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Telemetry Control Unit Installation Guide

REV: 1.5 03-17-23

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1. Revision Log

Rev	Date	By	Approved	Description
1.00	07-16-2018	WCH		Initial release
1.1	10-02-2018	JZ		Updated with REV Fire Feedback and Other cleanup
1.2	11-13-18	JZ		Final Comments from REV Team
1.3	9-23-19	WCH		Added Telemetry Control Unit Device Compatibility Table
1.4	02-08-21	DW		Updated images in 4.2 and clarified battery and ignition connections in 4.2.1
1.5	03-17-23	SH DW		Replaced Vehicle Gateway with Telemetry Control Unit Updated Connector wiring information in 3.1

2. Location and Mounting

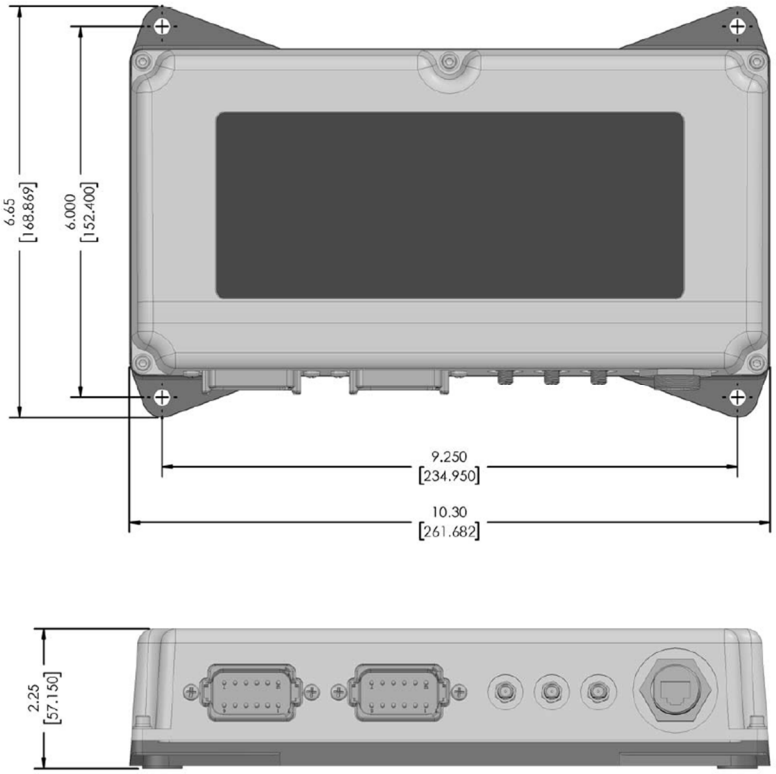
2.1. Telemetry Control Unit Device Hardware Mounting

The Control Unit should be mounted within a dry body compartment such as cab interior where RF and Ethernet connectors are protected from direct exposure to water, dust, gravel, and mechanical impact.

The Telemetry Control Unit orientation within the vehicle is not critical to its function but the following practices should be observed when selecting device location:

- Harnessing must be properly secured to support its own weight and to reduce mechanical movement during vehicle operation
- Connectors ideally will be directed downward such that any inadvertent water exposure is not captured on or within the connectors
- Harness should allow for sufficient wire bend radii and service loop
- The indicator LEDs and 7-segment display should be visible and the configuration buttons accessible to a service technician without having to unfasten or disconnect the Telemetry Control Unit from its mounting surface and harnessing.
- The Telemetry Control Unit should not be mounted on or near a surface exposed to engine exhaust system heat or climate system heat sources.
- The Telemetry Control Unit is dissipating some power and its enclosure will operate at an elevated temperature over its surrounding surface temperatures by not more than 10ºC.
- To reduce RF interference concerns, Telemetry Control Unit harnessing, coax, and Ethernet should be separated from any vehicle radio or antenna wiring.

