VAMP 257

Feeder and motor manager

Operation and configuration instructions

Technical description

Table of Contents

1. General

This first part of the publication contains general descriptions of the functions, of the feeder and motor managers VAMP 257, as well as manager operation instructions. It also includes instructions for parameterization and configuration of the managers and instructions for changing settings.

The second part of the publication includes detailed protection function descriptions as well as application examples and technical data sheets.

The Mounting and Commissioning Instructions are published in a separate publication with the code VMMC.EN0xx.

Manager software revision history:

First Version

1.1. Manager features

The comprehensive protection functions of the manager make it ideal for utility, industrial, marine and off-shore power distribution applications. The manager features the following protection functions:

- Directional overcurrent protection I>, I>>, I>>>
- Directional earth fault protection Iφ>, Iφ>>, Iφ>>>, Iφ>>>>
- Broken conductor protection I2/I1>
- Unbalance protection I2> *
- Phase reversal / incorrect phase sequence protection I2>> *
- Stall protection Ist> *
- Earth fault protection Io>, Io>>, Io2>, Io2>>
- Directional earth fault protection Ioφ>, Ioφ >>
- Overvoltage protection U>,U>>,U>>>
- Undervoltage protection U<,U<<,U<<<
- Residual voltage protection Uo>, Uo>>
- Overload protection T>
- Configurable frequency protection f>< (fX), f>><< (fXX)
- Under frequency protection f<, f<<
- Frequent start protection N> *
- Circuit-breaker failure protection CBFP

- Arc fault protection ArcI>, ArcIo>, ArcIo2>
- Automatic re-close Recl
- Inrush detector If2>
- Syncrocheck function Δf, ΔU, $\Delta \varphi$

*) Only available when application option is in motor protection

Further the manager includes a disturbance recorder. Arc supervision is optionally available.

The manager communicates with other systems using common protocols, such as the ModBus RTU, ModBus TCP, Profibus DP, IEC 60870-5-103, SPA bus and DNP 3.0.

1.2. Operating Safety

The terminals on the rear panel of the manager may carry dangerous voltages, even if the auxiliary voltage is switched off. A live current transformer secondary circuit must not be opened. **Disconnecting a live circuit may cause dangerous voltages!** Any operational measures must be carried out according to national and local handling directives and instructions.

Carefully read through all operation instructions before any operational measures are carried out.

2. User interface

2.1. General

The manager can be controlled in three ways:

- Locally with the push-buttons on the manager front panel
- Locally using a PC connected to the serial port on the front panel or on the rear panel of the manager (both cannot be used simultaneously)
- Via remote control over the remote control port on the manager rear panel.

2.2. Manager front panel

The figure below shows, as an example, the front panel of the feeder manager VAMP 257 and the location of the user interface elements used for local control.

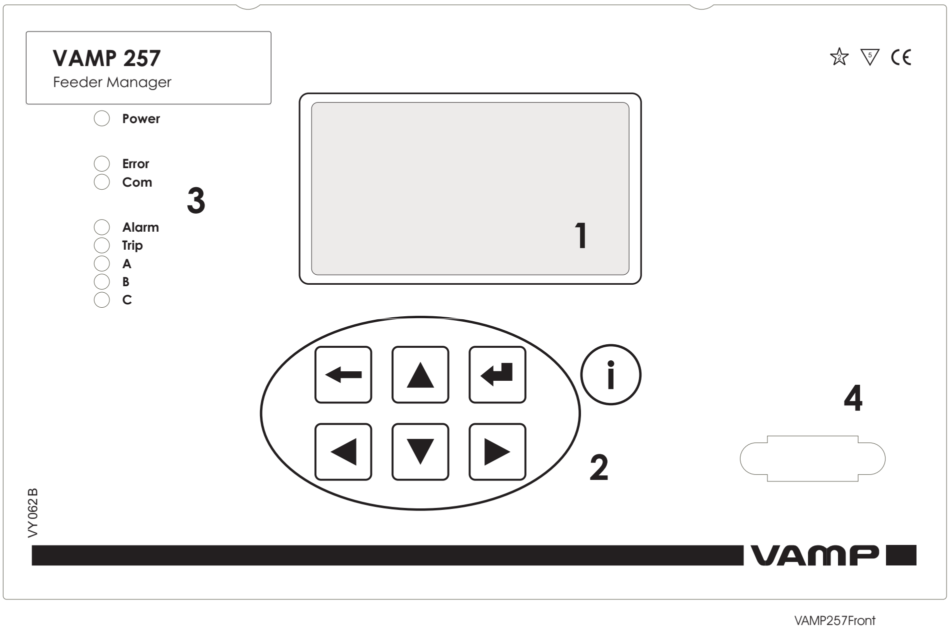


Figure 2.2-1. Manager front panel (Example VAMP 257)

1. LCD dot matrix display
2. Keypad
3. LED indicators
4. RS 232 serial communication port for PC

2.2.1. Display

The manager is provided with a backlit LCD dot matrix display. The display has 128 x 64 dots, which enables showing 21 characters in one row and eight rows at the same time. The display has two different purposes: one is to show the single line diagram of the feeder with the object status, measurement values, feeder identification etc. (Figure 2.2.1-1). The other purpose is to show the configuration and parameterization values of the manager (Figure 2.2.1-2).

sld

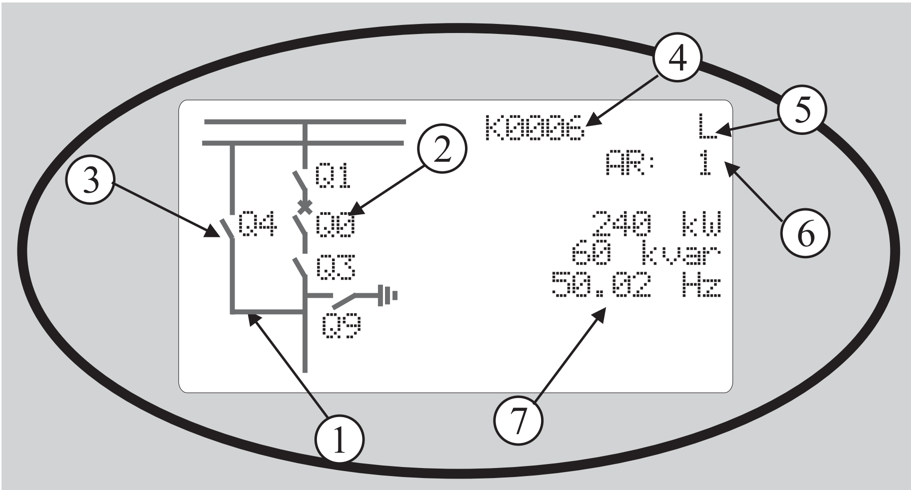


Figure 2.2.1-1 Sections of the LCD dot matrix display

1. Freely configurable single-line diagram
2. Six controllable objects
3. Eight object statuses
4. Bay identification
5. Local/Remote selection
6. Auto-reclose on/off selection (if applicable)
7. Freely selectable measurement values (max. six values)

lcd2

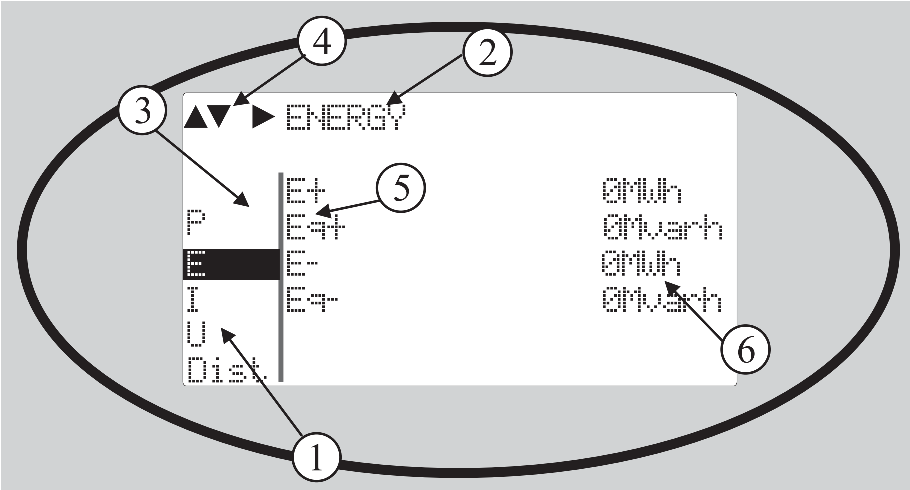


Figure 2.2.1-2 Sections of the LCD dot matrix display

1. Main menu column
2. The heading of the active menu
3. The cursor of the main menu
4. Possible navigating directions (push buttons)
5. Measured/setting parameter
6. Measured/set value

2.2.2. Menu navigation and pointers

1. Use the arrow keys UP and DOWN to move up and down in the main menu (1), that is, on the left-hand side of the display. The active main menu option is indicated with a cursor (3). The options in the main menu items are abbreviations, e.g. Evnt = events.
2. After any selection, the arrow symbols (4) in the upper left corner of the display show the possible navigating directions (applicable navigation keys) in the menu.
3. The name of the active submenu and a possible ANSI code of the selected function are shown in the upper part of the display (2), e.g. CURRENTS.
4. Further, each display holds the measured values and units of one or more quantities or parameters (5), e.g. ILmax 300A.

2.2.3. Keypad

You can navigate in the menu and set the required parameter values using the keypad and the guidance given in the display. Furthermore, the keypad is used to control objects and switches on the single line diagram display. The keypad is composed of four arrow keys, one cancel key, one enter key and one info key.

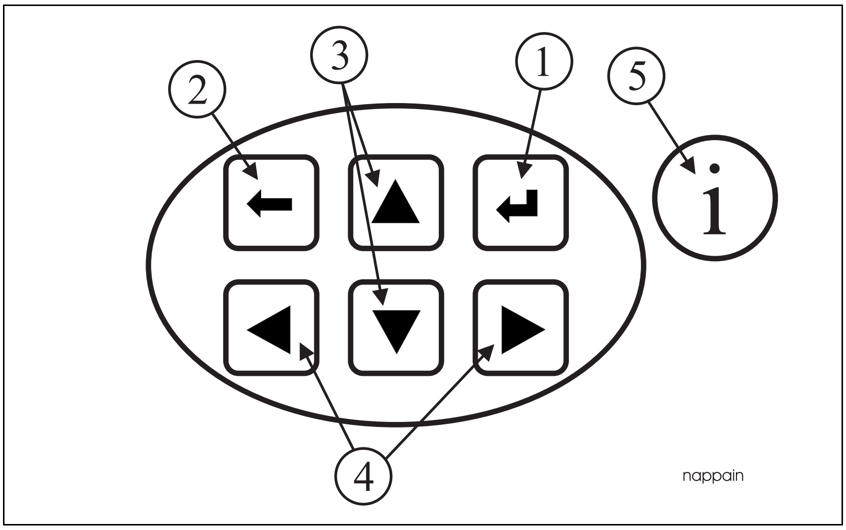


Figure 2.2.3-1 Keys on the keypad

1. Enter and confirmation key (ENTER)
2. Cancel key (CANCEL)
3. Up/Down [Increase/Decrease] arrow keys (UP/DOWN)
4. Keys for selecting submenus [selecting a digit in a numerical value] (LEFT/RIGHT)
5. Additional information key (INFO)

Note!

The term, which is used for the buttons in this manual, is inside the brackets.

2.2.4. Indicators

The manager is provided with eight LED indicators:

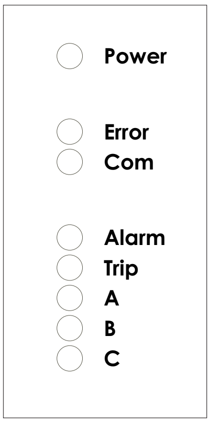


Figure 2.2.4-1. Operation indicators of the manager

Power	Auxiliary voltage switched on
Error	Internal fault, operates in parallel with the self supervision output relay
Com	Serial communication indicator
Alarm	The start indicator of the protection stage
Trip	The trip indicator of the protection stage
A - C	Freely programmable application-related status indications

3. Local panel operations

The local panel can be used to control objects, change the local/ remote status, read the measured values, set parameters, and to configure manager functions. Some parameters, however, can only be set by means of a PC connected to one of the local communication ports. Some parameters are factory-set.

3.1. Navigating in menus

All the menu functions are based on the main menu/submenu structure:

1. Use the arrow keys UP and DOWN to move up and down in the main menu.
2. To move to a submenu, repeatedly push the RIGHT key until the required submenu is shown. Correspondingly, push the LEFT key to return to the main menu.
3. Push the ENTER key to confirm the selected submenu. If there are more than six items in the selected submenu, a black line appears to the right side of the display (Figure 3.1-1). It is then possible to scroll down in the submenu.
4. Push the CANCEL key to cancel a selection.
5. Pushing the UP or DOWN key in any position of a sub-menu, when it is not selected, brings you directly one step up or down in the main menu.

The active main menu selection is indicated with black back-ground color. The possible navigating directions in the menu are shown in the upper-left corner by means of black triangular symbols.

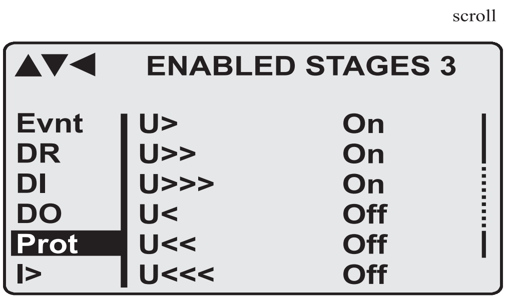


Figure 3.1-1. Example of scroll indication

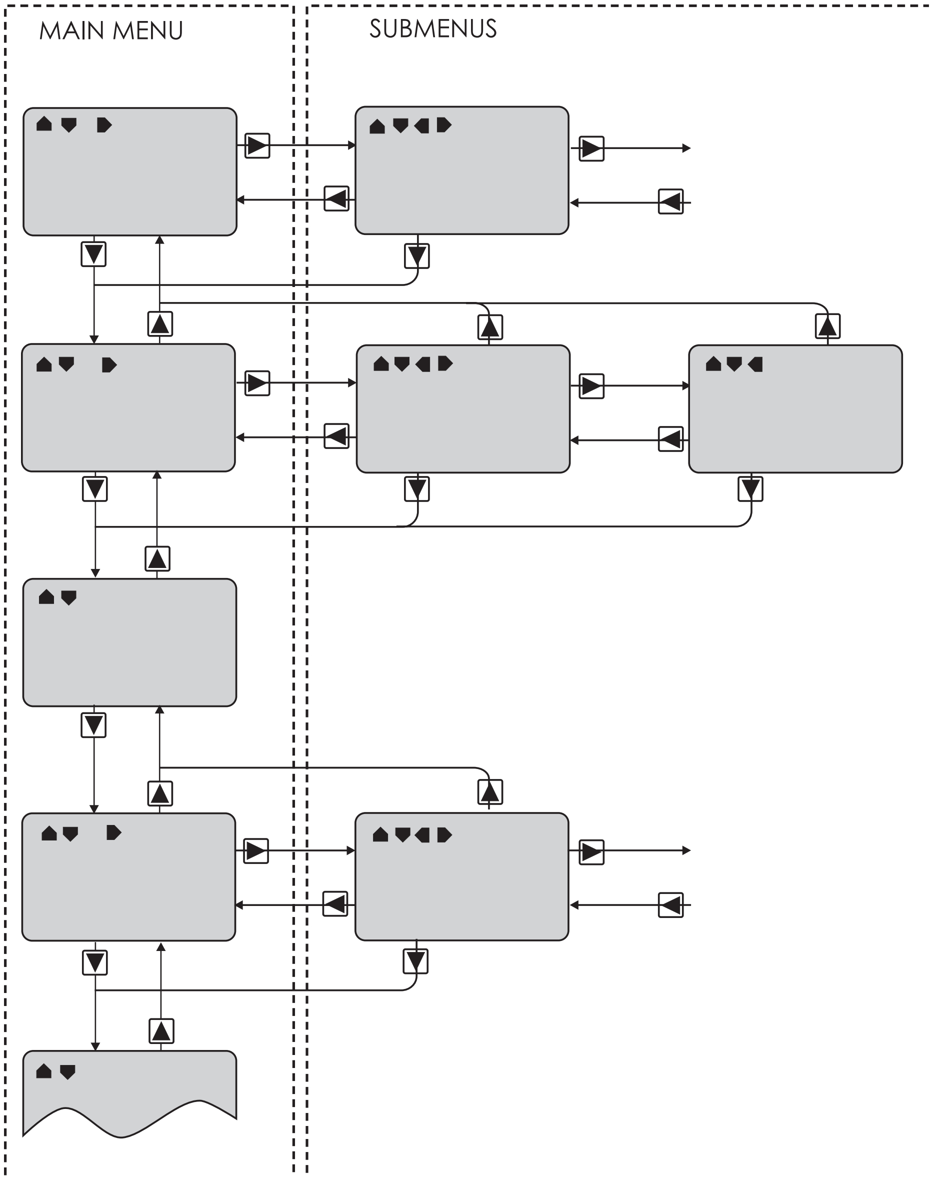


Figure 3.1-2. Principles of the menu structure and navigation in the menus

6. Push the INFO key to obtain additional information about any menu item.
7. Push the CANCEL key to revert to the normal display.

3.1.1. Function menu table

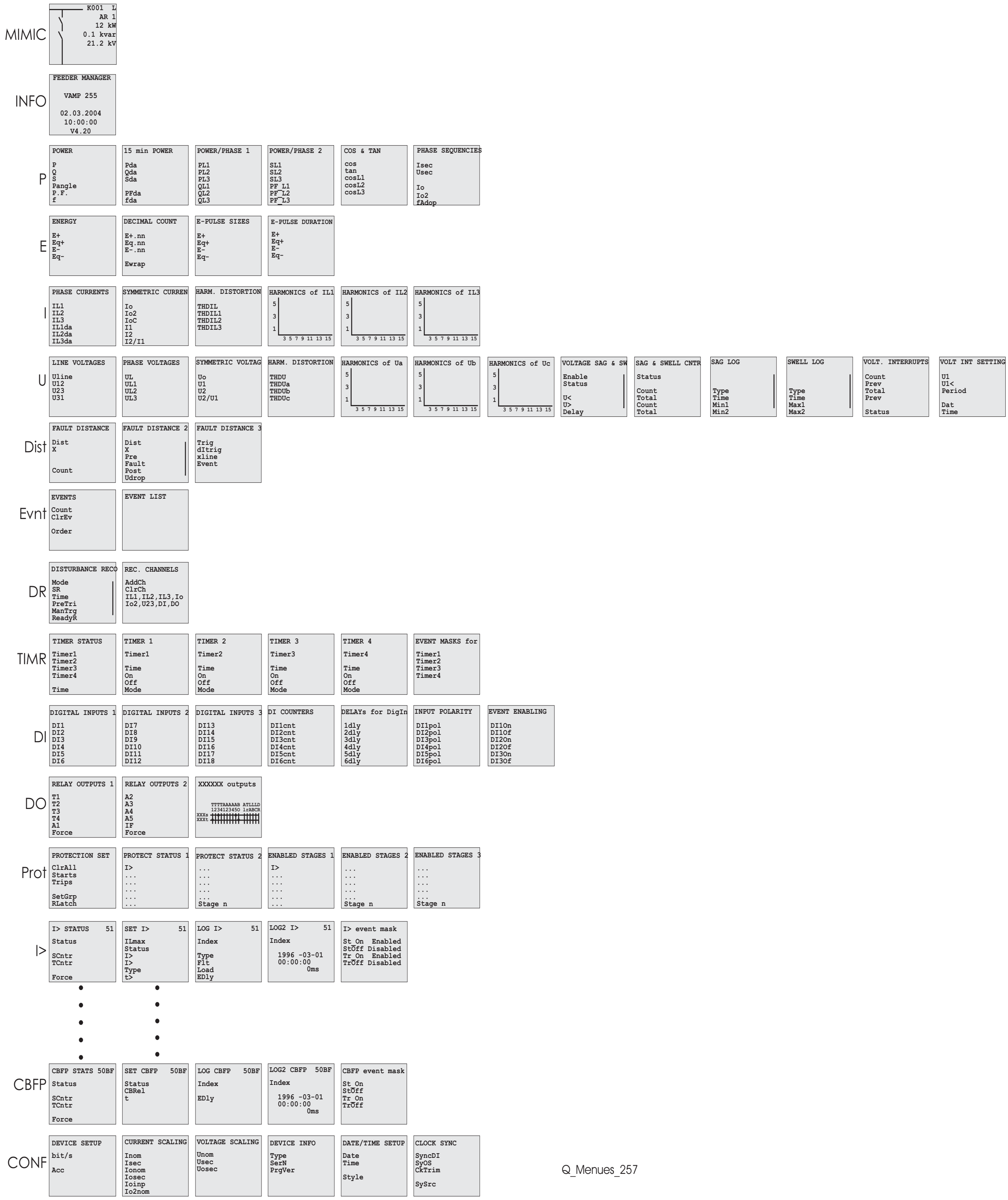


Figure 3.1.1-1. Menu structure

The menu structure shown above is an example of VAMP 257. The structure is dependent on the manager type and options chosen. In the menu, only supported functions are shown.

3.1.2. Basic menu structure of protection functions

Example I>:

I>STATUS:

Status	Trip	State of protection function (-, Start, Trip)
SCntr	8	Start counter
TCntr	7	Trip counter
Force	Off	Forced operation of state (ON, OFF)

SET I> (several SET menus possible):

ILmax	100A	Actual value, the value on which the protection is based
Status	-	State of protection function (-, Start, Trip)
I> I>	110A 1.10pu	Set value of protection function [A] Set value of protection function [pu]
Type	DT	Selection of delay time curve (DT, NI, VI, EI, LTI)
t>	0.30s	

LOG I>:

Index	1	Order number of start 1 - 8
Type	-	Recorded event data
Flt Load	A A	Maximum fault current [A] 1 s mean value of the pre-fault phase current [A]
EDly	%	Duration of fault (100% = the stage has tripped)

LOG2 I>:

Index	1	Order number of start 1 - 8
	2002-08-22 20:34:11 67ms	Event time stamp

I> event mask:

St_On	Selection of events into Event list (Enabled)
St_Off	Selection of events into Event list (Enabled)
Tr_On Tr_Off	Selection of events into Event list (Enabled) Selection of events into Event list (Enabled)

3.2. Setting groups

Most of the protection functions of the manager have two setting groups. These groups are useful for example when the network topology is changed frequently. The active group can be changed by a digital input, through remote communication or locally by using the local panel.

The active setting group of each protection function can be selected separately. Figure 3.2-1 shows an example where the changing of the I> setting group is handled with digital input one (SGrpDI). If the digital input is TRUE, the active setting group is group two and correspondingly, the active group is group one, if the digital input is FALSE. If no digital input is selected (SGrpDI = -), the active group can be selected by changing the value of the parameter SetGrp.

group1

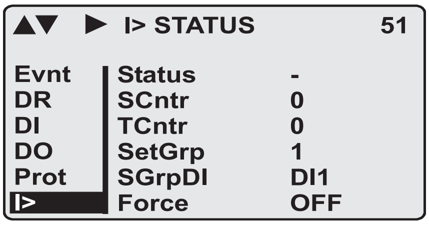


Figure 3.2-1. Example of protection submenu with setting group parameters

The changing of the setting parameters can be done easily. When the desired submenu has been found (with the arrow keys), press the ENTER key to select the submenu. Now the selected setting group is indicated in the down-left corner of the display (See Figure 3.2-2). Set1 is setting group one and Set2 is setting group two. When the needed changes, to the selected setting group, have been done, press the LEFT or the RIGHT key to select another group (the LEFT key is used when the active setting group is 2 and the RIGHT key is used when the active setting group is 1).

group2

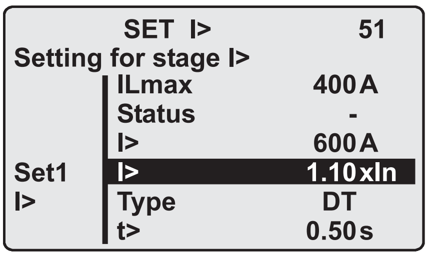


Figure 3.2-2. Example of I> setting submenu

3.3. Fault logs

All the protection functions include fault logs. The fault log of a function can register up to eight different faults with time stamp information, fault values etc. Each function has its own logs (See Figure 3.3-1).

log1

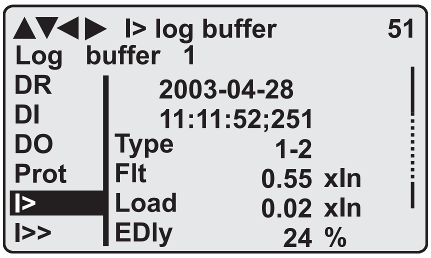


Figure 3.3-1. Example of fault log

To see the values of, for example, log two, press the ENTER key to select the current log (log one). The current log number is then indicated in the down-left corner of the display (See Figure 3.3-2, Log2 = log two). The log two is selected by pressing the RIGHT key once.

log2

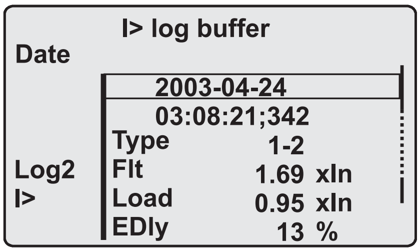


Figure 3.3-2. Example of selected fault log

3.4. Operating levels

The manager has three operating levels: *User level*, *Operator level* and *Configuration level*. The purpose of the operating levels is to prevent accidental change of manager configurations, parameters or settings.

USER level

Use:	Possible to read e.g. parameter values, measurements and events
Opening:	Level permanently open
Closing:	Closing not possible

OPERATOR level

Use:	Possible to control objects and to change e.g. the settings of the protection stages
Opening:	Default password 0001
Setting state:	Push ENTER
Closing:	The level is automatically closed after 10 minutes idle time. Giving the password 9999 can also close the level.

CONFIGURATION level

Use:	The configuration level is needed during the commissioning of the manager. E.g. the scaling of the voltage and current transformers can be set.
Opening:	Default password 0002
Setting state:	Push ENTER
Closing:	The level is automatically closed after 10 minutes idle time. Giving the password 9999 can also close the level.

3.4.1. Opening operating levels

1. Push the INFO key and the ENTER key on the front panel.

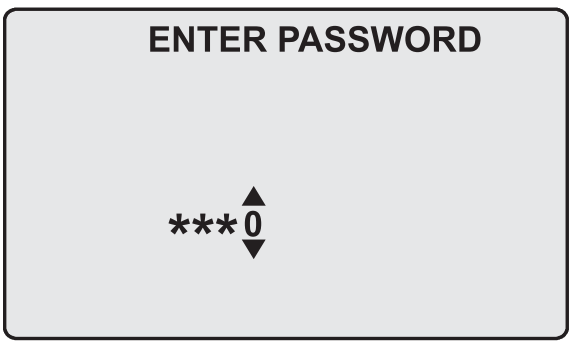


Figure 3.4.1-1. Opening the operating level

2. Enter the password needed for the desired level: the password can contain four digits. The digits are supplied one by one by first moving to the position of the digit using the RIGHT key and then setting the desired digit value using the UP key.
3. Push the ENTER key.

3.4.2. Password handling

The passwords can only be changed using VAMPSET software connected to the local RS-232 port on the manager.

It is possible to restore the password(s) in case the password is lost or forgotten. In order to restore the password(s), a manager program is needed. The serial port settings are 38400 bps, 8 data bits, no parity and one stop bit. The bit rate is configurable via the front panel.

Command	Description
get pwd_break	Get the break code (Example: 6569403)
get serno	Get the serial number of the manager (Example: 12345)

Send both numbers to vamp@vamp.fi. A device specific break code is sent back to you. The break code will be valid for the next two weeks.

Command	Description
set pwd_break=4435876	Break the passwords (The number “4435876” is sent by VAMP Ltd.)

Now the passwords are restored to the default values (See chapter 3.4).

4. Operating measures

General

Study carefully the operating instructions presented in chapters 1 to 3 in this manual before taking any operating measures or changing any manager settings or functions.

The manager can be controlled via the manager front panel, a PC running the VAMPSET software, a PC running suitable manager software or via a remote control system.

4.1. Control functions

The default display of the local panel is a single-line diagram including manager identification, Local/Remote indication, Auto-reclose on/off selection and selected analogue measurement values.

Please note that the operator password must be active in order to be able to control the objects. Please refer to chapter 3.4.1.

To toggle Local/Remote control:

1. Push the ENTER key. The previously activated object starts to blink.
2. Select the Local/Remote object ("L" or "R" squared) by using the arrow keys.
3. Push the ENTER key. The L/R dialog opens. Select "REMOTE" to enable remote control and disable local control. Select "LOCAL" to enable local control and disable remote control.
4. Confirm the setting by pushing the ENTER key. The Local/Remote state will change.

To control an object:

1. Push the ENTER key. The previously activated object starts to blink.
2. Select the object to control by using the arrow keys. Please note that only controllable objects can be selected.
3. Push the ENTER key. A control dialog opens.
4. Select the "Open" or "Close" command by using the UP and DOWN arrow keys.
5. Confirm the operation by pushing the ENTER key. The state of the object changes.

To toggle auto-reclose on/off:

1. Push the ENTER key. The previously activated object starts to blink.
2. Select the AR object ("0" or "1" squared) by using the UP and DOWN arrow keys.
3. Push the ENTER key. The AR dialog opens.
4. Select "AR_Off" to disable the auto-reclose function. Select "AR_On" to enable the auto-reclose function.
5. Confirm the setting by pushing the ENTER key. The state of the auto-reclose changes.

To toggle virtual inputs

1. Push the ENTER key. The previously activated object starts to blink.
2. Select the virtual input object (empty or black square)
3. The dialog opens
4. Select "VIon" to activate the virtual input or select "VIoff" to deactivate the virtual input

4.2. Measured data

The measured values can be read from the P*, E*, I and U* menus and their submenus. Furthermore, any measurement value in the following table can be displayed on the main view next to the single line diagram. Up to six measurements can be shown.

Value:	Menu/Submenu:	Description:
P	P/POWER	Active power [kW]
Q	P/POWER	Reactive power [kvar]
S	P/POWER	Apparent power [kVA]
φ	P/POWER	Active power angle [°]
P.F.	P/POWER	Power factor [ ]
f	P/POWER	Frequency [Hz]
Pda	P/15 MIN POWER	Active power [kW] *
Qda	P/15 MIN POWER	Reactive power [kvar] *
Sda	P/15 MIN POWER	Apparent power [kVA] *
Pfda	P/15 MIN POWER	Power factor [ ] *
fda	P/15 MIN POWER	Frequency [Hz] *
PL1	P/POWER/PHASE 1	Active power of phase 1 [kW]
PL2	P/POWER/PHASE 1	Active power of phase 2 [kW]
PL3	P/POWER/PHASE 1	Active power of phase 3 [kW]
QL1	P/POWER/PHASE 1	Reactive power of phase 1 [kvar]
QL2	P/POWER/PHASE 1	Reactive power of phase 2 [kvar]
QL3	P/POWER/PHASE 1	Reactive power of phase 3 [kvar]
SL1	P/POWER/PHASE 2	Apparent power of phase 1 [kVA]

SL2	P/POWER/PHASE 2	Apparent power of phase 2 [kVA]
SL3	P/POWER/PHASE 2	Apparent power of phase 3 [kVA]
PF_L1	P/POWER/PHASE 2	Power factor of phase 1 [ ]
PF_L2	P/POWER/PHASE 2	Power factor of phase 2 [ ]
PF_L3	P/POWER/PHASE 2	Power factor of phase 3 [ ]
cos	P/COS & TAN	Cosine phi [ ]
tan	P/COS & TAN	Tangent phi [ ]
cosL1	P/COS & TAN	Cosine phi of phase L1 [ ]
cosL2	P/COS & TAN	Cosine phi of phase L2 [ ]
cosL3	P/COS & TAN	Cosine phi of phase L3 [ ]
Iseq	P/PHASE SEQUENCIES	Actual current phase sequency [OK; Reverse; ?=Unknown
Useq	P/PHASE SEQUENCIES	Actual voltage phase sequency [OK; Reverse; ?=Unknown
Ioφ	P/PHASE SEQUENCIES	Io/Uo angle [°]
Io2φ	P/PHASE SEQUENCIES	Io2/Uo angle [°]
fAdop	P/PHASE SEQUENCIES	Adopted frequency [Hz]
E+	E/ENERGY	Exported energy [MWh]
Eq+	E/ENERGY	Exported reactive energy [Mvar]
E-	E/ENERGY	Imported energy [MWh]
Eq-	E/ENERGY	Imported reactive energy [Mvar]
E+.nn	E/DECIMAL COUNT	Decimals of exported energy [ ]
Eq.nn	E/DECIMAL COUNT	Decimals of reactive energy [ ]
E-.nn	E/DECIMAL COUNT	Decimals of imported energy [ ]
Ewrap	E/DECIMAL COUNT	Energy control
E+	E/E-PULSE SIZES	Pulse size of exported energy [kWh]
Eq+	E/E-PULSE SIZES	Pulse size of exported reactive energy [kvar]
E-	E/E-PULSE SIZES	Pulse size of imported energy [kWh]
Eq-	E/E-PULSE SIZES	Pulse duration of imported reactive energy [ms]
E+	E/E-PULSE DURATION	Pulse duration of exported energy [ms]
Eq+	E/E-PULSE DURATION	Pulse duration of exported reactive energy [ms]
E-	E/E-PULSE DURATION	Pulse duration of imported energy [ms]
Eq-	E/E-PULSE DURATION	Pulse duration of imported reactive energy [ms]
E+	E/E-pulse TEST	Test the exported energy pulse [ ]
Eq+	E/E-pulse TEST	Test the exported reactive energy [ ]
E-	E/E-pulse TEST	Test the imported energy [ ]
Eq-	E/E-pulse TEST	Test the imported reactive energy [ ]
IL1	I/PHASE CURRENTS	Phase current IL1 [A]
IL2	I/PHASE CURRENTS	Phase current IL2 [A]
IL3	I/PHASE CURRENTS	Phase current IL3 [A]
IL1da	I/PHASE CURRENTS	15 min average for IL1 [A]

IL2da	I/PHASE CURRENTS	15 min average for IL2 [A]
IL3ad	I/PHASE CURRENTS	15 min average for IL3 [A]
Io	I/SYMMETRIC CURRENTS	Primary value of zerosequence/ residual current Io [A]
Io2	I/SYMMETRIC CURRENTS	Primary value of zero-sequence/residual current Io2 [A]
IoC	I/SYMMETRIC CURRENTS	Calculated Io [A]
I1	I/SYMMETRIC CURRENTS	Positive sequence current [A]
I2	I/SYMMETRIC CURRENTS	Negative sequence current [A]
I2/I1	I/SYMMETRIC CURRENTS	Negative sequence current related to positive sequence current (for unbalance protection) [%]
THDIL	I/HARM. DISTORTION	Total harmonic distortion of the mean value of phase currents [%]
THDIL1	I/HARM. DISTORTION	Total harmonic distortion of phase current IL1 [%]
THDIL2	I/HARM. DISTORTION	Total harmonic distortion of phase current IL2 [%]
THDIL3	I/HARM. DISTORTION	Total harmonic distortion of phase current IL3 [%]
Diagram (see Figure 4.2-1)	I/HARMONICS of IL1	Harmonics of phase current IL1 [%]
Diagram (see Figure 4.2-1)	I/HARMONICS of IL2	Harmonics of phase current IL2 [%]
Diagram (see Figure 4.2-1)	I/HARMONICS of IL3	Harmonics of phase current IL3 [%]
Uline	U/LINE VOLTAGES	Average value for the three line voltages [V]
U12	U/LINE VOLTAGES	Phase-to-phase voltage U12 [V]
U23	U/LINE VOLTAGES	Phase-to-phase voltage U23 [V]
U31	U/LINE VOLTAGES	Phase-to-phase voltage U31 [V]
UL	U(PHASE VOLTAGES	Average for the three phase voltages [V]
UL1	U/PHASE VOLTAGES	Phase-to-earth voltage UL1 [V]
UL2	U/PHASE VOLTAGES	Phase-to-earth voltage UL2 [V]
UL3	U/PHASE VOLTAGES	Phase-to-earth voltage UL3 [V]
Uo	U/SYMMETRIC VOLTAGES	Residual voltage Uo [%]
U1	U/SYMMETRIC VOLTAGES	Positive sequence voltage [%]
U2	U/SYMMETRIC VOLTAGES	Negative sequence voltage [%]
U2/U1	U/SYMMETRIC	Negative sequence voltage related to

	VOLTAGES	positive sequence voltage [%]
THDU	U/HARM. DISTORTION	Total harmonic distortion of the mean value of voltages [%]
THDUa	U/HARM. DISTORTION	Total harmonic distortion of the voltage input a [%]
THDUb	U/HARM. DISTORTION	Total harmonic distortion of the voltage input b [%]
THDUc	U/HARM. DISTORTION	Total harmonic distortion of the voltage input c [%]
Diagram (see Figure 4.2-1)	U/HARMONICS of Ua	Harmonics of voltage input Ua [%]
Diagram (see Figure 4.2-1)	U/HARMONICS of Ub	Harmonics of voltage input Ub [%]
Diagram (see Figure 4.2-1)	U/HARMONICS of Uc	Harmonics of voltage input Uc [%]
Count	U/VOLT. INTERRUPTS	Voltage interrupts counter [ ]
Prev	U/VOLT. INTERRUPTS	Previous interruption [ ]
Total	U/VOLT. INTERRUPTS	Total duration of voltage interruptions [days, hours]
Prev	U/VOLT. INTERRUPTS	Duration of previous interruption [s]
Status	U/VOLT. INTERRUPTS	Voltage status [LOW; NORMAL]

*) The length of the window can be selected

harm

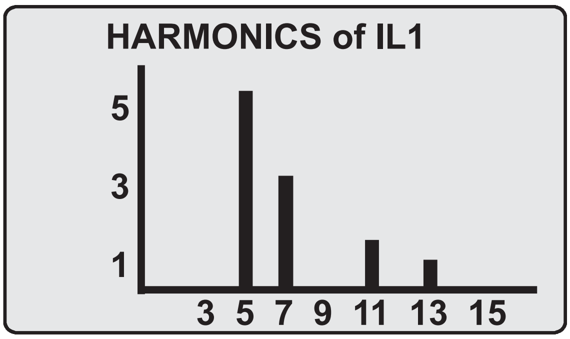


Figure 4.2-1. Example of harmonics bar display

4.3. Operation indicators

LED indicator	Meaning	Measure/ Remarks
Power LED lit	The auxiliary power has been switched on	Normal operation state
Error LED lit	An internal fault has been detected	The manager attempts to reboot [REBOOT]. If the error LED remains lit, call for maintenance.
Com LED lit or flashing	The serial bus is in use and transferring information	Normal operation state
Alarm LED lit	One or several signals of the output relay matrix have been assigned to output Al and the output has been activated by one of the signals. (For more information about output relay configuration, please see chapter 5.4 on page 32).	The LED is switched off when the signal that caused output Al to activate, e.g. the START signal, is reset. The resetting depends on the type of configuration, connected or latched.
Trip LED lit	One or several signals of the output relay matrix have been assigned to output Tr, and the output has been activated by one of the signals. (For more information about output relay configuration, please see chapter 5.4 on page 32).	The LED is switched off when the signal that caused output Tr to activate, e.g. the TRIP signal, is reset. The resetting depends on the type of configuration, connected or latched.
A- C LED lit	Application-related status indicators.	Configurable

Resetting latched indicators and output relays

All the indicators and output relays can be given a latching function in the configuration.

There are several ways to reset latched indicators and relays:

- From the alarm list, move back to the initial display by pushing the CANCEL key for approx. 3 s. Then reset the latched indicators and output relays by pushing the ENTER key.
- Acknowledge each event in the alarm list one by one by pushing the ENTER key equivalent times. Then, in the initial display, reset the latched indicators and output relays by pushing the ENTER key.

The latched indicators and relays can also be reset via a remote communication bus or via a digital input configured for that purpose.

4.4. Reading event register

The event register can be read from the Evnt submenu:

1. Push the RIGHT key once.
2. The EVENT LIST appears. The display contains a list of all the events that have been configured to be included in the event register.

event_list

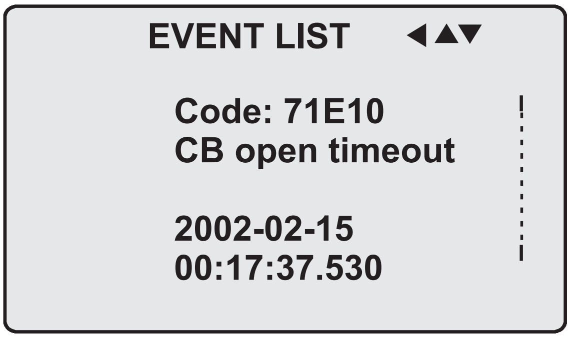


Figure 4.4-1. Example of an event register

3. Scroll through the event list with the UP and DOWN keys.
4. Exit the event list by pushing the LEFT key.

It is possible to set the order in which the events are sorted. If the “Order” -parameter is set to “New-Old”, then the first event in the EVENT LIST is the most recent event.

4.5. Forced control (Force)

In some menus it is possible to switch a function on and off by using a force function. This feature can be used, for instance, for testing a certain function. The force function can be activated as follows:

1. Move to the setting state of the desired function, for example DO (see chapter 5, on page 29).
2. Select the Force function (the background color of the force text is black).

force

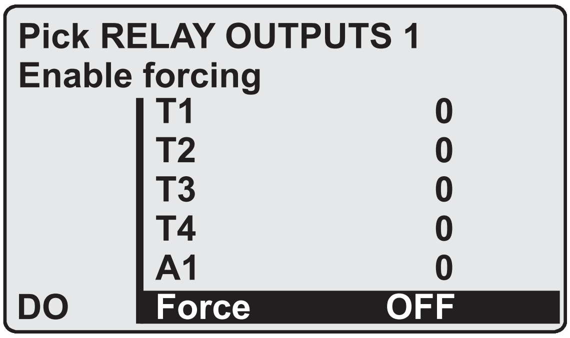


Figure 4.5-1. Selecting Force function

3. Push the ENTER key.
4. Push the UP or DOWN key to change the "OFF" text to "ON", that is, to activate the Force function.
5. Push the ENTER key to return to the selection list. Choose the signal to be controlled by force with the UP and DOWN keys, for instance the T1 signal.
6. Push the ENTER key to confirm the selection. Signal T1 can now be controlled by force.
7. Push the UP or DOWN key to change the selection from "0" (not alert) to "1" (alert) or vice versa.
8. Push the ENTER key to execute the forced control operation of the selected function, e.g., making the output relay of T1 to pick up.
9. Repeat the steps 7 and 8 to alternate between the on and off state of the function.
10. Repeat the steps 1...4 to exit the Force function.
11. Push the CANCEL key to return to the main menu.

Note!

All the interlockings and blockings are bypassed when the force control is used.

4.6. Setting range limits

If the given parameter setting values are out-of-range values, a fault message will be shown when the setting is confirmed with the ENTER key. Adjust the setting to be within the allowed range.

illegal

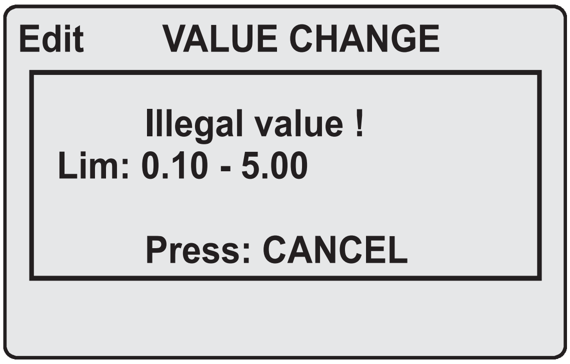


Figure 4.6-1. Example of a fault message

The allowed setting range is shown in the display in the setting mode. To view the range, push the INFO key. Push the CANCEL key to return to the setting mode.

infoset_I

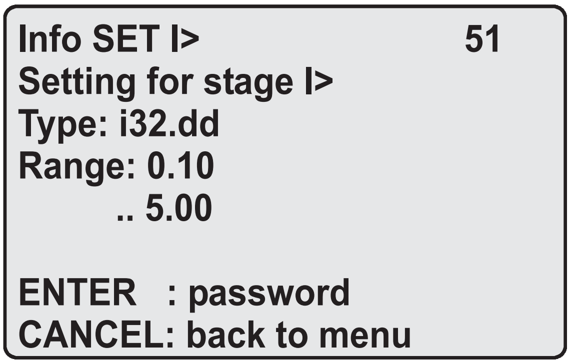


Figure 4.6-2. Allowed setting ranges show in the display

4.7. Adjusting display contrast

The readability of the LCD varies with the brightness and the temperature of the environment. The contrast of the display can be adjusted via the PC user interface, see chapter 6 on page 38.

5. Configuration and parameter setting

Operating level: CONFIGURATION

- Choose and configure the digital inputs in the DI submenu.
- Configure the digital outputs in the DO submenu.
- Select the needed protection functions in the Prot submenu.
- Set the ”Device Setup”, the scaling (for example Inom, Isec, etc.) and the date and time in the CONF submenu.
- Change the parameters of the protection functions in the function-related submenus, for example I>.
- Choose and configure the communication buses in the Bus submenu.
- Configure interlockings for objects and protection functions with the VAMPSET software.

Note!

Some of the parameters can only be changed via the RS-232 serial port using the VAMPSET software. Such parameters, (for example passwords, blockings and mimic configuration) are normally set only during commissioning.

Some of the parameters require the restarting of the manager. This restarting is done automatically when necessary. If a parameter is tried to change the manager will inform about the auto-reset feature (see Figure 5-1).

autoboot

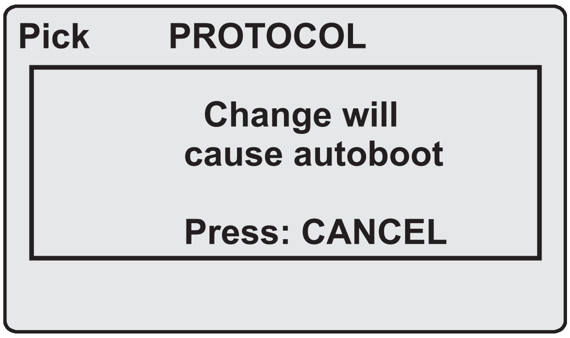


Figure 5-1. Example of auto-reset display

Press CANCEL to return to the setting view. If a parameter must be changed, press the ENTER key again. The parameter can now be set. When the parameter change is confirmed with the ENTER key, a [RESTART]- text appears to the top-right corner of the display. This means that auto-resetting is pending. If no key is pressed, the auto-reset will be executed within few seconds.

