

# VAMP 96

Measuring and monitoring unit

Operation and configuration instructions

Technical description





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# 1. General

This part of the manual (Operation and configuration) describes the functions of the measuring and monitoring unit VAMP 96 and includes the unit operation instructions. It also contains instructions for parameterization and configuration of the unit and instructions for changing settings.

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

## 1.1. Unit features

VAMP 96 measuring and monitoring unit is a compact multi-function monitoring device with extensive measuring and calculation functions. Setting and programming possibilities are comprehensive and versatile. VAMP 96 is ideal for measuring and monitoring management of industrial low and medium voltage power distribution products.

The unit measures three-phase currents, voltages and frequency and calculates following values:

- Active, reactive and apparent power
- Active and reactive energy
- Harmonics and THD of currents and voltages
- Programmable demand value calculations

Further, the unit includes :

- one normal open solid state output
- three configurable digital channels.

VAMP 96 communicates with other systems using common protocols, such as the Modbus RTU, ModbusTCP, Profibus DP, IEC 60870-5-103, SPA bus, IEC 60870-5-101, DNP 3.0.

## 1.2. User interface

VAMP 96 measuring and monitoring unit can be controlled in three ways:

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

## 1.3. Operating Safety



The terminals on the rear panel of the unit 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. Local panel user interface

### 2.1. Unit front panel

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

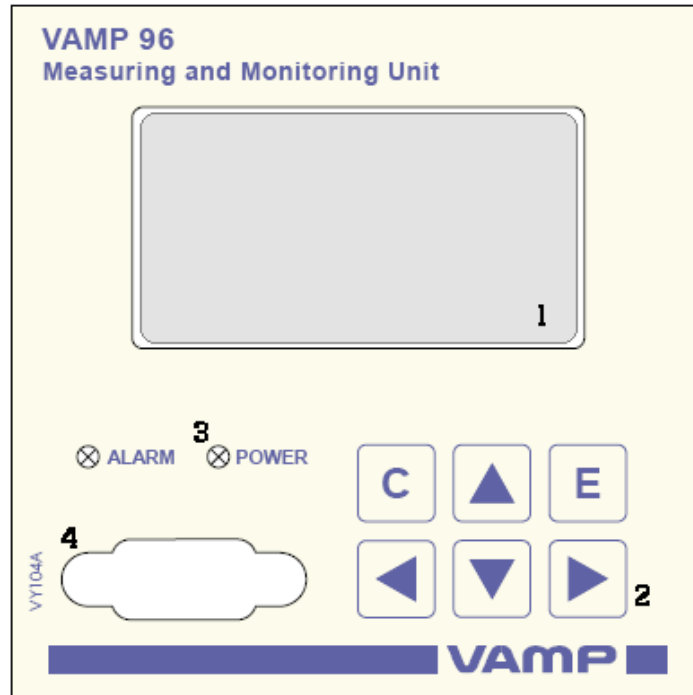


Figure 2.1-1 VAMP 96 front panel

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

## 2.1.1. Display

VAMP 96 is provided with a backlit LCD 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 is divided into sections as shown in the next figure

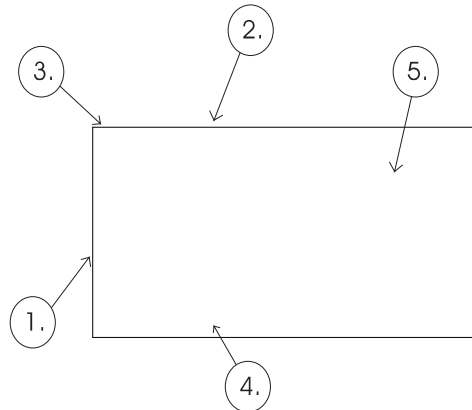


Figure 2.1.1-1 Sections of the LCD dot matrix display

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

## 2.1.2. Keypad

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

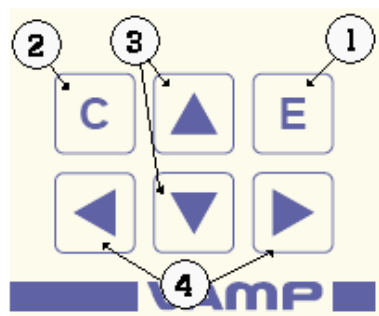


Figure 2.1.2-1 Keys on the keypad

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)

**NOTE!**

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

### 2.1.3. Operation Indicators

The unit is provided with two LED indicators:



Figure 2.1.3-1 Operation indicators of the unit

LED indicator	Meaning	Measure/ Remarks
Power LED lit	The auxiliary power has been switched on	Normal operation state
Alarm LED lit	One or several signals of the output matrix have been assigned to the LED and the LED is activated by one of the signals.	The LED is switched off when the signal that caused the activation is reset. The resetting depends on the type of configuration, connected or latched.

#### Resetting latched alarm indicator

The alarm indicator can be given a latching function in the configuration.

There are several ways to reset latched alarm indicator:

- From the alarm list, move back to the initial display by pushing the CANCEL key for approx. 3 s. Then reset the latched alarm indicator 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 alarm indicator by pushing the ENTER key.

The latched alarm indicator can also be reset via a remote communication bus or via a digital input configured for that purpose.

### 2.1.4. 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. More information, please see chapter 3.

## 2.2. Local panel operations

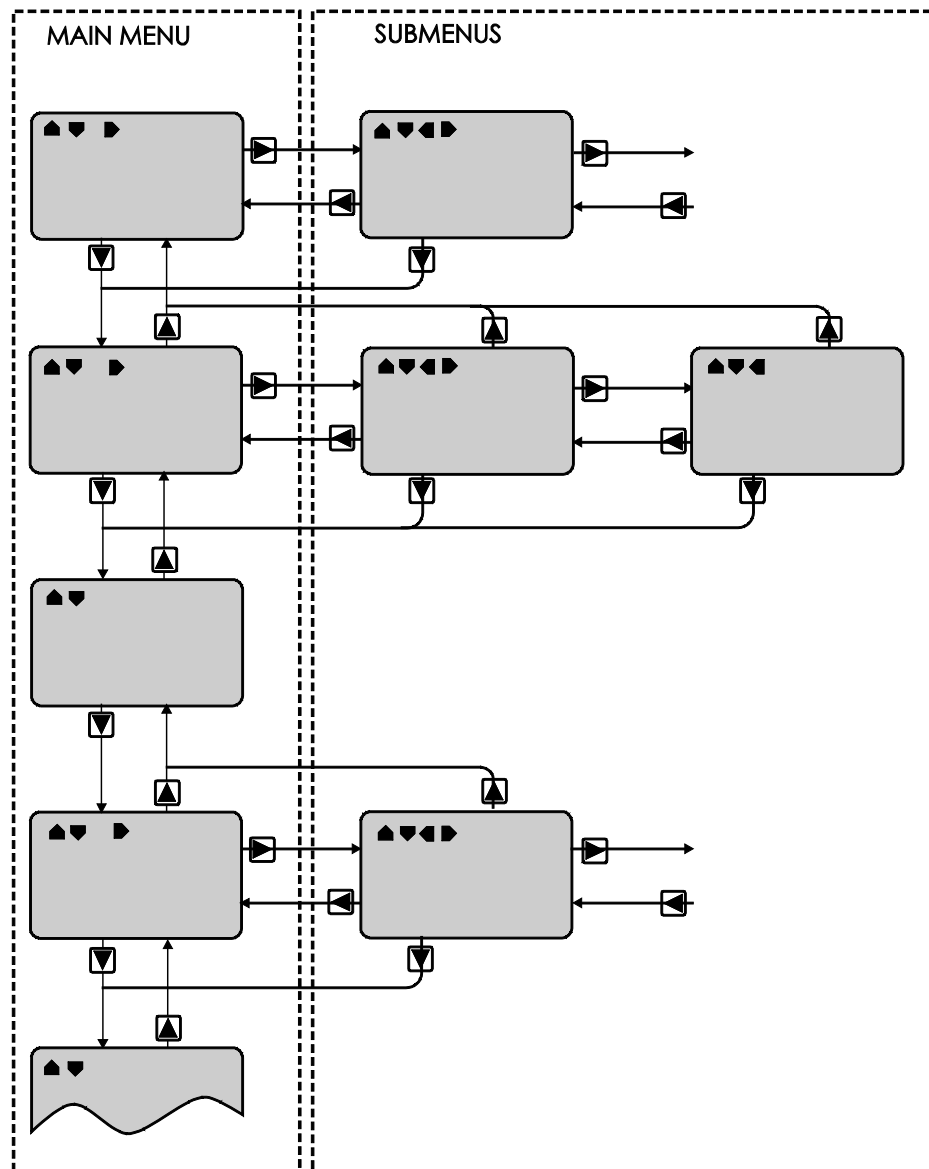
The local panel is being used to read measured values, to set parameters and to configure unit functions. Some parameters, however, can only be set by means of a PC connected to one of the local communication ports. Further some parameters are factory set.

### 2.2.1. 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. For moving 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.
4. Push the CANCEL key to cancel a selection.
5. Pushing the UP or DOWN key in any position of a submenu, 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 background color. The possible navigating directions in the menu are shown in the upper-left corner by means of black triangular symbols.



*Figure 2.2.1-1 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.

## Main menu

Main menu	Number of menus	Description	Note
	5	Double size measurements defined by the user	1
	1	Title screen with device name, time and firmware version.	
P	15	Power measurements	
E	5	Energy measurements	
I	14	Current measurements	
U	19	Voltage measurements	
Dema	15	Demand values	
Umax	8	Time stamped min & max of voltages	
Imax	8	Time stamped min & max of currents	
Pmax	5	Time stamped min & max of power and frequency	
Mont	20	Maximum values of the last 31 days and the last twelve months	
Evnt	2	Events	
DR	2	Disturbance recorder	2
Runh	2	Running hour counter. Active time of a selected digital input and time stamps of the latest start and stop.	
TIMR	6	Day and week timers	
DI	5	Digital inputs including virtual inputs	
DO	2	Digital outputs (relays) and output matrix	
Alrm	5	Alarm set	
Prg1	3	1st programmable stage	4
Prg2	3	2nd programmable stage	4
Prg3	3	3rd programmable stage	4
Prg4	3	4th programmable stage	4
Prg5	3	5th programmable stage	4
Prg6	3	6th programmable stage	4
Prg7	3	7th programmable stage	4
Prg8	3	8th programmable stage	4
Lgic	2	Status and counters of user's logic	1
CONF	9	Device setup, scaling etc.	6
Bus	10	Serial port and protocol configuration	7
Diag	8	Device selfdiagnosis	

## 2.2.2. Operating levels

The unit has two operating levels: *User level* and *Configurator level*. The purpose of the access levels is to prevent accidental change of unit 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

### CONFIGURATOR level

Use:	The configurator level is needed during the commissioning of the unit. E.g. the scaling of the voltage and current transformers can be set.
Opening:	Default password 2
Setting state:	Push ENTER
Closing:	The level is automatically closed after 10 minutes idle time. Giving the password 9999 can also close the level.

### Opening access

1. Push the LEFT key and the RIGHT key on the front panel simultaneously.

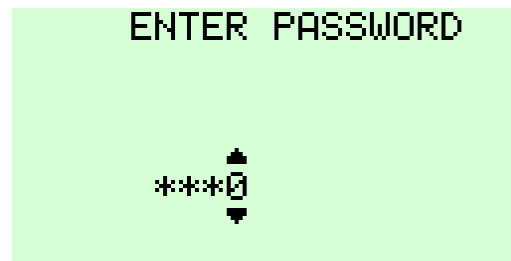


Figure 2.2.2-1. Opening the operating level

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.

## Password handling

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

It is possible to restore the password(s) in case the password is lost or forgotten. In order to restore the password(s), VAMPSET software 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 unit (Example: 12345)

Send both numbers to [vampsupport@vamp.fi](mailto:vampsupport@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.

## 2.3. Operating measures

VAMP 96 can be controlled via the unit front panel, a PC running the VAMPSET software, a PC running suitable unit software or via a remote control system.

### 2.3.1. Default displays

VAMP 96 has 5 default displays.

Display 1/5 contains IL1, IL2 and IL3.

Display 2/5 contains U12, U23, U31 and Uo.

Display 3/5 contains UL1, UL2, UL3 and Uo.

Display 4/5 contains f, P, Q and S.

Display 5/5 contains PF and CosPhi.

You can change these default values using VAMPSET software.

### 2.3.2. Measured data

The measured values can be read from the P, E, I and U menus and their submenus. Some of these values can also be seen in default displays 1-5.

Value	Menu/Submenu	Description
P	P/POWER	Active power [kW]
Q	P/POWER	Reactive power [kvar]
S	P/POWER	Apparent power [kVA]
$\phi$	P/POWER	Active power angle [°]
P.F.	P/POWER	Power factor [ ]
f	P/POWER	Frequency [Hz]
Prms	P/RMS POWER	RMS of active power
Qrms	P/RMS POWER	RMS of reactive power
Srms	P/RMS POWER	RMS of apparent power
Diagram	P/PQ DIAGRAM	Active and reactive power diagram
Pda	P/POWER DEAMAND	Active power demand value
Qda	P/POWER DEAMAND	Reactive power demand value
Sda	P/POWER DEAMAND	Apparent power demand value
PFda	P/POWER DEAMAND	Power factor demand value
fda	P/POWER DEAMAND	Frequency demand value
Prmsda	RMS POWER DEMAND	Active power RMS demand value
Qrmsda	RMS POWER DEMAND	Reactive power RMS demand value
Srmsda	RMS POWER DEMAND	Apparent power RMS demand value
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; ??]
Useq	P/PHASE SEQUENCIES	Actual voltage phase sequency [OK; Reverse; ??]
fAdop	P/PHASE SEQUENCIES	Adopted frequency [Hz]
PODir	P/PHASE SEQUENCIES	Power direction
Diagram	P/PL1 DIAGRAM	Diagram of active power PL1
Diagram	P/PL2 DIAGRAM	Diagram of active power PL2
Diagram	P/PL3 DIAGRAM	Diagram of active power PL3

Diagram	P/ ACTIVE POWER TREND	Trend of active power
Diagram	P/ REACTIVE POWER TREND	Trend of reactive power
Diagram	P/ APPARENT POWER TREND	Trend of apparent power
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/Epulse TEST	You may give test pulse
Eq+	E/Epulse TEST	You may give test pulse
E-	E/Epulse TEST	You may give test pulse
Eq-	E/Epulse TEST	You may give test pulse
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]
IL3da	I/PHASE CURRENTS	15 min average for IL3 [A]
Angle diagram	I/ANGLE DIAGRAM	Angle of currents IL1-IL3
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	I/HARMONICS of IL1	Harmonics of phase current IL1 [%]
Diagram	I/HARMONICS of IL2	Harmonics of phase current IL2 [%]
Diagram	I/HARMONICS of IL3	Harmonics of phase current IL3 [%]
Diagram	I/IL1 WAVEFORM	Waveform of IL1
Diagram	I/IL2 WAVEFORM	Waveform of IL2
Diagram	I/IL3 WAVEFORM	Waveform of IL3
Diagram	I/IL1 TREND	Trend of IL1
Diagram	I/IL2 TREND	Trend of IL2
Diagram	I/IL3 TREND	Trend of 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]
Diagram	U/ ANGLE DIAGRAM 1	Diagram of line voltages
Diagram	U/ ANGLE DIAGRAM 2	Diagram of phase voltages
Uo	U/SYMMETRIC VOLTAGES	Uo value [%]
U1	U/SYMMETRIC VOLTAGES	Positive sequence voltage [%]
U2	U/SYMMETRIC VOLTAGES	Negative sequence voltage [%]
U2/U1	U/SYMMETRIC VOLTAGES	Negative sequence voltage related to 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	U/HARMONICS of Ua	Harmonics of voltage input Ua [%]
Diagram	U/HARMONICS of Ub	Harmonics of voltage input Ub [%]
Diagram	U/HARMONICS of Uc	Harmonics of voltage input Uc [%]

