

BPC (Overspeed Protection Device)



Overview

BPC Overspeed Protection Device is 2oo3 (two-out-of-three) TMR (Triple Module Redundant) SIL3 functional safety device.

Main safety function of BPC Device is protection of rotating machinery, i.e. turbines, compressors etc. in case of overspeed event based on processing of Speed sensors' signals. Device's functions are:

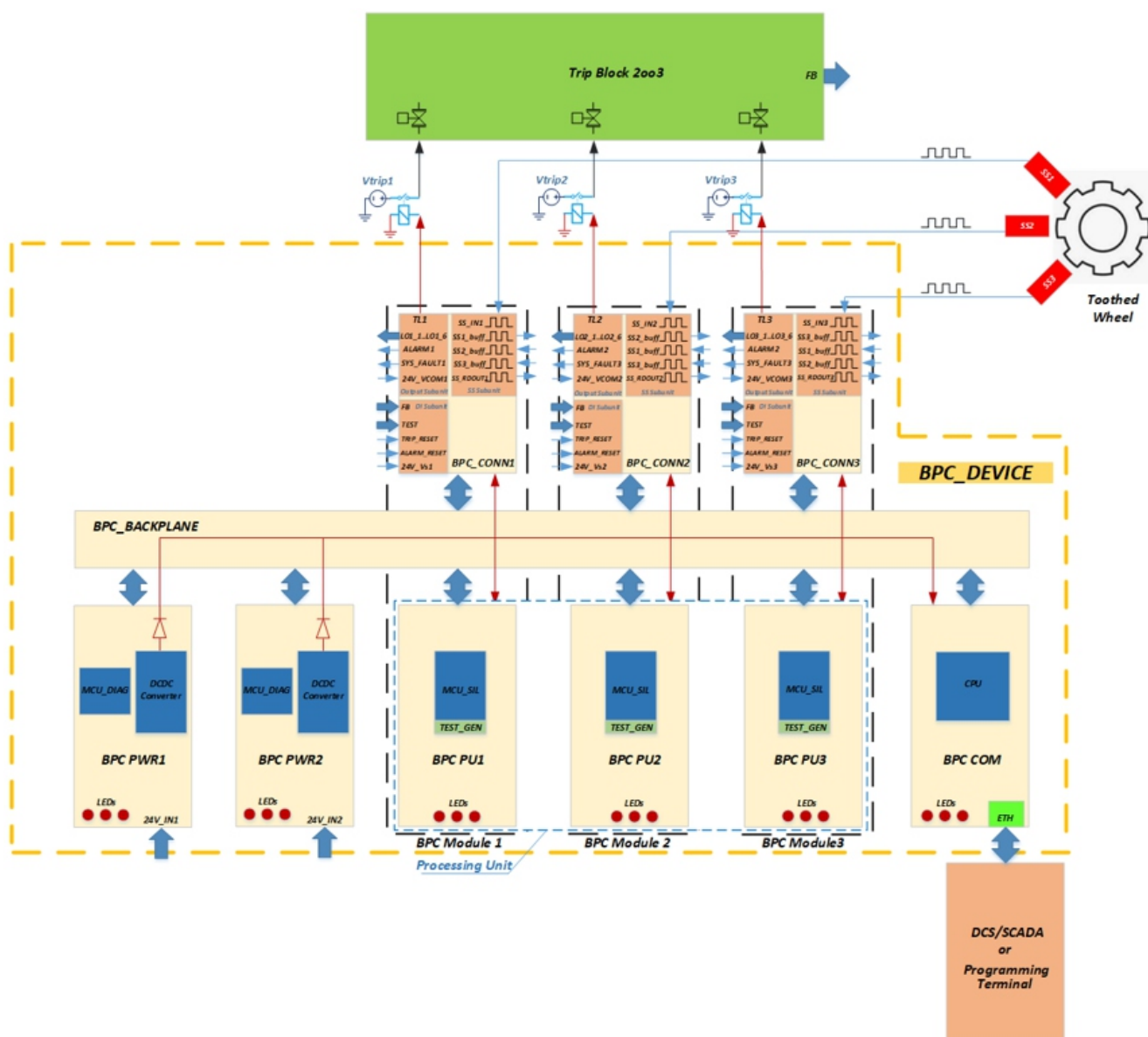
- Monitoring of three Speed sensor's signals and Readout signal
- Wide Speed sensor's input frequency range (0 to 10kHz) by using prescaler of 1, 2, 4 or 8
- Redundant power supply
- Providing 15V DC power supply for Speed sensors
- SIL3 Trip outputs (1 per channel, 3 in total) to Trip Block (solenoid valve block)
- SIL2 Logical outputs (6 per channel, 18 in total) to DCS
- Alarm and System Fault outputs (1 Alarm and 1 System Fault per channel) to DCS
- Generation of Speed sensors' Readout signals to DCS or other monitoring devices
- Keeping device's parameters in non-volatile memory (CRC protected)
- Performing overspeed test per channel initiated by the test inputs from DCS
- Trip_Reset and Alarm_Reset inputs initiated by DCS
- Trip Block feedback monitoring
- Watch Dog Timer
- Trip outputs latching functionality (enabled/disabled by configuration)
- Galvanic isolation between all inputs and outputs and digital electronic circuitry
- LED indications of all inputs, outputs and states
- CAN communication between modules (CAN1 – safety communication between BPC PU modules, CAN2 – communication between all modules for configuration, diagnostics and monitoring)
- Device configuration and monitoring through web application

