错误提示: 步进不平衡或互感器变比不同	检查 CT 连接。 检查电容器和接触器（或其他切换装置）接线。 检查每相电容器电流。
错误提示: 步进差距过大	检查投切序列和各段电容容量。

A4. 保护动作后重新启动程序

一旦达到保护值（参见 4.2.1.4.1）或当 RVT 内部温度高于 85 °C 时：

- 所有电容器步都被切除
- 显示屏出现一条报警信息
- 报警继电器动作

当保护条件消失后，RVT 会自动重新启动。在重新启动程序，将根据引起保护的事件类型而不同：

保护动作原因	RVT **重新启动流程**
电压有效值 < 保护电压最低值	- 立即打开报警继电器。 - 投入延迟(*)时间之后，恢复正常流程
断电	- 复位延迟 (*) 的时间之后，恢复正常流程。
电压有效值 > 保护电压最大值	- 立即打开报警继电器。 - 投入延迟(*)时间之后，恢复正常流程
内部温度 > 85°C	- 当内部温度 < 80°C 时，事件被视为已消失。 - 立即打开报警继电器。 - 投入延迟 (*) 时间之后，恢复正常流程。
八个温度探头中的其中一个探头温度 > 其最大保护值	- 立即打开报警继电器（可选的外接探头 T1-8） - 经过一段相当于投入延迟 (*) 时间之后，恢复正常流程。
THDV > THDV 最大保护值	- 立即打开报警继电器。 - 投入延迟 (*) 时间之后，恢复正常流程。 共振保护：如果在一小时内发生同样的事件，RVT 将以 2 倍的投入延迟时间恢复正常运作。 如果在一小时内再次发生同样的事件，RVT 将以 4 倍的投入延迟时间恢复正常运作。以此类推，最长可达一小时。 此规则可以避免谐波与电容引起共振现象。
外接输入通道被激活	- 立即打开报警继电器。 - 经过投入延迟 (*) 时间之后，重新开始正常流程。

(*) 有关复位延迟和投入延迟的参数信息，参见 4.2.1.1 款中的全面介绍。

A5. 电压测量和电源连接

本附录介绍了 RVT 的电压测量和电源连接的方法。

说明

如图 57 所示，RVT 具有两个电源输入端和三个电压测量端。

RVT 在进行电压测量时不采用其电源电压值。仅通过专门的电压测量输入端进行电压测量。

如果 RVT 辅助电源和电压测量的信号出自同一来源，可在相应的端子之间采用一下连接方式。

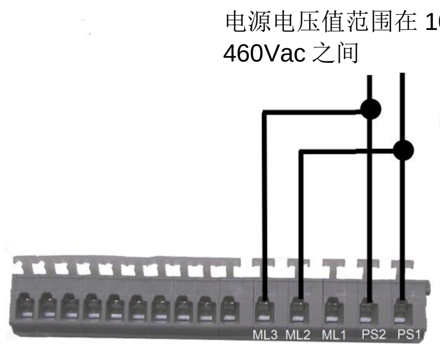


图 57：端子

桥式接线（建议）

由于空间所限，不可能在一个单槽内插入两股电缆。因此可以采用将两股电缆连接到同一个端子的替代方法。

存在多种接线方案可实现上述接法。下面是其中一种，参见图 58。

如下图所示管型接线端子可以将两股缆线并入一个端子。该方法所需端子和相应的压接工具均易在全球各地获得。请注意，所压接线缆必须相同线径。

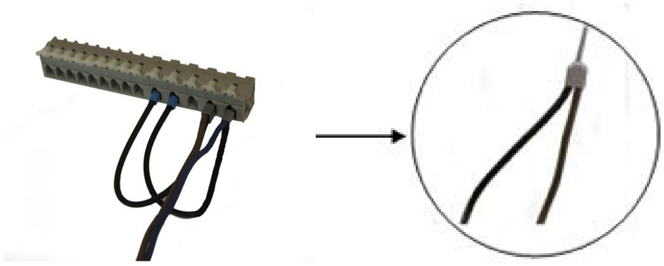
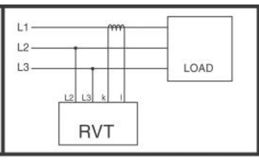
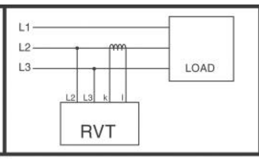
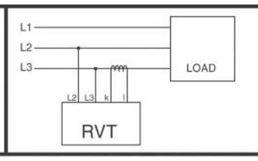
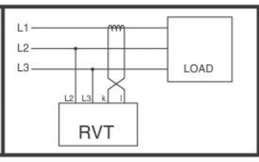
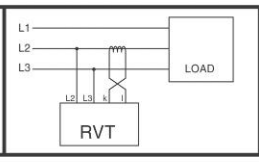
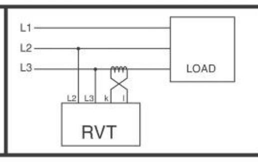


图 58：桥式接线

A6. 相位移表（适用于基本型号）

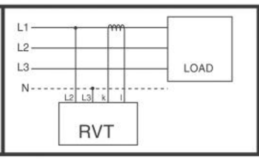
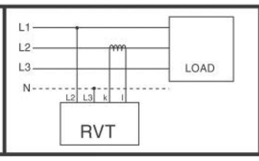
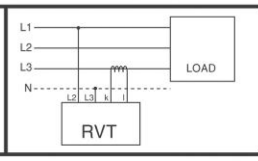
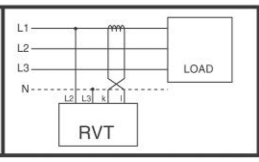
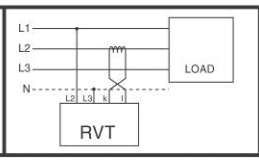
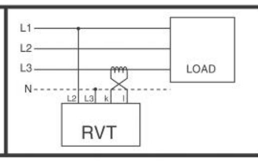
三相连接（相对相）

L2 和 L3 之间的电压测量

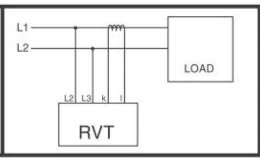
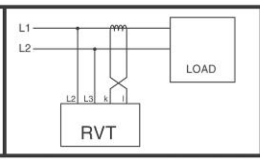
L1 Direct		90
L2 Direct		-30
L3 Direct		-150
L1 Inverted		-90
L2 Inverted		150
L3 Inverted		30

三相连接（相对中性点）

L1 和 中性点之间的电压测量

L1 Direct		0
L2 Direct		-120
L3 Direct		120
L1 Inverted		180
L2 Inverted		60
L3 Inverted		-60

单相连接

L1 Direct		0
L2 Direct		180

A7. 共补/分补 CT 连接类型说明和控制器端子上的 CT 接线

Connection type		RVT 12 - 3P	RVT 6 / RVT 12	Phase shift	Voltages						Currents				Compensation type		
Name	Schematics	Connection	Connection	adjustment	L12	L23	L31	L1N	L2N	L3N	L1	L2	L3	N	Full C3[1]	Full C1[2]	Mixed C3+C1
1Ph-1LL1	L2 L3	L2, L3, CT; ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	L2, L3, CT; N.C. ML2 ML3 N.C. k l N.C. N.C. N.C. N.C.	0° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	-	yes	-
3Ph-1LL1	L1 L2 L3 N	L2, L3, CT; ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	L2, L3, CT; N.C. ML2 ML3 N.C. k l N.C. N.C. N.C. N.C.	90° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	yes	-	-
3Ph-1LN1	L1 L2 L3 N	L1, N, CT; ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	L1, N, CT; N.C. ML2 ML3 N.C. k l N.C. N.C. N.C. N.C.	0° by default (see phase shift table)	-	-	-	Measured	-	-	Measured	-	-	-	yes	-	-
3Ph-3LL3	L1 L2 L3 N	L1, L2, L3, CT1, CT2, CT3; ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-3LL2	L1 L2 L3	L1, L2, L3, CT1, CT2; ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Calculated	(3)	yes	yes	yes
3Ph-3LN3	L1 L2 L3 N	L1, L2, L3, N, CT1, CT2, CT3; ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - phase rotation - CT redirection)	Calculated	Calculated	Calculated	Measured	Measured	Measured	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LL3	L1 L2 L3 N	L2, L3, CT1, CT2, CT3; ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - CT redirection)	-	Measured	-	-	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LN3	L1 L2 L3 N	L1, N, CT1, CT2, CT3; ML1 ML2 ML3 N k1 l1 k2 l2 k3 l3	-	0° by default (Adjust - CT redirection)	-	-	-	Measured	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes

A8. 分补或混补控制（适用于 RVT12-3P 型号）

注：混补在此指共补加分补。RVT12-3P 的 12 路输出可用于分补和共补，如果该控制器同时控制单相和三相电容，则称为混补控制。

只有 RVT12-3P 三相型号具备分补和混补功能。

与基本型号功率因数的共补控制类似, 三相型号的分补/混补功能也是通过比较各相的启动电流 C/k 值与工频电流来实现功率因数控制。

功因控制因 CT 连接方式和所连接电容类型（单相或三相）的不同而不同。(见 A7. 共补/分补 CT 连接类型说明和控制器端子上的 CT 接线)

CT 连接方式说明（亦可参见 38 页）

wPh- xLyz **定义说明**：

w： 单相或三相网络

x: 电压测量个数

y: 定义相间（L-L）或相与中性线连接(L-N)

z : CT 个数

wPh-1Ly1 **控制类型** (**单** CT)

如果只有一个 CT， 那么控制基于 L1 （默认）的电流测量或该 CT 所在相。

3Ph-xLy2 **和** 3Ph-xLy3 **控制类型** (**有** 2 **或** 3 CT)

如果使用了多于一个 CT，如下控制逻辑保证各段电容（单相或三相）得到有效投切。

不平衡负载的投切控制逻辑（按次序）：

在标准或积分投切模式下， 在投切延时期间计算 L1, L2 和 L3 各相无功电流。

判断需要投切的最小步进三相电容。

判断需要投切的最小步进单相电容。

如上所述，如果任何已投切或待投切单相电容可以转换为（或等效于）三相电容那么优先投切三相电容。

按照直投/渐进或线性/循环所设定模式投切相应电容。

以下为一些典型示例:

- 12 **段单相电容投切控制** / **单** CT (**仅限于** 1Ph-1LL1) à 投切控制基于该 CT 所在相的测量电流。

à 共补 C/k 值作为各段电容投切的判据 (在此共补和分补 C/k 值应设为相同值)

- 12 **段三相电容投切控制 / 单** CT (**仅限于** 3Ph-1Ly1)

à 投切控制基于该 CT 所在相的测量电流。

à 共补 C/k 值作为各段电容投切的判据 (在此共补和分补 C/k 值应设为相同值)

- 12 **段三相电容** / 2 **或** 3 **个** CT’s (**适用于** 3Ph-3LL2 **或** 3Ph-xLy3 **连接类型**)

à 投切控制基于这两个或三个 CT 所在相的测量电流。

à 投切控制遵循上述不平衡负载的投切控制逻辑**。**

à 共补 C/k 用于三相电容投切控制。

- **每相有四段单相电容接于相与中性线之间。** / 2 **或** 3 **个** CT

(**适用于** 3Ph-3LL2 **或** 3Ph-xLy3)

à 投切控制基于这两个或三个 CT 所在相的测量电流。

à 投切控制遵循上述不平衡负载的投切控制逻辑**。**

à 分补 C/k 用于单相电容投切控制。

- 6 **个三相电容** + **每相有两段单相电容接于相与中性线之间。** / 2 **或** 3 **个** CT (**适用于** 3Ph-3LL2 **或** 3Ph-xLy3)

à 投切控制基于这两个或三个 CT 所在相的测量电流。

à 投切控制遵循上述不平衡负载的投切控制逻辑**。**

à 共补 C/k 用于三相电容投切控制。

à 分补 C/k 用于单相电容投切控制。

A9. 回收处理

产品本身和手册上此标志意味着本产品不能象某些生活垃圾随意丢弃。为避免对环境和人身健康的危害请将此产品与其他废物分开单独处理, 尽量回收利用。

私人家庭用户需联系零售商或当地政府相关部门了解如何环保回收处理此产品废物。

商业客户应联系供应商并参考采购合同的相应条款。本产品不得与其他商业废弃物一并处理。根据欧盟电子电气废弃物指令（WEEE）本产品不含任何危险物质成分;并符合电气、电子设备中限制使用某些有害物质指令（RoHS）要求。对本产品所含电池的处理应参照当地标准或规范（或参照欧盟电池指令）。

印刷电路板的回收应遵循当地法规。

塑料部件需单独回收。

本产品含 CR2032 Li-MnO2 纽扣电池。不要替换内部 CR2032 锂电池。该电池易于拆卸(卸掉产品背面的四个螺钉后打开塑料外壳取下电池)。

A10. Additional provision on Open Source Software:

The product contains – in part – some free software (software licensed in a way that ensures your freedom to run, copy, distribute, study, change and improve the software). The following products are concerned : Linux-2.6.30.1 which is subject to "GNU General Public License", Version 2, busybox-1.15.3 which is subject to "GNU General Public License", Version 2, dropbear-0.48.1 which is subject to "GNU General Public License", Version 2, iana-etc-2.20 which is subject to "GNU General Public License", Version 2, mtd-utils-1.2.0 which is subject to "GNU General Public License", Version 2, u-boot-1.3.4 which is subject to "GNU General Public License", Version 2, ifplugd-0.28 which is subject to "GNU General Public License", Version 2, AT91Bootstrap1.9 which is subject to "GNU General Public License", Version 2, and uClibc v 0.9.29 which is subject "GNU Lesser General Public License", Version 2.1,(purchaser or user shall not be prohibited to modify libraries provided under Lesser General Public License (version 2.1) and/or to reverse engineer such libraries for debugging such modifications).

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Instruções de instalação e operação

Conteúdo

Leia-me

Sobre este manual de instruções

Este manual de instruções fornece informações detalhadas para ajudá-lo a instalar e operar de forma eficiente o controlador de fator de potência RVT.

Atenção

Atenção, perigo: Este símbolo é um aviso indicativo para salientar uma informação importante.

Antes de instalar e operar o RVT, leia as instruções de segurança com atenção.

Mantenha este manual à disposição dos funcionários responsáveis pela instalação, manutenção e operação da sua planta. ge of installation, maintenance and operation.

Segurança

O RVT atende a Norma Diretiva Européia LVD 2006/95/EC.

Cuidado, risco de choque elétrico: Este símbolo informa ao leitor que as informações de segurança devem ser levadas em consideração.

Instalação, manutenção e operação do controlador RVT deve ser realizada por eletricistas qualificados. Não instalar com alimentação eletrificada. Para limpeza, remova a poeira com uma toalha seca. Não utilizar abrasivos, solventes ou álcool. Antes de limpar por favor desligue a fonte de alimentação e medição de tensão do circuito. Não abra o envólucro do RVT. Não há partes reparáveis no interior do mesmo. O controlador RVT é conectado a um transformador de corrente. Não desconecte o TC antes de assegurar que o mesmo esteja curto-circuitado ou conectado a outra carga paralela com carga de impedância suficientemente baixa. A não realização deste procedimento poderá causar perigosas sobre tensões.
Não utilize este produto para nenhuma outra função para qual não tenha sido projetado.

Compatibilidade eletromagnética

O RVT está em conformidade com a Norma Diretiva Euroéia EMC 2004/108/EC.

Quando um equipamento é utilizado em um sistema, as Normas Européias podem exigir que o EMC do sistema seja verificado.

Os tópicos a seguir são de grande utilidade por contribuir com o desempenho do EMC em um sistema: Caixas metálicas geralmente aumentam o desempenho do EMC.

1. Instale os cabos longe das aberturas das caixas.
2. Instale os cabos próximos a estruturas metálicas aterradas.
3. Utilize vários cabos de aterramento para as portas ou outras partes necessárias do painel.
4. Evite impedâncias comuns à terra.

1 Introdução ao controlador

1.1 O que este capítulo contém

Este capítulo apresenta uma descrição geral do controlador de fator de potência RVT. Ele ilustra a estrutura básica do controlador, principais características bem como a interface touch screen.

1.2 Um poderoso controlador de fator de potência trifásico com análise individual de cada fase

O controlador é capaz de compensar o fator de potência tanto em redes balanceadas quanto desbalanceadas. Existem dois tipos de controladores RVT: RVT modelo básico RVT6/RVT12 e o RVT modelo trifásico RVT12-3P. O modelo básico é totalmente compatível com os RVTs anteriores com 6 e 12 saídas, que é aplicável em sistemas trifásicos balanceados ou sistemas monofásicos (fase-fase). A versão trifásica RVT12-3P é uma versão mais poderosa com funções de controle de fator de potência individuais por fase graças aos 3 TCs de medição, um para cada fase. O RVT12-3P possui apenas a opção com 12 saídas.

O RVT pode também ser utilizado para banco de capacitors automáticos em Média Tensão. Detalhes de como conectar o RVT a um banco de MT pode ser encontrado em 4.3.1.1.

1.3 Principais caractrísticas do RVT

1.3.1 Controle da correção do fator de potência

O controlador de fator de potência RVT é a unidade de controle de um banco de capacitores automático que é utilizado para compensar a potência reativa em uma instalação onde exista a predominância de cargas indutivas.

Ele secciona os capacitores de forma a alcançar o valor de cos j definido pelo usuário.

- Todos os parâmetros de seccionamento podem ser programados manualmente ou automaticamente (descrição nos capítulos 4.3.2 e 4.3.1).
- Adicionalmente ao valor de cos j definido, pode-se programar um valor cos j noturno bem como um valor de cos j em modo regenerativo. (descrição no capítulo 4.3.1.3).
- Para o modelo trifásico RVT12-3P, o controlador pode ser configurado para ligar/desligar capacitors monofásicos em redes desbalanceadas. Esta função é utilizada para corrigir baixo fator de potência em cada fase individualmente; por exemplo, FP=0,6 na fase 1, FP=0,8 na fase 2 e FP=0,95 na fase 3. Isto é muito prático para áreas residenciais/comerciais onde as 3 fases podem estar desbalanceadas pelo fato de existirem muitas cargas monofásicas.

1.3.2 Medições e monitoramento

- Medições (descrição no capítulo 4.2).
- Proteção contra fenômenos inesperados e/ou utilização não autorizada (descrição nos capítulos 3.2.4 e 4.3.1.1).
- Registro das informações e mensagens baseado em um relógio com horário real (descrição nos capítulos 4.2.5 e 4.4).
- Checagem e teste do estado dos relés (descrição nos capítulos 4.4.2 e 4.4).
- Medição de temperature: até 8 pontos de medição podem ser conectados (descrição no capítulo 4.3.1.4.3).

1.3.3 Comunicações

- Conexão Modbus (é necessário um adaptador Modbus RS485)
- Conexão USB (Compatível com as especificações USB 2.0)
- Interface Ehernet TCP/IP
- Conexão CAN 2.0 com saídas extensíveis para 32. Hardware instalado nesta versão do RVT, de forma que o software será implementado no futuro breve.

Informações detalhadas no capítulo 4.5.

1.4 Visões frontal e traseira

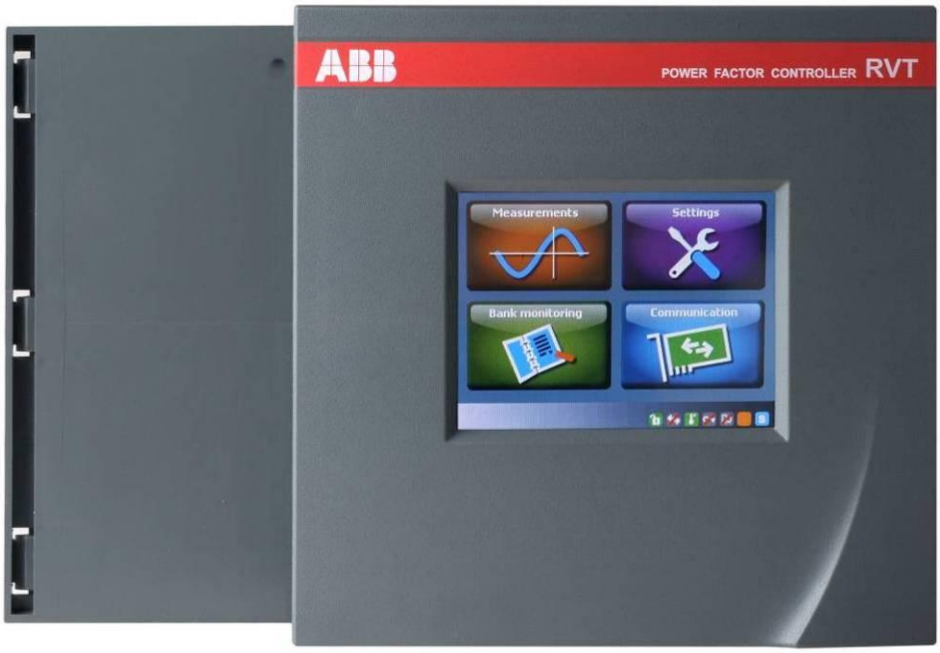


Figura 1: Visão frontal do RVT

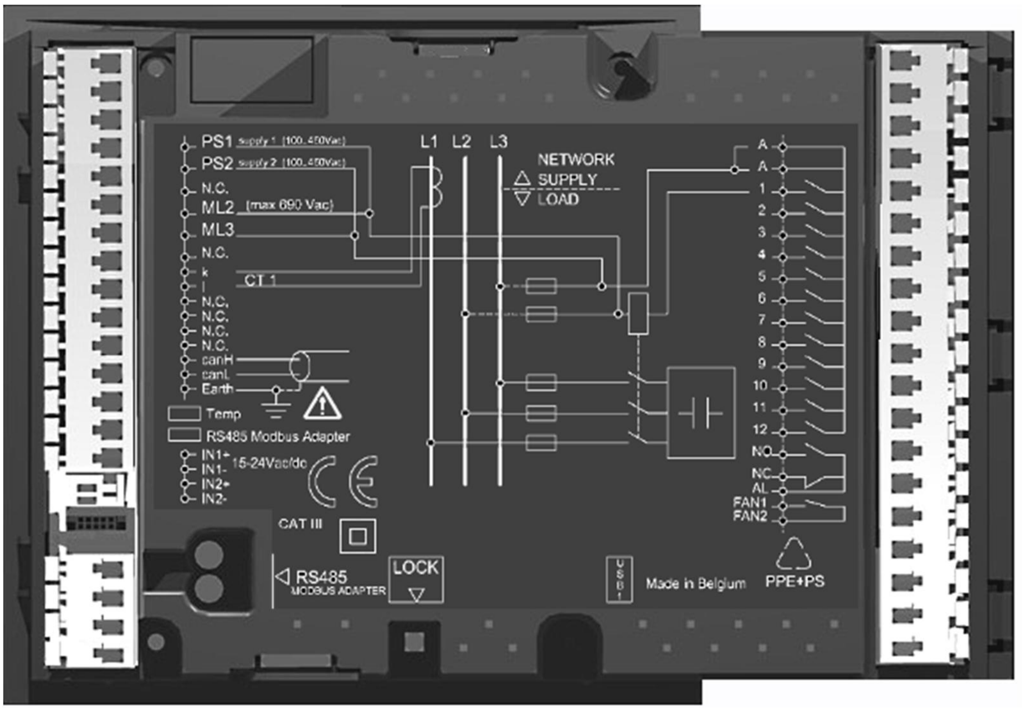


Figura 2: Visão traseira do RVT (Modelo básico RVT6/RVT12)

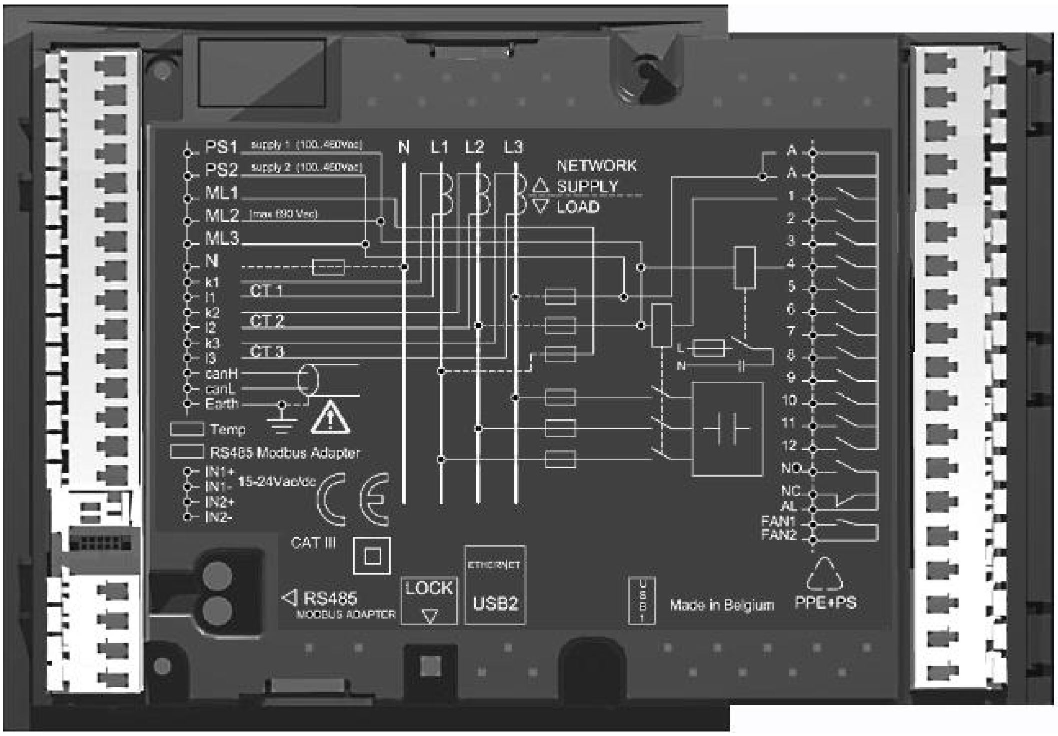


Figura 3: Visão traseira do RVT (Modelo trifásico RVT12-3P)

1.5 Interface touch screen colorida

Uma tela touch screen QVGA 320 x 240 pixels auxilia o usuário a operar o controlador de forma mais fácil. Todos os menus e parâmetros são fáceis e intuitivos graças ao touch screen.

Figura 4: Tela inicial do RVT

O menu detalhado poderá ser encontrado no capítulo 3.2.

2 Instalação

2.1 O que este capítulo contém

Este capítulo apresenta as instruções de montagem do controlador no painel e explica como fazer a conexão elétrica do controlador. O diagrama de cabeamento é apresentado no capítulo 2.4.

2.2 Montagem

Por favor siga os passoa abaixo para montar o RVT no painel..

Passo 1: Encaixe o RVT perpendicularmente ao painel do banco de capacitores (b).
Passo 2: Gire o RVT para inserí-lo no painel do banco de capacitores.

Figura 5: Montagem do RVT

Nota: Dimensões do corte no painel: 138x138 mm.

Passo 3: Inserir o suporte de montagem (c) nos furos de fixação correspondentes (d) no RVT.

Passo 4: Puxe o suporte de montagem para trás.

Passo 5: Gire o parafuso (e) dentro do suporte de montage e aperte-o até o RVT estar fixo no local de instalação.

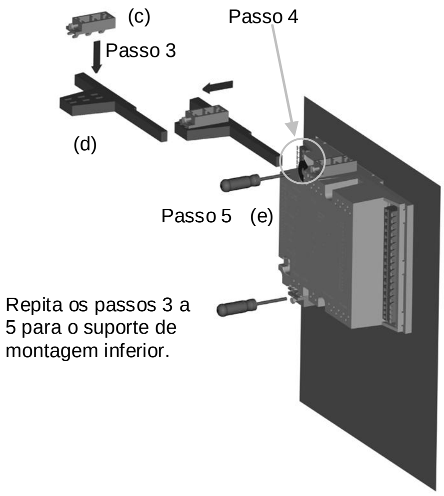


Figura 6: Montagem do RVT

2.3 Conexão de cabos

Siga as instruções abaixo para conectar os cabos aos terminais na parte traseira do controlador.

1. Empurre a alavanca do borne com uma chave de fenda.

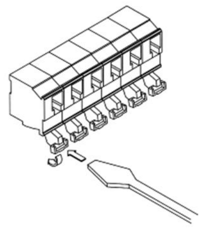


Figura 7: Conexão de cabos

2. Insira o cabo (até 2,5mm² / rígido) no borne correto enquanto estiver pressionando a alavanca.

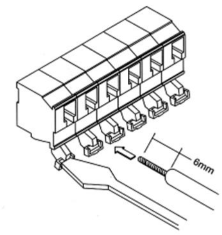


Figura 8: Conexão de cabos

3. Solte a alavanca do borne.

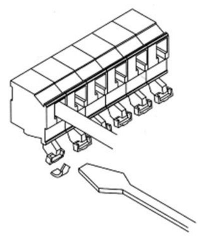


Figura 8: Conexão de cabos

4. Pronto! O cabo está fixo.

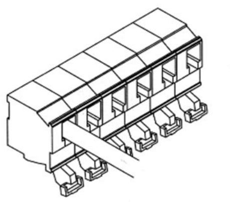


Figura 9: Conexão de cabos

2.4 Diagrama de ligação

O diagrama de ligação mostra as conexões dos circuitos principais e dos circuitos de controle.

Modelo básico RVT6/RVT12

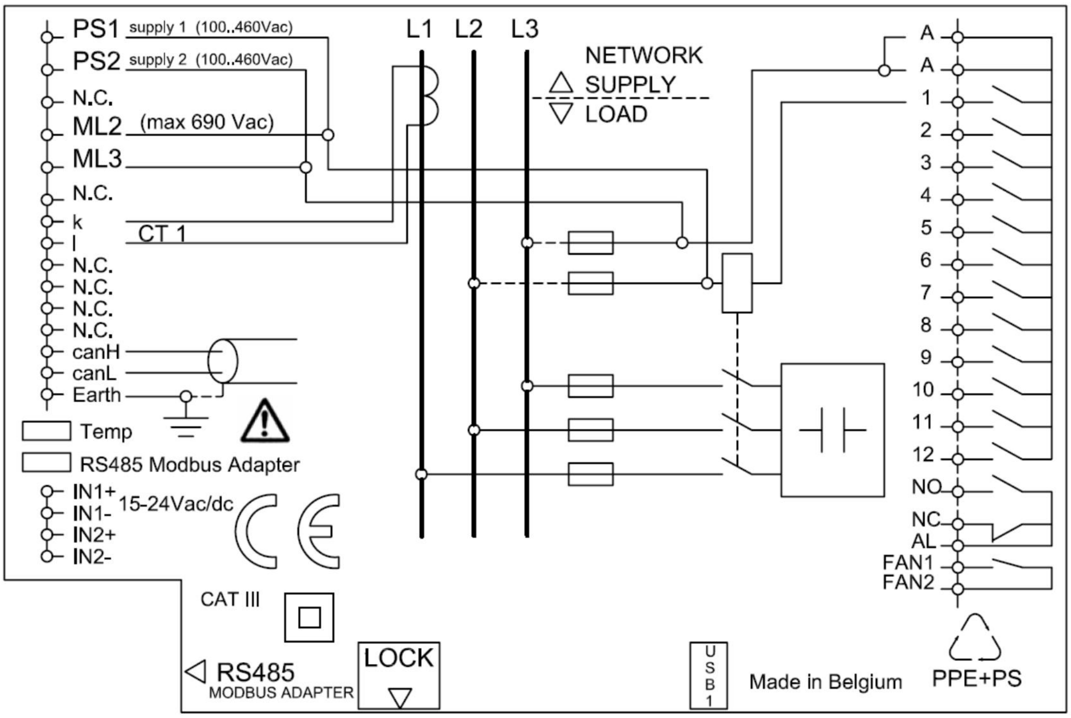


Figura 10: diagrama de ligação RVT (modelo básico RVT6/RVT12)

Modelo trifásico RVT12-3P

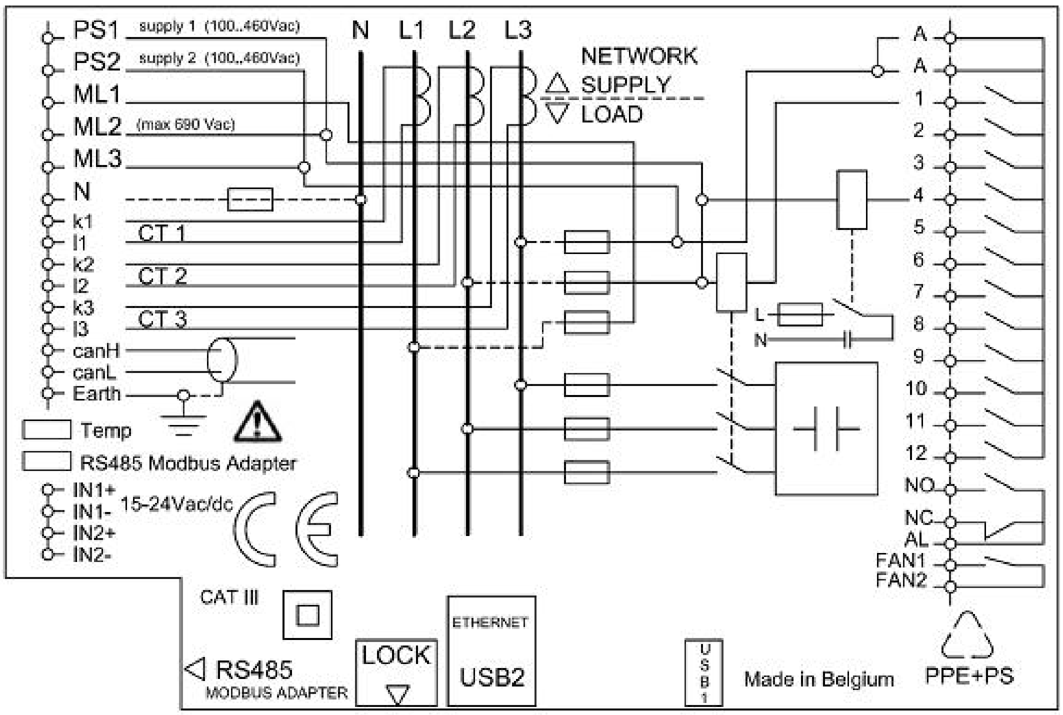


Figura 11: diagrama de ligação RVT (modelo trifásico RVT12-3P)

PS1, 2	Fonte de alimentação
ML1-3	Medição de tensão
N.C.	Não conectado
N	Conexão do neutro
k1-3, l1-3	Conexão dos TCs

canH, canL	Barramento CAN
Earth	Aterramento
Temp	Conexão dos pontos de prova para medição de temperatura
RS485 Adap. Modbus	Interface RS485
IN1+/-	Entrada digital para selecionar o cos j para o dia/noite
IN2+/-	Entrada digital para ativação de alarme externo
A	Fonte comum para relé de saída
1-12	Relés de saída
NO/NC	Contatos de saída do relé de alarme
AL	Fonte comum para o relé de alarme
FAN 1-2	Ventilador/Relé externo de alarme
USB	Conexão USB
RJ45	Conexão Ethernet
Lock	Travamento do hardware

Atenção: Uma proteção de sobrecorrente é recomendada para as conexões PS1-PS2. Conexões: fusíveis 6Arms 10x38 gl 690 V.

3 Início simples

3.1 O que este capítulo contém

Este capítulo descreve brevemente uma forma simples de iniciar a utilização do RVT bem como o procedimento para o comissionamento automático do controlador.

3.2 Menu de navegação

Quando o RVT é ligado após o processo de inicialização (onde o logo da ABB é mostrado) a tela de início é a primeira tela que sera mostrada conforme a Figura 12.

Figura 12: Tela inicial do RVT

No centro da tela, os 4 ícones (Medições, Configurações, Monitoramento dos bancos e Comunicações) representam os 4 níveis-raiz do menu.

Na parte inferior da tela, a barra de status mostra quais estágios de capacitores estãoa tivos, o estado do bloqueio do RVT, avisos, a fonte de controle do RVT (local pela tela touch screen ou via comunicação),

At the bottom of the screen, the status bar shows the active capacitor steps, RVT Lock status, warnings, the control source of the RVT(by local touch screen or communications), demanda de ligar/desligar estágios, modo de operação: A (automatico), M (manual) e S (ajustes). Significados detalhados dos ícones de estado podem ser encontrados nas legendas abaixo.

3.2.1 Legendas para os ícones da tela touch screen

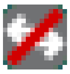
 … 

Ativo (fechado) saídas (saídas inativas não são realçadas)


Configurações do banco desbloqueado


Configurações do banco bloqueado


Configurações podem ser feitas apenas através de comunicação

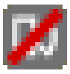

Configurações podem ser feitas através da interface touch screen ou comunicação


Alarme de temperatura (relé do alarme está ativado) ou aviso (o relé de aviso do ventilador está ativado)

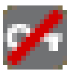

Sem avisos nem alarmes relacionados a temperatura ativados (alarme e ventilador / relé desativados)

Nível de aviso alcançado (o relé do ventilador está ativado)


Alarme ativado (relé do alarme está ativado)


Alarme desativado (relé do alarme não está ativado)


Configurações bloqueadas pela chave na traseira do controlador


Configurações desbloqueadas pela chave na traseira do controlador


Demanda para ligar estágios


Demanda para desligar estágios


Sem nenhuma demanda para ativar / desativar estágios

Modo automático (estágios são automaticamente acionados de acordo com as configurações)

Modo manual (estágios podem ser acionados manualmente)

Modo de configuração (Configurações podem ser definidas)

Troca de modo

Ajuda

Fechar janela

Validação


Próxima página

Excluindo a tela inicial, todas as outras telas do RVT possuem 3 partes: barra de títulos no topo, barra de status na parte inferior e área de configurações no centro da tela.

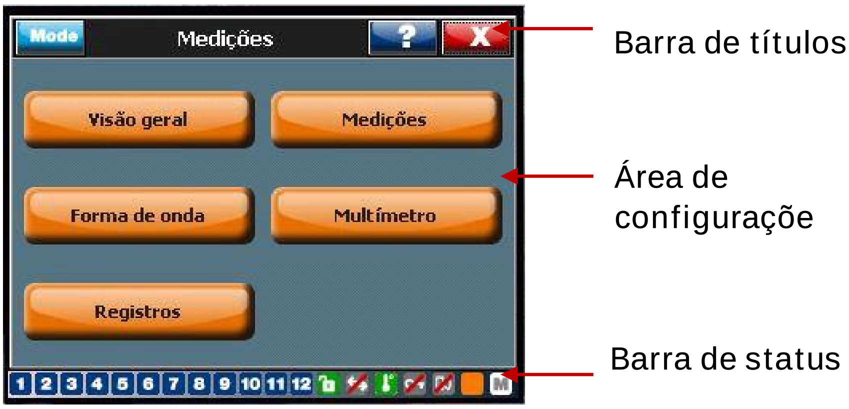


Figura 13: Composição da tela do RVT

3.2.2Barra de títulos

No canto esquerto da barra de títulos, o botão Modo é utilizado para escolher entre os 3 modos de operação do RVT: Automático, Manual e Configurações. A tela abaixo, conforme Figura 14 aparece quando o botão Modo é pressionado. Quando um dos modos é selecionado, por exemplo, se o modo Configurações for selecionado, uma letra S maiúscula aparecerá no canto direito da barra de status. Esta letra  na barra de status indica que o modo atual do RVT é o modo Configurações.

Figura 14: RVT – Troca de Modos

No centro da barra de títulos, como “Medições” na Figura 13, mostra o nome do menu que está sendo apresentado na tela no momento.

Ao clicar no  ponto de interrogação, uma informação relevante irá aparecer para auxiliá-lo a entender e definir os parâmetros de forma mais fácil. A tela abaixo irá aparecer após clicar no ponto de interrrogação da tela da Figura 14:

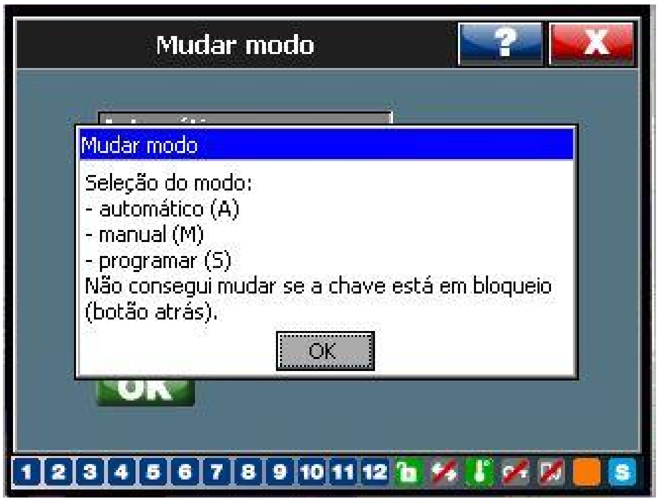


Figura 15: RVT – Informações relevantes

Clique no “X” vermelho no canto direito da barra de títulos , a tela atual será fechada.

