PowerLogic P1F

Protection Relay

User Manual

Version: P1F/EN M/1.2.1
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Legal Information

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General information

Legal notice

Disclaimer

No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this document. This document is not intended as an instruction manual for untrained persons. This document gives instructions on device installation, commissioning and operation. However, the manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific issues, do not take any action without proper authorisation. Contact Schneider Electric and request the necessary information.

Contact information

35 rue Joseph Monier
92500 Rueil-Malmaison
FRANCE
Phone: +33 (0) 1 41 29 70 00
Fax: +33 (0) 1 41 29 71 00
www.se.com

Purpose

This user manual is intended for people who are experts on electrical power engineering, panel builder, commissioner, and experienced users, communication specialists or general users of the PowerLogic™ P1 protection relays.
The complete manual is arranged as follows:

- Preliminary sections, with the details of the manual (how to use it, glossary) and technical data.
- Functions of the protection relay.
  Explanations, diagrams and settings of the protection, control, monitoring and maintenance, measurement, recording and programmable logic functions are detailed in these sections.
- Installation and commissioning.
- Local control panel use, troubleshooting and maintenance instructions.

The following documents complete this manual:

- Quick Start Guide, delivered in the relay package, summarises instructions for installation.
- Communication Manual, for the understanding and the setup of the communication protocols with PowerLogic P1 protection relays.

We welcome your comments about this document. You can reach us by contacting Customer Care Centre Contact page:
http://www.se.com/CCC

Safety information and password protection

Important information

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

⚠	The addition of this symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in death or serious 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.

Failure to follow these instructions 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.

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

CAUTION

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

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

NOTICE

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

Failure to follow these instructions can result in equipment damage.

User qualification

Electrical equipment should be installed, operated, serviced, and maintained only by trained and 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, installation, and operation of electrical equipment and has received safety training to recognise and avoid the hazards involved.

Use the password protection feature in order to protect untrained person interacting with the PowerLogic P1 protection relay.

Presentation

Introduction

The PowerLogic P1F Family

The PowerLogic P1F is a member of PowerLogic P1 product family. The PowerLogic P1F family of protection relays is designed for the protection and operation of MV/LV utility substations and electrical distribution networks in industrial installations.
It comprises six models suitable for normal protection applications involving current metering:

- PowerLogic P1F model L (3 + WD relay outputs, without communication port) for phase overcurrent and earth fault protection
- PowerLogic P1F model L (3 + WD relay outputs, with communication port) for phase overcurrent and earth fault protection
- PowerLogic P1F model N (5 + WD relay outputs, with communication port) for phase overcurrent, earth fault protection and thermal overload protection
- PowerLogic P1F model B (4 binary inputs, 3 + WD relay outputs, with communication port) for phase overcurrent, earth fault protection, thermal overload protection, switch on to fault and external trip
- PowerLogic P1F model A (4 binary inputs, 7 + WD relay outputs, with communication port) for phase overcurrent, earth fault protection, thermal overload protection, switch on to fault, external trip and inrush block
- PowerLogic P1F model E (8 binary inputs, 5 + WD relay outputs, with communication port) for phase overcurrent, earth fault protection, thermal overload protection, switch on to fault, external trip, inrush block, negative sequence overcurrent, broken conductor and autoreclose
- PowerLogic P1F model E+ (8 binary inputs, 5 + WD relay outputs, with communication port) for phase overcurrent, directional and admittance earth fault protection, thermal overload protection, switch on to fault, external trip, inrush block, negative sequence overcurrent, broken conductor and autoreclose

Example: PowerLogic P1F

Main Advantages of PowerLogic P1F

PowerLogic P1F is easily installed in a switchboard:

- It is compact with uniquely small installation footprint
- It is held in place in the switchboard by spring clips or screw clamps (fastening elements)
- The connection terminals are clearly identified.

PowerLogic P1F is quick to commission:

- It comes with default parameters.
- Its settings are entered on the front panel by means of its display and well-designed keypad.

- It can be commissioned without using a PC.
- It can be commissioned with using a PC and dedicated software (eSetup Easergy Pro)

PowerLogic P1F makes it easy to operate substations:

- It has numerous customization options so that it can be adapted to specific operating constraints.
- Its display unit can display screens in several languages.
- It indicates tripping explicitly and spontaneously.

PowerLogic P1F is a robust product that is easy to maintain:

- The case is made of insulated plastic.
- The unit can withstand harsh environments:
  - Front panel degree of protection: IP54
  - Range of operating temperatures-25°C to +60°C (-13°F to +140°F)
- No battery inside – data and time are maintained by a backup capacitor.

PowerLogic P1F Applications

PowerLogic P1F relays provide accurate protection for various applications requiring phase overcurrent and/or earth fault protection. With a focus on tailoring to user's needs, PowerLogic P1F is offered in 6 hardware model variants. All of them are housed in uniquely small case what:

- **Model L**

  Basic phase and earth fault current protection with fault recording and two setting groups. With only 4 relay output contacts and circuit breaker control keys, this model is the most economical option in the range. A good choice for retrofit of older technology devices or for a low cost medium or low voltage substations. This model is offered as non-communicating however it may be extended with a rear RS485 port for remote communication (switchable IEC 60870-5- 103 or Modbus).

- **Model N**

  Communicating device with basic phase overcurrent and earth fault protection. It provides thermal overload function, fault and events recording and two setting groups. It comprises 6 relay outputs, a front USB and rear RS485 communication port with switchable IEC 60870-5-103 or Modbus protocol. Circuit breaker control can be effected via front panel keys and from SCADA. This model is cost-optimized for essential protection functions that require serial communication. Suited to industrial or commercial sites with medium voltage electric supply as back-up protection or to low voltage substations.

- **Model B**

  Standard protection relay with phase overcurrent, earth fault protection and communication. It provides switch on to fault and blocking logic functions, event and fault recording and two setting groups. It comprises 4 relay outputs and 4 binary inputs, a front USB and rear RS485 communication port. Circuit breaker control is effected by front panel keys, remote communication port or via binary input. It’s suited to industrial or commercial sites with medium voltage supply as cost optimized protection solution for feeder, incomer or transformer. Thus, it is one of the best choices for panel builders and OEMs as a standard, compact and effective protection relay.

- **Model A**

Advanced model with phase overcurrent and earth fault protection. Covering all features of model B, it's comprises additionally inrush blocking function and in-built circuit breaker and trip circuit supervision. Moreover it can store 4 sec of disturbance records. CB control can be realized via front panel keys, remotely thru communication port or via binary input. This model offers a unique functionality of powering HMI board via USB front port. It means that setting and data downloading can be done without auxiliary voltage presence. Having 4 binary inputs and 8 relays outputs it can be applied to more advanced schemes within utilities or industrial sites as feeder, incomer or transformer protection.

- **Model E**

  More advanced model with phase overcurrent and earth fault protection. Covering all features of model A it comprises 8 binary inputs and 6 output relays. This relay can meet the requirements of more advanced applications in medium and low voltage substation. Additionally, in-built negative sequence overcurrent protection, broken conductor detection and 4 shot auto-reclose function makes PowerLogic P1F suitable as a feeder protection of overhead lines. Thanks to small size and high functionality, this relay is regarded as a good retrofit solution for almost all overcurrent electromechanical devices including auto-reclose relays. If back-up protection relay is needed, the PowerLogic P1F model E will provide required functionality and will keep the budget healthy.

- **Model E+**

  It's a highest model in PowerLogic P1F range. Covering all features of model E it comprises 8 binary inputs and 6 output relays. This relay can meet the requirements of more advanced applications in medium and low voltage substation. Additionally, in-built directional and/or admittance earth fault protection makes PowerLogic P1F suitable as a feeder protection of overhead lines. If back-up protection relay is needed, the PowerLogic P1F model E will provide required functionality and will keep the budget healthy.

Selection Table

The selection table lists the functions performed by the various PowerLogic P1F models in standard operation.

		PowerLogic P1F model						
	ANSI code	L	L (RS485)	N	B	A	E	E+
Hardware								
Phase current inputs		3	3	3	3	3	3	3
Residual current inputs		1	1	1	1	1	1	1
Neutral voltage inputs		-	-	-	-	-	-	1
Digital inputs		-	-	-	4	4	8	8
Digital outputs		3+WD	3+WD	5+WD	3+WD	7+WD	5+WD	5+WD
USB front port with powering		-	-	1	1	1	1	1
RS485 rear port		-	1	1	1	1	1	1
Protection functions								
Phase overcurrent	50/51	3	3	3	3	3	3	3
Earth fault overcurrent	50N/51N	2	2	2	2	2	3	3
Negative sequence overcurrent	46	-	-	-	-	-	1	1
Broken conductor	46BC	-	-	-	-	-	1	1
Thermal overload	49	-	-	1	1	1	1	1

Circuit Breaker failure	50BF	1	1	1	1	1	1	1
Switch on to fault (SOTF)	50HS	-	-	-	1	1	1	1
Directional earth-fault o/c	67N	-	-	-	-	-	-	2
Admittance	21YN	-	-	-	-	-	-	2
Inrush block	68F2	-	-	-	-	1	1	1
Auto-recloser	79	-	-	-	-	-	4	4
Lockout	86	1	1	1	1	1	1	1
Cold load pick-up		1	1	1	1	1	1	1
Blocking logic		-	-	-	1	1	1	1
IDMT curves		21	21	21	21	21	21	21
Setting groups		2	2	2	2	2	2	2
Auxiliary timers		-	-	-	4	4	4	4
Control functions								
Local/remote function		-	●	●	●	●	●	●
Local control with I/O keys		●	●	●	●	●	●	●
Remote control with RS485		-	●	●	●	●	●	●
Remote control with digital inputs		-	-	-	●	●	●	●
Time Synchronisation with digital input		-	-	-	-	-	●	●
Measurement								
RMS current values		●	●	●	●	●	●	●
Thermal overload		-	-	●	●	●	●	●
Inrush current ratio		-	-	-	-	●	●	●
Positive sequence of current Is1		-	-	-	-	-	●	●
Negative sequence of current Is2		-	-	-	-	-	●	●
Relative Is2/IS1		-	-	-	-	-	●	●
Phase Peak Demand Current Values		●	●	●	●	●	●	●
Logs and Records								
Fault record		20	20	20	20	20	20	20
Event record		-	200	200	200	200	200	200
Disturbance record		-	-	-	-	4 sec	4 sec	4 sec
Monitoring functions								
Trip circuit supervision	74	-	-	-	1	1	1	1
Circuit breaker monitoring & diagnostics		-	-	-	-	1	1	1
Counters		-	-	-	-	1	1	1
Self-supervision (WD)		●	●	●	●	●	●	●

Earth Fault Protection

To help to protect networks against phase-to-earth faults, the earth fault protection sensitivity level must be selected at the time of ordering from one of two values. The sensors to be used and the set point setting range depend on the chosen sensitivity:

Sensitivity	**Sensors**	**Setting range**
Standard	3 phase CTs or 1 earth CT	(0.05 – 12) Ion
Sensitive	3 phase CTs or 1 earth CT (i.g. CSH120, CSH200, CSH300)	(0.01 – 2) Ion

Power Supply Voltage

The PowerLogic P1F power supply voltage can be DC or AC. Three power supply voltage ranges are available, as indicated in the following table:

	PowerLogic P1F model					
Power Supply Voltage	L	N	B	A	E	E+
24 – 240 V ac 24 – 250 V dc	•	•	-	-	-	-
24 – 60 V ac 24 – 60 V dc	-	-	•	•	•	•
90 – 240 V ac 90 – 250 V dc	-	-	•	•	•	•

Identification

Reference Code

The reference code for a PowerLogic P1F is an alphanumeric code that defines the PowerLogic P1F main functions and hardware options. List of available model look as follows:

Model L: 4 relay outputs, without binary inputs and communication

Cortec no.	Ion	Vx	Catalogue no.
P1F1L1N0N92N0NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 24-240Vac and Vx = 24-250Vdc	**REL15000**
P1F1L1N3N92N0NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 24-240Vac and Vx = 24-250Vdc	**REL15001**

Model L: 4 relay outputs, without binary inputs, rear RS485 port included

Cortec no.	Ion	Vx	Catalogue no.
P1F1L1N0N92N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 24-240Vac and Vx = 24-250Vdc	**REL15002**
P1F1L1N3N92N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 24-240Vac and Vx = 24-250Vdc	**REL15003**

Model N: 6 relay outputs, without binary inputs, rear RS485 and front USB port

Cortec no.	Ion	Vx	Catalogue no.
P1F1N1N0N92N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 24-240Vac and Vx = 24-250Vdc	**REL15004**
P1F1N1N3N92N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 24-240Vac and Vx = 24-250Vdc	**REL15005**

Model B: 4 binary inputs; 4 relay outputs, rear RS485 and front USB port including powering

Cortec no.	Ion	Vx	Catalogue no.
P1F1B1N0N91N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 24-60Vac/Vdc	**REL15006**
P1F1B1N0N92N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15007**
P1F1B1N3N91N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 24-60Vac/Vdc	**REL15008**
P1F1B1N3N92N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15009**

Model A: 4 binary inputs, 8 relay outputs, rear RS485, front USB with powering, disturbance recorder

Cortec no.	Ion	Vx	Catalogue no.
P1F1A1N0N91N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 24-60Vac/Vdc	**REL15010**
P1F1A1N0N92N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15011**
P1F1A1N3N91N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 24-60Vac/Vdc	**REL15012**
P1F1A1N3N92N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15013**

Model E: 8 binary inputs; 6 relay outputs, rear RS485, front USB with powering, disturbance rec., auto reclose

Cortec no.	Ion	Vx	Catalogue no.
P1F1E1N0N91N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 24-60Vac/Vdc	**REL15014**
P1F1E1N0N92N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15015**
P1F1E1N3N91N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 24-60Vac/Vdc	**REL15016**
P1F1E1N3N92N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15017**

Model E+: 8 binary inputs; 6 relay, rear RS485, front USB with powering, disturbance rec., auto reclose, directional earth fault protection

Cortec no.	Ion	Vx	Catalogue no.
P1F1E110N91N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 24-60Vac/Vdc	**REL15020**
P1F1E110N92N1NN11N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15021**
P1F1E113N91N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 24-60Vac/Vdc	**REL15022**
P1F1E113N92N1NN11N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15023**

For Euroasian Customs Union EAC

Model B: 4 binary inputs; 4 relay outputs, rear RS485 and front USB port including powering

Cortec no.	Ion	Vx	Catalogue no.
P1F1B1N0N92N1NN11E	Ion = 1A/5A ; (0.01-2)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15007R**
P1F1B1N3N92N1NN11E	Ion = 1A/5A ; (0.05-12)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15009R**

Model A: 4 binary inputs, 8 relay outputs, rear RS485, front USB with powering, disturbance recorder

Cortec no.	Ion	Vx	Catalogue no.
P1F1A1N0N92N1NN11E	Ion = 1A/5A ; (0.01-2)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15011R**
P1F1A1N3N92N1NN11E	Ion = 1A/5A ; (0.05-12)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15013R**

Model E+: 8 binary inputs; 6 relay outputs, rear RS485, front USB with powering, disturbance rec., auto reclose, directional earth fault protection

Cortec no.	Ion	Vx	Catalogue no.
P1F1E110N92N1NN11E	Ion = 1A/5A ; (0.01-2)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15021R**
P1F1E113N92N1NN11E	Ion = 1A/5A ; (0.05-12)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15023R**

Asian HMI language package

Model B: 4 binary inputs; 4 relay outputs, rear RS485 and front USB port including powering

Cortec no.	Ion	Vx	Catalogue no.
P1F1B1N0N91N1NN31N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 24-60Vac/Vdc	**REL15006C**
P1F1B1N0N92N1NN31N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15007C**
P1F1B1N3N91N1NN31N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 24-60Vac/Vdc	**REL15008C**
P1F1B1N3N92N1NN31N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15009C**

Model E: 8 binary inputs; 6 relay outputs, rear RS485, front USB with powering, disturbance rec., auto reclose

Cortec no.	Ion	Vx	Catalogue no.
P1F1E1N0N91N1NN31N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 24-60Vac/Vdc	**REL15014C**
P1F1E1N0N92N1NN31N	Ion = 1A/5A ; (0.01-2)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15015C**
P1F1E1N3N91N1NN31N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 24-60Vac/Vdc	**REL15016C**
P1F1E1N3N92N1NN31N	Ion = 1A/5A ; (0.05-12)Ion	Vx = 90-240Vac and Vx = 90-250Vdc	**REL15017C**

Accessories for PowerLogic P1 series

Type	Catalogue no.
Adapter for PowerLogic P1 standard flush mounting case to allow mounting on the wall	**REL15039**
Front cover with sealing for PowerLogic P1 standard case helping to prevent from unauthorised access	**REL15040**
Spare mounting spring clips for PowerLogic P1 (standard mounting)	**REL15041**
Spare mounting screw clamps for PowerLogic P1 (alternative mounting)	**REL15042**

Installation

Safety Precautions

Before Starting

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

You should also 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 to confirm that all power is off.
- Before performing visual inspections, tests, or maintenance on this equipment:
  - Disconnect 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 back-feeding.
- 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.
- The successful operation of PowerLogic P1 depends upon proper installation, setting, and operation.
- Setting the PowerLogic P1 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.

⚠ CAUTION

HAZARD OF DAMAGE

- 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 relay. High voltage testing may damage electronic components contained in the relay.
- Do not open the device case. The PowerLogic P1 relay contains components that are susceptible to electrostatic discharge. It is assembled in specially equipped premises.

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

Precautions

Introduction

PowerLogic P1F relays are supplied in one of the following ways:

- Individually packaged
- Installed in a cubicle

The transport, handling and storage precautions for PowerLogic P1F relays vary depending on which of these two methods is used.

PowerLogic P1F in its Original Packaging

- **Transport**

PowerLogic P1F relays can be shipped to any destination by all suitable means of transport, without taking any additional precautions.

- **Handling**

PowerLogic P1F relays can be handled without any particular care and can withstand being dropped from a height of 1 m (3.28 ft).

- **Storage**

An PowerLogic P1F relay can be stored in its original packaging in a location with the following environmental characteristics:

  - Temperature: -30...+70 °C (or -22...+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 (or +104 °F).

For more information, refer to Climatic Requirements in Functions Characteristics chapter Technical Characteristic section.

If the relays are to be stored for an extended period, we recommend the following:

  - Do not unpack the PowerLogic P1F prior to its intended period of use.
  - Check the environment and the condition of the packaging annually.

Once the PowerLogic P1F relay has been unpacked, it should be energized as soon as possible.

PowerLogic P1F Installed in a Cubicle

- **Transport**

PowerLogic P1F 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 PowerLogic P1F's condition by visual inspection and energizing.

- **Storage**

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

PowerLogic P1F relays, like all electronic units, should not be stored in a damp environment for more than a month. They should be energized as quickly as possible. If this is not possible, the cubicle reheating system should be activated.

PowerLogic P1F Used in a Damp Environment

The temperature/relative humidity factors must be compatible with the PowerLogic P1F relay's environmental withstand characteristics: Refer to Climatic Requirements in Functions Characteristics chapter Technical Characteristic section.

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

PowerLogic P1F Used in a Polluted Environment

The effect of corrosion on PowerLogic P1F relays has been tested according to the IEC 60068-2-60 standard under the following "4-gas" test conditions:

- 21 days' duration
- 25 °C (or 77°F), 75% relative humidity
- H_2S (10ppb), SO_2 (200ppb), Cl_2 (10ppb), NO_2 (200ppb)

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.

Equipment Receipt and Identification

Equipment Receipt

The PowerLogic P1F unit is shipped in a cardboard box which helps to protect it against any knocks received in transport.

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

NOTICE
Our products leave our factory in closed, sealed original packaging. At delivery, if the packaging is opened or the seal is broken, Schneider Electric must be informed. Failure to follow this instruction can result in compromised confidentiality and authenticity of the information contained in the products.

Package Contents

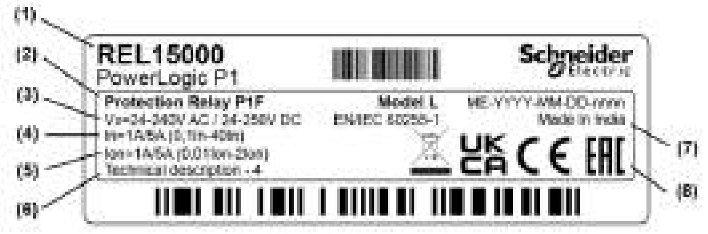
The box contains the following items:

- An PowerLogic P1F relay
- An instruction sheet providing the main information about installation and use-Quick Start
- A certificate of conformity and tests
- Safety guide
- The bag with mounting accessory (spring clips REL15041 and pouch on LEDs description)

Identification Label

The identification label on the top of the relays is used to identify the PowerLogic P1F:

Figure 1. Identification label



1 Reference number
2 Device type
3 Power supply voltage
4 Nominal phase current CT input and measuring range
5 Nominal earth fault current CT input measuring range
6 Nominal neutral voltage input measuring range
7 Serial number
8 EAC Logo For REL150xxR Commercial References only

For the meaning of the identification codes, refer to Presentation chapter Identification section.

Check After Unpacking

Make sure the delivered PowerLogic P1F relay corresponds to the product ordered. In particular, check the power supply voltage if it is correct for your installation.

Mounting and Assembly

Introduction

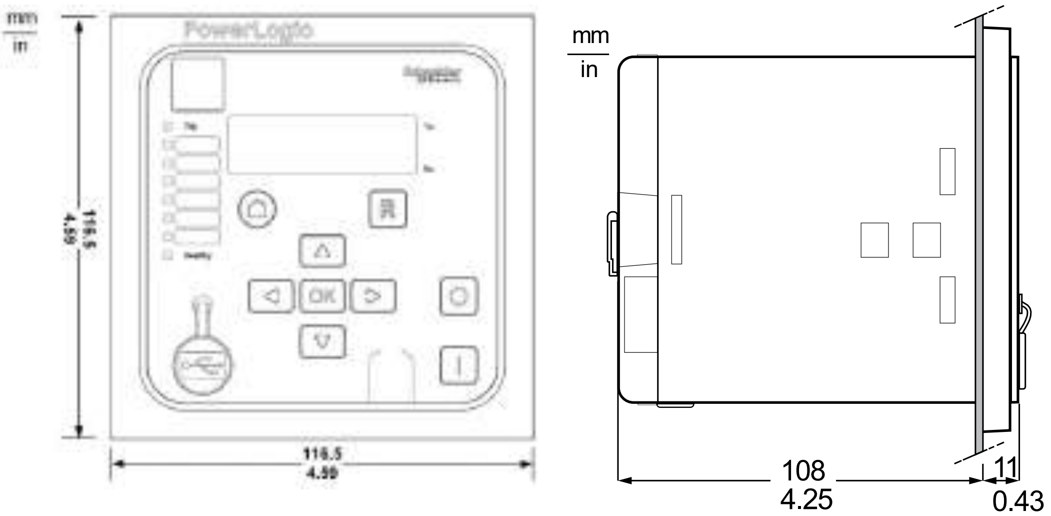
PowerLogic P1F relays weigh 0.8 kg (1.76 lb.) maximum and are flush-mounted in a mounting plate 1.5 to 4 mm (0.06 to 0.16 in) thick or 4 to 6 mm (0.16 to 0.24 in) depending on method of spring clips mounting direction.

They are designed to be mounted indoors (flush mounting). It is possible to use extra case adapter to wall mounting to which the relay is mounted using fastening element.

To help to ensure a waterproof seal, the surface of the panel must be smooth and solid. The front panel is sealed from behind

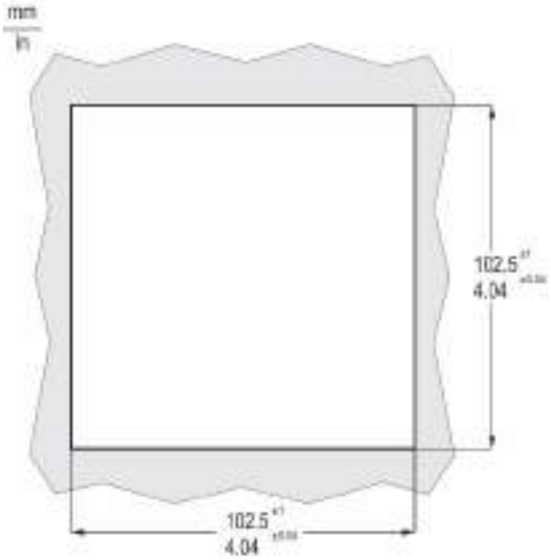
Dimensions

Figure 2. Dimensions



Cut-out

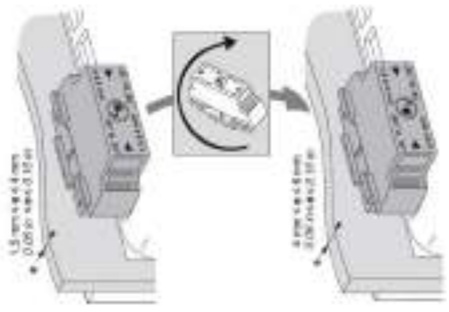
Figure 3. Dimensions of cut out



⚠ 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 PowerLogic P1F

PowerLogic P1F relay is held in place by 2 catches on the sides, behind the front panel.

Step	Action	Illustration
1	Prepare the relay and the spring clips	
2	Insert the PowerLogic P1F unit through the cut-out	
3	Verify the thickness of the panel sheet for correct spring clips direction adjustment	

Step	Action	Illustration
4	Mount the clip and release the springs by pressing the clip trigger, repeat the operation on the other side	
5	Make sure the PowerLogic P1F is mounted firmly	

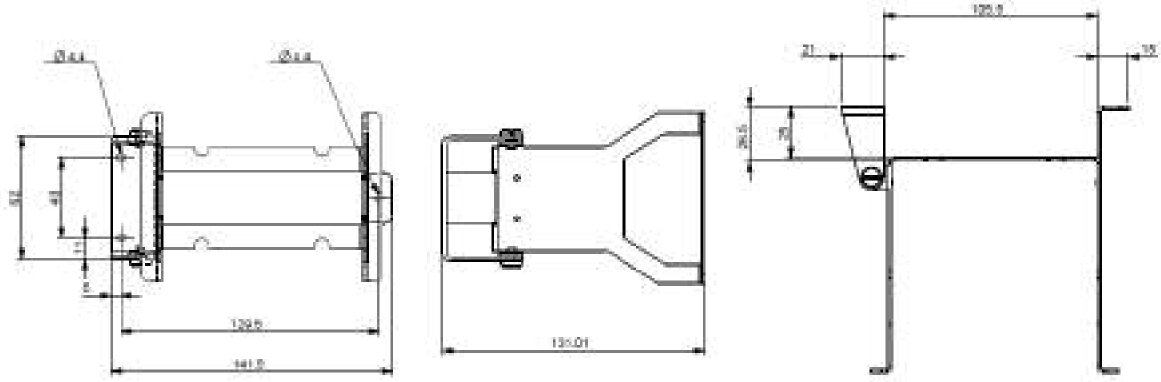
Removing P1F

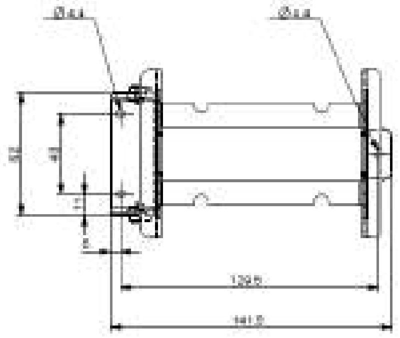
1	To remove the relay unlock spring clips by press until click, so that the spring clips could be taken out (repeat the operation on the other side), and then the relay could be withdrawn from the cut-out in the mounting plate.	

Wall mounted relay

PowerLogic P1F relay is held in place by 2 catches on the sides, behind the front panel. Flush mounting case of P1F can be mounted on the wall by using optional Wall Mounting Case Adaptor (Figure 4).

Figure 4. P1F Wall Mounting Case Adaptor Dimensions



1	Tighten the Adaptor Case in the required place with three M4 screws or equivalent.	
2 - 4	Do the steps 2-4 from Instaling PowerLogic P1F section (page 21)	
5	Make sure the PowerLogic P1F is mounted firmly	
6	To remove PowerLogic P1F from case adaptor do step 1 from section Removing PowerLogic P1F (page 22)	

Connectors

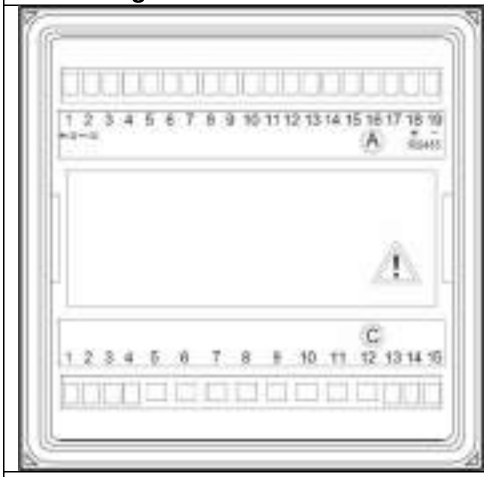
Introduction

All the PowerLogic P1F connectors can be accessed on the rear panel.

The wires are fixed using a flat blade screwdriver.

Identification of the Connectors on the Rear Panel

Figure 5. Rear connectors

PowerLogic P1F model L	PowerLogic P1F model N
	
PowerLogic P1F model B	**PowerLogic P1F model A**
	
PowerLogic P1F model E	**PowerLogic P1F model E+**
	

Ref.	PowerLogic P1F
A	Connector for the auxiliary power supply and WD, relay outputs RL1 to RL3, binary inputs L1 to L2 (**B, A, E, E+**), communication port RS485 (**N, B, A, E, E+,** model **L** - option)
B	Connector for the relay outputs RL4 to RL5 (**A, E, E+**) and binary inputs L3 to L4 (**A**) or L5 to L8 (**E, E+**)
C	Connector for phase and earth fault current inputs, 3Vo voltage input (**E+**) and binary inputs L3 to L4 (**B, E, E+**) or relay outputs RL4 to RL5 (**N**) or RL6 to RL7 (**A**).

Connector Wiring

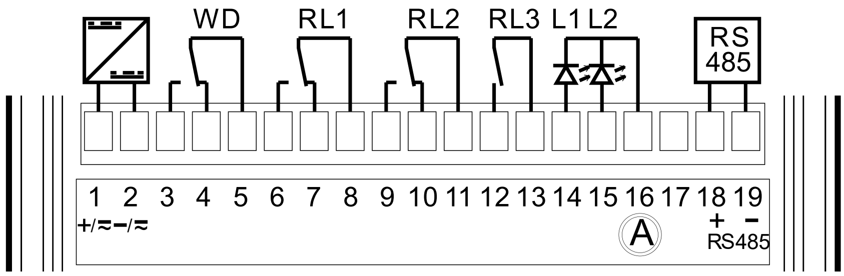
Ref. Terminal block	Wiring	Type of Terminal	Screwdriver	Tightening Torque
A	• 0.2 - 4 mm^2 single-core • 0.2 - 2.5 mm^2 finely stranded	M3	3.0 mm flat blade (0.12 in)	0.6 Nm (5.31 lb.-in)
B	• 0.2 - 4 mm^2 single-core • 0.2 - 2.5 mm^2 finely stranded	M3	3.0 mm flat blade (0.12 in)	0.6 Nm (5.31 lb.-in)
C 3Vo, binary inputs, relay outputs terminals	• 0.2 - 4 mm^2 single-core • 0.2 - 2.5 mm^2 finely stranded	M3	3.0 mm flat blade (0.12 in)	0.6 Nm (5.31 lb.-in)
C AC current inputs terminals	• 0.2 - 6 mm^2 single-core • 0.2 - 4 mm^2 finely stranded	M3	3.0 mm flat blade (0.12 in)	0.8 Nm (7.1 lb.-in)

Terminal Block A Connections

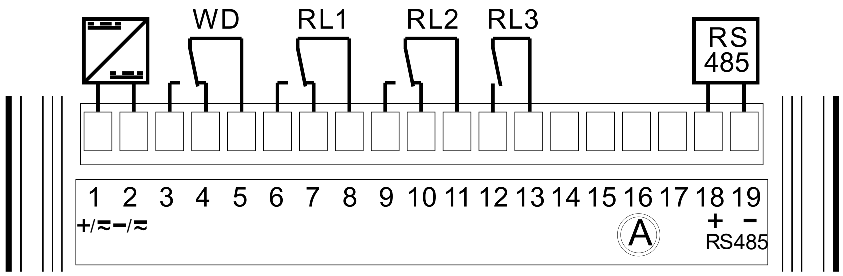
Figure 6. Terminal block A connections

Diagram

For model **B, A, E, E+**



For model **L, N**



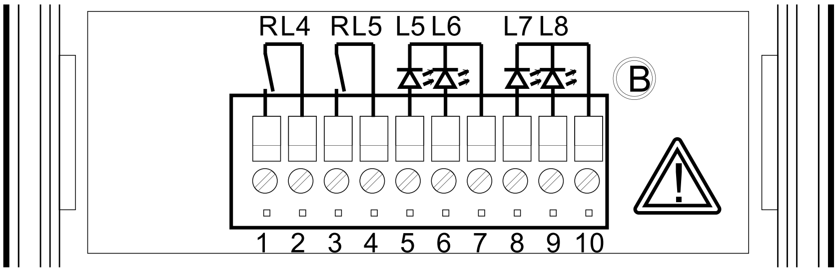
Terminal	Data Item Connected
A1-A2	Auxiliary AC/DC power supply
A3-A4-A5	Output relay: Watchdog • Terminal A5: Common • Terminal A4: Normally closed contact (NC) • Terminal A3: Normally open contact (NO)
A6-A7-A8	Output relay: RL1 • Terminal A8: Common • Terminal A7: Normally closed contact (NC) • Terminal A6: Normally open contact (NO)
A9-A10-A11	Output relay: RL2 • Terminal A11: Common • Terminal A10: Normally closed contact (NC) • Terminal A9: Normally open contact (NO)
A12-A13	Output relay: RL3 • Normally open contact (NO)
A14-A15-A16	Binary inputs: L1, L2 (**B, A, E, E+**) • Terminal A16: Common • Terminal A15: binary input L2 • Terminal A14: binary input L1
A18-A19	RS485 communication port terminals (**L** - option) • Terminal A18 – "+" (plus) • Terminal A19 – "-" (minus)

Terminal Block B Connections

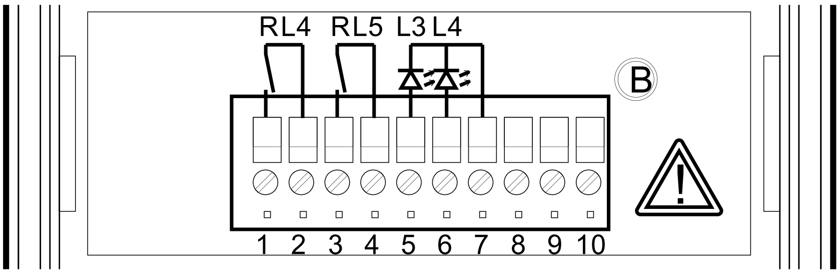
Figure 7. Terminal block B connections

Diagram

For model **E, E+**



For model **A**



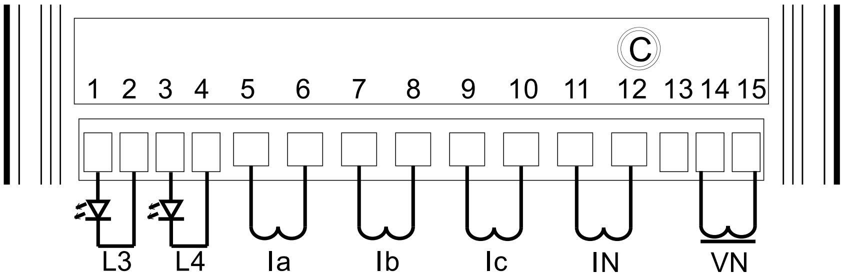
Terminal	Data Item Connected
B1-B2	Output relay: RL4 Normally open contact (NO)
B3-B4	Output relay: RL5 • Normally open contact (NO)
B5-B6-B7	Binary inputs: L5, L6 (**E, E+**) or L3, L4 (**A**) • Terminal B7: Common • Terminal B6: binary input L6/L4 • Terminal B5: binary input L5/L3
B8-B9-B10	Binary inputs: L7, L8 (**E, E+**) • Terminal B10: Common • Terminal B9: binary input L8 • Terminal B8: binary input L7

Terminal Block C Connections

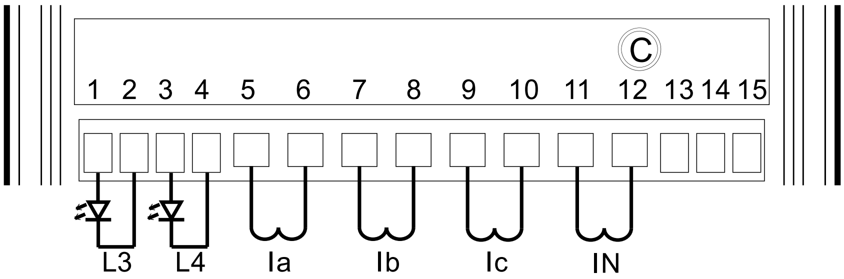
Figure 8. Terminal block C connections

Diagram

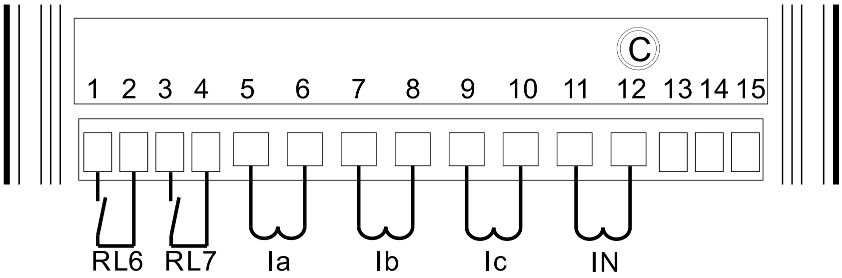
For model **E+**



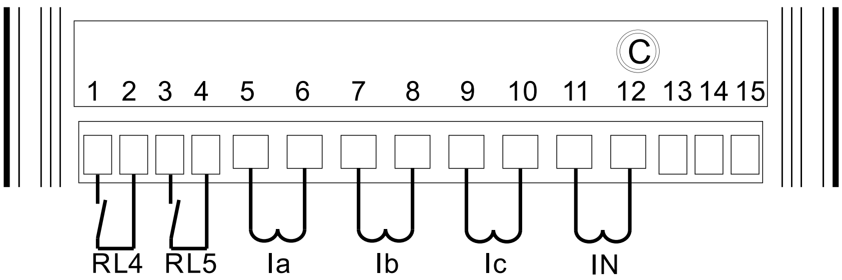
For model **B, E**



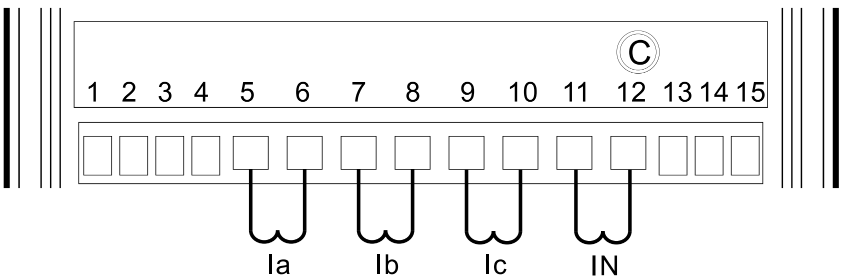
For model **A**



For model **N**



For model **L**



Terminal	Data Item Connected
C1-C2	Binary inputs: L3 (**B, E, E+**) or Output relay RL6 for model **A** or Output relay RL4 for model **N** (Normally open contact, NO)
C3-C4	Binary inputs: L4 (**B, E, E+**) or Output relay RL7 for model **A** or Output relay RL5 for model **N** (Normally open contact, NO)
C5-C6	Phase A current input
C7-C8	Phase B current input
C9-C10	Phase C current input
C11-C12	Earth fault current input
C14-C15	Neutral voltage input (**E+**)

Connection Diagrams

General Safety 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.
- Wear insulating gloves to avoid any contact with a conductor that has accidentally been energized.
- Screw tight all terminals, even those not in use.

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

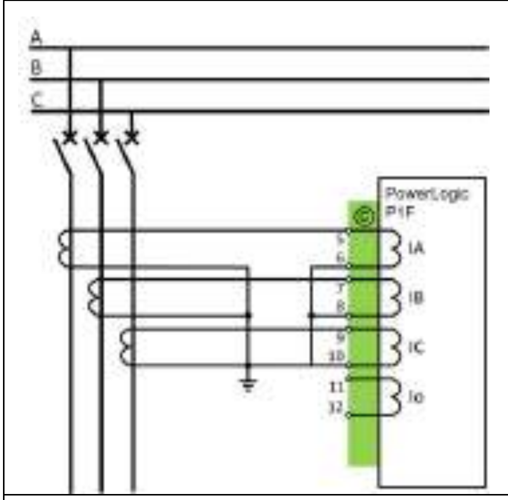
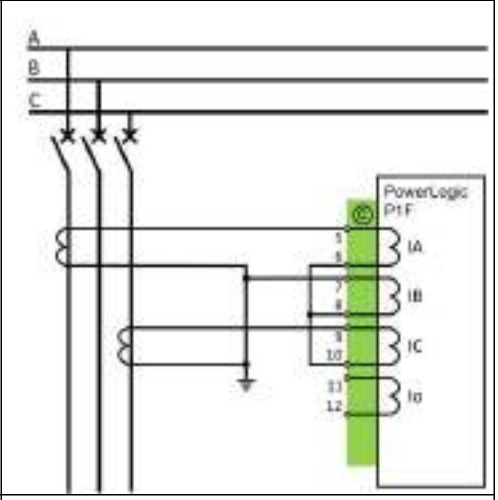
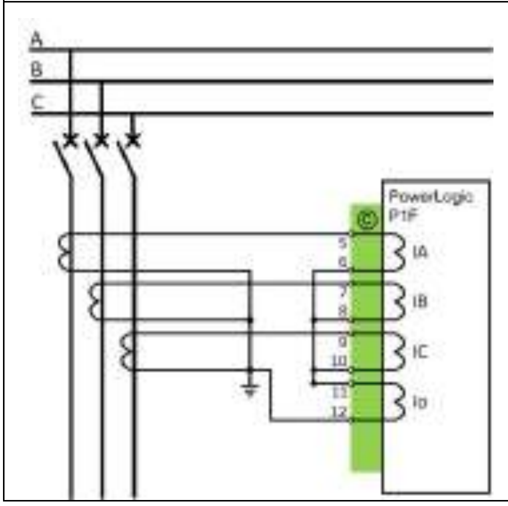
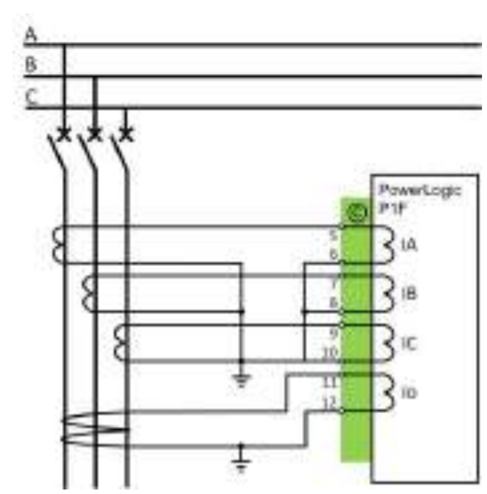
Earthing

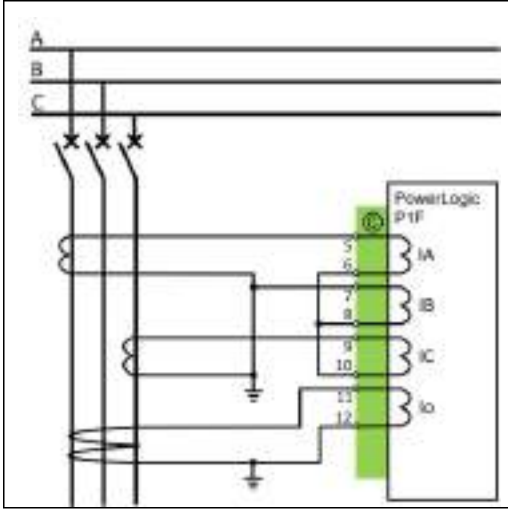
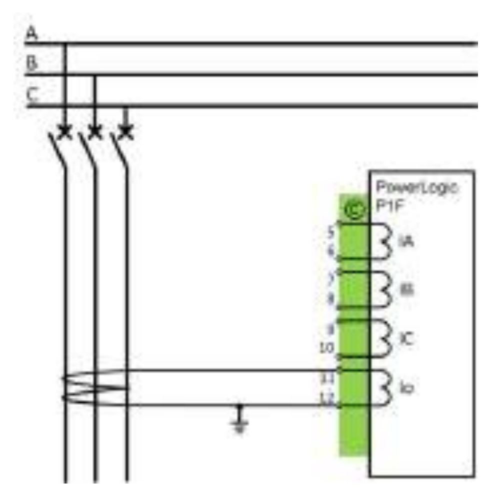
The earth terminal is not required for the PowerLogic P1F devices due to the plastic casing.

PowerLogic P1F models

Each model (L, N, B, A, E, E+) PowerLogic P1F relays measure the following currents:

- Phase currents measured by 2 or 3 phase CTs
- 1 earth fault current measured either:
  - By 1 earth CT
  - On the common point of the 3 phase CTs (residual current)
- Each model can be use in earth fault application when earth fault current input is used only.

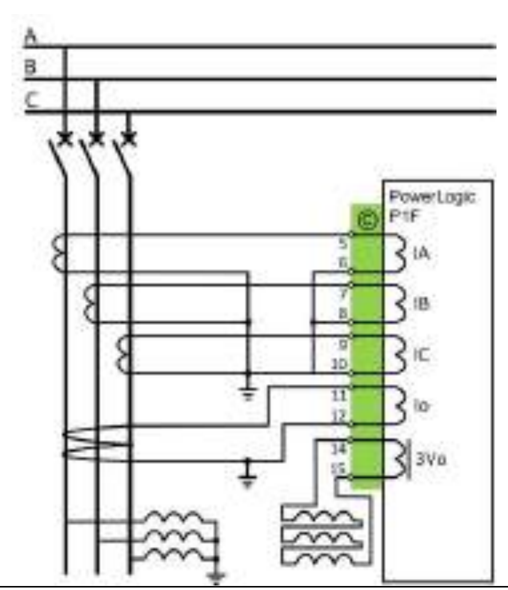
Variant No. 1	**Variant No. 2**
Typical connection 3 phase CTs	Typical connection 2 phase CTs
	
Variant No. 3	**Variant No. 4**
Typical connection 3 phase CTs, earth fault current measured on the common point of the 3 phase CTs	Typical connection 3 phase CTs, earth fault current measured by core balance CT
	

Variant No. 5	**Variant No. 6**
Typical connection 2 phase CTs, earth fault current measured by core balance CT	Earth fault current measured by 1 earth CT
	

PowerLogic P1F model E+

PowerLogic P1F model **E+** measure extra:

- Neutral voltage 3Vo from open delta connection

Variant
Typical connection 3 phase CTs, earth fault CBCT and neutral voltage


Connecting Current Transformers (CTs)

Connecting

Standard 1 A or 5 A current transformers (CTs) can be connected to PowerLogic P1F, to measure phase currents and the earth fault current.

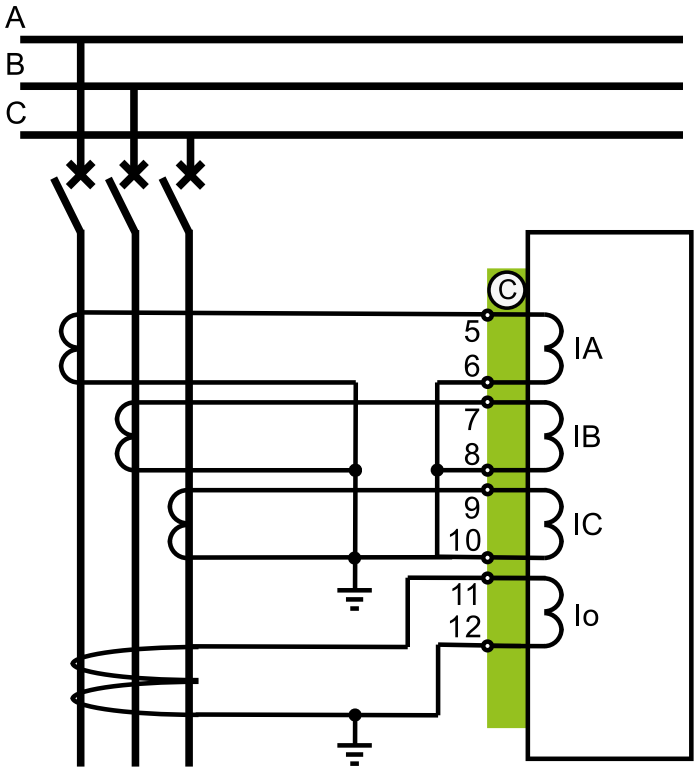
To determine the CT size, refer to *Dimensioning the CTs of this chapter*, page 40.

Connection Example

The diagram below shows the connection of:

- 3 phase CTs to measure phase currents
- 1 earth fault CT to measure the earth fault current

Figure 9. Connecting current transformer diagram



Core Balance CT

See Connecting a Core Balance Current Transformer section.

Connection Precautions

- In the cubicle CT compartment, check that the common points of the CT secondaries are connected, using wires of equal length and as short as possible, to a copper bar with a rectangular cross-section connected to the cubicle protective earth.
- Flatten the cable against the metal frames of the cubicle.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Never leave the current transformer secondary in open circuit. The high voltage that would result from opening the circuit is dangerous for the operator and for the equipment.
- Never undo the ring lugs on the cables of the CT secondaries when there is current on the primary.

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

If you need to disconnect the PowerLogic P1F current inputs:

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Wear insulating gloves to avoid any contact with a conductor that has accidentally been energized.

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

Recommended Cable

The cross-section of the cable for connecting the CTs must be selected according to the characteristics of the CT secondary and the length of the link so as to limit the wiring energy consumption.

For more information, refer to *Dimensioning the CTs, page* 40.

Connecting a Core Balance CT

Connecting

Standard 1 A or 5 A core balance current transformer (CBCT) can be connected to PowerLogic P1F, to measure earth fault current.

The specifically designed CSH120, CSH200, CSH300 core balance CTs are for direct earth fault current measurement. They should be used with PowerLogic P1F relays with sensitive earth fault protection.

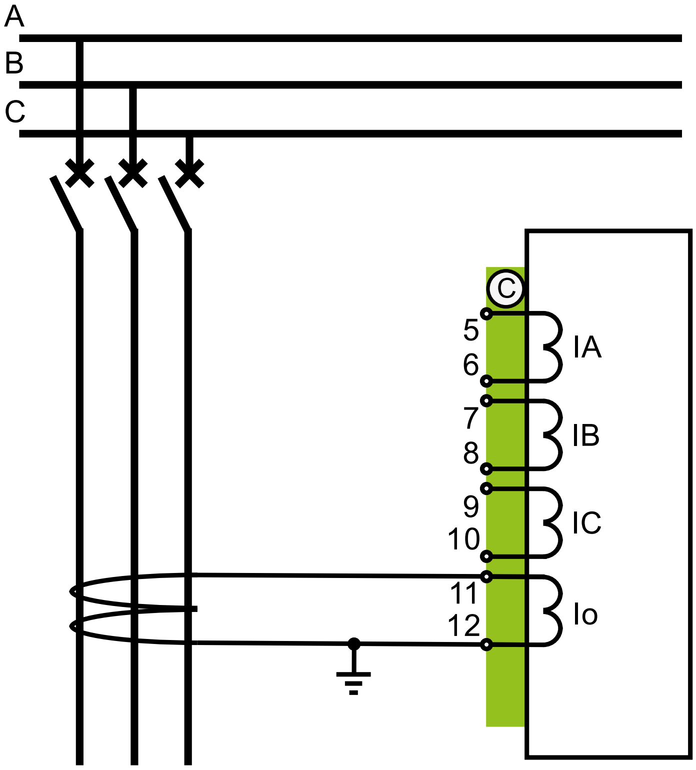
They can be connected to earth fault current inputs (terminal numbers C11 - C12)

For detailed characteristics of core balance CTs, refer to CSH120, CSH200, CSH300 *Core Balance CTs, page* 43.

Connection Example

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

Figure 10. Connecting core balance CT diagram

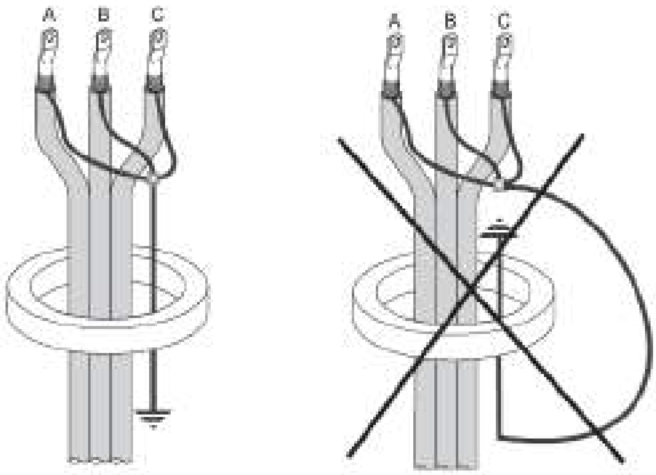


Core Balance CT

The core balance CT must only measure the sum of the 3 phase currents. The current circulating in the medium voltage cable shielding must therefore be excluded. To avoid the current circulating in the cable shielding being detected by the core balance CT, its component must be canceled by making this current circulate a second time through the core balance CT in the opposite direction.

This is achieved by connecting the shields coming out of the cable ends to earth via a wire that passes through the core balance CT. This wire must not come into contact with any part c connected to earth before it passes through the core balance CT, otherwise use an insulated wire.

Figure 11. Correct and not correct connecting the shields of the cable



Connection Precautions

- Connect the core balance CT secondary to the cubicle protective earth, by connecting terminal C12 on the PowerLogic P1F relay to the protective earth.
- Flatten the cable against the metal frames of the cubicle.
- Do not ground the cable by any other means.

Connecting Binary Inputs and Outputs Relays

Safety Precautions

⚠ DANGER

HAZARDOUS VOLTAGE

Do not allow hazardous live voltages to coexist with voltages that could be connected to accessible parts (SELV, PELV or PEB) on power supply and I/O block terminals A, B and C. The logic inputs and output relays are isolated from one another with simple isolation.

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

⚠ CAUTION

RISK OF DAMAGE TO THE I/O

Do not supply the logic inputs and relay outputs from sources of power that could come from different phases of a 3-phase supply.

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

Connecting the Output Relays

The PowerLogic P1F output relays have volt-free contacts.

⚠ CAUTION

LOSS OF PROTECTION OR RISK OF NUISANCE TRIPPING

If the PowerLogic P1F is no longer supplied with power or is in fail-safe position, the protection functions are no longer active and all the PowerLogic P1F output relays are de-energized. Check that this operating mode and the watchdog relay wiring are compatible with your installation.

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

Connecting the Logic Inputs

The PowerLogic P1F logic inputs are volt-free.

The PowerLogic P1 power supply voltage determines:

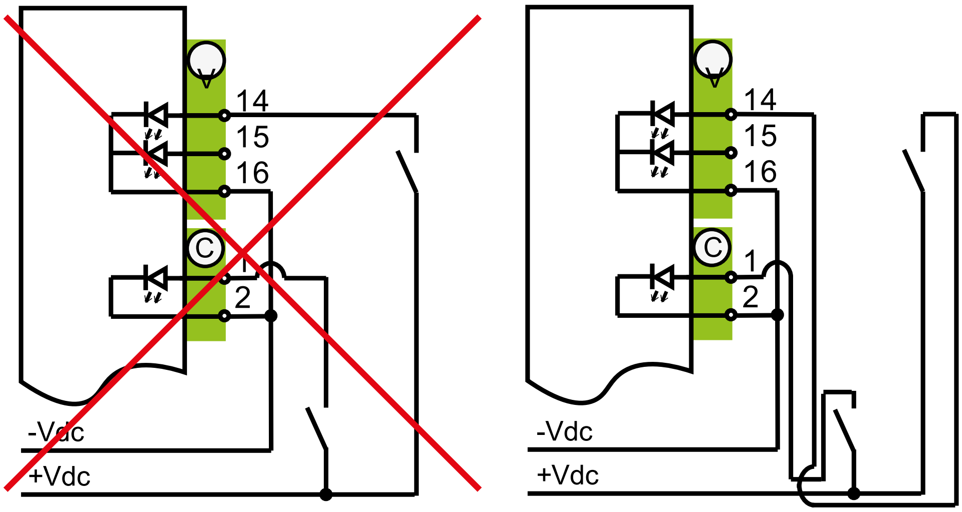
- The logic input supply voltage range
- The logic input switching threshold

PowerLogic P1F relay binary inputs can be triggered both with AC or DC voltage signals.

Advice on Connecting Logic Inputs

To reduce the consequences of electromagnetic disturbance, there should not be a loop between live conductors contained in a single connection. A connection made with a twisted pair helps to ensure that the outward and return conductors remain in close proximity along the whole length of the connection.

Figure 12. Correct and not correct connecting the logic inputs



Connecting the Communication Port

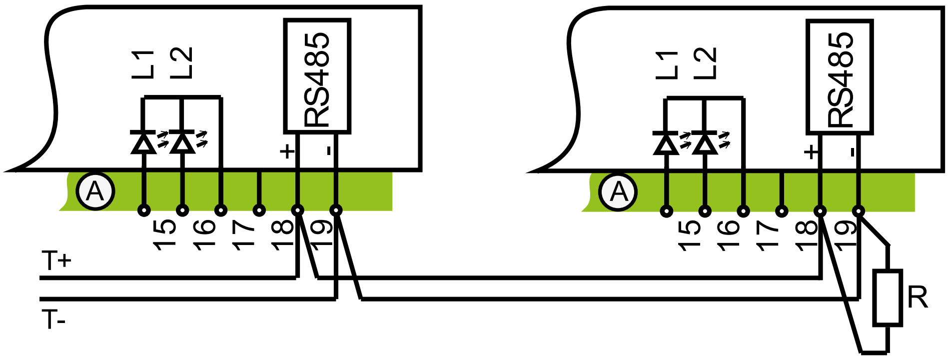
Introduction

PowerLogic P1F can communicate using a 2-wire RS 485 EIA communication port. Connection to the bus is direct, and needs no accessories.

Connection Diagram

Connection is in a daisy-chain and requires a line termination resistor.

Figure 13. RS485 connection diagram



Terminal	Data Item Connected	Description
A18	T+	Connected to terminal (+) of the SCADA communication port
A19	T-	Connected to terminal (–) of the SCADA communication port

Connection Precautions

The number of connected PowerLogic P1F relays must not exceed 32 and the total cable length must not exceed 1300 m (4265 ft).

The cable shielding connection must also be as short as possible.

If the PowerLogic P1F is at the end of the line, install a 120 Ω impedance matching resistor between terminals A18 and A19.

Dimensioning the CTs

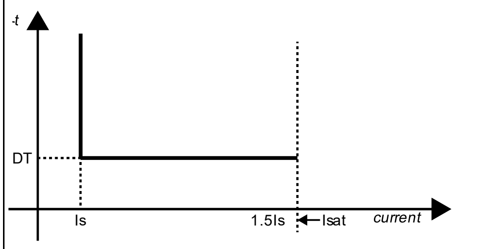
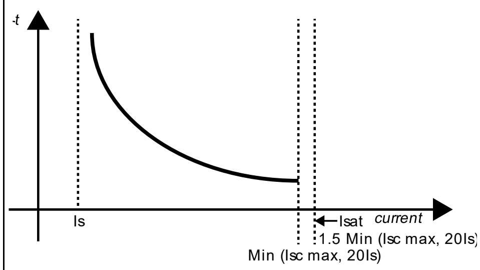
Introduction

The PowerLogic P1F phase and earth fault current inputs can be connected to standard 1 A or 5 A CTs.

CT Selection Principle

The CTs must be dimensioned so that they do not become saturated at currents where accuracy is required (with a minimum of 5 In).

The condition to be fulfilled by the CT saturation current (Isat) depends on the type of overcurrent protection time delay:

Time Delay	Condition to be Fulfilled	Illustration
Definite Time	Isat > 1.5 x threshold (Is)	
IDMT	Isat > 1.5 x the curve value, which is the smallest of the following 2 values: • Isc max, maximum installation short circuit current • 20x Is (IDMT curve dynamic range)	

The method for calculating the saturation current depends on the CT accuracy class as indicated below.

Practical Information

In the absence of any information about the settings, the characteristics below are suitable for most situations:

Rated secondary current	Rated burden	Accuracy class and accuracy limit factor	CT secondary Resistance	Wiring resistance
Ins	VAct		Rct	Rw
1 A	2.5 VA	5P20	< 3 Ω	< 0.075 Ω
5 A	7.5 VA	5P20	< 0.2 Ω	< 0.075 Ω

Principle for Calculating the Saturation Current in Class P

A class P CT is characterized by:

- Inp: Rated primary current (in A)
- Ins: Rated secondary current (in A)
- Accuracy class, expressed by a percentage, 5P or 10P, followed by the accuracy limit factor (FLP), whose usual values are 5, 10, 15, 20, 30

- VAct: Rated burden, whose usual values are 2.5/5/7.5/10/15/30 VA
- Rct: Maximum resistance of the secondary winding (in Ω)

The installation is characterized by the load resistance Rw at the CT secondary (wiring + protection relay).

If the CT load complies with the rated burden, i.e. Rw x $Ins^2 \leq$ VAct, the saturation current is higher than FLP x Inp.

If the resistance Rct is known, it is possible to calculate the actual CT FLP, which takes account of the actual CT load. The saturation current equals actualFLP x Inp, where:

$$\text{actualFLP} = \text{FLP} \cdot \frac{\text{Rct} \cdot \text{Ins}^2 + \text{VAct}}{(\text{Rct} + \text{Rw}) \cdot \text{Ins}^2}$$

Examples of Calculating the Saturation Current in Class P

Say for a CT with the following characteristics:

- Transformation ratio: 100 A/5 A
- Rated burden: 2.5 VA
- Accuracy class and accuracy-limit factor: 5P20
- Resistance of the secondary winding: 0.1 Ω

To have an FLP of at least 20, i.e. a saturation current of 20 x Inp = 2 kA, the load resistance Rw of the CT must be less than:

$$\text{Rw, max} = \frac{\text{VAct}}{\text{Ins}^2} = \frac{2.5}{5^2} = 0.1\Omega$$

This represents 12 m (39 ft) of wire with cross-section 2.5 mm2 (AWG 12) for a resistance per unit length of 8 Ω/km (2.4 mΩ/ft) approximately.

For an installation with 50 m (164 ft) of wiring with section 2.5 mm2 (AWG 12), Rw = 0.4 Ω.

As a result:

$$\text{actualFLP} = \text{FLP} \cdot \frac{\text{Rct} \cdot \text{Ins}^2 + \text{VAct}}{(\text{Rct} + \text{Rw}) \cdot \text{Ins}^2} = 20 \cdot \frac{0.1 \cdot 25 + 2.5}{(0.1 + 0.4) \cdot 25} = 8$$

Therefore, the saturation current Isat = 8 x Inp = 800 A.

NOTE: The impedance of a PowerLogic P1F relay's current inputs (0.002 Ω) is often negligible compared to the wiring resistance.

Principle for Calculating the Saturation Current in Class PX

A class PX CT is characterized by:

- Inp: Rated primary current (in A)
- Ins: Rated secondary current (in A)
- Vk: Rated knee-point voltage (in V)
- Rct: Maximum resistance of the secondary winding (in Ω)

The saturation current is calculated by the load resistance Rw at the CT secondary (wiring + protection relay):

$$\text{Isat} = \cdot \frac{\text{Vk}}{\text{Rct} + \text{Rw}} \cdot \frac{\text{Inp}}{\text{Ins}}$$

Examples of Calculating the Saturation Current in Class PX

CT ratio	Vk	Rct	Rw	Saturation current
100 A/5 A	17.4V	0.13 Ω	0.4 Ω	$Isat = \cdot \frac{17.4}{0.13 + 0.4} \cdot \frac{Inp}{5} = 6.56 \cdot Inp = 656\,A$
100 A/1 A	87.7V	3.5 Ω	0.4 Ω	$Isat = \cdot \frac{87.7}{3.5 + 0.4} \cdot \frac{Inp}{1} = 22.48 \cdot Inp = 2248\,A$

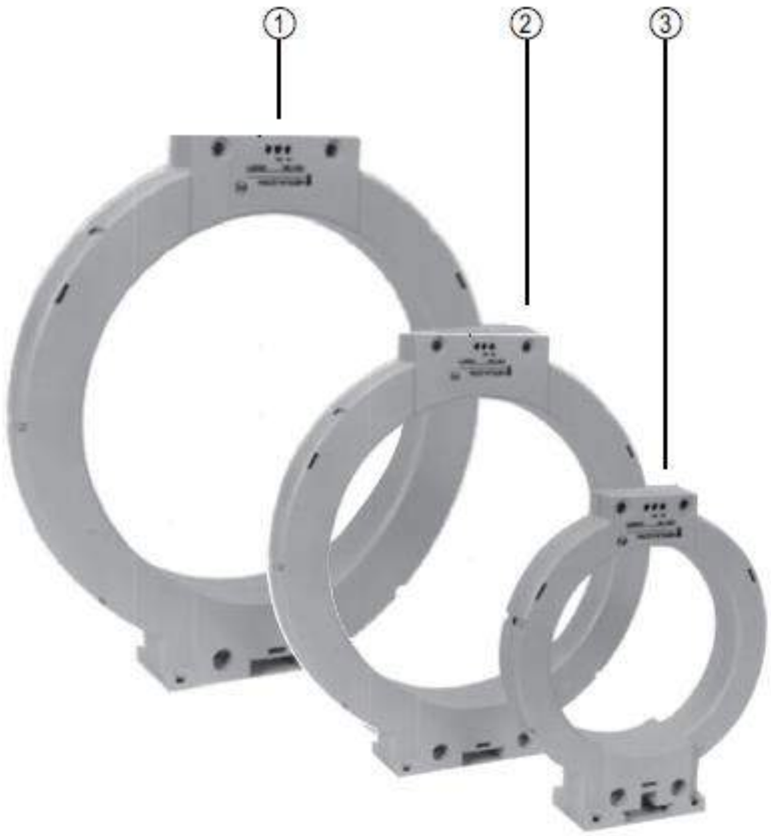
CSH120, CSH200 and CSH300 Core Balance CTs

Function

The specifically designed CSH120, CSH200 and CSH300 core balance CTs are for direct earth fault current measurement. Due to their low voltage insulation, they can only be used on cables.

- CSH120, CSH200 and CSH300 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 CSH300 inner diameter is 291 mm (11.46 in).

Figure 14. CSH120, CSH200, CSH300 core balance CTs photo



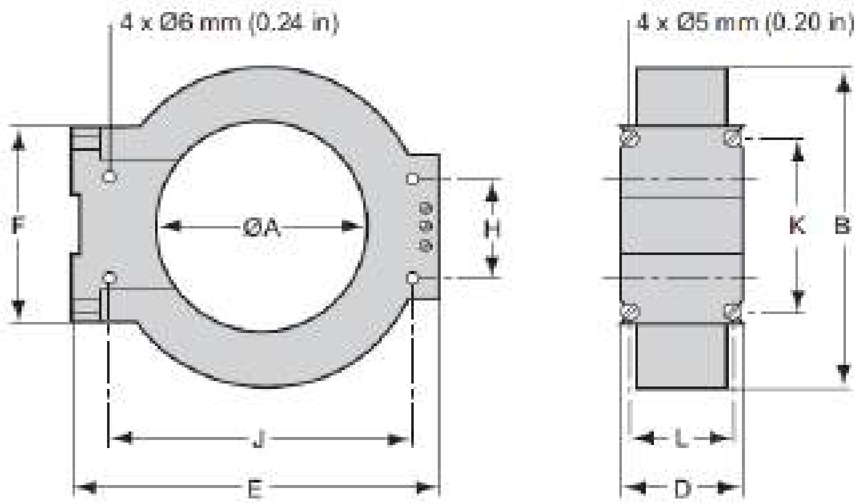
1 CSH300
2 CSH200
3 CSH120

Characteristics

		CSH120	CSH200	CSH300
Inner diameter		120 mm (4.7 in)	196 mm (7.7 in)	291mm (11.46 in)
Weight		0.6 kg (1.32 lb.)	1.4 kg (3.09 lb.)	2.5 kg (5.51 lb.)
Accuracy	at 20°C (68°F)	5 %	5 %	5 %
	at – 25…+70°C (-13…+158°F)	< 6 %	< 6 %	< 6 %
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)		

CHS120, CSH200 and CSH300 Dimensions

Figure 15. CSH current transformers 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
CSH300	mm	291	360	46	390	120	60	369	104	37
	in	11.46	14.17	1.81	15.35	4.72	2.36	14.53	4.09	1.46

Mounting Precaution

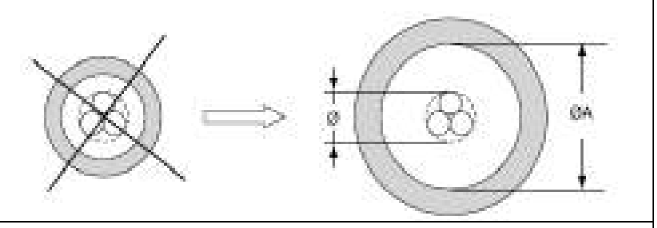
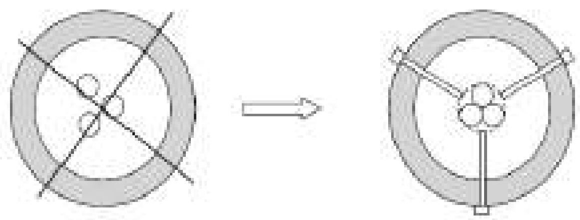
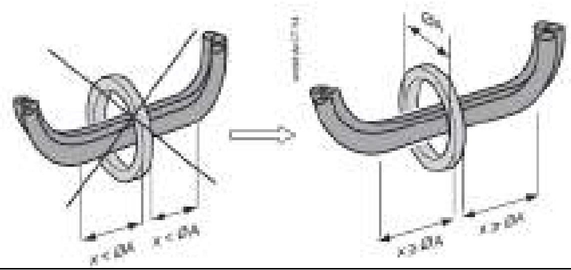
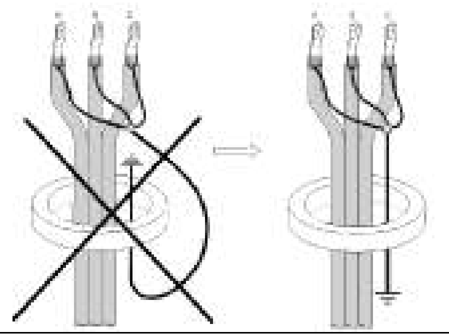
⚠ DANGER

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.
- 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.	

Connection Characteristics

CT	Wiring	Type of terminals	Tools	Tightening Torque
CSH120 CSH200 CSH300	• 1..2.5 mm2 wire (AWG 18...12) • Stripped length: 8 mm (0.31 in)	M3.5 screw	Flat blade Screwdriver 3.5 mm (0.14 in)	0.8...1 N•m (7.1...8.8 lb-in)

Commissioning

Safety Precautions

Before Starting

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

You should also 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 to confirm that all power is off.
- Before performing visual inspections, tests, or maintenance on this equipment:
  - Disconnect 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 back-feeding.
- 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.
- The successful operation of PowerLogic P1 depends upon proper installation, setting, and operation.
- Setting the PowerLogic P1 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.

⚠ CAUTION

HAZARD OF DAMAGE

- 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 relay. High voltage testing may damage electronic components contained in the relay.
- Do not open the device case. The PowerLogic P1 relay contains components that are susceptible to electrostatic discharge. It is assembled in specially equipped premises.

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

Principles

PowerLogic P1F Tests

Protection relays are tested prior to commissioning, with the dual aim of maximizing availability and minimizing the risk of malfunction of the assembly being commissioned. The question is to define the list of tests required at the time of commissioning.

Protection relays based on electromechanical and solid state technologies, whose performance cannot be fully reproduced, must be systematically submitted to detailed testing, not only to test their operational performance, but also to check that they are in good working order and have the required level of performance.

These tests are not necessary for relays based on digital technology:

- The use of this technology helps to ensure reproducibility of the stated performances.
- An internal self-testing system provides continuous information on the state of the electronic components and the integrity of the functions, thereby helping to ensure a high level of availability.

Each of the PowerLogic P1F functions has undergone full factory performance testing. The PowerLogic P1F relay is therefore ready to operate without requiring any additional performance testing that concerns it directly.

Commissioning PowerLogic P1F Relays

The preliminary PowerLogic P1F commissioning tests can therefore be limited to a commissioning check, i.e.:

- Only carrying out the checks specific to the hardware configuration and the functions activated
- Checking compliance with BOMs and hardware installation diagrams and rules during a preliminary general check
- Checking compliance of the general settings and protection settings entered with the preliminary studies
- Checking connections of the current inputs by secondary injection tests
- Checking the CT ratio
- Checking connection of the logic inputs and output relays by simulating input data and forcing the output relay status
- Validating the complete protection chain
- Using the test sheet provided to record the results of the commissioning tests

The Commissioning chapter describes the simple but exhaustive procedure to apply when performing these checks.

It is no longer essential to test each individual protection or control and monitoring function. However, if it is does prove necessary to test a function, the test procedures are described in this chapter.

Which Tests Do You Need to Perform?

Not all the checks and tests described in this chapter apply to all PowerLogic P1F models (L, N, B, A, E, E+). Each check or test begins with indicating which PowerLogic P1F models it applies to: it does not apply to models whose identifier (L, N, B, A, E, E+) has a bar over it.

Example

~~L~~	~~N~~	~~B~~	A	E	E+

means that the check or test only applies to PowerLogic P1F model A, E, and E+

Testing and Metering Equipment Required

Current Generator

To check the current input connections, use a sinusoidal AC current generator of the following type:

- 50 or 60 Hz frequency (according to the country of use)
- Single-phase (as minimum), adjustable from 0 to 32 A RMS
- Three-phases (recommended), adjustable from 0 to 32 A RMS per phase
- With injection-controlled digital chronometer, accurate to 10 ms
- With connector suited to the built-in test terminal block in the current input connection diagram

If the current generator is equipped with electronic on/off controls, check that the current is definitely zero in the automatic stop position (depending on the cursor position, the solid state contactor can allow more than 5% of the current to flow through).

Voltage Generator

To check that the PowerLogic P1F (B, A, E, E+) logic inputs are connected correctly and directional earth fault protection use one of the following:

- A DC voltage generator, adjustable from 0 to 200 V DC for adaptation to the voltage level of the tested input
- A DC voltage auxiliary power supply the same as the PowerLogic P1F auxiliary supply voltage
- A AC voltage generator, adjustable from 0 to 130 V AC to check directional earth fault protection function

Accessories

Accessories are required for the following connections:

- A plug with cord corresponding to the test terminal block for installed currents
- An electric cord with clamps, wire grip or touch probes

Metering Devices

Class 1 metering devices are required:

- An ammeter (0 to 50 A RMS)
- A voltmeter (0 to 250 V RMS)

Documents

The set of installation documents includes:

- The complete PowerLogic P1F connection diagram, showing:
    - Connection of the phase current inputs to the corresponding CTs via the test terminal block
    - Connection of the earth fault current input
    - Connection of the logic inputs and output relays
- The hardware bill of material and installation rules
- The settings sheet with all the PowerLogic P1F parameters and settings
- The test sheets

Tolerances and Injection Limits

The current generator must satisfy the following conditions:

- Minimum injection current: 1.5% of the CT secondary rated current (15 mA or 75 mA)
- Maximum injection current:
  - Continuous: 4 times the CT secondary rated current (20 A)
  - For 3 seconds: 40 times the CT secondary rated current (200 A)
- Frequency: 50 Hz +/- 10% or 60 Hz +/- 10%

Energization

Checks to be Performed Prior to Energization

Apart from the mechanical state of the equipment, use the diagrams and BOMs provided by the contractor to check:

- The PowerLogic P1F label
- Conformity of the PowerLogic P1F power supply voltage (indicated on the identification label on the front panel) with the power supply voltage of the switchboard (or cubicle)
- Correct connection of the auxiliary power supply:
- Whether an earth CT is present
- The presence of test terminal blocks upstream from the current inputs
- Conformity of connections between the PowerLogic P1F terminals and the test terminal blocks

Checking the Connections

With the equipment de-energized, check that the connections are tightened.

Energization Procedure

1. Switch on the auxiliary power supply.
2. Check that the Healthy LED lights up. Check that watchdog changes status.

The default screen is displayed (phase and earth fault currents measurement of In/Ien).

PowerLogic P1F Identification

Record the PowerLogic P1F serial number (found on the identification label on the top of the relay or menu cell ***OP PARAMETERS/Serial number***) on the test sheet. Record the PowerLogic P1F software version number (menu cell ***OP PARAMETERS/ Firmware Version*** and ***Firmware Release***) on the test sheet.

Validation of the Complete Protection Chain

Principle

The complete protection chain is validated during the simulation of a fault that causes tripping of the circuit breaker by PowerLogic P1F.
Simply testing one function can help to ensure that the whole system is working correctly, provided it has been installed correctly.

Procedure

To validate the complete protection chain, proceed as follows:

Step	Description
1	Select one of the protection functions that trips the circuit breaker.
2	Depending on the function(s) selected, inject a current corresponding to a fault and note whether the circuit breaker trips.
3	If the switchgear is equipped in terminal blocks put the covers back on the test terminal blocks.

Checking Settings

Determining Parameter and Protection Settings

All the PowerLogic P1F parameter and protection settings are determined beforehand by the design department in charge of the application and should be 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 PowerLogic P1F parameter and protection settings should be available for commissioning in the form of a dossier.

Checking Parameter and Protection Settings

Checks should be made when the PowerLogic P1F parameter and protection settings have not been entered during commissioning tests, to confirm the conformity of the parameter and protection settings entered with the values determined during the study.

These checks consist of:

- Going through all the PowerLogic P1F parameter and protection setting cells
- For each menu cell, comparing the values entered in the PowerLogic P1F relay with the values recorded in the parameter and protection settings file
- Correcting any parameter and protection settings that have not been entered correctly.

NOTE: Once the checks are complete, as of that phase, the parameter and protection settings should not be changed any further and are considered to be final.

The tests which follow must be performed with these parameter and protection settings. It will not be possible to modify any values, even temporarily. The only exception to this is the disabling of protection functions in order to isolate the protection function being tested.

Checking the CT Ratio

Purpose of the Check

In the context of checking the complete protection chain, checking each CT verify that its transformation ratio conforms to expectations and is identical for the 2 or 3 phase CTs.

Purpose

The CT conformity certificates can be used as a basis for the check. If these documents are missing, proceed as follows:

Step	Action
1	Check that the CT primary circuit is accessible, de-energized and completely isolated.
2	Using documents (diagrams, etc.), determine the expected ratio and check the corresponding PowerLogic P1F setting.
3	Make sure that the CT secondary is connected to the PowerLogic P1F relay or short-circuited and install a clamp ammeter on the secondary circuit of the first CT.
4	Connect the generator to the CT primary circuit.
5	Inject a current of at least 0.2 In (In: CT primary rated current) if possible and measure the injected current.
6	Read the current measured in the secondary circuit by the clamp ammeter and check that the transformation ratio conforms to expectations. If the CT is connected to PowerLogic P1F, check that the current displayed by PowerLogic P1F is the same as the current injected in the CT primary.
7	Repeat steps 3 to 6 for the other phase CT(s) and check that the results obtained are identical for both or all 3 CTs.
8	If the earth fault current is measured by a 1 A or 5 A CT, repeat steps 3 to 6 to check its transformation ratio.
9	Record your measurements on the test sheet.

