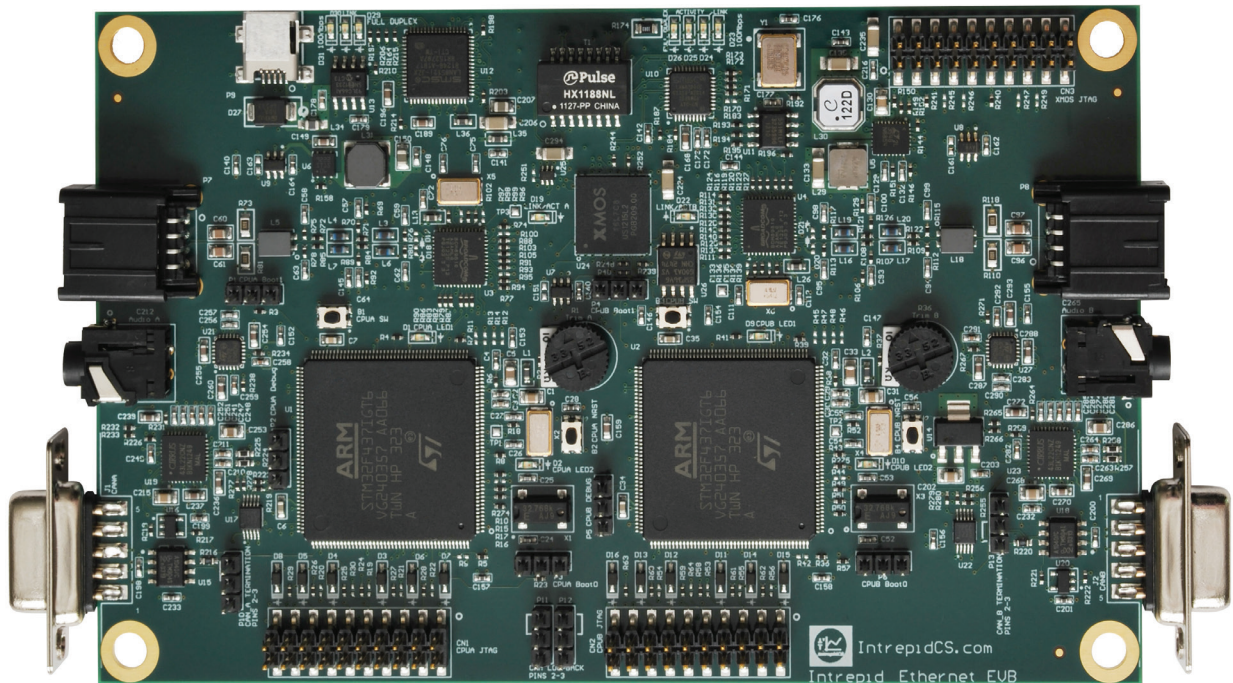


# Ethernet EVB

Ethernet Experimentation & Evaluation Board



## User's Guide

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# 1 Introduction to the Intrepid Ethernet EVB

Congratulations on purchasing an Intrepid Control Systems (ICS) Ethernet Experimentation and Evaluation Board, known more simply as the *Ethernet EVB* or just *EEVB*. This low-cost education and analysis tool is an excellent way to get up to speed with the exciting new vehicle networking technology known as *Automotive Ethernet*.

The Ethernet EVB contains two fully-functional BroadR-Reach Automotive Ethernet nodes and a special active test access point (active tap) that allows you to monitor Ethernet messages in real time. The two nodes can be scripted to implement arbitrary Ethernet functionality, including the simulation of TCP/IP and Audio Video Bridging (AVB) applications. The board also contains two programmable CAN nodes, allowing you to create experiments that combine Ethernet and CAN.

## 1.1 About the Ethernet EVB User's Guide and Lab Manual

Intrepid has created two documents to help you get the most of your new Ethernet EVB.

The first, which you are reading right now, is the *Ethernet EVB User's Guide*. This reference introduces the EEVB and describes its features, components and functions, helping you better understand the device and how it works. The User's Guide contains instructions for setting up the board, installing and configuring Vehicle Spy 3, and ensuring that the two are working well together. This guide will also guide you through an initial demo so you can get your first taste of using the EEVB, and be sure that it's working correctly. Finally, troubleshooting information is provided to help you deal with common issues that may crop up as you begin using your device.

