EcoStruxure™
Innovation At Every Level

PowerLogic™ P7

Catalog 2023

Network Protection and Control Devices

se.com/PowerLogic P7

Life Is On Schneider Electric

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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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 enhances device maintenance and reduces installation downtime
- IEC 61850 Ed2.1 provides more efficient delivery, engineering, operation, and maintenance with seamless integration in power automation systems
- Interact easily via large and intuitive industrial 7″ color touchscreen

Electrical Safety and Security

- Current transformer auto-shorting capability provides enhanced safety during maintenance
- 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 design

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 IK7 impact-strength front panel design

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 Toolsuite Saves Time, Improves Efficiency

- PowerLogic Engineering Toolsuite 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 Toolsuite software** with next generation in tools for full configuration and maintenance of your system architecture
- **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 journey to select the product needed

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.

450000

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

EcoStruxure ready

Efficient asset management

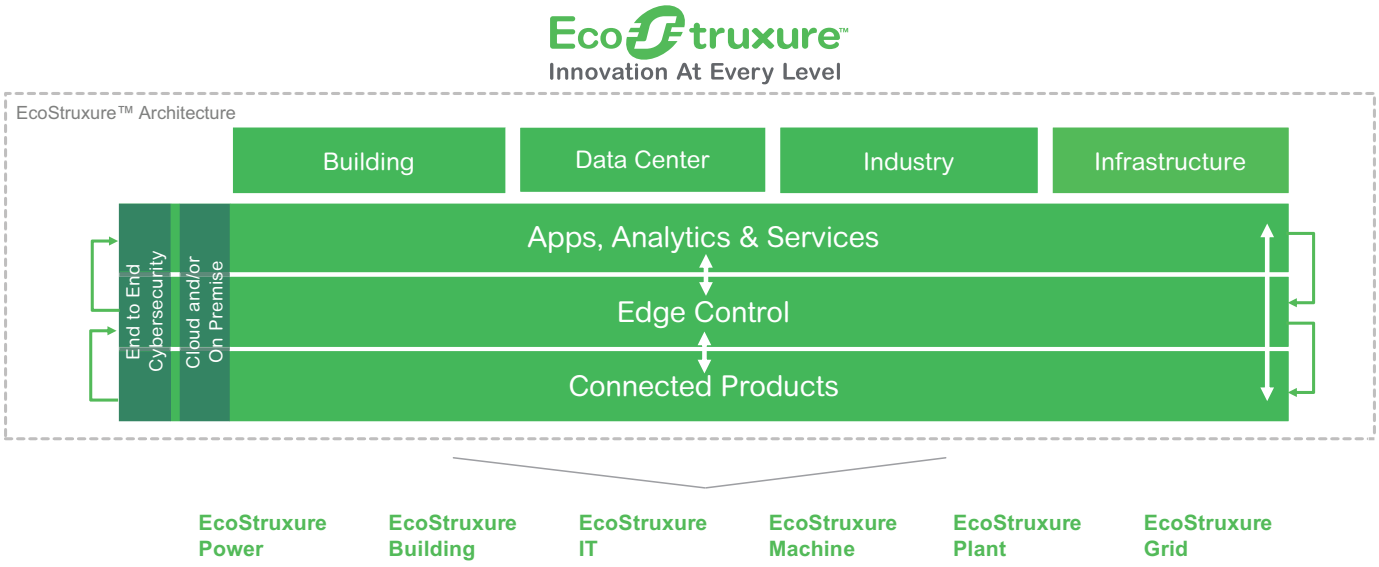
Boost your efficiency and reduce downtime using predictive maintenance tools

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 support.
- Efficient engineering thanks to IEC 61850 Edition 2.1.

PM107437

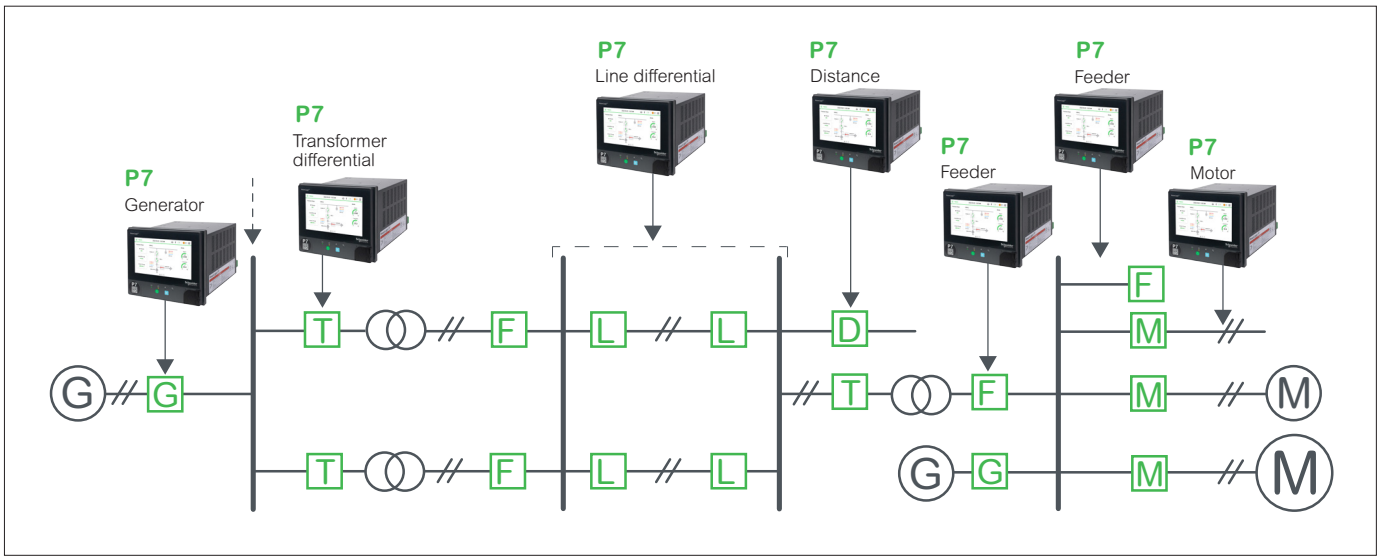
PowerLogic P7

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

- Utilities
- Critical buildings and Industry:
  - Data Center
  - Transportation
- Large industrial processes:
  - Oil and Gas
  - Mining
  - Mineral and Metals
  - Electro-intensive

Range Overview

DM107110



Range overview shows future application scope

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
Arc-flash sensor inputs		-
Digital	Inputs	8...40 (40TE)
	Outputs	8...32 (40TE) + Watchdog (WD)
Temperature sensor input		0 to 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 10 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	IEC 61850 Logical node	ANSI code	Motor application (stages instantiated)		Generator application (stages instantiated)	
			Level 0	Level 1	Level 0	Level 1
Current protection functions						
Protection trip conditioning	**PTRC**	86	1	2	1	4
Phase overcurrent[1]	PH**PTOC**	50/51	2	2	2	4
Ground fault overcurrent[2]	EF**PTOC**	50N/51N	4	6	4	8
Sensitive ground fault overcurrent	VSEF**PTOC**	50SG/51SG	2	2	2	2
Negative sequence overcurrent	NPS**PTOC**	46	2	2	2	2
Inrush	ID**PHAR**	68ID	2	2	2	2
Selective overcurrent logic (SOL)	SOL**GAPC**	N/A	1	1	1	1
Phase undercurrent	PH**PTUC**	37	2	2	-	-
Voltage dependent overcurrent	PH**PVOC**	51V	-	-	1	1
Voltage protection functions						
Undervoltage	PH**PTUV**	27	2	2	2	2
Overvoltage	PH**PTOV**	59	2	2	2	2
Positive phase sequence undervoltage	PPS**PTUV**	47	1	1	1	2
Neutral overvoltage[3]	EF**PTOV**	59N	1	4	1	3
Negative phase sequence overvoltage	NPS**PTOV**	47	1	1	1	1
Frequency protection functions						
Overfrequency	**PTOF**	81O	*	2	*	2
Underfrequency	**PTUF**	81U	*	4	*	4
Differential protection functions						
High impedance differential[4]	HIZ**PDIF**	87/64REF	*	1	*	1
Biased differential protection	PH**PDIF**	87	*	1	*	1
Temperature protection functions						
Thermal overload protection for machine	THM**PTTR**	49	1	1	1	1
Temperature supervision	**STMP**	38/49T	8	8	8	8
Motor protection functions						
Motor monitoring	**ZMOT**	N/A	1	1	-	-
Motor start-up supervision, locked rotor	**PMSS**	48	1	1	-	-
Stall	JAM**PTOC**	51LR	1	1	-	-
Motor restart inhibition	**PMRI**	66	1	1	-	-
Voltage check	VC**PTUV**	47	1	1	-	-
Generator protection functions						
Third harmonic undervoltage	ST**PTUV**	27TN	-	-	1	1
Inter-turn protection based on split phase[5]	IT**PDIF**	87G	-	-	*	1
Inadvertent energization	IE**PIOC**	50/27	-	-	1	1
Speed protection functions						
Overspeed	**POVS**	12	1	2	1	2
Underspeed[6]	**PZSU**	14	2	3	2	3
Speed detection	**TRTN**	N/A	1	1	1	1
Distance/impedance protection functions						
Field failure	FF**PDIS**	40	*	1	*	1
Underimpedance	UZ**PDIS**	21	-	-	*	1
Out of step	OOS**PPAM**	78	*	1	*	1
Power protection functions						
Directional active overpower	P**PDOP**	32P	-	-	2	4
Directional reactive overpower	Q**PDOP**	32Q	2	2	1	2
Directional active underpower	P**PDUP**	37P	2	2	1	1

(1) PHPTOC1/2 are on PHTCTT1 and PHPTOC3/4 are on PHTCTT2
(2) EFPTOC1/2 are on PHTCTT1 and EFPTOC7/8 are on PHTCTT2; EFPTOC3/4 are on TCTR1 and EFPTOC5/6 are on TCTR2.
(3) For P7M, EFPTOV1 is on PHTVTT1 and EFPTOV2/3/4 are on TVTR1/2/3.
For P7G, EFPTOV1 is on PHTVTT1 and EFPTOV2/3 are on TVTR2/3.
(4) HIZPDIF1 is on PHTCTT2 and TCTR2.
(5) ITPDIF1 is on PHTCTT2.
(6) One PZSU stage is dedicated to Zerospeed ZEROPZSU.

* represents that the function will be available from the higher application level.
\- represents that the function is not available for the application type.