Checking the Phase Current Input Connections

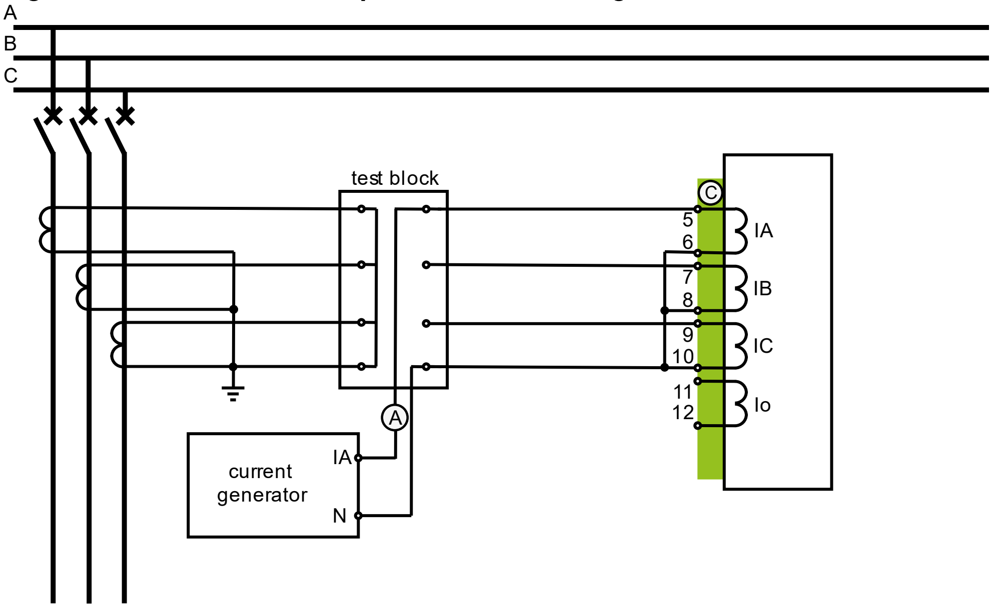
Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Wiring Diagram

To inject a current into the phase A current input, connect the single-phase current generator to the test terminal block, as shown in the diagram below.

Figure 16. Phase currents input connections diagram



Procedure

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Never leave the current transformer secondary in open circuit. The high voltage that would result from opening the circuit is dangerous for the operator and for the equipment.
- Never undo the ring lugs on the cables of the CT secondaries when there is current on the primary.

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

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Wear insulating gloves to avoid any contact with a conductor that has accidentally been energized.
- Short-circuit secondary current transformer winding by use test block without disconnecting the wires from it. This connector ensures continuity of the current transformer secondary circuits.

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

Step	Action
1	Connect the current generator to inject a current into a phase current input.
2	Turn on the generator.
3	Inject the CT secondary rated current (1 A/5 A).
4	On the P1F display, check that the value of the phase A current is approximately equal to the CT primary rated current or related to In (depends on setting).
5	Turn off the generator.
6	Repeat steps 1 to 5 for the other two phase current inputs.
7	Replace the cover on the test terminal block.

Checking the Earth Fault Current Input Connections

Applicable to PowerLogic P1F Series

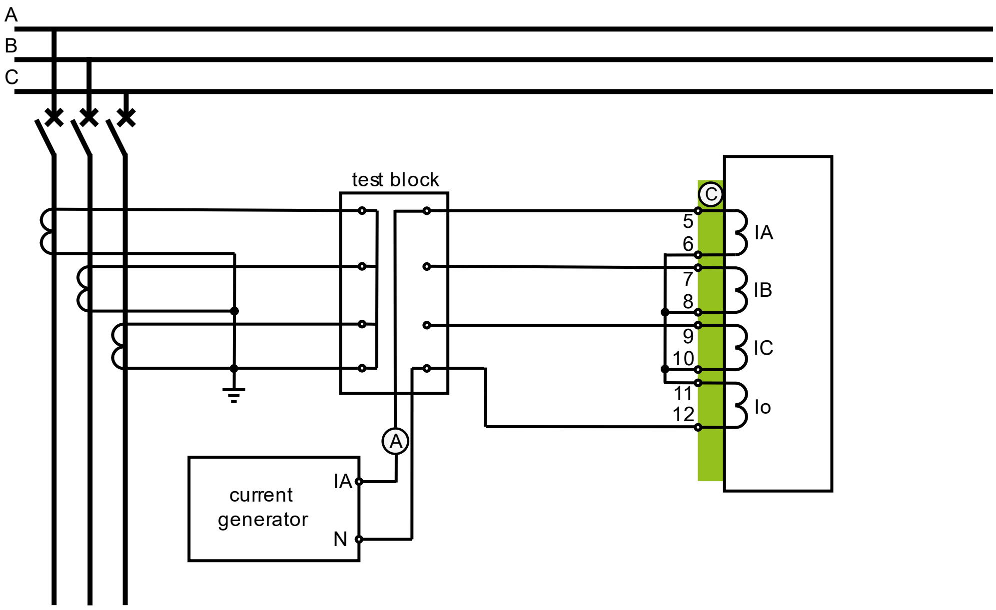
L	N	B	A	E	E+

Wiring Diagram

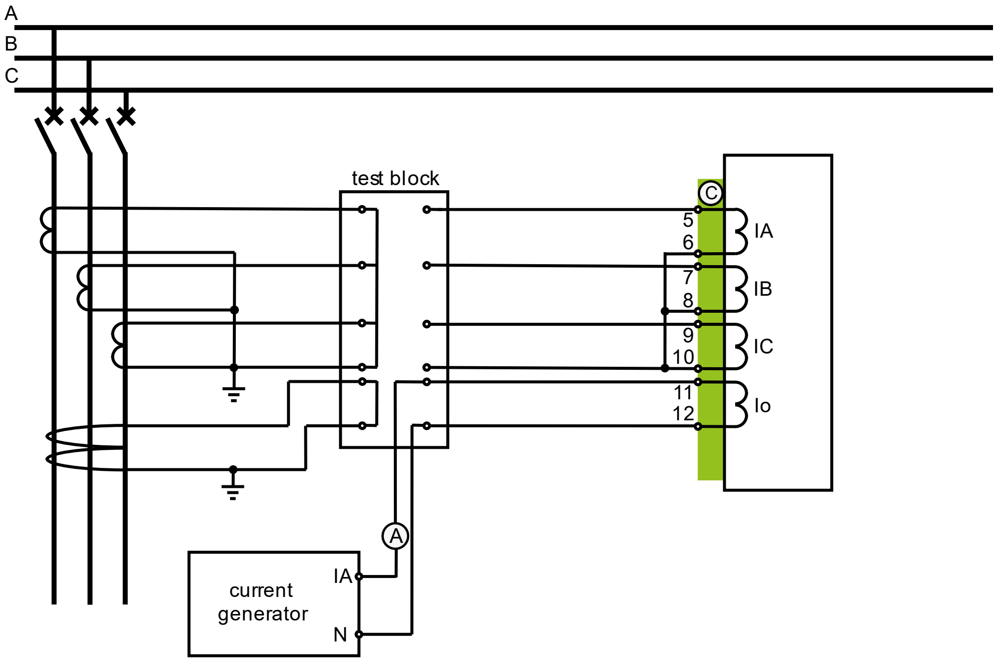
Connect the single-phase current generator to the test terminal block, as shown in the diagram below (two applications – a) measurement residual earth fault current and b) measurement earth fault current from core balance current transformer):

Figure 17. Earth fault current input connections diagrams

a)



b)



Residual Earth Fault Current Input Check Procedure

Step	Action
1	Connect the current generator to inject a current into a phase current input.
2	Turn on the generator.
3	Inject the CT secondary rated current (1 A/5 A).
4	Check on the P1F display that the earth fault current value is approximately equal to 1 A/5 A.
5	Turn off the generator.
6	Replace the cover on the test terminal block.

CBCT Input Check Procedure

Step	Action
1	Turn on the generator.
2	Inject the CT secondary rated current (1 A/5 A).
3	Check on the P1F display that the earth fault current value is approximately equal to 1 A/5 A.
4	Turn off the generator.
5	Replace the cover on the test terminal block.

Phase Overcurrent Protection (ANSI 50/51) Test

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Purpose of the Test

The phase overcurrent protection test is used to check the setting values for the following protection functions:

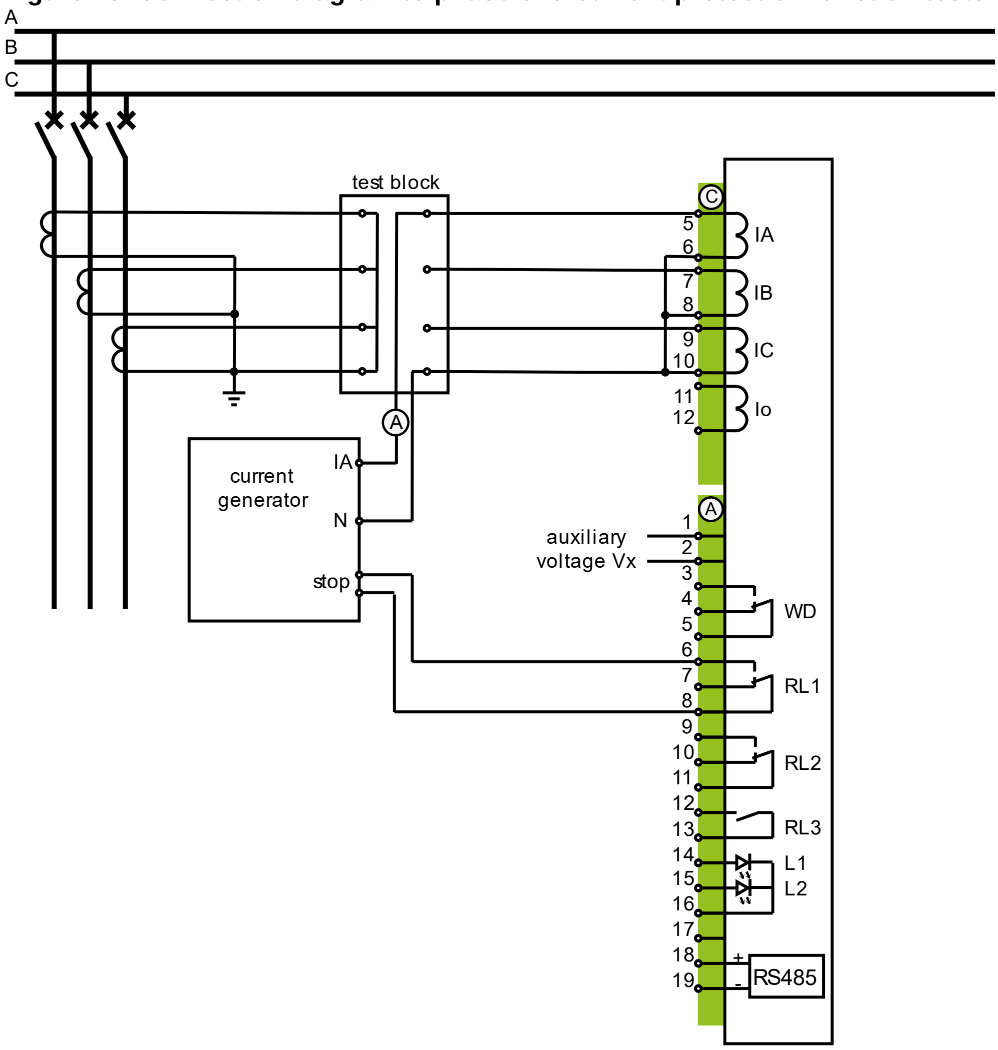
- Tripping threshold
- Tripping time delay

Wiring Diagram

To inject current into the phase A current input, connect the single-phase current generator as shown in the diagram below.

Use one of the P1F output relays to stop the chronometer. If you are using a circuit breaker contact to stop the chronometer, the measured time includes the circuit breaker operating time.

Figure 18. Connection diagram to phase overcurrent protection function tests



Definite Time Protection Test

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Never leave the current transformer secondary in open circuit. The high voltage that would result from opening the circuit is dangerous for the operator and for the equipment.
- Never undo the ring lugs on the cables of the CT secondaries when there is current on the primary.

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

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Wear insulating gloves to avoid any contact with a conductor that has accidentally been energized.
- Short-circuit secondary current transformer winding by use test block without disconnecting the wires from it. This connector ensures continuity of the current transformer secondary circuits.

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

A definite time protection function uses two settings that are independent of one another:

- The current set point (I>, I>> or I>>>)
- The time delay

Two checks are therefore required

Threshold check:

Step	Action
1	If necessary disable: • the earth fault protections (if they are based on the sum of the 3 phase CTs). • negative sequence overcurrent protection function. • Switch on to fault protection function (B, A, E, E+). • Broken conductor protection function (E, E+). • thermal overload protection (N, B, A, E, E+). • cold load pick up. • auto reclose (if is triggered by current protection functions, E, E+).
2	Inject a current approximately equal to 80% of the threshold value.
3	Increase the current slowly until the P1F relay trips or until the overcurrent protection (signals: tI>, tI>>, tI>>>) LED flashes quickly (if are assigned).
4	Record the current value at the time of tripping on the test sheet and compare it with the value on the settings sheet.
5	Reset P1F (R key).
6	If you are not performing any other checks: • Re-enable the protections and functions required by the settings sheet. • Reset the thermal capacity used to 0%. • When a blocking input is used, re-enable the back-up time delay associated with each threshold.

Time delay check:

Step	Action
1	If necessary disable: • the earth fault protections (if they are based on the sum of the 3 phase CTs). • negative sequence overcurrent protection function. • Switch on to fault protection function (B, A, E, E+). • Broken conductor protection function (E, E+). • thermal overload protection (N, B, A, E, E+). • cold load pick up. • auto reclose (if is triggered by current protection functions, E, E+).
2	Short-circuit the generator to avoid injecting current into the P1F relay.
3	Prepare to inject a current at least twice as high as the tripping current measured in the threshold check.
4	Re-establish the injection circuit in the P1F relay and set the chronometer to zero.
5	Start current injection and the chronometer simultaneously and use the ammeter to make sure the injected current is stable. When P1F trips, the chronometer stops.
6	Record the time elapsed on the test sheet and compare it with the value on the settings sheet.
7	Reset device (R key).
8	If you are not performing any other checks: • Re-enable the protections and functions required by the settings sheet. • Reset the thermal capacity used to 0%. • When a blocking input is used, re-enable the back-up time delay associated with each threshold.

IDMT Protection Test

IDMT protection uses a standardized curve (I, *t*).

The test consists of testing a few points on the curve, in the tripping zone for the threshold I>.

Checking a point on the curve:

Step	Action
1	If necessary disable: • the earth fault protections (if they are based on the sum of the 3 phase CTs). • negative sequence overcurrent protection function. • Switch on to fault protection function (B, A, E, E+). • Broken conductor protection function (E, E+). • thermal overload protection (N, B, A, E, E+). • cold load pick up. • auto reclose (if is triggered by current protection functions, E, E+).
2	Choose a point (I/I>, *t*) to be tested in the threshold tripping zone, using the *Overcurrent Protection Tripping Curves, page 129 and subsequent ones.*
3	Set the generator for the current determined in step 2.
4	Reset the chronometer to zero and reset P1F if necessary (R key).
5	Start current injection and the chronometer simultaneously and use the ammeter to make sure the injected current is stable. When P1F trips, the chronometer stops.
6	Record the time elapsed on the test sheet and compare it with the expected value.
7	Reset device (R key).
8	If you are not performing any other checks: • Re-enable the protections and functions required by the settings sheet. • Reset the thermal capacity used to 0%. • When a blocking input is used, re-enable the back-up time delay associated with each threshold.

Earth Fault Protection (ANSI 50N/51N) Test

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Purpose of the Test

The earth fault protection test is used to check the setting values for the following protection functions:

- Tripping threshold
- Tripping time delay

There are two possible wiring diagrams, depending on whether the earth fault current is being measured:

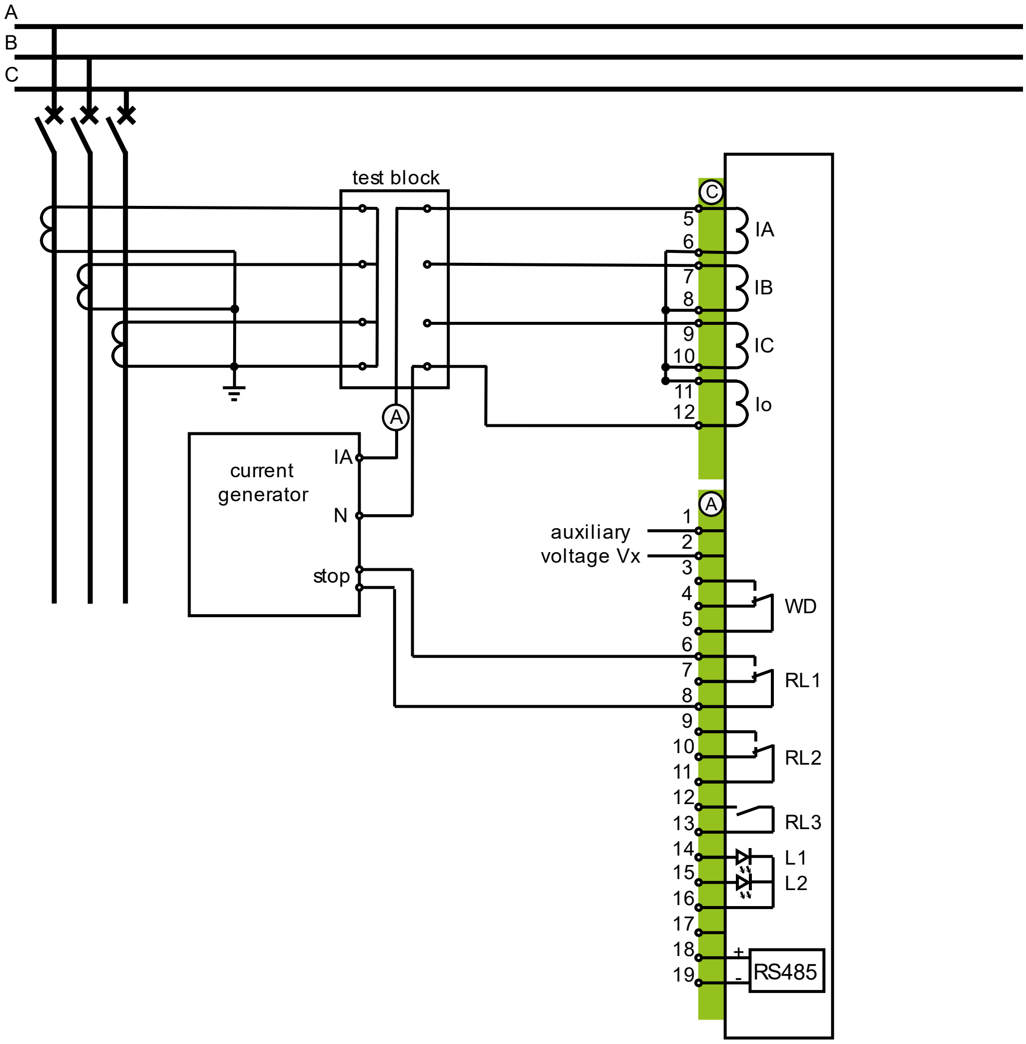
- Using the electrical sum of the currents measured by the 3 phase CTs – residual current
- Using an earth fault core balance CT

Wiring Diagram with 3 Phase CTs – Residual Current

To inject current into the phase A current input, connect the single-phase current generator as shown in the diagram below.

Use one of the P1F output relays to stop the chronometer. If you are using a circuit breaker contact to stop the chronometer, the measured time includes the circuit breaker operating time.

Figure 19. Connection diagram to earth (residual current) fault protection function tests

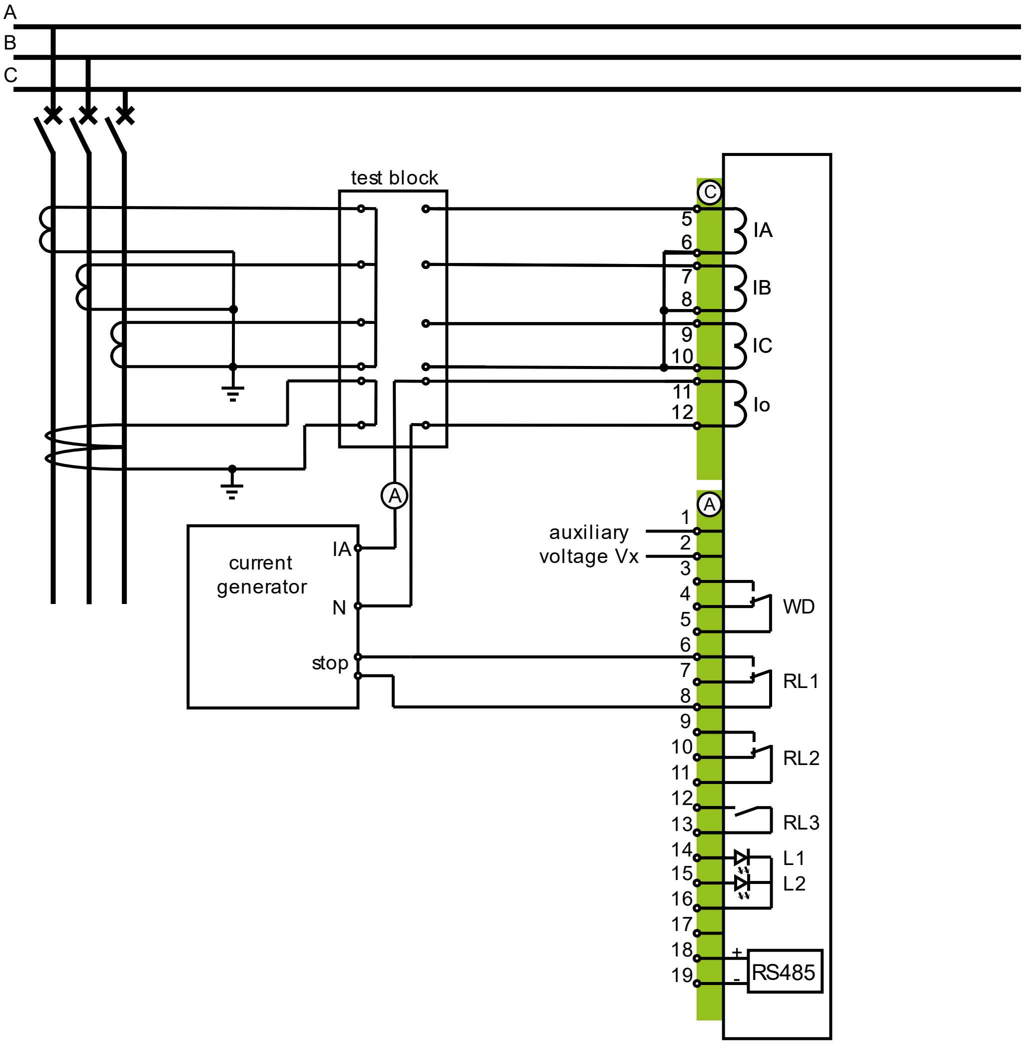


Wiring Diagram with Core Balance Current Transformer

To inject current into the phase Io current input, connect the single-phase current generator as shown in the diagram below.

Use one of the P1F output relays to stop the chronometer. If you are using a circuit breaker contact to stop the chronometer, the measured time includes the circuit breaker operating time.

Figure 20. Connection diagram to earth (CBCT) fault protection function tests



Definite Time Protection Test

A definite time protection function uses two settings that are independent of one another:

- The current set point (IN_1, IN_2 or IN_3 (E, E+))
- The time delay

Two checks are therefore required

Threshold check:

Step	Action
1	If necessary disable: • Phase overcurrent protections. • negative sequence overcurrent protection function. • Switch on to fault protection function (B, A, E, E+). • Broken conductor protection function (E, E+). • thermal overload protection (N, B, A, E, E+). • cold load pick up. • auto reclose (if is triggered by current protection functions, E, E+).
2	Inject a current approximately equal to 80% of the threshold value.
3	Increase the current slowly until the P1F relay trips or until the overcurrent protection (signals: tIN_1, tN_2, tIN_3) LED flashes quickly (if are assigned).
4	Record the current value at the time of tripping on the test sheet and compare it with the value on the settings sheet.
5	Reset P1F (R key).
6	If you are not performing any other checks:

	• Re-enable the protections and functions required by the settings sheet. • Reset the thermal capacity used to 0%. • When a blocking input is used, re-enable the back-up time delay associated with each threshold.

Time delay check:

Step	Action
1	If necessary disable: • Phase overcurrent protections. • negative sequence overcurrent protection function. • Switch on to fault protection function (B, A, E, E+). • Broken conductor protection function (E, E+). • thermal overload protection (N, B, A, E, E+). • cold load pick up. • auto reclose (if is triggered by current protection functions, E, E+).
2	Short-circuit the generator to avoid injecting current into the P1F relay.
3	Prepare to inject a current at least twice as high as the tripping current measured in the threshold check.
4	Re-establish the injection circuit in the P1F relay and set the chronometer to zero.
5	Start current injection and the chronometer simultaneously and use the ammeter to make sure the injected current is stable. When P1F trips, the chronometer stops.
6	Record the time elapsed on the test sheet and compare it with the value on the settings sheet.
7	Reset P1F (R key).
8	If you are not performing any other checks: • Re-enable the protections and functions required by the settings sheet. • Reset the thermal capacity used to 0%. • When a blocking input is used, re-enable the back-up time delay associated with each threshold.

IDMT Protection Test

IDMT protection uses a standardized curve (Io, *t*).

The test consists of testing a few points on the curve, in the tripping zone for the threshold I>.

Checking a point on the curve:

Step	Action
1	If necessary disable: • Phase overcurrent protections. • negative sequence overcurrent protection function. • Switch on to fault protection function (B, A, E, E+). • Broken conductor protection function (E, E+). • thermal overload protection (N, B, A, E, E+). • cold load pick up. • auto reclose (if is triggered by current protection functions, E, E+).
2	Choose a point (Io/IN_1, *t*) to be tested in the threshold tripping zone, using the *Overcurrent Protection Tripping Curves, page 129 and subsequent.*
3	Set the generator for the current determined in step 2.
4	Reset the chronometer to zero and reset P1F if necessary (R key).
5	Start current injection and the chronometer simultaneously and use the ammeter to make sure the injected current is stable. When P1F trips, the chronometer stops.
6	Record the time elapsed on the test sheet and compare it with the expected value.
7	Reset P1F (R key).
8	If you are not performing any other checks:

	• Re-enable the protections and functions required by the settings sheet. • Reset the thermal capacity used to 0%. • When a blocking input is used, re-enable the back-up time delay associated with each threshold.

Thermal Overload Protection (ANSI 49) Test

Applicable to PowerLogic P1F Series

~~L~~	N	B	A	E	E+

Purpose of the Test

The thermal overload protection test is used to check the operation setting values for this protection functions:

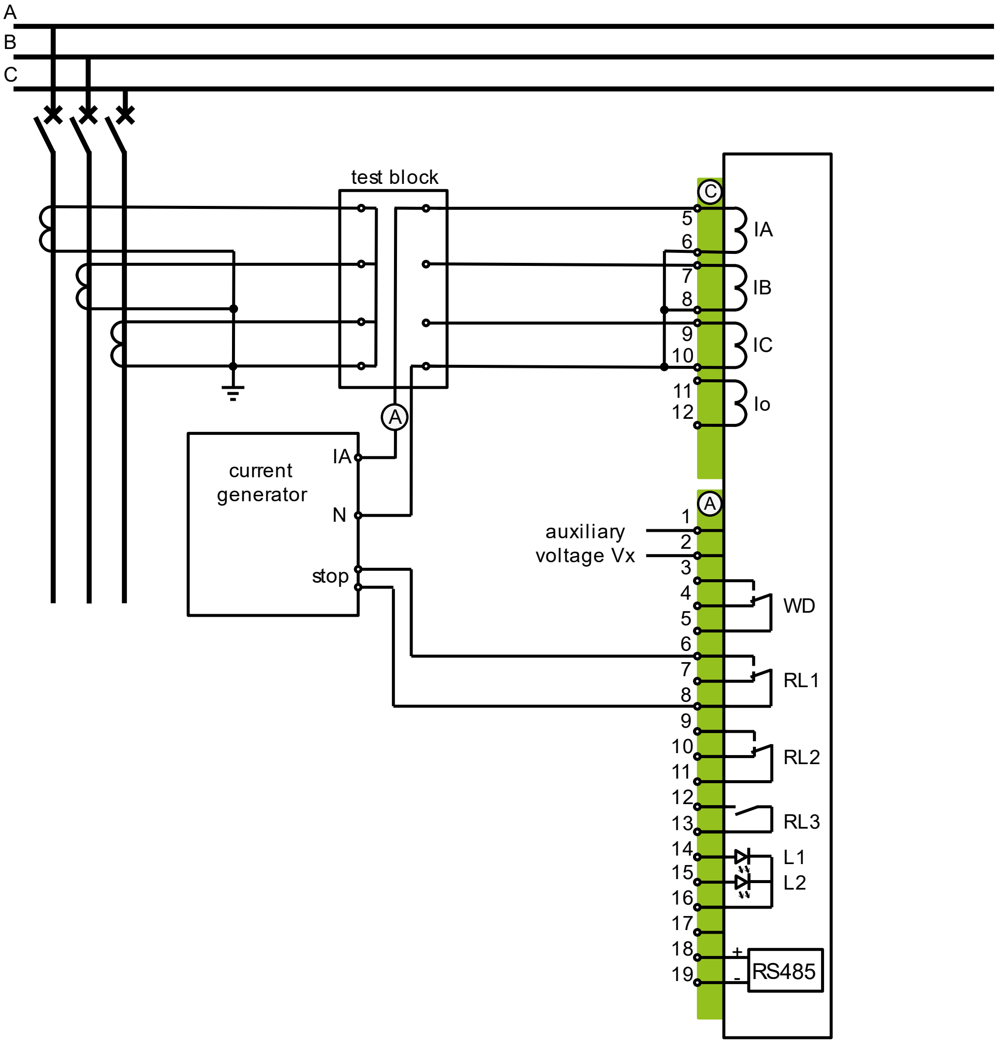
- Calculation of the thermal capacity used
- Alarm set point
- Tripping time delay

Wiring Diagram

To inject current into the phase A current input, connect the single-phase current generator as shown in the diagram below.

Use one of the P1F output relays to stop the chronometer. If you are using a circuit breaker contact to stop the chronometer, the measured time includes the circuit breaker operating time.

Figure 21. Connection diagram to overload protection function tests



Thermal Overload Protection Test

Thermal overload protection uses a curve (I, *t*).

The test consists of testing a few points on the curve, in the tripping zone for the threshold.

Checking a point on the curve:

Step	**Action**
1	If necessary disable: • Phase overcurrent protections. • Earth fault protection • negative sequence overcurrent protection function. • Switch on to fault protection function (B, A, E, E+). • Broken conductor protection function (E, E+). • cold load pick up. • auto reclose (if is triggered by current protection functions, E, E+).
2	From thermal equation/curves (*Function and Parameters chapter, Thermal Overload Protection section*) determine the coordinates for a point (I/I_{therm},*t*) to be tested.
3	Set the generator for the current determined in step 2.
4	Reset the chronometer to zero and reset P1F if necessary (R key).
5	Reset the thermal capacity used to 0%.
6	Start current injection and the chronometer simultaneously and use the ammeter to make sure the injected current is stable. When P1F trips, the chronometer stops.
7	Record the time elapsed on the test sheet and compare it with the expected value.
8	Reset P1F (R key)
9	If you are not performing any other checks: • Re-enable the protections and functions required by the settings sheet. • Reset the thermal capacity used to 0%. • When a logic discrimination blocking order is used, re-enable the back-up time delay associated with each threshold.

Checking the Logic Input Connections

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	B	A	E	E+

Checking the Logic Inputs

To check the logic inputs, proceed as follows for each input.

Step	Action
1	Display the ***I/P Status*** menu cell in the relay menu.
2	• If the input power supply voltage is available, use an electric cord to short-circuit the contact that delivers logic data to the input. • If the input power supply voltage is not available, apply a voltage supplied by the DC voltage generator to the terminal of the contact linked to the chosen input. To adjust the voltage level: refer to *Connecting the Logic Inputs, page 37.*
3	Note any change in the display.
4	If necessary, reset the P1F (R key).

Operational Commissioning

Final Check

When the tests are complete, proceed as follows for the final check:

Step	Action
1	Put the cover back on the test block
2	Look through all the screens relating to the PowerLogic P1F protection functions and check that only the desired protections are active.
3	Check the conformity of the validated parameters in PowerLogic P1F against the settings sheet.
4	Record the last event recorded by PowerLogic P1F on the test sheet so that you can distinguish between the values attributable to the tests and those due to subsequent activation of the protections by a fault on the installation. The PowerLogic P1F relay is now operational.

PowerLogic P1F Test Sheet

Use

This test sheet can be used to record the results of the commissioning tests.
Each test is described in detail in the Commissioning chapter.
Only carry out the tests required, depending on the relay type and the functions in use.
Check the box ☐ when the check has been made and is conclusive.

Identification

Workstation		Test Conducted on:	By:
Cubicle		Comments	
Type of PowerLogic P1			
Serial Number			
Software version			
(to be read in the parameters menu on screen)			

Overall Checks

Type of Check	
Preliminary inspection, prior to energization	☐
Energization	☐
Checking parameters and settings	☐
Connecting the logic inputs (PowerLogic P1F, model **B, A, E, E+**)	☐
Validation of the Complete Protection Chain	☐

Checking the CT Ratio

CT Checked	Theoretical Transformation Ratio	Primary Injection Current	Current Measured at the Secondary	Measured Transformation Ratio	
Phase CT A					☐
Phase CT B					☐
Phase CT C					☐
Earth CT					☐

Checking the Current Inputs

Type of Check	Test Performed	Result	Display	
Connecting the phase current inputs	Secondary injection of the CT rated current, either 1 A or 5 A.	CT primary rated current	IA = ... IB = ... IC = ...	☐
Connecting the earth fault current input	Standard method: Injection of 5 A into primary circuit of core balance CT or CT	Injected current value	Io = ...	☐

Phase Overcurrent Protection (ANSI 50/51) Tests

I> set point with definite time curve

Current Set Point Test ☐		**Time Delay Test** ☐	
Set point set	Set point measured	Time delay set	Time delay measured

I> set point with IDMT curve

	Injected Current	**Tripping Time**		
	Measured	**Theoretical**	**Measured**	
Point 1				☐
Point 2				☐
				☐
				☐

I>> set point with definite time curve

Current Set Point Test ☐		**Time Delay Test** ☐	
Set point set	Set point measured	Time delay set	Time delay measured

I>> set point with IDMT curve

	Injected Current	**Tripping Time**		
	Measured	**Theoretical**	**Measured**	
Point 1				☐
Point 2				☐
				☐
				☐

I>>> set point with definite time curve

Current Set Point Test ☐		**Time Delay Test** ☐	
Set point set	Set point measured	Time delay set	Time delay measured

Earth Fault Protection (ANSI 50N/51N) Tests

IN_1 set point with definite time curve

Current Set Point Test ☐		**Time Delay Test** ☐	
Set point set	Set point measured	Time delay set	Time delay measured

IN_1 set point with IDMT curve

	Injected Current	**Tripping Time**		
	Measured	**Theoretical**	**Measured**	
Point 1				☐
Point 2				☐
				☐
				☐

IN_2 set point with definite time curve

Current Set Point Test ☐		**Time Delay Test** ☐	
Set point set	Set point measured	Time delay set	Time delay measured

IN_3 set point with definite time curve

Current Set Point Test ☐		**Time Delay Test** ☐	
Set point set	Set point measured	Time delay set	Time delay measured

Negative Sequence Overcurrent Protection (ANSI 46) Tests

Is2> set point with definite time curve

Current Set Point Test ☐		**Time Delay Test** ☐	
Set point set	Set point measured	Time delay set	Time delay measured

Is2> set point with IDMT curve

	Injected Current Measured	**Tripping Time**		
		Theoretical	**Measured**	
Point 1				☐
Point 2				☐
				☐
				☐

Circuit Breaker Failure (ANSI 50BF) Tests

I< Threshold set point with definite time curve

Current Set Point Test ☐		**Time Delay Test** ☐	
Set point set	Set point measured	Time delay set	Time delay measured

IN< Threshold set point with definite time curve

Current Set Point Test ☐		**Time Delay Test** ☐	
Set point set	Set point measured	Time delay set	Time delay measured

External Trip (Auxiliary Timers) Tests

AUX1 with definite time curve

Time Delay Test ☐	
Time delay set	Time delay measured

AUX2 with definite time curve

Time Delay Test ☐	
Time delay set	Time delay measured

AUX3 with definite time curve

Time Delay Test ☐	
Time delay set	Time delay measured

AUX4 with definite time curve

Time Delay Test ☐	
Time delay set	Time delay measured

Switch On To Fault Protection Tests

SOTF set point with definite time curve

Current Set Point Test ☐		Time Delay Test ☐	
Set point set	Set point measured	Time delay set	Time delay measured

Broken Conductor Protection (46BC) Tests

Ratio I2/I1 set point with definite time curve

Current Set Point Test ☐		Time Delay Test ☐	
Set point set	Set point measured	Time delay set	Time delay measured

Thermal Overload Protection (ANSI 49) Tests

	Injected Current Measured	Tripping Time		
		Theoretical	Measured	
Point 1				☐
Point 2				☐
				☐
				☐

Logic Selectivity Tests

	Time Delay Test		
	Time delay set	Time delay measured	
SEL1 tI>>			☐
SEL1 tI>>>			☐
SEL1 tIN>>			☐
SEL1 tIN>>>			☐

	Time Delay Test		
	Time delay set	Time delay measured	
SEL2 tI>>			☐
SEL2 tI>>>			☐
SEL2 tIN>>			☐
SEL2 tIN>>>			☐

Cold Load Pick-up Tests

Cold load PU Level set point with definite time curve

	Current Set Point Test ☐			Time Delay Test		
	Set point set	Set point measured		Time delay set	Time delay measured	
CLPU I>			☐			☐

CLPU I>>			☐			☐
CLPU I>>>			☐			☐
CLPU IN_1			☐			☐
CLPU IN_2			☐			☐
CLPU IN_3			☐			☐
CLPU Brkn Cond			☐			☐
CLPU Itherm			☐			☐
CLPU I2>			☐			☐

Binary Inputs Tests

Binary Inputs	Working
L1	☐
L2	☐
L3	☐
L4	☐
L5	☐
L6	☐
L7	☐
L8	☐

Relay Outputs Tests

Relay Outputs	Working
RL1	☐
RL2	☐
RL3	☐
RL4	☐
RL5	☐
RL6	☐
RL7	☐
WD	☐

LEDs Tests

Relay Outputs	Working
LED 1 Trip	☐
LED 2 Alarm	☐
LED 3	☐
LED 4	☐
LED 5	☐
LED 6	☐
LED 7	☐
LED 8 Healthy	☐

Comments

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Commissioning Engineer	Customer
Date:	Date:

Use

Human Machine Interface

Front Panel

The Human Machine Interface (HMI) on the front panel of P1F relays consists of a display, LEDs, keys and front local communication port (mini USB).

A sealable pivoting flap can help to prevent access to the setting keys by unauthorized persons (optional equipment).

Figure 22. Front panel of the relay:

1 – Red “Trip” LED
2, 3, 4, 5, 6, 7, – Freely programmable LED (second LED is yellow, rest of them red)
8 – Green “Healthy” LED (Watchdog)
9 – Display (graphic liquid crystal display - LCD)
10 – Home key, return to top menu “Record” when pressed
11 – Reset/Clear key, return to upper level menu when pressed
12 – 4 arrow keys, and confirm entry OK key

- Return to upper level menu
- Enter lower level menu
- Go to previous menu at same level
- Go to next menu at same level
- \+ Enter edit mode
- \+ + Exit edit mode

13 – CB Open key
14 – CB Close Key
15 – Mini-USB type B port for local connections

Healthy LED Status

Healthy LED status	Function
Green LED On	P1F on
Green LED Flashing	P1F in the fail position

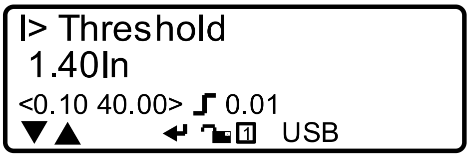
Display

The display is a backlit LCD unit.

Each P1F protection function is presented in a screen consisting of the following items:

- First line: Protection function name
- Second line: Displays protection function status or set values of parameters associated with the function
- Third line:
  <0.10 40.00> setting range:
  0.01 step values of parameters associated with the function
- Fourth line: The following special symbols may appear:

	possible to move up by pressing the .
	possible to move left by pressing the key.
	possible to move down by pressing the key.
	possible to move right by pressing the key.
	the last menu cell in the column. If the key is pressed here the cursor will reach the first cell in the column.
	possible to edit the displayed values. A menu pointer, on the left: it points to the pictogram for the selected menu
	Edition of values on the display password-protected
	Edition of setting value is possible (the level correct password has been entered)
1	On the last line: Setting group 1 is displayed. In the bottom right corner: Setting group 1 is active.
2	On the last line: Setting group 2 is displayed. In the bottom right corner: Setting group 2 is active.
USB	USB communication port is active. When communication port is disabled then USB pictogram is not displayed.



Menu organization

The menu content depends on the PowerLogic P1F model. The list of screens by menu, for each model, is given at the end of this chapter – Menu Map. Menu in PowerLogic P1F has got pulldown structure.

Default Display

A default screen is displayed automatically 10 minutes after the last keystroke. This default screen is (depends on settings ***GLOBAL SETTINGS/LOC/Default Display***):

- The screen displaying the three phase and earth fault currents per unit (in reference to In or Ion)
- The screen displaying the three phase and earth fault currents in amperes
- The screen displaying CB status and possibility to CB control
- The screen displaying auto reclose status and possibility to blocking of auto reclose
- The screen displaying control mode status and possibility to change the control mode

Operation

Access to Data

During operation, the user can access the following data:

- Readout of measurements, parameters and protection settings
- Local annunciation of the last fault:
    - by a light up LED associated with a fault
    - by a fault screen on the display unit
- Acknowledgement of the last fault
- Readout of the 20 last recorded faults
- Readout of the 5 last recorded alarms
- Readout of the 5 last recorded triggers
- Readout counters:
    - control counters
    - fault counter
    - auto reclose counter
    - CB monitoring counter
- Reset of latched LEDs and relay outputs (if the causes disappeared)
- LED test

Readout of Measurements, Parameters and Protection Settings

When the P1F operate, the user can read all the data contained in the relay.

Announcement of the Last Fault

When a fault is detected by P1F, it may be indicated locally by:

- A fault LED (Trip and any other freely configurable LEDs, depending on configuration), which lights up for as long as the fault is present and has not been acknowledged
- A fault screen, which is displayed on the display unit and remains displayed until the operator presses a key

The operator can acknowledge faults locally by pressing the Reset key.

P1F relays connected to a communication network:

- Indicate faults remotely-indication bit
- Can receive an order to acknowledge faults from the communication

Fault and LEDs Signals

The fault and signals LEDs light up to indicate a fault or any other signals assigned to LEDs (depending on configuration).

Trip and Healthy LEDs are fixed, the rest of LEDs are freely configurable. LEDs can be latched or not. If latching of LED is disabled, the LED goes out once the cause disappeared.

Fault Screens (Fault Record)

Fault screens (column) inform the operator about the characteristics of the last fault detected by the P1F relay.

The operator can consult the other cells using the , or  keys. If the relay is reset the operator can still consult the 20 last recorded faults in the ***FAULT RECORDS*** menu (column).

Menu Cell	Description
Trip tI> ▼▲	Fault origin Protection function that caused the trip
Fault Time 00:24:01.760 ▼▲	Time of the fault
Fault Date 01/01/15 ▼▲	Date of the fault
Active Set Group Group 1 ▼▲	Which setting group was active at the time of the fault
Fault Origin Phase A ▼▲	Phase fault origin
IA= 3.34A IB= 0.00A ▼▲	Value of the currents in phase A and B measured at the time of the fault
IC= 0.00A IN= 0.00A ▼▲	Value of the currents in phase C and neutral measured at the time of the fault
VN= 0.00V angle IN= 0Deg. ↵▲	Value of the neutral voltage and angle of neutral current measured at the time of the fault (E+)

Fault Acknowledgement

Pressing the Reset key acknowledges faults locally and causes:

- The latched output relays to be reset
- The fault LED to go out

After acknowledgement, the P1F relay displays the default display (set in ***GLOBAL SETTINGS/LOC/Default Display***).

Readout of the 20 Last Recorded Faults

Each P1F relays record the characteristics of the 20 last faults.

These records can be accessed in the ***RECORDS/FAULT RECORDS*** menu. Selection of fault number is possible in below cell (first cell in ***FAULT RECORDS*** column):

```
Record Number
1:Fault 1
```

Readout of the 5 Last Recorded Alarms

Each P1F relays record the characteristics of the 5 last alarms.

These records can be accessed in the ***RECORDS/ALARM RECORDS*** menu. Selection of alarm number is possible in below cell (first cell in ***ALARM RECORDS*** column):

```
Record Number
1:Alarm 1
```

Readout of the 5 Last Recorded Triggers

Each P1F relays record the characteristics of the 5 last triggers.

These records can be accessed in the RECORDS/INSTANTANEOUS RECORD menu. Selection of triggers number is possible in below cell (first cell in INSTANTANEOUS RECORD column):

```
Record Number
1:Start 1
```

Readout Counters

P1F relays models **A, E, E+** count the following values:

- CONTROL COUNTERS
    - Trip numbers
    - Close numbers
- FAULT COUNTER
    - Fault Trips number
    - Fault Starts number
    - Alarms number
    - Hardware Warnings number
- AUTO RECLOSE COUNTER
    - [79] Action Total number
    - Trips&Lockout Total number
    - Successful total number
    - Cycle 1 Reclose number
    - Cycle 2 Reclose number
    - Cycle 3 Reclose number
    - Cycle 4 Reclose number

Each above counter can be reset in below cell (in the end of each counter column)

```
Counter Reset
1:Reset
```

- CB MONITORING COUNTER

- CB close monitoring number
- CB open monitoring number
- CB AMPS Value

Reset of Latched LEDs and Relay Outputs

Reset of latched LEDs and relay outputs is possible if the causes disappeared.
Reset can be done by:

- Use reset key
- Assigned binary inputs
- From Scada system (depends on select control mode)

LED Test

The LED test is used to check that each LED on the front panel are working correctly.

To perform the test (when any protections are not triggered and PowerLogic P1F is energized from the voltage), press R button from default display cell level. After this, all LEDs on the front panel light up for approx. 1s.

Settings

Access to Parameters and Settings

These parameters and settings are divided into the following menus:

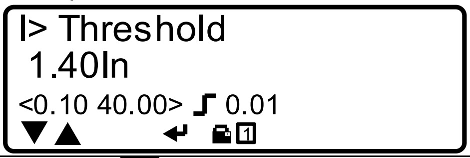
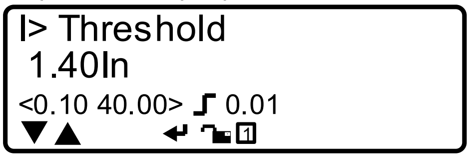
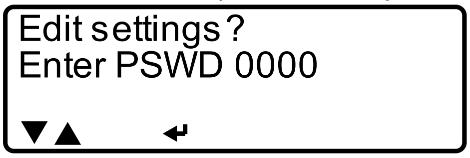
- The protection menu (***SETTING GROUP x***), which contains the essential settings for setting up the protection functions
- The parameters menu (***GLOBAL SETTINGS***), which contains the parameters that can be used to adapt PowerLogic P1F operation to particular applications

Access the Settings with a Password

By default, modification of the PowerLogic P1F protection and parameter settings is accessed by a password. Refer to *Password*, page 162
In this mode (passworded device), P1F will ask automatically about the password if the OK key is pressed in any editable menu cell during a setting operation (edit mode). The password is a 4-digit number. Depends on the level (***Configurator***, ***Operator***, ***User***) passwords are different.
Once the correct code has been entered, modification of the settings is allowed for 10 minutes after the last keystroke. When the user wants to exit from edit mode faster then one can select ***Edit settings?*** cell from menu (***SETTING CHANGE MODE*** column) and press OK key.

Setting a Parameter

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

Step	Action
1	Select the menu cell for the function to be set using the , , or keys. Example: 
2	Press the OK key: • If password protection is not active, the function parameter flashes - the parameter is selected and can be set (edition is possible – edit mode, padlock is open):  • Otherwise, the password entry menu cell is displayed:  and refer to the *Entering the Password* section.
3	Use the , , and keys to scroll through the parameter values until the desired value is displayed.
4	• To confirm the new parameter value, press the OK key: the set parameter value is displayed (not flashing) to indicate that it has been considered by P1F only after exit from setting mode.

Step	Action
	• To abort the current parameter entry, back to step 2 and set again previous value or set.
5	• If the set parameter is completely set, then you can select a new settings (menu cells) using the , , and keys and set as described in step 3.
6	If all required P1F protection and parameter settings are completely set then to confirm all new settings it is necessary exit from setting mode. To exit from setting mode select ***Edit settings?*** cell from menu (***SETTING CHANGE MODE*** column): Edit settings? Exit: Press OK ▼▲ and press OK key.

Setting a Relay Outputs

The procedure for assigning a relay outputs is as follows:

Step	Action
1	Using the , , or keys to select in ***SETTING GROUP x/ OUTPUT RELAYS CONFIGURATION Gx*** signal or signals which to be assigned to the outputs. Example (**E, E+**) Protect 54321 Trip 00000 ▼▲ Digits in first row (54321) means number of relay outputs: 5 – RL 5 4 – RL 4 3 – RL 3 2 – RL 2 1 – RL 1 Digits in second row (00000) means that the signal is assigned to definite relay output or outputs. The high state of the function mapped to the output determines the high state of the output relay. The low state of this function does not change the state of the output relay.
2	Press the OK key: • If password protection is not active, the first digits on the right side in second row flashes (edition is possible – edit mode): Protect 54321 Trip 00000 ▼▲ • Otherwise, the password entry menu cell is displayed: Edit settings? Enter PSWD 0000 ▼▲ and refer to the *Entering the Password* section.

Step	Action
3	Using the △, ▽, ◁ or ▷ keys select output or outputs to assigned definite signal. Digit 0 (in second row) under the relay output number means that signal is not assigned to output. Digit 1 (in second row) under the relay output number means that selected signal is assigned to selected output (for example to RL 1 and RL 4): Protect 54321 Trip 01001 ▼▲ ↵
4	Press the OK key to confirm the new settings for relay outputs: the set parameter value is displayed (not flashing) to indicate that it has been considered by P1F only after exit from setting mode.
5	If the relay outputs is completely set, then you can select a new signals using the △ and ▽ keys and set as described in step 2 and 3.
6	If all required P1F relay outputs are completely set then to confirm all new settings it is necessary exit from setting mode (refer section <u>*Setting a Parameter*</u>).

Setting a Binary Input

The procedure for assigning a binary input is as follows:

Step	Action
1	Using the △, ▽, ◁ or ▷ keys to select in ***SETTING GROUP x/ INPUTS CONFIGURATION Gx*** signal or signals which to be assigned to the binary inputs. Example (**E, E+**) Status 87654321 CB 52A 00000000 ▼▲ ↵ Digits in first row (87654321) means number of binary inputs: 8 – BI 8 7 – BI 7 6 – BI 6 5 – BI 5 4 – BI 4 3 – BI 3 2 – BI 2 1 – BI 1 Digits in second row (00000000) means that the signal is assigned to definite relay input or inputs – 1, or not assigned – 0 .
2	Press the OK key: • If password protection is not active, the first digits on the right side in second row flashes (edition is possible – edit mode): Status 87654321 CB 52A 00000000 ▼▲ ↵ • Otherwise, the password entry menu cell is displayed: Edit settings ? Enter PSWD 0000 ▼▲ ↵ and refer to the <u>*Entering the Password*</u> section.

Step	Action
3	Using the △, ▽, ◁ or ▷ keys select input or inputs to assigned definite signal. Digit 0 (in second row) under the binary input number means that signal is not assigned to input. Digit 1 (in second row) under the binary input number means that selected signal is assigned to selected input (for example to BI 2 and BI 8): Status 87654321 CB 52A 10000010 ▼▲ ↵
4	Press the OK key to confirm the new settings for binary inputs: the set parameter value is displayed (not flashing) to indicate that it has been considered by P1F only after exiting from setting mode.
5	If the binary inputs is completely set, then you can select a new signals using the △ and ▽ keys and set as described in step 2 and 3.
6	If all required P1F binary inputs are completely set then to confirm all new settings it is necessary exit from setting mode (refer section <u>*Setting a Parameter*</u>).

Setting a LED Indicators

The procedure for assigning a LED indicator is as follows:

Step	Action
1	Using the △, ▽, ◁ or ▷ keys to select in ***SETTING GROUP x/ LEDS CONFIGURATION Gx*** signal or signals which to be assigned to the LED indicators. Example: Protect. 765432 Trip 000000 ▼▲ ↵ Digits in first row (765432) means number of LED indicators: 7 – LED 7 6 – LED 6 5 – LED 5 4 – LED 4 3 – LED 3 2 – LED 2 Digits in second row (000000) means that the signal is assigned to definite LED indicator or indicators – 1, or not assigned – 0.
2	Press the OK key: • If password protection is not active, the first digits on the right side in second row flashes (edition is possible – edit mode): Protect. 765432 Trip 000000 ▼▲ ↵ • Otherwise, the password entry menu cell is displayed: Edit settings? Enter PSWD 0000 ▼▲ ↵

Step	Action
	and refer to the *Entering the Password* section.
3	Using the , , or keys select LED or LEDs to assigned definite signal. Digit 0 (in second row) under the LED indicator number means that signal is not assigned to this LED. Digit 1 (in second row) under the LED indicator number means that selected signal is assigned to selected LED (for example to LED 5 and LED 7): Protect. 765432 Trip 101000
4	Press the OK key to confirm the new settings for LED indicators: the set parameter value is displayed (not flashing) to indicate that it has been considered by P1F only after exit from setting mode.
5	If the LED indicator is completely set, then you can select a new signal using the and keys and set as described in step 2 and 3.
6	If all required P1F LED indicators are completely set then to confirm all new settings it is necessary exit from setting mode (refer section *Setting a Parameter*).

NOTE: Trip LED is fixed.

Entering a Password to Authorize a Setting

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

Step	Action
1	The password entry screen is displayed and the first from the right digit (0) flashes: Edit settings? Enter PSWD 0000
2	Use the , , and keys to scroll through the digits from 0 to 9 and select correct password.
3	Once the password has been entered: • If the password is correct: the current setting menu cell is displayed again. It is then possible to modify the protection and parameter settings. • If the password is incorrect: the message ***Protected*** is displayed and this means that no protection and parameter settings can be change. Setting change: Protected

Lost Password

If you lost the password, read the serial number on the PowerLogic P1F label and contact your local Schneider Electric after-sales service.

NOTICE
Please take care of your modified new password, reseting password may cause some inconvenience or extra cost.

Method for Resetting the Thermal Image

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

Step	Action
1	Select in ***MEASUREMENT*** column in main menu following menu cell: Thermal: 89% 0:No operation
2	Press the OK key: • If password protection is not active, the possibility of reset function flashes Thermal: 89% 0:No operation • Otherwise, the password entry menu cell is displayed. Refer to the *Entering the Password* section.
3	Use the key to select reset function of thermal image: Thermal: 89% 1:Reset
4	Press the OK key to confirm thermal image reset.
5	Exit from the setting mode.

More information about possibility to reset thermal image can be found in *Thermal Overload Protection (ANSI 49)* section, page 144.

Password Protection

More details are described in Password subchapter in Function and Parameters chapter (see on page 162).

USB Communication Port

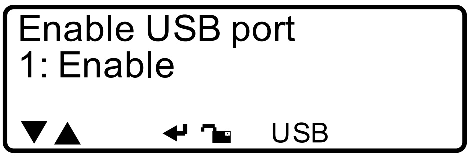
Introduction

Mini-USB type B front port is dedicated to local connection with eSetup Easergy Pro setting and operating software tool for configuring PowerLogic P1 devices. By default, port is disabled.

NOTICE
USB communication port is dedicated to set the relay; extract settings, event, disturbance recorder files. USB port is not dedicated to energizing the device.

Operation

After downloading the FW, the USB port is **enabled** and keep enabled. When USB communication is active then on LCD following pictogram is displayed:



The USB port will not be disabled automatically.

It is possible to disable a USB communication port from the local panel of PowerLogic P1 protection relay only. To disable USB communication port qualified personnel must be logged in to the relay from the Configurator level. The modification of USB communication port parameters does not require saving of all settings – exit from edit mode (warm restart).

It is not possible to enable USB communication port by rear RS485 communication port.

Setting

Settings for the COMMUNICATION USB port can be found in ***GLOBAL SETTINGS/ COMMUNICATION USB*** menu:

Available Setting	Authorized Values	Default Setting
Enable USB Port	0: Disable 1: Enable	Enable
Protocol	0: Modbus S1 1: IEC-103 2: Modbus Std 3: GetSet	GetSet
Baud Rate	0: 4800 1: 9600 2: 19200 3: 38400 4: 57600 5: 115200 6: 187500	115200
Parity	0: No parity 1: Odd parity 2: Even parity	No parity
Stop Bits	0: 1 stop bit 1: 2 stop bits	1 stop bit

GetSet protocol is dedicated to communication PowerLogic P1 with eSetup Easergy Pro. Recommended USB parameters to communication with eSetup Easergy Pro are presented below:

Setting	**Recommended Setting**
Enable USB Port	Enable
Protocol	GetSet
Baud Rate	115200
Parity	No parity
Stop Bits	1 stop bit

RS485 Communication Port

Introduction

RS485 rear port is dedicated to connection with SCADA system. By default port is disabled.

It is possible to enable a communication port from the local panel of PowerLogic P1 protection relay or from eSetup Easergy Pro with the CONFIGURATOR access right (COMMUNICATION/Communication RS485 – see below).

Figure 23. eSetup Easergy Pro Communication RS485 window

Setting

Settings for the COMMUNICATION USB port can be found in ***GLOBAL SETTINGS/ COMMUNICATION RS485*** menu:

Available Setting	Authorized Values	Default Setting
Enable USB Port	0: Disable 1: Enable	Disable
Protocol	0: Modbus S1 1: IEC-103 2: Modbus Std 3: GetSet 4: Modbus PO	Modbus S1
Relay Address RS485	1-247 (Step 1)	247
Baud Rate	0: 4800 1: 9600 2: 19200 3: 38400 4: 57600 5: 115200	115200
Parity	0: No parity 1: Odd parity 2: Even parity	No parity
Stop Bits	0: 1 stop bit 1: 2 stop bits	1 stop bit

First Steps with eSetup Easergy Pro

Overview

eSetup Easergy Pro is a setting and operating software tool for configuring PowerLogic P1 devices, local operation and customization functions. The eSetup Easergy Pro software is supplied directly through the Schneider – Electric website www.schneider-electric.com, along with the eSetup Easergy Pro program for recovering disturbance recording files, and all the PowerLogic P1 documentation in PDF format.

Figure 24. eSetup Easergy Pro menu bar and tool bar

The eSetup Easergy Pro software has a graphical interface where the protection relay settings and parameters are grouped under nine menu tabs:

- General
- Measurements
- Control
- Protection
- Matrix
- Logs
- Communication

The contents of the tabs depend on the device type and the selected application mode. Refer to the User Manual of eSetup Easergy Pro for detailed information on the setting views of each menu.

The eSetup Easergy Pro stores the device configuration in a setting file. The configuration of one physical device is saved in one setting file. The configurations can be printed out and saved for later use.

When starting to work with eSetup Easergy Pro, you have three options:

- Create a new setting file without connecting to a protection relay
- Open an existing (previously saved) setting file without connecting to a

protection relay

- Connect to a relay and read the settings from the protection relay.

eSetup Easergy Pro can be connected to a single relay via the USB port in the protection relays front panel or via RS485 in the protection relays rear port.

Operation Modes

The eSetup Easergy Pro software can be used in three operation modes:

- Disconnected mode
- Single unit connecting mode
- Network connecting mode

Using eSetup Easergy Pro in disconnected mode

The disconnected mode allows you to prepare parameters and settings files for PowerLogic P1 prior to commissioning.

The parameter and protection setting files prepared in disconnected mode will be downloaded later to the PowerLogic P1 protection relays in connected mode.

In Disconnected mode, the user can create a setting file from scratch, or open a previously saved setting file as a basis for creating configuration for a protection relay of the same type. Refer to the User Manual of eSetup Easergy Pro for more information.

Using eSetup Easergy Pro connected to a single PowerLogic P1

The single connection mode is used during commissioning of an PowerLogic P1 protection relay:

- To upload, download or modify PowerLogic P1 parameters and settings.

  Refer to the User Manual of eSetup Easergy Pro for more information on uploading (writing)/downloading (reading) setting files to/from the connected protection relays.

NOTICE

After writing new settings, configurations or firmware to a protection relay, perform a test to verify that the protection relay operates correctly with the new settings.

Failure to follow these instructions can result in unwanted shutdown of the electrical installation.

- To have all the measurements and supporting data available for commissioning.

The PC fitted with the eSetup Easergy Pro software is connected to the USB port on the front panel of the PowerLogic P1 using a USB cord.

Cable Type: USB 2.0:

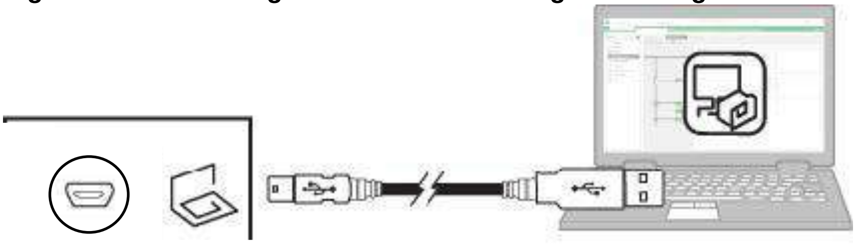
- Connectors:

  PC: type A male

  P1F: type mini B 5-pin male

- USB Cable: minimum 1P*28AWG/2C*24AWG, max: 2m

Figure 25. Connecting a PC to the PowerLogic P1 using a USB cable



Using eSetup Easergy Pro connected to an PowerLogic P1 network

The network connection mode is used during operation:

- To manage the protection system.
- To check the status of the power supply.
- To diagnose any incident occurring on the power supply.

The PC fitted with the eSetup Easergy Pro software is connected to a group of PowerLogic P1 units via a communication network (connection via serial link).

The connection window allows configuration of the PowerLogic P1 network, and provides access to the parameter and protection setting files of the PowerLogic P1 units on the network.

Connecting to a single protection relay using USB cable

1. Install the USB driver from the eSetup Easergy Pro file package (location: Drivers/P3 – for the PowerLogic P1 is the same driver as PowerLogic P3) for the first time connecting the PowerLogic P1 protection relay to a PC running eSetup Easergy Pro

2. Connect the USB cable between the PC running eSetup Easergy Pro and the local port of the PowerLogic P1 protection relay, with the mini-USB type B connector of the cable plugged into the protection relay and the type A connector to the PC.

3. On the eSetup Easergy Pro toolbar, click the ON connection button. The Login pop-up window opens.

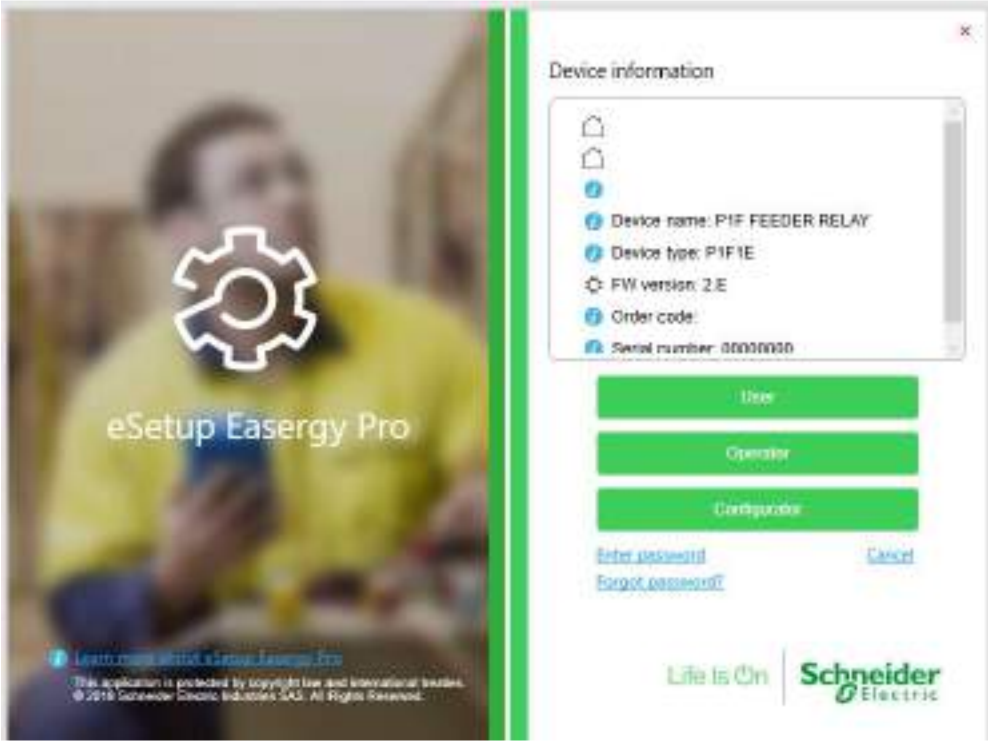
Figure 26. The connection buttons on the tool bar

4. Select the right USB serial port and connection speed.

Figure 27. Connect window in the eSetup Easergy Pro

5. Click Connect.
   A new window showing the relay information opens.

Figure 28. Window of access level selection in the eSetup Easergy Pro



6. Enter the user name and password to login.

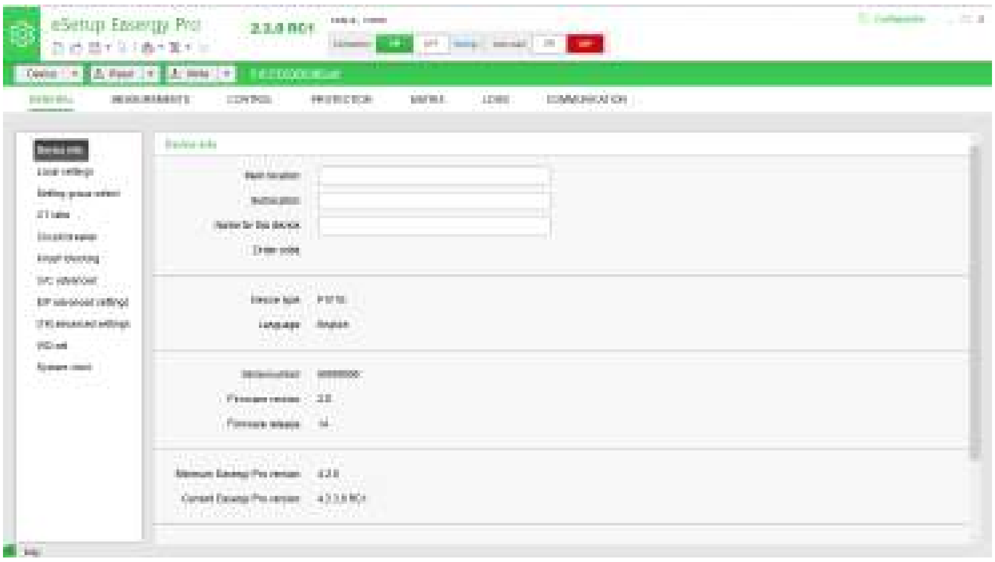
Figure 29. Main menu window in the eSetup Easergy Pro

Name of the login for each levels are given in below table.

Level	**Login**
Configurator	conf
Operator	oper
User	user

7. eSetup Easergy Pro’s main view opens.

Figure 30. Main menu window in the eSetup Easergy Pro



NOTE: If you connect for the first time to a device on which the default users and passwords are used, see Password subchapter in Function and Parameters chapter, page 162.

Menu Map

The menu content depends on the PowerLogic P1F model. Binary inputs and relay outputs menu cells content maximum number of binary inputs and relay outputs which are different depends on the model. For example, for model A in relay outputs menu cells is displayed 7 relay outputs (maximum), and for model E (or E+) 5 relay outputs only.

	Binary inputs	Relay Outputs
Model L	0	3+WD
Model N	0	5+WD
Model B	4	3+WD
Model A	4	7+WD
Model E	8	5+WD
Model E+	8	5+WD

