INSTALLATION INSTRUCTIONS FOR THE **BATTERY SAFETY PRESSURE SENSOR**

3011-8666
Issue 1

AEC-Q100

GENERAL INFORMATION

Honeywell Battery Safety Pressure Sensor (BPS) is 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 the early detection of a thermal runaway event in a lithium-ion battery.

Figure 1. Mounting Direction

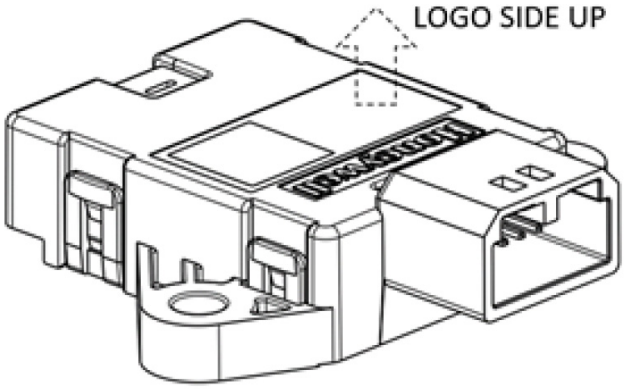

Figure 2. Pin Description

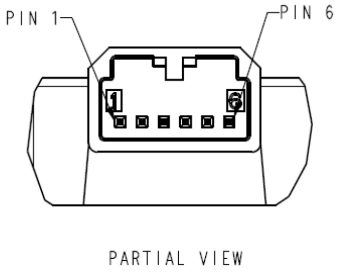

TABLE 1. PINOUT

PIN	DEFINITION
1	Vpwr
2	GND
3	CAN_H
4	CAN_L
5	Wakeup
6	Request

2.0 INSTALLATION

2.1 Install sensor with Honeywell logo facing up as shown in Figure 1.

2.2 Plastic housing material: PBT-GF30

2.3 Mount the sensor using two mounting holes and two M5 screws or bolts.

- 2.3.1 3 Nm max torque for hexagon lobular socket pan head screw
- 2.3.2 5 Nm max torque for hexagon bolt with flange

2.4 Mating connector: TE MPN 175507-2

3.0 GENERAL SPECIFICATION

TABLE 2. 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.

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4.0 CAN (CONTROLLER AREA NETWORK) OUTPUT

The BPS Series is able to provide outputs using the CAN communication protocol. See Table 3 for additional information.

TABLE 3. OPERATING SPECIFICATIONS FOR CAN VERSIONS[1]

CHARACTERISTIC	MIN.	TYP.	MAX.	UNIT	CONDITION
CANBUS protocol	—	—	—	—	Version 2.0A/B
Baud rate	—	—	500	kbps	—
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** **t = 2 s**	 — —	 — —	 200 100	 µA µA	 1 s ECO Mode cycle time 2 s ECO Mode cycle time
Wake-up output: **high level voltage** **low level voltage** **output capability** **default state (low level voltage)**	 5.5 — 0.6 —	 12 — 1.2 —	 18 0.15 1.8 0.15	 V V mA V	 — — — —
REQUEST input from from BMS to BPS: **voltage** **sink current** **enable voltage level** **disable voltage level** **enable signal time**	 5.5 — 5.5 — —	 12 — 12 — 50	 18 0.15 18 0.5 —	 V mA V V ms	 — — — — —
Minimum data bit (resolution)	0.1	—	—	kPa	-40°C to 105°C
Absolute accuracy: **10°C to 100°C** **-40°C to 105°C**	 -2 -4	 — —	 2 4	 kPa kPa	 — —
ECO Mode detection cycle time	400	1000	2000	ms	ECO Mode, configurable
Response time	—	30	—	ms	—

BMS: BATTERY MANAGEMENT SYSTEM

TABLE 4. 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.

