

# V-MUX<sup>®</sup> Diagnostics

User Manual , January 2011



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## **General Computer Requirements:**

A Microsoft Windows® based computer host. Non-Windows computers are not supported.

Computer Operating System: Microsoft Windows 2000®, XP®, Vista, Windows 7.

NOTE: V-MUX® Diagnostics may be incompatible with the Windows 95, 98, ME, or Windows NT computer operating systems due to USB hardware support issues. These versions are not recommended.

Computer hardware requirements (minimums):

- 900 MHz processor speed.
- 512 MByte RAM memory.
- 100 MByte free hard drive space.
- USB port.



## V-MUX Diagnostics Kit Contents:

#6131-0000-00 -- Includes USB transceiver, USB cable, V-MUX hook-up cable, tools, software, and carry case. All earlier kits using an RS-232 serial port plug-in are obsolete. Contact Weldon for upgrade if necessary.

#6111-0000-00

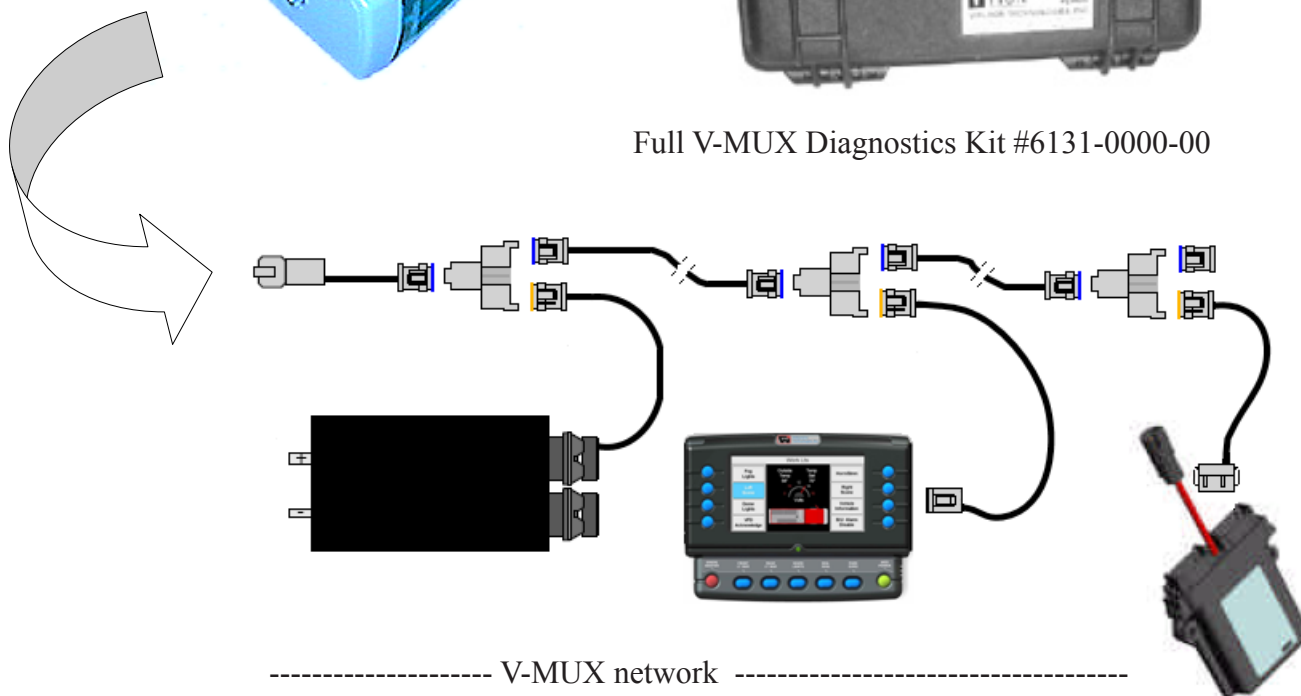
USB Transceiver upgrade from original COM-style box with cables and software.

#0N40-1638-01

Replacement USB Transceiver with USB cable.



Full V-MUX Diagnostics Kit #6131-0000-00



### USB Transceiver software set-up:

A one-time USB driver set-up is required to operate this kit with a computer. See page 8.



TIP: Look for the official USB logo to identify and locate the USB port on the computer.

## **Installing V-MUX Diagnostics software:**

### **Installing the Diagnostics software from the included USB memory stick**

Insert the included software memory stick drive into the computer's USB port. Windows will usually assign to it the default drive letter of "D:" or "E:". Once the memory stick is recognized by the computer, open the top-level folder (named "0S90-2118-00" or similar).

The Diagnostics installation program is located in a sub-folder named "Diagnostics" or similar.

There is one file inside of this folder:

VMUXDiagnostics142\_Install.exe

This file is the automated software installer for current version 1.4.2.

The Windows Installation Wizard will begin. Follow all prompts.

Once the Downloader is installed, Windows will assign it an icon link on the Start Menu

**Start ➡ All Programs ➡ V-MUX Software ➡ V-MUX Diagnostics**

The installed path to the Diagnostics program is by default:

**C:\Program Files\V-MUX Software\V-Mux Diagnostics\V-MUX Diagnostics.exe**

It is best to keep this path as is.

## Installing V-MUX Diagnostics software:

### Installing the Diagnostics software from the online Weldon web resource site

All V-MUX software may always be accessed for free from Weldon's on-line V-MUX support page:

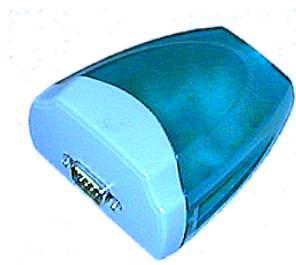
[http://www.v-mux.com/pages/v\\_mux.html](http://www.v-mux.com/pages/v_mux.html)  
from  
[www.weldoninc.com](http://www.weldoninc.com) or [www.v-mux.com](http://www.v-mux.com)

The image is a promotional banner for Weldon, a division of Akron Brass. It features a yellow background. At the top left is the Weldon logo, a stylized 'W' with a flame, followed by the text 'WELDON' and 'A DIVISION OF AKRON BRASS'. Below the logo is a vertical navigation menu with links: 'Team', 'Products', 'V-MUX Files', 'What's New', 'Contacts', 'Company Info', and 'Warranty & Repairs'. The 'V-MUX Files' link is highlighted. In the center is a large circular image of a V-MUX diagnostic device showing a screen with '9:14' and 'Main Menu - Ready'. To the right of the device are two circular inset images: one of a school bus and one of a fire truck. Below the main image is a 'New Products' section with two circular inset images of new products. At the bottom is a 'New PDF Catalog' section with a PDF icon, the text 'New PDF Catalog', and 'Click Here For Download Options'. Below this is a small image of a catalog. At the very bottom, it states 'Weldon & Akron Brass Company are ISO 9001: 2000 Registered Companies'.

Click on the link “V-MUX Files”. Most of the support files are archived with a “.zip” filename and require an unzipping utility to access them.

## Installing V-MUX Diagnostics software:

### First-time only USB driver set-up:



The first time the V-MUX USB transceiver box is plugged into the computer, the Windows Hardware Wizard will recognize it as a new device and install the necessary USB driver software. Appendix A of this manual reviews the driver installation process.

Additionally, the document “**USB Transceiver Setup.pdf**” covers driver installation in even greater detail. It is available on the install medium (disk or USB memory stick) and also from the Weldon on-line V-MUX support page:

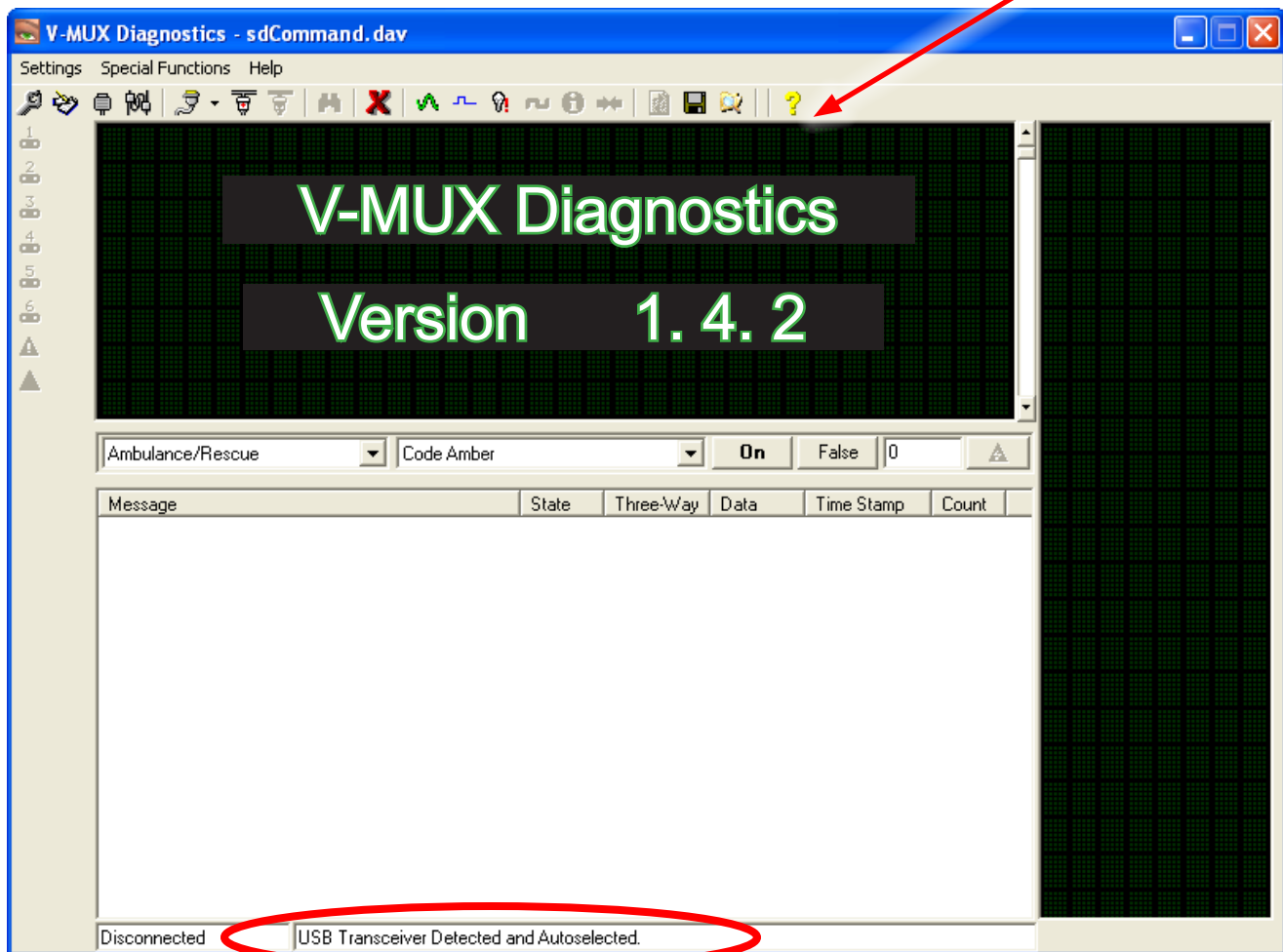
<http://www.v-mux.com/pages/downloads/USB%20Transceiver%20Setup.pdf>

### Verifying the USB driver installation:

- 1) Plug the provided USB cable into both the V-MUX transceiver and the computer’s USB port
- 2) Start the V-MUX Diagnostics program (after the transceiver is plugged in) from the standard Start button path:

**Start → All Programs → V-MUX Software → V-MUX Diagnostics:**

- 3) Diagnostics will open as a compact dialogue interface. The interface window is not resizable. The latest software version is 1.4.2.



- 4) Verify that “**USB Transceiver Detected and Autoselected**” is indicated at bottom.

If the USB transceiver is not detected, exit the Diagnostics program completely, unplug the USB cable and repeat from step 1. Review “**USB Transceiver Setup.pdf**” for step-by-step troubleshooting help.

## Connecting V-MUX Diagnostics:

Connect the V-MUX transceiver box and USB cable into the computer's USB port.

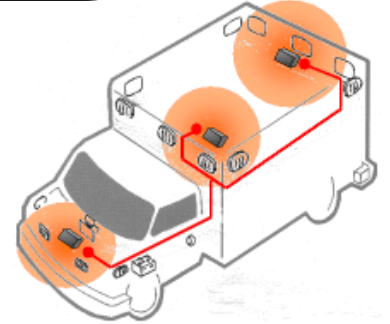


(computer)



(transceiver)

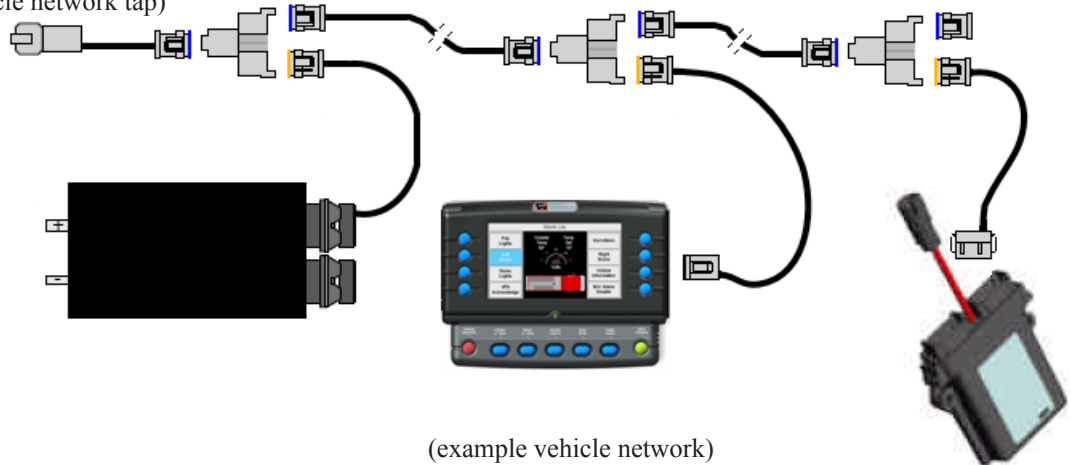
Connect the V-MUX truck-side cable. The 9-pin end of the cable connects into the transceiver box. The 4-pin end of the cable connects to the vehicle network port. See vehicle OEM instructions for the network port location.



(V-MUX vehicle)



(vehicle network tap)



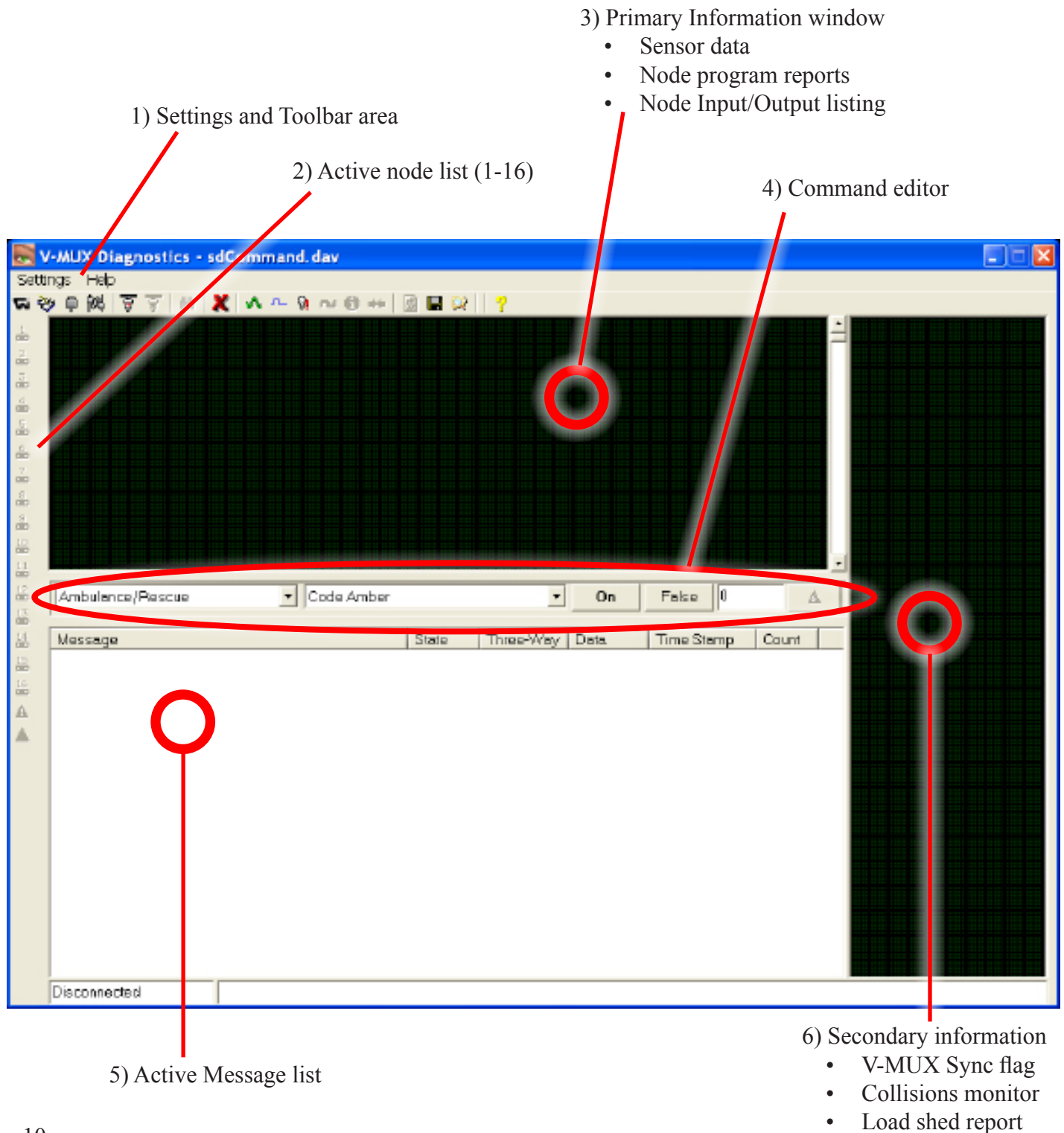
(example vehicle network)

## Screen Layout --

## Overall View

The Diagnostics interface window is divided into six specialized working areas:

- 1) The **Settings and Toolbar area** -- connection activity and optional features are accessed here.
- 2) The **Active Node list** -- enables Diagnostics to focus its resources on particular V-MUX nodes in a 1-16 node network.
- 3) The **Primary Information window** -- detailed V-MUX information from nodes and sensors is presented here.
- 4) The **Command editor** -- enables the Diagnostics user to create and send virtual V-MUX messages into an active network.
- 5) The **Active Message list** -- shows in real-time all active messages on the V-MUX sytem network.
- 6) The **Secondary information window** -- shows additional V-MUX activity being reported on the network







Click on the “Connect” toolbar icon. This is the fifth tool from the left.