Figure 31. Menu map main menu

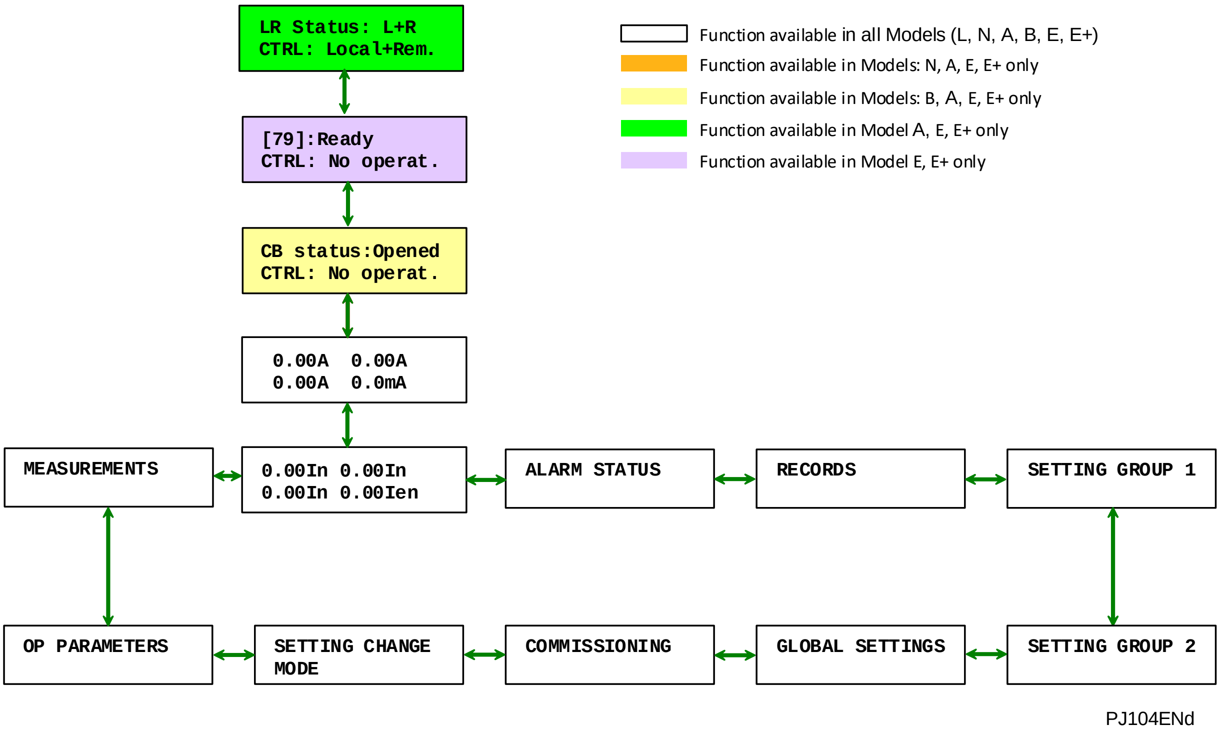


Figure 32. Menu map submenu part 1

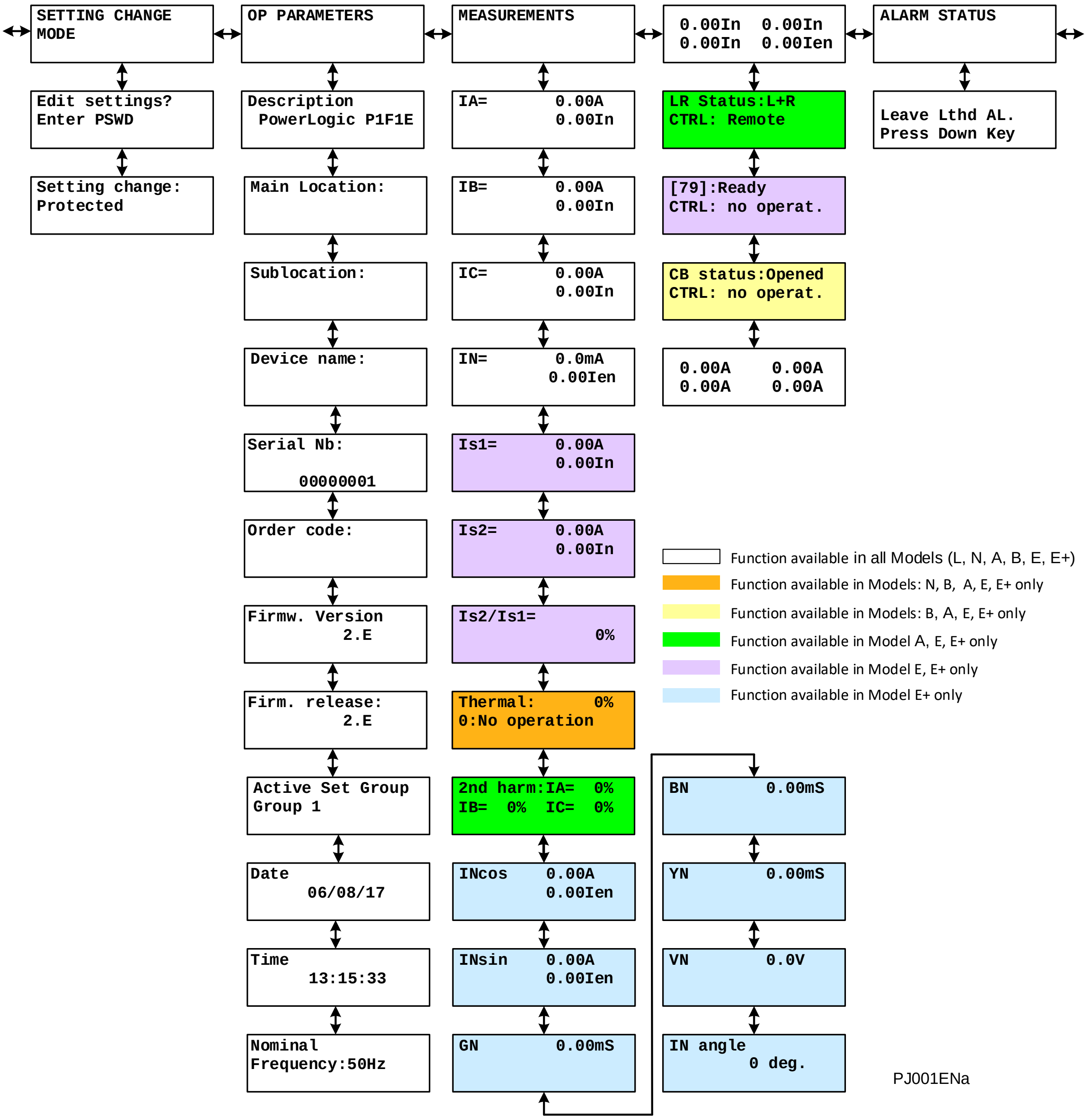


Figure 33. Menu map submenu part 2

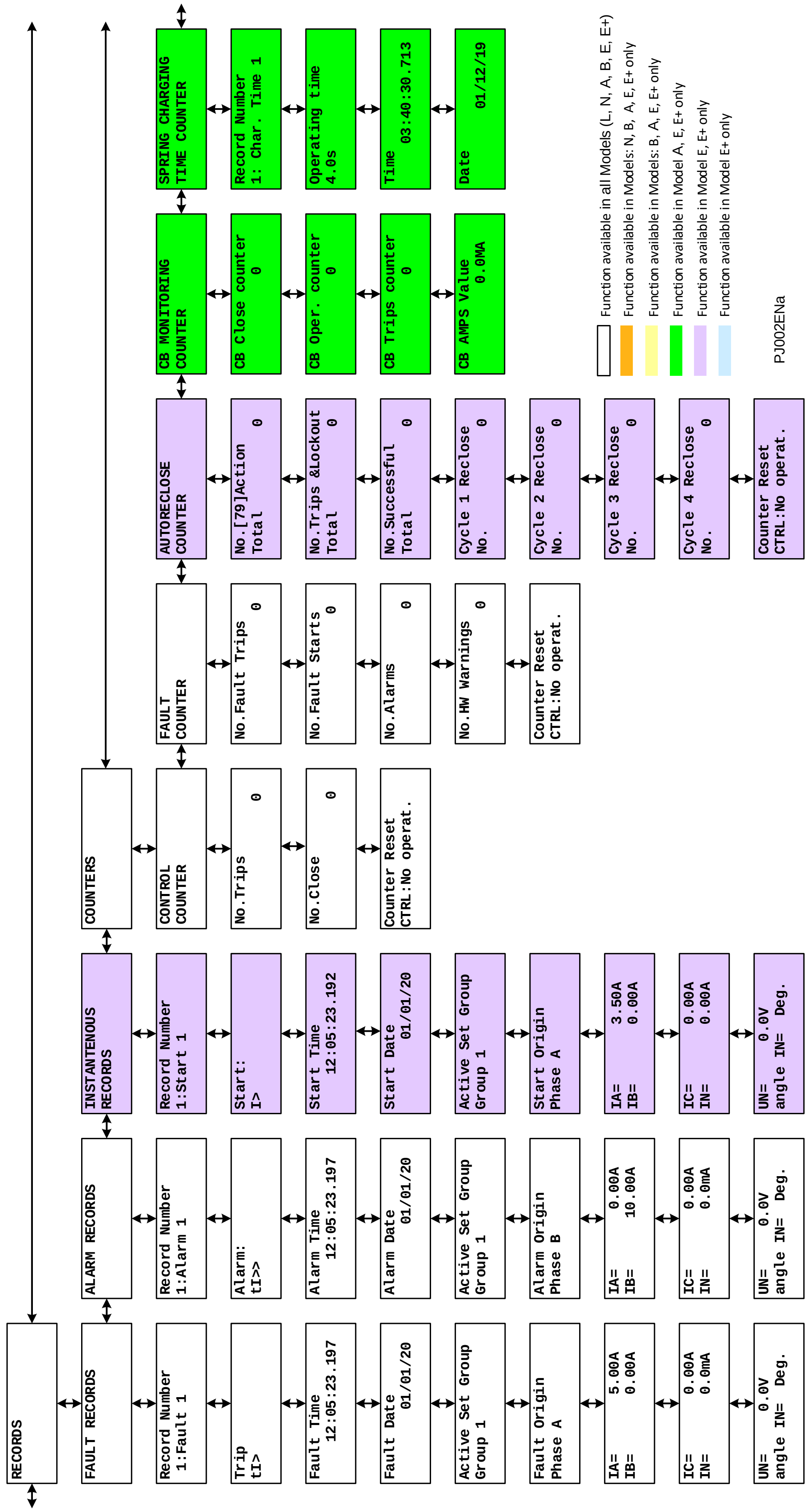


Figure 34. Menu map submenu part 3

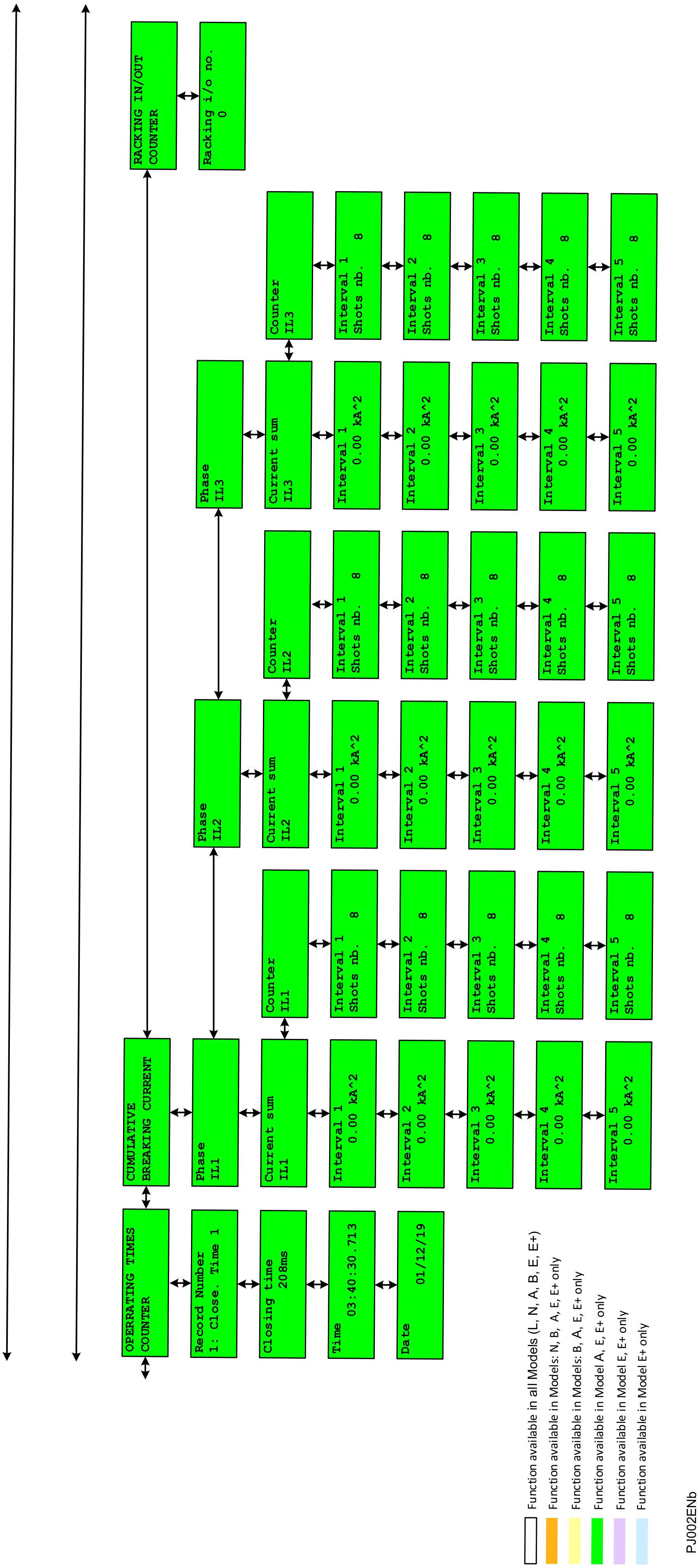


Figure 35. Menu map submenu part 4

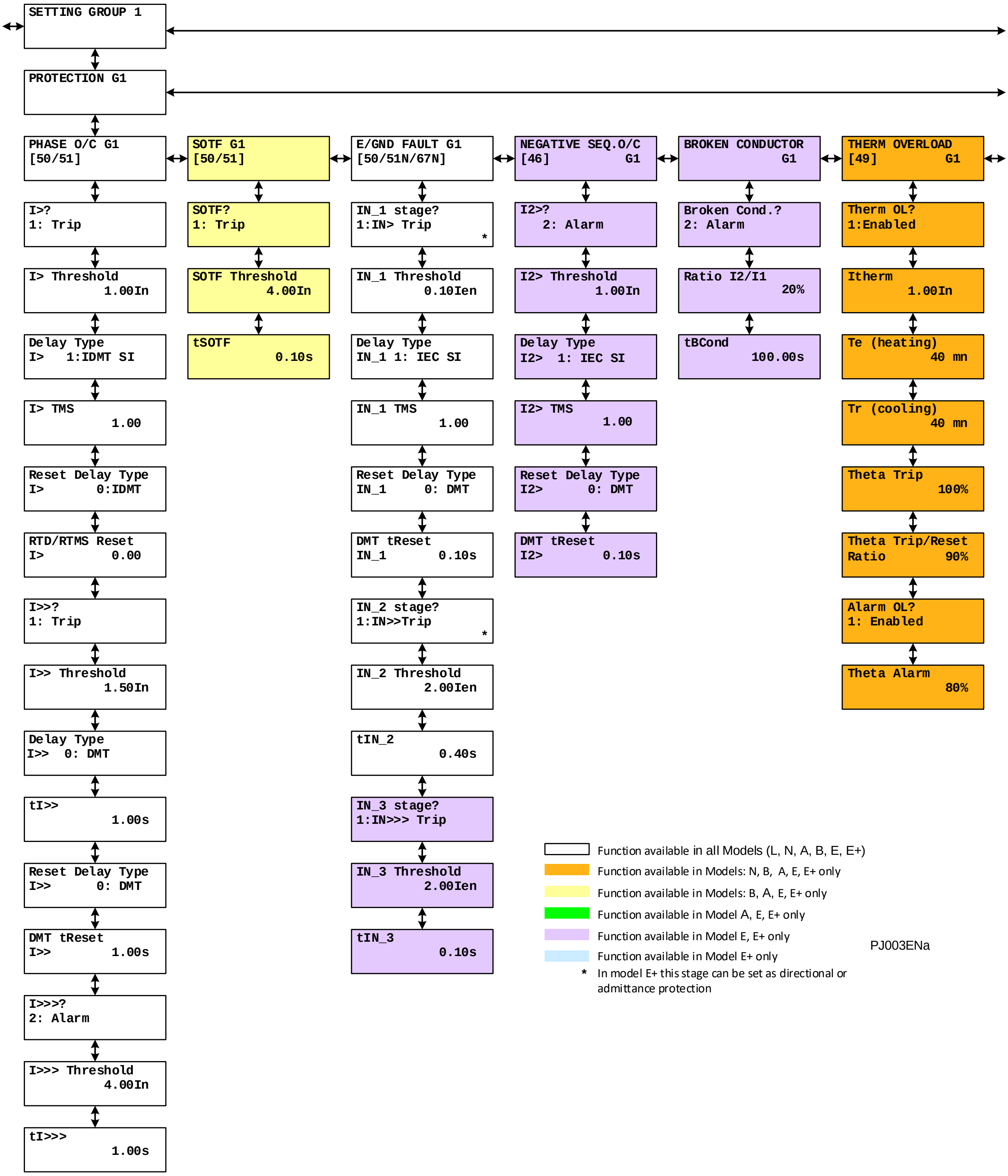


Figure 36. Menu map submenu part 5

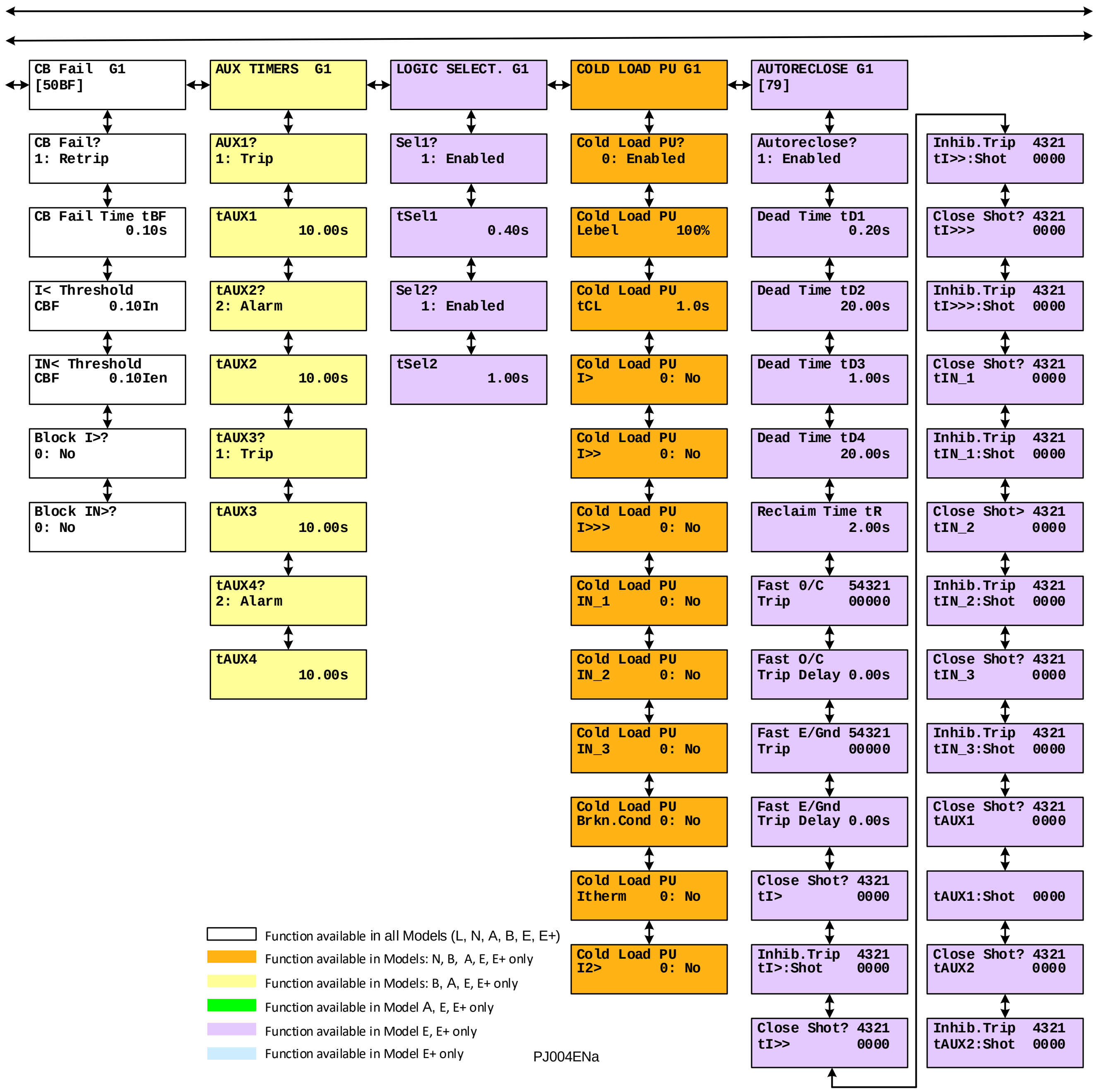


Figure 37. Menu map submenu part 6

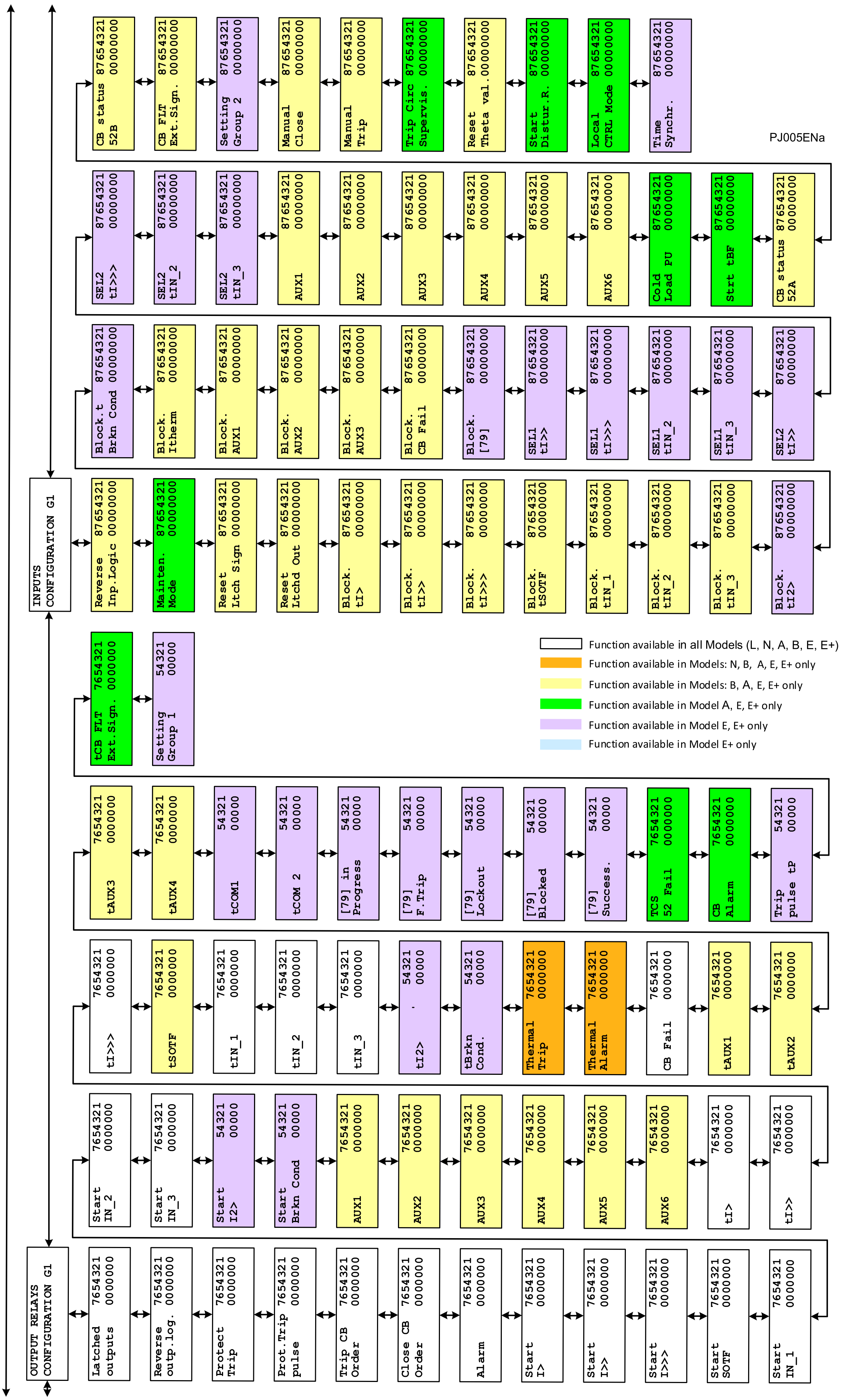


Figure 38. Menu map submenu part 7

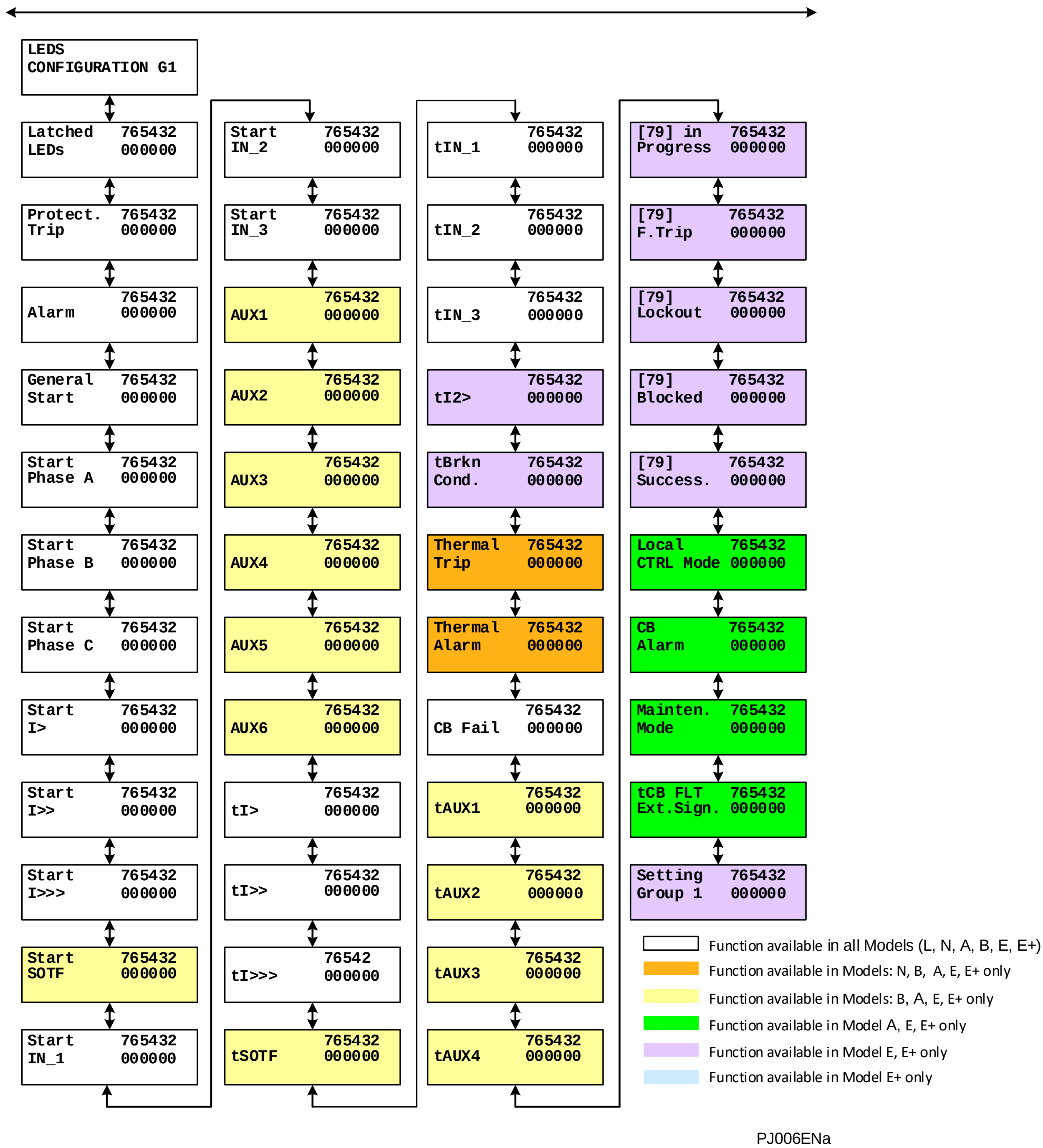


Figure 39. Menu map submenu part 8

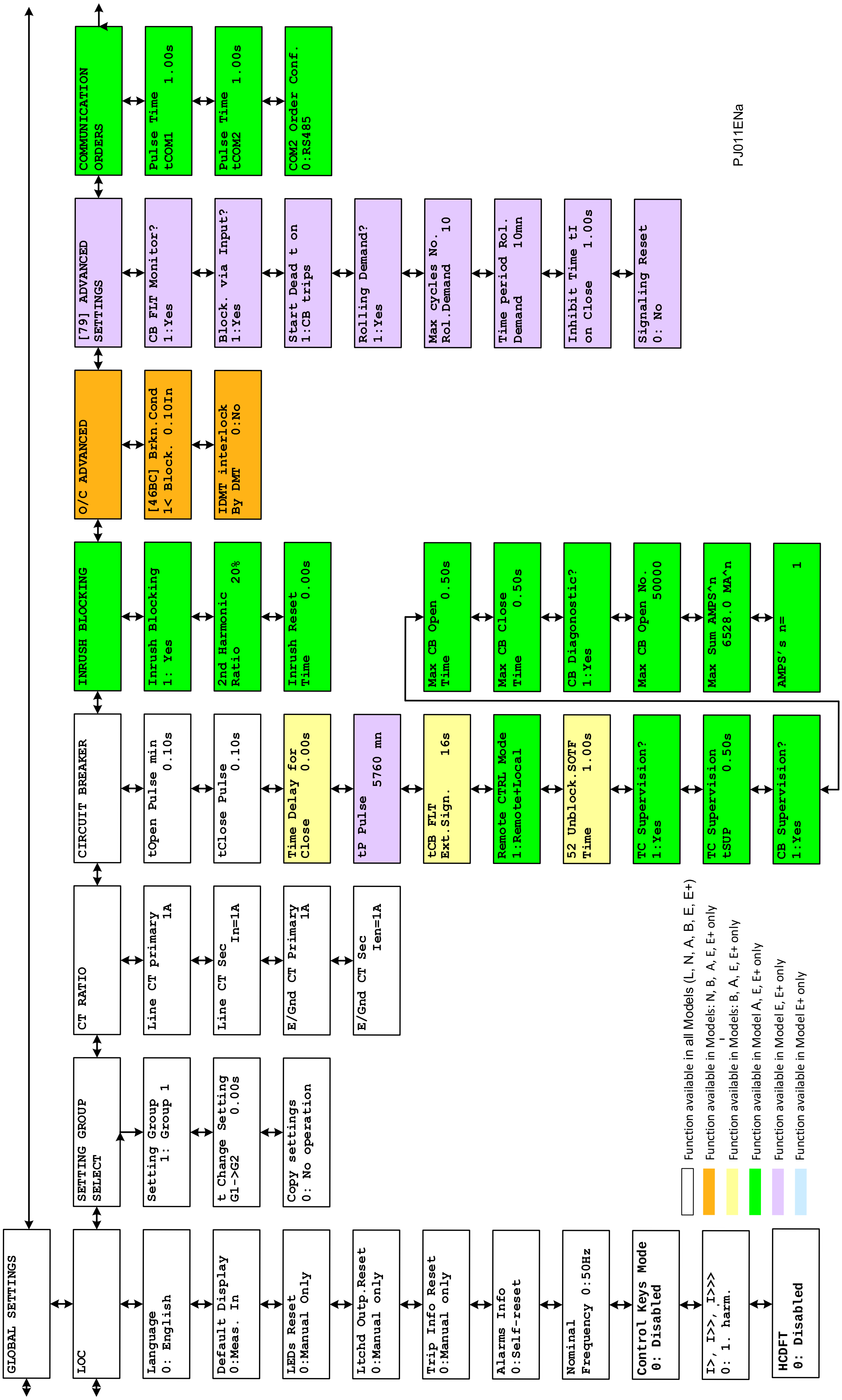
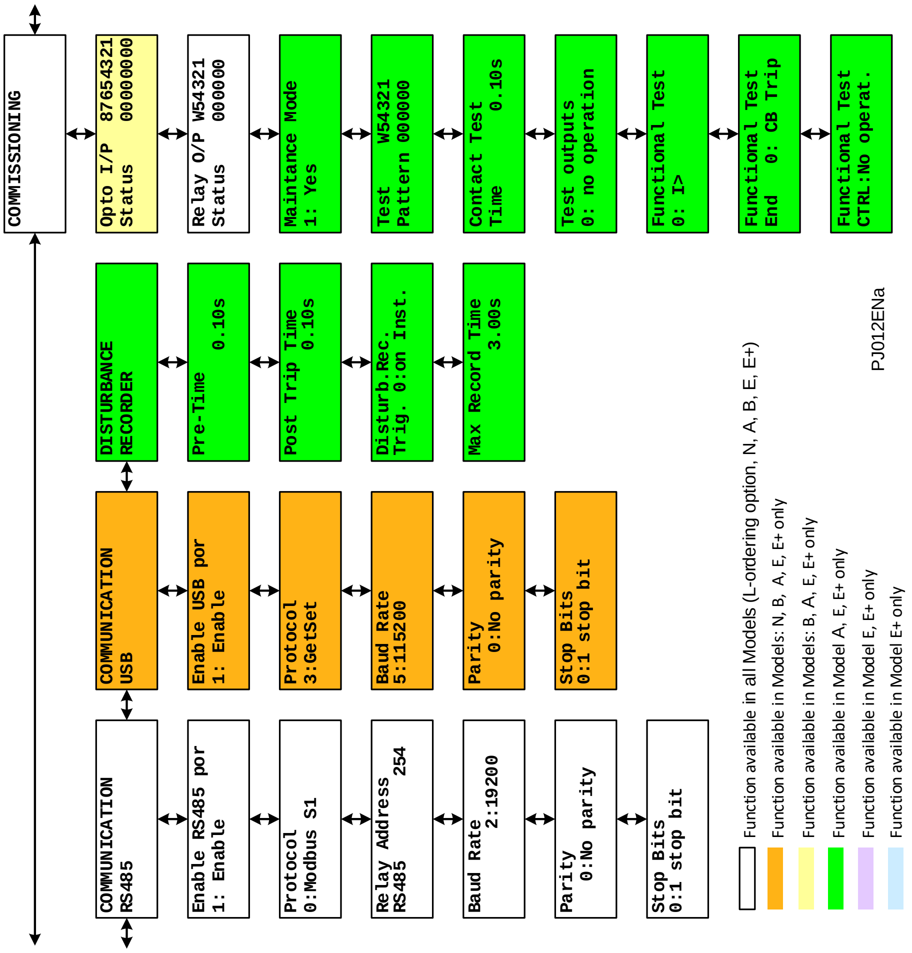


Figure 40. Menu map submenu part 9



Communication with Power Operation

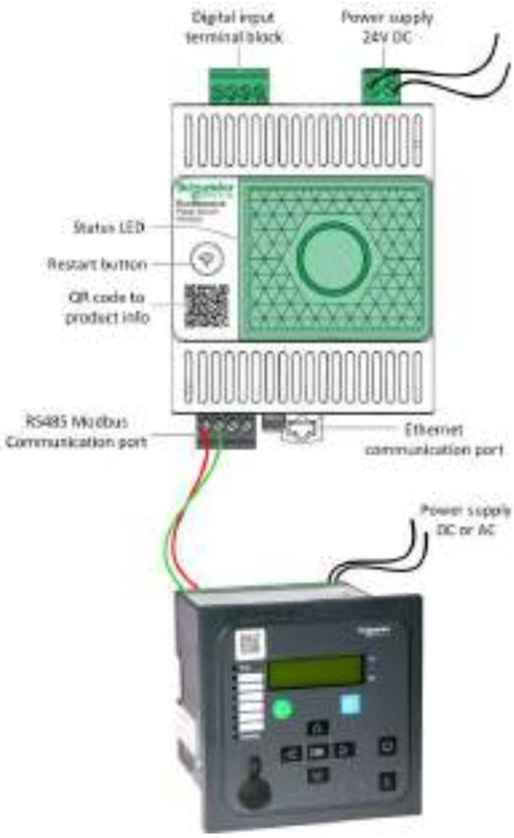
Introduction

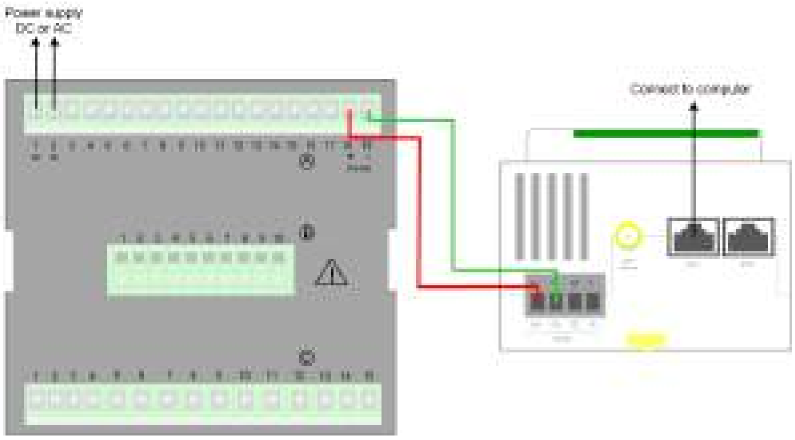
EcoStruxure Power Operation is an advanced, cybersecure power management software platform engineered for electro-intensive and mission-critical facilities that require secure, dedicated, power automation, power monitoring, and power events analysis. Refer to Power Operation System Guide for detailed introduction.

Connect with EcoStruxure Panel Server

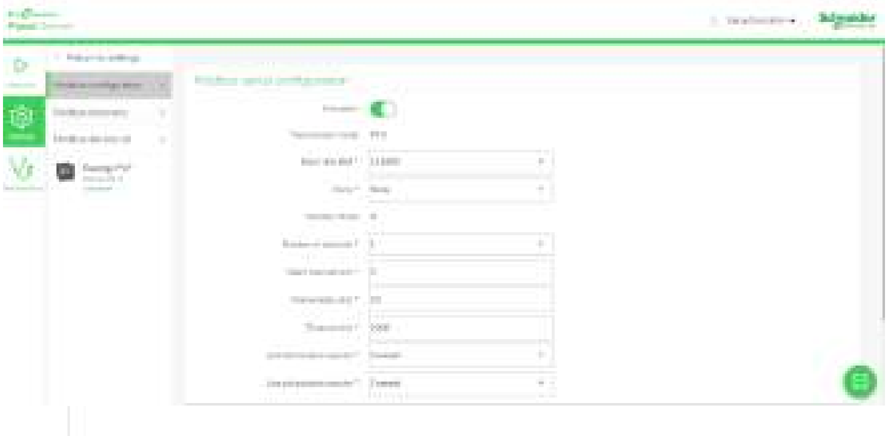
1) Connect P1F device with EcoStructure Panel Server.

   Refer to EcoStruxure Panel Server for the Gateway introduction. Connection diagram as below.





2) Configure connection to EcoStructure Panel Server via IP address on local computer:



3) Open Power Operation connection from P1F via Easergy Pro or HMI:

GLOBAL SETTINGS -> COMMUNICATION RS485

Enable RS485 port:	***Enable***
Protocol:	***Modbus PO***

Functions and Parameters

Phase CT Ratio

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

The phase CT ratio can be accessed in the protection menu and must always be set at the time of commissioning. It is used by all PowerLogic P1 functions which deal with the current.

NOTE: Good practice is to set this ratio before implementing the protection settings.

The parameter to be set is:

- Phase CT ratio setting (***GLOBALSETTINGS/CT RATIO*** menu cell).

Settings

Settings for the primary and secondary current can be found in ***GLOBALSETTINGS/ CT RATIO*** menu:

Available Setting	Authorized Values	Default Setting
Line CT Primary	1…30 kA (step: 1.0)	1 A
Line CT Sec	1 or 5 A (step: N/A)	1 A

Earth CT Ratio or Core Balance CT Rating

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

The earth CT ratio (or core balance CT rating) can be accessed in the protection menu and must always be set at the time of commissioning. It is used by all PowerLogic P1 functions which deal with the earth fault current.

NOTE: Good practice is to set this ratio before implementing the protection settings.

Example of PowerLogic P1 Relays for Standard or Sensitive Earth Fault Protection

The PowerLogic P1 relays concerned are:

- PowerLogic P1F (0,05-12)Ion -•1• (standard earth fault protection)
- PowerLogic P1F (0,01-2)Ion - •2• (sensitive earth fault protection)

These PowerLogic P1 relays can be connected to a dedicated earth CT (core balance current transformer) or to the common point of the 3 phase CTs (residual current).

The parameter to be set is:

- Earth CT ratio (***GLOBAL SETTINGS/CT RATIO E/Gnd CT Primary*** and ***E/Gnd CT Sec*** screens)

If connected to the common point of the 3 phase CTs, this parameter must be set to the same value as the phase CT ratio.

Example of PowerLogic P1 Relays for Sensitive Earth Fault Protection

The PowerLogic P1 relays concerned are PowerLogic P1F – 2 (sensitive earth fault protection). This type of PowerLogic P1 is designed to be connected to a core balance current transformer (e.g. CSH120).

- For CSH core balance current transformer (CT ratio 470A / 1A) measuring range for primary side is from 4,7A to 940A.
- For CSH core balance current transformer is recommended to use sensitive earth fault (0.01-2)Ion measuring range. Very sensitive range compatible with CSH please contact us to availability.
- For another core balance current transformer (CT ratio 100A / 1A) measuring range for primary side is from 1A to 200A.

Settings

Settings for the primary and secondary current can be found in ***GLOBALSETTINGS/ CT RATIO*** menu:

Available Setting	Authorized Values	Default Setting
E/Gnd CT Primary	1…30 kA (step: 1.0)	1 A
E/Gnd CT Sec	1… 5 A (step: N/A)	1 A

Network Frequency

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

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 PowerLogic P1F functions which deal with the phase current and the earth fault current.

PowerLogic P1F uses this parameter to adapt operation of the measurement 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.

Settings

*Settings for the network frequency selection can be found in **GLOBALSETTINGS/ LOC/Nominal Frequency*** menu:

Available Setting	Authorized Values	Default Setting
Nominal Frequency	50 or 60 Hz (step: N/A)	50 Hz

Phase Overcurrent (ANSI 50-51)

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

The overcurrent protection included in the PowerLogic P1F relays provides three-stage, non-directional overcurrent protection with independent time-delay characteristics. All overcurrent settings apply to all three phases but are independent for each of the three stages.

Each protection stage can be selected to Trip the CB or to issue a signal (Alarm) only.

If an overcurrent protection stage (I**>?**, I**>>?** Or I**>>>?** Menu) is set to ***Trip***, ***Trip-Inrush Bl*** (**applicable for model A, E, E+**), ***Trip-Latch*** (**A, E, E+**), ***Trip-Phase A*** (**A, E, E+**), ***Trip-Phase B*** (**A, E, E+**) or ***Trip-Phase C*** (**A, E, E+**) it means that stage is linked to the ***Protect.Trip*** and ***Prot.Trip pulse*** functions (see Setting a LED indicators and Setting a Relay Output in chapter Use).

If an overcurrent protection stage (I**>?**, I**>>?** Or I**>>>?** Menu) is set to ***Alarm***, it means that that stage is linked to the ***Alarm*** function (see Setting a LED indicators and Setting a Relay Output in chapter Use).

If ***Trip-Inrush Bl*** is selected, the overcurrent stage is blocked via the ***Inrush Blocking*** function (refer to *Inrush Blocking section*).

If ***Trip-Latch*** is selected, the overcurrent stage will remain high after a trip, until it is reset via a binary input, the HMI or a remote RESET command.

If ***Trip-Phase A*** is selected, the overcurrent stage is compared with the current in phase A only (tripping is based on phase A measurement only; the rest phases: B and C are ignored).

If ***Trip-Phase B*** is selected, the overcurrent stage is compared with the current in phase B only (tripping is based on phase B measurement only, the rest phases: A and C are ignored).

If ***Trip-Phase C*** is selected, the overcurrent stage is compared with the current in phase C only (tripping is based on phase C measurement only, the rest phases: A and B are ignored).

Phase overcurrent protection in PowerLogic P1 series is used to detect overcurrents due to phase-to-phase faults. It uses the measurements of the fundamental component of the currents produced by 2 or 3 phase CTs, with 1 A or 5 A secondary rating.

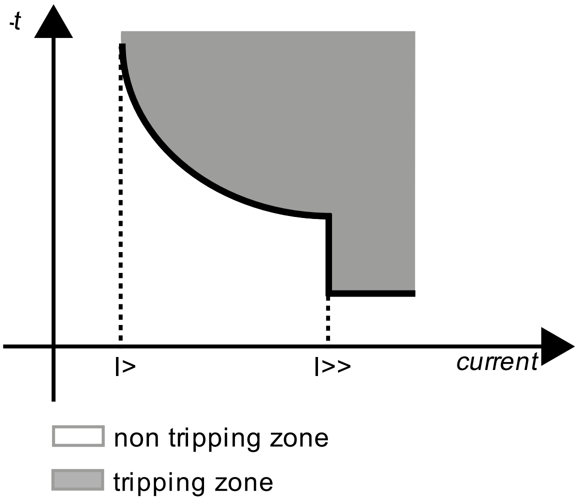
3 independent stages (I>, I>> and I>>>) can be set to offer optimal discrimination:
- The first two stages (I> and I>>) have either a definite time (DMT) or inverse definite minimum time (IDMT) setting with different types of standardized curve (IEC, IEEE, RI).
- The third stage (I>>>) only has a definite time (DMT) setting. The minimum setting can be used to obtain instantaneous operation (ANSI 50 function).

These stages can be used:
- In all cases, to detect phase-to-phase ground faults with 1 or 2 stages 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> stage with an IDMT curve (see example 2).

Example 1: Example of typical application: Protection curve with a first IDMT I> stage and a second DMT I>> stage

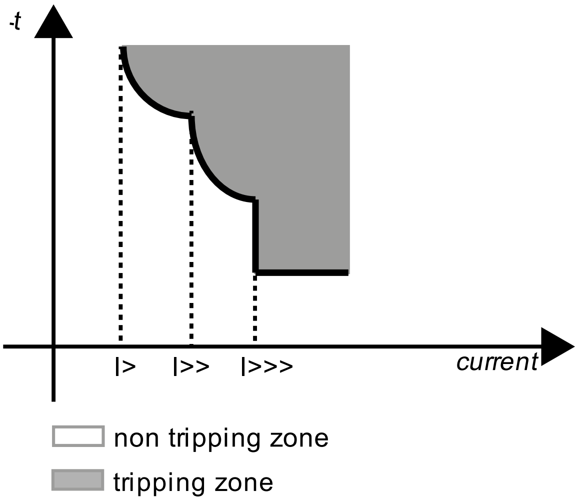
Figure 1. Tripping curve for example 1



Example 2: Example of application with current limiting:

- Limiting curve with a first IDMT I> stage 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>> stage and the third DMT I>>> stage

Figure 2. Tripping curve for example 2



Additional Functions

Reset IDMT Characteristic (IEEE/US/IEC)

The first two stages of the overcurrent protection in the PowerLogic P1F relays are provided with a timer hold facility, which may either be set to zero or to a definite time value. Setting of the timer to zero means that the overcurrent timer for that stage will reset instantaneously once the current falls below 95% of the current setting. Setting of the hold timer to a value other than zero, delays the resetting of the protection element timers for this period. When the reset time of the overcurrent relay is instantaneous, the relay will be repeatedly reset and not be able to trip until the fault becomes permanent. By using the Timer Hold facility the relay will integrate the fault current pulses, thereby reducing fault clearance time.

The timer hold facility can be found for the first and second overcurrent stages as settings ***DMT tReset I> (***and ***RTD/RTMS Reset I>)*** and ***DMT tReset I>> (***and ***RTD/RTMS Reset I>>)***, respectively.

The IEEE/US/IEC curves may have an inverse time reset characteristic (***I>*** (***I>>)*** ***Reset Delay Type 1: IDMT*** setting) or instantaneous reset (***I>*** (***I>>***) ***Reset Delay Type 0: DMT*** setting). If IDMT reset is selected (***I>*** (***I>>***) ***Reset Delay Type 1: IDMT*** setting) then the following menu will be available: ***I>*** (***I>>***) ***RTD/RTMS RESET***.

For more details and equations that can be used to calculate the inverse reset time for IEEE/US/IEC curves refer to: *Overcurrent Protection Tripping Curves*, page 129.

Cold Load Pick-up

This feature allows selected settings of PowerLogic P1F relays to be changed to react to temporary overload conditions that may occur during cold starts. This condition may happen by switching on large heating loads after a sufficient cooling period, or loads that draw high initial starting currents.

When a feeder is energized, the current levels that flow for a period of time following energizing may differ greatly from the normal load levels. Consequently, overcurrent settings that have been applied to give short circuit protection may not be suitable during this period.

This function acts upon the following protection functions:

- Phase overcurrent (I>, I>> and I>>> stages (**L, N, B, A, E, E+**))
- Earth fault (IN_1>, and IN_2> stages (**L, N, B, A, E, E+**))
- Earth fault (IN_3 stage (**E, E+**))
- Broken Conductor I2/I1 element (**E, E+**)
- Thermal Overload I_{therm} setting (**N, B, A, E, E+**)
- Negative sequence overcurrent (**E, E+**)

For more information on **Cold Load Pick-up** refer to: *Cold Load Pick-up*, page 139.

SOTF: Switch On To Fault (B, A, E, E+)

In some feeder applications, fast tripping may be required if a fault is still present on the feeder after the reclosure of the circuit breaker (Close on to fault).

In the case of a CB being manually closed, a switch on to an existing fault may occur. This situation is particularly critical because the overcurrent protection element would not clear the fault until the set time-delay has elapsed. It is then desirable to clear the fault as fast as possible.

Enabling and setting the SOTF (Switch On To Fault) function can be done under the ***SETTING GROUP x/PROTECTION Gx/SOTF?*** Submenu.

Crossing the SOTF Threshold will initiate the SOTF function. The ***tSOTF*** time-delay will then be started. If the SOTF element is set to ***Trip***, **Trip-Inrush Bl** (**A, E, E+**) or ***Trip-Latch*** (**A, E, E+**), it means that it is linked to the ***Protect. Trip*** and ***Prot. Trip pulse*** functions (see Setting a LED indicators and Setting a Relay Output in chapter Use).

If the ***SOTF*** element is set to ***Alarm***, it means that it is linked to the ***Alarm*** function (see Setting a LED indicators and Setting a Relay Output in chapter Use).

If **Trip-Inrush Bl** (**A, E, E+**) is selected, the SOTF element is blocked via the ***Inrush Blocking*** function (refer to *Inrush Blocking section*, page 141).

If ***Trip-Latch*** (**A, E, E+**) is selected, the SOTF element will remain high after a trip, until it is reset

For more information on **SOTF** refer to *Switch-On-To-Fault*, page 181.

Inrush Blocking (**A, E, E+**)

The Inrush Blocking function measures the ratio of second to fundamental harmonic currents. It can be used as a "blocking logic" of I>, I>>, I>>>, IN_1, IN_2, (**A, E, E+**) IN_3 (**E, E+**), I2> (**E, E+**), SOTF (**A, E, E+**), Broken Cond (**E, E+**), CB Fail (**A, E, E+**), and AUXn (**A, E, E+**) in cases where the 2nd harmonic ratio is higher than the settable threshold. Indeed, inrush blocking functions will reset the selected protection function starts.

Blocked by the second harmonic ratio of a protection element is set in the main setting cell for that element (for example***: I>? 3: Trip-Inrush Bl***). Each protection element set to ***3: Trip-Inrush Bl*** will be blocked by the Inrush current function.

The minimum duration of an overcurrent threshold inhibition (tReset) can be also set (***GLOBAL SETTINGS/INRUSH BLOCKING/Inrush Reset Time***). This value depends on the transformer power transient inrush duration: between 0.1 second (for a 100 kVA transformer) to 1.0 second (for a large unit). It is used to avoid any maloperation during a fixed time period in case of too sensitive a setting.

Logic Selectivity (E, E+)

In the case of ***Logic Selectivity*** (Sel), the start contacts are used to raise the time-delays of upstream relays, instead of blocking them. This provides an alternative approach to achieving non-cascade types of overcurrent scheme. This may be more familiar to some utilities than the blocked overcurrent arrangement. The ***Logic Selectivity*** function provides the ability to temporarily increase the time-delay settings of the second and third stages of phase overcurrent and measured earth fault protection elements.

Two independent Logic Selectivity functions are available: ***Sel1*** and/or ***Sel2****.*

This logic is initiated by energization of the appropriate binary input assigned to Sel1 (Sel2).

To allow time for a start contact to initiate a change of setting, the time settings of the second and third stages should include a nominal delay.

For more information see *Logic Selectivity*, page 302.

Logic Discrimination (B, A, E, E+)

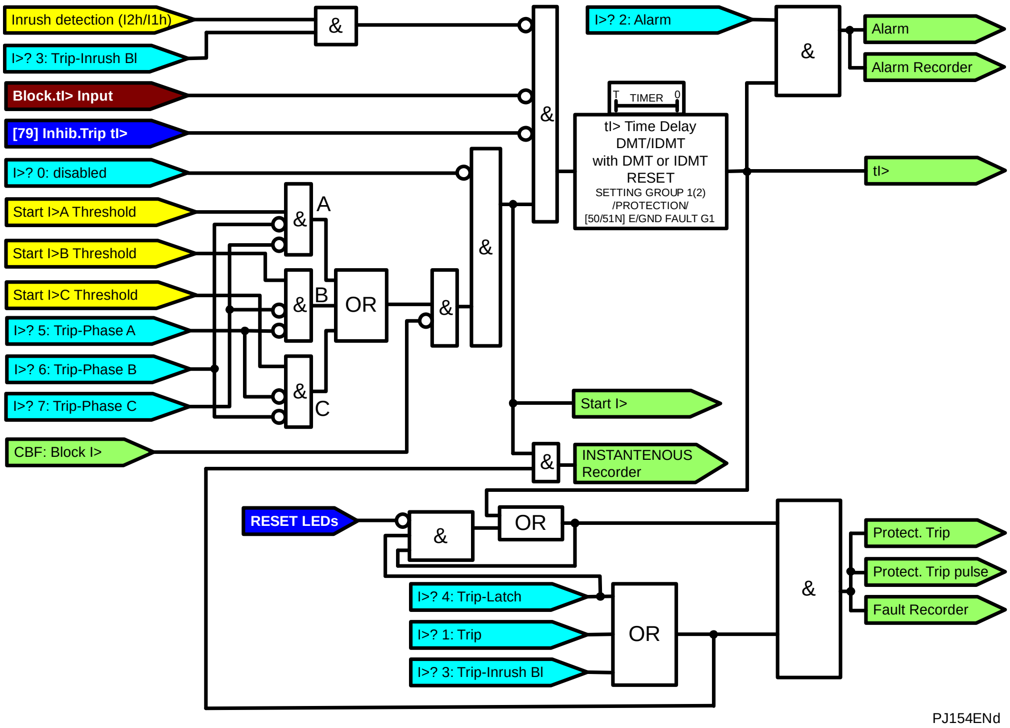
Each stage of the phase protection element can be blocked via an appropriately configured binary input. Binary inputs can be assigned to various functions (for the list of available functions refer to *Connecting Binary Inputs and Outputs Relays*, page 37). Such a configured input can be used by the blocking logic function or by a protection element disabling function (Auto-reclose (**E, E+**), CB Fail or AUX (**B, A, E, E+**)).

For more information see *Logic Discrimination*, page 152.

Block Diagram

Phase Overcurrent protection logic diagram is shown below:

Figure 3. Operating principles diagram for phase overcurrent protection



Additional Functions

By default, this function is off.

Settings

Phase O/C [50/51]

The overcurrent protection included in the PowerLogic P1F relay provides non-directional three-phase overcurrent protection with independent time-delay characteristics. All overcurrent settings apply to all of the three phases but are independent for each of the three stages.

The first two overcurrent stages have time-delayed characteristics which are selectable between inverse definite minimum time (IDMT) and definite time (DMT). The third stage has definite time characteristics (DMT) only.

Setting the I> and I>> stages	Authorized Values	Default Setting
I>? I>>?	Disabled Trip, Alarm Trip-Inrush Bl (A, E, E+) Trip-Latch (A, E, E+) Trip-Phase A (A, E, E+) Trip-Phase B (A, E, E+) Trip-Phase C (A, E, E+)	Disabled
2> Threshold I>> Threshold	0.1… 40.0 In (step: 0.01 In)	1.2 In 1.4 In
Delay Type For more information on tripping curves and the reset time, refer to *Overcurrent Protection Tripping Curves, page 129*.	DMT IEC SI IEC VI IEC EI LTI STI RC RI IEEE MI	IEC SI

	IEEE VI IEEE EI US CO2-P20 US CO8 RXIDG BNP EDF US CO2-P40 US CO5 US CO6 US CO7 US CO9 US CO11 HV_Fuse	
tI> tI>>	0.05… 200 s (step: 0.01 s)	1 s
2> TMS I>> TMS	0.02… 1.5 s (step: 0.01 s)	1 s
2> Time Dial I>> Time Dial	0.02… 100 s (step: 0.01 s)	1 s
Reset Delay Type I> Reset Delay Type I>>	DMT IDMT	DMT
DMT tReset I> DMT tReset I>>	0.0… 600 s (step: 0.01 s)	0 s
RTD/RTMS Reset I> RTD/RTMS Reset I>>	0.0… 600 (step: 0.01)	0

Setting the I>>> stage	**Authorized Values**	**Default Setting**
I>>>?	Disabled Trip, Alarm Trip-Inrush Bl (A, E, E+) Trip-Latch (A, E, E+) Trip-Phase A (A, E, E+) Trip-Phase B (A, E, E+) Trip-Phase C (A, E, E+)	Disabled
I>>> Threshold	1… 40.0 In (step: 0.01 In)	4.0 In
tI>>>	0.0… 200 s (step: 0.01 s)	0 s

IDMT tripping can be blocked if any DMT stage is started (**L, N, A, B, E, E+**), settings: IDMT interlock by DMT (***GLOBAL SETTINGS/O/C ADVANCED*** column). This setting is common for E/Gnd Fault [50N/51N] and Phase O/C [50/51]:

Setting the overcurrent stages	**Authorized Values**	**Default Setting**
IDMT interlock by DMT	No Yes	No

Earth Fault Protection (ANSI 50N-51N)

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+*

*available directional (**67N**) and/or admittance (**21YN**) earth fault protection

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 according to several connection diagrams (see below).

This protection can be used in various application scenarios:

- Incomer/feeder protection
- Neutral point protection

Two (**L, N, B, A**) or three (**E, E+**) independent stages (***IN_1***, ***IN_2, IN_3***) can be set to offer optimum discrimination:

- The ***IN_1*** stage has either a definite time (DMT) or inverse definite minimum time (IDMT) setting with different types of standardized curve (IEC, IEEE, RI).
- The ***IN_2*** stage only has a definite time (DMT) setting. The minimum setting can be used to obtain instantaneous operation (ANSI 50N function).
- The ***IN_3*** stage only has a definite time (DMT) setting. The minimum setting can be used to obtain instantaneous operation (ANSI 50N function). Third ***IN_3*** stage is applicable for models **E** and **E+** only.

If an earth fault stage (***IN_1 stage?***, ***IN_2 stage?*** Or ***IN_3 stage?*** (**E, E+**) menu) is set to ***Trip***, ***Trip-Inrush Bl*** (**A, E, E+**) or ***Trip-Latch*** (**A, E, E+**), ***Incos Trip*** (**E+**), ***Insin Trip*** (**E+**), ***GN Trip*** (**E+**), ***BN Trip*** (**E+**), ***YN Trip*** (**E+**), it means that stage is linked to the ***Protect. Trip*** and ***Prot. Trip pulse*** functions (see *LED configuration, page 308*).

If an earth fault stage (***IN_1 stage?***, ***IN_2 stage?*** Or ***IN_3 stage?*** (**E, E+**) menu) is set to ***Alarm***, ***Incos Alarm*** (**E+**), ***Insin Alarm*** (**E+**), ***GN Alarm*** (**E+**), ***BN Alarm*** (**E+**), ***YN Alarm*** (**E+**), it means that stage is linked to the ***Alarm*** function (see *LED configuration, page 308*).

If an earth fault stage (***IN_1 stage?*** Or ***IN_2 stage?*** Menu) in **E+** model is set to ***Incos Trip*** (**E+**), ***Incos Alarm*** (**E+**), ***Insin Trip*** (**E+**), ***Insin Alarm*** (**E+**), ***GN Trip*** (**E+**), ***GN Alarm*** (**E+**), ***BN Trip*** (**E+**), ***BN Alarm*** (**E+**), ***YN Trip*** (**E+**), ***YN Alarm*** (**E+**), it means that stage operate depends on fault direction.

If **Trip-Inrush Bl** (**A, E, E+**) is selected, the earth fault stage is blocked via the ***Inrush Blocking*** function (refer to *Inrush Blocking*, page 141).

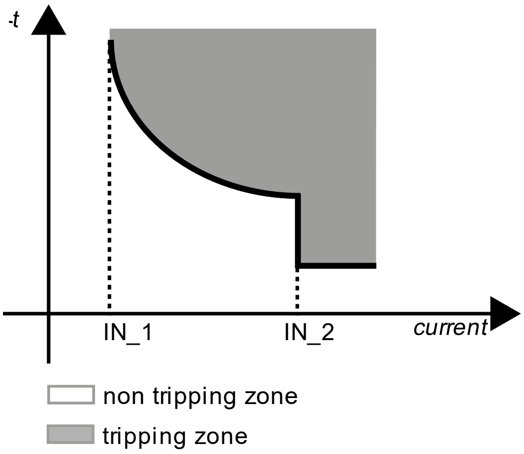
If ***Trip-Latch*** (**A, E, E+**) is selected, the earth fault stage will remain after a trip, until it is reset via a binary input, the HMI or a remote RESET command.

Operation of the ***IN_1***, ***IN_2*** and ***IN_3*** stages can be associated with the Earth Fault Cold Load Pick-Up (**N, B, A, E, E+**) and *Inrush Blocking* (**A, E, E+**) function (see page 141), which is used to avoid nuisance tripping of the protection when the installation is energized. In particular, the CLPU Io function incorporates the option of activating restraint based on the detection of a second harmonic component in the phase currents.

Activation of this restraint is recommended on transformer applications, if the earth fault current measurement is based on the sum of the 3 phase CTs. In this case, 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 CLPU and inrush restraint can be used to detect this *incorrect* residual current and inhibit the earth fault stages during the transient currents linked to energizing.

Example: Curve for IDMT type IN_1 stage and DMT type IN_2 stage

Figure 4. Tripping curve for IN_1 and IN_2 stages for earth fault protection

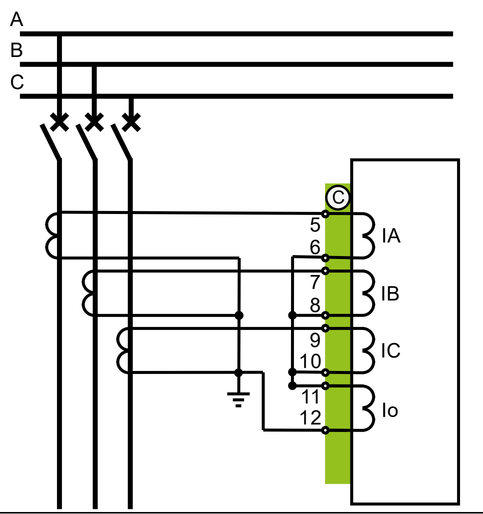
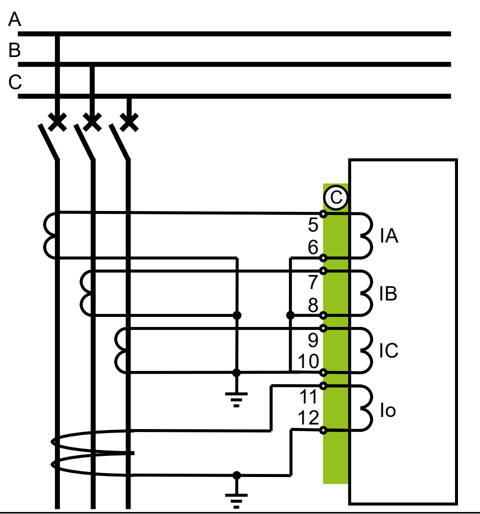


Sensitivity and Principle of Connection Diagrams

Depending on the sensitivity level required, two types of PowerLogic P1F relay are available. Each type authorizes one or more connection diagrams to measure the earth fault current.

Standard earth fault protection – PowerLogic P1F (0,05-12)Ion.

There are two possible connection diagrams:

Diagram 1	**Diagram 2**
Earth fault current measurement using the common point of the 3 phase CTs, with 1 A or 5 A secondary rating.	Current measurement from an earth CT with 1 A or 5 A secondary rating.
The connection is as follows:	The connection is as follows:
	

This version allows a minimum protection setting of 5% of the phase CT rating (diagram1) or the earth CT rating (diagram2).

Sensitive earth fault protection – PowerLogic P1F (0,01-2)Ion

The connection diagrams are the same as the standard version. However, the minimum protection setting is divided by 2 compared with the standard version. It is 1% of CT rating.

However, if the protection stage needs to be set with low-level current values, use of an core balance CT is strongly recommended (diagram 2). In the case of diagram 1, precision errors in the 3 phase CTs can result in *incorrect* earth fault current measurement. For stage below 5% CT In, this inaccuracy could lead to nuisance tripping of the protection.

Additional Functions

PowerLogic P1F integrates functions that complement earth fault protection:

Reset time

With an IDMT setting, the stage 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. Refer to *Reset IDMT Characteristic, page137*.

Cold load pick-up for earth fault (CLPU) (N, B, A, E, E+)

Operation of the ***IN_1***, ***IN_2*** and ***IN_3*** stages can be associated with the CLPU function, which is used to avoid nuisance tripping of the protection when the installation is energized. By default, the CLPU function is not active. Refer to *Cold Load Pick-up and Inrush Blocking, page 139 and 141 respectively*.

Logic Selectivity (E, E+)

In the case of ***Logic Selectivity***, the start contacts are used to raise the time-delays of upstream relays, instead of blocking them. This provides an alternative approach to achieving non-cascade types of overcurrent scheme. This may be more familiar to some utilities than the blocked overcurrent arrangement. The ***Logic Selectivity*** function provides the ability to temporarily increase the time-delay settings of the second and third stages of phase overcurrent and measured earth fault protection elements.

Two independent **Logic Selectivity** functions are available: ***Sel1*** and/or ***Sel2****.*

This logic is initiated by energization of the appropriate binary input assigned to Sel1 (Sel2).

To allow time for a start contact to initiate a change of setting, the time settings of the second and third stages should include a nominal delay.

For more information see *Logic Selectivity*, page 302.

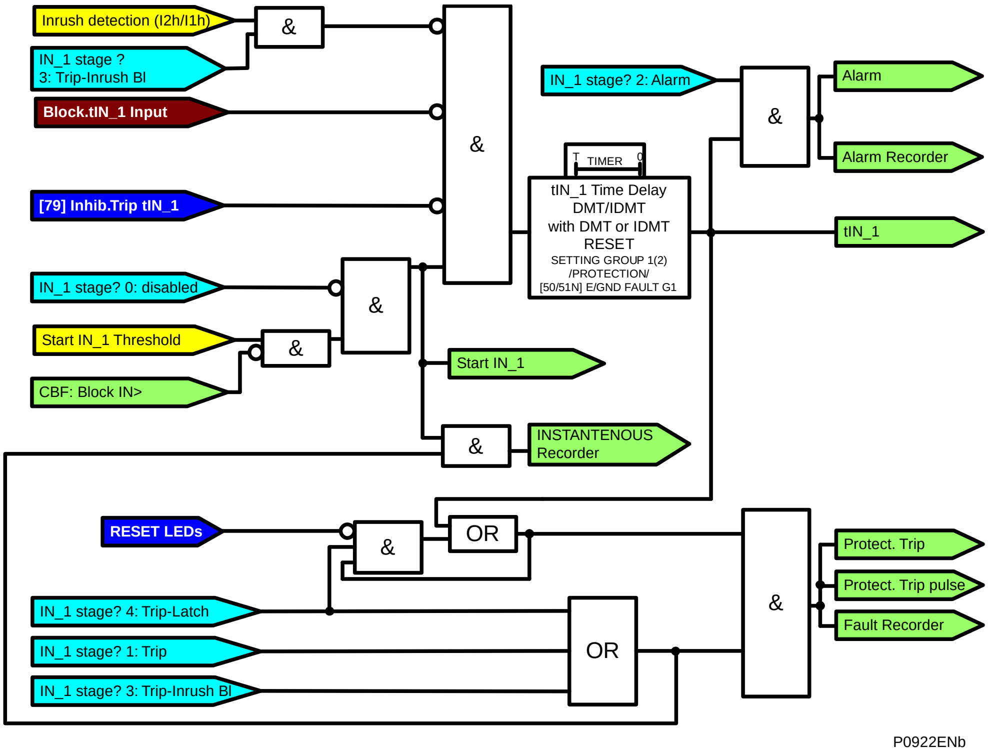
Logic discrimination

PowerLogic P1F can be integrated in the logic discrimination system. This system can be used when the installation requires the fault to be cleared within a short time. It is used to bypass the time interval between the protection stages, imposed by time discrimination. By default, on the PowerLogic P1F logic discrimination is not assigned, therefore to use is has to be configured. Refer to *Logic Discrimination (ANSI 68), page 152*.

Block Diagram

Earth Fault protection logic diagram is shown below:

Figure 5. Operating principles diagram for earth fault protection



Earth Fault protection logic diagrams for IN_1, IN_2 and IN_3 are the same but without the IDMT characteristics for IN_2 and IN_3.

Additional Functions

By default, this function is off.

Settings

The earth fault element operates from earth fault current that is measured directly from the network; either by means of a separate CT located in a power system earth connection or via a residual connection of the three line CTs.

All overcurrent settings are independent for each of the two stages (Model **E, E+**: three stages).

The first stage of e/f non-directional overcurrent protection has time-delayed characteristics which are selectable between inverse definite minimum time (IDMT) and definite time (DMT). The second stage and the third (**E, E+**) have definite time characteristics only.

Setting IN_1, IN_2, IN_3 stages (E, E+)	**Authorized Values**	**Default Setting**
IN_1 Stage?	Disabled Trip Alarm Trip-Inrush BI (A, E, E+) Trip-Latch (A, E, E+) Incos Trip (E+) Incos Alarm (E+) Insin Trip (E+) Insin Alarm (E+) GN Trip (E+) GN Alarm (E+) BN Trip (E+) BN Alarm (E+) YN Trip (E+) YN Alarm (E+)	Disabled
IN_1 Threshold	0.05… 12 Ien (step: 0.001 Ien) Standard version	0.2 Ien
	0.01… 2 Ien (step: 0.001 Ien) Sensitive version	0.2 Ien
Delay Type IN_1 For more information on tripping curves and the reset time, refer to *Earth Fault Protection Tripping Curves, page 129.*	DMT IEC SI IEC VI IEC EI UK LTI UK STI UK RC RI IEEE MI IEEE VI IEEE EI US CO2-P20 US CO8 RXIDG BNP EDF US CO2-P40 US CO5 US CO6 US CO7 US CO9 US CO11 HV_Fuse	IEC SI
tIN_1	0.05… 200 s (step: 0.01 s)	1 s
IN_1 TMS	0.02… 1.5 s (step: 0.01 s)	1 s
IN_1 Time Dial	0.02… 100 s (step: 0.01 s)	1 s
Reset Delay Type IN_1	DMT IDMT	DMT
RTD/RTMS Reset IN_1	0.0… 600 (step: 0.01)	0.02
DMT tReset IN_1	0.0… 600 s (step: 0.01 s)	0 s
IN_2 stage?	Disabled Trip Alarm Trip-Inrush BI (A, E, E+) Trip-Latch (A, E, E+) Incos Trip (E+) Incos Alarm (E+) Insin Trip (E+) Insin Alarm (E+) GN Trip (E+) GN Alarm (E+) BN Trip (E+) BN Alarm (E+) YN Trip (E+) YN Alarm (E+)	Disabled
IN_2 Threshold	0.3… 12 Ien (step: 0.001 Ien) Standard version	0.4 Ien
	0.05… 2 Ien (step: 0.001 Ien) Sensitive version	0.4 Ien
tIN_2	0.0… 200 s (step: 0.01 s)	0.0 s
IN_3 stage? (E, E+)	Disabled Trip Alarm Trip-Inrush BI (E, E+) Trip-Latch (E, E+)	Disabled
IN_3 Threshold (E, E+)	0.3… 12 Ien (step: 0.001 Ien) Standard version	0.4 Ien

Setting IN_1, IN_2, IN_3 stages (E, E+)	Authorized Values	Default Setting
	0.05… 2 Ien (step: 0.001 Ien) Sensitive version	0.4 Ien
tIN_3 (E, E+)	0… 200 s (step: 0.01 s)	0 s

Advanced earth fault settings (**E+**) concerning directional and admittance protections can be found in following menu column: ***GLOBAL SETTINGS/E/F ADVANCED***:

Setting the earth fault stages	Authorized Values	Default Setting
VN Threshold	5.0… 90.0 V (step: 0.1 V)	5.0 V
G1 IN_1 direct.	Line Bus no direction	Line
G1 IN_2 direct.	Line Bus no direction	Line
G2 IN_1 direct.	Line Bus no direction	Line
G2 IN_2 direct.	Line Bus no direction	Line
Incos, Insin Sector Angle	10… 90 ° (step 1 °)	90 °

IDMT tripping can be blocked if any DMT stage is started (**L, N, B, A, E, E+**), settings: IDMT interlock by DMT (***GLOBAL SETTINGS/O/C ADVANCED*** column). This setting is common for E/Gnd Fault [50N/51N] and Phase O/C [50/51]:

Setting the earth fault stages	Authorized Values	Default Setting
IDMT interlock by DMT	No Yes	No

Settings for Using the Function

Compulsory settings in the *GLOBAL SETTINGS* menu:

- CT ratio setting (***E/Gnd CT Primary*** and ***E/Gnd CT Sec*** screens). If the measurement is taken on the common point of the 3 phase CTs, this setting is the same as the phase CT ratio.
- IN_1 stage setting (***IN_1 Threshold*** menu cell)
- IN_2 stage setting (***IN_2 Threshold*** menu cell)
- IN_3 stage setting (***IN_3 Threshold*** menu cell)
- Network frequency selection (***Nominal Frequency*** menu cell)

Additional settings in the *PARAMETERS* menu:

- Activation of the reset time (***Reset delay time, DMT tReset*** and ***IDMT tReset*** screens). Those parameters are dedicated to first stage ***IN_1*** only.
- Cold Load Pick-Up setting (***COLD LOAD PU Gx*** menu cell)

Additional Information (E+)

Directional and admittance earth fault protection

Active/reactive neutral current component criterion to earth fault detection

For the selective detection of earth faults, the measurement of zero sequence of power flow direction is used. This criterion based on the set value of zero component of current *I*o, zero component of voltage *V*o and angle φo between them.

Active/reactive neutral current component criteria allow selective detection of earth faults in networks where neutral point is not directly grounded. In compensated networks or grounded by resistor the active part of zero component of current is used, while in isolated networks reactive part of zero components of current. Therefore, the criterion signals are as follows:

- In compensated network:

*I*ncos(φo)>*I*s

- In isolated network:

*I*nsin(φo)>*I*s

where:

*I*s – threshold of earth fault protection (in P1F – *IN_1* and *IN_2*)

On the figures 1 and 2 bellow are presented tripping and inhibit area for criteria:

1. *I*ncos

   a) operation in line direction, b) operation in bus direction.

2. *I*nsin

   2) operation in line direction, b) operation in bus direction.

The above cases were considered for the maximum characteristic angle 90° (***GLOBAL SETTINGS/E/F ADVANCED/Incos, Insin Sector Angle***). Characteristic angle can be set from 10° to 90° with step 1°.

Figure 6. Operation principle for *Io*cos earth fault protection

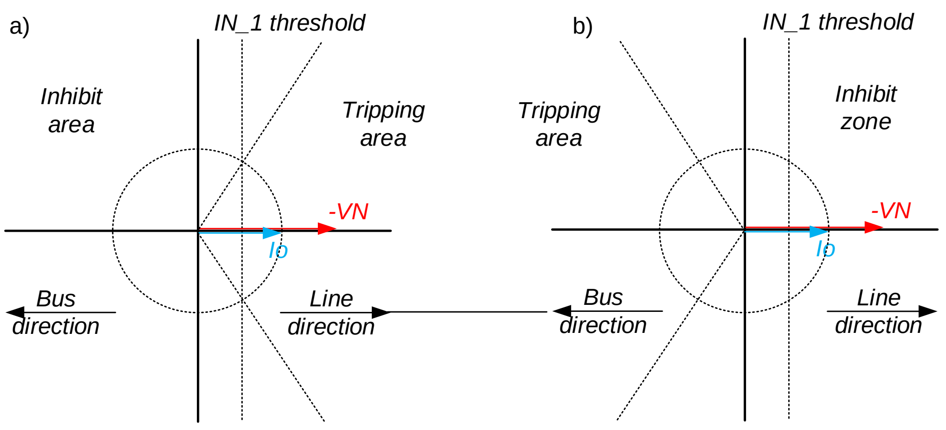
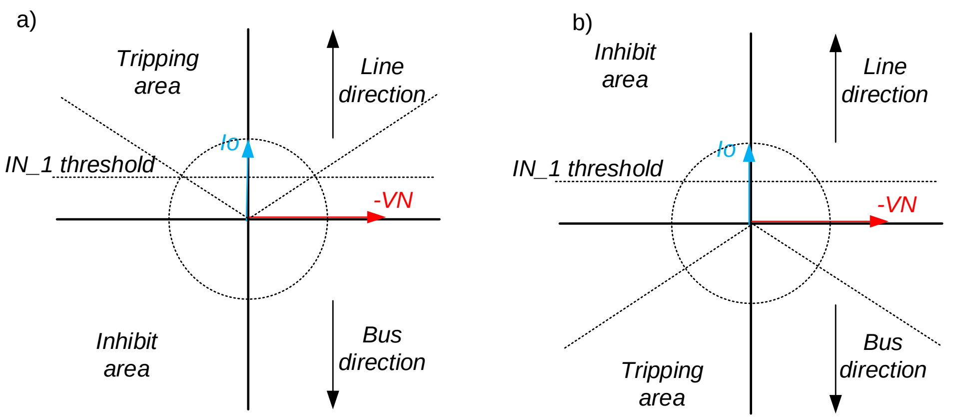


Figure 7. Operation principle of *Io*sin earth fault protection



Conductance criterion *GN*

In order to help to ensure selective operation of earth fault protection in compensated networks, is recommended to use conductance criterion *GN*. Conductance criterion based on zero sequence (*GN*) of conductance, which is determined following equation:

$$GN = \frac{3Io}{3Vo}\cos(\varphi o) * 1000$$

Conditions to operate conductance protections are following:

$$GN \geq Gs$$

and:

$$Vo \geq Vo\ set\ value$$

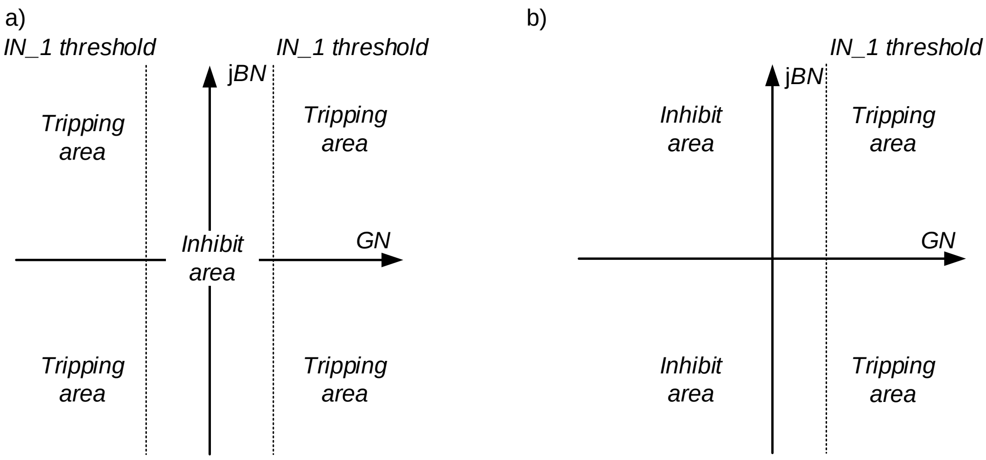
where:

Gs – threshold of conductance protection (in P1F – *IN_1* and *IN_2*, if ***GN Trip*** or ***GN Alarm*** are selected),

Vo set value – (***GLOBAL SETTINGS/E/F ADVANCED/VN Threshold***) should be selected so that the threshold could be left out the neutral voltage of the network capacitive asymmetry.

Operation mode of the conductance protection can be directional or non-directional. On the figure (Figure 8. Operation principle of GN earth fault protection) below are presented tripping and inhibit area for conductance criterion: a) for non-directional set, b) for directional set.

Figure 8. Operation principle of *GN* earth fault protection



<u>Susceptance criterion *BN*</u>

In order to help to ensure selective operation of earth fault protection in networks with isolated neutral point, is recommended to use susceptance criterion *BN*. Susceptance criterion based on zero sequence (*BN*) of susceptance, which is determined following equation:

$$BN = \frac{3Io}{3Vo}\sin(\varphi o) * 1000$$

Conditions to operate susceptance protections are following:

$$BN \geq Bs$$

and

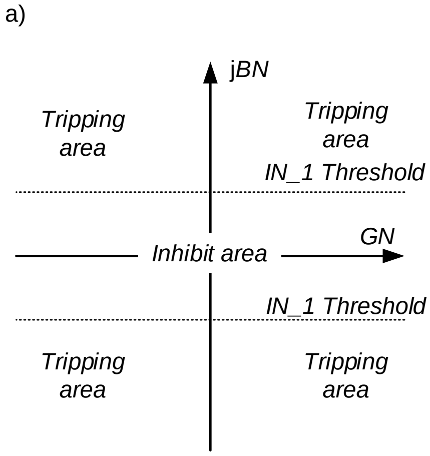
$$Vo \geq Vo\ set\ value$$

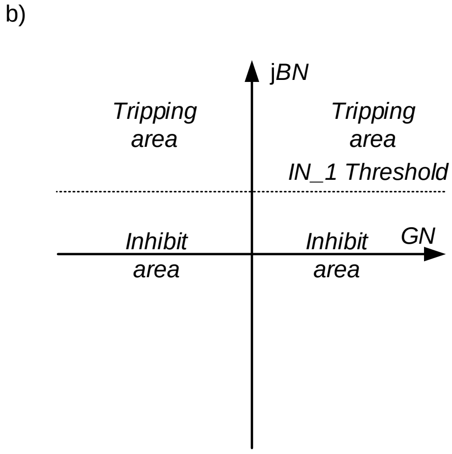
where:

Bs – threshold of susceptance protection (in P1F – *IN_1* and *IN_2*, if ***BN Trip*** or ***BN Alarm*** are selected),

Operation mode of the susceptance protection can be directional or non-directional. On the Figure 9 bellow is presented tripping and inhibit area for susceptance criterion: a) for non-directional set, b) for directional set.

Figure 9. Operation principle of *BN* earth fault protection





<u>Admittance criterion *Y*N</u>

In the case of compensated networks admittance protection can be used as a backup protection.
The criterion is to act in the event of a network over- or undercompensation by Petersen's coil in the case where an earthing resistor gets damaged. Admittance criterion is non-directional protection only.
Admittance criterion based on zero sequence (*YN*) of admittance, which is determined following equation:

$$YN = \frac{3Io}{3Vo} * 1000$$

Conditions to operate admittance protections are following:

$$YN \geq Ys$$

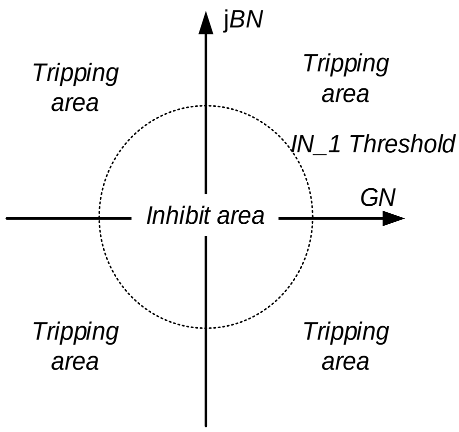
and:

$$Vo \geq Vo\ set\ value$$

where:
Ys – threshold of admittance protection (in P1F – *IN_1* and *IN_2*, if ***YN Trip*** or Y***N Alarm*** are selected),

This criterion can be use in networks with isolated neutral point also.
On the Figure 10 bellow are presented tripping and inhibit area for admittance criterion:

Figure 10. Operation principle of *YN* earth fault protection



Overcurrent Protection Tripping Curves

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Introduction

Phase, earth fault and negative sequence overcurrent protection can be delayed using the following types of tripping curve:

- Definite time (DT): I>, I>>, I>>>, Io> and Io>>, Is2> stages
- IDMT: I>, I>>, Io> and Is2> stages only

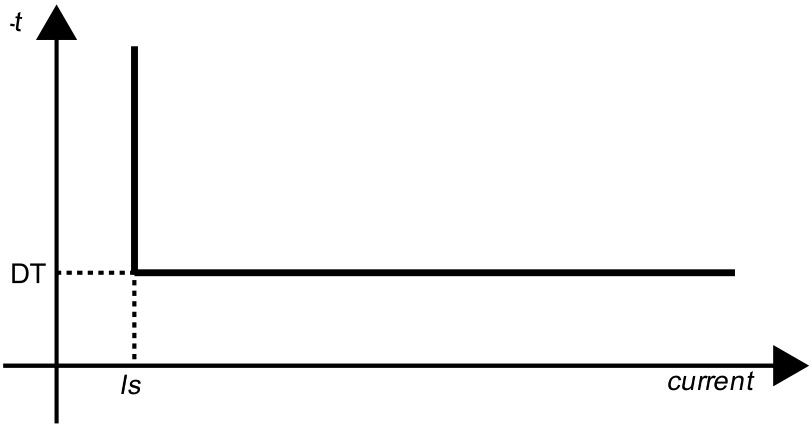
In the case of standardized IDMT curves (IEC and IEEE type), a reset time can be activated. This reset time enables PowerLogic P1F coordination with electromechanical relays, placed upstream.

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 threshold Is is passed.

Definite time protection principle

Figure 11. DT tripping curve

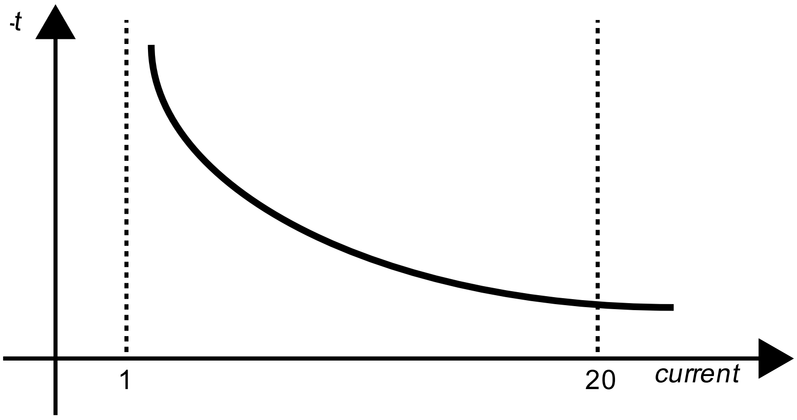


IDMT Curve

In IDMT protection functions, the tripping time depends on the measured value (phase, earth fault or negative sequence current).

Operation is represented by characteristic curves t = f(I/Is), t = f(Io/Is) or t = f(Is2/Is) (where Is is the setting threshold), which look like this:

Figure 12. IDMT tripping curve



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.

Equation

Curves are defined by the following equation:

- $$t = \mathrm{T} \cdot \left(\frac{\mathrm{k}}{\left(\frac{I}{\mathrm{Is}} \right)^{\alpha} - \mathrm{P}} + \mathrm{c} \right)$$

where:

t - Operating time in [s]
k, P, c, α - Constants
Is - Current threshold setting [A]
I - Measured current in [A]
T - TMS – Time multiplier setting for IEC curves (setting range 0.02 – 1.5)
- TD – Time dial setting for IEEE and BNP (EDF) curves (setting range 0.02 – 100)
- Time coefficient for RI curve (setting range 0.1 – 10)
- Time coefficient for HV_Fuse curve (setting range 0.5 – 2)

Type of Curve according to IEC 60255-151 std definition	**Standard**	**k**	**c**	**α**	**P**
IEC Standard Inverse Time (SI)	IEC/A	0.14	0	0.02	1
IEC Very Inverse Time (VI)	IEC/B	13.5	0	1	1
IEC Extremely Inverse Time (EI)	IEC/C	80	0	2	1
IEC Long Time Inverse (LTI)	IEC	120	0	1	1
FR Short Time Inverse (STI)	FR	0.05	0	0.04	1
UK Rectifier (Rect)	UK	45900	0	5.6	1
IEEE Moderately Inverse Time (MI)	IEEE (IEC/D)	0.0515	0.114	0.02	1
IEEE Very Inverse Time (VI)	IEEE (IEC/E)	19.61	0.491	2	1
IEEE Extremely Inverse Time (EI)	IEEE (IEC/F)	28.2	0.1217	2	1
US Short Time Inverse (CO2 P20)	US	0.02394	0.01694	0.02	1
US Short Time Inverse (CO2 P40)	US	0.16758	0.11858	0.02	1
US Long Time (CO5)	US	4.842	1.967	1.1	1
US Definite Minimum Time (CO6)	US	0.3164	0.1934	1.4	1
US Moderately Inverse Time (CO7)	US	0.0094	0.0366	0.02	1
US Time Inverse (CO8)	US	5.95	0.18	2	1
US Very Inverse Time (CO9)	US	4.120	0.0958	2	1
US Extreme Inverse Time (CO11)	US	5.570	0.028	2	1
BNP (EDF)	EDF	1000	0.655	2	1
RI		-4.2373	0	-1	1.43644
HV_Fuse		80	0	3	1

A time multiplier setting TMS is used to adjust the operating time of IEC & UK IDMT curves.

A time multiplier setting TD is used to adjust the operating time of IEEE or US IDMT curves.

Note:

1. For (CO2 P20), TD is defined like in MiCOM P20 series
2. For (CO2 P40), TD is defined like in MiCOM P40 series

RXIDG Curves and RI Curves

The operate delays of RI and RXIDG depend on the measured value and other parameters according to following equations.

These equations can only be used to draw graphs or when the measured value I is constant during the fault.

Modified versions are implemented in the relay for real-time usage.

