VAMP 221

Arc protection system

Operation and configuration instructions
Technical description
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1. **General**

This first part, Operation and configuration instructions, of the Manual contains a general description of and user instructions for the VAMP 221 Arc Protection System components and functions. This section also includes parametering and configuration instructions and instructions for changing the setting values.

The second part, Technical description, contains a detailed description of the protection functions, application examples and technical data.

1.1. **VAMP 221 arc protection system components**

VAMP 221 is an easily adaptable arc protection system for the protection of electricity distribution systems. VAMP 221 significantly reduces the risk of potential personal damage, and material and production losses caused by arc fault.

VAMP 221 in a nutshell:
- system operating time 7 milliseconds
- accurate location of arc fault
- four selective protection zones
- self-supervision of the entire system
- system cabling with standard cables
- automatic system configuration
- phase current measuring
- earth-fault current measuring

VAMP 221 complies with the latest standards concerning the electromagnetic compliance (EMC) of protective relays.
VAMP 221 is a modular system consisting of a central unit, I/O units, arc sensors and possible multiplying relays.

Thanks to its modularity, the system can easily be adapted to different targets requiring arc protection, from simple systems comprising one central unit and one I/O unit to versatile selective systems comprising several central units.

The VAMP 221 arc protection system is suitable for both low and medium voltage switchgear. In addition to new switchgear, the system can also be installed on existing switchgear.
1.1.1. Central unit VAMP 221

The central unit VAMP 221 contains the following functions:

- 3-phase overcurrent and arc stage
- Alternatively, 2-phase overcurrent, earth-fault and arc stage
- Circuit breaker failure protection stage (CBFP)
- Optional trip criteria (I>&L>, I0>&L> or L>)
- Two mutually independent tripping groups
- Four output trip relays
- Four protection zones
- BI/O bus for light and overcurrent information
- Status, fault and trip indications
- Accommodates up to 16 I/O units
- System self-supervision
1.1.2. **I/O units VAM 10L, VAM 3L and VAM 4C**

Sensors are connected to the central unit via I/O units.
- VAM 10L accommodates up to 10 arc sensors
- VAM 3L accommodates up to 3 fibre loops
- VAM 3C accommodates up to 3 current transformers
- The I/O units are equipped with one output trip relay.
- Indication of active sensor.
- Protection zone addresses (max. 4 zones)
- Detachable external wiring terminal blocks (does not apply to the current terminals of VAM 4C).
- Connection for a portable arc sensor (VAM 10L and 3L)
- Free placement in the switchgear.
- Intra-unit cabling with factory-made modular cable or instrumentation cable.
1.1.3. **Arc sensors VA 1 DA, VA 1 EH, ARC-SLx and VA 1 DP**

Sensors placed in the switchgear transfer the light information to the I/O units.

**Arc sensor VA 1 DA**

![Arc sensor VA 1 DA](image)

*Figure 1.1.3-1 Arc sensor VA 1 DA*

- Strong light is transformed to a current signal in the sensor
- VAM 10L transfers the current signal to the central unit
- Standard cable lengths 6 m and 20 m
- The sensor type offers a cost-effective arc protection solution
- Easy to install and repair (after arc faults, for example)
- Normal installation involves one sensor in each switchgear compartment
- Self-supervised arc sensor
**Arc sensor VA 1 EH**

- Strong light is transformed to a current signal in the sensor
- VAM 10L transfers the current signal to the central unit
- Standard cable lengths 6 m and 20 m
- The sensor type offers a cost-effective arc protection solution
- The sensor can be installed in a tube, for example, so that the active light detector sees the monitored zone.
- Self-supervised arc sensor
The fibre sensor is a durable glass fibre, which is manufactured in lengths of 10, 15, 20, 25, 30 and 35 metres.

The first 2.5 metres of the fibre are insulated against light.

The detected light information is transferred to the VAM 3L unit inside the fibre.

The fibre will be installed to go through the supervised compartments.

Monitoring the light information with a fibre system is a cost-effective solution e.g. in low voltage switchgears with several compartments.

Self-supervised arc sensor.

Figure 1.1.3-3 Arc fibre sensor ARC-SLx
Portable arc sensor VA 1 DP

- Improves personal safety when working with live voltage switchgear.
- The sensor is to be connected to the nearest light I/O unit (VAM 10L or VAM 3L) using a snap-in connector
- Cable length 5 metres
- The sensor is designed to be attached e.g. to the edge of a pocket in the technician’s working wear
1.1.4. **Other system components**

**Multiplying relay VAR 4CE**

![Multiplying relay VAR 4CE](image)

*Figure 1.1.4-1 Multiplying relay VAR 4CE*

- Four potential-free electromechanical output trip relays.
- Multiplying relay operating time 5 ms
- Control either through the I/O unit trip relay or DO output
Modular cable VX001

The I/O and master units are to be connected to each other using a modular cable approved by the manufacturer. The cable is equipped with quick-disconnect connectors.

You can also use an instrumentation cable, in which case the connection is made via the screw terminals in the central unit and the I/O units.

Modular cables are available in lengths of 1, 3, 5, 7, 10, 15, 20, 25, 30, 40 and 50 metres. If necessary, custom lengths exceeding 10 metres can also be provided.

**NOTE!** The total length of the modular or instrumentation cables of the system, measured from the central unit to the furthest I/O unit, may not exceed 100 metres.

1.2. ** Operational safety**

Dangerous voltages may occur at the terminal in the back panel of the central unit, even though the auxiliary power supply has been disconnected. Do not open the secondary circuit of a live current transformer. Disconnecting the secondary circuit of a live current transformer may cause dangerous overcurrents! Always observe all national and regional regulations and guidelines.

Read any instructions carefully before performing any operations.
2. User interface

The control and acknowledgement functions of the VAMP 221 arc protection system are mainly carried out using the push buttons on the central unit. Information on equipment status and operation can also be read on the central unit’s display and indicator lights.

2.1. Front panel of the central unit VAMP 221

Figure 2.1-1 Central unit VAMP 221 - front panel

The front panel of the central unit contains all the programming and control buttons, and the DIP-switches that control the operation of the central unit.
2.1.1. Display and status indications

1. Operating status indication lights, see section ‘Moving in menus’
   - **RUN**: normal operation
   - **INSTALL**: system configuration
   - **INFO**: system configuration check
   - **TEMP SET**: reserved for future use
   - **TEMP**: reserved for future use
   - **CURRENT**: current setting limit and measurement indication
   - **ERROR**: reading and resetting of fault memory

2. Display
3. **POWER** indicator light, indicates all supply voltages are in order.
4. **COM** indicator light, blinks in INSTALL mode when the central units and I/O units are communicating.
5. **ERROR** indicator light, indicates internal fault detected by the relay self-diagnostics.

   **NOTE!** The light also blinks dimly in normal operating mode (visible only in the dark).

6. Trip indication lights, indicate which trip stages have been activated.
7. **I>int** LED light, indicates overcurrent activation of the central unit.
8. **I>int** LED light, indicates overcurrent activation outside the central unit.

   **NOTE!** Any rippling in the display is due to its refresh rate.
NOTE! Moving in the operating menus does not affect the operation of the arc protection; the system is ready to activate once the system has been configured and while the central unit is connected to an operating voltage.

2.1.2. **Buttons and programming switches**

![Figure 2.1.2-1 Buttons and programming switches](image)

1. Programming switches for the trip relay matrix
2. Selection switch for the secondary current of the current transformer
3. Overcurrent setting knob (I_{L1}, I_{L3}), setting range 0.5...6\times I_n
4. Overcurrent setting knob (I_{L1}, I_0), setting range 0.05...5\times I_n
5. Navigation keys
6. SET push button for activating functions
7. ENTER push button for executing functions
8. Communication port for loading software updates, not needed in normal operation.

For more details on the trip relay matrix, see section 3.3 Using programming switches.
2.1.3. Moving in menus

![Diagram showing the operation sequence for moving in menus]

Figure 2.1.3-1 Moving in the mode menu
Select the operating status with the up and down navigation keys on the central unit.

To activate a function, use the S key. A blinking display indicates that the function has been activated. Press E to confirm the execution of an activated function. To cancel an activated function, press S again.

Use the left and right navigation keys to browse parallel information: for example, you can change the I/O unit you wish to view in the INFO mode or compare the current limit setting values the measured earth-fault and/or phase currents.

**NOTE!** If you do not touch the buttons for one minute, the central unit automatically returns to the normal operating mode (RUN). Regardless of which menu is displayed the arc system will always be ready to operate!

2.2. **I/O unit front panels**

Usually, there is no need to touch the front panel during normal operation, since all the necessary information can be read from the central unit display. However, after a new installation or a system expand you will need to program certain functions (zone/address, trip output) in the I/O unit.

**NOTE!** If you unfasten the terminal blocks during installation, remember to tighten the fixing screws after installation! Also tighten the screws even if you did not unfasten the blocks.
2.2.1. VAM 10L - front panel

Figure 2.2.1-1 Arc sensor I/O unit VAM 10L

1. Connection for portable arc sensor (VA 1 DP)
2. Programming switches
3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the central unit and I/O units are communicating. See page 16.
5. ERROR indicator light, indicates an internal fault detected by the component’s self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors. See page 16.
6. Connector sockets for the VX001 modular cables
7. LED lights indicating sensor activation
8. Terminal block for ten arc sensors
9. Portable arc sensor VA 1 DP connected and operational
10. Portable arc sensor activated
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal
2.2.2. **I/O unit VAM 3L - front plate**

![Diagram of I/O unit VAM 3L - front plate]

**Figure 2.2.2-1 Arc fibre sensor I/O unit VAM 3L**

1. Connection for portable arc sensor (VA 1 DP)
2. Programming switches
3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the central units and I/O units are communicating. See page 16.
5. ERROR indicator light, indicates an internal fault detected by the component’s self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors. See page 16.
6. Connector sockets for the VX001 modular cables
7. LED lights indicating sensor activation
8. Terminals for three fibre sensors
9. Portable arc sensor VA 1 DP connected and operational
10. Portable arc sensor activated
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal
2.2.3. I/O unit VAM 4C - front plate

Figure 2.2.3-1 Current I/O unit VAM 4C

1. Programming switches
2. POWER indicator light, indicates the supply voltages of each component are in order.
3. COM indicator light, lit when the central units and I/O units are communicating. See page 16.
4. ERROR indicator light, indicates an internal fault detected by the component’s self-diagnostics. Such faults include faulty current transformer or phase current unbalance. See page 16.
5. Connector sockets for the VX001 modular cables
6. LED lights indicating that I> stage has started
7. Terminals for three current transformers
8. Current transformer programming switches
9. Overcurrent setting knob (I_{L1}, I_{L3}), setting range 0.5…6\times I_n
10. Overcurrent setting knob (I_{L1}, I_0), setting range 0.05…5\times I_n
11. I/O unit trip relay activated

12. Terminal block for external communication and BI/O channels and trip signal

13. Indicator leds for current setting

2.2.4. Multipliyng relay VAR 4CE - front plate

![Multiplying relay VAR 4CE - front plate diagram]

Figure 2.2.4-1 Multiplying relay VAR 4CE

1. POWER LED, indicates that the external operating voltage of +24 Vdc is connected.

2. Terminals for external operating voltage (+24 Vdc). Can be supplied by central units or I/O units.

3. Terminals for incoming trip signal (external dry contact).

4. Terminals for outgoing trip signals (four potential-free contacts, normally open).
2.2.5. Multiplying relay VAMP 4R - front plate

Figure 2.2.5-1 Multiplying relay VAMP 4R

1. POWER LED, indicates that the external operating voltage of +24 Vdc is connected.

2. Terminals for external operating voltage (+24 Vdc). Can be supplied by central units or I/O units.

3. Terminals for incoming trip signal (24 Vdc, 2 groups).

4. Terminals for outgoing trip signals (8 potential-free contacts, 4 normally open, 4 normally closed).
3. **VAMP 221 arc protection system operation and troubleshooting**

Under normal conditions the arc protection system requires very little attention. The only servicing measures required in field conditions are scheduled operational tests, the intervals and scope of which depends on local legislation.

3.1. **System status indications**

The arc protection system has an extensive indication for different operation modes e.g. sensor activated, overcurrent activated, arc protection tripped, and disturbance. System configuration and measurements can also be checked during operation.

![Figure 3.1-1 VAMP 221 in normal mode](image)

In normal mode, only the RUN and POWER indicator lights are lit continuously. The COM indicator light blinks occasionally, indicating communication between units and during installation. The POWER indicator lights of the I/O units must also be permanently lit and the COM indicator light blink during communication.
3.1.1. **Arc fault**

*Figure 3.1.1-1 VAMP 221 has tripped due to arc fault, light indication I/O unit 1 sensor 1*

*Figure 3.1.1-2 VAM 10L indicates light on channel 1*

When the arc protection activates due to arc fault, the alarm relay activates and the trip indicator lights indicate the activated output trip relays.

The display at the central unit shows which arc sensor first gave the light information. This sensor information is only visible in the RUN mode. If several sensors were activated during the fault, the other activated sensors can be identified from the arc sensor leds (I/O units' indicator lights). The address of an activated sensor is stored in the fault memory, even if activation did not lead to tripping. See Figure 3.1.1-2. When the light information is transferred via the BI/O bus, the source of the light information is not visible on the display and the source must be located using other VAMP protection relays connected with the BI/O bus.
To reset the arc fault memory, do the following:

- Press the S button to activate the RUN mode.
- When the sensor address blinks on the display, press the E button.

The fault memory resets automatically two hours after activation.

### 3.1.2. Overcurrent alarm

*Figure 3.1.2-1 VAMP 221 activated due to overcurrent*

*Figure 3.1.2-2 VAM 4C indicates overcurrent on channel L2*
When any component of the current measuring system detects a current exceeding the setting value of the unit, it sends current information to all other units. The I>int indicator light is lit when the central unit measures the overcurrent. If the current information is obtained from outside the central unit (either through the BI/O bus or from a current I/O unit), the I>ext LED indicator light is lit. The indicator light of the activated stage is lit in the current I/O unit (VAM 4C).

![Diagram of current measurement](image)

*Figure 3.1.2-2 Reading measured currents in the CURRENT mode*

To read the current values measured by the central unit, do the following:

- Select the CURRENT mode using the up and down arrow keys.
- The earth fault current/phase 2 current setting value appears on the screen (I₀).
- Press the right arrow key to view the phase current setting value and instantaneous values measured in the current measuring channels.
3.1.3. Self-supervision alarm

The system’s self-supervision function continuously monitors the operation of the arc protection system. The self-supervision function supervises all the components and cables of the system. When self-supervision detects an internal fault, it activates the SF alarm relay in the central unit and lights the ERROR indicator led.

Self-supervision generates a fault code for the detected fault, which is stored in the fault memory of the central unit. The fault memory may contain up to three faults (latest faults).

Fault codes can be read only in ERROR CODE mode.

To reset the arc fault memory, do the following:

- Press the S button to activate the ERROR CODE mode. The fault code starts blinking.
- Press the E button to erase the latest fault code from the memory. The next fault code, if any, appears on the screen.
- Once you have acknowledged each fault code separately, the display becomes dark in the ERROR CODE mode.
NOTE! If the fault that caused the fault code disappears by itself, the fault code in the fault memory is also erased automatically two hours after the disappearance of the fault.

### 3.1.4. Fault codes

The following table lists the fault codes and gives a brief description of each fault. A more detailed description of the fault and advice on how to locate the faulty component will be given below.

<table>
<thead>
<tr>
<th>Fault code</th>
<th>Fault type</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>System configuration fault</td>
<td>Number of sensors changed</td>
</tr>
<tr>
<td>11</td>
<td>Damaged I/O unit</td>
<td>Faulty I/O unit in the system</td>
</tr>
<tr>
<td>12</td>
<td>Long BI/O bus activation</td>
<td>Faulty arc sensor or too low setting in the current I/O unit</td>
</tr>
<tr>
<td>13</td>
<td>Communication fault</td>
<td>Faulty communication channel</td>
</tr>
<tr>
<td>14</td>
<td>BI/O channel fault</td>
<td>Communication between two central units interrupted</td>
</tr>
<tr>
<td>18</td>
<td>Current measuring unbalance</td>
<td>Significant deviation detected during current measuring between different phases</td>
</tr>
</tbody>
</table>

*Table 3.1.4-1 Self-supervision fault codes*
System configuration fault (fault code 10)

This fault code indicates a change in system configuration.

Potential causes:

1. Sensors have been added to the system after system implementation.
   
   Corrective measures:
   
   • Check the sensor connections of the I/O unit indicated by the fault code and the programmed configuration in the INFO mode (see Chapter 3.4.1).
   
   • If the number of sensors in the I/O unit is higher than the number given by the central unit, re-configure the system (see Chapter 3.4).