The second resource for the board is the *Ethernet EVB Lab Manual*. This document contains examples and scenarios that showcase some of the many ways that the Ethernet EVB can be used to demonstrate the operation of Automotive Ethernet. The Lab Manual uses special downloadable scenario setup files—available free on the ICS website—and step-by-step instructions to show you how Automotive Ethernet frames are sent and received. It walks you through various sample applications such as an ARP Request/Reply exchange, custom-programmed input and output, sending data using IP messages, and much more.

Be sure to also visit Intrepid's special web page dedicated specifically to the Ethernet EVB, which can be found at <http://www.intrepidcs.com/ae/eevb/>.



**Note:** To avoid repetition, the Lab Manual assumes that you have already reviewed the User's Guide and followed the instructions it contains for setting up the Ethernet EVB board and Vehicle Spy 3 software. For this reason, we recommend reading the User's Guide before proceeding to the Lab Manual.

## 1.2 Using Vehicle Spy 3 with the Ethernet EVB

A computer without software is just a paperweight, and in a similar way, the Ethernet EVB without software would just be a fancy circuit board with blinking lights. Your EEVB needs a partner to help it live up to its full potential, which ICS provides in the form of its powerful *Vehicle Spy 3* monitoring and diagnostic software (often abbreviated as *VSpy*).

Vehicle Spy 3 is designed to work hand in hand with the Ethernet EVB. As we go through this guide you will see how VSpy is used to set up example applications, create scripts for the EEVB and program its Ethernet nodes, and monitor Ethernet traffic captured by the board. We'll also see in much greater detail in the Lab Manual how Vehicle Spy 3 can be used to monitor Ethernet traffic on other network interfaces, allowing you to analyze frames coming into a PC from any source.

Each EEVB purchase comes with a three-month license for the (fully-functional) demo version of Vehicle Spy 3 Professional. As you go through the User's Guide and the Lab Manual, you will learn that Vehicle Spy 3 is a comprehensive tool incorporating dozens of functions and features to enable analysis, simulation, diagnostics and data acquisition on all common automotive networks.

## 1.3 Overview of Operation and Essential Features

Let's start out with a brief discussion of how the Intrepid Ethernet EVB works, and some of its more important features. The description that follows will help you understand better what the board is all about, and how it works with Vehicle Spy 3. This will also set the stage for the detailed descriptions and examples found in the Lab Manual.

### ***Scriptable BroadR-Reach (Automotive Ethernet) Nodes***

The heart of the Ethernet EVB is its pair of BroadR-Reach nodes, each of which contains the components necessary to fully simulate the operation of an Automotive Ethernet ECU. Each node is based around an ARM Cortex-M4 32-bit microprocessor designed by ST Microelectronics, running at up to 180 MHz, which serves as the "brain" of the node. It is supported by various other components that allow the node to be programmed and updated, and its status monitored.

The ARM CPUs have 2 MB of integrated flash memory each, which is used for two purposes. First, it implements standard Ethernet Media Access Control (MAC) functionality, permitting the node to behave as a standard Ethernet device using a Broadcom BroadR-Reach chip at the physical layer. Second, this flash memory holds the custom programs that implement examples and demos, such as the one we will use later in this guide, and the others described in the Lab Manual.

To use the nodes, their desired operation is first programmed using the powerful scripting features found in Vehicle Spy 3. Each script is then compiled into a special module known as

a *CoreMini*, which is programmed (flashed, downloaded) into the ARM chip using VSpy. The script then runs on the node, implementing the feature desired by the example or application.



**Note:** The EEVB is normally shown with its USB connection at the top and CAN connectors on the bottom. In this orientation, the BroadR-Reach node on the left is called *Node A*, while the right-hand node is *Node B*.

### ***Programmable Input and Output Devices***

Each BroadR-Reach node includes four special input and output components:

- **Pushbutton:** A small black button is located just above each ARM chip that can be used as a simple binary input, such as to start or stop a particular function, or signal the generation of a message or event. It is read as a 0 value by the node in its default state, or a 1 while the button is depressed. (Each node also has a second pushbutton used to reset its CPU.)
- **Potentiometer:** For more flexible input, a potentiometer (variable resistor) is provided within both nodes. Each appears as a small black dial that can be turned using your fingers, generating a 12-bit input corresponding to decimal values from 0 to 4,095.
- **Output LEDs:** Each node has a pair of LED indicators that, by default, indicate the state of the node's CPU. However, both can also be turned on or off under program control to indicate status or communicate other information.