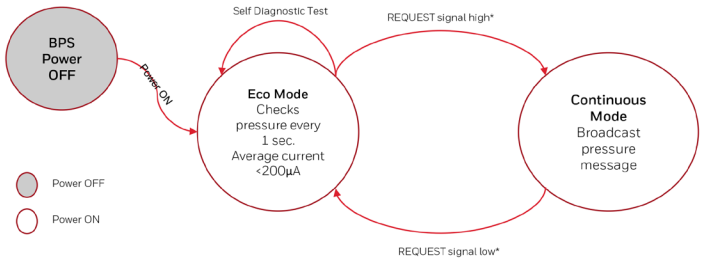
5.0 THERMAL RUNAWAY WARNING

5.1 **Operating Modes**: The BPS series is designed to work in two operating modes:

5.1.1 **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 sensed pressure is above the set threshold, a wake-up signal is sent to the BMS to initiate a full battery system check.

5.1.2 **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 (slope) of pressure to the BMS using CAN communication. The sensor can be switched to ECO mode by setting the request pin voltage to low.

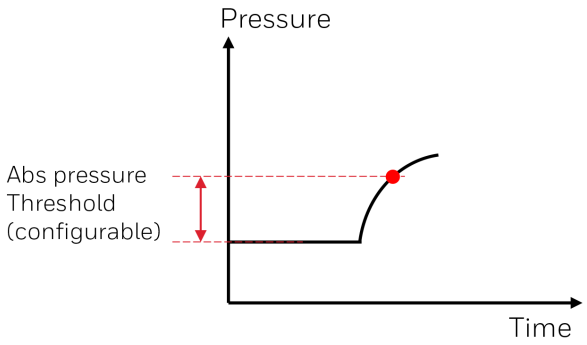
Figure 3. State Diagram for Operating Modes



5.2 **Thermal Runaway Warning Message**: The BPS series uses two warning flags to report the occurrence of a thermal runaway event. These flags are only available in Continuous mode through the CAN broadcast message. In ECO mode, CAN communication is disabled.

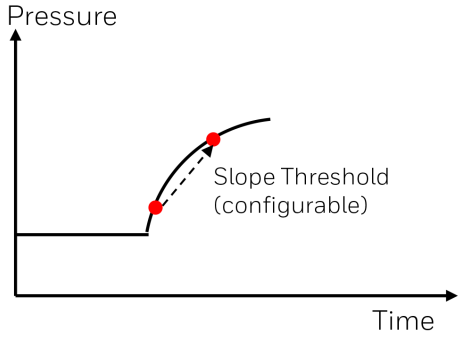
5.2.1 **Absolute Threshold**: If the air pressure in the battery pack is greater than the configured absolute pressure threshold, the CAN broadcast message BpsOverAbsThresholdFlg bit is updated from 0 to 1. The absolute pressure threshold can be configured.

Figure 4. Absolute Pressure Threshold Monitoring



5.2.2 **Slope Threshold**: If the rate of change (slope) of the air pressure in the battery pack is greater than the configured rate of change (slope) threshold, the CAN broadcast message BpsOverSlopeThresholdFlg bit is updated from 0 to 1. The rate of change (slope) threshold can be configured. The default setting is 0.5 Kpa/sec.

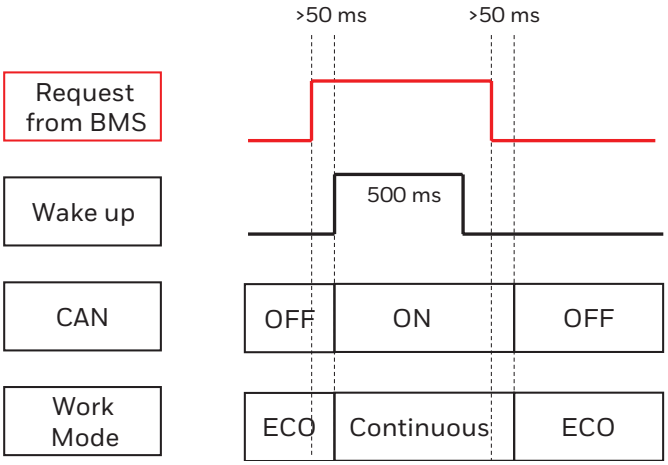
Figure 5. Rate of Change (Slope) Threshold Monitoring



5.3 **Signal Timing Diagram**: The timing diagrams outlines the timing of events in the right order.

