EcoStruxure™
Innovation At Every Level

PowerLogic™ P7

Catalog 2024
Network Protection and Control Devices

www.se.com

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Note: Electrical power systems are dangerous, protection relays are defined and governed by international standards such as IEC 60255 “Measuring relays and protective equipment” and IEEE C37.97 “Protective relay applications to power systems buses”. Never attempt to install or operate protection relays or associated equipment without the necessary qualifications, training and tools. Exposure to electrical arc-flash incidents can be life threatening, no situation can ever be deemed fully safe. Standards such as NFPA 70E define important risk categorization and such standards identify both distance from, and energy of the arc incident to be important factors.

This catalog doesn’t replace the user manual of PowerLogic P7. For further information please see the user manual or contact your local Schneider Electric sales account.

General Contents

PM107471

PowerLogic™ P7 Range Description

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PowerLogic™ P7 Range Description

The PowerLogic™ P7 at a Glance

The PowerLogic™ P7 is a high-end protection and control device for most of your demanding protection applications. It offers unparalled flexibility and digital performance for industry-leading protection relay functionality to secure your power system, improve network reliability and asset condition monitoring, all with advanced and modular connectivity. Part of the PowerLogic range of power monitoring and control solutions, PowerLogic P7 is built on more than 100 years of experience in protection relays, including Sepam, MiCOM, and Vamp ranges, renowned for their reliability and performance.

Operational Efficiency and Digital Experience

- Tailor and adapt to customer needs throughout device life cycle with a highly flexible, modular hardware and easy-to-expand application-oriented firmware
- Modular board design with plug and play concept enhances device maintenance and reduces installation downtime
- Compliance with IEC 61850 Ed. 2.1 provides more efficient delivery, engineering, operation and maintenance with seamless integration in power automation systems
- Stand-alone merging unit complying to IEC 61869-13, IEC 61869-9, IEC 61850-9-2LE
- Easily interact via the large and highly intuitive 7″ color industrial touchscreen

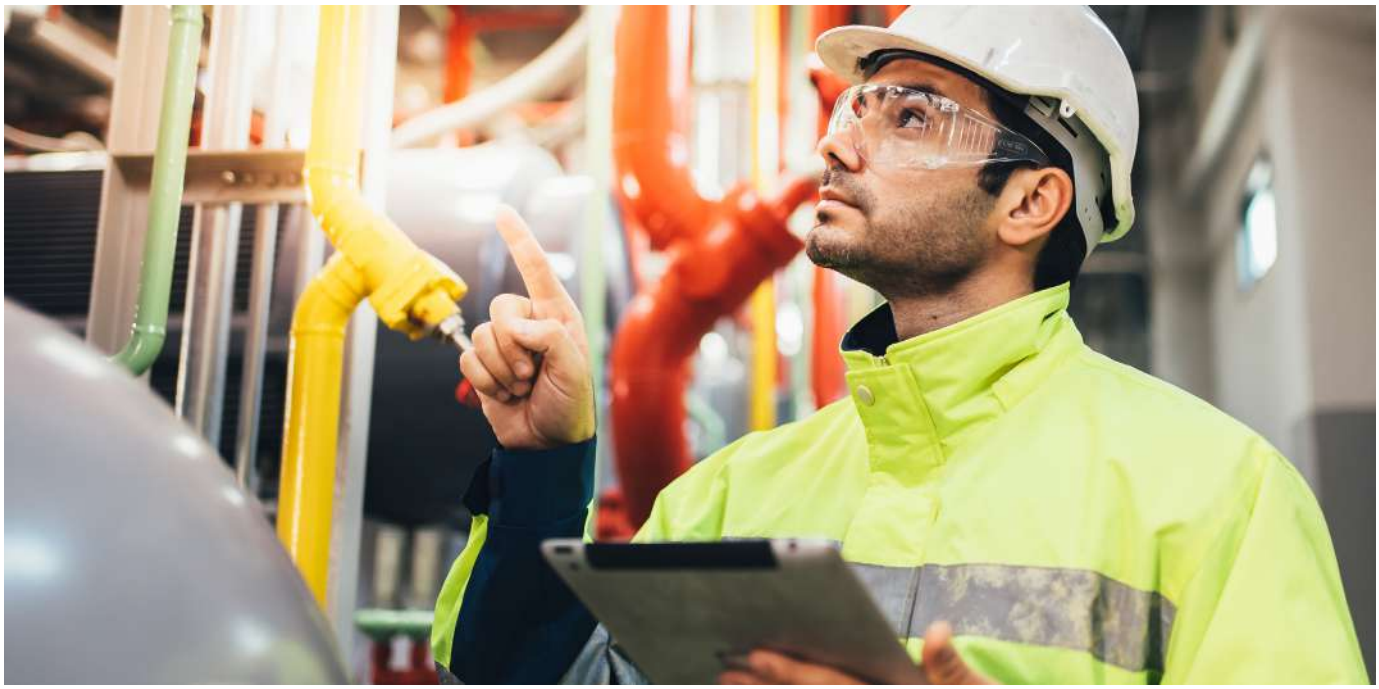
Electrical Safety and Security

- Enhanced maintenance safety with current transformer auto-shorting capability
- Reduce exposure to cyber threats with IEC62443 SL2 features
- Condition-monitoring allows targeted maintenance to maximize asset life
- Increased device robustness with IP54 front face and IK7 protected impact-strength design of the 7” touchscreen

Power Availability and Sustainability

- Avoid downtime with best-in-class, easily tailored protection applications
- Adapt to network evolutions with new flexible firmware application concept
- Future-ready, long-term solution built on more than 100 years of experience in protection relays
- Versatile operation range with a mission profile of -40 to 70 °C (-40 to 158 °F) and suitable for harsh environment

Enjoy a Package of Sought-After Features in One Device



The PowerLogic P7 presents a major step forward for protection relays, bringing several best-in-class features together in one device.

Advanced Cybersecurity

IEC 62443 SL2, the PowerLogic P7 has been designed with a native cybersecurity package. This means reduced exposure to cyber threats and improved operational security. By default, the PowerLogic P7 includes important features such as firmware signature, secure boot, LDAP/Radius communication, password management, port hardening, and secured communication compliant to the latest international standards.

Modular, Flexible Design

Additional hardware like I/O cards, communication modules or accessories like RTD inputs or analogue I/O can be added at any time. In addition, the flexible application concept allows you to customize the PowerLogic P7 to your needs at any time of the product life cycle.

Improved Recovery Time

When maintenance or testing is required, PowerLogic P7 significantly decreases outage time thanks to the intuitive HMI with clear and easily accessible device status information, plug & play boards, clear and simple slot numbering and removable wiring interfaces.

Greater Connectivity

The protection relay features multiple communication protocols. This includes IEC 61850 Edition 2.1, Modbus (serial/TCP), and DNP3 (serial/TCP). PowerLogic P7 can support up to 3 Ethernet protocols simultaneously, including offering redundancy with PRP/HSR and RSTP protocols. Optional Ethernet communication modules (SFP*) can be added at any time, including on-site, during the product life cycle to allow you to upgrade your device in line with future network evolutions.

* SFP – Small Form-factor pluggable module

Comprehensive Digital Tools for Mobile, Tablet or Desktop

PowerLogic™ Engineering Suite Saves Time, Improves Efficiency

- PowerLogic Engineering Suite is an easy-to-use, versatile tool with functionalities and features needed throughout the life cycle of Schneider Electric protection and control IEDs, including support for seamless integration into EcoStruxure Power & Grid.
- One Tool Suite for all connected products offline/online
- Flexible and adaptable for multiple personas
- User-experience driven with built in contextual help
- Modern ergonomic design
- Future-proof, IEC 61850 compliant

Full Operation from a Safe Distance

Digital tools provide simpler installation, configuration, and maintenance, enabling smoother operations, saving both time and money. Digital tools include:

- **PowerLogic Engineering Suite** with our next generation of tools, for device and system architecture configuration, engineering and maintenance
- **mySchneider app** allows to access product information and documentation in a very simple way, just by flashing the QR code on the device
- **Product Selector tool** helps the user during the selection and configuration steps to choose the right set of product options/features, according to the needs

As an EcoStruxure-ready solution, the PowerLogic P7's digital benefits can be taken even further with best-in-class monitoring of substation equipment health. For example, when paired with **EcoStruxure Asset Advisor**, users get data for predictive maintenance, which helps them reduce OpEx, speed up processes, and boost efficiency.

Take PowerLogic™ P7 Further with EcoStruxure™

EcoStruxure, Schneider Electric's IoT-enabled, open and interoperable architecture and platform, brings together Connected Products, Edge Control, and Apps, Analytics & Services. EcoStruxure connected products deliver enhanced value around safety, reliability, efficiency, sustainability, and connectivity.

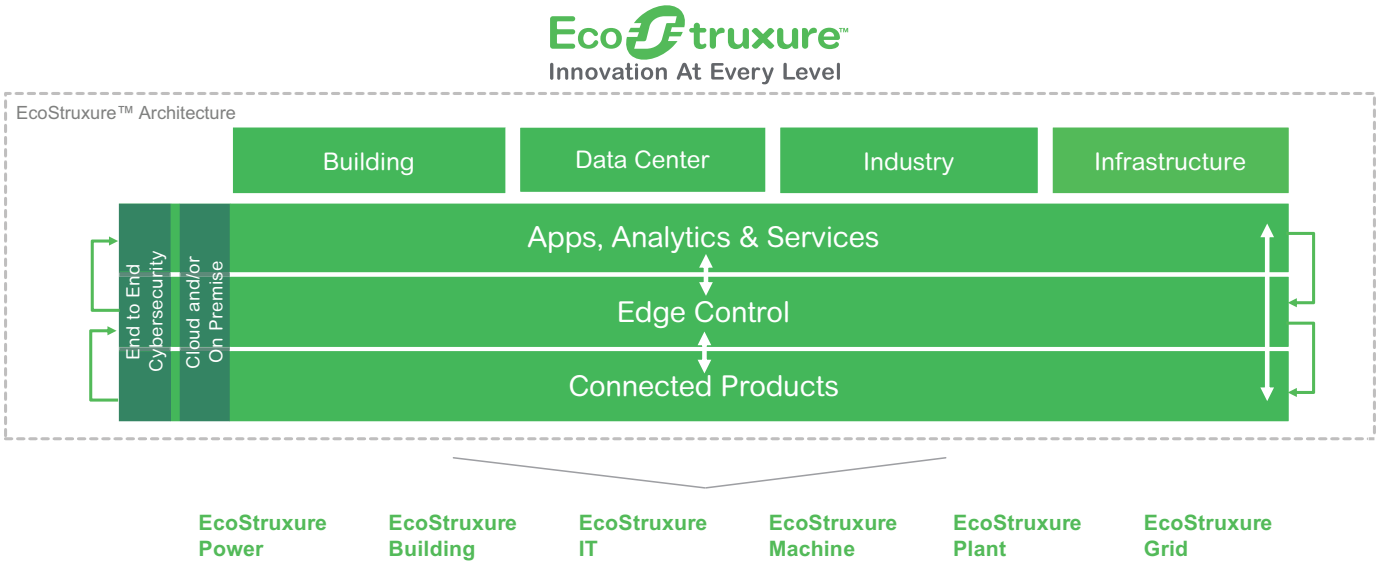
More than 450 000
EcoStruxure systems deployed since 2007 with the support of our 9,000 system integrators

EcoStruxure ready

Efficient asset management
Boost your efficiency and reduce downtime using predictive maintenance tools

24/7 connectivity
Make better informed decisions with real-time data that's available everywhere, anytime

Enhanced safety
Advanced features designed-in based on well-known designs, experience, and technology



Overview

PowerLogic™ P7 protection and control devices are based on state-of-the-art technology concepts and developed in close cooperation with customers, so it's built to meet your toughest demands:

- Flexible and modular design that allows the user to adapt the hardware to their needs.
- Embeds latest cybersecurity functionality to help prevent intentional misuse and cyber-threats.
- Fast and simple maintenance thanks to modularity and standardized boards and modules.

PowerLogic™ products are designed to be user friendly, a feature that is proven in our customer reports day after day. You'll benefit from features that include:

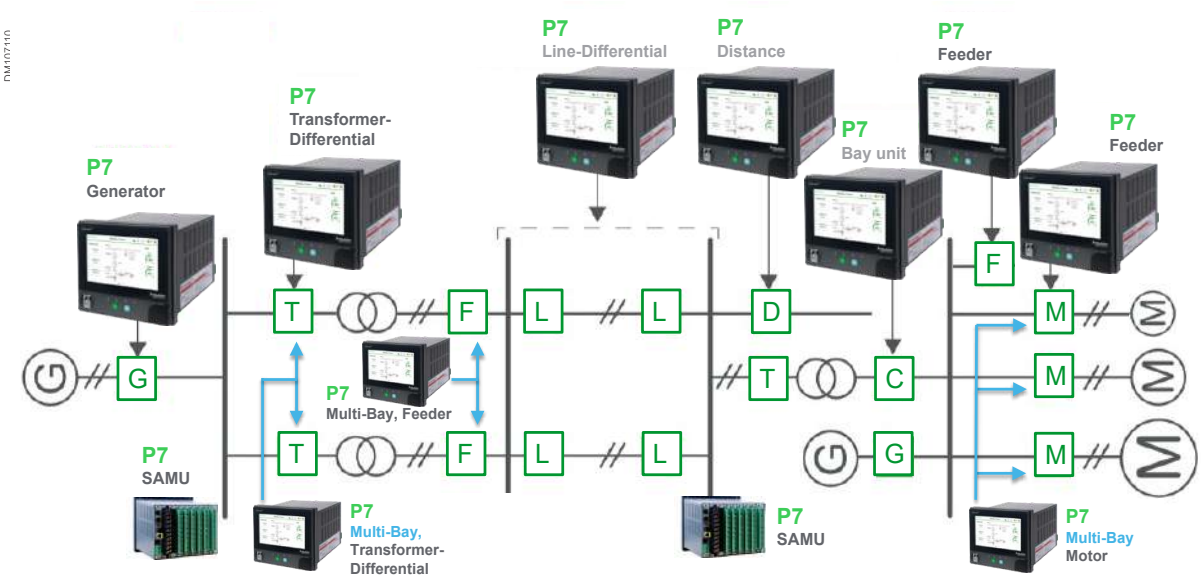
- A complete set of flexible, configurable protection and control functions related to the application.
- Switchgear control with tailorable single-line diagram, programmable function keys, LEDs, and customizable alarms.
- 7" touchscreen with intuitive navigation concept.
- Easy-to-use Engineering tool for setting parameters, device configuration, and network fault analysis.
- Both serial and Ethernet communication, including Ethernet redundancy with RSTP/HSR/PRP/failover support.
- Efficient engineering thanks to IEC 61850 Edition 2.1.

PowerLogic P7

PowerLogic™ P7 high-end protection and control devices are designed for electrical power systems in:

- Power & Grid:
  - Transmission Utilities
  - Distribution Utilities
  - Distributed Energy Resources
  - Wind/Solar Farm
- Critical Infrastructure:
  - Data Center
  - Transportation
- Energy & Chemicals:
  - Oil and Gas
  - Mining
  - Mineral and Metals

Range Overview



Range overview shows future application scope

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Selection Guide

PowerLogic™ P7 provides specific functions to address your needs in a one-box design, regardless of application.		PowerLogic P7
		
Motor		●
Generator		●
Characteristics		
Measuring inputs	Current	4CT (1/5A) or 6CT (1/5A per analogue module)
	Core balance current	1CT (1A) core balanced
	Voltage	4VT or 3VT per analogue module
Digital	Inputs	8...40 (40TE)
	Outputs	8...36 (40TE) + Watchdog (WD)
	HSHB outputs	0...4
Temperature sensor input		0...8 (external module)
Front ports		1 mini-USB for configuration
Power supply		24...34 Vdc; 48...125 Vdc; 110...250 Vdc/ac
Ambient temperature, in service		-40...70 °C (-40...158 °F)
Communication		
Hardware modules	Serial	●
	Ethernet	●
	Redundant Ethernet	Optional SFP modules
Protocols	DNP3 Ethernet	●
	DNP3 serial	●
	Modbus Ethernet	●
	Modbus serial	●
Redundancy protocols	RSTP	●
	PRP / HSR	●
	Failover	●
Time synchronization	IRIG-B(1), Protocol	●
	SNTP, PTP IEEE 1588	●
Others		
Control		Mimic, up to 12 controlled objects
Logic (Matrix + Logic Equations)		●
Cybersecurity		●
Modular hardware (board withdrawability)		●
Mounting variants	Flush/rack	●/●

(1) IRIG-B module is a separate accessory

Selection Guide by Functionality

PowerLogic P7 Function Selection Table for Motor Application and Generator Application

	IEC 61850 Logical node	ANSI code	Motor application (stages instantiated)		Generator application (stages instantiated)		Functional routing support
			Level 0	Level 1	Level 0	Level 1	
Current protection functions							
Protection trip conditioning	PTRC	86	1	2	1	4	FALSE
Phase direction	PHRDIR	67	*	1	*	1	TRUE
Phase overcurrent	PHPTOC	50/51	2	2	2	4	TRUE
Ground direction	EFRDIR	67N	*	1	*	1	TRUE
Ground fault overcurrent	EFPTOC	50N/51N	2	2	2	4	TRUE
Sensitive ground fault overcurrent	VSEFPTOC	50SG/51SG	2	2	2	2	TRUE
Negative sequence overcurrent	NPSPTOC	46	2	2	2	2	TRUE
Inrush detection	IDPHAR	68ID	2	2	*	2	TRUE
Selective overcurrent logic (SOL)	SOLGAPC	N/A	1	1	1	1	FALSE
Phase undercurrent	PHPTUC	37	2	2	-	-	TRUE
Voltage dependent overcurrent	PHPVOC	51V	-	-	1	2	TRUE
Sensitive directional earthfault	PSDE	32N	*	2	*	2	TRUE
Ground admittance	EFPADM	21N	-	-	*	2	TRUE
Voltage protection functions							
Undervoltage	PHPTUV	27	2	2	2	2	TRUE
Overvoltage	PHPTOV	59	2	2	2	2	TRUE
Positive phase sequence undervoltage	PPSPTUV	27D	1	1	0	2	TRUE
Positive phase sequence overvoltage	PPSPTOV	N/A	*	2	*	2	TRUE
Neutral overvoltage	EFPTOV	59N	1	3	1	2	TRUE
Negative phase sequence overvoltage	NPSPTOV	47	1	1	1	1	TRUE
Inter-turn overvoltage	ITPTOV	59IT	-	-	*	1	TRUE
Overfluxing	PVPH	24	-	-	*	1	TRUE
Frequency protection functions							
Overfrequency	PTOF	81O	*	2	2	2	FALSE
Underfrequency	PTUF	81U	*	4	4	4	FALSE
Frequency supervised ROCOF	PFRC	81R	*	4	*	4	FALSE
Differential protection functions							
High impedance differential	HIZPDIF	87/64REF	*	1	*	1	TRUE
Biased differential protection	PHPDIF	87	*	1	*	1	TRUE
Low impedance differential	RGFPDIF	64REF	*	1	*	1	TRUE
Temperature protection functions							
Motor thermal overload	THMPTTR	49	1	1	1	1	TRUE
Overtemperature	STMP	38/49T	8	8	8	8	FALSE
Negative phase sequence thermal overload	NPSPTTR	49N	1	1	1	1	TRUE

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Selection Guide by Functionality

PowerLogic P7 Function Selection Table for Motor Application and Generator Application (cont'd)

	IEC 61850 Logical node	ANSI code	Motor application (stages instantiated)		Generator application (stages instantiated)		Functional routing support
			Level 0	Level 1	Level 0	Level 1	
Motor protection functions							
Motor monitoring	ZMOT	N/A	1	1	-	-	TRUE
Motor start-up supervision, locked rotor	PMSS	48	1	1	-	-	TRUE
Locked rotor	JAMPTOC	51LR	1	1	-	-	TRUE
Motor restart inhibition	PMRI	66	1	1	-	-	FALSE
Voltage check	VCPTUV	47	1	1	-	-	TRUE
Generator protection functions							
Third harmonic undervoltage	STPTUV	27TN	-	-	0	1	TRUE
Inter-turn protection based on split phase	ITPDIF	87G	-	-	*	1	TRUE
Inadvertent energization	IEPIOC	50/27	-	-	1	1	TRUE
Speed protection functions							
Overspeed	POVS	12	0	2	0	2	FALSE
Underspeed1	PZSU	14	0	2	0	2	FALSE
Speed detection	TRTN	N/A	0	1	0	1	FALSE
Distance/impedance protection functions							
Field failure	FFPDIS	40	*	1	*	1	TRUE
Underimpedance	UZPDIS	21	-	-	*	1	TRUE
Out of step	OOSPPAM	78	*	1	*	1	TRUE
Power protection functions							
Overpower	PPDOP	32P	-	-	2	4	FALSE
Reactive overpower	QPDOP	32Q	2	2	1	2	FALSE
Underpower	PPDUP	37P	2	2	1	1	FALSE
Monitoring functions							
CT supervision	CTSSCTR	60	1	2	1	2	FALSE
VT supervision	VTSSVTR	60FL	1	1	1	2	FALSE
Circuit breaker supervision	CBSCBR	N/A	1	1	1	1	TRUE
Switch monitoring	SWSSWI	N/A	5	9	5	9	FALSE
DC battery voltage monitoring	ZBAT	N/A	1	1	1	1	FALSE
Bay dead	PDGAPC	N/A	1	1	1	1	TRUE
Voltage variation	QVVR	N/A	*	1	*	1	TRUE
Control functions							
Circuit breaker proxy	CBXCBR	N/A	1	1	1	1	TRUE
Circuit breaker control	CBCSWI	N/A	1	1	1	1	FALSE
Circuit breaker interlocking	CBCILO	N/A	1	1	1	1	FALSE
Circuit breaker failure	RBRF	50BF	1	1	1	1	TRUE
Switch proxy	SWXSWI	N/A	5	9	5	9	FALSE
Switch control	SWCSWI	N/A	5	9	5	9	FALSE

Selection Guide by Functionality

PowerLogic P7 Function Selection Table for Motor Application and Generator Application (cont'd)

	IEC 61850 Logical node	ANSI code	Motor application (stages instantiated)		Generator application (stages instantiated)		Functional routing support
			Level 0	Level 1	Level 0	Level 1	
Control functions (cont'd)							
Switch interlocking	SWCILO	N/A	5	9	5	9	FALSE
Synchro-check	RSYN	25	-	-	1	1	TRUE
Logs and records							
Sequence of event record	GENGLOG	N/A	1	1	1	1	FALSE
Disturbance record	DRRDRE	N/A	1	1	1	1	FALSE
Fault record	TCRGLOG	N/A	1	1	1	1	FALSE
Operation log	GENGLOG	N/A	1	1	1	1	FALSE
Power quality record	PQGLOG	N/A	*	1	*	1	FALSE
CT group measurement							
3ph current	VECAMMXU	N/A	1	2	1	2	FALSE
3ph RMS current	RMSAMMXU	N/A	1	2	1	2	FALSE
Sequence current	AMSQI	N/A	1	2	1	2	FALSE
1ph current	VECAXMMXU	N/A	1	2	1	2	FALSE
1ph RMS current	RMSAXMMXU	N/A	1	2	1	2	FALSE
VT group measurement							
3ph voltage	VECVMMXU	N/A	1	1	1	2	FALSE
3ph RMS voltage	RMSVMMXU	N/A	1	1	1	2	FALSE
Sequence voltage	VMSQI	N/A	1	1	1	2	FALSE
1ph voltage	VECVXMMXU	N/A	*	2	1	2	FALSE
1ph RMS voltage	RMSVXMMXU	N/A	*	2	1	2	FALSE
Bay measurement							
Fundamental frequency active, reactive and apparent power values, power factor	BAYMMXU	N/A	1	1	1	1	FALSE
RMS active, reactive and apparent power	BAYMMXU	N/A	1	1	1	1	FALSE
Minimum and maximum demand values: RMS phase currents	DVALMMXU	N/A	1	1	1	1	FALSE
Minimum and maximum demand values: active, reactive, apparent power and power factor	DVALMMXU	N/A	1	1	1	1	FALSE
Active and reactive of energy values	EMMTR	N/A	1	1	1	1	FALSE
Bay Fourier current	BAYMMXU	N/A	1	1	1	1	FALSE
Bay RMS current	BAYMMXU	N/A	1	1	1	1	FALSE
Bay sequence current	BAYMMXU	N/A	1	1	1	1	FALSE
Bay Fourier voltage	BAYMMXU	N/A	1	1	1	1	FALSE
Bay RMS voltage	BAYMMXU	N/A	1	1	1	1	FALSE
Bay sequence voltage	BAYMMXU	N/A	1	1	1	1	FALSE
Bay harmonics current and voltage	MHAI	N/A	*	1	*	1	FALSE

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Selection Guide by Functionality

PowerLogic P7 Function Selection Table for Feeder Application and Transformer Application

	IEC 61850 Logical node	ANSI code	Feeder application (stages instantiated)		Transformer application (stages instantiated)		Functional routing support
			Level 0	Level 1	Level 0	Level 1	
Current protection functions							
Protection trip conditioning	PTRC	86	1	4	2	6	FALSE
Phase direction	PHRDIR	67	1	2	*	3	TRUE
Phase overcurrent	PHPTOC	50/51	4	8	2	6	TRUE
Ground direction	EFRDIR	67N	1	2	*	3	TRUE
Ground fault overcurrent	EFPTOC	50N/51N	4	8	2	6	TRUE
Sensitive ground fault overcurrent	VSEFPTOC	50SG/51SG	4	8	2	3	TRUE
Negative sequence overcurrent	NPSPTOC	46	4	8	2	3	TRUE
Inrush detection	IDPHAR	68ID	2	2	2	3	TRUE
Selective overcurrent logic (SOL)	SOLGAPC	N/A	1	1	1	1	FALSE
Voltage dependent overcurrent	PHPVOC	51V	1	2	*	2	TRUE
Sensitive directional earthfault	PSDE	32N	1	2	1	3	TRUE
Ground admittance	EFPADM	21N	*	2	*	2	TRUE
Voltage protection functions							
Undervoltage	PHPTUV	27	4	4	2	2	TRUE
Overvoltage	PHPTOV	59	4	4	2	2	TRUE
Positive phase sequence undervoltage	PPSPTUV	27D	2	2	-	-	TRUE
Positive phase sequence overvoltage	PPSPTOV	N/A	2	2	-	-	TRUE
Neutral overvoltage	EFPTOV	59N	4	4	2	2	TRUE
Negative phase sequence overvoltage	NPSPTOV	47	2	2	-	-	TRUE
Overfluxing	PVPH	24	-	-	1	2	TRUE
Frequency protection functions							
Overfrequency	PTOF	81O	2	2	2	2	FALSE
Underfrequency	PTUF	81U	4	4	4	4	FALSE
Frequency supervised ROCOF	PFRC	81R	4	10	4	10	FALSE
Differential protection functions							
High impedance differential	HIZPDIF	87/64REF	*	1	*	1	TRUE
Low impedance differential	RGFPDIF	64REF	*	1	2	3	TRUE
Basic transformer differential	TR2PDIF	87T	-	-	1	-	TRUE
Advanced transformer differential	TR3PDIF	87T	-	-	-	1	TRUE
Temperature protection functions							
Thermal overload	THFPTTR	49F	1	1	*	1	TRUE
Overtemperature	STMP	38/49T	*	8	*	8	FALSE

Selection Guide by Functionality

PowerLogic P7 Function Selection Table for Feeder Application and Transformer Application (cont'd)

	IEC 61850 Logical node	ANSI code	Feeder application (stages instantiated)		Transformer application (stages instantiated)		Functional routing support
			Level 0	Level 1	Level 0	Level 1	
Distance/impedance protection functions							
Underimpedance	UZPDIS	21	-	-	*	1	TRUE
Power protection functions							
Overpower	PPDOP	32P	2	2	*	2	FALSE
Reactive overpower	QPDOP	32Q	2	2	*	2	FALSE
Underpower	PPDUP	37P	2	2	*	2	FALSE
Monitoring functions							
CT supervision	CTSSCTR	60	1	3	2	3	FALSE
VT supervision	VTSSVTR	60FL	1	2	1	2	FALSE
Circuit breaker supervision	CBSCBR	N/A	1	2	1	3	TRUE
Switch monitoring	SWSSWI	N/A	5	9	5	9	FALSE
Monitoring functions (cont'd)							
DC battery voltage monitoring	ZBAT	N/A	1	1	1	1	FALSE
Bay dead	PDGAPC	N/A	1	1	1	1	TRUE
Voltage variation	QVVR	N/A	*	1	*	1	TRUE
Control functions							
Circuit breaker proxy	CBXCBR	N/A	1	2	1	3	TRUE
Circuit breaker control	CBCSWI	N/A	1	2	1	3	FALSE
Circuit breaker interlocking	CBCILO	N/A	1	2	1	3	FALSE
Circuit breaker failure	RBRF	50BF	1	2	1	3	TRUE
Switch proxy	SWXSWI	N/A	5	9	5	9	FALSE
Switch control	SWCSWI	N/A	5	9	5	9	FALSE
Switch interlocking	SWCILO	N/A	5	9	5	9	FALSE
Synchro-check	RSYN	25	1	2	*	2	TRUE
Auto-recloser	TRIRREC	79	1	2	-	-	FALSE
Logs and records							
Sequence of event record	GENGLOG	N/A	1	1	1	1	FALSE
Disturbance record	DRRDRE	N/A	1	1	1	1	FALSE
Fault record	TCRGLOG	N/A	1	1	1	1	FALSE
Operation log	GENGLOG	N/A	1	1	1	1	FALSE
Power quality record	PQGLOG	N/A	*	1	*	1	FALSE

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Selection Guide by Functionality

