BPS SERIES

006004
Issue 2

Battery Safety Pressure Sensors
CAN Communication Output

DESCRIPTION

The BPS Series are automotive-grade pressure sensors designed to detect and report thermal runaway events in lithium-ion battery packs. They use a combination of MEMS (Micro-Electromechanical System) and ASIC (Application-Specific Integrated Circuit) technologies to detect pressure changes in the battery packs of electric vehicles and energy storage systems (ESS). The detected value is transmitted to the battery management system (BMS) using CAN (Controller Area Network) communication.

The BPS Series measures from 50 kPa to 300 kPa absolute pressure. It has settable warning thresholds for both absolute pressure and rate of change of pressure. The BPS Series allows early detection of a thermal runaway event in a lithium-ion battery pack. This product delivers on performance and reliability.

The BPS Series is automotive qualified and incorporates integrated circuits that are AEC-Q100 qualified to meet higher quality and reliability requirements. The BPS series is also RoHS compliant.

CUSTOMIZATION

The BPS Series may be customized to better meet application needs. Solutions may be tailored to exact specifications for improved time to market, lower total system costs and enhanced reliability. For technical assistance, we provide global engineering and service support for your needs.

OPERATING MODES

The sensors function in the following operating modes:

- **ECO Mode:** The sensor operates in ECO mode when the request pin voltage is set to low. The sensor wakes up for 15 ms and hibernates for the remaining 985 ms (typical) to reduce power consumption during each measurement cycle of 1 second (default value). In ECO Mode, CAN communication is disabled. If the absolute pressure or rate of change of pressure is above the set threshold, a wake-up signal is sent to the BMS to initiate a full battery system check.
- **Continuous Mode:** The sensor operates in Continuous Mode when the request pin voltage is set to high by the BMS. CAN communication is enabled in Continuous mode. In Continuous mode, the sensor monitors and outputs the absolute pressure and rate of change of pressure to the BMS using CAN communication. The sensor can be switched to ECO mode by setting the request pin voltage to low.

WORKING LOGIC FUNCTIONS

- **Request Signal :** The BMS controls the sensor's operating mode through the request pin of the sensor.
- **Wake-up Signal:** When the sensor detects that the absolute pressure or rate of change of pressure is above a set threshold, the wake-up pin is set to high to wake up the BMS.

TRANSPORTATION APPLICATIONS

- Battery pack systems for electric vehicles and energy



FEATURES

- High accuracy and low temperature drift
- CAN communication protocol
- Wake-up output and request input for high reliability system integration
- Settable warning thresholds for absolute pressure and rate of change of pressure allow use with different equipment types

VALUE TO CUSTOMERS

- Early detection of thermal runaway has the potential to mitigate the loss of life and property
- ECO mode enables continuous system monitoring in low power mode
- Thermal runaway detection sensor allows compliance with international regulations and recommendations
- Solutions may be tailored to exact specifications for improved time to market
- Lower total system costs and enhanced reliability

PORTFOLIO

The BPS Series joins the Battery Monitoring Suite. To view the entire product portfolio, **click here.**

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BATTERY SAFETY
PRESSURE SENSORS

1.0 GENERAL SPECIFICATIONS

TABLE 1. GENERAL SPECIFICATIONS[1]

CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	CONDITION
Operating and storage temperature ranges	-40 [-40]	—	105 [221]	°C [°F]	—
Absolute pressure detection range	50	—	300	kPa	—
Maximum withstand pressure	—	—	400	kPa	—
Maximum failure pressure	—	—	500	kPa	—

[1] All specifications are at room temperature unless otherwise noted.

2.0 CAN (CONTROLLER AREA NETWORK) OUTPUT

The BPS Series is able to provide outputs using the CAN communication protocol. See Table 2 for additional information.