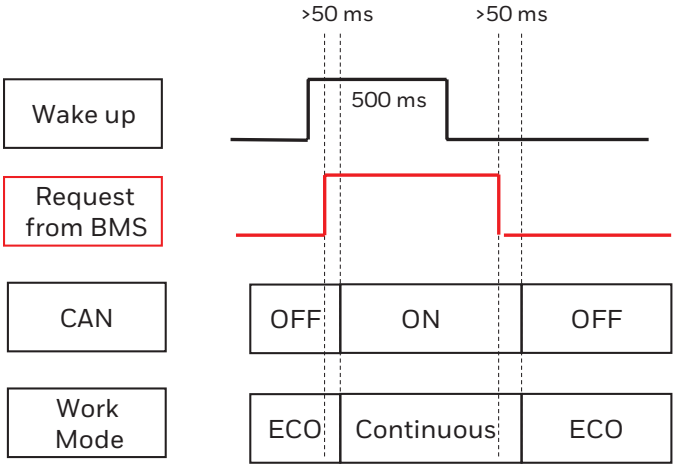
5.3.1 **Request Signal Set to High (Figure 6)**: The BPS enters Continuous mode due to Request signal set to high by the BMS. This is triggered by an external command.

Figure 6. Request Signal Timing Diagram



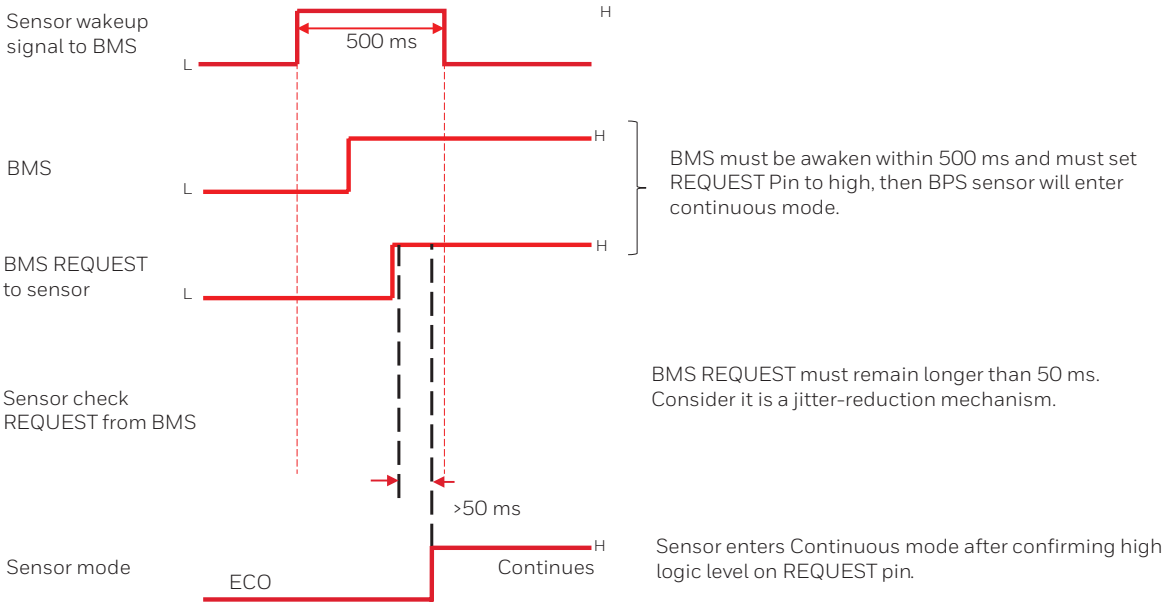
5.3.2 **Wake-up Signal Set to High**: The BPS sets its Wake-up signal to high when in ECO mode and the absolute pressure or rate of change of pressure in the battery pack is above the configured threshold.