TIP: If the mouse cursor is allowed to hover over each icon, a brief description of the tool function will appear in a text box. All toolbar functions are defined in the Toolbar section of this manual (Page 20)

Upon connection, nodes in the live V-MUX system will be recognized by Diagnostics through a series of automatic **Pings** and **Node Ping Replies**. All nodes which Diagnostics identifies as having replied to their Pings will be listed with an active icon in the **Active node list** along the left side.

**Example:** Two active nodes (#1, #2) have replied to their Diagnostic Ping messages. They are identified and highlighted by Diagnostics with active icons. All non-replying nodes remain as ghosted icons.

The sequence of Pings and Ping Replies is also shown in the lower **Active Message list**.

Message	State	Three-Way	Data	Time Stamp	Count
⚡ Ping	Off	False	1	10:07:39.35	16
⚡ Node Ping Reply	On	False	1	10:07:39.48	7
⚡ Ping	Off	False	2	10:07:39.48	17
⚡ Node Ping Reply	On	False	2	10:07:39.59	8

Connected    Nodes Detected

If no replies are seen, try manually pinging the live System with the “PING”



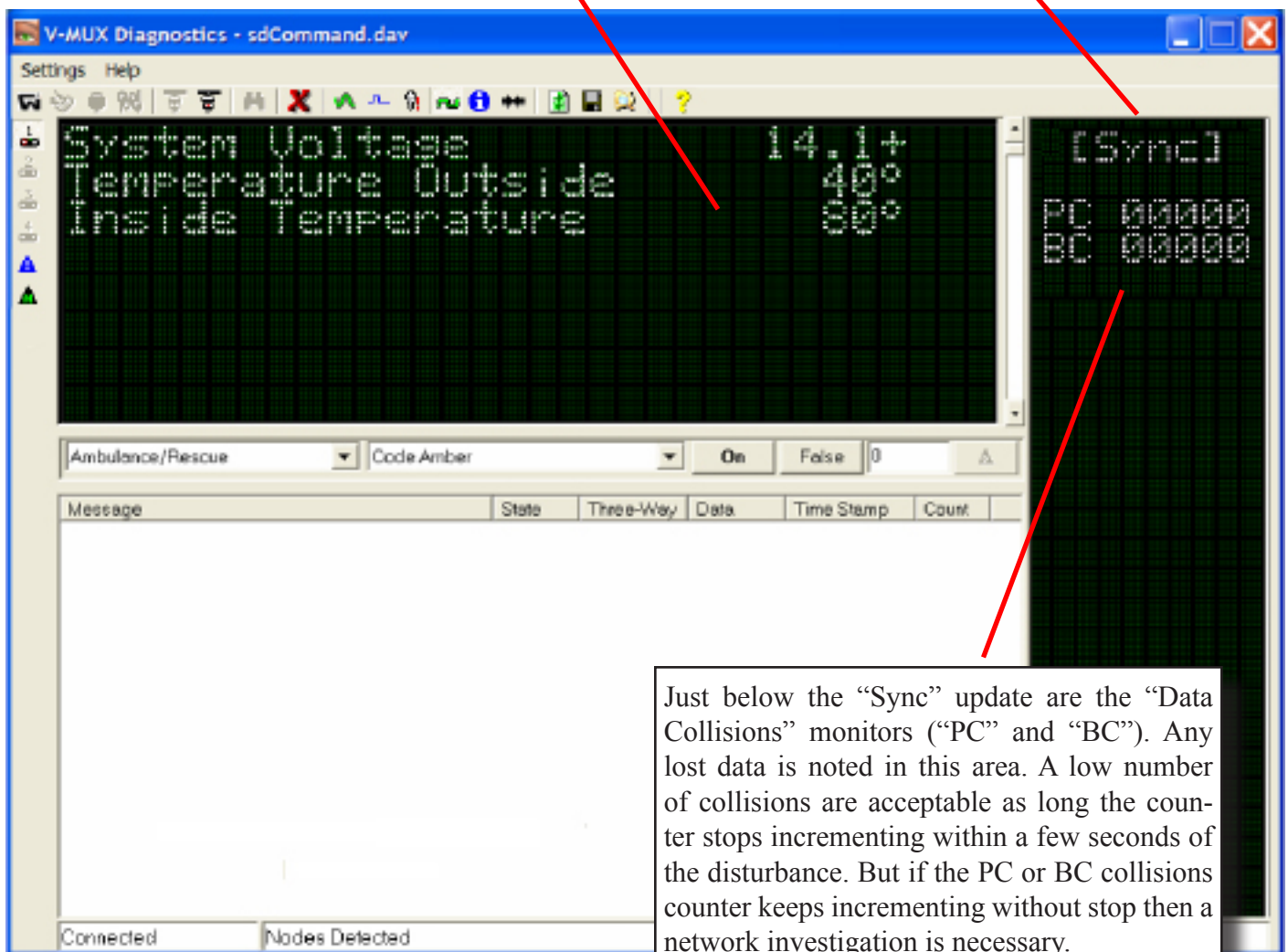
icon (Tool 7). If nothing still happens, check the physical cable hook-up and the USB port selection.

The Primary information window initially displays sensor data from all nodes in the vehicle. If any node is wired to a sensor, it will report in here. The sensor data is continuously updated in real-time as the nodes collect new measurements -- usually every several seconds, but sometimes as fast as twice a second. The System Voltage is always sent in from node #1 in a V-MUX network.

Node 1 generates a "Synchronize" message and repeats it continuously about every 2.5 seconds. The purpose of the synchronize command is twofold:

- 1) It coordinates warning light flash patterns between separate nodes so that alternating ON/OFF lights are precisely synchronized with each other.
- 2) It indicates that network data traffic is transmitting normally. If any node fails to hear the "Sync" it will repeatedly transmit a distress message: "VM\_OUT\_OF\_NETWORK".

Synchronize" message  
(from node 1)



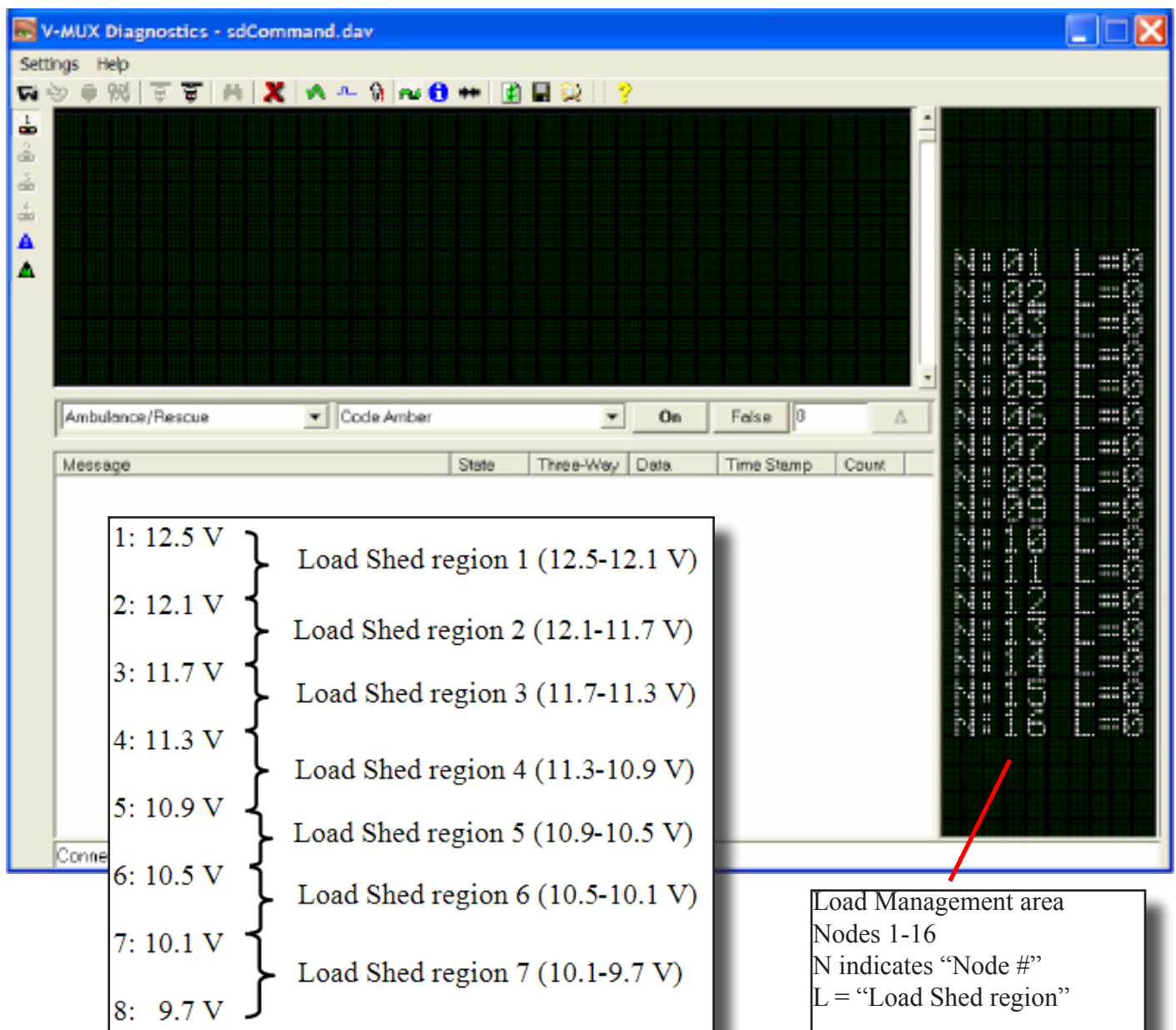
Just below the "Sync" update are the "Data Collisions" monitors ("PC" and "BC"). Any lost data is noted in this area. A low number of collisions are acceptable as long the counter stops incrementing within a few seconds of the disturbance. But if the PC or BC collisions counter keeps incrementing without stop then a network investigation is necessary.



The vehicle designer is able to set Load Management, also known as Load Shedding, for node output channels individually. The basis of load management is the measured voltage at the local node itself; in other words, the node that is controlling the output channel.

Load Shedding voltage thresholds begin at 12.5 Volts and continue downwards in increments of 0.4 Volts (12.1 Volts, 11.7 Volts, etc...). Each threshold is numbered (1-8) and so defines a Load Shed region 0.4 Volts wide. If a node continues to lose voltage it will enter each of the eight defined regions, as shown below. The node reports to the network each time it passes a voltage threshold. This threshold number is what is indicated in the Load Management area of Diagnostics with “L=\_” for each node.

An indication of L=0 means that the node voltage level is above the 12.5 V threshold or no report has been sent by the node.

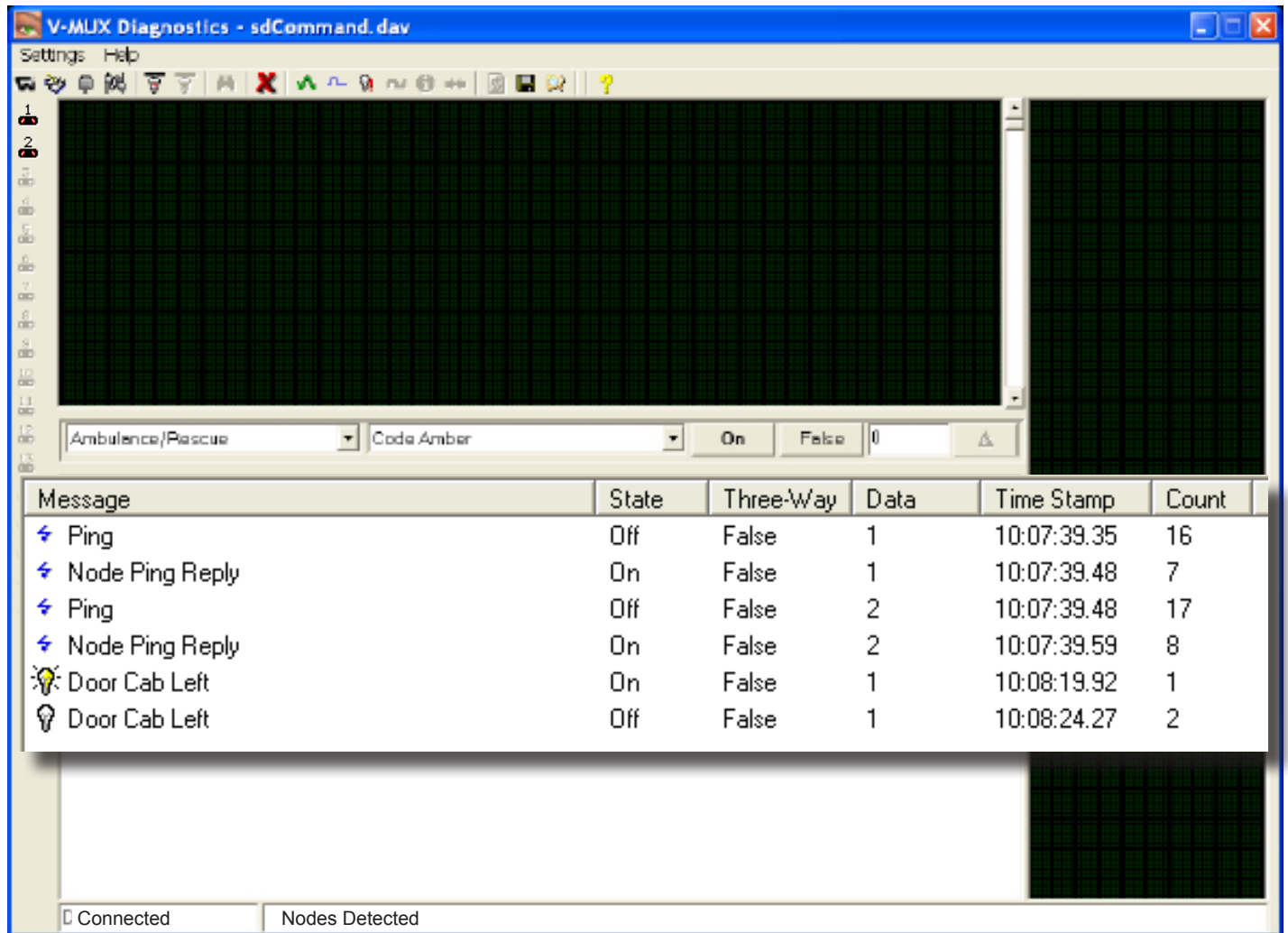


## Screen Layout –

## The Message List area

All V-MUX network activity is listed in the lower Active Message List area. By default all messages are displayed from top-down as they are received.



