DTC P0A81 - Fan Monitor Fault

Product Family	Fault Supported
Orion BMS [Original] (24 - 180 Cell)	**YES**
Orion BMS 2 (24 - 180 Cell)	**YES**
Orion JR [Original] (16 Cell)	**NO**
Orion JR 2 (16 Cell)	**NO**

FAULT DESCRIPTION

The Orion BMS has the ability to monitor the performance (output) of a connected blower fan for cooling the battery pack. This is done by measuring the voltage of the Fan Monitor / Multi-Purpose Input 3 (Pin 9) input on the Main I/O harness which is provided by the fan itself. This fault is triggered when this voltage is below (or above if inverted) the error threshold programmed into the BMS profile. This is used strictly for monitoring performance of an external fan and alerting the user of a possible fan failure.

This fault will only be set if the "Monitor Fan For Faults" option is enabled in the "Thermal Settings" section of the BMS profile settings.

Fault Code	Fault Description	Possible Trouble Area
P0A81	Battery blower fan monitor fault detected. Measured fan voltage does not correspond with expected voltage range.	- Fan Blower Assembly - Fan Power Relay - Main I/O Wire Assembly - Internal BMS Fault

FAULT BEHAVIOR

This fault is **Informational Only** and does not alter the operation of the BMS in any way.

FAULT THRESHOLDS

Fault will trigger when **BOTH** of the following conditions are satisfied	(a) **AND** (b)
(a) Voltage measured at the Fan Monitor input (pin 9)	Measured voltage is outside expected range for current fan speed for more than 5 seconds.
(b) Fan Monitoring active / enabled	Fan monitoring feature is enabled in the BMS profile settings

IMPORTANT NOTE:
Both the Fan Enable and Fan PWM Signal outputs are open drain outputs. This means they pull to ground when active and float when inactive. If the fan blower being used requires active outputs (voltage sourced) then a pull-up resistor is necessary. Please see the Orion BMS Wiring Manual for details on how to accomplish this.

WIRING DIAGRAM
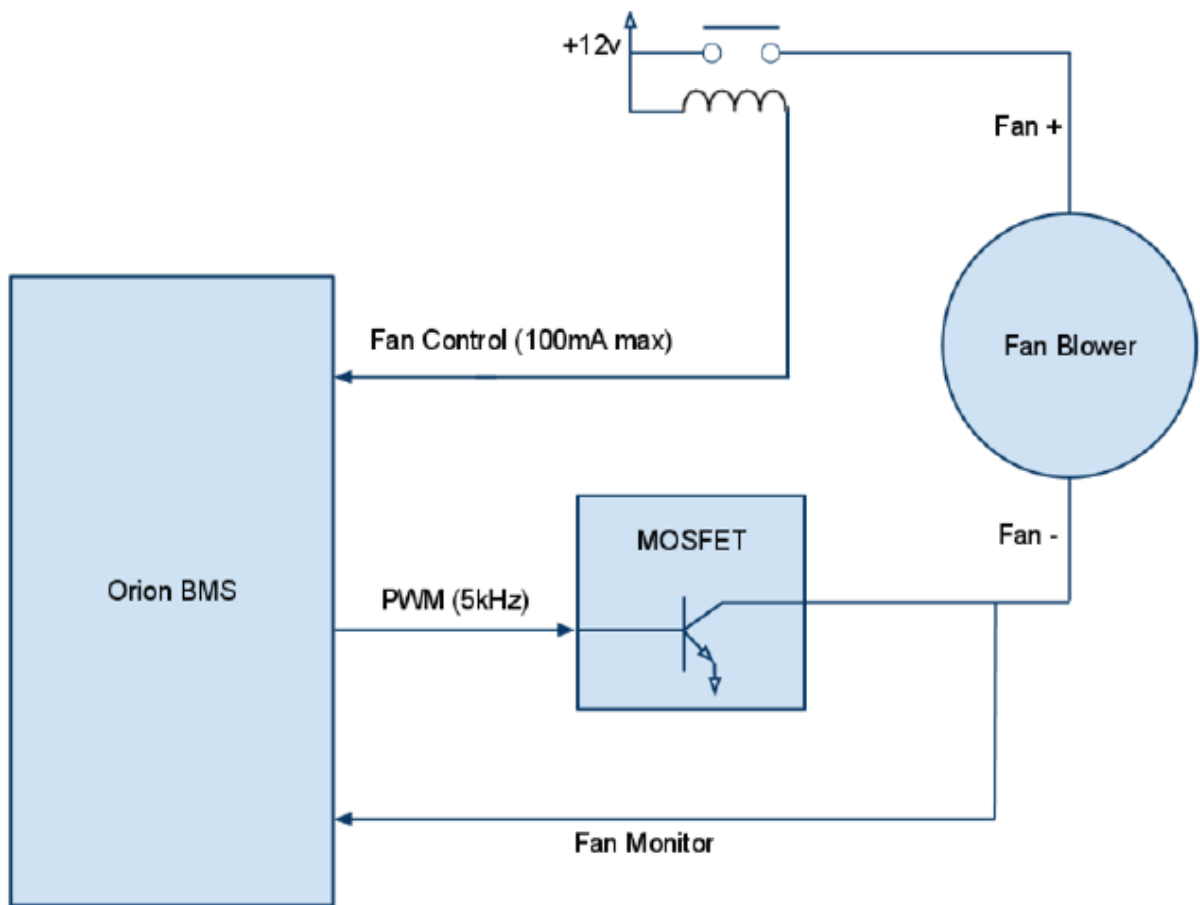
Above diagram illustrates the internal circuitry inside the BMS for the fan control