Enable	U/VOLTAGE SAG & SWELL	On/off
Status	U/VOLTAGE SAG & SWELL	Voltage status
U<	U/VOLTAGE SAG & SWELL	Alarm level [%]
U>	U/VOLTAGE SAG & SWELL	Alarm level [%]
Delay	U/VOLTAGE SAG & SWELL	Delay in seconds [s]
LVBkck	U/VOLTAGE SAG & SWELL	Block level [%]
SagOn	U/VOLTAGE SAG & SWELL	Sag on event
SagOff	U/VOLTAGE SAG & SWELL	Sag off event
SwelOn	U/VOLTAGE SAG & SWELL	Swell on event
SwelOf	U/VOLTAGE SAG & SWELL	Swell off event
Status	U/SAG & SWELL CNTRS	High
Count	U/SAG & SWELL CNTRS	Sag counter
Total	U/SAG & SWELL CNTRS	Total sag length in seconds
Count	U/SAG & SWELL CNTRS	Swell counter
Total	U/SAG & SWELL CNTRS	Total swell length in seconds
	U/SAG LOG	Date of sag [yyyy:mm:dd]
	U/SAG LOG	Time of sag [hh:mm:ss:ms]
Type	U/SAG LOG	Type of sag [Phases]
Duration	U/SAG LOG	Duration of sag [s]
Min1	U/SAG LOG	Minimum phase1 % of Un
Min2	U/SAG LOG	Minimum phase2 % of Un
Min3	U/SAG LOG	Minimum phase3 % of Un
Ave1	U/SAG LOG	Mean phase1 % of Un
Ave2	U/SAG LOG	Mean phase2 % of Un
Ave3	U/SAG LOG	Mean phase3 % of Un
Max1	U/SAG LOG	Maximum phase1 % of Un
Max2	U/SAG LOG	Maximum phase2 % of Un
Max3	U/SAG LOG	Maximum phase3 % of Un
	U/SWELL LOG	Date of swell [yyyy:mm:dd]
	U/SWELL LOG	Time of swell [hh:mm:ss:ms]
Type	U/SWELL LOG	Type of swell [Phases]
Duration	U/SWELL LOG	Duration of swell [s]
Max1	U/SWELL LOG	Maximun phase1 % of Un
Max2	U/SWELL LOG	Maximun phase2 % of Un
Max3	U/SWELL LOG	Maximun phase3 % of Un

Ave1	U/SWELL LOG	Mean phase1 % of Un
Ave2	U/SWELL LOG	Mean phase2 % of Un
Ave3	U/SWELL LOG	Mean phase3 % of Un
Min1	U/SWELL LOG	Minimum phase1 % of Un
Min2	U/SWELL LOG	Minimum phase2 % of Un
Min3	U/SWELL LOG	Minimum phase3 % of Un
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]
U1	U/ VOLT INT SETTING	Current state of U1
U1<	U/ VOLT INT SETTING	Voltage interrupt limit [%]
Period	U/ VOLT INT SETTING	8h/day/week/month/year
Date	U/ VOLT INT SETTING	Year-month-day
Time	U/ VOLT INT SETTING	Hours-minutes-seconds
Event	U/ VOLT INT SETTING	Enabled
I_On	U/ VOLT INT SETTING	Interrupt on event
I_Off	U/ VOLT INT SETTING	Interrupt off event

### 2.3.3.

## 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.

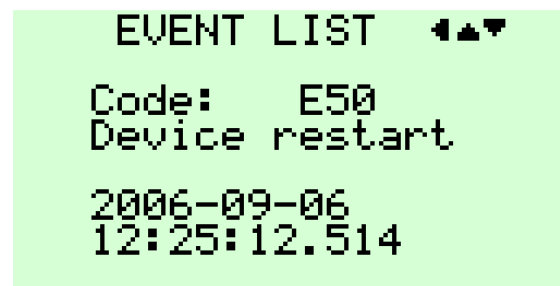


Figure 2.3.3-1 Example of an event register

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.

## 2.4. Configuration and parameter setting

The minimum procedure to configure a unit is

1. Open the access level "Configurator". The default password for configurator access level is 2.
2. Set the rated values in menu [CONF] including at least current transformers, voltage transformers and generator ratings. Also the date and time settings are in this same main menu.
3. Enable the needed protection functions and disable the rest of the protection functions in main menu [Prot].
4. Set the setting parameter of the enable protection stages according the application.
5. Connect the output units to the start and trip signals of the enabled protection stages using the output matrix. This can be done in main menu [DO], although the VAMPSET program is recommended for output matrix editing.
6. Configure the needed digital inputs in main menu [DI].
7. Configure blocking and interlockings for protection stages using the block matrix. This can be done in main menu [Prot], although VAMPSET is recommended for block matrix editing.

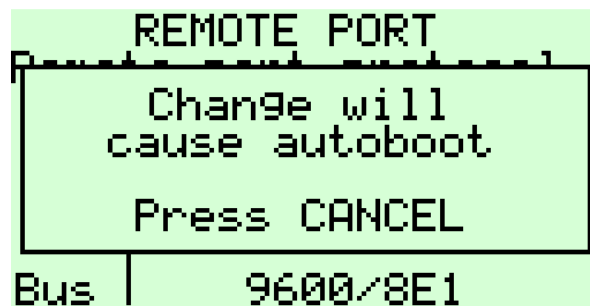


Figure 2.4-1 Example of auto-reset display

Press CANCEL to return to the setting view. If a special parameter need to be changed, press the ENTER key again and the parameter can 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.

## 2.4.1. 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 “configurator” access level by pushing the LEFT and RIGHT keys simultaneously and then using the arrow keys and the ENTER key (default value = 0002). For more information about the operating levels, please refer to 3.2.
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.
7. Push the CANCEL key to move back to one level up menu.
8. Push the CANCEL key to move back to main menu.

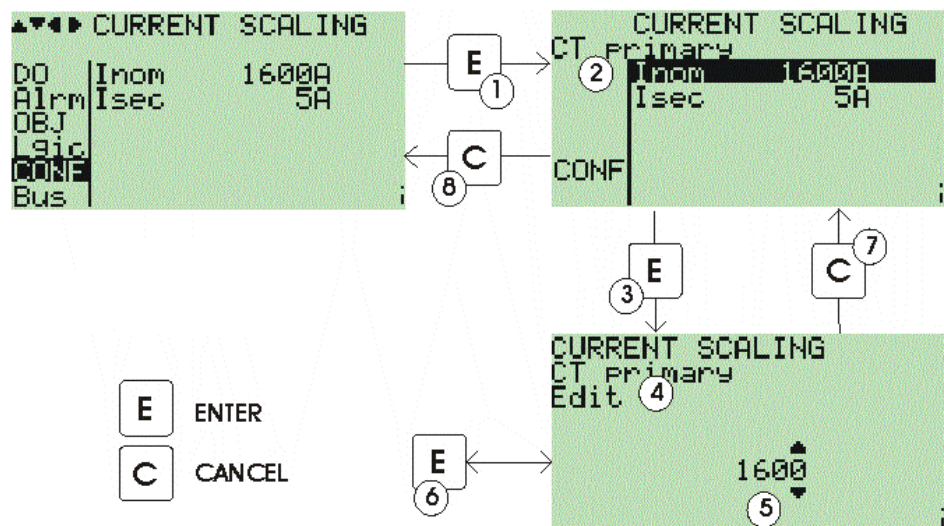


Figure 2.4.1-1 Changing parameters

## 2.4.2. 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:**

- DO, DI
- Uline, Uphase
- IL
- U2/U1, U2, U1
- I2/In, I2/I1, I2, I1, IoCalc
- CosFii
- PF, S, Q, P
- f
- UL3, UL2, UL1
- U31, U23, U12
- IL3, IL2, IL1
- Prms, Qrms, Srms
- Tanfii
- THDIL1, THDIL2, THDIL3
- THDUa, THDUb, THDUc
- Uo
- IL1RMS, IL2RMS, IL3RMS
- ILmin, ILmax, ULLmin, ULLmax, ULNmin, ULNmax

### 2.4.3. 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 1-3)
- Operation counters (DI COUNTERS)
- Operation delay (DELAYs for DigIn)
- Operation DI NO /NC, alarm display, event mask (on/off event)
- Event enabling EVENT MASK1

### 2.4.4. Configuring digital output

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

- The status of the output unit
- The configuration of the output signal to the output unit.  
The configuration of the operation indicator (LED) Alarm.

### 2.4.5. 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

- List of available language in the unit

#### CURRENT SCALING

- Rated phase CT primary current (Inom)
- Rated phase CT secondary current (Isec)

#### VOLTAGE SCALING

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

#### FUNDAMENTAL/RMS

- Energy calculation mode
- Display fundamental measurements
- Display RMS measurements

### DEVICE INFO

- Unit type
- Serial number (SerN)
- Software version (PrgVer)
- Bootcode version (BootVer)

### DATE/TIME SETUP

- Day, month and year (Date)
- Time of day (Time)
- Date format (Style). The choices are "yyyy-mm-dd", "dd.nn.yyyy" and "mm/dd/yyyy".

### CLOCK SYNC

- Digital input for minute sync pulse (SyncDI). If any digital input is not used for synchronization, select "-".
- Daylight saving time for NTP synchronization (DST).
- Detected source of synchronization (SyScr).
- Synchronization message counter (MsgCnt).
- Latest synchronization deviation (Dev).

## 2.4.6.

### Protocol menu Bus

#### REMOTE PORT

- Communication protocol for remote port X3 [Protocol].
- Message counter [Msg#]. This can be used to verify that the device is receiving messages.
- Communication error counter [Errors].
- Communication time-out error counter [Tout].
- Information of bit rate/data bits/parity/stop bits.  
This value is not directly editable. Editing is done in the appropriate protocol setting menus.

The counters are useful when testing the communication.

#### LOCAL PORT

This port is disabled, if a cable is connected to the front panel connector.

- Communication protocol for the local port X3 [Protocol]. For VAMPSET use "None" or "SPABUS".
- Message counter [Msg#]. This can be used to verify that the device is receiving messages.
- Communication error counter [Errors].
- Communication time-out error counter [Tout].

- Information of bit rate/data bits/parity/stop bits.  
This value is not directly editable. Editing is done in the appropriate protocol setting menus. For VAMPSET and protocol "None" the setting is done in menu CONF/DEVICE SETUP.

### MODBUS

- Modbus address for this slave device [Addr]. This address has to be unique within the system.
- Modbus bit rate [bit/s]. Default is "9600".
- Parity [Parity]. Default is "Even".

For details see the technical description part of the manual.

### SPA BUS

Several instances of this protocol are possible.

- SPABUS address for this device [Addr]. This address has to be unique within the system.
- Bit rate [bit/s]. Default is "9600".
- Event numbering style [Emode]. Default is "Channel".

For details see the technical description part of the manual.

### IEC 60870-5-103

Only one instance of this protocol is possible.

- Address for this device [Addr]. This address has to be unique within the system.
- Bit rate [bit/s]. Default is "9600".
- Minimum measurement response interval [MeasInt].
- ASDU6 response time mode [SyncRe].

For details see the technical description part of the manual.

### IEC 103 DISTURBANCE RECORDINGS

For details see the technical description part of the manual.

### PROFIBUS

Only one instance of this protocol is possible.

- [Mode]
- Bit rate [bit/s]. Use 2400 bps. This parameter is the bit rate between the main CPU and the Profibus ASIC. The actual Profibus bit rate is automatically set by the Profibus master and can be up to 12 Mbit/s.
- Event numbering style [Emode].
- Size of the Profibus Tx buffer [InBuf].
- Size of the Profibus Rx buffer [OutBuf].

When configuring the Profibus master system, the length of these buffers are needed. The size of the both buffers is set indirectly when configuring the data items for Profibus.

- Address for this slave device [Addr]. This address has to be unique within the system.

- Profibus converter type [Conv]. If the shown type is a dash “-“, either Profibus protocol has not been selected or the device has not restarted after protocol change or there is a communication problem between the main CPU and the Profibus ASIC.

For details see the technical description part of the manual.

### DNP3

Only one instance of this protocol is possible.

- Bit rate [bit/s]. Default is "9600".
- [Parity].
- Address for this device [SlvAddr]. This address has to be unique within the system.
- Master's s [MstrAddr].

For further details see the technical description part of the manual.

### IEC 60870-5-101

- Bit rate [bit/s]. Default is "9600".
- [Parity].
- Link layer address for this device [LLAddr].
- ASDU address [ALAddr].

For further details see the technical description part of the manual.

### TCP/IP

These TCP/IP parameters are used by the ethernet interface module. For changing the nnn.nnn.nnn.nnn style parameter values, VAMPSET is recommended.

- IP address [IpAddr].
- Net mask [NetMsk].
- Gateway [Gatew].
- Name server [NameSw].
- Network time protocol (NTP) server [NTPSvr].
- Protocol port for IP [Port]. Default is 502.

## 3. VAMPSET PC software

The PC user interface can be used for:

- On-site parameterization of the unit
- Loading unit software from a computer
- Reading measured values, registered values and events to a computer.
- Continuous monitoring of all values and events.

Two RS 232 serial ports are available for connecting a local PC with VAMPSET to the unit; one on the front panel and one on the rear panel of the unit. These two 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 a serial port, use a connection cable of type VX 003-3.

The VAMPSET program can also use TCP/IP LAN connection. Optional hardware is required.

There is a free of charge PC program called VAMPSET available for configuration and setting of VAMP devices. Please download the latest VAMPSET.exe from our web page [www.vamp.fi](http://www.vamp.fi). For more information about the VAMPSET software, please refer to the user's manual with the code VMV.EN0xx. Also the VAMPSET user's manual is available at our web site.

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# 1. Introduction

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

The VAMP 96 is a basic multimeter used as a stand alone meter in industrial low and medium voltage power distribution panels.

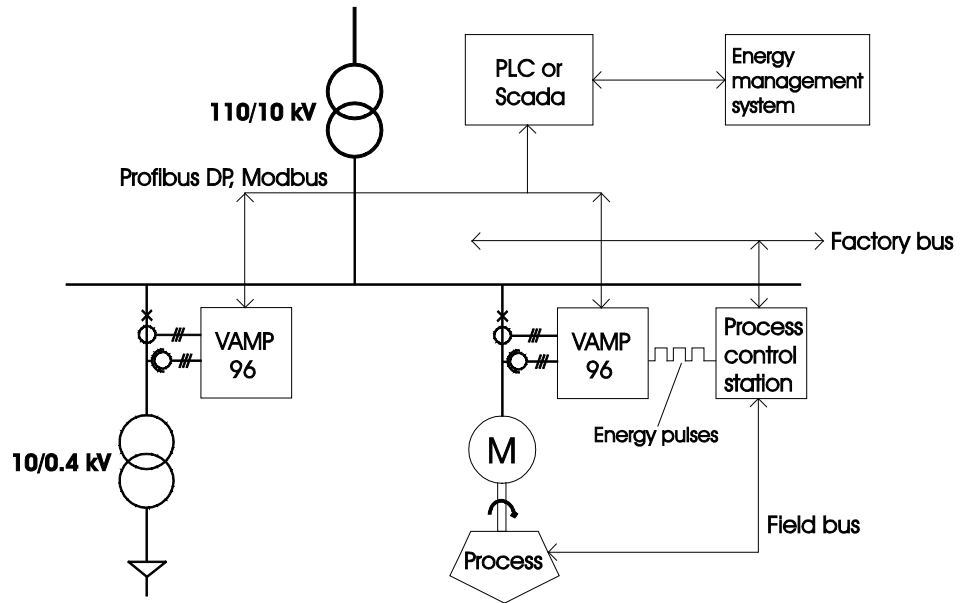


Figure 1-1. Application of the monitoring unit

VAMP 96 can be connected to SCADA or energy management system in order to provide required measurements, alarms, condition data and events to the operator using various communication protocols. VAMP 96 shall be connected to measurement core of the current and voltage transformers.

