VAMP 265

Generator, transformer and motor differential protection relay

Operation and configuration instructions

Technical description

Table of Content

1. General

This part of the manual describes the general functions of the generator, transformer and motor differential protection relay VAMP 265 and includes the relay operation instructions. It also contains instructions for parameterization and configuration of the relay 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.

1.1. Relay features

The differential, overcurrent and earth-fault relay VAMP 265 is ideal for differential protection of transformers, generators and motors. It features the following protection functions:

- Three phase biased differential stage.
- Three phase differential stage.
- One overcurrent stage.
- Two earth-fault stages.
- Circuit breaker failure protection
- Trip circuit supervision

Further the relay includes a disturbance recorder and is optionally available with an arc supervision unit. The relay also has a high stability against faults occurring outside the protection area.

The relay communicates with other systems using common protocols, such as the ModBus RTU, ModBus TCP, Profibus DP, IEC 60870-5-103 and it can be connected to a fibre-optic SPA bus.

1.2. Operating safety

The terminals on the rear panel of the relay 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 the relay operation instructions before any relay operational measures are carried out!

2. User interface

2.1. General

The VAMP 265 protection relay can be controlled in three ways:

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

2.2. Relay front panel

The figure below shows the front panel of the relay and the location of the user interface elements used for local control.

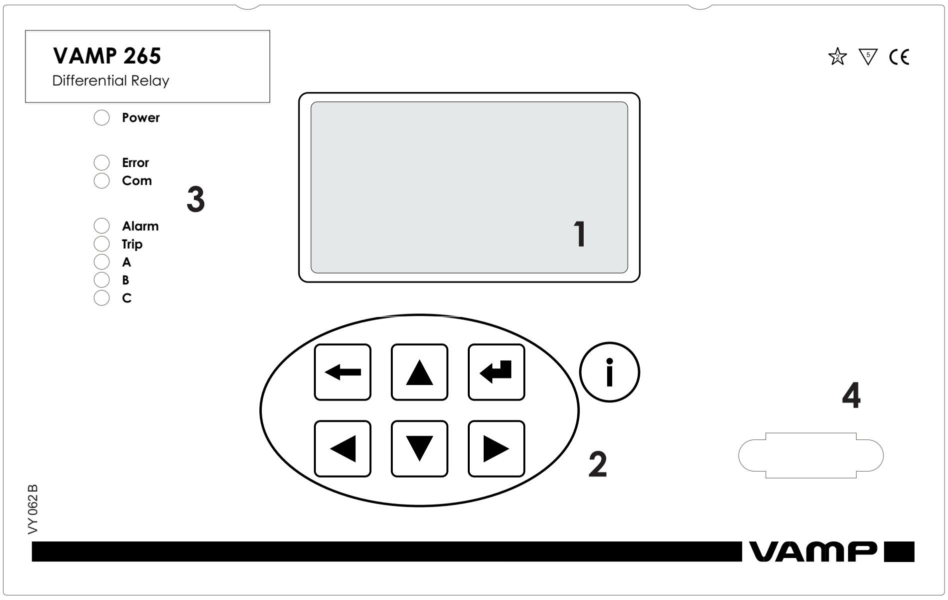

Figure 2.2-1 Relay front panel.

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

2.2.1. Display

The VAMP 265 protection relay is provided with a back lit LCD dot matrix display. The display is divided into sections as shown in the next figure.

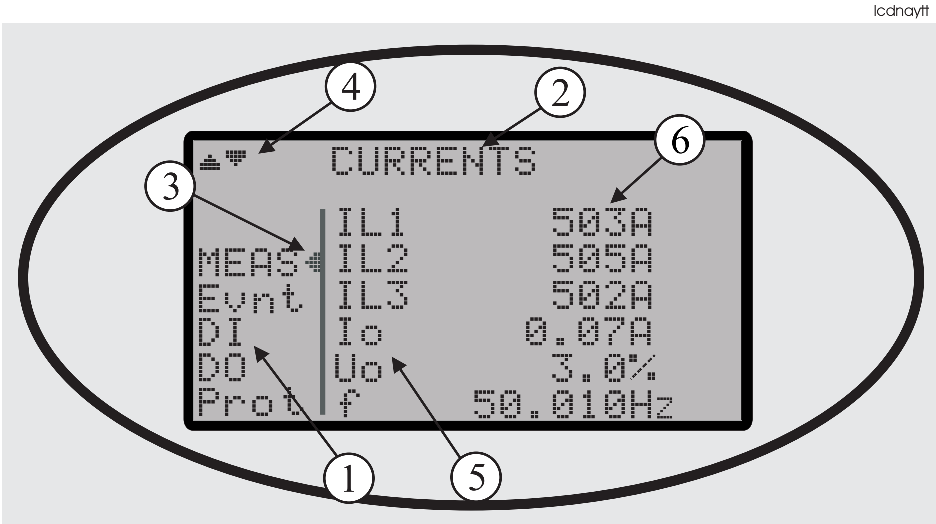

Figure 2.2.1-1 Sections of the LCD dot matrix display.

1. Main menu column
2. Heading of active menu
3. Cursor of main menu
4. Possible navigating directions (push buttons)
5. Measured/adjustable quantity
6. Measured/set value

2.2.2. Key pad

You can navigate in the menu and set required parameter values using the key pad and the guidance given in the display. The key pad is composed of four arrow keys, one cancel key, one enter key and one info key.

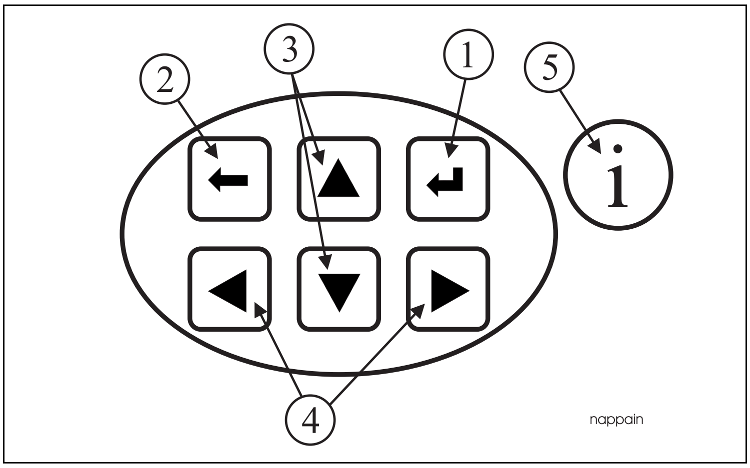

Figure 2.2.2-1 The keys on the key pad.

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

Inside brackets is the term used for the buttons in this manual.

2.2.3. Indicators

The relay is provided with eight LED indicators on the relay front panel:

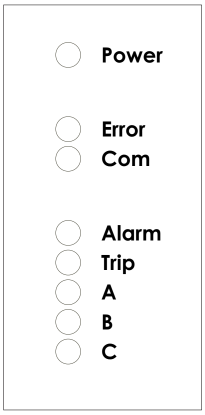

Figure 2.2.3-1 Operation indicators of the relay.

Relay operation indicators

Power	Auxiliary voltage indicator
Error	Internal relay fault, operates in parallel with the self supervision output relay
Com	Serial communication indicator
Alarm	Start indicator of protection stage
Trip	Trip indicator of protection stage
A - C	Can be programmed for application-related status indications

3. Local panel operations

The local panel can be used to read measured values, to set parameters and to configure relay 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. Navigation in the menus

All 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. For moving to a submenu, repeatedly push the RIGHT key until the required submenu is shown. Correspondingly, push the LEFT key to cancel the selection.
3. Push the ENTER key to confirm the selected submenu.
4. Push the CANCEL key to cancel a selection.
5. Pushing the UP or DOWN key in any position of a submenu will bring you directly one step up or down in the main menu.

The active main menu selection is indicated with a small triangular cursor sliding along the vertical line to the right of the main menu column. The possible navigating directions in each part of the menu are shown in the upper left corner by means of the black triangular symbols.

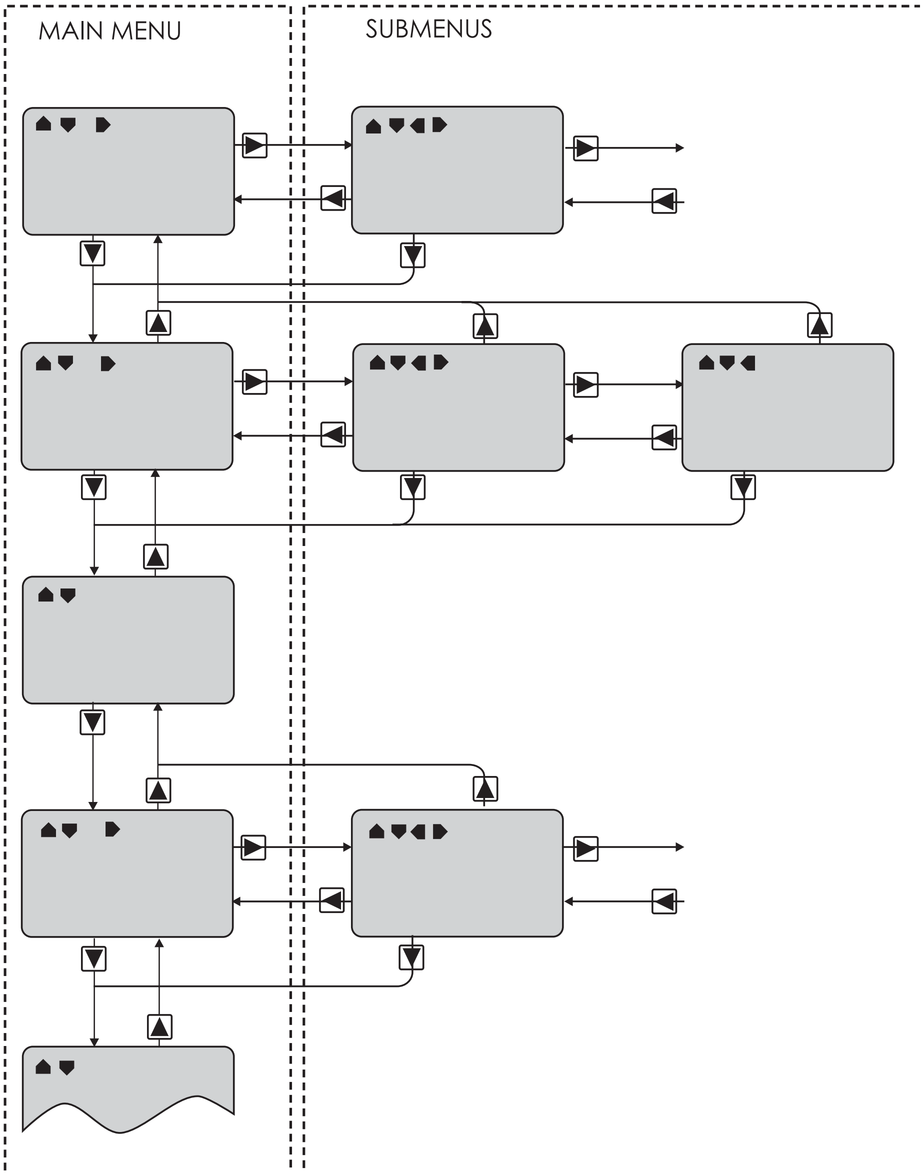

Figure 3.1-1 The principles of the menu structure and navigation in the menus.

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

The main menu item is bolded and the corresponding submenus can be found listed under each main menu item.

MEAS

- CURRENTS
- WINDING CURRENTS
- CURRENT DIFF.
- ANGLES
- WINDING ANGLES
- Io, f, PHASE SEQ

Evnt

- EVENT COUNT
- EVENT LIST

DR

- DISTURBANCE RECO
- REC: COUPLING

DI

- DIGITAL INPUTS
- DELAYs for DigIn
- INPUT POLARITY
- EVENT MASK1
- EVENT MASK1

DO

- RELAY OUTPUTS 1
- RELAY OUTPUTS 2
- Matrix emblems
- XXX xxx output (Output Matrix)

Prot

- PROTECTION SET
- PROTECT STATUS
- ENABLED STAGES
- ENABLED STAGES
- XXX xxx output (Blocking Matrix)

ΔI>

- ΔI> STATUS 87
- SET ΔI> 87
- SET2 ΔI> 87
- SET3 ΔI> 87
- LOG ΔI> 87
- LOG2 ΔI> 87
- ΔI> event mask

ΔI>>

- ΔI>> STATUS 87
- SET ΔI>> 87
- LOG ΔI>> 87
- LOG2 ΔI>> 87
- ΔI>> event mask

I>

- I> STATUS 51
- SET I> 51
- LOG I> 51
- LOG2 I> 51
- I> event mask

Io>

- Io> STATUS 51N
- SET Io> 51N
- LOG Io> 51N
- LOG2 Io> 51N
- Io> event mask

Io2>

- Io2> STATUS 51
- SET Io2> 51
- LOG Io2> 51
- LOG2 Io2> 51
- Io2> event mask

CBFP

- CBFP STATUS 50BF
- SET CBFP 50BF
- LOG CBFP 50BF
- LOG2 CBFP 50BF
- CBFP event mask

ArI>

- Arc I STAT 50AR
- SET Arc I 50AR
- LOG Arc I 50AR
- Arc event mask

ArI’

- Arc I’ STAT 50AR
- SET Arc I’ 50AR
- LOG Arc I’ 50AR
- Arc event mask

ArIo

- Arc Io STAT 50NAR
- SET Arc Io 50NAR
- LOG Arc Io 50NAR
- Arc event mask

ArIo

- Arc Io1 STA 50NAR
- SET Arc Io2 50NAR
- LOG Arc Io2 50NAR
- Arc event mask

CONF

- DEVICE SETUP
- CURRENT SCALING
- CURRENT SCALING
- UNIT TRANSFORMTO
- DEVICE INFO
- DATE/TIME SETUP
- CLOCK SYNC
- CLOCK SYNC 2 (Conf access required)

Bus

- PROTOCOL
- MODBUS
- SPABUS SLAVE
- IEC 60870-5-103
- ProfiBus DP
- TCP/IP

3.1.2. Basic menu structure of protection functions

Example I>:

I>STATUS:

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

SET I> (several SET menus possible):

I max	100A	Actual value, the value on which the protection is based
Status	-	State of protection function (-, Start, Trip, Blocked)
I> I>	110A 1.10xIn	Set value of protection function [A] Set value of protection function [pu]
t>	0.30s	

LOG I>:

Index	1	Order number of start 1 – 8, 1=latest
Type	-	Recorded event data
Flt Load	x In x In	Fault current Current before fault
EDly	%	Elapsed delay, 100% = tripped

LOG2 I>:

Index	1	Order number of start 1 – 8, 1=latest
	2002-08-22 20:34:11 67ms	Time stamp of event

I> event mask:

S_On	Start on event
S_Off	Start off event
T_On	Trip on event
T_Off	Trip off event

3.2. Operating levels

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

USER level

Use:	Parameter values can be read
Opening:	Level permanently open
Closing:	Closing not possible

OPERATOR level

Use:	Settings of protection stages can be changed
Opening:	Default password 0001
Setting state:	On entering the parameter setting state a password must be given, see 3.2.1
Closing:	The level is automatically closed when 10 minutes has elapsed since a key was pushed or a setting was done via the local port. The level can also be closed by giving the password 9999

CONFIGURATION level

Use:	The configuration level is needed during the commissioning of the relay. E.g. the turn ratios of the voltage and current transformers can be set.
Opening:	Default password 0002
Setting state:	On entering the parameter setting state a password must be given, see 3.2.1
Closing:	The level is automatically closed when 10 minutes has elapsed since a key was pushed or a setting was done via the local port. The level can also be closed by giving the password 9999

3.2.1. Opening operating levels

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

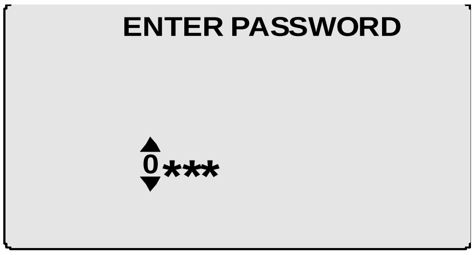

Figure 3.2.1-1 Opening an operating level

2. Enter the password needed for the desired level: The password may 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 ENTER.

3.2.2. Changing passwords

The set passwords can only be changed using a PC connected to the local RS-232 port on the relay.

4. Operating measures

General

Carefully study the operating instructions in chapters 1 through 3 of this manual before taking any operating measures or changing any relay settings or functions.

The relay can be controlled from the relay front panel, from a PC running the VAMPSET software, from a PC running a suitable terminal software, or from a remote control system.

4.1. Measured data

The measured values can be read from the main menu MEAS and its submenus.

Submenu CURRENTS

The CURRENTS display shows a list of parameters and their values.

currents

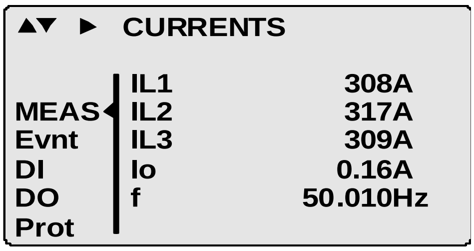

Figure 4.1-1 Current and frequency data.

4.2. 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 relay fault has been detected	The relay 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 Alarm and the output has been activated by one of the signals. (Output relay configuration, see chapter 5.4 on page 23)	The LED is switched off, when the signal that caused output Alarm 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 Trip and the output has been activated by one of the signals. (Output relay configuration, see chapter 5.4 on page 23)	The LED is switched off, when the signal that caused output Trip 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.	

