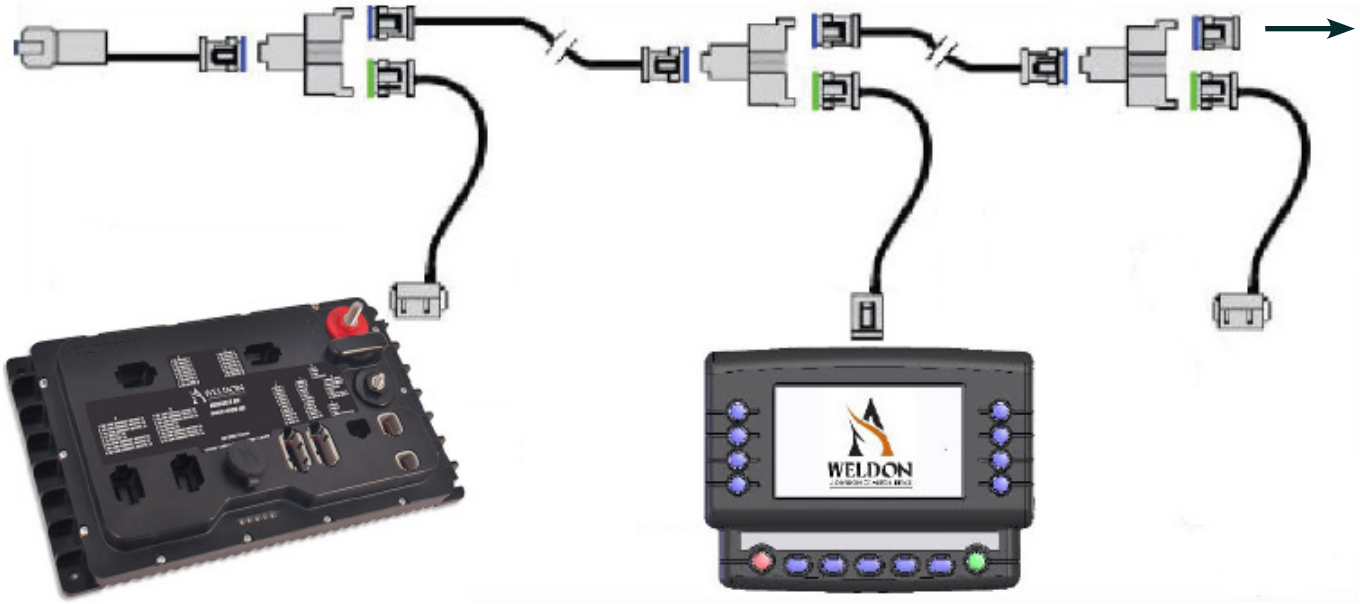
WELDON
A DIVISION OF AKRON BRASS



V-MUX® Essentials

March 2019

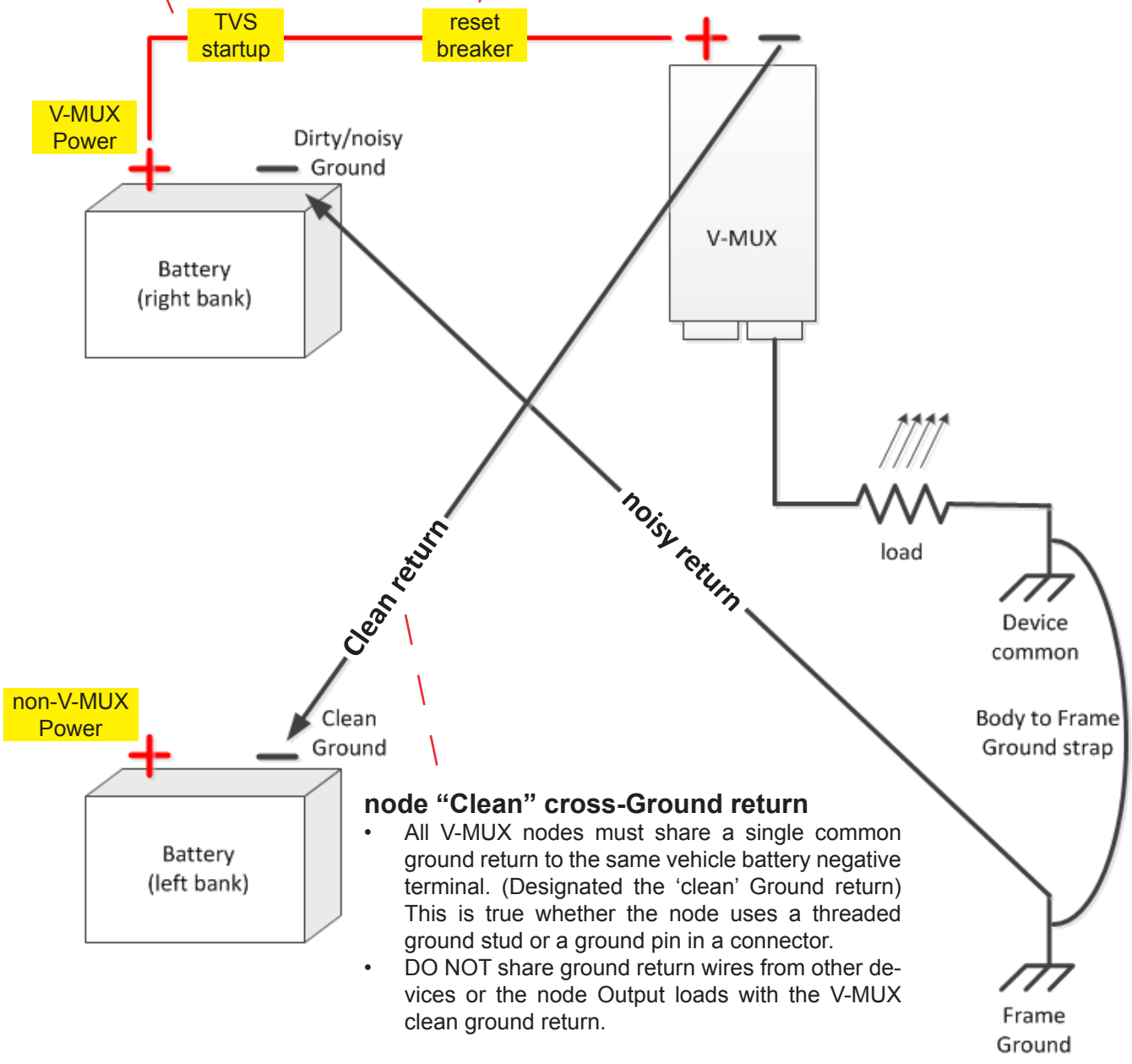
constructing robust V-MUX systems
--- Power and Ground ---

Power to nodes

- Power to all V-MUX nodes shall be provided through a Transient Voltage Suppression style (TVS) startup solenoid.

Circuit breaker protection

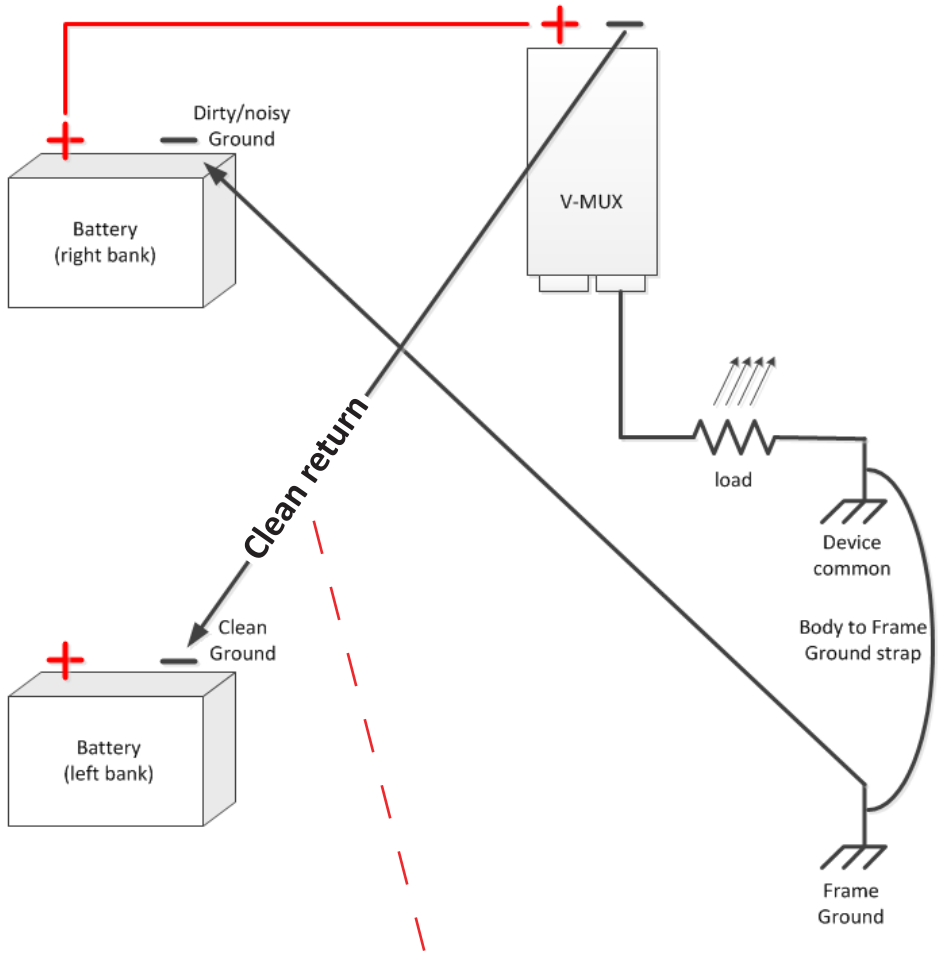
- Each V-MUX node shall have an appropriately sized circuit breaker for wire protection.
- V-MUX nodes are internally protected against reverse polarity even without a circuit breaker.