## 1.1. Main features

- Fully digital signal handling with high measuring accuracy on all the setting ranges.
- 3 pcs configurable digital inputs.
- One durable output relay (solid state) that can be used as energy pulse output.
- 5 displays to show the main measurements
- Recording of events and fault values into an event register.
- Indication LED status and the latest 200 events are stored in a non-volatile memory.
- Easy configuration, parameterisation and reading of information via the local human man interface (HMI), or with the free of charge VAMPSET PC program.
- Built-in, self-regulating ac/dc converter for auxiliary power supply from any typical power source.
- Built-in disturbance recorder for evaluating all the analogue and digital signals.
- Versatile of measuring functions including power outages, under voltage and over voltage disturbances, current unbalance, reactive power and energy.
- Easy adaptation to process automation systems or SCADA system using wide range of available communication protocols.
- Power quality monitoring function like current and voltage harmonics (THD), voltage sags & swell and voltage interruptions.

# 2. Main Functions

## 2.1. Event log

Event log is a buffer of event codes and time stamps including date and time. For example each start-on, start-off, trip-on or trip-off of any alarm has a unique event number code. Such a code and the corresponding time stamp is called an event. The event codes are listed in a separate document VAMP2xx\_Events.pdf.

As an example of information included with a typical event an Programmable stage Trip.

EVENT	Description	Local panel	Communication protocols
Code: 46E2	Channel 46, event 2	Yes	Yes
Prg1 trip on	Event text	Yes	No
1.25 x In	Fault value	Yes	No
2007-01-31	Date	Yes	Yes
08:35:13.413	Time	Yes	Yes

Events are the major data for a SCADA system. SCADA systems are reading events using any of the available communication protocols. Event log can also be scanned using the front panel or using VAMPSET. With VAMPSET the events can be stored to a file especially in case the unit is not connected to any SCADA system.

Only the latest event can be read when using communication protocols or VAMPSET. Every reading increments the internal read pointer to the event buffer. (In case of communication error, the latest event can be reread any number of times using an other parameter.) On the local panel scanning the event buffer back and forth is possible.

### Event enabling/masking

In case of an uninteresting event, it can be masked, which prevents the particular event(s) to be written in the event buffer.

As a default there is room for 200 latest events in the buffer. Event buffer size can be modified from 50 to 2000 in all v.10.xx softwares. Modification can be done in “Local panel conf” – menu. Alarm screen (popup screen) can also be enabled in this same menu when Vampset –setting tool is used. The oldest one will be overwritten, when a new event does occur. The shown resolution of a time stamp is one millisecond, but the actual resolution depends of the particular function creating the



event. For example most protection stages create events with 10 ms or 20 ms resolution. The absolute accuracy of all time stamps depends on the time synchronizing of the relay. See chapter 2.6 for system clock synchronizing.

### Event buffer overflow

The normal procedure is to poll events from the device all the time. If this is not done, the event buffer will eventually overflow. On the local screen this is indicated with string "OVF" after the event code.

### Setting parameters for events

Parameter	Value	Description	Note
Count		Number of events	
ClrEn	– Clear	Clear event buffer	Set
Order	Old- New New- Old	Order of the event buffer for local display	Set
FVScal	PU Pri	Scaling of event fault value Per unit scaling Primary scaling	Set
Display Alarms	On Off	Alarm pop-up display is enabled No alarm display	Set
<b>FORMAT OF EVENTS ON THE LOCAL DISPLAY</b>			
Code: CHENN		CH = event channel, NN=event code	
Event description		Event channel and code in plain text	
yyyy-mm-dd		Date (for available date formats see chapter 2.6)	
hh:mm:ss.nnn		Time	

## 2.2. 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) and digital outputs (DO).

### Triggering the recorder

The recorder can be triggered by any start or trip signal from any programmable stage, virtual input, logic output, digital input etc. The triggering signal is selected in the output matrix (vertical signal DR). The recording can also be triggered manually. All recordings are time stamped.

### Reading recordings

The recordings can be uploaded, viewed and analysed with the VAMPSET program. The recording is in COMTRADE format. This means that also other programs can be used to view and analyse the recordings made by the unit.

For more details, please see a separate VAMPSET manual.

### Number of channels

At the maximum, there can be 12 recordings, and the maximum selection of channels in one recording is also 12 (limited in waveform recording). The digital inputs reserve one channel (includes all the inputs). Also the digital outputs reserve one channel (includes all the outputs). If digital inputs and outputs are recorded, there will be still 10 channels left for analogue waveforms.

### Available channels

The following channels i.e. signals can be linked to a disturbance recorder:

Channel	Description
IL1, IL2, IL3	Phase current
U12, U23, U31	Line-to-line voltage
UL1, UL2, UL3	Phase-to-neutral voltage
Uo	Measured residual voltage
f	Frequency
P, Q, S	Active, reactive, apparent power
P.F.	Power factor
CosFii	Cosφ
IoCalc	Phasor sum $I_o = (I_{L1} + I_{L2} + I_{L3})/3$
I1	Positive sequence current
I2	Negative sequence current
I2/I1	Relative current unbalance
I2/IN	Current unbalance [xIN]
U1	Positive sequence voltage
U2	Negative sequence voltage
U2/U1	Relative voltage unbalance
IL	Average $(IL1 + IL2 + IL3)/3$
Uphase	Average $(UL1 + UL2 + UL3)/3$
Uline	Average $(U12 + U23 + U31)/3$
DO	Digital outputs
DI	Digital inputs
TanFii	Tanφ
Prms	Active power RMS value
Qrms	Reactive power RMS value
Srms	Apparent power RMS value
THDIL1	Total harmonic distortion of IL1
THDIL2	Total harmonic distortion of IL2
THDIL3	Total harmonic distortion of IL3
THDUa	Total harmonic distortion of input Ua
THDUb	Total harmonic distortion of input Ub
THDUc	Total harmonic distortion of input Uc
IL1RMS	IL1 RMS for average sampling
IL2RMS	IL2 RMS for average sampling



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IL3RMS	IL3 RMS for average sampling
ILmin	Current minimum of IL1, IL2 and IL3
ILmax	Current maximum of IL1, IL2 and IL3
ULLmin	Line voltage minimum of U12, U23 and U31
ULLmax	Line voltage maximum of U12, U23 and U31
ULNmin	Phase voltage minimum of UL1, UL2 and UL3
ULNmax	Phase voltage maximum of UL1, UL2 and UL3

**Disturbance recorder parameters**

Parameter	Value	Unit	Description	Note
Mode	Saturated Overflow		Behaviour in memory full situation: No more recordings are accepted The oldest recorder will be overwritten	Set
SR	32/cycle 16/cycle 8/cycle 1/10ms 1/20ms 1/200ms 1/1s 1/5s 1/10s 1/15s 1/30s 1/1min		Sample rate Waveform Waveform Waveform One cycle value *) One cycle value **) Average Average Average Average Average Average Average	Set
Time		s	Recording length	Set
PreTrig		%	Amount of recording data before the trig moment	Set
MaxLen		s	Maximum time setting. This value depends on sample rate, number and type of the selected channels and the configured recording length.	
Status	- Run Trig FULL		Status of recording Not active Waiting a triggering Recording Memory is full in saturated mode	
ManTrig	- Trig		Manual triggering	Set
ReadyRec	n/m		n = Available recordings m = maximum number of recordings The value of 'm' depends on sample rate, number and type of the selected channels and the configured recording length.	



Parameter	Value	Unit	Description	Note
AddCh	IL1, IL2, IL3 U12, U23, U31 UL1, UL2, UL3 Uo f P, Q, S P.F. CosFii IoCalc I1 I2 I2/I1 I2/In U1 U2 U2/U1 IL Uphase Uline DO DI TanFii Prms Qrms Srms THDIL1 THDIL2 THDIL3 THDUa THDUb THDUc IL1RMS IL2RMS IL3RMS ILmin Ilmax ULLmin ULLmax ULNmin ULNmax		Add one channel. Maximum simultaneous number of channels is 12.	Set
ClrCh	- Clear		Remove all channels	Set
(Ch)			List of selected channels	

Set = An editable parameter (password needed)

\*) This is the fundamental frequency rms value of one cycle updated every 10 ms.

\*\*\*) This is the fundamental frequency rms value of one cycle updated every 20 ms.

## 2.3. 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 voltage sag and swell monitoring.

VAMP provides separate monitoring logs for sags and swells. The voltage log is triggered, if any voltage input either goes under the sag limit (U<) or exceeds the swell limit (U>). There are four registers for both sags and swells in the fault log. Each register will have start time, phase information, 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. Voltage interruptions

VAMP 96 includes a simple function to detect voltage interruptions. The function calculates the number of voltage interruptions and the total time of the voltage-off time within a given calendar 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 old 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. Whenever the measured  $U_1$  goes below the limit, the interruption counter is increased, and the total time counter starts increasing.

Shortest recognized interruption time is 40 ms. If the voltage-off time is shorter it may be recognized depending on the relative depth of the voltage dip.

If the voltage has been significantly over the limit  $U_1 <$  and then there is a small and short under-swing, it will not be recognized (Figure 2.4-1).

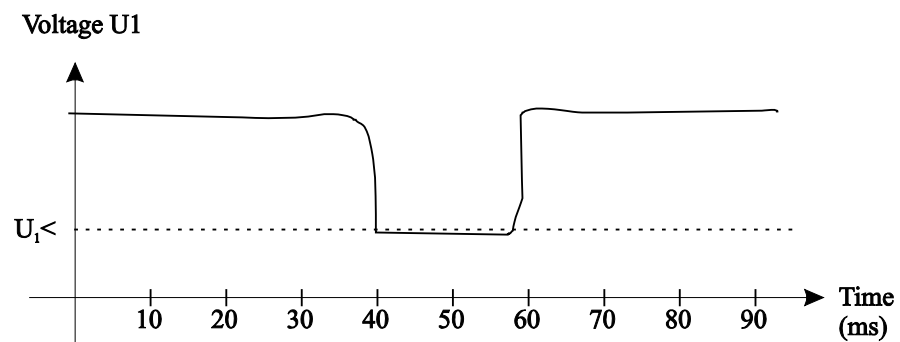


Figure 2.4-1. A short voltage interruption which is probably not recognized

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 2.4-2).

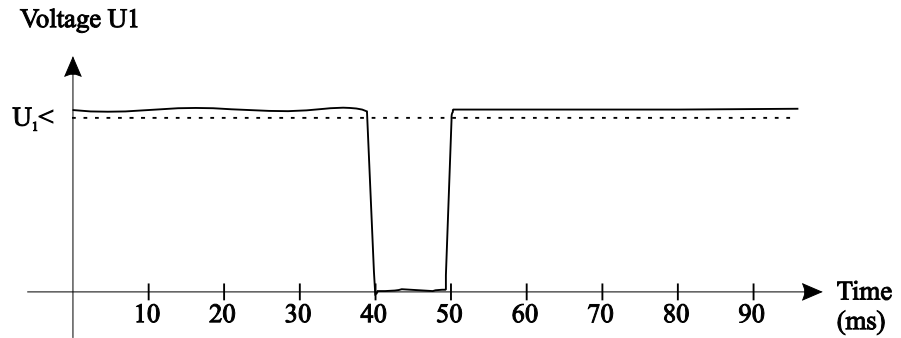


Figure 2.4-2 A short voltage interrupt that will be recognized

**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

## 2.5. Energy pulse outputs

The device can be configured to send a pulse whenever certain amount of energy has been imported or exported. The principle is presented in Figure 2.5-1. Each time the energy level reaches the pulse size, an output relay is activated and the unit will be active as long as defined by a pulse duration setting.

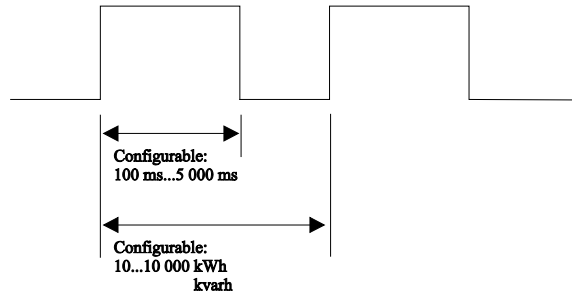


Figure 2.5-1 Principle of energy pulses

VAMP 96 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 output relays using 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 output parameters

	Parameter	Value	Unit	Description
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	kvarh	Pulse size of reactive imported energy
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.

### 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.

### 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.

### 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.

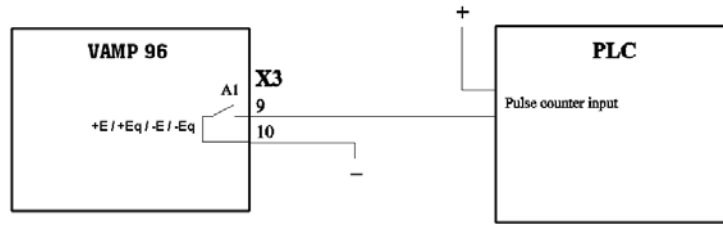


Figure 2.5-2. Application example of wiring the energy pulse output to a PLC having common plus and using an external wetting voltage

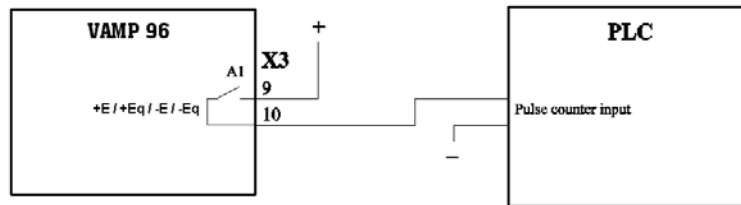


Figure 2.5-3 Application example of wiring the energy pulse output to a PLC having common minus and using an external wetting voltage

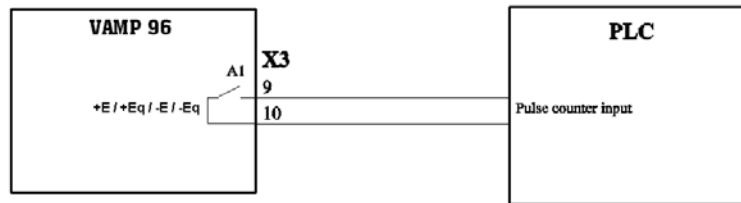


Figure 2.5-4 Application example of wiring the energy pulse output to a PLC having common minus and an internal wetting voltage

## 2.6. System clock and synchronization

The internal clock of the unit is used to time stamp events and disturbance recordings.

The system clock should be externally synchronised to get comparable event time stamps for all the units in the system.

The synchronizing is based on the difference of the internal time and the synchronising message or pulse. This deviation is filtered and the internal time is corrected softly towards a zero deviation.

### Adapting auto adjust

During tens of hours of synchronizing the device will learn its average error and starts to make small corrections by itself. The target is that when the next synchronizing message is received, the deviation is already near zero. Parameters "AAIntv" and "AvDrft" will show the adapted correction time interval of this  $\pm 1$  ms auto-adjust function.

### Time drift correction without external sync

If any external synchronizing source is not available and the system clock has a known steady drift, it is possible to roughly correct the clock error by editing the parameters "AAIntv" and "AvDrft". The following equation can be used if the previous "AAIntv" value has been zero.

$$AAIntv = \frac{604.8}{DriftInOneWeek}$$

If the auto-adjust interval "AAIntv" has not been zero, but further trimming is still needed, the following equation can be used to calculate a new auto-adjust interval.

$$AAIntv_{NEW} = \frac{1}{\frac{1}{AAIntv_{PREVIOUS}} + \frac{DriftInOneWeek}{604.8}}$$

The term  $DriftInOneWeek/604.8$  may be replaced with the relative drift multiplied by 1000, if some other period than one week has been used. For example if the drift has been 37 seconds in 14 days, the relative drift is  $37 \cdot 1000 / (14 \cdot 24 \cdot 3600) = 0.0306$  ms/s.