Resetting latched indicators and output relays

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

There are two ways to reset latched indicators and relays:

1. Move to the initial display, see Figure 2.2-1, from the alarm list, by pushing the CANCEL key for approx. 3 s. Then reset the latched indicators and output relays by pushing the ENTER key.
2. Acknowledge each event in the alarm list one by one, by pushing ENTER the equivalent times. Then, in the initial display, reset the latched indicators and output relays by pushing the ENTER key.

The latchings can also be reset via the communications bus or via a DI input configured for that purpose.

4.3. Reading event register

The event register can be read from the Evnt option of the main menu:

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

event_list

Figure 4.3-1 Event register, example.

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

4.4. Forced control (Force)

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

1. Open operating level CONFIGURATION, see 3.2.1
2. Move to the setting state of the desired function, for example DO (see chapter 5, on page 21).
3. Select the Force function (the black cursor is in line with the Force text).

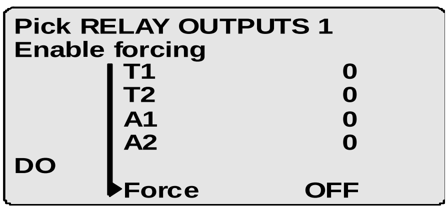

Figure 4.4-1 Selection of the Force function.

4. Push the ENTER key.
5. Push the UP or DOWN key to change the "OFF" text to "ON", i.e., to activate the Force function.
6. 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.

7. Push the ENTER key to confirm the selection. Signal T1 can be controlled by force.
8. Push the UP or DOWN key to change the selection from "0" (not alert) to "1" (alert) or vice versa.
9. 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.
10. Repeat steps 7 and 8 to alternate between the on and off state of the function.
11. Repeat steps 1...4 to exit the Forced control function.
12. Push the CANCEL key to return to the main menu.

4.5. Setting range limits

Note!

If parameters requiring a numerical setting value are given out-of-range settings, a fault message will be obtained when the setting is confirmed with the ENTER key. Adjust the setting to within the allowed setting range.

The allowed setting range is shown in the display in setting mode:

1. Push the INFO button.

infoset_I

```
Info SET I>                51
Setting for stage I>
Type: i32.dd
Range: 0.10
       .. 0.50

ENTER   : password
CANCEL: back to menu
```

Figure 4.5-1 Display of allowed setting ranges

2. Push the CANCEL key to return to the setting mode.

4.6. 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 27.

5. Configuration and parameter setting

Operating level: CONFIGURATION

- Choose and configure the digital inputs in the DI position of the main menu.
- Configure the digital outputs in the DO position of the main menu.
- Choose and configure the protection functions and configure the interlockings in the Prot position of the main menu.
- Change the parameters of the protection functions in the function-related submenus, e.g. I>.
- Set the ”Device Setup”, the scaling (e.g. of Inom, Isec, etc.), date and time in the CONF position of the main menu.
- Choose and configure the communication buses in the Bus position of the main menu.

NOTE!

Some of the parameters can only be altered via the RS-232 serial port using a PC, e.g. changing password.

5.1. Principle of parameter setting

1. Move to the setting state of the desired menu, e.g. CONF/CURRENT SCALING, by pushing the ENTER key. The Pick text appears in the upper left part of the display.
2. Supply the password associated with the configuration level (default value = 0002).
3. Scroll through the parameters with the UP and DOWN keys. If a certain parameter can be set, the cursor to the left of the value takes the form of a black filled triangle. If the parameter cannot be set the cursor takes the form of a non-filled triangle.
4. Select the desired parameter, e.g. 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 step from digit to digit, and the UP and DOWN keys to change the digits.
6. Push the ENTER key to accept the new value.
7. If you want to leave the parameter value unchanged, then exit the edit state by pushing the CANCEL key.

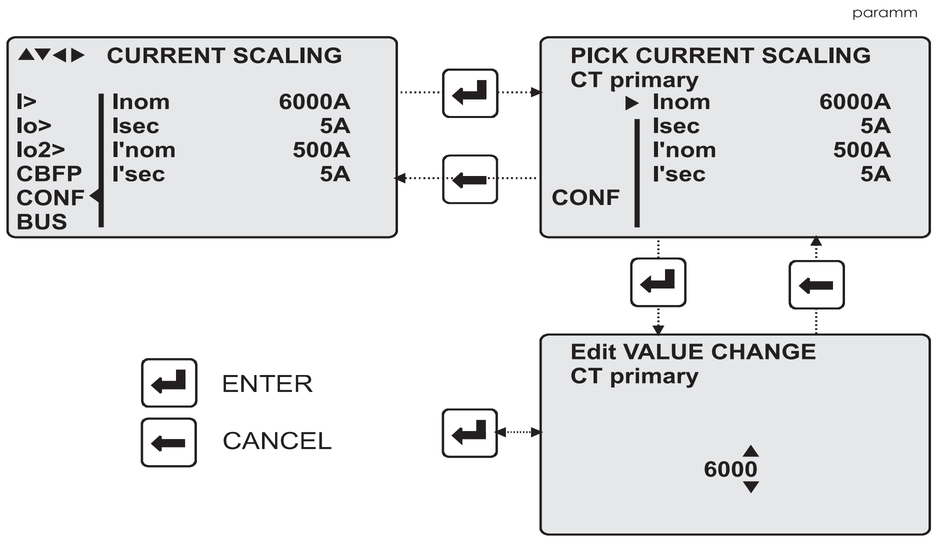

Figure 5.1-1Changing parameters.

5.2. Disturbance recorder menu DR

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

DISTURBANCE RECO

- 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:

- f
- IL1, IL2, IL3
- I'L1, I'L2, I'L3
- IL1w, IL2w, IL3w
- I'L1w, I'L2w, I'L3w
- Io, Io2
- DL1, DL2, DL3
- IL, I'L
- DI, DO

5.3. Configuring digital inputs DI

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

- Status of digital inputs (DIGITAL INPUTS)
- Operation delay (DELAYs for DigIn)
- Polarity of the input signal (INPUT POLARITY), either normally open (NO) or normally closed (NC) circuit
- Selection to event register EVENT MASK1 and EVENT MASK2

5.4. Configuring digital outputs DO

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

- Status of the output relays (RELAY OUTPUTS1 and 2)
- Forcing of the output relays (RELAY OUTPUTS1 and 2) (only if Force = ON):
    - Forced control (0 or 1) of the Trip relays T1 and T2
    - Forced control (0 or 1) of the Alarm relays A1…A5
    - Forced control (0 or 1) of the IF relay
- Configuration of the output signals to the output relays T1 and T2, A1 - A5 and the operation indicators (LED) Alarm and Trip, that is, the output relay matrix.

5.5. Configuring protection functions Prot

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

- In the Prot menu you can reset all counters (PROTECTION SET/ClALL)
- Read the status of all protection functions (PROTECT STATUS 1-3)
- Enable and disable protection functions (ENABLED STAGES 1-3)
- Define the interlockings between signals.

5.6. Setting protection function parameters

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

Available Protection stages

- ΔI>, ΔI>>
- I>
- Io>, Io2>
- CBFP
- ArcI>, ArcI'>, ArcIo>, ArcIo2>

5.7. Configuration menu CONF

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

DEVICE SETUP

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

CURRENT SCALING

- Rated CT primary current (Inom)
- Rated CT secondary current (Isec)
- Rated CTb primary current (I'nom)
- Rated CTb secondary current (I'sec)

CURRENT SCALING

- I_0 CT primary current (Ionom)
- I_0 CT secondary current (Iosec)
- I_{02} CT primary current (Io2nom)
- I_{02} CT secondary curren (Io2sec)
- I_0 compensation (IoCmps)
- I'_0 compensation (I'oCmps)

TRANSFORMER

- Rated IL side nominal voltage (Un)
- Rated I'L side nominal voltage (U'n)
- Transformer nominal power (Sn)
- Connection group (ConGrp)
- Transformer nominal current IL (In)
- Transformer nominal current I'L (I'n)

DEVICE INFO

- Relay type (Type VAMP 265)
- Serial number (SerN)
- Software version (PrgVer)

DATE/TIME SETUP

- Date (Dat)
- Time (Time)
- Presentation style of date information (Style)

CLOCK SYNC

- Minute sync pulse DI (SyncDI)
- Sync correction (SyOS)
- RTC Trim (CkTrim)
- Sync source (SySrc)

5.8. Protocol menu Bus

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

PROTOCOL

- Communication protocol of REMOTE port (Protoco)
- Message counter (Msg#)
- Communication error counter (Errors)
- Communication time-out counter (Tout)

MODBUS

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

SPABUS SLAVE

- Slave number (Addr) when relay connected to SPA-Bus
- SPA-Bus transfer rate (bit/s)
- Event mode (Emode)

IEC-60870-5-103

- Slave address (Addr)
- Transfer rate (bit/s)

ProfiBus DP

- ProfiBus profile (Mode)
- Transfer rate of converter (bit/s)
- ProfiBus Tx Buf length (InBuf)
- ProfiBus Rx Buf length (OutBuf)
- Profibus Address (Addr)
- Type of the Profibus converter (Conv)

TCP/IP (Only in VAMPSET)

- IP address of the relay (IpAddr)
- Subnet mask (NetMsk)
- IP address of the Gateway (Gatew)
- IP address of the Name Server (NameSv)
- IP address of the SNTP Server (NTPSvr)
- IP Port number for protocol (Port)

6. PC software

6.1. PC user interface

The PC interface is intended to be used for onsite parameterization of the relay, for reading measured values to a computer or loading relay software from a computer.

Two RS 232 serial ports are available for the connection of a local PC, one on the front panel and one on the rear panel of the relay. The serial ports are connected in parallel. However, if both ports are fitted with a connection cable, only the port on the front panel will be active. To connect a PC to a serial port, use a connection cable of type VX 003-3.

6.1.1. Using the VAMPSET program

See separate user's manual for the VAMPSET software, VMV.EN0xx. If the VAMPSET software is not available, please download it from our web site at www.vamp.fi.

6.2. Remote control connection

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

ModBus, SPA_Bus, IEC 60870-5-103, ProfiBus or ModBus TCP can be used as REMOTE communication protocols (see details in Chapter 2.5.2 in 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 relay has been given factory default settings or settings defined by the customer. The actual configuration can be read from the workshop test report or from the final test report.

7.1.1. Configuration during commissioning

The settings of the generator, transformer and motor differential protection relay VAMP 265 can be defined and checked during commissioning in accordance with the instructions given in chapter 5 of this manual, for example, in the following order:

1. Scaling of the rated values of the phase currents (CONF/CURRENT SCALING menu)
2. Scaling of earth fault current (CONF/Io/Uo SCALING menu)

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

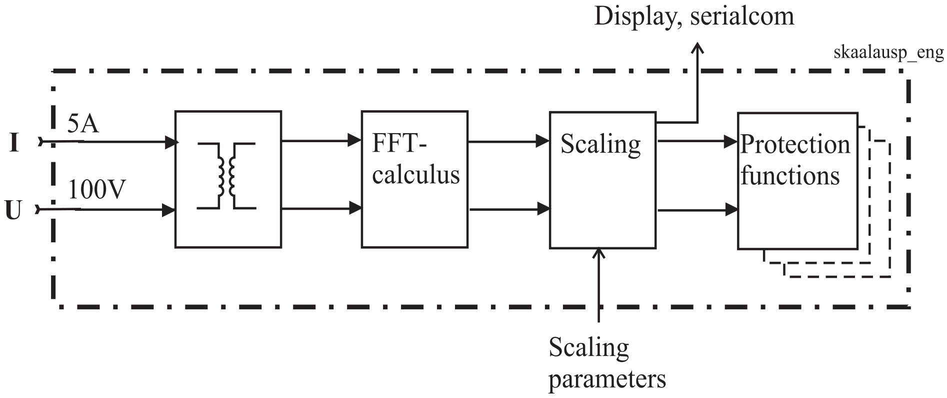

Figure 7.1.1-1 Principle for scaling the measured values of the VAMP 265 relay.

3. Activation of desired protection functions, Prot menu. See chapter 5.5 on page 4.
4. Setting values of the protection function parameters (e.g. I> menu). See chapter 5.6 on page 24.
5. Routing of trip and alarm signals from the protection functions to the desired output relays and LED indicators (DO menu). See chapter 5.4 on page 23.

6. Configuration of blocking matrix (Prot menu). See chapter 5.5 on page 23.
7. Configuration of desired DI inputs, e.g., external blockings (DI menu), see chapter 5.3on page 23.
8. Configuration of communication parameters (Bus menu), see chapter 5.8 on page 25.

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 in figure 3.1 -1 in chapter 3 of the Technical Description.

The application uses the following protection functions and parameters:

- Differential protection ΔI>, ΔI>> (Status, ΔI>, Slope1, Ibias2, Slope2, Harm2; Status, ΔI>>)
- Overcurrent protection I> (Status, I>, t>)
- Earth fault protection I_0> (Status, I_0>, t>)
- Earth fault protection I_{02}> (Status, I_{02}>, t>)
- Circuit Breaker Failure Protection CBFP (Status, CBrel, t)

The above functions are enabled via the Prot/ENABLED STAGES_ -menu by selecting "On" in the Enable display, see chapter 5.5 on page 23. The functions not to be included are disabled by selecting the "Off" value.

1 Start data

Given within parenthesis are the configuration menus where the settings are done.

Transforming ratios of measurement transformers:

Current transformers (CT) (CONF/CURRENT SCALING)	I_{nom} I_{sec} I'_{nom} I'_{sec}	600A 5.0A 200A 5A
I_0 current transformer (CT) (CONF/I_0 SCALING)	I_{0nom} I_{0sec} I_{02nom} I_{02sec} I_{0Cmps} I'_{0Cmps}	50A 5.0A 50A 5.0A OFF ON

Transformer ratings (CONF/UNIT TRANSFORMTO)	U_n U'_n S_n ConGrp	6300V 20000V 5500kVA Dy11

2 Settings for protection stages

Protection stage:	Parameter:	Setting:
Differential stage ΔI>	ΔI> Slope1 Ibias2 Slope2 Harm2	20 x I_n 50 % 2.00 x I_n 150 % 0%

Differential stage ΔI>>	ΔI>>	30.0 x I_n

Overcurrent stage I>	I> t>	1.20 x I_n 0.15 s

Earth-fault stage Io>	Io> t>	0.050 pu 0.15 s

Earth-fault stage Io2>	Io2> t>	0.150 pu 1.00 s

CBFP	CBRel t>	1 0.2 s

3 Blocking matrix

The required blockings are made in the Prot menu, see chapter 5.5 on page 23.

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 23.

7.1.3. Automatic CT correction

VAMP 265 calculates the transformer nominal current by,
$I_n = S / (\sqrt{3} \times U_n)$

Example calculation:

Transformer: 16 MVA, 110 kV / 20 kV
HV side: 16 MVA / (1.732 * 110) = 84.0 A
LV side: 16MVA / (1.732 * 20) = 462 A

HV CT ratio selection: 100/5
LV CT ratio selection: 500/5

Secondary CT current at nominal load:

CT HV side: 84/100 * 5 = 4.20 A
CT LV side: 462/500 * 5 = 4.62 A

The relay will correct with following factors:

4.20/5 = 0.84 (HV)
4.62/5 = 0.92 (LV)

Table of Content

1. Introduction

This part of the user's manual describes the protection functions, provides a few application examples and contains technical data. This part of the manual also includes the operating instructions.

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

1.1. Application

The numerical generator, transformer and motor differential protection relay VAMP includes all the essential functions needed for differential overcurrent, overcurrent and earth fault protection of generator and transformer applications. Further the relay includes several programmable functions, such as arc, trip circuit supervision and circuit breaker protection and communication protocols for various protection and communication situations.

The generator, transformer and motor differential protection relay VAMP 265 can be used for selective differential overcurrent, short-circuit protection of generators, transformers and motors in solidly or impedance earthed power systems. The relay can also be used for single, two or three-phase overcurrent and/or sensitive earth fault protection.

The modern technology in association with an extensive self-supervision system and a reliable construction ensures an extremely high availability for the VAMP 265 protection relay.

1.2. Main features

- Fully digital signal handling with a powerful 16 bit micro processor and high measuring accuracy on all setting ranges due to an accurate 16 bit A/D conversion technique.
- Wide setting ranges for the protection functions.
- The relay can be matched to the requirements of the application by disabling functions not needed.
- Flexible control and blocking possibilities due to the six digital signal control inputs (DI).
- Easy adaptability of the relay to various substations and alarm systems due to a flexible signal-grouping matrix in the relay.

- Recording of events and fault values into an event register, from which data can be read via the key pad and the display or by means of the PC based VAMPSET user interface
- Handy configuration, parameterization and reading of information via the user panel or with 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 40 to 265 V dc or ac.
- Built-in disturbance recorder for evaluating primary and secondary side, as well as neutral currents at the protected object.

2. Functions

The individual protection functions of the generator, transformer and motor differential protection relay VAMP 265 can independently of each other be enabled or disabled according to the requirements of the intended application. See the configuration instructions, Chapter 5 and 7, in the first part of this manual.

2.1. Principles of the numerical protection technique

The generator, transformer and motor differential protection relay VAMP 265 is fully designed using numerical technology. This means that all signal filtering, protection and control functions are implemented through digital processing.

The numerical technique used in the relay is primarily based on an adapted fast Fourier transformation (FFT), in which the number of calculations (multiplications and additions) 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 period. This means that the frequency must be measured and the number of samples per period must be controlled accordingly, so that the number of samples per period remains constant, if the frequency changes.

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 relay. The main components are the energizing inputs, digital input elements, output relays, A/D converters and the micro controller including memory circuits. Further a relay contains a power supply unit and a man-machine interface (MMI).

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.

