DTC P0A9C - Battery Thermistor Fault

Orion Product	Fault Supported
Orion BMS [Original] (24 - 180 Cell)	**YES**
Orion BMS 2 (24 - 180 Cell)	**YES**
Orion JR [Original] (16 Cell)	**YES**
Orion JR 2 (16 Cell)	**YES**

FAULT DESCRIPTION

A thermistor fault is triggered if the analog voltage measured from the battery thermistor is detected outside of the normal thermal operating range. This error can be triggered if the temperature of the thermistor rises above 85C or drops lower than -40C. A shorted or open wire can result in artificially high or low measurements that would result in this error code. Additionally the use of an incompatible thermistor can cause inaccurate readings and trigger this error code.

Fault Code	Fault Description	Possible Trouble Area
P0A9C: Subcode 1-8	One or more locally connected thermistors are in fault state (the subcode indicates which thermistor ID)	- Thermistor Wire Assembly - Configuration Settings
P0A9C: Subcode 100 - 10A	CANBUS communication was lost with an enabled external Thermistor Expansion Module (TEM).	- Thermistor Expansion Module - CANBUS Wiring or Baud-rate - Configuration Settings (On BMS or Thermistor Expansion Module)

P0A9C: Subcode 300 - 30A	A thermistor fault was detected on external Thermistor Expansion Module (TEM).	• Thermistor Expansion Module Thermistor Wiring • Configuration Settings (Thermistor Expansion Module)
P0A9C: Subcode 900	Too many thermistor faults have occurred, resulting in termination of the primary outputs based on configuration of the BMS. This option is available on the "Fault Settings" tab of the BMS profile settings.	• Thermistor Wire Assembly
P0A9C: Subcode 1000	An internal error occurred in the thermistor processing logic onboard the BMS.	• Internal BMS Fault • Configuration Settings

FAULT BEHAVIOR

This fault is **Primarily Informational**, however if a particular thermistor does generate a fault the BMS will ignore that thermistor until the fault is cleared or the BMS is power cycled. If too many thermistors are faulted out (determined by configuration of the unit), this will result in the BMS terminating the outputs which would impact operation.

FAULT THRESHOLDS

Fault will trigger when **ONE** of the following conditions are satisfied	(a) **OR** (b) **OR** (c) **OR** (d)
(a) One or more populated thermistors is in an error state	If a thermistor is reading an invalid value (greater than 85C or less than -40C) for more than 2 seconds this will trigger a Thermistor Fault for it and the BMS will ignore that particular thermistor.

(b) A communication timeout with an external Thermistor Expansion Module	If the BMS loses CANBUS communications with an external Thermistor Expansion Module that it is expecting this will trigger a Thermistor Fault.
(c) One or more thermistors loaded on an external Thermistor Expansion Module is in an error state	If a thermistor loaded on an external Thermistor Expansion Module is reading an invalid value (greater than 85C or less than -40C) this will trigger a Thermistor Fault.
(d) An internal processing (logic) error in the thermistor calculation software	If an internal logic processing fault occurs in the thermistor measurement handler this will trigger a Thermistor Fault.

DIAGNOSTIC STEPS

1.	**Determine if the BMS should have the faulted thermistor loaded.** If the application does not have the faulted thermistor actually connected to the BMS (it is not loaded) yet it is populated (enabled) in the BMS settings, then the BMS will continue to throw a fault. In this situation the thermistor should be disabled in the BMS profile settings (on the "Thermal Settings" tab for the Orion Standard and the "General Settings" tab for the Orion JR). If the fault is related to an external Thermistor Expansion Module, verify that the external Thermistor Expansion Module is infact connected and present. If it is not available in the application then it can be disabled in the BMS profile settings (under "Addon Settings").
2.	**Verify thermistor connector is plugged in.** If the thermistor connector was not inserted into the BMS when it was powered up this will cause a Thermistor Fault. Make sure that the thermistor connector is securely plugged in and try clearing the error codes or restart the BMS to see if the fault codes return. If so, continue to the next step.

