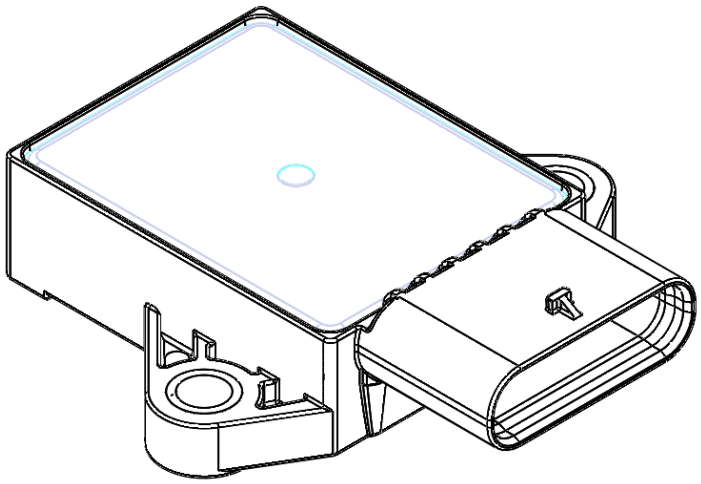
PRODUCT SPECIFICATION

TEM000003 PWM VERSION

BATTERY PACK PRESSURE SENSOR FOR THERMAL RUNAWAY DETECTION



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REVISION LOG

Revision	Description	Date	Changes
1	Initial release	Mar. 4 2022	Tem version Initial Release

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1 GENERAL DATA

1.1 DESCRIPTION

In this specification a sensor is described that has the objective to measure absolute pressure in the battery pack of electric vehicle. The sensor will provide a PWM output to battery management system (BMS) with the duty cycle proportional to the measured pressure.

The power consumption working mode of this sensor is either controlled by BMS through request pin (the one that takes precedence) or switched by sensor itself using monitored pressure as trigger condition. When voltage on request pin is high level, sensor works in high consumption working mode to provide a continuous PWM output. When voltage on request pin is low level, sensor works in low power consumption working mode to monitor internal pressure of battery pack discontinuously, and there is no PWM output provided. Once sensor monitored pressure triggers the set threshold, sensor will switch from low power consumption working mode to wake up working mode and send out a wake-up signal to BMS (also simultaneously send out PWM signal to BMS).

1.2 CODING

Sensor coding conform to the envelope drawing : TEM000003-ENV

1.3 CONFIGURATION

The shape, material and the dimensions of the sensor are in accordance with the envelope drawing : TEM000003-ENV

1.4 GENERAL REQUIREMENTS

The performance of the sensor is in accordance with the requirements as defined in chapter 2 of this specification and can only be guaranteed if the sensor is used in environmental conditions as specified in this document. Any deviation from usage as defined in this document will void this specification. Test climate unless mentioned otherwise is according to : Normal, 23/50-2 DIN 50 014

1.5 LEGAL DISCLAIMER PRODUCT USE (AUTOMOTIVE SENSORS)

Churod Sensing Technologies products are developed for automotive applications. They may only be used

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within the parameters of these Product Specifications. Churod Sensing Techologies products are provided with the express understanding that there is no warranty of fitness for a particular purpose. They are not fit for use other than specified, tested and validated within the release process during product launch. Fit for use warranty claims will be compared with the provided PPAP release package. Warranty claims that goes beyond of what is agreed in that PPAP package will not be awarded.

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2 CHARACTERISTICS

2.1 GENERAL PROPERTIES

2.1.1 Operating measurement pressure range

The operating range of absolute pressure is in the herein defined operating temperature range, operating voltage range and life time. : 50 to 165 kPa abs

