VIP40, VIP45

Protection Relays

User Manual

NRJED311207EN-01
02/2025

www.se.com

Legal Information

Table of Contents

Safety Information

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

Document Scope

This manual is intended for personnel responsible for installing, commissioning and using VIP protection relays (hereafter referred to as VIP, VIP40, or VIP45).

Validity Note

This manual is applicable to all versions of the VIP40 and VIP45 protection relays.

The table below lists the revisions of VIP firmware versions:

Firmware version	Date	Revision
V1.1.0	September 2011	First version
V1.2.0	November 2011	Bug fixing: untimely E16 error code Improvement of the frequency measurement for Io Trip tests
V1.3.0	November 2012	Bug fixing: firmware version was not displayed when current lower than 5 A

Information on Non-Inclusive or Insensitive Terminology

As a responsible, inclusive company, Schneider Electric is constantly updating its communications and products that contain non-inclusive or insensitive terminology. However, despite these efforts, our content may still contain terms that are deemed inappropriate by some customers.

At a Glance

Introduction

VIP40 and VIP45

VIP40 and VIP45 are designed for the protection and operation of MV/LV utility substations up to 200 A primary belonging to electrical distribution networks in industrial installations.

VIP40 and VIP45 are protection relays with a self-powered supply. They are powered by their current sensor and operate without an auxiliary power supply.

- The VIP40 helps to protect against phase faults.
- The VIP45 helps to protect against phase faults and earth faults.

VIP40 and VIP45 are available in 2 versions: 100 A and 200 A.

Main Advantages of VIP40 and VIP45

The VIP is part of a complete protection chain:

- This protection chain cannot be separated and includes the dedicated current sensor, the VIP and the Mitop trip unit.
- The use of dedicated current sensors helps guarantee the complete protection chain performance. No sizing study is necessary when choosing the sensor. The sensor dedicated to VIP operation is dual core type, which provides the power supply and the metering signal separately.

The VIP is easy to install:

- It is compact.
- The connection terminals are clearly identified.
- The sensor and Mitop trip unit connections are prefabricated.
- The settings are entered via adjustable switches, using a screwdriver.

The VIP is robust:

- The case is made of insulating material.
- The unit can withstand harsh environments:
  - Front panel degree of protection: IP54
  - Range of operating temperatures: from -40...+70 °C (-40... +158 °F)

VIP40 and VIP45 Applications

VIP40 and VIP45 are suitable for substations without an auxiliary power supply. They are dedicated to protecting MV/LV transformers.

They offer the following functions:

- Phase overcurrent protection
- Earth fault protection (VIP45 only)
- Current metering display

Selection Table

The selection table lists the functions performed by VIP40 and VIP45.

Function	VIP40	VIP45
Phase overcurrent protection (ANSI 50-51)	•	•
Earth fault protection using the sum of the currents (ANSI 51N)		•
Tripping annunciation via LED	•	•
Phase current measurement	•	•
Earth fault current measurement		•
Phase peak demand current values	•	•
Tripping by Mitop trip unit	•	•
Mitop trip unit trip circuit supervision	•	•

VIP References

Reference	Description
REL59910	VIP40 100 A
REL59911	VIP40 200 A
REL59912	VIP45 100 A
REL59913	VIP45 200 A

Accessory References

Reference	Description
LV434206	Pocket battery module

Phase Current Sensor

The VIP operates with the dual core current sensor (200 A primary).

This sensor provides:

- The VIP power supply
- Metering of all 3 phase currents and the earth fault current

The use of a dedicated sensor contributes to the performance of the complete protection chain (sensor, VIP, Mitop trip unit).

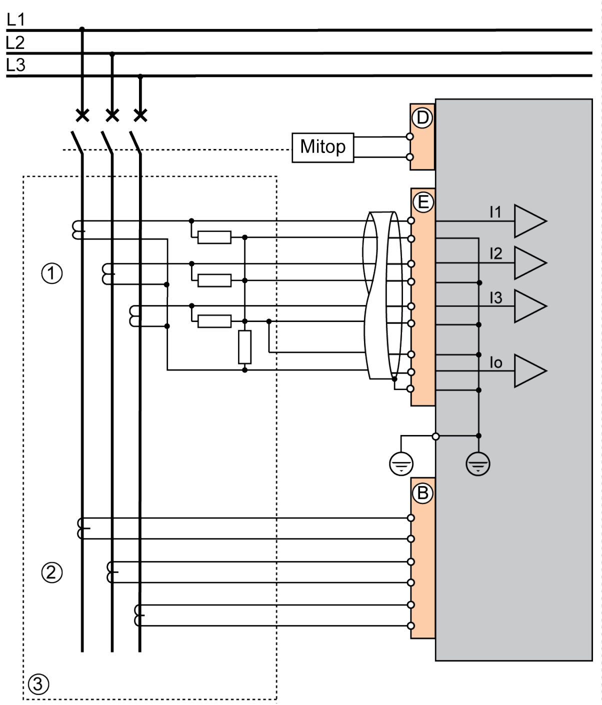
The connection of the VIP to the current sensor is simplified by two pre-wired sensor connectors:

- 1 x 9-pin SUBD connector for metering the phase and earth fault currents
- 1 x 6-pin lockable connector for the VIP power supply

The current sensor consists of 2 windings per phase, one winding providing the VIP power supply, the other winding enabling the VIP to measure the phase currents. The earth fault current is determined by measuring the sum of the 3 phase currents inside the sensor.

Reference	Designation	Rating current (In)	To be used with MV equipment
P7M13002	CUa	200 A	Premset
S1B31558	CUar	200 A	RM6
CGA200	CGa	200 A	RN2D, SM6 24, RM AirSeT
03816992N0	CSa4	200 A	SFset
RMU-LPCT90-VIP-200	CHa	200 A	RM AirSeT

Current Sensor Connection Block Diagram



1 Metering windings

2 VIP power supply windings

3 Dual core sensor

Current Sensor Characteristics

For the different sensors, the metering winding is a magnetic core winding hard-wired onto a built-in resistor (LPCT type) supplying the signals necessary to the VIP metering and protection functions. Characterized in accordance with class P, the accuracy limit factor is equivalent to 5P50 for the current sensor.

Parameters	CUa, MU-LPCT90-VIP-200
Ipn rated primary current	200 A
Isn rated secondary current	0.0833 A
Rated transformation ratio	1/2400
Rated kneepoint voltage Ek (50 Hz)	72 V
Maximum magnetizing current Ie to Ek	4 mA
Maximum resistance of the secondary winding at 75 °C	18.8 Ohm
Metering resistance integral to the sensor	1.8 Ohm
Voltage at the terminal of the metering resistance integral to the sensor (Usr rated secondary voltage)	150 mV/In

The power supply winding is a magnetic core winding that provides the VIP power supply.

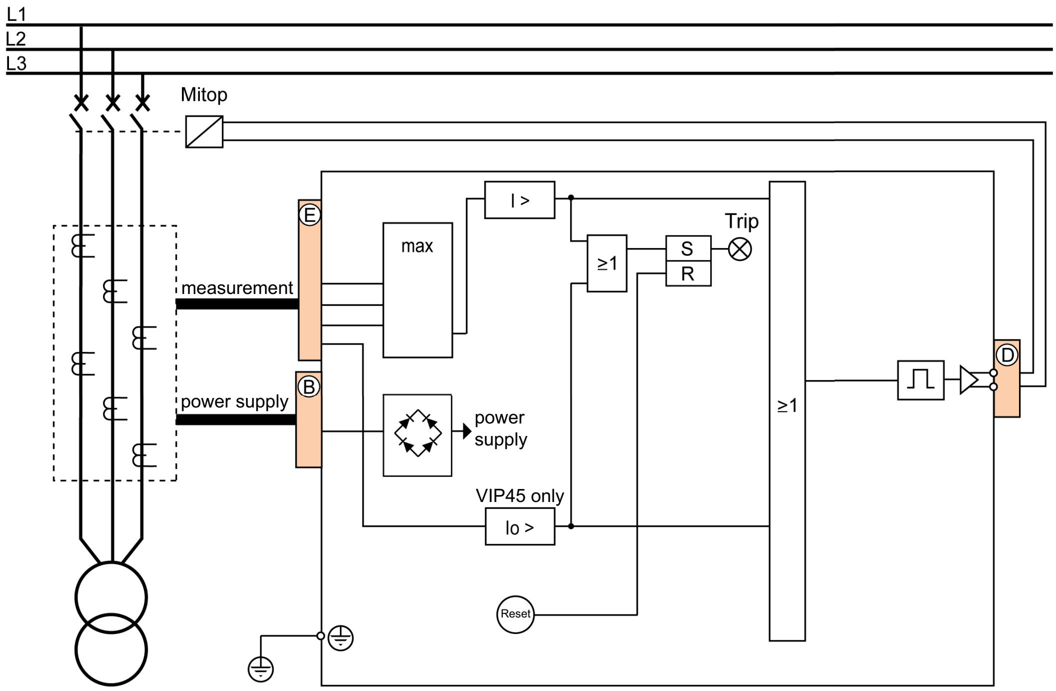
Parameters	CUa, MU-LPCT90-VIP-200
Ipn rated primary current	200 A
Isn rated secondary current	0.377 A
Rated transformation ratio	1/530
Rated kneepoint voltage Ek (50 Hz)	32.9 V
Maximum magnetizing current Ie to Ek	13.5 mA
Maximum resistance of the secondary winding at 75 °C	12.4 Ohm
Consumption at the rated load current	75 mW

Circuit Breaker Control via Mitop Trip Unit

The VIP is compatible with eco 540-turn Mitop trip units.

Standard Operation

Mimic Diagram of VIP40 and VIP45 Operation



Installation

Safety Precautions

Before Starting

You are responsible for compliance with all the existing international and national electrical codes concerning protective grounding of any device.

You should also carefully read the safety precautions described below. These instructions must be followed strictly when installing, servicing or repairing electrical equipment.

DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC, BURNS OR EXPLOSION

- This equipment must only be installed and serviced by personnel with electrical network protection qualification.
- Read this entire set of instructions before performing such work.
- Never work alone.
- Wear appropriate personal protective equipment (PPE) and follow safe electric work practices. See NFPA 70E or CSA Z462 standard.
- Before working on or inside it for visual inspections, tests, or maintenance, turn off all power supplies to the equipment and the transformer.
- Respect the LOTO (Lock Out Tag Out) procedure.
- Use a properly rated voltage sensing device (EN 61243) to confirm that all power is off.
- Before carrying out any other actions, check the integrity of protective conductor connection.
- After working on or inside it, carefully inspect the work area for tools and objects that may have been left inside the equipment.

Failure to follow these instructions will result in death or serious injury.

DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Never leave the current sensor secondary in open circuit.
- Never disconnect the VIP current sensor connectors unless the MV circuit breaker is in the open position and completely isolated.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

CAUTION

HAZARD OF INCORRECT OPERATION

- Before performing Dielectric (Hi-Pot) or Megger testing on any equipment in which the relay is installed, disconnect all input and output wires to the VIP.
- Do not open the VIP case.

Failure to follow these instructions can result in injury or equipment damage.

The only permitted operation is the removal of the depleted battery from its compartment on a VIP.

Precautions

Introduction

The VIP is supplied in one of the following ways:

- Individually packaged
- Installed in a cubicle

The transport, handling and storage precautions for VIP vary depending on which of these two methods is used.

VIP in its Original Packaging

- **Transport**

  The VIP can be shipped to any destination by all suitable means of transport, without taking any additional precautions.

- **Storage**

  The VIP can be stored in their original packaging in a location with the following environmental characteristics:

  - Temperature: -40...+70 °C (-40...+158 °F)
  - Humidity ≤ 90%
  - Storage is limited to a maximum of one month if the relative humidity is higher than 93% and the temperature higher than +40 °C (+104 °F).

  If the relay is to be stored for an extended period, we recommend the following:

  - Do not unpack the VIP prior to its intended period of use.
  - Check the environment and the condition of the packaging annually.

  Once the VIP has been unpacked, it should be energized as soon as possible.

More information on handling and storage is available in the VIP Technical Characteristics, page 65.

VIP Installed in a Cubicle

- **Transport**

  The VIP can be transported by all suitable means of transport in the usual conditions for cubicles. Storage conditions should be taken into consideration for a long period of transport.

- **Handling**

  If the cubicle is dropped, check the VIP condition by visual inspection and energizing.

- **Storage**

  We recommend keeping the cubicle protective packaging for as long as possible.

  VIP, like all electronic units, should not be stored in a damp environment for more than one month. They should be energized as quickly as possible. If this is not possible, the cubicle reheating system should be activated.

VIP Used in a Damp Environment

The temperature/relative humidity factors must be compatible with the VIP environmental withstand characteristics, page 67.

If the conditions of use are outside the normal zone, special arrangements should be made before commissioning, such as air conditioning of the premises.

VIP Used in a Polluted Environment

An industrial atmosphere contaminated by the presence of chlorine, hydrofluoric acid, sulfur, solvents, etc. can cause corrosion of the electronic components. In this case, environmental control arrangements should be made (such as closed, pressurized premises with filtered air, etc.) before commissioning.

The effect of corrosion on VIP has been tested in accordance with the IEC 60068-2-60 standard under the following “2-gas” test conditions:

- 21 days duration
- 25 °C (77 °F), 75% relative humidity
- 0.5 ppm H_2S, 1 ppm SO_2

Equipment Receipt and Identification

Equipment Receipt

The VIP is shipped in packaging which helps protect it against any knocks received in transport.

On receipt, check that the packaging has not been damaged. If it has, note any anomaly on the delivery slip and inform your supplier.

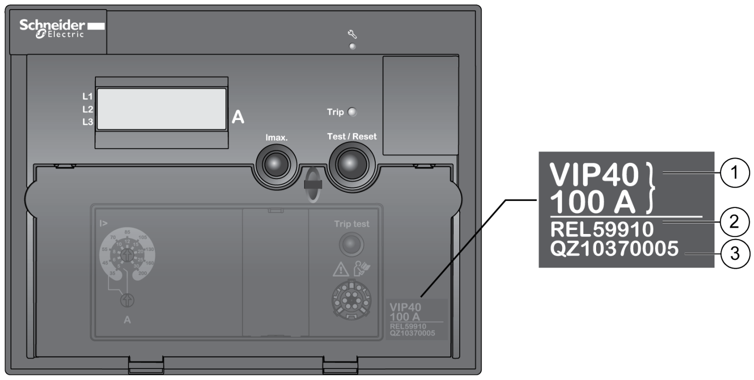
Package Contents

The box contains the following items:

- A VIP protection relay
- A certificate of conformity

Identification Label

The identification label on the front panel is used to identify the VIP:



1 Product name

2 Product reference

3 Serial number

Check After Unpacking

Make sure that the VIP supplied corresponds to the product ordered.