2. A sensor connected to the system or its wiring is faulty.
   
   Corrective measures:
   
   • Check the configuration in the INFO mode (see Chapter 3.4.1)
   
   • If the number of sensors in the unit is lower than the number given by the central unit, check the unit wiring visually and tighten the connections.
   
   • Configure the system (see Chapter 3.4)
   
   • If the system still cannot find all the sensors, disconnect the sensor wires one at a time and configure the system after each disconnection.
   
   • Once you have identified the faulty sensor, check the wiring and replace the sensor, if necessary.

**NOTE!** The current I/O unit normally indicates three sensors, even if the number of current transformers connected is only one or two.
Damaged I/O unit (fault code 11)

![Diagram of VAMP 221 Arc Protection Relay]

*Figure 3.1.4-2 The system indicates a fault in the I/O unit whose address is 01*

This fault code indicates a damaged I/O unit.

**NOTE!** While this fault is activated, no sensor activation connected to the faulty unit will be transferred to the central unit.

**Potential causes:**

1. A sensor connected to the unit has remained activated for longer than three seconds.

   **Corrective measures:**
   - Check the physical location of the activated sensor.
   - Strong, direct light may activate the sensor
   - If the arc sensor is not exposed to direct light, remove one of the sensor conductors to check that the sensor cable is not short-circuited. If the fault disappears, the sensor or cable is probably damaged. In this case, replace the faulty sensor.
   - In the overcurrent unit, check the range of the overcurrent setting and whether the nominal values of the current transformers’ secondary circuits are compatible.

2. The modular cable connecting the units is loose or faulty.

   **Corrective measures:**
   - Check the connection and status of the modular cable connected to the I/O unit indicated in the fault code.

3. The I/O unit has no supply voltage.

   **Corrective measures:**
   - Check whether the POWER indicator light of the I/O unit is lit.
   - If the light is not lit, measure if the I/O received a supply voltage of 24 Vdc (X2-1 +24 Vdc, X2-2 GND). If the voltage supply is in order but the light is not lit, replace the faulty I/O unit.
• If there is no voltage supply, find out whether it should be supplied from the central unit or an external voltage supply. Check the voltage of the external voltage supply, if any.

• If the voltage is supplied by the central unit, measure its 24 Vdc supply voltage (X3-2 +24 Vdc, X3-1 GND). If there is no voltage, replace the central unit.

4. The I/O unit is faulty.
Corrective measures:
• If the TEST/ERROR indication light is permanently lit and no sensor is activated, either the modular cable (see above) or the I/O unit is faulty. In this case the I/O unit must be replaced.

**Too long BI/O bus activation (fault code 12)**

![Figure 3.1.4-3 The system indicates that the BI/O bus has remained activated for longer than three seconds](image)

This fault code indicates that the system’s BI/O bus has remained activated for too long for normal operation.

Potential causes:

1. A sensor connected to the unit via the BI/O bus has remained activated for longer than three seconds.

Corrective measures:
• Check the physical location of the activated sensor.
• Strong direct light may activate the sensor
• If the arc sensor is not exposed to direct light, remove one of the sensor conductors to check that the sensor cable is not short-circuited. If the fault disappears, the sensor or cable is probably faulty. In this case, replace the faulty sensor.
• In the overcurrent unit, check the range of the overcurrent setting and whether the nominal values of the current transformers’ secondary circuits are compatible.
Communication fault (fault code 13)

Figure 3.1.4-4 The system indicates a disturbance in the communication between units.

This fault code indicates faulty operation of the system’s communication bus.

Potential causes:

1. The modular cable between units or external wiring has become disconnected or faulty.

BI/O channel fault (fault code 14)

Figure 3.1.4-5 The system indicates a disturbance in the communication between two central units connected via a BI/O bus.

This fault code indicates a fault in the system’s BI/O bus.

Potential causes:

1. Fault in the BI/O system cable
   
   Corrective measures:
   
   • Check the cable. If necessary, repair or replace the cable.

2. The central unit connected to the BI/O is faulty.
   
   Corrective measures:
   
   • Check the central units. If necessary, replace a central unit.
Unbalance fault (fault code 18)

Figure 3.1.4+6 The system indicates that the current measuring unit has detected significant unbalance between the measuring channels.

This fault code indicates that the measuring channels of the current measuring unit connected to the system have detected significant unbalance between the different measuring channels. If the channel $I_{L2}/I_0$ of the current measuring unit is used to measure phase current, the $I_{L2}/I_0$ settings must be the same as for $I_{L1}/I_{L3}$. In this case the $I_{L2}/I_0$ channel is also covered by the unbalance alarm; otherwise, the system only compares the unbalance between two phase currents.

The factory setting for unbalance is 20% of the measured currents. The alarm does not function with currents below 5%*I_n, which effectively prevents false alarms.

Potential causes:

1. The current transformers connected to the current channels have different transformation ratios.

Corrective measures:

- Check the transformation ratios. The zero current measurement is normally connected to the $I_{L2}/I_0$ channel. This makes it possible to set different values to the channels.
- Connect similar current transformers to the $I_{L1}$ and $I_{L3}$ channels.

2. The secondary circuit of the current transformers is short-circuited.

Corrective measures:

- With a clip-on ammeter, check whether the measuring current travels through the current measuring unit.
- Check which other components are connected to the current circuit and whether the current travels through them,
- Once you have found the short circuit, check the status of the current circuit before removing the short circuit.
3. The current measuring channel is faulty.

Corrective measures:

- With a clip-on ammeter, check whether the measuring current travels through the current measuring unit.
- If the current travels through the unit but the device does not measure any current, the central unit must be replaced.

**NOTE!** Do not open a loaded current measuring circuit before you have reliably short-circuited the secondary circuit of the current transformer. **An open secondary circuit in the current transformer may destroy the current transformer!**

### 3.2. Using programming switches

Before system implementation, check the positions of the programming switches in accordance with the following basic principles:

- Each I/O unit connected to the communication bus has its own address (each I/O unit have an unique address).
- Set the programming switches before connecting the supply voltage.
- If you have to change the switch positions once the supply voltage has been connected, disconnect the supply voltage to the unit in question for the duration of the programming and re-configure the system.
3.2.1. Central unit’s programming switches

The central unit’s programming switches mainly affect the operation of the central unit’s trip relays.

Relay Matrix

**Figure 3.2.1-1 Programming switches in the front plate of the central unit**

- **Switch 1** determines trip relay latch. When the switch is in the OFF position the trip relays remain engaged after the arc trip until the fault is acknowledged at the central unit’s panel (see 3.1.1). In the ON position the trip relays follow the arc fault.

- **Switch 2** determines the arc trip criteria. When the switch is in the ON position the trip is based on light information only; in the OFF position both fault currents exceeding the current limit and light information are required.

- **Switch 3** determines the operating speed of the second trip relay (TRIP 2 and 4) of each tripping group. When the switch position is OFF, the trip relays act as CBFP as follows: TRIP 2 acts as CBFP if central unit measures overcurrent, TRIP 4 acts as CBFP if overcurrent information comes from another device; tripping delay time either 100 ms or 150 ms. In the ON position the trip relays serve as fast relays (delay time 7 ms).

- **Switch 4** determines the CBFP operating speed. When the switch is in the ON position the trip delay time is 150 ms, and in the OFF position 100 ms.

- **Switches 5, 6 and 7** determine the relay connection matrix. In the matrix the arc trips in different zones can be directed to two separate tripping groups (see Figure 3.2.1-1).
Switch 8 determines the mode of the central unit. When the switch is in the ON position the central unit operates in SUB-UNIT mode; in the OFF position the central unit serves as the central unit for the entire system.

**NOTE!** If several central units are connected to the same communication bus, only one unit may operate in CENTRAL UNIT mode.

### 3.2.2. Programming switches - I/O units

The programming switches of the I/O units are used to determine the unit address and trip relay function.

The system accommodates up to 16 I/O units. Eight addresses are reserved for each protection zone:

- **Zone 1** addresses 0...7
- **Zone 2** addresses 8...15
- **Zone 3** addresses 16...23
- **Zone 4** addresses 24...31

The programming switches have different weight factors. To create an address for the I/O unit, turn switches with different values to the ON position and calculate the sum of their weight factors. The following table shows the weight factors of each programming switch.

<table>
<thead>
<tr>
<th>Switch No.</th>
<th>Weight factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>4 *)</td>
<td>16</td>
</tr>
</tbody>
</table>

*Table 3.2.2-1 Programming switch weight factors, *) VAM 10L and VAM 3L only*

The address range for current I/O units is (32),33...46 (zone 5). Do not use address 32, because in this case the current I/O unit operates in CENTRAL UNIT mode and the actual central unit must be set to SUB-UNIT mode (see 3.2.1). To determine the address of a current I/O unit, add the sum of the weight factors to 32 (for example, programming switch values total 7, address of the current I/O unit 32 + 7 = 39).

**NOTE!** Do not use 32 as the unit address if system have central unit.

Other programming switches have different functions in different units, as described below.
**VAM 10L and VAM 3L**

Switch 1 determines which light activation activates the arc stage. When the switch position is ON, the arc stage only activates on the light information provided by the unit’s own sensors. In OFF position the arc stage activates on the light information received from any unit in the same protection zone. (Please see Technical description part, Chapter 3.1. Application examples)

Switch 2 determines the trip relay latch. When the switch is in ON position the trip relay remains engaged after the arc trip until the fault is acknowledged at the central unit’s panel (see 3.1.1). In the OFF position the trip relay follows the arc fault.

Switch 3 determines the arc trip criteria. When the switch is in ON position the trip is based on light information only; in OFF position both fault currents exceeding the current limit and light information are required.

**VAM 4C**

**Figure 3.2.2-1 Programming switches for VAM 10L and VAM 3L**

**Figure 3.2.2-2 Programming switches of VAM 4C**
### SW1 switch settings

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zone 1</td>
<td>System operating zone 1 (light information)</td>
</tr>
<tr>
<td>2</td>
<td>Zone 2</td>
<td>System operating zone 2 (light information)</td>
</tr>
<tr>
<td>3</td>
<td>Zone 3</td>
<td>System operating zone 3 (light information)</td>
</tr>
<tr>
<td>4</td>
<td>Zone 4</td>
<td>System operating zone 4 (light information)</td>
</tr>
<tr>
<td>5</td>
<td>Addr</td>
<td>Address weighting coefficient 8</td>
</tr>
<tr>
<td>6</td>
<td>Addr</td>
<td>Address weighting coefficient 4</td>
</tr>
<tr>
<td>7</td>
<td>Addr</td>
<td>Address weighting coefficient 2</td>
</tr>
<tr>
<td>8</td>
<td>Addr</td>
<td>Address weighting coefficient 1</td>
</tr>
</tbody>
</table>

### SW2 switch settings

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Latch</td>
<td>Position &quot;0&quot; (switch down): trip relay is only operational while the protection is activated. Position &quot;1&quot; (switch up): trip relay changes to latching status after trip.</td>
</tr>
<tr>
<td>2</td>
<td>1A / 5A *</td>
<td>Position &quot;0&quot; (switch down): rated secondary current of the current transformer is 1 A. Position &quot;1&quot; (switch up): rated secondary current of the current transformer is 5 A.</td>
</tr>
<tr>
<td>3</td>
<td>I&gt; out</td>
<td>Position &quot;0&quot; (switch down): unit does not transmit the current criteria to other units. Position &quot;1&quot; (switch up): unit transmits the current criteria to other units.</td>
</tr>
<tr>
<td>4</td>
<td>I&gt; in</td>
<td>Position &quot;0&quot; (switch down): unit does not receive the current criteria from other units. Position &quot;1&quot; (switch up): unit receives the current criteria from other units.</td>
</tr>
</tbody>
</table>

*) As in CT
3.3. **Adjusting the overcurrent setting**

In the VAM 221 Arc Protection System all the overcurrent settings are expressed as multiples of the secondary rated current. For example, with a secondary selection of 5 A, the setting value 1.5 corresponds to a current of 7.5 A in the secondary circuit of the circuit breaker.

Adjusting the overcurrent setting is most convenient following the setting value in the CURRENT operating mode.

**NOTE!** The overcurrent settings will be changed regardless of the mode of the central unit. The new settings will be effective immediately. However, settings should be adjusted in CURRENT mode only, since the new setting value is visible immediately in this mode.

![Diagram showing overcurrent settings](image)

Figure 3.3-1 Adjusting overcurrent settings

- Select the secondary $I_n$ of the CT using the selection switch.
- Select the CURRENT mode using the up and down arrow keys.
- The earth fault current/phase current L2 setting value appears on the screen. Adjust the $L2/I_0$ setting value (0.05...5.0*$I_0$) from the potentiometer.
- Press the right arrow key to view the current phase setting value. Adjust the $L1/I_0$ setting value (0.5...6.0*$I_0$) using the potentiometer.
Figure 3.3-2 Adjusting the current setting in the central unit

The principles for changing the current setting in VAM 4C units are the same as for the central unit. You can see the estimated current setting from the led bar on the right side of the unit.

The most accurate way of setting the current limit for the unit is as follows:

- Turn the potentiometer to the maximum value.
- Feed a test current corresponding to the required setting using a testing device.
- Lower the setting until the current activation indicator led of the I/O unit and the I>ext indicator led in the central unit are lit.

Figure 3.3-3 Adjusting the current setting in VAM 4C
3.4. Configuration of the arc protection system

Before system configuration, check the following:

- Have all the system sensors been connected to the I/O units?
- Have all the modular cables between I/O units been connected?
- Have all the I/O units been assigned individual addresses before the supply voltage is connected?

Once you have checked these and made any necessary corrections, you can connect supply voltage and read the system configuration into the central unit’s memory as follows:

- Select the INSTALL mode using the up and down arrow keys.
- Press the S button to activate the INSTALL mode. The display starts blinking.
- Press E to start the reading.
- The central unit locates all I/O units connected to the system and their sensors. This takes some seconds. Once the configuration is complete, the display shows the number of I/O units and sensors.
**NOTE!** The current I/O unit normally indicates three sensors, even if the number of current transformers connected is only one or two.

- After reading the system configuration, the central unit automatically changes to normal mode.
- Check the configuration in the INFO mode according to section 3.4.1.
- When configuring arc protection system with multiple central units, disconnect I/O-units from central units in slave mode during their installation procedure.

### 3.4.1. Checking system configuration

To check system configuration in INFO mode, do the following:

- Select the INFO mode using the up and down arrow keys.
- You can read the I/O unit address and the number of sensors stored in the memory from the central unit's display.
- Use the side arrow keys to move between the I/O units.
- When the correct I/O unit shows on the display, press S to activate the INFO mode.
- To check the number of connected sensors, press E.
- The central unit will display the number of sensors connected to the I/O unit for two seconds, after which it will show the number of sensors stored in the memory. If the numbers are not the same, see section 3.1.3.

**NOTE!** Checking system configuration will not affect the configuration stored in the central unit's memory. If you wish to modify the configuration, see section 3.4.
4. **System commissioning**

The following equipment is required for commission testing:

- Current supply for feeding either primary or secondary current.
- A flashlight or other source of bright light
- A multi-function measuring instrument including a clip-on ammeter and resistance measurement for verifying the operation of potential-free output contact.

The flashlight must be able to provide a sufficiently long light pulse for the sensors.

If you are using a torch, adjust the beam until its edge is sharp to ensure sensor activation.

Commissioning testing must be documented in writing, detailing system operation and settings.

4.1. **Testing - general**

Before initiating the testing, determine the system configuration and scope. Pay particular attention to safety during the work and ensure the testing will not cause unnecessary tripping of feeders that are in use.

Determine the following:

- Is any unit connected to another central unit or protection relay via a BI/O bus?
- Where have the trips been wired to from the central units and I/O units?
- What is the total number of I/O units and sensors? Has the system been configured as instructed? (see 3.4)
- Has any other protection or measuring equipment been connected to the current measuring circuits?
- Have any sensors been placed near live components?
4.2. Performing the testing

The system should be tested systematically, since correct operation of the arc protection system guarantees personal safety.

- Activate each sensor separately and ensure at the central unit that the light information travels through the entire communication channel. Enter the test result of each sensor under item 4 of Table 4.2-1, for example.
- Once you have tested each sensor channel separately, activate a few sensor channels’ together with current criteria and verify tripping (preferably at least one trip per I/O unit). Enter the activated channels under items 5 and 6 and the trip in column 7 in Table 4.2-1.
- If light or current identifier information is transferred from one central unit to another or between relays and the central unit through the BI/O bus, ensure that this information is transferred between the central units or between the relays and the central unit. Enter the light or current information (L > or I >) received by the central unit under item 2 in Table 4.2-12.
- Ensure the selectivity of the protection zones.