2.1.2 Operating temperature range

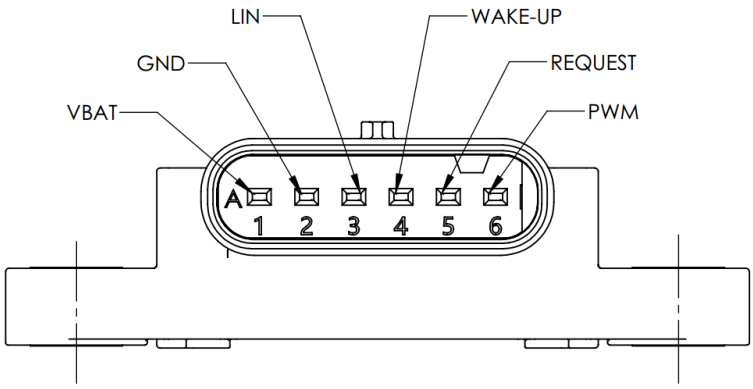
The operating temperature range is : -40 to 105 ^{o}C

2.1.3 Proof pressure

Proof pressure of the sensor is without irreversible loss of functionality in the herein defined operating temperature range, operating voltage range and life time. : 400 kPa abs

2.1.4 Sensor pins definition

This sensor has : 6 pins
VBAT pin is used for : power supply
GND pin is used for : ground
LIN pin is reserved for : program upgrade
Wake-up pin is used to : wake up BMS
Request pin is used to : control sensor working mode
PWM pin is used to provide : pressure signal



2.1.5 Pressure output transfer curve

The nominal transfer curve of pressure output is as described in the envelope drawing : TEM000003-ENV

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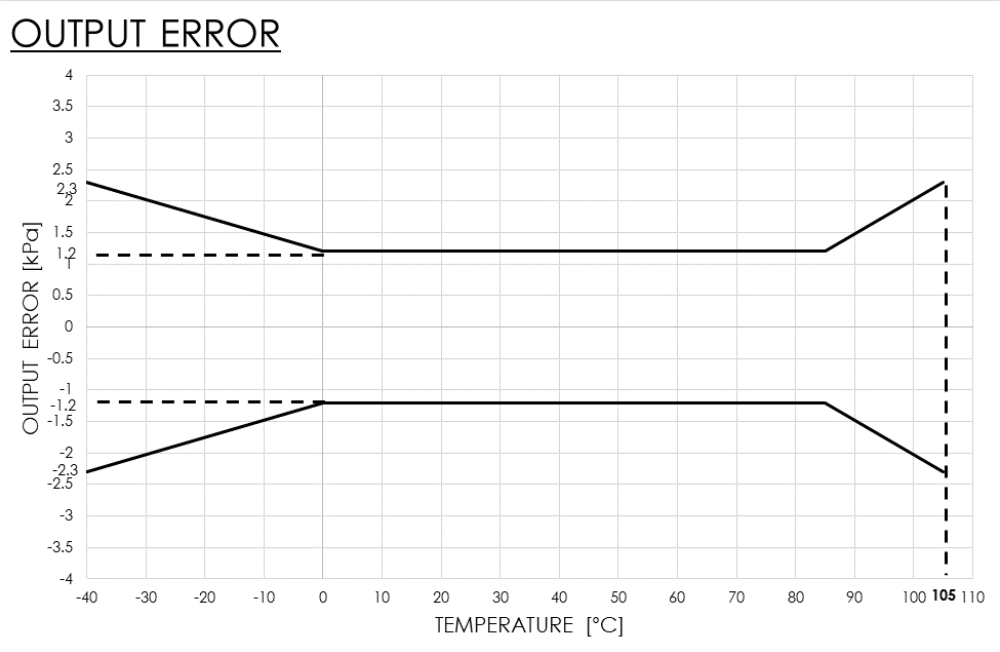
Pressure output signal	: 100 Hz PWM
PWM high level voltage	: 6 to 16 VDC, 12 VDC Typ.
Transfer function	: %PWM = 16*P/23– 570/23 P = absolute pressure in kPa %PWM = Duty Cycle*100
Output duty cycle under normal pressure	: 10%~90% Duty Cycle
High clamp band	: %PWM = 92 ± 2
Low clamp band	: %PWM = 8 ± 2
Diagnostic band	: %PWM > 96 or %PWM< 4

2.1.6 Pressure output accuracy

The maximum absolute error compared to the transfer curve is	: ±1.2 kPa from 0 to 85°C ±2.3 kPa at -40 ˚C & 105°C



The absolute error includes hysteresis, repeatability, linearity and ageing effects.