5.1. Principle of parameter setting

1. Move to the setting state of the desired menu (for example CONF/CURRENT SCALING) by pushing the ENTER key. The Pick text appears in the upper-left part of the display.
2. Enter the password associated with the configuration level by pushing the INFO key and then using the arrow keys and the ENTER key (default value = 0002). For more information about the operating levels, please refer to 3.4.
3. Scroll through the parameters using the UP and DOWN keys. A parameter can be set if the background color of the line is black. If the parameter cannot be set the parameter is framed.
4. Select the desired parameter (for example Inom) with the ENTER key.
5. Use the UP and DOWN keys to change a parameter value. If the value contains more than one digit, use the LEFT and RIGHT keys to shift from digit to digit, and the UP and DOWN keys to change the digits.
6. Push the ENTER key to accept a new value. If you want to leave the parameter value unchanged, exit the edit state by pushing the CANCEL key.

paramm

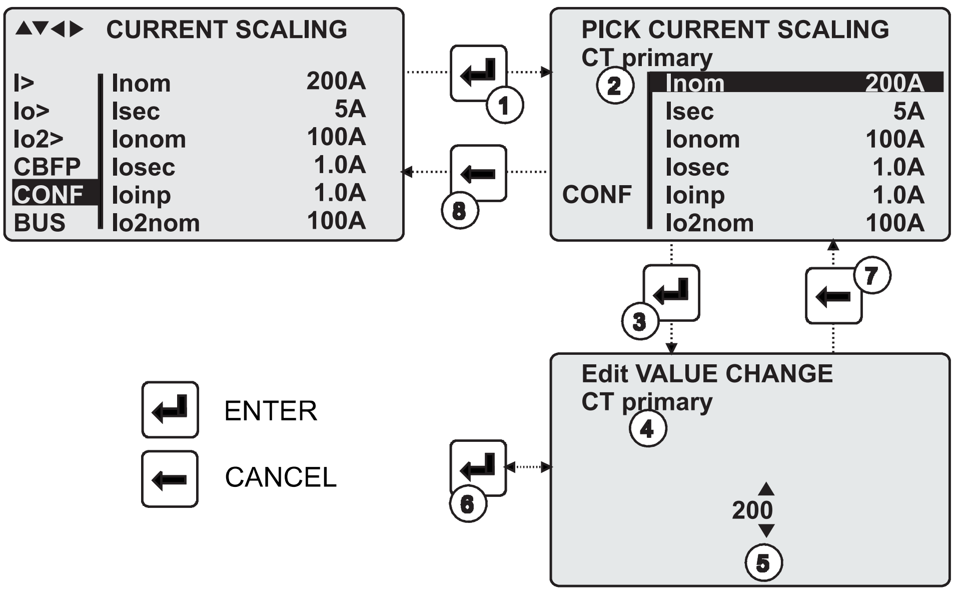


Figure 5.1-1.Changing parameters

5.2. Disturbance recorder menu DR

Via the submenus of the disturbance recorder menu the following functions and features can be read and set:

DR

- Recording mode (Mode)
- Sample rate (Rate)
- Recording time (Time)
- Pre trig time (PreTrig)
- Manual trigger (MnlTrig)
- Count of ready records (ReadyRe)

REC. COUPLING

- Add a link to the recorder (AddLink)
- Clear all links (ClrLnks)

Available links:

- DO, DI, D1_2
- Uline, Uphase
- IL
- U2/U1, U2, U1
- I2/In, I2/I1, I2, I1, IoCalc
- CosFii
- PF, S, Q, P
- f
- Uo
- UL3, UL2, UL1
- U31, U23, U12
- Io2, Io
- IL3, IL2, IL1
- Prms, Qrms, Srms
- Tanfii
- THDIL1, THDIL2, THDIL3
- THDUa, THDUb, THDUc
- fy, fz, U12y, U12z

5.3. Configuring digital inputs DI

The following functions can be read and set via the submenus of the digital inputs menu:

- The status of digital inputs (DIGITAL INPUTS 1-32)
- Operation counters (DI COUNTERS)
- Operation delay (DELAYs for DigIn)
- The polarity of the input signal (INPUT POLARITY). Either normally open (NO) or normally closed (NC) circuit.
- Event enabling EVENT MASK1

5.4. Configuring digital outputs DO

The following functions can be read and set via the submenus of the digital outputs menu:

- The status of the output relays (RELAY OUTPUTS 1,2 and 3)
- The forcing of the output relays (RELAY OUTPUTS 1, 2 and 3) (only if Force = ON):
  - Forced control (0 or 1) of the Trip relays
  - Forced control (0 or 1) of the Alarm relays
  - Forced control (0 or 1) of the IF relay
- The configuration of the output signals to the output relays. The configuration of the operation indicators (LED) Alarm and Trip and application specific alarm leds A, B and C (that is, the output relay matrix).

5.5. Configuration of Prot menu

The following functions can be read and set via the submenus of the Prot menu:

- Reset all the counters (PROTECTION SET/ClAll)
- Read the status of all the protection functions (PROTECT STATUS 1-x)
- Enable and disable protection functions (ENABLED STAGES 1-x)
- Define the interlockings between signals (only with VAMPSET).

Each stage of the protection functions can be disabled or enabled individually in the Prot menu. When a stage is enabled, it will be in operation immediately without a need to reset the manager.

The manager includes several protection functions. However, the processor capacity limits the number of protection functions that can be active at the same time.

5.6. Setting protection function parameters

The settings of the selected protection function can be read and set separately in the submenus of each function.

Available Protection stages

- Non-directional overcurrent protection I>, I>>, I>>>
- Directional overcurrnet protection Iφ>, Iφ>>, Iφ>>>, Iφ>>>>
- Broken conductor protection I2/I1>
- Unbalance protection I2> *
- Phase reversal / incorrect phase sequence protection I2>> *
- Stall protection Ist> *
- Earth fault protection Io>, Io>>, Io2>, Io2>>
- Directional earth fault protection Ioφ>, Ioφ >>
- Overvoltage protection U>,U>>,U>>>
- Undervoltage protection U<,U<<,U<<<
- Residual voltage protection Uo>, Uo>>
- Overload protection T>
- Configurable frequency protection f>< (fX), f>><< (fXX)
- Under frequency protection f<, f<<
- Frequent start protection N> *
- Circuit-breaker failure protection CBFP
- Arc fault protection ArcI>, ArcIo>, ArcIo2>
- Automatic re-close Recl
- Inrush detector If2>
- Synchrocheck function Δf, Δu, Δφ

*) Available only when the application option is in motor protection

5.7. Configuration menu CONF

The following functions and features can be read and set via the submenus of the configuration menu:

DEVICE SETUP

- Transfer rate of local serial bus (bit/s)
- "AccessLevel" display (Acc)
- Language selection

CURRENT SCALING

- Rated phase CT primary current (Inom)
- Rated phase CT secondary current (Isec)
- Rated Io CT primary current (Ionom)
- Rated Io CT secondary current (Iosec)
- The rated current of the Io current input (Ioinp)
- Rated Io2 CT primary current (Io2nom)
- Rated Io2 CT secondary current (Io2sec)
- The rated current of the Io2 current input (Io2inp)

MOTOR CURRENT

- Rated current of the motor

VOLTAGE SCALING

- Rated VT primary voltage (Uprim)
- Rated VT secondary voltage (Usec)
- Rated Uo VT secondary voltage (Uosec)
- Voltage measuring mode (Umode) *

DEVICE INFO (only display)

- Manager type (Type VAMP 2XX)
- Serial number (SerN)
- Software version (PrgVer)
- Bootcode version (BootVer)

DATE/TIME SETUP

- Date (Dat)
- Time (Time)
- Date information format (Style)

SW OPTIONS

- Application option (ApplMod) *
- External LED-panel option (LedModule) *

- Earth-fault distance (E-FDist)

*) Only visible when access level is configuration

5.8. Protocol menu Bus

COMMUNICATION OPTIONS

- Communication module attached to port 1
- Communication module attached to port 2

REMOTE PORT

- The communication protocol of the REMOTE port (Protoc)
- Message counter (Msg#)
- Communication error counter (Errors)
- Communication time-out counter (Tout)
- Baudrate

LOCAL PORT

- The communication protocol of the LOCAL port (Protoc)
- Message counter (Msg#)
- Communication error counter (Errors)
- Communication time-out counter (Tout)
- Baudrate

PC (Local / SPABus)

- Bytes in TX buffer
- Message counter
- Error counter
- Timeout counter
- Baudrate

EXTENSION PORT

- The communication protocol of the EXTENSION port (Protoc)
- Message counter (Msg#)
- Communication error counter (Errors)
- Communication time-out counter (Tout)
- Baudrate

MODBUS

- The device slave number at Modbus Slave Protocol or the target slave number at Modbus Master Protocol (Addr)
- Modbus transfer rate (bit/s)
- Modbus parity check (Parity)

EXTERNAL I/O

- Baudrate
- Parity

SPABUS

- Slave number (Addr) when a manager is connected to SPA-Bus
- SPA-Bus transfer rate (bit/s)
- Event mode

IEC 60870-5-103

- Slave address (Addr)
- Transfer rate (bit/s)
- Measurement interval (MeasIn)
- Time synchronization response mode (Sync)

IEC 60870-5-103 DISTURBANCE RECORDER

- ASDU23 activation (ASDU23)
- samples per message (smpls/msg)
- Time out
- DR Debug
- Fault
- Tag position
- Chn
- ChnPos

ProfiBus DP

- ProfiBus profile (Mode)
- The transfer rate of the converter (bit/s)
- Event mode
- ProfiBus Tx Buf length (InBuf)
- ProfiBus Rx Buf length (OutBuf)

DNP 3.0

- Transfer rate (bit/s)
- Parity

- Slave address (SlvAddr)
- Master address (MstrAddr)
- Link layer confirmation timeout (LLTout)
- Link layer retry counter (LLRetry)
- Application layer confirmation timeout (APLTout)
- Application layer confirmation mode
- Double-Bit input support (DBISup)
- Clock sync mode

TCP/IP

- The IP address of the manager (Ip)
- Subnet mask (N)
- The IP address of the Gateway (Gatew)
- The IP address of the Name Server (NameSv)
- The IP address of the SNTP Server (NTPSvr)
- The port number used in remote protocol (e.g. ModBusTCP) communication (Port)

5.9. Single line diagram editing

The single-line diagram is drawn with the VAMPSET software. For more information, please refer to the VAMPSET manual (VMV.EN0xx).

5.10. Blocking and interlockings configuration

The configuration of the blockings and interlockings is done with the VAMPSET software. Any start or trip signal can be used for blocking the operation of any protection stage. Furthermore, the interlocking between objects can be configured in the same blocking matrix of the VAMPSET software. For more information, please refer to the VAMPSET manual (VMV.EN0xx).

Note!

Interlocking object 7 and 8 are not possible.

6. PC software

6.1. PC user interface

The PC user interface can be used for:

- On-site parameterization of the manager
- Loading manager software from a computer
- Reading measured values to a computer

Two RS 232 serial ports are available for connecting a local PC; one on the front panel and one on the rear panel of the manager with the right operation model (see details in the technical description). The serial ports are connected in parallel. However, if the connection cables are connected to both ports, only the port on the front panel will be active. To connect a PC to the front panel serial port, use a connection cable of type VX 003-3.

You can also use the VAMPSET software through a TCP/IP LAN connection. Optional hardware is required.

6.1.1. Using VAMPSET program

For more information about the VAMPSET software, please refer to the user's manual with the code VMV.EN0xx. If the VAMPSET user's manual is not available, please download it from our web site at www.vamp.fi.

6.2. Remote control connection

The protection manager communicates with higher-level systems, e.g. remote control systems, via the serial port (REMOTE) on the rear panel of the manager.

ModBus, SPABus, IEC 60870-5-103, ProfiBus, ModBus TCP or DNP 3.0 can be used as REMOTE communication protocols (see details in the technical description).

Additional operation instructions for various bus types are to be found in their respective manual.

7. Commissioning configuration

7.1. Factory settings

When delivered from the factory, the manager has got either factory default settings or settings defined by the customer. The configuration can be read from the workshop test reports or from the final test reports.

7.1.1. Configuration during commissioning

The settings of the manager can be defined and checked during the commissioning in accordance with the instructions given in chapter 5 of this manual. The order can be, for example, the following:

1. The scaling of the rated values of the phase currents (CONF/CURRENT SCALING menu)
2. The scaling of the rated values of the voltages (CONF/VOLTAGE SCALING menu)

The scaling is done in the software block of the measured signals (see Figure 7.1.1-1). Thus, the scaling will affect all the protection functions.

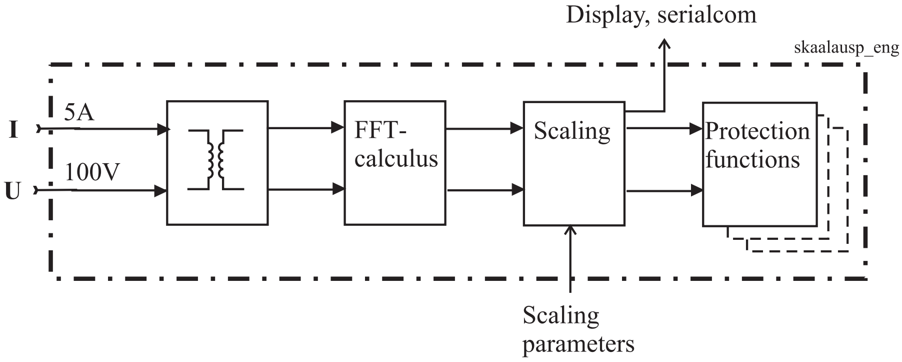


Figure 7.1.1-1. Principle for scaling the measured values of the manager

3. The activation of the desired protection functions, Prot menu. See chapter 5.5.
4. The setting values of the protection function parameters (e.g. I> menu). See chapter 5.6 on page 33.
5. The routing of the trip and alarm signals from the protection functions to the desired output relays and LED indicators (DO menu). See chapter 5.4 on page 32.
6. The configuration of the blocking matrix (VAMPSET software).

7. The configuration of the desired DI inputs, for example external blockings (DI menu). See chapter 5.2 on page 31.
8. Configuration of communication parameters (Bus menu). See chapter 5.8 on page 35.
9. Drawing of the mimic picture.

7.1.2. Configuration example

The example below illustrates the calculation and scaling of setting values and the grouping of output relays in a typical protection configuration. The numerical values given in the example are to be regarded as guidelines only.

Example:

The example is based on the application shown in figure 3.1 -1 in the chapter 3 of the Technical Description.

The application uses the following protection functions and parameters:

- Two-stage overcurrent protection I>, I>> (Status, I>, Type, t>; Status, I>>, t>)
- Unbalance protection I_2> (Status, I_2>, t>)
- Earth fault protection I_0> (Status, I_0>, Type, t>)
- Directional earth fault protection $I_0\varphi$> (Status, $I_0\varphi$>, t>, ChCtrl, U_0, Offset)
- Residual voltage protection U_0> (Status, U_0>, t>)
- Overload stage T> (Temp, Status, T>, Alarm, tau)
- Auto-reclose function AR (ReclT, PulseL, ReadyT)
- 2. harmonics stage I2f> (2. Harm, t_2Har)

The above functions are enabled via the Prot/ENABLED STAGES_ -menu by selecting "On" in the Enable display, see chapter 5.5 on page 32. The functions that are not needed can be disabled by selecting the "Off" value.

1 Start data

The configuration menus where the settings are done are given in parenthesis.

Transforming ratios of measurement transformers:

Phase current transformers (CT) (CONF/CURRENT SCALING)	Inom Isec	500A 5.0A
I_0 current transformer (CT) (CONF/CURRENT SCALING)	Ionom Iosec Ioinp	100A 1.0A 1.0A
Uo voltage transformers (VT) (CONF/VOLTAGE SCALING)	Usec	100V

2 Settings for protection stages

Protection stage:	Parameter:	Setting:
Overcurrent stage I>	I> Type t> k> (NI, VI, EI, LTI)	1.20 x In DT 0.30 s 1.00

k> is valid only for inverse time.

Overcurrent stage I>>	I>> t>	2.50 x In 0.20 s

Unbalance stage I2>	I2> t>	20 % 10.0 s

Earth fault stage Io>	Io> Type t> k> (NI, VI, EI, LTI)	20 % DT 1.00 s 1.00

k> is valid only for inverse time.

Directional Earth fault stage Ioφ>	Ioφ> t> Uo> Offset ChCtrl	0.20 pu 1.00 s 10 % 0° DI13

See section 2.2.3 from technical description.

Earth fault stage Uo>	Uo> t>	10 % 2.0 s

Thermal stage T>	T> Alarm Tau	1.06 x In 90 % 60 min

Auto reclose	ReclT PulseL ReadyT	10.0 s 0.20 s 10.0 s

2. Harmonics stage	2. Harm	10 %

3 Blocking matrix

The required blockings are made by using the VAMPSET software.

4 Configuration of output relays

The required groupings of the output relays and output signals are configured in the DO menu, see chapter 5.4 on page 32.

Table of Contents

1. Introduction

This part of the user manual describes the protection functions, provides a few application examples and contains technical data.

Mounting and commissioning instructions are given in a separate mounting and commissioning manual (VMMC.EN0xx).

Manual revision history:

VM257.001 First revision

1.1. Application

The numerical VAMP 257 feeder and motor manager includes all the essential protection functions needed to protect feeders and motors in distribution networks of utilities, industry, power plants and offshore applications. Further, the manager includes several programmable functions, such as arc (option), thermal, trip circuit supervision and circuit breaker protection and communication protocols for various protection and communication situations.

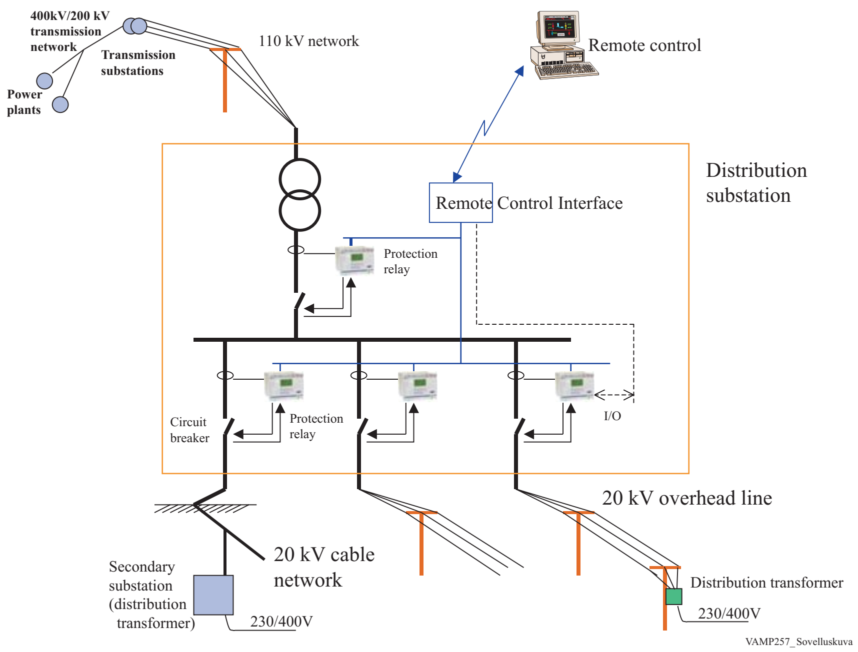


Figure 1.1-1. Application of the feeder and motor managers

The VAMP feeder terminals can be used for selective short-circuit feeder protection of radial or meshed feeders regardless of the earthing principle of the network. The manager can also be used for single-, two- or three-phase directional or non-directional overcurrent and/or sensitive, directional or non-directional earth fault protection. Furthermore, the voltage measurements enable several other protection functions like voltage and frequency protection.

The modern technology in association with an extensive self-supervision system and a reliable construction ensures an extremely high availability for the VAMP feeder and motor managers.

1.2. Main features

- Fully digital signal handling with a powerful 16-bit microprocessor, and high measuring accuracy on all the setting ranges due to an accurate 16-bit A/D conversion technique.
- Wide setting ranges for the protection functions, e.g. the earth fault protection can reach a sensitivity of 0.5%.
- Integrated fault location for short-circuit faults.
- The manager can be matched to the requirements of the application by disabling the functions that are not needed.
- Flexible control and blocking possibilities due to digital signal control inputs (DI) and outputs (DO).
- Easy adaptability of the manager to various substations and alarm systems due to flexible signal-grouping matrix in the manager.
- Possibility to control six objects (e.g. circuit-breakers, disconnectors).
- Status of eight objects (e.g. circuit-breakers, disconnectors, switches).
- Freely configurable display with six measurement values.
- Freely configurable interlocking schemes with basic logic functions.
- Recording of events and fault values into an event register from which the data can be read via a keypad and a local HMI or by means of a PC based VAMPSET user interface.
- All events and indications are in non-volatile memory.
- Easy configuration, parameterisation and reading of information via local HMI, or with a VAMPSET user interface.
- Easy connection to power plant automation system due to a versatile serial connection and several available communication protocols.

- Built-in, self-regulating dc/dc converter for auxiliary power supply from any source within the range from 40 to 265 V dc or ac. The alternative power supply is for 18 to 36 V dc.
- Built-in disturbance recorder for evaluating all the analogue and digital signals.

2. Functions

The individual protection functions of the manager can independently be enabled or disabled according to the requirements of the intended application. For more information, please see the configuration instructions in chapter 5 and 7 in the first part of this manual.

2.1. Principles of numerical protection techniques

The manager is fully designed using numerical technology. This means that all the signal filtering, protection and control functions are implemented through digital processing.

The numerical technique used in the manager is primarily based on an adapted Fast Fourier Transformation (FFT). In FFT the number of calculations (multiplications and additions), which are required to filter out the measuring quantities, remains reasonable.

By using synchronized sampling of the measured signal (voltage or current) and a sample rate according to the 2^n series, the FFT technique leads to a solution, which can be realized with just a 16 bit micro controller, without using a separate DSP (Digital Signal Processor).

The synchronized sampling means an even number of 2^n samples per period (e.g. 32 samples per a period). This means that the frequency must be measured and the number of the samples per period must be controlled accordingly so that the number of the samples per period remains constant if the frequency changes. Therefore, some current has to be injected to the current input IL1 to adapt the network frequency for the manager. However, if this is not possible then the frequency must be parameterised to the manager.

Apart from the FFT calculations, some protection functions also require the symmetrical components to be calculated for obtaining the positive, negative and zero phase sequence components of the measured quantity. The function of the undervoltage stage, for instance, is based on the use of the positive phase sequence component of the voltage, and the function of the unbalanced load protection stage is based on the use of the negative phase sequence component of the current.

Figure 2.1-1 shows a principle block diagram of a numerical manager. The main components are the energizing inputs, digital input elements, output relays, A/D converters and the micro controller including memory circuits. Further, a manager contains a power supply unit and a human-machine interface (HMI).

Figure 2.1-2 shows the heart of the numerical technology. That is the main block diagram for calculated functions.

Figure 2.1-3 shows a principle diagram of a single-phase overvoltage or overcurrent function.

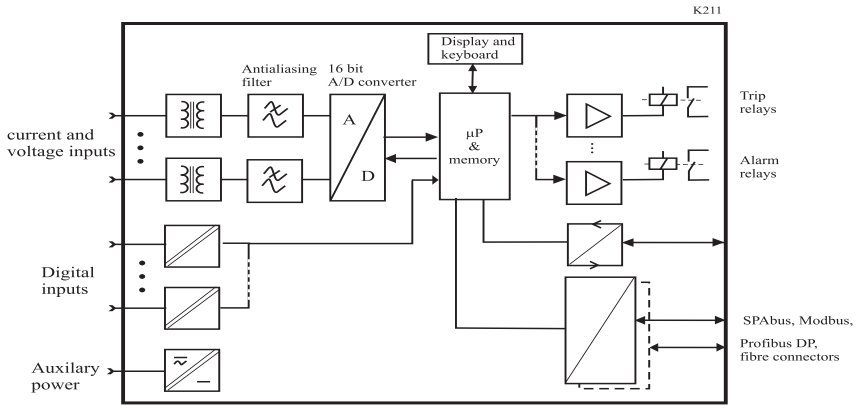


Figure 2.1-1. Principle block diagram of a numerical feeder manager

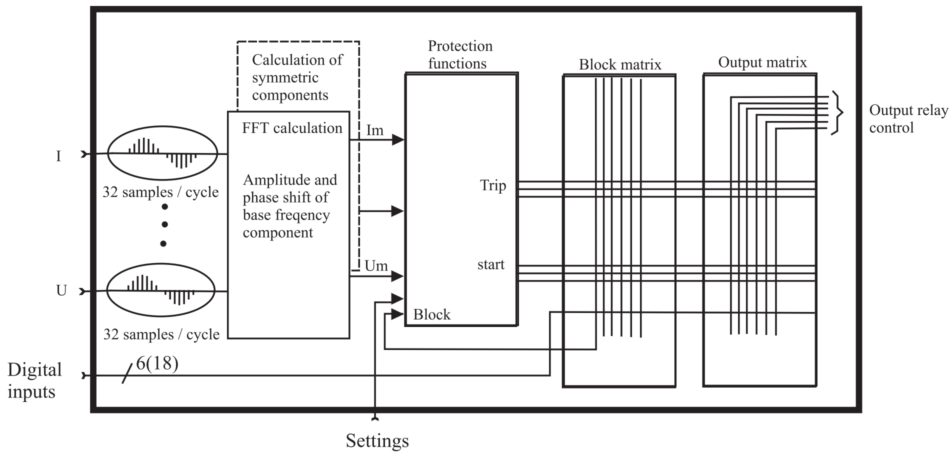


Figure 2.1-2. Block diagram of a software based protection function

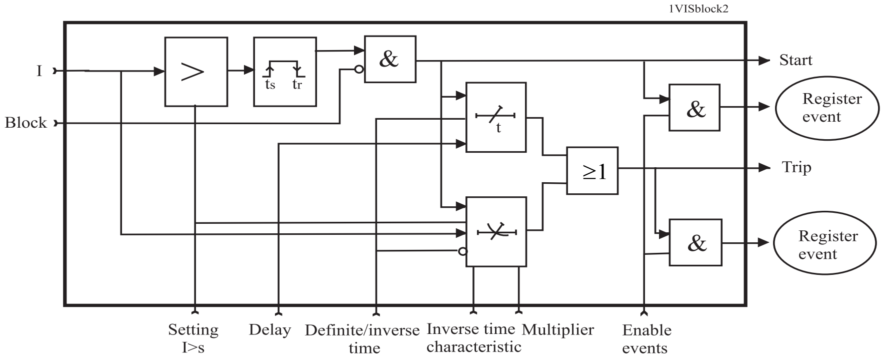


Figure 2.1-3. Block diagram of a single phase protection function

2.2. Manager function dependencies

2.2.1. Manager function reference guide

	IEEE no	IEC symbol	Function name	VAMP 257	
Protection functions	50/51	3I>, 3I>>, 3I>>	Overcurrent protection	X	
	67	I_{dir}>, I_{dir}>>, I_{dir}>>>, I_{dir}>>>>	Directional overcurrent protection	X	
	46	I_2/I_1>	Broken conductor protection	X	
	46	I_2>	Unbalance protection	X	*
	47	I_2>>	Phase reversal / incorrect phase sequence protection	X	*
	48	Ist>	Stall protection	X	*
	66	N>	Frequent start protection	X	*
	37	I<	Undercurrent protection	X	
	67N	$I_{0\varphi}$>, $I_{0\varphi}$>>	Directional earth fault protection	X	
	50N/51 N	I_0>, I_0>>, I_{02}>, I_{02}>>	Earth fault protection	X	
	59N	U_0>, U_0>>	Residual voltage protection	X	
	49	T>	Overload protection	X	
	79		Auto reclose function	X	
	59	U>, U>>, U>>>	Overvoltage protection	X	
	27	U<, U<<, U<<<	Undervoltage protection	X	
	81O/ 81U	f><, f>><<	Configurable frequency protection	X	
	81U	f<, f<<	Under frequency protection	X	
	68	2.ha	Second harmonic stage /inrush	X	
	50BF	CBFP	Circuit-breaker failure protection	X	
	50AR	ArcI>	Arc fault protection	X	**
			Fault location	X	
	25	Δf, ΔU, Δφ	Synchrocheck	X	
			Capacitor bank unbalance protection	X	
Measurement functions		3I	Three-phase current	X	
		Io	Neutral current	X	
		I_2	Current unbalance	X	
		IL	Average and maximum demand current	X	
		3U	Phase and line voltages	X	
		Uo	Residual voltage	X	
		U_2	Voltage unbalance	X	
		Xfault	Short-circuit fault reactance	X	
		Xfault	Earth-fault reactance	X	
		f	System frequency	X	

*) Only available when application mode is motor protection

**) Option

	IEEE no	IEC symbol	Function name	VAMP 257	
Measurement and monitoring functions		P	Active power	X	
		Q	Reactive power	X	
		S	Apparent power	X	
		E+, E-	Active Energy, exported / imported	X	
		Eq+, Eq-	Reactive Energy, exported / imported	X	
		PF	Power factor	X	
			Phasor diagram view of voltages	X	
			Phasor diagram view of currents	X	
			2nd to 15th harmonics and THD of currents	X	
			2nd to 15th harmonics and THD of voltages	X	
			Condition monitoring CB wear	X	
			Condition monitoring CT supervision	X	
			Condition monitoring VT supervision	X	
			Voltage interruptions	X	
			Voltage sags and swells	X	
Communication			IEC 60870-5-103	X	
			Modbus TCP	X	
			Modbus RTU	X	
			Profibus DP	X	
			SPA-bus communication	X	
			Man-Machine-Communication, display	X	
			Man-Machine-Communication, PC	X	
Hardware			Number of phase current CT's	3	
			Number of residual current CT's	2	
			Number of voltage input VT's	3	
			Number of digital inputs	26	
			Number of extra digital inputs with the DI19/DI20 option.	2	*
			Digital inputs parallel T5, T6, T7, T8	4	
			Number of trip outputs	8	
			Number of alarm outputs	1	
			Number of heavy duty alarm outputs	4	

*) Only one arc channel is available with DI19/DI20 option

2.2.2. Application modes

The application modes available are the feeder protection mode and the motor protection mode. In the feeder protection mode all current dependent protection functions are relative to nominal current I_n derived by CT ratios. The motor protection functions listed in chapter 2.2.1 are unavailable in the feeder protection mode. In the motor protection mode all current dependent protection functions are relative to motor's nominal current I_{MOT}. The motor protection mode enables motor protection functions which are listed in chapter 2.2.1. All functions which are available in the feeder protection mode are also available in the motor protection mode. Default value of the application mode is the feeder protection mode.

The application mode can be changed with vampset-software or from config menu of the relay. Changing the application mode requires configurator password.

NOTE!

Please see the next chapter for current based protection function dependencies.

2.2.3. Current protection function dependencies

The current based protection functions are relative to I_{mode}, which is dependent of the application mode. In the motor protection mode all of the current based functions are relative to I_{mot} and in the feeder protection mode to I_n with following exceptions.

I_2> (46), I_2>> (47), Ist> (48), N> (66) are always dependent on I_{mot} and they are only available when application mode is in the motor protection.

2.3. Manager functions

2.3.1. Overcurrent protection (50/51)

The three-phase overcurrent function consists of three separately adjustable overcurrent stages; stage I>, stage I>> and stage I>>>.

The overcurrent function measures the fundamental frequency component of the phase currents. The protection is based on the highest phase current value.

The low-set stage I> can be configured for definite time or inverse time operation characteristic. Four characteristic curve sets according to the standard IEC 60255-3 are available: NI (Normal Inverse), VI (Very Inverse), EI (Extremely Inverse) and LTI (Long Time Inverse). The stages I>> and I>>> are configured for definite time operation characteristic (DT).

Limitations:

1. The maximum measured current is 50 x I_{mode}. This limits the scope of inverse curves when the setting is more than 2.5 x I_{mode} (see Figure 2.1-1). For example, at setting 4 x I_{mode} the maximum setting relative current is 12.5 x I_{set}/I_{mode} although the curves are defined up to 20 x I_{set}/I_{mode}.

2. The fastest possible operating time is about 60 ms at inverse time characteristic according to curve types VI and EI.

Figure 2.3.1-1 shows a functional block diagram of the I> stage of the overcurrent function.

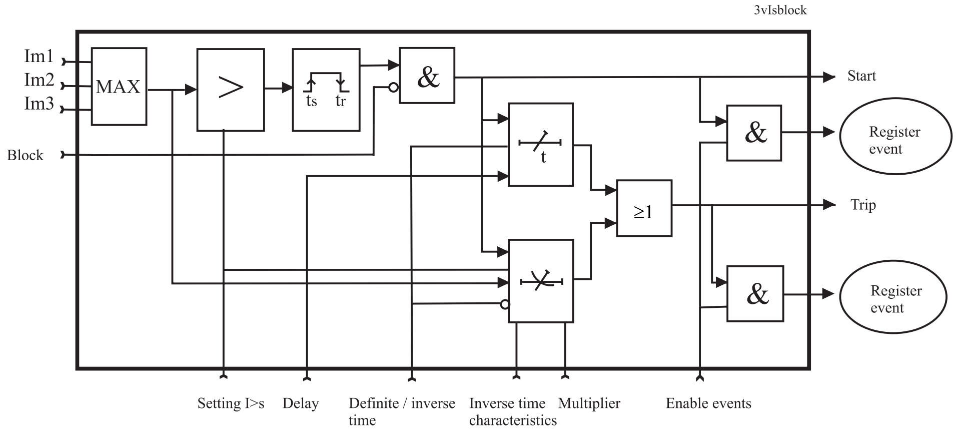


Figure 2.3.1-1. Block diagram of the three-phase overcurrent stage I>

Setting parameters of overcurrent stages:

I>, I>>, I>>> (50/51)

Parameter:	Values:	Unit:	Default:	Description:
I>, I>>, I>>>	0.10…5.00 (I>); 0.10…20.0 (I>>); 0.10…40.0 (I>>>)	xI_{mode}	1.20 (I>) 2.50 (I>>) 5.00 (I>>>)	Setting value
Curve	DT IEC/VK IEEE/VS ANSI RI Prg 1 Prg 2 Prg 3	-	IEC/VK (I>)	Operational delay type (I>)
Type	DT (Definite Time) NI (Normal Inverse) VI (Very Inverse) EI (Extremely Inverse) LTI (Long Time Inverse)	-	NI (I>)	Selection of definite time or inverse time characteristics (I>)
t>, t>>, t>>>	0.08…300.0 (t>); 0.04…300.0 (t>>); 0.04…300.0 (t>>>)	s	0.60 (t>>) 0.10 (t>>>)	Definite operating time
k>	0.05…20.0	-	1.00 (I>)	Time multiplier at inverse time (I>) *
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event

T_Off	Enabled; Disabled	-	Enabled	Trip off event

* Minimum allowed k> value is 0.5 for all curves; except for IEC/UK, it can be lower.

Measured and recorded values of overcurrent stages:

I>, I>>, I>>> (50/51)

	Parameter:	Values:	Unit:	Description:
Measured value	ILmax		A	Corresponding primary value
Recorded values	SCntr			Cumulative start counter
	TCntr			Cumulative trip counter
	Type	1-N, 2-N, 3-N		Fault type/single-phase fault e.g.: 1-N = fault on phase L1
		1-2, 2-3, 1-3		Fault type/two-phase fault e.g.: 2-3 = fault between L2 and L3
		1-2-3		Fault type/three-phase fault
	Flt		xI_{mode}	The max. value of fault current as compared to I_n
	Load		A	1 s mean value of pre-fault phase currents IL1…IL3
	Edly		%	Elapsed time as compared to the set operating time, 100% = tripping