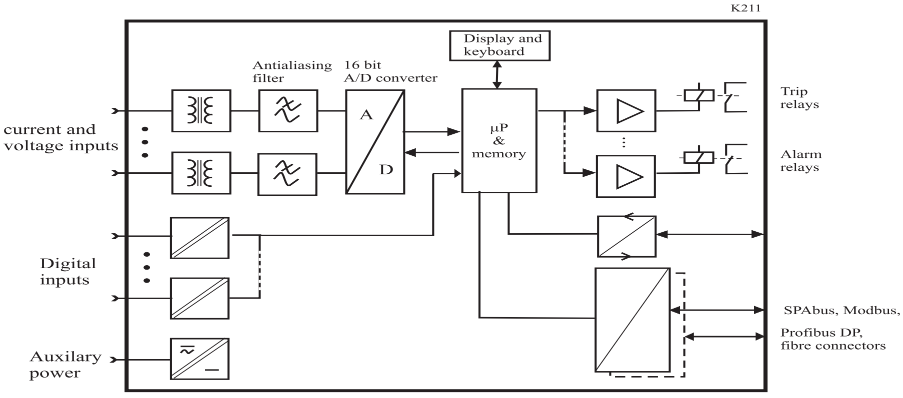

Figure 2.1-1 Principle block diagram of a numerical protection relay

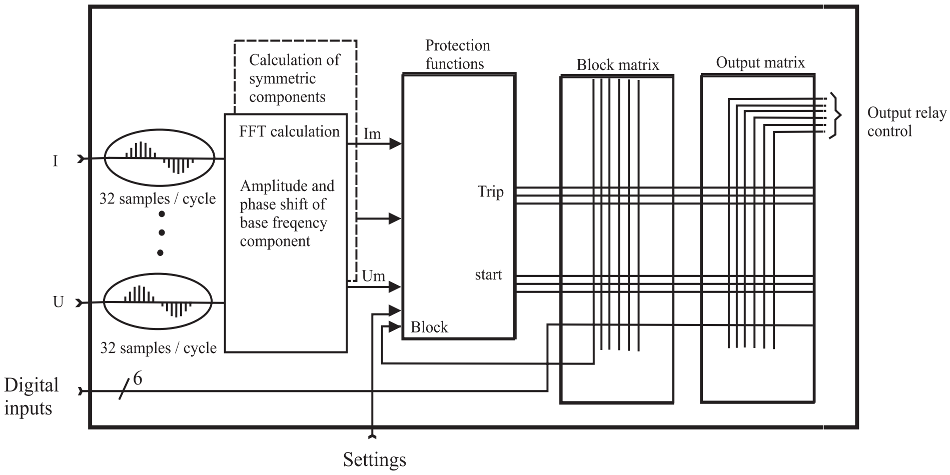

Figure 2.1-2 Block diagram of a software based protection function.

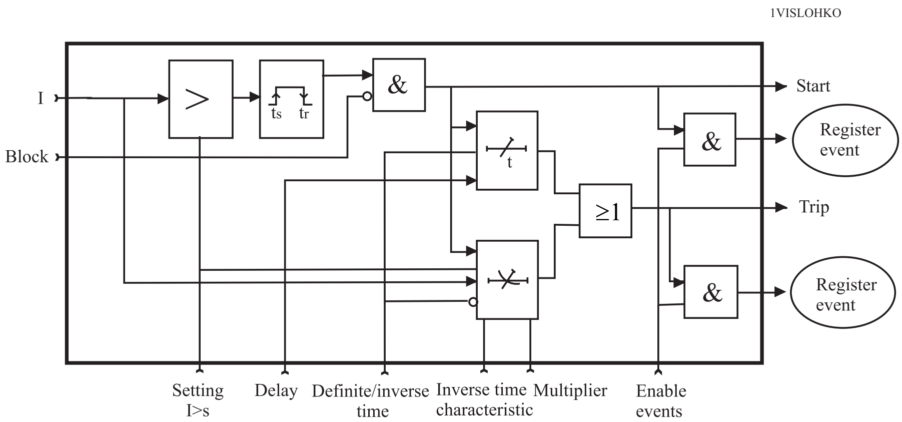

Figure 2.1-3 Block diagram of a single phase protection function.

2.2. Protection relay functions

2.2.1. Differential overcurrent protection (87)

The differential overcurrent protection comprises two separately adjustable stages, stage ΔI> and stage ΔI>>.

The differential protection is based on winding currents difference between IL and I'L side. In transformer applications the current calculation depends on transformer connection group. E.g. in Yy0 connection measured currents are also winding currents, see Figure 2.2.1-1. In generator applications the connection group is always Yy0 and measured currents are also winding currents.

WindingCurrent1

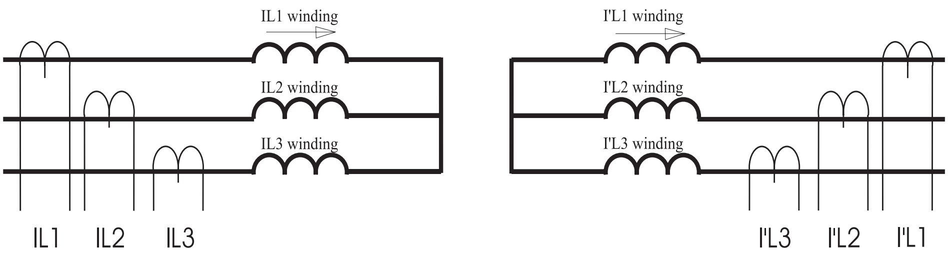

Figure 2.2.1-1 Winding currents in connection group Yy0.

In the second example if transformer IL side is connected to open delta, e.g. Dy11, then winding currents are calculated in delta side (IL side), see Figure 2.2.1-2.

WindingCurrent2

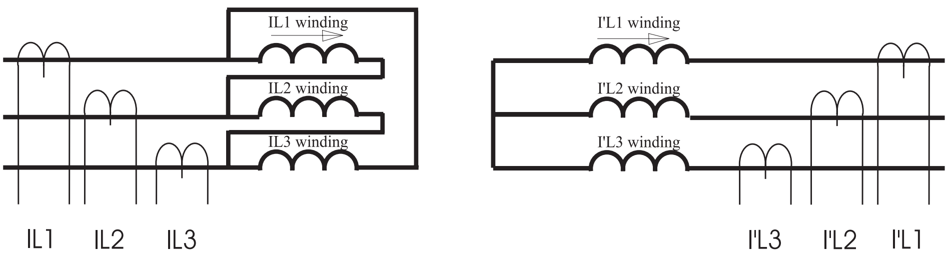

Figure 2.2.1-2 Winding currents in connection group Dy11.

Equation 1: Winding current calculation in delta side, Dy11 connection

$$\overline{I_{L1W}} = \overline{I_{L1}} - \overline{I_{L2}}$$

$$\overline{I_{L2W}} = \overline{I_{L2}} - \overline{I_{L3}}$$

$$\overline{I_{L3W}} = \overline{I_{L3}} - \overline{I_{L1}}$$

Equation 2: Winding currents in star side, Dy11 connection

$$\overline{I'_{L1W}} = \overline{I'_{L1}}$$

$$\overline{I'_{L2W}} = \overline{I'_{L2}}$$

$$\overline{I'_{L3W}} = \overline{I'_{L3}}$$

Equation 3: Bias current

$$I_b = \frac{\left|\overline{I}_W\right| + \left|\overline{I}'_W\right|}{2}$$

Equation 4: Differential current

$$I_d = \left|\overline{I}_W + \overline{I}'_W\right|$$

Bias current calculation is only used in protection stage ΔI>. Bias current describes the average current flow in transformer. Bias and differential currents are calculated individually for each phase.

If transformer is earthed, e.g. connection group Dyn11, then zero current must be compensated before differential and bias current calculation. Zero current compensation can be selected individually for IL and I'L side.

Table 2.2.1-1 describe connection group and zero current compensation for different connection groups. If protection area is only generator then connection group setting is always Yy0, see Table 2.2.1-2. Also the settings of Un and U'n are set to be the same, e.g. generator nominal voltage.

Transformator Connection group	Relay setting ConnGrp	Io cmps	I'o cmps
YNy0	Yy0	ON	OFF
YNyn0	Yy0	ON	ON
Yy0	Yy0	OFF	OFF
Yyn0	Yy0	OFF	ON
YNy6	Yy6	ON	OFF
YNyn6	Yy6	ON	ON
Yy6	Yy6	OFF	OFF
Yyn6	Yy6	OFF	ON
Yd1	Yd1	OFF	OFF
YNd1	Yd1	ON	OFF
Yd5	Yd5	OFF	OFF
YNd5	Yd5	ON	OFF
Yd7	Yd7	OFF	OFF
YNd7	Yd7	ON	OFF
Yd11	Yd11	OFF	OFF
YNd11	Yd11	ON	OFF
Dy1	Dy1	OFF	OFF
Dyn1	Dy1	OFF	ON
Dy5	Dy5	OFF	OFF
Dyn5	Dy5	OFF	ON
Dy7	Dy7	OFF	OFF
Dyn7	Dy7	OFF	ON
Dy11	Dy11	OFF	OFF
Dyn11	Dy11	OFF	ON

Table 2.2.1-1 Zero current compensation in transformer applications.

Genarator only	Relay setting ConnGrp	Io cmps	I'o cmps
None earthing	Yy0	OFF	OFF

Table 2.2.1-2 Zero current compensation in generator applications.

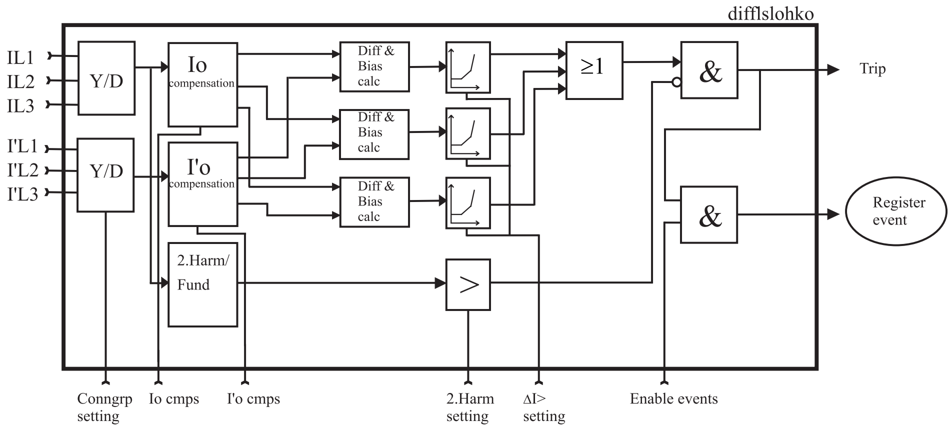

Figure 2.2.1-3 Block diagram of the differential overcurrent stage ΔI>.

The stage ΔI> can be configured to operate as shown in Figure 2.2.1-4. This dual slope characteristic allows more differential current at higher currents before tripping.

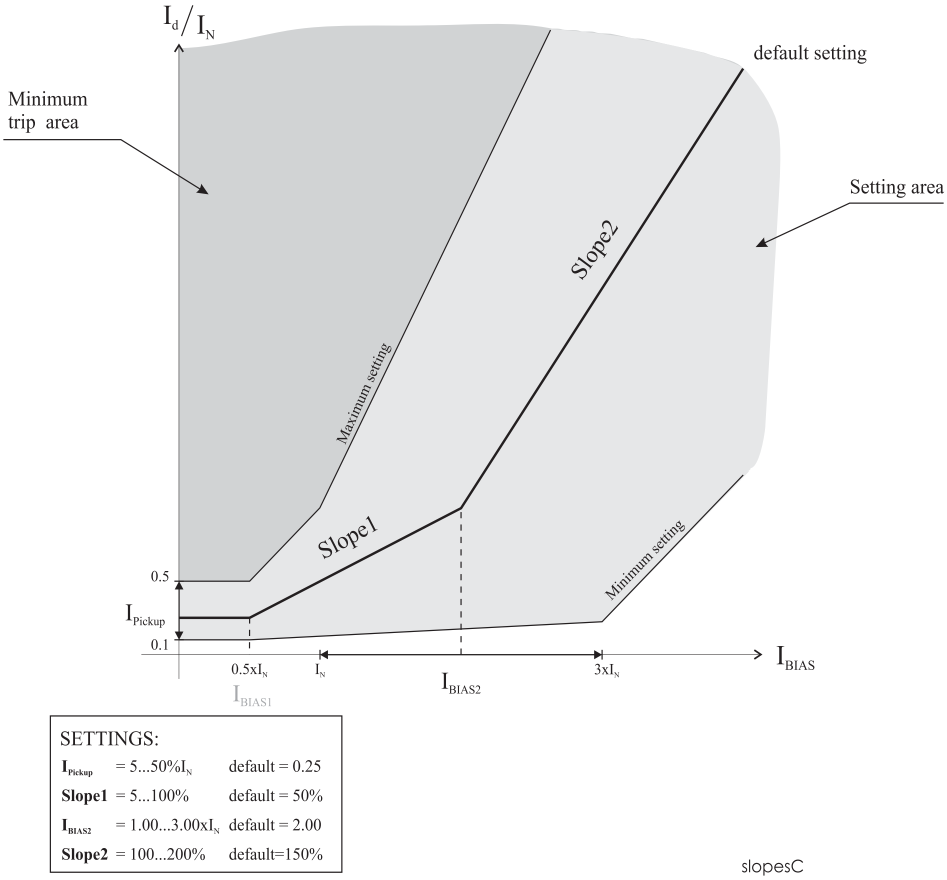

Figure 2.2.1-4 Example of differential overcurrent characteristics.

The stage also includes second harmonics blocking. The second harmonic is calculated from winding currents. Harmonic ratio is:

$$100 \times I_{f2\_Winding} / I_{f1\_Winding} \ [\%].$$

Fast differential overcurrent stage ΔI>> does not include slope characteristics and second harmonics blocking.

Parameters of the differential overcurrent stages:

ΔI> (87)

	Parameter:	Value/unit:	
Measured values (1	ΔL1 ΔL2 ΔL3	xIn	Current difference value
Setting values (2	ΔI>	%In	Setting value
	Slope1	%	Slope 1 setting
	Ibias2	xIn	Bias current start of slope 2
	Slope2	%	Slope 2 setting
	Harm2>	On/Off	2. harmonic blocking enable/disable
	Harm2>	%	2. harmonic block limit

Recorded values	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
	ΔFlt	xIn	Max. value of fault differential current as compared to I_n
	Bias	xIn	Value of bias current of faulted phase as compared to I_n
	Load	xIn	1 s mean value of pre-fault phase currents IL1…IL3

1) Measurement ranges are described in section 5.1.1 on page 43

2) Setting ranges are described in section 5.3.1 on page 46

ΔI>> (87)

	Parameter:	Value/unit:	
Measured values	ΔL1 ΔL2 ΔL3	xIn	Current difference value
Setting values	ΔI>>	xIn	Setting value
Recorded values	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
	ΔFlt	xIn	Max. value of fault differential current as compared to I_n
	Load	xIn	1 s mean value of pre-fault phase currents IL1…IL3

2.2.2. Overcurrent protection (50/51)

The six-phase overcurrent unit includes one adjustable overcurrent stage, stage I>.

The overcurrent unit measures the fundamental frequency component of the phase currents on both sides of the transformer or generator. The stage I> can be configured for definite time operation characteristic. Figure 2.2.2-1 shows a functional block diagram of the I> stage of the overcurrent unit.

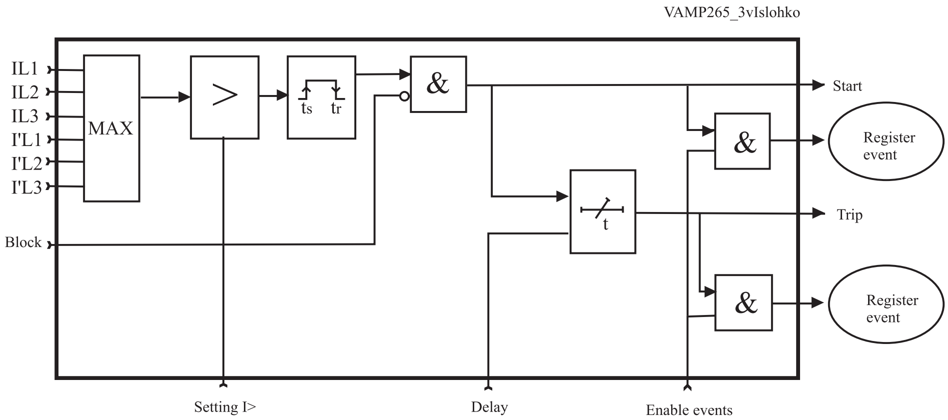

Figure 2.2.2-1 Block diagram of the three-phase overcurrent stage I>.

Parameters of the overcurrent stages:

I> (50/51)

	Parameter:	Value/unit:	
Measured value	I max	xIn	Corresponding primary value as compared to In
Setting values	I>	xIn	Setting value
	t>	s	Operating time [s]
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
		1'-N, 2'-N, 3'-N	Fault type/single-phase fault e.g.: 1'-N = fault on phase L1 on I'L side
		1'-2', 2'-3', 1'-3'	Fault type/two-phase fault e.g.: 2'-3' = fault between L2 and L3 on I'L side
		1' - 2' - 3'	Fault type/three-phase fault on I'L side
	Flt	xI_n	Max. value of fault current as compared to In
	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

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

The earth fault unit includes two adjustable overcurrent stages, stage I_0> and I_{02}>, it measures the fundamental frequency component of the zero current. The stages can be configured for definite time operation characteristic.