Nota: O RVT retorna automaticamente para o modo Manual quando o touch screen não é tocado por mais de 5 minutos.

3.2.3 Área de configurações

A área de configurações consiste em botões e campos de informações. Após finalizar a configuração em uma tela, clique no botão OK  para validar a configuração. No caso de haver mais opções a ponto de não caber na tela, a flecha  irá aparecer na tela. Ao clicar na flecha, as outras opções serão mostradas na próxima tela.

3.2.4 Barra de status

A barra de status mostra quais estágios estão acionados e o estado atual do RVT. O significado dos ícones de estado do RVT podem ser encontrados no capítulo 3.2.1.

Bloqueio de hardware e software

O RVT possui ambos bloqueios, de hardware e software. Uma chave azul na parte traseira do RVT é responsável por esse bloqueio/desbloqueio. Quando está pressionado, o RVT fica bloqueado e o ícone  irá aparecer na barra de status. Quando está solto, o mesmo ícone irá mudra para: . Se o RVT estiver bloqueado, então todos as configurações do banco não estarão acessíveis e o comissionamento também sera desativado.

O ícone  significa que as configurações do banco no RVT estão bloqueadas via software. O ícone  significa que as configurações do banco no RVT estão desbloqueadas via software. Quando o controlador estiver bloqueado via software, todas as configurações de banco estarão protegidas e inacessíveis.

Descrição sobre bloqueio via software poderá ser encontrado no capítulo 4.3.1.1.

3.2.5 Interface de teclado

Todas as informações serão inseridas a partir de uma interface de teclado.

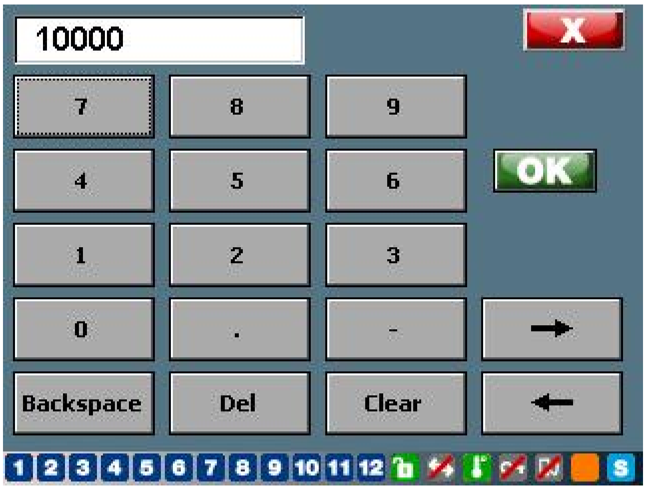
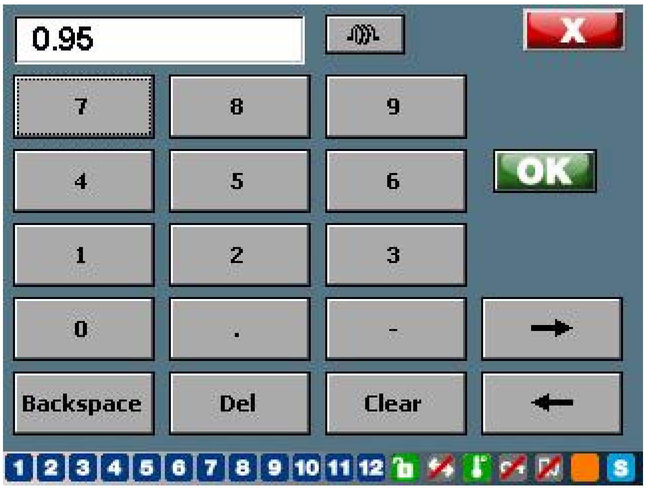


Figura 16: Interface de teclado

Valores de Cos j podem ser inseridos com os símbolos (indutivo) ou (capacitivo).



3.3 Iniciando o RVT

Quando o RVT é ligado, a tela inicial, coforme Figura 12 será mostrada.

Existem 4 grandes ícones na tela inicial: Medições, Configurações, Monitoramento de Banco e Comunicação. Ao tocar em algum dos quatro ícones, o próximo nível do menu poderá ser acessado.

O RVT possui seis opções de idiomas: Inglês, Francês, Alemão, Espanhol, Chinês e Português. Seguindo o caminho abaixo você poderá definir o idioma de sua preferência:

Tela inicial è Comunicação è Configurações I/O è Definir idioma

3.4 Comissionamento automático

Comissionar um RVT é muito simples. O comissionamento automatic do RVT auxilia o usuário a iniciar o controlador rapidamente.

3.4.1 Descrição

O RVT executa o comissionamento automático da seguinte maneira:

- Reconhecimento automatic de:
    - Mudança de fase e sentido para cada tipo de conexão pré-definida
    - Número de saídas
    - Tipo de sequencia de chaveamento
- Definição automatic do: C/k, corrente inicial, descrição detalhada sobre o C/k poderá ser encontrada no capítulo 4.3.1.2.

3.4.2 Preparação para o comissionamento automático

Parâmetros exigidos durante o comissionamento automático:

- Tipo de conexão. Define o tipo de ligação dos TCs no RVT. Existem 8 formas de conectar os TCs, que depende da quantidade de TCs e como eles estão conectados na rede. Descrição detalhada dos tipos de conexões pode ser encontrado no capítulo 4.3.1.2.
- Relação do TC: por exemplo se o TC for de 250A/5A, a relação do TC é de 50. Mais informações podem ser encontradas no capítulo 4.3.1.2.
- Cos j objetivo (ver capítulo 4.3.1.3.)

3.4.3 Comissionamento automático

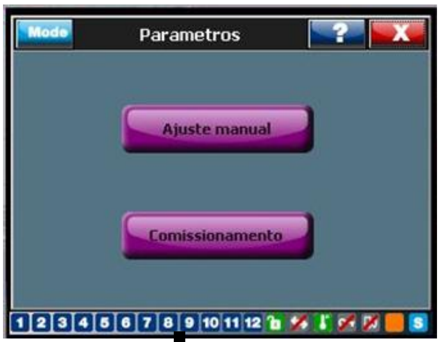
- Se você tiver um curto-circuito no secundário dos TCs não se esqueça de abri-lo após ligar a corrente de entrada do controlador de Fator de Potência.
- Se um transformador é utilizado para medição de tensão, o o valor do Vescala precisa ser alterado conforme o transformador (ver capítulo 4.3.1).

Notas: quando o ícone  (bloqueio de hardware) aparecer na barra de status na parte inferior da tela, significa que o RVT está bloqueado. O acesso ao modo configurações é negado e o comissionamento não pode ser realizado enquanto o RVT não for desbloqueado (ver capítulo4.3.1.1).

As imagens das telas a seguir mostram como se faz um típico comissionamento automático:

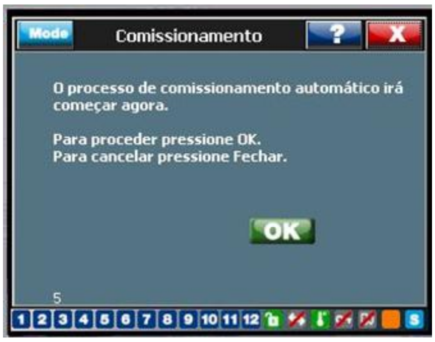
1. Tela inicial, clicar em “Configurações”:

2. Clicar em comissionamento:



3. Clicar em automático:

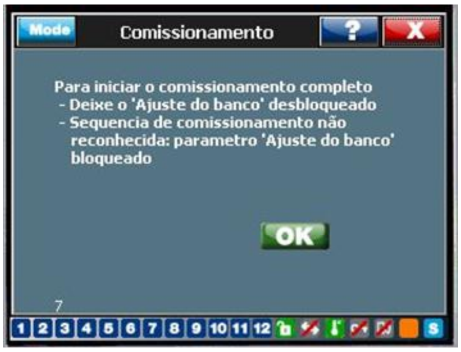
4. Clicar OK:



5. Clicar OK:

6. Selecione o tipo de conexão (Apêndice 7):

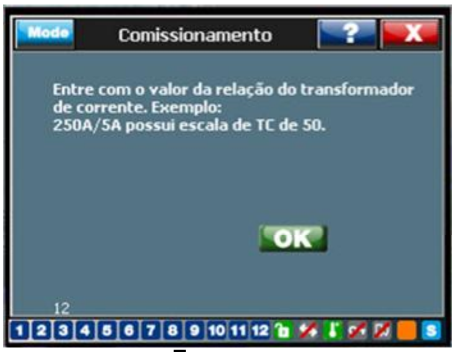
7. Clicar OK:



8. Bloqueie ou desbloqueie as configurações do banco – OK

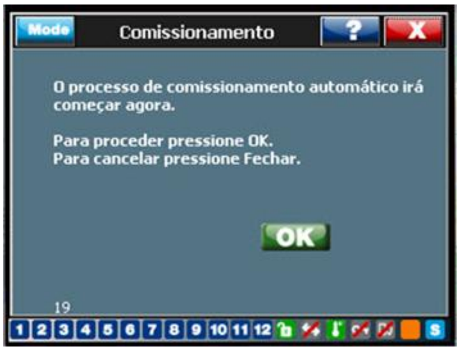
9. Clicar OK:

10. Clicar OK:



11. Inserir relação do TC: 50:

12. Clicar OK:



13. Clicar OK:

14. Clicar OK:

15. Clicar OK:

16. Clicar OK:

17. Clicar OK:

18. Clicar OK:

19. Clicar OK:

20. Clicar OK:

21. Comissionamento automático finalizado:

O processo acima é um típico comissionamento automático. Algumas configurações como relação e tipo de conexão do TC podem ser diferentes das utilizadas neste exemplo.

Em caso de erros ocorrerem durante o comissionamento automático, o botão de “Ajuda” irá instruir o usuário a identificar as causas e completar o comissionamento.

4 Medições e configurações

4.1 O que este capítulo contém

Este capítulo descreve todos os menus/submenus para medições, configurações, monitoramento de bancos, comunicações, etc.

4.2 Medições

Este menu permite ao usuário visualizar vários parâmetros como tensão, corrente, potência, temperatura. Cinco submenus estão inclusos neste menu principal: Visão geral, Medições, Formas de onda, Medições e Registros.

O RVT é muito poderoso em medições e muito versátil para apresentá-las na tela. Todas as medições podem ser mostradas em uma única tabela. Para medições com forma de onda como tensão e corrente, um gráfico também está disponível. Um gráfico de barras é fornecido para a medição de todas as harmônicas.

Visão Geral

O submenu Visão Geral nos dá uma lista complete de todas as medições.

Medições da rede

Medições da rede como tensão, corrente, potência, energia e temperature. Para o modelo trifásico RVT12-3P, são apresentados também valores para cada fase individualmente.

Forma de onda

Tensão e corrente da rede (fase-fase ou fase-neutro) podem ser mostradas em formas de onda.

Registros

Este submenu permite ao usuário visualizar os valores extremos de alguns parâmetros chave.

Banco de medições

Esta função oferece ao usuário a possibilidade de mostrar na tela três medições que ele escolher. Instruções detalhadas para esta função poderão ser encontradas no capítulo 4.2.4.

4.2.1 Visão geral

Detalhes de todas as medições disponíveis através do RVT:

Tabela 1: Visão geral das medições

Medição	Unid	Descrição			
Tensão			Faixa	Precisão	Valor máximo
Vrms	V	Tensão RMS	Até 690Vac	± 1 %	10^6 V
V1	V	Tensão RMS na frequência fundamental	Até 690Vac	± 1 %	10^6 V
Frequência	Hz	Frequência fundamental	45Hz - 65Hz	± 0.5%	45Hz - 75 Hz
THDV	%	Taxa de distorção harmônica de tensão	0 - 300%	± 1 %	1000 %
V harm. tabela		Harmônica de tensão mostrada em uma tabela	2nd-49th	Ver nas páginas a seguir	
V harm. gráfico		Harmônica de tensão mostrada em um gráfico	2nd-49th	Ver nas páginas a seguir	
Corrente			Faixa	Precisão	Valor máximo
Irms	A	Corrente RMS	0 - 5 A	± 1 %	10^6 A
I1	A	Corrente RMS para a frequência fundamental	0 - 5 A	± 1 %	10^6 A
THDI	%	Taxa total de distorção harmônica de corrente	0 - 300%	± 1 %	1000%
I harm. tabela		Harmônica de corrente mostrada em uma tabela	2nd-49th	Ver nas páginas a seguir	
I harm. gráfico		Harmônica de corrente mostrada em um gráfico	2nd-49th	Ver nas páginas a seguir	
Potência			Faixa	Precisão	Valor máximo
Cos j		Cos j	-1 è +1	± 0.02	-1 è +1
PF		Fator de potência	-1 è +1	± 0.02	-1 è +1
P	W	Potência ativa	-10^9 è 10^9 W	± 2%	-10^9 è 10^9 W
Q	var	Potência reativa	-10^9 è 10^9 var	± 2%	-10^9 è 10^9 var
S	VA	Potência aparente	0 è 10^9 VA	± 2%	0 è 10^9 VA

Missing Q	var	Potência remanescente para alcançar o cos j pré definido	0 è 10^9 var	± 2%	0 è 10^9 var
Missing Steps		Capacitores remanescentes para alcançar o cos j pré definido			
Temperatura (opcional)			Faixa	Precisão	Valor máximo
T1-T8	°C/°F	Temperatura T1-T8 (Sensores externos de temperature. Máx de 8 sensores)	-40°C è +105°C	± 1°C	-40°C è +150°C
Energias			Faixa	Precisão	Valor máximo
Energia ativa fornecida	kWh	Energia ativa para a rede	0 è 10^{12}	± 3%	0 è 10^{12}
Energia ativa consumida	kWh	Energia ativa para a carga	0 è 10^{12}	± 3%	0 è 10^{12}
Energia ativa total	kWh	Soma da energia fornecida e consumida	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
Energia reativa indutiva	kvarh	Energia indutiva	0 è 10^{12}	± 3%	0 è 10^{12}
Energia reativa capacitiva	kvarh	Energia capacitiva	0 è 10^{12}	± 3%	0 è 10^{12}
Energia reativa total	kvarh	Soma da energia indutiva e capacitiva	-10^{12} è 10^{12}	± 3%	-10^{12} è 10^{12}
Energia total aparente	kVAh	Soma da energia ativa e reativa	0 è 10^{12}	± 3%	0 è 10^{12}

Notas

- Todas as medicões são médias e atualizadas a cada um segundo.
- Se um transformador for utilizado para medição de tensão, a medição da harmônica de tensão poderá ser imprecisa devido ao comportamento de filtro do transformador. A utilização de transformadores de alta qualidade minimizarão o erro.

(1) A faixa de valores devem ser multiplicados pela relação do TC (Irms - I1 - P - Q - S – Q remanescente) e a relação do transformador de tensão (Vrms - V1 - P - Q - S – Q remanescente).

(2) Cos j : cálculo baseado no valor fundamental das medições. Este valor é utilizado como referência para as concessionárias de energia.

(3) Fator de potência: cálculo baseado no valor das medições fundamental e das harmônicas. O fator de potência é sempre menor ou igual ao cos j .

O menu Visão Geral apresenta todos os itens medidos em uma lista.

O usuário pode customizar a tabela com os valores medidos conforme sua necessidade pessoal apenas movendo os itens para a posição em que desejar.

Selecione o item da lista que deverá ser movido (no exemplo abaixo, o THDV L-L foi escolhido)

Então selecione a posição para onde o item deverá ser movido (no exemplo o THDV L-L foi movido para a posição da Freqência.

A tela Visão Geral é também um menu onde é possível acionar manualmente os estágios. Pressione o modo “Manual” clicando no botão “Modo”.

Então o botão para ativar/desativar estágios estará ativado.

Clique nestes botões para acionar os estágios manualmente.

Nota: O RVT12-3P mostrará uma nova tela perguntando qual tipo de estágio deverá ser ativado/desativado. Diferenças entre estes estágios podem ser encontradas no capítulo 4.3.1.1.

4.2.2 Medições da rede

O menu de Medições da Rede mostra todas as medicos da rede separadas por tipo como podemos ver na Figura 17. Para o modelo trifásico RVT12-3P, o valores individuais por fase também são inclusos.

Figura 17: Valores da rede

Medições de tensão / corrente

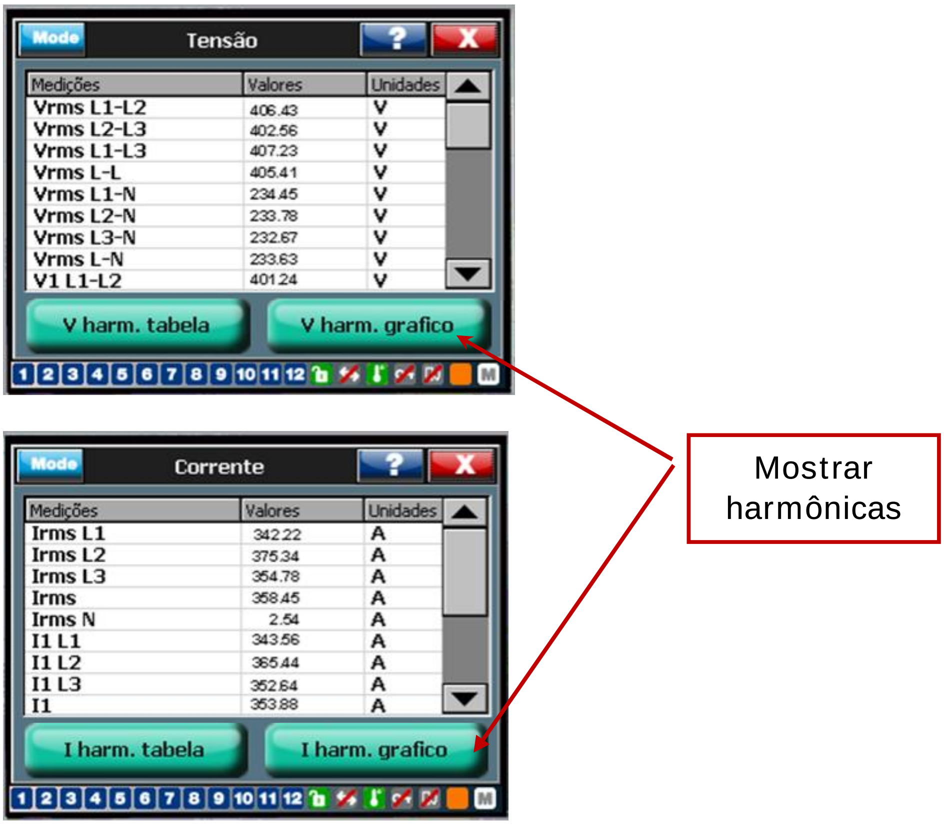


Tabela e gráfico de harmônicas de tensão e corrente

Harmônicas de tensão/corrente podem ser ilustradas em gráfico de barras conforme mostrado abaixo. Com uma barra de rolagem é possível escolher uma harmônica específica para ser mostrado no topo da tela: a ordem da harmônica, o valor e porcentagem comparado com a fundamental.

Para valores de tensão e corrente, o RVT é capaz de mostrar as harmônicas em tabela ou em spectro. Clique no botação “Selecionar” para escolher qual medição será mostrada na tabela ou gráfico das harmônicas.

Figura 18: Harmônicas de tensão em gráfico

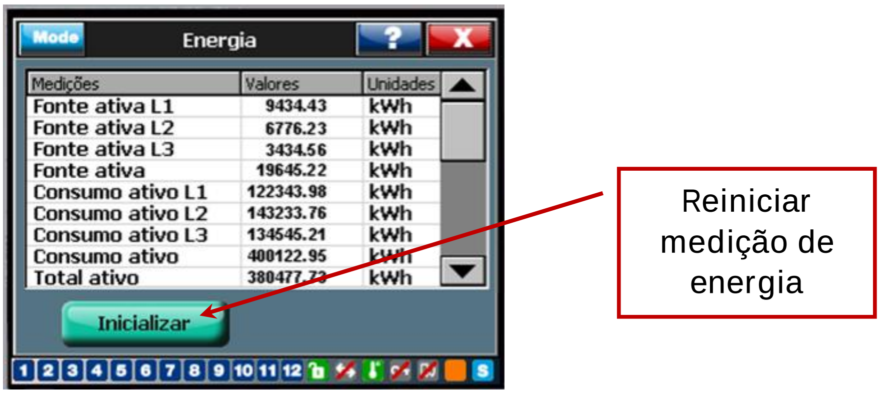
Figura 19: Harmônicas de tensão em tabela

Comentário: a precisão da harmonica de tensão é de ± 1 % da Vrms (Irms)

Medições de Potência e Fator de Potência

Medição de Temperatura

Medição de Energia



Medições de energia são disponível no RVT12-3P (o modelo trifásic é equipado com um relógio de tempo real).

Os valores de energia podem ser “zerados”.

4.2.3 Forma de onda

Uma vez que a tensão e corrente estiverem disponíveis (dependendo do tipo de conexão utilizada no (RVT), poderão ser mostradas na tela como forma de onda. A Figura 20 mostra a forma de onda da tensão entre fase e neutron.

Figura 20: Formas de onda de tensão e corrente

4.2.4 Banco de medições

Esta função oferece ao usuário uma melhor visualização das medições mais importantes.

Clique no item desejado e então clique em “Selecionar” para inserir os valores no banco de medições.

Um exemplo é apresentado abaixo para as 3 medições mais importantes.

Figura 21: três medições mostradas no banco de medições

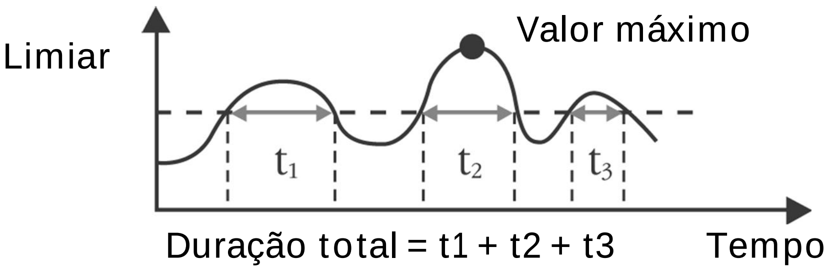
4.2.5 Registro de eventos

Descrição

A função para registro de eventos permite ao usuário registrar cada item significante (veja lista abaixo):

- valor máximo (ou mínimo)
- A duração acima (ou abaixo) do limiar.

Uma vez que o limiar foi definido (veja o exemplo abaixo), o RVT inicia a gravação dos valores máximos (ou mínimos) automaticamente como também a duração total até o usuário reiniciar a medição.



Valores registrados

A função de registro permite ao usuário registrar o tempo de duração acima do limiar que cada medição realizada apresentou para os seguintes parâmetros: Vrms [V], Irms [A], P [kW], Q [kvar], S [kVA], THDV [%], THDI [%],Q [kvar] faltante, frequência* [Hz], T1* [°C ou °F] até T8* [°C ou °F].

* Valores mínimos e durações abaixo do limiar estipulado também são gravados para frequência e temperaturas.

Figura 22: Valores gravados no registro de eventos

Exemplo

Gravação de informação do Vrms.

Tensão da rede: 400V.

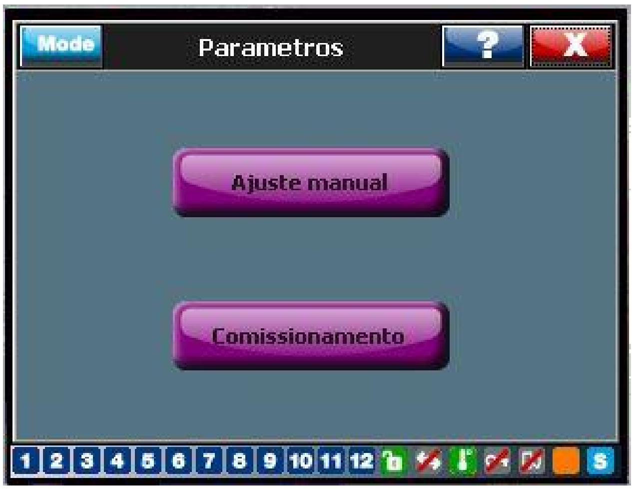
Figura 23: Configuração do limiar para registro de eventos - Vrms

Figura 24: Configuração do limiar para registro de eventos - Frequência

A informação gravada (valor máximo e duração total) pode ser removida selecionando e confirmando no botão “Reset”.

4.3 Configurações

O menu principal Configurações possui submenus multi-nível que permite ao usuário programar o controlador como também comissioná-lo e testá-lo.



4.3.1 Configurações manuais (Modo “Set”)

A configuração manual permite ao usuário acessar todo o banco, instalação, configurações do usuário e configurações das proteções/avisos. O usuário pode também restabelecer as configurações de fábrica através deste submenu.

Figura 25: Configurações manuais

Antes de realizer qualquer configuração no controlador, por favor certifique-se que o mesmo se encontra no modo “Set”. Verificar capítulo 3.2.4 e 4.3.1.1. para bloqueio/desbloqueio.

4.3.1.1 Configurações do banco

Início->Configurações->Configurações manuais->Configurações do banco

O menu de configurações do banco inclui todos os parâmetros configuráveis relacionado ao banco.

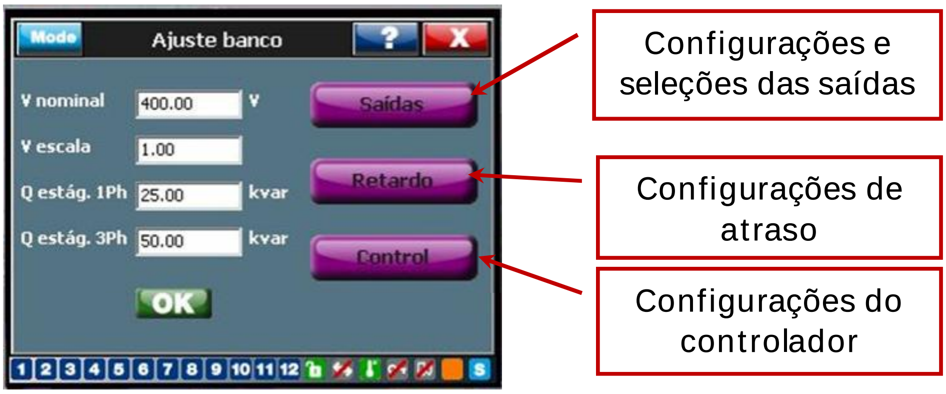


Figura 26: Configurações do banco

Em seguida mostra a lista de configurações dos parâmetros do banco

V nominal: tensão nominal do banco.

Quando a tensão nominal é selecionada, as proteções de sub-tensão e sobre-tensão são automaticamente ajustadas para 80% e 120% da tensão nominal.

Estes valores podem ser alterados manualmente.

V escala: Escala do TP externo

Exemplos: para um transformador de 15kV/100V, V escala = 150.

Se não existe nenhum transformador externo então V escala = 1.

Esta função permite que o RVT controle um banco de capacitores em média tensão. Uma tensão correta deve ser conectada nos terminais de medição do RVT. Então o RVT irá mostrar a medição em média tensão de acordo com as configurações definidas.

Q est 1fs: o menor estágio monofásico (fase-neutro) que será utilizado para correção de fator de potência individual em uma rede desbalanceada.

Q est 3fs: o menor estágio trifásico que será utilizado para uma rede balanceada.

Para ambas as configurações,

a) Após o comissionamento automático, este valor será determinado de acordo com o menor estágio no banco de capacitores.

b) Para comissionamento guiado (ver 4.2.2.2), este valor precisa ser definido manualmente.

Segue um exemplo de banco de capacitores com correção de fator de potência monofásica e trifásica:

Sequência monofásica*: 1 (5kvar) 2 (10kvar) 2 (10kvar) è Q est 1fs = 5 kvar

Sequência trifásica: 1 (10kvar) 2 (20kvar) 2 (20kvar) è Q est 3fs = 10 kvar

Ou,

Sequência trifásica: 2 (15kvar) 4 (30kvar) 5 (37.5kvar) è Q est = 7.5 kvar

*Sequência: potência reativa relative ao valor dos capacitores conectados nas saídas do RVT. Estes valores relativos podem ser entre 0 e 8.

Para ambos os modelos, básico (RVT6/RVT12) e trifásico (RVT12-3P), a sequência padrão de fábrica é 1:1:.....:1. Sequências customizadas podem ser introduzidas manualmente.l

Para customizar a sequência, navegue no menu conforme abaixo:

Início->Configurações->Configurações manuais->Configurações do banco->Saídas

A Figura 27 mostra as saídas 1 – 6; clique na flecha  , a próxima tela mostrará as saídas remanescentes 7-12 como mostrado na Figura 28.

Figura 27: RVT - Saídas 1-6

Figura 28: RVT - Saídas 7-12 (Modelo trifásico RVT12-3P)

Na direita da tela, o “Status” inclui seis atributos de cada saída:

“Desligado fixo”: esta saída está desativada (padrão de fábrica);

“Ligado fixo”: esta saída está ativada (o capacitor correspondente ficará sempre ativado);

“1FsL1, 1Fsl2, 1FsL3”: esta saída controla um capacitor conectado na fase e neutron, onde a fase é 1, 2 ou 3 respectivamente.

“3Fs”: esta saída controla um capacitor trifásico.

Para o modelo básico RVT6/RVT12, apenas as opções “Desligado fixo, ligado fixo e ativado” estão disponíveis para os status de saída. Uma saída precisa estar “Ativada” antes do controlador acionar o capacitor para Ligado ou Desligado.

Algumas configurações de saída típicas para o modelo trifásico RVT12-3P:

1° Configuração típica: 12 estágios monofásicos (fase-neutro):

Figura 29: Configuração típica para 12 capacitores monofásicos (modelo RVT12-3P)

2° Configuração típica: 6 estágios trifásicos + 6 estágios monofásicos (fase-neutro):

Figura 30: Configuração típica para 6 capacitores trifásicos + 6 monofásicos (modelo RVT12-3P)

Atraso

Clique no botão “Atraso” na tela mostrada na Figura 26, o usuário pode configurar o atraso para o acionamento dos capacitores.

Figura 31: Configurações de atraso do RVT

Atraso-Ligar:

- Em uma operação normal, é o tempo exigido para ligar um estágio após ter ligado o anterior.

- Em uma operação integral, é o tempo integral entre duas decisões de acionamento.

O atraso-ligar é necessário para permitir que o capacitor descarregue antes de acioná-lo.

Atenção: curtos atrasos podem causar danos graves no banco.

Atraso-Desligar:

- Em uma operação normal, é o tempo exigido entre desligar o próximo estágio após desligar o estágio atual.
- Em uma operação integral, o Atraso-Desligar não é utilizado.

Atraso para restabelecimento: o tempo que o RVT aguarda antes de reiniciar a operação do banco após uma queda de energia.

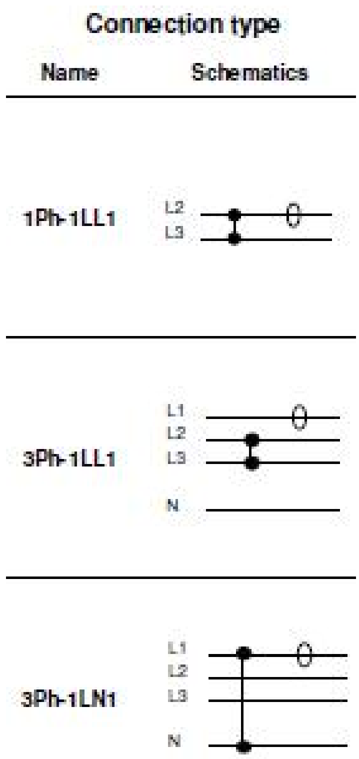
Ao clicar no botão “Controle” na tela mostrada na Figura 26, o usuário poderá determinar as medições do transformador de corrente bem como as estratégias de comutação conforme tela abaixo.

Figura 32: Configurações de controle do banco com RVT

1Fs/3Fs

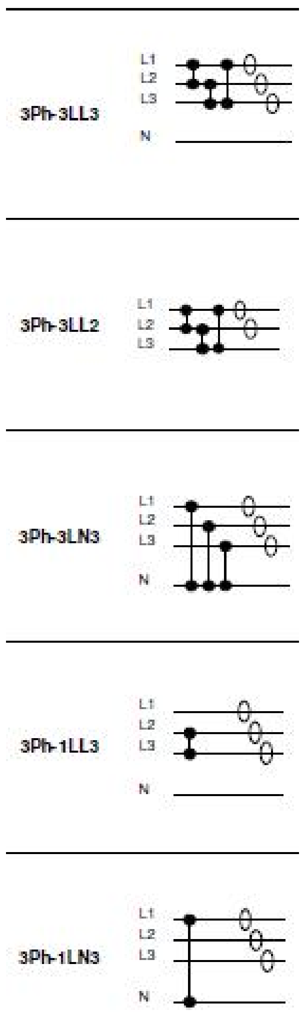
Estas configurações definem o tipo de conexão para a medição de corrente. O RVT permite até 8 tipos de conexões de TCs baseados no tipo de rede (trifásico a 3 fios, trifásico a 4 fios ou monofásico fase-fase):

Medição de corrente monofásica (disponível para ambos os modelos básicos RVT6/12 e RVT12-3P):1Fs-1LL1, 3Fs-1LL1, 3Fs-1LN1,



Medição de corrente trifásica (disponível para o modelo RVT12-3P):

3Fs-3LL3, 3Fs-3LL2 (sem conexão de neutron na instalação), 3Fs-3LN3, 3Fs-1LL3, 3Fs-1LN3.



Instruções detalhadas das conexões podem ser encontradas no A7. Ilutração dos tipos de conexão dos TCs e dos cabos do TC nos terminais do controlador na seção de apêndices no final deste manual.

Definição dos tipos de conexão acima:

3Fs – 3 LN 3

- 3 (último): 1: uma conexão de TC, 2: duas conexões de TCs, 3: três conexões de
- LN: LN: Medição do V entre L e N, LL V medição entre fases
- 3: 1: uma medição de V, 3: três medições de V
- 3Fs: 1Fs: rede monofásica (L-N ou L-L), 3Fs: rede trifásica

NOTA: L refere a Fase, N refere a Neutro

Linear / Circular (Lin./Circ. na tela)

Acionamento Linear segue o princípio "primeiro a entrar, ultimo a sair”.

Acionamento Circular segue o princípio “primeiro a entrar, primeiro a sair”.

Ambas as operações são descritas na tabela abaixo.

Acionamento circular aumenta o tempo de vida dos capacitores e contatores equilibrando a quantidade de utilização das saídas.

No caso de “duplo primeiro estágio” (1:1:2:2:..., 1:1:2:4:4.,...), a circularidade é aplicada aos dois primeiros estágios e também na saída de maior valor.

Linear

	C1	C2	C3	C4	...	C11	C12
Sequence	1	1	1	1		1	1
	■	□	□	□	...	□	□
↗	■	■	□	□	...	□	□
↗	■	■	■	□	...	□	□
↘	■	■	□	□	...	□	□
↘	■	□	□	□	...	□	□

Circular

	C1	C2	C3	C4	...	C11	C12
Sequence	1	1	1	1		1	1
	■	□	□	□	...	□	□
↗	■	■	□	□	...	□	□
↗	■	■	■	□	...	□	□
↘	□	■	■	□	...	□	□
↘	□	□	■	□	...	□	□

ì Necessidade para adicionar

î Necessidade para remover estágio

n Saída fechada

o Saída aberta

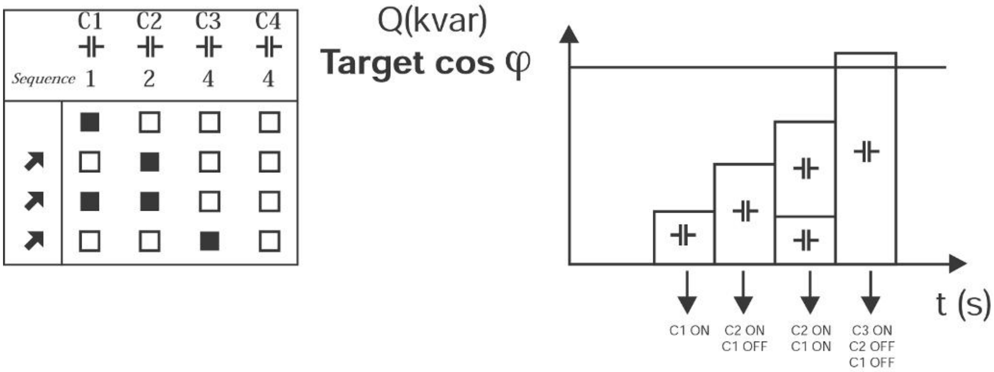
Progressivo / Direto (Prog./Direto na tela)

A operação progressiva aciona os estágios sequencialmente um por um, baseado no valor definido para o atraso-ligar.

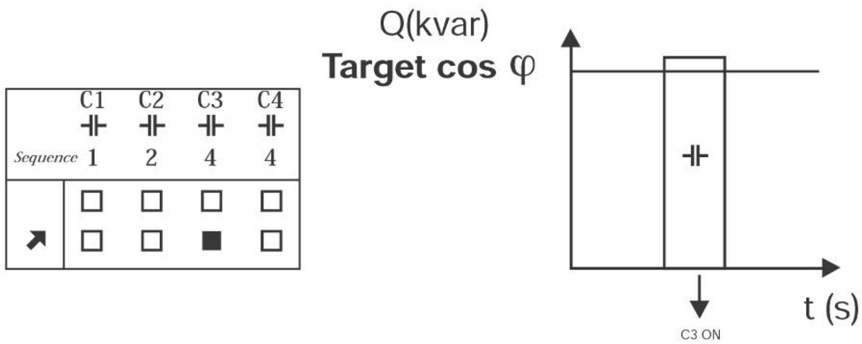
A operação direta aciona os maiores estágios primeiro e então os outros estágios com um atraso fixo de 12s, para alcançar o valor target do cos j de forma mais rápida.

O acionamento direto evita o acionamento intermediário inútil de capacitores.

Progressivo



Direto

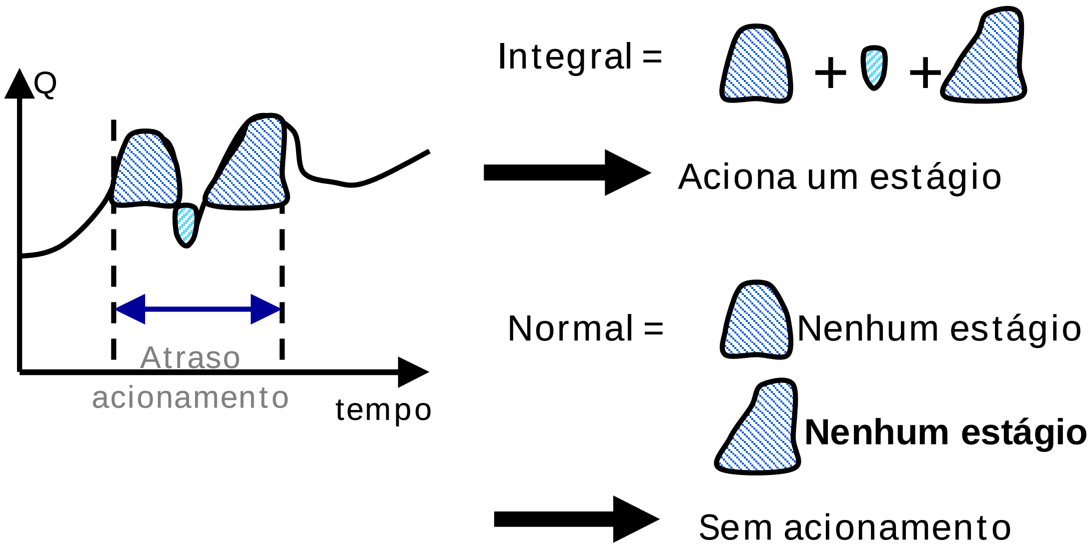


Normal / Integral (Normal/Int. on the screen)

Operação normal: aciona os estágios quando a demanda é presente durante todo o tempo de atraso determinado.