4.3. Periodic commissioning

We recommend that VAMP 221 arc protection system functionality shall be tested every five years or according to the law.
### Table 4.3-1 Example of testing protocol

<table>
<thead>
<tr>
<th>Name of station:</th>
<th>Switchgear:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of commissioning</td>
<td></td>
</tr>
<tr>
<td>Comissioners:</td>
<td></td>
</tr>
<tr>
<td>Standards used:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VAMP 221 serial number (1)</th>
<th>Light Y/N</th>
<th>Current Y/N</th>
<th>Sensor channel status Y/N (4)</th>
<th>Tripping from current and</th>
<th>Tripping ensured Y/N (7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the unit receives BIO-message from other unit (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address of I/O unit (3)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selectivity of tripping ensured (8)</td>
<td>Y/N</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**Table 4.3-1 Example of testing protocol**

**Descriptions:**

1. Information available on the unit’s name plate.
2. Read the activation of the BI/O channel from the central unit’s display.
3. Read the I/O unit’s address from the address selection switches.
4. Read the address of the activated indicator channel from the display of the central unit.
5. Current value exceeds the I> setting? (Y/N)
6. Light information activated L>? (Y/N)
7. Trip verified either from relay output contacts or breaker operation.
8. Selectivity checked though cross-testing.
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4.6.5. VAMP 221 signaling diagram

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4.7.2. VAM 10L

4.7.3. VAM 3L

4.7.4. VAM 4C

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1. Introduction

This User’s Manual contains a functional description of the protection system, application examples and technical data. Installation and user instructions can be found in the Operation and configuration instructions.

1.1. Purpose

The main purpose of the arc protection relay is to protect an electrical installation against the destructive impact of an arc short circuit, minimize physical damages and mitigate potential injuries. The arc protection relay VAMP 221 was originally designed for this purpose.

In addition, the VAMP 221 Arc Protection System has several user-friendly features, such as four separate protection zones: current measurement indication in the central unit; versatile, partially programmable output relays; comprehensive self-supervision of functions; and the ability to interconnect VAMP protection relays and arc protection via the BI/O bus.

The VAMP 221 Arc Protection System can be easily installed on both new and existing low and medium voltage switchgear.

1.2. Main properties

VAMP 221 is a modular system consisting of a central unit, I/O units, arc sensors and possible multiplying relays.

Due to its modularity, the system is suitable for a range of arc protection applications, from simple systems with one central unit and one I/O unit to more complex solutions comprising several central units used for selective arc protection.

The central unit VAMP 221 includes all arc protection system functions, such as overcurrent and arc supervision.

The I/O unit VAM 10L serves as link between the system’s point sensors and the central unit. Each I/O unit has connections for ten arc sensors, one portable pin sensor and one trip output.
The I/O unit VAM 3L serves as link between the system’s fibre sensors and the central unit. Each I/O unit has connections for three arc sensors, one pin sensor and one trip output.

The I/O unit VAM 4C serves as link between the system’s current inputs and the central unit. Each I/O unit has connections for three current transformers and one trip output.

The arc sensor VA 1 DA is activated by strong light. The sensor transforms the light information into the current signal, which is forwarded through the I/O unit to the central unit. The arc sensor VA 1 EH also operates on the same principle.

The pin sensor VA 1 DP has the same functions as an arc sensor but can be temporarily connected to an I/O unit. The sensor can be fixed to the breast pocket of a technician to improve safety when working with live switchgear.

The multiplying relay VAR 4CE contains four normal open trip relays. The multiplying relay can be connected to the central unit or to I/O units.
2. Functions

2.1. Protection functions

The arc protection functions of the arc protection relay are always operational. You can select the circuit breaker failure protection stage using the programming switches.

2.1.1. Arc (fault) protection (50AR)

Arc protection involves the central unit, I/O units, a range of light sensitive elements and a instantaneous overcurrent stage module. The module can be connected to 1, 2 or 3-phase current or earth-fault current and 2-phase current.

Arc protection is operational when the light I/O unit transfers the light information from the arc sensor to the system and, simultaneously, overcurrent stage of the I/O unit status. These signals are visible in all system components, each of which generates an arc fault trip according to its own settings. The system or a system component can also be programmed to operate on light information alone.

The operating time of the arc protection stage is 7 ms.

Arc protection setting parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1-2</td>
<td>ON/OFF</td>
<td></td>
<td>OFF</td>
<td>Settings for arc fault trip criteria:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OFF: tripping based on light and current criteria</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ON: tripping based on light criteria</td>
</tr>
<tr>
<td>SW1-5 ... 7</td>
<td>ON/OFF</td>
<td></td>
<td></td>
<td>Trip relay matrix for protection zones</td>
</tr>
<tr>
<td>L1 / L3</td>
<td>0.8 ... 6</td>
<td>pu</td>
<td>1.0</td>
<td>Current criteria setting value for current channels L1 and L2</td>
</tr>
<tr>
<td>L2 / Io</td>
<td>0.05 ... 5</td>
<td>pu</td>
<td>1.0</td>
<td>Current criteria setting value for current channel L2/Io</td>
</tr>
</tbody>
</table>
### VAM 10L

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
</table>
| SW1-1     | ON/OFF|      | OFF     | Scope of arc fault trip:  
 OFF: tripping based on light information within zone  
 ON: tripping based on light information detected by the unit only |
| SW1-3     | ON/OFF|      | OFF     | Settings for arc fault trip criteria:  
 OFF: tripping based on light and current criteria  
 ON: tripping based on light criteria |

### VAM 3L

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
</table>
| SW1-1     | ON/OFF|      | OFF     | Selection of digital output for use.  
 OFF: light information sent from DO  
 ON: overcurrent information sent from DO |
| SW1-3     | ON/OFF|      | OFF     | Settings for arc fault trip criteria:  
 OFF: tripping based on light and current criteria  
 ON: tripping based on light criteria |

### VAM 4C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1-1 ... 4</td>
<td>ON/OFF</td>
<td></td>
<td>OFF</td>
<td>Selection of trip protection zone</td>
</tr>
</tbody>
</table>
| SW2-3     | ON/OFF|      | OFF     | Transmission of current criteria  
 OFF: unit does not transmit the current criteria to other units  
 ON: unit transmits the current criteria to other units |
| SW2-4     | ON/OFF|      | OFF     | Reception of current criteria:  
 OFF: unit does not receive the current criteria from other units  
 ON: unit receives the current criteria from other units |
| L1 / L3   | 0.5 ... 6 | pu  | 1.0  | Current criteria setting value for current channels L1 and L2 |
| L2 / Io   | 0.05 ... 5 | pu  | 1.0  | Current criteria setting value for current channel L2/Io |
2.1.2. **Unbalance alarm**

The purpose of the unbalance alarm is to identify an abnormal distribution of load currents in the measuring circuit. Such abnormal situations occur mainly in connection with equipment failure or faulty secondary circuit wiring in current transformers.

The system uses either two-phase or three-phase connections. The system uses a two-phase connection, when the \( L_2/I_0 \) overcurrent setting deviates from the \( L_1/L_2 \) overcurrent limit by more than 90%. When the settings are approximately the same, the phase discontinuity function monitors all three current phases.

The current measuring channels \( L_1 \) and \( L_3 \) must be used in connection with two-phase current measuring. Single-phase current or earth-fault current must always be connected to the current measuring channel \( L_2/I_0 \); otherwise, an unbalance error will occur.

The protection is solely based on measuring the magnitudes of the phase currents. If the detected deviation exceeds 90%, the system gives an unbalance alarm after a 10-second delay time. The alarm does not affect other operations of the arc protection system.

The phase discontinuity settings are non-adjustable, since all the setting values have been programmed in the current measuring unit.

2.1.3. **Circuit breaker failure protection stage (50BF)**

The circuit breaker failure protection stage (CBFP) is based on operating time monitoring. The operating time is calculated as the time from the tripping of the trip relay until it resets. If the operating time exceeds the CBFP operating delay time, it activates another output relay, which remains active until the primary trip relay resets.

In CBFP, TRIP 2 provides CBFP if master unit measures overcurrent and any light zone is activated. TRIP 4 provides CBFP if overcurrent information comes from other unit e.g. VAM 4C and any light zone is activated.
CBFP setting parameters:

**VAMP 221**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1-3</td>
<td>ON/OFF</td>
<td></td>
<td>OFF</td>
<td>CBFP options: OFF: CBFP not in use ON: CBFP in use</td>
</tr>
<tr>
<td>SW1-4</td>
<td>ON/OFF</td>
<td></td>
<td>OFF</td>
<td>CBFP delay time options: OFF: delay time 100 ms ON: delay time 150 ms</td>
</tr>
</tbody>
</table>

2.2. Measurements

The central unit VAMP 221 has a three-phase current measuring function that can be used to measure either three phase currents or two phase currents and a summation current. Current measuring is indicated on the display of the central unit.

The current I/O unit VAM 4C has a current measuring function but no indication. The unit only gives an indication when the measured current exceeds the current limit setting.

2.3. Output relay functions

The central unit VAMP 221 has four trip relays, which can be controlled as two tripping groups (two contacts in each group). One contact in each group can be used to trip the CBFP stage. The central unit also has a general contact for arc fault trip alarms and two contacts for internal fault alarms.

The tripping groups are controlled using the trip relay matrix.

![Figure 2.3-1 VAMP 221 relay matrix](image-url)
The output trip relays of the central unit can also operate selectively during arc faults in different protection zones. The output trip relays of the I/O units can also be used for tripping in different protection zones. Each I/O unit has one output trip relay, which trips either in faults in its own zone (VAM 10L and VAM 3L) or in the programmed zone (VAM 4C). If necessary, trips can be multiplied using the multiplying relay VAR 4CE.

2.4. **Self-supervision**

The system monitors the microcontroller and related circuit operation, and program execution with a separate supervision circuit. In addition to system supervision, the circuit attempts to re-start the microcontroller in the event of a fault. If the re-start fails, the supervision circuit gives a self-supervision alarm on a permanent internal fault. In case of a microcontroller failure the trip functions still work but latching is blocked. Whenever the supervision circuit detects a permanent fault in any system component it ignores activation signals coming from this component e.g. faulty arc sensor.

The supervision circuit also monitors the internal operating voltage. In the event of loss of operating voltage in the central unit, the system automatically gives an IF alarm, since the IF output relay operates on steady-state current; in other words, the IF relay is actuated when the operating voltage is on and within the permitted limits.

2.5. **BI/O bus interface**

All VAMP 221 Arc Protection System units can receive or transmit light and/or current criteria (depending on the unit) on the BI/O bus. VAMP 221 can send BI/O information to two central units or two protection relays. If there are more than two recipients of BI/O information or the length of the BI/O bus exceeds 100 m, the BI/O bus must be equipped with a line amplifier as shown in the figure below.
2.5.1.

**Connection to another central unit**

In applications with multiple central units the central units can be interconnected also via BI/O connections (binary input/output). In this case, each part of the system can control four protection zones per system communication bus. In this case, arc and overcurrent information is transferred between the central units without address information.

The following BI/O connections are included in the standard delivery:

- **La>in X3-8**  Arc input, tripping group 1
- **Lb>in X3-9**  Arc input, tripping group 2
- **Ib> in/out X3-10**  Overcurrent input/output
- **La> out X3-11**  Arc output, tripping group 1
- **Lb> out X3-12**  Arc output, tripping group 2
- **GND X3-13,**  **X3-14**  Grounding for all BI/O signals
2.5.2. **Connection to I/O unit**

Each I/O unit also has a BI/O bus. The light I/O units (VAM 10L, VAM 3L) can transmit trip information to the central unit or current I/O unit. The current I/O unit (VAM 4C) can receive the light information and send the current information either to other I/O units or the multiplying relay.

**The following DI and DO connections are included in the standard delivery of VAM 10L and VAM 3L units:**

<table>
<thead>
<tr>
<th>DI</th>
<th>GND</th>
<th>Trip out</th>
<th>GND</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2-8</td>
<td>X2-7</td>
<td>X2-10</td>
<td>X2-9</td>
</tr>
<tr>
<td>Zone shift 1 ➔ 2, 2 ➔ 1, 3 ➔ 4, 4 ➔ 3</td>
<td>Trip information, 24 V dc</td>
<td>Trip information earth</td>
<td>Trip information earth</td>
</tr>
</tbody>
</table>

**The following DI and DO connections are included in the standard delivery of VAM 4C units:**

<table>
<thead>
<tr>
<th>L&gt;in</th>
<th>GND</th>
<th>Trip out</th>
<th>GND</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2-8</td>
<td>X2-7</td>
<td>X2-10</td>
<td>X2-9</td>
</tr>
<tr>
<td>Light input, 24-48 V dc</td>
<td>Light input earth</td>
<td>Trip information</td>
<td>Trip information earth</td>
</tr>
</tbody>
</table>

2.5.3. **Connection to protection relay**

The VAMP 221 Arc Protection System can also send light or current criteria to other VAMP protection relays, if they are equipped with an arc protection circuit board (optional). The voltage level of the connected signal must be 48 V dc, which means the I/O units alone cannot send their signals directly to the protection relay. See the relay manual for more information on BI/O bus connections.
3. Application examples

This Chapter describes some technical application examples of the VAMP 221 arc protection system.

3.1. Selective fibre solution, 3 incomers, 3 protection zones, CBFP in use

Figure 3.1-1 Selective fibre solution, 3 incomers, 3 protection zones, CBFP in use
Figure 3.1-2 Selective fibre solution, 3 power flow directions, 3 protection zones, CBFP in use
Figure 3.1-3 Selective feeder solution with VAM 3L in internal mode (dip sw #1 "ON")
### 3.1.1. Functional system description

The protected installation is medium voltage switchgear with three separate incomers. The switchgear has longitudinal busbars between the incomers.

To minimize the fault zone, the switchgear is divided into three separate zones when structurally possible. The different zones are limited by circuit breakers and monitored by arc sensors (2, 4 and 5). The system receives current criteria from the central unit (1) and current I/O units (3 and 6), which have been installed at the incomers.

Switchgear back-up protection has been ensured by wiring the CBFP contacts to the upper side of the supply transformers. When setting the CBFP delay time, the standard break-time of the feeder circuit breaker of the switchgear must be taken into account. This may be very long for old circuit breakers.

The central unit, I/O units and multiplying relays (7 and 8) serve as trip units. The central unit (1) trips its own feeder circuit breaker in zone 1 faults (tripping group 1) and serves as CBFP in zone 1, 2 and 4 faults (tripping groups 1 and 2), if the current limit is exceeded. The multiplying relay (7) multiplies the CBFP trip to all upstream circuit breakers. The arc sensor I/O unit (2) trips the bus-coupler circuit breaker between zones 1 and 2 in faults in its own zone. The zone 2 current I/O unit (3) trips its own input circuit and the bus-coupler circuit breaker between zones 1 and 2. The trip has been multiplied with the trip multiplier relay (8). The arc sensor I/O units (4 and 5) trip the bus-coupler circuit breaker between zones 2 and 4 in faults in their own zone. The zone 3 current I/O unit (6) trips its own incomer circuit breaker, and arc I/O unit (5) trips the tie-breaker to this zone.

Arc alarm is taken from the alarm relay of the central unit, which activates in faults in all zones. System self-supervision alarm is also taken from the central unit alarm relay.

### 3.1.2. System components

The system configuration comprises the following components:

- one (1) VAMP 221 central units
- two (2) VAM 4C current I/O unit
- three (3) VAM 3L fibre I/O units
- two (2) VAR 4CE multiplying relays
- six (6) ARC-SLx fibre sensors
3.1.3. System configuration

Configuration of the central unit VAMP 221 (1)

**SW1 switch settings**

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Latch</td>
<td>0</td>
<td>Position &quot;1&quot; (switch on the right): trip relay is only operational while the protection is activated. Position &quot;0&quot; (switch on the left): trip relay changes to latching status after trip.</td>
</tr>
<tr>
<td>2</td>
<td>L&gt;&amp;I&gt; / L&gt;</td>
<td>0</td>
<td>Position &quot;0&quot; (switch on the left): trip is activated by arc and current criteria. Position &quot;1&quot; (switch on the right): trip is activated by light criteria alone.</td>
</tr>
<tr>
<td>3</td>
<td>CBFP/ Fast</td>
<td>0</td>
<td>Position &quot;0&quot; (switch on the left): output trip relays 2 and 3 serve as CBFP. Position &quot;1&quot; (switch on the right): output trip relays 2 and 3 serve as fast trip.</td>
</tr>
<tr>
<td>4</td>
<td>CBFP 100/150 ms</td>
<td>1</td>
<td>Position &quot;0&quot; (switch on the left): CBFP delay time 100 ms. Position &quot;1&quot; (switch on the right): CBFP delay time 150 ms.</td>
</tr>
<tr>
<td>5</td>
<td>Relay matrix</td>
<td>0</td>
<td>Relay matrix</td>
</tr>
<tr>
<td>6</td>
<td>Relay matrix</td>
<td>1</td>
<td>Relay matrix</td>
</tr>
<tr>
<td>7</td>
<td>Relay matrix</td>
<td>0</td>
<td>Relay matrix</td>
</tr>
<tr>
<td>8</td>
<td>central unit/sub-unit</td>
<td>0</td>
<td>Position &quot;0&quot; (switch on the left): central unit in central unit mode. Position &quot;1&quot; (switch on the right): central unit in sub-unit mode.</td>
</tr>
</tbody>
</table>

Since VAMP 221 serves as the central unit for I/O units, VAMP 221 must be in the central unit operating mode.