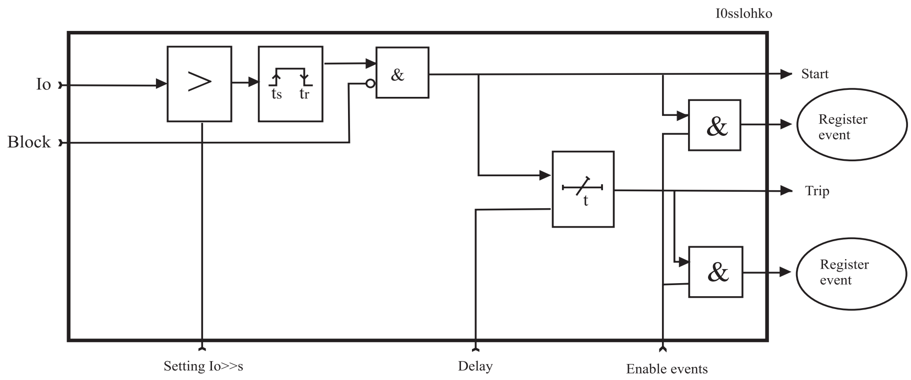

Figure 2.2.3-1 Block diagram of the earth fault stages I_0> and I_{02}>.

Parameters of the earth fault protection:

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

	Parameter:	Value/unit:	
Measured value	I_0	A	Primary earth-fault current I_0
Display	I_0>	A	Setting value I_0
Setting values	I_0>	xIon	Setting value
	t>	s	Operating time [s] at definite time function
Recorded values	SCntr		Cumulative start counter
	TCntr		Cumulative trip counter
	Flt	pu	Max. fault value
	EDly	%	Elapsed time as compared to the set operating time, 100% = tripping

2.2.4. Circuit-breaker failure protection (50BF)

The operation of the circuit-breaker failure protection is based on the supervision of the operating time, from the pick-up 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 both in overcurrent and earth fault situations, because its function is merely based on supervision of the control of the output relay.

Parameters of the circuit-breaker failure protection:

CBFP (50BF)

	Parameter:	Value/unit:	
Setting values	CBRel	pu	Output relay to check
	t>	s	Operating time
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

2.2.5. Arc fault protection (option) ArcI> (50AR), ArcI'> (50AR), ArcI$_0$> (50NAR), ArcI$_{02}$> (50NAR)

The arc fault protection has been realized with an arc sensor (or sensors) and an extremely fast overcurrent function Iarc and Ioarc using the arc optional card.

The arc protection unit operates, when the arc sensor detects an arc fault or the binary input (BI) of the arc option card is activated and the fast overcurrent stage ArcI> measures overcurrent simultaneously.

The earth-fault arc protection unit operates, when the arc sensor detects an arc fault or the binary input (BI) of the arc option card is activated and the earth-fault function ArcIo> measures earth-fault simultaneously.

The sensor connections (S1, S2) and binary input (BI) can be set, individually or any combination of these, to operate the ArcI> and ArcIo> protection stages.

The operating time of the arc protection stages are approximately 15 ms.

The sensor connections and binary input can be set to activate the binary output (BO) in the output matrix, DO menu. The binary output can be used to forward light information to another relay, e.g. VAMP 140. The binary output can be connected to a maximum of three binary inputs of another relay.

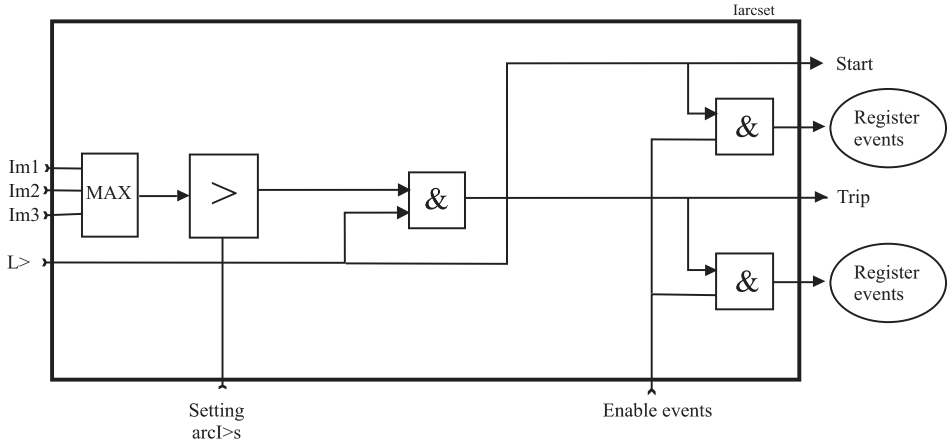

Figure 2.2.5-1 Block diagram of the arc protection stage.

In the above figure the symbol of the starting of the arc sensor is ’L>’ and ’Iarc’ of the fast overcurrent stage.

Parameters of the arc protection stage:

ArcI>, ArcI’>

	Parameter:	Value/unit:	
Setting values	ArcI>, ArcI’>	pu	Setting value as per times In
	ArcCn		Arc sensor connection: S1, S2, BI, S1/S2, S1/BI, S2/BI, S1/S2/BI
Recorded values	LCntr		Cumulative start counter, all arc activations
	SCntr		Cumulative start counter, only selected ArcCn arc activations
	TCntr		Cumulative trip counter
	Flt	%	Max. fault current
	Load	Pu	1s mean value pre-fault phase currents IL1 – IL3

ArcI$_0$>, ArcI$_{02}$>

	Parameter:	Value/unit:	
Setting values	ArcI$_0$>, ArcI$_{02}$>	pu	Setting value as per times I_{0n}
	ArcCn		Arc sensor connection: S1, S2, BI, S1/S2, S1/BI, S2/BI, S1/S2/BI
Recorded values	LCntr		Cumulative start counter, all arc activations
	SCntr		Cumulative start counter, only selected ArcCn arc activations
	TCntr		Cumulative trip counter
	Flt	%	Max. fault current

2.3. Measurement functions of the relay

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

Phase currents I_{L1}, I_{L2}, I_{L3}, I'_{L1}, I'_{L2}, I'_{L3}

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

Earth fault current I_0, I_{02}

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

Frequency f

Measuring range	16 - 75 Hz

2.4. Output relay and blocking functions

In the generator, transformer and motor differential protection relay VAMP 265 all 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 2.4-1 shows the operating principle of the grouping and blocking matrices.

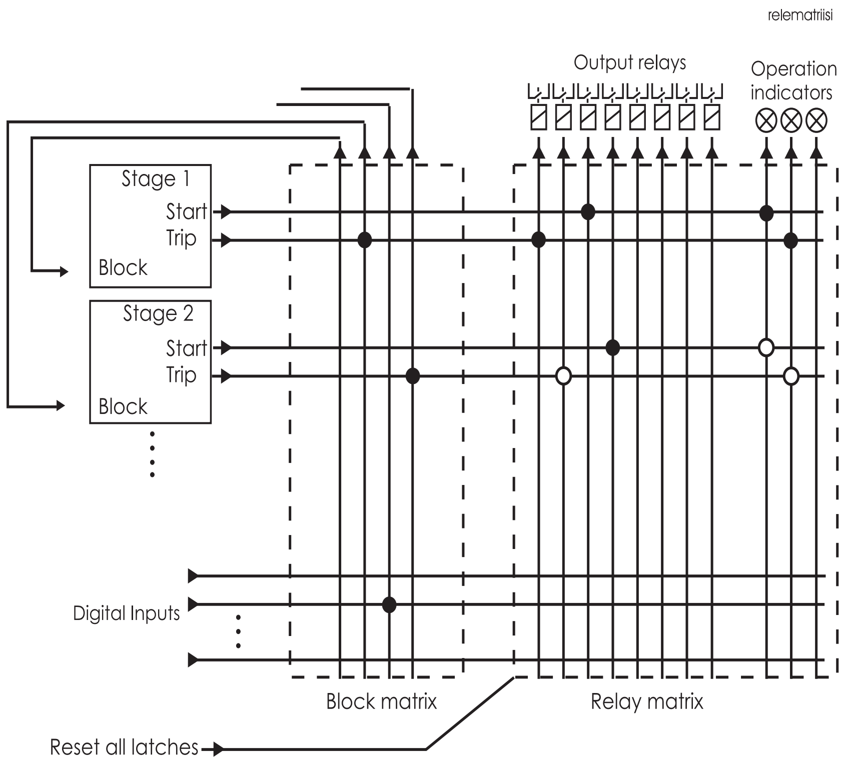

Figure 2.4-1 Operating principle of the grouping and blocking matrices.

2.4.1. Output relay matrix

By means of the relay matrix the output signals of the various protection stages can be combined with the trip relay T1 and T2, alarm relays A1...A5 and the operation indicator L1 (Alarm) and L2 (Trip).

When a connection is made, two functions can be selected, the signal follower function (•) or the latching function (o), see Figure 2.4-1.

The "Reset all Latches" signal resets all latched output relays and operation indicators. The reset signal can be given via a digital input, the keypad or the serial port. If the reset signal is to be given via one of the digital inputs DI1...DI6, the Remote Release (“RemRel”) input must be configured for that purpose.

2.4.2. Blocking matrix

By means of the block matrix the operation of a protection stage can be blocked. During blocking, a stage will not start or if already started the delay counter is halted, thus preventing tripping. The blocking signal can originate from the digital inputs DI1…DI6, or it can be a start or trip signal from a protection stage. In Figure 2.4-1 blocking connection is indicated with a black dot (•) in the crossing point of a blocking signal and a signal to be blocked.

2.5. Communication

2.5.1. PC port

The PC port is used for on-site parameterization of the relay, for downloading of the program and for reading relay parameters to a PC.

For connection to a PC, one RS 232 serial port is available on the front panel of the relay. Any connection to the port is done with the connection cable type VX 003-3.

2.5.2. Remote control connection

The relay can be connected to higher level systems, e.g. network control systems via the serial port named REMOTE on the rear panel. To the port a SPA-Bus, ModBus, ProfiBus or IEC-103 connection can be made using a special internal or external bus connection module. The bus type selection and the parameterization of the bus are carried out as the relay is configured.

Optional accessories are available for RS 485 connection (VMA 3 CG), Ethernet connection over TCP/IP protocol (VEA 3 CG) and ProfiBus connection (VPA 3CG). Please see the corresponding documentation for more details.

	Standards interface	Option modules			
		Internal	Internal	Internal	External
Protocol	RS 232: VX004-M3 or VX008-4	Plastic or Glass	RS 485:	ProfiBus:	Ethernet: VEA3CG + VX003 + (VX004-M3)
ModBus	X	X	X		
SPA-Bus	X	X	X		
ProfiBus				X	
IEC-60870-5-103	X	X	X		
ModBus/ TCP					X
Transparent TCP/IP					X

2.6. Disturbance recorder

The disturbance recorder can be used to record all measured signals i.e. currents and voltages, status information of digital inputs (DI) and digital outputs (DO). The digital inputs include also the Arc light information. The digital outputs include the Arc binary output information (BO).

Recorder capacity is 48 000 bytes. There can be a maximum of 5 recordings and the maximum selection of channels in one recording is 12 (limited in waveform recording).

The recorder can be triggered by any protection stage start or trip signal. The trig signal is selected in the output matrix. The recording can also be triggered manually.

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

The recordings can be viewed by VAMPSET program. The recording is in COMTRADE format so also other programs can be used to view the recordings.

For more detailed information, see separate Disturbance Recorder manual VMDR.EN0xx.

Available links

The following channels can be linked to Disturbance Recorder:

- IL, IL1, IL2, IL3, I'L, I'L1, I'L2, I'L3
- IL1w, IL2w, IL3w, I'L1w, I'L2w, I'L3w
- Io, Io2
- ΔL1, ΔL2, ΔL3
- f
- DI, DO

Parameters of the Disturbance Recorder

	Parameter:	Value/unit:	
Setting values	Mode		Mode of the recording
	Rate		Sample rate
	Time	s	Recording time
	PreTrig	%	Pre-trigger time
	MnlTrig		Manual trig
	Size		Size of one recording
	MAX time	s	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 the recorder
	Time status	%	Status of the pre-triggering
	ReadyRec		Number of ready records

2.7. 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 relay 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 relay fault.

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

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

3. Applications

The following examples illustrate the versatile functions of the generator, transformer and motor differential protection relay VAMP 265.

3.1. Restricted earth fault protection

Restricted earth fault (REF) protection is a sensitive way to protect a zone between two measuring points against earth faults. See Figure 3.1-1.

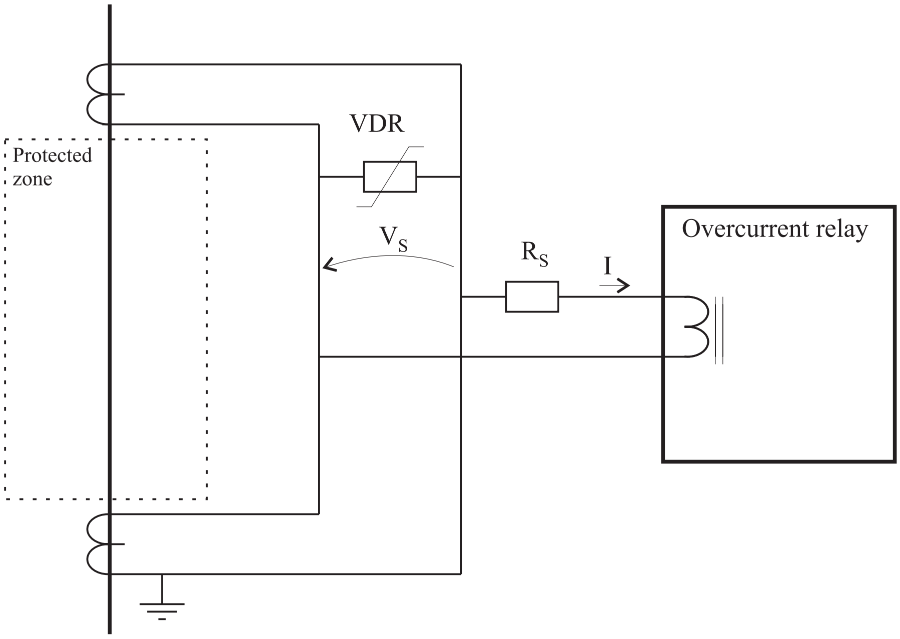

Figure 3.1-1 Principle of restricted earth fault protection. The CT secondaries are wired to cancel each other's currents during through faults and to drive all to the relay when the fault is inside the protected zone. (Saturation of the CTs makes the situation a little more complicated than that.) The stabilizing resistor R_S guarantees that the relay will not trip during a through fault. The VDR is used to protect the CTs and the wiring by limiting the voltage V_S during heavy inside faults.

When there is a fault outside the protected zone the CT secondaries will cancel each other's currents. This is partly true even if both or only one of the CTs saturates, because the impedance of a saturated CT secondary will collapse to near zero. The non-zero wiring impedance and CT impedance will however cause a voltage V_S, but the resistor R_S will prevent the relay from tripping. RS is called the stabilizing resistor.

During an inside fault the secondary currents of the two CTs have no other way to go than the relay. The relay will trip when the current $I = V_S/R_S$ exceeds the setting I_S of the relay. The voltage dependent resistor (VDR, varistor, METROSIL) is used to protect the CTs and wiring by limiting the voltage V_S during heavy inside faults.

The resistance of the secondary loop connecting the CTs together should be as low as possible.

3.2. Restricted earth fault protection for a transformer with neutral connection

Figure 3.2-1 shows and example where three phase current CTs are connected parallel with each other and then in series with the CT in the neutral point. Figure 3.2-2 is a similar application but the phase CTs are used for overcurrent protection as well.

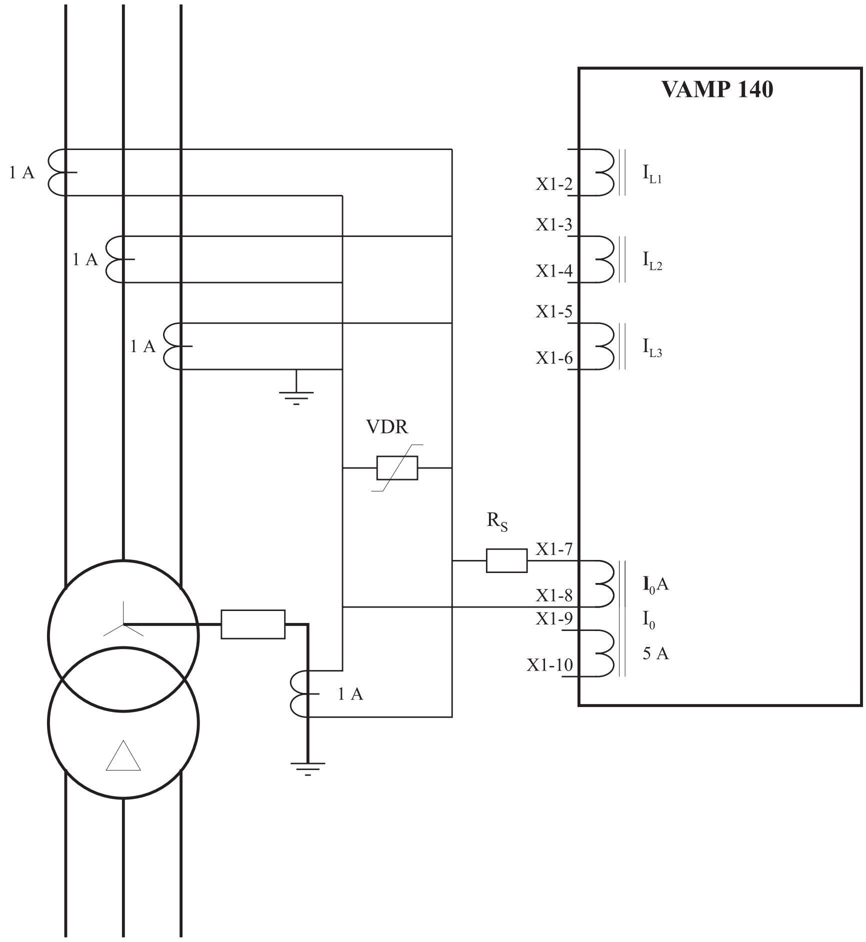

Figure 3.2-1 Restricted earth fault protection of a transformer's wye winding using VAMP 140 relay. All the CTs have the same ratio and nominal secondary current 1 A. During a through fault the residual secondary currents of phase CTs and the neutral CT cancel each other. During an inside fault the two residual secondary currents are summed up and forced to flow through the relay and the voltage limiting VDR.

