

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

3011-8665

Issue 1



1.0 – INTRODUCTION

1.1 – Product Description

The BAS Series are automotive-grade aerosol sensors that use the principle of light scattering to detect and report thermal runaway events in lithium-ion battery packs. They use the light scattering principle to detect the presence and concentration of aerosols such as smoke, liquid and other particles that are early indicators of a thermal runaway event in an enclosed lithium-ion battery pack.

The BAS Series have a factory-programmed, thermal runaway warning threshold of 5000 $\mu\text{g}/\text{m}^3$.

1.2 – General Requirements

The performance of the sensor meets the requirements defined in this specification when the sensor is used under the environmental conditions specified in this document. Any deviation from the use defined in this document will invalidate this specification.

2.0 – INSTALLATION

2.1 Sensor may be installed in any orientation.

2.1a Ensure battery pack vent valve is unblocked.

2.2 Install sensor with 10 cm clearance on both sides of the hollow sensing chamber.

Figure 1. BAS Side Mount

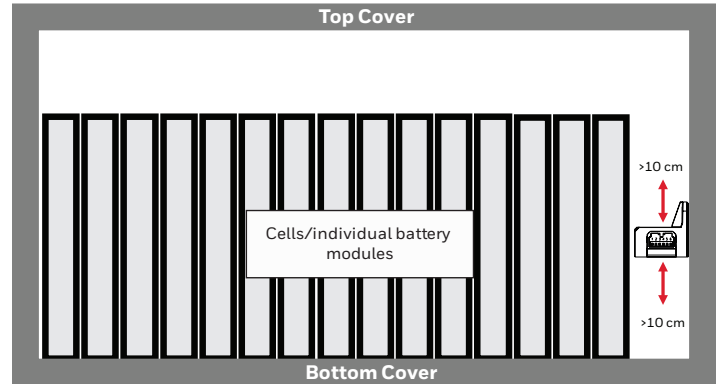


Figure 2. BAS Bottom Mount

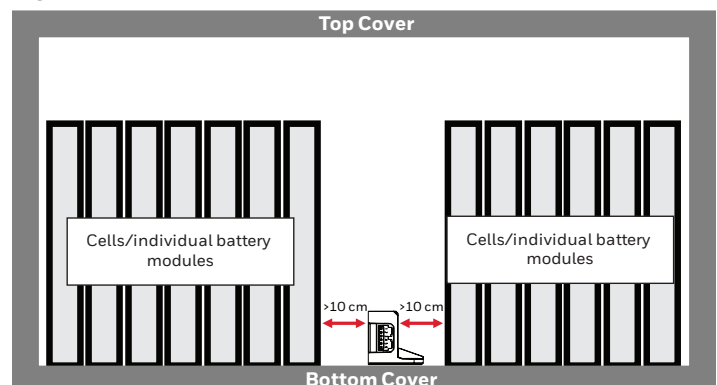
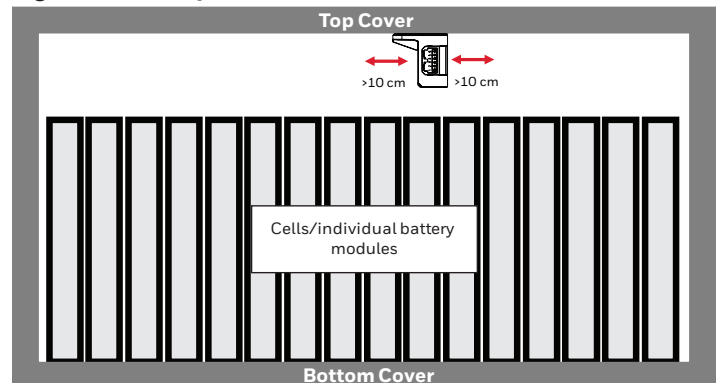


Figure 3. BAS Top Mount



2.3 Mount the sensor using two mounting holes and two M6 screws.

2.4 10 Nm max. torque for mounting screw.

