Technical Information

English

eXRCPU/eXRLCPU

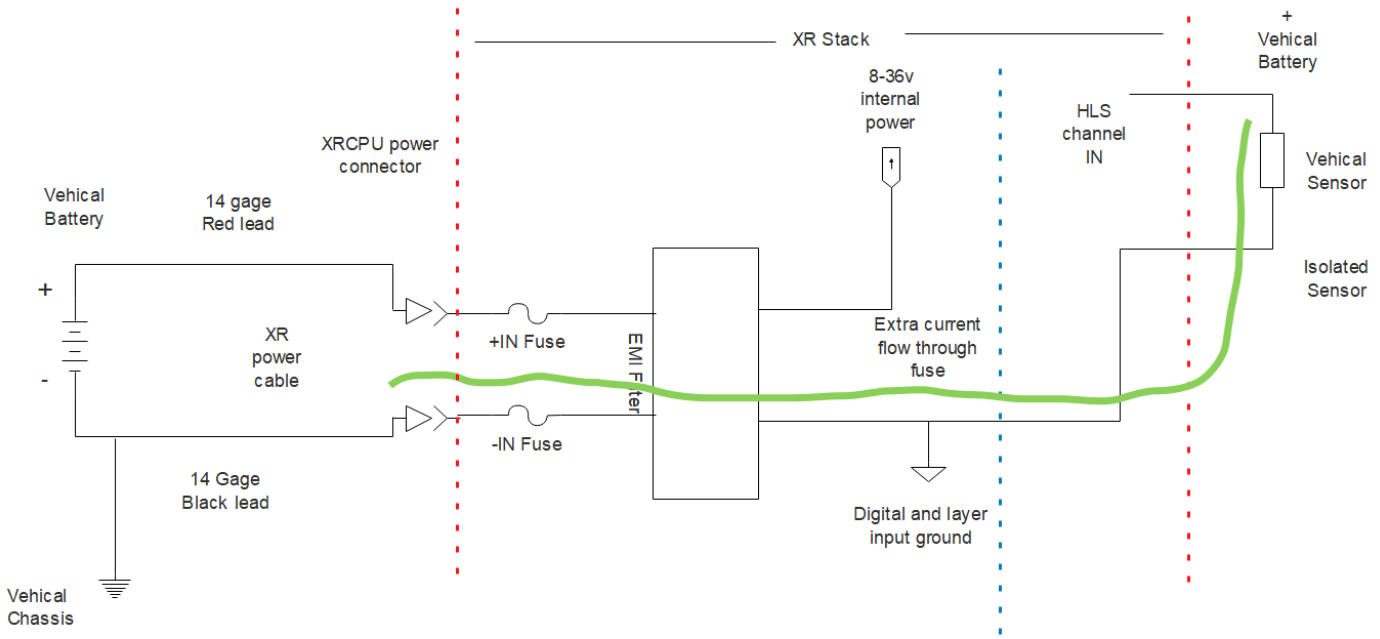
External Fuse Usage

1 Background

Customers are experiencing blown fuses in some installations. For the XRCPU and XRLCPU these fuses are not field replaceable. Once the IN+ or IN- fuse is blown, factory service is required. To prevent the internal fuse from blowing it is recommended that an external fuse be added to the Power Cable 1-EXR-PWR-PT-2 or 1-EXR-PWR-IO-PT-2. While the IN+ and IN- can both be fused, the IN- (or battery negative) side has been the most problematic in the field.

There are many factors that can cause the internal fuse to blow even though the CPU has internal current and reverse voltage protection. The XRCPU series has a different grounding mechanism than the eDAQ. The eDAQ has a single ground having vehicle chassis, digital and -IN all connected together. The XR series has a separated Chassis, -IN and Digital ground. XR's internal electronic safety measures are very effective when the grounds, especially the -IN are separated. However, in a mixed system, one with the XRCPU and eDAQ Legacy layers, the grounding mechanism is changed due to the design of the eDAQ layers. Depending on the grounding configuration and the usage of legacy layers, a particular installation can have additional ground current flow though -IN thus blowing the fuse.

It is believed that the negative battery side of the XRCPU connection is blowing due to external currents of the vehicle flowing back through digital ground. The Diagram below shows a possible scenario.