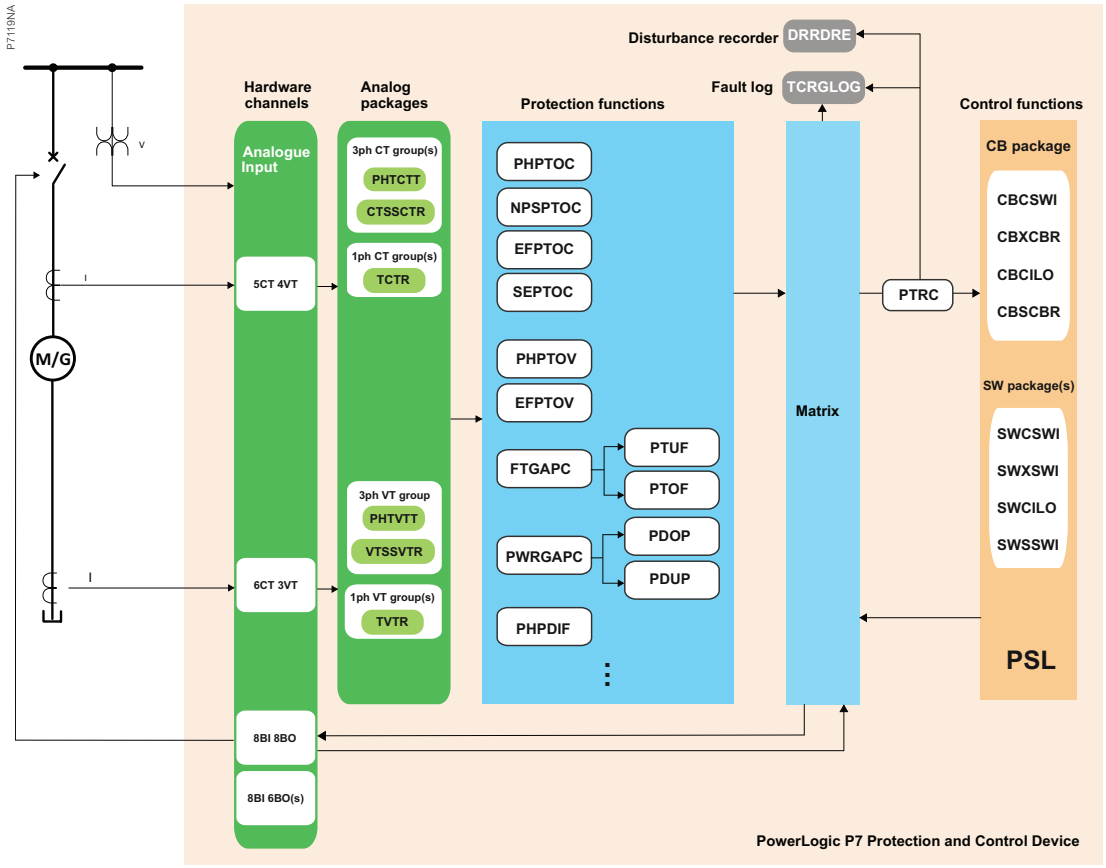
Selection Guide by Functionality

PowerLogic P7 function	IEC 61850 Logical node	ANSI code	Motor application (stages instantiated)		Generator application (stages instantiated)	
			Level 0	Level 1	Level 0	Level 1
Monitoring functions						
CT supervision	CTS**SCTR**	60	1	2	1	2
VT supervision	VTS**SVTR**	60FL	1	1	1	1
Circuit breaker supervision	CB**SCBR**	N/A	1	1	1	1
Switch monitoring	SW**SSWI**	N/A	5	9	5	9
DC battery voltage monitoring	**ZBAT**	N/A	1	1	1	1
Bay dead	PD**GAPC**	N/A	1	1	1	1
Control functions						
Circuit breaker proxy	CB**XCBR**	N/A	1	1	1	1
Circuit breaker control	CB**CSWI**	N/A	1	1	1	1
Circuit breaker interlocking	CB**CILO**	N/A	1	1	1	1
Circuit breaker failure	**RBRF**	50BF	1	1	1	1
Switch proxy	SW**XSWI**	N/A	5	9	5	9
Switch control	SW**CSWI**	N/A	5	9	5	9
Switch interlocking	SW**CILO**	N/A	5	9	5	9
Logs and records						
Sequence of event record	GEN**GLOG**	N/A	1	1	1	1
Disturbance record	DR**RDRE**	N/A	1	1	1	1
Fault record	TCR**GLOG**	N/A	1	1	1	1
Operation log	GEN**GLOG**	N/A	1	1	1	1
CT group measurement						
3ph current	VECA**MMXU**	N/A	1	2	1	2
3ph RMS current	RMSA**MMXU**	N/A	1	2	1	2
Sequence current	A**MSQI**	N/A	1	2	1	2
1ph current	VECAX**MMXU**	N/A	1	2	1	2
1ph RMS current	RMSAX**MMXU**	N/A	1	2	1	2
VT group measurement						
3ph voltage	VECV**MMXU**	N/A	1	1	1	1
3ph RMS voltage	RMSV**MMXU**	N/A	1	1	1	1
Sequence voltage	V**MSQI**	N/A	1	1	1	1
1ph voltage	VECVXMMXU	N/A	*	3	1	3
1ph RMS voltage	RMSVX**MMXU**	N/A	*	3	1	3
Bay measurement						
Fundamental frequency active, reactive and apparent power values, power factor	BAY**MMXU**	N/A	1	1	1	1
RMS active, reactive and apparent power	BAY**MMXU**	N/A	1	1	1	1
Minimum and maximum demand values: RMS phase currents	DVAL**MMXU**	N/A	1	1	1	1
Minimum and maximum demand values: active, reactive, apparent power and power factor	DVAL**MMXU**	N/A	1	1	1	1
Active and reactive of energy values	E**MMTR**	N/A	1	1	1	1
Bay Fourier current	BAY**MMXU**	N/A	1	1	1	1
Bay RMS current	BAY**MMXU**	N/A	1	1	1	1
Bay sequence current	BAY**MMXU**	N/A	1	1	1	1
Bay Fourier voltage	BAY**MMXU**	N/A	1	1	1	1
Bay RMS voltage	BAY**MMXU**	N/A	1	1	1	1
Bay sequence voltage	BAY**MMXU**	N/A	1	1	1	1

Selection Guide by Application

Application Overview

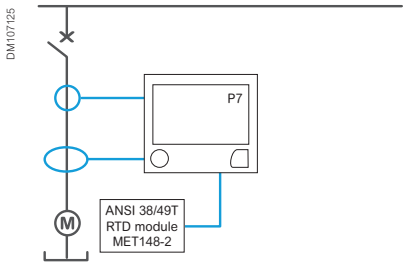
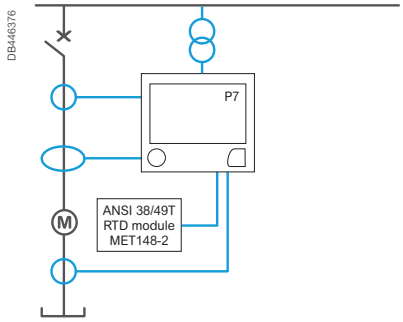
Functional Diagram



Selection Guide by Application

Motor and Motor-Differential Application

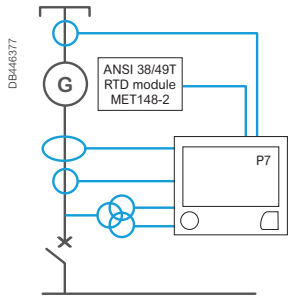
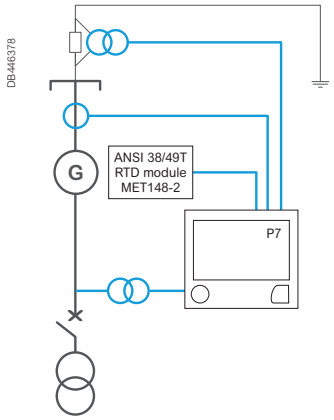
Motor and Motor-Differential Application

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**
	

Functions and Description

Phase Overcurrent (PHPTOC, ANSI 50/51)

The phase overcurrent function is applied to detect phase-to-phase short-circuits current (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.

Setting name	Description	Setting range	Step size	Default setting
MeasType	Measurement Type	Fourier RMS Fourier-I0	NA	Fourier
StrVal	Start value (Is Threshold)	0.005...40 pu	0.001 pu	1 pu
StrMul	Start Factor Multiplier	1...10	0.001	1
TmACrv	Active curve characteristic	ANSI Extremely Inverse ANSI Very Inverse ANSI Normal Inverse ANSI Moderate Inverse ANSI Definite Time IEC Normal Inverse IEC Very Inverse IEC Extremely Inverse IEC Long-Time inverse IEC Ultra Inverse Rectifier Inverse RI FR Short Inverse US Inverse CO8 US Short Inv CO2 ANSI Short Inv ANSI Long Inv IAC Inverse IAC very Inverse IAC Extremely Inverse	NA	DT
OpDlTmms	DT time delay (for TmACrv=DT) Act as DT adder (for TmACrv=IDMT)	0...10000000 ms	1 ms	0 ms
TmMult	Time Multiplier	0...20	0.001	1
Min-OpTmms	Minimum Operating Time	0...100000 ms	1 ms	0 ms
TypRsCrv	Reset Curve Type	DT IDMT		DT
RsDlTmms	Reset Delay	0...1000000 ms	1 ms	40 ms
OpStat	Operate Logic Status: 1/3 or 2/3	1/3 2/3	NA	1/3
DStrVal	Dynamic Start Current	0.005...40 pu	0.001 pu	1 pu
DStrMul	Dynamic Start Factor Multiplier	1...10	0.001	1
DOpDlTmms	Dynamic DT time delay (for TmACrv=DT) Act as DT adder (for TmACrv=IDMT)	0...10000000 ms	1 ms	0 ms
DTmMult	Dynamic Time Multiplier	0...20	0.001	1
DMinOpTmms	Dynamic Minimum Operating Time	0...100000 ms	1 ms	0 ms
DRsDlTmms	Dynamic Reset Delay	0...1000000 ms	1 ms	40 ms

Functions and Description

Ground Fault Overcurrent (EFPTOC, ANSI 50N/51N)

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.

The protection can also be provided using a toroidal CT around all phases or the transformer neutral. The ground fault overcurrent protection function does not need to consider the load so it can be set quite sensitively.

Setting Name	Description	Setting Range	Step Size	Default Setting
MeasType	Measurement Type	Fourier RMS	NA	Fourier
TmACrv	Active operate curve characteristic	ANSI Extremely Inverse ANSI Very Inverse ANSI Normal Inverse ANSI Moderate Inverse ANSI Definite Time IEC Normal Inverse IEC Very Inverse IEC Extremely Inverse IEC Long-Time inverse IEC Ultra Inverse Rectifier Inverse RI FR Short Inverse BPN US Inverse CO8 US Short Inv CO2 ANSI Short Inv ANSI Long Inv IAC Inverse IAC very Inverse IAC Extremely Inverse RXIDG	NA	DT
StrVal	Start value (Is Threshold)	0.005...40 pu	0.001 pu	1 pu
StrMul	Start Factor Multiplier	1...10	0.001	1
OpDlTmms	DT time delay (for TmACrv=DT) Acts as DT adder (for TmACrv=IDMT)	0...10000000 ms	1 ms	0 ms
TmMult	Time dial multiplier TMS	0...20	0.001	1
TypRsCrv	Type of reset curve	Inverse Definite Time	NA	DT
RsDlTmms	Reset Delay Time	0...10000000 ms	1 ms	40 ms
MinOpTmms	Minimum Operating Time	0...100000 ms	1 ms	0 ms
DStrVal	Dynamic Start Current	0.005...40 pu	0.001 pu	1 pu
DStrMul	Dynamic Start Factor Multiplier	1...10	0.001	1
DOpDlTmms	Dynamic DT time delay (for TmACrv=DT) Acts as DT adder (for TmACrv=IDMT)	0...10000000 ms	1 ms	0 ms
DTmMult	Dynamic Timer Multiplier	0...20	0.001	1
DRsDlTmms	Dynamic Reset Delay	0...1000000 ms	1 ms	40 ms
DMinOpTmms	Dynamic Minimum operating time	0...100000 ms	1 ms	0 ms

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 underground 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).

Setting name	Description	Setting range	Step size	Default setting
TmACrv	Active operate curve characteristic	ANSI Extremely Inverse ANSI Very Inverse ANSI Normal Inverse ANSI Moderate Inverse ANSI Definite Time IEC Normal Inverse IEC Very Inverse IEC Extremely Inverse IEC Long-Time inverse IEC Ultra Inverse Rectifier Inverse RI FR Short Inverse BPN US Inverse CO8 US Short Inv CO2 EPATR-B ANSI Short Inv ANSI Long Inv IAC Inverse IAC very Inverse IAC Extremely Inverse RXIDG EPATR-C	NA	DT
StrVal	Start value (Is Threshold)	0.001...1 pu	0.001 pu	1 pu
StrMul	Start Factor Multiplier	1...10	0.001	1
OpDlTmms	DT time delay (for TmACrv=DT) Act as DT adder (for TmACrv=IDMT)	0...10000000 ms	1 ms	0 ms
TmMult	Time dial multiplier TMS	0...20	0.001	1
TypRsCrv	Type of reset curve	DT IDMT	NA	DT
RsDlTmms	Reset Delay Time	0...10000000 ms	1 ms	40 ms
Min-OpTmms	Minimum Operating Time	0...100000 ms	1 ms	0 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.

Setting name	Description	Setting range	Step size	Default setting
StrVal	Start value (Is Threshold)	0.005...40 pu	0.001 pu	1 pu
StrMul	Start Factor Multiplier	1...10	0.001	1
TmACrv	Operating curve	DT IEC Standard Inverse (or IEC/A) IEC Very Inverse (or IEC/B) IEC Extremely Inverse (IEC/C) IEC Long Time inverse IEC Ultra Time inverse IEEE Moderately Inv. (or IEC/D) IEEE Very Inverse (or IEC/E) IEEE Extremely Inverse (or IEC/F) Rectifier inverse FR Short Time Inverse RI ANSI Normal Inverse ANSI Short Time Inverse ANSI Long Time Inverse US Inverse CO8 US Short Time Inverse CO2 IAC inverse IAC very inverse IAC extremely inverse Programmable curve (option)	NA	DT
OpDlTmms	Operate Delay	0...10000 s	1 ms	0 s
TmMult	Time Multiplier TMS	0...20	0.001	1
MinOpTmms	Minimum Operating Time	0...100 s	1 ms	0 ms
TypRsCrv	Reset Curve Type	DT IDMT	NA	DT
RsDlTmms	Reset Delay	0...10000 s	1 ms	40 ms
DStrVal	Dynamic Start Current	0.005...40 pu	0.001 pu	1 pu
DStrMul	Dynamic Start Factor Multiplier	1...10	0.001	1
DOpDlTmms	Dynamic Operate Delay	0...10000 s	1 ms	0 s
DTmMult	Dynamic Timer Multiplier TMS	0...20	0.001	1
DMinOpTmms	Dynamic Minimum operating time	0...100 s	1 ms	0 ms
DRsDlTmms	Dynamic Reset Delay	0...10000 s	1 ms	40 ms

Functions and Description

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

Setting name	Description	Setting range	Step size	Default setting
2HRatio	2nd harmonic/fundamental current ratio	5...70%	1%	20%
CurBlkVal	Maximum phase current for Inrush operation	1...40 pu	0.001 pu	15 pu
MinOpTmms	Minimum operate time	0...10,000,000 ms	1 ms	0
CrossBlk	Cross blocking status	Disabled/Enabled	NA	Enabled

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.

Setting name	Description	Setting range	Step size	Default setting
StrVal	Start value of under current	0.005...40 pu	0.001 pu	1 pu
OpDlTmms	Time Delay for Alarm signal setting	0...10000 s	1 ms	0 ms
RsDlTmms	Reset Time Delay	0...10000 s	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.

Setting name	Description	Setting range	Step size	Default setting
MeasType	Measurement type	Fourier RMS Fourier-I0	NA	Fourier
TmACrv	Active operate curve characteristic	DT IEC Normal Inverse IEC Very Inverse IEC Extremely Inverse IEC Long Time inverse IEC Ultra Time inverse ANSI Moderately Inverse ANSI Very Inverse ANSI Extremely Inverse ANSI Normal Inverse ANSI Short Time Inverse ANSI Long Time Inverse Rectifier Inverse RIUS Inverse CO8 US Short Time InverseCO2 IAC inverse IAC very inverse IAC extremely inverse Programmable curve (Option)	NA	DT
StrVal	Start value (Is Threshold)	0.05...40 pu	0.001 pu	1 pu
OpDlTmms	DT time delay (for TmACrv=DT) Act as DT adder (for TmACrv=IDMT)	0...10000000 ms	1 ms	0 ms
TmMult	Time multiplier	0...20	0.001	1
TypRsCrv	Type of reset curve	DT IDMT	NA	DT
RsDlTmms	Reset delay	0...1000000 ms	1 ms	40 ms
MinOpTmms	Minimum operating time	0...100000 ms	1 ms	0 ms
VDOStrVal1	VDO V < set point 1	0.05...1.1 Unp	0.01	0.8
VDOStrVal2	VDO V < set point 2	0.05...1.1 Unp	0.01	0.6
VDOMult	VDO K multiplying factor	0.1...1	0.005	0.25

Functions and Description

Undervoltage (PHPTUV, ANSI 27)

The phase undervoltage protection function helps to 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-phase or phase-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.