Typical installation

Best position for Toothed wheel to be mounted is directly on the shaft of rotation machine, e.g. steam turbine. Speed sensors are to be mounted radially to Toothed wheel so that frequency of their output signals are proportional to toothed wheel rotational speed, i.e. turbine rotational speed. BPC Device provides power supply for Speed sensors.

$$f = \frac{\omega}{60} * N_{tooth} [Hz] \quad (1)$$

$$\omega = \frac{60}{N_{tooth}} * f [rpm] \quad (2)$$



Rotating speed is calculated using equation (2). Ntooth, thresholds as well as other parameters are set through web application. Trip outputs TL1, TL2 and TL3 are normally closed (NC). In case of overspeed event all Trip outputs shall go to Safe state so that inputs to Trip Block are deenergized. Trip Block shall cut oil supply to safety valves on turbine's protection system in case two out of its three its inputs are deenergized.

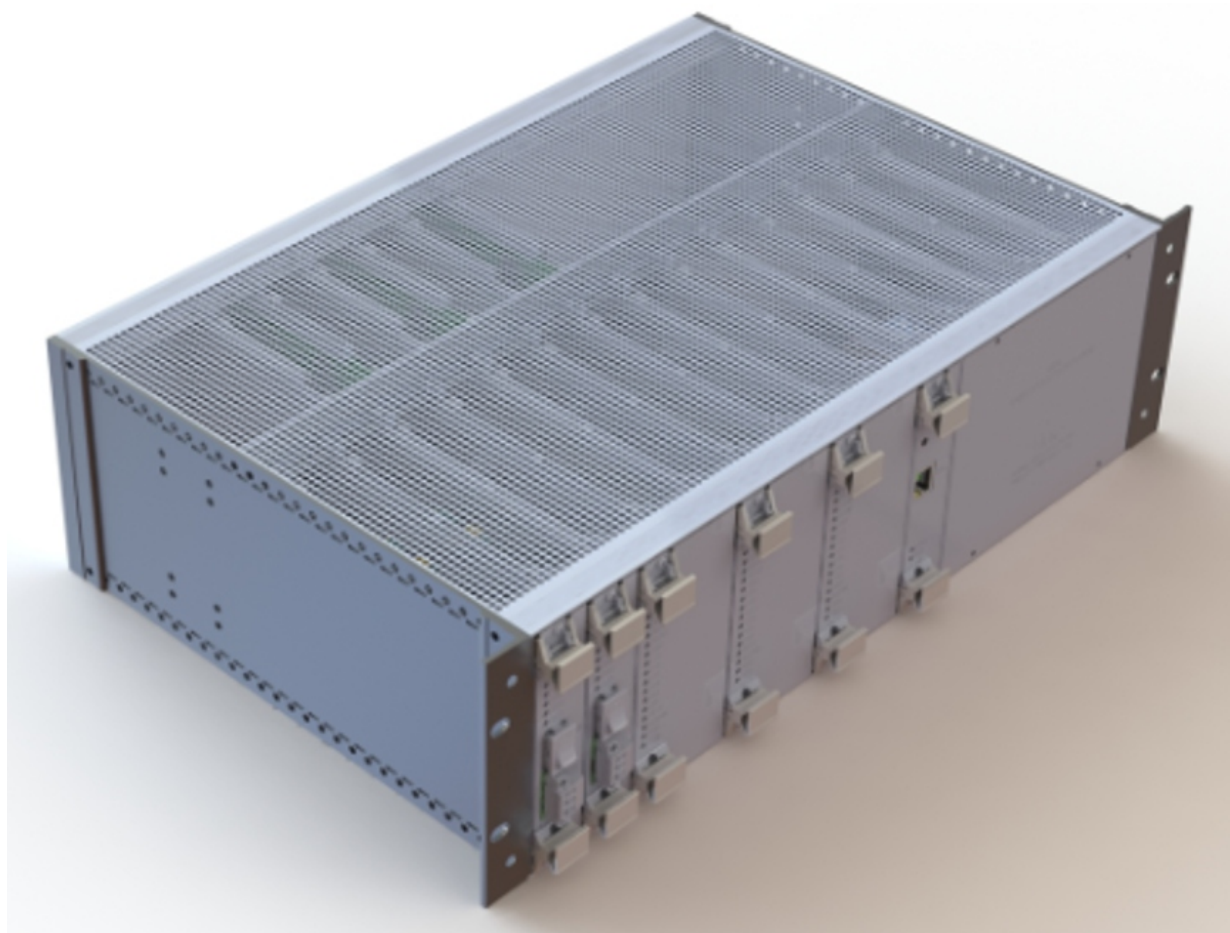
Certifications

BPC Overspeed Protection Device is SIL3 certified by Dekra to be compliant with IEC 61508 standard.

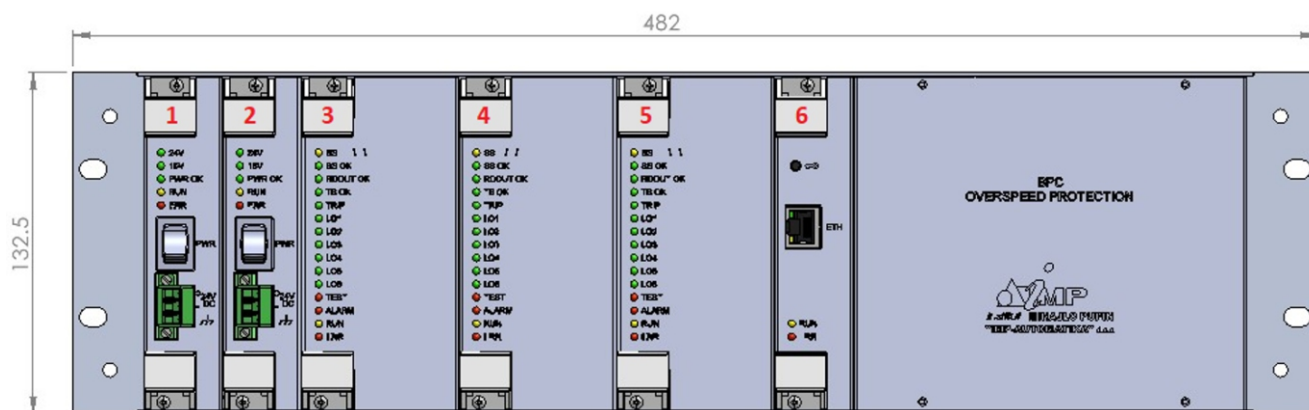
Conformity to Standards

IEC 61131-2, EN 61000-6-2, EN 61000-6-4
IEC 61508

Mechanical Design



BPC Overspeed Protection Device is housed in standard 19" rack (3HE 84TE). Rack dimensions are 482 mm x 132.5 mm x 301 mm (W x H x D).