DIAGNOSTIC STEPS

1.	**Determine if the system should be monitoring the fan voltage.** If the fan blower is not connected then the "Enable Fan Control Circuit" settings should be disabled in the "Thermal Settings" tab of the BMS profile. If the fan is connected but voltage performance monitoring is not required or desired then the "Monitor Fan For Faults" option can simply be disabled.
2.	**Review the settings for the fan blower function in the BMS utility.** On the "Thermal Settings" tab of the BMS utility, verify whether the fan blower polarity is high or low (meaning whether the fan is expecting a low signal for ON or a high signal for ON) and whether the correct frequency is selected for the

	control line. Also verify whether the maximum fan monitor voltage value is correct (eg: if the fan is a 12vDC fan this should be approximately 12vDC). **NOTE:** **The Fan PWM Signal output line will not output a wave signal unless it is enabled in the BMS profile settings. Please see the relevant sections in the "Thermal Settings" tab for details.**
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.	**Review the wiring for the blower fan.** Inspect the fan blower control signal wiring and the fan monitor wiring for breaks or cuts. a) Disconnect the Main I/O harness from the BMS and the control / voltage sense lines from the blower fan. Check the resistance between <u>Pin 9 (Fan Monitor / Multi Purpose Input 3)</u> and the corresponding wire at the fan blower. Resistance should be less than 1 Ohm. Repeat this test for <u>Pin 10 (Fan Power Control / Multi Purpose Output 3)</u> and <u>Pin 24 (Fan PWM Signal)</u> if these are used. b) With the Main I/O harness plugged into the BMS, measure the voltage reaching the fan power to ensure it has proper voltage. If the fan is not powered that could indicate a wiring issue elsewhere in the application. c) Wiggle the wiring at the BMS and at the fan blower assembly to determine if a connection might be loose.
5.	**Verify that the BMS shares the same ground as the fan.**

	The BMS requires that the fan be grounded to the same point that the BMS low voltage power source is, <u>Pin 12 (Ground)</u>. If the fan has a different reference ground than the BMS power ground then the BMS will not be able to control the fan PWM signal. **<u>SAFETY WARNING:</u> Bridging the ground between the BMS and fan may break isolation if the fan is being powered off the battery pack. It is up to the user to determine if it is safe to bridge the ground between the BMS and the fan if this will potentially break isolation between the BMS and the battery pack.**
6.	**If the Fan PWM Signal output on the BMS is used, verify the integrity of the PWM output wave with an oscilloscope.** Perform an active test on the fan by forcing the blower to a certain speed: 1. Connect to the BMS using the Orion BMS utility. 2. Go to the "Live Text Data" screen at the top, then click the "Show Active Commands" button at the bottom of the screen. 3. Check the "Control Battery Blower Speed" option to engage the command, then select a value of "1" for the parameter. This will force the fan into Speed 1 and will command the PWM output to activate regardless of what the battery pack temperature is. With the above test running and the Main I/O harness still connected to the BMS, connect an oscilloscope to the other end of <u>Pin 24 (Fan PWM Signal / Multi Purpose Output 4)</u> measuring against BMS ground. There should be a PWM pulse visible. The amplitude and frequency of this pulse will depend on what the current fan speed is and what frequency is programmed in for the fan to operate at. **<u>IMPORTANT NOTE:</u> Remember that the Fan PWM Signal is an open drain output which means it pulls to ground when active and floats when inactive. In order to see the fan PWM output signal a pull-up resistor may be necessary. Please see the Orion BMS Wiring Manual for details on how to accomplish this.**
7.	**If the Fan Power output on the BMS is used, verify operation of the output with a multimeter.** If the <u>Pin 10 (Fan Power / Multi Purpose Output 3)</u> output is powering a relay, use a multimeter to determine whether the relay is activating or not. If the relay is not firing, check to see if the relay is properly wired. **<u>NOTE:</u> The <u>Pin 10 (Fan Power / Multi Purpose Output 3)</u> output will only be active when the fan is commanded to be on (fan speed is greater than 0). See the instructions in Step 4 above for details on how to manually command the fan to turn on.**

8.	**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.**