Operação integral: aciona os estágios de acordo com a média de valor médio da potência reativa solicitada.

Operação integral é muito útil para aplicações em que a carga varia rapidamente.



Proteção das configurações do banco (bloqueio via software)

As configurações do banco podem ser protegidas de acessos não autorizados ambos via software quanto via hardware. A proteção via hardware é descrita em 3.2.4. As telas a seguir ilustram como o bloqueio via software funciona. O caminho para a tela é mostrado na Figura 33:

Início â Configurações â Configurações manuais â Configurações do banco â Controle.

Figura 33: Configurações da proteção do banco: não protegido

Para bloquear as configurações selecione a caixa de diálogo “Configurações do banco desbloqueadas”, então a tela será alterada confome a Figura 34.

1. Os campos de configurações do banco ficam cinza.
2. “Configurações do banco desbloqueadas” é alterado para “Configurações do banco bloqueadas”
3. Na barra de status, o ícone de cadeado é ativado: 

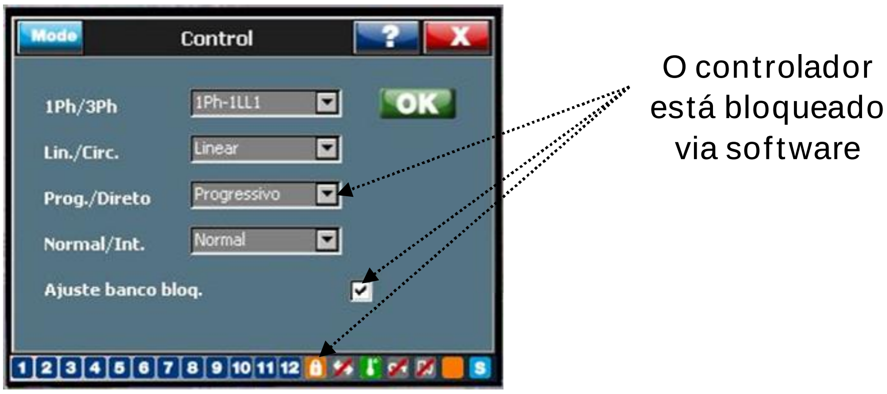


Figura 34: Configurações da proteção do banco: protegido

4.3.1.2 Configurações de instalação

Início-> Configurações-> Configurações manuais-> Configurações de instalação

As configurações de instalação do RVT fornecem instruções de como configurar os parâmetros relacionados aos TCs.

Figura 35: Configurações de instalação do RVT

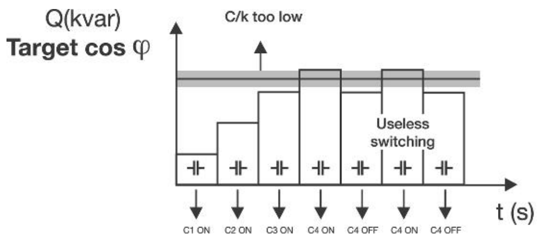
TC escala: escala do transformador de corrente.

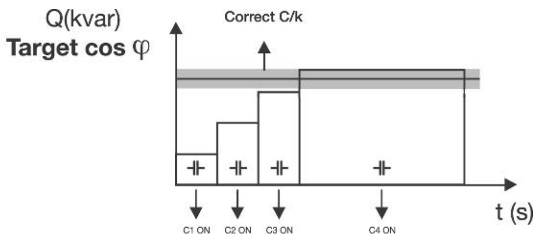
Exemplo: um TC de 250A / 5A possui escala de 50.

C/k: corrente inicial do controlador RVT. É geralmente configurado para 2/3 do valor do estágio de capacitor. (Qstep) (ver parágrafo 4.3.1.1)

Isto representa o valor do limiar de corrente para o RVT ligar ou desligar um estágio de capacitor. O C/k pode ser programado de 0.01 to 5.

O exemplo abaixo mostra o efeito de como um C/k muito baixo pode levar a um acionamento inútil de capacitores:





Um C/k muito alto irá levar a um número insuficiente de estágios sendo acionados para alcançar ocos j desejado.

A configuração recomendada do C/k pode ser calculada pela formula abaixo ou pode ser lida diretamente na tabela também abaixo.

Fórmula

Rede trifásica

$$C/k = 0.67\ x \frac{Qstep\ x\ 1000}{\sqrt{3}\ x\ Vnom\ x\ CTscaling}$$

Rede monofásica (L-L ou L-N)

$$C/k = 0.67\ x \frac{Qstep\ x\ 1000}{Vnom\ x\ CTscaling}$$

Tabela 2: Tabela do C/k para um sistema trifásico em 400V

TC escala		K	Valor do estágio do capacitor (kvar)											
			5	10	15	20	30	40	50	60	70	90	100	120
10/1	50/5	10	0.48	0.97	1.45	1.93	2.90	3.87	4.84					
20/1	100/5	20	0.24	0.48	0.73	0.97	1.45	1.93	2.42	2.90	3.38	4.35	4.84	
30/1	150/5	30	0.16	0.32	0.48	0.64	0.97	1.29	1.61	1.93	2.26	2.90	3.22	3.87
40/1	200/5	40	0.12	0.24	0.36	0.48	0.73	0.97	1.21	1.45	1.69	2.18	2.42	2.90
60/1	300/5	60	0.08	0.16	0.24	0.32	0.48	0.64	0.81	0.97	1.13	1.45	1.61	1.93
80/1	400/5	80	0.06	0.12	0.12	0.24	0.36	0.48	0.60	0.73	0.85	1.09	1.21	1.45
100/1	500/5	100	0.05	0.10	0.15	0.19	0.29	0.39	0.48	0.58	0.68	0.87	0.97	1.16
120/1	600/5	120	0.04	0.08	0.12	0.16	0.24	0.32	0.40	0.48	0.56	0.73	0.81	0.97
160/1	800/5	160	0.03	0.06	0.09	0.12	0.18	0.24	0.30	0.36	0.42	0.54	0.60	0.73
200/1	1000/5	200	0.02	0.05	0.07	0.10	0.15	0.19	0.24	0.29	0.34	0.44	0.48	0.58
300/1	1500/5	300	0.02	0.03	0.05	0.06	0.10	0.13	0.16	0.19	0.23	0.29	0.30	0.39
400/1	2000/5	400	0.01	0.02	0.04	0.05	0.07	0.10	0.12	0.15	0.17	0.22	0.23	0.29
600/1	3000/5	600	0.01	0.02	0.02	0.03	0.05	0.06	0.08	0.10	0.11	0.15	0.15	0.19

Nota:

Para o RVT12-3P, dois C/k estão disponíveis: 1 para monofásico e outro para trifásico; no RVT6/RVT12 apenas 1 C/k está disponível.

O C/k trifásico é aplicável para instalações com um , dois ou três TCs; o C/k monofásico é aplicável para instalações com 3 TCs (instalações trifásicas desbalanceadas). Considera-se que todos os TCs conectados ao RVT12-3P (2 ou 3 TCs com diferentes tipos de conexão) possuem a mesma escala. Entretanto, o estágio mínimo para cada capacitor monofásico ou trifásico podem ser diferentes, isso requer dois C/K diferentes para o RVT.

Diferença de fase (aplicável somente ao modelo básico): a diferença de fase entre tensão e corrente lida pelas conexões de medições.

Se o RVT estiver conectado conforme o diagram descrito no capítulo 2.4, o valor da diferença de fase é de 90° (configuração padrão).

Para outro tipo de conexão, a diferença de fase a ser inserida pode ser selecionada nas tabelas presentes no apêndice A6.

O RVT detecta automaticamente a fase correta no comissionamento automático.

4.3.1.3 Configurações do usuário

Início-> Configurações-> Configurações manuais-> Configurações do usuário

As configurações do usuário permitem ao usuário definir diferentes alvos para fator de potência e atraso de alarmes.

Figura 36: RVT – Configurações do usuário

Cos j alvo: fator de potência alvo.

O fator de potência alvo pode ser determinado entre 0.70 indutivo e 0.70 capacitivo.

indica um cos j indutivo e indica um cos j capacitivo.

Cos j noturno: fator de potência alternative (desativado como padrão de fábrica).

A troca entre o cos j alvo e o cos j alternativo é realizada a partir de um sinal externo aplicado na entrada digital IN 1+/- (descrito no capítulo 2.4).

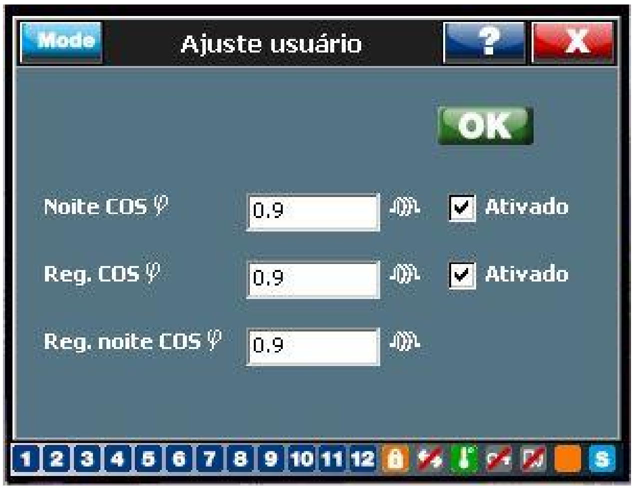


Figura 37: RVT – Configurações do usuário: ativar fator de potência alternativo

Reg. cos **j** : fator de potência alternativo. Ativado quando o fluxo de energia está invertido: P < 0 (desativado como padrão).

Alarme: Os parâmetros do relé de alarme podem ser definidos para a condição de alarme para cos j :
A condição de alarme para o cos j é alcançada quando: todos os estágios de capacitores estão ligados e o cos j está abaixo do limite definido.

- Atraso do alarme: atraso no fechamento do relé de alarme do cos j .
- Atraso reset alarme: atraso na abertura do relé após a condição de alarme desaparecer.
- Alarme cos **j** : valor limite

4.3.1.4 Proteções e avisos

Início-> Configurações-> Configurações manuais-> prot&aviso

O RVT irá ativar certas ações quando algum valor do sistema exceder os limites pré-estabelecidos. O nível de Proteção é maior que os de Aviso.

Figura 38: Configurações de Proteção e Aviso do RVT

4.3.1.4.1 Proteções

Figura 39: Configurações de Proteção do RVT

Níveis de Proteção: definir os níveis de proteção contra subtensão, sobretensão, harmônicas proibidas, Trms máxima; também permite proteção externa através da entrada 2 opto-isolada. O relé de alarme possui 1 contato NA e um 1 contato NF.

Uma vez que o nível de proteção é alcançado, as ações abaixo ocorrem:

- Todos os estágios de capacitores são desligados
- Uma mensagem de alarme aparece no display
- relé de alarme é ativado (NA abre / NF fecha)
- ícone  é realçado.

Nota: se o sinal externo IN2 (descrito no capítulo 2.4) é ativado, todos os estágios de capacitores serão desativados e os parâmetros de proteção conduzem o comportamento do relé de alarme:

- Desconexão e alarme
- Desconexão (sem alarme)

Após o evento desaparecer, o RVT irá reiniciar sua operação normalmente após um atraso definido. Este atraso depende dos tipos de eventos. O procedimento de reinício do RVT após alarme é descrito em detalhes no Apêndice A4

Nota: quandoa tivado, a proteção externa (Prot.Ext.) pode ser ativada aplicando um sinal externo através da entrada digital 2 (ver capítulo 1.4).

4.3.1.4.2 Avisos

Os níveis de Avisos são no geral abaixo dos níveis de Proteção. Quando um nível de aviso é alcançado as ações abaixo ocorrem:

- relé de alarme é ativado: o contato NA irá fechar.

- ícone  será realçado

Figura 40: Configurações de Avisos do RVT

4.3.1.4.3Proteções de temperatura

O RVT proporciona a leitura da temperatura do banco através de 8 sondas de temperatura. O nível de proteção de cada sonda de temperatura pode ser configurado individualmente. Quando o nível de proteção de alguma das 8 sondas é alcançado:

- Todos os estágios de capacitores são desligados
- Uma mensagem de alarme aparece no display
- O relé de alarme é ativado (NA abre / NF fecha)
- Os ícones  e  são realçados

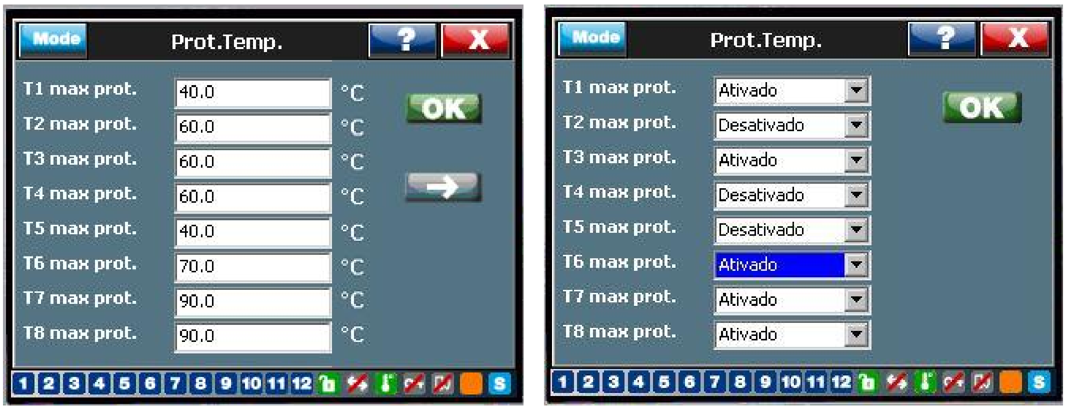


Figura 41: Configurações da proteção de temperature do RVT

4.3.1.4.4Avisos de temperatura

O RVT proporciona a leitura da temperatura do banco através de 8 sondas de temperatura. O nível de aviso de cada sonda de temperatura pode ser configurado individualmente. Quando o nível de aviso de alguma das 8 sondas é alcançado:

- O relé de alarme sera ativado: o contato NA irá fechar

- ícone  será realçado

Figura 42: Configurações de aviso de temperatura

Nota 1: O RVT é auto protegido contra temperaturas internas altas de até 85°C. As ações descritas acima irão ocorrer quando a temperatura interna exceder este nível de proteção.

O RVT irá reiniciar automaticamente quando a temperatura interna voltar para abaixo de 80°C.

Nota 2: O nível de proteção de temperatura estará desativado como padrão. Quando um nível é determinado, o RVT checa uma das oito sondas conectadas.

4.3.1.5 Restaurar configurações padrão

Início->Configurações->Configurações Manuais->Restaurar config padrão

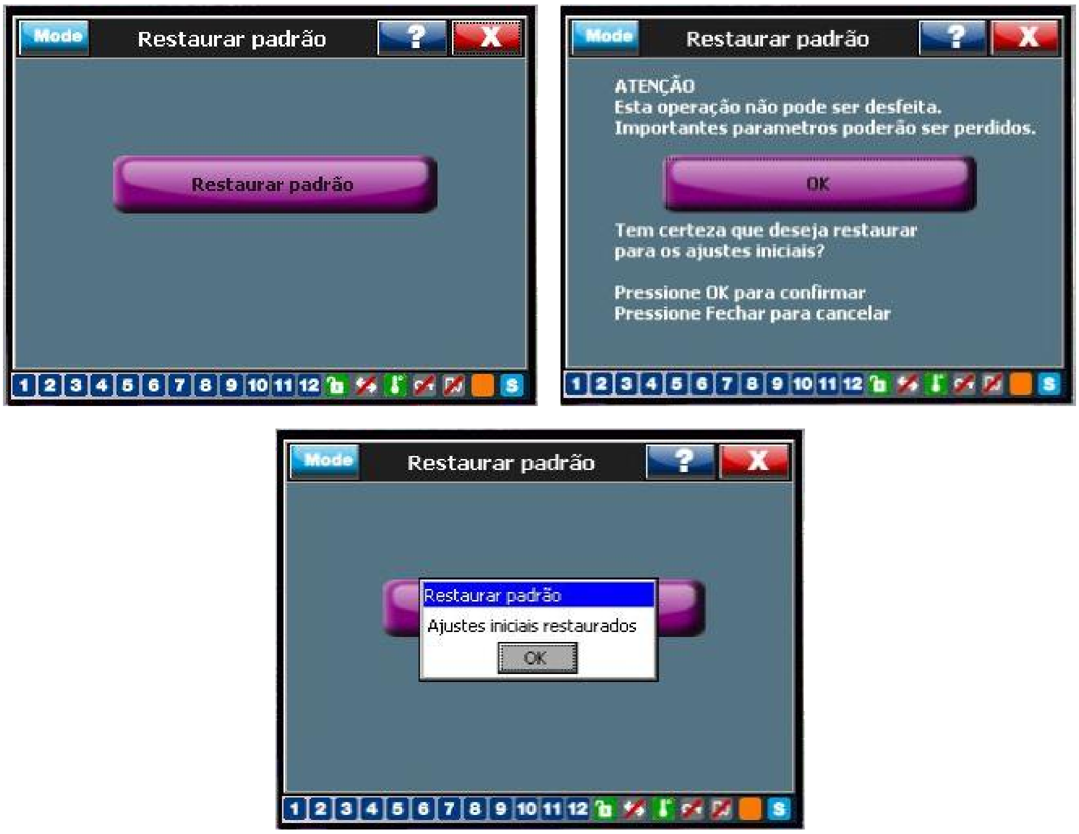


Figura 43: Restaurar configurações padrão do RVT

Ao selecionar e validar a opção “Restaurar config padrão”, todos os valores dos parâmetros do RVT serão alterados para seus valores padrão (ver documento que acompanha o RVT), exceto se as configurações de banco estão bloqueadas, neste caso as configurações do banco não são alteradas.

Aviso: parâmetros importantes podem ser perdidos.

Comentário: antes de restaurar as configurações de fábrica verifique se:

- RVT está desbloqueado (capítulos 3.2.4 e 4.3.1.1)
- RVT está no modo Configuração (capítulo 3.2.2.)

4.3.2 Comissionamento (Modo Configuração)

Este sub-menu permite ao usuário realizar um comissionamento automático completo ou um comissionamento guiado pelo controlador.

Figura 44: Comissionamento do RVT

4.3.2.1 Comissionamento automático

Verificar capítulo 3.4 para mais detalhes.

4.3.2.2 Comissionamento guiado

O RVT realiza um comissionamento guiado. Os parâmetros a seguir precisarão ser inseridos.

Nota:

Antes de realizer um comissionamento guiado, tenha certeza de que:

1. RVT está desbloqueado (capítulos 3.2.4 e 4.3.1.1)
2. RVT está no modo Configuração(capítulo 3.2.2.)
3. Se você realizou um curto circuito no secundário dos TCs não esqueça de abrí-lo após conectar a medição de corrente no controlador RVT.

Comissionamento guiado (parâmettros para inserir)

Parâmetro	Descrição
1Fs / 3Fs	Tipo de conexão das medições do banco
Rot. de Fase	Checar rotação de fase
TC escala	Relação do TC
TC direção	Redireciona a entrada do TC em caso dos TCs serem colocados em fase errada
Mudança de fase	Mudança de fase entre tensão e corrente retirada a partir dos pontos de medição. A fase é d e90° (config padrão) quando o RVT estiver conectado conforme mostrado no diagram (ver capítulo 2.4). Para outras conexões ver Apêndice A5.
V escala	Relação do transformador externo.
V nom	Tensão nominal do banco.
ON-Delay	Atraso-Ligar.

OFF-Delay	Atraso-Desligar.
Sequência	Valor da potência reativa relative de cada saída.
Q estag	Menor diferença de potência reativa entre os estágios.
C/k	Definir a corrente inicial
Cos j alvo	Fator de potência alvo.

4.3.2.3 Comissionamento das sondas

O RVT pode conectar até 8 sondas de temperatura em série. Cada sonsa precisa ser comissionada conforme procedimentos antes de ser utilizada.

Cada sonda precisa ser reconhecida uma a uma:

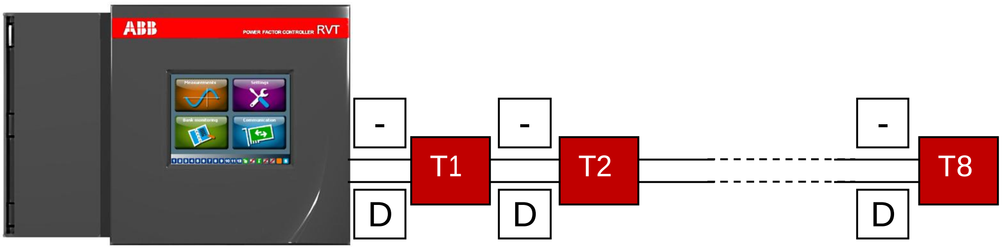
- Conecte a sonda na entrada de sondas (apenas uma)
- Clique na coluna para indicar um número para a sonda
- Clique no botão “Início”
- RVT reconhece o endereço da sonda automaticamente
- Reinicie o mesmo procedimento para cada sonda

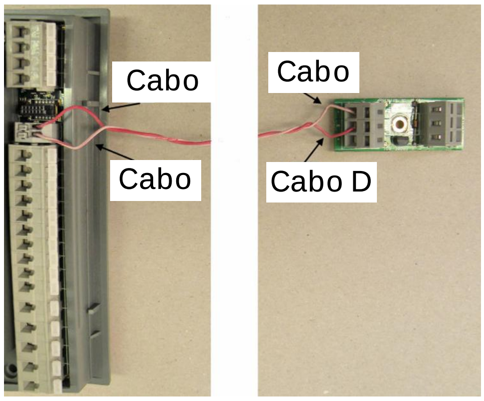
Quando uma das sondas apresentam um problema, pode ser rapidamente liberado clicando no botão “liberar”

Um endereço único sera definido para cada sonda assim que o processo de reconhecimento estiver finalizado.

Figura 45: Reconhecimento automático da sonda de temperatura

- Conectar cada sonda sucessivamente:





4.4 Monitoramento do banco

O monitoramento do banco via RVT fornece ao usuário acesso para diagnosticar, registro de alarmes, função teste e um relógio com horário real (apenas o modelo trifásico RVT12-3P possui o relógio de com horário real).

Isto o torna uma ferramenta de análise muito útil.

Figura 46:Monitoramento do banco

4.4.1 Diagnóstico

Lista o número de manobras que cada saída de relé de capacitor realizou desde que o RVT foi fabricado.

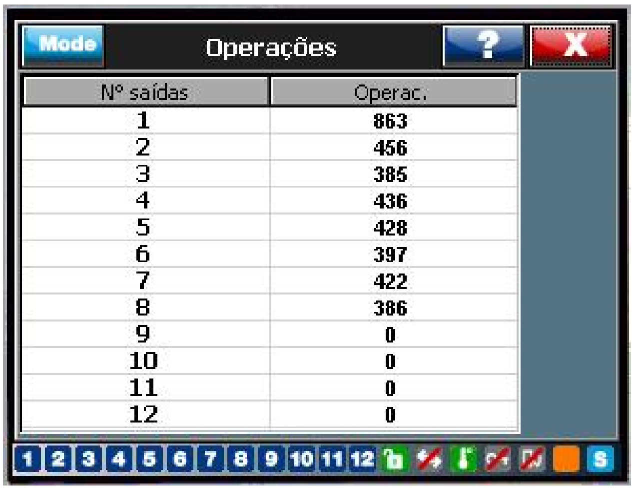


Figura 47: Diagnósticos

4.4.2 Função Teste

Este submenu permite ao usuário testar cada relé do RVT.

Teste alarm: permite testar o relé de alarme

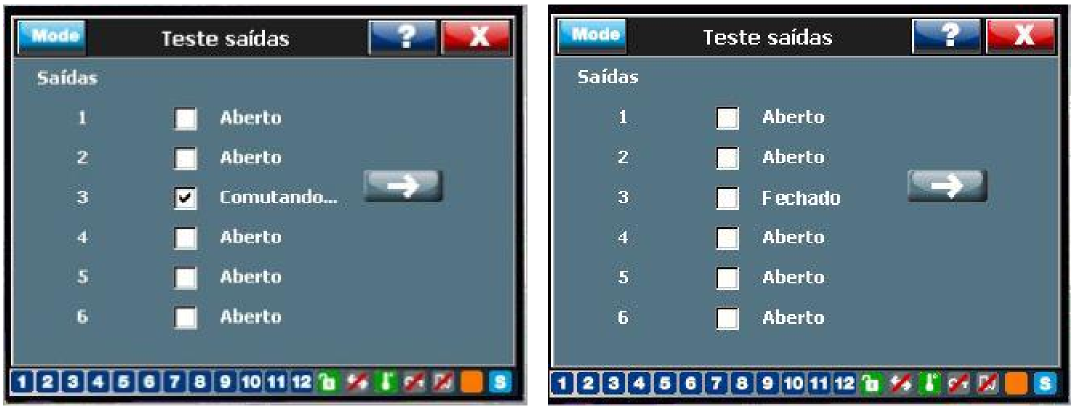
Teste aviso: permite testar o relé de aviso

Teste saídas: permite testar cada saída dos relés de capacitores (o RVT irá considerar os atrasos programados)

Figura 48: Função teste

Figura 49: Testes das saídas

Clique no check box para selecionar Ligar/Desligar para o relé correspondente



Antes de proceder com a função de teste, certifique-se de que:

- O RVT está desbloqueado (capítulos 3.2.4 e 4.3.1.1)
- O RVT está no modo Configurações (capítulo 3.2.2.)

4.4.3 Registro de Alarme

O registro de alarme mostra os 5 últimos alarmes com o horário real do evento.

Figura 50: Registro de Alarmes do RVT

4.4.4 Relógio com horário real

Figura 51: Horário real do RVT

O horário do RVT continua a funcionar mesmo quando ele não está conectado na enrgia.

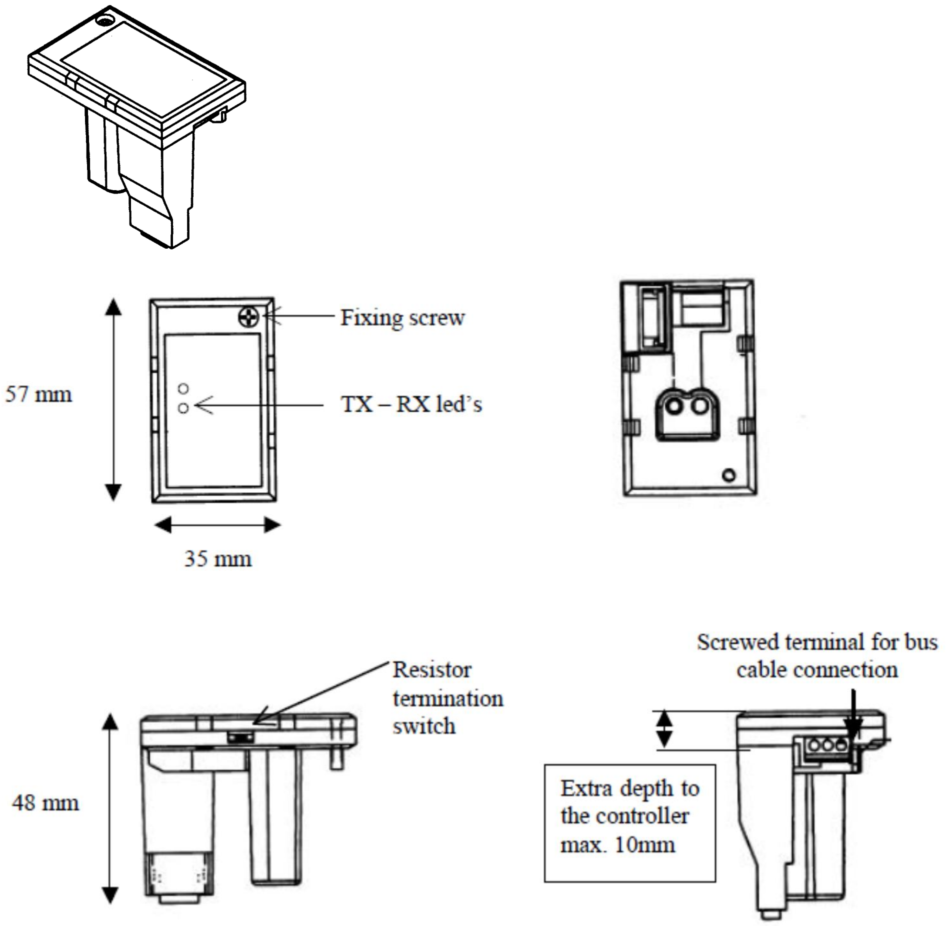
4.5 Comunicações

O RVT fornece uma variedade de métodos de comunicação. No menu principal temos configuração de idioma, configuração de temperatura, configuração da tela, configurações para Ethernet e Modbus. Mais informações sobre Modbus, USB, TCP/IP e programação, verificar o manual: 2GCS213013A0050_RVT comunicação via Modbus, USB ou protocolo TCP/IP.

RS485 / Adaptador Modbus

O adaptador Modbus é um acessório para o RVT que permite a conexão do RVT a um sistema RS485-Modbus. O controlador é considerado como um slave em uma rede Modbus.

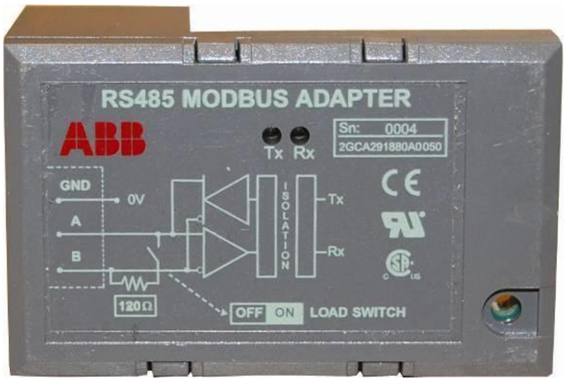
Analise o guia do usuário 2GCS214013A0050-RVT Modbus RS485 adapter para maiores informações.



Atenção: o adaptador RS485 é o que possui um texto VERDE (3.3V de alimentação).

O modelo com texto em BRANCO é o modelo antigo (5V de alimentação).

Isto significa: o nome adaptador Modbus não é compatível com o RVT antigo; e o adaptador Modbus antigo não pode ser utilizado no RVT novo (RVT touchscreen).

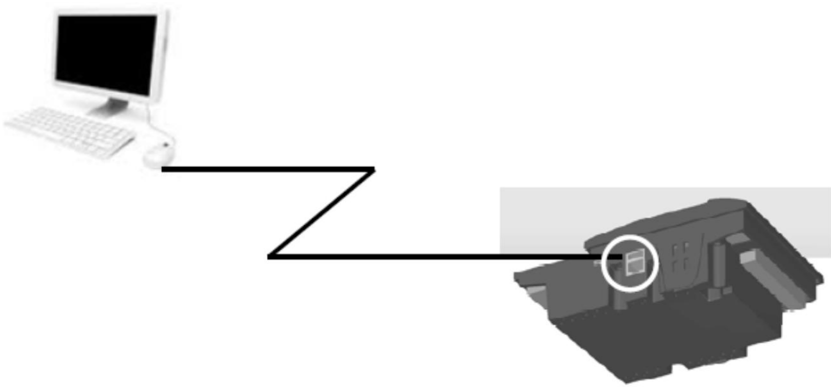


Ethernet / TCP/IP

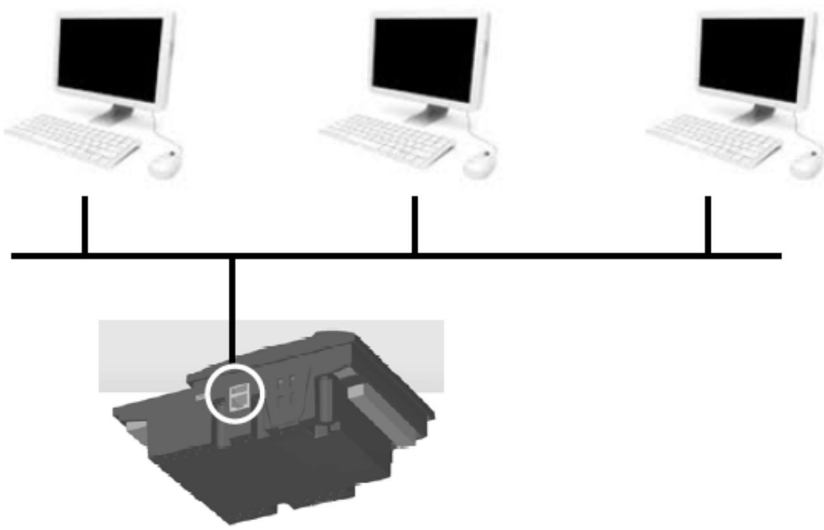
As conexões TCP/IP podem ser iniciadas localmente ou remotamente.

A porta TCP utilizada como padrão é a 4250.

A conexão ao RVT é feita com um cabo Ethernet RJ45.

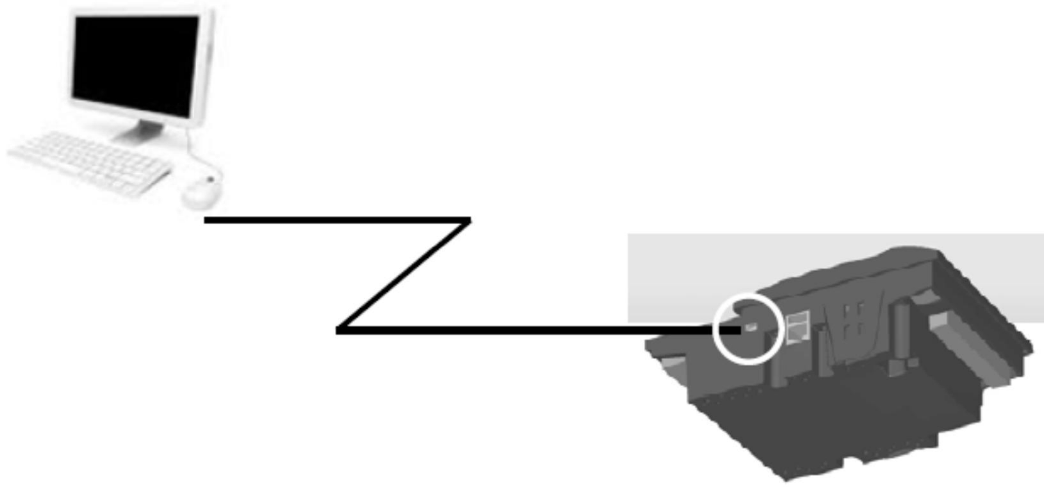


O RVT pode ser conectado diretamente em uma LAN ou através da Internet.

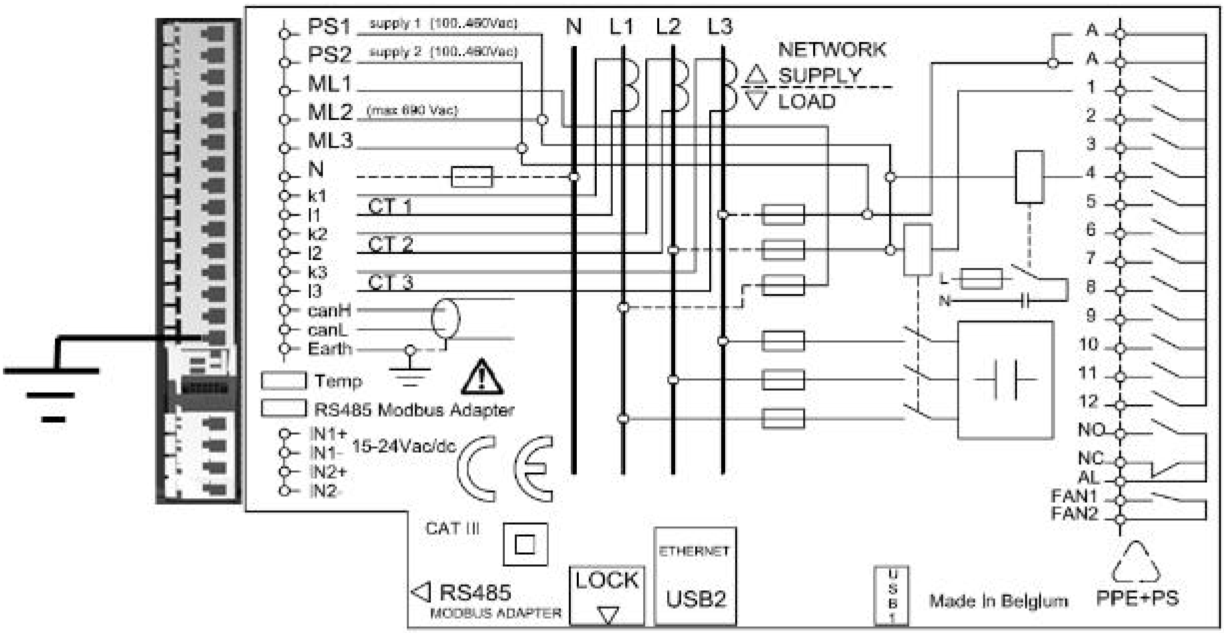


USB

O computador é conectado através do USB-A macho para o USB-Mini B macho.



Atenção: A conexão USB do RVT não é isolada. É obrigatório conectar o Terra quando utilizer conexão USB.



4.5.1 Configurações I/O

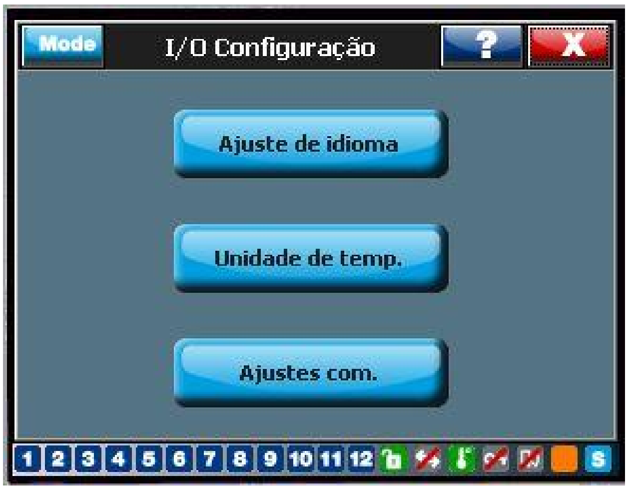


Figura 52:Configuração I/O

4.5.1.1 Definição de Idioma

Seis idiomas diferentes podem ser selecionados para o RVT.

O usuário deverá retornar ao menu principal para alteração ser ativada.

Figura 53: Definição de idio,a

4.5.1.2 Unidade de temperatura

Este menu permite a escolha de duas unidades de medição: Celsius and Fahrenheit.

A unidade selecionada será aplicada para todas as outras medições e configurações.

4.5.1.3 Configurações de comunicação

Conexões Modbus e ethernet devem ser configuradas para serem executadas corretamente.

Figura 54: RVT communications protocol setting

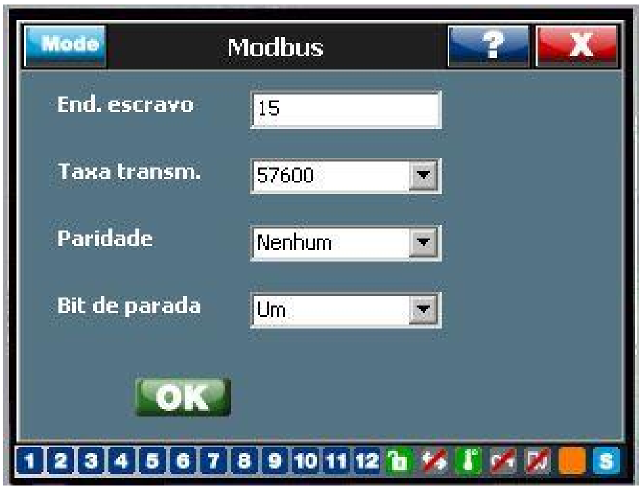


Figura 55: Configurações do protocol Modbus

O endereço escravo é o utilizado pelo Modbus mestre para endereçar o RVT através da rede Modbus.

Taxa de transmissão, Paridade, Bit de parada deve coincidir exatamente com as configurações de comunicação do mestre Modbus que controla o adaptador de rede RS485 / Modbus.

O RVT precisa de um endereço IP para se conectar diretamente a um PC ou rede Ethernet.

Este endereço de IP pode ser fixo e digitado manualmente se o DHCP estiver desabilitado. O endereço padrão é 192.168.1.40.