#### Example 1.

If there has been no external sync and the unit's clock is leading sixty-one seconds a week and the parameter AAIIntv has been zero, the parameters are set as

$$AvDrft = Lead$$

$$AAIntv = \frac{604.8}{61} = 9.9s$$

With these parameter values the system clock corrects itself with -1 ms every 9.9 seconds which equals -61.091 s/week.

#### Example 2.

If there is no external sync and the unit's clock has been lagging five seconds in nine days and the AAIIntv has been 9.9 s, leading, then the parameters are set as

$$AAIntv_{NEW} = \frac{1}{\frac{1}{9.9} - \frac{5000}{9 \cdot 24 \cdot 3600}} = 10.6$$

$$AvDrft = Lead$$

**NOTE!** When the internal time is roughly correct – deviation is less than four seconds – any synchronizing or auto-adjust will never turn the clock backwards. Instead, in case the clock is leading, it is softly slowed down to maintain causality.

**System clock parameters**

Parameter	Value	Unit	Description	Note
Date			Current date	Set
Time			Current time	Set
Style	y-d-m d.m.y m/d/y		Date format Year-Month-Day Day.Month.Year Month/Day/Year	Set
SyncDI	- DI1 ... DI6		The digital input used for clock synchronisation. DI not used for synchronizing Minute pulse input	***)
TZone	-12.00 ... +14.00 *)		UTC time zone for SNTP synchronization. Note: This is a decimal number. For example for state of Nepal the time zone 5:45 is given as 5.75	Set
DST	No Yes		Daylight saving time for SNTP	Set
SySrc	Internal DI SNTP SpaBus ModBus ProfibusDP IEC-103 DNP3		Clock synchronisation source No sync recognized since 200 s Digital input Protocol sync Protocol sync Protocol sync Protocol sync Protocol sync	
MsgCnt	0 ... 65535, 0 ... etc.		The number of received synchronisation messages or pulses	
Dev	±32767	ms	Latest time deviation between the system clock and the received synchronization	
SyOS	±10000.000	s	Synchronisation correction for any constant error in the synchronizing source.	Set
AAIntv	±10000	s	Adapted auto adjust interval for 1 ms correction	Set** )
AvDrft	Lead Lag		Adapted average clock drift sign	Set **)
FilDev	±125	ms	Filtered synchronisation deviation	

Set = An editable parameter (password needed).

\*) Astronomically a range -11 ... +12 h would be enough, but for political and geographical reasons a larger range is needed.

\*\* ) If external synchronization is used this parameter will be set automatically.

\*\*\*) Set the DI delay to its minimum and the polarity such that the leading edge is the synchronizing edge.

### Synchronisation with DI

Clock can be synchronized by reading minute pulses from digital inputs, virtual inputs or virtual outputs. Sync source is selected with **SyncDI** setting. When rising edge is detected from the selected input, system clock is adjusted to the nearest minute. Length of digital input pulse should be at least 50 ms. Delay of the selected digital input should be set to zero.

### Synchronisation correction

If the sync source has a known offset delay, it can be compensated with **SyOS** setting. This is useful for compensating hardware delays or transfer delays of communication protocols. A positive value will compensate a lagging external sync and communication delays. A negative value will compensate any leading offset of the external sync source.

### Sync source

When the device receives new sync message, the sync source display is updated. If no new sync messages are received within next 1.5 minutes, the device will change to internal sync mode.

### Deviation

The time deviation means how much system clock time differs from sync source time. Time deviation is calculated after receiving new sync message. The filtered deviation means how much the system clock was really adjusted. Filtering takes care of small errors in sync messages.

### Auto-lag/lead

The device synchronizes to the sync source, meaning it starts automatically leading or lagging to stay in perfect sync with the master. The learning process takes few days.

## 2.7. Running hour counter

This function calculates the total active time of the selected digital input, virtual I/O or output matrix output signal. The resolution is ten seconds.

### Running hour counter parameters

Parameter	Value	Unit	Description	Note
Runh	0 ... 876000	h	Total active time, hours Note: The label text "Runh" can be edited with VAMPSET.	(Set)
	0 ... 3599	s	Total active time, seconds	(Set)
Starts	0 ... 65535		Activation counter	(Set)
Status	Stop Run		Current status of the selected digital signal	
DI	- DI1 ...DI3, VI1...VI4, LedAI, VO1...VO6		Select the supervised signal None Physical inputs Virtual inputs Output matrix out signal AI Virtual outputs	Set
Started at			Date and time of the last activation	
Stopped at			Date and time of the last inactivation	

Set = An editable parameter (password needed).

(Set) = An informative value which can be edited as well.

## 2.8. Timers

The VAMP protection platform includes four settable timers that can be used together with the user's programmable logic or to control setting groups and other applications that require actions based on calendar 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 according the day of week (See the setting parameters for details). The timer outputs are available for logic functions and for the block and output matrix.



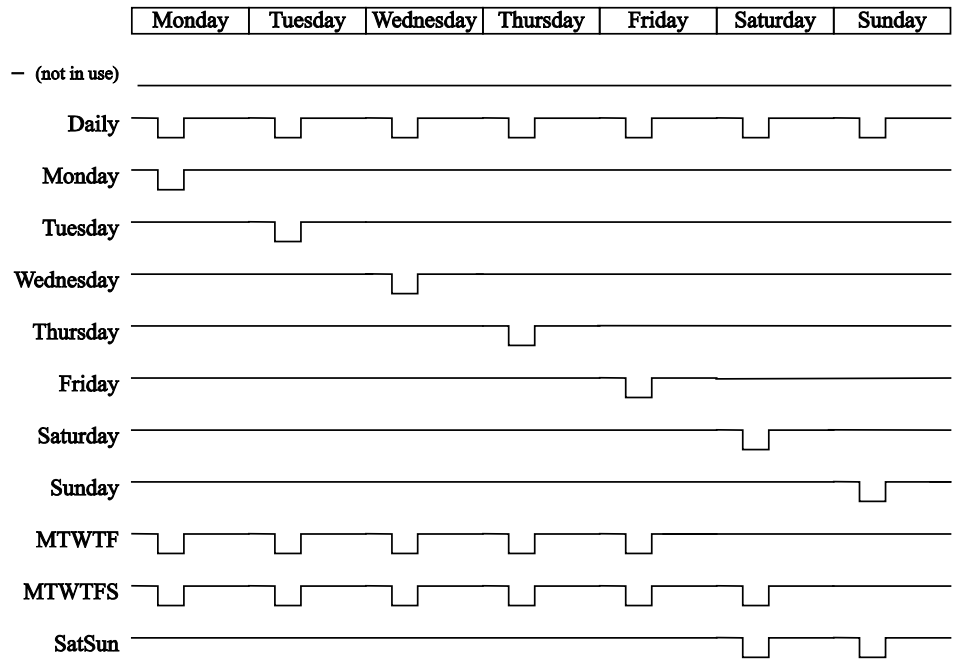


Figure 2.8-1. Timer output sequence in different modes.

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 relay A1.

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	Description
TimerN	-	Timer status Not in use
	0	Output is inactive
	1	Output is active
On	hh:mm:ss	Activation time of the timer
Off	hh:mm:ss	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.	



## 2.9. Programmable stages (99)

For special applications the user can built his own protection stages by selecting the supervised signal and the comparison mode.

The following parameters are available:

- **Priority**  
If operation times less than 60 milliseconds are needed select 10 ms. For operation times under one second 20 ms is recommended. For longer operation times and THD signals 100 ms is recommended.
- **Link**  
The name of the supervised signal (see table below).
- **Cmp**  
Compare mode. '>' for over or '<' for under comparison.
- **Pick-up**  
Limit of the stage. The available setting range and the unit depend on the selected signal.
- **t**  
Definite time operation delay
- **Hyster**  
Dead band (hysteresis)
- **NoCmp**  
Only used with compare mode under ('<'). This is the limit to start the comparison. Signal values under NoCmp are not regarded as fault.

**Table 2.9-1 Available signals to be supervised by the programmable stages**

IL1, IL2, IL3	Phase currents
U12, U23, U31	Line-to-line voltages
UL1, UL2, UL3	Phase-to-ground voltages
Uo	Zero-sequence voltage
f	Frequency
P	Active power
Q	Reactive power
S	Apparent power
CosFii	Cosine $\varphi$
IoCalc	Phasor sum $\underline{I}_{L1} + \underline{I}_{L2} + \underline{I}_{L3}$
I1	Positive sequence current
I2	Negative sequence current
I2/I1	Relative negative sequence current
I2/IN	Negative sequence current in pu
U1	Positive sequence voltage
U2	Negative sequence voltage
U2/U1	Relative negative sequence voltage
IL	Average $(I_{L1} + I_{L2} + I_{L3})/3$
Uphase (ULN)	Average $(U_{L1} + U_{L2} + U_{L3})/3$
Uline (ULL)	Average $(U_{12} + U_{23} + U_{31})/3$
TanFii	Tangent $\varphi$ [ $=\tan(\arccos\varphi)$ ]
Prms	Active power
Qrms	Reactive power
Srms	Apparnet power
THDIL1	Total harmonic distortion of $I_{L1}$
THDIL2	Total harmonic distortion of $I_{L2}$
THDIL3	Total harmonic distortion of $I_{L3}$
THDUa	Total harmonic distortion of input $U_a$
THDUc	Total harmonic distortion of input $U_b$
THDUb	Total harmonic distortion of input $U_c$
IL1RMS	Phase current $I_{L1}$ RMS value
IL2RMS	Phase current $I_{L2}$ RMS value
IL3RMS	Phase current $I_{L3}$ RMS value
ILmin	Current minimum of $I_{L1}$ , $I_{L2}$ and $I_{L3}$
ILmax	Current maximum of $I_{L1}$ , $I_{L2}$ and $I_{L3}$
ULLmin	Line voltage minimum of $U_{12}$ , $U_{23}$ and $U_{31}$
ULLmax	Line voltage maximum of $U_{12}$ , $U_{23}$ and $U_{31}$
ULNmin	Phase voltage minimum of $U_{L1}$ , $U_{L2}$ and $U_{L3}$
ULNmax	Phase voltage maximum of $U_{L1}$ , $U_{L2}$ and $U_{L3}$

## Eight independent stages

VAMP 96 has eight independent programmable stages. Each programmable stage can be enabled or disabled to fit the intended application.

## Setting groups

There are two settings groups available. Switching between setting groups can be controlled by digital inputs, virtual inputs (communication, logic) and manually.

There are two identical stages available with independent setting parameters.

## Parameters of the programmable stages PrgN (99)

Parameter	Value	Unit	Description	Note
Status	- Blocked Start Trip		Current status of the stage	F F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
SetGrp	1 or 2		Active setting group	Set
SGrpDI	- DI <sub>x</sub> VI <sub>x</sub> LED VO <sub>x</sub>		Digital signal to select the active setting group None Digital input Virtual input LED indicator signal Virtual output	Set
Force	Off On		Force flag for status forcing for test purposes. Automatically reset by a 5-minute timeout.	Set
Link	(See table Table 2.9-1)		Name for the supervised signal	Set
(See table above)			Value of the supervised signal	
Cmp	> <		Mode of comparison Over protection Under protection	Set
Pickup			Pick up value scaled to primary level	
Pickup		pu	Pick up setting in pu	Set
t		s	Definite operation time.	Set
Hyster		%	Dead band setting	Set
NoCmp		pu	Minimum value to start under comparison. (Mode='<')	Set

Set = An editable parameter (password needed)

C = Can be cleared to zero

F = Editable when force flag is on

### Recorded values of the latest eight faults

There are detailed information available of the eight latest faults: Time stamp, fault value and elapsed delay.

### Recorded values of the programmable stages PrgN (99)

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		pu	Fault value
EDly		%	Elapsed time of the operating time setting. 100% = trip
SetGrp	1 2		Active setting group during fault

## 2.10. 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 device, the watchdog circuit attempts to restart the micro controller in a fault situation. If the restarting fails, the watchdog issues a self-supervision alarm indicating a permanent internal fault.

In addition, the internal supply voltages are supervised.

### 2.10.1. Diagnostics

The device runs self-diagnostic tests for hardware and software in every boot sequence and also performs runtime checking.

#### Fatal errors

If fatal error has been detected, the local panel will display an error message about the detected fault.

#### Runtime errors

When self-diagnostic function detects a fault, **Selfdiag Alarm** matrix signal is set and an event (E56) is generated. In case the error was only temporary, an off event is generated (E57). Self diagnostic error can be reset via local panel interface.

#### Error registers

There are four 16-bit error registers which are readable through remote protocols. The following table shows the meaning of each error register and their bits.



Register	Bit	Code	Description
SelfDiag3	0	-	-
	1	STACK	OS: stack fault
	2	MemChk	OS: memory fault
	3	BGTask	OS: background task timeout
	4	DI	Digital input fault (DI1, DI2)
	5	-	-
	6	-	-
	7	SecPulse	Hardware error
	8	RangeChk	DB: Setting outside range
	9	CPUload	OS: overload
	10	± 12V	Internal voltage fault
	11	+ 5V	
	12	ITemp	Internal temperature too high
	13	ADChk1	A/D converter error
	14	ADChk2	A/D converter error
15 (MSB)	E2prom	E2prom error	
SelfDiag4	0 (LSB)	+12V	Internal voltage fault
	1	ComBuff	BUS: buffer error

The error code is displayed in self diagnostic events and on the diagnostic menu on local panel and VAMPSET.

### 3. Measurement functions

All the direct measurements are based on fundamental frequency values. (The exception is the frequency.) The figure shows a current waveform and the corresponding fundamental frequency component, second harmonic and rms value in a special case, when the current deviates significantly from a pure sine wave.

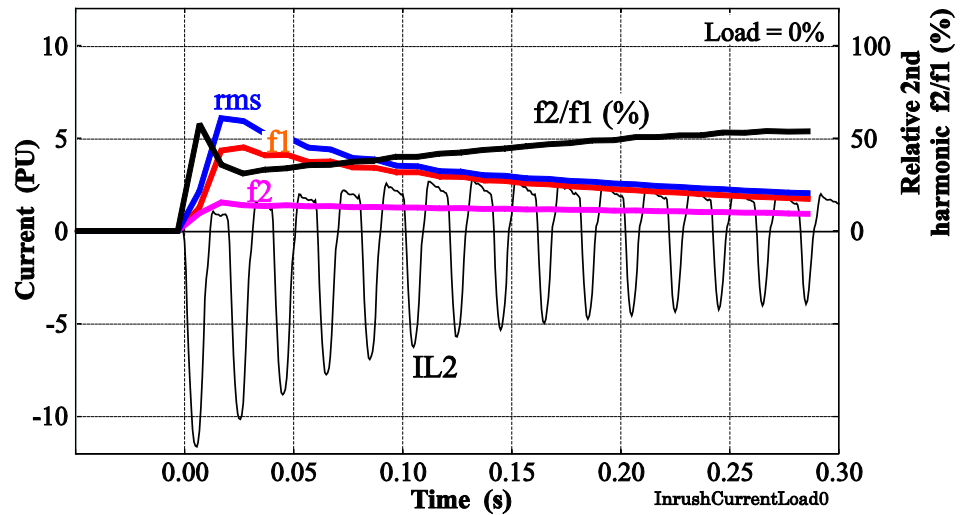


Figure 3-1 Example of various current values of a transformer inrush current.

#### 3.1. Measurement accuracy

The specified frequency range for all measurements except frequency is 45 Hz – 65 Hz.

##### Phase current inputs $I_{L1}$ , $I_{L2}$ , $I_{L3}$

Measuring range	0 – 1.2 x $I_N$
Inaccuracy	$I \leq 0.5 \times I_N$ : $\pm 0.8$ % of value
	$I > 0.5 \times I_N$ : $\pm 0.4$ % of value
Squelch level	0.001 x $I_N$

The rated input  $I_N$  is 5 A. It is specified in the order code of the unit.