These components can be used singly or in combination. For example, later we will see a sample test setup that uses the potentiometer setting of each node to control the flash rate of one of its output LEDs, while also displaying the status of its pushbutton.

### ***BroadR-Reach Active TAP for Ethernet Monitoring***

Unlike more traditional automotive networks such as CAN, it is not possible to directly connect a probe to an Automotive Ethernet cable to monitor its activity. To implement this essential function, the Ethernet EVB includes a special chip from XMOS that serves as an active tap.

The XMOS chip captures all traffic that is sent or received by the BroadR-Reach PHY chip of Node 0, placing each frame in a special “wrapper” to allow it to be retransmitted in its entirety. This allows even frames with errors to be preserved for analysis. These are then sent to an integrated standard 10/100 Ethernet PHY, and from there to an Ethernet/USB hub, which forwards the frames to your PC using the EEVB's USB 2.0 connection. These frames can then be displayed and processed in Vehicle Spy 3.

### ***Audio Support Hardware***

Each node includes a standard 4-contact headset jack, which is connected to a Cirrus audio codec and a microphone amplifier, components that are in turn linked to the ARM CPU. This permits single-channel (mono) audio to be input to each node, as well as dual-channel (stereo) audio output. These components can be used to aid in creating simulations and applications involving AVB, one of the most common early applications of Automotive Ethernet.

### ***Scriptable CAN Nodes***

The board contains a pair of CAN nodes, each with its own standard DE-9 connector. These nodes can be scripted, just like the Ethernet nodes. A bridge is provided to allow the CAN nodes to be linked together.