No caso de um IP automático dado pelo roteador ou rede Ethernet, deixe o DHCP ativado.

Alguns exemplos são dados abaixo:

Examplo 1 : A tela abaixo apresenta as configurações padrão para conexão direta com um PC (note que o PC precisa ser configurado com o IP fixo 192.168.1.1, máscara de subrede 255.255.255.0 , DHCP desabilitado)

Figura 56: Configurações de protocolo TCP/IP

Examplo 2 : A tela abaixo mostra as configurações padrão para conectar o RVT em uma rede Ethernet (note que o PC que também estiver conectado na LAN tem que possuir seu próprio endereço IP dado pela rede com o DHCP ativado).

Detalhes sobre configurações de comunicação podem ser encontrados no manual: 2GCS213013A0050_RVT comunicação através de Modbus, USB ou protocolo TCP/IP.

Reinicie o RVT para que os parâmetros sejam considerados.

4.5.2 Configurações ethernet

Este menu apresenta o atual endereço IP, máscara de subrede e gateway estático.

Dependendo do estado DHCP , a data apresentada pode ser diferentes.

A tela abaixo mostra o resultado para os exemplos 1 e 2 supra citados:

Examplo 1 : A tela mostra o endereço de IP fixo com o DHCP desabilitado.

Examplo 2 : A tela abaixo mostra as configurações atuais de IP automático com o DHCP habilitado.

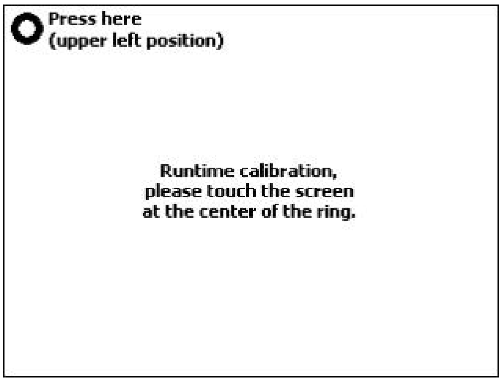
4.5.3 Configuração da tela

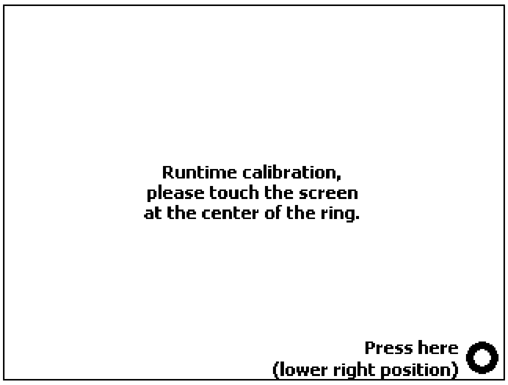
Este menu auxilia o usuário a ajustar as coordenadas XY do touch screen e o brilho da tela.

A calibração do touch screen não é normalmente necessária para utilizações naturais e condições de ambiente padrão.

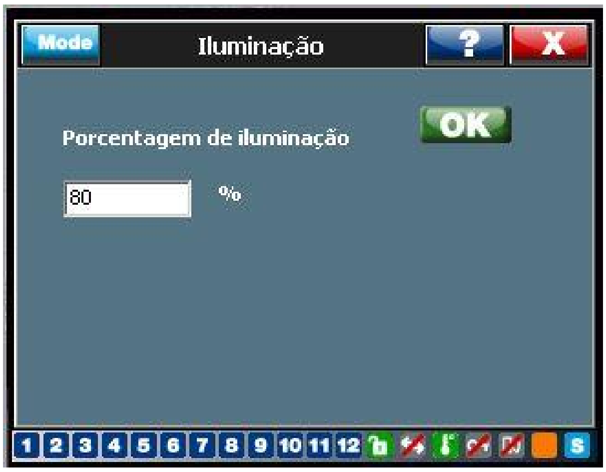
Para previnir danos na interface touch screen, existe a possibilidade do usuário calibrar as coordenadas XY necessárias para detectar a ativação dos botões.

Atenção: A calibração do touch screen deve ser feita cuidadosamente com uma caneta ou *stylus* para marcar de forma precisa os pontos de calibração.





O menu de ajuste do brilho define a intensidade padrão do brilho quando o touch screen é utilizado. Após 10 minutos de inatividade no touch screen a intensidade do brilho reduz para 10%.

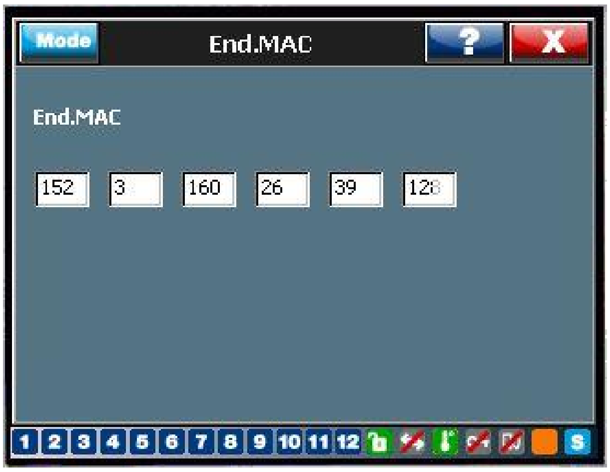


4.5.4 Sobre

Este menu apresenta a versão do software do RVT, o número de série, código do item e modelo do controlador.

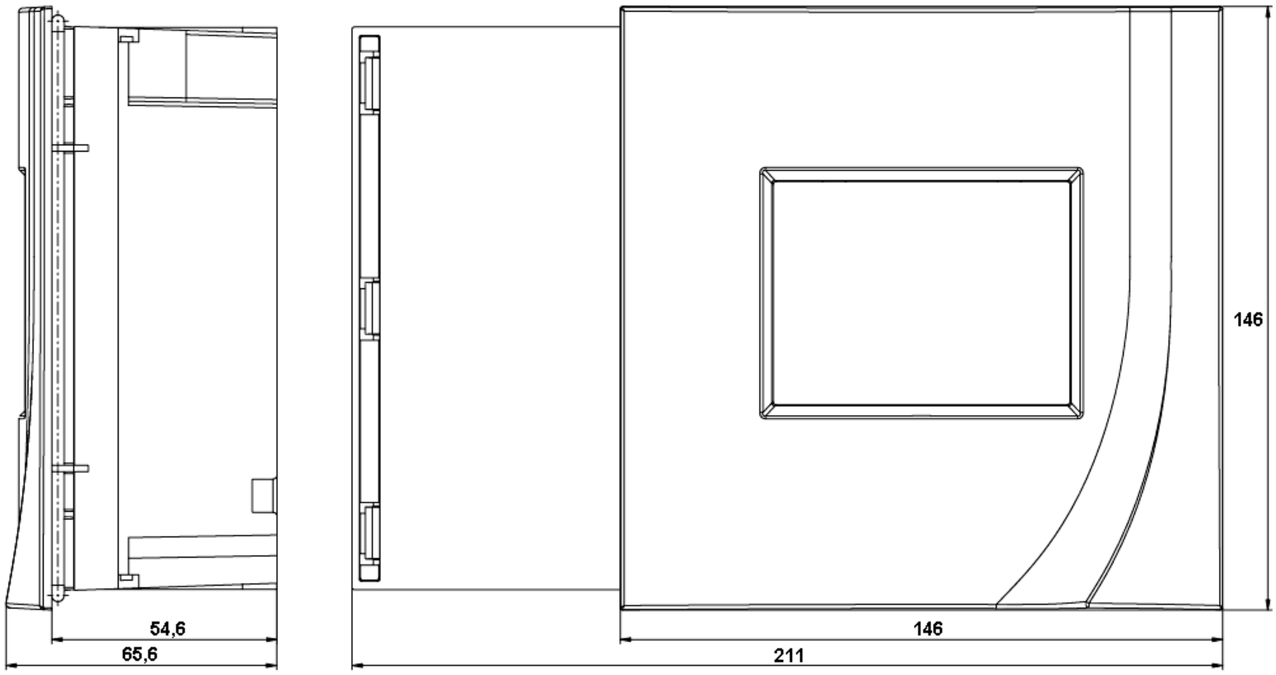
4.5.5 Endereço MAC

Este menu apresenta o endereço MAC físico.



Apêndices

A1. Dimensões



A2. Especificações técnicas

Modelos de RVT:

Característica	RVT 6 / RVT 12	RVT 12-3P
1 / 3 medições de fases	1 entrada de medição de tensão 1 entrada de medição de corrente	3 entradas de medição de tensão 3 entradas de medição de corrente
Horário em tempo real	Não	Sim
Medição de energias	Não	Sim
Conexão ethernet	Não	Sim
Conexão USB host	Não	Sim
Conexão de dispositivo USB	Sim	Sim
Entradas digitais	Sim	Sim
Relés de Alarme / Ventilador	Sim	Sim
Relés de saída	6 ou 12	12
Botão de bloqueio	Sim	Sim
Conexão RS485 Modbus	Sim	Sim
Sondas externas para medição de temperatura	Sim	Sim

Sistema de medição:

Sistema microprocessado para rede trifásica balanceada e desbalanceada. Controlador de fator de potência trifásico disponível.

Tensão de alimentação:

100Vca até 460Vca.

Consumo:

15 VA max.

Tipo de conexão:

Fase-fase ou fase-neutro para redes balanceadas e desbalanceadas

Tolerância de tensão:

± 10% da tensão indicada.

Categoria de medição (according IEC 61010-1) :

CAT III

Medição de tensão:

Até 690Vca ou mais com um transformador de tensão.

Precisão: 1% escala cheia

Frequência:

45 a 65 Hz (ajusta-se automaticamente à frequência da rede).

Entrada de corrente:

5A ou 1A (RMS) (classe1 C.T.).

Impedância de corrente de entrada:

< 0.1 Ohm.

Desligamento em queda de energia:

Desligamento automático de todos os capacitores em caso de queda de energia maior que 20ms.

Número de saídas:

RVT6/RVT12 Modelo básico: 6 ou 12 saídas programáveis

RVT12-3P Modelo trifásico: 12 saídas programáveis

Capacidade do contato de saída:

- Máx. corrente constante: 1.5A (ca) – 0.3A (110V cc).
- Máx. corrente de pico: 8A
- Máx. tensão: 440 Vca.
- Terminal A-A são projetados para uma corrente constant de até 18A (9A/terminal).

Capacidade do contato de alarme (contato livre de tensão)

- 1 NA + 1 NF
- Máx corrente constant: 1.5A (ca).
- Tensão operacional: 250Vca (max. tensão: 440Vac).

Capacidade do contato do ventilador: (contato livre de tensão)

- 1 NA
- Máx corrente constant: 1.5A (ca).
- Tensão operacional: 250Vca (max. tensão: 440Vac).

Configuração do fator de potência:

De 0.7 indutivo a 0.7 capacitivo.

Configuração da sensibilidade de corrente (C/k):

- 0.01 to 5A.
- Medição automática do C/k.

Sequências de estágios:

1:1:1:1:1:..:1 - 1:2:2:2:2:..:2 - 1:2:4:4:4:..:4

1:2:4:8:8:..:8 - 1:1:2:2:2:..:2 - 1:1:2:4:4:..:4

1:1:2:4:8:..:8 - 1:2:3:3:3:..:3 - 1:2:3:6:6:..:6

1:1:2:3:3:..:3 - 1:1:2:3:6:..:6

E qualquer outra sequência programada pelo usuário.

Conexão 10/100 Ethernet

Conexão a um PC ou LAN através de protocolo TCP/IP.

Isolação electric entre o RVT e o sinal RJ45: 1500Vrms

Taxa de transmissão Modbus:

300 - 600 - 1200 - 2400 - 4800 - 9600 - 19200 - 38400 – 57600 bps

Conexão CAN:

Suporte a interface Can 2.0B (para uso futuro)

Conexão USB host:

(para uso futuro)

Conexão de dispositivo USB

Conexão das sondas de temperatura

Apenas 2 contatos utilizando o protocol 1-wire

- Modo de fornecimento parasita (sem necessidade de alimentação externa)
- Ligação de mais nós em uma rede em cadeia

- Conexão de 8 sondas de temperatura
- Distância máxima de 8 metros entre o RVT e sondas a entre as sondas
- Máximo 64 metros de comprimento
- Medição de temperaturas de -55°C a 125°C (-67°F to +257°F)
- Precisão de +/-0.5°C de -10°C a +85°C
- Montagem em trilho DIN
- Conexão ao RVT utilizando 2 cabos, par trançado CAT-1

Tipo de configuração:

Auto, fixo, desabilitado.

Display:

QVGA 320 x 240 pixels, colorido, touch-screen.

Brilho de tela ajustável

Seccionamento entre estágios:

Programável de 1s a 18h.

Função salvar:

Todos os parâmetros programados são salvos em memória não volátil.

Auto ajuste à conexão e rotação de fase da rede.

Auto ajuste à conexão dos terminais do TC.

A operação de correção de fator de potência não é afetada pela presença de harmônicas.

Trabalhando com cargas passivas e regenerativas (operação nos 4 quadrantes).

Temperatura de operação:

-20° C to 70° C.

Temperatura de armazenagem:

- 30° C to 85° C.

Posição de montagem:

Montagem na posição vertical

Dimensões:

Frontal: 146 x 146 mm (LxA)

Traseira: 205 x 135 mm

Dimensões gerais: 146 x 211 x 67 mm (LxAxP)

Dimensões do recorte: 138 x 138 mm (LxA)

Peso:

650g

Conector:

Tipo grampo (2.5mm² - cabos de núcleo único).

Front plate protection:

IP 43 (IP 54 sob consulta).

Humidade relativa:

Máximo 95%; sem-condensação.

Marcação CE.

A3. Testes e solução de problemas

Testes

Após a instalação e programação do parâmetros de seccionamento do banco de capacitores automático, os testes abaixo podem ser realizados de acordo com a situação da carga.

A. Sem carga ou cos j = 1 ou carga capacitiva (configure cos j para 0.95 ind.)

1. Selecione modo manual.
2. Adicione dois ou mais estágios.
3. Selecione modo automático.

Todos os estágios de capacitores devem ser desligados conforme tempo de atraso entre cada operação de seccionamento.

Se todos os estágios não desligaram, checar:

- Uma carga indutiva foi conectada?
- Os valores de C/k e dos estágios foram configurados corretamente?

(é recomendável que o C/k inserido seja levemente maior do que o calculado)

B. Carga indutiva

1. Configure para cos j =1
2. Selecione modo automático.

Os capacitores agora irão automaticamente ligar para compensar a carga indutiva (o controlador não irá acionar nenhum estágio caso a corrente indutiva seja menor do que o C/k configurado. Neste caso teste conforme o item A acima).

Se todos os estágios ligarem e ainda for necessário demanda para estágios adicionais, verifique a configuração do C/k.

Se estiver correto, então o banco é muito pequeno para compensar de forma a alcançar cos j = 1. Configure um valor mais baixo de cos j .

Quando um estágio repetidamente liga e desliga, significa que o C/k está muito baixo (a menos que a carga atual lute periodicamente em um período de tempo próximo ao atraso de seccionamento do capacitor).

Solução de problemas

Falhas	Ações recomendadas
O controlador está conectado mas não funciona (nada no display)	Checar a tensão de alimentação e o fusível de proteção.
O controlador não secciona os estágios mesmo com a carga indutiva variando consideravelmente.	Checar se o controlador está no modo automatic. Checar a configuração de fase e do C/k. Checar se a ponte de curto-circuito do TC foi removida.
O controlador não parece ativar nenhum estágio.	Aguarde pelo tempo de atraso de ligar e/ou o ataso devido a queda de energia.
O fator de potência determinado não está sendo alcançado.	Com baixa ou sem nenhuma carga, um fator de potência baixo pode corresponder a uma corrente indutiva baixa. O estágios de capacitores disponíveis são muito altos para compensação. Se a média do cos j durante este período é muito baixa, o cos j deve ser reconfigurado.
Todos os capacitores estão ligados mesmo que a potência reativa solicitada seja baixa.	Checar a configuração de fase e do C/k.

Após o comissionamento automático parar e o display do controlador mostrar as seguintes mensagens:

Mensagens durante um comissionamento automático	Ações recomendadas
Rotação de fase está incorreta. As fases L2 e L3 serão internamente invertidas. Pressione OK para validar Phase rotation was detected to be wrong. L2 and L3 phases will be internally inverted. Press OK to validate.	Pressione OK
Erro: próximo estágio muito pequeno	Adapte o estágio do capacitor ou a relação do TC
Erro: TC não está lendo nenhuma corrente	Checar se a ponte de curto-circuito do TC foi removida, se as conexões dos TCs foram feitas corretamente e reinicie o comissionamento automático.
Erro: carga alterando muito rapidamente	Reinicie o comissionamento automatic sob condições mais estáveis ou configure os parâmetros manualmente.
Erro: Dispersão de fase muito alta nas entradas “X”, “Y”, “Z”	Para cada TC de entrada e para cada saída, o reconhecimento de fase pe realizado e a dispersão de fase é checada. Checar a conexão dos capacitores e conectores. Chcar a corrente de cada fase do capacitor.
Erro: Pelo menos dois TCs de entrada estão coletando sinal da mesma fase.	Checar instalação dos TCs

Erro: Sem corrente significante de entrada “X”, “Y”, “Z”	Checar se a ponte de curto-circuito do TC foi removida , se as conexões dos TCs estão corretas e reiniciar o comissionamento automático.
Erro: Mudança de fase inconsistente	Checar conexão e instalação dos TCs. Checar conexões dos contatores e capacitores. Checar a corrente de cada fase do capacitor.
Erro: Estágio desbalanceado ou a relação do TC é diferente nas linhas para saídas ‘A’ ‘B’ ‘C’ ‘D’…	Checar se as relações dos TCs são iguais. Checar a conexão dos capacitores e conectores. Chcar a corrente de cada fase do capacitor.
Erro: Diferença de estágio muito grande	Checar sequência e energia reativa por saída.

A4. Procedimento para reinício pós alarme

Uma vez que o nível de proteção é alcançado (ver capítulo 4.3.1.4.1) ou quando a temperature interna é maior que 85°C:

- Todos os capacitores são desligados.
- Uma mensagem de alarme aparece no display LCD.
- relé de alarme abre.

Quando a condição de alarme desaparece, o RVT irá reiniciar automaticamente.

O procedimento de reinício dependerá do tipo de evento que causou o alarme, conforme indicado na tabela abaixo:

Evento que ocorreu	Comportamento de reinício do RVT
Urms < Umin prot	- Abre o relé de alarme imediatamente - Inicia o comportamento normal após o Atraso-Ligar (*)
Queda de tensão	- Inicia o comportamento normal após o Atraso-Desligar (*)
Urms > U max prot.	- Abre o relé de alarme imediatament. - Inicia o comportamento normal após o Atraso-Ligar (*)
Temp interna > 85°C	- Evento será considerado como desaparecido quando Temp interna < 80°C - Abre o relé de alarme imediatamente - Inicia o comportamento normal após o Atraso-Ligar (*)
Uma das 8 sondas de temp > max nível prot	- Abre o relé de alarme imediatamente - Inicia o comportamento normal após o Atraso-Ligar (*)
THDV > THDV prot max.	- Abre o relé de alarme imediatamente - Resumes normal behavior after a time equal to ON-Delay(*). Proteção anti-hunting: Se o mesmo evento ocorrer em menos de 1 hora, o RVT irá reiniciar a operação normal após 2 x Atraso-Ligar

	Se o mesmo evento ocorrer novamente em menos de 1 hora o RVT irá reiniciar a operação normal após 4 x Atraso-Ligar. Esta regra permite evitar a ressonância através do fenômeno efeito hunting.
Entrada externa ativada	- Abre o relé de alarme imediatamente - Inicia o comportamento normal após o Atraso-Ligar (*)

(*) Para mais informações sobre os Atrasos veja capítulo 4.3.1.1.

A5. Medição de tensão e conexão de fonte de alimentação

Este apêndice apresenta uma forma prática de conectar a medição de tensão ao RVT quando é a mesma fonte que alimenta o RVT.

Descrição

Conforme apresentado na Figura 57, o RVT possui dois terminais para sua própria alimentação e três outros terminais para entrada de medição de tensão.

O RVT não utiliza a fonte de alimentação como ponto de medição.

A medição de tensão é realizada apenas através dos terminais de entrada dedicados.

Se a alimentação do RVT e a medição de tensão for vier do mesmo sinal, é possível realizar uma ponte entre os terminais:

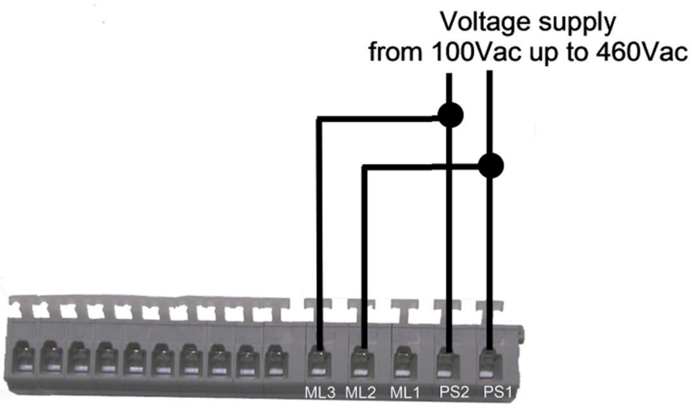


Figura 57: Terminais

Conexão de ponte (proposta prática)

Devido ao espaço limitado não é possível inserir dois cabos em um único compartimento, portanto métodos alternativos devem ser utilizados para tal.

Existem muitas formas práticas e corretas para realizer esta conexão. Uma destas soluções é descrita na Figura 58.

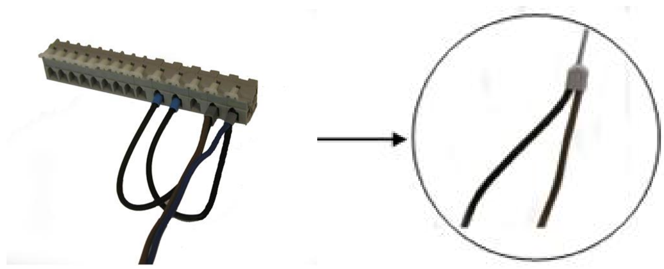
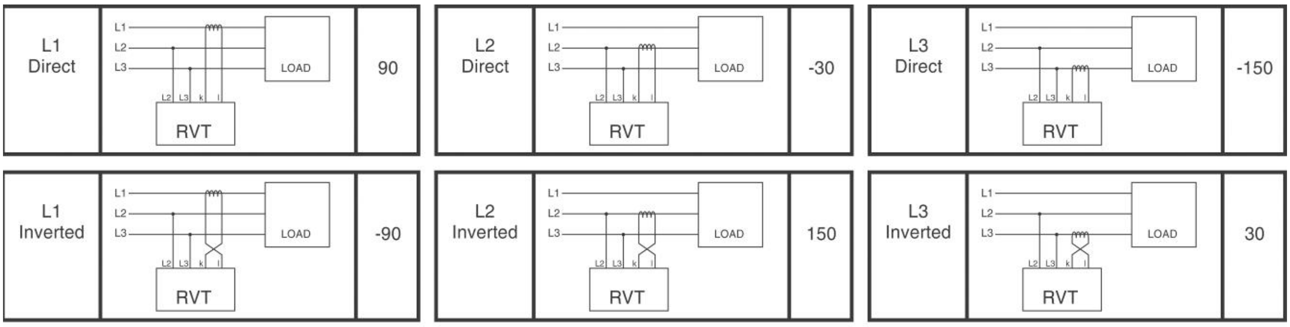


Figura 58: Conexão em ponte

A6. Tabela de mudança de fase (aplicável ao Modelo Base)

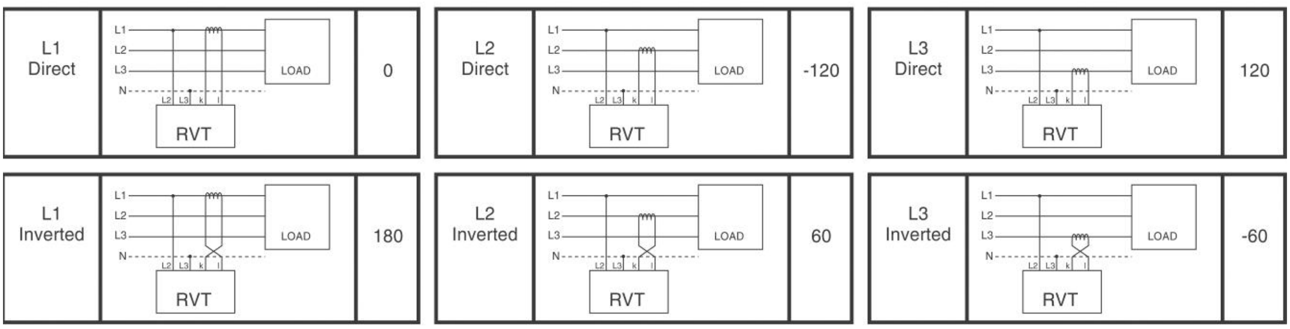
Conexão trifásica (Fase-Fase)

Tensão é medida entre as fases L2 e L3.

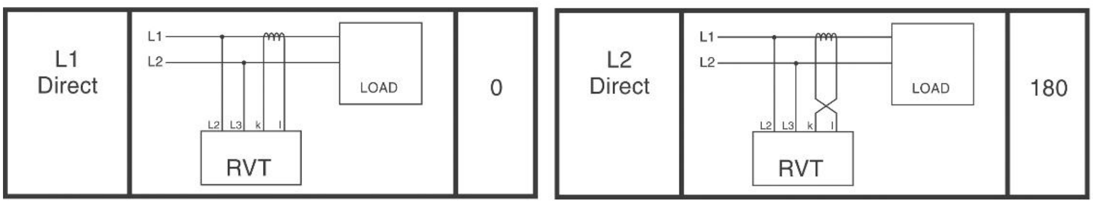


Conexão trifásica (Fase-Neutro)

Tensão é medida entre L1 e N.



Conexão monofásica



A7. Ilutração dos tipos de conexão dos TCs e dos cabos do TC nos terminais do controlador

Connection type		RVT 12 - 3P	RVT 6 / RVT 12	Phase shift	Voltages						Currents				Compensation type		
Name	Schematics	Connection	Connection	adjustment	L12	L23	L31	L1N	L2N	L3N	L1	L2	L3	N	Full C3[1]	Full C1[2]	Mixed C3+C1
1Ph-1LL1	L2 L3	L2, L3, CT → ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	L2, L3, CT → N.C., ML2, ML3, N.C., k, l, N.C., N.C., N.C., N.C.	0° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	-	yes	-
3Ph-1LL1	L1 L2 L3 N	L2, L3, CT → ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	L2, L3, CT → N.C., ML2, ML3, N.C., k, l, N.C., N.C., N.C., N.C.	90° by default (see phase shift table)	-	Measured	-	-	-	-	Measured	-	-	-	yes	-	-
3Ph-1LN1	L1 L2 L3 N	L1, N, CT → ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	L1, N, CT → N.C., ML2, ML3, N.C., k, l, N.C., N.C., N.C., N.C.	0° by default (see phase shift table)	-	-	-	Measured	-	-	Measured	-	-	-	yes	-	-
3Ph-3LL3	L1 L2 L3 N	L1, L2, L3, CT1, CT2, CT3 → ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-3LL2	L1 L2 L3	L1, L2, L3, CT1, CT2 → ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - phase rotation - CT redirection)	Measured	Measured	Measured	Calculated	Calculated	Calculated	Measured	Measured	Calculated	(3)	yes	yes	yes
3Ph-3LN3	L1 L2 L3 N	L1, L2, L3, N, CT1, CT2, CT3 → ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - phase rotation - CT redirection)	Calculated	Calculated	Calculated	Measured	Measured	Measured	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LL3	L1 L2 L3 N	L2, L3, CT1, CT2, CT3 → ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - CT redirection)	-	Measured	-	-	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes
3Ph-1LN3	L1 L2 L3 N	L1, N, CT1, CT2, CT3 → ML1, ML2, ML3, N, k1, l1, k2, l2, k3, l3	-	0° by default (Adjust - CT redirection)	-	-	-	Measured	-	-	Measured	Measured	Measured	Calculated	yes	yes	yes

A8. Controle de fator de potência monofásico (aplicável para o modelo trifásico RVT12-3P)

Como padrão, apenas o modelo de 12 saídas está disponível para controle de fator de potência monofásico.

O controle é feito comparando-se o C/k com o valor da corrente fundamental reativa medida.

O controle é feito em diferentes maneiras, baseado no tipo de conexão (veja Apêndice A7) e no tipo das saídas (trifásico ou monofásico).

wPh- xLyz onde :

w determina uma rede monofásica ou trifásica

x é o número de medições de tensão utilizada

y determina se a conexão é Fase-Fase ou Fase-Neutro

z é o número de TCs utilizados

wPh-1Ly1 tipo de controle (apenas um TC)

Basicamente, se apenas um TC é utilizado, o controle é feito de acordo com a fase 1 (ou a fase em que ele está conectado).

3Ph-xLy2 e 3Ph-xLy3 tipos de controle (2 ou 3 TCs)

Se mais de um TC é utilizado, o controlador estrategicamente segue um princípio simples e eficiente para conseguir manejar todas as saídas de uma forma compreensível. A estratégia abaixo é implementada:

Estratégia de seccionamento em rede desbalanceada:

Aguardar pelo Atraso-Ligar enquanto calcula a corrente reativa nas fases L1, L2 e L3 de acordo com a configuração Normal/Integral.

Análise da menor saída trifásica

Análise da menor saída monofásica

Se algum bloco de saídas monofásicas (já ligadas ou que serão ligadas) podem ser transferidas para um estágio trifásico então o estágio trifásico preferencialmente será utilizado

Liga ou desliga o estágio de acordo com Progressivo/Direto, Linear/Circular.

Seguem alguns exemplos típicos:

- 12 capacitores monofásicos / 1 TC (1Ph-1LL1 apenas)

  à O controle é feito através da fase onde o TC está instalado

  à O parâmetro do C/k trifásico é utilizado para seccionamento dos estágios (equivalente ao parâmetro do C/k nos modelos RVT 6 e 12)

- 12 capacitores trifásicos / 1 TC (3Ph-1Ly1 apenas) à O controle é feito através da fase onde o TC está instalado

à O parâmetro do C/k trifásico é utilizado para seccionamento dos estágios (equivalente ao parâmetro do C/k nos modelos RVT 6 e 12)

- 12 capacitores trifásicos / 2 ou 3 TC's (3Ph-3LL2 ou 3Ph-xLy3 apenas)

à O controle é feito peloTC1 na fase 1, TC2 na fase 2 e TC3 na fase 3.

à O controle é feito confome a estratégia de seccionamento em rede desbalanceada

à O C/k trifásico é utilizado para seccionamento de estágios trifásicos

- 4* 3 capacitores monofásicos conectados entre L-N / 2 ou 3 TCs (3Ph-3LL2 ou 3Ph-xLy3 apenas)

à O controle é feito peloTC1 na fase 1, TC2 na fase 2 e TC3 na fase 3.

à O controle é feito confome a estratégia de seccionamento em rede desbalanceada

à O C/k monofásico é utilizado para seccionamento de estágios monofásicos

- 6 capacitores trifásicos + 2 * 3 capacitores monofásicos conectados entre L-N / 2 ou 3 CT (3Ph-3LL2 ou 3Ph-xLy3 apenas)

à O controle é feito peloTC1 na fase 1, TC2 na fase 2 e TC3 na fase 3.

à O controle é feito confome a estratégia de seccionamento em rede desbalanceada

à O C/k monofásico é utilizado para seccionamento de estágios monofásicos

à O C/k trifásico é utilizado para seccionamento de estágios trifásicos

A9. Reciclagem

Este símbolo mostrado no produto ou no manual, indica que não deve ser jogado no lixo no final da sua vida útil. Para previnir possíveis danos ao meio ambiente ou à saúde das pessoas por depósito em lixos, por favor separe este item de outros itens e recicle este material para promover a sustentabilidade e reutilização de recursos.

Usuários domésticos devem contatar o distribuidor onde adquiriram o produto para informações de como descartar o produto de forma segura para o meio ambiente.

Usuários comerciais devem contatar seu fornecedor a fim de checar os termos e condições contratuais de compra. Este produto não deve ser descartado junto com outros tipos de lixo comercial em conformidade com a diretiva WEEE.

Este produto não contém nenhuma substância perigosa e está em conformidade com RoHS.

O descarte das baterias deve ser realizado de acordo com os regulamentos nacionais.

Placas eletrônicas devem ser reciclados de acordo com o regulamento local.

Capsula externa e o restante das peças devem ser reciclados separadamente.

Este produto contém a célula de bacteria CR2032 Li-MnO2. Não substitua a bateria interna CR2032. Para reciclar ela poderá ser removida após abertura do encapsulamento plastic (4 parafusos no fundo do produto).

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INSTRUCTION MANUAL

RVT communication
How to use RS485 – USB – Ethernet RVT connections

Table of contents

1 Introduction to the controller

1.1 Intended audience

This manual is intended for programmers, commissioning people, supervision people who need to start communication, access data, and to develop supervision software which will interact with the Power Factor Controller RVT.

1.2 Before you start

This manual describes the RVT data table. These data are accessible through RS485, USB, or Ethernet, using Modbus RTU and TCP protocols or PQ-Link software.

All information available from the keyboard of the RVT will be available through the data table. Addresses, access levels and protocol information are of concerns.

To be able to access data of the Power Factor Controller RVT consistently, a basic knowledge of it is needed. Functionality of the RVT, meaning of various measurements, logging of data are some particular aspects that should be familiar. Look in the RVT operating manual to know more about it.

1.3 How to use this manual

Chapter 2 gives details concerning the Modbus protocol.

Chapter 3 describes Modbus functions and how Modbus is implemented in the controller.

Chapter 4 describes USB / TCP/IP protocol and how it is implemented in the controller.

Chapter 5 contains the table reference and formats to access measurements / settings data.

Chapter 6 describes the Windows DLL to handle USB / TCP/IP requests in a user specific application.

1.4 Software protocols and physical interface

The RVT Power Factor Controller supports three communication protocols:

Modbus RTU and Modbus TCP (Chapter 2 and 3) and PQ-Link protocol (Chapter 6).

Three physical connections are available:

RS485 with the Modbus Adapter option (Chapter 2), USB (Chapter 4), Ethernet-RJ45 (Chapter 4).

The table below resumes the availability of communication protocols depending on the RVT type and the connection provided.

Communication protocol		Available connection		
		RS485 Modbus Adapter (option)	USB	Ethernet-RJ45
RVT Type	RVT 6	Modbus RTU	PQ-Link	Not available
	RVT 12	Modbus RTU	PQ-Link	Not available
	RVT 12-3P	Modbus RTU	PQ-Link	PQ-Link and Modbus TCP

2 Modbus protocol overview

2.1 Overview

MODBUS RTU

MODBUS RTU is a non-proprietary serial communications protocol that is widely used in the process control industry. The protocol was developed by Modicon for PLC communications and later released for public use.

This protocol is available in all major Human Machine Interface (HMI) software packages and terminals. Many of the major controller and PLC manufacturers also offer MODBUS protocol as a standard or optional protocol in their instrumentation.

The hardware over which MODBUS RTU communications are performed is not defined by the protocol. MODBUS RTU is supported on RS-232, RS-422, RS-485, Ethernet and other electrical standards. It should be noted that MODBUS RTU, MODBUS ASCII and MODBUS Plus are unique communication formats, and are not compatible with each other. This document will discuss MODBUS RTU only.

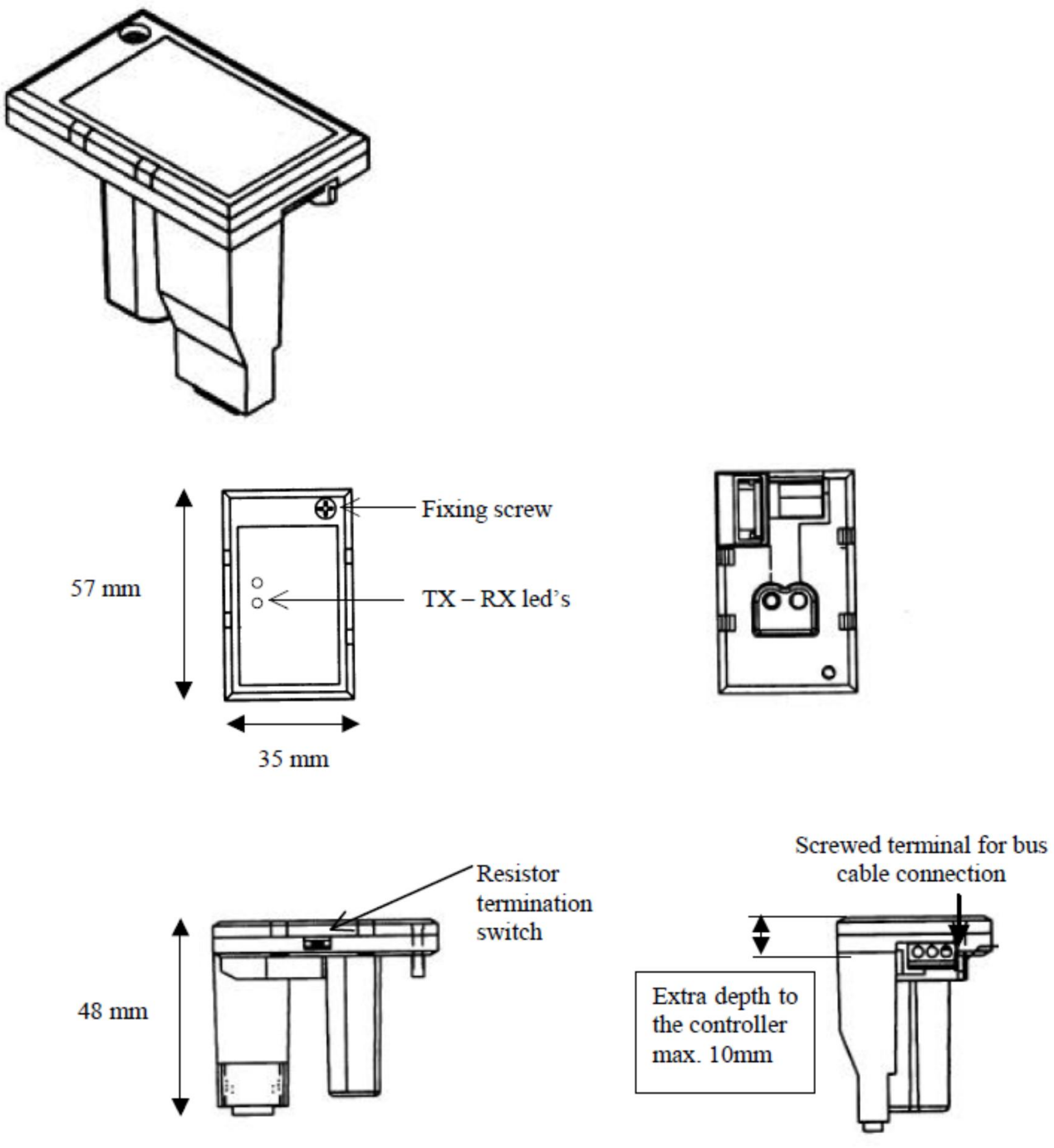
MODBUS TCP

MODBUS TCP is a MODBUS RTU message transmitted with a TCP/IP wrapper and sent over an Ethernet network instead of serial lines. The Server does not have a SlaveID as in RTU since it uses an IP Address instead.

