VIP400, VIP410

Electrical Network Protection
Reference Manual

03/2013

NRJED311206EN

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The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information that is contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to observe this information can result in injury or equipment damage.

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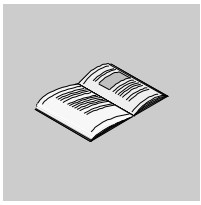
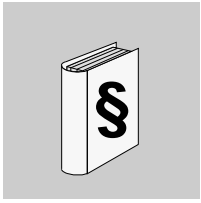


Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, 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 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 an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

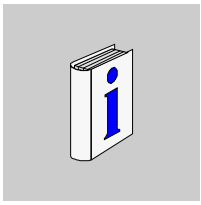
NOTICE is used to address practices not related to physical injury.

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



At a Glance

Document Scope

This manual is intended for personnel responsible for installing, commissioning and using VIP protection relays.

Validity Note

This manual is applicable to all versions of the VIP protection relay.

The table below lists the VIP software version upgrades.

Software Version	Date	Revision
V1.0.0	March 2011	First version of VIP
V1.1.0	October 2011	First commercialization version
V1.2.2	March 2012	Second commercialization version (VIP400)
V2.0.3	March 2013	Joint commercialization version for VIP400 and VIP410

User Comments

We welcome your comments about this document. You can reach us by e-mail at techcomm@schneider-electric.com.

At a Glance

1

What Is in This Chapter?

This chapter contains the following topics:

Introduction

VIP400s and VIP410s

VIP400 and VIP410 protection relays are designed for the protection and operation of MV/LV utility substations and electrical distribution networks in industrial installations.

They are suitable for typical protection applications that require current metering, phase overcurrent and earth fault protection, and thermal overload protection.

The VIP400 is a relay with a self-powered supply. It is powered by its current sensors and operates without an auxiliary power supply.

The VIP410 is a relay with a dual power supply. It is powered both by its current sensors, just like the VIP400, and also by an auxiliary power supply. The protection functions work autonomously, like those on the VIP400.

With the VIP410, the auxiliary power supply is needed for the communication, the output relays and the very sensitive earth fault protection to work. The VIP410 protection functions work even if the auxiliary power supply fails.

Main Advantages of VIP400s and VIP410s

VIPs are part of a complete protection chain:

- This protection chain cannot be separated and includes the dedicated current sensors, the VIP protection relay and the Mitop trip unit.
- The use of dedicated current sensors means the complete protection chain performance can be guaranteed. No sizing study is necessary when choosing the sensors. The phase current sensors dedicated to VIP operation are dual core type, which provide the power supply and the metering signal separately.

VIPs are easy to install:

- They are compact.
- They are held in place by catches which are locked and unlocked from the front.
- The connection terminals are clearly identified.
- The sensor and Mitop trip unit connections are prefabricated.

VIPs are quick to commission:

- They come with default parameters.
- Their settings are entered on the front panel by means of the display and well-designed keypad.
- They can be commissioned without using a PC.

VIPs make it easy to operate substations:

- The VIP customization options allow them to be adapted to specific operating constraints.
- The display unit can display screens in several languages.
- They indicate tripping explicitly and spontaneously.

VIP are 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)

VIP400 Applications

VIP400s are suitable for substations without an auxiliary power supply. They can be used for the following applications:
- protection of incomers and feeders
- protection of MV/LV transformers

They offer the following functions:
- phase overcurrent protection
- earth fault protection
- thermal overload protection
- current metering display

VIP410 Applications

VIP410s are suitable for substations whose auxiliary power supply is not backed up. They can be used for the following applications:
- protection of incomers and feeders
- protection of MV/LV transformers

They offer the same functions as the VIP400. These functions work even if the auxiliary power supply fails.

In addition, VIP410s have the following functions that run off the auxiliary power supply:
- Communication.
- Very sensitive earth fault protection. This protection function can work autonomously, but it needs the auxiliary power supply to work if the current in the network is too low.
- Tripping by an external volt-free contact (Buchholz relay or other external protection device).

Function Table

The function table lists the functions performed by the VIP400 and VIP410.

Function	VIP400	VIP410
Phase overcurrent protection: 3 set points (ANSI 50-51)	•	•
Earth fault protection based on the sum of the currents: 2 set points (ANSI 50N-51N)	•	•
Very sensitive earth fault protection with core balance CT: 2 set points (ANSI 50N-51N) (2)		•
Thermal overload protection (ANSI 49RMS)	•	•
Phase overcurrent cold load pick-up (CLPU I)		•
Earth fault cold load pick-up (CLPU Io)		•
Tripping by an external volt-free contact (Buchholz or other external protection device) (2)		•
Tripping by Mitop trip unit	•	•
Mitop trip circuit supervision	•	•
Tripping annunciation via LEDs	•	•
3 annunciation relays (1)		•
Setting groups A and B		•
Communication using Modbus protocol (1)		•
Circuit breaker remote control via the communication (1)		•
Customization of annunciation relays		•••
Watchdog (1)		•••
Customized operation of the Mitop trip unit	•••	•••
Phase and earth fault current metering	•	•
Phase peak demand current values	•	•
Load current history	•	•
Display of the last fault	•	•
Time-tagged record of the last 5 events	•	•
Counting the number of trips on a fault	•	•
Breaking current history	•	•

• function available in standard mode
••• function available in custom mode
1 needs the auxiliary power supply to work
2 needs the auxiliary power supply to work, and can also work autonomously if the load current is adequate

VIP References

Reference	Designation	Auxiliary Power Supply
REL59915	VIP400	
REL59916	VIP410 A	24...125 V DC, 100...120 V AC
REL59917	VIP410 E	110...250 V DC, 100...240 V AC

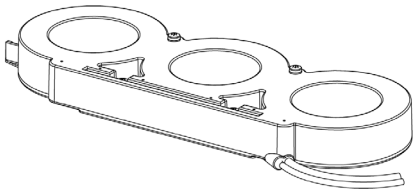
Accessory References

Reference	Designation
LV434206	Pocket battery module

Phase Current Sensors

VIPs operate exclusively with dual core CUa (200 A primary) and CUb (630 A primary) current sensors.

These sensors provide:
- the VIP power supply
- metering of all 3 phase currents and the earth fault current

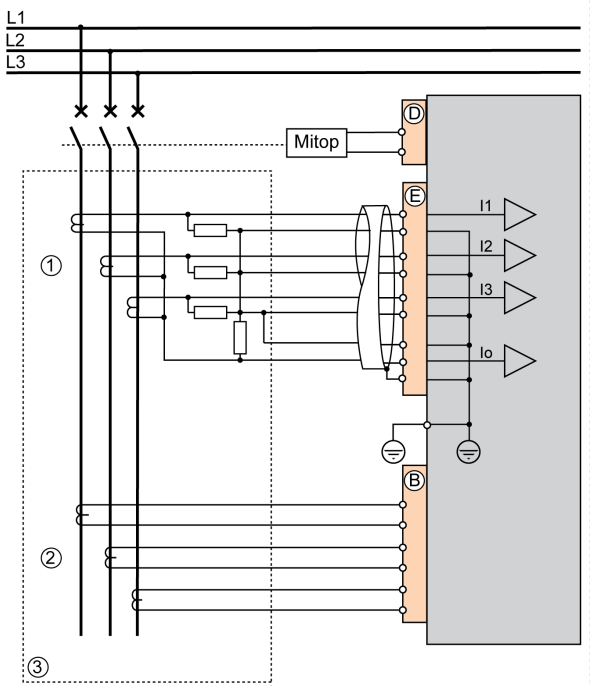


The use of dedicated sensors means the complete protection chain performance (sensor, VIP, Mitop trip unit) can be guaranteed.

It is very easy to connect VIP relays to the CUa or CUb sensors by means of 2 prewired connectors from the sensors:
- 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 CUa and CUb current sensors consist 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.

Current Sensor Connection Block Diagram



1 Metering windings
2 VIP power supply windings
3 dual core CUa or CUb sensor

Earth Fault Protection

The VIP400 and VIP410 provide protection against earth faults by measuring the sum of the 3 phase currents. This method does not need an additional earth CT. The summed earth fault current measurement is provided directly by the CUa and CUb sensors.

The VIP410 can also provide earth fault protection from a core balance CT. This protection offers better sensitivity than protection calculated by measuring the sum of the currents. The method to be used should be chosen in the protection menu during commissioning. By default, the VIP410 is configured for operation based on the sum of the phase currents.

The sensors to be used and the set point setting range depend on the required sensitivity:

Sensitivity	Measurement Method	Setting Range
Standard	Sum of the phase currents	0.025...10 In
Very sensitive	CSH120, CSH200 or GO110 specific core balance CT, or CSHU CT with ratio 470/1	0.2...240 A primary

Resources

The table below lists the VIP400 and VIP410 resources.

Inputs/Outputs	VIP400	VIP410
Phase current inputs	3 for the power supply 3 for measurement	3 for the power supply 3 for measurement
Earth fault current inputs using sum of the 3 CTs	1	1
Earth fault current inputs using core balance CT	0	1
Mitop trip unit control output	1	1
Output relays	0	3
Tripping by external volt-free contact inputs	0	1
Communication port	0	1

Operating Modes

There are 2 possible operating modes:

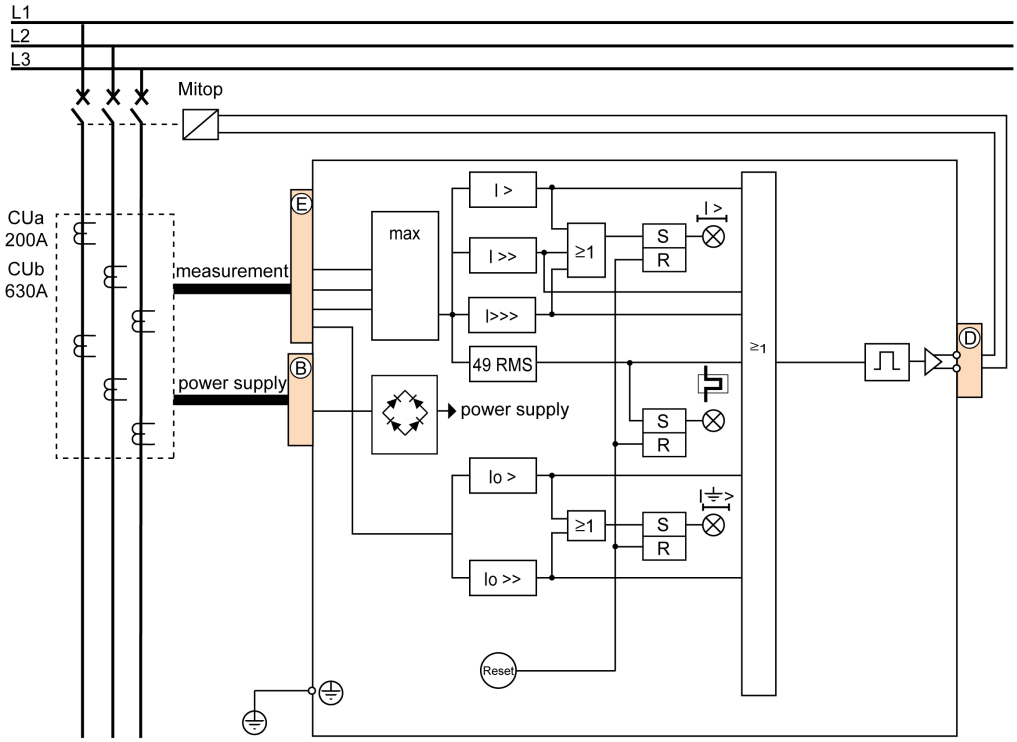
- The *standard* operating mode corresponds to default operation of the Mitop trip unit control and the VIP410 annunciation relays. More information is available in the Functions and Parameters section *(see page 63)*.
  VIP relays are delivered from the factory in this mode.
- *Custom* operating mode can be used, if necessary, to modify operation of the Mitop trip unit control and the VIP410 annunciation relays. More information is available in the Custom Operating Mode section *(see page 131)*.

Circuit Breaker Control via Mitop Trip Unit

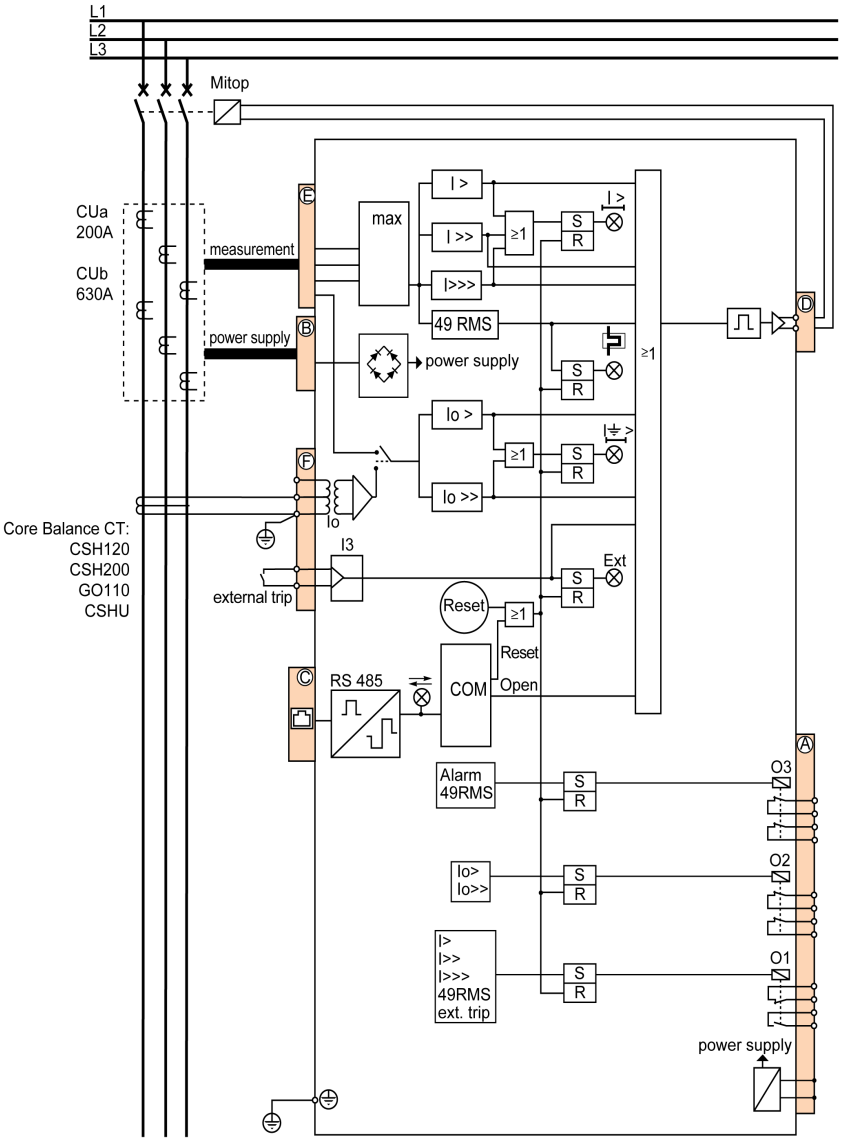
VIPs are compatible with eco 540-turn Mitop trip units.

Standard Operation

Mimic Diagram of VIP400 Operation



Mimic Diagram of VIP410 Operation



Installation

2

What Is in This Chapter?

This chapter contains the following topics:

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

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it.
- Always use a properly rated voltage sensing device (EN 61243) to confirm that all power is off.
- Before performing visual inspections, tests, or maintenance on this equipment:
  - Turn off all sources of electric power.
  - Assume that all circuits are live until they have been completely de-energized, tested and tagged.
  - Pay particular attention to the design of the power system: consider all sources of power, including the possibility of backfeeding to the cubicle where the VIP is installed.
- Beware of potential hazards, wear personal protective equipment, and carefully inspect the work area for tools and objects that may have been left inside the equipment.
- Successful VIP operation depends upon proper installation, setting, and operation.
- Setting the VIP relay requires relevant expertise in the field of electrical network protection. Only competent people who have this expertise are allowed to set this product.

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. The high voltage that would result from opening the circuit is dangerous for the operator and for the equipment.
- Never disconnect the VIP protection relay 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.
- Screw tight all terminals, even those not in use.

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

⚠ CAUTION

RISK OF DAMAGE TO THE VIP

- 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 relay. High voltage testing may damage electronic components contained in the VIP relay.
- Do not open the VIP case. The VIP relay contains components that are susceptible to electrostatic discharge. It is assembled in specially equipped premises. The only permitted operation is removal of the depleted battery from its compartment on a VIP relay.

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

Precautions

Introduction

VIP protection relays are supplied in one of the following ways:
- Individually packaged
- Installed in a cubicle

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

VIP in its Original Packaging

- **Transport**
  VIP relays can be shipped to any destination by all suitable means of transport, without taking any additional precautions.
- **Storage**
  VIP relays 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 relays are 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 relay has been unpacked, it should be energized as soon as possible.

More information on handling and storage is available in the VIP Technical Characteristics *(see page 216)*.

VIP Installed in a Cubicle

- **Transport**
  VIP relays 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's condition by visual inspection and energizing.
- **Storage**
  We recommend keeping the cubicle protective packaging for as long as possible.
  VIP relays, 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 *(see page 216)*.

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 relays 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 relay is shipped in packaging which protects 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.

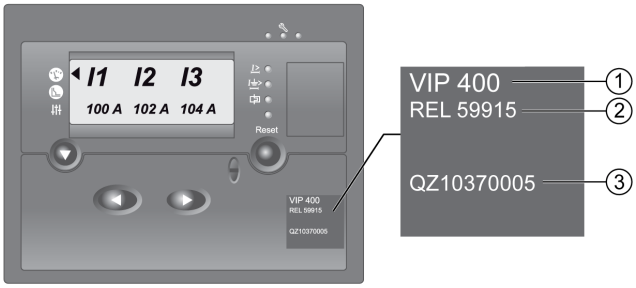
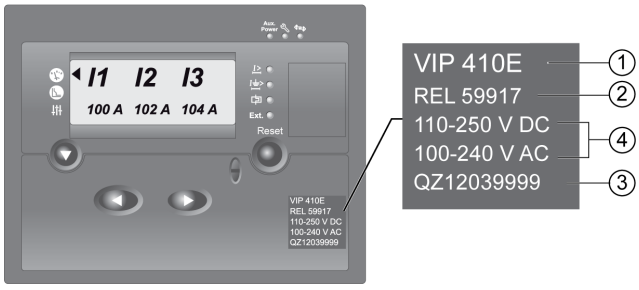
Package Contents

The box contains the following items:

- a VIP
- a certificate of conformity
- a bag containing the connectors (VIP410)

Identification Label

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

VIP400	VIP410
	

1 Product name
2 Product reference
3 Serial number
4 Power supply voltage (VIP410)

Check After Unpacking

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

For the VIP410, check in particular that the power supply voltage is the correct one for your installation.

Mounting/Assembly

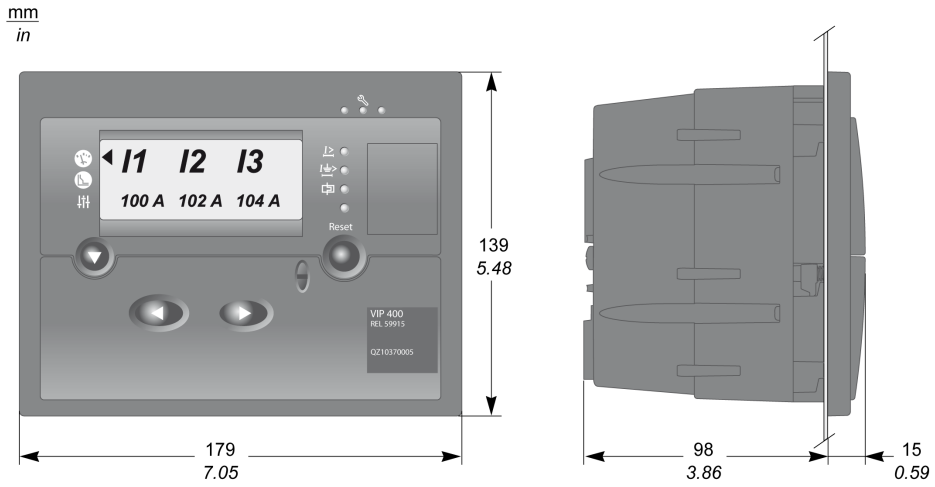
Introduction

The VIP400 weighs 740 g (1.6 lb). The VIP410 weighs 1 kg (2.2 lb). VIPs are flush-mounted in a mounting plate 1.5 to 4 mm (0.06 to 0.16 in.).

They are designed to be mounted indoors.

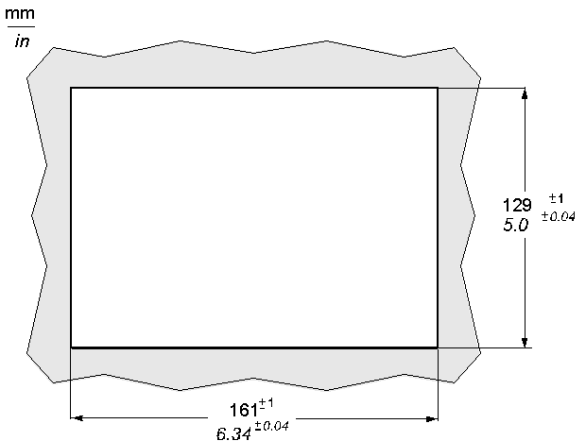
To ensure an IP54 waterproof seal, the surface onto which it is fitted must be smooth and solid.

Dimensions



Cut-Out

Cut out the mounting plate as indicated:



⚠ CAUTION

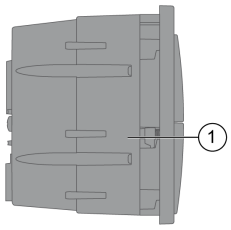
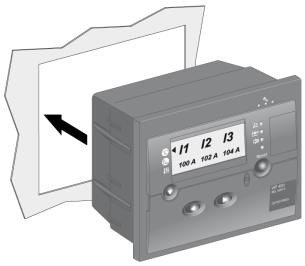
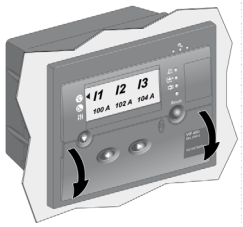
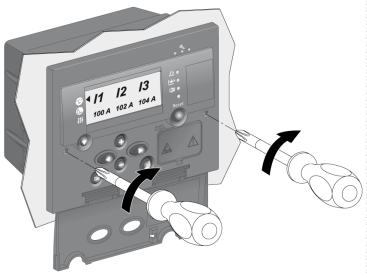
HAZARD OF CUTS

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 relay is held in place by 2 catches on the sides, behind the front panel:

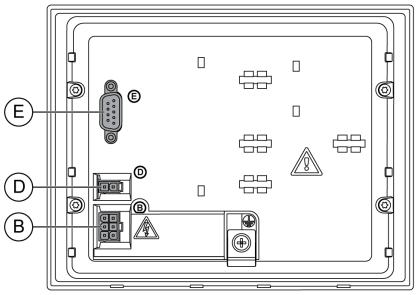
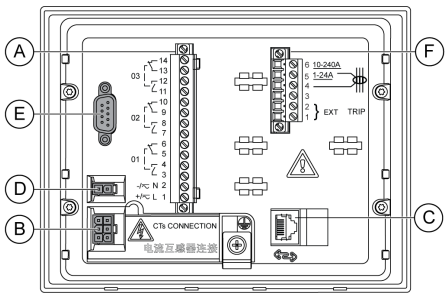
Step	Action	Illustration
1	Mark the catches (1).	
2	Insert the VIP unit through the cut-out.	
3	Open the settings protective flap.	
4	Tighten the screws as indicated using a no. 1 Pozidriv® screwdriver (maximum tightening torque: 2 N•m/17.7 lb-in.).	
5	Check the position of the catches at the rear.	–
6	Close the settings protective flap.	–

Connectors

Introduction

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

Identification of the Connectors on the Rear Panel

VIP400	VIP410
	

A Connector for the auxiliary power supply and output relays O1 to O3 (VIP410)

B Connector for the self-powered supply

C 2-wire RS 485 communication port (VIP410)

D Connector for the Mitop trip unit

E Connector for the phase and earth fault current inputs

F Connector for the sensitive earth fault current and external trip inputs (VIP410)

⏚ Protective earth

Connecting the VIP to the Current Sensors

Introduction

The VIP protection relay is connected to the dual core CUa (200 A) or CUb (630 A) 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

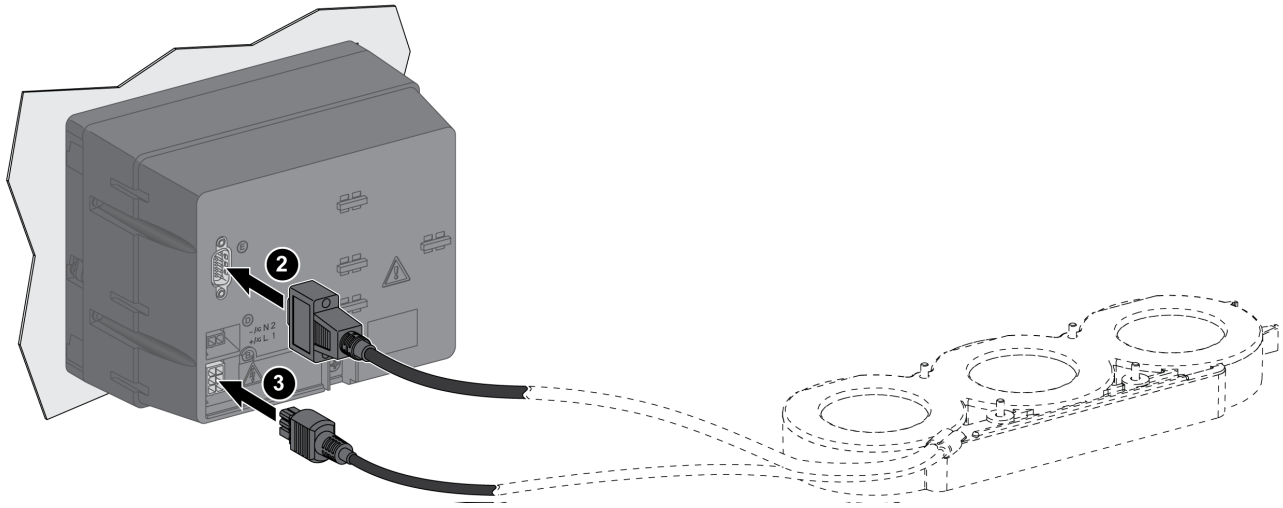
HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- 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 protection relay 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.



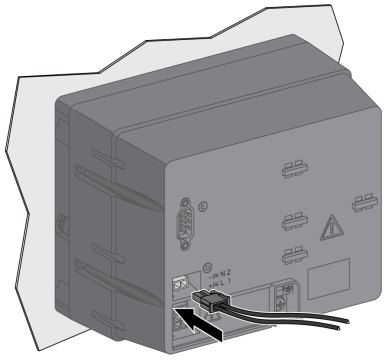
Connecting the VIP to the Mitop Trip Unit

Introduction

The VIP protection relay 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

Ref.	Wiring	Type of Terminal	Screwdriver	Tightening Torque
⏚	• Green-yellow wire 6 mm² (AWG 10) • Lug with internal diameter 4 mm (0.16 in.) maximum • Length < 0.5 m (20 in.)	M4 screw	Pozidriv no. 2	1.2...1.5 N•m (10.6...13 lb-in.)

⚠ WARNING

HAZARD OF ELECTRIC SHOCK

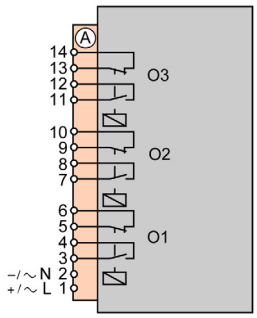
Connect the VIP to earth.

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

Connecting the Auxiliary Power Supply and Outputs O1 to O3 (VIP410)

Connection Characteristics

Ref.	Diagram	Wiring	Type of Terminal	Screwdriver	Tightening Torque

A		• Wiring without fittings:
		  • 1 wire: 0.2..2.5 mm^2 (AWG 24...12)
		  • 2 wires: 0.2...1 mm^2 (AWG 24...18)
		  • stripped length: 8...10 mm (0.31...0.39 in.)
		• Wiring with fittings:
		  • 1 wire 1.5 mm^2 (AWG 16) with DZ5CE015D fitting
		  • 1 wire 2.5 mm^2 (AWG 12) with DZ5CE025D fitting
		  • 2 wires 1 mm^2 (AWG 18) with DZ5CE010D fitting
		  • stripped length: 8 mm (0.31 in.)
			M2.5 screw	2.5 mm flat blade (0.09 in.)	0.4...0.5 N•m (3.5...4.4 lb-in.)

⚠ WARNING

FIRE HAZARD

Ensure the product phase (L) and neutral (N) are correctly connected to the installation.

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

If the phase (L) and neutral (N) connections are swapped over, there is a risk of fire in the event of internal product failure.

NOTE: Connector A supplied with the VIP410 can be replaced by the ring lug connector indicated in the table below. This connector is not supplied and should be ordered separately.

Ref.	Wiring	Type of Terminal	Connector Reference
A	Wire: 0.5..2.5 mm^2 (AWG 22...12)	M3.5 screw	Pitch Beau EuroMate™ Molex no. 0399400414

Replacing the connector supplied as standard changes the degree of protection for people against electric shocks.

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

Check conformity to local standards when replacing the connector supplied as standard.

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

The conductors connected to connector A can reach high voltages, it is advisable to ensure that, following accidental disconnection, they cannot touch a part that is not normally dangerous.

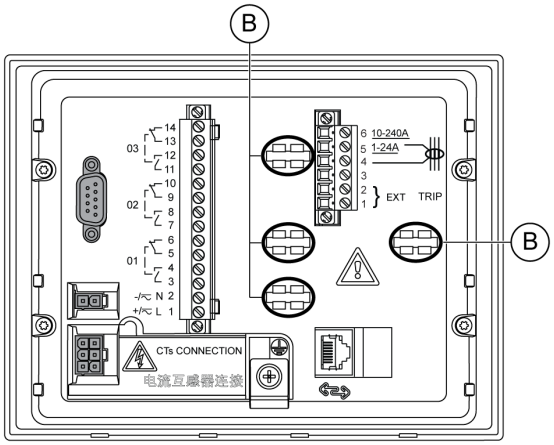
⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

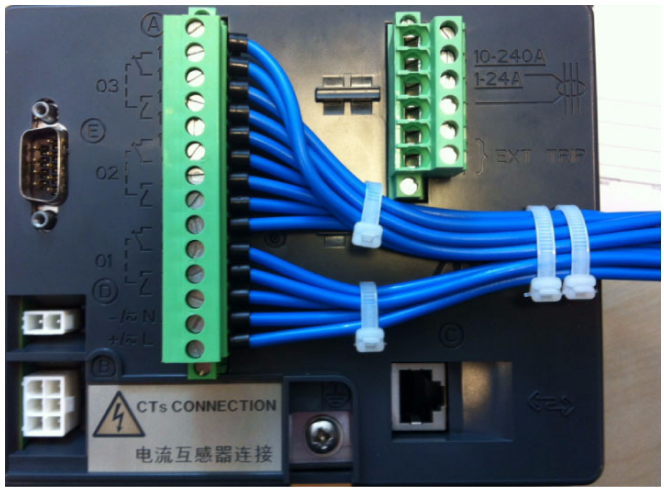
Use the cable anchor brackets on the rear panel of the VIP410.

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

The diagrams below show the position of the cable anchor brackets on the rear panel of the VIP410, and how the cables should be fixed.



B Cable anchor bracket



Connecting a Core Balance CT (VIP410)

Introduction

The specifically designed CSH120, CSH200, GO110 and CSHU core balance CTs are for direct earth fault current measurement. They should be used with the VIP410 for very sensitive earth fault protection.

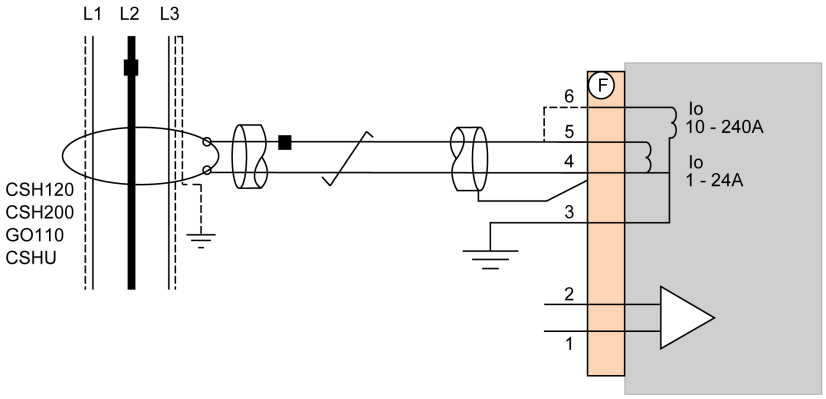
They can be connected to 2 earth fault current inputs with different sensitivities:
- 10-240 A input
- 1-24 A input

For detailed characteristics of core balance CTs, refer to the following sections:
- CSH120, CSH200 and GO110 core balance CTs *(see page 34)*
- CSHU core balance CT *(see page 37)*

NOTE: The CSHU CT is dedicated to operation in a Premset switchboard. It is integrated in the switchgear in the factory.

Connection Diagram

The diagram below shows the connection of a core balance CT to measure the earth fault current:



Connection Precautions

- Connect terminal 3 of connector **F** to earth.
- Connect the CT secondary to terminals 6 and 4 (10–240 A rating) or to terminals 5 and 4 (1–24 A rating).
- Flatten the cable against the metal frames of the cubicle.
- Connect the cable shielding (terminal 4) in the shortest manner possible to the protective earth of connector **F**.
- Do not ground the cable by any other means.

For more information about the CT wiring, refer to the CSH120, CSH200 and GO110 Core Balance CTs section *(see page 34)*.

Ref.	Core Balance CT	Wiring	Type of Terminal	Screwdriver	Tightening Torque
F	CSH120, CSH200, GO110	• sheathed cable shielded by tinned copper strap • minimum cable cross-section: 0.93 mm^2 (AWG 18) • linear resistance:< 100 mΩ/m (30.5 mΩ/ft) • minimum dielectric withstand: 1000 V (700 V RMS)	M2.5 screw	2.5 mm flat blade (0.09 in.)	0.4...0.5 N•m (3.5...4.4 lb-in.)
	CSHU	Supplied with the CSHU CT			

NOTE: The maximum resistance of the VIP410 connection wiring must not exceed 4 Ω (i.e. 20 m maximum for 100 mΩ/m or 66 ft for 30.5 mΩ/ft).

Connection of the External Trip Input (VIP410)

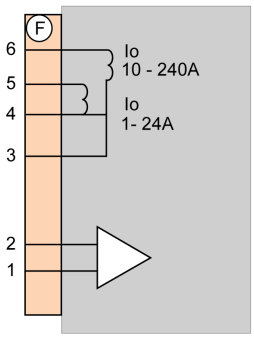
Introduction

The VIP410 has an external trip input that can be used to take account of a trip order issued by an external protection device (Buchholz, gas, pressure, temperature detectors).

Connection Characteristics

Connect both pins on the external protection device volt-free contact to terminals 1 and 2 on connector F.

Ref.	Diagram	Wiring	Type of Terminal	Screwdriver	Tightening Torque

F		• Wiring without fittings:
		  • 1 wire: 0.2..2.5 mm^2 (AWG 24...12)
		  • maximum length: 2 x 50 m
		  • stripped length: 8...10 mm (0.31...0.39 in.)
		• Wiring with fittings:
		  • 1 wire 1.5 mm^2 (AWG 16) with DZ5CE015D fitting
		  • 1 wire 2.5 mm^2 (AWG 12) with DZ5CE025D fitting
		  • stripped length: 8 mm (0.31 in.)
			M2.5 screw	2.5 mm flat blade (0.09 in.)	0.4...0.5 N•m (3.5...4.4 lb-in.)

Connecting the Modbus Communication Port (VIP410)

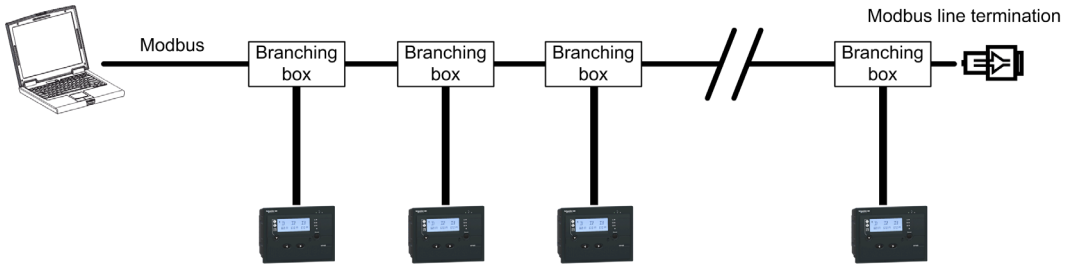
Introduction

The VIP410 can communicate using a 2-wire RS 485 Modbus communication port. Connection to the Modbus network is direct, via an RJ45 connector.

Connection Diagram

Connection to the Modbus network is in a daisy-chain and requires a line termination resistor:

Depending on the bus configurations, daisy-chain wiring can require the use of a Modbus branching box.

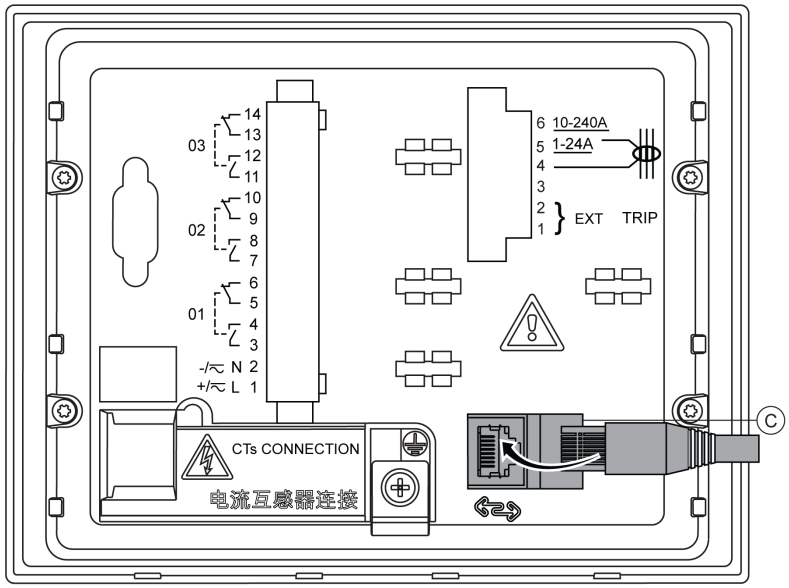


In cases where the VIP410 is used with SC100 modules (control and monitoring of MV equipment), daisy-chain wiring is created directly by these modules using the 3 RJ45 connectors present (Modbus "T" function).

Connection Precautions

Connect the Modbus network RJ45 cable to connector **C** on the VIP410.

NOTE: The number of connected VIP410s must not exceed 31 and the total cable length must not exceed 500 m so that the maximum network speed (38.4 kbps) can be used.

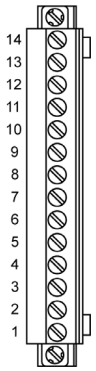


Recommended Connection Accessories

Description	Length	Reference
Modbus RJ45 cable	0.3 m	VW3 A8 306 R03
	1 m	VW3 A8 306 R10
	3 m	VW3 A8 306 R30
Modbus line termination	–	VW3 A8 306 RC
Modbus branching box	–	TWDXCAT3RJ

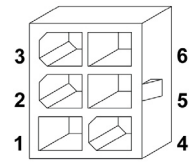
Connector Pinout

Connector A Pinout (VIP410)

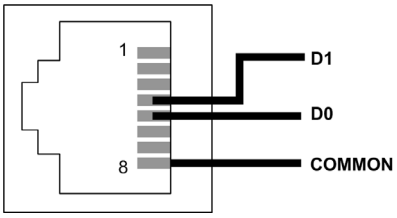
Connecting the Auxiliary Power Supply and the TOR Annunciation Outputs	Terminals	Data Item Connected
	11-12 and 13-14	Output relay O3: ● Terminals 11-12: Normally open contact (NO) ● Terminals 13-14: Normally closed contact (NC)
	7-8 and 9-10	Output relay O2: ● Terminals 7-8: Normally open contact (NO) ● Terminals 9-10: Normally closed contact (NC)
	3-4 and 5-6	Output relay O1: ● Terminals 3-4: Normally open contact (NO) ● Terminals 5-6: Normally closed contact (NC)

	1–2	Auxiliary power supply
		● AC power supply voltage:
		  ● phase on terminal 1
		  ● neutral on terminal 2
		● DC power supply voltage:
		  ● positive on terminal 1
		  ● negative on terminal 2

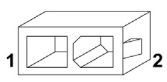
Connector B Pinout

Connecting the VIP Self-Powered Supply	Terminals	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

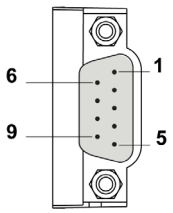
Connector C Pinout (VIP410)

Connecting the RS 485 Communication Port	Terminals	Data Item Connected
	1	NC
	2	NC
	3	NC
	4	D1
	5	D0
	6	NC
	7	NC
	8	COMMON

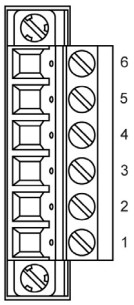
Connector D Pinout

Connecting the Mitop Trip Unit to the VIP	Terminals	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	Terminals	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 CUa or CUb sensors)
	6	Phase current 1 (Signal)
	7	Phase current 2 (Gnd)
	8	Phase current 3 (Signal)
	9	Earth fault current (Gnd)

Connector F Pinout (VIP410)

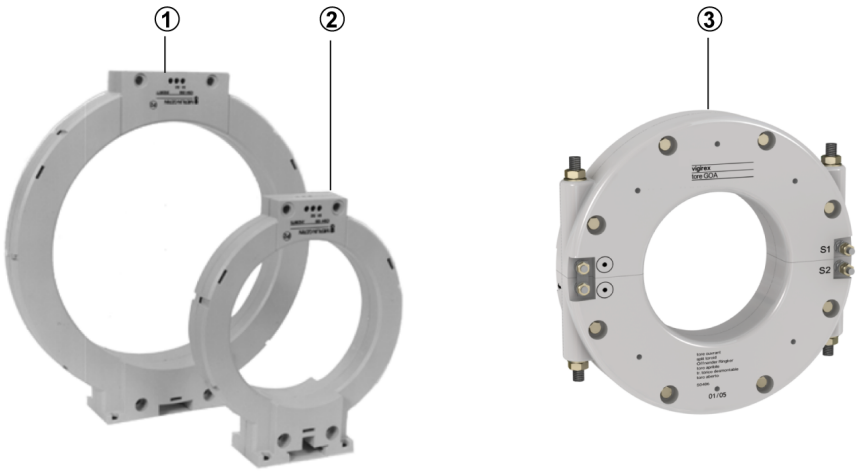
Connecting the Sensitive Earth Fault Current and External Trip Inputs	Terminals	Data Item Connected
	6	Very sensitive Io earth fault current input (10–240 A rating)
	5	Very sensitive Io earth fault current input (1–24 A rating)
	4	Very sensitive Io earth fault current input (common)
	3	–
	2	External trip input
	1	External trip input

CSH120, CSH200 and GO110 Core Balance CTs

Function

The specifically designed CSH120, CSH200 and GO110 core balance CTs are for direct earth fault current measurement. Due to their low voltage insulation, they can only be used on cables.

- CSH120 and CSH200 are closed CTs, with different inner diameters:
  - The CSH120 inner diameter is 120 mm (4.75 in.).
  - The CSH200 inner diameter is 196 mm (7.72 in.).
- The GO110 is a split CT, with an inner diameter of 110 mm (4.33 in.).

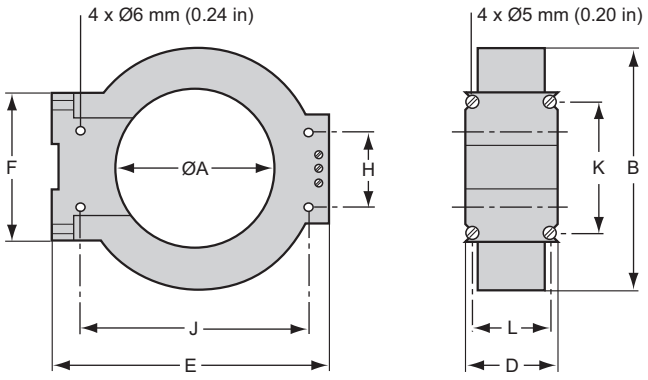


1 CSH200
2 CSH120
3 GO110

Characteristics

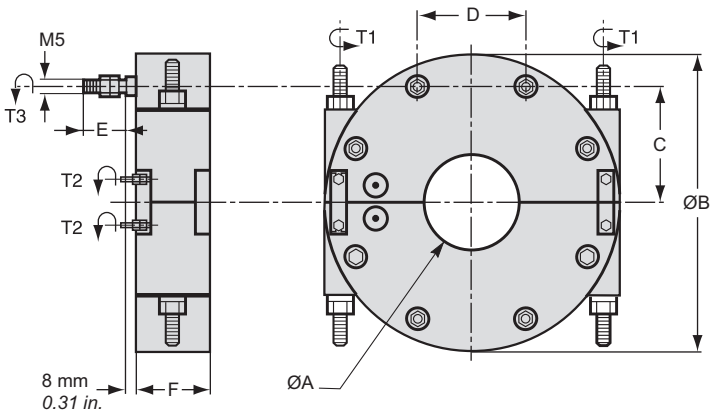
		CSH120	CSH200	GO110
Inner diameter		120 mm (4.7 in.)	196 mm (7.7 in.)	110 mm (4.3 in.)
Weight		0.6 kg (1.32 lb)	1.4 kg (3.09 lb)	3.2 kg (7.04 lb)
Accuracy	at 20°C (68°F)	5%	5%	< 0.5% (10...250 A)
	at –25...+70°C (–13...+158°F)	< 6%	< 6%	< 1.5% (10...250 A)
Transformation ratio		470/1		
Maximum permissible current		20 kA - 1 s		
Operating temperature		–25...+70°C (–13...+158°F)		
Storage temperature		–40...+85°C (–40...+185°F)		

CSH120 and CSH200 Dimensions



Dimension		A	B	D	E	F	H	J	K	L
CSH120	mm	120	164	44	190	80	40	166	65	35
	in.	4.75	6.46	1.73	7.48	3.15	1.57	6.54	2.56	1.38
CSH200	mm	196	256	46	274	120	60	254	104	37
	in.	7.72	10.1	1.81	10.8	4.72	2.36	10.0	4.09	1.46

GO110 Dimensions



Dimension		A	B	C	D	E	F
GO110	mm	110	224	92	76	16	44
	in.	4.33	8.82	3.62	2.99	0.63	1.73

Opening the GO110

To open the GO110 CT, proceed as follows:

Step	Action
1	Undo both T1 nuts and remove the 2 pins.
2	Undo both T2 nuts and remove the 2 bars.