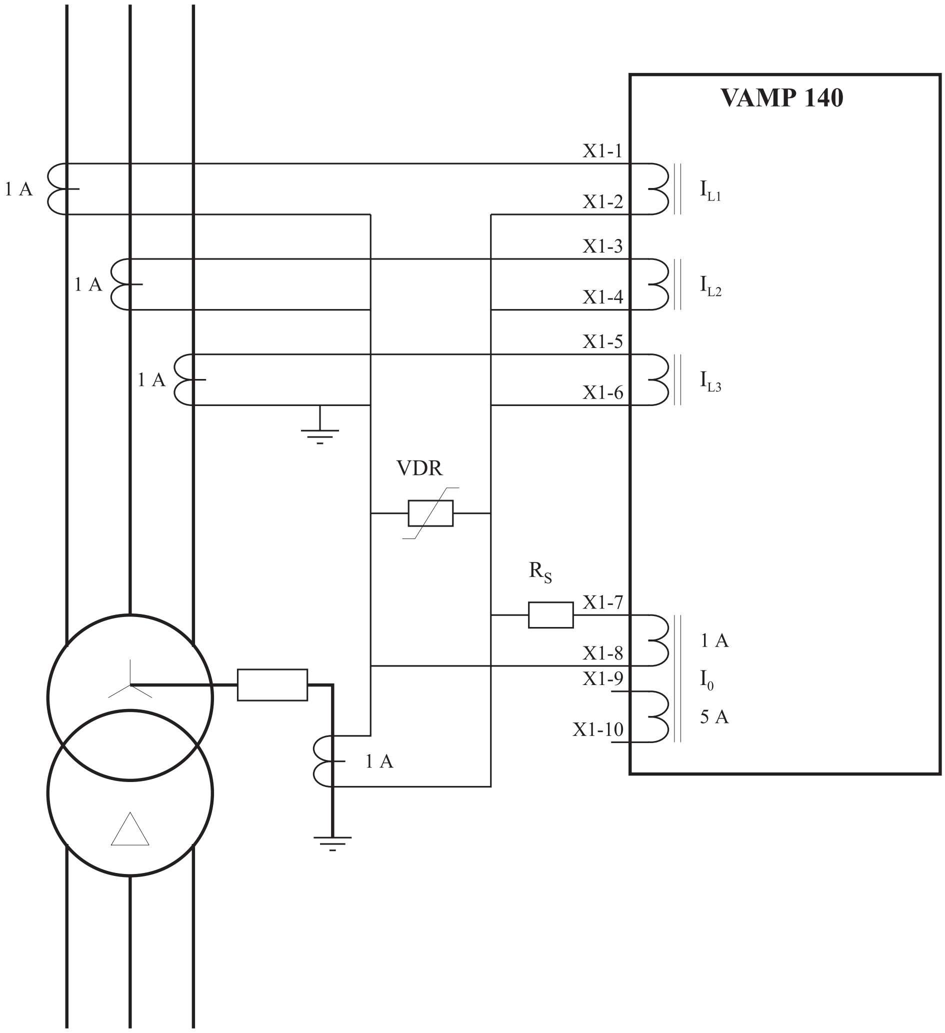

Figure 3.2-2 Overcurrent and restricted earth fault protection of a transformer's wye winding. All the CTs have the same ratio and nominal secondary current 1 A. In through fault the residual secondary currents of phase CTs and the neutral CT cancel each other and in inside fault the two residual secondary currents are summed up and forced to flow through the I_0 input of the relay and the voltage limiting VDR.

3.2.1. CT requirements

Any difference between the CTs will give a misleading residual current signal to the relay. Especially during heavy through faults (i.e. the fault is outside the protected zone) the dissimilar saturation of the CTs should not yield to a REF trip. On the other hand a very high fault current causing an unselective earth fault start or trip is not a fatal error.

Class X CT

In restricted earth fault protection the high and low side CTs should give similar responses even for high over currents.

Class X CTs will fulfil this requirement. Their performance is defined in terms of a knee-point voltage (V_{KP}), the magnetizing current at the knee point voltage and the resistance of the secondary winding at +75 °C.

Knee point voltage (V_{KP}) is the secondary voltage at which a 50 % increase of primary current is needed to increase the secondary voltage by 10 %.

3.3. Calculating the stabilizing resistance R_S, VDR value and actual sensitivity

3.3.1. Value of stabilizing resistor R_S

The voltage V_S (Figure 3.1-1) is:

Equation 1

$$V_S = I_{MAXT} \frac{CT_{SEC}}{CT_{PRIM}} R_{CT} + R_W$$

I_{MAXT}	=	Maximum through fault current not to cause an REF trip[1]
CT_{SEC}	=	Nominal secondary current of the CT
CT_{PRI}	=	Nominal primary current of the CT
R_{CT}	=	Resistance of CT secondary.
R_W	=	Total resistance of wiring, connections etc.

The CT should be of class X (see chapter 3.2.1) and the knee point voltage should be twice the calculated V_S.

[1] Selecting a low value helps to achieve more sensitivity and helps to avoid the usage of a voltage limiting VDR. An unselective earth fault pick-up/trip is not always a problem if a fast overcurrent stage will clear the fault anyway.

The stabilizing resistor R_S is calculated as:

Equation 2

$$R_S = \frac{V_S}{I_{Set}}$$

I_{Set} = Setting value of the relay as secondary value.

3.3.2. Voltage limitation

During heavy inside faults the voltage in the secondary circuit may rise to several kilovolts depending on the fault currents, CT properties and the stabilizing resistor R_S. If the secondary voltage would exceed 2 kV it should be limited using a voltage dependent resistor (VDR).

The peak voltage according a linear CT model is:

Equation 3

$$V_p = I_{MAXF} \frac{CT_{SEC}}{CT_{PRIM}} B_{CT} + R_W + R_S$$

I_{MAXF}	=	Maximum fault current when the fault is inside the protected zone
CT_{SEC}	=	Nominal secondary current of the CT
CT_{PRI}	=	Nominal primary current of the CT
R_{CT}	=	Resistance of CT secondary.
R_W	=	Total resistance of wiring, connections, relay input etc.
R_S	=	Stabilizing resistor according equation 2.

The peak voltage of a saturating CT can be approximated using P. Mathews' formula:

Equation 5

$$V_{sp} = 2\sqrt{2V_{KP}V_P - V_{KP}}$$

V_{KP}	=	Knee point voltage of the CT. The secondary voltage at which a 50 % increase of primary current is needed to increase the secondary voltage by 10%.
V_P	=	Peak voltage according linear model of a CT

This approximating formula does not hold for an open circuit condition and is inaccurate for very high burden resistances.

3.3.3. Actual operating sensitivity

The differential scheme will multiply the fault current by two thus increasing the sensitivity from the actual setting. The quiescent current of the possible VDR will decrease the sensitivity from the actual setting value.

3.3.4. Example

CT	=	2000/1	V_{KP} = 100 V
I_{MAXT}	=	16 kA = 8 x I_N	
I_{REF}	=	5 % = 50 mA	Setting value scaled to secondary level
R_{CT}	=	6 Ω	
R_W	=	0.4 Ω	
I_{MAXF}	=	25 kA	

Maximum secondary voltage during a through fault (eq. 1):

$$V_S = 16000\,\frac{1}{2000}\,6 + 0.4 - 51.2\text{ V}$$

Conclusion: The knee point voltage of 100 V is acceptable being about twice the V_S..

Serial resistance for the relay input (equation 2):

$$R_S = \frac{51.2}{0.05} = 1024\ \Omega \approx 1000\ \Omega$$

Maximum peak voltage during inside fault using a linear model for CT (equation 3):

$$V_p = 25000\,\frac{1}{2000}(6 + 0.4 + 1000) = 12.6\text{ kV}$$

Approximation of peak voltage during inside fault using a non-linear model for a saturating CT (equation 4):

$$V_{sp} = 2\sqrt{2 \cdot 100(12600 - 100)} = 3.2\text{ kV}$$

This is a too high value and a VDR must be used to reduce the voltage below 3 kV.

A zinc oxide varistor (i.e. VDR, METROSIL) of 1 kV will limit the voltage. Using a 400 J model allows two 20 VA CTs feeding ten times their nominal power during one second before the energy capacity of the varistor is exceeded.

3.4. Current transformer selection

Iron core current transformers (CT) are accurate in amplitude and phase when used near their nominal values. At very low and at very high currents they are far from ideal. For overcurrent and differential protection, the actual performance of CTs at high currents must be checked to ensure correct function of the protection relay.

3.4.1. CT classification according IEC 60044-1, 1996

CT model

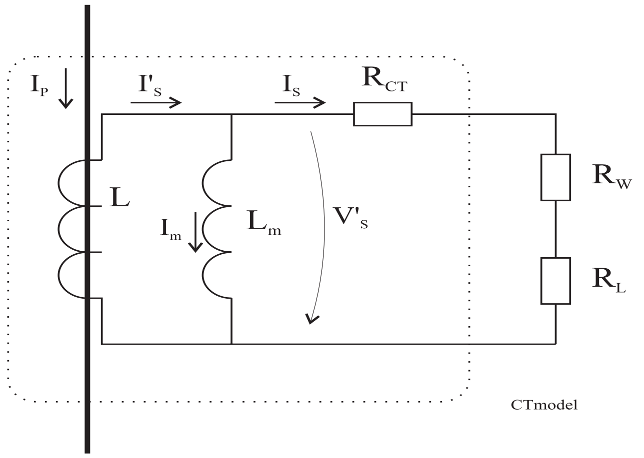

Figure 3.4.1-1 A CT equivalent circuit. L_m is the saturable magnetisation inductance, L is secondary of an ideal current transformer, R_{CT} is resistance of the CT secondary winding, R_W is resistance of wiring and R_L is the burden i.e. the protection relay.

Composite error ε_C

Composite error is the difference between the ideal secondary current and the actual secondary current under steady-state conditions. It includes amplitude and phase errors and also the effects of any possible harmonics in the exciting current.

Equation 6.

$$\varepsilon_C = \frac{\sqrt{\frac{1}{T}\int_0^T (K_N i_S - i_P)^2 dt}}{I_P} \cdot 100\%$$

T = Cycle time
K_N = Rated transformation ratio $I_{NPrimary}/I_{Nsecondary}$
i_S = Instantaneous secondary current
i_P = Instantaneous primary current
I_P = Rms value of primary current

Note:

All current based protection functions of VAMP relays, except arc protection, thermal protection and 2nd harmonic blocking functions, are using the fundamental frequency component of the measured current. The IEC formula includes an RMS value of the current. That is why the composite error defined by IEC 60044-1 is not ideal for VAMP relays. However the difference is not big enough to prevent rough estimation.

Standard accuracy classes

At rated frequency and with rated burden connected, the amplitude error, phase error and composite error of a CT shall not exceed the values given in the following table.

Accuracy class	Amplitude error at rated primary current (%)	Phase displacement at rated primary current (°)	Composite error ε_C at rated accuracy limit primary current (%)
5P	±1	±1	5
10P	±3	-	10

Marking:

The accuracy class of a CT is written after the rated power.
E.g. 10 VA **5P**10, 15 VA **10P**10, 30 VA **5P**20

Accuracy limit current I_{AL}

Current transformers for protection must retain a reasonable accuracy up to the largest relevant fault current. Rated accuracy limit current is the value of primary current up to which the CT will comply with the requirements for composite error ε_C.

Accuracy limit factor k_{ALF}

The ratio of the accuracy limit current to the rated primary current.

Equation 7

$$K_{ALF} = \frac{I_{AL}}{I_N}$$

The standard accuracy limit factors are 5, 10, 15, 20 and 30.

Marking:

Accuracy limit factor is written after the accuracy class.
E.g. 10 VA 5P**10**, 15 VA 10P**10**, 30 VA 5P**20**.

The actual accuracy limit factor k_A depends on the actual burden.

Equation 8.

$$k_A = k_{ALF} \frac{|S_i + S_N|}{|S_i + S_A|}$$

k_{ALF} = Accuracy limit factor at rated current and rated burden
S_i = Internal secondary burden. (Winding resistance R_{CT} in Figure 3.4.1-1)
S_N = Rated burden
S_A = Actual burden including wiring and the load.

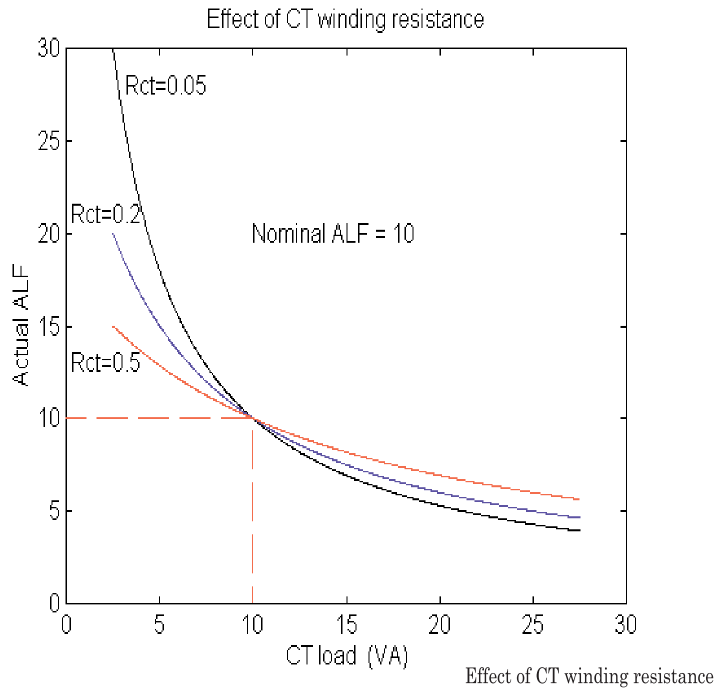

Figure 3.4.1-2 This figure of equation 3 shows that it is essential to know the winding resistance R_{CT} of the CT if the load is much less than the nominal. A 10 VA 5P10 CT with 25% load gives actual ALF values from 15..30 when the winding resistance varies from 0.5 Ω to 0.05 Ω.

3.4.2. CT requirements for protection

When the through current equals and exceeds $k_A x I_N$ there may be enough secondary differential current to trip a relay although there is no in zone fault. This is because the CTs are unique and they do not behave equally when approaching saturation.
To avoid false trips caused by heavy through faults the actual accuracy limit factor k_A of the CTs should exceed the relative setting I_{SET} of the non-stabilized differential stage.

Equation 9

$$k_A > c \cdot I_{SET} \cdot \frac{I_{NTra}}{I_{NCT}}$$

c	=	Safety factor
I_{SET}	=	Relative setting of the non-stabilized differential current stage
I_{NTra}	=	Rated current of the transformer (primary side or secondary side)
I_{NCT}	=	Rated primary current of the CT (primary side or secondary side)

Using slightly smaller safety factor than indicated in the table will increase the setting inaccuracy.

Protection application	Safety factor c
Overcurrent	2
Earth-fault, cable transformer	3
Earth-fault overcurrent, sum of three phase currents [2]	6
Transformer differential, Δ-winding or unearthed Y-winding	3
Transformer differential, earthed Y-winding	4
Generator differential	3

Formula to solve needed CT power S_N

By replacing the complex power terms with corresponding resistances in equation 6 we get,

$$k_A = k_{ALF} \frac{R_{CT} + R_N}{R_{CT} + R_W + R_L}$$

where the nominal burden resistance is

$$R_N = \frac{S_N}{I_{NCT\sec}^2}$$

R_{CT}	=	Winding resistance (See Figure 3.4.1-1)
R_W	=	Wiring resistance (from CT to the relay and back)
R_L	=	Resistance of the protection relay input
S_N	=	Nominal burden of the CT
I_{NCTsec}	=	Nominal secondary current of the CT

By solving S_N and substituting k_A according equation 8, we get

$$S_N > \left[\frac{cI_{SET} I_{NTra}}{k_{ALF} I_{NCT}} (R_{CT} + R_W + R_L) - R_{CT} \right] I_{NCT\sec}^2 \qquad \text{(eq. 9)}$$

[2] Sensitive earth-fault current settings, < 5% x I_N, should be avoided in this configuration because a set of three CTs are not exactly similar and will produce some secondary residual current even though there is no residual current in the primary side.

Example 1

Transformer:

16 MVA YNd11 $Z_k = 10\%$
110 kV / 21 kV (84 A / 440 A)

CT's on HW side:

100/5 5P10
Winding resistance $R_{CT} = 0.07\ \Omega$

(R_{CT} depends on the CT type, I_{NCT} and power rating. Let's say that the selected CT type, 100 A and an initial guess of 15 VA yields to 0.07 Ω.)

Safety factor c = 4.

(Transformer differential, earthed Y.)

CTs on LV side:

500/5 5P10

(Max. short circuit current is 4400 A = 8.8 x 500 A)

Winding resistance $R_{CT} = 0.28\ \Omega$

(R_{CT} depends on the CT type, I_{NCT} and power rating. Let's say that the selected CT type, 500 A and an initial guess of 15 VA yields to 0.28 Ω.)

Safety factor c = 3.

(Transformer differential, Δ.)

Differential current setting of the non-stabilized stage ΔI>>:
$I_{SET} = 9 \times I_N$

R_L	=	0.008 Ω Typical burden of a VAMP relay current input.
R_{WHV}	=	0.138 Ω Wiring impedance of high voltage side. (2x16 m, 4 mm²)
R_{WLV}	=	0.086 Ω Wiring impedance of low voltage side. (2x10 m, 4 mm²)

The needed CT power on HV side will be

$$S_N > \left[\frac{4 \cdot 9 \cdot 84}{10 \cdot 100} \cdot (0.07 + 0.138 + 0.008) - 0.07\right] \cdot 5^2 = 14.6\ \text{VA}$$

⇒ 15 VA is a good choice for HV side.