2.1.1. Mounting Dimensions



2.1.2. Other mounting considerations

- The length of the antenna cable should be considered when choosing the mounting location. Standard antenna cable lengths are 20 feet. It is recommended that both the Telemetry Control Unit and the antenna location be chosen prior to mounting either piece. Ensure that there is adequate cable length to reach from antenna mounting location to the Telemetry Control Unit location. Also, if there is no suitable location in the cab, the antenna cable will have to pass through the cab pivot for tilt cab apparatus.
- Harness routing is also a defining factor when choosing a mounting location. Since there will be multiple locations that the harness may have to route to, there must be ample room to route, secure and protect the harnesses. As mentioned above, care should be taken to avoid routing near other radio or antenna wiring to avoid RF interference.
- Optimum locations for the Telemetry Control Unit are the center dash area, driver or officer kick plate areas and/or driver or officer overhead areas. Space is typically limited in these areas and may not provide adequate space.

Center dash area and kick plate

Overhead dash area

- In the vehicle example shown above the preferred areas were not suitable for mounting the Telemetry Control Unit Device hardware. As an alternative, we were able to mount the Telemetry Control Unit box on the rear of the engine cover inside the cab and us a support brace to get the antenna cabling up to the roof.

Rear of engine cover and support brace to roof

- While this is not the optimal location, our test vehicle had other electronics mounted in the same area with a protective cover over them. There was also a wiring chase that led to the center dash that allowed for power, ground, and communication bus wiring.

2.2. Antenna Mounting

Customers may supply their own antenna or purchase one from Weldon. There are two choices -- permanent roof mount or adhesive glass mount. Permanent roof mount antennas give the best performance and reliability results and should be the first choice. An alternative adhesive mount antenna is offered in situation where a roof mount install cannot occur. Please note that the adhesive mount is not weatherproof and is not intended for outside installation location.

Permanent Roof Mount

Information and Performance Specifications
https://www.taoglas.com/product/storm-ma411-3in1-permanent-mount-gpsglonassbeidou-2g3g4g-2xmimo-antenna-2/
https://cdn.taoglas.com/datasheets/MA411.A.LBI.001.pdf

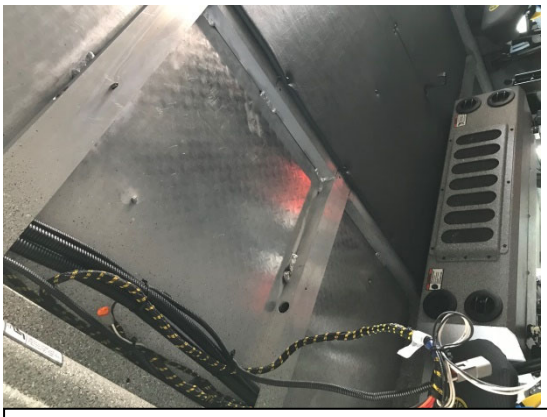
Dash or Window Adhesive Mount

Information and Performance Specifications
https://www.taoglas.com/product/sentinel-ma252/
https://cdn.taoglas.com/datasheets/MA252.A.LB.001.pdf

2.2.1. Antenna mounting considerations

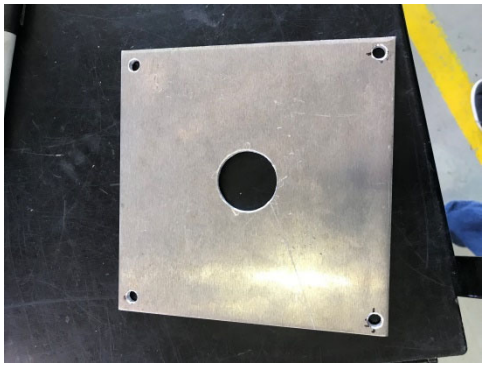
- It is necessary to look above and below the roof surface when identifying proper antenna mounting locations. Care should be taken to ensure that no HVAC lines, wiring harness or other systems are above or below prior to drilling any holes in the roof. This will require removing the head liner inside the cab for access and inspection.

Headliner removal



Headliner removed – Note Harness and potential cross member interference

- Because roof surfaces are not always smooth, it may be necessary to use an adapter plate to ensure a proper seal. In our test case, the roof material was diamond plate which would have prevented the antenna from properly sealing to the roof surface. The roof mount antenna has a peal and stick adhesive to seal the antenna to its mounting surface. An adapter plate was made to accommodate the roofs uneven surface. Silicone was applied to the surface between the roof and the adapter plate and then the antenna was secured to the plate through the roof with its peal and stick adhesive.