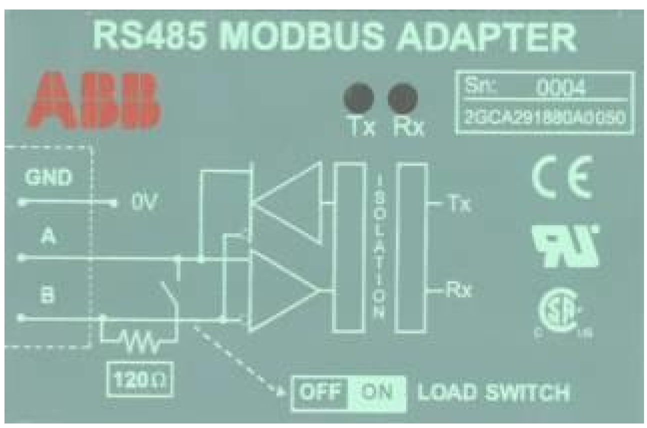
2.2 RS485 Modbus Adapter

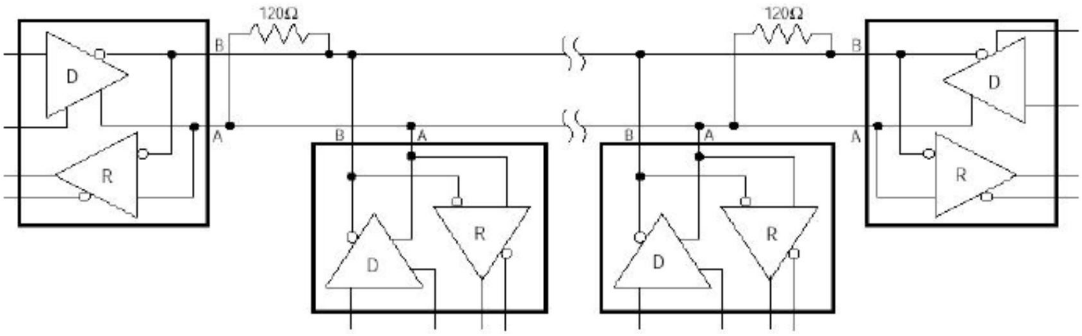
The Modbus protocol communicates with the instrumentation by means of an industry standard serial interface. This interface may be RS-232, RS-422 or RS-485. Some systems may also support the protocol over other busses or networks, such as Ethernet. An RS-232 interface allows only two devices to be connected together. RS-422 supports 1 driver and up to 10 receivers on a single network. For bi-directional communications, special tri-state circuitry is provided. RS-485 supports up to 32 driver/receiver pairs. With special hardware, the RS-422 and RS-485 limits can be expanded to allow as many as 248 devices on a single network. Each device on a network must have a unique address, which may be soft configured. Address zero is reserved for broadcast messages from the host to all slaves.

The RS485 Modbus Adapter is an option to the RVT. It enables the connection of the RVT controller to an RS485 Modbus network.



CAUTION: Be careful that the RS485 MODBUS ADAPTER is the one with a GREEN text colour (3.3V power supply). The one with a WHITE text colour is reserved for the old model (5V power supply).





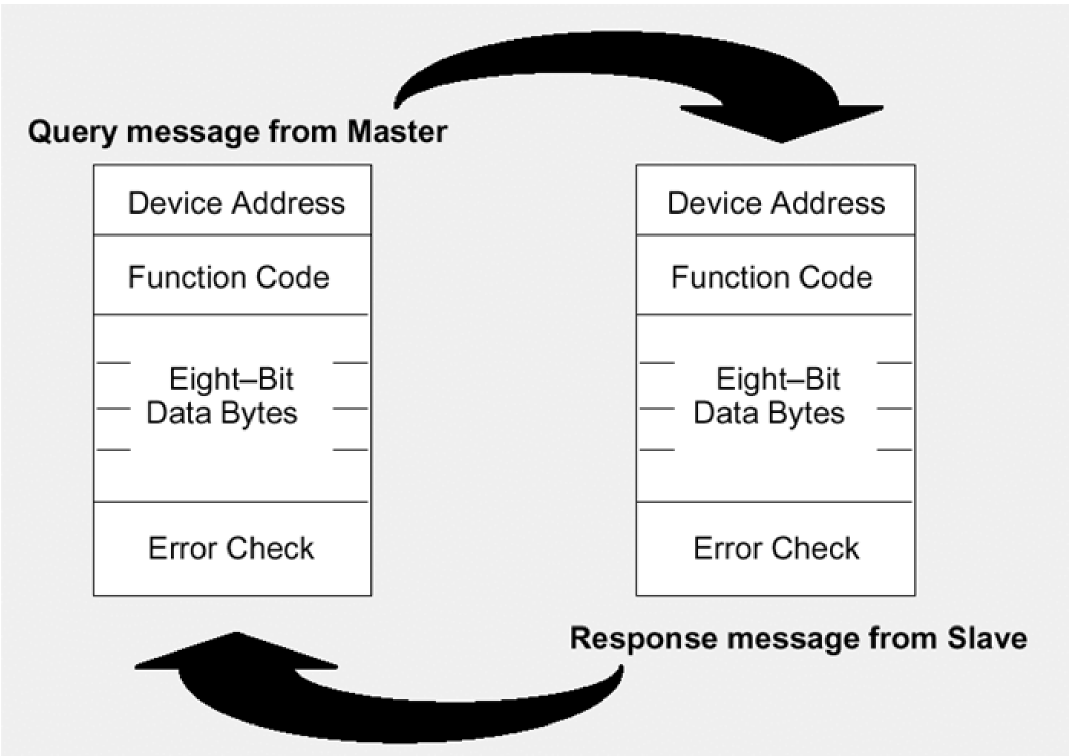
2.3 Transactions on Modbus Networks

Modbus protocol uses a master–slave technique, in which only one device (the master) can initiate transactions (called 'queries'). The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested in the query. Typical master devices include host processors and programming panels. Typical slaves include programmable controllers.

The master can address individual slaves, or can initiate a broadcast message to all slaves.

Slaves return a message (called a 'response') to queries that are addressed to them individually. Responses are not returned to broadcast queries from the master.

The Modbus protocol establishes the format for the master's query by placing into it the device (or broadcast) address, a function code defining the requested action, any data to be sent, and an error–checking field. The slave's response message is also constructed using Modbus protocol. It contains fields confirming the action taken, any data to be returned, and an error–checking field. If an error occurred in receipt of the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send it as its response.



The Query:

The function code in the query tells the addressed slave device what kind of action to perform. The data bytes contain any additional information that the slave will need to perform the function.

The data field must contain the information telling the slave which register to start at and how many registers to read.

The error check field provides a method for the slave to validate the integrity of the message contents.

The Response:

If the slave makes a normal response, the function code in the response is an echo of the function code in the query. The data bytes contain the data collected by the slave, such as register values or status. If an error occurs, the function code is modified to indicate that the response is an error response, and the data bytes contain a code that describes the error.

The error check field allows the master to confirm that the message contents are valid.

2.4 Serial Transmission Mode

The transmission mode defines the bit contents of message fields transmitted serially on the networks. It determines how information will be packed into the message fields and decoded.

Modbus defines two transmission modes: ASCII or RTU.

Only RTU mode will be used here. The mode and serial parameters must be the same for all devices on a Modbus network.

RTU Mode

The main advantage of this mode is that its greater character density allows better data throughput than ASCII for the same baud rate.

Each message must be transmitted in a continuous stream.

The format for each byte in RTU mode is:

Bits per Byte:

1 start bit

8 data bits, least significant bit sent first

1 bit for even/odd parity; no bit for no parity

1 stop bit if parity is used; 2 bits if no parity

Error Check Field: Cyclical Redundancy Check (CRC)

The messages are transmitted in the network from left to right, i.e. the Least

Significant Bit (LSB) first and the Most Significant Bit (MSB) last.

With parity checking

START	1	2	3	4	5	6	7	8	PARITY	STOP

Without parity checking

START	1	2	3	4	5	6	7	8	STOP	STOP

Description of the bit sequence for the RTU mode

2.5 Modbus Message Framing

A Modbus message is placed by the transmitting device into a frame that has a known beginning and ending point. This allows receiving devices to begin at the start of the message, read the address portion and determine which device it is, and to know when the message is completed.

Partial messages can be detected and errors can be set as a result.

Modbus RTU Framing

In RTU mode, messages start with a silent interval of at least 3.5 character times.

This is most easily implemented as a multiple of character times at the baud rate that is being used on the network (shown as T1–T2–T3–T4 in the figure below).

Another factor to consider is that each device has its own response time. This response time can be anywhere from a few milliseconds to a few hundred milliseconds. The Host must be configured to allow adequate time for the slowest device to respond.

The first field then transmitted is the device address.

Networked devices monitor the network bus continuously, including during the ‘silent’ intervals. When the first field (the address field) is received, each device decodes it to find out if it is the addressed device.

Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval.

The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.

Similarly, if a new message begins earlier than 3.5 character times following a previous message, the receiving device will consider it is a continuation of the previous message. This will set an error, as the value in the final CRC field will not be valid for the combined messages. A typical message frame is shown below.

START	ADDRESS	FUNCTION	DATA	CRC CHECK	END
T1–T2–T3–T4	8 BITS	8 BITS	*n* x 8 BITS	16 BITS	T1–T2–T3–T4

For a complete description of the Modbus protocol, please look at the Modicon Modbus Protocol Reference Guide (PI–MBUS–300 Rev. J).

Modbus TCP Framing

Modbus TCP/IP (also Modbus-TCP) is simply the Modbus RTU protocol with a TCP interface that runs on Ethernet.

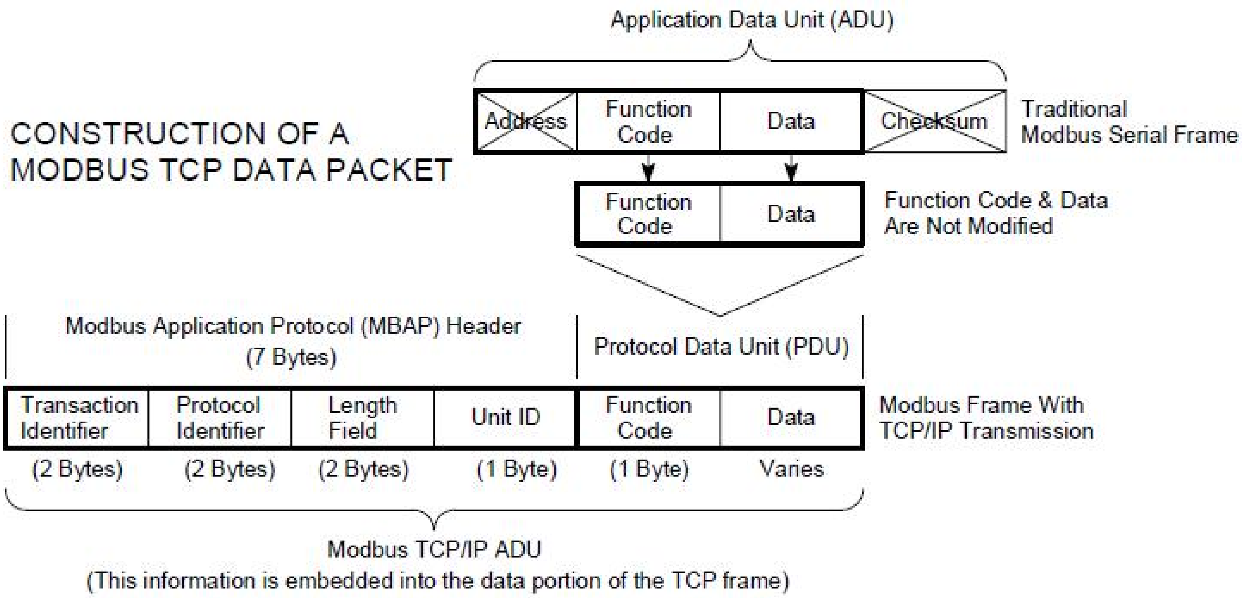
The Modbus messaging structure is the application protocol that defines the rules for organizing and interpreting the data independent of the data transmission medium.

TCP/IP refers to the Transmission Control Protocol and Internet Protocol, which provides the transmission medium for Modbus TCP/IP messaging.

Simply stated, TCP/IP allows blocks of binary data to be exchanged between computers. It is also a world-wide standard that serves as the foundation for the World Wide Web. The primary function of TCP is to ensure that all packets of data are received correctly, while IP makes sure that messages are correctly addressed and routed. Note that the TCP/IP combination is merely a transport protocol, and does not define what the data means or how the data is to be interpreted (this is the job of the application protocol, Modbus in this case).

So in summary, Modbus TCP/IP uses TCP/IP and Ethernet to carry the data of the Modbus message structure between compatible devices. That is, Modbus TCP/IP combines a physical network (Ethernet), with a networking standard (TCP/IP), and a standard method of representing data (Modbus as the application protocol). Essentially, the Modbus TCP/IP message is simply a Modbus communication encapsulated in an Ethernet TCP/IP wrapper.

In practice, Modbus TCP embeds a standard Modbus data frame into a TCP frame, without the Modbus checksum, as shown in the following diagram.



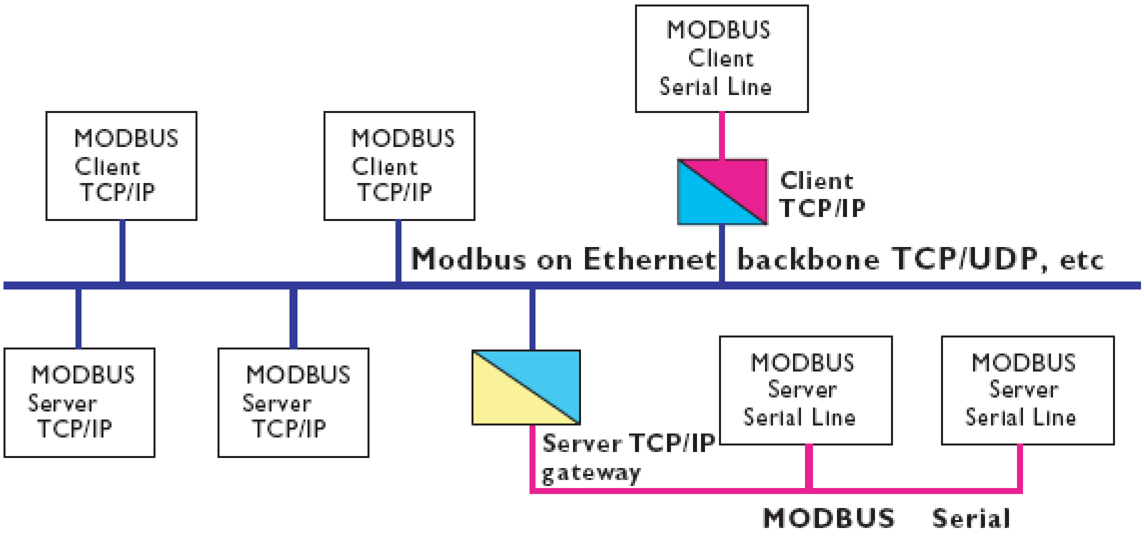
The complete Modbus TCP/IP Application Data Unit is embedded into the data field of a standard TCP frame and sent via TCP to well-known system port 502, which is specifically reserved for Modbus applications. Modbus TCP/IP clients and servers listen and receive Modbus data via port 502.

Modbus TCP must establish a connection before transferring data, since it is a connection-based protocol. The Master (or Client in Modbus TCP) establishes a connection with the Slave (or Server). The Server waits for an incoming connection from the Client. Once a connection is established, the Server then responds to the queries from the Client until the client closes the connection.

The number of Clients connected to 1 specific RVT is limited to 5.

In summary:

- Modbus TCP allows the user to connect to a RVT12-3P through Ethernet or Internet using Modbus standard protocol (with HMI, SCADA...)
- The slave address of Modbus RTU specification is replaced by the IP address via TCP port 502.
- Multiple Clients may access multiple RVT Servers.


MODBUS
Client
Serial Line
MODBUS
Client
TCP/IP
MODBUS
Client
TCP/IP
Client
TCP/IP
Modbus on Ethernet backbone TCP/UDP, etc
MODBUS
Server
TCP/IP
MODBUS
Server
TCP/IP
Server TCP/IP
gateway
MODBUS
Server
Serial Line
MODBUS
Server
Serial Line
MODBUS Serial

3 Modbus function codes

3.1 Data Addresses in Modbus Messages

Modbus defines 4 address spaces: 2 address spaces for bit addressable data and 2 address spaces for 16 bits addressable data.

Address space	Data	Readable/writable	Modbus name
OXXXX	Output bit	Read & write	Coil status
1XXXX	Input bit	Read	Input status
3XXXX	Input word	Read	Input register
4XXXX	Output word	Read & write	Holding register

Input register address space will be mainly used for measurements.

Holding register address space will contain settings.

All data addresses in Modbus messages are referenced to zero.

For example:

The coil known as ‘coil 1’ in a programmable controller is addressed as coil 0000 in the data address field of a Modbus message.

Coil 127 decimal is addressed as coil 007E hex (126 decimal).

Holding register 40001 is addressed as register 0000 in the data address field of the message.

The function code field already specifies a ‘holding register’ operation. Therefore the ‘4XXXX’ reference is implicit.

Holding register 40108 is addressed as register 006B hex (107 decimal).

3.2 Supported function codes

The following table gives the Modbus functions which are implemented and supported.

The code is the one used in function field of the Modbus message.

The address space concerned and the purpose of the function are given below.

Code	Function	Address range/remark
1	Read coil status	0XXXX reads the on/off status of discrete outputs
2	Read input status	1XXXX reads the on/off status of discrete inputs
3	Read holding registers	4XXXX reads contents of output registers
4	Read input registers	3XXXX reads contents of input registers
5	Force single coil	0XXXX sets the status of a discrete output
6	Preset single register	4XXXX sets the value of a holding register

7	Read exception status	Device specific
8	Diagnostics	Checks the communication system between the master and the slave
11	Fetch comm. event ctr.	Returns the amount of successful read / write operations on data points
12	Fetch comm. event log	Returns log registers of communication events
15	Force multiple coils	0XXXX sets the status of multiple discrete outputs
16	Preset multiple registers	4XXXX sets the value of multiple holding registers
17	Report slave ID	Device specific
22	Mask write 4X registers	4XXXX and / or write of a holding register
23	Read / write 4X registers	4XXXX reads a set of holding registers and writes a set of holding registers in one query

Remark: please note that for security reasons broadcast is not supported by the RVT.

3.3 Master’s queries and Slave’s responses

When a master device sends a query to a slave device it expects a normal response. One of four possible events can occur from the master’s query:

- If the slave device receives the query without a communication error, and can handle the query normally, it returns a normal response.
- If the slave does not receive the query due to a communication error, no response is returned. The master program will eventually process a timeout condition for the query.
- If the slave receives the query, but detects a communication error (parity or CRC), no response is returned. The master program will eventually process a timeout condition for the query.
- If the slave receives the query without a communication error, but cannot handle it (for example, if the request is to read a non–existent coil or register), the slave will return an exception response informing the master of the nature of the error.

3.4 Reads and writes to Modbus addresses (functions 1, 2, 3, 4, 5, 6, 15, 16, 22, 23)

The format of a read function (read coil status (01), read input status (02), read input registers (04), read holding registers (03)) is as follows:

QUERY		RESPONSE	
Slave address	1 byte	Slave address	1 byte (echo of master's query)
Function	1 byte	Function	1 byte (echo of master's query)
Starting data address	2 bytes	Byte count	1 byte
Quantity of points	2 bytes	Data values	N bytes
Error check field CRC	2 bytes	Error check field CRC	2 bytes

The format of a force single coil (05) or a preset single register (06) function is as follows:

QUERY		RESPONSE	
Slave address	1 byte	Slave address	1 byte (echo of master's query)
Function	1 byte	Function	1 byte (echo of master's query)
Data address	2 bytes	Data address	2 bytes
Data value	2 bytes	Data value	2 bytes
Error check field CRC	2 bytes	Error check field CRC	2 bytes

The format of a force multiple coil (15) or a preset multiple registers (16) function is as follows:

QUERY		RESPONSE	
Slave address	1 byte	Slave address	1 byte (echo of master's query)
Function	1 byte	Function	1 byte (echo of master's query)
Data address	2 bytes	Data address	2 bytes
Quantity of points	2 bytes	Quantity of points	2 bytes
Byte count	1 byte	Error check field CRC	2 bytes
Data values	N bytes		
Error check field CRC	2 bytes		

The format of a read/write multiple registers (23) function is as follows:

QUERY		RESPONSE	
Slave address	1 byte	Slave address	1 byte (echo of master's query)
Function	1 byte	Function	1 byte (echo of master's query)
Read data address	2 bytes	Byte count	1 byte
Read quantity of points	2 bytes	Data values	N bytes
Write data address	2 bytes	Error check field CRC	2 bytes
Write quantity of points	2 bytes		
Byte count	1 byte		
Write data values	N bytes		
Error check field CRC	2 bytes		

The format of a Mask/write register (22) function is as follows:

QUERY		RESPONSE	
Slave address	1 byte	Slave address	1 byte (echo of master's query)
Function	1 byte	Function	1 byte (echo of master's query)
Data address	2 bytes	Data address	2 bytes
And mask	2 bytes	And mask	2 bytes
Or mask	2 bytes	Or mask	2 bytes
Error check field CRC	2 bytes	Error check field CRC	2 bytes

3.5 Fetch comm event counter (function 11)

The controller's event counter is incremented once for each successful message completion. It is not incremented for exception responses, poll commands, or fetch event counter commands. It returns amount of successful read/write operations on data points.

The format of a Fetch comm event counter (11) function query is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Status word	2 bytes (0)
Event counter	2 bytes
Error check field CRC	2 bytes

3.6 Fetch comm event log (function 12)

Returns a status word, the comm event counter (see function 11), the bus message counter (see function 08 subfunction 11), and a field of event bytes from the slave.

The format of a Fetch comm event log (12) function query is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Byte count	1 byte
Status word	2 bytes (0)
Event counter	2 bytes
Bus message counter	2 bytes
Event log buffer	N bytes
Error check field CRC	2 bytes

The 64 bytes wide Event log buffer is filled with communication events. The most recent communications event is shown in the Event 0 byte.

Event bytes are stored in the Even log buffer for 4 different reasons.

The bit will be set to logic ‘1’ if the corresponding condition is TRUE.

Slave Modbus Receive Event

This type of event byte is stored by the slave when a query message is received.

It is stored before the slave processes the message.

Bit	Contents
0	Not Used
1	Communications Error
2	Not Used
3	Not Used
4	Character Overrun
5	Currently in Listen Only Mode
6	Broadcast Received
7	1

Slave Modbus Send Event

This type of event byte is stored by the slave when it finishes processing a query message.

It is stored if the slave returned a normal or exception response, or no response.

Bit	Contents
0	Read Exception Sent (Exception Codes 1-3)
1	Slave Abort Exception Sent (Exception Code 4)
2	Not used
3	Not used
4	Write Timeout Error Occurred
5	Currently in Listen Only Mode
6	1
7	0

Slave Entered Listen Only Mode

This type of event byte is stored by the slave when it enters the Listen Only Mode.

The event is defined by a content of ‘04’ hex.

Slave Initiated Communication Restart

This type of event byte is stored by the slave when its communications port is restarted. The slave can be restarted by the Diagnostics function (code 08), with subfunction Restart Communications Option (code 01).

The event is defined by a contents of ‘00’ hex.

3.7 Diagnostics function and subfunctions (function 8)

The format of a diagnostics (08) function query is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Subfunction	2 bytes
Data field	2 bytes
Error check field CRC	2 bytes

The format of a response to a diagnostics function query is an echo of the query itself.

If the request is directed to a counter, however, the slave returns the counter’s value in the data field.

00 Return Query Data

The data in the query data field is to be returned (looped back) in the response. The entire response should be identical to the query.

01 Restart Communication Option

The slave's peripheral port is to be initialized and restarted, and all of its communication event counters are to be cleared. If the port is currently in the Listen Only Mode, no response will be sent. If the port is not currently in the Listen Only Mode, a normal response will be sent. This occurs before the restart is executed.

02 Return Diagnostic Register (Not supported)

03 (Not supported)

04 Force Listen Only Mode

Forces the addressed slave to enter the Listen Only Mode for Modbus communications.

10 Clear Counters and Diagnostic Register

Clears all counters and the diagnostic register.

11 Return Bus Message Count

The response data field returns the total quantity of messages that the slave has detected in the communications system since its last restart, clear counters operation, or power-up.

12 Return Bus Communication Error Count

The response data field returns the quantity of CRC errors encountered by the slave since its last restart, clear counters operation, or power-up.

13 Return Bus Exception Error Count

The response data field returns the quantity of Modbus exception responses returned by the slave since its last restart, clear counters operation, or power-up.

14 Return Slave Message Count

The response data field returns the quantity of messages addressed to the slave, or broadcast that the slave has processed since its last restart, clear counters operation, or power-up.

15 Return Slave No Response Count

The response data field returns the quantity of messages addressed to the slave for which it sent no response (neither a normal response nor an exception response) since its last restart, clear counters operation, or power-up.

16 Return Slave NACK Response Count (Not supported)

17 Return Slave Busy Response Count (Not supported)

18 Return Bus Character Overrun Count

The response data field returns the quantity of messages addressed to the slave that it could not handle due to a character overrun condition since its last restart, clear counters operation, or power-up

19 (Not supported)

20 (Not supported)

21 (Not supported)

Diagnostic counters

Bus Message Counter	The total number of messages that the slave device has detected in the communications system since its last restart, clear counters operation, or power-up.
Bus Communication Error Counter	The number of CRC or LRC errors encountered by the slave device since its last restart, clear counters operation, or power-up.
Bus Exception Error Counter	The number of Modbus exception responses sent by the slave device since its last restart, clear counters operation, or power-up.
Slave Message Counter	The number of messages addressed to the slave device or broadcast that the slave device has processed since its last restart, clear counters operation, or power-up.
Slave No Response Counter	The number of messages addressed to the slave device for which it sent no response (neither a normal response nor an exception response) since its last restart, clear counters operation, or power-up.
Bus Character Overrun Counter	The number of messages addressed to the slave device that it could not handle due to a character overrun condition since its last restart, clear counters operation, or power-up .

3.8 Exception responses

Exception responses are sent when the slave device cannot handle the query. The format of an exception response to a master's query is as follows:

01 ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the slave device (see paragraph 2.2).
02 ILLEGAL DATA ADDRESS	The data address or number of items received in the query is not allowable or correct for the slave device. The slave device will send this exception response if an attempt to read or write part of a multiple register database object is detected. Possible objects are time, strings and counters

03 ILLEGAL DATA VALUE	A value contained in the query data field is out of range. The contents of the register or the status of the coil has not changed (see paragraph 4.3).
04 SLAVE DEVICE ABORT	An unrecoverable error occurred while the slave was attempting to perform the requested action. This may happen when the access level for changing a parameter is not reached (see paragraph 4.2.)
05 ACKNOWLEDGE	Not supported
06 SLAVE DEVICE BUSY	Not supported
07 NEGATIVE ACKNOWLEDGE	Not supported
08 MEMORY PARITY ERROR	Not supported

An application program in the master is responsible for handling exception responses. Typical processes include successive attempts to send a query, sending diagnostic messages to the slave, and notifying the operators.

3.9 CRC generation

The Cyclical Redundancy Check (CRC) field is two bytes, containing a 16–bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

Placing the CRC into the Message:

When the 16–bit CRC (two 8–bit bytes) is transmitted in the message, the low-order byte will be transmitted first, followed by the high-order byte.

Example: here is an example of calculating directly the CRC.

```
/*--------------------------------------------------------------
FUNCTION             : This routine calculates the crc high and low byte of a message.
 --------------------------------------------------------------
INPUT PARAMETERS  :        buf  -> Array containing message to be sent to controller
                           start -> Start of loop in crc counter, usually 0.
                           cnt   ->  Amount of bytes in message being sent to
controller
 --------------------------------------------------------------
OUTPUT                    :        temp -> Returns crc byte for message.
 --------------------------------------------------------------
*/
```

```
word crc(byte *buf,word start,word cnt)
{
word    i,j;
word    temp,temp2,flag;
  temp=0xFFFF;
  for (i=start; i<cnt; i++)
  {
            temp=temp ^ buf[i];
            for (j=1; j<=8; j++)
            {
                      flag=temp & 0x0001;
                      temp=temp >> 1;
                      if (flag) temp=temp ^ 0xA001;
            }
  }
  /* Reverse byte order. */
  temp2=temp >> 8;
  temp=(temp << 8) | temp2;
  temp &= 0xFFFF;
  return(temp);
}
```

4 Ethernet / RJ45 and USB connections for PQ-Link protocol

4.1 General overview

The Data of the RVT can be accessed by different means:

- TCP/IP connection from a local client or from a remote client
- USB seen as a USB UART interface

The server will allow local and distant access to the RVT. Different access levels will be implemented to restrict certain functionality to given users. A login and password will therefore be required.

The format of the messages transferred via those two medium will be the same.

4.2 Physical layer

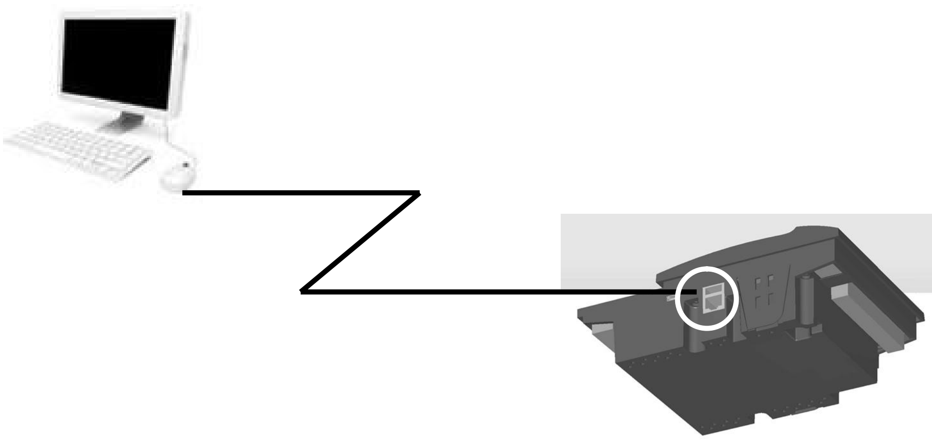
4.2.1 TCP/IP

TCP/IP connections can be indifferently initiated locally or remotely. As the local connection is used by the UI, it will have extended access rights to parameters compared to a remote connection.

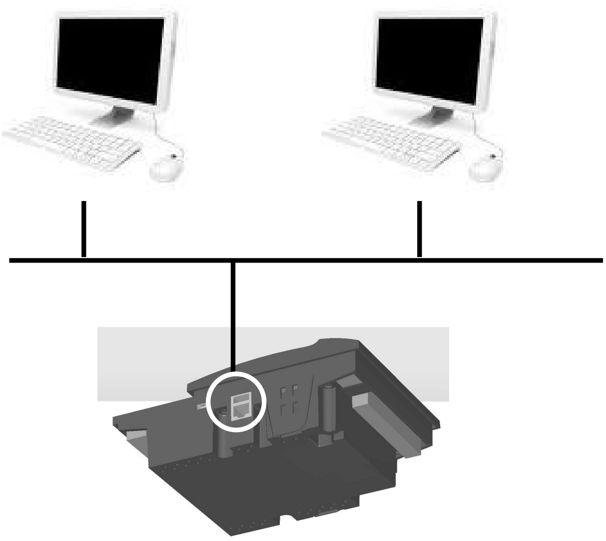
The TCP port used by default is 4250.

The maximum number of TCP/IP clients to the RVT is 2.

The connection to the RVT is an RJ45 Cat5e Ethernet cable



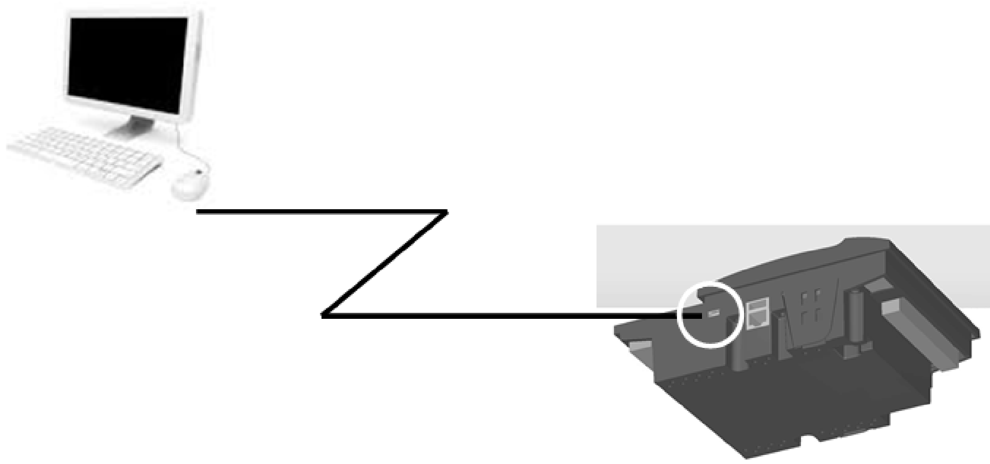
The RVT can be connected directly to a LAN or through Internet



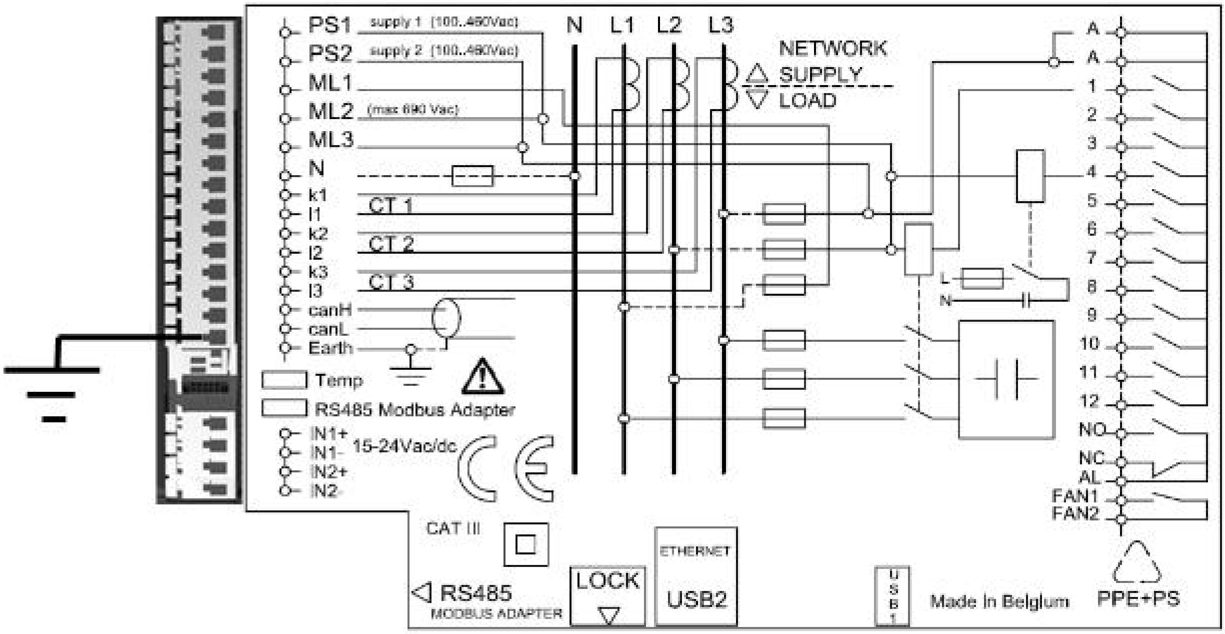
4.2.2 USB

The USB interface is used to present the RVT as a serial interface on its USB port.

The computer is connected through a USB-A male to USB-Mini B male.



Caution: The USB connection to the RVT is not isolated. It is mandatory to connect the protective EARTH connection when using the USB.



4.3 Framing layer & Command layer

The data can be accessed by different means:

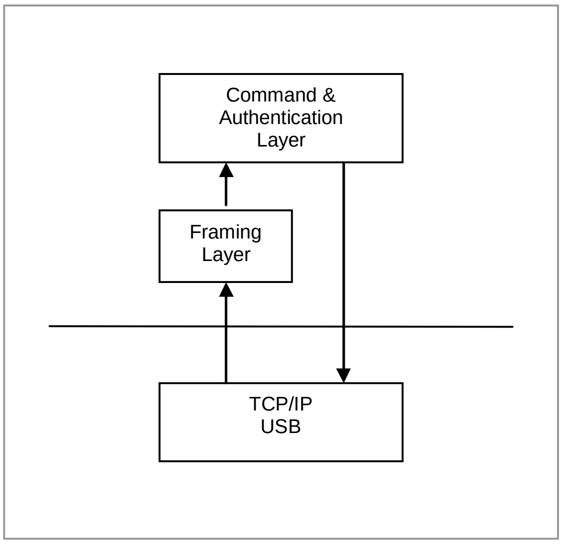
- TCP/IP connection from a local client or from a remote client
- USB seen as a USB UART interface

The server will allow local and distant access to the RVT. Different access levels will be implemented to restrict certain functionality to given users. A login and password will therefore be required.

The format of the messages transferred via those two medium will be the same.

Two layers will be put on top of them:

Framing Layer	This layer is taking care of receiving the frames. The byte stream is decoded and frames generated are passed to the layers above.
Command Layer	This is the upper layer taking care of the commands. It will also take care of the authentication of the client during the connection via some specific commands.



Those two layers will use the same format regardless of the actual “transmission medium” used.

The data is arranged in packets with integrated error checking.

The Windows DLL (chapter 6) incorporates all framing and command issues needed to communicate with the RVT.

5 Data table

5.1 Overview

There's quite an extensive set of parameters available in the RVT.

The individual parameters have been put together in groups to ease manipulation and transfers between the different layers of the application.

The parameters won't be individually accessible to the application. Only groups of parameters will be exchanged between the application and the lower layers.

This will allow the lower layer to be quite independent from the parameters contained within the group.

The parameter groups will be split in two types:

- Groups that are needed by the lower layers. They will have known and fixed group IDs in all different applications.
- Groups which are specific to an application. Their IDs will be known by the applicative layer. The lower-layers won't know the internals of these parameter groups.

5.2 Parameter Types

There are three basic types of parameter groups:

- Configuration parameters are defining the behaviour of the system.
- Measurement parameters are generated as data.
- Info parameters are kind of internal information.

The parameters IDs allowed are set as follows:

Type	**Sub-type**	**Access type**	**Allowed IDs**	
			Lower	Upper
Configuration	Universal	R/W	0x0000	0x0FF
	Access protected	R/W	0x0100	0x07FF
	Application Specific	R/W	0x0800	0x0FFF
Measurement	Application Specific	R	0x1000	0x1FFF
Info	Universal	R	0x2000	0x20FF
	Application Specific	R	0x2100	0x2FFF

The access type is given from the perspective of the local or distant user interface.

The "Configuration – Universal" parameters are considered as system parameters. As such, they are only modifiable by users that have at least "Administrator" rights.

The “Configuration – Access Protected” parameters can be modified by users that have at least “Configurator” rights so that their value can be reset or modified.

The “Configuration – Application Specific” parameters can be modified by users that have at least “Configurator” rights.

The other read-only parameters are accessible by any kind of user.

Values of single parameters within a group can be of different types. Here is a list of these types and the associated memory usage:

Type	Size in bytes	Remarks
Byte	1	Unsigned
Signed char	1	Signed
Word	2	Unsigned
Dword	4	Unsigned
64-bits	8	Unsigned
Time	6	Same format as used in the RTC parameter
Float	4	IEEE-754 floating-point number
String	Variable	NULL-terminated ASCII string

5.3 Parameter Changes and access

Please note that the RVT is fitted with some locking function, independently than the administrator rights.

- MODE: the RVT must be in SET Mode to allow parameters settings modifications.
- LOCK SWITCH: the lock switch have to be released
- BANK SETTINGS: the parameter Bank Settings must be set to Unlocked.
- The parameter COMMUNICATION LOCK is used to add an access level to users. When locked, all parameter settings modifications (except the Communication lock item setting) from the RVT touchscreen are forbidden. Parameters may meanwhile be modified by the communication access only (provided all others access levels are fulfilled).

Variable	Group ID	locked	Unlocked
Mode	0x0802	0 : AUTO 1 : MAN	2 : SET
Lock switch status	0x0014	0 : Lock switch pushed	1 : Lock switch released
Bank Settings	0x0802	1 : Bank Settings are locked	0 : Bank Settings are unlocked
Communication Lock	0x0809	1 : Communication lock	0 : Communication unlocked

Note: The RVT returns automatically to AUTO mode when the touch screen is not pressed for more than five minutes.