**Current pick-up setting potentiometer settings L1/L3 and L2/I0**

* L1 / L3
  Potentiometer settings are used to set the light activation level for phase currents I_L1 and I_L3. The setting zone is 0.5 ... 6 x I_n. This current setting is separate from the I_L2/I_0 setting.

* L2 / I0
  Potentiometer settings are used to set the light activation level for phase currents I_L2 or earth-fault current I_0. The setting zone is 0.05 ... 5 x I_n. This current setting is separate from the I_L1/I_L3 setting.
NOTE! If three phase currents are connected to the central unit, both L1/L3 and L2 settings must be made.

**Configuration of the current I/O unit VAM 4C (3 and 6)**

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>VAM4C(3) Setting</th>
<th>VAM4C(6) Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zone 1</td>
<td>0</td>
<td>0</td>
<td>System operating zone 1 (light information)</td>
</tr>
<tr>
<td>2</td>
<td>Zone 2</td>
<td>1</td>
<td>0</td>
<td>System operating zone 2 (light information)</td>
</tr>
<tr>
<td>3</td>
<td>Zone 3</td>
<td>0</td>
<td>1</td>
<td>System operating zone 3 (light information)</td>
</tr>
<tr>
<td>4</td>
<td>Zone 4</td>
<td>0</td>
<td>0</td>
<td>System operating zone 4 (light information)</td>
</tr>
<tr>
<td>5</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 8</td>
</tr>
<tr>
<td>6</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 4</td>
</tr>
<tr>
<td>7</td>
<td>Addr</td>
<td>0</td>
<td>1</td>
<td>Address weighting coefficient 2</td>
</tr>
<tr>
<td>8</td>
<td>Addr</td>
<td>1</td>
<td>0</td>
<td>Address weighting coefficient 1</td>
</tr>
</tbody>
</table>

VAM 4C (3) address “1” (33)
VAM 4C (6) address “2” (34)
### SW2 switch settings

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>VAM4C(3) Setting</th>
<th>VAM4C(6) Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Latch</td>
<td>1</td>
<td>1</td>
<td>Position &quot;0&quot; (switch down): trip relay is only operational while the protection is activated. Position &quot;1&quot; (switch up): trip relay changes to latching status after trip.</td>
</tr>
<tr>
<td>2</td>
<td>1A / 5A</td>
<td>0 *)</td>
<td>0 *)</td>
<td>Position &quot;0&quot; (switch down): rated secondary current of the current transformer is 1 A. Position &quot;1&quot; (switch up): rated secondary current of the current transformer is 5 A.</td>
</tr>
<tr>
<td>3</td>
<td>I&gt; out</td>
<td>1</td>
<td>1</td>
<td>Position &quot;0&quot; (switch down): unit does not transmit the current criteria to other units. Position &quot;1&quot; (switch up): unit transmits the current criteria to other units.</td>
</tr>
<tr>
<td>4</td>
<td>I&gt; in</td>
<td>1</td>
<td>1</td>
<td>Position &quot;0&quot; (switch down): unit does not receive the current criteria from other units. Position &quot;1&quot; (switch up): unit receives the current criteria from other units.</td>
</tr>
</tbody>
</table>

*) As in CT

**Current pick-up setting potentiometer settings L1/L3 and L2/I0**

- **L1 / L3**
  - Potentiometer settings are used to set the light activation level for phase currents IL1 and IL3. The setting zone is 0.5 ... 6 x In. This current setting is separate from the IL2/I0 setting.
  
- **L2 / I0**
  - Potentiometer settings are used to set the light activation level for phase currents IL2 or earth-fault current I0. The setting zone is 0.05 ... 5 x In. This current setting is separate from the IL1/IL3 setting.

**NOTE!** If three phase currents are connected to the I/O unit, both L1/L3 and L2 settings must be made.
Configuration of the fibre I/O unit VAM 3L (2,4 and 5)

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>VAM3L(2) Setting</th>
<th>VAM3L(4) Setting</th>
<th>VAM3L(5) Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BIO</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Position &quot;0&quot; (switch on the left) BIO out sends light information Position &quot;1&quot; (switch on the right): BIO out sends overcurrent information</td>
</tr>
<tr>
<td>2</td>
<td>Latch</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Position &quot;0&quot; (switch on the left) trip relay is only operational while the protection is activated Position &quot;1&quot; (switch on the right) trip relay changes to latching status after trip</td>
</tr>
<tr>
<td>3</td>
<td>L+I / L</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Position &quot;0&quot; (switch on the left) trip is activated by arc and current criteria Position &quot;1&quot; (switch on the right) trip is activated by light criteria alone</td>
</tr>
<tr>
<td>4</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Address weighting coefficient 16</td>
</tr>
<tr>
<td>5</td>
<td>Addr</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Address weighting coefficient 8</td>
</tr>
<tr>
<td>6</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 4</td>
</tr>
<tr>
<td>7</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 2</td>
</tr>
<tr>
<td>8</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 1</td>
</tr>
</tbody>
</table>

VAM 3L (2) unit address 0 (protection zone 1)
VAM 3L (4) unit address 8 (protection zone 2)
VAM 3L (5) unit address 16 (protection zone 3)

3.1.4. Testing of example application

NOTE! For general testing instructions, see the Implementation and Configuration Guide, Chapter 4.

Testing of the central unit VAMP 221 (1)

The system is configured in INSTALL mode once the settings of each system component have been completed. You can verify the system configuration against the physical connections in the INFO mode.

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x Iₙ). You can monitor unit activation by the I>int indicator light.
To verify the setting value, feed the targeted start current to the current channel L2 or I0 (for example, 3 x I0). You can monitor unit activation by the I>int indicator light.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a fault alarm (alarm No. 18). This alarm will not prevent unit operation, however. Each unbalance alarm must be separately acknowledged in the central unit.

**Testing of the current I/O unit VAM 4C (3.6)**

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x I0). Then turn the potentiometer until the unit activates and the L1 or L3 current channel indicator light is lit.

To verify the setting value, feed the targeted start current to the current channel L2 or I0 (for example, 3 x I0). Then turn the potentiometer until the unit activates and the L2 or I0 current channel indicator light is lit. When the overcurrent stage on VAM 4C is activated the I>ext indicator on central unit will also lit.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a blinking LED in connection with the deviating phase. The unit also sends a fault alarm to the central unit, where it must be separately acknowledged. This alarm will not prevent unit operation, however.

**Testing of the fibre I/O unit VAM 3L (2, 4, 5)**

To verify the transfer of the light information, activate each fibre loop sensor using a powerful light source, such as a flashlight. To verify the data transfer, check the light activation from the unit’s indicator lights and central unit display.

**Testing of overall system operation**

Feed a test current exceeding the current limit to the current channels of the central unit and the current I/O units. To obtain light information, activate each light I/O unit (at least one light criterion per I/O unit). Verify tripping and its selectivity.

Verify the trip circuit wiring by tripping each system circuit breaker at least once using the system’s output trip relay.

Fill in a testing report (see model report in the User’s Manual) during the test.

Close the hard wire connection terminals opened during testing and remove temporary connections. The system is ready for commissioning.
3.2. Selective sensor solution, 2 incomers, 2 protection zones, CBFP in use

Figure 3.2-1 Selective sensor solution, 2 power flow directions, 2 protection zones, CBFP in use

Figure 3.2-2 Selective sensor solution, 2 power flow directions, 2 protection zones, CBFP in use
3.2.1. **Functional system description**

The protected object is medium voltage switchgear with two separate inputs. The switchgear has a longitudinal busbar in a bus-bar between the inputs.

To minimize the fault zone, the switchgear is divided into two separate zones when structurally possible. The different zones are limited by bus-coupler circuit breakers and monitored by light sensitive elements (3 and 4). The system receives current criteria from the central unit (1) and current I/O unit (26), which have been installed on incomers.

Switchgear protection has been ensured by wiring the CBFP contacts to the opposite side of the supply transformers. When setting the CBFP delay time, the standard break-time of the feeder circuit breaker of the actual switchgear must be taken into account. This may be very long for old circuit breakers.

The central unit and I/O units serve as trip units. The central unit (1) trips its own feeder circuit breaker in zone 1 faults (tripping group 1) and serves as CBFP in zone 1 and 2 faults (tripping groups 1 and 2), if the current limit is exceeded. The arc sensor I/O units (3 and 4) trip the bus-coupler circuit breaker between zones 1 and 4 in faults in their own zone. The zone 2 current I/O unit (3) trips its own bus-coupler circuit breaker.

Arc alarm is taken from the alarm relay of the central unit, which activates in faults in all zones. System self-supervision alarm is also taken from the central unit alarm relay.

3.2.2. **System components**

The system configuration comprises the following components:

- one (1) VAMP 221 central units
- one (1) VAM 4C current I/O unit
- two (2) VAM 10L current I/O units
- sixteen (16) VA 1 DA light sensitive elements
## 3.2.3. System configuration

### Configuration of the central unit VAMP 221 (1)

#### SW1 switch settings

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1      | Latch               | 1       | Position "0" (switch on the left): trip relay is only operational while the protection is activated  
                                               Position "1" (switch on the right) trip relay changes to latching status after trip |
| 2      | L> & I> / L>       | 0       | Position "0" (switch on the left): trip is activated by arc and current criteria  
                                               Position "1" (switch on the right) trip is activated by light criteria alone |
| 3      | CBFP/Fast           | 0       | Position "0" (switch on the left): output trip relays 2 and 3 serve as CBFP  
                                               Position "1" (switch on the right) output trip relays 2 and 3 serve as fast trip |
| 4      | CBFP 100/150 ms    | 1       | Position "0" (switch on the left): CBFP delay time 100 ms  
                                               Position "1" (switch on the right) CBFP delay time 150 ms |
| 5      | Relay matrix        | 1       | Relay matrix                                                                                                                               |
| 6      | Relay matrix        | 0       | Relay matrix                                                                                                                               |
| 7      | Relay matrix        | 0       | Relay matrix                                                                                                                               |
| 8      | central unit/sub-unit | 0       | Position "0" (switch on the left): central unit in central unit mode  
                                               Position "1" (switch on the right) central unit in sub-unit mode |

Since VAMP 221 serves as the central unit for I/O units, VAMP 221 must be in the central unit operating mode.

### Current pick-up setting potentiometer settings L1/L3 and L2/I0

#### L1 / L3

Potentiometer settings are used to set the light activation level for phase currents IL1 and IL3. The setting zone is 0.5 ... 6 x In. This current setting is separate from the I_L2/I_0 setting.

#### L2 / I_0

Potentiometer settings are used to set the light activation level for phase currents I_L2 or earth-fault current I_0. The setting zone is 0.05 ... 5 x In. This current setting is separate from the I_L1/I_L3 setting.

**NOTE!** If three phase currents are connected to the central unit, both L1/L3 and L2 settings must be made.
Configuration of the current I/O unit VAM 4C (2)

### SW1 switch settings

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>VAM4C(2) Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zone 1</td>
<td>0</td>
<td>System operating zone 1 (light information)</td>
</tr>
<tr>
<td>2</td>
<td>Zone 2</td>
<td>1</td>
<td>System operating zone 2 (light information)</td>
</tr>
<tr>
<td>3</td>
<td>Zone 3</td>
<td>0</td>
<td>System operating zone 3 (light information)</td>
</tr>
<tr>
<td>4</td>
<td>Zone 4</td>
<td>0</td>
<td>System operating zone 4 (light information)</td>
</tr>
<tr>
<td>5</td>
<td>Addr</td>
<td>0</td>
<td>Address weighting coefficient 8</td>
</tr>
<tr>
<td>6</td>
<td>Addr</td>
<td>0</td>
<td>Address weighting coefficient 4</td>
</tr>
<tr>
<td>7</td>
<td>Addr</td>
<td>0</td>
<td>Address weighting coefficient 2</td>
</tr>
<tr>
<td>8</td>
<td>Addr</td>
<td>1</td>
<td>Address weighting coefficient 1</td>
</tr>
</tbody>
</table>

VAM 4C (2) address "1" (33)

### SW2 switch settings

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>VAM4C(2) Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Latch</td>
<td>1</td>
<td>Position &quot;0&quot; (switch down): trip relay is only operational while the protection is activated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Position &quot;1&quot; (switch up): trip relay changes to latching status after trip</td>
</tr>
<tr>
<td>2</td>
<td>1A / 5A</td>
<td>0 *)</td>
<td>Position &quot;0&quot; (switch down): rated secondary current of the current transformer is 1 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Position &quot;1&quot; (switch up): rated secondary current of the current transformer is 5 A</td>
</tr>
<tr>
<td>3</td>
<td>I&gt; out</td>
<td>1</td>
<td>Position &quot;0&quot; (switch down): unit does not transmit the current criteria to other units</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Position &quot;1&quot; (switch up): unit transmits the current criteria to other units</td>
</tr>
<tr>
<td>4</td>
<td>I&gt; in</td>
<td>1</td>
<td>Position &quot;0&quot; (switch down): unit does not receive the current criteria from other units</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Position &quot;1&quot; (switch up): unit receives the current criteria from other units</td>
</tr>
</tbody>
</table>

*) As in CT
Current pick-up setting potentiometer settings L1/L3 and L2/I0

**L1 / L3**

Potentiometer settings are used to set the light activation level for phase currents $I_{L1}$ and $I_{L3}$. The setting zone is $0.5 \ldots 6 \times I_n$. This current setting is separate from the $I_{L2}/I_0$ setting.

**L2 / I0**

Potentiometer settings are used to set the light activation level for phase currents $I_{L2}$ or earth-fault current $I_0$. The setting zone is $0.05 \ldots 5 \times I_n$. This current setting is separate from the $I_{L1}/I_{L3}$ setting.

**NOTE!** If three phase currents are connected to the I/O unit, both L1/L3 and L2 settings must be made.

**Configuration of the light I/O unit VAM 10L (3 and 4)**

**SW1 switch settings**

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>VAM10L(3) Setting</th>
<th>VAM10L(4) Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L&gt; ext/int</td>
<td>0</td>
<td>0</td>
<td>Position “1” (switch on the right) unit does not receive the light criteria from other units Position “0” (switch on the left): unit receives the light criteria from other units in the same protection zone</td>
</tr>
<tr>
<td>2</td>
<td>Latch</td>
<td>1</td>
<td>1</td>
<td>Position “0” (switch on the left) trip relay is only operational while the protection is activated Position “1” (switch on the right) trip relay changes to latching status after trip</td>
</tr>
<tr>
<td>3</td>
<td>L+I / L</td>
<td>0</td>
<td>0</td>
<td>Position “0” (switch on the left) trip is activated by arc and current criteria Position “1” (switch on the right) trip is activated by light criteria alone</td>
</tr>
<tr>
<td>4</td>
<td>Zone 4</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 16</td>
</tr>
<tr>
<td>5</td>
<td>Addr</td>
<td>0</td>
<td>1</td>
<td>Address weighting coefficient 8</td>
</tr>
<tr>
<td>6</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 4</td>
</tr>
<tr>
<td>7</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 2</td>
</tr>
<tr>
<td>8</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 1</td>
</tr>
</tbody>
</table>

VAM 10L (3) unit address “0” (protection zone 1)
VAM 10L (4) unit address “8” (protection zone 2)
3.2.4. **System testing**

**Testing of the central unit VAMP 221 (1)**

The system is configured in INSTALL mode once the settings of each system component have been completed. You can verify the system configuration against the physical connections in the INFO mode.

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x Iₙ). You can monitor unit activation on the current measuring display and by the I>int indicator light.

To verify the setting value, feed the targeted start current to the current channel L2 or I₀ (for example, 3 x I₀). You can monitor unit activation on the current measuring display and by the I>int indicator light.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a fault alarm (alarm No. 18). This alarm will not prevent unit operation, however. Each unbalance alarm must be separately acknowledged in the central unit.

**Testing of the current I/O unit VAM 4C (2)**

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x Iₙ). Then turn the potentiometer until the unit activates and the L1 or L3 current channel indicator light is lit.