Adapter Plate

Antenna Installation complete

3. Telemetry Control Unit Electrical Connections

3.1. Connector Definitions

Green connector

Mating connector: Deutsch DT06-12SC GREEN
Mating sockets: Deutsch 0462-201-16141
Gold mating sockets: Deutsch 0462-201-1631
Recommended wire gage: 16-20 AWG
Wedge lock: W12S

PIN	CIRCUIT	DESCRIPTION
1	CAN 1 HIGH	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
2	CAN 2 SHIELD	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
3	CAN 2 HIGH	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
4	CAN 3 HIGH	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
5	CAN 4 SHIELD	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
6	CAN 4 HIGH	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
7	CAN 4 LOW	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
8	CAN 3 SHIELD	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
9	CAN 3 LOW	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
10	CAN 2 LOW	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
11	CAN 1 SHIELD	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s
12	CAN 1 LOW	(DATA) CAN 2.0B , 125Kbits/s - 1Mbits/s

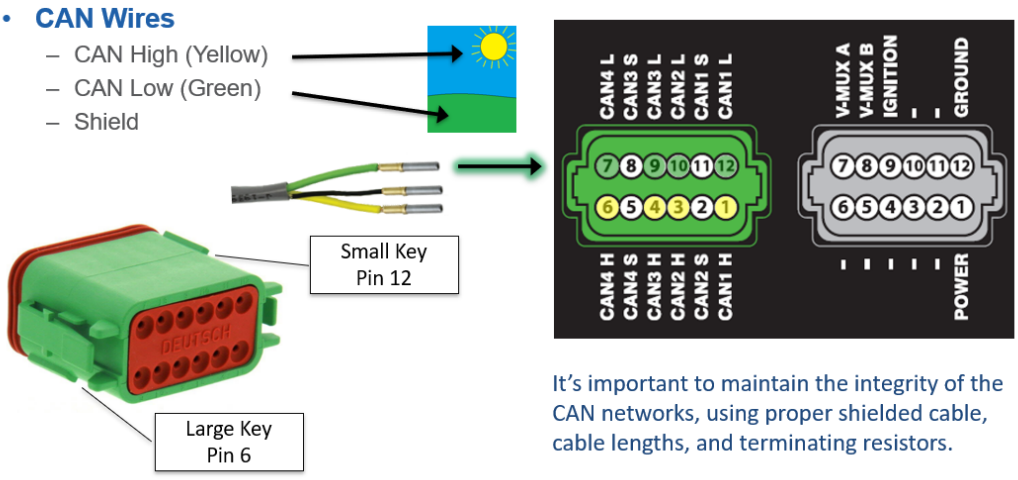
Gray connector

Mating connector: Deutsch DT06-12SA GRAY
Mating sockets: Deutsch 0462-201-16141
Gold mating sockets: Deutsch 0462-201-1631
Recommended wire gage: 16-20 AWG
Wedge lock: W12S

PIN	CIRCUIT	DESCRIPTION
1	SYS POWER	(INPUT) – battery voltage (+9VDC…+32VDC)
2		
3		
4		
5		
6		
7	V-MUX-A	(DATA) RS484 9600 baud
8	V-MUX B	(DATA) RS485 9600 baud
9	IGNITION	
10		
11		
12	SYS GROUND	(INPUT) – battery ground

Wiring should follow this structure:

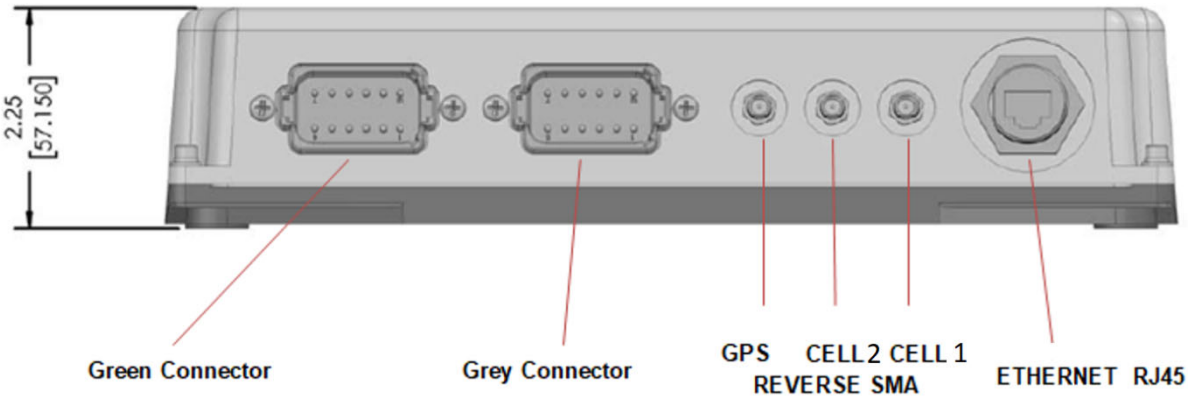
- CAN 1: J1939/OBD-II, Pump and Gov Network
  - This chassis network connection is crucial. The Telemetry Control unit will not function without it
- CAN 2: ES-Key Multiplex Network
- CAN 3: Valve + Monitor Network
- CAN 4: AUX Expansion Network