node “Clean” cross-Ground return

- All V-MUX nodes must share a single common ground return to the same vehicle battery negative terminal. (Designated the ‘clean’ Ground return) This is true whether the node uses a threaded ground stud or a ground pin in a connector.
- DO NOT share ground return wires from other devices or the node Output loads with the V-MUX clean ground return.

wire size of the node cross-Ground returns



1. Determine the ground return current from the individual node boards
2. Clean Return -- size for the nodes only, not the Output device returns
   For example -- (1) Hercules-04 node internal, various worst case (external pull-up)
   (2) Ground channels used: 2x4 = 8 Amps
   (1) Ground channel used: 1x4 = 4 Amps
   (0) Ground channels used: board only = 150 mAmp

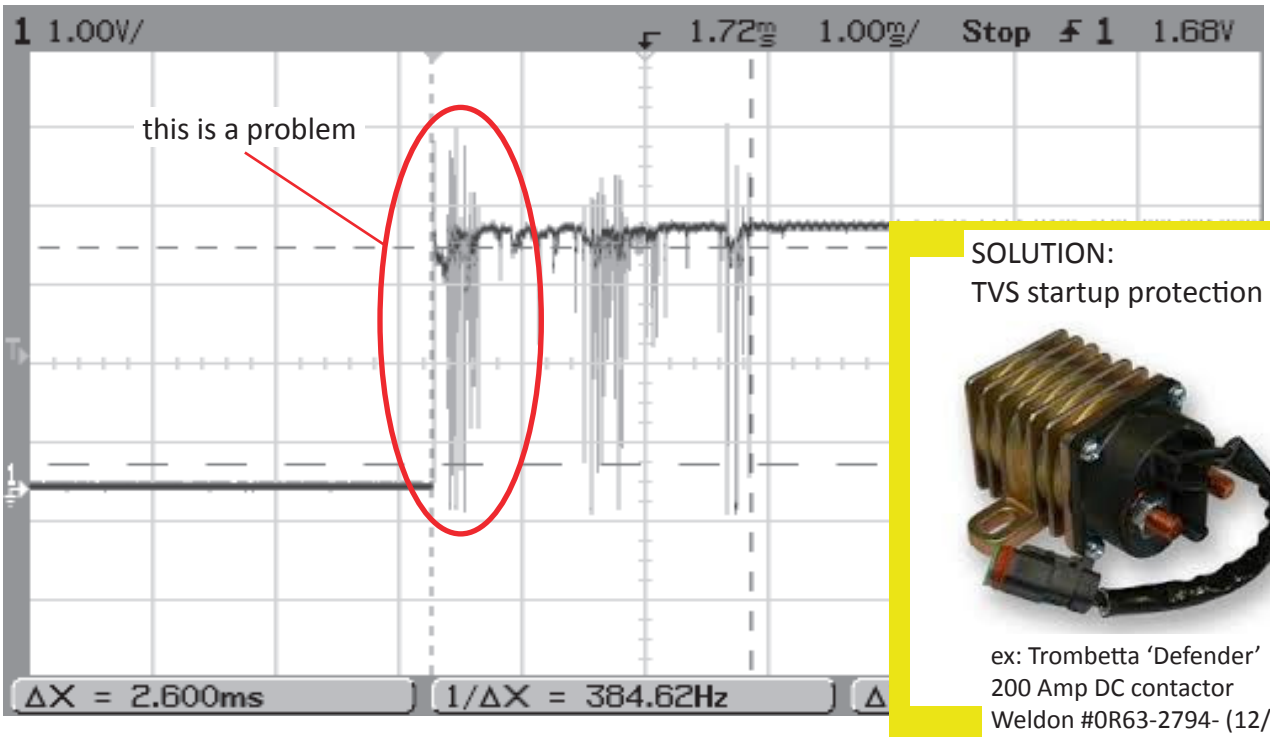
   For example -- (1) Hercules HC 6060 node internal, various worst case (external pull-up)
   (4) Ground channels used: 4x4 = 16 Amps
   (3) Ground channels used: 3x4 = 12 Amps
   (2) Ground channels used: 2x4 = 8 Amps
   (1) Ground channel used: 1x4 = 4 Amps
   (0) Ground channels used: board only = 150 mAmp

3. Using a wire gauge calculator
   enter Amps
   enter Voltage
   enter the return run length
   enter conductor material (copper usually)

4. Size the wire gauge (AWG) that allows for no worse than a 3% drop in Voltage over the full length of the current return to battery

constructing robust V-MUX systems
--- STARTUP: protecting against electrical transients ---

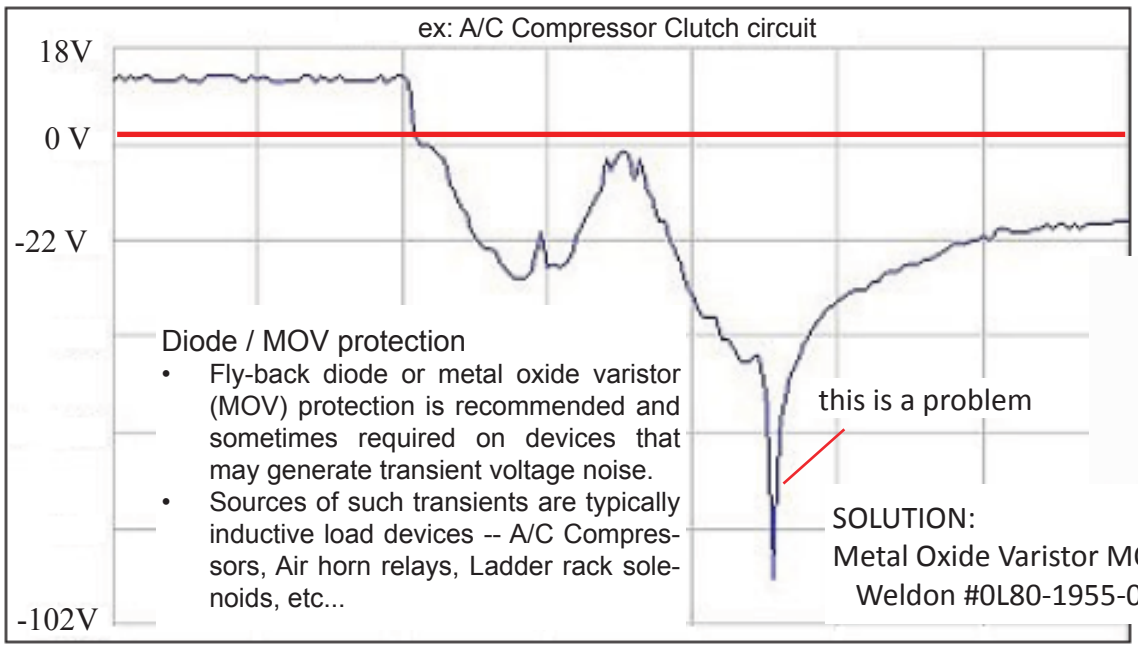
PROBLEM:
Voltage transients from contact bounce on the startup switch



SOLUTION:
TVS startup protection

ex: Trombetta 'Defender'
200 Amp DC contactor
Weldon #0R63-2794- (12/24)

PROBLEM:
Voltage transients from inductive flyback on motorized loads



Diode / MOV protection

- Fly-back diode or metal oxide varistor (MOV) protection is recommended and sometimes required on devices that may generate transient voltage noise.
- Sources of such transients are typically inductive load devices -- A/C Compressors, Air horn relays, Ladder rack solenoids, etc...