And on the LV side

$$S_N > \left[\frac{3 \cdot 9 \cdot 440}{10 \cdot 500} \cdot (0.28 + 0.086 + 0.008) - 0.28\right] \cdot 5^2 = 15.2\ \text{VA}$$

⇒ 15 VA is a good choice for LV side.

3.5. Protection at a Dyn11 transformer

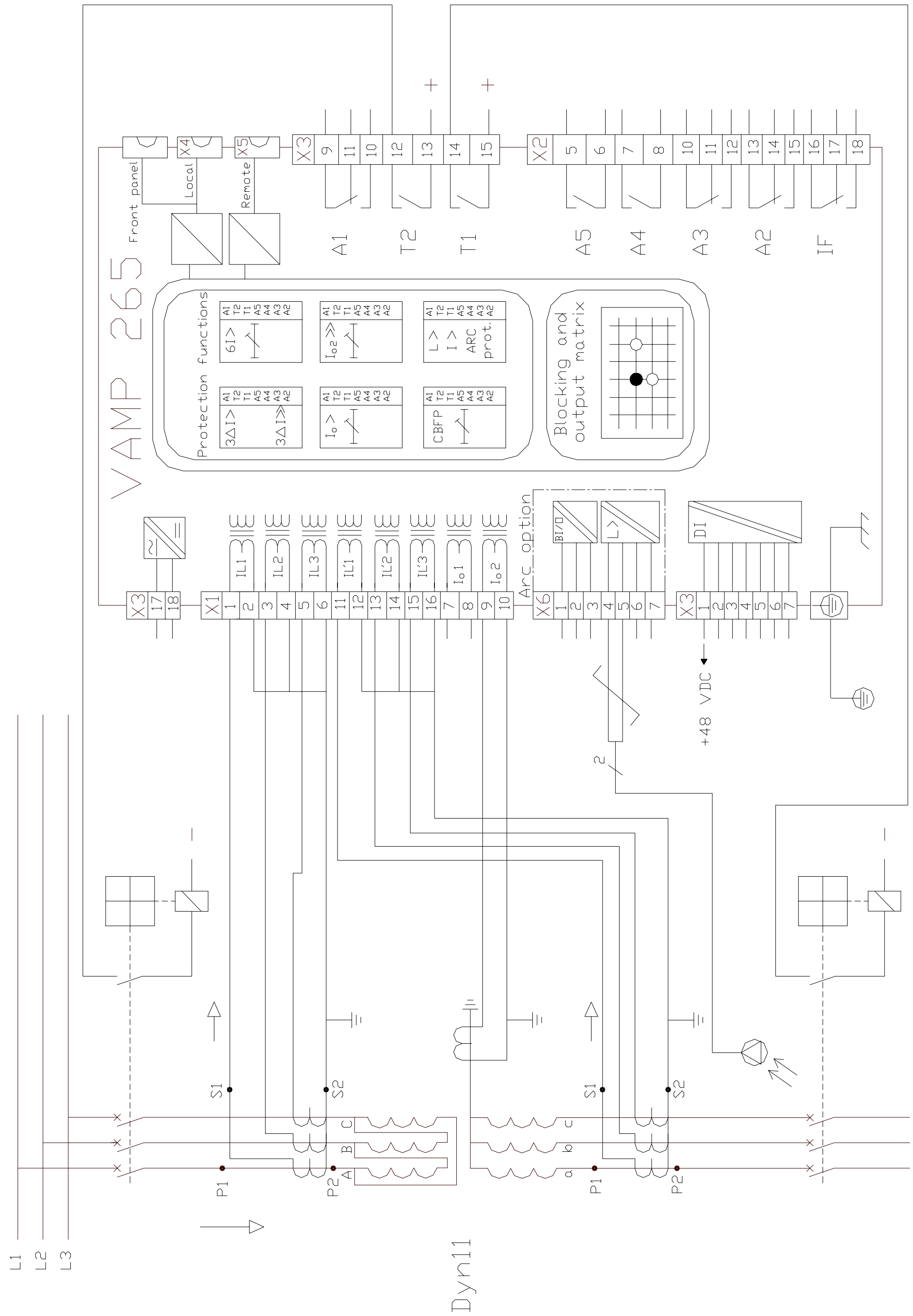

Figure 3.5-1 Differential protection of a Dyn11 transformer using VAMP 265. Primary and secondary current transformers are connected according to subtractive polarity.

Settings:

ConnGrp	Dy11
IoCmps	OFF
I'oCmps	ON
Un	High side voltage
U'n	Low side voltage

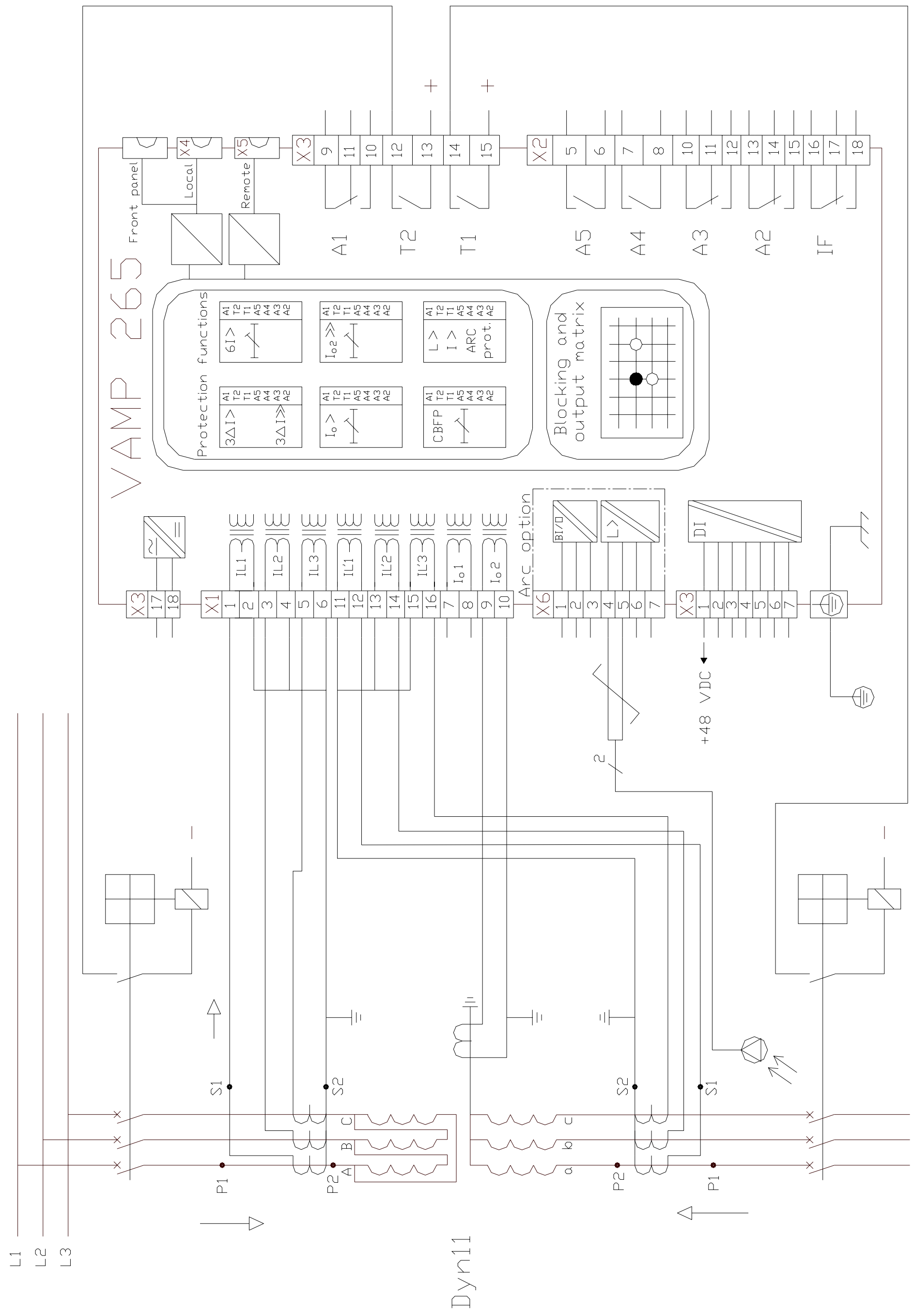

Figure 3.5-2 Differential protection of a Dyn11 transformer using VAMP 265. Primary and secondary current transformers are connected according to additive polarity.

Settings:

ConnGrp	Dy11
IoCmps	OFF
I'oCmps	ON
Un	High side voltage
U'n	Low side voltage

3.6. Protection at a Yd11 transformer

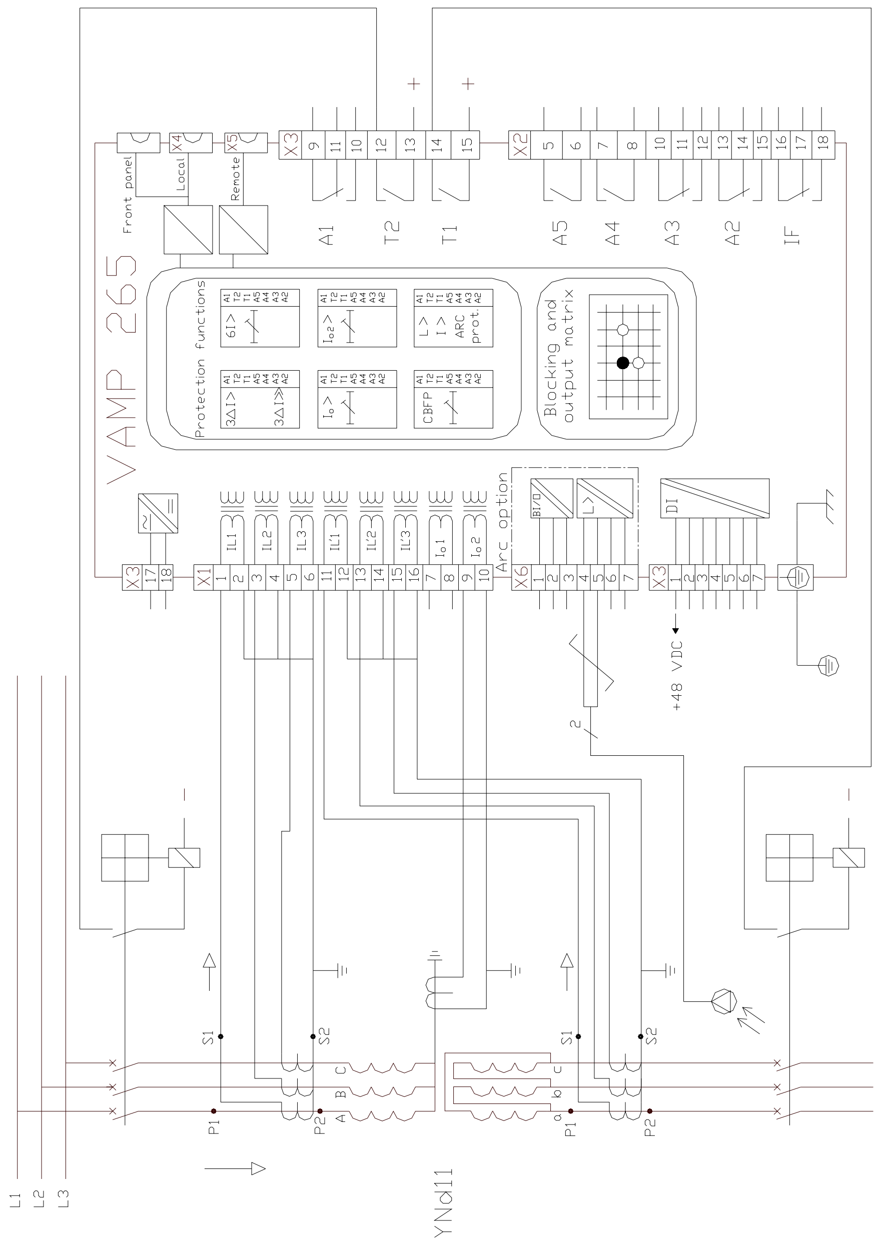

Figure 3.6-1 Differential protection of a YNd11 transformer using VAMP 265.

Settings:

ConnGrp	Yd11
IoCmps	ON
I'oCmps	OFF
Un	High side voltage
U'n	Low side voltage

3.7. Protection at generator and block transformer

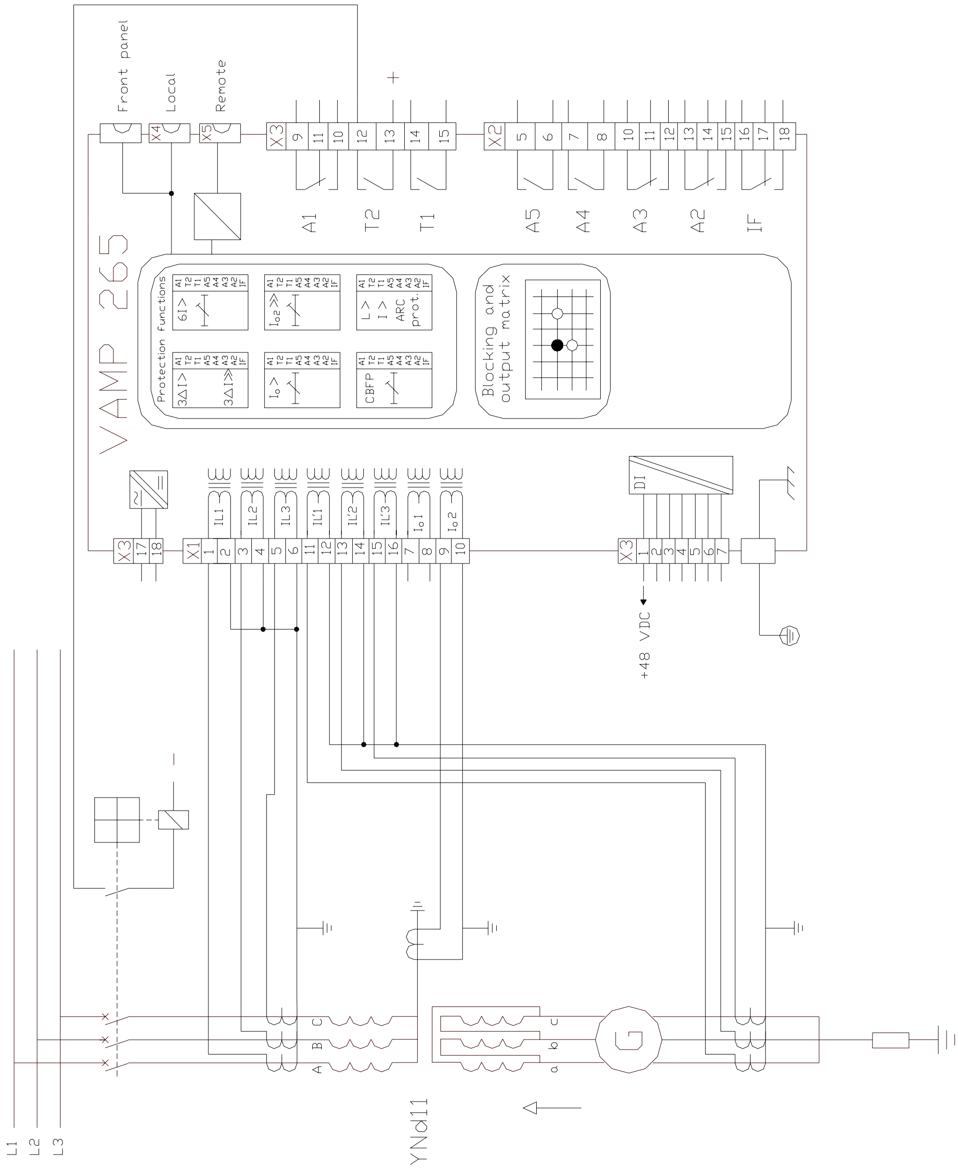

Figure 3.7-1 Differential protection of a YNd11 transformer and generator using VAMP 265.