Mounting/Assembly

Introduction

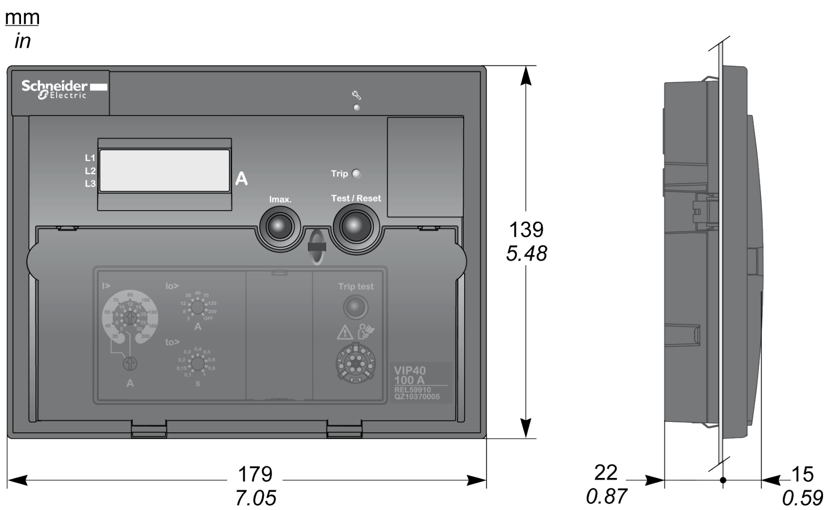
The VIP weighs 380 g (0.84 lb) maximum.

The VIP is flush-mounted in a mounting plate 1 to 2.5 mm (0.04 to 0.1 in) thick.

It is designed to be mounted indoors.

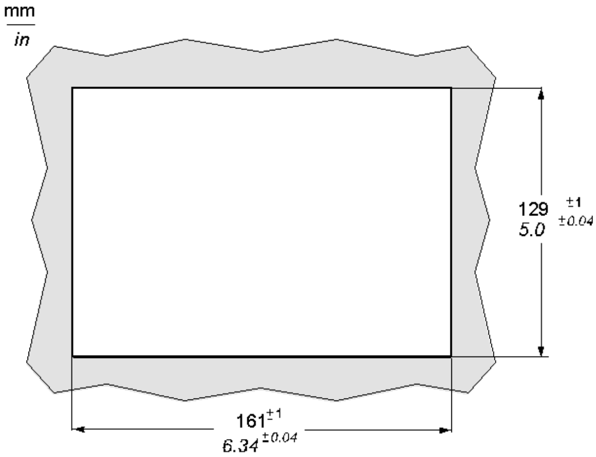
To help ensure an IP54 waterproof seal, the surface onto which it is fitted must be smooth and solid.

Dimensions



Cut-Out

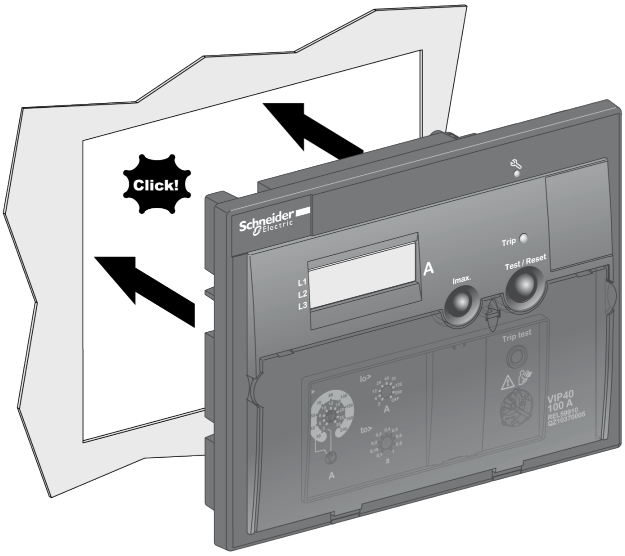
Cut out the mounting plate as indicated:



⚠ CAUTION
HAZARD OF CUTS Trim the edges of the cut-out plates to remove any jagged edges. **Failure to follow these instructions can result in injury or equipment damage.**

Installing the VIP

The VIP is held in place by 6 metal catches on the sides, behind the front panel:

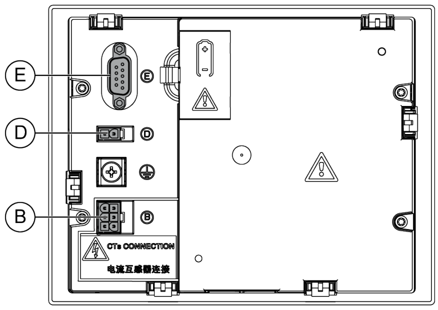


Connectors

Introduction

All the VIP connectors are removable. These connectors can be accessed on the rear panel.

Identification of the Connectors on the Rear Panel



B Connector for the self-powered supply

D Connector for the Mitop trip unit

E Connector for the phase and earth fault current inputs

⏚ Protective earth

Connecting the VIP to the Current Sensors

Introduction

The VIP is connected to the dual core current sensor using 2 prewired connectors:

- 1 x 9-pin SUBD connector to measure the phase and earth fault currents (connector E)
- 1 x 6-pin lockable connector for the VIP power supply (connector B)

DANGER

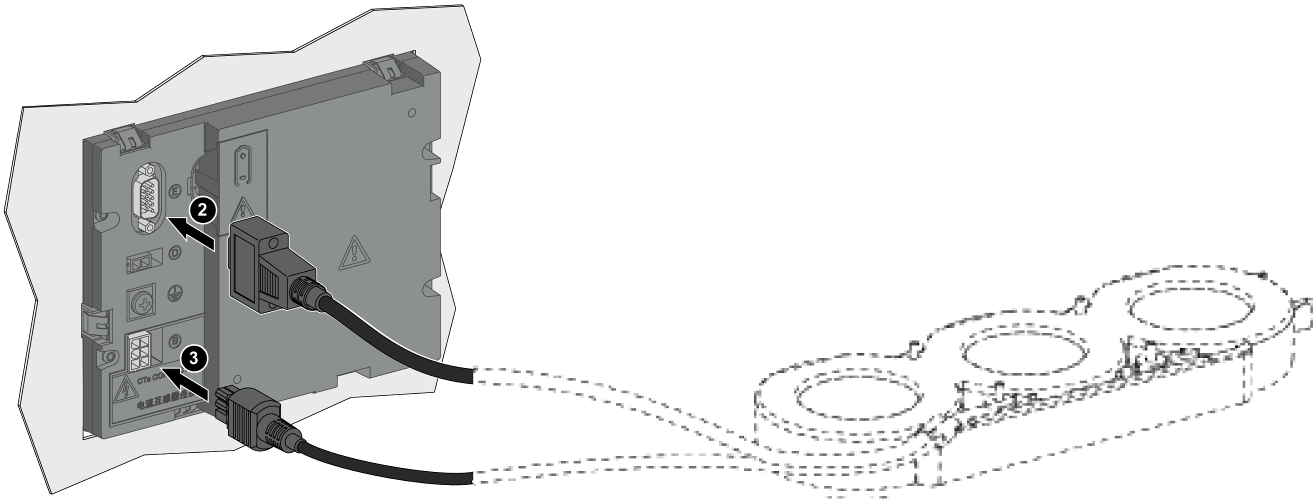
HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Check the integrity of protective conductor connection before carrying out any other actions.
- Never leave the current sensor secondary in open circuit. The high voltage that would result from opening the circuit is dangerous for the operator and for the equipment.
- Never disconnect the VIP current sensor connectors unless the MV circuit breaker is in the open position and completely isolated.
- Wear insulating gloves to avoid any contact with a conductor that has accidentally been energized.
- Wear personal protective equipment in compliance with current regulations.

Failure to follow these instructions will result in death or serious injury.

Connection Precautions

1	Check that the MV circuit breaker is in the open position or is not connected to the electrical network.
2	Connect the 9-pin SUBD connector to connector E on the VIP and tighten the 2 mounting screws.
3	Connect the 6-pin lockable connector to connector B on the VIP.



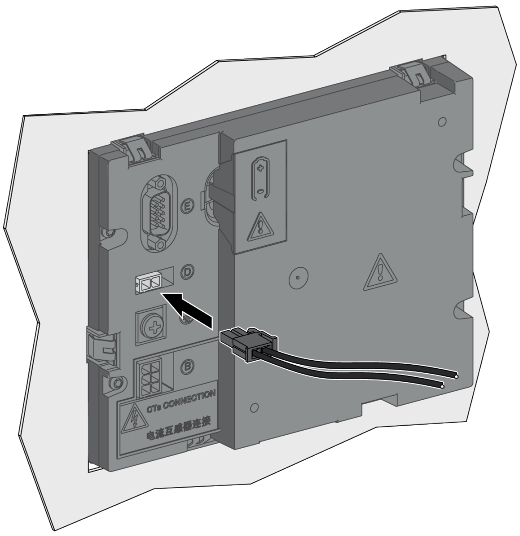
Connecting the VIP to the Mitop Trip Unit

Introduction

The VIP is connected to the Mitop trip unit with a 2-pin prewired connector from the Mitop trip unit.

Connection Precautions

Connect the lockable 2-pin connector to the VIP (item **D**).



Earthing

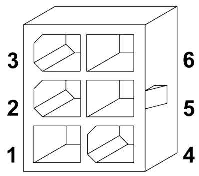
Connection Characteristics

> **⚠⚠WARNING**
>
> **HAZARD OF ELECTRIC SHOCK**
>
> - Connect the VIP to earth.
> - Check the integrity of protective conductor connection before carrying out any other action.
>
> **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

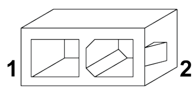
Ref.	Wiring	Type of terminal	Screwdriver	Tightening torque
	• Green-yellow wire 6 mm² (AWG 10) • Lug with internal diameter 5 mm (0.197 in) maximum • Length < 0.5 m (20 in)	M5 screw	Pozidriv no. 2	2...2.3 N•m (17.7...20.4 lb-in)

Connector Pinout

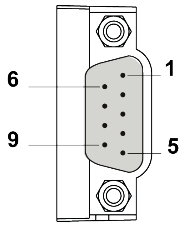
Connector B Pinout

Connecting the VIP self-powered supply	Terminal	Data item connected
	1	Phase current output 1
	2	Phase current output 2
	3	Phase current output 3
	4	Phase current input 1
	5	Phase current input 2
	6	Phase current input 3

Connector D Pinout

Connecting the Mitop trip unit to the VIP	Terminal	Data item connected
	1	Mitop trip unit - terminal
	2	Mitop trip unit + terminal

Connector E Pinout

Connecting the phase and earth fault current measurement inputs	Terminal	Data item connected
	1	Phase current 1 (Gnd)
	2	Phase current 2 (Signal)
	3	Phase current 3 (Gnd)
	4	Earth fault current (Signal)
	5	Gnd (not connected to the dual core sensor)
	6	Phase current 1 (Signal)
	7	Phase current 2 (Gnd)
	8	Phase current 3 (Signal)
	9	Earth fault current (Gnd)

Use

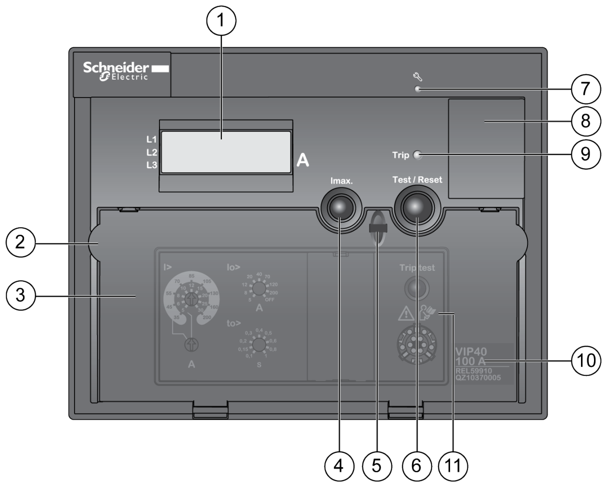
Human Machine Interface

Front Panel

The Human Machine Interface (HMI) on the front panel of the VIP consists of a display, LEDs, keys and adjustment dials.

A transparent sealable pivoting flap helps prevent access to the adjustment dials by unauthorized persons.

The illustration below shows the front panel of the VIP40:



1 Display

2 Lugs for opening the transparent protective flap

3 Transparent protective flap

4 Imax. peak demand display button

5 Sealing ring

6 Test/Reset button

7 Status LED

8 Zone for a user-customizable label

9 Trip fault indication LED

10 Identification label

11 Symbol indicating that it is necessary to read the manual

Display

The display is an LCD unit.

During operation, the display indicates the value of the current on each phase in succession. Each phase remains displayed for 3 seconds before automatically changing to the next. The display is in amps, on three digits.

> **NOTE:** If the phase current is less than the pick-up current, page 66, the VIP is not activated and the display is off.

Lugs for Opening the Transparent Protective Flap

To open the flap, pull both lugs simultaneously. The flap pivots open on its 2 bottom hinges.

Transparent Protective Flap

The sealable flap helps prevent modification of the VIP settings. Because the flap is transparent, the settings are legible when it is closed.

Imax. Button: Peak Demand Display

Pressing the Imax. button triggers a sequence displaying the peak demand currents for all 3 phases in succession. After this sequence, the VIP automatically returns to displaying the phase currents.

Test/Reset Button

After a trip, pressing this button stops the flashing trip indication.

This button can also be used to:

- Test the built-in battery. When pressing the Test/Reset button, the fault indication LED lights up immediately to indicate that the battery is OK.
- Perform the “lamp test” if the relay is supplied with power. Pressing the Test/Reset button for 5 seconds causes all the display segments and the status LED to light up, and displays the software version number.

Status LED

The status LED provides information about the VIP general status: refer to Indication LEDs on the Front Panel, page 39.

Trip LED: Fault Indication

The fault indication LED flashes to indicate that the VIP has sent a trip order to the circuit breaker. After circuit breaker opening, when the VIP is no longer supplied with power by its sensor, the built-in battery makes the LED flash.

The LED stops flashing:

- Automatically after 24 hours
- When the current returns, on circuit breaker closing (if the current is higher than the pick-up current)
- When the Test/Reset button is pressed
- When the pocket battery module is connected then disconnected

NOTE: The VIP built-in battery only supplies power to the fault indication LED and displays the type of fault. It has no role in operating the protection functions.

Identification Label

The identification label on the front panel is used to identify the VIP:

- Product name
- Product reference
- Serial number

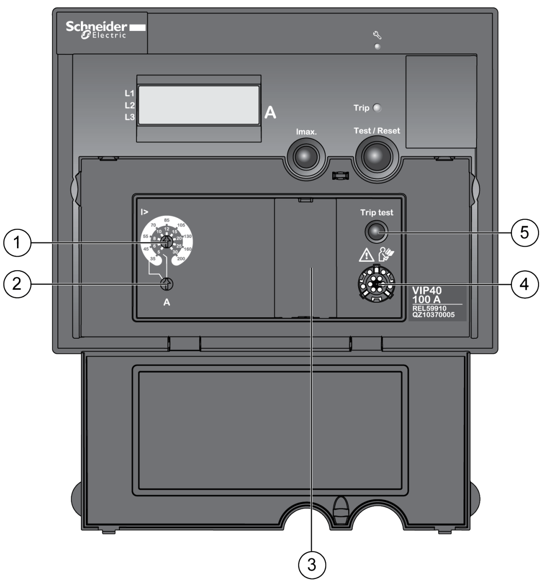
Symbol: Necessary to Read the Manual

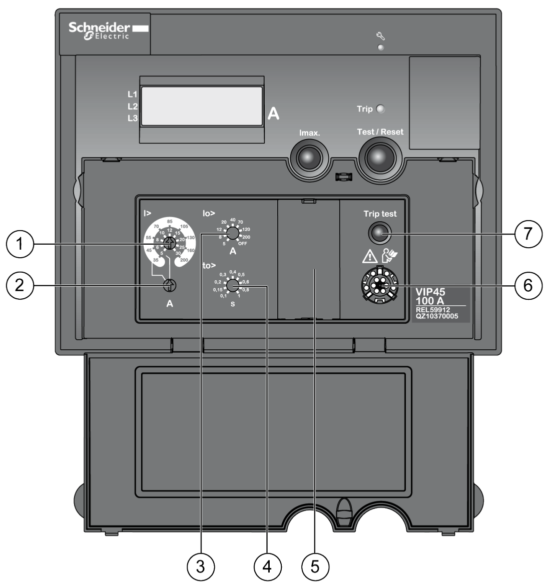
The  symbol indicates that it is necessary to read the VIP user manual before working on the product.