To verify the setting value, feed the targeted start current to the current channel L2 or I₀ (for example, 3 x I₀). Then turn the potentiometer until the unit activates and the L2 or I₀ current channel indicator light is lit.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a blinking LED in connection with the deviating phase. The unit also sends a fault alarm to the central unit, where it must be separately acknowledged. This alarm will not prevent unit operation, however.

**Testing of the light I/O unit VAM 10L (4, 5)**

To verify the transfer of the light information, activate each sensor using a powerful light source, such as a flashlight. To verify the data transfer, check the light activation from the unit’s indicator lights and central unit display.
Testing of overall system operation

Feed a test current exceeding the current limit to the current channels of the central unit and the current I/O units and provide light information for each light I/O unit (at least one light criterion per I/O unit). Verify tripping and its selectivity. Verify the trip circuit wiring by tripping each system circuit breaker at least once using the system’s output trip relay. Fill in a testing report (see model report in the User’s Manual) during the test.

Close the hard wire connection terminals opened during testing and remove temporary connections. The system is ready for commissioning.
3.3. Selective fibre sensor solution, multiple incomers, multiple protection zones, CBFP in use

Figure 3.3-1 Selective fibre sensor solution, multiple power flow directions, multiple protection zones, CBFP in use
Figure 3.3-2 Selective fibre sensor solution, multiple power flow directions, multiple protection zones, CBFP in use
3.3.1. **Functional system description**

The protected installation is an extensive industrial medium-voltage distribution system comprising two switchgears and five supplies. The switchgears have longitudinal busbars in a bus-bar between the inputs. The system also monitors the auxiliary supply connections, each one of which forms a separate protection zone. The system comprises two independent systems connected to each other with a BI/O bus, which makes it possible to use several protection zones.

To minimize the fault zone, the switchgear is divided into two separate zones when structurally possible. The different zones are limited by bus-coupler circuit breakers and monitored by light sensitive elements (5, 7, 10 and 12). The system receives current criteria from the central units (1, 2, 3, and 4) and current I/O unit (8), which have been installed on incomers. The auxiliary supply connections are monitored by light sensitive elements (5, 7, 10, and 13).

Switchgear protection has been ensured by wiring the CBFP contacts to the opposite side of the supply transformers. When setting the CBFP delay time, the standard break-time of the feeder circuit breaker of the actual switchgear must be taken into account. This may be very long for old circuit breakers.

The central units, I/O units and multiplying relays (14, 15, 16, and 17) serve as trip units.

The central unit (1) trips its own feeder circuit breaker and those between zones 1.1 and 1.2, 1.1 and 1.3, and 1.1 and 2.1 in zone 1.1 faults (tripping group 1) and serves as CBFP in faults in these zones (tripping group 1) if the current limit is exceeded. The trip has been multiplied with a relay (14). In addition, the central unit (1) trips the circuit breaker between zones 1.1 and 1.2 in zone 1.2 faults (tripping group 2) if the current limit is exceeded. CBFP tripping is multiplied for each feeder circuit breaker with a relay (18).

The central unit (2) trips its own feeder circuit breaker and those between zones 1.2 and 1.4, 1.3 and 1.4, and 1.4 and 2.4 in zone 1.4 faults (tripping group 2) if the current limit is exceeded. The trip has been multiplied with a relay (15). In addition, the central unit (2) trips the circuit breaker between zones 1.3 and 1.1 in zone 1.1 faults (tripping group 1) if the current limit is exceeded.

The central unit (3) trips its own feeder circuit breaker and those between zones 2.1 and 2.2, 2.1 and 2.3, and 1.1 and 2.1 in zone 2.1 faults (tripping group 1) and serves as CBFP in faults in these zones (tripping group 1) if the current limit is exceeded. The trip has been multiplied with a relay (16). In addition, the central unit (2) trips the circuit breaker between
zones 2.1 and 2.2 in zone 2.2 faults (tripping group 2) if the current limit is exceeded.

The central unit (4) trips its own feeder circuit breaker and those between zones 2.2 and 2.4, 2.3 and 2.4, and 1.4 and 2.4 in zone 2.4 faults (tripping group 1) if the current limit is exceeded. The trip has been multiplied with a relay (17). In addition, the central unit (4) trips the circuit breaker between zones 2.3 and 2.4 in zone 2.4 faults (tripping group 2) if the current limit is exceeded.

The current I/O unit (8) trips its own bus-coupler circuit breaker in zone 1.1 faults, if the current limit is exceeded.

The arc sensor I/O unit (6) trips the circuit breaker between zones 1.2 and 1.4 in faults in its own zone.

The arc sensor I/O unit (9) trips the circuit breaker between zones 1.3 and 1.4 in faults in its own zone.

The arc sensor I/O unit (13) trips the circuit breaker between zones 2.2 and 2.4 in faults in its own zone.

The arc sensor I/O unit (11) trips the circuit breaker between zones 2.1 and 2.3 in faults in its own zone.

Arc alarm is taken from the alarm relays of the central units, which activate in faults in all zones. System self-supervision alarms are also taken from the central unit alarm relays.

3.3.2. System components

The system configuration comprises the following components:

- four (4) VAMP 221 central units
- one (1) VAM 4C current I/O unit
- eight (8) VAM 10L current I/O units
- a maximum of eighty (80) VA 1 DA light sensitive elements
- four (4) VAR 4CE multiplying relays
### 3.3.3. System configuration

#### Configuration of the central unit VAMP 221 (1, 2, 3 and 4)

#### SW1 switch settings

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>VAMP221(1) Setting</th>
<th>VAMP221(2) Setting</th>
<th>VAMP221(3) Setting</th>
<th>VAMP221(4) Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Latch</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Position &quot;0&quot; (switch on the left): trip relay is only operational while the protection is activated. Position &quot;1&quot; (switch on the right): trip relay changes to latching status after trip</td>
</tr>
<tr>
<td>2</td>
<td>L&gt;_&amp;I&gt;/ L&gt;</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Position &quot;0&quot; (switch on the left): trip is activated by arc and current criteria. Position &quot;1&quot; (switch on the right): trip is activated by light criteria alone</td>
</tr>
<tr>
<td>3</td>
<td>CBFP/Fast</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Position &quot;0&quot; (switch on the left): output trip relays 2 and 3 serve as CBFP. Position &quot;1&quot; (switch on the right): output trip relays 2 and 3 serve as fast trip</td>
</tr>
<tr>
<td>4</td>
<td>CBFP 100/ 150 ms</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Position &quot;0&quot; (switch on the left): CBFP delay time 100 ms. Position &quot;1&quot; (switch on the right): CBFP delay time 150 ms</td>
</tr>
<tr>
<td>5</td>
<td>Relay matrix</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Relay matrix</td>
</tr>
<tr>
<td>6</td>
<td>Relay matrix</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Relay matrix</td>
</tr>
<tr>
<td>7</td>
<td>Relay matrix</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Relay matrix</td>
</tr>
<tr>
<td>8</td>
<td>central unit/sub-unit</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Position &quot;0&quot; (switch on the left): central unit in central unit mode. Position &quot;1&quot; (switch on the right): central unit in sub-unit mode</td>
</tr>
</tbody>
</table>

Since VAMP 221 (1 and 3) serves as the central unit for I/O units, VAMP 221 (1 and 3) must be in the central unit operating mode.

VAMP 221 (2 and 4) must be in the sub-unit operating mode.
Current pick-up setting potentiometer settings L1/L3 and L2/I0

L1 / L3
Potentiometer settings are used to set the light activation level for phase currents I_L1 and I_L3. The setting zone is 0.5 ... 6 x I_n. This current setting is separate from the I_L2/I_0 setting.

L2 / I_0
Potentiometer settings are used to set the light activation level for phase currents I_L2 or earth-fault current I_0. The setting zone is 0.05 ... 5 x I_n. This current setting is separate from the I_L1/I_L3 setting.

**NOTE!** If three phase currents are connected to the central unit, both L1/L3 and L2 settings must be made.

**Configuration of the current I/O unit VAM 4C (8)**

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>VAM4C(8) Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zone 1</td>
<td>0</td>
<td>System operating zone 1 (light information)</td>
</tr>
<tr>
<td>2</td>
<td>Zone 2</td>
<td>0</td>
<td>System operating zone 2 (light information)</td>
</tr>
<tr>
<td>3</td>
<td>Zone 3</td>
<td>0</td>
<td>System operating zone 3 (light information)</td>
</tr>
<tr>
<td>4</td>
<td>Zone 4</td>
<td>1</td>
<td>System operating zone 4 (light information)</td>
</tr>
<tr>
<td>5</td>
<td>Addr</td>
<td>0</td>
<td>Address weighting coefficient 8</td>
</tr>
<tr>
<td>6</td>
<td>Addr</td>
<td>0</td>
<td>Address weighting coefficient 4</td>
</tr>
<tr>
<td>7</td>
<td>Addr</td>
<td>0</td>
<td>Address weighting coefficient 2</td>
</tr>
<tr>
<td>8</td>
<td>Addr</td>
<td>1</td>
<td>Address weighting coefficient 1</td>
</tr>
</tbody>
</table>

VAM 4C (8) address "1" (33)
**SW2 switch settings**

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Latch</td>
<td>1</td>
<td>Position &quot;0&quot; (switch down):&lt;br&gt;trip relay is only operational while the protection is activated&lt;br&gt;Position &quot;1&quot; (switch up):&lt;br&gt;trip relay changes to latching status after trip</td>
</tr>
<tr>
<td>2</td>
<td>1A / 5A</td>
<td>0 *)</td>
<td>Position &quot;0&quot; (switch down): rated secondary current of the current transformer is 1 A&lt;br&gt;Position &quot;1&quot; (switch up):&lt;br&gt;rated secondary current of the current transformer is 5 A</td>
</tr>
<tr>
<td>3</td>
<td>I&gt; out</td>
<td>1</td>
<td>Position &quot;0&quot; (switch down):&lt;br&gt;unit does not transmit the current criteria to other units&lt;br&gt;Position &quot;1&quot; (switch up):&lt;br&gt;unit transmits the current criteria to other units.</td>
</tr>
<tr>
<td>4</td>
<td>I&gt; in</td>
<td>1</td>
<td>Position &quot;0&quot; (switch down):&lt;br&gt;unit does not receive the current criteria from other units&lt;br&gt;Position &quot;1&quot; (switch up):&lt;br&gt;unit receives the current criteria from other units.</td>
</tr>
</tbody>
</table>

*) As in CT

**Current pick-up setting potentiometer settings L1/L3 and L2/I0**

**L1 / L3**

Potentiometer settings are used to set the light activation level for phase currents \( I_{L1} \) and \( I_{L3} \). The setting zone is \( 0.5 \ldots 6 \times I_n \). This current setting is separate from the \( I_{L2}/I_0 \) setting.

**L2 / I0**

Potentiometer settings are used to set the light activation level for phase currents \( I_{L2} \) or earth-fault current \( I_0 \). The setting zone is \( 0.05 \ldots 5 \times I_n \). This current setting is separate from the \( I_{L1}/I_{L3} \) setting.

**NOTE!** If three phase currents are connected to the I/O unit, both L1/L3 and L2 settings must be made.
Configuration of the light I/O unit VAM 10L (5,6,7,9,10,11,12 and 13)

### SW1 switch settings

<table>
<thead>
<tr>
<th>Switch</th>
<th>Definition</th>
<th>VAM10L(5,10) Setting</th>
<th>VAM10L(6,13) Setting</th>
<th>VAM10L(9,11) Setting</th>
<th>VAM10L(7,12) Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L&gt; ext/int</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Position &quot;1&quot; (switch on the right) unit does not receive the light criteria from other units Position &quot;0&quot; (switch on the left): unit receives the light criteria from other units in the same protection zone</td>
</tr>
<tr>
<td>2</td>
<td>Latch</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Position &quot;0&quot; (switch on the left) trip relay is only operational while the protection is activated Position &quot;1&quot; (switch on the right) trip relay changes to latching status after trip</td>
</tr>
<tr>
<td>3</td>
<td>L+I / L</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Position &quot;0&quot; (switch on the left) trip is activated by arc and current criteria Position &quot;1&quot; (switch on the right) trip is activated by light criteria alone</td>
</tr>
<tr>
<td>4</td>
<td>Zone 4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Address weighting coefficient 16</td>
</tr>
<tr>
<td>5</td>
<td>Addr</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Address weighting coefficient 8</td>
</tr>
<tr>
<td>6</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 4</td>
</tr>
<tr>
<td>7</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 2</td>
</tr>
<tr>
<td>8</td>
<td>Addr</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Address weighting coefficient 1</td>
</tr>
</tbody>
</table>

VAM 10L (5,10) unit address “0” (protection zone 1)  
VAM 10L (6,13) unit address “8” (protection zone 2)  
VAM 10L (9,11) unit address “16” (protection zone 3)  
VAM 10L (7,12) unit address “24” (protection zone 4)

#### 3.3.4. System testing

Configuration of the central unit VAM 221 (1, 2, 3, 4)

The system is configured in INSTALL mode on central units in the central unit mode once the settings of each system component have been completed. You can verify system configuration against the physical connections in the INFO mode.
To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x $I_n$). You can monitor unit activation on the current measuring display and by the I>int indicator light.

To verify the setting value, feed the targeted start current to the current channel L2 or $I_0$ (for example, 3 x $I_n$). You can monitor unit activation on the current measuring display and by the I>int indicator light.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a fault alarm (alarm No. 18). This alarm will not prevent unit operation, however. Each unbalance alarm must be separately acknowledged in the central unit.

**Testing of the current I/O unit VAM 4C (8)**

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x $I_n$). Then turn the potentiometer until the unit activates and the L1 or L3 current channel indicator light is lit.

To verify the setting value, feed the targeted start current to the current channel L2 or $I_0$ (for example, 3 x $I_n$). Then turn the potentiometer until the unit activates and the L2 or $I_0$ current channel indicator light is lit.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a blinking LED in connection with the deviating phase. The unit also sends a fault alarm to the central unit, where it must be separately acknowledged. This alarm will not prevent unit operation, however.

**Testing of the light I/O unit VAM 10L (5, 6, 7, 9, 10, 11, 12, 13)**

To verify the transfer of the light information, activate each sensor using a powerful light source, such as a flashlight. To verify the data transfer, check the light activation from the unit’s indicator lights and central unit display.

**Testing of overall system operation**

Feed a test current exceeding the current limit to the current channels of the central unit and the current I/O units and provide light information for each light I/O unit (at least one light criterion per I/O unit). Verify tripping and its selectivity. Verify the operation of the BI/O bus by feeding overcurrent information from one system to another.

Verify the trip circuit wiring by tripping each system circuit breaker at least once using the system’s output trip relay.
Fill in a testing report (see model report in the User's Manual) during the test.
Close the hard wire connection terminals opened during testing and remove temporary connections. The system is ready for commissioning.

3.4. Arc protection current measuring based on earth-fault current

For example:
- Max E/F 300-600A
- phase setting 1.3 x In
- E/F setting 5% of primary ratio
  => if CT ratio 2000/1 primary setting = 100A
  => Io setting = 0.05 x In

Maximum earth fault current 300...650 A

Figure 3.4-1 Arc protection current measuring based on earth-fault current

Figure 3.4-2 Arc protection current measuring based on earth-fault current
3.4.1. **Functional system description**

The purpose of this application example is to demonstrate the implementation of the arc protection light criteria using earth-fault current.