It is possible that any signal ground used from a layer or a port of the XRCPU could create extra ground current through the -IN fuse. If the + Vehicle battery was not connected and the sensor was powered then the current could flow though the -IN fuse. If any digital ground touched a power source, that current would flow though the -IN fuse. This can happen if the XRCPU is powered on or off. It can also happen if the + lead of the XR power cable is not even connected. Even if a senor is connected to Vehicle chassis, any interruption in that chassis connection could allow ground current to flow though -IN Fuse.

2 Recommendation

To protect the internal fuses of the XRCPU, it is possible to place inline fuses before the vehicle battery. It is most important to fuse the -IN of the CPU but the +IN will provide extra protection.

The EXRCPU uses a fast blow 15A fuse. The EXRLCPU uses a 12A slow blow fuse. The recommendation is to use an eDAQ style ATM (mini) automotive fuse rated at 10A. Our testing has shown that the ATM 10A fuse will blow before the internal fuses in most cases. A direct short to the battery to digital ground may still blow the XRCPU fuse. Even though the fuse is 15A and the ATM fuse is 10A, the reaction time of the fast blow fuse may still allow it to open first. However, if there is a moderate over current to 16A, the ATM fuse will blow first. The EXLCPU will withstand a direct short to battery. The slow blow nature of the fuse allows it to withstand the current spike

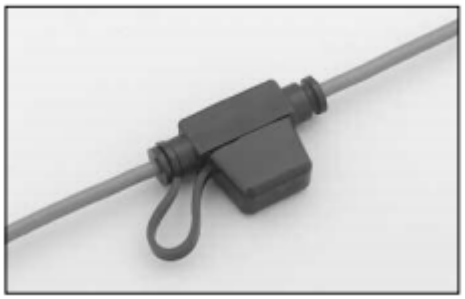
However, there are many external factors when determining the operation of a fuse. All fuses work on a thermal material basis. If the ATM fuse is in a cooler environment than the XRCPU this will change the dynamics. It is almost assured that the internal fuse of the XRCPU will be hotter than the external ATM fuse. This will reduce the time it takes for the Internal XRCPU fuse to react to an over current condition causing it to blow quicker. This needs to be considered when selecting a fuse especially for the XRCPU. The choices in ATM size fuses are minimal and step from 7.5A to 10A. Whenever possible, try to use a 7.5A for the highest level of protection.

3 Implementation

There are a number of ways to implement an inline fuse solution to the XR power cable Power 1-EXR-PWR-PT-2 or 1-EXR-PWR-IO-PT-2. The most important aspects are to keep the additional cable as short as possible and provide a water resistant connection. Availability of parts can be an issue. The recommendations below have shown to be stock items at most electronics distributors.

Fuse, ATM 10A Fast blow. eDAQ fuse is acceptable. Mouser 504-ATM-10-2
https://www.mouser.com/ProductDetail/Bussmann-Eaton/ATM-10?qs=GM6gGTqOQCtX2uOooBOFCw%3D%3D

Fuse holder ATM style with a cap Mouser 504-HHM 12AWG red wire
https://www.mouser.com/ProductDetail/Bussmann-Eaton/HHM?qs=yHx7kt6%2FI%2FlCjxFAn851Mg%3D%3D



Heat shrink, 5mm Mouser 650-ZH150-5/2.5-0-SP
https://www.mouser.com/ProductDetail/TE-Connectivity-Raychem/ZH150-5-25-0-SP?qs=VBQ3p0kw5tgqRVTJ3MBNBQ%3D%3D

Butt connectors with heat shrink, McMaster 7934K14
https://www.mcmaster.com/watertight-electrical-connectors/heat-shrink-reducing-crimp-on-butt-splices/

Installation is simple using the Butt connectors and the holder. The butt connector has one opening for the 12AWG wire from the fuse and the one for the 14AWG from the cable. Then insert the wires into the splice and crimp both ends. Heat the connector with a heat gun or other source and shrink the tubing in place. This will create a robust connection. Insert the fuse into the holder and snap the cover in place.

Be mindful that both the positive and negative leads on the cable will be using a fuse holder with red wires. A holder with black wires generally reduced the size AWG of the wire. A fuse holder wit black leads with 14 or 12 AWG are rare. To keep confusion to a minimum, it is recommended that black heat shrink be applied to the red leads of the fuse holder to signify that it is to be connected to ground or negative post of the battery.

Note: While the fuse holder and fuse will present a minor voltage drop at 12 volts and above, lower voltage operation may be impeded. A .5V drop over the fuse, reduces the input to the XRCPU from 10V to 9.5V. Cold Crank testing may be affected.

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