Closing the GO110

To close the GO110 CT, proceed as follows:

Step	Action
1	Replace the 2 bars and tighten both T2 nuts. T2 tightening torque = 30 N•m or 0.34 lb-in.
2	Replace the 2 pins and tighten both T1 nuts. T1 tightening torque = 70 N•m or 0.79 lb-in.

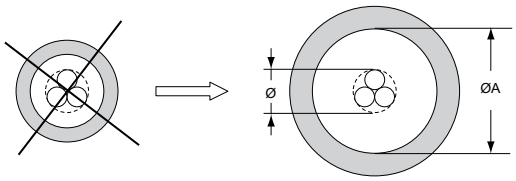
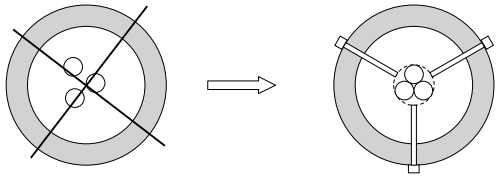
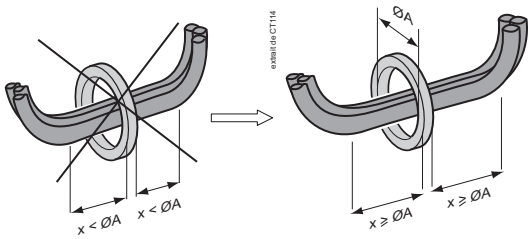
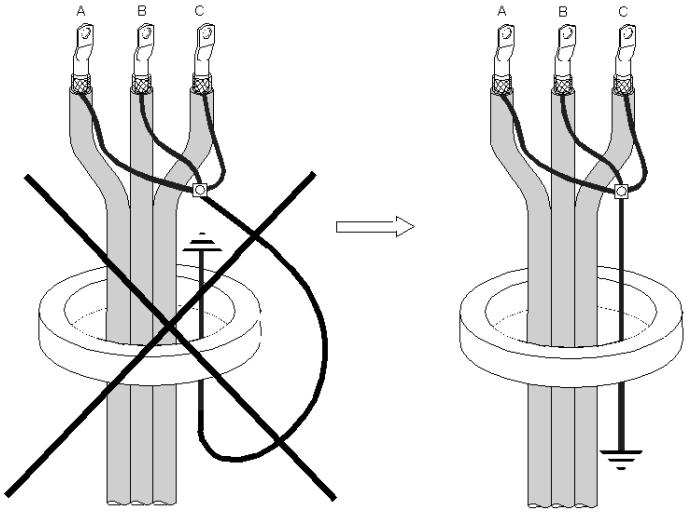
Mounting Precautions

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Screw tight all terminals, even those not in use.
- Only CSH120, CSH200 and GO110 core balance CTs can be used for very sensitive earth fault current measurement.
- Install the core balance CTs on insulated cables (the CTs do not have MV insulation).
- Cables with a rated voltage of more than 1000 V must also have shielding connected to the protective earth.

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

Mounting Instruction	Illustration
Select a CT with a diameter at least twice the size of the cable harness going through it.	
Group the cable(s) in the middle of the CT and use non-conducting binding to hold the CT in place around the cable harness.	
Do not bend the cable(s) close to the CT: install the CT on a straight section of the cable(s) that is at least twice as long as the CT diameter.	
Remember to pass the shield earthing braid on the 3 cables back through the CT. Check that the braid goes the right way through the CT.	

CSHU Core Balance CT

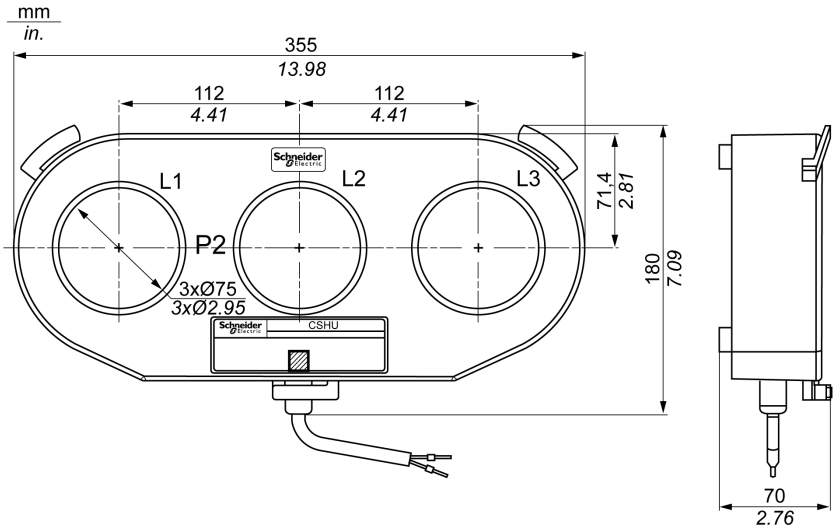
Function

The CSHU core balance CT has been specially developed to simplify integration of very sensitive earth fault current measurement into Premset cubicles. It is mounted in the switchgear in the factory. It enables direct earth fault current measurement.

Characteristics

Characteristics	Values
Weight	6 kg
Accuracy	< 5%
Transformation ratio	470/1
Maximum permissible current	20 kA–1 s
Operating temperature	-25...+70°C (-13...+158°F)
Storage temperature	–40...+85°C (–40...+185°F)

Dimensions



Use

3

What Is in This Chapter?

This chapter contains the following topics:

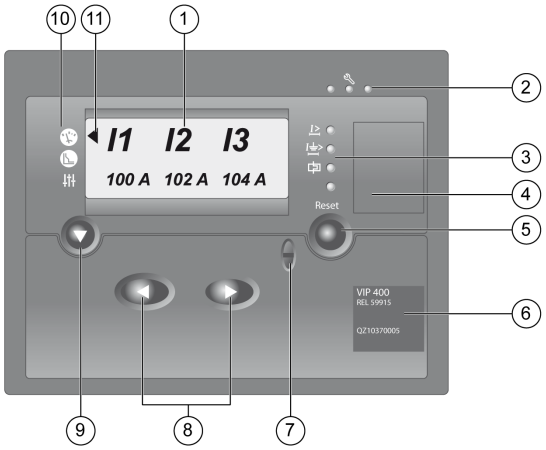
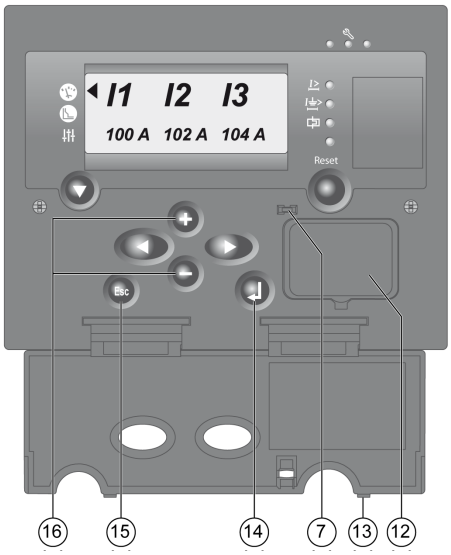
User-Machine Interface

Front Panel

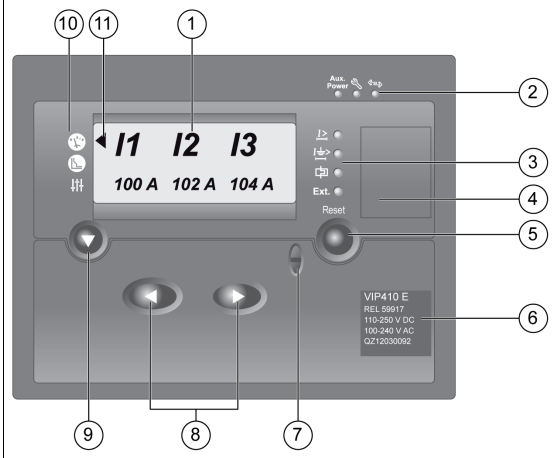
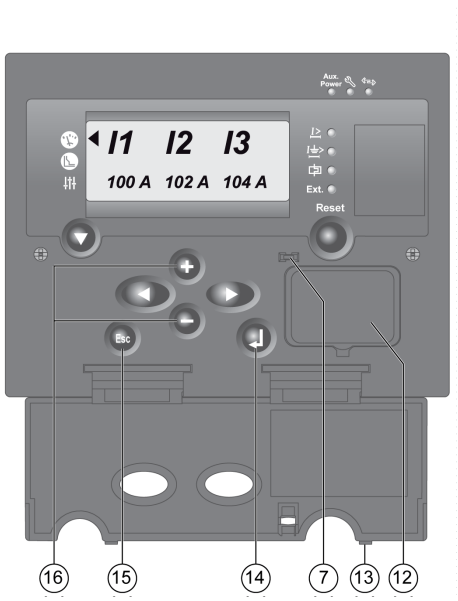
The User-Machine Interface (UMI) on the front panel of VIP relays consists of a display, LEDs and keys.

A sealable pivoting flap can prevent access to the setting keys by unauthorized persons.

The illustrations below show the front panel of the VIP400 with both positions of the sealable pivoting flap:

Flap Closed	Flap Open
	

The illustrations below show the front panel of the VIP410 with both positions of the sealable pivoting flap:

Flap Closed	Flap Open
	

1 Display
2 Status LEDs
3 Fault indication LEDs
4 Zone for a user-customizable label with pictograms of the fault indication LEDs
5 Acknowledgement key
6 Identification label
7 Sealing ring
8 Selection keys
9 Key for selecting menus and testing LEDs. When the VIP is not supplied with power, this key can also be used to start the VIP from the battery in order to enter settings
10 Menu pictograms
11 Menu selection pointer
12 Battery compartment and socket for connecting the pocket battery module
13 Settings protective flap
14 Confirm entry key
15 Abort entry key
16 Setting keys

Status LEDs

The status LEDs provide information about the VIP's general status:

Pictogram	Function	VIP400	VIP410
Aux. Power	Green LED: auxiliary power supply present	–	•
	• Red LED permanently on: VIP unavailable (VIP in the fail-safe position). • Red LED flashing: a failure has been detected but does not involve the VIP going into the fail-safe position.	•	•
	Yellow LED flashing: communication active	–	•

Display

The display is an LCD unit. It is only back-lit on the VIP410, when the auxiliary power supply is present.

Each VIP function is presented in a screen consisting of the following items:
- First line: symbols for electrical values or function name
- Second line: displays the values of measurements or parameters associated with the function
- A menu pointer, on the left, this points to the pictogram for the selected menu

Menu Organization

All the data available in the VIP relay is divided between 3 menus:

- The metering menu ( ) contains the current measurements, peak demand currents, load history, event records, fault trip counter and the breaking current history.
- The protection menu ( ) contains the essential settings for setting up the protection functions.
- The parameters menu ( ) contains the parameters that are used to adapt VIP operation to particular applications. When a VIP is new, all the parameters in this menu have a default value. The protection functions are operational even with the parameters menu default values.

The menu content depends on the VIP model. The screens corresponding to each menu appear at the end of this section:
- for the VIP400 *(see page 51)*
- for the VIP410 *(see page 56)*

Selecting a Screen in a Menu

Step	Action
1	Press the key to select one of the 3 menus. The menu pointer indicates the selected menu: : metering menu : protection menu : parameters menu
2	Press the or keys to scroll through the screens in the selected menu, until the desired screen is displayed.

Default Screen

A default screen is displayed automatically 3 minutes after the last keystroke. This default screen is the screen displaying the phase currents.

Operation According to the Power Supply Mode

VIP400

The VIP400 is a stand-alone protection relay powered by its current sensors. When current is present in the medium-voltage (MV) network, the protections and the display work and it is possible to enter settings and view measurements. The current in the MV network on which the VIP operates is called the “pick-up current”.

When no current is flowing through the circuit breaker (for example circuit breaker open), or when the current in the MV network is too low, the VIP is off and nothing appears on its display. If current appears, the protection functions are activated and trip the circuit breaker - or not - according to their settings. The additional time taken by the VIP to start when current appears is called the “pick-up time”.

More information on the value of the pick-up current and the pick-up time are available in the VIP *(see page 202)* Function Characteristics.

VIP410

The VIP410 is a relay with a dual power supply. It is powered both autonomously by its sensors and by the auxiliary power supply.

Like for the VIP400, the self-powered supply allow the protection functions to work even if the auxiliary power supply fails.

The auxiliary power supply is used to power functions that do not depend on the current being present in the MV network. These functions are marked in the function table *(see page 11)*. The auxiliary power supply must be present in order them to work.

Embedded Battery

The VIP400 and VIP410 have an embedded battery. It is used to:
- activate the user-machine interface in order to enter settings when the VIP is not supplied with power
- illuminate the fault indication LEDs when the VIP is no longer supplied with power after giving the opening order to the circuit breaker
- power the internal calendar

When the VIP is not supplied with power:

- Pressing and holding down the  key will activate battery-powered operation of the user-machine interface. It is then possible to access the menus in order to enter settings. In this case, the display turns off automatically after 3 minutes of inactivity on the keypad.
- The protection functions are activated automatically if the current reappears.

The embedded battery plays no part in protection function operation. The protection functions work even when there is no battery.

NOTE:

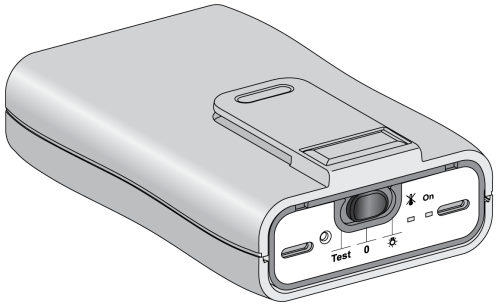
- In battery operation mode, the VIP processor runs with a reduced clock frequency to ensure the battery life is maintained. As a result, the user-machine interface may be slower to react.
- During a setting operation with the VIP powered by its internal battery alone, the clock display is not refreshed on screen. However the internal clock increments normally.

Pocket Battery Module

The pocket battery module is an accessory that can be connected to the front panel of VIP relays. It contains a battery that can be used to power the VIP in order to:

- enter settings if the embedded battery is missing and if the VIP is not powered by the current sensors
- test the VIP *(see page 189)*
- display the cause of the last trip by the VIP *(see page 46)*

More information on connecting the pocket battery module to the VIP is available in the Connection to the VIP *(see page 191)* section.



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.

Operation

Access to Data

During operation, when the settings protective flap is closed, the user can access the following data:
- readout of measurements, parameter and protection settings
- local annunciation of the last fault:
  - by a flashing fault indication LED
  - by a fault screen on the display unit
- acknowledgement of the last fault
- readout of the last saved faults
- reset of peak demand values
- LED and display unit test
- battery test

Readout of Measurements, Settings and Parameters

When the settings protective flap is closed, the user can read all the data contained in the VIP relay.

It is not possible to modify any protection or parameter settings.

Fault Indication LEDs

VIP relays have fault indication LEDs. They flash to indicate a fault, as shown in the table below.

Pictogram	Fault	VIP400	VIP410
I>	Detection of a fault by the phase overcurrent protection or in the event of tripping by the temporary test mode	•	•
Ie>	Detection of a fault by the earth fault protection	•	•
θ	Detection of a fault by the thermal overload protection	•	•
Ext.	Tripping by a volt-free contact connected to the external trip input	–	•

After a trip, the fault indication LEDs are powered by the battery embedded in the VIP or by the VIP410 auxiliary power supply.

Fault indication by the LEDs can be stopped:
- by pressing the **Reset** key
- automatically by the reappearance of a current in the network higher than the pick-up current
- automatically after 24 hours
- by remote control order via the communication (VIP410)

For the first 3 LEDs, faster flashing may occur before the protection trips, to indicate the following information:

Pictogram	Overshoot
I>	Overshoot of the instantaneous set point for phase overcurrent protection (I> or I>> or I>>> pick-up outputs)
Ie>	Overshoot of the instantaneous set point for earth fault protection (Io> or Io>> pick-up outputs)
θ	Overshoot of the alarm set point for thermal overload protection

NOTE: In custom mode, the protection set points may not be assigned to the Mitop trip unit output. In this case, the fault indication LED may be active, without being associated with the circuit breaker trip. Depending on the application, this can indicate the presence of a fault without tripping the circuit breaker *(see page 133)*.

The fault indication LED pictograms can be customized by sticking a label to the right of the LEDs.

Display of the Last Fault

VIPs automatically display the last fault that appeared. The fault display contains:
- First line: name of the fault screen with its queue number. Events are numbered continuously from 0 to 99,999, then back to 0.
- Second line: scrolling display of the event characteristics:
  - origin of the event
  - date and time of the event
  - values of the currents measured at the time of the event

Whether the fault 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 trip, the display goes off. Pressing and holding down the key activates embedded battery operation of the user-machine interface and the fault message appears. It remains until the operator uses the keypad.
- If the VIP is still supplied with power after the trip, the fault message may disappear automatically from the screen depending on the VIP power supply conditions. This example is not an actual operating situation, but may be encountered during a lab test.

NOTE: The last fault displayed disappears when the operator uses the keypad. However, it is still possible to view the last recorded fault in the metering menu.

NOTE: The VIP can also be powered with the pocket battery module *(see page 44)*.

Fault Acknowledgement

Pressing the **Reset** key acknowledges faults locally and causes:
- extinction of the fault indication LED
- deletion of the last fault message
- return to off-state of the annunciation relays

Readout of the Last 5 Faults

VIPs record the last 5 events. They can be viewed in the metering menu. Their content is identical to the display of the last fault.

Reset of Peak Demand Values

The method for resetting the phase current peak demand values is indicated below:

Step	Action
1	Display the phase current peak demand values screen.
2	Press the **Reset** key for 2 seconds: the peak demand values are reset to zero.

LED and Display Unit Test

The LED and display unit test is used to check that each LED on the front panel and in each segment of the display is working correctly.

To perform the test, press and hold down the key.
- If the VIP is powered by its current sensors or the pocket battery module: after 2 seconds, the LEDs light up one after another and all segments of the display light up.
- If the VIP is not supplied with power: pressing and holding down the key activates embedded battery operation. In this case, the same sequence happens, after the VIP starting phase indicated by a bar chart.

Battery Test

To check that the battery is in good working order, press the **Reset** key until the fault indication LEDs are activated. The LEDs should light up in less than 30 seconds and remain on clearly without fading for the whole time the key is pressed. If not, replace the battery *(see page 199)*.

Setting

Access to Parameters and Settings

The VIP protection and parameter settings can be modified using the keys that are revealed when the settings protective flap is opened.

These parameters and settings are divided into the following two menus:

- The protection menu ( ), which contains the essential settings for setting up the protection functions.
- The parameters menu ( ), which contains the parameters that can be used to adapt the VIP operation to particular applications.

When the VIP400 or the VIP410 is not supplied with power, pressing and holding down the key can also be used to start it from the battery in order to enter settings.

NOTE: It can also be powered with the VIP pocket battery module *(see page 44)*.

Protecting the Settings with a Password

By default, modification of the VIP protection and parameter settings is not protected by a password.

Password protection of the settings can be activated if necessary in the parameters menu.

If password protection has been activated at the time of commissioning, the VIP will ask for the password automatically the first time the key is pressed during a setting operation. The password is a 4-digit number.

More information is available in the Entering a Password to Authorize a Setting procedure *(see page 48)*.

Once the correct password has been entered, modification of the settings is allowed for 3 minutes after the last keystroke.

Setting a Parameter

The procedure for setting a protection function or a parameter is as follows:

Step	Action
1	Select the screen for the function to be set using the , or keys.
2	Press the key: ● If password protection is not active, the first function parameter flashes: the parameter is selected and can be set. ● Otherwise, the password entry screen is displayed: refer to the sections below.
3	Use the / keys to select the parameter to be set. The selected parameter flashes.
4	Use the / keys to scroll through the parameter values until the desired value is displayed. **NOTE:** ● Holding the / keys down makes the values scroll faster. ● Pressing the / keys aborts the parameter entry and selects the previous or next parameter.
5	● To confirm the new parameter value, press the key: the set parameter value is displayed (not flashing) to indicate that it has been taken into account by the VIP. ● To abort the current parameter entry, press the Esc key: all parameters are deselected and are displayed (not flashing).
6	● If the set parameter is the last parameter in the function, the function is completely set and you can select a new screen using the / keys. ● Otherwise, the next parameter flashes and can be set as described in step 4.

NOTE: When the user-machine interface is operating from the battery, the VIP processor runs with a reduced clock frequency in order to ensure the battery life is maintained. As a result, the user-machine interface may be slower to react.

Entering a Password to Authorize a Setting

The 4 password digits must be entered separately. The procedure for entering the password is as follows:

Step	Action
1	The password entry screen is displayed and the first digit (0) flashes: 
2	Press the / keys to scroll through the digits from 0 to 9 and select the password digit.
3	Press the key to confirm the selected digit: ● A star is displayed rather than the selected digit. ● The next digit is a flashing 0.
4	Repeat steps 2 and 3 until all 4 password digits have been entered.
5	Once the password has been entered: ● If the password is correct: the current setting screen is displayed again. It is then possible to modify the protection and parameter settings. ● If the password is incorrect: the message **PASSWORD NOT OK** is displayed temporarily, then the current setting screen is displayed again.

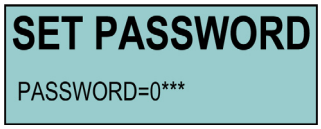
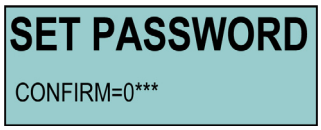
Activating the Password at the Time of Commissioning

The procedure for activating password protection of the settings is as follows:

Step	Action
1	Select the password setting screen in the parameters menu using the , or keys: 
2	Press the key: **NO PASSWORD** flashes.
3	Press the / keys, then the key: the VIP asks you to define the password you want. The password is defined in the next section.

Password Definition

The password is a 4-digit number, and each digit must be entered separately. The password must be re-entered to confirm it. The procedure for defining the password is as follows:

Step	Action
1	The password setting screen is displayed. Press the key until the first password digit (0) flashes: 
2	Press the / keys to scroll through the digits from 0 to 9 and select the password digit.
3	Press the key to confirm the selected digit: ● A star is displayed rather than the selected digit. ● The next digit is a flashing 0.
4	Repeat steps 2 and 3 until all 4 password digits have been entered.
5	Once the password has been defined, it must be re-entered a second time following the same procedure as confirmation: 
6	Once the password has been entered and confirmed: ● If both passwords entered are identical: the **PASSWORD SET** message is displayed temporarily and the new password is active. ● If both passwords entered are not identical: the **CONFIRMATION ERROR** message is displayed temporarily.

Disabling the Password

The procedure for disabling password protection of the settings is as follows:

Step	Action
1	Select the password setting screen in the parameters menu using the , or keys: 
2	Press the key: the VIP asks you to enter the active password to authorize changing the parameter. More information is available in the Entering a Password to Authorize a Setting procedure *(see page 48)*.
3	Once the password has been entered: ● If the password is correct and the VIP returns to the **SET PASSWORD** screen: use the / keys to select **NO PASSWORD**, then press the key. Password protection is disabled. ● If the password is incorrect: the **PASSWORD NOT OK** message is displayed temporarily. The VIP displays the screen for step 1 again.

Lost Password

If you lose the password, read the serial number on the VIP front panel and contact your local Schneider Electric after-sales service.

Thermal Capacity Used Reset

The calculated thermal capacity used for the thermal overload protection can be reset by the user to:

- authorize circuit breaker reclosing after a thermal overload protection trip, without waiting for the normal cooling time
- delay tripping due to thermal overload protection after the thermal alarm set point is reached

The thermal capacity used reset is protected by the same password as the protection function settings.

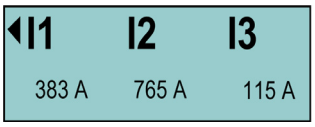
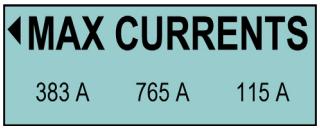
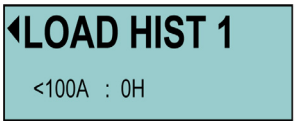
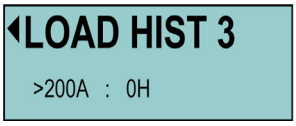
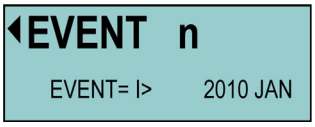
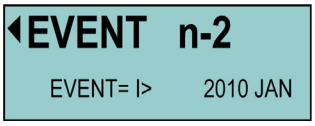
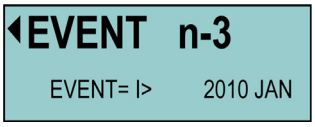
Method for Resetting the Thermal Capacity Used

The procedure for resetting the thermal capacity used is as follows:

Step	Action
1	Display the **THERMAL 49 2** thermal alarm screen in the protection menu, where the value of the thermal capacity used calculated by the VIP appears.
2	Press the key: ● If password protection is not active, the thermal alarm set point flashes. ● Otherwise, the password entry screen is displayed *(see page 48)*.
3	Select the thermal capacity used using the key: the thermal capacity used flashes.
4	Press the key to reset the thermal capacity used value.
5	Press the key to confirm the thermal capacity used reset.

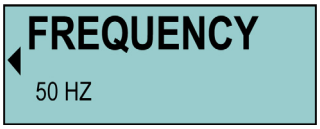
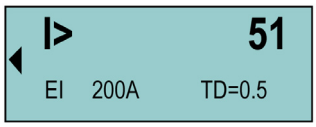
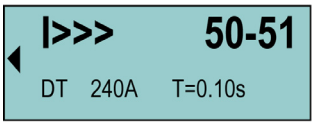
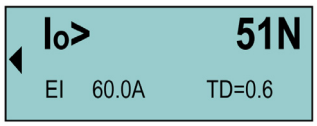
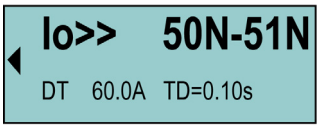
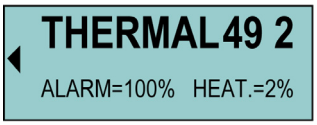
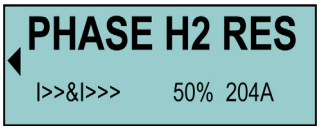
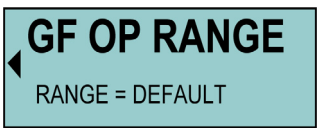
List of VIP400 Screens

Metering Menu

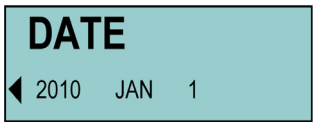
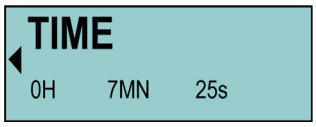
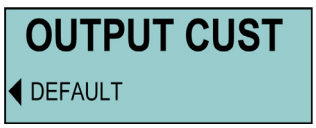
No.	Screen	Description
1		Display of 3 phase currents. This is the default screen for VIP400s.
2		Display of the earth fault current
3		Display of peak demand values for the 3 phase currents.
4		Load history: display of the number of VIP operating hours in the first current range, depending on the Ib operating current setting.
5		Load history: display of the number of VIP operating hours in the second current range, depending on the Ib operating current setting.
6		Load history: display of the number of VIP operating hours in the third current range, depending on the Ib operating current setting.
7		Display of the characteristics of the last event (number n). This screen is only present when the VIP relay has already recorded a fault.
8		Display of the characteristics of event number n-1. This screen is only present when the VIP relay has already recorded 2 faults.
9		Display of the characteristics of event number n-2. This screen is only present when the VIP relay has already recorded 3 faults.
10		Display of the characteristics of event number n-3. This screen is only present when the VIP relay has already recorded 4 faults.
11		Display of the characteristics of event number n-4. This screen is only present when the VIP relay has already recorded 5 faults.

No.	Screen	Description
12		Display of the number of trips on phase fault and earth fault.
13		Display of the number of trips on thermal overload protection fault.
14		Display of the number of breaks in the first current range, depending on the dual core current sensor rating.
15		Display of the number of breaks in the second current range, depending on the dual core current sensor rating.
16		Display of the number of breaks in the third current range, depending on the dual core current sensor rating.
17		Display of the number of breaks in the fourth current range, depending on the dual core current sensor rating.

Protection Menu

No.	Screen	Description
1		Network frequency selection.
2		Display and setting of the I> parameters for the phase overcurrent protection: ● activation and tripping curve ● tripping set point ● tripping time delay
3		Display and setting of the I>> parameters for the phase overcurrent protection: ● activation and tripping curve ● tripping set point ● tripping time delay
4		Display and setting of the I>>> parameters for the phase overcurrent protection: ● activation and tripping curve ● tripping set point ● tripping time delay
5		Display and setting of the Io> parameters for the earth fault protection: ● activation and tripping curve ● tripping set point ● tripping time delay
6		Display and setting of the Io>> parameters for the earth fault protection: ● activation and tripping curve ● tripping set point ● tripping time delay
7		Display and setting of the trip parameters for the thermal overload protection: ● activation ● maximum permissible continuous current ● time constant of the protected equipment
8		Display and setting of the alarm parameters for the thermal overload protection if this has been activated: ● alarm set point as a percentage of the calculated thermal capacity used ● calculated thermal capacity used (display 0...999% and reset)
9		Display and setting of the parameters of the phase overcurrent protection H2 restraint function: ● activation and operation ● H2 ratio set point ● minimum short-circuit current
10		Display and setting of the parameters of the earth fault protection H2 restraint function: activation and operation
11		Display and setting of the Io> set point setting range.

Standard Parameters Menu

No.	Screen	Description
1		Display and selection of the operating language.
2		Display and selection of the calculation period for the peak demand values.
3		Display and setting of the Ib operating current.
4		Activation of the reset time for the phase and earth fault overcurrent protections.
5		Display and setting of the VIP date: ● year ● month ● day
6		Display and setting of the VIP date: ● hours ● minutes ● seconds
7		Password activation and definition.
8		Activation of temporary trip test mode.
9		Display and setting of the screen contrast level.
10		Display of the VIP software version number.
11		Display and selection of the VIP Mitop trip unit output custom mode: default/custom. **NOTE:** If the custom option is activated, screen 11a appears. If the custom option is not activated, screen 11a does not appear.
12		Display and validation of display or not of the VIP parameters relating to the circuit breaker characteristics. **NOTE:** If the DISPLAY option is activated, screens 12a, 12b and 12c appear. If the NO DISPLAY option is activated, screens 12a, 12b and 12c do not appear.

Mitop Trip Unit Output Custom Parameters Menu

After selection of the Mitop trip unit output custom mode, an additional screen can be used to customize assignment of the Mitop trip unit output.

No.	Screen	Description
11a		Display and selection of the Mitop trip unit output assignment.

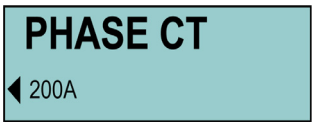
Circuit Breaker Custom Parameters Menu

After selection of the display of parameters relating to the circuit breaker characteristics, additional screens can be used to customize:

- the dual core current sensor rating
- activation of the minimum tripping time **MIN TRIPTIME**
- the method of display and selection of the Mitop trip unit output assignment

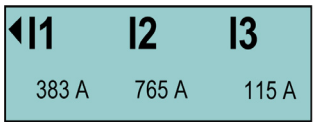
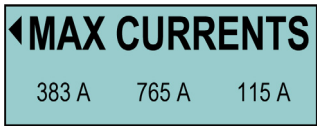
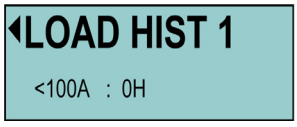
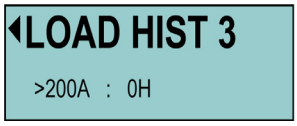
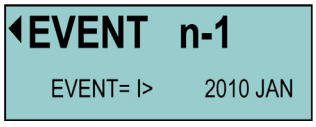
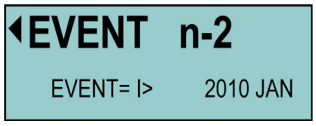
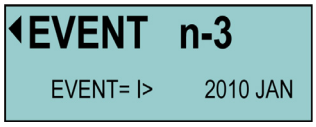
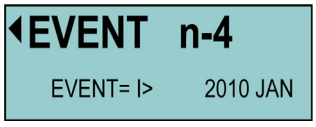
These parameters are displayed for viewing, and can only be set by Schneider Electric (factory setting).

Viewing these parameters allows the user to check that their values are compatible with the MV circuit breaker.

No.	Screen	Description
12a		Display and setting of the dual core current sensor rating.
12b		Activation of the minimum tripping time.
12c		Display and setting of the method of display and selection of the Mitop trip unit output assignment.

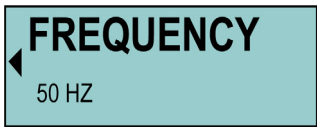
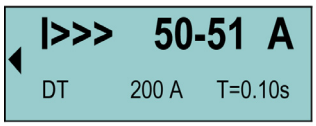
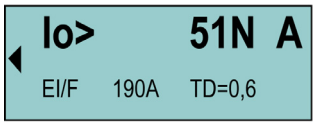
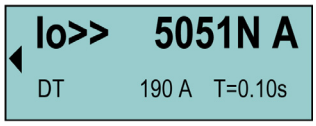
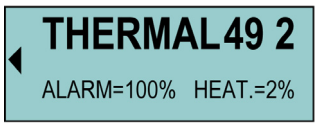
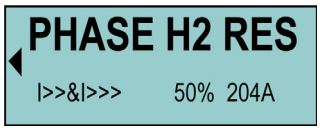
List of VIP410 Screens

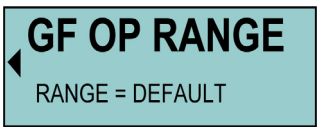
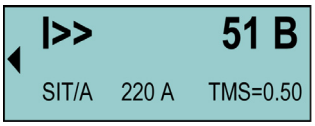
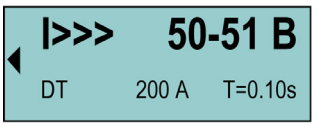
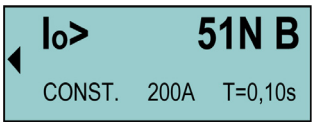
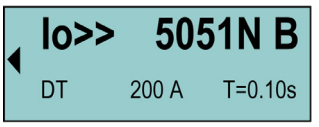
Metering Menu

No.	Screen	Description
1		Display of 3 phase currents. This is the default screen for VIP410s.
2		Display of the earth fault current
3		Display of peak demand values for the 3 phase currents.
4		Load history: display of the number of VIP operating hours in the first current range, depending on the Ib operating current setting.
5		Load history: display of the number of VIP operating hours in the second current range, depending on the Ib operating current setting.
6		Load history: display of the number of VIP operating hours in the third current range, depending on the Ib operating current setting.
7		Display of the characteristics of the last event (number n). This screen is only present when the VIP relay has already recorded a fault.
8		Display of the characteristics of event number n-1. This screen is only present when the VIP relay has already recorded 2 faults.
9		Display of the characteristics of event number n-2. This screen is only present when the VIP relay has already recorded 3 faults.
10		Display of the characteristics of event number n-3. This screen is only present when the VIP relay has already recorded 4 faults.
11		Display of the characteristics of event number n-4. This screen is only present when the VIP relay has already recorded 5 faults.

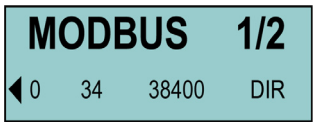
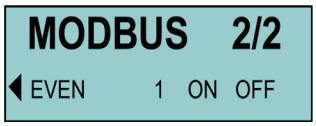
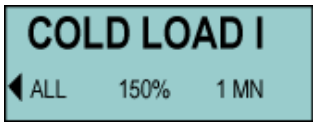
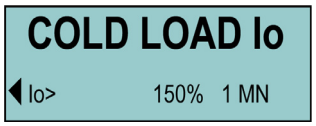
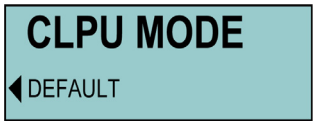
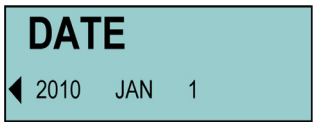
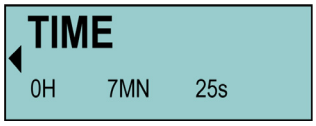
No.	Screen	Description
12		Display of the number of trips on phase fault and earth fault.
13		Display of the number of trips on thermal overload protection fault and external tripping.
14		Display of the number of breaks in the first current range, depending on the dual core current sensor rating.
15		Display of the number of breaks in the second current range, depending on the dual core current sensor rating.
16		Display of the number of breaks in the third current range, depending on the dual core current sensor rating.
17		Display of the number of breaks in the fourth current range, depending on the dual core current sensor rating.

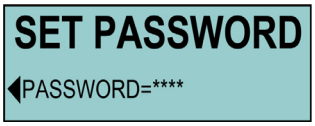
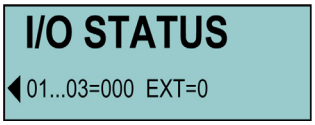
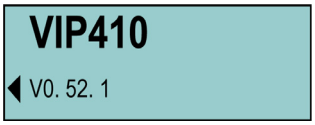
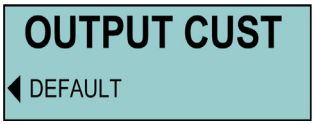
Protection Menu

No.	Screen	Description
1		Display and selection of: ● the earth fault sensor type ● the measurement range by the earth fault core balance CT: 1–24 A/10–240 A
2		Network frequency selection.
3		Display and setting of the I> parameters for the phase overcurrent protection belonging to setting group A: ● activation and tripping curve ● tripping set point ● tripping time delay
4		Display and setting of the I>> parameters for the phase overcurrent protection belonging to setting group A: ● activation and tripping curve ● tripping set point ● tripping time delay
5		Display and setting of the I>>> parameters for the phase overcurrent protection belonging to setting group A: ● activation and tripping curve ● tripping set point ● tripping time delay
6		Display and setting of the Io> parameters for the earth fault protection belonging to setting group A: ● activation and tripping curve ● tripping set point ● tripping time delay
7		Display and setting of the Io>> parameters for the earth fault protection belonging to setting group A: ● activation and tripping curve ● tripping set point ● tripping time delay
8		Display and setting of the trip parameters for the thermal overload protection: ● activation ● maximum permissible continuous current ● time constant of the protected equipment
9		Display and setting of the alarm parameters for the thermal overload protection if this has been activated: ● alarm set point as a percentage of the calculated thermal capacity used ● calculated thermal capacity used (display 0...999% and reset)
10		Activation of the external trip input.
11		Display and setting of the parameters of the phase overcurrent protection H2 restraint function: ● activation and operation ● H2 ratio set point ● minimum short-circuit current

No.	Screen	Description
12		Display and setting of the parameters of the earth fault protection H2 restraint function: activation and operation.
13		Display and setting of the Io> set point setting range.
14		Display and setting of the setting groups: ● choice of whether to display setting group B or not ● choice of active setting group: A or B.
15		Display and setting of the I> parameters for the phase overcurrent protection belonging to setting group B: ● activation and tripping curve ● tripping set point ● tripping time delay
16		Display and setting of the I>> parameters for the phase overcurrent protection belonging to setting group B: ● activation and tripping curve ● tripping set point ● tripping time delay
17		Display and setting of the I>>> parameters for the phase overcurrent protection belonging to setting group B: ● activation and tripping curve ● tripping set point ● tripping time delay
18		Display and setting of the Io> parameters for the earth fault protection belonging to setting group B: ● activation and tripping curve ● tripping set point ● tripping time delay
19		Display and setting of the Io>> parameters for the earth fault protection belonging to setting group B: ● activation and tripping curve ● tripping set point ● tripping time delay

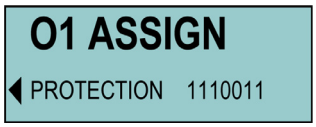
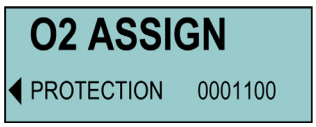
Standard Parameters Menu

No.	Screen	Description
1		Display and selection of the operating language.
2		Display and selection of the calculation period for the peak demand values.
3		Display and setting of the Ib operating current.
4		Display and setting of the Modbus communication protocol parameters: ● cubicle number ● address ● baud rate ● remote control order: direct/confirmed (SBO)
5		Display and setting of the Modbus communication protocol parameters: ● parity ● number of stop bits ● enabling of remote settings ● activation of Autogo
6		Display and setting of the phase overcurrent cold load pick-up function parameters: ● activation and operation ● cold load pick-up percentage or set point blocking ● cold load pick-up duration
7		Display and setting of the earth fault cold load pick-up function parameters: ● activation and operation ● cold load pick-up percentage or set point blocking ● cold load pick-up duration
8		Display and setting of the cold load pick-up function mode: default/secondary.
9		Activation of the reset time for the phase and earth fault overcurrent protections.
10		Display and setting of the VIP date: ● year ● month ● day
11		Display and setting of the VIP date: ● hours ● minutes ● seconds

No.	Screen	Description
12		Password activation and definition.
13		Display of the status of output relays O1 to O3 and the external trip input, from left to right: state 0 (off)/state 1 (on)
14		Activation of temporary trip test mode.
15		Display and setting of the screen contrast level.
16		Display of the VIP software version number.
17		Display and selection of the VIP Mitop trip unit output custom mode: default/custom. **NOTE:** ● If the custom option is activated, screens 17a to 17e appear. ● If the custom option is not activated, screens 17a to 17e do not appear.
18		Display and validation of display or not of the VIP parameters relating to the circuit breaker characteristics. **NOTE:** ● If the **DISPLAY** option is activated, screens 18a, 18b and 18c appear. ● If the **NO DISPLAY** option is activated, screens 18a, 18b and 18c do not appear.

Output Custom Menu

After selection of the output custom mode, an additional screen can be used to customize:
- assignment of the Mitop trip unit output
- assignment of the output relays
- whether or not the output relays are latched

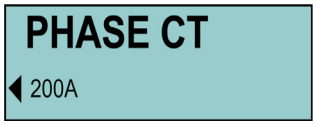
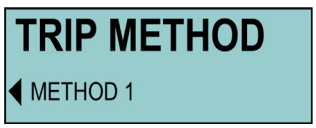
No.	Screen	Description
17a		Display and selection of the Mitop trip unit output assignment.
17b		Display and selection of output relay O1 assignment.
17c		Display and selection of output relay O2 assignment.
17d		Display and selection of output relay O3 assignment.
17e		Display and selection of output relay O1, O2 and O3 assignment.

Circuit Breaker Custom Parameters Menu

After selection of the display of parameters relating to the circuit breaker characteristics, additional screens can be used to customize:
- the dual core current sensor rating
- activation of the minimum tripping time **MIN TRIPTIME**
- the method of display and selection of the Mitop trip unit output assignment

These parameters are displayed for viewing, and can only be set by Schneider Electric (factory setting).

Viewing these parameters allows the user to check that their values are compatible with the MV circuit breaker.

No.	Screen	Description
18a		Display and setting of the dual core current sensor rating.
18b		Activation of the minimum tripping time.
18c		Display and setting of the method of display and selection of the Mitop trip unit output assignment.

Functions and Parameters

4

What Is in This Chapter?

This chapter contains the following topics:

General Principle

Introduction

This chapter describes the metering functions, the protection functions and the additional functions associated with them, as well as the parameters required for commissioning.

All this data is organized into the three menus described below:
- metering menu
- protection menu
- parameters menu

Metering Menu

The metering menu is used to read values relating to the currents in the network and the characteristics of the recorded faults. The data in this menu can only be viewed. It cannot be modified.

Protection Menu

The protection menu contains the settings that are essential for operation of the metering and protection functions. These settings correspond to the electrical engineering characteristics for the installation to be protected, and must always be implemented at the time of commissioning.

Parameters Menu

The parameters menu contains the parameters and additional functions that can be used to adapt operation of the VIP protection relay to particular applications. On leaving the factory, all these parameters are preset to a default value. The protection functions are operational even if these parameters have not been set at the time of commissioning.

Standard Mode or Custom Mode

In the parameters menu, the **OUTPUT CUST** screen can be used to choose standard or custom operating mode. This concerns operation of the Mitop trip unit output, and customization of the output relays (VIP410).

By default, these elements operate in standard mode and the customization screens do not appear in the parameters menu. More information is available in the mimic diagrams of VIP operation in standard mode *(see page 14)*.

Custom mode can be used to modify operation of the Mitop trip unit output, and customization of the output relays (VIP410). In this case, the screens required to customize or view operation of these elements appear in the parameters menu. More information is available in the Custom Operating Mode section *(see page 131)*.

Customization Associated with the Circuit Breaker

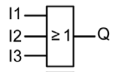
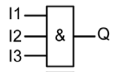
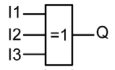
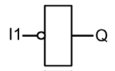
In the parameters menu, the **CB CUSTOM** screen can be used to choose whether or not to display VIP customization to the circuit breaker. By default, the customization screens do not appear in the parameters menu. More information is available in the Customization Associated with the Circuit Breaker section *(see page 137)*.

Definition of Symbols

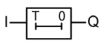
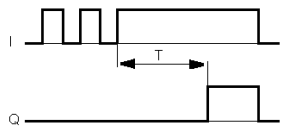
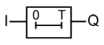
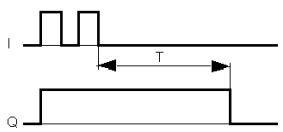
Introduction

The symbols used in the various block diagrams in this chapter are defined below. They are used to represent functions or settings.