Figure 7. Wake-up Signal Timing Diagram



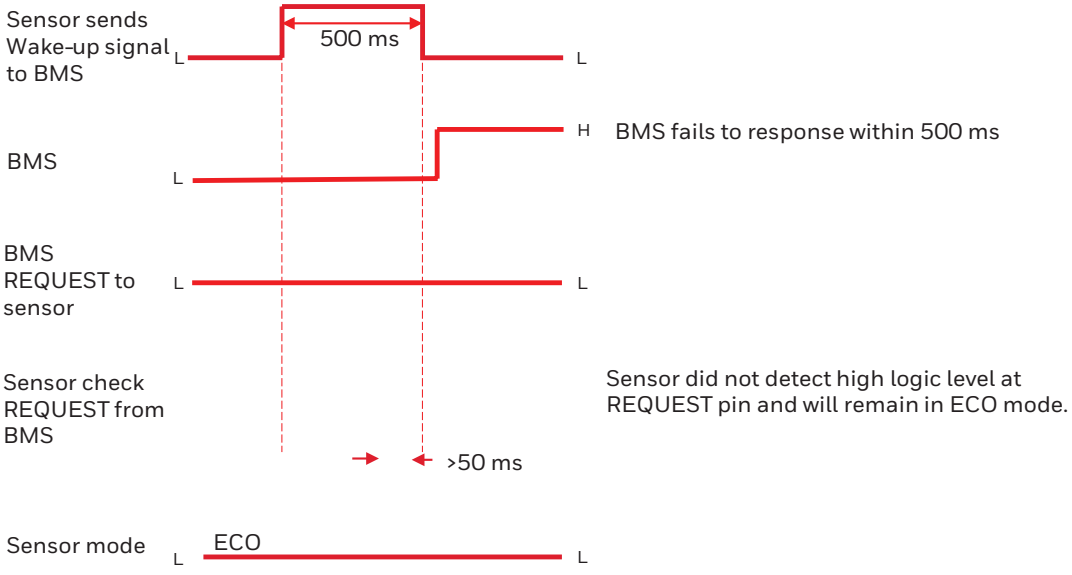
5.3.3 Ideal Timing Sequence

Figure 8. Ideal Timing Sequence Diagram



5.3.4 No Feedback Timing Sequence

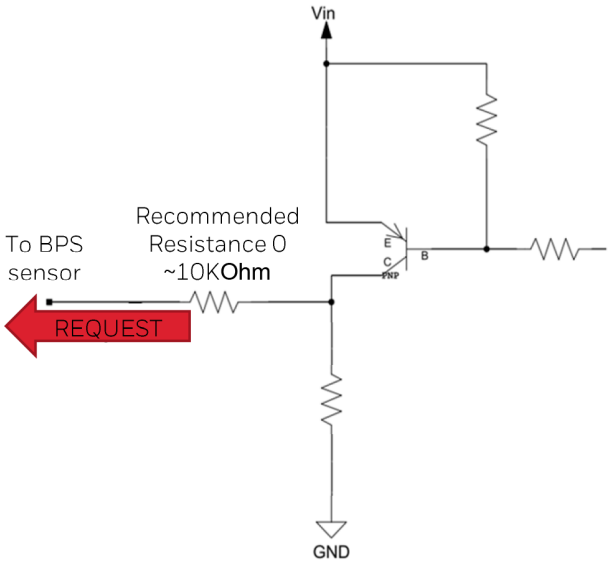
Figure 9. No Feedback Sequence Diagram



6.0 HARDWARE INTERFACE

6.1 **Recommended Request Pin Interface Circuit at BMS**: The Request signal is a logic signal from the BMS to the BPS sensor. See table below. The default state is active low.

Figure 10. Request Pin Interface Circuit



6.2 **Recommended Wake-up Pin Interface Circuit at BMS**: The Wake-up signal is a 500ms logic signal from the BPS sensor to the BMS sensor. See table below.