In the example shown here, we see that the switch message from **Door Cab Left** has turned ON and OFF. The current switch state is always shown on the lowest line.



The screenshot shows the V-MUX Diagnostics - sdCommand.dav window. The main area is a large black grid. Below the grid is a control bar with dropdown menus for 'Ambulance/Rescue' and 'Code Amber', and buttons for 'On', 'False', and a numeric input field '0'. At the bottom is a table of messages.

Message	State	Three-Way	Data	Time Stamp	Count
⚡ Ping	Off	False	1	10:07:39.35	16
⚡ Node Ping Reply	On	False	1	10:07:39.48	7
⚡ Ping	Off	False	2	10:07:39.48	17
⚡ Node Ping Reply	On	False	2	10:07:39.59	8
💡 Door Cab Left	On	False	1	10:08:19.92	1
💡 Door Cab Left	Off	False	1	10:08:24.27	2

At the bottom of the window, there are two status indicators: 'Connected' and 'Nodes Detected'.

The real-time ON/OFF state is indicated two ways -- with icons (  ,  ) to the immediate left of any switch message and also with the text “On”/”Off” listed in the **State** column to the immediate right of any switch message. In some messages, like the two Pings shown above, the switch state is not meaningful and so the State column can be ignored. Notice that the icons to the left of the Ping messages are System message ( ⚡ ) icons. They do not indicate ON/OFF.

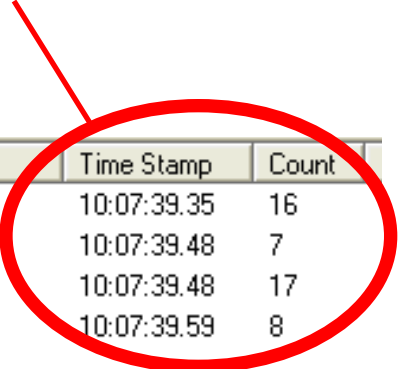
The **Three-Way** column is available in case two independent switches are both programmed to issue the same Command. This would be the case, for example, if a vehicle light were to operate from both a forward and a rear switch. Any change in state of either switch would toggle the state of the light. To keep track of the two switches, the Three-Way flag (True/False) becomes necessary. Most of the time such a set-up is not used and so the Three-Way column “True”/”False” is ignored. “False” is the default.

## Screen Layout –

## The Message List area

In the Active Message List area, the first four columns (**Message**, **State**, **Three-Way**, **Data**) show information that is carried within each V-MUX message packet on the network. The last two columns, **Time Stamp** and **Count**, only show information put onto the screen by the Diagnostics program after the message has been read.

**Time Stamp** shows the computer clock reading associated with the arrival of the message (based on the start of the computer clock's day at midnight). **Count** keeps a tally of each change in a messages state since the Diagnostics program started.



Message	State	Three-Way	Data	Time Stamp	Count
⚡ Ping	Off	False	1	10:07:39.35	16
⚡ Node Ping Reply	On	False	1	10:07:39.48	7
⚡ Ping	Off	False	2	10:07:39.48	17
⚡ Node Ping Reply	On	False	2	10:07:39.59	8

The **Data** column here indicates a V-MUX node number. The Ping messages are being sent to nodes 1 and 2 and the Replies are coming back from nodes 1 and 2.

However, the Data column can carry information beyond a simple node number, as shown below:

Message	State	Three-Way	Data	Time Stamp	Count
🚨 E Emergency Master	On	False	1	14:04:27.49	1
🚨 E Front Light Bar	On	False	0	14:04:27.49	1
🚨 E Grill Lights	On	False	0	14:04:27.50	1
🚨 E Front Intersection	On	False	0	14:04:27.50	1
🚨 E Warning Lts	On	False	0	14:04:27.52	1
🚨 E Warning Lts Rear	On	False	0	14:04:27.52	1
🚨 E Emergency Master	Off	False	1	14:04:28.17	2
🚨 E Front Light Bar	Off	False	0	14:04:28.17	2
🚨 E Grill Lights	Off	False	0	14:04:28.20	2
🚨 E Warning Lts	Off	False	0	14:04:28.20	2
🚨 E Warning Lts Rear	Off	False	0	14:04:28.21	2

### Example -- Command Sets and Free Commands in the Message List:

The Emergency Master switch is wired into node 1 as indicated in the Data column. In turn, the Emergency Master ON state triggers a Command Set which sends out five more ON Commands:

- E Front Lght Bar
- E Grill Lights
- E Front Intersection
- E Warning Lights
- E Warning Lights Rear

Next, the Emergency Master OFF state turns OFF all five of the listed Commands.

For items originating from a **Command Set** or a **Free Command** the Data column always indicates "0", no matter which node issues the Command.

Door Switches	Door Cab Left	Off	False	0	
Message	State	Three-Way	Data	Time Stamp	Count
Door Cab Left	On	False	1	11:25:00.51	13
Door Cab Left	Off	False	1	11:25:06.84	15
Door Cab Left	On	False	0	11:25:141.00	17
Door Cab Left	Off	False	0	11:25:18.23	19

### Example -- Commands that originate from the Diagnostics program

The Command “Door Cab Left” is first shown On and Off by way of node 1, as seen by the Data column “1”. The very same Command is again indicated On and Off but the Data column indicates “0”. This is because in this case the Message was crafted and sent from Diagnostics as a virtual Command. The value of “0” comes directly from the Data field in the Message editing area. Sending virtual Messages is described on the next page.

V-MUX Diagnostics - sdCommand.dav

Settings Help

Four general types of V-MUX Messages display in the Active Message List by default:

- Switched events** – A switch or button has changed state (ex: Rear Scene ON/OFF)
- Logically triggered events** -- From Command Sets or Free Commands (ex: EMERGENCY MASTER)
- System events** – Requests and transfers of system information (ex: PING)
- Sensor triggers** – A sensor has passed some warning threshold (ex: Low Voltage warning)

It is possible to also display analog sensor data traffic and other messages in the Active Message List. Right-click in the Active Message List area to invoke a Message Options pop-up window. Check the “Show all messages” option for sensor data to be listed.

☒ Show all messages  
☐ Don't display duplicate commands  
☐ Display message data in Hex

**Message Options: (3 options)**

- 1) “Show all messages” – Shows sensor data in the Active Message List area. Not checked by default.
- 2) “Don't display duplicate messages” – Places Messages of the same Command to overlay the previous Message. Checked by default
- 3) “Display message data in Hex” – Switches the display of message Data so as to be shown in hexadecimal (base-16) instead of decimal (base-10). Hex format is used when interpreting error codes. Not checked by default

Connected Nodes Detected

## Screen Layout –

## The Command Editor area

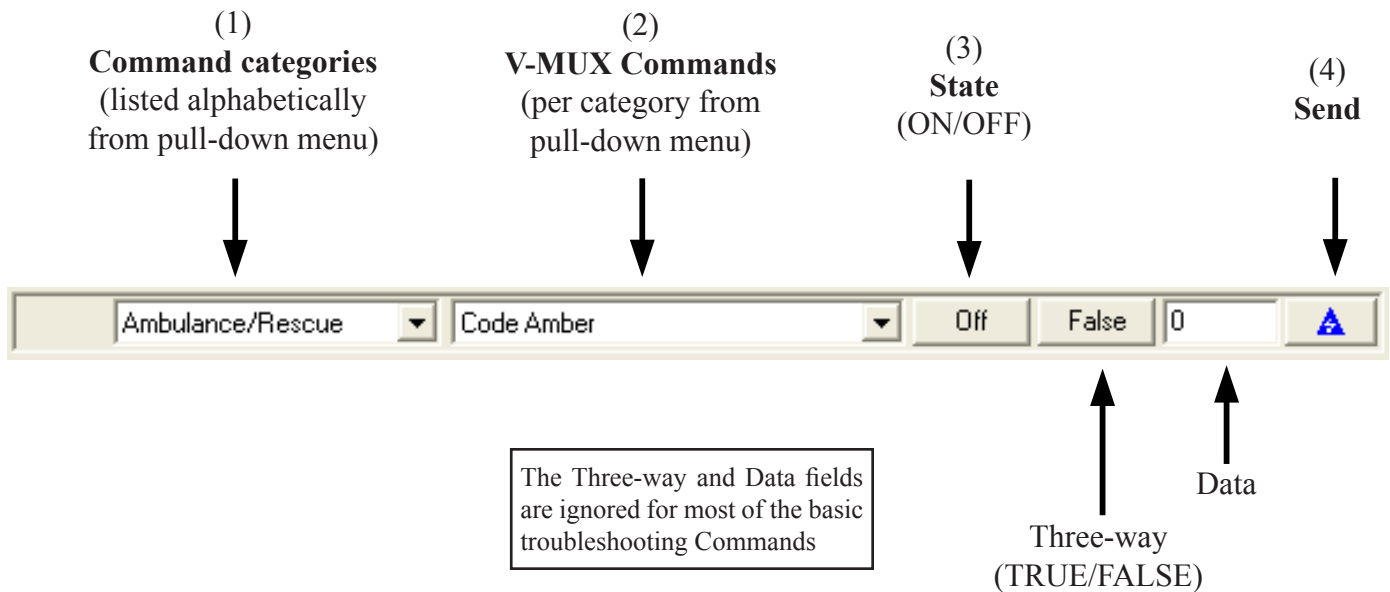
The Diagnostics Command Editor allows a V-MUX Command to be created and sent into a live system as a virtual command. The virtual command will act exactly as a normal command. Before sending virtual commands, make sure that the vehicle network is powered and Diagnostics is connected to it.

### To edit a message:

- 1) Select the Command Category (left pull-down menu)
- 2) Select the V-MUX Command (middle pull-down menu).
- 3) Set the state to ON or OFF as needed.

### To Send a message:

- 4) Click the blue triangle icon at the far right to Send the V-MUX message.



### Advanced message options -- **Three-way** and **Data**:

- When troubleshooting devices that operate from more than one switch, set the **Three-Way** field to 'True'. (Normally this field is ignored and may be left as 'False' .)
- Some tests will require that a **Data** field value be set. (Normally this field is ignored and may be left as '0')

Example -- We wish to test changes in brightness of a Vacuum Fluorescent (VFD) Display:

**Send [Category = V-MUX, Command = VFD Luminance, State = ON, Three-Way FALSE, Data = 75]**  
to dim the VFD two-line display to a 75% brightness level.

**Send [Category = V-MUX, Command = VFD Luminance, State = ON, Three-Way FALSE, Data = 50]**  
to dim the VFD two-line display to a 50% brightness level.

**Send [Category = V-MUX, Command = VFD Luminance, State = ON, Three-Way FALSE, Data = 25]**  
to dim the VFD two-line display to a 25% brightness level.



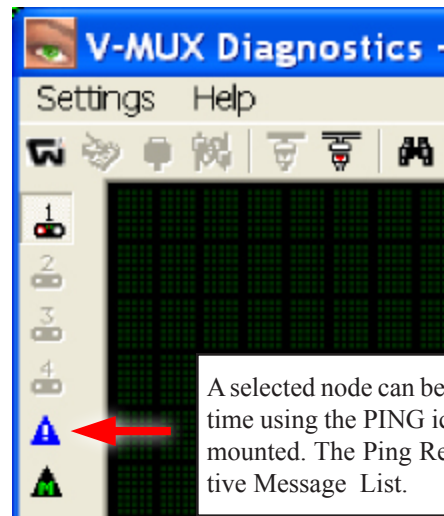
## Selecting and Mounting Nodes:

### Method 1

“Mounting” a V-MUX node allows Diagnostics to monitor and retrieve information from that specific node. In general the node should be selected and mounted as shown in steps 1 and 2.

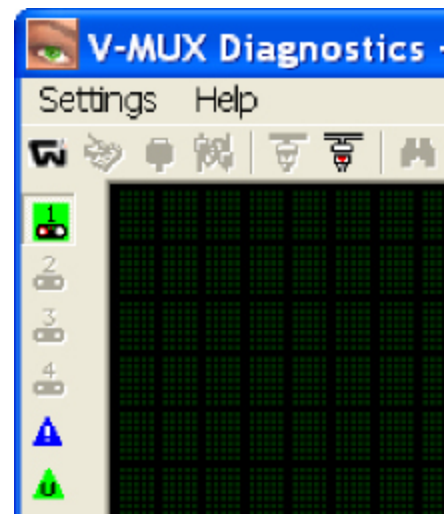
1) Select the desired node from the live status bar on the left side.

2) Click the **Mount** node icon at the bottom of the node status bar.

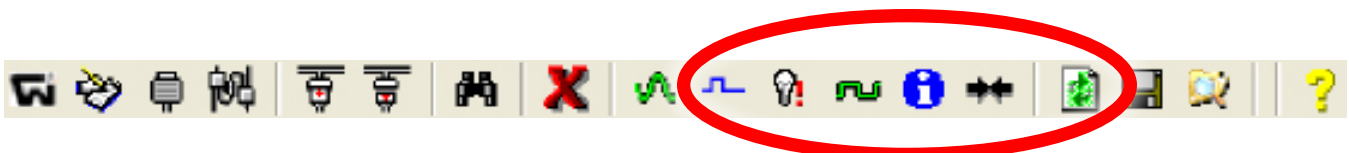


A selected node can be individually pinged at any time using the PING icon, even when the node is mounted. The Ping Reply will appear in the Active Message List.

Once a node is mounted the icons for both the selected node and the Mount function turn GREEN. The M inside the lower icon becomes a U because the next time that icon is clicked, it will **Unmount** the selected node.



Some of the toolbar icons only become active when a node has been selected and/or mounted. These tools will enable information about node operation and programming to be monitored. Each of these icons is discussed in detail in the TOOLBAR section of this manual.



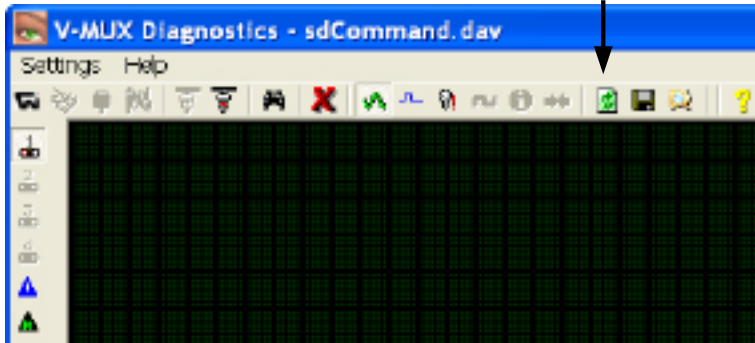
## Selecting and Mounting Nodes:

### Method 2

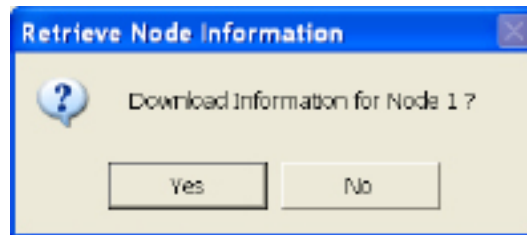
Shown below is an alternate retrieval method that saves a step:

2) Click the “Retrieve Node Information” icon.

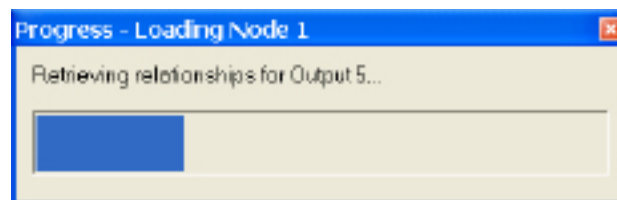
1) Select the desired node from the live status bar on the left side.



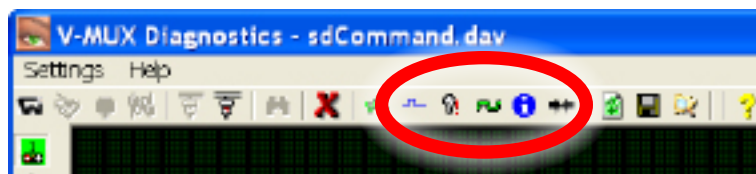
3) A pop-up box will ask to download information from the selected node's memory. Click “yes”



4) While retrieving the node's program memory a progress indicator will appear.