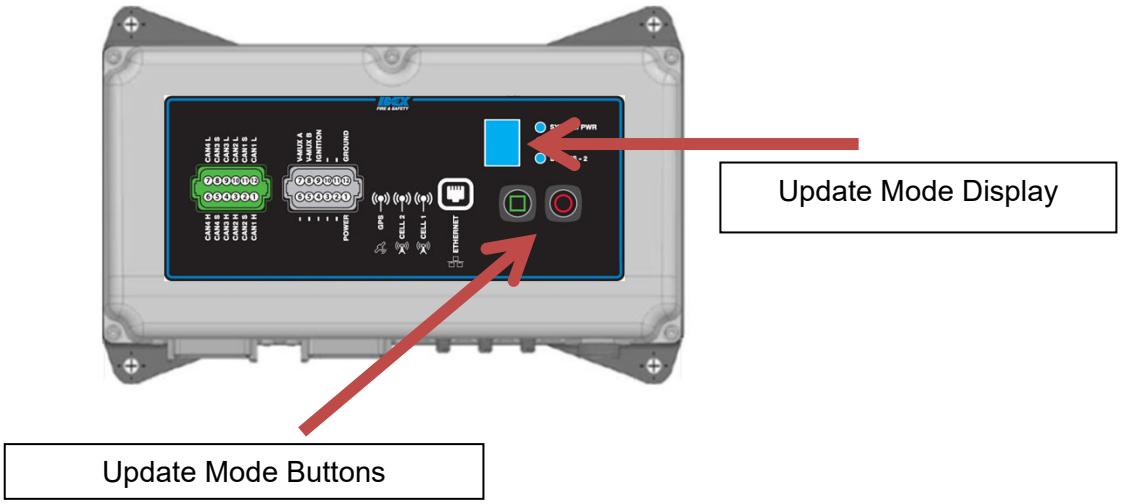
It's important to maintain the integrity of the CAN networks, using proper shielded cable, cable lengths, and terminating resistors.

The shield wire should be pinned for all CAN port connections.
The shield wire should NOT be pinned for the V-Mux connection.

3.2. Connector Locations



Update Mode Buttons



Telemetry Control Unit Device hardware can accept an Over-The-Air update to both the Telemetry Control Unit Device hardware device OS as well as accept remote multiplex updates for both V-MUX and ES-Key systems. The Telemetry Control Unit Device hardware device must be physically placed into program accept mode to allow a remote user to send a file down to the box. To do this, users must:

1. Simultaneously hold the Green Square and Red Circle button down for 5 seconds
2. Release the buttons simultaneously when the Program Mode Display reads “update ready”
3. Once File transfer has finished, cycle power to the vehicle / TELEMETRY CONTROL UNIT
4. After power cycle, display should *not* read “update ready” anymore and return to its normal state

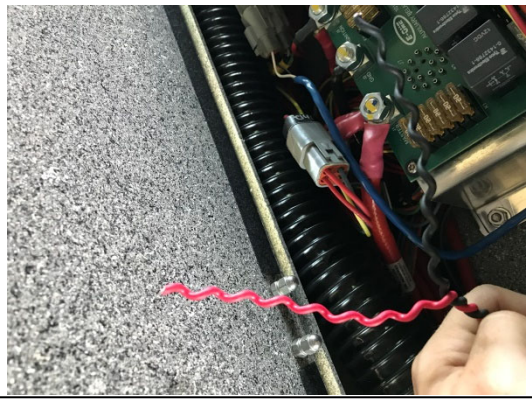
Possible “Update Mode Display” messages can be as follows:

