DTC U0100 - External Communication Fault

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

FAULT DESCRIPTION

This fault is only enabled if the BMS is specifically configured to monitor for the presence of external CAN message, if used with an external module that requires 2-way communication such as a thermistor expansion module or if multiple BMS units are strung together in series (master-slave mode). This error is set if communication messages are not received after a specified amount of time. This error is most commonly caused if the BMS and the other device are powered up or down at slightly different times (not powered by the same power rail) or if the CANBUS is not properly terminated.

Fault Code	Fault Description	Possible Trouble Area
U0100: Subcode 1-F	Expected CANBUS keep-alive message was not received within expected timeframe.	• CANBUS Network Assembly • Third Party CANBUS Device • BMS Configuration Settings
U0100: Subcode 10	CANBUS communications have been lost between this BMS and the Slave BMS (CANBUS multi-unit series communication).	• CANBUS Network Assembly • BMS Configuration Settings

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U0100: Subcode 11	CANBUS communications have been lost between this BMS and the Master BMS (CANBUS multi-unit series communication).	• CANBUS Network Assembly • BMS Configuration Settings
U0100: Subcode 100 - 2F0	External communications have been lost between this BMS and the Remote Module.	• Remote Module Communication Wiring Assembly • BMS Configuration Settings

FAULT BEHAVIOR

This fault will trigger **Voltage Failsafe Mode** which will inhibit the BMS from allowing charging or discharging of the battery pack.

NOTE: This will only occur if the BMS is being used in a multi-unit series configuration.

FAULT THRESHOLDS

Fault will trigger when **ANY** of the following conditions are satisfied	(a) **OR** (b) **OR** (c) **OR** (d)
(a) Failure to receive designated Keep-Alive CANBUS message(s) within specified timeframe.	The BMS does not receive a programmed (expected) keep-alive CANBUS message within the programmed timeframe.
(b) Communication lost between the master BMS and a slave BMS when configured for multi-unit series operation (CANBUS or dedicated remote module communication interface).	Failure to communicate reliably between the master BMS and one or more configured slave BMS units.
(c) Communication lost between a slave BMS and the master BMS when configured for multi-unit series operation (CANBUS or dedicated remote module communication interface).	Failure to communicate reliably between a slave BMS and the master BMS unit.