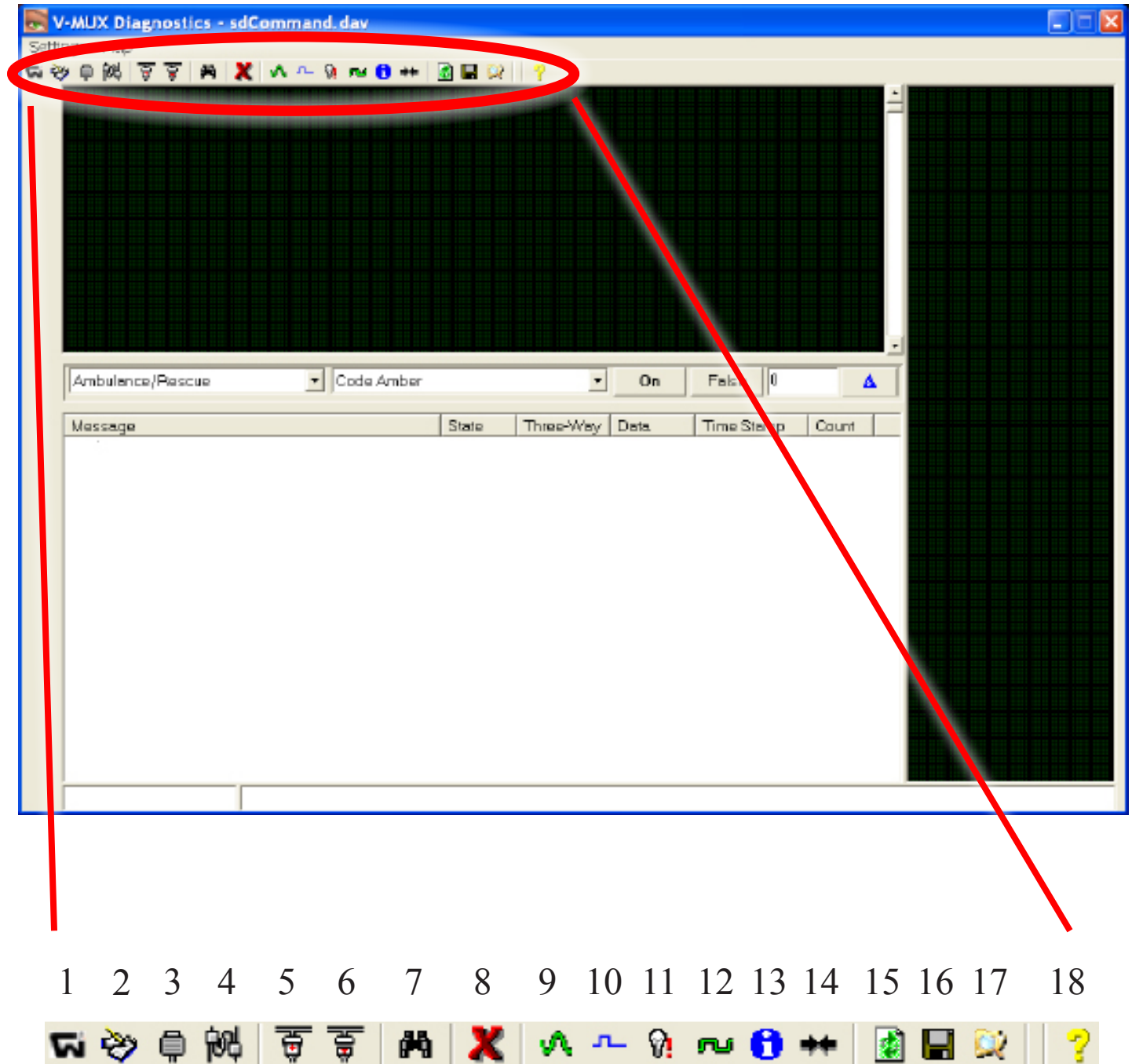


Five of the toolbar icons become available to gather information specific to the mounted node. Each of these icons is discussed in detail in the TOOLBAR section of this manual.



## Diagnostics TOOLBAR – In Depth and Advanced Features:

How to use tools 1-18 to change settings, gather V-MUX data, and use advanced features:

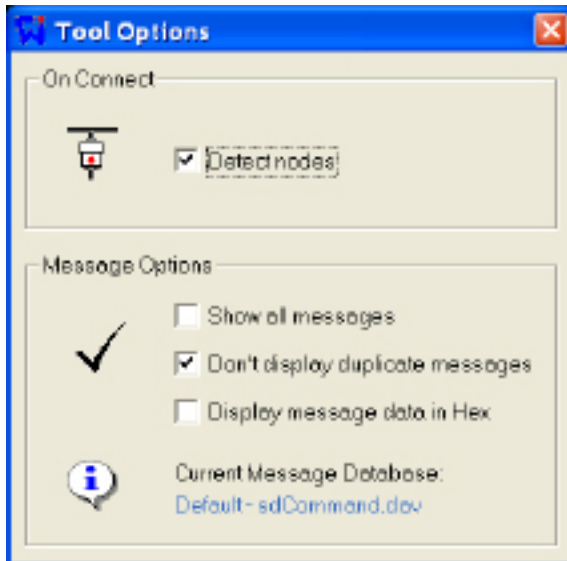






Tool 1) **“Tool Options”** -- Invokes a pop-up window to indicate various Diagnostics program options:

- **On Connect** -- behavior upon connection to a V-MUX node or network
- **Message Options** -- how messages are displayed in the Active Message List area
- **Current Message Database** -- indicates which set of V-MUX Commands will be used by Diagnostics



**On Connect:** (1 option)

Sets Diagnostics to automatically Ping for live nodes (“Detect nodes”) upon each V-MUX network connect. Checked by default.

**Message Options:** (3 options)

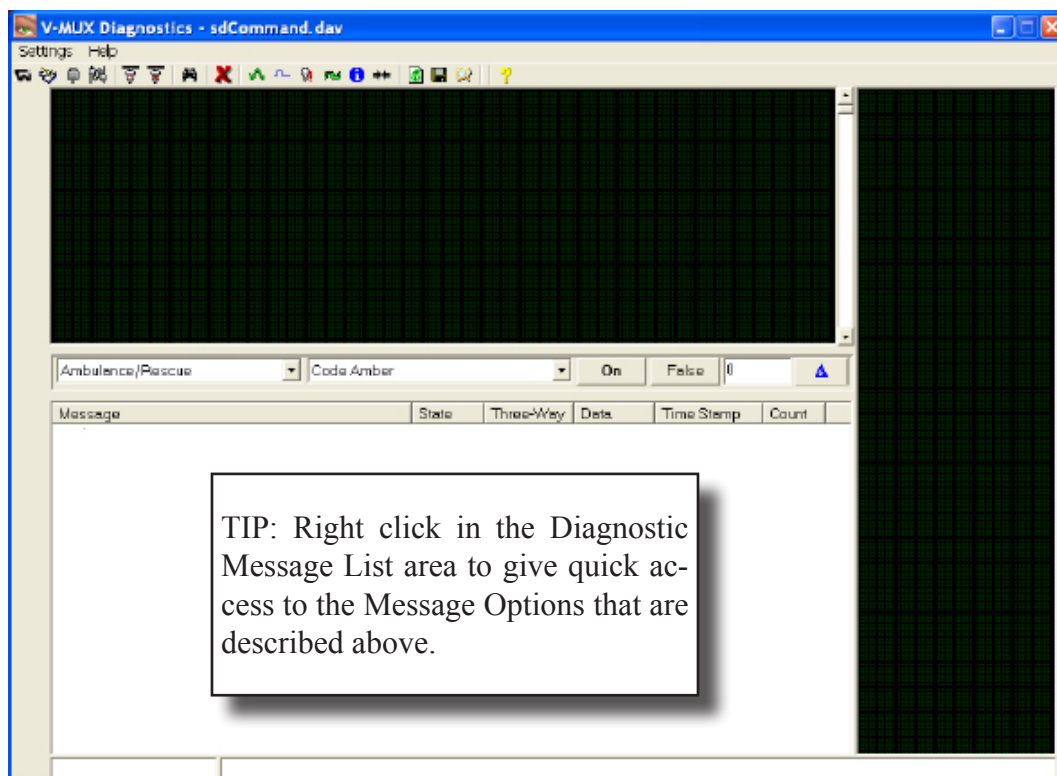
1) “Show all messages” – Shows sensor data in the Active Message List area. Not checked by default.


2) “Don’t display duplicate messages” – Places Messages of the same Command to overlay the previous Message. Checked by default

3) “Display message data in Hex” – Switches the display of message Data so as to be shown in hexadecimal (base-16) instead of decimal (base-10). Hex format is used when interpreting error codes. Not checked by default

**Current Message Database**

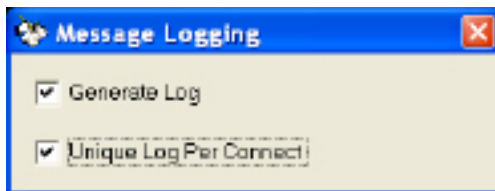
Shows the database file which associates V-MUX message codes with readable text Commands. For example, message code 4 = “Reverse” because the database matches the two. The default V-MUX Diagnostics database file is **sdCommands.dav**. Other databases may be chosen by use of Icon 4, “Database Options”. (see pg 24)



Tool 2)  “Message Logging” -- Enable a Diagnostics session log file report:



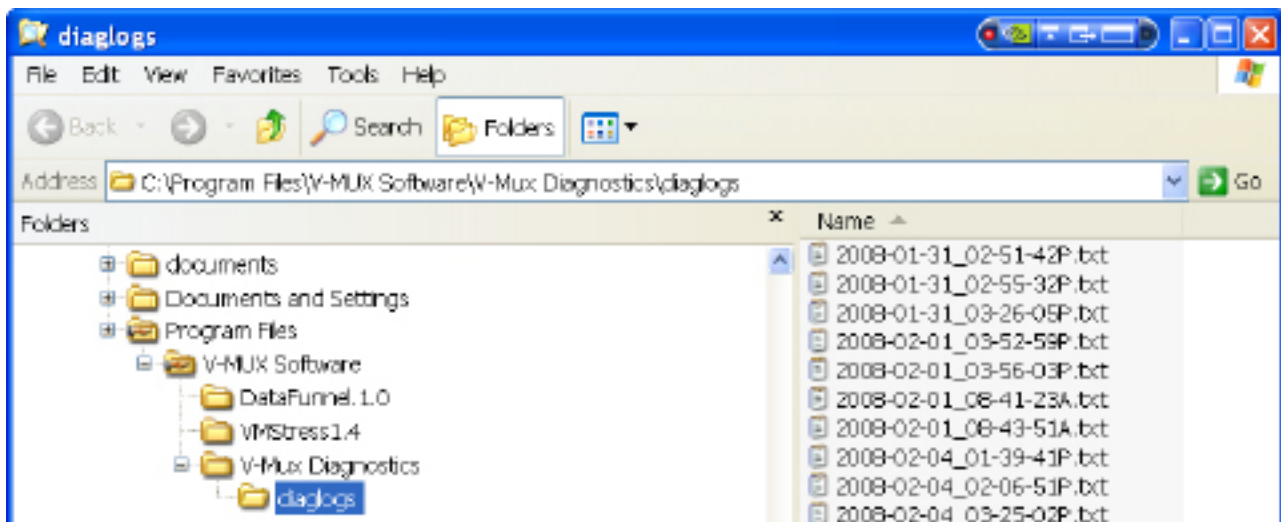
A pop-up box will appear with options to enable message logs and also to create a unique log for each Diagnostic session.



NOTE: Diagnostics must be disconnected (Icon 6) from the V-MUX system for this tool to be available.

The log file may be accessed by clicking on Icon 17 to “Explore Diagnostic’s Log Directory”.

The log directory is simply a Windows sub-folder of the Diagnostics directory. It is named “diaglogs”.



**Log files can be identified by a standard naming syntax:**

**Example --** 2008-02-04\_03-25-02P.txt

The file format is as follows:


2008-02-04 means this file was created on February 4, 2008

03-25-02P means the computer clock was at 3:25:02 PM.

Each log file will get a unique date and time for the name. The log file is simple text and can be opened with Windows Notepad or any other text editor.

The log file is useful for situations in which it is necessary to capture a time-stamped record of a V-MUX event (or non-event).

**Example:** The vehicle door ajar beacon operates haphazardly and it is suspected that one or more magnetic door switches are faulty or mis-aligned. A logged V-MUX Diagnostics session while the vehicle is driven can capture each door switch event and write it to the log file for later investigation.

Tool 3)  **“Network Options”** -- Invokes a pop-up window to indicate various Diagnostic options:



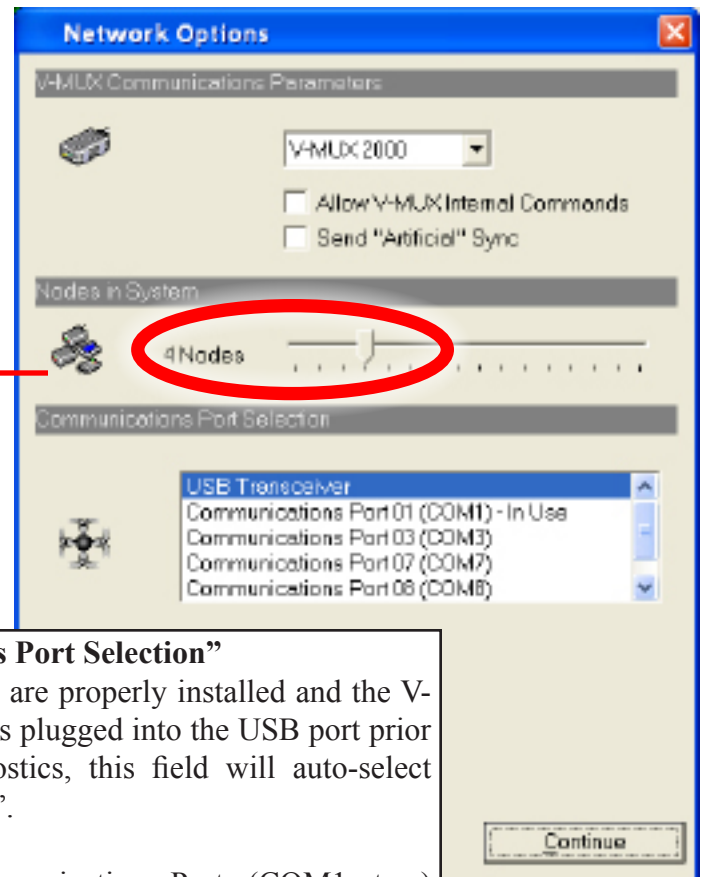
NOTE: Diagnostics must be disconnected (Icon 6) from the V-MUX system for this tool to be available.

#### **“V-MUX Communications Parameters”**

- select V-MUX 2000 (default) or V-MUX 98:  
All V-MUXed vehicles produced from the year 2000 are of type “V-MUX 2000”. Do not select V-MUX 98 unless told to do so by Weldon.
- “Allow V-MUX Internal Commands”  
Select this for access to the V-MUX commands that relate to basic system utilities and memory access. WARNING: Certain internal commands can erase the memory of a V-MUX node. Contact Weldon before using this feature.
- “Send ‘Artificial’ Sync”:  
Used when a Node #1 in network is not available. (Example: On a test stand)

#### **“Nodes in System”**

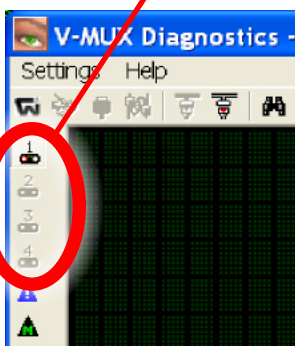
Slide control sets the number of nodes (1-16) available along the Diagnostics active node list..




#### **“Communications Port Selection”**

If the USB drivers are properly installed and the V-MUX transceiver is plugged into the USB port prior to starting Diagnostics, this field will auto-select “USB Transceiver”.

The standard Communications Ports (COM1 etc...) are a legacy from versions of Diagnostics that worked from a 9-pin serial port connection. Although Diagnostics still supports the standard COM ports, Weldon recommends that the USB port be used.



Tool 4)  “Database Options” -- Select a vehicle specific Diagnostics database if desired:



NOTE: Diagnostics must be disconnected (Icon 6) from the V-MUX system for this tool to be available.

### Current Message Database

V-MUX messages are simply numerical codes that get transmitted on the multiplex network. In order to display a readable Command with a message, for example “Reverse”, Diagnostics uses a database of text Commands that match to each code. The name of this database file, common to every V-MUX user, is **sdCommands.dav**. The great advantage of this common database is that V-MUX Diagnostics can tap into any V-MUXed vehicle and troubleshoot it because the codes are translated into common Commands.

A disadvantage is that a common database is inflexible when showing vehicle specific information, such as a list of switch Inputs and device Outputs.

The solution is to allow Diagnostics to extract from the V-MUX network a database specific to that vehicle. This database can then be saved for future use and other vehicle databases can also be saved along side it.

Database Options allows for any saved database to be used with Diagnostics.