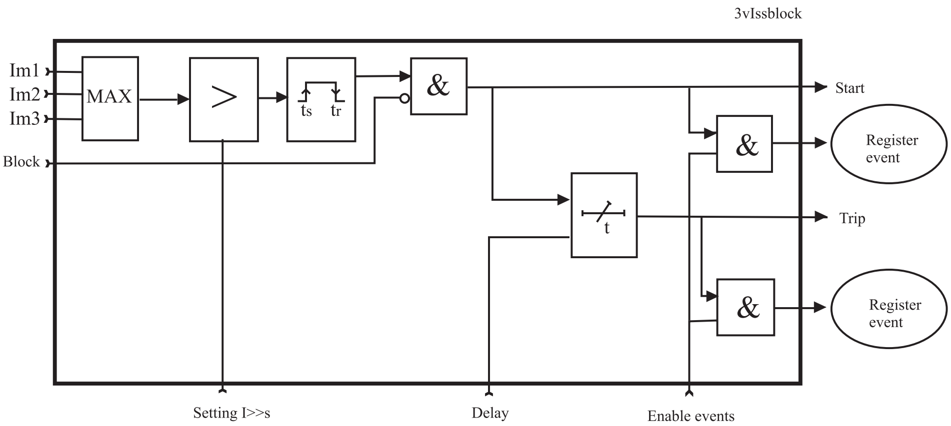


Figure 2.3.1-2. Block diagram of the three-phase overcurrent stage I>>

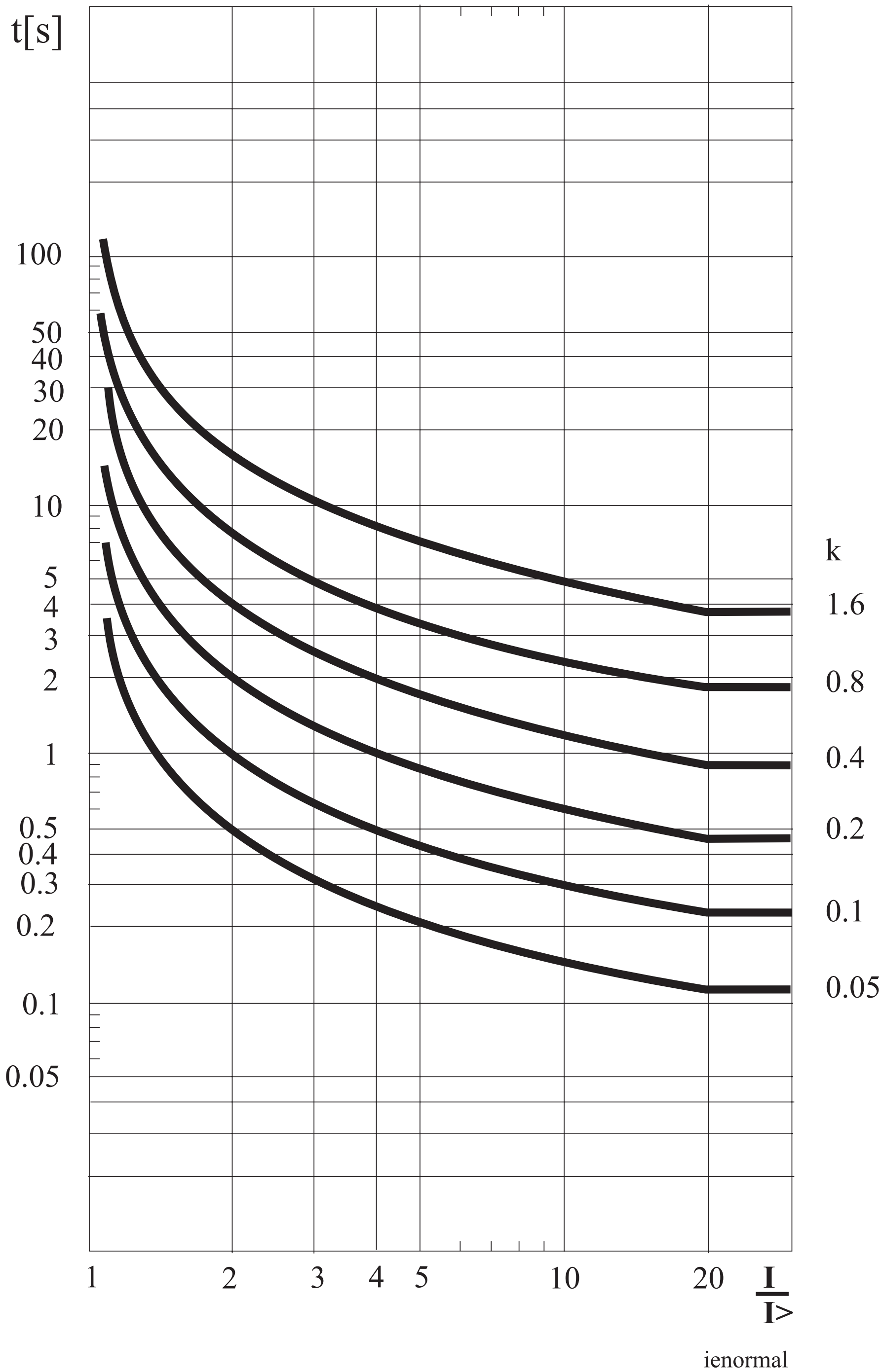


Figure 2.3.1-3. Normal Inverse (IEC 60255-3) characteristic

$$t = 0,14 \cdot \frac{k}{\left(\frac{I}{I>}\right)^{0,02} - 1}$$

t[s]	=	Trip time
K	=	Time multiplier
I	=	Measured current
I>	=	I set current

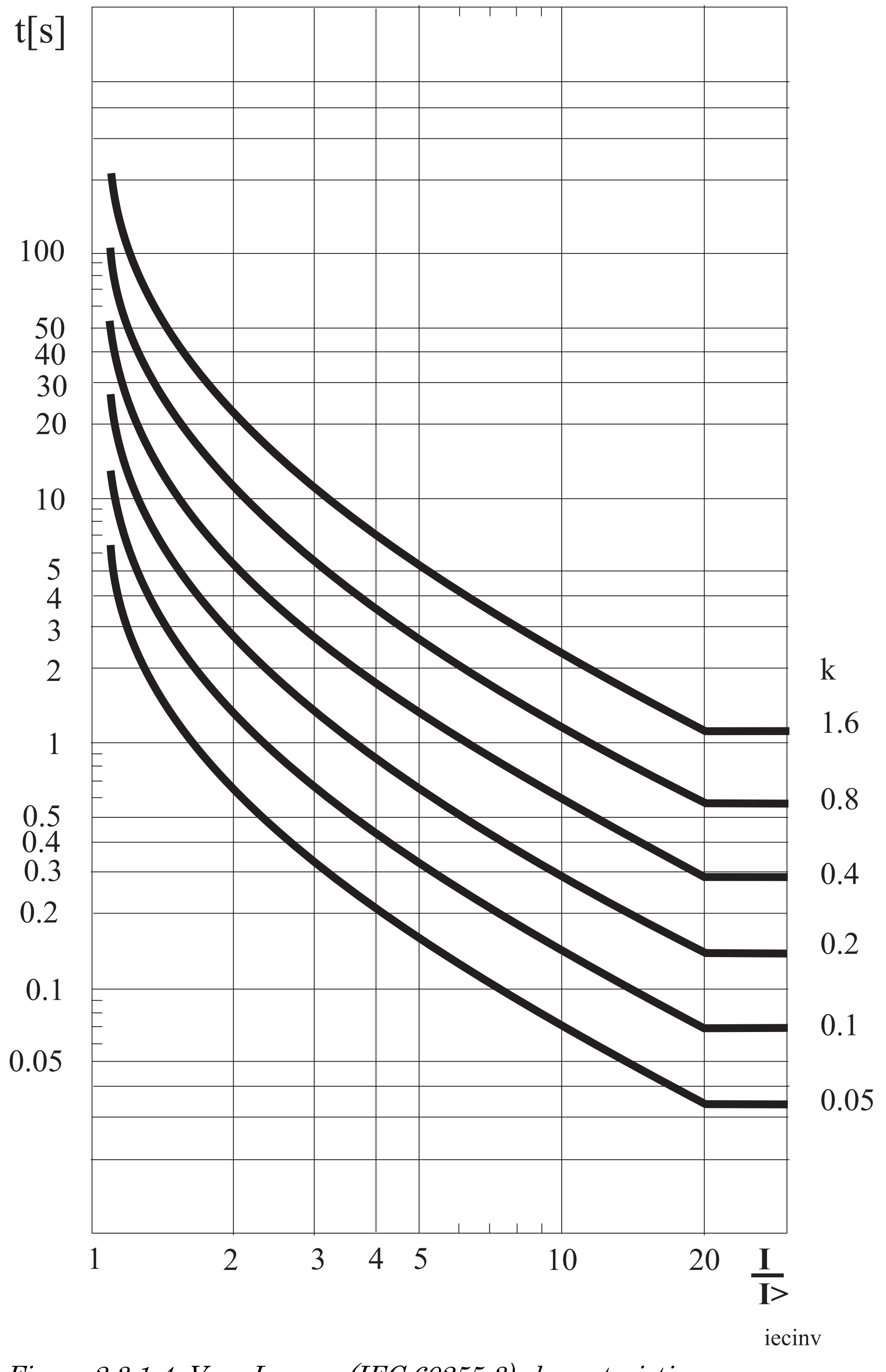


Figure 2.3.1-4. Very Inverse (IEC 60255-3) characteristic

$$t = 13,5 \cdot \frac{k}{\left(\frac{I}{I>}\right) - 1}$$

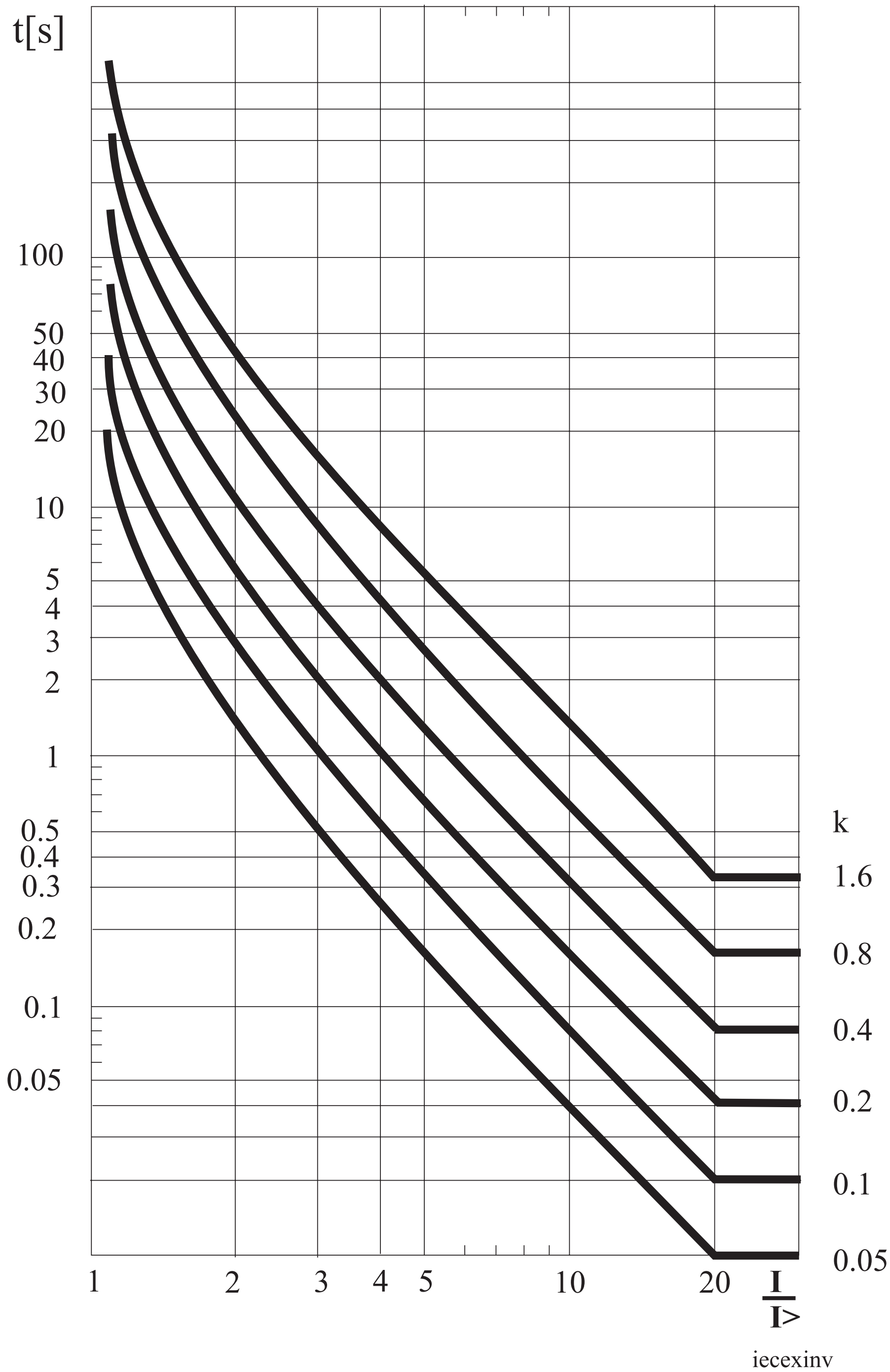


Figure 2.3.1-5. Extremely Inverse (IEC 60255-3) characteristic

$$t = 80 \cdot \frac{k}{\left(\frac{I}{I>}\right)^2 - 1}$$

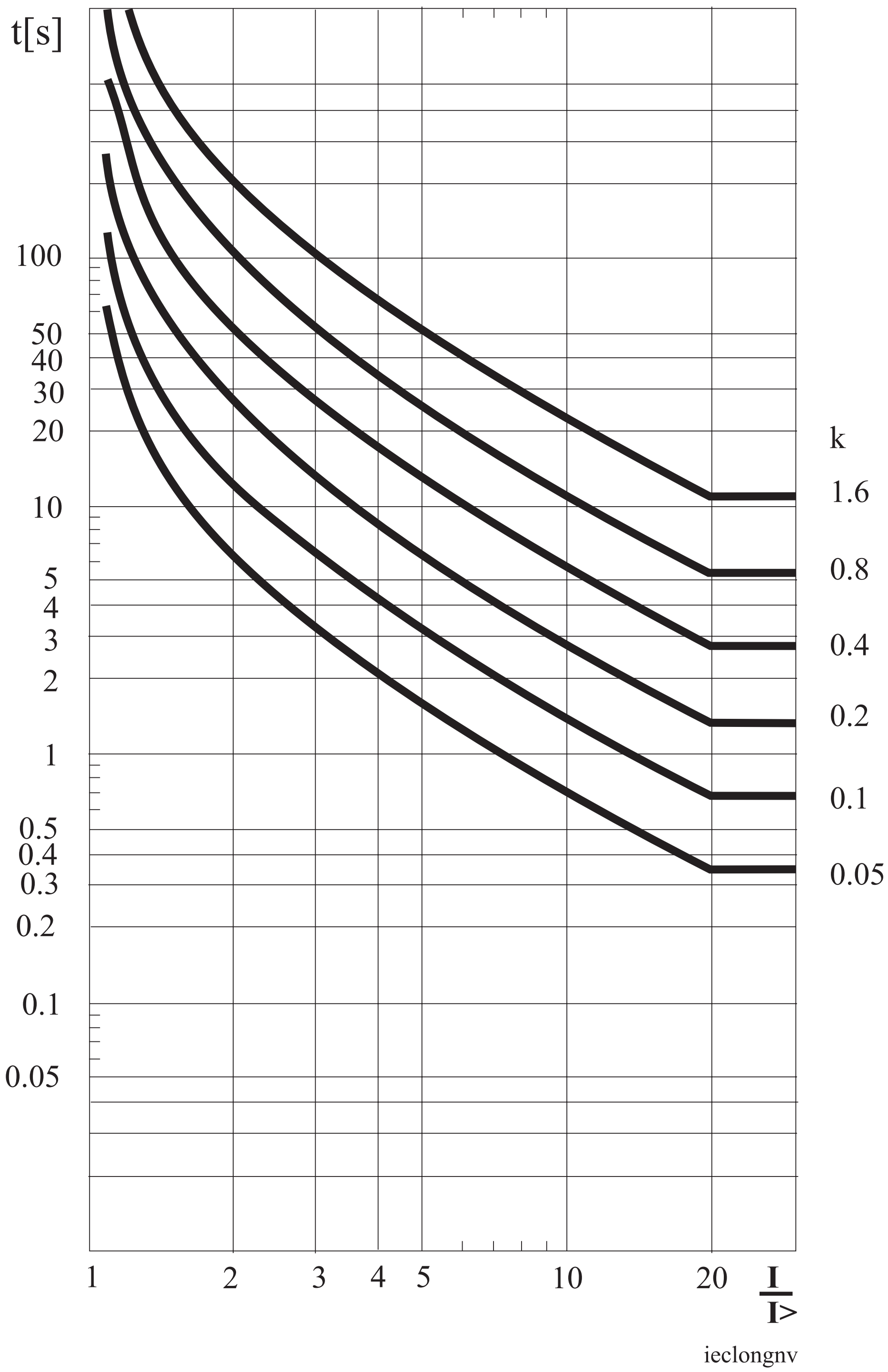


Figure 2.3.1-6. Long Time Inverse (IEC 60255-3) characteristic

$$t = 120 \cdot \frac{k}{\left(\frac{I}{I >}\right) - 1}$$

2.3.2. Short-circuit fault location

The manager includes a sophisticated stand-alone fault location algorithm. The algorithm can locate a short-circuit accurately in radially operated networks. The fault location is given in reactance value, and also the distance to the fault is displayed on the local HMI. This value can then be exported, for example, with event to a DMS (Distribution Management System). The system can then localize the fault. If a DMS is not available, the distance to the fault is displayed as kilometres, as well as a reactance value. However, the distance value is valid only if the line reactance is set correctly. Furthermore, the line should be homogenous, that is, the wire type of the line should be the same for the whole length. If there are several wire types on the same line, an average line reactance value can be used to get an approximate distance value to the fault (examples of line reactances: Overhead wire Sparrow: 0.408 ohms/km and Raven: 0.378 ohms/km).

The fault location is normally used in the incoming bay of the substation. Therefore, the fault location is obtained for the whole network with just one manager. This is very cost-effective upgrade of an existing system.

The algorithm functions in the following order:

1. The needed measurements (phase currents and voltages) are continuously available.
2. The fault distance calculation can be triggered in two ways: by opening a feeder circuit-breaker due to a fault (that is, by using a digital input) or the calculation can be triggered if there is a sudden increase in the phase currents (e.g. short-circuit).
3. Phase currents and voltages are registered in three stages: before the fault, during the fault and after the faulty feeder circuit-breaker was opened.
4. The fault distance quantities are calculated.
5. Two phases with the biggest fault current are selected.
6. The load currents are compensated.
7. The faulty line length reactance is calculated.

Setting parameters of fault location:

Dist

Parameter:	Value:	Unit:	Default:	Description:
Trig	dI; DI1…DI32	-	-	Trigger mode (dI= triggering based on sudden increase of phase current)
Line reactance	0.010…10.000	Ohms/km	0.378	Line reactance of the line. This is used only to convert the fault reactance to kilometres.
dItrig	5…800	% I_{mode}	20	Trig current (sudden increase of phase current)
Kd	0.00…1.00	-	0.31	Load distribution factor
Event	Disabled; Enabled	-	Enabled	Event mask

Measured and recorded values of fault location:

Dist

	Parameter:	Value:	Unit:	Description:
Measured values/ recorded values	Distance		km	Distance to the fault
	Xfault		ohm	Fault reactance
	Date		-	Fault date
	Time		-	Fault time
	Time		ms	Fault time
	Cntr		-	Number of faults
	Pre		A	Pre-fault current (=load current)
	Fault		A	Current during the fault
	Post		A	Post-fault current
	Udrop		$\%U_n$	Voltage dip during the fault
	Durati		s	Fault duration
	Xfault		ohm	Fault reactance

2.3.3. Earth-fault location

The manager includes a sophisticated stand-alone earth-fault location algorithm. The algorithm can locate an earth-fault accurately in radially operated compensated earthed networks.

The function can locate a fault only if the fault resistance is low, say less than 50 ohms. The fault location is given in reactance value. This value can then be exported, for example, with event to a DMS (Distribution Management System). The system can then localize the fault and display it on a map.

The fault location must be used in the incoming bay of the substation. Therefore, the fault location is obtained for the whole network with just one manager. This is very cost-effective upgrade of an existing system.

Please note also that the earth-fault location function requires a change during an earth-fault. This change is done by switching the secondary resistor of the compensation coil on or off. The fault should be allowed to be on at least 200 ms, of which 100 ms without the resistor. The resistor change can be done by using the logic functionality of the manager.

The reactance value is converted to distance in the DMS. The following formula is used:

$$s = \frac{3 * X}{Xo + X_1 + X_2}$$

Where

s = distance in km

X = reactance calculated by the manager

X_o = zero sequence reactance per kilometre of the line

X_1 = positive sequence reactance per kilometre of the line

X_2 = negative sequence reactance per kilometre of the line

The algorithm functions in the following order:

1. The needed measurements (phase currents and voltages) are continuously available.
2. The fault distance calculation can be triggered in two ways: by switching ON or OFF the secondary resistor (that is, by using a digital input) or the calculation can be triggered if there is a change in earth fault or negative sequence current
3. The fault phase is identified by that the voltage of the faulted phase is decreased at least by half.
4. The fault distance is calculated by dividing the change of the voltage by the change of the negative sequence current.
5. Only the imaginary part is used, so then the reactance is solved.

Setting parameters of earth-fault location:

EFDi

Parameter:	Value:	Unit:	Default:	Description:
EFMode	Normal; Reverse	-	Normal	Normal: The resistor is switched ON during a fault. Reverse: The resistor is switched OFF during a fault
TrigIn	Io1;I2;DI1	-	Io1	Triggering input: Io1: earth fault current will trig the function. I2: negative phase sequence current will trig the function DI1: the function is triggered by activating the digital input 1
UoTrig	1…80	% Uon	20	Trig level for Uo
Itrig	10…800	% In	80	Trig level for current
Event	On: Off	-	On	Event mask

Measured and recorded values of earth-fault location:

EFDi

	Parameter:	Value:	Unit:	Description:
Measured values/ recorded values	Fault ph			Fault phase information
	X		ohm	Fault reactance
	Date		-	Fault date
	Time		-	Fault time
	Time		ms	Fault time
	Count		-	Number of faults

2.3.4. Directional overcurrent protection (67)

The three-phase directional overcurrent function consists of four separately adjustable stages, stage I_{dir}>, stage I_{dir}>>, stage I_{dir}>>> and stage I_{dir}>>>>.

These directional overcurrent stages can be used for directional short circuit protection. The stages have two modes: directional and non-directional. The bi-directional operation is possible by setting the both stages in a directional mode and setting the base angle to have a 180° difference.

The direction is based on the phase angle of the power phasor. The power phasor is calculated from the base frequency components of the measured phase currents and line voltages, taking into account the 30° phase/main angle.

The base angle is configurable. For a short circuit with power factor 0.707 (the resistive and inductive components of the fault impedance are equal) an ideal base angle setting would be -45° for forward protection and -45° + 180° = +135° for reverse protection. The angles are independent of the system frequency within the range 16 to 70 Hz. See Figure 2.3.4-2.

When any of the three currents exceeds the setting value, the phase angle of the power phasor is checked by taking into account the base angle, too. If the angle is within the protected area, the stage starts. After the operation delay the stage will trip.

Stages I_{dir}> and I_{dir}>> can be configured for definite time or inverse time operation characteristic. Four characteristic curve sets according to the standard IEC 60255-3 are available: NI (Normal Inverse), VI (Very Inverse), EI (Extremely Inverse) and LTI (Long Time Inverse). Stages I_{dir}>>> and I_{dir}>>>> are configured for Definite Time operation characteristic (DT).

Limitations:

1. The maximum measured current is 50 x I_{mode}. This limits the scope of inverse curves when the setting is more than 2.5 x I_{mode}. For example at setting 4 x I_{mode} the maximum setting relative current is 12.5 x I_{set}/I_{mode} although the curves are defined up to 20 x I_{set}/I_{mode}.
2. The fastest possible operating time is about 60 ms at inverse time characteristic according to curve types VI and EI.

Figure 2.3.4-1 shows a functional block diagram of the I_{dir}> stage of the directional overcurrent function.

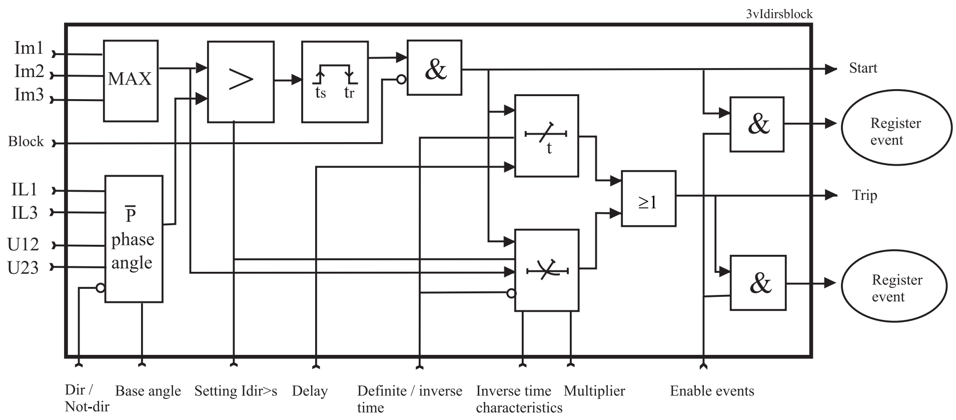


Figure 2.3.4-1. Block diagram of the three-phase overcurrent stage I_{dir}>

The following figure shows an example of directional overcurrent angle characteristics. The base angle setting is set to -45°. The stage will trip when the tip of the current phasor is in the grey area.

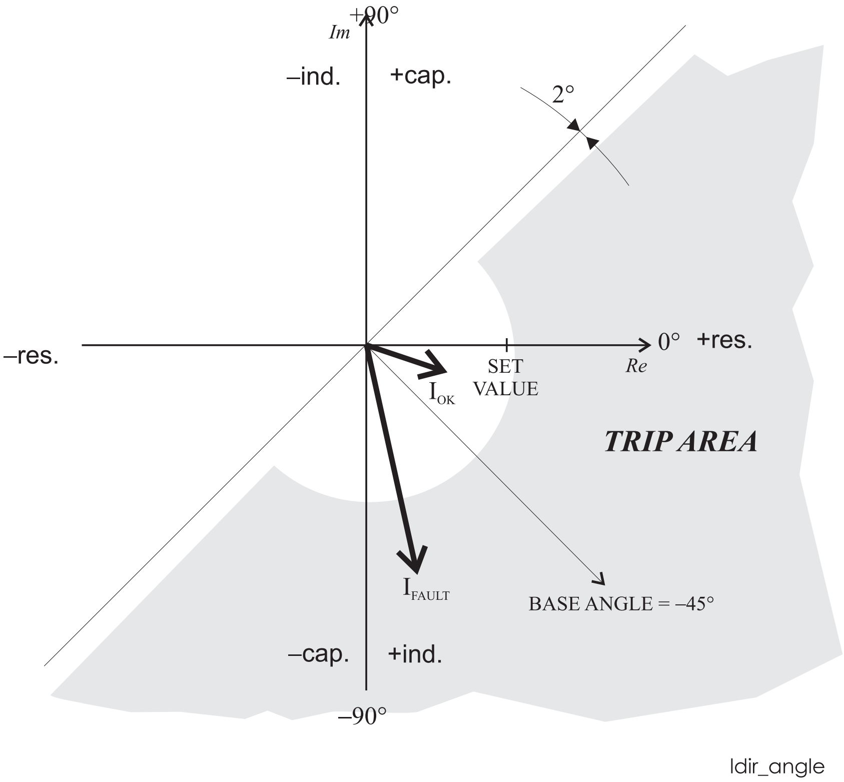


Figure 2.3.4-2. Example of directional overcurrent angle characteristics

Setting parameters of directional overcurrent stages:

I_{dir}>, I_{dir}>>, I_{dir}>>> and I_{dir}>>>> (67)

Parameter:	Value:	Unit:	Default:	Description:
I_{dir}>, I_{dir}>>, I_{dir}>>> and I_{dir}>>>>	0.10…4.00 (I_{dir}>, I_{dir}>>) 0.10…20.00 (I_{dir}>>>, I_{dir}>>>>)	xI_{mode}	1.20	Setting value
Curve	DT IEC/VK IEEE/VS ANSI RI Prg 1 Prg 2 Prg 3	-	IEC/UK (I_{dir}>, I_{dir}>>)	Operational delay type (I_{dir}>, I_{dir}>>)
Type	DT (Definite Time) NI (Normal Inverse) VI (Very Inverse) EI (Extremely Inverse) LTI (Long Time Inverse)	-	NI (I_{dir}>, I_{dir}>>)	The selection of definite time or inverse time characteristics
Mode	Dir (Directional) Undir (Un-directional)	-	Dir	Directional / Un-directional mode
Offset	-180…+179	°	0°	Base angle offset
t>, t>>, t>>>, t>>>>	0.06…300.00	s	0.30 (I_{dir}>>>, I_{dir}>>>>)	Definite operating time

k>	0.05…3.20	-	0.20 (I_{dir}>, I_{dir}>>)	Time multiplier at inverse time (I_{dir}>, I_{dir}>>) *
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

* Minimum allowed k> value is 0.5 for all curves; except for IEC/UK, it can be lower.

Measured and recorded values of directional overcurrent stages:

I_{dir}>, I_{dir}>>, I_{dir}>>> and I_{dir}>>>> (67)

	Parameter:	Value:	Unit:	Description:
Measured value	ILmax		A	Corresponding primary value
	U1		V	Positive sequence voltage
	φ		°	Active power angle
Recorded values	SCntr		-	Cumulative start counter
	TCntr		-	Cumulative trip counter
	Type	1-N, 2-N, 3-N		Fault type/single-phase fault, e.g. 1-N = fault on phase L1
		1-2, 2-3, 1-3		e.g. 2-3 = fault between L2 and L3
		1-2-3		Fault type/three-phase fault
	U1		V	Positive sequence voltage
	φ		°	Active power angle
	Flt		xI_{mode}	Max. fault current
	Load		xI_{mode}	1 s mean value of pre-fault phase currents IL1…IL3
	EDly		%	The elapsed time compared to the set operating time, 100% = tripping

2.3.5. Broken conductor protection (46)

The purpose of the broken conductor protection is to detect unbalanced load conditions, for example a broken wire of a heavy loaded overhead line in case there is no earth fault.

The operation of the unbalanced load function is based on the negative phase sequence component I_2 related to the positive phase sequence component I_1. This is calculated from the phase currents using the method of symmetrical components. The function requires that the measuring inputs are connected correctly so that the rotation direction of the phase currents are as in Figure 4.10.1-1. The unbalance protection has definite time operation characteristic.

Setting parameters of unbalanced load function:

I_2/I_1> (46)

Parameter:	Value:	Unit:	Default:	Description:
I_2/I_1>	2…70	%	20	Setting value, I_2/I_1
t>	1.0…600.0	s	10.0	Definite operating time
Type	DT INV	-	DT	The selection of time characteristics
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Measured and recorded values of unbalanced load function:

I_2/I_1> (46)

	Parameter:	Value:	Unit:	Description:
Measured value	I_2/I_1		%	Relative negative sequence component
Recorded values	SCntr			Cumulative start counter
	TCntr			Cumulative start counter
	Flt		%	Maximum I_2/I_1 fault component
	EDly		%	Elapsed time as compared to the set operating time, 100% = tripping

2.3.6. Unbalance protection (46)

Note!

This function is available only in motor protection mode.

The unbalance stage protects the motor against unbalanced phase currents and single phasing. The protection is based on the negative sequence current.

Both definite time and inverse time characteristics are available. The inverse delay is based on Equation 2.3.6-1. Only the base frequency components of the phase currents are used to calculate the negative sequence value I_2.

Equation 2.3.6-1

$$T = \frac{K_1}{(\frac{I_2}{I_{MOT}}) - K_2^2}$$

where,

T	=	Operation time
K_1	=	Thermal time constant of the motor (I_2^2t value)
I_2	=	Negative sequence phase current, base frequency component
I_{MOT}	=	Nominal current of the motor
K_2	=	The maximum allowed degree of unbalance

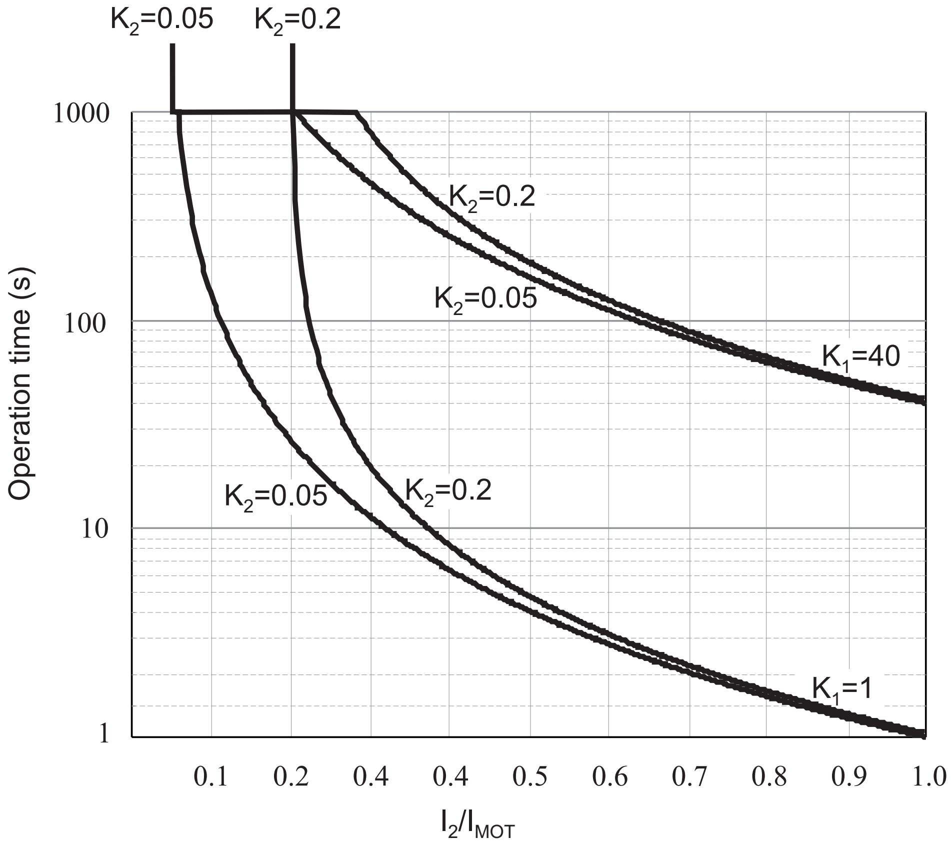


Figure 2.3.6-1. Inverse operation delay of current unbalance stage I_2>. The longest delay is limited to 1000 seconds (=16min 40s).

2.3.7. Phase reversal / incorrect phase sequence protection (47)

Note!

This function is available only in motor protection mode.

The phase sequence stage prevents the motor from running in the wrong direction, thus protecting the load.

When the ratio between negative and positive sequence current exceeds 80%, the phase sequence stage starts and trips after 100 ms.

Parameters of the incorrect phase sequence stage:

I2>> (46)

	Parameter:	Value/unit:	
Measured value	I2/I1	%	Neg. phase seq. current/pos. phase seq. current
Recorded values	SCntr		Start counter (Start) reading
	TCntr		Trip counter (Trip) reading
	Flt	%	Max. value of fault current
	EDly	%	Elapsed time as compared to the set operate time, 100% = tripping

2.3.8. Stall protection (48)

Note!

This function is available only in motor protection mode.

The stall protection unit Ist> measures the fundamental frequency component of the phase currents.

Stage Ist> can be configured for definite time or inverse time operation characteristic.

The stall protection stage protects the motor against prolonged starts caused by e.g. a stalled rotor. While the current has been less than I_{STOP} and then within 200 milliseconds exceeds $I_{StartMin}$ the stall protection stage starts to count the operation time T according to Equation 2.3.8-1. The equation is also drawn in Figure 2.3.8-1. When current drops below 120 % x I_{MOT} the stall protection stage releases.

Equation 2.3.8-1

$$T = \frac{I_{START}}{I_{MEAS}} T_{START}$$

where,

T	=	Operation time
I_{START}	=	Start current of the motor. Default 6.00xI_{MOT}
I_{MEAS}	=	Measured current during start
T_{START}	=	Maximum allowed start time for the motor

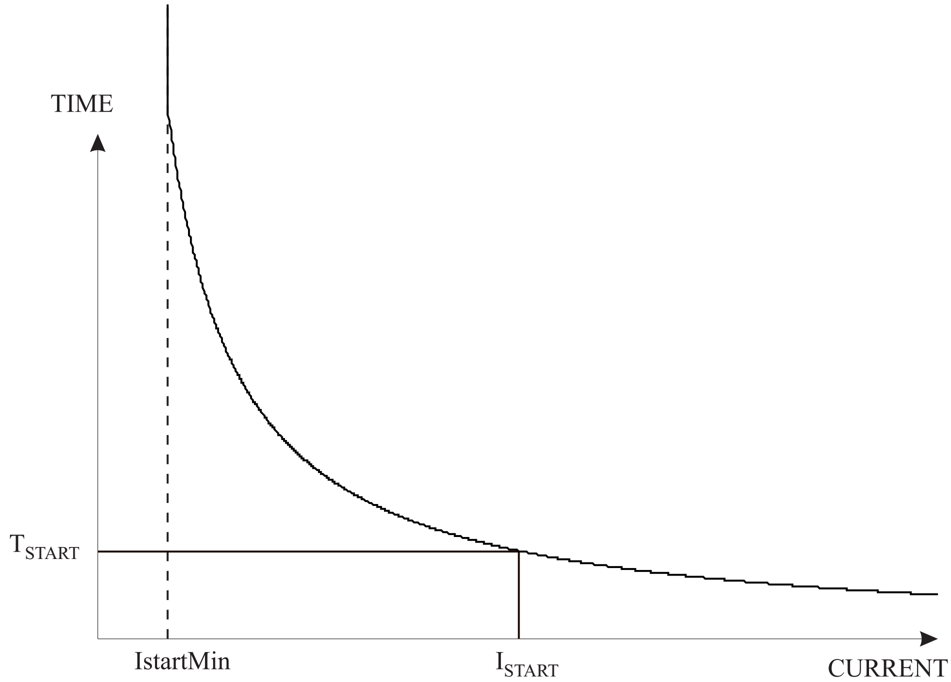


Figure 2.3.8-1. Operation time delay of the stall protection stage Ist>.

If the measured current is less than the specified start current I_{START} the operation time will be longer than the specified start time T_{START} and vice versa.

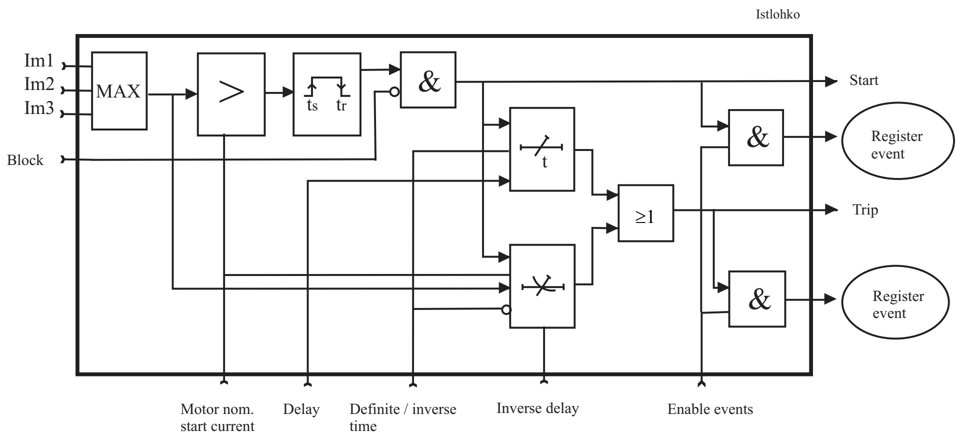


Figure 2.3.8-2. Block diagram of the stall protection stage Ist>.

Parameters of the stall protection stage:

Ist> (48)

	Parameter:	Value/unit:	
Setting values	ImotSt	xI_{MOT}	Nominal motor starting current
	Ist>	%Imot	Start detect current. Must be less than initial motor starting current.

	Type	DT	Operation charact./ definite time
		Inv	Operation charact./ inverse time
	tDT>	s	Operation time [s]
	tInv>	s	Time multiplier at inverse time
Recorded values	SCntr		Start counter (Start) reading
	TCntr		Trip counter (Trip) reading
	Flt	xI_{MOT}	Max. value of fault.
	EDly	%	Elapsed time as compared to the set operate time, 100% = tripping

2.3.9. Frequent start protection (66)

Note!

This function is available only in motor protection mode.

The simplest way to start an asynchronous motor is just to switch the stator windings to the supply voltages. However every such start will heat up the motor considerably because the initial currents are significantly above the rated current.

If the motor manufacturer has defined the maximum number of starts within on hour or/and the minimum time between two consecutive starts this stage is easy to apply to prevent too frequent starts.

When current has been less that I_{STOP} and then exceeds $I_{StartMin}$ the situation is recognized as a start. The maximum current for a stopped motor I_{STOP} is 10 % x I_{MOT}. The minimum current for a just started motor $I_{StartMin}$ is 150 % x I_{MOT}.

The stage will give a start signal when the second last start has been done. The trip signal is normally activated and released when there are no starts left. Figure 2.3.9-1 shows an application.

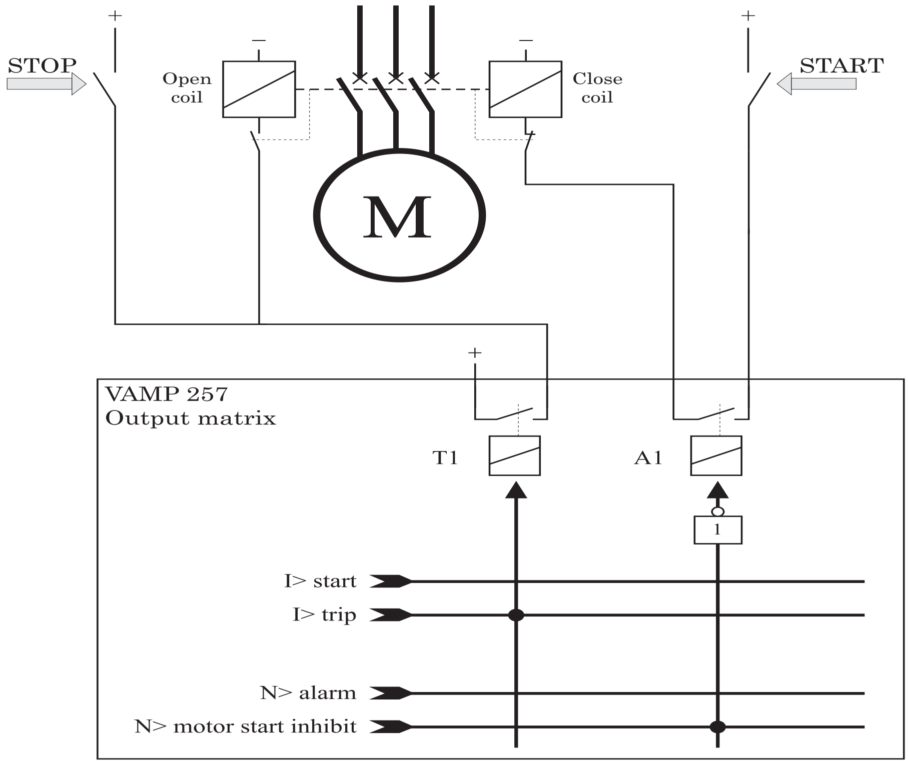


Figure 2.3.9-1 Application for preventing too frequent starting, using the N> stage. The relay A1 has been configured to be "normal closed". The start is just an alarm telling that there is only one start left at the moment.

Parameters of the frequent start protection:

N> (66)

	Parameter:	Value/unit:	
Measured value	Mot strs		Motor starts in last hour
	T	Min	Elapsed time from motor start
Setting values	Sts/h		Max. starts in one hour
	Interval	Min	Min. interval between two consecutive starts
Recorded values	SCntr		Start counter (Start) reading
	TCntr		Trip counter (Trip) reading
	Descr	1StartLeft	1 start left, activates the N> start signal
		MaxStarts	Max. start trip, activates the N> trip signal
		Interval	Min. interval between two consecutive starts has not yet been elapsed, activates the N> trip signal
	Tot Mot Strs		Number of total motor starts
	Mot Strs/h		Number of motor starts in last hour
	El. Time from mot Strt	Min	Elapsed time from the last motor start

2.3.10. Undercurrent protection (37)

The three-phase undercurrent unit measures the fundamental frequency component of the phase currents.

The stage I< can be configured for definite time characteristic.

The undercurrent stage is protecting rather the device driven by the motor e.g. a submersible pump, than the motor itself.

Parameters of the undercurrent stage:

I< (37)

	Parameter:	Value/unit:	
Measured value	IL_{MIN}	A	Min. value of phase currents IL1..IL3 in primary value
Setting values	I<	xI_{mode}	Setting value as per times I_{MOT}
	t<	S	Operation time [s]
Recorded values	SCntr		Start counter (Start) reading
	TCntr		Trip counter (Trip) reading
	Type	1-N, 2-N 3-N	Fault type/single-phase fault e.g.: 1-N = fault on phase L1
		1-2, 2-3 1-3	Fault type/two-phase fault e.g.: 2-3 = fault between L2 and L3
		1-2-3	Fault type/three-phase fault
	Flt	%	Min. value of fault current as per times I_{MOT}
	Load	%	1s mean value of pre-fault currents IL1—IL3
	EDly	%	Elapsed time as compared to the set operate time, 100% = tripping

2.3.11. Directional earth fault protection (67N)

The directional earth fault protection is used in networks where a sensitive earth fault protection is needed and in applications with varying network structure and length.

The manager consists of versatile protection functions for network earth fault protection. The earth fault current is measured via energizing input I_0 or I_{02}, or the earth fault current can be calculated from the phase currents internally. The residual voltage is measured via energizing input U_0 (e.g. broken delta connection), or it can be calculated from the phase voltages internally according to the selected protection mode:

- **Phase**: the residual voltage is calculated from the phase voltages and therefore a separate residual voltage transformer is not needed. The setting values are relative to the VT secondary voltage (Usec) defined in configuration.
- **Line+Uo**: The residual voltage is measured with voltage transformers (e.g. a broken delta connection). The setting

values are relative to the VTo secondary voltage (Uosec) defined in configuration.

For the I_0 and U_0 measurement, the fundamental frequency components are used. Thus, the degree of the third harmonic attenuation is at least 60 dB, which contributes to the extremely high accuracy of the earth fault protection.

The directional earth fault protection measures the residual voltage U_0, earth fault current I_0 and the phase angle φ between U_0 and I_0.

The directional earth fault protection includes two separate protection stages, that is, $I_0φ>$ and $I_0φ>>$. Both the stages have their own operation time settings. The protection stage starts when the setting values of $I_0φ>$ and $U_0>$ are simultaneously exceeded.

The I_0Res mode (I_0cosφ) is used in rigidly, resistance and resonant earthed networks, and in the I_0Cap mode (I_0sinφ) in isolated networks. The user can set this characteristic, or it can be controlled dynamically using any digital input. The control input is usually used in compensated applications, where the compensation coil can be switched on and off.

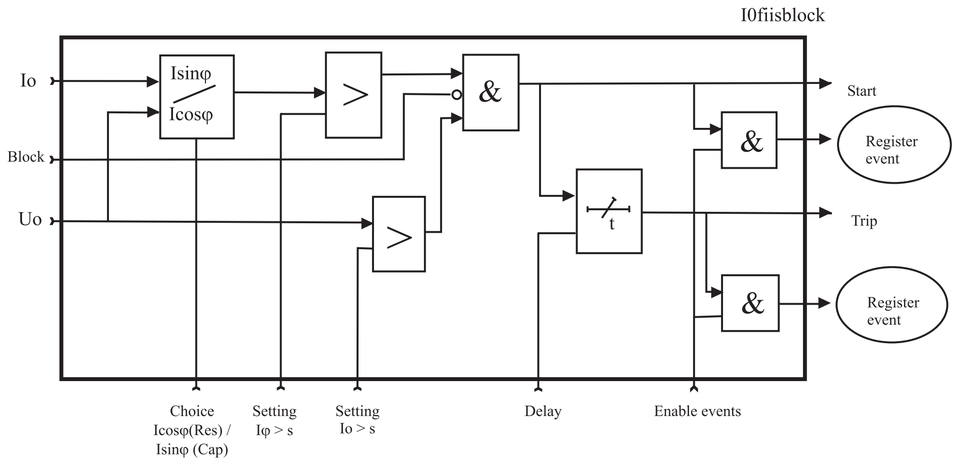


Figure 2.3.11-1. Block diagram of the directional earth fault stages $I_0φ>$ and $I_0φ>>$

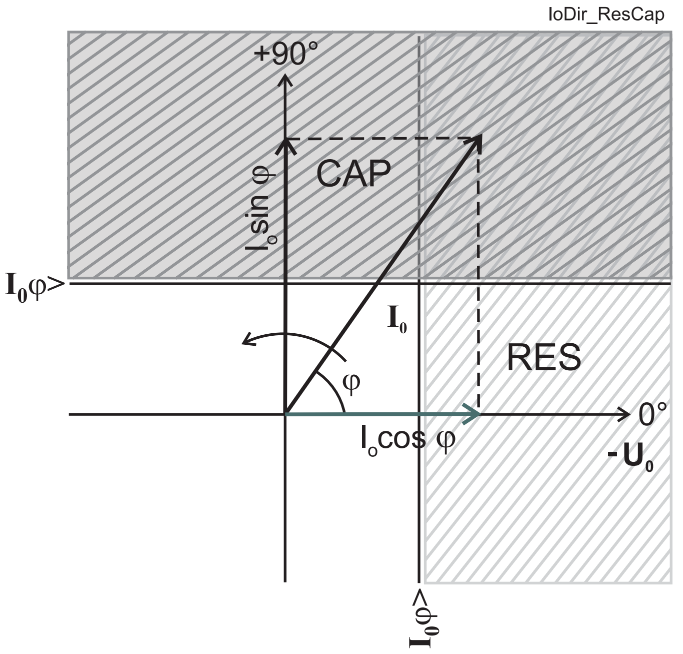


Figure 2.3.11-2. Operation characteristic of the directional I_0 in Res or Cap mode

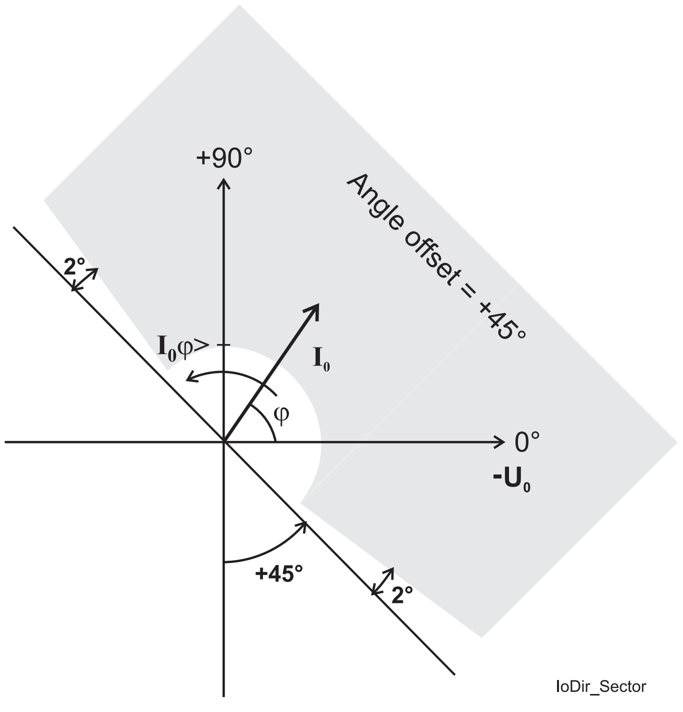


Figure 2.3.11-3. Operation characteristic of the directional I_0 in sector mode

Setting parameters of directional earth-fault protection:

$I_0\varphi$>, $I_0\varphi$>> (67N)

Parameter:	Value:	Unit:	Default:	Description:
Input	I_0, I_{02}, I_0C	-	Io	Selection of the current input or the calculated value
Mode	ResCap, Sector, Undir	-	ResCap	Selection of operation mode.
Curve	DT; IEC/UK; IEEE/US; ANSI; RI; Prg 1; Prg 2; Prg 3	-	DT	Operational delay type
Type	DT, NI, VI, EI, LTI		DT	Selection of definite time or inverse time characteristics.
$I_0\varphi$>, $I_0\varphi$>>	0.01…8.00	xI_{0N}	0.20	Setting value
t>, t>>	0.10…300.0	S	1.00	Operating time
ChCtrl	Res; Cap; Dix		Res	Control of operation characteristics (if one of the digital inputs is TRUE=Capacitive; FALSE=Resistive)
U_0>, U_0>>	1…20	%	10	Residual voltage setting
Intrmt	0.00…300.0	S	0.50	Intermittent time
Offset	-180…+179	°	0	Phase angle between I_0 and U_0
K>	0.05…3.20	–	0.20	Time multiplier at inverse time *
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

* Minimum allowed k> value is 0.5 for all curves; except for IEC/UK, it can be lower.

Measured and recorded values of directional earth fault protection:

$I_0\varphi$>, $I_0\varphi$>> (67N)

	Parameter:	Value:	Unit:	Description:
Measured values	I_0Res/Cap		A	Primary (Res/Cap) earth fault current I_0
	U_0		%	Residual voltage U_0
Display	$I_0\varphi$>, $I_0\varphi$>>		A	Setting value as primary value

	Char	Res; Cap		Actual operation characteristic (Res=Resistive; Cap=Capacitive)
Recorded values	SCntr			Cumulative start counter
	TCntr			Cumulative trip counter
	Flt		pu	Max. fault current
	EDly		%	The elapsed time compared to the set operating time; 100% = tripping
	Angle		o	Phase angle between residual voltage and current
	U_0		%	The max. residual voltage under fault condition

2.3.12. Earth fault protection (50N/51N)

The manager has two separate energizing inputs rated 1 A (I_0> and I_0>>) and 5 A (I_{02}> and I_{02}>>), both of which can be used simultaneously. The function of the stages I_0> and I_0>> is based on the measured current connected to the input 4 (terminal X1:7-8). The function of the stages I_{02}> and I_{02}>> is based on the measured current connected to the input 5 (terminal X1:9-10).

The terminal measures the fundamental frequency component Io. Thus, the degree of attenuation of the third harmonic is at least 60 dB. This contributes to the extremely high accuracy of the earth fault protection, which is insensitive against harmonics.