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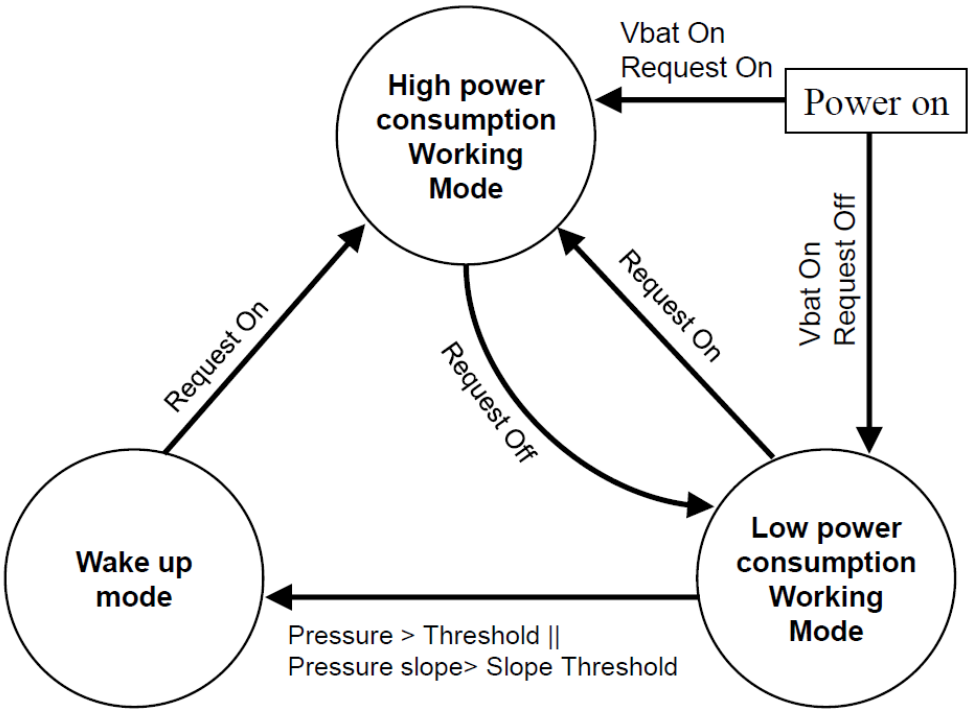
2.1.7 State machine



Request on: voltage on request pin is high level changed from low level (i.e. rising edge trigger);
Request off: voltage on request pin is low level changed from high level (i.e. falling edge trigger);

2.1.8 Working mode

1. High power consumption working mode

Sensor works in high power consumption mode when voltage on request pin : high level (6~16VDC)
changed from voltage : low level (≤0.5VDC)
(i.e. rising edge trigger)
Sensor switches from low power consumption working mode to wake up mode when sensor monitored internal pressure of battery pack exceeds : threshold

At the same time, sensor will send wake-up signal to BMS (also simultaneously send PWM signal to BMS).

When sensor entering high power consumption mode, there will be a 4s high level voltage on wakeup terminal and the high level voltage will be set to low when request off.

2. Low power consumption working mode

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Sensor works in low power consumption mode when voltage on request pin is : low level (≤0.5VDC)
changed from voltage : high level (6~16VDC)
(i.e. rising edge trigger)
and sensor monitored internal pressure of battery pack is less than : threshold
Sensor checks pressure : every 300ms
and there is no PWM output provided in low power consumption working mode.

2.1.9 Wake-up function

A wake-up signal will be sent from sensor to BMS through : Wake-up pin
Once sensor detects internal monitored pressure exceeds the threshold during low power consumption working mode.
At the same time, PWM signal will be sent out. Once a high-level voltage on request pin is detected, sensor will set the signal on wake-up pin to low level voltage.

2.1.10 Request signal

A request signal shall be provided by : BMS
to control the working mode of sensor.

The function of request pin is as described in section 2.1.8 and 2.1.9.