Setting

Front Panel

When the protective flap is opened, you can enter the protection settings by means of the rotary switches. To do this, use a 3 mm (0.12 in) flat blade screwdriver.

<table>
<tr><th>VIP40</th><th>VIP45</th></tr>
<tr><td>

1 Phase overcurrent protection adjustment dial
2 Setting range selector switch
3 Advanced settings protective cover
4 Connection port for the pocket battery module
5 Trip test button</td>
<td>

1 Phase overcurrent protection adjustment dial
2 Setting range selector switch
3 Earth fault protection set point adjustment dial
4 Earth fault protection time delay adjustment dial
5 Advanced settings protective cover
6 Connection port for the pocket battery module
7 Trip test button</td></tr>
</table>

Phase Overcurrent Protection Adjustment Dial

The setting is entered directly in Amps using the 9-position switch. The selector switch has 2 graduated rings, each corresponding to a range of settings. The range is selected using the setting range selector switch.

Setting Range Selector Switch

The setting range selector switch has 2 positions. It selects the active graduated ring.

Earth Fault Protection Adjustment Dial

The set point is set directly in Amps using the 9-position switch.

The time delay setting is entered directly in seconds using the 9-position switch.

NOTE: The earth fault protection adjustment dials are only found on the VIP45.

Temporary Display of the Changed Setting

When VIP is energized, they display temporarily the value of the setting after a switch has changed position.

Connection Port for the Pocket Battery Module

The connector is used to connect the pocket battery module so that the VIP can be energized and tested. For more information, refer to Commissioning, page 44.

NOTE: The pocket battery module should only be used during maintenance or commissioning by qualified personnel and must never be left permanently connected to a running VIP.

Trip Test Button

The Trip test button is used for testing VIP. A 5 mm (0.20 in) diameter pointed tool is needed to activate it. More information is available in the section describing Commissioning, page 44.

Frequency

The network frequency (50 Hz or 60 Hz) is a parameter that must be known for operation of the VIP40 and VIP45 signal processing algorithms. They therefore have an automatic frequency recognition system. The recognized value (50 Hz or 60 Hz) is stored and the VIP works permanently with this value. This stored value will be used each time the VIP starts.

For the VIP to recognize the network frequency and store it, it has to detect a current on phase 1 for a minimum period of 5 seconds in the range 50 Hz ± 2 Hz or 60 Hz ± 2 Hz. This detection happens when the VIP starts.

Advanced Settings

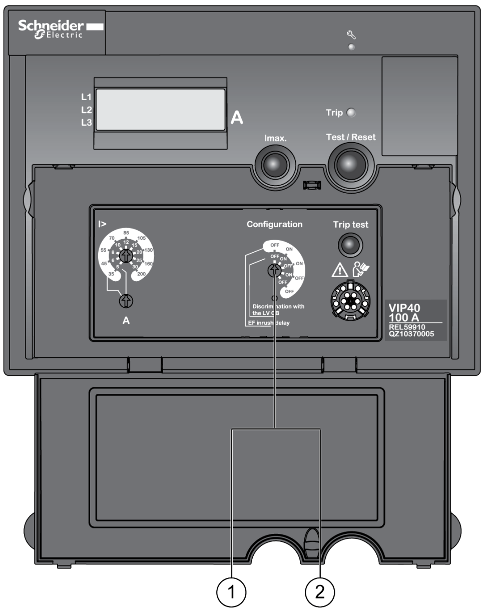
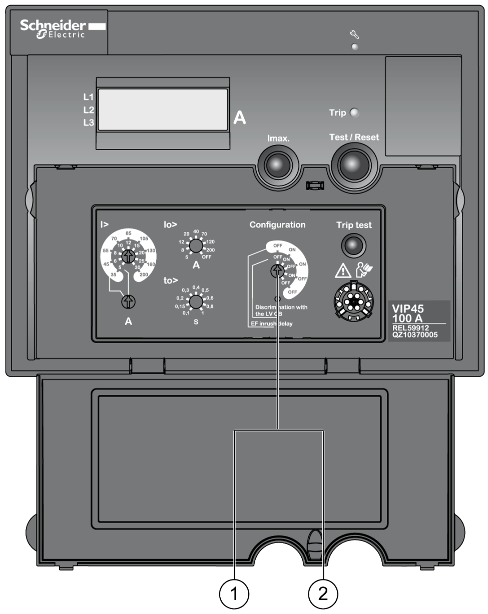
Front Panel

To access the advanced settings, remove the advanced settings protective cover.

Both settings can be entered using a single selector switch:

- Discrimination with the LV CB
- Earth fault protection inrush current delay

NOTE: These settings are entered, if necessary, when the installation is commissioned. By default, they are in the OFF position.

VIP40	VIP45
	
1 Discrimination with the LV CB **2** Earth fault protection inrush current delay	

Discrimination With the LV CB

On the VIP front panel, this function is identified by Discrimination with the LV CB.

This function is used, if necessary, to adapt the VIP phase overcurrent protection tripping curve when the MV/LV transformer secondary is protected by a circuit breaker. The 2 possible settings for this function are as follows:

Setting	Description
ON	An additional time delay is implemented to provide discrimination with the downstream circuit breaker short time set point.
OFF	When the transformer secondary is protected by LV fuses, it is advisable to leave the function OFF.

For more information, refer to Phase Overcurrent Protection, page 28.

Earth Fault Protection Inrush Current Delay

The earth fault protection inrush current delay function is only found on the VIP45. On the front panel, it is identified by EF inrush delay.

Setting	Description
ON	Time delay activated routinely when the VIP45 starts up. This time delay only applies to earth fault protection and does not apply to overcurrent protection.
OFF	No additional time delay.

For more information, refer to Earth Fault Protection, page 33.

List of VIP40 and VIP45 Screens

Phase Current Menu

The screens scroll down one after another. These are the default screens for the VIP40 and VIP45:

No.	Screen	Description
1	189	Displays phase current I1.
2	188	Displays phase current I2.
3	0.0	Displays phase current I3.
4	E r 14	Error code after I3: the detected failure does not involve a risk of nuisance tripping. Refer to Operation of the Self-Test System, page 41.

Peak Demand Values Menu

The screens scroll down one after another:

No.	Screen	Description
1	M1	Displays the data tag for peak demand phase current I1.
2	232	Displays the value of peak demand phase current I1.
3	M2	Displays the data tag for peak demand phase current I2.
4	189	Displays the value of peak demand phase current I2.
5	M3	Displays the data tag for peak demand phase current I3.
6	20.0	Displays the value of peak demand phase current I3.

Expert Menu

Refer to **Expert** Menu, page 52.

Functions and Parameters

Phase Overcurrent Protection (ANSI 50-51)

Description

Phase overcurrent protection is used to detect overcurrents due to overloads or phase-to-phase faults. It uses a special tripping curve, adapted to protection of MV/LV transformers.

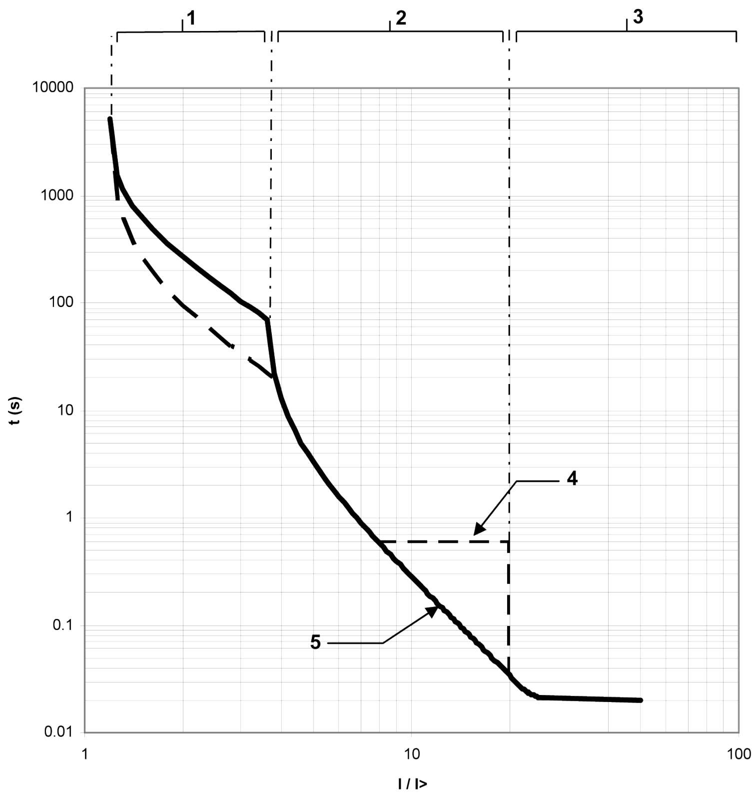
The I> set point is the only setting for this protection function. It should be set to a value higher than or equal to the rated current for the MV/LV transformer to be protected.

From this one setting, the 3 tripping curve zones help protect the transformer against:

- **Overloads**, via thermal overload protection based on measurement of the rms currents from the 3 phase CTs, taking account of harmonic numbers up to 15 at 50 Hz (or up to 13 at 60 Hz).
- **Phase-to-phase faults at the transformer secondary**, via a special IDMT curve with a slope comparable to the MV or LV fuse curves. This special curve simplifies coordination with downstream LV fuses or upstream MV fuses. If the VIP is upstream of an LV circuit breaker, a setting can be activated to modify the curve and simplify coordination of the VIP with the short time set points of the downstream LV trip units.
- **Phase-to-phase faults at the transformer primary**, via an instantaneous DT curve, which helps guarantee a fast tripping time (typically less than 30 ms, depending on the parameter setting).

The phase-to-phase fault tripping curve (at the primary or the secondary) is based on the measurement of the fundamental component of the currents produced by all 3 phase CTs. This type of measurement can be used to reduce the sensitivity of the transformer inrush currents.

Tripping Curve



1 “Overload” pick-up curves

2 “Secondary fault” pick-up curve

3 “Primary fault” pick-up curve

4 CB curve

5 FUSE curve

Setting the I> set point triggers movement of the whole curve. The characteristics of the 3 tripping curve zones are detailed below.

“Overload” Pick-Up Curve (Between 1.2 and 3.5 I>)

The “overload” pick-up curve is based on a thermal model which allows users to calculate the thermal capacity used based on the current measurements. The thermal capacity used is calculated using the formula defined by standard IEC 60255-8. It is proportional to the square of the current taken and depends on the previous thermal capacity used status. Operation is comparable to the long time set points of the downstream LV breaker trip units.

It is expressed using the equation below:

$$E(t) = E(t - \Delta t) + \left(\frac{I(t)}{1.2 \cdot I>} \right)^2 \bullet \frac{\Delta t}{\tau} - E(t - \Delta t) \bullet \frac{\Delta t}{\tau}$$

where:

- E(t): thermal capacity used value at time t
- E(t-Δt): thermal capacity used value at time t-Δt
- I(t): current value measured at time t
- I>: value of the ANSI 50-51 protection setting set point
- τ: heating/cooling time constant, defined at 10 minutes, typical value for MV/LV transformers

The heat transfer of the current I(t) is defined by the term below:

$$\left(\frac{I(t)}{1.2 \cdot I>}\right)^2 \bullet \frac{\Delta t}{T}$$

The device natural cooling is defined by the term below:

$$E(t-\Delta t) \bullet \frac{\Delta t}{T}$$

The protection trips if the thermal capacity used is more than 100 %.

The asymptote of the tripping curve is defined by the I> setting multiplied by a fixed coefficient of 1.2.

Calculating the Tripping Time

For a continuous current higher than the tripping set point, it is possible to calculate the tripping time using the equation below:

$$Td(I) = \tau \bullet \ln\left(\frac{I^2 - Ito^2}{I^2 - (1.2 \cdot I>)^2}\right)$$

where:

- I: overload current (maximum of the 3 phase currents)
- I>: ANSI 50-51 protection setting set point
- τ: heating/cooling time constant (10 min = 600 s)
- Ito: equivalent thermal current before application of the overload
- ln(): natural logarithm function

The equivalent thermal current Ito corresponds to the continuous current which would have resulted in the same thermal capacity used before application of the overload.

The tripping curve shown in the figure above is given for a zero initial thermal current Ito.

This curve, called "cold curve", is defined by the equation below:

$$Td(I) = 600 \bullet \ln\left(\frac{I^2}{I^2 - (1.2 \cdot I>)^2}\right)$$

The dotted-line curve in the overload zone corresponds to the tripping time for an initial thermal capacity used equal to the I> setting set point.

This curve, called "warm curve", is defined by the equation below:

$$Td(I) = 600 \bullet \ln\left(\frac{I^2 - I>^2}{I^2 - (1.2 \cdot I>)^2}\right)$$

Examples of tripping times (rounded up or down to the nearest 0.1 s):

Current	Td (Where Ito = 0)	Td (Where Ito = I>)
1.5 I>	613.0 s	260.3 s
2 I>	267.8 s	95.2 s
2.5 I>	157.1 s	52.5 s
3 I>	104.6 s	33.9 s
3.5 I>	75.0 s	23.9 s

Depending on the initial thermal capacity used caused by changes in the load current, the tripping time in the event of an overload will be in the range of times indicated above.

The current thermal capacity used is not saved in the event of loss of the VIP power supply, or when the phase currents fall below the value of the VIP pick-up current. Each time the VIP wakes up, the equivalent thermal current Ito is reset to zero.

“Secondary Fault” Pick-up Curve (Between 3.5 and 20 I>)

The “secondary fault” pick-up curve is IDMT type, with a tripping time that depends on the current value. It allows the phase-to-phase fault at the MV/LV transformer secondary to be eliminated, while ensuring coordination with the downstream fuses or LV circuit breakers.

This curve, called FUSE, is defined by the special equation below:

$$Td(I) = \frac{6.3}{\left(\frac{I}{3.5 \cdot I >}\right)^3 - 1}$$

where:

- I: measured fault current (maximum of the 3 phase currents)
- I>: 50-51 protection setting set point

The main characteristics of the FUSE curve are:

- An asymptote defined at 3.5 I>
- A “$1/I^3$” slope to obtain a slope comparable with the LV or MV blown fuse curves This similarity simplifies coordination with downstream LV fuses or upstream MV fuses.

This IDMT curve is managed in accordance with the recommendations of standard IEC 60255-151, which defines the standardized IDMT curves (IEC or IEEE curves). In particular, this curve applies the concept of integration if the current amplitude changes during the fault (open-ended fault). This concept can ensure discrimination between the VIP curve and an upstream protection relay that uses standardized IDMT curves.

FUSE/CB Curve Selection:

By default, the VIP uses the FUSE curve over the whole range 3.5 I> to 20 I>. This curve simplifies coordination with downstream LV fuses.

If the VIP is upstream of an LV circuit breaker, it is advisable to activate the CB curve via the setting on the front panel.

The CB curve activates a minimum time delay of 600 ms, which is applied between 8 I> and 20 I> (dotted-line curve in the above figure). This time delay ensures coordination with the short time set point of the downstream LV trip unit. This short time set point is usually set with a DT time delay of 0.2 s to 0.4 s, which could overlap with the FUSE curve and make both protection stages non-discriminating. If necessary, activation of the CB curve can ensure discrimination with the LV circuit breaker.