Setting Name	Description	Setting Range	Step Size	Default Setting
MuMod	Measurement mode	PH-PH PH-N	N/A	PH-PH
OpMod	Operation mode	ANY PHASE 2 ELEMENTS 3 ELEMENTS	N/A	3 ELEMENTS
TmVCrv	Active curve characteristic	DT IDMT	N/A	DT
StrVal	Pickup threshold	0.02...1.2 pu	0.01 pu	0.8 pu
TMS	Time multiplier setting	0...20	0.001	1
OpDlTmms	Operate time delay	0...300 s	0.01 s	0.1 s
RsDlTmms	Reset time delay	0...100 s	0.01 s	0 s
CBOpBlk	CB open block	ON/OFF	N/A	OFF

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	Description	Setting range	Step size	Default setting
MuMod	Measurement mode	PH-PH PH-N	N/A	PH-PH
OpMod	Operation mode	ANY PHASE 2 ELEMENTS 3 ELEMENTS	N/A	3 ELEMENTS
TmVCrv	Active curve characteristic	DT IDMT	N/A	DT
StrVal	Pickup threshold	0.02...1.5 pu	0.01 pu	1.2 pu
TMS	Time multiplier setting	0...20	0.001	1
OpDlTmms	Operate time delay	0...300 s	0.01 s	0.1 s
RsDlTmms	Reset time delay	0...100 s	0.01 s	0 s

Positive Phase Sequence Undervoltage (PPSPTUV, ANSI 47)

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	Description	Setting range	Step size	Default setting
StrVal	Start value	0.01...2 pu	0.01 pu	0.7 pu
OpDlTmms	Operate time delay	0...10000 s	1 ms	0 s
RsDlTmms	Reset time delay	0...10000 s	1 ms	0 s

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	Description	Setting Range	Step Size	Default Setting
StrVal	Start value (Vs Threshold)	0.001...5 pu	0.001 pu	0.01 pu
OpDlTmms	Timer setting	0...10000000 ms	1 ms	0
RsDlTmms	Timer setting	0...10000000 ms	1 ms	0

Generator Inter-Turn Protection by Zero Voltage

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 using the EFPTOV.

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	Description	Setting range	Step size	Default setting
StrVal	Start value	0.01...2 pu	0.01 pu	0.2 pu
OpDlTmms	Operate time delay	0...10000 s	1 ms	0 ms
RsDlTmms	Reset time delay	0...10000 s	1 ms	0 ms

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	Description	Setting Range	Step Size	Default Setting
StrVal	Start value of over frequency	40...65 Hz	0.01 Hz	51.00 Hz
OpDlTmms	Timer setting	0...10000 s	1 ms	0 ms
LVVal	Start value for low voltage blocking	0.10...1.00 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.

Setting Name	Description	Setting Range	Step Size	Default Setting
StrVal	Start value of under frequency	40...65 Hz	0.01 Hz	49.00 Hz
OpDlTmms	Timer setting	0...10000 s	1 ms	0 ms
LVVal	Start value for low voltage blocking	0.10...1.00 pu	0.01 pu	0.7 pu

Functions and Description

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 phase applications a CT is placed at each end of the zone per phase. For REF applications all phases are paralleled with the neutral CT.

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.

Setting name	Description	Setting range	Step size	Default setting
OpMod	Operating mode: • Phase mode for phase selective operation on a phase-to-ground fault or phase-to-phase fault. • Ground mode for neutral operation on ground fault.	Phase/Ground	N/A	Phase
StrVal	Operate current for high impedance differential protection	0.01...2 pu	0.01 pu	1 pu
SupMod	CT supervision mode	Disable/Enable	N/A	Disable
SupSet	CT supervision current	0.005...2 pu	0.01 pu	1 pu
SupDlTmms	CT supervision time	0.1...10 s	0.1 s	3 s

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	Description	Setting range	Step size	Default setting
LoSet	Minimum differential current setting (Is)	0.01...3 pu	0.01 pu	0.2 pu
DiffSlp1	K1	0.01...2	0.01	0.3
Slp2Set	Slope 2 pickup	1...10 pu	0.01 pu	1.5 pu
DiffSlp2	K2	0.1...2	0.01	1.5
OpDlTmms	Operate delay	0...10000000 ms	1 ms	0
SPhMod	Split phase mode	On, Off		Off
SatTC	Saturation time constant	0...500	1	500

Functions and Description

Thermal Overload Protection (THMPTTR, ANSI 49M)

The thermal overload protection function helps to prevent damage on the stator and rotor against overloading conditions due to balanced and unbalanced currents.

- The Thermal overload protection 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.
- Flexible choices of time constants used in stator thermal level calculation are provided. The four settable constants align with the four-machine status. In addition, a four-point curve can be defined for the overload state.
- Temperature influence is provided to compensate for the reduction in the machine 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.

Setting name	Description	Setting range	Step size	Default setting
FLA	Full load amps	0.1...3.25 pu	0.01 pu	1.0 pu
NegQ	Negative sequence current factor	0...20	0.1	0
StrVal	Overload threshold	1.0...1.5 FLA	0.01	1.0
RunTC	Running time constant of the thermal model	1...1000 min	0.1 min	30 min
OlTC	Overload time constant of the thermal model	1...1000 min	0.1 min	30 min
StrTC	Starting time constant of the thermal model	1...1000 min	0.1 min	30 min
StpTC	Stopped time constant of the thermal model	1...1000 min	0.1 min	30 min
AlmVal	Thermal alarm value (%)	50...100%	1%	90%
RsvVal	Reserve time thermal alarm value	1...1000 min	0.1 min	30 min
TmpNom	Nominal or rated ambient temperature (ºC)	-40...300 ºC	0.1 ºC	40 ºC
TmpMax	Maximum object temperature (ºC)	0...300 ºC	0.1 ºC	40 ºC
LckRotA	Locked rotor current	3...10 FLA	0.01	6
StrTrq	Rated start torque	0.1...1 pu	0.01 pu	0.7 pu
NomSlip	Machine nominal slip	0.0001...0.3	0.0001	0.05
Tcold	Stall tolerance time at cold status	1...10000 s	0.001 s	10 s
Thot	Stall tolerance time at hot status	0...10000 s	0.001 s	0 s
RestrMod	Restart mode	Automatic/Manual	NA	Manual
RsvTL	Setting of start thermal level	5...100%	1%	30%
RotMod	Rotor thermal mode	ON/OFF	NA	OFF
TmACrv	Overload curve	Thermal/Curve	NA	Thermal
TmACrvPt0	Custom curve point at 1.4 FLA	1...1000 min	0.1 min	30 min
TmACrvPt1	Custom curve point at 1.6 FLA	1...1000 min	0.1 min	30 min
TmACrvPt2	Custom curve point at 1.8 FLA	1...1000 min	0.1 min	30 min
TmACrvPt3	Custom curve point at 2.0 FLA	1...1000 min	0.1 min	30 min

Functions and Description

Temperature Supervision (STMP, ANSI 38/49T)

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 (**NOTE:** Once temperature reaches this threshold, an alarm signal will be issued).
- Tripping set point. (**NOTE:** If temperature keeps rising and exceeds the operate temperature, operate signal will be issued to trip the protection).

A fixed operate delay exists before issuing alarm temperature signal and operate temperature signal. The measurement is valid from -31°C to 201°C. Exceeding this range leads to the output of RTD fail signal.

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.

Setting Name	Description	Setting Range	Step Size	Default Setting
AlmSet	Alarm temperature level threshold	-30...200 °C	1 °C	80 °C
TripSet	Operate temperature level threshold	-30...200 °C	1 °C	100 °C
TmpLab	Temperature source label	NA	NA	RTDx
TmpFun	Temperature source function	Ambient/Bearing/Winding/Other	NA	Selectable

Motor Monitoring (ZMOT)

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

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

Each start and reacceleration are counted. The counters can be reset individually. If the number of starts counter value reaches the set threshold, an alarm is issued.

When the motor is in Running or Starting status, the running hours are accumulated. The running hours can be reset. Two running hours alarms will be asserted when corresponding alarm is enabled, and time exceeds its threshold setting.

Please see the PowerLogic P7 user manual for additional information.

Setting name	Description	Setting range	Step size	Default setting
FLA	Full Load Amps	0.1...4 pu	0.01 pu	1 pu
StrCurVal	Start current detection value	0.01...40 FLA	0.001 FLA	3 FLA
HrRAlm1Val	Hour running alarm 1 value	0...9999 hours	1	0 hours
HrRAlm2Val	Hour running alarm 2 value	0...9999 hours	1	0 hours
NbStrAlmVal	Number of starts alarm value	0...999	1	0
ReAccTmSt	Enable reacceleration detection function	Disabled, Enabled		Disabled
ReAccVVal	Undervoltage setting to detect voltage reduction before reacceleration	0.01...1 Vn	0.01 Vn	0.7 Vn
ReStoVVal	Overvoltage setting to detect voltage restoration	0.01...1 Vn	0.01 Vn	0.9 Vn

Start (PMSS, ANSI 48/51LR)

Start 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.

   The excessive starting time delay uses DT or IDMT timer based on the prolonged start mode setting.

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 threshold 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.

Parameter	Description	Setting range	Step size	Default setting
PSMod	Prolonged start mode	ANSI Definite Time; Start Op Inverse		ANSI Definite Time
SetA	Starting current at nominal voltage (IDMT)	0.005...40 In	0.001 In	6 In
SetTms	Maximum start time	0...10000000 ms	1 ms	5000 ms
LokRotTms	Start stall time	0...10000000 ms	1 ms	2000 ms

Stall (JAMPTOC, ANSI 51MS)

Stall 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 stall protection will operate more quickly than the thermal element which allows a shorter time to restart once the jam is cleared.

Following a successful start, if the current exceeds the stalling current threshold and fails to fall below the threshold before the stall time delay elapsed, then the operate signal is issued. The element will not operate when the motor is starting and is protected by separate start protection. Reacceleration can be applied in the motor monitor function to prevent operation on voltage drops.

Setting name	Description	Setting range	Step size	Default setting
StrVal	Start value	0.005...40 pu	0.001 pu	1 pu
OpDlTmms	Operate time	0...10000000 ms	1 ms	0 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.

Setting name	Description	Setting range	Step size	Default setting
MaxStrTmm	Monitoring time period	10...120 min	1 min	60 min
MaxNumStr	Maximum number of starts	1...10	1	1
InhTmm	Start inhibition time delay	10...120 min	1 min	10 min
MaxStrRteTmm	Minimum time between starts (start rate)	10...120 min	1 min	2 min
EnMaxNumStr	Enable maximum number of start per hour function	Enabled/Disabled	N/A	Enabled
EnMaxStrRte	Enable maximum start rate function	Enabled/Disabled	N/A	Enabled
AbsTmms	Anbi-backspin timer	1...100000000 ms	1 ms	300 ms
ZerSpdTmms	Time delay for zero speed switch to reset restart inhibit output	1...100000000 ms	1 ms	300 ms

Functions and Description

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.

This function is normally linked to the CB control to inhibit closing and can be inhibited when the bay is live.

Setting name	Description	Setting range	Step size	Default setting
StrVal	Threshold of low voltage	0.1...2 pu	0.01 pu	0.80 pu
OpDlTmms	Operate delay	1...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. To help protect the last 5% of the stator winding, close to the neutral end, third harmonic voltage measurement can be performed. In 100% stator E/F 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 as it is less effected by load. Combined with neutral displacement it provides coverage for entire stator winding against earth faults. Various checks such as terminal voltage, generator power output or minimum total third harmonic voltage can be applied to ensure the element is stable during startup.

Setting name	Description	Setting range	Step size	Default setting
V3HDiffType	Operating Mode	V3N/V3GDIff	N/A	V3N
V3HRatio	Start value of third harmonic ratio of neutral to Diff OpMode=VN3H/V3HDiff <	0.000...1.000 pu	0.001 pu	0.1 pu
V3HBlkVal	If VT3 is below limit third harmonic, Diff is blocked	0...1.25 pu	0.001 pu	0.01 pu
UVBlkVal	V< Inhibit	0...1.25 pu	0.001 pu	0.8 pu
UPBlkVal	P< Inhibit	0...1.25 pu	0.01 pu	0.03 pu
V3NStrVal	Start value of third harmonic at neutral terminal OpMode =VN3H<	0.001...1.25 pu	0.001 pu	0.01 pu
OpDlTmms	Third harmonic operate delay	0...10000000 ms	1 ms	0 ms
RsDlTmms	Third harmonic reset time	0...10000000 ms	1 ms	0 ms

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

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.

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.

Setting name	Description	Setting range	Step	Default setting
StrValA	Aph Start Current	0.005...40000 pu	0.001 pu	1pu
StrValB	Bph Start Current	0.005...40000 pu	0.001 pu	1pu
StrValC	Cph Start Current	0.005...40000 pu	0.001 pu	1pu
OpDlTmms	DT Operate Delay	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 and starting sequence, faults and inadvertent energization. The element is only active once the current and voltage are below set levels for the activation time. It will then deactivate when voltage is above setting for the release delay. If current appears above setting when the element is active it will operate.

Setting name	Description	Setting range	Step size	Default setting
StrValA	Start value for over current	0.1...2 pu	0.01 pu	0.1 pu
StrValV	Start value for under voltage	0.1...1 pu	0.01 pu	0.8 pu
ActDlTmms	Activation time delay	0...10000 ms	10 ms	5000 ms
DlTmms	Release time delay	0...10000 ms	10 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.

Setting Name	Description	Setting Range	Step Size	Default Setting
PPR	Pulse per rotation	1...24	1	1
NomSpd	Nominal speed	15...10000 rpm	1	3000
ZeroTmms	Zero speed time delay	0...300000 ms	1000	60000

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.

Overspeed protection is only available when speed detection function is enabled. Whenever the motor speed reaches the threshold, this function starts and an instantaneous start signal is issued. If the fault remains active longer than the operate delay setting, a trip signal is issued.

Setting parameter	Description	Setting range	Step size	Default setting
StrVal	Rotational speed pick-up threshold	1.0...1.6 pu	0.01 pu	1.0 pu
OpDITmms	Operate time delay	0...300 s	1 s	1 s

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.

Underspeed protection is only available when speed detection function is enabled. The underspeed protection is active after rotational speed reached the threshold.

Setting parameter	Description	Setting range	Step size	Default setting
StrVal	Rotational speed pick-up threshold	0.01...1.0 pu	0.01 pu	0.4 pu
OpDITmms	Operate time delay	0...300 s	1 s	1 s

Zerospeed (ZEROPZSU, ANSI 14)

The zerospeed protection is only available when speed detection function is enabled.

This function 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.

Setting parameter	Description	Setting range	Step size	Default setting
StrVal	Rotational speed pick-up threshold	0.01...1.0 pu	0.01 pu	0.05 pu
OpDITmms	Operate time delay	0...300 s	1 s	1 s

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. Stage 1 will normally detect any field failure but is delayed to avoid operation on power swings. If required, stage 2 can be enabled to operate faster for a reduced impedance not affected by power swings.