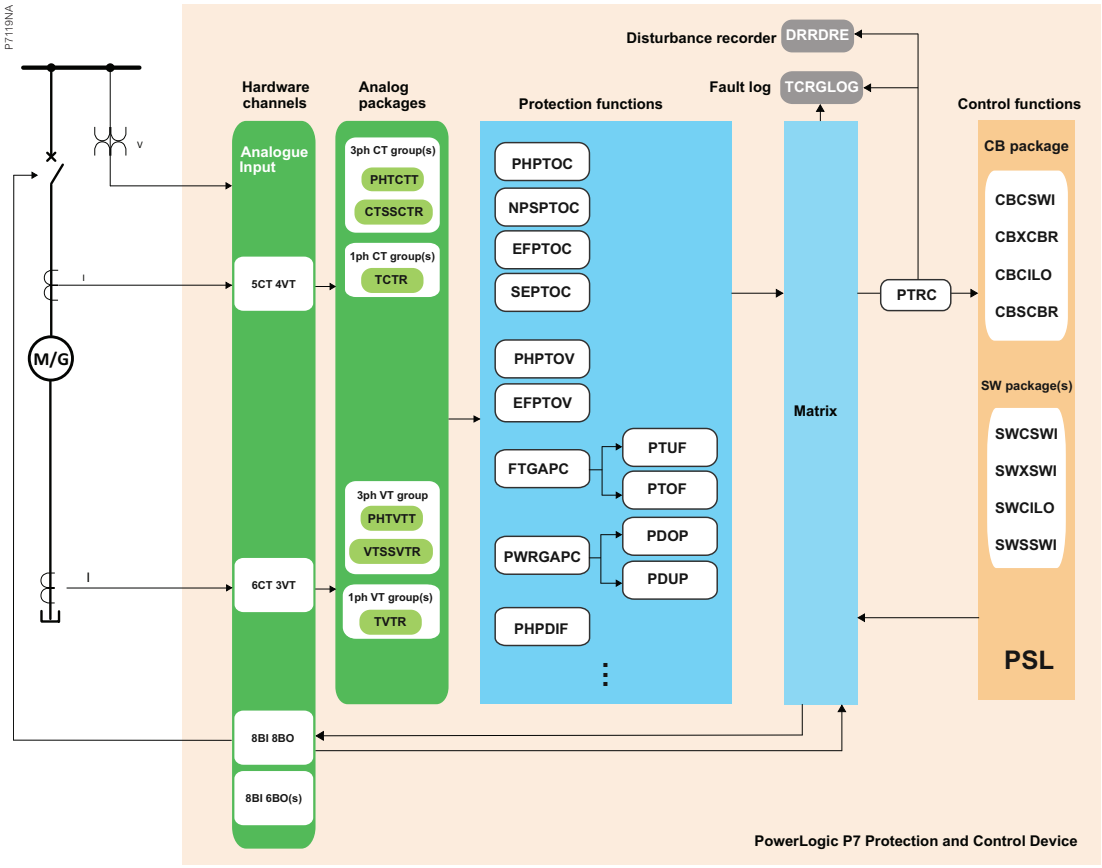
PowerLogic P7 Function Selection Table for Feeder Application and Transformer Application (cont'd)

	IEC 61850 Logical node	ANSI code	Feeder application (stages instantiated)		Transformer application (stages instantiated)		Functional routing support
			Level 0	Level 1	Level 0	Level 1	
CT group measurement							
3ph current	VECAMMXU	N/A	1	3	2	3	FALSE
3ph RMS current	RMSAMMXU	N/A	1	3	2	3	FALSE
Sequence current	AMSQI	N/A	1	3	2	3	FALSE
1ph current	VECAXM-MXU	N/A	1	3	2	3	FALSE
1ph RMS current	VECAXM-MXU	N/A	1	3	2	3	FALSE
VT group measurement							
3ph voltage	VECVMMXU	N/A	1	2	1	2	FALSE
3ph RMS voltage	RMSVMMXU	N/A	1	2	1	2	FALSE
Sequence voltage	VMSQI	N/A	1	2	1	2	FALSE
1ph voltage	VECVXM-MXU	N/A	1	2	1	2	FALSE
1ph RMS voltage	VECVXM-MXU	N/A	1	2	1	2	FALSE
Bay measurement							
Fundamental frequency active, reactive and apparent power values, power factor	BAYMMXU	N/A	1	1	1	1	FALSE
RMS active, reactive and apparent power	BAYMMXU	N/A	1	1	1	1	FALSE
Minimum and maximum demand values: RMS phase currents	DVALMMXU	N/A	1	1	1	1	FALSE
Minimum and maximum demand values: active, reactive, apparent power and power factor	DVALMMXU	N/A	1	1	1	1	FALSE
Active and reactive of energy values	EMMTR	N/A	1	1	1	1	FALSE
Bay Fourier current	BAYMMXU	N/A	1	1	1	1	FALSE
Bay RMS current	BAYMMXU	N/A	1	1	1	1	FALSE
Bay sequence current	BAYMMXU	N/A	1	1	1	1	FALSE
Bay Fourier voltage	BAYMMXU	N/A	1	1	1	1	FALSE
Bay RMS voltage	BAYMMXU	N/A	1	1	1	1	FALSE
Bay sequence voltage	BAYMMXU	N/A	1	1	1	1	FALSE
Bay harmonics current and voltage	MHAI	N/A	*	1	*	1	FALSE

Selection Guide by Application

Application Overview

Functional Diagram



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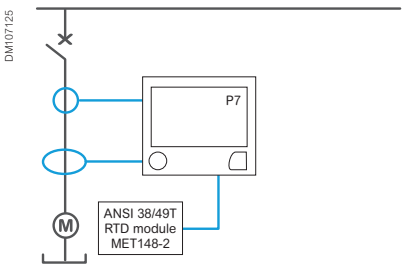
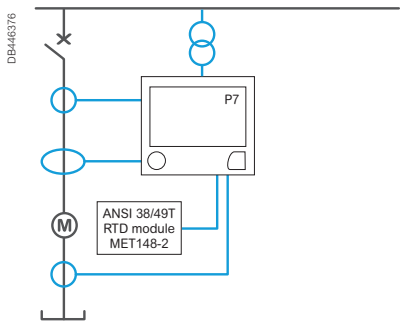
Selection Guide by Application

Motor and Motor-Differential Application

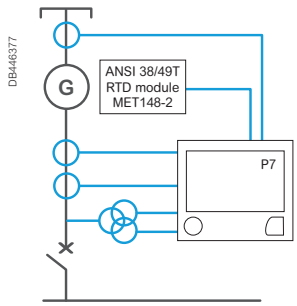
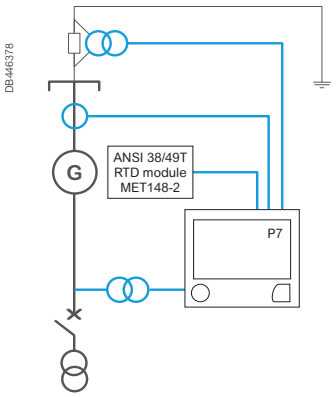
Motor and Motor-Differential Application

Motor Protection	
• Motor overcurrent and earth/ground fault overcurrent • Thermal overload • Motor start-up supervision • Motor restart inhibition • Speed protection (Sensor required)	• Motor-Differential voltage & frequency protection • Neutral displacement • Power protection • Field failure • Out of step
Motor protection without voltage monitoring  • Temperature measurement (stator, bearings)	Motor/Motor-Differential with voltage monitoring 

Selection Guide by Application

Generator and Generator-Differential Application

Generator and Generator-Differential Application

Generator protection	
• Generator Differential • Short circuit protection • Earth fault protection • Voltage & frequency protection • Thermal overload (ANSI 38/49T)	• 100% stator earth fault • Neutral displacement • Voltage & frequency protection
Generator protection with voltage & frequency monitoring	Generator protection with voltage & frequency monitoring
	

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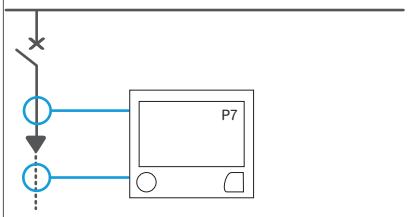
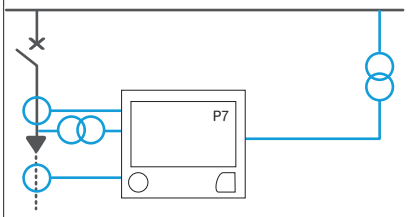
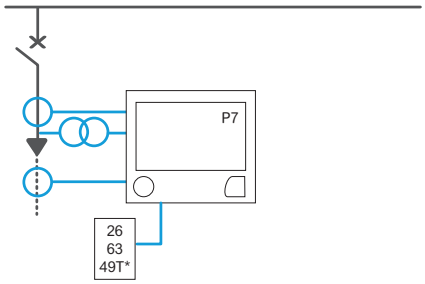
Selection Guide by Application

Feeder Application

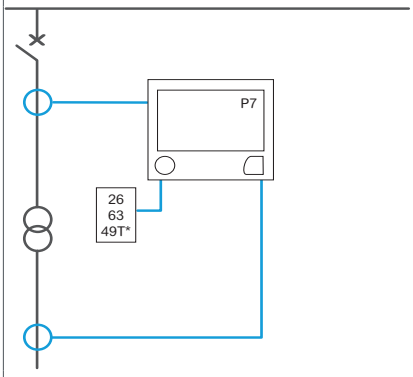
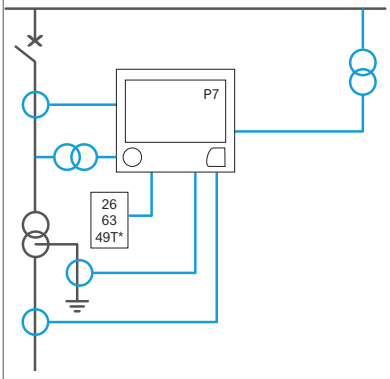
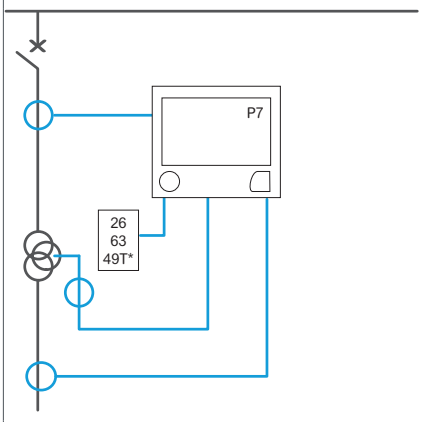
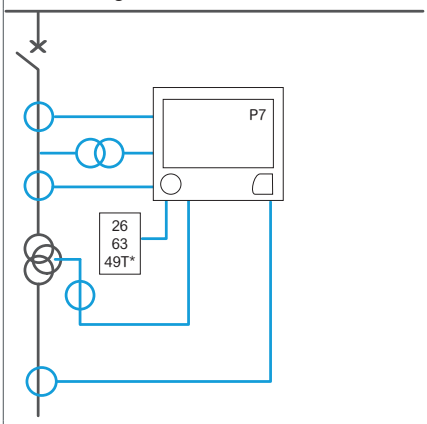
Feeder Application

Feeder Protection	
• Phase overcurrent protection • Ground fault protection • Sensitive ground fault protection • Recloser	• Directional phase overcurrent protection • Directional ground fault protection • Directional sensitive ground fault protection • Voltage/Frequency protection • Recloser • Power protection • Synchro-check • Power Quality
Outgoing/Incomer feeder protection 	Outgoing/Incomer feeder & Overhead line protection with voltage & frequency monitoring 
• Directional phase overcurrent protection • Directional ground fault protection • Directional sensitive ground fault protection • Overvoltage protection • Voltage/Frequency protection • Recloser • Power protection • Power Quality	
Outgoing/Incomer feeder & Overhead line protection with voltage & frequency monitoring  • Temperature measurement	

Selection Guide by Application

Transformer Application

Transformer Application

Transformer Protection	
• Transformer DIfferential protection (2 wdg) • Transformer Feeder protection • Ground fault protection • Thermal overload protection • External trip form e.g. Buchholz	• Transformer DIfferential protection (2 wdg) • Transformer Feeder protection • Synchro-check • Directional overcurrent protection • Directional ground fault protection • Underimpedance protection • Thermal overload protection • Restricted ground fault protection • Voltage/Frequency protection • Power protection • External trip form e.g. Buchholz • Power Quality
Transformer differential protection  • Temperature measurement	Transformer differential protection with voltage & frequency monitoring 
• Transformer DIfferential protection (3 wdg) • Transformer Feeder protection • Ground fault protection • Thermal overload protection • External trip form e.g. Buchholz	• Transformer DIfferential protection (3 wdg) • Transformer Feeder protection • Directional overcurrent protection • Directional ground fault protection • Underimpedance protection • Thermal overload protection • Voltage/Frequency protection • Power protection • External trip form e.g. Buchholz • Power Quality
Transformer differential protection (3 wdg)  • Temperature measurement	Transformer differential protection (3 wdg) with voltage & frequency monitoring 

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Phase overcurrent (PHPTOC/PHRDIR, ANSI 50/51/ANSI 67)

Phase Overcurrent

The phase overcurrent function is applied to detect phase-to-phase short-circuit currents (phase-to-ground in specific cases).

Discrimination is achieved because of the current threshold and operate delay of the different stages of the protection.

The measurement type can be subject to the phase overcurrent function: either the fundamental value or the RMS value of the phase currents, or the fundamental minus the zero sequence current.

Operation can be set to 1 of 3 or 2 of 3 mode. In 2 of 3 mode the element will only operate when 2 elements operate and will typically not operate for ground faults. The start signals are phase based, however, the timers will only start when the number of operating elements exceed the operating mode. A Drop Out output signal is provided to indicate the start has reset but the timers are being held by the reset timer.

Additional functions such as Selective Overcurrent Logic (SOL) and variable loading improve the behavior of the protection function in terms of stability or sensitivity.

Directional phase overcurrent

The directional phase overcurrent protection function is optionally linked to the phase overcurrent function, which can then be selected as forward, reverse, or non-directional. When selected as non-directional, the directional element is ignored and only the phase overcurrent function is applied. When selected as forward or reverse, the current direction is determined based on the comparison of voltage and current angles.

This function is applied to systems where phase-to-phase fault currents can flow in both directions, such as parallel feeders, ring feeders, and interlocked overcurrent busbar schemes. Depending on the application, the direction signal is used to generate either a tripping or a blocking.

Settings of PHPTOC

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
MeasType	Measure- ment mode	Fast Fourier Transform (FFT) is usually used. RMS settings need to consider the measured value may be higher with offset waveforms. FFT-I0 can be applied to transformer star winding to improve sensistivity for phase to phase faults	• FFT • RMS • FFR-I0		FFT
OpStat	Operation mode	If 1/3 is selected any phase pickup will start the function. 2/3 requires 2 phases to pickup	• 1/3 • 2/3		1/3
DirMod	Directional mode	Directional mode	• Non directional • Forward • Reverse		Non directional
TmACrv	Operating curve	Operating curve	• ANSI extremely inverse • ANSI very inverse • ANSI normal inverse • ANSI moderate inverse • Definite time • IEC normal inverse • IEC very inverse • IEC extremely inverse • IEC long inverse • IEC ultra inverse • Rectifier inverse • RI • FR short inverse • US inverse CO8 • US short inverse CO2 • ANSI short inverse • ANSI long inverse • IAC inverse • IAC very inverse • IAC extremely inverse	1 ms	0 ms

Functions and Description

Settings of PHPTOC (cont'd)

Setting name	Short label	Infotip	Setting range	Step size	Default setting
StrVal	Start value	This is the base current used for operating curves. The operating time is based on the measured current as a multiple of this value	0.005...40 pu	0.001 pu	1 pu
StrMult	Start value multiplier	Multiplied by Start value to give the Start/ Threshold/Pickup level	1...10	0.001	1
OpDlTmms	DT/IDMT adder op time	Time delay in DT mode. In IDMT modes this time is added to the curve operating time	0...10000000 ms	1 ms	0 ms
TmMult	IDMT time multiplier	IDMT time multiplier or TMS	0...20	0.001	1
MinOpTmms	IDMT min op time	For IDMT curves this is the minimum tripping time excluding IDMT adder. Usually used to coordinate with downstream fuses. A zero setting means the curve determines the minimum time	0...100000 ms	1 ms	0 ms
TypRsCrv	Reset curve	Reset curve	• Definite time • Inverse		Definite time
RsDlTmms	DT reset time	DT reset time	0...1000000 ms	1 ms	40 ms
DStrVal	Dynamic start value	Active setting when the dynamic input is active	0.005...40 pu	0.001 pu	1 pu
DStrMult	Dyn start value multiplier	Active setting when the dynamic input is active	1...10	0.001	1
DOpDlTmms	Dyn DT/ IDMT adder op time	Active setting when the dynamic input is active	0...10000000 ms	1 ms	0 ms
DTmMult	Dyn IDMT time multiplier	Active setting when the dynamic input is active	0...20	0.001	1
DMinOpTmms	Dyn IDMT min op time	Active setting when the dynamic input is active	0...100000 ms	1 ms	0 ms
DRsDlTmms	Dyn DT reset time	Active setting when the dynamic input is active	0...1000000 ms	1 ms	40 ms

Settings of PHRDIR

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
ChrAng	Characteristic angle	This is the maximum torque angle or the mid point between the directional boundaries of I and V quadrature (eg IA to VBC). It is typically set to 30 for transmission systems and 45 for distribution systems	30...45 deg	15 deg	45 deg
MinPPV	Minimum line voltage	When the measured quadrature voltage drops below this level the element will use memory voltage if available	0.01...2 pu	0.01 pu	0.7 pu
BlkValA	Minimum current	Minimum current for operation	0.01...40 pu	0.001 pu	0.01 pu

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Functions and Description

Ground fault overcurrent (EFPTOC/EFRDIR, ANSI 50N/51N/ANSI 67N)

The ground fault overcurrent protection function is used on three wire systems to detect when one of the phases has come into contact with ground. This can be due to insulation failure in insulated cables or fallen wires/external contact in uninsulated applications.

The ground fault overcurrent protection function can be provided by the summation of three-phase currents either numerically or physically.

When the CT connection type is 3ph+N or 2ph+N, the ground fault overcurrent protection function will use the measured value. When the CT connection type is 3ph, the protection will use the derived value. When the CT connection type is 2ph, the input of the protection will be invalid.

The protection can also be provided using a toroidal CT around all phases or the transformer neutral.

Directional ground fault overcurrent

The directional ground fault overcurrent protection function is optionally linked to the ground fault overcurrent function which can then be selected as forward, reverse, or non-directional.

The EFRDIR is used when ground faults can flow in multiple directions:

• Parallel feeders

• Interlocked overcurrent busbar schemes

• Ring feeder protection

These systems will have directional overcurrent, but the directional ground fault is usually also applied for greater sensitivity. It applies to solid and low resistance grounded systems where ground current flows from a system ground to the fault.

Several devices may see the fault simultaneously and graded operation is required. Primary ground fault current exceeds 100 A and will normally be measured using residual current either calculated from phase currents or using a Holmgreen connection.

Settings of EFPTOC

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
MeasType	Measurement mode	Fast Fourier Transform (FFT) is usually used. RMS settings need to consider the measured value may be higher with offset waveforms	• FFT • RMS		FFT
DirMod	Directional mode	Directional mode	• Non directional • Forward • Reverse		Non directional
TmACrv	Operating curve	Operating curve	• ANSI extremely inverse • ANSI very inverse • ANSI normal inverse • ANSI moderate inverse • Definite time • IEC normal inverse • IEC very inverse • IEC extremely inverse • IEC long inverse • IEC ultra inverse • Rectifier inverse • RI • FR short inverse • BPN • US inverse CO8 • US short inverse CO2 • ANSI short inverse • ANSI long inverse • IAC inverse • IAC very inverse • IAC extremely inverse • RXIDG		Non directional

Functions and Description

Settings of EFPTOC (cont'd)

Name	Short label	Infotip	Setting range	Step size	Default setting
StrVal	Start value	This is the base current used for operating curves. The operating time is based on the measured current as a multiple of this value	0.005...40 pu	0.001 pu	1 pu
StrMult	Start value multiplier	Multiplied by Start value to give the Start/Threshold/ Pickup level	1...10	0.001	1
OpDlTmms	DT/IDMT adder op time	Time delay in DT mode. In IDMT modes this time is added to the curve operating time	0...10000000 ms	1 ms	0 ms
TmMult	IDMT time multiplier	IDMT time multiplier	0...20	0.001	1
MinOpTmms	IDMT min op time	For IDMT curves this is the minimum tripping time excluding IDMT adder. Usually used to coordinate with downstream fuses. A zero setting means the curve determines the minimum time	0...100000 ms	1 ms	0 ms
TypRsCrv	Reset curve	Reset curve	• Definite time • Inverse		Definite time
RsDlTmms	DT reset time	DT reset time	0...10000000 ms	1 ms	40 ms
DStrVal	Dynamic start value	Active setting when the dynamic input is active	0.005...40 pu	0.001 pu	1 pu
DStrMul	Dyn start value multiplier	Active setting when the dynamic input is active	1...10	0.001	1
DOpDlTmms	Dyn DT/IDMT adder op time	Active setting when the dynamic input is active	0...10000000 ms	1 ms	0 ms
DTmMult	Dyn IDMT time multiplier	Active setting when the dynamic input is active	0...20	0.001	1
DMi nOpTmms	Dyn IDMT min op time	Active setting when the dynamic input is active	0...100000 ms	1 ms	0 ms
DRsDlTmms	Dyn DT reset time	Active setting when the dynamic input is active	0...1000000 ms	1 ms	40 ms

Settings of EFRDIR

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
ChrAng	Characteristic angle	This is the maximum torque angle or the mid point between the directional boundaries of IN and -VN. It is typically set to -30 for transmission systems and -45 for distribution systems	-60...0 deg	15 deg	-45 deg
PolQty	Polarization mode	This is typically set to Zero sequence when available from the VT (3 single phase VTs or 5 limb). 3 limb VTs typically have only phase connections and require Negative sequence polarization	• Zero sequence • Negative sequence		Zero sequence
BlkValV	Minimum voltage	Minimum voltage for operation	0.01...2 pu	0.01 pu	0.05 pu
BlkValA	Minimum current	Minimum current for operation	0.01...40 pu	0.001 pu	0.01 pu

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Sensitive Ground Fault Overcurrent (VSEFPTOC, ANSI 50SG/51SG)

The sensitive ground fault overcurrent protection function is applied to the system in which a single phase ground fault is not detected by means of standard current operated ground fault protection. A fully discriminative ground fault protection is achieved by the sensitive ground fault overcurrent protection function that is used to detect the resultant imbalance in the system charging currents that occurs under ground fault conditions, usually achieved by direct measurement of ground current through a toroid on the ground connection or around all the phase connections.

The current measurement can come from a summated input (physical or numerical), standard 1A/5A CT input, or the 1A core balance CT (when fitted).

When summated inputs are used, CT errors may cause operation for settings below 1%.

When the CT connection type is 3ph+N or 2ph+N, the ground fault protection will use the measured value. When the CT connection type is 3ph, the protection will use the derived value. When the CT connection type is 2ph, the input of the protection will be invalid.

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
TmACrv	Operating curve	Operating curve	• ANSI extremely inverse • ANSI very inverse • ANSI normal inverse • ANSI moderate inverse • Definite time • IEC normal inverse • IEC very inverse • IEC extremely inverse • IEC long inverse • IEC ultra inverse • Rectifier inverse • RI • FR short inverse • BPN • US inverse CO8 • US short inverse CO2 • EPATR-B • ANSI short inverse • ANSI long inverse • IAC inverse • IAC very inverse • IAC extremely inverse • RXIDG • EPATR-C		
StrVal	Start value	This is the base current used for operating curves. The operating time is based on the measured current as a multiple of this value	0.001...1 pu	0.001 pu	1 pu
StrMult	Start value multiplier	Multiplied by Start value to give the Start/Threshold/ Pickup level	1...10	0.001	1
OpDlTmms	DT/IDMT adder op time	Time delay in DT mode. In IDMT modes this time is added to the curve operating time	0...10000000 ms	1 ms	0 ms
TmMult	IDMT time multiplier	IDMT time multiplier	0...20	0.001	1
MinOpTmms	IDMT min op time	For IDMT curves this is the minimum tripping time excluding IDMT adder. Usually used to coordinate with downstream fuses. A zero setting means the curve determines the minimum time	0...100000 ms	1 ms	0 ms
TypRsCrv	Reset curve	Reset curve	• Definite time • Inverse		Definite time
RsDlTmms	DT reset time	DT reset time	0...10000000 ms	1 ms	40 ms

PrimIRt: Inherited from configuration of CT primary.

NOTE: This inherited CT configuration is used in the IDMT curve of EPATR C which are based on primary currents.

Negative Sequence Overcurrent (NPSPTOC, ANSI 46)

The negative sequence overcurrent protection gives greater sensitivity to detect phase-to-phase faults at the end of long lines, where phase overcurrent elements may not operate.

For rotating machines, the negative sequence overcurrent function provides the protection against a temperature rise caused by an unbalance power supply, phase inversion, loss of phase, and unbalanced phase current.

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
TmACrv	Operating curve	Operating curve	• ANSI extremely inverse • ANSI very inverse • ANSI normal inverse • ANSI moderate inverse • Definite time • IEC normal inverse • IEC very inverse • IEC extremely inverse • IEC long inverse • IEC ultra inverse • Rectifier inverse • RI • FR short inverse • US inverse CO8 • US short inverse CO2 • ANSI short inverse • ANSI long inverse • IAC inverse • IAC very inverse • IAC extremely inverse		
StrVal	Start value	This is the base current used for operating curves. The operating time is based on the measured current as a multiple of this value	0.005...40 pu	0.001 pu	1 pu
StrMult	Start value multiplier	Multiplied by Start value to give the Start/Threshold/ Pickup level	1...10	0.001	1
OpDlTmms	DT/IDMT adder op time	Time delay in DT mode. In IDMT modes this time is added to the curve operating time	0...10000000 ms	1 ms	0 ms
TmMult	IDMT time multiplier	IDMT time multiplier	0...20	0.001	1
MinOpTmms	IDMT min op time	For IDMT curves this is the minimum tripping time excluding IDMT adder. Usually used to coordinate with downstream fuses. A zero setting means the curve determines the minimum time	0...100000 ms	1 ms	0 ms
TypRsCrv	Reset curve	Reset curve	• Definite time • Inverse		Definite time
RsDlTmms	DT reset time	DT reset time	0...10000000 ms	1 ms	40 ms
DStrVal	Dynamic start value	Active setting when the dynamic input is active	0.005...40 pu	0.001 pu	1 pu
DStrMul	Dyn start value multiplier	Active setting when the dynamic input is active	1...10	0.001	1
DOpDlTmms	Dyn DT/IDMT adder op time	Active setting when the dynamic input is active	0...10000000 ms	1 ms	0 ms
DTmMult	Dyn IDMT time multiplier	Active setting when the dynamic input is active	0...20	0.001	1
DMinOpTmms	Dyn IDMT min op time	Active setting when the dynamic input is active	0...100000 ms	1 ms	0 ms
DRsDlTmms	Dyn DT reset time	Active setting when the dynamic input is active	0...10000000 ms	1 ms	40 ms

Inrush Detection (IDPHAR, ANSI 68ID)

The Inrush detection (ID) function detects high inrush current flows that occur when transformers or machines are connected (transformer differential use its own inrush detection). The inrush current detection is determined by 2nd harmonic/fundamental current ratio. Inrush which is non directional could be used to block the following functions:

- 50/51: Phase overcurrent
- 50N/51N: Standard ground fault
- 50SG/51SG: Sensitive ground fault
- 46: Negative sequence overcurrent
- 32P/32Q: Directional overpower

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
H2Ratio	H2/H1 start value	Percentage ratio of second harmonic to fundamental	5...70 %	1 %	20 %
CurBlkVal	Current block value	Fundamental current above this level will block the element	1...40 pu	0.001 pu	15 pu
MinOpTmms	Operate time	Operate time	0...10,000,000 ms	1 ms	0 ms
CrossBlk	Cross block	All phases are operated for operation on any phase	• Off • On		Off

Selective Overcurrent Logic (SOL) (SOLGAPC)

The SOL function provides the ability to temporarily increase the time delay setting of the following protections which the SOL output is linked to through matrix.

- 50/51: PHPTOC
- 50N/51N: EFPTOC
- 46: NPSPTOC

This function is just corresponding to the SOL order sender, and the SOL order receiver is in related overcurrent function. The creation of SOL order is dependent on the following signal inputs and settings:

- Start signals from PHPTOC, EFPTOC or NPSPTOC.
- Input signal from RBRF

When a fault is cleared by the downstream CB, the start signal of the protection is disengaging, and the SOL order is also disengaging. If the disengaging time between both devices (downstream and upstream) is not same (because the execution cycle is not synchronized between devices, or the ratio fault current/threshold is not same, which has an impact on the disengaging time, etc.), the SOL order is disengaged before disengaging of the start signal of the upstream device. In this situation, there could be a false trip of the upstream device, because the SOL order disappears before disengaging of the start signal and the shorter timer could be elapsed. An OFF-delay timing (e.g. 1 cycle-20 ms) is added after the OR of all start signals.

When the downstream CB fails to clear the fault, the SOL signal is reset by the downstream device unblocking the upstream device. Therefore, a CBF signal from RBRF Function is used to reset the SOL signal.

Phase Undercurrent (PHPTUC, ANSI 37)

The phase undercurrent protection is used to detect under current conditions. This protection detects the loss of load in motor applications but can also be applied to other applications.

To differentiate between normal operation of the Circuit Breaker (CB) and undercurrent conditions, the element is blocked when the maximum of the phase currents drops below 0.015 pu to avoid the unwanted tripping.

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Element starts for currents below this value and above 0.015pu	0.02...40 pu	0.001	20 %
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
RsDlTmms	Reset time	Reset time	0...10000000 ms	1 ms	0 ms

Voltage Dependent Overcurrent (PHPVOC, ANSI 50V/51V)

Voltage Dependent Overcurrent (VDO) calculates different settings during every protection execution in accordance with the measured voltage and the characteristic of VDO. It can be set to provide voltage restrained or voltage-controlled overcurrent.

Settings of PHPVOC

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
MeasType	Measure- ment mode	Fast Fourier Transform (FFT) is usually used. RMS settings need to consider the measured value may be higher with offset waveforms. FFT-I0 can be applied to transformer star winding to improve sensistivity for phase to phase faults	• FFT • RMS • FFR-I0		FFT
TmACrv	Operating curve	Operating curve	• ANSI extremely inverse • ANSI very inverse • ANSI normal inverse • ANSI moderate inverse • Definite time • IEC normal inverse • IEC very inverse • IEC extremely inverse • IEC long inverse • IEC ultra inverse • Rectifier inverse • RI • FR short inverse • US inverse CO8 • US short inverse CO2 • ANSI short inverse • ANSI long inverse • IAC inverse • IAC very inverse • IAC extremely inverse	1 ms	0 ms

Settings of PHPVOC (cont'd)

Setting name	Short label	Infotip	Setting range	Step size	Default setting
StrVal	Start value	This is the base current used for operating curves. The operating time is based on the measured current as a multiple of this value	0.005...40 pu	0.001 pu	1 pu
OpDlTmms	DT/IDMT adder op time	Time delay in DT mode. In IDMT modes this time is added to the curve operating time	0...10000000 ms	1 ms	0 ms
TmMult	IDMT time multiplier	IDMT time multiplier or TMS	0...20	0.001	1
MinOpTmms	IDMT min op time	For IDMT curves this is the minimum tripping time excluding IDMT adder. Usually used to coordinate with downstream fuses. A zero setting means the curve determines the minimum time	0...100000 ms	1 ms	0 ms
TypRsCrv	Reset curve	Reset curve	• Definite time • Inverse		Definite time
RsDlTmms	DT reset time	DT reset time	0...1000000 ms	1 ms	40 ms
VDOStrVal1	Max dependent voltage	For voltages below this value the start current is proportionally reduced. If set the same as the minimum voltage then the element is voltage controlled	0.05. 1.1 pu	0.01 pu	0.8 pu
VDOStrVal2	Min dependent voltage	The start value is multiplied by the voltage dependent multiplier when the voltage is below this value	0.05. 1.1 pu	0.01 pu	0.6 pu
VDOMult	Voltage dependent multiplier	The start value is multiplied by this value in proportion to max-min dependent voltage	0.1...1	0.005	0.25
DRsDlTmms	Dyn DT reset time	Active setting when the dynamic input is active	0...1000000 ms	1 ms	40 ms

Sensitive directional earthfault (PSDE, ANSI 32N)

The sensitive directional earthfault protection function (ANSI 32N) is applied for ground fault detection on Petersen coil, isolated and high impedance grounded system. On these systems, the primary ground fault current is low. The grounded fault is detected by standard current measurement, but non-faulted circuits may have more current than faulted circuits. The PSDE is used to distinguish between faulted and non-faulted circuits when there is a grounded fault occurs in system.