The earth-fault current can be measured directly from the summation connection of the instrument transformer, in which case the sum of the phase currents is wired through the \( L_2/I_0 \) current measuring channel. (Figure 3.4-1)

An alternative, more accurate, method is to connect a current transformer that measures earth-fault current directly to the \( L_2/I_0 \) current measuring channel.
4. **Interfaces**

4.1. **Rear panel view**

![Rear panel view diagram](image)

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1:1</td>
<td>IL1 (S1)</td>
<td>Current input 1 (S1)</td>
</tr>
<tr>
<td>X1:3</td>
<td>IL2 / Io (S1)</td>
<td>Current input 2 (S1)</td>
</tr>
<tr>
<td>X1:5</td>
<td>IL3 (S1)</td>
<td>Current input 3 (S1)</td>
</tr>
<tr>
<td>X1:7</td>
<td>TRIP 1</td>
<td>Trip relay 1</td>
</tr>
<tr>
<td>X1:9</td>
<td>TRIP 2</td>
<td>Trip relay 1</td>
</tr>
<tr>
<td>X1:11</td>
<td>TRIP 3</td>
<td>Trip relay 1</td>
</tr>
<tr>
<td>X1:13</td>
<td>TRIP 4</td>
<td>Trip relay 1</td>
</tr>
<tr>
<td>X1:15</td>
<td>TRIP ALARM</td>
<td>Normally open trip alarm relay</td>
</tr>
<tr>
<td>X1:17</td>
<td>SF(NC)</td>
<td>Self-supervision relay, closed when Relay energized</td>
</tr>
<tr>
<td>X1:19</td>
<td>SF(NO)</td>
<td>Self-supervision relay, open when Relay energized</td>
</tr>
</tbody>
</table>
**Terminal X1, right side**

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1:2</td>
<td>IL1 (S2)</td>
<td>Current input 1 (S2)</td>
</tr>
<tr>
<td>X1:4</td>
<td>IL2 / I0(S2)</td>
<td>Current input 2 (S2)</td>
</tr>
<tr>
<td>X1:6</td>
<td>IL3 (S2)</td>
<td>Current input 3 (S2)</td>
</tr>
<tr>
<td>X1:8</td>
<td>TRIP 1</td>
<td>Trip relay 1</td>
</tr>
<tr>
<td>X1:10</td>
<td>TRIP 2</td>
<td>Trip relay 1</td>
</tr>
<tr>
<td>X1:12</td>
<td>TRIP 3</td>
<td>Trip relay 1</td>
</tr>
<tr>
<td>X1:14</td>
<td>TRIP 4</td>
<td>Trip relay 1</td>
</tr>
<tr>
<td>X1:16</td>
<td>TRIP ALARM</td>
<td>Normally open trip alarm relay</td>
</tr>
<tr>
<td>X1:18</td>
<td>SF(NC)</td>
<td>Self-supervision relay, closed when Relay energized</td>
</tr>
<tr>
<td>X1:20</td>
<td>SF(NO)</td>
<td>Self-supervision relay, open when Relay energized</td>
</tr>
</tbody>
</table>

**Terminal X3**

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X3:1</td>
<td>GND</td>
<td>I/O unit ground potential</td>
</tr>
<tr>
<td>X3:2</td>
<td>+24V</td>
<td>I/O unit operating voltage</td>
</tr>
<tr>
<td>X3:3</td>
<td>RS_B</td>
<td>Data bus</td>
</tr>
<tr>
<td>X3:4</td>
<td>RS_A</td>
<td>Data bus</td>
</tr>
<tr>
<td>X3:5</td>
<td>CAN_L</td>
<td>Data bus</td>
</tr>
<tr>
<td>X3:6</td>
<td>CAN_H</td>
<td>Data bus</td>
</tr>
<tr>
<td>X3:7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X3:8</td>
<td>La&gt; in</td>
<td>Arc input, tripping group 1</td>
</tr>
<tr>
<td>X3:9</td>
<td>Lb&gt; in</td>
<td>Arc input, tripping group 2</td>
</tr>
<tr>
<td>X3:10</td>
<td>I&gt; in/out</td>
<td>Current input</td>
</tr>
<tr>
<td>X3:11</td>
<td>La&gt; out</td>
<td>Arc output, tripping group 1</td>
</tr>
<tr>
<td>X3:12</td>
<td>Lb&gt; out</td>
<td>Arc output, tripping group 2</td>
</tr>
<tr>
<td>X3:13</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>X3:14</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>X3:15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X3:16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X3:17</td>
<td>Us</td>
<td>Operating voltage</td>
</tr>
<tr>
<td>X3:18</td>
<td>Us</td>
<td>Operating voltage</td>
</tr>
</tbody>
</table>
Terminal X6

<table>
<thead>
<tr>
<th>Terminal No</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X6:1</td>
<td>Modular cable terminal 1</td>
</tr>
<tr>
<td>X6:2</td>
<td>Modular cable terminal 2</td>
</tr>
</tbody>
</table>

4.2. Analogue measurements

VAMP 221:
- 3 current measuring channels 1/5A

VAM 4C:
- 3 current measuring channels 1/5A

VAM 10L:
- 10 light measuring channels for point sensors

VAM 3L:
- 3 light measuring channels for fibre loop sensors

4.3. Digital inputs (BI/O bus)

The following BI/O interfaces are included in the standard VAMP 221 delivery:
- La>in X3:8 Arc input, tripping group 1
- Lb>in X3:9 Arc input, tripping group 2
- Ib> in/out X3:10 Overcurrent input/output
- La> out X3:11 Arc output, tripping group 1
- Lb> out X3:12 Arc output, tripping group 2
- GND X3:13, X3:14 Grounding for all BI/O signals

The following BI/O interfaces are included in standard VAM 10L and VAM 3L deliveries:
- I>in X2:8 Zone shift, 24-48 VDC
- GND X2:7 Current input earth
- Trip out X2:10 Trip output, 24 VDC
- GND X2:9 Trip output earth
The following BI/O connections are included in the standard VAMP 4C delivery:

<table>
<thead>
<tr>
<th>BI/O</th>
<th>Terminals</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L&gt;in</td>
<td>X2-8</td>
<td>Arc input, 24-48 VDC</td>
</tr>
<tr>
<td>GND</td>
<td>X2-7</td>
<td>Arc input earth</td>
</tr>
<tr>
<td>I&gt;out</td>
<td>X2-10</td>
<td>Current output, 24 VDC</td>
</tr>
<tr>
<td>GND</td>
<td>X2-9</td>
<td>Current output earth</td>
</tr>
</tbody>
</table>

4.4. **Auxiliary power supply**

Connect the auxiliary supply voltage to the $U_s$ input, terminals X3-17 X3-18.

4.5. **Output relays**

4.5.1. **VAMP 221**

Connect the circuit breaker’s trip circuits to the following terminals (a maximum of four separate trip outputs in two separate groups):

- **TRIP1**: X1-7, X1-8 (fast, group 1)
- **TRIP2**: X1-9, X1-10 (fast/CBFP, group 1)
- **TRIP3**: X1-11, X1-12 (fast, group 2)
- **TRIP4**: X1-13, X1-14 (fast/CBFP, group 2)

Connect the self-supervision alarm output to an IF change-over contact, either terminals X1-17, X1-18 (normally open) or X1-19, X1-20 (normally closed).

During normal system operation (no internal fault) and with the auxiliary power supply connected, the terminal X1-17 or X1-18 is open and X1-19 or X1-20 is closed.

Connect the trip alarm output to the closing terminals X1-15, X1-16.

4.5.2. **VAM 10L, VAM 3L and VAM 4C**

Connect the circuit breaker’s trip circuit to the following terminals:

- **TRIP1**: X2-15, X2-16 (fast)

The output trip relay of the arc I/O units (VAM 10L and VAM 3L) operates during faults in its own zone. In the current I/O unit (VAM 4C), select the protection zone controlling the I/O unit using the programming switches.
4.6. Block diagram

4.6.1. VAMP 221

*) Connector X7 is reserved only for production purposes

**) When energized and no internal faults
4.6.2. VAM 10L

4.6.3. VAM 3L
4.6.4.  VAM 4C

Communication

X2:1 +24V  X2:3 CAN_L  X2:6 RS485
X2:2 GND  X2:4 CAN_H  X2:8 RX
X2:5 RS422  X2:7 TX

COM1

COM2

DI & DO

X2:7 DI in GND  X2:8 DI in +34...+48V
X2:9 DO out GND  X2:10 DO out +24V

VAM 4C

T1 (no)

X1:1  X1:3  X1:5  X1:7  X1:9  X1:11

X2:15  X2:16
4.6.5. VAMP 221 signaling diagram
4.7. Connection examples

4.7.1. VAMP 221
4.7.2. VAM 10L

X1-1.2 : arc sensor channel 1
X1-3.4 : arc sensor channel 2
X1-5.6 : arc sensor channel 3
X1-7.8 : arc sensor channel 4
X1-9.10: arc sensor channel 5
X1-11.12: arc sensor channel 6
X1-13.14: arc sensor channel 7
X1-15.16: arc sensor channel 8
X1-17.18: arc sensor channel 9
X1-19.20: arc sensor channel 10

X2-1 : +24V supply from masterunit or external power supply
X2-2 : GND
X2-3 : CAN-L
X2-4 : CAN-H
X2-5 : Serial B
X2-6 : Serial A
X2-7 : DI GND
X2-8 : DI (24-48Vdc)
X2-9 : DO GND
X2-10 : DO +24Vdc
X2-11 : + Temp sensor
X2-12 : - Temp sensor
X2-13:
X2-14:
X2-15 :
X2-16 :

Figure 4.7.2-1. VAM 10L interfaces
4.7.3. VAM 3L

X1-R1 : Fiber receiver connection
X1-T1 : Fiber transmitter connection
X1-R2 : Fiber receiver connection
X1-T2 : Fiber transmitter connection
X1-R3 : Fiber receiver connection
X1-T3 : Fiber transmitter connection

X2-1 : +24V supply from master unit or external power supply
X2-2 : GND
X2-3 : CAN-L
X2-4 : CAN-H
X2-5 : Serial B
X2-6 : Serial A
X2-7 : DI GND
X2-8 : DI [24-48Vdc]
X2-9 : DO GND
X2-10 : DO +24Vdc
X2-11 : + Temp sensor
X2-12 : - Temp sensor
X2-13:
X2-14:
X2-15 : Trip relay (NO)
X2-16:

Zone information (L>, I>)
Zone change (1 -> 2; 2 -> 1; 3 -> 4; 4 -> 3)
Trip information (DI&DO)
Not in use

Channel 1
Channel 2
Channel 3

Figure 4.7.3 VAM 3L interfaces
4.7.4. VAM 4C

X1-1,3 : Current input IL1
X1-5,7 : Current input IL2 / Io
X1-9,11 : Current input IL3

X2-1 : +24V supply from master unit or external power supply
X2-2 : GND
X2-3 : CAN-L
X2-4 : CAN-H
X2-5 : Serial B
X2-6 : Serial A
X2-7 : DI GND
X2-8 : DI (24-48Vdc)
X2-9 : DO GND
X2-10: DO +24Vdc
X2-11:
X2-12:
X2-13:
X2-14:
X2-15: Trip relay (NO)
X2-16: Trip relay (NO)

Figure 4.7.4-4.7-1. VAM 4C interfaces
5. **Change of DIP-switches in I/O units 10L, 3L and 4C**

In I/O units delivered before 11th March 2005, the DIP-switches are in an order opposite to the order shown in the photos in this manual.

Units delivered before this date can be identified from the following external details:

1. The I/O unit has a serial number smaller than 10,000
2. The type designation in the upper left corner is different in style than in the photos in this manual.
3. The numbering of the I/O unit terminal block is not embossed on the front panel.
4. The DIP-switches are in reverse order.

![Figure 5-1. Order of DIP-switches in I/O units delivered before 11th March 2005](image)

On request we can deliver following stickers which are recommended to be attached on the I/O units manufactured before 11th March 2005.

![Figure 5-2 Sticker for I/O units delivered before 11th March 2005](image)

The numbering of SW1 of this unit differs from the numbering presented in the manual. Please refer to chapter 5.
## 6. Technical data

### 6.1. Connections

#### 6.1.1. Measuring circuits

| **VAMP 221** |  
|---|---|---|---|
| Rated current L1 / L3 | 1 or 5 A (optional) 50/60Hz | 0 ... 6 A (0 ... 6* I_n [I_n =1A]); | 0 ... 30 A (0 ... 6*I_n[I_n =5A]) |
| · current measuring zone | 300 A (for 1s) | 100 A (for 10s) | 20 A (continuous) |
| · thermal withstand capability | | | |
| · power consumption | <0.3 VA | | |
| Rated current L2 / I_0 | 1 or 5 A (optional) 50/60Hz | 0...6 A (0...6*I_n [I_n =1A]); | 0...30 A (0...6* I_n [I_n =5A]) |
| · current measuring zone | 300 A (for 1s) | 100 A (for 10s) | 20 A (continuous) |
| · thermal withstand capability | | | |
| · power consumption | <0.3 VA | | |
| Terminal: | Maximum cross-section area of wire |  
| · single or multi-strand wire | 4 mm² (10-12 AWG) |

| **VAM 10L** |  
|---|---|---|---|
| Sensor connections | 10 arc sensors (type VA 1 DA or VA 1 EH) | 1 portable arc sensor (type VA 1 DP) |
| Terminal: | Maximum cross-section area of wire |  
| · Phoenix MVSTBW or similar | 2.5 mm² (13-14 AWG) |

| **VAM 3L** |  
|---|---|---|---|
| Sensor connections | 3 fibre loop sensors (type ARC-SLx) | 1 portable arc sensor (type VA 1 DP) |
VAM 4C

<table>
<thead>
<tr>
<th>Rated current L1 / L3</th>
<th>1 or 5 A (optional) 50/60Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>- current measuring zone</td>
<td>0 ... 6 A (0 ... 6*In [In =1A]);</td>
</tr>
<tr>
<td>- thermal withstand capability</td>
<td>0 ... 30 A (0 ... 6*In [In =5A])</td>
</tr>
<tr>
<td>- power consumption</td>
<td>300 A (for 1s)</td>
</tr>
<tr>
<td></td>
<td>100 A (for 10s)</td>
</tr>
<tr>
<td></td>
<td>20 A (continuous)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rated current L2 / I0</th>
<th>1 or 5 A (optional) 50/60Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>- current measuring zone</td>
<td>0 ... 6 A (0 ... 6*In [In =1A]);</td>
</tr>
<tr>
<td>- thermal withstand capability</td>
<td>0 ... 30 A (0 ... 6*In [In =5A])</td>
</tr>
<tr>
<td>- power consumption</td>
<td>300 A (for 1s)</td>
</tr>
<tr>
<td></td>
<td>100 A (for 10s)</td>
</tr>
<tr>
<td></td>
<td>20 A (continuous)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terminal:</th>
<th>Maximum cross-section area of wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>- single or multi-strand wire</td>
<td>4 mm² (10-12 AWG)</td>
</tr>
</tbody>
</table>

6.1.2. Auxiliary power supply

VAMP 221

<table>
<thead>
<tr>
<th>Rated voltage Uaux</th>
<th>48-265 V ac/dc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>110/120/220/240 VAC 50/60Hz</td>
</tr>
<tr>
<td></td>
<td>48/60/110/125/220 V dc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>&lt; 7 W (in normal mode)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 10 W (output relays activated)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terminal:</th>
<th>Maximum cross-section area of wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Phoenix MVSTBW or similar</td>
<td>2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>

VAM 10L, VAM 3L, VAM 4C

<table>
<thead>
<tr>
<th>Rated voltage Uaux</th>
<th>24 V dc</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>&lt; 1 W (in normal mode)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 1.5 W (output relays activated)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terminal:</th>
<th>Maximum cross-section area of wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Phoenix MVSTBW or similar ( RJ 45 when supply from central unit)</td>
<td>2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>

VAR 4CE

<table>
<thead>
<tr>
<th>Rated voltage Uaux</th>
<th>24 V dc</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>&lt; 0.5 W (in normal mode)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 4.5 W (output relays activated)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terminal:</th>
<th>Maximum cross-section area of wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>- fixed terminal</td>
<td>2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>
### VAMP 4R

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage $U_{aux}$</td>
<td>24 V dc</td>
</tr>
<tr>
<td>Current consumption</td>
<td></td>
</tr>
<tr>
<td>- one relay group activated</td>
<td>20 mA stby</td>
</tr>
<tr>
<td>- both relay groups activated</td>
<td>80 mA</td>
</tr>
<tr>
<td>- both relay groups activated</td>
<td>180 mA</td>
</tr>
</tbody>
</table>

### VA 1 DA, VA 1 EH, VA 1 DP

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage $U_{aux}$</td>
<td>12 V dc (from I/O unit)</td>
</tr>
<tr>
<td>Power consumption</td>
<td></td>
</tr>
<tr>
<td>- in normal mode</td>
<td>&lt; 35 mW</td>
</tr>
<tr>
<td>- activated</td>
<td>&lt; 450 mW</td>
</tr>
</tbody>
</table>

### 6.1.3. Digital inputs (BI/O bus)

#### VAMP 221

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of inputs</td>
<td>2 pcs $I_{in}$ in</td>
</tr>
<tr>
<td>- $La_1$ tripping group 1</td>
<td></td>
</tr>
<tr>
<td>- $Lb_1$ tripping group 2</td>
<td></td>
</tr>
<tr>
<td>2 pcs $I_{out}$</td>
<td></td>
</tr>
<tr>
<td>- $Ia_1$ tripping group 1</td>
<td></td>
</tr>
<tr>
<td>- $Ib_1$ tripping group 2</td>
<td></td>
</tr>
<tr>
<td>Internal operating voltage</td>
<td>48 V dc</td>
</tr>
<tr>
<td>Load capacity (max.)</td>
<td>5 mA</td>
</tr>
<tr>
<td>Terminal:</td>
<td></td>
</tr>
<tr>
<td>- Phoenix MVSTBW or similar</td>
<td>Maximum cross-section area of wire 2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>