TABLE 2. OPERATING SPECIFICATIONS FOR CAN VERSIONS[1]

CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	CONDITION
CANBUS protocol	—	—	—	—	Version 2.0A/B
Supply voltage (Vs)	6	12	18	V	—
Over voltage	—	—	24	V	for Vs, 1 min at 25°C
Reverse voltage	—	—	-20	V	for Vs, 1 min at 25°C
Supply current	—	25	30	mA	Continuous Mode
ECO mode current:					
t = 1 s	—	—	200	µA	1 s ECO Mode cycle time
t = 2 s	—	—	100	µA	2 s ECO Mode cycle time
Wake-up output:					
high level voltage	5.5	12	18	V	—
low level voltage	—	—	0.15	V	—
output capability	0.6	1.2	1.8	mA	—
default state (low level voltage)	—	—	0.15	V	—
REQUEST input from from BMS to BPS:					
voltage	5.5	12	18	V	—
sink current	—	—	0.15	mA	—
enable voltage level	5.5	12	18	V	—
disable voltage level	—	—	0.5	V	—
enable signal time	—	50	—	ms	—
Minimum data bit (resolution)	0.1	—	—	kPa	-40°C to 105°C
Absolute accuracy:					
10°C to 100°C	-2	—	2	kPa	—
-40°C to 105°C	-4	—	4	kPa	—
ECO Mode detection cycle time	400	1000	2000	ms	ECO Mode, configurable
Response time	—	30	—	ms	—

[1] All specifications are at room temperature unless otherwise noted.

TABLE 3. COMMUNICATION SETTINGS

Baud Rate	ID	Period	Length
500 kbps	0x310	30 ms	8 bytes

TABLE 4. BPS FRAME AND SIGNAL INFORMATION

Signal Name	General Description	Start Bit	Length(bit)	Range	Scaling Factor	Offset	Unit	Usage
BpsOutMeasureableFlg	Battery pressure out measurable range flag	8	1	0-1	1	0	—	0 means no fault 1 means pressure out of measurable range (300 kpa)
BpsOverAbsThresholdFlg	Battery pressure over absolute threshold	9	1	0-1	1	0	—	0 means no fault 1 means pressure out of absolute threshold value
BpsOverSlopeThresholdFlg	Battery pressure rise too fast, over slope	10	1	0-1	1	0	—	0 means no fault 1 means over the slope threshold value
BpsWakeupAbnFlg	Battery pressure wakeup signal abnormal	11	1	0-1	1	0	—	0 means no fault 1 means wakeup signal abnormal
BpsPressureData	Battery pressure data	12	12	0-4095	0.1	0	kPa	Latest Measured Pressure
BpsPowerLowFlg	BPS power lower than 6 V	20	1	0-1	1	0	—	0 means no fault 1 means BPS power lower than 6 V
BpsPowerHighFlg	BPS power higher than 18 V	21	1	0-1	1	0	—	0 means no fault 1 means BPS power higher than 18 V
BpsInternalErrorFlag	BPS internal error flag	22	1	0-1	1	0	—	0 means no error happens 1 means error happens
ReservedBits1	Reserved bits	23	1	0	1	0	—	Fix to 0x0
BpsPressureDataAlarm	Battery pressure data alarm	24	12	0-4095	0.1	0	kPa	2 cycles pressure data before alarm
BpsHwSubVer	BPS hardware sub version	32	4	—	1	0	—	TBD
BpsHwMajorVer	BPS hardware major version	36	4	—	1	0	—	TBD
BpsFwSubVer	BPS firmware sub version	40	4	—	1	0	—	TBD
BpsFwMajorVer	BPS firmware major version	44	4	—	1	0	—	TBD
BpsRollingCounter	Increased from 0 to 255 when the CAN frame are transmitted	48	8	0-255	1	0	—	Number counter from 0 to 15
BpsCheckSum	The sum of first seven bytes	56	8	0-255	1	0	—	The sum of first seven bytes

TABLE 5. ORDER GUIDE

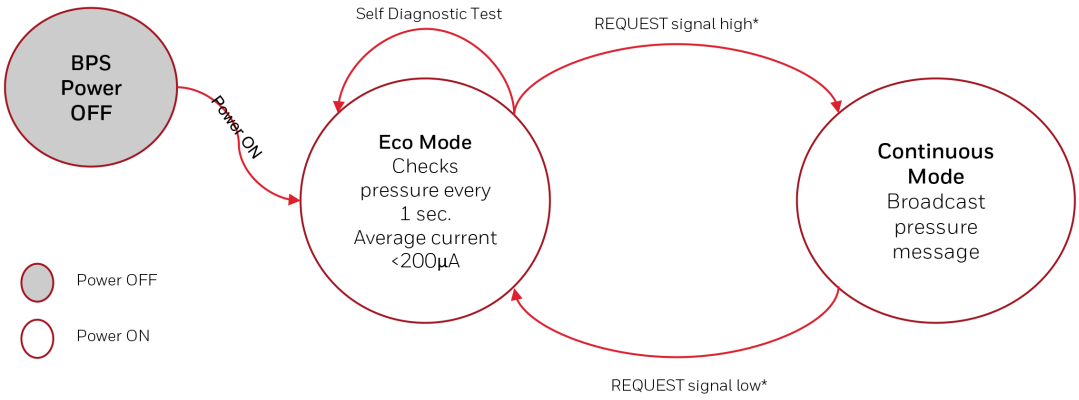
Catalog Listing	Description
BPS6C-X00	BPS Series, battery safety pressure sensor, six pins, CAN output signal, MCU1 version
BPS6C-H00	BPS Series, battery safety pressure sensor, six pins, CAN output signal, MCU2 version