“Primary Fault” Pick-Up Curve (Above 20 I>)

The “primary fault” pick-up curve is DT type, with an instantaneous tripping time delay for a current higher than 20 I>. It allows a phase-to-phase fault at the MV/LV transformer primary to be eliminated quickly.

If the I> set point is set to a value higher than or equal to the rated current for the protected MV/LV transformer, this high set point, above 20 In, does not see faults at the secondary. This current discrimination ensures coordination with LV protection functions.

The VIP tripping time in this range is less than 20 ms (VIP already supplied with power) for short-circuit currents higher than 40 I>.

Minimum tripping time:

Depending on the device used, a minimum tripping time can be activated to comply with the circuit breaker breaking capacities. In this example, an additional 30 ms time delay is added to the primary fault pick-up curve.

For more information, refer to Minimum Tripping Time, page 38.

Protection Operation

If the maximum of the 3 phase currents exceeds the 1.2 I> set point, the Trip fault indication LED flashes quickly. If the current falls back below the 1.2 I> set point before the time delay expires, the Trip LED goes out.

After expiry of the tripping time delay:

- The Trip LED flashes slowly.
- The Mitop trip unit output is activated.
- The **OC** error message is displayed on the screen.

Pressing the Test/Reset button acknowledges the fault, page 40 and causes the Trip LED to go out.

Settings

Setting		Authorized values
I> set point	VIP40 100 A VIP45 100 A	5 A, 6 A, 7 A, 8 A, 10 A, 12 A, 15 A, 18 A, 21 A, 25 A, 30 A, 35 A, 40 A, 50 A, 60 A, 70 A, 80 A, 100 A
	VIP40 200 A VIP45 200 A	5 A, 6 A, 8 A, 10 A, 12 A, 15 A, 20 A, 25 A, 30 A, 35 A, 45 A, 55 A, 70 A, 85 A, 105 A, 130 A, 160 A, 200 A
Discrimination with LV CB		OFF / ON

Mandatory setting for using the function: I> set point

Typically, the set point is defined at the setting immediately above the rated current for the protected MV/LV transformer.

Example:

For a transformer 1 MVA - 11 kV/0.4 kV where In = 52.5 A:

- With the VIP 100 A, I> is set at 60 A.
- With the VIP 200 A, I> is set at 55 A.

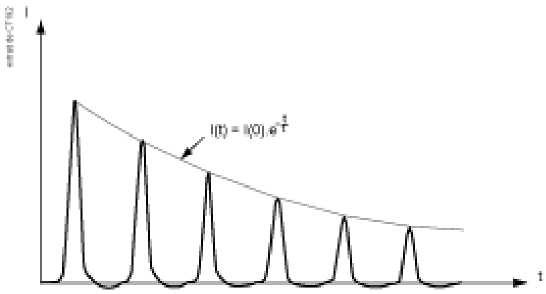
Additional setting: activation of the CB curve

- **OFF** (default setting): if the VIP is upstream of the LV fuses.
- **ON**: if the VIP is upstream of an LV circuit breaker and the discrimination rules between the FUSE curve and the short time set points of the LV protection functions are not adhered to (minimum discrimination interval of 200 ms).

Sensitivity to Transformer Inrush Currents

When a transformer closes, the magnetizing currents can reach amplitudes, in peak values, of around 5 to 15 times the rated transformer current. These transient currents can be the source of nuisance tripping of the ANSI 51 protection functions.

These inrush currents have a strong aperiodic component, as can be seen in the curve below:



If the VIP I> set point is set to a value higher than or equal to the transformer rated current, the VIP protection relay IDMT curve will not be affected by the inrush currents.

In addition, the VIP current measurement used for the secondary fault and primary fault pick-up curves is based on the measurement of the current fundamental component (50 Hz or 60 Hz component). De facto, it is unaffected by the presence of an aperiodic component. Typically, the maximum current measured by the VIP during closing will be 35 % of the inrush current peak value stated by the transformer manufacturer.

This 35 % factor takes account of:

- The 1/√2 factor for switching from the peak value to the rms value
- The 1/2 factor associated with elimination of the DC component

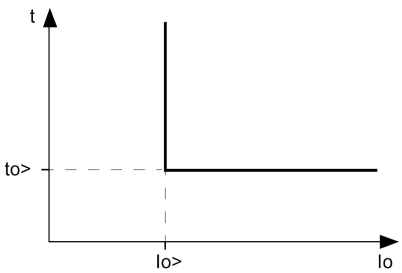
Earth Fault Protection (ANSI 51N)

Description

Earth fault protection is used to detect overcurrents due to phase-to-earth faults. It uses the measurement of the earth fault current fundamental component, calculated based on the sum of the 3 phase CTs.

This protection offers a definite time tripping curve, with setting of the Io> set point and to> time delay.

Example: definite time tripping curve



Additional Functions

The VIP integrates functions that complement earth fault protection:

- Harmonic 2 restraint:

  Since the earth fault current measurement is calculated from the sum of the 3 phase CTs, the aperiodic component of the transformer inrush currents can cause transient saturation of the phase CTs and lead to “incorrect” earth fault current measurement likely to result in nuisance tripping of the earth fault protection. To authorize relatively sensitive settings, without a risk of nuisance tripping when the transformer is energized, operation of the earth protection function is dependent upon a restraint based on detection of the second harmonic component in the phase currents. This harmonic 2 restraint is always active.

- Inrush current delay (inrush current delay):

  In certain cases, the harmonic 2 restraint may not be enough to avoid nuisance tripping of the earth fault protection when the transformer trips. In these scenarios, it is possible to implement a 1-second time delay, activated at the time the VIP wakes up, which is added to the to> earth fault protection time delay. This time delay can avoid tripping of the earth fault inrush current protection. Other application scenarios for this time delay are described in the rest of this section. By default, this inrush current delay is not active.

Protection Operation

If the residual current exceeds the Io> set point, the Trip LED flashes quickly. If the current falls back below the Io> set point before the time delay expires, the Trip LED goes out.

After expiry of the to> tripping time delay:

- The Trip LED flashes slowly.
- The Mitop trip unit output is activated.
- The **EF** error message is displayed on the screen.

Pressing the Test/Reset button acknowledges the fault, page 40 and causes the Trip LED to go out.

Earth Fault Protection Harmonic 2 Restraint Operation

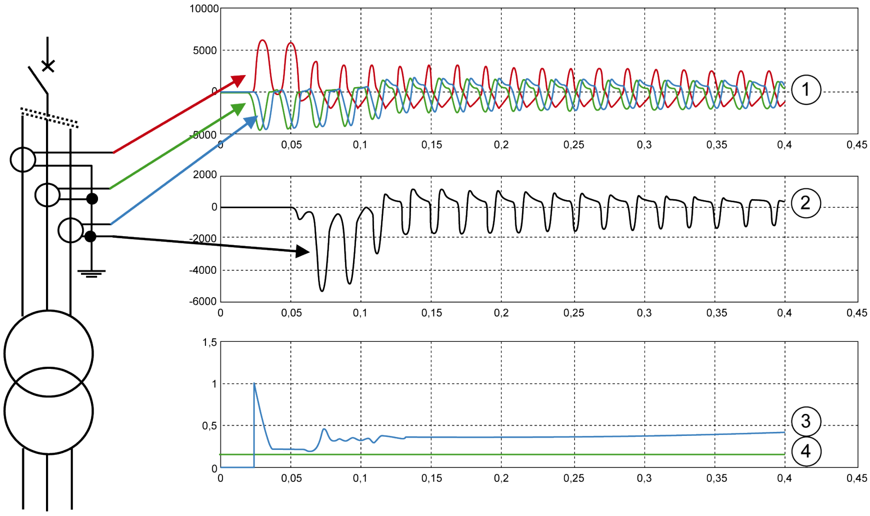
Harmonic 2 restraint is based on the continuous calculation of the harmonic 2 ratio in all 3 phase currents. This ratio is calculated on the basis of the quadratic sums of the fundamental (H1) and harmonic 2 (H2) components.

$$tauxH2 = \sqrt{\frac{I1_{H2}^{2} + I2_{H2}^{2} + I3_{H2}^{2}}{I1_{H1}^{2} + I2_{H1}^{2} + I3_{H1}^{2}}}$$

This ratio is compared to a fixed set point of 17 %. If the set point is exceeded, the Io> set point is inhibited.

An increase in the harmonic 2 ratio in the phase currents is typical of saturation of the phase CTs on a primary current with an aperiodic component. On power transformer energizing, the aperiodic component of the magnetizing currents usually results in saturation of the CTs. Detection of harmonic 2 can be used to inhibit the earth fault protection throughout energization. This restraint automatically disables itself once the H2 ratio decreases.

The graph below illustrates the "incorrect" residual current and the change in the transformer inrush current harmonic 2 ratio:



1 Inrush phase currents 1, 2, 3

2 "Incorrect" residual current

3 Harmonic 2 ratio

4 H2 restraint set point: 17 %

This restraint may not be enough in two relatively unusual scenarios:

- The power transformer magnetizing currents and saturation of the phase CTs do not generate sufficient H2 component levels for the H2 ratio to exceed the restraint pick-up threshold.
- Transformer energizing creates a large load on the secondary, which can significantly reduce the H2/H1 ratio at the time of energization, and help prevent activation of the restraint.

In these scenarios, if transformer energizing results in nuisance tripping of the earth fault protection, it is advisable to increase the earth fault protection set point or activate the inrush current delay, page 35.

In the event of an intermittent phase-to-earth fault (or recurrent fault), the H2 restraint ratio can exceed the 17 % set point and result in unwanted blocking of the earth fault protection. An algorithm patented by Schneider Electric helps prevent this unwanted activation of the restraint on this type of fault. This principle is based on detection of a sufficient H2/H1 ratio in at least 2 phase currents.

Operation of the Inrush Current Delay

If this function is activated from the front panel of the protection relay, it implements a 1-second time delay, activated each time the VIP wakes up. This time delay is added to the earth fault protection to> time delay. On transformer energizing, the phase currents rising above the pick-up current cause the VIP to wake up and activates the 1-second time delay. This time delay allows the "incorrect" residual current associated with the transformer magnetizing currents to pass through. Depending on the transformer power, these magnetizing currents have time constants of around 100 to 500 ms. The 1-second time delay hides the "incorrect" residual current, even for a to> time delay set to its minimum value (0.1 second).

This inrush current delay has no effect on the phase protection.

If the harmonic 2 restraint is sufficient to stabilize the earth fault protection, it is not advisable to implement this time delay because it has the disadvantage of starting each time the VIP wakes up. If the load current falls below the pick-up current (without circuit breaker opening) and the VIP waking up is associated with the appearance of a phase-to-earth fault, this current inrush delay postpones circuit breaker tripping unnecessarily.

Settings

Setting		Values
Io> set point	VIP40 100 A VIP45 100 A	5, 8, 12, 20, 30, 45, 65, 100, OFF
	VIP40 200 A VIP45 200 A	5, 8, 15, 25, 40, 70, 120, 200, OFF
to> time delay	Settings (s)	0.1 – 0.15 – 0.2 – 0.3 – 0.4 – 0.5 – 0.6 – 0.8 – 1(1)
Inrush current delay (): (EF inrush delay)		OFF / ON

NOTE: (1) Impact of the pick-up time:

- In the event of an earth fault, with the load current previously lower than the pick-up current or in the event of closure on a fault, the tripping time is equal to the time delay that has been set plus the VIP45 pick-up time.
- For an earth fault current higher than 10 A, the pick-up time is between 15 ms and 120 ms depending on the fault current, page 66.
- For an earth fault current lower than 10 A, the pick-up time can exceed the time interval that helps guarantee time discrimination with the upstream relay. In this particular scenario, the pick-up time can lead to the VIP45 and the upstream relay tripping twice.

Settings for Using the Function

Compulsory settings:

- Io> set point setting
- to> delay setting

Additional setting:

- Activation of the inrush current delay: OFF by default

Circuit Breaker Trip (Mitop Trip Unit Output)

Description

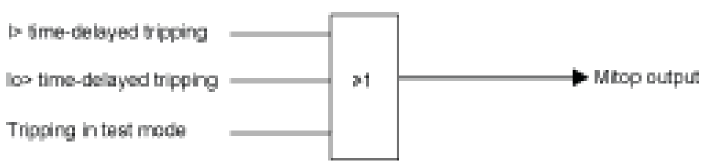
The two protections integrated in the VIP are:

- Phase overcurrent (ANSI 50/51)
- Earth fault protection (ANSI 51N)

The two integrated protection functions and tripping in temporary test mode cause activation of the Mitop trip unit. The Mitop trip unit is integrated in the circuit breaker opening mechanism.

Operation

The Mitop trip unit output activation logic is defined by the following block diagram:



Phase Current Measurement

Description

The phase current measurement is displayed on the default screen. All 3 phase currents are displayed in succession for 2 seconds for each phase. An indicator to the left of the screen indicates the phase corresponding to the measurement displayed.

The phase current measured is the rms value of the current, and takes account of harmonic numbers up to 15 at 50 Hz (or up to 13 at 60 Hz).

The display range is 0 to 999 A.

For a phase current higher than 999 A, the display indicates "---".

Earth Fault Current Measurement

Description

The earth fault current measurement function displays the value of the earth fault current fundamental; this corresponds to the residual current calculated based on the sum of the 3 phase currents. The metering display is in the **Expert** menu, page 52.

The display range is 0 to 299 A.

For a residual current higher than 299 A, the display indicates "---".

Phase Peak Demand Current Values

Description

The phase peak demand current metering function can be accessed by pressing the Imax. button. The screen displays the peak demand for all 3 phases in succession before reverting to measuring the 3 phase currents (default screens).

The peak demand values display the largest demand current value for each phase over a fixed 5-minute integration period. This function makes it possible to find out the current taken during the load peaks.

Peak Demand Values Reset

Step	Action
1	Press and release the Imax. button to start displaying the peak demand values.
2	Press the Imax. and Test/Reset buttons simultaneously while the peak demand values are scrolling to reset all 3 peak demand values.

NOTE:

- When the VIP is first initialized (on leaving the factory), the values of the 3 peak demand values display 0 A. The VIP needs to have run for at least 5 minutes with a current other than zero for the peak demand values to display values other than zero.
- All 3 peak demand values are saved in the event of loss of the VIP power supply (phase currents lower than the pick-up current).

Minimum Tripping Time

Description

The minimum tripping time is to be commissioned or not, according to the type of circuit breaker.

This time is activated to avoid the circuit breaker breaking at the start of asymmetry during a high short-circuit current which could cause tripping too quickly.

These parameter is set in the factory. However, so that checks can be made on site, the **Expert** menu can be used to view the factory-set parameters.

For more information, refer to **Expert** menu, page 52.

Operation

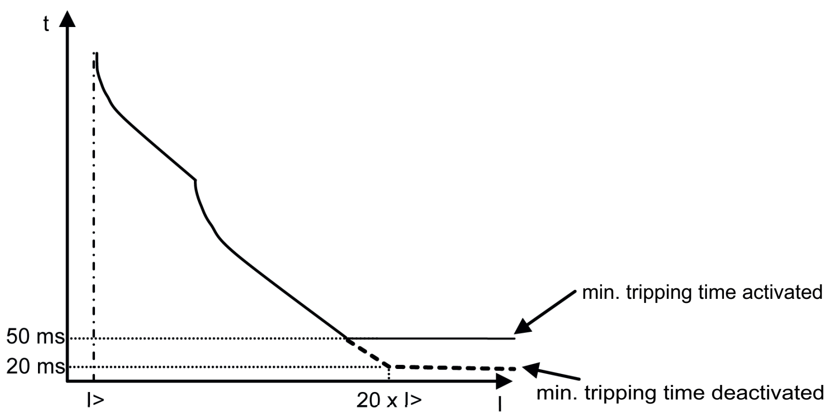
If the minimum tripping time has been activated, a minimum time delay of 30 ms is applied to the instantaneous output of the phase protection function.