SOLUTION:
Metal Oxide Varistor MOV
Weldon #0L80-1955-00

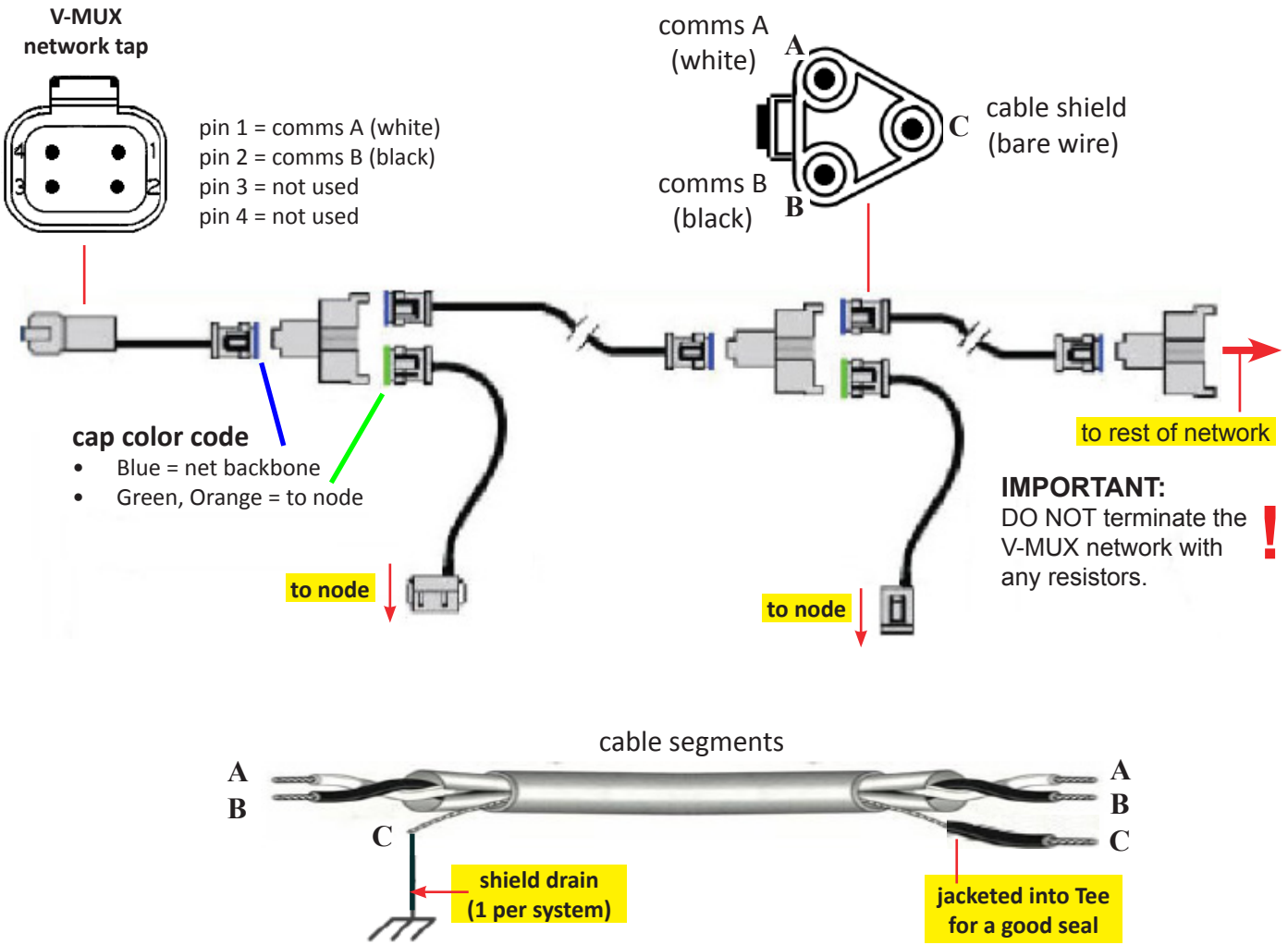
constructing a V-MUX network
--- Connections ---

Communications cable

- The only acceptable communications cable for a V-MUX network is Weldon twisted-pair #0L20-1600-xx
- Twisted pair wire should be one twist per at a minimum each inch of cable length

0L20-1600 twisted pair cable

- V-MUX comms A (white)
- V-MUX comms B (black)
- shield wire C (bare)



the shield wire ground (the single drain)

- The shield wire 'C' shall be single-grounded at one end of the entire V-MUX network.

DO NOT MULTIPLE GROUND THE SHIELD

- Use a single isolated ground away from the V-MUX node grounds
- Where each segment of the V-MUX network cable joins other segments, the shield wires shall remain electrically common through each pin "C" at the Tee junctions.
- Cover all exposed shield wire to prevent accidental electrical shorts, which can damage the communications cable.
- At the Tees (pin C) splice appropriately gauged and jacketed wire to the end of each shield so as to seal into the Tee. Failure to properly seal Tee-connectors and other places the shield wire passes through may result in a loss of communications due to moisture infiltration across the A and B communications contacts.

constructing a V-MUX network
--- Components ---

(1) V-MUX network tap

0K90-3111-00
connector kit

at each node
drop-off

0K90-2056-00
junction kit

RS-485 twisted pair

0L20-1600-xx
cable spool

IMPORTANT:
DO NOT terminate the V-MUX network with any resistors.

to rest of network

at each node
drop-off use
(1)
0K90-xxxx-00
node specific
connector kit

the Node 1 position must be occupied by an Input/Output type of node
- 6060 Hercules HC
- 6000 Hercules
- 6010 Mini 4x12
- 6030 8x16

Nodes 2-32 may be occupied by any type of node (ex: **Vista display**)

Checklist for troubleshooting V-MUX network communications

1. Verify how many nodes are installed in the system, using the V-MUX Report or Vista Diagnostics

2. 'Ping' the nodes from Diagnostics to determine which do or do not 'Reply'.

If a node does not Reply to a Ping

3. for the Input/Output nodes -- Hercules, Minis, 8x16s -- Check the Green and Red LED status lights
   - Green light (status blinking) to verify Power/Ground is On
   - Green light (status: simple heartbeat) to verify it is programmed
   - Check Red Receive (Rx) light for network activity; Rx light flickers at least every 4 seconds
   - Check Red Transmit (Tx) for a possible "OUT OF NETWORK" distress signal; Tx light flickers every four seconds.
4. for the Display nodes -- Vista III, Vista IV:
   - The Vista display nodes indicate readiness with their various menu screens.

Check the Tee junctions at the affected nodes (see next page)

5. Tee junction quality:
   - pin assignments: A = white wire, B= black wire, C = shield wire
   - no moisture/corrosion visible
   - all inserts are locked in place
6. Split the network into smaller segments at the Tees:
   - Verify with a meter that the harness wires (A/B, C=shield) are open circuit when fully disconnected from Tees and nodes
   - Power Off measurement:

     For a single V-MUX node the A/B pins should have high resistance between them (180K Ω or above)

     By node type, Third generation nodes will measure about 180K Ω between A/B
     - Hercules-04 about 180K Ω
     - 8x16 about 180 K Ω

     By node type, Fourth generation nodes will measure above 300K Ω between A/B
     - Hercules 6060 about 315K Ω
     - Vista IV 6241 about 315 K Ω
     - VDR 6444 about 430 K Ω

7. Check the network resistance (power Off)

- In a network of nodes the A/B wires should <u>at a minimum</u> measure the following

  Network Resistance Ohms (Ω) $R_{TOTAL} = (180K\ \Omega) \div (\text{number of nodes})$

8. Verify that there is <u>no terminating resistor</u> in the V-MUX network.
- V-MUX is different from CAN networks and does not use 120 Ohm termination.

Installation: #6060 Hercules HC

USB program port:
Verify that the protective cover to the USB port is securely fastened.