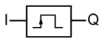
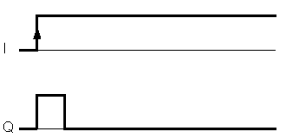
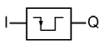
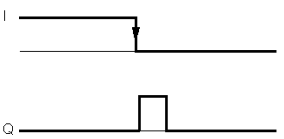
Logic Functions

Function	Equation	Description	Symbol
"OR"	Q = I1 + I2 + I3	Q = 1 if at least one input is at 1.	
"AND"	Q = I1 x I2 x I3	Q = 1 if all inputs are at 1.	
Exclusive "OR"	$Q = I1 \times \overline{I2} \times \overline{I3} + \overline{I1} \times I2 \times \overline{I3} + \overline{I1} \times \overline{I2} \times I3$	Q = 1 if only one input is at 1.	
Complement	$Q = \overline{I1}$	Q = 1 if I1 = 0.	

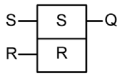
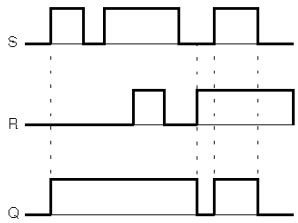
Time Delays

Type	Description	Symbol	Timing Diagram
Pick-up	Used to delay appearance of a data item for a time T.		
Drop-out	Used to delay disappearance of a data item for a time T.		

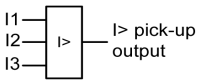
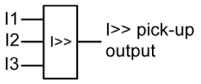
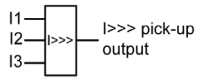
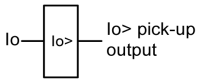
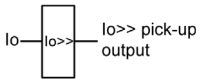
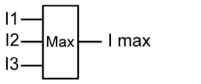
Monostable Function

Type	Description	Symbol	Timing Diagram
Pick-up	Used to create a short pulse (1 cycle) each time a logic signal appears.		
Drop-out	Used to create a short pulse (1 cycle) each time a logic signal disappears. **NOTE:** Disappearance of a data item can be caused by loss of the power supply.		

Bistable Toggle Function

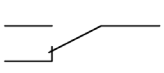
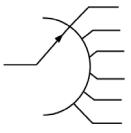
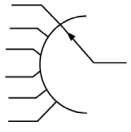
Function	Description	Symbol	Timing Diagram
Bistable toggle	Used to store information. Equation: $Q = S + \overline{R} \times Q$		

Current Input Functions

Function	Description	Symbol
I>	Indicates overshoot of the instantaneous I> set point for phase overcurrent protection.	
I>>	Indicates overshoot of the instantaneous I>> set point for phase overcurrent protection.	
I>>>	Indicates overshoot of the instantaneous I>>> set point for phase overcurrent protection.	
Io>	Indicates overshoot of the instantaneous Io> set point for earth fault protection.	
Io>>	Indicates overshoot of the instantaneous Io>> set point for earth fault protection.	
Max	Selects the maximum rms values for all 3 phase currents.	

Settings

Using settings, the user can modify the VIP logic. Ladder symbols are used to represent these settings, especially customizations.

Function	Description	Symbol
Switch	Assigns a signal to a logic function input.	
Selector switch with 2 inputs	Selects one of 2 inputs.	
Selector switch with 1 input - ***n*** outputs	Selects one of *n* outputs.	
Selector switch with ***n*** inputs - 1 output	Selects one of *n* inputs.	

Choice of Earth Fault Current Measurement Method (VIP410)

Description

On the VIP410, there are two earth fault current measurement methods:
- summing the common point of the 3 phase CTs
- from a CSHU core balance CT (Premset switchboard only), or CSH120, CSH200 or GO110 core balance CT (for very sensitive earth fault protection).

The method should be chosen in the protection menu and must always be selected at the time of commissioning. The chosen method is used by all VIP410 functions which deal with the earth fault current.

NOTE: This setting must be done before entering the protection function settings. If the protection settings are entered before the method is entered, one or more of the protection set points may be outside the permitted current range. In this case, the VIP410 itself resets the set point at the upper or lower limit of the permitted range and the operator has to re-check all the earth fault current settings.

The parameters to be set are:
- Type of core balance CT measurement (**EF OPERATION** screen).
  The possible choice is: **SUM** or **CORE CT**.
- Choice of earth fault current measurement range if a CT is used.
  The possible choice is: 1–24 A or 10–240 A.
  This choice must correspond to the current input to which the core balance CT is connected. For more information, refer to Connecting a Core Balance CT *(see page 29)*. If not, the current measurement will be incorrect and the earth fault protection will not work properly.

Network Frequency

Description

The network frequency can be accessed in the protection menu and must always be indicated (50 or 60 Hz) at the time of commissioning. It is used by all VIP functions which deal with the phase current and the earth fault current.

The VIP uses this parameter to adapt operation of the metering and protection algorithms to the network frequency. If the setting is implemented incorrectly, the accuracy of the metering and protection functions will be seriously affected.

The parameter to be set is the network frequency (**FREQUENCY** screen).

Phase Overcurrent Protection (ANSI 50-51)

Description

Phase overcurrent protection is used to detect overcurrents due to phase-to-phase faults. It uses the measurement of the fundamental component of the currents produced by all 3 phase CTs.

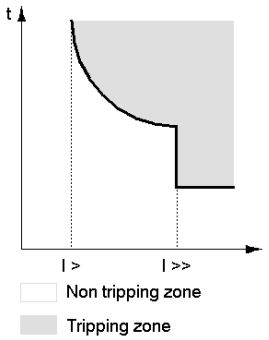
3 independent set points (I>, I>> and I>>>) can be set to offer optimum discrimination:

- The first 2 set points (I> and I>>) have either a definite time (DT) or inverse definite minimum time (IDMT) setting with different types of standardized curve (IEC, IEEE, RI).
- The third set point (Io>>>) has a definite time (DT) or instantaneous (INST) setting. The INST setting can be used to obtain instantaneous tripping (ANSI 50 function).

These set points can be used:

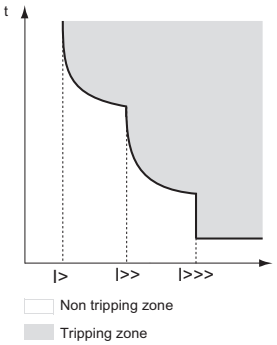
- In all cases, to detect phase-to-phase ground faults with 1 or 2 set points depending on the protection plan adopted (see example 1).
- In the case of a protection located at the connection point to the distributor network, to provide current limiting and thus comply with the maximum subscribed demand defined in the contract for connection to the distributor network. If the distributor imposes this limiting, this can be performed by the first I> set point with an IDMT curve (see example 2).

Example 1: Example of typical application: protection curve with a first IDMT I> set point and a second DT I>> set point



Example 2: Example of application with current limiting:

- Limiting curve with a first IDMT I> set point to limit the current to the subscribed demand defined in the contract for connection to the distributor network.
- Protection curve against phase-to-phase faults with the second IDMT I>> set point and the third DT I>>> set point.

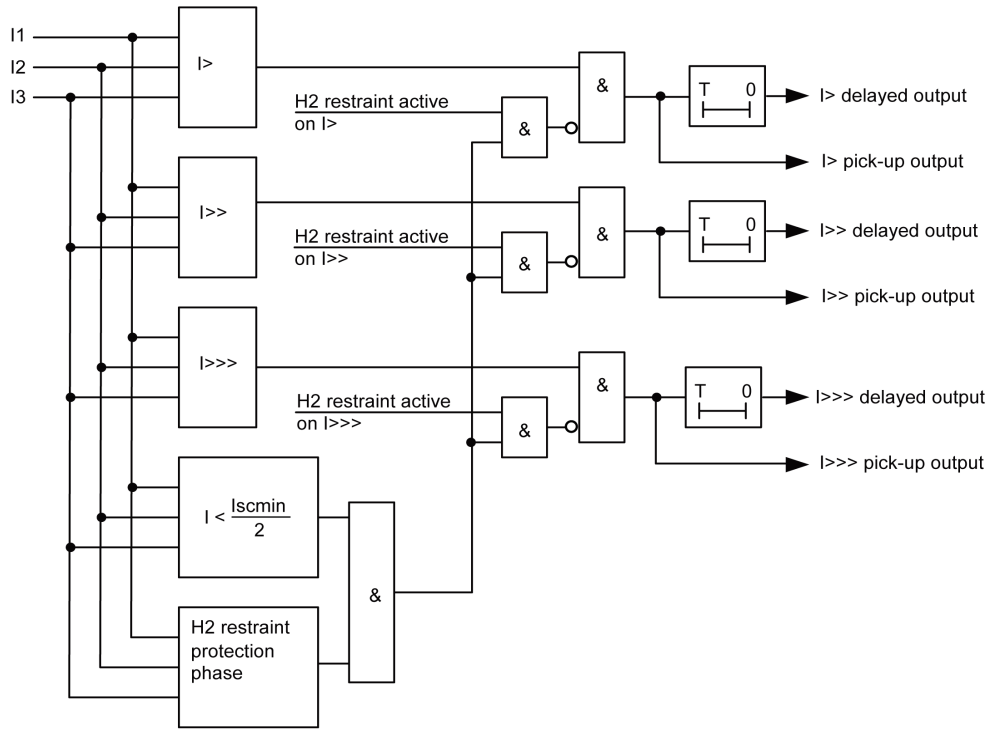


Additional Functions

The VIP integrates functions that complement phase overcurrent protection:

- Harmonic 2 restraint specific to phase overcurrent protection:
  Conditions for operation of all 3 I>, I>> and I>>> set points can be imposed by a restraint based on the detection of a second harmonic component in the phase currents. Activation of this restraint is recommended for applications where the phase set points must be set at levels close to the installed base current (example: settings imposed by the distributor's requirements). These settings, which are relatively sensitive, are likely to trip on transient currents related to energization of one or more power transformers downstream of the protection. The H2 restraint can be used to detect that the harmonic content of the phase currents is symptomatic of the transformer energization currents. The H2 restraint inhibits the set points during the transient linked to transformer energizing. By default, the H2 restraint function is not active. Refer to the rest of this section for more information.
- Reset time:
  With an IDMT setting, the set point parameters are set in order to activate an IDMT reset time. This enables coordination with electromechanical relays. By default, the reset time is not active. More information is available about tripping curves *(see page 84)*.
- Phase overcurrent Cold Load Pick-Up (CLPU I), (VIP410):
  Operation of all 3 I>, I>> and I>>> set points can be associated with the CLPU I function, which is used to avoid nuisance tripping of the protection when the installation is energized. By default, the CLPU I function is not active. Refer to Phase Overcurrent Cold Load Pick-Up (Cold Load Pick-Up I) *(see page 94)*.
- Setting groups A and B (VIP410):
  Phase overcurrent protection (and earth fault protection) offers 2 distinct setting groups so that the settings can be adapted to a change of electrical network operating mode. The setting group can be switched from the keypad on the front panel or from the communication interface. Refer to the rest of this section for more information.

Block Diagram



Standard Operation

If the 3 phase overcurrents exceed the I>, I>> or I>>> set point:

- The I> LED flashes quickly.
- The corresponding pick-up output changes state.
  Only the I>>> set point pick-up output is accessible on the Mitop trip unit output or output relays (VIP410), (see Note below).

After the time delay associated with the I>, I>> or I>>> set point has elapsed:

- The I> LED flashes slowly.
- The Mitop trip unit output is activated.
- An event is recorded in the list of the last 5 events.
- Output relay O1 changes state if the auxiliary power supply is present (VIP410).

Pressing the **Reset** key acknowledges the fault, causes the LED to go out I> and return to its initial state of the O1 relay (VIP410).

NOTE: If the I>>> set point curve selection is set to **INST** (instantaneous), the I>>> delayed output is equivalent to the I>>> pick-up output.

The **INST** setting can only be accessed if the VIP is configured without a minimum tripping time. This parameter setting is defined by customizing the VIP associated with the circuit breaker *(see page 137)*.

Customization Option

VIP's custom mode can be used to modify standard operation:

- Assignment of the I>, I>> and I>>> set points to the Mitop trip unit output can be modified.
- Assignment of the I>, I>> and I>>> set points to the O1 trip unit output can be modified (VIP410).
- Latching of output relays O1, O2, O3 associated with the protection functions or the external trip can be disabled (VIP410).

More information is available in the Custom Operating Mode section *(see page 131)*.

Phase Protection Harmonic 2 Restraint Operation

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

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

This ratio is compared to an adjustable set point (from 5% to 50%). If the set point is exceeded, the I> and/or I>> and/or I>>> set points are inhibited, depending on the parameter setting of the H2 restraint.

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 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 phase protection throughout energization. This restraint automatically disables itself once the H2 ratio decreases.

The harmonic 2 level depends on the build characteristics of the power transformers and the network load level at the time of energization. The setting range for the second-harmonic set point can be used to adapt the restraint to various application scenarios. A default set point of 17% is proposed, since this setting is suitable for the majority of application scenarios.

In the event of a phase-to-phase short-circuit, the restraint must not operate, to avoid introducing a delay in the phase protection tripping. The short-circuit may have an aperiodic component likely to result in transient saturation of the CTs. From then on, the protection may measure a harmonic 2 restraint likely to activate the phase protection restraint unintentionally. To avoid this scenario, the restraint takes account of the installation minimum short-circuit current value (Isc_{min} setting). If one of the 3 phase currents is higher than half the minimum short-circuit current value, the restraint is inhibited automatically throughout the short-circuit duration.

Operation of Setting Groups A and B (VIP410)

Phase protection integrates 2 setting groups for the I>, I>> and I>>> set points. Each set offers the following settings:

- the choice of tripping curve (DT, IDMT, etc.)
- the set point setting
- the delay setting

The other possible phase protection settings are common to both setting groups (harmonic 2 restraint, reset time, phase Cold Load Pick-Up). Setting group A applies by default.

The setting groups can be switched:

- from the keypad on the front panel. Refer to the Use section *(see page 39)*.
- from the communication interface via a remote control order. Refer to the Communication section *(see page 143)*.

Settings

Setting the I> and I>> Set Points		Authorized Values
Tripping curve More information is available about the overcurrent protection tripping curves *(see page 82)*.		The following values are authorized: ● OFF: set point off ● DT: definite time ● SIT/A: IEC/A standard inverse time ● LTI/B: IEC long time inverse ● VIT/B: IEC/B very inverse time ● EIT/C: IEC/C extremely inverse time ● MI/D: IEEE moderately inverse or IEC/D ● VI/E: IEEE very inverse or IEC/E ● EI/F: IEEE extremely inverse or IEC/F ● RI
I> or I>> set point	DT curve	0.05...20 In
	IDMT curve	0.05...2 In
Time delay	DT curve	0.05...300 s in steps of: ● 0.01 s, from 0.05 to 9.99 s ● 0.1 s, from 10.0 to 99.9 s ● 1 s, from 100 to 300 s
	IEC, RI curves	TMS: 0.02...2 (step: 0.01)
	IEEE curves	TD: 0.5...15 (step: 0.1)
	Reset time	Setting common to I>, I>> and Io> set points: ● OFF: reset time off ● ON: reset time on

Setting the I>>> Set Points		Authorized Values
Tripping curve		The following values are authorized: ● OFF: set point off ● DT: definite time ● INST: instantaneous set point (pick-up), refer to the second note below.
I>>> set point	INST or DT curve	0.1...20 In
Time delay	DT curve	0.05...300 s in steps of: ● 0.01 s, from 0.05 to 9.99 s ● 0.1 s, from 10.0 to 99.9 s ● 1 s, from 100 to 300 s

Phase Protection Harmonic 2 Restraint Settings	Authorized Values
Activity	● OFF: off ● ALL: action on I>, I>> and I>>> ● I>: action on I> only ● I>>: action on I>> only ● I>>>: action on I>>> only ● I> & I>>: action on I> and I>> ● I> & I>>>: action on I> and I>>> ● I>> & I>>>: action on I>> and I>>>
Second-harmonic set point	5...50% in steps of 1%
Minimum short-circuit current Isc_{min}	In...25 kA

NOTE:

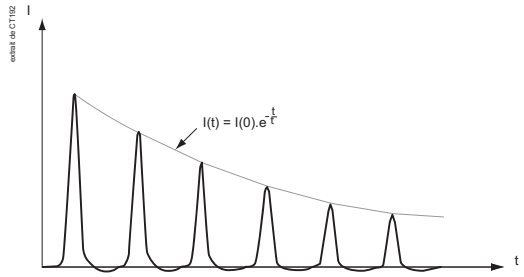
In is the phase CT primary rated current:
- In = 200 A for the CUa sensors
- In = 630 A for the CUb sensors

NOTE: The **INST** setting for the Io>> set point can only be accessed if the VIP is configured without a minimum tripping time. This parameter setting is defined by customizing the VIP associated with the circuit breaker *(see page 137)*.

Sensitivity to Transformer Inrush Currents

When a transformer closes, the magnetizing currents can reach amplitudes, in peak values, of around 5 to 12 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:



Measurement of the VIP currents is not affected by the presence of an aperiodic component (50 Hz or 60 Hz), which allows a significant reduction in the ANSI 51 protection function settings.

In instantaneous protection (ANSI 50), the I>>> set point should be set to at least 37% of the peak value of the inrush current stated by the transformer manufacturer.

With delayed protection (ANSI 51), the same rule applies, taking account of the current attenuation according to the time constant stated by the transformer manufacturer.

If the protection plan requirements impose settings that do not comply with the above rules, it is advisable to activate the phase protection harmonic 2 restraint.

Settings for Using the Function

Compulsory settings in the protection menu:

- Network frequency selection (**FREQUENCY** screen)
- I> set point setting (**I> 51** screen)
- I>> set point setting (**I>> 51** screen)
- I>>> set point setting (**I>>> 50-51** screen)

Additional settings in the protection menu:

- Use of the phase protection harmonic 2 restraint (**PHASE H2 RES** screen)
- For the VIP410: I>, I>> and I>>> set point settings for setting group B (**SET GROUPS** screen)

Additional settings in the parameters menu:

- Activation of the reset time (**RESET TIME** screen) This setting is common to the I>, I>> and Io> set points.
- For the VIP410: Phase Cold Load Pick-Up setting (**COLD LOAD I** screen)

Earth Fault Protection (ANSI 50N-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.

With the VIP410, the earth fault current can be measured using two measurement methods (see diagram below):

- earth fault current measurement based on the sum of the 3 phase CTs (same as VIP400)
- earth fault current measurement via a CSH120, CSH200, GO110 or CSHU core balance CT. The use of these sensors results in earth fault protection with excellent sensitivity.

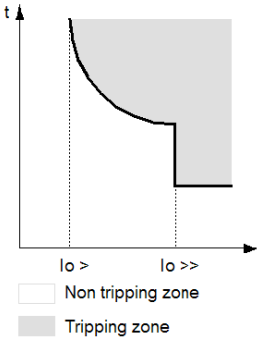
Earth fault protection can be used in a variety of application scenarios:

- incomer/feeder protection
- neutral point protection (VIP410)

2 independent set points (Io> and Io>>) can be set to offer optimum discrimination:

- The set point (Io>) has either a definite time (DT) or inverse definite minimum time (IDMT) setting with different types of standardized curve (IEC, IEEE, RI).
- The set point (Io>>) has a definite time (DT) or instantaneous (INST) setting. The **INST** setting can be used to obtain instantaneous tripping (ANSI 50N function).

Example: Curve for IDMT type Io> set point and DT type Io>> set point

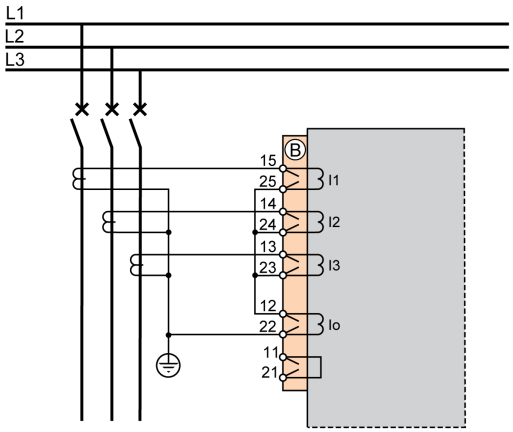


Sensitivity and Connection Block Diagrams

Depending on the required sensitivity level, the VIP enables 2 residual current measurement methods associated with the earth fault current:

- earth fault protection using sum of the 3 CTs (VIP400 and VIP410)
- earth fault protection using core balance CT (VIP410)

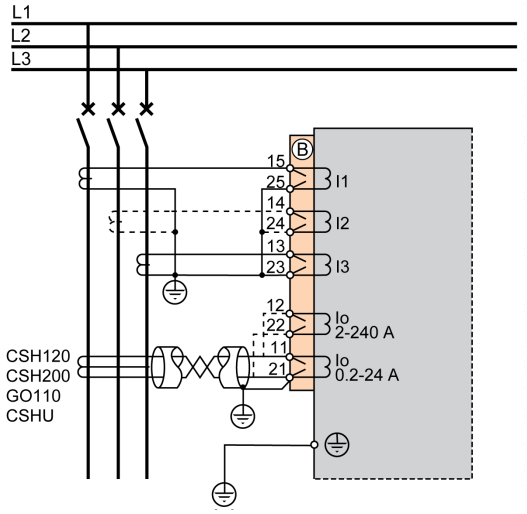
Earth fault protection using sum of the 3 CTs (VIP400 and VIP410):



This method allows a minimum protection setting of 2.5% of the phase CT rating. However, if the protection set point needs to be set to low current values (e.g.: a few amps), associated with a reduced time delay (e.g.: DT definite time delay of 100 ms), it is highly advisable to use a core balance CT (diagram below).

In the case of measurement based on the sum of the 3 CTs, transient saturation of the phase CTs on the aperiodic primary components (short-circuit, transformer energizing, etc.) can lead to measurement of an incorrect earth fault current and result in nuisance tripping of the protection. In the majority of application scenarios, the harmonic 2 restraint can reduce this risk, but if installation of a core balance CT is possible, this solution will allow more sensitive setting levels.

Earth fault protection using core balance CT (VIP410):



This method works with specifically designed core balance CTs. 4 types of core balance CT are proposed:

Core Balance CT	Ratio	CT Type	Inner Diameter
CSH120	470/1	Closed	120 mm (4.7 in.)
CSH200	470/1	Closed	196 mm (7.7 in.)
GO110	470/1	Open	110 mm (4.3 in.)
CSHU	470/1	Closed	N/A: sensor integrated in the cubicle.

For more information about installation of core balance CTs, refer to the following sections:
- CSH120, CSH200 and GO110 Core Balance CTs *(see page 34)*
- CSHU Core Balance CT *(see page 37)*

This method of wiring the VIP410 is particularly suitable for application scenarios that require detection of low levels of earth fault current, wired as an alarm or as a trip.

The VIP410 proposes 2 sensitivity ranges, depending on how the core balance CT is connected to the VIP410:
- 1 A–24 A range (primary current), with a minimum setting of 1 A with a DT curve or 0.2 A with an IDMT curve
- 10–240 A range (primary current), with a minimum setting of 10 A with a DT curve or 2 A with an IDMT curve

For more information about connecting the core balance CT to the VIP410, refer to the Mounting Instructions *(see page 36)*.

Recommended Settings

Depending on the earth fault current measurement method used, the table below defines the recommended earth fault protection set point settings. This involves general recommendations that can be affected by the general installation characteristics, namely:

- the installed power of power transformers downstream of the VIP relay
- setting of the earth fault protection delays, usually imposed by the installation protection plan

Earth Sensor	Recommendation Concerning the Minimum Set Point	Comments
Sum of the 3 phase CTs	Iso ≥ 2.5 % to 10% CT In In = 630 A or 200 A	With H2 restraint activated or possibly CLPU Io
CSH120 CSH200 GO110	Iso ≥ 1 A (DT time delay) Iso ≥ 0.2 A (IDMT time delay)	Without H2 restraint and without CLPU Io
CSHU	Iso ≥ 5 A: case of 630 A circuit breaker Iso ≥ 2 A: case of 200 A circuit breaker	Without H2 restraint and without CLPU Io (see Note below)

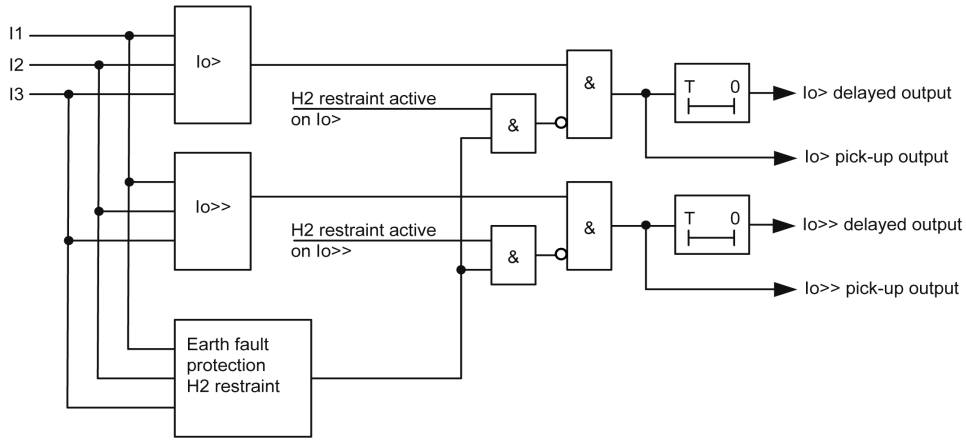
NOTE: With a CSHU CT and installed power of power transformers downstream of the VIP that would correspond to a current higher than 630 A, it is advisable to activate the H2 restraint. This restraint eliminates the risk of nuisance tripping of the earth fault protection when all the power transformers are energized simultaneously.

Additional Functions

The VIP integrates functions that complement earth fault protection:

- Harmonic 2 restraint specific to earth fault protection:
  Conditions for operation of both the Io> and Io>> set points can be imposed by a restraint based on the detection of a second harmonic component in the phase currents. Activation of this restraint is recommended on incoming and outgoing transformer applications, if the earth fault current measurement is based on the 3 phase CTs. In this example, the aperiodic component of the transformer inrush currents can cause transient saturation of the phase CTs and result in “incorrect” earth fault current measurement likely to result in nuisance tripping of the earth fault protection. The harmonic 2 restraint can be used to detect this “incorrect” residual current and inhibits the earth fault set points during the transient currents linked to energizing.
- Reset time:
  For an IDMT setting, the set point parameters are configured so as to activate an IDMT reset time. This enables coordination with electromechanical relays. By default, the reset time is not active *(see page 84)*.
- Earth Fault Cold Load Pick-Up (CLPU Io (VIP410):
  Operation of both the Io> and Io>> set points can be associated with the CLPU Io function, which is used to avoid nuisance tripping of the protection when the installation is energized. By default, the CLPU Io function is not active. Refer to the Earth Fault Cold Load Pick-Up Io section *(see page 97)*.
- Setting groups A and B (VIP410):
  Earth fault protection (and phase overcurrent protection) offers 2 distinct setting groups so that the settings can be adapted to a change of electrical network operating mode. The setting group can be switched from the keypad on the front panel or from the communication interface. Refer to the rest of this section for more information.

Block Diagram



Standard Operation

If the earth fault current exceeds the Io> or Io>> set point:

- The  LED flashes quickly
- The corresponding pick-up output changes state.
  Only the Io>> set point pick-up output is accessible on the Mitop trip unit output or output relays (VIP410) (see Note below).

After expiry of the time delay associated with the Io> or Io>> set point:

- The  LED flashes slowly
- The Mitop trip unit output is activated.
- An event is recorded in the list of the last 5 events.
- Output relay O2 changes state if the auxiliary power supply is present (VIP410).

Pressing the **Reset** key acknowledges the fault and causes the LED to go out  .

NOTE: If the Io>> time delay is set to **INST** (instantaneous), the Io>> delayed output is equivalent to the Io>> pick-up output.

The **INST** setting can only be accessed if the VIP is configured without a minimum tripping time. This parameter setting is defined by customizing the VIP associated with the circuit breaker *(see page 137)*.

Customization Option

The VIP's custom mode can be used to modify standard operation:

- Assignment of the Io> and Io>> set points to the Mitop trip unit output can be modified.
- Assignment of the Io> and Io>> set points to output relay O2 can be modified (VIP410).
- Latching of output relays O1, O2, O3 associated with the protection functions or the external trip can be disabled (VIP410).

More information is available in the Custom Operating Mode section *(see page 131)*.

Earth Fault Protection Harmonic 2 Restraint Operation

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

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

This ratio is compared to a fixed set point of 17%. If the set point is exceeded, the Io> and/or Io>> set points are inhibited, depending on the parameter setting of the H2 restraint.

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 energization of the power transformer(s), 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.

To avoid this restraint becoming active in the event of a phase-to-earth fault, make sure that the phase-to-earth fault current remains lower than the phase CT saturation current:

- In an impedant earthing system, since the earth fault current is limited, this operating condition is usually fulfilled.
- In a directly earthed system, the earth fault current is high. Since the set points can be set at high levels, there is no need to use the harmonic 2 restraint function.

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 can 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 Setting Groups A and B (VIP410)

Earth fault protection integrates both setting groups for the Io> and Io>> set points. Each set offers the following settings:

- the choice of tripping curve (DT, IDMT, etc.)
- the set point setting
- the delay setting

The other possible earth fault protection settings are common to both setting groups (harmonic 2 restraint, reset time, earth fault Cold Load Pick-Up). Setting group A applies by default.

The setting groups can be switched:

- from the keypad on the front panel. Refer to the Use section *(see page 39)*.
- from the communication interface via a remote control order. Refer to the Communication section *(see page 143)*.

Io> Set Point Setting Ranges (Sum of the 3 Phase CTs Method)

Due to restricted operation in the event of low load current, inherent in a stand-alone relay, the earth fault protection Io> low set point can be defined in 2 setting ranges:

- The default setting range is 0.1 In to 10 In, which corresponds to the default parameter setting. The use of this range guarantees operation of the earth fault protection for all examples of setting, regardless of the load current. The lowest set point in the range (0.1 In) is higher than the pick-up current.
- The extended setting range is 0.025 In to 10 In, allowing more sensitive earth fault protection settings. In this case, the lowest set point for earth fault protection can be lower than the pick-up current. Given that the VIP operates independently, use of this range requires the following technical limitations to be taken into consideration:
  - In the event of a low setting, the earth fault protection will only operate if the phase current is higher than the pick-up current.
  - 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 VIP400 pick-up time. For an earth fault current higher than 0.06 In, the pick-up time is between 20 ms and 140 ms, depending on the fault current *(see page 211)*. For an earth fault current lower than 0.06 In, the pick-up time can exceed the time interval that guarantees time discrimination with the upstream relay. In this particular example, the pick-up time can lead to the VIP400 relay and the upstream relay tripping twice.

Activation of the Io> Set Point Extended Setting Range

Activation of the Io> earth fault set point extended range is accessible from the **GF OP RANGE** screen in the protection menu. This screen offers 2 possible settings:

- **RANGE=DEFAULT**, to activate the default setting range
- **RANGE=EXTENDED**, to activate the extended setting range

After reading the above operating recommendations, if the extended setting range needs to be activated, simply configure the screen with the **RANGE=EXTENDED** setting, and the extended range will be enabled for the screen used for setting the Io> set point in the protection menu *(see page 53)*.

Settings

Io> Set Point Settings				**Authorized Values**
Tripping curve More information is available about the overcurrent protection tripping curves *(see page 82)*.				The following values are authorized: ● OFF: set point off ● DT: definite time ● SIT/A: IEC/A standard inverse time ● LTI/B: IEC long time inverse ● VIT/B: IEC/B very inverse time ● EIT/C: IEC/C extremely inverse time ● MI/D: IEEE moderately inverse or IEC/D ● VI/E: IEEE very inverse or IEC/E ● EI/F: IEEE extremely inverse or IEC/F ● RI
Io> set point	DT curve	Sum of the 3 CTs method		Default range: 0.1...10 In Extended range: 0.025...10 In
		Core balance CT method	1–24 A rating	0.002...0.05 Ino (1...24 A)
			10-240 A rating	0.02...0.5 Ino (10...240 A)
	IDMT curve	Sum of the 3 CTs method		Default range: 0.05...1 In Extended range: 0.025...1 In
		Core balance CT method	1-24 A rating	0.0004...0.005 Ino (0.2...2.4 A)
			10-240 A rating	0.004...0.05 Ino (2...24 A)
Time delay	DT curve			0.05...300 s in steps of: ● 0.01 s, from 0.05 to 9.99 s ● 0.1 s, from 10.0 to 99.9 s ● 1 s, from 100 to 300 s
	IEC, RI curves			TMS: 0.02...2 (step: 0.01)
	IEEE curves			TD: 0.5...15 (step: 0.1)
	Reset time			Setting common to I>, I>> and Io> set points: ● OFF: reset time off ● ON: reset time on

Io>> Set Point Settings				**Authorized Values**
Tripping curve				The following values are authorized: ● OFF: set point off ● DT: definite time ● INST: instantaneous set point (pick-up), refer to the second note below.
Io>> set point	DT curve	Sum of the 3 CTs method		0.1...10 In
		Core balance CT method	1-24 A rating	0.002...0.05 Ino (1...24 A), see third note below
			10-240 A rating	0.02...0.5 Ino (10...240 A), see third note below
Time delay	DT curve			Instantaneous (pick-up) or 0.05...300 s in steps of: ● 0.01 s, from 0.05 to 9.99 s ● 0.1 s, from 10.0 to 99.9 s ● 1 s, from 100 to 300 s

NOTE:

For the sum of the 3 CTs method, the In current is the phase CT primary rated current:

- In = 200 A for the CUa sensors
- In = 200 A for the CUb sensors

For the core balance CT version, the Ino current is the CSH120, CSH200, GO110 or CSHU core balance CT primary rated current:
- Ino = 470 A

NOTE: The **INST** setting for the Io>> set point can only be accessed if the VIP is configured without a minimum tripping time.

This parameter setting is defined by customizing the VIP associated with the circuit breaker *(see page 137)*.

NOTE: If the Io> set point uses a IDMT curve, the Io>> set point setting range depends on the Io> setting, with the following limits:

	Rating	**Io> Setting (IDMT)**	**Io>> Setting Range (DT)**
Core balance CT method	1–24 A	0.2...0.3 A	1...8 A
		0.4...0.5 A	1...12 A
		0.6...1.1 A	1...24 A
		1.2...2.4 A	1.2...24 A
	10–240 A	2...3.5 A	10...80 A
		3.6...5.6 A	10...120 A
		5.7...11.9 A	10...240 A
		12...24 A	12...240 A

Earth Fault Protection Harmonic 2 Restraint Settings	**Authorized Values**
Activity	• OFF: off • ALL: action on Io> and Io>> • Io>: action on Io> only • Io>>: action on Io>> only
Second-harmonic set point	17% (not adjustable)

NOTE:

The In current is the phase CT primary rated current.
- In = 200 A for the CUa sensors
- In = 630 A for the CUb sensors

NOTE: The **INST** setting for the Io>> set point can only be accessed if the VIP is configured without a minimum tripping time.

This parameter setting is defined by customizing the VIP associated with the circuit breaker *(see page 137)*.

Settings for Using the Function

Compulsory settings in the protection menu:
- Network frequency selection (**FREQUENCY** screen)
- Low set point Io> setting (**Io> 51N** screen)
- High set point Io> setting (**Io>> 51N** screen)
- For the VIP410: Choice of earth fault current measurement method (**EF OPERATION** screen, **SUM** or **CORE CT** settings). With a **CORE CT** type sensor, 1…24 A or 10…240 A operating range setting.

Additional settings in the protection menu:
- Use of the earth fault protection harmonic 2 restraint (**EARTH H2 RES** screen).
- For the VIP410: Io> and Io>> set point settings for setting group B (**SET GROUPS** screen).

Additional settings in the parameters menu:
- Activation of the reset time (**RESET TIME** screen). This setting is common to the I>, I>> and Io> set points.
- For the VIP410: Earth fault Cold Load Pick-Up setting (**COLD LOAD Io** screen).

Overcurrent Protection Tripping Curves

Introduction

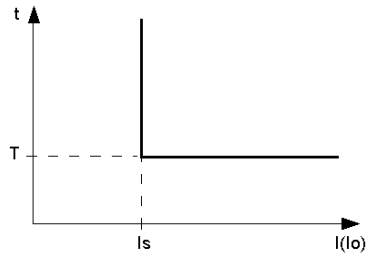
Phase or earth fault overcurrent protection can be delayed using the following types of tripping curve:
- Definite time (DT): I>, I>>, I>>>, Io> and Io>> set points
- IDMT: I>, I>> and Io> set points only

In the case of standardized IDMT curves (IEC and IEEE type only), a reset time can be activated. This reset time enables the VIP's coordination with electromechanical relays, placed upstream.

Definite Time (DT) Curve

In definite time (DT) protection functions, the tripping time is constant. The time delay is initialized as soon as the operating set point Is is passed.

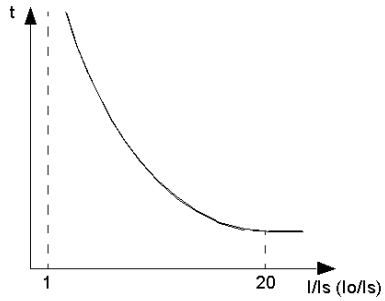
Definite time protection principle



IDMT Curve

In IDMT protection functions, the tripping time depends on the measured value (phase or earth fault current), in accordance with standards IEC 60255-151 and IEEE C-37112.

Operation is represented by characteristic curves t = f(I/Is) or t = f(Io/Is) (where Is is the operating set point), which look like this:



The curve is defined by:
- its type (IEC, IEEE, inverse, very inverse, extremely inverse, etc.)
- its current setting Is, which corresponds to the vertical asymptote of the curve
- its time delay setting, which corresponds to a multiplying factor:
  - TMS (Time Multiplying Setting) for IEC and RI curves
  - TD (Time Dial) for IEEE curves

When a high current is being measured, the following rules apply:
- When the value being monitored is more than 20 times the set point, the maximum tripping time corresponds to a value of 20 times the set point.
- For low-level TMS or TD settings, the minimum tripping time can be defined by the instantaneous operating time of the pick-up output or by the minimum tripping time, if this parameter has been activated. This parameter is set from the **MIN TRIPTIME** *(see page 137)* screen.

Equation for IEC Curves (A, B, C Curves)

IEC curves are defined by the following equation:

$$td(I) = \frac{k}{\left(\frac{I}{Is}\right)^{\alpha} - 1} \times TMS$$

Tripping curve parameters depending on the type of curve:

Characteristic Curve	k	α
IEC standard inverse time SIT or IEC/A in accordance with standard IEC 60255-151	0.14	0.02
IEC very inverse time VIT or IEC/B in accordance with standard IEC 60255-151	13.5	1
IEC long time inverse LTI	120	1
IEC extremely inverse time EIT or IEC/C in accordance with standard IEC 60255-151	80	2

Equation for IEEE Curves (or IEC, Curves D, E, F)

IEEE curves are defined by the following equation:

$$td(I) = \left(\frac{k}{\left(\frac{I}{Is}\right)^{\alpha} - 1} + c \right) \times TD$$

Tripping curve parameters depending on the type of curve:

Characteristic Curve	k	c	α
IEEE moderately inverse (MI) or IEC/D in accordance with standard IEC 60255-151	0.0103	0.0228	0.02
IEEE very inverse (VI) or IEC/E in accordance with standard IEC 60255-151	3.922	0.0982	2
IEEE extremely inverse (EI) or IEC/F in accordance with standard IEC 60255-151	5.64	0.02434	2

NOTE: Compared to the coefficients defined in standard IEC 60255-151, the k and c coefficients of the VIP D, E, F curves are divided by a 5 coefficient. But this 5 coefficient is integrated in the TD (Time Dial) setting, to propose a setting range from 0.5 to 15, comparable to the ranges for the IEEE electromechanical relays. Finally, setting a VIP IEEE curve with a TD equal to 10 is equivalent to setting an IEC curve type D, E or F with a TMS or TD coefficient equal to 2.

Equation for the RI Curve

The RI curve is defined by the following equation:

$$td(I) = \frac{1}{0,339 - 0,236\left(\frac{I}{Is}\right)^{-1}} \times TMS$$

Reset Time

When the I>, I>> and Io> set points use standardized IDMT curves (IEC or IEEE type), it is possible to activate an IDMT reset time. This characteristic ensures coordination of a VIP with an electromechanical overcurrent relay, placed upstream.

Without a reset time, the tripping time delay counter is reset once the current drops back below the set point (I < 95% Is).

With a reset time, when the current drops back below the set point, the time delay counter is decremented in line with a curve that depends on the measured current value. The aim is to reproduce the operation of the electromechanical relay disk. The reset time corresponds to the time it would take the disk to return from its maximum position (fault current) to its off-position. This time depends on the current measured by the VIP relay.

The reset time curve is defined in standard IEEE C-37112.

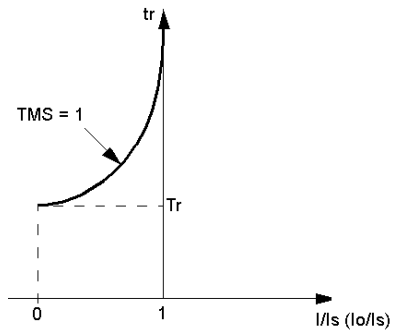
It is defined by the following equation:

$$tr(I) = \frac{Tr}{1 - \left(\frac{I}{Is}\right)^2} \times TMS$$

where:
- Is: Tripping set point value
- I (Io): Current measured by the protection function
- TMS (or TD): Tripping curve setting
- Tr: Value of the reset time for a zero current and TMS = 1, this value Tr is defined in the table below:

Characteristic Curve	Tr
IEC standard inverse time SIT/IEC A	12.1
IEC very inverse time VIT/IEC B	43.2
IEC long time inverse LTI	120
IEC extremely inverse time EIT/IEC C	80
IEEE moderately inverse (MI)/IEC D	0.97
IEEE very inverse (VI)/IEC E	4.32
IEEE extremely inverse (EI)/IEC F	5.82

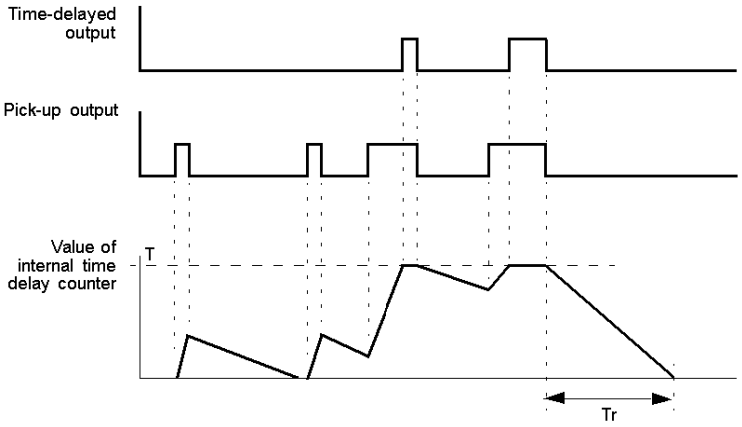
The corresponding curve looks like this:



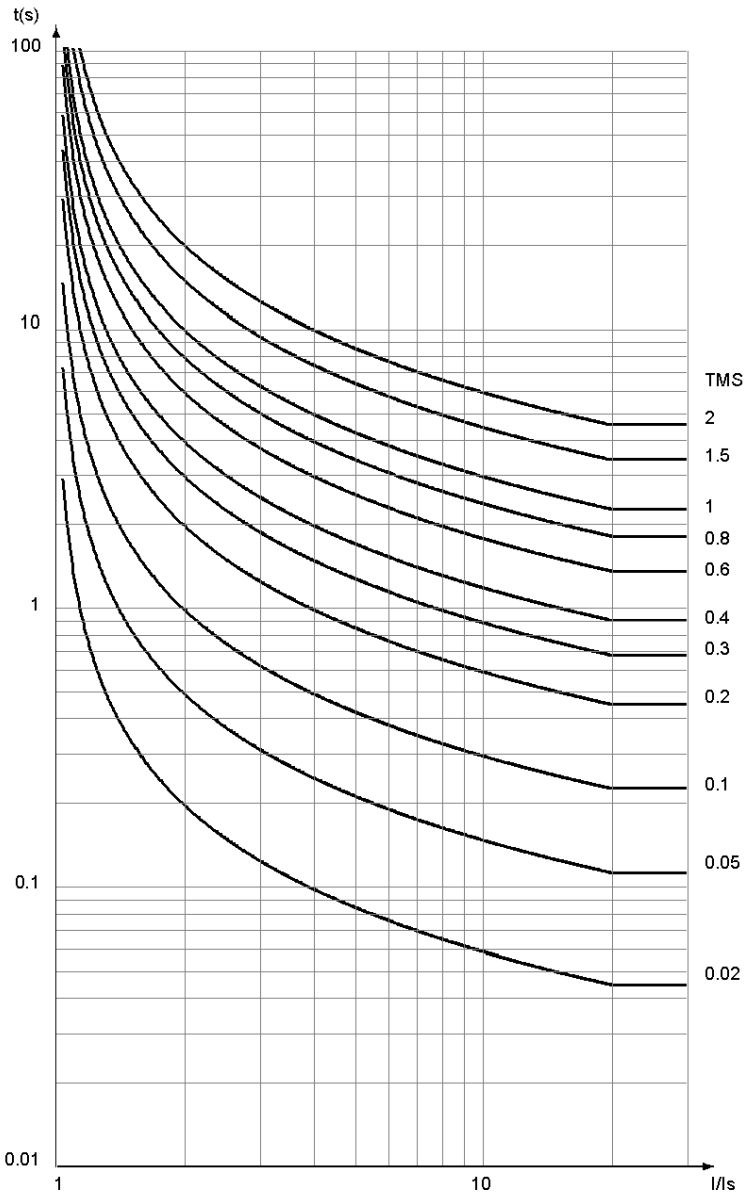
NOTE: Like for the tripping curves, the Tr coefficient of the VIP D, E, F curves is divided by a 5 coefficient compared to the coefficients defined in standard IEC 60255-151. But this 5 coefficient is integrated in the TD (Time Dial) setting, to propose a setting range from 0.5 to 15, comparable to the ranges for the IEEE electromechanical relays. Finally, setting a VIP IEEE curve with a TD equal to 10 is equivalent to setting an IEC curve type D, E or F with a TMS or TD coefficient equal to 2.