##### Voltage inputs $U_a$ , $U_b$ , $U_c$

The voltage measurement mode in VAMP 96 is 3LN (see chapter 3.4). Every voltage is from phase to neutral.

Measuring range	0 – 265 V
Inaccuracy	$\pm 0.5$ % or $\pm 0.3$ V
Squelch level	0.1 V

**Frequency**

Measuring range	16 Hz – 75 Hz
Inaccuracy	±10 mHz

The frequency is measured from voltage inputs  $U_a$  and/or  $U_b$ .

**Power measurements P, Q, S**

Inaccuracy	$ PF  > 0.5$	±1 % of value or ±3 VA <sub>SEC</sub>
------------	--------------	---------------------------------------

**Power factor,  $\cos\phi$ ,  $\tan\phi$** 

Inaccuracy	$ PF  > 0.5$	±2° or ±0.02
------------	--------------	--------------

**Energy counters E+, Eq+, E-, Eq-**

Inaccuracy	$ PF  > 0.5$	±1 % of value or ±3 Wh <sub>secondary</sub> /1 h
------------	--------------	--

**THD and harmonics**

Inaccuracy	I, U > 0.1 PU	±2 % units
Update rate		At least once a second

## 3.2. Power calculation

The equations used for power calculations are described in this chapter.

**The unit is connected to line-to-neutral voltage**

When the unit is connected to line-to-neutral voltages, the voltage measurement mode is set to equal to "3LN". The following equation is used for power calculation.

$$\bar{S} = \bar{U}_{L1} \cdot \bar{I}_{L1}^* + \bar{U}_{L2} \cdot \bar{I}_{L2}^* + \bar{U}_{L3} \cdot \bar{I}_{L3}^*, \text{ where}$$

$\bar{S}$  = Three phase power phasor

$\bar{U}_{L1}$  = Measured voltage phasor corresponding the fundamental frequency voltage of phase L1.

$\bar{I}_{L1}^*$  = Complex conjugate of the measured phase L1 fundamental frequency current phasor.

$\bar{U}_{L2}$  = Measured voltage phasor corresponding the fundamental frequency voltage of phase L2.

$\bar{I}_{L2}^*$  = Complex conjugate of the measured phase L2 fundamental frequency current phasor.

$\bar{U}_{L3}$  = Measured voltage phasor corresponding the fundamental frequency voltage of phase L3.

$\bar{I}_{L3}^*$  = Complex conjugate of the measured phase L3 fundamental frequency current phasor.

Apparent power, active power and reactive power are calculated similarly as with line-to-line voltages

$$S = |\bar{S}|$$

$$P = \text{real}(\bar{S})$$

$$Q = \text{imag}(\bar{S})$$

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

### 3.3. Energy calculations

Calculated energy measures (E+, Eq+, E-, Eq-) are based on the calculated power measures and the internal clock. Energies flown to both directions are calculated and displayed as separate values.

Energy information can be obtained as energy pulses through the contact outputs, too.

### 3.4. 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 from the 2<sup>nd</sup> to the 15<sup>th</sup> of phase currents and voltages. (The 17<sup>th</sup> harmonic component will also be shown partly in the value of the 15<sup>th</sup> harmonic component. This is due to the nature of digital sampling.)

The harmonic distortion is calculated using equation

$$THD = \frac{\sqrt{\sum_{i=2}^{15} h_i^2}}{h_1}, \text{ where}$$

$h_1$  = Fundamental value

$h_{2...15}$  = Harmonics

#### Example

$h_1$  = 100 A

$h_3$  = 10 A

$h_7$  = 3 A

$h_{11}$  = 8 A

$$THD = \frac{\sqrt{10^2 + 3^2 + 8^2}}{100} = 13.2\%$$

For reference the RMS value is:

$$RMS = \sqrt{100^2 + 10^2 + 3^2 + 8^2} = 100.9A$$

Another way to calculate THD is to use the RMS value as reference instead of the fundamental frequency value. In the example above the result would then be 13.0 %.

## 3.5. RMS values

### RMS currents

The device calculates the RMS value of each phase current. The minimum and the maximum of RMS values are recorded and stored (see chapter 3.7).

$$I_{rms} = \sqrt{I_{f1}^2 + I_{f2}^2 + \dots + I_{f15}^2}$$

### RMS voltages

The device calculates the RMS value of each voltage input. The minimum and the maximum of RMS values are recorded and stored (see chapter 3.7).

$$U_{rms} = \sqrt{U_{f1}^2 + U_{f2}^2 + \dots + U_{f15}^2}$$

## 3.6. Demand values

The unit calculates average i.e. demand values of phase currents  $I_{L1}$ ,  $I_{L2}$ ,  $I_{L3}$  and power values S, P and Q. The demand time is configurable from 10 minutes to 30 minutes with parameter "Demand time".

### Demand value parameters

Parameter	Value	Unit	Description	Set
Time	10 ... 30	min	Demand time (averaging time)	Set
<b>Fundamental frequency values</b>				
IL1da		A	Demand of phase current IL1	
IL2da		A	Demand of phase current IL2	
IL3da		A	Demand of phase current IL3	
Pda		kW	Demand of active power P	
PFda			Demand of power factor PF	
Qda		kvar	Demand of reactive power Q	
Sda		kVA	Demand of apparent power S	
<b>RMS values</b>				
IL1da		A	Demand of phase current IL1	
IL2da		A	Demand of phase current IL2	
IL3da		A	Demand of phase current IL3	

### 3.7. Minimum and maximum values

Minimum and maximum values are registered with time stamps since the latest manual clearing or since the device has been restarted. The available registered min & max values are listed in the following table.

Min & Max measurement	Description
IL1, IL2, IL3	Phase current (fundamental frequency value)
IL1RMS, IL2RMS, IL3RMS	Phase current, rms value
U12, U23, U31	Line-to-line voltage
U <sub>0</sub>	Zero sequence voltage
f	Frequency
P, Q, S	Active, reactive, apparent power
IL1da, IL2da, IL3da	Demand values of phase currents
IL1da, IL2da, IL3da (rms value)	Demand values of phase currents, rms values
PFda	Power factor demand value

The clearing parameter "ClrMax" is common for all these values.

#### Parameters

Parameter	Value	Description	Set
ClrMax	- Clear	Reset all minimum and maximum values	S

### 3.8. Maximum values of the last 31 days and twelve months

Some maximum and minimum values of the last 31 days and the last twelve months are stored in the non-volatile memory of the unit. Corresponding time stamps are stored for the last 31 days. The registered values are listed in the following table.

Measurement	Max	Min	Description
IL1, IL2, IL3	X		Phase current (fundamental frequency value)
S	X		Apparent power
P	X	X	Active power
Q	X	X	Reactive power

The value can be a one cycle value or an average according parameter "Timebase".



### Parameters of the day and month registers

Parameter	Value	Description	Set
Timebase		Parameter to select the type of the registered values.	S
	20 ms	Collect min & max of one cycle values *)	
	200 ms	Collect min & max of 200 ms average values	
	1 s	Collect min & max of 1 s average values	
	1 min	Collect min & max of 1 minute average values	
	demand	Collect min & max of demand values (see chapter 3.6)	
ResetDays		Reset the 31 day registers	S
ResetMon		Reset the 12 month registers	S

\*) This is the fundamental frequency rms value of one cycle updated every 20 ms.

## 3.9. Current measurement mode

### Three phase current measurement mode "3LN"

Three phase current measurement is commonly used in protection and monitoring applications in most substations and secondary substations. Three phase currents, with own amplitude and angle are measured. This makes it possible to calculate other measurements like residual current and current unbalance.

### One phase current measurement mode "1LN"

In some cases, there is only one phase current transformer available in the station. For such a situation, the device has to be connected to current measurement mode "1LN". In this mode, only one current is connected to the measurement unit but the unit assumes that the two other currents have same amplitude and they are symmetric. Energy and power measurements are available but in unbalanced network calculations are not accurate because of lack of measured information. When "1LN" current measurement mode is used, calculated residual current  $I_0$  and current unbalance  $I_2$  values are always 0A so these attributes are useless.

## 3.10. Symmetric components

In a three phase system, the voltage or current phasors may be divided in symmetric components according C. L. Fortescue (1918). The symmetric components are:

- Positive sequence 1
- Negative sequence 2
- Zero sequence 0

Symmetric components are calculated according the following equations:

$$\begin{bmatrix} \underline{S}_0 \\ \underline{S}_1 \\ \underline{S}_2 \end{bmatrix} = \frac{1}{3} \begin{bmatrix} 1 & 1 & 1 \\ 1 & \underline{a} & \underline{a}^2 \\ 1 & \underline{a}^2 & \underline{a} \end{bmatrix} \begin{bmatrix} \underline{U} \\ \underline{V} \\ \underline{W} \end{bmatrix}, \text{ where}$$

- $\underline{S}_0$  = zero sequence component
- $\underline{S}_1$  = positive sequence component
- $\underline{S}_2$  = negative sequence component

$$\underline{a} = 1 \angle 120^\circ = -\frac{1}{2} + j \frac{\sqrt{3}}{2}, \text{ a phasor rotating constant}$$

- $\underline{U}$  = phasor of phase L1  
(phase current or line-to-neutral voltage)
- $\underline{V}$  = phasor of phase L2
- $\underline{W}$  = phasor of phase L3

**Example: two phase injection with adjustable phase angle**

$$U_{GN} = 100 \text{ V}$$

Voltage measurement mode is "3LN".

Injection:

- $U_a = U_{L1} = 100/\sqrt{3} \text{ V } \angle 0^\circ = 57.7 \text{ V } \angle 0^\circ$
- $U_b = U_{L2} = 100/\sqrt{3} \text{ V } \angle -120^\circ = 57.7 \text{ V } \angle -120^\circ$
- $U_c = U_{L3} = 0 \text{ V}$

$$\begin{aligned} \begin{bmatrix} \underline{U}_0 \\ \underline{U}_1 \\ \underline{U}_2 \end{bmatrix} &= \frac{1}{3} \begin{bmatrix} 1 & 1 & 1 \\ 1 & \underline{a} & \underline{a}^2 \\ 1 & \underline{a}^2 & \underline{a} \end{bmatrix} \begin{bmatrix} \frac{100}{\sqrt{3}} \angle 0^\circ \\ \frac{100}{\sqrt{3}} \angle -120^\circ \\ 0 \end{bmatrix} = \frac{1}{3\sqrt{3}} \begin{bmatrix} 100 \angle 0^\circ + 100 \angle -120^\circ \\ 100 \angle 0^\circ + 100 \angle 0^\circ \\ 100 \angle 0^\circ + 100 \angle +120^\circ \end{bmatrix} = \\ &= \frac{1}{3\sqrt{3}} \begin{bmatrix} 100 \angle -60^\circ \\ 200 \angle 0^\circ \\ 100 \angle 60^\circ \end{bmatrix} = \begin{bmatrix} 19.2 \angle -60^\circ \\ 38.5 \angle 0^\circ \\ 19.2 \angle +60^\circ \end{bmatrix} \end{aligned}$$

$$\begin{aligned}
 U_0 &= 19.2 \% \\
 U_1 &= 38.5 \% \\
 U_2 &= 19.2 \% \\
 U_2/U_1 &= 50 \%
 \end{aligned}$$

Figure 3.10-1 shows a graphical solution. The input values have been scaled with  $\sqrt{3}/100$  to make the calculation easier.

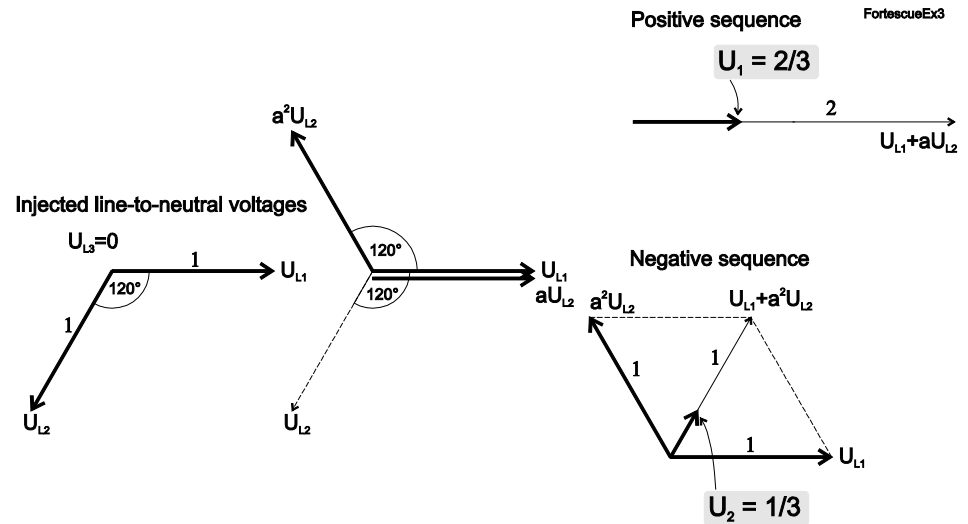


Figure 3.10-1 Example of symmetric component calculation using line-to-neutral voltages.

Unscaling the geometric results gives

$$\begin{aligned}
 U_1 &= 100/\sqrt{3} \times 2/3 = 38.5 \% \\
 U_2 &= 100/\sqrt{3} \times 1/3 = 19.2 \% \\
 U_2/U_1 &= 1/3 : 2/3 = 50 \%
 \end{aligned}$$

# 4. Control functions

## 4.1. Output relay

The output relay is also called digital output. Any internal signal can be connected to the output relay using output matrix. An output relay can be configured as latched or non-latched. See output matrix for more details. There is one alarm relay A1.

A1 alarm relay is NO solid state.

### Parameters of output relays

Parameter	Value	Unit	Description	Note
A1	0 1		Status of alarm output relay	F
Force	On Off		Force flag for output relay forcing for test purposes. The output relay and this flag are automatically reset by a 5-minute timeout.	Set
<b>REMOTE PULSES</b>				
A1	0.00 ... 99.98 or 99.99	s	Pulse length for direct output relay control via communications protocols. 99.99 s = Infinite. Release by writing "0" to the direct control parameter	Set
<b>NAME for OUTPUT RELAY (editable with VAMPSET only)</b>				
Description	String of max. 32 characters		Names for DO on VAMPSET screens. Default is "Alarm relay 1"	Set

Set = An editable parameter (password needed)

F = Editable when force flag is on

## 4.2. Digital inputs

There are 3 digital inputs available for control purposes. The polarity – normal open (NO) / normal closed (NC – and a delay can be configured according the application. The signals are available for the output matrix, block matrix, user's programmable logic etc.

The contacts connected to digital inputs DI1 ... DI3 must be dry (potential free). These inputs use the common internal 12 Vdc wetting voltage from terminal X2B:8, only.

Label and description texts can be edited with VAMPSET according the application. Labels are the short parameter names used on the local panel and descriptions are the longer names used by VAMPSET.



### Parameters of digital inputs

Parameter	Value	Unit	Description	Set
DI1 ... DI3	0 1		Status of digital input	
<b>DI COUNTERS</b>				
DI1 ... DI3	0 ... 65535		Cumulative active edge counter	(Set)
<b>DELAYS FOR DIGITAL INPUTS</b>				
DI1 ... DI3	0.00 ... 60.00	s	Definite delay for both on and off transitions	Set
<b>CONFIGURATION DI1 ... DI3</b>				
Inverted	no yes		For normal open contacts (NO). Active edge is 0⇒1 For normal closed contacts (NC) Active edge is 1⇒0	Set
Alarm display	no yes		No pop-up display Alarm pop-up display is activated at active DI edge	Set
On event	On Off		Active edge event enabled Active edge event disabled	Set
Off event	On Off		Inactive edge event enabled Inactive edge event disabled	Set
<b>NAMES for DIGITAL INPUTS (editable with VAMPSET only)</b>				
Label	String of max. 10 characters		Short name for DIs on the local display Default is "DI $n$ ", $n=1...3$	Set
Description	String of max. 32 characters		Long name for DIs. Default is "Digital input $n$ ", $n=1...3$	Set

Set = An editable parameter (password needed)

## 4.3. Virtual inputs and outputs

There are four virtual inputs and six virtual outputs. The four virtual inputs acts like normal digital inputs. The state of the virtual input can be changed from communication bus and from VAMPSET. For example setting groups can be changed using virtual inputs.