### Available V-MUX Systems:

“sdCommands.dav” is the default database. Use the selection window to use a previously saved database file.

### System Information:

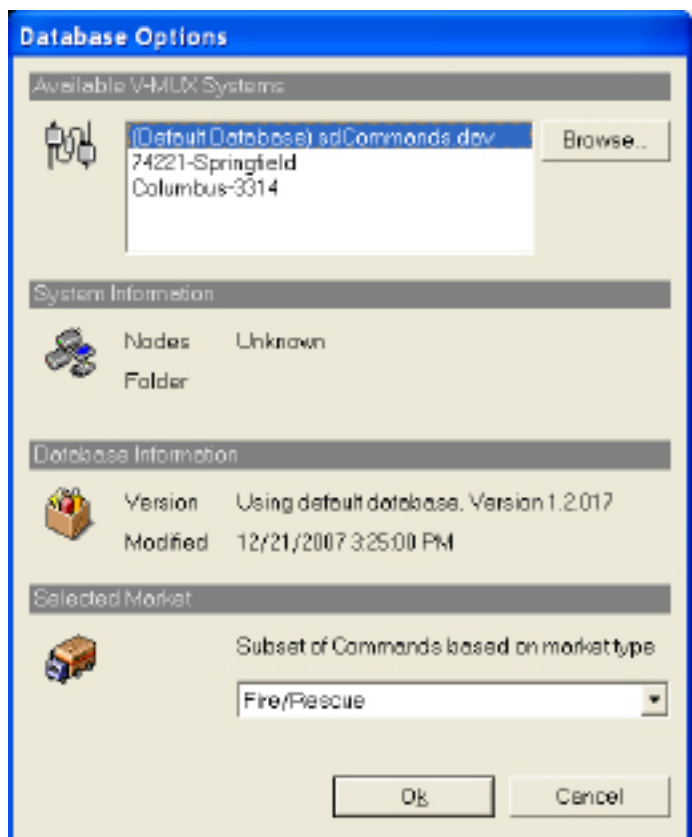
Shows node count and file path in the V-MUXed vehicle system.


### Database Information:

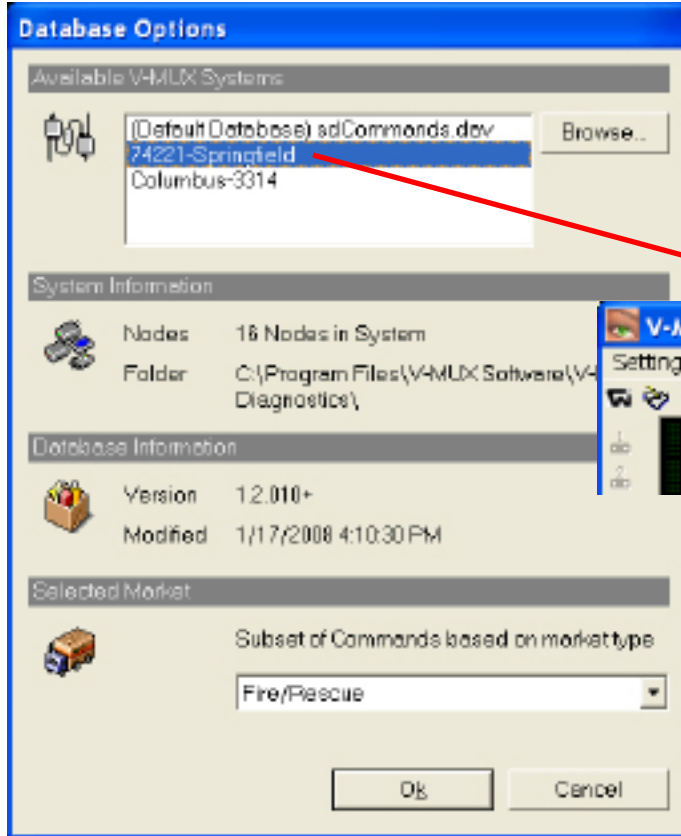
Shows the version number of the database and when it was last modified.

### Selected Market:

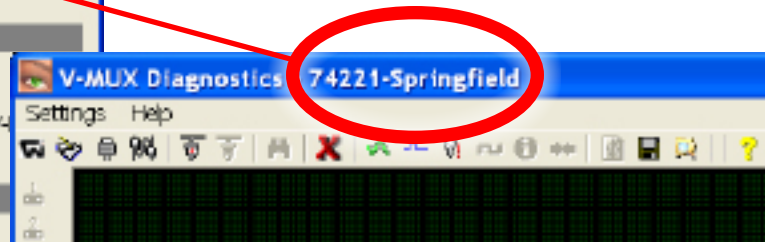
The Fire/Rescue market is the default.



Tool 4)  “Database Options” -- Select a vehicle specific Diagnostics database if desired:



**Example:** From the Database Options window we change the database file to vehicle **74221-Springfield**. The change in database is indicated at the top of the main Diagnostics window for the rest of the session.



The fields for **System Information** and **Database Information** will automatically update to match the selected database.

### Special Commands

There is an additional database not shown by the Database Options window. The file **SpecialCommands.dav** adds extra troubleshooting related messages to Diagnostics. Unlike sdCommand.dav, this extra database is not required and if it is missing from the folder, Diagnostics will still run, but without the extra messages.

Each of the following messages from SpecialCommands.dav will include the Node number and the channel number involved:

- Fault detected on \_\_\_\_\_
- Short detected on \_\_\_\_\_
- Open detected on \_\_\_\_\_
- Overcurrent detected on \_\_\_\_\_
- Direct PWM at \_\_\_\_\_

The following messages will include the node number in the data column of the Active Message List

#### Errors

- Bad Hercules Node Binary
- Bad Vista Node Binary
- Bad Gateway Node Binary
- Bad Mini Node Binary
- PIC Not Responding

#### Info

- PIC Reply Timeout



Tools 5 & 6)  “Connect Com Port” and “Disconnect Com Port” --



Note that Icons 5 and 6 are mutually exclusive -- when one is ON the other is OFF.



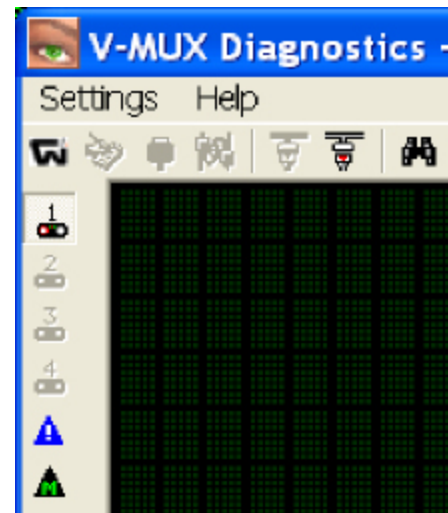
Click on Tool 5 to **Connect**. The Diagnostics program then opens the USB communications port and sends out Ping messages to nodes in the V-MUX system (if set to detect nodes).

Tools 2, 3, 4 become unavailable while connected.

If a V-MUX network is detected one or more nodes will reply to PING Commands. Diagnostics will activate the vertical node status bar and highlight all nodes that PING REPLY, up to the limit of 16. (Nodes may also be manually pinged with the **Ping Nodes** Tool 7 -- see below.)

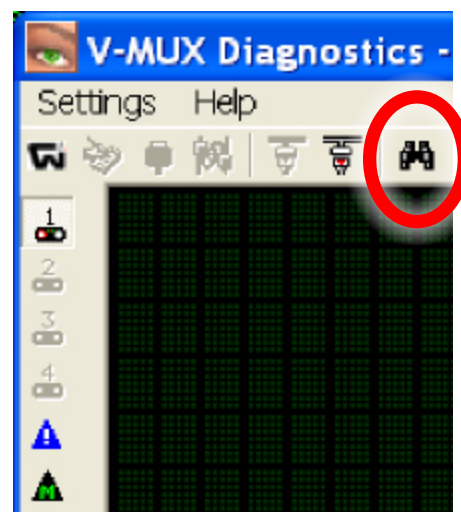
**Example:** Here we see that Node 1 has replied to its Ping message from Diagnostics. Its icon becomes available and we can see that it is distinctly highlighted.


Nodes 2, 3, and 4 have not replied to their Ping messages and so their icons remain ghosted and unavailable.

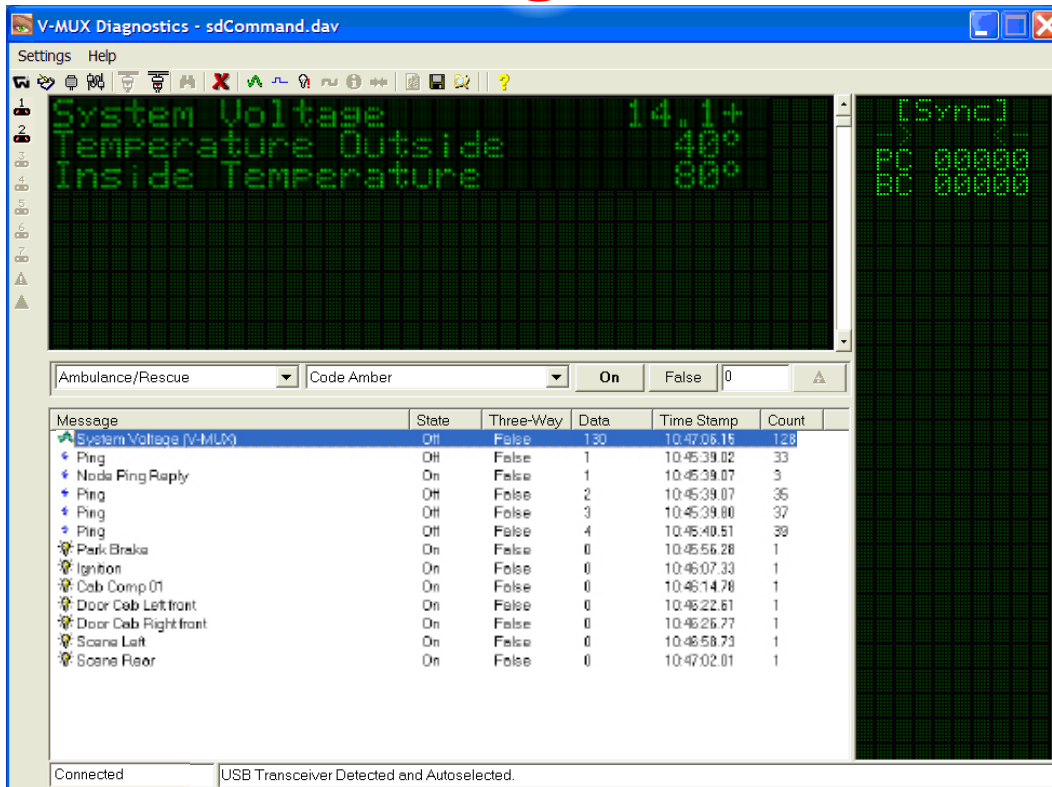


Tool 7)  **Detect Active Nodes** Re-Pings nodes up to the limit set in Network Options (Tool 3):

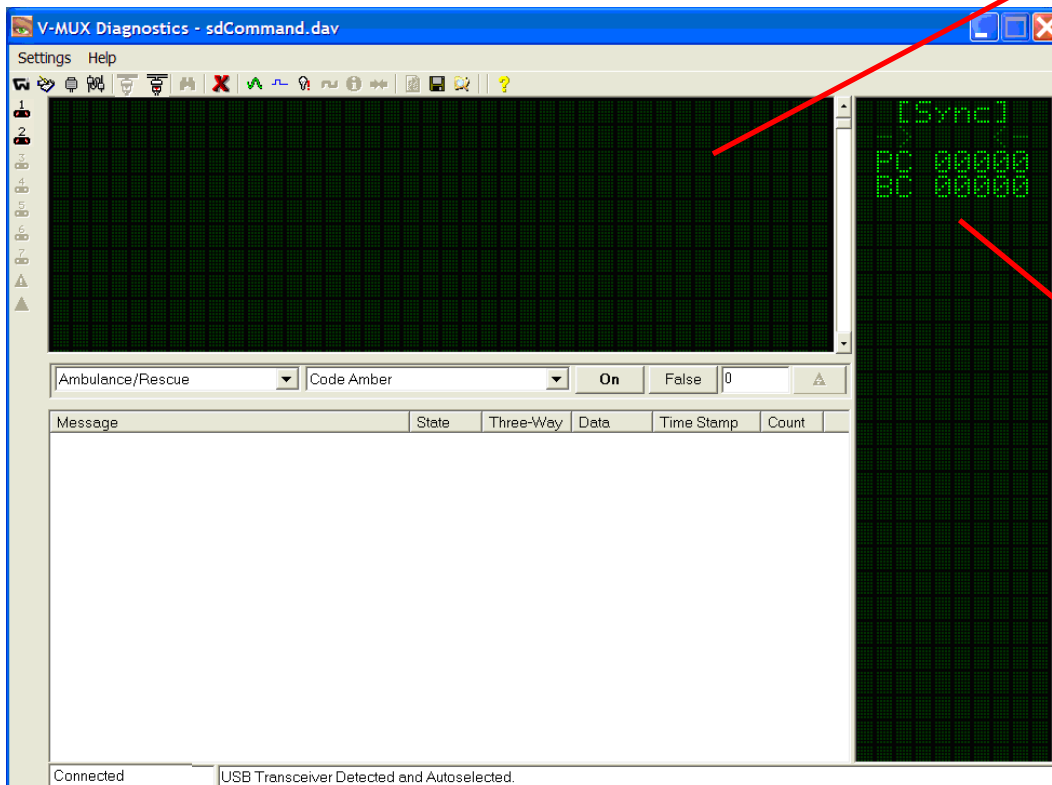
**Example:** Clicking on Tool 7 will Re-Ping Nodes 1 - 4. Four nodes is the limit, as seen from the left side list.



Tool 8)  **Clear Message List** -- Clears the upper and lower message areas:




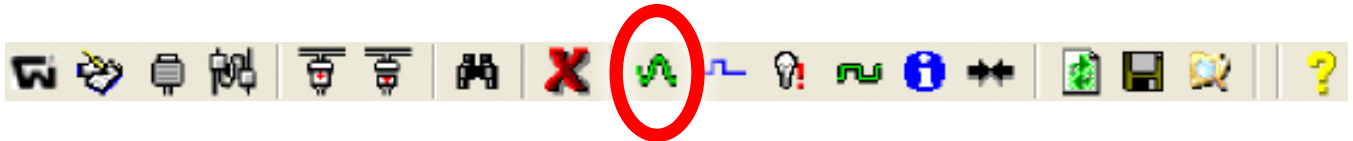
Even though the message lists are cleared, Diagnostics remains connected.