5.4 Parameter Groups

5.4.1 Configuration

5.4.1.1 Universal

These are the different groups with their size, type and assigned group IDs:

Group ID	Description	Size (in bytes)	Modbus Base address
0x0000	Real-time Clock	6	40000
0x0001	Modbus Data	5	40100
0x0002	Ethernet Data	21	31700
0x0004	Touch screen Calibration Data	17	40400
0x0013	Backlight Settings	1	41900
0x0014	Input Information	5	31400

5.4.1.2 Access Protected

These are the different groups with their size, type and assigned group IDs:

Group ID	Description	Size (in bytes)	Modbus Base Address
0x0100	Event Logging L1-L2	88	30000
0x0101	Event Logging L2-L3	88	30100
0x0102	Event Logging L3-L1	88	30200
0x0103	Event Logging Total	158	30300
0x0104	Event Logging Temperature	160	30400
0x0105	Energy	80	42000
0x0106	Installation Settings 2	48	42100
0x0107	Status information	146	42200
0x0109	Alarm Logging	36	42300

5.4.1.3 RVT specific

These are the different groups with their size, type and assigned group IDs:

Group ID	Description	Size (in bytes)	Modbus Base Address
0x0801	Bank Settings	25	42800
0x0802	I/O	5	42900
0x0803	Protection (Alarm Relay no 1)	62	43000
0x0804	Warning (Alarm Relay no 2)	61	43100
0x0805	Event Logging Settings	140	43200
0x0806	Installation Settings 1	12	43300
0x0807	User Settings	31	43400
0x0808	ID	57	43500
0x0809	Status information	9	32500

5.4.1.4 Measurement

These are the different groups with their size, type and assigned group IDs:

Group ID	Description	Size (in bytes)	Modbus Base Address
0x1000	Voltages	104	30500
0x1001	Line Currents	56	30600
0x1002	Temperature	36	30700
0x1003	Powers	88	30800
0x1005	PFC Control Data	24	30900
0x1006	Status information	32	31000

5.4.1.5 Universal

These are the different groups with their size, type and assigned group IDs:

Group ID	Description	Size (in bytes)	Modbus Base Address
0x2001	Ethernet current settings	20	32600
0x2081	LED control	1	31100

5.5 Parameter List

The parameter list is organized in several group of parameter.

Each group of parameter is identified by a Group ID.

A few data specifies how and where the data is available or can be programmed.

Parameters settings values have a limited range. If a written value exceeds the minimum and maximum allowable values, the written group of parameter will be omitted.

1/ Byte offset - Offset in bytes of the data into the Group of parameters

2/ Description - General description

3/ Units - Units depending of the type of data

4/ RVT - Applicable for the RVT 6 or 12. Some data are not available for the basic standard RVT

5/ RVT3P - Applicable for the RVT 12 with 3 phase measurement. All data are available into this full version of the RVT.

6/ Data type - Format

7/ Size in bytes - Depending on the data type

8/ Default value - Default value programmed as factory settings

9/ Min value - Minimum level allowed by this data

10/ Max value - Maximum level allowed by this data

11/ Modb @ - Base Modbus address where the data is located while accessing through Modbus protocol

5.5.1 Configuration (Universal)

5.5.1.1 Real Time Clock (GroupID = 0x0000)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Hours	Hour		*	Byte	1	0	0	23	40001
1	Minutes	Minutes		*	Byte	1	0	0	59	40002
2	Seconds	Seconds		*	Byte	1	0	0	59	40003
3	Year			*	Byte	1	109	0	255	40004
4	Month			*	Byte	1	1	1	12	40005
5	Day			*	Byte	1	1	1	31	40006

The Year 0 is defined as 1900 i.e. the year 2010 will be encoded as 110.

5.5.1.2 Modbus Data (GroupID = 0x0001)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Modbus address		*	*	Byte	1	1	1	247	40101
1	NOT USED		*	*	Byte	1	0			40102
2	Modbus baud rate	Bit/ second	*	*	Byte	1	9	1	9	40103
3	parity		*	*	Byte	1	0	0	2	40104
4	stop bits		*	*	Byte	1	0	0	1	40105

The ‘Baud rate’ is defined as follows:

Value	Description
1	300 bauds
2	600 bauds
3	1200 bauds
4	2400 bauds
5	4800 bauds
6	9600 bauds
7	19200 bauds
8	38400 bauds
9	57600 bauds

The ‘Parity’ is defined as follows:

Parity	Signification
0	No parity
1	Even
2	Odd

The 'Stop Bits' are defined as follows:

Value	Description
0	1 stop bit
1	2 stop bit

5.5.1.3 Ethernet Data (GroupID = 0x0002)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Static IP address			*	Dword	4	192.168.1.40	0	0xFFFFFFFF	
4	Static IP mask			*	Dword	4	255.255.255.0	0	0xFFFFFFFF	
8	Static Gateway IP address			*	Dword	4	0	0	0xFFFFFFFF	
12	NOT USED			*	Dword	4	0			
16	NOT USED			*	Dword	4	0			
20	DHCP client enabled			*	Byte	1	1	0	0X01	

The 'DHCP client enabled' is defined as follows:

Value	Description
0	DHCP disabled
1	DHCP enabled

The IP addresses are expected to be provided in network order (big endian).

5.5.1.4 Touchscreen Calibration Data (GroupID = 0x0004)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	X factor 0		*	*	Dword	4	3868	0	0xFFFFFFFF	40401
4	Y factor 0		*	*	Dword	4	3686	0	0xFFFFFFFF	40403
8	X factor 1		*	*	Dword	4	162	0	0xFFFFFFFF	40405
12	Y factor 1		*	*	Dword	4	334	0	0xFFFFFFFF	40407
16	Calibration Done		*	*	Byte	1	1	0	1	40409

The 'Calibration Done' is defined as follows:

Value	Description
0	Undone
1	Done

5.5.1.5 Backlight settings (GroupID = 0x0013)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Backlight percentage	%	*	*	Byte	1	100	10	100	41901

5.5.1.6 Input information (GroupID = 0x0014)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	NOT USED		*	*	Word	2			31401
2	NOT USED		*	*	Word	2			31402
4	Lock switch status		*	*	Byte	1	0	1	31403

The 'Lock switch' parameter is defined as follows:

Value	Description
0	Unlock
1	Locked

5.5.2 Configuration (Access Protected)

5.5.2.1 Event Logging L1 (GroupID = 0x0100)

Note:

- Voltage loggings refers to ML1-ML2 in case of Connection type Line to Line and ML1-N in case of Connection type L-N
- Current loggings refers to CT1 input
- Powers loggings refers to L1

Please refer to Appendix A7 of the RVT Manual for more information.

Byte Offset	Description	Units	RVT	RVT 3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Urms peak	V		*	Float	4	0	0	9e6	30001
4	Accumulated peak Urms duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30003
10	Urms Lowest	V		*	Float	4	0	0	9e6	30006
14	Irms peak	A	*	*	Float	4	0	0	9e6	30008
18	Accumulated peak Irms duration	s	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30010
24	Irms Lowest	A	*	*	Float	4	0	0	9e6	30013
28	peak active power	W		*	Float	4	0	-1e9	1e9	30015
32	Accumulated peak active power duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30017

38	peak reactive power	var		*	Float	4	0	-1e9	1e9	30020
42	Accumulated peak reactive power duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30022
48	peak missing reactive power	var		*	Float	4	0	-1e9	1e9	30025
52	Accumulated peak missing reactive power duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30027
58	peak apparent power	VA		*	Float	4	0	-1e9	1e9	30030
62	Accumulated peak apparent power duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30032
68	peak THDU	%		*	Float	4	0	0	1000	30035
72	Accumulated peak THDU duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30037
78	peak THDI	%	*	*	Float	4	0	0	1000	30040
82	Accumulated peak THDI duration	s	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30042

The communication from the user to the RVT is limited to the reset of data, it means that all the Group ID is transmitted with some data set to 0 and 0:0:0:0:0:0.

5.5.2.2 Event Logging L2 (GroupID = 0x0101)

Note:

- Voltage loggings refers to ML2-ML3 in case of Connection type Line to Line and ML2-N in case of Connection type L-N
- Current loggings refers to CT2 input
- Powers loggings refers to L2

Please refer to Appendix A7 of the RVT Manual for more information.

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Mod b @
0	Urms peak	V	*	*	Float	4	0	0	9e6	30101
4	Accumulated peak Urms duration	s	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30103
10	Urms Lowest	V	*	*	Float	4	0	0	9e6	30106
14	Irms peak	A		*	Float	4	0	0	9e6	30108
18	Accumulated peak Irms duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30110
24	Irms Lowest	A		*	Float	4	0	0	9e6	30113
28	peak active power	W		*	Float	4	0	-1e9	1e9	30115

32	Accumulated peak active power duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30117
38	peak reactive power	var		*	Float	4	0	-1e9	1e9	30120
42	Accumulated peak reactive power duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30122
48	peak missing reactive power	var		*	Float	4	0	-1e9	1e9	30125
52	Accumulated peak missing reactive power duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30127
58	peak apparent power	VA		*	Float	4	0	-1e9	1e9	30130
62	Accumulated peak apparent power duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30132
68	peak THDU	%	*	*	Float	4	0	0	1000	30135
72	Accumulated peak THDU duration	s	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30137
78	peak THDI	%		*	Float	4	0	0	1000	30140
82	Accumulated peak THDI duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30142

The communication from the user to the RVT is limited to the reset of data, it means that all the Group ID is transmitted with some data set to 0 and 0:0:0:0:0:0.

5.5.2.3 Event Logging L3 (GroupID = 0x0102)

Note:

- Voltage loggings refers to ML3-ML1 in case of Connection type Line to Line and ML3-N in case of Connection type L-N
- Current loggings refers to CT3 input
- Powers loggings refers to L3

Please refer to Appendix A7 of the RVT Manual for more information.

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Urms peak	V		*	Float	4	0	0	9e6	30201
4	Accumulated peak Urms duration	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30203
10	Urms Lowest	V		*	Float	4	0	0	9e6	30206
14	Irms peak	A		*	Float	4	0	0	9e6	30208

18	Accumulated peak Irms duration	s	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30210
24	Irms Lowest	A	*	Float	4	0	0	9e6	30213
28	peak active power	W	*	Float	4	0	-1e9	1e9	30215
32	Accumulated peak active power duration	s	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30217
38	peak reactive power	var	*	Float	4	0	-1e9	1e9	30220
42	Accumulated peak reactive power duration	s	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30222
48	peak missing reactive power	var	*	Float	4	0	-1e9	1e9	30225
52	Accumulated peak missing reactive power duration	s	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30227
58	peak apparent power	VA	*	Float	4	0	-1e9	1e9	30230
62	Accumulated peak apparent power duration	s	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30232
68	peak THDU	%	*	Float	4	0	0	1000	30235
72	Accumulated peak THDU duration	s	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30237
78	peak THDI	%	*	Float	4	0	0	1000	30240
82	Accumulated peak THDI duration	s	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30242

The communication from the user to the RVT is limited to the reset of data, it means that all the Group ID is transmitted with some data set to 0 and 0:0:0:0:0:0.

5.5.2.4 Event Logging Total (GroupID = 0x0103)

Note:

- Voltage loggings refers to the averaging of the voltage measurements on the 3 phases. In case of Connection type where only one voltage measurement is present, please refer to the above Event Logging tables.
- Current loggings refers to the averaging of the current measurements on the 3 phases. In case of Connection type where only one current measurement is present, please refer to the above Event Logging tables.
- Powers loggings refers to the power calculations on all phases.

Please refer to Appendix A7 of the RVT Manual for more information.

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Urms L-L peak	V		*	Float	4	0	0	9e6	30301
4	Accumulated peak Urms L-L duration	S		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30303
10	Urms L-L Lowest	V		*	Float	4	0	0	9e6	30306
14	Irms peak	A		*	Float	4	0	0	9e6	30308
18	Accumulated peak Irms duration	S		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30310
24	Irms Lowest	A		*	Float	4	0	0	9e6	30313
28	peak active power	W	*	*	Float	4	0	-1e9	1e9	30315
32	Accumulated peak active power duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30317
38	peak reactive power	var	*	*	Float	4	0	-1e9	1e9	30320
42	Accumulated peak reactive power duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30322
48	peak missing reactive power	var	*	*	Float	4	0	-1e9	1e9	30325
52	Accumulated peak missing reactive power duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30327
58	peak apparent power	VA	*	*	Float	4	0	-1e9	1e9	30330
62	Accumulated peak apparent power duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30332

68	peak THDU	%		*	Float	4	0	0	1000	30335
72	Accumulated peak THDU duration	S		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30337
78	peak THDI	%		*	Float	4	0	0	1000	30340
82	Accumulated peak THDI duration	S		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30342
88	peak Supplied Active energy	W		*	Float	4	0	0	1e9	30345
92	Accumulated peak Supplied Active energy duration	S		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30347
98	peak Consumed Active energy	W		*	Float	4	0	0	1e9	30350
102	Accumulated peak Consumed Active energy duration	S		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30352
108	peak Inductive Reactive energy	var		*	Float	4	0	0	1e9	30355
112	Accumulated peak Inductive Reactive energy duration	S		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30357
118	peak Capacitive Reactive energy	var		*	Float	4	0	0	1e9	30360
122	Accumulated peak Capacitive Reactive energy duration	S		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30362
128	peak Total Apparent energy	VA		*	Float	4	0	0	1e9	30365
132	Accumulated peak Total Apparent energy duration	S		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30367
138	peak frequency max	Hz	*	*	Float	4	40	40	70	30370

142	Accumulated peak frequency max duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30372
148	peak frequency min	Hz	*	*	Float	4	70	40	70	30375
152	Accumulated peak frequency min duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30377

The communication from the user to the RVT is limited to the reset of data, it means that all the Group ID is transmitted with some data set to 0 and 0:0:0:0:0:0.

5.5.2.5 Event Logging Temperature (GroupID = 0x0104)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	peak Temperature max T1	°C/°F	*	*	Float	4	-40	-40	150	30401
4	Accumulated Temperature max T1 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30403
10	peak Temperature min T1	°C/°F	*	*	Float	4	150	-40	150	30406
14	Accumulated Temperature min T1 duration	°C/°F	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30408
20	peak Temperature max T2	S	*	*	Float	4	-40	-40	150	30411
24	Accumulated Temperature max T2 duration	°C/°F	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30413
30	peak Temperature min T2	°C/°F	*	*	Float	4	150	-40	150	30416
34	Accumulated Temperature min T2 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30418
40	peak Temperature max T3	°C/°F	*	*	Float	4	-40	-40	150	30421
44	Accumulated Temperature max T3 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30423

50	peak Temperature min T3	°C/°F	*	*	Float	4	150	-40	150	30426
54	Accumulated Temperature min T3 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30428
60	peak Temperature max T4	°C/°F	*	*	Float	4	-40	-40	150	30431
64	Accumulated Temperature max T4 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30433
70	peak Temperature min T4	°C/°F	*	*	Float	4	150	-40	150	30436
74	Accumulated Temperature min T4 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30438
80	peak Temperature max T5	°C/°F	*	*	Float	4	-40	-40	150	30441
84	Accumulated Temperature max T5 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30443
90	peak Temperature min T5	°C/°F	*	*	Float	4	150	-40	150	30446
94	Accumulated Temperature min T5 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30448
100	peak Temperature max T6	°C/°F	*	*	Float	4	-40	-40	150	30451
104	Accumulated Temperature max T6 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30453
110	peak Temperature min T6	°C/°F	*	*	Float	4	150	-40	150	30456
114	Accumulated Temperature min T6 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30458

120	peak Temperature max T7	°C/°F	*	*	Float	4	-40	-40	150	30461
124	Accumulated Temperature max T7 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30463
130	peak Temperature min T7	°C/°F	*	*	Float	4	150	-40	150	30466
134	Accumulated Temperature min T7 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30468
140	peak Temperature max T8	°C/°F	*	*	Float	4	-40	-40	150	30471
144	Accumulated Temperature max T8 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30473
150	peak Temperature min T8	°C/°F	*	*	Float	4	150	-40	150	30476
154	Accumulated Temperature min T8 duration	S	*	*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	30478

The communication from the user to the RVT is limited to the reset of data, it means that all the Group ID is transmitted with some data set to 0 and 0:0:0:0:0:0.

5.5.2.6 Energy (GroupID = 0x0105)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	Supplied Active energy L1	Wh		*	Float	4	-1e12	1e12	42001
4	Supplied Active energy L2	Wh		*	Float	4	-1e12	1e12	42003
8	Supplied Active energy L3	Wh		*	Float	4	-1e12	1e12	42005
12	Supplied Active energy	Wh		*	Float	4	-1e12	1e12	42007
16	Consumed Active energy L1	Wh		*	Float	4	-1e12	1e12	42009
20	Consumed Active energy L2	Wh		*	Float	4	-1e12	1e12	42011
24	Consumed Active energy L3	Wh		*	Float	4	-1e12	1e12	42013

28	Consumed Active energy	Wh	*	Float	4	-1e12	1e12	42015
32	Total Active energy	Wh	*	Float	4	-1e12	1e12	42017
36	Inductive Reactive energy L1	varh	*	Float	4	-1e12	1e12	42019
40	Inductive Reactive energy L2	varh	*	Float	4	-1e12	1e12	42021
44	Inductive Reactive energy L3	varh	*	Float	4	-1e12	1e12	42023
48	Capacitive Reactive energy L1	varh	*	Float	4	-1e12	1e12	42025
52	Capacitive Reactive energy L2	varh	*	Float	4	-1e12	1e12	42027
56	Capacitive Reactive energy L3	varh	*	Float	4	-1e12	1e12	42029
60	Total Reactive energy	varh	*	Float	4	-1e12	1e12	42031
64	Total Apparent energy L1	VAh	*	Float	4	-1e12	1e12	42033
68	Total Apparent energy L2	VAh	*	Float	4	-1e12	1e12	42035
72	Total Apparent energy L3	VAh	*	Float	4	-1e12	1e12	42037
76	Total Apparent energy	VAh	*	Float	4	-1e12	1e12	42039

The communication from the user to the RVT is limited to the reset of data, it means that all the Group ID is transmitted with some data set to 0 and 0:0:0:0:0:0.

5.5.2.7 Installation Settings 2 (GroupID = 0x0106)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	C/k 1Ph	A		*	Float	4	1	0.01	5	42101
4	C/k 3Ph	A	*	*	Float	4	1	0.01	5	42103
8	Qstep 1Ph	var		*	Float	4	50000	10	100e6	42105
12	Qstep 3Ph	var	*	*	Float	4	50000	10	100e6	42107
16	Phase Shift	°	*	*	Float	4	90	-179	180	42109
20	size output 1	Step	*	*	Byte	1	1	0	9	42111
21	size output 2	Step	*	*	Byte	1	1	0	9	42112
22	size output 3	Step	*	*	Byte	1	1	0	9	42113
23	size output 4	Step	*	*	Byte	1	1	0	9	42114
24	size output 5	Step	*	*	Byte	1	1	0	9	42115
25	size output 6	Step	*	*	Byte	1	1	0	9	42116
26	size output 7	Step	*	*	Byte	1	1	0	9	42117

27	size output 8	Step	*	*	Byte	1	1	0	9	42118
28	size output 9	Step	*	*	Byte	1	1	0	9	42119
29	size output 10	Step	*	*	Byte	1	1	0	9	42120
30	size output 11	Step	*	*	Byte	1	1	0	9	42121
31	size output 12	Step	*	*	Byte	1	1	0	9	42122
32	Status output 1		*	*	Byte	1	1	0	5	42123
33	Status output 2		*	*	Byte	1	1	0	5	42124
34	Status output 3		*	*	Byte	1	1	0	5	42125
35	Status output 4		*	*	Byte	1	1	0	5	42126
36	Status output 5		*	*	Byte	1	1	0	5	42127
37	Status output 6		*	*	Byte	1	1	0	5	42128
38	Status output 7		*	*	Byte	1	1	0	5	42129
39	Status output 8		*	*	Byte	1	1	0	5	42130
40	Status output 9		*	*	Byte	1	1	0	5	42131
41	Status output 10		*	*	Byte	1	1	0	5	42132
42	Status output 11		*	*	Byte	1	1	0	5	42133
43	Status output 12		*	*	Byte	1	1	0	5	42134
44	RedirectCTInput L1		*	*	Byte	1	0	0	2	42135
45	RedirectCTInput L2			*	Byte	1	1	0	2	42136
46	RedirectCTInput L3			*	Byte	1	2	0	2	42137
47	Phase rotation		*	*	Byte	1	0	0	1	42138

Bidirectional update is necessary to let the user set the data in manual mode and retrieve calculated value after auto commissioning.

The ‘Output status’ parameter is defined as follows:

Value	Description
0	Fixed OFF
1	1Ph L1
2	1Ph L2
3	1Ph L3
4	3Ph
5	Fixed ON

5.5.2.8 Status information (GroupID = 0x0107)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Add step status 1Ph L1			*	Byte	1	0	0	1	42201
1	Add step status 1Ph L2			*	Byte	1	0	0	1	42202
2	Add step status 1Ph L3			*	Byte	1	0	0	1	42203
3	Add step status 3Ph		*	*	Byte	1	0	0	1	42204
4	Remove step status 1Ph L1			*	Byte	1	0	0	1	42205
5	Remove step status 1Ph L2			*	Byte	1	0	0	1	42206
6	Remove step status 1Ph L3			*	Byte	1	0	0	1	42207
7	Remove step status 3Ph		*	*	Byte	1	0	0	1	42208
8	Next relay status		*	*	Word	2	0	0	0x3FFF	42209
10	Step size in MAN mode 1Ph L1	Steps	*	*	Word	2	0	0	500	42210
12	Step size in MAN mode 1Ph L2	Steps	*	*	Word	2	0	0	500	42211
14	Step size in MAN mode 1Ph L3	Steps	*	*	Word	2	0	0	500	42212
16	Step size in MAN mode 3Ph	Steps	*	*	Word	2	0	0	500	42213
18	Address Low External temperature probe 1		*	*	64 bits	8	0	0	0xFFF…	42214
26	Address High External temperature probe 1		*	*	64 bits	8	0	0	0xFFF…	42218
34	Address Low External temperature probe 2		*	*	64 bits	8	0	0	0xFFF…	42222
42	Address High External temperature probe 2		*	*	64 bits	8	0	0	0xFFF…	42226
50	Address Low External		*	*	64 bits	8	0	0	0xFFF…	42230

	temperature probe 3								
58	Address High External temperature probe 3	*	*	64 bits	8	0	0	0xFFF…	42234
66	Address Low External temperature probe 4	*	*	64 bits	8	0	0	0xFFF…	42238
74	Address High External temperature probe 4	*	*	64 bits	8	0	0	0xFFF…	42242
82	Address Low External temperature probe 5	*	*	64 bits	8	0	0	0xFFF…	42246
90	Address High External temperature probe 5	*	*	64 bits	8	0	0	0xFFF…	42250
98	Address Low External temperature probe 6	*	*	64 bits	8	0	0	0xFFF…	42254
106	Address High External temperature probe 6	*	*	64 bits	8	0	0	0xFFF…	42258
114	Address Low External temperature probe 7	*	*	64 bits	8	0	0	0xFFF…	42262
122	Address High External temperature probe 7	*	*	64 bits	8	0	0	0xFFF…	42266
130	Address Low External temperature probe 8	*	*	64 bits	8	0	0	0xFFF…	42270
138	Address High External temperature probe 8	*	*	64 bits	8	0	0	0xFFF…	42274

The ‘Add step status’ parameter is defined as follows:

Value	Description
0	No change
1	Ask for at least 1 more step

The ‘Remove step status’ parameter is defined as follows:

Value	Description
0	No change
1	Ask for at least 1 more step

These step statuses are updated according to the Auto mode or Manual mode.

Value	Description
0	Relay to open
1	Relay to close

The ‘Next relay Status’ parameter is defined as follows:

Bit used	Output relay
Bit 0	1
Bit 1	2
Bit 2	3
Bit 3	4
Bit 4	5
Bit 5	6
Bit 6	7
Bit 7	8
Bit 8	9
Bit 9	10
Bit 10	11
Bit 12	Alarm
Bit 13	Fan
Bit 14	Not used
Bit 15	Not used

5.5.2.9 Alarm Logging (GroupID = 0x0109)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Buffer 0	Alarm Type	*	*	Byte	1	0	0	9	42301
1	Time stamp of alarm in buffer 0	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	42302
7	Buffer 1	Alarm Type	*	*	Byte	1	0	0	9	42305
8	Time stamp of alarm in buffer 1	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	42306
14	Buffer 2	Alarm Type	*	*	Byte	1	0	0	9	42309
15	Time stamp of alarm in buffer 2	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	42310
21	Buffer 3	Alarm Type	*	*	Byte	1	0	0	9	42313
22	Time stamp of alarm in buffer 3	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	42314
28	Buffer 4	Alarm Type	*	*	Byte	1	0	0	9	42317
29	Time stamp of alarm in buffer 4	s		*	Time / 6 bytes	6	0:0:0:0:0:0	0:0:0:0:0:0	255:12:30:23:59:59	42318
35	Buffer index		*	*	Byte	1	0	0	5	42321

This table contains the alarm messages and the time stamp of their occurrences.

There is a circular buffer where both information are stored

- Kind of alarm logged.
- Time stamp.

This buffer may contain until 5 consecutive alarms.

A buffer index points to the eldest alarm logged.

When the buffer is full, the eldest alarm in the buffer is overwritten with the new one and the index is incremented.

The alarm type is defined as follows:

Value	Type	Description
0	No alarm	This alarm buffer is unused for now
1	Protection cos j	Insufficient available reactive power

2	Protection Temp Sensor	Temperature sensor lost while monitoring
3	Protection U Max	Overvoltage detection
4	Protection T Max	Internal temperature threshold reached
5	Protection External T Max	Temperature sensor threshold reached
6	Protection I Max	Over current detection
7	Protection THDU	THDU threshold reached
8	Protection External	External input protection activated
9	Protection U Min	Under voltage detection

5.5.3 Configuration (RVT Specific)

5.5.3.1 Bank Settings (GroupID = 0x0801)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	V nominal	V	*	*	Float	4	400	10	9e6	42801
4	V scale		*	*	Float	4	1.0	0.1	10000	42803
8	1Ph/3Ph/3Ph-N		*	*	Byte	1	1	0	7	42805
9	Lin / Circ		*	*	Byte	1	1	0	1	42806
10	Prog/direct		*	*	Byte	1	1	0	1	42807
11	Normal / Integral		*	*	Byte	1	1	0	1	42808
12	NOT USED		*	*	Byte	1	0			42809
13	delay ON	Sec	*	*	Dword	4	40	1	64800	42810
17	delay OFF	Sec	*	*	Dword	4	40	1	64800	42812
21	Delay reset	Sec	*	*	Dword	4	3	1	64800	42814

The ‘1Ph/3Ph/3Ph-N’ parameter is defined as follows:

Value	Description
0	1Ph-1LL1
1	3Ph-1LL1
2	3Ph-1LN1
3	3Ph-3LL3
4	3Ph-3LL2
5	3Ph-3LN3
6	3Ph-1LL3
7	3Ph-1LN3

The ‘Linear/Circular’ parameter is defined as follows:

Value	Description
0	Linear
1	Circular

The ‘Progressive/Direct’ parameter is defined as follows:

Value	Description
0	Progressive
1	Direct

The ‘Normal/Integral’ parameter is defined as follows:

Value	Description
0	Normal
1	Integral

5.5.3.2 I/O (GroupID = 0x0802)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Language		*	*	Byte	1	0	0	4	42901
1	Temperature unit		*	*	Byte	1	0	0	1	42902
2	Mode		*	*	Byte	1	0	0	2	42903
3	Bank settings lock	Unlocked/ Locked	*	*	Byte	1	0	0	1	42904
4	NOT USED		*	*	Byte	1	100			42905

The ‘Language parameter’ is defined as follows:

Value	Description
0	English
1	French
2	Deutsch
3	Spanish
4	Chinese

The ‘Temperature unit’ parameter is defined as follows:

Value	Description
0	°C
1	°F

The ‘Mode’ parameter is defined as follows:

Value	Description
0	Auto
1	Manual
2	Set

The ‘Bank Settings Lock’ parameter is defined as follows:

Value	Description
0	Unlocked
1	Locked

5.5.3.3 Protection (alarm relay n°1) (GroupID = 0x0803)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	V min prot.	V	*	*	Float	4	90	5	9e6	43001
4	V max prot.	V	*	*	Float	4	480	5	9e6	43003
8	T1 max prot.	°C or °F	*	*	Float	4	40	-40	150	43005
12	T2 max prot.	°C or °F	*	*	Float	4	40	-40	150	43007
16	T3 max prot.	°C or °F	*	*	Float	4	40	-40	150	43009
20	T4 max prot.	°C or °F	*	*	Float	4	40	-40	150	43011
24	T5 max prot.	°C or °F	*	*	Float	4	40	-40	150	43013
28	T6 max prot.	°C or °F	*	*	Float	4	40	-40	150	43015
32	T7 max prot.	°C or °F	*	*	Float	4	40	-40	150	43017
36	T8 max prot.	°C or °F	*	*	Float	4	40	-40	150	43019
40	THDV max prot.	%	*	*	Float	4	10	0.5	1000	43021
44	Irms max prot.	Ä	*	*	Float	4	1	0.1	9e6	43023
48	Ext. prot.		*	*	Byte	1	0	0	1	43025
49	V min Enable		*	*	Byte	1	0	0	1	43026
50	V max Enable		*	*	Byte	1	0	0	1	43027
51	T1 max Enable.		*	*	Byte	1	0	0	1	43028

52	T2 max Enable.		*	*	Byte	1	0	0	1	43029
53	T3 max Enable.		*	*	Byte	1	0	0	1	43030
54	T4 max Enable.		*	*	Byte	1	0	0	1	43031
55	T5 max Enable.		*	*	Byte	1	0	0	1	43032
56	T6 max Enable.		*	*	Byte	1	0	0	1	43033
57	T7 max Enable.		*	*	Byte	1	0	0	1	43034
58	T8 max Enable.		*	*	Byte	1	0	0	1	43035
59	THDV max Enable.		*	*	Byte	1	0	0	1	43036
60	Irms max Enable.		*	*	Byte	1	0	0	1	43037
61	Ext. Prot. Alarm		*	*	Byte	1	0	0	1	43038

The External protection parameter is defined as follows:

Value	Description
0	Disabled
1	Enabled

The External protection Alarm parameter is defined as follows:

Value	Description
0	Disconnection & alarm
1	Disconnection only

5.5.3.4 Warning (warning / fan relay) (GroupID = 0x0804)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	V min warning	V	*	*	Float	4	90	5	9e6	43101
4	V max warning	V	*	*	Float	4	480	5	9e6	43103
8	T1 max start fan	°C or °F	*	*	Float	4	40	-40	150	43105
12	T2 max start fan	°C or °F	*	*	Float	4	40	-40	150	43107

16	T3 max start fan	°C or °F	*	*	Float	4	40	-40	150	43109
20	T4 max start fan	°C or °F	*	*	Float	4	40	-40	150	43111
24	T5 max start fan	°C or °F	*	*	Float	4	40	-40	150	43113
28	T6 max start fan	°C or °F	*	*	Float	4	40	-40	150	43115
32	T7 max start fan	°C or °F	*	*	Float	4	40	-40	150	43117
36	T8 max start fan	°C or °F	*	*	Float	4	40	-40	150	43119
40	THDV max warning	%	*	*	Float	4	10	0.5	300	43121
44	Irms max warning	A	*	*	Float	4	1	0.1	9e6	43123
48	NOT USED		*	*	Byte	1	0			43125
49	V min Enable		*	*	Byte	1	0	0	1	43126
50	V max Enable		*	*	Byte	1	0	0	1	43127
51	T1 max Enable.		*	*	Byte	1	0	0	1	43128
52	T2 max Enable.		*	*	Byte	1	0	0	1	43129
53	T3 max Enable.		*	*	Byte	1	0	0	1	43130
54	T4 max Enable.		*	*	Byte	1	0	0	1	43131
55	T5 max Enable.		*	*	Byte	1	0	0	1	43132
56	T6 max Enable.		*	*	Byte	1	0	0	1	43133
57	T7 max Enable.		*	*	Byte	1	0	0	1	43134
58	T8 max Enable.		*	*	Byte	1	0	0	1	43135
59	THDV max Enable.		*	*	Byte	1	0	0	1	43136
60	Irms max Enable.		*	*	Byte	1	0	0	1	43137

5.5.3.5 Event Logging Settings (GroupID = 0x0805)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Vrms Threshold	V	*	*	Float	4	1000	10	9e6	43201
4	Irms Threshold	A	*	*	Float	4	1000	0	9e6	43203
8	Total active power threshold	W	*	*	Float	4	1e6	0	1e9	43205
12	Line active power threshold	W	*	*	Float	4	1e6	0	1e9	43207
16	Total reactive power threshold	var	*	*	Float	4	1e6	0	1e9	43209
20	Line reactive power threshold	var	*	*	Float	4	1e6	0	1e9	43211
24	Total missing reactive power threshold	var	*	*	Float	4	1e6	0	1e9	43213
28	Line missing reactive power threshold	var	*	*	Float	4	1e6	0	1e9	43215
32	Total apparent power threshold	VA	*	*	Float	4	1e6	0	1e9	43217
36	Line apparent power threshold	VA	*	*	Float	4	1e6	0	1e9	43219
40	THDV threshold	%	*	*	Float	4	30	0	1000	43221
44	THDI threshold	%	*	*	Float	4	100	0	1000	43223
48	Supplied Active energy threshold	Wh		*	Float	4	1e6	0	1e9	43225
52	Consumed Active energy threshold	Wh		*	Float	4	1e6	0	1e9	43227
56	Inductive reactive energy threshold	varh		*	Float	4	1e6	0	1e9	43229
60	Capacitive reactive energy threshold	varh		*	Float	4	1e6	0	1e9	43231
64	Apparent energy threshold	VAh		*	Float	4	1e6	0	1e9	43233
68	frequency max threshold	Hz	*	*	Float	4	65	40	70	43235
72	frequency min threshold	Hz	*	*	Float	4	45	40	70	43237
76	temperature T1 threshold max	°C or °F	*	*	Float	4	150	-40	150	43239
80	temperature T1 threshold min	°C or °F	*	*	Float	4	-40	-40	150	43241

84	temperature T2 threshold max	°C or °F	*	*	Float	4	150	-40	150	43243
88	temperature T2 threshold min	°C or °F	*	*	Float	4	-40	-40	150	43245
92	temperature T3 threshold max	°C or °F	*	*	Float	4	150	-40	150	43247
96	temperature T3 threshold min	°C or °F	*	*	Float	4	-40	-40	150	43249
100	temperature T4 threshold max	°C or °F	*	*	Float	4	150	-40	150	43251
104	temperature T4 threshold min	°C or °F	*	*	Float	4	-40	-40	150	43253
108	temperature T5 threshold max	°C or °F	*	*	Float	4	150	-40	150	43255
112	temperature T5 threshold min	°C or °F	*	*	Float	4	-40	-40	150	43257
116	temperature T6 threshold max	°C or °F	*	*	Float	4	150	-40	150	43259
120	temperature T6 threshold min	°C or °F	*	*	Float	4	-40	-40	150	43261
124	temperature T7 threshold max	°C or °F	*	*	Float	4	150	-40	150	43263
128	temperature T7 threshold min	°C or °F	*	*	Float	4	-40	-40	150	43265
132	temperature T8 threshold max	°C or °F	*	*	Float	4	150	-40	150	43267
136	temperature T8 threshold min	°C or °F	*	*	Float	4	-40	-40	150	43269

5.5.3.6 Installation Settings 1 (GroupID = 0x0806)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	CT scaling		*	*	Float	4	1	0.1	10000	43301
4	NOT USED			*	Float	4	1			43303
8	NOT USED			*	Float	4	1			43305

5.5.3.7 User Settings (GroupID = 0x0807)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Target cos j		*	*	Float	4	1	0.7	1.3	43401
4	Night cos j		*	*	Float	4	1	0.7	1.3	43403
8	Regenerative cos j		*	*	Float	4	-1	-1.3	-0.7	43405
12	Night Reg cos j		*	*	Float	4	-1	-1.3	-0.7	43407
16	alarm delay	Sec	*	*	Dword	4	360	1	64800	43409

20	alarm reset delay	Sec	*	*	Dword	4	1	1	64800	43411
24	alarm cos j		*	*	Float	4	1	0.7	1.3	43413
28	Night cos j Enable		*	*	Byte	1	0	0	1	43415
29	Regenerative cos j Enable		*	*	Byte	1	0	0	1	43416
30	NOT USED		*	*	Byte	1	0			43417

The Power factor or cos j format is defined as follows:

P >= 0: 0.0 to 0.5 to 1.0 inductive value = 0.0 …0.5… 1.0

1.0 to 0.5 to 0.0 capacitive value = 1.0 …1.5… 2.0

P < 0: -0.0 to -0.5 to -1.0 inductive value = -0.0 …-0.5… -1.0

-1.0 to -0.5 to -0.0 capacitive value = -1.0 …-1.5… -2.0

Positive values are for passive loads. Negative values represent regenerative mode.

5.5.3.8 ID (GroupID = 0x0808)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Serial number low		*	*	Dword	4		0	0xFFFFFFFF	43501
4	Serial number high		*	*	Dword	4		0	0xFFFFFFFF	43503
8	Article number		*	*	Dword	4		0	0xFFFFFFFF	43505
12	RVT relay number		*	*	Byte	1		6	12	43507
13	RVT model (RVT/RVT3P)		*	*	Byte	1		0	1	43508
14	ABB IDnr1		*	*	Byte	1		0	0xFF	43509
15	ABB IDnr2		*	*	Word	2		0	0xFFFF	43510
17	ABB IDnr3		*	*	Dword	4		0	0xFFFFFFFF	43511
21	Soft Version		*	*	Dword	4		0	0xFFFFFFFF	43513
25	Internal Temperature protection		*	*	Float	4	85	0	120	43515
29	Product ID 0		*	*	Word	2		0	0xFFFF	43517
31	Product ID 1		*	*	Word	2		0	0xFFFF	43518
33	Product ID 2		*	*	Word	2		0	0xFFFF	43519
35	Product ID 3		*	*	Word	2		0	0xFFFF	43520
37	Product ID 4		*	*	Word	2		0	0xFFFF	43521
39	Product ID 5		*	*	Word	2		0	0xFFFF	43522

41	Product ID 6	*	*	Word	2	0	0xFFFF	43523
43	Product ID 7	*	*	Word	2	0	0xFFFF	43524
45	Product ID 8	*	*	Word	2	0	0xFFFF	43525
47	Product ID 9	*	*	Word	2	0	0xFFFF	43526
49	Product ID 10	*	*	Word	2	0	0xFFFF	43527
51	Product Type 0	*	*	Word	2	0	0xFFFF	43528
53	Product Type 1	*	*	Word	2	0	0xFFFF	43529
55	Product Type 2	*	*	Word	2	0	0xFFFF	43530

This group ID is a read-only group of parameters.

The ‘RVT model’ parameter is defined as follows:

Value	Description
0	RVT version
1	RVT 3-phase version

5.5.3.9 Status information (GroupID = 0x0809)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Default value	Min value	Max value	Modb @
0	Communication lock status		*	*	Byte	1	0	0	1	32501
1	NOT USED		*	*	Byte	1	0			32502
2	NOT USED		*	*	Byte	1	0			32503
3	NOT USED		*	*	Byte	1	0			32504
4	NOT USED		*	*	Byte	1	0			32505
5	NOT USED		*	*	Byte	1	0			32506
6	NOT USED		*	*	Byte	1	0			32507
7	NOT USED		*	*	Byte	1	0			32508
8	NOT USED		*	*	Byte	1	0			32509

The ‘Communication lock status’ parameter is defined as follows:

Value	Description
0	Unlocked
1	Locked

5.5.4 Measurement

5.5.4.1 Voltage (GroupID = 0x1000)

The data provided in this table depends on the connection type of the voltage measurement inputs to the RVT. Non connected inputs will give not applicable (n.a.) results. Please refer to Appendix A7 of the RVT Manual for more information.