This function provides three

operating modes,

• IN mode

• INcosø mode

• PN mode

This element can be set to either:

• forward fault zone

• reverse fault zone

The forward zone issues the signal or the trip command during a fault on the downstream side of the protection. The reverse zone issues a signal during a fault on the upstream side of the protection.

Settings of PSDE

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
OpMod	Operation mode	Selects operation based on IN, IN cos (phi) or PN (wattmetric)	• IN • PN		IN
GndStr	IN start value	This must be exceeded in all modes for the element to start	0.001...1 pu	0.001 pu	1 pu
BlkValV	VN start value	This must be exceeded in all modes for the element to start	0.01...2 pu	0.01 pu	0.1 pu
BlkValP	PN start value	Wattmetric (PN) start value	0...2 pu	0.001 pu	0 pu
VNSupDlT- mms	VN supervision time	VN must be present for this period before starting can be confirmed	0...10000000 ms	1 ms	60 ms
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	1000 ms
RsDlTmms	Reset time	Reset time	0...10000000 ms	1 ms	40 ms
DirMod	Directional mode	Forward compares IN to -VN. Reverse compares IN to VN.	• Forward • Reverse		Forward
Ang	Characteristic angle	This is the maximum torque angle or the mid point between the directional boundaries of IN to VN	-179...180 deg	1 deg	0 deg
Sector	Sector angle	This is the angle from the Characteristic angle to the boundary in both directions. Will only affect PN if it crosses its characteristic	1...135 deg	1 deg	90 deg

Ground Admittance (EFPADM, ANSI 21N)

The ground admittance protection function is applied for ground-fault detection on high-resistance grounded, ungrounded or compensated power systems.

This function uses neutral current and voltage to calculate the admittance (YN).

Angle correction can be achieved via settings of 1ph CT group if needed.

YN = GN + jBN = IN/-VN = 3I0/-3V0 Conductance (Gn) is the real part of YN while susceptance (Bn) is the imaginary part of YN.

This function supports over-admittance, over-conductance, over-susceptance or any combination of the three elements. When any of the selected elements meets its operation criteria for the configured operate time, the function trips.

Settings of EFPADM

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
OpMod	Operation mode	Select between ground admittance (YN), conductance (GN), susceptance (BN) or a combination of the three	• YN • BN • GN • YN+BN • YN+GN • BN+GN • YN+BN+GN		YN
DirMod	Directional mode	Directional mode of BN/GN	• Non directional • Forward • Reverse		Non directional

Settings of EFPADM (cont'd)

Setting name	Short label	Infotip	Setting range	Step size	Default setting
YNStrVal	YN start value	YN start value	0.01. 2.5 pu	0.01 pu	0.5 pu
BNStrVal	BN start value	BN start value	0.01. 1.25 pu	0.01 pu	0.05 pu
GNStrVal	GN start value	GN start value	0.01. 1.25 pu	0.01 pu	0.05 pu
StrDlTm- ms	VN supervision time	VN must be present for this period before starting can be confirmed	0...10000000 ms	1 ms	60 ms
OpDlTm- ms	Operate time	Operate time	0...10000000 ms	1 ms	1000 ms
RsDlTm- ms	Reset time	Reset time	0...10000000 ms	1 ms	0 ms
BlkValA	Minimum current	Minimum current for operation	0.001...1 pu	0.001 pu	0.1 pu
BlkValV	Minimum voltage	Minimum voltage for operation	0.01...2 pu	0.01 pu	0.1 pu
BlkValA	Minimum current	Minimum current for operation	0.001...1 pu	0.001 pu	0.1 pu
BlkValV	Minimum voltage	Minimum voltage for operation	0.01...2 pu	0.01 pu	0.1 pu

Undervoltage (PHPTUV, ANSI 27)

The undervoltage protection function is used to detect undervoltage conditions to help protect plant under conditions such as:

- Increased system loading which normally is handled by voltage regulating equipment.
- Faults which cause a reduction in the phase voltages associated with the fault.
- Loss of busbar voltage that requires isolation of output circuits.
- Excessive voltage dips that cause motor loads to stall.

The function can measure phase-to-phase or phase-to-neutral voltages and operation can be based on one, two or three elements dropping below the start setting, and a start signal is issued. If the fault situation remains on longer than the operate time setting, a trip signal is issued. The input voltage may be configured as phase-to-phase or phase-to-ground for 1, 2 or 3 VT phases.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
MuMod	Measurement mode	Measurement mode	• Phase-phase • Phase- neutral		Phase-phase
OpMod	Operation mode	Selects the number of phases required to start the element	• One phase • Two phase • Three phase		Three phase
TmVCrv	Operating curve	Operating curve	• Inverse • Definite time		
StrVal	Start value	Start value	0.02. 1.2 pu	0.01 pu	0.8 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	10 ms	100 ms
Tms	IDMT time multiplier	IDMT time multiplier	0...20	0.001	1
RsDlTmms	Reset time	Reset time	0...100000 ms	10 ms	100 ms

Remanent Undervoltage Application

This is used in auto transfer schemes to ensure large motors have been disconnected or run down before transferring to the alternate supply. This helps avoid system shock and possible damage to the motor shaft and windings.

In this application the undervoltage element is measuring the busbar voltage.

When the incomer or an upstream breaker opens, the motor will start to run down and back feed other loads if present. Normally the motor breaker will trip on undervoltage, but until this occurs the motor will output a voltage at a frequency proportional to the speed.

The undervoltage element can be used for this application and will function down to 10 Hz. The element will operate when the voltage is below the setting or 10 Hz and indicates to the auto transfer scheme there is no remanent voltage on the bus. It is

normally set to 20% nominal volts with a short delay of 100 ms.

Overvoltage (PHPTOV, ANSI 59)

The overvoltage protection function is used to detect system voltages that are too high.

The function measures either phase-phase or phase-neutral voltage and operation can be on one, two or three elements exceeding the start value.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
MuMod	Measurement mode	Measurement mode	• Phase-phase • Phase- neutral		Phase-phase
OpMod	Operation mode	Selects the number of phases required to start the element	• One phase • Two phase • Three phase		Three phase
TmVCrv	Operating curve	Operating curve	• Inverse • Definite time		
StrVal	Start value	Start value	0.02. 1.5 pu	0.01 pu	1.2 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	10 ms	100 ms
Tms	IDMT time multiplier	IDMT time multiplier	0...20	0.001	1
RsDlTmms	Reset time	Reset time	0...100000 ms	10 ms	100 ms

Positive Phase Sequence Undervoltage (PPSPTUV, ANSI 27D)

Positive phase sequence undervoltage protection function helps protect motors against faulty operation due to insufficient or unbalanced network voltage.

This undervoltage protection function calculates the positive sequence of the fundamental frequency component V1.

By using the positive sequence, all three phases are supervised, with one value, and if the motor loses the connection to the network (loss of mains), the undervoltage situation is detected even if the frequency decreases significantly from nominal frequency.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Start value	0.01...2 pu	0.01 pu	0.7 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
RsDlTmms	Reset time	Reset time	0...10000000 ms	1 ms	0 ms

Functions and Description

Positive phase sequence overvoltage (PPSPTOV, ANSI 59)

The positive sequence overvoltage protection function is applied to help protect plant from faulty operation caused by network overvoltage.

This function uses the positive sequence voltage as its main input to supervise all three phases. Once the positive sequence voltage exceeds the start value, a start signal is issued. If the fault condition remains longer than the operate time setting, a trip signal is issued.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Start value	0.01...2 pu	0.01 pu	1.1 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
RsDlTmms	Reset time	Reset time	0...10000000 ms	1 ms	0 ms

Neutral Overvoltage (EFPTOV, ANSI 59N)

The neutral overvoltage protection function is used as non-selective backup for ground faults and for selective ground fault protection for motors having a unit transformer between the motor and the busbar.

This function is sensitive to the fundamental frequency component of the neutral displacement voltage.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Start value	0.005...2 pu	0.001 pu	0.2 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	100 ms
RsDlTmms	Reset time	Reset time	0...10000000 ms	1 ms	100 ms

Generator inter-turn overvoltage application

Inter-turn faults in a generator with a single winding can be detected by observing the zero sequence voltage across the machine. Normally, no zero sequence voltage should exist but a short circuit of one or more turns on one phase will cause the generated Electro Motive Force (EMF) to contain some zero sequence component.

This method of inter-turn protection requires a dedicated insulated VT with its neutral connected to the generator star point. The VT will normally provide a broken delta secondary which can be monitored by an EFPTOV element.

Negative Phase Sequence Overvoltage (NPSPTOV, ANSI 47)

The negative phase sequence overvoltage protection monitors the voltage phase sequence detecting a reverse rotation or voltage unbalance due to a missing (asymmetrical) phase. The detection of these conditions is used to trip the machine and prevent damage to both the motor and the mechanically coupled process. If the negative sequence voltage input exceeds the voltage setting, this function starts instantaneously, and it operates with the definite time delay.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Start value	0.01...2 pu	0.01 pu	0.2 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
RsDlTmms	Reset time	Reset time	0...10000000 ms	1 ms	0 ms

Inter-turn overvoltage (ITPTOV, ANSI 59IT)

The inter-turn overvoltage protection function is applied to help detect inter-turn faults. For higher sensitivity, this function is normally applied to generators whose stator winding has limited branches and turns, such as large steam generators.
This function does not require a dedicated inter-turn VT, but instead uses the interturn voltage calculated from the star point voltage (Vsp) and the summated threephase voltage (VN). When the calculated inter-turn voltage exceeds the start value for the configured operate delay, a trip signal is sent.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Start value	0.005...5 pu	0.001 pu	0.01 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	100 ms

Overfluxing (PVPH, ANSI 24)

The overfluxing protection function is applied to help protect transformers and generators from excessive magnetic flux, which induces excessive magnetizing current and, in turn, results in overheating and possible insulation failure.

Excessive magnetic flux can be caused by voltage increase, frequency decrease, or both. The higher the V/Hz ratio, the greater the magnetic flux and the risk of damage.

This function uses the V/Hz ratio to monitor the magnetic flux in the iron core of the plant. When calculating the V/Hz ratio, the voltage value is taken from the maximum of the phase-to-phase voltages for delta windings, the maximum of the phase-to-ground voltages for solidly earthed star windings, or the maximum phase to phase voltage minus zero sequence voltage for resistance earthed windings.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
MuMod	Measurement mode	Measurement mode	• Phase-phase • Phase- neutral • Phase-neutral - V0		Phase-phase
AlmVal	VperHz alarm value	VperHz alarm value	1...2 pu	0.01 pu	1.05 pu
AlmDlTmms	Alarm time delay	Alarm time delay	0...10000000 ms	1 ms	10000 ms
StrVal	Start value	Start value	1...2 pu	0.01 pu	1.1 pu
VHzCrv	Operating curve	Type A is an inverse curve. Type B is very inverse and Type C is extremely inverse	• Definite time • Type A • Type B • Type C		
OpDlTmms	DT/IDMT adder op time	Time delay in DT mode. In IDMT modes this time is added to the curve operating time	0...10000000 ms	1 ms	0 ms
TmMult	IDMT time multiplier	IDMT time multiplier	0.01...12	0.01	1
MinOpTmms	Min op time	For IDMT curves this is the minimum tripping time excluding IDMT adder. A zero setting means the curve determines the minimum time	0...100000 ms	1 ms	0 ms
MaxOpTmms	Max op time	Maximim operating time when V/Hz exceeds the start value excluding the IDMT adder	10000...10000000 ms	1 ms	100000 ms
RsDlTmms	Reset time	Reset time	0...10000000 ms	1 ms	100 ms
RsvVal	Time to operate alarm	The time to operate is calculated based on the current measurement. If the time is less than this value the alarm is raised	1...1000 s	1 s	60 s

Overfrequency (PTOF, ANSI 81O)

The overfrequency protection detects the abnormally high frequency compared to the rated frequency to monitor power supply quality or help to protect a generator against overspeed.

The overfrequency protection is generally applied where the generation capacity is greater than the connected load to prevent the system frequency from increasing above a specified threshold and subjecting the generator to an overspeed condition.

This protection is used in load restoration schemes to detect that the power system frequency is recovered sufficiently to allow load which is previously shed to be reconnected.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Start value	40...65 Hz	0.01 Hz	51 Hz
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
LVVal	UV inhibit value	The element is blocked for voltage below this level	0.1...1 pu	0.01 pu	0.7 pu

Underfrequency (PTUF, ANSI 81U)

The underfrequency protection detects the abnormally low frequency compared to the rated frequency to monitor power supply quality. The protection is used for overall tripping or load shedding.

The underfrequency protection is generally applied where the generation capacity is less than the connected load to prevent the system frequency from decreasing below a specified threshold.

This protection is used in load shedding schemes, often in conjunction with rate of change of frequency protection, to cover slow or fast reductions in frequency caused by the prevailing system conditions, including consideration of rotating loads. The frequency measurement is fixed to the bay VT input.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Start value	40...65 Hz	0.01 Hz	49 Hz
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
LVVal	UV inhibit value	The element is blocked for voltage below this level	0.1...1 pu	0.01 pu	0.7 pu
DfdtVal	ROCOF inhibit value	Rate of change of frequency above this level will inhibit element operation. Used to avoid operation during motor backfeeds to isolated buses.	0.1...20 Hz/s	0.1 Hz/s	5 Hz/s

Rate of change of frequency (PFRC, ANSI 81R)

The Rate of change of frequency (ROCOF) protection function is applied to detect the immediate condition of power imbalance, and can help shed the load in a more timely manner to reduce the possibility of a widespread network collapse.

- If the operation mode is set as falling, the function is frequency-supervised RoCoF for underfrequency.
- If the operation mode is set as rising, the function is frequency-supervised RoCoF for overfrequency.

Settings of PRFC

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
ClcIntvPer	Measuring window	Measurement period used for ROCOF. Set above low frequency oscillation periods.	50...1000 ms	5 ms	50 ms
StrVal	Start value	This is the ROCOF start value. If the operation mode is both the element will start if this value is exceeded. If the operation mode is rising or falling it will start if this value is exceeded and the frequency value above the frequency release value for rising or below the frequency release value for falling	0.1...10 Hz/s	0.1 Hz/s	1 Hz/s
OpMod	Operation mode	Operation mode	• Rising • Falling • Both		Falling
BlkHzVal	Frequency release value	When operation mode is rising the frequency must also be above this value for operation.	• Rising • Falling • Both	0.01 pu	1.1 pu
When operation mode is falling the frequency must also be below this value.	40...65 Hz	0.01 Hz	• 50 Hz		
OpDlTmms	Operate time	Operate time	0...100000 ms	1 ms	500 ms
RsDlTmms	Reset time	Reset time	0...100000 ms	1 ms	0 ms
SetBlkRo- CoF	High ROCOF blocking	The element is blocked for Rate Of Change Of Frequency (ROCOF) above this level	• Off • On		On
BlkRoCoFV- al	ROCOF inhibit value	Rate of change of frequency above this level will inhibit element operation. Used to avoid operation during motor backfeeds to isolated buses.	0.1...20 Hz/s	0.1 Hz/s	5 Hz/s

High Impedance Differential (HIZPDIF, ANSI 87/64REF)

For high impedance differential protection, CTs are placed at the ends of the differential zone and paralleled. A resistor is placed in series with the PowerLogic P7 CT input to stabilize the protection for CT saturation during through fault conditions.

For high impedance applications, the measurement mode should be set to Peak to peak. For core balance applications, measurement mode should be set to FFT.

High impedance differential protection requires all CTs to be the same ratio. The high impedance principle is best explained by considering a differential scheme where one CT is saturated for an external fault.
Please see the PowerLogic P7 User manual for additional information.

Settings of HIZPDIF

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
Meas- Type	Measure- ment mode	Peak to peak is normally used in high impedance applications. The element can be used without external resistor as an instantaneous overcurrent where Fast Fourier Transform (FFT) or Peak to peak can be used	• FFT • Peak to peak		Peak to peak
OpMod	Operation mode	Select between phase high impedance and ground high impedance (REF)	• Phase • Ground		Phase
StrVal	Start value	Operate value. Usually set above load if possible	0.01...2 pu	0.01 pu	1 pu
SupMod	CT supervision mode	CT supervision will block operation when a CT fault is detected. Can only be used if the element is set above load	• Off • On		Off
SupSet	CT supervision start value	If this current is seen in any phase for more than the operate time then CT supervision will operate	0.005...2 pu	0.001 pu	0.1 pu
SupDlTmms	CT supervision operate time	Set above the maximum fault time	100...10000 ms	100 ms	3000 ms

Biased Differential Protection (PHPDIF, ANSI 87)

The biased differential protection calculates the difference between the currents entering and leaving a protected zone. The protection operates when this difference exceeds the threshold.

Differential currents may also be generated due to CT saturation. To provide stability during saturation, the PowerLogic P7 adopts a biasing technique. This method effectively raises the setting of the device in proportion to the value of saturation to prevent relay maloperation.

A three-slope biased differential protection operating characteristic is applied. The lower slope K1 provides stability for small CT mismatches, whilst ensuring good sensitivity to resistive faults under heavy load conditions. The higher slope K2 is used to improve device stability under heavy through fault conditions where CT saturation may occur. Split phase mode is provided for multi-turn generators typically used on hydro providing differential and interturn protection.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
LoSet	Start value	Pickup or low set value	0.01...3 pu	0.01 pu	0.2 pu
DiffSlp1	Slope 1	Lower slope for mismatch	0...2	0.01	0.3
Slp2Set	Slope 2 start value	Upper slope value normally set above load	1...10 pu	0.01 pu	1.5 pu
DiffSlp2	Slope 2	Upper slope for CT saturation	0.1...2	0.01	1.5
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
HiSet	High set op value	Instantaneous high set operate value. Normally set above maximum through fault level	0...100 pu	0.01 pu	0 pu
SPhMod	Split phase mode	Used on double wound generators to provide differential and interturn	• Off • On		Off
SatTC	Saturation time constant	Set above the system time constant. Can normally be left at maximum	0...500	1	500

Functions and Description

Restricted ground fault (RGFPDIF, ANSI 64REF)

The restricted ground fault protection function is used for resistance grounded transformers where the backup ground fault time is usually too long to prevent excessive transformer damage and inadequate coverage provided by differential.

The RGFPDIF can also be applied to the following:

- Autotransformers to provide a differential unaffected by transformer ratio.
- Grounded star windings to provide a more sensitive ground fault detection than that available from differential.

NOTE: The element applies low impedance restricted ground fault, high impedance restricted ground fault is also available in the high impedance (HIZPDIF) element.

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
OpMod	Operation mode	Selects the type of winding to be protected	• Star • Auto • 4 wire		Star
LoSet	Start value	Start value	0.001...3 pu	0.001 pu	0.2 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
NeutChkVa- IA	IN check value	The neutral current must exceed this value for operation. Phase comparison applied when the line current also exceeds this value	0...3 pu	0.001 pu	0.2 pu

Transformer differential (TR2PDIF and TR3PDIF, ANSI 87T)

The transformer differential function is used for all transformers above 1 MVA to help protect the transformer against internal faults. Most transformers have 2 windings, but 3 windings are often used for for applications such as rectifiers above 20 MVA.

Settings of TR2PDIF

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
MF1	Winding 1 matching factor	The matching factor is typically set to the nominal current for the winding	0.2...20	0.01	1
Zero- Seq1	Winding 1 I0 filter	Zero sequence filtering is applied when the winding can provide ground fault current	• Off • On		On
Wndg2	Winding 2 phase shift	The vector group relative to winding 1	0...11	1	0
MF2	Winding 2 matching factor	The matching factor is typically set to the nominal current for the winding	0.2...20	0.01	1
Zero- Seq2	Winding 2 I0 filter	Zero sequence filtering is applied when the winding can provide ground fault current	• Off • On		'On
LoSet	Start value	Pickup or low set value	0.01...3 pu	0.01 pu	0.2 pu
DiffSlp1	Slope 1	Lower slope for mismatch	0.01...2	0.01	0.3
Slp2Set	Slope 2 start value	Upper slope value normally set above load	1...10 pu	0.01 pu	1.5 pu
DiffSlp2	Slope 2	Upper slope for CT saturation	0.1...2	0.01	0.7
OpDIT- mms	Operate time	Operate time of the low set bias differential	0...10000000 ms	1 ms	0 ms

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Functions and Description

Settings of TR2PDIF

Setting name	Short label	Infotip	Setting range	Step size	Default setting
HiSet	High set op value	The element operates instantaneously for currents above this level	0...100 pu	0.01 pu	0 pu
H2Blk	H2 blocking	Enables second harmonic blocking for inrush	• Off • On • Cross		Cross
H2Ratio	H2/H1 ratio block value	H2/H1 ratio block value	5...70 %	1 %	20 %
H5Blk	H5 blocking	Enables fifth harmonic blocking for overfluxing	• Off • On • Cross		On
H5Ratio	H5/H1 ratio block value	H5/H1 ratio block value	5...70 %	1 %	35 %
H5Alm- Tmms	H5 alarm time	When fifth harmonic blocking exceeds this period an alarm is raised	• 0...10000000 ms	1 ms	10000 ms
Harm- Rel	Harmonic block limit	The second and fifth harmonic blocks are removed when the bias exceeds this level	0...100 pu	0.01 pu	10 pu

Settings of TR3PDIF

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
OpMod	Transformer type	Transformer type	• 2 winding • 3 winding		2 winding
MF1	Winding 1 matching factor	The matching factor is typically set to the nominal current for the winding	0.2...20	0.01	1
Zero- Seq1	Winding 1 I0 filter	Zero sequence filtering is applied when the winding can provide ground fault current	• Off • On		On
Wndg2	Winding 2 phase shift	The vector group relative to winding 1	0...11	1	0
MF2	Winding 2 matching factor	The matching factor is typically set to the nominal current for the winding	0.2...20	0.01	1
Zero- Seq2	Winding 2 I0 filter	Zero sequence filtering is applied when the winding can provide ground fault current	• Off • On		On
Wndg3	Winding 3 phase shift	The vector group relative to winding 1	0...11	1	0
MF3	Winding 3 matching factor	The matching factor is typically set to the nominal current for the winding	0.2...20	0.01	1
Zero- Seq3	Winding 3 I0 filter	Zero sequence filtering is applied when the winding can provide ground fault current	• Off • On		On
LoSet	Start value	Pickup or low set value	• 0.01...3 pu	0.01 pu	0.2 pu
DiffSlp1	Slope 1	Lower slope for mismatch	• 0.01...2	0.01	0.3
Slp2Set	Slope 2 start value	Upper slope value normally set above load	• 1...10 pu	0.01 pu	1.5 pu
DiffSlp2	Slope 2	Upper slope for CT saturation	• 0.1...2	0.01	0.7
OpDIT- mms	Operate time	Operate time of the low set bias differential	• 0...10000000 ms	1 ms	0 ms
HiSet	High set op value	The element operates instantaneously for currents above this level	• 0...100 pu	0.01 pu	0 pu
H2Blk	H2 blocking	Enables second harmonic blocking for inrush	• Off • On • Cross		Cross

Settings of TR3PDIF

Setting name	Short label	Infotip	Setting range	Step size	Default setting
H2Ratio	H2/H1 ratio block value	H2/H1 ratio block value	• 5...70 %	1 %	20 %
H5Blk	H5 blocking	Enables fifth harmonic blocking for overfuxing	• Off • On • Cross		On
H5Ratio	H5/H1 ratio block value	H5/H1 ratio block value	5...70 %	1 %	35 %
H5Alm- Tmms	H5 alarm time	When fifth harmonic blocking exceeds this period an alarm is raised	0...10000000 ms	1 ms	10000 ms
Harm- Rel	Harmonic block limit	The second and fifth harmonic blocks are removed when the bias exceeds this level	0...100 pu	0.01 pu	10 pu

Motor thermal overload (THMPTTR, ANSI 49)

The motor thermal overload protection function can be applied to help prevent damage on the stator and rotor against overloading conditions due to balanced and unbalanced currents.

- This function incorporates current based stator and rotor thermal levels, using three-phase RMS currents and sequence currents to reproduce the heating and cooling of the equipment to be protected.
- The stator thermal level considers the overheating generated by three-phase RMS currents and the negative sequence current. The average of the threephase currents is used, and the weighting of negative sequence current is settable depending on motor characteristic.
- Flexible choices of time constants used in stator thermal level calculation are provided. The four settable constants align with the four machine statuses. In addition, a four-point curve can be defined for the overload state.
- Temperature influence is provided to compensate for the reduction in the motor thermal limits when the ambient temperature is above the rated ambient. If ambient temperature measurement is not available, the factor is ignored.
- The rotor thermal level takes heating generated from the negative and positive sequence currents and heating transfer from stator. Two calculation methods are applied for starting and non-starting motor status separately.
- The start thermal level of the stator is monitored, and the maximum start level is memorized. It can be used to automatically adapt the thermal restart inhibit based on the maximum of the last 5 starts.

Please see the PowerLogic P7 User Manual for additional information.

Functions and Description

Settings of THMPTTR

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value (xFLA)	The start value is a multiple of the full load current which is defined in bay configuration	1...1.5	0.01	1
NegQ	Neg seq factor	This sets the negative sequence factor in the equivalent thermal current formula. It can be calculated from nominal slip, locked rotor current and starting torque	0...20	0.1	0
StpTC	Stopped time constant	This time constant is used when the current is below 0.05pu and is taken from the motor data sheet	1...1000 min	0.1 min	30 min
RunTC	Running time constant	This time constant is used when the current is above 0.05pu and below the start value. It is taken from the motor data sheet	1...1000 min	0.1 min	30 min
OlTC	Overload time constant	This time constant is used when the current is above the start value and below 2.8 x FLA in thermal mode. It is determined from the overload curve. In 4 point mode it is the time constant at 2.8 x FLA	1...1000 min	0.1 min	30 min
StrTC	Starting time constant	This time constant is used when current is above 2.8 x FLA. It is usually the same as the overload time constant	1...1000 min	0.1 min	30 min
AlmVal	Thermal alarm value	Thermal alarm value	50...100 %	1 %	90 %
RsvVal	Time to operate alarm	The time to operate is calculated based on the current measurement. If the time is less than this value the alarm is raised	1...1000 min	1 min	30 min
TmpNom	Nominal temperature	The machine nominal temperature is normally 40 °C	-40...300 °C	1 °C	40 °C
TmpMax	Max temperature	The maximum temperature is normally determined based on the machine insulation class	0...300 °C	1 °C	130 °C
RotMod	Rotor mode	In rotor mode the rotor has a different thermal model above 2.8 x FLA based on the stall times	• Off • On		Off
LckRotA	Locked rotor current (xFLA)	The locked rotor current is used with stall times	3...10	0.01	6
StrTrq	Start torque	Start torque	0.1...1	0.01	0.7
NomSlip	Nominal slip	Nominal slip	0.0001. 0.3 pu	0.0001 pu	0.01 pu
Tcold	Cold stall time	Cold stall time	1...10000 s	0.001 s	10 s
Thot	Hot stall time	Hot stall time	0...10000 s	0.001 s	6 s
RestrMod	Restart mode	In auto mode the maximum thermal capacity used in the last 5 starts is used to determine the restart level with a 5% buffer	• Auto • Manual		Auto
RsvTL	Restart level	The stator thermal level must drop below this value to allow starting	5...100 %	1 %	30 %
TmACrv	Overload characteristic	In thermal mode the overload time constant is used between the start value and 2.8 x FLA. In 4 point mode the time constant is interpolated between the 4 points and the overload time constant	• Thermal • 4 point curve		

Settings of THMPTTR (cont'd)

Setting name	Short label	Infotip	Setting range	Step size	Default setting
TmACrvPt0	1.4 x FLA time constant	1.4 x FLA time constant	1...1000 min	0.1 min	30 min
TmACrvPt1	1.6 x FLA time constant	1.6 x FLA time constant	1...1000 min	0.1 min	30 min
TmACrvPt2	1.8 x FLA time constant	1.8 x FLA time constant	1...1000 min	0.1 min	30 min
TmACrvPt3	2.0 x FLA time constant	2.0 x FLA time constant	1...1000 min	0.1 min	30 min

Thermal overload (THFPTTR, ANSI 49F)

The thermal overload protection can be applied to help prevent the plant damage caused by operating at temperatures exceeding design limits. Such damage includes excessive sagging of overhead lines, destruction of the conductor material, insulation deterioration in cables, overloads in transformers and so on.

A thermal model is used to calculate the thermal level of the plant, which can be feeder, transformer and so on. The thermal model uses the maximum of the three phase RMS currents, configurable time constants, and optionally the ambient temperature, as the main inputs to calculate the thermal level.

Additional features:

- Remaining time to trip
- Blocking time to restart

Settings of THFPTTR

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value (xFLA)	The start value is a multiple of the full load current which is defined in bay configuration	1...1.5	0.01	1
CoolTC	Cooling time constant	This time constant is used when the current is below 0.05pu.	1...1000 min	0.1 min	30 min
RunTC	Running time constant	This time constant is used when the current is above 0.05pu and below the start value	1...1000 min	0.1 min	30 min
OlTC	Overload time constant	This time constant is used when the current is above the start value in thermal mode. In 4 point mode it is the time constant above 2.8 x FLA	1...1000 min	0.1 min	30 min
AlmVal	Thermal alarm value	Thermal alarm value	50...100 %	1 %	90 %
RsvVal	Time to operate alarm	The time to operate is calculated based on the current measurement. If the time is less than this value the alarm is raised	1...1000 min	1 min	30 min
TmpNom	Nominal temperature	The plant nominal temperature is normally 40 °C	-40...300 °C	1 °C	40 °C
TmpMax	Max temperature	The maximum temperature is normally determined based on the plant insulation withstand or line sag	0...300 °C	1 °C	130 °C
RsvTL	Restart level	The thermal level must drop below this value to allow closing	5...100 %	1 %	90 %

Functions and Description

Settings of THFPTTR (cont'd)

Setting name	Short label	Infotip	Setting range	Step size	Default setting
TmACrv	Overload characteristic	In thermal mode the overload time constant is above the start value. In 4 point mode the time constant is interpolated between the 4 points and the overload time constant	• Thermal • 4 point curve		
TmACrvPt0	1.4 x FLA time constant	1.4 x FLA time constant	1...1000 min	0.1 min	30 min
TmACrvPt1	1.6 x FLA time constant	1.6 x FLA time constant	1...1000 min	0.1 min	30 min
TmACrvPt2	1.8 x FLA time constant	1.8 x FLA time constant	1...1000 min	0.1 min	30 min
TmACrvPt3	2.0 x FLA time constant	2.0 x FLA time constant	1...1000 min	0.1 min	30 min

The temperature is monitored by Resistance Temperature Detector (RTD), it is installed in different locations (bearing/winding/ambient etc.)