NOTE: MCU1 is a drop-in replacement for MCU2. No change to product fit, form and function. The MCU options improve material supply.

3.0 SENSOR OVERVIEW

Figure 1. State Diagram

The BPS Series has two operating modes: ECO mode and Continuous mode.
The state diagram below describes these operating modes and the transition between the modes.



NOTE: * The state of the REQUEST signal is determined by the BMS. See figure 2.

Figure 2. BPS and BMS Signal Interface

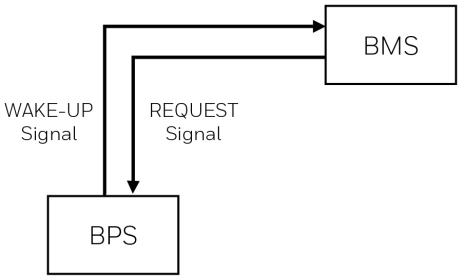
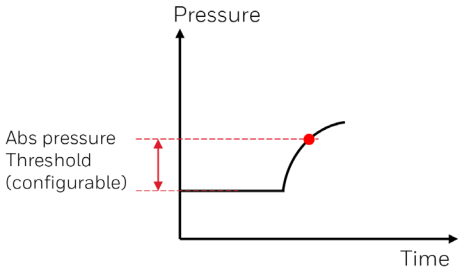
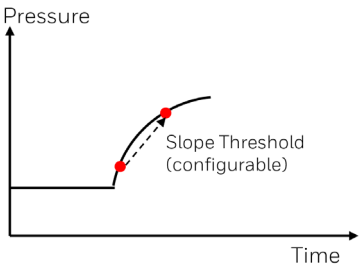


Figure 3. Absolute Pressure Sensing



The absolute pressure is the air pressure in the battery pack. The absolute pressure settable warning threshold can be configured. When the air pressure in the battery pack is greater than the absolute pressure threshold, the BPS flags this event. Refer to Installation Instructions for more information.

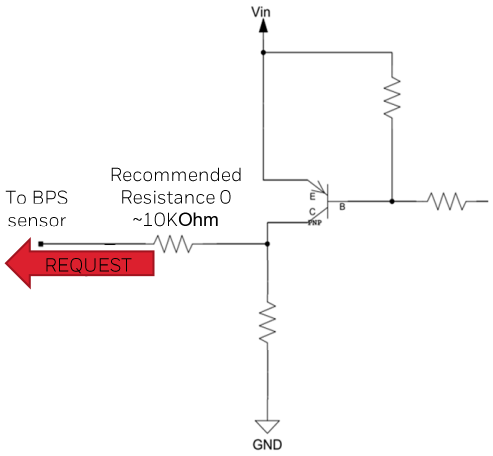
Figure 4. Rate of Change (Slope) Threshold Monitoring



The rate of change of absolute pressure is monitored in the battery pack. The rate of change (slope) threshold can be configured. When the rate of change of air pressure in the battery pack is greater than the slope threshold, the BPS flags this event. Refer to Installation Instructions for more information.