- { DeviceUpdate.Status.ERROR_BAD_CHECKSUM, "bad cs " },
- { DeviceUpdate.Status.ERROR_BAD_URI, "bad url " },
- { DeviceUpdate.Status.ERROR_FILE_NA, "file error " },
- { DeviceUpdate.Status.ERROR_NODE_TRANSFER, "transfer error " },
- { DeviceUpdate.Status.ERROR_UNKNOWN_FILE_TYPE, "bad file " },
- { DeviceUpdate.Status.FAILURE, "update failed " },
- { DeviceUpdate.Status.IDLE, "idle " },
- { DeviceUpdate.Status.IN_PROGRESS, "updating " },
- { DeviceUpdate.Status.PENDING, "update ready " },
- { DeviceUpdate.Status.READY, "update ready " },
- { DeviceUpdate.Status.SUCCESS, "update successful " },
- { DeviceUpdate.Status.UNKNOWN, "error " }

The Update Display also shows an active IP address in the window when one is acquired either via cellular or via external ethernet routers. The Update Display will typically show a value of “1” as the leading digit of the IP address. Users can press the Green square Update Mode button to cycle through the remaining IP address: a typical address will be something to the effect of “192.xx.xx”. This will indicate pathway to the internet from the TELEMETRY CONTROL UNIT.

3.2.1. Battery Power, Ignition, and Ground Connections

Two power connections are required, unswitched Battery + to Pin1, and Ignition to Pin 8 of the gray connector. These connections were routed to the center dash area and connected to the battery and ignition circuits using inline fuse holders and 5 Amp fuses.

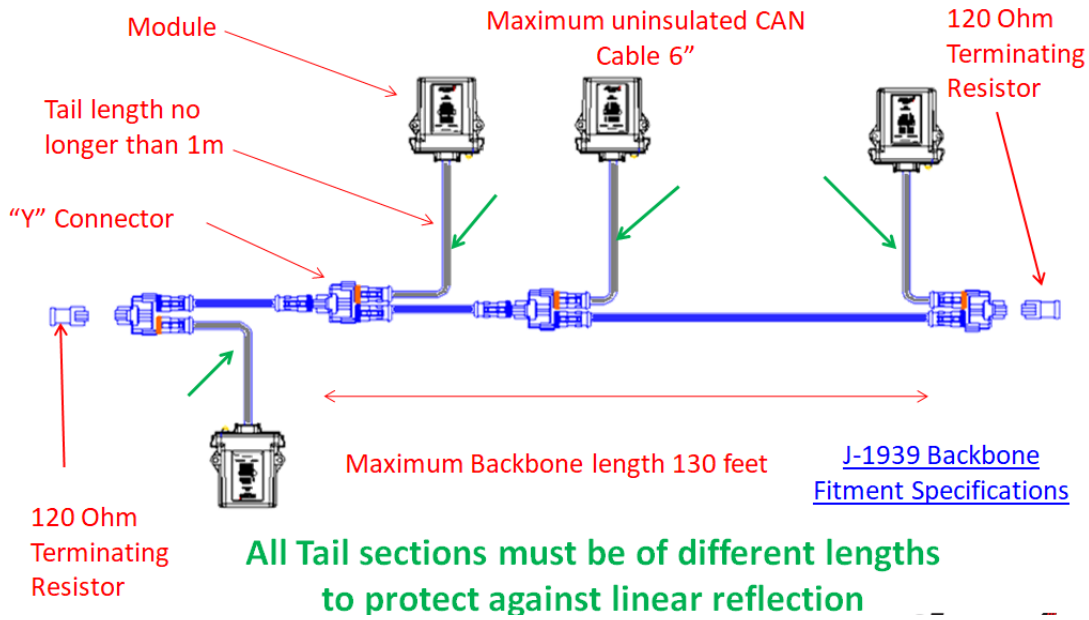


Power and Ground routed to the center dash area 18 AWG 5A maximum.