Example of Reset Time

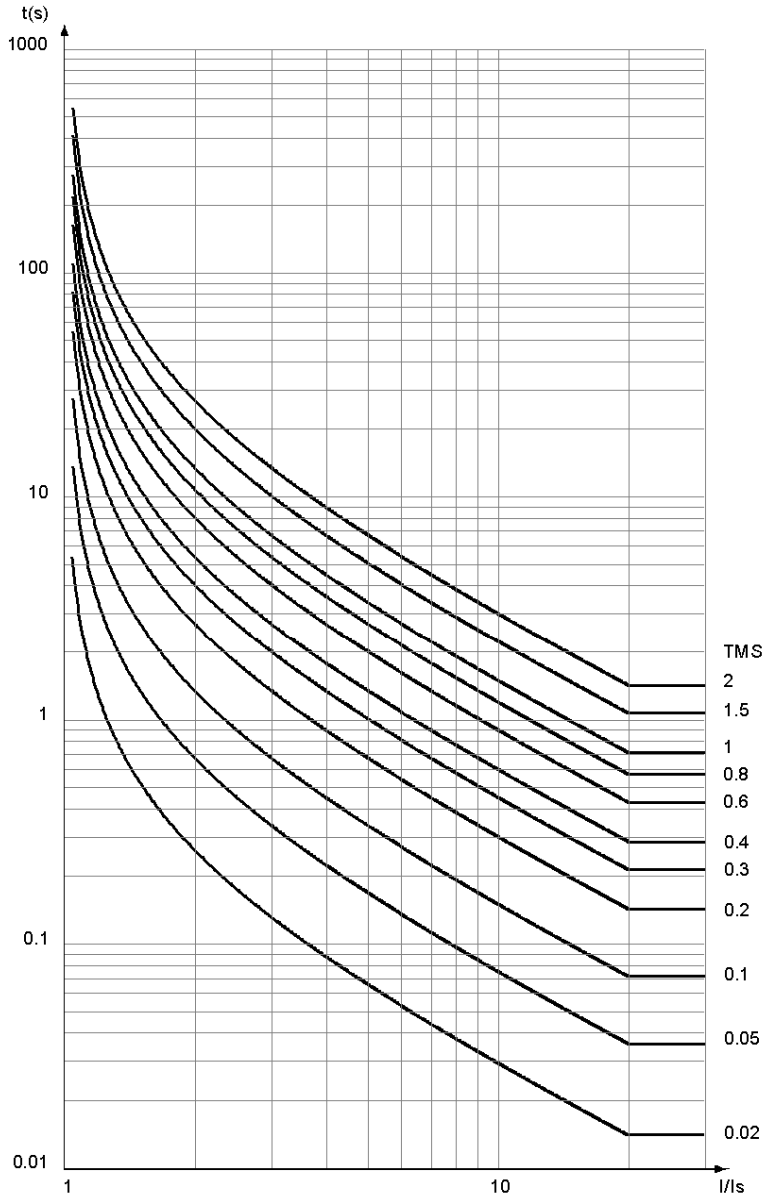
The timing diagram below explains the operation caused by the current-dependent reset time:



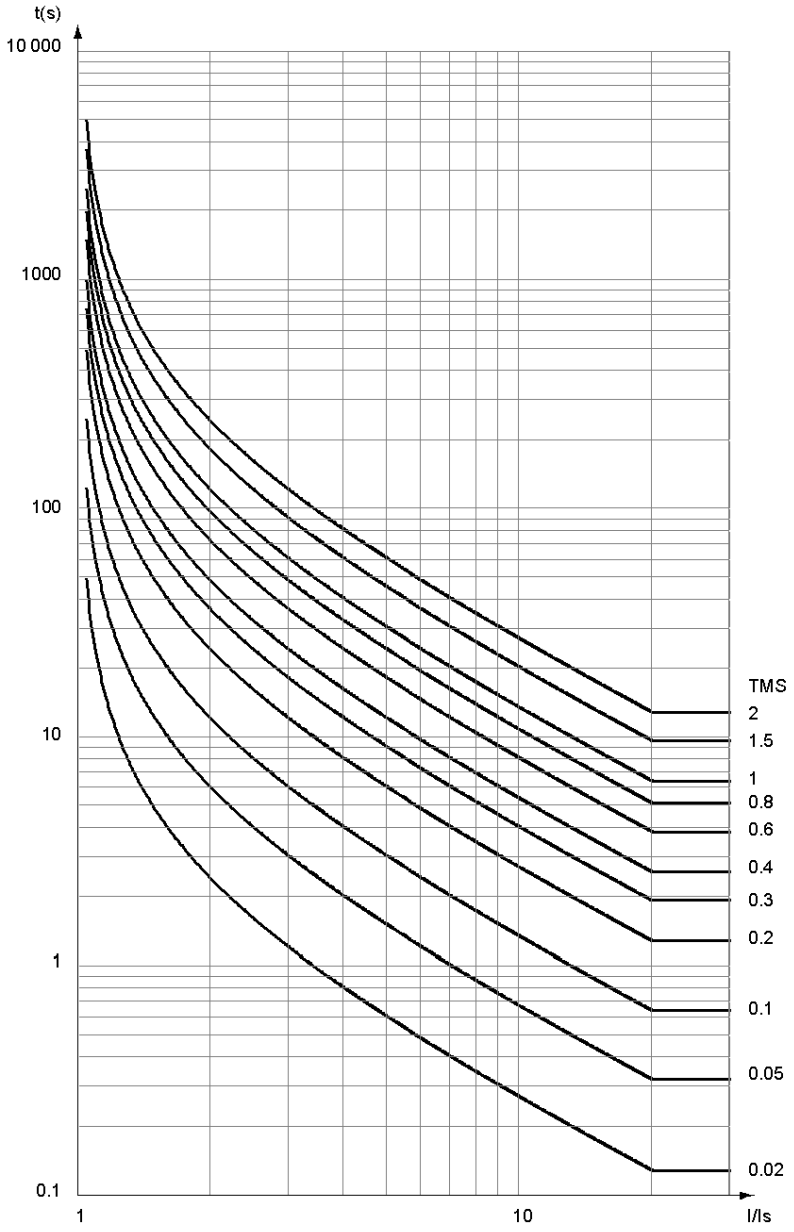
IEC Standard Inverse Time Curve (IEC/SIT or IEC/A)



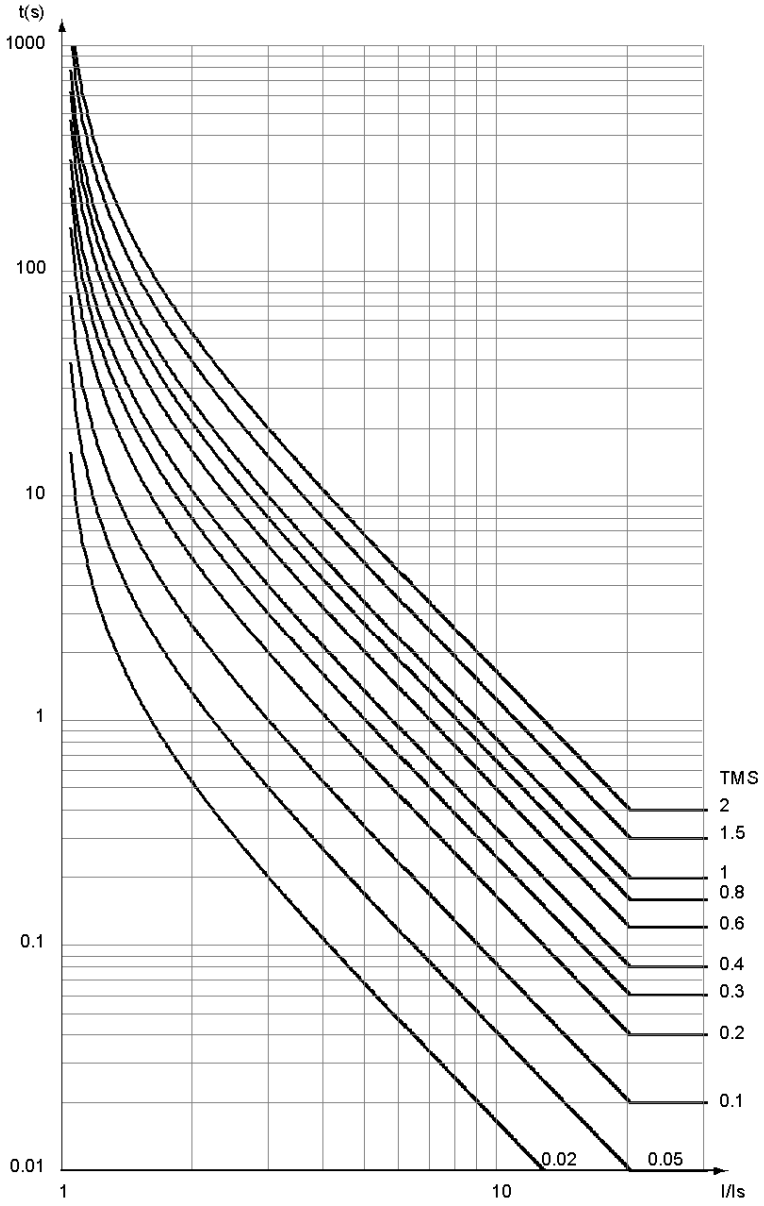
IEC Very Inverse Time Curve (IEC/VIT or IEC/B)



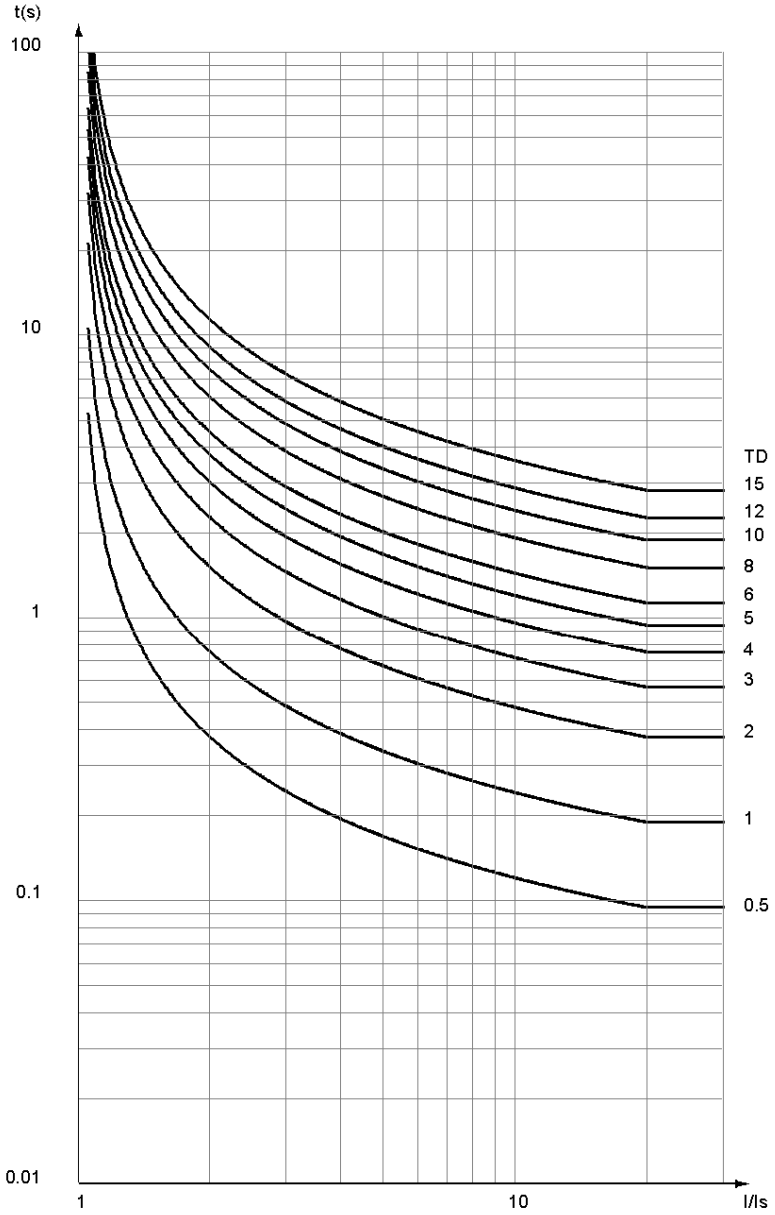
IEC Long Time Inverse Curve (IEC/LTI)



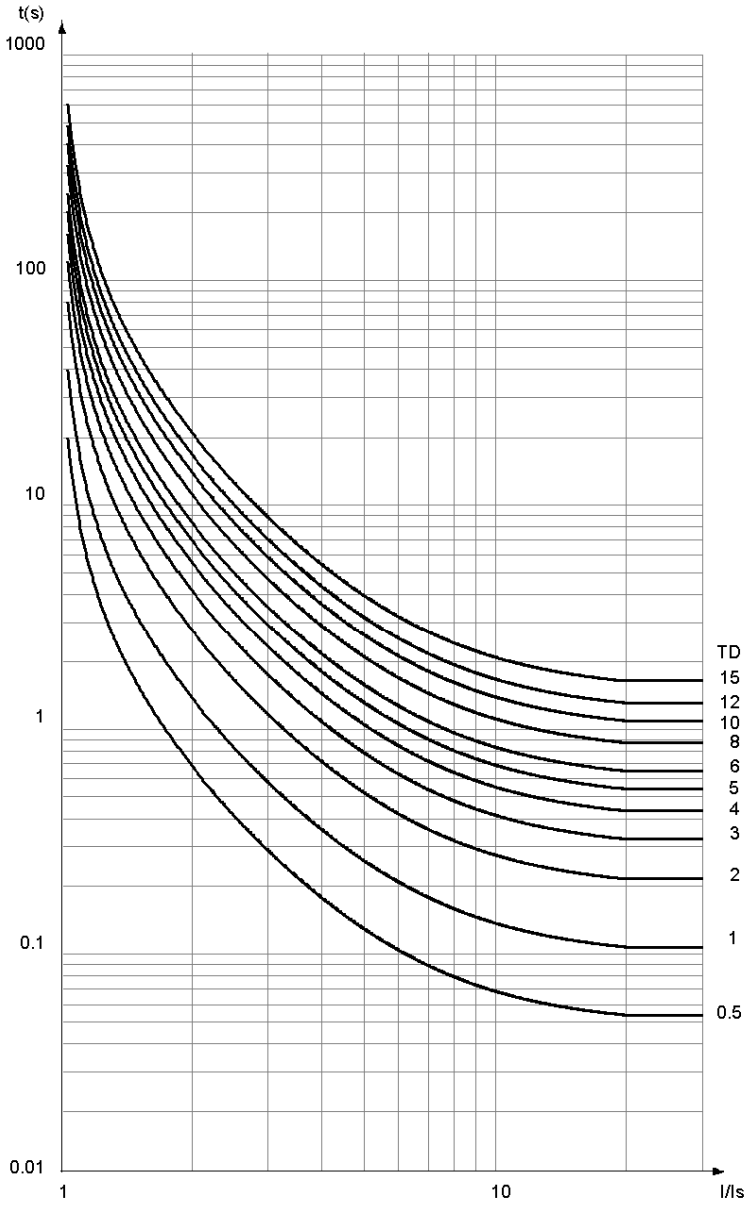
IEC Extremely Inverse Time Curve (IEC/EIT or IEC/C)



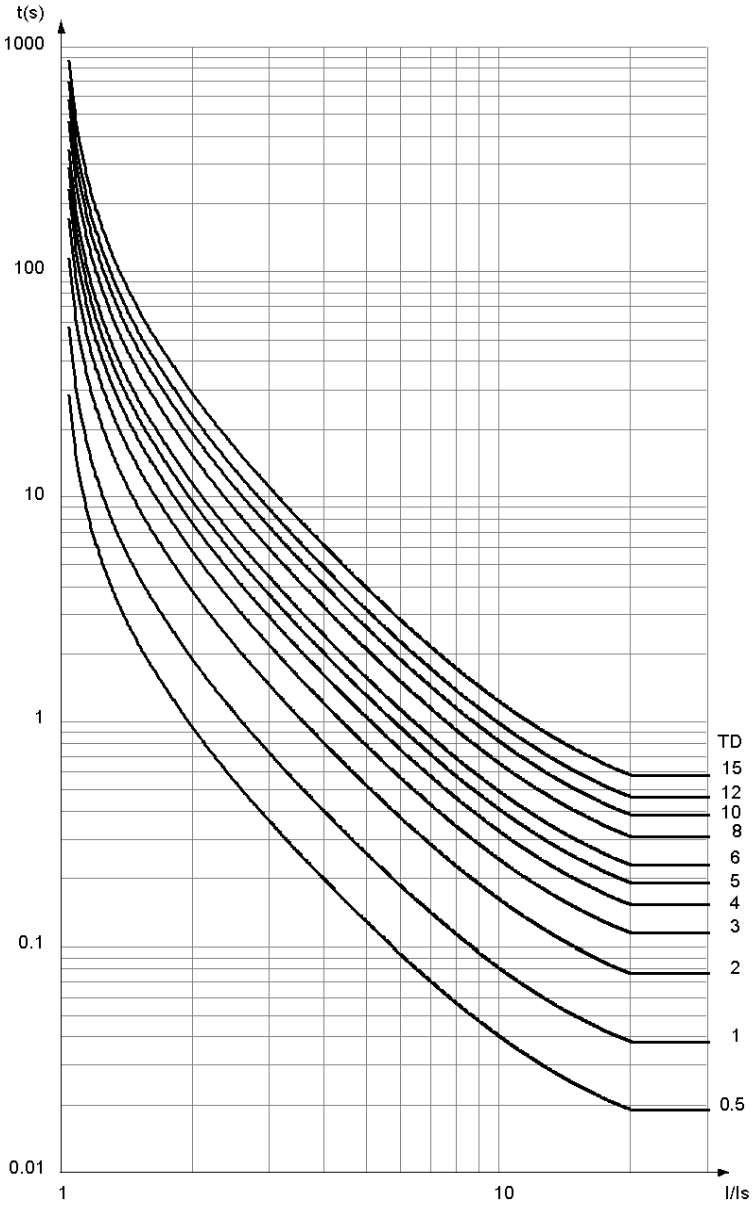
IEEE Moderately Inverse Curve (IEEE/MI or IEC/D)



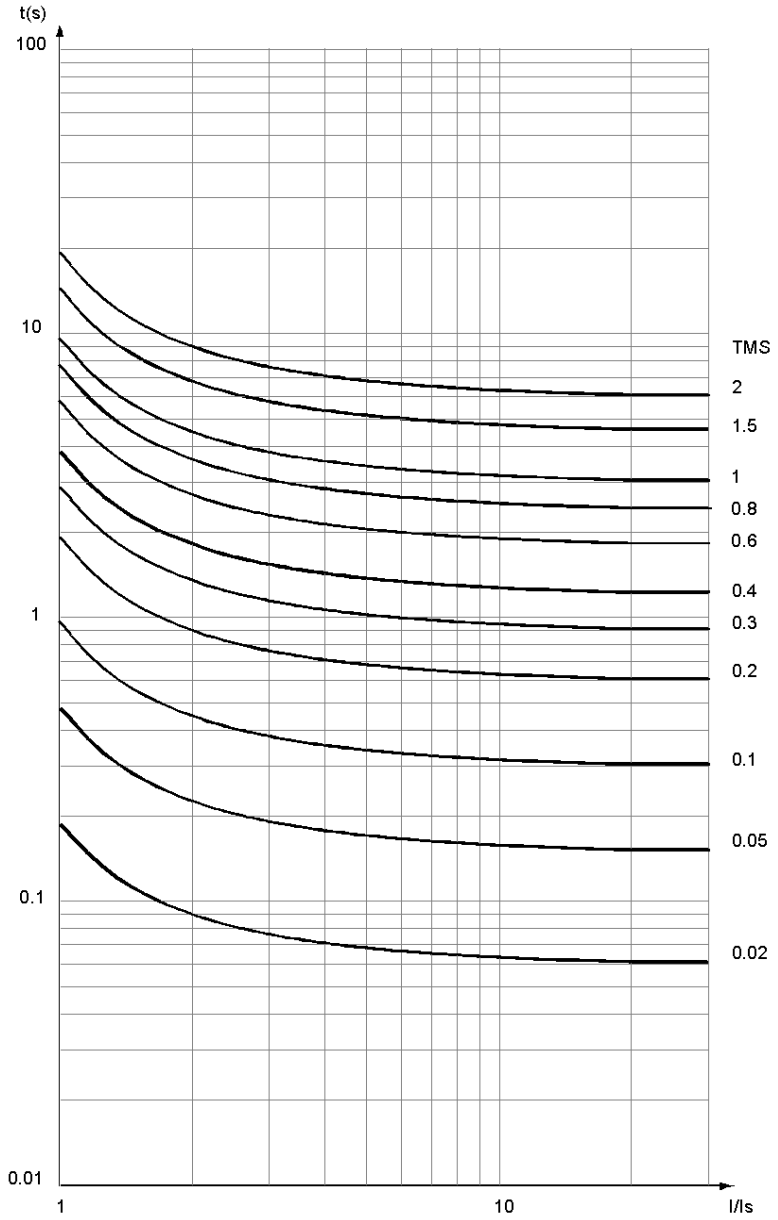
IEEE Very Inverse Curve (IEEE/VI or IEC/E)



IEEE Extremely Inverse Curve (IEEE/EI or IEC/F)



RI Curve



Harmonic 2 Restraint

The phase and earth fault overcurrent protections incorporate a harmonic 2 restraint. The characteristics and settings of these restraints are specific to each protection. They are described in the following sections:

- Phase Overcurrent Protection (ANSI 50-51) *(see page 69)*
- Earth Fault Protection (ANSI 50-51) *(see page 75)*

Phase Overcurrent Cold Load Pick-Up (Cold Load Pick-Up I) (VIP410)

Description

The phase overcurrent protection cold load pick-up function is only available in the VIP410.

This function avoids nuisance tripping of the phase overcurrent protection (ANSI 50-51) during energization after a long outage. It is used to increase the protection set point temporarily.

Depending on the installation characteristics, these operations can generate transient inrush currents likely to exceed the protection set points.

These transient currents may be due to:
- simultaneous resetting of all the loads in an installation (air conditioning, heating, etc.)
- the power transformer magnetizing currents
- the motor starting currents

In normal circumstances, the protection settings should be defined so as to avoid tripping due to these transient currents. However, if this rule results in inadequate sensitivity levels or delays that are too long, this function can be used to increase or inhibit set points temporarily after energization. Use of this function maintains a good level of protection sensitivity, regardless of the constraints affecting energization.

NOTE: In the rest of this manual, this function is referred to by its abbreviation CLPU I.

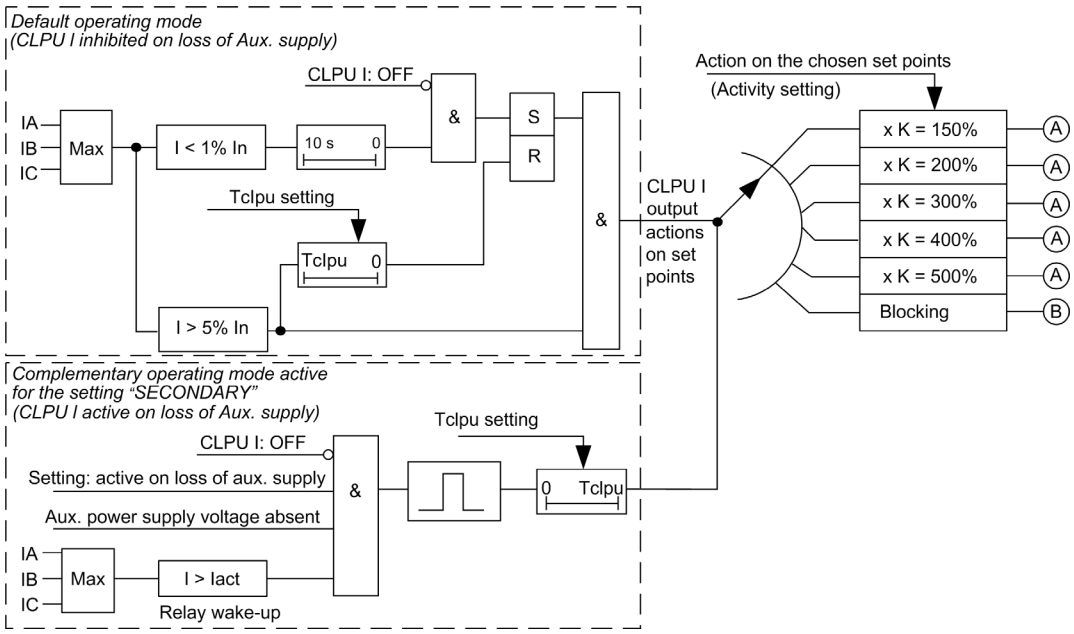
The CLPU I function automatically detects the appearance of a phase current after re-energization of the supply.

Setting the function parameters allows the user to define:
- the set points on which the CLPU I output acts: I>, I>>, I>>>, I> and I>>, I>> and I>>>, I> and I>>>, I> and I>> and I>>>
- the type of action on the chosen set points:
  - temporary multiplying factor applied to the set point (x1.5 to 5)
  - temporary set point blocking
- for how long the set point increase or blocking is applied after detection
- the CLPU I operating mode in the event of loss of the auxiliary power supply

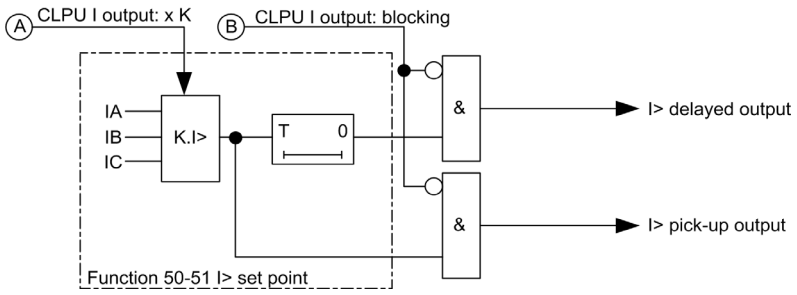
By default, this function is off.

Block Diagrams

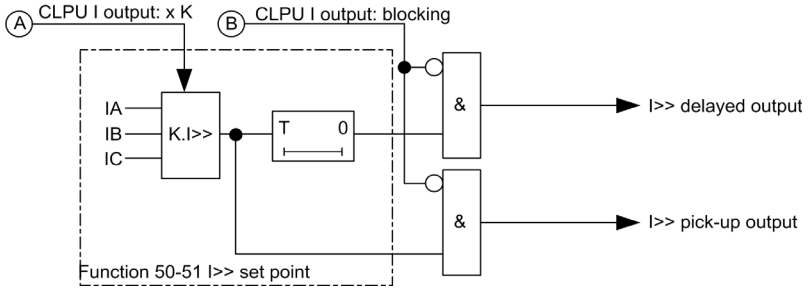
The block diagram of phase overcurrent protection cold load pick-up is shown below:



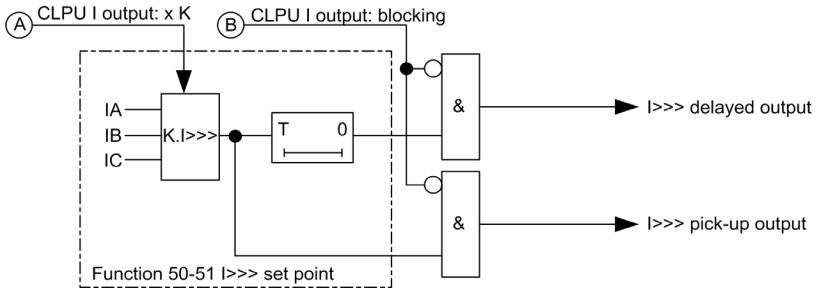
The CPLU I action on the I> set point (depending on Activity setting) is shown below:



The CPLU I action on the I>> set point (depending on Activity setting) is shown below:



The CPLU I action on the I>>> set point (depending on Activity setting) is shown below:



Default Operation: CLPU I Inhibited on Loss of Auxiliary Power Supply (DEFAULT Mode Setting)

The CLPU I function is made up of two modules:

- One module automatically detects re-energization.
- One module acts on the I> and/or I>> and/or I>>> set points of the ANSI 50-51 protection function.

Detection of re-energization is based on the appearance of phase currents. To activate the CLPU I function, the following conditions must be met:

- Detection of the disappearance of the 3 phase currents (less than 1% In) for longer than 10 seconds (this information is memorized, while waiting for the current to reappear). This detection requires the auxiliary power supply to remain present throughout the period when the current has disappeared.
- Detection of the appearance of a phase current (more than 5% In). In this case, the CLPU I output is activated for a configurable duration Tclpu. If the 3 phase currents drop back below 5% In before the end of the time delay Tclpu, the CLPU I output is deactivated.

After detection of re-energization, the CLPU I output acts on the ANSI 50-51 protection set points, with two possible actions depending on the parameter setting:

- multiplication of the set point (I> and/or I>> and/or I>>>) by a configurable coefficient (1.5 to 5), or
- blocking of the set point (I> and/or I>> and/or I>>>)

After time delay Tclpu has elapsed, the CLPU action is interrupted, and the ANSI 50-51 protection set points revert to normal operation.

Secondary Operation: CLPU I Active on Loss of Auxiliary Power Supply (SECONDARY Mode Setting)

The CLPU I parameter setting can be used to activate an operating mode that is secondary to the above one, that makes the CLPU I operational independently of the presence of the auxiliary power supply.

In default mode, if disappearance of the phase currents is associated with disappearance of the auxiliary power supply, CLPU I is inhibited automatically. If the VIP410 is woken up by return of the phase currents, this does not activate set point cold load pick-up.

In secondary operating mode, if the auxiliary power supply is absent, CLPU I is activated each time the VIP410 wakes up (phase currents higher than the pick-up current). This operating mode can be used in cases where the absence of phase current is associated with absence of the auxiliary power supply. The typical scenario is the VIP410 used as protection for the MV/LV transformer feeder, with an auxiliary power supply voltage connected to the transformer secondary.

In this secondary mode, if the auxiliary power supply remains present, CLPU I operates in the same way as in default mode.

This secondary operating mode has the disadvantage of always activating set point cold load pick-up whenever the relay wakes up, if the auxiliary power supply is absent. Activation of this secondary operating mode is not recommended when the following conditions are met:

- The VIP is not connected to an auxiliary power supply voltage (secure or otherwise).
- Fluctuating load current with a risk of regularly falling below the pick-up current.

In this example, set point cold load pick-up will be activated each time the current falls below the pick-up current.

Settings

Settings	Authorized Values
Activity	• OFF: off • ALL: action on I>, I>> and I>>> • I> I>>: action on I> and I>> • I>> I>>>: action on I>> and I>>> • I> I>>>: action on I> and I>>> • I>: action on I> only • I>>: action on I>> only • I>>>: action on I>>> only
Action on set points	• 150%: set point x 1.5 • 200%: set point x 2 • 300%: set point x 3 • 400%: set point x 4 • 500%: set point x 5 • BLOCK: set point blocked
Time delay	• 1...60 s in steps of 1 s • 1...240 min in steps of 1 min
Operating mode (common to the CLPU I and CLPU Io)	• **DEFAULT** • **SECONDARY**

Settings for Using the Function

Settings in the parameters menu:

- Cold Load Pick-Up I (**COLD LOAD I** screen)
- Cold Load Pick-Up mode (**CLPU MODE** screen, setting common to the CLPU I and Io functions)

Earth Fault Cold Load Pick-Up (Cold Load Pick-Up Io) (VIP410)

Description

The earth fault protection cold load pick-up function is only available in the VIP410.

This function avoids nuisance tripping of the earth fault protection (ANSI 50N-51N) during energization. Depending on the installation characteristics, such operations can generate transient inrush currents. If the earth fault current measurement is based on the sum of the 3 phase CTs, the aperiodic component of these transient currents can result in saturation of the phase CTs. This saturation can lead to measurement of an *incorrect* earth fault current likely to exceed the protection set points.

These transient currents are mainly due to the power transformer magnetizing currents or the motor starting currents. In normal circumstances, the protection settings should be defined so as to avoid tripping due to these transient currents. However, if this rule results in inadequate sensitivity levels or delays that are too long, the cold load pick-up function can be used to increase or inhibit set points temporarily after re-energization.

Use of this function maintains a good level of protection sensitivity, regardless of the constraints affecting re-energization.

In the case of earth fault current measurement by an earth CT (CSH120, CSH200, GO110 or CSHU CT), there is less risk of measuring an *incorrect* earth fault current. If the sensor is used correctly, there is no need to activate this function.

NOTE: In the rest of this manual, this function is referred to by its abbreviation CLPU Io.

The CLPU Io function automatically detects the appearance of a phase current after re-energization of the supply.

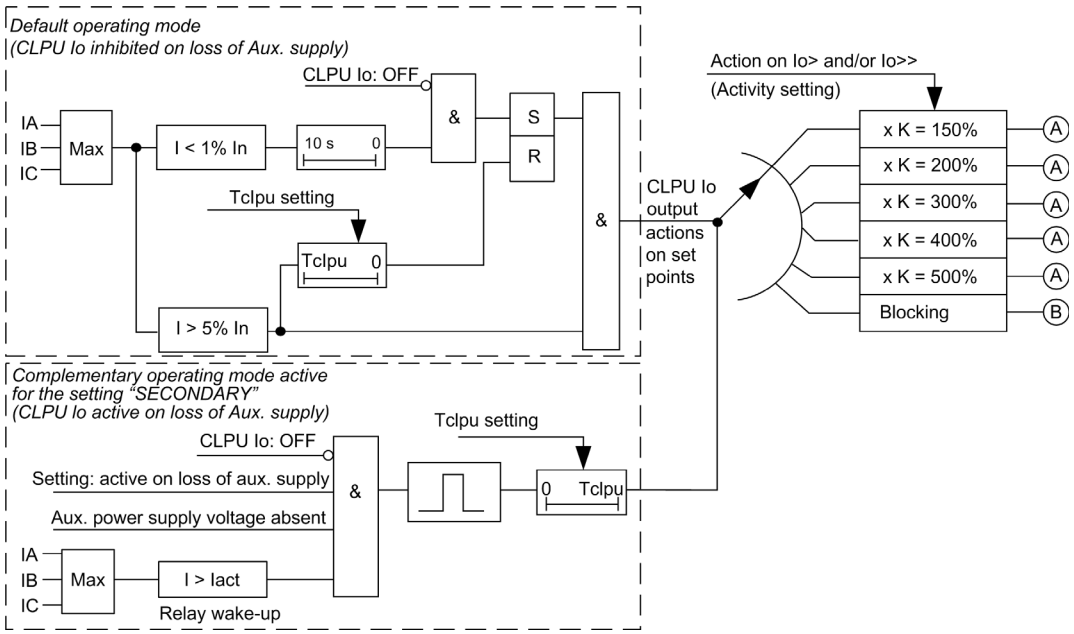
Setting the function parameters allows the user to define:

- the set points on which the CLPU Io acts: the Io> set point or Io>> set point or simultaneously on both set points
- the type of action on the chosen set points (Io> and/or Io>>):
  - temporary multiplying factor applied to the set point (x 1.5 to 5)
  - temporary set point blocking
- for how long the set point increase or blocking is applied after detection of re-energization
- the CLPU Io operating mode in the event of loss of the auxiliary power supply

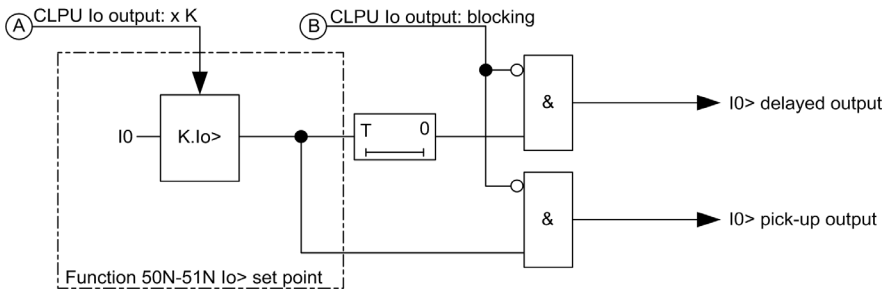
By default, this function is off.

Block Diagram

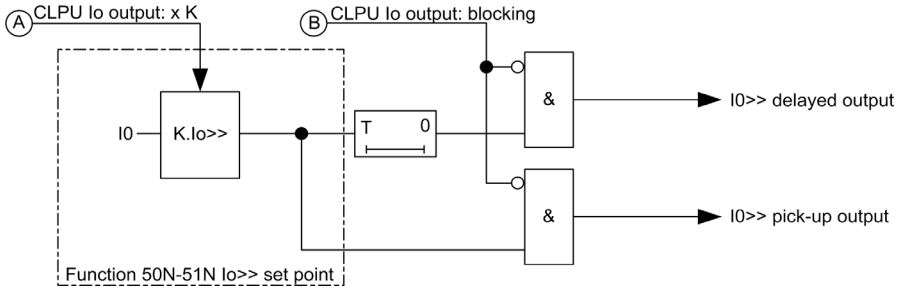
The block diagram of earth fault cold load pick-up is shown below:



The CPLU Io action on the Io> set point (depending on Activity setting) is shown below:



The CPLU Io action on the Io>> set point (depending on Activity setting) is shown below:



Default Operation: CLPU I Inhibited on Loss of Auxiliary Power Supply (DEFAULT Mode Setting)

The CLPU Io cold load pick-up by set point increase or blocking function is made up of two modules:
- One module automatically detects re-energization.
- One module acts on the Io> and/or Io>> set points of the ANSI 50-51N protection function.

Detection is based on the appearance of phase currents, in the conditions below:
- Detection of the disappearance of the 3 phase currents (less than 1% In) for longer than 10 seconds (this information is memorized, while waiting for the current to reappear). This detection requires the auxiliary power supply to remain present throughout the period when the current has disappeared.
- Detection of the appearance of a phase current (more than 5% In). In this case, the CLPU Io output is activated for a configurable duration Tclpu. If the 3 phase currents drop back below 5% In before the end of the time delay Tclpu, the CLPU Io output is deactivated.

After detection of energization, the CLPU Io output acts on the ANSI 50-51N protection set points, with two possible actions depending on the parameter setting:
- multiplication of the set point (Io> and/or Io>>) by a configurable coefficient (1.5 to 5)
- blocking of the set point (Io> and/or Io>>)

After time delay Tclpu has elapsed, the CLPU Io action is interrupted, and the ANSI 50-51N protection set points revert to normal operation.

Secondary Operation: CLPU Io Active on Loss of Auxiliary Power Supply (SECONDARY Mode Setting)

The CLPU Io parameter setting can be used to activate an operating mode that is secondary to the above one, that makes the CLPU Io operational independently of the presence of the auxiliary power supply.

In default mode, if disappearance of the phase currents is associated with disappearance of the auxiliary power supply, the CLPU Io is inhibited automatically. If the VIP410 is woken up by return of the phase currents, this does not activate set point cold load pick-up.

In secondary operating mode, if the auxiliary power supply is absent, CLPU Io is activated each time the VIP410 wakes up (phase currents higher than the pick-up current). This operating mode can be used in cases where the absence of phase current is associated with absence of the auxiliary power supply. The typical scenario is the VIP410 used as protection for the MV/LV transformer feeder, with an auxiliary power supply voltage connected to the transformer secondary.

In this secondary mode, if the auxiliary power supply remains present, the CLPU Io operates in the same way as in default mode.

This secondary operating mode has the disadvantage of always activating set point cold load pick-up whenever the relay wakes up, if the auxiliary power supply is absent. Activation of this secondary operating mode is not recommended when the following conditions are met:
- The VIP is not connected to an auxiliary power supply voltage (secure or otherwise).
- Fluctuating load current with a risk of regularly falling below the pick-up current.

In this example, set point cold load pick-up will be activated each time the current falls below the pick-up current.

Settings

Settings	Authorized Values
Activity	• OFF: off • Io> Io>>: action on Io> and Io>> • Io>: action on Io> only • Io>>: action on Io>> only
action on set points	• 150%: set point x 1.5 • 200%: set point x 2 • 300%: set point x 3 • 400%: set point x 4 • 500%: set point x 5 • BLOCK: set point blocked
Time delay	• 1...60 s in steps of 1 s • 1...60 min in steps of 1 min
Operating mode (common to the CLPU I and CLPU Io)	• **DEFAULT** • **SECONDARY**

Settings for Using the Function

Settings in the parameters menu:

- Cold Load Pick-Up Io (**COLD LOAD Io** screen)
- Cold Load Pick-Up mode (**CLPU MODE** screen, setting common to the CLPU I and Io functions)

Thermal Overload Protection (ANSI 49RMS)

Description

Thermal overload protection is used to protect the MV/LV cables and transformers against overloads, based on the measurement of the current taken. A prolonged overload causes heat rises that result in premature deterioration of the insulation. This premature ageing can lead, in time, to an insulation fault.

This protection is based on a thermal model which is used to calculate the thermal capacity used based on the current measurements. The current used by this protection function is a 3-phase rms current that takes account of harmonic numbers up to 15 at 50 Hz (or up to 13 at 60 Hz).

The protection function requires three settings:
- setting for the tripping set point or maximum permissible continuous current, which corresponds to the maximum thermal withstand for the device to be protected
- setting for the device heating/cooling time constant
- setting for the alarm set point expressed as a % of the maximum permissible thermal capacity used (tripping set point)

The calculated value of the device thermal capacity used expressed as a % can be accessed on the display. It can be reset from the keypad on the front panel. If a password is active, then it must be entered before this reset can be performed.

Thermal Capacity Used Calculation Principle

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.

It is expressed using the equation below:

$$E(t) = E(t-\Delta t) + \left(\frac{I(t)}{K \cdot Is}\right)^2 \bullet \frac{\Delta t}{T} - E(t-\Delta t) \bullet \frac{\Delta t}{T}$$

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
- Is: set point value expressed as permissible current
- K: constant applied to the Is set point where K = 1.05
- T: heating/cooling time constant

The term below expresses the heat transfer of the current I(t):

$$\left(\frac{I(t)}{1.05 \cdot I_S}\right)^2 \bullet \frac{\Delta t}{T}$$

The term below expresses the device's natural cooling:

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

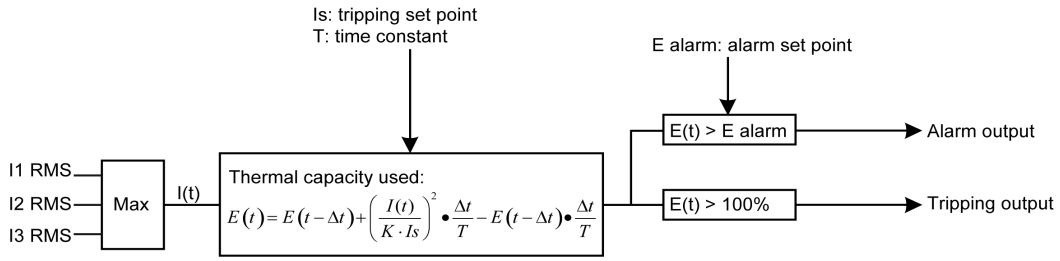
In steady state, for a current I, the thermal capacity used is:

$$E = \left(\frac{I}{1.05 \cdot I_S}\right)^2$$

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

NOTE: Where the coefficient K=1.05, the asymptote of the protection tripping curve corresponds to the value K.Is. If the Is set point is set at the circuit breaker rated current (In), the K coefficient can guarantee certain non-tripping of the thermal protection with a load current equal to the circuit breaker rated current. The coefficient K=1.05 can be used to take the accuracy of the metering chain into account.

Block Diagram



Standard Operation

If the thermal capacity used value exceeds the alarm set point:

- The LED flashes quickly.
- An alarm screen is displayed. This screen disappears when the operator uses the keypad.
- An event is recorded in the list of the last 5 events.
- Output relay O3 changes state if the auxiliary power supply is present (VIP410).

  If the thermal capacity used drops back below the alarm set point, the LED stops flashing and output relay O3 returns to its initial state (VIP410). This event remains accessible in the time-tagged records of the last 5 events *(see page 117)*.

If the thermal capacity used value exceeds the tripping set point (100%):

- The LED flashes slowly.
- The Mitop trip unit output is activated.
- An event is recorded in the list of the last 5 events.
- Output relay O1 changes state if the auxiliary power supply is present (VIP410).

Pressing the **Reset** key acknowledges the fault, causes the LED to go out and returns the O1 (VIP410 relay to its initial state).

On the VIP410, the communication interface can be used to inhibit or reactivate tripping by the ANSI 49RMS protection function *(see page 143)*. This function can be used in exceptional electrical network operating conditions, to authorize overload conditions temporarily.

One of the ANSI 49MRS protection setting screens can be used to reset the thermal capacity used. This reset can be used during the commissioning tests to measure the tripping times for the "cold" curve (with initial thermal capacity used), or reset the thermal capacity used after injection tests that would result in the thermal capacity used being higher than 100%.

NOTE: Output relay O3, associated with the alarm set point by default, returns to its initial state when the measured thermal capacity used drops back below the alarm set point.

Customization Option

VIP's custom mode can be used to modify standard operation:

- Assignment of the 49RMS tripping output to the Mitop trip unit output can be modified.
- Assignment of the 49RMS tripping output to output relay O1 can be modified (VIP410).
- Assignment of the 49RMS tripping output to output relay O3 can be modified (VIP410).
- Latching of the output relays associated with the protection functions or the external trip can be disabled (VIP410).

More information is available in the Custom Operating Mode section *(see page 131)*.

Calculating the Operating Time

For a continuous current higher than the tripping set point, it is possible to calculate the tripping time for the ANSI 49RMS protection function using the equation below:

$$t = T \cdot \ln\left(\frac{\frac{I^2}{(1.05.I_s)^2} - E0}{\frac{I^2}{(1.05.I_s)^2} - 1}\right)$$

where:

- I: short-time current (maximum of the 3 phase currents)
- Is: permissible current set point
- T: heating/cooling time constant
- E0: initial thermal capacity used prior to application of the overload
- ln( ): natural logarithm function

If the initial thermal capacity used Eo is due to a constant load current Ich, then its value is given by the equation below:

$$E0 = \left(\frac{Ich}{1.05.Is}\right)^2$$

The table below indicates the thermal capacity used reached for a continuous load current Ich:

Ich/Is	Thermal Capacity Used (%)
1,05	100
1	91
0,9	73
0,8	58
0,7	44
0,6	33
0,5	23
0,4	15
0,3	8

The tripping curves are used to determine the tripping times for different initial thermal capacity used values *(see page 104)*.