The function has two independent set points:

- Alarm set point
- Tripping set point

MET148-2 is a remote module, it is in charge of the acquisition of temperatures. This module communicates with the PowerLogic P7 through the Controller Area Network (CAN) link and up to 8 sensors can be connected to each module.

Settings of STMP

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
LabelSetting	Name	Name or Location of RTD			label
Function- Setting	Function	Function of RTD	• Other • Winding • Bearing • Ambient	0.1 min	30 min
AlmSet	Alarm value	Alarm value	-30...200 °C	1 °C	80 °C
TripSet	Trip value	Trip value	-30...200 °C	1 °C	100 °C

Negative phase sequence thermal overload (NPSPTTR, ANSI 49N)

The negative phase sequence thermal overload protection function is applied to help protect motors or generator rotors from overheating caused by negative sequence currents, which are generated from unbalanced supply such as single phasing. When the negative sequence current exceeds the start value, this function uses either an I2t curve or a thermal curve to calculate the operate time, after which the element trips. When the negative sequence current drops below the start value, this function will reset based on the reset characteristic.

Settings of NPSPTTR

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value (xFLA)	The start value is a multiple of the full load current which is defined in bay configuration	0.01...0.5	0.01	0.1
MaxThm	Nominal op time	This is the operating time with I2 FLA. It is used to determine the time constant for thermal mode as Nominal op time/ Start value²	1...100 s	0.1 s	15 s
TmACrv	Operating curve	Machine unbalance characteristic. Thermal is asymptotic as it approches the start value where I²t isn't	• I²t • Termal		
RstMul	Reset multiplier	Nominal op time/ Start value² is multiplied by this value to give the reset time in I²t mode or the reset time constant in Thermal mode	0...10	0.1	1
Min- OpTmms	Min op time	Minimum operating time	0...100000 ms	1 ms	250 ms
MaxOpTms	Max op time	Maximim operating time when I2 exceeds the start value	100...10000 s	1 s	1000 s

Motor Monitoring (ZMOT)

The motor monitoring function is available in the PowerLogic P7.

There are three statuses for a motor: Stopped, Starting or Running.

The PowerLogic P7 motor status is based on the Bay Dead signal and the phase currents.

Please see the PowerLogic P7 user manual for additional information.

Settings of ZMOT

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		On
StrCurVal	Start value (xFLA)	Current used to determine motor status. It is a multiple of the full load current which is defined in bay configuration	0.01...40	0.001	3
HrRAlm1Val	Hours run alarm 1 value	Hours run alarm 1 value	0...9999 hr	1 hr	0 hr
HrRAlm2Val	Hours run alarm 2 value	Hours run alarm 2 value	0...9999 hr	1 hr	0 hr
NbStrAlmVal	Start number alarm value	Start number alarm value	0...999	1	0

Settings of ZMOT (cont'd)

Setting name	Short label	Infotip	Setting range	Step size	Default setting
ReAccTmSt	Reacceleration status	Reacceleration will allow the motor to go from running state to starting state during voltage dips. This avoids locked rotor operation	• On • Off		Off
ReAccVVal	Reacceleration voltage	This is the voltage level to initiate reacceleration. The voltage must be below this level for 100ms	0.01...1	0.01	0.7
ReStoVVal	Restoration voltage	If reacceleration voltage is detected the motor status will go to starting if this voltage is exceeded and current above the start level occurs in the next 5 seconds	0.01...1	0.01	0.9

Motor start supervision (PMSS, ANSI 48)

The motor start supervision protection function includes two parts:

1. Excessive starting time

   After a motor start is detected, before starting supervision time expires, if current successfully falls below the starting current threshold, it means the motor start successfully, otherwise the operate signal will be issued after starting time delay.

2. Locked rotor during starting

   For certain applications, the stall withstand time is less than the starting time. A zero speed input is used to indicate the machine is starting and not stalled. If the current exceeds the starting current threshold13 and the speed of the motor is equal to zero (zero speed switch input is active), the operate signal will be issued after the stall time.

Settings of PMSS

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	The element will only operate when the motor status is starting	• On • Off		Off
PSMod	Operating curve	An inverse curve can be used to provide longer start times at reduced voltage	• Definite time • Inverse		
SetA	Nom voltage start current (xFLA)	In inverse mode the opeate time equals the Nominal voltage start time at this multiple of full load current which is defined in bay configuration	0.005...40 pu	0.001 pu	6 pu
SetTms	Nom voltage start time	In inverse mode this is the operating time at start current. In definite time mode this is the operating time for all currents	0...10000000 ms	1 ms	5000 ms
LokRotTms	Locked rotor time	This is the operating time when zero speed input is active	0...10000000 ms	1 ms	2000 ms

Locked rotor (JAMPTOC, ANSI 51LR)

Locked rotor protection function is used for motors. If a machine load becomes jammed when running, it will cause start-up current to flow. As the machine is not spinning, there is reduced windage, so the rotor rapidly overheats. The protection will operate more quickly than the thermal element which allows a shorter time to restart once the jam is cleared.

Settings of JAMPTOC

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Element will start if current is above this level when the motor is running	0.005...40 pu	0.001 pu	3 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	2000 ms

Motor Restart Inhibition and Emergency Restart (PMRI, ANSI 66)

The motor restart inhibition includes three functions - starts inhibition, time between starts and anti-backspin.

The emergency restart effectively removes restart inhibition from thermal overload, starts inhibition, and time between starts inhibition.

Starts Inhibition

Any motor has a restriction on the number of starts within a defined period to avoid the over temperature of the motor, mainly inside the rotor. The maximum allowable number of starts per period is an auto-reset inhibit function which monitors the number of motor starts.

Time between Starts

Once a motor start is detected, the PowerLogic P7 initiates the minimum time between starts.

Anti-Backspin

The anti-backspin function is used in applications where the motor may spin backwards after stopping due to the load such as inclined conveyors. If a start is attempted the motor will draw excess current for an extended time which will likely lead to an unsuccessful start. The function is used to detect when the rotor has completely stopped, to allow restarting of the motor. The anti-backspin protection is initiated by motor Stopped status from motor monitor function. Zero speed can also be checked to ensure the motor is not spinning.

Emergency Restart

Where a motor forms part of an essential process, it is sometimes desirable for it to continue operation, even under severe overload conditions. This usually means the motor being subjected to temperatures in excess of its design limits. Even though this may decrease the life of the motor, or even burn the motor out, such conditions may be justified in an emergency.

Please see the PowerLogic P7 User manual for additional information.

Settings of PMRI

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
MaxStrTmm	Start number period	The number of starts is normally given in starts per hour	0...120 min	1 min	60 min
MaxNumStr	Start number in period	The number of starts allowed in the start period. Typically 2 or 3 starts per hour	1...10	1	1
InhTmm	Start number min inhibition time	If the number of starts is exceeded, starting is blocked for the mimimum of this setting and the remaining time in the start period	0...120 min	1 min	10 min
MaxStrRteTmm	Time between starts	Time between starts	0...120 min	1 min	2 min
AbsTmms	Anti backspin time	This is the time to wait to ensure the motor is not being run backwards by the load	1...10000000 ms	1 ms	300 ms
ZerSpdTmms	Zero speed time	Zero speed needs to be active for this time to allow a restart	1...10000000 ms	1 ms	300 ms

Voltage Check (VCPTUV, ANSI 27D)

The voltage check function is normally used in motor applications to help ensure the machine has the correct voltage before attempting to start. The voltage should come from a busbar VT for this function to operate. The PowerLogic P7 monitors the input voltage rotation and magnitude to determine both correct phase rotation and sufficient supply voltage, prior to permitting motor starting.

Settings of PMRI

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Checks V1 is adequate for starting. A reverse indication is given if V2 is above the start value	• On • Off		Off
StrVal	Start value	Minimum positive sequence voltage for starting	0.1...2 pu	0.01 pu	0.8 pu
OpDlTmms	Operate time	Operate time	0...100000 ms	1 ms	0 ms

Third Harmonic Undervoltage (STPTUV, ANSI 27TN)

Neutral displacement protection measures the fundamental frequency voltage component at the generator star point, and it operates when the fundamental frequency voltage exceeds the preset value. By applying this principle, approximately 95% of the stator winding can be protected. In order to help protect the last 5% up to 100% of the stator winding, close to the neutral end, third harmonic voltage measurement can be performed. In STPTUV protection, either the neutral point third harmonic undervoltage principle, or differential principle based on the magnitude ratio of the neutral point third harmonic voltage to the third harmonic differential voltage can be applied. However, differential principle is strongly recommended. Combined with neutral displacement it provides coverage for entire stator winding against ground faults.

Settings of STPTUV

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
V3HDiff- Type	Operation mode	Choose differential or neutral undervoltage mode	• Diff under ratio • Neutral undervoltage		Neutral undervoltage
V3HRatio	Diff ratio start value	Operation when V3N is less than this setting multiplied by the total third harmonic voltage (V3T-V3N)	0.001...1	0.001	0.1
V3NStrVal	Neutral UV start value	Operation when V3N is less than this setting	0.001...1.25 pu	0.001 pu	0.01 pu
V3HBlkVal	H3 diff block value	Operation blocked if the total third harmonic voltage (V3T-V3N) is less than this value. Set to zero to disable this check	0...1.25 pu	0.001 pu	0.01 pu
UVBlkVal	Undervoltage block value	Operation blocked when V3T is below this value. Set to zero to disable this check	0...1.25 pu	0.001 pu	0.8 pu
UPBlkVal	Underpower block value	Operation blocked when bay power is below this value. Set to zero to disable this check	0…1.25 pu	0.001 pu	0.03 pu
OpDlTmms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
RsDlTmms	Reset time	Reset time	0...10000000 ms	1 ms	0 ms

Inter-Turn Protection Based on Split Phase (ITPDIF, ANSI 87G)

Introduction of generator inter-turn protection of split phase

For generators with multi-turn stator windings, there is the possibility of a winding inter-turn fault occurring. Unless such a fault evolves to become a stator earth fault, it will not otherwise be detected with conventional protection arrangements. Hydro generators usually involve multi-stator windings with parallel windings.

Generator differential inter-turn protection

In this scheme the circuits in each phase of the stator winding are split into two equal groups and the current of each group are compared. A difference in these currents indicates an unbalance caused by an inter-turn fault. Since there is normally some current unbalance between windings, the protection is set so that it will not respond to this normal unbalance but will pick-up for the unbalance caused by a single turn fault. Phase based settings are provided to allow the intentional shorting of a winding.

Settings of ITPDIF

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrValA	Aph start value	All start values are usually the same unless a winding is intentionally shorted	0.005...40 pu	0.001 pu	1 pu
StrValB	Bph start value	All start values are usually the same unless a winding is intentionally shorted	0.005...40 pu	0.001 pu	1 pu
StrValC	Cph start value	All start values are usually the same unless a winding is intentionally shorted	0.005...40 pu	0.001 pu	1 pu
OpDlTm- ms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms

Inadvertent Energization (IEPIOC, ANSI 50/27)

Accidental energization of a generator can cause severe damage to the machine. When the machine is at standstill, if the Circuit Breaker (CB) is closed, then the generator begins to act as an induction motor with the surface of the rotor core, and the rotor winding slot wedges acting as the rotor current conductors. This abnormal current in the rotor can cause overheating and damage. The protection is capable of differentiating between a normal generator shutdown/starting sequence, and a generator shutdown/inadvertent energization sequence.

Settings of IEPIOC

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrValA	Overcurrent start value	Overcurrent start value	0.1...2 pu	0.01 pu	0.1 pu
StrValV	Undervoltage start value	Undervoltage start value	0.1...1 pu	0.01 pu	0.8 pu
ActDlTmms	Activation time	The element is active if the current and voltage are below start values for this period	0...10000 ms	1 ms	5000 ms
DlTmms	Release time	If voltage above start is present for this time the element will deactivate. During this release period operation will occur if current exceeds the start value	0...10000 ms	1 ms	500 ms

Speed Detection (TRTN)

Speed detection function is applied to motor or generator applications where the rotation speed is measured using cams mounted on the rotor, with detection by means of proximity detectors. The output from the proximity sensor is a train of electrical pulses, each pulse corresponds to the detection of an individual cam.

Settings of POVS

Name	Short label	Infotip	Setting range	Step size	Default setting
PPR	Pulses per rotation	Pulses per rotation	1...24	1	1
NomSpd	Nominal speed	Nominal speed	15...10000 rpm	1 rpm	3000 rpm
ZeroTmms	Zero operate time	When a pulse is not received for this time the zero speed output will be set	0...300000 ms	1000 ms	60000 ms

Overspeed (POVS, ANSI 12)

The overspeed protection function is applied to motor or generator applications. The rotation speed of the applications is measured using cams mounted on the rotor, with the detection by means of a proximity sensor.

Settings of POVS

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Start value	1…1.6 pu	0.01 pu	1 pu
OpDlTmms	Operate time	Operate time	0...300000 ms	1000 ms	0 ms

Underspeed (PZSU, ANSI 14)

Based on the measurement using cams mounted on the rotor, with detection by means of a proximity sensor, the underspeed protection function is applied to motor or generator applications to detect the slow downs of rotational speed after starting, resulting from the mechanical overloads or locked rotor.

Settings of PZSU

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
StrVal	Start value	Start value	0.01…1 pu	0.01 pu	0.4 pu
OpDlTmms	Operate time	Operate time	0...300000 ms	1000 ms	0 ms

Zerospeed (ZEROPZSU, ANSI 14)

The zerospeed protection is active when the motor speed is less than the threshold, which means the start signal will be asserted if the speed measured drops below the speed threshold. This function is inactive when the speed exceeds 105% of the threshold, which means the start signal will be deasserted. If the start time of the zerospeed protection function exceeds the operate delay time setting, an operate signal is issued. This is usually used with other functions such as PMSS or PMRI.

Settings of ZEROPZSU

Setting name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Checks V1 is adequate for starting. A reverse indication is given if V2 is above the start value	• On • Off		Off
StrVal	Start value	Per unit speed below this value will start the operation timer	• 0.01...1 pu	0.01 pu	0.05 pu
OpDlTmms	Operate time	Operate time	• 0...300000 ms	1000 ms	0 ms

Field failure (FFPDIS, ANSI 40)

Complete loss of excitation may arise as a result of accidental tripping of the excitation system, an open circuit or short circuit occurring in the excitation DC circuit, flashover of any slip rings or failure of the excitation power source.

When the excitation of a synchronous motor fails, not enough synchronizing torque is provided to keep the rotor locked in step with the stator rotating magnetic field. The machine would then be excited from the power system and hence be operating as an induction motor.

In generator applications, if the field is lost the generator can slightly overspeed. Without a field the stator windings will appear as an inductive load fed from the power system. These conditions will result in an increasing level of reactive power being drawn from the power system. If the system cannot supply enough reactive power the system voltage will drop and the system may become unstable.

Settings of FFPDIS

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
Ofs	Stage 1 offset	Stage 1 offset	0.0005...5 pu	0.0001 pu	0.2 pu
PoRch	Stage 1 diameter	Stage 1 diameter	0.0005...5 pu	0.0001 pu	2 pu
OpDlTmms	Stage 1 operate time	Stage 1 operate time	0...10000000 ms	1 ms	5000 ms

Settings of FFPDIS (cont'd)

Name	Short label	Infotip	Setting range	Step size	Default setting
Mho2Mod	Stage 2 status	If required, stage 2 is usually set with the same offset as stage 1 with a smaller diameter and faster operating time. It should be set to avoid operation on power swings	• Off • On		Off
SndOfs	Stage 2 offset	Stage 2 offset	0.0005...5 pu	0.0001 pu	0.2 pu
SndPoRch	Stage 2 diameter	Stage 2 diameter	0.0005...5 pu	0.0001 pu	1 pu
SndOpDlTmms	Stage 2 operate time	Stage 2 operate time	0...10000000 ms	1 ms	0 ms

Underimpedance (UZPDIS, ANSI 21)

Underimpedance protection function is used to detect faults on either side of the step up transformer. The transformer is typically star-delta producing a 2-1-1 fault distribution on the generator (delta) side for a phase-phase fault on the grid (star) side. The impedance is calculated using phase-phase voltage divided by phase currents to detect this condition.

- ZA=VAB/IA
- ZB=VBC/IB
- ZC=VCA/IC

Two zones are available for the underimpedance protection function. Zone 2 can be enabled or disabled separately.

Stage 1 is normally set to see faults on either side of the step-up transformer and must grade with the outgoing protection.

Stage 2 can be enabled to provide faster tripping for faults up to the transformer.

Settings of UZPDIS

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
PoChr	Stage 1 start value	Usually set to see faults through the step up transformer	0.0005...5 pu	0.0001 pu	0.7 pu
OpDlTmms	Stage 1 operate time	Usually set to grade with outgoing protection on the HV of the step up transformer	0...10000000 ms	1 ms	2000 ms
RsDlTmms	Stage 1 reset time	Stage 1 reset time	0...10000000 ms	1 ms	0 ms
Z2Mod	Zone 2 status	A second stage can be applied for faster backups of faults within the generator or step up transformer	• Off • On		Off
Po2Chr	Stage 2 start value	Usually set to cover the generator and partially into the step up transformer	0.0005...5 pu	0.0001 pu	0.25 pu
Op2DlTm- ms	Stage 2 operate time	Usually set with a small delay to backup other protection	0...10000000 ms	1 ms	500 ms
Rs2DlTm- ms	Stage 2 reset time	Stage 2 reset time	0...10000000 ms	1 ms	0 ms

Out of Step (OOSPPAM, ANSI 78)

An out of step condition may occur on a generator or a synchronous machine. For a generator a pole slip will occur whenever the load (or rotor) angle reaches 90°.

A pole slip is normally caused by the slow clearance of a fault.

During a pole slip the machine will lose synchronism and then try to re-establish synchronism as the load angle passes near the stability point. If left in this state, the slip rate will create low frequency sub-harmonics, stressing windings and causing vibration which can affect the machine mechanical components. During power swings it is critical the machine is not tripped as this would overload other machines and may lead to blackouts. In some cases, if adequate system impedance is seen by the machine during the pole slip, the stress on the machine is reduced and a small number of pole slips may be tolerated.

Please see the PowerLogic P7 User Manual for additional information.

Settings of OOSPPAM

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
PoRch	Inner forward reach	The inner zone is used for operation when the fault locus exits with the opposite sign resistance to entry. This is the inner zone forward reach on the blinder angle detemined by the maximum generation voltage to system voltage ratio	0.0005...5 pu	0.0001 pu	1 pu
PoRchRev	Inner reverse reach	This is the inner zone reverse reach on the blinder angle detemined by the minimum generation voltage to system	0.0005...5 pu	0.0001 pu	1 pu
RisPhRch	Inner res forward reach	This is the inner zone resistive forward reach detemined by the maximum pole slip rate time to travel from the outer zone for generator applications	0.0005...5 pu	0.0001 pu	1 pu
RisPhRchRev	Inner res reverse reach	This is the inner zone resistive reverse reach detemined by the maximum pole slip rate time to travel from the outer zone for motoring applications	0.0005...5 pu	0.0001 pu	1 pu
PctRch	Outer/Inner forward reach	This is the ratio of the outer zone reach to the iner zone forward reach. The impedance must be in the outer zone for greater than 25ms to avoid operation during faults. Load impedance must be outside the outer zone	110...1000 %	10 %	110 %
PctRchRev	Outer/Inner reverse reach	Outer/Inner reverse reach	110...1000 %	10 %	110 %
PctRisRch	Outer/Inner res forward reach	Outer/Inner resistive forward reach	110...1000 %	10 %	110 %
PctRisR- chRev	Outer/Inner res reverse reach	Outer/Inner resistive reverse reach	110...1000 %	10 %	110 %
BldAng	Blinder angle	This is the tilt of the inner and outer characteristics	20...90 deg	1 deg	80 deg
PctRchZ1	Z1/Inner forward reach	This is the forward reach of Z1 along the blinder angle relative to the inner zone forward reach. This sets the lower portion of then inner zone for generator slips when different slip counts are required for generator and power system slips	0.01...1	0.01	1
SlpCnt1	Slip count zone 1	Slip counts for zone 1 (generator)	1...20	1	1
SlpCnt2	Slip count zone 2	Slip counts for zone 2 (transformer/ system)	1...20	1	1

Note: SlpCnt1 and SlpCnt2 should meet the formula SlpCnt1 ≤ SlpCnt2.

Settings of OOSPPAM (cont'd)

Name	Short label	Infotip	Setting range	Step size	Default setting
SlpCnt2	Slip count zone 2	Slip counts for zone 2 (transformer/ system)	1...20	1	1
OpDlTmms	Operate time	Operation is instant when the fault locus leaves the inner zone. This delays the operate signal to avoid operation during high current levels	0...10000000 ms	1 ms	0 ms
RsDlTmms	Reset time	This is the time after a slip when the slip count is reset. When multiple slips are set the time between slips must be less than this value	0...10000000 ms	1 ms	30000 ms

Note: SlpCnt1 and SlpCnt2 should meet the formula SlpCnt1 ≤ SlpCnt2.

Overpower (PPDOP/QPDOP, ANSI 32P/32Q)

The overpower protection (PDOP) is used to detect overpower conditions to help protect power plants. It is applied to limit total power output (active or reactive) or for reverse power protection of generators depending upon the directional mode.

Reactive overpower can also be used to detect underexcitation.

Settings of PPDOP/QPDOP

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
PoChr	Stage 1 start value	Usually set to see faults through the step up transformer	• Forward • Reverse		Forward
StrVal	Start value	Start value	0.005. 3.25 pu	0.001 pu	1 pu
OpDlTm- ms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
RsDlTm- ms	Reset time	Reset time	0...10000000 ms	1 ms	0 ms

Underpower (PPDUP, ANSI 37P)

The underpower protection (PDUP) is used to detect underpower conditions to help protect power plants. It can be used to detect loss of load for motors and also for low forward power shutdown of generators.

Settings of PPDUP

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
DirMod	Directional mode	Directional mode	• Forward • Reverse		Forward
StrVal	Start value	Start value	0.005. 3.25 pu	0.001 pu	0.2 pu
OpDlTm- ms	Operate time	Operate time	0...10000000 ms	1 ms	0 ms
RsDlTm- ms	Reset time	Reset time	0...10000000 ms	1 ms	0 ms

Functions and Description

Bay Dead (PDGAPC)

The bay dead function is applied to give an indication if all phases of the line are dead. A bay dead condition is determined by monitoring the status of the CBclosed input and by measuring the phase currents and voltages.

Protection Trip Conditioning (PTRC, ANSI 86)

Protection Trip Conditioning (PTRC) function provides the combination of all protection functions' start outputs and operate outputs to a general start and a general operate respectively, according to the start and operate I/O mapping of PTRC for each protection. The general operate will trigger the general trip signal which can be directly connected to a binary output to trip the breaker.

Settings of PTRC

Name	Short label	Infotip	Setting range	Step size	Default setting
LOMod	Lockout mode	This forces the trip output to lockout for any connected operate signal. Individual signals can lockout via matrix input	• Off • On		Off
TrPlsTm- ms	Trip pulse time	This is the minimum trip pulse time (dwell) when a connected operate signal is active	0...10000 ms	1 ms	1000 ms

Circuit Breaker Failure (RBRF, ANSI 50BF)

The Circuit Breaker Failure (CBF) protection function operates when a fault condition is not cleared due to failure of the circuit breaker to operate when a protection-initiated tripping order is sent. In this case, the CBF function sends a tripping order to the upstream or adjacent circuit breaker to help clear the fault.

In applications where a circuit breaker has two sets of trip coils, the CBF function may send a tripping order to the second set of trip coils (retripping) and if this does not result in fault clearance, the CBF function will then send a tripping order (backtripping) to the upstream or adjacent circuit breaker. The PowerLogic P7 CBF function has two stages. The retrip stage can be enabled or disabled via a setting and the backtrip stage is always enabled.

Settings of RBRF

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		On
FailMod	Breaker fail mode	Breaker fail mode	• Current • CB status • Current and CB status		Current
ReTripMod	Retrip	Retrip	• Off • On		Off
DetValA	Current start value	Reset current for current mode	0.02...20 pu	0.001 pu	0.2 pu
PhChkValA	Phase current check value	Minimum phase current for current mode. If zero element is always released	0...20 pu	0.001 pu	0 pu
NeutChkVa- IA	Neutral current check value	Minimum neutral current for current mode. If zero element is always released	0...20 pu	0.001 pu	0 pu
I2ChkValA	Neg seq current check value	Minimum negative phase sequence current for current mode. If zero element is always released	0...20 pu	0.001 pu	0 pu
TPTrTmms	Retrip time	Retrip time	0...10000000 ms	1 ms	100 ms
FailTmms	Backtrip time	Backtrip time	0...10000000 ms	1 ms	250 ms
RstTmms	Reset time	Reset time for retrip and backtrip. This provides a minimum pulse to remote trip coils	0...10000000 ms	1 ms	250 ms

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Monitoring Functions Current Transformer Supervision (CTSSCTR)

The Current Transformer Supervision (CTS) feature is included with each 3ph CT group and is used to detect failure of a phase current input to the protection device. Failure of a phase CT or an open circuit of the interconnecting wiring can result in:

- Incorrect operation of protection functions
- High CT secondary voltages

The CT connection types 3ph, 3ph+N and 2ph+N are monitored.

Settings of CTSSCTR

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	The function will operate when one current is lost while the other two currents are in the normal load range	• On • Off		Off
OpDlTmms	Alarm time	Delay from Block to Alarm output activation. Alarm has 10s fixed reset	• 0...10000000 ms	1 ms	5000 ms
INdiffMod	IN diff mode	When the CT mode is IA IB IC IN this compares the measured IN to IA + IB + IC	• Off • On		Off
INdiffVal	IN diff start value	IN differential above this level will operate CTS	0.001...40 pu	0.001 pu	0.1 pu

Voltage Transformer Supervision (VTSSVTR, ANSI 60FL)

The Voltage Transformer Supervision (VTS) feature is included with each 3ph VT group and is used to detect failure of the voltage inputs to the protection device. If there is a fuse in the voltage transformer circuitry, the blown fuse prevents or distorts the voltage measurement. Therefore, a VTS alarm should be issued. Furthermore, in some applications, protection functions using voltage signals should be blocked to avoid false tripping.

Settings of VTSSVTR

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
OpDlTmms	Operate time	Delay from Block to Alarm output activation. Alarm has 10s fixed reset	0...10000000 ms	1 ms	5000 ms
IminStrVal	Min current check value	This current must be present for operation except for VN diff	0.005...40 pu	0.001 pu	0.05 pu
V2StrVal	Neg seq OV start value	Negative sequence voltage above this level without blocking current will operate NPS VTS	0.1...2 pu	0.001 pu	0.2 pu
I2StrVal	Neg seq OC block value	Negative sequence current above this level will block NPS VTS	0.005...40 pu	0.001 pu	0.05 pu
VmaxStrVal	3ph UV start value	All phases below this level without blocking current will operate 3ph VTS	0.1...2 pu	0.01 pu	0.1 pu
ImaxStrVal	3ph OC block value	All phases above this level will block 3ph VTS	0...40 pu	0.001 pu	10 pu
VNdiffMod	VN diff mode	When the VT mode is VA VB VC VN this compares the measured VN to VA + VB + VC	• Off • On		Off
VNdiffStrVal	VN diff start value	VN differential above this level will operate VTS	0.1...2 pu	0.01 pu	0.1 pu

Functions and Description

Circuit Breaker Supervision (CBSCBR)

Periodic maintenance of Circuit Breakers (CB) is necessary to ensure that the trip circuit and mechanism operate correctly and the interrupting capability is uncompromised due to the previous fault interruptions. The CB supervision function is included in each CB package and records various statistics related to each CB operation, allowing an accurate assessment of the CB condition.

Statistics are recorded to allow the evaluation of both the electrical wear of the breaker contacts and the mechanical wear of the breaker mechanism.

Settings of CBSCBR

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		On
SwACff	Abrasion exponent (y)	This is used to measure the abrasion in A^y. y is usually 2 and accumulates at each opening	1...4	0.1	2
AbrWrnLev	Abrasion warning value	The warning value is the summated abrasion in A^y	0...65000 pu²	1 pu²	0 pu²
AbrAlmLev	Abrasion alarm value	The alarm value is the summated abrasion in A^y	0...65000 pu²	1 pu²	0 pu²
OpWrnNum	Operations warning value	This counts both control open and trip operations	0...10000	1	0
OpAlmNum	Operations alarm value	This counts both control open and trip operations	0...10000	1	0
TrWrnNum	Trip count warning value	This only counts trip operations	0...10000	1	0
TrAlmNum	Trip count alarm value	This only counts trip operations	0...10000	1	0
OpOpnWrn- Tm	Open time warning value	The output will be set if the measured time exceeds this value. The time is from the open signal to the change of position	0...10000 ms	1 ms	0 ms
OpOp- nAlmTm	Open time alarm value	The output will be set if the measured time exceeds this value. The time is from the open signal to the change of position	0...10000 ms	1 ms	0 ms
OpClsWrnT- m	Close time warning value	The output will be set if the measured time exceeds this value. The time is from the close signal to the change of position	0...10000 ms	1 ms	0 ms
OpCl- sAlmTm	Close time alarm value	The output will be set if the measured time exceeds this value. The time is from the close signal to the change of position	0...10000 ms	1 ms	0 ms
NoOpAlmTm	Inactivity alarm value	The output will be set when the breaker has not operated for a period exceeding this time. Useful for older breakers whose first operation will slow over time	0...10000 days	1 days	0 days
TCSMode	TCS mode	Block by state is used when 52b is not in circuit and will block when the breaker is open or being opened/ tripped. Block by trip is normally used with latched tripping with a single opto monitoring both CB states.	• Off • On • Block by state • Block by trip		Off
TCSTmms	TCS operate time	In single opto schemes this is set longer than the CB open/trip pulse. In multiple opto schemes this is set longer than the 52a/52b intermediate state	0...10000000 ms	1 ms	1000 ms

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Settings of CBSCBR

Name	Short label	Infotip	Setting range	Step size	Default setting
CCSMode	CCS mode	Enables Close Circuit Supervision (CCS). Block by state is used when 52a is not in circuit and will block when the breaker is closed or being closed. Block by close can be used when a single opto monitoring both CB states.	• Off • On • Block by state • Block by close		Off
CCSTmms	CCS operate time	In single opto schemes this is set longer than the CB close pulse. In multiple opto schemes this is set longer than the 52a/52b intermediate state	0...10000000 ms	1 ms	1000 ms

Trip Circuit Supervision

Trip circuit supervision monitors the trip circuit to detect open circuit trip coils or broken wiring. The trip circuit is monitored by connecting one of the relay opto inputs in series with the trip coil. Various schemes are available to allow TCS to work in open or closed position as well as with latched trip contacts.

Two schemes are available:

- One-input schemes are straightforward and look for an energized input and sometimes are blocked by the trip signal or breaker position.
- Two-input schemes can simply provide the same logic as a one-input scheme with the two optos ORed avoiding the need to block the element for beaker position or tripping.