2.1.11 Threshold inside sensor

The threshold inside sensor as described in section 2.1.8 is initially calibrated by Churod. The initial value of set threshold will be defined together with customer.

The threshold consists of P_{set} and P_{limit} with a relation of logical 'OR' – wake up signal can be sent out with either one is triggered.

P_{set} consists of two parts, basic pressure value plus delta pressure.
The basic value is : Ambient pressure
Delta pressure is : 3kPa
The pressure threshold will be flashed during sensor low power consumption working mode every : 30 seconds

As for the slope of pressure rising, P_{limit} is : 0.5kPa/s
The threshold is only valid when sensor works in low power consumption working mode.

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2.2 OPERATING ENVIRONMENT

2.2.1 Operating ambient temperature range

The operating ambient temperature range The minimum and maximum operating temperature are the lowest and highest temperature respectively at which the sensor will perform according to the characteristics listed in this chapter	: -40 to +105°C

2.2.2 Storage temperature range

The storage temperature range The minimum and maximum storage temperature are the lowest and highest ambient temperature respectively at which the sensor can be kept for long period without negative effects on performance.	: -40 to +105°C

2.2.3 Application medium

The application medium is	: Air

2.2.4 Protection rating

The sensor complies to under the condition that the pressure port and electrical connector are both applied.	: IP 6KX

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2.3 ELECTRICAL CHARACTERISTICS

2.3.1 Supply voltage

The sensor is directly powered by lead-acid battery.
The sensor will operate properly at any supply voltage
in the range : 6 to 16 VDC, 12 VDC Typ.

2.3.2 Power consumption

The sensor power consumption is : 16mA Typ.
in : high power consumption mode
and : 0.4mA Typ.
In : Low power consumption mode
at : room temperature
at the power supply of : 12VDC

2.3.3 Pressure response time (t_{10-90})

The time needed for the pressure output to increase
from : 10%
to : 90 %
of its final value will be less than: : 22ms
in high power consumption mode

2.3.4 Electrical parameters

The parameters as listed in Table 1 are tested at room temperature unless otherwise specified.

Table 1: Electrical parameters

Parameter	Min	Typical	Max	Unit	Remark
Operating supply voltage	6	12	16	VDC	
High power consumption [1)]		16		mA	
Low power consumption [2)]		0.4		mA	
PWM output signal [3,4)]					
High level voltage	6	12	16	VDC	
Low level voltage			0.5	VDC	
Frequency	95	100	105	Hz	
Rising time		10		µs	
Falling time		10		µs	
Wake-up signal [4)]					
High level voltage	6	12	16	VDC	

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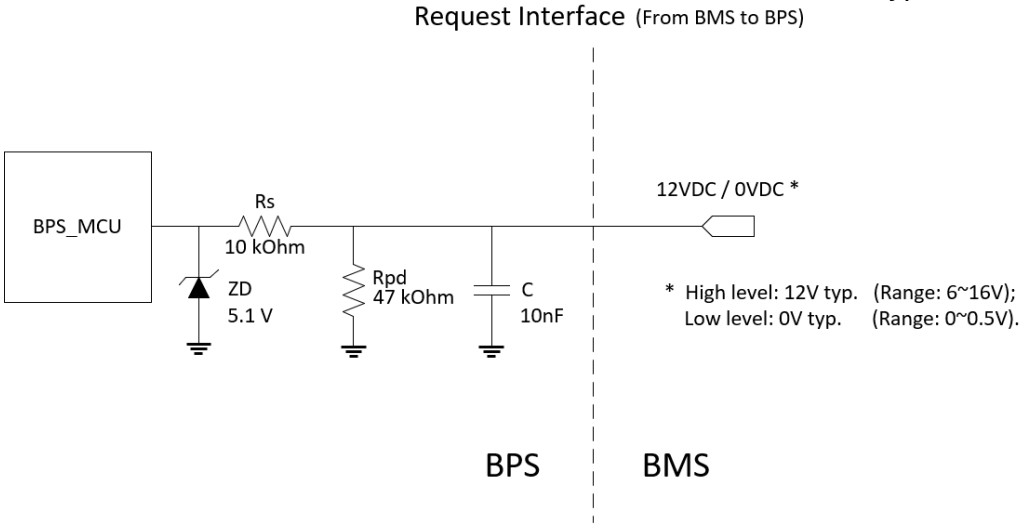
Low level voltage			0.5	VDC	
Request signal from BMS	6	12	16	VDC	
Overvoltage capability			24	VDC	1 minute, RT
Reverse voltage capability	-14			VDC	1 minute, RT