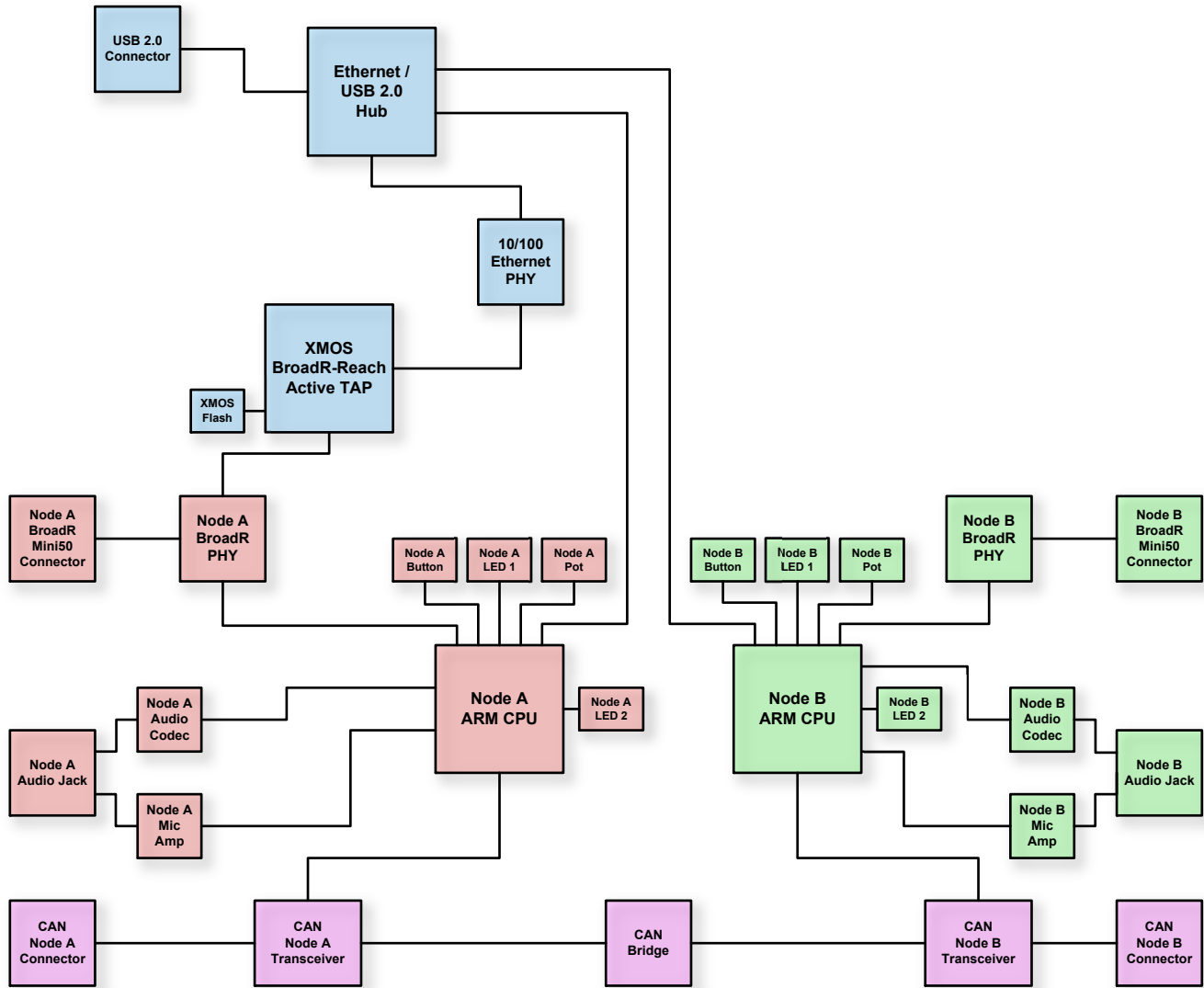


**Note:** By convention, with the board in its standard orientation (USB connector at the top) the CAN node bottom left is *Node A*, while the one bottom right is *Node B*.

## **1.4 Ethernet EVB Block Diagram**

Figure 1 shows a basic block diagram of the Ethernet EVB, illustrating its most important components. The blocks are coded according to their basic function: red and green for BroadR-Reach Node A and Node B respectively; blue for Ethernet monitoring and interfacing hardware; and magenta for the CAN circuitry. The diagram has been organized to approximately match the configuration of the actual components on the board, though it is not exact (nor is it to scale).