**Parameters of virtual inputs**

Parameter	Value	Unit	Description	Set
VI1 ... VI4	0 1		Status of virtual input	
Events	On Off		Event enabling	Set
<b>NAMES for VIRTUAL INPUTS (editable with VAMPSET only)</b>				
Label	String of max. 10 characters		Short name for VIs on the local display Default is "VIn", n=1...4	Set
Description	String of max. 32 characters		Long name for VIs. Default is "Virtual input n", n=1...4	Set

Set = An editable parameter (password needed)

The six virtual outputs do act like output relays, but there are no physical contacts. Virtual outputs are shown in the output matrix and the block matrix. Virtual outputs can be used with the user's programmable logic and to change the active setting group etc.

## 4.4. Output matrix

By means of the output matrix, the output signals of the various programmable stages, digital inputs, logic outputs and other internal signals can be connected to the output relay, front panel indicators, virtual outputs etc.

There is one LED indicator named "Alarm" on the front panel. In addition, the triggering of the disturbance recorder (DR) and virtual outputs are configurable in the output matrix. See an example in Figure 4.4-1.

An output relay or indicator LED can be configured as latched or non-latched. A non-latched relay follows the controlling signal. A latched relay remains activated although the controlling signal releases.

There is a common "release latched" signal to release the latched relay. This release signal resets the latched output relay and all 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 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.



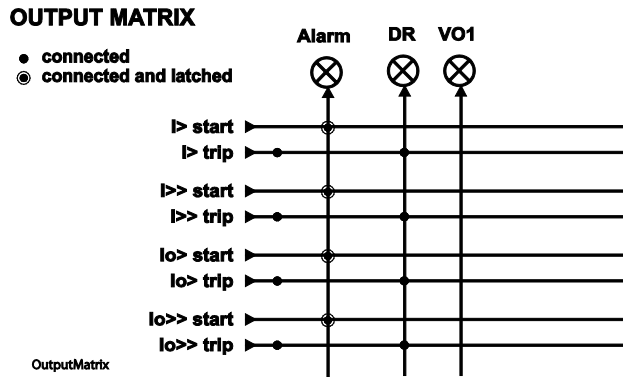


Figure 4.4-1 Output matrix.

## 4.5. Blocking matrix

By means of a blocking matrix, the operation of any function can be blocked. The blocking signal can originate from the digital inputs DI1 to DI3, or it can be a start or trip signal from a programmable stage or an output signal from the user's programmable logic. In the block matrix Figure 4.5-1 an active blocking is indicated with a black dot (•) in the crossing point of a blocking signal and the signal to be blocked.

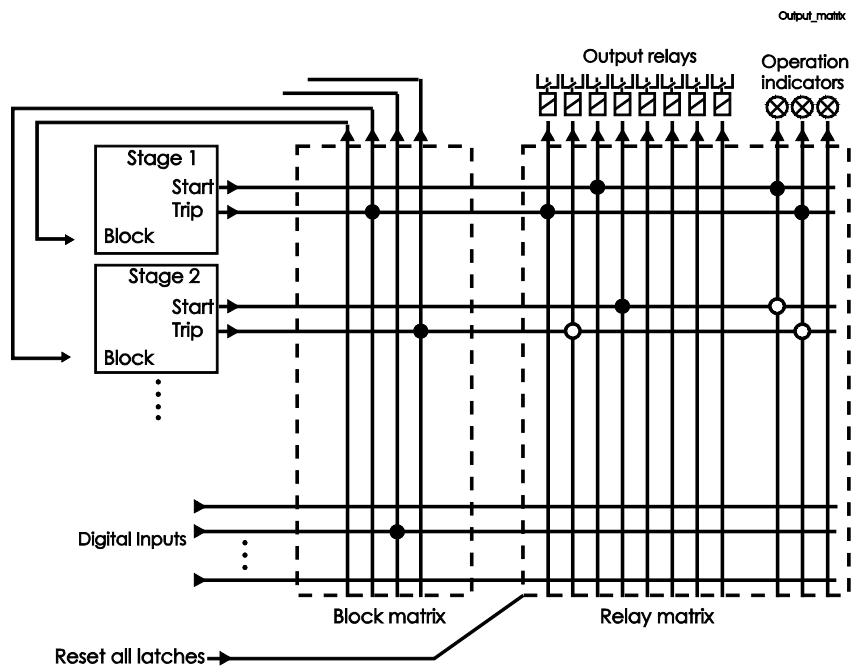


Figure 4.5-1 Blocking matrix and output matrix

## 4.6. Logic functions

The unit supports customer-defined programmable logic for boolean signals. The logic is designed by using the VAMPSET setting tool and downloaded to the unit. Functions available are:

- AND
- OR
- XOR
- NOT
- COUNTERs
- RS & D flip-flops

Maximum number of outputs is 20. Maximum number of input gates is 31. An input gate can include any number of inputs. For detailed information, please refer to the VAMPSET manual (VMV.EN0xx).

# 5. Communication

## 5.1. Communication ports

The unit has two communication ports as standard. Ethernet is available as a external module. See Figure 5.1-1.

The X3 connector includes two ports: local port and remote port. The front panel RS-232 port will shut off the local port on the rear panel when a VX003 cable is inserted.

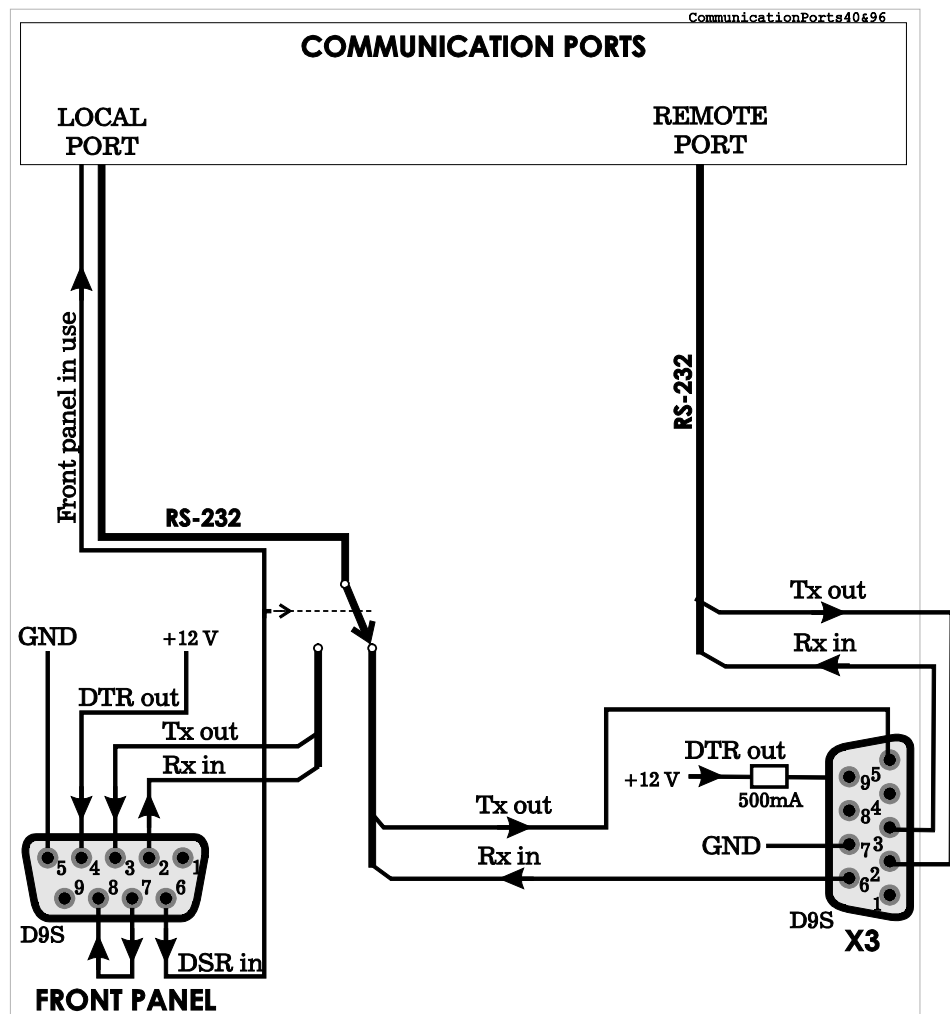


Figure 5.1-1. Communication ports and connectors. By default the X3 is a D9S type connector. The DSR signal from the front panel port selects the active connector for the RS232 local port.

## 5.1.1. Local port

The local port has two connectors:

- On the front panel
- X3 the rear panel (D9S pins 5, 6 and 7)

Only one can be used at a time.

**NOTE!** The remote port is locating in the same X3 connector.

**NOTE!** When the VX003 cable is inserted to the front panel connector it activates the front panel port and disables the rear panel local port by connecting the DTR pin 6 and DSR pin 4 together. See Figure 5.1-1.

### Protocol for the local port

The front panel port is always using the command line protocol for VAMPSET regardless of the selected protocol for the rear panel local port.

If other than "None" protocol is selected for the rear panel local port, the front panel connector, when activated, is still using the plain command line interface with the original speed, parity etc. For example if the rear panel local port is used for remote VAMPSET communication using SPA-bus default 9600/7E1, it is possible to temporarily connect a PC with VAMPSET to the front panel connector with the default 38400/8N1. While the front panel connector is in use, the rear panel local port is disabled. The communication parameter display on the local display will show the active parameter values for the local port.

### Physical interface

The physical interface of this port is RS-232.

## Parameters

Parameter	Value	Unit	Description	Note
Protocol	None SpaBus ProfibusDP ModbusSla ModbusTCPs IEC-103 ExternalIO DNP3		Protocol selection for the rear panel local port. Command line interface for VAMPSET SPA-bus (slave) Profibus DB (slave) Modbus RTU slave Modbus TCP slave IEC-60870-5-103 (slave) Modbus RTU master for external I/O-modules DNP 3.0	Set
Msg#	0 ... $2^{32}-1$		Message counter since the device has restarted or since last clearing	Clr
Errors	0 ... $2^{16}-1$		Protocol errors since the device has restarted or since last clearing	Clr
Tout	0 ... $2^{16}-1$		Timeout errors since the device has restarted or since last clearing	Clr
	speed/DPS  Default = 38400/8N1 for VAMPSET		Display of actual communication parameters. speed = bit/s D = number of data bits P = parity: none, even, odd S = number of stop bits	1)
VAMPSET communication (Direct or SPA-bus embedded command line interface)				
Tx	bytes/size		Unsent bytes in transmitter buffer/size of the buffer	
Msg#	0 ... $2^{32}-1$		Message counter since the device has restarted or since last clearing	Clr
Errors	0 ... $2^{16}-1$		Errors since the device has restarted or since last clearing	Clr
Tout	0 ... $2^{16}-1$		Timeout errors since the device has restarted or since last clearing	Clr

Set = An editable parameter (password needed)

Clr = Clearing to zero is possible

1) The communication parameters are set in the protocol specific menus. For the local port command line interface the parameters are set in configuration menu.

## 5.1.2. Remote port X3

### Physical interface

The physical interface of this port is RS-232. See Figure 5.1-1, chapter 10 Order information and the table below.

### Parameters

Parameter	Value	Unit	Description	Note
Protocol	None SPA-bus ProfibusDP ModbusSla ModbusTCPs IEC-103 ExternalIO DNP3		Protocol selection for remote port - SPA-bus (slave) Profibus DB (slave) Modbus RTU slave Modbus TCP slave IEC-60870-5-103 (slave) Modbus RTU master for external I/O-modules DNP 3.0	Set
Msg#	0 ... 2 <sup>32</sup> -1		Message counter since the device has restarted or since last clearing	Clr
Errors	0 ... 2 <sup>16</sup> -1		Protocol errors since the device has restarted or since last clearing	Clr
Tout	0 ... 2 <sup>16</sup> -1		Timeout errors since the device has restarted or since last clearing	Clr
	speed/DPS		Display of current communication parameters. speed = bit/s D = number of data bits P = parity: none, even, odd S = number of stop bits	1)
Debug	No Binary ASCII		Echo to local port No echo For binary protocols For SPA-bus protocol	Set

Set = An editable parameter (password needed)

Clr = Clearing to zero is possible

1) The communication parameters are set in the protocol specific menus. For the local port command line interface the parameters are set in configuration menu.

## 5.2. Communication protocols

This protocols enable the transfer of the following type of data:

- events
- status information
- measurements
- control commands.
- clock synchronizing
- Settings (SPA-bus and embedded SPA-bus only)

### 5.2.1. PC communication

PC communication is using a VAMP specified command line interface. The VAMPSET program can communicate using the local RS-232 port or using TCP/IP and ethernet interface. It is also possible to select SPA-bus protocol for the local port and configure the VAMPSET to embed the command line interface inside SPA-bus messages. For TCP/IP configuration see chapter 5.2.8.

### 5.2.2. Modbus TCP and Modbus RTU

These Modbus protocols are often used in power plants and in industrial applications. The difference between these two protocols is the media. Modbus TCP uses Ethernet and Modbus RTU uses asynchronous communication (RS-485, optic fibre, RS-232).

VAMPSET will show the list of all available data items for Modbus. A separate document Modbus parameters.pdf is also available.

The Modbus communication is activated usually for remote port via a menu selection with parameter "Protocol". See chapter 5.1.

For TCP/IP configuration see chapter 5.2.8.

#### Parameters

Parameter	Value	Unit	Description	Note
Addr	1 – 247		Modbus address for the device. Broadcast address 0 can be used for clock synchronizing. Modbus TCP uses also the TCP port settings.	Set
bit/s	1200 2400 4800 9600 19200	bps	Communication speed for Modbus RTU	Set

Parameter	Value	Unit	Description	Note
Parity	None Even Odd		Parity for Modbus RTU	Set

Set = An editable parameter (password needed)

### 5.2.3. Profibus DP

The Profibus DP protocol is widely used in industry. An external VPA 3CG or an internal Profibus module (see the order code in chapter 10.) is required.

#### Device profile "continuous mode"

In this mode the device is sending a configured set of data parameters continuously to the Profibus DP master. The benefit of this mode is the speed and easy access to the data in the Profibus master. The drawback is the maximum buffer size of 128 bytes, which limits the number of data items transferred to the master. Some PLCs have their own limitation for the Profibus buffer size, which may further limit the number of transferred data items.

#### Device profile "Request mode"

Using the request mode it is possible to read all the available data from the VAMP device and still use only a very short buffer for Profibus data transfer. The drawback is the slower overall speed of the data transfer and the need of increased data processing at the Profibus master as every data item must be separately requested by the master.

**NOTE!** In request mode it is not possible to read continuously only one single data item. At least two data items must be read in turn to get updated data from the device.

There is a separate manual for VPA 3CG with the code VMVPA.ENXX available for the continuous mode and request mode.

#### Available data

VAMPSET will show the list of all available data items for both modes. A separate document "Profibus parameters.pdf" is also available.

The Profibus DP communication is activated usually for remote port via a menu selection with parameter "Protocol". See chapter 5.1.