1)Power consumption in high power consumption mode at room temperature and 12VDC power supply;
2)Average power consumption in low power consumption mode at room temperature and 12VDC power supply;
3)The clock frequency of the sampling channel of the PWM monitoring device should >100 kHz;
4)The high-/low-level voltage of PWM and Wakeup signal is also determined by the electrical interfaces of BMS.

2.3.5 Recommended electrical interface

1. Request interface

High level : 6~16VDC, typ.12V
Low level : ≤0.5V, typ. 0V



2. PWM interface

OC output type
Pull-up resistance : ≥4.7kOhm with 5V pull-up voltage
: ≥10kOhm with 12V pull-up voltage

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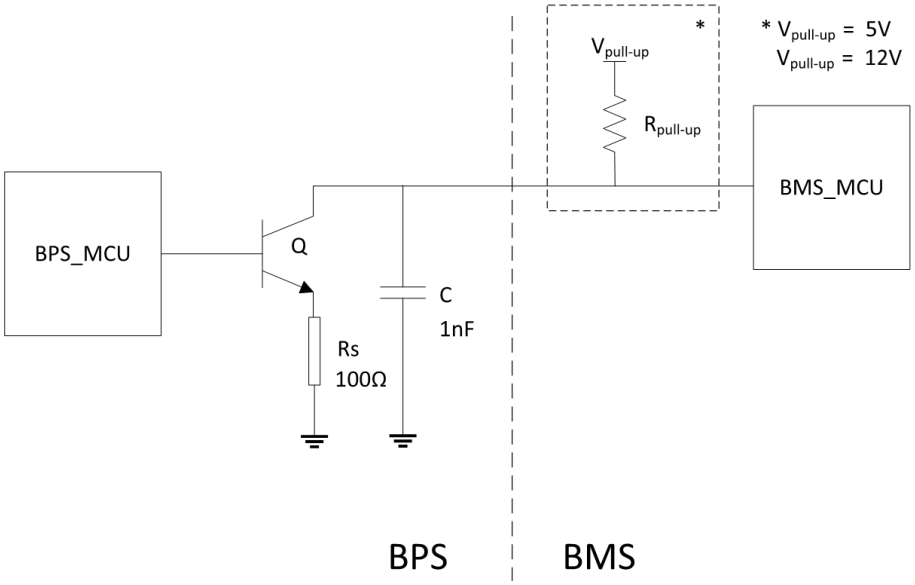
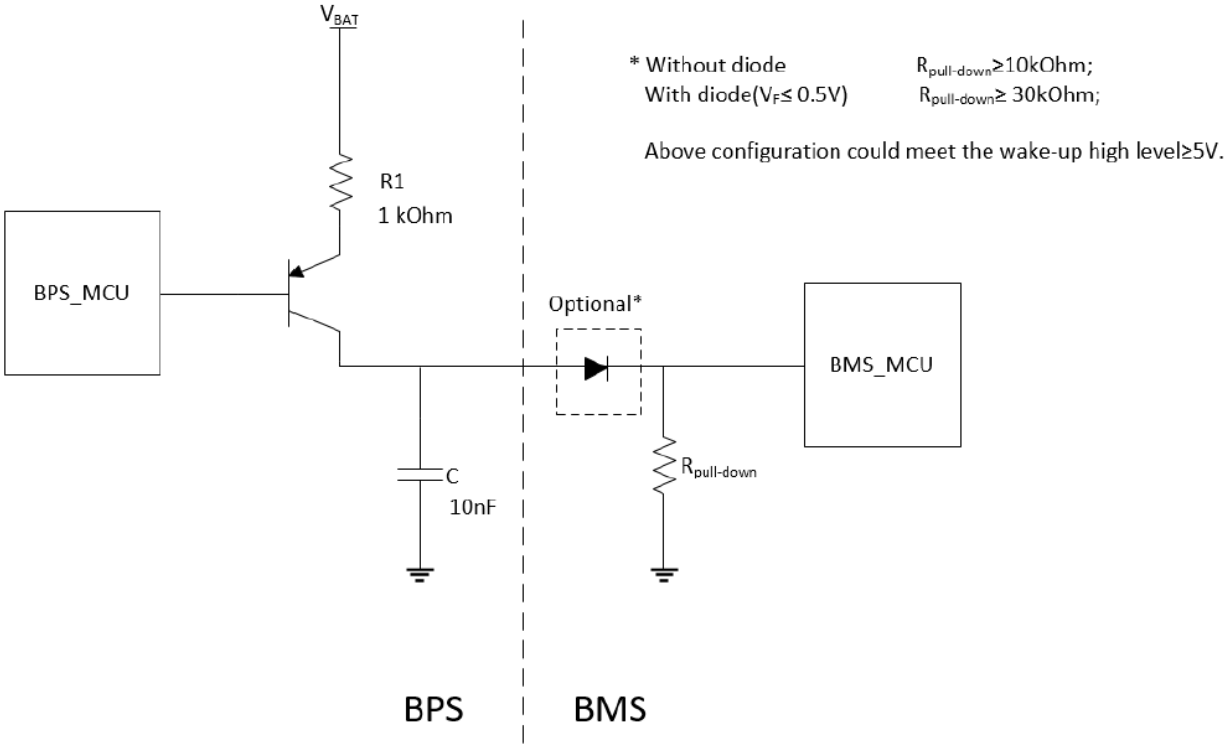
PWM Interface (From BPS to BMS)