3.	### Download the freeze frame for the fault code using the BMS Utility. The BMS will normally produce a freeze frame on the "Diagnostic Trouble Codes" screen in the BMS Utility when this fault code occurs that contains a comprehensive list of BMS data parameters at the time the fault occurred. **It is strongly recommended that the freeze frame be downloaded from the BMS and saved to disk before the fault is cleared again** as this data may assist in the future if further diagnostics are required. <u>Additionally this freeze frame data may be requested by Technical Support if further assistance is required.</u> **NOTE:** Only Fault Codes with a (F) next to them have freeze frame data available for download. If there is no (F) next to the fault, there is no stored freeze frame available and this step can be skipped. Steps to download the Freeze Frame: 1) Connect to the BMS using the Orion BMS utility. 2) Click the "Diagnostic Trouble Codes" tab at the top. 3) Select the correct fault code by clicking on the ID on the left side of the screen to initiate the Freeze Frame retrieval. 4) Once the retrieval process is complete, click the "Export (CSV)" button to save the freeze frame data to the computer disk.
4.	### Verify the main thermistor fuse (**Orion Jr / Orion Jr 2 ONLY**) The **Orion Jr / Orion Jr 2** has a dedicated internal fuse for the 3 external thermistor sensors. If this fuse is compromised or blown during operation it will prevent the BMS from properly reading any of the thermistors connected. Steps to check the main thermistor fuse: 1) Unplug the main I/O connector harness from the Orion Jr BMS. 2) Using a multi-meter, test the continuity between pins 6 and 8 on the Orion Jr BMS unit itself (bottom row, 3rd and 4th pins from the left when looking into the BMS with the locking tab facing up). **If there is no continuity between these two pins on the Orion Jr BMS unit itself, this means the internal fuse has blown.** The fuse is designed to blow in the event that a thermistor shorts to a cell or to some other source of voltage. 3) <u>If the fuse is determined to be blown, the unit will need to be sent in for servicing.</u> This part is not field repairable unfortunately.
5.	### For thermistor faults on the main BMS unit, inspect the thermistor wiring. Carefully inspect the wiring for the identified thermistor. 1. Inspect the entire length of cable for the thermistor (both leads) for any signs of breakage, cuts or shorts. Also look for slits in the insulation covering. If either of the thermistor leads are shorting together or

potentially shorting to anything else (such as ground) that can completely distort the thermistor value being read.

2. Wiggle the thermistor wiring to see if the problem changes. This can help identify loose or intermittent connections.
3. Verify that the thermistor leads go to the correct thermistor inputs on the BMS itself.
4. Using the Orion BMS utility, go to "Live Text Data" and select "Temperature Parameters" from the drop-down menu at the bottom to see the individual thermistor values reported by the BMS. The displayed temperature value for the faulted thermistor may help diagnose problems further.
   ○ A value of -41C likely indicates either an open (break) in the line or that it is shorted to the BMS power supply input voltage.
   ○ A value of 85C or higher likely indicates that the thermistor lead is likely shorted to ground (the wire could be punctured or pinched by something that is grounded).
5. Using a multimeter, measure the resistance across the thermistor at the connector to the BMS. It should read approximately 10K Ohms at 25 degrees Celsius. A significantly different reading at 25 degrees Celsius could indicate a failure of the thermistor itself or help diagnose a wiring problem.

6.

For Thermistor Expansion Module related faults, inspect the Thermistor Expansion Module connections and wiring.

Based on which subcode is set, carefully inspect the wiring for the external Thermistor Expansion Module (CANBUS communication wires, power inputs and actual thermistor wiring harnesses).

Use the built-in Thermistor Expansion Module utility (by clicking the "Expansion Modules" menu item at the top of the Orion BMS utility and then "Thermistor Expansion Utility") to further diagnose any potential issues with the Thermistor Expansion Module itself.

For CANBUS Communication-related faults (subcodes 100 - 10A):

There are a number of configuration settings related items that should be checked when diagnosing subcodes 100 - 10A.

1. Verify that the BMS and thermistor expansion module are both configured for the same CANBUS baud rate. Both devices will need to be operating at the same baud rate in order to communicate. **If the baud rates do not match, one of the two devices may need to be powered down to allow for communication with the other.**

2. Verify that the thermistor expansion module is configured with the correct target J1939 BMS address (the address the thermistor module is expecting to transmit data to). **If this value does not match the BMS J1939 address, then the BMS will not receive traffic from it.** To do this, first, determine what the BMS J1939 address is by going to the

"CANBUS Settings" tab in the configuration settings (listed as "J1939 ECU Address"). Next, determine what J1939 address the thermistor module is configured to transmit to by opening the thermistor expansion module settings and reviewing the "BMS J1939 Address" field. **The two addresses must match for proper communications.** If they do not, please change one or the other so that they do and apply the changes.

3. Verify that the thermistor expansion module is configured as the correct module device number (in the thermistor module settings dialog, ensure that the "Expansion Module #" value is set correctly). If only 1 thermistor module is expected in a given system then this value should be set to "1". If 2 or more are expected, then it is important that each thermistor module is configured with a unique number (eg: 1 & 2 if 2 devices are expected).

4. In the BMS configuration settings (under Addon Settings), verify that the proper number of thermistor expansion modules are configured. For example, if 2 thermistor modules are being used, the "Number of Thermistor Expansion Modules" would be set to "2".

In addition to configuration related issues, the following external issues may also cause CANBUS communication-related faults (subcodes 100 - 10A):

1. As with any CANBUS network, verify that the CANBUS wiring is correct and properly installed. Wiring issues (such as the use of non-twisted pair cabling or incorrect termination resistor count can cause significant communication issues).

2. Verify that the thermistor expansion module is powered. There must be +12v present on at least one of the two power sources going to the thermistor expansion module (it is acceptable for both power lines to be energized at once if desired). Please see the thermistor expansion module manual for details on this.

7.		**If the problem persists, contact technical support.** If all above steps fail to determine the cause of the fault then additional support is needed. **Please contact the company or reseller that the BMS was originally purchased from for additional questions, warranty claims, repair requests and technical support.**