The RXIDG curves available follow the formula:

$$t = 5.8 - 1.35 \cdot \ln\left(\frac{1}{\left(k \cdot \frac{Is}{I}\right)}\right)$$

Where:
t = tripping time
k = coefficient (from 0.3 to 1, by steps of 0.01), k = TMS/TD
Is = value of the programmed threshold (Pick-up value)
I = value of measured current

The RI curves available follow the formula:

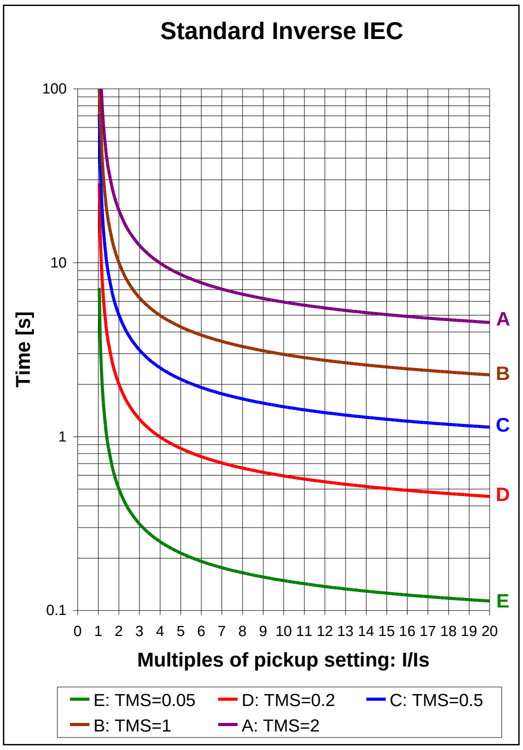
$$t = \frac{\mathrm{k}}{0.339 - 0.236 \cdot \frac{\mathrm{Is}}{I}}$$

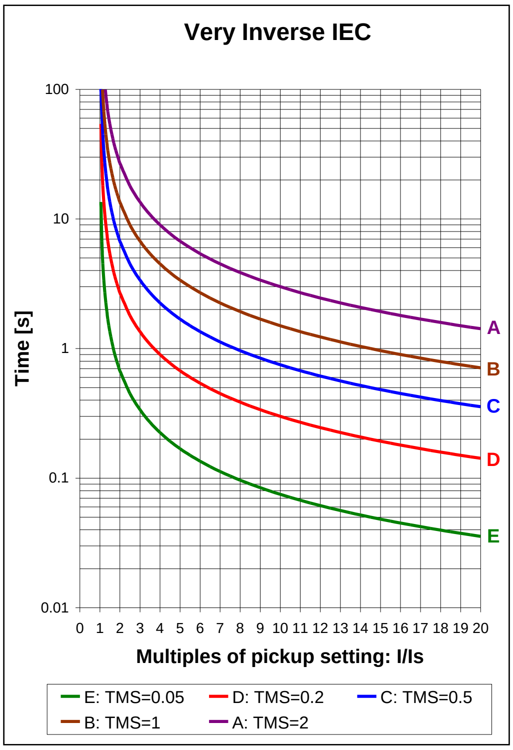
which is same as

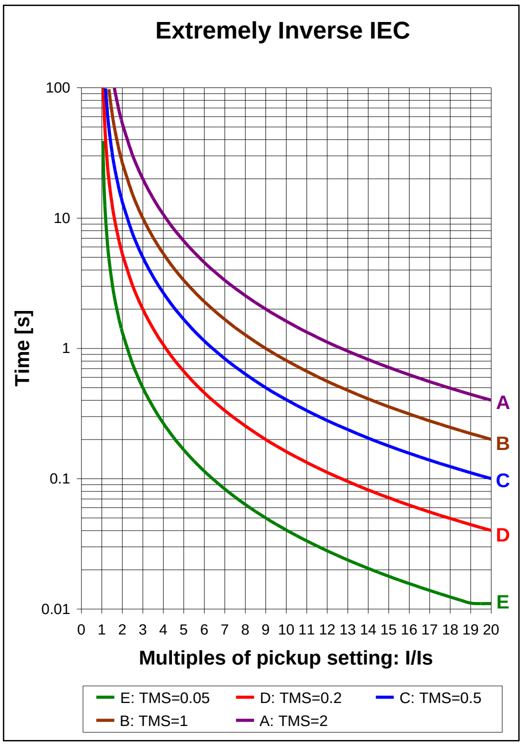
$$t = \mathrm{TD} \cdot \frac{-4{,}237}{\left(\frac{I}{\mathrm{Is}}\right)^{-1} - 1{,}436}$$

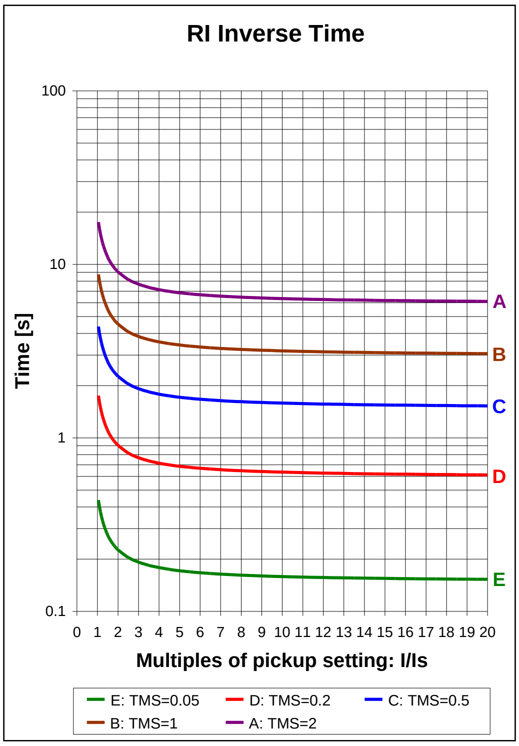
Where:
t = tripping time
k = coefficient (from 0.02 to 10, by steps of 0.01), k = TMS/TD
Is = value of the programmed threshold (Pick-up value)

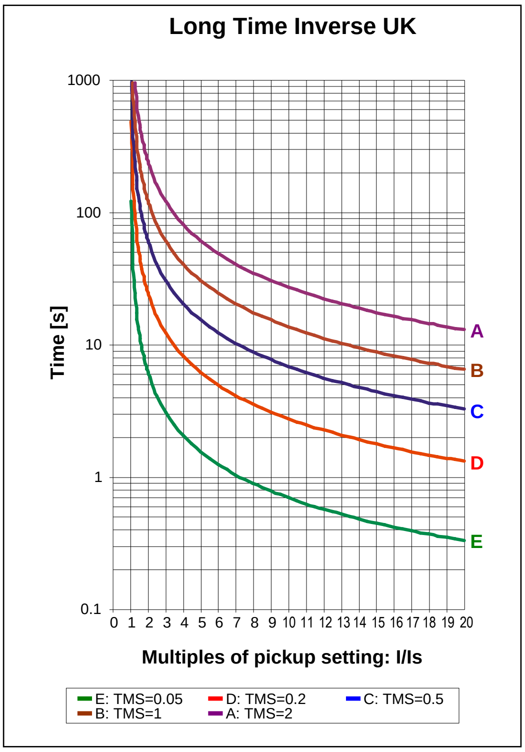
I = value of measured current

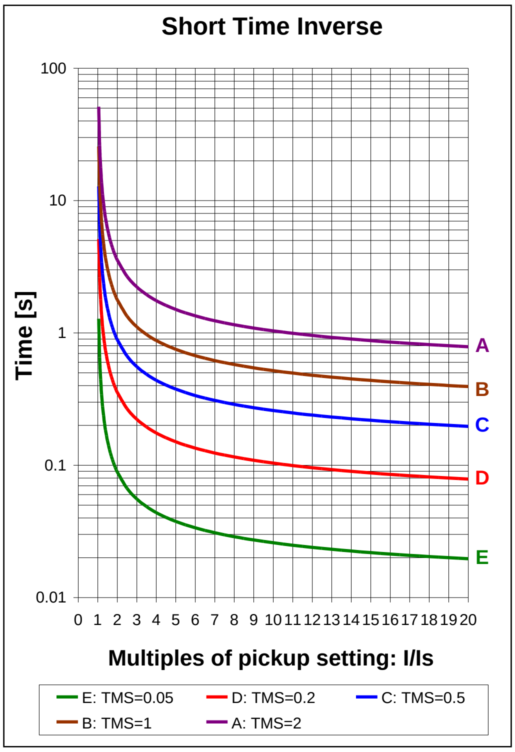

Standard Inverse IEC
Time [s]
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2

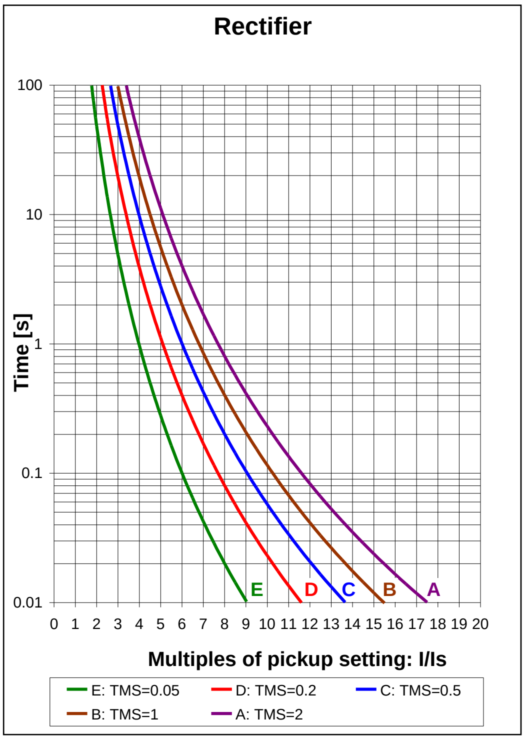

Very Inverse IEC
Time [s]
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2

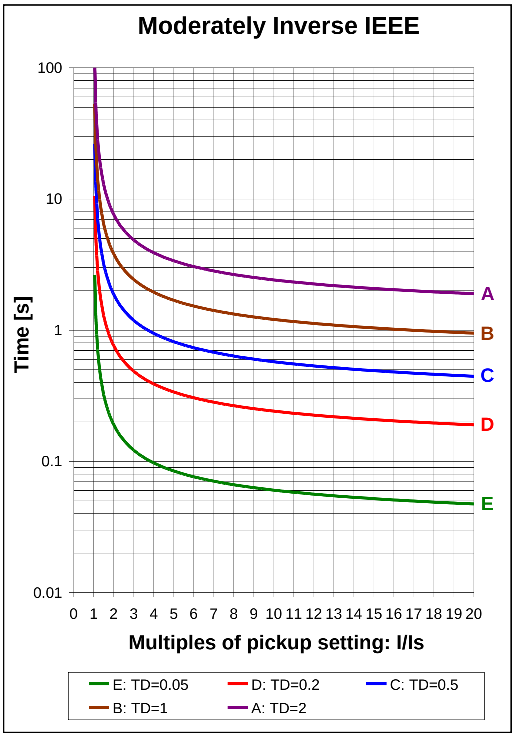

Extremely Inverse IEC
Time [s]
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2

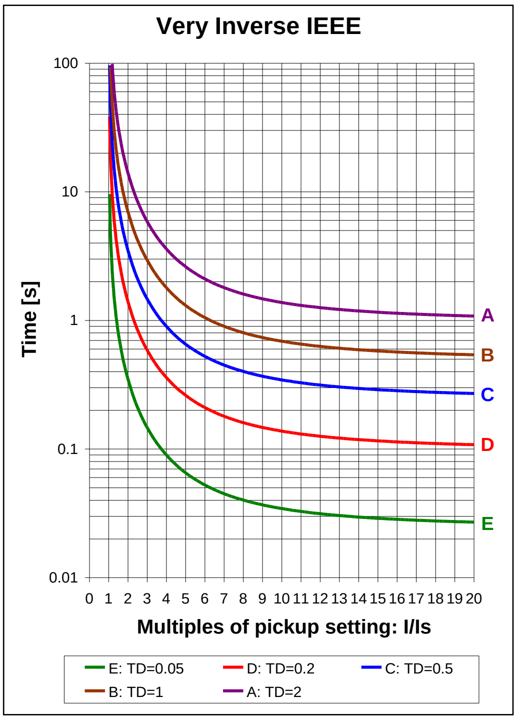

RI Inverse Time
Time [s]
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2


Long Time Inverse UK
Time [s]
1000
100
10
1
0.1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2

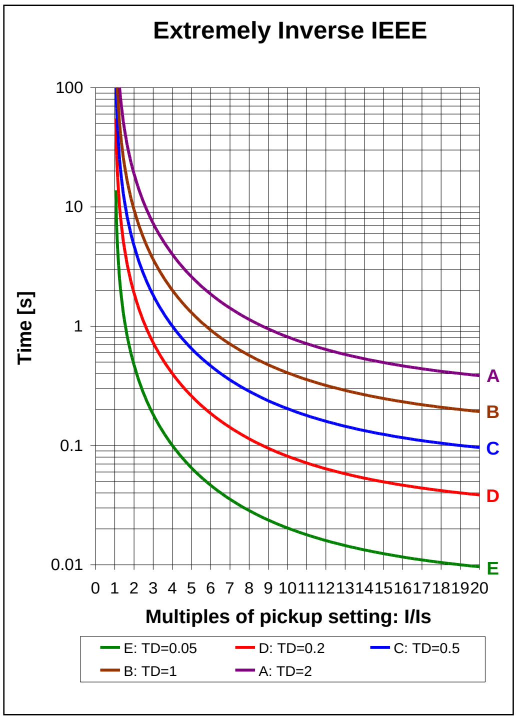

Short Time Inverse
Time [s]
100
10
1
0.1
0.01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2


Rectifier
Time [s]
100
10
1
0.1
0.01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
E
D
C
B
A
E: TMS=0.05
D: TMS=0.2
C: TMS=0.5
B: TMS=1
A: TMS=2

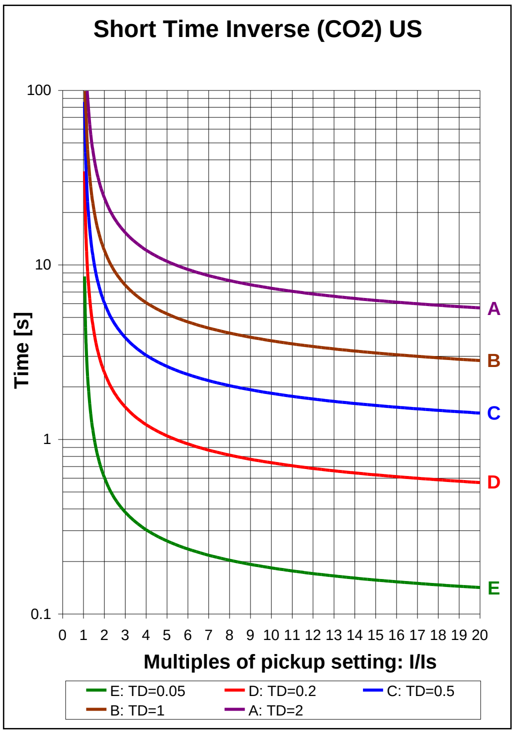

Moderately Inverse IEEE
Time [s]
100
10
1
0.1
0.01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2



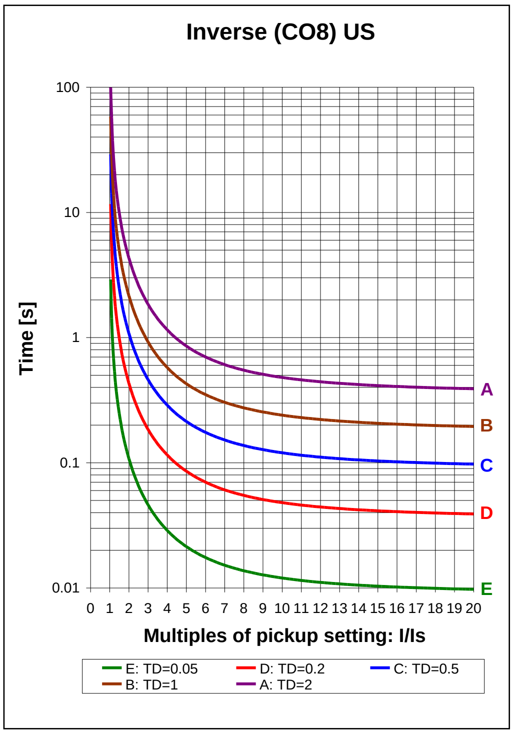
Very Inverse IEEE
Time [s]
100
10
1
0.1
0.01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2



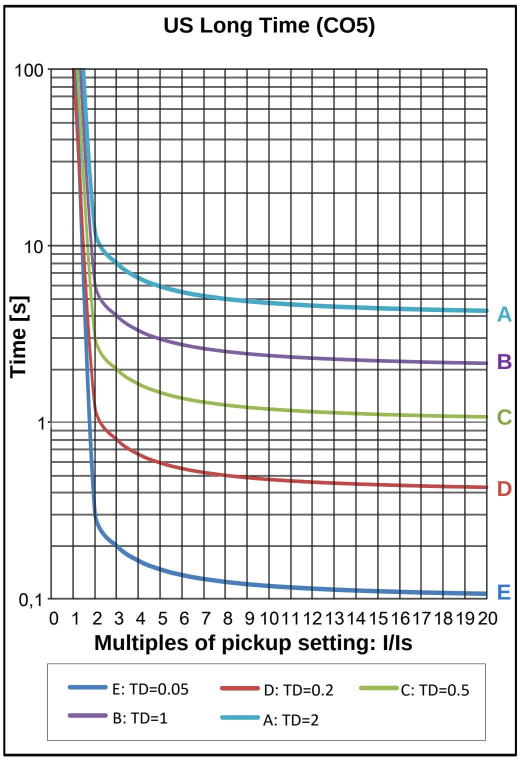
Extremely Inverse IEEE
Time [s]
100
10
1
0.1
0.01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2

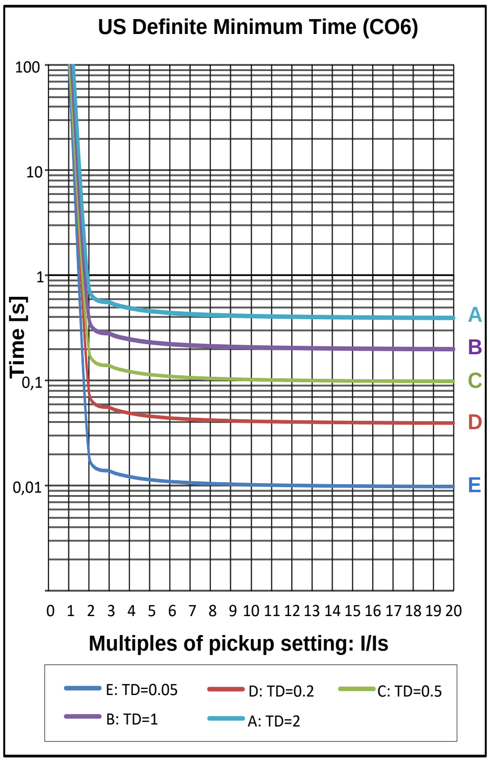


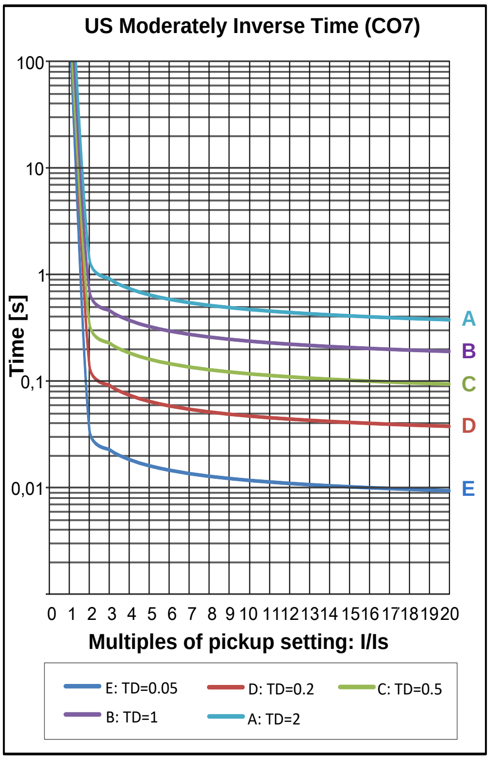
Short Time Inverse (CO2) US
Time [s]
100
10
1
0.1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2

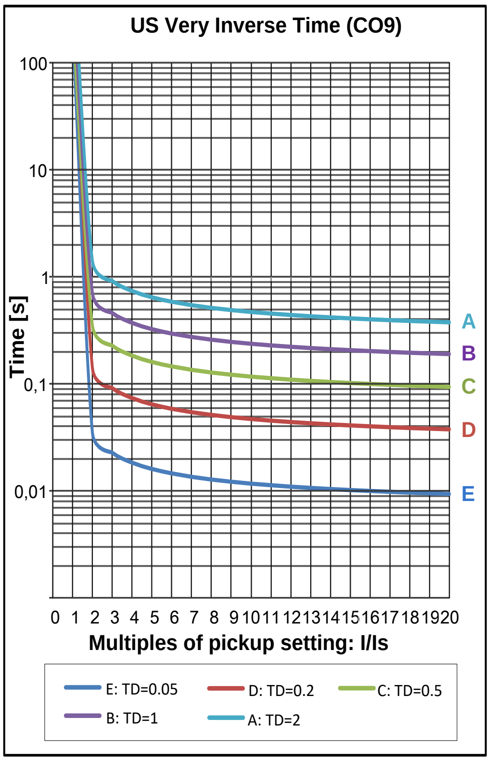


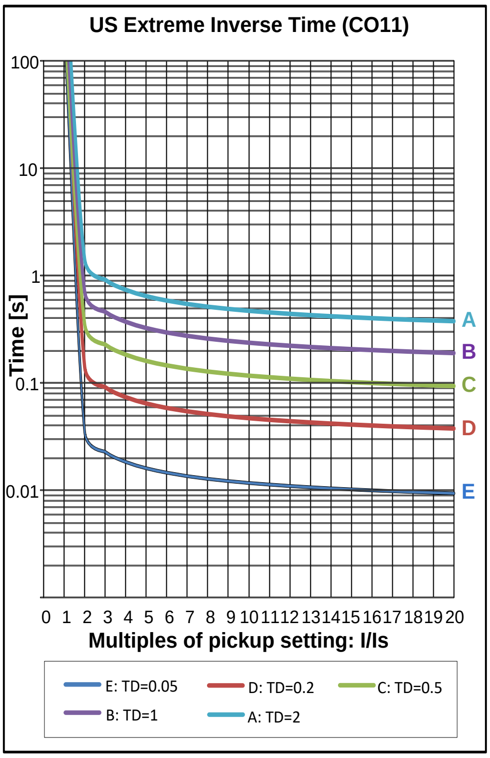
Inverse (CO8) US
Time [s]
100
10
1
0.1
0.01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2


US Long Time (CO5)
Time [s]
100
10
1
0,1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2


US Definite Minimum Time (CO6)
Time [s]
100
10
1
0,1
0,01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2


US Moderately Inverse Time (CO7)
Time [s]
100
10
1
0,1
0,01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2


US Very Inverse Time (CO9)
Time [s]
100
10
1
0,1
0,01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Multiples of pickup setting: I/Is
A
B
C
D
E
E: TD=0.05
D: TD=0.2
C: TD=0.5
B: TD=1
A: TD=2



Reset IDMT Characteristic

The IEEE/US/IEC curves may have an inverse time reset characteristic (***I> (I>>) Reset Delay Type 1: IDMT*** setting) or instantaneous reset (***I> (I>>) Reset Delay Type 0: DMT*** setting). If IDMT reset is selected (***I> (I>>) Reset Delay Type 1: IDMT*** setting) then the following menu will be available: ***I> (I>>) RTD/RTMS RESET***. The following equation can be used to calculate the inverse reset time for IEEE/US/IEC curves:

- For IEC/UK/FR standard curves:

$$\textit{reset time} = \mathrm{RTMS} \cdot \left(\frac{\mathrm{tr}}{1 - \left(\frac{I}{\mathrm{Is}} \right)^{\mathrm{P}}} \right)$$

- For IEEE/US standard curves:

$$\textit{reset time} = \mathrm{RTD} \cdot \left(\frac{\mathrm{tr}}{1 - \left(\frac{I}{\mathrm{Is}} \right)^{\mathrm{P}}} \right)$$

where:

tr, P	- Constants
Is	- Current threshold setting [A]
I	- Measured current in [A]
RTD	- Time dial setting for IEEE/US curves
RTMS	- A time multiplier setting for IEC and HV_Fuse curves

Note:

To be in line with IEEE/US/IEC the RTMS (RTD) value should be equal to the TMS (TD) value. The setting for RTMS or RTD is given to adjust the reset characteristic to specific applications. Typically, RTMS = TMS and RTD = TD.

Type of Curve	**Standard**	**tr**	**P**
IEC Standard Inverse Time (SI)	IEC/A	12.1	2
IEC Very Inverse Time (VI)	IEC/B	43.2	2
IEC Extremely Inverse Time (EI)	IEC/C	80	2
IEC Long Time Inverse (LTI)	IEC	0	0
FR Short Time Inverse (STI)	FR	0	0
UK Rectifier (Rect)	UK	0	0
IEEE Moderately Inverse Time (MI)	IEEE (IEC/D)	4.9	2
IEEE Very Inverse Time (VI)	IEEE (IEC/E)	21.6	2
IEEE Extremely Inverse Time (EI)	IEEE (IEC/F)	29.1	2
Long Time (CO5)	US	4.85	2
Definite Minimum Time (CO6)	US	31	2
Moderately Inverse Time (CO7)	US	0.94	2
Time Inverse (CO8)	US	5.95	2
Very Inverse Time (CO9)	US	4.12	2
Extreme Inverse Time (CO11)	US	5.57	2
Short Time Inverse (CO2_P20)	US	2.261	2
Short Time Inverse (CO2_P40)	US	2.261	2
BNP EDF	BNP EDF	0	0
RXIDG	RXIDG	0	0
HV_Fuse		80	2

Note:

1. For CO2_P20, RTD is defined like in MiCOM P20 series
2. For CO2_P40, RTD is defined like in MiCOM P40 series
3. 0 in above table means resetting immediately

Cold Load Pick-up

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

The Cold Load Pick-up feature allows selected settings of P1F relays to be changed to react to temporary overload conditions that may occur during cold starts. This condition may happen by switching on large heating loads after a sufficient cooling period, or loads that draw high initial starting currents.

When a feeder is energized, the current levels that flow for a period of time following energizing may differ greatly from the normal load levels. Consequently, overcurrent settings that have been applied to give short circuit protection may not be suitable during this period.

These transient currents may occur 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.

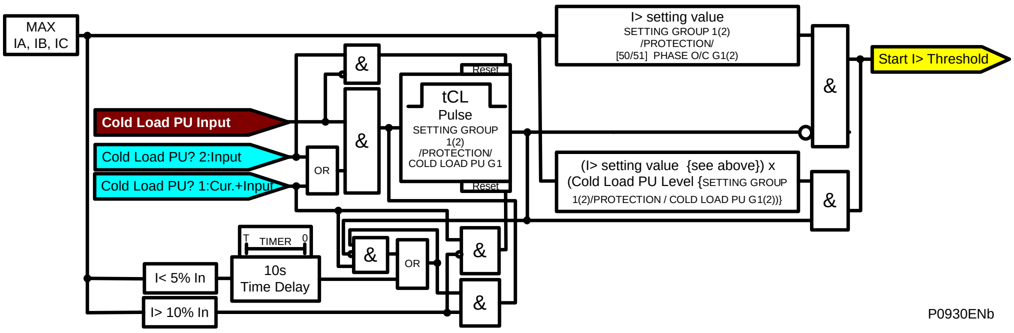
NOTE: In the rest of this manual, this function is referred to by abbreviation: CLPU.

Setting the function parameters allows the user to:

- Define the type of triggering CLPU (current or binary input criteria or both)
- Choose which stages it acts on: I>, I>>, I>>>, IN>, IN>>, IN>>>, Broken Conductor, Itherm, I2>
- Define temporary pick-up level (in %) to increase (or decrease) set points.
- Define for how long the set point increase is applied after detection

Block Diagram

Figure 13. Operating principles diagram for cold load pick-up



Operation

The Cold Load Pick-up feature allows selected settings of P1F relays to be changed to react to temporary overload conditions that may occur during cold starts. This condition may happen by switching on large heating loads after a sufficient cooling period, or loads that draw high initial starting currents.

When a feeder is energized, the current levels that flow for a period of time following energizing may differ greatly from the normal load levels. Consequently, overcurrent settings that have been applied to give short circuit protection may not be suitable during this period.

The Cold Load Pick-up (CLPU) logic raises the settings of selected stages for a set duration (*tCLPU*). This allows the protection settings to be set closer to the load profile. Cold load pick-up cannot restart until the end of *tCLPU* duration. The CLPU logic provides stability, without compromising protection performance during starting.

The CLPU can be triggered by a digital logic Input Cold Load PU (***Cold Load PU? 1: Cur+Input*** or ***Cold Load PU? 2: Input*** (**A, E, E+**)) which can be assigned to 52a CB status or by current stages logic (***Cold Load PU? 1: Cur+Input***). If the CLPU logic has to be triggered by current criteria only, ***Cold Load PU Input*** (**A, E, E+**) function must not be configured to any digital input. Typically, ***Cold Load PU*** (**A, E, E+**) binary Input is wired to 52A CB status. If this function is configured to selected input, both criteria will work in parallel way.

Additional Functions

By default, this function is off.

Settings

Setting	Authorized Values	Default Setting
Cold Load PU?	Disabled, Input+Curr Input Only (A, E, E+)	N/A
Cold load PU Level	20…999 % (step: 1 %)	
Cold load PU tCL	0…6000 s (step: 100 ms)	
CLPU I>	Yes or No	
CLPU I>>	Yes or No	
CLPU I>>>	Yes or No	
CLPU IN_1 (IN>)	Yes or No	
CLPU IN_2 (IN>>)	Yes or No	
CLPU IN_3 (IN>>>) (E, E+)	Yes or No	
CLPU Brkn Cond (E, E+)	Yes or No	
CLPU Itherm (N, A, B, E, E+)	Yes or No	
CLPU I2> (E, E+)	Yes or No	

Additional Info

By default, this function is off.

Inrush blocking

Applicable to PowerLogic P1F

~~L~~	~~N~~	~~B~~	A	E	E+

Description

In applications where the sensitivity of overcurrent thresholds need to be set below the prospective peak inrush current, the inrush blocking function can be used to block the overcurrent, earth fault and negative sequence overcurrent stages. During transformer inrush conditions, the second harmonic component of the inrush current may be as high as 70%. In practice, the second harmonic level may not be the same for all phases during an inrush and therefore the relay will issue an Inrush Blocking signal for any phase above the set threshold. A setting of 15% to 20% for the Inrush harmonic 2 ratio can be applied in most cases. Care must be taken that it is not set too high, as inrush blocking may not operate for low levels of second harmonic current which may result in the O/C element tripping during transformer energization. Similarly, if it is set too low, inrush blocking may prevent tripping for some internal transformer faults with significant second harmonic current

The inrush blocking function help to ensure protection stability during transformer energizing based on the presence of harmonic 2. The Inrush Blocking function measures the ratio of second to fundamental harmonic currents. It can be used as “blocking logic” for I>, I>>, I>>>, SOTF (**B, A, E, E+**), IN_1, IN_2, IN_3 (**E, E+**), I2> (**E, E+**), Broken Conduct (**E, E+**), in cases where the harmonic 2 ratio is higher than the set threshold. Indeed, inrush blocking functions will reset selected protection starts.

Two options are available (***GLOBAL SETTINGS/INRUSH BLOCKING*** menu):

1: Yes

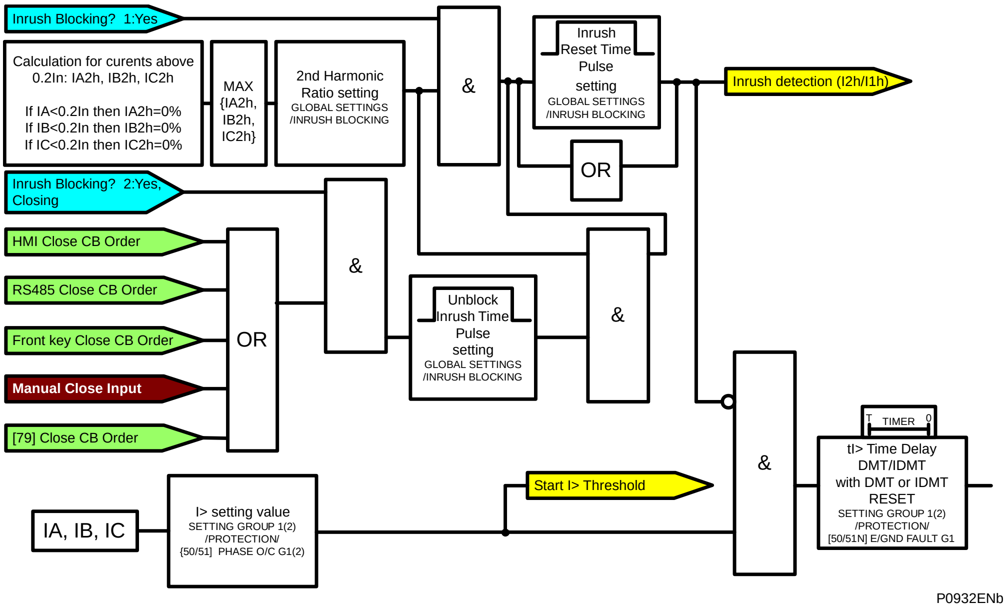
2: Closing

If ***1: Yes,*** is selected, the minimum duration of the overcurrent stage inhibition (***Inrush Reset Time***) can be also set. This value depends on the transformer power transient inrush duration: between 0.1 second (for a 100 kVA transformer) to 1.0 second (for a larger unit). It is used to avoid any maloperation during a fixed time period in case of too sensitive a setting. For example, this option is recommended for incoming feeders where the inrush current is caused by a transformer connected to an outgoing line. However, using the second harmonic can increase the tripping time in case of a fault, especially with DC component included. This option can also be used if the CB contacts are not assigned to any P1F inputs (no information about CB closing).

If ***2: Closing*** is selected, the protection element block is active after the CB closes until ***Unblock Inrush Time*** elapses (this can be also set in the ***GLOBAL SETTINGS/INRUSH BLOCKING*** menu column). If ***1: Closing*** is selected, the minimum duration of the overcurrent stage inhibition (***Inrush Reset Time***) can be also set (see above: ***1: Yes***). This option can increase protection reliability, because inrush blocking is limited to cases where inrush current can appear (closing of CB). Therefore it can be used on outgoing lines with transformers. Note that for incoming feeders the inrush current can be also present when CB is closed and an outgoing line with a transformer is closing. In such a case the CB status of the incoming feeder is not changed but Inrush current can trip protection element. The ***2: Closing*** option is not recommended for such an application.

Block Diagram

Figure 14. Diagram depicts the example for the I> protection element only



Operation

For each of the three phases currents (IA, IB, IC), the harmonic restraint function compares the ratio of 2nd harmonic to the fundamental with the set ratio (Harmonic 2/Fundamental settable from 10 % up to 50 % in steps of 1%).

The minimum fundamental current value required for operation of the Inrush Blocking function is 0.2 In, and there is no upper limit to disable this feature. However, in transformer protection, the high set overcurrent stage should not be controlled by this Inrush Blocking feature; this enables detection of all high current faults without inrush blocking.

It is possible to set two options for Inrush Current logic in the ***GLOBAL SETTINGS/ INRUSH BLOCKING/Inrush Blocking?*** Menu:

1: Yes – monitoring is permanent. The Inrush Blocking function will block the selected protection stages every time inrush conditions are present on the line (Ratio of 2nd Harmonics measured greater than Inrush set ratio), and will be active at least for the duration of ***Inrush Reset Time***. This timer defines the minimum duration of overcurrent threshold inhibition (0-200 s, settable). This timer starts as soon as operating inrush current threshold picks up:

- If the inrush condition lasts less than the set value for ***Inrush Reset Time***, the selected overcurrent function will be inhibited for the duration of ***Inrush Reset Time***.
- If the inrush condition lasts longer than the set value for ***Inrush Reset Time***, the selected overcurrent function will remain inhibited as long as the inrush condition is present.

2: Closing – monitoring is based on the ***Close CB order*** output. The Inrush Blocking function will block the selected protection stages every time a close command is executed and the Ratio of measured 2nd harmonics is greater than the set Inrush set ratio, and will be active at least for the duration of ***Unblock Inrush Time***.

NOTE: Inrush Blocking in PowerLogic P1F relays is not phase-selective. If an inrush condition occurs on any phase, the selected protection stages will be blocked in all 3 phases.

Additional Functions

By default, this function is off.

Settings

Setting	Authorized Values	Default Setting
Inrush Blocking?	0: No 1: Yes 2: Closing	0: No
2nd Harmonic Ratio	10…50 % (step: 1 %)	20%
Inrush Reset Time	0.0…200 s (step: 0.01 s)	0.0 s
Unblock Reset Time	0.0…200 s (step: 0.01 s)	1.0 s

Additional Info

The 2nd harmonic blocking detects high inrush current flows that occur when transformers or machines are connected. The function will then block the following functions:

- ***PHASE O/C [50/51]***
- ***SOTF [50/51]*** (**B, A, E, E+**)
- ***E/GND FAULT [50/51N]***
- ***NEGATIVE SEQ. O/C [46]*** (**E, E+**)
- ***BROKEN CONDUCTOR*** (**E, E+**)
- ***AUX TIMERS*** (**B, A, E, E+**)

Blocking of a protection function is enabled if the main configuration of protection criteria is set to "Trip-Inrush Bl" (for example: "***SETTING GROUP x/PROTECTION Gx/PHASE O/C [50/51] Gx/I>? Trip-Inrush Bl"*** submenu)

The 2nd harmonic blocking function identifies an inrush current by evaluating the ratio of the second harmonic current components to the fundamental wave. If this ratio exceeds the set thresholds, then the inrush stabilization function operates.

The minimum fundamental current value required for operation of the inrush blocking function is 0.2 In, and there is no upper limit to disable this feature.

2nd harmonic blocking operates across all phases.

Thermal Overload Protection (ANSI 49)

Applicable to PowerLogic P1F Series

~~L~~	N	B	A	E	E+

Description

The relay incorporates a current-based thermal replica, using r.m.s. load current to model heating and cooling of the protected plant. The element can be set with both alarm and trip stages.

The heat generated within an item of plant, such as a cable or a transformer, is the resistive loss (I^2R x t). Thus, heating is directly proportional to current squared. The thermal time characteristic used in the relay is therefore based on current squared, integrated over time. The relay automatically uses the largest phase current for input to the thermal model.

The equipment is designed to operate continuously at a temperature corresponding to its full load rating, where the generated heat is balanced by heat dissipated through radiation, etc.

Over-temperature conditions therefore occur when currents in excess of the rating are allowed to flow for a period of time. It can be shown that temperatures during heating follow exponential time constants and a similar exponential decrease of temperature occurs during cooling.

This characteristic is used to help to protect cables, dry type transformers (e.g. type AN), and capacitor banks.

The thermal time characteristic is given by:

$$tTrip = \mathrm{T_e} \cdot \ln\left(\frac{\left|K^2 - \theta_p\right|}{\left|K^2 - \theta_{trip}\right|}\right)$$

Where:
$tTrip$ = Tripping time (in seconds)
T_e = Thermal time constant of the equipment to be protected (in seconds)
θ_P = Steady state pre-loading thermal state before application of the overload
θ_{trip} = Trip thermal state. If the trip thermal state is set at 100%, then θ trip = 1

K = Thermal overload equal to $\dfrac{I_{eq}}{1.05 \cdot I_{therm}}$

I_{eq} = Equivalent current corresponding to the R.M.S. value of the largest phase current
I_{therm} = Setting value. It is full load current rating

The tripping time varies according to the load current carried before application of the overload, i.e. whether the overload was applied from '**hot**" or "**cold**".

The parameter settings are available in the various menus. The calculation of the thermal state is given by the following formula:

$$\theta_{\tau+1} = \left(\frac{I_{eq}}{1.05 \cdot I_{therm}}\right)^2 \left[1 - e^{\left(\frac{-t}{T_e}\right)}\right] + \theta_\tau e^{\left(\frac{-t}{T_e}\right)}$$

θ is calculated every 10 ms.

If all the phase currents are above 0.1 x I_{therm} the value of T_r (time constant for cooling) is used instead of T_e (time constant for heating):

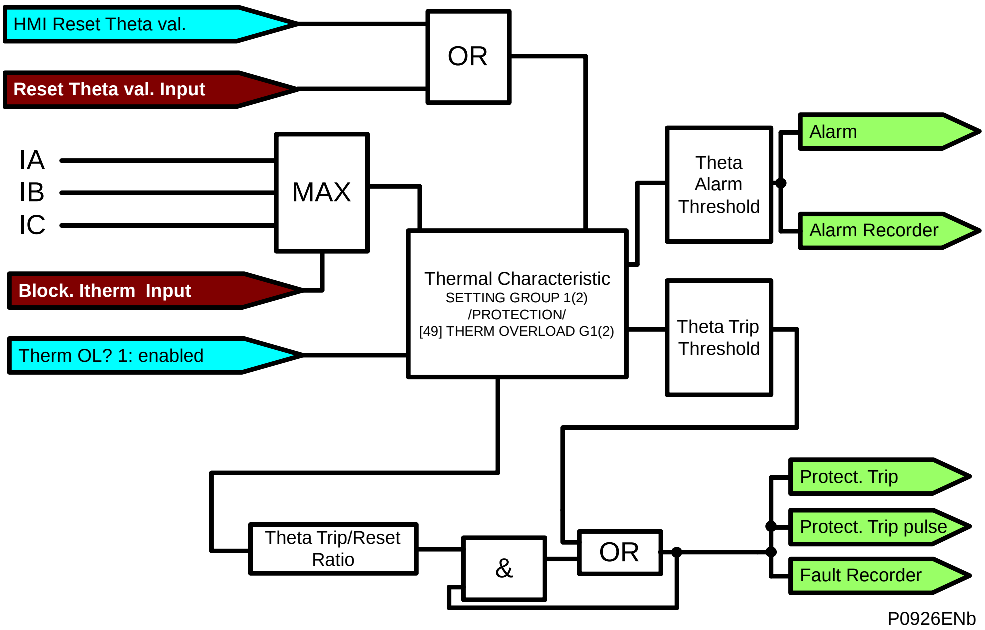
$$\theta_{\tau+1} = \left(\frac{I_{eq}}{1.05 \cdot I_{therm}}\right)^2 \left[1 - e^{\left(\frac{-t}{T_r}\right)}\right] + \theta_\tau e^{\left(\frac{-t}{T_r}\right)}$$

In a typical application (transformer, cable, ...) T_r should be equal to T_e. Different setting values of T_e and T_r are only used in motor applications.

NOTE: A current of 105% Is (kI_{FLC}) has to be applied for several time constants to cause a thermal state measurement of 100%.

Block Diagram

Figure 15. Operating principle diagram for thermal overload protection



Operation

The magnitudes of the three phase currents are compared and the largest magnitude selected as the input to the thermal overload function. If this current exceeds the thermal trip threshold setting a start condition is asserted.

Additional Functions

By default, this function is off.

Settings

Thermal Overload Protection	Authorized Values	Default Setting
Therm. OL?	Disabled, Enabled	Disabled
Itherm	0.1… 3.0 In (step: 0.01 In)	1In
Te (heating)	1… 200 mn (step: 1 mn)	40mn
Tr (cooling)	1… 999 mn (step: 1 mn)	40mn
Theta Trip	50… 200 % (step: 1%)	100%
Theta Reset Ratio	20… 99 % (step: 1%)	90%
Theta Alarm ?	Disabled, Enabled	Disabled
Theta Alarm	20… 200 % (step: 1%)	100%

Additional Info

The magnitudes of the three phase currents are compared and the largest magnitude selected as the input to the thermal overload function. If this current exceeds the thermal trip threshold setting a start condition is asserted.

The Thermal Trip signal remains high until the thermal state drops below the thermal reset threshold.

The thermal reset threshold is settable using the ***Theta Trip/Reset Ratio*** value.

The Thermal Reset Ratio is calculated:

Thermal Reset Threshold = ***Theta Trip/Reset Ratio*** x ***Theta Trip***

For ***Theta Trip/Reset Ratio*** = 90% (0.9) and ***Theta Trip***=120%:

Thermal Reset Threshold = 0.9 x 120%=108%

If the Thermal State is above the ***Theta Trip*** threshold and then drops, the Thermal Trip signal will reset when the Thermal State drops below the ***Thermal Reset Threshold***.

If ***Blocking Ithermal Input*** (**B, A, E, E+**) is in high state, for calculation Thermal Characteristic uses current value 0xIn instead of measured value.

Thermal protection also provides an indication of the thermal state in the ***MEASUREMENTS*** column of the relay. The thermal state can be reset by either an opto-input (if assigned to this function using the programmable scheme logic) or the relay menu.

The reset function in the menu is also found in the ***MEASUREMENTS*** column with the thermal state menu.

Circuit Breaker Control

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

The P1F relays includes the following options for control of a single circuit breaker:
- Local tripping and closing, via the relay menu or function keys (**L, N, B, A, E, E+**)
- Local tripping and closing, via relay binary inputs (**B, A, E, E+**)
- Remote tripping and closing, using the relay communications (**N, B, A, E, E+**)

Operation

A manual trip will be permitted provided that the circuit breaker is initially closed. Likewise, a close command can only be issued if the CB is initially open. To confirm these states, it will be necessary to use the breaker 52A (assigned to ***CB status 52A*** input (**B, A, E, E+**)) and/or 52B (assigned to ***CB status 52B*** input (**B, A, E, E+**)) contacts. Under these circumstances manual CB control will be possible, but the Auto-reclose function will not be available. Additionally, it will be not possible to see the CB status in the Control default cell.

Once a CB Close command is initiated the output contact (***Close CB order***) can be set to operate following a user-defined time-delay (***Time delay for Close*** setting in ***GLOBAL SETTINGS/CIRCUIT BREAKER*** menu). This would give personnel time to move away from the circuit breaker following the close command. This time-delay will apply to all manual CB Close commands.

The length of the trip or close control pulse can be set via the ***tOpen pulse*** and ***tClose Pulse*** settings respectively (***GLOBAL SETTINGS/CIRCUIT BREAKER*** menu). These should be set long enough to ensure the breaker has completed its open or close cycle before the pulse has elapsed.

Note: The manual trip and close commands are found in the default Control cell and the Close/Trip keys on the front panel.

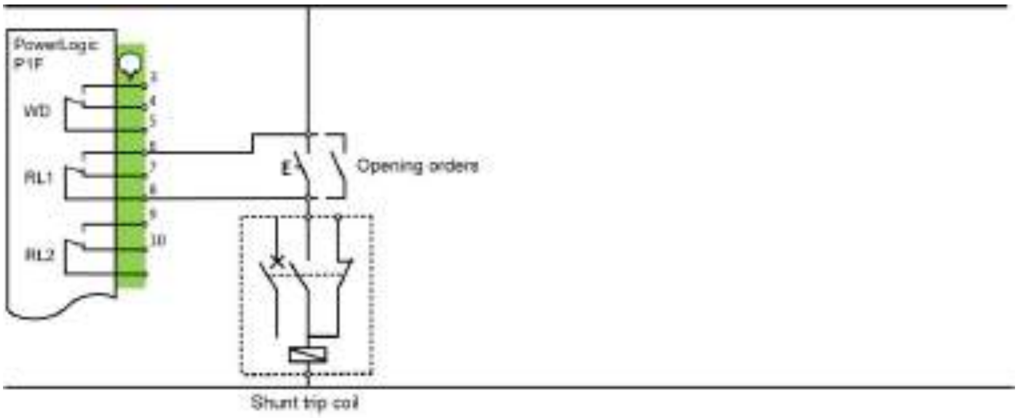
If an attempt to close the breaker is being made, and a protection trip signal is generated, the protection trip command overrides the close command.

If ***CB FLT Ext.Sign.*** (**B, A, E, E+**) is assigned to a binary input this signal is checked before manual closing of the CB. This function uses the signal received at the relay's binary input to confirm whether the breaker is capable of closing (sufficient circuit breaker energy for example). A user-settable time-delay, ***tCB FLT Ext.Sign.*** (**B, A, E, E+**), is included for manual closure. If, following a close command, the CB does not signal a healthy condition before that timer elapses, then the relay will lockout and issue an alarm.

Connection of Output RL1: Circuit Breaker Tripping

Shunt trip coil

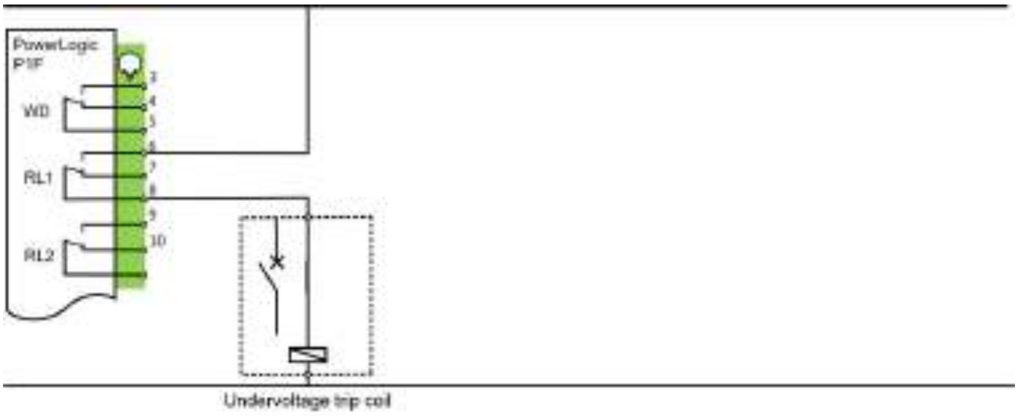
Figure 16. Shunt trip coil application



If PowerLogic P1F detects a fault, closing of the output relay RL1 normally open contact trips opening of the circuit breaker by supplying power to the shunt trip coil. This contact stays closed after the circuit breaker trips, until the fault is acknowledged.

Undervoltage trip coil

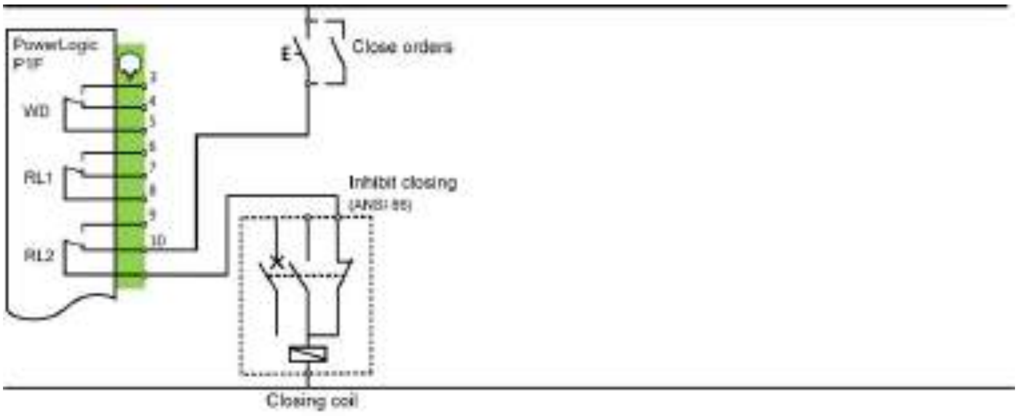
Figure 17 Undervoltage trip coil application



In this case, it is necessary to invert the control logic for output relay RL1. The normally open contact will be kept in the closed position continuously, until a fault appears. If P1F detects a fault, opening of the contact trips opening of the circuit breaker by opening the undervoltage trip coil power supply circuit. This contact stays open after the circuit breaker trips, until the fault is acknowledged.

Connection of Output RL2: Trip Lockout (ANSI 86 Function)

Figure 18.Trip Lockout diagram



If P1F detects a fault, opening of the RL2 output relay normally closed contact cuts the closing coil power supply circuit. This contact stays open after the trip order, until the fault is acknowledged. In this state, all close orders are inhibited.

Additional Functions

By default, this function is off.

Settings for Using the Function

Circuit breaker (Circuit breaker control settings)	**Authorized Values**	**Default Setting**
tOpen pulse	0.10… 10.00 s (step: 0.01 s)	0.10 s
tClose Pulse	0.10… 10.00 s (step: 0.01 s)	0.10 s
Time Delay for Close Command	0.01… 200.0 s (step: 0.01 s)	0.00 s
tCB FLT Ext.Sign.	1.00… 200.0 s (step: 1.00 s)	16 s

External Trip (Auxiliary timers)

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	B	A	E	E+

Description

Using a binary input, PowerLogic P1F relays can be used to take account of a trip order issued by an external protection device.

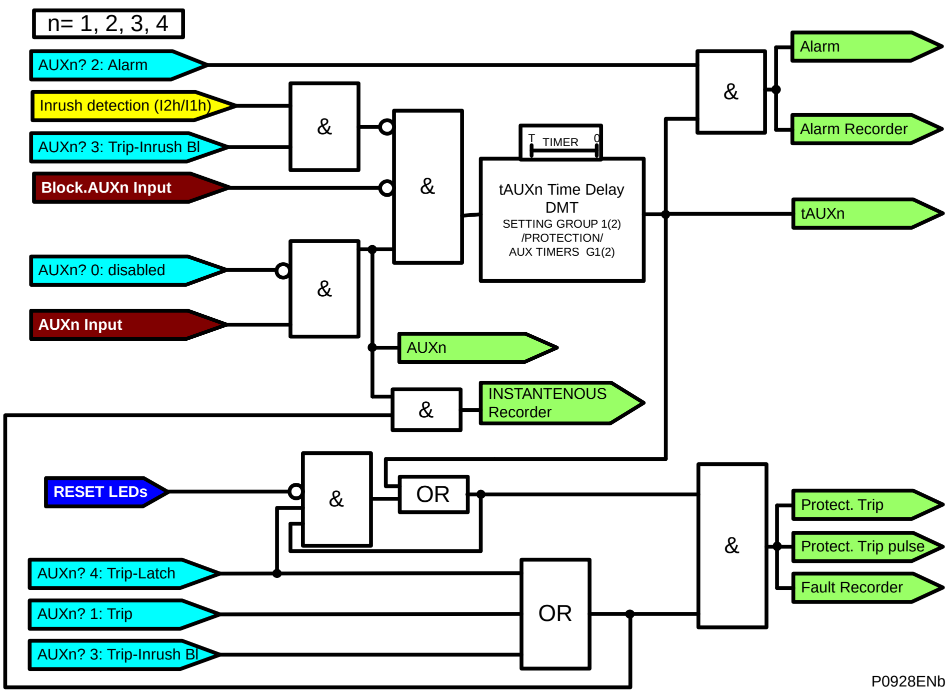
For example, specific protection devices for power transformers (Buchholz, gas-pressure-temperature detectors, etc.) can be hard-wired on an PowerLogic P1F binary input to trip the circuit breaker.

The external devices can be hard-wired directly into the circuit breaker trip circuit, but there are three advantages in connecting a PowerLogic P1F binary input:

- External trip orders will be memorized by the ANSI 86 function, integrated in the PowerLogic P1F unit. Trip lockout will apply until the fault is acknowledged.
- The trip order and its origin will be indicated on the PowerLogic P1F front panel. The trip will be saved and time tagged in the log of the last 20 faults.
- The circuit breaker trip circuit is simplified, and hence more reliable.

Block Diagram

Figure 19. Operating principle diagram for exteranal trip (auxiliary timers)



Standard Operation

Four auxiliary timers, tAux1, tAux2, tAux3 and tAux4, are available and associated with logic inputs Aux1, Aux2, Aux3 and Aux4 (refer to the ***SETTING GROUP x/INPUTS CONFIGURATION*** menu). When these inputs are energized, the associated timers start and, when the set time has elapsed, the associated LEDs (***SETTING GROUP 1(2)/LEDs CONFIGURATION*** menu) are lit or/and the associated output relays close (refer to the ***SETTING GROUP 1(2)/OUTPUT RELAYS CONFIGURATION*** menu). Time-delays can be independently set from 0 ms to 600 s.

Each auxiliary timer can be set independently to:

- ***Alarm:*** Alarm signal
- ***Trip***: Protection Trip signal
- ***Trip-Inrush Bl*** (**A, E, E+**): Protection Trip signal with inrush blocking
- ***Trip-Latch*** (**A, E, E+**)***:*** Protection Trip signal latched until it is reset via a binary input (***Reset Ltch Sign***), the HMI or a remote reset command

In the ***SETTING GROUP x/INPUTS CONFIGURATION*** (**B, A, E, E+**) menu ***AUX5*** (**B, A, E, E+**) and/or ***AUX6*** (**B, A, E, E+**) can be mapped to inputs. These input functions have no timers (instantaneous action). They can be used as bridges between inputs and LEDs or inputs and outputs. It is not possible to link this input function to a ***Trip*** or ***Alarm*** signal.

Additional Functions

By default, this function is off.

Settings for Using the Function

SETTING GROUP x/PROTECTION Gx/AUX TIMERS Gx screen:

Aux timers	Authorized Values	Default Setting
AUX1	Disabled, Trip, Alarm, Trip-Inrush Bl (A, E, E+), Trip-Latch (A, E, E+), Load Shedding (E, E+), AR after LS Hi (E, E+), AR after LS Lo (E, E+)	Disabled
tAUX1	0.00… 600.00 s (step: 0.01 s)	0.00 s
AUX2	Disabled, Trip, Alarm, Trip-Inrush Bl (A, E, E+), Trip-Latch (A, E, E+), Load Shedding (E, E+), AR after LS Hi (E, E+), AR after LS Lo (E, E+)	Disabled
tAUX2	0.00… 600.00 s (step: 0.01 s)	0.00 s
AUX3	Disabled, Trip, Alarm, Trip-Inrush Bl (A, E, E+), Trip-Latch (A, E, E+), Load Shedding (E, E+), AR after LS Hi (E, E+), AR after LS Lo (E, E+)	Disabled
tAUX3	0.00… 600.00 s (step: 0.01 s)	0.00 s
AUX4	Disabled, Trip, Alarm, Trip-Inrush Bl (A, E, E+), Trip-Latch (A, E, E+), Load Shedding (E, E+), AR after LS Hi (E, E+), AR after LS Lo (E, E+)	Disabled
tAUX4	0.00… 600.00 s (step: 0.01 s)	0.00 s

Logic Discrimination (ANSI 68)

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	B	A	E	E+

All PowerLogic P1F relays can send a logic discrimination blocking order.

Only PowerLogic P1F model **B, A, E, E+** relays can receive a logic discrimination blocking order.

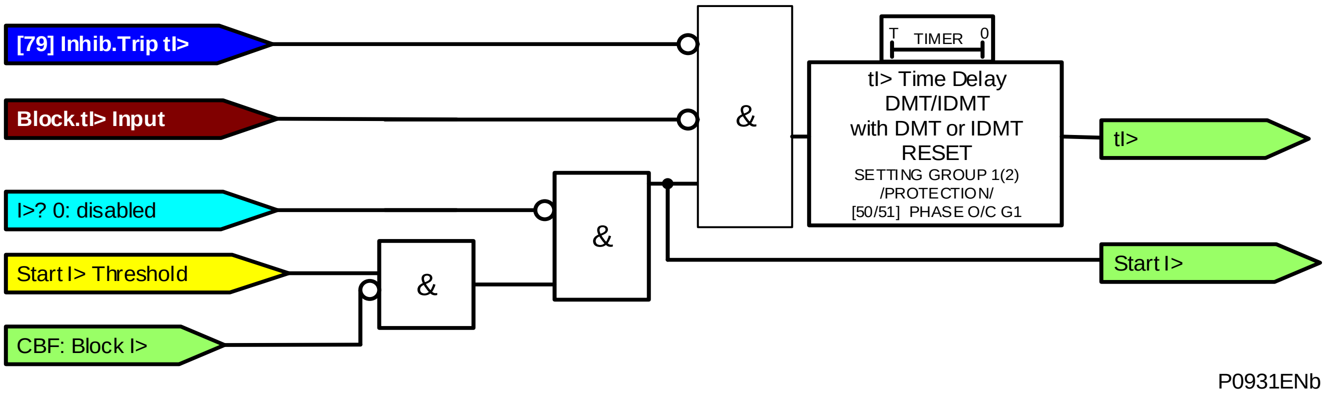
Description

The logic discrimination function can achieve a significant reduction in tripping times for circuit breakers located right next to the source. It can mitigate the disadvantages of the conventional time discrimination process.

This function exploits the hard-wiring of a logic data item between the protection functions, making it possible to block the protection upstream by protection functions located downstream. With logic discrimination, the protection settings should be fixed in relation to the element to be protected without worrying about the discrimination aspect.

Block Diagram

Figure 20. Operating principles diagram for logic discrimination



Standard Operation

Each stage of the phase protection element can be blocked via an appropriately configured binary input. Binary inputs can be assigned to the following functions (***SETTING GROUPx/INPUT CONFIGURATION Gx***):

- Block.tI> (**ABE**)
- Block.tI>> (**ABE**)
- Block.tI>>> (**ABE**)
- Block.tSOTF (**ABE**)
- Block.tIN_1 (**ABE**)
- Block.tIN_2 (**ABE**)
- Block.tIN_3 €
- Block.tI2> €
- Block.tBrkn Cond €

- Block.Itherm (**ABE**)
- Block.AUX1 (**ABE**)
- Block.AUX2 (**ABE**)
- Block.AUX3 (**ABE**)
- Block.tCB Fail (**ABE**)
- Block. [79] €

Such a configured input can be used by the blocking logic function or by a protection element disabling function (Auto-reclose I, CB Fail or AUX (ABE)).

The blocking logic function can be applied to radial feeder circuits where there is little or no back feed. For parallel feeders, ring circuits or where there can be a back feed from generators, directional relays should be considered.

The blocking logic function allows the upstream IDMT relay to be blocked by the start output of a downstream relay that has detected the presence of a fault current above its threshold. Thus both upstream and downstream relays can have the same current and time settings, and the blocking feature will automatically provide grading.

If in ***SETTING GROUPS x/PROTECTION Gx/[[50BF] CB Fail*** the function: ***Block I> (IN>)?*** I is set to ***0: Yes*** and the Circuit Breaker Fail protection is enabled, the blocking command on the upstream relay will be removed if the downstream circuit breaker fails to trip.

Additional Functions

By default, this function is off.

Settings for Using the Function

Logic discrimination	Authorized Values	Default Setting
Sel1	Disabled, Enabled.	Disabled
tSel1	0.00… 600.00	0.40
Sel2	Disabled, Enabled.	Disabled
tSel2	0.00… 600.00	0.40

Operating Language

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

The default language is English.

Settings

Selection of the operating language can be accessed in the parameter's menu. The parameter to be set is ***GLOBAL SETTINGS/LOC/LANGUAGE*** screen.

For ordering options: REL15000, REL15001, REL15002, REL15003, REL15004, REL15005, REL15006, REL15007, REL15008, REL15009, REL15010, REL15011, REL15012, REL15013, REL15014, REL15015, REL15016, REL15017, REL15020, REL15021, REL15022, REL15023.

GLOBAL SETTINGS/LOC/Language menu cell

Language	Authorized Values	Default Setting
Language (L, N, B, A, E, E+)	English, German French Spanish Russian Turkish Portuguese Polish	English

For ordering options (EAC marking): REL15007R, REL15009R, REL15011R, REL15013R, REL15021R, REL15023R.

GLOBAL SETTINGS/LOC/Language menu cell

Language	Authorized Values	Default Setting
Language (B, A, E+)	English, German French Spanish Russian Turkish Portuguese Polish	English

For ordering options: REL15006C, REL15007C, REL15008C, REL15009C, REL15014C, REL15015C, REL15016C, REL15017C.

GLOBAL SETTINGS/LOC/Language menu cell

Language	Authorized Values	Default Setting
Language (B, E)	English, Chinese	English

Trip Circuit Supervision (TCS)

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	~~B~~	A	E	E+

Description

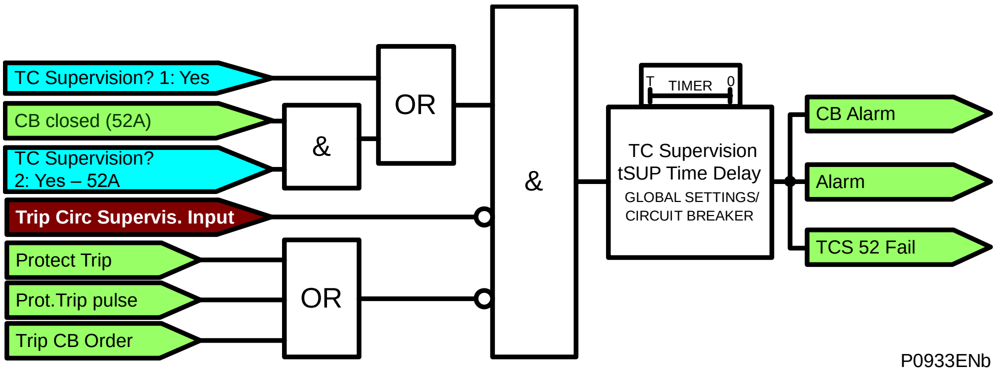
The trip circuit extends beyond the relay's enclosure and passes through more components, such as fuses, wires, relay contacts, auxiliary switch contacts and so on.

These complications, coupled with the importance of the circuit, have directed attention to its supervision.

The simplest arrangement for trip circuit supervision contains a healthy trip lamp in series with a resistance placed in parallel with the trip output relay contacts of the protection device.

Block Diagram

Figure 21. Operating principle diagram for trip circuit supervision



Standard Operation

The Trip Circuit Supervision function included in the **PowerLogic P1F** relays is described below:

A logic input is programmed to the ***GLOBAL CONFIGURATION/CIRCUIT BREAKER/TC Supervision*** function. The logic input is associated to the label ***Trip Circ Supervis.*** Within the ***SETTING GROUPx/INPUT CONFIGURATION Gx*** menu. Then, this logic input is wired in the trip circuit according to one of the typical application diagrams shown in the following example.

When the TC Supervision function is set to ***Yes*** under the ***CIRCUIT BREAKER*** sub-menu, the relay checks continuously on trip circuit continuity whether the CB's status is open or closed.

When the TC Supervision function is set to ***Yes-52A*** under the ***CIRCUIT BREAKER*** sub-menu, the relay checks continuously on trip circuit continuity in case when the CB's status is closed only.

The TC Supervision function is enabled when the ***Protect.trip*** or ***Trip CB order*** output is not energized. The ***TC Supervision*** function is not enabled when the ***Protect.trip*** or ***Trip CB*** is energized.

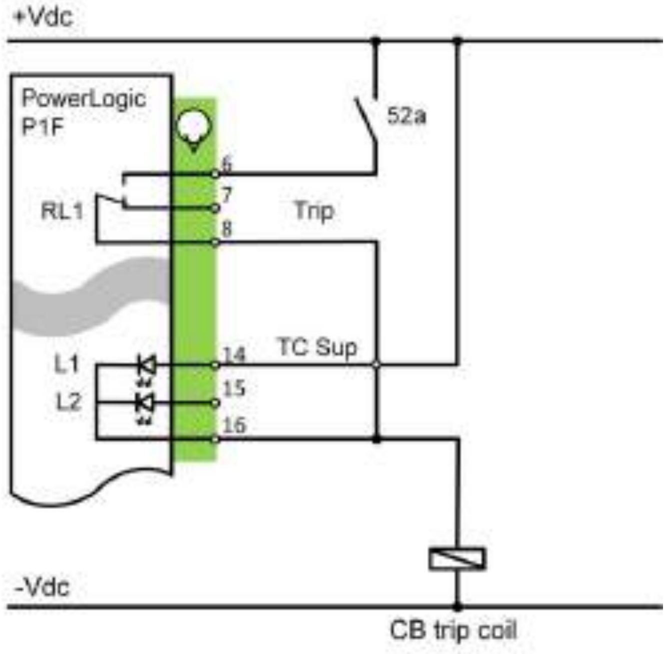
A ***TCS 52 Fail*** and ***CB Alarm*** output function, ***TCS Supervision Alarm*** and ***CB Alarm*** LEDs function signal is generated if the logic input detects no voltage signal during a time longer than the settable timer ***tSUP*** (in ***GLOBAL CONFIGURATION/CIRCUIT BREAKER*** menu).

As this function is disabled when the ***Protect.trip*** or ***Trip CB order*** output is energized, this function is suitable for use with the enabled relay latching logic.

Example 1

In this example only the 52a auxiliary contact is available, the PowerLogic P1F relay monitors the trip coil whatever the CB status is (CB open or CB closed).

Figure 22. Example 1 – Trip Coil Monitoring

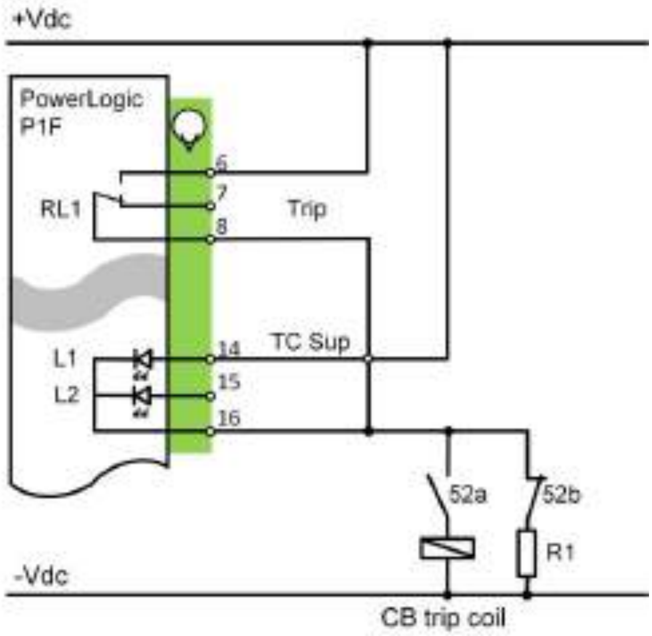


Example 2

In this example both 52a and 52b auxiliary contacts are available; the PowerLogic P1F relay monitors the complete trip circuit when the CB is closed and a part of the trip circuit when the CB is open.

In this case it is necessary to insert a resistor R1 in series with 52b, if either the output trip is latched or if it stays accidently closed, or if a long-time trip pulse is programmed.

Figure 23. Example 2 – Trip Coil and Auxiliary Contact Monitoring

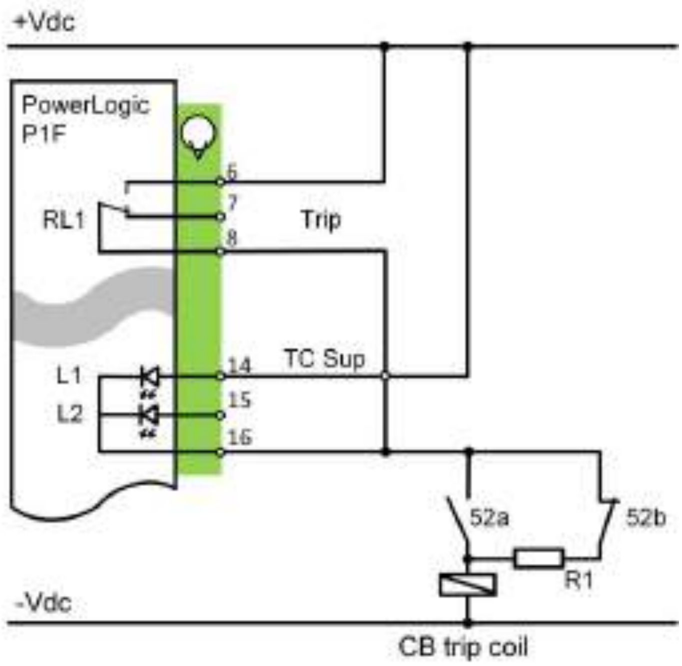


Example 3

In this example both 52a and 52b auxiliary contacts are available, the PowerLogic P1F relay monitors the complete trip circuit whatever the CB status (CB open or CB closed).

In this case it is necessary to insert a R1, if either the output trip is latched, or if it stays accidently closed, or if a long-time trip pulse is programmed.

Figure 24. Example 3 – Trip Coil and Auxiliary Contact Monitoring Whatever the Position of the CB contacts



External Resistor R1 Calculation

The calculation of the R1 resistor value will consider the fact that a minimum current is flowing through the logic input. This minimum current value is a function of the relay auxiliary voltage range (U_{aux}).

<u>1 – Case of example 2</u>:

The R1 resistor maximum value (in Ohm) is defined by the following formula:

$$R1 < \frac{0.8 \times U_{aux} - U_{min}}{I_{min}} \, \Omega$$

Where:

U_{aux} = auxiliary voltage value (in this case a DC voltage; range is given on label under the top hinged cover. See table below).
U_{min} = input limit voltage at state 1 (see table on page 316).
I_{min} = minimum current value needed for the opto logic input to operate.
$I_{min} = U_{min}/R_{input}$

Relay auxiliary voltage range (U_{aux})	
24-60 Vdc (ordering code P1F1Enhxxxxxx**1**xxxxxxx)	90-250 Vdc/ac (ordering code P1F1Enhxxxxxx2xxxxxxx)
R1 < (0.8 x U_{aux} – 19V)/ (19V/6000Ω)	R1 < (0.8 x U_{aux} – 72V)/ (72V/109000Ω)

The R1 resistor withstand value (in Watt) is defined below:

$$P_{R1} > 2 \times \frac{(1.2 \times U_{aux})^2}{R1} \text{ Watts}$$

<u>2 – Case of example 3:</u>

The R1 resistor maximum value (in Ohm) is defined by the following formula:

$$R1 < \frac{0.8 \times U_{aux} - U_{min}}{I_{min}} - R_{coil} \;\; \Omega$$

Where:

U_{aux} - auxiliary voltage value (in this case a DC voltage; its range is given on the
label - under the top hinged cover. See table below.)
U_{min} - internal minimum voltage value needed for the opto-input to operate.
I_{min} - minimum current value needed for the opto-input to operate.
R_{coil} - trip coil resistance value.

Relay auxiliary voltage range (U_{aux})	
24-60 Vdc	90-250 Vdc/ac
R1 < (0.8 x U_{aux} – 19)/(19V/6000Ω) – R_{coil}	R1 < (0.8 x U_{aux} – 72)/ (72V/109000Ω) – R_{coil}

The R1 resistor withstand value (in Watt) is defined below:

Notes:

– The presence of auxiliary relays, such as an anti-pumping system for instance, in the trip circuit must be considered for the R1 resistance values specification.
– We consider that the maximum variation of the auxiliary voltage value is ±20%.

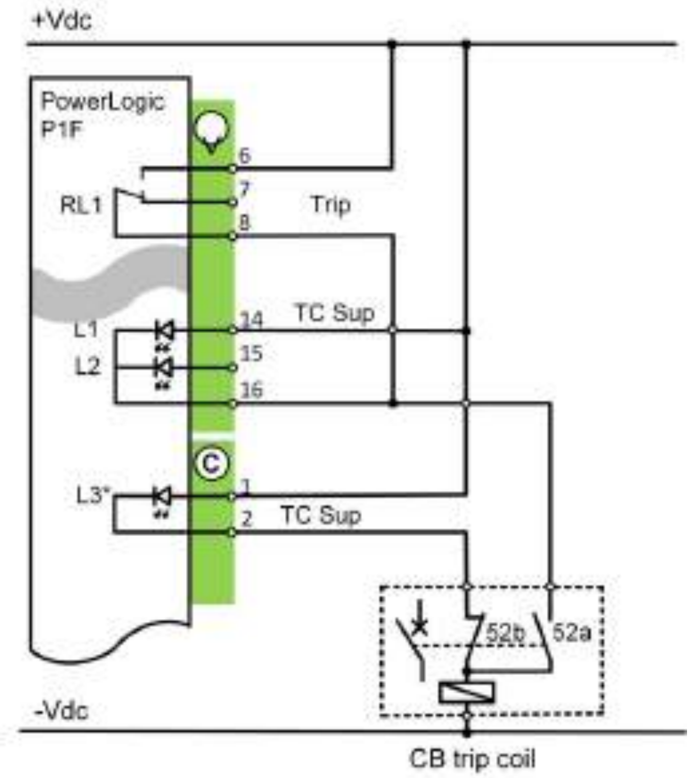
Example 4

In this example both 52a and 52b auxiliary contacts are available, the PowerLogic P1F relay monitors the complete trip circuit whatever the CB status (CB open or CB closed).

This application needs to assign two Binary Inputs to one ***TC Sup.*** Input logic function.

In this case it is necessary to insert a RL1, if either the output trip is latched, or if it stays accidently closed, or if a long-time trip pulse is programmed.

Figure 25. Example 4 – Trip Coil and Auxiliary Contact Monitoring by using two Binary Inputs



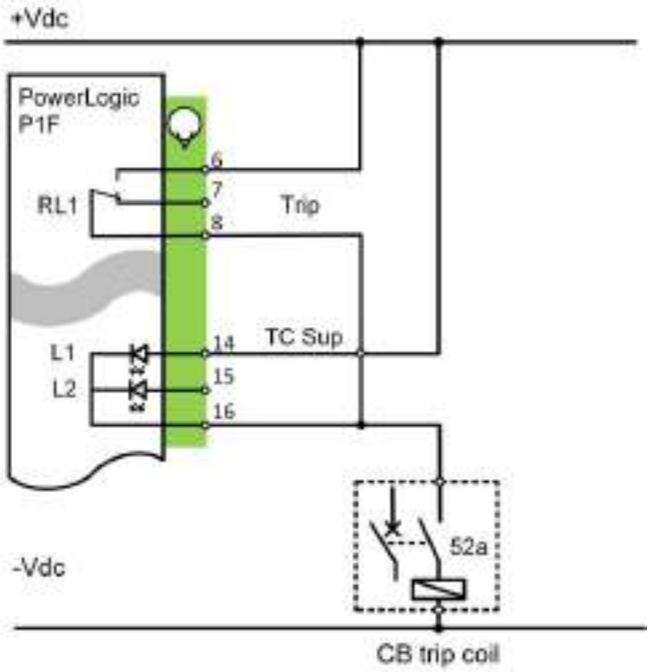
Example 5

In this example 52a auxiliary contacts is available, the PowerLogic P1F relay monitors the complete trip circuit if the CB status is closed.

This application needs to assign one Binary Input to ***TC Sup.*** Input logic function.

In this case it is necessary to insert a RL1, if either the output trip is latched, or if it stays accidently closed, or if a long-time trip pulse is programmed.

Figure 26. Example 5 – Trip Coil and Auxiliary Contact Monitoring by using two Binary Inputs



Additional Functions

By default, this function is off.

Settings

GLOBAL SETTINGS/CIRCIUT BREAKER/TC Supervision screen

Logic discrimination	Authorized Values	Default Setting
TC Supervision	No Yes Yes-52a	No
tSUP	0.100… 10.00 s	0.500 s

Date and Time

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

PowerLogic P1F 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 200 events function
- To other time-tagged events (Fault recorder), which can be accessed via the communication

If the relay is powered from auxiliary voltage then the internal clock is maintained from this voltage. In the event of failure of the PowerLogic P1F auxiliary power supply, the internal clock is maintained by a backup capacitor (no battery inside). If the backup capacitor will be discharged (161pprox.. after 72hours without voltage), the internal clock will reset itself to 01/01/2015 00:00:00.

NOTE: Operation of the protection functions is not affected by the charged or discharged of the backup capacitor.

Settings

The date and time setting can be accessed in the ***OP PARAMETERS*** menu.

The parameters to be set are:

- Date setting (***Date*** menu cell)
- Time setting (***Time*** menu cell)

The date and time setting in the parameter's menu is not considered when the PowerLogic P1F date and time are synchronized via the communication.

Password

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

The password protection of the relay comprises three levels:

– ***Configurator*** (Administrator) – all the menu settings may be changed. On this password level all programmable LEDs (from 3 up to 7 LEDs) sequential flashing.

– ***Operator*** (Protection setting) – it is possible to change settings in the ***PROTECTION*** column; ***CTRL Default Windows (CB status CTRL, L/R status CTRL, [79] CTRL)*** and ***COMMISSIONING/Maintenance Mode*** windows are also possible. On this password level all programmable LEDs (from 3 up to 7 LEDs) sequential flashing.

– ***User*** (Control only) – this level is used for tests and/or control execution only (no changing of setting parameters) so signaling of ***SETTING CHANGE MODE*** differs from above. On this password level all programmable LEDs (from 3 up to 7 LEDs) flashing in the same time.

All password levels are additionally signaled by the special sign: , which informs that change settings or controls (depend on password level) are allowed.

For each level the password consists of 4 digits (0 to 9)

NOTE: The default password for each password level:

1. **Configurator – 0002**
2. **Operator – 0001**
3. **User – 0000**

It is recommended to change default passwords from 0000, 0001, 0002 to unique value for every password level.

If the first password is different, this means that the *Configurator* password has been changed.

The *Operator* password is still 0000. Therefore, to help to protect settings against unauthorized access it is necessary to change the *Protection setting* password by first entering 0000 then a new value.

The User password is still 0000. Therefore, if it is necessary to change it, first enter 0000 then the new value (*Control* right) of the password.

Notes: 1. If the *Operator* rights have not been changed, or if it has been set to the default value (0000), it is possible to change all the settings in the ***PROTECTION*** column, reset the counters and control the CB without entering a password, simply by pressing the OK navigation key. This makes it possible to change a chosen parameter by automatically switching the P1F to the ***SETTING CHANGE MODE*** (the programmable LEDs are flashing). This means that even after changing only one parameter it is necessary to switch the P1F back to ***PROTECTION MODE*** in order to activate the new settings (warm restart).

2. If the *User* rights password has not been changed or if it has been set to the default value (0000) it is possible to control the CB in menu without password protection.

Additional Functions

SETTING CHANGE MODE

The ***SETTING CHANGE MODE*** should be used to change settings.

Using the ***SETTING CHANGE MODE*** helps to ensure that all changed parameters will be applied simultaneously so as to avoid any problems caused by possible setting inconsistencies.

The ***SETTING CHANGE MODE*** makes it possible to change settings while the relay is active without any risk (the P1F continues to use the previous settings).

After exiting the ***SETTING CHANGE MODE,*** a warm reset of firmware is applied so that all the protection counters are reset.

Note: Latched LEDs and outputs are reset (stored values are cleared during a P1F reset).

To switch the P1F to the ***SETTING CHANGE MODE*** navigate to the ***SETTING CHANGE MODE*** main header, then press the key:

```
Edit settings?
Enter PSWD
```

Press the OK navigation key.

```
Edit settings?
Enter PSWD 0000
```

The 0 digit furthest to the right is flashing.