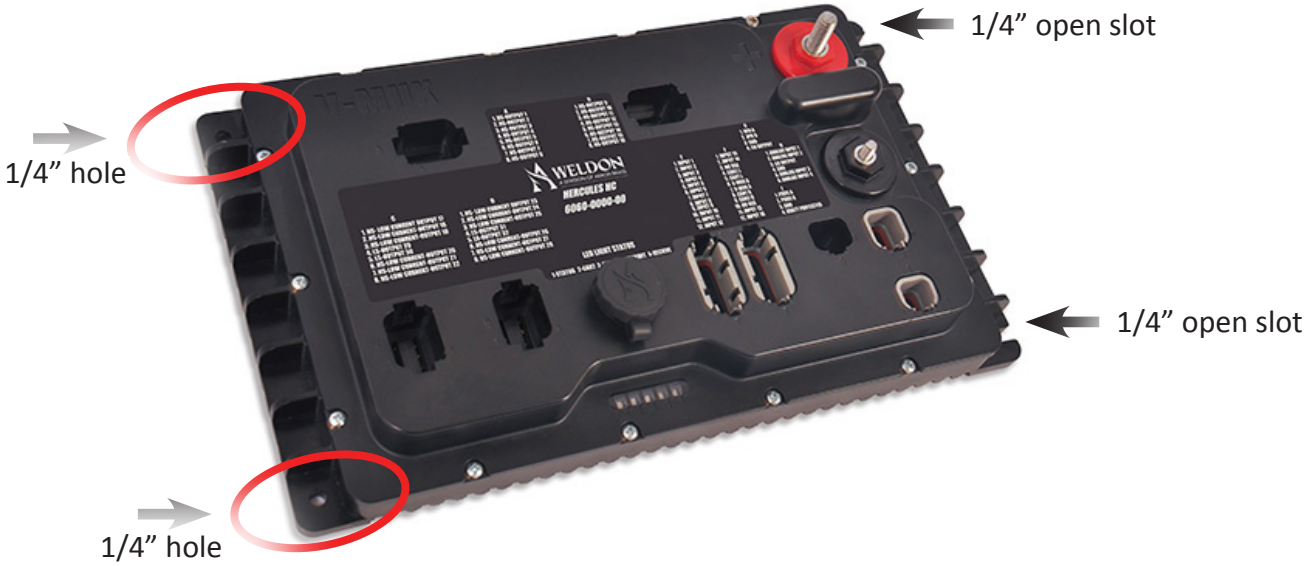
Power and Ground studs:
- Power (+) 3/8”-16 (stainless steel)
- Ground (-) 1/4”-20 (stainless steel)

indicator LEDs

(5) indicator LEDs
- all indicators to be viewable

1. Green: Program Status
2. Amber: CAN port 2 active
3. Amber: CAN port 1 active
4. Red: V-MUX Transmit
5. Red: V-MUX Receive

Footpad fasteners:
- Use ANSI #12 or 1/4” fasteners at (4) locations
- (2) 1/4” thru-hole -- at left
- (2) 1/4” open-end slot -- at right



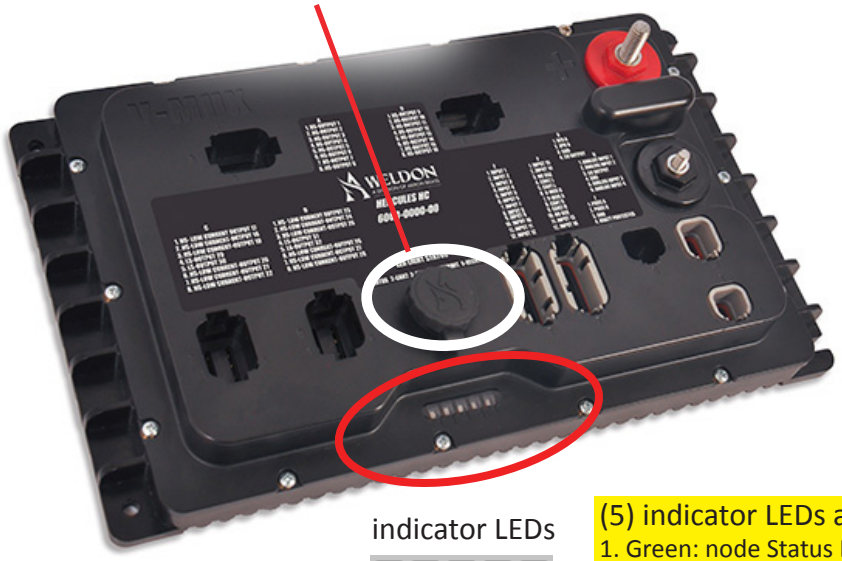
Installation: #6060 Hercules HC

Programming the Hercules HC from the USB port

The Hercules HC node supports two methods to load program file updates

- By use of the standard V-MUX transceiver that connects at the communications port F on pins 7,6 (see pinouts, next page)
- By use of a USB memory stick that plugs into the USB program port

USB program port



indicator LEDs

(5) indicator LEDs at bottom
1. Green: node Status LED
2. Amber: CAN port 2 active
3. Amber: CAN port 1 active
4. Red: V-MUX Transmit
5. Red: V-MUX Receive

Loading files at the USB port

- Place the node binary file on a USB memory stick. The file must be saved to the root level, *i.e.* not placed in any folder
- If the Hercules OS file **vm6060.bin** is also to be updated, then place both the OS file and the node binary file together onto the memory stick (root level)

Power-on the Hercules HC with the USB memory stick inserted

the sequence viewed at the GREEN Status LED

1. Solid green while node searches for compatible files
2. Rapid 'streaming' blink as the discovered file data streams into node
3. Very brief pause
4. Repeat rapid blink if both the OS file and the binary file are loaded in (2 files)

done with transfer

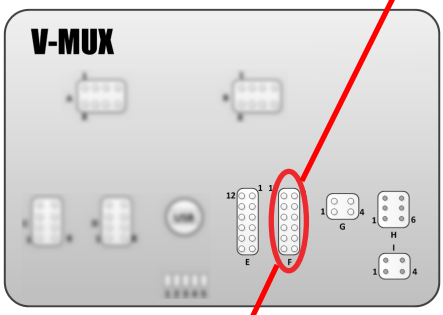
5. Standard "end of transfer" pattern – 4 slow blinks with a pause

Power Off the Hercules HC and remove the USB memory stick.

Power the node back On -- the Green LED will blink with the On/Off 'heartbeat', meaning the program has been succesfully loaded.

Hercules HCN Port F as a Gateway between V-MUX and CAN networks

communications PORT F
- V-MUX -- pins 7,6
- CAN 1 -- pins 8,5
- CAN 2 -- pins 9,4



V-MUX CAN ports are able to:
- run independently
- support different data rates
- filter for desired messages
- alert on missing messages

Port F

existing (2) 120 Ohm CAN termination

to CAN2 backbone

usually peripheral CAN devices, such as the pressure governor

	12	1	
	11	2	
	10	3	
CAN 2 high	9	4	CAN 2 low
CAN 1 high	8	5	CAN 1 low
V-MUX high	7	6	V-MUX low

existing (2) 120 Ohm CAN termination

to CAN1 backbone

typically the vehicle J1939 network

NO V-MUX termination resistor

V-MUX backbone

NO V-MUX termination resistor

V-MUX node

V-MUX display

Installation: #6000 series = Hercules Input/Output node:

Footpad fasteners:
- Use ANSI #12 or 1/4” fasteners
- (4) open slot locations

Power and Ground stud fasteners:
- Power 3/8”-16(stainless steel) -- torque to 90 inch/lbs.
- Ground 1/4”-20 (stainless steel) -- torque to 50 inch/lbs.

Status and Network activity LEDS:
- The Hercules node should be mounted so that the LED indicator lights can be easily seen for trouble shooting purposes.

Power/Ground
at top

Input/Output
harness at bottom

<u>Moisture conditions:</u>
- If the Hercules node is exposed to moisture conditions it shall be mounted vertically with the power and ground studs pointing upward.
- The node is splash proof but exposure to water could result in a breach of the module.
- By pointing the power and ground studs upward any breached water will be captured in a cavity designed to keep the water away from the electronics.
- Failure to mount nodes in this manner will void the warranty if the node is returned due to water damage.