Settings of CTSSCTR

Setting name	Description	Setting range	Step size	Default setting
TCSMod	TCS mode	• Off • On • Blocked by status • Blocked by trip		Off
TCSTmms	TCS time	0...10000000 ms	1 ms	1000 ms
CCSMod	CCS mode	• Off • On • Blocked by status • Blocked by close		Off
CCSTmms	CCS time	0...10000000 ms	1 ms	1000 ms

Functions and Description

Switch Supervision (SWSSWI)

Periodic maintenance of the switch is required to ensure correct operation.

Switch supervision is included with each switch package and includes the following information related to the switch operation:

Two schemes are available:

- Number of the switch close to open.
- Switch open time and close time.

Settings of SWSSWI

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		On
OpWrnNum	Operations warning value	Sets the operation warning output when the opening count exceeds this value	0...10000	1	0
OpAlmNum	Operations alarm value	Sets the operation alarm output when the opening count exceeds this value	0...10000	1	0
OpOpnWrnTm	Open time warning value	Sets the open time warning output when the time from the open command to position change exceeds this value	0...100000 ms	1 ms	0 ms
OpOpnAlmTm	Open time alarm value	Sets the open time alarm output when the time from the open command to position change exceeds this value	0...100000 ms	1 ms	0 ms
OpClsWrnTm	Close time warning value	Sets the close time warning output when the time from the close command to position change exceeds this value	0...100000 ms	1 ms	0 ms
OpClsAlmTm	Close time alarm value	Sets the close time alarm output when the time from the close command to position change exceeds this value	0...100000 ms	1 ms	0 ms

DC Battery Voltage Monitoring (ZBAT)

The DC battery voltage monitoring function is used to monitor the DC voltage of the PowerLogic P7 and helps to detect issues such as battery charger failures.

The DC battery voltage monitoring function provides four alarm signals when the auxiliary DC voltage input exceeds or falls below the corresponding set thresholds.

Settings of ZBAT

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
Nom- BatVol	Nominal DC	Nominal battery voltage. Float voltage can also be used and alarm values varied to suit	24...250 V	1 V	110 V
LoBat- Vol	Low alarm value	Low alarm value	0.8...1 pu	0.01 pu	0.8 pu
LoLo- BatVol	Low low alarm value	Low low alarm value	0.8...1 pu	0.01 pu	0.8 pu
HiBat- Vol	High alarm value	High alarm value	1…1.35 pu	0.01 pu	1.2 pu
HiHiBat- Vol	High high alarm value	High high alarm value	1…1.35 pu	0.01 pu	1.2 pu

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Voltage Variation (QVVR)

The voltage variation function is applied to monitor and analyze voltage quality. Voltage can have disturbances such as periods of voltage swell, voltage dip, or voltage interruption, which can cause equipment damage.

This function has three parts, each of which corresponds to one of the aforementioned voltage disturbances.

This function measures the three-phase RMS voltage including harmonics up to 20th order and supports measurement modes of phase-to-phase and phase-toground. If, for a configured duration, the measured voltage surpasses the swell start value, drops below the dip start value, or has an interruption, the corresponding voltage swell, dip, or interruption is logged as an event. Each of those event logs includes phase, start time, duration, maximum or minimum voltage.

Settings of SWSSWI

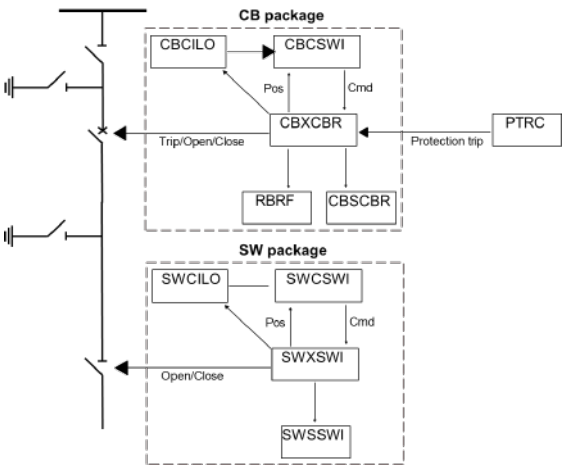
Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
DipStrVal	Dip start value	Dip start value	0.1. 1.2 pu	0.01 pu	0.9 pu
SwlStrVal	Swell start value	Swell start value	0.1. 1.5 pu	0.01 pu	1.1 pu
IntrStrVal	Interruption start value	Interruption start value	0.01. 1.2 pu	0.01 pu	0.05 pu
DipDlTmms	Dip operating time	Dip operating time	10...1000 ms	10 ms	10 ms
SwlDlTmms	Swell operating time	Swell operating time	10...1000 ms	10 ms	10 ms
IntrDlTmms	Interruption operating time	Interruption operating time	0...1000 ms	10 ms	10 ms
MuMod	Measurement mode	Measurement mode	• Phase-phase • Phase-neutral		Phase-phase

Control Functions

The PowerLogic P7 provides control and monitoring functionality for circuit breakers (CB), disconnectors or earthing switches from the local HMI or via remote controls.

The large 7” coloured touch screen HMI supports multi-page mimc with single-line diagram including the capability to control switchgear and receive position indication from them. Interlocking schemes required by the application can be configured using the PowerLogic Engineering Suite.

The PowerLogic P7 can control and monitor one (1) CB and up to nine (9) switches.



Functions and Description

The CB package contains the following functions that are needed for three-pole CB control:

- Circuit breaker control (CBCSWI)
  - Receive local/remote opening and closing orders
  - Manage opening and closing operations
  - Publish CB calculated position
- Circuit breaker proxy (CBXCBR)
  - Receive orders from protection functions and CB control
  - Make the CB position available
  - Circuit breaker interlocking (CBCILO)
  - Check the interlocking
  - Circuit breaker supervision (CBSCBR)
  - Monitor the CB condition
- Circuit breaker failure (RBRF)
  - Retrips when a fault condition is not cleared due to failure of the circuit breaker to operate

The switch package contains the following functions:

- Switch control (SWCSWI)
  - Receive local/remote opening and closing orders
  - Manage opening and closing operations
  - Publish switch calculated position.
- Switch proxy (SWXSWI)
  - Receive orders from switch control.
  - Make the switch position available
- Switch interlocking (SWCILO)
  - Check the interlocking conditions
- Switch monitoring (SWSSWI)
  - Monitor the switch condition

The PowerLogic P7 can control and monitor one CB and five switches in the basic application level and up to 3CBs and 9 switches in the standard application level depending on the choosen application.

CB and Switch Control (CBCSWI/SWCSWI)

Control Interface

The control function is used to process and manage the CB and switch command issued from any interface:

- Local control from the bay station level using HMI interface
- Remote control using supported protocols
- Direct control via digital inputs

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Interlocking (CBCILO/SWCILO)

The switching commands to the controllable switching devices in the bay are enabled only after interlocking conditions have been checked.
Boolean signals can be mapped to the block inputs via matrix. The interlocking function only blocks control actions and has no effect on the operation of protection functions.

Circuit Breaker Proxy (CBXCBR)

The functions of the circuit breaker proxy are:

- Issue CB state information based on CB auxiliary contacts.
- Block control operations when trips are present. The trip signal is also provided as an output allowing trips to be inhibited when required.
- Process the closing/opening request coming from CB control function.
- Count CB operation number.

CB Opening and Closing Logic

1. Protection trip logic

   If Protection trip from PTRC function is active and either of the Inhibit and BlkOpn is inactive, opening CB pulse is triggered.
2. Control opening logic

   CB opening will be blocked by Inhibit, BlkOpn, Protection trip and CB severe problems (EEHthAlm).
3. Control closing logic

   CB closing will be blocked by Inhibit, BlkCls, Protection trip, CB minor problems (EEHthWrn) and CB severe problems (EEHthAlm).

Settings of SWSSWI

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		On
CBAuxM	Status input	Used for position. If set to None position will use bay dead signal	• None • 52a • 52b • Both		None
CBCmdM	Command mode	The control signal will be held for at least the pulse time in dwell mode or reset when the position changes in status reset mode	• Dwell • Status reset		Dwell
CBClsTmms	Close pulse time	Close pulse time	100...10000 ms	10 ms	200 ms
CBOpTmms	Open pulse time	Open pulse time	100...10000 ms	10 ms	200 ms
CBTmms	CB closing time	Closing time of the breaker	0...1000 ms	1 ms	50 ms

Functions and Description

Switch Proxy (SWXSWI)

The functions of the switch proxy are:

- Issue switch state information based on switch auxiliary contacts.
- Process the closing/opening request coming from switch control function.
- Count switch operation number (OpCnt).

Settings of SWXSWI

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
SwTypSet	Switch type	Used for Switch type indication	• Load break switch • Disconnector • Grounding switch • High speed grounding switch		Load break switch
SwAuxM	Status input	Used for position indication	• None • 89a • 89b • Both		None
SwCmdM	Command mode	The control signal will be held for at least the pulse time in dwell mode or reset when the position changes in status reset mode	• Dwell • Status reset		Status reset
SwClsTmms	Close time	Close pulse length	100...100000 ms	10 ms	200 ms
SwOpnTmm-s	Open time	Open pulse length	100...100000 ms	10 ms	200 ms
SwMotCtlE-na	Direct motor control	Allows direct drive of the switch mechanism. The Power contactor outputs will select open or close direction and then power the DC drive in that direction	• Off • On		Off
SwMOpDlT-mms	Motor op delay	Time between selecting direction and applying power	1...1000 ms	1 ms	100 ms
SwMRsDlT-mms	Motor reset delay	Time between disconnecting power and releasing direction	1...1000 ms	1 ms	100 ms
SwMOpTm-Out	Motor control timeout	Time between power contactor output and feedback on power operation input. Set 0 to ignore power operation input	0...1000 ms	1 ms	0 ms

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Switchgear Motor Direct Control

The switchgear motor direct control function is used to directly drive the isolator motor open or closed to change the isolator status. The motor is driven in one direction by positive voltage and the other direction by negative voltage.

Auto-Recloser (TRIRREC, ANSI 79)

Dependent on the application, a high percentage of faults on the electrical network are transient, such as lightning or insulator flashovers. The auto-recloser (AR) function is designed to automatically restore power to a feeder or overhead line after a protection trip has occurred by a trip/close sequence (auto-reclosing cycle), to minimize the down-time of the network power in case of a transient fault.

This means that in most fault incidents, if the faulty line is immediately tripped, reclosure of the CB will result in the line being successfully reenergized (such as Closed/Open/Closed cycle). But, as permanent faults can also occur, an AR scheme must be also designed, to allow elimination of this fault case by, after a defined number of auto-reclosing cycles, leaving the circuit breaker in the open state (such as Closed/Open/Closed/ Open cycle).

The AR can provide up to 4 reclosing attempts or shots. A reclosing shot is initiated by operation of a protective element (internal or external trip).

Settings of TRIRREC

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
UseCyc	Number of shots	Number of shots (cycles)	1...4	1	4
Rec3Tmm-s1	Dead time 1	Dead (reclose) time for shot 1	10...10000000 ms	10 ms	10000 ms
Rec3Tmm-s2	Dead time 2	Dead (reclose) time for shot 2	10...10000000 ms	10 ms	60000 ms
Rec3Tmm-s3	Dead time 3	Dead (reclose) time for shot 3	10...10000000 ms	10 ms	180000 ms
Rec3Tmm-s4	Dead time 4	Dead (reclose) time for shot 4	10...10000000 ms	10 ms	180000 ms
RclTmms	Reclaim time	Reclaim time	1000...600000 ms	10 ms	180000 ms
SyncChk1	Sync check shot 1	Sync check is required for the first shot	• Off • On		Off
SyncChk2	Sync check shot 2	Sync check is required for the second shot	• Off • On		Off
SyncChk3	Sync check shot 3	Sync check is required for the third shot	• Off • On		Off
SyncChk4	Sync check shot 4	Sync check is required for the fourth shot	• Off • On		Off
SyncTmms	Sync check timeout	Sync check timeout	10...600000 ms	10 ms	1000 ms
CBOpTmms	CB operation timeout	The recloser goes to lockout if the requested operation is not successful in this period. It will check opening occurs within this period when the recloser is initiated and closing occurs within this period when the recloser issues a close signal	10...600000 ms	10 ms	5000 ms

Settings of TRIRREC (cont'd)

Name	Short label	Infotip	Setting range	Step size	Default setting
ManClsTmms	Manual close timeout	The recloser is blocked for this time after a manual close	10...3600000 ms	10 ms	5000 ms
RecStrMod	Initiate on trip reset	If On the dead time will start when the trip signal resets otherwise the dead time will start from the trip signal	• Off • On		Off

Synchro-Check (RSYN, ANSI 25)

The synchro-check function checks the synchronization of the electrical networks on either side of a circuit breaker to avoid shocks to the system or breaker flashover during closing.

The RSYN function monitors the voltage amplitude, frequency and phase angle difference between two voltages.The function operates in different conditions according to four synchronization modes:

- Disabled
- Asynchronus
- Synchronous
- Generator

In the PowerLogic P7, the synchro-check can be bypassed via the Bypass input.

Settings of RSYN

Name	Short label	Infotip	Setting range	Step size	Default setting
SetMod	Function status	Function status	• On • Off		Off
BayVT	Bay VT location	Select bay VT location as Bus or Line	• Bus • Line		Bus
PhSel	Phase selection	Phase selection	• VA • VB • VC • VAB • VBC • VCA • 3VPN • 3VPP		VAB
OpMod	Sync check mode	Synchronous is used for systems in sync. Asynchronous is used for unsynched systems and uses the CB closing time to close with minimal angle difference. Generator operates in a similar fashion to Synchronous except the frequency and voltage differential must both be positive	• Off • Synchronous • Asynchronous • Generator		Off
DifV	Max voltage diff	Max voltage difference for closing	0.01...2 pu	0.01 pu	0.06 pu
DifHz	Max slip	Max frequency slip for closing	0.005...2 Hz	0.005 Hz	0.05 Hz
DifAng	Max angle diff	Max angle difference for closing	1...90 deg	1 deg	20 deg
OpDlTm- ms	Sync check time	Check time for Sync check modes	0...10000000 ms	1 ms	100 ms

Settings of RSYN (cont'd)

Name	Short label	Infotip	Setting range	Step size	Default setting
LivDea- Mod	Volt check mode	Allows closing when either the line or bus is dead. DLDB enables Dead Line Dead Bus closing. LLDB enables Live Line Dead Bus closing. DLLB enables Dead Line Live Bus closing	• Off • DLDB • LLDB • DLLB • DLDB-LLDB • DLDB-DLLB • LLDB-DLLB • DLDB-LLDB-DLLB		Off
LivLinVal	Live line value	Live line value	0.01...2 pu	0.01 pu	0.5 pu
LivBusV- al	Live bus value	Live bus value	0.01...2 pu	0.01 pu	0.5 pu
DeaLinV- al	Dead line value	Dead line value	0.01...2 pu	0.01 pu	0.15 pu
Dea- BusVal	Dead bus value	Dead bus value	0.01...2 pu	0.01 pu	0.15 pu
DeaTm- ms	Volt check time	Check time for Live dead modes	0...10000000 ms	1 ms	100 ms
BlkVVal	Overvoltage block	If any voltage used for for check sync or voltage check exceeds this level the function is blocked	0.01...2 pu	0.01 pu	1.2 pu
BlkV2Val	Unbalance block	Unbalance block	0...2 pu	0.01 pu	0.1 pu

Synchro-Check (RSYN, ANSI 25)

The synchro-check function checks the synchronization of the electrical networks on either side of a circuit breaker to avoid shocks to the system or breaker flashover during closing.

The RSYN function monitors the voltage amplitude, frequency and phase angle difference between two voltages.The function operates in different conditions according to four synchronization modes:

- Disabled
- Asynchronus
- Synchronous
- Generator

In the PowerLogic P7, the synchro-check can be bypassed via the Bypass input.

Settings of the SWXSWI				
Parameter name	**Description**	**Setting range**	**Step size**	**Default setting**
SwClsTmms	Closing pulse time of the switch	100...10000 ms	10 ms	200 ms
SwOpnTmms	Opening pulse time of the switch	100...10000 ms	10 ms	200 ms
SwTypSet	Switch type	Load break switch Disconnector Earthing switch High speed Earthing switch	N/A	Load break switch
SwAuxM	Switch auxiliary management	None/89a/89b/Both	N/A	Both
SwCmdM	Switch command management	Dwell/Status Reset	N/A	Dwell

Functions and Description

Logging and Recording Functions

The PowerLogic P7 stores time tagged logs and records which can be used for fault analysis. These data can be read from the device and analyzed using the corresponding tools.

The items that are time tagged and logged are:

- SOE (sequence of events)
- Disturbance record
- Operation log
- Maintenance record
- Fault record

The PowerLogic P7 time stamp resolution is 1 ms.

SOE

The PowerLogic P7 is capable of logging and recording of all events that happen during power system operation. This function is modelled by Logical Node GENGLOG in IEC 61850. All operationally relevant signals, each fully tagged with date and time at signal start and signal end, are registered and stored in chronological order. The maximum size of the buffer is 3000 events.

Operation Log

The PowerLogic P7 supports logging and recording of all IED operations including command, like:

- Operation (select, operate, select with value, cancel)
- Control block operation (active setting group (SG), edit SG, confirm, edit and enable GOOSE control block)
- Setting change

This function is modelled with SOE log by Logical Node GENGLOG in IEC 61850. The maximum size of the buffer is 500 logs.

Maintenance Record

The PowerLogic P7 provides a detailed diagnostic record, which can be used by the Schneider Electric technical support team to investigate issues and troubleshoot the device..

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Functions and Description

Disturbance Record

The PowerLogic P7 provides for fault events a disturbance recording with the sampled analog values of all used analog currents and voltages before, during and after a fault event. This function is modelled by Logical Node DRRDRE in IEC 61850. The recording is in COMTRADE format. A maximum of 50 records are stored with a mix of analog and binary signals:

- All analog channels used in the bay are recorded.
- All digital channels within the bay are recorded if they are active or changed during the recording period. All device binary signals (for example, binary input and output status) will also be included if active or changed during the recording period.
- All records are stored in non-volatile memory in the PowerLogic P7.

Fault Record

Fault record provides fault signals including the measured fault data captured during a fault sequence. This function is modelled by logical node TCRGLOG in IEC 61850.

The fault records are logged in chronological order with reference to the specific fault.

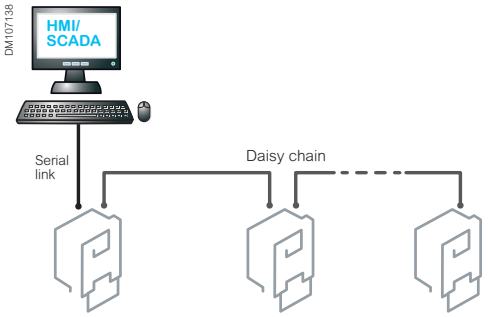
Each bay has independent fault record. The fault record is triggered by any start and any trip signals which are connected by default in the matrix to PTRC.

The fault record details any protection operations when the PTRC is started. When any starts or any trip picks up, the fault record starts to record.

The maximum size of the buffer is 50 fault records.

Communication

Examples of Architectures



Connection to SCADA using Serial

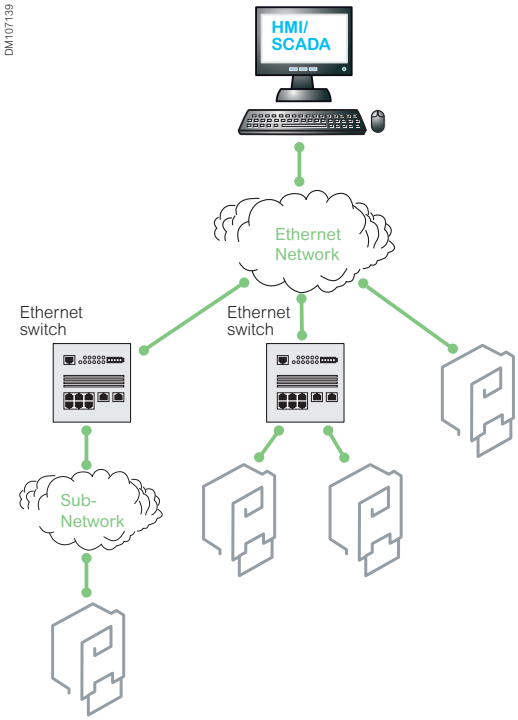
This architecture allows you to connect HMI/SCADA to a set of PowerLogic P7 devices using a multi-drop serial communication link with client-server communication.

Available protocols:

- Modbus RTU
- DNP3

Time synchronization protocol:

- IRIG-B
- Modbus RTU/DNP3



Connection to SCADA using Ethernet

This architecture allows you to connect a set of PowerLogic P7 devices directly to an Ethernet network.

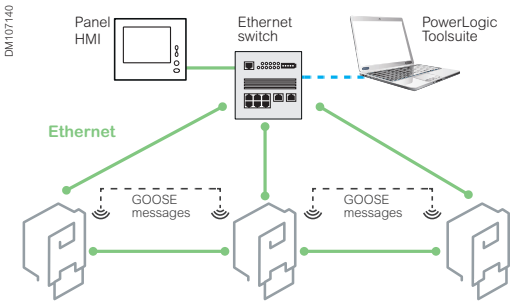
Available protocols:

- IEC 61850 Edition 2.1
- DNP3 over Ethernet
- Modbus TCP/IP

Time synchronization protocol:

- SNTP
- PTP (IEEE 1588)
- IRIG-B
- Modbus TCP/DNP over Ethernet

NOTE: It is possible to mix any of the three Ethernet protocols (IEC61850, DNP3, Modbus slave) on the same SCADA Ethernet network. The architecture allows the use of Generic Object-Oriented Substation Event (GOOSE) messages between devices together with another protocol for communication to Supervisory Controland Data Acquisition (SCADA). It is also possible to connect PowerLogicP7 devices to more than one control system, using the same Ethernet communication port with one of the chosen protocols. PowerLogic P7 devices handle the IEC 61850 station bus, in compliance with standards IEC 61850-6,7-1, 7-2, 7-3, 7-4 and 8-1 Edition 2.1, according to configuration.



Switchboard Internal Network

This architecture allows fast GOOSE communication between protection relays in the same switchboard, this avoiding costly wiring. Typical uses are logic discrimination, load shedding, etc.

In addition, a panel HMI featuring a web browser can be used to monitor and control the entire switchboard.

A spare connection on the panel Ethernet switch can also be provided for connecting the PowerLogic Engineering Suite setting and configuration tool.

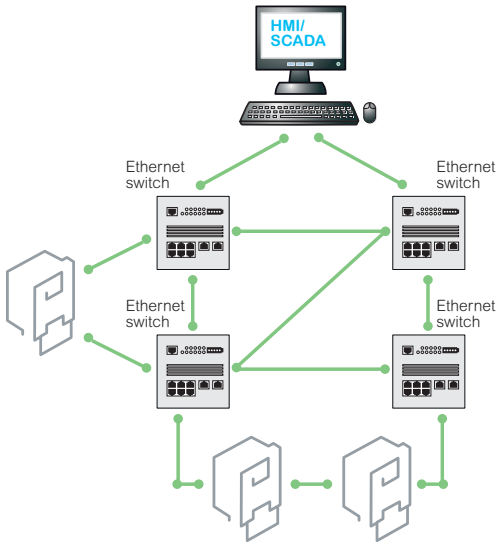
On PowerLogic P7 models, two independent Ethernet communication interfaces are available. This allows implementation of the switchboard internal network and the communication to SCADA on two separate Ethernet networks.

Life Is On Schneider Electric

Communication

Redundancy Protocols

DM107141

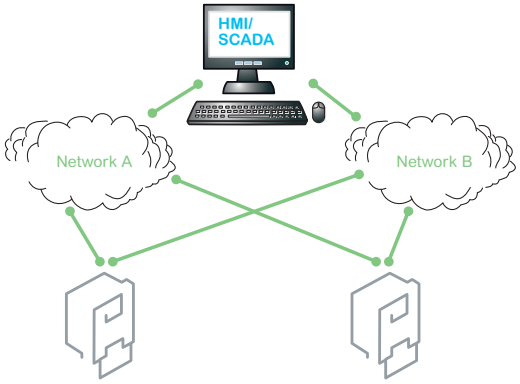


RSTP (Rapid Spanning Tree Protocol)

The principle of RSTP is to virtually remove all links that are not necessary at a given time, changing the meshed topology into a tree topology.

The main advantage of RSTP is that it is widespread and works on any network topology. On the other hand, RSTP takes milliseconds or seconds to reconfigure the network in case of network interruption.

DM107142



PRP (Parallel Redundancy Protocol)

The principle of PRP is to transmit frames in parallel on two independent network infrastructures: A and B.

The receiving device is in charge of removing the redundant frame, if it has already been received.

PRP protocol provides an instantaneous recovery time in case of failure, since no re-transmission of the message is needed.

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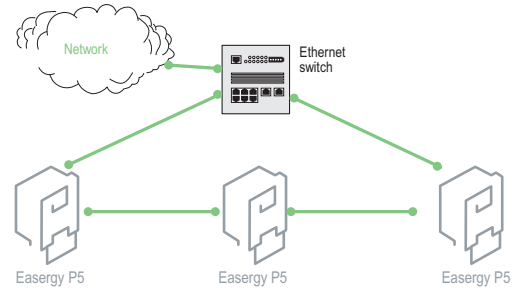


HSR (High-availability Seamless Redundancy)

HSR is similar to PRP but only works on a ring architecture.

Frames are transmitted on the ring in both directions and the receiving device eliminates redundant frames.

HSR protocol provides an instantaneous recovery time and is an alternative to PRP when network topology is restricted to a ring.

Both PRP and HSR protocols are listed in IEC 62439-3 as part of IEC 61850 standard. They both provide standardized, interoperable and high performance redundant Ethernet solutions.

Communication

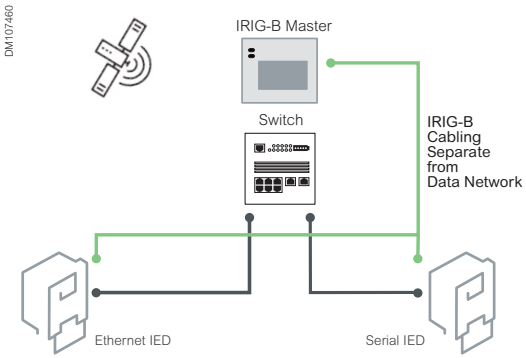
Time Synchronization

PowerLogic™ P7 offer several solutions for time synchronization:

Various communication protocols, IRIG-B, SNTP and PTP.

In modern protective schemes it is required to synchronize the internal real-time clock of the relay, so that events from different relays can be placed in chronological order.

This can be done using the communication interfaces connected to the substation control system using DNP3 or Modbus protocol or via dedicated time synchronization options provided by PowerLogic P7: IRIG-B time code and SNTP or PTP IEEE 1588v2 over Ethernet networks.

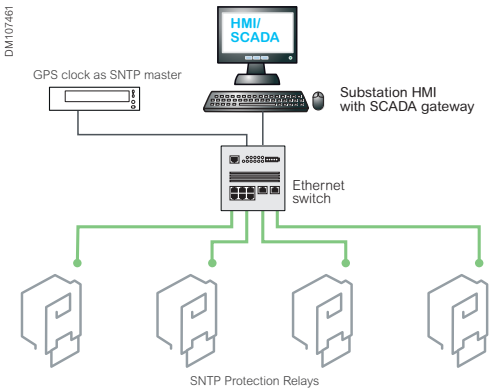


IRIG-B

Inter-Range Instrumentation Group time code B (IRIG-B) is a standard format for transferring timing information. IRIG-B time synchronization standard is based on a frame of 100 data bits sent every second to the device.

This time synchronization standard is supported in PowerLogic P7 by the IRIG-B module connected to the optional extension port of the relay.

The module provides both a modulated and an unmodulated input and can automatically detect which input type is used. The time synchronization accuracy in PowerLogic P7 with this mode is less than 5 ms. For more information, see the IRIG-B module details on page 108.

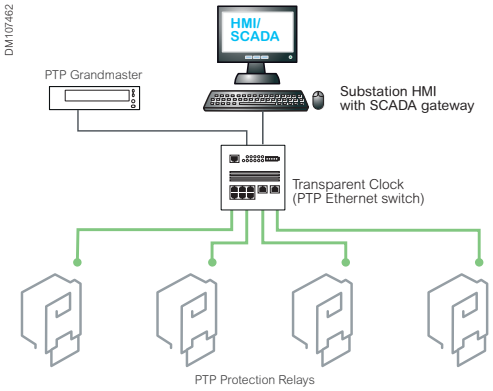


SNTP

Simple Network Time Protocol (SNTP) is a less complex implementation of Network Time Protocol (NTP), using the same protocol but without requiring the storage of state over extended periods of time. SNTP is used to synchronize the clocks of computer systems over packet switched, variable-latency data networks.

A jitter buffer is used to reduce the effects of variable latency introduced by queuing in packet switched networks, ensuring a continuous data stream over the network.

The PowerLogic P7 protection relay receives the synchronization from the SNTP/NTP server. The time synchronization accuracy in this mode is less than 5 ms.



PTP

Precision Time Protocol according to IEEE 1588-2008 (v2) standard. The PTP implementation in PowerLogic P7 protection relay is compliant to IEC61850-9-3 standard. This protocol enables precise synchronization of clocks in measurement and control systems implemented with technologies such as network communication, local computing, and distributed objects.

The protocol is applicable to systems communicating via Ethernet. Systemwide synchronization accuracy and precision in the sub-microsecond range are supported with minimal network and local clock computing resources. The time synchronization accuracy in PowerLogic P7 with this mode is less than 1 ms.

Life Is On Schneider Electric

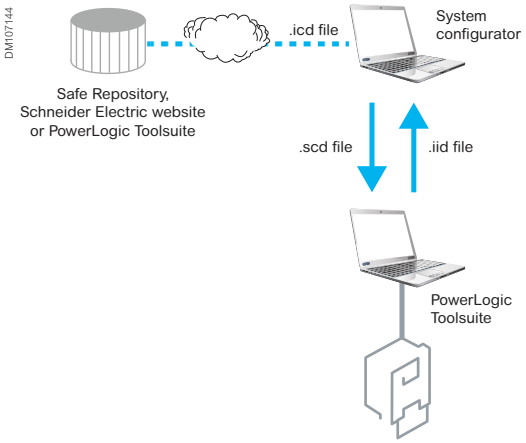
Communication

Data Exchanged

Data Exchanged with SCADA

Ports	Ethernet	Serial or Ethernet	
Protocol	IEC 61850	DNP3	Modbus
Real time data			
Measurement	●	●	●
Alarms and status	●	●	●
Controls	●	●	●
Time-stamped events	●	●	●
Historical data			
Disturbance records	●	●	-
Sequence of event record files	-	-	-
Setting management			
Setting group change	●	●	●
Settings	●	-	●

Data Exchanged According to IEC 61850



The Methodology described in the IEC 61850-6 standard can be applied with PowerLogic P7, to build a protection and control system based on this standard.

.icd file

For each model of PowerLogic P7, the IED capability file will be created by the PowerLogic Engineering Suite during the configuration process of the device.