Enter the password:

1. If the digit is flashing, change the digit to the required value by pressing the key or the key.
2. Change the flashing digit by pressing the key or key.
3. Continue as above to set the whole password (4 digits)
4. If the correct password is set, press the OK navigation key

The LCD displays 'OK' during approximately 1 second, then the new ***SETTING CHANGE*** cell is displayed:

If the password entered is for:

- *Configurator* rights:

```
Setting change:
Configurator
```

To indicate that the P1F is in ***SETTING CHANGE MODE*** on the level: ***Configurator*** the programmable LEDs are sequential flashing

- *Operator* settings:

```
Setting change:
Operator
```

To indicate that the P1F is in ***SETTING CHANGE MODE*** on the level: ***Operator*** the programmable LEDs are sequential flashing

- *User* only:

```
Setting change:
User
```

To indicate that the P1F is in ***SETTING CHANGE MODE*** on the level: ***User*** the programmable LEDs are flashing (all LEDs in the same time). ***User*** mode is active by 5 minutes only (since the last menu activity). After this time the relays automatically leaves this mode.

The screen displays the scope of the current modification rights.

At this time, it is possible to start changing the setting parameters.

Note: The parallel pressing: and keys it makes jump from any place to:

```
Edit settings?
 Enter PSWD
```

the menu cell in which the password can be entered (hot keys).

If all settings are changed, it is necessary to return to ***PROTECTION MODE*** to apply a warm reset.

Press the and keys simultaneously to jump to the following cell:

```
Edit settings?
Exit:press ENTER
```

Press the OK navigation key to apply a warm reset and display the following cell:

```
Setting change:
       Protected
```

The programmable LEDs stop flashing. The P1F is in ***PROTECTION MODE***.

Note: In ***SETTING CHANGE MODE*** all functions use the previously stored settings (before the ***SETTING CHANGE MODE*** was entered).

Changing of a single setting parameter

- Go to the required setting cell.

- Press the HMI OK key:

```
Edit settings?
Enter PSWD 0000
```

Enter the password and then press OK navigation key to confirm the password and switch to ***SETTING CHANGE MODE***.

- Press OK navigation key to enter the chosen setting parameter.

- Set the required value.

- Confirm the change by pressing the OK navigation key.

- Switch from ***SETTING CHANGE MODE*** to ***PROTECTION MODE***.

Changing the password

To change the password, first enter the existing password to obtain the appropriate password protection rights.

Press the key to display the following cell:

```
Change Password
```

Press *the* OK navigation key, to display:

```
Change Password
           0000
```

Enter the new password.

Press OK navigation key to confirm the new password and jump to the cell displaying information on protection rights.

Switch from ***SETTING CHANGE MODE*** to ***PROTECTION MODE***. After this the settings are password-protected and the P1F is in ***PROTECTION MODE****.* Additionally the programmable LEDs stop flashing.

Watchdog Relay

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

PowerLogic P1F

PowerLogic P1F relays are equipped as standard with a watchdog relay (WD, terminal numbers A3-A4-A5, see Installation chapter). This is a changeover relay output which is kept permanently in the on-position (A3 – A5) by PowerLogic P1F. In the event of PowerLogic P1 failure, or if the auxiliary power supply fails, the watchdog relay reverts to the off-position.

Note: In special application watchdog relay (normally open terminals A4-A5) can be used as typical relay outputs. In this case to WD relay can be assigned ***Alarm*** signal only from ***SETTING GROUP x/OUTPUT RELAYS CONFIGURATION Gx*** signals. This ***Alarm*** signal comes from protection function set on ***Alarm*** only.

When WD relay is used as typical WD contacts (not assigned ***Alarm*** signal to WD) then WD status in ***COMMISSIONING/RELAY O/P Status*** cell is not visible.

Auto-Reclose (ANSI 79)

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	~~B~~	~~A~~	E	E+

Description

The auto-reclose function is enabled in the ***SETTING GROUP x/PROTECTION Gx/[79] AUTORECLOSE Gx*** menu. The current state of the auto-reclose function is shown in the default Autoreclose cell of the menu:

```
[79]: Ready
CTRL: no operation
```

The first line informs about the current state of the auto-reclose function. The following can be displayed:

- ***[79] Ready*** – The auto-reclose function is unblocked and ready to operate.
- ***[79] In progress*** – An auto-reclose cycle is in progress.
- ***[79] Tempor.Block***. – The auto-reclose function is temporary blocked after Closing of CB (from RS485, Front Panel or via configured Binary Input) during ***Inhibit Time tI on Close*** (***GLOBAL SETTINGS/[79] ADVANCED SETTINGS/Inhibit Time tI on Close***). Also, temporary blocking feature is activated when breaker closes (either 52a contact energizes or 52b contact de-energizes) and [79] – IN PROGRESS is inactive. In this way the temporary blocking feature will not be activated when the [79] function initiates the reclose, only when its manually done by an operator who turns a control switch.
- ***[79]: Lockout*** – The auto-reclose function is internally blocked up to reset signaling (Input assigned to ***Reset Latched Signals***, ***C*** clear key on the front panel, ***Reset Latched Signals*** via RS485, closing of CB command via P1F or ***Unlockout*** command in CTRL line).
- ***[79] Block:CTRL***. – The auto-reclose function is blocked via the communication port or from P1F menu via the Auto-reclose default cell (CTRL line)
- ***[79] Block:Input*** – The auto-reclose function is blocked via a binary input assigned to this effect.
- ***[79] Disabled*** – The auto-reclose function is disabled in the ***SETTING GROUP x/PROTECTION Gx/AUTORECLOSE Gx [79]*** submenu.

There are two menu columns in which the Auto-reclose function can be configured:

- ***SETTING GROUP x/PROTECTION Gx/AUTORECLOSE Gx [79]*** – separate settings for each setting group,
- ***GLOBAL SETTINGS/ [79] ADVANCED SETTING*** – common settings for all setting groups.

The Auto-reclose function of the PowerLogic P1F is available only if the following conditions are verified:

- The auxiliary contact of the CB status, 52a or 52b, must be connected to the relay. Refer to the ***SETTING GROUP Gx/INPUTS CONFIGURATION Gx*** menu.
- The auto-recloser is ready for operation (neither disabled nor blocked). The Autoreclose default cell should display: ***[79]: Ready***.
- The trip output relay must be set to ***Prot.Trip pulse*** (recommended if an output contact is used) or/and ***Protect Trip*** (if an energy trip output is used) and not latched in the protection element's settings (for example I***>? Trip-Latch***). The trip output must not be latched either.

- The ***Close CB Order*** command must be assigned to the close CB output. The close contact output must not be latched.
- In the ***SETTING GROUP x/PROTECTION Gx/AUTORECLOSE Gx [79]*** menu all settings are properly configured.

NOTE: If the auxiliary supply is lost during an auto-reclose cycle, the auto-reclose function is totally disabled.

In addition to ***[79] AUTORECLOSE Gx*** settings, the user will be able to fully link the auto-reclose function to the protection function using the menus:

- ***SETTING GROUPS x/PROTECTION Gx/[50/51] PHASE O/C Gx***,
- ***SETTING GROUPS x/PROTECTION Gx/[50/51N] E/GND FAULT Gx,***
- ***SETTING GROUPS x/PROTECTION Gx/AUX TIMERS Gx.***

Logic Inputs

The auto-reclose function has four inputs that can be assigned to the auto-reclose logic. These inputs can be mapped to opto-isolated inputs in the ***SETTING GROUP x/PROTECTION Gx/INPUTS CONFIGURATION Gx*** menu. External contacts can then be wired to these inputs and influence the auto-recloser scheme. These four logic inputs are:

- one external ***CB FLT Ext Sign***. – external information that CB is not ready to close (a spring not charged, too low level of CB gas, etc.),
- ***AUX 1*** or ***AUX 2*** assigned to trip and [79] shots – the external starting commands,
- ***Block [79]*** – the external blocking command (for example: an external switch).

Logic Description

The auto-reclose function makes it possible to automatically control the CB's reclosing cycles (two, three or four shot cycle, settable using the ***Close Shot?*** Parameter – separate for each protection element (***SETTING GROUP x/PROTECTION Gx/[79] AUTORECLOSE G1(2)*** menu).

Dead times for all the shots (reclose attempts) can be independently adjusted.

The number of shots is directly related to the types of fault likely to occur on the system and the voltage level of the system (for instance medium voltage networks).

The Dead Time (tD1, tD2, tD3 and tD4) and the minimum drop-off time start when the CB has tripped (when the 52a input has dropped off – ***Start Dead t on 1: CB trips*** or the protection element has reset – ***Start Dead t on 0: Protect.Reset*** configuration option). The Dead Time is set to initiate the auto-recloser when the circuit breaker is opened.

At the end of the relevant dead time the close command (***Close CB Order***) is executed and the CB supervision timer is started. The length of this timer is equal to: ***tClose Pulse*** (***GLOBAL SETTINGS/CIRCUIT BREAKER***) + 150 ms (***Auto-reclose CB Supervision*** logic). If the CB is not closed after this time-delay, the auto-recloser is locked out (***[79] Lockout***) and the Alarm is issued (***Alarm CB Time Monitor***).

The reclaim time (***Reclaim Time tR***) starts when the CB has closed. If the circuit breaker does not trip again, the auto-reclose function resets at the end of the reclaim time.

If a protection element operates during the reclaim time, the relay either advances to the next shot programmed in the auto-reclose cycle, or it locks out (see ***Inhib.Trip*** function description).

The total number of reclosures is displayed in the ***RECORDS /COUNTERS/ AUTORECLOSE COUNTER*** menu cell.

Standard Operation

The auto-reclose function provides the ability to automatically control the recloser, with one, two, three, or four shot cycles. Each cycle implements a dead time and a reclaim time.

During the auto-reclosing cycle, if the relay receives a command to switch setting groups, this command is kept in memory, and will be executed only after the timer elapses.

The auto-reclose function is available if:

- a logical input is assigned to the 52a state (if the ***CB trips*** option is set in submenu: ***GLOBAL SETTINGS/[79] ADVANCED SETTINGS/Start Dead t on***)
- and the trip output relay is not latched to the earth and/or phase protection element.

In addition to these settings, the user can fully link the auto-reclose function to the protection function using the menus ***PROTECTION G1 / Phase OC*** and ***PROTECTION G1/ E/Gnd***.

Additional Functions

External CB faulty signal

Most circuit breakers provide one trip-close-trip cycle. A time-delay is necessary for the CB to return to its nominal state (for example, the spring that allows the circuit breaker to close should be fully charged). The state of the CB can be checked using an input assigned to the ***CB FLT Ext.Sign.*** function. If the ***CB FLT Ext.Sign.*** signal is detected during Closing time, the Auto-reclose Close Command is interrupted and blocked and the CB remains open. In this case the Autorecloser will be Lockout by not successful close command monitored by ***Auto-reclose CB Supervision*** logic (it's separate function to ***CB Supervision*** in ***GLOBAL SETTINGS/CIRCUIT BREAKER*** column). If, on completion of the ***tCB FLT ext*** time (***GLOBAL SETTINGS/CIRCUIT BREAKER*** submenu), the **CB FLT ext** (Alarm) indicates a failed state of the CB, a lockout occurs and the CB remains open.

External Starting Commands

Two independent and programmable inputs (AUX1 and AUX2) can be used to initiate the auto-reclose function from an external device (such as an existing overcurrent relay). These logic inputs may be used both independently and in parallel with the overcurrent elements.

Note:

1. The input must be assigned to an AUXx function (***SETTING GROUPx/INPUTS CONFIGURATION Gx***),

2. AUXx must be set to ***Trip*** (***SETTING GROUP x/PROTECTION Gx/AUX TIMERS Gx/AUXx?***) and time-delay ***tAUXx*** must be configured (instantaneous: ***tAUXx*** set to 0 s),

3.The ***tAUXx Close Shot*** cell must be set for every cycle (Close shot).

Internal and External Blocking Commands

The auto-recloser can be blocked by an internal or an external control. It can be used when protection is needed without requiring the use of the auto-reclose function.

The external block is executed by the ***Block. [79]*** input, Blocking via RS485, [79] default cell in CTRL line, or temporary blocked after a close command made by an operator until ***Time Inhibit tI on Close*** set in ***GLOBAL SETTINGS/ [79] ADVANCED SETTINGS*** column.

The internal block can be executed by a final trip, a number of valid A/R rolling demands or an A/R conflict.

A typical example is on a transformer feeder, where the auto-recloser may be initiated from the feeder protection device but needs to be blocked on the transformer protection side.

Auto-reclose Output Information

The following output signals can be mapped to an LED (see ***SETTING GROUP x /LEDS CONFIGURATION Gx*** menu) or to output relays (see ***SETTING GROUP x/OUTPUT RELAYS CONFIGURATION Gx*** menu) in order to provide information about the status of the auto-reclose cycle:

- Auto-reclose cycle in progress
- Final Trip
- Internal block
- External block
- Auto-reclose successful

The following table gives the ***SETTING GROUP x /LEDS CONFIGURATION Gx*** and the ***SETTING GROUP x/OUTPUT RELAYS CONFIGURATION Gx*** menus used to assign the auto-reclose output signal.

	LEDs menu	**Output relays menu**
Auto-reclose in progress	***[79] in Progress***	***[79] in Progress***
Final Trip	***[79] Trip Final***	***[79] F.Trip Final***
Internal block	***[79] Lockout***	***[79] Lockout***
External block	***[79] Blocked***	***[79] Blocked***
Auto-reclose successful	***[79] Success.***	***[79] Success.***

Auto-reclose in Progress

The **Auto-reclose in progress** signal is present during the complete reclosing cycles from protection initiation to the end of the reclaim time or lockout.

Final Trip

The **Final trip** signal indicates that a complete auto-reclose cycle has been performed and that the fault has not been cleared.

The **Final trip** signal can be reset after a manual closing of the CB after the settable ***Inhibit Time tI on Close*** (***GLOBAL SETTINGS/ [79] ADVANCED SETTING***) time-delay or reset via a Reset Command (assigned Binary Input, RS485 Reset Latched Signaling command, C clear key).

Auto-reclose Inhibit Trip

Freely settable the inhibit of the trip after closing command issued via the [79], set separately for each protection element:

tI>, tI>>, tI>>>, tIN_1, tIN_2, tIN_3, tAUX1, tAUX2

The trip inhibit is used for following cases:

- e/f protection in neutral-insulated or compensated systems. The [79] can clear a non-permanent fault in the first cycles. If it will be permanent fault, there will be no the final trip up to reset of the protection trip. For 4-cycle [79]: ***Inhibit Trip 1000*** setting. In the first three cycles (***000***) the trip is executed to allow fault clearance, but the last one (***1***) is with inhibition, so no trip is executed in case of permanent fault).

- application where for example the setting for the I> stage covers more than the protected zone, so that the [79] can clear faults downstream too, but the final trip will be executed by the downstream relay or a fuse, therefore in the upstream relay, tI> should be inhibited – waiting for tI>> trip of the downstream relay).

Note: for this case ***Fast Trip O/C*** function can be used too (see below).

Inhibit Trip setting:

- ***0***: means that after close via the [79], the protection element trip will be not inhibited (function is disabled).
- ***1***: means that after close via the [79], the protection element trip will be inhibited.

It is recommended to set another protection stage with setting for Alarm only, to inform that this fault was not cleared by autorecloser so it’s still present (tripping from this protection element is inhibited). For above case when the auto-reclose is successful, the reset of inhibition is applied after reset of protection stage (current below the stage value). For another case when during inhibition of protection element, another protection element (set to run [79]) makes a trip after going to the next cycle (the next [79] close command is executed) the inhibition is reset and the further action depends on the configuration:

if in the next cycle this protection element is still set with inhibition, the protection element is still inhibited

if in the next cycle this protection element is not set with inhibition, but the fault is still not cleared, this protection element will trip CB (If another protection element moves auto-reclose to the next cycle, the inhibition is removed automatically and [79] logic checks configuration for the next [79] shot).

Auto-reclose Fast Trip

On circuits using time-graded protection, the auto-recloser allows the use of instantaneous (fast) protection (***Fast O/C Trip*** function in ***SETTING GROUP x/PROTECTION Gx/AUTORECLOSE Gx [79]*** menu) to issue a high speed first trip. With fast tripping, the duration of the power arc resulting from an overhead line fault is reduced to a minimum, thus lessening the chance of damage and of the transient fault developing into a permanent fault. To avoid maloperation because of transients, it is possible to assign a short time-delay to the fast trip: ***Fast O/C Trip Delay*** setting (***SETTING GROUP x/PROTECTION Gx/AUTORECLOSE Gx [79]*** menu column) above the typical transient time value. The fast trip can be associated with phase-to-phase faults (***Fast O/C Trip***) and/or earth faults (***Fast E/Gnd Trip***), separately for every shot in the auto-reclose sequence. If in ***Fast O/C Trip*** configuration the setting for chosen trip shot is ‘ ***0*** ‘, the trip is executed after the time-delay of the protection element. If it is set to ‘ ***1*** ‘, the time-delay set in the ***Fast O/C Trip Delay*** menu cell is applied. In some regions the typical setting of the fast trip for a 2-shot AR is set:

- ***Fast O/C Trip*** (trip shots): ***00011*** (The first and second trips with ***Fast O/C Trip Delay*** to reduce to minimum the resulting power arc; The third – final – trip after the time-delay of the protection element to help to ensure the grading in the power system – trip selectivity)
- ***Fast E/GND Trip*** (trip shots): 00000 (all trips re executed after the time-delays of the protection elements).

Fast O/C Trip – refers to all O/C stages in the PHASE O/C menu column: I>, I>>, I>>>.

Fast E/GND Trip – refers to all E/GND stages in the ***PHASE E/GND*** menu column: ***IN_1***, ***IN_2***, ***IN_3***.

Fast O/C (E/GND) Trip Delay is associated with a DMT characteristic even if the protection element is set to an IDMT characteristic. For the fast trip the reset time-delay of the protection element is not applied.

Auto-reclose Inhibit after Manual Closing

The ***Inhibit Time tI on Close*** timer (***GLOBAL SETTINGS/[79] ADVANCED SETTING)*** can be used to block the auto-reclose cycle being initiated after the CB has been manually closed onto a fault. The auto-recloser is blocked for the duration of ***Inhibit Time tI on Close*** after a manual CB Closure.

Recloser Lockout

If a protection element operates during the reclaim time, following the final reclose attempt, the relay will lockout and the auto-reclose function will be disabled until the lockout condition is reset.

The lockout condition is reset by a manual closing after the ***Inhibit Time tI on Close*** timer elapses.

Additionally, the lockout condition is reset by a reset signaling command (via Inputs, HMI 0 key, Remote Reset command),

The auto-recloser can also be locked out using a ***CB FLT Ext.Sign.*** input. This information can be issued from the “not charged” or “Low gas pressure” indications of CB springs.

Note that the auto-recloser can also be locked out by:

- The fact that the CB does not open after the tBF delay (CB Fail) elapses,
- An operating time longer than the set thresholds,
- Local or remote manual Close or Open command when the auto-reclose is in progress,
- The Rolling Demand function detects too many auto-reclose shots.
- CB monitoring logic detects abnormal CB position (opened and closed, or not opened and not closed) for longer than set: ***Max CB Close*** or ***Max CB Open*** time.

In the lockout condition the ALARM with the cause: ***ALARM [79] Lockout*** is displayed up to reset of the lockout condition.

Setting Group Change when the auto-reclose is in progress

During the auto-reclose cycle, if the relay receives a command to switch setting groups, it is executed after the end of auto-reclose action (if auto-reclose is not in progress).

Rolling Demand

This specific counter avoids frequent operations of a CB in case of intermittent faults. The numbers of shots can be set from 2 to 100 in the cell ***Max cycles No. Rol.Demand***, settable over a time period (***GLOBAL SETTINGS/[79] ADVANCED SETTING /Time period Rol.Demand***) from 1 min to 24 hours.

The rolling demand is used when a defined number of successful recloses are performed over a defined time. If it is happened auto-reclose function is Lockout and he ALARM with the cause: ***ALARM [79] Roll.Demand*** is displayed up to reset the lockout condition.

If after ***Alarm [79] Rolling Demand*** signaling, the lockout condition reset is applied, the recorded number of rolling demand shots are cleared.

Signaling Reset after Close via 79.

In the ***GLOBAL SETTINGS/ [79] ADVANCED SETTING*** menu it is possible to set the signaling reset after a close command executed by the auto-recloser. If ***Signaling Reset*** is set to **1: Close via 79**, after the auto-recloser's close shot (confirmed by the 52a CB status), signaling (LEDs, display) of the last trip before the close shot is reset:

- Latched LEDs,
- Trip information on the PowerLogic P1F front panel,
- Electromagnetic Flag Indicators on the Front Panel,
- Latched outputs.

This function signals the final trip only and clears signaling if the CB remains closed (Auto-reclose is successful). This function is recommended if the P1F is integrated into a SCADA system or if the substation is rarely supervised by maintenance personnel. In this case it is not necessary to clear signaling if the fault has disappeared and the line is healthy.

Note: Reset of signaling and of latched outputs can be done using the General resetting function.

This configuration can be set in the ***GLOBAL SETTINGS/LOC*** submenu:

- LEDs Reset:
    - ***0: Manual only*** (via Inputs, HMI 0 key, Remote Reset command)
    - ***1: Start protect.*** (Start of the protection element set to Trip)
- Ltchd Outp.Reset:
    - ***0: Manual only*** (via Inputs, HMI 0 key, Remote Reset command)
    - ***1: Start protect.*** (Start of the protection element set to Trip)

The ***Manual only*** option helps to prevent a close command from being issued without readout of the cause of trip by maintenance personnel. It reduces the risk to switch on to fault.

The ***Start protect*** option allows signaling of the latest trip only.

Additional Functions

By default, this function is off.

Settings

Multishot Auto-recloser Settings

Menu Text	Authorized Values	Default Setting
Auto-reclose?	Disabled Enabled	Disabled
Dead Time tD1	0.0… 600 s (step: 0.01 s)	0.2 s
Dead Time tD2	0.0… 600 s (step: 0.01 s)	20 s
Dead Time tD3	0.0… 600 s (step: 0.01 s)	1 s
Dead Time tD4	0.0… 600 s (step: 0.01 s)	20 s
Reclaim Time tR	0.0… 600 s (step: 0.01 s)	2 s
Menu Text	**5, 4, 3, 2, 1 trip shot**	**54321 trip shot**
Fast O/C Trip	0-1 (step: 1)	00000
Fast O/C Trip Delay	0.0… 9.99 s (step: 0.01 s)	0.0 s
Fast E/Gnd Trip	0-1 (step: 1)	00000
Fast E/Gnd Trip Delay	0.0… 9.99 s (step: 0.01 s)	0.0 s
Menu Text	**4, 3, 2, 1 reclosing shot**	**4321 reclosing shot**
Close Shot? tI>	0-1 (step: 1)	0000
Inhib.Trip tI>: Shot	0-1 (step: 1)	0000
Close Shot? tI>>	0-1 (step: 1)	0000
Inhib.Trip tI>>: Shot	0-1 (step: 1)	0000
Close Shot? tI>>>	0-1 (step: 1)	0000
Inhib.Trip tI>>>: Shot	0-1 (step: 1)	0000
Close Shot? tIN_1	0-1 (step: 1)	0000
Inhib.Trip tIN_1: Shot	0-1 (step: 1)	0000
Close Shot? tIN_2	0-1 (step: 1)	0000
Inhib.Trip tIN_2: Shot	0-1 (step: 1)	0000
Close Shot? tIN_3	0-1 (step: 1)	0000
Inhib.Trip tIN_3: Shot	0-1 (step: 1)	0000
Close Shot? tAUX1	0-1 (step: 1)	0000
Inhib.Trip tAUX1: Shot	0-1 (step: 1)	0000
Close Shot? tAUX2	0-1 (step: 1)	0000
Inhib.Trip tAUX2: Shot	0-1 (step: 1)	0000

Auto-reclose settings, common for Group 1 and Group 2, are available in column: ***GLOBAL SETTINGS/[79] Advanced Settings***.

[79] Advanced Settings

Menu Text	Authorized Values	Default Setting
CB FLT Monitor?	No Yes	No
Block.via Input?	No Yes	No
Start Dead t on	Protect.Reset CB trips	CB trips
Rolling Demand?	No Yes	No
Max cycles No. Rol.Demand	2… 100 (step: 1)	10
Time period Rol. Demand	1… 1410 mn	10 mn
Inhibit Time tI On Close	0.00… 600.00 s (step: 0.01 s)	1.00 s
Signaling Reset	No Close via 79	No

Negative Sequence Overcurrent (ANSI 46)

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	~~B~~	~~A~~	E	E+

Description

In traditional phase overcurrent protection schemes, overcurrent thresholds must be set above the maximum load current levels. This limits the sensitivity of the relay. Most protection schemes also use an earth fault element based on residual current, which improves sensitivity for earth faults. However, it can happen that some faults occur and stay undetected by such schemes.

Any unbalanced fault condition will produce negative sequence current. Thus, a negative phase sequence overcurrent element can detect both phase-to-phase and phase-to-earth faults.

The negative phase sequence overcurrent element included in the PowerLogic P1F relays provides one stage non-directional overcurrent protection with independent time-delay characteristics, which are selectable between inverse definite minimum time (IDMT) and definite time (DMT). The inverse time-delayed characteristics support both IEC and IEEE curves. Please refer to Overcurrent Protection Tripping Curves in this chapter for the detailed description.

This section describes how negative phase sequence overcurrent protection may be applied in conjunction with standard overcurrent and earth fault protection in order to solve some application problems.

- Negative phase sequence overcurrent protection is more sensitive to resistive phase-to-phase faults than phase overcurrent elements, which may not operate.
- In some applications, an earth fault relay may not be able to detect a residual current because of the configuration of the network. For example, an earth fault relay connected on the delta side of a delta-star transformer is unable to detect earth faults on the star side. However, negative sequence current will be present on both sides of the transformer in any fault condition, independently of the transformer configuration. Therefore, negative phase sequence overcurrent element may be used to provide time-delayed back-up protection for any uncleared asymmetrical faults.
- Where fuses are used to protect motors on rotating machines, a blown fuse produces a large amount of negative sequence current. This is a dangerous condition for the machine because negative phase sequence current generates overheating. Then, a negative phase sequence overcurrent element may be used to back-up motor protection relays.
- It may also be required to trigger an alarm to announce the presence of negative phase sequence currents in the system. Operators are then prompted to investigate the cause of the unbalance.

The negative phase sequence overcurrent elements have a current pick up setting, I2>, and can be time-delayed using configurable timer tI2>.

The current pick-up stage I2> must be set to a value that is higher than the normal negative phase sequence current because of the normal unbalance conditions on the network. This can be done practically during the commissioning, using the ***MEASUREMENTS*** menu of the relay to display the negative phase sequence current value. Then, this value has to be increased by 20%.

It is essential to set correctly the time-delay associated with this function. It should also be noted that this element is used primarily as a back-up protection to other protective devices or to provide an alarm. Therefore, this function is usually set with a long time-delay.

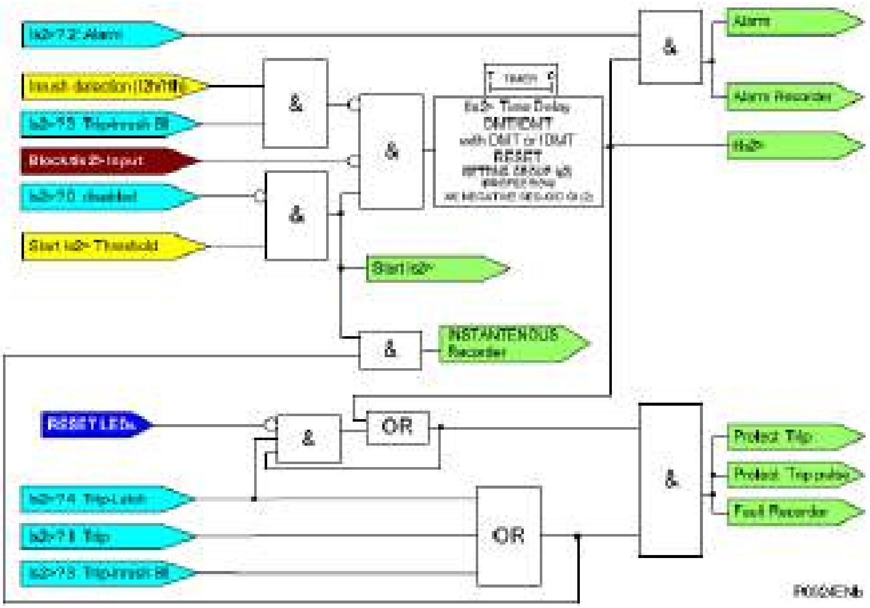
NOTE: care must be made to help to ensure that the time-delay is set above the operating time of any other protection device (at minimum fault level) present on the system and that may react to unbalanced faults, such as:

- Phase overcurrent elements.
- Earth fault elements.
- Broken conductor elements.
- Negative phase sequence influenced thermal protection elements.

The tI2> time-delay associated with the I2> stage can be set under the menu ***SETTING GROUP x/PROTECTION Gx/[46] NEGATIVE SEQ. O/C***.

Block Diagram

Figure 27. Operating principle diagram for negative sequence overcurrent



Operation

If the I**2>** protection element is set to ***Trip***, **Trip-Inrush Bl** or ***Trip-Latch***, it means that that element is linked to the ***Protect.Trip*** and ***Prot.Trip pulse*** functions (see Setting a LED indicators and Setting a Relay Output in chapter Use).

If the I**2>** protection element is set to ***Alarm***, it means that that element is linked to the ***Alarm*** function (see Setting a LED indicators and Setting a Relay Output sections in chapter Use).

If **Trip-Inrush Bl** is selected, the negative sequence overcurrent element is blocked via the ***Inrush Blocking*** function (refer to Inrush Blocking section, page 141).

If ***Trip-Latch*** is selected, the negative sequence overcurrent element will remain high after a trip, until it is reset via a binary input, the HMI or a remote RESET command.

Additional Functions

By default, this function is off.

Settings

Menu Text	Authorized Values	Default Setting
I2>?	Disabled Trip Alarm Trip-Inrush BI Trip-Latch	Disabled
I2> Threshold	0.1… 4.0 In (step: 0.01 In)	1.0 In
I2> Delay Type	DMT IEC SI IEC VI IEC EI LTI STI RC RI IEEE MI IEEE VI IEEE EI US CO2-P20 US CO8 RXIDG BNP EDF US CO2-P40 US CO5 US CO6 US CO7 US CO9 US CO11	IEC SI
tI2>	0.05… 200 s (step: 0.01 s)	1 s
I2> TMS	0.02… 1.5 s (step: 0.01 s)	1 s
I2> Time Dial	0.02… 100 s (step: 0.01 s)	1 s
Reset Delay Type I2>	DMT IDMT	DMT
DMT tReset I2>	0.0… 600 s (step: 0.01 s)	0 s
RTD/RTMS Reset I2>	0.0… 600 s (step: 0.01 s)	0.02

Broken Conductor (ANSI 46BC)

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	~~B~~	~~A~~	E	E+

Description

Most of the faults that affect a power system occur between one phase and the earth or between two phases and the earth. These faults are shunt faults and are caused by lightning discharges and other overvoltages generating flashovers. They may also arise from birds on overhead lines or mechanical damage on underground cables, etc.

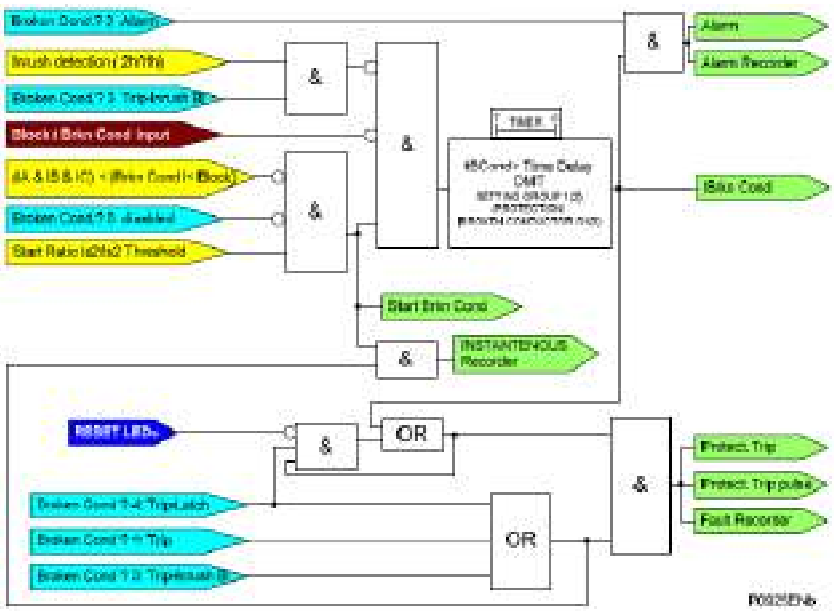
Such faults lead the current to increase appreciably and therefore they can easily be detected in most applications. Open circuit faults are a different type of faults that can happen in electrical networks. These faults can be caused by broken conductors, blown fuses or maloperation of a pole of a circuit-breaker.

Series faults will not lead to an increase in phase current and therefore they cannot easily be detected by common overcurrent relays. However, this type of fault produces an unbalance that creates negative phase sequence current, which can be detected. The use of negative phase sequence overcurrent is then recommended to detect such faulty conditions. However, on lightly loaded lines, the value of the negative sequence current caused by a faulty condition may be very close to, or even inferior, to the full load steady state unbalance generated by CT errors, load unbalances, etc. As a consequence, a negative sequence protection element would not work for low level of loads.

As a solution, the PowerLogic P1F have a protection element that measures the ratio between the negative and the positive phase sequence current (I2/I1). By using this ratio rather than only the measured I2, the relay will be able to detect a fault condition independently of the load level on the power system, since the ratio remains approximately constant whatever the variations in load current. It is then possible to have a more sensitive setting.

Block Diagram

Figure 28. Operating principle diagram for broken conductor protection



Operation

The relay incorporates an element that measures the ratio of negative to positive phase sequence of current (I2/I1). This will be affected to a lesser extent than the measurement of negative sequence current alone, since the ratio is approximately constant with variations in load current. Hence, a more sensitive setting may be achieved. The logic diagram is as shown below. The ratio of I2/I1 is calculated and compared with the ***Ratio* I*2/*I*1*** threshold. If it exceeds the threshold then the time-delay ***tBCond*** is initiated. The ***Brkn Cond I< block*** signal is used to disable Broken Conductor function if the max current value from three phases is too low. The ***Brkn Cond I< block*** undercurrent threshold is settable (***GLOBAL SETTINGS/O/C ADVANCED/[46BC]Brkn.Cond. I< Block.***). Factory setting value is 0.1 In.

Additional Functions

By default, this function is off.

Settings

BROKEN CONDUCTOR [46BC] settings

Menu Text	Authorized Values	Default Setting
Broken Cond.?	Disabled Trip Alarm Trip-Inrush BI Trip-Latch	Disabled
Ratio I2/I1	20… 100 % (step: 1 %)	20 %
tBCond	0.05… 600 s (step: 0.01 s)	100 s

O/C ADVANCED

Menu Text	Authorized Values	Default Setting
[46BC]Brkn.Cond. I< Block.	0.10… 1.00 In (step 0.01In)	0.10 In

Additional Info

The Broken Conductor function can be set to: ***Trip***, **Trip-Inrush BI**, ***Trip-Latch*** or ***Alarm***.

If the ***Broken Conductor*** element is set to ***Trip***, **Trip-Inrush BI** or ***Trip-Latch***, it means that it is linked to the ***Protect.Trip*** and ***Prot.Trip pulse*** functions (see *LED configuration*, page 308).

If the ***Broken Conductor*** element is set to ***Alarm***, it means that it is linked to the ***Alarm*** function (see *LED configuration*, page 308).

If **Trip-Inrush BI** is selected, the I2/I1 threshold is blocked via the ***Inrush Blocking*** function (refer to *Inrush Blocking,* page 141).

If ***Trip-Latch*** is selected, the Broken Conductor element will remain high after a trip, until it is reset via a binary input, the HMI or a remote RESET command.

NOTE: The Broken Conductor function is inhibited if the value of the current flowing in each of the three phases is below ***[46BC]Brkn.Cond I< Block.*** Undercurrent threshold (factory setting: 10% of the nominal current).

Switch-On-To-Fault

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	B	A	E	E+

Description

In some feeder applications, fast tripping may be required if a fault is still present on the feeder after the reclosure of the circuit breaker (Close on to fault).

Some faults may not be cleared after a reclose due to the fact that the conditions that led to the fault have not been removed from the feeder after a reclosing cycle or a manual trip, or due to earthing clamps left on after a maintenance visit. In these cases, it may be desirable to clear the fault more quickly, rather than wait for the DMT or IDMT trip time-delay associated with the involved protection to elapse.

In the case of a CB being manually closed, a switch on to an existing fault may occur. This situation is particularly critical because the overcurrent protection element would not clear the fault until the set time-delay has elapsed. It is then desirable to clear the fault as fast as possible.

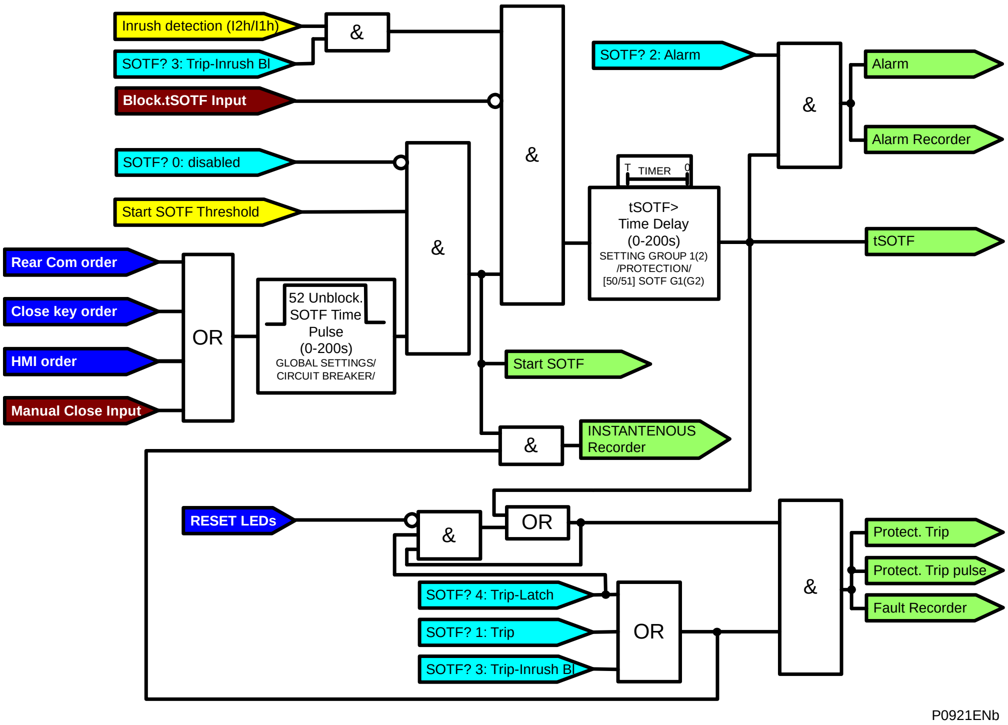
Enabling and setting the SOTF (Switch-On-To-Fault) function can be done under the ***SETTING GROUP x/PROTECTION Gx/SOTF Gx*** submenu.

Crossing of SOTF threshold will initiate the SOTF function which can be activated with the following functions:

- closing by Input (***Manual Close*** binary input order),
- manual closing controlled by the HMI, (close key order),
- front panel communication control (HMI order),
- rear communication control (rear RS485 communication port order),

Block Diagram

Figure 29. Operating principle diagram for switch on to fault



Operation

When at least one of the selected signals has been detected, a ***52 Ublock.SOTF Time*** (***GLOBAL SETTINGS/CIRCUIT BREAKER/52 Unblock.SOTF Time*** submenu) timer starts to activates SOTF protection element

Once this timer (***52 Ublock.SOTF Time***) is active and SOTF thresholds have been crossed, the ***tSOTF*** settable time-delay starts. This settable time-delay is particularly useful in applications where fault selectivity in stages two or three is required.

This time-delay (***tSOTF***) is also useful in cases where serious transients may be present, where the three poles of the CB do not all close at the same time and in cases where the CB may not close instantaneously.

tSOTF can also be considered as a trip time-delay that substitutes itself to the trip time-delay associated with the crossed threshold so that the tripping time is accelerated.

If a trip due to switch on to fault occurs during the reclaim time of the ARC, the trip will be final and the ARC will be locked.

If the SOTF stage is reset before the settable time-delay ***tSOTF*** elapses, the SOTF function is reset.

Additional Functions

By default, this function is off.

Settings

With the **Switch-On-To-Fault** (SOTF) submenu, it is possible to shorten the time to trip when for example the relay has detected a fault that is still present on a feeder after energizing.

The SOTF overcurrent element is activated after the CB’s state changes from open to closed. SOTF is blocked when the auto-recloser is running (**E, E+**).

Menu Text	Authorized Values	Default Setting
SOTF?	Disabled Trip Alarm Trip Inrush Bl (A, E, E+) Trip Latch (A, E, E+)	Disabled
SOTF	1.0… 40 In (step: 0.01 In)	4 x In
tSOTF	0.0…. 600 s (step: 0.01 s)	0.1 s

GLOBAL SETTINGS/CIRCUIT BREAKER/52 Unblock.SOTF Time

Menu Text	Authorized Values	Default Setting
52 Unblock.SOTF Time	0.10… 200.00 s (step: 0.01 s)	1.00 s

Circuit Breaker Failure (ANSI 50BF)

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

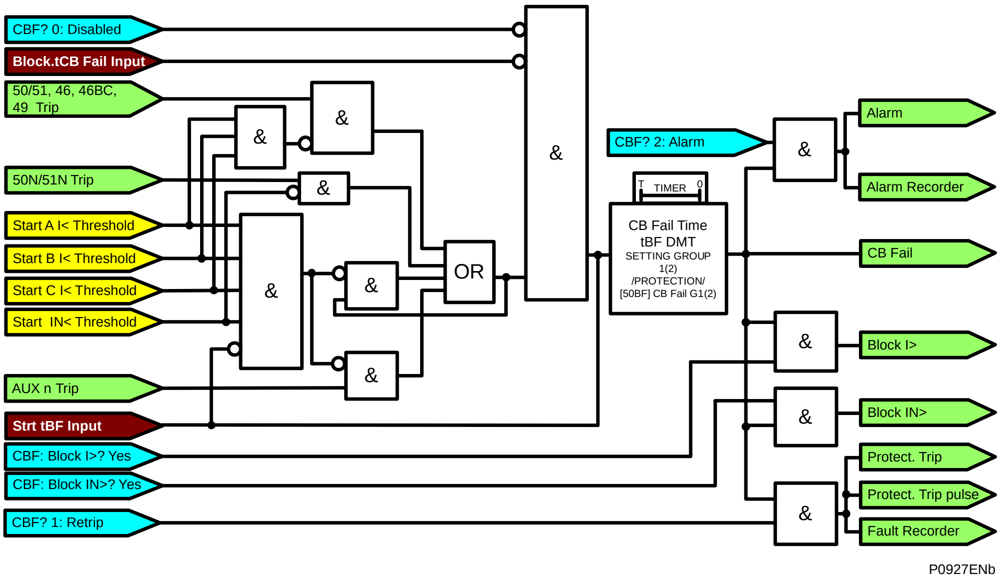
When a fault is detected, one or more main protection elements will issue a trip command to the associated circuit breaker(s). To isolate the fault, and prevent (further) damage to the power system it is essential that the circuit breaker operates correctly.

A fault that is not cleared quickly enough threatens the stability of the system. It is therefore common practice to install circuit breaker failure protection devices/elements that check that the circuit breaker has opened within a reasonable period of time. If the fault current has not been eliminated after the set time-delay, breaker failure protection (CB Fail) will send a signal.

The CB Fail protection element can be used to back-trip upstream circuit breakers to ensure that the fault is correctly isolated. The CB Fail protection element can also clear all blocking commands associated with logic selectivity.

Block Diagram

Figure 30. Operation principle diagram for circuit breaker failure



Operation

The circuit breaker failure protection function incorporates one timer allowing configuration for the following scenario: upon any protection trip, ***CB Fail Timer tBF*** is started, and normally reset when the circuit breaker opens to isolate the fault. If breaker opening is not detected, ***CB Fail Timer tBF*** times out and closes an output contact assigned to ***CB Fail***. This contact is used to backtrip upstream switchgear, generally tripping all infeeds connected to the same busbar section.

The CBF element ***CB Fail Timer tBF*** operates for trips triggered by protection elements within the relay or via an external protection device (binary input). The latter is achieved by assigning one of the relay opto-isolated inputs to ***AUX n*** (**B, A, E, E+**) set for tripping or ***Strt tBF*** (**B, A, E, E+**) (depends on the application).

When CBF is triggered by a current-based protection element included in the P1F, it is reset by an undercurrent element (I***<Threshold CBF*** or I***N< Threshold CBF***) only.

When it is triggered via the ***AUX n*** (**B, A, E, E+**) input, CBF is reset by an undercurrent element.

When it is triggered via the ***Strt tBF*** input (**B, A, E, E+**), CBF is reset by the low state of this input only.

The ***Block I>?*** (**E, E+**) and ***Block IN>?*** (**E, E+**) settings are used to cancel starts issued by the overcurrent and earth fault elements, respectively, following a breaker fail time out. The start is cancelled when the cell is set to ***Yes.***

If the ***Retrip*** option is selected for the ***CB Fail*** function, it means that it is linked to the ***Protect.Trip*** and ***Prot.Trip pulse*** functions (see **LED and Output configuration**).

If ***CB Fail*** is set to ***Alarm***, any outputs and LEDs assigned to the ***Alarm*** or ***tCBF*** function are energized.

If ***CB Fail*** is not set to ***Disabled***, any outputs and LEDs assigned to the ***tCBF*** function are energized.

Additional Functions

By default, this function is off.

Settings

Menu Text	Authorized Values	Default Setting
CBF?	Disabled Retrip Alarm	Disabled
CB Fail Time tBF	0.0… 10 s (step: 0.01 s)	0.1 s
I< Threshold CBF	0.1…. 2.00 In (step: 0.01 In)	0.1 In
IN< Threshold CBF	0.1…. 2.00 Ien (step: 0.01 Ien)	0.1 Ien
Block I>?	No Yes	No
Block IN>?	No Yes	No

NOTE: One of the following options must be set in order to enable CB Fail protection:

- ***Retrip***: a retrip signal is issued concurrently with the ***CB Fail*** output (***Protect.Trip*** and ***Prot.Trip pulse*** output). The TRIP LED is activated,
- ***Alarm***: typical setting. In case of CB Failure, an alarm is issued concurrently with the ***CB Fail*** output. The ***Alarm*** LED is lit.

Additional Info

The ***CB Fail Timer tBF*** timer is initiated when a trip command is issued by a protection element. Note that the trip command can be issued either by a protection element, or by a logic input (**B, A, E, E+**) assigned to an AUX counter. Then the relay monitors the current signal of each phase and compares each phase current signal with the band zone made by the undercurrent I< threshold. This value can be set under the ***SETTING GROUP x/PROTECTION Gx/[50BF] CB FAIL Gx*** menu.

Communication Orders

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	~~B~~	A	E	E+

Description

In PowerLogic P1F are available two communication orders commands:

- ***Comm.Order 1*** is used for control of outputs via an RS485 command. The pulse duration is set at ***GLOBAL SETTING/COMMUNICATION ORDER/Pulse Time tCOM1***
- ***Comm.Order 2*** is used for control of outputs via an RS485 command (if in ***GLOBAL SETTINGS/COMMUNICATION ORDERS/COM2 order Conf.*** “***0:RS485***” or “***1:RS485+Button_C***” is set) or via pressing “C” clear key on the front panel (if in ***GLOBAL SETTINGS/COMMUNICATION ORDERS/COM2 order Conf.*** “***2: Button_C***” or “***1:RS485+Button_C***” is set) The pulse duration set in ***GLOBAL SETTING/COMMUNICATION ORDER/Pulse Time tCOM2***

Settings

Menu Text	Authorized Values	Default Setting
Pulse Time tCOM1	0.00… 200 s (step: 0.01 s)	1.00 s
Pulse Time tCOM2	0.00… 200 s (step: 0.01 s)	1.00 s
COM2 Order Conf.	0: RS485 1: RS485+Button C 2: Button C	RS485

Circuit Breaker Monitoring

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	~~B~~	A	E	E+

Description

The PowerLogic P1 protection relay has a condition monitoring function that supervises circuit breaker (CB) wear. The condition monitoring can provide an alarm to help prevent a CB maintenance.

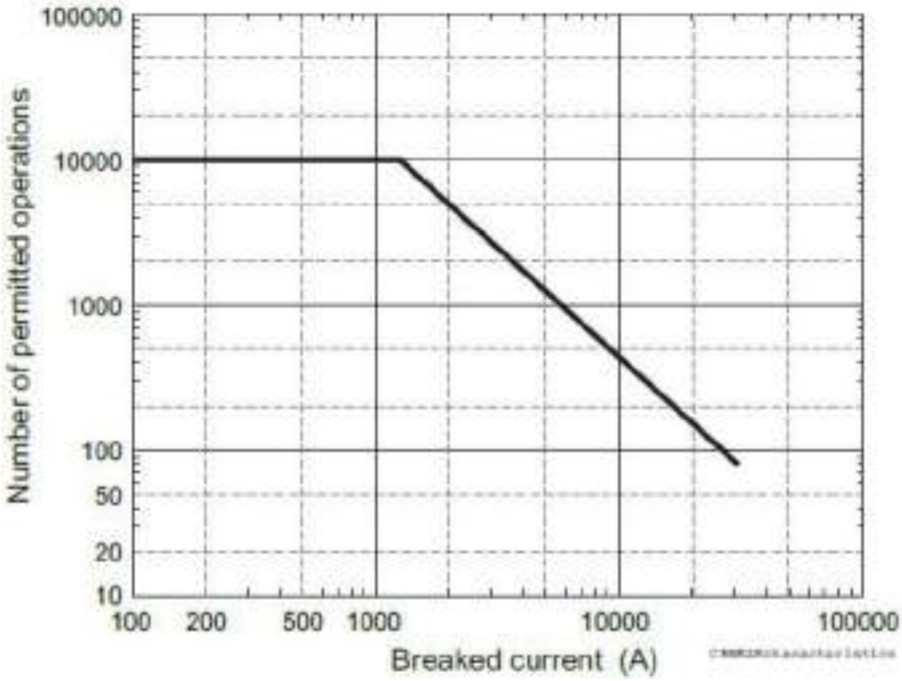
The CB condition monitoring measures the breaking current of each CB pole separately and then estimates CB wear according to the permissible cycle diagram.

Periodic maintenance of circuit breakers is necessary to help to ensure that the trip circuit and mechanism operate correctly and that the interrupting capability has not been compromised due to previous fault interruptions. The PowerLogic P1 protection relay records various statistics related to each circuit breaker operation, allowing an accurate assessment of the circuit breaker condition. Statistics are recorded to allow evaluation of both the electrical wear of the breaker contacts and the mechanical wear of the breaker mechanism.

Circuit breaker curve

The permitted CB operation number is defined by a CB permissible operation curve. This curve is usually available in the documentation of the CB manufacturer. The curve specifies the permissible number of operations for every level of broken current.

Figure 41. An example of a circuit breaker permissible operation curve



Point	Interrupted current (kA)	Number of permitted operations
1	0 (mechanical age)	10000
2	1.25 (rated current)	10000
3	31.0 (maximum breaking current)	80
4	100	1
5	100	1
6	100	1
7	100	1
8	100	1

Two alarms on “Operations left” limit

The CB monitoring function is designed with two alarms, each with two parameters:

• Current

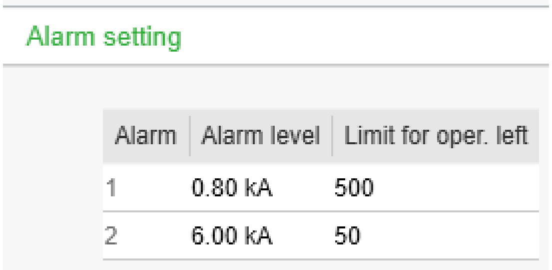
This parameter can be set to the CB’s nominal current or any typical application current for the first alarm, and to a typical fault current for the second alarm.

• Operations left

This parameter determines when an alarm is activated. When the “operations left” at the given current level drops below this limit, the alarm is started.

The permitted operations at these two alarm levels can be calculated automatically according to the breaker curve and logarithmic interpolation (see next section). Any actual interrupted current is logarithmically weighted for the two given alarm current levels and the number of operations left at the alarm points is decreased accordingly. As shown in the figure below, the PowerLogic P1 protection relay shows the allowed “operations left” based on the breaker curve, logarithmic interpolation and actual interrupted current.

Figure 42. Permitted “Operations left” settings for the alarms



Logarithmic interpolation

The permitted number of operations for the currents between the defined points is logarithmically interpolated using this equation:

$$C = \frac{a}{I^n}$$

where:
C = permitted operations
I = broken current

a, n = constant according to the following two equations, where ln represents the natural logarithm function, C_k/C_{k+1} is the permitted number of operations defined by

CurveN, Curve(N+1) in the breaker curve table, and I_k/I_{k+1} is the corresponding broken current defined by CurveIk, CurveI(k+1) in the breaker curve table.

$$a = C_k I_k^n$$

$$n = \frac{\ln\left(\frac{C_k}{C_{k+1}}\right)}{\ln\left(\frac{I_{k+1}}{I_k}\right)}$$

Each time a trip signal is detected, the corresponding permitted operations should be calculated based on the broken current I_{brk}:

$$C_{brk} = \frac{a}{I_{brk}^n}$$

The corresponding decreased number of operations of the alarm level is calculated as:

$$\Delta = \frac{C_{alarm}}{C_{brk}}$$

Example of logarithmic interpolation

According to the equations above and the breaker operation curve points definition taken from ***Values of the above circuit breaker wear characteristic graph***,

- 10000 operations at 1.25 kA
- 80 operations at 31 kA

if the alarm 2 current setting is 6 kA, then the permitted number of operations can be calculated as follows:

$$n = \frac{\ln\left(\frac{10000}{80}\right)}{\ln\left(\frac{31000}{1250}\right)} = 1.5038$$

$$a = 10000 \cdot 1250^{1.5038} = 454 \cdot 10^6$$

$$C_{brk} = \frac{a}{I_{brk}^n} = \frac{454 \cdot 10^6}{6000^{1.5038}} = 945$$

Thus, the maximum number of current-breaking operations at 6 kA is 945. A useful alarm level for “Operations left” could be in this case for example 50, which is about five percent of the maximum.

If the interrupted three phase currents are L1 = 12.5 kA, L2 = 12.5 kA and L3 = 1.5 kA, the corresponding decreased number of operations of phase L1, L2 for alarm 2 are calculated as:

$$C_{brk1,2} = \frac{a}{I_{brk}^n} = \frac{454 \cdot 10^6}{12500^{1.5038}} = 313$$

$$\Delta = \frac{945}{313} = 3$$

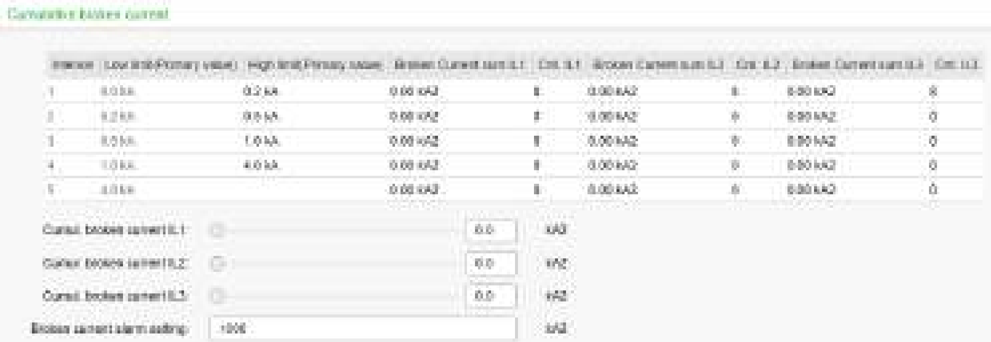
In phase L3, the current is less than the alarm limit current 6 kA. For such currents, the decrement is one.

Five ranges of cumulative current

Each time the CB opens, the broken current is added to the corresponding total cumulative broken current, phase by phase. The cumulative broken current is given in $(kA)^2$.

In addition to the total cumulative broken current, there are five cumulative broken current ranges to assess the breaking device pole condition. Each range's high limit value is configurable and the low limit value equals to the high limit of its previous range. Each range has three different counters, one for each phase, to record how many times the broken current falls into the range. See figure below.

Figure 43. Cumulative broken current record



The cumulative broken current is also computed by phase. When the PowerLogic P1 protection relay is in test mode, the cumulative broken current and counters are not updated.

An alarm signal will be generated when the cumulative broken current of any phase exceeds the broken current alarm setting.

Mechanical wear

CB Open counter, Protection Trip counter and Rack out counter

The "CB Open" counter is to record the number of CB close to open operation. It is incremented even if the PowerLogic P1 protection relay is in test mode.

The "Protection Trip" counter is to record CB open times issued from trip (global trip). This counter can also be set to a custom value but it does not increment during test mode.

If, for whatever reason the circuit breaker does not open successfully after the pulse setting time out (500ms), the trip counters are not incremented.

The "Rack out" counter is to record the number of racking in/out operations of the CB truck. It is incremented in test mode.

Open time, close time and charging time

If two different digital signals are used to indicate the 52a and 52b status of the CB position, the open time is measured from the moment when the "52b" status becomes false to the moment when the "52a" status becomes true; the close time is measured from the moment when the "52a" status becomes false to the moment when the "52b" status becomes true.

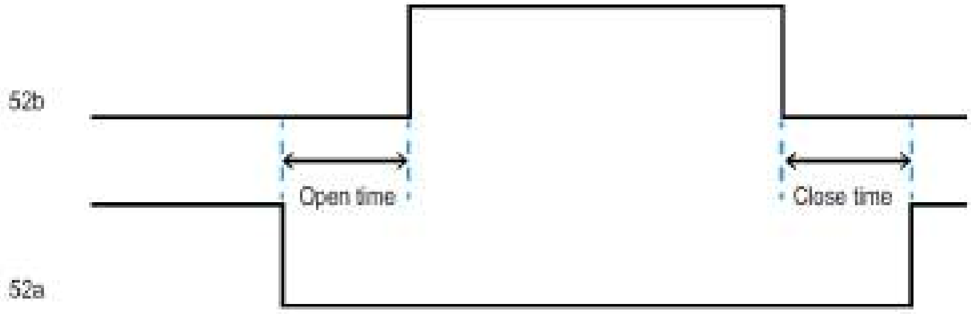
However, if the CB position is only configured as 52a or 52b, the open time and close time will not be recorded.

The charging time is computed from the moment when the CB position changes to the moment when the spring status changes to ready. The spring status is configured through ***CB FLT Ext.Sign_G1*** for Setting group 1 and ***CB FLT Ext.Sign_G2*** for Setting group 2 setting in MATRIX/Inputs configuration.

Totally 8 the last CB open/close times and charging times are recorded in the PowerLogic P1, each with a timestamp. If the time recorded exceeds the range, the time will be tagged as an “out of range“, which allows the customer to easily detect something is wrong with the CB.

These CB open times, close times and charging times are also recorded when the PowerLogic P1 is in test mode.

Figure 44. Open and close time calculation



Standard Operation

Periodic maintenance of circuit breakers is generally based on a fixed time interval, or a fixed number of fault current interruptions.

The relays record the following controls and statistics related to each circuit breaker trip operation:

- time-delay setting
- monitoring time for CB open and close operations
- CB open count
- summation of the current interrupted by the CB
- exponent for the summation
- tripping and closing pulse time

For each circuit breaker trip operation, the relay records statistics. The **RECORDS/ COUNTERS/CB Monitoring** menu cells shown are counter values only:

- No.CB Close Mon. – number of closing circuit breaker
- No.CB Open Mon. – number of opening circuit breaker
- CB AMPS Value. – sum of the current (in Amps or square Amps) interrupted by the circuit breaker

The circuit breaker condition monitoring counter increases when it receives:

- a protection trip command (***Protect Trip, Prot.Tr pulse***),
- an HMI (eSetup Easergy Pro) opening command (***Trip CB Order***),
- a rear com opening command (***Trip CB Order***),
- a digital input opening command (***Trip CB Order***).

In cases where the breaker is tripped by an external protection device it is also possible to update the CB condition monitoring. This is achieved by assigning one of the logic inputs or via the communication to accept a trigger from an external device.

Additional Functions

By default, this function is off. Its mean that all counters are incremented, but not generate alarms. When the functions is enabled all counters are incremented and generate alarms signals.

Settings

Parameter	Value	Unit	Description	Note
CB monitoring status				
Last broken current				
Phase current IL1 / IL1 Phase current IL2 / IL2 Phase current IL3 / IL3		A A A	Broken current of phase L1 Broken current of phase L2 Broken current of phase L3	
Cumul. Broken current IL1/CmltvIL1		$(kA)^2$		
Cumul. Broken current IL2/CmltvIL2		$(kA)^2$		
Cumul. Broken current IL3/CmltvIL3		$(kA)^2$		
Alarm				
Alarm 1				
Current	0.00 – 100.00	kA	Alarm1 current level	Editable
Cycles	100,000 – 1		Alarm1 limit for operations left	Editable
Alarm 2				
Current	0.00 – 100.00	kA	Alarm2 current level	Editable
Cycles	100,000 – 1		Alarm2 limit for operations left	Editable
Cumulative broken current setting				
High limit / Iprim	0.0 – 100.0	kA	High limit setting for each bin	Editable
Broken current alarm setting	0 – 65,535		Cumulative broken current alarm threshold	Editable

Circuit Breaker Status Monitoring

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	B	A	E	E+

Description

CB positions can be selected at ***SETTING GROUP x/INPUTS CONFIGURATION Gx***:

- *CB status 52A*
- *CB status 52B*

If two inputs are assigned to both the above inputs, CB status is based on both indications.

If only one function is used, CB status is based on a single-bit information only (the second is derived from the first one).

The CB status is indicated on the LCD display in control menu cell as follows:

CB status: Opened
CTRL: No operat.

CB status is used by various protection and monitoring functions (e.g. auto-reclose, open time etc.) for proper operation.

Example

To binary input 1 is assigned CB status 52a and AUX5
To binary input 2 is assigned CB status 52b and AUX6
To LED 7 is assigned to AUX5
To LED 8 is assigned to AUX6

In the above configuration LED7 indicates the CB closed position and LED8 indicates the CB open position.

Circuit Breaker Supervision

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	~~B~~	A	E	E+

Description

Periodic maintenance of circuit breakers is generally based on a fixed time interval, or a fixed number of fault current interruptions, thus PowerLogic P1F relays record controls and statistics related to each circuit breaker trip or close operation allowing proper maintenance and operation of substation equipment.

Standard Operation

The relays record the following controls and statistics related to each circuit breaker trip or close operation:

- monitoring time for CB opening (triggered by the ***Trip CB order*** and ***Protect.Trip*** outputs). Operations based on the setting
  - time-delay setting for tripping (***GLOBAL SETTINGS/CIRCUIT BREAKER/ Max CB Open Time***)

  If CB opening time is longer than ***Max CB Open Time*** the Alarm is issued (***Alarm CB Time Monit.***). This function can be activated in the menu: ***GLOBAL SETTINGS/CIRCUIT BREAKER/ CB Supervision? 1: Yes***,

- monitoring time for CB closing (triggered by the ***Close CB order*** output). Operations based on the setting:
  - time-delay setting for closing (***GLOBAL SETTINGS/CIRCUIT BREAKER/ Max CB Close Time***)

  If CB closing time is longer than ***Max CB Close Time*** the Alarm is issued (***Alarm CB Time Monit.***). This function can be activated in the menu: ***GLOBAL SETTINGS/CIRCUIT BREAKER/ CB Supervision: 1: Yes***,

- CB open operations counter (triggered by ***Trip CB order:*** HMI, Manual Trip Logic Input, HMI, open control key, rear communication trip command, USB port (NABE) trip command
  - Number of open operations ***(RECORDS/COUNTERS/CONTROL COUNTER/No.Trips)***
- CB close operations counter (triggered by ***Close CB order***: HMI, Manual Close Logic Input, HMI ‘Close’ key, rear communication close command, USB port (NABE) close command)
  - Number of close operations (***RECORDS/COUNTERS/CONTROL COUNTER/No. Close)***
- protection CB open operations counter (triggered by ***Protect Trip***, ***Prot.Tr pulse*** output)
  - Number of CB open operations ***(RECORDS/COUNTERS/FAULT COUNTER/No. Fault Trips)***
- CB open operations counter monitoring (triggered by the ***Trip CB order*** and ***Protect Trip, Prot.Tr pulse*** output function)
  - setting threshold (***GLOBAL SETTINGS/CIRCUIT BREAKER/MAX CB Open Time.***)

- current value (***RECORDS/COUNTERS/CB MONITORING COUNTER/ CB Oper. Counter***).

- summation of the current interrupted by the CB (triggered by the ***Protect.Trip***, ***Prot.Tr pulse*** output function):
  - current value (***RECORDS/COUNTERS/CB MONITORING COUNTER/CB AMPS Value***),

  This function can be activated in menu: ***GLOBAL SETTINGS/CIRCUIT BREAKER/CB Diagnostic: 1: Yes.***

  NOTE: summation of the current interrupted by CB is phase selective, but the max value from three phases is displayed in menu only. If the new value is entered, it is applied for all phases.

  CB Alarm output function and ***CB Alarm*** LEDs function signal is generated if ***CB Supervision*** or ***CB Diagnostic*** function detects any problem.

  Additionally ***CB Diagnostic*** function triggers TCS 52 Fail output function.

CB Alarm output function and ***CB Alarm*** LEDs function signal is generated if ***CB Supervision*** or ***CB Diagnostic*** function detects any problem.

Additionally ***CB Diagnostic*** function triggers TCS 52 Fail output function.

Cause of Alarm	Alarm function	Key setting	Alarm Label	Output	LED
The monitoring time for CB opening	***CB Supervision***	***Max CB Open Time***	***CB Time Monit.***	***CB Alarm***	***CB Alarm***
The monitoring time for CB closing	***CB Supervision***	***Max CB Close Time***	***CB Time Monit.***	***CB Alarm***	***CB Alarm***
The abnormal CB's position for two bits CB's connection (00 or 11)	***CB Supervision***	***value: Max CB Close Time*** *or* ***Max CB Open Time***	***State of CB***	***CB Alarm***	***CB Alarm***
CB open operations counter monitoring	***CB Diagnostic***	***MAX CB Open No***	***CB Nb Diagn.***	***CB Alarm***, ***TCS 52 Fail***	***CB Alarm***
Summation of the current interrupted by the CB	***CB Diagnostic***	***Max Sum AMPS^n***	***CB Curr, Diagn.***	***CB Alarm***, ***TCS 52 Fail***	***CB Alarm***

Settings

Menu Text	Authorized Values	Default Setting
CB Supervision?	Yes No	No
Max.CB Open Time	0.50… 10.00 s (step: 0.01 s)	0.1 s
Max.CB Close Time	0.50… 10.00 s (step: 0.01 s)	0.5 s
CB Diagnostic?	Yes No	No
Max.CB Open Nb	0.… 500000 (step: 1)	0
Max Sum AMPS^n	0.1…. 6553.5 MA^n (step: 0.1 MA^n)	0.1 MA^n
AMPS's n=	1…. 2 (step: 1)	1

Local / Remote Mode

Applicable to PowerLogic P1F Series

~~L~~	~~N~~	~~B~~	A	E	E+

Description

The Local / Remote Mode function is to make possible blocking commands sent remotely through communication networks (such as setting parameters, control commands, etc.), to help to prevent any accidents or maloperation during maintenance work performed on site.

Standard Operation

PowerLogic P1 can be operated in three modes: "***Remote***", "***Local***" and "***L+R***" (local and remote) depending on the user selected settings. Main setting is available at ***GLOBAL SETTINGS/CIRCUIT BREAKER/Remote CTRL Mode:***

0: Remote only – remote control is permitted only. All manual controls (HMI, Close/Trip function keys, Binary Inputs assigned to Manual Close or Trip) are blocked.

In ***Remote only*** mode the menu default control mode cell looks as follow:

```
LR Stat.: Remote
CTRL: Remote
```

Remote only status means that remote control via RS485/USB is possible only (local control is rejected by PowerLogic P1F).

This control mode can be changed (the second line (***CTRL***) of menu cell) from ***Remote*** to ***Local*** and inversely.

To change from ***Remote*** to ***Local*** mode it is necessary to press the ***OK*** button, enter Control Password (if set), press ***OK*** button (confirm password – if set; and select changing). Press down or up button to choose ***Local*** and confirm with ***OK*** button. After applying above procedure the menu cell looks as follow:

```
LR Stat.: Local
CTRL: Local
```

Local status means that local control is possible only. Remote commands via RS485/USB are rejected by PowerLogic P1F (except the synchronizing time signal, ***CTRL: Remote*** or ***CTRL: Local, Comms. Order*** commands).

With Local/Remote control mode functionality the digital input label "***Local CTRL mode***" can be associated. When this signal is assigned to any digital input then Local/remote control mode gets following functionality:

- With **Local CTRL Mode** binary input energized the menu cell looks as follow:

```
LR Stat.: Local
```

LR Stat.: Local status means that only local control is possible. It is not possible to change the control mode from the HMI.

- With **Local CTRL Mode** binary input deenergized the menu cell looks as follow:

```
LR Stat.: Remote
```

LR Stat.: Remote status means that remote control commands can be issued. It is not possible to change the control mode from the HMI.

1: Remote + Local – remote and local control permitted.

In ***Remote + Local*** mode the menu default control mode cell looks as follow:

```
LR Stat.: L+R
CTRL: Remote
```

Remote only status means that both the local (HMI, control buttons on the front panel, binary inputs) and remote control (RS485/USB) is possible.

This control mode can be changed (the second line (***CTRL***) of menu cell) from ***L+R*** to ***Local*** and inversely.

```
LR Stat.: Local
CTRL: Local
```

Local status means that local control is possible only

With Local/Remote control mode functionality the digital input label "***Local CTRL mode***" can be associated. When this signal is assigned to any digital input then Local/remote control mode gets following functionality:

- With **Local CTRL Mode** binary input energized the menu cell looks as follow:

```
LR Stat.: Local
```

LR Stat.: Local status means that only local control is possible. It is not possible to change the control mode from the HMI.

- With **Local CTRL Mode** binary input deenergized the menu cell looks as follow:

```
LR Stat.: Remote
```

LR Stat.: Remote status means that remote control commands can be issued. It is not possible to change the control mode from the HMI.

Settings

Local / remote parameters can be selected at ***GLOBAL SETTING /CIRCUIT BRAKER/ Remote CTRL Mode***:

Menu Text	Authorized Values	Default Setting
Remote CTRL Mode	0: Remote only 1: Remote+LOC	0: Remote only

Setting Group Selection

Applicable to PowerLogic P1F Series

L	N	B	A	E	E+

Description

PowerLogic P1 relays have two protection setting groups called ***PROTECTION G1*** and ***PROTECTION G2***. Only one group is active at a time.

Standard Operation

If a group is used in an application it is not possible to remove the other group from the menu. If one group only is chosen the relay uses Group 1 even if the other parameters are set to Group 2 (Inputs(**B, A, E, E+**), Menu, Remote Group Setting).

Switching between groups can be done via:

- the selected binary input (**B, A, E, E+**) assigned to the **Setting Group 2** logic input (***SETTING GROUP x/INPUTS CONFIGURATION Gx*** submenu)
- the relay front panel interface (***GLOBAL SETTINGS/SETTING GROUP SELECT/ Setting Group: 1: Group1*** or ***2: Group2***),
- through the communications port (refer to the Mapping Database for detailed information).

Switching between setting groups can be done even while a protection function is active, but it resets all timers, LEDs on P1F front panel).

The user can check which one of the setting groups is active in the menu ***OP PARAMETERS/Active Set Group*** cell.

The user can also assign the active group (***Setting Group x*** function) to an output relay (***SETTING GROUP x/OUTPUT RELAYS CONFIGURATION Gx***) or to an LED (***SETTING GROUP x/LEDs CONFIGURATION G1***).

Setting group change via a digital input

It is possible to change the setting group by energizing a digital input (**B, A, E, E+**) (operates on level: logic input is low – setting group 1, logic input is high – setting group 2).

If the setting group switchover is done via a binary input (**B, A, E, E+**), the change from Group 1 to Group 2 is executed after the set time-delay: ***t Change Setting G1 ->G2*** (***GLOBAL SETTINGS/SETTING GROUP SELECT***) (**B, A, E, E+**). The switching from Group 2 back to Group 1 is instantaneous.

NOTE: If the digital input that has been assigned to the setting group change operates on level (low or high), it is not possible to change the setting group via remote communications.

Switching between Active Groups via a Binary Input (B, A, E, E+)

When powering up the relay, the selected group (Group 1 or Group 2) corresponds to the state of the logic input assigned to ***Setting Group 2***. This means:

A – ***Reverse Inp.Logic*** = 0 and ***Setting Group 2*** = 1
(***SETTING GROUP x/INPUTS CONFIGURATION Gx*** submenu).

If the programmed logic input starts being supplied with +V, then after the ***t Change Setting G1->G2*** time-delay the active group will be G2. If the programmed logic input is not supplied with +V, the active group will be G1.

B – ***Reverse Inp.Logic*** = 1 and ***Setting Group 2*** = 1 (***SETTING GROUP x/INPUTS CONFIGURATION Gx*** submenu).

If the programmed logic input is supplied with +V, then the active group will be G1. If the programmed logic input stops being supplied with +V , then after the ***t Change Setting G1->G2*** time-delay the active group will be G2.

NOTES:
- Binary Input configuration is associated with both Setting Groups, so that if in a Setting Group the selected binary input is assigned to ***Setting Group 2***, in the other group it must be set to ***Setting Group 2*** as well, otherwise no switch will occur.
- If the PowerLogic P1F is powering up (from the currents or the auxiliary voltage) and Group 2 is selected via a binary input, the ***t Change Setting G1->G2*** time-delay is ignored (changing to setting group 2 is instantaneous – without time-delay).
- The setting group switch is based on the level of the binary input. So as long as Setting Group 2's logic signal is high, the PowerLogic P1F uses Setting Group 2.

If the programmed logic input is supplied with +V, then the active group will be G1. If the programmed logic input stops being supplied with +V , then after the ***t Change Setting G1->G2*** time-delay the active group will be G2.

Switch between Active Groups via the Menu or a Remote Command (RS485, USB)

By using the relay front panel interface it is possible to change the active setting group:

1: Group 1 or ***2: Group 2*** (menu cell: ***GLOBAL SETTINGS/SETTING GROUP SELECT/ Setting Group***).

This menu cell is commonly used for switching groups from the front panel interface and via a remote command (RS485 or USB).

It means that if the ***GLOBAL SETTINGS/SETTING GROUP SELECT/ Setting Group*** menu cell is set to ***1: Group 1*** and the remote setting group 2 command is executed, the value of menu cell: ***GLOBAL SETTINGS/SETTING GROUP SELECT/ Setting Group*** will be changed to ***2: Group 2*** (Active group: 2).

Setting group 1 will be applied if:
- ***1: Group 1*** is set in the ***GLOBAL SETTINGS/SETTING GROUP SELECT/ Setting Group*** menu cell from the relay's front panel interface,
- *the remote setting group 1 command is executed. The value of the* ***GLOBAL SETTINGS/SETTING GROUP SELECT/ Setting Group*** *menu cell will then be changed to* ***1: Group 1***

Priority

NOTE: If the digital input that has been assigned to the setting group change operates on level (low or high), it is not possible to change the setting group via neither remote communications nor the front panel.

The detailed logic table for setting group selection is shown below:

Binary Input Setting Group 2 (ABE)	Front Panel and Remote Setting	Active Group
Not configured	*G1*	***G1***
Not configured	*G2*	***G2***
G1	*G1*	***G1***
G1	*G2*	***G1***
G2	*G1*	***G2***
G2	*G2*	***G2***

NOTE: If a setting group change initiated by a remote command has not been effected due of priority settings, that command is ignored (not recorded in the P1F's logic for the future, when priority settings allow changing).

It is possible to assign an Active Group state to an output contact by setting the output contact to the ***Setting Group x*** output (***SETTING GROUP x/OUTPUT RELAYS CONFIGURATION Gx)***.

If Active Group signaling is required, some LEDs should be assigned to the ***Setting Group x*** function (***SETTING GROUP x/LEDs CONFIGURATION Gx***).

Settings

Setting group select parameters can be selected at ***GLOBAL SETTINGS/SETTING GROUP SELECT***:

Menu Text	Authorized Values	Default Setting
Setting Group	Group 1 Group 2	Group 1
t Change Settings G1→G2 (B, A, E, E+)	0.00 to 200 s, (step 0.01 s)	0.00 s
Copy Settings	No Operation Copy G1→G2 Copy G2→G1	No Operation

Commissioning Mode

Applicable to PowerLogic P1F relays

~~L~~	~~N~~	~~B~~	A	E	E+

Description

Commissioning Mode in PowerLogic P1F relays (A, E, E+) has three modes: ***Maintenance mode***, ***Output tests*** and ***Functional test***, amongst which the last two are available only if ***Maintenance mode*** is active.

Maintenance Mode

Maintenance mode menu allows the user to check the operation of the protection functions.

It is possible to set following ***Maintenance mode*** options (settings):

- ***No*** – maintenance mode is disabled. All window cells below are hidden (***Maintenance mode*** is the latest cell in ***COMMISIONING*** column).
- ***Yes*** – maintenance mode is enabled. In this mode all test cells in ***COMMISIONING*** column are shown. During the tests outputs are energized (control of outputs are not blocked).
- ***Yes – Bl.Out.*** – maintenance mode is enabled and all test cells in ***COMMISIONING*** column are shown. In this mode, the high state of output functions are ignored (control of outputs are blocked)

This option allows the user to check the operation of the protection functions without actually sending any external command (Tripping or signaling).

Independently on the rear protocol selected in menu (Modbus RTU or IEC 60870-5-103), transmission of information to SCADA is active with additional information to know that PowerLogic P1F is in Maintenance mode (refer to Communication chapter and IEC 60870-5-103 standard).

Changing of setting from ***No*** to ***Yes*** or ***Yes – Bl.Out.*** from the front panel activate this mode for 10 minutes only. After this time setting is automatically switched to ***No***.

The selection of the maintenance mode is possible by logic input (the level), control command (rear or front port), or by front panel HMI. The maintenance mode is terminated by:

- Low state of logic input assigned to ***Maintenance mode*** function.
- Control command which activate this mode (rear command or setting: ***Yes***, ***Yes – Bl.Out.***) and by turning off the power supply.

NOTE: Maintenance rear command is available in Modbus protocol only.

```
Maintenance Mode
1: Yes
```

It is possible to assign the state of ***Maintenance mode*** to programmable LEDs.

In ***Yes – Bl.Out.*** case, all the output contacts are blocked, and no command can be issued to these contacts, even if a protection threshold associated with one of these output contacts has been crossed. (If a protection threshold is crossed, all associated LEDs will be ON, even the TRIP LED, if protection element is set to ***Trip***).

If the input assigned ***to Maintenance mode*** is logical high the Maintenance Mode is active (without any time limitation) up to low state of the logical input.

Outputs Test

This function is available after activation of ***Maintenance mode*** – setting ***Yes***.

The commissioning cells allow the user to check the external wiring to the relay's output contacts. To do this, the user has only to set to 1 the desired output contact's corresponding bit, and this will close the contact and allow the continuity of the wiring to be checked.

```
Test         7654321
Pattern      0000000
```

In the cell below, the contact test time can be set:

```
Contact Test
Time         1.00s
```

If the outputs for test are selected and Time for output closing is set, the closing command can be executed in this cell:

```
Test output
0: no operation
```

To execute the test, press **OK** key, select ***1: Apply test*** and confirm action by **OK**. The contact will be closed for the duration of the ***Contact Test Time*** pulse.

Functional Test

This function is available after activation of ***Maintenance mode.***

This functionality is used to check the functional outputs of the PowerLogic P1F. To do this, the user has only to select which protection element will be triggered, and this will close the contact assigned to this protection element and allow the continuity of the wiring to be checked. If the protection element is disabled there will be no action.

```
Functional Test
0: I>
```

In the cell below the end of the functional test can be configured:

```
Functional Test
End 0: CB trip
```

The following options are possible:

- ***0: CB trip*** – after triggering the functional test, the test is interrupted after trip command.
- ***1: Time*** – *the protection element will be triggered for the duration of the pulse time.*

If the ***1: Time*** option is selected it is necessary to set the pulse length:

```
Functional Test
Time         01.00s
```

The next cell is used for functional test execution:

```
Functional Test
0: no operation
```

To execute this test, press the **OK** key, select ***1: Operate*** and confirm action by pressing **OK**. The contact will be closed for the duration of the ***Functional Test Time*** pulse.