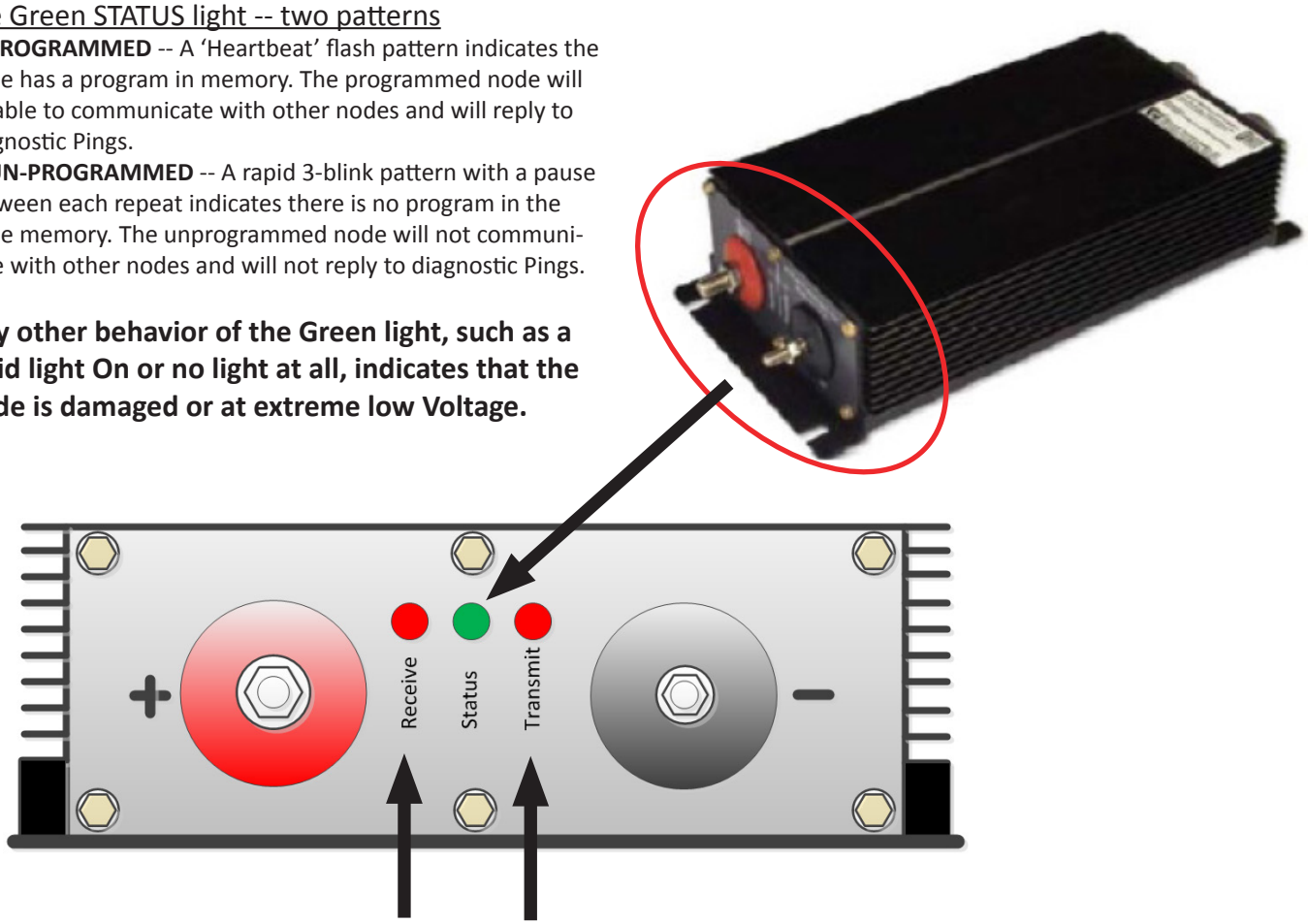
Installation: #6000 series = Hercules Input/Output node:

Indicator LEDs are located between the node Power and Ground studs. The Green status light indicates if the node is programmed.

<u>the Green STATUS light -- two patterns</u>

1. **PROGRAMMED** -- A 'Heartbeat' flash pattern indicates the node has a program in memory. The programmed node will be able to communicate with other nodes and will reply to diagnostic Pings.
2. **UN-PROGRAMMED** -- A rapid 3-blink pattern with a pause between each repeat indicates there is no program in the node memory. The unprogrammed node will not communicate with other nodes and will not reply to diagnostic Pings.

Any other behavior of the Green light, such as a solid light On or no light at all, indicates that the node is damaged or at extreme low Voltage.



The two Red status lights (**Receive** / **Transmit**) indicate node communication with the V-MUX network.

Unlike the Green light which will have a set pattern, the Red 'Receive' and 'Transmit' lights should flicker intermittantly, depending on the amount of network traffic. The absolute minimum amount of network traffic on a normal V-MUX network is at least one message every four seconds.

There are two normal behaviors observable for the Red lights:
1. The lower Red receive light (Rx) flickers by itself due to network activity. The node is receiving network messages from other V-MUX nodes. There is no transmit involved so the Tx light will be Off.
2. Both the upper and lower Red lights (Rx/Tx) flicker together, indicating the node has transmitted a message. The reason for both Tx and Rx lighting at the same instant is that every Hercules node hears its own messages, known as the 'local echo'.

IMPORTANT: V-MUX node #1 generates the SYNC message. Every other node in network expects to hear the SYNC message at least every four seconds. If the SYNC message is not heard the nodes will immediately issue an 'OUT OF NETWORK' distress message which causes the RX and Tx Red lights to flicker simultaneously every four seconds.

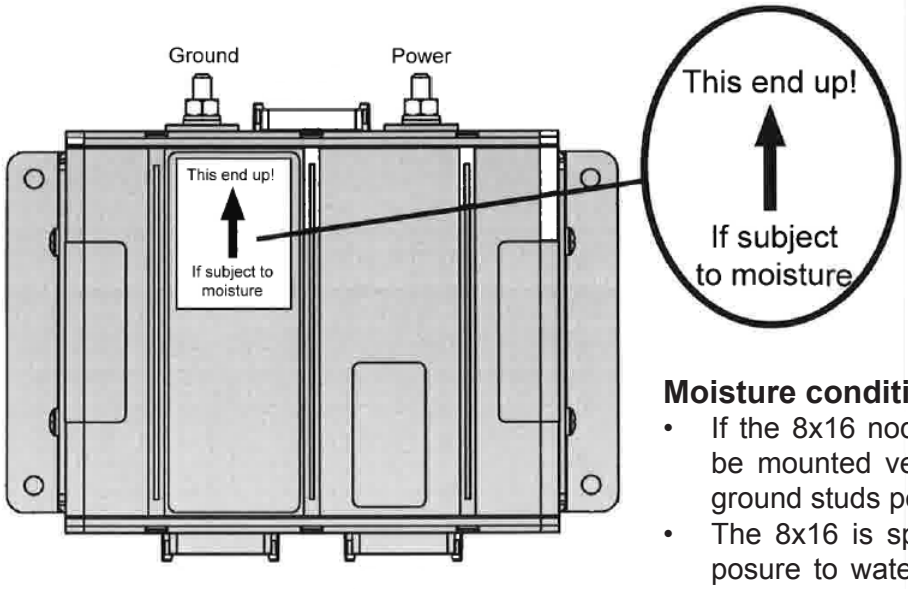
Any other behavior of the Red lights, such as a solid lights On or no lights at all, indicates that the node or network is damaged or at extreme low Voltage.

Installation: #6030 series = 8x16 Input/Output node:

Footpad fasteners:
- Use ANSI #12 or 1/4” fasteners
- (4) thru-hole locations

Power and Ground stud fasteners:
- Power 1/4”-20 (stainless steel) -- torque to 55 inch/lbs
- Ground 1/4”-20 (stainless steel) -- torque to 55 inch/lbs

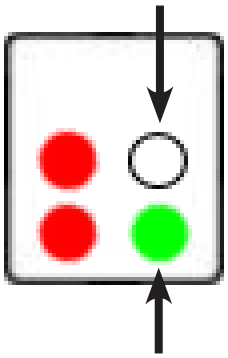
Status and Network activity LEDS:
- The 8x16 node should be mounted so that the LED indicator lights can be easily seen for trouble shooting purposes.

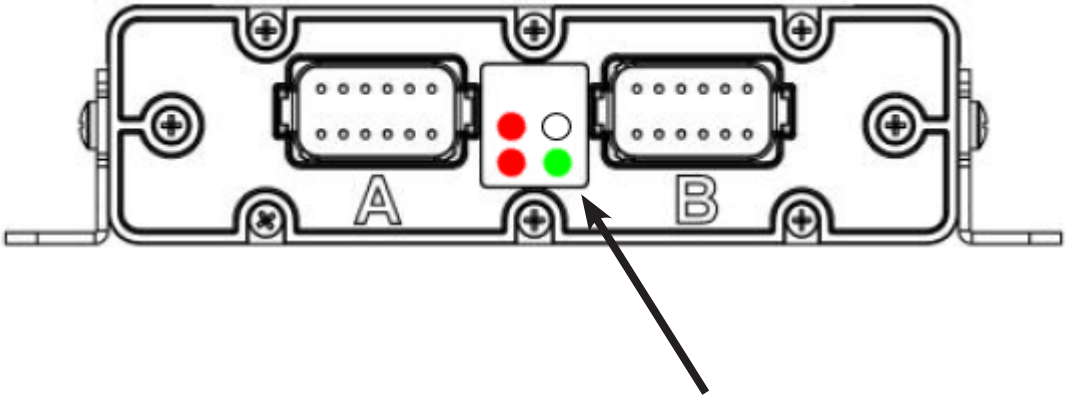


Moisture conditions:
- If the 8x16 node is exposed to moisture it shall be mounted vertically such that the power and ground studs point upwards.
- The 8x16 is splash resistant but prolonged exposure to water could result in a breach of the module.
- Orient the power and ground studs upward so any internal moisture falls towards a lower area free of electronics.
- Failure to orient in this manner will void the warranty if the node is returned due to water damage.

