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OrionBMS Master/Slave Supplement

Document Version 0.2

Master / Slave (Series) Overview

As of firmware version v2.4.0, multiple Orion BMS units can be configured to operate together in series. This allows very large packs (over 180 cells in series) or for packs split into multiple physical locations (IE: front and back of a vehicle) to be safely and easily monitored.

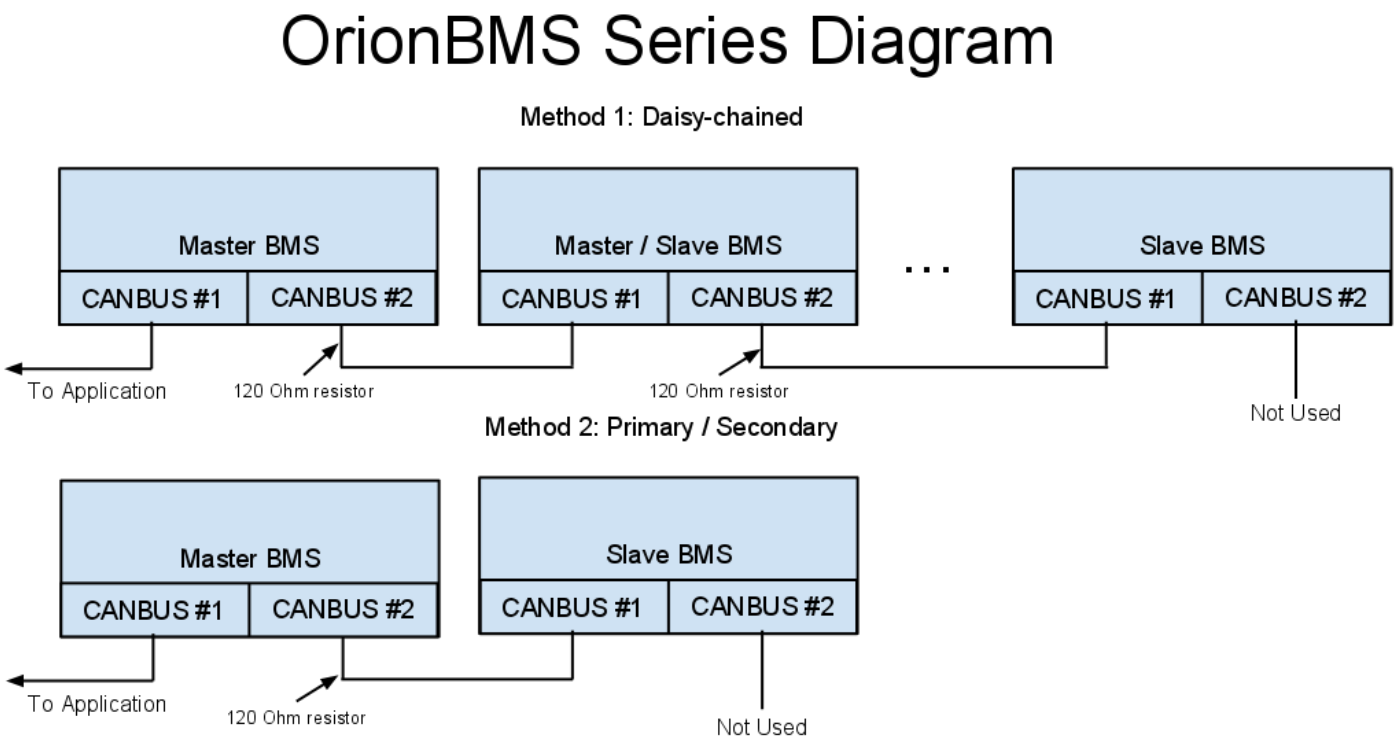

Diagram 1: Two methods of configuring multiple OrionBMS units in series

Safety

Important Safety Note: If the combined voltage for your entire battery pack will exceed 1000v (approx 300 cells in series) then the following additional safety measures must be taken:

- The Orion BMS units must be special ordered without the high voltage isolation detection circuit loaded.
- Additional external isolation may be necessary for the CANBUS networks and the low voltage signals (power supply, etc) must be isolated using suitable isolation.

Connecting the Hardware (Wiring)

Setting up the hardware for multiple BMS units in series is fairly straightforward. As seen in the diagram above, the master (primary) BMS unit is configured such that the CAN1 interface can be used as a general-use CANBUS interface but the CAN2 interface is linked to the CAN1 interface on the next BMS in series (the slave or the master-slave unit depending on how many are in series).

This process continues until the last BMS in series is reached (the end of the line). This last BMS in series is called the slave BMS and only has the CAN1 interface connected (CAN2 could be used as a general-use CANBUS interface).

It is important that the total pack voltage sensor wires for each BMS are connected only to the cells that it monitors (ie: if 48 cells are on BMS #1 and 60 cells are on BMS #2, the HV pack sensor wires for BMS #1 are connected to the 48 cells and the HV pack sensor wires for BMS #2 are connected to the 60 cells).

NOTE: It is very important that exactly two (2) termination resistors (120 Ohm each, placed between the CAN-High and CAN-Low wires on the physical ends of the CANBUS) are in each CANBUS network (ie: in this case, every CAN1 and CAN2 interface pairing). The BMS already has 1 termination resistor internally on the CAN1 interface, so a second termination resistor must be added on every CAN2 interface in the series configuration.