This minimum time delay is mainly applied to the phase protection primary fault pick-up curve, for phase currents 20 times higher than the set point.

For tripping times longer than 50 or 70 ms (overload or secondary fault detection zones), this minimum tripping time serves no purpose.

The minimum tripping time has no impact on earth fault protection because the minimum tripping time is 100 ms.

The impact of the minimum tripping time on the phase overcurrent protection curve is illustrated in the figure below:



Mitop Trip Unit Trip Circuit Supervision

Description

The VIP continuously tests the Mitop trip unit control loop to help ensure there are no breaks.

If a break is detected in the circuit, the VIP does not go into the fail-safe position and remains operational:

- The  status LED on the front panel flashes as long as the failure is present.

- The **Er14** message is displayed on the front panel as long as the failure is present.

Indication LEDs on the Front Panel

Status LED

The VIP has one status LED:

Pictogram	Color	Event
	Red	• Permanently on: VIP in the fail-safe position. VIP unavailable. • Flashing: possible failure detected, but does not involve the VIP going into the fail-safe position. VIP operational.

Fault Indication LED

The VIP has a red Trip fault indication LED.

The Trip LED flashes to indicate that the VIP has sent a trip order to the circuit breaker. An error message is always associated with this flashing, page 39.

After circuit breaker opening, when the VIP is no longer supplied with power by its sensor, the built-in battery makes the LED flash.

The LED turns off after a fault acknowledgement action:

- By pressing the Test/Reset button
- Automatically, when primary current is present
- Automatically after 24 hours, to preserve the battery life
- After connecting then disconnecting the pocket battery module

The fault indication LED is as follows:

Pictogram	Slow flashing
Trip	Tripping: • By the phase overcurrent protection • By the earth fault protection (VIP45 only) • By the temporary test mode

Quicker flashing may occur before the protection trips, to indicate the following information:

Pictogram	Quick flashing
Trip	• Overshoot of the instantaneous set point for phase overcurrent protection (pick-up output) • Overshoot of the instantaneous set point for earth fault protection (VIP45 only: pick-up output) • Downcounting of the tripping time delay in temporary test mode

Display of the Last Fault

Each time a fault is detected by the VIP, a screen corresponding to the detected fault is generated and memorized.

Whether the error message is displayed on the screen depends on the VIP power supply status after the fault:

- If the VIP is no longer supplied with power after the fault, the error message is displayed on screen thanks to the internal battery. The message disappears:
  - By pressing the Test/Reset button while the error message is displayed
  - Automatically, when primary current is present
  - Automatically after 24 hours, to preserve the battery life. In this case, the cause of the last trip can be displayed again by connecting the pocket battery module. If the cause of the last trip had not been acknowledged earlier, it is displayed on screen and can be acknowledged using the Test/Reset button.
  - After connecting then disconnecting the pocket battery module
- If the VIP is still supplied with power by the primary current after the fault, the error message can appear temporarily on screen, then disappear because it is automatically acknowledged if the primary current remains higher than the pick-up current after the trip. This example is not an actual operating scenario, but may be encountered during a lab test.

If the battery is missing or depleted, the cause of the last trip is displayed automatically (if it had not been acknowledged earlier) when the pocket battery module is connected.

NOTE: Display of the last fault disappears when the operator presses the Test/Reset button or when primary current is present. However, it is still possible to view the last recorded fault in the **Expert** menu.

Particular Scenarios

Scenario 1: If power is restored to the VIP (primary current or test battery module) during the 24 hours after tripping on a fault that has not been acknowledged, the 24-hour time delay is reactivated (fault message displayed and fault indication LED flashing).

Scenario 2: At the end of the 24-hour time delay, if the fault has not been acknowledged, restoring power to the VIP causes the last fault message to be re-displayed and the LED to flash. The 24-hour time delay is not restarted.

Fault Acknowledgement

Description

Faults are acknowledged:

- Manually, by pressing the Test/Reset button when the error message is displayed
- Automatically when primary current is present

Fault acknowledgement includes:

- Extinction of the fault indication LED
- Disappearance of the error message

NOTE: Acknowledgement of a fault does not change the last fault that can be viewed in the **Expert** menu.

NOTE: If the fault has not been acknowledged by one of the above-mentioned methods and the pocket battery module is connected, the LED and the error message remain active until the pocket battery module is disconnected.

Reliability

General Principle

Taking Account of Protection Relay Failures

Operational reliability is the property that allows its users to have well-placed confidence in the service that the VIP delivers. For a VIP, operational reliability consists of ensuring the safety and availability of the installation.

This means avoiding the following 2 situations:

- Nuisance tripping of the protection:

  Continuity of the electrical power supply is as vital for a manufacturer as it is for an electricity distribution company. Nuisance tripping caused by the protection can result in considerable financial losses. This situation affects the availability of the protection.
- Failure of the protection to trip:

  The consequences of a fault that is not eliminated can be catastrophic. For safety of operation, the protection relay must detect faults in the electrical network as quickly as possible, using discrimination. This situation affects the safety of the installation.

To comply with this approach, the VIP is equipped with self-tests that continuously check all its electronics and embedded software are operating correctly.

The purpose of the self-tests is to put the VIP into a deterministic position, called the fail-safe position, in the event of failure or malfunction of one of its internal components.

The VIP detected failure must never cause the circuit breaker to open. However, in the event of a detected failure, the protection is no longer operational and discrimination no longer occurs. This is not a problem while no other faults exist downstream and the network can be used temporarily as it is.

When a new downstream fault occurs, the circuit breaker upstream trips and a larger part of the network is shut down. To avoid leaving the network permanently in this state, with a detected failure that has not been announced, it is essential to monitor that the VIP is operating correctly.

Fail-Safe Position

In fail-safe position:

- The VIP is no longer operational and the network is no longer protected.
- The  status LED is permanently on, if there is sufficient network current to power the VIP.

Operation of the Self-Test System

Purpose of the Self-Test System

On initialization and cyclically during operation, the VIP runs a series of self-tests. These self-tests detect any hardware or software failure and can avoid random VIP behavior. The main aim is to avoid nuisance tripping or failure to trip in the event of a fault.

A distinction must therefore be made between the two following scenarios:

1	A detected failure involving a risk of nuisance tripping.
2	A detected failure not involving a risk of nuisance tripping or a detected failure involving a risk of no tripping.

Scenario 1: When a failure involving a risk of nuisance tripping is detected, the VIP goes into the fail-safe position:

- The Mitop trip unit control is blocked and the VIP cannot send a trip order to the circuit breaker.
- If the VIP is supplied with power:
  - The status LED on the front panel is permanently on.
  - A 2-digit code is displayed on the front panel: this allows Schneider Electric to make a diagnosis (**E xx** message).

  NOTE: Once the VIP has gone into the fail-safe position, it remains in this mode, even in the event of restarting following loss and return of the power supply.

Scenario 2: When a failure not involving a risk of nuisance tripping is detected, the VIP does not go into the fail-safe position and remains operational (if the VIP is supplied with power):

- The status LED on the front panel flashes as long as the failure is present.

  NOTE: To check that a VIP not supplied with power has not gone into the fail-safe position, use the pocket battery module or the embedded battery to make a routine check, page 54.

List of Self-Tests

The self-tests are described in the table below:

Name	Description	Execution period	Change to Fail-Safe position
Detection of loss of the main regulation	Checks that the main regulation is working correctly	During operation	NO
Detection of a malfunction in the analog input module	Detects disconnection of the 9-pin SUBD connector (item **E**) or a malfunction in the analog/digital conversion	During operation	NO
Detection of incorrect operations	Detection of exception faults by the processor (division by 0, illegal instructions, etc.)	On energization and during operation	YES
Software execution test	Detection of endless processing by the processor, OS processing errors, check of correct execution of periodic activities	On energization and during operation	YES
Reset detection	Detects resets of unknown origin	On energization and during operation	YES
Processor instruction set test	Processing sequence involving math and logic functions whose result is known	During operation	YES
Memory test (SRAM)	Checks programming of the data pointers	During operation	YES
Memory (SRAM) addressing test	Checks the memory bit-by-bit addressing	On VIP restarting after a detected failure	YES
Used memory (SRAM) test	Checks the memory zone used by the program	During operation or on VIP restarting after a detected failure	YES
Software queue test	Checks that the software queue has not overflowed	During operation	YES
Used memory (Flash) test	Checks the memory zone reserved for the VIP program	During operation or on VIP restarting after a detected failure	YES
VIP configuration test	Checks the product configuration data	On energization	YES

Name	Description	Execution period	Change to Fail-Safe position
Memory (EEPROM) test	Checks the product configuration data and the user-programmed data	On energization and during operation	YES
Test of analog/digital conversion is operation	Checks that the various component functions are working correctly (sequencing, power supply, processor, memory, communication, etc.)	On energization and during operation	YES
Detection of failure of the Mitop trip unit control	Checks that the Mitop trip unit electronics are working correctly	During Mitop trip unit control	YES
Address switch test position	Detects invalid address switch positions	On energization and during operation	NO
Mitop trip circuit supervision	For more information, refer to Mitop Trip Unit Trip Circuit Supervision, page 38.	During operation	NO
Key test	Detects stuck keys (key held down for at least 1 minute)	During operation	NO
Test of the maximum number of write operations to EEPROM memory	Detects that the maximum number of write operations to EEPROM memory has been reached and stops saving the type of fault (EF/OC) in the EEPROM memory. This detected failure does not affect operation of the protection functions.	On energization and during operation	NO

Commissioning

Safety Precautions

Before Starting

You are responsible for compliance with all the existing international and national electrical codes concerning protective grounding of any device.

You should also carefully read the safety precautions described below. These instructions must be followed strictly when installing, servicing or repairing electrical equipment.

DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC, BURNS OR EXPLOSION

- This equipment must only be installed and serviced by personnel with electrical network protection qualification.
- Read this entire set of instructions before performing such work.
- Never work alone.
- Wear appropriate personal protective equipment (PPE) and follow safe electric work practices. See NFPA 70E or CSA Z462 standard.
- Before working on or inside it for visual inspections, tests, or maintenance, turn off all power supplies to the equipment and the transformer.
- Respect the LOTO (Lock Out Tag Out) procedure.
- Use a properly rated voltage sensing device (EN 61243) to confirm that all power is off.
- Before carrying out any other actions, check the integrity of protective conductor connection.
- After working on or inside it, carefully inspect the work area for tools and objects that may have been left inside the equipment.

Failure to follow these instructions will result in death or serious injury.

DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Never leave the current sensor secondary in open circuit.
- Never disconnect the VIP current sensor connectors unless the MV circuit breaker is in the open position and completely isolated.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

CAUTION

HAZARD OF INCORRECT OPERATION

- Before performing Dielectric (Hi-Pot) or Megger testing on any equipment in which the relay is installed, disconnect all input and output wires to the VIP.
- Do not open the VIP case.

Failure to follow these instructions can result in injury or equipment damage.

The only permitted operation is the removal of the depleted battery from its compartment on a VIP.

Introduction

At a Glance

When commissioning, user intervention is limited to:

- Entering settings
- Checking the physical integrity of the complete protection chain: sensors, VIP, Mitop trip unit. If necessary, this can be used to make sure that it has not suffered any damage during transport and installation.

Settings

Determining Protection Settings

All the VIP protection settings must be determined beforehand by the design department in charge of the application and approved by the customer.

It is presumed that the study has been carried out with all the attention necessary, or even consolidated by a discrimination study. All the VIP settings must be available for commissioning.

Entering Settings

For more information on entering settings, refer to Settings, page 23.

NOTE: The sensor rating is not set on the VIP40 and VIP45, as these only work with the dual core sensors.

Particular Scenario Concerning Network Frequency

The network frequency (50 Hz or 60 Hz) is a parameter that must be known for operation of the VIP40 and VIP45 signal processing algorithms. They therefore have an automatic frequency recognition system. The recognized value (50 Hz or 60 Hz) is stored and the VIP works permanently with this value. This stored value will be used each time the VIP starts.

For the VIP to recognize the network frequency and store it, it has to detect a current on phase 1 for a minimum period of 5 seconds in the range 50 Hz ± 2 Hz or 60 Hz ± 2 Hz. This detection happens when the VIP starts.

Ex works, the VIP is initialized with a network frequency value of 50 Hz.

Checking VIP Operation

Simplified Check

The pocket battery module contains a battery which can be used to power the VIP to check it is working correctly.

The pocket battery module is used to:

- Check that the VIP processor is working correctly
- Test the circuit breaker trip circuit

To check that the VIP processor is working correctly, proceed as follows:

Step	Action
1	Connect the pocket battery module and move the slide switch to the Test position.
2	Check that the VIP starts and displays the phase currents.
3	Make sure that the status LED 🔧 is off. If so, this means that the VIP self-tests do not detect a malfunction. **Result**: The VIP processor is working correctly.

Checking the MV Circuit Breaker Trip Circuit

When the pocket battery module is connected, the integrity of the circuit breaker trip circuit can be checked by sending an opening order to the circuit breaker via the Mitop trip unit. In order for this trip order to be sent, the VIP must be switched to temporary test mode.

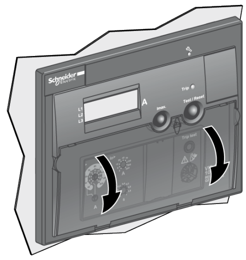
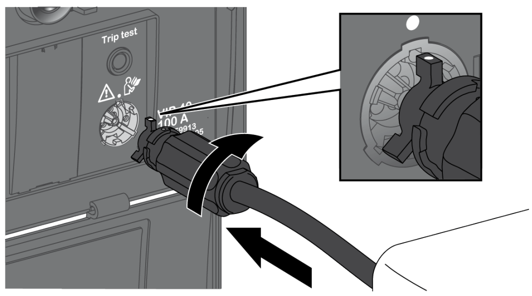
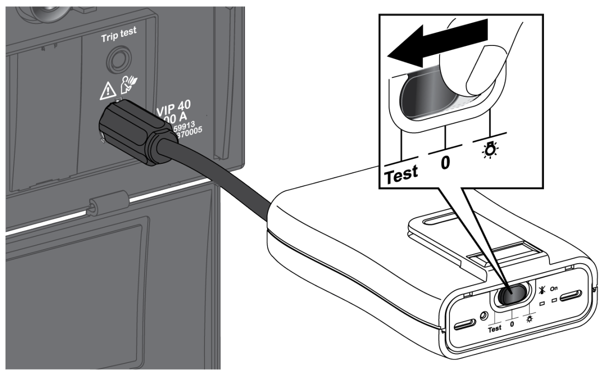
The check helps make sure that:

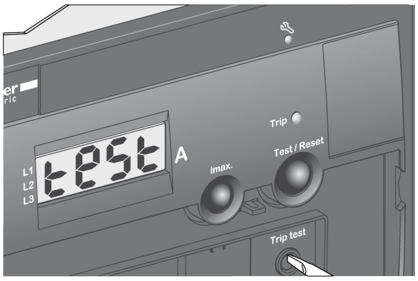
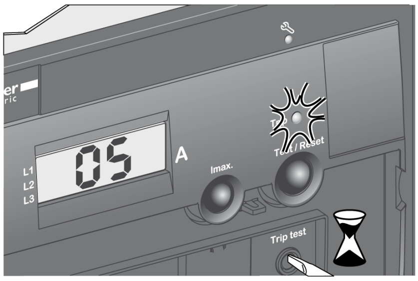
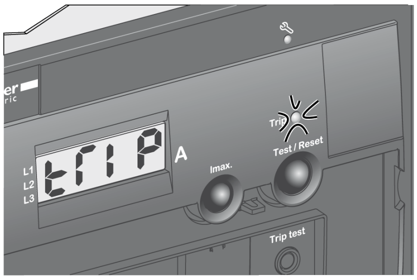
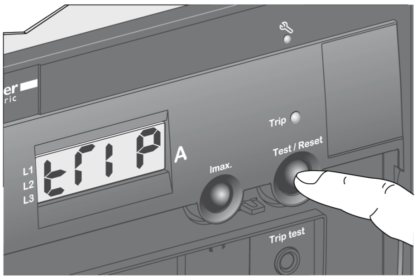
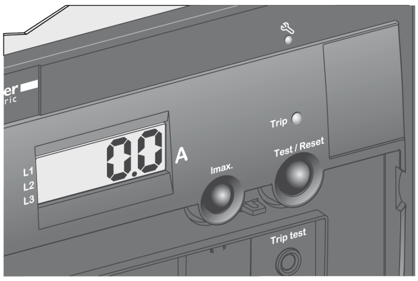
- The VIP processor is working correctly
- The VIP and the Mitop trip unit are connected
- The Mitop trip unit is working correctly

The check cannot ensure that the VIP is connected to the sensor.