Installation: #6030 series = 8x16 Input/Output node:

Green status light -- Power and Program status





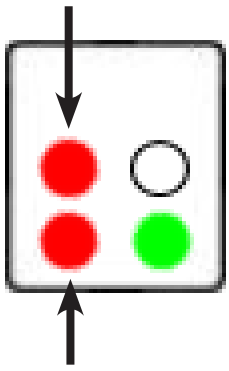
The Green status light (CPU) indicates the node is operating electrically.

There are two flash (blinking) patterns for the Green light:
1. PROGRAMMED -- An On/Off 'Heartbeat' flash pattern indicates the node has a program in memory. The programmed node will be able to communicate with other nodes and will reply to diagnostic Pings
2. UN-PROGRAMMED -- A rapid 3-blink pattern with a pause between each repeat indicates there is no program in the node memory. The unprogrammed node will not communicate with other nodes and will not reply to diagnostic Pings.

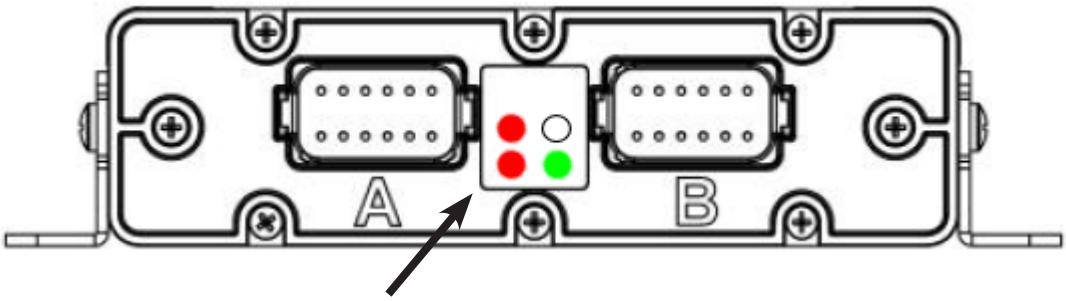
Any other behavior of the Green light, such as a solid light On or no light at all, indicates that the node is damaged or at extreme low Voltage.

V-MUX 8x16 Input/Output node
Red lights -- network activity

Red ‘Transmit’ light (Tx)
upper left



Red ‘Receive’ light (Rx)
lower left



The two Red status lights (Tx / Rx) indicate node communication with the V-MUX network.

Unlike the Green light which has a set flash pattern, the Red receive (Rx) and transmit (Tx) lights should flicker intermittantly, depending on the amount of network traffic. The absolute minimum amount of network traffic on a normal V-MUX network is at least one message every four seconds. So the Red Rx light should flicker at least once every four seconds.

There are two normal behaviors observable for the Red Tx and Rx lights:

1. The lower Red light (Rx = receive) flickers by itself due to the message activity of other nodes in the network. There is no transmit involved so the Tx light will be Off.
2. The upper Red light (Tx = transmit) flickers, indicating the node has transmitted a message.

IMPORTANT: Every V-MUX node expects to hear the network ‘SYNC’ message at least every four seconds. If the SYNC message is not heard the node will immediately issue an ‘OUT OF NETWORK’ distress message.

Any other behavior of the Red lights, such as a solid lights On or no lights at all, indicates that the node or network is damaged or at extreme low Voltage.

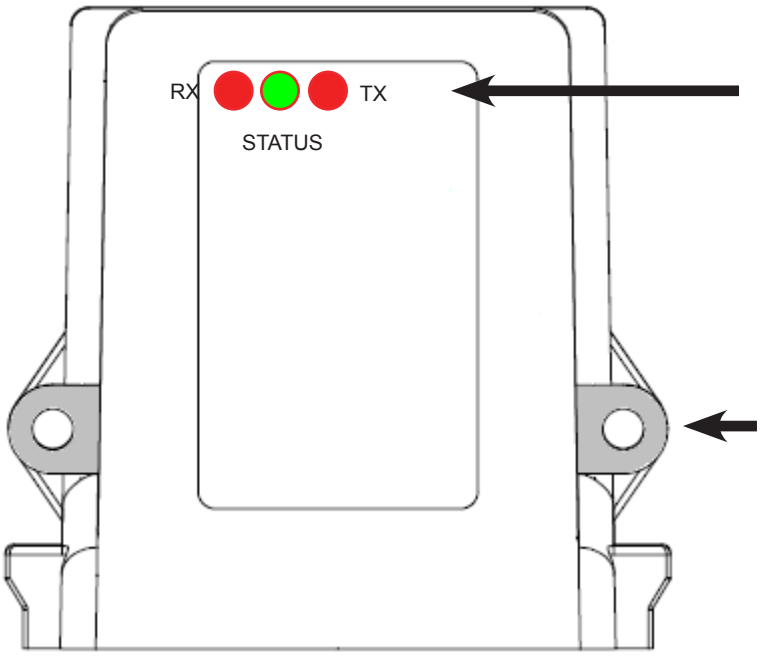
Installation: Mini 4x12, Mini 16x0

#6010 series
Mini 4x12

#6020 series
Mini 16x0

The smaller V-MUX node types all share the same Deutsch EEC-325X4B housing. Generally this is referred to as the 'Mini' housing type, from the original 6010 Mini 4x12.

The hardware used to mount shall be (2) ANSI #12 or 1/4"screw fasteners. Mount so that the LED indicator lights can be seen. If exposed to moisture the connector should point down.



(3) status and network LEDs
- all LED indicators to be viewable
- program STATUS (Green)
- RX (Red) message Receive
- TX (Red) message Transmit

(2) Footpad fasteners
- Use ANSI #12 or 1/4" fasteners
- (2) thru-hole locations

Power and Ground circuits
- Power
- Ground

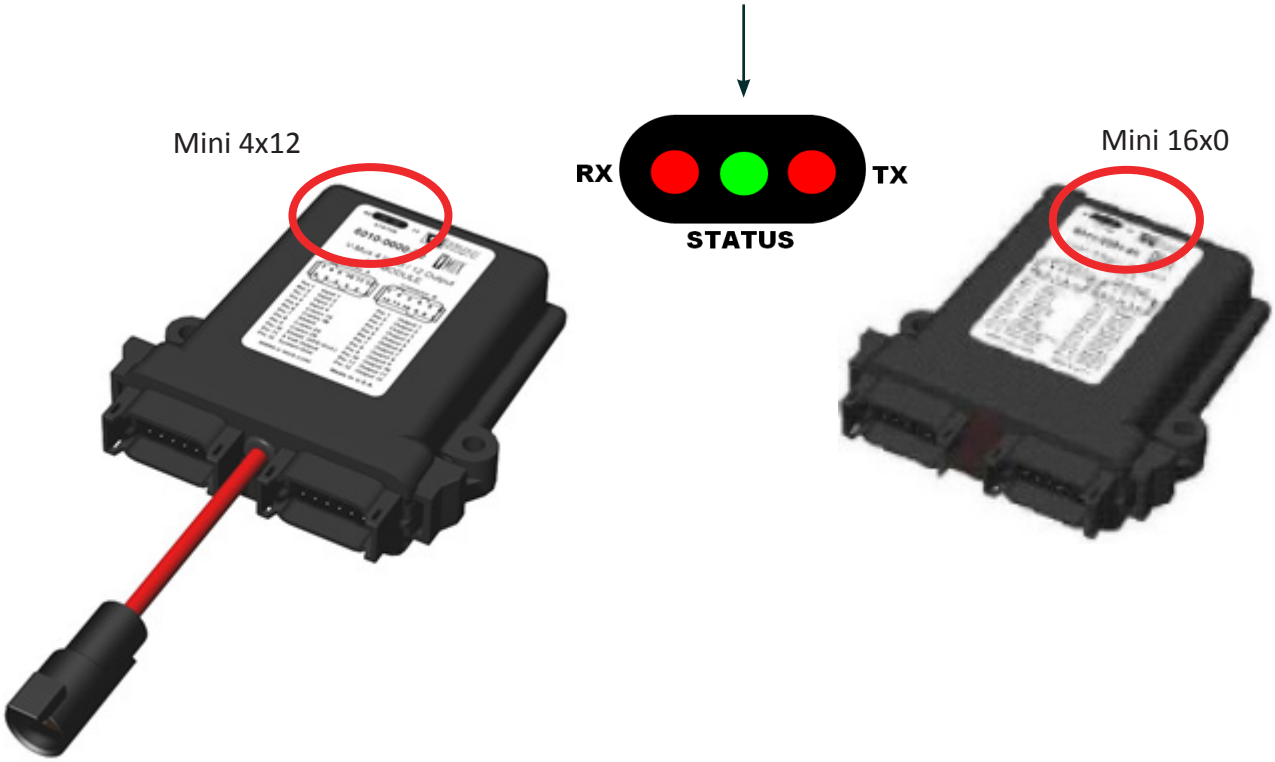
The Mini nodes: 6010 Mini 4x12 and 6020 Mini 16x0

- Indicator LEDs are located between the node Power and Ground studs. The Green status light indicates if the node is programmed.