#### VAM 10L, VAM 3L

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of inputs</td>
<td>1 pcs $I_{in}$ in</td>
</tr>
<tr>
<td>- arc fault trip out</td>
<td></td>
</tr>
<tr>
<td>Internal operating voltage</td>
<td>24…48 V dc (BIO in)</td>
</tr>
<tr>
<td>- 24 V dc (BIO out)</td>
<td></td>
</tr>
<tr>
<td>Load capacity (max.)</td>
<td>5 mA</td>
</tr>
<tr>
<td>Terminal:</td>
<td></td>
</tr>
<tr>
<td>- Phoenix MVSTBW or similar</td>
<td>Maximum cross-section area of wire 2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>

#### VAM 4C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of inputs</td>
<td>1 pcs $I_{in}$ in</td>
</tr>
<tr>
<td>- 1 pcs $I_{out}$</td>
<td></td>
</tr>
<tr>
<td>Internal operating voltage</td>
<td>24…48 V dc (BIO in)</td>
</tr>
<tr>
<td>- 24 V dc (BIO out)</td>
<td></td>
</tr>
<tr>
<td>Load capacity (max.)</td>
<td>5 mA</td>
</tr>
<tr>
<td>Terminal:</td>
<td></td>
</tr>
<tr>
<td>- Phoenix MVSTBW or similar</td>
<td>Maximum cross-section area of wire 2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>
### VAMP 4R

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating voltage</td>
<td>18…265 V ac/dc</td>
</tr>
<tr>
<td>Current consumption</td>
<td>2 mA</td>
</tr>
</tbody>
</table>

### 6.1.4. Trip contacts

#### VAMP 221

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of contacts</td>
<td>4 closing contacts (relays T1-T4)</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>250 V ac/dc</td>
</tr>
<tr>
<td>Continuous withstand capacity</td>
<td>5 A</td>
</tr>
<tr>
<td>Maximum breaking current, 0.5s</td>
<td>30 A</td>
</tr>
<tr>
<td>Maximum breaking current, 3s</td>
<td>15 A</td>
</tr>
<tr>
<td>Breaking capacity, dc(L/R=40 ms)</td>
<td></td>
</tr>
<tr>
<td>At 48 V dc</td>
<td>1 A</td>
</tr>
<tr>
<td>At 110 V dc</td>
<td>0.44 A</td>
</tr>
<tr>
<td>At 220 V dc</td>
<td>0.22 A</td>
</tr>
<tr>
<td>Relay material</td>
<td>AgCdO₂</td>
</tr>
<tr>
<td>Terminals</td>
<td></td>
</tr>
<tr>
<td>Maximum cross-section area of wire</td>
<td>2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>

#### VAM 10L, VAM 3L, VAM 4C

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of contacts</td>
<td>1 closing contact (relay T1)</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>250 V ac/dc</td>
</tr>
<tr>
<td>Continuous withstand capacity</td>
<td>5 A</td>
</tr>
<tr>
<td>Maximum operating current, 0.5s</td>
<td>30 A</td>
</tr>
<tr>
<td>Maximum operating current, 3s</td>
<td>15 A</td>
</tr>
<tr>
<td>Breaking capacity, dc(L/R=40 ms)</td>
<td></td>
</tr>
<tr>
<td>At 48 V dc</td>
<td>1 A</td>
</tr>
<tr>
<td>At 110 V dc</td>
<td>0.44 A</td>
</tr>
<tr>
<td>At 220 V dc</td>
<td>0.22 A</td>
</tr>
<tr>
<td>Relay material</td>
<td>AgCdO₂</td>
</tr>
<tr>
<td>Terminals</td>
<td></td>
</tr>
<tr>
<td>Maximum cross-section area of wire</td>
<td>2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>

- Phoenix MVSTBW or similar
**VAR 4CE**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of contacts</td>
<td>4 closing contacts (relays T1-T4)</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>250 V ac/dc</td>
</tr>
<tr>
<td>Continuous withstand capacity</td>
<td>5 A</td>
</tr>
<tr>
<td>Maximum operating current, 0.3s</td>
<td>30 A</td>
</tr>
<tr>
<td>Maximum operating current, 3s</td>
<td>15 A</td>
</tr>
<tr>
<td>Breaking capacity, dc(L/R=40 ms)</td>
<td></td>
</tr>
<tr>
<td>At 48 V dc:</td>
<td>5 A</td>
</tr>
<tr>
<td>At 110 V dc:</td>
<td>3 A</td>
</tr>
<tr>
<td>At 220 V dc:</td>
<td>1 A</td>
</tr>
<tr>
<td>Relay material</td>
<td>AgCdO₂</td>
</tr>
<tr>
<td>Terminal:</td>
<td>Maximum cross-section area of wire</td>
</tr>
<tr>
<td></td>
<td>2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>

**VAMP 4R**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4N/O / 4N/C rated voltage</td>
<td>250V ac/dc</td>
</tr>
<tr>
<td>Continuous withstand capacity</td>
<td>5 A</td>
</tr>
<tr>
<td>Maximum current, 0.5s</td>
<td>30 A</td>
</tr>
<tr>
<td>Maximum current, 3s</td>
<td>15 A</td>
</tr>
<tr>
<td>N/O breaking capacity dc (L/R=40ms)</td>
<td></td>
</tr>
<tr>
<td>At 48 V dc:</td>
<td>1A</td>
</tr>
<tr>
<td>At 110 V dc:</td>
<td>0.44A</td>
</tr>
<tr>
<td>At 220 V dc:</td>
<td>0.22A</td>
</tr>
<tr>
<td>Contact material</td>
<td>AgCdO₂</td>
</tr>
<tr>
<td>Terminal:</td>
<td>Maximum cross-section area of wire</td>
</tr>
<tr>
<td></td>
<td>2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>

**6.1.5. Alarm contacts**

**VAMP 221**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of contacts</td>
<td>2 normally open contacts (relay A1&amp;IF*)</td>
</tr>
<tr>
<td></td>
<td>1 normally closed contact (IF*)</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>250 V ac/dc</td>
</tr>
<tr>
<td>Continuous withstand capacity</td>
<td>5 A</td>
</tr>
<tr>
<td>Maximum operating current, 0.5s</td>
<td>10 A</td>
</tr>
<tr>
<td>Maximum operating current, 3s</td>
<td>8 A</td>
</tr>
<tr>
<td>Breaking capacity, dc(L/R=40 ms)</td>
<td></td>
</tr>
<tr>
<td>At 48 V dc:</td>
<td>1 A</td>
</tr>
<tr>
<td>At 110 V dc:</td>
<td>0.25 A</td>
</tr>
<tr>
<td>At 220 V dc:</td>
<td>0.05 A</td>
</tr>
<tr>
<td>Relay material</td>
<td>AgCdO₂</td>
</tr>
<tr>
<td>Terminal:</td>
<td>Maximum cross-section area of wire</td>
</tr>
<tr>
<td></td>
<td>2.5 mm² (13-14 AWG)</td>
</tr>
</tbody>
</table>

*) Relay IF is the unit’s self-supervision relay
### 6.1.6. Communication bus interface

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ports</td>
<td>2 in the back plate (VAMP 221) 2 in the front panel (I/O units)</td>
</tr>
<tr>
<td>Electrical connection</td>
<td>RJ 45</td>
</tr>
<tr>
<td>Max. number of used units</td>
<td>16 I/O units 3 central units</td>
</tr>
<tr>
<td>Auxiliary voltage supply to I/O units</td>
<td>Floating 24 Vdc</td>
</tr>
<tr>
<td>Communication</td>
<td>RS485 (15 kV) information / self-supervision</td>
</tr>
<tr>
<td>Light/current signal</td>
<td>4 arc protection zones 1 overcurrent zone</td>
</tr>
</tbody>
</table>

### 6.1.7. Local serial communication port

**VAMP 221**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ports</td>
<td>1 pcs in front panel</td>
</tr>
<tr>
<td>Electrical connection</td>
<td>RS 232</td>
</tr>
<tr>
<td>Data transfer rate</td>
<td>9600 kb/s (software update)</td>
</tr>
</tbody>
</table>

### 6.2. Tests and environmental conditions

#### Disturbance tests

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emission (EN 50081-1)</td>
<td>0.15 – 30 MHz 30 – 1000 MHz</td>
</tr>
<tr>
<td>· Conducted transients (EN 55022B)</td>
<td></td>
</tr>
<tr>
<td>· Radiated transients (CISPR 11)</td>
<td></td>
</tr>
<tr>
<td>Immunity</td>
<td></td>
</tr>
<tr>
<td>· static discharges (ESD)</td>
<td>EN 61000-4-2 class III 6 kV breaking capacity</td>
</tr>
<tr>
<td></td>
<td>8 kV air discharge</td>
</tr>
<tr>
<td>· fast transients (EFT)</td>
<td>EN 61000-4-4 class III 4 kV 5/50 ns power supply circuits</td>
</tr>
<tr>
<td></td>
<td>2 kV 5/50 ns other circuits</td>
</tr>
<tr>
<td></td>
<td>2.5 kV common mode</td>
</tr>
<tr>
<td>· high-frequency (1 MHz) transients</td>
<td>1.0 kV differential mode</td>
</tr>
<tr>
<td>· conducted high-frequency field</td>
<td>EN 61000-4-6 0.15 ... 80 MHz, 10 V/m</td>
</tr>
<tr>
<td>· radiated high-frequency field</td>
<td>EN 61000-4-3 80 ... 1000 MHz, 10 V/m</td>
</tr>
<tr>
<td>EMC tests</td>
<td>EN 20081-2 and EN 50082-2</td>
</tr>
<tr>
<td></td>
<td>CE approved</td>
</tr>
</tbody>
</table>

#### Immunity

- static discharges (ESD)
- fast transients (EFT)
- high-frequency (1 MHz) transients
- conducted high-frequency field
- radiated high-frequency field
6.2.1. **Test voltages**

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation test voltages</td>
<td>IEC 255-5 2.5 kV, 50 Hz, 1 min</td>
</tr>
<tr>
<td>Surge voltage</td>
<td>IEC 255-5 5 kV, 1.2/10 µs, 0.5 J</td>
</tr>
</tbody>
</table>

6.2.2. **Mechanical tests**

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration</td>
<td>2 ... 13.2 Hz, amplitude 3.5 mm 13.2 ... 100 Hz, acceleration 1 g</td>
</tr>
<tr>
<td>Shock/bump (IEC 255-21-2)</td>
<td>10 g, 1,000 bumps in the direction of X, Y and Z axis</td>
</tr>
</tbody>
</table>

6.2.3. **Environmental conditions**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature range</td>
<td>-10 ... +55°C</td>
</tr>
<tr>
<td>Transport and storage temperature range</td>
<td>-40 ... +70°C</td>
</tr>
<tr>
<td>Relative air humidity</td>
<td>&lt;75% (1 year, average) &lt;90% (30 days per year, condensation not allowed)</td>
</tr>
</tbody>
</table>

6.2.4. **Casing**

**VAMP 221**

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing class (IEC 60529)</td>
<td>IP20</td>
</tr>
<tr>
<td>Dimensions (WxHxD)</td>
<td>208x155x223 mm</td>
</tr>
<tr>
<td>Material</td>
<td>1mm steel plate</td>
</tr>
<tr>
<td>Weight</td>
<td>4.2 kg</td>
</tr>
<tr>
<td>Colour code</td>
<td>RAL 7032 (housing) / RAL 70035 (back plate)</td>
</tr>
</tbody>
</table>

**VAM 10L, VAM 3L, VAM 4C**

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing class (IEC 60529)</td>
<td>IP21</td>
</tr>
<tr>
<td>Dimensions (WxHxD)</td>
<td>157x92x25 mm</td>
</tr>
<tr>
<td>Material</td>
<td>1mm steel plate</td>
</tr>
<tr>
<td>Weight</td>
<td>0.75 kg</td>
</tr>
<tr>
<td>Colour code</td>
<td>RAL 7032 (housing) / RAL 70035 (back plate)</td>
</tr>
</tbody>
</table>

**VAR 4CE**

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing class (IEC 60529)</td>
<td>IP21</td>
</tr>
<tr>
<td>Dimensions (WxHxD)</td>
<td>140x90x60 mm</td>
</tr>
<tr>
<td>Material</td>
<td>PLASTIC</td>
</tr>
<tr>
<td>Weight</td>
<td>0.75 kg</td>
</tr>
</tbody>
</table>
VA 1 DA, VA 1 EH, VA 1 DP

<table>
<thead>
<tr>
<th>Housing class (IEC 60529)</th>
<th>IP21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (WxHxD)</td>
<td>25x55x14 mm (VA 1 DA)</td>
</tr>
<tr>
<td></td>
<td>411x62 mm (VA 1 EH)</td>
</tr>
<tr>
<td></td>
<td>440x7 mm (VA 1 DP)</td>
</tr>
<tr>
<td>Material</td>
<td>Plastic</td>
</tr>
<tr>
<td>Weight</td>
<td>0.01 kg</td>
</tr>
<tr>
<td>Cable length</td>
<td>6 m or 20 m</td>
</tr>
<tr>
<td></td>
<td>(VA 1 DP 5 m)</td>
</tr>
</tbody>
</table>

6.2.5. Package

<table>
<thead>
<tr>
<th>Dimensions (WxHxD)</th>
<th>VAMP 221: 215 x 160 x 275 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VAM 10L: 157 x 92 x 25 mm</td>
</tr>
<tr>
<td></td>
<td>VAM 3L: 157 x 92 x 25 mm</td>
</tr>
<tr>
<td></td>
<td>VAM 4C: 157 x 92 x 25 mm</td>
</tr>
<tr>
<td></td>
<td>VAMP 4R: 157 x 92 x 25 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight (unit, box and user instructions)</th>
<th>VAMP 221: 5.2 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VAM 10L: 0.5 kg</td>
</tr>
<tr>
<td></td>
<td>VAM 3L: 0.5 kg</td>
</tr>
<tr>
<td></td>
<td>VAM 4C: 0.5 kg</td>
</tr>
<tr>
<td></td>
<td>VAMP 4R: 0.5 kg</td>
</tr>
</tbody>
</table>

6.3. Protection stages

NOTE! See Chapter 2.1 for description.

6.3.1. Arc (fault) protection

**L1/L3 setting stage**

<table>
<thead>
<tr>
<th>Start current</th>
<th>0.5...6*I_n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating time</td>
<td>7 ms</td>
</tr>
<tr>
<td>Detection period</td>
<td>2 ms</td>
</tr>
<tr>
<td>Resetting period</td>
<td>30 ms</td>
</tr>
</tbody>
</table>

**L2/I_o setting stage**

<table>
<thead>
<tr>
<th>Start current</th>
<th>0.05...5*I_n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating time</td>
<td>7 ms</td>
</tr>
<tr>
<td>Detection period</td>
<td>2 ms</td>
</tr>
<tr>
<td>Resetting period</td>
<td>30 ms</td>
</tr>
</tbody>
</table>

6.3.2. Circuit breaker failure protection stage (50BF)

<table>
<thead>
<tr>
<th>Monitored relay</th>
<th>One relay in the tripping group (Trip 2 or Trip 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating time</td>
<td>100 ms or 150 ms</td>
</tr>
</tbody>
</table>
6.4. Unbalance alarm

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Detecting limit</td>
<td>90%</td>
</tr>
<tr>
<td>Operating time</td>
<td>10 s</td>
</tr>
</tbody>
</table>
7. Construction

7.1. Dimensional drawings

7.1.1. VAMP 221

7.1.2. VAM 10L / 3L / 4C, VAMP 4R
7.1.3. **VAR 4CE**

![VAR 4CE diagram]

35 mm DIN rail

7.1.4. **VA 1 DA**

![VA 1 DA diagram]
7.1.5. **VA 1 EH**

![VA 1 EH diagram](VA1EH_mittakuva)

7.1.6. **VYX 001**

![VYX 001 diagram](VYX001_mittakuva)
7.1.7. VYX 002

[Diagram of VYX 002]

This is preliminary version. All rights for changes reserved.
7.1.8. **VYX 076**

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VYX076_mittakuva
7.1.9. VYX 077

Caution!
Read this User's Manual carefully before undertaking any installation or wiring work.

Safety instructions
Always observe the national electrical safety regulations when working under live conditions. The unit manufacturer is not liable for damage due to incorrect working methods or failure to observe safety instructions.

The correct handling of the unit under all mounting and operating conditions forms the foundation for its safe use.

Caution!
Any separately marked notes and warnings must be observed. The wiring work must be performed according to national standards and any requirements specified by the customer.
Caution!
Do not connect the auxiliary supply voltage until the installation has been completed.

Before installation
Before installation, make sure the environmental conditions comply with the requirements specified in Chapter 5.

Caution!
The unit contains components liable to damage if exposed to an electrostatic discharge (ESD). Do not open the unit unless you have taken appropriate protective measures against ESD.