Connection type: 1Ph-1LL1, 3Ph-1LL1, and 3Ph-1LL3

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	n.a.								30501
4	RMS voltage L-L	V	*	*	Float	4	10	9,00E+06	30503
8	n.a.								30505
12	n.a.								30507
16	n.a.								30509
20	n.a.								30511
24	n.a.								30513
28	n.a.								30515
32	n.a.								30517
36	Fundamental voltage L-L	V	*	*	Float	4	10	9,00E+06	30519
40	n.a.								30521
44	n.a.								30523
48	n.a.								30525
52	n.a.								30527
56	n.a.								30529
60	n.a.								30531
64	n.a.								30533
68	Voltage THD L-L	%	*	*	Float	4	0	1000	30535
72	n.a.								30537
76	n.a.								30539
80	n.a.								30541
84	n.a.								30543
88	n.a.								30545
92	n.a.								30547
96	Frequency	Hz	*	*	Float	4	45	75	30549
100	n.a.								30551

Connection type: 3Ph-1LN1

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	n.a.								30501
4	RMS voltage L-N	V	*	*	Float	4	10	9,00E+06	30503
8	n.a.								30505
12	n.a.								30507

16	n.a.								30509
20	n.a.								30511
24	n.a.								30513
28	n.a.								30515
32	n.a.								30517
36	Fundamental voltage L-N	V	*	*	Float	4	10	9,00E+06	30519
40	n.a.								30521
44	n.a.								30523
48	n.a.								30525
52	n.a.								30527
56	n.a.								30529
60	n.a.								30531
64	n.a.								30533
68	Voltage THD L-N	%	*	*	Float	4	0	1000	30535
72	n.a.								30537
76	n.a.								30539
80	n.a.								30541
84	n.a.								30543
88	n.a.								30545
92	n.a.								30547
96	Frequency	Hz	*	*	Float	4	45	75	30549
100	n.a.								30551

Connection type: 3Ph-3LL3, 3Ph-3LL2, and 3Ph-3LN3

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	RMS voltage L1-L2	V		*	Float	4	10	9e6	30501
4	RMS voltage L2-L3	V		*	Float	4	10	9e6	30503
8	RMS voltage L3-L1	V		*	Float	4	10	9e6	30505
12	Total RMS voltage L-L	V		*	Float	4	10	9e6	30507
16	RMS voltage L1-N	V		*	Float	4	10	9e6	30509
20	RMS voltage L2-N	V		*	Float	4	10	9e6	30511
24	RMS voltage L3-N	V		*	Float	4	10	9e6	30513
28	Total RMS voltage L-N	V		*	Float	4	10	9e6	30515
32	Fundamental voltage L1-L2	V		*	Float	4	10	9e6	30517

36	Fundamental voltage L2-L3	V		*	Float	4	10	9e6	30519
40	Fundamental voltage L3-L1	V		*	Float	4	10	9e6	30521
44	Total Fundamental voltage L-L	V		*	Float	4	10	9e6	30523
48	Fundamental voltage L1-N	V		*	Float	4	10	9e6	30525
52	Fundamental voltage L2-N	V		*	Float	4	10	9e6	30527
56	Fundamental voltage L3-N	V		*	Float	4	10	9e6	30529
60	Total Fundamental voltage L-N	V		*	Float	4	10	9e6	30531
64	Voltage THD L1-L2	%		*	Float	4	0	1000	30533
68	Voltage THD L2-L3	%		*	Float	4	0	1000	30535
72	Voltage THD L3-L1	%		*	Float	4	0	1000	30537
76	Total THD L-L	%		*	Float	4	0	1000	30539
80	Voltage THD L1-N	%		*	Float	4	0	1000	30541
84	Voltage THD L2-N	%		*	Float	4	0	1000	30543
88	Voltage THD L3-N	%		*	Float	4	0	1000	30545
92	Total THD L-N	%		*	Float	4	0	1000	30547
96	Frequency	Hz		*	Float	4	45	75	30549
100	Voltage imbalance	%		*	Float	4	0	300	30551

Connection type: 3Ph-1LN3

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	n.a.								30501
4	n.a.								30503
8	n.a.								30505
12	n.a.								30507
16	n.a.								30509
20	RMS voltage L-N	V		*	Float	4	10	9,00E+06	30511
24	n.a.								30513
28	n.a.								30515
32	n.a.								30517
36	n.a.								30519
40	n.a.								30521
44	n.a.								30523
48	n.a.								30525

52	Fundamental voltage L-N	V	*	Float	4	10	9,00E+06	30527
56	n.a.							30529
60	n.a.							30531
64	n.a.							30533
68	n.a.							30535
72	n.a.							30537
76	n.a.							30539
80	n.a.							30541
84	Voltage THD L-N	%	*	Float	4	0	1000	30543
88	n.a.							30545
92	n.a.							30547
96	Frequency	Hz	*	Float	4	45	75	30549
100	n.a.							30551

5.5.4.2 Line Currents (GroupID = 0x1001)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	RMS line current L1	A	*	*	Float	4	0	9e6	30601
4	RMS line current L2	A		*	Float	4	0	9e6	30603
8	RMS line current L3	A		*	Float	4	0	9e6	30605
12	Total RMS line current	A		*	Float	4	0	9e6	30607
16	RMS neutral current	A		*	Float	4	0	9e6	30609
20	Fundamental line current L1	A	*	*	Float	4	0	9e6	30611
24	Fundamental line current L2	A		*	Float	4	0	9e6	30613
28	Fundamental line current L3	A		*	Float	4	0	9e6	30615
32	Total Fundamental line current	A		*	Float	4	0	9e6	30617
36	Line current THD L1	%	*	*	Float	4	0	1000	30619
40	Line current THD L2	%		*	Float	4	0	1000	30621
44	Line current THD L3	%		*	Float	4	0	1000	30623
48	Total Line current THD	%		*	Float	4	0	1000	30625
52	Current imbalance	%		*	Float	4	0	300	30627

5.5.4.4 Temperatures (GroupID = 0x1002)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	Internal Temperature	°C or °F	*	*	Float	4	-40	150	30701
4	External temperature probe 1	°C or °F	*	*	Float	4	-40	150	30703
8	External temperature probe 2	°C or °F	*	*	Float	4	-40	150	30705
12	External temperature probe 3	°C or °F	*	*	Float	4	-40	150	30707
16	External temperature probe 4	°C or °F	*	*	Float	4	-40	150	30709
20	External temperature probe 5	°C or °F	*	*	Float	4	-40	150	30711
24	External temperature probe 6	°C or °F	*	*	Float	4	-40	150	30713
28	External temperature probe 7	°C or °F	*	*	Float	4	-40	150	30715
32	External temperature probe 8	°C or °F	*	*	Float	4	-40	150	30717

5.5.4.5 Powers (GroupID = 0x1003)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	Active power L1	W		*	Float	4	-1e9	1e9	30801
4	Active power L2	W		*	Float	4	-1e9	1e9	30803
8	Active power L2	W		*	Float	4	-1e9	1e9	30805
12	Total Active power	W	*	*	Float	4	-1e9	1e9	30807
16	Mean Active power over 15min	W		*	Float	4	-1e9	1e9	30809
20	Reactive power L1	var		*	Float	4	-1e9	1e9	30811
24	Reactive power L2	var		*	Float	4	-1e9	1e9	30813
28	Reactive power L3	var		*	Float	4	-1e9	1e9	30815
32	Total Reactive power	var	*	*	Float	4	-1e9	1e9	30817
36	Apparent power L1	VA		*	Float	4	-1e9	1e9	30819
40	Apparent power L2	VA		*	Float	4	-1e9	1e9	30821

44	Apparent power L3	VA		*	Float	4	-1e9	1e9	30823
48	Total Apparent power	VA	*	*	Float	4	-1e9	1e9	30825
52	Power factor L1			*	Float	4	-2	2	30827
56	Power factor L2			*	Float	4	-2	2	30829
60	Power factor L3			*	Float	4	-2	2	30831
64	Total Power factor		*	*	Float	4	-2	2	30833
68	Displacement power factor (cos ϕ) L1			*	Float	4	-2	2	30835
72	Displacement power factor (cos ϕ) L2			*	Float	4	-2	2	30837
76	Displacement power factor (cos ϕ) L3			*	Float	4	-2	2	30839
80	Total displacement power factor (cos ϕ)		*	*	Float	4	-2	2	30841
84	NOT USED			*	Float	4	-2	2	30843

See above the Power factor or cos j format (GroupID 0x0807)

5.5.4.6 PFC Control Data (GroupID = 0x1005)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	Missing reactive power L1	var		*	Float	4	0	1e9	30901
4	Missing reactive power L2	var		*	Float	4	0	1e9	30903
8	Missing reactive power L3	var		*	Float	4	0	1e9	30905
12	Missing reactive power	var	*	*	Float	4	0	1e9	30907
16	Missing steps L1	steps		*	Word	2	0	500	30909
18	Missing steps L2	steps		*	Word	2	0	500	30910
20	Missing steps L3	steps		*	Word	2	0	500	30911
22	Missing steps	steps	*	*	Word	2	0	500	30912

5.5.4.7 Status information (GroupID = 0x1006)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	Relay status		*	*	Word	2	0	0x3FFF	31001
2	External input status		*	*	Byte	1	0	3	31002
3	Temperature status		*	*	Byte	1	0	1	31003
4	Alarm status		*	*	Byte	1	0	1	31004

5	NOT USED	*	*	Byte	1	0	0XFF	31005
6	NOT USED	*	*	Byte	1	0	0xFF	31006
7	NOT USED	*	*	Byte	1	0	0xFF	31007
8	NOT USED	*	*	Byte	1	0	0xFF	31008
9	NOT USED	*	*	Byte	1	0	0xFF	31009
10	NOT USED	*	*	Byte	1	0	0xFF	31010
11	NOT USED	*	*	Byte	1	0	0xFF	31011
12	NOT USED	*	*	Byte	1	0	0xFF	31012
13	NOT USED	*	*	Byte	1	0	0xFF	31013
14	NOT USED	*	*	Byte	1	0	0xFF	31014
15	NOT USED	*	*	Byte	1	0	0xFF	31015
16	NOT USED	*	*	Byte	1	0	0xFF	31016
17	NOT USED	*	*	Byte	1	0	0xFF	31017
18	NOT USED	*	*	Byte	1	0	0xFF	31018
19	NOT USED	*	*	Byte	1	0	0xFF	31019
20	NOT USED	*	*	Dword	4	0	0xFFFFFFFF	31020
24	NOT USED	*	*	Dword	4	0	0xFFFFFFFF	31022
28	NOT USED	*	*	Dword	4	0	0xFFFFFFFF	31024

The ‘Relay Status’ parameter is defined as follows:

Value	Description
0	Relay open
1	Relay closed

Bit used	Output relay
Bit 0	1
Bit 1	2
Bit 2	3
Bit 3	4
Bit 4	5
Bit 5	6
Bit 6	7
Bit 7	8
Bit 9	10
Bit 10	11
Bit 11	12
Bit 12	Alarm

Bit 13	Fan
Bit 14	Not used

The ‘External input status’ parameter is defined as follows:

Value	Description
0	External input reset
1	External input set

Bit used	External Input Number
Bit 0	1
Bit 1	2
Bit 2	Not used
Bit 3	Not used
Bit 4	Not used
Bit 5	Not used
Bit 6	Not used
Bit 7	Not used

The ‘Temperature status’ parameter is defined as follows:

Value	Description
0	Reset
1	Set

The ‘Alarm status’ parameter is defined as follows:

Value	Description
0	Reset
1	Set

5.5.5 Info – Universal

5.5.5.1 Ethernet current configuration (GroupID = 0x2001)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	Current IP address			*	Dword	4	0	0xFFFFFFFF	32601
4	Current IP mask			*	Dword	4	0	0xFFFFFFFF	32603
8	Current Gateway IP address			*	Dword	4	0	0xFFFFFFFF	32605

12	NOT USED	*	Dword	4	0	0xFFFFFFFF	32607
16	NOT USED	*	Dword	4	0	0xFFFFFFFF	32609

These variables are providing information about the current network configuration.

When DHCP is disabled, those values will be the same as the one from the Ethernet Data parameter.

When DHCP is enabled, those values will be different than the static ones provided in the Ethernet Data parameter.

5.5.5.2 LED control (GroupID = 0x2081)

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	Min value	Max value	Modb @
0	Led frequency Status		*	*	Byte	1	0	4	31101

The ‘LED frequency status’ parameter is defined as follows:

Value	Blinking rate
0	Always off
1	0.5 second
2	1 second
3	2 seconds
4	Always on

5.6 Source IDs

Here are the different curves available on the RVT and their associated ID:

Byte Offset	Description	Units	RVT	RVT3P	Data type	Size in bytes	# elts	Min value	Max value
0	Voltage Spectrum L1-L2	V		*	Float	4	49	-9e6	9e6
1	Voltage Spectrum L2-L3	V	*	*	Float	4	49	-9e6	9e6
2	Voltage Spectrum L3-L1	V		*	Float	4	49	-9e6	9e6
3	Current Spectrum L1	A	*	*	Float	4	49	-9e6	9e6
4	Current Spectrum L2	A		*	Float	4	49	-9e6	9e6
5	Current Spectrum L3	A		*	Float	4	49	-9e6	9e6
6	Current Spectrum N	A		*	Float	4	49	-9e6	9e6

7	Voltage Spectrum L1-L2	%V1		*	Word	2	49	0	300
8	Voltage Spectrum L2-L3	%V1	*	*	Word	2	49	0	300
9	Voltage Spectrum L3-L1	%V1		*	Word	2	49	0	300
10	Current Spectrum L1	%A1	*	*	Word	2	49	0	300
11	Current Spectrum L2	%A1		*	Word	2	49	0	300
12	Current Spectrum L3	%A1		*	Word	2	49	0	300
13	Current Spectrum Neutral	%A1		*	Word	2	49	0	300
14	Samples L1-L2	V		*	Float	4	128	-9e6	9e6
15	Samples L2-L3	V	*	*	Float	4	128	-9e6	9e6
16	Samples L3-L1	V		*	Float	4	128	-9e6	9e6
17	Samples L1-N	V		*	Float	4	128	-9e6	9e6
18	Samples L2-N	V		*	Float	4	128	-9e6	9e6
19	Samples L3-N	V		*	Float	4	128	-9e6	9e6
20	Samples I1	A	*	*	Float	4	128	-9e6	9e6
21	Samples I2	A		*	Float	4	128	-9e6	9e6
22	Samples I3	A		*	Float	4	128	-9e6	9e6
23	Samples INeutral	A		*	Float	4	128	-9e6	9e6

These IDs will have to be used in the TCP/IP server/client command requesting to gather some curve information.

6 Windows Communication DLL for PQ-Link protocol

6.1 Introduction

This document describes the interface of the Windows Communication DLL.

The interface is heavily based on the protocol described Chapter 4 of this document.

This document will focus on the differences with the protocol. Indeed, to ease the life of DLL user, some code has been added to handle annoying parts of the protocol.

Moreover, to be compatible with Visual Basic 6.0, some types have had to be modified as VB does not support certain types (unsigned 16-bits integer for example).

The DLL allows communicating with the RVT through:

- a TCP/IP network connection
- the RVT USB serial interface

6.2 Interface

6.2.1 Introduction

All exported library functions follow some similar syntax:

```
COMMANDCLIENTDLL_API int __stdcall CommandClient_Fct(…);
```

The first item is defined as follows:

```
#ifdef COMMANDCLIENTDLL_EXPORTS
#define COMMANDCLIENTDLL_API __declspec(dllexport)
#else
#define COMMANDCLIENTDLL_API __declspec(dllimport)
#endif
```

The “COMMANDCLIENTDLL_EXPORTS” define is used within the DLL to make sure that the functions get exported. When the DLL is used in an external program, it is not defined and the functions are then imported from the DLL.

All functions return an integer providing an error code to the calling layer.

The “__stdcall” specifier is used to indicate that the calling convention to be used is the standard one.

Special care has been taken so that the function names exported by the DLL are the same as the ones defined above.

WARNING: in the rest of this chapter, “COMMANDCLIENTDLL_EXPORTS” and “__stdcall” have been removed from the documentation to ease the reading. They are naturally always present in the header file.

6.2.2 Opening and Closing

6.2.2.1 CommandClient_Init

This function opens the connection to the RVT.

It has the following prototype:

```
int CommandClient_Init(char *RVTAddress,
                       int   ConnectionType,
                       void ( __stdcall *Callback_ConnectionReset)(void));
```

The RVTAddress parameter is an IP address in the case of a TCP/IP connection e.g. “192.168.1.40” or a COM port in the case of a serial connection e.g. “COM11”.

The ConnectionType can take two values:

- 0 or CONNECTION_TYPE_TCPIP for a TCP/IP connection
- 1 or CONNECTION_TYPE_SERIAL for a serial connection

The Callback_ConnectionReset is a pointer to a function that will be called if a loss of connection with the RVT is detected.

If one does not wish to use the callback mechanism, this parameter can be set to NULL. Unwanted disconnections can then be detected when any of the DLL function call returns the “RVT_SYS_SOCKET_DISCONNECTED” error code.

When a disconnection is happening, it is necessary to call the clean function to free the PC resources used and try to connect to the RVT again.

6.2.2.2 CommandClient_Clean

This function closes the connection to the RVT.

It has the following prototype:

```
int CommandClient_Clean();
```

The closing allows to free resources allocated both on the PC side and on the RVT side.

6.2.3 Authentication

Please note that the user account covered here are applicative user account handled by the RVT.

Once the TCP/IP, USB or Modbus connection has been established to the server, the client must authenticate itself.

As the system can be accessed remotely, some basic authentication is put in place. This allows distinguishing users and granting them certain rights to do things.

This authentication is mentioned as the first point of the command layer for the very important reason that no command will be accepted before an authentication is performed. The only exception is for the local administrator user that is automatically detected based on its local connection to the server.

6.2.3.1 CommandClient_Authenticate

This function allows authenticating as a given user on the RVT.

It has the following prototype:

```
int CommandClient_Authenticate(char          *Login,
                               char          *Password,
                               unsigned char *AccessLevel);
```

The password is here given as a string and transformed by the DLL to be used in the protocol.

The Login and Password parameters are used to authenticate oneself and the AccessLevel is returned to indicate the associated access level.

Access levels

The following access levels are defined:

Level	Name	Description
0x00	Monitor	Very basic user allowing only reading measurements and curves from the device.
0x10	Configurator	More advanced user allowed modifying measurement parameters.
0x40	Administrator	User allowed modifying any parameter of the device and to create and delete users.
0x80	Local application	Special user created for internal use only. It has the same rights as an Administrator.
0xFF	Reserved	Reserved.

6.2.3.2 CommandClient_CreateUser

This function allows creating a new user account on the RVT.

It has the following prototype:

```
int CommandClient_CreateUser(char          *Login,
                             char          *Password,
                             unsigned char AccessLevel);
```

The password is here given as a string and transformed by the DLL to be used in the protocol.

The AccessLevel parameter specifies what access level to associate with the new user account.

6.2.3.3 CommandClient_DeleteUser

This function allows deleting a user account on the RVT.

It has the following prototype:

```
int CommandClient_DeleteUser(char *Login);
```

6.2.4 Parameter access

6.2.4.1 CommandClient_GetParameter

This function allows getting a parameter group from the RVT.

It is restricted to configuration, measurement and information parameters.

The parameter is read from the actual parameters memory.

Note that the parameters that have been set in the shadow memory but not yet applied are not returned when a “Get Parameter” command is issued.

For a reason of transmission efficiency, it is only possible to transfer parameter by groups of parameters; in other words, transmission of individual parameters is not foreseen.

One must have at least Monitor rights to perform this task.

It has the following prototype:

```
int CommandClient_GetParameter(int            ParamGroupID,
                               unsigned char *Value,
                               int           *Size);
```

The ParamGroupID is specifying which parameter group to get.

The Value and Size parameters are pointers to the buffer where the parameter group values will be stored and to the actual size of this parameter group.

6.2.4.2 CommandClient_SetParameter

This function allows setting a parameter group in the RVT.

It is restricted to configuration parameters.

The modification of application specific parameters is applied in a shadow memory. Parameter changes will only be copied to parameters memory after an “Apply Parameter Changes” command is issued.

The modification of universal parameters is applied directly i.e. no “Apply Parameter Changes” command is required.

For a reason of transmission efficiency, it is only possible to transfer parameter by groups of parameters; in other words, transmission of individual parameters is not foreseen.

One must have at least Configurator rights to set application specific parameters and at least administrator rights to set universal parameters.

It has the following prototype:

```
int CommandClient_SetParameter(int            ParamGroupID,
                               unsigned char *Value,
                               int            Size);
```

The ParamGroupID is specifying which parameter group to set.

The Value parameter is a pointer to the buffer where the data to write is stored and the Size is specifying the amount of data to be written.

6.2.4.3 CommandClient_ApplyParameterChanges

This function applies the shadowed parameter changes in the parameter memory of the RVT.

One must have at least Monitor rights to perform this task.

It has the following prototype:

```
int CommandClient_ApplyParameterChanges();
```

6.2.4.4 CommandClient_ConvertRVTtoVB

This helper function allows retrieving a single parameter value from a parameter group.

It has the following prototype:

```
int CommandClient_ConvertRVTtoVB(unsigned char *ParamGroupValue,
                                 int            Offset,
                                 unsigned char  ValueType,
                                 char          *OutputString,
                                 int           *OutputStringSize);
```

The ParamGroupValue are the parameter group value as returned by the CommandClient_GetParameter command. This is a buffer of unsigned char values.

The Offset and ValueType are specifying where to find the wanted data and what is the type of the wanted value.

The OutputString and OutputStringSize are specifying where the string should be placed and what its size is.

One should make sure that there’s enough space in the output buffer for the string. Currently, the biggest parameters defined for the RVT are 180 bytes big and are of the string type. Numbers are converted into much smaller strings.

6.2.4.5 CommandClient_ConvertVBtoRVT

This helper function allows setting a single parameter value into a parameter group.

It has the following prototype:

```
int CommandClient_ConvertVBtoRVT(char          *InputString,
                                 unsigned char *ParamGroupValue,
                                 int            Offset,
                                 unsigned char  ValueType);
```

The InputString is the value to be converted and stored in the parameter group.

The ParamGroupValue is the parameter group value as returned by the CommandClient_GetParameter command. This is a buffer of unsigned char values.

The Offset is specifying where to store the converted data and the ValueType is specifying what type of data should be written to the parameter group.

One should make sure that the Offset and ValueType will not cause writing out of the ParamGroupValue buffer.

6.2.5 Curve access

6.2.5.1 CommandClient_RequestCurveEx (future use)

This function makes a request to get a curve available.

Wanted curve is identified by their Source ID.

One must have at least Monitor rights to perform this task.

The curves will be too big to be retrieved with a single command. As a consequence, the data will be split in chunk. The server is specifying the size of those chunks and is warning the client of how many of those chunks will need to be transferred to get the complete curve.

It has the following prototype:

```
int CommandClient_RequestCurveEx(int            SourceID,
                                 unsigned char  NumberOfPeriods,
                                 unsigned char  TriggerEnable,
                                 int            TriggerSource_ID,
                                 int            TriggerSource_Offset,
                                 unsigned char  TriggerComparator,
                                 unsigned char  TriggerValue_Type,
                                 char          *TriggerValue_ValueString,
                                 int           *CurveDescriptor);
```

The CurveDescriptor is made out of the NumberOfChunks and ChunkSize as defined in the protocol.

The Trigger Value to be used is here provided as a string and is converted by the DLL to the type specified by TriggerValue_Type.

It can take some time between the moment of the request and the time where the first data gets available.

IMPORTANT NOTE:

- Number of periods is “1” by default
- Trigger function is reserved for future use : “0” by default

6.2.5.2 CommandClient_RequestCurve

This is a simplified version of the CommandClient_RequestCurveEx command where triggering is disabled.

It has the following prototype:

```
int CommandClient_RequestCurve(int            SourceID,
                               unsigned char  NumberOfPeriods,
                               int           *CurveDescriptor);
```

6.2.5.3 CommandClient_ReleaseCurve

This function is telling the RVT to stop getting data for the given curve.

If the curve was requested by a single client, the curve is not made available anymore for the client and the slot is freed.

If the curve was requested by multiple clients, the freeing is only made when the last client releases the curve.

Note that the effect of this command may not be immediate.

One must have at least Monitor rights to perform this task.

It has the following prototype:

```
int CommandClient_ReleaseCurve(int SourceID);
```

6.2.5.4 CommandClient_GetCurve

This function is getting curve data from the RVT.

It has the following prototype:

```
int CommandClient_GetCurve(int            SourceID,
                           int            CurveDescriptor,
                           unsigned char *Value,
                           int           *Size);
```

The SourceID and CurveDescriptor are identifying the curve.

The Value is a buffer where the curve will be stored and the Size is the actual size of the curve returned. One should make sure that the buffer is big enough to contain the curve.

The curves are transferred by chunks.

This function is taking care of downloading the number of chunks required to get the complete curve. It is also taking care that all chunks returned do belong to the same curve set.

One must have at least Monitor rights to perform this task.

6.2.5.5 CommandClient_GetCurveIDs

This function is getting all the SourceIDs currently in use by the DLL.

One must have at least Monitor rights to perform this task.

It has the following prototype:

```
int CommandClient_GetCurveIDs(int *SourceIDs,
                              int *Size);
```

The Size is specifying how many SourceIDs have been returned and copied to the location pointed by the SourceIDs pointer. One must ensure that the location is big enough to contain the maximum number of curves allowed by the system.

6.2.5.6 CommandClient_GetCurveCharacteristics

This function is getting the characteristics of a given curve.

It has the following prototype:

```
int CommandClient_GetCurveCharacteristics(int            SourceID,
                                          unsigned char *NumberOfPeriods,
                                          unsigned char *TriggerEnable,
                                          int           *TriggerSource_ID,
                                          int           *TriggerSource_Offset,
                                          unsigned char *TriggerComparator,
                                          unsigned char *TriggerValue_Type,
```

```
char   *TriggerValue_ValueString,
int    *TriggerValue_ValueStringSize,
int            *CurveDescriptor);
```

This function can be seen as a way to get back the parameters that were passed at the moment of requesting the curve.

This function along with the GetCurveIDs function allow for an easy re-populating of the user interface. The interface does not have to store the characteristics of all the curves it currently manages; it can just ask it back to the RVT.

One must have at least Monitor rights to perform this task.

6.2.6 Miscellaneous

Reset

This function allows to remotely restarting the RVT.

It has the following prototype:

```
int CommandClient_Reset();
```

After calling this command, the connection should be closed using the CommandClient_Clean function and should be re-established again.

One needs at least Configurator rights to perform this task.

6.3 Important considerations

6.3.1 Visual Basic 6.0 support

This DLL has been built with support for VB6.0 in mind.

6.3.2 Multi-threading

The DLL is not coded for multi-threaded application.

The first consequence is that all calls to the DLL should be called from a single thread. Calling from different thread could be possible but protection should then be implemented outside of the DLL.

The second consequence is that all calls to the DLL are blocking. In usual cases it is not a problem but when the connection gets lost for example, it could take a short amount of time to return from a called function.

The only alternative is to go for non-blocking behaviour but then the programming of the application will become more complex as a request issued would not have a direct answer with data to process but the answer would come at a later asynchronous stage.

6.3.3 Sequence of actions

The following sequence of action should be followed when using this DLL to communicate with a RVT:

1. Connect to the RVT
2. Authenticate on the RVT

3. Perform wanted actions (Get / Set parameters, Get curves…)
4. Go back to step 3. while the connection should be active
5. Disconnect from the RVT

One should not forget the authentication phase otherwise no subsequent action will be possible and the connection will be closed by the RVT. Moreover, the authentified user's access level will make it possible to perform certain actions or not.

Unwanted TCP/IP or serial disconnections with the RVT can be monitored through the callback provided at initialization time or through the returning o of the "RVT_SYS_SOCKET_DISCONNECTED" code. When that is happening, it is necessary to call the clean function and try to connect to the RVT again.

6.4 Error codes

The following error codes can be returned by the DLL:

Error code define	Value
RVT_SUCCESS	0
RVT_SYS_MEMORY	1
RVT_SYS_TASK_CREATE	2
RVT_SYS_SEMAPHORE_CREATE	3
RVT_SYS_SEMAPHORE_FAILURE	4
RVT_SYS_PERIPHERAL_IO	5
RVT_MEMORY_CORRUPT	6
RVT_SYS_SOCKET_OPEN	10
RVT_SYS_SOCKET_BIND	11
RVT_SYS_SOCKET_LISTEN	12
RVT_SYS_SOCKET_CONNECT	13
RVT_SYS_SOCKET_DISCONNECTED	14
RVT_SYS_INVALID_OBJECT	16
RVT_SYS_BUFFER_OVERFLOW	17
RVT_SYS_BUFFER_TOO_SMALL	18
RVT_NO_MORE_OBJECT_ALLOWED	20
RVT_OBJECT_NOT_FOUND	21
RVT_OBJECT_OPEN_ERROR	22
RVT_OBJECT_IO_ERROR	23
RVT_NO_MORE_OBJECT	24
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6.5 Example codes

6.5.1 Visual Basic 6.0 project

The project is built around a single form for the user interface and a module to define the interface to the DLL.

The form code contains necessary initialization steps to make the DLL available from another directory. It obviously also contain the code for the user interface and associated calls to the DLL functions.

The module contains the necessary constant and function declarations. It also contains some helper functions to be used when using helper functions to convert parameter; these functions take care of memory allocation for the returned strings.

7 Appendices

A1 List of abbreviations

ASCII	American Standard Code for Information Interchange
Baud rate	Unit for measuring transmission speed in bits/s;
Bit	A binary digit, representing a one or zero
Bus	An electrical circuit over which data is transmitted
Byte	A whole number value represented by eight bits (0 to 255)
Chassis or Chassis Ground	A connection to an electrically conductive housing or frame of a device. It may or may not be connected to Earth Ground.
Coil	The telegram structure for Modbus transmission is implemented in registers (WORD) or coils (BOOL). A coil may be either 8 or 16 bits in length.
Common	The voltage reference point of a circuit. It may or may not be connected to earth ground, though it is generally assumed to be at zero volts, unless otherwise indicated. In floating circuits, the common is sometimes at a relatively high potential. This term is sometimes used interchangeably with the term “Ground” or GND
CRC	Cyclic Redundancy Check. Complex error checking on a message block.
CTS	ClearToSend hardware handshaking signal. Used with RequestToSend.
DHCP	is an autoconfiguration protocol used on IP networks. Computers that are connected to IP networks must be configured before they can communicate with other computers on the network. DHCP allows a computer to be configured automatically, eliminating the need for intervention by a network administrator
DLL	Dynamic-link library is Microsoft’s implementation of the shared library concept in the Microsoft Windows and OS/2 operating systems. These libraries usually have the file extension DLL, OCX (for libraries containing ActiveX controls), or DRV (for legacy system drivers). The file formats for DLLs are the same as for Windows EXE files — that is, Portable Executable (PE) for 32-bit and 64-bit Windows. As with EXEs, DLLs can contain code, data, and resources, in any combination.

Earth or Earth Ground

Global zero voltage reference point. Physical connection is made to the earth through a grounding rod, water pipe or other reliable connection.

Ethernet — is a family of frame-based computer networking technologies for local area networks (LANs). It defines a number of wiring and signalling standards for the Physical layer of the OSI networking model as well as a common addressing format and Media Access Control at Data Link Layer.

Ground Voltage reference point of a circuit.

It may or may not be connected to earth ground, though it is generally assumed to be at zero volts. Sometimes used interchangeably with the term “Common”.

Handshaking — method of data flow control for serial communications

Hexadecimal or HEX — A number system using a decimal 16 as its base. A single digit number in HEX ranges from 0 to 15, represented by 0 to 9 and A to F.

HMI — Human-Machine Interface (formerly MMI)

Industrial^{IT} — Umbrella concept for ABB’s vision for enterprise automation.

Industrial^{IT} Architecture

The architecture of the Industrial IT system. The architecture defines how the system is built, in terms of basic concepts, underlying technologies, system topology, modularity, and mechanisms for interaction between different parts of the system. It also defines concepts, rules, and guidelines that a component must comply with in order to fit in the Industrial IT system. A central feature of the IIT architecture is that information and functions are centred on Aspect Objects.

Industrial^{IT} Enabled — A product that is Industrial IT enabled has been verified according to the process of Industrial IT certification. It has the right to use the “Industrial IT enabled” symbol.

IP address — An Internet Protocol (IP) address is a numerical label that is assigned to devices participating in a computer network that uses the Internet Protocol for communication between its nodes. An IP address serves two principal functions: host or network interface identification and location addressing.

Loopback — A test used for checking functionality of a serial port, utilizing a test plug that connects send, receive and handshaking signals

Long Integer — Analog value consisting of two consecutive 16-bit registers

LRC — Longitudinal Redundancy Check

MAC address	In computer networking, a Media Access Control address (MAC address) is a unique identifier assigned to most network adapters or network interface cards (NICs) by the manufacturer for identification, and used in the Media Access Control protocol sub-layer. If assigned by the manufacturer, a MAC address usually encodes the manufacturer's registered identification number.
Measurement	A measurement is a value computed by the controller through its analog and digital inputs. Measurements can be read from the RVT front plate, or through the Modbus protocol.
Modbus adapter	It is an optional small interface module through which the RVT is connected to an external Modbus serial communication bus. It performs an optical to RS485 conversion. The communication with the Modbus adapter is activated with an RVT parameter.
OPC	OLE™ for Process Control. OPC is Plug-n-Play in the field of Automation and HMI. OLE™ for Process Control (OPC™) is the most standard way for connecting hardware and data devices with HMI client applications. OPC is a concept agreed upon by a committee of members from the OPC foundation. Most automation companies in the market place including ABB are members of this foundation. OPC uses state-of-the art technologies like COM, DCOM, ActiveX of Microsoft and makes development and programming easier. In the OPC world, there are two major types of applications: OPC Servers and OPC Clients.
OPC Servers	OPC Server applications are used to collect data from the data sources like hardware devices. At the bottom level, the servers are mainly for reading inputs and writing outputs of the data sources. At the upper level, the servers make the data available in a standard way to the OPC client applications.
OPC Clients	The OPC Client applications can communicate directly with the OPC servers and get the data. This way OPC enhances the interface between client and server applications by providing a standard mechanism to communicate data from a data source to any client application.
Parameter	A parameter is an operating data for the controller. Parameters can be read and programmed with the RVT front plate, or through the Modbus protocol.
Parity	Simple method of data error checking performed at the byte level. May be user-specified as Odd, Even or None with most equipment and software.
PC	Personal Computer

Power[IT] Power Factor Controller	
	Microprocessor based controller from the ABB industrial controller range. The Power[IT] Power Factor Controller RVT is intended to switch capacitor in order to compensate the power factor of the electrical network.
Receive	Incoming communication signal. (Rx)
RTS	RequestToSend hardware handshaking signal. Used with ClearToSend.
RVT	see Power[IT] Power Factor Controller RVT
Rx	See Receive
PLC	Programmable Logic Controller
RTS	Request To Send
RTU	Remote Terminal Unit
Time-out	Parameter specifying the max. wait time in ms. Waiting for a response in the range 0..10000 ms.
Signed Integer	Whole number value represented by 16 bits (-32768 to 32767)
SMTP	Simple Mail Transfer Protocol (SMTP) is an Internet standard for electronic mail (e-mail) transmission across Internet Protocol (IP) networks. SMTP is specified for outgoing mail transport. While electronic mail servers and other mail transfer agents use SMTP to send and receive mail messages, user-level client mail applications typically use only SMTP for sending messages to a mail server for relaying. For receiving messages, client applications usually use either the Post Office Protocol (POP) or the Internet Message Access Protocol (IMAP) or a proprietary system (such as Microsoft Exchange or Lotus Notes/Domino) to access their mail box accounts on a mail server.
SNMP	Simple Network Management Protocol (SNMP) is a UDP-based network protocol. It is used mostly in network management systems to monitor network-attached devices for conditions that warrant administrative attention. SNMP is a component of the Internet Protocol Suite. It consists of a set of standards for network management, including an application layer protocol, a database schema, and a set of data objects
TCP/IP	The Internet Protocol Suite is the set of communications protocols used for the Internet and other similar networks. It is commonly also known as TCP/IP, named from two of the most important protocols in it: the Transmission Control Protocol (TCP) and the Internet Protocol (IP), which were the first two networking protocols defined in this standard.

Transmit	Outgoing communication signal. (Tx)
Tri-State	The ability of a communications transmitter to turn its circuitry off, reducing the load on the network
Tx	see Transmit
Unsigned Integer	Positive whole number value represented by 16 bits (0 to 65535)
USB	Universal Serial Bus is a specification to establish communication between devices and a host controller (usually personal computers).
Word	A group of 16 bits
Xon/Xoff	Software implementation of data flow control

A2 References

- 2GCS212014A0050 - RS485 adapter-Installation and start-up guide.pdf
- 2GCS214014A0050 - RS485 adapter- User guide.pdf
- 2GCS215081A0050_RVT Manual.pdf
- 2GCS220013A0050_Quick start.pdf
- 2GCS221013A0050_ABB Power Quality Link.pdf
- Modicon Modbus Protocol Reference Guide (PI–MBUS–300 Rev. J).

A3 Description of open ports

Port	State
502/TCP	Open
4250/TCP	Open
10022/TCP	Open

A4 Cyber Security Disclaimer note

This product is designed to be connected to and to communicate information and data via a network interface. It is User’s sole responsibility to provide and continuously ensure a secure connection between the product and User’s network or any other network (as the case may be). The User shall 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.

Please note that an ssh account exists for maintenance & development purposes.

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INSTRUCTION MANUAL

RS485 Modbus adapter for RVT controller
Installation and start-up guide

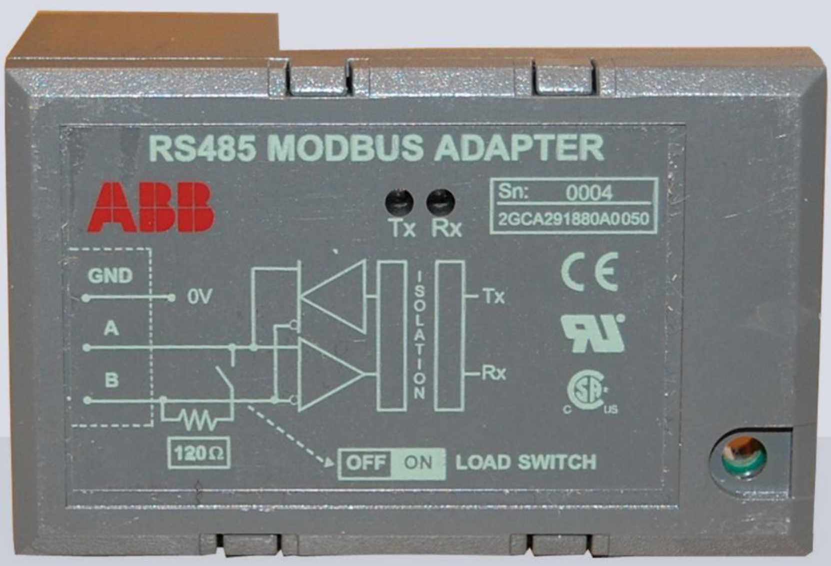


Table of contents

1 Introduction

1.1 Intended audience

This manual is intended for installers, commissioning people, network managers who need to install an RS485 network, start or maintain a supervision system based on the Modbus protocol.

1.2 Before you start

This manual describes the RS485 Modbus adapter.

To be able to access data of the Power Factor Controller RVT Touchscreen consistently, a basic knowledge of it is needed. Functionality of the RVT, meaning of various measurements, logging of data are some particular aspects that should be familiar.

If not, please refer to the RVT Installation and operating Instructions to get the sufficient knowledge.

To know more about the RVT data access, please refer to the RVT Modbus data table.

As other devices may be connected through the RS485 Modbus adapter, the term “controller” will be used here to define the device.

1.3 How to use this manual

Chapter 2 is a short description of the Modbus adapter.

Chapter 3 contains a description of the physical layer. Connection to a controller is described.

Chapter 4 gives all technical details concerning the Modbus adapter.

Chapter 5 is an overview of the Modbus protocol and how Modbus is implemented in the controller.

Chapter 6 contains the table reference and formats to access data.

Chapter 7 is a reference in case of problems

Chapter 8 is dedicated to annexes

2 Overview

This chapter contains a short description of the Modbus protocol and the RS485 interface.

2.1 Introduction to Modbus

Modbus is a serial, asynchronous protocol. The Modbus protocol does not specify the physical interface. The typical physical interfaces are RS-232 and RS-485. The Interface Module uses the RS-485 interface.

Modbus is designed for integration with PLCs or other automation devices, and the services closely correspond to the PLC architecture.

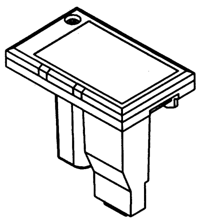
The Modbus commands and services supported by the Modbus adapter are discussed in Chapter 5.

2.2 The Modbus adapter

The Modbus adapter is an optional device for the Power Factor Controller RVT Touchscreen which enables the connection of the RVT to a Modbus system. The controller is considered as a slave unit in the Modbus network.