Settings

Settings	Authorized Values
Activity	• OFF : protection off • ON: protection on
Alarm set point	50...100% (as a % of the permissible thermal capacity used)
Tripping set point	0.05...In (permissible current value)
Time constant T	1...120 min

NOTE:

The In current is the phase CT primary rated current.
- In = 200 A for the CUa sensors
- In = 630 A for the CUb sensors

Settings for Using the Function

Compulsory settings in the protection menu:
- tripping and time constant set point for the ANSI 49RMS function (**THERM 49 1** screen)
- network frequency (**FREQUENCY**)

Additional settings in the protection menu:
- alarm set point for the ANSI 49RMS function (**THERM 49 2** screen)
- ANSI 49RMS function thermal capacity used reset (**THERM 49 2** screen)

Typical Values for the Thermal Time Constant

- **For a cable:**
  A cable's thermal time constant depends on its cross-section, operating voltage and installation method. The typical time constant values range from 20 to 60 minutes for buried cables, and 10 to 40 minutes for cables that are not buried.
- **For a transformer:**
  For medium-voltage network power transformers, the time constant typical values range from 20 to 40 minutes. This technical data should be supplied by the manufacturer.

Saving the Current Thermal Capacity Used

The thermal protection saves the current thermal capacity used in the event of loss of the VIP power supply, or the phase currents falling below the pick-up current. When the VIP power supply returns, the thermal state of the equipment to be protected is initialized with the saved value.

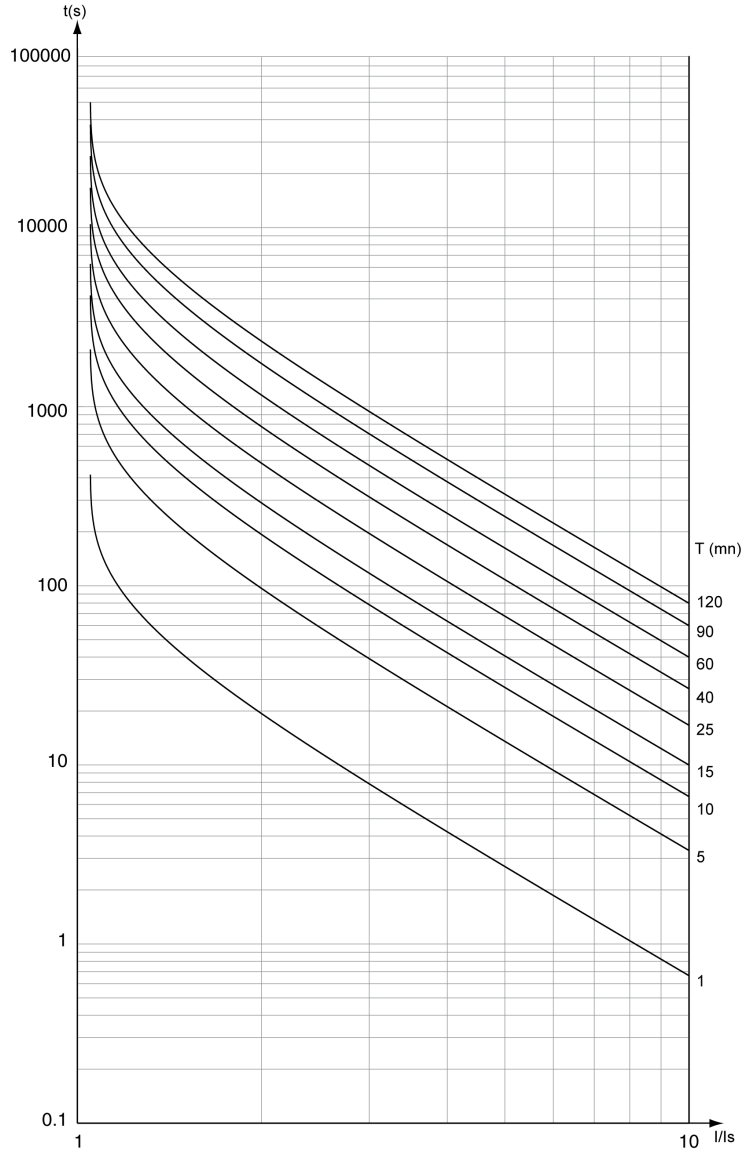
The current thermal capacity used is saved using the following 4 ranges:

- Range 0 to 40%: saved state: 0 %
- Range 40% to 70%: saved state: 40 %
- Range 70% to 90%: saved state: 70 %
- Range > 90%: saved state: 90 %

Each time the VIP power supply is lost, the lowest value in the current thermal capacity used range is saved. If there is an increase in the thermal capacity used, the ranges are defined by the 40%, 70% and 90% set points. If there is a reduction in the thermal capacity used, a 10% hysteresis is applied to the above set points, and crossing of the ranges is defined by the 36%, 63% and 81% set points.

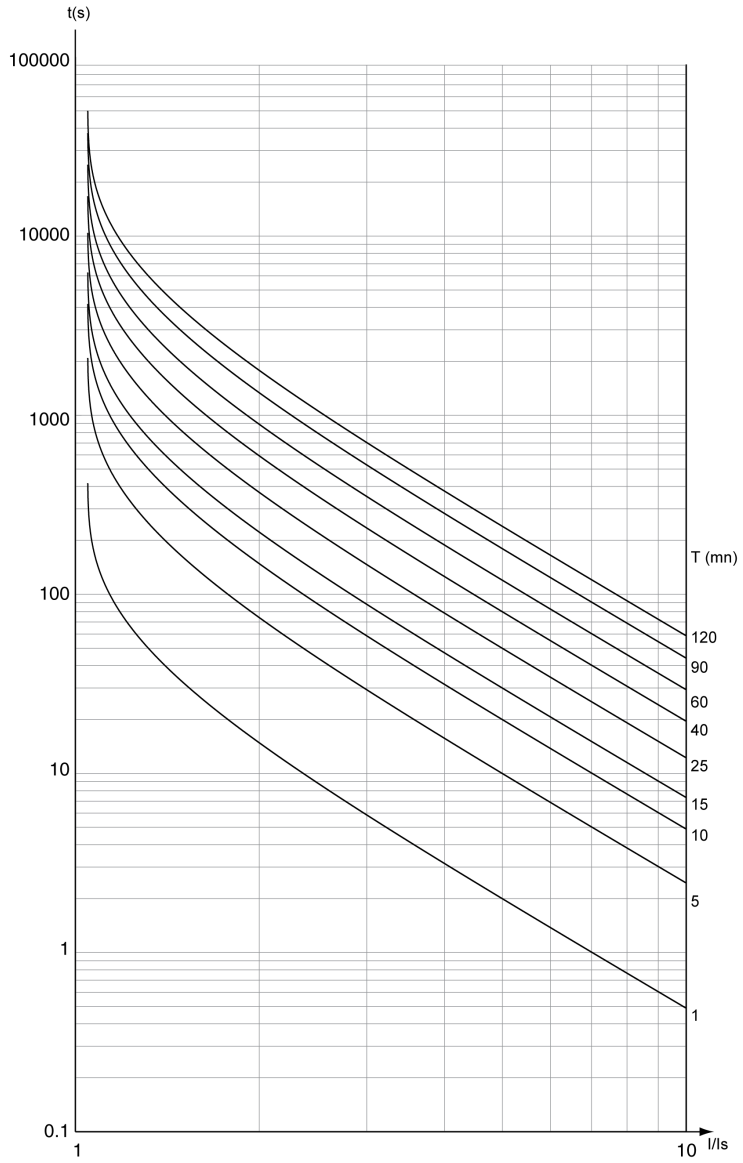
Curves for an Initial Thermal Capacity Used of 0%

The tripping curves for an initial thermal capacity used of 0% and different values for the time constant T are shown below:



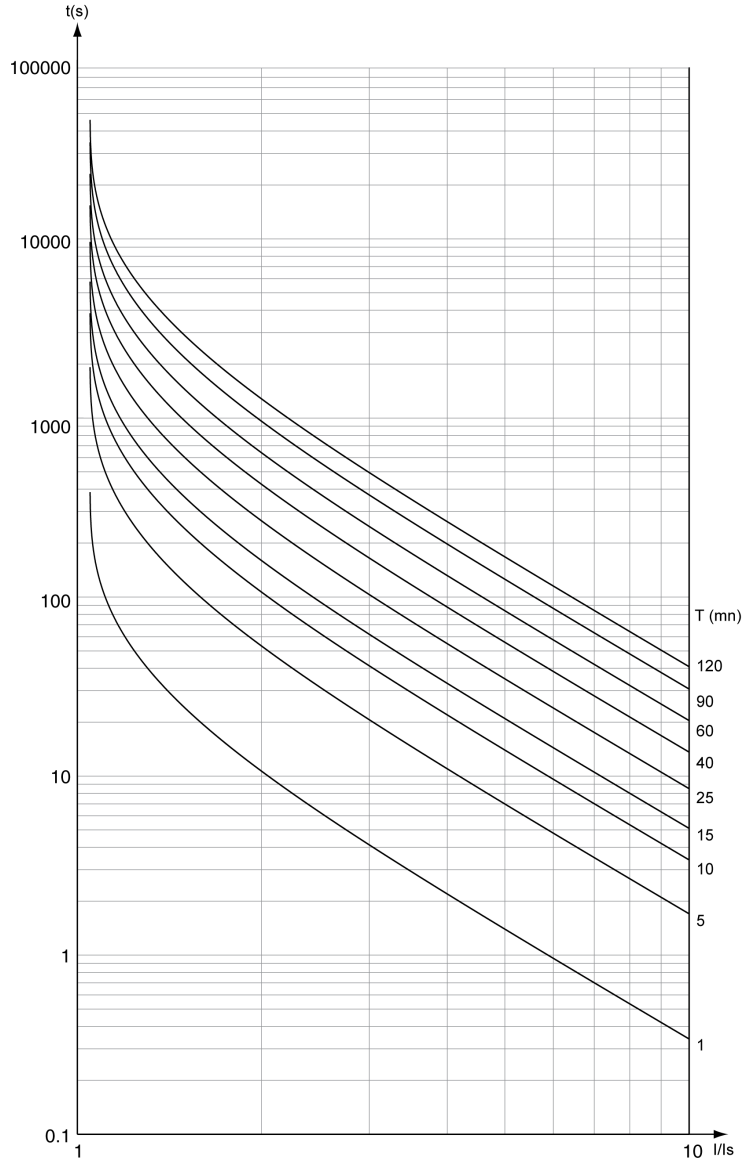
Curves for an Initial Thermal Capacity Used of 30%

The tripping curves for an initial thermal capacity used of 30% and different values for the time constant T are shown below:



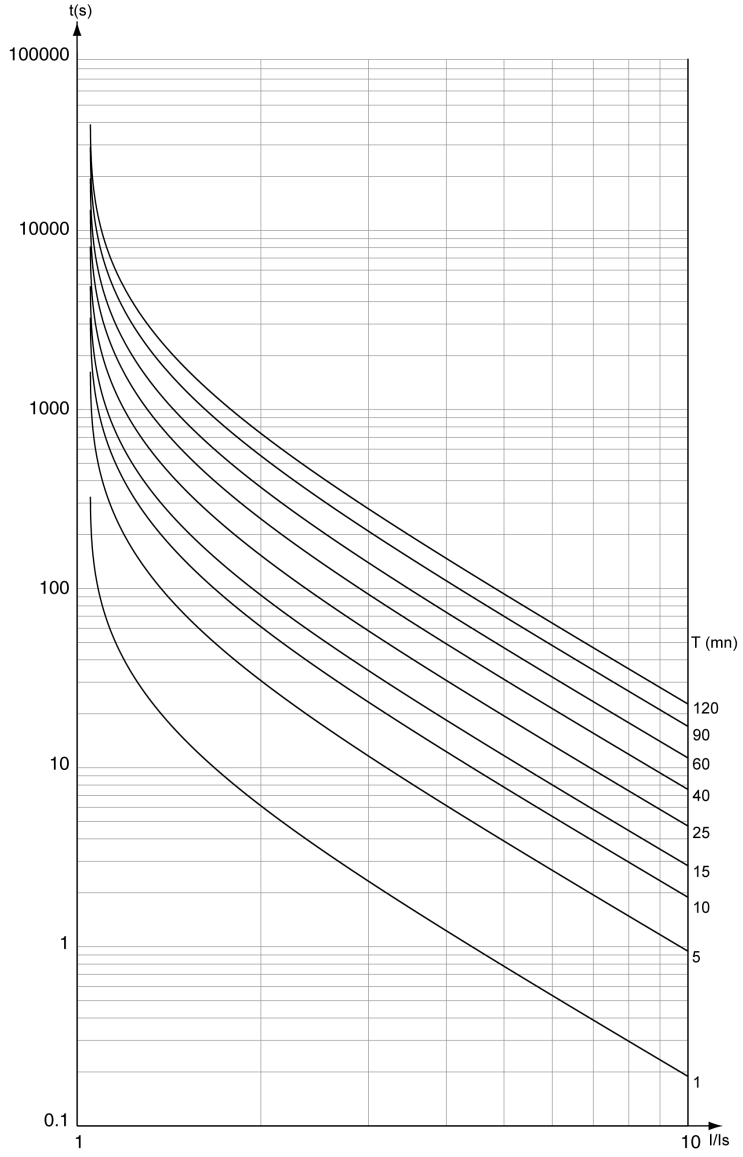
Curves for an Initial Thermal Capacity Used of 50%

The tripping curves for an initial thermal capacity used of 50% and different values for the time constant T are shown below:



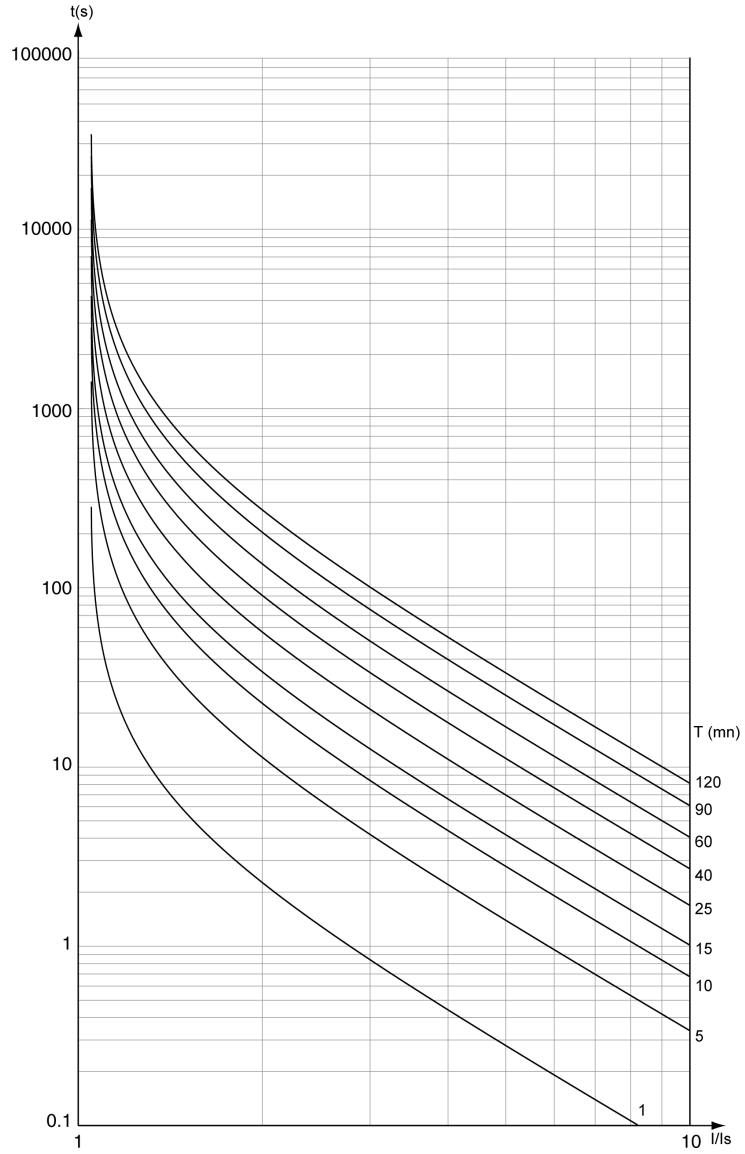
Curves for an Initial Thermal Capacity Used of 70%

The tripping curves for an initial thermal capacity used of 70% and different values for the time constant T are shown below:



Curves for an Initial Thermal Capacity Used of 90%

The tripping curves for an initial thermal capacity used of 90% and different values for the time constant T are shown below:



Circuit Breaker Trip (Mitop Trip Unit Output)

Description

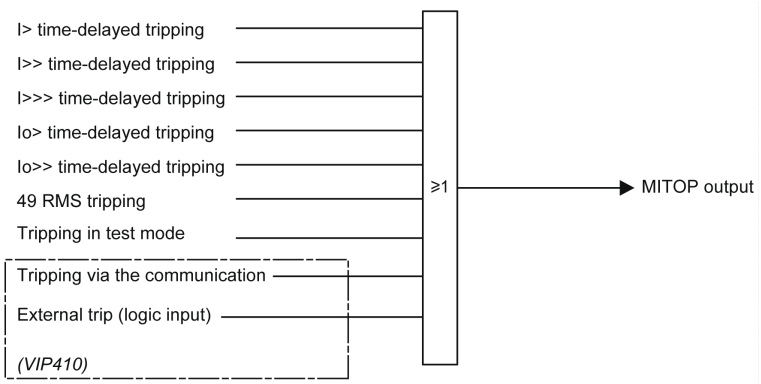
All the protections integrated in the VIP:
- phase overcurrent (ANSI 50/51)
- earth fault overcurrent (ANSI 50N/51N)
- thermal overload (ANSI 49RMS)
- external trip (logic input on VIP410)

and the following trip orders:
- tripping via the communication (VIP410)
- tripping in test mode

cause activation of the Mitop trip unit. The Mitop trip unit is integrated in the circuit breaker opening mechanism. Activation of the Mitop trip unit is available via the communication (VIP410) *(see page 143)*.

Standard Operation

In standard operation, the Mitop trip unit output activation logic is defined by the following block diagram:



Customization Option

The VIP's custom mode can be used to modify the standard operation described above:
- Assignment of the I>, I>>, I>>> set points to the Mitop trip unit output can be disabled independently of one another.
- Assignment of the Io>, Io>> set points to the Mitop trip unit output can be disabled independently of one another.
- Assignment of the thermal tripping output to the Mitop trip unit output can be disabled.

More information is available in the Custom Operation of the Mitop Trip Unit Output section *(see page 133)*.

External Trip (VIP410)

Description

Using a logic input wired to a volt-free contact, the VIP410 can be used to take account of a trip order issued by an external protection device.

For example, specific protection devices for power transformers (Buchholz, gas-pressure-temperature detectors, etc.) can be hard-wired on the VIP410 logic input to trip the circuit breaker.

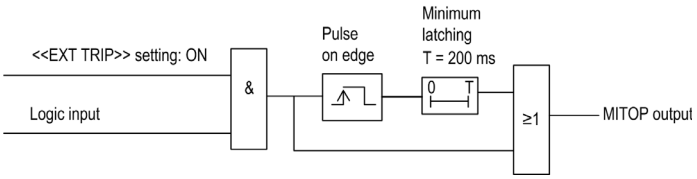
The logic input can be used to provide:
- the interface between the external protection devices and the Mitop trip unit
- tripping annunciation on the VIP410 the front panel
- time-tagged record of the last 5 events

This input must be hard-wired on a volt-free contact. The contact is polarized by the VIP, with 24 V auxiliary voltage.

If the VIP410 is operating without an auxiliary power supply (self-powered supply via the phase current sensors), polarization of the volt-free contact leads to an increase in the pick-up current. More information is available in the Self-Powered Supply Characteristics *(see page 212)*. If this input is not used, it is advisable not to activate the external trip function in the parameters menu (**EXT TRIP** screen).

By default, taking account of the external trip input is not active.

Block Diagram



Standard Operation

To use the external trip input, it is necessary to:
- wire the logic input on the external device *(see page 30)*
- activate taking account of the input in the **EXT TRIP** screen in the parameters menu

After activation of the logic input:

- the **Ext.** fault LED flashes
- output relay O1 changes state if the auxiliary power supply is present
- an event is recorded in the list of the last 5 events

Pressing the **Reset** key causes:
- acknowledgement of the fault
- extinction of the **Ext.** LED
- return of relay O1 to its initial state

NOTE: The time delay of 200 ms in the block diagram ensures activation of the output relay O1 will have a minimum duration.

Customization Option

VIP410's custom mode can be used to modify standard operation:
- Assignment of the external trip logic input to output relays can be modified.
- Latching of the output relays associated with the protection functions or the external trip can be disabled.

More information is available in the Custom Operating Mode section *(see page 131)*.

Settings for Using the Function

Compulsory settings in the parameters menu:
- activation of taking account of the logic input (**EXT TRIP** screen)

Phase Current Measurement

Description

The phase current measurement function can be accessed in the metering menu. It displays the rms value of the phase currents, and takes account of harmonic numbers up to 15 at 50 Hz (or up to 13 at 60 Hz). The VIP automatically returns to the screen displaying the phase current measurements 3 minutes after the last keystroke.

On the VIP410, the phase current measurements can also be accessed via the communication.

Earth Fault Current Measurement

Description

The earth fault current measurement function can be accessed in the metering menu. It displays the value of the earth fault current fundamental.

On the VIP400, the earth fault current corresponds to the residual current calculated based on the sum of the 3 phase currents.

On the VIP410, depending on the earth fault current measurement method selected, the earth fault current comes from the:

- sum of the 3 phase currents (**EF OPERATION**: **SUM** setting)
- the CSH120, CSH200, GO110 or CSHU core balance CT (**EF OPERATION** : **CORE CT** setting)

On the VIP410, the earth fault current measurement can also be accessed via the communication.

Phase Peak Demand Current Values

Description

The Phase peak demand current values function can be accessed in the metering menu. It displays the largest demand current value on each of the 3 phases and makes it possible to find out the current taken during the load peaks.

Resetting is possible via the **Reset** key on the front panel. To do this, this key must be pressed for 2 seconds when the peak demand values function is selected on screen.

On the VIP410, the phase current measurements and their resets can also be accessed via the communication.

Settings

In the parameters menu, it is possible to adapt the setting for the demand calculation period (**PEAK DEMAND** screen).

The default value is 5 minutes, with a setting range 1...60 minutes and a setting interval of 1 minute.

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 longer than the calculation period, with phase currents other than zero, for the peak demand values to display values other than zero.
- The 3 peak demand values are saved in the event of loss of the VIP power supply.

Load Current History

Description

The load current history function can be accessed in the metering menu. It displays the division of the time spent by the load current into 3 distinct current ranges. These current ranges are defined using the base current Ib, to be set to a value close to the installed load current. The load current is calculated using the maximum of the demand values of the 3 phase currents. Like for the phase peak demand current values function, the demand values are calculated over the time period, which can be set in the **PEAK DEMAND** screen.

The 3 load history current ranges are defined by the following limits:
- First range: I < 0.5 Ib
- Second range: 0.5 Ib < I < Ib
- Third range: I > Ib

This function indicates the running total of hours in each of the ranges. All 3 counters can be accessed in the 3 consecutive **LOAD HISTORY** screens in the metering menu.

The counters can be reset from the front panel. The maximum range for each counter is 200,000 hours (> 20 years).

On the VIP410, the values of these histories and their resets can also be accessed via the communication.

Operation

The running hours counters increment at intervals of 1 hour, but incrementation of the internal VIP counters is synchronized with the integration period for the phase current peak demand values. More information is available in the Phase Current Peak Demand Values section *(see page 113)*.

With a setting of 10 minutes or less, incrementation of the internal counters occurs every 10 minutes.

With a setting of more than 10 minutes, incrementation of the internal counters occurs at an interval identical to the integration period for the peak demand values.

The function's internal counters and the counters displayed on the front panel are saved in the event of loss of the VIP power supply.

The counters can be reset from the front panel by following the procedure below:

Step	Action
1	Open the settings protective flap.
2	Display one of the 3 **LOAD HISTORY** screens in the metering menu.
3	Press the **Reset** key for longer than 2 s.
4	Respond to the reset confirmation request by activating the **YES** setting with the setting keys and the confirm key. **NOTE:** If the settings protective flap is closed when the reset confirmation screen is activated, it is possible to exit this screen by pressing one of the keypad keys, without risking causing a counter reset. **Result of the procedure:** The counters are reset to zero. **NOTE:** Activating the **NO** setting or pressing the cancel key can exit this confirmation screen without resetting the counters. More information on navigation is available in the User-Machine Interface section *(see page 40)*.

Settings

In the parameters menu, it is possible to adapt the following settings:
- Base current Ib setting (**LOAD HISTORY** screen)
- Demand calculation period (**PEAK DEMAND** screen), a common setting with the function. More information on this setting is available in the Phase Current Peak Demand Values section *(see page 113)*.

NOTE: The Ib current is set by default to the CT rated current. So that this function can be used, the Ib current must be set to a value close to the installed current, taking account of the actual load on the downstream installation. For example, if the Ib current is set to a value equal to the sum of the rated currents for the MV/LV transformers downstream, with transformers with load levels less than 50%, the counters in the 2 upper ranges risk staying at 0 and only the counter in the lowest range will keep a running total of the operating hours.

Counting the Number of Trips on a Fault

Description

The number of trips on a fault function can be accessed in the metering menu. It displays 3 counters (VIP400) or 4 counters (VIP410) that indicate the trip order number sent by the VIP protections, according to the following categories:

- phase-to-phase fault tripping by the I>, I>> and I>>> set points of the phase overcurrent protection (50/51)
- phase-to-earth fault tripping by the Io> and Io>> set points of the earth fault protection (50N/51N)
- tripping on an overload by the thermal overload protection set point (49RMS)
- tripping via activation of the “external trip” logic input (VIP410)

These counters can be accessed in the 2 consecutive **NB OF TRIP** screens in the metering menu. The counters can be reset from the front panel.

On the VIP410, the counter values can also be accessed via the communication.

Operation

The number of trips on a fault function counters are saved in the event of loss of the VIP power supply. The maximum range for each counter is 9999 trips on a fault.

The counters can be reset from the front panel by following the procedure below:

Step	Action
1	Open the settings protective flap.
2	Display one of the 2 **NB OF TRIP** screens in the metering menu.
3	Press the **Reset** key for longer than 2 s.
4	Respond to the reset confirmation request by activating the **YES** setting with the setting keys and the confirm key. **NOTE:** If the settings protective flap is closed, if the reset confirmation screen is activated, it is possible to exit this screen by pressing one of the keypad keys, without risking causing a counter reset. **Result of the procedure:** The counters are reset to zero. **NOTE:** Activating the **NO** setting or pressing the cancel key can exit this confirmation screen without resetting the counters. More information on navigation is available in the User-Machine Interface section *(see page 40)*.

Breaking Current History

Description

The breaking current history function can be accessed in the metering menu. It measures the fault current at the time of circuit breaker opening and displays the number of trip orders sent by the VIP in each of the following ranges:

Current Ranges	200 A CUa Sensor	630 A CUb Sensor
Range 1	< 200 A	< 630 A
Range 2	200 A...2 kA	630 A...10 kA
Range 3	2 kA...8 kA	10 kA...20 kA
Range 4	> 8 kA	> 20 kA

This function can be used to obtain an indication of the circuit breaker demand level.

All 4 counters can be accessed in the 4 consecutive **BREAK HIST** screens in the metering menu. The maximum range for each counter is 9999 trips. The counters can be reset from the front panel.

On the VIP410, the counter values can also be accessed via the communication.

Operation

The breaking current measurement taken into account at the time of circuit breaker opening corresponds to the maximum value of the 3 phase currents measured by the VIP at the time of sending the trip order to the Mitop trip unit output. This value corresponds to the maximum value of the currents displayed by the record of the last 5 events function, where the event is associated with a trip order.

The breaking current history function internal counters are saved in the event of loss of the VIP power supply.

Counter Reset

The counters can be reset from the front panel by following the procedure below:

Step	Action
1	Open the settings protective flap.
2	Display one of the 4 **BREAK HIST** screens in the metering menu.
3	Press the **Reset** key for longer than 2 s.
4	Respond to the reset confirmation request by activating the **YES** setting with the setting keys and the confirm key. **NOTE:** If the settings protective flap is closed, if the reset confirmation screen is activated, it is possible to exit this screen by pressing one of the keypad keys, without risking causing a counter reset. **Result of the procedure:** The counters are reset to zero. **NOTE:** Activating the **NO** setting or pressing the cancel key can exit this confirmation screen without resetting the counters. More information on navigation is available in the User-Machine Interface section *(see page 40)*.

Time-Tagged Record of Last 5 Events

Description

The time-tagged record of the last 5 events function can be accessed in the metering menu. It is used to display the characteristics of the last 5 events in 5 consecutive screens in the metering menu. For each event, the VIP indicates its origin, the date and time of the fault.

For events that cause the circuit breaker to open, the value of the 3 phase currents and the earth fault current measured at the time of activation of the Mitop trip unit output is indicated. Messages associated with events such as thermal protection alarm set point, faulty Mitop trip circuit, and circuit breaker closing via the communication (VIP410) do not include the value of the tripping currents.

Since the message length is more important than the size of the display, this function has a display that scrolls in a loop. This information cannot be reset to zero.

So that they can be identified, each event has an absolute queue number which increments from 0 to 99999. Once this number is reached, the queue number returns to 0.

With each new event, the VIP deletes the oldest in the list. When a VIP delivered from the factory has not yet saved 5 events, the number of corresponding screens in the metering menu is less than 5.

The recorded events are as follows:

Event (VIP400 and VIP410)	Message on the Display
I> protection tripping	**I>**
I>> protection tripping	**I>>**
I>>> protection tripping	**I>>>**
Io> protection tripping	**Io>**
Io>> protection tripping	**Io>>**
Thermal overload protection tripping	**THERMAL**
Mitop trip circuit fault	**MITOP FAULT**
49RMS thermal protection alarm set point detection	**THERMAL ALARM**
Tripping in temporary test mode	**TRIP BY TEST**

The recorded events specific to the VIP410 are as follows:

Event (VIP410)	Message on the Display
Tripping by external input	**EXT TRIP**
Circuit breaker trip via the communication	**TRIP BY COMM**
Circuit breaker closing via the communication	**CLOSE BY COMM**

NOTE:

The phase and earth fault current measurement ranges at the time of the trip are given in the Characteristics section *(see page 202)*. If the current values recorded at the time of the trip are not within the measurement ranges, the corresponding fields are filled with:

- **> 40 In** for phase currents
- **> 40 In0** for earth fault current measurement using the sum of the 3 phase CTs
- **> xxx A** (xxx depends on the Io> and Io>> set point setting) for the earth fault current measured by a core balance CT on the 10–240 A rating (VIP410)
- **> xxx A** (xxx depends on the Io> and Io>> set point setting) for the earth fault current measured by a core balance CT on the 1-24 A rating (VIP410)

NOTE:

After a fault that has resulted in a trip order from the MV circuit breaker, any other event occurring within a window of around 400 ms after this fault will not be saved.

Settings

Setting the time on the VIP internal clock can be accessed in the parameters menu:

- setting the date (**DATE** screen)
- setting the time (**TIME** screen)

Customization Option

Customizing the VIP can enable it, if necessary, to indicate faults without giving the trip order to the circuit breaker.

For example, when the network is used with sustained earth fault, custom mode allows all the following options:

- not assigning earth fault protection to tripping
- indicating the fault via the LED on the front panel or via an output relay used as an alarm (VIP410)
- recording an event in the list of the last 5 events

More information is available in the Custom Operating Mode section *(see page 131)*.

Operating Language

Description

The default language is UK English.

Settings

Selection of the operating language can be accessed in the parameters menu.

The parameter to be set is the language selection (***LANGUAGE*** screen).

The following languages can be selected:

- UK English
- US English
- Spanish
- French
- Italian
- German
- Turkish
- Portuguese
- Chinese
- Russian

Communication

Communication Protocols

The VIP410 is equipped with an RS 485 communication port.

It operates with Modbus protocol.

The VIP410 can be used for in the context of the Easergy substation control and monitoring system, or as a product to be integrated in an open Modbus system.

To this end:
- it conforms to the Modbus specifications
- it integrates as effectively as possible in the Easergy system with the RTU R200 while minimizing configuration and diagnostic work

More information on the Modbus protocol is available in the Communication section *(see page 143)*.

Setting the Modbus Protocol Parameters

The Modbus protocol parameters are set in the standard parameters menu (**MODBUS** screens).

These parameters are described in the table below:

Parameters	Authorized Values
Cubicle number	Adjustable from 0 to 29: ● 0: use of the Modbus addressing conventional system ● 1…29: use of the VIP410 associated with the RTU R200. In this case, this number corresponds to the cubicle number and the RTU automatically assigns the Modbus address.
Modbus address	1...247 If the cubicle number has been programmed between 1 and 29, the Modbus address cannot be modified.
Baud rate	● 4,800 Baud ● 9,600 Baud ● 19,200 Baud ● 38,400 Baud
Remote control order	● **DIR**: direct mode remote control order ● **SBO**: confirmed mode remote control order (Select Before Operate)
Parity	● none (1 or 2 adjustable stop bits) ● even (1 fixed stop bit) ● odd (1 fixed stop bit)
Number of stop bits	● 1 ● 2 (choice possible only if “no parity” has been set earlier, and if Autogo is disabled)
Authorization of remote settings	● **OFF**: remote settings not enabled ● **ON**: remote settings enabled
Activation of Autogo	● **OFF**: AUTOGO off ● **ON**: AUTOGO on

NOTE: In the event of use in the context of the Easergy system, allocate the cubicle number, the slave address is calculated automatically. Otherwise, force the cubicle number to 0, and enter the slave address.

Circuit Breaker Control via the Communication

The VIP410 can be used to control circuit breaker tripping or reclosing via the communication port by means of a predefined double remote control order.

The circuit breaker is tripped via the communication using the Mitop trip unit output. The output relay O1 to O3 parameters can be set in custom mode to indicate cause of tripping via the communication. The output relay O1 to O3 parameters can be set in custom mode to control circuit breaker reclosing via the communication. More information is available in the Relay O1 to O3 Characteristics.

NOTE: On receipt of a closing remote control order, activation of the associated output relays is maintained for a set period of 200 ms, to ensure that the command is taken into account.

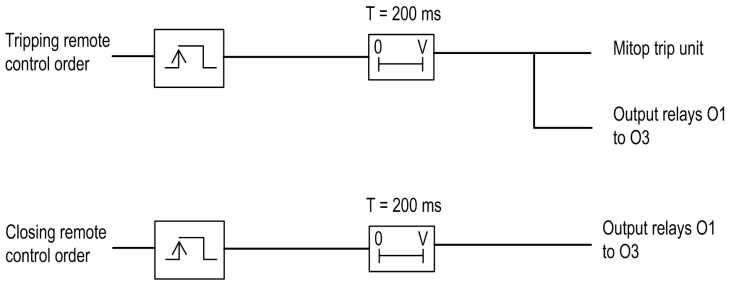
This characteristic is illustrated in the block diagram below.

NOTE: On receipt of a tripping remote control order, the behavior of the relays depends on the relay latching mode (latched or pulsed). If the relays are latched, activation of the associated output relay is maintained until tripping is acknowledged.

NOTE: The closing via the communication function must be used with caution since the VIP does not take account of the cubicle status (circuit breaker position, local/remote mode, interlocking, etc.). For this function, it is advisable to use the VIP in the context of the Easergy system.

Block Diagram: Circuit Breaker Control via the Communication

The block diagram dealing with remote opening/closing orders is shown below:



Mitop Trip Unit Trip Circuit Supervision

Description

The VIP continuously tests the Mitop trip unit control loop to 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 VIP unavailable red LED on the front panel flashes while the fault is present.
- A **MITOP FAULT** event is generated and recorded in the list of the last 5 events.
- The **MITOP FAULT** message corresponding to the event recorded in the battery is displayed on the front panel while the failure is present. The user can get rid of the message by pressing any key. After 30 seconds, the message will reappear automatically.

NOTE: The fault is only recorded in the list of the last 5 events if a Mitop trip unit fault was not already recorded as the last event in the list.

On the VIP410, the Mitop fault information is also available via the communication.

Date and Time

Description

The VIP has an internal clock which can be used to assign a date and time:
- to events recorded by the time-tagged record of the last 5 events function
- to other time-tagged events, which can be accessed via the communication (VIP410)

In the event of all sources of power to the VIP (self-powered, auxiliary and pocket battery module) being cut, the internal clock is maintained by the battery. If the battery has been removed or is not working, the internal clock is powered as soon as one of the VIP's power supplies (self-powered, auxiliary or pocket battery module) is present. If the battery is removed or runs down while one of these power supplies is missing, the internal clock will reset itself to:

Date: ----/---/--

Time: --h --mn --s

NOTE:

- Operation of the protection functions is not affected by the presence or absence of the battery.
- During a setting operation with the VIP powered by its internal battery alone, the clock display is not refreshed on screen. However the internal clock increments normally.

Settings

The date and time setting can be accessed in the parameters menu.

The parameters to be set are:
- Date setting (**DATE** screen)
- Time setting (**TIME** screen)

Setting the date and time in the parameters menu is not possible when the VIP date and time is synchronized via the communication (VIP410).

Password

Description

A 4-digit password is used to protect modification of the VIP protection and parameter settings.
Password activation and definition are possible in the parameters menu.
The parameter to be set is: **NO PASSWORD** or **PASSWORD = xxxx** (**SET PASSWORD** screen).
More information is available in the Protection Setting section *(see page 47)*.

Display the Status of the Output Relays (VIP410)

Description

The Display the Status of Output Relays O1 to O3 function can be accessed in the parameters menu. A logic status 1 indicates that the corresponding output relay is in the on-position. The logic output status is accessible in read mode only.

The corresponding screen, **I/O STATUS**, does not have any modifiable parameters.

The status of the output relays appears after the **O1…O3=** field.

Display the Status of the External Trip Input (VIP410)

Description

The Display the Status of the External Trip Input function can be accessed in the parameters menu. The input status is accessible in read mode only.

The corresponding screen, **I/O STATUS**, does not have any modifiable parameters.

The input status appears after the **EXT=** field.

Watchdog Relay (VIP410)

Description

It is possible to assign one of the output relays O1 to O3 to the watchdog function. More information is available in the Custom Operating Mode section *(see page 131)*.

In this case, in the event of VIP410 failure, or if the auxiliary power supply fails, the relay set to watchdog reverts to the off-position.

Indicator LEDs on the Front Panel

Status LED

Depending on the model, VIPs have 1 or 3 status LEDs:

Pictogram	Color	Event
Aux. Power	Green	The power supply voltage is present on the VIP input (VIP410).
	Red	• LED permanently on: the VIP has gone into the fail-safe position following detection by the embedded self-tests of the failure of one of its internal components, involving a risk of nuisance tripping. In this case, the VIP is no longer operational. **NOTE:** This LED may light up briefly when the VIP is energized and during battery charging of the user-machine interface: this is normal and does not indicate a failure. • LED flashing: the VIP has detected an internal failure not involving a risk of nuisance tripping. The VIP remains operational. The LED stops flashing as soon as the failure disappears.
	Yellow flashing	An activity is present on the communication link (VIP410).

Fault LEDs

Depending on the model, the VIP has 3 or 4 red fault indicator LEDs.

By default, these LEDs indicate a trip order and are latched: thanks to the product's internal battery, these LEDs continue to indicate the fault, even when it has disappeared.

The LEDs go out after a fault acknowledgement action:
- by pressing the **Reset** key
- automatically when primary current is present
- automatically after 24 hours, to preserve the battery life on a VIP400 and a VIP410 without an auxiliary power supply. On a VIP410 with auxiliary power supply present, there is no 24-hour time delay.
- via the VIP410 communication port (by remote control order)

NOTE: In custom mode (output custom mode selected in the **CB TRIPPING** menu), each type of fault can be hard-wired individually, or not, to the circuit breaker trip and thus avoid circuit breaker tripping. In this case, the corresponding LED operates as a fault present indicator and flashes while the fault is present and goes out as soon as it disappears.

The fault indication LEDs are as follows:

Pictogram	Slow Flashing
	Phase overcurrent protection trip or tripping in temporary test mode
	Earth fault protection trip
	Thermal overload protection trip
Ext.	Tripping by the logic input wired on the external protection device (VIP410).

For the first 3 LEDs, quicker flashing may occur before the protection trips, to indicate the following information:

Pictogram	Quick Flashing
	Overshoot of the instantaneous set point for phase overcurrent protection (I>, I>> or I>>> pick-up output) or downcounting of the tripping time delay in temporary test mode
	Overshoot of the instantaneous set point for earth fault protection (Io> or Io>> pick-up output)
	Overshoot of the alarm set point for thermal overload protection

Display of the Last Fault

Each time a fault is detected by the VIP, a screen corresponding to the fault is generated and memorized. This screen contains the same information as that memorized by the time-tagged record of the last 5 events function.

The display of the fault message on the screen depends on the VIP power supply status after the fault:

- If the VIP is still supplied with power after the fault (custom mode or auxiliary power supply present), the fault message appears on the screen instantly. The message remains displayed until the operator uses the keypad.
- If the VIP is no longer supplied with power after the fault, the display goes off. Pressing and holding down the  key activates embedded battery operation of the user-machine interface and the fault message appears. The message remains displayed until the operator uses the keypad.

The VIP can also be powered with the pocket battery module. More information is available in the Pocket Battery Module section *(see page 191)*.

NOTE:

- Display of the last fault disappears when the operator uses the keypad or when the primary current is disconnected and reconnected. However, it is still possible to view the last recorded fault in the metering menu.
- After a fault that has resulted in a trip order from the MV circuit breaker, any other event occurring within a window of around 400 ms after this fault will not be saved.

Fault Acknowledgement

Description

Faults are acknowledged:
- manually, by pressing the **Reset** key
- automatically when primary current is present
- automatically, after a 24-hour time delay when the product is no longer supplied with power after the fault
- via the (VIP410) communication port

Fault acknowledgement includes:
- extinction of the fault indication LEDs
- replacement of the fault screen with the previously displayed screen (in cases where the VIP protection relay is supplied with power)
- return of the output relays to their initial status (VIP410)

NOTE: Acknowledgement of a fault does not change the list of faults memorized by the time-tagged record of the last 5 events function.

NOTE: Restoring power to the VIP from the pocket battery module or its auxiliary power supply (VIP410) during the 24 hours in which the fault indication LEDs were activated restarts this 24-hour time delay.

NOTE: Acknowledgement of the output relays is only possible when the VIP user-machine interface is started, therefore, in cases where the VIP is powered by the self-powered or auxiliary power supply (VIP410), or the pocket battery, or the embedded battery.

The output relays cannot therefore be acknowledged after a 24-hour time delay when the product is no longer supplied with power after the fault. Only the fault indication LEDs are acknowledged after the 24-hour time delay.

Custom Operating Mode

5

What Is in This Chapter?

This chapter contains the following topics:

Introduction

At a Glance

This chapter describes the organization of several menus used to:
- customize operation of the Mitop trip unit output (circuit breaker trip logic)
- customize the output relays (VIP410)
- customize the VIP associated with the MV circuit breakers

Menu Organization

All the data available in the VIP relay is divided between 3 menus:
- The metering menu contains the current measurements, load histories, breaking current histories, fault trip counters and time-tagged records of the latest events.
- The protection menu contains the essential settings for setting up the protection functions.
- The parameters menu contains parameters that can be used to customize and adapt VIP operation to particular applications. All these parameters have a default value. The protection functions are operational even with the parameters menu default values.

Customizing Operation of the Mitop Trip Unit Output

There are 2 possible operating modes for the circuit breaker trip unit (Mitop) output:

- Standard mode (default mode) corresponds to the operation described in the Functions and Parameters *(see page 63)*chapter, for which the Mitop trip unit output is preassigned to the protection function outputs.
- Custom mode is used, if necessary, to modify assignment of the protection outputs to the Mitop trip unit output.

Customizing the Output Relays (VIP410)

There are 2 possible operating modes for the output relays and the associated latching function:
- Standard mode (default mode) corresponds to the operation described in the Functions and Parameters *(see page 63)*chapter, for which the output relays are preassigned. The latching function is active by default for the output relays associated with protection tripping (relays O1 and O2).
- Custom mode is used, if necessary, to modify assignment of outputs O1 to O3 to create annunciations or alarms and delete the latching function for the outputs associated with the protection functions.

Customization Associated with the Circuit Breaker

This customization is used to adapt all the parameters relating to the type of switchgear on which the VIP is mounted.

This customization is done in the factory. The user is not able to access these settings and modify them.

However, so that checks can be made on site, screens can be used to view the factory-set parameters.

Customizing Operation of the Mitop Trip Unit Output

At a Glance

This section describes the customization options for the Mitop trip unit output with a block diagram and the description of the associated customization screens in the parameters menu.

Selecting the Mitop Trip Unit Output Operating Mode

This customization can be used to define the tripping logic of the Mitop trip unit output. The **OUTPUT CUST** screen is located at the end of the parameters menu; it can be used to choose the operating mode:
- standard mode, **DEFAULT** setting
- custom mode, **CUSTOM** setting

After selecting custom mode, the screen required to customize operation of the Mitop trip unit output appears in the parameters menu following the **OUTPUT CUST** screen.

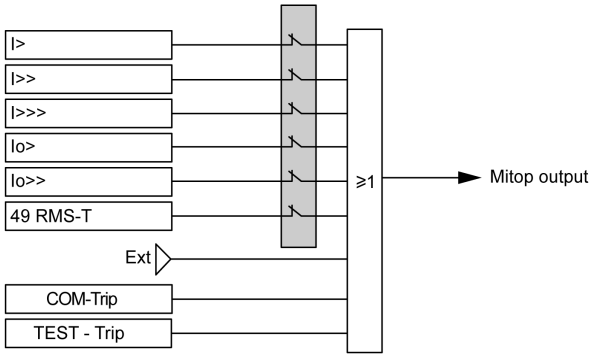
Setting Methods

Depending on the setting method chosen in the custom menu and associated with the circuit breaker, the parameter-setting screen interface varies.

There are 2 possible setting methods:
- Method 1: Each protection and each set point can be assigned independently to the Mitop trip unit output.
- Method 2: The set points of the protection functions wired on the Mitop trip unit output are in 3 groups.

The switches shown on the block diagrams are fictional switches, each of which represents an option in one of the customization screens. They are drawn in the default position (standard mode).

Method 1: Block Diagram



The **CB TRIPPING** screen is used to select the protection function outputs connected to the Mitop trip unit output.

The screen contains 6 digits. Each digit is associated with the output for a protection function.