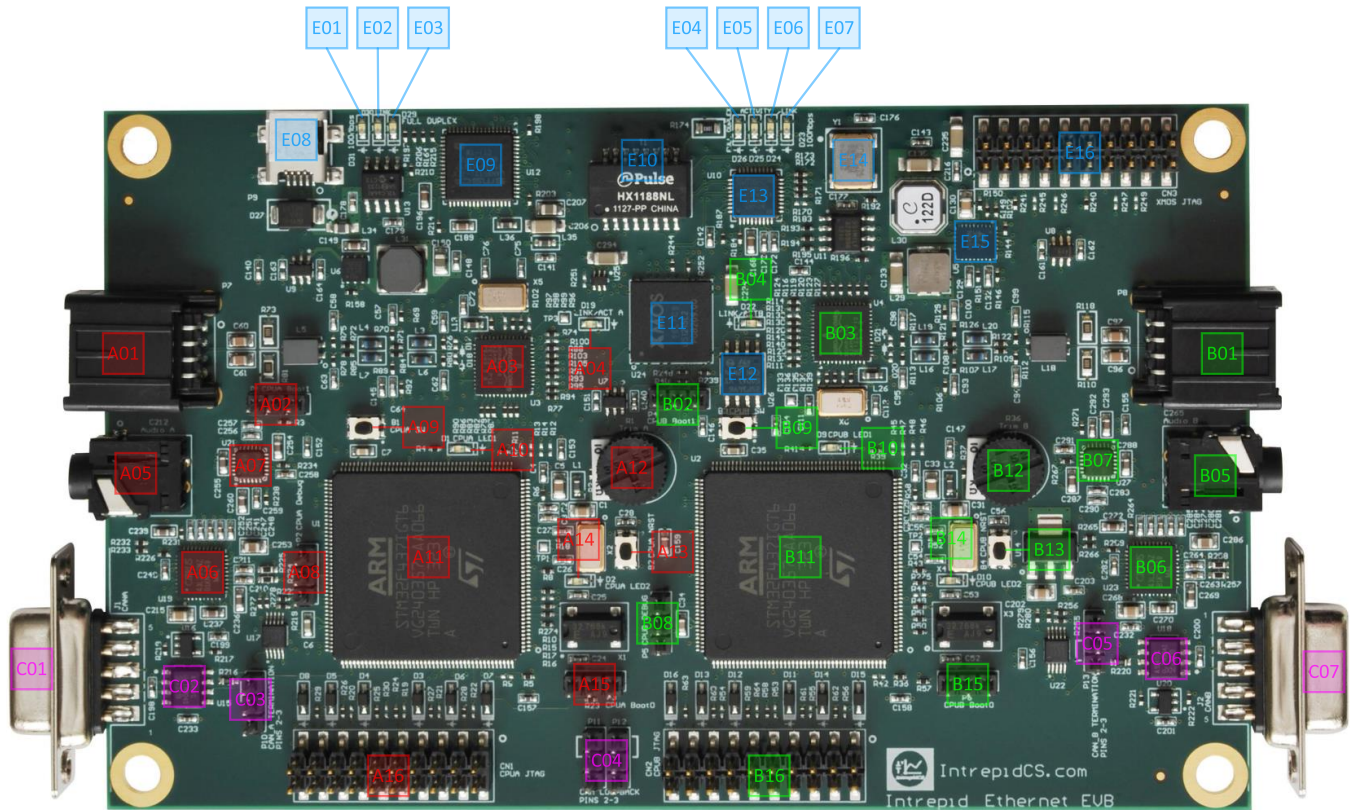


**Figure 1: Ethernet EVB Block Diagram.** This illustration lays out the major functional elements of the Intrepid Ethernet EVB.

## 1.5 Identification and Description of Ethernet EVB Components

In Figure 2 you will find a photograph of the Ethernet EVB with numeric labels superimposed upon, or pointing to, each of its essential components. You may notice that the labels use the same four colors as the block diagram in Figure 1, which naturally is not a coincidence! Each of the four areas of the board also has its components numbered in a different sequence to make it easier to identify and keep track of each part. We make reference to this diagram later in this guide, as well as in the Lab Manual, when it is necessary to identify specific parts for various reasons.

Below we will list and briefly describe each of the components in the figure by functional area.



**Figure 2: Ethernet EVB Component Identification.** This illustration shows the Ethernet EVB with all major components labeled for easy identification and reference.

### ***BroadReach Node A and Node B***

These components are labeled with red and green numbers, starting with “A” for Node A and with “B” for Node 1. Since the nodes have the same basic components, they have been numbered so that the digits following the letter represent the identical device on each node. The parts are as follows:

- **A01/B01:** Molex Mini50 BroadR-Reach connectors. These can be used to link the nodes to each other using the supplied cable, or to connect them to other BroadR-Reach nodes (such as switch ports).
- **A02/B02:** Bootstrap blocks for the ARM CPUs (ICS use only).
- **A03/B03:** Broadcom BroadR-Reach Physical Layer (PHY) chips.



- **A04/B04:** BroadR-Reach PHY link/activity LEDs. Each indicator flashes when its corresponding PHY is connected to another BroadR-Reach device; both will flash under normal operation when the two nodes are linked to each other using the supplied cable.
- **A05/B05:** Audio input/output jacks.
- **A06/B06:** Cirrus Logic audio codecs for stereo audio output.
- **A07/B07:** Microphone amplifier chips for mono audio input.
- **A08/B08:** CPU debug ports (ICS use only).
- **A09/B09:** Pushbutton inputs.
- **A10/B10:** CoreMini activity/output LEDs (LED 1). By default these LEDs flash 5 times per second when a CoreMini program is running on the corresponding node, but they can also be turned on and off under program control.
- **A11/B11:** ARM Cortex-M4 CPUs.
- **A12/B12:** Potentiometer inputs.
- **A13/B13:** ARM CPU reset buttons.
- **A14/B14:** CPU activity/output LEDs (LED 2). By default these LEDs flash 5 times per second when *no* CoreMini is running on the associated node, but these can also be script-controlled.
- **A15/B15:** Bootstrap blocks for the ARM CPUs (ICS use only).
- **A16/B16:** JTAG debug headers for the ARM CPUs (ICS use only).