Figure 11. Wake-up Signal Specification

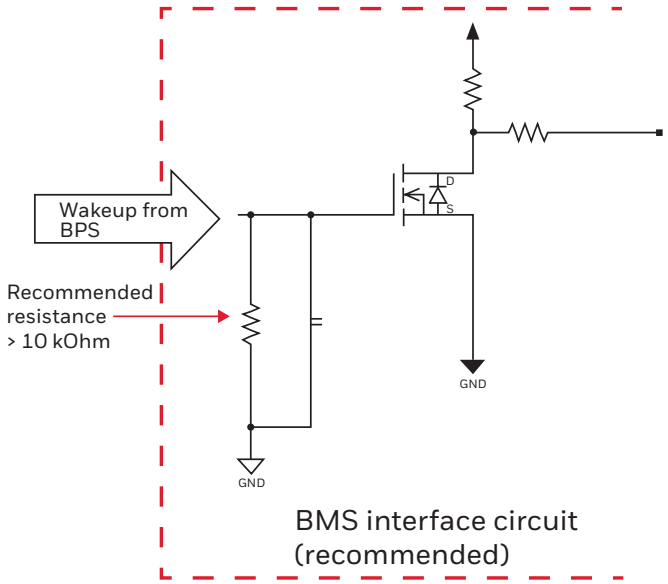


TABLE 5. BMS REQUEST INPUT

PARAMETER	MIN	TYPICAL	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

TABLE 6. WAKEUP OUTPUT

PARAMETER	MIN	TYPICAL	MAX	UNIT
Wakeup high level voltage	5.5	12	18	V
Wakeup low level voltage	–	–	0.5	V
Wakeup output capacity	0.6	1.2	1.8	mA
Default state (low level voltage)	–	–	0.5	V

7.0 SOFTWARE INTERFACE

7.1 Signal Description

TABLE 7. SIGNAL DESCRIPTION

FAULT CATEGORY	SIGNAL NAME	FAULT DESCRIPTION
Thermal runaway warning	BpsOverAbsThresholdFlg	Absolute pressure alarm
Thermal runaway warning	BpsOverSlopeThresholdFlg	Pressure rate of change (slope) alarm
BPS self-test	BpsOutMeasureableFlg	Indicates pressure out of range (>300 kpa)
BPS self-test	BpsWakeupAbnFlg	Internal self-check initiated by the sensor to ensure the Wake-up pin is working as specified. An abnormal flag will set if wake-up pin level is inconsistent with settings
BPS self-test	BpsPowerLowFlg	Supply voltage under voltage diagnosis
BPS self-test	BpsPowerHighFlg	Supply voltage overvoltage diagnosis
BPS self-test	BpsErrorIndictorFlg	BPS internal module fault, including pressure module short circuit to power supply/ground, pressure chip internal fault, MCU EEPROM CRC fault