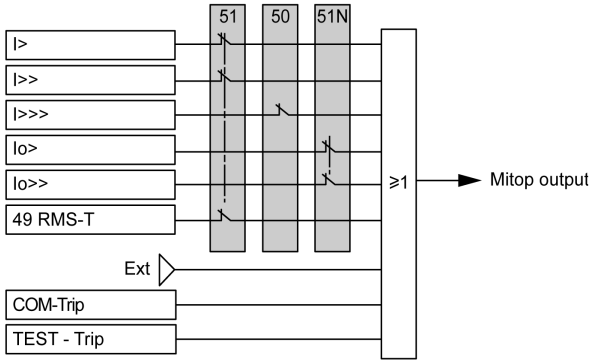
From left to right, the digits are associated with the following functions:
- delayed output for the phase overcurrent protection, I> set point
- delayed output for the phase overcurrent protection, I>> set point
- delayed output for the phase overcurrent protection, I>>> set point
- delayed output for the earth fault protection, Io> set point
- delayed output for the earth fault protection, Io>> set point
- thermal overload protection trip output (ANSI 49RMS-T)

If the digit value equals 1, the associated protection function output is connected to the Mitop trip unit output.

During the setting operation, the function associated with the selected digit is indicated on the left side of the bottom line as a reminder.

The following outputs are always connected to the Mitop trip unit output:
- tripping via the "Ext" external trip input (VIP410)
- tripping order via the "COM-Trip" communication port (VIP410)
- tripping in “TEST - Trip” temporary test mode

Method 2: Block Diagram



The **CB TRIPPING** screen is used to select the protection function outputs connected to the Mitop trip unit output.

The screen contains 3 settings, associated with the following protection functions:

- Setting 51, associated with the following functions:
  - delayed output for the phase overcurrent protection, I> set point
  - delayed output for the phase overcurrent protection, I>> set point
  - Thermal overload protection trip output (ANSI 49RMS-T)
- Setting 50, associated with the following function:
  - delayed output for the phase overcurrent protection, I>>> set point
- Setting 51N, associated with the following functions:
  - delayed output for the earth fault protection, Io> set point
  - delayed output for the earth fault protection, Io>> set point

Connection of the protection function outputs to the Mitop trip unit output depends on the setting:

- If the corresponding setting is **ON**, the associated protection function outputs are connected to the Mitop trip unit output.
- If the corresponding setting is **OFF**, the associated protection function outputs are not connected to the Mitop trip unit output.

The following outputs are always connected to the Mitop trip unit output:

- tripping via the "Ext" external trip input (VIP410)
- tripping order via the "COM-Trip" communication port (VIP410)
- tripping in “TEST - Trip” temporary test mode

Storing the Custom Mode Parameters

After setting the parameters for the custom operating mode, it is possible to return to standard operating mode.

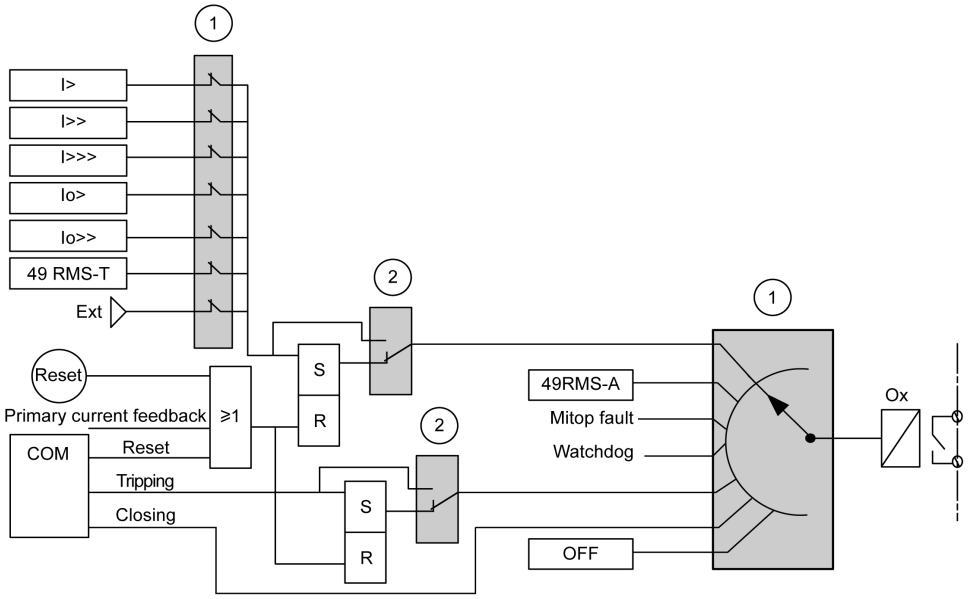
The custom operating mode parameters are then stored by the VIP. On returning to custom operating mode, the stored parameters are restored.

Impact of Customization on Fault Indication

If one of the protection outputs is not wired on the circuit breaker trip (set point used as an alarm only), the corresponding LED operates as a fault presence indicator. The LED flashes while the fault is present and goes out when it disappears. More information is available in the Fault Indication LEDs section *(see page 128)*.

Customizing the Output Relays (VIP410)

Block Diagram



1 Assignment of output relays O1 to O3
2 Latching the output relays

Assignment of Output Relays O1 to O3

The **O1 ASSIGN**, **O2 ASSIGN** and **O3 ASSIGN** screens are used to assign output relays O1, O2 and O3 to one of the following functions:

- protection functions output
- thermal overload protection alarm output (ANSI 49RMS-A)
- faulty Mitoptrip unit circuit
- watchdog
- tripping order sent via the communication port
- closing order sent via the communication port
- not used (**OFF**)

If an output relay is assigned to the protection functions output, it is possible to select which protections will activate it. In this case, the screen contains 7 digits. Each digit is associated with the output for a protection function.

From left to right, the digits are associated with the following functions:

- delayed output for the phase overcurrent protection, I> set point
- delayed output for the phase overcurrent protection, I>> set point
- delayed output for the phase overcurrent protection, I>>> set point
- delayed output for the earth fault protection, Io> set point
- delayed output for the earth fault protection, Io>> set point
- thermal overload protection trip output (ANSI 49 RMS-T)
- external trip order

If the digit value equals 1, the associated protection function output is connected to the output relay.

During the setting operation, the function associated with the selected digit is indicated on the left side of the bottom line as a reminder.

Latching the Output Relays

The **RELAYS LATCH** screen is used to enable or disable the latching function for each of output relays O1, O2 and O3.

The parameters to be set are:
- O1 latched: **YES** or **NO**
- O2 latched: **YES** or **NO**
- O3 latched: **YES** or **NO**

Meaning:
- **YES** means that the output relay is latched. In this case, it stays in the on-position after receiving a trip order (as long as the auxiliary power supply is present), until acknowledged by the **Reset** or by the primary current feedback or by the communication. This is default operation.
- **NO** means that the output relay reverts to its off-position as soon as the order given by the protection has disappeared.

NOTE: The latching function only applies to the outputs associated with protection functions and tripping via the communication. For the other outputs (alarm 49RMS, Mitop trip unit fault, watchdog, and closing via the communication), the latching parameter setting does not apply, the output is always unlatched, as stated in the block diagram.

Customization Associated with the Circuit Breaker

At a Glance

This section describes the content of the 3 customization screens associated with the type of circuit breaker.

The following screens are accessible:
- **PHASE CT** screen to define the phase CT primary rated current.
- **MIN TRIPTIME** screen to activate the minimum tripping time.
- **TRIP METHOD** screen to define the parameter-setting method for the Mitop trip unit output.

Display of the Customization Menu Associated with the Circuit Breaker

This customization is used to adapt all the parameters relating to the type of switchgear on which the VIP is mounted.

The **CB CUSTOM** screen (last parameters menu) is used to display or hide the customization screens associated with the type of circuit breaker.

By default, the **CB CUSTOM** screen indicates the **NO DISPLAY** setting and the customization screens associated with the circuit breaker do not appear.

After activation of the **DISPLAY** setting, the customization screens appear in the parameters menu, after the **CB CUSTOM** screen.

PHASE CT Screen

This screen can be used to define the phase CT rated current.

There are 2 possible values:
- CUa sensor: 200 A
- CUb sensor: 630 A

NOTE: If the phase CT rating indicated by this screen does not correspond to the CUa or CUb sensor rating, the VIP current measurements are incorrect. Should this occur, it is vital to call on Schneider Electric's services to correct this parameter setting.

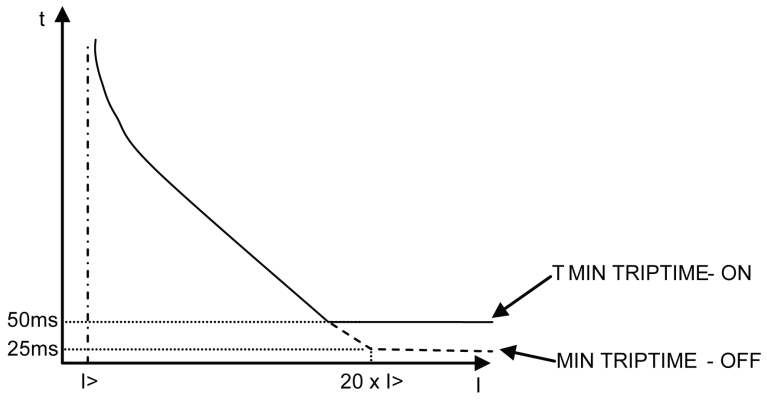
MIN TRIPTIME Screen

This screen is used to activate the minimum tripping time for the VIP. This minimum tripping time is to be commissioned or not according to the type of circuit breaker. By default this time is ON. 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.

If the **MIN TRIPTIME** is set to **ON**, the minimum tripping time for the VIP will be 50 ms.

For tripping time delays longer than 50 ms, this minimum tripping time serves no purpose.

The impact of the minimum tripping time on an IDMT curve is illustrated in the figure below. In this example, the TMS setting leads to a tripping on high current time (I > 20Is) identical to the instantaneous operating time (typically 25 ms).



If the **MIN TRIPTIME** screen is set to **ON**, the INST setting (instantaneous output, not delayed) for the I>>> and Io>> set points is not accessible. The I>>> and Io>> screens are necessarily associated with a definite time delay (DT setting), with a minimum setting of 50 ms (setting range minimum value).

TRIP METHOD Screen

This screen defines the parameter-setting method for the Mitop trip unit output.

It proposes 2 settings that correspond to 2 interfaces in the customization screen for the Mitop trip unit output:

- **METHOD 1** setting: Each protection and each set point can be assigned independently to the Mitop trip unit output.
- **METHOD 2** setting: The set points of the protection functions wired or not on the Mitop trip unit output are in 3 groups.

More information is available in the Custom Operation of the Mitop Trip Unit Output section *(see page 133)*.

Reliability

6

What Is in This Chapter?

This chapter contains the following topics:

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 protection relay 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's failure must never cause the circuit breaker to open. However, in the event of a 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 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.
- The watchdog relay, if it exists, is in the off-position (VIP410).
- The output relays are in the off-position (VIP410).
- The communication is inoperative (VIP410).

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 2 following scenarios:
1 A failure involving a risk of nuisance tripping.
2 A failure not involving a risk of nuisance tripping or a failure involving a risk of no tripping.

Case 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 code of 8 alphanumeric characters is displayed on the front panel: this allows Schneider Electric to make a diagnosis (**MAINTENANCE** message).
  - The watchdog relay, if it exists, is in the off-position (VIP410).
  - The output relays are in the off-position (VIP410).
  - The communication is inoperative (VIP410).

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.

Case 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.
- A code of 8 alphanumeric characters is displayed on the front panel as long as the failure is present. This code allows the customer to make an initial diagnosis (**ERROR** message). However, pressing one of the keys on the keypad makes the message disappear temporarily to allow the the operator to use the keypad and the display.

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 *(see page 190)*.

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 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 failure	YES
Used memory (SRAM) test	Checks the memory zone used by the program	During operation or on VIP restarting after a failure	YES
Software queue test	Checks that the software queue has not overflowed	During operation	YES

Name	Description	Execution Period	Change to Fail-Safe Position
Used memory (Flash) test	Checks the memory zone reserved for the VIP program	During operation or on VIP restarting after a failure	YES
Memory (EEPROM) test	Checks the product configuration data, user-programmed data and communication with the EEPROM component.	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
Configuration test of the Mitop trip unit control	Checks the configuration of the microcontroller ports corresponding to the Mitop trip unit control	During operation	YES
Mitop trip circuit supervision	More information is available in the Mitop *(see page 122)* Trip Unit Supervision section.	During operation	NO
Key test	Detects stuck keys (key held down for at least 1 minute)	During operation	NO
Test of the analog input module software components	Checks the life of the analog input module software components	During operation	YES
Test of the critical data stored in SRAM	Checks that the critical data stored in SRAM has not changed	During operation	YES
Test of detection of loss of the clock (RTC)	Checks the clock is present	On energization and during operation	NO
Compatibility test between boot software and operating software	Checks the consistency of the version of data exchanged between the boot software and the operating software	On energization	YES
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 information relating to tripping in the event of an electrical fault in the EEPROM memory. This failure does not affect operation of the protection functions.	On energization and during operation	NO
Test of the output relay control configuration (VIP410)	Checks the configuration of the microcontroller ports corresponding to the output relay controls	During operation	YES
External trip input test (VIP410)	Checks the validity of information on the external input	During operation	YES
Configuration test of the inputs relating to the power supplies	Checks the configuration of the microcontroller ports corresponding to the VIP power supply management	During operation	YES
Software queue test on start-up	Checks that the software queue used on start-up has not overflowed	On energization	NO
Calibration coefficient validity test	Checks that the calibration coefficients in the permitted range have not overflowed	On energization	NO

Communication

7

What Is in This Chapter?

This chapter contains the following topics:

At a Glance

General

Each VIP410 has a communication port.

Modbus communication allows VIP410 relays to be connected to a supervisor or any other device with a master Modbus communication port. VIP410s are always slaves.

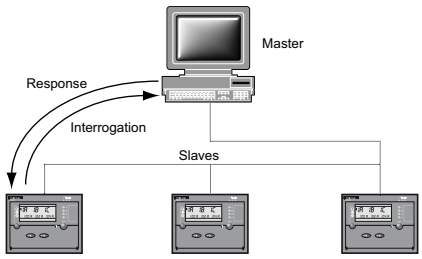
Accessible Data

Modbus communication can be used to perform functions remotely such as:
- reading of measurements, counters and diagnosis
- reading of status conditions and remote indications
- transfer of time-tagged events
- reading of VIP identification
- time-setting and synchronization
- reading of settings
- remote settings when these have been enabled
- transmission of remote controls

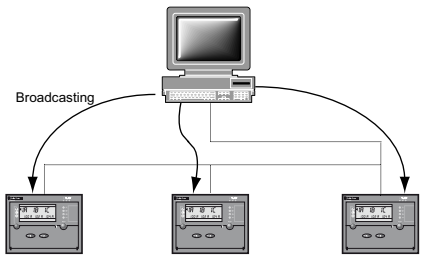
Modbus Protocol

Protocol Principle

The Modbus protocol is used to exchange data by means of a request-response type mechanism between one station called the master and N slaves. Exchange initialization (sending the request) is always initiated by the master. The slave (VIP) can only respond to a request sent to it. When the network hardware infrastructure allows, several slaves can be connected to the same master. The request contains a slave number (address) to identify which is the destination. This number must be unique. Slaves that are not destinations ignore the request received:



The master can also address all slaves using the conventional address 0. This mechanism is called broadcasting. Slaves do not respond to a broadcast message. Only messages that do not require data to be sent back by the slaves can be broadcast:



Multi-Master Operation

When VIPs are connected by a gateway to a network that allows multiple access (Ethernet, Modbus+, etc.), several masters are likely to address the same VIP on the same communication port.

It is the network designer's responsibility to resolve any conflicts that may occur.

Frame Structure

Each exchanged frame consists of a maximum of 255 bytes divided as follows (any frame with an error in format, parity, CRC 16, etc. is ignored):

Slave Number	Function Code	Data or Sub-Function Code	Control Word
1 byte	1 byte	n bytes	2 bytes
Request destination ● 0: broadcast (all) ● 1...247 (unique)	Refer to the next section	Request or response data (addresses/bit or word values, number of bits/bytes/data words) Sub-function code	CRC 16 (for detection of transmission errors)

The first two fields in the response are usually identical to those in the request.

Modbus Functions Supported

The VIP Modbus protocol is a subset of the Modbus RTU protocol:

- Data exchange functions
  - 1: read n output or internal bits
  - 2: read n input bits
  - 3: read n output or internal words
  - 4: read n input words
  - 5: write 1 bit
  - 6: write 1 word
  - 15: write n bits
  - 16: write n words
- Communication management functions
  - 8: read Modbus diagnosis counters
  - 11: read Modbus event counter
  - 43 with sub-function 14: read identification
  - 43 with sub-function 15: read date and time
  - 43 with sub-function 16: write date and time
- Protocol for managing time-tagged events
- Protocol for managing date and time synchronization

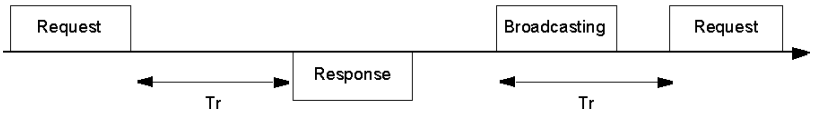
Structure of Exception Frames

An exception frame sent by the destination VIP for the request consists of the following fields:

Slave Number	Exception Function Code	Exception Code	Control Word
1 byte	1 byte	1 byte	2 bytes
Request destination	Request function code + 128 (80h)	Possible codes ● 1: unknown function code ● 2: incorrect address ● 3: incorrect data ● 4: slave not ready (impossible to process request) ● 7: non-acknowledgment (remote reading)	CRC 16 (for detection of transmission errors)

Turnaround Time

The turnaround time Tr is the time between the end of receipt of a request and sending the response:



NOTE: Tr includes the silence between 2 frames and is usually expressed for a format of 8 bits, odd parity, 1 stop bit, at 9,600 Bauds.

The VIP turnaround time is less than 10 ms.

Synchronizing Exchanges

Any character received after a silence lasting more than 3.5 characters is deemed to be the start of a frame.

A minimum silence equivalent to 3.5 characters must always be kept between 2 frames.

A slave ignores any frame:

- received with a physical error on one or more characters (format, parity error, etc.)
- with an invalid CRC 16
- which is not addressed to it

Commissioning and Diagnosis

Modbus Protocol Parameters

Parameters	Authorized Values	Default Value
Cubicle number	• 0 (not significant, the Modbus address is then adjustable) • 1…29 (the Modbus address is not adjustable because it is determined automatically according to the cubicle number)	0
Address	1...247	1
Baud rate	• 4,800 Baud • 9,600 Baud • 19,200 Baud • 38,400 Baud	38400
Remote control order	• DIR: direct mode remote control order • SBO: confirmed mode remote control order (Select Before Operate)	Direct mode
Parity	• none (1 or 2 adjustable stop bits) • even (1 fixed stop bit) • odd (1 fixed stop bit)	Even
Number of stop bits	• 1 • 2 (choice possible only if “no parity” has been set earlier and if Autogo is disabled)	1
Authorization of remote settings	• **OFF**: remote settings not enabled • **ON**: remote settings enabled	**ON**
Activation of Autogo	• **OFF**: AUTOGO off • **ON**: AUTOGO on	**ON**

Modbus Link Diagnosis

To check that the link is operating correctly, the user can refer to:
1. the link activity LED, on the front panel
2. the test zone
3. the Modbus diagnosis counters and the Modbus event counter

Link Activity LED

The  LED is activated by the transmission or reception of frames on the Modbus network.

NOTE: Flashing indicates that there is traffic. It does not mean that the exchanges are valid.

Using the Test Zone

Run a read/write/re-read cycle in the test zone, for example:

Function	Frame Sent	Frame Expected in Response
Reading 2 words at address 0C00h	01 03 0C00 0002 C75B	01 03 04 0000 0000 FA33
Writing a word with the value 1234 at address 0C00h	01 10 0C00 0001 02 1234 6727	01 10 0C00 0001 0299
Reading 1 word at address 0C00h	01 03 0C00 0001 B75A	01 03 02 1234 B539

More information is available in the Test Zone section *(see page 154)*.

Description of Counters

The VIP manages diagnosis counters CPT1 to CPT8 and the event counter CPT9:

- CPT1: number of valid frames of 4 to 255 bytes received, whether the relevant VIP is the destination or not
- CPT2: Number of request or broadcast frames received, with one or other of the following errors:
  - CRC error (but with a correct frame length) for frames addressed to the relevant VIP or not
  - incorrect length (< 4 or > 255 bytes) whether the relevant VIP is the destination or not
- CPT3: number of exception responses generated by the relevant VIP (except after a broadcast)
- CPT4: number of valid frames received by the relevant VIP (including during broadcast)
- CPT5: number of error-free request frames that have not received a response (excluding broadcast)
- CPT6: not significant
- CPT7: not significant
- CPT8: number of frames received with at least one character having a physical error (parity or overrun or framing, break on the line), whether the relevant VIP is the destination or not
- CPT9: number of requests (except function 11) received by the relevant VIP, valid and correctly executed

Counter Reset

The counters are reset to 0:

- when they reach the maximum value FFFFh (65535)
- when they are reset by a Modbus command (function 8, sub-code 000Ah)
- during a VIP power outage

Using the Counters

The diagnosis counters are read using function 8 and sub-codes 000Bh to 0012h depending on the counter.

Function 8 can also be used in echo mode (sub-code 0000h):

Function	Frame Sent	Frame Expected in Response
8 in echo mode	01 08 0000 1234 ED7C	01 08 0000 1234 ED7C

Event counter CPT9 is read using function 11.

Even in echo mode, the VIP recalculates and checks the CRC sent by the master:

- If the CRC received is valid, the VIP replies.
- If the CRC received is invalid, the VIP does not reply.

Automatic Adaptation of the Configuration: AUTOGO

At a Glance

The Autogo mechanism is a device for simplifying the Modbus device configuration. Its algorithm allows a VIP410 (slave) to automatically detect the configuration used on the Modbus bus to which it is connected.

Operation

The algorithm in the Autogo mechanism automatically detects the network parameters by testing the available transmission speeds and parities. The Modbus master must send at least 13 frames on the Modbus network before the Autogo mechanism algorithm works. There must be enough traffic on the bus before the VIP410 can be deemed to be absent or faulty.

The detected network parameters are deemed to be valid after correct reception of three different frames. In this case, the product will use the detected parameters and will save them in non-volatile memory.

NOTE: If the Modbus configuration set on the VIP410 is modified manually by the installer, the Autogo mechanism will be reset and will revert to the find configuration state.

NOTE: On restarting the VIP410, the saved Modbus parameters on the product will be revalidated. In the event of a fault on restarting, the search phase will be repeated after receipt of 7 invalid frames. Subsequently, the search phase is not repeated if a fault occurs during operation.

NOTE:

In the event of a problem in establishing communication, it is advisable to follow the procedure below:
1. Send the VIP a “Read multiple registers (FC03) from 1 register” request to any address.
2. Send this request at least 20 times.
3. If there is still no answer, check the Modbus diagnosis LED, wiring, polarization and line terminations.

Moreover it is possible to disable the Autogo mechanism and then manually set the Modbus network parameters.

Detectable Configurations

The 3 configurations supported by the algorithm are as follows:
- “Even” parity, 1 stop bit
- “Odd” parity, 1 stop bit
- no parity, 2 stop bits

associated with the following 4 transmission speeds:
- 4,800 Baud
- 9,600 Baud
- 19,200 Baud
- 38,400 Baud

i.e. a total of 12 detectable configurations.

Only the “no parity, 1 stop bit” configuration (available by manually configuring VIP410) is not supported by the Autogo mechanism for all the above speeds. If this configuration is selected on the product, the Autogo mechanism must be disabled manually by the installer.

Access to Data

Addressing a Word

All VIP data that can be accessed by Modbus communication is organized into 16-bit words. Each word is identified by its address, coded on 16 bits, i.e. from 0 to 65535 (FFFFh).

In the rest of the document, all addresses are expressed in hexadecimal format.

Addressing a Bit

Some data can also be accessed in the form of a bit.

The bit address is then deducted from the word address by:

Bit address = (word address x 16) + bit number (0...15)

Example

address word 0C00h

bit 0 address = C000h

bit 14 address = C00Eh

Undefined Addresses

Only addresses defined in this document should be used. If other addresses are used, the VIP can either respond with an exception message, or provide non-significant data.

Access Modes

The data are direct-access: they are permanently identified by their Modbus address. These can be reached in a single read or write operation, applying to all or part of the relevant zone.

In VIP, all zones are accessed directly, however for some zones, such as those for time-tagged events, a particular protocol can be used to optimize exchanges with the supervisor. This protocol is specified in the relevant zones.

List of Address Zones

Similar data in terms of control and monitoring applications or their coding are grouped into adjacent address zones:

Address Zones	Word Address Range	Access Mode	Access Type
Synchronization	0002h...0005h	direct	word
Identification	0006h...003Fh 0A20h...0A25h	direct	word
Remote controls	00F0h...00FDh	direct	word/bit
Remote control, status condition and remote indication feedback code	00FFh...0108h	direct	word/bit
Network diagnosis	0250h...025Bh	direct	word
Measurements - 16S format (x10) Measurements - 32S format	0400h...0457h	direct	word
Counters	0500h...0515h	direct	word
Test	0C00h...0C0Fh	direct	word/bit
Remote settings	1E00h...1E9Eh	direct	word
Time-Tagged Events	E000h...E4B1h	indirect	word

Data Coding

Formats Used

Apart from exceptions mentioned in the text, VIP data is coded in one of the formats below:
- 32S: signed value, coded on 32 bits
- 16S: signed value, coded on 16 bits
- B: bit or set of bits
- ASCII *nc*: string of n characters in ASCII code
- IEC: time coding format on 4 words conforming to IEC 60870-5-4

32S Format

In 32S format, the first word is the most significant.

An incalculable value, whether invalid or outside the authorized range, is fixed at 80000000h.

Example

An I1 current of 10,000 A is coded with a resolution of 0.1 A, and is therefore represented by the value 100,000 or 000186A0h, i.e.:
- at address 0440h: 0001h
- at address 0441h: 86A0h

16S Format

An incalculable value, whether invalid or outside the authorized range, is fixed at 8000h.

ASCII Format

ASCII format is used to code the identification strings for a VIP.

When the ASCII strings do not fill up the field entirely, they are completed with null bytes.

The first character occupies the most significant byte on the first word, the second the least significant byte on the first word, etc.

Example

“VIP 410” is coded as follows:

Word	**Most Significant Byte**		**Least Significant Byte**	
	Character	**Hexadecimal Value**	**Character**	**Hexadecimal Value**
1	V	56	I	49
2	P	50	SP	20
3	4	34	1	31
4	0	30	NUL	00

IEC Format

The date and time are coded on 4 words, in IEC 60870-5-4 format (bits at 0 in the table are not used: they are always read at 0 and ignored in write mode):

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 1	Reserved (0 in read mode, variable in write mode)								0	Year (0...99)						
Word 2	0	0	0	0	Month (1...12)				0	0	0	Day (1...31)				
Word 3	0	0	0	Hour (0...23)					0	0	Minutes (0...59)					
Word 4	Milliseconds (0...59,999)															

Synchronization, Identification, Metering, Network Diagnosis and Test Zones

Introduction

Synchronization, identification, metering, network diagnosis and test zones are accessed directly and do not contain any events.

For each zone, a table contains the following information:
- description of the addresses in the zone
- codes for Modbus functions that can be used in read mode
- codes for Modbus functions that can be used in write mode
- if necessary, the formats and resolution of the stored data

Synchronization Zone

The synchronization zone contains the 4 words used to code the absolute time required for time-tagging events:

Description	Address	Read	Write	Format
Binary time (year)	0002h	3	16	IEC
Binary time (month + day)	0003h	3		
Binary time (hours + minutes)	0004h	3		
Binary time (milliseconds)	0005h	3		

NOTE: The write operation should be performed on the whole zone and uses start address 0002 with a length of 4 words.

Identification Zone (Label)

The identification label contains:
- 8 words, used to code the serial number on a VIP unit
- 1 word for the cubicle number
- 1 word for the product type
- 41 to encode the basic identification data, the software version and the VIP communication protocol version.

Description	Addresses	Read	Write	Format	Value
Serial number	0006h...000Dh	3	–	ASCII	See below
Cubicle number	000Eh	3	–	16S	• 1 to 29 • 0 means not used
Product type	000Fh	3	–	16S	2 = Protection
VendorName	0010h...0018h	3	–	ASCII	“Schneider Electric”
ProductCode (reference coded in EAN13 format)	0019h...0022h	3	–	ASCII	“(EAN13)3 60648 •••••• •” See description of the EAN13 code in the Read VIP *(see page 176)* Identification section.
MajorMinorRevision (application version number)	0023h...0026h	3	–	ASCII	“xxx.yyy” example “001.000”
SubRevision (last field of the application version number)	0027h...0028h	3	–	ASCII	“zzz” example “001”
ProductName	0029h...002Ch	3	–	ASCII	“VIP 410”
ModelName (short identification code)	002Dh...0032h	3	–	ASCII	“VIP 410 A” or “VIP 410 E”
UserApplicationName	0033h...0038h	3	–	ASCII	“Operation”
PPID MajorMinorRevision (communication protocol version)	0A20h...0A23h	3	–	ASCII	“xxx.yyy” example “001.000”
PPID SubRevision (last field of the communication protocol version number)	0A24h...0A25h	3	–	ASCII	“zzz” example “001”

The serial number is coded as follows (bits at 0 in the table are not used: they are always read at 0):

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
0006h	Manufacturing plant number (First ASCII character: A...Z)								Manufacturing plant number (Second ASCII character: A...Z)							
0007h	Year (First ASCII character: “0”...”9”)								Year (Second ASCII character: “0”...”9”)							
0008h	Week (First ASCII character: “0”...”5”)								Week (Second ASCII character: “0”...”9”)							
0009h	Day of the week (ASCII character: “1”...”7”)								Sequence number in week (First ASCII character: “0”...”9”)							
000Ah	Sequence number in week (Second ASCII character: “0”...”9”)								Sequence number in week (Third ASCII character: “0”...”9”)							
000Bh	Sequence number in week (Fourth ASCII character: “0”...”9”)								Reserved (0)							
000Ch	Reserved (0)								Reserved (0)							
000Dh	Reserved (0)								Reserved (0)							

Metering Zone in 16S Format

The 16S metering zone contains measurements coded on 16 bits:

Description	Address	Read	Write	Format	Units
Phase current I1	0400h	3, 4	–	16S	1 A
Phase current I2	0401h	3, 4	–	16S	1 A
Phase current I3	0402h	3, 4	–	16S	1 A
Earth fault current Io	0403h	3, 4	–	16S	1 A
Reserved	0404h	–	–	–	–
Phase demand current Im1	0405h	3, 4	–	16S	1 A
Phase demand current Im2	0406h	3, 4	–	16S	1 A
Phase demand current Im3	0407h	3, 4	–	16S	1 A
Phase peak demand current IM1	0408h	3, 4	–	16S	1 A
Phase peak demand current IM2	0409h	3, 4	–	16S	1 A
Phase peak demand current IM3	040Ah	3, 4	–	16S	1 A
Thermal capacity used	040Bh	3, 4	–	16S	1%

Metering Zone in 32S Format

The 32S metering zone contains measurements coded on 32 bits:

Description	Addresses	Read	Write	Format	Units
Phase current I1	0440h - 0441h	3, 4	–	32S	0.1 A
Phase current I2	0442h - 0443h	3, 4	–	32S	0.1 A
Phase current I3	0444h - 0445h	3, 4	–	32S	0.1 A
Earth fault current Io	0446h - 0447h	3, 4	–	32S	0.1 A
Reserved	0448h - 0449h	–	–	–	–
Phase demand current Im1	044Ah - 044Bh	3, 4	–	32S	0.1 A
Phase demand current Im2	044Ch - 044Dh	3, 4	–	32S	0.1 A
Phase demand current Im3	044Eh - 044Fh	3, 4	–	32S	0.1 A
Phase peak demand current IM1	0450h - 0451h	3, 4	–	32S	0.1 A
Phase peak demand current IM2	0452h - 0453h	3, 4	–	32S	0.1 A
Phase peak demand current IM3	0454h - 0455h	3, 4	–	32S	0.1 A
Thermal capacity used	0456h - 0457h	3, 4	–	32S	1%

Network Diagnosis Zone

The network diagnosis zone contains the characteristics of the last trip:

Description	Addresses	Read	Write	Format	Units
Trip date and time	0250h...0253h	3, 4	–	IEC	–
Phase 1 tripping current	0254h - 0255h	3, 4	–	32S	0.1 A
Phase 2 tripping current	0256h - 0257h	3, 4	–	32S	0.1 A
Phase 3 tripping current	0258h - 0259h	3, 4	–	32S	0.1 A
Earth fault current Io	025Ah - 025Bh	3, 4	–	32S	0.1 A

Test Zone

The test zone contains 16 words used to simplify the communication tests at the time of commissioning or to test the connection. More information is available in the Using the Test Zone section *(see page 147)*.

Description	Addresses	Read	Write	Format
Test zone	0C00h...0C0Fh	1, 2, 3, 4	5, 6, 15, 16	–

These words are reset when the VIP is initialized.

Remote Control Zone

Introduction

Remote control orders are transmitted to the VIP via pulse type remote control orders using one of the following two modes, chosen via the settings:

- Direct mode
- Confirmed SBO (Select Before Operate) Mode

Remote Control Zone

The remote control zone contains:

Description	Word Addresses	Read	Write	Format
Single remote control orders	00F0h	1, 2, 3, 4	5, 6, 15, 16	B
Reserved	00F1h-00F2h	–	–	–
Selection of single remote control orders	00F3h	1, 2, 3, 4	5, 6, 15, 16	B
Reserved	00F4h-00F5h	–	–	–
Double remote control orders	00F6h	1, 2, 3, 4	5, 6, 15, 16	B
Reserved	00F7h-00F9h	–	–	–
Selection of double remote control orders	00FAh	1, 2, 3, 4	5, 6, 15, 16	B

Single Remote Control Order Words

The remote control order assigned to each bit in the remote control words (address 00F0h) and remote control selection words (address 00F3h) is predefined:

Bit	Remote Control Word	Selection Word	Remote Control Order
	Bit Address	Bit Address	
00	0F00h	0F30h	Reset a trip annunciation
01	0F01h	0F31h	Reset phase peak demand current values
02	0F02h	0F32h	Reset the load current history
03...14	0F03h...0F0Eh	0F33h...0F3Eh	Reserved
15	0F0Fh	0F3Fh	Product check by visual annunciation (the fault indication LEDs flash for 30 s)

NOTE: A single remote control order changing to zero does not generate time-tagged events.

Example of a single remote control order:

Product check by visual annunciation

Visual annunciation is activated by setting bit 15 to "1". To do this, write the value 01h at bit address 0F0Fh. This remote control order can also be executed by writing 8000h in the register at word address 00F0h.

Double Remote Control Order Words

The remote control order assigned to each pair of bits in the remote control words (address 00F6h) and remote control selection words (address 00FAh) is predefined:

Bit	Remote Control Word	Selection Word	Remote Control Order
	Bit Address	Bit Address	
00-01	0F61h-0F60h	0FA1h-0FA0h	Tripping and closing via the communication
02-03	0F63h-0F62h	0FA3h-0FA2h	Tripping and closing simulated via the communication
04-05	0F65h-0F64h	0FA5h-0FA4h	Choice of setting group
06...13	0F66h...0F6Dh	0FA6h...0FADh	Reserved
14-15	0F6Fh-0F6Eh	0FAFh-0FAEh	Configuration token monitoring

Double remote control orders are coded on 2 bits with the following possible values (“most significant bit”/“least significant bit”):

- 0/1 for “Tripping via the communication”, “Selection of setting group A”, “Release of configuration token”
- 1/0 for “Closing via the communication”, “Selection of setting group B”, “Reservation of configuration token”

NOTE: “Tripping and closing simulated via the communication” remote control order

This remote control order can be used to check the SCADA communication link to the module by simulating tripping or closing without physically acting on the VIP outputs. This implies that no event has been generated on the HMI, just that time-tagged events *(see page 162)* corresponding to "tripping and closing via the communication" *(see page 159)* double remote control orders have been generated.

NOTE: Sending the remote control order reserving the token can return an error *(see page 165)*.

NOTE: Value 1/1 is prohibited.

NOTE: A double remote control order changing to zero does not generate time-tagged events.

Example of double remote control orders:

“Tripping via the communication” remote control order

Tripping via the communication is activated by setting bit 0 to "1". To do this, write the value 01h at bit address 0F60h. This remote control order can also be executed by writing 0001h in the register at word address 00F6h.

“Closing via the communication” remote control order

Closing via the communication is activated by setting bit 1 to "1". To do this, write the value 01h at bit address 0F61h. This remote control order can also be executed by writing 0002h in the register at word address 00F6h.

Direct Mode

If remote control orders are configured in “direct” mode, the remote control order is executed immediately on writing to the remote control word. Resetting is performed by the control logic after the remote control order has been taken into account.

Confirmed SBO Mode

The remote control order is executed in two steps:

1. Selection by the supervisor of the command to be sent by writing the bit in the remote control selection word and checking the selection if necessary by re-reading this word.
2. Execution of the command to be sent by writing the bit in the remote control word.

NOTE: When this mode is selected, it applies to all control orders.

The remote control order is executed if the remote control selection word bit and the associated remote control word bit are set, both word bits are reset by the control logic after the remote control order has been taken into account. Deselection of the selection word bit occurs:

- if the supervisor deselects it by writing in the selection word
- if the supervisor selects (writes) a different bit from that already selected
- if the supervisor sets a bit in the remote control word that does not correspond to that selected (in this case no remote control order will be executed)
- if the corresponding order is not sent within a period of 30 seconds

Remote Control Order, Status Condition and Remote Indication Feedback Code Zone

Introduction

Status conditions and remote indications are pre-assigned to protection or control functions or to logic inputs or output relays. They can be read using bit or word functions.

Remote Control Order, Status Condition and Remote Indication Feedback Code Zone

The status condition and remote indication zone contains 10 words that group together status bits. It also provides the remote control order feedback code:

Description	Word Address	Bit Address	Read	Write	Format
Remote control order feedback code	00FFh	0FF0h…0FFFh	1, 2, 3, 4	–	B
Control word	0100h	1000h...100Fh	1, 2, 3, 4	–	B
Status word	0101h	1010h...101Fh	1, 2, 3, 4	–	B
Remote indication no. 1 word	0102h	1020h...102Fh	1, 2, 3, 4	–	B
Reserved	0103h	1030h...103Fh	–	–	–
Remote indication no. 3 word	0104h	1040h...104Fh	1, 2, 3, 4	–	B
Reserved	0105h	1050h...105Fh	–	–	–
Logic input states	0106h	1060h...106Fh	1, 2, 3, 4	–	B
Logic output states	0107h	1070h...107Fh	1, 2, 3, 4	–	B
Double remote indication word	0108h	1080h...108Fh	1, 2, 3, 4	–	B

Remote Control Order Feedback Code (Address 00FFh)

Bit	Bit Address	Status
00	0FF0h	Remote control order executed successfully (0)/Remote control order execution in progress (1)
01...15	0FF1h…0FF Fh	Reserved

NOTE: As soon as a remote control order is received by the VIP, it is executed immediately. In practice, the feedback code is always 0.

Control Word (Address 0100h)

Bit	Bit Address	Status
00...03	1000h...1003h	Reserved
04	1004h	VIP time incorrect
05	1005h	VIP not synchronized
06	1006h	VIP initialization in progress
07	1007h	Reserved
08	1008h	Minor fault: detection of a failure not involving a risk of nuisance tripping *(see page 141)*
09...15	1009h...100Fh	Reserved

NOTE: Bit 06 changing to zero does generate not time-tagged events.

Status Word (Address 0101h)

The status word specifies the main functions when on:

Bit	Bit Address	Status
00	1010h	Protection 50-51 I> set point on (1)/off (0)
01	1011h	Protection 50-51 I>> set point on (1)/off (0)
02	1012h	Protection 50-51 I>>> set point on (1)/off (0)
03	1013h	Protection 50N-51N Io> set point on (1)/off (0)
04	1014h	Protection 50N-51N Io>> set point on (1)/off (0)
05	1015h	Thermal overload protection on (1)/off (0)
06	1016h	CLPU I on (1)/off (0)
07	1017h	CLPU Io on (1)/off (0)
08	1018h	Phase overcurrent protection harmonic 2 restraint, on (1)/off (0)
09	1019h	Earth fault protection harmonic 2 restraint, on (1)/off (0)
10	101Ah	External trip input protection on (1)/off (0)
11...12	101Bh...101Ch	Reserved
13	101Dh	Change of VIP settings or parameters
14	101Eh	Authorization of remote settings, enabled (1)/disabled (0)
15	101Fh	Remote control mode, direct (0)/“Select Before Operate” (SBO) (1)

NOTE: Bit 13 changing to zero does not generate time-tagged events.

Remote Indication No. 1 Word (Address 0102h)

This remote indication word signals overshooting of the setpoints for the various protection functions:

Bit	Bit Address	Remote Indication
00	1020h	Protection 50-51 delayed I> set point
01	1021h	Protection 50-51 delayed I>> set point
02	1022h	Protection 50-51 delayed I>>> set point
03	1023h	Protection 50-51 pick-up I> set point
04	1024h	Protection 50-51 pick-up I>> set point
05	1025h	Protection 50-51 pick-up I>>> set point
06	1026h	Protection 50N-51N delayed Io> set point
07	1027h	Protection 50N-51N delayed Io>> set point
08	1028h	Protection 50N-51N pick-up Io> set point
09	1029h	Protection 50N-51N pick-up Io>> set point
10	102Ah	Protection 49 RMS thermal alarm
11	102Bh	Protection 49 RMS thermal tripping
12	102Ch	CLPU I in action
13	102Dh	CLPU Io in action
14...15	102h...102Fh	Reserved

Remote Indication No. 3 Word (Address 0104h)

Bit	Bit Address	Remote Indication
00	1040h	Mitop trip unit circuit error (detection of a break in the Mitop trip unit trip circuit) in progress
01	1041h	Tripping by external input in progress
02	1042h	Tripping in progress
03	1043h	Tripping by the temporary test menu in progress
04	1044h	Tripping on a fault indication
05...15	1045h…104Fh	Reserved

Logic Input Status Word (Address 0106h)

Bit	Bit Address	Status
00	1060h	External trip input
01...15	1061h...106Fh	Reserved

Output Relay Status Word (Address 0107h)

Bit	Bit Address	Status
00	1070h	Output O1
01	1071h	Output O2
02	1072h	Output O3
03...15	1073h...107Fh	Reserved

Double Remote Indication Word (Address 0108h)

Bit	Bit Address	Status
00...01	1080h-1081h	Reserved
02	1082h	Tripping simulated via the communication
03	1083h	Closing simulated by the communication
04	1084h	Setting group A selected
05	1085h	Setting group B selected
06...13	1086h...108Dh	Reserved
14	108Eh	Release of configuration token
15	108Fh	Reservation of configuration token

Time-Tagged Events

Introduction

The VIP410 includes a time-tagged event mechanism so that its operation can be monitored using a supervisor. This mechanism is common to several products in Schneider Electric's ranges.

This data can be retrieved via the Modbus link. This data is volatile and will therefore be lost if the product is de-energized.

Event Types

A *logic event* is the change of state of a VIP logic variable (bit in control, status or remote indication words).

An *analog event* is the record of a tripping current.

Each event is mainly characterized by:
- an address: that belonging to the associated bit or word (depending on the type)
- a value (for logic events, it is the direction of change)
- a date and time: the event is time-tagged (resolution: 1 ms)

NOTE: By extension, an event also designates all the characteristics of the change in state.

Time-Tagging

Time-tagging of events uses the VIP internal clock. When an event is detected, the VIP's current time is associated with it.

The clock accuracy depends mainly on the quality of synchronization of the VIP *(see page 174)* internal clock.

The presence of a valid clock on VIP is not guaranteed throughout product operation. In fact, during the initialization phase, the clock will not be accessible; it will only become so once the product has booted up fully.

In the event of loss of the clock *(see page 123)*, detected events will be time-tagged with a default date until the clock is reset. This default date starts on "1st January 2000 00h 00min 0sec".

The chronology of detected events remains valid in all cases.

Description of How to Code an Event

An event is coded on 12 words with the following structure:

Word	Information	Coding	
		Logic Events	**Analog Events**
1	Event number	Between 1 and 65535	
2...5	Date and time of the event	In IEC 60870-5-4 format	
6 (MSB)	Number of associated events	0 (no secondary event associated with the VIP events)	
6 (LSB)	Type of data	Boolean (04h)	32-bit signed integer (21h)
7	Event address	Address of the bit that identifies it	Word address
8...11	Associated data	Direction of the event: ● 0: deactivation/disappearance ● 1: activation/appearance	Current value in 32S format
12	Primary or secondary event identifier	Between 1 and 65533. Used to identify the event.	

NOTE:

- Event numbering starts at no. 1 and ends with no. 65535. When event no. 65535 is detected, the next event numbering restarts at no. 1.
- Only two data types are conveyed in the VIP410 events, Boolean type and 32-bit signed type.
- The most significant byte of word no. 6 corresponds to the type of event (primary or secondary). On VIP, events are always primary type (no associated secondary events).
- The event address always corresponds to a Modbus register defined on the VIP.
- For Boolean type, words 8, 9 and 10 are set to 0. For 32-bit signed type, words 8 and 9 are set to 0.
- Word 12 is incremented 2 at a time on each event.

Event Tables

The VIP manages an internal storage table with a capacity of 100 events.

Upstream of the table, 2 words contain:
- the current number of events present in the queue (between 0 and 100)
- the number of the last detected event

Both these words and the number of the first event in the table form a header that will be used by the supervisor to detect presence of new events.

The table can be seen as a FIFO type stack.

		Addresses	Description	Read	Write
Header		E000h	Number of events in table	3	–
		E001h	Number of last event in table	3	–
	Table of 100 events	E002h	Index 0 event (event number)	3	–
		E003h…E00Dh	Index 0 event (rest of data)	3	–
		E00Eh…E019h	Index 1 event	3	–
		...	...	3	–
		E4A5h…E4B1h	Index 99 event	3	–

NOTE: Reading the events table is not “destructive”. An event no. “x” will only be removed from the table if 100 new events have been detected (in other words, event no. “x+100” has been detected).

Initializing the Events Table

On starting, the VIP initializes its events table by filling all the registers (table and header) with the value 0 (no event recorded).

When it starts, the VIP always adds three events:
- initialization in progress
- date/time incorrect (not configured since startup)
- not synchronized

These three events are destined for the supervisor for time synchronization and detection of product resetting.