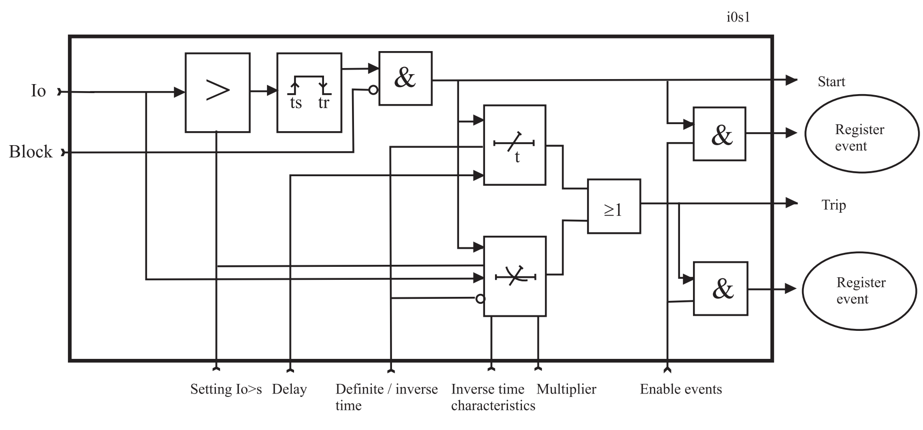


Figure 2.3.12-1. Block diagram of the earth fault stages I_0>

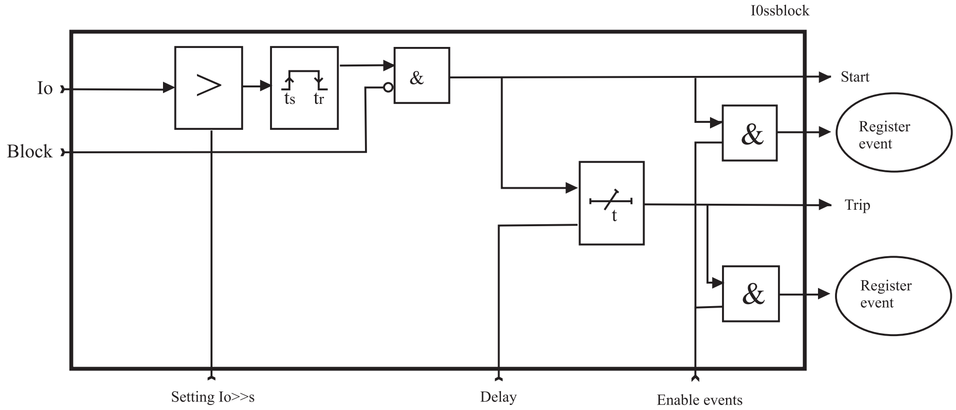


Figure 2.3.12-2. Block diagram of the earth fault stages I_0>>, I_{02}> and I_{02}>>

Setting parameters of earth fault protection:

I_0>, I_0>>, I_{02}>, I_{02}>> (50N/51N)

Parameter:	Value:	Unit:	Default:	Description:
I_0>, I_0>>, I_{02}>, I_{02}>>	0.005…8.000 (I_0>); 0.01…8.00 (I_0>>)**; 0.01…8.000 (I_{02}>); 0.01…8.00 (I_{02}>>)	pu	0.050 (I_0>) 0.100 (I_0>>) 0.10 (I_{02}>) 0.20 (I_{02}>>)	Setting value
Curve	DT, IEC/UK, IEEE/US, ANSI, RI, Prg 1, Prg 2, Prg3	-	DT (I_0>)	Operational delay type (I_0>)
Type	DT (Definite Time) NI (Normal Inverse) VI (Very Inverse) EI (Extremely Inverse) LTI (Long Time Inv.)	-	DT (I_0>)	Selection of definite time or inverse time characteristics (I_0>)
t>	0.08…300.00	s	1.00 (I_0>, I_0>>, I_{02}>>) 0.50 (I_{02}>)	Definite operating time
k>	0.05…3.20	-	-	Time multiplier at inverse time *
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

* Minimum allowed k> value is 0.5 for all curves; except for IEC/UK, it can be lower.

Measured and recorded values of earth fault protection:

I_0>, I_0>>, I_{02}>, I_{02}>> (50N/51N)

	Parameter:	Value:	Unit:	Description:
Measured value	I_0>, I_0>>, I_{02}>, I_{02}>>		A	Primary earth fault current I_0
Display	I_0>, I_0>>, I_{02}>, I_{02}>>		A	Setting value I_0
Recorded values	SCntr		-	Cumulative start counter
	TCntr		-	Cumulative trip counter
	Flt		pu	The max. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

2.3.13. Capacitor bank unbalance protection

The manager enables versatile capacitor, filter and reactor bank protection, with its five current measurement inputs. The fifth input is typically useful for unbalance current measurement of a double-wye connected unearthed bank. Furthermore, the unbalance protection is highly sensitive to internal faults of a bank because of the sophisticated natural unbalance compensation. However, the location method gives the protection a new dimension and enables easy maintenance monitoring for a bank.

This protection scheme is specially used in double wye connected capacitor banks. The unbalance current is measured with a dedicated current transformer (could be like 5A/5A) between two starpoints of the bank. The unbalance current is not affected by system unbalance. However, due to manufacturing tolerances, some amount of natural unbalance current exists between the starpoints. This natural unbalance current affects the settings, thus, the setting has to be increased.

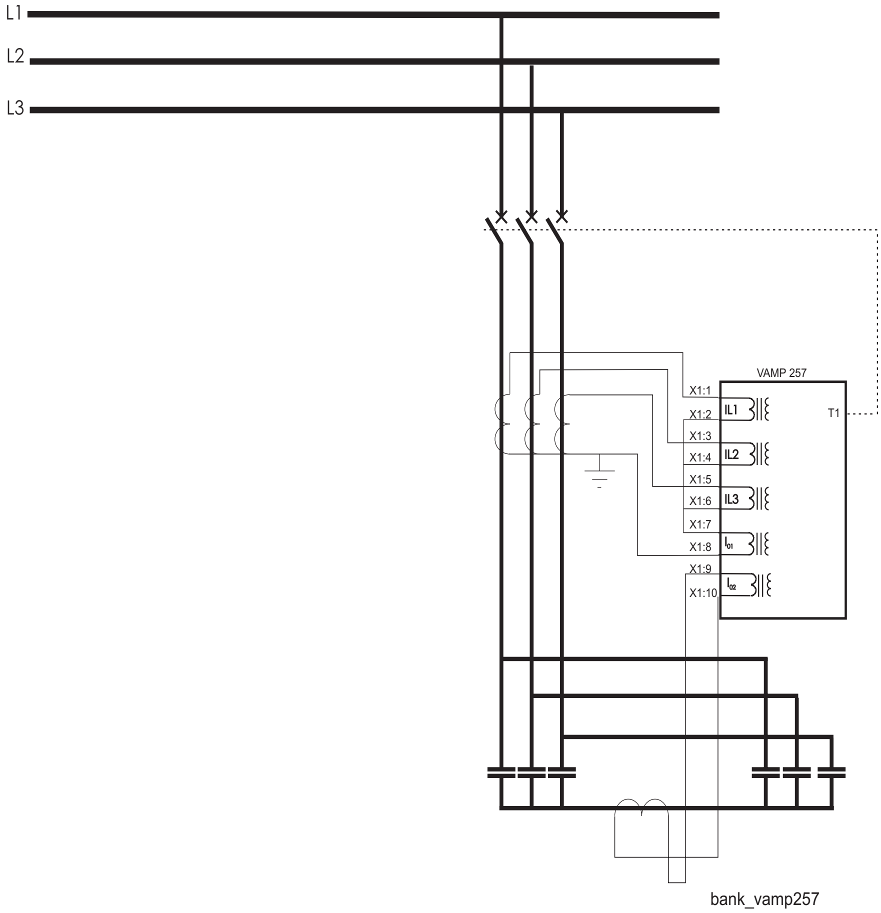


Figure 2.3.13-1. Typical capacitor bank protection application with VAMP 257

Compensation method

The sophisticated method for unbalance protection is to compensate the natural unbalance current. The compensation is triggered manually when commissioning. The phasors of the unbalance current and one phase current are recorded. This is because one polarizing measurement is needed. When the phasor of the unbalance current is always related to IL1, the frequency changes or deviations have no effect on the protection.

After recording the measured unbalance current corresponds the zero-level and therefore, the setting of the stage can be very sensitive.

Compensation and location

The most sophisticated method is to use the same compensation method as mentioned above, but the add-on feature is to locate the branch of each faulty element or to be more precise, the broken fuse.

This feature is implemented to the stage Io2>>, while the other stage Io2> can still function as normal unbalance protection stage with compensation method. Normally, the Io2>> could be set as an alarming stage while stage Io2> will trip the circuit-breaker.

The stage Io2>> should be set based on the calculated unbalance current change of one faulty element. This can be easily calculated. However, the setting must be, say 10% smaller than the calculated value, since there are some tolerances in the primary equipment as well as in the relay measurement circuit. Then, the time setting of Io2>> is not used for tripping purposes. The time setting specifies, how long the manager must wait until it is certain that there is a faulty element in the bank. After this time has elapsed, the stage Io2>> makes a new compensation automatically, and the measured unbalance current for this stage is now zero. Note, the automatic compen-sation does not effect on the measured unbalance current of stage Io2>.

If there is an element failure in the bank, the algorithm checks the phase angle of the unbalance current related to the phase angle of the phase current IL1. Based on this angle, the algorithm can increase the corresponding faulty elements counter (there are six counters).

The user can set for the stage Io2>> the allowed number of faulty elements, e.g. if set to three elements, the fourth fault element will issue the trip signal.

The fault location is used with internal fused capacitor and filter banks. There is no need to use it with fuseless or external fused capacitor and filter banks, nor with the reactor banks.

Setting parameters of capacitor bank unbalance protection:

I_{02}>, I_{02}>> (50N/51N)

Parameter:	Value:	Unit:	Default:	Description:
I_{02}>, I_{02}>>	0.01…8.000 (I_{02}>); 0.01…8.00 (I_{02}>>);	pu	0.10 (I_{02}>) 0.20 (I_{02}>>)	Setting value
t>	0.08…300.00	s	0.50 (I_{02}>), 1.00 (I_{02}>>)	Definite operating time
Input	Io; Io2; IoCalc	-	Io2	Current measurement input. Note! Do not use the calculated value which is only for earth fault protection purposes
CMode	Off; On (I_{02}>); Off; Normal; Location(I_{02}>>)	-	Off	Compensation selection
SaveBa	-; Get	-	-	Trigg the phasor recording

SetBal	0.010…3.000	pu	0.050	Compensation level
S_On	On; Off	-	On	Start on event
S_Off	On; Off	-	On	Start off event
T_On	On; Off	-	On	Trip on event
T_Off	On; Off	-	On	Trip off event
DIoSav	On; Off	-	Off	Recording trigged event
DIoSav	On; Off	-	Off	Recording ended event

Measured and recorded values of capacitor bank unbalance protection:

I_{02}>, I_{02}>> (50N/51N)

	Parameter:	Value:	Unit:	Description:
Measured values	I_{02}, I_{02}		Pu	unbalance current I_{02} (including the natural unbalance current)
	dIo		A	Compensated unbalance current
Display	I_{02}>, I_{02}>>		A	Setting value I_{02}
Recorded values	SCntr		-	Cumulative start counter
	TCntr		-	Cumulative trip counter
	Flt		pu	The max. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping
	Isaved		A	Recorded natural unbalance current
	SavedA		deg	Recorded phase angle of natural unbalance current
	Faults (I_{02}>> only)		-	Allowed number of element failures
	Total (I_{02}>> only)		-	Actual number of element failures in the bank
	Clear (I_{02}>> only)	-; Clear	-	Clear the element counters
	L1-B1 (I_{02}>> only)		-	Number of element failures in phase L1 in brach 1 (left side)
	L1-B2 (I_{02}>> only)		-	Number of element failures in phase L1 in brach 2 (right side)
	L2-B1 (I_{02}>> only)		-	Number of element failures in phase L2 in brach 1 (left side)
	L2-B2 (I_{02}>> only)		-	Number of element failures in phase L2 in brach 2 (right side)

	L3-B1 (I_{02}>> only)		-	Number of element failures in phase L3 in brach 1 (left side)
	L3-B2 (I_{02}>> only)		-	Number of element failures in phase L3 in brach 2 (right side)
	Locat (I_{02}>> only)		-	Changed unbalance current (after automatic compensation)
	LocAng (I_{02}>> only)		-	Changed phase angle of the unbalance current (after automatic compensation)

2.3.14. Residual voltage protection (59N)

The residual voltage function comprises two separately adjust-table residual voltage stages (stage U_0> and U_0>>).

The residual voltage function measures the fundamental frequency component of the residual voltage. This means that harmonics will not cause a trip. The protection stages operate with definite time characteristics.

The function starts if the actual value for the residual voltage exceeds the setting value. If the overvoltage situation continues after the start delay has elapsed, the function trips.

The residual voltage is either measured with voltage transformers (e.g. broken delta connection) or calculated from the phase voltages according to the selected protection mode:

- Phase: the residual voltage is calculated from the phase voltages and therefore a separate residual voltage transformer is not needed. The setting values are relative to the VT secondary voltage (Usec) defined in the configuration.
- 2 Line+Uo / 2 side+Uo: the residual voltage is measured with voltage transformers (e.g. a broken delta connection). The setting values are relative to the VTo secondary voltage (Uosec) defined in the configuration.
- 3 side: the residual voltage not available

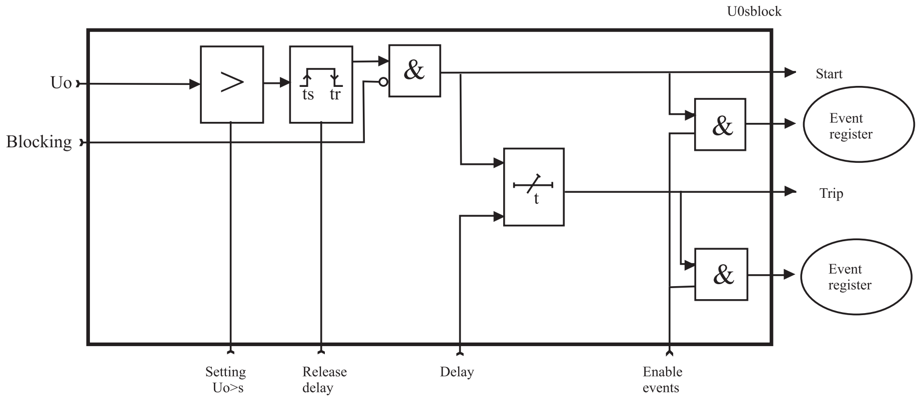


Figure 2.3.14-1. Block diagram of the residual voltage stages U_0> and U_0>>

Setting parameters of residual voltage protection stages:

U_0>, U_0>>, (59N)

Parameter:	Value:	Unit:	Default:	Description:
U_0>, U_0>>	1.0…60	% U_0n	10 (U_0>) 20 (U_0>>)	Setting value
t>, t>>	0.3…300.0	s	2.0 (t>) 0.5 (t>>)	Definite operation time
ReleaseDly		s		Release delay [s] (only Uo>)
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Measured and recorded values of residual voltage protection stages:

U_0>, U_0>>, (59N)

	Parameter:	Value:	Unit:	Description:
Measured value	U_0>, U_0>>		V	Residual voltage U_0 as primary value
Recorded values	SCntr			Start counter (Start) reading
	TCntr			Trip counter (Trip) reading
	Flt		%Uo	The max. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

2.3.15. Overload protection (49)

The overload function protects the line or protective object against thermal overload. The measuring is based on the RMS (Root Mean Square) value of the phase currents from which the heating of the cable to be protected is calculated. Thermal stress can be supervised by means of a thermal image. The thermal image can be calculated from the standard heating expression according to IEC 60255-8:

$$t = \tau \cdot \ln \frac{I^2 - I_p^2}{I^2 - (k \cdot I_n)^2}$$

where:

τ	=	heating time constant (cooling)
ln	=	natural logarithm
I	=	measured phase current (the max. value of three phase currents)
Ip	=	preload current (corresponds to the heating level reached)
k	=	overload factor (setting value of T>) k x I_n = steady-state current which corresponds to the setting value of T> (the thermal trip)
I_n	=	rated current

The heating time constant (tau [τ]) and the load current factor (k) corresponding to the maximum thermal load are settable.

The factor k defines the load current value which, when exceeded, results in a thermal trip.

The cooling time constant of the thermal overload protection is the same as the heating time constant. Cooling time constant is available only in motor protection mode.

The thermal overload stage is provided with a separately settable alarm function, the setting range of which is from 60 to 99% of the thermal trip level.

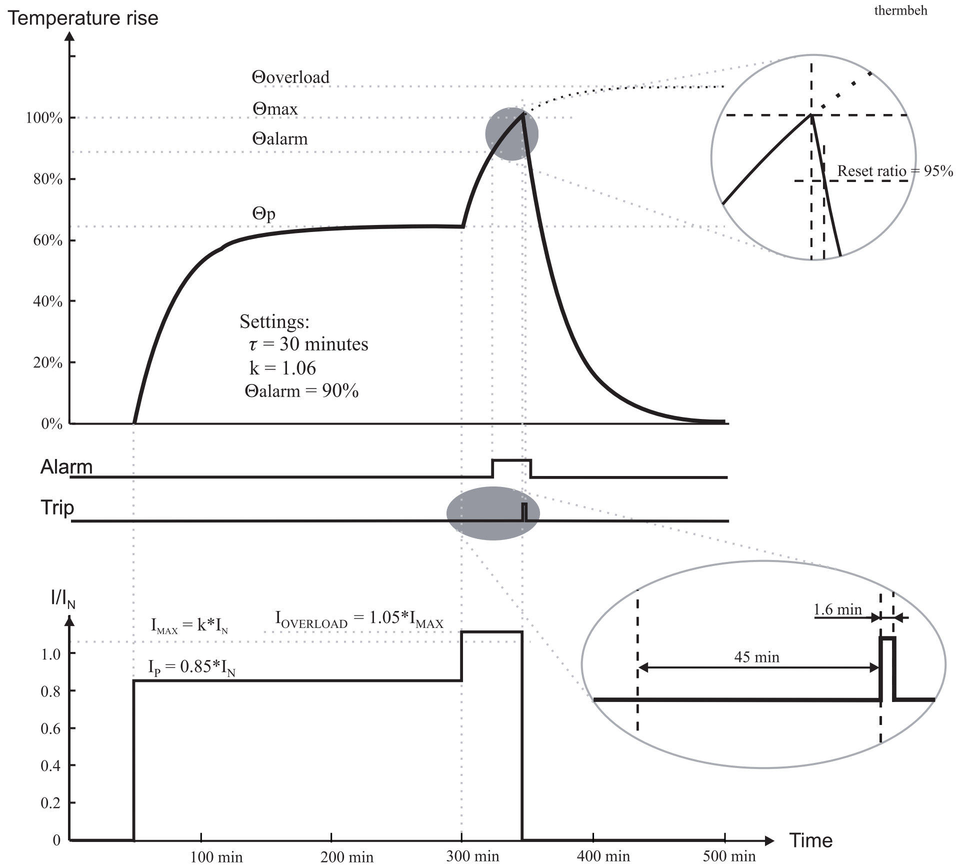


Figure 2.3.15-1. Overload protection

Setting parameters of overload protection:

T> (49)

Parameter:	Value:	Unit:	Default:	Description:
T>	0.50…1.20	xI_{mode}	1.06	Setting value T> (=k x In)
Alarm	60…99	%	90	Alarm setting T>
Tau	2…60	min	60	Heating/cooling time constant
Tau2	1..10	xTau	1	Cooling time multiplier for Tau
I_{MAX40}	0.7…1.2	xI_{mode}	1	Relative allowed overload when Θ_{AMB} is +40 °C
I_{MAX70}	0.5…1	xI_{mode}	0.78	Relative allowed overload when Θ_{AMB} is +70 °C
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

NOTE!

Setting the values of I_{MAX40}, I_{MAX70} and Tau2 is possible only in motor protection mode.

Measured and recorded values of overload protection:

T> (49)

	Parameter:	Value:	Unit:	Description:
Measured value	T		%	Temperature rise
Display	T>		A	Setting value T>
Recorded values	SCntr			Cumulative start counter
	TCntr			Cumulative trip counter

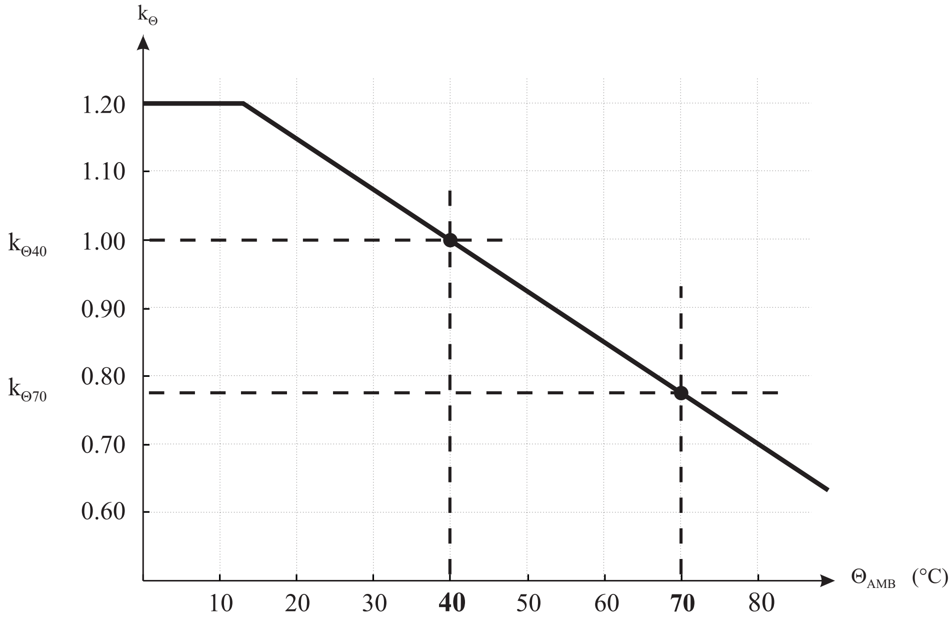


Figure 2.3.15-2. Ambient temperature correction of the overload stage T>. NOTE! Ambient temperature correction is only available in motor protection mode.

NOTE!

Ambient temperature correction is only available in motor protection mode.

Ambient temperature correction for the maximum allowed continuous current used by the thermal overload stage. The slope is defined by the user giving the relative motor currents at ambient temperatures +40 °C and +70 °C. The default values are I_{MAX40} = 100% and I_{MAX70} = 78%.

The device is updating the thermal image continuously. If the calculated temperature exceeds the given alarm limit Θ_{ALARM} the stage gives out a start signal. When the temperature exceeds the trip level Θ_{TRIP} the stage activates the trip signal. The start and trip signals are controlling the output relays via the user configured output relay matrix. The start signal is not released until the temperature is $\Theta_{DEADBAND}$ below Θ_{MAX}. The temperature dead band $\Theta_{DEADBAND}$ is 10 % x Θ_{TRIP}.

Whenever the current is below I_{STOP} the motor is supposed to be stopped and a longer time constant is used for modeling the temperature. The maximum current for a stopped motor I_{STOP} is 10 % x I_{MOT}.

NOTE!

If the motor manufacturer gives a t_{6x} value instead of τ, the τ can be calculated using Equation 2.3.15-1 assuming that the t_{6x} is given for a motor in normal operating temperature. If the t_{6x} is given for a cold motor then Equation 2.3.15-2 should be used.

Equation 2.3.15-1

$$\tau = 71 \cdot t_{6X}$$

Equation 2.3.15-2

$$\tau = 35.5 \cdot t_{6X}$$

2.3.16. Auto-reclose function (79)

The auto-reclose (AR) matrix in the following Figure 2.3.16-1 describes the start and trip signals forwarded to the auto-reclose function.

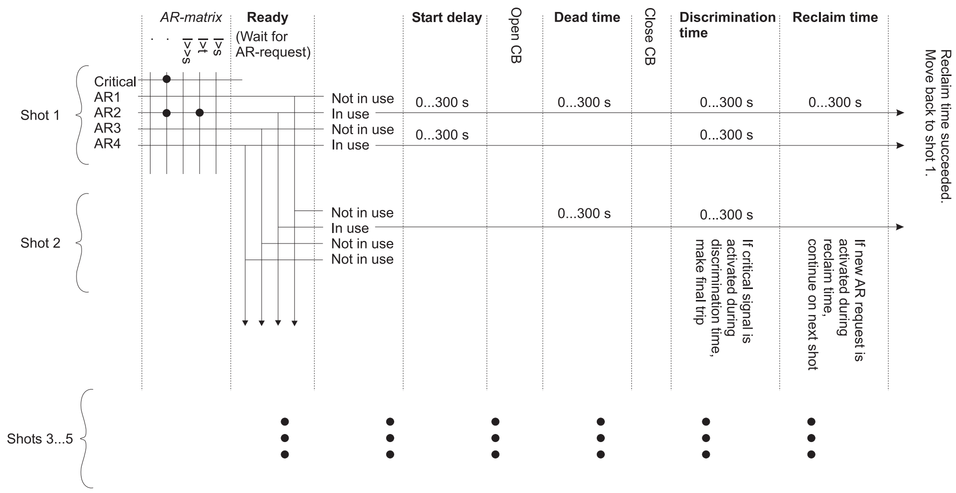


Figure 2.3.16-1. Auto-reclose matrix

The AR matrix above defines which signals (the start and trip signals from protection stages or digital input) are forwarded to the auto-reclose function. In the AR function, the AR signals can be configured to initiate the reclose sequence. Each shot from 1 to 5 has its own enabled/disabled flag. If more than one AR signal activates at the same time, AR1 has highest priority and AR4 the lowest. Each AR signal has an independent start delay for the shot 1. If a higher priority AR signal activates during the start delay, the start delay setting will be changed to that of the highest priority AR signal.

After the start delay the circuit-breaker (CB) will be opened if it is closed. When the CB opens, a dead time timer is started. Each shot from 1 to 5 has its own dead time setting.

After the dead time the CB will be closed and a discrimination time timer is started. Each shot from 1 to 5 has its own discrimination time setting. If a critical signal is activated during the discrimination time, the AR function makes a final trip. The CB will then open and the AR sequence is locked. Closing the CB manually clears the "locked" state.

After the discrimination time has elapsed, the reclaim time timer starts. If any AR signal is activated during the reclaim time or the discrimination time, the AR function moves to the next shot. The reclaim time setting is common for every shot.

If the reclaim time runs out, the auto-reclose sequence is successfully executed and the AR function moves to ready -state and waits for a new AR request in shot 1.

A trip signal from the protection stage can be used as a backup. Configure the start signal of the protection stage to initiate the AR function. If something fails in the AR function, the trip signal of the protection stage will open the CB. The delay setting for the protection stage should be longer than the AR start delay and discrimination time.

If a critical signal is used to interrupt an AR sequence, the discrimination time setting should be long enough for the critical stage, usually at least 100 ms.

Setting parameters of AR function:

Parameter:	Value:	Unit:	Default:	Description:
ARena	ARon; ARoff	-	ARon	Enabling/disabling the autoreclose
Block	DI1; DI2; …DI32; none	-	-	The digital input for block information. This can be used, for example, for Synchrocheck.
AR_DI	DI1; DI2; …DI32; none	-	-	The digital input for toggling the ARena parameter
AR2grp	ARon; ARoff	-	ARon	Enabling/disabling the autoreclose for group 2
ReclT	0.02…300.00	s	10.00	Reclaim time setting. This is common for all the shots.
ARreq	On; Off	-	Off	AR request event
ShotS	On; Off	-	Off	AR shot start event
ARlock	On; Off	-	Off	AR locked event
CritAr	On; Off	-	Off	AR critical signal event
ARrun	On; Off	-	Off	AR running event
FinTrp	On; Off	-	Off	AR final trip event
ReqEnd	On; Off	-	Off	AR end of request event
ShtEnd	On; Off	-	Off	AR end of shot event
CriEnd	On; Off	-	Off	AR end of critical signal event
ARUnl	On; Off	-	Off	AR release event
ARStop	On; Off	-	Off	AR stopped event
FTrEnd	On; Off	-	Off	AR final trip ready event
ARon	On; Off	-	Off	AR enabled event
ARoff	On; Off	-	Off	AR disabled event

CRITri	On; Off	-	On	AR critical final trip on event
AR1Tri	On; Off	-	On	AR AR1 final trip on event
AR2Tri	On; Off	-	On	AR AR2 final trip on event
AR3Tri	On; Off	-	On	AR AR3 final trip on event
AR4Tri	On; Off	-	On	AR AR4 final trip on event
CRITri	On; Off	-	On	AR critical final trip off event
AR1Tri	On; Off	-	On	AR AR1 final trip off event
AR2Tri	On; Off	-	On	AR AR2 final trip off event
AR3Tri	On; Off	-	On	AR AR3 final trip off event
AR4Tri	On; Off	-	On	AR AR4 final trip off event
Shot settings				
DeadT	0.02…300.00	s	5.00	The dead time setting for this shot. This is a common setting for all the AR lines in this shot
AR1	On; Off	-	Off	Indicates if this AR signal starts this shot
AR2	On; Off	-	Off	Indicates if this AR signal starts this shot
AR3	On; Off	-	Off	Indicates if this AR signal starts this shot
AR4	On; Off	-	Off	Indicates if this AR signal starts this shot
Start1	0.02…300.00	s	0.02	AR1 Start delay setting for this shot
Start2	0.02…300.00	s	0.02	AR2 Start delay setting for this shot
Start3	0.02…300.00	s	0.02	AR3 Start delay setting for this shot
Start4	0.02…300.00	s	0.02	AR4 Start delay setting for this shot
Discr1	0.02…300.00	s	0.02	AR1 Discrimination time setting for this shot
Discr2	0.02…300.00	s	0.02	AR2 Discrimination time setting for this shot
Discr3	0.02…300.00	s	0.02	AR3 Discrimination time setting for this shot
Discr4	0.02…300.00	s	0.02	AR4 Discrimination time setting for this shot

Measured and recorded values of AR function:

	Parameter:	Value:	Unit:	Description:
Measured or recorded values	Obj1	UNDEFINED; OPEN; CLOSE; OPEN_REQUEST; CLOSE_REQUEST; READY; NOT_READY; INFO_NOT_AVAILABLE; FAIL	-	Object 1 state
	Status	INIT; RECLAIM_TIME; READY; WAIT_CB_OPEN; WAIT_CB_CLOSE; DISCRIMINATION_TIME; LOCKED; FINAL_TRIP; CB_FAIL; INHIBIT	-	AR-function state
	Shot#	1...5	-	The currently running shot
	ReclT	RECLAIMTIME; STARTTIME; DEADTIME; DISCRIMINATIONTIME	-	The currently running time (or last executed)
	SCntr		-	Total start counter
	Fail		-	The counter for failed AR shots
	Shot1 *		-	Shot1 start counter
	Shot2 *		-	Shot2 start counter
	Shot3 *		-	Shot3 start counter
	Shot4 *		-	Shot4 start counter
	Shot5 *		-	Shot5 start counter

*) There are 5 counters available for each one of the four AR signals.

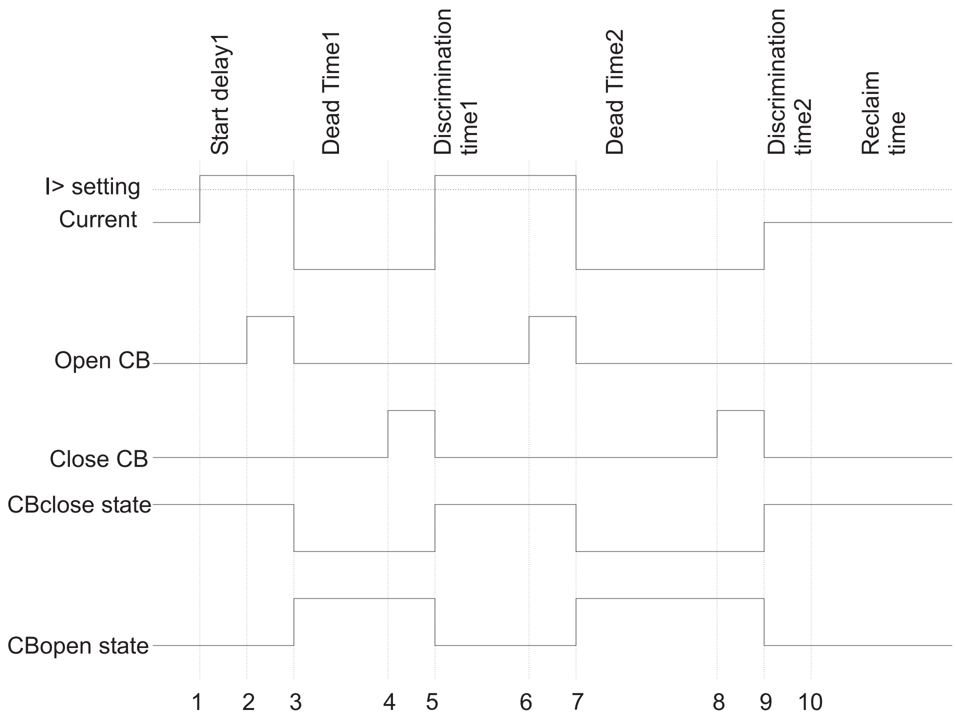


Figure 2.3.16-2. Example sequence of two shots. After shot 2 the fault is cleared.

1. Current exceeds the I> setting; the start delay from shot 1 starts.
2. After the start delay, an OpenCB relay output closes.
3. A CB opens. The dead time from shot 1 starts, and the OpenCB relay output opens.
4. The dead time from shot 1 runs out; a CloseCB output relay closes.
5. The CB closes. The CloseCB output relay opens, and the discrimination time from shot 1 starts. The current is still over the I> setting.
6. The discrimination time from the shot 1 runs out; the OpenCB relay output closes.
7. The CB opens. The dead time from shot 2 starts, and the OpenCB relay output opens.
8. The dead time from shot 2 runs out; the CloseCB output relay closes.
9. The CB closes. The CloseCB output relay opens, and the discrimination time from shot 2 starts. The current is now under I> setting.
10. Reclaim time starts. After the reclaim time the AR sequence is successfully executed. The AR function moves to wait for a new AR request in shot 1.

2.3.17. Overvoltage protection (59)

The three-phase overvoltage function consists of three separately adjustable overvoltage stages (stage U>, U>> and U>>>).

The overvoltage function measures the fundamental frequency component of the line voltages. The protection stages operate with definite time characteristics.

The function starts if the actual value of any phase exceeds the setting value. If an overvoltage situation continues after the operation time has elapsed, the function trips.

The overvoltage stages have a fixed start delay. If a delayed alarm about a voltage fault is required, a settable start delay and trip time can be obtained by combining two stages. See Figure 2.3.17-1. Both the stages detect the overvoltage, but the start signals are ignored. The trip signal of stage U> is used as an alarm signal, and the trip information from stage U>> is used for the actual trip. The overvoltage setting value for stage U>> has to be higher than the setting value for stage U> to ensure an alarm before trip.

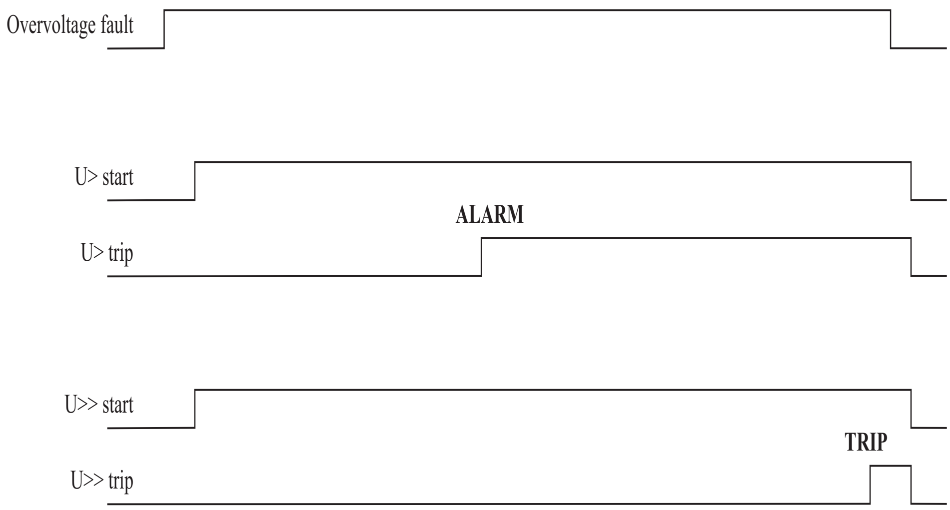


Figure 2.3.17-1. Settable start delay is obtained by combining two protection stages

The U> stage has a settable release delay, which enables detecting instantaneous faults. This means that the time counter of the protection function does not reset immediately after the fault is cleared, but resets only after the release delay has elapsed. If the fault appears again before the delay time has elapsed, the delay counter continues from the previous value. This means that the function trips after a certain number of instantaneous faults.

Another application for an extended release delay is to disconnect a small generator from the network during the dead time of an auto-reclose (see Figure 2.3.17-2). In a fault situation, the breaker 1Q0 starts the auto-reclose sequence and opens. The voltage function at 2Q0 will also pick up any under-voltage or residual overvoltage fault. If the voltage fault remains, the 2Q0 will also trip and the reclosing cycle can continue.

However, if opening the 1Q0 clears the fault, the 2Q0 will not trip since the voltage relay at 2Q0 has a long start release time. In most cases, the isolated load is too much for the generator to maintain the frequency during this release time. Then the 2Q0 will be tripped by a frequency stage and the possible past voltage fault. A frequency fault or a voltage fault in the network alone will not trip the 2Q0. An asynchronised connection of breaker 1Q0 to the network is blocked with a synchro-check relay.

During a short circuit or an earth fault, the breaker 1Q0 performs an auto-reclose. The breaker 2Q0 has to be tripped before the auto-reclose of the breaker 1Q0 in order to ensure that the generator does not continue to feed the fault.

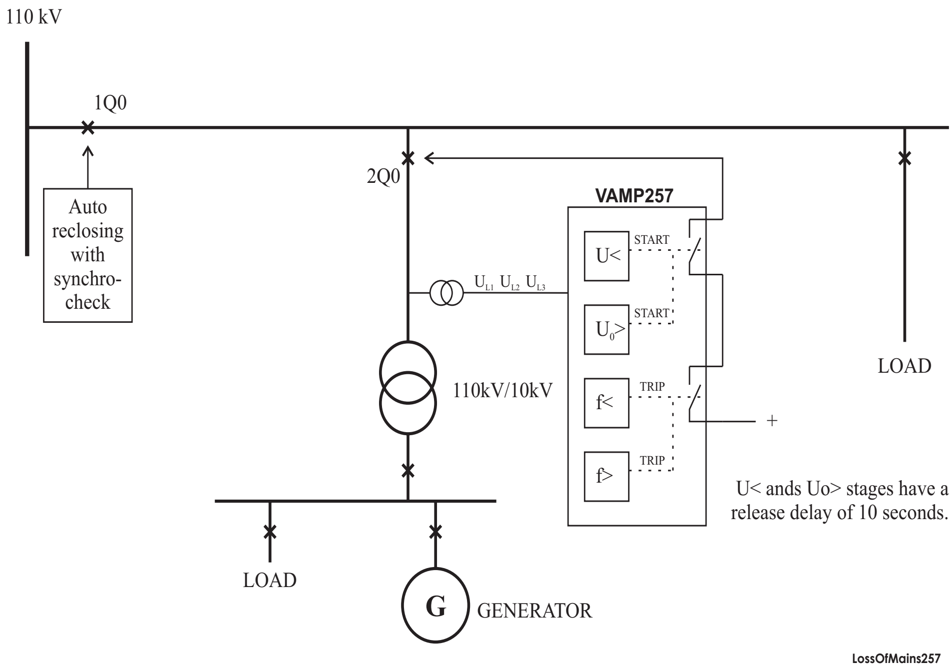


Figure 2.3.17-2. Disconnection of a generator from the network during the dead time of an auto-reclose cycle (Loss of mains application).

Figure 2.3.17-3 shows the functional block diagram of the overvoltage function stages U>, U>> and U>>>.

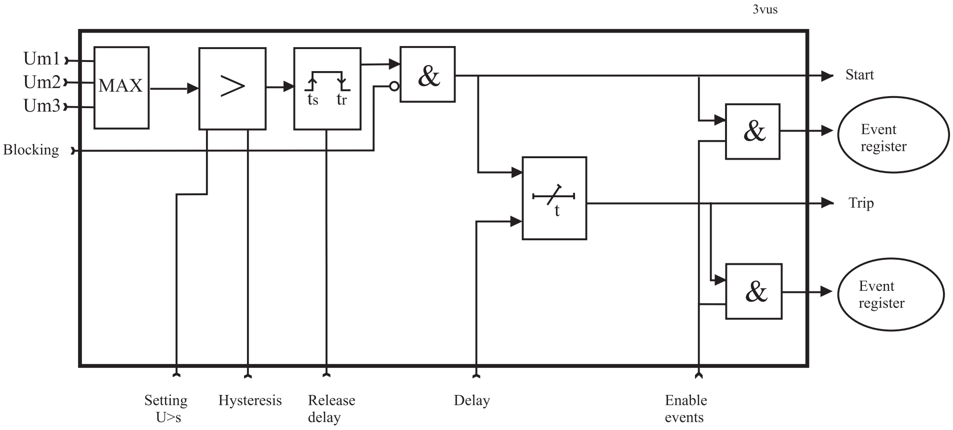


Figure 2.3.17-3. Block diagram of the three-phase overvoltage stages U>, U>> and U>>>

Setting parameters of overvoltage stages:

U>, U>>, U>>> (59)

Parameter:	Value:	Unit:	Default:	Description:
U>, U>>, U>>>	50…150 (U>, U>>) 50…160 (U>>>)	%Un	120 (U>) 130 (U>>, U>>>)	Overvoltage setting
t>, t>>, t>>>	0.08…300.0 (U>,U>>) 0.06…300.00 (U>>>)	s	0.20 (U>) 0.10 (U>>, U>>>)	Definite operation time
ReleaseDly	0.06…300.0	s	-	Release delay [s] (only U>)
Hysteresis	0.1…20.0	%	-	Deadband (only U>)
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Measured and recorded values of overvoltage stages:

U>, U>>, U>>> (59)

	Parameter:	Value:	Unit:	Description:
Measured value	Ummax		V	Maximum value of line voltages
Recorded values	SCntr		-	Start counter (Start) reading
	TCntr		-	Trip counter (Trip) reading
	Flt		%Un	The max. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

2.3.18. Undervoltage protection (27)

The three-phase undervoltage function consists of three separately adjustable undervoltage stages (stage U<, U<< and U<<<).

The undervoltage function measures the positive sequence component of the line voltages. The protection stages operate with definite time characteristics.

The function starts if a positive sequence component exceeds the setting value. If the undervoltage situation continues after the start delay has elapsed, the function trips.

The undervoltage stage U< has a settable release delay, which enables detecting instantaneous faults. This means that the time counter of the protection function does not reset immediately after the fault is cleared, but resets only after the release delay has elapsed. If the fault appears again before the delay time has elapsed, the trip counter continues from the previous fault value. This means that the function trips after a certain number of instantaneous faults.

The undervoltage function can be blocked with an external digital signal for example if the secondary voltage of the measuring transformers disappears (e.g. fuse failure). The undervoltage function can also be blocked with an internal blocking signal, which is defined during the parameterisation. Further, the function can be blocked with a separate NoCmp setting. With this setting, all the protection stages are blocked even when the actual values for all the phases fall below the set value.

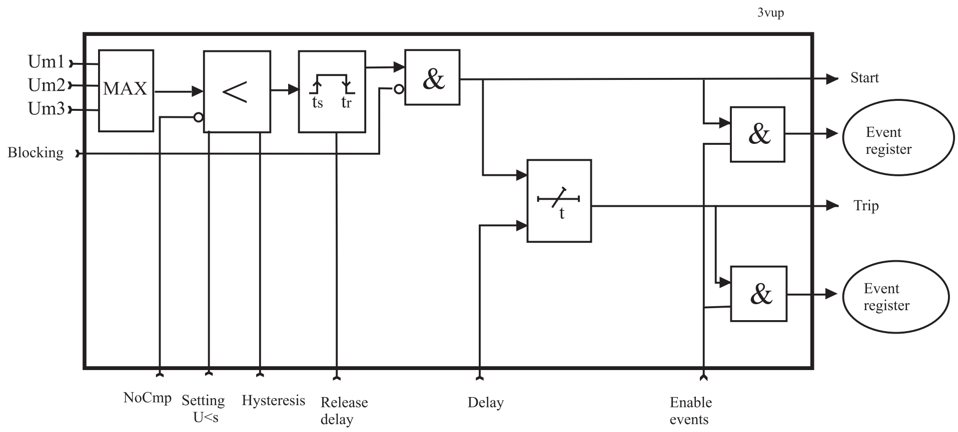


Figure 2.3.18-1. Block diagram of the three-phase undervoltage stages U<, U<< and U<<<

Setting parameters of undervoltage stages:

U<, U<<, U<<< (27)

Parameter:	Value:	Unit:	Default:	Description:
U<, U<<, U<<<	20…120	%Un	80 (U<) 70 (U<<, U<<<)	Undervoltage setting
t<, t<<, t<<<	0.08…300.00 0.06…300.00	s	20.00 (U<) 2.00 (U<<, U<<<)	Definite operation time
NoCmp	0…80	%Un	10	Self-blocking value
ReleaseDly	0.06…300.0	s	-	Release delay (only U<)
Hysteresis	0.1…20.0	%	-	Deadband (only U<)
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Measured and recorded values of undervoltage stages:

U<, U<<, U<<< (27)

	Parameter:	Value:	Unit:	Description:
Measured value	Ummin		V	Minimum value of line voltages
Setting values	U<, U<<, U<<<	20…120	%Un	Under-voltage setting
	t<, t<<, t<<<	0.08…300.00 0.06…300.00	s	Definite operation time
	NoCmp	0…80	%Un	Self-blocking value
	ReleaseDly	0.06…300.0	s	Release delay (only U<)
	Hysteresis	0.1…20.0	%	Deadband (only U<)
Recorded values	SCntr		-	Start counter (Start) reading
	TCntr		-	Trip counter (Trip) reading
	Flt		%Un	The min. fault value
	EDly		%	Elapsed time as compared to the set operating time, 100% = tripping

2.3.19. Configurable frequency protection (81O/81U)

The configurable frequency function consists of two separately adjustable frequency stages (stage f>< or abbreviated form fX and f>><< or abbreviated form fXX). The protection stages operate with definite time characteristics. The stages can be separately configured as either overfrequency or under-frequency stages. The frequency function measures the frequency based on the measured voltage depending on the configurations of the relay.

If a stage is configured as an underfrequency stage then it functions as explained in paragraph 2.3.20.

When a stage is configured as an overfrequency stage, it starts if the actual value of the frequency exceeds the setting value. If the overfrequency situation continues after the start delay has elapsed, the function trips.

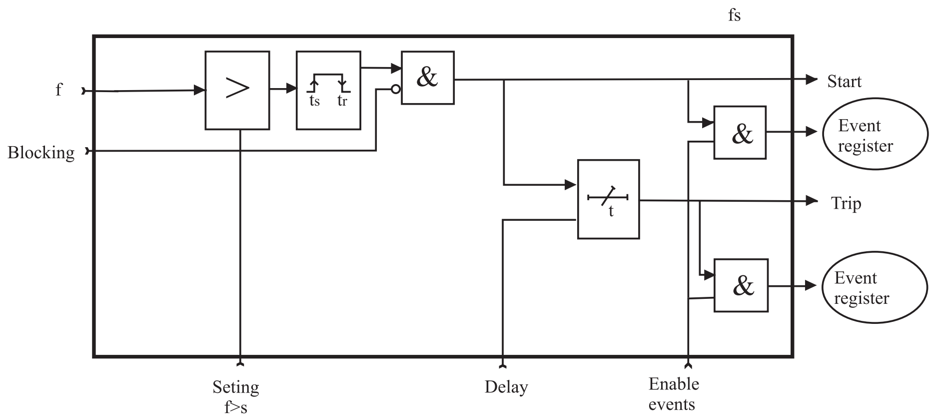


Figure 2.3.19-1. Block diagram of the overfrequency stages f> and f>>

Setting parameters of configurable frequency stages:

f><, f>><< (81)

Parameter:	Value:	Unit:	Default:	Description:
f><, f>><<	40.0…70.0	Hz	51.0 (f><) 52.0 (f>><<)	Frequency setting
t><, t>><<	0.10…300.0	s	0.20 (t><) 0.10 (t>>><)	Definite operation time
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event
Mode	> or <	.	>	Frequency protection mode

LVBlck	2…100	%Un	40	Configurable low voltage blocking limit. Common for f><, f< and f><><, f<<

Measured and recorded values of the configurable frequency stages:

f><, f>><< (81)

	Parameter:	Value:	Unit:	Description:
Measured value	f		Hz	Frequency
Recorded values	SCntr		-	Start counter (Start) reading
	TCntr		-	Trip counter (Trip) reading
	Flt		Hz	The ma><. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

2.3.20. Underfrequency protection (81U)

The underfrequency unit consists of two individually adjustable frequency stages (stage f< and f<<). The protection stages operate with definite time characteristics. The overfrequency function measures the frequency based on the measured voltage depending on the configuration.