2.5 Mating connector: TE MPN 175507-2

TABLE 3. GENERAL SPECIFICATIONS¹

Characteristic	Parameter
Operating temperature range	-40°C to 85°C [-40°F to 185°F]
Particulate matter measurement range	200 µg/m ³ to 10000 µg/m ³
Accuracy	±15 % at threshold concentration of 5000 µg/m ³
Response time	≤1 s
Current consumption (average): ECO mode Continuous working mode	<0.5 mA <30 mA
ECO Mode wake-up threshold	5000 µg/m ³

¹ All specifications are at room temperature unless otherwise noted.

TABLE 4. ELECTRICAL SPECIFICATIONS ¹

Characteristic	Min.	Typ.	Max.	Unit
Supply voltage (Vs)	8	12	16	Vdc
Wake-up signal:				
High level voltage	8	12	16	Vdc
Low level voltage	—	—	0.5	Vdc
Output current	0.6	1.2	1.8	mA
REQUEST Input from from BMS to BAS:				
High level voltage	8	12	16	Vdc
Over voltage capability	—	—	24	Vdc
Reverse voltage capability	-14	—	—	Vdc

¹ All specifications are at room temperature unless otherwise noted.

TABLE 5. COMMUNICATIONS SETTINGS

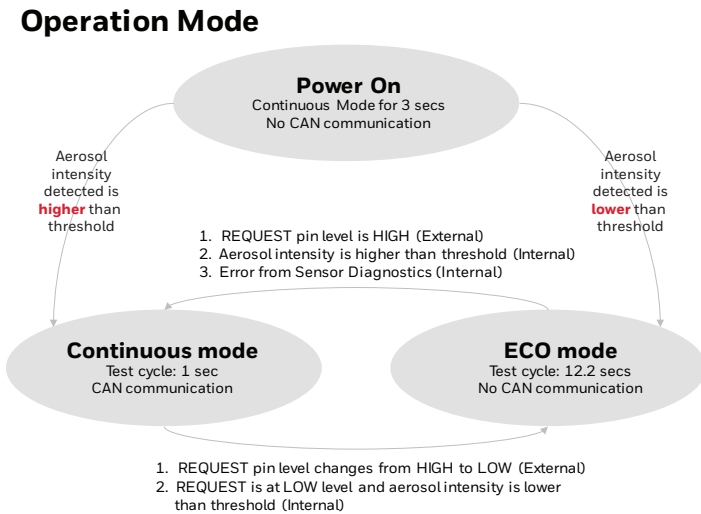
Baud Rate	ID	Period	Length
500 kbps	0x667	1 s	8 Bytes

TABLE 6. MESSAGE FORMAT

Byte	Name	Definition
BYTE0	particulate matter concentration	—
BYTE1	particulate matter concentration	—
BYTE2	Low-power mode wake-up threshold	—
BYTE3	Low-power mode wake-up threshold	—
BYTE4	0-2	status 0x00 = normal 0x01 = alarm 0x02 = reserved
	3-7	fault 0x00 = normal 0x01 = photoelectric device fault 0x02 = Vs over voltage 0x03 = Vs under voltage others = reserved
BYTE5	0-3	rolling counter
BYTE6	4-7	—
BYTE7	CRC check code	

4.0 – THERMAL RUNAWAY WARNING

Figure 5. State Diagram for Operating Modes



4.1 Operating Modes

The BAS Series is designed to work in two operating modes:

4.1.1 ECO Mode

The sensor operates in ECO Mode when the request pin voltage is set to low. The sensor wakes up for 200 ms and hibernates for the remaining 12000 ms (typical) to reduce power consumption during each measurement cycle of 12200 ms (default value). In ECO Mode, CAN communication is disabled. If the sensor detects an aerosol concentration above the set threshold, a wake-up signal is sent to the BMS (Battery Management System) to initiate a full battery system check.

4.1.2 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 aerosol concentration to the BMS using CAN communication. The sensor may be switched to ECO Mode by setting the request pin voltage to low.