SCHEMATIC DIAGRAMS AND OUTPUT SIGNALS

Figure 5. Recommended REQUEST pin BMS interface circuit



DEFAULT STATE: ACTIVE LOW

TABLE 6. REQUEST SIGNAL

Parameter	Min.	Typ.	Max.	Unit
BMS request input voltage	5.5	12	18	V
Sink current	—	—	0.15	mA
Request enable voltage level	5.5	12	18	V
Request disable voltage level	—	—	0.5	V
Request enable signal time	—	50	—	ms

Figure 6. Recommended WAKEUP pin interface circuit

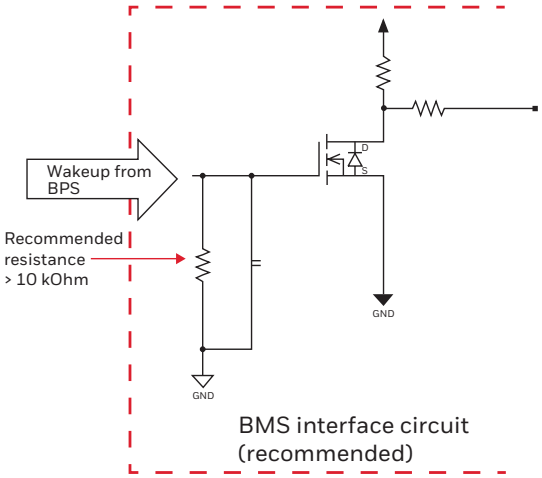


TABLE 7. WAKEUP SIGNAL

Parameter	Min.	Typ.	Max.	Unit
Wakeup high level voltage	5.5	12	18	V
Wakeup low level voltage	—	—	0.5	V
Wakeup output capability	0.6	1.2	1.8	mA
Default state (Low level voltage)	—	—	0.5	V

BATTERY SAFETY
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Figure 7. Product Nomenclature

For example, **BPS6C-X00** defines a BPS Series, battery safety pressure sensor, six pins, CAN output signal, MCU1 version.

B	P	S	6	C	–	X[1]	00
Battery	Type	Sensor	Number of Pins	Output Signal		Reserved Product Number	Customization[2]
B Battery safety	P Pressure	S Sensor	6 Six pins	C CAN		X MCU1 version H MCU2 version	00 Default

[1]The MCU1 version is a drop-in replacement for the MCU2 version. There is no change to product fit, form or function. The MCU options improve material supply.
[2] Customizations are available. Contact Honeywell Customer Service for more information

Figure 8. Mounting Dimensions (For reference only)