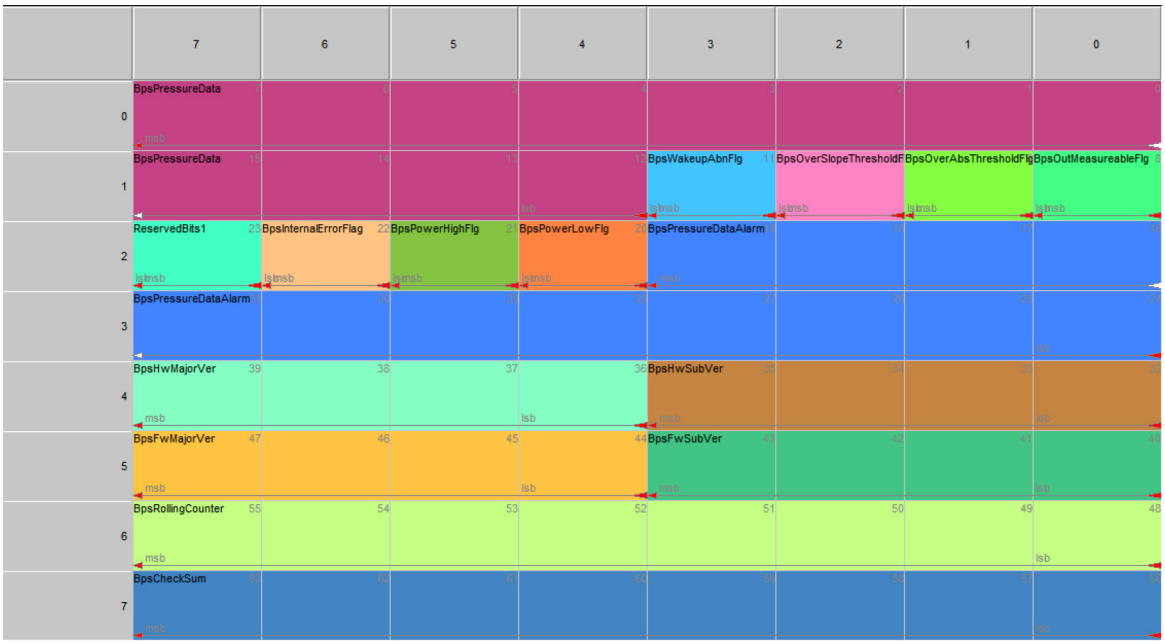
7.2 DBC Parse

Frame: BpsDataState_Cycle
Frame ID: 0x310 Periodic Frames
Frame Period:30ms
Function: Report real-time pressure information and fault information in Continuous mode.

TABLE 8. BPS PRESSURE AND FAULT 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 wakeup (signal self diagnositics)	12	12	0-4095	1	0	—	0 means no fault 1 means wakeup signal abnormal
BpsPressureData	Battery pressure data	20	1	0-1	1	0	—	0 means no fault 1 means BPS power lower than 6V
BpsPowerLowFlg	BPS power lower than 6V	21	1	0-1	1	0	—	0 means no fault 1 means BPS power higher than 18V
BpsPowerHighFlg	BPS power higher than 18V	22	1	0-1	1	0	—	0 means no internal Error 1 means Internal Error
BpsInternalErrorFlag	BPS internal error flag BPS internal fault flag bit: pressure module short circuit to power supply/ ground; pressure chip internal fault; MCU CRC failure	22	1	0-1	1	0	—	0 means no internal error 1 means internal error
ReservedBits1	ReservedBits	23	1	0	1	0	—	Fix to 0x0
BpsPressureDataAlarm	Battery pressure data alarm	24	12	0	0.1	0	kPA	Pressure data 2 seconds before wake-up signal is triggered will be recorded
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 15 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

Figure 12. Layout Diagram Of Pressure Information And Fault Information CAN Frame Message Structure