NOTE: It is very important that the wire used for CAN-high and CAN-low is twisted pair (shielded would be preferable as well). Even a small length (a few inches) of untwisted wire can expose the CANBUS network to EMI and cause significant communication issues.

Configuring the Software (Profile)

There are several important requirements for setting up the series configuration:

- Each BMS unit in series must have a different / unique OBD2 identifier (set in the "Communications" tab of the BMS profile). This allows each BMS to be distinguished from each other.
- Each BMS unit must have firmware version 2.4.0 or higher.
- The same firmware version must be installed on all BMS units in series.

- The CANBUS frequencies must be the same on all BMS units in series (500 kbps is recommended). This only applies to the CANBUS interfaces used by the master/slave communication system (interfaces marked as general-use do not need to be the same frequency).
- All hardware recommendations and requirements mentioned in the above sections must be followed.

In order for each BMS to know what it is suppose to do, the "Unit Type" parameter (set in the "Addons" tab of the BMS profile) must be properly set. There are three different unit types: Master, Master / Slave, Slave (selecting "None" will disable the series system and the BMS will operate normally). A "master" or primary unit is configured to receive incoming data from a slave (sometimes referred to as secondary) unit. A master/slave unit is configured to both receive incoming data from a slave as well as transmit data on to another master unit (as if it were a slave). Finally, the slave unit is configured simply to transmit information to a listening master unit and does not have any slave units that it is listening for.

All communication between the BMS units takes place over the CANBUS interfaces. In a properly configured system the master unit will transmit / receive slave information on the CANBUS #2 interface (CANBUS interface #1 can be used for normal communication). The slave units will receive information from the master unit via CANBUS #1 interface (see above diagram for more details). This allows for more than 2 units to be daisy-chained together (method #1 in above diagram) or for only 2 units to be put in series (method #2 in above diagram).

NOTE: It is not recommended to have any additional transmitted messages or nodes on the CANBUS lines being used for series communication (lines between master and slave units) due to traffic volume and speed. If additional messages are necessary on master/slave communication interfaces they should be kept to a minimum and low transmit speed (100ms or slower is recommended).

NOTE: The CANBUS message IDs for master / slave communication are not programmable as they are intended to be the sole messages on a given interface. For reference, the IDs used are 0x100, 0x101 and 0x102. These should not be intercepted or altered in any way. Altering or tampering with these messages can prevent the BMS from properly protecting the battery pack.

Operation

Each BMS in the master / slave configuration stores its' own information about the cells it is monitoring. Because of this, the majority of the parameters visible in the BMS utility are specific to the cells directly wired to each unit.

The following parameters are summed (added, negotiated or accumulated) by the master unit and when requested from the master unit are reflective of all the BMS units in series combined:

- Total pack voltage
- Total pack open voltage
- Total pack resistance
- Malfunction Indicator Lamp (MIL) signal
- Cell balancing voltages (not displayed or available as a requested parameter)

- State of Charge (SOC)

All other parameters (eg: temperatures, highest cell voltage, lowest cell voltage, pack amperage) are BMS specific and may vary depending on which BMS is connected to the OBD2 utility.

NOTE: While the MIL (error indicator signal) may activate on the master BMS unit, the actual DTC (diagnostic trouble code) may be set on any of the BMS units in series. In order to identify which BMS has the error code set, the utility would need to be connected to each BMS unit in series until the DTC code is discovered.

NOTE: Due to bandwidth restrictions, it is not possible to view all the cell voltages from all the BMS units in series by connecting to one single BMS unit with the utility (ie: only the cells directly wired to the given BMS are visible in the utility). It is necessary to connect to each BMS individually in order to view all the cell voltages together via the utility. The Orion BMS does support transmission of cell voltages on a regularly scheduled interval via the “Battery Cell Broadcast” parameter in the “Communications” tab of the profile though again this will only be for the cells directly wired to that specific BMS.

Frequently Asked Questions

Q: Can I access both OrionBMS units in series from the same CANBUS network using the BMS utility?

A: Yes, if you only have two OrionBMS units connected in series you can bridge the CAN2 interface on the slave BMS to the CAN1 interface on the master unit so that they both are connected to the same CANBUS network. Then, using the utility, both BMS units can be connected to and configured as long as they each have unique OBD2 ECU Identifiers.

Q: Why can’t the master BMS unit keep track of all the cells from the slave unit as well so that I just have one large BMS unit?

A: The BMS takes very accurate readings from each of the cells in the battery pack. These readings are time sensitive and the amount of latency (delay) introduced by transmitting these values over the CANBUS to the master unit would significantly reduce the accuracy and increase code complexity. To reduce costs and to increase accuracy, each BMS unit monitors only the cells directly connected to it and forwards the important information on to the master unit.

Q: The MIL (malfunction indicator lamp, or general error) signal is active meaning I have a code set, but when I connect to the BMS there are no codes shown.

A: The most likely reason is that the code is set on the other BMS that is connected in series (ie: the user connects to the master but the code is set on the slave). The MIL signal is propagated (distributed) to the other BMS units in series but the code will only show up on the actual BMS that it is set on. To figure out what code is set the user should try connecting to the other BMS in series and checking for codes.