Settings:

ConnGrp	Yd11
IoCmps	ON
I'oCmps	OFF
Un	High side voltage
U'n	Low side voltage

3.8. Application example of differential protection using VAMP 265

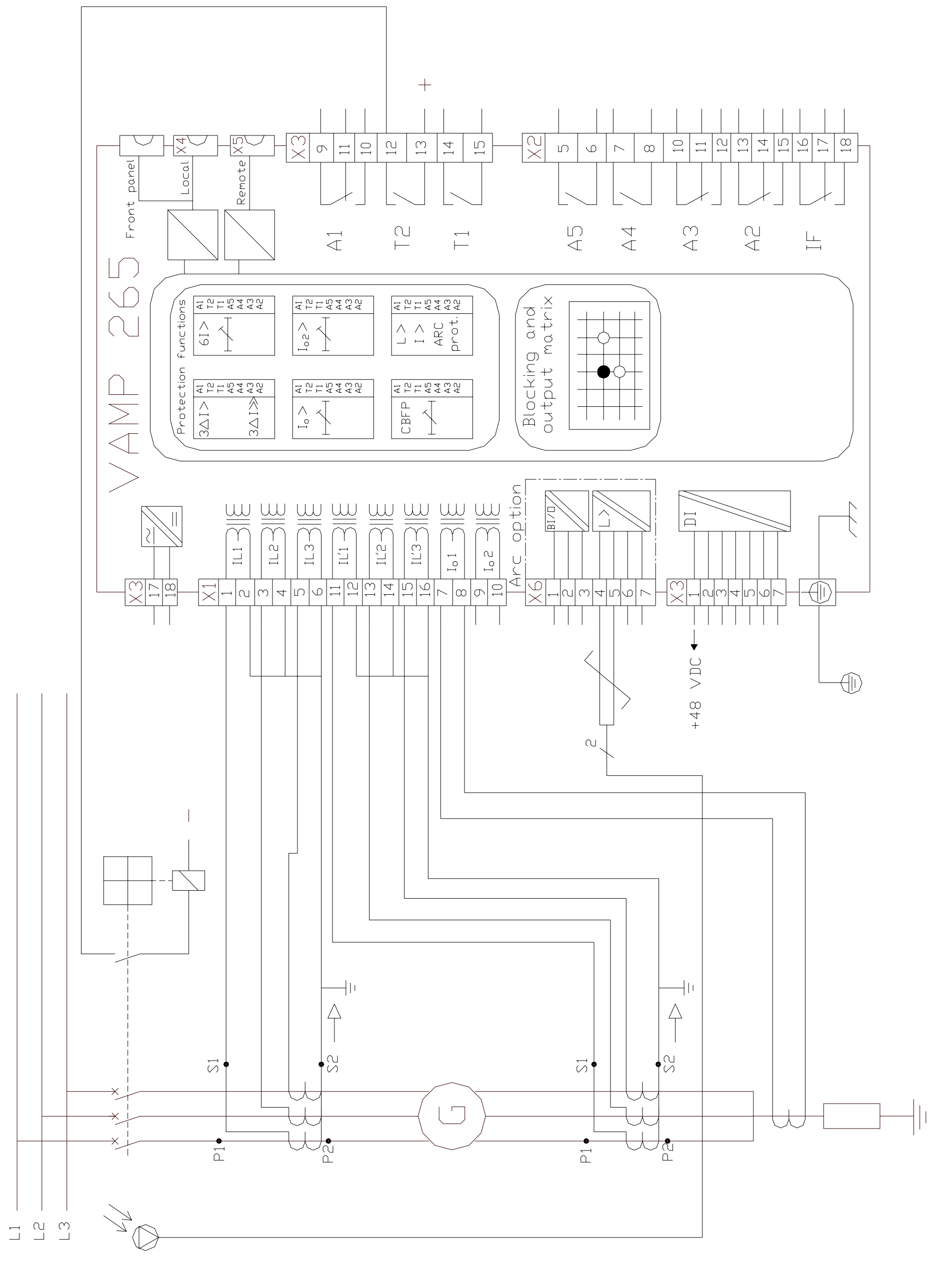

Figure 3.8-1 Differential protection of a generator using VAMP 265.

Settings:

ConnGrp	Yy0
IoCmps	OFF
I'oCmps	OFF
Un	Generator nominal voltage
U'n	Generator nominal voltage

3.9. Trip circuit supervision

Trip circuit supervision is used to ensure that the wiring from the protective relay to the circuit breaker is in order. This circuit is most of the time unused, but when the protection relay 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.

A digital input of the relay can be used for trip circuit monitoring.

- The digital input is connected to an auxiliary miniature relay, which is connected parallel with the trip contacts.
- A resistor module VR11CB enables supervision also when the circuit breaker is open. The module consists of a resistor for 110 Vdc and is connected according the auxiliary voltage.
- 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 remains closed because of latching.

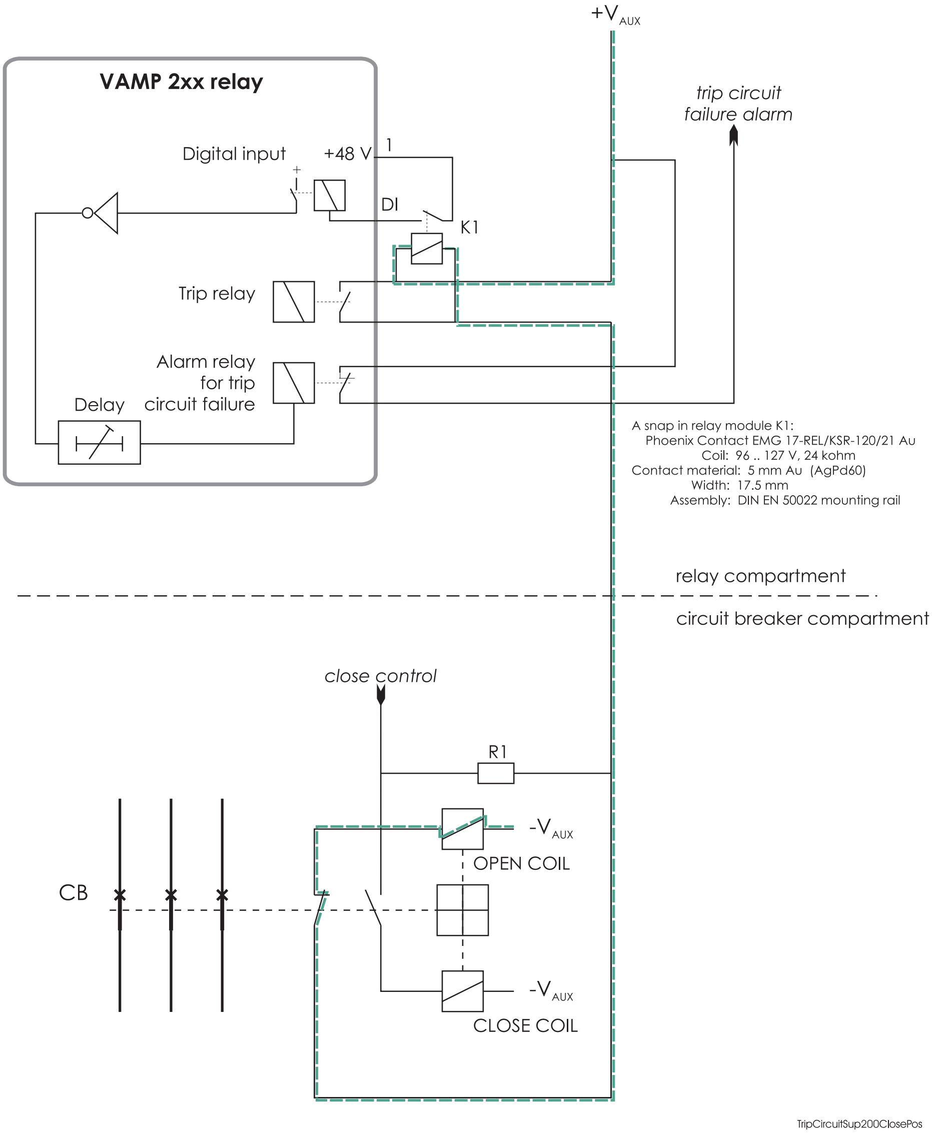

Figure 3.9-1. Trip circuit supervision when the circuit-breaker is closed. The supervised circuitry in this CB position is double-lined. The digital input is in active state.

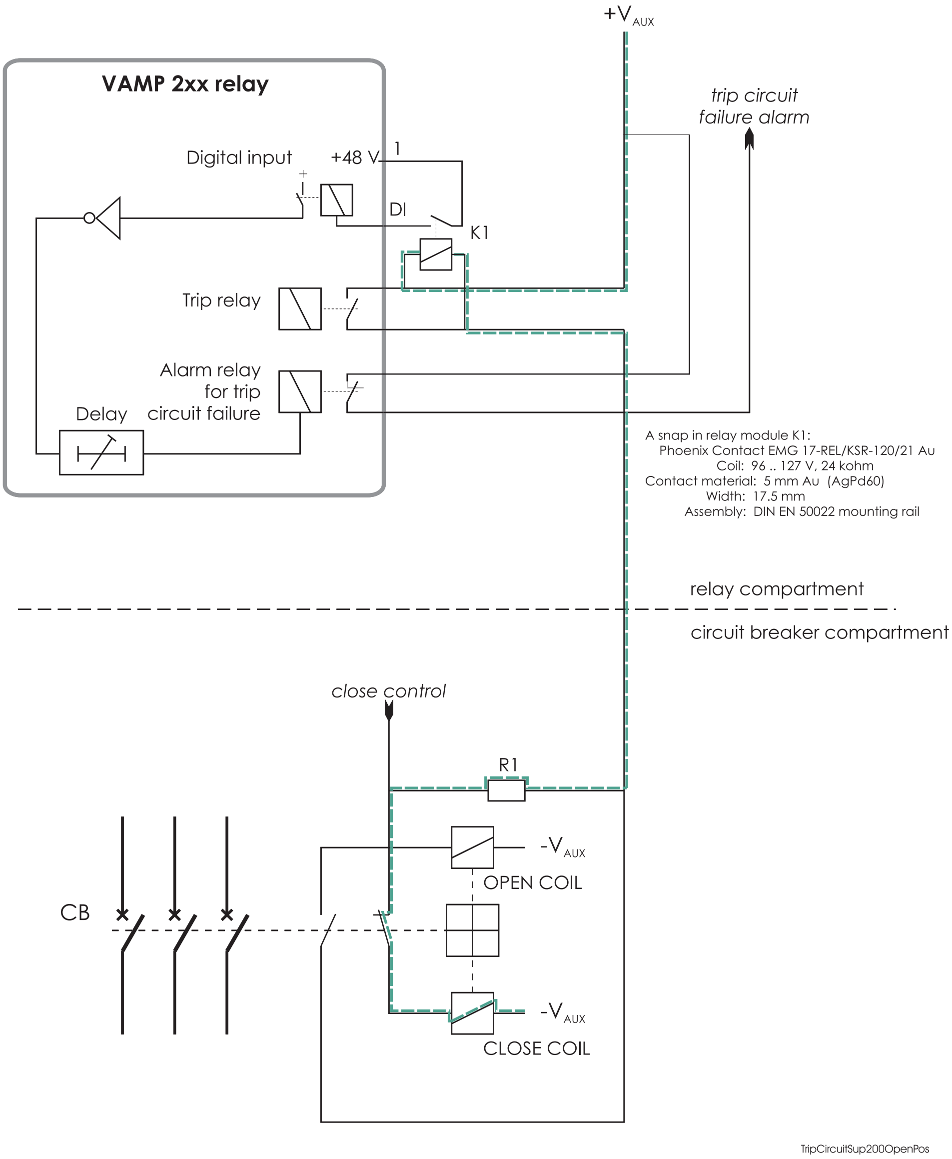

Figure 3.9-2. Trip circuit supervision when the circuit-breaker is open. The supervised circuitry in this CB position is doubled-lined.

4. Connections

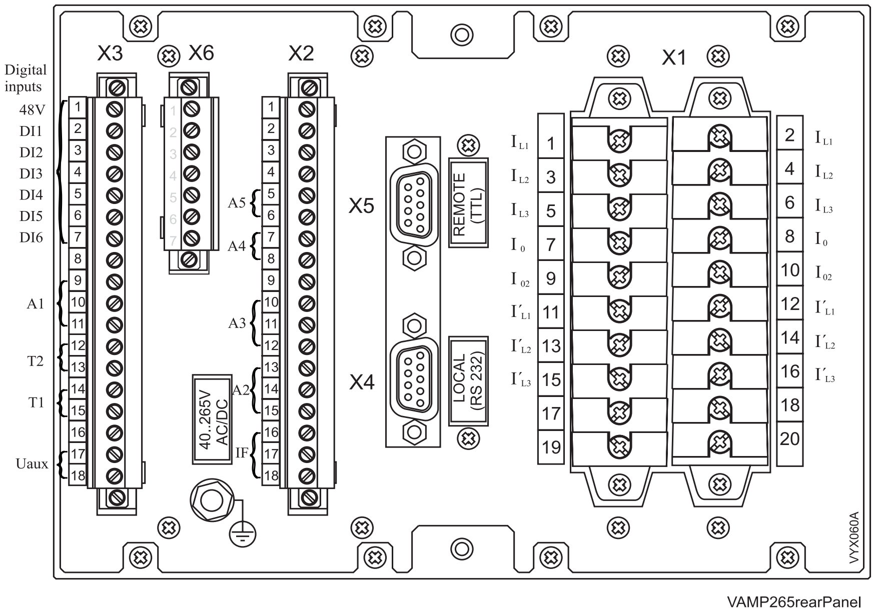

Figure 4-1 Connections on the rear panel of the relay.

The generator, transformer and motor differential protection relay is connected to the protected object through the following measuring and control connections, Figure 4-1:

- Phase currents I_{L1}, I_{L2} and I_{L3} (terminals X1: 1-6)
- Phase currents I'_{L1}, I'_{L2} and I'_{L3} (terminals X1: 11-16)
- Earth fault current I_0 (terminals X1: 7-8)
- Earth fault current I_{02} (terminals X1: 9-10)

4.1. Digital Inputs

Further the generator protection relay can collect status information and alarm signals via six digital inputs (terminals X3: 2-7).

The digital inputs can be used to:

- Block protection stages under certain conditions.
- Get time stamped event code from any auxiliary contact.
- Control the output relays.
- Supervise the trip circuit.

The digital uses the internal 48 V dc auxiliary voltage of the relay (terminal X3: 1). Potential-free contacts must be available in the protected object for transfer of status information to the relay.

4.2. Auxiliary voltage

The external auxiliary voltage Uaux (standard 40…265 V ac or dc) for the relay 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.

4.3. Output relays

The generator, transformer and motor differential protection relay is equipped with seven 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)
- Alarm relays A1 - A5 (terminals X2: 5-6, 7-8, 10-12, 13-15 and X3: 9-11)
- Self-supervision system output relay IF (terminals X2: 16-18)

4.4. Serial communication connection

- RS 232 serial communication connection for computers, connector LOCAL (RS 232), connectors on front panel and rear panel connected in parallel, see Figure 4-1.
- Remote control connection, connector REMOTE (TTL) on the rear panel of the relay, see Figure 4-1.

4.5. Arc Protection

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 the digital input and output channels. This is a 48 Vdc signal.

Connections:

- X6: 1 Digital input (BI)
- X6: 2 Digital 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.

4.6. Block diagram

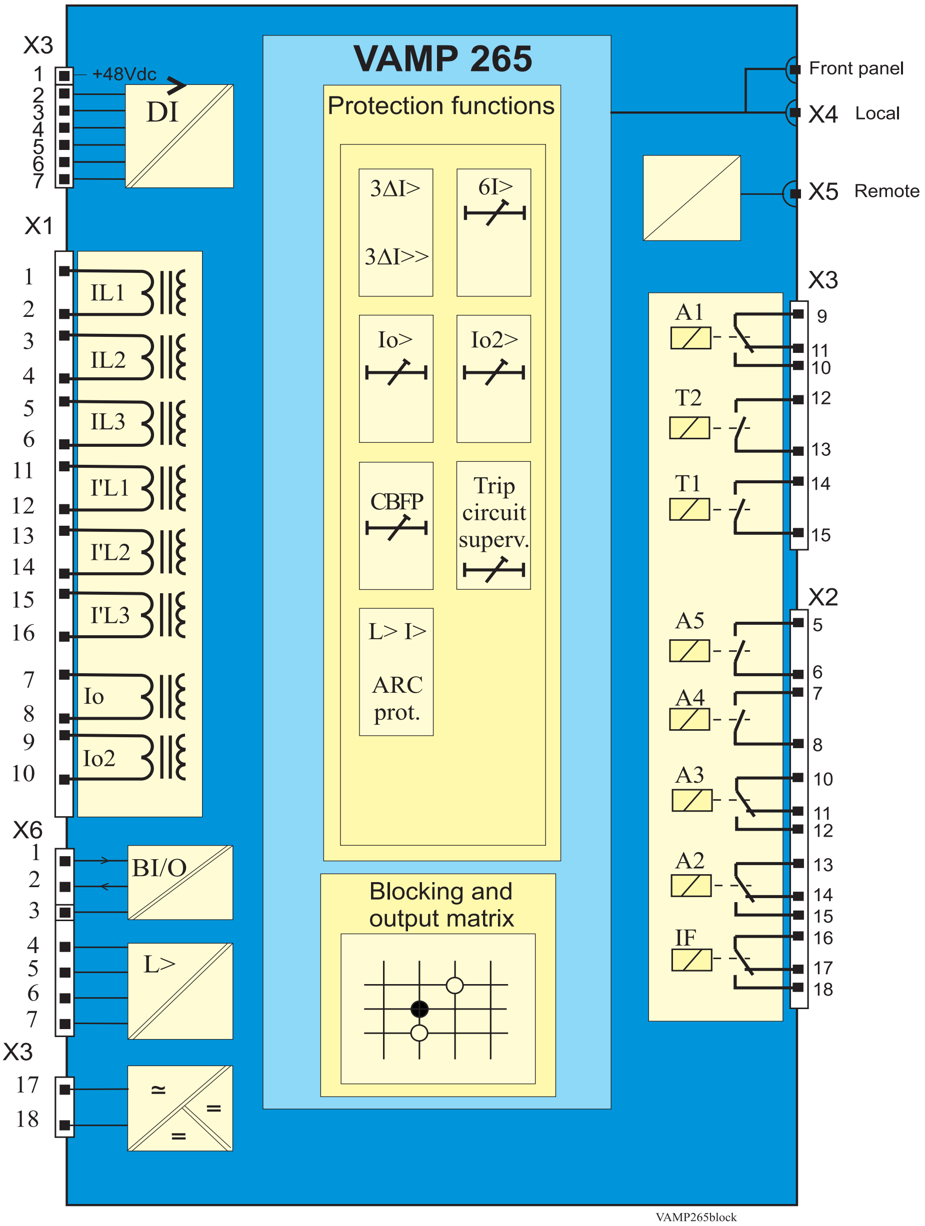

Figure 4.6-1 Block diagram of the generator, transformer and motor differential protection relay VAMP 265.