3. Wake-up interface

OC output type.

Effective Signal, High Level	: 6~16vdc, Typ 12vdc
Without diode, pull-down resistance	: ≥10kOhm
With diode, pull-down resistance	: ≥30kOhm



4. Program upgrade by LIN interface

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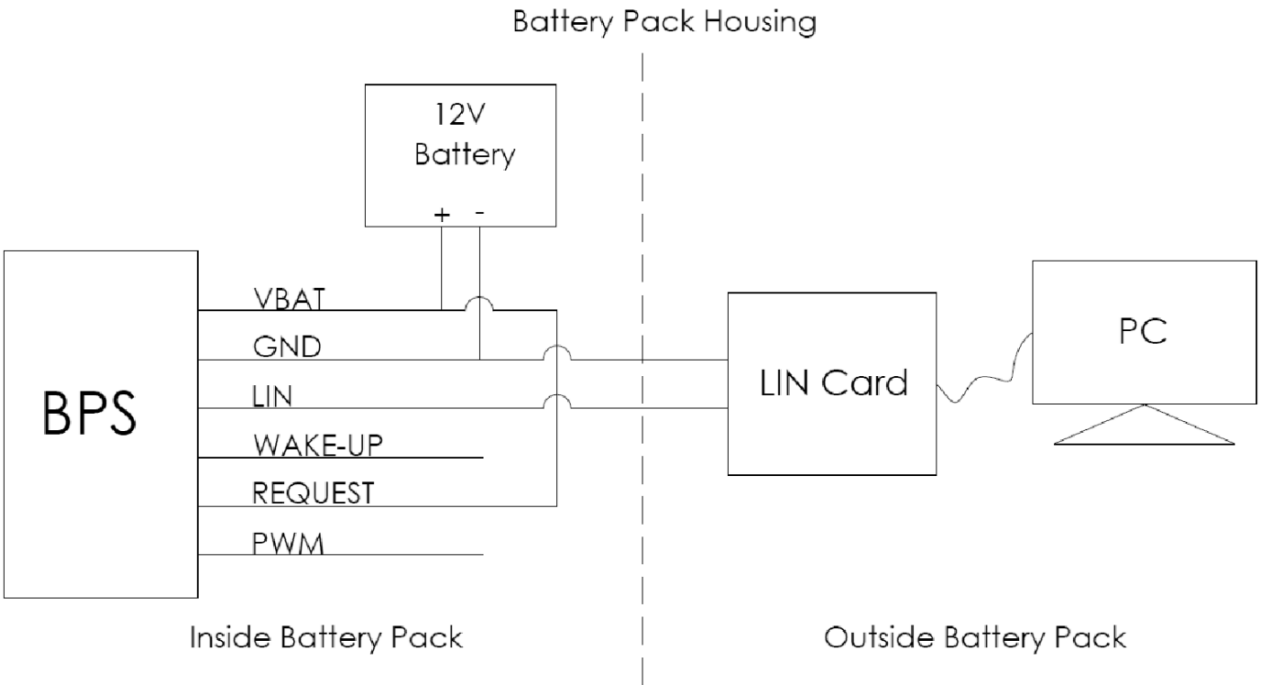