For this test, the MV circuit breaker must not be connected to any power source (either upstream or downstream) so that it can be opened and closed safely.

To check the circuit breaker trip circuit, proceed as follows:

Step	Action	Illustration
1	Open the settings transparent protective flap.	
2	Connect the pocket battery module by lining up the white dots on the plug and on the VIP front panel.	
3	Move the pocket battery module slide switch to the Test position. Check that the VIP starts and displays the phase currents. Close the MV circuit breaker.	

Step	Action	Illustration
4	Use a pointed tool to press the Trip test button and release. The VIP displays **TEST** indicating that it has switched to temporary test mode.	
5	Use a pointed tool to press and hold down the Trip test button. **Result:** • The Trip LED flashes quickly to indicate that tripping is about to occur. • 5 seconds are counted down on the display. **NOTE:** The Trip test button must be pressed a second time within 5 seconds of **TEST** being displayed. If not, the VIP exits temporary test mode.	
6	After 5 seconds, the VIP sends an opening order to the circuit breaker and displays **TRIP**. The Trip LED flashes slowly, indicating that the VIP has sent a trip order. **NOTE:** If the Trip test button is released before the 5-second countdown has finished, the VIP does not send the trip order.	
7	Press the Test/Reset button to acknowledge the fault. **Result:** • The **TRIP** message disappears: • The Trip LED goes out.	
8	The VIP redisplays the phase currents.	

The VIP exits temporary test mode:

- Automatically:
  - After sending the opening order
  - After 5 seconds
  - When its power supply via the pocket battery module is removed

- Manually:
  - When the Test/Reset button is pressed
  - After the Trip test button is released during the 5-second countdown before the trip order is sent

Checking the Complete Protection Chain

Principle

The complete protection chain can be checked by a test that injects current into the sensor primary. This test can check complete integrity of the protection chain, without disconnecting the sensors and without changing the VIP settings.

It can be used to check that:

- The sensors are connected correctly
- The VIP is working and is measuring the current correctly
- The Mitop trip unit is connected correctly and trips the circuit breaker

For these tests, the MV circuit breaker must not be connected to any MV power source, so that it can be opened and closed safely.

NOTE: For the primary injection test, it is advisable to control injection stopping by using a circuit breaker auxiliary contact. Otherwise, if the primary injection is not stopped the VIP may continue to send trip pulses to no purpose.

Scenario 1:

If the protection settings are low and the injection device used can deliver sufficient current to activate the protections, the integrity of the VIP and the complete protection chain can be checked directly by primary injection. This test can be performed by single-phase injection, in succession on each of the 3 phases, in order to check that the protections trip.

Scenario 2:

Depending on the protection setting values, it is not always possible to inject sufficient primary current to achieve the level required for tripping. If this is the case, to get round this difficulty, it is possible to activate a protection temporarily with a low set point dedicated to this test, in order to check operation of the sensors and the VIP, until the circuit breaker trips. For this test, it is necessary to switch the VIP to its temporary test mode before activating the protection dedicated to the test.

The rest of this section describes the procedure to be followed for scenario 2.

The characteristics of the test protection are:

- Phase overcurrent protection with definite time delay
- 10 A/5 s
- Accuracy: same accuracy as the I> protection function, page 64

This protection is independent of the VIP phase and earth fault protection functions. Its temporary nature contributes to an automatic return to the current settings.

The VIP exits temporary test mode:

- Automatically:
  - After sending the opening order
  - After 5 seconds
  - When its power supply from the sensors has been removed

- Manually:
  - When the Test/Reset button is pressed
  - After the Trip test button is released during the 5-second countdown before the trip order is sent

Testing and Metering Equipment Required

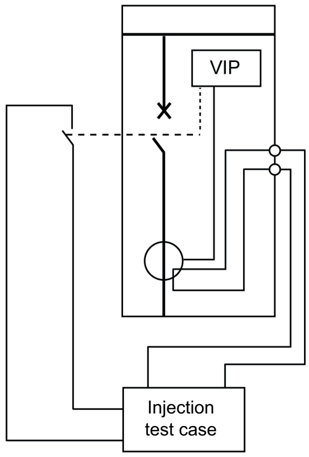
For the primary injection test, use a sinusoidal AC current generator fitted with its connection accessories:

- 50 or 60 Hz frequency (according to the country of use)
- Single-phase or three-phase, adjustable from 0 to 20 A RMS

Primary Injection Circuit Block Diagram (if the Cubicle has one)

In this case, 1 primary injection winding per phase is prewired in the cubicle and connected to a C60 type LV circuit breaker. Refer to the cubicle documentation to identify the terminals.

Step	Action
1	Connect the injection case to the C60 type LV circuit breaker.
2	Turn off injection control using an MV circuit breaker auxiliary contact. **NOTE:** Do not hard-wire the auxiliary contact in series in the injection circuit.



Checking the Sensor Connection

For this test, the MV circuit breaker must not be connected to any power source (either upstream or downstream) so that it can be opened and closed safely.

To perform the sensor connection check, proceed as follows:

Step	Action
1	Check that the pocket battery module is not connected.
2	Inject a primary current on phase 1 using the cubicle primary injection circuit if it has a value of 10 A.
3	Check that the VIP displays the injected current (accuracy = ± 5%) and that the status LED is off.
4	Repeat this operation for phases 2 and 3. **Result:** The sensor connection to the VIP is checked.

Checking the Circuit Breaker Trip Circuit

The rest of the procedure can be used, if necessary, to activate test protection temporarily in order to check the Mitop trip unit is connected and that the circuit breaker trips.

To perform this check, proceed as follows:

Step	Action
1	Close the MV circuit breaker.
2	Inject a 16 A primary current into one of the phases.
3	Switch the VIP to temporary test mode: • Use a pointed tool to press the Trip test button. • The VIP displays **TEST** indicating that it has switched to temporary test mode.
4	Activate test protection to trip the circuit breaker by using a pointed tool to press and hold down the Trip test button: • The Trip LED flashes quickly to indicate that tripping is about to occur. • 5 seconds are counted down on the display. **Result:** After the countdown, the VIP gives a trip order via the Mitop trip unit and the circuit breaker opens. The VIP displays the **TRIP** message. **NOTE:** The Trip testbutton must be pressed a second time within 5 seconds of **TEST** being displayed. If not, the VIP exits temporary test mode.
5	Turn off injection, then disconnect the primary injection equipment.

The VIP exits temporary test mode:

- Automatically:
  - After sending the opening order
  - After 5 seconds
  - When its power supply from the sensors has been removed
- Manually:
  - When the Test/Reset button is pressed
  - After the Trip test button is released during the 5-second countdown before the trip order is sent

Elements Checked During the Tests

Both tests check that:

- The VIP is correctly connected to its metering and power supply sensors.
- The sensor rating (200 A) is as expected.
- The VIP and its sensors are measuring the current value in the network correctly.
- The VIP processor is working correctly.
- The VIP is connected to the Mitop trip unit correctly.

Commissioning

Prerequisites

Operational commissioning of the cubicle must not take place before the following checks have been performed:

- Checking the integrity of protective conductor connection before carrying out any other actions

- Checking the VIP by one of the methods described above, page 45
- Cubicle and circuit breaker tests in line with the recommendations mentioned in their specific documentation

Checks and Settings

In the event of uncertainty or a missing report, check the settings:

- VIP40: values of the I> set point
- VIP45: values of the I>, Io> and to> set points
- Values of the 2 configuration parameters: Discrimination with the LV CB and EF inrush delay
- Correct the setting values if required.

Once this check has been made, you should make no further changes to the parameter and protection settings, which are now deemed to be definitive.

Frequency Value Check

Check that the VIP electrical network has been initialized with the correct rated frequency. To do this, read the frequency value in the **Expert** Menu, page 52.

If it has not, the earth fault protection does not work during automatic recognition of the rated frequency, which takes around 5 seconds, page 45. This frequency initialization is essential for the H2 restraint associated with the earth fault protection to work correctly.

Commissioning

After closing the circuit breaker, check the current value measured by the VIP.

If...	**Then...**
The current circulating in the network is higher than the pick-up current, page 66	• The VIP is activated. • Check that: ◦ The status LED is off ◦ The VIP displays the measurement of all 3 phase currents
The current in the network is lower than the pick-up current	The VIP displays nothing.

Maintenance

Expert Menu

Introduction

The VIP contains an **Expert** menu that allows the user to view additional information useful for commissioning or maintaining devices.

Each item in the **Expert** menu is displayed on 2 screens, displayed alternately.

The items in the **Expert** menu are as follows:

- Io earth fault current value (VIP45 only)
- Cause of the last trip: OC, EF or TRIP
- Network frequency: 50 or 60 Hz
- Phase overcurrent protection set point: I> selector switch position
- Earth fault protection set point: Io> selector switch position (VIP45 only)
- Earth fault protection time delay: to> selector switch position (VIP45 only)
- "Advanced settings" selector switch position
- Activation of the minimum tripping time
- Type of VIP
- Last failure detected by the VIP

Method

Step	Action
1	To display the **Expert** menu, press and hold down the Imax. button for 15 seconds.
2	Items in the **Expert** menu are displayed on 2 screens for each item. It is possible to: • Scroll through all the items automatically by holding down the Imax. button • Stay on a given item by releasing the Imax. button The next item can be viewed after pressing the Imax. button.
3	To exit the **Expert** menu, press the Test/Reset button. **NOTE:** The VIP automatically exits the **Expert** menu after a 1-minute time delay.

List of Screens

Screen	Description
I o 0.0	Earth fault current value (VIP45 only)
t r I OC	Cause of the last trip: • OC (Over Current): phase overcurrent protection. • EF (Earth Fault): earth fault protection. • TRIP: temporary test mode.
F	Network frequency: • 50 Hz

Screen	Description
50	• 60 Hz **NOTE:** The VIP automatically detects the network frequency (50 or 60 Hz), from phase 1. The **Expert** menu screen displays the frequency detected by the VIP and should correspond to the frequency of the protected network.
I r 45	Phase overcurrent protection set point (I> selector switch position)
I o r 40	Earth fault protection set point (Io> selector switch position, VIP45 only)
t o 0.30	Earth fault protection time delay (to> selector switch position, VIP45 only)
COnF OF.OF	Advanced settings selector switch position: • The first two characters (ON/OFF) correspond to the discrimination setting with an LV breaker (Discrimination with the LV CB). • The last two characters (ON/OFF) correspond to the earth fault protection inrush current delay setting (EF inrush delay).
d d.On	Activation of the minimum tripping time: • d.On: minimum time active • d.off: minimum time not active
TYPe 200E	Type of VIP: • 100 P for VIP40 100 A • 200 P for VIP40 200 A • 100 E for VIP45 100 A • 200 E for VIP45 200 A
E r O E	Last failure detected by the VIP, page 42

Preventive Maintenance

Introduction

To obtain maximum availability of the installation, it is essential to make sure that the VIP is operational at all times. The VIP internal self-tests alert the user in the event of a detected failure of the VIP, page 41.

Nonetheless, elements outside the VIP are not subject to these self-tests and it is therefore necessary to carry out regular preventive maintenance..

Apart from the battery, which can be accessed on the rear panel, nothing inside the VIP can be replaced by the user.

List of Interventions

The table below gives the typical frequency of interventions. The intervals between visual inspections depends on the installation operating conditions.

Intervention	Frequency
Routine check	Depending on the operating conditions
LED and display unit test Checking the battery status	Annual
Checking the complete trip chain	Every 5 years

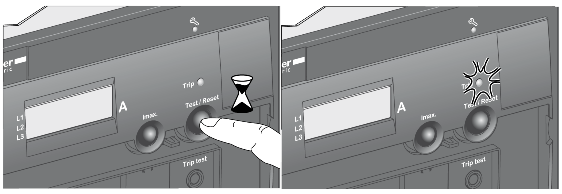
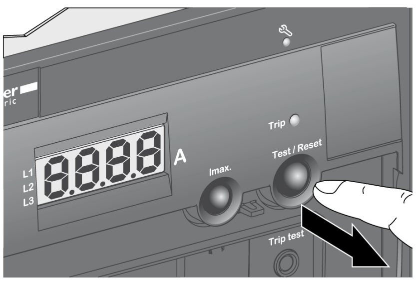
Routine Check

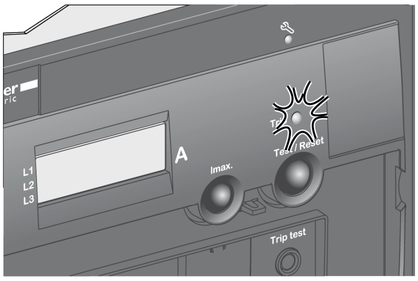
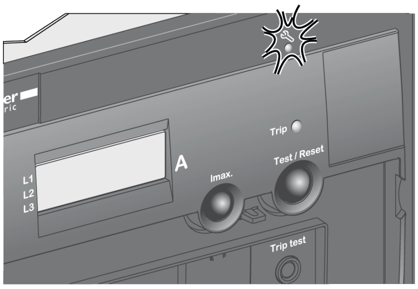
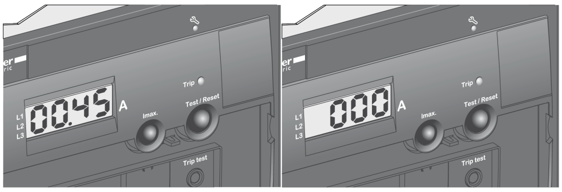
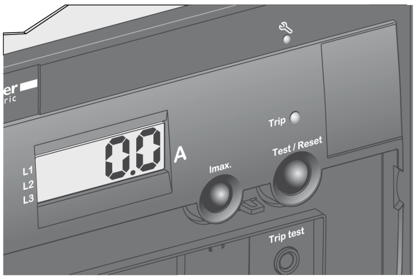
- Check that the status LED is off.
- Make sure that the phase currents and the earth fault current (VIP45 only) measured by the VIP are appropriate for the load being powered.
- If the VIP is not supplied with power (insufficient network load), the VIP must be supplied with power to perform the above checks. To do this, power the VIP with the pocket battery module.
- Then check that the status LED is still off.