4.7. Connection diagram

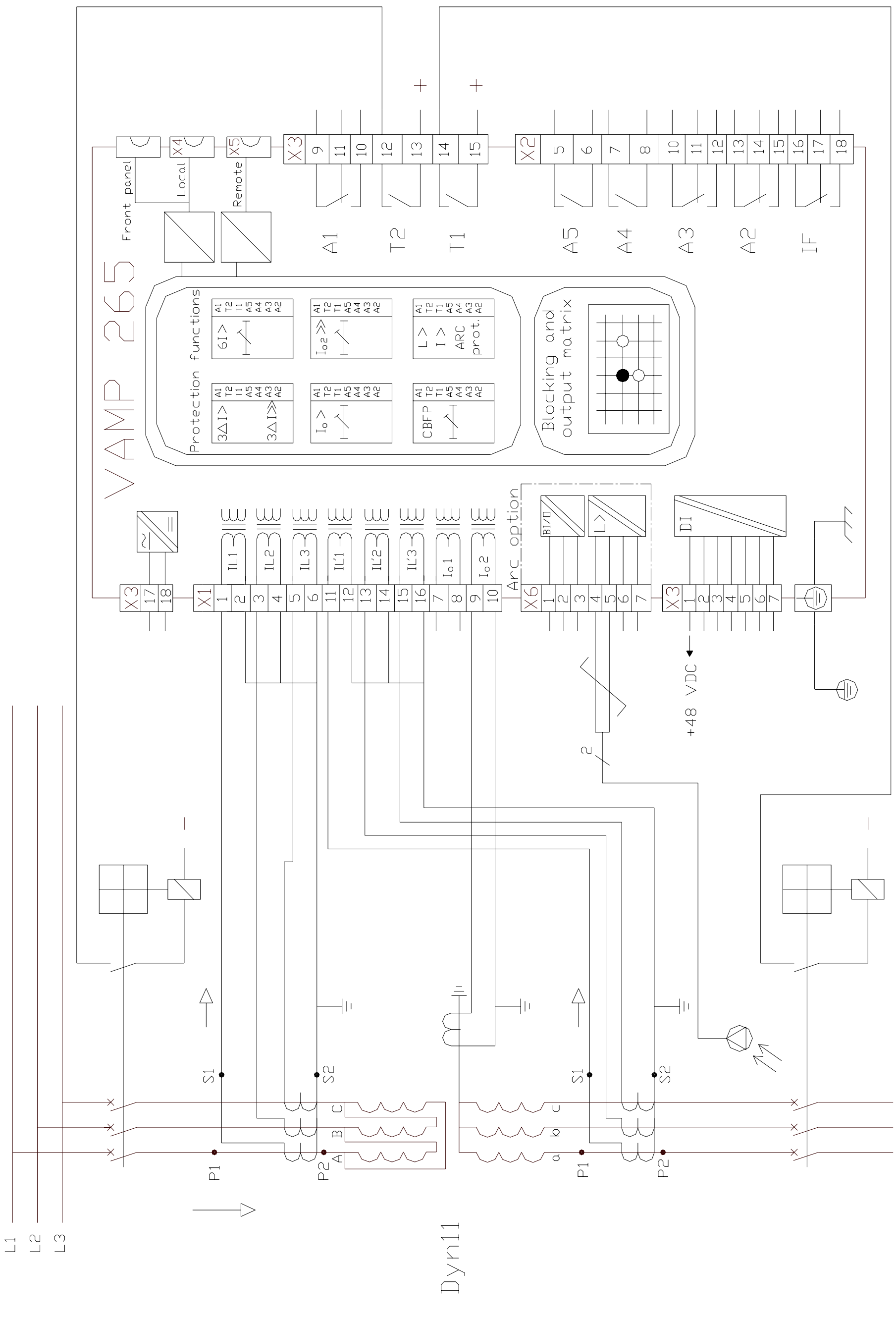

Figure 4.7-1 VAMP 265 connection diagram

5. Technical data

5.1. Connections

5.1.1. Measuring circuitry

Rated current In - Current measuring range - Thermal withstand - Burden	1 A or 5 A 0 - 50 x In 4 x In (continuously) 20 x In (for 10 s) 100 x In (for 1 s) < 0.1 VA (In = 1 A) < 0.2 VA (In = 5 A)
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	45 - 65 Hz 16 - 75 Hz
Terminal Block: - Solid or stranded wire	Max. 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 Max. permitted interruption time	< 7 W (normal conditions) < 15 W (output relays activated) < 50 ms (110 V dc)	
Terminal Block: - Phoenix MVSTBW or equivalent	Max. wire dimension: 2.5 mm² (13-14 AWG)	

5.1.3. Digital inputs

Number of inputs	6
Operation time	0.00 – 60.00 s (step 0.01 s)
Polarity	NO (normal open) or NC (normal closed)
Inaccuracy: - Operate time	 ±1% or ±10 ms
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	Max. wire dimension: 2.5 mm² (13-14 AWG)

5.1.4. Trip contacts (T1 and T2)

Number of contacts	2 making contacts
Rated voltage	250 V ac/dc
Continuous carry	5 A
Max. making current	15 A
Breaking capacity, AC	2 000 VA
Breaking capacity, DC (L/R=40ms)	50 W
Contact material	AgNi 90/10
Terminal Block: - Phoenix MVSTBW or equivalent	Max. wire dimension: 2.5 mm² (13-14 AWG)

5.1.5. Alarm contacts (A1 - A5) and IF

Number of contacts	3 change-over contacts (relays A1, A2 and A3) 2 making contacts (relays A4 and A5) 1 change-over contact (IF relay)
Rated voltage	250 V ac/dc
Max. make current	15 A
Continuous carry	5 A
Breaking capacity, AC	2 000 VA
Contact material	AgNi 0.15 goldplated
Terminal Block: - Phoenix MVSTBW or equivalent	Max. 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	1200 - 38 400 kb/s

5.1.7. Remote control connection

Number of ports	1 on rear panel
Electrical connection	TTL (standard) RS 485 (option) RS 232 (option) Plastic fibre connection (option)
Data transfer rate	1 200 - 38 400 kb/s
Protocols	ModBus,, RTU master ModBus,, RTU slave SpaBus, slave IEC-60870-5-103 Profibus DP (option) TCP/IP (option)

5.2. Tests and environmental conditions

5.2.1. Disturbance tests (EN 50263)

Emission - Conducted (EN 55022) - Emitted (EN 55022)	 0.15 - 30 MHz 30 - 1 000 MHz
Immunity - Static discharge (ESD) - Fast transients (EFT) - Surge - Conducted RF field - Emitted RF 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 1 kV, 1.2/50 µs, common mode 2 kV, 1.2/50 µs, differential mode EN 61000-4-6 0.15 - 80 MHz, 10 V/m, 80% AM (1 kHz) EN 61000-4-3 80 - 1000 MHz, 10 V/m, 80% AM (1 kHz) EN 61000-4-3 900 MHz, 10 V/m, pulse modulated
1 MHz burst	IEC 60255-22-1 1 kV, differential mode 2,5 kV, common mode
Voltage interruption	IEC 60255-11

5.2.2. Test voltages

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

5.2.3. Mechanical tests

Vibration (IEC 60255-21-1)	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)	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
Color code	RAL 7032 (Casing) / RAL 7035 (Back plate)

5.2.6. Package

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

5.3. Protection stages

5.3.1. Overcurrent protection stages

Differential overcurrent stage ΔI> (87)

Setting range	5 - 50 % I_n
Bias current for start of slope 1	0.50 x I_n
Slope 1	5 - 100 %
Bias current for start of slope 2	1.00 - 3.00 x I_n
Slope 2	100 - 200 %
Second harmonic blocking	5 - 30 %, or disable
Reset time Reset ratio	< 60 ms 0.95
Inaccuracy: - Starting - Operating time (I_d > 1.2 x I_{set}) - Operating time (I_d > 3 x I_{set})	 ±3% of set value or ±0.5% of rated value < 60 ms < 50 ms

Differential overcurrent stage ΔI>> (87)

Setting range	5.0 - 40.0 x I_n
Reset time Reset ratio	< 60 ms 0.95
Inaccuracy: - Starting - Operating time	 ±3% of set value or ±0.5% of rated value < 40 ms

Overcurrent stage I> (50/51)

Setting range	1.00 - 40.00 x I_n
Definite time function: - Operating time	 0.08 - 300.00 s (step 0.02 s)
Start time Reset time Reset ratio	< 60 ms < 60 ms 0.97
Inaccuracy: - Starting - Operate time	 ±3% of set value or 0.5% of rated value ±1% or ±30 ms

5.3.2. Earth-fault protection stages

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

Setting range	0.100 - 2.000 pu
Definite time function: - Operating time	 0.08 – 300.00 s (step 0.02 s)
Start time Reset time Reset ratio	< 60 ms < 60 ms 0.97
Inaccuracy: - Starting - Operate time	 ±3% of set value or ±0.5% of rated value ±1% or ±30 ms

5.3.3. Circuit breaker failure protection stage

Circuit breaker failure protection CBFP (50BF)

Relay to be supervised	T1 or T2
Definite time function - Operating time	 0.1 – 10.0 s (step 0.1 s)
Inaccuracy - Operating time	 ±100 ms

5.3.4. Arc fault protection stages (option)

The operation of the arc protection depends on the setting value of the ArcI> current limit. The current limit cannot be set, unless the relay is provided with the optional arc protection card.

Arc protection stages ArcI>, ArcI'> (50AR)

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

Arc protection stages $ArcI_0>$, $ArcI_{02}>$ (50AR)

Setting range	0.05 - 1.00 pu
Arc sensor connection	S1, S2, S1/S2, BI, S1/BI, S2/BI, S1/S2/BI
Operating time	~15 ms

5.4. Disturbance Recorder (DR)

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

Disturbance recorder (DR)

Mode of recording:	Saturated / Overflow
Sample rate:	
- Waveform recording	32/cycle, 16/cycle, 8/cycle
- Trend curve recording	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

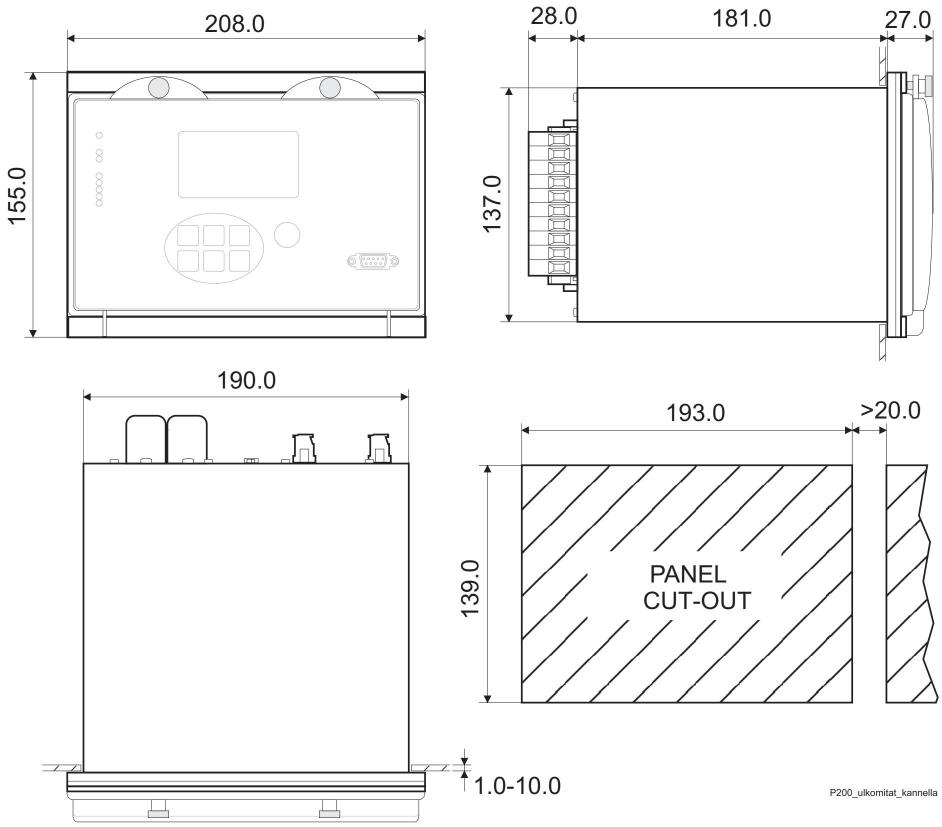

Figure 6.1-1 Dimensional drawing and panel cutout dimensions.

6.2. Panel mounting

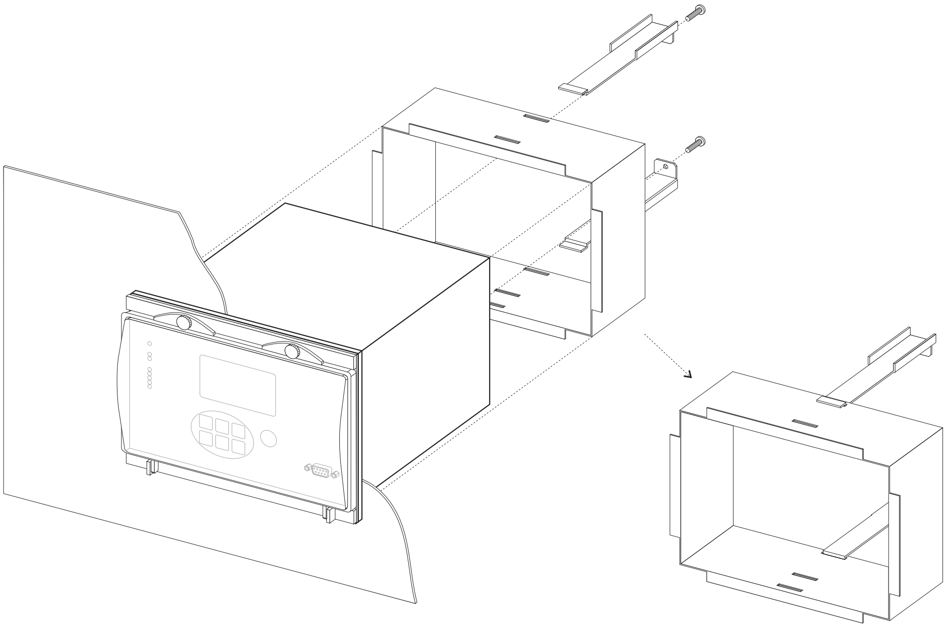

Figure 6.2-1 Flush-mounting of protection relay in panel.

6.3. Semi-flush mounting

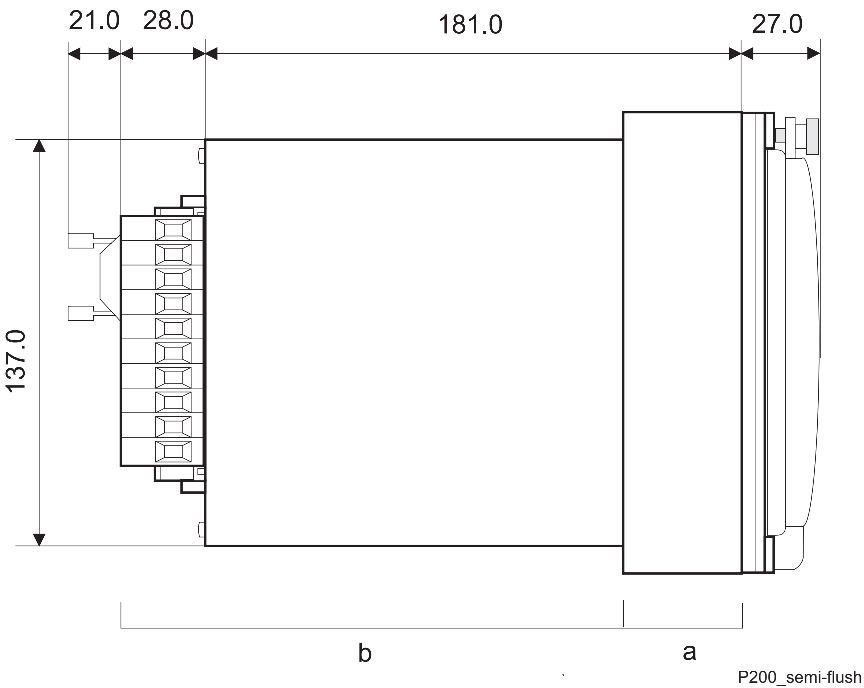

Figure 6.3-1 Semi-flush mounting of protection relay

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 265

Quantity:

Auxiliary voltage:

Rated current:

Rated earth fault current:

Options:

VAMP 265 ORDERING CODE

VAMP 265 - □□ 7 □□□

Nominal current, HV & LV side [A]
- **1** = 1A & 1A
- **3** = 1A & 5A
- **4** = 5A & 1A
- **5** = 5A & 5A

Nominal earth-fault currents Io & I'o [A]
- **A** = 5A & 5A
- **B** = 5A & 1A
- **C** = 1A & 5A
- **D** = 1A & 1A

Frequency [Hz]
- **7** = 50/60Hz

Supply voltage [V]
- **A** = 40.. 265Vac/dc
- **B** = 18.. 36Vdc
- **C** = 40.. 265Vac/dc + ARC Protection
- **D** = 18.. 36Vdc + ARC Protection

Optional hardware
- **A** = None
- **B** = Plastic/Plastic fibre interface
- **C** = Profibus Interface
- **D** = RS485 Interface
- **E** = Glass/Glass Optic Interface
- **F** = Plastic/Glass Optic Interface
- **G** = Glass/Plastic Optic Interface

Optional software
- **A** = None

Accessories :

Order Code	Explanation	Note
VEA 3 CG	Ethernet Interface Module	VAMP Ltd
VPA 3 CG	Profibus Interface Module	VAMP Ltd
VMA 3 CG	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
VX008-4	TTL/RS232 Converter Cable (for Modem MD42, ILPH, ..)	Cable length 4m
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 Users's Manual VMV.EN0xx

Manufacturer data:

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Fax. +358 (0)20 753 3205
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