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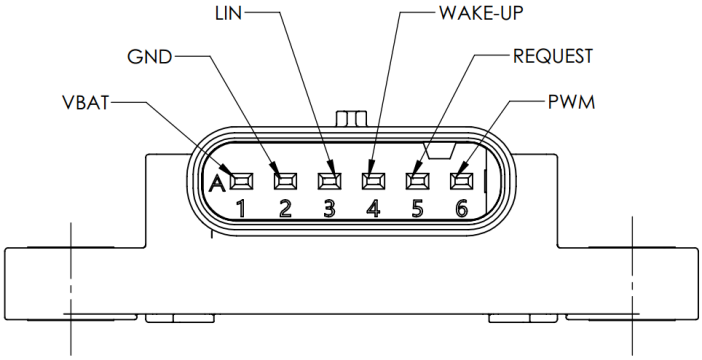
2.4 MECHANICAL CHARACTERISTICS

2.4.1 Dimensions

Sensor dimensions conform to the envelope drawing : TEM000003-ENV

2.4.2 Connector pin sequence

The connector pin sequence : see below figure.



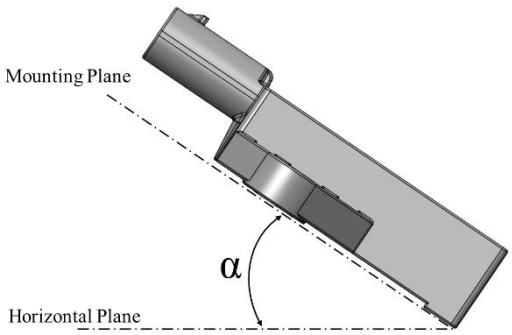
The electrical connector is mated with : TE 1924292-5 or 1-1718646-1
Terminal Ag plated

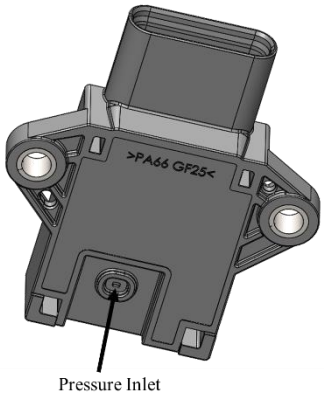
2.4.3 Installation

The sensor will perform the herein described characteristics when mounted correctly.
The recommended screwing torque is : 5 Nm ± 10%
for mounting with two M5 bolts
The interfacing surface below each bolt should be according to : DIN 125 M5 or GB/T 97 M5
Or use a flange bolt according to : DIN 921 M5 or GB/T 16674.1 M5

Do not apply any mounting torque or load on the connector (plastic part) of the sensor.

Maximum allowed angle between mounting surface and horizontal plane in any direction is : 90°
Detailed mounting and handling instructions see : TEM000003-TMI





3 PERFORMANCE TESTS

The sensor is exposed to absolute pressures (in kPaA) : 50, 80, 100, 120, 150, 165, 150, 120, 100, 80, 50

Pressures are applied at each temperature (in °C) : 25, 0, -20, -40, 85 °C
All characteristics must be within the values mentioned in §2.1.6.

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