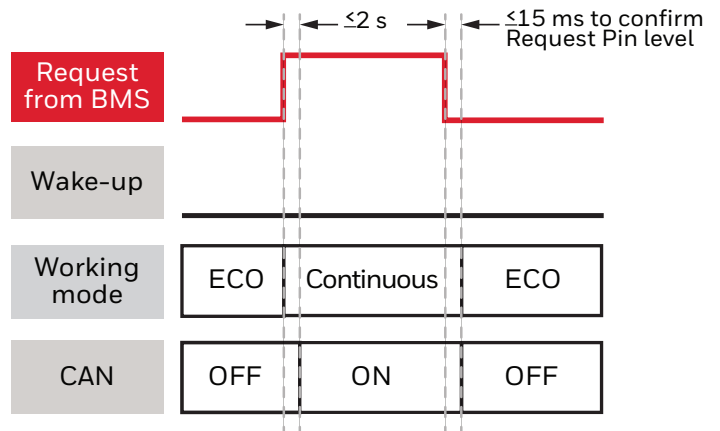
4.2 Signal Timing Diagram

The timing diagram outlines the timing of events in the right order.

4.2.1 Request Signal Set to High

The BAS enters Continuous mode due to Request signal set to high by the BMS.

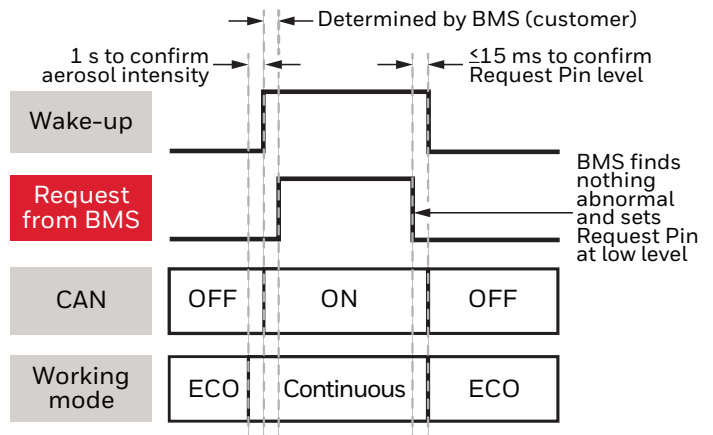
Figure 6. ECO Mode



4.2.2 Wake-up Signal Signal Set to High

The BAS sets its Wake-up signal to high when it is in ECO mode and the detected aerosol concentration is above the 5000 µg/m³ threshold..

Figure 7. Continuous Mode



5.0 – HARDWARE INTERFACE

5.1 Recommended Wake-up Pin Interface Circuit at BMS

The Wake-up signal is a logic signal from the BAS sensor to the BMS. See table below.

5.2 Recommended Request Pin Interface Circuit at BMS

The Request signal is a logic signal from the BMS to the BAS sensor. See table below. The default state is active low.