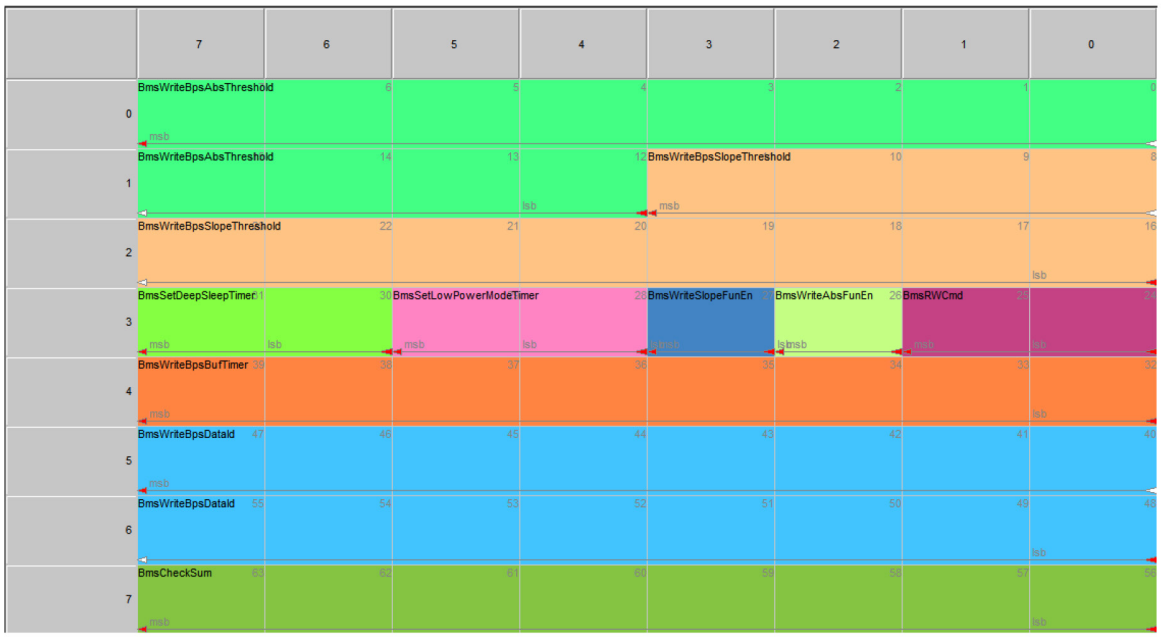


7.3 **Frame: BmsRWBpsPara**
Frame ID:0x312
Function: Read and write BPS parameters

TABLE 9. BPS READ AND WRITE PARAMETERS

Signal Name	General Description	Start bit	Length (bit)	Range	Scaling Factor	Offset	Unit	Usage
BmsWriteBpsAbsThreshold	BMS write battery pressure absolute threshold value to BPS	12	12	0-4095	0.1	0	kPa	Absolute threshold value write To BPS configurable range: 1-4095
BmsWriteBpsSlopeThreshold	BMS write battery pressure slope threshold value to BPS	16	12	0-4095	0.1	0	kPa/s	Slope threshold value writes to BPS configurable range: 5-200
BmsRWCmd	BMS write or read command to or from BPS	24	2	0-1	1	0	—	0: This is a read command 1: This is a write command
BmsWriteAbsFunEn	Battery pressure absolute alarm function enable or disable	26	1	0-1	1	0	—	0: Disable 1: Enable
BmsWriteSlopeFunEn	Battery pressure slope alarm function enable or disable	27	1	0-1	1	0	—	0: Disable 1: Enable
BmsSetLowPowerModeTimer	BMS set BPS echo mode wakeup Timer ECO (eco mode cycle time)	28	2	0-3	1	0	—	0: Default 1s 1: 400ms 2: 660ms 3: 2s
BmsSetDeepSleepTimer	BMS set how long BPS will go to sleep mode after in echo mode (deep sleep cycle time)	30	2	0-3	1	0	—	0: Default disable 1: 12 hour 2: 24 hour 3: 48 hour
BmsWriteBpsBufTimer	BMS set how long BPS will save original data buffer in ABS alarm algorithm	32	8	0-7	10	0	—	Default value: 12(0x0C) 12 X10 = 120 Secs Configurable range : 1-33(decimal)
BmsWriteBpsDataId	BMS set the BPS's data CAN ID	48	16	0-4095	1	0	—	Configured CAN ID for BPS's data frame configurable range: 0x01-0x7FF
BmsCheckSum	The sum of first seven bytes	56	8	0-255	1	0	—	The sum of first seven bytes recorded