The function starts if the actual value for the frequency goes below the setting value. If the underfrequency situation continues after the start delay has elapsed, the function trips.

The underfrequency stages are typically used for load shedding purposes as well. In this case, one stage sheds non-important load when the frequency starts decreasing. If the frequency still decreases, another stage sheds more non-important load to gain balance between the load and the source. By this way, the important loads remain connected.

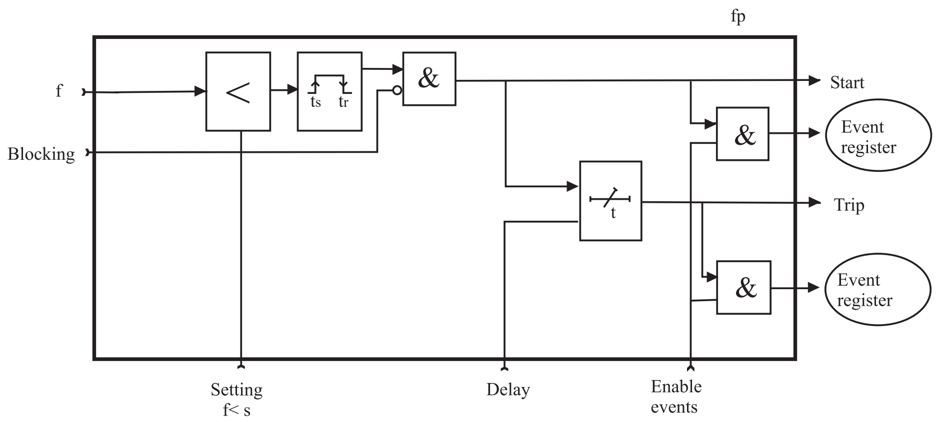


Figure 2.3.20-1. Block diagram of the underfrequency stages f< and f<<

Setting parameters of underfrequency stages:

f<, f<< (81U)

Parameter:	Value:	Unit:	Default:	Description:
f<, f<<	40.0…64.0	Hz	48.0	Frequency setting
t<, t<<	0.10…300.0	s	3.00 (t<) 0.10 (t<<)	Definite operation time
Ublock	2…100	%Un	40	Undervoltage blocking limit
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Measured and recorded values of underfrequency stages:

f<, f<< (81U)

	Parameter:	Value:	Unit:	Description:
Measured value	f		Hz	Frequency
Recorded values	SCntr		-	Start counter (Start) reading
	TCntr		-	Trip counter (Trip) reading
	Flt		Hz	Min. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

2.3.21. Second harmonic stage / inrush (68)

This stage is mainly used to block other stages. The ratio between the second harmonic component and the fundamental frequency component is measured on all the phase currents. When the ratio in any phase exceeds the setting value, the stage gives a start signal. After a settable delay, the stage gives a trip signal.

The start and trip signals can be used for blocking the other stages. The trip delay is irrelevant if only the start signal is used for blocking.

The trip delay of the stages to be blocked must be more than 60 ms to ensure a proper blocking.

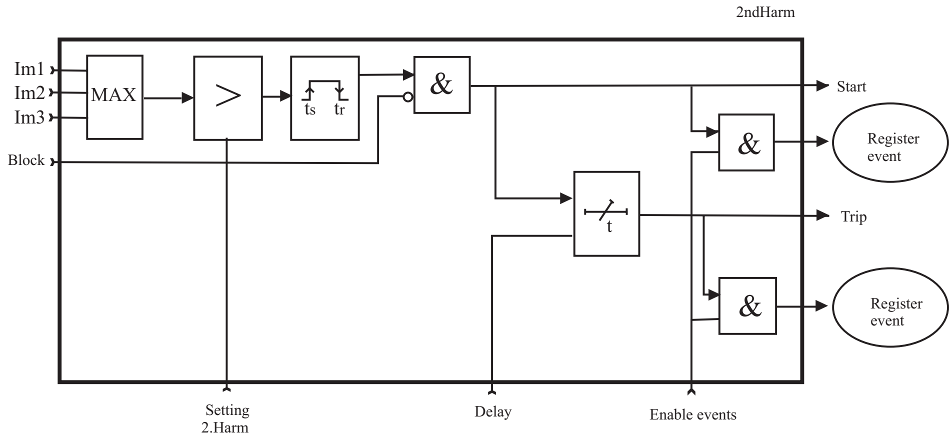


Figure 2.3.21-1. Block diagram of the second harmonic stage.

Setting parameters of second harmonic blocking:

2.Ha (68)

Parameter:	Value:	Unit:	Default:	Description:
If2>	10…100	%	10	Setting value If2/Ifund
t_f2	0.05…300.0	s	0.05	Definite operating time
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Measured and recorded values of second harm. blocking:

2.Ha (68)

	Parameter:	Value:	Unit:	Description:
Measured values	IL1H2.		%	2. harmonic of IL1, proportional to the fundamental value of IL1
	IL2H2.		%	2. harmonic of IL2
	IL3H2.		%	2. harmonic of IL3
Recorded values	Flt		%	The max. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

2.3.22. Synchrocheck (25)

VAMP257 includes a function that will check synchronism when the circuit-breaker is closed. The function will monitor voltage amplitude, frequency and phase angle difference between two voltages. Since there are two stages available, it is possible to monitor three voltages. The voltages can be busbar and line or busbar and busbar (bus coupler).

The synchrocheck causes that the normal measuring modes cannot be used. Therefore, “2Side”, “2side+Uo” or “3side” voltage measuring mode must be selected to enable synchrocheck function. If “2Side”- or “2Side+Uo”-mode is selected, one stage is available. The “3Side”-mode enables using two stages.

The voltage used for sychrochecking is always phase-to-phase voltage U12. The sychrocheck stage 1 compares U12 with U12y always. The compared voltages for the stage 2 can be selected.

Setting parameters of synchrocheck stages :

SyC1, SyC2 (25)

Parameter:	Values:	Unit:	Default:	Description:
Side	U12/U12y; U12/U12z; U12y/U12z	-	U12/U12z	Voltage selection. The stage 1 has fixed voltages U12/U12y.
CBObj	Obj1-Obj6	-	Obj1	The selected object for CB control. The synchrocheck closing command will use the closing command of the selected object. Note! The stage 1 is always using the object 1. The stage 2 can use objects 2-6.
SMode	Async; Sync; Off	-	Sync	Synchrocheck mode. Off = only voltage check Async = the function checks dU, df and dangle. Furthermore, the frequency slip, df, determines the remaining time for closing. This time must be longer than “CB time”. Sync mode = Synchronization is tried to make exactly when angle difference is zero. In this mode df-setting should be enough small (<0.3Hz).
UMode	-, DD, DL, LD, DD/DL, DD/LD, DL/LD, DD/DL/LD	-	-	Voltage check mode: The first letter refers to the reference voltage and the second letter refers to the comparison voltage. D means that the side must be “dead” when closing (dead = The voltage below

				the dead voltage limit setting) L means that the side must be "live" when closing (live = The voltage higher than the live voltage limit setting) Example: DL mode for stage 1: The U12 side must be "dead" and the U12y side must be "live".
CBtime	0.04…0.6	s	0.1	Typical closing time of the circuit-breaker.
DIbypass	Digital inputs	-	-	Bypass input. If the input is active, the function is bypassed.
Bypass	0; 1	-	0	The bypass status. "1" means that the function is bypassed. This parameter can also be used for manual bypass.
CBCtrl	Open;Close	-	-	Circuit-breaker control
ShowInfo	Off; On	-	On	Additional information display about the sychrocheck status to the mimic.
SGrpDI	Digital inputs	-	-	The input for changing the setting group.
SetGrp	1; 2	-	1	The active setting group.

Measured and recorded values of synchrocheck stages:

SyC1, SyC2 (25)

	Parameter:	Values:	Unit:	Description
Measured values	df	-	Hz	Measured frequency difference
	dU	-	% Un / deg	Measured voltage amplitude and phase angle difference
	UState	-	-	Voltage status (e.g. DD)
	SState	-	-	Synchrocheck status
	ReqTime	-	-	Request time status
	f1)	-	Hz	Measured frequency (reference side)
	fy1)	-	Hz	Measured frequency (comparison side)
	U121)	-	% Un	Measured voltage (reference side)
	U12y1)	-	% Un	Measured voltage (comparison side)
Recorded values	ReqCntr	-	-	Request counter

	SyncCntr	-	-	Synchronising counter
	FailCntr	-	-	Fail counter
	f[1)]	-	Hz	Recorded frequency (reference side)
	fy[1)]	-	Hz	Recorded frequency (comparison side)
	U12[1)]	-	% Un	Recorded voltage (reference side)
	U12y[1)]	-	% Un	Recorded voltage (comparison side)
	dAng	-	Deg	Recorded phase angle difference, when close command is given from the function
	dAngC	-	Deg	Recorded phase angle difference, when the circuit-breaker actually closes.
	EDly	-	%	The elapsed time compared to the set request timeout setting, 100% = timeout

[1)] Please note that the labels (parameter names) change according to the voltage selection.

The following signals of the both stages are available in the output matrix and the logic: “Request”, “OK” and “Fail”. The “request”-signal is active, when a request has received but the breaker is not yet closed. The “OK”-signal is active, when the synchronising conditions are met, or the voltage check criterion is met. The “fail”-signal is activated, if the function fails to close the breaker within the request timeout setting. See below the figure.

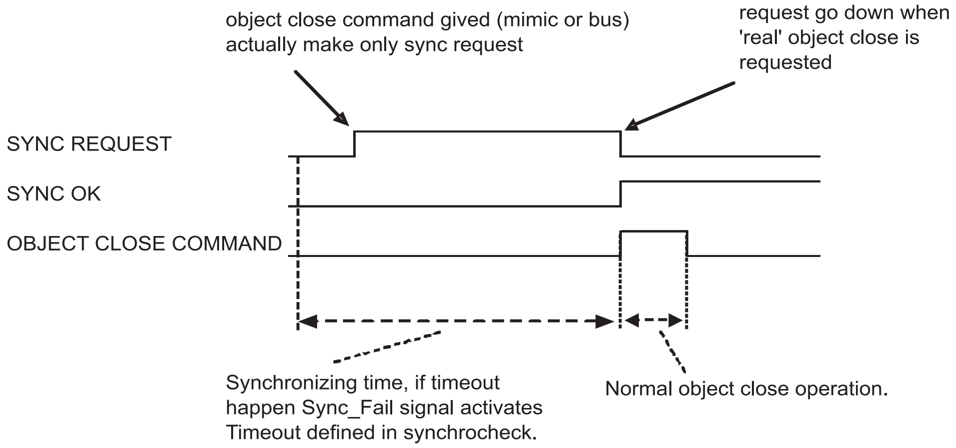


Figure 2.3.22-1 The principle of the synchrocheck function

Please note that the control pulse of the selected object should be long enough. For example, if the voltages are in opposite direction, the synchronising conditions are met after several seconds.

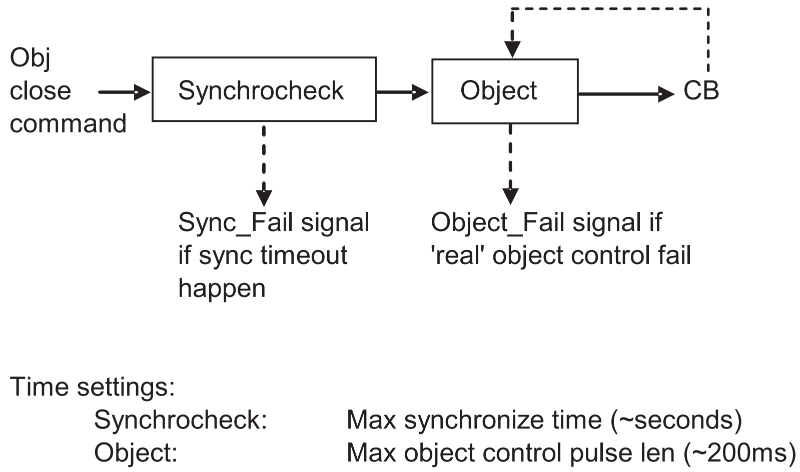


Figure 2.3.22-2. The block diagram of the synchrocheck and the controlling object

Please note that the wiring of the secondary circuits of voltage transformers to the relay terminal depends on the selected voltage measuring mode.

Voltage input:	Terminals:	Signals in mode "2Line+Uo":	Signals in mode "2Side+Uo":	Signals in mode "2Side":	Signals in mode "3Side":
Ua	X1:11-12	U12	U12	U12	U12
Ub	X1:13-14	U23	U12y	U23	U12y
Uc	X1:17-18	Uo	Uo	U12y	U23z
		No sync. stages	One sync. stage available	One sync. stage available	Two stages available
		Uo stages available	Uo stages available	No Uo stages	No Uo stages
		3-phase power	1-phase power	3-phase power, symmetrical condition	1-phase power

The following application examples show the correct connection of the voltage inputs. In the Figure 2.3.22-3 the application requires only one stage (Voltage measuring mode is "2Side+Uo"). Two stages are needed for the application presented in Figure 2.3.22-4 (Voltage measuring mode is "3Side").

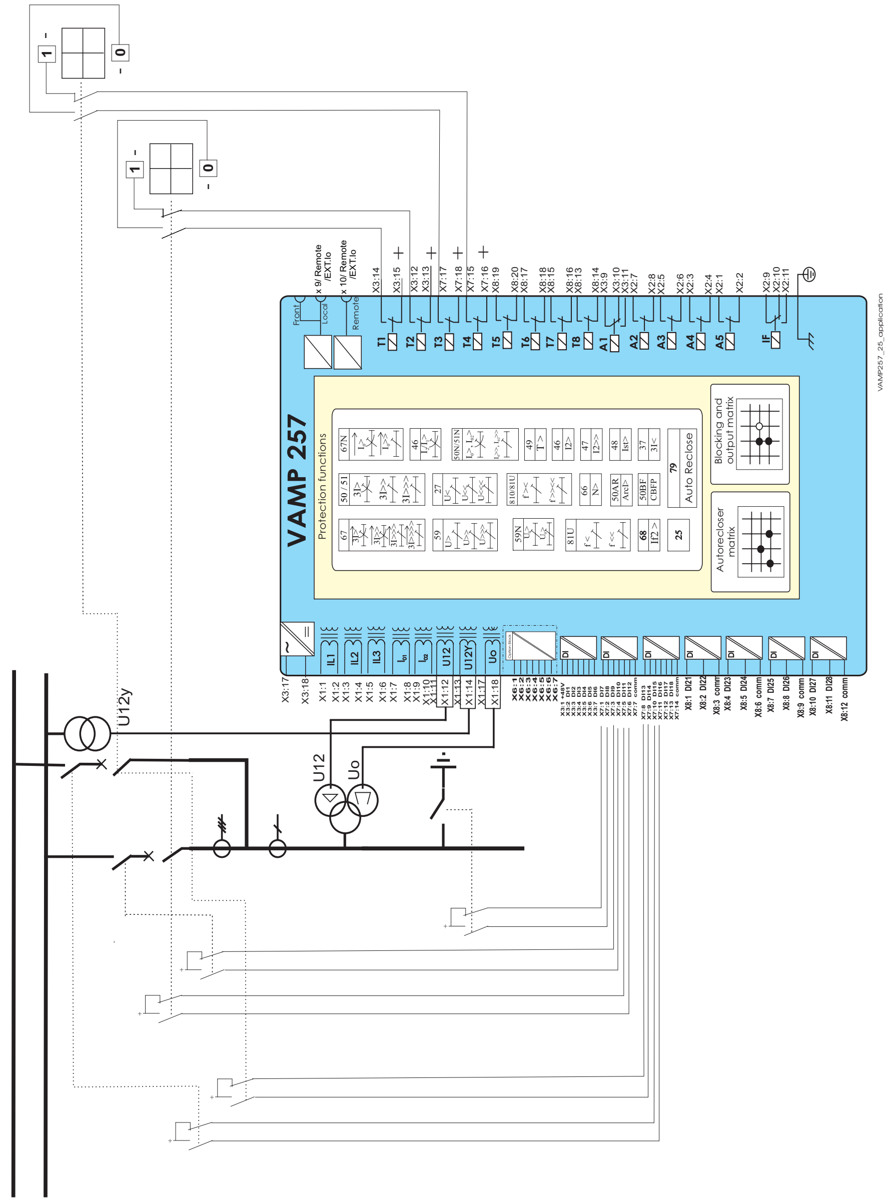


Figure 2.3.22-3. One synchrocheck stage needed with "2Side+Uo"-mode.

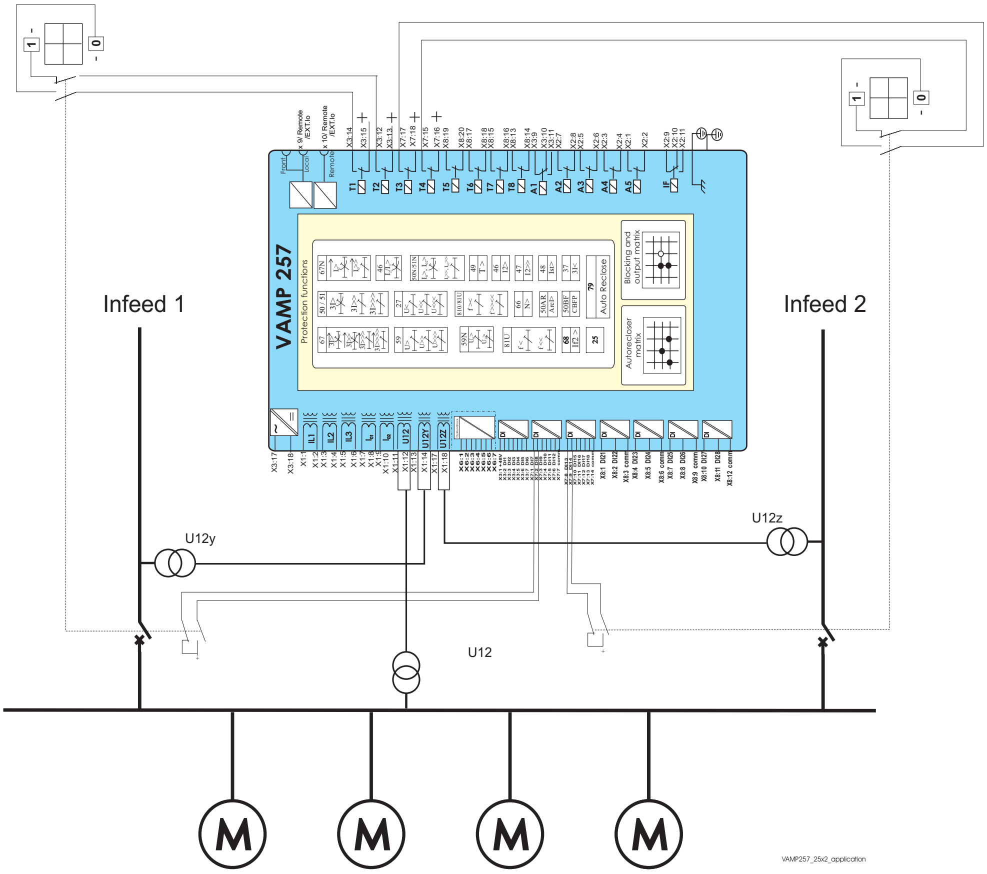


Figure 2.3.22-4. Two synchrocheck stages needed with "3Side"-mode.

2.3.23. Circuit-breaker failure protection (50BF)

The operation of the circuit-breaker failure protection (CBFP) is based on the supervision of the operating time from the pickup of the configured trip relay to the dropout of the same relay. If that time is longer than the operating time of the CBFP stage, the CBFP stage activates another output relay, which will remain activated until the primary trip relay resets.

The CBFP stage functions with all the protection functions since it supervises the trip relay.

Setting parameters of circuit-breaker failure protection:

CBFP (50BF)

Parameter:	Value:	Unit:	Default:	Description:
CBRel	1…4	-	1	Output relay to check (trip relay)
t>	0.10…10.0	s	0.2	Operating time
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event

T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Measured and recorded values of circuit-breaker failure protection:

CBFP (50BF)

	Parameter:	Value:	Unit:	Description:
Recorded values	SCntr		-	Cumulative start counter, only selected ArcCn arc activations
	TCntr		-	Cumulative trip counter
	EDly		%	Elapsed time as compared to the set operating time, 100%=tripping

2.3.24. Arc fault protection (50AR) (option)

The arc fault protection has been realised with arc sensor inputs and an extremely fast overcurrent function ArcI> or the earth fault functions ArcI$_0$> and ArcI$_{02}$>.

The arc protection function operates when one of the arc sensors detects an arc fault. The arc protection function operates also when the binary input of the arc option card is activated and the fast overcurrent stage ArcI> measures an overcurrent, or the earth fault stage ArcI$_0$> or ArcI$_{02}$> measures an earth fault current at the same time.

There are input switches by which the use of the arc inputs or the binary input in connection with the ArcI>, ArcI$_0$> or ArcI$_{02}$> protection stage can be selected or deselected (see Figure 2.3.24-1).

The operating time of the arc protection stage is approximately 15 ms.

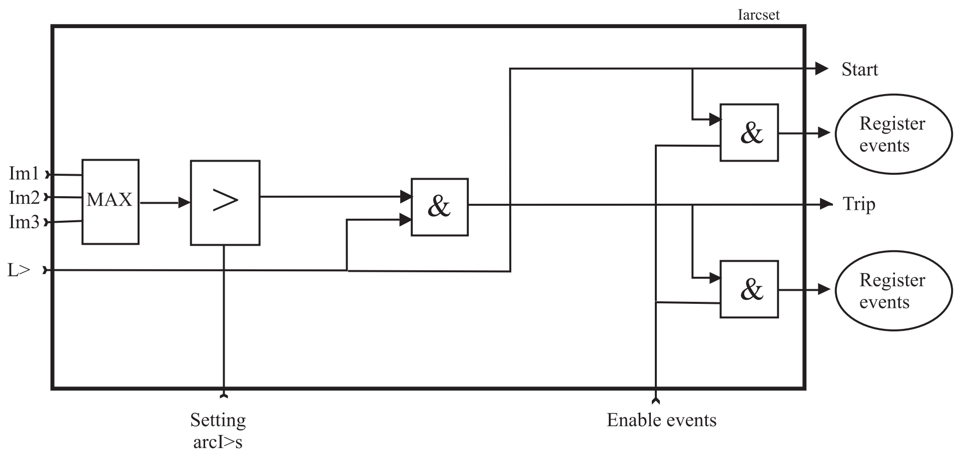


Figure 2.3.24-1 Block diagram of the arc protection stage

In the above figure, the symbol of the arc sensor start is 'L>' and 'Iarc' of the fast overcurrent stage.

Setting parameters of arc I> protection:

ArcI>

Parameter:	Value:	Unit:	Default:	Description:
ArcI>	0.5…10.0	pu	1.0	Setting value
ArcCn	S1; S2; BI; S1/S2; S1/BI; S2/BI; S1/S2/BI		SI/S2/BI	Arc sensor connection (S1 = sensor 1 at terminal X6:4-5, S2 = sensor 2 at terminal X6:6-7)
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Measured and recorded values of arc I> protection:

ArcI>

	Parameter:	Value:	Unit:	Description:
Recorded values	LCntr			Cumulative start counter, all the arc activations
	SCntr			Cumulative start counter, only the selected ArcCn arc activations
	TCntr			Cumulative trip counter
	Flt		pu	The maximum value of fault current (xIn)
	Load		pu	Pre-fault (load) current (xIn)

Setting parameters of arc I_0> protection:

ArcI_0>, ArcI_{02}>

Parameter:	Value:	Unit:	Default:	Description:
ArcI_0>, ArcI_{02}>	0.05…1.00	pu	0.10	Setting value (xI_0n)
ArcCn	S1; S2; BI; S1/S2; S1/BI; S2/BI; S1/S2/BI	-	SI/S2/BI	Arc sensor connection (S1 = sensor 1 at terminal X6:4-5, S2 = sensor 2 at terminal X6:6-7)
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Measured and recorded values of arc Io> protection:

$ArcI_0$>, $ArcI_{02}$>

	Parameter:	Value:	Unit:	Description:
Recorded values	LCntr			Cumulative start counter, all the arc activations
	SCntr			Cumulative start counter, only selected ArcCn arc activations
	TCntr			Cumulative trip counter
	Flt		pu	The max. fault current (xIon)

2.3.25. Programmable stage

The manager has eight identical programmable stages (PROGRAMMABLE STAGE 1-8). All programmable stages can be enabled or disabled one by one from the menu to fit the intended application. All the enabled programmable stages have the following programmable parameters:

- Link: link to a measured or calculated value, see table below.
- Cmp: mode (< or >)
- Pick-up: alarm limit of the stage (the setting range and the unit depend on the signal)
- t: operation delay 0.08 - 300.0 s, step 0.01 s or 0.02 s
- Hyster: hysteresis 0.2 – 10.0%, step 0.1%
- NoCmp: no compare limit (visible only for active < mode)

Programmable stage link signals:

Alarm stages link signals	Interval
P, Q, S, f, P.F, cosφ, tanφ Prms, Qrms, Srms IL1 – IL3, IL, IL max of IL1 – IL3 Io, Io2, Iocalc, I1, I2, I2/I1, I2/In U12, U23, U31, Uline UL1 – UL3, Uphase Uo, U1, U2, U2/U1 THDIL1, THDIL2, THDIL3, THDUa,THDUb, THDUc	Selectable 10ms, 20ms or 100ms

The outputs of the programmable stages can control any combination of output relays and indicator LEDs, see Figure 2.3.25-1 and Figure 2.3.25-2

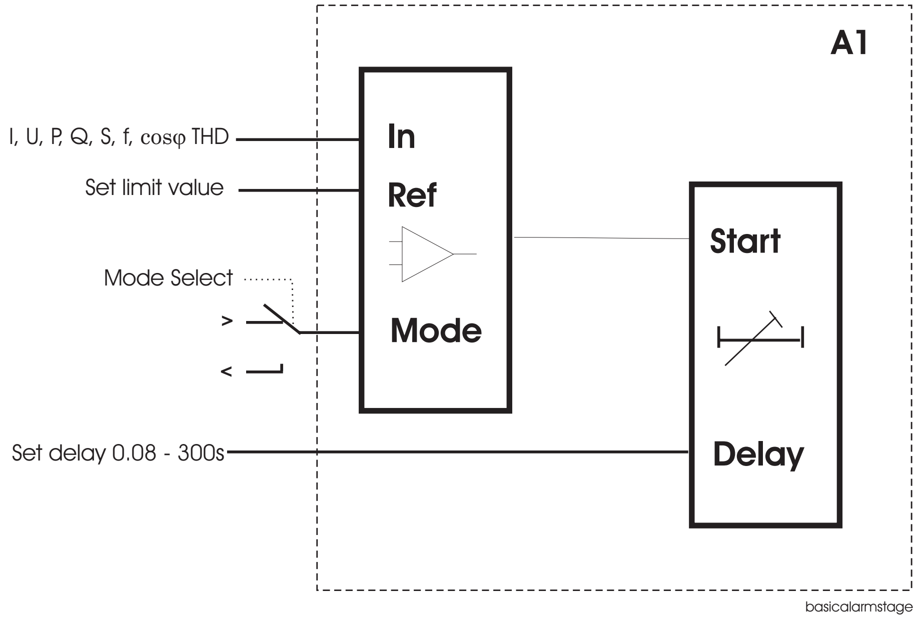


Figure 2.3.25-1 Principle of programmable stage

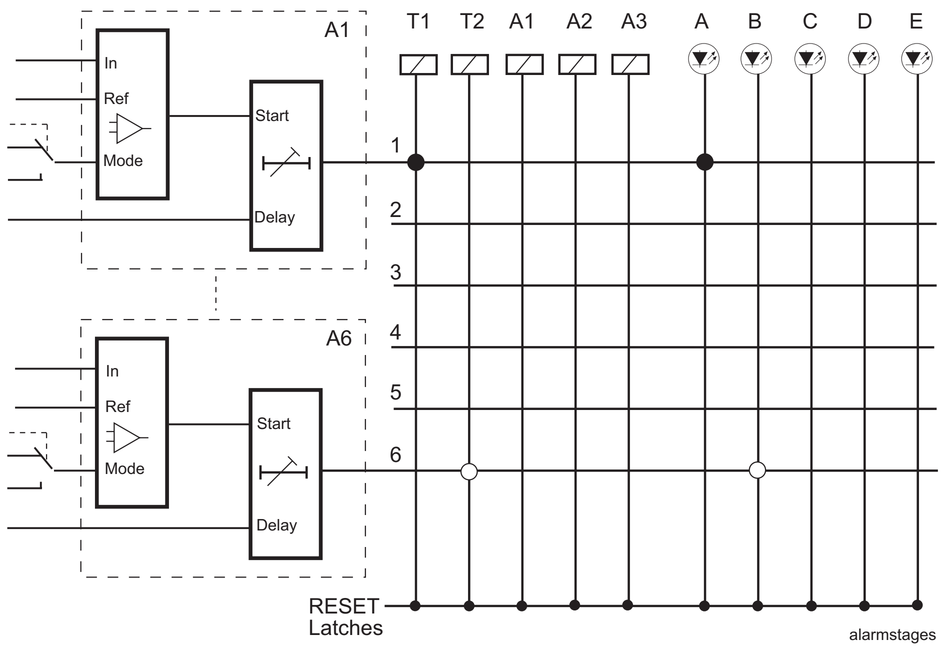


Figure 2.3.25-2 Programmable stages in the output matrix

Start and trip signals can also be activated using the Force-setting of each programmable stage.

2.4. Measurement functions

2.4.1. Fundamental frequency measurement

All the measurements, except frequency, are based on fundamental frequency values. They are not RMS values.

The device calculates the active (P), reactive (Q), apparent power (S) and energy measures (E+, Eq+, E-, Eq-)* from voltage and current measurements.

Phase currents I_{L1}, I_{L2}, I_{L3}

Measuring range	0 - 50 x In	In = 1 A or 5 A

Phase voltages U_{L1}, U_{L2}, U_{L3}

Measuring range	0 - 175 V ac

Earth fault currents I_0, I_{02}

Measuring range	0 - 5 x I_{mode}	In = 1 A or 5 A

Residual voltage U_0

Measuring range	0 - 175 V ac

Frequency f

Measuring range	16 - 75 Hz

2.4.2. Power calculations

The power calculations in the VAMP feeder terminals are dependant on the voltage measurement mode, see chapter 4.2. The formulas used by the feeder terminals for power calculations are found in this chapter

Phase to neutral voltages measured (Phase mode)

Active power calculation for one phase:

$$P_{L1} = U_{L1} \cdot I_{L1} \cdot \cos\varphi$$

Reactive power calculation for one phase:

$$Q_{L1} = U_{L1} \cdot I_{L1} \cdot \sin\varphi$$

where,

U_{L1} = Measured L1 phase voltage

I_{L1} = Measured L1 current

φ = Angle between U_{L1} and I_{L1}

Active, reactive and apparent power are calculated as follows:

$$P = P_{L1} + P_{L2} + P_{L3}$$

$$Q = Q_{L1} + Q_{L2} + Q_{L3}$$

$$S = \sqrt{P^2 + Q^2}$$

$$\cos\varphi = \frac{P}{S}$$

Line to line voltages measured (Line+U_0)

$$\overline{S} = \overline{U}_{12} \cdot \overline{I}*_{L1} - \overline{U}_{23} \cdot \overline{I}*_{L3}$$

where,

$\overline{U}_{12}$	=	Measured line voltage L1-L2 phasor, fundamental frequency component.
$\overline{I}*_{L1}$	=	Complex conjugate of the measured phase L1 current phasor.
$\overline{U}_{23}$	=	Measured line voltage L2-L3 phasor, fundamental frequency component
$\overline{I}*_{L3}$	=	Complex conjugate of the measured phase L3 current phasor.

$$P = real(\overline{S})$$

$$Q = imag(\overline{S})$$

$$\cos\varphi = \frac{P}{|\overline{S}|}$$

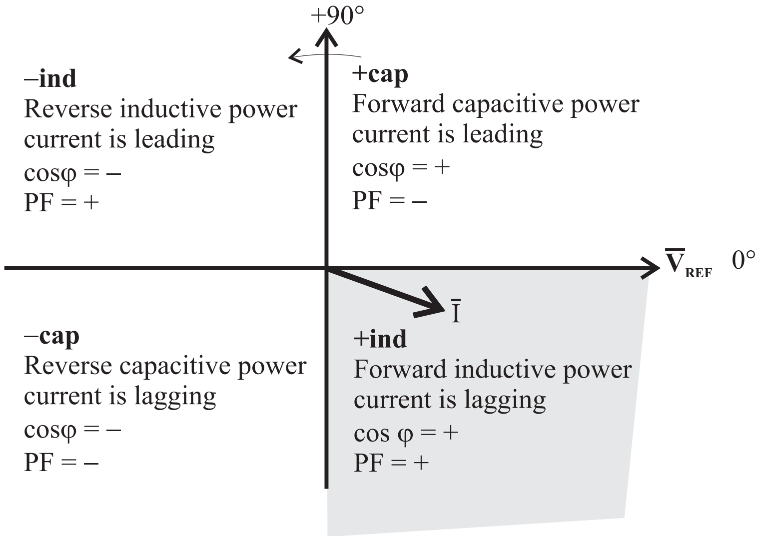


Figure 2.4.2-1 Quadrants of voltage/current phasor plane

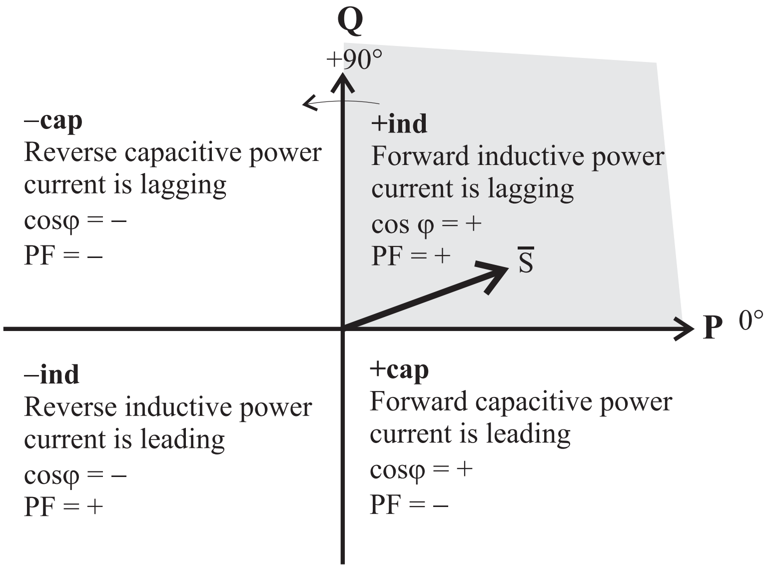


Figure 2.4.2-2 Quadrants of power plane

Power quadrant	Current related to voltage	Power direction	cosfii	Power factor
+ inductive	Lags	Forward	+	+
+ capacitive	Leads	Forward	+	-
- inductive	Leads	Reverse	-	+
- capacitive	Lags	Reverse	-	-

2.4.3. Harmonics and Total Harmonic Distortion (THD)

The device calculates the THDs as percentage of the base frequency for currents and voltages.

The device calculates the harmonics for phase currents and phase voltages from the 2nd to the 15th order. (The 17^{th} harmonic component will also be shown partly in the value of the 15^{th} harmonic component. This is due to the nature of digital sampling.)

2.4.4. Voltage interruptions

The manager includes a simple function to detect and measure voltage sags.

The function calculates the number of voltage interruptions and the total time of the voltage interruptions within a period. The period is based on the real time clock of the device. The available periods are:

- 8 hours, 00:00 – 08:00, 08:00 – 16:00, 16:00 – 24:00
- one day, 00:00 – 24:00
- one week, Monday 00:00 – Sunday 24:00

- one month, the first day 00:00 – the last day 24:00
- one year, 1st January 00:00 – 31st December 24:00

After each period, the number of interruptions and the total interruption time are stored as previous values. The interruption counter and the total time are cleared for a new period. The pre-previous values are overwritten.

The voltage interruption is based on the value of the positive sequence voltage U_1 and a user given limit value U_1<. Whenever the measured U_1 goes below the limit, the interruption counter is increased, and the total time starts cumulating.

Shortest recognized interruption time is 40 ms. If the voltage-off time is shorter it may be recognized depending on the depth of the voltage dip, the ratio of the limit and the voltage value before the dip.

If the voltage has been significantly over the limit U_1< and then there is a small and short underswing, it will not be recognized (Figure 2.4.4-1).

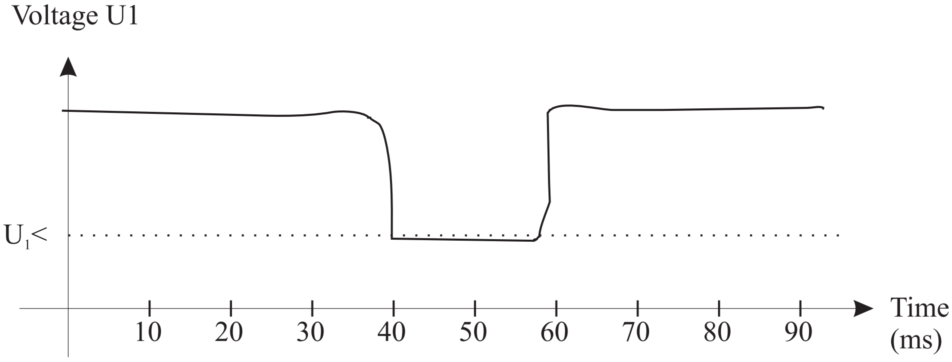


Figure 2.4.4-1. Short voltage sag which is probably not recognized

On the other hand, if the limit U_1< is high and the voltage has been near this limit, and then there is a short but very deep dip, it will be recognized (Figure 2.4.4-2).

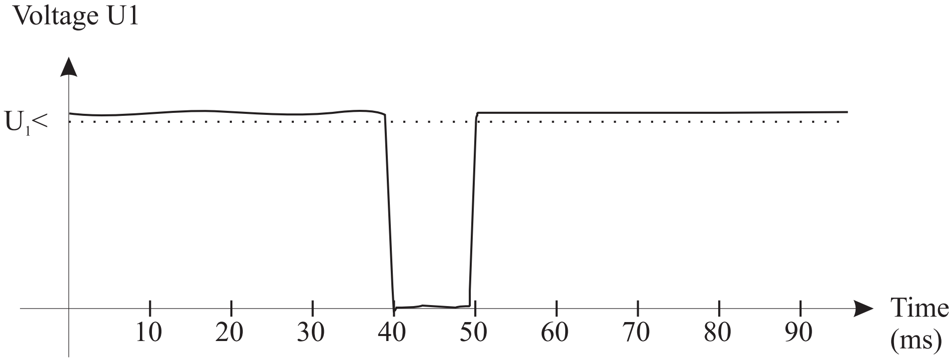


Figure 2.4.4-2. Short voltage sag that is recognized

Setting parameters of the voltage sag measurement function:

Parameter:	Value:	Unit:	Default:	Description:
U1<	10.0…120.0	%	64	Setting value
Period	8h; Day; Week; Month	-	Month	Length of the observation period
Date		-	-	Date
Time		-	-	Time

Measured and recorded values of voltage sag measurement function:

	Parameter:	Value:	Unit:	Description:
Measured value	Voltage	LOW; OK	-	Current voltage status
	U1		%	Measured positive sequence voltage
Recorded values	Count		-	Number of voltage sags during the current observation period
	Prev		-	Number of voltage sags during the previous observation period
	Total		s	Total (summed) time of voltage sags during the current observation period
	Prev		s	Total (summed) time of voltage sags during the previous observation period

2.4.5. Voltage sags and swells

The power quality of electrical networks has become increasingly important. The sophisticated loads (e.g. computers etc.) require uninterruptible supply of “clean” electricity. VAMP protection platform provides many power quality functions that can be used to evaluate, monitor and alarm on the basis of the quality. One of the most important power quality functions are sag monitoring and swell monitoring.

VAMP provides separate monitoring logs for sags and swells. The voltage log is trigg, if any voltage input either decreases under the sag limit (U<) or increases over the swell limit (U>). There are four registers for both sags and swells in the fault log. Each register will have start time, type (which phases), duration, minimum, average, maximum voltage values of each sag and swell event. Furthermore, there are total number of sags and swells counters as well as total timers for sags and swells.

The voltage power quality functions are located under the submenu “U”.

Setting parameters of sags and swells monitoring:

Parameter:	Value:	Unit:	Default:	Description:
U>	20…150	%	110	Setting value of swell limit
U<	10…120	%	90	Setting value of sag limit
Delay	0.04…1.00	s	0.06	Delay for sag and swell detection
SagOn	On; Off	-	On	Sag on event
SagOff	On; Off	-	On	Sag off event
SwelOn	On; Off	-	On	Swell on event
SwelOf	On; Off	-	On	Swell off event

Recorded values of sags and swells monitoring:

	Parameter:	Value:	Unit:	Description:
Recorded values	Count		-	Cumulative sag counter
	Total		-	Cumulative sag time counter
	Count		-	Cumulative swell counter
	Total		-	Cumulative swell time counter
				Sag/swell logs 1…4
	Date		-	Date of the sag/swell
	Time		-	Time stamp of the sag/swell
	Type		-	Voltage inputs that had the sag/swell
	Time		s	Duration of the sag/swell
	Min1		%Un	Minimum voltage value during the sag/swell in the input 1
	Min2		%Un	Minimum voltage value during the sag/swell in the input 2
	Min3		%Un	Minimum voltage value during the sag/swell in the input 3
	Ave1		%Un	Average voltage value during the sag/swell in the input 1
	Ave2		%Un	Average voltage value during the sag/swell in the input 2
	Ave3		%Un	Average voltage value during the sag/swell in the input 3
	Max1		%Un	Maximum voltage value during the sag/swell in the input 1
	Max2		%Un	Maximum voltage value during the sag/swell in the input 2
	Max3		%Un	Maximum voltage value during the sag/swell in the input 3

2.4.6. Current transformer supervision

VAMP257 supervises the external wiring between the relay terminal and current transformer secondary connection, as well. Furthermore, this is a safety feature, since an open secondary of a CT, causes very dangerous voltages.

CT supervisor measures phase currents. If one of the three phase currents drops below Imin< setting, while another phase current is exceeding the Imax> setting, the supervisor will issue an alarm after the operation delay has elapsed.

Setting parameters of CT supervisor:

CTSV ( )

Parameter:	Value:	Unit:	Default:	Description:
Imax>	0.0…10.0;	xIn	2.0	Upper setting for CT supervisor
Imin<	0.0…10.0;	xIn	0.2	Lower setting for CT supervisor
t>	0.02…600.00	s	0.10	Operation delay
CT on	On; Off	-	On	CT supervisor on event
CT off	On; Off	-	On	CT supervisor off event

Measured and recorded values of CT supervisor:

CTSV ( )

	Parameter:	Value:	Unit:	Description:
Measured value	ILMax		A	Maximum of phase currents
	ILMin		A	Minimum of phase currents
Display	Imax>,Imin<		A	Setting values as primary values
Recorded values	Date		-	Date of CT supervision alarm
	Time		-	Time of CT supervision alarm
	Imax		A	Maximum phase current
	Imin		A	Minimum phase current

2.4.7. Voltage transformer supervision

VAMP257 supervises the external wiring between the relay terminal and voltage transformer secondary connection, as well. If there is a fuse in the voltage transformer circuitry, the blown fuse causes that the relay cannot measure voltages. Therefore, an alarm should be issued. Furthermore, in some cases, the protection functions that are using voltage signals, should be blocked to avoid false trippings.

VT supervisor measures phase voltages and currents. Then it calculates the negative sequence voltage (U2) and the negative sequence current (I2). If the U2 is more that the U2> setting and at the same time, I2 is less than the I2< setting, the supervisor will issue an alarm after the operation delay has elapsed.

Setting parameters of VT supervisor:

VTSV ( )

Parameter:	Value:	Unit:	Default:	Description:
U2>	0.0…200.0;	%Un	34.6	Upper setting for VT supervisor
I2<	0.0…200.0;	%In	100.0	Lower setting for VT supervisor
t>	0.02…600.00	s	0.10	Operation delay
VT on	On; Off	-	On	VT supervisor on event
VT off	On; Off	-	On	VT supervisor off event

Measured and recorded values of VT supervisor:

VTSV ( )

	Parameter:	Value:	Unit:	Description:
Measured value	U2		%Un	Measured negative sequence voltage
	I2		%In	Measured negative sequence current
Recorded values	Date		-	Date of VT supervision alarm
	Time		-	Time of VT supervision alarm
	U2		%Un	Recorded negative sequence voltage
	I2		%In	Recorded negative sequence current

2.4.8. Circuit breaker condition monitoring

VAMP257 has an advanced condition monitoring function that supervises the wearing of the circuit-breaker. Thus, the condition monitoring can give alarm for the need of CB maintenance; well before the CB condition is critical.

The CB wear function measures the breaking current of each CB pole separately and then estimates the wearing of the CB accordingly a permissible cycle diagram.

The permissible cycle diagram is usually available in the documentation of the CB manufacturer. The diagram specifies the permissible number of cycles for every level of the breaking current. This diagram is parameterised to the unit with eight cycle points (current, cycles).

There are two alarm levels in this function. One can parameterise so that the nominal current of the CB is given and then, how many times the CB must be able the break the nominal current, when the alarm is given. The second one can be set accordingly a typical fault current.