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WIRING DIAGRAM

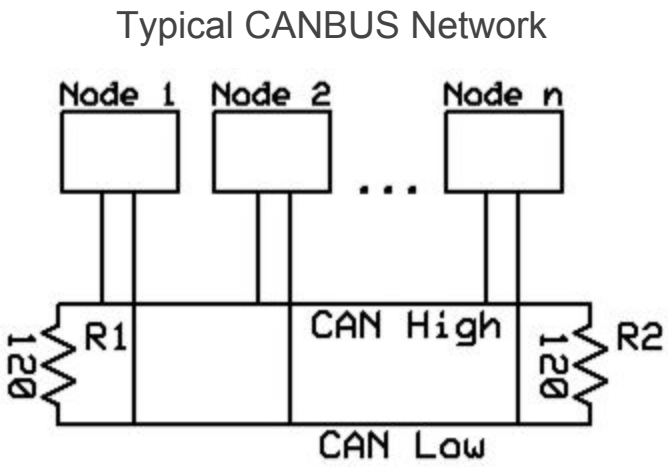

Diagram of a multi-node CANBUS with 120 ohm termination resistors at the ends

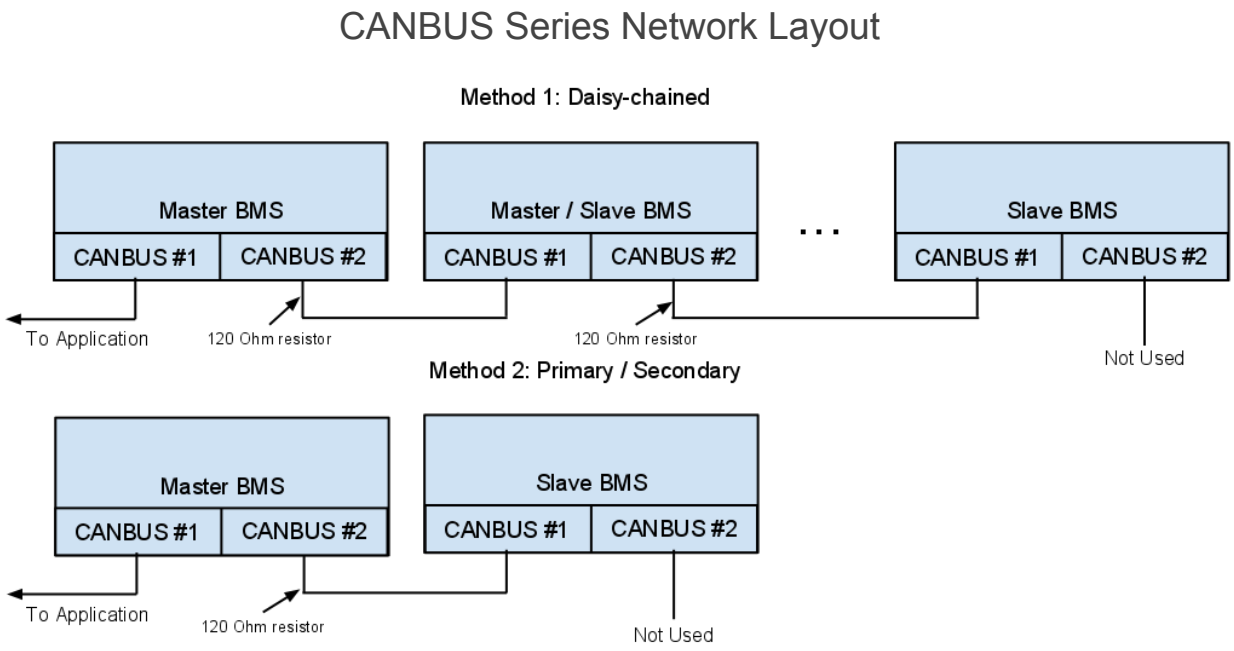

Diagram of two methods of configuring multiple OrionBMS units in series via CANBUS

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Remote Module Network Layout (Orion 2)

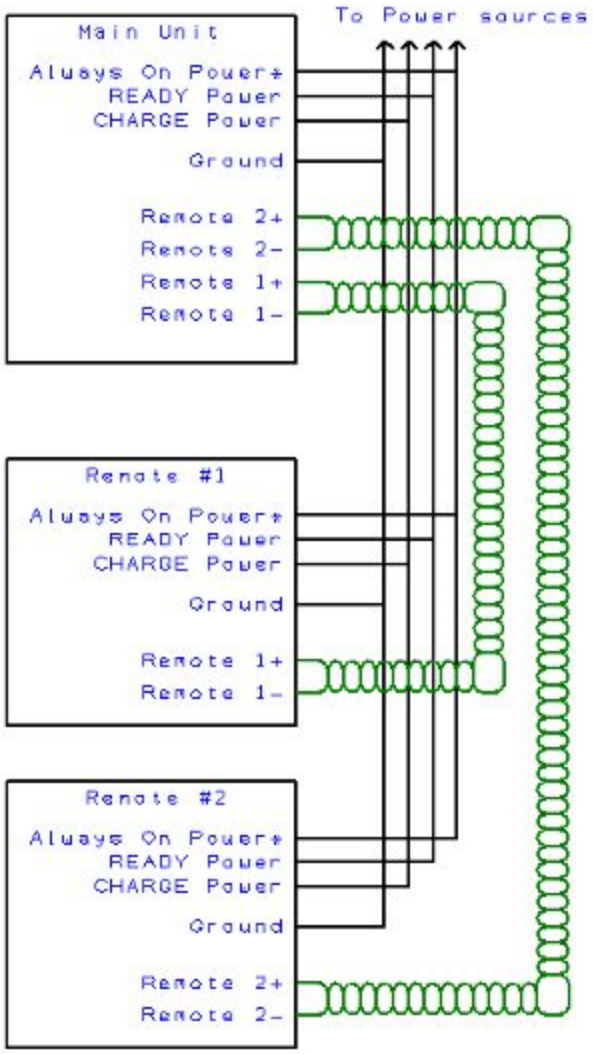

Diagram showing the wiring connections between the main unit and remote modules for Orion 2 BMS