### ***Ethernet Monitoring and USB Interface***

These components, tagged with blue labels, implement the EEVB's Ethernet functionality, including the BroadR-Reach active tap, Ethernet/USB hub and USB interface:

- **E01:** Ethernet speed LED (Hub to PC). When on, indicates 100 Mb/s communication over the USB link to the PC; when off, speed is 10 Mb/s. Normally on.
- **E02:** Ethernet link/activity LED (Hub to PC). When on, a link is established between the Ethernet/USB hub and the PC. Flashing indicates the transmission of frames over the link.
- **E03:** Ethernet full-duplex LED (Hub to PC). This will normally be on, as full-duplex communication is the default.
- **E04:** Ethernet full-duplex LED (10/100 PHY to Hub). Again, normally this will remain lit.
- **E05:** Ethernet activity LED (10/100 PHY to Hub). Flashes when traffic is passed between the Ethernet 10/100 PHY and the integrated Ethernet/USB hub.

- **E06:** Ethernet link LED (10/100 PHY to Hub). Normally on to indicate a link between the Ethernet PHY and hub.
- **E07:** Ethernet speed LED (10/100 PHY to Hub). When lit (normal), indicates 100 Mb/s operation between the Ethernet PHY and hub; when dark, 10 Mb/s.
- **E08:** Mini-USB jack, used both to supply power to the EEVB and to send Ethernet frames to and from the PC over USB.
- **E09:** Ethernet/USB hub. Connects the 10/100 PHY and the PC, translating between Ethernet and USB formats as needed. The hub is also connected directly to the two CPUs to allow CoreMini programs to be transferred to them.
- **E10:** Transformer for Ethernet PHY.
- **E11:** XMOS Active tap. Monitors Node 0 BroadR-Reach PHY and sends frames to the PC through the hub.
- **E12:** Boot flash memory for the XMOS chip.
- **E13:** 10/100 Ethernet PHY.
- **E14:** Oscillator for the 10/100 PHY.
- **E15:** Power supply for the 10/100 PHY.
- **E16:** JTAG debug header for the XMOS chip (ICS use only).

### ***CAN Node A and Node B***

Along the bottom of the Ethernet EVB circuit board are several components that implement its two CAN nodes, which have magenta labels in Figure 2:

- **C01:** CAN Node A DE-9 connector.
- **C02:** CAN Node A transceiver. This chip implements the CAN network functionality for Node A.
- **C03:** CAN Node A termination selection block.
- **C04:** CAN bridge. This jumper block can be used to bridge CAN Node A and CAN Node B to each other.
- **C05:** CAN Node B termination selection block.
- **C06:** CAN Node B transceiver.
- **C07:** CAN Node B DE-9 connector.

## 1.6 Hardware and Software Requirements

The EEVB's hardware and software prerequisites are based on two factors: the resources needed to support the board itself, and those necessary for running Vehicle Spy 3.

### *EEVB Hardware Requirements*

The EEVB requires two USB 2.0 (or 3.0) ports on the host computer to which it is attached. As we'll see shortly, the board uses a special USB cable with two standard connectors: one provides power and facilitates data transmission from the board to the host machine, while the second provides supplemental power to run the many components on the board.

If necessary, the EEVB can be connected to a USB 2.0 hub that is in turn plugged into the computer on which VSpy runs. Depending on the amount of electrical energy provided by the computer's own USB ports, a powered hub (one with its own power supply) may be required.

### *Vehicle Spy 3 System Requirements*

Vehicle Spy 3 is designed to run on most modern PC compatible computers and modern versions of Microsoft Windows. The current minimum requirements are as follows:

- **Operating System:** Microsoft Windows XP (SP 3), Windows Vista (Pre-SP, SP 1, or SP2), Windows 7 (Pre-SP or SP1), Windows 8, or Windows 8.1.
- **System Memory:** 512 MB.
- **Display Resolution:** 1024x768.

Vehicle Spy 3 will run on both 32-bit and 64-bit versions of Windows. However, Windows RT is not supported (as it does not run on PCs).

For an optimal experience, Intrepid recommends at least the following:

- **Operating System:** Windows XP (SP 3), Windows Vista (Pre-SP, SP 1, or SP2), Windows 7 (Pre-SP or SP1), Windows 8, or Windows 8.1.
- **Processor:** Intel or AMD x86 (32-bit) or x86-64 (64-bit) CPU, 2 GHz or higher.
- **System Memory:** 2 GB.
- **Display Resolution:** 1280x1024.