.scd file

The system description file generated by the system configurator can be processed by PowerLogic Engineering Suite and the relevant system settings integrated in the PowerLogic P7 configuration.

.iid file

When the configuration of an PowerLogic P7 protection relay is completed or modified, PowerLogic Engineering Suite can generate an Instantiated IED Description file to be used by the system configurator to update the system description.

Cybersecurity

Cybersecurity features implemented in PowerLogic™ P7 help to mitigate cyber threats.

Cybersecurity

Cybersecurity in the scope of energy management is a set of rules, methods, and technical features intended to improve the quality of service and minimize risk of interruption of deliveries, resulting from accidental or intentional actions.

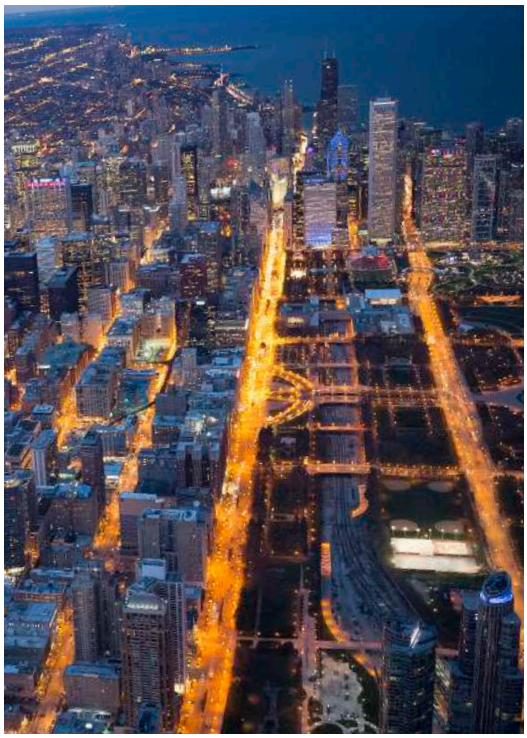
The PowerLogic P7 is designed with special attention to cybersecurity aspects, with compliance to Schneider Electric's Cybersecurity Policy and following Secure Development Lifecycle process.

Cybersecurity in PowerLogic P7 helps to provide:

- Confidentiality (to help prevent unauthorized access).
- Integrity (to help prevent unauthorized modification).
- Availability/authentication (preventing the denial of service and assuring authorized access).
- Non-repudiation (preventing the denial of an action that took place).
- Traceability/detection (logging and monitoring).

More info on the Schneider Electric Cybersecurity Support portal:

www.se.com/ww/en/work/support/cybersecurity/overview.jsp



Cybersecurity Features

Secure-by-design, incorporating IEC 62351 role-based access control principles.

- Secured communication between PowerLogic P7 and associated tools.
- Port hardening
- Local and central user authentication RADIUS / LDAP
- Firmware signature
- Password based user authentication
- Role Based Access Control (RBAC) authorization management
- Secured log storage
- Client IP address filter
- IEC 62443 SL2, NERC CIP and BDEW Cyber security features
- Security banner

For more information about PowerLogic P7 Cybersecurity capabilities please refer to the user manual.

The PowerLogic P7 is delivered with auto-login via the local control panel (HMI) with the default ENGINEER role. It is to facilitate the commissioning work by e.g. panel builder and system integrator. The auto-login function can be configured with the parameter **Local Default Access** using CAE tool.

In the PowerLogic P7, the control of accessibility to the settings, parameters, configuration, and logs is done with a user authentication after **Log in**, with a name and password.

The PowerLogic P7 controls the access:

- through the front panel
- through the PowerLogic Engineering Suite (front and rear connection)

The Ethernet communication with the PowerLogic Engineering Suite is encrypted.

Cybersecurity

Cybersecurity - Advanced Level

PM108582

Cybersecurity with EcoStruxure Cybersecurity Admin Expert

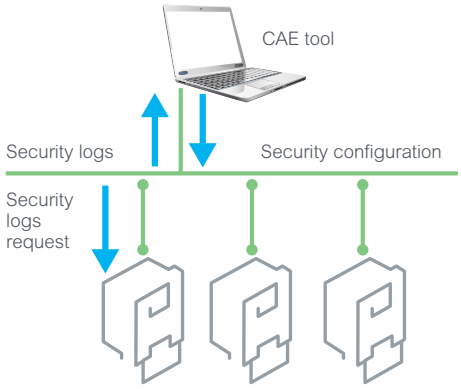
PowerLogic P7 leverages of EcoStruxure Cybersecurity Admin Expert (CAE), a comprehensive and intuitive, software-based, cybersecurity configuration and policy tool for your operational technology environment.

EcoStruxure Cybersecurity Admin Expert (CAE) facilitates operations and maintenance, being a single interface to manage and perform a mass update of your security configuration to the entire system.

CAE is free-of-charge and helps to:

- Define the security policy, including for example: password complexity or password strategy.
- Define rules for security logs, choose between NERC CIP, BDEW, P1686 2014 or a combination.
- Define the RBAC (Role Base Access Control) parameters of your environment.
- Define system or device users and assign one or several roles per user customized based on organization.
- Retrieve security logs including several Schneider Electric devices.

DM107145



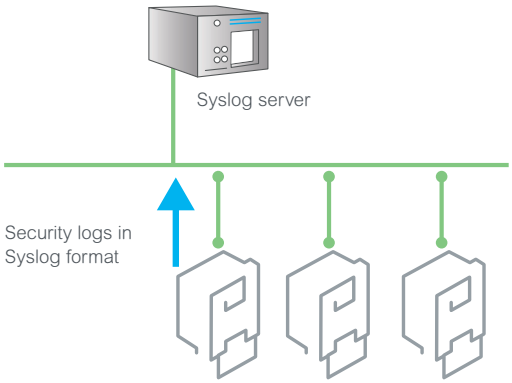
In summary, PowerLogic P7 becomes part of a cybersecurity management system consisting of servers for security logs, authentication, and authorization, using standard network protocols.

EcoStruxure Cybersecurity Admin Expert (CAE) facilitates the management of cybersecurity in your electrical network's operational technology (OT) from policy definition, thru configuration, commissioning, operation, and maintenance stages.

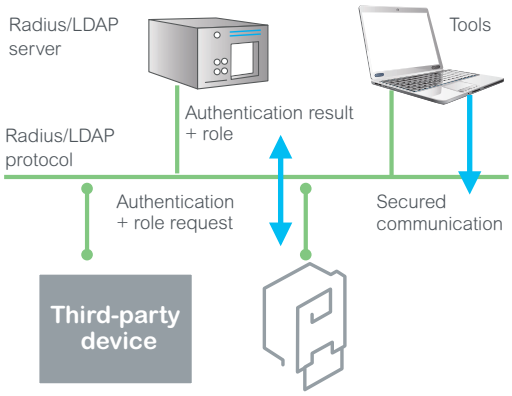
Cybersecurity

Cybersecurity - Advanced Level

DM107146



DM107147



Two use Cases are Available for Authentication and Authorization Features:

Local Authentication and Authorization

In this use case, local authentication and authorization don't rely on any external servers. Security configuration is stored locally in each PowerLogic P7. User authentication and authorization using associated roles are performed locally (RBAC). CAE is used to update the global security configuration of all the PowerLogic P7 devices located inside the substation, so that users, associated passwords, and other parameters are consistent on all devices.

Centralized Authentication and Authorization

In this use case, centralized authentication and authorization relies on one or two Radius/LDAP servers with the IEC 62351-8 extension.

This allows the use of a Unified Account management system shared across heterogenous solutions. The same credentials are used at the front panel of each device, tools and also third-party devices.

The Radius/LDAP server is in charge of authenticating users and providing the associated role. Then PowerLogic P7 allow access based on this role and the internal security configuration (RBAC).

Schneider Electric can also provide an IEC62351-8 compliant Radius server already configured with authorization. This server allows a fast and reliable solution, managed by the CAE software, including a syslog server.

Life Is On Schneider Electric

PowerLogic™ P7
Product Description

PowerLogic™ P7 Product Description

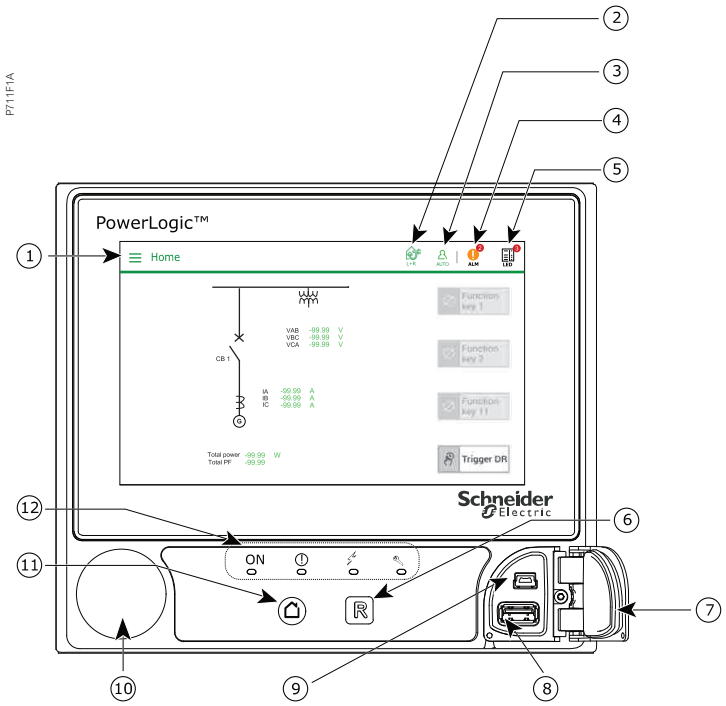
Life Is On Schneider Electric

Base Unit Description

Front Panel Description

Front panel

PUSH BUTTONS	
	HOME key: push-button for cancelling the operation or returning to the home page
	Reset control key to release latches, BOs, alarms and LEDs
PHYSICAL LEDs	
ON	ON: device is powered on
	ALARM: an alarm is active
	TRIP: a trip has occurred
	MAINTENANCE: the device is not fully functional or in test mode
1	Menu icon on the touchscreen display
2	Remote /Local mode icon on the touchscreen display
3	User icon on the touchscreen display
4	Alarm icon on the touchscreen display
5	Virtual LED icon on the touchscreen display
6	Reset key
7	USB door
8	Not available (future use: USB A connector for data transfer)
9	Mini-USB connector for connecting laptop
10	Reference label
11	Home key
12	Physical LEDs



LEDs

There are four LEDs located on the front panel representing the status of the PowerLogic P7 regarding power, alarm, trip, and operation mode.

Additional virtual LEDs (24 in total) can be configured via PowerLogic Engineering Suite. They can be configured in three different colors: green, red, yellow, and gray (off), and be individually latched or self-reset. Please see the PowerLogic P7 User Manual for configuration instructions.

Working Languages

All texts and messages displayed on the PowerLogic P7 HMI are available in English, French, German, Spanish, Polish, and Chinese.

Dimensions and Weight

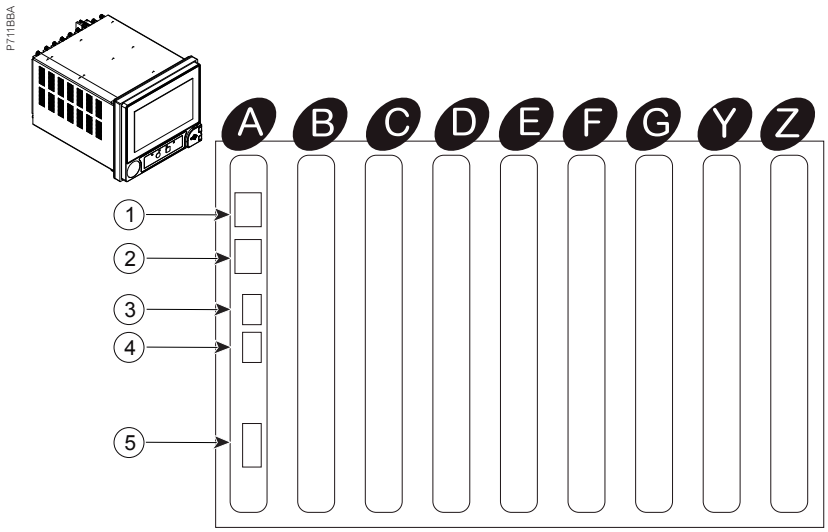
Dimensions	mm	in
Height	180	7
Width	205	8
Depth	280	11
Weight	**kg**	**lb**
Weight (maximum)	8.8	19.4

Base Unit Description

Rear Panel Description

Rear panel layout

The PowerLogic P7's rear panel contain the following modules installed in slots and identified by letters.



PowerLogic P7	Slot: Module and port
✓	A: CPU • ① EXT: CAN bus port for connection with additional accessories like IRIG-B module, RTD module. • ② Port 1: Single Ethernet communication port (RJ45) • ③ Port 2 (optional): SFP (RJ45/100 Mb/s multimode/100 Mb/s singlemode) with HSR/PRP or RSTP redundancy • ④ Port 3 (optional): SFP (RJ45/100 Mb/s multimode/100 Mb/s singlemode) with HSR/PRP or RSTP redundancy • ⑤ Serial port: 2-wire RS485
✓	B-C (2 slots): CT/VT analog input module (6CT + 3VT or 5CT + 4VT);
Optional	D-E (2 slots): CT/VT analog input module (6CT + 3VT or 5CT + 4VT); D/E/F/G: MIO (mixed binary input/output module), CTR (Direct motor control module).
✓	Y: TIO (power supply unit auxiliary)
✓	Z: PSU (power supply unit)

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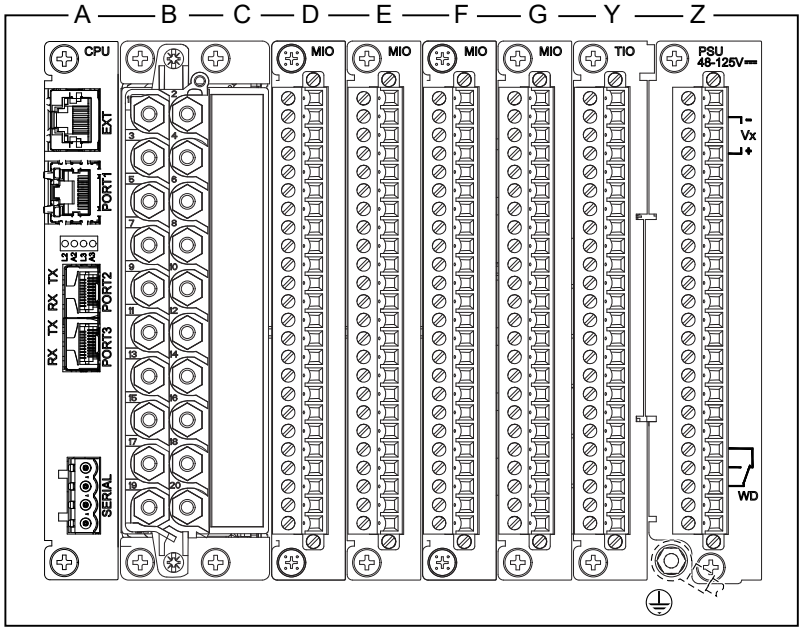
Base Unit Description

Rear Panel Terminals

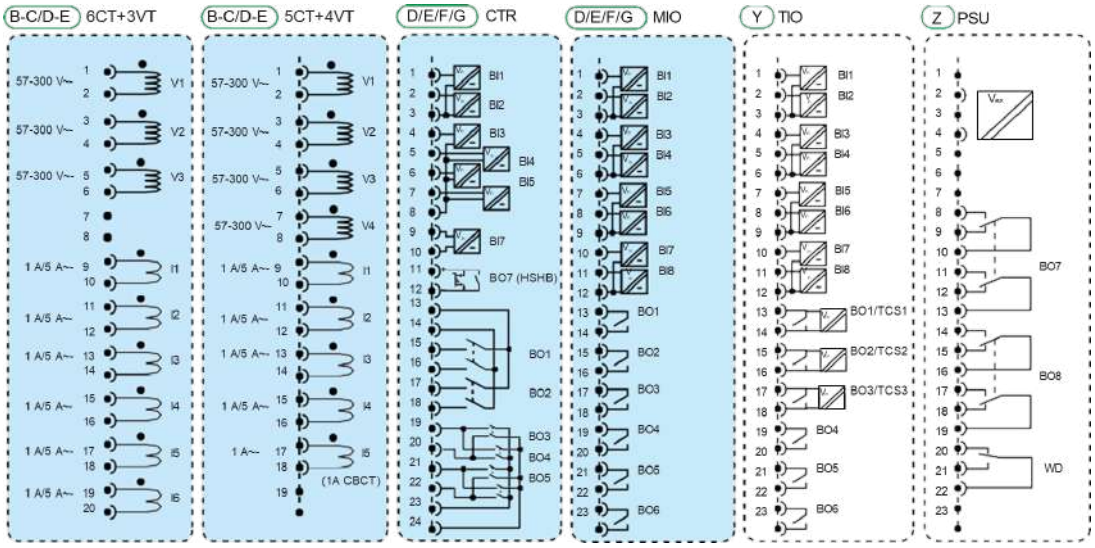
Rear Panel Terminals

PM107490



Example with slots B and C for CT/VT analogue input module, slots D to G for mixed I/O modules).

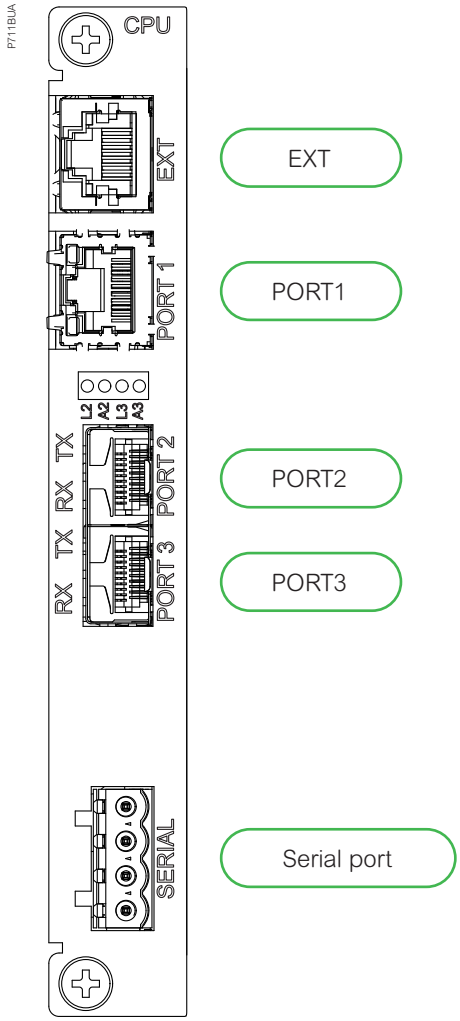
Rear Terminal Designations



= Optional
Ix = Current
BIx = Binary input
BOx = Binary output
Vx = Voltage
CBCT = Core balance current transformer
WD = Watchdog contact
TCS = Trip Circuit Supervision

Base Unit Description

Rear Communication Ports



Extension Port

The extension port is a CAN bus port located at the slot A (CPU) of the device.

The following PowerLogic P7 accessories can be connected to the extension port:

- IRIG-B module (see IRIG-B module (reference REL51045)
- MET148-2 temperature sensor module (see MET148-2 - temperature sensor module (reference 59641)

Port 1: Ethernet Communication Port

Port 1 is a single Ethernet communication port with fixed RJ45 connector and it is located at slot A (CPU).

Port 2 and 3: Optional Ethernet SFP Modules

The SFP modules are inserted in port 2 and/ port 3 of the slot A (CPU). It can be selected as an accessory when ordering the device or purchased later and installed on site.

The SFP modules are available for copper wire, multi-mode fiber optic or singlemode fiber optic connection. The SFP modules with RJ45 or LC connector provide RSTP (Rapid Spanning Tree Protocol), PRP (Parallel Redundancy Protocol), HSR (High-availability Seamless Redundancy) and Failover selectable by configuration.

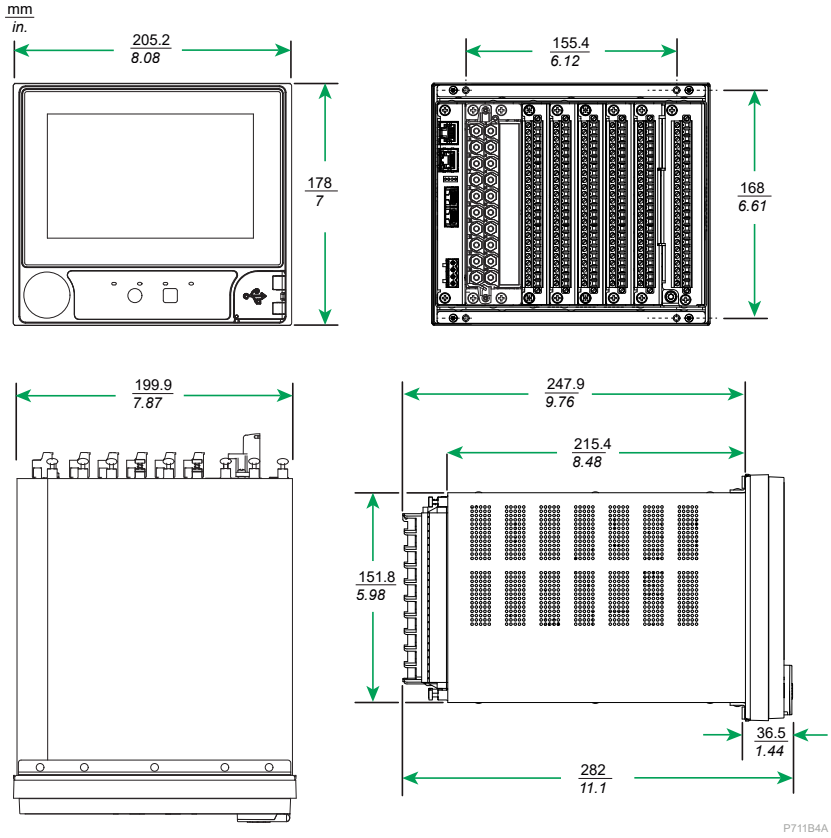
RS485 Serial Communication Port

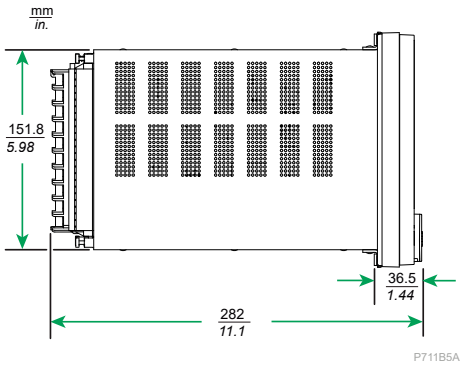
The PowerLogic P7 can be connected to any 2-wire RS485 half duplex communication network and can exchange the data necessary for centralized management of the electrical installation by SCADA.

Life Is On Schneider Electric

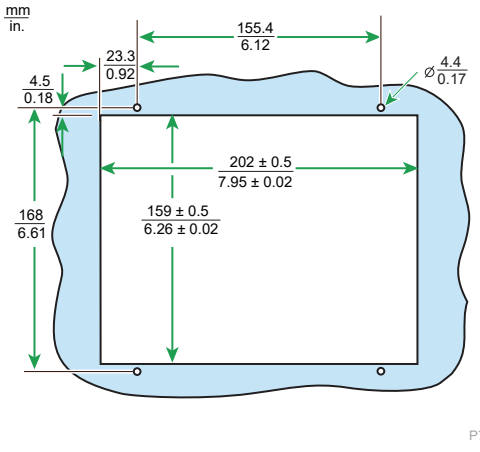
Base Unit Description

Dimensions and Weight





Flush Mounting Installation



Cut-out dimensions	mm	in
Height	159	6.26
Width	202	7.95

NOTE: Please see the appropriate Safety Guide or User Guide for correct installation information.

Connection Diagrams

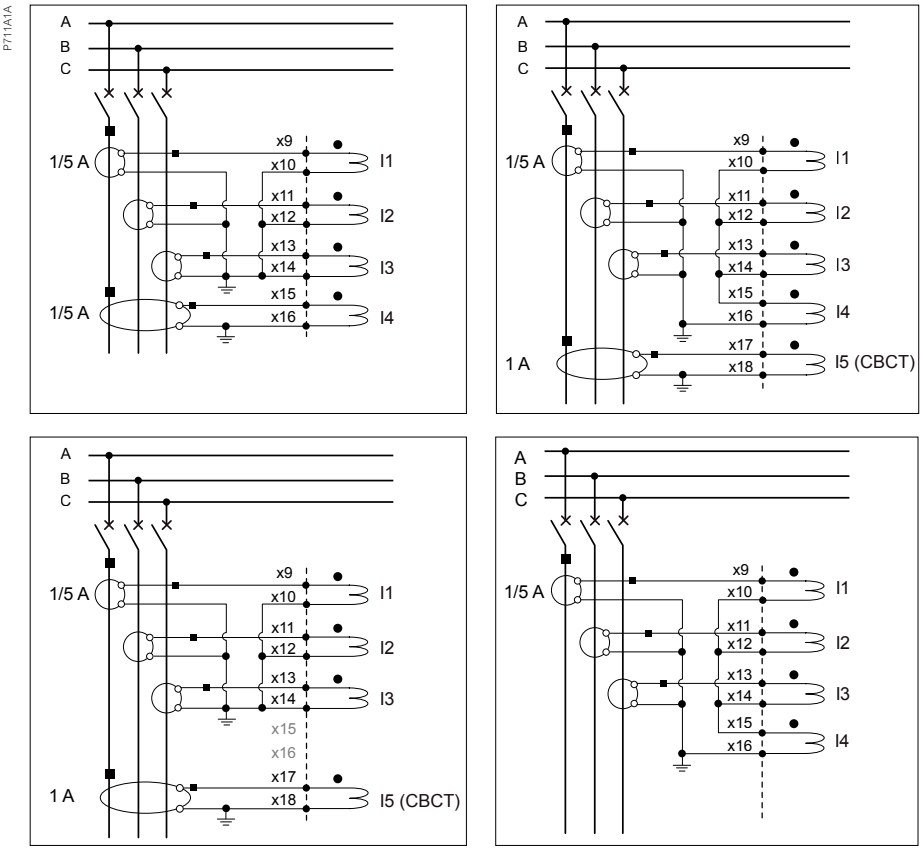
Typical Application Diagrams

CT Typical Application

The following sections describe typical application diagrams.

NOTE: Since the flexible hardware configuration of the PowerLogic P7, the slot number and terminal number of the binary I/O modules in the following diagrams are just for an example. The actual number should be based on the location of the PSU module, CPU module and the number of other modules such as CT/VT, I/O.

Three Phase and Ground Connection



CBCT: Core balance current transformer

x: The first slot used by the CT/VT analog module which takes 2 slots. For example, if the analog module is fitted in slots B & C then x1 becomes B1.

NOTE: Please see the appropriate User Guide or user manual for correct installation information.

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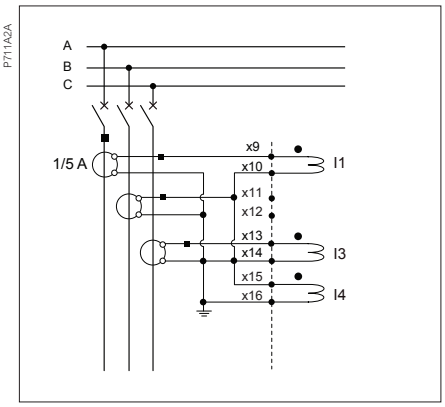
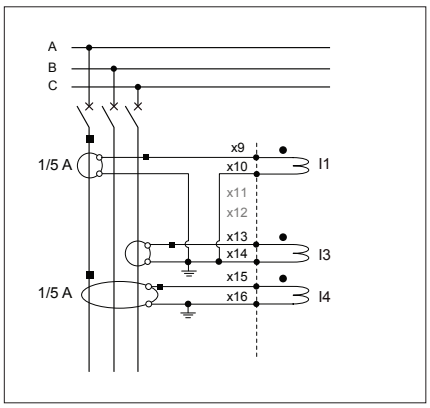
Connection Diagrams

Typical Application Diagrams

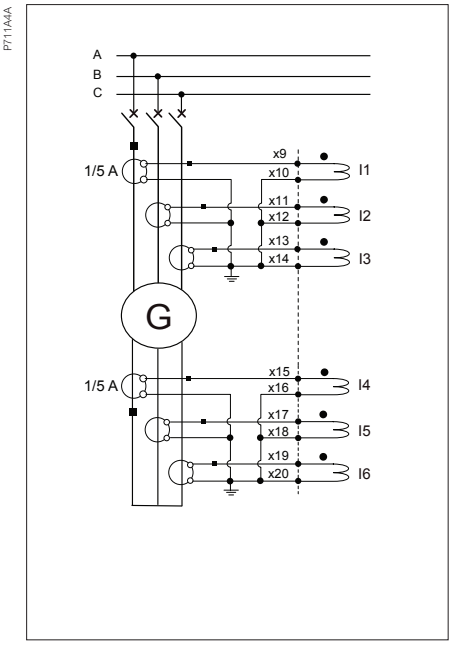
CT Typical Application (cont'd)

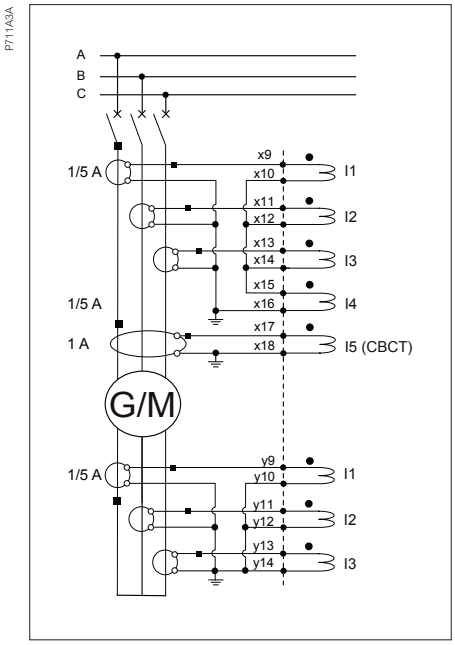
Two Phase and Ground Connection





Three Phase Connection for Differential Application





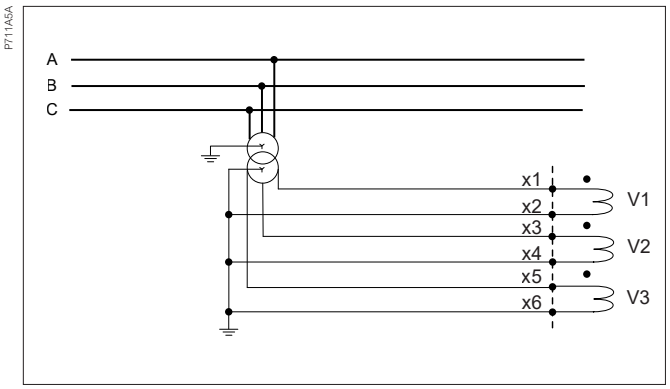
NOTE: Please see the appropriate User Guide or user manual for correct installation information.