Setting name	Description	Setting range	Step size	Default setting
Ofs1	Offset from origin of stage1	0.0005...5 pu	0.0001 pu	0.2 pu
PoRch1	Diameter of mho of stage1	0.0005...5 pu	0.0001 pu	2 pu
OpDlTmms1	Operate delay of stage1	0...10000000 ms	1 ms	5 s
Mho2Mod	Enable stage2 of field failure function	Off, On	N/A	Off
Ofs2	Offset from origin of stage2	0.0005...5 pu	0.0001 pu	0.2 pu
PoRch2	Diameter of mho of stage2	0.0005...5 pu	0.0001 pu	1 pu
OpDlTmms2	Operate delay of stage2	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

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.

Setting name	Description	Setting range	Step size	Default setting
PoChr	Impedance circle zone 1 boundary	0.0005...5 pu	0.0001 pu	0.7 pu
OpDlTmms	Zone 1 operate delay	0...10000000 ms	1 ms	2 s
RsDlTmms	Zone 1 reset time	0...10000000 ms	1 ms	0 ms
Z2Mod	Impedance circle zone 2 Turn On or Off	On/Off	N/A	Off
Po2Chr	Impedance circle zone 2 boundary	0.0005...5 pu	0.0001 pu	0.25 pu
Op2DlTmms	Zone 2 operate delay	0...10000000 ms	1 ms	500 ms
Rs2DlTmms	Zone 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°.

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.

Power swings will tend to follow the same locus as pole slips but will not cross the line between the system and machine origins. They will approach the line but then turn and head back towards the load impedance which is normally in the first quadrant. As this impedance can almost touch the line between origins the power swing detection element includes logic to distinguish between a power swing and a pole slip. It also incorporates a transition timer to distinguish between faults and pole slips by only enabling the function when the locus takes more than 25 ms to travel through the outer zone. The inner zone can be divided into 2 zones with different slip counts for applications where additional slips can be tolerated further into the system. The slip count increments whenever the impedance exits with opposite resistance to entry indicating a pole slip has occurred. The count resets if the reset delay expires after the last slip. If the count exceeds the zone counter the element will operate after the operate delay which is set to avoid operation when current is at it's highest.

Setting name	Description	Setting range	Step size	Default setting
PoRch	Inner forward reach	0.0005...5 pu	0.0001 pu	1 pu
PoRchRev	Inner reverse reach	0.0005...5 pu	0.0001 pu	1 pu
RisPhRch	Inner resistive forward reach	0.0005...5 pu	0.0001 pu	1 pu
RisPhRchRev	Inner resistive reverse reach	0.0005...5 pu	0.0001 pu	1 pu
PctRch[1]	Outer/Inner forward reach	110...1000%	10%	110%
PctRchRev[1]	Outer/Inner reverse reach	110...1000%	10%	110%
PctRisRch[1]	Outer/Inner resistive reach	110...1000%	10%	110%
PctRisRchRev[1]	Outer/Inner resistive reverse reach	110...1000%	10%	110%
BldAng	Blinder Angle	20...90 degree	1 degree	80 degree
PctRchZ1[2]	Z1/Inner reach	0.01...1[3]	0.01	1
SlpCnt1	Slip counter Zone 1	1...20	1	1
SlpCnt2	Slip counter Zone 2	1...20	1	1
OpDlTmms	Operate Delay	0...10000000 ms	1 ms	0 ms
RsDlTmms	Reset Delay	0...10000000 ms	1 ms	30000 ms

1 The percentage of the inner characteristic.
2 The percentage of the forward reach which defines zone 1.
3 A setting of 1 means zone 1 is equal to zone 2.

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

The Directional Overpower Protection (PDOP) is used to detect overpower conditions to 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 under excitation.

Setting parameter	Description	Setting range	Step size	Default setting
DirMod	Directional mode	Forward/Reverse	N/A	Forward
StrVal	Start threshold for three-phase	0.005...3.250 pu	0.001 pu	1 pu
OpDITmms	Operate time delay	0...10000000 ms	1 ms	0 ms
RsDITmms	Reset time delay	0...10000000 ms	1 ms	0 ms

Directional Underpower (PPDUP, ANSI 37P)

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

Setting parameter	Description	Setting range	Step size	Default setting
DirMod	Directional mode	Forward/Reverse	N/A	Forward
StrVal	Start threshold for three-phase	0.005...3.250 pu	0.001 pu	0.2 pu
OpDITmms	Operate time delay	0...10000000 ms	1 ms	0 ms
RsDITmms	Reset time delay	0...10000000 ms	1 ms	0 ms

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 BayLive input and by measuring the phase currents and voltages.

The output signal BayDead is asserted when one of the following conditions applies.

- BayLive is inactive. None of the three phase currents exceeds the current threshold.
- None of the three phase currents exceeds the current threshold. None of the three phase-to-phase voltages exceeds the voltage threshold. The duration time is more than 20 ms.

NOTE: It is recommended to configure the BayLive input to all CB positions in the bay via matrix. When all CB positions are in open position, BayLive is set to inactive.

When the BayLive input is not configured via matrix, the default value of BayLive is inactive.

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.

The trip signal has a settable minimum dwell or can be set to always latch. It also has a latch input which will force a latched trip if active with an operate input. A latched trip can be cleared by the reset button, or a matrix or control input providing the operate signal is not still active.

Setting Name	Description	Setting Range	Step Size	Default Setting
LOMod	Lock out Mode	Enable Disable	NA	Enable
TrPlsTmms	Minimum trip Pulse	0...10000 ms	1 ms	0 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 (back tripping) to the upstream or adjacent circuit breaker. Additional fault checks can be applied to current based operation to increase security by ensuring a fault is present on the system. Initiation of current or CB status operation can be configured independently via the matrix.

Setting name	Description	Setting range	Step size	Default setting
FailMod	Breaker failure detection mode	Current, CB status, Current and CB status	N/A	Current
ReTrMod	Disable or enable CBF Retrip	On, Off	N/A	Off
DetValA	Threshold for phase undercurrent detector to reset CB failure	0.02...20 pu	0.001 pu	0.2 pu
PhChkValA	Phase overcurrent check threshold	0.00...20 pu	0.001 pu	0 pu
NeutChkValA	Neutral overcurrent check threshold	0.00...20 pu	0.001 pu	0 pu
I2ChkValA	Negative sequence overcurrent check threshold	0.00...20 pu	0.001 pu	0 pu
TPTrTmms	Retrip time delay	0.00...10000000 ms	1 ms	100 ms
FailTmms	Backtrip time delay	0.00...10000000 ms	1 ms	250 ms
RstTmms	Reset delay	0.00...10000000 ms	1 ms	250 ms

Functions and Description

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 a 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 Toolsuite.

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

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
- Circuit breaker proxy (CBXCBR)
  - Receive orders from protection functions and CB control and Monitor CB status
- Circuit breaker interlocking (CBCILO)
  - Check the interlocking
- Circuit breaker monitoring (CBSCBR)
  - Monitor the CB condition
- Circuit breaker failure (RBRF)
  - Retrips or backtrips 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
- 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

Functions and Description

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 legacy protocols
- Remote control using IEC 61850 communication
- Direct control via digital inputs

Interlocking (CBCILO/SWCILO)

The switching commands to the controllable switching devices in the bay are enabled only after interlocking conditions have been checked.

Circuit Breaker Proxy (CBXCBR)

Description

The functions of the circuit breaker proxy are:

- Issue CB state information based on CB auxiliary contacts.
- Process the trip order coming from the internal protection functions.
- 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).

Circuit Breaker Proxy (CBXCBR) (cont'd)

Setting Parameters

Settings of the CBXCBR				
Setting parameter	**Description**	**Setting range**	**Step size**	**Default setting**
CBClsTmms	Closing pulse time of CB	100...10000 ms	10 ms	200 ms
CBOpTmms	Opening pulse time of CB	100...10000 ms	10 ms	200 ms
CBAuxM	CB auxiliary management	None/52a/52b/Both	N/A	Both
CBCmdM	CB command management	Dwell/Status reset	N/A	Dwell

Switch Proxy (SWXSWI)

The functions of the switch proxy are:

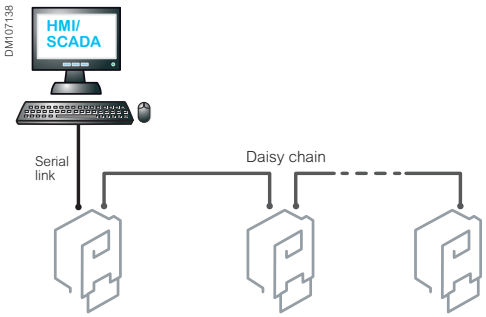
- Issue switch state information based on switch auxiliary contacts.
- Process the closing/opening request coming from switch control function.
- Count switch operation number (OpCnt).

Setting Parameters

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

Communication

Examples of Architectures



Connection to SCADA using Serial

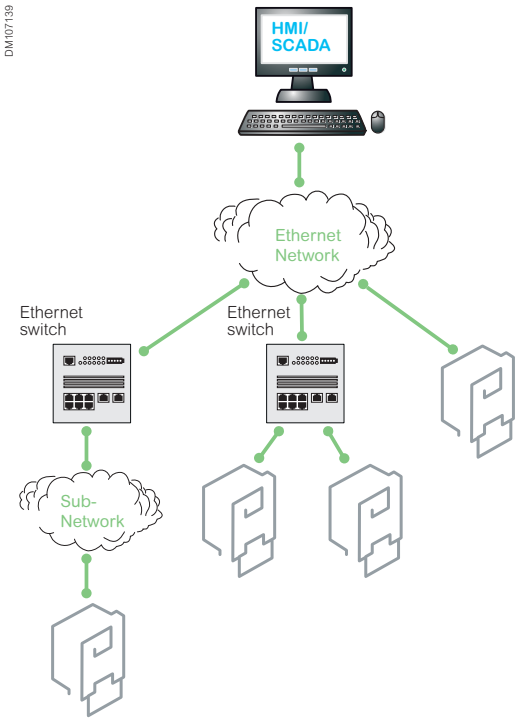
This architecture allows you to connect HMI/SCADA to a set of PowerLogic P7 devices using a multi-drop serial communication link with client-server communication.

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.

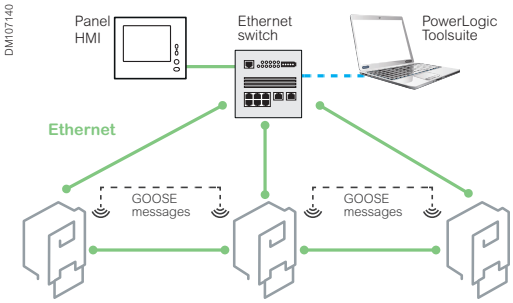
Available protocols:

- 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 Toolsuite 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.

Communication

Redundancy Protocols

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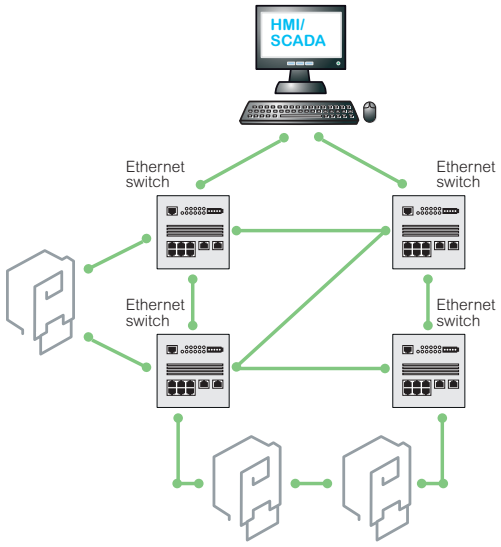

RSTP (Rapid Spanning Tree Protocol)

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.

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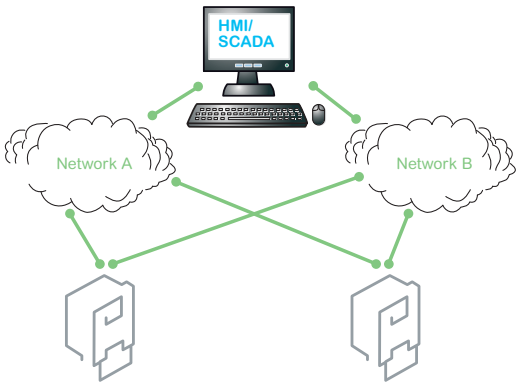

PRP (Parallel Redundancy Protocol)

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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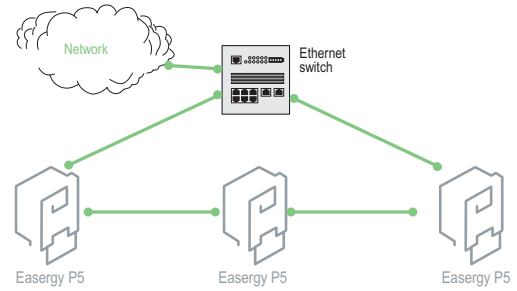


HSR (High-availability Seamless Redundancy)

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.

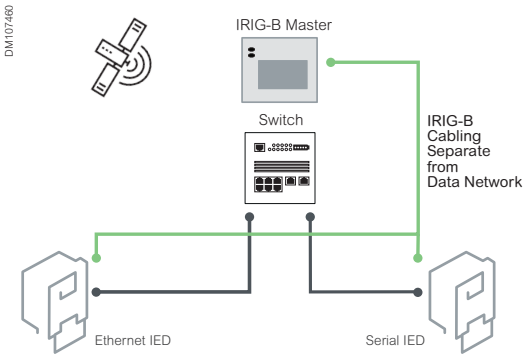
Communication

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.

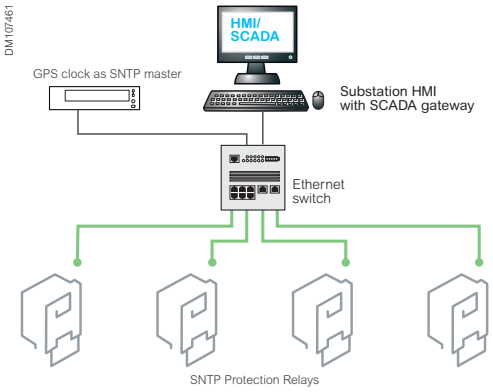


IRIG-B

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 77.