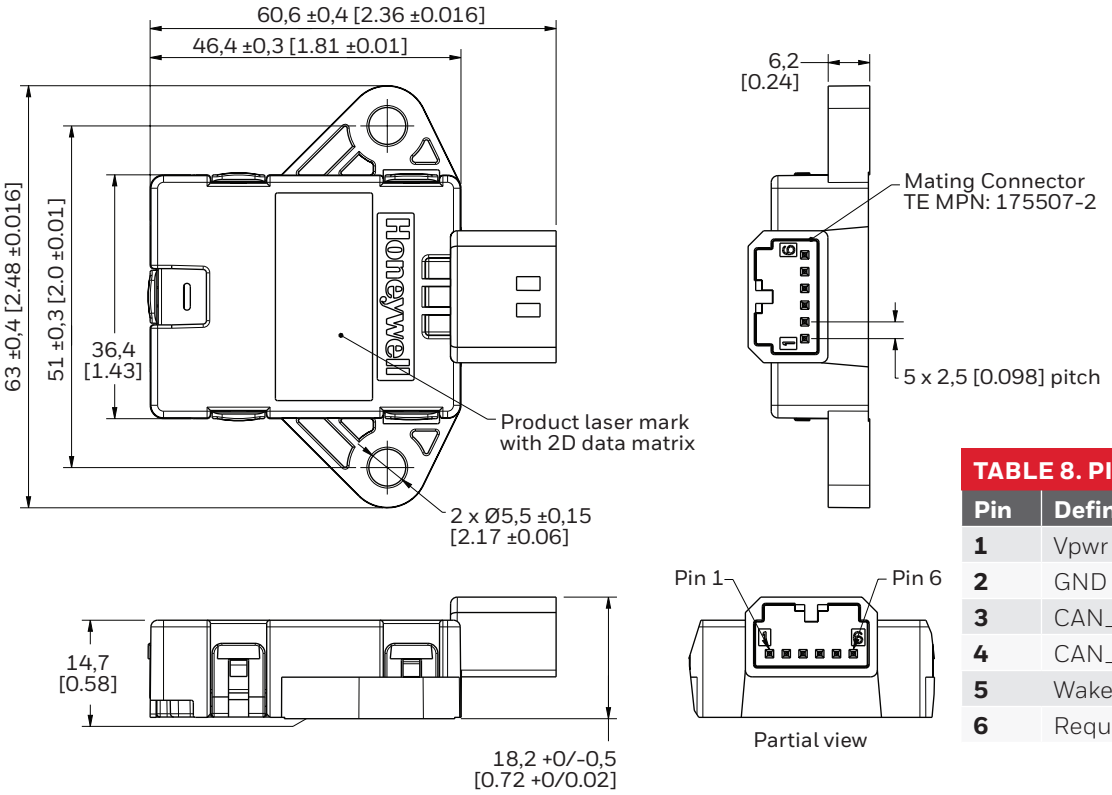


TABLE 8. PINOUT

Pin	Definition
1	Vpwr
2	GND
3	CAN_H
4	CAN_L
5	Wakeup
6	Request

TABLE 9. MECHANICAL SPECIFICATIONS

Parameter	Characteristic
Mounting screw	M5
Adapter connector model	175507-2
Recommended torque[1]	3 Nm

[1] The installation bracket should have a flatness tolerance of ±0,2 mm. The size tolerances of the installation bracket and nut, as well as the use of installation tools and fixtures, have an impact on the maximum installation torque of the product. If there are any relevant design or process changes, it is advisable to implement them after verification.

Figure 9. Sensor Installation Recommendation
Sensors can be mounted in any orientation

Note: There are 5 vents ports for pressure detection (see 1 to 5)
At a minimum, one vent port must remain unobstructed inside the battery space.

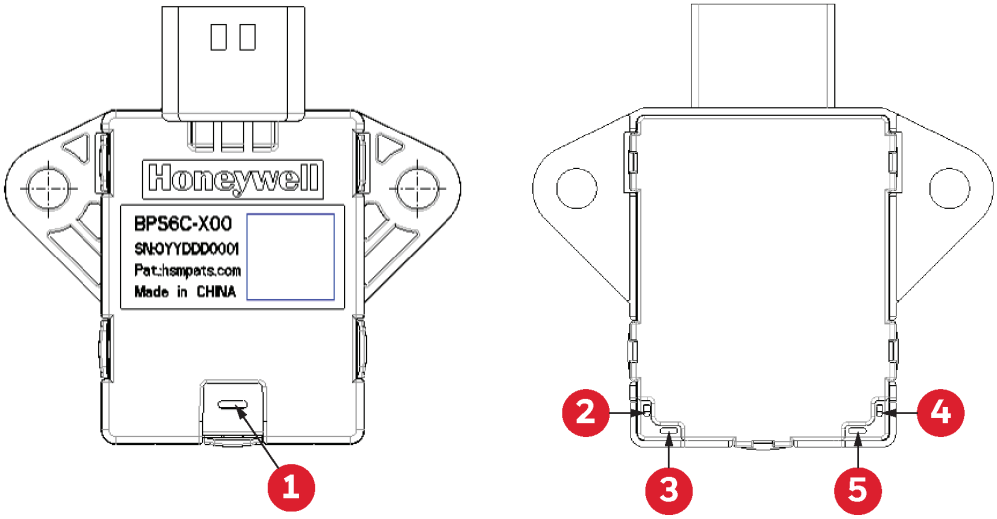


TABLE 10. EMC TEST SPECIFICATIONS		
Test	**Standard**	**Procedure**
CISPR 25 Conducted RF Emissions - Voltage on Supply Lines	CISPR25	According to CISPR 25:2008 Commission Form of Testing
CISPR 25 Conducted RF Emissions - Current on Supply Lines	CISPR25	According to CISPR 25:2008 Commission Form of Testing
Electromagnetic Field Far-field Radiation Emission	CISPR25	According to CISPR 25:2008 Commission Form of Testing
CISPR 25 Radiated Emissions	CISPR25	According to CISPR 25:2008 Commission Form of Testing
Transient Conducted Emission	ISO 7637-2	According to ISO 7637-2:2004
Immunity to Magnetic Field	ISO 11452-8	According to ISO 11452-8
Bulk Current Injection (BCI) Test	ISO 11452-4	According to ISO 11452-4
ALSE with a Ground Plane	ISO 11452-2	According to ISO 11452-2
Transient Immunity	IEC 61000-4-4	According to IEC 61000-4-4
Transient Coupling Immunity	IEC 61000-4-4	100 V for 1 min,-150 V for 1min, CCC, According to IEC 61000-4-4
Electrostatic Discharge	ISO 10605	Unpowered direct contact discharge: ±4 kV,±6 kV Unpowered air discharge: ±8 kV Powered-up direct contact discharge: ±4 kV, ±6 kV , ±8 kV Powered-up air discharge: ±15 kV