Read Sequence

The consultation protocol for time-tagged events includes a standard sequence that can be executed by a supervisor to detect and retrieve new events present on the VIP.

This sequence is divided into two parts:
- detection of new events on the VIP
- reading of new events on the VIP

Detection of new events on the VIP: New events are detected by periodic reading of the header in the time-tagged events zone (addresses E000h to E002h).

If the “number of last event” in table changes between two header readings, one or more events have been added to the table. The supervisor can then read the new events.

Read Previous Header (n-1)		Read Current Header (n)	
Address	**Value**	**Address**	**Value**
E000h	X	E000h	X’
E001h	Y	E001h	Y’
E002h	Z	E002h	Z’

Reading of new events on the VIP: On the basis of values read in the headers, the supervisor can determine the Modbus register ranges to be read to obtain the new event data.

The number of new events detected equals “Y’-Y”.

The supervisor determines the position (index) in the table of the first and last new event starting from the event number stored at index 0 of the table (“Z’”).

The Modbus register addresses associated with the new events can be deduced from the indexes:
- event start address = E002h + index * 12
- event end address = E002h + (index + 1) * 12 - 1

Loss of Events

If the number of new events exceeds the table capacity, only the 100 most recent events will still be accessible. The oldest events will be lost forever.

The supervisor is responsible for retrieving events from the VIP. It is up to him to adapt his consultation strategy to avoid the loss of events.

List of Possible Events

The VIP has 62 sources of time-tagged events whose descriptions appear below.

Boolean events:
- Data type: Boolean (format code: 04h)
- Possible values: 0 or 1
- The description corresponds to value “1” of the event.
- The “↑” column indicates events generated only on a change to “1”.

Bit Address	Description	↑
1004h	VIP time incorrect	
1005h	VIP not synchronized	
1006h	VIP initialization in progress	•
1008h	Minor fault: detection of a failure not involving a risk of nuisance tripping *(see page 141)*	
1010h	Protection 50-51 I> set point on	
1011h	Protection 50-51 I>> set point on	
1012h	Protection 50-51 I>>> set point on	
1013h	Protection 50N-51N Io> set point on	
1014h	Protection 50N-51N Io>> set point on	
1015h	Thermal overload protection on	
1016h	CLPU I on	
1017h	CLPU Io on	
1018h	Phase overcurrent protection harmonic 2 restraint on	
1019h	Earth fault protection harmonic 2 restraint on	
101Ah	External trip input protection on	
101Dh	Change of VIP settings or parameters	•
101Eh	Authorization of remote settings enabled	
101Fh	“Select Before Operate (SBO)” mode for the remote control orders	
1020h	Protection 50-51 delayed I> set point	
1021h	Protection 50-51 delayed I>> set point	
1022h	Protection 50-51 delayed I>>> set point	
1023h	Protection 50-51 pick-up I> set point	
1024h	Protection 50-51 pick-up I>> set point	
1025h	Protection 50-51 pick-up I>>> set point	
1026h	Protection 50N-51N delayed Io> set point	
1027h	Protection 50N-51N delayed Io>> set point	
1028h	Protection 50N-51N pick-up Io> set point	
1029h	Protection 50N-51N pick-up Io>> set point	
102Ah	Protection 49 RMS thermal alarm	
102Bh	Protection 49 RMS thermal tripping	
102Ch	CLPU I in action	
102Dh	CLPU Io in action	
1040h	Mitop trip unit circuit error (detection of a break in the Mitop trip unit trip circuit) in progress	
1041h	Tripping by external input in progress	
1042h	Tripping in progress	
1043h	Tripping by the temporary test menu in progress	
1044h	Presence of tripping that has not been acknowledged	
1060h	External trip input set	
1070h	Output O1 set	

Bit Address	Description	↑
1071h	Output O2 set	
1072h	Output O3 set	
1082h	Tripping simulated via the communication	
1083h	Closing simulated by the communication	
1084h	Setting group A selected	
1085h	Setting group B selected	
108Eh	Release of configuration token	
108Fh	Reservation of configuration token	
0F00h	Reset a trip annunciation	•
0F01h	Reset phase peak demand current values requested	•
0F02h	Reset load current history requested	•
0F60h	Tripping via the communication requested	•
0F61h	Closing via the communication requested	•
0F62h	Tripping simulated via the communication requested	•
0F63h	Closing simulated by the communication requested	•
0F64h	Selection of setting group A requested	•
0F65h	Selection of setting group B requested	•
0F6Eh	Release of configuration token requested	•
0F6Fh	Reservation of configuration token requested	•

NOTE: Events at bit addresses “1006h” and “101Dh” do not generate an event on drop-out.

Analog events:
- Data type: 32-bit signed (format code: 21h)
- Possible values: 0 to FFFFFFFFh

Word Address	Description
0254h	Phase 1 tripping current
0256h	Phase 2 tripping current
0258h	Phase 3 tripping current
025Ah	Earth fault tripping current

Access to Remote Settings

At a Glance

Access to the VIP remote settings via the Modbus communication allows:
- remote reading of settings
- remote modification of settings (remote setting), provided this has been enabled

Settings Zones

Description	Word Addresses	Read	Write
Date of last setting	1E00h…1E03h	3, 4	–
Remote settings zone no. 1	1E04h…1E3Ch	3, 4	6,16
Remote settings zone no. 2	1E50h…1E7Bh	3, 4	6,16
Assignment remote settings zone	1E80h…1E9Eh	3, 4	6,16

The date of last setting is in IEC 60870-5-4 format.

Remote settings zone no. 1 mainly contains the settings relating to the protection functions and the electrical network. Remote settings zone no. 2 contains the other parameters (HMI, communication, assignment of outputs, rated current, etc.). The last remote settings zone uses the parameters for assignment of outputs in zone no. 2 by changing the data coding.

NOTE: Detailed information about these zones will be given in the settings table.

Types of Settings

Format

Most of the remote setting parameters are contained on a Modbus register (16 signed bits). Only the protection set points and the output assignments are contained on two Modbus registers, i.e. 32 signed bits.

For 32-bit parameters, the word with the lower address corresponds to the most significant data word; the word with the higher address corresponds to the least significant data word.

Writing a 32-bit parameter must be done by writing both registers via a single Modbus request (function 16).

Coding

Remote settings use two coding types:
- numerical coding (Num)
- bitstring coding (Bitstring)

Numerical coding is the most common, a numerical value is attached to a status or a setpoint or operating mode for the parameter.

Bitstring coding corresponds to a string of binary states (“0” = false and “1” = true). This coding is used on VIP to assign protection functions to the product outputs. For example, the decimal value “154” corresponds to bitstring “10011010”.

NOTE: The parameter format and coding will be given in the settings table.

NOTE: The “16 signed bits” format will appear as “16S”, and the “32 signed bits” format will appear as “32S”.

Settings Access Rights

The VIP parameters are accessible with two types of access rights:
- remote reading only (R)
- remote reading and remote setting (RW)

“Remote reading” affects all the VIP parameters (general parameters, protection functions, etc.).

“Remote setting” affects the parameters relating to the protection functions and similar ones. Their values will be modifiable by remote settings.

Parameters that are not accessible by remote setting should be configured via the user screen.

The remote setting function can be prohibited by a parameter available in the Modbus communication configuration menu. In default configuration (factory setting), the remote setting function is enabled.

NOTE: The settings access rights will be given in the settings table.

Configuration Token

Remote settings are a sensitive operation on the VIP. They should be performed carefully by the supervisor, who also needs to protect himself against actions by the user and other supervisors.

A configuration token is therefore made available to the supervisor so as to reserve access to the product settings.

This token can be reserved (and released) by a supervisor via a remote control, by the user, on entering (and exiting) a setting “edit” mode on the user screen.

If the token has already been reserved, reserving the token returns an error:
- in Modbus with the remote control, error code 4: product not ready
- on the user screen: scrolling message, “remote setting in progress”

NOTE: If it is not released, the token is automatically released 30 minutes after reservation.

Accessibility to Settings

Some VIP settings depend on the values of other settings. This is why some settings cannot be read and written if their accessibility conditions are not met.

For example, the protection tripping time can depend on the tripping curve to which a protection function is attached. If the protection is disabled, it will then be impossible to consult or modify its time delay value.

If an attempt is made to read an inaccessible parameter, the value returned will be as follows (no Modbus error will be returned):
- 8000h, if the setting is in 16-bit format
- 80000000h, if the setting is in 32-bit format

If an attempt is made to write an inaccessible parameter, the new value requested for the setting concerned will not be taken into account. No Modbus error will be returned.

NOTE: The accessibility conditions for the various settings in Modbus are very close to those in the user screen settings menus.

Remote Reading Procedure

To perform remote reading, the supervisor simply reads the value of the Modbus register for the desired setting.

The value of a setting is automatically updated when a value is changed via the user interface or via a remote setting.

Remote Setting Procedure

To perform remote setting, the supervisor should:
1. Reserve the configuration token.
2. Write the new value(s) of one or more parameters.
3. Release the configuration token.

One or more settings can be the target of a single remote setting request.

Remote setting of a setting larger than 16 bits must be performed by a write request that covers all the Modbus registers associated with this setting. For example, only writing the least or most significant word of a 32-bit setting will not modify the setting value.

A remote setting request will return a Modbus error in the following cases:
- remote settings not enabled (specific product setting)
- product unavailable (processing of a previous remote setting request in progress, or editing during a setting via the user screen)
- one of the settings targeted is not accessible for remote setting

Taking Account of Remote Setting

Processing of one or more remote settings is asynchronous. To release the communication bus as quickly as possible, the VIP only applies the new settings values after responding to the Modbus write request. Some tests (particularly concerning the validity of the new values submitted for the settings) will be performed during processing.

If a new setting value is invalid, the VIP ignores modification of the setting, and processes subsequent modifications (if any). No Modbus error can be fed back.

The supervisor should check the setting value to make sure that its modification has indeed been applied.

NOTE: When processing remote settings, the VIP may need to reconfigure its current metering and/or protection chain. The remote settings processing time does not exceed 200 milliseconds. Once processing is complete, the VIP restarts these protection functions.

Settings Table

Phase Overcurrent Protection (50-51)

Settings Coding

(C1) Tripping curves (I>, I>>):
- 0 = OFF: set point off
- 1 = DT : definite time
- 2 = SIT/A: IEC/A standard inverse time
- 3 = LTI/B: IEC long time inverse
- 4 = VIT/B: IEC/B very inverse time
- 5 = EIT/C: IEC/C extremely inverse time
- 6 = MI/D: IEEE moderately inverse or IEC/D
- 7 = VI/E: IEEE very inverse or IEC/E
- 8 = EI/F: IEEE extremely inverse or IEC/F
- 9 = RI

(C2) Tripping curves (I>>>):
- 0 = OFF: set point off
- 1 = DT : definite time
- 2 = INST: instantaneous if the minimum tripping time (MIN TRIPTIME) is disabled

(P1) Phase overcurrent protection harmonic 2 restraint assignment:
- 0 = OFF: set point off
- 1 = ALL: action on I>, I>> and I>>>
- 2 = I>: action on I> only
- 3 = I>>: action on I>> only
- 4 = I>>>: action on I>>> only
- 5 = I> & I>>: action on I> and I>>
- 6 = I> & I>>>: action on I> and I>>>
- 7 = I>> & I>>>: action on I>> and I>>>

Settings Table

Protection I>:

Group A Word Addresses	Group B Word Addresses	Description	Format	Unit	Coding	Access
1E07h	1E1Bh	Tripping curve	16S	–	See settings coding (C1)	RW
1E08h-1E09h	1E1Ch-1E1Dh	Tripping set point	32S	0.1 A	See Characteristics of the I> and I>> Set Points *(see page 203)*	RW
1E0Ah	1E1Eh	Tripping time delay	16S	0.01 s (DT) 0.01 (TMS) 0.1 (TD)	See Characteristics of the T> and T>> Time Delays *(see page 203)*	RW

Protection I>>:

Group A Word Addresses	Group B Word Addresses	Description	Format	Unit	Coding	Access
1E0Bh	1E1Fh	Tripping curve	16S	–	See settings coding (C1)	RW
1E0Ch-1E0Dh	1E20h-1E21h	Tripping set point	32S	0.1 A	See Characteristics of the I> and I>> Set Points *(see page 203)*	RW
1E0Eh	1E22h	Tripping time delay	16S	0.01 s (DT) 0.01 (TMS) 0.1 (TD)	See Characteristics of the T> and T>> Time Delays *(see page 203)*	RW

Protection I>>>:

Group A Word Addresses	Group B Word Addresses	Description	Format	Unit	Coding	Access
1E0Fh	1E23h	Tripping curve	16S	–	See settings coding (C2)	RW
1E10h-1E11h	1E24h-1E25h	Tripping set point	32S	0.1 A	See Characteristics of the I>>> Set Point *(see page 203)*	RW
1E12h	1E26h	Tripping time delay	16S	0.01 s (DT) 0.01 (TMS) 0.1 (TD)	See Characteristics of the T>>> Time Delay *(see page 203)*	RW

Phase overcurrent protection harmonic 2 restraint

Word Addresses	Description	Format	Unit	Coding	Access
1E35h	Activity	16S	–	See settings coding (P1)	RW
1E36h	Second-harmonic set point	16S	%	See Characteristics of the Second-Harmonic Set Point *(see page 203)*	RW
1E37h-1E38h	Minimum short-circuit current	32S	0.1 A	See Characteristics of the Isc Min *(see page 203)*	RW

Earth Fault Protection (50N-51N)

Settings Coding

(C3) Tripping curves (Io>):
- 0 = OFF: set point off
- 1 = DT : definite time
- 2 = SIT/A: IEC/A standard inverse time
- 3 = LTI/B: IEC long time inverse
- 4 = VIT/B: IEC/B very inverse time
- 5 = EIT/C: IEC/C extremely inverse time
- 6 = MI/D: IEEE moderately inverse or IEC/D
- 7 = VI/E: IEEE very inverse or IEC/E
- 8 = EI/F: IEEE extremely inverse or IEC/F
- 9 = RI

(C4) Tripping curves (Io>>):
- 0 = OFF: set point off
- 1 = DT : definite time
- 2 = INST: instantaneous if the minimum tripping time (MIN TRIPTIME) is disabled

(T1) Earth fault protection harmonic 2 restraint assignment:
- 0 = OFF: set point off
- 1 = ALL: action on Io> and Io>>
- 2 = Io>: action on Io> only
- 3 = Io>>: action on Io>> only

Settings Table

Protection Io>:

Group A Word Addresses	Group B Word Addresses	Description	Format	Unit	Coding	Access
1E13h	1E27h	Tripping curve	16S	–	See settings coding (C3)	RW
1E14h-1E15h	1E28h-1E29h	Tripping set point	32S	0.1 A	See Characteristics of the Io> Set Point *(see page 205)*	RW
1E16h	1E2Ah	Tripping time delay	16S	0.01 s (DT) 0.01 (other)	See Characteristics of the To> Time Delay *(see page 205)*	RW

Protection Io>>:

Group A Word Addresses	Group B Word Addresses	Description	Format	Unit	Coding	Access
1E17h	1E2Bh	Tripping curve	16S	–	See settings coding (C4)	RW
1E18h-1E19h	1E2Ch-1E2Dh	Tripping set point	32S	0.1 A	See Characteristics of the Io>> Set Point *(see page 205)*	RW
1E1Ah	1E2Eh	Tripping time delay	16S	0.01s (DT) - (INST)	See Characteristics of the To>> Time Delay *(see page 205)*	RW

Earth fault protection harmonic 2 restraint:

Word Addresses	Description	Format	Unit	Coding	Access
1E39h	Activity	16S	–	See settings coding (T1)	RW

Thermal Overload Protection (49RMS)

Word Addresses	Description	Format	Unit	Coding	Access
1E2Fh	Activity	16S	–	0 = off 1 = on	RW
1E30h-1E31h	Tripping set point	32S	0.1 A	See Characteristics of the Thermal Set Point *(see page 207)*	RW
1E32h	Time constant	16S	min	See Thermal Time Constant Characteristic *(see page 207)*	RW
1E33h	Alarm set point	16S	%	50 to 100%	RW
1E34h	Thermal capacity used	16S	%	0 to 999%	R

Additional Metering and Earth Fault Protection Characteristics

Word Addresses	Description	Format	Unit	Coding	Access
1E04h	Earth fault current metering mode	16S	–	1 = Sum 2 = Core balance CT	R
1E05h	Earth fault current measurement range with core balance CT	16S	–	1 = 1 A…24 A 2 = 10 A…240 A	R
1E06h	Frequency	16S	Hz	50 or 60	R
1E3Ah	Io> set point setting range	16S	–	1 = Default range 2 = Extended range	R

Setting Groups

Word Addresses	Description	Format	Unit	Coding	Access
1E3Bh	Setting groups - Groups used	16S	–	1 = Group A only 2 = Groups A and B	RW
1E3Ch	Setting groups - Group selected	16S	–	1 = Group A selected 2 = Group B selected	RW

General Settings

Settings Coding

(LAN1) Operating language:

- 0 = UK English
- 1 = US English
- 2 = Spanish
- 3 = French
- 4 = Italian
- 5 = German
- 6 = Turkish
- 7 = Portuguese
- 8 = Chinese
- 9 = Russian

General settings:

Word Addresses	Description	Format	Unit	Coding	Access
1E50h	Language	16S	–	See settings coding (LAN1)	R
1E51h	Peak demand value integration period	16S	min	1 min…60 min	R
1E52h-1E53h	Load current (Ib)	32S	0.1 A	20 A…200 A (In = 200 A) 50 A…630 A (In = 630 A)	R
1E64h	Protection reset time	16S	–	0 = off 1 = on	R
1E65h	External input protection	16S	–	0 = off 1 = on	R
1E66h	LCD screen contrast	16S	–	1…10	R
1E67h	Output customization	16S	–	1 = Default 2 = Custom	R
1E78h	Circuit breaker customization	16S	–	1 = Displayed 2 = Not displayed	R

Modbus Communication

Word Addresses	Description	Format	Unit	Coding	Access
1E54h	Autogo	16S	–	0 = off 1 = on	R
1E55h	Speed	16S	–	1 = 4,800 Baud 2 = 9,600 Baud 3 = 19,200 Baud 4 = 38,400 Baud	R
1E56h	Parity	16S	–	1 = None 2 = Even 3 = Odd	R
1E57h	Number of stop bits	16S	–	1 or 2	R
1E58h	Modbus address	16S	–	1 to 247	R
1E59h	Cubicle number	16S	–	0 = Not used Otherwise between 1 and 29	R
1E5Ah	Remote control mode	16S	–	1 = Direct 2 = SBO	R
1E5Bh	Authorization of remote settings	16S	–	0 = Not enabled 1 = Enabled	R

Phase Overcurrent Cold Load Pick-Up

Settings Coding

(CLPU1) CLPU phase assignment:
- 0 = OFF: off
- 1 = ALL: action on I>, I>> and I>>>
- 2 = I>: action on I> only
- 3 = I>>: action on I>> only
- 4 = I>>>: action on I>>> only
- 5 = I> & I>>: action on I> and I>>
- 6 = I> & I>>>: action on I> and I>>>
- 7 = I>> & I>>>: action on I>> and I>>>

(CLPU2) CLPU earth fault assignment:
- 0 = OFF: off
- 1 = ALL: action on Io> and Io>>
- 2 = Io>: action on Io> only
- 3 = Io>>: action on Io>> only

(CLPU3) Set point increase ratios:
- 1 = 150%
- 2 = 200%
- 3 = 300%
- 4 = 400%
- 5 = 500%
- 6 = Blocking of the set point

Settings Table

Cold Load Pick-Up operating mode:

Word Addresses	Description	Format	Unit	Coding	Access
1E62h	Operating mode	16S	–	1 = Default 2 = Secondary	R

Phase overcurrent Cold Load Pick-Up

Word Addresses	Description	Format	Unit	Coding	Access
1E5Ch	Activity	16S	–	See settings coding (CPLU1)	RW
1E5Dh	Action on set points	16S	–	See settings coding (CPLU3)	RW
1E5Eh	Time delay	16S	s	See Characteristics of the CLPU I Time Delay *(see page 207)*	RW

Earth fault Cold Load Pick-Up:

Word Addresses	Description	Format	Unit	Coding	Access
1E5Fh	Action field	16S	–	See settings coding (CPLU2)	RW
1E60h	Set point increase ratio	16S	–	See settings coding (CPLU3)	RW
1E61h	Time delay	16S	s	See Characteristics of the CLPU Io Time Delay *(see page 208)*	RW

Mitop Trip Unit Output Parameter Setting

Settings Coding

(MITOP1) Assignment to the Mitop trip unit output (method 1):

Bitstring coding for assignment of the protection functions to the Mitop trip unit output, if assignment method no. 1 has been selected.

Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
I>	I>>	I>>>	Io>	Io>>	Ith

Example: The value “29” (or 1Dh) means that the protections I>>, I>>>, Io> and 49RMS are assigned to the Mitop trip unit output.

Settings Table

Mitop trip unit output parameter setting:

Word Addresses	Description	Format	Unit	Coding	Access
1E68h	Parameter setting with method 1	16S	–	See settings coding (MITOP1) (value only significant if method 1 has been chosen)	R
1E69h	Parameter setting with method 2 - Protection functions 50	16S	–	0 = No 1 = Yes (value only significant if method 2 has been chosen)	R
1E6Ah	Parameter setting with method 2 - Protection functions 51	16S	–	0 = No 1 = Yes (value only significant if method 2 has been chosen)	R
1E6Bh	Parameter setting with method 2 - Protection functions 51N	16S	–	0 = No 1 = Yes (value only significant if method 2 has been chosen)	R

Mitop trip unit output parameter setting with method 1 (one protection at a time):

Another method of setting the protection assignments to the Mitop trip unit output, when assignment “method 1” has been selected:

Word Addresses	Description	Format	Unit	Coding	Access
1E80h	Assignment to the Mitop trip unit output on protection 50-51 I>	16S	–	0 = Not assigned 1 = Assigned (value only significant if method 1 has been chosen)	R
1E81h	Assignment to the Mitop trip unit output on protection 50-51 I>>	16S	–	0 = Not assigned 1 = Assigned (value only significant if method 1 has been chosen)	R
1E82h	Assignment to the Mitop trip unit output protection 50-51 I>>>	16S	–	0 = Not assigned 1 = Assigned (value only significant if method 1 has been chosen)	R
1E83h	Assignment to the Mitop trip unit output on protection 50N-51N Io>	16S	–	0 = Not assigned 1 = Assigned (value only significant if method 1 has been chosen)	R
1E84h	Assignment to the Mitop trip unit output on protection 50N-51N Io>>	16S	–	0 = Not assigned 1 = Assigned (value only significant if method 1 has been chosen)	R
1E85h	Assignment to the Mitop trip unit output on Ith thermal protection	16S	–	0 = Not assigned 1 = Assigned (value only significant if method 1 has been chosen)	R

Annunciation Output Parameter Settings

Settings Coding

(OUT1) Output parameter settings:
- 0 = OFF: off
- 1 = “Protection” function
- 2 = Thermal alarm
- 3 = Mitop fault
- 4 = Watchdog
- 5 = Tripping via the communication
- 6 = Closing via the communication

(OUT2) Protection assignments to the output:
- Bitstring coding for assignment of protection functions to the output.

Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
I>	I>>	I>>>	Io>	Io>>	Ith	Ext

Example: The value “1100101” (or 65h) means that the protections I>, I>>, Io>> and External are assigned to the output.

Settings Table

Annunciation output parameter settings:

Word Addresses	Description	Format	Unit	Coding	Access
1E6Ch	Output O1 parameter setting	16S	–	See settings coding (OUT1)	R
1E6Dh	Protections assigned to output O1 (if set to “Protections” function)	16S	–	See settings coding (OUT2)	R
1E6Fh	Output O2 parameter setting	16S	–	See settings coding (OUT1)	R
1E70h	Protections assigned to output O2 (if set to “Protections” function)	16S	–	See settings coding (OUT2)	R
1E72h	Output O3 parameter setting	16S	–	See settings coding (OUT1)	R
1E73h	Protections assigned to output O3 (if set to “Protections” function)	16S	–	See settings coding (OUT2)	R

Parameter setting of protection functions assigned to the annunciation outputs (one protection at a time):

Another method of setting the protection assignments to the annunciation outputs, when these are set to the “Protections” function:

Word Addresses for Assignments to:			Description	Format	Unit	Coding	Access
Output O1	Output O2	Output O3					
1E88h	1E90h	1E98h	Assignment of protection 50-51 I>	16S	–	0 = Not assigned 1 = Assigned	R
1E89h	1E91h	1E99h	Assignment of protection 50-51 I>>	16S	–	0 = Not assigned 1 = Assigned	R
1E8Ah	1E92h	1E9Ah	Assignment of protection 50-51 I>>>	16S	–	0 = Not assigned 1 = Assigned	R
1E8Bh	1E93h	1E9Bh	Assignment of protection 50N-51N Io>	16S	–	0 = Not assigned 1 = Assigned	R
1E8Ch	1E94h	1E9Ch	Assignment of protection 50N-51N Io>>	16S	–	0 = Not assigned 1 = Assigned	R
1E8Dh	1E95h	1E9Dh	Assignment of Ith thermal protection	16S	–	0 = Not assigned 1 = Assigned	R
1E8Eh	1E96h	1E9Eh	Assignment of Ext external protection	16S	–	0 = Not assigned 1 = Assigned	R

Latching of annunciation outputs (if “Protections and/or Tripping via the communication” function selected):

Word Addresses	Description	Format	Unit	Coding	Access
1E75h	Output O1 latching	16S	–	0 = Not latched 1 = Latched	R
1E76h	Output O2 latching	16S	–	0 = Not latched 1 = Latched	R
1E77h	Output O3 latching	16S	–	0 = Not latched 1 = Latched	R

Circuit Breaker Customization

Word Addresses	Description	Format	Unit	Coding	Access
1E79h	Phase CT rated current	16S	A	200 A or 630 A	R
1E7Ah	Minimum tripping time delay	16S	–	0 = off 1 = on	R
1E7Bh	Mitop trip unit output parameter setting method	16S	–	1 = Method 1 2 = Method 2	R

Date and Time-Setting and Synchronization

Introduction

The VIP manages the date and time internally. If the auxiliary power supply fails, this information continues to be maintained, as long as a battery in good working order has been inserted in the device.

The VIP internal time is used, in particular, to date alarms and events.

The date and time can be read on the display (parameters menu).

The VIP also delivers a VIP time incorrect data item (bit 12) to the control word, indicating the need to set the time.

Time and Date-Setting

When the VIP is energized, the time is set automatically from the battery-backed clock, provided the battery is working.

The time and date are set:
- in local mode from the front panel (parameters menu)
- by writing, in a single block, the new date and time value in the synchronization zone (Modbus time frame)
- by using function 43 with sub-function 16 *(see page 175)*

Synchronization

The time frame is used both for setting the time and synchronizing the VIP. In this case, it should be transmitted regularly at close intervals (10 to 60 seconds) to obtain a synchronous time. It is usually transmitted by broadcasting (slave number = 0).

In synchronous state, the absence of receipt of a time frame for more than 200 seconds causes a loss of synchronism (bit 05 of the control word at 1).

On receipt of the date and time, the VIP saves the new date. It also checks whether the difference between this new date and the current date is more than 100 ms. If so, the VIP changes to non-synchronous state (bit 05 of the control word at 1). It will return to synchronous state (bit 05 of the control word at 0) as soon as the time difference between the new date it has received and the current date is less than 100 ms.

Synchronization Cycle

Each synchronization cycle is executed as follows:

Phase	Description
1	The supervisor writes its date and time value in the synchronization zone or by function 43-16 *(see page 175)*.
2	The VIP changes to non-synchronous state (bit 05 of the control word at 1) and resets its clock.
3	If the reset amplitude is less than 100 ms, the VIP changes back to synchronous state.

Time-Tagged Events Generated

When the VIP is energized, it generates the following events in succession:
- “Appearance of VIP time incorrect”
- “Appearance of VIP not synchronous”

When the first synchronization message is broadcast by the supervisor, the VIP generates the following events in succession:
- “Disappearance of VIP time incorrect”
- “Disappearance of VIP not synchronous”

After a loss of synchronization, the VIP generates the following event:
- “Appearance of VIP not synchronous”

After synchronization reappears, the VIP generates the following event:
- “Disappearance of VIP not synchronous”

Clock Accuracy

The clock accuracy is linked to the master and its control of the time frame transmission delay on the communication network. Before sending a time frame, the supervisor must ensure that all the read requests sent have received a response. Synchronization of the VIP is performed immediately after the frame is received.

For optimum synchronization, the supervisor must compensate for the frame transmission time. The frame transmission time is compensated by the VIP.

If the frames pass through a gateway (multi-master operation), make sure that this does not slow down the frames.

Managing the Date and Time Using Function 43

Introduction

Access to and setting the date and time on VIP is also possible via two sub-functions of the Modbus 43 function. These two sub-functions will be referred to as function 43-15 and function 43-16 hereafter.

Function 43-15

Function 43-15 is a read VIP date and current time function. It is an alternative to reading the Modbus registers at addresses 0002h to 0005h inclusive.

The IEC 60870-5-4 format is used for data returned by function 43-15 (common to reading via the Modbus registers).

Request frame structure:

Slave Number	Function Code	MEI Type (Sub-Function Code)	Reserved	Control Word
1 byte	1 byte	1 byte	1 byte	2 bytes
Request destination: ● 1…247 (unique)	43 (decimal)	15 (decimal)	0	CRC 16

Correct response frame structure:

Slave Number	Function Code	MEI Type (Sub-Function Code)	Reserved	Data	Control Word
1 byte	1 byte	1 byte	1 byte	8 bytes	2 bytes
Request destination: ● 1…247 (unique)	43 (decimal)	15 (decimal)	0	Date and time in IEC 60870-5-4 format	CRC 16

Function 43-16

Function 43-16 is a write VIP date and current time function. It is an alternative to writing the Modbus registers at addresses 0002h to 0005h inclusive.

The IEC 60870-5-4 format is used for data supplied to function 43-16 (common to reading via the Modbus registers).

Correct request frame structure:

Slave Number	Function Code	MEI Type (Sub-Function Code)	Reserved	Data	Control Word
1 byte	1 byte	1 byte	1 byte	8 bytes	2 bytes
Request destination: ● 0: broadcast ● 1…247 (unique)	43 (decimal)	16 (decimal)	0	Date and time in IEC 60870-5-4 format	CRC 16

Response frame structure: No response if it is sent in broadcast mode. Otherwise the response is as follows:

Slave Number	Function Code	MEI Type (Sub-Function Code)	Reserved	Data	Control Word
1 byte	1 byte	1 byte	1 byte	8 bytes	2 bytes
Request destination: ● 1…247 (unique)	43 (decimal)	16 (decimal)	0	VIP date and current time in IEC 60870-5-4 format after updating	CRC 16

Read VIP Identification

Introduction

The Read Device Identification function can be used for standard access to the information required for unambiguous identification of a device.

VIP processes the read identification function (conformity level: 83h). For a complete description of the function, refer to the www.modbus.org website. The description below is a subset of the function options, adapted to the example of VIP.

VIP Identification

VIP identification consists of strings of ASCII characters called *objects*.

VIP objects are divided into three groups:

Group	No.	Object	Value	Length
1 Basic	0	VendorName	“Schneider Electric”	18 (12h)
	1	ProductCode (reference coded in EAN13 format)	“(EAN13)3 60648 •••••• •”	20 (14h)
	2	MajorMinorRevision (application version number)	“xxx.yyy”	7
2 Regular	3	VendorURL	“www.schneider-electric.com”	26 (1Ah)
	4	ProductName	“VIP 410”	7
	5	ModelName (short identification code)	“VIP 410 •”	9
	6	UserApplicationName	“Operation”	12 (0Ch)
3 Extended	80	FirmwareSubRevision number (last field of the application version number)	“zzz”	3
	81	PPID MajorMinorRevision (communication protocol version)	“xxx.yyy”	7
	82	PPID SubRevision number (last field of the communication protocol version number)	“zzz”	3
	83	Serial number	Refer to the identification zone that describes the serial number format *(see page 152)*.	16 (10h)

ProductCode

The EAN13 code identifies the reference for a VIP universally in 13 digits:

Standards Organization	Manufacturer	Reference	Checksum
3	60648	04673•	Calculated with reference to http://www.ean-int.org

Identification Codes and References

The ModelName character string is the short VIP identification code. Each ModelName string has a corresponding ProductCode string (one only):

ModelName	ProductCode
“Unknown application”	“(EAN13)0 00000 000000 0”
“VIP 410 A”	“(EAN13)3 60648 046734 9”
“VIP 410 E”	“(EAN13)3 60648 046735 6”

NOTE:

- The length of the “Unknown application” string is 19 characters.
- The spaces in the ProductCode column are not significant: the EAN13 code has no spaces between the digits.

Request Frame

The read identification request frame consists of the following fields:

Field	Size (Bytes)	Value
Slave number	1	1...247
Function code	1	43 (2Bh)
MEI type (sub-function code)	1	14 (0Eh)
Read type	1	01 or 02 or 03 or 04
Not used	1	00
CRC16	2	Calculated

Response Frame

The response frame consists of the following fields:

Field	Size (Bytes)	Value
Slave number	1	1...247
Function code	1	43 (2Bh)
MEI type (sub-function code)	1	14 (0Eh)
Read type	1	01 or 02 or 03 or 04
Conformity level	1	83h
Not used	1	00
Not used	1	00
Number of objects	1	n = 3, 7 or 11, according to the Read type field
First object number	1	obj1
First object length	1	lg1
First object ASCII string	lg1	txt1
...	...	...
*n*th object number	1	objn
*n*th object length	1	lgn
*n*th object ASCII string	lgn	txtn
CRC16	2	Calculated

Exception Frame

If an error occurs while processing the request, the VIP sends an exception frame, consisting of the following fields:

Field	Size (Bytes)	Value
Slave number	1	1...247
Function code increased by 80h	1	171 (ABh)
MEI type (sub-function code)	1	14 (0Eh) or other if MEI type received is incorrect
Exception code	1	01: MEI type received is incorrect($\neq$ 14) 02: in cases of individual access (read code 04), if the requested object does not exist 03: incorrect data (frame length incorrect or read code invalid)
CRC16	2	Calculated

Commissioning

8

What Is in This Chapter?

This chapter contains the following topics:

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

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it.
- Always use a properly rated voltage sensing device (EN 61243) to confirm that all power is off.
- Before performing visual inspections, tests, or maintenance on this equipment:
  - Turn off all sources of electric power.
  - Assume that all circuits are live until they have been completely de-energized, tested and tagged.
- Beware of potential hazards, wear personal protective equipment, and carefully inspect the work area for tools and objects that may have been left inside the equipment.
- Successful VIP operation depends upon proper installation, setting, and operation.
- Setting the VIP relay requires relevant expertise in the field of electrical network protection. Only competent people who have this expertise are allowed to set this product.

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. The high voltage that would result from opening the circuit is dangerous for the operator and for the equipment.
- Never disconnect the VIP protection relay 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.

⚠ CAUTION

RISK OF DAMAGE TO THE VIP

- 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 relay. High voltage testing may damage electronic components contained in the VIP relay.
- Do not open the VIP case. The VIP relay contains components that are susceptible to electrostatic discharge. It is assembled in specially equipped premises. The only permitted operation is removal of the depleted battery from its compartment on a VIP relay.

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

Introduction

At a Glance

The VIP is a protection relay that uses digital technology. This technology ensures the reproducibility of its performance. The whole VIP protection chain has been performance-tested at one time and factory-tested at the time of mounting on the circuit breaker. As a result, the VIP is ready to operate without requiring any additional tests. The VIP is equipped with internal self-tests that continuously provide information on the state of its electronic components and the integrity of the internal functions.

As a result, 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 ensure that it has not suffered any damage during transport and installation.

Settings

Determining Parameter and Protection Settings

All the VIP parameter and 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 parameter and protection settings must be available for commissioning. The VIP settings sheet can be used to list all the parameter and protection settings to be entered.

VIP Power Supply for Entering Settings

The VIP is a protection relay with a self-powered supply. It is powered by its current sensors and operates without an auxiliary power supply. As a result, before commissioning, when the circuit breaker is open, the VIP must be supplied with power so that settings can be entered.

For this, the VIP can be supplied with power:
- from the embedded battery
- from the pocket battery module

The VIP410 can also be supplied by its auxiliary power supply if this is available before the cubicle is commissioned.

Power Supply from the Embedded Battery

The embedded battery can be used to activate operation of the user-machine interface and to access menus in order to enter settings. To do this, press and hold down the key. If there is no activity, the battery power will cut out automatically after 3 minutes to save the battery.

NOTE: The embedded battery plays no part in operating the protection functions. The protection functions work even when there is no battery.

NOTE: In battery-powered operating mode, the VIP processor works at a reduced clock frequency. As a result, the user-machine interface may be slower to react than when operating self-powered or when powered by the pocket battery module.

Power Supply from the Pocket Battery Module

The pocket battery module can be connected on the front panel of VIP protection relays. This module contains a battery and can be used to supply the VIP with power when its embedded battery is missing.

More information on connecting the pocket battery module to the front panel of VIP relays is available in the Pocket Battery Module section *(see page 191)*.

Entering Settings

More information on entering settings is available in the Settings section *(see page 47)*.

NOTE: The current sensor rating is factory preset when the VIP is mounted on the circuit breaker. This operation is no longer necessary during commissioning.

Checking VIP Operation

Example Where the VIP is Not Supplied With Power

This section describes the minimum test that can be performed when the VIP is not supplied with power, either because there is no current in the circuit breaker, or because the pocket battery module is not available. This test is also possible on a VIP410 that is not powered by its auxiliary power supply.

When the VIP is not supplied with power, this simplified check can ensure that the VIP processor is working correctly by activating the user-machine interface from the embedded battery.

To perform the check, proceed as follows:

Step	Action
1	First check that the battery is present and working correctly by performing the battery test. To do this, press the **Reset** key. **Result:** If the battery is OK, the indicator LEDs light up. If the battery is missing, the simplified check cannot be performed. In this case, the user must supply the VIP with power from the pocket battery module *(see page 183)*.
2	Activate battery operation of the user-machine interface by pressing and holding down the key. **NOTE:** In battery-powered operating mode, the VIP processor works at a reduced clock frequency. The user-machine interface may then be slower to react than when self-powered by the sensors or powered by the pocket battery module. **Result:** ● The status LED lights up temporarily. ● The VIP displays a bar chart during the starting time. ● The VIP displays the peak demand current screen.
3	Check that you can access the setting menus by pressing the , and keys.
4	Check that the status LED is off: this means that the VIP self-tests have not detected a malfunction. **Result of the procedure:** The VIP processor is working correctly.

Example Where the VIP can be Powered by the Pocket Battery Module

This section describes the minimum test that can be performed with the pocket battery module when the VIP400 or VIP410 is not supplied with power, because there is no current in the circuit breaker, or because the auxiliary power supply is missing (as with the VIP410).

The pocket battery module contains a battery which can be used to power the VIP to check it is working correctly, or to enter settings if the embedded battery is missing.

The pocket battery module is also used to:
- check that the VIP processor is working correctly
- check the trip unit connection Mitop and test circuit breaker tripping

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

Step	Action
1	Connect the pocket battery module and move the switch to the Test position.
2	Check that the VIP starts and displays the phase currents screen.
3	Check that you can access the setting menus by pressing the , and keys.
4	Check that the status LED is off: this means that the VIP self-tests do not detect a malfunction. **Result of the procedure:** The VIP processor is working correctly.

Checking the Mitop Trip Unit Connection and Testing Circuit Breaker Tripping

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 ensures 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 sensors.

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
1	Connect the pocket battery module and move the switch to the Test position.
2	Check that the VIP starts and displays the phase currents screen.
3	Check that the status LED is off.
4	Close the MV circuit breaker.
5	Switch the VIP to temporary test mode: ● Go into the parameters menu ( ) by pressing the key ● Select the **TRIP TEST** screen by pressing the and keys. ● Select the **ACTIVE** value by pressing the key and using the / keys. ● Press again to confirm selection. **POCKET BATTERY** is permanently displayed to indicate that the setting has been taken into account by the VIP. The VIP is then in temporary test mode. **NOTE:** This operation may require the password to be entered, if this has been set up earlier.
6	Press the key for 5 seconds: the LED flashes quickly to indicate that tripping is about to occur. **Result:** After 5 seconds, the VIP sends an opening order to the circuit breaker and displays a message indicating the VIP has sent a trip order. **NOTE:** This action is only taken into account by the VIP when it is in temporary test mode.

The VIP exits temporary test mode:
- Automatically:
  - after sending the opening order
  - after one minute
  - when its power supply via the pocket battery module is removed.
- Manually:
  - when the **Reset** key is pressed
  - when the key is pressed

Case of the VIP410:
- When the VIP410 is not powered by its auxiliary power supply, the whole of the above procedure applies.
- When the VIP410 is powered by its auxiliary power supply, to test circuit breaker tripping, the pocket battery module must also be connected because it must be present in order to enter temporary test mode.

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

The test described in this chapter is applicable to VIP400 and to VIP410. In the case of the VIP410, it is advisable to perform the test without connecting the auxiliary power supply, this tests that it can work autonomously.

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 and will increment its event counters to no purpose (test scenario 1 only).

Case 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. In particular, this test can be performed by single-phase injection, in succession on each of the 3 phases, in order to check that the earth fault protection trips.

Case 2:

Depending on the protection setting values, it is not always possible to inject sufficient primary current to 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 if VIP hard-wired to the CUa sensor (200 A)
- 31.5 A/5 s if VIP hard-wired to the CUb sensor (630 A)
- accuracy: same accuracy as the I> *(see page 202)* protection function

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

The VIP exits temporary test mode:
- automatically:
  - after sending the opening order
  - after one minute
  - when its power supply from the sensors has been removed
- Manually:
  - when the **Reset** key is pressed
  - when the Esc key is pressed

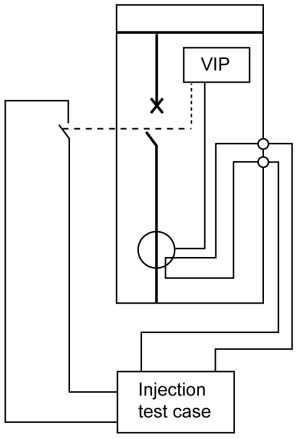
Testing and Metering Equipment Required

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 50 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 single-phase primary current using the cubicle's primary injection circuit if it has one: ● 16 A for a circuit breaker equipped with 200 A CUa sensors ● 50 A for a circuit breaker equipped with 630 A CUb sensors
3	Check that the VIP displays the injected current (accuracy = +/- 5%) and that the status LED is off.
4	Repeat this operation for all phases. In the event of discrepancy between the injected current and the measured current, check in the parameters menu that the sensor primary rated current has been set correctly: 200 A or 630 A depending on the sensors. **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 the same current as in one of the phases: ● 16 A for a circuit breaker equipped with 200 A CUa sensors ● 50 A for a circuit breaker equipped with 630 A CUb sensors
3	Switch the VIP to temporary test mode: ● Go into the parameters menu ( ) by pressing the key ● Select the **TRIP TEST** screen by pressing the and keys. ● Select the **ACTIVE** value by pressing the key and using the / keys. ● Press again to confirm selection. The value of the currents is displayed. The VIP is then in temporary test mode. **NOTE:** This operation may require the password to be entered, if this has been set up earlier.
4	Activate test protection to trip the circuit breaker by pressing the key for 5 s: the I> LED flashes quickly to indicate that tripping is about to occur. **Result:** After the time delay has elapsed, the VIP gives a trip order via the Mitop trip unit and the circuit breaker opens. The VIP displays a message indicating that the I> protection has sent a trip order. **NOTE:** Injection must be interrupted after the trip via the circuit breaker auxiliary contact wiring. If this is not done, the message indicating that the I> protection has sent a trip order will be acknowledged automatically and will no longer be displayed.
5	Turn off current injection, then disconnect the primary injection equipment.

The VIP exits temporary test mode:

- Automatically:
  - after sending the opening order
  - after one minute
  - in the event of loss of the VIP power supply
- Manually:
  - when the **Reset** key is pressed
  - when the Esc key is pressed

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 or 630 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 VIP protection relay by one of the methods described above *(see page 183)*
- 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:

- Browse all the VIP parameter and protection setting screens and compare the values entered in the VIP with the values stated in the parameter and protection settings file.
- Correct any parameter and protection settings that have not been entered correctly.

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.

NOTE: It is advisable to make a note of the last event recorded by the VIP on the test sheet (this can be accessed in the metering menu) so that you can distinguish between the values attributable to the tests from those due to subsequent activation of the protections by a fault on the installation.

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 *(see page 211)*	• 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

9

What Is in This Chapter?

This chapter contains the following topics:

Preventive Maintenance

Introduction

To obtain maximum availability of the installation, it is essential to ensure that the VIP is operational at all times. The VIP internal self-tests alert the user in the event of internal failure of the VIP *(see page 141)*.

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 front 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 depend 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 measured by the VIP are appropriate for the load being powered.
- In cases where the VIP is not supplied with power (insufficient network load or lack of auxiliary power supply: VIP410), the VIP must be supplied with power to perform the above checks. To do this, use one of the methods below:
  - Press and hold down the menu selection key . The VIP starts up thanks to its embedded battery and displays its bar chart. Then check that the status LED is off and that the menus are accessible.
  - Power the VIP with the pocket battery module *(see page 191)*. Then check that the status LED is off and that the menus are accessible.

LED and Display Unit Test

The LED and display unit test is used to check that each LED on the front panel and all the pixels on the display are working correctly. To perform this test, the VIP must be supplied with power.

In cases where there is insufficient network load or no auxiliary power supply for the VIP410, power the VIP using one of the 2 methods below:

- Press and hold down the menu selection key . The VIP starts up thanks to its embedded battery and displays its bar chart.
- Power the VIP with the pocket battery module *(see page 191)*.

To perform the test, press and hold down the menu selection key. After 4 seconds have elapsed, all the pixels on the display are displayed in black (except the LED for the auxiliary power supply) and the LEDs light up one after another for 1 second (chaser effect). Release the key at the end of the test.

Checking the Battery Status

The VIP has a battery. To check that the battery is in good working order, press the **Reset** key until the fault indication LEDs light up. The LEDs should light up in less than 30 seconds and remain on without fading for the whole time the key is pressed. If not, replace the battery *(see page 199)*.

Checking the Trip Chain

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

More information on the operations to be performed is available in the Checking the Complete Protection Chain section *(see page 185)*.