NOTE: In ***Maintenance mode*** PowerLogic P1F works with full functionality (ready to trip in a fault condition, even during functional test). During functional test of selected stage (for example tI>), P1F measures currents so the rest active stages (for example tI>>, tIN>, etc) work on the measured current from the field. Only the tested stage (for example tI>) sees test current: two times greater than tI> current setting value in all phases. After functional test of Thermal replica, the thermal value is set to 0%. After test, in the fault record all recorded current values are based on the currents measured in the field.

If Functional Test will be applied for protection element which is disabled there will be no any action done.

Real Time Clock Synchronization via Opto-Inputs

Applicable to PowerLogic P1F relays

~~L~~	~~N~~	~~B~~	~~A~~	E	E+

Description

In modern protective schemes it is often desirable to synchronize the relay's real time clock so that events from different relays can be placed in chronological order. This can be done using the communication interface connected to the substation control system or via a binary input.

Any of the available binary inputs on the PowerLogic P1F relay can be selected for synchronization. Pulsing this input will result in the real time clock snapping to the nearest minute.

Recommended pulse duration is 20 ms, repeated no more than once per minute.

Standard Operation

The example of time synchronization function is shown in table below:

Time of "Sync. Pulse"	Corrected Time
19:47:00.000 to 19:47:29.999	*19:47:00.000*
19:47:30.000 to 19:47:59.999	*19:48:00.000*

NOTE: The above assumes a time format of hh:mm:ss

The input is configured in the ***SETTING GROUP x/INPUTS CONFIGURATION Gx*** menu. The input must be assigned to the ***Time Synchr.*** Input.

Resetting of Latched LEDs and Outputs

Applicable to PowerLogic P1F relays

L	N	B	A	E	E+

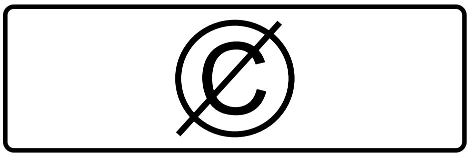
Description

The way or resetting the latched LEDs and outputs is determined by the inputs assigned to the resetting of latched LED. Outputs can be reset via external inputs, by pressing the R key on the PowerLogic P1F's front panel if the LCD shows the default display or via the communication port.

NOTICE

Resetting of LEDs and relay outputs is impossible if reason of the triggering and/or tripping any protections or functions still exist (e.g. trip signal occurred, but CB is closed and fault current flowing thru analog inputs of the relay).

In this case if R button was pushed on the relay LCD is displayed following window:



It is mean that reset of the LEDs and outputs in this moment is impossible.

Standard Operation

The resetting configuration can be entered in the ***GLOBAL SETTINGS/LOC*** menu:

- ***LEDs Reset***:
  - ***0: Manual only*** (via Inputs, HMI (R key), Remote Reset command)
  - ***1: Start protect.*** (Start of a protection element set to Trip)
  - ***2: Close Command*** (Resetting of latched LEDs upon Close Command applied by PowerLogic P1F)
- ***Ltchd Outp.Reset***:
  - ***0: Manual only*** (via Inputs, HMI (R key), Remote Reset command)
  - ***1: Protect.Start*** (Start of a protection element set to Trip)
  - ***2: Close Command*** (Resetting of latched LEDs upon Close Command applied by PowerLogic P1F)
- ***Trip Info Reset***:
  - ***0: Manual only*** (via Inputs, HMI (R key), Remote Reset command)
  - ***1: Protect.Start*** (Start of a protection element set to Trip)
  - ***2: Close Command*** (Resetting of latched LEDs upon Close Command applied by PowerLogic P1F)
- ***Alarms Info.***:
  - ***0: Self Reset –*** This option means that if an alarm signal has disappeared no information is available in the ***ALARM STATUS*** column

- ***1: Manual Reset –*** this option means that if an alarm signal has disappeared information is still available in the ***ALARM STATUS*** column until it is reset in the ***ALARM STATUS/Alarm Reset*** cell.

The ***Manual only*** option helps to prevent a close command from being issued without readout of the cause of trip by maintenance personnel. It reduces the risk to switch on to fault.

The ***Start protect*** and ***Protect.Start*** options allows to signal the latest trip only: Start of any protection element set to trip the CB, reset all latched LEDs and show the default display.

Settings

Resetting method of latched LEDs can be selected at ***GLOBAL SETTINGS/LOC***:

Menu Text	Authorized Values	Default Setting
LEDs Reset	Manual only Start protect. Close command	Manual only
Ltchd Outp.Reset	Manual only Protect.Start Close command	Manual only
Trip Info Reset	Manual only Protect.Start Close command	Manual only
Alarms Info	Self Reset Manual Reset	Self Reset

Fault and Alarm Records

Applicable to PowerLogic P1F relays

L	N	B	A	E	E+

Description

The specified, for each type of PowerLogic P1F series, data is recorded for any relevant elements that operated during a fault or an alarm. The recorded data can be viewed in each of the last 20 fault records for fault elements and 5 records for alarm elements.

Standard Operation

Each fault and alarm record is generated with time stamp.

Both fault and alarm records are stored in non-volatile memory (FRAM memory). This type of memory does not require any maintenance (no battery inside the PowerLogic P1F is required). Fault records are stored without any time limitation even if the PowerLogic P1F is not supplied from any power source.

- **Fault records**

  The following data is recorded for any relevant elements that operated during a fault, and can be viewed in each of the last 20 fault records:

  - Event Text (the reason for a trip):

    2> trip
    I>> trip
    I>>> trip
    SOTF trip (**A, B, E, E+**)
    IN_1 trip
    IN_2 trip
    IN_3 trip (**E, E+**)
    I2> trip (**E, E+**)
    Brkn Cond (**E, E+**) trip
    CB Fail trip
    AUX1 trip (**B**, **A, E, E+**)
    AUX2 trip (**B**, **A, E, E+**)
    AUX3 trip (**B**, **A, E, E+**)
    AUX4 trip (**B**, **A, E, E+**)
    Therm OL (**N, A, B, E, E+**)

  - Active setting Group
  - Fault Time an Fault Date
  - Fault Origin: type of fault (for example: phase A-B, A-B-C, etc.)
  - Event Value:

    Per phase record of the current value during the fault:
    IN, VN and (3Vo) φ

- **Alarm records**

  The following data is recorded for any relevant elements that operated during an alarm, and can be viewed in each of the last 5 alarm records:

  - Event Text (the reason for a protection alarm):

    tI> Alarm
    tI>> Alarm
    tI>>> Alarm
    tSOTF Alarm (**B**, **A, E, E+**)
    tIN_1 Alarm
    tIN_2 Alarm
    tIN_3 Alarm (**E, E+**)
    tI2> Alarm (**E, E+**)
    tBrkn Cond Alarm (**E, E+**)
    tCB Fail Alarm
    tAUX1 Alarm (**B**, **A, E, E+**)
    tAUX2 Alarm (**B**, **A, E, E+**)
    tAUX3 Alarm (**B**, **A, E, E+**)
    tAUX4 Alarm (**B**, **A, E, E+**)
    tTherm OL Alarm (**N, A, B, E, E+**)

  - Active setting Group
  - Alarm Time an Alarm Date
  - Alarm Origin: type of alarm (for example: phase A-B, A-B-C, etc.)
  - Event Value:

    Per phase record of the current value during the fault:
    IN, VN and (3Vo) φ

Instantaneous Records

Applicable to PowerLogic P1F relays

~~L~~	~~N~~	~~B~~	~~A~~	E	E+

Description

Each time any of set thresholds are crossed, an instantaneous record is created and displayed in the ***RECORDS/INSTANTANEOUS RECORD*** menu. The last five starting records are available, with the duration of the signal.

The following information is displayed in the ***RECORDS/INSTANTANEOUS RECORD*** menu: number of starts, time, date, origin (crossing of a current threshold or start of a protection element's time-delay), current values.

The recorder stores data of the last 5 instantaneous records.

Standard Operation

Each instantaneous record is generated with time stamp.

Instantaneous record are stored in non-volatile memory (FRAM memory). This type of memory does not require any maintenance (no battery inside the PowerLogic P1F is required). Instantaneous record is stored without any time limitation even if the PowerLogic P1F is not supplied from any power source.

Alarm Status

Applicable to PowerLogic P1 Series

L	N	B	A	E	E+

Description

The Alarm status function presents the current Alarm signals.

Standard Operation

The Alarm signals information can be realized with latching or without latching, depending on the ***GLOBAL SETTINGS/LOC/Alarms Info*** value:

- ***0:Self-reset*** – only current Alarm status is displayed,
- ***1:Manual Reset*** – Alarm information is latched up, to reset via cell **ALARM STATUS/Reset** Press ENTER cell.

The following Alarm statuses can be displayed:

Time of "Sync. Pulse"	Corrected Time
tI> Alarm	Alarm by the first phase overcurrent stage
tI>> Alarm	Alarm by the second phase overcurrent stage
tI>>> Alarm	Alarm by the third phase overcurrent stage
tSOTF Alarm (B, A, E, E+)	Alarm by SOTF element
tIN_1 Alarm	Alarm by the first earth fault overcurrent stage
tIN_2 Alarm	Alarm by the second earth fault overcurrent stage
tIN_3 Alarm (E, E+)	Alarm by the third earth fault overcurrent stage
tI2> Alarm (E, E+)	Alarm by the negative sequence overcurrent element
tBrkn Cond Alarm	Alarm by Broken Conductor protection
CB Fail Alarm	Circuit Breaker Failure protection time-delay elapsed
tAUX1 Alarm (B, A, E, E+)	tAUX1 time-delay elapsed
tAUX2 Alarm (B, A, E, E+)	tAUX2 time-delay elapsed
tAUX3 Alarm (B, A, E, E+)	tAUX3 time-delay elapsed
tAUX4 Alarm (B, A, E, E+)	tAUX4 time-delay elapsed
Thermal Overload Alarm (N, A, B, E)	Thermal Alarm stage crossed by actual Thermal State value
tCB FLTY Ext.Sign. Alarm	An input mapped to this function detects CB problems that may influence control possibilities (for example spring problem, insufficient pressure, etc.)
Inrush Bl. Alarm. (A, E, E+)	Inrush Blocking (the second harmonic level crossing threshold)
TC Supervision Alarm. (A, E, E+)	Trip Circuit Supervision detects a problem
CB Time Monit. Alarm. (A, E, E+)	The monitoring time for CB opening/closing
CB Curr.Diagn. Alarm. (A, E, E+)	Summation of the current interrupted by the CB
CB Nb Diagn. Alarm. (A, E, E+)	CB open operations counter monitoring
[79] Lockout Alarm (E, E+)	Auto-recloser lockout condition
Hardw.Warning Alarm	Any hardware problem detected
State of CB Alarm (A, E, E+)	The abnormal CB's position for two bits CB's connection (00 or 11)
[79] Roll.Demand Alarm (E, E+)	The number of Autoreclose cycles in the defined (set) time window is greater than set value

Event Records

Applicable to PowerLogic P1F relays

L*	N	B	A	E	E+

*event recorder is not available if model L is not equipped with RS485 communication port (hardware option).

Description

The PowerLogic P1F relay records and time tags up to 200 events and stores them in non-volatile FRAM memory. This enables the system operator to establish the sequence of events that occurred within the relay following a particular power system condition, switching sequence etc. When the available space is exhausted, the oldest event is automatically overwritten by the most recent one.

The real time clock within the relay provides the time tag for each event, with a resolution of 1 ms.

The event records are available for remote viewing, via the communications ports RS485 or USB.

For extraction from a remote source via communications ports, refer to the SCADA Communications section where the procedure is fully explained.

Standard Operation

Any event may be a change of state of a control input or output relay, a trip condition, etc.

The following sections show the various items that constitute as an event:

- **Change of state of binary inputs** (**B, A, E, E+**)

  If one or more of the binary inputs has changed state since the last time that the protection algorithm ran, the new status is logged as an event. The information is available if the event is extracted and viewed via a PC.

- **Change of state of one or more output relay contacts**

  If one or more of the output relay contacts have changed state since the last time that the protection algorithm ran, then the new status is logged as an event. The information is available if the event is extracted and viewed via PC.

- **Relay alarm conditions**

  Any alarm conditions generated by the relays will also be logged as individual events. The following table shows examples of some of the alarm conditions and how they appear in the event list:

Alarm Condition	Event Text	Event Value
Auxiliary Supply Fail	Vx Fail ON/OFF	Bit position 0 in 32 bit field

  The above table shows the abbreviated description that is given to the various alarm conditions and also a corresponding value between 0 and 31. This value is appended to each alarm. It is used by the event extraction software, such as eSetup , to identify the alarm. Either ON or OFF is shown after the description to signify whether the particular condition is operational or has reset.

- **Protection element trips**

  Any operation of protection elements (a trip condition) will be logged as an event record, consisting of a text string indicating the operated element and an event value. Again, this value is intended for use by the event extraction software, such as eSetup Easergy Pro.

Measurements and Related Settings

Applicable to PowerLogic P1F Relays

L	N	B	A	E	E+

Description

For the convenience of an operator and substation maintenance process the PowerLogic P1F relay produces a variety of directly measured power system quantities.

Standard Operation

The directly measured power system quantities available in PowerLogic P1F relay are listed below:

IA, IB, IC	- R.M.S. values
I1 (**E, E+**)	- calculated positive (I1)
I2 (**E. E+**)	- calculated negative (I2)
I2/I1 (**E, E+**)	- calculated negative to positive ratio
IN	- measured fundamental harmonic only (E/F analogue input)
Thermal (**N, B, A, E, E+**)	- thermal state based on RMS value from the max phase current
IA 2nd harmonic (**A, E, E+**)	- second harmonic in phase A
IB 2nd harmonic (**A, E, E+**)	- second harmonic in phase B
IC 2nd harmonic (**A, E, E+**)	- second harmonic in phase C

NOTE: All the measured current values depends on the CT Ratio setting (***GLOBAL SETTINGS/CT RATIO***). The typical deviations of measurements for phase and earth currents is ±2% at In and ±2% at Ien.

Standard Operation

The following settings under the measurements heading can be used to configure the relay measurement function:

- CT Ratio setting – responsible for phase and earth currents transformer input's primary and secondary current ratings, can be found in: ***GLOBAL SETTINGS/CT RATIO*** menu.
- Default Measuring Window – displayed after connection of power supply to PowerLogic P1 or after resetting of signaling, can be found in: ***GLOBAL SETTINGS/ LOC*** menu.
- Measurement criteria – the ***LOC*** submenu makes it possible to set parameters associated with this function (fundamental harmonic (1. Harm.) or true RMS (True RMS)): ***GLOBAL SETTINGS/LOC*** menu.

Counters

Applicable to PowerLogic P1F Relays

~~L~~	~~N~~	~~B~~	A	E	E+

Description

The PowerLogic P1F's counters gather information on the vast number of various events during relay operation, e.g.: manual trip commands, trip commands from protection elements, hardware problems detected by the self-monitoring function, auto-recloser starts, etc.

Standard Operation

The PowerLogic P1F's counters are available in the ***RECORDS/COUNTERS*** menu:

- ***CONTROL COUNTER***:
  - ***No. Trips*** – number of manual trip commands (inputs, menu default control window, control key, remote control via RS485 or USB).
  - ***No. Close –*** Number of manual close commands (inputs, menu default Control Window, control key, remote control via RS485 or USB).

  Counters can be reset in the ***CONTROL COUNTER*** column – ***Counter Reset*** cell.

- ***FAULT COUNTER***:
  - ***No. Fault Trips –*** number of trip commands from protection elements (current based protection element trip, AUX trips and Auto-recloser trips).
  - ***No. Fault Starts*** – Number of timer starts by protection elements set to trip (current-based protection element and AUX).
  - ***No. Alarms*** – number of Alarm signals from protection elements set to Alarm or functions mapped to an Alarm signal.
  - ***No. HW Warnings*** – Number of hardware problems detected by the self-monitoring function.

  Counters can be reset in the ***FAULT COUNTER*** column – ***Counter Reset*** cell.

- ***AUTORECLOSE COUNTER* (E, E+)**:
  - ***No. [79] Action Total –*** total number of Auto-recloser starts.
  - ***No. Trips&Lockout Total*** – total number of final trips or lockouts.
  - ***No. Successful Total –*** total number of successful auto-reclosures (the reclaim time has elapsed without tripping).
  - ***Cycle 1 Reclose No. –*** number of first shots (the counter is incremented with each first close shot, even if the following trip occurs during the reclaim time).
  - ***Cycle 2 Reclose No. –*** number of second shots (the counter is incremented with each second close shot, even if the following trip occurs during the reclaim time).
  - ***Cycle 3 Reclose No. –*** number of third shots (the counter is incremented with each third close shot, even if the following trip occurs during the reclaim time).
  - ***Cycle 4 Reclose No. –*** Number of fourth shots (the counter is incremented with each fourth close shot, even if the following trip occurs during the reclaim time).

Counters can be reset in the ***AUTORECLOSE COUNTER*** column – ***Counter Reset*** cell.

NOTE: For a 4-shot auto-reclose sequence (TCTCTC, the next TCTC, the next TCTCTCTCT and the next TCT (lockout)) the counters shows:

Total [79] action:	4
Total Trips&Lockout:	1
Total Successful:	2
Cycle 1 Reclose:	4
Cycle 2 Reclose:	3
Cycle 3 Reclose:	2
Cycle 4 Reclose:	1

- ***CB MONITORING COUNTER*** **(A, E, E+)**:
  For complete description see: *Circuit Breaker Monitoring* subchapter, page 186
- ***SPRING CHARGING TIME COUNTER***
  For complete description see: *Circuit Breaker Monitoring* subchapter, page 186
- ***OPERATING TIME COUNTER***
  For complete description see: *Circuit Breaker Monitoring* subchapter, page 186
- ***CUMULATIVE BREAKING CURRENT***
  For complete description see: *Circuit Breaker Monitoring* subchapter, page 186
- ***RACINH IN/OUT COUNTER***
  For complete description see: *Circuit Breaker Monitoring* subchapter, page 186

Disturbance Records

Applicable to PowerLogic P1F Relays

~~L~~	~~N~~	~~B~~	A	E	E+

Description

The PowerLogic P1F's integral disturbance recorder has an area of memory specifically set aside for record storage. The number of records that may be stored by the relay is dependent upon the selected recording duration.

Standard Operation

The total number of records available in PowerLogic P1F's models **A, E** disturbance recorder is:

- 1 – for set ***Max Record Time*** in range of: 2.51s – 4.00s
- 2 – for set ***Max Record Time*** in range of: 1.67s – 2.50s
- 3 – for set ***Max Record Time*** in range of: 1.26s – 1.66s
- 4 – for set ***Max Record Time*** in range of: 1.01s – 1.25s
- 5 – for set ***Max Record Time*** in range of: 0.10s – 1.00s

NOTE: For models **A, E** the maximum recording time is 4 s.

The total number of records available in PowerLogic P1F's model E+ (with Vo) disturbance recorder is:

- One – for set Max Record Time from in range: 2.51s – 3.00s
- Two – for set Max Record Time from in range: 1.67s – 2.50s
- Three – for set Max Record Time from in range: 1.26s – 1.66s
- Four – for set Max Record Time from in range: 1,01s – 1.25s
- Five – for set Max Record Time from in range: 0.10s – 1,00s

NOTE: For model **E+** the maximum recording time is 3 s.

NOTE: The maximum number of records is 5.

The recorder stores actual samples that are taken at a rate of 16 samples per cycle. The recording is in COMTRADE format. Each disturbance record consists of eight analog data channels and thirty-two digital data channels. The relevant CT ratio for the analog channels are also extracted to enable scaling to primary quantities.

NOTE: If a CT ratio is set to less than a unit, the relay will choose a scaling factor of zero for the appropriate channel.

Settings

The ***GLOBAL SETTINGS/DISTURBANCE RECORDER*** menu column is shown in the following table:

Menu Text	Authorized Values	Default Setting
Pre-Time	0.1… 2.00 s (step: 0.01 s)	0.10 s
Post-Fault Time	0.1… 1.00 s (step: 0.01 s)	0.10 s
Disturb.Rec.Trig.	0: on Inst. 1: on Trip	0: on Inst.
Max Record Time	0.1… 4.00 s (step: 0.01 s) (A, E) 0.1… 3.00 s (step: 0.01 s) (E+)	1.0 s

It is not possible to display the disturbance records locally on the LCD; they must be extracted using suitable software such as eSetup Easergy Pro.

Communication

Introduction

Applicable to PowerLogic P1F Series

L*	N	B	A	E	E+

*hardware option

Purpose of this document

This document describes the characteristics of the different communication protocol of PowerLogic P1F relay.

The available communication protocols of PowerLogic P1F relay are as follows:

- MODBUS.
- IEC 60870-5-103.

NOTE:

This document shows all available functions in P1F. To see which function are available in model refer to the rest chapters/sections of this manual.

For example: disturbance recorder is available in model A, E and E+ only, etc.

Glossary

IA, IB, IC : currents measured on the concerned phases (A, B, C)
IN : residual current measured by earth input (= 3Io zero sequence)
pf : soft weight of a word of 16 bits
PF : heavy weight of a word of 16 bits.

MODBUS PROTOCOL

PowerLogic P1F relay can communicate by a RS 485 link behind the unit following the MODBUS MODICON RTU protocol.

In PowerLogic P1F the status of the rear communication port is signaled by flashing rectangles in the top and bottom right corners of the display. Tx (Transmit) is assigned to the top right corner, Rx (Receive) is assigned to the bottom right corner of the display. Flashing of the rectangles indicate the operation of the communication port only (not frames received and/or transmitted).

TECHNICAL CHARACTERISTICS OF THE MODBUS CONNECTION

Parameters of the MODBUS Connection

The different parameters of the MODBUS connection are as follows:

- Isolated two-point RS485 connection (2kV 50Hz),
- MODBUS MODICON line protocol in RTU mode
- Communication speed can be configured by an operator dialog in the front panel of the relay:

Baud rate
4800
9600
38400
57600
115200

Transmission mode of the configured characters by operator dialog:

Mode
1 start / 8 bits / 1 stop: total 10 bits
1 start / 8 bits / even parity / 1 stop: total 11 bits
1 start / 8 bits / odd parity / 1 stop: total 11 bits
1 start / 8 bits / 2 stops: total 11 bits

Synchronization of Exchanges Messages

All character received after a silence on the line with more or equal to a transmission time of 3 characters is considered as a firm start.

Message Validity Check

The frame validity is working with a cyclical redundancy code CRC with 16 bits. The generator polynomial is:

$1 + x^2 + x15 + x16$ = 1010 0000 0000 0001 binary = A001h

Address of the PowerLogic P1 relays

The address of the PowerLogic P1F relay on a same MODBUS network is situated between 1 and 247. The address 0 is reserved for the broadcast messages.

MODBUS Functions of the PowerLogic P1F Relays

The MODBUS functions implemented on the PowerLogic P1F relays are:

Function 3 or 4: Reading of n words

Function 5: Writing of 1 bit

Function 6: Writing of 1 word

Function 7: Fast reading of 8 bits

Function 16: Writing of n words

Presentation of the MODBUS Protocol

Master slave protocol, all exchange understands a master query and a slave response

Frame size received from PowerLogic P1F relay

Frame transmitted by the master (query):

Slave number	Function code	Information	CRC1 6
1 byte	1 byte	n bytes	2 bytes
0 to F7h	3h, 5h, 6h, 7h, Ah, Fh, 2Bh		

Slave number:

The slave number is situated between 1 and 247.

A frame transmitted with a slave number 0 is globally addressed to all pieces of equipment (broadcast frame)

Function code:

Requested MODBUS function (1 to 16)

Information:

Contains the parameters of the selected function.

CRC16:

Value of the CRC16 calculated by the master.

Note: The PowerLogic P1F relay does not respond to globally broadcast frames sent out by the master.

Format of Frames Sent by the PowerLogic P1F Relay

Frame sent by the PowerLogic P1F relay (response)

Slave number	Function code	Data	CRC16
1 byte	1 byte	n bytes	2 bytes
0 to F7h	3h, 5h, 6h, 7h, Ah, Fh, 2Bh		

Slave number:

The slave number is situated between 1 and 247.

Function code:

Processed MODBUS function (1 to 16).

Data:

Contains reply data to master query.

CRC 16:

Value of the CRC 16 calculated by the slave.

Messages Validity Check

When PowerLogic P1F relay receive a master query, it validates the frame:

- If the CRC is false, the frame is invalid. PowerLogic P1F relay do not reply to the query. The master must retransmit its query. Excepting a broadcast message, this is the only case of non-reply by PowerLogic P1F relay to a master query.
- If the CRC is good but the PowerLogic P1F relay cannot process the query, it sends an exception response.

Warning frame sent by the PowerLogic P1F relay (response)

Slave number	Function code	Warning code	CRC16
1 byte	1 byte	1 byte	2 bytes
1 to F7h	81h, 83h, 85h, 86h, 87h, 8Ah, 8Fh, Abh		pf ... PF

Slave number:

The slave number is situated between 1 and 247.

Function code:

The function code returned by the PowerLogic P1F relay in the warning frame is the code in which the most significant bit (b7) is forced to 1.

Warning code:

On the 8 warning codes of the MODBUS protocol, the PowerLogic P1F relay manages two of them:

- code 01: function code unauthorized or unknown.
- code 03: reading.

Control of pages being read

Control of pages being written

Control of addresses in pages

Length of request messages

CRC16:

Value of the CRC16 calculated by the slave.

POWERLOGIC P1F RELAY DATABASE ORGANIZATION

Description of the Application Mapping

Settings

PowerLogic P1F application mapping has 9 pages of parameters.

Page 0h: Product information, remote signaling, measurements

Page 1h: General remote parameters

Page 2h: Setting group 1 remote parameters

Page 3h: Setting group 2 remote parameters

Page 4h: Remote controls

Pages 5h/6h: Reserved pages

Pages 7h: Quick reading byte

Pages 8h: Time synchronization

Disturbance Records

Before uploading any disturbance record, a service request must be sent to select the record number to be uploaded.

The answer following this request contains the following information:

- Numbers of samples (pre and post time)
- Phase CT ratio
- Earth CT ratio
- Internal phase and earth ratios
- Number of the last disturbance mapping page
- Number of samples in this last disturbance mapping page

The mapping pages used for this service request are from 38h to 3Ch.

Pages 9h to 21h: Contain the disturbance data (25 pages)

A disturbance mapping page contains 250 words:
0900 to 09Fah: 250 disturbance data words
0A00 to 0AFAh: 250 disturbance data words
0B00 to 0BFAh: 250 disturbance data words
......
2100 to 21Fah: 250 disturbance data words

The disturbance data pages contain the sample of a single channel from a record.

Page 22h: contains the index of the disturbance

Page 38h to 3Ch: Selection of the disturbance record and channel

Page 3Dh: A dedicated request allows to know the number of disturbance records stored in FRAM memory.

Event records

To upload the event records two requests are allowed:

Page 35h: Request to upload an event record without acknowledge of this event.

Used addresses:

3500h: EVENT 1

.....
35C8h: EVENT 200

Page 36h: Request to upload the non-acknowledged oldest stored event record.

Two modes are available for the acknowledgement: automatic acknowledgement or manual acknowledgement.

In automatic acknowledgement, the bit1 of the remote order frame (format F38B – mapping address 0402h) should be set to 1. On event retrieval, this event record is acknowledged.

In manual acknowledgement, the bit12 of the remote order frame (format F38 – mapping address 0400h) should be set to 1. On event retrieval, this event record is not acknowledged. To acknowledge this event, another remote order should be sent to the relay. The bit 13 of this frame (format F38 – mapping address 0400h) should be set to 1.

Fault records

Page 37h: Page dedicated to upload fault record

Used addresses:

3700h: FAULT 1
3701h: FAULT 2

.....
3713h: FAULT 20

Page 3Eh: Request to upload the non-acknowledged oldest stored fault record.

Two modes are available for the acknowledgement: automatic acknowledgement or manual acknowledgement.

In automatic acknowledgement, the bit1 of the remote order frame (format F38B – mapping address 0402h) should be set to 1. On fault retrieval, this fault record is acknowledged.

In manual acknowledgement, the bit12 of the remote order frame (format F38 – mapping address 0400h) should be set to 1. On fault retrieval, this fault record is not acknowledged. To acknowledge this fault, another remote order should be sent to the relay. The bit 14 of this frame (format F38 – mapping address 0400h) should be set to 1.

Characteristics

Page 0h can only be read through communication.

Pages 1h, 2h, 3h and 4h can be read and written.

Page 7h can be access in quick reading only.

Page 8h can be write.

They are described more precisely in the following chapters.

Page 0h: Product Information, Remote Signaling, Measurements

Read access only

Address	Group	Description	Values range	Step	Unit	Format	Default Value
	Product Information						
0000		Relay description characters 1 and 2	32-127	1	-	F10	P1
0001		Relay description characters 3 and 4	32-127	1	-	F10	F1
0002		Relay description characters 5 and 6	32-127	1	-	F10	
0003		Unit reference characters 1 and 2	32-127	1	-	F10	SE
0004		Unit reference characters 3 and 4	32-127	1	-	F10	
0005		Software Version	10 to 99	1	-	F15	
0006		Hardware Version	0 to 3	1	-	F58	
0007		Line CT Sec	9	1	-	F23	
0008		E/Gnd CT Sec	0, 3, 4	1	-	F23A	
0009		Active Set Group	0 to 1	1	-	F32	0
000A		Nominal frequency	0 to 1	1	-	F57	0
000B		Software Version Number	0 to 99	1	-	F90	
000C-000F		Reserved			-		
	Remote signaling						
0010		Logical inputs	0 to 255	1	bits	F11	
0011		Current Protection disable status (1)	0 to 4095	1	bits	F12	
0012		Protection Function disable status (2)	0 to 1023	1	bits	F12A	
0013		Output contacts status	0 to 31	1	bits	F24	
0014		Logical LEDs status	0 to 255	1	bits	F25	
0015		Latched Output info.: Current Protection starting status (1)	0 to 65535	1	bits	F28	
0016		Latched Output info.: Protection Function starting status (2)	0 to 511	1	bits	F28A	
0017		Latched Output info.: Current Protection trip status (1)	0 to 65535	1	bits	F29	
0018		Output information: Protection Function trip status (2)	0 to 511	1	bits	F29A	
0019		Latched Output info.: Current Protection Alarm status 1	0 to 4095	1	bits	F31	
001A		Latched Output info.: Protection Function Alarm status 2	0 to 8191	1	bits	F31A	

Address	Group	Description	Values range	Step	Unit	Format	Default Value
001B		CB status	0 to 4	1	-	F30	
001C		[79] Status	0 to 32767	1	-	F59	
001D		[79] Blocking Status	0 to 6	1	-	F60	
001E		Local/Remote Mode Status	0 to 2	1	-	F61	
001F		Maintenance Mode	0 to 2	1	-	F62	
0020		Hardware Warning	0 to 31	1	-	F26	
0021		Output information: I>	0 to 255	1	bits	F37	
0022		Output information: I>>	0 to 255	1	bits	F37	
0023		Output information: I>>>	0 to 255	1	bits	F37	
0024		Output information: IN_1 stage	0 to 255	1	bits	F50	
0025		Output information: IN_2 stage	0 to 255	1	bits	F50	
0026		Output information: IN_3 stage	0 to 255	1	bits	F50	
0027		Output information: AUX1	0 to 127	1	bits	F51	
0028		Output information: AUX2	0 to 127	1	bits	F51	
0029		Output information: CB Fail	0 to 127	1	bits	F51	
002A		Output information: tCB ext. sign	0 to 127	1	bits	F51	
002B		Output information: SOTF	0 to 255	1	bits	F37	
002C		Output information: I<	0 to 255	1	bits	F50	
002D		Output information: I2>	0 to 255	1	bits	F50	
002E		Output information: Brkn.Cond	0 to 255	1	bits	F50	
002F		Output information: Thermal OL	0 to 255	1	bits	F50	
0030		Output information: AUX3	0 to 127	1	bits	F51	
0031		Output information: AUX4	0 to 127	1	bits	F51	
0032		Output information: Input Protection blocking 1	0 to 4095	1	bits	F101	
0033		Output information: Input Protection blocking 2	0 to 255	1	bits	F102	
0034		Output information: Input Selective logic 1	0 to 255	1	bits	F103	
0035		Output information: Trip latch status 1	0 to 32767	1	bits	F17	
0036		Output information: Trip latch status 2	0 to 2047	1	bits	F17A	
0037		Output information: Input logic data	0 to 32767	1	bits	F104	
0038 – 0039		Reserved					
003A		CB Status	0 to 255	1	bits	F14	
003B		LR Status	0 to 15	1	bits	F13	
003C		Maintenance Mode Status	0 to 15	1	bits	F13A	
003D – 003F		Reserved					

Address	Group	Description	Values range	Step	Unit	Format	Default Value
	Remote measurements						
0040		Phase IA (L1) secondary current [A]	0 to 60 000	1	[A]/100	F1	
0041		Phase IB (L2) secondary current [A]	0 to 60 000	1	[A]/100	F1	
0042		Phase IC (L3) secondary current [A]	0 to 60 000	1	[A]/100	F1	
0043		E/GND IN (IE) secondary current [A]	0 to 60 000	1	[A]/1000	F1	
0044		I2 (negative sequence) secondary current [A]	0 to 60 000	1	[A]/100	F1	
0044		I1 (positive sequence) secondary current [A]	0 to 60 000	1	[A]/100	F1	
0045-004F		Reserved					
0050		Phase IA (L1) current [In]	0 to 60 000		[In]/100	F1	
0051		Phase IB (L2) current [In]	0 to 60 000	1	[In]/100	F1	
0052		Phase IC (L3) current [In]	0 to 60 000	1	[In]/100	F1	
0053		E/F current [Ien]	0 to 60 000	1	[Ien]/100	F1	
0054		I2 (negative sequence) current [In]	0 to 60 000	1	[In]/100	F1	
0055		I1 (positive sequence) current [In]	0 to 60 000	1	[In]/100	F1	
0056-005F		Reserved					
0060		I2/I1 current [%]	0 to 100	1	[%]	F1	
0061		Thermal Overload [%]	0 to 300	1	[%]	F1	
0062		2th harmonic [%] Phase A	0 to 100	1	[%]	F1	
0063		2th harmonic [%] Phase B	0 to 100	1	[%]	F1	
0064		2th harmonic [%] Phase C	0 to 100	1	[%]	F1	
0066-00FF		Reserved					

Calculation Formula for Phase Current Values

Line phase current value (primary value) = phase sampled value (e.g. address 0040h, 0041h or0042h) * {line primary CT ratio (address 0120h)/Line CT sec (address 0121h)} A/100.

Calculation Formula for Earth Current Values

Line phase current value (primary value) = earth sampled value (e.g. address 0043h) * {line primary CT ratio (address 0122h)/Line CT sec (address 0123h)} A/1000.

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Read and write access

Address	Group	Description	Values range	Step	Unit	Format	Default Value
	Remote parameters						
0100		Address	1 to 247	1	-	F1	247
0101		Protocol for RS485	0 to 1	1		F56	0
0102		Baud Rate	0 to 5	1		F19	2
0103		Parity	0 to 2	1		F20	0
0104		Stop bits	0 to 1	1		F22	0
0105-010F		Reserved					
	Counters						
0110		Trips Number	0 to 65535	1	-	F1	0
0111		Close Number	0 to 65535	1	-	F1	0
0112		Fault Trips Number	0 to 65535	1	-	F1	0
0113		Fault Start Number	0 to 65535	1	-	F1	0
0114		Alarm Number	0 to 65535	1	-	F1	0
0115		HW Warnings Number	0 to 65535	1	-	F1	0
0116		79 Action Total	0 to 65535	1	-	F1	0
0117		79 Total Trips&Lockout	0 to 65535	1	-	F1	0
0118		79 Successful Number	0 to 65535	1	-	F1	0
0119		79 Cycle 1 Recloses	0 to 65535	1	-	F1	0
011A		79 Cycle 2 Recloses	0 to 65535	1	-	F1	0
011B		79 Cycle 3 Recloses	0 to 65535	1	-	F1	0
011C		79 Cycle 4 Recloses	0 to 65535	1	-	F1	0
011D		CB close Monitoring	0 to 65535	1	-	F1	0
011E		CB open Monitoring	0 to 65535	1	-	F1	0
011F		CB AMPS Value	0 to 65535	1	-	F1	0
0116-011F		Reserved					
	CT Ratio						
0120		Line CT primary	1 to 30000	1	A	F1	
0121		Line CT Sec.	0 to 1	1	-	F91	
0122		E/Gnd CT Primary	1 to 30000	1	A	F1	
0123		E/GND CT Sec.	0 to 1	1	-	F92	
0122-012F		Reserved					
	Blocking Inrush						
0130		Inrush Blocking?	0 to 2	1	-	F74	0
0131		2nd Harmonic Ratio	10 to 50	1	%	F1	20
0132		Inrush Reset Time	0 to 20000	1	1/100 s	F1	100

Address	Group	Description	Values range	Step	Unit	Format	Default Value
0133		Unblock Inrush Time	0 to 20000	1	1/100 s	F1	100
0134-013F		Reserved					
	O/C Advanced Settings						
0137		I< stage for Broken Conductor	10 to 100	1	[In]/100	F1	10
0138		IDMT interlock by DMT stage	0 to 1	1	-	F88	0
			GLOBAL SETTINGS				
	LOC						
0140		Language	0 to 5	1	-	F52	0
0141		Default display	0 to 2	1	-	F53	0
0142		LEDs Reset by	0 to 2	1	-	F54	0
0143		Ltchd Outp Reset	0 to 2	1	-	F54	0
0144		Trip Info Reset	0 to 2	1	-	F54	0
0145		Alarm Display Reset	0 to 1	1	-	F55	0
0146		Nominal frequency	0 to 1	1	-	F57	0
0147		Reserved					
0148		Control Keys Mode	0 to 2	1	-	F82	0
0149		I>, I>>, I>>> (1harmonic or True RMS)	0 to 1	1	-	F81	0
014A		I>>>, IN>>>, IN>> HCDFT	0 to 1	1	-	F109	0
014B-014F		Reserved					
	SETTING GROUP SELECT						
0150		Number of Setting Groups	0 to 1	1	-	F71	0
0151		Setting group change	0 to 1	1	-	F32	0
0152		t Change Setting G1->G2	0 to 20000	1	1/100 s	F1	0
0153-0154		Reserved					
	E/F ADVANCED						
0155		UN Threshold	5.0 to 90.0	0.1	v	F1	5.0 v
0156		G1 IN_1 direct.	0-2	1	-	F3	0
0157		G1 IN_2 direct.	0-2	1	-	F3	0
0158		G2 IN_1 direct.	0-2	1	-	F3	0
0159		G2 IN_2 direct.	0-2	1	-	F3	0
015A		Incos, Insin Sector Angle	10 to 90°	1	°	F1	90°
015B-015F		Reserved					
	[79] ADVANCED SETTINGS						
0160		[79] CB Healthy Monit?	0 to 1	1	-	F63	
0161		[79] Block via Input?	0 to 1	1	-	F63	0
0162		[79] Start Dead t On	0 to 1	1	-	F64	1

Address	Group	Description	Values range	Step	Unit	Format	Default Value
0163		Rolling Demand?	0 to 1	1	-	F54	0
0164		Max cycles Nb Rol.Demand	2 to 100	1	-	F1	2
0165		Time Period Rol.Demand	1 to 1410	1	mn	F1	
0166		[79] Time Inhibit on Close	1 to 60000	1	1/100 s	F1	100
0167		[79] Reset Signaling on Close	0 to 1	1	-	F106	0
0168-017F		Reserved					
	CIRCUIT BREAKER						
0180		tOpen pulse min	10 to 1000	1	1/100 s	F1	50
0181		tClose Pulse	10 to 1000	1	1/100 s	F1	50
0182		Time Delay for close Command	0 to 20000	1	1/100 s	F1	0
0184		tCB FLT ext.sign.	1 to 200	1	S	F1	16
0185		Remote Mode	0 to 1	1	-	F73	
0186		52 Unblock SOTF Time	10 to 20000	1	1/100 s	F1	100
0187		TC Supervision?	0 to 2	1	-	F107	0
0188		tSUP	10 to 1000	1	1/100 s	F1	10
0189		CB Supervision?	0 to 1	1	-	F63	0
018A		Max CB Open Time	1 to 1000	1	1/100 s	F1	10
018B		Max CB Close Time	1 to 1000	1	1/100 s	F1	10
018C		CB Diagnostic?	0 to 1	1	-	F63	0
018D		Max CB Open No.	0 to 65535	1	-	F1	0
018E		Max Sum AMPS^n	0 to 65535	1	-	F1	0
018F		AMPS's n=	1 to 2	1	-	F1	2
0190		Reserved					
	DISTURBANCE RECORDER						
019A		Pre-Time	10 to 700	1	1/100 s	F1	10
019B		Post TripTime	10 to 100	1	1/100 s	F1	10
019C		Distrurb Rec Trig	0 to 1	1	-	F65	0
019D		Max record Time	150 to 750	1	1/100 s	F1	10
019E-01A4		Reserved					
	COMMISIONING						
01A5		Maintenance Mode	0 to 2	1	-	F62	0
01A6		Test Pattern		1	bits	F40	00000000
01A7		Contact Test Time	0-20000	1	1/100 s	F1	10
01A8		Test Outputs	0 to 1	1	-	F75	0
01A9		Functional Test Pattern	0 to 4095	1	-	F76	0
01AA		Functional Test End	0 to 1	1	-	F77	0
01AB		Functional Test Time	10-20000	1	1/100 s	F1	10

Address	Group	Description	Values range	Step	Unit	Format	Default Value
01AC		Functional Test	0 to 1	1	-	F75	0
01AD-01AF		Reserved					
01C3-01FF		Reserved					

Page 2h : setting Group 1

Access in reading and in writing

Address	Group	Description	Values range	Step	Unit	Format	Default Value
	Setting Group 1 / Protection G1 /Phase O/C						
0200		I>?	0-7	1	-	F16A	0
0201		I> threshold	10 to 4000	1	In/100	F1	140
0202		ItI>/TMS/TD	2 to 20000	1	1/100 s	F1	100
0203		I> Delay Type	0 to 21	1	-	F18	1
0204		I> Reset Delay Type	0-1	1	-	F41	0
0205		I> DMT/RTMS tReset	0 to 20000	1	1/100 s	F1	0
0206		I>>?	0-7	1	-	F16A	0
0207		I>> Threshold	10 to 4000	1	In/100	F1	140
0208		tI>>/TMS/TD	2 to 20000	1	1/100 s	F1	100
0209		I>> Delay Type	0 to 21	1	-	F18	1
020A		I>> Reset Delay Type	0-1	1	-	F41	0
020B		I>> DMT/RTMS tReset	0 to 20000	1	1/100 s	F1	0
020C		I>>>?	0-7	1	-	F16A	0
020D		I>>> Threshold	10 to 4000	1	In/100	F1	400
020E		tI>>>	0 to 20000	1	1/100 s	F1	100
	Setting Group 1 / Protection G1 /SOTF G1						
020F		SOTF?	0-4	1	-	F16	0
0210		SOTF Threshold	10 to 4000	1	In/100	F1	400
0211		tSOTF	0 to 60000	1	1/100 s	F1	100
	Setting Group 1 / Protection G1 /E/GND Fault						
0212		IN_1 stage?	0-14	1	-	F84	0
0213		IN_1 Threshold	Ref TD	1	Ien/100	F1	10 50 100
0214		tIN_1/TMS/TD	2 to 20000	1	1/100 s	F1	100
0215		IN_1 Delay Type	0 to 21	1	-	F18	1
0216		IN_1 Reset Delay Type	0-1	1	-	F41	0
0217		IN_1 DMT tReset	0 to 20000	1	1/100 s	F1	0
0218		IN_2?	0-14	1	-	F84	0
0219		IN_2 Threshold	Ref TD	1	Ien/100	F1	options
021A		tIN_2	0 to 20000	1	1/100 s	F1	10
021B		IN_3?	0-4	1	-	F84	0
021C		IN_3 Threshold	Ref TD	1	Ien/100	F1	options

Address	Group	Description	Values range	Step	Unit	Format	Default Value
021D		tIN_3	0 to 20000	1	1/100 s	F1	10
	Setting Group 1 / Protection G1 /Neg.Seq.O/C						
0221		I2>?	0-4	1	-	F16	0
0222		I2> threshold	10 to 400	1	In/100	F1	140
0223		tI2>/TMS/TD	2 to 20000	1	1/100 s	F1	100
0224		I2> Delay Type	0 to 21	1	-	F18	1
0225		I2> Reset Delay Type	0-1	1	-	F41	0
0226		I2> DMT/RTMS tReset	0 to 60000	1	1/100 s	F1	0
	Setting Group 1 / Protection G1 /Broken Conductor						
0227		Broken Cond.?	0-4	1	-	F16	0
0228		Ratio I2/I1	20 to 100	1	%	F1	20
0229		tBCond	0 to 60000	1	1/100 s	F1	100
	Setting Group 1 / Protection G1 /Thermal Overload						
022A		Therm OL?	0-1	1	-	F109	0
022B		Itheta>	10 to 300	1	In/100	F1	140
022C		Therm Alarm?	0-1	1	-	F109	0
022D		Te	1 to 200	1	min	F1	1
022E		Tr	1 to 999	1	min	F1	1
022F		Theta Trip	50 to 200	1	%	F1	100
0230		Theta Reset	20 to 99	1	%	F1	95
0231		Theta Alarm	20 to 200	1	%	F1	80
	Setting Group 1 / Protection G1 /Aux Timers						
0232		AUX1?	0-7	1	-	F110	0
0233		tAUX1	0 to 60000	1	1/100 s	F1	0
0234		AUX2?	0-7	1	-	F110	0
0235		tAUX2	0 to 60000	1	1/100 s	F1	0
0236		AUX2?	0-7	1	-	F110	0
0237		tAUX2	0 to 60000	1	1/100 s	F1	0
0238		AUX2?	0-7	1	-	F110	0
0239		tAUX2	0 to 60000	1	1/100 s	F1	0
	Setting Group 1 / Protection G1 /CB Fail						
023A		CB Fail?	0-2	1	-	F111	0
023B		CB Fail Time tBF	0 to 1000	1	1/100 s	F1	20
023C		I< Threshold CBF	10 to 200	1	In/100	F1	10

Address	Group	Description	Values range	Step	Unit	Format	Default Value
023D		IN< Threshold CBF	10 to 200	1	Ien/100	F1	10
023E		Block I>	0 to 1	1	-	F63	0
023F		Block IN>	0 to 1	1	-	F63	0
	Setting Group 1 / Protection G1 /Logic Selective						
0240		Sel1?	0-1	1	-	F109	0
0241		tSEL1	0 to 60000	1	1/100 s	F1	0
0242		Sel2?	0-1	1	-	F109	0
0243		tSEL2	0 to 60000	1	1/100 s	F1	0
	Setting Group 1 / Protection G1 /Cold Load PU						
0244		Cold Load PU?	0-1	1	-	F109	0
0245		Cold Load PU Level	20 to 999	1	%	F1	100
0246		Cold Load PU tCL	0 to 60000	1	1/100 s	F1	0
0247		Cold Load PU I>	0-1	1	-	F63	0
0248		Cold Load PU I>>	0-1	1	-	F63	0
0249		Cold Load PU I>>>	0-1	1	-	F63	0
024A		Cold Load PU IN_1	0-1	1	-	F63	0
024B		Cold Load PU IN_2	0-1	1	-	F63	0
024C		Cold Load PU IN_3	0-1	1	-	F63	0
024D		Cold Load PU Brkn Cond	0-1	1	-	F63	0
024E		Cold Load PU Itherm	0-1	1	-	F63	0
024F		Cold Load PU I2>	0-1	1	-	F63	0
	Setting Group 1 / Protection G1 /Autoreclose						
0250		Autoreclose?	0-1	1	-	F109	0
0251		Dead Time tD1	0 to 60000	1	1/100 s	F1	0
0252		Dead Time tD2	0 to 60000	1	1/100 s	F1	0
0253		Dead Time tD3	0 to 60000	1	1/100 s	F1	0
0254		Dead Time tD4	0 to 60000	1	1/100 s	F1	0
0255		Dead Time tR	0 to 60000	1	1/100 s	F1	0
0256		Fast O/C Trip	0 to 31	1	Bits	F72	00000
0257		Fast O/C Trip Delay	0 to 999	1	1/100 s	F1	0
0258		Fast E/GND Trip	0 to 31	1	Bits	F72	00000
0259		Fast E/GND Trip Delay	0 to 999	1	1/100 s	F1	0
025A		tI> Close Shot?	0 to 15	1	Bits	F67	0000
025B		tI> Inhibit Trip: Shot	0 to 15	1	Bits	F67	0000
025C		tI>> Close Shot?	0 to 15	1	Bits	F67	0000
025D		tI>> Inhibit Trip: Shot	0 to 15	1	Bits	F67	0000
025E		tI>>> Close Shot?	0 to 15	1	Bits	F67	0000
025F		tI>>> Inhibit Trip: Shot	0 to 15	1	Bits	F67	0000

Address	Group	Description	Values range	Step	Unit	Format	Default Value
0260		tIN_1 Close Shot?	0 to 15	1	Bits	F67	0000
0261		tIN_1 Inhibit Trip: Shot	0 to 15	1	Bits	F67	0000
0262		tIN_2 Close Shot?	0 to 15	1	Bits	F67	0000
0263		tIN_2 Inhibit Trip: Shot	0 to 15	1	Bits	F67	0000
0264		tIN_3 Close Shot?	0 to 15	1	Bits	F67	0000
0265		tIN_3 Inhibit Trip: Shot	0 to 15	1	Bits	F67	0000
0266		tAUX1 Close Shot?	0 to 15	1	Bits	F67	0000
0267		tAUX1 Inhibit Trip: Shot	0 to 15	1	Bits	F67	0000
0268		tAUX2 Close Shot?	0 to 15	1	bits	F67	0000
0269		tAUX2 Inhibit Trip: Shot	0 to 15	1	bits	F67	0000
	Setting group 1 /Inputs configuration						
026A		Reverse Input Logic	0 to 255	1	bits	F35	00000000
026B		Maintenance Mode	0 to 255	1	bits	F35	00000000
026C		Reset Latched Signaling	0 to 255	1	bits	F35	00000000
026D		Reset Latched Outputs	0 to 255	1	bits	F35	00000000
026E		Blocking tI>	0 to 255	1	bits	F35	00000000
026F		Blocking tI>>	0 to 255	1	bits	F35	00000000
0270		Blocking tI>>>	0 to 255	1	bits	F35	00000000
0271		Blocking tSOTF	0 to 255	1	bits	F35	00000000
0272		Blocking tIN_1	0 to 255	1	bits	F35	00000000
0273		Blocking tIN_2	0 to 255	1	bits	F35	00000000
0274		Blocking tIN_3	0 to 255	1	bits	F35	00000000
0275		Reserved					
0276		Blocking tI2>	0 to 255	1	bits	F35	00000000
0277		Blocking tBroken Conductor	0 to 255	1	bits	F35	00000000
0278		Blocking Itherm	0 to 255	1	bits	F35	00000000
0279		Blocking tAUX1	0 to 255	1	bits	F35	00000000
027A		Blocking tAUX2	0 to 255	1	bits	F35	00000000
027B		Blocking tAUX3	0 to 255	1	bits	F35	00000000
027C		Blocking CB Fail	0 to 255	1	bits	F35	00000000
027D		Blocking Autoreclose [79]	0 to 255	1	bits	F35	00000000
027E		Selectivity Logic 1 tI>>	0 to 255	1	bits	F35	00000000
027F		Selectivity Logic 1 tI>>>	0 to 255	1	bits	F35	00000000
0280		Selectivity Logic 1 tIN_2	0 to 255	1	bits	F35	00000000
0281		Selectivity Logic 1 tIN_3	0 to 255	1	bits	F35	00000000
0282		Selectivity Logic 2 tI>>	0 to 255	1	bits	F35	00000000
0283		Selectivity Logic 2 tI>>>	0 to 255	1	bits	F35	00000000
0284		Selectivity Logic 2 tIN_2	0 to 255	1	bits	F35	00000000
0285		Selectivity Logic 2 tIN_3	0 to 255	1	bits	F35	00000000
0286		AUX1	0 to 255	1	bits	F35	00000000

Address	Group	Description	Values range	Step	Unit	Format	Default Value
0287		AUX2	0 to 255	1	bits	F35	00000000
0288		AUX3	0 to 255	1	bits	F35	00000000
0289		AUX4	0 to 255	1	bits	F35	00000000
028A		AUX5	0 to 255	1	bits	F35	00000000
028B		AUX6	0 to 255	1	bits	F35	00000000
028C		Cold Load Pick Up	0 to 255	1	bits	F35	00000000
028D		Start tBF (CB Fail)	0 to 255	1	bits	F35	00000000
028E		CB status 52A	0 to 255	1	bits	F35	00000000
028F		CB status 52B	0 to 255	1	bits	F35	00000000
0290		CB Faulty External Signal	0 to 255	1	bits	F35	00000000
0291		Setting Group 2	0 to 255	1	bits	F35	00000000
0292		Manual Close	0 to 255	1	bits	F35	00000000
0293		Manual Trip	0 to 255	1	bits	F35	00000000
0294		Trip Circuit Supervision	0 to 255	1	bits	F35	00000000
0295		Reset Theta value	0 to 255	1	bits	F35	00000000
0296		Start Disturbance Recorder	0 to 255	1	bits	F35	00000000
0297		Local CTRL Mode	0 to 255	1	bits	F35	00000000
0298		Time Synchronization	0 to 255	1	bits	F35	00000000
	Setting group 1 /Outputs relays configuration						
0299		Latched outputs	0 to 127	1	bits	F36	0000000
029A		Reverse output Logic	0 to 127	1	bits	F36	0000000
029B		Protection Trip	0 to 127	1	bits	F36	0000000
029C		Protection Trip (pulse)	0 to 127	1	bits	F36	0000000
029D		Trip CB order	0 to 127	1	bits	F36	0000000
029E		Close CB order	0 to 127	1	bits	F36	0000000
029F		Alarm	0 to 127	1	bits	F33	0000000
02A0-02A2		Reserved					
02A3		Start I>	0 to 127	1	bits	F36	0000000
02A4		Start I>>	0 to 127	1	bits	F36	0000000
02A5		Start I>>>	0 to 127	1	bits	F36	0000000
02A6		Start SOTF	0 to 127	1	bits	F36	0000000
02A7		Start IN_1	0 to 127	1	bits	F36	0000000
02A8		Start IN_2	0 to 127	1	bits	F36	0000000
02A9		Start IN_3	0 to 127	1	bits	F36	0000000
02AA		Reserved					
02AB		Start I2>	0 to 127	1	bits	F36	0000000
02AC		Start Broken Conductor	0 to 127	1	bits	F36	0000000
02AD		AUX1	0 to 127	1	bits	F36	0000000
02AE		AUX2	0 to 127	1	bits	F36	0000000
02AF		AUX3	0 to 127	1	bits	F36	0000000
02B0		AUX4	0 to 127	1	bits	F36	0000000
02B1		AUX5	0 to 127	1	bits	F36	0000000
02B2		AUX6	0 to 127	1	bits	F36	0000000

Address	Group	Description	Values range	Step	Unit	Format	Default Value
02B3		tI>	0 to 127	1	bits	F36	0000000
02B4		tI>>	0 to 127	1	bits	F36	0000000
02B5		tI>>>	0 to 127	1	bits	F36	0000000
02B6		tSOTF	0 to 127	1	bits	F36	0000000
02B7		tIN_1	0 to 127	1	bits	F36	0000000
02B8		tIN_2	0 to 127	1	bits	F36	0000000
02B9		tIN_3	0 to 127	1	bits	F36	0000000
02BA		Reserved					
02BB		tI2>	0 to 127	1	bits	F36	0000000
02BC		t Broken Conductor	0 to 127	1	Bits	F36	0000000
02BD		Thermal Trip	0 to 127	1	Bits	F36	0000000
02BE		Thermal Alarm	0 to 127	1	bits	F36	0000000
02BF		CB Fail	0 to 127	1	bits	F36	0000000
02C0		tAUX1	0 to 127	1	bits	F36	0000000
02C1		tAUX2	0 to 127	1	bits	F36	0000000
02C2		tAUX3	0 to 127	1	bits	F36	0000000
02C3		tAUX4	0 to 127	1	bits	F36	0000000
02C4		Communication Order 1 (remote via RS485)	0 to 127	1	bits	F36	0000000
02C5		Communication Order 2 (remote via RS485)	0 to 127	1	bits	F36	0000000
02C6		[79] Autoreclose in progress	0 to 127	1	bits	F36	0000000
02C7		[79] Autoreclose Final Trip	0 to 127	1	bits	F36	0000000
02C8		[79] Autoreclose Lockout (internal block)	0 to 127	1	bits	F36	0000000
02C9		[79] Autoreclose blocked (external blocking)	0 to 127	1	bits	F36	0000000
02CA		79 Autoreclose Successful	0 to 127	1	bits	F36	0000000
02CB		TCS Trip Circuit Supervision (52): CB Fail	0 to 127	1	bits	F36	0000000
02CC		CB Alarm (CB diagnostic)	0 to 127	1	bits	F36	0000000
02CD		Reserved					
02CE		tCB Faulty detection based on External Signal (input)	0 to 127	1	bits	F36	0000000
02CF		Setting Group 1 is set	0 to 127	1	bits	F36	0000000
	Setting group 1 /LEDs configuration						
02D0		Latched LEDs	0 to 63	1	bits	F39	000000
02D1		Protection Trip	0 to 63	1	bits	F39	000000
02D2		Alarm	0 to 63	1	bits	F39	000000
02D3		General Start	0 to 63	1	bits	F39	000000
02D4		Start Phase A	0 to 63	1	bits	F39	000000
02D5		Start Phase B	0 to 63	1	bits	F39	000000
02D6		Start Phase C	0 to 63	1	bits	F39	000000
02D7		Start I>	0 to 63	1	bits	F39	000000
02D8		Start I>>	0 to 63	1	bits	F39	000000
02D9		Start I>>>	0 to 63	1	bits	F39	000000
02DA		Start SOTF	0 to 63	1	bits	F39	000000

Address	Group	Description	Values range	Step	Unit	Format	Default Value
02DB		Start IN_1	0 to 63	1	bits	F39	000000
02DC		Start IN_2	0 to 63	1	bits	F39	000000
02DD		Start IN_3	0 to 63	1	bits	F39	000000
02DE		AUX1	0 to 63	1	bits	F39	000000
02DF		AUX2	0 to 63	1	bits	F39	000000
02E0		AUX3	0 to 63	1	bits	F39	000000
02E1		AUX4	0 to 63	1	bits	F39	000000
02E2		AUX5	0 to 63	1	bits	F39	000000
02E3		AUX6	0 to 63	1	bits	F39	000000
02E4		tI>	0 to 63	1	bits	F39	000000
02E5		tI>>	0 to 63	1	bits	F39	000000
02E6		tI>>>	0 to 63	1	bits	F39	000000
02E7		tSOTF	0 to 63	1	bits	F39	000000
02E8		tIN_1	0 to 63	1	bits	F39	000000
02E9		tIN_2	0 to 63	1	bits	F39	000000
02EA		tIN_3	0 to 63	1	bits	F39	000000
02EB		Reserved					
02EC		tI2>	0 to 63	1	bits	F39	000000
02ED		tBroken Conductor	0 to 63	1	bits	F39	000000
02EE		Thermal Trip	0 to 63	1	bits	F39	000000
02EF		Thermal Alarm	0 to 63	1	bits	F39	000000
02F0		tCB Fail	0 to 63	1	bits	F39	000000
02F1		tAUX1	0 to 63	1	bits	F39	000000
02F2		tAUX2	0 to 63	1	bits	F39	000000
02F3		tAUX3	0 to 63	1	bits	F39	000000
02F4		tAUX4	0 to 63	1	bits	F39	000000
02F5		[79] Autoreclose in progress	0 to 63	1	bits	F39	000000
02F6		[79] Autoreclose Final Trip	0 to 63	1	bits	F39	000000
02F7		[79] Autoreclose Lockout (internal block)	0 to 63	1	bits	F39	000000
02F8		[79] Autoreclose blocked (external blocking)	0 to 63	1	bits	F39	000000
02F9		[79] Autoreclose Successful	0 to 63	1	bits	F39	000000
02FA		Local CTRL Mode	0 to 63	1	bits	F39	000000
02FB		CB Alarm (CB diagnostic)	0 to 63	1	bits	F39	000000
02FC		Maintenance Mode	0 to 63	1	bits	F39	000000
02FD		tCB Faulty detection based on External Signal (input)	0 to 63	1	bits	F39	000000
02FE		Setting Group 1 is set	0 to 63	1	bits	F39	000000

Page 3h: Setting Group 2

Access in reading and in writing

Address	Group	Description	Values range	Step	Unit	Format	Default Value
	Setting Group 2 / Protection G2 /Phase O/C						
0300		I>?	0-7	1	-	F16A	0
0301		I> threshold	10 to 4000	1	In/100	F1	140
0302		ItI>/TMS/TD	2 to 20000	1	1/100 s	F1	100
0303		I> Delay Type	0 to 21	1	-	F18	1
0304		I> Reset Delay Type	0-1	1	-	F41	0
0305		I> DMT/RTMS tReset	0 to 20000	1	1/100 s	F1	0
0306		I>>?	0-7	1	-	F16A	0
0307		I>> Threshold	10 to 4000	1	In/100	F1	140
0308		tI>>/TMS/TD	2 to 20000	1	1/100 s	F1	100
0309		*I>> Delay Type*	0 to 21	1	-	F18	1
030A		*I>> Reset Delay Type*	0-1	1	-	F41	0
030B		*I>> DMT/RTMS tReset*	0 to 20000	1	1/100 s	F1	0
030C		*I>>>?*	0-7	1	-	F16A	0
030D		I>>> Threshold	10 to 4000	1	In/100	F1	400
030E		tI>>>	0 to 20000	1	1/100 s	F1	100
	Setting Group 2 / Protection G2 /SOTF G1						
030F		SOTF?	0-4	1	-	F16	0
0310		SOTF Threshold	10 to 4000	1	In/100	F1	400
0311		tSOTF	0 to 60000	1	1/100 s	F1	100
	Setting Group 2 / Protection G2 /E/GND Fault						
0312		IN_1 stage?	0-14	1	-	F84	0
0313		IN_1 Threshold	Ref TD	1	Ien/100	F1	10 50 100
0314		tIN_1/TMS/TD	2 to 20000	1	1/100 s	F1	100
0315		IN_1 Delay Type	0 to 21	1	-	F18	1
0316		IN_1 Reset Delay Type	0-1	1	-	F41	0
0317		IN_1 DMT tReset	0 to 20000	1	1/100 s	F1	0
0318		IN_2?	0-14	1	-	F84	0
0319		IN_2 Threshold	Ref TD	1	Ien/100	F1	options
031A		tIN_2	0 to 20000	1	1/100 s	F1	10
031B		IN_3?	0-4	1	-	F84	0
031C		IN_3 Threshold	Ref TD	1	Ien/100	F1	options
031D		tIN_3	0 to 20000	1	1/100 s	F1	10

Address	Group	Description	Values range	Step	Unit	Format	Default Value
031E -0320		Reserved					
	Setting Group 2 / Protection G2 /Neg.Seq.O/C						
0321		I2>?	0-4	1	-	F16	0
0322		I2> threshold	10 to 400	1	In/100	F1	140
0323		tI2>/TMS/TD	2 to 20000	1	1/100 s	F1	100
0324		I2> Delay Type	0 to 21	1	-	F18	1
0325		I2> Reset Delay Type	0 -1	1	-	F41	0
0326		I2> DMT/RTMS tReset	0 to 60000	1	1/100 s	F1	0
	Setting Group 2 / Protection G /Broken Conductor						
0327		Broken Cond.?	0-4	1	-	F16	0
0328		Ratio I2/I1	20 to 100	1	%	F1	20
0329		tBCond	0 to 60000	1	1/100 s	F1	100
	Setting Group 2 / Protection G2 /Thermal Overload						
032A		Therm OL?	0-1	1	-	F109	0
032B		Itheta>	10 to 300	1	In/100	F1	140
032C		Therm Alarm?	0-1	1	-	F109	0
032D		Te	1 to 200	1	min	F1	1
032E		Tr	1 to 999	1	min	F1	1
032F		Theta Trip	50 to 200	1	%	F1	100
0330		Theta Reset	20 to 99	1	%	F1	95
0331		Theta Alarm	20 to 200	1	%	F1	80
	Setting Group 2 / Protection G2 /Aux Timers						
0332		AUX1?	0-7	1	-	F110	0
0333		tAUX1	0 to 60000	1	1/100 s	F1	0
0334		AUX2?	0-7	1	-	F110	0
0335		tAUX2	0 to 60000	1	1/100 s	F1	0
0336		AUX2?	0-7	1	-	F110	0
0337		tAUX2	0 to 60000	1	1/100 s	F1	0
0338		AUX2?	0-7	1	-	F110	0
0339		tAUX2	0 to 60000	1	1/100 s	F1	0
	Setting Group 2 / Protection G2 /CB Fail						
033A		CB Fail?	0-2	1	-	F111	0
033B		CB Fail Time tBF	0 to 1000	1	1/100 s	F1	20
033C		I< Threshold CBF	10 to 200	1	In/100	F1	10

Address	Group	Description	Values range	Step	Unit	Format	Default Value
033D		IN< Threshold CBF	10 to 200	1	Ien/100	F1	10
033E		Block I>	0 to 1	1	-	F63	0
033F		Block IN>	0 to 1	1	-	F63	0
	Setting Group 2 / Protection G2 /Logic Selective						
0340		Sel1?	0-1	1	-	F109	0
0341		tSEL1	0 to 60000	1	1/100 s	F1	0
0342		Sel2?	0-1	1	-	F109	0
0343		tSEL2	0 to 60000	1	1/100 s	F1	0
	Setting Group 2 / Protection G2 /Cold Load PU						
0344		Cold Load PU?	0-1	1	-	F109	0
0345		Cold Load PU Level	20 to 999	1	%	F1	100
0346		Cold Load PU tCL	0 to 60000	1	1/100 s	F1	0
0347		Cold Load PU I>	0 -1	1	-	F63	0
0348		Cold Load PU I>>	0 -1	1	-	F63	0
0349		Cold Load PU I>>>	0 -1	1	-	F63	0
034A		Cold Load PU IN_1	0 -1	1	-	F63	0
034B		Cold Load PU IN_2	0 -1	1	-	F63	0
034C		Cold Load PU IN_3	0 -1	1	-	F63	0
034D		Cold Load PU Brkn Cond	0 -1	1	-	F63	0
034E		Cold Load PU Itherm	0 -1	1	-	F63	0
034F		Cold Load PU I2>	0 -1	1	-	F63	0
	Setting Group 2 / Protection G2 /Autoreclose						
0350		Autoreclose?	0 -1	1	-	F109	0
0351		Dead Time tD1	0 to 60000	1	1/100 s	F1	0
0352		Dead Time tD2	0 to 60000	1	1/100 s	F1	0
0353		Dead Time tD3	0 to 60000	1	1/100 s	F1	0
0354		Dead Time tD4	0 to 60000	1	1/100 s	F1	0
0355		Dead Time tR	0 to 60000	1	1/100 s	F1	0
0356		Fast O/C Trip	0 to 31	1	bits	F72	00000
0357		Fast O/C Trip Delay	0 to 999	1	1/100 s	F1	0
0358		Fast E/GND Trip	0 to 31	1	bits	F72	00000
0359		Fast E/GND Trip Delay	0 to 999	1	1/100 s	F1	0
035A		tI> Close Shot?	0 to 15	1	bits	F67	0000
035B		tI> Inhibit Trip: Shot	0 to 15	1	bits	F67	0000
035C		tI>> Close Shot?	0 to 15	1	bits	F67	0000
035D		tI>> Inhibit Trip: Shot	0 to 15	1	bits	F67	0000
035E		tI>>> Close Shot?	0 to 15	1	bits	F67	0000
035F		tI>>> Inhibit Trip: Shot	0 to 15	1	bits	F67	0000

Address	Group	Description	Values range	Step	Unit	Format	Default Value
0360		tIN_1 Close Shot?	0 to 15	1	bits	F67	0000
0361		tIN_1 Inhibit Trip: Shot	0 to 15	1	bits	F67	0000
0362		tIN_2 Close Shot?	0 to 15	1	bits	F67	0000
0363		tIN_2 Inhibit Trip: Shot	0 to 15	1	bits	F67	0000
0364		tIN_3 Close Shot?	0 to 15	1	bits	F67	0000
0365		tIN_3 Inhibit Trip: Shot	0 to 15	1	bits	F67	0000
0366		tAUX1 Close Shot?	0 to 15	1	bits	F67	0000
0367		tAUX1 Inhibit Trip: Shot	0 to 15	1	bits	F67	0000
0368		tAUX2 Close Shot?	0 to 15	1	bits	F67	0000
0369		tAUX2 Inhibit Trip: Shot	0 to 15	1	bits	F67	0000
	Setting group 2 /Inputs configuration G2						
036A		Reverse Input Logic	0 to 255	1	bits	F35	00000000
036B		Maintenance Mode	0 to 255	1	bits	F35	00000000
036C		Reset Latched Signaling	0 to 255	1	bits	F35	00000000
036D		Reset Latched Outputs	0 to 255	1	bits	F35	00000000
036E		Blocking tI>	0 to 255	1	bits	F35	00000000
036F		Blocking tI>>	0 to 255	1	bits	F35	00000000
0370		Blocking tI>>>	0 to 255	1	bits	F35	00000000
0371		Blocking tSOTF	0 to 255	1	bits	F35	00000000
0372		Blocking tIN_	0 to 255	1	bits	F35	00000000
0373		Blocking tIN_2	0 to 255	1	bits	F35	00000000
0374		Blocking tIN_3	0 to 255	1	bits	F35	00000000
0375		Reserved					
0376		Blocking tI2>	0 to 255	1	bits	F35	00000000
0377		Blocking tBroken Conductor	0 to 255	1	bits	F35	00000000
0378		Blocking Itherm	0 to 255	1	bits	F35	00000000
0379		Blocking tAUX1	0 to 255	1	bits	F35	00000000
037A		Blocking tAUX2	0 to 255	1	bits	F35	00000000
037B		Blocking tAUX3	0 to 255	1	bits	F35	00000000
037C		Blocking CB Fail	0 to 255	1	bits	F35	00000000
037D		Blocking Autoreclose [79]	0 to 255	1	bits	F35	00000000
037E		Selectivity Logic 1 tI>>	0 to 255	1	bits	F35	00000000
037F		Selectivity Logic 1 tI>>>	0 to 255	1	bits	F35	00000000
0380		Selectivity Logic 1 tIN_2	0 to 255	1	bits	F35	00000000
0381		Selectivity Logic 1 tIN_3	0 to 255	1	bits	F35	00000000
0382		Selectivity Logic 2 tI>>	0 to 255	1	bits	F35	00000000
0383		Selectivity Logic 2 tI>>>	0 to 255	1	bits	F35	00000000
0384		Selectivity Logic 2 tIN_2	0 to 255	1	bits	F35	00000000
0385		Selectivity Logic 2 tIN_3	0 to 255	1	bits	F35	00000000
0386		AUX1	0 to 255	1	bits	F35	00000000

Address	Group	Description	Values range	Step	Unit	Format	Default Value
0387		AUX2	0 to 255	1	bits	F35	00000000
0388		AUX3	0 to 255	1	bits	F35	00000000
0389		AUX4	0 to 255	1	bits	F35	00000000
038A		AUX5	0 to 255	1	bits	F35	00000000
038B		AUX6	0 to 255	1	bits	F35	00000000
038C		Cold Load Pick Up	0 to 255	1	bits	F35	00000000
038D		Start tBF (CB Fail)	0 to 255	1	bits	F35	00000000
038E		CB status 52A	0 to 255	1	bits	F35	00000000
038F		*CB status 52B*	0 to 255	1	bits	F35	00000000
0390		CB Faulty External Signal	0 to 255	1	bits	F35	00000000
0391		Setting Group 2	0 to 255	1	bits	F35	00000000
0392		Manual Close	0 to 255	1	bits	F35	00000000
0393		Manual Trip	0 to 255	1	bits	F35	00000000
0394		Trip Circuit Supervision	0 to 255	1	bits	F35	00000000
0395		Reset Theta value	0 to 255	1	bits	F35	00000000
0396		Start Disturbance Recorder	0 to 255	1	bits	F35	00000000
0397		Local CTRL Mode	0 to 255	1	bits	F35	00000000
0398		Time Synchronization	0 to 255	1	bits	F35	00000000
	Setting group 2 /Outputs relays configuration G2						
0399		Latched outputs	0 to 127	1	bits	F36	0000000
039A		Reverse output Logic	0 to 127	1	bits	F36	0000000
039B		Protection Trip	0 to 127	1	bits	F36	0000000
039C		Protection Trip (pulse)	0 to 127	1	bits	F36	0000000
039D		Trip CB order	0 to 127	1	bits	F36	0000000
039E		Close CB order	0 to 127	1	bits	F36	0000000
039F		Alarm	0 to 127	1	bits	F33	0000000
03A0-03A2		Reserved	0 to 127	1	bits	F36	0000000
03A3		Start I>	0 to 127	1	bits	F36	0000000
03A4		Start I>>	0 to 127	1	bits	F36	0000000
03A5		Start I>>>	0 to 127	1	bits	F36	0000000
03A6		Start SOTF	0 to 127	1	bits	F36	0000000
03A7		Start IN_1	0 to 127	1	bits	F36	0000000
03A8		Start IN_2	0 to 127	1	bits	F36	0000000
03A9		Start IN_3	0 to 127	1	bits	F36	0000000
03AA		Reserved					
03AB		Start I2>	0 to 127	1	bits	F36	0000000
03AC		Start Broken Conductor	0 to 127	1	bits	F36	0000000
03AD		AUX1	0 to 127	1	bits	F36	0000000
03AE		AUX2	0 to 127	1	bits	F36	0000000
03AF		AUX3	0 to 127	1	bits	F36	0000000
03B0		AUX4	0 to 127	1	bits	F36	0000000
03B1		AUX5	0 to 127	1	bits	F36	0000000
03B2		AUX6	0 to 127	1	bits	F36	0000000

Address	Group	Description	Values range	Step	Unit	Format	Default Value
03B3		tI>	0 to 127	1	bits	F36	0000000
03B4		tI>>	0 to 127	1	bits	F36	0000000
03B5		tI>>>	0 to 127	1	bits	F36	0000000
03B6		tSOTF	0 to 127	1	bits	F36	0000000
03B7		tIN_1	0 to 127	1	bits	F36	0000000
03B8		tIN_2	0 to 127	1	bits	F36	0000000
03B9		tIN_3	0 to 127	1	bits	F36	0000000
03BA		Reserved					
03BB		tI2>	0 to 127	1	bits	F36	0000000
03BC		t Broken Conductor	0 to 127	1	bits	F36	0000000
03BD		Thermal Trip	0 to 127	1	bits	F36	0000000
03BE		Thermal Alarm	0 to 127	1	bits	F36	0000000
03BF		CB Fail	0 to 127	1	bits	F36	0000000
03C0		tAUX1	0 to 127	1	bits	F36	0000000
03C1		tAUX2	0 to 127	1	bits	F36	0000000
03C2		tAUX3	0 to 127	1	bits	F36	0000000
03C3		tAUX4	0 to 127	1	bits	F36	0000000
03C4		Communication Order 1 (remote via RS485)	0 to 127	1	bits	F36	0000000
03C5		Communication Order 2 (remote via RS485)	0 to 127	1	bits	F36	0000000
03C6		[79] Autoreclose in progress	0 to 127	1	bits	F36	0000000
03C7		[79] Autoreclose Final Trip	0 to 127	1	bits	F36	0000000
03C8		[79] Autoreclose Lockout (internal block)	0 to 127	1	bits	F36	0000000
03C9		[79] Autoreclose blocked (external blocking)	0 to 127	1	bits	F36	0000000
03CA		79 Autoreclose Successful	0 to 127	1	bits	F36	0000000
03CB		TCS Trip Circuit Supervision (52): CB Fail	0 to 127	1	bits	F36	0000000
03CC		CB Alarm (CB diagnostic)	0 to 127	1	bits	F36	0000000
03CD		Reserved					
03CE		tCB Faulty detection based on External Signal (input)	0 to 127	1	bits	F36	0000000
03CF		Setting Group 2 is set	0 to 127	1	bits	F36	0000000
	Setting group 2 /LEDs configuration G2						
03D0		Latched LEDs	0 to 63	1	bits	F39	000000
03D1		Protection Trip	0 to 63	1	bits	F39	000000
03D2		Alarm	0 to 63	1	bits	F39	000000
03D3		General Start	0 to 63	1	bits	F39	000000
03D4		Start Phase A	0 to 63	1	bits	F39	000000
03D5		Start Phase B	0 to 63	1	bits	F39	000000
03D6		Start Phase C	0 to 63	1	bits	F39	000000
03D7		Start I>	0 to 63	1	bits	F39	000000
03D8		Start I>>	0 to 63	1	bits	F39	000000
03D9		Start I>>>	0 to 63	1	bits	F39	000000
03DA		Start SOTF	0 to 63	1	bits	F39	000000

Address	Group	Description	Values range	Step	Unit	Format	Default Value
03DB		Start IN_1	0 to 63	1	bits	F39	000000
03DC		Start IN_2	0 to 63	1	bits	F39	000000
03DD		Start IN_3	0 to 63	1	bits	F39	000000
03DE		AUX1	0 to 63	1	bits	F39	000000
03DF		AUX2	0 to 63	1	bits	F39	000000
03E0		AUX3	0 to 63	1	bits	F39	000000
03E1		AUX4	0 to 63	1	bits	F39	000000
03E2		AUX5	0 to 63	1	bits	F39	000000
03E3		AUX6	0 to 63	1	bits	F39	000000
03E4		tI>	0 to 63	1	bits	F39	000000
03E5		tI>>	0 to 63	1	bits	F39	000000
03E6		tI>>>	0 to 63	1	bits	F39	000000
03E7		tSOTF	0 to 63	1	bits	F39	000000
03E8		tIN_1	0 to 63	1	bits	F39	000000
03E9		tIN_2	0 to 63	1	bits	F39	000000
03EA		tIN_3	0 to 63	1	bits	F39	000000
03EB		Reserved					
03EC		tI2>	0 to 63	1	bits	F39	000000
03ED		tBroken Conductor	0 to 63	1	bits	F39	000000
03EE		Thermal Trip	0 to 63	1	bits	F39	000000
03EF		Thermal Alarm	0 to 63	1	bits	F39	000000
03F0		tCB Fail	0 to 63	1	bits	F39	000000
03F1		tAUX1	0 to 63	1	bits	F39	000000
03F2		tAUX2	0 to 63	1	bits	F39	000000
03F3		tAUX3	0 to 63	1	bits	F39	000000
03F4		tAUX4	0 to 63	1	bits	F39	000000
03F5		[79] Autoreclose in progress	0 to 63	1	bits	F39	000000
03F6		[79] Autoreclose Final Trip	0 to 63	1	bits	F39	000000
03F7		[79] Autoreclose Lockout (internal block)	0 to 63	1	bits	F39	000000
03F8		[79] Autoreclose blocked (external blocking)	0 to 63	1	bits	F39	000000
03F9		[79] Autoreclose Successful	0 to 63	1	bits	F39	000000
03FA		Local CTRL Mode	0 to 63	1	bits	F39	000000
03FB		CB Alarm (CB diagnostic)	0 to 63	1	bits	F39	000000
03FC		Maintenance Mode	0 to 63	1	bits	F39	000000
03FD		tCB Faulty detection based on External Signal (input)	0 to 63	1	bits	F39	000000
03FE		Setting Group 2 is set	0 to 63	1	bits	F39	000000

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Access in reading only

0191		Phase SBC Alarm Threshold	0 to 65535	1	kA2	F1	1000
0192		SBC Interval 1 High Limit	0 to 65535	1	1/10 kA2	F1	2
0193		SBC Interval 2 High Limit	0 to 65535	1	1/10 kA2	F1	5
0194		SBC Interval 3 High Limit	0 to 65535	1	1/10 kA2	F1	10
0195		SBC Interval 4 High Limit	0 to 65535	1	1/10 kA2	F1	40
0196		CB Alarm Threshold 1	0 to 65535	1	1/100 kA	F1	80
0197		CB Alarm Counter 1	0 to 65535	1		F1	500
0198		CB Alarm Threshold 2	0 to 65535	1	1/100 kA	F1	600
0199		CB Alarm Counter 2	0 to 65535	1		F1	50

Page 4h; CB Monitoring

Access in reading only

0408		CB Close Counter	0 to 65535	1		F1	0
0409		CB Open Counter	0 to 65535	1		F1	0
040A		CB Trips Counter	0 to 65535	1		F1	0
040B		**S**quared **B**reaking **C**urrent Total	0 to 65535	1	1/10 MA	F1	0
040C		SBC Phase A Interval 1	0 to 65535	1	1/10 kA2	F1	0
040D		SBC Phase A Interval 2	0 to 65535	1	1/10 kA2	F1	0
040E		SBC Phase A Interval 3	0 to 65535	1	1/10 kA2	F1	0
040F		SBC Phase A Interval 4	0 to 65535	1	1/10 kA2	F1	0
0410		SBC Phase A Interval 5	0 to 65535	1	1/10 kA2	F1	0
0411		Phase A Interval 1 Counter	0 to 65535	1		F1	0
0412		Phase A Interval 2 Counter	0 to 65535	1		F1	0
0413		Phase A Interval 3 Counter	0 to 65535	1		F1	0
0414		Phase A Interval 4 Counter	0 to 65535	1		F1	0
0415		Phase A Interval 5 Counter	0 to 65535	1		F1	0
0416		SBC Phase B Interval 1	0 to 65535	1	1/10 kA2	F1	0
0417		SBC Phase B Interval 2	0 to 65535	1	1/10 kA2	F1	0
0418		SBC Phase B Interval 3	0 to 65535	1	1/10 kA2	F1	0
0419		SBC Phase B Interval 4	0 to 65535	1	1/10 kA2	F1	0
041A		SBC Phase B Interval 5	0 to 65535	1	1/10 kA2	F1	0
041B		Phase B Interval 1 Counter	0 to 65535	1		F1	0
041C		Phase B Interval 2 Counter	0 to 65535	1		F1	0
041D		Phase B Interval 3 Counter	0 to 65535	1		F1	0
041E		Phase B Interval 4 Counter	0 to 65535	1		F1	0

041F		Phase B Interval 5 Counter	0 to 65535	1		F1	0
0420		SBC Phase C Interval 1	0 to 65535	1	1/10 kA2	F1	0
0421		SBC Phase C Interval 2	0 to 65535	1	1/10 kA2	F1	0
0422		SBC Phase C Interval 3	0 to 65535	1	1/10 kA2	F1	0
0423		SBC Phase C Interval 4	0 to 65535	1	1/10 kA2	F1	0
0424		SBC Phase C Interval 5	0 to 65535	1	1/10 kA2	F1	0
0425		Phase C Interval 1 Counter	0 to 65535	1		F1	0
0426		Phase C Interval 2 Counter	0 to 65535	1		F1	0
0427		Phase C Interval 3 Counter	0 to 65535	1		F1	0
0428		Phase C Interval 4 Counter	0 to 65535	1		F1	0
0429		Phase C Interval 5 Counter	0 to 65535	1		F1	0
042A		SBC Phase A Total	0 to 65535	1	kA2	F1	0
042B		SBC Phase B Total	0 to 65535	1	kA2	F1	0
042C		SBC Phase C Total	0 to 65535	1	kA2	F1	0
042D		Reserved					
042E		Racking Counter	0 to 65535	1		F1	0
042F		Racking Input Group1	0 to 1	1	bits	F35	000000
0430		Racking Input Group2	0 to 1	1	bits	F35	000000
0431-043E		Reserved					
043F		CB Spring Ready Input Group1	0 to 1	1	bits	F35	000000
0440		CB Spring Ready Input Group2		1	bits	F35	000000

Page 4h : Remote Controls

In P1F it is possible to use both functions Function 5 or Function 6

Access in writing.