Technical Specification

Speed Measurement:

Input signal frequency	0 to 10kHz
Speed Precision	± 0.02%
Reaction Time	< 5ms
Hysteresis	2%
$\Delta\omega$ max=1% of Nominal speed	

Power supply for device (input)	2x24VDC, 3A (front side 3-pin connectors)
Command voltage (input)	3x24VDC, 3A (back side, one per channel)
Signalization voltage (input)	24VDC, 0.6A
	(back side, same for all three channels)
Power supply for Speed sensors (output)	3x15VDC, 0.15A
	(back side, one per channel, provided by BPC)
Communication	Ethernet (front side, RJ45 connector)
Working Temperature	0°C ..+60°C

LED Indications

BPC PWR Module

	STATUS	
24V ●	ON	24V_IN input voltage present
	OFF	24V_IN input voltage not present
15V ●	ON	15V present on Backplane
	OFF	15V not present on Backplane
RUN ●	ON	Power OK
	OFF	Power Not OK
ERR ●	Blinking	Communication with COM module via CAN2 present
	ON/OFF	No communication with COM module via CAN2

BPC PU Module

LED	Status	
SS 	ON	Tooth on toothed wheel detected
	OFF	Notch on toothed wheel detected
SS OK 	Green ON	Primary Speed sensor OK
	Red ON	Primary Speed sensor Error
	OFF	Primary Speed sensor No Signal
RDOUT OK 	Green ON	RDOUT signal in Normal state
	Red ON	RDOUT signal is cut-off
	OFF	RDOUT signal is not used
TB OK 	Green ON	Trip Block in expected state
	Red ON	Trip Block not in expected state
	OFF	Trip Block in expected state
TRIP 	Green ON	Trip output in Normal state (closed)
	Red ON	Trip output in Safe state (opened)
	OFF	Illegal state
LO1 	Green ON	LO1 in Normal state (closed)
	Red ON	LO1 in Safe state (opened)
	OFF	LO1 output not used (opened)
LO2 	Green ON	LO2 in Normal state (closed)
	Red ON	LO2 in Safe state (opened)
	OFF	LO2 output not used (opened)
LO3 	Green ON	LO3 in Normal state (closed)
	Red ON	LO3 in Safe state (opened)
	OFF	LO3 output not used (opened)
LO4 	Green ON	LO4 in Normal state (closed)
	Red ON	LO4 in Safe state (opened)
	OFF	LO4 output not used (opened)
LO5 	Green ON	LO5 in Normal state (closed)
	Red ON	LO5 in Safe state (opened)
	OFF	LO5 output not used (opened)
LO6 	Green ON	LO6 in Normal state (closed)
	Red ON	LO6 in Safe state (opened)
	OFF	LO6 output not used (opened)
TEST 	Blinking	Module in Self-test
	OFF	Module in Normal operation
ALARM 	ON	Alarm output activated (opened)
	OFF	Alarm output not activated (closed)
RUN 	Blinking	Communication with Redundant BPC Modules via CAN1 bus present
	ON/OFF	No communication with Redundant BPC Modules via CAN1 bus
ERR 	ON	Module in System Fault
	OFF	Module in Normal operation

BPC COM Module

LED	Status	Description
RUN 	Blinking	Communication with BPC PU and BPC PWR modules via CAN2 bus present
	ON/OFF	No communication with BPC PU and BPC PWR modules via CAN2 bus
ERR 	ON	Error in communication with BPC PU and BPC PWR modules via CAN2
	OFF	No Error in communication with BPC PU and BPC PWR modules via CAN2

Wiring

Back Connectors (i=1, 2 and 3)

BPC CONN X2, X4, X6				BPC CONN X1, X2, X3		
#	C	B	A	C	B	A
1	+24V VS OUT	+24V VS	+24V VS	+15V SS i		
2	TRIP RESET		TEST III	SS IN i		
3	TEST EN		ALARM RESET	GND_SS i		
4	TEST I		FB1			
5	TEST II		FB2			
6	FB4		FB3			
7						
8	GND_VS	GND_VS	GND_VS			
9						
10						
11						
12						
13						
14						
15						
16						
17	LO1 i		LO5 i	SS_RDOUT i		
18	LO2 i		LO6 i	GND_RDOUT i		
19	LO3 i		ALARM i			
20	LO4 i		SYS FAULT i			
21						
22	+24V_VCOM i	+24V_VCOM i	+24V_VCOM i			
23						
24	GND_VCOM	GND_VCOM	GND_VCOM			
25						
26	TL i					
27						
28						
29						
30						
31						
32	GND_VCOM	GND_VCOM	GND_VCOM			