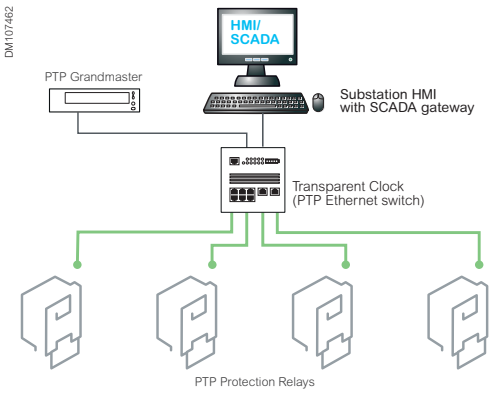


SNTP

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.

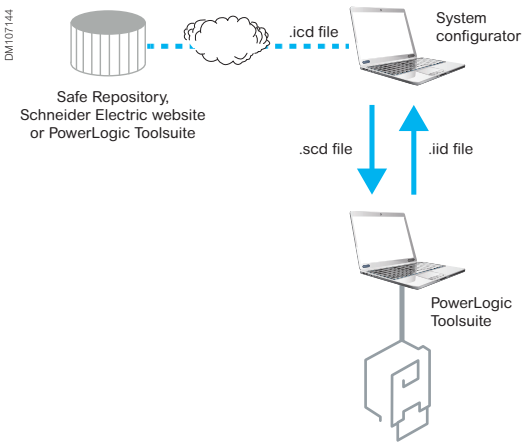
Communication

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 Toolsuite during the configuration process of the device.

.scd file

The system description file generated by the system configurator can be processed by PowerLogic Engineering Toolsuite 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 Toolsuite 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.

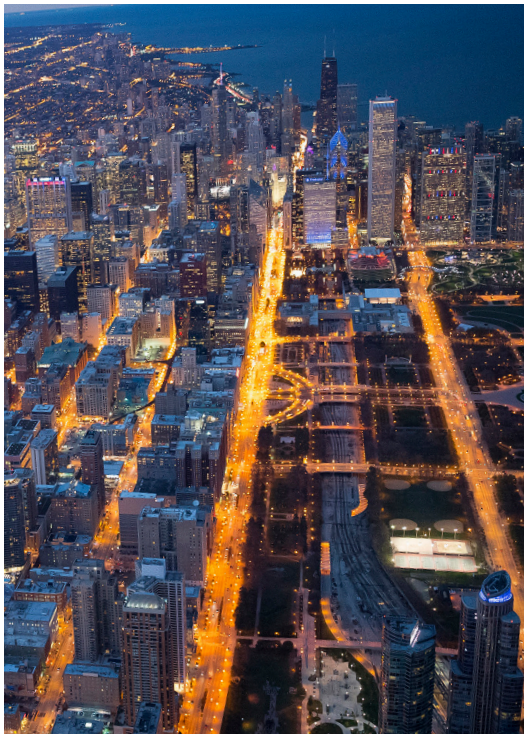
The PowerLogic P7 is designed with special attention to cybersecurity aspects, with compliance to Schneider Electric's Cybersecurity Policy and following Secure Development Lifecycle process.

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

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 with the default ENGINEER role. 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

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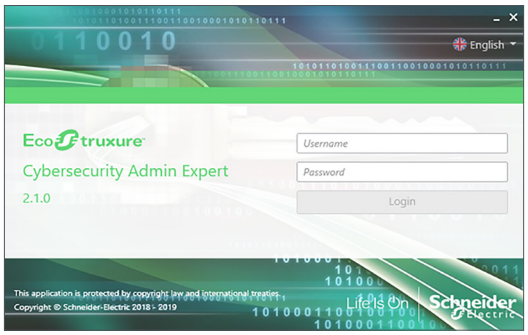


Cybersecurity with EcoStruxure Cybersecurity Admin Expert

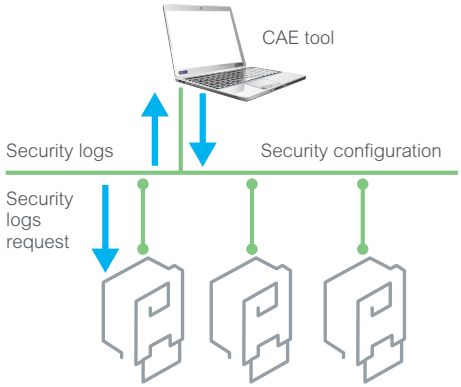
PowerLogic P7 leverages of EcoStruxure Cybersecurity Admin Expert (CAE), a comprehensive and intuitive, software-based, cybersecurity configuration and policy tool for your operational technology environment.

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



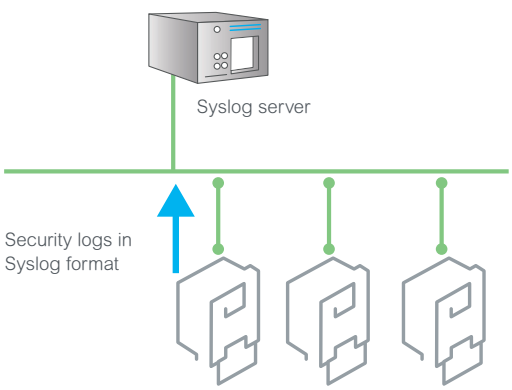
In summary, PowerLogic P7 becomes part of a cybersecurity management system consisting of servers for security logs, authentication, and authorization, using standard network protocols.

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.

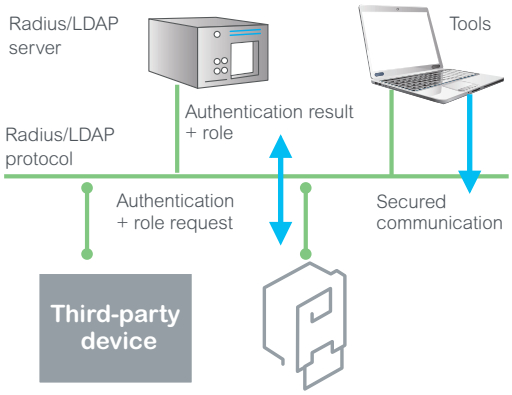
Cybersecurity

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.

PowerLogic™ P7 Product Description

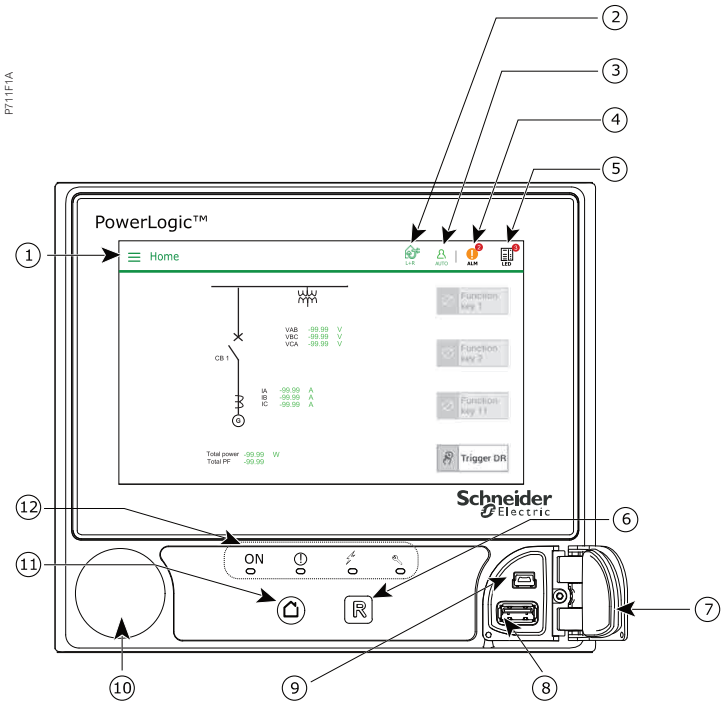
PowerLogic™ P7 Product Description

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



Virtual LEDs

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 and Chinese.

Dimensions and Weight

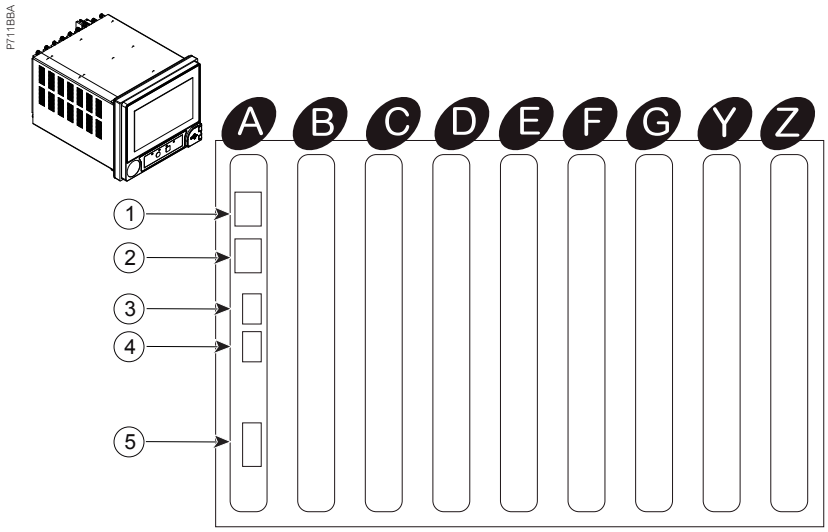
Dimensions	mm	in
Height	180	7
Width	205	8
Depth	280	11
Weight	**kg**	**lb**
Weight (maximum)	8.8	19.4

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.

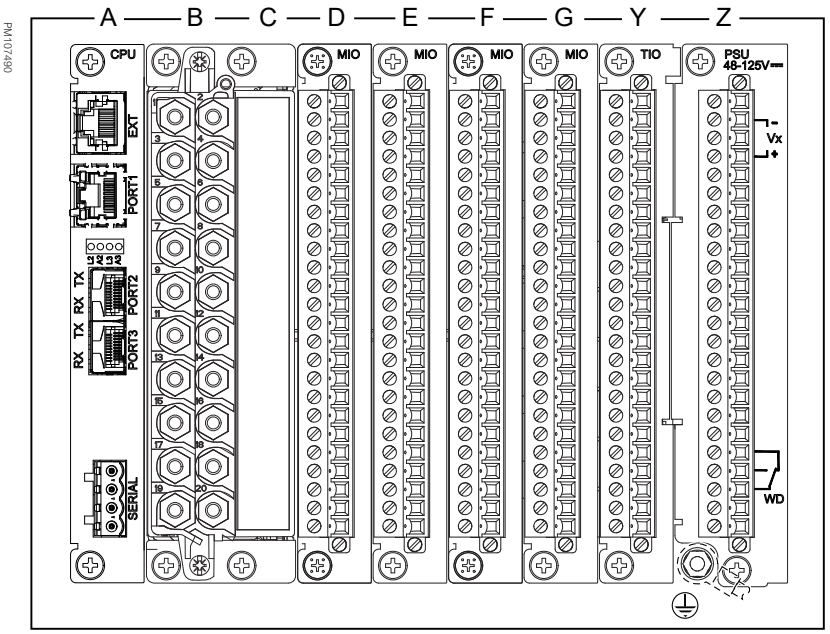


PowerLogic P7	Slot: Module and port
✓	A: CPU • ① EXT: CAN bus port for connection with additional accessories like IRIG-B module, RTD module. • ② Port 1: Single Ethernet communication port (RJ45) • ③ Port 2 (optional): SFP (RJ45/100 Mb/s multimode/100 Mb/s singlemode) with HSR/PRP or RSTP redundancy • 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).
✓	Y: TIO (power supply unit auxiliary)
✓	Z: PSU (power supply unit)

Base Unit Description

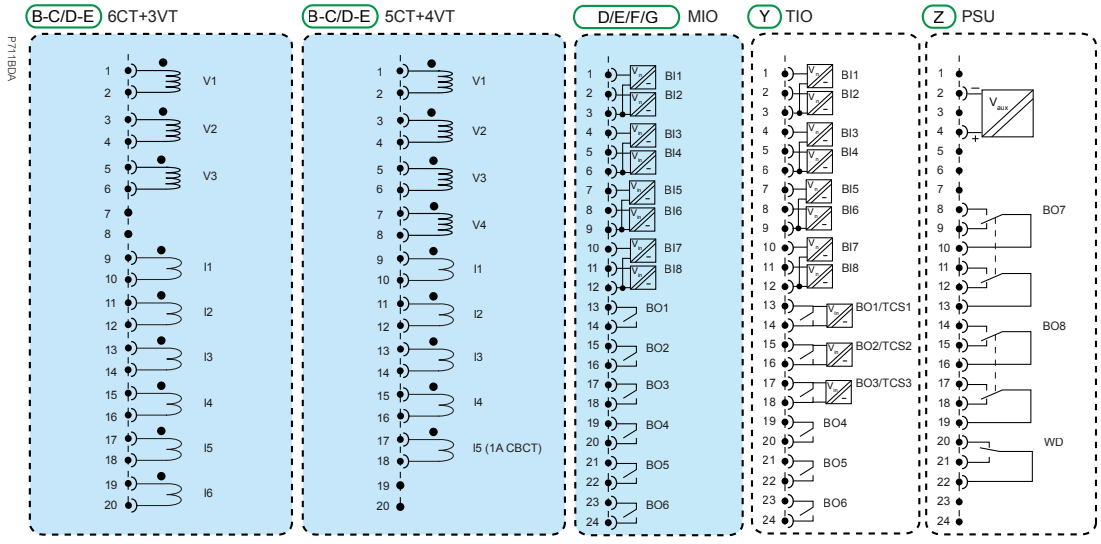
Rear Panel Terminals

Rear Panel Terminals



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

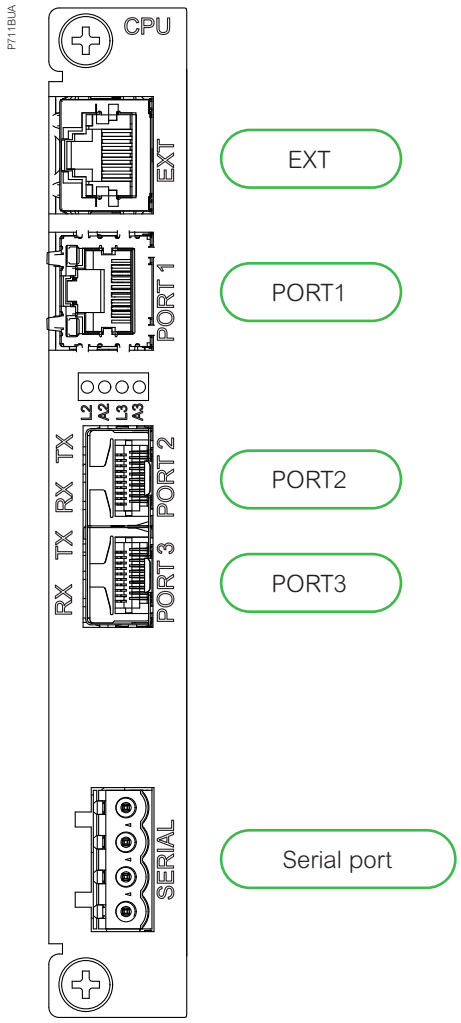
Rear Terminal Designations



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

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.