TABLE 11. ENVIRONMENTAL TEST SPECIFICATIONS

Test	Standard	Procedure
Random Vibration Test	IEC 60068-2-64-2008	5 Hz to 2000 Hz, 8 hr/axis, 3 axis during test. Power on in continuous mode. Performance test before and after test only at 25°C and VS nom.
Mechanical Shock Test	IEC 60068-2-64-2008	50 g, 6 ms, 10 times total, half sine pulse. Power on in continuous mode. Performance test before and after test only at 25°C and VS nom.
Drop Test	IEC 60068-2-32	1st fall of each DUT at a different dimensional axis, 2nd fall with the given DUT at the same dimensional axis but on the opposite side of the housing, from 1 m on concrete floor. Performance test before and after test only at 25°C and VS nom.
Resonance Frequency Point Analysis Test	ISO16750-3	1 g, 10 Hz to 2000 Hz, 1 oct/min, 1 sweep, 3 axis during test. Power off. Performance test before and after test only at 25°C and VS nom.
High Temperature Storage Test	ISO16750-4:2010	504h & 48h, 105°C. Power off. Performance test before and after test only at 25°C and VS nom.
Low Temperature Storage Test	ISO16750-4:2010	24 h, -40°C. Power off. Performance test before and after test only at 25°C and VS nom.
Thermal Cycle Test	ISO16750-4:2010	40 cycles, one cycle contains -40°C (90 min soak) & 105°C (120 min soak).Transition time = 60 min. Power on in continuous mode. Performance test before and after test only at 25°C and VS nom.
High Humidity and Heat Durability	IEC 60068-2-78:2001	1000 hr, 85°C, 85 % humidity, power on in continuous mode. Performance test before and after test only at 25°C and VS nom.
Waterproof and Dust (and other Solid Intrusion)	ISO20653	IP category: 40

TABLE 12. ELECTRICAL TEST SPECIFICATIONS

Test	Standard	Procedure
Transient Overvoltage Test	ISO16750-2	Power supply at 18 V for 400 ms, power supply at 17 V for 600 ms, according to ISO16750-2
Slow Decrease/Increase of Supply Voltage	ISO 16750-2-4.5	Power supply changes from 16 V to 0 V/ 0 V to 16 V, according to ISO 16750-2-4.5.
Superimposed Alternating Voltage	ISO 16750-2	15 cycles, one cycle = 120 s. Test voltage Uc max 16 V for 12 V systems; A.C. 15 Hz~30 Hz, UPP = 2 V, 3 V, 6 V
Reverse Voltage Test	ISO16750-2-4.7	Power supply from 0 V to -14 V for 60 s. Power supply from 10.8 V to -4 V for 60 s.
Load Dump	ISO 16750-2-4.6.4	Pulse described in Table 6. See Fig. 9 of ISO 16750-2-4.6.4
Short Circuit Protection	ISO 16750-2-4.10	Connect sensor to power supply and power on the sensor by 14 V. Apply short circuit between wakeup & GND, request & GND, CAN-H & GND, CAN-L & GND, CAN-H & Us, CAN-L & Us, wakeup & Us, request & Us. Each hold for 60 s.
Long Time Overvoltage Test	ISO16750-2	Power supply at 18V for 60min. According to ISO16750-2
Insulation Resistance Test	ISO 16750-2-4.12	500 Vdc for 60 s; resistance criteria: > 10 MOhm
Momentary Drop in Supply Voltage	ISO 16750-2-4.6.1	Ucmin to 4.5 V. See Fig. 4 in ISO 16750-2-4.6.1
Reset Behavior at Voltage Drop	ISO16750-2-4.6.2.2	See Fig. 6 in ISO16750-2-4.6.2.2
ac Voltage Insulation Test		Test voltage: 500 Vac. Frequency: 50 Hz. Test duration: 60 s

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DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

⚠ WARNING
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- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

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