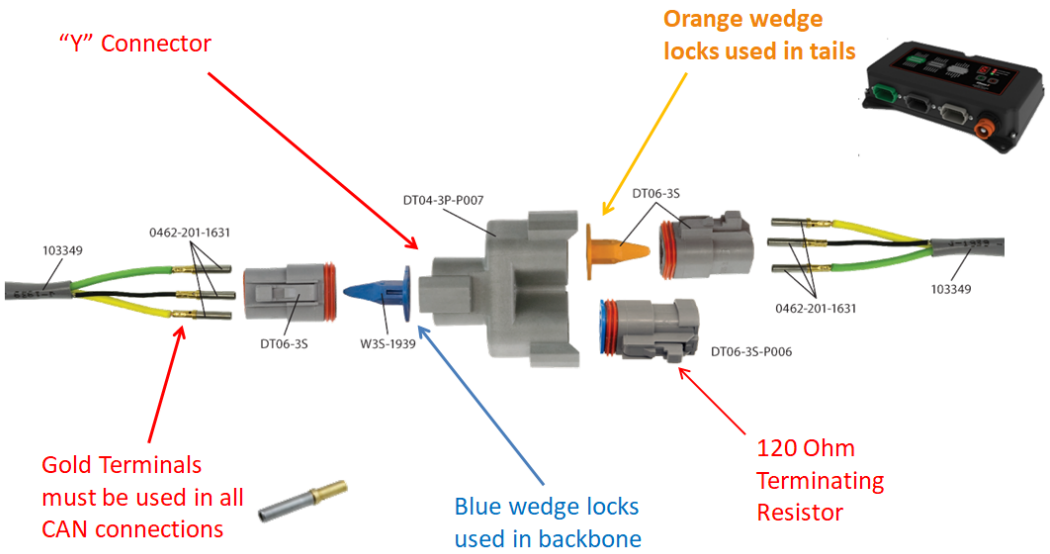
Fuse Holder

3.2.2. Network Connections

A. J1939 PHYSICAL LAYER



Typical J1939 physical layer

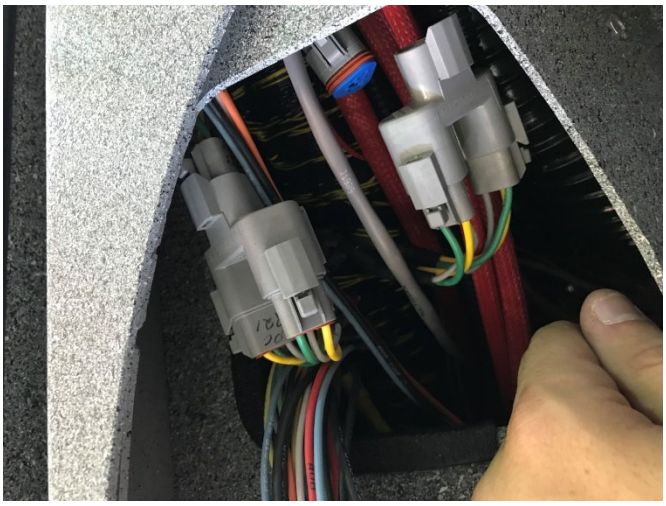


Typical installation using Deutsch product

B. *J1939 PUBLIC CAN BUS*

The J1939 public CAN bus is where the engine, transmission, ABS, governor control and other information will come from. It is connected to the Telemetry Control Unit Device Telemetry Control Unit's Green connector CAN 1.

We traced the CAN bus from the diagnostic connector under the dash back to the main back bone. Using Deutsch product we added a segment to the back bone and a drop out to the Telemetry Control Unit Device Telemetry Control Unit. The J1939 CAN bus segment was added behind the driver's instrument cluster.



C. *V-MUX CONNECTION*

If the vehicle is equipped with the V-MUX system, it will be connected to the Telemetry Control Unit's Gray connector, V-MUX A and V-MUX B pins 7 and 8.

The VMUX Network is a RS485 network. Although it is typically wired much the same way as a CAN bus, it does not use terminating resistors. Please do **not** install terminating resistors in the VMUX network.

D. *ES-KEY CONNECTION*

If the vehicle is equipped with the ES-Key System, it will be connected to the Telemetry Control Unit's Green connector CAN 2.