## Parameters

Parameter	Value	Unit	Description	Note
Mode	Cont Reqst		Profile selection Continuous mode Request mode	Set
bit/s	2400	bps	Communication speed from the main CPU to the Profibus converter. (The actual Profibus bit rate is automatically set by the Profibus master and can be up to 12 Mbit/s.)	
Emode	Channel  (Limit60) (NoLimit)		Event numbering style. Use this for new installations. (The other modes are for compatibility with old systems.)	(Set)
InBuf		bytes	Size of Profibus master's Rx buffer. (data to the master)	1) 3)
OutBuf		bytes	Size of Profibus master's Tx buffer. (data from the master)	2) 3)
Addr	1 – 247		This address has to be unique within the Profibus network system.	Set
Conv	– VE		Converter type No converter recognized Converter type "VE" is recognized	4)

Set = An editable parameter (password needed)

Clr = Clearing to zero is possible

1) In continuous mode the size depends of the biggest configured data offset of a data item to be send to the master. In request mode the size is 8 bytes.

2) In continuous mode the size depends of the biggest configured data offset of a data to be read from the master. In request mode the size is 8 bytes.

3) When configuring the Profibus master system, the length of these buffers are needed. The device calculates the lengths according the Profibus data and profile configuration and the values define the in/out module to be configured for the Profibus master.

4) If the value is "-", Profibus protocol has not been selected or the device has not restarted after protocol change or there is a communication problem between the main CPU and the Profibus ASIC.

### 5.2.4. SPA-bus

The unit has full support for the SPA-bus protocol including reading and writing the setting values. Also reading of multiple consecutive status data bits, measurement values or setting values with one message is supported.

Several simultaneous instances of this protocol, using different physical ports, are possible, but the events can be read by one single instance only.

There is a separate document “Spabus parameters.pdf” of SPA-bus data items available.

#### Parameters

Parameter	Value	Unit	Description	Note
Addr	1 – 899		SPA-bus address. Must be unique in the system.	Set
bit/s	1200 2400 4800 9600 (default) 19200	bps	Communication speed	Set
Emode	Channel  (Limit60) (NoLimit)		Event numbering style. Use this for new installations. (The other modes are for compatibility with old systems.)	(Set)

Set = An editable parameter (password needed)

### 5.2.5. 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 device 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 device:

- 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 device 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.

For more information on IEC 60870-5-103 in Vamp devices refer to the "IEC103 Interoperability List" document.

### Parameters

Parameter	Value	Unit	Description	Note
Addr	1 – 254		An unique address within the system	Set
bit/s	9600 19200	bps	Communication speed	Set
MeasInt	200 – 10000	ms	Minimum measurement response interval	Set
SyncRe	Sync Sync+Proc Msg Msg+Proc		ASDU6 response time mode	Set

Set = An editable parameter (password needed)

**Parameters for disturbance record reading**

Parameter	Value	Unit	Description	Note
ASDU23	On Off		Enable record info message	Set
SmpIs/msg	1–25		Record samples in one message	Set
Timeout	10–10000	s	Record reading timeout	Set
Fault			Fault identifier number for IEC-103. Starts + trips of all stages.	
TagPos			Position of read pointer	
Chn			Active channel	
ChnPos			Channel read position	
<b>Fault numbering</b>				
Faults			Total number of faults	
GridFlts			Fault burst identifier number	
Grid			Time window to classify faults together to the same burst.	Set

Set = An editable parameter (password needed)

## 5.2.6. DNP 3.0

The unit supports communication using DNP 3.0 protocol.

The following DNP 3.0 data types are supported:

- binary input
- binary input change
- double-bit input
- binary output
- analog input
- counters

Additional information can be obtained from the “DNP 3.0 Device Profile Document” for VAMP 2xx.

DNP 3.0 communication is activated via menu selection. RS-485 interface is often used but also RS-232 and fibre optic interfaces are possible.

### Parameters

Parameter	Value	Unit	Description	Set
bit/s	4800 9600 (default) 19200 38400	bps	Communication speed	Set
Parity	None (default) Even Odd		Parity	Set
SlvAddr	1 – 65519		An unique address for the device within the system	Set
MstrAddr	1 – 65519 255=default		Address of master	Set
LLTout	0 – 65535	ms	Link layer confirmation timeout	Set
LLRetry	1 – 255 1=default		Link layer retry count	Set
APLTout	0 – 65535 5000=default	ms	Application layer confirmation timeout	Set
CnfMode	EvOnly (default) All		Application layer confirmation mode	Set
DBISup	No (default) Yes		Double-bit input support	Set
SyncMode	0 – 65535	s	Clock synchronization request interval. 0 = only at boot	Set

Set = An editable parameter (password needed)

### 5.2.7. IEC 60870-5-101

The IEC 60870-5-101 standard is derived from the IEC 60870-5 protocol standard definition. In Vamp devices, IEC 60870-5-101 communication protocol is available via menu selection. The Vamp unit works as a controlled outstation (slave) unit in unbalanced mode.

Supported application functions include process data transmission, event transmission, command transmission, general interrogation, clock synchronization, transmission of integrated totals, and acquisition of transmission delay.

For more information on IEC 60870-5-101 in Vamp devices refer to the “IEC 101 Profile checklist & datalist” document.

#### Parameters

Parameter	Value	Unit	Description	Note
bit/s	1200 2400 4800 9600	bps	Bitrate used for serial communication.	Set
Parity	None Even Odd		Parity used for serial communication	Set
LLAddr	1 - 65534		Link layer address	Set
LLAddrSize	1 – 2	bytes	Size of Link layer address	Set
ALAddr	1 – 65534		ASDU address	Set
ALAddrSize	1 – 2	Bytes	Size of ASDU address	Set
IOAddrSize	2 - 3	Bytes	Information object address size. (3-octet addresses are created from 2-octet addresses by adding MSB with value 0.)	Set
COTsize	1	Bytes	Cause of transmission size	
TTFFormat	Short Full		The parameter determines time tag format: 3-octet time tag or 7-octet time tag.	Set
MeasFormat	Scaled Normalized		The parameter determines measurement data format: normalized value or scaled value.	Set
DbandEna	No Yes		Dead-band calculation enable flag	Set
DbandCy	100 - 10000	ms	Dead-band calculation interval	Set

Set = An editable parameter (password needed)



## 5.2.8. TCP/IP

Modbus TCP uses TCP/IP protocol. Also VAMPSET and SPA-bus and DNP 3.0 communication can be directed via TCP/IP.

The VSE 005-1 external adaptor is designed for TCP/IP protocol. (See chapter 10 Order information for more information).

### Parameters

Parameter	Value	Unit	Description	Set
IpAddr	n.n.n.n		Internet protocol address (set with VAMPSET)	Set
NetMsk	n.n.n.n		Net mask (set with VAMPSET)	Set
Gatew	default = 0.0.0.0		Gateway IP address (set with VAMPSET)	Set
NameSv	default = 0.0.0.0		Name server (set with VAMPSET)	Set
NTPSvr	n.n.n.n		Network time protocol server (set with VAMPSET) 0.0.0.0 = no SNTP	Set
Port	502 = default		Port 502 is reserved for Modbus TCP	Set

Set = An editable parameter (password needed)

## 5.2.9. External I/O (Modbus RTU master)

External Modbus I/O devices can be connected to the unit using this protocol. (See chapter External input / output module for more information).

# 6. Applications

The following example illustrates the versatile functions of VAMP 96 in medium voltage applications.

VAMP 96 includes three-phase voltage and three-phase current measuring. It has three digital inputs for various alarm contacts.

VAMP 96 is used to measure electrical quantities and energy of feeders (U,I,P,Q,S,THD,E). These values can be sent to higher level of automation and energy management system using a communication bus.

The solid state output can be used locally to give energy pulses for automation and control systems.

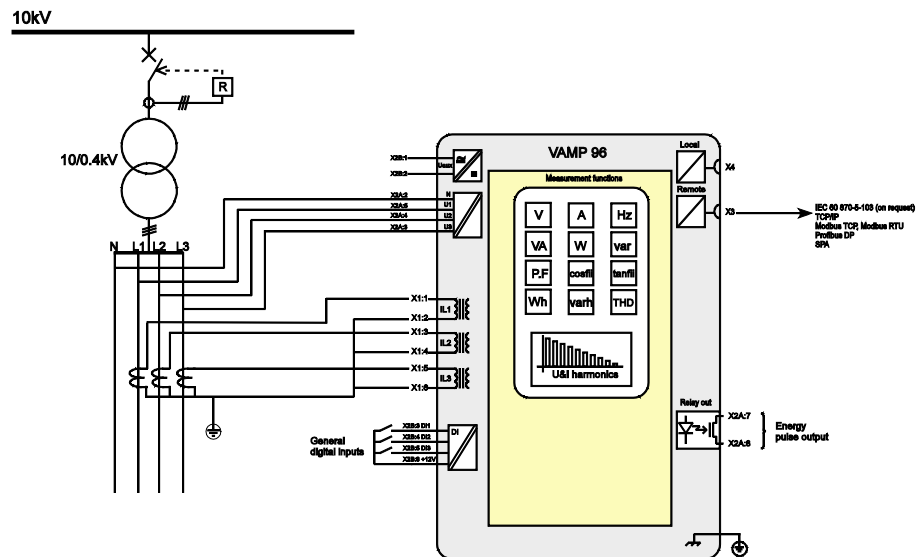


Figure 6-1 VAMP 96 connection diagram

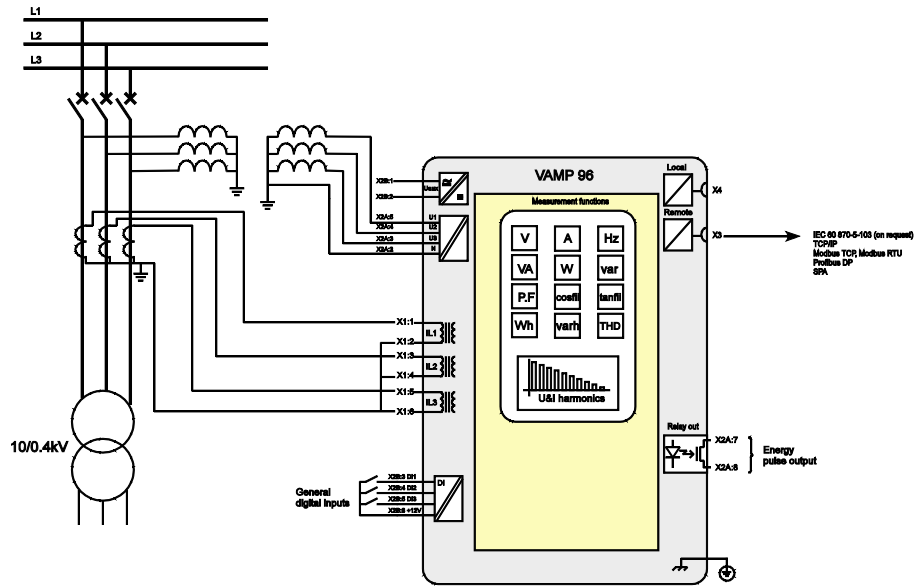


Figure 6-2 VAMP 96 used with 3 CT's.

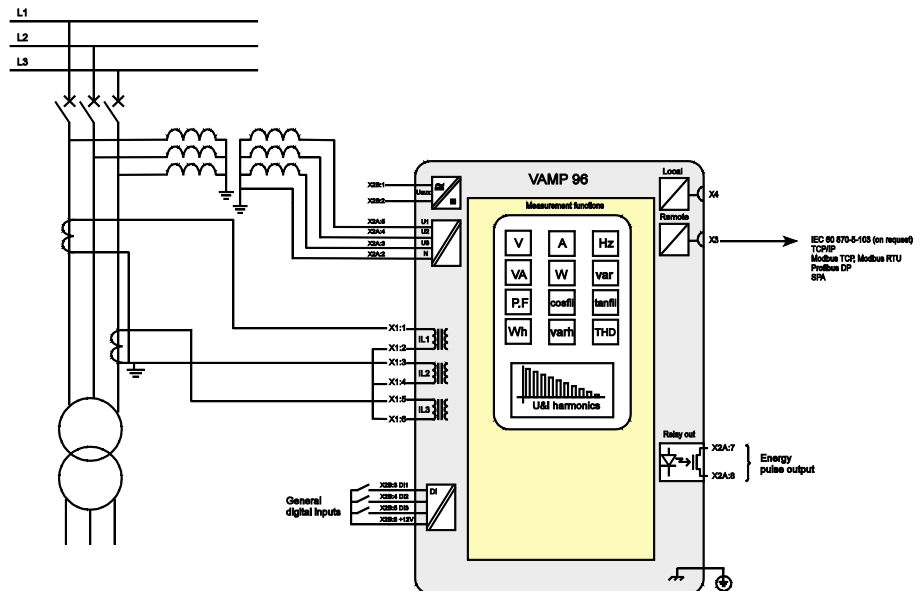


Figure 6-3 VAMP 96 used with 2 CT's when the network is isolated.

# 7. Connections

## 7.1. Rear panel view

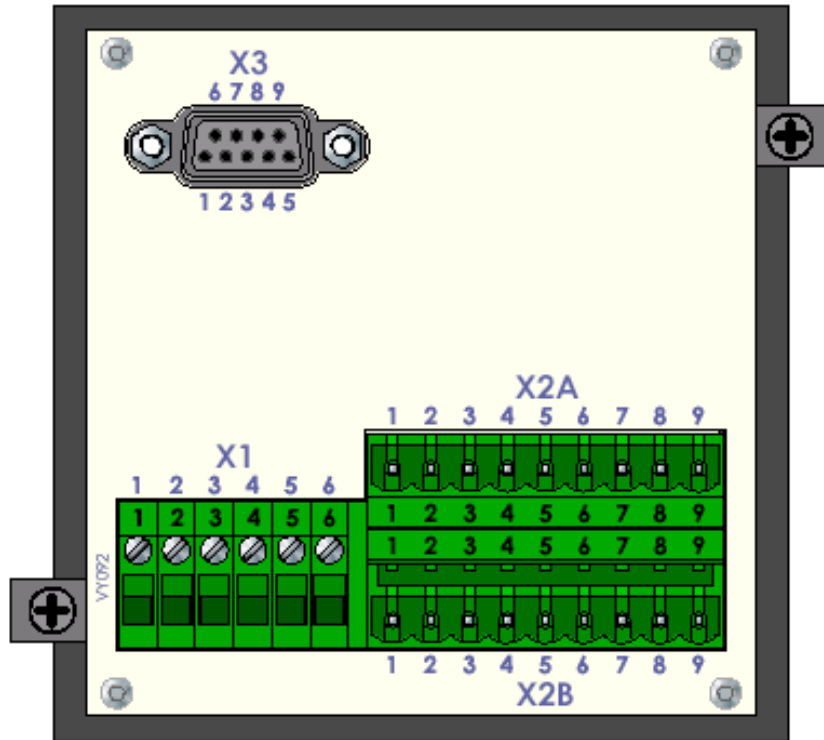
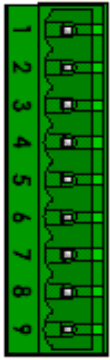


Figure 7-1 Connections on the rear panel of the VAMP 96

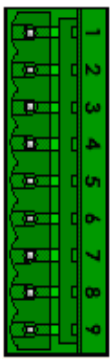
### Terminal X1



No:	Symbol	Description
<u>1</u>	<u>IL1</u>	<u>Phase current L1</u>
<u>2</u>	<u>IL1</u>	<u>Phase current L1</u>
<u>3</u>	<u>IL2</u>	<u>Phase current L2</u>
<u>4</u>	<u>IL2</u>	<u>Phase current L2</u>
<u>5</u>	<u>IL3</u>	<u>Phase current L3</u>
<u>6</u>	<u>IL3</u>	<u>Phase current L3</u>

**Terminal X2A**

No:	Symbol	Description
<u>1</u>	<u>::</u>	<u>::</u>
<u>2</u>	<u>N</u>	<u>N</u>
<u>3</u>	<u>UL3</u>	<u>Phase voltage L3</u>
<u>4</u>	<u>UL2</u>	<u>Phase voltage L2</u>
<u>5</u>	<u>UL1</u>	<u>Phase voltage L1</u>
<u>6</u>	<u>::</u>	<u>::</u>
<u>7</u>	<u>A1</u>	<u>Solid state relay output, normal open</u>
<u>8</u>	<u>A1</u>	<u>Solid state relay output, normal open</u>
<u>9</u>	<u>::</u>	<u>::</u>

**Terminal X2B**

No:	Symbol	Description
<u>1</u>	<u>Uaux</u>	<u>Voltage +</u>
<u>2</u>	<u>Uaux</u>	<u>Voltage -</u>
<u>3</u>	<u>DI1</u>	<u>Digital input 1</u>
<u>4</u>	<u>DI2</u>	<u>Digital input 2</u>
<u>5</u>	<u>DI3</u>	<u>Digital input 3</u>
<u>6</u>	<u>::</u>	<u>::</u>
<u>7</u>	<u>::</u>	<u>::</u>
<u>8</u>	<u>+12V</u>	<u>+12V out</u>
<u>9</u>	<u>::</u>	<u>::</u>

## 7.2. Analogue measurements

- Phase currents  $I_{L1}$ ,  $I_{L2}$  and  $I_{L3}$  (terminals X1: 1-6)
- Phase voltages  $U_{L1}$ ,  $U_{L2}$  and  $U_{L3}$  (terminals X2A: 3-5)

## 7.3. Digital inputs

Further, the unit can collect status information and alarm signals via 3 digital inputs. The three digital inputs in VAMP 96 use an internal 12 V dc auxiliary voltage of the unit.