Green light: two patterns

1. **PROGRAMMED** -- A 'Heartbeat' flash pattern indicates the node has a program in memory. The programmed node will be able to communicate with other nodes and will reply to diagnostic Pings.
2. **UN-PROGRAMMED** -- A rapid 3-blink pattern with a pause between each repeat indicates there is no program in the node memory. The unprogrammed node will not communicate with other nodes and will not reply to diagnostic Pings.

Any other behavior of the Green status light, such as a solid On, or no light at all, indicates that the node is damaged or at extreme low Voltage.



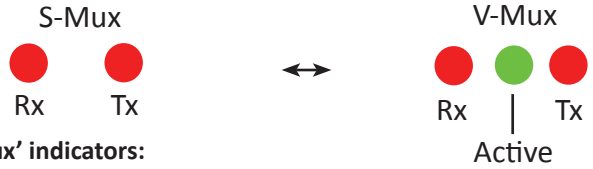
The two Red status lights (Tx / Rx) indicate node communication with the V-MUX network.
Unlike the Green light which will have a set pattern, the Red 'Receive' and 'Transmit' lights should flicker intermittantly, depending on the amount of network traffic. The absolute minimum amount of network traffic on a normal V-MUX network is at least one message every four seconds.

There are two normal behaviors observable for the Red lights:
1. The lower Red receive light (Rx) flickers by itself due to network activity. The node is receiving network messages from other V-MUX nodes. There is no transmit involved so the Tx light will be Off.
2. Both the upper and lower Red lights (Rx/Tx) flicker together, indicating the node has transmitted a message. The reason for both Tx and Rx lighting at the same instant is that every Hercules node receives its own messages, known as the 'local echo'.
IMPORTANT: Every V-MUX node expects to hear the 'SYNC' message at least every four seconds. If the SYNC message is not heard the node will immediately issue an 'OUT OF NETWORK' distress message which causes both the RX and Tx Red lights to flicker every four seconds.

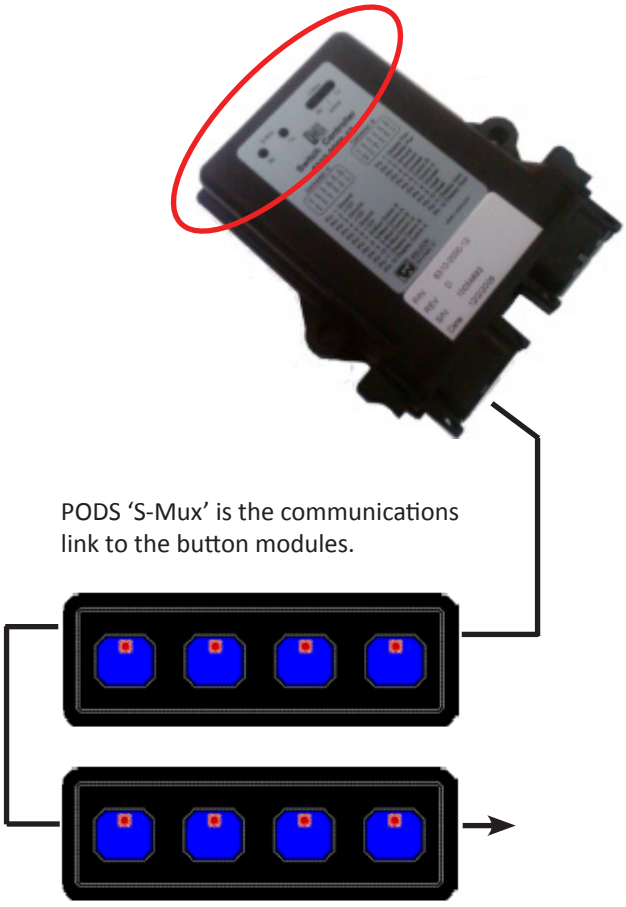
Any other behavior of the Red lights, such as a solid lights On or no lights at all, indicates that the node or network is damaged or at extreme low Voltage.

6310 PODS Switch Controller (this hosts the PODS button modules)

- IMPORTANT -- the 6060 Hercules HC nodes now support button PODS modules
- if a Hercules HC is used as a PODS host, it replaces the older 6310 host



'S-Mux' indicators:
The two Red LED lights (Rx / Tx) indicate node communication between the controller and the button modules.



PODS 'S-Mux' is the communications link to the button modules.

'V-Mux' indicators:

Green LED ('Active') : two patterns

1. **PROGRAMMED** -- A 'Heartbeat' flash pattern indicates the node has a program in memory. The programmed node will be able to communicate with other nodes and will reply to diagnostic Pings.
2. **UN-PROGRAMMED** -- A rapid 3-blink pattern with a pause between each repeat indicates there is no program in the node memory. The unprogrammed node will not communicate with other nodes and will not reply to diagnostic Pings.

Any other behavior of the Green light, such as a solid light On or no light at all, indicates that the node is damaged or at extreme low Voltage.

Red LEDs:

The two Red status lights (Rx / Tx) indicate node communication with the V-MUX network.

Unlike the Green light which has a set flash pattern, the Red receive (Rx) and transmit (Tx) lights should flicker intermittantly, depending on the amount of network traffic. The absolute minimum amount of network traffic on a normal V-MUX network is at least one message every four seconds. So the Red Rx light should flicker at least once every four seconds.

There are two normal behaviors observable for the Red Tx and Rx lights on the PODS:

1. The lower Red light (Rx = receive) flickers by itself due to the message activity of other nodes in the network. There is no transmit involved so the Tx light will be Off.
2. The upper Red light (Tx = transmit) flickers, indicating the node has transmitted a message.

IMPORTANT: Every V-MUX node expects to hear the network 'SYNC' message at least every four seconds. If the SYNC message is not heard the node will immediately issue an 'OUT OF NETWORK' distress message.

Any other behavior of the Red lights, such as a solid lights On or no lights at all, indicates that the node or network is damaged or at extreme low Voltage.

Installation: #6444 Vehicle Data Recorder

active Status

V-MUX communications

CAN1

CAN2 (not used)

Indicator LEDs are located in the upper portion of the device housing. The Green status light indicates if the node is programmed.

6444 VDR

Green STATUS: two patterns

1. **PROGRAMMED** -- A 'heartbeat' flash pattern indicates the VDR has a program in memory. The programmed node will be able to communicate with other nodes and will reply to diagnostic Pings.
2. **UN-PROGRAMMED** -- A rapid 3-blink pattern with a pause between each pattern repeat indicates there is no program in the node memory. The unprogrammed node will not communicate with other nodes and will not reply to diagnostic Pings.

Any other behavior of the Green LED, such as a solid light On or no light at all, indicates that the node is damaged or at extreme low Voltage.

The Red 'V-MUX' light (left, lower) indicate node communication with the V-MUX network.

Unlike the Green light which has a set flash pattern, the Red 'V-MUX' light should flicker intermittantly, depending on the amount of network traffic. The light flickers on Received messages from other V-MUX nodes or Transmitted messagesThe absolute minimum amount of network traffic on a normal V-MUX network is at least one message every four seconds.

If within a 5-minute period the VDR does not detect any activity that it was programmed to record, the second by second onboard record log will pause with an END OF RECORD stamp. The device will remain in this sleep mode until it is either power recycled Off/On or it again detects recordable activity. Other background messages between the other V-MUX nodes will not start the device recording again although there will be flickering indicated on the Red V-MUX light and the Green status light will still indicate a heartbeat pattern.