Setting parameters of CB wear condition monitoring:

CBWEAR ( )

Parameter:	Value:	Unit:	Default:	Description:
Alarm1 Current	0.00…100.00;	kA	2.00 kA	Current level for alarm 1
Alarm1 Cycles	0…100000	-	30	Permissible cycle for alarm 1
Alarm2 Current	0.00…100.00	kA	0.63	Current level for alarm 1
Alarm2 Cycles	0…100000	-	200	Permissible cycle for alarm 1
Clear	-; CB1; CB2; CB3; All	-	-	Clear cycle counters (CB1 = pole L1)
Breaker curve points:				
Current1	0.00…100.00	kA	0.00	Current value for curve point 1
Current2	0.00…100.00	kA	0.05	Current value for curve point 2
Current3	0.00…100.00	kA	0.30	Current value for curve point 3
Current4	0.00…100.00	kA	0.60	Current value for curve point 4
Current5	0.00…100.00	kA	1.00	Current value for curve point 5
Current6	0.00…100.00	kA	5.00	Current value for curve point 6
Current7	0.00…100.00	kA	10.00	Current value for curve point 7
Current8	0.00…100.00	kA	16.00	Current value for curve point 8
Cycles1	0…100000	-	100000	Cycle value for curve point 1
Cycles2	0…100000	-	15000	Cycle value for curve point 2
Cycles3	0…100000	-	15000	Cycle value for curve point 3
Cycles4	0…100000	-	15000	Cycle value for curve point 4
Cycles5	0…100000	-	5000	Cycle value for curve point 5
Cycles6	0…100000	-	200	Cycle value for curve point 6
Cycles7	0…100000	-	45	Cycle value for curve point 7
Cycles8	0…100000	-	20	Cycle value for curve point 8
Alarm 1 on event	On; Off	-	On	

Alarm 1 off event	On; Off	-	On	
Alarm 2 on event	On; Off	-	On	
Alarm 2 off event	On; Off	-	On	

2.4.9. Energy pulses

The terminal can be configured to send a pulse whenever certain amount of energy has been imported or exported. The basic idea is presented in Figure 2.4.9-1. Each time the energy level reaches the pulse size, an output relay is activated and the relay will be active as long as defined by a pulse duration setting.

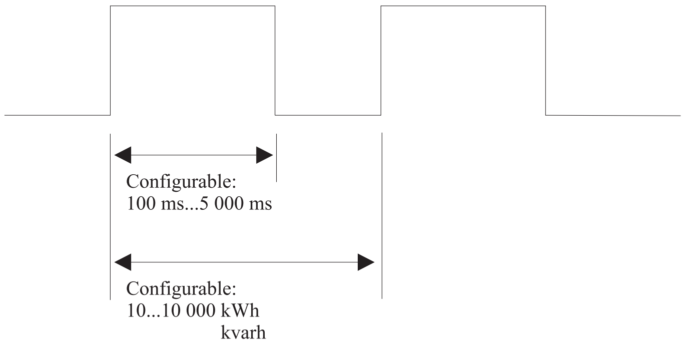


Figure 2.4.9-1. Principle of energy pulses

The manager has four energy pulse outputs. The output channels are:

- Active exported energy
- Reactive exported energy
- Active imported energy
- Reactive imported energy

Each channel can be connected to any combination of the thirteen output relays. The connection is configured in the output matrix. The parameters for the energy pulses can be found in the E menu under the submenus E-PULSE SIZES and E-PULSE DURATION.

Energy pulse function parameters:

	Parameter:	Value:	Unit:	Description:
Setting values / E-PULSE SIZES	E+	10…10 000	kWh	Pulse size of active exported energy
	Eq+	10…10 000	kvarh	Pulse size of reactive exported energy
	E-	10…10 000	kWh	Pulse size of active imported energy

	Eq-	10…10 000	kvar h	Pulse size of reactive imported energy
Setting values / E-PULSE DURATION	E+	100…5000	ms	Pulse length of active exported energy
	Eq+	100…5000	ms	Pulse length of reactive exported energy
	E-	100…5000	ms	Pulse length of active imported energy
	Eq-	100…5000	ms	Pulse length of reactive imported energy

Scaling examples

Example 1.

Average active exported power is 250 MW.

Peak active exported power is 400 MW.

Pulse size is 250 kWh.

The average pulse frequency will be 250/0.250 = 1000 pulses/h.

The peak pulse frequency will be 400/0.250 = 1600 pulses/h.

Set pulse length to 3600/1600 – 0.2 = 2.0 s or less.

The trip relay lifetime will be $50x10^6$/1000 h = 6 a.

This is not a practical scaling example unless an output relay lifetime of about six years is accepted.

Example 2.

Average active exported power is 100 MW.

Peak active exported power is 800 MW.

Pulse size is 400 kWh.

The average pulse frequency will be 100/0.400 = 250 pulses/h.

The peak pulse frequency will be 800/0.400 = 2000 pulses/h.

Set pulse length to 3600/2000 – 0.2 = 1.6 s or less.

The trip relay lifetime will be $50x10^6$/250 h = 23 a.

Example 3.

Average active exported power is 20 MW.

Peak active exported power is 70 MW.

Pulse size is 60 kWh.

The average pulse frequency will be 25/0.060 = 416.7 pulses/h.

The peak pulse frequency will be 70/0.060 = 1166.7 pulses/h.

Set pulse length to 3600/1167 – 0.2 = 2.8 s or less.

The trip relay lifetime will be $50x10^6$/417 h = 14 a.

Example 4.

Average active exported power is 1900 kW.

Peak active exported power is 50 MW.

Pulse size is 10 kWh.

The average pulse frequency will be 1900/10 = 190 pulses/h.
The peak pulse frequency will be 50000/10 = 5000 pulses/h.
Set pulse length to 3600/5000 – 0.2 = 0.5 s or less.
The trip relay lifetime will be $50 \times 10^6/190$ h = 30 a.

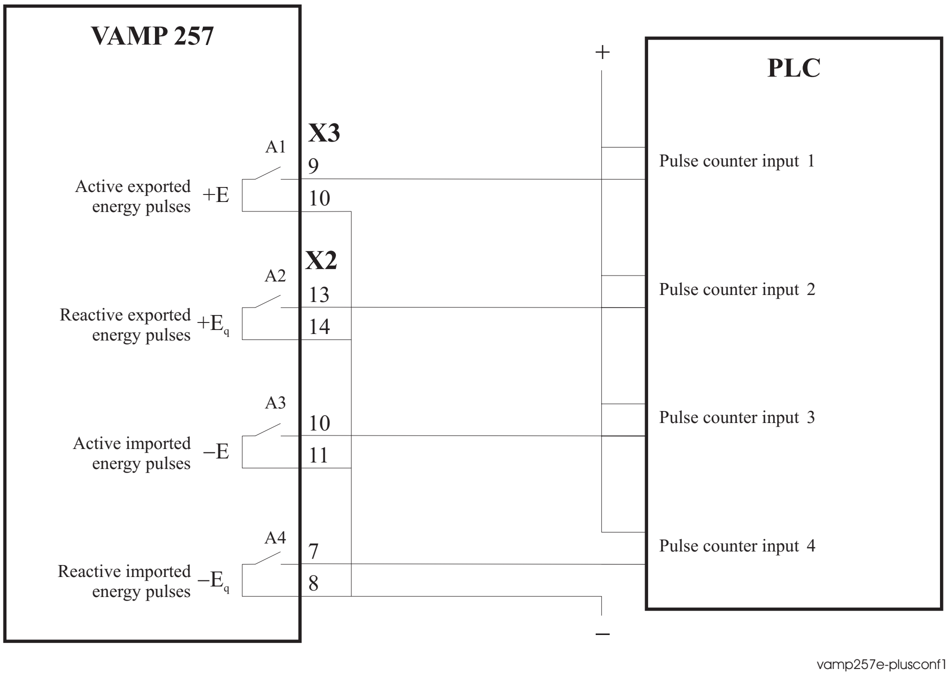


Figure 2.4.9-2. Application example of wiring the energy pulse outputs to a PLC having common plus and using an external wetting voltage

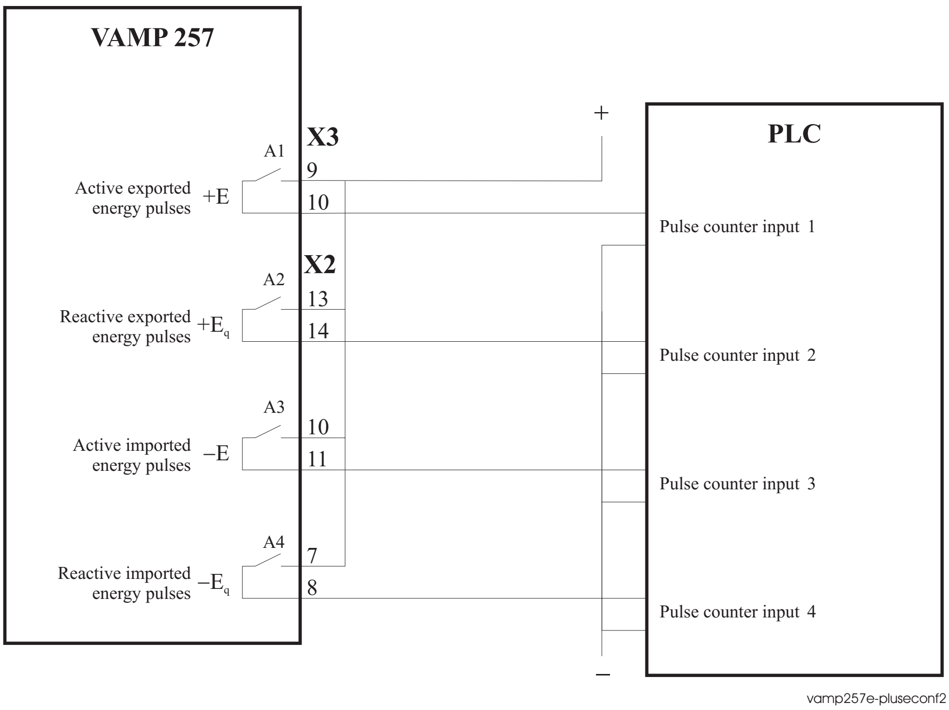


Figure 2.4.9-3. Application example of wiring the energy pulse outputs to a PLC having common minus and using an external wetting voltage

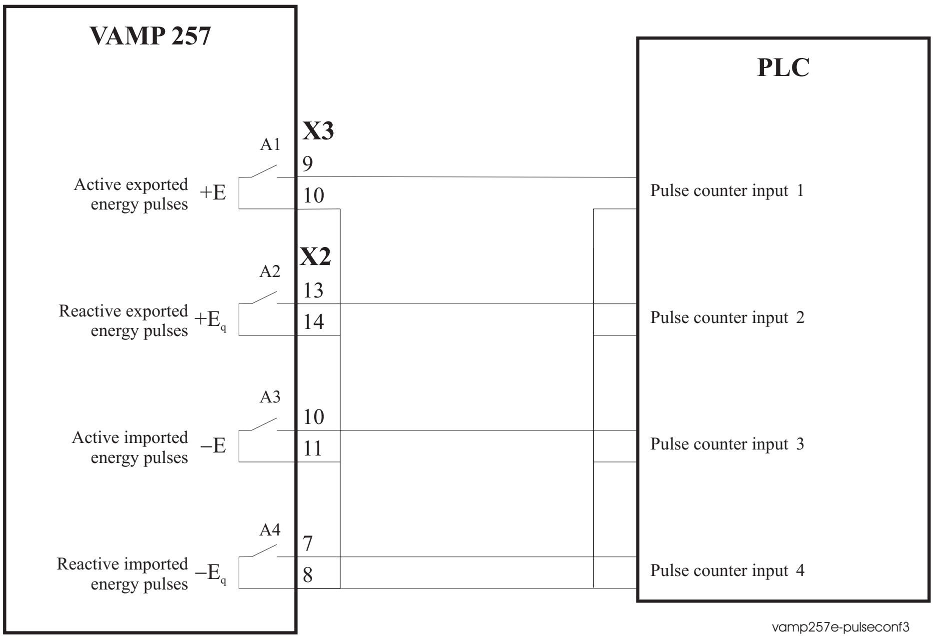


Figure 2.4.9-4. Application example of wiring the energy pulse outputs to a PLC having common minus and an internal wetting voltage

2.5. Control functions

2.5.1. Controllable objects

The manager allows controlling of six objects, that is, circuit-breakers, disconnectors and earthing switches. Controlling can be done by "select-execute" or "direct control" principle.

The logic functions can be used to configure interlocking checks for a safe controlling before the output pulse is issued. The objects 1, 2, 3, 4, 5 and 6 are controllable while the object 7 and 8 are not (for these, only the status is shown).

Controlling is possible by the following ways:

- through a local HMI
- through a remote communication
- through a digital input.

The connection of an object to specific output relays is done via an output matrix (object 1-6 open output, object 1-6 close output). There is also an output “Object failed”, which is activated if the controlling of an object is unsuccessful.

Object parameters (only in VAMPSET software):

	Parameter:	Value:	Unit:	Description:
States	Obj1 State	Close; Open; Undefined(00); Undefined(11)		Actual state of object 1
	Obj2 State	Close; Open; Undefined(00); Undefined(11)		Actual state of object 2
	Obj3 State	Close; Open; Undefined(00); Undefined(11)		Actual state of object 3
	Obj4 State	Close; Open; Undefined(00); Undefined(11)		Actual state of object 4
	Obj5 State	Close; Open; Undefined(00); Undefined(11)		Actual state of object 5
	Obj6 State	Close; Open; Undefined(00); Undefined(11)		Actual state of object 6
	Obj7 State	Close; Open; Undefined(00); Undefined(11)		Actual state of object 7
	Obj8 State	Close; Open; Undefined(00); Undefined(11)		Actual state of object 8
Settings	Obj 1 close status input	DI1; DI2; … DI32; none		Close information of object 1
	Obj 1 open status input	DI1; DI2;… DI32; none		Open information of object 1
	Obj 1 ready input	DI1; DI2; … DI32; none		Ready information of object 1 (spring charged)
	Obj 1 close command input	DI1; DI2; … DI32; none		Close command digital input for object 1
	Obj 1 open command input	DI1; DI2; … DI32; none		Open command digital input for object 1
	Obj 1 pulse	0.02…600.00	s	Pulse length of open and close commands for object 1
	Obj 1 ready timeout	0.02…600.00	s	Timeout of ready indication for object 1

	Control Obj 1	Open; Close		Control object 1
	Obj 2 close status input	DI1; DI2; … DI32; none		Close information of object 2
	Obj 2 open status input	DI1; DI2; … DI32; none		Open information of object 2
	Obj 2 ready input	DI1; DI2; … DI32; none		Ready information of object 2 (spring charged)
	Obj 2 close command input	DI1; DI2; … DI32; none		Close command digital input for object 2
	Obj 2 open command input	DI1; DI2; … DI32; none		Open command digital input for object 2
	Obj 2 pulse	0.02…600.00	s	Pulse length of open and close commands for object 2
	Obj 2 ready timeout	0.02…600.00	s	Timeout of ready indication for object 2
	Control Obj 2	Open; Close		Control object 2
	Obj 3 close status input	DI1; DI2; … DI32; none		Close information of object 3
	Obj 3 open status input	DI1; DI2; … DI32; none		Open information of object 3
	Obj 3 ready input	DI1; DI2; … DI32; none		Ready information of object 3 (spring charged)
	Obj 3 close command input	DI1; DI2; … DI32; none		Close command digital input for object 3
	Obj 3 open command input	DI1; DI2; … DI32; none		Open command digital input for object 3
	Obj 3 pulse	0.02…600.00	s	Pulse length of open and close commands for object 3
	Obj 3 ready timeout	0.02…600.00	s	Timeout of ready indication for object 3
	Control Obj 3	Open; Close		Control object 3
	Obj 4 close status input	DI1; DI2; … DI32; none		Close information of object 4
	Obj 4 open status input	DI1; DI2; … DI32; none		Open information of object 4
	Obj 4 ready input	DI1; DI2; … DI32; none		Ready information of object 4 (spring charged)
	Obj 4 close command input	DI1; DI2; … DI32; none		Close command digital input for object 4

	Obj 4 open command input	DI1; DI2; … DI32; none		Open command digital input for object 4
	Obj 4 pulse	0.02…600.00	s	Pulse length of open and close commands for object 4
	Obj 4 ready timeout	0.02…600.00	s	Timeout of ready indication for object 4
	Control Obj 4	Open; Close		Control object 4
	Obj 5 close status input	DI1; DI2; … DI32; none		Close information of object 5
	Obj 5 open status input	DI1; DI2; … DI32; none		Open information of object 5
	Obj 5 ready input	DI1; DI2; … DI32; none		Ready information of object 5 (spring charged)
	Obj 5 close command input	DI1; DI2; … DI32; none		Close command digital input for object 5
	Obj 5 open command input	DI1; DI2; … DI32; none		Open command digital input for object 5
	Obj 5 pulse	0.02…600.00	s	Pulse length of open and close commands for object 5
	Obj 5 ready timeout	0.02…600.00	s	Timeout of ready indication for object 5
	Control Obj 5	Open; Close		Control object 5
	Obj 6 close status input	DI1; DI2; … DI32; none		Close information of object 6
	Obj 6 open status input	DI1; DI2; … DI32; none		Open information of object 6
	Obj 6 ready input	DI1; DI2; … DI32; none		Ready information of object 6 (spring charged)
	Obj 6 close command input	DI1; DI2; … DI32; none		Close command digital input for object 6
	Obj 6 open command input	DI1; DI2; … DI32; none		Open command digital input for object 6
	Obj 6 pulse	0.02…600.00	s	Pulse length of open and close commands for object 6
	Obj 6 ready timeout	0.02…600.00	s	Timeout of ready indication for object 6
	Control Obj 6	Open; Close		Control object 6
	Obj 7 close status input	DI1; DI2; … DI32; none		Close information of object 7

	Obj 7 open status input	DI1; DI2; … DI32; none		Open information of object 7
	Obj 7 timeout	0.02…600.00	s	Timeout of object 7
	Obj 8 close status input	DI1; DI2; … DI32; none		Close information of object 8
	Obj 8 open status input	DI1; DI2; … DI32; none		Open information of object 8
	Obj 8 timeout	0.02…600.00	s	Timeout of object 8

2.5.2. Local/Remote selection

In Local mode, the output relays can be controlled via a local HMI, but they cannot be controlled via a remote serial communication interface.

In Remote mode, the output relays cannot be controlled via a local HMI, but they can be controlled via a remote serial communication interface.

The selection of the Local/Remote mode is done by using a local HMI, or via one selectable digital input. The digital input is normally used to change a whole station to a local or remote mode. The selection of the L/R digital input is done in the "Objects" menu of the VAMPSET software.

Note!

A password is not required for a remote control operation.

2.5.3. Logic functions

The manager supports customer-defined logics. The logics are designed by using the VAMPSET setting tool and downloaded to the manager. For detailed information, please refer to the VAMPSET manual (VMV.EN0xx).

2.6. Blocking and output relay functions

All the start and trip signals of the protection stages can be freely routed to the output relays and operation indicators according to the requirements of the application. The functions can also be blocked, and for this purpose both internal relay signals and external control signals can be used. Figure shows the operating principle of the output and blocking matrixes.

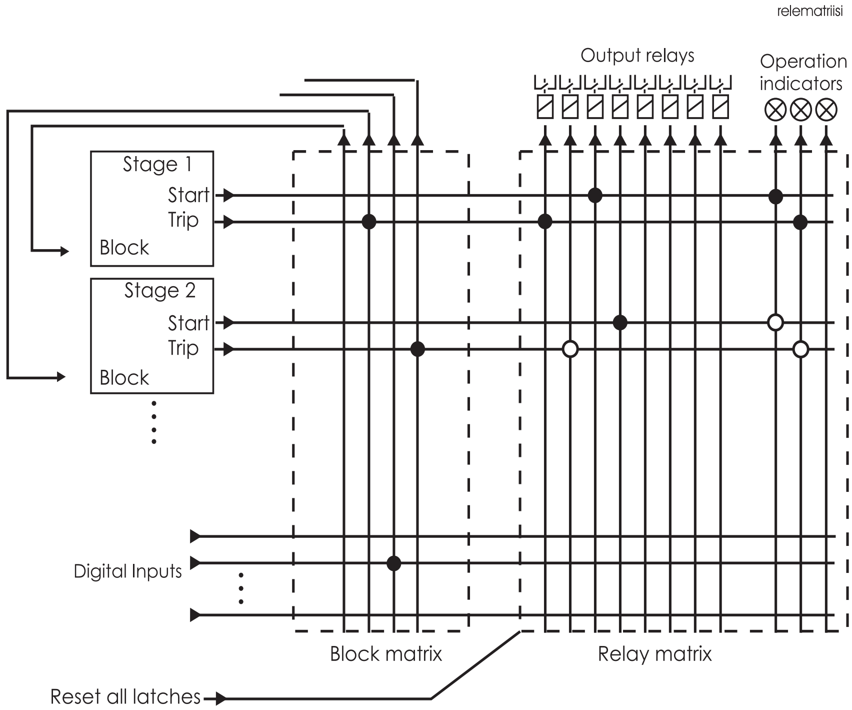


Figure 2.6-1. Operating principle of the output and blocking matrixes

2.6.1. Blocking matrix

By means of a blocking matrix (Block matrix), the operation of protection stage can be blocked. The blocking signal can originate from the digital inputs DI1 to DI32, or it can be a start or trip signal from a protection stage. Furthermore, the logic functions can be used to develop a blocking signal. In Figure, an active blocking is indicated with a black dot (•) in the crossing point of a blocking signal and the signal to be blocked.

Note!

The blocking matrix is available for configuration only in the VAMPSET software.

2.6.2. Output matrix

By means of an output matrix, the output signals of the various protection stages can be combined with the trip relays T1 to T8, the alarm relays from A1 to A5 and the operation indicators Al (Alarm led) and Tr (Trip led).

Furthermore, there are three leds (A, B and C) available for customer-specific indications. In addition, the triggering of the disturbance recorder (Dr) is configured in the output matrix.

When the signals are combined, two functions can be selected: the signal follower function (o) or the latching function (•), see Figure.

The reset signal resets all the latched output relays and operation indicators. The reset signal can be given via a digital input, via a keypad or through communication. Any digital input can be used for resetting. The selection of the input (from DI1 to DI32) is done with the VAMPSET software under the menu "Release output matrix latches". Under the same menu, the "Release latches" parameter can be used for resetting. The remote communication protocols use "RemRel" signal for resetting purposes.

2.6.3. Virtual inputs and outputs

Virtual inputs acts like normal digital inputs. The state of the virtual input can be changed from display, communication bus and from Vampset. For example setting groups can be change via virtual inputs.

Virtual outputs act like output relays. Virtual outputs are shown in blocking and output matrixes. Virtual outputs can also change the active setting group.

2.7. Disturbance recorder

The disturbance recorder can be used to record all the measured signals, that is, currents, voltages and the status information of digital inputs (DI, DI_2) and digital outputs (DO). The digital inputs include also the arc light information (S1, S2 and Arc binary input BI). The digital outputs include the Arc binary output information (BO).

At the maximum, there can be 5 recordings, and the maximum selection of channels in one recording is 12 (limited in waveform recording). The digital inputs reserve two channels (includes all the inputs, DI for digital inputs 1-20 and DI_2 for digital inputs 21-32). The digital outputs reserve one channel (includes all the outputs). If all digital inputs and outputs are recorded, there will be still 9 channels left for analogue waveforms.

The recorder can be triggered by any protection-stage start or trip signal, Arc sensors (S1, S2, BI) or by a digital input. The trig signal is selected in the output matrix (signal DR). The recording can also be triggered manually.

When a recording is made, also the time stamp will be memorized.

The recordings can be uploaded, viewed and analysed with the VAMPSET program (version 8.x or newer). The recording is in COMTRADE format. This means that also other programs can be used to view and analyse the recordings made by the manager.

For more detailed information about, for example, uploading, please see a separate VAMPSET manual.

Available links

The following channels can be linked to a disturbance recorder:

- DO, DI, DI_2
- Uline, Uphase
- IL
- U2/U1, U2, U1
- I2/In, I2/I1, I2, I1, IoCalc
- CosFii
- PF, S, Q, P
- f
- Uo
- UL3, UL2, UL1
- U31, U23, U12
- Io2, Io
- IL3, IL2, IL1
- Prms, Qrms, Srms
- Tanfii
- THDIL1, THDIL2, THDIL3
- THDUa, THDUb, THDUc
- fy, fz, U12y, U12z

Note!

The available channels (that is, what signals are measured) depend on the configuration.

Disturbance recorder parameters:

	Parameter:	Value:	Unit:	Description:
Setting values	Mode	Saturated; Overflow	-	Mode of the recording
	Rate	32 samples/cycle; 16 samples/cycle; 8 samples/cycle; 10ms; 20ms; 200ms; 1s; 5s; 10s; 15s; 30s; 1min;	-	Sample rate
	Time		s	Recording time (the maximum time calculated automatically)
	PreTrig	0…100	%	Pre-trigger time
	MnlTrig	-;Trig	-	Manual trig
	Size			Size of one recording
	MAX time		s	The maximum time of recordings
	MAX size			Maximum size of recordings
Recorder links	Links			Connected links
	AddLink			Add links
	ClrLnks			Clear links
Recorded values	Status			Status of recorder
	Time status		%	Status of pre-triggering
	ReadyRec		-	The number of ready records

2.8. Self-supervision

The functions of the micro controller and the associated circuitry, as well as the program execution are supervised by means of a separate watchdog circuit. Besides supervising the manager, the watchdog circuit attempts to restart the micro controller in a fault situation. If the restarting fails, the watchdog issues a self-supervision alarm because of a permanent internal fault.

When the watchdog circuit detects a permanent fault, it always blocks any control of other output relays (except for the self-supervision output relay) until the fault has disappeared.

In addition, the internal supply voltage is supervised. Should the auxiliary supply of the manager disappear, an IF alarm is automatically given because the IF output relay functions on a working current principle. This means that the IF relay is energized when the auxiliary supply is on and within the permitted range.

2.9. Clock synchronisation

The internal clock of the manager can be externally synchronised. Thus, the events and recordings are time stamped very accurately.

Clock synchronisation parameters:

	Parameter:	Value:	Unit:	Description:
Display	SySrc	Internal; DIx		Clock synchronisation source
Setting values	SyncDI	-;DI1; DI2; …DI32	-	The digital input used for clock synchronisation
	SyOS		ms	Synchronisation correction
	CkTrim		ppm	Real time clock trim
Recorded values	MsgCnt			The number of synchronisation messages
	Dev		ms	Latest time deviation
	FilDev			Filtered synchronisation deviation
	I		ms	Cumulative deviation
	MaxAdj		ms	The maximum adjustment of internal clock
	MinAdj		ms	The minimum adjustment of internal clock

2.10. Timers

The VAMP protection platform includes four settable timers that can be used in many different applications that require actions based on time. Each timer has its own settings. The selected on time and off time is set and then the activation of the timer can be set to be as daily or different week days (See the setting parameters for details). The timer outputs are available for logic functions, block and output matrix.

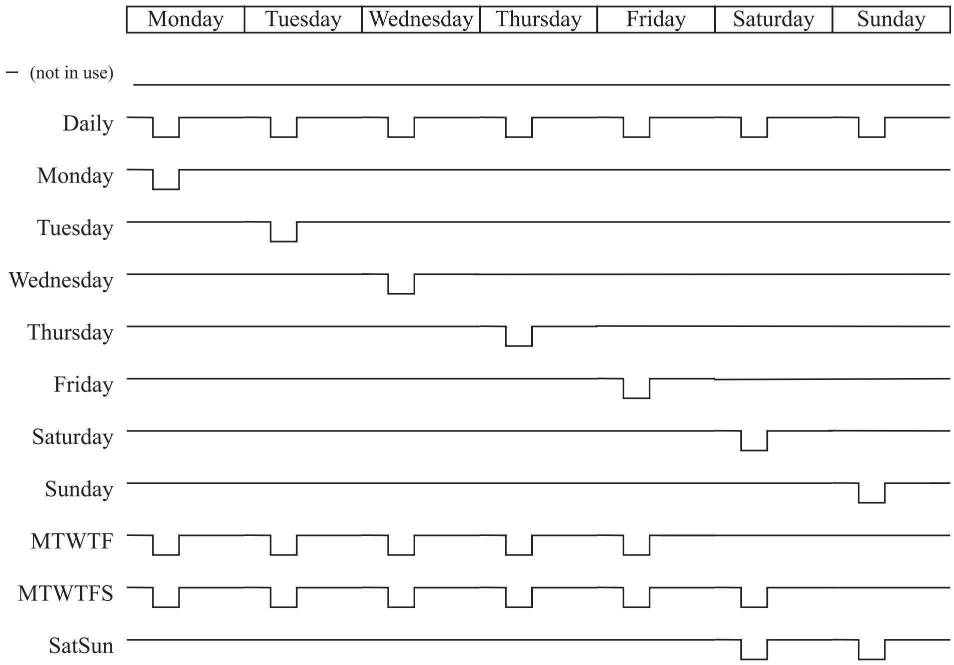


Figure 2.10-1. Timer output sequence in different modes.

The user can force any timer, which is in use, on or off. The forcing is done by writing a new status value. No forcing flag is needed as in forcing i.e. the output relays.

The forced time is valid until the next forcing or until the next reversing timed act from the timer itself.

The status of each timer is stored in non-volatile memory when the auxiliary power is switched off. At start up, the status of each timer is recovered.

Setting parameters of timers:

Parameter:	Value:	Unit:	Default:	Description:
On	hh:mm:ss	-	07:00:00	Activation time of the timer
Off	hh:mm:ss	-	16:00:00	De-activation time of the timer
Mode				For each four timers there are 12 different modes available:
	-;	-	-	The timer is off and not running. The output is off i.e. 0 all the time.
	Daily;			The timer switches on and off once every day.
	Monday;			The timer switches on and off every Monday.
	Tuesday;			The timer switches on and off every Tuesday.
	Wednesday;			The timer switches on and off every Wednesday.
	Thursday;			The timer switches on and off every Thursday.
	Friday;			The timer switches on and off every Friday.
	Saturday;			The timer switches on and off every Saturday.
	Sunday;			The timer switches on and off every Sunday.
	MTWTF;			The timer switches on and off every day except Saturdays and Sundays
	MTWTFS;			The timer switches on and off every day except Sundays.
	SatSun;			The timer switches on and off every Saturday and Sunday.
SagOn	On; Off	-	On	Sag on event
SagOff	On; Off	-	On	Sag off event
SwelOn	On; Off	-	On	Swell on event
SwelOf	On; Off	-	On	Swell off event

2.11. Non-volatile memory

There is a non-volatile memory for the following data :

- Disturbance recordings
- Events
- States at LEDS
- Blackout data

The contents of the non-volatile memory is not lost even if there is max. 1day failure in the auxiliary power supply.

3. Applications

The following examples illustrate the versatile functions of the feeder and motor manager VAMP 257 in different applications.

3.1. Substation feeder protection

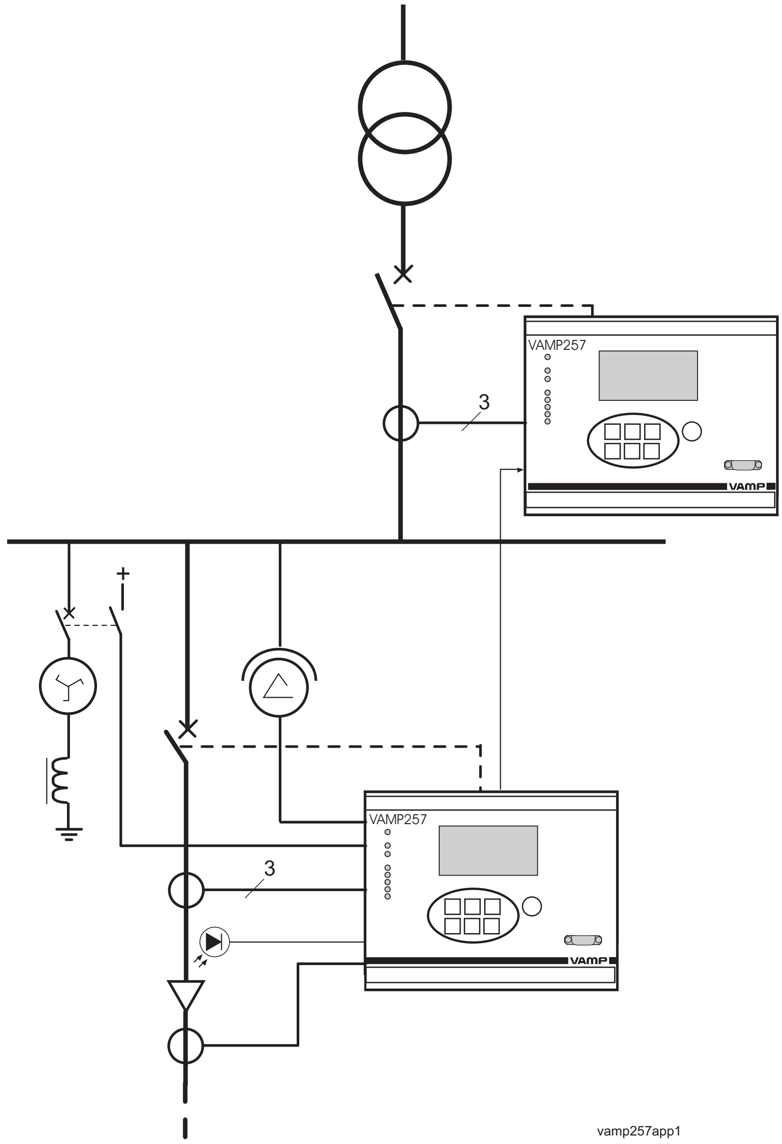


Figure 3.1-1 VAMP feeder and motor managers used in substation feeder protection

The feeder manager includes three-phase overcurrent protection, directional earth fault protection and fast arc protection. At the incoming feeder, the instantaneous stage I>>> of the VAMP feeder managers is blocked with the start signal of the overcurrent stage. This prevents the trip signal if the fault occurs on the outgoing feeder.

For the directional function of earth fault function, the status information (on/off) of the Petersen coil is routed to one of the digital inputs of the feeder manager so that either $I_0 \sin\varphi$ or $I_0 \cos\varphi$ function is obtained.

The function $I_0 \sin\varphi$ is used in isolated networks, and the function $I_0 \cos\varphi$ is used in resistance or resonant earthed networks.

3.2. Industrial feeder protection

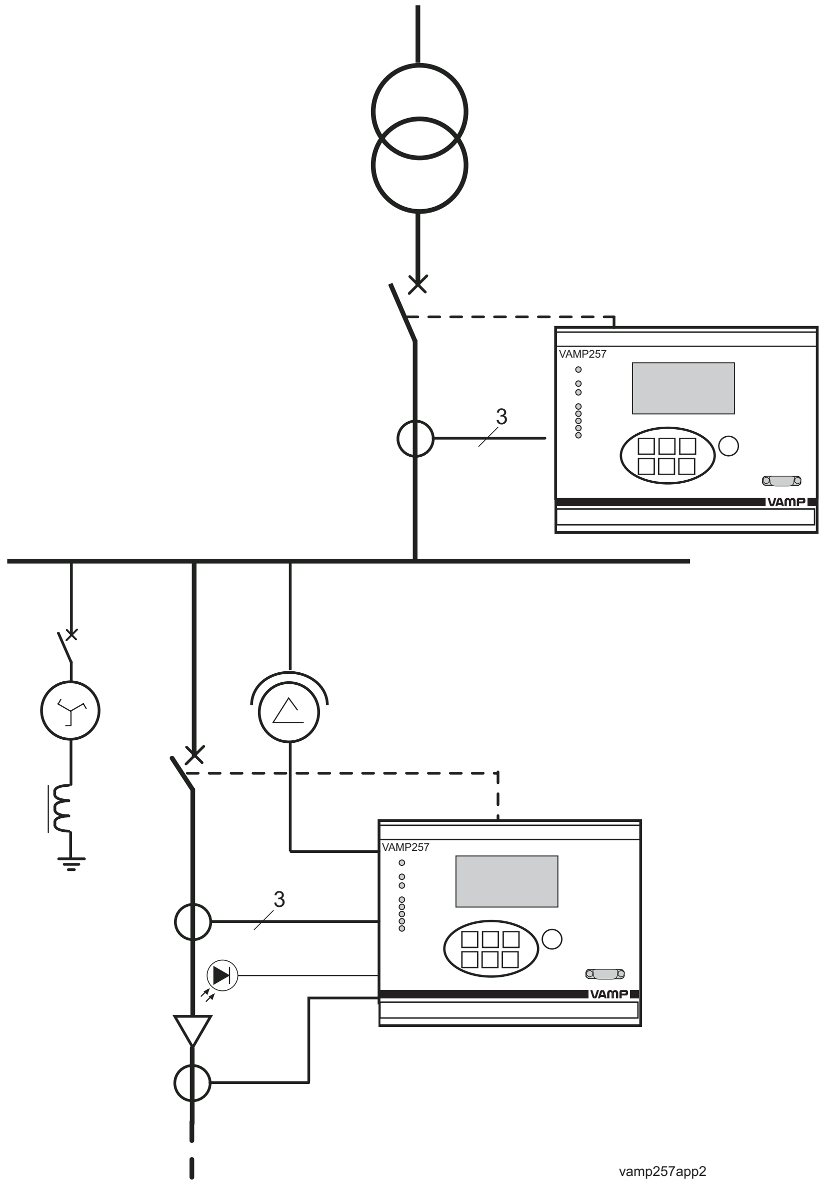


Figure 3.2-1 VAMP feeder and motor managers used in cable protection of an industry plant network

Directional earth fault protection and three-phase overcurrent protection is required in a cable feeder. Furthermore, the thermal stage can be used to protect the cable against overloading. This example also includes fast arc protection.

3.3. Parallel line protection

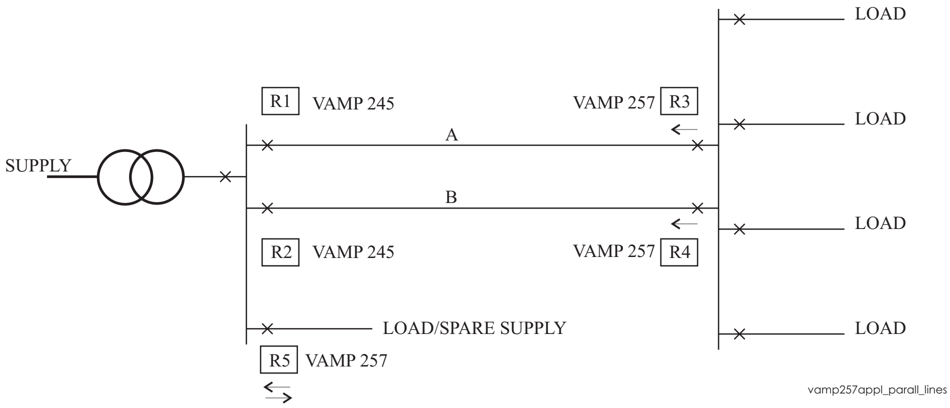


Figure 3.3-1. Feeder and motor manager VAMP 257 used for protection of parallel lines.

Figure 3.3-1 shows two parallel lines, A and B, protected with overcurrent relays R1, R2, R3 and R4. The relays R3 and R4 are directional.

If there is a fault in one of the lines, only the faulty line will be switched off because of the direction functions of the relays R3 and R4. A detailed schematic of e.g. the relay R3 is shown in Figure 3.3-2.

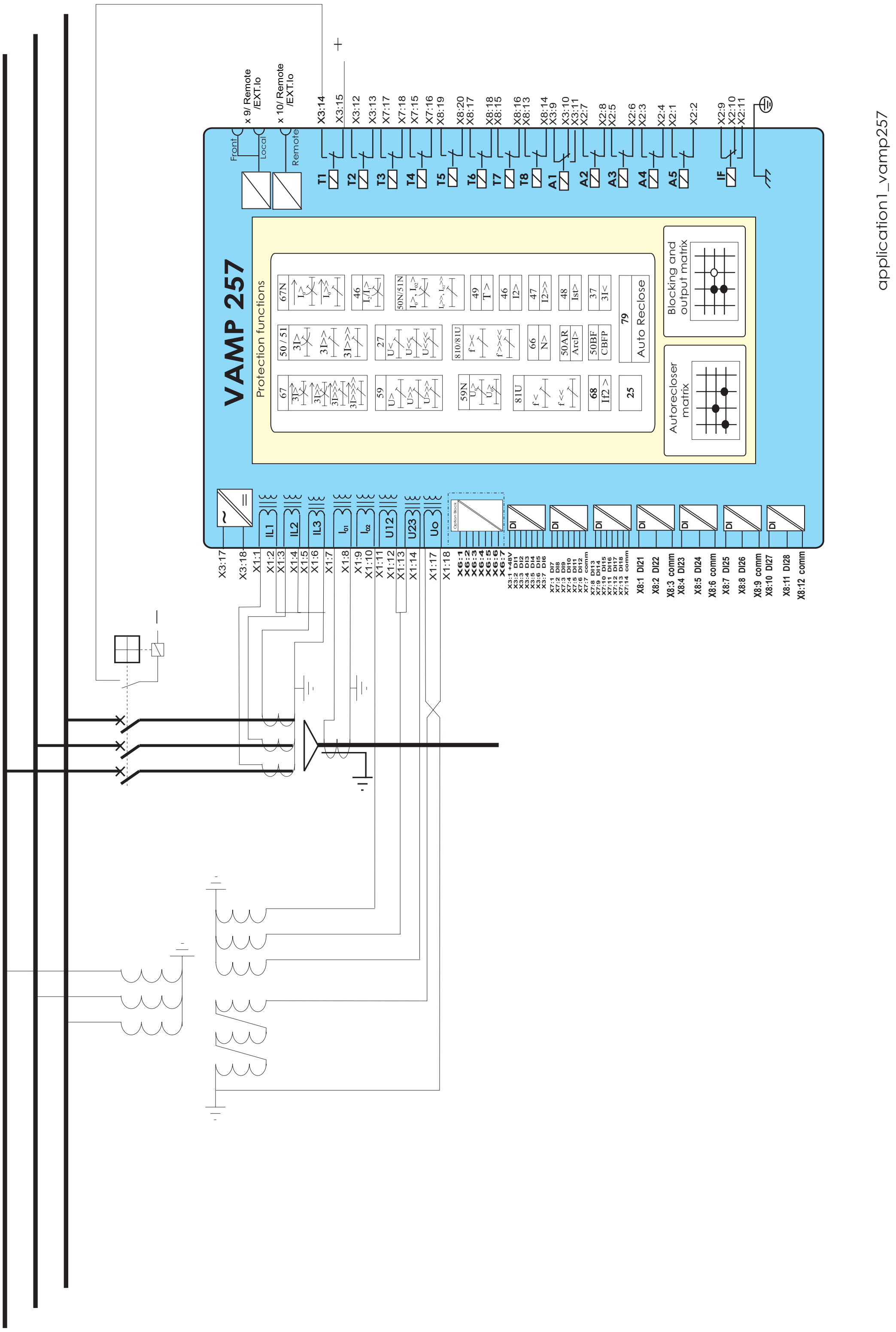


Figure 3.3-2. Example connection VAMP 257. Both short-circuits and earth-faults will be detected. The outgoing line is one of several parallel lines or the line is feeding a ring network.

3.4. Ring network protection

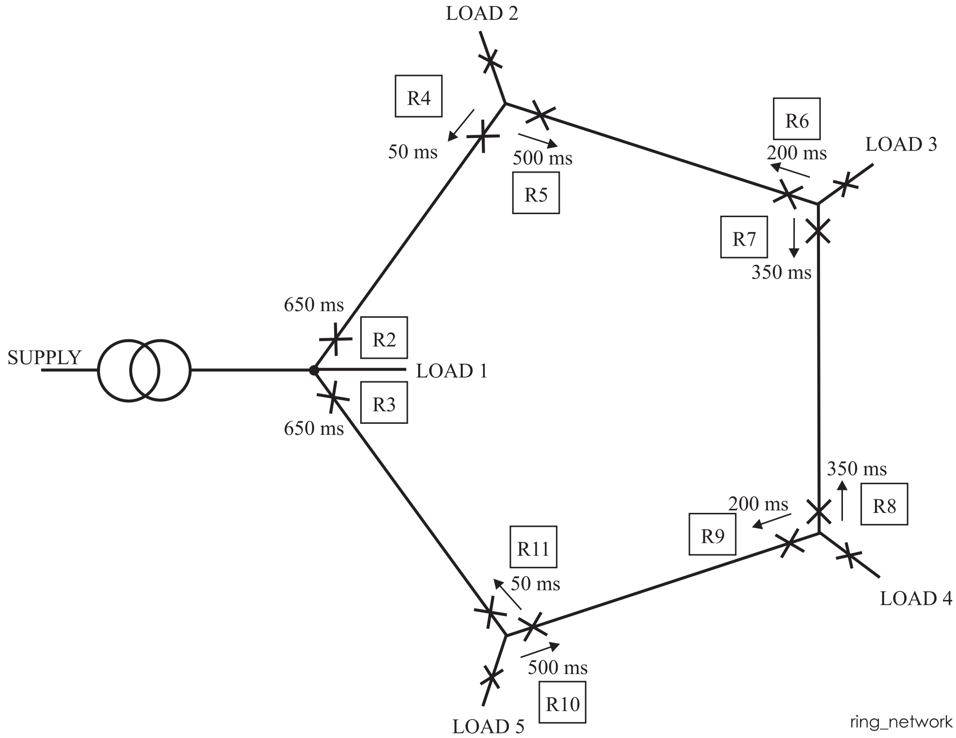


Figure 3.4-1 Feeder terminals VAMP 257 used for protection of ring main circuit with one feeding point.

Ring networks can be protected with complete selectivity using directional overcurrent relays as long as there is only one feeding point in the network. Figure 3.4-1 shows an example of a ring main with five nodes using one circuit breaker at each end of each line section (e.g. a ring main unit). When there is a short-circuit fault in any line section, only the faulty section will be disconnected. The grading time in this example is 150 ms.

3.5. Trip circuit supervision

Trip circuit supervision is used to ensure that the wiring from a protective manager to a circuit-breaker is in order. This circuit is unused most of the time, but when a feeder manager detects a fault in the network, it is too late to notice that the circuit-breaker cannot be tripped because of a broken trip circuitry.

The digital inputs of the manager can be used for trip circuit monitoring.