Potential-free contacts must be available in the supervised object for transferring status information to the unit.

## 7.4. Output relay

The terminal is equipped with one potential free Solid state output contact.

## 7.5. Serial communication connection

- RS 232 serial communication connection for computers, connector LOCAL (RS 232), the connectors on the front and rear panel are connected in parallel.
- Remote control connection with the following options:
  1. RS-485
  2. Plastic fibre
  3. Glass fibre
  4. Profibus RS-485 (9-pin)
  5. TCP/IP

### 7.5.1. Pin assignments of communication ports

The pin assignment of remote port is presented in the following table.

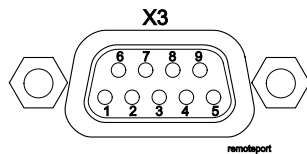


Figure 7.5.1-1 Pin numbering of the rear communication port, REMOTE

Pin	Signal
1	
2	TX remote
3	RX remote
4	
5	TX local
6	RX local
7	GND
8	
9	+12V

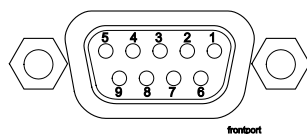


Figure 7.5.1-2 Pin numbering of the front communication port, LOCAL

Pin	Signal
1	
2	RX / RS232 in
3	TX / RS232 out
4	+12V out
5	GND
6	DSR in
7	
8	
9	

**NOTE!** DSR must be connected to +12 V to activate the front panel interface.

## 7.5.2. External input / output module

The relay supports an optional external input/output modules used to extend the number of digital inputs and outputs. Also modules for analogue inputs and outputs are available. The following types of devices are supported:

- Analog input modules (RTD)
- Analog output modules (mA-output)
- Binary input/output modules

EXTENSION port is primarily designed for IO modules. This port is found in the LOCAL connector of the relay backplane and IO devices should be connected to the port with VSE003 adapter.

**NOTE!** If ExternalIO protocol is not selected to any communication port, VAMPSET doesn't display the menus required for configuring the IO devices. After changing EXTENSION port protocol to ExternalIO, restart the relay and read all settings with VAMPSET.

External analog inputs configuration (VAMPSET only)

EXTERNAL ANALOG INPUTS											
AI Enabled	AI Meas	AI Unit	AI Slave Address	AI ModBus Address	AI Register Type	AI Offset	x1	y1	x2	y2	AI Error Counter
On	0.00 C	C	1	1	HoldingR	0	0	0	1	1	0
Off	0.00 C	C	1	2	HoldingR	0	0	0	1	1	0
Off	0.00 C	C	1	3	HoldingR	0	0	0	1	1	0
Range		Description									
		Communication read errors									
X: -32000...32000 Y: -1000...1000		Scaling		Y2	Scaled value		Point 2				
				X2	Modbus value						
				Y1	Scaled value		Point 1				
				X1	Modbus value						
-32000...32000				Off set	Subtracted from Modbus value, before running XY scaling						
InputR or HoldingR		Modbus register type									
1...9999		Modbus register for the measurement									
1...247		Modbus address of the I/O device									
C, F, K, mA, Ohm or V/A		Unit selection									
		Active value									
On / Off		Enabling for measurement									

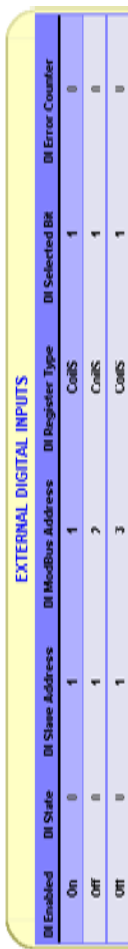
Alarms for external analog inputs

Range	Description	
0...10000	Hysteresis for alarm limits	
-21x107... ...21x107	Alarm >	Limit setting
- / Alarm		Active state
-21x107... ...21x107	Alarm >	Limit setting
- / Alarm		Active state
	Active value	
1...9999	Modbus register for the measurement	
1...247	Modbus address of the I/O device	
On / Off	Enabling for measurement	

Analog input alarms have also matrix signals, “Ext. AIx Alarm1” and “Ext. AIx Alarm2”.

External digital inputs configuration (VAMPSET only)

Range	Description
	Communication read errors
1...16	Bit number of Modbus register value
CoilS, InputS, InputR or HoldingR	Modbus register type
1...9999	Modbus register for the measurement
1...247	Modbus address of the I/O device
0 / 1	Active state
On / Off	Enabling for measurement



External digital outputs configuration (VAMPSET only)

EXTERNAL DIGITAL OUTPUTS					Range	Description
DO Enabled	DO State	DO Slave Address	DO ModBus Address	DO Error Counter		
On	0	1	1	0		Communication errors
Off	0	1	2	0	1...9999	Modbus register for the measurement
Off	0	1	3	0	1...247	Modbus address of the I/O device
	0 / 1				0 / 1	Output state
	On / Off				On / Off	Enabling for measurement

External analog outputs configuration (VAMPSET only)

Range	Description
	Communication errors
-32768...+32767 (0...65535)	Modbus value corresponding Linked Val. Max
	Modbus value corresponding Linked Val. Min
InputR or HoldingR	Modbus register type
1...9999	Modbus register for the output
1...247	Modbus address of the I/O device
0...42x108, -21...+21x108	Maximum limit for lined value, corresponding to "Modbus Max"
	Minimum limit for lined value, corresponding to "Modbus Min"
	Link selection
-21x107... ...+21x107	Minimum & maximum output values
	Active value
On / Off	Enabling for measurement



## 8. Technical data

### 8.1. Connections

#### 8.1.1. Measuring circuitry

Rated current $I_n$ - Current measuring range - Thermal withstand - Burden	5 A 0-5 A 6 A (continuously) < 0.1 VA
Rated voltage $U_n$ - Voltage measuring range - Continuous voltage withstand - Burden	230 V ac 0 – 265 V ac 275 V ac < 0.5 VA
Rated frequency $f_n$ - Frequency measuring range	50 Hz 45 – 65 Hz
Terminal block: - Solid or stranded wire	Maximum wire dimension: 2,5 mm <sup>2</sup> (13-14 AWG)

#### 8.1.2. Auxiliary voltage

	Type A (standard)	Type B (option)	Type G (option)
Rated voltage $U_{aux}$	90 – 264 V ac / 120 – 370 V dc 110/230 V ac	18 · 75 V dc 48 V dc	9 – 36 V dc 24 V dc
Power consumption	< 5 W (normal conditions) < 10 W (output relay activated)		
Max. permitted interruption time	< 15 ms (230 V ac)		
Terminal block: - Phoenix MVSTBW or equivalent	Maximum wire dimension: 2.5 mm <sup>2</sup> (13-14 AWG)		

#### 8.1.3. Digital inputs

##### Internal operating voltage

Number of inputs	3
Internal operating voltage	12 V dc
Current drain when active (max.)	Approx. 5 mA
Current drain, average value	< 2,5 mA
Terminal block: - Phoenix MVSTBW or equivalent	Maximum wire dimension: 2.5 mm <sup>2</sup> (13-14 AWG)

#### 8.1.4. Alarm contact

Number of contacts:	1 MOSFET contact
Rated voltage	320 V ac
Continuous carry	50 mA
Terminal block: - Phoenix MVSTBW or equivalent	Max. wire dimension: 2.5 mm <sup>2</sup> (13-14 AWG)

### 8.1.5. Local serial communication port

Number of ports	1 on front and 1 shared on rear panel
Electrical connection	RS 232
Data transfer rate	9600 - 38 400 kb/s

### 8.1.6. Remote control connection

Number of ports	1 shared on rear panel
Electrical connection	RS 232 (standard) RS 485 (with external module) Profibus bus (with optional external module) TCP/IP (with optional external module) Plastic fibre connection (with external module)
Data transfer rate	9600 kb/s
Protocols	Modbus, RTU master Modbus, RTU slave SPA bus, slave IEC 60870-5-103 Profibus DP TCP/IP DNP 3.0

## 8.2. Tests and environmental conditions

### 8.2.1. Disturbance tests

Emission - Conducted (EN 55022B) - Emitted (CISPR 11)	0.15 – 30 MHz 30 – 1000 MHz
Immunity - 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 61000-4-6, 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) EN61000-4-3 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

### 8.2.2. 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

### 8.2.3. Mechanical tests

Vibration (IEC 60255-21-1)	10...60 Hz, amplitude $\pm 0.035$ mm 60...150 Hz, acceleration 0.5 g 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

### 8.2.4. Environmental conditions

Operating temperature	-25 to +50 °C
Operating temperature (display)	0 to +50 °C
Transport and storage temperature	-10 to +60 °C
Relative humidity	< 75% (1 year, average value) < 90% (30 days per year, no condensation permitted)

### 8.2.5. Casing

Degree of protection (IEC 60529)	IP20
Dimensions (W x H x D)	96 x 96 x 151 mm
Material	Polyphenylene oxide
Weight	1.2 kg
Colour code	

### 8.2.6. Package

Dimensions (W x H x D)	105 x 105 x 175 mm
Weight (Unit and Package)	1.4 kg

# 9. Dimensional drawing

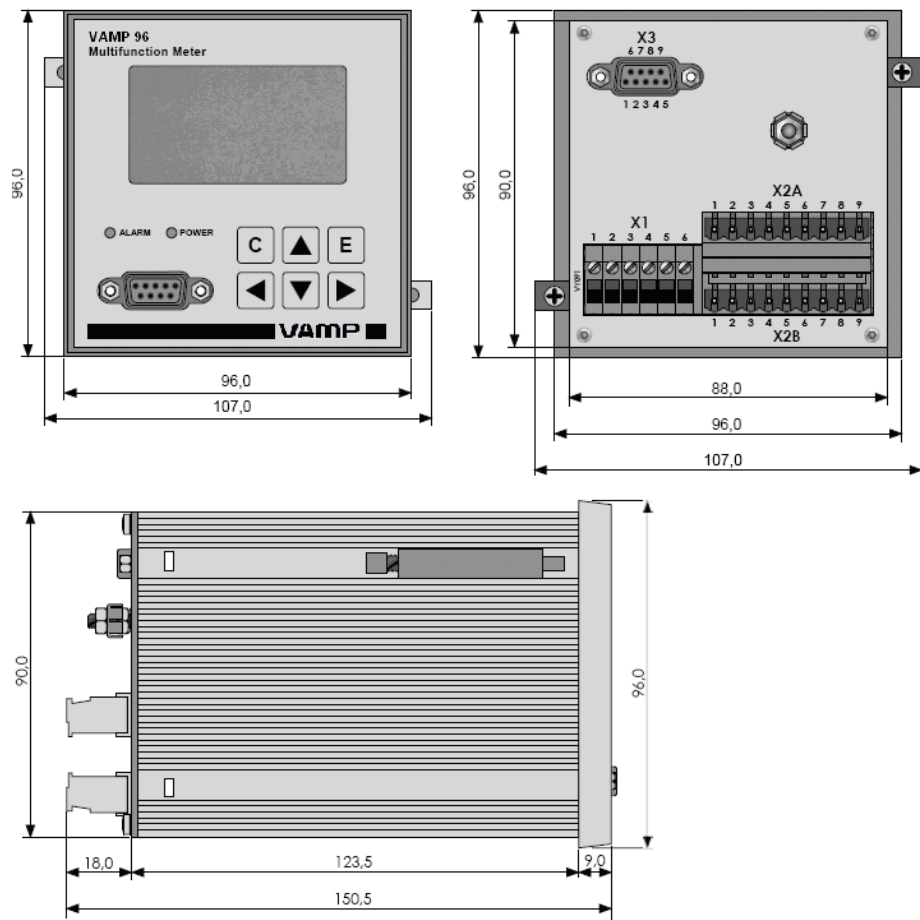


Figure 9-1 Dimensional drawing



# 10. Order information

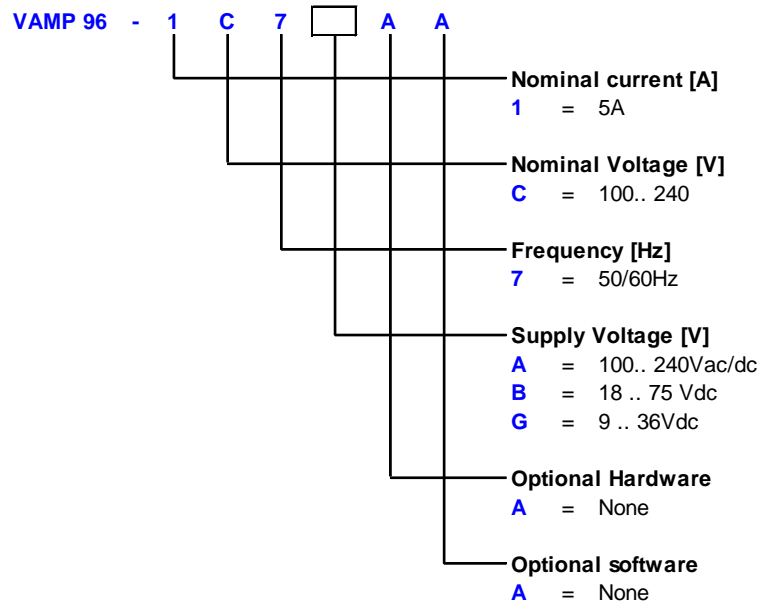
When ordering, please state:

Type designation: VAMP 96

Quantity :

Options ( see respective ordering code):

## VAMP 96 ORDERING CODE



### Accessories :

Order Code	Explanation	Note
VEA3CGi	External ethernet interface module	
VPA3CG	Profibus interface module	
VSE001	Fiber optic Interface Module	
VSE004	RS485 Interface Module, Ext I/O interface	
VX003-3	RS232 programming cable (Vampset, VEA 3CGi)	Cable length 3m
VX028-3	Interface cable to VPA 3 CG (Profibus module)	Cable length 3m
VX032-3	Back panel programming cable	Cable length 3m
VX030-3	Interface cable to VEA 3 CG (Ethernet module)	Cable length 3m

# 11. Reference information

**Documentation:**

VAMPSET User's Manual VMV.EN0xx

**Manufacturer / Service data:**

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The logo consists of a solid blue horizontal bar. On the right side of this bar, the word "VAMP" is written in a bold, white, sans-serif font. The letters are slightly shadowed, giving the impression that they are floating above or attached to the bar.

**VAMP**