LED and Display Unit Test

The LED and display unit test is used to check that the fault indication LED, each segment of the display and the status LED are working correctly. To perform this test, the VIP must be supplied with power.

If the network load is insufficient, power the VIP using the pocket battery module.

Step	Action	Illustration
1	Press and hold down the Test/Reset button. **NOTE:** If the battery is not depleted, the Trip LED lights up in less than 4 seconds.	
2	After 5 seconds, all segments of the display light up. Release the Test/Reset button.	

Step	Action	Illustration
3	The Trip LED lights up.	
4	The  status LED lights up.	
5	The VIP software version is displayed (2 consecutive screens).	
6	The LED and display unit test cycle is then complete and the VIP displays the metering information.	

Checking the Battery Status

The VIP has a battery. To check that the battery is in good working order, press the Test/Reset button until the fault indication LED is activated. This LED should light up in less than 5 seconds and remain on clearly without fading for the whole time the button is pressed. If not, replace the battery, page 62.

Checking the Trip Chain

It is important to check regularly that the complete trip chain (current sensor, VIP, Mitop trip unit) is always operational.

For more information on the operations to be performed, refer to Checking the Complete Protection Chain, page 48.

Pocket Battery Module

At a Glance

The pocket battery module is an accessory that can be connected to the front panel of VIP. Refer to Accessory References, page 8. It contains a battery that can be used to power the VIP in order to:

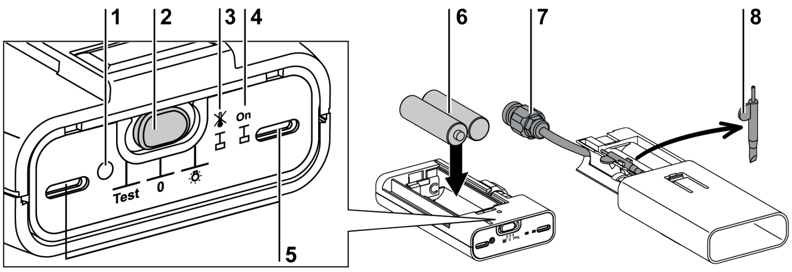
- Enter settings if the integrated battery is missing and if the VIP is not supplied with power
- Test the VIP, page 52
- Display the cause of the last trip by the VIP

  NOTE: This module can also be used for control and maintenance of Schneider Electric's Compact NSX circuit breakers.

  NOTE: Do not leave the pocket battery module permanently connected to a running VIP.

Description

The pocket battery module contains 2 ordinary batteries or rechargeable batteries which can be connected to the VIP test port.



1 Not used

2 3-position slide switch:

Left = test position; Center = OFF; Right = pocket flashlight

3 Not used

4 Green LED for checking the battery status

5 Two illumination LEDs

6 Two 1.5 V type AA batteries (not supplied)

7 Connector for the VIP test port

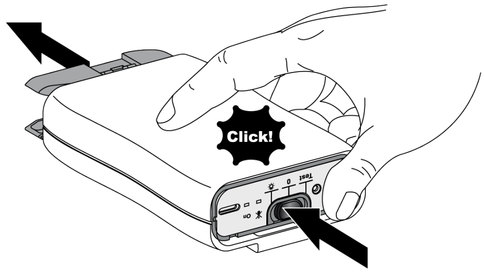
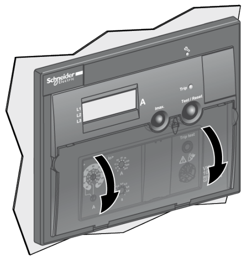
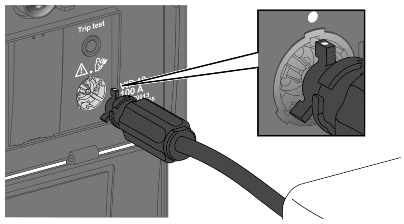
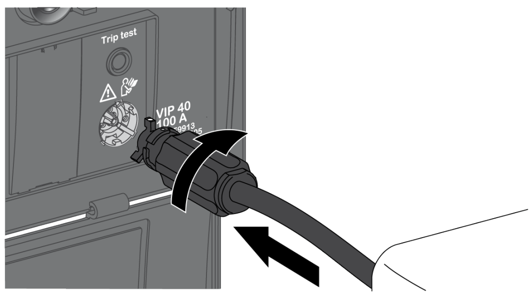
8 Stylus/screwdriver

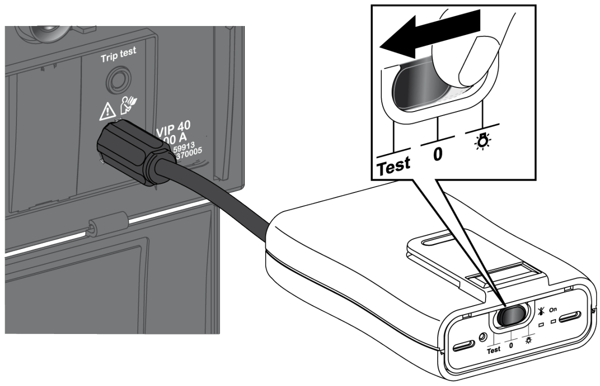
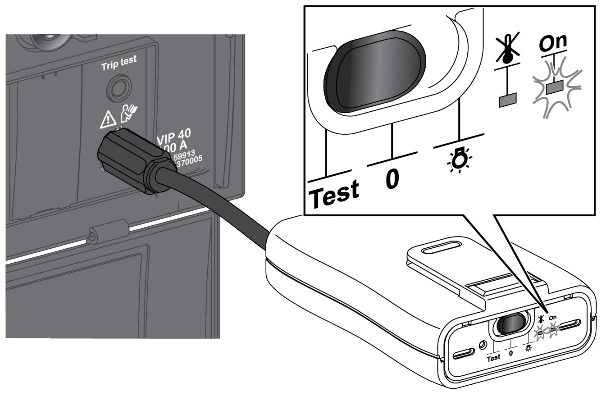
Pocket Flashlight Function

To use the module as a pocket flashlight, move the slide switch to the pocket flashlight position (right).

Connection to the VIP

To prepare the equipment before carrying out maintenance:

Step	Action	Illustration
1	Slide open the protective cover to access the VIP connector.	
2	Open the VIP settings protective flap.	
3	Line up the connector with the VIP test port and align the white mark on the connector with the mark on the VIP (they should be vertical, at the top).	
4	Click the battery module connector into the test port on the VIP.	

Step	Action	Illustration
5	Move the slide switch to the Test position (left).	
6	Check the battery status: the green LED should be on.	

Inspection and Checking

After preparing the equipment, the VIP is powered up. Then perform the desired checking and inspection operations:

Operation	Refer to...
Routine check	Routine Check, page 54
LED and display unit test	LED and Display Unit Test, page 54
Checking the integrity of the trip chain	Checking the Integrity of the Trip Chain, page 55
Readout of the last fault message	Display of the Last Fault, page 39

NOTE: At the end of the checks and inspections, de-energize the VIP by positioning the pocket battery module switch on 0 before disconnecting it from the VIP.

Troubleshooting Assistance

Introduction

The paragraphs below list the actions to be taking after observing abnormal VIP behavior.

LEDs and Display Unit Off

Symptom	Possible causes	Action/Remedy	Refer to...
All the LEDs are off, as well as the display unit.	Insufficient network load to power the VIP	This is normal: the VIP will start instantly if the current reappears.	–
	Power supply connector unplugged	Check that the power supply connector is connected to the VIP correctly.	Commissioning, page 44
	Internal failure detected	Perform the routine check.	Preventive Maintenance, page 53

Status LED Permanently On

Lighting up of the LED indicates that the VIP has gone into the fail-safe position following detection by the embedded self-tests of the failure of one of its components. For m ore information, refer to Operation of the Self-Test System, page 41.

NOTE: This LED may light up briefly when the VIP is energized. This is normal and does not indicate a failure.

The fail-safe position is characterized by:

- status LED permanently on
- Display of a **MAINTENANCE** screen containing a 2-digit code.

In this case, the VIP is no longer operational. Make a note of the code and replace the VIP, page 60.

Status LED Flashing and ERROR Screen

Lighting up of the LED (flashing) and display of an **ERROR** screen after I3 indicate that the VIP has detected a fault via the embedded self-tests not involving a risk of nuisance tripping. In this case, the VIP does not go into the fail-safe position and remains operational. For more information, refer to Operation of the Self-Test System.

This state is characterized by:

- The status LED is flashing
- Cyclic display of an **ERROR** screen containing a 2-digit code.

Fault code	Possible causes	Action/Remedy	Refer to...
Er 19	Maximum number of write operations to EEPROM memory has been reached and type of fault (EF/OC) no longer saved in the EEPROM memory. This fault does not affect operation of the protection functions. This detected failure can be linked to the circuit breaker failing to open, causing the trip order to be sent repeatedly.	Check that the trip chain is working correctly until the MV circuit breaker opens. Change the VIP during the next maintenance operation.	• Checking the MV Circuit Breaker Trip Circuit, page 46 • Removing the VIP, page 60
Er 18	Detection of loss of the main regulation of the VIP's self-powered supply. The VIP then operates with backup regulation.	Change the VIP.	Removing the VIP, page 60
Er 16	Detection of a failure of the metering connector or disconnection of the metering connector or malfunction of the analog/digital conversion.	Check the connection of the current metering inputs to the VIP. If the fault persists, change the VIP.	Removing the VIP, page 60
Er 15	Detection of stuck keys (key held down for at least 1 minute).	Check that none of the keypad keys is stuck. If the fault persists, change the VIP.	Removing the VIP, page 60
Er 14	Detection of a fault in the Mitop trip unit connection circuit.	Check the wired connection between the VIP and the Mitop trip unit. If the fault persists, change the VIP.	Removing the VIP, page 60

No TRIP Indication After Circuit Breaker Opening on a Fault

Symptom	Possible causes	Action/Remedy	Refer to...
MV circuit breaker open and no fault indication LED lit up on the VIP.	The MV circuit breaker has not been opened by the VIP (manual or other type of opening).	None: normal operating scenario.	–
	Battery depleted or battery missing.	Check the battery and replace it if necessary.	Checking the VIP Battery Status, page 62
	More than 24 hours have elapsed since the MV circuit breaker opening order for the VIP.	None: normal operating scenario. If you wish to read the cause of the last trip on the display, start the VIP using the pocket battery module.	Operation with the Pocket Battery Module, page 56

Removing the VIP

Introduction

If the VIP cannot be repaired by following the instructions in Troubleshooting Assistance, page 58, it must be replaced.

Removing the VIP

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Check the integrity of protective conductor connection before carrying out any other actions.
- Wear insulating gloves to avoid any contact with a conductor that has accidentally been energized.
- Open the MV circuit breaker so you can disconnect the VIP protection relay from the sensors.

Failure to follow these instructions will result in death or serious injury.

The procedure for removing the VIP is as follows:

Step	Action
1	If the VIP allows you to, read and make a note of the last trips/events that have occurred. Use the pocket battery module if necessary.
2	Make a note of the symptoms observed, in particular the failure codes displayed.
3	Unscrew and unplug all the connectors.
4	Disconnect the VIP protective earth.
5	Remove the VIP.

Return for Expert Assessment

If returning the VIP for expert assessment, use the original packaging or packaging offering level 2 protection against vibrations and against shocks.

The VIP must be returned accompanied by its settings sheet and the following information:

- Name and address of the initiator
- VIP type and serial number
- Date of the incident
- Description of the incident
- LED status and message displayed at the time of the incident
- List of stored events

End of Life

If the VIP needs to be replaced:

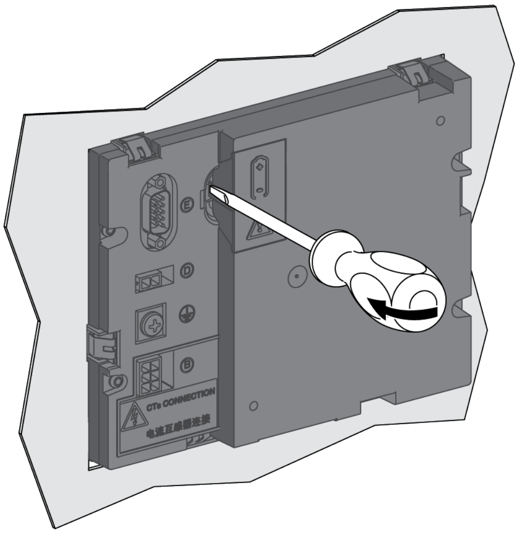
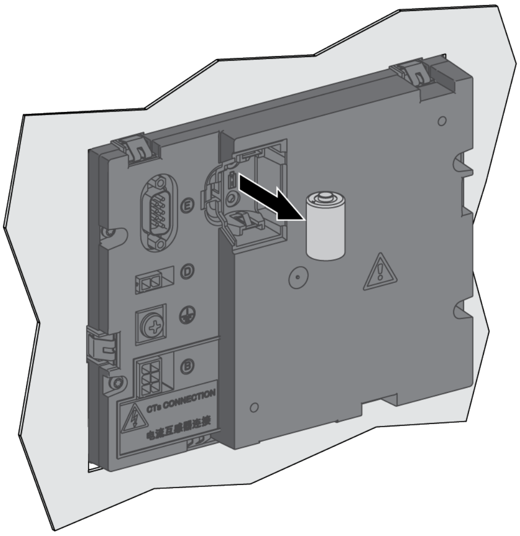
Step	Action
1	Remove the battery, page 62.
2	Remove the VIP as indicated above.
3	Dismantle the VIP in accordance with the End-of-Life Recycling for the VIP document.

Replacing the VIP Battery

Removal Procedure

The battery should be removed when depleted and at the end of life of the VIP. It can be removed when the VIP is supplied with power. In this case, do not disconnect the cables on the rear panel. If the cables have to be disconnected, open the MV circuit breaker first.

It can be removed with the VIP energized.

Step	Action	Illustration
1	Lift the removable cover shielding the battery compartment at the rear of the VIP using a flat blade screwdriver.	
2	Remove the battery.	

Battery Recycling

⚠WARNING

HAZARD OF EXPLOSION

- Do not recharge the battery.
- Do not short circuit the battery.
- Do not crush the battery.
- Do not disassemble the battery.
- Do not heat the battery above 100 °C (212 °F).
- Do not throw the battery into fire or water.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The used battery should be disposed of by an approved certified recycling company in compliance with current regulations.

Battery Characteristics

- 1/2 AA 3.6 V lithium battery
- Model: LS14250 from SAFT
- Storage conditions: as defined in EN 60086-4
- Do not use rechargeable batteries or other types of battery

Replacement Procedure

When depleted, the battery is replaced as follows:

Step	Action
1	Insert a battery with the above characteristics, respecting the polarity (+ facing up).
2	Replace the battery protective cover.
3	Test the battery by pressing the Test/Reset button for 2 to 3 seconds: the Trip LED should remain on clearly without fading for the whole time the button is pressed.

Cleaning Product

To clean the product (especially when dusting), simply use a damp cloth.

Characteristics

Function Characteristics

General Remarks

In the tables below:

- In is the phase CT primary rated current.
- All the accuracy values are stated in the reference conditions (according to IEC 60255-1 standard). Unless stated otherwise, the sensor accuracy is included in the values indicated.