3.5.1. Internal parallel digital inputs

- The output relays T5, T6, T7 and T8 have internal, parallel digital inputs available for trip circuit supervision.
- These inputs are DI29, DI30, DI31 and DI32.

3.5.2. Trip circuit supervision with one digital input

- The digital input is connected parallel with the trip contacts (Figure 3.5.2-1).
- The digital input is configured as Normal Closed (NC).
- The digital input delay is configured longer than maximum fault time to inhibit any superfluous trip circuit fault alarm when the trip contact is closed.
- The trip relay should be configured as non-latched. Otherwise, a superfluous trip circuit fault alarm will follow after the trip contact operates, and the relay remains closed because of latching.

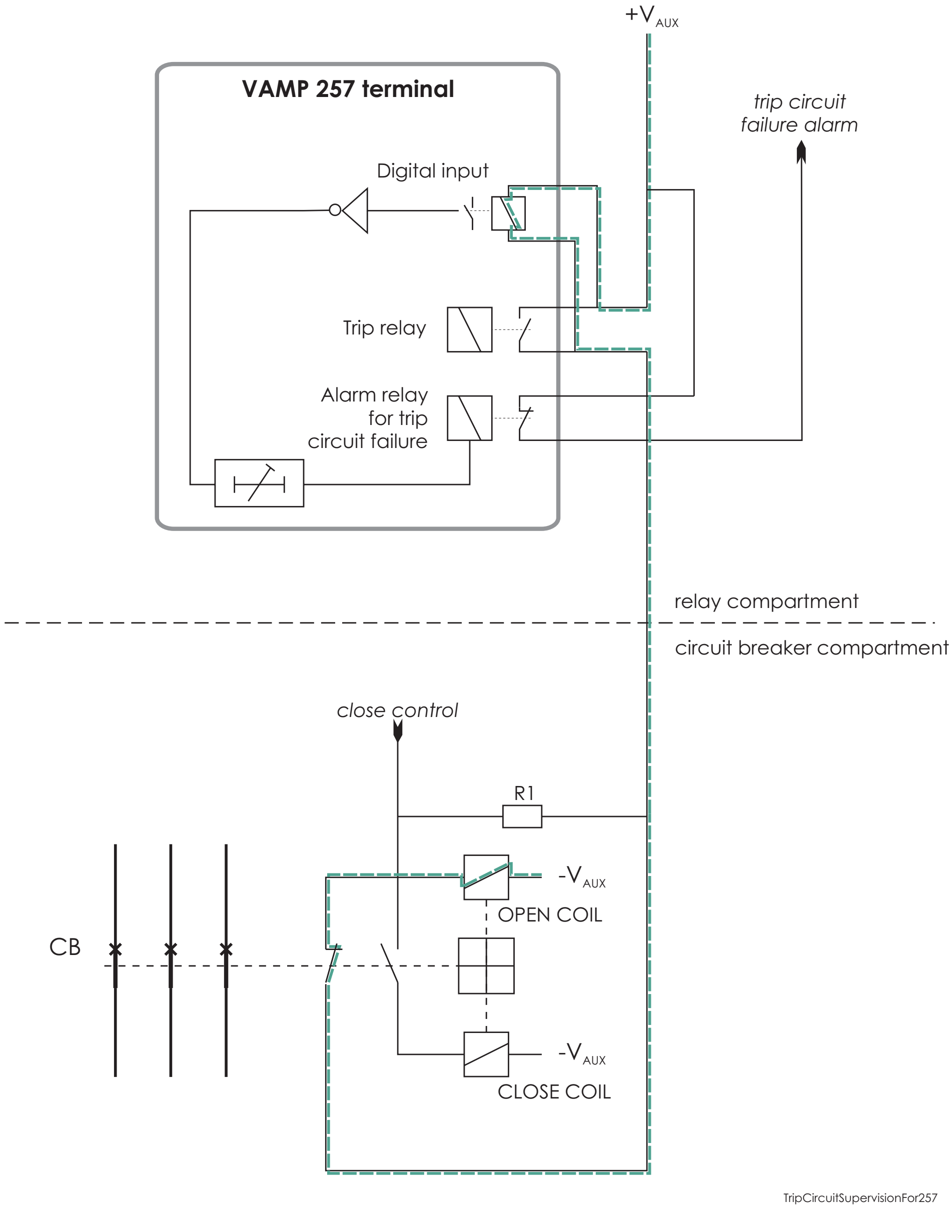


Figure 3.5.2-1. Application example when one of digital inputs 7…32 is used for trip circuit supervision. Trip circuit supervision when the circuit-breaker is closed. The supervised circuitry in this CB position is double-lined. The digital input is in active state. For the application to work when the circuit-breaker is opened, a resistor R1 must be placed. The value for it can be calculated from the external wetting supply, so that the current over R1 is >1 mA.

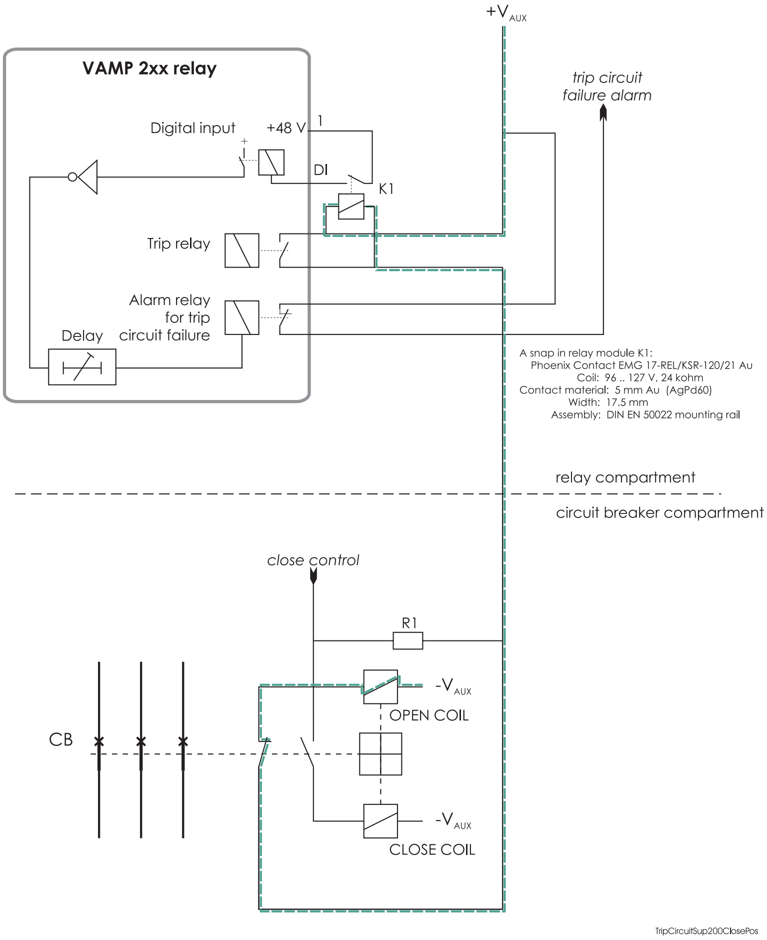


Figure 3.5.2-2. Application example, when one of digital inputs 1…6 is used for trip circuit supervision. Trip circuit supervision when the circuit-breaker is closed. The supervised circuitry in this CB position is double-lined. The digital input is in active state. The value for R1 in this application is 3k3 and 2W. These can be calculated from the resistance and voltage operating range of the coil of K1 and the tolerance of the wetting voltage.

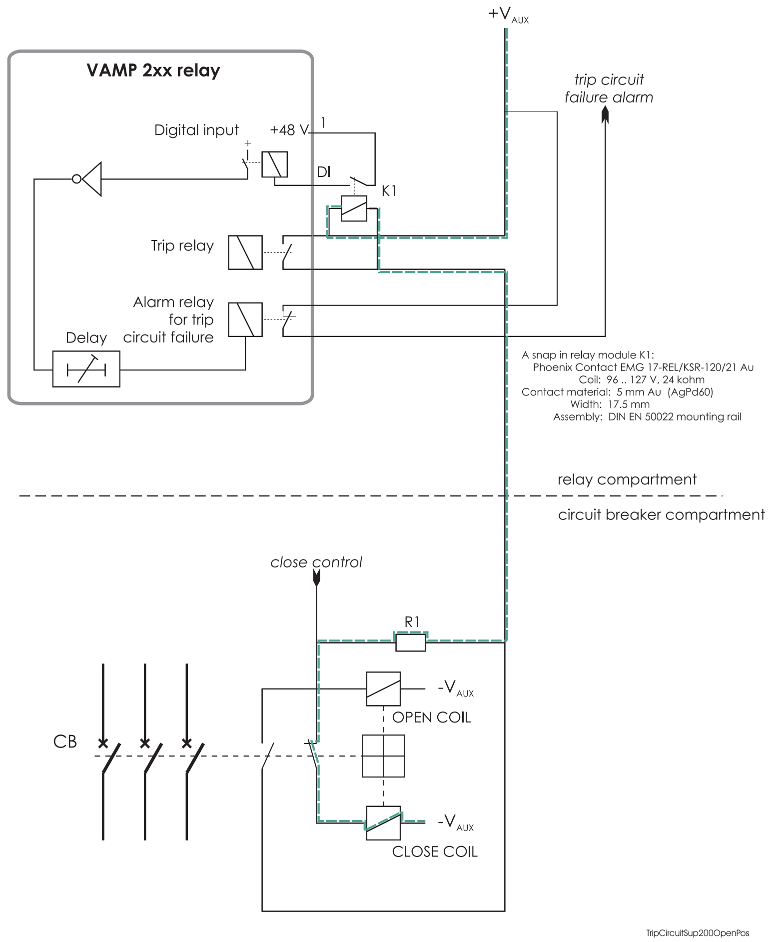


Figure 3.5.2-3. Application example, when one of digital inputs 1…6 is used for trip circuit supervision. Trip circuit supervision when the circuit-breaker is open. The supervised circuitry in this CB position is doubled-lined. The value for R1 in this application is 3k3 and 2W. These can be calculated from the resistance and voltage operating range of the coil of K1 and the tolerance of the wetting voltage.

3.5.3. Trip circuit supervision with two digital inputs

- The first digital input is connected parallel with the trip contacts (Figure 3.5.3-1)
- The second digital input is connected parallel with the auxiliary contact of the circuit breaker.
- Both inputs are configured as normal closed (NC).
- The digital input delay is configured longer than maximum fault time to inhibit any superfluous trip circuit fault alarm when the trip contact is closed.
- The trip relay should be configured as non-latched. Otherwise, a superfluous trip circuit fault alarm will follow after the trip contact operates, and the relay remains closed because of latching.

Both digital inputs must have their own common.

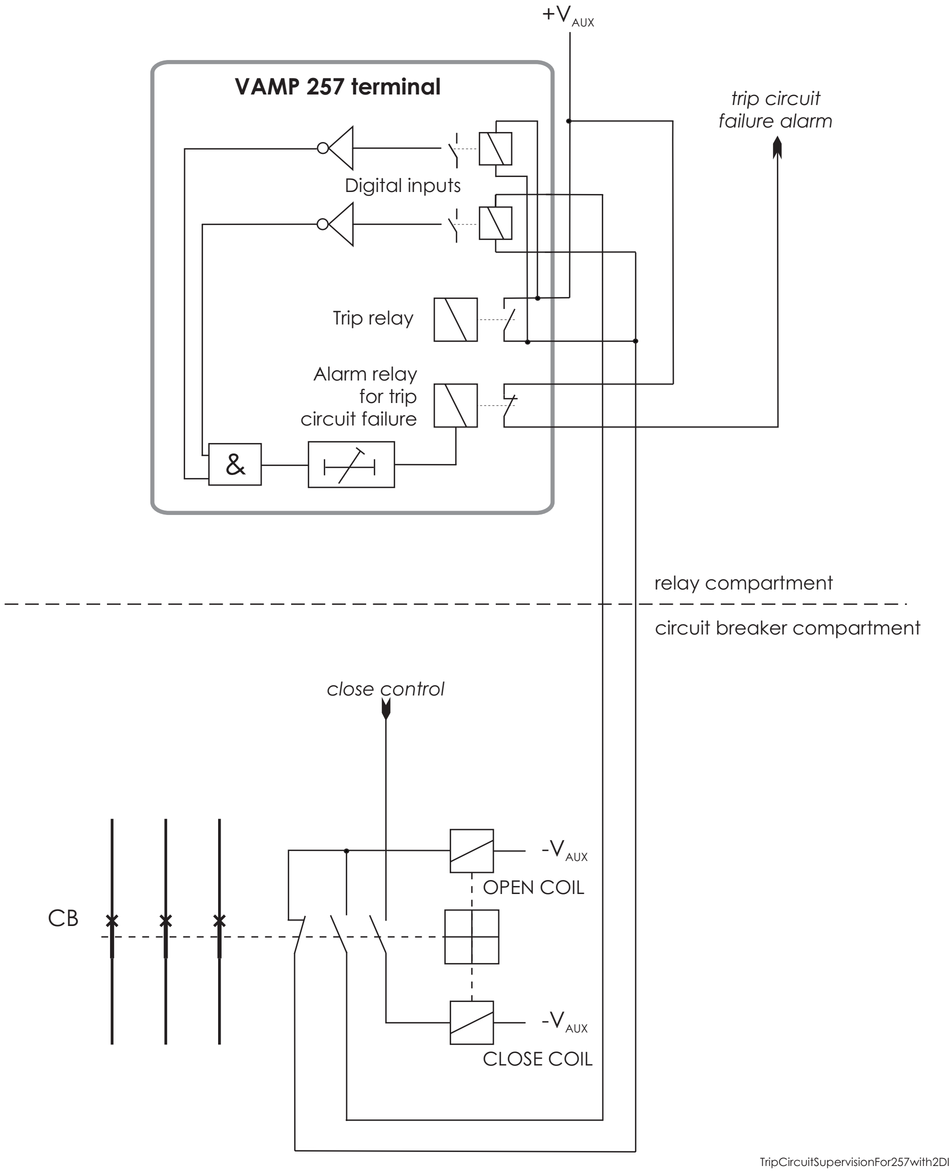
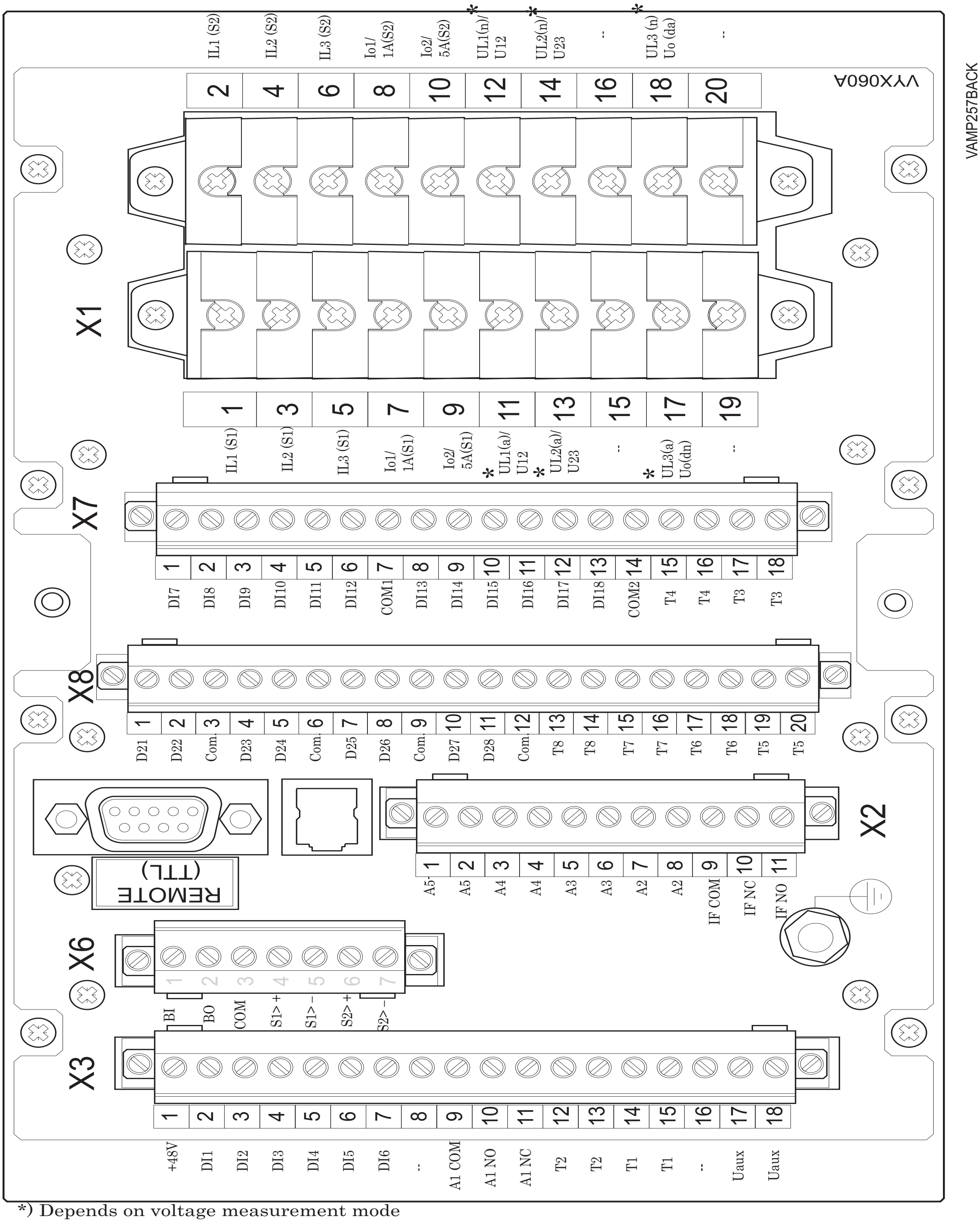


Figure 3.5.3-1. Trip circuit supervision with two digital inputs.

4. Connections

4.1. Rear panel view

4.1.1. Feeder manager VAMP 257

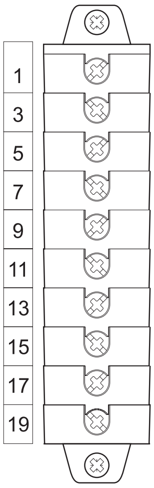


*) Depends on voltage measurement mode

Figure 4.1.1-1 Connections on the rear panel of the VAMP 257

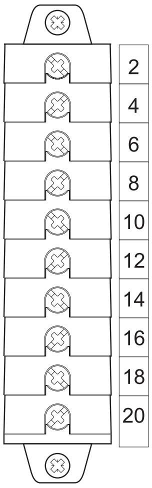
The feeder and motor manager VAMP 257 is connected to the protected object through the following measuring and control connections:

Terminal X1 left side



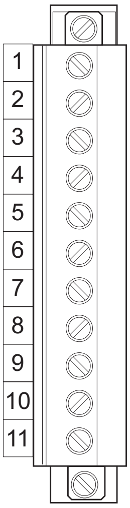
No:	Symbol	Description
1	IL1(S1)	Phase current L1 (S1)
3	IL2(S1)	Phase current L2 (S1)
5	IL3(S1)	Phase current L3 (S1)
7	Io1/1A(S1)	Residual current Io1(S1)
9	Io2/5A(S1)	Residual current Io2(S1)
11	UL1(a)/U12	Phase to earth voltage L1 (a) or phase to phase voltage U12
13	UL2(a)/U23	Phase to earth voltage L2 (a) or phase to phase voltage U23
15	--	--
17	UL3(a)/Uo(dn)	Phase to earth voltage L3 (a) or residual voltage Uo(dn)
19	--	--

Terminal X1 right side



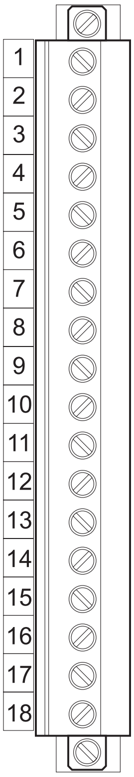
No:	Symbol	Description
2	IL1(S2)	Phase current L1 (S2)
4	IL2(S2)	Phase current L2 (S2)
6	IL3(S2)	Phase current L3 (S2)
8	Io1/1A(S2)	Residual current Io1 (S2)
10	Io2/5A(S2)	Residual current Io2 (S2)
12	UL1(n)/U12	Phase to earth voltage L1 (n) or phase to phase voltage U12
14	UL2(n)/U23	Phase to earth voltage L2 (n) or phase to phase voltage U23
16	--	--
18	UL3(n)/Uo(da)	Phase to earth voltage L3 (n) or residual voltage Uo(da)
20	--	--

Terminal X2



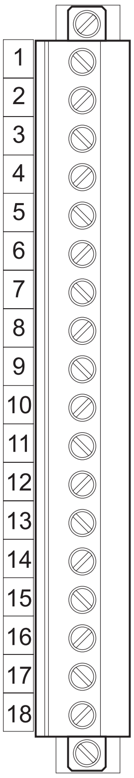
No:	Symbol	Description
1	A5	Alarm relay 5
2	A5	Alarm relay 5
3	A4	Alarm relay 4
4	A4	Alarm relay 4
5	A3	Alarm relay 3
6	A3	Alarm relay 3
7	A2	Alarm relay 2
8	A2	Alarm relay 2
9	IF COM	Internal fault relay, common connector
10	IF NC	Internal fault relay, normal closed connector
11	IF NO	Internal fault relay, normal open connector

Terminal X3



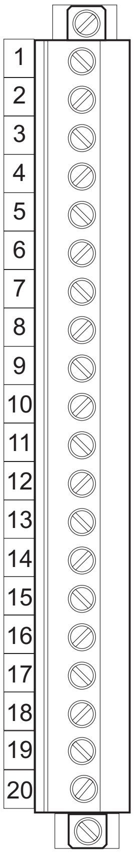
No:	Symbol	Description
1	+48V	Internal control voltage for digital inputs 1 – 6
2	DI1	Digital input 1
3	DI2	Digital input 2
4	DI3	Digital input 3
5	DI4	Digital input 4
6	DI5	Digital input 5
7	DI6	Digital input 6
8	--	--
9	A1 COM	Alarm relay 1, common connector
10	A1 NO	Alarm relay 1, normal open connector
11	A1 NC	Alarm relay 1, normal closed connector
12	T2	Trip relay 2
13	T2	Trip relay 2
14	T1	Trip relay 1
15	T1	Trip relay 1
16	--	--
17	Uaux	Auxiliary voltage
18	Uaux	Auxiliary voltage

Terminal X7



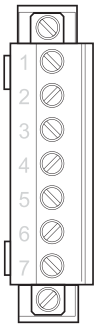
No:	Symbol	Description
1	DI7	Digital input 7
2	DI8	Digital input 8
3	DI9	Digital input 9
4	DI10	Digital input 10
5	DI11	Digital input 11
6	DI12	Digital input 12
7	COM1	Common potential of digital inputs 7 - 12
8	DI13	Digital input 13
9	DI14	Digital input 14
10	DI15	Digital input 15
11	DI16	Digital input 16
12	D117	Digital input 17
13	DI18	Digital input 18
14	COM2	Common potential of digital inputs 13 – 18
15	T4	Trip relay 4
16	T4	Trip relay 4
17	T3	Trip relay 3
18	T3	Trip relay 3

Terminal X8



No:	Symbol	Description
1	DI21	Digital input 21
2	DI22	Digital input 22
3	COM1	Common potential of digital inputs 21-22
4	DI23	Digital input 23
5	DI24	Digital input 24
6	COM2	Common potential of digital inputs 23-24
7	DI25	Digital input 25
8	DI26	Digital input 26
9	COM3	Common potential of digital inputs 25-26
10	DI27	Digital input 27
11	DI28	Digital input 28
12	COM4	Common potential of digital inputs 27-28
13	T8	Tip relay 8/ Digital input 32
14	T8	Tip relay 8/ Digital input 32
15	T7	Tip relay 7/ Digital input 31
16	T7	Tip relay 7/ Digital input 31
17	T6	Tip relay 6/ Digital input 30
18	T6	Tip relay 6/ Digital input 30
19	T5	Tip relay 5/ Digital input 29
20	T5	Tip relay 5/ Digital input 29

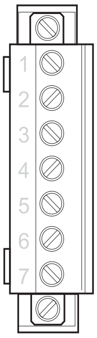
Terminal X6



No:	Symbol	Description
1	BI	External arc light input
2	BO	Arc light output
3	COM	Common connector of arc light I/O
4	S1>+	Arc sensor 1, positive connector *
5	S1>–	Arc sensor 1, negative connector *
6	S2>+	Arc sensor 2, positive connector *
7	S2>–	Arc sensor 2, negative connector *

*) Arc sensor itself is polarity free

Terminal X6 with DI19/DI20 option



No:	Symbol	Description
1	DI19	Digital input 19
2	DI19	Digital input 19
3	DI20	Digital input 20
4	DI20	Digital input 20
5	--	--
6	S1>+	Arc sensor 1, positive connector *
7	S1>–	Arc sensor 1, negative connector *

*) Arc sensor itself is polarity free

4.2. Analogue measurements

- Phase currents I_{L1}, I_{L2} and I_{L3} (terminals X1: 1-6)
- Earth fault current I_0 (terminals X1: 7-8)
- Earth fault current I_{02} (terminals X1: 9-10)
- Voltage modes:
  - **Phase**: voltages U_{L1}, U_{L2} and U_{L3} (terminals X1: 11-14 and 17-18)
  - **2 Line+U_0**: Line voltages U_{12} and U_{23} (terminals X1: 11-14) and neutral voltage U_0 (terminals X1:17-18)

4.3. Digital inputs

Further, the manager can collect status information and alarm signals via 32 digital inputs (terminals X3: 2-7, X7: 1-14 and X8: 1-20). The digital inputs can also be used to block protection stages under certain conditions. The six digital inputs in manager X3 use an internal 48 V dc auxiliary voltage of the manager (terminal X3: 1).

Potential-free contacts must be available in the protected object for transferring status information to the manager. In VAMP 257 the digital inputs 7-18 in terminal X7 and the digital inputs 21-32 in terminal X8 need an external control voltage. These inputs are ideal for transferring the status information of switching devices into the manager. Please note that it is possible to use different control voltages in the terminal X7 and X8 as there are many common inputs: the common input X7: 7 for inputs X7: 1-6, the common input X7: 14 for inputs X7: 7-13, the common input X8: 3 for the inputs X8: 21-22, the common input X8: 6 for the inputs X8: 23-24, the common input for X8: 9 for the inputs X8: 25-26, and the common input X8: 12 for the inputs X8: 27-28. For inputs X8: 29-32, it is possible to use different control voltages individually.

The digital input signals can also be used as blocking signals and control signals for the output relays.

4.4. Auxiliary voltage

The external auxiliary voltage Uaux (standard 40…265 V ac or dc) for the terminal is connected to the terminals X3: 17-18.

Note!

Polarity of the auxiliary voltage Uaux (24 V dc, option B):

- = X3: 17 and + = X3: 18.

4.5. Output relays

The terminal is equipped with thirteen configurable output relays, and a separate output relay for the self-supervision system.

- Trip relays T1 and T2 (terminals X3: 12-13 and 14-15)
- Trip relays T3 and T4 (terminals X7: 17-18 and 15-16)
- Trip relays T5, T6, T7 and T8 (terminals X8:19-20, 17-18, 15-16 and 13-14)
- Alarm relays A1 - A5 (terminals X3: 9-11, X2: 7-8, 5-6, 3-4, 1-2) *
- Self-supervision system output relay IF (terminals X2: 9-11)

*) Alarm relay 2-5 can also be used as trip relay

4.6. Serial communication connection

VAMP 257 can be equipped with two optional communication modules: Communication Module 1 and Communication Module 2. The physical location of the modules is at the back of the relay. The modules can be installed in the field (when power is first turned off).

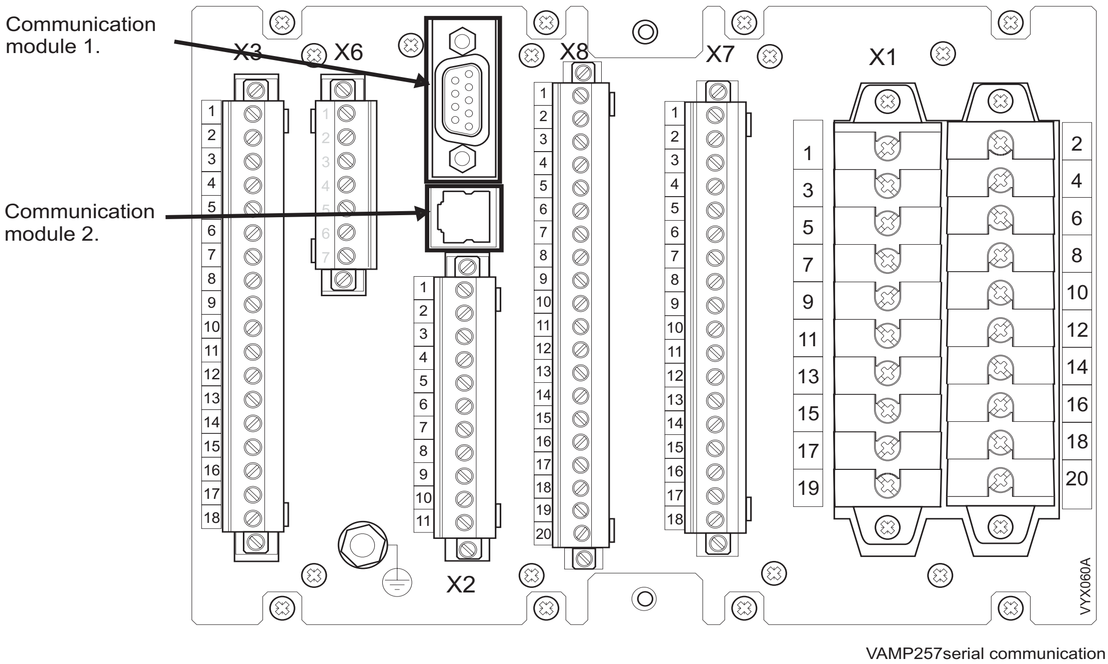


Figure 4.6-1 VAMP257 back panel serial communication connection

The internal connection in both communication modules is identical (see figure 2.) The transmit and receive lines of all the three “logical communication ports” REMOTE, LOCAL and EXTENSION port are available for both modules (RS-232 signal levels). Depending on the module type one or more of these ports are physically available at the external connector.

The communication modules convert the RS-232 signal levels to some other levels e.g. TTL, RS-485 or fibre-optics. The modules may also contain intelligence to make protocol conversion on software level.

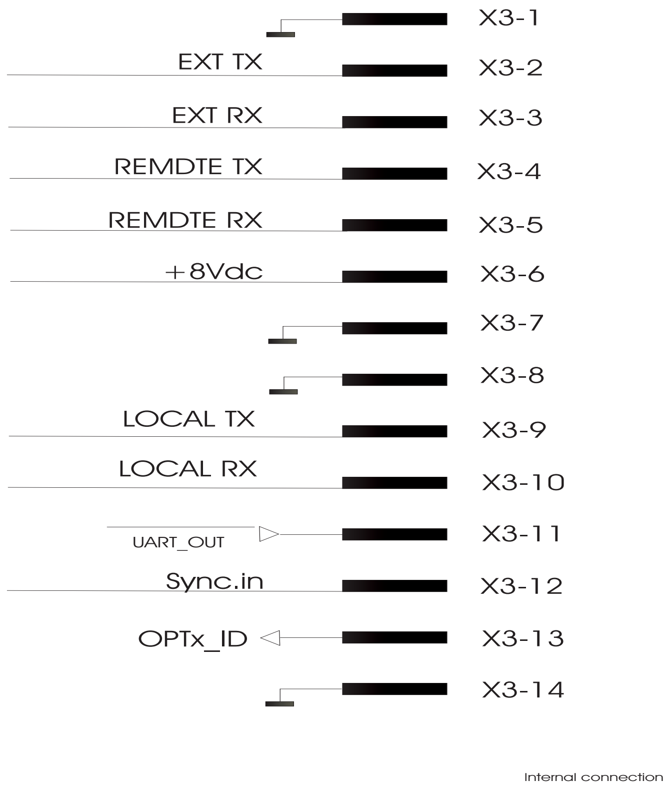


Figure 4.6-2 Internal connection to communication modules

The internal connection of the communication modules contain the RX/TX signals from the communication ports, general output (UART_OUT), clock sync/general input (Sync.in) and OPTx_ID for module detection.

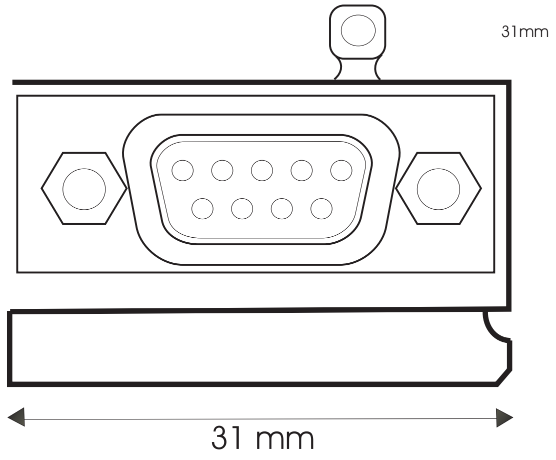


Figure 4.6-3 Communication module with a height of 31mm

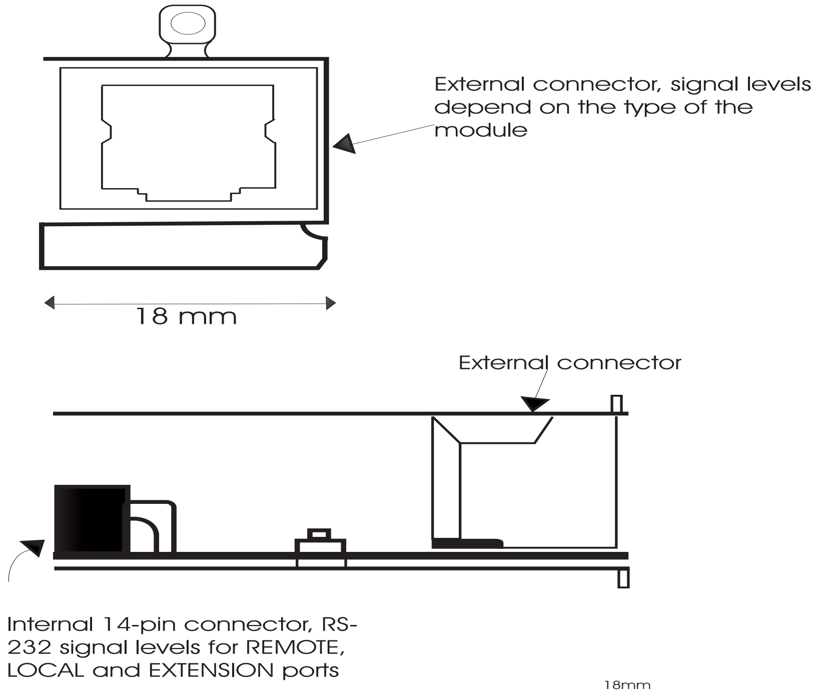


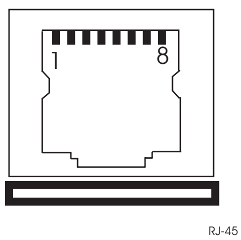
Figure 4.6-4 Communication module with a height of 18mm

The device has a 31mm high “slot” for Communication Module 1 and 18mm high “slot” for Communication Module 2. The option modules are either 31mm or 18mm high, the 18mm modules can be used either in the 31mm or 18mm slot.

4.6.1. Pin assignments of communication options

The communication module types and their pin assignments are introduced in the following table.

18mm high modules:

Type	Communication ports	Signal levels	Connector	Pin usage
VCM 232	REMOTE, LOCAL and EXTENSION	RS-232	RJ-45 connector 	1= LOC TX 2= EXT TX 3= +8V 4= GND 5= REM TX 6= REM RX 7= LOC RX 8= EXT RX
VCM TCP	REMOTE or LOCAL selectable with dip switch	Ethernet	RJ-45 connector	Standard Ethernet pin usage
VCM 485-2	REMOTE, LOCAL or EXTENSION port selectable with a switch	RS-485 (2-wire connection)	3-pole screw connector	1= - 2= + 3= GND

32mm high modules:

Type	Communication ports	Signal levels	Connector	Pin usage
VCM TTL	REMOTE LOCAL EXTENSION	REMOTE: TTL or RS-232 selectable with dip switch LOCAL: RS-232 EXTENSION: RS-232	D-connector	1= EXT TX 2= REM TX 3= REM RX 4= SYNC IN 5= LOC TX 6= LOC RX 7= GND 8= EXT RX 9= +8V
VCM 485-4	REMOTE, LOCAL or EXTENSION port selectable with a switch	RS-485 (2- or 4-wire connection)	5- pole screw connector	1= GND 2= R- 3= R+ 4= T- 5= T+
VCM fiber PP	REMOTE	Light, switch for echo/ no-echo and light/ no-light selection	Snap-in connector	
VCM fiber GG	REMOTE	Light, switch for echo/ no-echo and light/ no-light selection	ST connector	
VCM fiber PG	REMOTE	Light, switch for echo/ no-echo and light/ no-light selection	Snap-in & ST connectors	
VCM fiber GP	REMOTE	Light, switch for echo/ no-echo and light/ no-light selection	ST & Snap-in connectors	

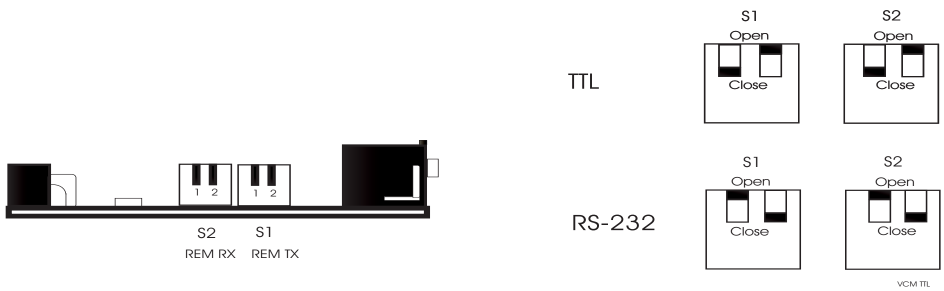


Figure 4.6.1-1 VCM TTL– module's dip-switches

Note!

Profibus will be supported by the external VPA 3CG module. This is connected with a VX007-F3 cable to VCM TTL module.

4.6.2. Pin assignment of the front communication port

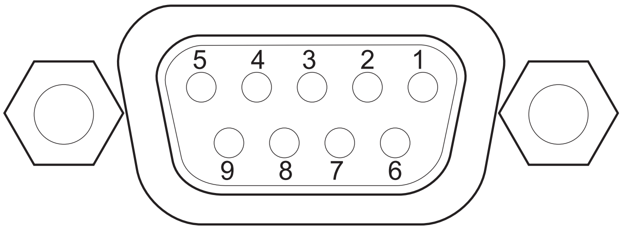


Figure 4.6.2-1. Pin numbering of the front communication port

Port (LOCAL)	Pin	Signal	Description
Front	1		
Front	2	RX /RS-232 in	
Front	3	TX /RS-232 out	
Front	4	DTR / +8Vout	
Front	5	GND	
Front	6	DSR / in	
Front	7		
Front	8		
Front	9		

Note!

DSR must be connected to DTR to activate the front panel interface.

4.6.3. Protocols

SPA-Bus

The manager has full support for the SPA-Bus protocol including the following features:

- event transfer
- time synchronization
- the transfer of status data
- the transfer of measurement data
- the reception of control commands
- the reading and writing of setting values
- the reading of multiple consecutive status data bits, measurement values or setting values with one message.

The physical connection from a manager is by default 9-pin D-connector with TTL level signals. This can only be used to connect to an external bus connection device or to a modem. Alternatively, RS-232 can be selected with a dip switch.

The manager can be equipped with a fibre optic option module, which includes fibre optic connectors (two plastic/two glass/one plastic and one glass).

ModBus RTU

The manager is also available with ModBus RTU slave or Modbus RTU master. These are often used in power plants or in industrial applications. The protocols enable the transfer of the following data:

- events
- statuses
- measurements and
- control commands.

The ModBus communication is activated via a menu selection. The Modbus RTU protocols can be used with RS-232, RS-485 or the fibre optic interface.

ModbusTCP

The manager is also available with the ModbusTCP protocol. This is often used in power plants or in industrial applications. The protocol enables the transfer of the same data as with the Modbus RTU slave protocol.

The ModbusTCP communication is activated via a menu selection. The use of ModbusTCP requires an optional Ethernet module (VCM TCP)

Profibus

The manager is also available with Profibus (Profibus DP slave) protocol. This is often used in power plants and in industrial applications. The protocols enable the transfer of the following data:

- events
- statuses
- measurements and
- control commands.

The Profibus communication is activated via a menu selection. An external VPA 36G Profibus module is required.

IEC 60870-5-103

The IEC standard 60870-5-103 “Companion standard for the informative interface of protection equipment” provides standardized communication interface to a primary system (master system).

The unbalanced transmission mode of the protocol is used, and the feeder manager functions as a secondary station (slave) in the communication. Data is transferred to the primary system using "data acquisition by polling"-principle. The IEC functionality includes the following application functions:

- station initialization
- general interrogation
- clock synchronization and
- command transmission.

It is not possible to transfer parameter data or disturbance recordings via the IEC 103 protocol interface.

The following ASDU (Application Service Data Unit) types will be used in communication from the feeder manager:

- ASDU 1: time tagged message
- ASDU 3: Measurands I
- ASDU 5: Identification message
- ASDU 6: Time synchronization and
- ASDU 8: Termination of general interrogation.

The feeder manager will accept:

- ASDU 6: Time synchronization
- ASDU 7: Initiation of general interrogation and
- ASDU 20: General command.

The data in a message frame is identified by:

- type identification
- function type and
- information number.

These are fixed for data items in the compatible range of the protocol, for example, the trip of I> function is identified by: type identification = 1, function type = 160 and information number = 90. "Private range" function types are used for such data items, which are not defined by the standard (e.g. the status of the digital inputs and the control of the objects).

The function type and information number used in private range messages is configurable. This enables flexible interfacing to different master systems.

DNP 3.0

The feeder and motor manager supports communication using DNP3 protocol.

The following DNP3 data types are supported:

- binary input
- binary input change
- double-bit input

- binary output
- analog input
- counters

Additional information can be obtained from the DNP3 Device Profile Document for VAMP 257.

DNP3 communication is activated via menu selection. RS-485 interface is often used but also RS-232 and fibre optic interfaces are possible.

4.7. Arc protection (option)

The optional arc protection card includes two arc sensor channels. The arc sensors are connected to terminals X6: 4-5 and 6-7.

The arc information can be transmitted and/or received through digital input and output channels. This is a 48 V dc signal.

Connections:

- X6: 1 Binary input (BI)
- X6: 2 Binary output (BO)
- X6: 3 GND
- X6: 4-5 Sensor 1
- X6: 6-7 Sensor 2

The GND must be connected together between the GND of the connected devices.

The binary output of the arc option card may be activated by one or both of the connected arc sensors, or by the binary input. The connection between the inputs and the output is selectable via the output matrix of the device. The binary output can be connected to an arc binary input of another VAMP protection relay or manager.

4.8. DI19/DI20 (option)

The DI19/DI20 option enables two more digital inputs. These inputs are very useful in applications where both positive and negative terminals are needed. For example, change of directional earth fault characteristic in the compensated networks. The inputs are connected to terminals X6:1 – X6:2 and X6:3 – X6:4.

NOTE!

With DI19/DI20 option only one arc sensor channel can be activated.
Both of the digital inputs must have their own common.

Connections:

- X6: 1 DI19+
- X6: 2 DI19-
- X6: 3 DI20+
- X6: 4 DI20-
- X6: 5 NC
- X6: 6 L+
- X6: 7 L-

4.9. External option modules

4.9.1. External LED module VAM 16D

The external VAM 16D led module provides 16 extra led-indicators in external casing. Module is connected to the serial port of the relays front panel. Please refer the User manual VAM 16 D, VM16D.Enxxx for details.

4.9.2. External input / output module

The feeder and motor manager supports now also external input / output modules used to extend the number of digital inputs and outputs. Another modules have analogue inputs and outputs. Please refer your sales contact in order to get more information.