As a 32-bit application, Vehicle Spy 3 cannot use of more than 2 GB of memory. However, additional memory allows greater flexibility to open multiple instances and deal with larger files.

Display resolution is also important, as more screen "real estate" will allow you to see a larger quantity of messages, graphs and other information on the screen at once. The EEVB documentation is based on the minimum of 1024x768, and the screenshots in the User's Guide and Lab Manual were taken at this resolution. However, a larger screen will improve your user experience.

## 2 Getting Started with the Intrepid Ethernet EVB

Now that we have covered the basics of the Intrepid Ethernet EVB and how it functions, we're ready to put your new board to work. In this chapter we'll review the contents of the EEVB package and get your hardware and software up and running.

### 2.1 Opening the EEVB Package and Examining Package Contents

The Ethernet EVB ships in a small, convenient box that contains all the hardware you need to set up your Automotive Ethernet experimentation network. You can also use the box to easily transport the setup to another computer or location, letting you take your network "on the road" whenever required.

Please open your EEVB box now and remove the components contained within it. Each package contains the following physical items (as shown in Figure 3):

- **Ethernet EVB Board:** The actual EEVB circuit board, which contains all of the electronic components required to create your Ethernet network.
- **Software and Documentation Disc:** A disc containing a demo version of Vehicle Spy 3, a license for the EEVB, and electronic copies of the User's Guide and Lab Manual.
- **"Two-Headed" USB Cable:** A special USB cable with a mini-USB connector on one end to attach to the EEVB, and a pair of standard USB connectors on the other to link the board to a PC.
- **BroadR-Reach Cable:** A single twisted pair cable with Molex Mini50 plugs on each end. This cable allows you to link the EEVB's two BroadR-Reach nodes to each other so they can communicate directly.

If any of these parts is missing from your Ethernet EVB package, or if they appear to be damaged in some way, please contact Intrepid Control Systems immediately for assistance in obtaining replacement hardware.

Along with your EEVB you will also receive a copy of ICS's industry-leading book, *Automotive Ethernet - The Definitive Guide*, which will be packaged separately. This book provides comprehensive information on Automotive Ethernet and the protocols used in the Lab Manual, where it is discussed further.



**Figure 3: Ethernet EVB Package Contents.** Your Ethernet EVB package contains the EVB itself, a special USB cable for powering the board and connecting it to your PC, a dual-plug BroadR-Reach cable, and a software and documentation disc. A copy of *Automotive Ethernet - The Definitive Guide* is also included, but packaged separately.

## 2.2 Vehicle Spy 3 Installation

It is possible to install your hardware and software in either order. However, the EEVB requires special drivers that are installed automatically along with Vehicle Spy 3. For this reason, we recommend installing VSpy before connecting the EEVB hardware to your PC.

Vehicle Spy 3 is packaged with an automated installer, which will do most of the work for you. Simply follow the instructions below to set up the program on your computer.

1. **Load the Software and Documentation Disc:** Put the disc that came with your EEVB into the optical drive of your computer. A few seconds later, the ICS software installation menu should automatically appear on your computer screen, as shown in Figure 4.


 **Note:** On some computers this window may not appear on its own. If this occurs, start Windows Explorer, navigate to the disc's letter under *Computer*, and then double-click the file *icsSetup.exe* to open the menu.





Figure 4: ICS Software Install Menu.

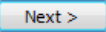

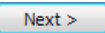
From this menu you can start installing Vehicle Spy 3, access electronic copies of the EEVB User's Guide and Lab Manual, or go to the support area on the Intrepid website.

2. **Start Vehicle Spy 3 Installation:** Click **Vehicle Spy 3 Install**.
3. **Select Language:** Choose your preferred language and then click  to proceed. (For the remainder of the manual we will assume that English has been used.)

The Vehicle Spy 3 setup wizard will now start, displaying a welcome screen as shown in Figure 5.



Figure 5: Vehicle Spy 3 Setup Wizard Welcome Screen.

4. **Start Vehicle Spy 3 Setup Wizard:** Click  to start the setup wizard.
5. **Review and Accept License Agreement:** Review the license agreement, and assuming its terms are acceptable, select , then click  (Figure 6).