MODBUS Function 6

Note: A one control can be executed in a one message only. Two control commands in a one message will be rejected by P1F

Address	Group	Description	Values range	Step	Unit	Format	Default Value
0400	**Remote control**	Remote control word 1	0 to 15	bits	-	F38	0
0401		Remote control word 2	0 to 15	bits	-	F38A	0
0402		Remote control word 3	0 to 15	bits	-	F38B	0

Examples of messages

The example 1
Query to apply “Thermal State reset” via PowerLogic P1F:

An example of request to “Thermal state reset” in slave 10 (dec):		
Field name	**Value (hex)**	**Remarks**
Slave Address	0A	P1F setting value
Function	06	
Register Address Hi (Address Hi)	04	Address
Register Address Lo (Address Lo)	01	(See table above)
Preset Data Hi	00	bit 3
Preset Data LO	08	(See format F38A)
Error Check (CRC)	-	-

The example 2
Query to apply “Remote CB Close Command” via PowerLogic P1F:

An example of request to “Remote CB close command” in slave 17 (dec):		
Field name	**Value (hex)**	**Remarks**
Slave Address	11	P1F setting value
Function	06	
Register Address Hi (Address Hi)	04	Address
Register Address Lo (Address Lo)	00	(See table above)
Preset Data Hi	80	bit 15
Preset Data LO	00	(See format F38)
Error Check (CRC)	-	-

MODBUS Function 5

Group	Modbus Coil Address Hi (hex)	Modbus Coil Address Lo (hex)			Force Data Hi (hex)	Force Data Lo (hex)
		Number of controls	Values range	Step		
Remote control	**04**	See format: F113	**0** to **21**	1	**FF**	**00**

The example of query to apply “Remote CB Close Command” via PowerLogic P1F:

An example of request to “remote CB close command” (force coil 0F – ON) in slave 17 (dec):		
Field name	**Value (Hex)**	**Remarks**
Slave Address	11	P1F setting value
Function	05	
Coil Address Hi	04	See table above
Coil Address Lo	0F	See format F113
Force Data Hi	FF	Fixed value
Force Data Lo	00	Fixed value
Error Check (CRC)	-	-

Pages 5h/6h

These pages are reserved.

Page 7h

Access in quick reading only (MODBUS 07 function)

Address	Group	Description	Values range	Step	Unit	Format	Default Value
0700	**Quick reading byte**	Relay status description		1	-	F49	0

Page 8h: Time Synchronization

Access in writing for n words (function 16). The time synchronization format is based on 8 bits (4 words) (Inverted IEC 60870-5-4 CP56Time2a):

Timer	Address (hex)	Nb bytes	Mask (hex)	Values range	Unit
	0800	1 (Hi)			
Year		1 (Lo)	7F	0 – 99 (2000-2099)	Year
Month	0801	1 (Hi)	0F	1 – 12	month
Day of week		1 (Lo)	E0	Not used in P1F	-
day of month		1 (Lo)	1F	1 – 31	Day
Season	0802	1 (Hi)	80	0 – 1 (summer-winter) Not used	
Hour		1 (Hi)	1F	0-23	Hour
Invalidity		1 (Lo)	80	0 -1 (valid – invalid)	
Minute		1 (Lo)	3F	0-59	Minute
Millisecond pF+pf	0803	2	FFFF	0 – 59999	ms

Mapping access characteristics

- Description of accessible addresses in reading of words (**function 03** and **04**).

PAGE 00h
0000h to 0064h

PAGE 01h
0100h to 01Ach

PAGE 02h
0200h to 02Feh

PAGE 03h
0300h to 03Feh

- Definition of accessible addresses in writing of 1 word (**function 06**).

PAGE 01h
0100h to 01Ach

PAGE 02h
0200h to 02Feh

PAGE 03h
0300h to 03Feh

- Definition of accessible addresses in writing of n words (**function 16**).

PAGE 01h
0100h to 01Ach

PAGE 02h
0200h to 02Feh

PAGE 03h
0300h to 03Feh

PAGE 08h
0800h to 0803h

- Definition of accessible addresses in reading of bits (**function 01** and **02**).

Not available

- Definition of accessible addresses in writing of 1 bit (**function 05**).

PAGE 04h
0400h to 0402h

Note: The bits number must not be higher than 16.

Page 9h to 21h: Disturbance Record Data (25 pages)

Access in words writing (**function 03**)
Each disturbance mapping page contain 250 words.

Address	Contents
0900h to 09Fah	250 disturbance data words
0A00h to 0AFAh	250 disturbance data words
0B00h to 0BFAh	250 disturbance data words
0C00h to 0CFAh	250 disturbance data words
0D00h to 0DFAh	250 disturbance data words
0E00h to 0DFAh	250 disturbance data words
0F00h to 0FFAh	250 disturbance data words
1000h to 10Fah	250 disturbance data words
1100h to 11Fah	250 disturbance data words
1200h to 12Fah	250 disturbance data words
1300h to 13Fah	250 disturbance data words
1400h to 14Fah	250 disturbance data words
1500h to 15Fah	250 disturbance data words
1600h to 16Fah	250 disturbance data words
1700h to 17Fah	250 disturbance data words

1800h to 18Fah	250 disturbance data words
1900h to 19Fah	250 disturbance data words
1A00h to 1AFAh	250 disturbance data words
1B00h to 1BFAh	250 disturbance data words
1C00h to 1CFAh	250 disturbance data words
1D00h to 1DFAh	250 disturbance data words
1E00h to 1EFAh	250 disturbance data words
1F00h to 1FFAh	250 disturbance data words
2000h to 20Fah	250 disturbance data words
2100h to 21Fah	250 disturbance data words

NB: The disturbance data pages contain values of one channel from one given disturbance record.

Meaning of each value channel

- IA, IB, IC and IN channels:

The value is a signed 16 bits word equivalent to the ADC value

Calculation formula for phase current values

Values in Amps can be calculated in following way:

$$\text{Value IA} = \sqrt{2} \cdot \frac{\text{sample\_IA} \cdot \text{Internal\_PhA} \cdot \text{Phase\_Primary\_CT\_In}}{\text{Phase\_Secondary\_CT\_In} \cdot 200}$$

$$\text{Value IB} = \sqrt{2} \cdot \frac{\text{sample\_IB} \cdot \text{Internal\_PhB} \cdot \text{Phase\_Primary\_CT\_In}}{\text{Phase\_Secondary\_CT\_In} \cdot 200}$$

$$\text{Value IC} = \sqrt{2} \cdot \frac{\text{sample\_IC} \cdot \text{Internal\_PhC} \cdot \text{Phase\_Primary\_CT\_In}}{\text{Phase\_Secondary\_CT\_In} \cdot 200}$$

Where:
Internal_PhA, Internal_PhB, Internal_PhC: Internal scalling (Page 38h to 3Ch)

Calculation formula for earth current values

Value in Amps can be calculated in following way:

$$\text{Value IN} = \sqrt{2} \cdot \frac{\text{sample\_IN} \cdot \text{Internal\_N} \cdot \text{Earth\_Primary\_CT\_Ien}}{\text{Earth\_Secondary\_CT\_Ien} \cdot 2000}$$

Where:
Internal_N: Internal scaling (Page 38h to 3Ch)

Calculation formula for voltage VN values

Value in Volts can be calculated in following way:

$$\text{Value VN} = \sqrt{2} \cdot \frac{\text{sample\_VN} \cdot \text{Internal\_VN}}{20}$$

Where:
Internal_VN: Internal scaling (Page 38h to 3Ch)

- Frequency channel:
Time between two samples in microseconds

- Logic channels:

Logic channel	Contents
Bit 0	Binary Input 1
Bit 1	Binary Input 2
Bit 2	Binary Input 3
Bit 3	Binary Input 4
Bit 4	Binary Input 5
Bit 5	Binary Input 6
Bit 6	Binary Input 7
Bit 7	Binary Input 8
Bit 8	Output RL1
Bit 9	Output RL2
Bit 10	Output RL3
Bit 11	Output RL4
Bit 12	Output RL5
Bit 13	Output RL6
Bit 14	Protection Trip
Bit 15	Start of protection which trips

Page 22h: Disturbance Record Index Frame

Access in word reading (function 03)

Address	Contents
2200h	Disturbance data index frame

Disturbance record index frame

Word	Contents
n° 1	Disturbance record number
n° 2	Disturbance record finish date (second)
n° 3	Disturbance record finish date (second)
n° 4	Disturbance record finish date (millisecond)
n° 5	Disturbance record finish date (millisecond)
n° 6	Disturbance record starting condition: 1: tripping 2: instantaneous 3: remote command 4: logic input

n° 7	Frequency at the post-time beginning

Page 30h (addresses 3000h to 3007h): CB open record data (6 words)

Word n° 1: Record number
Word n° 2: CB open time (ms)
Words n° 3 & 4 & 5 & 6: Event date is Inverted IEC 60870-5-4 CP56Time2a: See format Page 8h

Page 31h (addresses 3100h to 3107h): CB close record data (6 words)

Word n° 1: Record number
Word n° 2: CB close time (ms)
Words n° 3 & 4 & 5 & 6: Event date is Inverted IEC 60870-5-4 CP56Time2a: See format Page 8h

Page 32h (addresses 3200h to 3207h): Spring charging record data (6 words)

Word n° 1: Record number
Word n° 2: Spring charging time (s)
Words n° 3 & 4 & 5 & 6: Event date is Inverted IEC 60870-5-4 CP56Time2a: See format Page 8h

Page 33h : Cumulative breaking current data

Access in word reading (**function 03**)

Address	Contents
3300h	Broken Current Sum IL1 – Interval 1
3301h	Broken Current Sum IL1 – Interval 2
3302h	Broken Current Sum IL1 – Interval 3
3303h	Broken Current Sum IL1 – Interval 4
3304h	Broken Current Sum IL1 – Interval 5
3305h	Broken Current Sum IL2 – Interval 1
3306h	Broken Current Sum IL2 – Interval 2
3307h	Broken Current Sum IL2 – Interval 3
3308h	Broken Current Sum IL2 – Interval 4
3309h	Broken Current Sum IL2 – Interval 5
330Ah	Broken Current Sum IL3 – Interval 1
330Bh	Broken Current Sum IL3 – Interval 2
370Ch	Broken Current Sum IL3 – Interval 3
370Dh	Broken Current Sum IL3 – Interval 4
370Eh	Broken Current Sum IL3 – Interval 5
370Fh	Broken Current Sum IL1
3710h	Broken Current Sum IL2
3711h	Broken Current Sum IL3

Each value read is a floating point type (4 bytes). More than one value can be read.

Page 35h (addresses 3500h to 354Ah): event record data (9 words)

Word n° 1: Event meaning
Word n° 2: MODBUS associated value
Word n° 3: MODBUS address
Word n° 4: Reserved
Words n° 5 & 6 & 7 & 8: Event date is Inverted IEC 60870-5-4 CP56Time2a: See format Page 8h
Word n° 9: Acknowledge
0=event non-acknowledged
1= event acknowledged)

Code	Meaning of the event	Type	MODBUS address
00	No event	-	-
01	CB closing (Remote/menu HMI)	F38 ↑	0400h (bit 15)
02	CB tripping (Remote/menu HMI)	F38 ↑	0400h (bit 7)
03	Reset latched outputs (Remote)	F38 ↑	0400h (bit 2)
04	Reset signaling (Remote)	F38 ↑	0400h (bit 1)
05	Reset signaling and latched outputs (Remote)	F38 ↑	0400h (bit 3)
06	Clear fault and disturbance recorder	F38A ↑	0401h (bit 0)
07	Clear event recorder	F38A ↑	0401h (bit 1)
08	Setting group change	-	-
09	Warm restart	↑	-
10	Reserved	-	-
11	Current Protection disable status	↑↓	-
12	START I>	F37↑↓	0021h (bit 0)
13	START I>>	F37↑↓	0022h (bit 0)
14	START IN_1	F50 ↑↓	0024h (bit 0)
15	START IN_2	F50 ↑↓	0025h (bit 0)
16	tI>	F37↑↓	0021h (bit 6)
17	tI>>	F37↑↓	0022h (bit 6)
18	tIN_1	F50 ↑↓	0024h (bit 6)
19	tIN_2	F50 ↑↓	0025h (bit 6)
20	tAUX1	F51 ↑↓	0027h (bit 6)
21	CB status: opened	F30 ↑	001Bh (value 0)
22	CB status: closed	F30 ↑	001Bh (value 1)
23	CB status: faulty	F30 ↑	001Bh (value 3)
24	CB status: undefined	F30 ↑	001Bh (value 4)
25	tCB Faulty External Signal.	F31A ↑	001Ah (bit 10)
26	Start tCB Fail Ext.	F51 ↑↓	002Ah (bit 0)
27	CHANGE OF INPUT LOGIC STATE	F11 ↑↓	0010h
28	CHANGE OF OUTPUT LOGIC STATE	F24 ↑↓	0013h
29	START I>>>	F37↑↓	0023h (bit 0)
30	tI>>>	F37↑↓	0023h (bit 6)

Code	Meaning of the event	Type	MODBUS address
31	Start I2>	F50 ↑↓	002Dh (bit 0)
32	tI2>	F50 ↑↓	002Dh (bit 6)
33	tAUX2	F51 ↑↓	0028 (bit 6)
34	tCB Fail	F51 ↑↓	0029h (bit 6)
35	Setting Group 1 active	F32↑	0009h (bit 0)
36	Setting Group 2 active	F32↑	0009h (bit 1)
37	tI> Alarm	F31↑↓	0019h (bit 0)
38	tI>> Alarm	F31↑↓	0019h (bit 1)
39	tI>>> Alarm	F31↑↓	0019h (bit 2)
40	tIN_1 Alarm	F31 ↑↓	0019h (bit 4)
41	tIN_2 Alarm	F31 ↑↓	0019h (bit 5)
42	tAUX1 Alarm	F31A ↑↓	001Ah (bit 5)
43	tAUX2 Alarm	F31A ↑↓	001Ah (bit 6)
44	tI2> Alarm	F31 ↑↓	0019h (bit 8)
45	tCB Fail Alarm	F31 ↑↓	0019h (bit 10)
46	Start AUX1	F51 ↑↓	0027h (bit 0)
47	Start AUX2	F51 ↑↓	0028h (bit 0)
48	[79] Autoreclose blocked (Remote/menu HMI)	F38 ↑	0400h (bit 8)
49	[79] Autoreclose unblocked (Remote/menu HMI)	F38 ↑	0400h (bit 9)
50	Reset latched Alarms	F38 ↑	0400h (bit 5)
51	Reserved	-	-
52	Reserved	-	-
53	Reserved	-	-
54	Ack oldest disturbance recorder record	F38A↑	0401h (bit 8)
55	Reserved	-	-
56	Disturbance recorder start (Remote)	F38A↑	0401h (bit 5)
57	Communication order 1	F38A↑	0401h (bit 14)
58	Communication order 2	F38A↑	0401h (bit 15)
59	Reserved	-	-
60	Thermal state reset (Remote/menu HMI)	F38A ↑	
61	Recloser counters reset (Remote/menu HMI)	F38A↑	0401h (bit 3)
62	Fault counters reset (Remote/menu HMI)	F38A↑	0401h (bit 10)
63	Control counters reset (Remote/menu HMI)	F38A↑	0401h (bit 12)
64	Maintenance mode	F38A↑	0401h (bit 13)
65	End of maintenance mode	F38A↑	0401h (bit 6)
66	START IN_3	F38A	0401h (bit 7)
67	tIN_3	F50 ↑↓	0026h (bit 0)
68	tIN_3 Alarm	F50 ↑↓	0026h (bit 6)
69	Start SOTF	F31 ↑↓	0019h (bit 6)
70	tSOTF	F37 ↑↓	002Bh (bit 0)

Code	Meaning of the event	Type	MODBUS address
71	tSOTF Alarm	F37 ↑↓	002Bh (bit 6)
72	Reserved	-	-
73	Reserved	-	-
74	Reserved	-	-
75	Start Broken Conductor	F31 ↑↓	0019h (bit 7)
76	tBroken Conductor	F50 ↑↓	002Eh (bit 0)
77	tBroken Conductor Alarm	F50 ↑↓	002Eh (bit 6)
78	Itherm>	F31 ↑↓	0019h (bit 9)
79	Thermal OL Trip	F50 ↑↓	002Fh (bit 0)
80	Thermal OL Alarm	F50 ↑↓	002Fh (bit 6)
81	START AUX3	F31 ↑↓	0019h (bit 11)
82	tAUX3	F51 ↑↓	0030h (bit 0)
83	tAUX3 Alarm	F51 ↑↓	0030h (bit 6)
84	Start AUX4	F31A ↑↓	001Ah (bit 7)
85	tAUX4	F51 ↑↓	0031h (bit 0)
86	tAUX4 Alarm	F51 ↑↓	0031h (bit 6)
87	Reserved	-	-
88	Reserved	-	-
89	Reserved	-	-
90-95	Reserved	-	-
96	Local CTRL mode	F61↑	001Eh (value: 2)
97	Remote CTRL mode	F61↑	001Eh (value: 1)
98	Local and remote CTRL mode	F61↑	001Eh (value: 0)
99	Reserved	-	-
100	Reserved	-	-
101	Reserved	-	-
102	Setting Group 2 set via Input	F104↑↓	0035h (bit 8)
103	Relays Test (Commissioning Test) active	↑	-
104	Test I> On	↑	-
105	Test I> Off	↑	-
106	Test I>> On	↑	-
107	Test I>> Off	↑	-
108	Test I>>> On	↑	-
109	Test I>>> Off	↑	-
110	Test SOTF On	↑	-
111	Test SOTF Off	↑	-
112	Test IN_1 On	↑	-
113	Test IN_1 Off	↑	-
114	Test IN_2 On	↑	-
115	Test IN_2 Off	↑	-

Code	Meaning of the event	Type	MODBUS address
116	Test IN_3 On	↑	-
117	Test IN_3 Off	↑	-
118	Reserved	-	-
119	Reserved	-	-
120	Test I2> On	↑	-
121	Test I2> Off	↑	-
122	Test Brkn. Cond. On	↑	-
123	Test Brkn. Cond. Off	↑	-
124	Test Thermal OL On	↑	
125	Test Thermal OL Off	↑	
126	Test CBF On	↑	-
127	Test CBF Off	↑	-
128	Blocking tI> active	F101↑↓	0032h (bit 0)
129	Blocking tI>> active	F101↑↓	0032h (bit 1)
130	Blocking tI>>> active	F101↑↓	0032h (bit 2)
131	Blocking tSOTF active	F101↑↓	0032h (bit 3)
132	Blocking tIN_1 active	F101↑↓	0032h (bit 4)
133	Blocking tIN_2 active	F101↑↓	0032h (bit 5)
134	Blocking tIN_3 active	F101↑↓	0032h (bit 6)
135	Reserved	-	-
136	Blocking tI2> active	F101↑↓	0032h (bit 8)
137	Blocking tBrkn. Conductor active	F101↑↓	0032h (bit 9)
138	Blocking Itherm. Active	F101↑↓	0032h (bit 11)
139	Blocking tAUX1 active	F102↑↓	0033h (bit 5)
140	Blocking tAUX2 active	F102↑↓	0033h (bit 6)
141	Blocking tAUX3 active	F102↑↓	0033h (bit 7)
142	Blocking CB Fail active	F101↑↓	0032h (bit 10)
143	Blocking [79] active	F102↑↓	0033h (bit 0)
144	Sel1 tI>> active	F103↑↓	0034h (bit 0)
145	Sel1 tI>>> active	F103↑↓	0034h (bit 1)
146	Sel1 tIN_2 active	F103↑↓	0034h (bit 2)
147	Sel1 tIN_3 active	F103↑↓	0034h (bit 3)
148	reserved	-	-
149	Sel2 tI>> ACTIVE	F103↑↓	0034h (bit 4)
150	Sel2 tI>>> ACTIVE	F103↑↓	0034h (bit 5)
151	Sel2 tIN_2 ACTIVE	F103↑↓	0034h (bit 6)
152	Sel2 tIN_3 ACTIVE	F103↑↓	0034h (bit 7)
153	reserved	-	-
154	Cold Load PU active	F104↑↓	0035h (bit 3)
155	Manual Close via Input	↑	-

Code	Meaning of the event	Type	MODBUS address
156	Manual Close via Function Key	↑	-
157	Manual Trip via Input	↑	-
158	Manual trip via Function Key	↑	-
159	TC Supervision alarm	F31A↑↓	001Ah (bit 11)
160	Theta Reset via Input	F104↑↓	0035h (bit 12)
161	Start Disturbance recorder via Input	↑	-
162	Changing CTRL mode via Input	F104↑	0035h (bit 14)
163	Changing CTRL mode (Remote/menu HMI)	F38↑	0400h (bit 4)
164	Active [79] in Progress	F59↑↓	001Ch (bit 1)
165	[79] Final trip	F59↑↓	001Ch (bit 4)
166	[79] Lockout	F59↑↓	001Ch (bit 6)
167	[79] Blocked	F59↑↓	001Ch (bit 0)
168	[79] Successful	F59↑↓	001Ch (bit 5)
169	[79] tD1 counting	F59↑↓	001Ch (bit 8)
170	[79] tD2 counting	F59↑↓	001Ch (bit 9)
171	[79] tD3 counting	F59↑↓	001Ch (bit 10)
172	[79] tD4 counting	F59↑↓	001Ch (bit 11)
173	[79] tR counting	F59↑↓	001Ch (bit 12)
174	Fast O/C trip Delay Elapsed	F59↑	001Ch (bit 13)
175	Fast E/GND Trip Delay Elapsed	F59↑	001Ch (bit 14)
176	[79] Reclose order	F59↑	001Ch (bit 3)
177	[79] Inhibit Trip tI> active	↑	-
178	[79] Inhibit Trip tI>> active	↑	-
179	[79] Inhibit Trip tI>>> active	↑	-
180	[79] Inhibit Trip tIN_1 active	↑	-
181	[79] Inhibit Trip tIN_2 active	↑	-
182	[79] Inhibit Trip tIN_3 active	↑	-
183	[79] Inhibit Trip tAUX1 active	↑	-
184	[79] Inhibit Trip tAUX2 active	↑	-
185	[79] Rolling demand blocking active	↑	-
186	[79] Inhibit time on close counting	F60↑↓	001Dh (bit 2)
187	Autoreclose: T-C	↑	-
188	Autoreclose: T-C-T	↑	-
189	Autoreclose: T-C-T-C	↑	-
190	Autoreclose: T-C-T-C-T	↑	-
191	Autoreclose: T-C-T-C-T-C	↑	-
192	Autoreclose: T-C-T-C-T-C-T	↑	-
193	Autoreclose: T-C-T-C-T-C-T-C	↑	-
194	Autoreclose: T-C-T-C-T-C-T-C-T	↑	-
195	Reserved	↑	-

Code	Meaning of the event	Type	MODBUS address
196	Reserved	-	-
197	CB Time Supervision Alarm	F31A↑↓	001Ah (bit 12)
198	Unblock SOTF active	↑↓	-
199	tReset I> active	F37↑↓	0021h (bit 5)
200-399	Reserved	-	-
400	tReset I>> active	F37↑↓	0022h (bit 5)
401	tReset IN_1 active	F50 ↑↓	0024h (bit 5)
402	tReset I2> active	F50 ↑↓	002Dh (bit 5)
403	Reserved	-	-
404	Reserved	-	-
405	Reserved	-	-
406	Reserved	-	-
407	Reset signaling via Input	F104↑	0035h (bit 1)
408	Reset latched outputs via Input	F104↑	0035h (bit 2)
409	Inrush threshold active	F28A ↑↓	0016h (bit 4)
410	Inrush unblock active	↑↓	-
411	Reset Signaling via Close command	↑	
412	State of CB Alarm	F31A↑↓	001Ah (bit 2)
413	[79] Rolling demand Alarm	F31A↑↓	001Ah (bit 9)
414	CB current diagnostic Alarm	F31A↑↓	001Ah (bit 0)
415	CB number diagnostic Alarm	F31A↑↓	001Ah (bit 1)
416	Max CB open number	-	-
418	Automatic acknowledgement of events enabled	↑	-
419	Automatic acknowledgement of events disabled	↑	-
421	LED Status	F25↑↓	0014h
422	Communication protocol changed	↑	0101h
423	[79] Status Changed	F59↑↓	001Ch
424	[79] Blocking Status Changed	F60↑↓	001Dh
425	Front Panel Operation	F2 ↑	000Ch
426	Cold Restart	↑	-

Note: The double arrow ↑↓ means the event is generated on event occurrence (↑) and on event disappearance (↓).

On event occurrence, the corresponding bit of the associated format is set to « 1 ».

On event disappearance, the corresponding bit of the associated format is set to « 0 ».

Page 36h

Most older event data

Access in word reading (**function 03**)

Address	Contents
3600h	Most older event data

Page 37h: Fault Record Value Data

Access in word reading (**function 03**)

Address	Contents
3700h	Fault value record n°1
3701h	Fault value record n°2
3702h	Fault value record n°3
3703h	Fault value record n°4
3704h	Fault value record n°5
3705h	Fault value record n°6
3706h	Fault value record n°7
3707h	Fault value record n°8
3708h	Fault value record n°9
3709h	Fault value record n°10
370Ah	Fault value record n°11
370Bh	Fault value record n°12
370Ch	Fault value record n°13
370Dh	Fault value record n°14
370Eh	Fault value record n°15
370Fh	Fault value record n°16
3710h	Fault value record n°17
3711h	Fault value record n°18
3712h	Fault value record n°19
3713h	Fault value record n°20

Word n° 1: Fault number

Words n° 2 & 3 & 4 & 5: see table below (Inverted IEC 60870-5-4 CP56Time2a)

Timer	Address (hex)	Nb bytes	Mask (hex)	Values range	Unit
	Word n° 2	1 (Hi)			
Year		1 (Lo)	7F	0 – 99 (2000-2099)	Year
Month	Word n° 3	1 (Hi)	0F	1 – 12	month
Day of week		1 (Lo)	E0	Not used in P1F	
day of month		1 (Lo)	1F	1 – 31	Day
Season	Word n° 4	1 (Hi)	80	0 – 1 (summer-winter) **Not used**	
Hour		1 (Hi)	1F	0-23	Hour

Invalidity		1 (Lo)	80	0 -1 (valid – invalid)	
Minute		1 (Lo)	3F	0-59	Minute
Millisecond pF+pf	Word n° 5	2	FFFF	0 – 59999	ms (included s)

Word n° 6: Reserved

Word n° 7: Active setting group during the fault (1 or 2)

Word n° 8: Fault origin

0= none
1= phase A
2= phase B
3= phase C
4= phases A-B
5= phases A-C
6= phases B-C
7= phases A-B-C
8= earth

Word n° 9: Fault recording starting origin

Fault nature code meaning

Code	**Fault origin**
00	Null event
01	Reserved
02	Thermal Overload
03	tI> trip
04	tI>> trip
05	tI>>> trip
06	tIN>_1 trip
07	tIN_2 trip
08	tIN_3 trip
09	Reserved
10	tBrkn Cond
11	t Aux 1 trip
12	t Aux 2 trip
13	tI2> trip
14	Reserved
15	t Aux 3 trip
16	t Aux 4 trip
17	CB Fail trip
18	tSOTF
19	Reserved
20	Cbext trip

Word n° 10:	Fault value current (nominal value)	
Word n° 11:	Phase A current value (nominal value)	
Word n° 12:	Phase B current value (nominal value)	
Word n° 13:	Phase C current value (nominal value)	
Word n° 14:	Earth current value (nominal value)	
Word n° 15:	Acknowledge of fault	0: fault non-acknowledged 1: fault acknowledged

Calculation Formula for Phase Current Values

Line phase current value (primary value) = phase sampled value (e.g. address 0040h, 0041h or 0042h) * {line primary CT ratio (address 0120h)/Line CT sec (address 0121h)} A/100.

Calculation Formula for Earth Current Values

Line phase current value (primary value) = earth sampled value (e.g. address 0043h) * {line primary CT ratio (address 0122h)/Line CT sec (address 0123h)} A/1000.

Page 3Eh: MOST OLDER FAULT RECORD VALUE DATA

Access in word reading (**function 03**)

Address	Contents
3E00h	Most older Fault record

Page 38h to 3Ch: Disturbance Recorder (A, E)

Selection of the disturbance record and channel (34 bytes are uploaded for each address reading)

Access in word reading (**function 03**)

Address	Disturbance record number	Format
3800h	1	IA
3801h	1	IB
3802h	1	IC
3803h	1	IN
3804h	1	Logic input and outputs
3805h	1	Frequency
3900h	2	IA
3901h	2	IB
3902h	2	IC
3903h	2	IN
3904h	2	Logic input and outputs
3905h	2	Frequency
3A00h	3	IA

3A01h	3	IB
3A02h	3	IC
3A03h	3	IN
3A04h	3	Logic input and outputs
3A05h	3	Frequency
3B00h	4	IA
3B01h	4	IB
3B02h	4	IC
3B03h	4	IN
3B04h	4	Logic input and outputs
3B05h	4	Frequency
3C00h	5	IA
3C01h	5	IB
3C02h	5	IC
3C03h	5	IN
3C04h	5	Logic input and outputs
3C05h	5	Frequency

Word n° 1: Number of samples included in the mapping
Word n° 2: Sample number in pre-time
Word n° 3: Sample number in post-time
Word n° 4: Line CT primary nominal current (***Phase_Primary_CT_In***)
Word n° 5: Line CT secondary nominal current (***Phase_ Secondary _CT_In***)
Word n° 6: E/GND CT primary nominal current (***Earth_Primary_CT_Ien***)
Word n° 7: E/GND CT secondary nominal current (***Earth_Secondary_CT_Ien)***
Float[1)] n° 1: Phase A Internal PhA ratio (***Internal_PhA***)
Float[1)] n° 2: Phase B internal PhB ratio (***Internal_PhB***)
Float[1)] n° 3: Phase C internal PhC ratio (***Internal_PhC***)
Float[1)] n° 4: Earth internal ratio (***Internal_N***)
Word n° 8: Mapping last page number
Word n° 9: Number of words in the mapping last page

2) Float – 4 bytes floating point number

Page 38h to 3Ch: Disturbance Recorder (E+)

Selection of the disturbance record and channel (38 bytes are uploaded for each address reading)

Access in word reading (**function 03**)

Address	Disturbance record number	Format
3800h	1	IA
3801h	1	IB
3802h	1	IC

3803h	1	IN
3804h	1	VN
3805h	1	Logic input and outputs
3806h	1	Frequency
3900h	2	IA
3901h	2	IB
3902h	2	IC
3903h	2	IN
3904h	2	VN
3905h	2	Logic input and outputs
3906h	2	Frequency
3A00h	3	IA
3A01h	3	IB
3A02h	3	IC
3A03h	3	IN
3A04h	3	VN
3A05h	3	Logic input and outputs
3A06h	3	Frequency
3B00h	4	IA
3B01h	4	IB
3B02h	4	IC
3B03h	4	IN
3B04h	4	VN
3B05h	4	Logic input and outputs
3B06h	4	Frequency
3C00h	5	IA
3C01h	5	IB
3C02h	5	IC
3C03h	5	IN
3C04h	5	VN
3C05h	5	Logic input and outputs
3C06h	5	Frequency

Word n° 1: Number of samples included in the mapping
Word n° 2: Sample number in pre-time
Word n° 3: Sample number in post-time
Word n° 4: Line CT primary nominal current (***Phase_Primary_CT_In***)
Word n° 5: Line CT secondary nominal current (***Phase_ Secondary _CT_In***)
Word n° 6: E/GND CT primary nominal current (***Earth_Primary_CT_Ien***)
Word n° 7: E/GND CT secondary nominal current
(***Earth_Secondary_CT_Ien)***
Float[1)] n° 1: Phase A Internal PhA ratio (***Internal_PhA***)
Float[1)] n° 2: Phase B internal PhB ratio (***Internal_PhB***)

Float[1) n° 3: Phase C internal PhC ratio (***Internal_PhC***)
Float[1) n° 4: Earth internal ratio (***Internal_N***)
Float[1) n° 5: VN internal ratio (***Internal_VN***)
Word n° 8: Mapping last page number
Word n° 9: Number of words in the mapping last page

2) Float – 4 bytes floating point number

Pages 3Dh: Number of Disturbance Records Available

Access in word reading (function 03)

Address	Contents
3D00h	Number of disturbances records available

Word n° 1: Number of disturbances records available
Word n° 2: Oldest disturbance record number (n)
Words n° 3 & 4: Oldest disturbance record date (second)
Words n° 5 & 6: Oldest disturbance record date (millisecond)
Word n° 7: Disturbance record starting origin
- 1= Protection trip
- 2= instantaneous threshold
- 3= remote command
- 4= logic input

Word n° 8: Acknowledge
Word n° 9: Disturbance record previous number (n+1)
Words n° 10 & 11: Previous disturbance record date (second)
Words n° 12 & 13: Previous disturbance record date (millisecond)
Word n° 14: Disturbance record starting origin
- 1= Protection trip
- 2= instantaneous threshold
- 3= remote command
- 4= logic input

Word n° 15: Acknowledge
Word n° 16: Disturbance record previous number (n+2)
Words n° 17 & 18: Previous disturbance record date (second)
Words n° 19 & 20: Previous disturbance record date (millisecond)
Word n° 21: Disturbance record starting origin
- 1= Protection trip
- 2= instantaneous threshold
- 3= remote command
- 4= logic input

Word n° 22: Acknowledge
Word n° 23: Disturbance record previous number (n+3)
Words n° 24 & 25: Previous disturbance record date (second)
Words n° 26 & 27: Previous disturbance record date (millisecond)
Word n° 28: Disturbance record starting origin
- 1= Protection trip
- 2= instantaneous threshold
- 3= remote command
- 4= logic input

Word n° 29: Acknowledge
Word n° 30: Disturbance record previous number (n+4)
Words n° 31 & 32: Previous disturbance record date (second)
Words n° 33 & 34: Previous disturbance record date (millisecond)

Word n° 35:	Disturbance record starting origin 1= Protection trip 2= instantaneous threshold 3= remote command 4= logic input
Word n° 36:	Acknowledge

Description of the Mapping Format, PowerLogic P1F

CODE	DESCRIPTION
F1	Unsigned integer – numerical data: 1 – 65535
F2	Edit mode – unsigned integer: 0: Edit mode not active 1: Edit mode active 2: Front panel (CB) operation
F3	Relay forward direction – unsigned integer: 0: Line 1: Bus 2: no direction
F10	Characters ASCII byte 1: ASCII character 32-127 byte 2: ASCII character 32-127
F11	Binary input status – unsigned integer (16-bits flag field): bit 0: logic input 1 bit 1: logic input 2 bit 2: logic input 3 bit 3: logic input 4 bit 4: logic input 5 bit 5: logic input 6 bit 6: logic input 7 bit 7: logic input 8 bit 8-15: reserved
F12	Current Protection disable status – unsigned integer (16-bits flag field): bit 0: I> disabled bit 1: I>> disabled bit 2: I>>> disabled bit 3: SOTF disabled bit 4: IN_1 disabled bit 5: IN_2 disabled bit 6: IN_3 disabled bit 7: reserved bit 8: I2> disabled bit 9: Brkn Cond. Disabled bit 10: CB Fail disabled bit 11: Thermal OL disabled bit 12 to 15: reserved
F12A	Protection Function disable status – unsigned integer (16-bits flag field): bit 0: 79 Autoreclose disabled bit 1: SEL1 disabled bit 2: SEL2 disabled bit 3: Cold Load PU disabled bit 4: Blocking Inrush disabled bit 5: AUX1 disabled bit 6: AUX2 disabled bit 7: AUX3 disabled bit 8: AUX4 disabled bit 9 to 15: reserved
F13	LR Status – unsigned integer (16-bits flag field) bit 1: L+R bit 2: Remote bit 3: Local bit 4: reserved bit 5: reserved bit 6: reserved bit 7: reserved bit 8: reserved bit 9: reserved bit 10: reserved bit 11: reserved bit 12: reserved bit 13: reserved

CODE	DESCRIPTION
	bit 14: reserved bit 15: reserved
F13A	Maintenance Mode Status – unsigned integer (16-bits flag field) bit 1: Maintenance Off bit 2: Maintenance On without out blocking bit 3: Maintenance On without blocking bit 4: reserved bit 5: reserved bit 6: reserved bit 7: reserved bit 8: reserved bit 9: reserved bit 10: reserved bit 11: reserved bit 12: reserved bit 13: reserved bit 14: reserved bit 15: reserved
F14	CB Status – unsigned integer (16-bits flag field) bit 0: CB open bit 1: CB close bit 2: CB Faulty bit 3: CB not defined bit 4: reserved bit 5: reserved bit 6: reserved bit 7: reserved bit 8: reserved bit 9: reserved bit 10: reserved bit 11: reserved bit 12: reserved bit 13: reserved bit 14: reserved bit 15: reserved
F15	Two-digit decimal number – Firmware version – unsigned integer 1^{st} digit – major version 2^{nd} digit – minor version 10: 1A 11: 1B 12: 1C 13: 1D etc.
F16	Configuration – unsigned integer 0: disabled 1: Trip 2: Alarm 3: Trip with Inrush Blocking 4: Trip with Latching
F16A	Configuration – unsigned integer 0: disabled 1: Trip 2: Alarm 3: Trip with Inrush Blocking 4: Trip with Latching 5: Trip-Phase A 6: Trip-Phase B 7: Trip-Phase C
F17	Trip latch status 1 – unsigned integer (16-bit flag field) bit 0: I> bit 1: I>> bit 2: I>>> bit 3: IN_1 bit 4: IN_2 bit 5: IN_3 bit 6: AUX1 bit 7: AUX2

CODE	DESCRIPTION
	bit 8: AUX3 bit 9: AUX4 bit 10: reserved bit 11: Is2 bit 12: BC bit 13: reserved bit 14: SOTF bit 15: reserved
F17A	Trip latch status 2 – unsigned integer (16-bit flag field) bit 0: reserved bit 1: reserved bit 2: reserved bit 3: reserved bit 4: reserved bit 5: reserved bit 6: reserved bit 7: reserved bit 8: reserved bit 9: reserved bit 10: reserved bit 11: Ext CBF bit 12: reserved bit 13: reserved bit 14: reserved bit 15: reserved
F18	Curves type – unsigned integer 0: DMT 1: SI IEC 2: VI IEC 3: EI IEC 4: LTI (IEC) 5: STI (IEC) 6: RC Rectifier curve 7: RI curve 8: MI IEEE 9: VI IEEE 10: EI IEEE 11: STI (US C02-P20) 12: LTI (US C08) 13: RXIDG 14: BPN EDF 15: STI (US C02-P40) 16: US C05 17: US C06 18: US C07 19: US C09 20: US C011 21: HV_Fuse
F19	Baud rate value – unsigned integer 0: 4800 baud 1: 9600 baud 2: 19200 baud 3: 38400 baud 4: 57600 baud 5: 115200 baud
F20	Parity – unsigned integer 0: NONE 1: ODD 2: EVEN
F22	Stop – unsigned integer 0: 1 stop 1: 2 stop
F23	Line CT Sec – unsigned integer 9: In = 1A/5A; 0.1-40In
F23A	E/GND Sec – unsigned integer 0: 0.01-2Ien

CODE	DESCRIPTION
	3: 0.05-12Ien 4: 0.01-12Ien
F24	Logical output status – unsigned integer (16-bits flag field): bit 0: logic output RL1 bit 1: logic output RL2 bit 2: logic output RL3 bit 3: logic output RL4 bit 4: logic output RL5 bit 5: logic output RL6 bit 6: **Reserved** bit 7-15: reserved
F25	Logical LED status – unsigned integer (16-bits flag field): bit 0: Trip bit 1: Alarm bit 2: LED3 bit 3: LED4 bit 4: LED5 bit 5: LED6 bit 6: LED7 bit 7: Healthy bit 8-15: reserved
F26	Logical heathy status – unsigned integer (16-bits flag field): bit 0: reserved bit 1: HW_OFFSET exceeded bit 2-3: reserved bit 4: Healthy bit 10-15: reserved
F28	Protection start status – unsigned integer (16-bits flag field): bit 0: I> bit 1: I>> bit 2: I>>> bit 3: SOTF bit 4: IN_1 bit 5: IN_2 bit 6: IN_3 bit 7: reserved bit 8: I2> bit 9: Brkn Cond. bit 10: tCB Fail Start bit 11: Itherm Start bit 12: starting in phase A bit 13: starting in phase B bit 14: starting in phase C bit 15: starting in N
F28A	Protection start status – unsigned integer (16-bits flag field): bit 0: Reserved bit 1: Reserved bit 2: Reserved bit 3: Cold Load PU active bit 4: Blocking Inrush active bit 5: AUX1 bit 6: AUX2 bit 7: AUX3 bit 8: AUX4 bit 9-15: Reserved
F29	Current Protection trip status – unsigned integer (16-bits flag field): bit 0: tI> bit 1: tI>> bit 2: tI>>> bit 3: tSOTF bit 4: tIN_1 bit 5: tIN_2 bit 6: tIN_3 bit 7: reserved bit 8: tI2> bit 9: tBrkn Conductor

CODE	DESCRIPTION
	bit 10: CB Fail bit 11: Thermal Overload bit 12: starting in phase A bit 13: starting in phase B bit 14: starting in phase C bit 15: starting in N
F29A	Protection Function trip status – unsigned integer (16-bits flag field): bit 0: Reserved bit 1: reserved bit 2: reserved bit 3: reserved bit 4: reserved bit 5: tAUX1 bit 6: tAUX2 bit 7: tAUX3 bit 8: tAUX4 bit 9-15: reserved
F30	CB status – unsigned integer (decimal value) 0: CB opened 1: CB closed 2: Not set state 3: CB position faulty 4: CB position undefined
F31	Protection Alarm status – unsigned integer (16-bits flag field): bit 0: tI> bit 1: tI>> bit 2: tI>>> bit 3: tSOTF bit 4: tIN_1 bit 5: tIN_2 bit 6: tIN_3 bit 7: reserved bit 8: tI2> bit 9: tBrkn Conductor bit 10: tCB Fail bit 11: Thermal Overload bit 12-15: reserved
F31A	Alarm Function status – unsigned integer (16-bits flag field): bit 0: CB current Diagnostic (Square Amps sum overreach) bit 1: CB number Diagnostic (operation number overreach) bit 2: State of CB Alarm bit 3: reserved bit 4: reserved bit 5: tAUX1 bit 6: tAUX2 bit 7: tAUX3 bit 8: tAUX4 bit 9: [79] Rolling demand Alarm bit 10: t CB Faulty ext sign bit 11: TC Supervision (Trip circuit self-test) bit 12: CB Time Supervision (time overreach) bit 13-15: reserved
F32	Setting group – unsigned integer 0: Setting group 1 1: Setting group 2
F33	Output configuration – unsigned integer (16-bits flag field): bit 0: RL1 bit 1: RL2 bit 2: RL3 bit 3: RL4 bit 4: RL5 bit 5: RL6 bit 6: RL7 bit 7: WD bit 8-15: reserved

CODE	DESCRIPTION
F35	Input configuration – unsigned integer (16-bits flag field): bit 0: Input L1 bit 1: Input L2 bit 2: Input L3 bit 3: Input L4 bit 4: Input L5 bit 5: Input L6 bit 6: Input L7 bit 7: Input L8 bit 8-15: reserved
F36	Output configuration – unsigned integer (16-bits flag field): bit 0: RL1 bit 1: RL2 bit 2: RL3 bit 3: RL4 bit 4: RL5 bit 5: RL6 bit 6: RL7 bit 7-15: reserved
F37	I>, I>>, I>>>, SOTF, CBF, Therm threshold phase information status – unsigned integer (16-bits flag field): bit 0: information threshold exceeded bit 1: Instantaneous IA bit 2: Instantaneous IB bit 3: Instantaneous IC bit 4: Blocking signal active bit 5: tReset active bit 6: Time delay elapsed bit 7: Alarm bit 8 to 15: reserved
F38	Remote control word – unsigned integer (16-bits flag field): 0: Warm restart 1: Reset LEDs 2: Reset Outputs 3: Reset LEDs and Outputs 4: Local Mode 5: Reserved 6: Setting change to Group 1 7: Remote or HMI CB open order 8: Remote or HMI [79] Autoreclose blocking 9: Remote or HMI [79] Autoreclose unblocking 10: Remote Mode 11: Setting change to Group 2 12: Disable automatic acknowledgement of events 13: Oldest event acknowledge 14: Oldest fault acknowledge 15: Remote or via HMI CB close order
F38A	Remote control word – unsigned integer (16-bits flag field): 0: Clear Recorders 1: Clear Events 2: reserved 3: Thermal state reset 4: Reserved 5: Disturbance record remote start 6: Maintenance mode 7: End of maintenance mode 8: Acknowledgement of the oldest disturbance record 9: Reserved 10: Recloser reset counters 11: Reserved 12: Reset Fault counters 13: Reset control counters 14: Communication Order 1 15: Communication Order 2
F38B	Remote control word – unsigned integer (16-bits flag field): 0: [79] Unlockout

CODE	DESCRIPTION
	1: Enable automatic acknowledgement of events 2: Change Modbus S1 to Modbus Std 3: Change Modbus Std to Modbus S1 4: Clear CB Open Time Recorder 5: Clear CB Close Time Recorder 6: Clear Spring Charging Time Recorder 7: Clear CB Counters 8: Clear Interval Square Breaking Current and Interval Counters 9: Clear Racking Counter 10-15: reserved
F39	LED function – unsigned integer (16-bits flag field): bit 0: LED2 bit 1: LED3 bit 2: LED4 bit 3: LED5 bit 4: LED6 bit 5: LED7 bit 6-15: reserved
F40	Output configuration – unsigned integer (16-bits flag field): bit 0: RL1 bit 1: RL2 bit 2: RL3 bit 3: RL4 bit 4: RL5 bit 5: RL6 bit 6: RL7 bit 7-15: reserved
F41	Curve Type – unsigned integer 0: DT 1: IDMT
F49	relay status – unsigned integer (16-bits flag field): bit 0: Relay status (major alarms) bit 1: Minor hardware alarm bit 2: Presence of non-acknowledged event bit 3: Synchronization state bit 4: Presence of non-acknowledged disturbance record bit 5: Presence of non-acknowledged fault record bit 6: Local Maintenance Ack state bit 7-15: reserved
F50	Current protection IN_1, IN_2, IN_3, I2>, BC – unsigned integer (16-bits flag field): bit 0: information threshold exceeded bit 1: reserved bit 2: reserved bit 3: reserved bit 4: Blocking signal active bit 5: tReset active bit 6: Time delay elapsed bit 7: Alarm information – Therm OL only bit 8 to 15: reserved
F51	Information status about additional protection AUX1, AUX2, AUX3, AUX4 CB Fail ext. sign. – unsigned integer (16-bits flag field): bit 0: start bit 1: Reserved bit 2: Reserved bit 3: Reserved bit 4: Blocking active bit 5: Start after blocking bit 6: Time delay elapsed bit 7 to 15: reserved
F52	Information about language in menu – unsigned integer 0: English; 1: German; 2: French; 3: Spanish

CODE	DESCRIPTION
	4: Russian 5: Turkish 6: Language 7
F53	Information about language in menu – unsigned integer 0: Measurements referred to In or Ien 1: Measurements referred to A 2: CB CTRL window 3: 79 CTRL window 4: CTRL Mode (Local/Remote)
F54	Unsigned integer: 0: Manual only 1: Start Protection 2: Close command
F55	Alarm Display Reset – unsigned integer 0: Self-Reset 1: Manual Reset
F56	Protocol – unsigned integer 0: Modbus S1 1: IEC103 2: Modbus Std 3: GetSet 4: Modbus PO
F57	Nominal Frequency – unsigned integer 0: 50Hz 1: 60Hz
F59	[79] status – unsigned integer (16-bits flag field): bit 0: Recloser blocked bit 1: Recloser in progress bit 2: reserved bit 3: Closing command executed via Autorecloser bit 4: Recloser final trip bit 5: Recloser successful bit 6: Recloser lockout bit 7: Trip locked via Recloser (inhibit of protection stage) bit 8: Dead Time tD1 counting bit 9: Dead Time tD2 counting bit 10: Dead Time tD3 counting bit 11: Dead Time tD4 counting bit 12: Reclaim Time tR counting bit 13: Fast O/C Trip Delay elapsed bit 14: Fast E/GND Trip Delay elapsed bit 15: reserved
F60	[79] blocking status – unsigned integer 0: Ready 1: In progress 2: Temporary blocked (after close signal) 3: Lockout 4: Blocked via CTRL (HMI+RS485) 5: Blocked via input 6: Disabled
F61	Local/Remote Mode – unsigned integer 0: Local and Remote 1: Remote only 2: Local only
F62	Maintenance Mode – unsigned integer 0: No 1: Yes 2: Yes- Bl.Outputs
F63	Configuration – unsigned integer 0: No 1: Yes

CODE	DESCRIPTION
F64	79 dead time configuration – unsigned integer 0: Protection reset 1: CB trips
F65	Disturbance recorder configuration – unsigned integer 0: On Instantaneous 1: On Trip
F66	Configuration – unsigned integer 0: Disabled 1: Current+Input 2: Input only
F67	Close Shot – unsigned integer (16-bits flag field): bit 0: First Reclose Shot bit 1: Second Reclose Shot bit 2: Third Reclose shot bit 3: Fourth Reclose shot bit 4-15: reserved
F71	Number of setting groups – unsigned integer 0: One Group 1: Two Groups
F72	AR trips cycle – unsigned integer (16-bits flag field): bit 0: First trip shot bit 1: Second trip shot bit 2: Third trip shot bit 3: Fourth trip shot bit 4: Fifth trip shot bit 5-15: reserved
F73	Remote Mode configuration – unsigned integer 0: Remote Only 1: Remote + Local
F74	Inrush Blocking configuration – unsigned integer 0: No 1: Yes 2: Closing
F75	Unsigned integer 0: No operation 1: Apply Test
F76	Function Test Pattern – unsigned integer (16-bits flag field): bit 0: tI> bit 1: tI>> bit 2: tI>>> bit 3: tSOTF bit 4: tIN_1 bit 5: tIN_2 bit 6: tIN_3 bit 7: tI2> bit 8: tBrkn Conductor bit 9: Reserved bit 10: Thermal OL Trip bit 11: CB Fail bit 12-15: reserved
F77	Functional Test End – unsigned integer 0: CB Trip 1: Time elapsed
F81	I>, I>>, I>>> (1 harmonic or True RMS) – unsigned integer 0: 1 Harmonic 1: True RMS
F82	Control keys Mode – unsigned integer 0: Disabled 1: No confirm 2: With confirm 3-15: reserved

CODE	DESCRIPTION
F84	Configuration – unsigned integer 0: Disabled 1: Trip 2: Alarm 3: Trip – Inrush Blocking 4: Trip – Latch 5: IN act, Trip 6: IN act, Alarm 7: IN react, Trip 8: IN react, Alarm 9: GN Trip 10: GN Alarm 11: BN Trip 12: BN Alarm 13: YN Trip 14: YN Alarm
F88	IDMT Interlock by DMT – unsigned integer 0: No 1: Yes
F90	Software Version Number: numeric data 0-99 – unsigned Integer
F91	Line CT Sec. – unsigned integer 0: In=1A 1: In=5A
F92	E/GND CT Sec. – unsigned integer 0: In=1A 1: In=5A
F101	Input Protection Blocking 1 - -unsigned integer (16-bits flag field): bit 0: tI> bit 1: tI>> bit 2: tI>>> bit 3: tSOTF bit 4: tIN_1 bit 5: tIN_2 bit 6: tIN_3 bit 7: reserved bit 8: tIs2> bit 9: tBCond bit 10: tCB Fail bit 11: Thermal OL bit 12-15: reserved
F102	Input Protection Blocking 2 – unsigned integer (16-bits flag field): bit 0: blocking [79] Autoreclose bit 1-4: reserved bit 5: AUX1 bit 6: AUX2 bit 7: AUX3 bit 8-15: Reserved
F103	Input Selective Logic – unsigned integer (16-bits flag field): bit 0: SEL1 tI>> bit 1: SEL1 tI>>> bit 2: SEL1 tIN_2 bit 3: SEL1 tIN_3 bit 4: SEL2 tI>> bit 5: SEL2 tI>>> bit 6: SEL2 tIN_2 bit 7: SEL2 tIN_3 bit 8-15: Reserved
F104	Input Logic Data – unsigned integer (16-bits flag field): bit 0: Maintenance Mode bit 1: Reset Latched Signaling bit 2: Reset Latched Outputs bit 3: Cold Load PU bit 4: reserved bit 5: CB status 52a

CODE	DESCRIPTION
	bit 6: CB status 52b bit 7: CB FLT External Signal bit 8: Setting Group 2 bit 9: Manual Close bit 10: Manual Trip bit 11: Trip Circuit Supervision bit 12: Reset Theta value bit 13: Start Disturbance Recorder bit 14: Local CTRL Mode bit 15: reserved
F106	Unsigned integer – Signaling Reset on 0: No 1: Close via 79
F107	TC supervision? – unsigned integer (16-bits flag field): 0: No 1: Yes 2: Yes-52a
F109	Configuration – unsigned integer 0: Disabled 1: Enabled
F110	Configuration – unsigned integer 0: Disabled 1: enable Trip 2: enable Alarm 3: enable Trip with Inrush Blocking 4: enable Trip with Latching 5: Load shedding 6: AR after LS Hi 7: AR after LS Lo
F111	Configuration – unsigned integer 0: Disabled 1: Retrip 2: Alarm 3: Retrip-Inrush 4: Retrip-Latch
F113	Modicon Modbus Coil Address Lo (hex) – unsigned integer 00: Warm restart 01: Reset LEDs 02: Reset Outputs 03: Reset LEDs and Outputs 04: Local Mode 05: Reserved 06: Setting change to Group 1 07: Remote CB open order 08: Remote [79] Autoreclose blocking 09: Remote [79] Autoreclose unblocking 0A: Remote Mode 0B: Setting change to Group 2 0C: Disable automatic acknowledgement of events 0D: Oldest event acknowledge 0E: Oldest fault acknowledge 0F: Remote CB close order 10: Clear Recorders 11: Clear Events 12: reserved 13: Thermal state reset 14: Reserved 15: Disturbance record remote start 16: Maintenance mode 17: End of maintenance mode 18: Acknowledgement of the oldest disturbance record 19: Reserved 1A: Recloser reset counters 1B: Reserved 1C: Reset Fault counters

CODE	DESCRIPTION
	1D: Reset control counters 1E: Communication Order 1 1F: Communication Order 2 20: [79] Unlockout 21: Enable automatic acknowledgement of events 22: Modbus S1 to Modbus Std 23: Modbus Std to Modbus S1

Request to retrieve the oldest non-acknowledge event

Slave number	Function code	Word address	Word number	CRC
xx	03h	36h 00	00 09h	xx xx

This event request may be answered an error message with the error code:

EVT_EN_COURS_ECRIT (5): An event is being written into the saved FRAM.

Note: On event retrieval, two possibilities exist regarding the event record acknowledgement:
a) Automatic event record acknowledgement on event retrieval.
b) Non-automatic event record acknowledgement on event retrieval.

2) Automatic event record acknowledgement on event retrieval:

The bit1 of the remote order frame (format F38B – mapping address 0402h) should be set to 1. On event retrieval, this event record is acknowledged.

b) Non-automatic event record acknowledgement on event retrieval:

The bit12 of the remote order frame (format F38 – mapping address 0400h) should be set to 1. On event retrieval, this event record is not acknowledged. To acknowledge this event, another remote order should be sent to the relay. The bit 13 of this frame (format F38 – mapping address 0400h) should be set to 1.

Request to retrieve a dedicated event

Slave number	Function code	Word address	Word number	CRC
xx	03h	Refer to mapping	00 09h	xx xx

This event request may be answered an error message with the error code:

EVT_EN_COURS_ECRIT (5): An event is being written into the saved FRAM.

Note: This event retrieval does not acknowledge this event.

Modbus request definition used to retrieve the fault records

Two ways can be followed to retrieve a fault record:

- Send a request to retrieve the oldest non-acknowledge fault record.
- Send a request to retrieve a dedicated fault record.

Request to retrieve the oldest non-acknowledge fault record

Slave number	Function code	Word address	Word number	CRC
xx	03h	3Eh 00	00 0Fh	xx xx

Note: On fault retrieval, two possibilities exist regarding the fault record acknowledgement:
a) Automatic fault record acknowledgement on fault retrieval.
b) Non-automatic fault record acknowledgement on fault retrieval.

a) Automatic fault record acknowledgement on fault retrieval:

The bit1 of the remote order frame (format F38B – mapping address 0402h) should be set to 1. On fault retrieval, this fault record is acknowledged.

b) Non-automatic fault record acknowledgement on fault retrieval:

The bit12 of the remote order frame (format F38 – mapping address 0400h) should be set to 1. On fault retrieval, this fault record is not acknowledged.
To acknowledge this fault, another remote order should be sent to the relay. The bit 14 of this frame (format F38 – mapping address 0400h) should be set to 1.

Request to retrieve a dedicated fault record

Slave number	Function code	Word address	Word number	CRC
xx	03h	Refer to mapping	00 0Fh	xx xx

Note: This fault value retrieval does not acknowledge this fault record.

IEC 60870-5-103 INTERFACE

The IEC 60870-5-103 interface is a master/slave interface with the relay as the slave device. This protocol is based on the VDEW communication protocol. The relay conforms to compatibility level 2, compatibility level 3 is not supported.

The following IEC 60870-5-103 facilities are supported by this interface:

Initialization (Reset)

Time Synchronization

Event Record Extraction

General Interrogation

Cyclic Measurements

General Commands

Physical Connection and Link Layer

Connection is available for IEC 60870-5-103 through the rear RS485 port. It is possible to select both the relay address and baud rate using the front panel interface. Following a change, a reset command is required to re-establish communications.

The parameters of the communication are the following:

Even Parity

8 Data bits

1 stop bit

Data rate 9600 to 115200 bauds

Initialization

Initialization is implemented according to clause 7.4.1 of IEC 60870-5-103.

Whenever the relay has been powered up, or if the communication parameters have been changed a reset command is required to initialize the communications. The relay will respond to either of the two reset commands (Reset CU or Reset FCB), the difference being that the Reset CU will clear any unsent messages in the relay's transmit buffer.

The relay will respond to the reset command with an identification message ASDU 5, the Cause of Transmission COT of this response will be either Reset CU or Reset FCB depending on the nature of the reset command. The following information will be contained in the data section of this ASDU:

Manufacturer Name: POWERLOGIC P1

According to the specification "Communication Architecture (ACA), Part 4: Communication based on IEC 60870-5-103" (Issue H, April 2010) the Software Identification Section will contain the relay model number and the version number to identify the type of relay.

Software Identification Section, Byte 0:	Numerical part of device type, hex, low
Software Identification Section, Byte 1:	Numerical part of device type, hex, low
Software Identification Section, Byte 2:	Software version, hex, low

Software Identification Section, Byte 3: Software version, hex, high

Letters in the software version are converted to numerical values according to the following rule: A=0, B=1, C=2, D=3 etc.

The Software Identification Section of PowerLogic P1F, version 1A, will then contain ‘111’ and ‘10’ as hexadecimal coded values:

Byte 0: 6FH

Byte 1: 00H

Byte 2: 10H

Byte 3: 00H

In addition to the above identification message, if the relay has been powered up it will also produce a power up event.

Time Synchronization

Time synchronization is implemented according to clause 7.4.2 of IEC 60870-5-103.

The relay time and date can be set using the time synchronization feature of the IEC 60870-5-103 protocol. The relay will correct for the transmission delay as specified in IEC 60870-5-103. If the time synchronization message is sent as a send/confirm message then the relay will respond with a confirm. Whether the time synchronization message is sent as a send confirm or a broadcast (send/no reply) message, a time synchronization message will be returned as Class 1 data.

Spontaneous Events

The events created by the relay will be passed to the master station using the compatible range and the private range of IEC 60870-5-103 function types and information numbers.

Events are categorized using the following information:

Common Address

Function Type

Information number

Below tables contains a complete listing of all events produced by the relay.

General Interrogation

General interrogation is implemented according to clause 7.4.3 of IEC 60870-5-103.

The GI request can be used to read the status of the relay, the function numbers, information numbers and common address offsets that will be returned during the GI cycle are indicated in below tables.

Cyclic Measurements

The relay will produce measured values using ASDU 3 and ASDU 9 on a cyclical basis. They can be read from the relay using a Class 2 poll.

It should be noted that the measurands transmitted by the relay are sent as a proportion of 2.4 times the rated value of the analogue value. The selection of 2.4 for a particular value is indicated in below tables.

Commands

Command transmission is implemented according to clause 7.4.4 of IEC 60870-5 -103.

A list of the supported commands is contained in below tables. The relay will respond to all other commands with an ASDU 1, with a cause of transmission (COT) of negative acknowledgement of a command

Blocking of Monitor Direction

The relay does not support a facility to block messages in the Monitor direction.

Spontaneous Messages Managed by PowerLogic P1F

These messages include a sub-assembly of events which are generated on the relay, because some generated events are not registered in VDEW. They are the most priority messages.

An event is always generated on the rising edge of the information.

Some events can be generated on the rising or lowering edge.

In the list below, events only generated on rising edge will be tagged with a '*'.

The following list of processed events contains the messages for the compatible and the private range for all Overcurrent protection functions, with the associated FUNCTION TYPE, INFORMATION NUMBER, ASDU TYPE, CAUSE OF TRANSMISSION

FUN <160>: Function type in Public range for Overcurrent Protections (compatible).

FUN <162>, <163>, <164>, <165>, <168>: Function type in Private range (Reserved for Overcurrent Protections).

Status indications in monitor direction (Type Identification 1)

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
	Indication (LEDs + Signal.) reset	160	19	1	1,7,11,12, 20, 21	*	
	Reset Latch. Sign Inp	162	223	1	1,7	*	
	Reset Latched Outputs (Inp+COM)	162	46	1	1,7,11,12, 20, 21	*	
	Reset Latched Signaling. And Outputs (HMI+COM)	249	131	1	1,7,11,12, 20, 21	*	
	Reset Latched Outputs (Inp)	162	86	1	1,7	*	
	Maintenance (Test) Mode Inp	162	157	1	1,7		
	Maintenance Mode (Test Mode)	160	21	1	11		
	Local Mode	160	22	1	11		
	Relay Blocked/faulty (Hardware Warning)	160	47	1	1,7		
	Setting Group number 1	160	23	1	1,7,11,12, 20, 21		
	Setting Group number 2	160	24	1	1,7,11,12, 20, 21		
	Order Command 1	249	129		1,7,11,12, 20, 21	*	
	Order Command 2	249	130		1,7,11,12, 20, 21	*	

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
	Auxiliary input 1	160	27	1	1,7,11		Status of input – it includes reverse logic configuration
	Auxiliary input 2	160	28	1	1,7,11		as above
	Auxiliary input 3	160	29	1	1,7,11		as above
	Auxiliary input 4	160	30	1	1,7,11		as above
	Auxiliary input 5	163	81	1	1,7,11		as above
	Auxiliary input 6	163	82	1	1,7,11		as above
	Input 1	163	160	1	1,7		Presence of the voltage on the input terminals
	Input 2	163	161	1	1,7		as above
	Input 3	163	162	1	1,7		as above
	Input 4	163	163	1	1,7		as above
	Input 5	163	164	1	1,7		as above
	Input 6	163	165	1	1,7		as above
	Input 7	163	166	1	1,7		as above
	Input 8	163	167	1	1,7		as above
	Relay output 1	249	1	1	1,7		Logical state of the output - before Reverse Logic. Logical state of the output can differ from Physical state – terminals if Reverse Logic for this output is set
	Relay output 2	249	2	1	1,7		as above
	Relay output 3	249	3	1	1,7		as above
	Relay output 4	249	4	1	1,7		as above
	Relay output 5	249	5	1	1,7		as above
	Relay output 6	249	6	1	1,7		as above
	Relay output 7	249	7	1	1,7		as above
	Relay output 8	249	8	1	1,7		as above
49	Therm: Starting Itherm	162	194	1	1,7		
49	Therm: Trip signal	162	67	1	1,7	*	
49	Therm: Reset Theta Val. (Inp)	162	234	1	1,7	*	
49	Therm: Thermal Alarm	162	226	1	1,7		
49	Therm: Reset replica (HMI+RS485+Inp)	162	231	1	1,7	*	
49	Term: Block Itherm Ext (Inp)	162	214	1	1,7		
46	Blocking tI2> Ext (Inp)	162	38	1	1,7		
SOTF	Blocking tSOTF Ext (Inp)	165	34	1	1,7		
46BC	Blocking tBrkCond Ext (Inp)	165	35	1	1,7		
AUX	Blocking tAUX1 Ext (Inp)	165	36	1	1,7		
AUX	Blocking tAUX2 Ext (Inp)	165	37	1	1,7		
AUX	Blocking tAUX3 Ext (Inp)	165	38	1	1,7		
79	CB drive ready Ext (Inp)	162	150	1	1,7		
79	Blocked/Lockout	162	185	1	1,7		Blocked = Tempor.Block or Lockout or Block:CTRL or Block:Input or Disabled

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
79	Enabled	160	16	1	1,7,11,12,20,21		Enabled = NOT (Block:CTRL or Block:Input or Disabled)
79	Reclaim time running	162	218	1	1,7		
79	Blocking EXT (Inp)	162	152	1	1,7		
79	Reclosure successful	163	73	1	1,7		
79	Reclosure final trip	165	40	1	1,7		
79	Running	162	233	1	1,7		
79	Dead time run	162	236	1	1,7		
79	(Re)close signal close (first shot)	160	128	1	1,7	*	
79	(Re)close signal closes (2nd to 4th shot)	160	129	1	1,7	*	
79	Fast Trip Phase	165	41	1	1,7	*	
79	Fast Trip Earth	165	42	1	1,7	*	
79	Not ready	160	130	1	1,7		
79	Ext./user enabled	162	144	1	1,7		Ext./user Enabled = NOT (Block:CTRL or Block:Input)
79	Recloser Lockout	165	43	1	1,7		Lockout: ARC internally blocked up to Signaling reset
79	Recloser Rolling Demand Alarm	165	44	1	1,7		too many of ARC cycles in settable monitoring window
	Manual. Trip Ext (Inp)	162	148	1	1,7	*	
	Trip CB Order (Inp+HMI+RS485)	162	9	1	1,7	*	
	Manual. Close Ext (Inp)	162	47	1	1,7	*	
	Manual. Close Command (Inp+HMI)	162	246	1	1,7	*	
	Close CB Order (Inp+HMI+RS485+79)	162	239	1	1,7	*	
	CB Status 52A Inp	163	253	1	1,7		
CBM	CB Trip Number Diagnostic Alarm	164	210	1	1,7		
CBM	CB Trip Current Diagnostic Alarm	164	212	1	1,7		
CBM	CBM: tCB FLT (faulty) Ext. Alarm	165	45	1	1,7		
CBM	TCS Trip Circuit Supervision Alarm	165	16	1	1,7		
CBM	CB Time Monitoring Alarm	165	46	1	1,7	*	
CBM	State of CB (not correct) ALARM	165	47	1	1,7		
	FT_RC: Faulty time tag	163	74	1	1,7	*	

Fault Indications in monitor direction (Type Identification 2)

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
	General Start / pick-up I>, I>>, I>>>, SOTF, IN_1, IN_2, IN_3	160	84	2	1,7		
	General Trip	160	68	2	1,7	*	
50/51	Start / pick-up A	160	64	2	1,7		
50/51	Start / pick-up B	160	65	2	1,7		
50/51	Start / pick-up C	160	66	2	1,7		

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
50/51	Start / pick-up N	160	67	2	1,7		
	Inrush restr. Trig	165	48	2	1,7		
50/51	Start / pick-up I>	162	111	2	1,7		
50/51	Blocking tI> Ext (Inp)	162	32	2	1,7		
50/51	tI> elapsed	162	169	2	1,7	*	
50/51	Trip tI>	160	90	2	1,7	*	
50/51	Start / pick-up I>>	162	96	2	1,7		
50/51	Blocking tI>> Ext (Inp)	162	33	2	1,7		
50/51	tI>> elapsed	162	162	2	1,7	*	
50/51	Trip tI>>	160	91	2	1,7	*	
50/51	Start / pick-up I>>>	162	56	2	1,7		
50/51	Blocking tI>>> Ext (Inp)	162	82	2	1,7		
50/51	tI>>> elapsed	162	163	2	1,7	*	
50/51	Trip tI>>>	162	141	2	1,7	*	
SOTF	Start / pick-up SOTF	165	32	2	1,7		
SOTF	tSOTF elapsed	165	33	2	1,7	*	
SOTF	Trip tSOTF	162	211	2	1,7	*	
50/51N	Start / pick-up IN_1 stage (IN>)	162	114	2	1,7		
50/51N	Blocking t N_1 stage (IN>) Ext (Inp)	162	83	2	1,7		
50/51N	tIN_1 stage (IN>) elapsed	162	164	2	1,7	*	
50/51N	Trip tIN_1 stage (IN>)	160	92	2	1,7	*	
50/51N	Start / pick-up IN_2 stage (IN>>)	162	97	2	1,7		
50/51N	Blocking tIN_2 stage (IN>>) Ext (Inp)	162	84	2	1,7		
50/51N	tIN_2 stage (IN>>) elapsed	162	186	2	1,7	*	
50/51N	Trip tIN_2 stage (IN>>)	160	93	2	1,7	*	
50/51N	Start / pick-up IN_3 stage (IN>>>)	162	57	2	1,7		
50/51N	Blocking tIN_3 stage (IN>>>) Ext (Inp)	162	85	2	1,7		
50/51N	tIN_3 stage (IN>>>) elapsed	162	74	2	1,7	*	
50/51N	Trip signal tIN_3 stage (IN>>>)	162	93	2	1,7	*	
46	Start / pick-up I2>	162	41	2	1,7		
46	tI2> elapsed	162	182	2	1,7	*	
46	Trip signal tI2>	162	171	2	1,7	*	
46BC	Start / pick-up BrkCond	165	15	2	1,7		
46BC	tBrkCond elapsed	165	49	2	1,7	*	
46BC	Trip signal tBrkCond	165	17	2	1,7	*	
CBF	CBF running	164	240	2	1,7	*	
CBF	Start tBF (Inp)	165	20	2	1,7		
CBF	tCBF elapsed	160	85	2	1,7	*	
CBF	Trip signal CBF	164	241	2	1,7	*	
AUX	Start AUX1	163	93	2	1,7		
AUX	tAUX1 elapsed	163	94	2	1,7		
AUX	Trip tAUX1	165	22	2	1,7	*	
AUX	Start AUX2	163	95	2	1,7		
AUX	tAUX2 elapsed	163	96	2	1,7		
AUX	Trip tAUX2	165	23	2	1,7	*	
AUX	Start AUX3	163	97	2	1,7		
AUX	tAUX3 elapsed	163	98	2	1,7		
AUX	Trip tAUX3	165	24	2	1,7	*	
AUX	Start AUX4	163	99	2	1,7		
AUX	tAUX4 elapsed	163	100	2	1,7		
AUX	Trip tAUX4	165	25	2	1,7	*	
FT_RC	System disturb. Run	162	241	2	1,7		

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
FT_RC	Record. In progress	162	220	2	1,7		
FT_RC	Start Distur. Recorder INP+COM	162	172	2	1,7		
FT_RC	Trigger INP	162	22	2	1,7		

Control Indications in Monitor Direction:

CB monitoring: FUN<242>; INF <1>; COT<1, 7,11>, <ADDR>

NOTE: The value of CB monitoring DPI can have 4 stages:

DPI

<0000 0000> "Undefined / Between closed and opened"

<0000 0001> "opened"

<0000 0010> "closed"

<0000 0011> "Undefined / Faulty"

List of data contained in General Interrogation

It is given in the answer to the General Interrogation (GI).

Relay state information are Class 1 data, they are systematically sent to the master station, during a General Interrogation.

The list of processed data, following a General Interrogation, is given below: it is a sub-assembly of the spontaneous message list, so like spontaneous messages, these data are generated on rising and lowering edge.

Status Indications (Monitor Direction):

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
	Maintenance (Test) Mode Inp	162	157	1	9		
	Maintenance Mode (Test Mode)	160	21	1	9		
	Local Mode	160	22	1	9		
	Relay Blocked/faulty (Hardware Warning)	160	47	1	9		
	Setting Group number 1	160	23	1	9		
	Setting Group number 2	160	24	1	9		
	Auxiliary input 1	160	27	1	9		
	Auxiliary input 2	160	28	1	9		
	Auxiliary input 3	160	29	1	9		
	Auxiliary input 4	160	30	1	9		
	Auxiliary input 5	163	81	1	9		
	Auxiliary input 6	163	82	1	9		
	Input 1	163	160	1	9		Presence of the voltage on the input terminals
	Input 2	163	161	1	9		as above
	Input 3	163	162	1	9		as above
	Input 4	163	163	1	9		as above
	Input 5	163	164	1	9		as above
	Input 6	163	165	1	9		as above
	Input 7	163	166	1	9		as above
	Input 8	163	167	1	9		as above
	Relay output 1	249	1	1	9		Logical state of the output - before Reverse Logic.

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
							Logical state of the output can differ from Physical state – terminals if Reverse Logic for this output is set
	Relay output 2	249	2	1	9		as above
	Relay output 3	249	3	1	9		as above
	Relay output 4	249	4	1	9		as above
	Relay output 5	249	5	1	9		as above
	Relay output 6	249	6	1	9		as above
	Relay output 7	249	7	1	9		as above
	Relay output 8	249	8	1	9		as above
49	Therm: Starting Itherm	162	194	1	9		
49	Therm: Thermal Alarm	162	226	1	9		
49	Term: Block Itherm Ext (Inp)	162	214	1	9		
46	Blocking tI2> Ext (Inp)	162	38	1	9		
SOTF	Blocking tSOTF Ext (Inp)	165	34	1	9		
46BC	Blocking tBrkCond Ext (Inp)	165	35	1	9		
AUX	Blocking tAUX1 Ext (Inp)	165	36	1	9		
AUX	Blocking tAUX2 Ext (Inp)	165	37	1	9		
AUX	Blocking tAUX3 Ext (Inp)	165	38	1	9		
79	CB drive ready Ext (Inp)	162	150	1	9		
79	Blocked/Lockout	162	185	1	9		Blocked = Tempor.Block or Lockout or Block:CTRL or Block:Input or Disabled
79	Enabled	160	16	1	9		Enabled = NOT (Block:CTRL or Block:Input or Disabled)
79	Reclaim time running	162	218	1	9		
79	Blocking EXT (Inp)	162	152	1	9		
79	Reclosure successful	163	73	1	9		
79	Reclosure final trip	165	40	1	9		
79	Running	162	233	1	9		
79	Dead time run	162	236	1	9		
79	Fast Trip Phase	165	41	1	9		
79	Fast Trip Earth	165	42	1	9		
79	Not ready	160	130	1	9		
79	Ext./user enabled	162	144	1	9		Ext./user Enabled = NOT (Block:CTRL or Block:Input)
79	Recloser Lockout	165	43	1	9		Lockout: ARC internally blocked up to Signaling reset
79	Recloser Rolling Demand Alarm	165	44	1	9		too many of ARC cycles in settable monitoring window
	CB Status 52A Inp	163	253	1	9		
CBM	CB Trip Number Diagnostic Alarm	164	210	1	9		

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
CBM	CB Trip Current Diagnostic Alarm	164	212	1	9		
CBM	CBM: tCB FLT (faulty) Ext. Alarm	165	45	1	9		
CBM	TCS Trip Circuit Supervision Alarm	165	16	1	9		
CBM	State of CB (not correct) ALARM	165	47	1	9		

Fault Indications in monitor direction

ASCI	Description	FUN	INF	ASDU	COT	ADDR	Notes
	General Start / pick-up I>, I>>, I>>>, SOTF, IN_1, IN_2, IN_3	160	84	2	9		
50/51	Start / pick-up A	160	64	2	9		
50/51	Start / pick-up B	160	65	2	9		
50/51	Start / pick-up C	160	66	2	9		
50/51	Start / pick-up N	160	67	2	9		
	Inrush restr. Trig	165	48	2	9		
50/51	Start / pick-up I>	162	111	2	9		
50/51	Blocking tI> Ext (Inp)	162	32	2	9		
50/51	Start / pick-up I>>	162	96	2	9		
50/51	Blocking tI>> Ext (Inp)	162	33	2	9		
50/51	Start / pick-up I>>>	162	56	2	9		
50/51	Blocking tI>>> Ext (Inp)	162	82	2	9		
SOTF	Start / pick-up SOTF	165	32	2	9		
50/51N	Start / pick-up IN_1 stage (IN>)	162	114	2	9		
50/51N	Blocking t N_1 stage (IN>) Ext (Inp)	162	83	2	9		
50/51N	Start / pick-up IN_2 stage (IN>>)	162	97	2	9		
50/51N	Blocking tIN_2 stage (IN>>) Ext (Inp)	162	84	2	9		
50/51N	Start / pick-up IN_3 stage (IN>>>)	162	57	2	9		
50/51N	Blocking tIN_3 stage (IN>>>) Ext (Inp)	162	85	2	9		
46	Start / pick-up I2>	162	41	2	9		
46BC	Start / pick-up BrkCond	165	15	2	9		
CBF	Start tBF (Inp)	165	20	2	9		
AUX	Start AUX1	163	93	2	9		
AUX	tAUX1 elapsed	163	94	2	9		
AUX	Start AUX2	163	95	2	9		
AUX	tAUX2 elapsed	163	96	2	9		
AUX	Start AUX3	163	97	2	9		
AUX	tAUX3 elapsed	163	98	2	9		
AUX	Start AUX4	163	99	2	9		
AUX	tAUX4 elapsed	163	100	2	9		
FT_RC	System disturb. Run	162	241	2	9		
FT_RC	Record. In progress	162	220	2	9		
FT_RC	Start Distur. Recorder INP+COM	162	172	2	9		
FT_RC	Trigger INP	162	22	2	9		

Control indications in monitor direction:

CB monitoring: FUN<242>; INF <1>; COT<9>, <ADDR>

NOTE: The value of CB monitoring DPI can have 4 stages:

DPI

<0000 0000>	“Undefined / Between closed and opened”
<0000 0001>	“opened”
<0000 0010>	“closed”
<0000 0011>	“Undefined / Faulty”

Processed Commands

System Commands:

Synchronization Command (ASDU 6): FUN<255>, INF <0>; TYP <6>; COT<8>

This command can be sent to a specific relay, or global. The time sent by master is the time of the first bit of the frame. The relay synchronizes with this time, corrected by the frame transmission delay. After updating its time, the relay sends back an acknowledge to the master, by giving its new current time.