Connection Diagrams

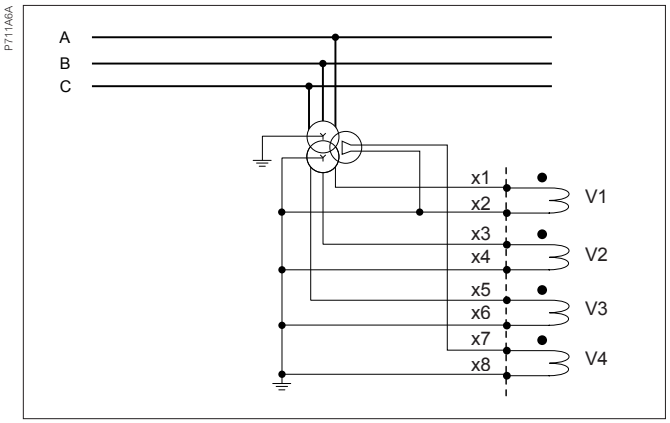
Typical application Diagrams

Voltage Transformer Application

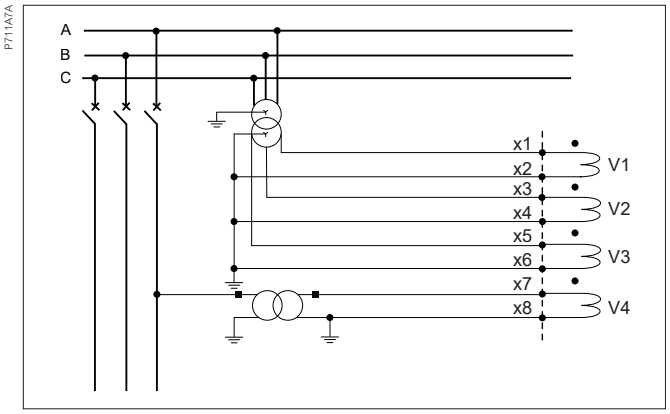
Three Phase-to-Ground Voltages



Three Phase-to-Ground Voltages and One Neutral Voltage



Three Phase-to-Ground Voltages and One Phase-to-Ground Voltage



NOTE: Please see the appropriate User Guide or user manual for correct installation information.

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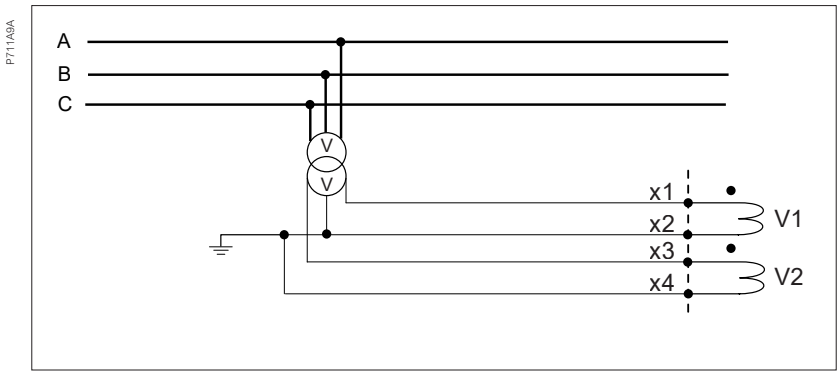
Connection Diagrams

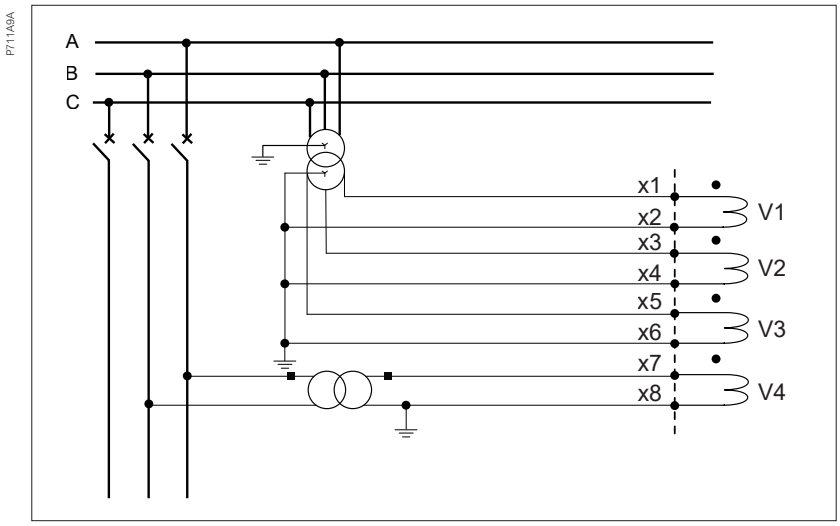
Typical Application Diagrams

Voltage Transformer Application (cont'd)

Two Phase-to-Phase Voltages



Two Phase-to-Phase Voltages



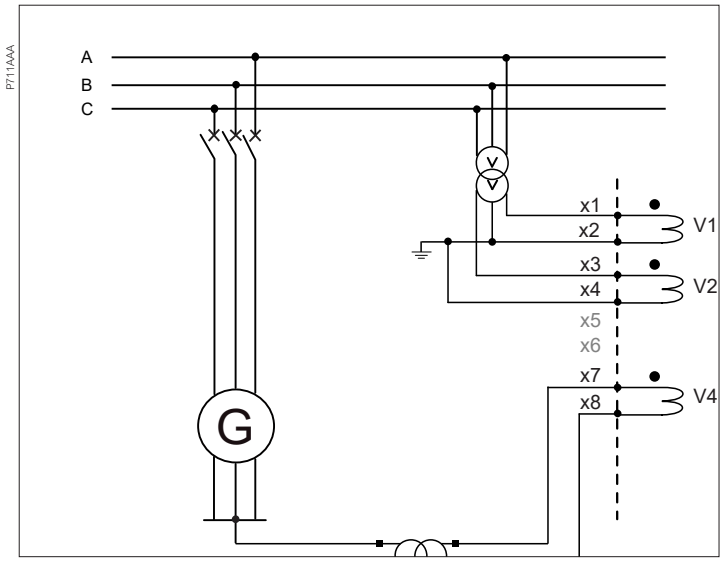
NOTE: Please see the appropriate User Guide or user manual for correct installation information.

Connection Diagrams

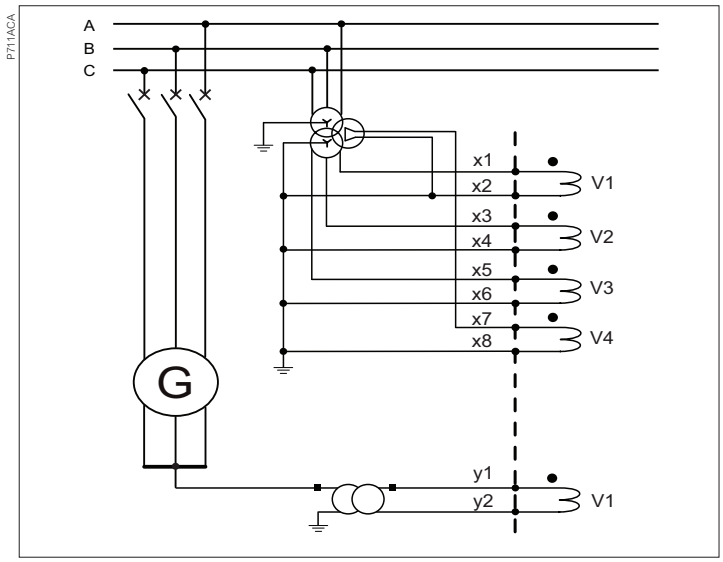
Typical Application Diagrams

Voltage Transformer Application (cont'd)

Two Phase-to-Phase Voltages and One Neutral Voltage



Three Phase-to-Ground Voltages and Two Neutral Voltages



NOTE: Please see the appropriate User Guide or user manual for correct installation information.

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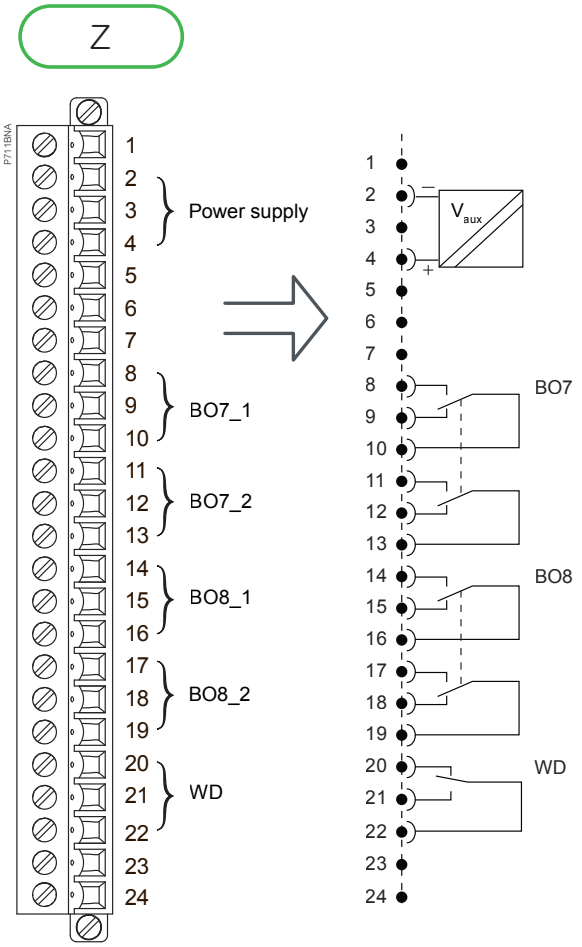
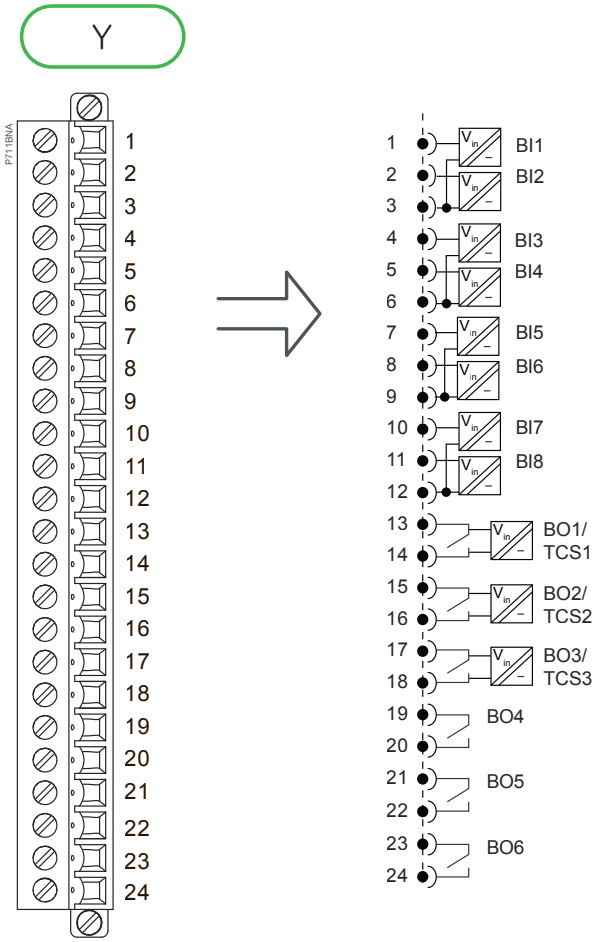
Connection Diagrams

Power supply, Inputs and Outputs

Slot Z: Power supply Module (PSU)



Slot Y: Auxiliary Power supply Module (TIO)



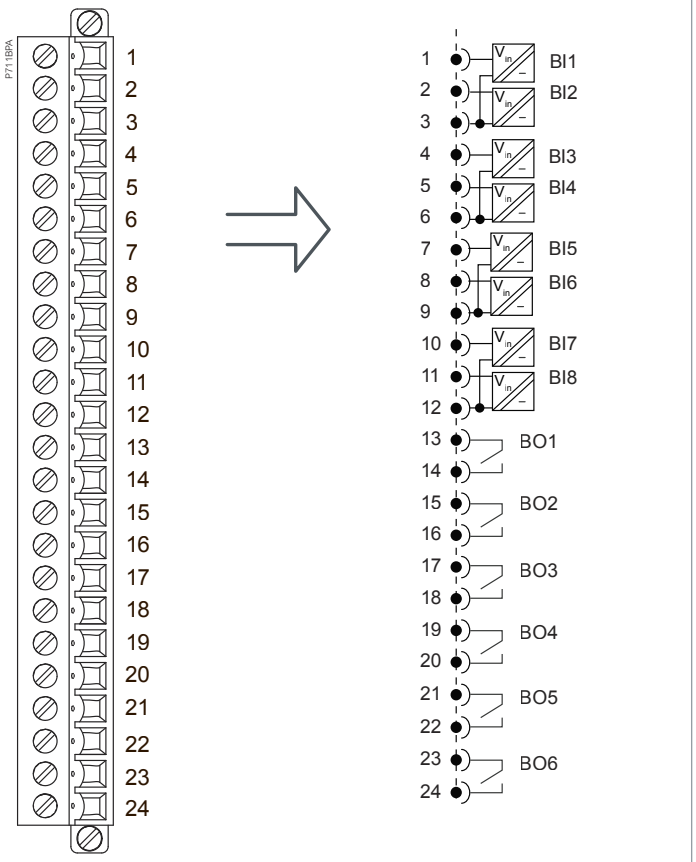
NOTE: Please see the appropriate User Guide or user manual for correct installation information.

Connection Diagrams

Power supply, Inputs and Outputs

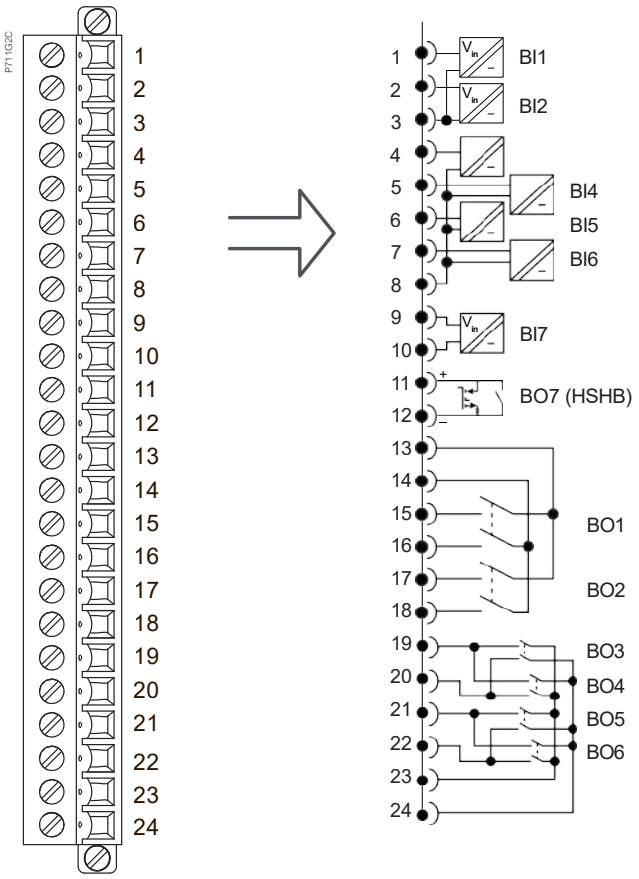
Slot D, E, F, G: Additional Mixed Binary Input/Output (MIO) Modules (8I6O)

D/E/F/G



Slot D, E, F, G: Additional Direct Motor Control (CTR) Module (7I7O)

D/E/F/G



NOTE: Please see the appropriate User Guide or user manual for correct installation information.

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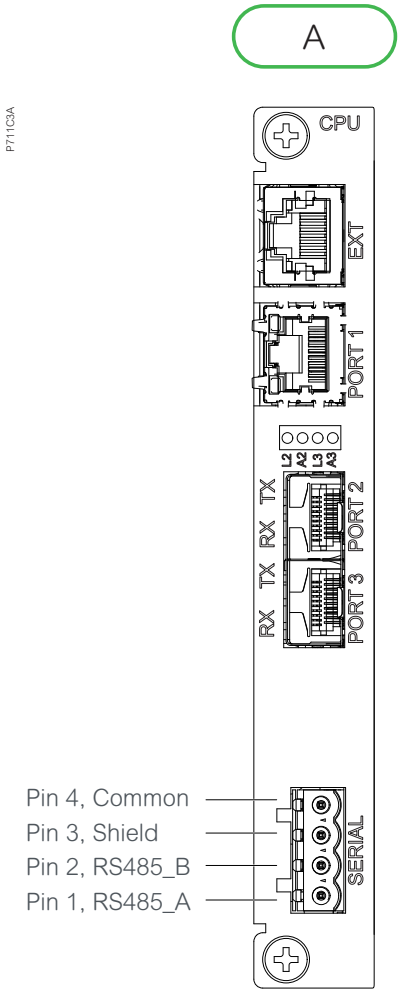
Connection Diagrams

Rear Communication Ports

Slot A: Rear Communication Ports



PowerLogic P7	
EXT	CAN bus port for connection with accessories like IRIG-B module, RTD module
PORT1	Single Ethernet communication port with RJ45 connector
PORT2	Optional SFP accessories: • Ethernet communication module RJ45 • Ethernet communication module 100 Mb/s fiber optic multimode • Ethernet communication module 100 Mb/s fiber optic singlemode
PORT3	Optional SFP accessories: • Ethernet communication module RJ45 • Ethernet communication module 100 Mb/s fiber optic multimode • Ethernet communication module 100 Mb/s fiber optic singlemode
Serial port	2-wire RS485 serial port

NOTE: Please see the appropriate User Guide or user manual for correct installation information.

Technical Characteristics

Power supply, Inputs and Outputs

Electrical Characteristics

Characteristic	Value
Power system frequency	
Rated frequency	50 Hz or 60 Hz
Operation frequency	
Operation frequency range	10...70 Hz
Frequency range (at claimed accuracy)	40...70 Hz
Power supply	
Operating range	Low range: DC: 24...34 Vdc, ±20% Mid-range: DC: 48...125 Vdc, ±20% High range: DC: 110...250 Vdc, -20...+20% AC: 110...250 Vac, -27...+15%
AC frequency operating range	50 Hz, ±10%; 60 Hz, ±10%
MCB recommendation	DC: 6 A; AC: 10 A
Burden DC	Typical: 24 W, maximum: 45 W
Burden AC	Typical: 60 VA, maximum: 112 VA at 230 Vac Typical: 48 VA, maximum: 75 VA at 100 Vac
RTC retention time	
RTC retention time	1 month typical, 1-week guaranteed[1]
Standard CT inputs	
CT secondary phase current	1 A or 5 A
Dynamic range	64 x CT rated current (or 32 x CT rated current + 32 x CT rated current DC offset)
Thermal withstand	Continuous: 20 A 1 s: 500 A Half period: 1250 A
Input impedance	< 0.01 Ω
Burden	< 0.03 VA at 1 A; < 0.3 VA at 5 A
Core balance CT	
CT rated secondary current	1 A
Dynamic range	20 A
Thermal withstand	Continuous: 4 A 1 s: 100 A Half period: 250 A
Input impedance	< 0.05 Ω
Burden	< 0.05 VA
VT inputs	
VT rated secondary voltage	100...440 V RMS (phase-to-phase). Phase-to-neutral connection must be used above 300 V.
Burden	< 0.01 VA
Binary inputs	
Operating nominal voltage	24...250 Vdc 220...250 Vac
Voltage withstand	300 V DC, 300 V rms
Standard binary output	
Contact rated voltage	250 Vdc or 250 Vac, 50 Hz or 60 Hz
Continuous current	Max: 8 A (UL: 5 A on MIO/TIO module, 2 A on PSU module)
Short duration withstand carry	30 A, 3 s 250 A, 30 ms

1 This value can be affected by high temperatures.

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Technical Characteristics

Power supply, Inputs and Outputs

Electrical Characteristics (cont'd)

Characteristic	Value
Standard binary output (cont'd)	
Make and break capacity	DC: 50 W resistive DC: 62.5 W inductive (L/R = 50 ms) AC: 2500 VA resistive (cosΦ = unity) AC: 2500 VA inductive (cosΦ = 0.7)
Make and carry	30 A for 3 s, DC resistive. 10000 operations (subject to the above limits of make/break capacity and rated voltage)
Make carry and break	30 A for 200 ms, AC resistive. 2000 operations (subject to the above limits of make/break capacity & rated voltage). 4 A for 1.5 s, DC resistive. 10,000 operations (subject to the above limits of make/break capacity & rated voltage). 0.5 A for 1 s, DC inductive. 10,000 operations (subject to the above limits of make/break capacity & rated voltage). 10 A for 1.5 s, AC resistive/inductive. 10000 operations (subject to the above limits of make/break capacity & rated voltage).
Operate time	< 5 ms, bounce time not included
Reset time	< 5 ms, bounce time not included
Loaded contact	10000 operations minimum
Unloaded contact	100000 operations minimum
High break (HSHB) binary output	
Contact rated voltage	250 V dc
Continuous current	Max: 10 A
Short duration withstand carry	30 A, 3 s 250 A, 30 ms
Mark and Break capacity	DC: 7500 W resistive DC: 2500 W inductive (L/R = 40 ms)
Make carry and break	30 A for 200 ms, DC resistive 10,000 operations (subject to the above limits of make/break capacity & rated voltage) 10 A for 1s, DC inductive 10,000 operations (subject to the above limits of make/break capacity & rated voltage)
Loaded contact	10,000 operations minimum
Unloaded contact	100,000 operations minimum
Operating time	< 0.2 ms
Reset time	< 8 ms
Watchdog binary output	
Contact rated voltage	240 Vdc or 240 Vac, 50 Hz or 60 Hz
Continuous current	2 A
Short duration withstand carry	30 A, 0.2 s
Minimum making current	10 mA with 50 mW minimum
Make and carry	1000 W with L/R = 40 ms 250 Vdc 1150 VA 230 Vac Duty cycle 1 s ON, 9 s OFF
Make, Carry & Break	30 W with L/R = 40 ms 250 Vdc 1150 VA 230 Vac Duty cycle 1 s ON, 9 s OFF
Loaded contact	10000 operations minimum
Unloaded contact	100000 operations minimum

Technical Characteristics

Power supply, Inputs and Outputs

Electrical Characteristics (cont'd)

Characteristic	Value
Size and weight	
40TE Case size (Width x Height x Depth)	205/180/280 mm (8/7/11 in) 250 mm depth in panel
Weight	Maximum weight: 8.8 kg (19.4 lb) (two analog boards and two mixed I/O boards)
Current Measurement (Phase Current)	
Measurement range	0.01...40 pu
Unit	A
Resolution	0.0001 pu
Accuracy	±5% for range 0.01...40 pu (symmetrical waveforms) ±1% for range 0.02...20 pu ±0.1% for range 0.2...2 pu
Current Measurement (Phase Angle)	
Range	-180°...+180°
Resolution	0.1°
Accuracy	±5° for range 0.01...40 pu ±1° for range 0.02...20 pu ±1° for range 0.2...2 pu
Current Measurement (Neutral Current)	
Measurement range	IN calculated: 0.01...40 pu IN measured by 1 A / 5 A CT: 0.01...40 pu IN measured by 1 A core balance CT: 0.002...4 A
Unit	A
Resolution	0.0001 pu
Accuracy, IN	Calculated by standard CT: ±5% for range 0.01...40 pu (symmetrical waveforms) ±1% for range 0.02...20 pu Measured by standard CT: ±10% for range 0.001...8 pu (rated secondary: 5 A) ±5% for range 0.01...40 pu (symmetrical waveforms) ±1% for range 0.02...20 pu ±0.1% for range 0.2...2 pu Measured by core balance CT: ±5% for range 0.001...4 pu ±1% for range 0.002...0.2 pu ±0.1% for range 0.2...2 pu
Voltage Measurement (Secondary Voltage)	
Measurement range	0...500 V secondary
Unit	V
Resolution	0.001 V
Accuracy	0.1% (46...300 V), 3% (3...500 V)
Voltage Measurement (Phase Angle)	
Range	-180°...+180°
Resolution	0.01°
Accuracy	0.1° (46...300 V), 2.5° (3...500 V)

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Technical Characteristic

Other Characteristics

Environmental Characteristics

Characteristic	Description/Value		
Power Supply			
Characteristics	Standard	Level/Class	Value
Voltage dips (DC)	IEC 61000-4-29		200 ms voltage dips 0%, 250 Vdc and above, Criteria A 100 ms voltage dips 0%, 110 Vdc 50 ms voltage dips 0%, 48 Vdc 50 ms voltage dips 0%, 24 Vdc
Ripple (DC)	IEC 61000-4-17		15%; 100 Hz/120 Hz, Criteria A
Voltage dips (AC)	IEC 61000-4-11		Criteria A 10 cycles, voltage dips 0%, 240 V AC 5 cycles, voltage dips 0%, 110 Vac
Product Safety			
Characteristics	Standard		Value
Insulation characteristics	IEC 60255-27		Insulation resistance > 100 MΩ at 500 Vdc (except VT port) Using only electronic/brushless insulation tester.
Creepage distances and clearances	IEC 60255-27		Pollution degree 2, Overvoltage category III
High voltages withstand (dielectric)	IEC 60255-27		2 kV rms AC, 1 min: between all case terminals connected together, and the case ground 2 kV rms AC, 1 min: between all terminals of independent circuits 1 kV rms AC for 1 min: across normally open control and signaling contacts 1 kV rms AC for 1 min: between RJ45 ports and the case ground None for internal connection IRIG-B port. None for high speed, high break control relay output due to solid state devices across normally open contact.
	IEEE C37.90		1.5 kV rms, 1 min: across open tripping contacts
Impulse voltage	IEC 60255-27		1.2 µs, 50 µs, 5 kV, 0.5 J between all terminals of independent circuits, and all terminals and case ground. 1.2 µs, 50 µs, 1.5 kV, 0.5 J between RJ45 ports and the case ground.
Electromagnetic Compatibility			
Characteristics	Standard	Level/Class	Value
Emission test			
Radiated disturbances	CISPR22 CISPR11 IEC 60255-26	Class A	
Conducted disturbances	CISPR 22 IEC 60255-26	Class A	
Radiated disturbances immunity tests			
Radiated radio frequency fields	IEC 61000-4-3	Level 3	10 V/m, 80 MHz...6 GHz, 80% AM (1 kHz) 30 V/m, 800 MHz...960 MHz/1.4 GHz...2 GHz, 80% AM (1 kHz)
	ANSI C37.90.2		20 V/m, 80 MHz...1GHz, 80% AM (1 kHz) 35 V/m, 80 MHz...1GHz, 100% pulse
Electrostatic discharges	IEC 61000-4-2	Level 4	15 kV air, 8 kV contact
	ANSI C37.90.3		15 kV air, 8 kV contact
Magnetic field at power frequency	IEC 61000-4-8	Level 5	100 A/m continuous; 1000 A/m, 1...3 s[1]

1 When protection function 50N/51N is used, test for 1000 A/m, an accuracy of 2% or 0.0025In at the lowest pickup value setting is required.

Technical Characteristic

Other Characteristics

Environmental Characteristics (cont'd)

Characteristic	Description/Value		
Pulse magnetic fields	IEC 61000-4-9	Level 5	1000 A/m
Oscillatory magnetic fields	IEC 61000-4-10	Level 5	100 A/m, 100 kHz and 1 MHz
Conducted Radio Frequency disturbances			
Conducted Radio Frequency disturbance	IEC 61000-4-6	Level 3	10 V rms common mode, 0.15...80 MHz, 80% AM (1 kHz)
Fast transient bursts	IEC 61000-4-4	Level 4	4 kV common mode, 5 kHz, 100 kHz
	ANSI C37.90.1		4 kV, 5 kHz, common mode and transversal mode
Slow damped oscillatory waves	IEC 61000-4-18	Level 3	2.5 kV common mode 1 kV differential mode, 100 kHz, 1 MHz
	ANSI C37.90.1		2.5 kV, 1 MHz, common mode and transversal mode
	IEC 61000-4-12	Level 3	2 kV common mode; 1 kV, differential mode, 100 kHz Source impedance: 12 Ω
Fast damped oscillatory waves	IEC 61000-4-18	Level 3	2 kV common mode, 3 MHz, 10 MHz, 30 MHz
Conducted disturbances 0 to 150 kHz	IEC 60255-26	Zone A	150 V rms, differential mode; 300 V rms, common mode
Surges[2]	IEC 61000-4-5	Level 4	4 kV, common mode; 2 kV, differential mode
Environmental conditions			
Characteristics	Standard	Test Method	Value
Operation			
Exposure to cold	IEC 60068-2-1	Ae	-40 °C (-40 °F), 96 hours.
Exposure to dry heat	IEC 60068-2-2	Be	+70 °C (+158 °F), 96 hours
UL test	UL 508	–	55 °C (131 °F), device operated continuously with 50% of contacts energized; 5 A on MIO/TIO module, 2 A on PSU module
Exposure to damp heat	IEC 60068-2-78	Cab	93% ± 3% RH; 40 °C (+104 °F), 56 days, without condensation
Temperature variation	IEC 60068-2-14	Nb	-40...+70 °C (-40...+158 °F), 1 °C/min (1.8 °F/min) 5 cycles
Damp heat cyclic test	IEC 60068-2-30	Db Variant 1	55°C/93% ± 3% RH and 25°C/97% -2% +3% RH, with condensation, 6 cycles (12 h + 12 h)
Storage			
Exposure to cold	IEC 60068-2-1	Ab	-40 °C (-40 °F), 96 hours
Exposure to dry heat	IEC 60068-2-2	Bb	+85 °C (+185 °F), 96 hours
Exposure to damp heat	IEC 60068-2-78	Cab	93% ± 3% RH; 40 °C (+104 °F), 56 days, without condensation
Corrosive atmosphere			
Salt mist	IEC 60068-2-52	Kb/1	4 spraying periods of 2 hours with a storage of 7 days after each
2 Gas	IEC 60068-2-60	Ke	+25°C (+77°F), 75% RH, 21 days method 1: 0.5 ppm SO_2; 0.1 ppm H_2S
4 Gas	IEC 60068-2-60	Ke	+25°C (+77°F), 75% RH, 21 days method 4: 0.11 ppm SO_2; 0.071 ppm H_2S; 0.034 ppm Cl_2, 0.26 ppm NO_2. (according to IEC 60721-3-3 level 3C2 concentration)
Mechanical Robustness			
Characteristics	Standard	Level	Value
Vibration response	IEC 60255-21-1	Class 2	1 Gn, 10...150 Hz
Vibration endurance	IEC 60255-21-1	Class 2	2 Gn, 10...150 Hz
Shock response	IEC 60255-21-2	Class 2	10 Gn, 11 ms
Shock withstand	IEC 60255-21-2	Class 1	15 Gn, 11 ms
Bump	IEC 60255-21-2	Class 1	10 Gn, 16 ms
Seismic test	IEC 60255-21-3	Class 2	2 Gn horizontal; 1 Gn vertical

2 It is recommended to use operation time of at least 30 ms at the lowest pickup value setting.

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Technical Characteristic

Other Characteristics

Environmental Characteristics (cont'd)

Characteristic	Description/Value		
Enclosure			
Front panel	IEC 62262	IK07	Degree of protection against mechanical impacts
	IEC 60529	IP54	Front panel
	NEMA	Type 12	
Rear panel	IEC 60529	IP20	Except area with ring terminal connection (analog inputs)
Case	IEC 60529	IP30	Except area with rear terminals
Fire resistance			
Fire resistance	IEC 60695-2-11		650 °C (1202 °F)
Packaging			
Resistance to shocks by free fall (with packaging)	IEC 68068-2-31		1 m (3.28 ft)
Certification/declaration			
CE European Commission's directives	EN 60255-26:2013		Electromagnetic Compatibility Directive (EMCD) 2014/30/EU
	EN 60255-27:2014		Low Voltage Directive (LVD) 2014/35/EU
	EN IEC 63000:2018		Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (ROHS) Directive 2015/863/EU
UK CA United Kingdom regulations	BS EN 60255-26:2013		Electromagnetic Compatibility (EMC) Regulations SI 2016 No. 1091
	BS EN 60255-27:2014		Electrical equipment (safety) regulations SI 2016 No. 1101
	BS EN IEC 63000:2018		Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (ROHS) regulations SI 2012 No.3033
c UL us LISTED UL Standards	UL 508 ANSI/IEEE C37.90 CAN/CSA C22.2 No.14		File E518585, NRGU

Digital Experience

Digital Experience

Setup Software

PowerLogic Engineering Suite

Comprehensive Digital Tools for Mobile, Tablet or Desktop

PowerLogic Engineering Suite Saves Time, Improves Efficiency

PowerLogic Engineering Suite is an easy-to-use, versatile tool with functionalities and features needed throughout the life cycle of Schneider Electric protection and control IEDs, including support for seamless integration into EcoStruxure Power & Grid.