There are two normal behaviors observable for the Red light:
1. The lower Red receive light (Rx) flickers by itself due to network activity. The node is receiving network messages from other V-MUX nodes. There is no transmit involved so the Tx light will be Off.
2. Both the upper and lower Red lights (Rx/Tx) flicker together, indicating the node has transmitted a message. The reason for both Tx and Rx lighting at the same instant is that every Hercules node receives its own messages, known as the 'local echo'.
IMPORTANT: Every V-MUX node expects to hear the 'SYNC' message at least every four seconds. If the SYNC message is not heard the node will immediately issue an 'OUT OF NETWORK' distress message which causes both the RX and Tx Red lights to flicker every four seconds.

Any other behavior of the Red lights, such as a solid lights On or no lights at all, indicates that the node or network is damaged or at extreme low Voltage.

Installation: #6240 Vista IV display

standard housing (push button type)

Corner post fasteners (option)

- (4) 1/4”-20 nut fastener hardware to existing posts

Center mount fasteners (option)

- (4) #8-32 screw fastener hardware
- (1) Pana-Vise™ arm mount (Weldon #0J50-1505-xx)

Moisture conditions:

- Vista IV with button housing are splash resistant on the front and back but not along the sides
- Vista IV Touchscreen is not splash resistant. Do not install in a location that is subject to moisture.
- Locate the Vista display in the most environmentally friendly location whenever possible
- Vista displays should never be subjected to pressurized water spray of any type
- Vista displays can be cleaned with detergeant type cleansers suitable for plastic materials
- Do not clean with solvent or ammonia type cleansers that may damage the plastic housing

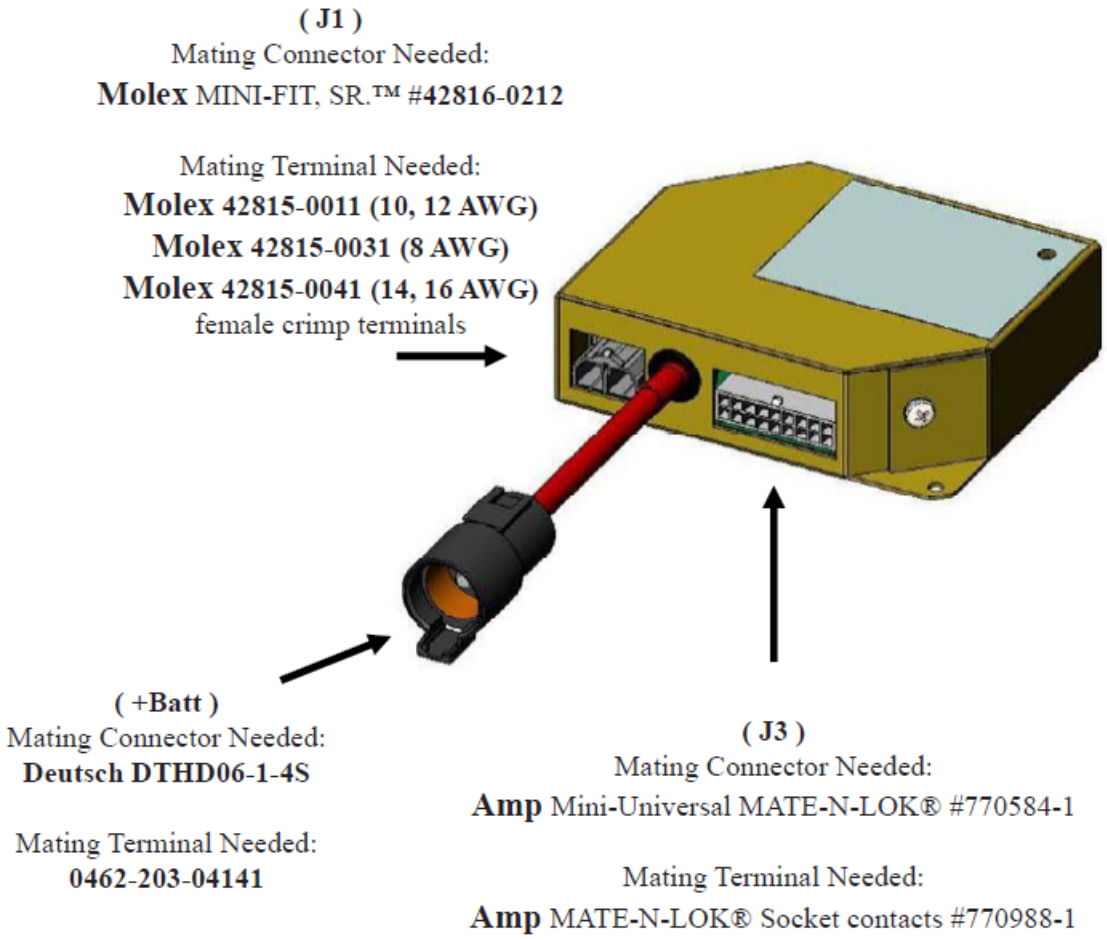
Vista IV Touch
double-DIN dash install kit

Vista IV Touch
panel mount with bezel

6241 series Touchscreen Vista IV

- The OEM builder is responsible for Touchscreen display housing. Contact Weldon for support.
- Be careful not to break the display screen when mounting. Any crack in the touch surface may make the entire display inoperable.
- No portion of the touchable area of the screen should make contact with the surrounding housing.

Installation: #0N70-1519-xx Climate Control Module:



Footpad fasteners:
Use (2) ANSI #6 or #8 fastener hardware at the footpad mounting locations of a Climate Module.

Node Power and Ground:
Power to the Climate Module is by a Deutsch DTHD06-1-4S connector and 0462-203-04141 terminal. (Center plug-in; red #6 AWG cable feed)
Ground to the Climate module is by an Amp Mini-Universal MATE-N-LOK® #770584-1 connector and Amp MATE-N-LOK® terminal #770988-1 (location J3-9)

Status and Network activity LEDS:
The Climate Module should be mounted so that the LED indicator lights can be easily seen for trouble shooting purposes.

Moisture conditions:
The Climate Module is not water resistant and must not be installed in any location that presents the possiblity of moisture affecting the module. Failure to install the Climate Module away from moisture will void the warranty if the component is returned due to water damage.

Vehicle final preparation:

Inspection / Checklist:

The functional and system specification should be reviewed in detail with use of a checklist during final vehicle inspection. All interlocks, switches and inputs, and overall system function must be validated and verified.

Wiring diagrams

Two wiring diagrams should be included with each delivered vehicle, along with a **V-MUX Input/ Output Relationships Report** as generated by the V-MUX System Designer program. The wire diagrams should include node locations and communications wire layout. All communications wire should be identifiable by color code or number.

V-MUX resource files should not be archived on a CD or other permanent media distributed for vehicle service purposes, as that can result in out-of-date files.

Important Redundancy items:

Pump Shift:

Fire truck pumps should include a manual pump override, so that a pump can be manually shifted into pump mode should any of the main switches or electrical connections fail. A second pump shift switch can also be added to the pump area as a backup before manual pump would be required.

Oxygen:

Weldon recommends that any electrical oxygen valve have a mechanical backup so that oxygen can be reliably delivered to a patient in any emergency.

DO NOT run any electric wires in proximity with the oxygen hoseline. An electrical spark or other issue with the wiring can cause a fire or explosion.

File Maintenance

- Weldon recommends the archiving of all V-MUX vehicle support files at an FTP or similiar on-line location for customer access 24/7. Online support can be rapidly updated, as many customers request changes upon delivery of new equipment.
- History has shown that storing files on a CD or other permanent storage medium is a mistake. Files can rapidly become superseded, with the danger of customers unwittingly working with out of date resources.

Training

- Weldon provides OEM Builder and Service-level training for the V-MUX SystemDesigner™, Diagnostics, and Downloader software.
- Training (p/n 6190-0000-00) is required before Weldon will provide V-MUX support.

Electrical

Discrete wires

- All insulated Wiring used for inputs and outputs shall meet SAE J-1128: "*Low Voltage Primary Cable*" specifications for high temperature (250 °F; 121 °C) and be coded for color, number and function.
- Wiring must be of the proper gauge and jacket type as specified by Deutsch (standard) or other connector manufacturer used in conjunction with the V-MUX system.

Harnesses

- Weldon recommends wire harnesses that have been designed specifically for use with the V-MUX system. There should be separate harness connections for each node.
- Cutting and chopping existing harnesses to hack or splice into a V-MUX system is not an acceptable practice.

High-speed scope for measurements

- It is recommended that all V-MUX builders have available a portable high-speed oscilloscope for purpose of tracking down any electrical transients. A two channel scope can be purchased at a reasonable price and is a great investment for resolving electrical transients.
- Measure for voltage transients before adding final circuit protection -- so as to document what type of noise was present prior to the change.