Figure 8. Interface Circuits

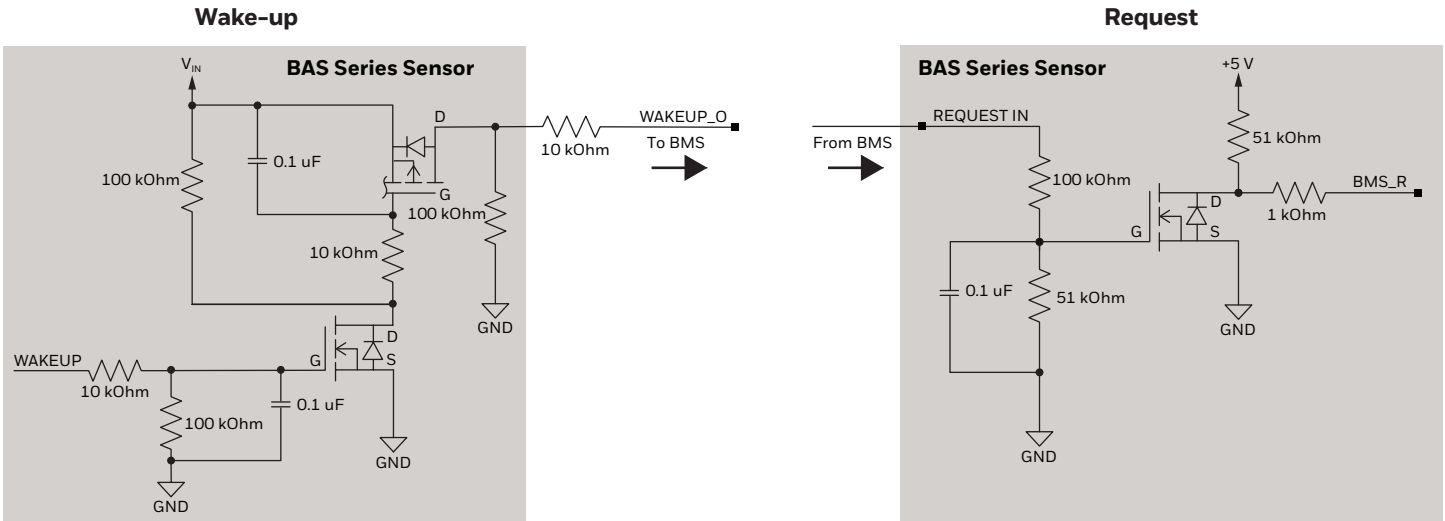


TABLE 7. WAKE-UP SIGNAL

Parameter	Min.	Typ.	Max.	Unit
High level voltage	8	12	16	Vdc
Low level voltage	—	—	0.5	Vdc
Output capability	6	12	18	mA

TABLE 8. REQUEST SIGNAL

Parameter	Min.	Typ.	Max.	Unit
High level voltage	8	12	16	Vdc
Low level voltage	—	—	0.5	Vdc

6.0 – FIRMWARE INTERFACE

6.1 Signal Description

TABLE 9. SIGNAL DESCRIPTION

Category	Signal Name	Signal Description
Thermal Runaway Warning	SmokeSensor_Monitor_Density	Aerosol Concentration measured in $\mu\text{g}/\text{m}^3$ unit
Thermal Runaway Warning	SmokeSensor_Status	Aerosol concentration Alarm, triggered when the aerosol concentration exceeds threshold value (5000 $\mu\text{g}/\text{m}^3$)
BAS Self - Test	SmokeSensor_FaultInfo	Diagnostics feature indicates normal and abnormal functionality of the sensor, abnormality covers internal failure due to photoelectric fault, Over voltage and under voltage conditions of the sensor
BAS Self - Test	SmokeSensor_CRC	Microcontroller EEPROM CRC fault indicator

6.2 BAS Frame and Signal Information

TABLE 10. PINOUT FOR CAN VERSIONS

Signal Name	General Description	Start Bit	Length (bit)	Range	Scaling Factor	Offset	Unit	Usage
SmokeSensor_Monitor_Density	Aerosol concentration	0	16	0-10000	1	0	$\mu\text{g}/\text{m}^3$	Aerosol Concentration
SmokeSensor_FaultThreshold	Aerosol Concentration Threshold Value	16	16	0-10000	1	0	–	Aerosol Concentration Threshold Value (wakeup threshold)
SmokeSensor_Status	Aerosol Sensor Status	32	3	0-7	1	0	–	0x00: Normal 0x01: Alarm Rest: Reserved
SmokeSensor_FaultInfo	The Details Fault Status of Aerosol Sensor	35	5	0-31	1	0	–	0x00: Normal 0x01: photoelectric device fault 0x02: power supply over voltage fault 0x03: power supply under voltage fault Rest: Reserved
Reserved_Bits0	Reserved Bits, Not Used Now	40	8	–	--	--	–	Not used, Reserved for More Information Later. Now Initialed as 0
SmokeSensor_Counter	Rolling Counter	48	4	0-15	1	0	–	0-15: Means the different CAN Frame
Reserved_Bits1	Reserved Bits, Not Used Now	52	4	–	–	–	–	Not used, Reserved for More Information Later. Now Initialed as 0
SmokeSensor_CRC	The CRC Value For Byte0 to Byte6	56	8	0-255	1	0	–	The CRC Value