As new sensor data arrives, the upper message area will quickly fill again with information

The right side window (Network traffic and Load Management info) remains unchanged by the Clear Message list action

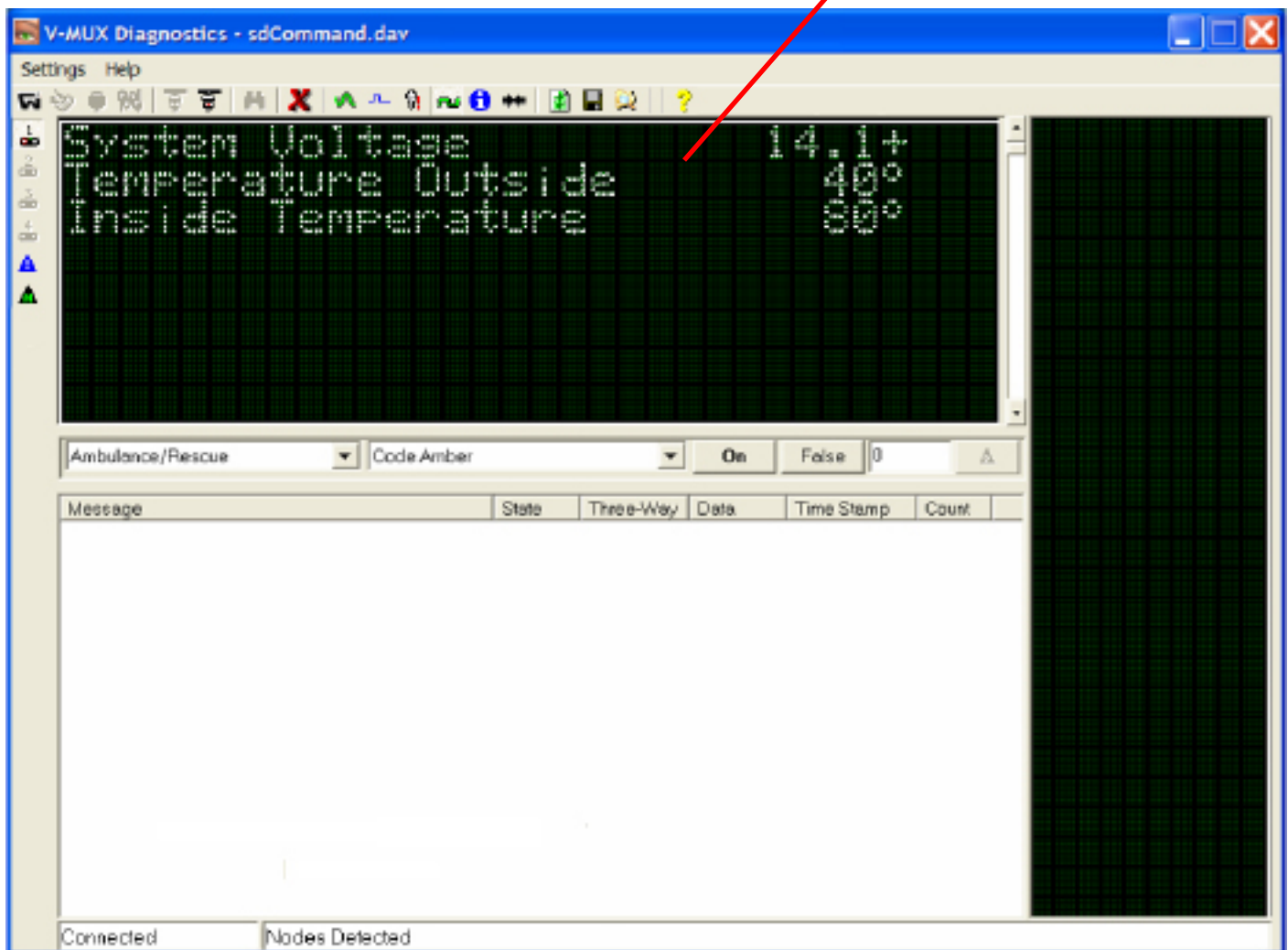
Tool 9)  “Display Analog Data” -- Sets the upper viewing area to display analog Sensor Data:



By default the Diagnostic window shows analog sensor data in the upper viewing area upon each Connect. If during a session the display has been changed to indicate other types of information, Icon 9 will return the view to analog sensor data.


V-MUX nodes transmit their sensor data (Voltage, Amps, Temperatures, etc...) with periodic updates for each measurement. Data refresh rates can be as fast as once every half second to as slow as once every 10 seconds. The sensor data is displayed line-by-line from top down as the data comes into Diagnostics.

Analog Sensor Data  
from all nodes

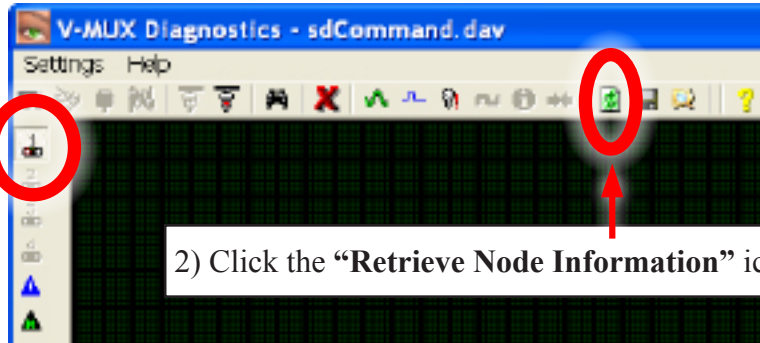
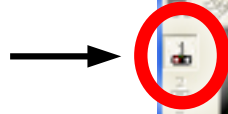






Tool 15,  **“Retrieve Node Information”**, becomes active when any node is selected from the left side list. This tool allows for the program memory of the node to be retrieved.

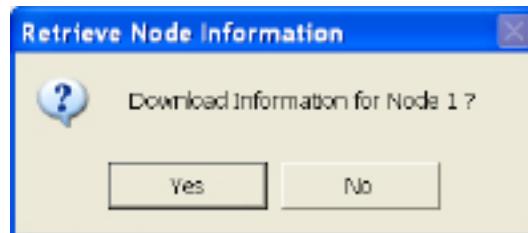
1) Select the desired node from the live status bar on the left side.



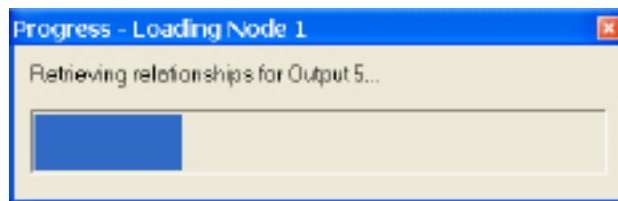
2) Click the **“Retrieve Node Information”** icon.

**“Retrieve Node Information”** is a necessary step whenever the Input/Output programming of the node needs to be examined. If the selected node is not already mounted, this tool will do the mount procedure automatically, thereby saving a step.

3) A pop-up box will ask to download information from the selected node’s memory. Click “yes”



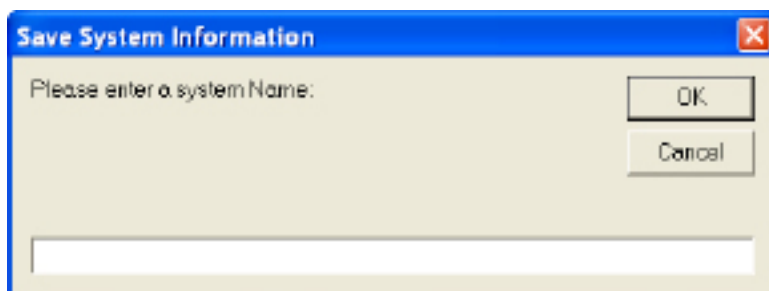
4) While retrieving the node’s program memory a progress indicator will appear.



#### Tool 16



Weldon recommends that the retrieved information be saved into a permanent database for future use.




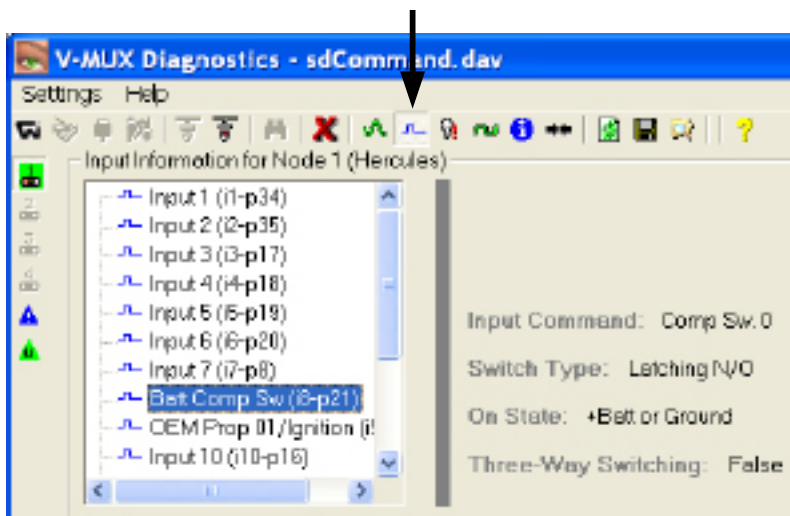
Enter a vehicle name for the database here. It will be saved to the local directory. The default database is named **sdCommand.dav**



**Tool 10) “Input Diagnostics”** -- Displays the Input List of a selected node:

The Input List comes from the node’s program memory.

Usually the selected node will have had its program information retrieved by use of Tool 15  for this feature to work. However, once the program information has been retrieved, it can be saved as a database available for future use with the V-MUXed vehicle.



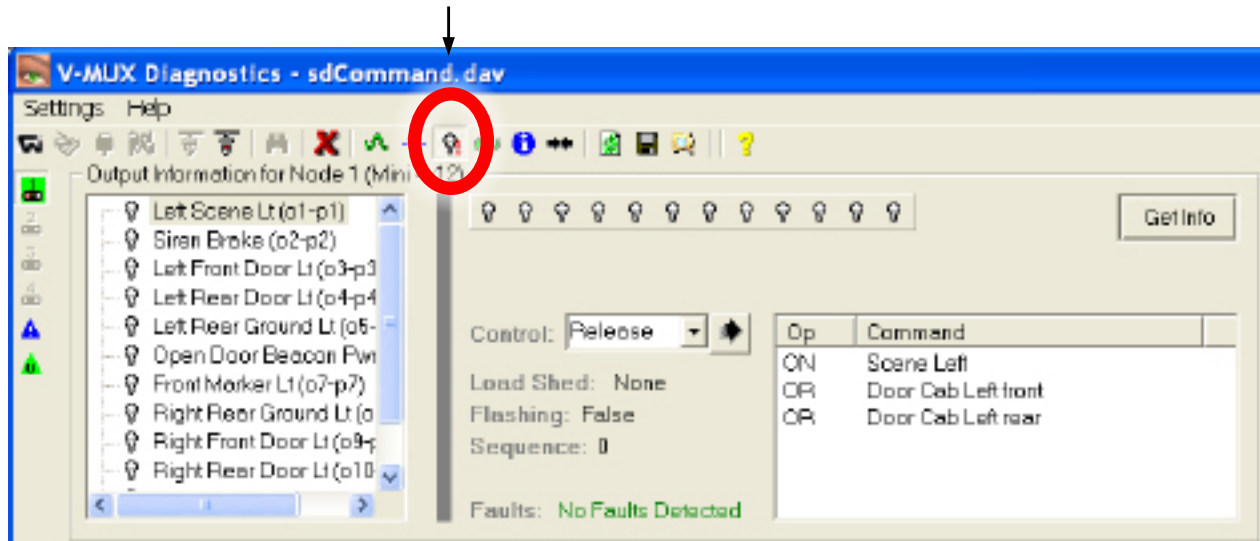
In the example shown here:

- the selected Node 1 is a **Hercules** node
- the OEM has assigned the name “**Bat Comp Sw**” to Input Channel 8 which is at pin 21 (**i8-p21**)
- the actual V-MUX Input Command that turns On and Off with the switch state is “**Comp Sw 0**”
- the switch type is **Latching - Normally Open**
- the ON state of the input channel can be triggered by either a **+VBatt** or a **Ground** signal (bi-directional)
- the switch is not used for any **Three-Way** output channel.




Tool 11) “Output Diagnostics” -- Displays the Output List of a selected node:


The Output List comes from the node’s program memory.



The Output List Manager contains two output channel control areas: **This example uses a Mini 4x12 node**

- The upper control of 12 light bulb icons  allows for each PWM modulated channel to be directly forced ON and OFF by clicking on the corresponding icon. The leftmost is channel 1 and the rightmost is channel 12. If you let the mouse cursor hover over a channel icon, a small text box will appear and name the output.

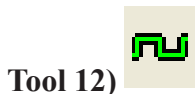
NOTE: A Hercules List Manager will have a set of 26 light bulb icons  but because only channels 1, 2, 15, 16 are modulated, only those four icons allow for direct control.

- The PWM Control  at the center allows you to change the Pulse Width Modulation of a selected channel by using a pull-down menu control. First select the desired channel (1-12) using the upper control. Next select the PWM percentage from the PWM Control then click on the arrow tool icon to send the PWM message for that channel. The “Release” option returns the output to its non-PWM state.

In the example shown above:

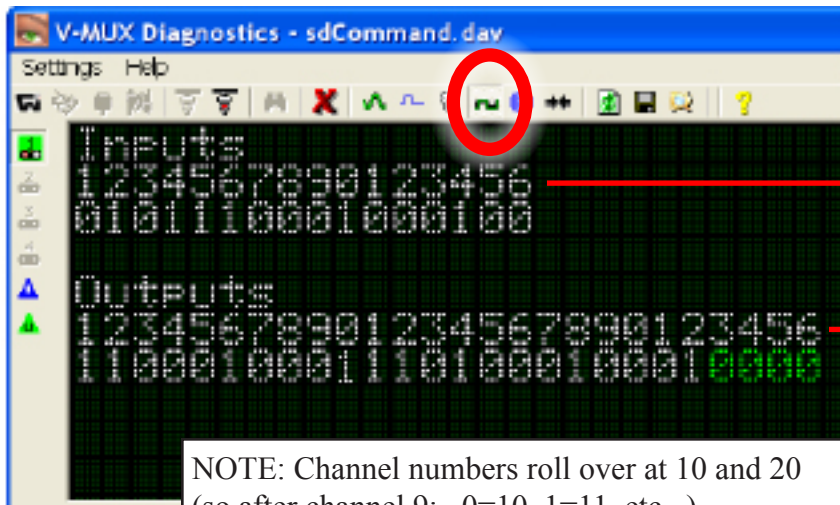
- the selected Node 1 is a **Mini 4x12** node
- the OEM has assigned the name “**Left Scene Lt**” to Output Channel 1 which is at pin 1 (**o1-p1**)
- Output Channel 1 will not **Load Shed** at any voltage
- Output Channel 1 will not **Flash** any ON/OFF pattern
- Output Channel 1 will not **Sequence** any ON/OFF delay
- No undercurrent or overcurrent **Faults** have been detected on this output.
- Output Channel 1 turns ON from the logical relationships

ON <Scene Left>  
OR <Door Cab Left front>  
OR <Door Cab Left rear>



Tool 12) “Monitor Inputs and Outputs” -- Displays the real-time state of Inputs/Outputs for the mounted node

Hercules node



Input channel numbers  
state (1=ON, 0=OFF)

Output channel numbers  
state (“1”=ON, “0”=OFF, dim “0” = not used)

NOTE: Channel numbers roll over at 10 and 20  
(so after channel 9: 0=10, 1=11, etc...)

Both the Mini 4x12 and the Mini 16x0 differ from the Hercules node in that for each Input channel there are six programmable electrical conditions that can trigger the ON state:

- +Batt
- Ground
- +Batt or Ground
- NOT +Batt
- NOT Ground
- Floating (open)

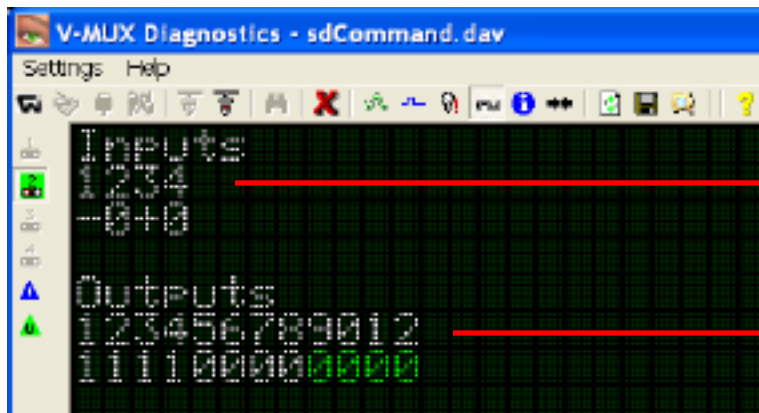
The benefit for troubleshooting is that Mini nodes are able to actively report on the electrical state of their inputs. An input state is indicated by one of three symbols.

Electrically by symbol:

- Floating (switch open) = “0”
- +Batt = “+”
- Ground = “-”

The logical ON/OFF state of the input is indicated in the Diagnostics lower Active Message List area. (See example next page)

Mini 4x12 node



Input channel numbers  
electrical state (“+”= +Batt, “-” = Ground, “0” = open)

Output channel numbers  
state (1=ON, 0=OFF, dim “0” = not used)



## Tool 12) “Monitor Inputs and Outputs” -- Displays the real-time state of Inputs/Outputs for the mounted node

The Mini 16x0 differs from the Mini 4x12 in that it has only inputs, therefore the Output List is blank. The Input List expands to 16 monitored channels, each programmed to electrically trigger from one of six possible conditions:

- +Batt
- Ground
- +Batt or Ground
- NOT +Batt
- NOT Ground
- Floating (open)

Electrically by symbol:

- Floating (open) = “0”
- +Batt = “+”
- Ground = “-”

The logical ON/OFF state of the input is indicated in the Diagnostics lower Active Message List area.

### Mini 16x0 node

The screenshot shows the V-MUX Diagnostics - sdCommand.dav window. The top section displays a list of inputs and outputs. The inputs are numbered 1 through 16, and the outputs are numbered 1 through 16. The inputs are currently showing a mix of symbols: '+' for inputs 5 and 6, '-' for inputs 8 and 9, and '0' for the remaining inputs. The outputs are all showing '0'. Below the input/output list, there is a dropdown menu for 'Ambulance/Rescue' and 'Code Amber', with buttons for 'On', 'False', and '0'. At the bottom, there is a table of active messages.