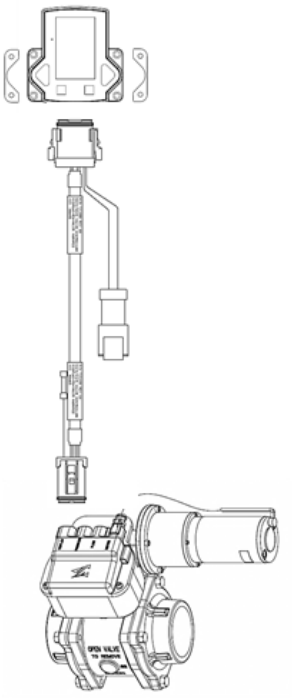
The ES-Key System network is a J1939 proprietary CAN bus and the same physical layer rules as above apply.

Ensure that a segment and drop out is added to the main ES-Key back bone just as the J1939 public network above.

E. AKRON VALVE NETWORK CONNECTION

The Akron Valve Network is another J1939 based CAN bus 3. It can be wired in a couple of different ways.

- Point to point- In a point-to-point application a single valve and valve controller is wired as an independent network.



- Multi-valve network – in a multi-valve network, more than one valve or valve controller is connected to the CAN bus network.

In order for the Telemetry Control Unit to obtain all of the information from all of the valves, the multivalve network wiring must be used. This may require that the valve networks be converted from a point-to-point network to a multi-valve network.

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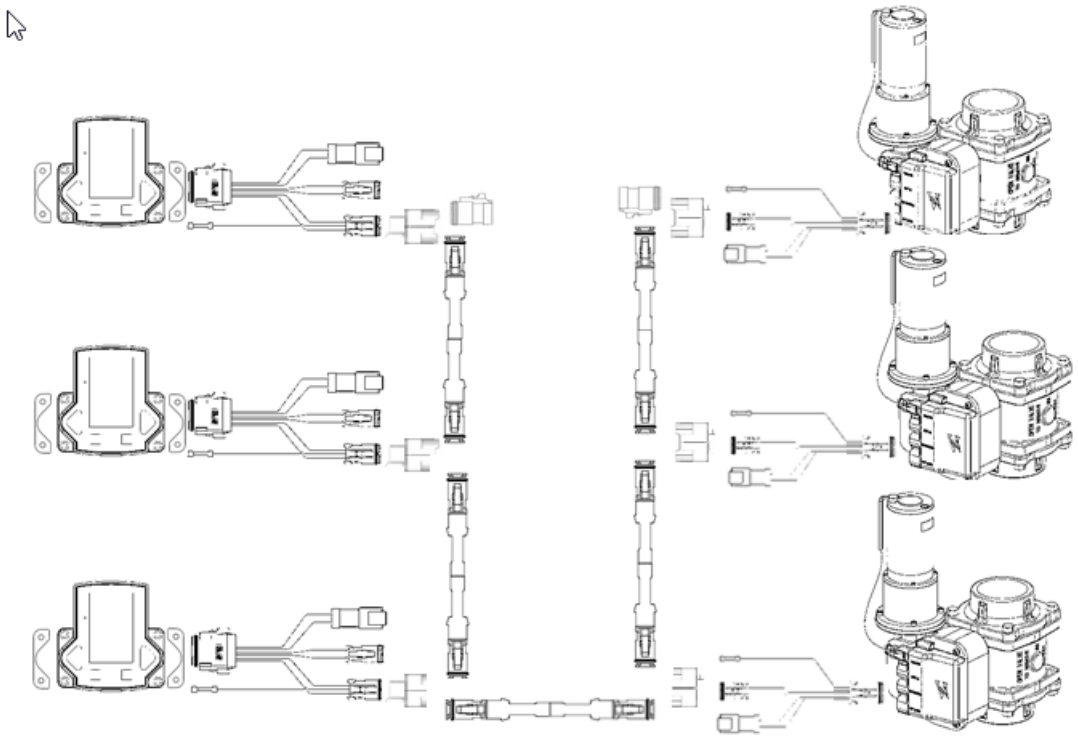
PRODUCT	Telemetry Control Unit			BY	SH



4. Technical Details

Product category	Telemetry Control Unit
Voltage range	+9VDC…+32VDC use body/Telemetry Control Unit disconnect circuit
Current Consumption	5A Max
Operational temperature range	-40ºC…+85ºC
Protection	Internal thermal fuse Reverse voltage protection (pins 1 and 12 of connector) CAN buses protected to 24V ESD voltage protected to SAE J1113 specifications Transient voltage protected to SAE J1113 specifications
Dimensions (W x H x D) in inches [mm]	10.30 [261.68] x 6.65 [168.86] x 2.25 [57.150]