Caution!
The manufacturer cannot guarantee operational safety in environments that do not satisfy the specified environmental conditions.

7.2.1. VAMP 221
The central unit is designed for flush mounting. Spacing adapters for reducing the installation depth are available on request.

Figure 6.2.1-1 Mounting the central unit
Wiring of the central unit, overview
The central unit can be connected to the following:

- secondary circuits of the current transformers of the switchgear
- the trip circuits of the circuit breakers
- alarm circuits
- auxiliary supply circuits
- protective earthing
- connections to I/O units (data communication and auxiliary supply)
- connections to other central units or protection relays

NOTE! The auxiliary supply connection is different to VAMP 220! In VAMP 221 the auxiliary supply is connected to terminals X3:17 and X3:18.

Wiring secondary circuits of the current transformers
Connect the secondary circuits of the current transformers to the following screw connectors in the back plate:

- X1-1, X1-2 (L1)
- X1-3, X1-4 (L2/I0)
- X1-5, X1-6 (L3)

The arc protection system can also be single or two-phase connected. Three-phase connection is nevertheless recommended for optimal operating speed.

NOTE! The current measuring channels L1 and L3 must be used in connection with two-phase current measuring. If only two phases are connected, they should be connected to L1 and L3. Single-phase current or earth-fault current must always be connected to the current measuring channel L2/I0; otherwise, an imbalance error will occur.

NOTE! The specified operating time of 7ms can only be guaranteed for three-phase current measurement.

Wiring the trip circuits of the circuit breakers
Connect the circuit breaker’s trip circuits to the following terminals (a maximum of four separate trip outputs in two separate groups):

TRIP1: X1-7, X1-8 (fast, group 1)
TRIP2: X1-9, X1-10 (fast/CBFP, group 1)
TRIP3: X1-11, X1-12 (fast, group 2)
TRIP4: X1-13, X1-14 (fast/CBFP, group 2)
In the event of an arc fault, the output contact will close at 7 ms when three-phase current measurement is used.
If CBFP is used, the trip relays 2 and 4 will operate after a preset delay time of 100 or 150 ms if the preconditions for the arc fault still exist.
If several trips are required, the multiplying relay VAR 4CE can be used.

**Wiring alarm circuits**
Alarm signals generated by the arc protection system (trip and self-supervision alarms) can be forwarded to higher-level switchgear supervision and control systems through the output contacts.

**Self-supervision alarms**
The self-supervision system issues a self-supervision alarm when it detects a fault in a central unit function or an incorrect number of sensors.
Connect the self-supervision alarm output to an IF change-over contact, either terminals X1-17, X1-18 (normally closed) or X1-18, X1-19 (normally open).
During normal system operation (no internal fault) and with the auxiliary power supply connected, the terminal X1-17 or X1-18 is open and X1-18 or X1-19 is closed.

**Trip alarms**
A trip alarm is generated when the arc fault system trips.
Connect the trip alarm output to the closing terminals X1-15, X1-16.

**Connecting protective earthing**
Connect the arc protection system to the earth using the PE terminal in the back plate.

**Wiring the auxiliary supply**
Connect the auxiliary supply voltage to the Us input, terminals X3-17 X3-18.

**NOTE!** If possible, the auxiliary supply should be taken from a power source that is not interrupted during arc protection system operation.

**CAUTION!**
Keep the auxiliary supply disconnected during mounting.
7.2.2. **VAM 10L, VAM 3L, VAM 4C**

The units are designed for mounting on a DIN rail. Mount the units on the rail in such a way that the indicator lights on the front panel are visible and the sensor wiring can be made as easily as possible.

![Dimensions and mounting of an I/O unit](image)

**Wiring I/O units**

The I/O units can be connected to the following:

- secondary circuits of the current transformers of the switchgear (VAM 4C only)
- the trip circuits of the circuit breakers
- external auxiliary supply circuits
- connections to the central unit or other I/O units (data communication and auxiliary supply)
- connections to other central units or protection relays (DI or DO bus)

**Wiring the secondary circuits of the current transformers (VAM 4C only)**

Connect the secondary circuits of the current transformers to the following screw connectors:

- X1-1, X1-3 (L1)
- X1-5, X1-7 (L2/I0)
- X1-9, X1-11 (L3)

The arc protection system can also be single or two-phase connected. Three-phase connection is nevertheless recommended for optimal operating speed.
NOTE! The current measuring channels L1 and L3 must be used in connection with two-phase current measuring. Single-phase current or earth-fault current must always be connected to the current measuring channel L2/I0; otherwise, an unbalance error will occur.

NOTE! The specified operating time of 7ms can only be guaranteed for three-phase current measurement.

**Wiring the trip circuits of the circuit breakers**

Connect the circuit breaker’s trip circuit to the following terminals:

TRIP1: X2-15, X2-16 (fast)

In the event of an arc fault, the output contact will close at 7 ms when three-phase current measurement is used.

The output trip relay of the light I/O units (VAM 10L and VAM 3 L) operates during faults in its own zone. In the current I/O unit (VAM 4 C), select the protection zone controlling the I/O unit using the programming switches.

If several trips are required, the multiplying relay VAR 4CE can be used.

**Wiring between the central unit and the I/O unit**

Connect the central unit to the I/O units with a modular cable of type VX001. The modular cable carries all information between the central unit and I/O units, including data in serial form, arc fault messages and operating supply to the I/O units.

- Connect the VX001 cable to the X6 cable outlet (COM2) or the interface X3-1...6 of the central unit (COM1). Both COM ports can be used simultaneously.

**CAUTION!**

If you use the terminal X3-1...6, pay particular attention to the wiring of the signals. Faulty wiring may damage the communication between the central unit and the I/O units.

- Connect the cable to COM1 or COM2 on the first I/O unit.
- Route the cable from COM1 or COM2 on the first I/O unit to COM1 or COM2 in the next unit, etc.

All the COM1 and COM2 interfaces are identical, i.e. the cable can always be connected to either interface. The maximum total length of the modular cable, taking into account all the I/O units connected to the central unit, is 100 m.

**Wiring separate auxiliary supplies**

When routing modular cables over long distances or when the system contains more than five I/O units, you should preferably
use a separate auxiliary supply parallel with the modular cable.

Connect the auxiliary supply to the 24 V terminals X3-1 and X3-2 in the central unit to the 24 V terminals X2-1 and X2-2 in the I/O units. Alternatively, you can also use a separate external direct voltage supply.

**NOTE!** Pay particular attention to the polarity of the cable connections.

### 7.2.3. **Arc sensors**

Mount the sensors on the switchgear in such a way that they cover the protection zone as completely as possible. The line of sight must be free between the sensor and the supervised area. If point sensors are used in open compartments (such as bus-bar sections), there should be a sensor approximately every 5 meters. Due to the wide detection range of the sensors and the light reflection inside the switchgear, the mounting position is not critical.

**Connecting sensors VA 1 DA and VA 1 EH to the I/O units**

The sensors are delivered with 6-metre standard cables or 20-metre shielded cables (to be specified in the order).

After mounting the sensors, connect them to the I/O units as follows:

- Draw the wire to the nearest I/O unit using the shortest route possible and cut it to a suitable length.
- Connect the arc sensors to the screw terminals X1-1…20. The polarity of the arc sensor cables is not critical.

**Connecting the ARC-SLx sensors to the I/O units**

The sensors are delivered in standard lengths (to be specified in the order) equipped with terminals compatible with VAM 3L units.

After mounting the sensors, connect them to the I/O units as follows:

- Draw each end of the sensor to the I/O unit and carefully form a loop of the extra fibre.

**NOTE!** Do not shorten the extra sensor fibre unless you have appropriate terminal connectors.

- Connect the arc sensors to plug-in terminals X1-R1, T1...R3, T3. While the polarity of the arc sensors is not critical, you must connect each end of the fibre to the same channels.
VA 1 DA

You can install the arc sensor onto the switchgear wall from the outside. Press the active part of the sensor through the 10-mm hole in the wall and fix it using a 4-mm screw.

![Figure 7.2.3-1 Mounting the arc sensor VA 1 DA](image)

You can also surface mount the sensor to the wall using the mounting plates VYX01 or VYX02, available as additional parts.

**NOTE!** The sensor must not be exposed to direct sunlight or other strong light. Do not mount the sensor directly under a light source.

![Figure 7.2.3-2 Arc sensor VA 1 DA](image)

![Figure 7.2.3-3 Sensitivity of the arc sensor VA 1 DA](image)
**VA 1 EH**

You can be install the arc sensor onto the switchgear wall from the outside. Press the active part of the sensor through the 10.5-mm hole in the wall.

You can also surface mount the sensor. To do this, push the sensor into a plastic mounting tube and fix it with heat shrink tubing.

**NOTE!** The sensor must not be exposed to direct sunlight or other strong light. Do not mount the sensor directly under a light source.

![Arc sensor VA 1 EH](image)

**ARC-SLx**

ARC-SLx is an fibre sensor that can be mounted on the switchgear to monitor several compartments simultaneously (various bus-bar compartmets, etc.).

The fibre must not touch any live parts of the switchgear or other hot components, since too high temperatures may destroy the fibre.

When mounting the sensor on the switchgear, ensure that the bending radius is long enough (min. 80 mm) and that it is safe from the sharp edges of the switchgear.

**NOTE!** The sensor must not be exposed to direct sunlight or other strong light. Do not mount the sensor directly under a light source.

**NOTE!** To avoid false tripping, cover any unused channels of the I/O unit.
**VA 1 DP**

The portable pin sensor can be temporarily connected to the I/O units. It is used to improve safety when working with live switchgear, for example. Attach the sensor close to the working area, for example in the breast pocket of the maintenance man. A pin sensor operates in the same way as a fixed arc sensor. The only difference is free mobility within the limits of the connecting cable.

![Figure 7.2.3-5 Pin sensor VA 1 DP](image)

**NOTE!** To avoid faulty tripping, disconnect the pin sensor from the system immediately after use.

**7.2.4. VAR 4 CE**

The multiplying relay VAR 4CE can be used when more than 4 trip outputs are needed simultaneously.

- Attach the multiplying relay to the DIN rail near where the central unit is mounted.

- Connect the auxiliary voltage to terminals X3-1 (+) and X3-2 (GND) of the central unit or to terminals X2:1 (+) and X2:2 (GND) in the I/O unit and to terminals 1 (+) and 3 (GND) or 2 (+) and 4 (GND) in the multiplying relay. Note the polarity of the wires.

- Connect the required trip output to terminals 5,7 or 6,8 in the multiplying relay.

- Connect the necessary trip controls to terminals TRIP1 - TRIP4 of the multiplying relay.
Figure 7.2.4-1 Multiplying relay

Figure 7.2.4-2 Multiplying relay interface
The multiplying relay VAMP 4R can be used when additional trip outputs are needed. VAMP 4R comprises 4 N/O contacts and 4 N/C contacts. They are divided into two separate groups which can be independently controlled by e.g. the binary output of the I/O units or the central unit (VAMP 221).

- Attach the VAMP 4R unit to a DIN rail.
- Connect the auxiliary voltage (+24V) to terminal X2-1 (+) and X2-2 (-). Terminals X2-3 and X2-5 are parallel inputs to X2-1. Terminals X2-4 and X2-6 are parallel inputs to X2-1. The auxiliary voltage (+24V) can be supplied from the central unit or nearest slave (X2-1 (+), X2-2 (-)).
- Connect the required signal (18-265 V ad/dc) to the trip control inputs.
- Input “TRIP 1” (X2-11, X2-12) is controlling the trip group 1.
  Input “TRIP 2” (X2-8, X2-9) is controlling the trip group 2.
- There are 2xN/C + 2xN/O contacts per trip group.

If necessary, input TRIP 1 and 2 can be connected in parallel. Then all trip relays will operate simultaneously.

Figure 7.2.5-1 VAMP 4R block diagram
7.2.6. **Wiring multiple central units**

A maximum of three central units can be connected to one communication bus. In this case, the units can operate on a maximum of four protection zones (depending on their programming switches). The light and current signals given by the I/O units, including address information, are transferred to each central unit.

If more than one central unit is to be connected to the same communication bus, one central unit must be in central unit mode and the other central units in sub-unit mode (programming switch SW1:8).

In applications with multiple central units the central units can be interconnected also via BI/O connections (binary input/output). In this case, each part of the system can control four protection zones per system communication bus. In this case, arc and overcurrent information is transferred between the central units without address information.

**NOTE!** When configuring arc protection system with multiple central units, disconnect I/O-units from central units in slave mode during their installation procedure.

**The following BI/O connections are included in the standard delivery:**

<table>
<thead>
<tr>
<th>Connection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>La&gt; in</td>
<td>X3-8 Arc input, tripping group 1</td>
</tr>
<tr>
<td>Lb&gt; in</td>
<td>X3-9 Arc input, tripping group 1</td>
</tr>
<tr>
<td>Ib&gt; in/out</td>
<td>X3-10 Overcurrent input/output</td>
</tr>
<tr>
<td>La&gt; out</td>
<td>X3-11 Arc output, tripping group 1</td>
</tr>
<tr>
<td>Lb&gt; out</td>
<td>X3-12 Arc output, tripping group 2</td>
</tr>
<tr>
<td>GND</td>
<td>X3-13, X3-14 Grounding for all BI/O signals</td>
</tr>
</tbody>
</table>

To obtain transfer of arc information between central units:

- Connect the systems using the BI/O terminals X3-8, 9, 11 or 12 (+).
- Connect the terminals X3-13 or 14 (GND).

To obtain transfer of overcurrent information between central units:

- Connect the systems using the BI/O terminals X3-10 (+).
- Connect the terminals X3-13 or 14 (GND).

**NOTE!** Note the polarity of the cables.
Figure 7.2.6-1 shows an example connection where arc information is transferred in both directions between central units. See Chapter 3.3 for an application example.

The system's I/O units should be connected to the central units in the same zone.

*Figure 7.2.6-1 Arc protection system with two central units (example)*
8. **Order information**

**VAMP 221 ORDERING CODE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAM 3L</td>
<td>Fiber sensor I/O unit (VAMP221)</td>
<td>3 Fiber Loops</td>
</tr>
<tr>
<td>VAM 10L</td>
<td>Point sensor I/O unit (VAMP221)</td>
<td>10 Sensor Inputs</td>
</tr>
<tr>
<td>VAM 4C</td>
<td>Current I/O unit (VAMP221)</td>
<td>Current Inputs</td>
</tr>
<tr>
<td>VAR 4 CE 4/0</td>
<td>Trip Multiplier Relay</td>
<td>1xNO -&gt; 4xNO</td>
</tr>
<tr>
<td>VAX 2 CB</td>
<td>Interface Unit ( use vx002 cable )</td>
<td>For Sensor Cable Extension</td>
</tr>
<tr>
<td>VA 1 DA-6</td>
<td>Arc Sensor</td>
<td>Cable length 6m</td>
</tr>
<tr>
<td>VA 1 DA-20</td>
<td>Arc Sensor</td>
<td>Cable length 20m</td>
</tr>
<tr>
<td>VA 1 DT-6</td>
<td>Temperature Sensor</td>
<td>Cable length 6m</td>
</tr>
<tr>
<td>VA 1 DP-5</td>
<td>Portable Arc Sensor</td>
<td>Cable length 5m</td>
</tr>
<tr>
<td>VX001-xx</td>
<td>Modular Cable VAM &lt;-&gt; VAM ( xx = Cable length [m] )</td>
<td>Note 1. Preferred Cable Lenghts</td>
</tr>
<tr>
<td>VX002-xx</td>
<td>Shielded Sensor Cable ( xx = Cable Length [m] )</td>
<td>Example: JAMAK</td>
</tr>
<tr>
<td>VYX001</td>
<td>Surface Mounting Plate for Sensors</td>
<td>Z-shaped</td>
</tr>
<tr>
<td>VYX002</td>
<td>Surface Mounting Plate for Sensors</td>
<td>L-shaped</td>
</tr>
<tr>
<td>VYX076</td>
<td>Raising Frame</td>
<td>Height 40mm</td>
</tr>
<tr>
<td>VYX077</td>
<td>Raising Frame</td>
<td>Height 60mm</td>
</tr>
<tr>
<td>VA 1 EH-6</td>
<td>Arc Sensor (Pipe type)</td>
<td>Cable length 6m</td>
</tr>
<tr>
<td>VA 1 EH-20</td>
<td>Arc Sensor (Pipe type)</td>
<td>Cable length 20m</td>
</tr>
</tbody>
</table>

Note 1. Cable lengths 1, 3, 5, 7, 10, 15, 20, 25 & 30
9. Reference information

**Documentation:**
Mounting and Commissioning Instructions VMMC.EN0xx

**Manufacturer data:**
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![24h Technical Support](VAMP+358+20+753+3264)
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