Message	State	Three-Way	Data	Time Stamp	Count
Ignition	On	False	3	13:45:17.23	2
Reverse	On	False	3	13:45:22.35	2
Door Cab Left Front	On	False	3	13:50:04.57	2
Door Cab Left Rear	On	False	3	13:50:35.71	2

#### Example -- For a Mini 16x0 node #3:

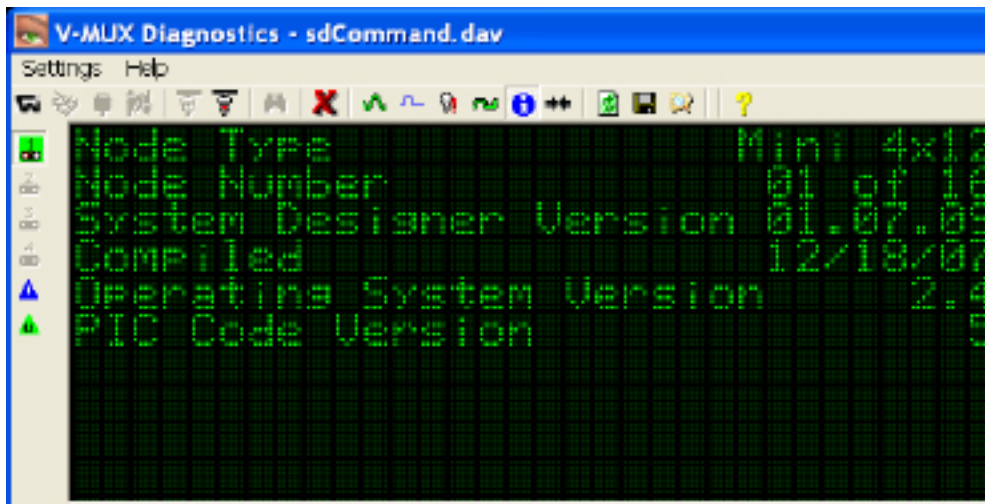
NOTE: All input switch locations on a mounted node are defined by Icon tool 10 “Input Diagnostics”.

- Inputs 5 and 6 are wired for Ignition and Reverse, respectively. The logical ON state for both of these switch signals is triggered electrically by +Batt. The top Input List shows this electrically with a “+” symbol at inputs 5 and 6. The lower Active Message List shows this logically with an ON icon and text.
- Inputs 8 and 9 are wired for the Left Front and Left Rear Cab Doors. The logical ON state for both of these door switch signals is triggered electrically by Ground. The top Input List shows this electrically with a “-” symbol at inputs 8 and 9. The lower Active Message List shows this logically with an ON icon and text.
- All other Inputs are electrically floating (open switch), which is indicated with a “0” symbol.

Tool 13)



**“Flash Information”** -- Displays the top-level contents of the node’s Flash memory.



In the example shown here:

- the selected **Node Type** is a Mini 4x12
- it is **Node Number** is #1 of 16 nodes in the vehicle network
- The node application file was created with V-MUX **System Designer Version** 1.7.9
- The node application file was created (**“Compiled”**) on December 18, 2007
- The node **Operating System Version** is 2.4

Mini 4x12 only -- There is a secondary controller on the node called a PIC processor with its own Operating System. The latest **PIC Code Version** is 5.

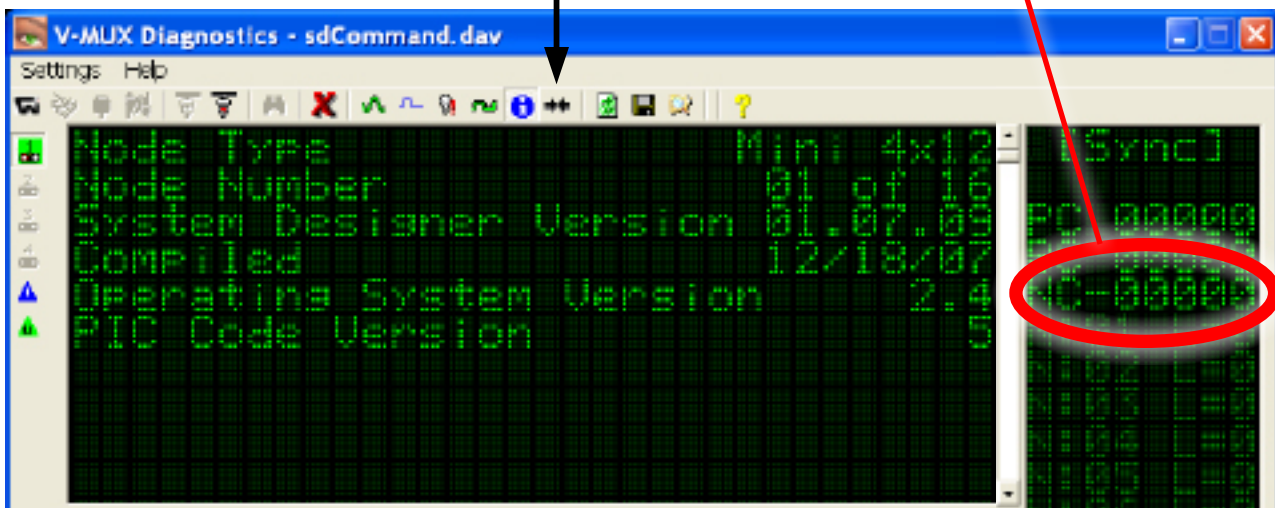


#### Tool 14)



**“Monitor Node Collisions”** -- Monitors loss of data reported by the mounted node.

Once the node collisions monitor is active there is a small rotating pipe ( | ) to the right of the “NC”.



V-MUX nodes listen to their own messages ( the “local echo”) as they transmit on the communications line. If a node fails to hear its own messages it attempts to re-transmit them and also keeps track of exactly how many messages have failed. These failed messages are referred to as “Collisions”, even though they may fail for various reasons.

#### **The three Collisions counters:**

**NC** -- By clicking on Icon 14, Diagnostics asks the mounted node to report how many collisions it alone has noted since being mounted. This is reported and updated in the NC field

**BC** -- When Diagnostics is monitoring a V-MUX network, all the unmounted nodes are able to report collisions. The BC field indicates the totality of collision on the network, and is updated in real time.

**PC** -- The Diagnostics program is also able to sense a failed transmit of its own messages (from the computer to the network). This is indicated in the PC field

A small number of collisions during a Diagnostics session is acceptable as long as the collisions completely stop after heavy Diagnostic activity, for example -- extracting node information, ceases.

A consistently incrementing counter for PC, BC, or NC is an indication of a serious failure of the communications link to carry data. It **MUST** be investigated and fixed or the loss of data will get worse over time.

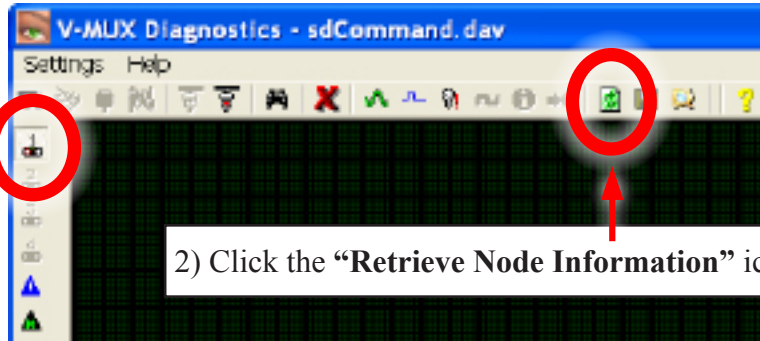
#### **Some common causes of collision activity:**

- Water in the communications links
- Mis-pinned communications links
- Improper node grounds
- Heavy flyback from inductive loads

Tool 15)  **“Retrieve Node Information”**-- Retrieves the node program memory.

Tool 15 becomes active when any node is selected from the left side list.

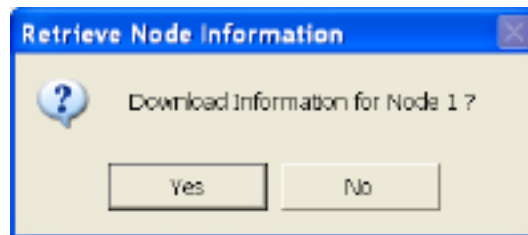
1) Select the desired node from the live status bar on the left side.



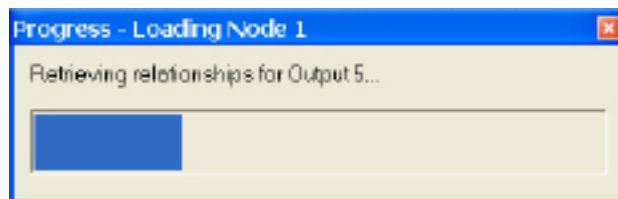
2) Click the **“Retrieve Node Information”** icon.

**“Retrieve Node Information”** is a necessary step whenever the Input/Output programming of the node needs to be examined. If the selected node is not already mounted, this tool will do the mount procedure automatically, thereby saving a step.

3) A pop-up box will ask to download information from the selected node's memory. Click “yes”



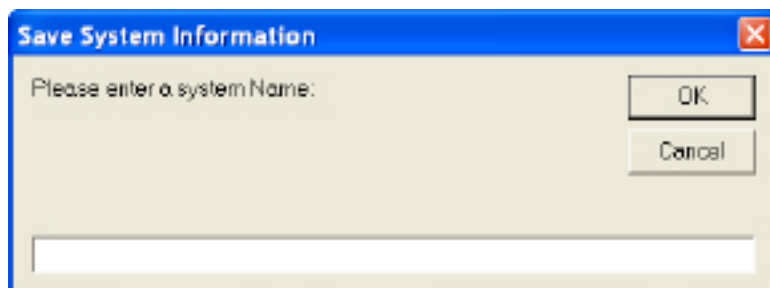
4) While retrieving the node's program memory a progress indicator will appear.



Tool 16)  **“Save Current System”**



Weldon recommends that the retrieved information be saved into a permanent database for future use.



Enter a vehicle name for the database here. It will be saved to the local directory. The default database is named **sdCommand.dav**



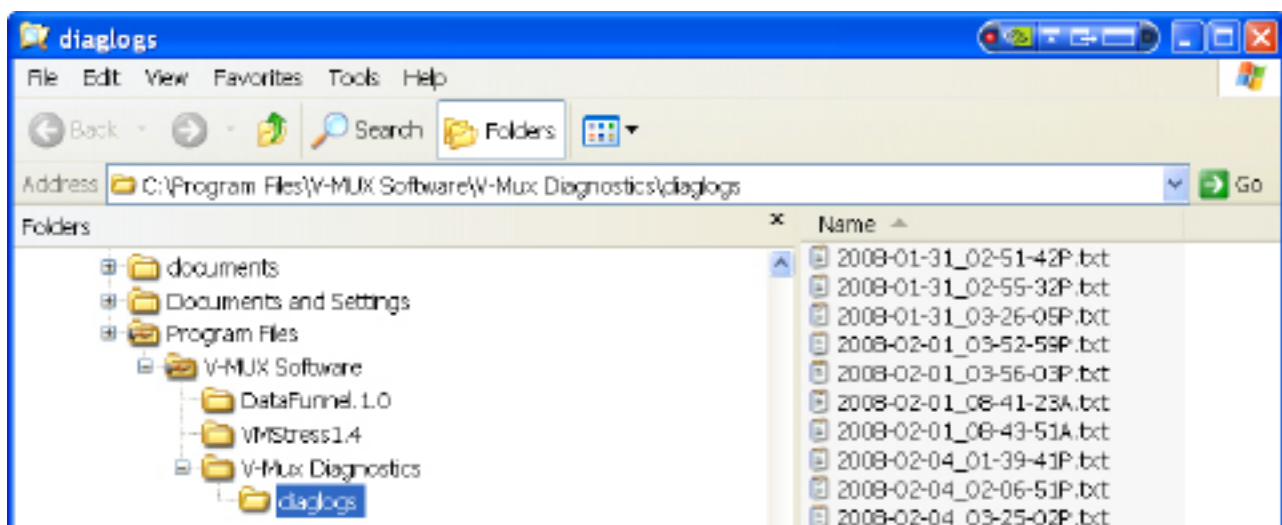
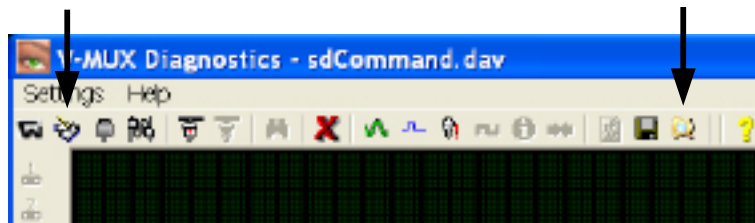
**Tool 17)**  “Explore Diagnostics Log Directory” -- Shows the folder holding all of the Diagnostics log files.

Log files are enabled from “Message Logging” Tool 2 . The folder is named “diaglogs”

The path to the Diagnostics session log files, shown in the view window, is:  
**C:\Program Files\V-MUX Software\V-Mux Diagnostics\diaglogs**

Tool 2 enables log file reporting

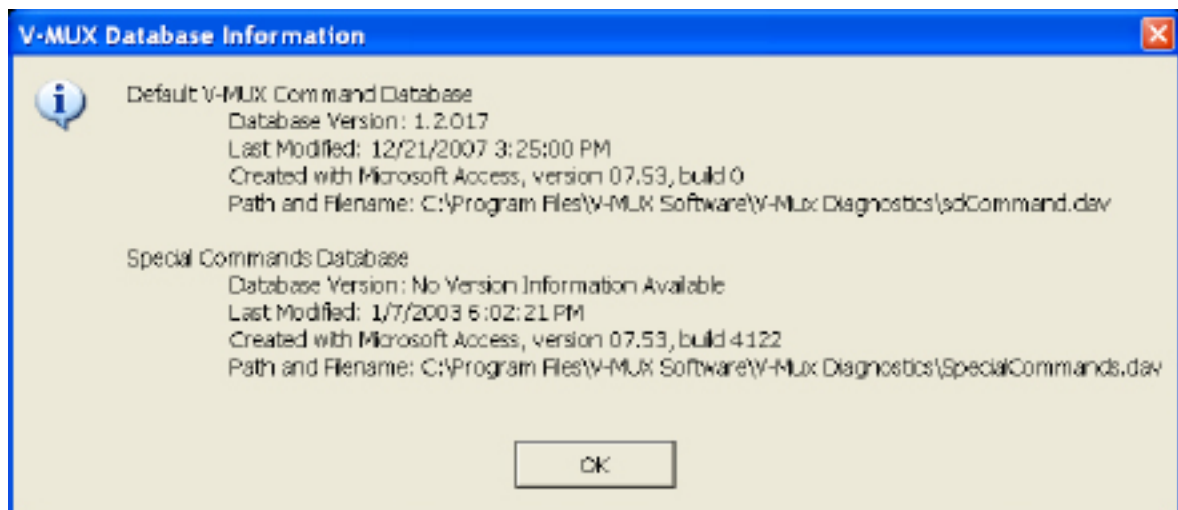
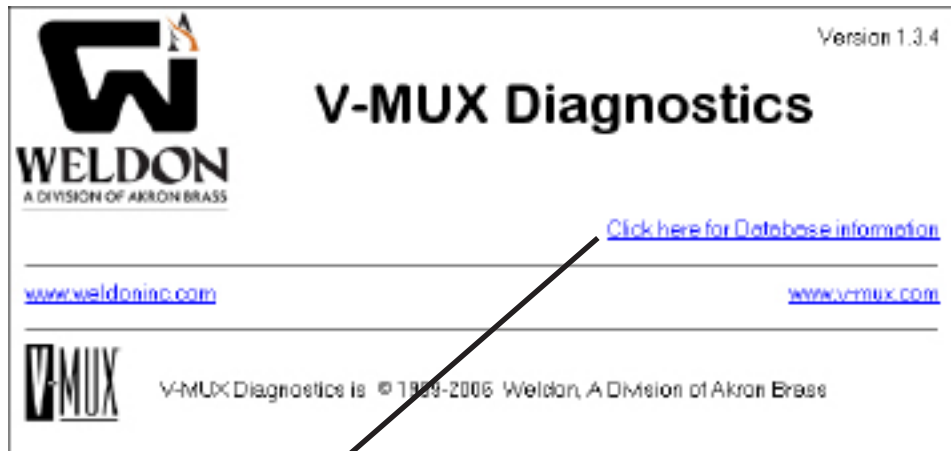
Tool 17 accesses log file reports