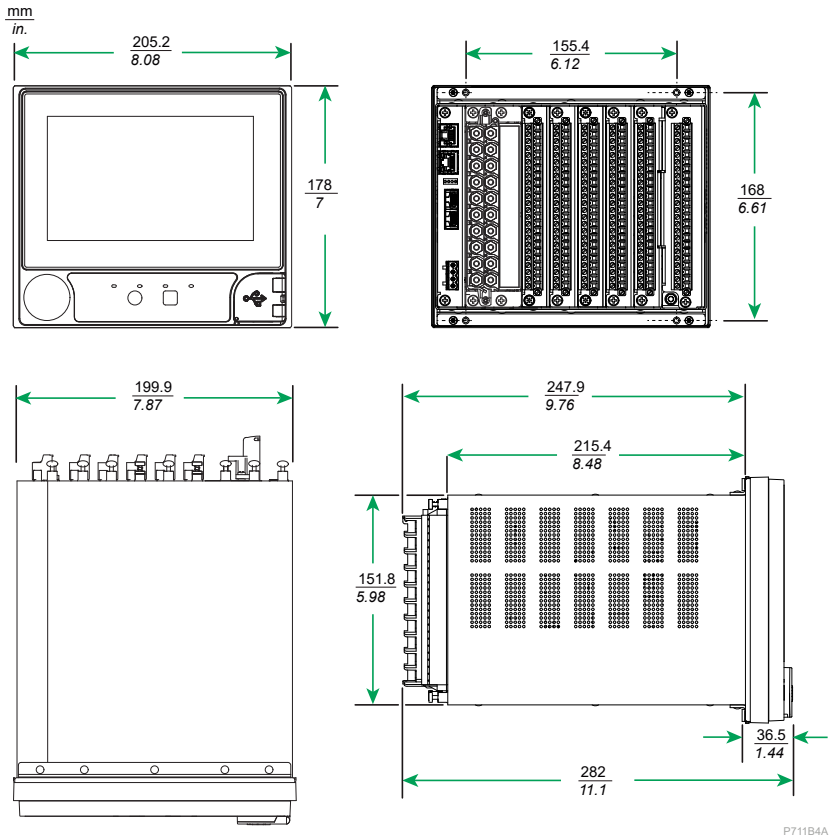
The SFP modules are available for copper wire, multi-mode fiber optic or singlemode fiber optic connection. The SFP modules with RJ45 or LC connector provide RSTP (Rapid Spanning Tree Protocol), PRP (Parallel Redundancy Protocol), HSR (High-availability Seamless Redundancy) and Failover selectable by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

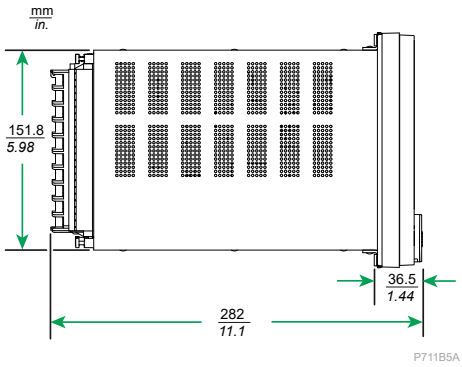
RS485 Serial Communication Port

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.

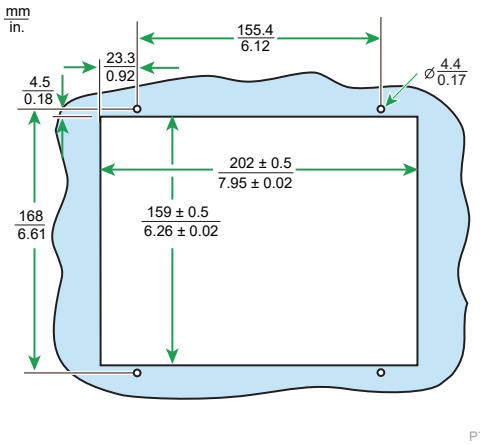
Base Unit Description

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

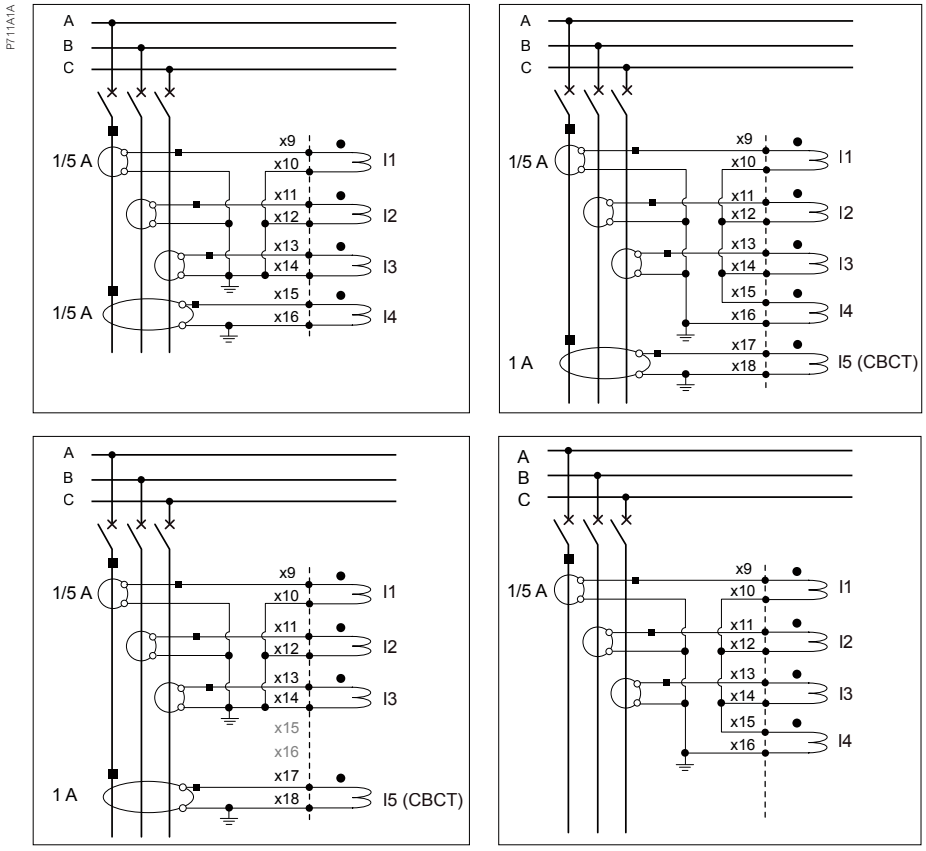
Typical Application Diagrams

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.

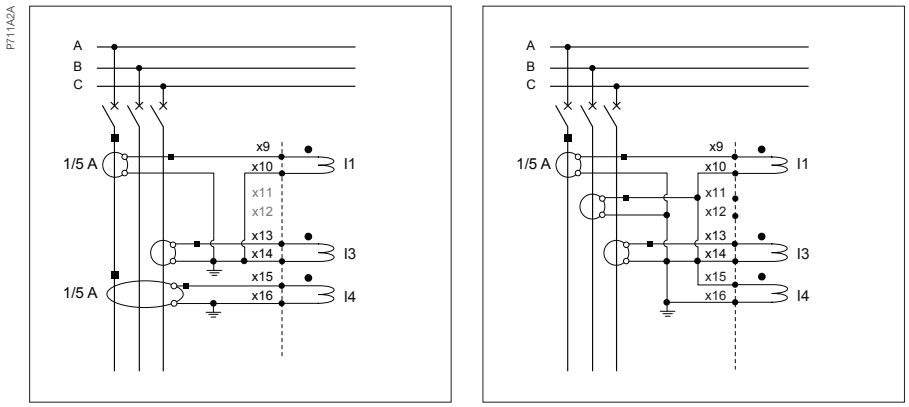
NOTE: Please see the appropriate User Guide or user manual for correct installation information.

Connection Diagrams

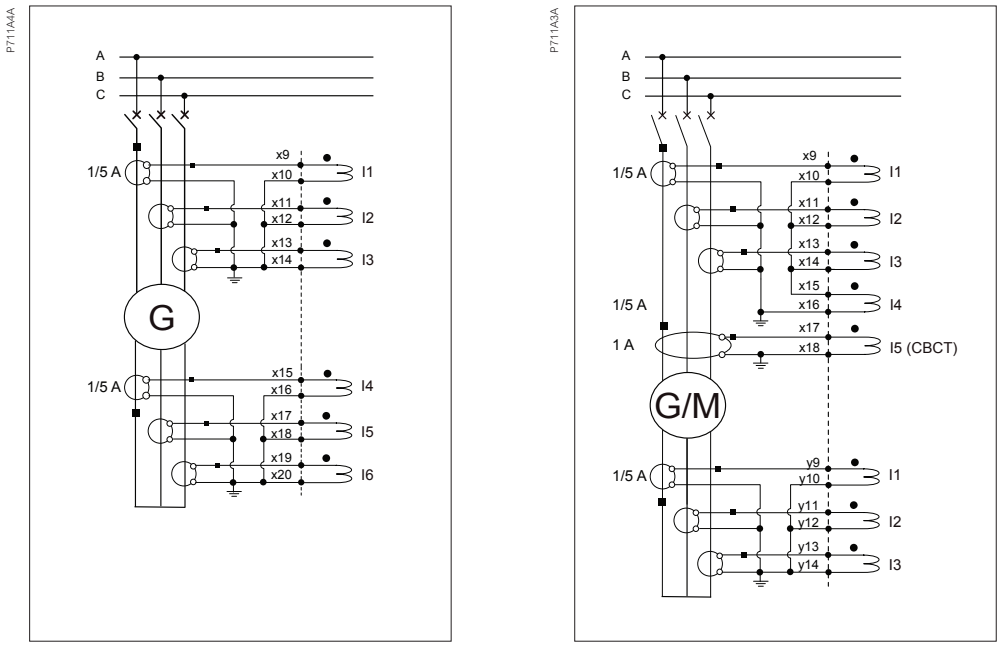
Typical Application Diagrams

CT Typical Application (cont'd)

Two Phase and Ground Connection



Three Phase Connection for Differential Application



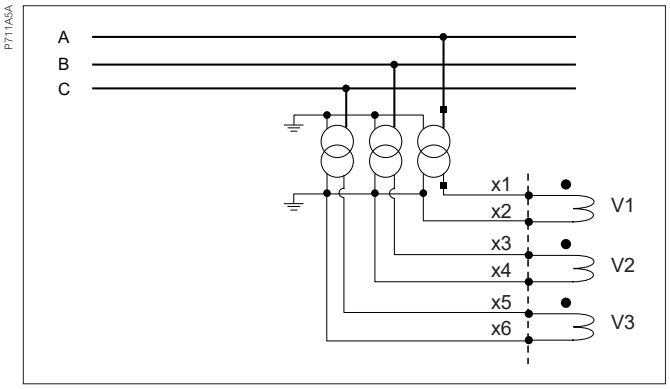
NOTE: Please see the appropriate User Guide or user manual for correct installation information.

Connection Diagrams

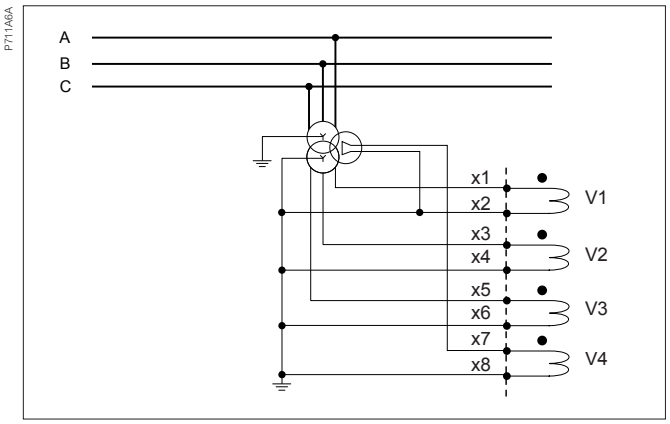
Typical application Diagrams

Voltage Transformer Application

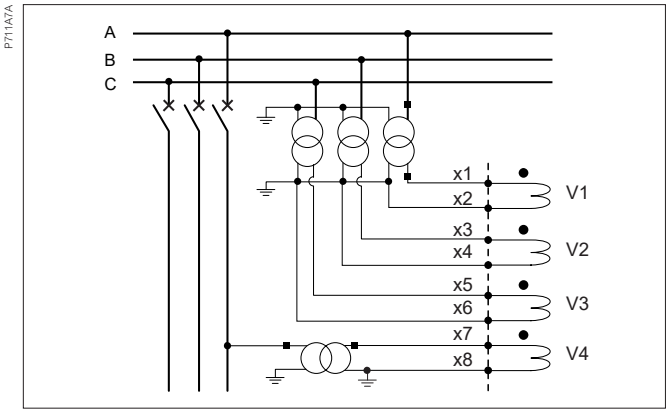
Three Phase-to-Ground Voltages



Three Phase-to-Ground Voltages and One Neutral Voltage



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



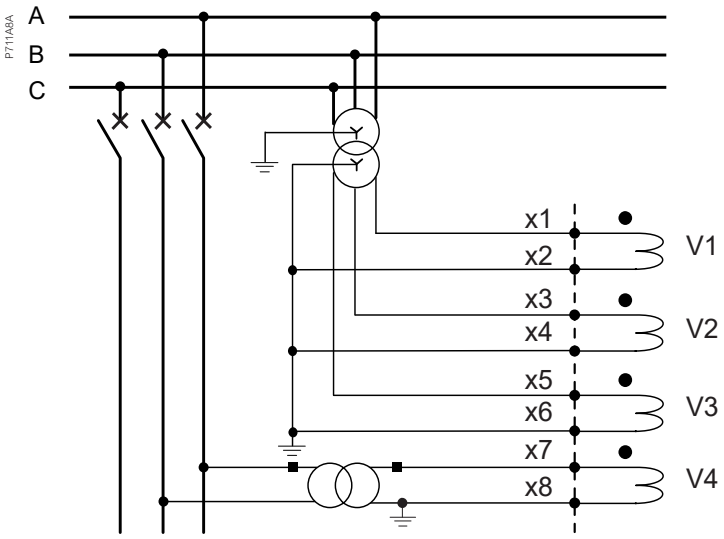
NOTE: Please see the appropriate User Guide or user manual for correct installation information.