Pocket Battery Module

At a Glance

The pocket battery module is an accessory that can be connected to the front panel of VIP relays. It contains a battery that can be used to power the VIP in order to:

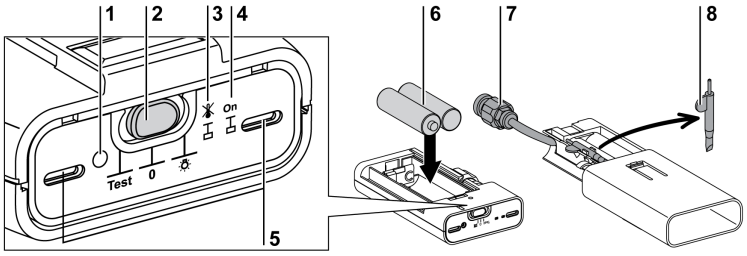
- enter settings if the integrated battery is missing and if the VIP is not supplied with power
- test the VIP *(see page 189)*
- display the cause of the last trip by the VIP *(see page 46)*

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.



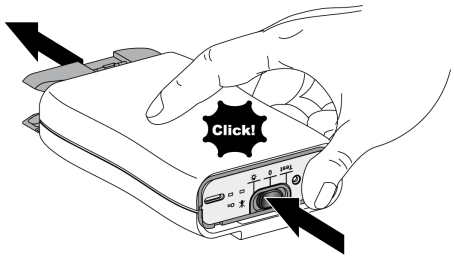
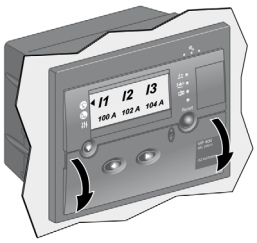
1 Not used
2 3-position slide switch:
Left = Test position; Center = OFF; Right = pocket flashlight
3 Not used
4 Green LED for checking the battery status
5 Two illumination LEDs
6 Two 1.5 V type AA batteries (not supplied)
7 Connector for the VIP test port
8 Stylus/screwdriver

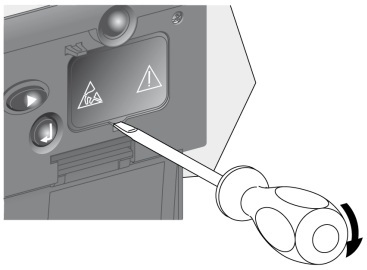
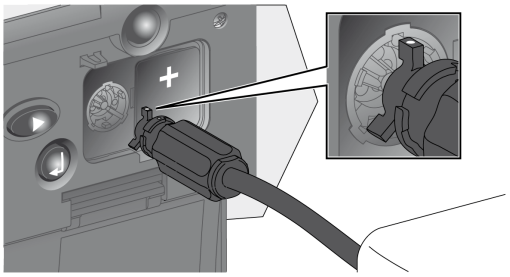
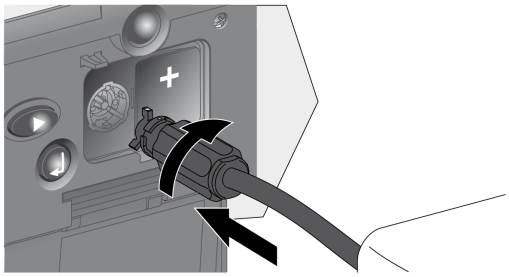
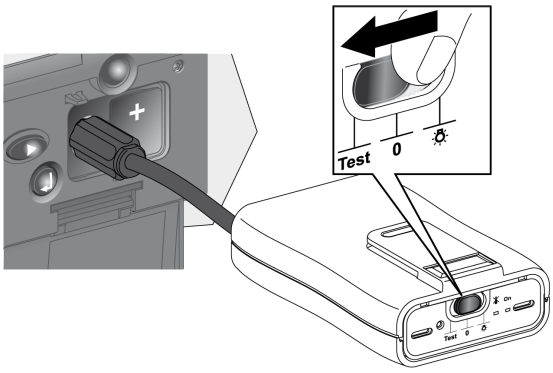
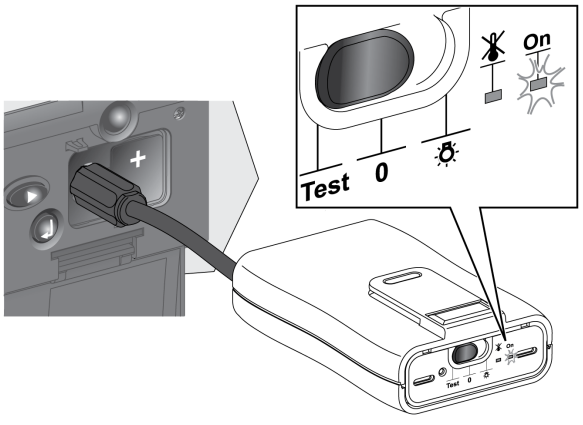
Pocket Flashlight Function

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.	

Step	Action	Illustration
3	Lift off the removable cover shielding the battery compartment and test port using a flat blade screwdriver.	
4	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).	
5	Click the battery module connector into the test port on the VIP.	
6	Move the slide switch to the Test position (left).	
7	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:

Operations	Refer to...
Readout/modifications of the settings and parameters	Operation *(see page 47)*
Routine check	Routine Check *(see page 190)*
LED and display unit test	LED and Display Unit Test *(see page 190)*
Checking the integrity of the trip chain	Checking the Integrity of the Trip Chain *(see page 185)*
Readout of the last fault message	Display of the Last Fault *(see page 46)*

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.

In the case of the VIP410, in the event of an anomaly, do not cut off the auxiliary power supply before making a diagnosis.

LEDs and Display Unit Off

Symptom	Possible Causes	Action/Remedy	Refer to...
VIP400: 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.	Connectors *(see page 23)*
	Internal failure	Perform the routine check.	Preventive Maintenance *(see page 190)*
VIP410: **Aux. Power** LED off	Auxiliary power supply connector not plugged in properly	Plug in connector A.	Connectors *(see page 23)*
	Auxiliary power supply absent	Check that the auxiliary power supply level is within the permissible range.	Power Supply Voltage *(see page 213)*
	Internal failure	Change the VIP410.	Removing the VIP *(see page 198)*

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. More information is available in the Operation of the Self-test System section *(see page 141)*.

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 code of 8 alphanumeric characters
- the watchdog relay, if it exists, being in the off-position (VIP410)
- the output relays being in the off-position (normal position) (VIP410)
- the communication being inoperative (VIP410)

In this case, the VIP is no longer operational. Make a note of the code and change the VIP *(see page 198)*.

Status LED Flashing and ERROR Screen

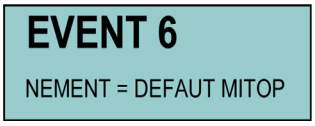
Lighting up of the LED (flashing) and display of an **ERROR** screen indicate that the VIP has detected a fault via the embedded self-tests not involving a risk of nuisance tripping. In this case, the VIP does not go into the fail-safe position and remains operational. More information is available in the Operation of the Self-test System section *(see page 141)*.

Fault Code	Possible Causes	Action/Remedy	Refer to...
00000002, E1000000	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 *(see page 198)*
00000800, E2000000	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 *(see page 198)*
00008000, E3000000	Detection of loss of the clock.	Change the VIP.	Removing the VIP *(see page 198)*
00400000, E4000000	Detects that the maximum number of write operations to EEPROM memory has been reached and stops saving information relating to tripping in the event of an electrical fault in the EEPROM memory. This failure does not affect operation of the protection functions. This failure can be linked to the circuit breaker failing to open, causing the trip order to be sent repeatedly.	Checks 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 *(see page 187)* • Removing the VIP *(see page 198)*
E5000000	Detects that the software queue has overflowed on start-up.	Change the VIP.	Removing the VIP *(see page 198)*
E6000000	Detects an invalid calibration coefficient.	Change the VIP.	Removing the VIP *(see page 198)*

Status LED Flashing and MITOP FAULT ALARM Screen

Lighting up of the LED (flashing) and display of the **MITOP FAULT** alarm indicate that the VIP has detected a fault in the Mitop trip unit connection circuit. In this case, the VIP does not go into the fail-safe position and remains operational. More information is available in the Mitop *(see page 122)* Trip Unit Trip Circuit Supervision section.

The VIP remains operational. Check the wired connection between the VIP and the Mitop trip unit. If the fault persists, change the VIP *(see page 198)*.



No TRIP Indication After Circuit Breaker Opening on a Fault

Symptoms	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 situation	–
	Battery depleted or battery missing (VIP400).	Check the battery and replace it if necessary.	Replacing the VIP Battery *(see page 199)*
	More than 24 hours have elapsed since the MV circuit breaker opening order for the VIP (VIP400).	None: normal operating scenario. If you wish to read the last event, start the VIP using the integrated battery or the pocket battery module.	• Operation With the Pocket Battery Module *(see page 191)* • Operation With the Integrated Battery *(see page 43)* • Display of the Last Fault *(see page 129)*

Fault LED Flashing and Circuit Breaker Closed (VIP400)

Symptoms	Possible Causes	Action/Remedy	Refer to...
One of the VIP fault LEDs flashes slowly but the MV circuit breaker is closed.	If the VIP trips almost simultaneously with a circuit breaker upstream or downstream (discrimination incorrectly coordinated), the fault can be eliminated before the VIP trips its circuit breaker. In this case, when the VIP400 sends its trip pulse to the Mitop trip unit, due to its independent operation, it is possible that the protection function will see the fault, but the energy available in the VIP400 is not sufficient to trip the Mitop trip unit. The fault LED lights up although the Mitop trip unit has not tripped the circuit breaker.	Check the coordination of the network upstream and downstream protection functions.	–

Impossibility of Starting the VIP in “Battery Mode”

Symptoms	Possible Causes	Action/Remedy	Refer to...
Since the VIP is connected to the CUa or CUb sensor but with insufficient network load and without an auxiliary power supply (VIP410), pressing and holding down the key does not start the VIP.	Battery depleted.	Test the battery.	Checking the Battery Status *(see page 190)*
	The network load is just below the VIP pick-up current.	Start the VIP with the pocket battery module.	Pocket Battery Module *(see page 191)*

Electrical Fault Indication (VIP400)

Symptoms	Possible Causes	Action/Remedy	Refer to...
After tripping on a fault then power being restored to the VIP (via the primary current or the pocket battery module) the fault indication LED does not flash (VIP400).	Battery depleted or battery missing.	Replace the VIP battery.	Checking the Battery Status *(see page 190)*

Incorrect Time

Symptom	Possible Causes	Action/Remedy	Refer to...
The time displayed is incorrect.	Battery depleted (VIP400) or auxiliary power supply cut off with an empty battery (VIP410).	Test the battery.	Checking the Battery Status *(see page 190)*
	Wrong time sent by the communication (VIP410).	Check the supervisor setup.	–

Lost Password

If you lose the password, read the serial number on the VIP front panel and contact your local Schneider Electric after-sales service.

Communication Problem (VIP410)

During normal operation, the  LED flashes at the same rate as frames are exchanged with the supervisor.

If the VIP410 is not communicating with the supervisor, check:
- that the supervisor is sending frames to the relevant VIP
- all the VIP communication parameters
- the wiring and correct connection of the communications connectors for the various products connected to the communication network
- the bus polarization, at a single point, in general by the master
- the line matching at the ends of the RS 485 network

If the problem persists, connect the VIPs one by one on the communication network to determine which VIP is responsible for the problem.

Trip When the E Measuring Connector is Handled

If the E measuring connector is handled while the product is energized and not connected to earth, there is a risk of nuisance tripping.

Always leave the product connected to earth during wiring operations when working on the product.

Removing the VIP

Introduction

If the VIP relay cannot be repaired by following the instructions in Troubleshooting Assistance *(see page 194)*, it must be replaced.

Removing the VIP

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- 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 CUa or CUb sensors.

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

The procedure for removing the VIP relay 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	Switch off the unit (VIP410).
4	Unscrew and unplug all the connectors.
5	Disconnect the VIP protective earth.
6	Open the settings protective flap.
7	Undo the screws on the 2 fixing catches and check that they pivot in order to release the VIP.
8	Re-close the flap.
9	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 (standard IEC 60255-21-1) and against shocks (standard IEC 60255-21-2).

The VIP relay 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

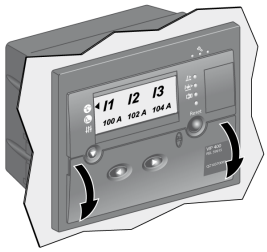
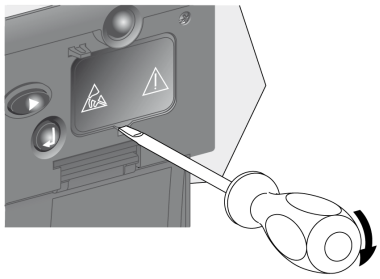
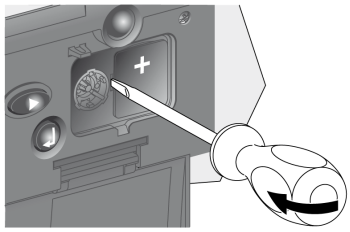
If the VIP needs to be replaced:

Step	Action
1	Remove the battery *(see page 199)*.
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 relay. It can be removed with the VIP energized.

Step	Action	Illustration
1	Open the settings protective flap.	
2	Lift the removable cover shielding the battery compartment using a flat blade screwdriver.	
3	Pull the battery compartment forward with the screwdriver.	
4	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	Re-close the battery compartment.
3	Replace the cover shielding the battery compartment.
4	Test the battery by pressing the **Reset** key for 2 to 3 seconds: the LEDs should remain on clearly without fading for the whole time the key is pressed.
5	Reset the VIP time if necessary.
6	Close the settings protective flap.

Cleaning Product

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

Characteristics

10

What Is in This Chapter?

This chapter contains the following topics:

Function Characteristics

General Remarks

In the tables below:
- In is the phase CT primary rated current.
- Ino is the core balance CT primary rated current.
- All the accuracy values are stated in the reference conditions (IEC 60255-6). Unless stated otherwise, the sensor accuracy is included in the values indicated.

Sensor Rating

Sensors	Characteristics	Values
Phase CT	Primary rated current (In)	● CUa: 200 A ● CUb: 630 A
Core balance CTs (VIP410): CSH120, CH200, GO110, CSHU	Primary rated current (Ino)	470 A (ratio 470/1)

Phase Current Measurement

Characteristics	Values
Measurement range	0.005...40 In*
Accuracy	● +/- 2% +/- 1 digit, 0.3...1 In ● +/- 5% +/- 1 digit, 0.1...0.3 In
Unit	A or kA
Resolution	0.1 A...0.1 kA depending on the value
Display format	3 digits
Display refresh period	1 s
* : Below 0.005 In, the value 0 A is displayed	

Earth Fault Current Measurement

Characteristics	Versions		Values
Measuring range	Sum of 3 CTs (VIP400 or VIP410)		0.01 In...40 In(2)
	Core balance CT (VIP410)	1–24 A rating	0.0002...0.1 Ino (0.1...47 A primary)[2]
		10–240 A rating	0.001... Ino (0.5...470 A primary)[2]
Accuracy	Sum of 3 CTs (VIP400 or VIP410)		● +/- 3% +/- 1 digit, 0.3...1 In ● +/- 5% +/- 1 digit, 0.1...0.3 In
	Core balance CT[1] (VIP410)	1–24 A rating	● +/- 2% +/- 1 digit, 0.003...0.1 Ino ● +/- 5% +/- 1 digit, 0.0005...0.003 Ino
		10–240 A rating	● +/- 2% +/- 1 digit, 0.03...1 Ino ● +/- 5% +/- 1 digit, 0.005...0.03 Ino
Unit			A or kA
Resolution			0.1 A...1 kA depending on the value
Display format			3 digits
Display refresh period			1 s
[1]: accuracy not taking account of core balance CT uncertainty [2]: Below the minimum values, the value 0 A is displayed			

NOTE: With a “Core balance CT” type sensor, the measurement ranges are indicated for Io> or Io>> set points associated with a definite time curve (DT). If the Io> set point is associated with an IDMT curve, the upper limit of the measurement range is 40×Io>.

Phase Peak Demand Current Values

Characteristics	Values
Measurement range	0.005...40 In
Accuracy	• +/- 2% +/- 1 digit, 0.3... 1 In • +/- 5% +/- 1 digit, 0.1...0.3 In
Unit	A or kA
Resolution	0.1 A...1 kA depending on the value
Display format	3 digits

Tripping Phase Currents

Characteristics	Values
Measurement range	0.005...40 In
Accuracy	Same as phase overcurrent protection set point
Unit	A or kA
Resolution	0.1 A...1 kA depending on the value
Display format	3 digits

Tripping Earth Fault Current

Characteristics	Versions		Values
Measurement range	Sum of 3 CTs (VIP400 or VIP410)		0.01...40 In
	Core balance CT (VIP410)	1–24 A rating	0.0002...0.1 Ino (0.1...47 A primary)
		10–240 A rating	0.001... Ino (0.5...470 A primary)
Accuracy			Same as earth fault protection set point
Unit			A or kA
Resolution			0.1 A...1 kA depending on the value
Display format			3 digits

Phase Overcurrent Protection

Characteristics of the I> and I>> Set Points		Values
Tripping curve		The following values are allowed: • OFF: set point off • DT : definite time • SIT/A: IEC/A standard inverse time • LTI/B: IEC long time inverse • VIT/B: IEC/B very inverse time • EIT/C: IEC/C extremely inverse time • MI/D: IEEE moderately inverse or IEC/D • VI/E: IEEE very inverse or IEC/E • EI/F: IEEE extremely inverse or IEC/F • RI
I> and I>> set point	DT curve	0.05...20 In
	IDMT curve	0.05...2 In
	Accuracy	+/- 5% or +/- 0.03 In
	Drop-out/pick-up ratio	95% +/- 3% or > (1- 0.015 In/I>) x 100%
	Transient overshoot	< 10%

Characteristics of the I> and I>> Set Points		Values
T> and T>> time delay	DT curve	0.05...300 s in steps of: ● 0.01 s, from 0.05 to 9.99 s ● 0.1 s, from 10.0 to 99.9 s ● 1 s, from 100 to 300 s
	IEC, RI curves	TMS: 0.02...2 (step: 0.01)
	IEEE curves	TD: 0.5...15 (step: 0.1)
	DT curve accuracy	+/- 2% or -15 ms/+25 ms
	IDMT curve accuracy	● 0.1 In...In: 5% or -15 ms/+25 ms according to IEC 60255-151 ● < 0.1 In or > 630 A: +/- 8% or -15 ms/+25 ms according to IEC 60255-151
	Reset time	Setting common to I>, I>> and Io> set points: ● OFF: reset time off ● ON: reset time on
Characteristic times	Overshoot time	< 40 ms at 2 I> or I>>

Characteristics of I>>> Set Point		Values
Tripping curve		● OFF: set point off ● DT : definite time ● INST: instantaneous if the minimum tripping time (MIN TRIPTIME) is disabled
I>>> set point	DT curve	0.1...20 In
	Accuracy	+/- 5% or +/- 0.03 In
	Drop-out/pick-up ratio	95% +/- 3% or > (1-0.015 In/I>>>) x 100%
	Transient overshoot	< 10%
T>>> time delay	DT curve	Instantaneous (pick-up) or 0.05...300 s in steps of: ● 0.01 s, from 0.05 to 9.99 s ● 0.1 s, from 10.0 to 99.9 s ● 1 s, from 100 to 300 s
	Accuracy	+/- 2% or -15 ms/+25 ms
Characteristic times	Instantaneous operating time	25 ms, typical 40 ms max. Conditions: ● VIP already supplied with power ● I= 2 I>>>
	Overshoot time	< 40 ms at 2 I>>>

Phase Protection Harmonic 2 Restraint Settings	Authorized Values
Activity	● OFF: off ● ALL: action on I>, I>> and I>>>> ● I>: action on I> only ● I>>: action on I>> only ● I>>>: action on I>>> only ● I> & I>>: action on I> and I>> ● I> & I>>>: action on I> and I>>> ● I>> & I>>>: action on I>> and I>>>
Second-harmonic set point	5...50% in steps of 1%
Minimum short-circuit current Isc_{min}	In...25 kA

Earth Fault Protection

Characteristics of the Io> Set Point				Values
Tripping curve				The following values are allowed: ● OFF: set point off ● DT : definite time ● SIT/A: IEC/A standard inverse time ● LTI/B: IEC long time inverse ● VIT/B: IEC/B very inverse time ● EIT/C: IEC/C extremely inverse time ● MI/D: IEEE moderately inverse or IEC/D ● VI/E: IEEE very inverse or IEC/E ● EI/F: IEEE extremely inverse or IEC/F ● RI
Io> set point	DT curve	Sum of 3 CTs (VIP400 or VIP410)		● Default range: 0.1...10 In ● Extended range: 0.025...10 In
		Core balance CT (VIP410)	1–24 A rating	0.002...0.05 Ino (1...24 A)
			10–240 A rating	0.02...0.5 Ino (10...240 A)
	IDMT curve	Sum of 3 CTs (VIP400 or VIP410)		● Default range: 0.05...1 In ● Extended range: 0.025...1 In
		Core balance CT (VIP410)	1–24 A rating	0.0004...0.005 Ino (0.2...2.4 A)
			10–240 A rating	0.004...0.05 Ino (2...24 A)
	Accuracy	Sum of 3 CTs (VIP400 or VIP410)		+/- 5% or +/- 0.03 In
		Core balance CT* (VIP410)	1–24 A rating	+/- 5% or +/- 0.0002 Ino (+/- 0.1 A)
			10–240 A rating	+/- 5% or +/- 0.0015 Ino (+/- 0.7 A)
	Drop-out/pick-up ratio	Sum of 3 CTs (VIP400 or VIP410)		95% +/- 3% or > (1-0.005 In/Io>) x 100%
		Core balance CT* (VIP410)	1–24 A rating	95% +/- 3%
			10–240 A rating	95% +/- 3%
	Transient overshoot			< 10%
To> time delay	DT curve			0.05...300 s in steps of: ● 0.01 s, from 0.05 to 9.99 s ● 0.1 s, from 10.0 to 99.9 s ● 1 s, from 100 to 300 s
	IEC, RI curves			TMS: 0.02...2 (step: 0.01)
	IEEE curves			TD: 0.5...15 (step: 0.1)
	DT curve accuracy			+/- 2% or -15 ms/+25 ms
	IDMT curve accuracy	Sum of 3 CTs (VIP400 or VIP410)		● > 0.1 In: +/- 5% or -15 ms/+25 ms according to IEC 60255-151 ● < 0.1 In: +/-8% or -15 ms/+25 ms according to IEC 60255-151
		Core balance CT* (VIP410)		+/- 5% or -15 ms/+25 ms according to IEC 60255-151
	Reset time			Setting common to I>, I>> and Io> set points: ● OFF: reset time off ● ON: reset time on
Characteristic times	Overshoot time			< 40 ms at 2 Io>
*: accuracy not taking account of core balance CT uncertainty				

Characteristics of the Io>> Set Point	Values
Tripping curve	● OFF: set point off ● DT : definite time ● INST: instantaneous if the minimum tripping time (MIN TRIPTIME) is disabled
*: accuracy not taking account of core balance CT uncertainty	

Characteristics of the Io>> Set Point				Values
Io>> set point	DT curve	Sum of 3 CTs (VIP400 or VIP410)		0.1...10 In
		Core balance CT (VIP410)	1–24 A rating	0.002...0.05 Ino (1...24 A) See Note
			10–240 A rating	0.02...0.5 Ino (10...240 A) See Note
	Accuracy	Sum of 3 CTs (VIP400 or VIP410)		+/- 5% or +/- 0.03 In
		Core balance CT* (VIP410)	1–24 A rating	+/- 5% or +/- 0.0002 Ino (+/- 0.1 A)
			10–240 A rating	+/- 5% or +/- 0.0015 Ino (+/- 0.7 A)
	Drop-out/pick-up ratio	Sum of 3 CTs (VIP400 or VIP410)		95% +/- 3% or > (1-0.005 In/Io>>)*100%
		Core balance CT* (VIP410)	1–24 A rating	95% +/- 3%
			10–240 A rating	95% +/- 3%
	Transient overshoot			< 10%
To>> time delay	DT curve			0.05...300 s in steps of: ● 0.01 s, from 0.05 to 9.99 s ● 0.1 s, from 10.0 to 99.9 s ● 1 s, from 100 to 300 s
	Accuracy			+/- 2% or -15 ms/+25 ms
Characteristic times	Instantaneous operating time (pick-up)			25 ms, typical 40 ms max. Conditions: ● VIP already supplied with power ● I=2 Io>>
	Overshoot time			< 40 ms at 2 Io>>
*: accuracy not taking account of core balance CT uncertainty				

NOTE: If the Io> set point uses an IDMT curve, the Io>> set point setting range depends on the Io> setting, with the following limits:

	Rating	Io> Setting (IDMT)	Io>> Setting Range (DT)
Core balance CT version (VIP410)	1–24 A	0.2…0.3 A	1…8 A
		0.4…0.5 A	1…12 A
		0.6…1.1 A	1…24 A
		1.2…2.4 A	1.2…24 A
	10–240 A	2…3.5 A	10…80 A
		3.6…5.6 A	10…120 A
		5.7…11.9 A	10…240 A
		12…24 A	12…240 A

Earth Fault Protection Harmonic 2 Restraint Settings	Authorized Values
Activity	● OFF: off ● ALL: action on Io> and Io>> ● Io>: action on Io> only ● Io>>: action on Io>> only
Second-harmonic set point	17% (not adjustable)

Thermal Overload Protection

Characteristics			Values
Activity			● OFF: protection off ● ON: protection on
Set points	Tripping	Setting range	0.05...In
		Accuracy	+/- 5%
	Alarm	Setting range	50...100% of the permissible thermal capacity used (tripping set point)
		Accuracy	+/- 5%
		k constant	1.05 (in accordance with IEC 60255-8)
Time constant	Setting range		1...120 min (identical value for heating and cooling)
	Resolution		1 min
Tripping time delay		Accuracy	● 1.2...2*Is: +/- 8% or +/- 2 s ● > 2*Is : +/- 5% or +/- 2 s

Phase Overcurrent Cold Load Pick-Up (CLPU I)

Characteristics		Values
Activity		● OFF: off ● ALL: action on I>, I>> and I>>> ● I> I>>: action on I> and I>> ● I>> I>>>: action on I>> and I>>> ● I> I>>>: action on I> and I>>> ● I>: action on I> only ● I>>: action on I>> only ● I>>>: action on I>>> only
Action on set points		● 150%: set point x 1.5 ● 200%: set point x 2 ● 300%: set point x 3 ● 400%: set point x 4 ● 500%: set point x 5 ● BLOCK: set point blocked
Operating mode (setting common to CLPU I and CLPU Io)		● DEFAULT: operation possible only if auxiliary power supply is present continuously (default setting). ● SECONDARY: operation possible after loss of the auxiliary power supply, when the VIP wakes up (for example in cases where the power supply is connected to the MV/LV transformer secondary)
Set point accuracy after CLPU I function action		Same as accuracy on I>, I>> and I>>> set points
Time delay	Setting ranges	1...60 s in steps of 1 s
		1...240 min in steps of 1 min
	Accuracy	+/- 2% or +/- 20 ms

Earth Fault Cold Load Pick-Up (CLPU Io)

Characteristics		Values
Activity		• OFF: off • Io> Io>>: action on Io> and Io>> • Io>: action on Io> only • Io>>: action on Io>> only
Action on set points		• 150% : set point x 1.5 • 200%: set point x 2 • 300%: set point x 3 • 400%: set point x 4 • 500%: set point x 5 • BLOCK: set point blocked • H2 RES.: harmonic 2 restraint
Operating mode (setting common to CLPU I and CLPU Io)		• DEFAULT: operation possible only if auxiliary power supply is present continuously (default setting). • SECONDARY: operation possible after loss of the auxiliary power supply, when the VIP wakes up (for example in cases where the power supply is connected to the MV/LV transformer secondary)
Set point accuracy after CLPU Io function action		Same as accuracy on Io> and Io>> set points
Time delay	Setting ranges	1...60 s in steps of 1 s
		1...60 min in steps of 1 min
	Accuracy	+/- 2% or +/- 20 ms

VIP Default Settings

Protection Menu Default Settings

Screen	VIP400	VIP410
EF OPERATION	–	SUM
FREQUENCY	50 Hz	50 Hz
I> 51	OFF	–
I>> 51	OFF	–
I>>> 50-51	OFF	–
Io> 51N	OFF	–
Io>> 50-51N	OFF	–
I> 51 A	–	OFF
I>> 51 A	–	OFF
I>>> 50-51 A	–	OFF
Io> 51N A	–	OFF
Io>> 50-51N A	–	OFF
THERMAL 49 1	OFF	OFF
THERMAL 49 2	–	–
EXT TRIP	–	OFF
PHASE H2 RES	OFF	OFF
EARTH H2 RES	ALL	ALL
GF OP RANGE	DEFAULT	DEFAULT
SET GROUPS	–	A ONLY
I> 51 B	–	OFF
I>> 51 B	–	OFF
I>>> 50-51 B	–	OFF
Io> 51N B	–	OFF
Io>> 50-51N B	–	OFF

Standard Parameters Menu Default Settings

Screen	VIP400	VIP410
LANGUAGE	ENGLISH UK	ENGLISH UK
PEAK DEMAND	5 MN	5 MN
LOAD HISTORY	200A	200A
MODBUS 1/2	–	0 1 38400 DIR
MODBUS 2/2	–	EVEN 1 ON OFF
COLD LOAD I	–	OFF
COLD LOAD Io	–	OFF
CLPU MODE	–	DEFAULT
RESET TIME	OFF	OFF
DATE	----/---/--	----/---/--
TIME	--H --MN --s	--H --MN --s
SET PASSWORD	NO PASSWORD	NO PASSWORD
TRIP TEST	DISABLED	DISABLED
CONTRAST	5	5
OUTPUT CUST	DEFAULT	DEFAULT
CB CUSTOM	NO DISPLAY	NO DISPLAY

Output Custom Menu Default Settings

Screen	VIP400	VIP410
CB TRIPPING	PROTECTION 111111	PROTECTION 111111
O1 ASSIGN	–	PROTECTION 1110011
O2 ASSIGN	–	PROTECTION 0001100
O3 ASSIGN	–	TH. ALARM
RELAYS LATCH	–	O1=YES O2=YES O3=NO

Default Settings for the Parameters Menu Related to the Circuit Breaker Characteristics

Screen	VIP400	VIP410
PHASE CT	200A	200A
MIN TRIPTIME	ON	ON
TRIP METHOD	METHOD 1	METHOD 1

Technical Characteristics

General Characteristics

Characteristics		Values
Dimensions		180 x 140 x 105 mm/7.09 x 5.51 x 4.13 in.
Weight	VIP400	740 g/1.63 lb
	VIP410	1000 g/2.2 lb
Type of battery		½ AA Li 3.6 V SAFT LS14250/1.10AH
Typical battery life		10 years(1)
Maximum internal clock drift		+/- 10 min a year
Maximum continuous consumption	VIP400	350 mW
	VIP410	3.7 W with 3 stuck relays
NOTE: (1) In extreme temperature conditions, the battery life may be shorter.		

Current Inputs

The VIP400 and VIP410 current inputs are designed to operate exclusively with the dual core CUa or CUb sensors.

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
Continuous thermal withstand of the earth fault protection input(1)	300 A primary
Transient thermal withstand of the earth fault protection input(1)	20 kA primary/1 s
Frequency	50 Hz +/-10%, 60 Hz +/-10%
NOTE: (1) On VIP410 only.	

External Trip Input Characteristics

The VIP410 has an external trip input. This input is designed to be connected to a volt-free contact (dry contact). If operation of the external trip input is enabled in the relay configuration, this contact closing will trip the circuit breaker.

Characteristics of the external contact:

Characteristics		Values
Volt-free contact	Maximum resistance	10 Ohm including the wiring
	Operating voltage	24 V
	Contact minimum operating current	3 mA minimum

Characteristics of the external trip input

Characteristics		Values
Tripping time delay		50 ms maximum if the VIP410 is already supplied with power
Isolation		250 V AC
Minimum primary current guaranteeing tripping on contact closing		CUa: 10 A single-phase CUb: 32 A single-phase
Protection against incorrect connections	In common or differential mode mode, criterion = no damage to product	240 V AC +20% continuous 340 V DC +20% continuous Operation is not guaranteed.

Self-Powered Supply Starting Characteristics (VIP400)

Characteristics		Values
Pick-up time	Earth fault current	Single-phase and three-phase
	0.06 In	< 140 ms
	0.12 In	< 75 ms
	1.2 In	< 40 ms
	5 In	< 30 ms
	10 In	< 20 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 set point.

Characteristics		Values	
Pick-up current (Iact)	Sensors	Single-phase	Three-phase
	CUa	10 A	7 A(1)
	CUb	28 A	14 A
NOTE: (1) 10 A if the VIP user-machine interface on embedded battery was activated when the fault occurred.			

NOTE: These values guarantee that the protection functions work but activation of the display is assured for higher values (typically 10 A for the CUa sensor, 31.5 A for the CUb sensor, with single-phase or three-phase injection).

Self-Powered Supply Starting Characteristics (VIP410)

The characteristics below apply to the VIP410 when it is powered by its self-powered power supply alone, without relying on its auxiliary power supply.

Characteristics		Values
Pick-up time	Earth fault current	Single-phase and three-phase
	0.06 In	< 140 ms
	0.12 In	< 75 ms
	1.2 In	< 40 ms
	5 In	< 30 ms
	10 In	< 20 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 set point.

		External trip input Off		External trip input On	
Pick-up current (Iact)	Sensors	Single-phase	Three-phase	Single-phase	Three-phase
	CUa	12 A	9 A	15 A	11 A
	CUb	38 A	19 A	48 A	23 A

Auxiliary Power Supply

The VIP410 relay should be powered by DC or AC voltage. The supply voltage depends on the version:

Characteristics		DC Values	AC Values
Nominal voltage	VIP410 A	24...125 V +/- 20%	100...120 V +/- 20%
	VIP410 E	110...250 V +/- 20%	100...240 V +/- 20%
Ripple content		< 15%	–
Frequency		–	50 Hz +/-10% 60 Hz +/-10%
Typical consumption (only watchdog relay active)		< 3 W	< 4.5 VA
Maximum consumption		< 8 W	< 13 VA
Inrush current		< 20 A for 100 µs	
Acceptable momentary outages (IEC 60255-11)		100%, 100 ms Conditions: 3 controlled relays, backlight LCD not supplied with power	
Overvoltage withstand in the event of accidental breaking of the neutral or overvoltage due to the battery charger.		VIP410 A: 250 V DC and 198 V AC VIP410 E: 500 V DC and 380 V AC	

Annunciation Relays

Output relays O1, O2, O3 for VIP410 A and VIP410 E:

Characteristics		DC Values	AC Values
Maximum voltage		250 V + 20%	240 V + 20%
Continuous current		5 A	–
Breaking capacity(1)	Resistive load	5 A/24 V 4 A/48 V 0.7 A/127 V 0.3 A/220 V	5 A/100...240 V
Maximum consumption	Load L/R < 40 ms	5 A/24 V 1 A/48 V 0.1 A/220 V	–
Inrush current	Load p.f. > 0.3	–	5 A/100...240 V
NOTE: Making capacities are indicated for use of either the normally open (NO) contact or the normally closed (NC) contact. There must not be any electrical link between the 2 contacts.			

Communication Port (VIP410)

Characteristics	Values
Type	2-wire RS 485
Connectors	RJ45
Line impedance	150 Ohm
Termination resistor	Not included

Current Sensor Characteristics

The metering winding is a magnetic core winding hard-wired onto a built-in resistor (LPCT type) that provides the signals needed by the VIP metering and protection functions. Characterized in accordance with class P, the accuracy limit factor is equivalent to 5P50 for the CUa sensor and 5P30 for the CUb sensor.

Parameters	**CUa**	**CUb**
Ipn rated primary current	200 A	630 A
Isn rated secondary current	0.0833 A	0.15 A
Rated transformation ratio	1/2400	1/4200
Rated kneepoint voltage Ek (50 Hz)	72 V	200 V
Maximum magnetizing current Ie to Ek	4 mA	2 mA
Maximum resistance of the secondary winding at 75°C	18.8 Ohm	50.4 Ohm
Metering resistance integrated in the sensor	1.8 Ohm	1 Ohm
Voltage at the terminal of the metering resistance integrated in the sensor (Usr rated secondary voltage)	150 mV/In	150 mV/In

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

Parameters	**CUa**	**CUb**
Ipn rated primary current	200 A	630 A
Isn rated secondary current	0.377 A	0.485 A
Rated transformation ratio	1/530	1/1300
Rated kneepoint voltage Ek (50 Hz)	32.9 V	20.1 V
Maximum magnetizing current Ie to Ek	13.5 mA	8 mA
Maximum resistance of the secondary winding at 75°C	12.4 Ohm	9.2 Ohm
Consumption at the rated load current	75 mW	150 mW

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
		IEC 60255-22-3		10 V/m; 80...1 GHz; 1.4 ...2.7 GHz
		IACS - E10	–	10 V/m; 80...2 GHz
	Low-frequency conducted disturbances	IACS - E10	–	AC: 50 Hz to 10 kHz; 10% of the power supply up to harmonic number 15 then 1% less up to harmonic number 100, 3 Vrms min DC: 50 Hz to 10 kHz; Test voltage 10% of the power supply, maximum 2W
	Electrostatic discharge	IEC 61000-4-2	3	8 kV air; 6 kV contact
		IEC 60255-22-2		
		IACS - E10	–	8 kV air; 6 kV contact
	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
		IEC 60255-22-6		
		IACS - E10	–	3 V MC; 0.15...80 MHz
	Electrical fast transients/burst	IEC 61000-4-4 IEC 60255-22-4	4	4 kV; 5 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
		IEC 60255-22-1	–	
	Fast damped oscillating wave	IEC 61000-4-18	3	3 MHz, 10 MHz, 30 MHz, 2 kV MC
	Surges	IEC 61000-4-5	3	2 kV MC, 1 kV MD
		IEC 60255-22-5	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
		IACS - E10	–	In accordance with IEC 60068-2-6, Fc test
	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; 1000 impulses
Enclosure protection	Tightness	IEC 60529	–	Front panel: IP54 Other parts: IP30
	Shocks on front panel	IEC 62262	IK7	2J
Packaging	Fall height in product packaging	NF 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 hrs(1)
	Exposure to dry heat	IEC 60068-2-2	Bd	+70°C (+158°F); 96 hrs
	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 hrs of operation Starting at -40°C
	Temperature variation in damp heat	IEC 60068-2-30	Db	2x12 hrs, +25°...+55°C (+77°...+131°F), 6 cycles, 93-95% RH, with condensation
Stored without its original packaging	Exposure to cold	IEC 60068-2-1	Ab	–40°C (–40°F); 96 hrs
	Exposure to dry heat	IEC 60068-2-2	Bb	+70°C (+158°F); 96 hrs
	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°C per minute
	Temperature variation in damp heat	IEC 60068-2-30	Db	2x12 hrs, +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 hrs 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, the display may be more difficult to read. This does not affect operation of the protection functions.				

Safety

Safety	Standard	Values
General	IEC 61010	–
Power frequency dielectric withstand	IEC 61010	Depends on the circuit tested
	IACS - E10	2 kV 50 Hz or 60 Hz
Surge	IEC 61010	Depends on the circuit tested
Insulation resistance	IACS - E10	500 V in common and differential mode R > 100 MΩ (B); R > 10 MΩ (A)
Fire withstand	IEC 60695-2-11 IEC 60695-2-10	850°C (1562°F)

Certification

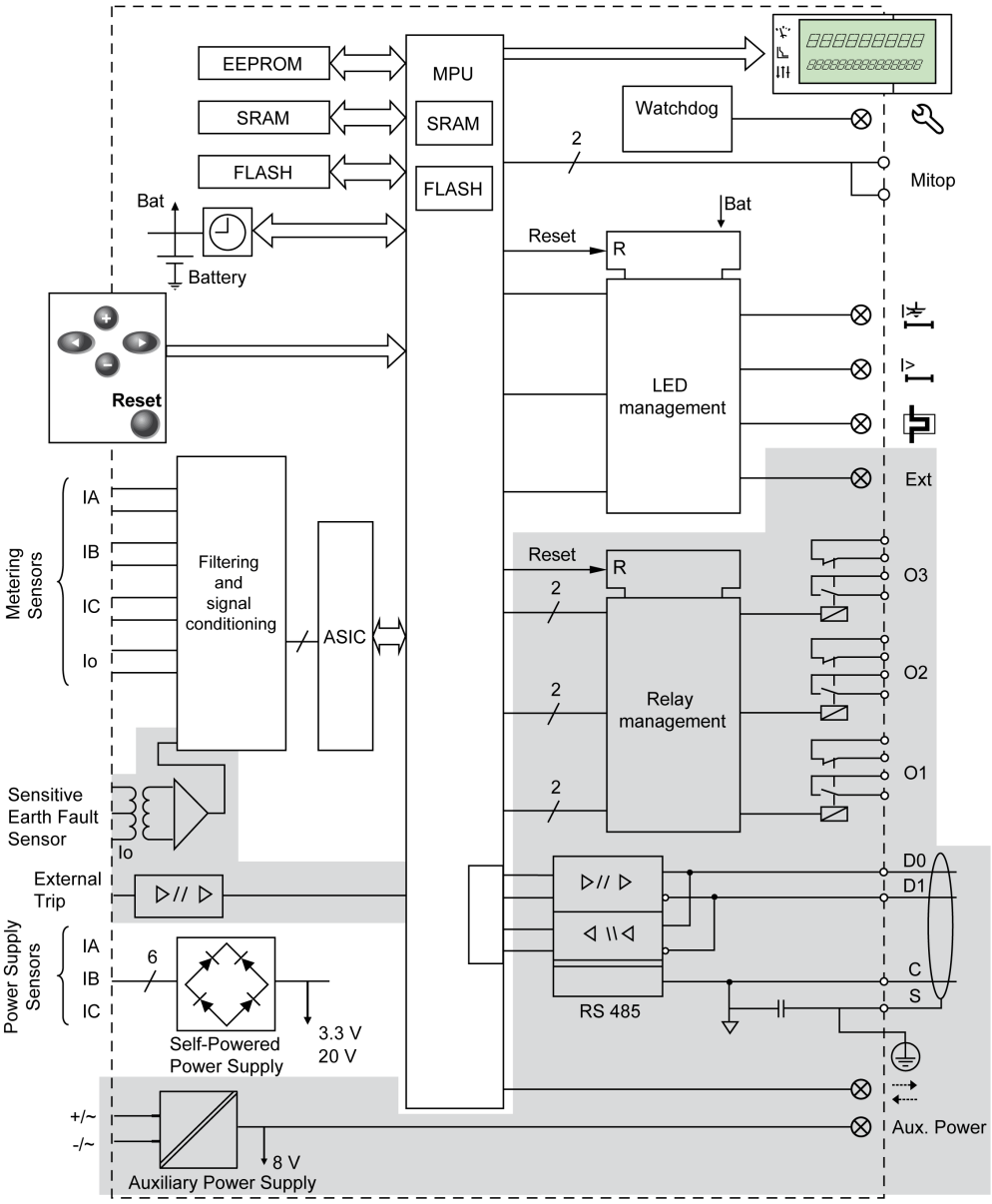
Certification	Reference Document

CE	Directives and amendments:
	● 89/336/EEC EMC directive on electromagnetic compatibility:
	  ● 92/31/EEC Amendment
	  ● 93/68/EEC Amendment
	● 73/23/EEC Low Voltage Directive
	  ● 93/68/EEC Amendment

Internal Operation

Block Diagram

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



NOTE: Grayed-out functions are only available on the VIP410.

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
  - control and monitoring (on VIP410)
  - alarm and annunciation
  - communication (on VIP410)
  - management of the user-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, as well as the fault log.
  These values are saved if the power supply fails.

A watchdog function is activated regularly by the microprocessor.

In the event of failure:

- It lights up the  status LED
- It changes the watchdog relay status (O3 by default for VIP410).

Current Inputs

The VIP is designed to be connected exclusively to dual core sensors, type CUa (200 A) or CUb (630 A). These sensors consist 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 harmonics up to the 13th order to pass through

Power supply circuit:

The VIP's self-powered supply uses the energy available at the secondary of the CUa and CUb 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 sensors integrated in the circuit breaker.

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

Auxiliary Power Supply

There are:

- VIP410 versions powered by 24–125 V DC or 100–120 V AC
- VIP410 versions powered by 110–250 V DC or 100–240 V AC

The power supply provides:

- electrical isolation vis-à-vis the primary voltages
- the voltage levels required by the electronic circuits

External Trip Inputs

The VIP410 has an external trip input. This input is designed to be connected to a volt-free contact (dry contact). If operation of the external trip input is enabled in the relay configuration, this contact closing will trip the circuit breaker.

Output Relays

VIP410s have annunciation relays with normally open (NO) or normally closed (NC) contacts.

For improved safety, two microprocessor commands, both independent of one another, must be given to change the annunciation relay status. One of the annunciation relays can be assigned to the watchdog function. In the event of failure of the microprocessor, the watchdog function causes the watchdog relay to change status. The watchdog relay can thus be used to monitor the microprocessor operation.

Display

The graphic display consists of a 136 x 48 dot matrix. Its robust technology can withstand several years of operation in a harsh environment.

The display is managed directly by the microprocessor.

Since the VIP400 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.

Since the VIP410 has an auxiliary power supply, there is the possibility of backlighting the display provided that the auxiliary power supply is connected. However, to maximize the life of the display, backlighting is automatically switched off when the keypad has not been used for 10 minutes. Without backlighting, the display continues to be usable at all times.

Communication

The microprocessor processes frames for the protocols supported by the VIP410.

The communication interface conforms to the TIA/EIA RS 485 standard. For improved electromagnetic compatibility, the common (C) and shielding (S) reference voltages are kept separate.

Internal Clock and Battery

The VIP has a real-time clock. This manages the time (date, hour, second and ms). The clock is powered by a battery for times when the VIP is de-energized.

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.

The battery is also used to set the relay parameters, without the need to connect an auxiliary source or to close the circuit breaker in order to benefit from the power supply with the correct current.

Electrical Isolation

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

- restricting the voltages on the Cua or CUb sensor inputs to safe values
- isolating the auxiliary power supply
- it is also necessary to connect the product to a protective earth

The inputs and outputs are isolated from one another by single isolation.

NRJED311206EN

Schneider Electric Industries SAS
35, rue Joseph Monier
CS30323
F - 92506 Rueil Malmaison Cedex

www.schneider-electric.com

03/2013