Sensor Rating

Sensor	Characteristic	Values
Phase CT	Primary rated current (In)	• CUa: 200 A • MU-LPCT90-VIP-200: 200 A

Phase Current Measurement

Characteristic	Values
Measuring range	0...999 A
Accuracy	• ± 2% ± 1 digit, 30...200 A • ± 5% ± 1 digit, 5...30 A
Resolution	0.1...1 A depending on the value
Display format	3 digits

Phase Peak Demand Current Values

Characteristic	Values
Measuring range	0...999 A
Accuracy	• ± 2% ± 1 digit, 30...200 A • ± 5% ± 1 digit, 5...30 A
Resolution	0.1...1 A depending on the value
Display format	3 digits

Phase Overcurrent Protection

Characteristic		Values
I> set point	VIP40 100 A VIP45 100 A	5, 6, 7, 8, 10, 12, 15, 18, 21, 25, 30, 35, 40, 50, 60, 70, 80, 100
	VIP40 200 A VIP45 200 A	5, 6, 8, 10, 12, 15, 20, 25, 30, 35, 45, 55, 70, 85, 105, 130, 160, 200
	Accuracy	± 5% or 0.01 In

Characteristic		Values
	Transient overshoot	< 10% (I> 20 Ir - primary fault curve)
Time delay	Setting	None
	Accuracy	± 7.5% or -15 ms/+25 ms according to IEC 60255-151
Characteristic times	Overshoot time	< 40 ms at 2 I>
	Instantaneous operating time	< 30 ms for I> 30 Ir < 20 ms for I> 40 Ir

Earth Fault Protection

Characteristics		Values
Io> set point	VIP45 100 A	5, 8, 12, 20, 30, 45, 65, 100, OFF
	VIP45 200 A	5, 8, 15, 25, 40, 70, 120, 200, OFF
	Accuracy	± 5% or 0.01 In
	Transient overshoot	< 10%
to> time delay	DT settings (s)	0.1 – 0.15 – 0.2 – 0.3 – 0.4 – 0.5 – 0.6 – 0.8 – 1
	Accuracy	± 2% or -15/+ 25 ms
Characteristic times	Overshoot time	< 40 ms at 2 Io>

Precautions During Laboratory Tests

The network frequency (50 Hz or 60 Hz) is a parameter that must be known for operation of the VIP40 and VIP45 signal processing algorithms. They therefore have an automatic frequency recognition system. The recognized value (50 Hz or 60 Hz) is stored and the VIP works permanently with this value. This stored value will be used each time the VIP starts.

For the VIP to recognize the network frequency and store it, it has to detect a current on phase 1 for a minimum period of 5 seconds in the range 50 Hz ± 2 Hz or 60 Hz ± 2 Hz. This detection happens when the VIP starts.

During laboratory tests, two series of tests may need to be run in succession, one at 50 Hz and the other at 60 Hz, or vice versa. In this case, after a change of frequency, it is important to wait until the VIP has recognized the new frequency on starting, before conducting subsequent tests. Otherwise, measurement errors, due to an inappropriate sampling period, could cause the protection functions to malfunction temporarily until the VIP has recognized the correct frequency.

If necessary, the network frequency recognized by the VIP can be checked in the **Expert** Menu, page 52.

Technical Characteristics

General Characteristics

Characteristic	Values
Dimensions	180 x 140 x 31 mm / 7.09 x 5.51 x 1.22 in
Weight	380 g/0.84 lb
Type of battery	½ AA Li 3.6 V SAFT LS14250 /1.10AH
Typical battery life	10 years[1]

Characteristic	Values
Maximum continuous consumption	150 mW
NOTE: (1) In extreme temperature conditions, the battery life may be shorter.	

Current Inputs

The VIP current inputs are designed to operate exclusively with the dual core sensor.

Characteristics	Values
Continuous thermal withstand of phase inputs	1.3 In
Transient thermal withstand of phase inputs	25 kA primary/2 s at ambient temperature
Frequency	50 Hz, 60 Hz

Self-Powered Supply Starting Characteristics

Characteristic		Values
Pick-up time	Earth fault current	Single-phase and three-phase
	10 A	< 120 ms
	12 A	< 80 ms
	16 A	< 30 ms
	240 A	< 20 ms
	1 kA	< 15 ms

The pick-up time is the time the VIP takes to start when not supplied with power. In the event of a fault, this time is added to the time delay that has been set. The pick-up time values are indicated for a fault current equal to 1.2 times the tripping set point.

Characteristics		Values	
Pick-up current	Sensor	Single-phase	Three-phase
	200 A rated sensor	6 A	4 A

NOTE: Around the pick-up current, you may see the display switch on and off. This is quite normal and does not affect operation of the protection functions.

Environmental Characteristics

Electromagnetic Compatibility

Electromagnetic compatibility		Standard	Level/ Class	Values
Emission	Radiated disturbances	CISPR 22	A	–
		CISPR 16	–	
Immunity tests	Radiated radiofrequency fields	IEC 61000-4-3	3	10 V/m; 80 MHz...3 GHz
		IACS - E10	–	10 V/m; 80 MHz...2 GHz
	Electrostatic discharge	IEC 61000-4-2	3	8 kV air; 6 kV contact

Electromagnetic compatibility		Standard	Level/ Class	Values
		IACS - E10	–	
	Magnetic fields at power frequencies	IEC 61000-4-8	4	30 A/m continuous, 300 A/m for 1 to 3 s
	Conducted radiofrequency disturbances	IEC 61000-4-6	3	10 V MC; 0.15...80 MHz
		IACS - E10	–	3 V MC; 0.15...80 MHz
	Electrical fast transients/ burst	IEC 61000-4-4	4	4 kV; 5 kHz, 100 kHz
		IACS - E10	–	2 kV on power supply, 1 kV on I/O - 5 kHz - 5 min
	Slow damped oscillating wave	IEC 61000-4-18	3	2.5 kV MC, 1 kV MD; 100 kHz and 1 MHz
	Fast damped oscillating wave	IEC 61000-4-18	3	2 kV MC, 3 MHz, 10 MHz, 30 MHz
	Surges	IEC 61000-4-5	3	2 kV MC, 1 kV MD
		IACS - E10	–	1 kV MC, 0.5 kV MD

Mechanical Robustness

Mechanical robustness		Standard	Level/ Class	Values
Energized	Vibration response	IEC 60255-21-1	2	1 Gn; 10...150 GHz; 1 cycle
		IEC 60068-2-6	–	3...13.2 Hz, amplitude ±1 mm
		IACS - E10		13.2...100 Hz, acceleration ±0.7 Gn
	Shock response	IEC 60255-21-2	2	10 Gn for 11 ms, 3 impulses
	Seismic response	IEC 60255-21-3	2	2 Gn horizontal, 1 Gn vertical
	Inclination	IEC 60092-504	–	static: 22.5 ° dynamic: 22.5 °
De-energized	Vibration withstand	IEC 60255-21-1	2	2 Gn; 10...150 Hz; 20 cycles
	Shock withstand	IEC 60255-21-2	2	30 Gn for 11 ms; 3 impulses
	Jolt withstand	IEC 60255-21-2	2	20 Gn for 16 ms; 1,000 impulses
Enclosure protection	Tightness	IEC 60529	–	Front panel: IP54 Other parts: IP30
	Shocks on front panel	IEC 62262	IK7	2 J
Packaging	Fall height in product packaging	EN 22248	B	1 m/6 sides/4 angles

Climatic Withstand

Climatic withstand		Standard	Level/ Class	Values
During operation	Exposure to cold	IEC 60068-2-1	Ad	-40 °C (-40 °F); 96 hours(1)
	Exposure to dry heat	IEC 60068-2-2	Bd	+70 °C (+158 °F); 96 hours
	Exposure to damp heat	IEC 60068-2-78	Cab	93% RH; +40 °C (+104 °F); 56 days
	Temperature variation	IEC 60068-2-14	Nb	Operating temperature -40...+70 °C (-40...+158 °F) 96 hours of operation Starting at -40 °C
	Temperature variation in damp heat	IEC 60068-2-30	Db	2x12 hours, +25...+55 °C (+77...+131 °F), 6 cycles, 93-95% RH, with condensation

Climatic withstand		Standard	Level/ Class	Values
Stored without its original packaging	Exposure to cold	IEC 60068-2-1	Ab	-40 °C (-40 °F); 96 hours
	Exposure to dry heat	IEC 60068-2-2	Bb	+70 °C (+158 °F); 96 hours
	Exposure to damp heat	IEC 60068-2-78	Cab	93% RH; +40 °C (+104 °F); 56 days without condensation
	Temperature variation	IEC 60068-2-14	Na	-40...+70 °C (-40...+158 °F) variation +5 ° per minute
	Temperature variation in damp heat	IEC 60068-2-30	Db	2x12 hours, +25...+55 °C (+77...+131 °F), 6 cycles, 93-95% RH, with condensation
Corrosive atmosphere	Salt mist	IEC 60068-2-52	Kb/1	4 cycles Pulverizing for 2 hours with 7 days storage
	2-gas test	IEC 60068-2-60	Ke	Method 1; 0.5 ppm H_2S, 1 ppm SO_2

NOTE: (1) Below -25 °C (-13 °F), the display may be more difficult to read. This does not affect operation of the protection functions.

NOTE: Device can work not ventilated within temperature range.

Safety

Safety	Standard	Values
Power frequency dielectric withstand	IACS - E10	2 kV, 50 Hz or 60 Hz
Voltage impulse	IEC 61010	4 kV, 1.2/50 µs, 0.5 J
Insulation resistance	IACS - E10	> 100 MΩ, 500 Vdc
Fire withstand	IEC 60092-101	5 times 15 s
	IEC 60695-2-12	850 °C (1562 °F)

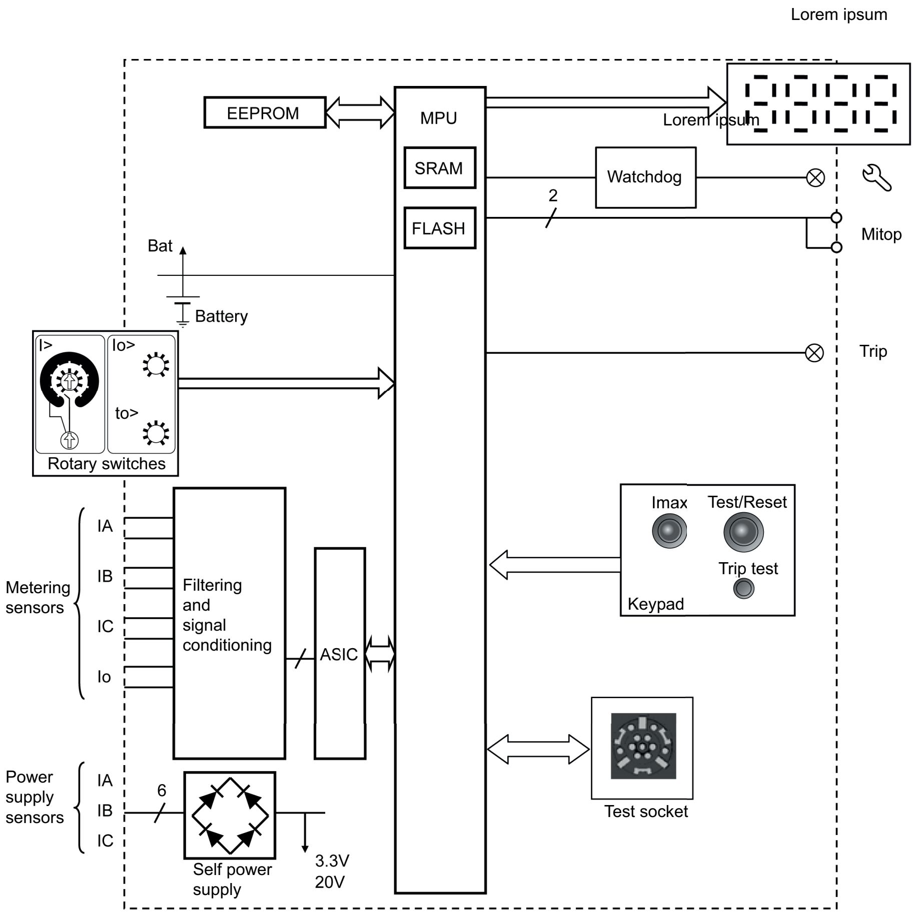
Certification

Characteristic	Standard	Value
CE European Commission's directives	EN IEC 60255-26:2013	Electromagnetic Compatibility (EMC) directive 2014/30/EU
	EN 60255-27:2014 IEC 60255-27:2013	Electrical Equipment (Safety) directive 2014/35/EU
	EN IEC 63000:2018	Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (ROHS) directive 2015/863/EU
UK CA United Kingdom regulations	BS EN 60255–27:2014	The Electrical Equipment (Safety) Regulations SI 2016 No. 1101
	BS EN 60255–26:2013	The Electromagnetic Compatibility Regulations SI 2016 No. 1091
	BS EN IEC 63000:2018	The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (ROHS) regulations SI 2012 No. 3032

Internal Operation

Block Diagram

The VIP is a multifunctional digital protection relay with a self-powered supply.



Electronic Components

The control electronics consist of the following items:

- An ASIC component, responsible mainly for acquisition and analog/digital conversion of the current inputs.
- A microprocessor, responsible for all processing operations:
  - Protection and metering
  - Management of the human machine interface
  - Self-tests
- An SRAM memory that contains all the VIP working data. This data is not saved if the power supply fails.
- A Flash memory containing the processing program.
- A standard EEPROM memory, that mainly contains the user's parameters and settings.

  These values are saved if the power supply fails.

A watchdog function is activated regularly by the microprocessor.

In the event of failure, the  status LED lights up.

Current Inputs

The VIP is designed to be connected exclusively to the dual core sensor, type 200 A. This sensor consists of 2 windings per phase, one winding providing the VIP power supply, the other winding enabling the VIP to measure the phase currents. The earth fault current is measured by taking the sum of the 3 phase currents inside the sensor.

Measurement circuit:

The VIP incoming electronic circuit adapts the signals from the metering sensors for processing by an analog to digital converter (ASIC). Low-pass filtering allows harmonic numbers up to 13 at 60 Hz and 15 at 50 Hz to pass through.

Power supply circuit:

The VIP self-powered supply uses the energy available at the secondary of the current sensor power supply windings.

Self-Powered Supply

This power supply supplies the power required by the VIP to perform its protection functions without having recourse to any other external power source. The power required comes from the specific current sensor integrated in the circuit breaker.

The VIP self-powered supply has redundant regulation contributing to people's safety by restricting the sensor voltage to a safe value.

Display

The segmented display, based on simple, robust technology can withstand several years of operation in a harsh environment: -40... +70 °C (-40...+158 °F).

The display is managed directly by the microprocessor.

Since the VIP is entirely self-powered, it is unable to backlight the display. However, it has sufficient contrast to be viewed with a minimal external light source.

Battery

The battery maintains the tripping indicator status for 24 hours after a a power outage.

The battery life is more than 10 years in normal use. Absence or failure of the battery has no effect on the VIP protection functions.

Safety of Personnel

The user is permanently protected from hazardous voltages on the front panel. This is achieved by:

- Restricting the voltages at the product input to safe values
- Asking the user to connect the product to a protective earth

Schneider Electric
35 rue Joseph Monier
92500 Rueil Malmaison
France

+ 33 (0) 1 41 29 70 00

www.se.com

As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

NRJED311207EN-01