Connection Diagrams

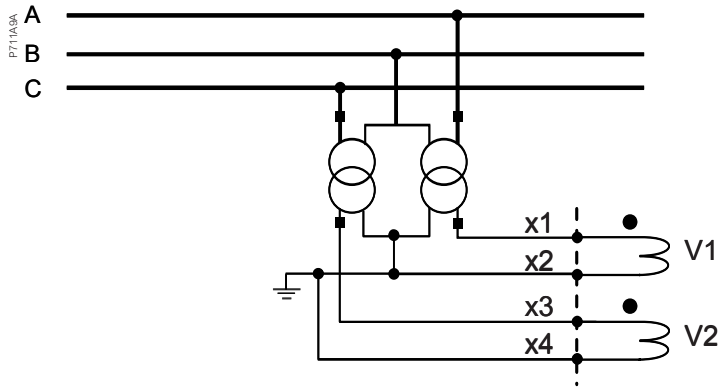
Typical Application Diagrams

Voltage Transformer Application (cont'd)

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



Two Phase-to-Phase Voltages



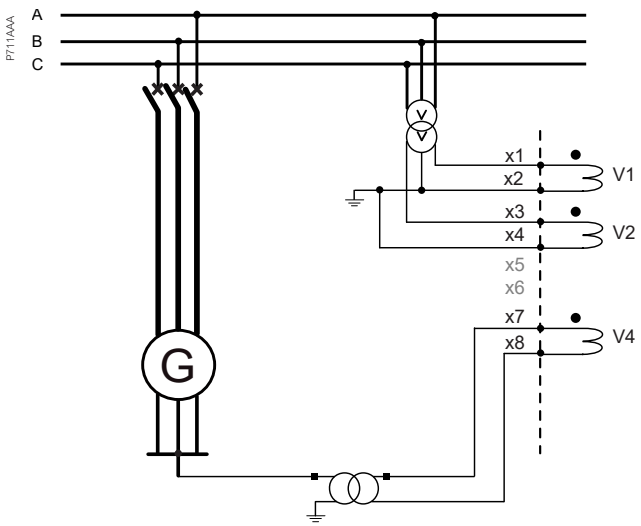
NOTE: Please see the appropriate User Guide or user manual for correct installation information.

Connection Diagrams

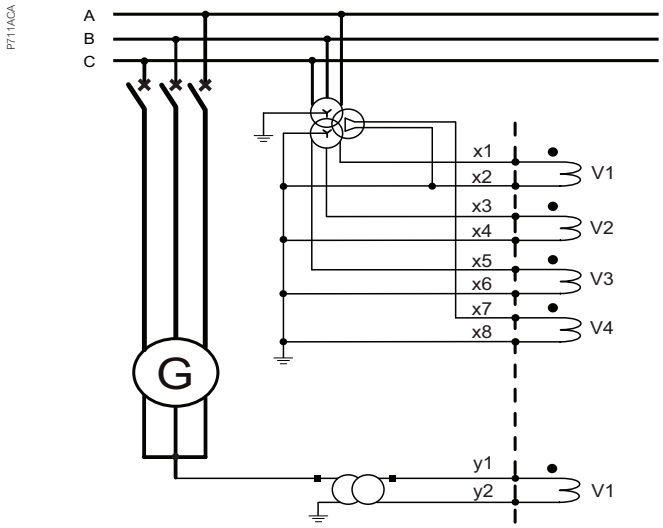
Typical Application Diagrams

Voltage Transformer Application (cont'd)

Two Phase-to-Phase Voltages and One Neutral Voltage



Three Phase-to-Ground Voltages and Two Neutral Voltages

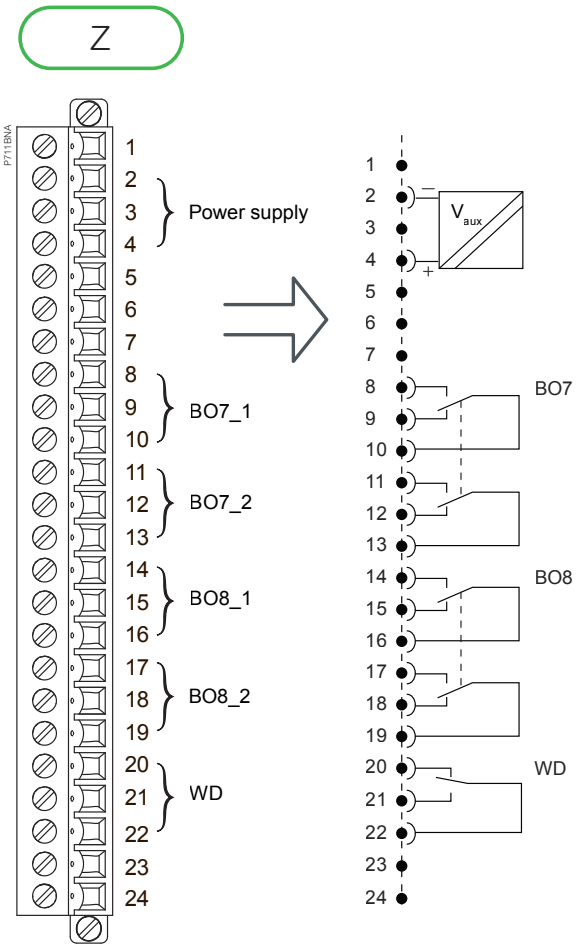


NOTE: Please see the appropriate User Guide or user manual for correct installation information.

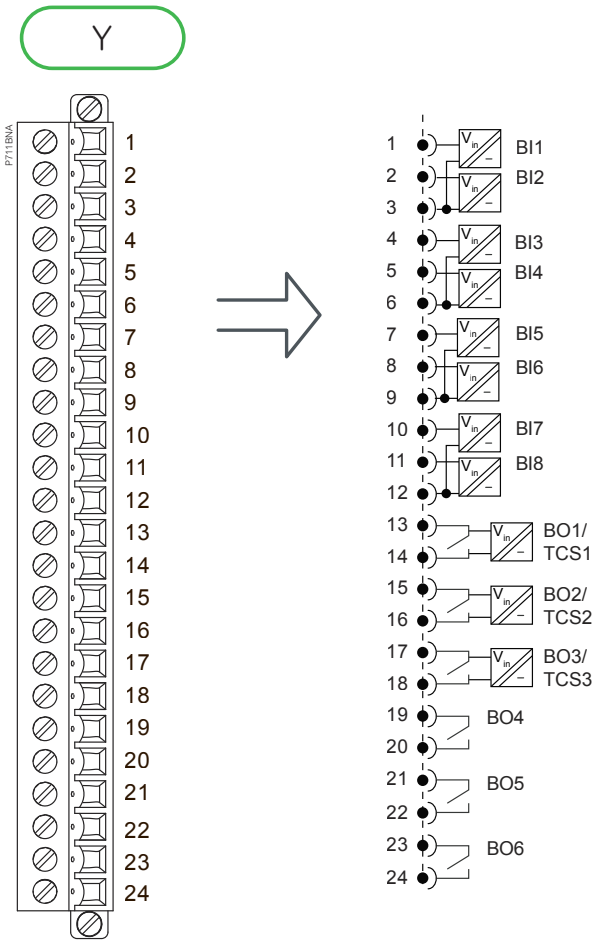
Connection Diagrams

Power supply, Inputs and Outputs

Slot Z: Power supply Module (PSU)



Slot Y: Auxiliary Power supply Module (TIO)



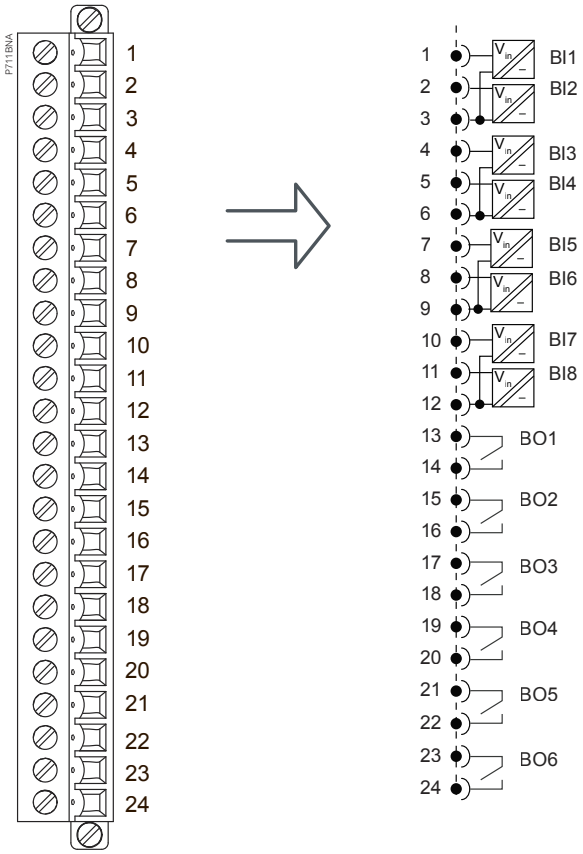
NOTE: Please see the appropriate User Guide or user manual for correct installation information.

Connection Diagrams

Power supply, Inputs and Outputs

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

D/E/F/G

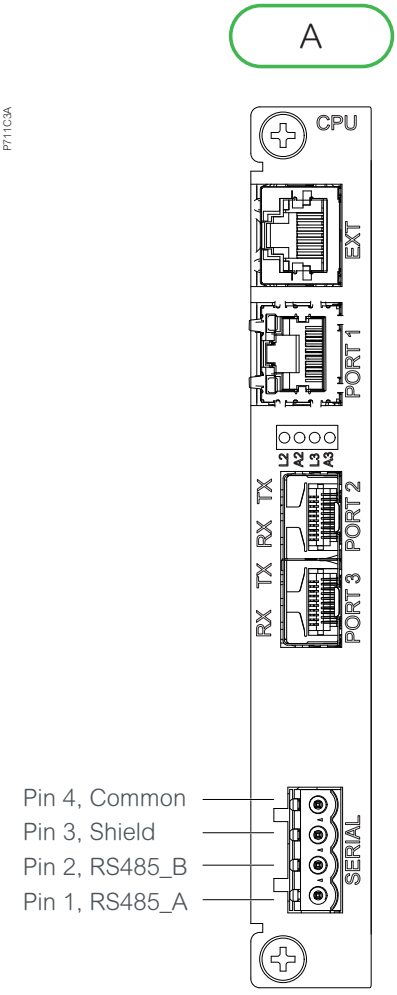


NOTE: Please see the appropriate User Guide or user manual for correct installation information.

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
Burden current	< 2 mA average continuous. A higher current pulse is needed for switch on to avoid operation on noise.

1 This value can be affected by high temperatures.

Technical Characteristics

Power supply, Inputs and Outputs

Electrical Characteristics (cont'd)

Characteristic	Value
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
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
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
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)

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.

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

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 Toolsuite 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

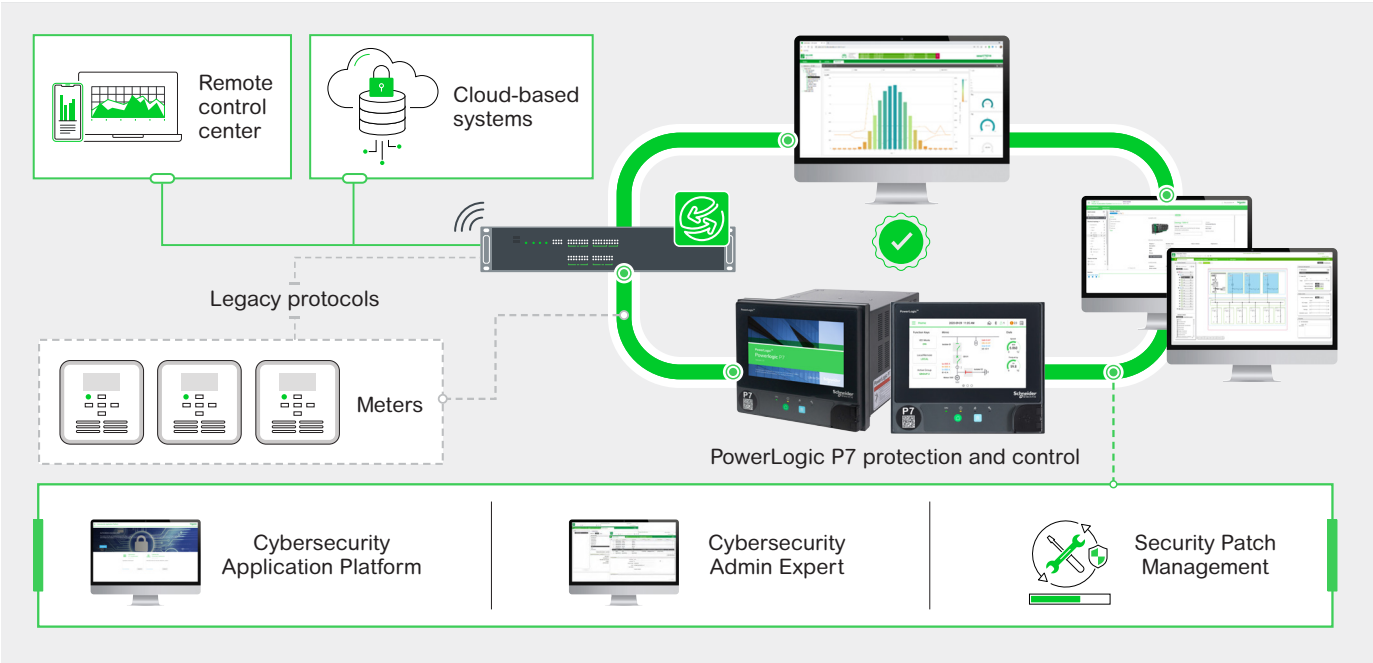
Full Operation from a Safe Distance

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

PowerLogic Engineering Suite software 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.