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DIAGNOSTIC STEPS

1.	**Determine whether fault is multi-unit series related or keep-alive.** If the fault code is Keep-Alive (also sometimes referred to as heartbeat) message related then the following diagnostic steps would be suggested: Steps to diagnose: 1) The specific subcode set along with the fault indicates which CANBUS message ID (in the custom CANBUS message transmission table) is responsible for setting the fault. Open the Custom CANBUS Message Editor (go to "CANBUS Settings" in the BMS profile settings -> "Edit CANBUS Messages") and determine what CANBUS message corresponds to the provided subcode. This message should be currently configured as a "Receive" message by the BMS. 2) Determine which ECU, computer system or device is responsible for transmitting this CANBUS message. If the message is not intended to be received by the BMS then this message should be disabled in the Custom CANBUS Message Editor. 3) If possible, use an external CANBUS device (such as a CANdapter or equivalent equipment) to view the active CANBUS messages on the CANBUS network. If using the CANdapter (an optional accessory sold with the Orion BMS) then this data can be viewed by navigating to the "Live CANBUS Traffic" tab in the BMS Utility and clicking "Start". This will display all the active CANBUS message traffic on the network. a) If the message in question **does not** appear on the active CANBUS message traffic then proceed to the next step. b) If the message in question **does** appear on the active CANBUS message traffic, then make sure that the message length matches what is programmed in to the Custom CANBUS Message Editor table (if the message being transmitted has a different length than what is expected it will not fulfill the keep-alive requirement). Also verify whether the message is configured for extended ID or not (this must also match what is expected by the BMS). 4) If the CANBUS message in question is not being seen or received on the CANBUS network, proceed to step 2 (Diagnosing CANBUS Communication Problems).
2.	**Troubleshooting subcodes 16 and 17** These subcodes will indicate that the BMS is being used in a multi-unit series configuration over a CANBUS communication link. Steps to diagnose: 1) Confirm that the BMS unit in question is intended to be configured for this role. If a BMS is programmed for the incorrect role (EG: a standalone BMS is configured as a master unit, or a slave unit is programmed as a master unit) then this fault will trigger. These settings

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are available on the "Addon Settings" section of the BMS utility profile settings.
2) Confirm that the BMS CANBUS lines are wired in accordance with the multi-unit series CANBUS communication schematic. Please see the Multi-Unit Series Manual for details.
3) The problem is most likely with the CANBUS wiring / connection. Proceed to the below section for Diagnosing CANBUS Communication Problems.

<u>Diagnosing CANBUS Communication Problems:</u>

CANBUS is a high speed network which requires high quality wiring in order to operate properly. As such, it is sensitive to improper wiring. The majority of CANBUS communication problems are caused by poor wiring, incorrect termination, or the use of multiple frequencies on the same bus. Below are some tips for diagnosing CANBUS communication problems:

- There must be exactly two (2) termination resistors of 120 ohms each at the physical ends of the CANBUS. These resistors may be external to the device, but some devices such as the Orion BMS (CAN1 only) or Orion Jr. BMS have termination resistors installed inside the device (may be ordered without). Correct termination resistance can be verified by measuring the resistance between CAN-High and CAN-Low with a multimeter. In order to do this, it is essential that all devices on the network are completely unpowered (this will not work if any device on the network has power). It should read approximately 60 Ohms. There must be exactly 2 termination resistors (120 Ohms each) on the network. Always use termination resistors. Even if the network appears to operate without termination resistors in quiet environments, it may not operate correctly when noise is introduced!
- Both termination resistors must be on the physical ends of the CANBUS (ends of the main trunk). If they are not at the physical ends of the network, then the effectiveness of the termination filtering resistors will be negated.
- The network must be shaped like a tree. The main length of the CANBUS is like the trunk of the tree and there can be small branches that come off the main trunk. The maximum length of the trunk and branches depends on the baud-rate running, but is typically limited to no more than 2 feet (0.6 meters)
- **All CANBUS wire must be twisted pair cable**, even short lengths (longer than 1 inch / 2 cm). The twisted pair wire is an essential part of how the differential mode filtering works on CANBUS, and without it the signal can be easily distorted.
- CAN-High and CAN-Low wires must be the same length. Differences in length between CAN-High and CAN-Low wires can cause distortion due to common mode filtering.
- Ensure that CAN-High and CAN-Low are connected in the correct order. If CAN-High and CAN-Low are backwards on any device on the network, it will obliterate or severely distort traffic and make communication impossible.
- Ensure CAN-High and CAN-Low are not shorted together or shorted to ground or V+. Test to make sure there is no electrical conductivity between CAN-High and ground or CAN-Low and ground (this can happen if one of the wires gets shorted to the shield or gets pinched or sliced by a metal enclosure).
- All devices on the CANBUS network must be running the same baud-rate. If there are devices running multiple different baud-rates then this may obliterate all CANBUS traffic. If the baud rate on an Orion BMS product must be changed, disconnect the device from the network, and update the baud rate with just the BMS product and the CANdapter connected. If the baud rate is changed on an Orion