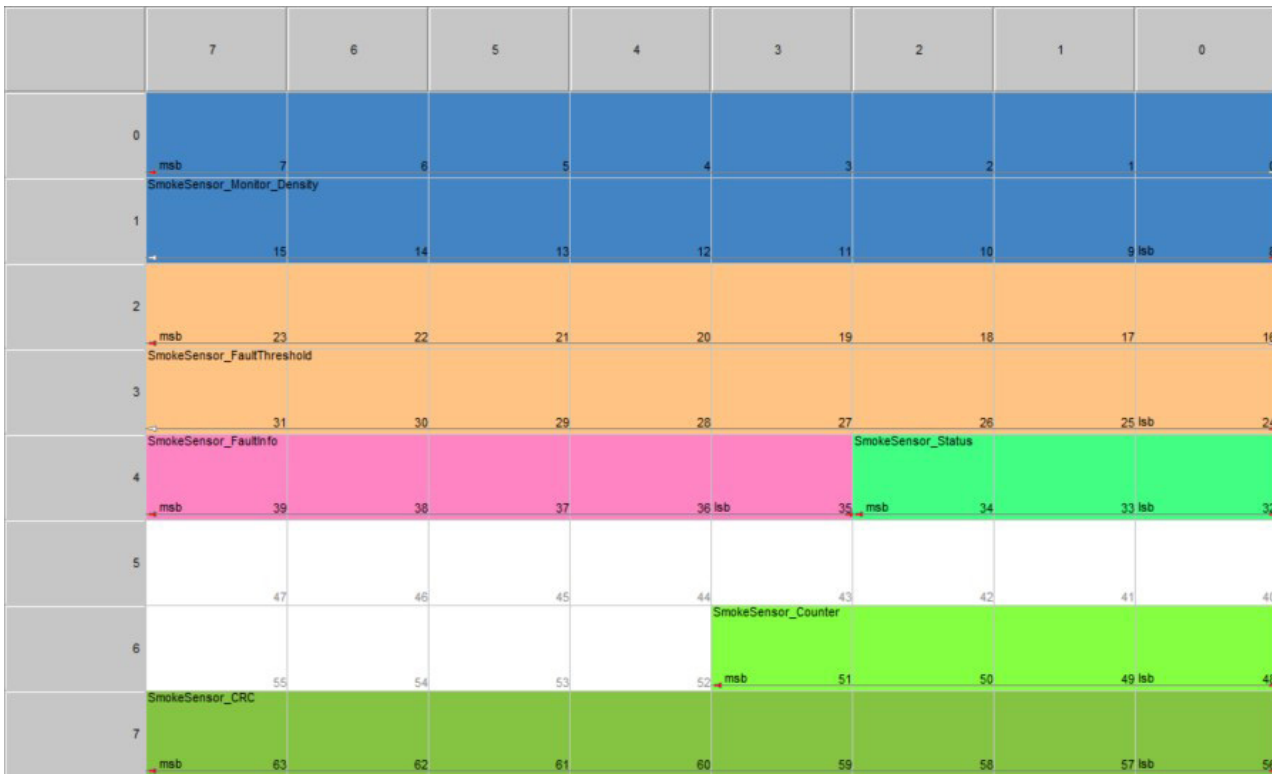
6.3 DBC Parse

Frame ID: 0x3C4

Frame Period: 1s

Function: Report real-time particulate matter concentration and fault information in Continuous mode.

6.4 Layout Diagram of BAS Frame Message Structure



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

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