- One Tool Suite for all connected products offline/online
- Flexible and adaptable for multiple personas
- User-experience driven with built in contextual help
- Modern ergonomic design
- Future-proof, IEC 61850 compliant

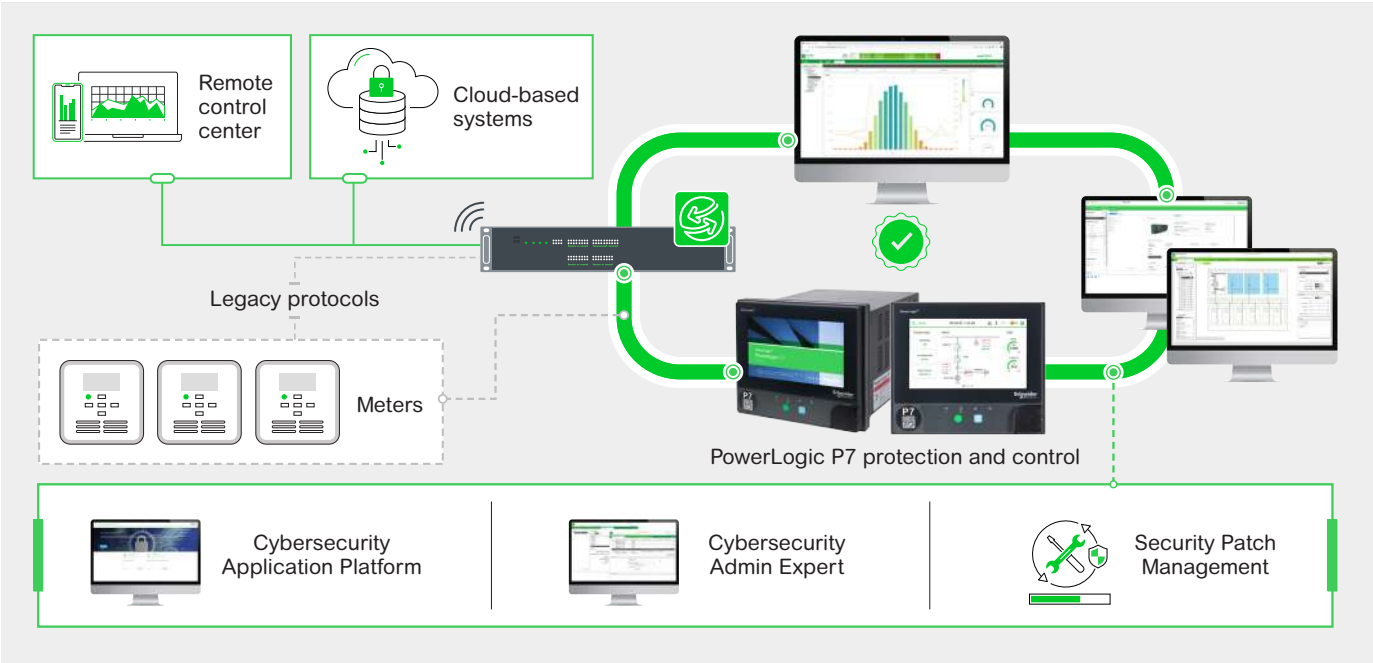
Full Operation from a Safe Distance

Digital tools provide simpler installation, configuration, and maintenance, enabling smoother operations, saved time and saved money. Digital tools include:

PowerLogic Engineering Suite our next generation of tools, for device and system architecture configuration, engineering, and maintenance

mySchneider allows to access product information and documentation in a very simple way, just by flashing the QR code on the device

Product Selector tool helps the user during the selection and configuration journey to select the product needed.



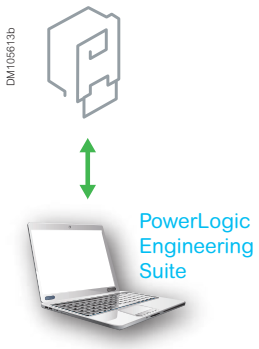
Configure, integrate, and maintain PowerLogic P7 devices in Schneider Electric's EcoStruxure™ Power Automation System (EPAS)

Setup Software

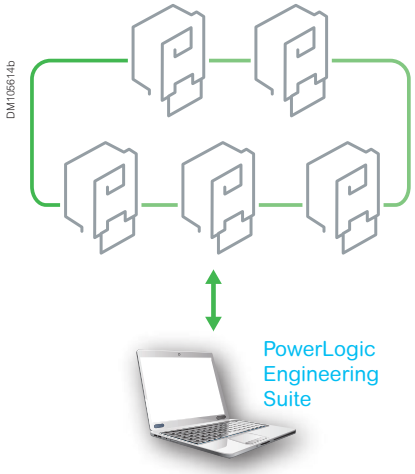
PowerLogic Engineering Suite

How to use PowerLogic Engineering Suite?

Use PowerLogic Engineering Suite in standalone mode during engineering to prepare the configuration.



Connect the PC running PowerLogic Engineering Suite to the USB port of the PowerLogic P7 during commissioning to adjust the settings and test the protection relay.



Connect the PC running PowerLogic Engineering Suite to the Ethernet network during operation to retrieve data from the protection relays and update the system.

Mobile Application

EB100314

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- Off-line and on-line catalog
- Manage and track your orders
- Advanced support

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Notes

Additional Modules and Accessories

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Additional Modules and Accessories

Communication Accessories

Modules

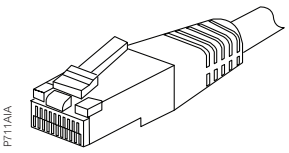
Optional SFP Modules

The optional SFP modules are inserted in port 2 and/or of the slot A (CPU). It can be selected as an accessory when ordering the device.

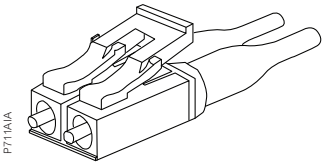
The SFP modules are available for copper wire, multi-mode fiber optic or singlemode fiber optic connection.

The SFP modules with RJ45 or LC connector provide RSTP (Rapid Spanning Tree Protocol), PRP (Parallel Redundancy Protocol), HSR (High-availability Seamless Redundancy) and Failover selectable by configuration.

REL70062: Ethernet SFP Module 100 Mb/s RJ45

Characteristics	
Location	Port 2 or Port 3 at slot A
Connection	RJ45 connectors with communication indicators  P711AIA
Ethernet connection	100 Mbps
Protocol	Failover, RSTP, HSR or PRP
Maximum cable length	100 m (32.8 ft)

REL70063: Ethernet SFP Module 100 Mb/s multimode

Characteristics	
Location	Port 2 or Port 3
Connection	LC connector  P711AIA
Ethernet connection	100 Mbps
Protocol	Failover, RSTP, HSR or PRP
Optical wavelength	850 nm
Fiber type	Multi-mode glass fiber
Maximum attenuation (fiber optic + connectors)	14 dB (at fiber optic diameter: 62.5/125 µm or 50/125 µm)
Maximum range	2000 m (3280.83 ft)

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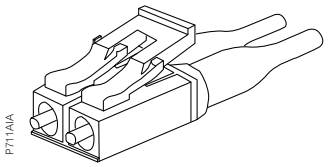
Communication accessories

Modules

REL70064: Ethernet SFP Module 100 Mb/s Singlemode

Characteristics	
Location	Port 2 or Port 3
Connection	LC connector  P711AIA
Ethernet connection	100 Mbps
Protocol	Failover, RSTP, HSR or PRP
Optical wavelength	1310 nm
Fiber type	Single-mode glass fiber
Maximum attenuation (fiber optic + connectors)	14 dB (at fiber optic diameter: 9/125 µm or 10/125 µm)
Maximum range	40 km (25 mi)

NOTE: Please contact Schneider Electric for availability.

IRIG-B Module

DM107171

REL51045: IRIG-B module

The IRIG-B module is an external module used for accurate time synchronization. It is connected to the extension port (EXT). It can be selected as an option when ordering the device or purchased later and installed on site. The module provides both a modulated (MOD INPUT) and an unmodulated input (UNMOD INPUT) and can automatically detect which input type is used by the user. No configuration of input type is needed in the PowerLogic P7 protection relay.

It does not require any auxiliary supply connection.

Mechanical characteristics	
Assembly	Symmetrical DIN rail

Modulated IRIG-B input	
Connection	BNC socket
Type of cable	50 ohms coaxial
Time code format	B124, B125 (1)
Input signal level	200mV...20V

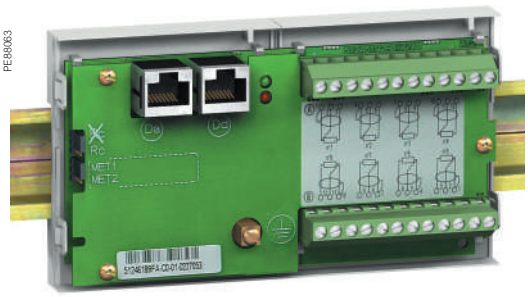
Demodulated IRIG-B input	
Connection	Screw-type terminals
Type of cable	Twisted pair
Time code format	B004, B005 (1)
Input signal level	TTL

(1) according to standard 200-04

Communication Accessories

Sensors

PE89063



Temperature Sensor Module

59641: Temperature Sensor Module

The Temperature sensor module is an external module used for temperature measurement with Resistance Temperature Detectors (RTDs). It is connected to the extension port (EXT). It can be selected as an option when ordering the device or purchased later and installed on site. It provides 8 RTD inputs.

It does not require any auxiliary supply connection.

Mechanical characteristics	
Assembly	Symmetrical DIN rail

RTD input	
Connection	Screw-type terminals
Type of cable	Shielded cable
Type of RTD	Pt100, Ni100, Ni120
Current injected in the RTD	4 mA

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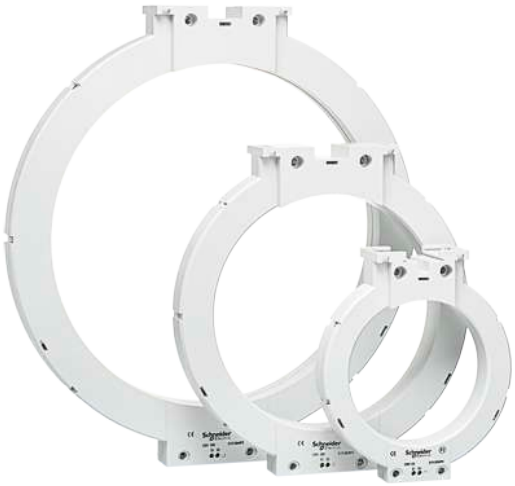
Communication Accessories

Sensors

DE88206



CSH120, CSH200 and CSH300 core balance CTs.

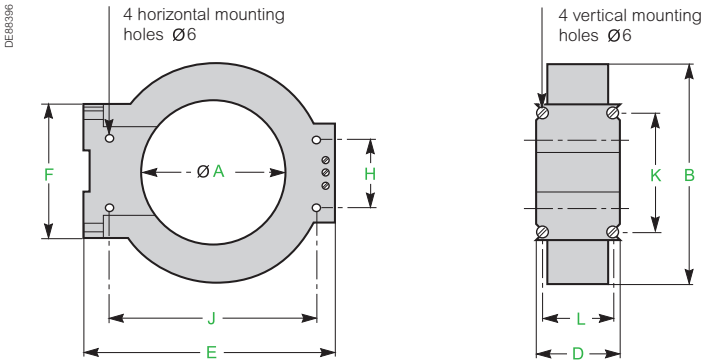
CSH Core-Balance Current Transformers

The CSH120, CSH200 and CSH300 core balance CTs are especially designed for direct residual or earth/ground fault current measurement. The only difference between them is the diameter. They can be connected to a standard or core balance input with a CT ratio set to 470:1

Core balance CT	REL59635: CSH120	REL59636: CSH200	REL59637: CSH300
Inner diameter	120 mm (4.72 in)	196 mm (7.72 in)	291 mm (11.46 in)
Weight	0.6 kg (1.32 lb)	1.4 kg (3.09 lb)	2.5 kg (5.51 lb)
Transformation ratio	1/470		
Maximum permissible current	20 kA - 1 s		

Dimensions

DE88396



	59635: CSH120		59636: CSH200		59637: CSH300	
	mm	in.	mm	in.	mm	in.
A	120	4.72	196	7.72	291	11.46
B	164	6.46	256	10.1	360	14.17
D	44	1.73	46	1.81	46	1.81
E	190	7.48	274	10.8	390	15.35
F	80	3.15	120	4.72	120	4.72
H	40	1.57	60	2.36	60	2.36
J	166	6.54	254	10	369	14.53
K	65	2.56	104	4.09	104	4.09
L	35	1.38	37	1.46	37	1.46

Services

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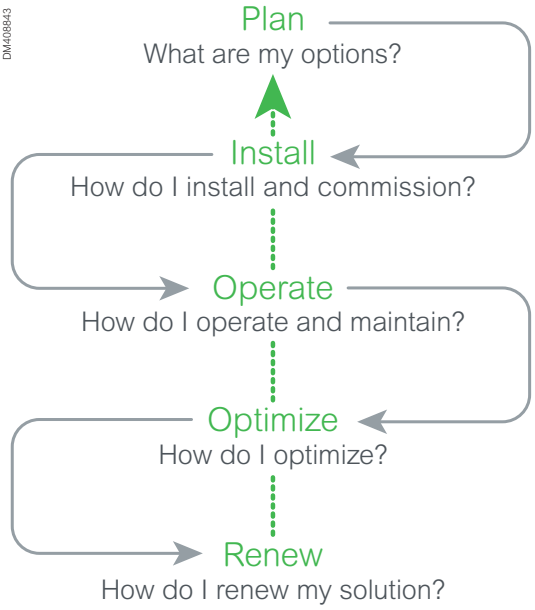
Services

Greater Peace of Mind Throughout your Installation Lifecycle

How can you reduce costs and improve performance at the same time?

When it comes to your electrical distribution infrastructure, the answer is straightforward: get professional expertise.

Life cycle services



Plan

Schneider Electric helps you plan the full design and execution of your solution, looking at how to make your process more dependable and optimize time:

- **Technical feasibility studies:** Design solution in your environment.
- **Preliminary design:** Accelerate turnaround time to reach a final solution design.

Install

Schneider Electric will help you to install more efficient, more reliable and safer solutions based on your plans:

- **Project management:** Complete your projects on time and within budget.
- **Commissioning:** Ensure your actual performance versus design, through on-site testing and commissioning, and tools and procedures.

Operate

Schneider Electric helps you maximize your installation uptime and control your capital expenditures through its services offering:

- **Asset operation solutions:** Provide the information you need to increase safety, enhance installation performance, and optimize asset maintenance and investment.
- **Advantage service plans:** Customize service plans that include preventive, predictive and corrective maintenance.
- **On-site maintenance services:** Deliver extensive knowledge and experience in electrical distribution maintenance.
- **Spare parts management:** Ensure spare parts availability and optimized maintenance budget of your spare parts.
- **Technical training:** Build necessary skills and competencies to properly and safely operate your installations.

Greater Peace of Mind Throughout your Installation Lifecycle

When it comes to your electrical distribution installation, we can help you:

- Increase productivity, reliability, and safety
- Mitigate risk and limit downtime
- Keep equipment up to date and extend lifespan
- Cut cost and increase savings
- Improve your return on investment

CONTACT US!

https://www.se.com/en/work/services/field-services/electrical-distribution/

Optimize

Schneider Electric proposes recommendations for improved safety, availability, reliability, and quality:

- **MP4 electrical assessment:** Define an improvement and risk management program.

Renew

We extend the life of your system while providing upgrades and we can even offer to take full responsibility for the end-of-life processing of old electrical equipment:

- **Retrofit:** Keep up to date and improve the performance of electrical installations.
- **MV product end of life:** Recycle and recover outdated equipment with end-of-life services.

Environmental Information with Green Premium™ Ecolabel

An industry leading portfolio of offers delivering sustainable value

More than 75% of our product sales offer superior transparency on the material content, regulatory information and environmental impact of our products:

- RoHS compliance
- REACh substance information
- Industry leading # of PEP's*
- Circularity instructions

Discover what we mean by green
Check your products!

The Green Premium program stands for our commitment to deliver customer valued sustainable performance. It has been upgraded with recognized environmental claims and extended to cover all offers including Products, Services and Solutions.

CO_2 and P&L impact through… Resource Performance

Green Premium brings improved resource efficiency throughout an asset's lifecycle. This includes efficient use of energy and natural resources, along with the minimization of CO_2 emissions.

Cost of ownership optimization through… Circular Performance

We're helping our customers optimize the total cost of ownership of their assets. To do this, we provide IoT-enabled solutions, as well as upgrade, repair, retrofit, and remanufacture services.

Peace of mind through… Well-being Performance

Green Premium products are RoHS and REACh compliant. We're going beyond regulatory compliance with step-by-step substitution of certain materials and substances from our products.

Improved sales through… Differentiation

Green Premium delivers strong value propositions through third-party labels and services. By collaborating with third-party organizations we can support our customers in meeting their sustainability goals such as green building certifications.

*PEP: Product Environmental Profile (i.e. Environmental Product Declaration)

Notes

Ordering

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Ordering

PowerLogic™ P7 Configurator

Selecting Product

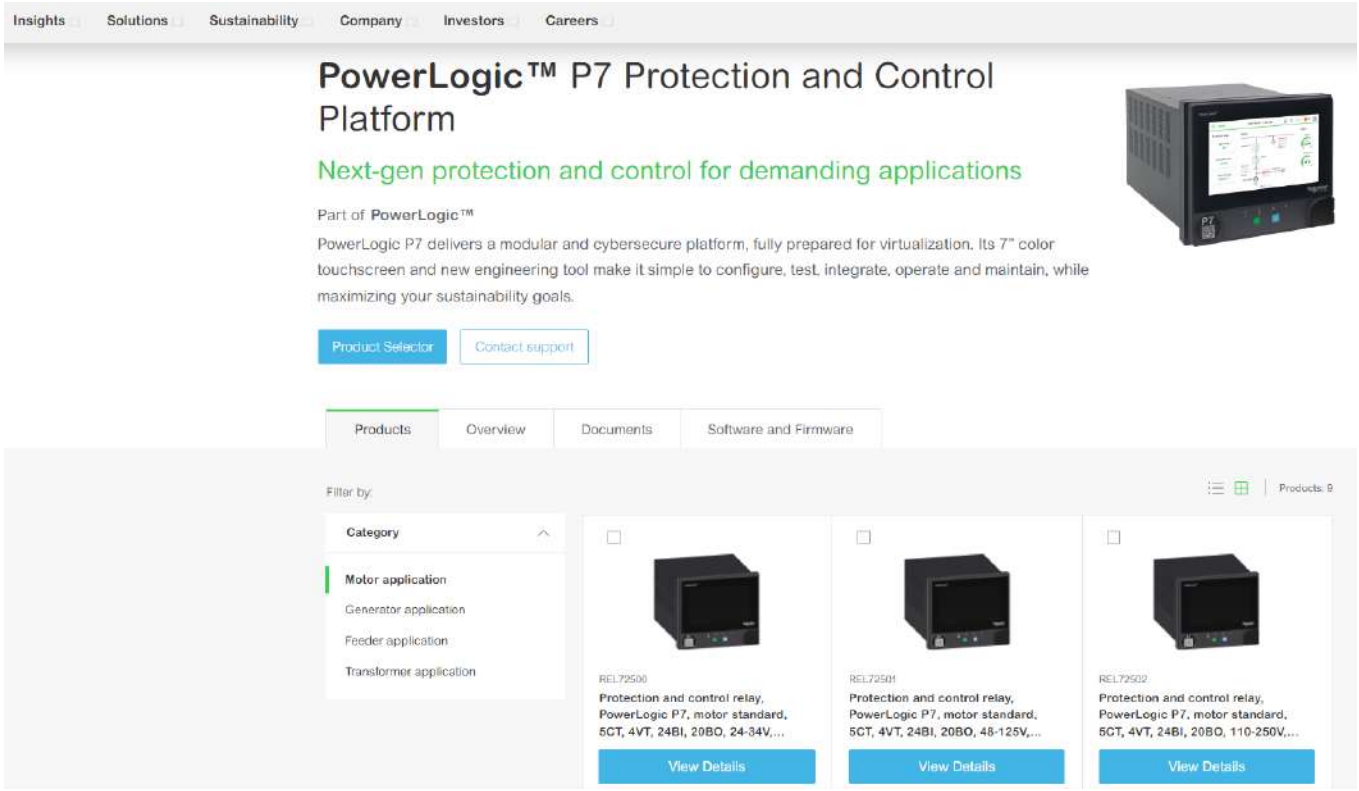
PowerLogic™ P7 CONFIGURATOR:
The unique web tool to quickly and easily configure your PowerLogic™ P7.

Fast and Simple

See more on:

- www.se.com

EB100315



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Ready-To-Use Configuration

PowerLogic P7 Order Information

NOTE:
See your Schneider Electric representative for complete ordering information.

When ordering, please state:

- Product code
- Quantity
- Accessories

Part No.	Qty.	Designation	
Motor Application			
REL72500		P7M41-1CR5NNMMNNNNNNNNN-TLB	P7 Motor Standard level 5CT 4VT 24BI 20BO 24-34V Eth RJ45
REL72501		P7M41-1CR5NNMMNNNNNNNNN-TMB	P7 Motor Standard level 5CT 4VT 24BI 20BO 48-125V Eth RJ45
REL72502		P7M41-1CR5NNMMNNNNNNNNN-THB	P7 Motor Standard level 5CT 4VT 24BI-20BO 110-250V Eth RJ45
REL72503		P7M41-1CR5MMMMNNNNNNNNN-TLB	P7 Motor Standard level 5CT 4VT 40BI 32BO 24-34V Eth RJ45
REL72504		P7M41-1CR5MMMMNNNNNNNNN-TMB	P7 Motor Standard level 5CT 4VT 40BI 32BO 48-125V Eth RJ45
REL72505		P7M41-1CR5MMMMNNNNNNNNN-THB	P7 Motor Standard level 5CT 4VT 40BI 32BO 110-250V Eth RJ45
REL72506		P7M41-1CR5R6MMNNNNNNNNN-TLB	P7 Motor Standard level 11CT 7VT 24BI 20BO 24-34V Eth RJ45
REL72507		P7M41-1CR5R6MMNNNNNNNNN-TMB	P7 Motor Standard level 11CT 7VT 24BI 20BO 48-125V Eth RJ45
REL72508		P7M41-1CR5R6MMNNNNNNNNN-THB	P7 Motor Standard level 11CT 7VT 24BI 20BO 110-250V Eth RJ45
Generator Application			
REL73500		P7G41-1CR5NNMMNNNNNNNNN-TLB	P7 Generator Standard level 5CT 4VT 24BI 20BO 24-34V Eth RJ45
REL73501		P7G41-1CR5NNMMNNNNNNNNN-TMB	P7 Generator Standard level 5CT 4VT 24BI 20BO 48-125V Eth RJ45
REL73502		P7G41-1CR5NNMMNNNNNNNNN-THB	P7 Generator Standard level 5CT 4VT 24BI 20BO 110-250V Eth RJ45
REL73503		P7G41-1CR5MMMMNNNNNNNNN-TLB	P7 Generator Standard level 5CT 4VT 40BI 32BO 24-34V Eth RJ45
REL73504		P7G41-1CR5MMMMNNNNNNNNN-TMB	P7 Generator Standard level 5CT 4VT 40BI 32BO 48-125V Eth RJ45
REL73505		P7G41-1CR5MMMMNNNNNNNNN-THB	P7 Generator Standard level 5CT 4VT 40BI 32BO 110-250V Eth RJ45
REL73506		P7G41-1CR5R6MMNNNNNNNNN-TLB	P7 Generator Standard level 11CT 7VT 24BI 20BO 24-34V Eth RJ45
REL73507		P7G41-1CR5R6MMNNNNNNNNN-TMB	P7 Generator Standard level 11CT 7VT 24BI 20BO 48-125V Eth RJ45
REL73508		P7G41-1CR5R6MMNNNNNNNNN-THB	P7 Generator Standard level 11CT 7VT 24BI 20BO 110-250V Eth RJ45

Ready-To-Use Configuration

PowerLogic P7 Order Information

NOTE:
See your Schneider Electric representative for complete ordering information.

When ordering, please state:

- Product code
- Quantity
- Accessories

Part No.	Qty.		Designation
Feeder Application			
REL71500	☐	P7F41-1CR5NNMMNNNNNNNNN-TLB	P7 Feeder Standard level 5CT 4VT 24BI 20BO 24-34V Eth RJ45
REL71501	☐	P7F41-1CR5NNMMNNNNNNNNN-TMB	P7 Feeder Standard level 5CT 4VT 24BI 20BO 48-125V Eth RJ45
REL71502	☐	P7F41-1CR5NNMMNNNNNNNNN-THB	P7 Feeder Standard level 5CT 4VT 24BI 20BO 110-250V Eth RJ45
REL71503	☐	P7F41-1CR5MMMMNNNNNNNNN-TLB	P7 Feeder Standard level 5CT 4VT 40BI 32BO 24-34V Eth RJ45
REL71504	☐	P7F41-1CR5MMMMNNNNNNNNN-TMB	P7 Feeder Standard level 5CT 4VT 40BI 32BO 48-125V Eth RJ45
REL71505	☐	P7F41-1CR5MMMMNNNNNNNNN-THB	P7 Feeder Standard level 5CT 4VT 40BI 32BO 110-250V Eth RJ45
Transformer Application			
REL76500	☐	P7T41-1CR6NNMMNNNNNNNNN-TLB	P7 Transformer Standard level 6CT 3VT 24BI 20BO 24-34V Eth RJ45
REL76501	☐	P7T41-1CR6NNMMNNNNNNNNN-TMB	P7 Transformer Standard level 6CT 3VT 24BI 20BO 48-125V Eth RJ45
REL76502	☐	P7T41-1CR6NNMMNNNNNNNNN-THB	P7 Transformer Standard level 6CT 3VT 24BI 20BO 110-250V Eth RJ45
REL76503	☐	P7T41-1CR6MMMMNNNNNNNNN-TLB	P7 Transformer Standard level 6CT 3VT 40BI 32BO 24-34V Eth RJ45
REL76504	☐	P7T41-1CR6MMMMNNNNNNNNN-TMB	P7 Transformer Standard level 6CT 3VT 40BI 32BO 48-125V Eth RJ45
REL76505	☐	P7T41-1CR6MMMMNNNNNNNNN-THB	P7 Transformer Standard level 6CT 3VT 40BI 32BO 110-250V Eth RJ45
REL76506	☐	P7T41-1CR6R6MMNNNNNNNNN-TLB	P7 Transformer Standard level 12CT 6VT 24BI 20BO 24-34V Eth RJ45
REL76507	☐	P7T41-1CR6R6MMNNNNNNNNN-TMB	P7 Transformer Standard level 12CT 6VT 24BI 20BO 48-125V Eth RJ45
REL76508	☐	P7T41-1CR6R6MMNNNNNNNNN-THB	P7 Transformer Standard level 12CT 6VT 24BI 20BO 110-250V Eth RJ45

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TOOLS

se.com

This international web site allows you to access all the Schneider Electric solutions and product information via:

- Comprehensive descriptions
- Range datasheets
- A download area
- Product selectors

You can also access information dedicated to your business and contact your Schneider Electric country support.

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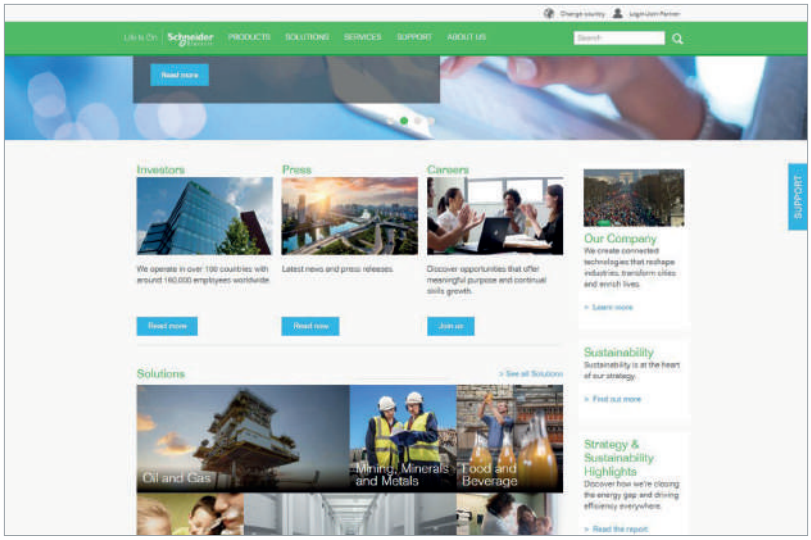

Web Selector

This site allows you to access the Schneider Electric products in just two clicks via a comprehensive range of datasheets, with direct links to:

- Complete libraries: technical documents, catalogs, FAQs, brochures
- Selection guides from the e-catalog
- Product discovery sites and their animations

You will also find illustrated overviews, news to which you can subscribe, and a list of country contacts.

Training

Training allows you to acquire the expertise (installation design, work with power on, etc.) to increase efficiency and improve customer service.

The training catalog includes beginner's courses in electrical distribution, knowledge of MV and LV switchgear, operation and maintenance of installations, and design of LV installations to give a few examples.

www.se.com

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