This acknowledge message will be an event of ASDU 6 type.

General Interrogation Initialization command (ASDU 7):

FUN<255>; INF <0>; TYP <7>; COT<9>

This command starts the relay interrogation:

The relay then sends a list of data containing the relay state (see list described above).

The GI command contains a scan number which will be included in the answers of the GI cycle generated by the GI command.

If a data has just changed before extracted by the GI, the new state is sent to the master station.

When an event is generated during the GI cycle, the event is sent in priority, and the GI cycle is temporarily interrupted. The end of the GI consists in sending an ASDU 8 to the master station.

If, during a General Interrogation cycle, another GI Initialization command is received, the precedent answer is stopped, and the new GI cycle started.

General Commands (ASDU 20) (Control direction): Availability

LED Reset and Sign. Reset:
This command reset LEDs, signaling:
FUN<160>; INF<19>, TYP<20>, COT <20>, <ADDR>

In LED Reset control command, the allowed value is:

DCO <0000 0010> “Reset”

Output Reset:
This command reset Latched Outputs:
FUN<162>; INF<46>, TYP<20>, COT <20>, <ADDR>

In Latched Outputs Reset control command the allowed value is:

DCO <0000 0010> “Reset”

Setting group number 1: FUN<160>; INF<23>, TYP<20>, COT <20>, <ADDR>
In Setting group number 1 control command the allowed value is:

DCO <0000 0010> “Set Group 1”

Setting group number 2: FUN<160>; INF<24>, TYP<20>, COT <20>, <ADDR>
In Setting group number 2 control command the allowed value is:

DCO <0000 0010> "Set Group 2"

Order Command 1: FUN<249>; INF <129>; COT<20>, <ADDR>
In Order Command 1 control command the allowed value is:

DCO <0000 0001> "OFF"

DCO <0000 0010> "ON"

Order Command 2: FUN<249>; INF <130>; COT<20>, <ADDR>
In Order Command 2 control command the allowed value is:

DCO <0000 0001> "OFF"

DCO <0000 0010> "ON"

Reset Latched Signaling and Outputs: FUN<249>; INF <131>; COT<20>, <ADDR>
Note: *Reset Latched Signaling and Outputs* is used for command and indication (see: ***Status indications in monitor direction Type Identification***).
Reset via RS485 the allowed value is:

DCO <0000 0001> "OFF"

DCO <0000 0010> "ON"

CB control Open command: FUN<242>; INF <65>; TYP <20>; COT<20>, <ADDR>
In CB control command the DCO allowed values are:

DCO <0000 0001> "OFF": "Close CB"

<0000 0010> "ON": "Open CB"

CB control Close command FUN<242>; INF <66>; TYP <20>; COT<20>, <ADDR>
In CB control command the DCO allowed values are:

DCO <0000 0001> "OFF": "Open CB"

<0000 0010> "ON": "Close CB"

ARC: Enabled FUN<160>; INF<16>; COT<20>, <ADDR>
Note: ARC: Enabled is used for command and indication (see: ***Status indications in monitor direction Type Identification***).
In ARC: Enabled command the DCO allowed values are:

DCO <0000 0001> "OFF"

<0000 0010> "ON"

General commands are processed according to clause 7.4.4 of IEC 60870-5-103.
After executing one of these commands, the relay sends a positive or negative acknowledge message, which contains the result of command execution.
If a state change is the consequence of the command, it must be sent in an ASDU 1 with COT 12 (remote operation).
If the relay receives another command message from the master station before sending the acknowledge message for the previous command, it will be discarded and a negative acknowledge message will be sent.
Commands which are not processed by the relay are rejected with a negative acknowledge message.

Relay re initialization

In case of relay re initialization, the relay send to the master station:

- a message indicating relay start/restart (FUN<160>;INF<5> ; TYP<5> COT<5>)
- or a message indicating Reset CU (FUN<160>;INF<5> ; TYP<3> COT<4>)
- or a message indicating Reset FCB (FUN<160>;INF<5> ; TYP<2> COT<3>)

Each identification message of the relay (ASDU 5) contains the manufacturer name in 8 ASCII characters (“PowerLo “) and 4 free bytes containing:

- byte [0] (device version, decimal): 1 (0 = P1F, 1 = P1V, 2 = P1P)
- byte [1] (firmware major, char): ‘2’, ‘3’, ...
- byte [2] (firmware major, char): ‘E’, ‘F’, ...
- byte [3] (firmware version, decimal): 16, 17, ...

Cyclic Messages (ASDU9 and ASDU3)

Only measurements can be stored in these messages.

The measured values are stored in lower levels of communication, before polling by master station.

Ia, Ib, Ic are transmitted with ASDU 9 (FUN<160>, INF<148>).

IN is transmitted with ASDU 3(FUN<160>, INF<147>).

All other measurements are unused in ASDU 3 and ASDU 9.

The values are stored with a rate of 2,4 * nominal value = 4096.

Thermal Overload value is transmitted with ASDU 3 (FUN<162>, INF<23>).

Scaling: 1% * value (range: 0-200)

Characteristics

Function Characteristics

General Characteristics

In the tables below:

- In is the phase CT primary rated current.
- Ion is the earth CT primary rated current.
- A full explanation is given in the reference conditions (IEC 60255-6).

CT Transformation Ratio

Current transformer	Characteristic	Values
Phase CT	Primary rated current (In)	1… 30000 A
	Step	1 A
	Secondary rated current	1 A/5 A
Earth CT	Primary rated current (Ion)	1… 30000 A
	Step	1 A
	Secondary rated current	1 A/5 A

Phase Currents

Characteristic	Values
Measuring range	0.1… 40 In
Accuracy	±(2% typical at In + 2 digits)
Unit	A or kA
Display Format	3 significant digits
Display refresh period	0.5 s

Earth Fault Currents

Characteristic	Versions	Values
Measuring range	Standard	0.05… 12 Ion
	Sensitive	0.01… 2 Ion
Accuracy	Standard	±(2% typical at Ion + 2 digits)
	Sensitive	±(2% typical at Ion + 2 digits)
Unit		A or kA
Display Format		3 significant digits
Display refresh period		0.5 s

Voltage (VN) Analog VT Input

Characteristic	Values
Measuring range	5… 130Vac
Accuracy	±(0.5% from measuring value + 0.1 digits)
Unit	V or kV
Display Format	3 significant digits
Display refresh period	0.5 s

Phase Overcurrent Protection

Characteristic of the I> and I>> Set Points			Values
I>? I>>?			Disabled Trip, Alarm Trip-Inrush Bl (A, E, E+) Trip-Latch (A, E, E+) Trip-Phase A (E, E+) Trip-Phase B (E, E+) Trip-Phase C (E, E+)
Tripping curve			DMT IEC SI IEC VI IEC EI LTI STI RC RI IEEE MI IEEE VI IEEE EI US CO2-P20 US CO8 RXIDG BNP EDF US CO2-P40 US CO5 US CO6 US CO7 US CO9 US CO11 HV_Fuse
I> Threshold I>> Threshold	DMT	Setting range	0.1… 40.0 In (step: 0.01 In)
		Accuracy	Is ±5% or ±0.01In
		Drop off	0.95 Is ±5% or ±0.01In
		Transient overreach	<10%
	IDMT	Setting range	0.1… 40.0 In (step: 0.01 In)
		Accuracy	1.1 Is ±5% or ±0.01In
		Drop off	1.05 Is ±5% or ±0.01In
I> Time delay I>> Time delay	DMT	Setting range	0.05… 200 s (step: 0.01 s)
		Accuracy	±2% or ±50ms*
	IDMT TMS**	Setting range	0.02… 1.5 s (step: 0.01 s)
		Accuracy	±5% or ±50ms
	IDMT TD**	Setting range	0.02… 100 s (step: 0.01 s)
		Accuracy	±5% or ±50ms

*During investigation of operation time – injection current must be 2 times greater than setting value.

**If TMS/TD value is selected in eSetup Easergy Pro from out of defined range then TMS/TD is set on 1.

Characteristic of the I>>> Set Points			Values
I>>>?			Disabled Trip, Alarm Trip-Inrush Bl (A, E, E+) Trip-Latch (A, E, E+) Trip-Phase A (E, E+) Trip-Phase B (E, E+) Trip-Phase C (E, E+)
Tripping curve			DMT
I>>> Threshold	DMT	Setting range	1.00… 40.0 In (step: 0.01 In)
		Accuracy	Is ±5% or ±0.01In
		Drop off	0.95 Is ±5% or ±0.01In
		Transient overreach	<10%
I>>> Time delay	DMT	Setting range	0.00… 200 s (step: 0.01 s)
		Accuracy**	±2% or ±50ms*

*During investigation of operation time – injection current must be 2 times greater than setting value

**The min trip time will be < 40ms, if timer is set to 0s.

In order to achieve 40ms min trip time, the submenu “LOC -> HCDFT” need to be set to Enabled during “I>, I>>, I>>> (1 harmonic or True RMS)” set to 1 harmonic, and “time delay” of I>>>, IN>>>, IN>> set to 0ms.
HCDFT means that I>>>, IN>>>, IN>> protection function can use Half cycle Fourier algorithm to detect big fault current faster.

Earth Fault Protection

Characteristic of the IN_1 Set Points				Values
IN_1>?				Disabled Trip, Alarm Trip-Inrush Bl (A, E, E+) Trip-Latch (A, E, E+) Incos Trip (E+) Incos Alarm (E+) Insin Trip (E+) Insin Alarm (E+) GN Trip (E+) GN Alarm (E+) BN Trip (E+) BN Alarm (E+) YN Trip (E+) YN Alarm (E+)
Tripping curve				DMT IEC SI IEC VI IEC EI LTI STI RC RI IEEE MI IEEE VI IEEE EI US CO2-P20 US CO8 RXIDG BNP EDF US CO2-P40 US CO5 US CO6 US CO7 US CO9 US CO11 HV_Fuse
IN_1> Threshold Non – directional	DMT	0.01…2Ion	Setting range	0.01… 2.00 Ion (step: 0.001 Ion)
			Accuracy	Ios ±5% or ±0.002 Ion
			Drop off	0.95 Ios ±5% or ±0.002 Ion
			Transient overreach	<10%
	DMT	0.05…12Ion	Setting range	0.05… 12.0 Ion (step: 0.001 Ion)
			Accuracy	Ios ±5% or ±0.005 Ion
			Drop off	0.95 Ios ±5% or ±0.005 Ion
			Transient overreach	<10%
	IDMT	0.01…2Ion	Setting range	0.01… 2.00 Ion (step: 0.001 Ion)
			Accuracy	1.1 Ios ±5% or ±0.002 Ion
			Drop off	1.05 Ios ±5% or ±0.002 Ion
	IDMT	0.05…12Ion	Setting range	0.05… 12.0 Ion (step: 0.001 Ion)
			Accuracy	1.1 Ios Ios ±5% or ±0.005 Ion
			Drop off	1.05 Ios ±5% or ±0.005 Ion
IN_1> Time delay Non – directional	DMT		Setting range	0.05… 200 s (step: 0.01 s)
			Accuracy	±2% or ±50ms*
	IDMT TMS**		Setting range	0.02… 1.5 s (step: 0.01 s)
			Accuracy	±5% or ±50ms***
	IDMT TD**		Setting range	0.02… 100 s (step: 0.01 s)
			Accuracy	±5% or ±50ms***
IN_1> Threshold Incosϕ Insinϕ	DMT	0.01…2Ion	Setting range	0.01… 2.00 Ion (step: 0.001 Ion)
			Accuracy	Ios ±5% or ±0.002 Ion**
			Drop off	0.95 Ios ±5% or ±0.002 Ion
	DMT	0.05…12Ion	Setting range	0.05… 12.00 Ion (step: 0.001 Ion)
			Accuracy	Ios ±5% or ±0.005 Ion**
			Drop off	0.95 Ios ±5% or ±0.002 Ion
	IDMT	0.01…2Ion	Setting range	0.01… 2.00 Ion (step: 0.001 Ion)
			Accuracy	1.1 Ios ±5% or ±0.002 Ion**

			Drop off	1.05 Ios ±5% or ±0.002 Ion
	IDMT	0.05…12Ion	Setting range	0.05… 12.00 Ion (step: 0.001 Ion)
			Accuracy	1.1 Ios ±5% or ±0.005 Ion**
			Drop off	1.05 Ios ±5% or ±0.002 Ion
IN_1> Threshold GN BN	DMT	0.1…200mS	Setting range	0.1…200mS (step: 0.01 mS)
			Accuracy	Set value ±10% or ±0.1mS**
			Drop off	0.95 Set value ±10% or ±0.1mS
	DMT	0.1…600mS	Setting range	0.1…600mS (step: 0.01 mS)
			Accuracy	Set value ±10% or ±0.1mS**
			Drop off	0.95 Set value ±10% or ±0.1mS
	IDMT	0.1…200mS	Setting range	0.1…200mS (step: 0.01 mS)
			Accuracy	1.1 Set value ±10% or ±0.1mS**
			Drop off	1.05 Set value ±10% or ±0.1mS
	IDMT	0.1…600mS	Setting range	0.1…600mS (step: 0.01 mS)
			Accuracy	1.1 Set value ±10% or ±0.1mS**
			Drop off	1.05 Set value ±10% or ±0.1mS
IN_1> Threshold YN	DMT	0.1…200mS	Setting range	0.1…200mS (step: 0.01 mS)
			Accuracy	Set value ±10% or ±0.1mS
			Drop off	0.95 Set value ±10% or ±0.1mS
	DMT	0.1…600mS	Setting range	0.1…600mS (step: 0.01 mS)
			Accuracy	Set value ±10% or ±0.1mS
			Drop off	0.95 Set value ±10% or ±0.1mS
	IDMT	0.1…200mS	Setting range	0.1…200mS (step: 0.01 mS)
			Accuracy	1.1 Set value ±10% or ±0.1mS
			Drop off	1.05 Set value ±10% or ±0.1mS
	IDMT	0.1…600mS	Setting range	0.1…600mS (step: 0.01 mS)
			Accuracy	1.1 Set value ±10% or ±0.1mS
			Drop off	1.05 Set value ±10% or ±0.1mS
IN_1> Time delay Incosϕ Insinϕ GN BN YN	DMT		Setting range	0.05… 200 s (step: 0.01 s)
			Accuracy	±2% or ±50ms*
	IDMT TMS****		Setting range	0.02… 1.5 s (step: 0.01 s)
			Accuracy	±8% or ±50ms***
	IDMT TD****		Setting range	0.02… 100 s (step: 0.01 s)
			Accuracy	±8% or ±50ms***

*During investigation of operation time – injection current must be 2 times greater than setting value

**Additional deviation should be added:

- |1/cosϕ|% for Incosϕ and GN
- |1/sinϕ|% for Insinϕ and BN

Additional deviation comes from the inaccuracy of the angle measurement between the current 3*I*o and voltage 3*V*o.

***According to standard IEC 60255-151. For RC characteristic: ±(12% + 50 ms).

****If TMS/TD value is selected in eSetup Easergy Pro from out of defined range then TMS/TD is set on 1.

Characteristic of the IN_2 Set Points				**Values**
IN_2?				Disabled Trip, Alarm Trip-Inrush Bl (A, E, E+) Trip-Latch (A, E, E+) Incos Trip (E+) Incos Alarm (E+) Insin Trip (E+) Insin Alarm (E+) GN Trip (E+) GN Alarm (E+) BN Trip (E+) BN Alarm (E+) YN Trip (E+) YN Alarm (E+)
Tripping curve				DMT
IN_2 Threshold Non-directional	DMT	0.05…2Ion	Setting range	0.01… 2.00 Ion (step: 0.001 Ion)
			Accuracy	Ios ±5% or ±0.002 Ion
			Drop off	0.95 Ios ±5% or ±0.002 Ion
			Transient overreach	<10%
	DMT	0.3…12Ion	Setting range	0.05… 12.0 Ion (step: 0.001 Ion)
			Accuracy	Ios ±5% or ±0.005 Ion
			Drop off	0.95 Ios ±5% or ±0.005 Ion
			Transient overreach	<10%
IN_2> Time delay Non – directional	DMT		Setting range	0.00… 200 s (step: 0.01 s)
			Accuracy***	±2% or ±50ms*
IN_2> Threshold	DMT	0.05…2Ion	Setting range	0.05… 2.00 Ion (step: 0.001 Ion)

Incosϕ Insinϕ			Accuracy	Ios ±5% or ±0.002 Ion**
			Drop off	0.95 Ios ±5% or ±0.002 Ion
	DMT	0.3…12Ion	Setting range	0.3… 12.00 Ion (step: 0.001 Ion)
			Accuracy	Ios ±5% or ±0.005 Ion**
			Drop off	0.95 Ios ±5% or ±0.002 Ion
IN_2> Threshold GN BN	DMT	0.1…200mS	Setting range	0.1…200mS (step: 0.01 mS)
			Accuracy	Set value ±10% or ±0.1mS**
			Drop off	0.95 Set value ±10% or ±0.1mS
	DMT	0.1…600mS	Setting range	0.1…600mS (step: 0.01 mS)
			Accuracy	Set value ±10% or ±0.1mS**
			Drop off	0.95 Set value ±10% or ±0.1mS
IN_2> Threshold YN	DMT	0.1…200mS	Setting range	0.1…200mS (step: 0.01 mS)
			Accuracy	Set value ±10% or ±0.1mS
			Drop off	0.95 Set value ±10% or ±0.1mS
	DMT	0.1…600mS	Setting range	0.1…600mS (step: 0.01 mS)
			Accuracy	Set value ±10% or ±0.1mS
			Drop off	0.95 Set value ±10% or ±0.1mS
IN_2> Time delay Incosϕ Insinϕ GN BN YN	DMT		Setting range	0.05… 200 s (step: 0.01 s)
			Accuracy	±2% or ±50ms*

*During investigation of operation time – injection current must be 2 times greater than setting value

**Additional deviation should be added:

- |1/cosϕ|% for Incosϕ and GN
- |1/sinϕ|% for Insinϕ and BN

Additional deviation comes from the inaccuracy of the angle measurement between the current 3*I*o and voltage 3*V*o.

***The min trip time will be < 40ms, if timer is set to 0s.

In order to achieve 40ms min trip time, the submenu “LOC -> HCDFT” need to be set to Enabled during “I>, I>>, I>>> (1 harmonic or True RMS)” set to 1 harmonic, and “time delay” of I>>>, IN>>>, IN>> set to 0ms.

HCDFT means that I>>>, IN>>>, IN>> protection function can use Half cycle Fourier algorithm to detect big fault current faster.

Characteristic of the IN_3 (E, E+) Set Points				**Values**
IN_3?				Disabled Trip, Alarm Trip-Inrush Bl Trip-Latch
Tripping curve				DMT
IN_3 Threshold	DMT	0.05…2Ion	Setting range	0.05… 2.00 Ion (step: 0.001 Ion)
			Accuracy	Ios ±5% or ±0.002 Ion
			Drop off	0.95 Ios ±5% or ±0.002 Ion
			Transient overreach	<10%
	DMT	0.3…12Ion	Setting range	0.3… 12.0 Ion (step: 0.001 Ion)
			Accuracy	Ios ±5% or ±0.005 Ion
			Drop off	0.95 Ios ±5% or ±0.005 Ion
			Transient overreach	<10%
IN_3> Time delay Non – directional	DMT		Setting range	0.00… 200 s (step: 0.01 s)
			Accuracy**	±2% or ±50ms*

*During investigation of operation time – injection current must be 2 times greater than setting value

**The min trip time will be < 40ms, if timer is set to 0s.

In order to achieve 40ms min trip time, the submenu “LOC -> HCDFT” need to be set to Enabled during “I>, I>>, I>>> (1 harmonic or True RMS)” set to 1 harmonic, and “time delay” of I>>>, IN>>>, IN>> set to 0ms.

HCDFT means that I>>>, IN>>>, IN>> protection function can use Half cycle Fourier algorithm to detect big fault current faster.

Cold Load Pick -up

Characteristics		Values
Cold Load PU?		Disabled, Input+Curr Input Only
Activity		Cold Load PU I> Cold Load PU I>> Cold Load PU I>>> Cold Load PU IN_1 (IN>) Cold Load PU IN_2 (IN>>) Cold Load PU IN_3 (IN>>>) (E, E+) Cold Load PU Brkn Cond (E, E+) Cold Load PU Itherm (N, A, B, E, E+) Cold Load PU I2> (E, E+)
Cold load PU Level	Setting range	20…999 % (step: 1 %)
Set point accuracy after CLPU function action		Same as accuracy on I>, I>>, I>>>, IN_1, IN_2, IN_3, Brkn Cond, Itherm, I2>
tCL (CLPU function time	Setting range	0.0… 6000.0 s (step: 0.1 s)
of activity)	Accuracy	±2% or ±40ms

Thermal Overload Protection

Characteristics			Values
Therm OL?			Disabled, Enabled
Tripping curve			DMT
Itherm Threshold	Alarm	Setting range	20…200 % (step: 1 %) of the permissible thermal capacity used (tripping set point)
		Accuracy	±5% or ±0.01 In
	Trip	Setting range	0.10… 3.00 In (step: 0.01 In)
		Accuracy	Itherm ±5% or ±0.01 In
		Drop-off	0.95 Itherm ±5% or ±0.01 In
Time constant		Setting range Te (heating)	1… 200 min (step: 1min)
		Setting range Tr (cooling)	1… 999 min (step: 1min)

External Trip (Auxiliary Timers) Protection

Characteristics		Values
AUX1? AUX2? AUX3? AUX4?		Disabled, Trip, Alarm, Trip-Inrush BI (A, E, E+), Trip-Latch (A, E, E+), Load Shedding (E, E+), AR after LS Hi (E, E+), AR after LS Lo (E, E+)
Tripping curve		DMT
Time delay tAUX1? tAUX2? tAUX3? tAUX4?	Setting range	0.0… 600.00 s (step: 0.01 s)
	Accuracy	±2% or ±50ms

Negative Sequence Overcurrent Protection

Characteristic of the Is2> Set Points	Values
Is2>?	Disabled Trip, Alarm, Trip-Inrush BI, Trip-Latch

Tripping curve			DMT IEC SI IEC VI IEC EI LTI STI RC RI IEEE MI IEEE VI IEEE EI US CO2-P20 US CO8 RXIDG BNP EDF US CO2-P40 US CO5 US CO6 US CO7 US CO9 US CO11 HV_Fuse
Is2> Threshold	DMT	Setting range	0.1… 4.00 In (step: 0.01 In)
		Accuracy	Is ±5% or ±0.01 In
		Drop off	0.95 Is ±5% or ±0.01 In
	IDMT	Setting range	0.1… 4.00 In (step: 0.01 In)
		Accuracy	1.1 Is ±5% or ±0.01 In
		Drop off	1.05 Is ±5% or ±0.01 In
Is2> Time delay	DMT	Setting range	0.05… 200 s (step: 0.01 s)
		Accuracy	±2% or ±50ms*
	IDMT TMS**	Setting range	0.02… 1.5 s (step: 0.01 s)
		Accuracy	±5% or ±50ms
	IDMT TD**	Setting range	0.02… 100 s (step: 0.01 s)
		Accuracy	±5% or ±50ms

*During investigation of operation time – injection current must be 2 times greater than setting value.

**If TMS/TD value is selected in eSetup Easergy Pro from out of defined range then TMS/TD is set on 1.

Broken Conductor

Characteristic of the Is2/Is1 Set Points		Values
Broken Cond.?		Disabled Trip, Alarm, Trip-Inrush Bl Trip-Latch
Tripping curve		DMT
Ratio Is2/Is1 Threshold	Setting range	20… 100 % (step: 1 %)
	Accuracy	Is ±5% or ±0.01 In
	Drop off	0.95 Is ±5% or ±0.01 In
tBCond Time delay	Setting range	0.05… 600 s (step: 0.01 s)
	Accuracy	±5% or ±50ms*

*During investigation of operation time – injection current must be 2 times greater than setting value.

Switch on to Fault

Characteristic of the SOTF Set Points		Values
SOTF.?		Disabled Trip, Alarm, Trip-Inrush Bl (A, E, E+), Trip-Latch (A, E, E+)
Tripping curve		DMT
SOTF Threshold	Setting range	1.00… 40.00 In (step: 0.01 In)
	Accuracy	Is ±5% or ±0.01 In
	Drop off	0.95 Is ±5% or ±0.01 In
tSOTF Time delay	Setting range	0.00… 600 s (step: 0.01 s)
	Accuracy	±2% or ±50ms*

*During investigation of operation time – injection current must be 2 times greater than setting value.

Circuit Breaker Failure

Characteristic of the I< and IN< Set Points		Values
CB Fail.?		Disabled Retrip, Alarm
Tripping curve		DMT
Activity I< Threshold IN< Threshold	Setting range I<	0.10… 2.00 In (step: 0.01 In)
	Setting range IN<	0.10… 2.00 Ion (step: 0.01 Ion)
	Accuracy	Same as accuracy on I>, I>>, I>>>, IN_1, IN_2, IN_3,
	Drop off	Same as accuracy on I>, I>>, I>>>, IN_1, IN_2, IN_3,
CB Fail Time tBF Time delay	Setting range	0.10… 10.00 s (step: 0.01 s)
	Accuracy	±2% or ±30ms*

*During investigation of operation time – injection current must be 2 times greater than setting value.

Autoreclose

Characteristic of the Autoreclose Set Points			Values
Autoreclose.?			Disabled Enabled
Activity			tI> tI>> tI>>> tIN_1 tIN_2 tIN_3 tAUX1 tAUX2
Associated Times	Dead time tD1 Dead time tD2 Dead time tD3 Dead time tD4	Setting range	0.0… 600.00 s (step: 0.01 s)
		Accuracy	±2% or ±30ms*
	Reclaim Time tR	Setting range	0.0… 600.00 s (step: 0.01 s)
		Accuracy	±2% or ±30ms*
	Fast O/C Trip Delay	Setting range	0.00… 9.99 s (step: 0.01 s)
		Accuracy	±2% or ±50ms*
	Fast E/Gnd Trip Delay	Setting range	0.00… 9.99 s (step: 0.01 s)
		Accuracy	±2% or ±50ms*

*During investigation of operation time – injection current must be 2 times greater than setting value.

Default Settings

Phase O/C [50/51]

Menu Text	Default Setting
I> ?	Disabled*
I> Threshold	1.2 x In
I> Delay Type	IEC SI
tI>	1 s
I> TMS	1
I> Time Dial	1
Reset Delay Type I>	DMT
DMT tReset I>	0 s
RTD/RTMS Reset I>	0.0 s
I>> ?	Disabled*
I>> Threshold	1.4 x In
Delay Type I>>	IEC SI
tI>>	1
I>> TMS	1
I>> Time Dial	1
Reset Delay Type I>>	DMT
DMT tReset I>>	0 s
RTD/RTMS Reset I>>	0.02 s
I>>> ?	Disabled*
I>>> Threshold	4 x In
tI>>>	0.0 s

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

Menu Text	Default Setting
IDMT interlock by DMT	No

SOTF (Switch On To Fault function)

Menu Text	Default Setting
SOTF?	Disabled*
SOTF Threshold	4 x In
tSOTF	0.1 s

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

E/Gnd Fault [50N/51N]

Menu Text	Default Setting
IN_1 stage ?	Disabled*
IN_1 Threshold	0.2 x Ien or 2 mS (if admittance protection is selected)
Delay Type IN_1	IEC SI
tIN_1	1 s
IN_1 TMS	1
IN_1 Time Dial	1
Reset Delay Type IN_1	DMT
RTD/RTMS Reset IN_1	0.02
DMT tReset IN_1	0 s
IN_2 stage?	Disabled*
IN_2 Threshold	0.4 x Ien or 4 mS (if admittance protection is selected)
tIN_2	0.0 s
IN_3 stage? (E, E+)	Disabled*
IN_3 Threshold (E, E+)	0.4 x Ien
tIN_3 (E, E+)	0.0 s

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

Menu Text	Default Setting
IDMT interlock by DMT	No

Negative Sequence O/C [46] I

Menu Text	Default Setting
I2> ?	Disabled*
I2> Threshold	1.0x In
I2> Delay Type	IEC SI
tI2>	1 s
I2> TMS	1
I2> Time Dial	1
Reset Delay Type I2>	DMT
DMT tReset I2>	0 s
RTD/RTMS Reset I2>	0.02

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

Broken Conductor I

Menu Text	Default Setting
Broken Cond.?	Disabled*
Ratio I2/I1	20%
tBCond	100 s

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

Thermal Overload [49] (NABE)

Menu Text	Default Setting
Therm OL?	Disabled*
Itherm	1.0 x In
Te (heating)	40 mn
Tr (cooling)	40 mn
Theta Trip	100%
Theta Trip/Reset Ratio	90%
Theta Alarm	100%

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

CB Fail [50BF]

Menu Text	Default Setting
CBF ?	Disabled*
CB Fail Time tBF	0.1 s
I< Threshold CBF	0.1 x In
IN< Threshold CBF	0.1 x Ien
Block I>? (E, E+)	No
Block IN>? (E, E+)	No

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

Auxiliary Timers (ABE)

Menu Text	Default Setting
AUX1?	0: Disabled*
tAUX1	0s
AUX2?	0: Disabled*
tAUX2	0 s
AUX3?	0: Disabled*
tAUX3	0 s
AUX4?	0: Disabled*
tAUX4	0 s

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

Logic Selectivity I

Menu Text	Default Setting
Sel1?	0: Disabled*
tSel1	0.4 s
Sel2?	Disabled*
tSel2	0.4 s

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

Cold Load Pick Up

Menu Text	Default Setting
Cold Load PU ?	Disabled*
Cold Load PU Level	100%
Cold Load PU tCL	1 s
Cold Load PU I>	No
Cold Load PU I>>	No
Cold Load PU I>>>	No
Cold Load PU IN_1	No
Cold Load PU IN_2	No
Cold Load PU IN_3 (E, E+)	No
Cold Load PU Brkn.Cond (E, E+)	No
Cold Load PU Itherm (N, B, A, E, E+)	No
Cold Load PU I2> (E, E+)	No

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

Autoreclose [79] I

Menu Text	Default Setting
Auto-reclose ?	Disabled*
Dead Time tD1	0.2 s
Dead Time tD2	20 s
Dead Time tD3	1 s
Dead Time tD4	20 s
Reclaim Time tR	2 s
Fast O/C Trip	00000
Fast O/C Trip Delay	0 s
Fast E/Gnd Trip	00000
Fast E/Gnd Trip Delay	0 s

Menu Text	**Default Setting**
Close Shot? tI>	0000
Inhib.Trip tI>: Shot	0000
Close Shot? tI>>	0000
Inhib.Trip tI>>: Shot	0000
Close Shot? tI>>>	0000
Inhib.Trip tI>>>: Shot	0000
Close Shot? tIN_1	0000
Inhib.Trip tIN_1: Shot	0000
Close Shot? tIN_2	0000
Inhib.Trip tIN_2: Shot	0000
Close Shot? tIN_3	0000
Inhib.Trip tIN_3: Shot	0000
Close Shot? tAUX1	0000
Inhib.Trip tAUX1: Shot	0000
Close Shot? tAUX2	0000
Inhib.Trip tAUX2: Shot	0000

*If the stage/function is disabled all settings concerning this stage/function in the menu cells are hidden.

Output Relay Configuration

Output settings define which signals are mapped to the P1F's outputs. Matrix configuration allows free mapping of any one function to each output.
Note:

- Model L have RL1 to RL3 + WD outputs
- Model N have RL1 to RL5 + WD outputs
- Model B have RL1 to RL3 + WD outputs
- Model A have RL1 to RL7 + WD outputs
- Model E have RL1 to RL5 + WD outputs

Menu Text	**Default Setting**
Description of bits:	RL: W7654321
Latched Outputs	0000000
Reverse outp.log.	0000000
Protection Trip	0000000
Prot.Trip pulse	0000000
Trip CB Order	0000000
Close CB Order	0000000
Alarm	00000000
Start I>	0000000
Start I>>	0000000
Start I>>>	0000000
Start SOTF (B, A, E, E+)	0000000
Start IN_1	0000000
Start IN_2	0000000
Start IN_3 (E, E+)	00000
Start I2> (E, E+)	00000
Start Brkn Cond (E, E+)	00000
AUX1 (B, A, E, E+)	0000000
AUX2 (B, A, E, E+)	0000000
AUX3 (B, A, E, E+)	0000000
AUX4 (B, A, E, E+)	0000000
AUX5 (B, A, E, E+)	0000000
AUX6 (B, A, E, E+)	0000000
tI>	0000000
tI>>	0000000
tI>>>	0000000
tSOTF (B, A, E, E+)	0000000
tIN_1	0000000
tIN_2	0000000
tIN_3 (E, E+)	00000

Menu Text	Default Setting
tI2> (E, E+)	00000
tBrkn Cond. (E, E+)	00000
Thermal Trip (N, B, A, E, E+)	0000000
Thermal Alarm (N, B, A, E, E+)	0000000
CB Fail	0000000
tAUX1 (B, A, E, E+)	0000000
tAUX2 (B, A, E, E+)	0000000
tAUX3 (B, A, E, E+)	0000000
tAUX4 (B, A, E, E+)	0000000
Comm. Order 1 (A, E, E+)	0000000
Comm. Order 2 (A, E, E+)	0000000
[79] in Progress (E, E+)	00000
[79] F.Trip (E, E+)	00000
[79] Lockout (E, E+)	00000
[79] Blocked (E, E+)	00000
[79] Success. (E, E+)	00000
TCS 52 Fail (A, E, E+)	0000000
CB Alarm (A, E, E+)	0000000
tCB FLT Ext.Sign (A, E, E+)	0000000
Setting Group 1	0000000

Input Configuration

Binary Input settings define which signals are mapped to the P1F's opto-isolated inputs. Matrix configuration allows free mapping of any one function to each input.
Note:

- Model L have no inputs
- Model N have no inputs
- Model B have 4 binary inputs (L1 to L4)
- Model A have 4 binary inputs (L1 to L4)
- Model E have 8 binary inputs programmable (L1 to L8).

Menu Text	Default Setting
Description of bits:	L: 87654321
Reverse Input Logic	00000000
Mainten. Mode (A, E, E+)	00000000
Reset Latchd Sign	00000000
Reset Latchd Outputs	00000000
Block. tI>	00000000
Block. tI>>	00000000
Block. tI>>>	00000000
Block. tSOTF (B, A, E, E+)	00000000
Block. tIN_1	00000000
Block. tIN_2	00000000
Block. tIN_3 (E, E+)	00000000
Block. tI2> (E, E+)	00000000
Block. tBrkn Cond (E, E+)	00000000
Block. Itherm. (N, B, E, E+)	00000000
Block. AUX1 (B, A, E, E+)	00000000
Block. AUX2 (B, A, E, E+)	00000000
Block. AUX3 (B, A, E, E+)	00000000
Block. tCB Fail	00000000
Block. [79] (E, E+)	00000000
SEL1 tI>> (E, E+)	00000000
SEL1 tI>>> (E, E+)	00000000
SEL1 tIN>> (E, E+)	00000000
SEL1 tIN>>> (E, E+)	00000000
SEL2 tI>> (E, E+)	00000000
SEL2 tI>>> (E, E+)	00000000
SEL2 tIN>> (E, E+)	00000000
SEL2 tIN>>> (E, E+)	00000000
AUX1 (B, A, E, E+)	00000000
AUX2 (B, A, E, E+)	00000000
AUX3 (B, A, E, E+)	00000000
AUX4 (B, A, E, E+)	00000000

Menu Text	Default Setting
AUX5 (B, A, E, E+)	00000000
AUX6 (B, A, E, E+)	00000000
Cold Load PU (A, E, E+)	00000000
Start tBF (A, E, E+)	00000000
CB Status 52A (B, A, E, E+)	00000000
CB Status 52B (B, A, E, E+)	00000000
CB FLT Ext.Sign (B, A, E, E+)	00000000
Setting group 2 (B, A, E, E+)	00000000
Manual Close (B, A, E, E+)	00000000
Manual Trip (B, A, E, E+)	00000000
Trip Circ Supervis. (A, E, E+)	00000000
Reset Theta val. (B, A, E, E+)	00000000
Start Distur. R. (A, E, E+)	00000000
Local CTRL Mode (A, E, E+)	00000000
Time Synchr. (B, E, E)	00000000

LED Configuration

LED configuration settings define which signals are mapped to the P1F’s LEDs. Matrix configuration allows free mapping of any one function to each LED.

Menu Text	Default Setting
Description of bits:	LED 765432
Latched LEDs	000000
Protect. Trip	000000
Alarm	000000
Start Phase A	000000
Start Phase B	000000
Start Phase C	000000
Start I>	000000
Start I>>	000000
Start I>>>	000000
Start SOTF (B, A, E, E+)	000000
Start IN_1	000000
Start IN_2	000000
Start IN_3 (E, E+)	000000
AUX1 (B, A, E, E+)	000000
AUX2 (B, A, E, E+)	000000
AUX3 (B, A, E, E+)	000000
AUX4 (B, A, E, E+)	000000
AUX5 (B, A, E, E+)	000000
AUX6 (B, A, E, E+)	000000
tI>	000000
tI>>	000000
tI>>>	000000
tSOTF (B, A, E, E+)	000000
tIN_1	000000
tIN_2	000000
tIN_3 (E, E+)	000000
tI2> (E, E+)	000000
tBrkn Cond. (E, E+)	000000
Thermal Trip (N, B, A, E, E+)	000000
Thermal Alarm (NBAE)	000000
CB Fail	000000
tAUX1 (B, A, E, E+)	000000
tAUX2 (B, A, E, E+)	000000
tAUX3 (B, A, E, E+)	000000
tAUX4 (B, A, E, E+)	000000

Menu Text	Default Setting
[79] in Progress (E, E+)	000000
[79] F.Trip (E, E+)	000000
[79] Lockout (E, E+)	000000
[79] Blocked (E, E+)	000000
[79] Success. (E, E+)	000000
Local CRTL Mode (A, E, E+)	000000
CB Alarm (A, E, E+)	000000
Maintenance Mode (A, E, E+)	000000
tCB FLT Ext.Sign (B, A, E, E+)	000000
Setting Group 1	000000

GLOBAL SETTINGS

LOC

Menu Text	Default Setting
Language	English
Default Display	Meas. In
LEDs Reset	Manual only
Ltchd Outp. Reset	Manual only
Alarm Info	Self-Reset
Nominal Frequency	50Hz
Control Keys Mode	Disabled
I>, I>>, I>>>	1 harm.
I>>>, IN>>>, IN>> HCDFT	Disabled

Setting Group Select

Menu Text	Default Setting
Setting Group	Group 1
t Change Settings G1→G2 (B, A, E, E+)	0.00 s
Copy Settings	No Operation

CT Ratio

Menu Text	Default Setting
Line CT Primary	1 A
Line CT Sec	1 A
E/Gnd CT Primary	1 A
E/Gnd CT Sec	1 A

Circuit Breaker

Menu Text	Default Setting
tOpen Pulse min	0.1 s
tClose Pulse	0.1 s
Time Delay for Close (B, A, E, E+)	0 s
tCB FLT ext (B, A, E, E+)	16 s
Remote CTRL Mode (A, E, E+)	0: Remote only
52 Unblock SOTF Time (B, A, E, E+)	1 s
TC Supervision? (A, E, E+)	No
TC Supervision tSUP (A, E, E+)	0.5 s
CB Supervision? (A, E, E+)	No
Max.CB Open Time (A, E, E+)	0.1 s
Max.CB Close Time (A, E, E+)	0.5 s

Inrush Blocking (A, E, E+)

Menu Text	Default Setting
Inrush Blocking?	0: No
2nd Harmonic Ratio	20%
Inrush Reset Time	0.0 s
Unblock Inrush Time	1 s

O/C Advanced (N, B, A, E, E+)

Menu Text	Default Setting
[46BC] Brkn.Cond I< Block (E, E+)	0.1 In
IDMT interlock by DMT (N, A, B, E, E+)	No

E/C Advanced (E+)

Menu Text	Default Setting
VN Threshold	5.0 V
G1 IN_1 direct.	Line
G1 IN_2 direct.	Line
G2 IN_1 direct.	Line
G2 IN_2 direct.	Line
Incos, Insin Sector Angle	90 °

[79] Advanced Settings (E, E+)

Menu Text	Default Setting
CB FLT Montor.?	No
Block.via Input?	No
Start Dead t on	CB trips
Rolling Demand?	No
Max cycles No. Rol.Demand	10
Time period Rol. Demmand	10 mn
Inhibit Time tI on Close	1 s
Signaling Reset	No

Communication Orders (A, E, E+)

Menu Text	Default Setting
Pulse Time tCOM1	1 s
Pulse Time tCOM2	1 s
COM2 Order Conf.	RS485

Communication (in Model L optional)

Menu Text	Default Setting
Protocol	Modbus
Relay Address	1
Baud Rate	19200 bits/s
Parity	No parity
Stop bits	1 stop bit

Disturbance Recorder (A, E, E+)

Menu Text	Default Setting
Pre-Time	0.1 s
Post-Time	0.1 s
Disturbance Rec.Trig.	on Inst.
Max Record Time	4 s

Commissioning (A, E, E+)

Menu Text	Default Setting
Description of bits:	L: 87654321
I/P Status	00000000
Description of bits:	RL: W54321
Relay O/P Status	000000
Maintenance Mode	No
Description of bits:	RL: W54321
Test Pattern	000000
Contact Test Time	0.1 s
Test outputs	no operation
Functional Test	I>
Functional Test End	Time
Functional Test Time	0.1 s
Functional Test CTRL	no operation

SETTING CHANGE MODE

Menu Text	Default Setting
Edit Settings?	Enter PSWD
Setting Change	Protected
Change Password	

OP PARAMETERS

This column contains menu cells to show some of the P1F’s parameters (column to read only).

Menu Text	Default Setting
Description	PowerLogic P1F1x
Main Location:	Substation
Sublocation:	Bay
Device name:	Name
Serial Nb	PP-YYYY-MM-DD-nnnn
Order Code	P1F1E1N0N92N1NN11N
Firmware Version	1.E
Firmware release	14
Active Set Group	Group 1 or 2
Date	01/01/15
Time	00:00:00
Nominal Frequency:	50Hz or 60Hz

Technical Characteristics

General Characteristics

Characteristics	Values
Dimensions	(W x H x D): 116,5 x 116,5 x 108 mm
Weight	Approx. 0.80kg
Maximal internal clock drift	+/-12 min a year

Auxiliary Power Supply

The PowerLogic P1F relays should be powered by DC or AC voltage:

Characteristics	DC Values	AC Values
Rated Voltage	24 – 60 V +10 %/-20 %	24 – 60 V +10 %/-2 0%
	90 – 250 V +10 %/-20 %	90 – 240 V +10 %/-20 %
Ripple content	15%	-
Frequency	-	40-70 Hz
Typical consumption	24 V – 2.5 W 240 V – 2.5 W	24 V – 4.0 VA 240 V – 10.5 VA
Maximal consumption	24 V – 4.0 W 240 V – 4.0 W	24 V – 6.0 VA 240 V – 13.5 VA
Acceptable momentary outages*	24 V – 20 ms 240 V – 1.2 s	24 V – 20 ms 240 V – 2.1 s

*Half of the binary inputs and half of the output relays should be energized. Communication modules should be activated. (EN 60255-26).

Current Analog Phase CT Input

Characteristics	Values
Nominal current In	1 or 5 A (as setting)
Input impedance	0.002 Ω
RMS measurement in range	40Hz – 1kHz
Fundamental harmonic measurement in range	40Hz – 70Hz
Operating range	0.1 – 40 In
Nominal burden at In	<0.3 VA at In = 5A <0.1 VA at In = 1A
Continuous thermal withstand	4 x In
Overload in accordance with IEC 60255-6	100 In at 1.00s
	40 In at 2.00s
	30 In at 10.00s

Current transformer requirement	Detailed information and CT requirement are given in Installation chapter Dimensioning the CTs section.

Current Analog Earth CT Input

Characteristics	Values
Nominal current Ion	1 or 5 A (as setting)
Input impedance	0.002 Ω
Fundamental harmonic measurement in range	40Hz – 70Hz
Operating range (depends on hardware option)	0.01 – 2Ion
	0.05 – 12Ion
Nominal burden at Ion	<0.3 VA at In = 5A <0.1 VA at In = 1A
Continuous thermal withstand	4 x In
Overload in accordance with IEC 60255-6	100 In at 1.00s
	40 In at 2.00s
	30 In at 10.00s
Current transformer requirement	Detailed information and CT requirement are given in Installation chapter Dimensioning the CTs section.

Voltage (VN) Analog VT Input

Characteristics	Values
Nominal voltage range	57 – 130 Vac
Input impedance	40 kΩ
Operation range	5 – 130 Vac
1st harmonic measurement in range	40 – 70 Hz
Nominal burden at voltages	
57 V	0.08 VA
100 V	0.25 VA
110 V	0.3025 VA

Binary Inputs

Binary inputs type: optically isolated inputs

Characteristics	Applicable to hardware option	DC Values	AC Values
Operating Range	24 – 60 Vac/dc	19 – 66 V	19 – 66 V
	90 – 240 Vac/250 Vdc	72 – 275 V	72 – 264 V
Minimum polarization voltage	24 – 60 Vac/dc	13 V	12 V
	90 – 240 Vac/250 Vdc	42 V	40 V
Maximum polarization current 316pprox..	24 – 60 Vac/dc	12 mA (66 V)	12 mA (66 V)
	90 – 240 Vac/250 Vdc	2.5 mA (275 V)	2.5 mA (264 V)
Maximum continuous withstand	24 – 60 Vac/dc	66 V	66 V
	90 – 240 Vac/250 Vdc	300 V	264 V
Filtering Time [1)]	24 – 60 Vac/dc	30 ms	30 ms
	90 – 240 Vac/250 Vdc	30 ms	30 ms

Note:

2) Filtering time is declared for Nominal Voltage range. For voltage value below this range additional filtering time delay: < 20ms must be considered.

Binary input energy consumption		
Logic input burden for Vx	24 – 60 Vac/dc	R imput = 316pprox.. 6 kΩ
	90 – 240 Vac/250 Vdc	R imput = 316pprox.. 109 kΩ
Logic input recognition time	24 – 60 Vac/dc	As filtering time + 2 ms
	90 – 240 Vac/250 Vdc	As filtering time + 2 ms

Control and Trip Relays

Below data applies following relay outputs: WD, RL1, RL2, RL3.

Characteristics	DC Values	AC Values
Contact relay	Dry contact, Ag Ni	Dry contact, Ag Ni
Rated voltage	250 V	250 V
Continuous current	5 A	5 A
Braking capacity	250 Vdc; 50 W resistive 30 W inductive (L/R = 40 ms)	1250 VA resistive (cos ϕ = unity) 1250 VA inductive (cos ϕ = 0.7)
Making capacity	250 V, 30 A, 200 ms 2000 operations	250 V, 30 A, 200 ms 2000 operations
Loaded contact	10000 operations minimum	10000 operations minimum
Unloaded contact	100000 operations minimum	100000 operations minimum
Operate time	Less than 10ms	
Reset time	Less than 5ms	

Signal Relays

Below data applies following relay outputs: RL4, RL5, RL6, RL7.

Characteristics	DC Values	AC Values
Contact relay	Dry contact, Ag Ni	Dry contact, Ag Ni
Rated voltage	250 V	250 V
Continuous current	5 A	5 A
Braking capacity	250 Vdc; 30 W resistive 15 W inductive (L/R = 40 ms)	1000 VA resistive (cos ϕ = unity) 1000 VA inductive (cos ϕ = 0.7)
Loaded contact	10000 operations minimum	10000 operations minimum
Unloaded contact	100000 operations minimum	100000 operations minimum
Operate time	Less than 10 ms	
Reset time	Less than 5 ms	

Communication Port

Characteristics	Values
Type	2-wire RS485 differential
Line impedance	120 Ω*

*Lack of internal terminating resistor

Environmental Characteristics

Electromagnetic Compatibility

Electromagnetic Compatibility		Standard	Level/Class	Value
Emission	Radiated emission	EN 60255-26 CISPR 11 CISPR 22	Class A	**Frequency range: (30-1000 MHz)** 30-230 MHz: 40 dB (µV/m) – measurement with detector QP 230-1000 MHz: 47 dB (µV/m) – measurement with detector QP **Frequency range: (1 GHz-2 GHz)** 56 dB (µV/m) – measurement with detector average 76 dB (µV/m) – measurement with detector peak at 3 m
	Conducted emission	EN 60255-26 CISPR 22	Class A	**Frequency Range: (0,15 – 30 MHz)** 0,15 MHz-0,5 MHz: 79 dB (µV) – measurement with detector QP 66 dB (µV) – measurement with detector AVG 0,5 MHz-30 MHz: 73 dB (µV) – measurement with detector QP 60 dB (µV) – measurement with detector AVG
Immunity tests	Radiated digital radio telephones	EN 61000-4-3	Level 3	10 V/m, 900 MHz 100% AM, 200 Hz/50% square wave
	Radiated electromagnetic energy	EN 61000-4-3	Level 3	Test field strength, frequency band: - 80 MHz to 1000 MHz: 10 V/m, - 1.4 GHz to 2.7 GHz: 10 V/m Test using AM: 1 kHz / 80% sinus Spot frequencies: 80 MHz, 160 MHz, 380 MHz, 450 MHz, 900 MHz, 1850 MHz, 2150 MHz 80 % AM, 1 kHz, 100 % (duty cycle)
	Electrostatic discharge	EN 61000-4-2	Level 3	8 kV discharge in air to all communication ports. 6 kV point contact discharge to any part of the front of the product.
	1 MHz Burst High Frequency Disturbance Test	EN 61000-4-18	Level 3	Common-mode test voltage: 2.5 kV, Differential test voltage: 1.0 kV, 1 Mhz, 75 ns, 400 Hz, 200 Ω Test duration: 2 s
	Magnetic fields at power frequencies	EN 61000-4-8	Level 5	50 Hz, 100 A/m – 1 minute for each position

				50 Hz, 1000 A/m – 1 seconds for each position
	Pulse magnetic fields immunity test	EN 61000-4-9	Level 5	6,4/16 µs magnetic pulse 1000 A/m. Applied to enclosure
	Conducted radiofrequency disturbances	EN 61000-4-6	Level 3	Disturbing test voltage: 10 V, 150 kHz to 80 MHz, 80% Amplitude Modulation, 1 kHz Spot frequencies: 27 MHz, 68 MHz
	Electrical fast transients/burst	EN 61000-4-4	Level 4	±4 kV, 5 kHz applied directly to auxiliary supply, CTs, VN, opto inputs, output relays. ±2 kV, 5 kHz applied to communication ports.
	Surges	EN 61000-4-5	Level 4	Time to half-value: 1.2/50 µs, Amplitude: 2 kV for line to line, 4 kV for line to earth In order to suppress transient interference peaks at the logic signal inputs it is suggested to set the parameter AUX timer to 20ms. Surge immunity test not required on communication port interfacing cables less than 10 m.
	ac and dc voltage dips	EN 61000-4-11 EN 61000-4-29	–	0% of residual voltage: 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms (ac/dc) 40 % of residual voltage: 200 ms (50 Hz), 200 ms(60 Hz) 200 ms (dc) 70 % of residual voltage: 500 ms (50 Hz), 500 ms(60 Hz) 500 ms (dc)
	ac and dc voltage interruptions	EN 61000-4-11 EN 61000-4-29	–	0% residual voltage, 5 s (50 Hz), 5 s (60 Hz) 5 s (dc)
	ac component in dc (ripple)	EN 61000-4-17	–	15 % of rated dc value 100 Hz and 120 Hz
	Logic Inputs at power frequency	EN 61000-4-18	Level 4	300 V MC, 150 V MD
	Gradual shut-down/start –up (for dc power supply)	EN 60255-26	–	Shut-down ramp 60 s power off 5 min start-up ramp 60 s

Mechanical Robustness

Mechanical Robustness	Standard	Level/Class	Value
Vibration	EN 60255-21-1	Class 1	Response 0,5 g_n: 10 Hz – 150 Hz Endurance 1 g_n; 10 Hz – 150 Hz
Shock and bump	EN 60255-21-2	Class 1	Shock response 5 g_n/11 ms Shock withstand 15 g_n/11 ms Bump 10 g_n/16 ms
Seismic	EN 60255-21-3	Class 2	2 g_n horizontal / 1 g_n vertical

Climatic Requirements

Climatic Requirements	Standard	Level/Class	Value
Ambient temperature range	EN 60255-1 EN 60068-2-1 EN 60068-2-2	Ad, Bd Ae, Be Ab, Bb	Operating temperature range: -25 °C to +60 °C (-13 °F to +140 °F), Short time operation temperature range (<16 h) -30 °C to +70 °C (-22 °F to +158 °F). Storage and transit: -30 °C to +70 °C (-22 °F to +158 °F).
Ambient humidity range	EN 60068-2-78	Cab	21 days at 93 % relative humidity and +40 °C 10 days at 93 % relative humidity and +60 °C
Cyclic temperature with humidity test	EN 60068-2-30	Db	Damp heat cyclic, six (12 + 12) hour cycles, 93% RH, +25 °C to +55 °C
Corrosive Environments	EN 60068-2-60	Ke (Method 4)	Industrial corrosive environments/poor environmental control, mixed gas flow test. 21 days at 75 % relative humidity and 25 °C Exposure to elevated concentrations of H2S(10 ppb), CI2 (10 ppb), NO2 (200 ppb), SO2 (200 ppb)
Cyclic temperature test	EN 60068-2-14	Nb	-25 °C to +60 °C 100 cycles

Safety Requirements

Safety Requirements	Standard	Value
Insulation	EN 60255-27	Insulation resistance > 500 MΩ at 500 Vdc (Using electronic/brushless insulation tester).

Safety Requirements	Standard	Value
Creepage distances and clearances	EN 60255-27	Pollution degree 2, Overvoltage category III, Impulse test voltage 5 kV,
High Voltage (dielectric) withstand	EN 60255-27	2 kV rms AC, 1 min: between all case terminals connected together, and the case earth/ground; 2 kV RMS AC, 1 minute: between all terminals of independent circuits. 1 kV rms AC for 1 min: across normally open control and signaling contacts
Impulse voltage withstand	EN 60255-27	Front time: 1.2 µs, Time to half-value: 50 µs, Peak value: 5 kV Source Characteristics: 500 Ohm, 0.5 J.

Enclosure Protection

Enclosure protection	Standard	Value
Enclosure protection	EN 60529	IP 20 Protection for relay housing IP 20 Protection for terminals. IP 54 Protection (front panel) for flush mounted case

Certification/declaration

CE European Commission's directives	EN 60255-26	EMC Directive 2014/30/EU
	EN 60255-27	LV Directive 2014/35/EU

Maintenance

Preventive Maintenance

Introduction

To obtain maximum availability of the installation, it is essential to keep PowerLogic P1F operational full time. The P1F internal self-tests (external memory (FRAM, FLASH), analog inputs waveform, RTC check, hardware watchdog), and the watchdog relay alert the user in the event of internal PowerLogic P1F failure.

Nonetheless, elements outside the P1F are not subject to these self-tests and it is therefore necessary to carry out regular preventive maintenance.

Nothing inside the PowerLogic P1F requires preventive maintenance, nor can anything be replaced by the user.

List of Interventions

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

Intervention	Frequency
Routine check	Weekly
LED test Inspection of the rear panel	Annual
Checking the complete trip chain	Every 5 years

Routine Check

- Veryfi that the phase currents and the earth fault current measured by PowerLogic P1F are appropriate for the load being powered.
- Check that the Healthy LED is on and not blinking.

LED Test

The LED test is used to check that each LED on the front panel are working correctly.

To perform the test (if any protections are not triggered and PowerLogic P1F is energized from the voltage), press R button from default display menu level. After this, all LEDs on the front panel light up for 322pprox.. 1 s.

Inspection of the Rear Panel

Check that the connections are tight and free from corrosion, paying particular attention to the earth terminal and the CT connections.

If the CT connections are not tightened properly, this generates excessive heat rise which can lead to the destruction of terminals and the CTs.

Checking the Trip Chain

It is important to check regularly that the complete trip chain, from the CTs to the P1F and through to the trip coil, is always operational.

Troubleshooting Assistance

Introduction

The paragraphs below list the actions to be taking after observing abnormal PowerLogic P1F behavior. 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…
All the LEDs are off, as well as the display unit	Auxiliary power supply is not connected	Connect auxiliary power supply to terminals A1 – A2	Identification of the Connectors on the Rear Panel, page 24
	Auxiliary power supply absent	Check that the auxiliary power supply level is within the permissible range.	Power Supply Voltage, page 314
	Internal failure	Change the P1F unit.	Removing P1F, page 22

PowerLogic P1F Healthy LED flashing

Flashing of the Healthy LED indicates that PowerLogic P1F has gone into the fail position following detection by the embedded self-tests of the failure of one of its components.

The fail position is characterized by:

- Healthy LED flashing
- Watchdog relay, in the off-position
- Output relays in the off-position (normal position)
- Communication inoperative

In this case, PowerLogic P1F is no longer operational. Change the P1F.

No Display or Incomplete Display

Symptom	Possible Causes	Action/Remedy	Refer to…
The Healthy LED is on (lights up green), but the display does not appear or is incomplete	Failure of the display unit	Change the P1F unit	Removing P1F, page 22

Communication Problem (L (option), N, B, A, E, E+)

During normal operation, the status of the rear communication port is signaled by flashing rectangles in the top and bottom right corners of the display. Tx (Transmit) is assigned to the top right corner, Rx (Receive) is assigned to the bottom right corner of the display. Flashing of the rectangles indicate the operation of the rear communication port.

If the PowerLogic P1F relay is not communicating with the SCADA system, check:

- That the supervisor is sending frames to the relevant P1F
- All the P1F communication parameters
- The wiring of each P1F
- The tightness of the screw terminals on connector C of each P1F
- 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 P1F relays one by one on the communication network to determine which P1F relay is responsible for the problem.

Lost Password

If you lost the password, read the serial number on the PowerLogic P1F label and contact your local Schneider Electric after-sales service.

NOTICE
Please take care of your modified new password, reseting password may cause some inconvenience or extra cost.

Removing PowerLogic P1F

Introduction

If the PowerLogic P1F relay cannot be repaired by following the instructions in *Troubleshooting Assistance*, page 323, it must be replaced.

Removing PowerLogic P1F

⚠DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC, BURNS OR EXPLOSION

- Wear insulating gloves to avoid any contact with a conductor that has accidentally been energized.
- Short-circuit secondary current transformer winding by use test block without disconnecting the wires from it. This connector ensures continuity of the current transformer secondary circuits.
- If you need to disconnect the wires connected to the test block, short-circuit the current transformer secondary circuits.

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

The procedure for removing the PowerLogic P1F relay is as follows:

Step	Action
1	If the P1F allows you to, read (or extract by eSetup Easergy Pro event and disturbance recorder) and make a note of the last trips/events that have occurred.
2	Make a note of the symptoms observed, in particular the failure codes displayed.
3	Switch off the unit.
4	Unscrew all wires
5	Depending on assembly method unscrew fastening elements or disassemble spring clips
6	Remove the PowerLogic P1F.

Return for Expert Assessment

If returning the PowerLogic P1F for expert assessment, use the original packaging or packaging offering level 1protection against vibrations (standard IEC 60255-21-1) and against shocks (standard IEC 60255-21-2).

The PowerLogic P1F relay must be returned accompanied by its settings sheet and the following information:

- Name and address of the initiator
- PowerLogic P1F 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 PowerLogic P1F is not repairable:

Step	Action
1	Remove the PowerLogic P1F as indicated above.
2	Dismantle the PowerLogic P1F in accordance with the End-of-Life Instructions for PowerLogic P1. These instructions provide: • Recyclability rates for our products. • Guidance for mitigating personnel hazards during the dismantling of your products and before recycling operations. • Parts identification for recycling or for selective treatment, to mitigate environmental hazards/incompatibility with standard recycling processes.

Application Cases

2CTs and CBCT application

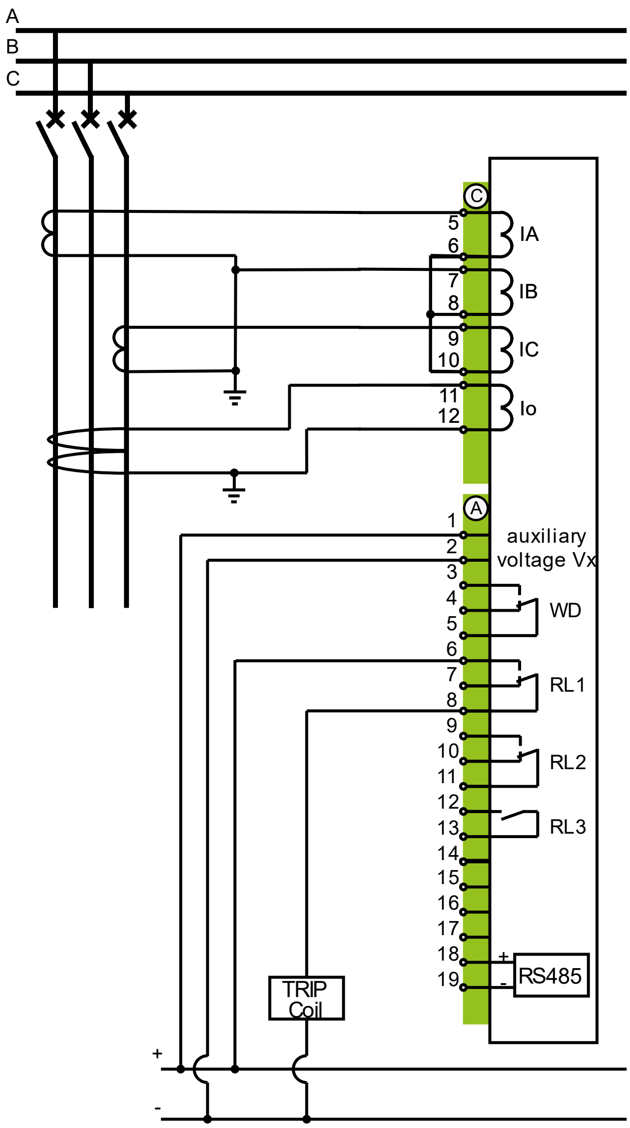
Description

Each model (**L, N, B, A, E, E+**) PowerLogic P1F relays can be use in following applications.

Details:

- Phase currents are measured in A and C phase
- B phase current is obtained from A and C phase currents
- Earth fault current is measured from dedicated earth CT
- Trip Signal is assigned to relay output 1

Figure 45. 2CTs and CBCT application diagram



3CTs and Residual Current application

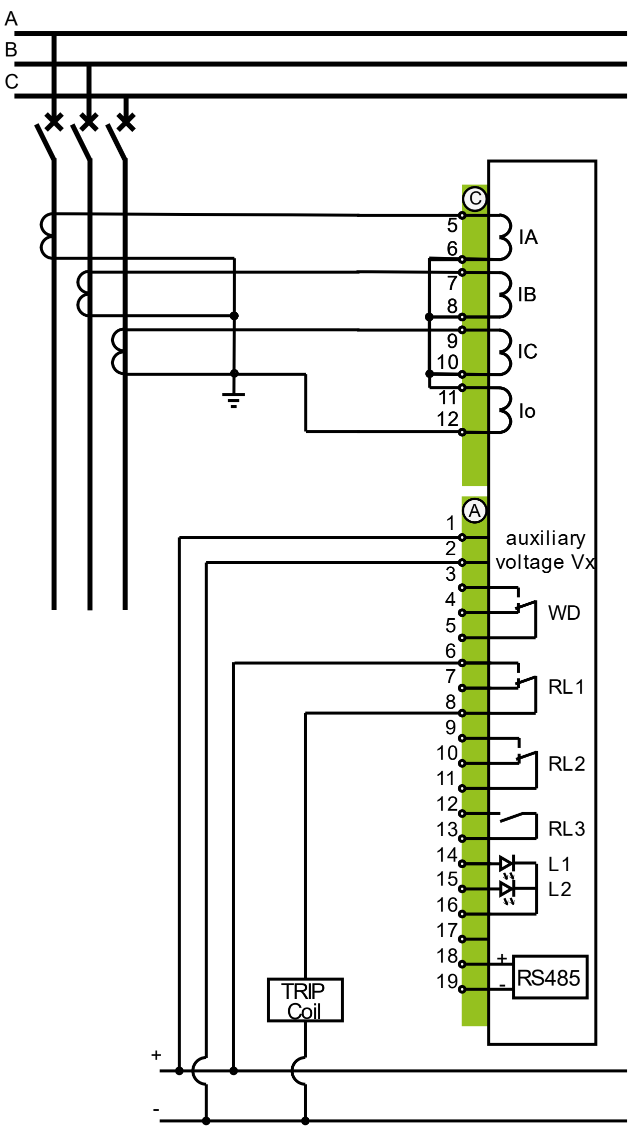
Description

Each model (**L, N, B, A, E, E+**) PowerLogic P1F relays can be use in following applications.

Details:

- Phase currents are measured in A, B and C phase
- Earth fault current is measured on the common point of the 3 phase CTs
- Trip Signal is assigned to relay output 1

Figure 46. 3CTs and residual application diagram



3CTs and CBCT Application with CB Control

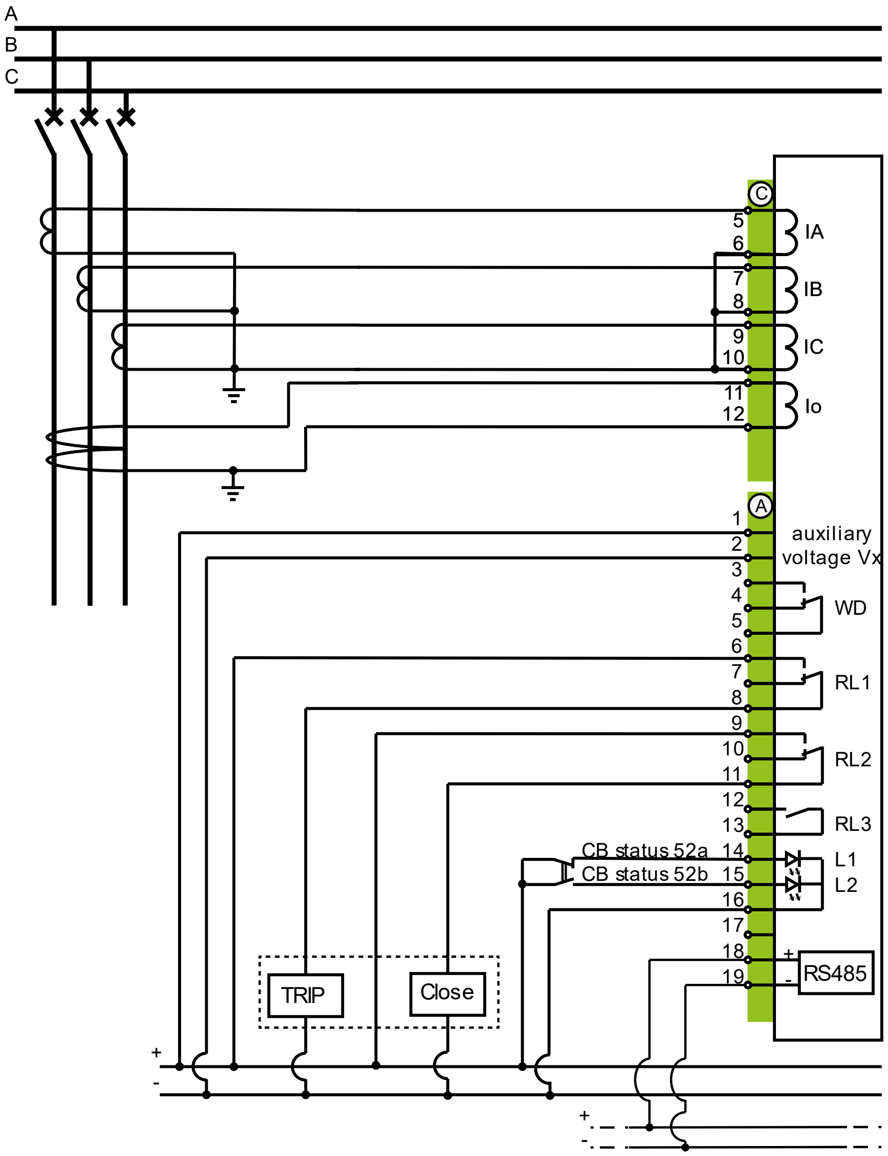
Description

Models **B, A, E, E+** of PowerLogic P1F relays can be use in following applications.

Details:

- Phase currents are measured in A, B and C phase
- Earth fault current is measured by core balance CT
- Trip and Trip CB Order signals are assigned to relay output 1
- Close CB Order signal is assigned to relay output 2
- CB status is assigned to binary inputs 1 (close) and 2 (open)
- Communication port RS 485 is connected to SCADA system (CB control is possible from SCADA also – depending on selected control mode)

Figure 47. 3CTs and CBCT application diagram



Single Phase Application

Description

Each model (**L, N, B, A, E, E+**) PowerLogic P1F relays can be use in following applications.

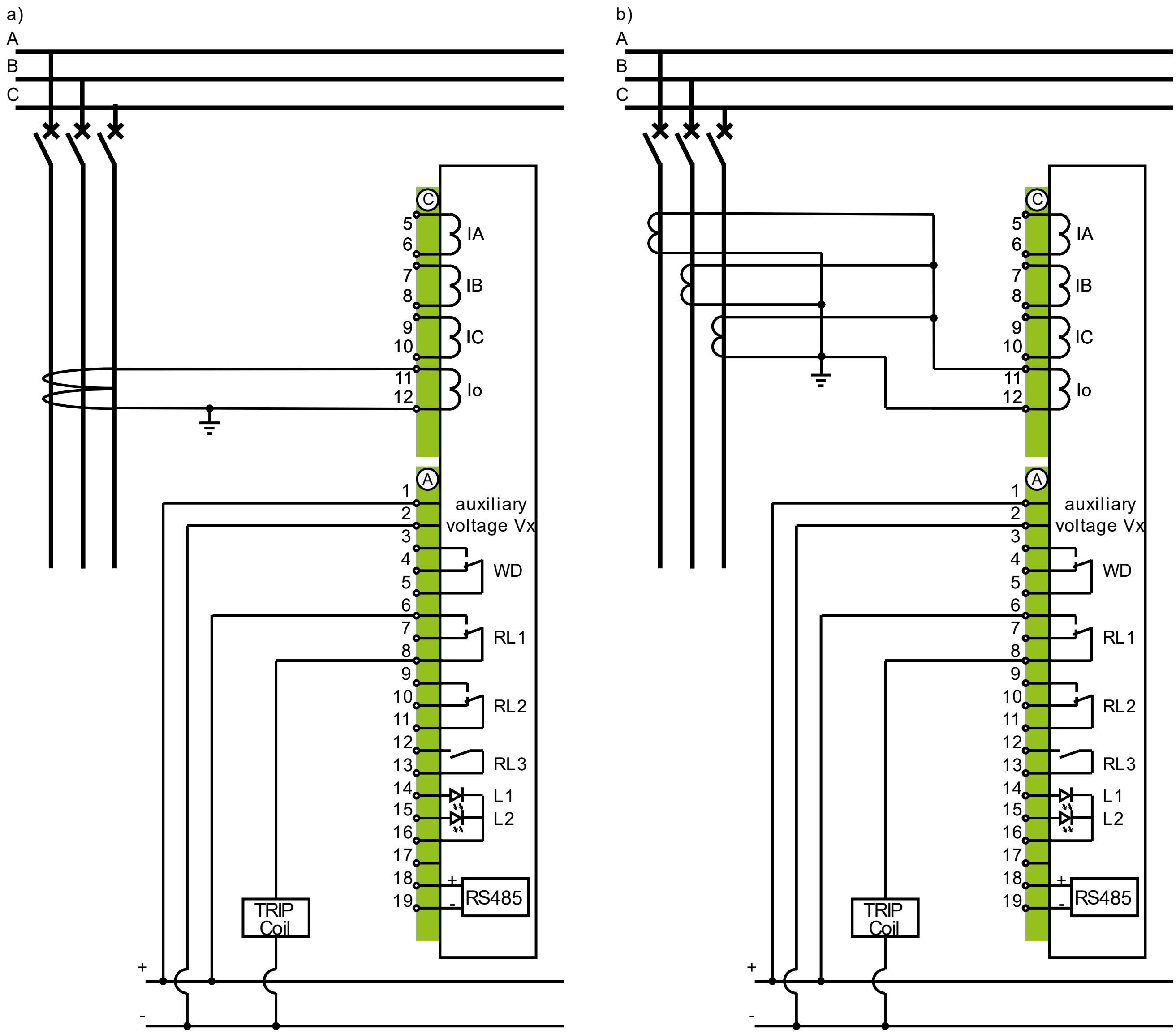
Details:

- Earth fault current is measured from dedicated earth CT (a) or measured on the common point of the 3 phase CTs (b)
- Trip Signal is assigned to relay output 1

Figure 48. Examples of single-phase application diagrams

Variant no. 1
Earth fault measured by dedicated CT

Variant no. 2
Earth fault measured on the common point of 3 phase CTs



Logic Discrimination

Description

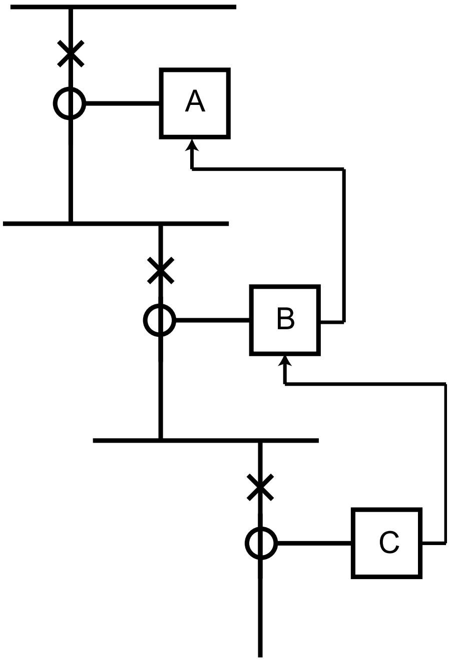
This type of protection (**B, A, E, E+**) can be applied to radial feeder circuits where there is little or no back feed. For parallel feeders, ring circuits or where there can be a back feed from generators, directional relays should be considered.

The blocking logic function allows the upstream IDMT relay to be blocked by the start output of a downstream relay that has detected the presence of a fault current above its threshold. Thus, both upstream and downstream relays can have the same current and time settings, and the blocking feature will automatically provide grading. If the CB failure protection is active, the blocking command on the upstream relay will be removed if the down-stream circuit breaker fails to trip.

Thus, for a fault downstream from relay C, the start output from relay C aim to prevent relay B from operating and the start output of relay B aim to prevent relay A from operating. Therefore all 3 relays could have the same timer and current settings and grading would be obtained by the blocking signal received from a relay closer to the fault. This gives a constant, close time grading, but there will be no back-up protection in the event of pilot wires being short-circuited.

In practice it is recommended to set the upstream relay to a value that is 10% higher than the downstream relay setting. This helps to ensure that the downstream relay successfully blocks the upstream relay when required.

Figure 49. Logic discrimination application diagram



The “Blocking Logic” functions are assigned in the ***SETTING GROUP x/ INPUT CONFIGURATION Gx/*** menu. Every protection element can be assigned a blocking function: Block.tI>, Block.tI>>, Block.tI>>>, Block.tSOTF, Block.tIN_1, Block.tIN_2, Block.tIN_3 (**E, E+**), Block.tIs2>(**E, E+**), Block.tBrkn Cond (**E, E+**), Block.Itherm, Block.AUX1, Block.AUX2, Block.AUX3, Block.CB Fail, Block.[79] (**E, E+**).

PowerLogic P1F relays have separate blocking functions, which can be used to block every protection element, for example: Earth fault and phase overcurrent stages.

Version History

Firmware version	Description	Date of issue	Manual Version
2.E.16	First version.		V1.0
2.E.17	1. Fix wrong pictogram in cell “Functional Test, setting 0:CB Trips”; 2. Add the .pro files in the release folder; 3. Correct the CB open and close keys; 4. 485 protocol default setting correct, need update the SET file; 5. E_U0.epro file update 6. Fix missing event and fault recorder when Vx goes down and return after several seconds; 7. Fix external protection generate maltrip signal for scenario with reverse BI and loss of Vx and return;	Nov 25, 2020	V1.1
2.E.18	1. Fix connection issue to ePro in Chinese module;	Jan 07, 2021	V1.2
2.E.19	1. P1F Chinese module been found a connect issue to ePro; 2. Change USB deactivation time from 10mins to 60mins; 3. FCT side change default setting from MODBUS to GETSET; 4. Bug fix: AUX1 trip enabled with delay of 1s, input 1 reversed and assigned to AUX1. In this case AUX is activated when no signal. With USB connected (AUX logic functions), when Vx power up, the AUX delay timer is reset and the trip is retook after the timer 1s; 5. P1F Chinese issues fix (almost translation error); 6. Bug fix: cannot read anything from 0X3E00H, request to retrieve the oldest non-acknowledge fault record; 7. Bug fix: modify USBport issue; 8. Bug fix: ADDR 3800H, reading 34 bytes will get nothing; 9. Bug fix: Latched RLs are not off when automatically exit maintenance mode;	Sept 01, 2021	V1.2
2.E.20	fix GetSet/IEC103, disable USBPORT and then recycle power, the relay not work	Nov 26, 2021	V1.2
2.E.21	1. Easergy -> PowerLogic in OP Parameters in Menu (LCD display); 2. MENU version update frome M_09 to M_0A (this version can't be compatible with version before 2.E.21); 3. Easergy -> PowerLogic in Device Information when using Easergy Pro to connect relay; 4. Fixed operate valid time enlarge from 13s to 90s in keyboard self-test; 5. Change answer ”Easergy” to “PowerLo” when IEC103 protocol asks device info; 6. Bug fix: P1F DR Current info is lost when In(Ien) CTsec=5A and CTprim=1A; 7. Bug fix: P1F1&P116 DR 2200h need to read 16 words when only 7 is needed 8. Bug fix: P1F Easergy Studio could not poll DR 9. Bug fix: P1F TCS function RL and LED is somehow latched 10. Bug fix: P1 timestamp swapped when read the oldest fault and event 11. Bug fix: P1F1E error trip without origin	Nov 22, 2023	V1.2.0
2.E.22	1. Add HalfDFT, PO Modbus new feature; 2. Fix CB diagnostic function issue; 3. After password correctly input, menu navigated back to where PASSWORD menu insert; 4. Add enable soft-switch of the keys O/I on front-panel in menu; 5. Change RI curve TMS setting range to 0.02…10 from 0.1…10, with STEP 0.01;	Jan 05, 2024	V1.2.1
2.E.23	1. Add control setting to enable or disable half cycle DFT algorithm 2. Bug fix: P1F IN measurement display not accurate when there is 2nd Harmonic wave 3. Bug fix: P1F will be locked eternally when wrong password 4. Bug fix: P1F chinese menu display issue on output/password editing	Mar 06, 2024	V1.2.1

Notes:

Customer Care Center

http://www.se.com/ccc

Schneider Electric
35 rue Joseph Monier
92506 Rueil-Malmaison FRANCE
Phone: +33 (0) 1 41 29 70 00
Fax: +33 (0) 1 41 29 71 00
www.se.com