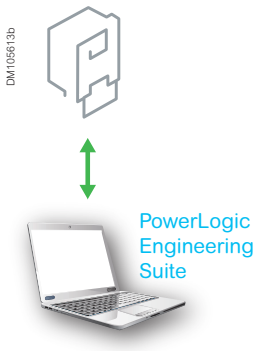
Configure, integrate, and maintain PowerLogic P7 devices in Schneider Electric's EcoStruxure™ Power Automation System (EPAS)

Setup Software

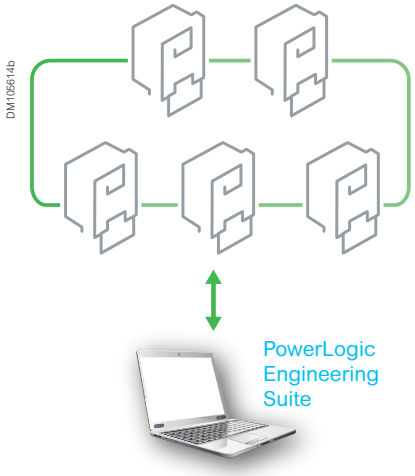
PowerLogic Engineering Suite

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

Get support anytime

- 24/7 self-service, mobile catalog and access to expert help
- Off-line and on-line catalog
- Manage and track your orders
- Advanced support

Free Download

MySchneider Application:

Download on the App Store

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MySchneider App

Notes

Additional Modules and Accessories

Additional Modules and Accessories

Communication Accessories

Modules

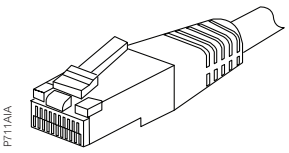
Optional SFP Modules

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.

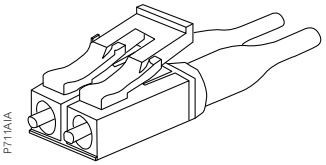
The SFP modules are available for copper wire, multi-mode fiber optic or singlemode fiber optic connection.

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)

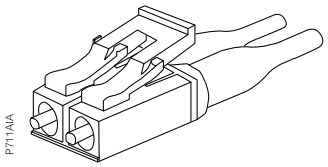
REL70063: Ethernet SFP Module 100 Mb/s multimode

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)

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

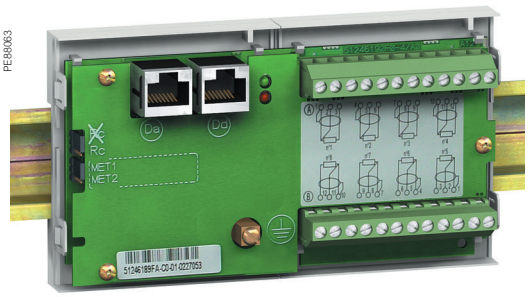
Modulated IRIG-B input	
Connection	BNC socket
Type of cable	50 ohms coaxial
Time code format	B124, B125 (1)
Input signal level	200mV...20V

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



Temperature Sensor Module

REL59641: 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.

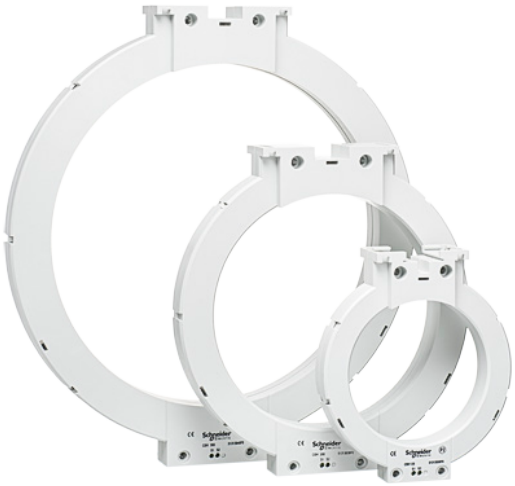
Mechanical characteristics	
Assembly	Symmetrical DIN rail

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

Communication Accessories

Sensors

DE88206



CSH120, CSH200 and CSH300 core balance CTs.

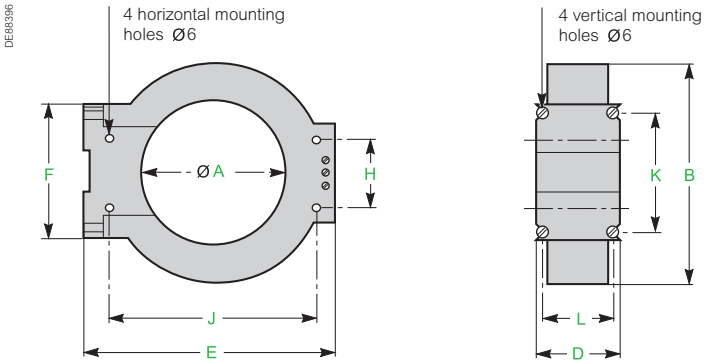
CSH Core-Balance Current Transformers

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

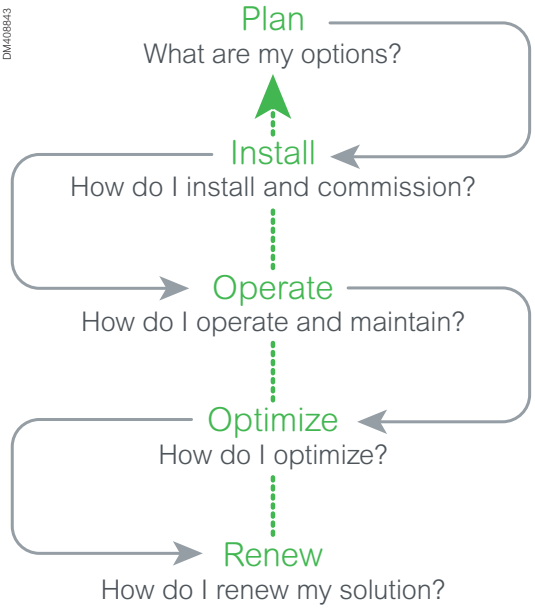
Services

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

Green Premium™

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

Ordering

PowerLogic™ P7 Configurator

Selecting Product

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

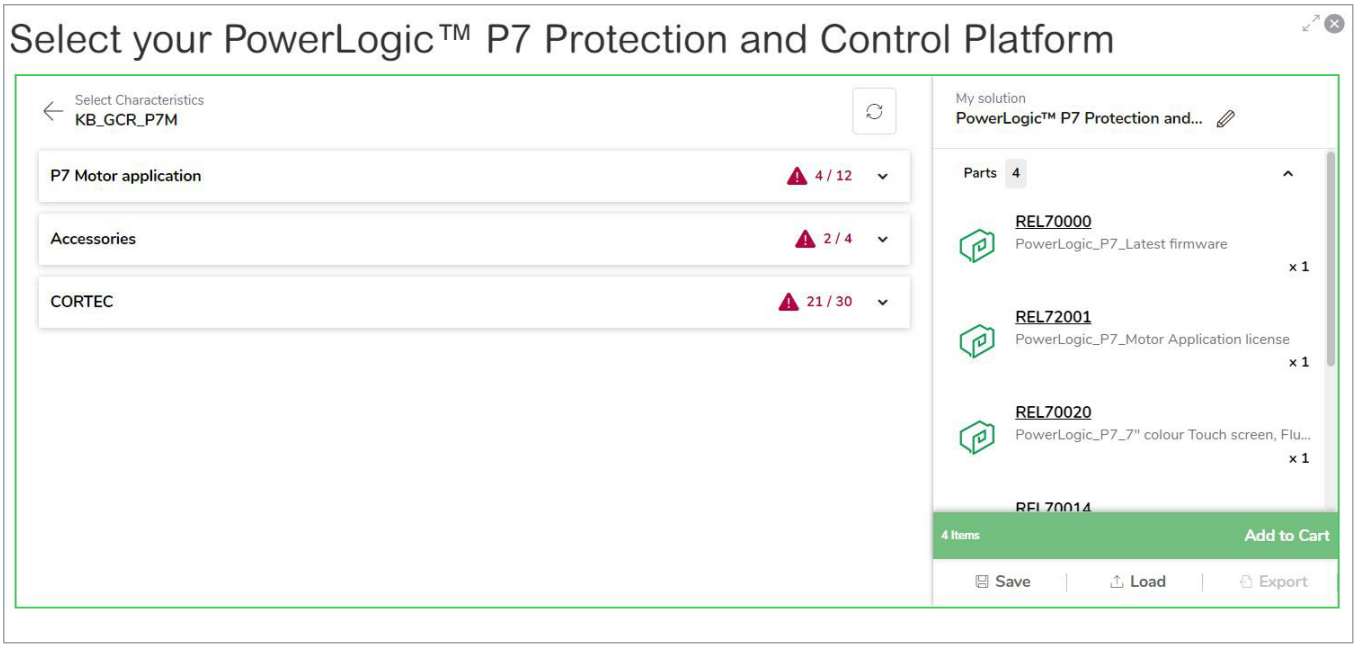
Fast and Simple

See more on:

- www.se.com/PowerLogic-p7

Or click directly on: **help me choose tool**

EB100315



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-TLA	P7 Motor Standard level 5CT 4VT 24BI 20BO 24-34V Eth RJ45
REL72501	☐	P7M41-1CR5NNMMNNNNNNNNN-TMA	P7 Motor Standard level 5CT 4VT 24BI 20BO 48-125V Eth RJ45
REL72502	☐	P7M41-1CR5NNMMNNNNNNNNN-THA	P7 Motor Standard level 5CT 4VT 24BI-20BO 110-250V Eth RJ45
REL72503	☐	P7M41-1CR5MMMMNNNNNNNNN-TLA	P7 Motor Standard level 5CT 4VT 40BI 32BO 24-34V Eth RJ45
REL72504	☐	P7M41-1CR5MMMMNNNNNNNNN-TMA	P7 Motor Standard level 5CT 4VT 40BI 32BO 48-125V Eth RJ45
REL72505	☐	P7M41-1CR5MMMMNNNNNNNNN-THA	P7 Motor Standard level 5CT 4VT 40BI 32BO 110-250V Eth RJ45
REL72506	☐	P7M41-1CR5R6MMNNNNNNNNN-TLA	P7 Motor Standard level 11CT 7VT 24BI 20BO 24-34V Eth RJ45
REL72507	☐	P7M41-1CR5R6MMNNNNNNNNN-TMA	P7 Motor Standard level 11CT 7VT 24BI 20BO 48-125V Eth RJ45
REL72508	☐	P7M41-1CR5R6MMNNNNNNNNN-THA	P7 Motor Standard level 11CT 7VT 24BI 20BO 110-250V Eth RJ45
Generator Application			
REL73500	☐	P7G41-1CR5NNMMNNNNNNNNN-TLA	P7 Generator Standard level 5CT 4VT 24BI 20BO 24-34V Eth RJ45
REL73501	☐	P7G41-1CR5NNMMNNNNNNNNN-TMA	P7 Generator Standard level 5CT 4VT 24BI 20BO 48-125V Eth RJ45
REL73502	☐	P7G41-1CR5NNMMNNNNNNNNN-THA	P7 Generator Standard level 5CT 4VT 24BI 20BO 110-250V Eth RJ45
REL73503	☐	P7G41-1CR5MMMMNNNNNNNNN-TLA	P7 Generator Standard level 5CT 4VT 40BI 32BO 24-34V Eth RJ45
REL73504	☐	P7G41-1CR5MMMMNNNNNNNNN-TMA	P7 Generator Standard level 5CT 4VT 40BI 32BO 48-125V Eth RJ45
REL73505	☐	P7G41-1CR5MMMMNNNNNNNNN-THA	P7 Generator Standard level 5CT 4VT 40BI 32BO 110-250V Eth RJ45
REL73506	☐	P7G41-1CR5R6MMNNNNNNNNN-TLA	P7 Generator Standard level 11CT 7VT 24BI 20BO 24-34V Eth RJ45
REL73507	☐	P7G41-1CR5R6MMNNNNNNNNN-TMA	P7 Generator Standard level 11CT 7VT 24BI 20BO 48-125V Eth RJ45
REL73508	☐	P7G41-1CR5R6MMNNNNNNNNN-THA	P7 Generator Standard level 11CT 7VT 24BI 20BO 110-250V Eth RJ45

TOOLS

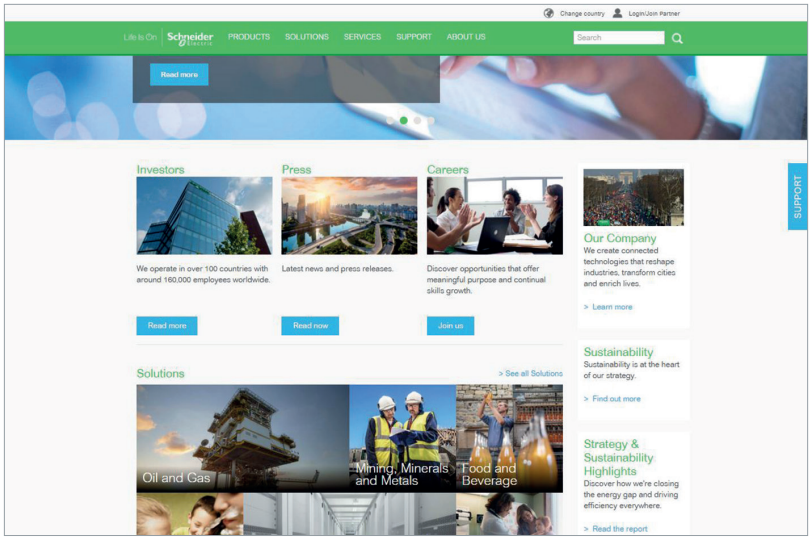
se.com

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.

PM103687



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.

Notes

www.se.com

Schneider Electric Industries SAS
35, Rue Joseph Monier
CS 30323
92506 Rueil Malmaison Cedex

RCS Nanterre 954 503 439
Capital social 928 298 512 €
www.se.com

September 2023
PowerLogic™ P7
NRJED323202EN

As standards, specifications and designs develop from time to time, please ask for confirmation of the information given in this document.

Over 75 % of Schneider Electric products have been awarded the Green Premium ecolabel.