4.10. Block diagrams

4.10.1. Feeder manager VAMP 257

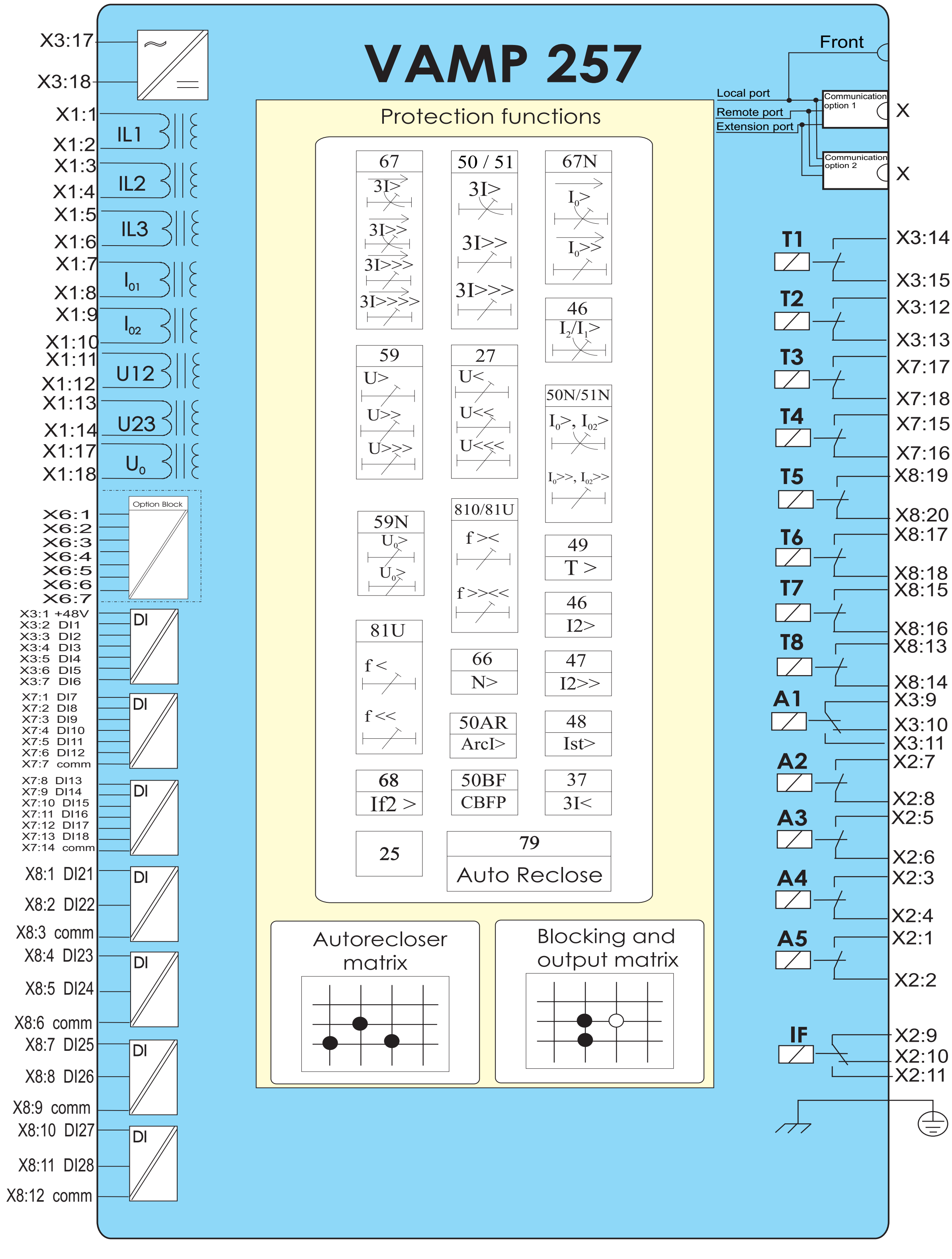


Figure 4.10.1-1. Block diagram of the feeder manager VAMP 257

4.11. Block diagrams of option modules

4.11.1. Optional arc protection

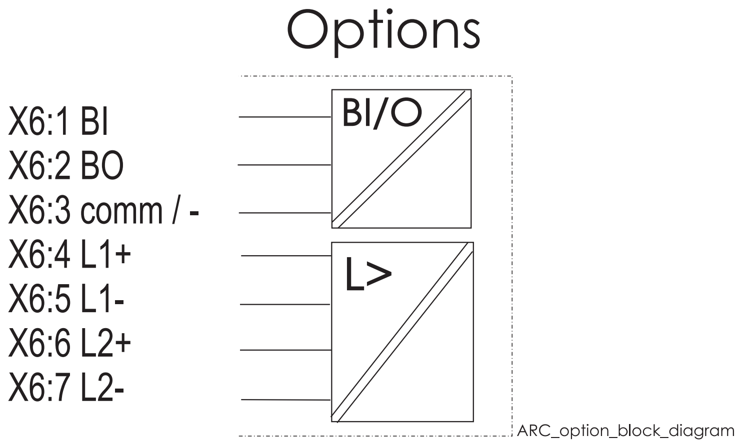


Figure 4.11.1-1. Block diagram of optional arc protection module.

4.11.2. Optional DI19/DI20

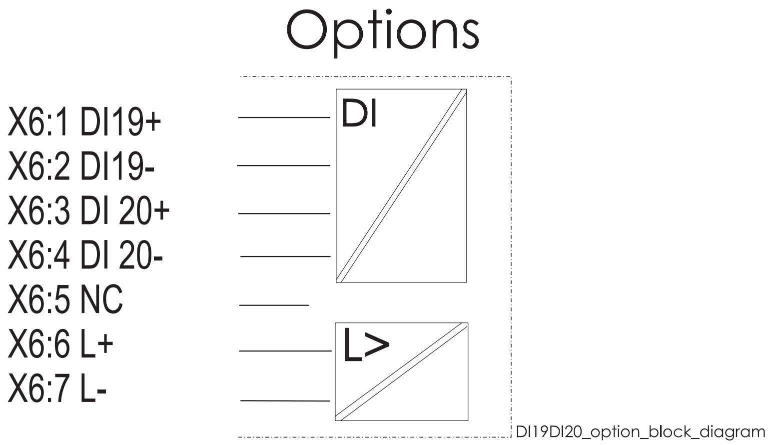


Figure 4.11.2-1. Block diagram of optional DI19/DI20 module with one arc channel.

4.12. Connection examples

4.12.1. Feeder manager VAMP 257

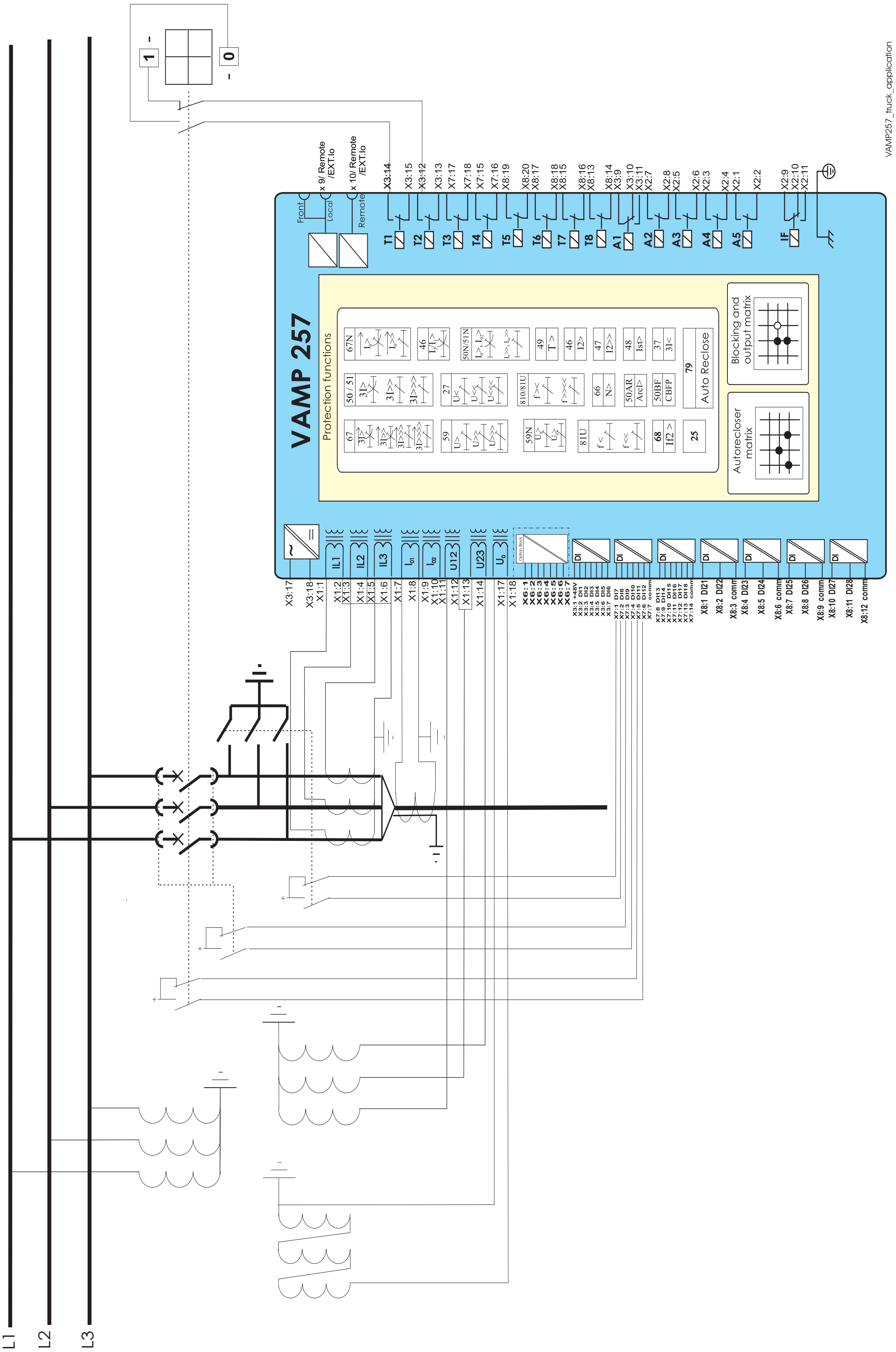


Figure 4.12-1. Connection example of feeder manager VAMP 257

4.12.2. Feeder manager VAMP 257 in a double busbar application

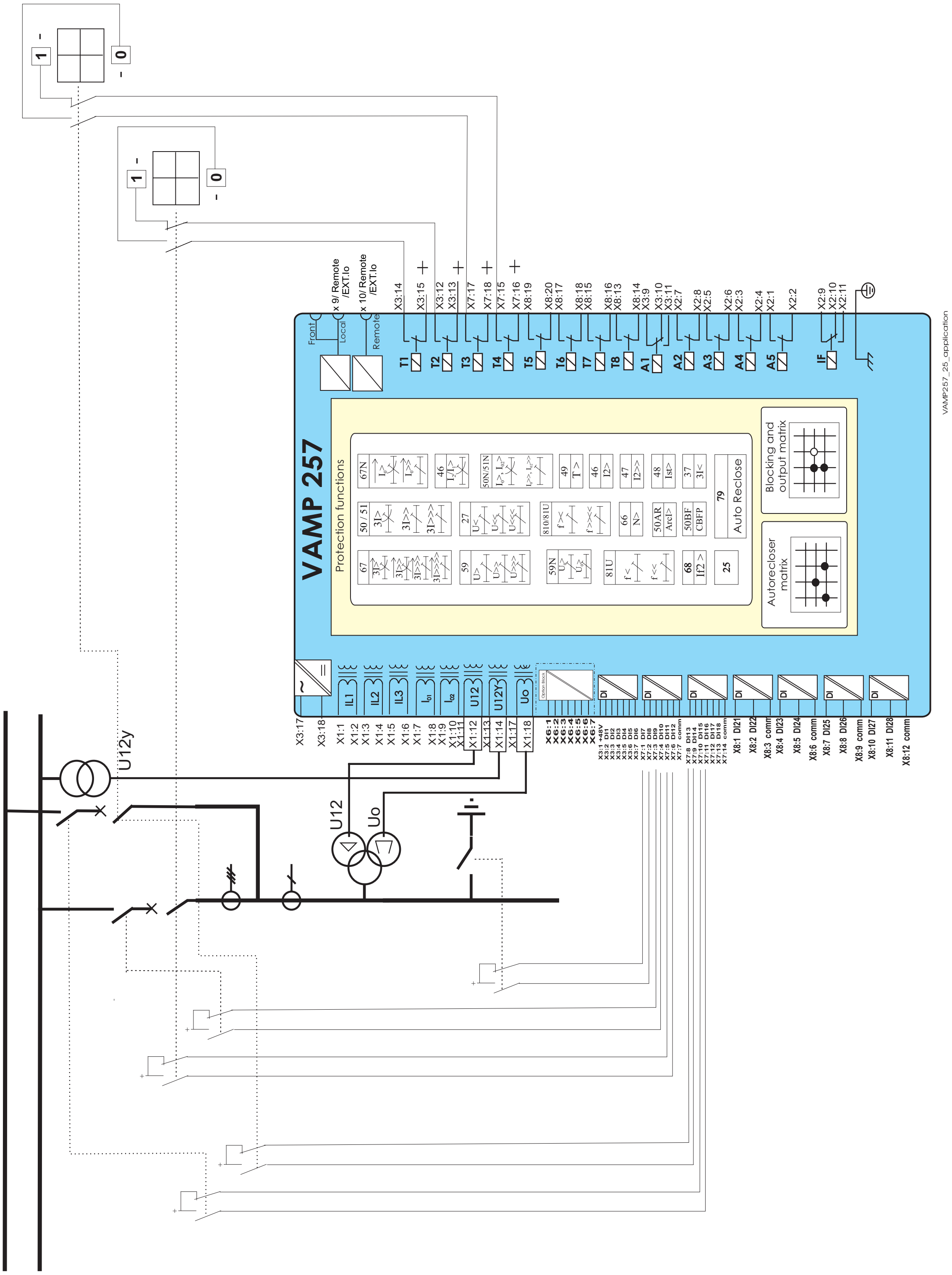


Figure 4.12.2-1 Connection example of feeder manager VAMP 257 in a double busbar application

4.12.3. Feeder manager VAMP 257 as a motor protection manager

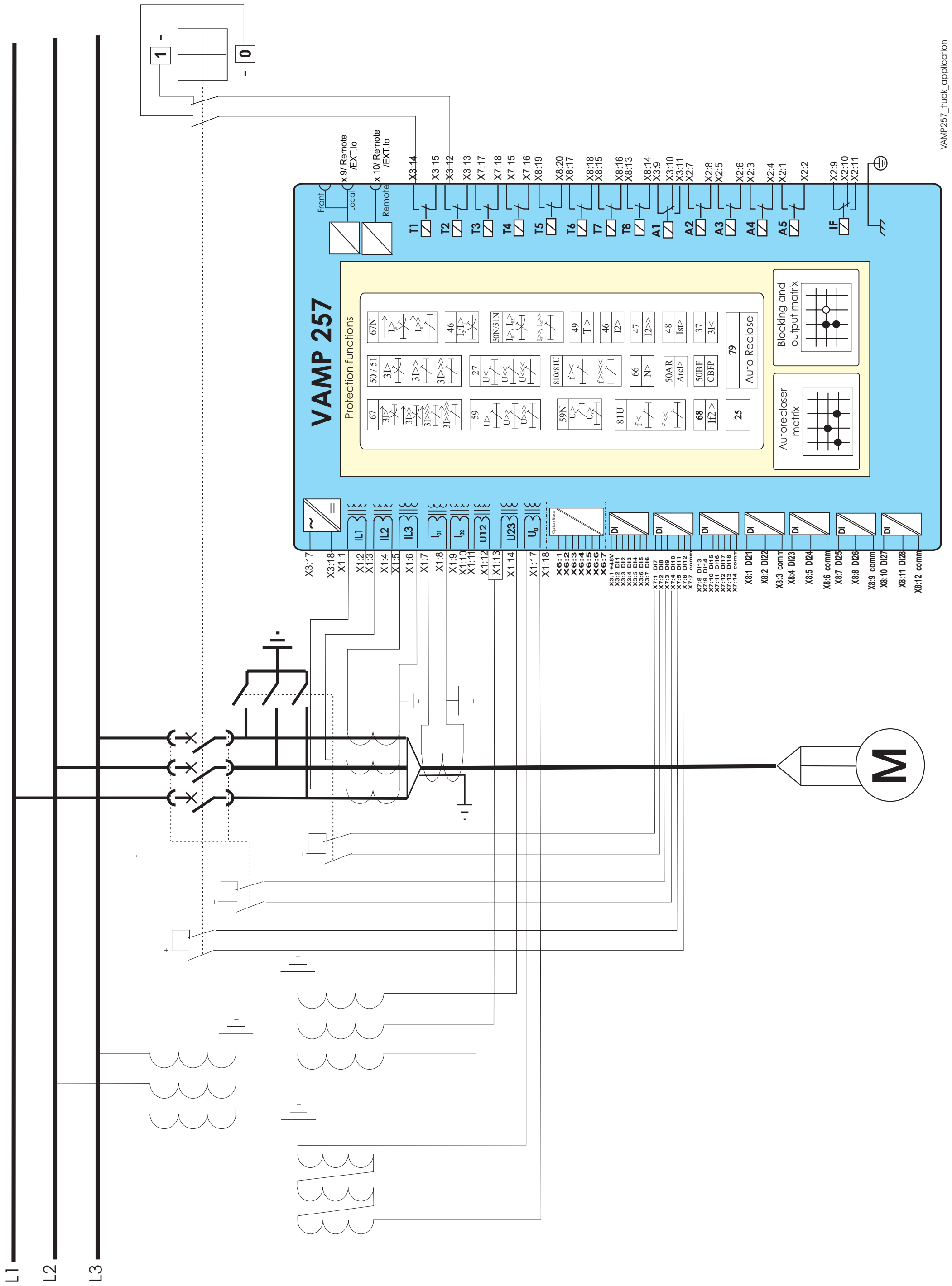


Figure 4.12.3-1. Connection example of feeder manager as a motor protection manager

5. Technical data

5.1. Connections

5.1.1. Measuring circuitry

Rated current In	1…10 A (software parameter)
- Current measuring range	0…250 A (0…50 x In [In=5 A]; 0…250 x In [In=1 A])
- Thermal withstand	20 A (continuously) 100 A (for 10 s) 500 A (for 1 s)
- Burden	< 0.2 VA
Rated current Ion - Current measuring range	1 A 0…10 A (0…10 x Ion)
Rated current Io2n - Current measuring range	5 A 0…50 A (0…10 x Io2n)
Rated voltage Un - Voltage measuring range - Continuous voltage withstand - Burden	50 – 120 V (configurable) 0 – 175 V (100 V/110 V) 250 V < 0.5V A
Rated frequency fn - Frequency measuring range	50 / 60 Hz (45 – 65 Hz) 16 – 75 Hz
Terminal block: - Solid or stranded wire	Maximum wire dimension: 4 mm² (10-12 AWG)

5.1.2. Auxiliary voltage

	Type A (standard)	Type B (option)
Rated voltage Uaux	40 – 265 V ac/dc 110/120/220/240 V ac 48/60/110/125/220 V dc	18…36 V dc 24 V dc
Power consumption	< 7 W (normal conditions) < 15 W (output relays activated)	
Max. permitted interruption time	< 50 ms (110 V dc)	
Terminal block: - Phoenix MVSTBW or equivalent	Maximum wire dimension: 2.5 mm² (13-14 AWG)	

5.1.3. Digital inputs

Internal operating voltage

Number of inputs	6
Internal operating voltage	48 V dc
Current drain when active (max.)	approx. 20 mA
Current drain, average value	< 1 mA
Terminal block: - Phoenix MVSTBW or equivalent	Maximum wire dimension: 2.5 mm² (13-14 AWG)

External operating voltage

Number of inputs	24
external operating voltage	18 V…265 Vdc
Current drain	approx. 2 mA
Terminal block: - Phoenix MVSTBW or equivalent	Maximum wire dimension: 2.5 mm² (13-14 AWG)

5.1.4. Trip contacts

Number of contacts	8 making contacts (relays T1, T2, T3, T4, T5, T6, T7 and T8)
Rated voltage	250 V ac/dc
Continuous carry	5 A
Make and carry, 0.5 s Make and carry, 3s	30 A 15 A
Breaking capacity, DC (L/R=40ms) at 48 VDC: at 110 VDC: at 220 VDC	 5 A 3 A 1 A
Contact material	AgNi 90/10
Terminal block: - Phoenix MVSTBW or equivalent	Maximum wire dimension: 2.5 mm² (13-14 AWG)

5.1.5. Alarm contacts

Number of contacts:	1 change-over contacts (relays A1) 4 making contacts (relays A2, A3, A4 and A5) 1 change-over contact (IF relay)	
Rated voltage	250 V ac/dc	
Continuous carry	5 A	
Breaking capacity, DC (L/R=40ms) at 48 VDC: at 110 VDC: at 220 VDC	A1, IF 1,3 A 0,4 A 0,2 A	A2, A3, A4, A5 2,6 A 0,8 A 0,4 A
Contact material	AgNi 0.15 gold plated	AgNi 90 / 10
Terminal block - Phoenix MVSTBW or equivalent	Maximum wire dimension 2.5 mm² (13-14 AWG)	

5.1.6. Local serial communication port

Number of ports	1 on front and 1 on rear panel
Electrical connection	RS 232
Data transfer rate	2 400 – 38 400 kb/s

5.1.7. Remote control connection

Number of ports	1 on rear panel
Electrical connection	TTL (standard) with VCM TTL RS 485 (option) with VCM 485 – 4 RS 232 (standard) with VCM TTL Plastic fibre connection (option) with VCM fiber Glass fibre connection (option) with VCM fiber Ethernet 10 Base-T (option) with VCM TCP
Data transfer rate	1 200 – 19 200 kb/s
Protocols	ModBus, RTU master ModBus' RTU slave SpaBus, slave IEC 60870-5-103 ProfiBus DP (option, with external module) ModBus TCP (option, with VCM TCP) DNP 3.0

5.1.8. Arc protection interface (option)

Number of arc sensor inputs Sensor type to be connected Operating voltage level Current drain, when active Current drain range	2 VA 1 DA 12 VDC > 11.9 mA 1.3…31 mA (Note! If the drain is outside the range, either sensor or the wiring is defected)
Number of binary inputs Operating voltage level	1 (optically isolated) +48 VDC
Number of binary outputs Operating voltage level	1 (transistor controlled) +48 VDC
Note! Maximally three arc binary inputs can be connected to one arc binary output without an external amplifier.	

5.2. Tests and environmental conditions

5.2.1. Disturbance tests

Emission (EN 50081-1) - Conducted (EN 55022B) - Emitted (CISPR 11)	 0.15 - 30 MHz 30 - 1 000 MHz
Immunity (EN 50082-2) - Static discharge (ESD) - Fast transients (EFT) - Surge - Conducted HF field - Emitted HF field - GSM test	 EN 61000-4-2, class III 6 kV contact discharge 8 kV air discharge EN 61000-4-4, class III 2 kV, 5/50 ns, 5 kHz, +/- EN 61000-4-5, class III 2 kV, 1.2/50 µs, common mode 1 kV, 1.2/50 µs, differential mode EN 61000-4-6 0.15 - 80 MHz, 10 V/m EN 61000-4-3 80 - 1000 MHz, 10 V/m ENV 50204 900 MHz, 10 V/m, pulse modulated

5.2.2. Test voltages

Insulation test voltage (IEC 60255-5) Class III	2 kV, 50 Hz, 1 min
Surge voltage (IEC 60255-5) Class III	5 kV, 1.2/50 µs, 0.5 J

5.2.3. Mechanical tests

Vibration (IEC 60255-21-1) Class I	10...60 Hz, amplitude ±0.035 mm 60...150 Hz, acceleration 0.5g sweep rate 1 octave/min 20 periods in X-, Y- and Z axis direction
Shock (IEC 60255-21-1) Class I	half sine, acceleration 5 g, duration 11 ms 3 shocks in X-, Y- and Z axis direction

5.2.4. Environmental conditions

Operating temperature	0 to +55 °C
Transport and storage temperature	-40 to +70 °C
Relative humidity	< 75% (1 year, average value) < 90% (30 days per year, no condensation permitted)

5.2.5. Casing

Degree of protection (IEC 60529)	IP20
Dimensions (W x H x D)	208 x 155 x 225 mm
Material	1 mm steel plate
Weight	4.2 kg

Colour code	RAL 7032 (Casing) / RAL 7035 (Back plate)

5.2.6. Package

Dimensions (W x H x D)	215 * 160 * 275
Weight (Terminal, Package and Manual)	5.2 kg

5.3. Protection stages

NOTE!

Please see chapter 2.2.2 for explanation of I_{mode}.

5.3.1. Non-directional current protection

Overcurrent stage I> (50/51)

Start current	0.10 – 5.00 x I_{mode}
Definite time function: - Operating time	DT 0.08**) – 300.00 s (step 0.02 s)
IDMT function: - 4 curve groups (IEC 60255-3) - Time multiplier k	 EI, VI, NI, LTI *) 0.05 - 3.20
Start time Reset time Reset ratio	60 ms <80 ms 0.97
Inaccuracy: - Starting - Operating time at definite time function - Operating time at IDMT function	 ±2% of the set value ±1% or ±30 ms ±5% or at least ±30 ms (I< 50 x I_{mode})

*) EI = Extremely Inverse, NI = Normal Inverse, VI = Very Inverse, LTI = Long Time Inverse

**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Overcurrent stages I>> and I>>> (50/51)

Start current	0.10 – 20.00 x I_n (I>>) 0.10 – 40.00 x I_n (I>>>)
Definite time function: - Operating time	 0.04**) – 300.00 s (step 0.01 s)
Start time Reset time Reset ratio	60 ms <80 ms 0.97
Inaccuracy: - Starting - Operation time	 ±2% of the set value ±1% or ±25 ms

**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Stall protection stage (48)

Setting range: - Ist> - I_{MOT}St Definite time characteristic: - operating time Inverse time characteristic: - 1 characteristic curve	 1.30 – 10.00 xI_{MOT} (step 0.01) 1.50 – 10.00 xI_{MOT} (step 0.01) 1.0 – 300.0 s (step 0.1) Inv

- Time multiplier tDT> Starting time Resetting time Resetting ratio Accuracy: - operating time	1.0 – 200.0 s (step 0.1) 60 ms 80 ms 0.90 ±5% or at ±80 ms

Thermal overload stage T> (49)

Setting range:	0.5 – 1.20 xI_{MOT} (step 0.01)
Alarm setting range:	60 – 99 % (step 1%)
Time constant Tau:	2 – 60 min (step 1)
Cooling time coefficient:	1.0 – 5.0 xTau (step 0.1)
Max. overload at +40 °C	70 – 120 %I_{MOT} (step 1)
Max. overload at +70 °C	50 – 100 %I_{MOT} (step 1)
Ambient temperature	-55 – 125 °C (step 1°)
Resetting ratio	0.95
Accuracy:	
- operating time	±5% or ±1 s

Unbalance stage I2> (46)

Setting range:	10 – 70% (step 1%)
Definite time characteristic:	
- operating time	1.0 – 600.0s s (step 0.1)
Inverse time characteristic:	
- 1 characteristic curve	Inv
- time multiplier	1 – 50 s (step 1)
Start time	<300 ms
Reset time	<300 ms
Reset ratio	0.95
Inaccuracy:	
- Starting	±3% of the set value or 0.5% of the rated value
- Operate time	±5% or ±300 ms

Incorrect phase sequence I2>> (46)

Setting:	80 % (fixed)
Operating time	<120 ms

Undercurrent protection stage I< (37)

Current setting range:	20 – 70 %I_{mode} (step 1%)
Definite time characteristic:	
- operating time	0.3 – 300.0s s (step 0.1)
Block limit:	15 % (fixed)
Starting time	<300 ms
Resetting time	<300 ms
Resetting ratio	1.05
Accuracy:	
- starting	±2% of set value
- operating time	±1% or ±200 ms

Unbalance / broken connector protection I_2/I_1> (46)

Settings: - Setting range I_2/I_1>	 2 – 70 %
Definite time function: - Operating time	 1.0 – 600.0 s (step 0.1 s)
Start time Reset time Reset ratio	<300 ms <300 ms 0.95
Inaccuracy:	

- Starting - Operate time	±3% of the set value or 0.5% of the rated value ±5% or ±300 ms

Earth fault stage I_0> (50N/51N)

Setting range I_0>	0.005 – 8.000 xIon
Definite time function: - Operating time	DT 0.08**) – 300.00 s (step 0.02 s)
IDMT function: - 4 curve groups (IEC 60255-3) - Time multiplier k	 EI, VI, NI, LTI *) 0.05 - 3.20
Start time Reset time Reset ratio	60 ms 80 ms 0.95
Inaccuracy: - Starting - Operating time at definite time function - Operating time at IDMT function.	 ±2% of the set value or ±0.3% of the rated value ±1% or ±30 ms ±5% or at least ±30 ms (I_0 < 5 x I_{0n})

**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Earth fault stages I_0>>, I_{02}>, I_{02}>> (50N/51N)

Setting range I_0>>	0.01 - 8.00 x Ion 0.005 - 8.00 x Io2n (Io2>) 0.01 - 8.00 x Io2n (Io2>>)
Definite time function: - Operating time	 0.08**) – 300.00 s (step 0.02 s)
Start time Reset time Reset ratio	60 ms 80 ms 0.95
Inaccuracy: - Starting - Operate time	 ±2% of the set value or ±0.3% of the rated value ±1% or ±30 ms

**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

5.3.2. Directional current protection

Directional overcurrent stages I_{dir}> and I_{dir}>> (67)

Start current	0.10 - 4.00 x I_{mode}
Mode	Directional/non-directional
Minimum voltage for the direction solving	2 V
Base angle setting range	-180° to + 179°
Operation angle	±88°
Definite time function: - Operating time	DT 0.06***) – 300.00 s (step 0.02 s)
IDMT function: - 4 curve groups (IEC 60255-3) - Time multiplier T_p	 EI, VI, NI, LTI **) 0.05 - 3.20
Start time Reset time Reset ratio	60 ms 80 ms 0.95
Inaccuracy: - Starting (rated value IN= 1 – 5A)	 ±3% of the set value or ±0.5% of the rated value

- Angle - Operate time at definite time function - Operate time at IDMT function	±2° ±1% or ±30 ms ±5% or at least ±30 ms (I< 50 x I_n)

**) EI = Extremely Inverse, NI = Normal Inverse, VI = Very Inverse, LTI = Long Time Inverse
***) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Limitations:

The maximum measured current is 50 x I_{mode}. This limits the scope of inverse curves when the setting is more than 2.5 x I_{mode}. For example, at setting 4 x I_{mode} the maximum setting relative current is 12.5 x I_{set}/I_{mode} although the curves are defined up to 20 x I_{set}/I_n.

The fastest possible operating time is about 60 ms at inverse time characteristic according to curve types VI and EI.

Directional overcurrent stages I_{dir}>>> and I_{dir}>>>> (67)

Start current	0.10 – 20.0 x I_{mode}
Mode	Directional/non-directional
Minimum voltage for the direction solving	0.01 pu
Base angle setting range	-180° to + 179°
Operation angle	±88°
Definite time function: - Operating time	DT 0.06**) – 300.00 s (step 0.02 s)
Start time Reset time Reset ratio	60 ms 80 ms 0.95
Inaccuracy: - Starting (rated value IN= 1 .. 5A) - Angle - Operate time at definite time function	 ±3% of the set value or ±0.5% of the rated value ±2° ±1% or ±30 ms

**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Directional earth fault stages $I_{0\varphi}$>, $I_{0\varphi}$>> (67N)

Start current	0.01 - 4.00 x Ion
Start voltage	1 – 20 %Uon
Mode	Non-directional/Sector/ResCap
Base angle setting range	-180° to + 179°
Operation angle	±88°
Definite time function: - Operating time	 0.10**) – 300.00 s (step 0.02 s)
IDMT function: - 4 curve groups (IEC 60255-3) - Time multiplier T_p	 EI, VI, NI, LTI *) 0.05 - 3.20
Start time Reset time Reset ratio	60 ms 80 ms 0.95
Inaccuracy: - Starting (rated value IN= 1 .. 5A) - Angle - Operate time at definite time function - Operate time at IDMT function	 ±3% of the set value or ±0.5% of the rated value ±2° ±1% or ±30 ms ±5% or at least ±30 ms (I< 50 x I_n)

*) EI = Extremely Inverse, NI = Normal Inverse, VI = Very Inverse, LTI = Long Time Inverse
**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Limitations:

The maximum measured current is 5 x I_{mode}.

The fastest possible operating time is about 100 ms at inverse time characteristic according to curve types VI and EI.

5.3.3. Frequent start protection

Frequent start protection N> (66)

Settings:	
- Max motor starts	1 – 20
- Min time between motor starts	0.0 – 100 min. (step 0.1 min)

5.3.4. Auto-reclose function

AR function (79)

Settings:	
- Reclaim time	0.02 – 300.00 s (step 0.01 s)
- CB pulse length	0.02 – 10.00 s (step 0.01 s)
- CB ready timeout	0.02 – 30.00 s (step 0.01 s)
- DI to get open information	Any digital input
- DI to get close information	Any digital input
- DI to get ready information	Any digital input
- DI to block reclose function	Any digital input
- DI to inhibit reclose function	Any digital input
AR shot settings (shot1 - shot5):	
- Deadtime	0.02 – 300.00 s (step 0.01 s)
- Discrimination time	0.02 – 300.00 s (step 0.01 s)
- Start delay (start1 - start4)	0.02 – 300.00 s (step 0.01 s)

5.3.5. Voltage protection

Overvoltage stages U>, U>> and U>>> (59)

Overvoltage setting range:	50 - 150 %Un (U>)
	50 - 160 %Un (U>>, U>>>)
Definite time characteristic:	
- operating time	0.08**) - 300.00 s (step 0.02) (U>, U>>)
	0.06**) - 300.00 s (step 0.02) (U>>>)
Release delay	0.06 - 300.00 s (step 0.02) (U>)
Hysteresis	0.1 - 20.0% (step 0.1%) (U>)
Starting time	60 ms
Resetting time	80 ms
Resetting ratio	0.97 (depends on the hysteresis setting)
Inaccuracy:	
- starting	±3% of the set value
- operate time	±1% or ±30 ms

**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Undervoltage stages U<, U<< and U<<< (27)

Undervoltage setting range	20 - 120 %Un
Definite time characteristic:	
- operating time	0.08**) - 300.00 s (step 0.02) (U<)
	0.06**) - 300.00 s (step 0.02) (U<<, U<<<)
Release delay	0.06 - 300.00 s (step 0.02) (U<)
Hysteresis	0.1 - 20.0% (step 0.1%) (U<)

Self-blocking value of the undervoltage Starting time Resetting time Resetting ratio Inaccuracy: - starting - operate time	0 - 80 %Un 60 ms 80 ms 1.03 (depends on the hysteresis setting) ±3% of the set value ±1% or ±30 ms

**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Residual voltage stages U_0> and U_0>> (59N)

Residual voltage setting range	10 – 60 %Uon
Definite time function: - Operating time	 0.3 – 300.0 s (step 0.1 s)
Start time Reset time Reset ratio	<300 ms <300 ms 0.97
Inaccuracy: - Starting - Operate time	 ±2% of the set value or ±0.3% of the rated value ±1% or ±150 ms

5.3.6. Frequency protection

Configurable frequency stages f>< and f>><<

Frequency measuring range Definite time function: -operating time Starting time Reset time Reset ratio (f> and f>>) Reset ratio (f< and f<<) Inaccuracy: - starting - operating time	46.0 - 70.0 Hz 0.10*) – 300.0 s (step 0.02 s) 80 ms 100 ms 0.998 1.002 ±20 mHz ±1% or ±30 ms

**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Underfrequency stages f< and f<<

Underfrequency measuring range Definite time function: -operating time Undervoltage blocking Starting time Reset time Reset ratio Inaccuracy: - starting - operating time	40.0 - 64.0 Hz 0.10**) - 300.0 s (step 0.02 s) 2 – 100 % 80 ms 100 ms 1.002 ±20 mHz ±1% or ±30 ms

*) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

5.3.7. Second harmonic function

2. Harmonic stage / Inrush (68)

Settings: - Setting range 2.Harmonic	 10 – 100 %

- Operating time	0.05* – 300.00 s (step 0.01 s)

*) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

5.3.8. Synchrocheck function

Sync mode	Off; ASync; Sync;
Voltage check mode	DD;DL;LD;DD/DL;DD/LD;DL/LD;DD/DL/LD
CB closing time	0.04 – 0.6 s
Udead limit setting	10 – 120 % Un
Ulive limit setting	10 – 120 % Un
Frequency difference	0.01 – 1.00 Hz
Voltage difference	1 – 60 % Un
Phase angle difference	2 – 90 deg
Request timeout	0.1 – 600.0 s
Frequency measuring range	46.0 - 70.0 Hz
Reset ratio (U)	0.97
Inaccuracy:	
- voltage	±3 % Un
- frequency	±20 mHz
- phase angle	±2 deg
- operating time	±1% or ±30 ms

5.3.9. Circuit-breaker failure protection

Circuit-breaker failure protection CBFP (50BF)

Relay to be supervised	T1, T2, T3, T4, T5, T6, T7 and T8
Definite time function - Operating time	 0.1* – 10.0 s (step 0.1 s)
Inaccuracy - Operating time	 ±100 ms

*) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

5.3.10. Arc fault protection stages (option)

The operation of the arc protection depends on the setting value of the ArcI>, $ArcI_0$> and $ArcI_{02}$> current limits. The arc current limits cannot be set, unless the manager is provided with the optional arc protection card.

Arc protection stage ArcI> (50AR), option

Setting range	0.5 - 10.0 x In
Arc sensor connection	S1, S2, S1/S2, BI, S1/BI, S2/BI, S1/S2/BI
Operating time	~15 ms

Arc protection stage $ArcI_0$> (50AR), option

Setting range	0.05 – 1.00 x Ion
Arc sensor connection	S1, S2, S1/S2, BI, S1/BI, S2/BI, S1/S2/BI
Operating time	~15 ms

Arc protection stage $ArcI_{02}$> (50AR), option

Setting range	0.05 – 1.00 x Io2n
Arc sensor connection	S1, S2, S1/S2, BI, S1/BI, S2/BI, S1/S2/BI
Operating time	~15 ms

5.3.11. Disturbance recorder (DR)

The operation of disturbance recorder depends on the following settings. The recording time and the number of records depend on the time setting and the number of selected channels.

Disturbance recorder (DR)

Mode of recording:	Saturated / Overflow
Sample rate: - Waveform recording - Trend curve recording	 32/cycle, 16/cycle, 8/cycle 10, 20, 200 ms 1, 5, 10, 15, 30 s 1 min
Recording time (one record)	0.1 s – 12 000 min (must be shorter than MAX time)
Pre-trigger rate	0 – 100%
Number of selected channels	0 – 12

6. Construction

6.1. Dimensional drawing

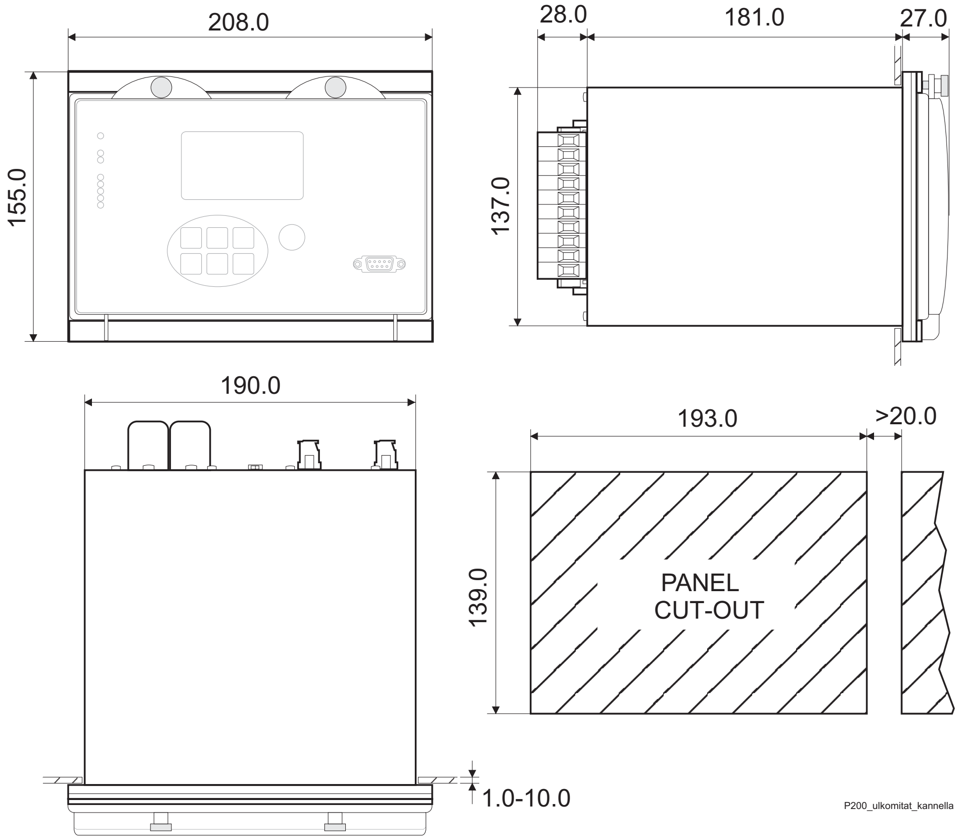


Figure 6.1-1. Dimensional drawing and panel cut-out dimensions

6.2. Panel mounting

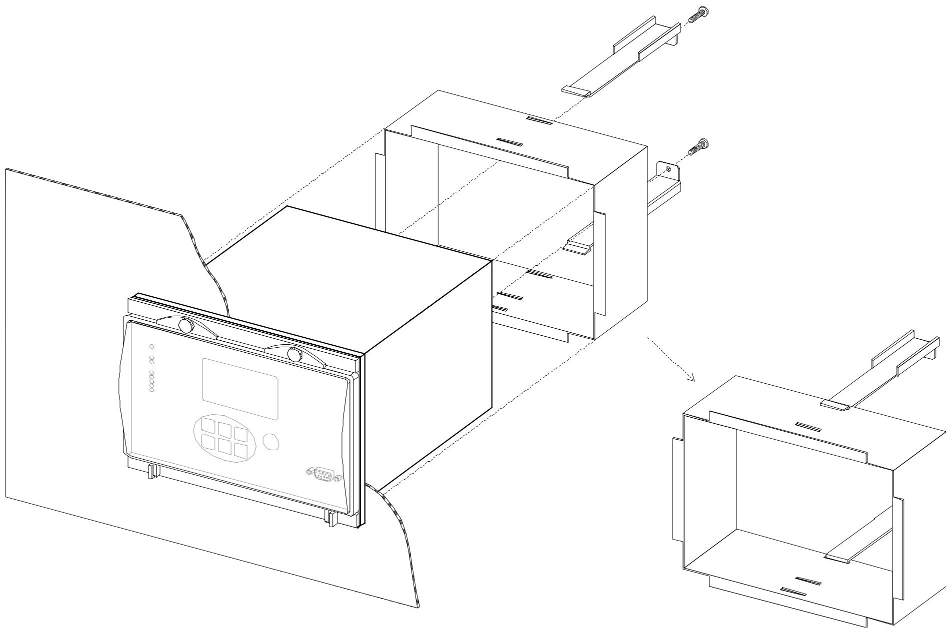


Figure 6.2-1. Flush-mounting of feeder manager in panel

6.3. Semi-flush mounting

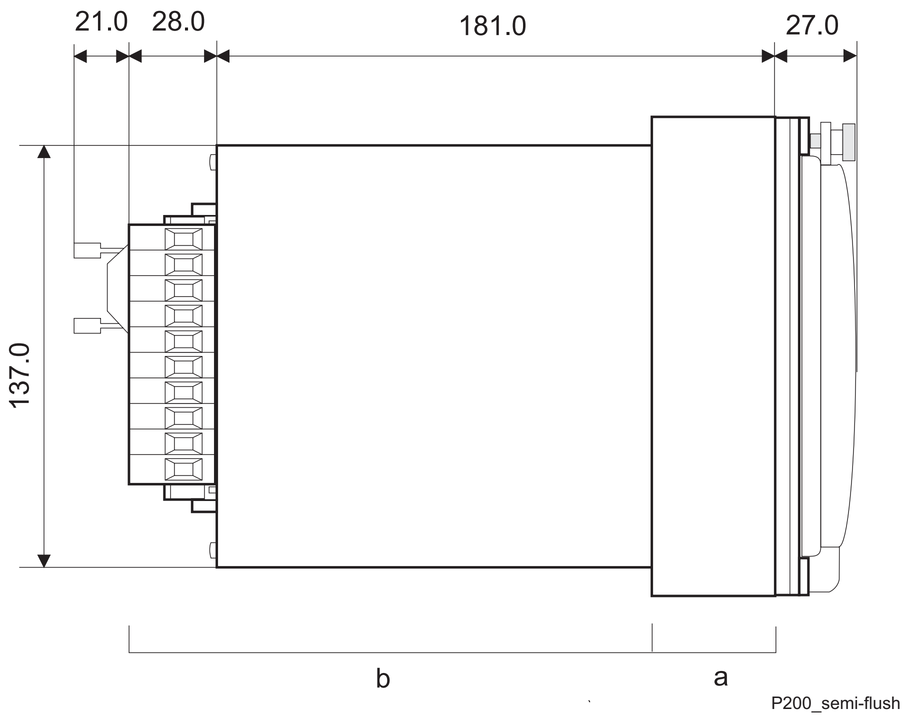


Figure 6.3-1. Semi-flush mounting of feeder manager

Depth with raising frames

Type designation	a	b
VYX076	40 mm	169.0 mm
VYX077	60 mm	149.0 mm

7. Order information

When ordering, please state:
Type designation: VAMP 257
Quantity:
Options (see respective ordering code):

7.1. Ordering codes of VAMP feeder managers

VAMP FEEDER MANAGER ORDER CODES

VAMP 257 - 3 ☐☐☐☐☐

Nominal current [A]
3 = 1A / 5A

Nominal earth-fault current Io1 & Io2 [A]
C = 1A / 5A
D = 0.2A / 1A

Additional I/O (X8 terminal)
6 = None
7 = 8 inputs and 4 outputs
8 = 10 outputs
9 = for future purposes

Supply voltage [V]
A = 40.. 265Vac/dc
B = 18.. 36Vdc
C = 40.. 265Vac/dc + ARC Protection
D = 18.. 36Vdc + ARC Protection
E = 40.. 265Vac/dc + DI19, DI20 Optional
F = 18.. 36Vdc + DI19, DI20 Optional

Optional hardware (communication port 1)
A = TTL/RS-232
B = Plastic/Plastic fibre interface (VCM fiber PP)
C = N/A
D = RS 485 Interface (VCM 485-4)
E = Glass/Glass Optic Interface (VCM fiber GG)
F = Plastic/Glass Optic Interface (VCM fiber PG)
G = Glass/Plastic Optic Interface (VCM fiber GP)
H = RJ-45 connection (Ethernet, VCM TCP)
I = RJ-45 connection (RS-232, VCM 232)

Optional hardware (communication port 2)
A = None
B = RJ-45 connection (Ethernet, VCM TCP)
C = RJ-45 connection (RS-232, VCM 232)
D = RS-485 Interface (VCM 485-2)

Accessories :

Order Code	Explanation	Note
VEA 3 CG	Ethernet Interface Module	VAMP Ltd
VPA 3 CG	Profibus Interface Module	VAMP Ltd
VSE001	Fiber optic Interface Module	VAMP Ltd
VSE002	RS485 Interface Module	VAMP Ltd
VX003-3	Programming Cable (VAMPSet, VEA 3 CG+200serie)	Cable length 3m
VX004-M3	TTL/RS232 Converter Cable (for PLC, VEA3CG+200serie)	Cable length 3m
VX007-F3	TTL/RS232 Converter Cable (for VPA 3 CG or VMA 3 CG)	Cable length 3m
VX015-3	TTL/RS232 Converter Cable (for 100serie+VEA3CG)	Cable length 3m
VA 1 DA-6	Arc Sensor	Cable length 6m
VYX076	Raising Frame for 200-serie	Height 40mm
VYX077	Raising Frame for 200-serie	Height 60mm

8. Reference information

Documentation:

Mounting and Commissioning Instructions VMMC.EN0xx
VAMPSET User's Manual VMV.EN0xx

Manufacturer data:

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FIN-65101 Vaasa, Finland
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Phone: +358 (0)207 533 200
Fax: +358 (0)207 533 205
URL: http://www.vamp.fi

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