Through the Modbus adapter it is possible to:

- Read measurements and logged values
- Read and write parameters settings of the controller
- Activate output relays
- Read status information
- Read device identification and type numbers



2.3 Compatibility

The Modbus adapter is compatible with any Power Factor Controller RVT Touchscreen. Other ABB controllers may be connected with the adapter.

CAUTION: Be careful that the RS485 MODBUS ADAPTER is the one with a GREEN text colour (3.3V power supply). The one with a WHITE text colour is reserved for the old model (5V power supply).

The Modbus protocol is compatible with all master stations that support the Modicon-defined Modbus serial communication protocol.

3 Serial interface considerations

The Modbus protocol communicates with the instrumentation by means of an industry standard serial interface. This interface may be RS-232, RS-422 or RS-485. Some systems may also support the protocol over other busses or networks, such as Ethernet.

An RS-232 interface allows only two devices to be connected together.

RS-422 supports 1 driver and up to 10 receivers on a single network.

For bi-directional communications, special tri-state circuitry is provided. RS-485 supports up to 32 driver/receiver pairs. With special hardware, the RS-422 and RS-485 limits can be expanded to allow as many as 248 devices on a single network. Each device on a network must have a unique address, which may be soft configured. Address zero is reserved for broadcast messages from the host to all slaves.

All devices on a network must also be configured with the same parameters, such as baud rate and parity. In designing the communication architecture, one should consider communications performance when deciding how many devices to connect to a host port. Generally, nearly twice the performance can be achieved by splitting the devices from one port, onto two ports.

3.1 Communication mode

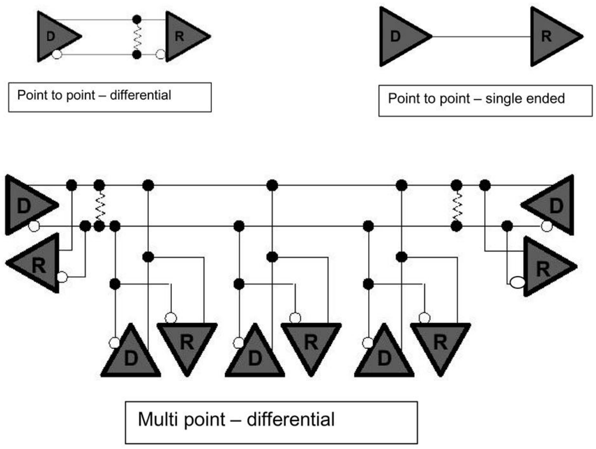
MODBUS protocol uses half-duplex communications, regardless of the hardware.

Half-duplex hardware shares the same lines for transmit and receive, whereas, full-duplex hardware has dedicated transmit and receive lines.

3.2 SINGLE ENDED versus DIFFERENTIAL data transmission

Single-ended transmission is performed on one signal line, and the logical state is interpreted with respect to ground. The main disadvantage of the single-ended solution is its poor noise immunity.

For differential transmission, a pair of signal lines is necessary for each channel. On one line, a true signal is transmitted, while on the second one, the inverted signal is transmitted. The receiver detects voltage difference between the inputs and switches the output depending on which input line is more positive. Differential data transmission schemes are less susceptible to common-mode noise than single-ended schemes.



3.3 RS-232 interface

An RS-232 interface is rated for distances up to 15 meters (50 feet). At least three wires are required for an RS-232 interface. Wires are required for Transmit, Receive and Signal Ground. Some devices support additional wires for communication handshaking. RS-232 hardware is a full-duplex configuration, having separate Transmit and Receive lines.

Each signal that transmits in an RS-232 data transmission system appears on the interface connector as a voltage with reference to a signal ground. The RS-232 receiver typically operates within the voltage range of +3 to +12 and -3 to -12 volts.

3.4 RS-422 interface

An RS-422 interface requires at least four wires. Two wires each are used for Transmit and Receive. A fifth wire is usually required for Signal Ground, when connecting non-isolated devices together. Handshaking lines may also be supported by some hardware. This interface is full duplex, allowing use of the same software drivers as for RS-232. The differential drivers allow for distances up to 1200 meters (4000 feet). The receivers of an RS-422 device are always enabled.

3.5 RS-485 interface

For multi-drop operation, drivers must be capable of tri-state operation.

An RS-485 interface requires at least two wires. In a two-wire configuration, the same pair of wires is used for Transmit and Receive. The two-wire configuration utilizes half-duplex communications. Transmit driver circuits are always taken off-line or tri-stated, when not in use. This tri-state feature reduces the load on the network, allowing more devices, without the need of special hardware. This interface also uses differential drivers, supporting distances up to 1200 meters (4000 feet).

In a differential system the voltage produced by the driver appears across a pair of signal lines that transmit only one signal. A differential line driver will produce a voltage from 2 to 6 volts across its A and B output terminals and will have a signal ground (C) connection. Although proper connection to the signal ground is important, it isn't used by a differential line receiver in determining the logic state of the data line.

A differential line receiver senses the voltage state of the transmission line across two signal input lines, A and B. It will also have a signal ground (C) that is necessary in making the proper interface connection. If the differential input voltage Vab is greater than +200 mV the receiver will have a specific logic state on its output terminal. If the input voltage is reversed to less than -200 mV, the receiver will create the opposite logic state on its output terminal.

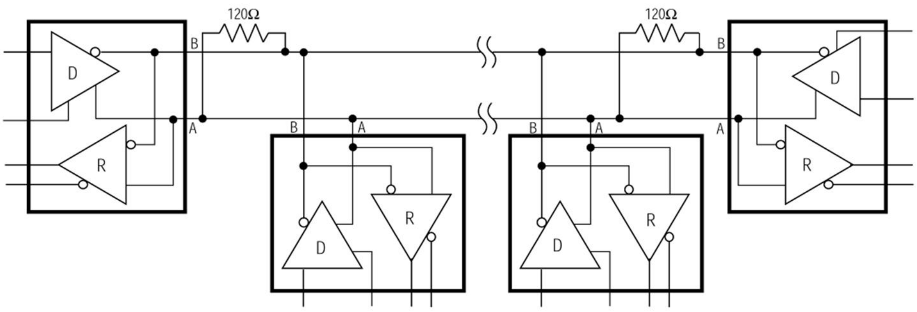
3.6 Bias resistors

RS-422 and RS-485 networks often require bias, or pull-up and pull-down resistors. These resistors are used to stabilize the network. By definition, in a MODBUS RTU network, it is the responsibility of the Master to provide this function.

Some systems may function without these stabilizing resistors, but may be more susceptible to communication errors. Though the pull-up and pull-down resistors are the same, the value of these resistors varies from device to device. The actual recommended resistance may be calculated, and varies with the number of devices on the bus.

3.7 Termination resistors

Termination resistors are often used to reduce reflections on the network. This problem occurs most with long wires and high baud rates. Due to variations in wire and equipment, whether or not to use these terminators is usually determined by system testing. The general rule is to add them only if needed. The resistors are typically 120 ohms, and installed across the Transmit and Receive wire pairs. Normally, one resistor is installed at each end of each pair of wires.



3.8 Shielding and grounding considerations

The signal ground conductor is often overlooked when ordering cable. An extra twisted pair must be specified to have enough conductors to run a signal ground. A two-wire system then requires two twisted pairs.

It is often hard to quantify if shielded cable is required in an application or not. Since the added cost of shielded cable is usually minimal it is worth installing the first time.

3.9 Cable requirements

The type of wire to use will vary with required length. Wire with twisted pairs and an overall shield is used most often. The shield is tied to earth ground or chassis, and typically at one end only (generally at the Modbus Master side). The shield is not to be used as a signal common or ground. The table below lists typical cable recommendations.

RS-232

Up to 15m (50ft) virtually any standard shielded twisted pair with drain (Belden 9502 or equivalent).

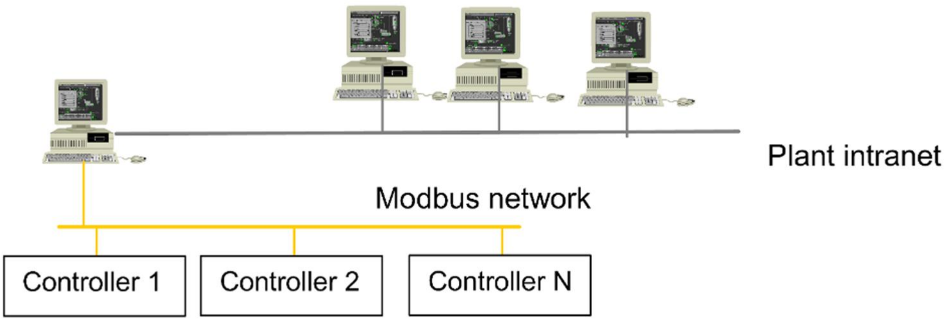
RS-422 and RS-485

Up to 1200m (4000ft) 24 AWG twisted pair with foil shield and drain wire on each pair (Belden 9841 for 2-wire and 9729 for 4-wire or equiv.).

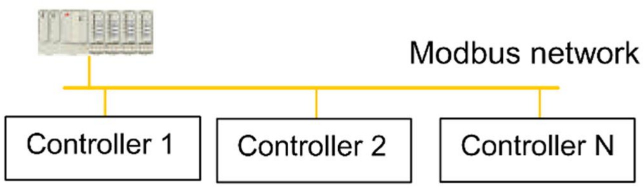
3.10 Network topology

Various kinds of network topologies may be done on the basis of an RS485 Modbus network.

The Modbus network may be managed by a computer collecting data. Typically this computer runs an OPC server connected to a plant intranet. OPC client applications may present this information to any supervision program that will perform the Human machine interface, data logging, and data setting ...



It is also possible to manage the RS485 Modbus network through a PLC.



Various kind of RS485 to RS232 converters exists.

To bridge the Modbus network to another kind of software protocol, various kinds of protocol converters may be used. They are often called 'protocol gateway: Modbus to Profibus, Ethernet, CAN ...

4 RS485 Modbus adapter

The RS485 Modbus adapter enables the connection of the controller to an RS485 Modbus network.

4.1 Main features

The adapter is self-powered through the power supply of the controller.

- Advantage: an external power supply is not needed.
- Advantage: low power consumption.

The adapter is fixed directly on the back side of the RVT.

- Advantage: the Modbus adapter does not need any rail DIN or such fixation methods.

The adapter is electrically isolated from the RVT power supply.

- Advantage: the RVT is protected against common mode voltage levels applied on the RS485 network.
- Advantage: no ground loop.

The adapter has an integrated terminator resistance which may be connected with a switch.

- Advantage: no external device to be added.

The adapter contains transient voltage suppressors.

- Advantage: the device and the network are protected against voltage surges.

The adapter is fitted with transmission and reception indication LED’s.

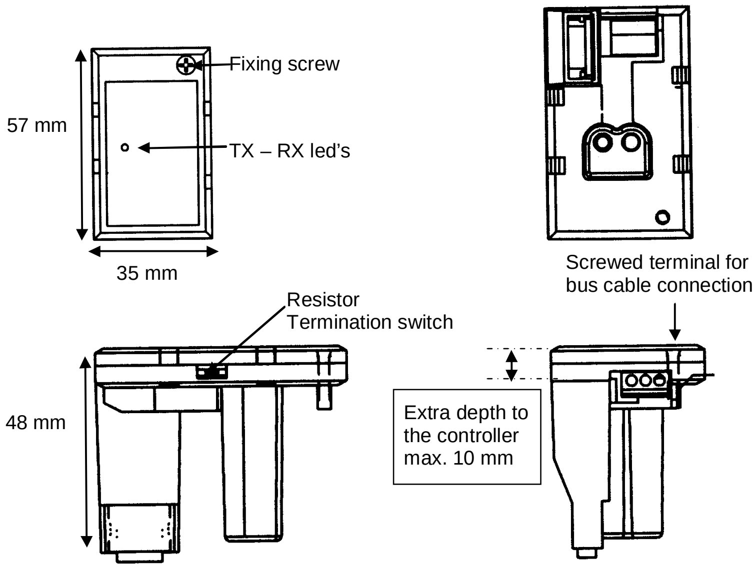
- Advantage: it allows visualizing Modbus queries and Modbus answers.

The controller allows a software adjustment of communication parameters.

- Advantage: no multiple hardware dipswitches to handle.
- Advantage: permits self-tuning of communication parameters with a higher level software application.

4.2 Physical dimensions

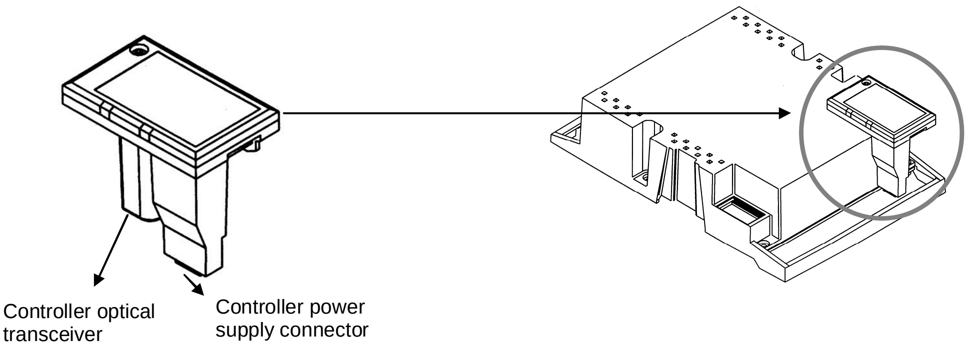
The Modbus adapter is especially suitable for application where space requirements are important.



4.3 Mounting

The Modbus adapter is specially shaped to fit the controller case and to plug into its dedicated connectors without any other additional fixation part than just a screw.

3D view **3D view inserted in back plate**



4.4 Technical data

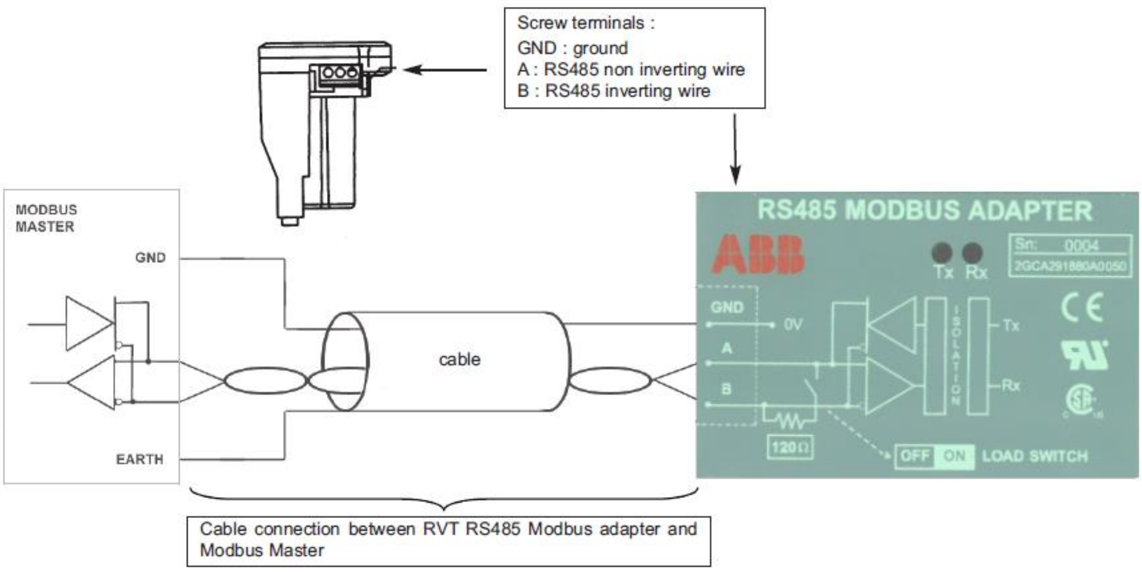
- Operating ambient temperature: -20 to +70 °C
- Number of nodes (Tx drive): 32 max
- Rx loading: receiver impedance is 1 unit load per RS485 Modbus adapter
- Size of the Link: 247 stations including repeaters (31 stations and 1 repeater per segment)
- Medium: Shielded, twisted pair RS485 cable (Belden 9841 typical)
- Maximum Bus Length: 1200 m
- Topology: Multi-drop
- Serial Communication Type: Asynchronous, 2 wires half Duplex
- Baud rate: 110, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 bauds selectable by the user (can be adjusted through the controller menus)

- Termination resistor: built in, selectable by a switch. 120 ohms resistor is needed at both end of the line and must be switched or not depending on the location in the Modbus network topology.
- Transient voltage suppressors
- Screwed terminals on the RS485 side
- TX – RX Led indication for easy debugging and troubleshooting
- Slew-Rate Limited for Error-Free Data Transmission (minimizing EMI and reducing reflections caused by improperly terminated cables)
- Drivers are short-circuit current limited
- The receiver input has a fail-safe feature in case of broken connection
- Compatible Devices: Any Modbus device capable of Modbus communication as a master.
- Speed reply time: better than 5 ms @ 57600 bauds
- Max data packet: Any complete table provided in the Modbus data table

4.5 Commissioning process

To install the RS485 Modbus adapter, follow the hereafter commissioning process.

- Disconnect power supply from the controller
- Wait the required time to ensure all capacitors are discharged
- Connect the signal ground (if present) to GND
- Connect the twisted pair to the A and B connections



Insert the RS485 Modbus adapter in the controller

- Fix it with the appropriate screw
- Ensure that all connections are tight.

- If the RS485 Modbus adapter is one of the two ending station on the communication line put the load termination switch in the ‘ON ‘position. If not, put it in the ‘OFF ‘position.
- Make sure all other Modbus stations (master and slaves) are properly connected
- Apply power on the controller
- Enter the MODBUS menu under:

  COMMUNICATION - I/O CONFIGURATION – COM. SETTINGS – MODBUS

  · Choose a slave address (the address must be unused in the Modbus network it is inserted in)
  · Select the right communication speed (baud rate)
  · Select the right parity checking
  · Select the right number of stop bits
- The Modbus slave is now ready to receive Modbus queries from the Modbus master and to send Modbus response accordingly
- If something goes wrong, see the trouble shooting section hereafter

4.6 To set the COMMUNICATION LOCK parameter

If the RVT’s parameters should be changed only from the Modbus network, set the Communication lock item as locked. It can be found under the following menu:

COMMUNICATION - I/O CONFIGURATION – COM. SETTINGS

- Set the Communication lock parameter to ‘Locked’

4.7 To test the communication

Depending on the way the controller is connected to the Modbus network, different ways of testing may be chosen.

The user can find much application on the internet to scan Modbus devices and test communication.

In case of problem, please refer to the troubleshooting paragraph.

5 Modbus protocol overview

5.1 Overview

MODBUS RTU is a non-proprietary serial communications protocol that is widely used in the process control industry. The protocol was developed by Modicon for PLC communications and later released for public use.

This protocol is available in all major Human Machine Interface (HMI) software packages and terminals. Many of the major controller and PLC manufacturers also offer MODBUS protocol as a standard or optional protocol in their instrumentation.

The hardware over which MODBUS RTU communications are performed is not defined by the protocol. MODBUS RTU is supported on RS-232, RS-422, RS-485, Ethernet and other electrical standards. It should be noted that MODBUS RTU, MODBUS ASCII and MODBUS Plus are unique communication formats, and are not compatible with each other. This document will discuss MODBUS RTU only.

5.1.1 Transactions on Modbus Networks

Modbus protocol uses a master–slave technique, in which only one device (the master) can initiate transactions (called ‘queries’). The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested in the query. Typical master devices include host processors and programming panels. Typical slaves include programmable controllers.

The master can address individual slaves, or can initiate a broadcast message to all slaves.

Slaves return a message (called a ‘response’) to queries that are addressed to them individually. Responses are not returned to broadcast queries from the master.

The Modbus protocol establishes the format for the master’s query by placing into it the device (or broadcast) address, a function code defining the requested action, any data to be sent, and an error–checking field. The slave’s response message is also constructed using Modbus protocol. It contains fields confirming the action taken, any data to be returned, and an error–checking field. If an error occurred in receipt of the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send it as its response.

5.1.2 Serial Transmission Mode

The transmission mode defines the bit contents of message fields transmitted serially on the networks. It determines how information will be packed into the message fields and decoded.

Modbus defines two transmission modes: ASCII or RTU.

Only RTU mode will be used here. The mode and serial parameters must be the same for all devices on a Modbus network.

5.2 Data Addresses in Modbus Messages

Modbus defines 4 address spaces: 2 address spaces for bit addressable data and 2 address spaces for 16 bits addressable data.

Address space	Data	Readable/writable	Modbus name
0XXXX	Output bit	Read & write	Coil Status
1XXXX	Input bit	Read	Input Status
3XXXX	Input word	Read	Input Register
4XXXX	Output word	Read & write	Holding Register

5.3 Supported function codes

The following table gives the Modbus functions, which are implemented and supported.

The code is the one used in function field of the Modbus message.

The address space concerned and the purpose of the function are given below.

Code	Function	Address range/remark
1	Read Coil Status	0XXXX Reads the on/off status of discrete outputs
2	Read Input Status	1XXXX Reads the on/off status of discrete inputs
3	Read Holding Registers	4XXXX Reads contents of output registers
4	Read Input Registers	3XXXX Reads contents of input registers
5	Force Single Coil	0XXXX Sets the status of a discrete output
6	Preset Single Register	4XXXX Sets the value of a holding register
7	Read Exception Status	Device specific (see Modbus data table of a device)
8	Diagnostics	Checks the communication system between the master and the slave
11	Fetch Comm. Event Ctr.	Returns amount of successful read/write operations on data points
12	Fetch Comm. Event Log	Returns log registers of communication events
15	Force Multiple Coils	0XXXX Sets the status of multiple discrete outputs
16	Preset Multiple Registers	4XXXX Sets the value of multiple holding registers
17	Report Slave ID	Device specific (see Modbus data table of the device)
22	Mask Write 4X registers	4XXXX And/Or write of a holding register
23	Read/Write 4X registers	4XXXX Reads a set of holding registers and writes a set of holding registers in one query

6 Data access

6.1 Access levels

Some access levels must be set to allow parameters to be changed. Here are some access levels used in the RVT.

SET MODE: The RVT must be in the Set Mode to allow parameter modifications.

LOCKING SWITCH: the locking switch has to be released

BANK SETTINGS: the parameter bank settings must be set as Unlocked (for more information on these settings, please refer to the RVT Installation and Operating manual).

Another parameter (COMMUNICATION LOCK) is used to add access rights to Modbus users.

The access levels of the Modbus writings are coded in the Modbus data table.

6.2 Minimum and maximum values

Variables have a limited range. If a write operation to a variable exceeds the minimum and maximum allowable values, the variable will be overridden with its minimum or maximum value.

An ILLEGAL DATA VALUE exception error is sent back.

See the Modbus data table for more details.

6.3 Modbus Data table

Data are arranged in several tables for convenience. Individual tables contain similar information. Table data may be read only or read / write access.

Data in each table is pointed to in a Modbus command by two consecutive data address bytes. The first byte defines the table number, and the second byte the offset of the data in the table. These two bytes are what is called the ‘Modbus address’ or the ‘Modbus register’.

A specific Modbus data table is dedicated to a specific product type.

Access (read or write) to a non-referenced Modbus address result in an ILLEGAL DATA ADDRESS exception error.

The Modbus Data table gives all information on the various data and how to access them.

To handle RVT data, please refer to the RVT Modbus Data table.

7 Troubleshooting

7.1 Preferred method of testing

In most cases the Modbus Master (usually a PC software package) will be running on a personal computer or on hardware which has RS232 communications ports. In these instances a converter will be needed to convert the RS232 signals to the RS485 standard used by the controller. Only when the Modbus Master is running on hardware fitted with RS485 ports is a converter unnecessary.

The preferred method of testing communications configuration is to operate with a single controller located close to the Master (PC, PLC etc) and minimum cable length.

Once cable connections, controller configuration and Modbus Master configuration have been successfully tested the system may be connected to the final installation (multiple slaves and extended cabling systems as needed to meet user requirements). Full system configuration and testing can then take place.

The software used to provide the Modbus Master functionality is not supplied. The commissioning engineer should be familiar with the use of the software both while testing connection to controllers and during full system configuration. In general software used during testing can be classed as either application software or Modbus test software, the principal differences between these two types are as follows.

Application software (such as Data Loggers or SCADA systems) is intended to use Modbus devices to perform a measurement, control or logging function. It often provides tools for quick configuration of known types of instrument. Such packages make it easy for a user to start a system without needing to know Modbus commands, but may not provide the tools for a commissioning engineer to diagnose problems when a system does not respond as anticipated.

Modbus test software normally allows Modbus commands to be generated as required and the responses analyzed. Some knowledge of the Modbus protocol and the instrument register addresses will be required before using such a package. Test packages will assist a commissioning engineer in diagnosing communication problems.

7.2 Check of identical Slave – Master configuration

In any case the master must have the same communication parameters as the controller:

Enter the MODBUS menu under:

COMMUNICATION - I/O CONFIGURATION – COM. SETTINGS – MODBUS

- Choose a slave address
- Select the right communication speed (baud rate)
- Select the right parity checking
- Select the right number of stop bits

7.3 Check the cabling of the RS485

- The non-inverting and the inverting output wires should be cabled respectively on non-inverting and inverting input respectively. No communication will take place if non-inverting wires are mixed with inverting wires.
- Load termination resistors are important at both end of the network to avoid distortion due to reflections in the communication line. Check that the ‘Load switch’ is at the right position (ON or OFF) according to the network configuration.
- Connection of a ground wire and presence of a shielding will improve reliability.

7.4 Check the Transmit – Receive indicators

This is a convenient way to check the presence of TX – RX signals:

- The Receive Led (yellow Led) indicates that a Modbus query is being received by the RS485 Modbus adapter.
- The Transmit Led (green Led) indicates that a Modbus response is being transmitted from the RS485 Modbus adapter.

If the Rx Led and the Tx Led never lit, the problem may come from:

- The wires of the RS485 cable are not properly fixed or cabled
- The query is not sent (see the application software)
- The controller and then the RS485 are not powered

If only the Tx Led never lit, the problem may come from:

- The controller settings are not correct (check communication parameters settings)
- The controller entered the ‘listen only’ mode (reset the controller or send the required command to disable the ‘listen only’ mode.)
  - The master sends Broadcast messages (address 0) which are to be acted on by all connected devices and do not require a reply

7.5 Check the function called and the register addresses

To ensure that a read or write message to a Modbus address will produce a normal response, check that the register address corresponds exactly to the desired data requested.

In Modbus register addressing there are several categories of register, including holding registers (numbered from 40001 upwards) and input registers (numbered from 30001 upwards). The category of register addressed is implicit in the Modbus function used, e.g. function 03 addresses holding registers and function 04 addresses input registers.

Irrespective of the function used, the register address 30001 or 40001 would be addressed in the transmitted message as register 0, 30002 or 40002 as register 1, 30010 or 40010 as register 9 and so on.

In the Modbus communications all these register addresses are not active and don't contain valid information. A read or write to an unused register address will produce an exception error.

7.6 Check the data access level and the limited range of data

To ensure that a write message to a Modbus address will produce a normal response, check that the data value and access level is valid.

Writings in the controller memory though Modbus are restricted to the setting of some access levels which need to be set. Look at:

- SET MODE
- LOCKING SWITCH
- BANK SETTINGS

Writings in the controller memory through Modbus are restricted to a limited range applied on that data. An exception error is sent in case of a writing exceeding the allowed limited range of a data.

7.7 Counters and Loopback diagnostics

Modbus offers some interesting functions to help the user to locate errors:

Fetch comm event counter (function 11) to catch successful messages.

Fetch comm event log (function 12) to look at the history of errors.

Diagnostics function and subfunctions (function 8)

Loopback diagnostics (subfunction 0) returns a response identical to the query

Restart communication (subfunction 1)

Force Listen only mode (subfunction 4)

Read various diagnostic counters

7.8 Debugging tool and documents

The user can find much application on the internet to scan Modbus devices and test communication.

Look in the documentation of the controller and the corresponding Modbus data table for appropriate information.

Look in the Modbus protocol for more information on Modbus.

8 Appendices

A1 List of abbreviations

ASCII	American Standard Code for Information Interchange
Baud rate	Unit for measuring transmission speed in bits/s;
Bit	A binary digit, representing a one or zero
Bus	An electrical circuit over which data is transmitted
Byte	A whole number value represented by eight bits (0 to 255)
Chassis or Chassis Ground	A connection to an electrically conductive housing or frame of a device. It may or may not be connected to Earth Ground.
Coil	The telegram structure for Modbus transmission is implemented in registers (WORD) or coils (BOOL). A coil may be either 8 or 16 bits in length.
Common	The voltage reference point of a circuit. It may or may not be connected to earth ground, though it is generally assumed to be at zero volts, unless otherwise indicated. In floating circuits, the common is sometimes at a relatively high potential. This term is sometimes used interchangeably with the term “Ground” or GND
CRC	Cyclic Redundancy Check. Complex error checking on a message block.
CTS	ClearToSend hardware handshaking signal. Used with RequestToSend.
Earth or Earth Ground	Global zero voltage reference point. Physical connection is made to the earth through a grounding rod, water pipe or other reliable connection.
Ground Voltage reference point of a circuit.	It may or may not be connected to earth ground, though it is generally assumed to be at zero volts. Sometimes used interchangeably with the term “Common”.
Handshaking	method of data flow control for serial communications
Hexadecimal or HEX	A number system using a decimal 16 as its base. A single digit number in HEX ranges from 0 to 15, represented by 0 to 9 and A to F.
HMI	Human-Machine Interface (formerly MMI)

Industrial^{IT}	Umbrella concept for ABB's vision for enterprise automation.
Industrial^{IT} Architecture	
	The architecture of the Industrial IT system. The architecture defines how the system is built, in terms of basic concepts, underlying technologies, system topology, modularity, and mechanisms for interaction between different parts of the system. It also defines concepts, rules, and guidelines that a component must comply with in order to fit in the Industrial IT system. A central feature of the IIT architecture is that information and functions are centred on Aspect Objects.
Industrial^{IT} Enabled	A product that is Industrial IT enabled has been verified according to the process of Industrial IT certification. It has the right to use the "Industrial IT enabled" symbol.
Loopback	A test used for checking functionality of a serial port, utilizing a test plug that connects send, receive and handshaking signals
Long Integer	Analog value consisting of two consecutive 16-bit registers
LRC	Longitudinal Redundancy Check
Measurement	A measurement is a value computed by the controller through its analog and digital inputs. Measurements can be read from the RVT front plate, or through the Modbus protocol.
Modbus adapter	It is an optional small interface module through which the RVT is connected to an external Modbus serial communication bus. It performs an optical to RS485 conversion. The communication with the Modbus adapter is activated with an RVT parameter.
OPC	OLE™ for Process Control. OPC is Plug-n-Play in the field of Automation and HMI. OLE™ for Process Control (OPC™) is the most standard way for connecting hardware and data devices with HMI client applications. OPC is a concept agreed upon by a committee of members from the OPC foundation. Most automation companies in the market place including ABB are members of this foundation. OPC uses state-of-the art technologies like COM, DCOM, ActiveX of Microsoft and makes development and programming easier. In the OPC world, there are two major types of applications: OPC Servers and OPC Clients.
OPC Servers	OPC Server applications are used to collect data from the data sources like hardware devices. At the bottom level, the servers are mainly for reading inputs and writing outputs of the data sources. At the upper level, the servers make the data available in a standard way to the OPC client applications.

OPC Clients	The OPC Client applications can communicate directly with the OPC servers and get the data. This way OPC enhances the interface between client and server applications by providing a standard mechanism to communicate data from a data source to any client application.
Parameter	A parameter is an operating data for the controller. Parameters can be read and programmed with the RVT front plate, or through the Modbus protocol.
Parity	Simple method of data error checking performed at the byte level. May be user-specified as Odd, Even or None with most equipment and software.
PC	Personal Computer
PLC	Programmable Logic Controller
Power^{IT} Power Factor Controller	Microprocessor based controller from the ABB industrial controller range. The Power^{IT} Power Factor Controller RVT is intended to switch capacitor in order to compensate the power factor of the electrical network.
Receive	Incoming communication signal. (Rx)
RTS	RequestToSend hardware handshaking signal. Used with ClearToSend.
RVT	see Power^{IT} Power Factor Controller RVT
RTU	Remote Terminal Unit
Rx	See Receive
Signed Integer	Whole number value represented by 16 bits (-32768 to 32767)
Time-out	Parameter specifying the max. wait time in ms. Waiting for a response in the range 0..10000 ms.
Transmit	Outgoing communication signal. (Tx)
Tri-State	The ability of a communications transmitter to turn its circuitry off, reducing the load on the network
Tx	see Transmit
Unsigned Integer	Positive whole number value represented by 16 bits (0 to 65535)
Word	A group of 16 bits
Xon/Xoff	Software implementation of data flow control

A2 References

- 2GCS213019A0050_RVT communication with Modbus RTU, Modbus TCP and PQ Link protocols

- 2GCS215081A0050_RVT Manual.pdf
- Modicon Modbus Protocol Reference Guide (PI–MBUS–300 Rev. J).

A3 Adequate choice of an RS232-RS485 converter at the computer side

In a RS-485 network, a control of the direction is needed to alternate between transmission and reception. Two cases may be found:

- No flow control:

  The direction control is done in the RS-232 to RS-485 converter. The converter senses the data direction and release automatically the line to tristate when no activity is found. The release time is typically one character length (11 bits / baudrate).

- RTS flow control:

  The direction control is done by setting RTS signal (Request To Send) and releasing RTS after transmission. This is done by software. The drawback is that if the software is busy by another task or if the PC is too slow, the direction control may be inverted too late, losing received data.

  In Modbus RTU framing, messages start with a silent interval of at least 3.5 character times. The table below is related to the RS-485 Modbus Adapter.

  It shows the timings of the minimum silent length between the reception of a query and the transmission of an answer at different Baud rate.

Baud rate (bits/sec)	Minimum silent length (ms)
110	350
300	160
600	80
1200	40
2400	18.8
4800	9.5
9600	5.5
19200	3.4
38400	1.6
57600	1.6

The choice of the RS-232 / RS-485 is then particularly important as a bad management of the direction of transmission may lead to communication errors or no communication at all. If RTS is released too early, the query will not arrive to the Modbus slave and no answer will be initiated. If RTS is released too late, the answer will not be received completely by the Modbus master.

As a consequence, to ensure higher throughput and reliable communication, the recommendation is done to choose an RS-232 / RS-485 able to sense and manage the data direction, and to avoid any computer dependent flow control. Missing to do so may lead to force the user to work with a slower transmission speed.

An also important feature is the isolation between the RS-232 side and the RS-485 side to avoid ground loops and to work safely.

Finally, port powered converters should be considered carefully as some computers don't have sufficient power to feed efficiently the RS-232-RS-485 converter.

—

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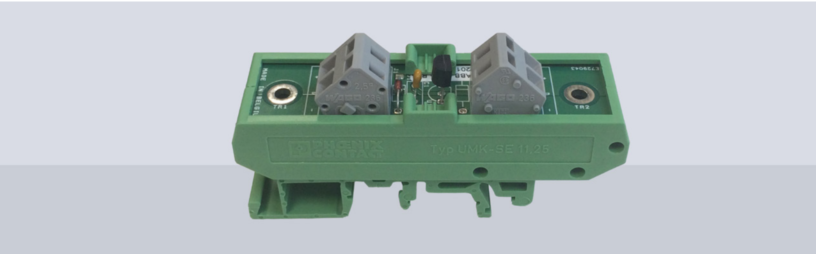
Additional information

2GCS212014A0050 – Rev D 28.02.2018

INSTRUCTION MANUAL

Temperature probe

Installation and start-up guide



RVT Power Factor controller can connect up to eight temperature probes in a daisy chain.

—
Temperature probe

Technical specification

Only 2 contacts using 1-wire protocol

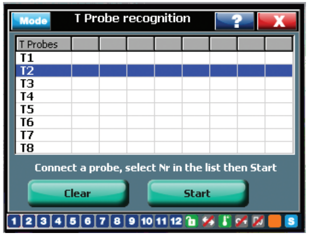
- Parasitic supply mode (no need of external power supply)
- Connection to more nodes in a daisy chain network
- 8 temperature probes connection
- 8 meters maximum between RVT to temperature probe or between probes
- 64 meters maximum length
- Measures temperatures from -55°C to +125°C (-67°F to +257°F)
- +/-0.5°C accuracy from -10°C to +85°C
- DIN rail mounting
- Connection to the RVT using a 2 wires , twisted pair Category 1 telecommunication cable

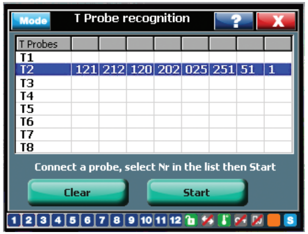
Temperature probes commissioning

Each probe needs to be commissioned as per the following procedures before it can be used. Each probe has to be recognized one by one:

- connect the probe to the temperature probe input (one probe only)
- click on a row to assign a probe number
- click on the “Start” button
- the RVT recognize automatically the probe address
- restart the same procedure for each probe

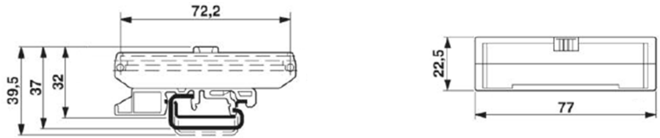
When one of the probes has a problem, it can be cleared by clicking the clear button. A unique address will be assigned to each activated probe after the recognition completes.





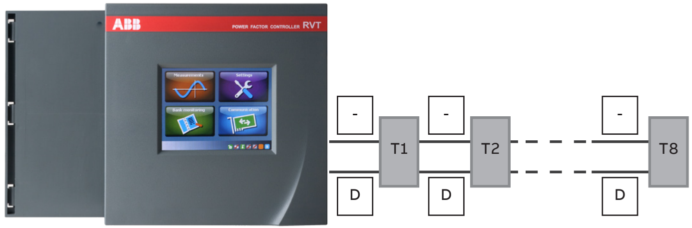
Temperature probe auto recognition

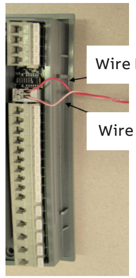
Mechanical dimensions

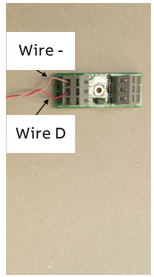


Temperature Probes installation

Connect each probe successively







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INSTRUCTION MANUAL

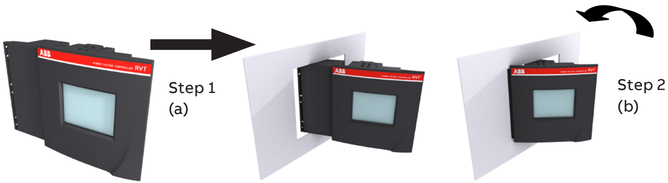
IP54 sealing gasket for RVT
Installation guide

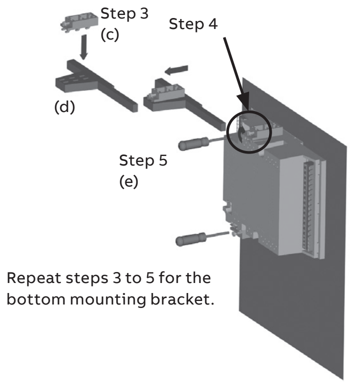
The IP54 sealing for RVT gives a protection from the front panel side.

—
RVT with IP54 sealing gasket

Technical specification

- IP5X :
  - Dust-protected. Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the apparatus or to impair safety.
  - Wire protected. Protected against access to hazardous parts with a wire of diameter 1 mm.
- IPX4 :
  - Protected against splashing water. Water splashed against the enclosure from any direction shall have no harmful effects.





Note: cut out dimensions are 138x138 mm.

IP54 sealing installation

- Step 1: Slide the RVT (a) perpendicularly to the capacitor bank cubicle.
- Step 2: Rotate the RVT (b) to insert it into the capacitor bank cubicle.
- Step 3: Insert the mounting bracket (c) in the corresponding fixation holes (d) of the RVT.
- Step 4: Pull the mounting bracket backwards.
- Step 5: Place the 1st IP54 sealing gasket between the front panel and the cubicle.
- Step 6: Turn lightly the screw (e) into the mounting brackets.
- Step 7: If any hole still exists (check the corners of the controller) a 2nd IP54 can be placed around the 1st one.
- Step 8: Push on the gasket on 4 sides of the RVT to insert it between the cubicle and the RVT enclosure so the gasket becomes invisible.
- Step 9: Turn the screw (e) into the mounting brackets and tighten until the RVT is secured in place.

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