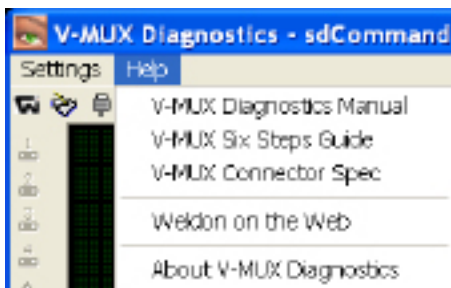
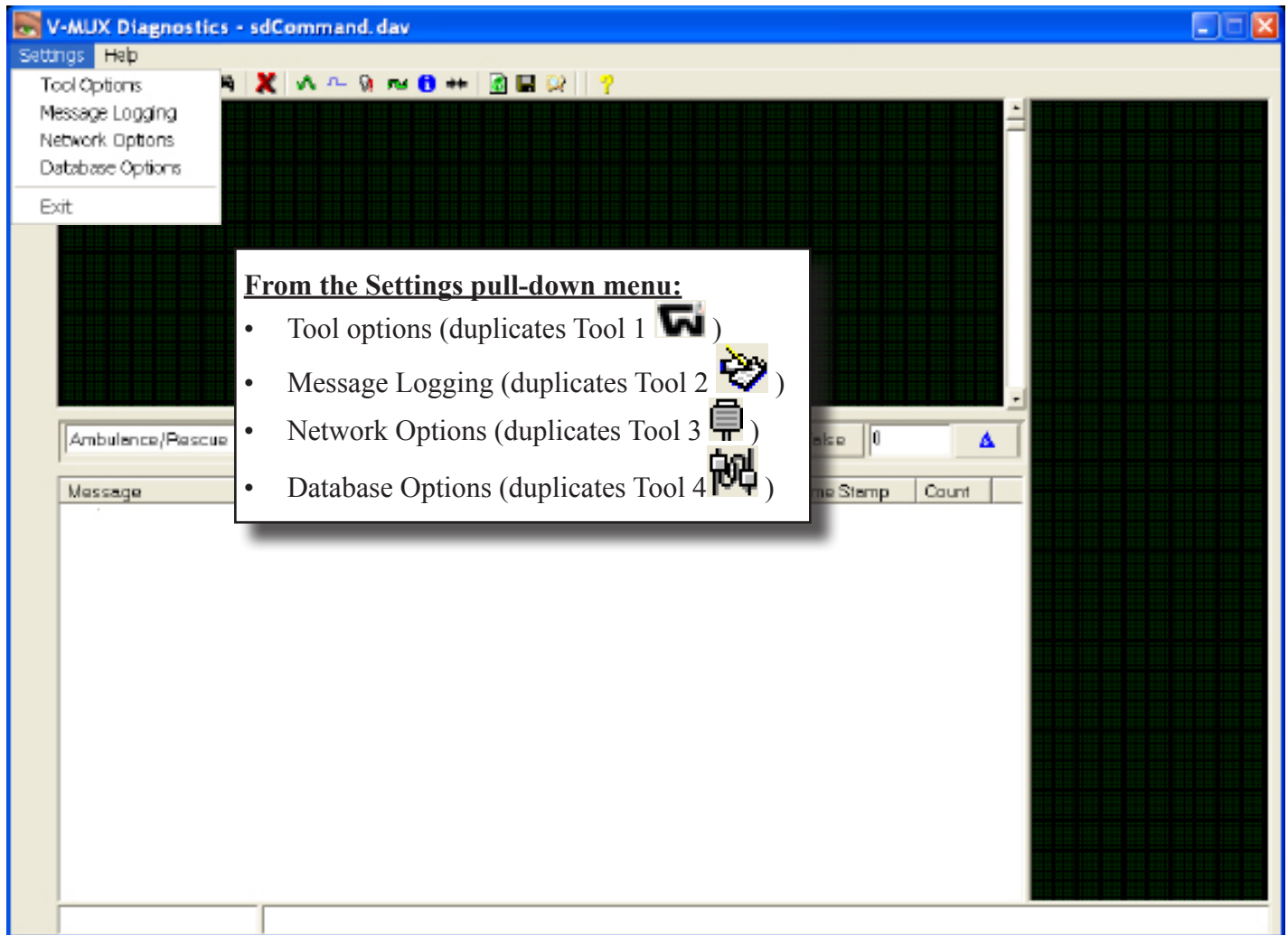
The Diagnostics log files are simple text files (\*.txt) with a time stamp in the filename area indicating when they were saved.

Tool 18)  “About” -- Invokes version and database related information

- The version (build) of the Diagnostics program. Current version is 1.3.4
- Shows the default database file **sdCommand.dav** installed version
- On-line website links: **www.weldoninc.com** and **www.v-mux.com**




## Top-Level Tool pull-down Menus -- “Settings” and “Help”



### **From the Help pull-down menu:**

--- All documents are in Adobe .pdf format ---

- V-MUX Diagnostics Manual ( this user manual)
- V-MUX Six Steps Guide ( a quick troubleshooting guide)
- V-MUX Connector Spec ( a reference to all V-MUX components)
- 
- Weldon on the Web ( an online link to [www.v-mux.com](http://www.v-mux.com); NOTE: the computer must be online with the world wide web for this link to work)
- About V-MUX Diagnostics (duplicates Tool 18 )

## V-MUX System Report Documents --

The entire V-MUX electrical design as created by the vehicle OEM can be put into document form for reference. The Microsoft Excel® spreadsheet program is used to create these documents. Two main reference documents will be created for you to use:

- 1) **The Input/Output Nodal Specification**
- 2) **The Nodal Relationships Specification**

Document 2, the Relationships Spec, is the more useful of the two for troubleshooting Command Logic.

**Inputs:** Both Digital (switches = ON/OFF) and Analog (sensors = 0-5VDC range) are listed.

**Node:** The live node number associated with this page is shown.

**Location:** Indicates where in the vehicle the node is located.

**Ch#:** The Weldon V-MUX channel number.

**Pin #:** The harness pin assignment on the terminating Deutsch end connector.

**OEM Wire:** The harness wire identifier.

**Command:** The V-MUX message command that will be issued when the switch is thrown.

**Qty:** NOT CURRENTLY USED. Will always be blank.

**Type:** Switch type; momentary, latching, normally open, normally closed.

**Comments:** Anything of importance the OEM designer wants you to know.

**Example:** Mini4x12 -- 4 switch inputs, 1 analog sensor input, 1 internal System Voltage.

Digital Inputs			Node 1	Location: Right-Mid		
Ch #	Pin #	OEM Wire	Command	Qty	Type	Comments
1	3		E Emergency Master		Latching N/O	
2	2		E Primary		Latching N/O	
3	10		E Secondary		Latching N/O	
4	4		Turn Signal Right		Latching N/O	
Analog Inputs						
Ch #	Pin #	OEM Wire	Command	Value Range		Comments
1	N/A		Unassigned	0	188	
2	1		Unassigned	0	255	

## V-MUX System Report Documents (continued) --

**Outputs:** Hercules node (High capacity = +12 VDC, 10.5 Amp/channel, channels 1-16

Low capacity = +12 VDC, 2 Amp/channel, channels 14-24

Low ground = GND , 2 Amp/channel, channels 25, 26)

Mini4x12 node (Medium capacity = +12 VDC, 7.5 Amp/channel)

**Priority Shedding:** Indicates the voltage level this output channel will Load Manage OFF at.

**Relationships:** Indicates the logical relationship a set of one or more input commands must have to cause the

High Capacity Outputs			Node 1		Location: Center-Front
CH #	Pin #	OEM Wire	Name	Priority Shedding	Relationships
1	R		Output 1	No Shed	(None)
2	S		Output 2	No Shed	(None)
3	F	LHF/SP380	HIGH IDLE	No Shed	<ON> Auto Throttle <AND> Park Brake <AND> Ignition <AND> <NOT> PTO Switch (Hot Shift) <AND> <NOT> Service Brake
4	T	LHT	L SIDE DC SCENE	2 (12.1 V)	<ON> Ignition <AND> Scene Left <AND> Park Brake
5	G	LHG	R SIDE DC SCENE	2 (12.1 V)	<ON> Ignition <AND> Park Brake <AND> Scene Right
6	U		Output 6	No Shed	(None)
7	H	LHH/WT118	PTO REQUEST	No Shed	<ON> PTO Switch (Hot Shift) <AND> Ignition <AND> Park Brake <AND> Park/Neutral
8	V	LHV	WARN FRONT ROCKER	No Shed	<ON> E Emergency Master
9	L	LHL/SP323/SF	L LT BAR RED RELAY	No Shed	<ON> E Emergency Master <AND> E Front Lightbar Red
10	B	LHB/SP324/SF	R LT BAR RED RELAY	No Shed	<ON> E Emergency Master <AND> E Front Lightbar Red
11	M	LHM/SP325/SF	PTO ENGAGE SOLENOID	No Shed	<ON> PTO Switch (Hot Shift) <AND> Park Brake <AND> Park/Neutral <AND> Ignition
12	C	LHC/SP326/SF	REAR DIRECTIONAL LIGHT	2 (12.1 V)	<ON> E Emergency Master <AND> Park Brake
13	N	LHN/SP327/SF	LT BAR CLEAR RELAY	No Shed	<ON> E Emergency Master <AND> E Front Lightbar Red <AND> <NOT> Park Brake
14	D	LHD/SP328/SF	MARS LIGHTS RELAY	0 (No Load)	<ON> E Grill Lights <AND> <NOT> Park Brake
15	O		Output 15	No Shed	(None)
16	P		Output 16	No Shed	<ON> E Emergency Master <AND> E Strobes Low
Low Capacity Outputs					
CH #	Pin #	OEM Wire	Name	Priority Shedding	Relationships
17	Q	LHO/SP329/SF	OPTICOM RELAY	No Shed	<ON> E Emergency Master <AND> E Front Lightbar Red <AND> <NOT> Park Brake
18	E	LHP/SP330/SF	WW STROBE SUPPLY	No Shed	<ON> E Emergency Master <AND> E Strobes Low
19	A	LLA	AC LOAD MGT RELAY	1 (12.5 V)	<ON> Ignition
20	J		Output 20	No Shed	(None)
21	W		Output 21	No Shed	(None)
22	X		Output 20	No Shed	(None)
23	K		Output 23	No Shed	(None)
24	7		Output 24	No Shed	(None)

## Appendix A: USB Driver Installation:

### **Driver installation instructions: V-MUX® Transceiver for USB**

Included with your USB transceiver kit:

- (1) USB to V-MUX transceiver box.
- (1) USB cable. Connects USB side of transceiver to user's computer.
- (1) V-MUX cable. Connects V-MUX side of transceiver to Diagnostics tap in vehicle.
- (2) Deutsch pin extractor tools -- red and blue plastic
- (3) Hook-up adapter tools for Hercules node, Mini-nodes, and CAN Gateway node.
- (2) Jumper wire tools -- red and black.
- (1) USB memory stick ("thumb drive") -- includes Diagnostics, Downloader, and USB device drivers software.

**NOTE:** The USB device drivers are only tested for Windows 2000, XP.

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#### **The included USB cable has two molded ends, each distinctly shaped.**

Plug the square-shaped end into the USB transceiver box.

Plug the rectangular end into the computer's USB port.

**NOTE:** there is a connection icon on the flat end to aid in the proper orientation of the cable into the USB port. The icon usually must point upward at the USB port, or match a corresponding icon printed at the port if sideways.

#### **First time users:**

Windows should auto-detect the first new USB hardware item. (There will be two altogether.) "Found new hardware: USB TO RS-422/485 ADAPTER"

The Found New Hardware Wizard should pop up.

#### **Do you have your USB transceiver drivers on the included USB memory stick?**

--- Place your USB memory stick in an available computer USB port.

--- Select "Install the software automatically (Recommended)".

--- Click "Next>". Windows will scan for the correct files and auto-install them.

OR

#### **Are your USB drivers in a different sub-directory because they were saved or downloaded to there?**

Windows may not be able to find them automatically.

--- Select "Install from a list or specific location (Advanced)".

--- Click "Next>".

--- Select "Search for the best driver in these locations."

---Are your USB drivers saved somewhere on your own A:\ floppy or CD-ROM disk?

----- Select "Search removable media (floppy, CD-ROM...)" Windows will search all.

---Do you know the correct path (maybe on the hard drive) to where your USB drivers are saved?

-----Select "Include this location in the search:" Use the Browse button to navigate to the correct directory.

-----When Windows sees the USB drivers' directory it will auto-install them.

Windows should next auto-detect the second new USB hardware item.

"Found new hardware: USB Serial Port"

The Found New Hardware Wizard should pop up for the second install.

Repeat the above procedure as before.

After the initial installation the driver settings should remain permanent.

If you have any problems with this setup please call **Weldon, A Division of Akron Brass**  
(800) 989-2718 -- V-MUX® support on extensions x9509, x9510



## Appendix B: V-MUX Internal Commands:

**Ack** – Acknowledge to clear Load shed, Analog Warnings and Diagnostic errors on the VFD.

**Download Code** – **\*\*DANGER\*\*** Tells a mounted node to INVALIDATE its current program for new programming.

**Download Data** – NOT USED , OBSOLETE

**Invalidate** – NOT USED, OBSOLETE

**Mount** – Puts selected node into a one-on-one state, this will allow you to extract certain types of information from the node. MOUNT must precede the DOWNLOAD CODE command.

**Set Load Level** – Use this command with a mounted node to set the Load shed level to any desired value – even though the actual voltage level is ok. Type the desired load level into the Data Byte click the send to set the load level.

**Pause System** – Pauses the system so that it will not send commands.

**Resume System** – Resumes the system after pause.


**PC Random Send** – Test command used for purposely creating collisions. Disabled in production code so it will not do anything if you use it.

-----  
Commands that begin with “Get” require you to mount the node you want to extract information from. The Node the Data Field of the Data Transport Command.

**Get Command Array** –Returns the value of all commands that are turned ON in the system. The command array is an internal array of all the commands available to the system. The value that returns will be a sum of all the positions. Value range is 0-1024.

**Get Input Array** – Extracts the status of the input array for the node you are mounted to. The value will be the sum of all the inputs turned on for that node.

**Get Output Array** – Returns the sum off all the outputs that are turned on for the node you are mounted to.

**Get Flash Data** – Returns the flash information in the data field. The Flash Information Icon 13  on the top tool bar is recommended; this will return information in the upper window that is already formatted.

**Get Protocol Errors** – NOT USED

**Get Collisions** – Retrieves the total number of collisions that have occurred on the network.

**Get Buffer High** – Retrieves the highest position that the receive buffer has reached. The buffer has 20 positions. If the number returned in the data field is 20 you should check the buffer overflows. Use GET ALL MAIL STATS for more information.

**Get Buffer Overflows** – If the Buffer High position reaches 20 then you can expect to see a number returned in this request. If the Buffer High is below 20 you should not see any value other than 0 returned.

**Get Command Checksum** – This command will return the checksum value of the command array.

## Appendix B: V-MUX Internal Commands (Continued):

**Get Analog Channel** – To obtain the raw value of the analog channel use this command. Enter the channel number of the request in the data field

**Get Voltage** – Returns the local voltage from any node (System Voltage is from node 1) .

**Get Load Level** – Returns the load-shed level from the node you have mounted.

**Get Embedded Version** – Returns the embedded code (operating system) version a node is running.

**Get All Mail Stats** – Using this command while mounted to a node will receive the network stats for that node. The request will go out to the node and the node will transport the network information back Via the Data Transport command. The network information will be in the following order with values for each item in the data byte:

Inbox high: The inbox has 20 positions; a value >20 usually means a network problem.  
Inbox overflows: This represents the number of times Inbox high has exceeded 20.  
Outbox high: This also has 20 positions and should always be a value lower than 20.  
Outbox overflows: This represents the number of time the Outbox has exceeded 20.  
Messages received: A running total of the number of messages that have been received.  
Messages sent: A running total of the number of messages that have been sent.

**Get TP and Set TP** – For Weldon use only. Used for debugging problems with Weldon test code; TP = Test Point.

----- Nodes transmit inter-System information to one another using the following commands. -----

**Data Transport** – This is the command that a node uses to transport data; for instance, a node uses this command to reply answers to your “Get” requests. Using this command from the PC will do nothing.

**VM Sync** – This command syncs all the nodes together; the nodes are synced in order to maintain patterns for flashing lights. Node 1 sends the Sync command every few seconds, if the other nodes on the network do not hear a Sync command they will start broadcasting an “Out of Network Message. You can observe this in the Diagnostics lower window.

**VM Load Shed** – This command is used for the nodes when transmitting the load shed values to each other. It is updated on the right side of the Diagnostics software

**VM Request for Command Checksum** -- A node that has been out of network or has had protocol errors will use this internal command.

**VM Diagnostics** – The nodes to transmit their diagnostic messages use this command.