Figure 13. Layout Diagram of Read and Write CAN Frame Message Structure

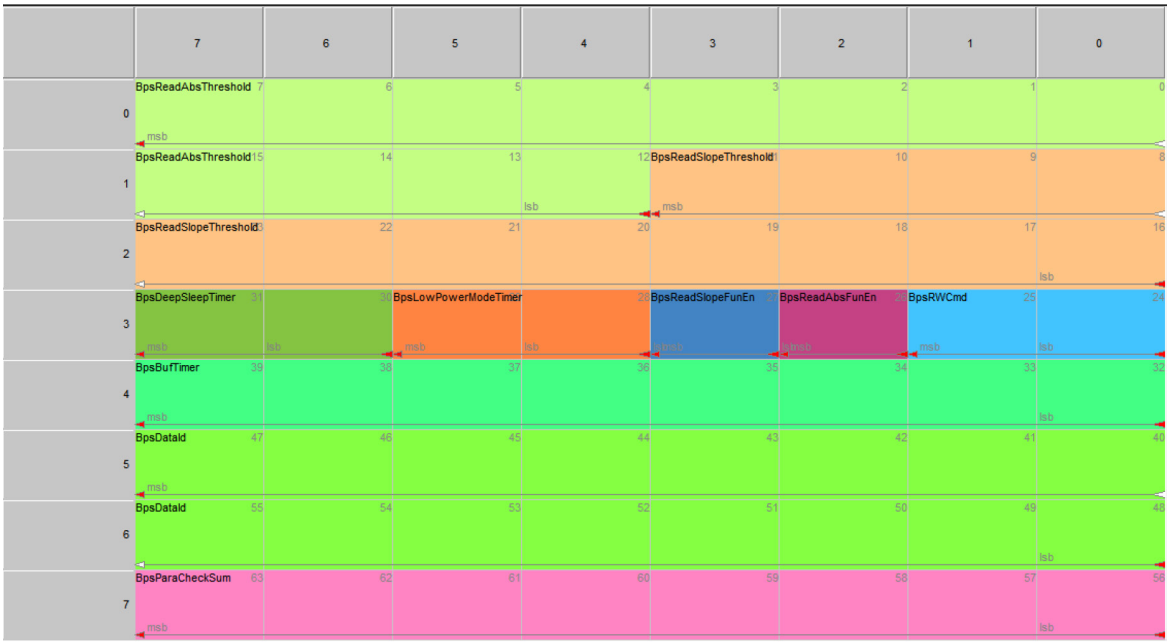


7.4 **Frame: BpsPara**
Frame ID: 0x311
Function: Read back BPS parameters

TABLE 9. BPS READ AND WRITE PARAMETERS, CONTINUED

Signal Name	General Description	Start bit	Length (bit)	Range	Scaling Factor	Offset	Unit	Usage
BpsReadAbsThreshold	BPS read back battery pressure absolute threshold value	12	12	0-4095	0.1	0	kPa	Absolute threshold value writes to BPS
BpsReadSlopeThreshold	BPS read back battery pressure slope threshold value	16	12	0-4095	0.1	0	kPa/s	Slope threshold value writes to BPS
BpsRWCmd	BPS response write or read command from BPS	24	2	0-1	1	0	—	0: This is read command 1: This is write command
BpsReadAbsFunEn	Battery pressure absolute alarm function enable or disable	26	1	0-1	1	0	—	0: Disable 1: Enable
BpsReadSlopeFunEn	Battery pressure slope alarm function enable or disable	27	1	0-1	1	0	—	0: Disable 1: Enable
BpsLowPowerModeTimer	BPS read back echo mode wakeup timer	28	2	0-3	1	0	—	0: Default 1s 1: 400ms 2: 660ms 3: 2s
BpsDeepSleepTimer	BPS read back how long BPS will go to sleep mode after In echo mode	30	2	0-3	1	0	—	0: Default Disable 1: 12 hour 2: 24 hour 3: 48 hour
BpsBufTimer	BPS read back how long BPS will save original data bufferIng ABS alarm algorithm	32	8	0-7	10	0	—	Default value: 12(0x0C) 12 X10 = 120 secs configurable range : 1-33
BpsDataId	BPS read back Tte BPS's data CAN ID	48	16	0-4095	1	0	—	Configured CAN ID for BPS's data frame
BpsCheckSum	The sum of first seven bytes	56	8	0-255	1	0	—	The sum of first seven bytes

Figure 14. Layout Diagram of Read Back CAN Frame Message Structure



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USA/Canada	+1 302 613 4491
Latin America	+1 305 805 8188
Europe	+44 1344 238258
Japan	+81 (0) 3-6730-7152
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Greater China	+86 4006396841

Honeywell
Sensing and Safety Technologies
830 East Arapaho Road
Richardson, TX 75081
sps.honeywell.com/ast

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