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	BMS product, the Orion BMS product must be power cycled for the new baud rate to take effect. ● **All devices on the network must share the same ground**. Different ground potentials between devices will lead to common mode voltages forming on the CANBUS. These will distort communication signals and can lead to damaged equipment and may also pose a safety hazard. If the same grounds cannot be used, an external CANBUS isolator may be required to provide galvanic isolation to disrupt ground loops. ● If the CANBUS wire being used is a shielded cable, the shield should be grounded on **one end only**. If both ends of the CANBUS wire shield is grounded ground loops may be formed which may cause interference. ● Ensure that all CANBUS wiring is solidly connected. CANBUS wire junctions must be soldered together or securely spliced. Junctions may NOT simply be twisted together or held together with wire nuts or friction. Do not use terminal blocks, phone cable junction blocks, or other signal processing blocks. These can distort CANBUS communication signals. ● When stripping the CANBUS wires back, it can be easy to accidentally pierce the insulation of the CAN-High or CAN-Low wires. Inspect any joint or section of wire where the outer CANBUS sleeve has been stripped back to ensure that the CAN wires were not inadvertently damaged as well. ● Whenever possible, route CANBUS wires away from noisy circuits. Do not twist CANBUS wires with other wires. If the problem persists after verifying the above items the CANBUS receiver inside the BMS may be damaged. Proceed to step 4.
3.	**Troubleshooting subcodes 100 - 2F0** These subcodes indicate that the BMS is configured to expect one or more Remote Modules via the dedicated Remote Module Communication interface (not CANBUS). <u>Steps to Diagnose:</u> 1) Determine if the BMS is intended to be configured to expect Remote Modules. If this is not desired, this should be removed from the configuration settings. This can be done on the "Addon Settings" tab of the BMS utility profile settings. 2) Verify that the Master BMS supports Remote Module operation (this is a special option that must be specified at time of ordering--by default this option is NOT loaded). The BMS software utility should alert the operator to this incompatibility condition when settings are uploaded, however if the settings are already loaded this warning may have been ignored. 3) If the Remote Module is expected and supported by the Master BMS, determine what the model number is for the Remote Module in question. The configured (expected) remote module module number in the BMS profile settings (on the "Addon Settings" tab) must match the actual

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	Remote Module model number exactly. If these differ, correct the programmed model number and see if the problem is resolved. 4) Ensure that the Remote Module is powered. The status LED on the front of the unit should either be green or red (depending on fault conditions) and may be flashing red if communication with the master BMS is lost. If the status LED is completely off (unpowered) that would likely indicate a lack of power to the Remote Module. a) The Remote Module requires power on either Charge Power (Pin 3) or Ready Power (Pin 2) to operate. If it only has Always On Power (Pin 1) it will not remain awake. Verify with a multi-meter that either Charge Power (Pin 3) or Ready Power (Pin 2) is energized. b) Verify that the Power Ground (Pin 12) is connected to the input power supply ground. If this is not making good contact it may prevent the Remote Module from powering up. c) **IMPORTANT NOTE: It is absolutely essential that the Remote Modules be powered from the same input power sources that the main Master BMS is** (that way the Remote Modules will power up at the exact same time as the Master BMS). If the Remote Modules are powered up slower than the Master BMS it may result in the Master BMS setting this fault. 5) Verify the communication wires going between the Master BMS and the Remote Module. a) **NOTE:** There are two interfaces supported by the Master BMS and it matters which one the Remote Module is connected to. Please see the Wiring Manual for details on which interface is which. b) Verify the integrity of the communication wires. If the cabling has been cut, crushed or otherwise damaged that may prevent reliable communication. Replace damaged cabling. c) **NOTE: All remote module communication wires MUST be twisted pair shielded cabling.** This is an absolute requirement for reliable communications. d) **Ensure that only ONE end of the cabling shield is connected to ground** (if both ends are grounded that can amplify noise rather than diverting it away from the communication wires).
4.	**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. Additionally this freeze frame data may be requested by Technical Support if further assistance is required. **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.

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	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.
5.	**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.**

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