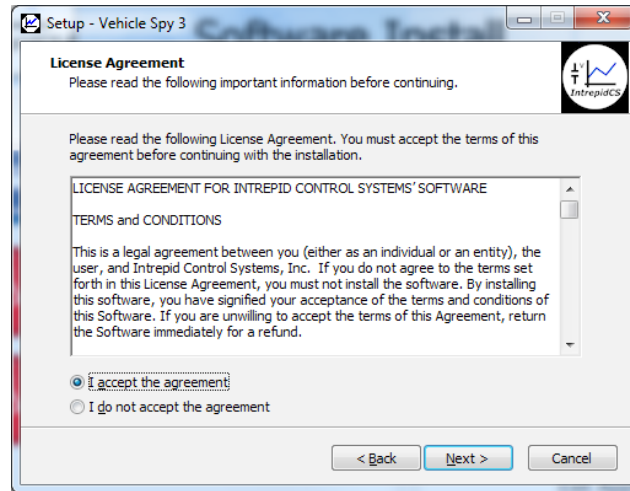
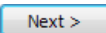
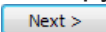


Figure 6: Vehicle Spy 3 License Agreement.

6. **Select Installation Type:** We are doing a new installation so simply click  to continue.
7. **Select Destination Location:** Choose where you want to install Vehicle Spy 3 (Figure 7). We normally recommend using the default location. Click .

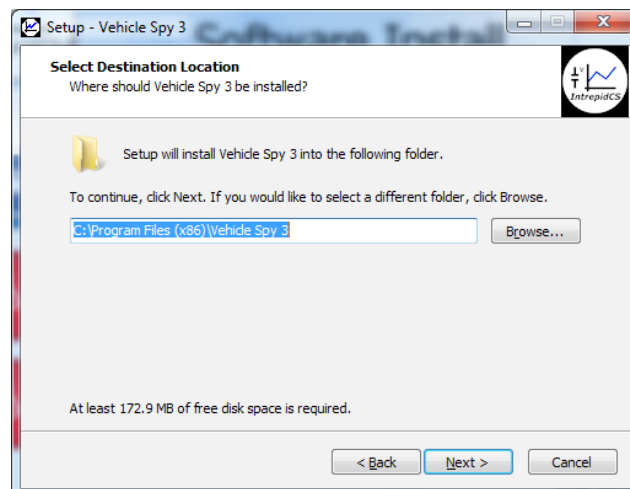


Figure 7: Choosing the Destination Location.

8. **Select Data Directory Location:** Next, choose where you want Vehicle Spy 3 to store its data files. We recommend sticking with the provided default, **C:\IntrepidCS\Vehicle Spy 3** (Figure 8). Click **Next >** to continue.

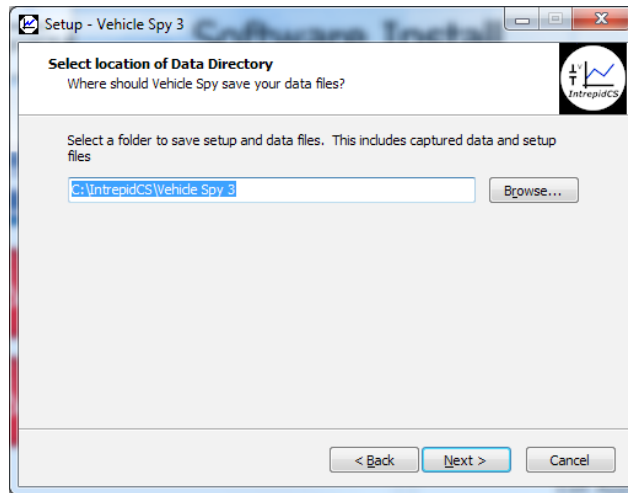


Figure 8: Selecting the Data Directory Location.

9. **Select Start Menu Folder:** Choose where you want your Windows shortcuts for Vehicle Spy 3 to reside. Again, the defaults are generally fine here, though you can change them if you wish. Click **Next >** to proceed.
10. **Select Additional Tasks:** The one option here is to create a desktop icon for Vehicle Spy 3, which is selected by default. Uncheck the box if you do not wish to have this icon created, then click **Next >**.

You have now provided all of the information the wizard needs to install Vehicle Spy 3. Your selected options will be displayed in a review box, as shown in Figure 9.

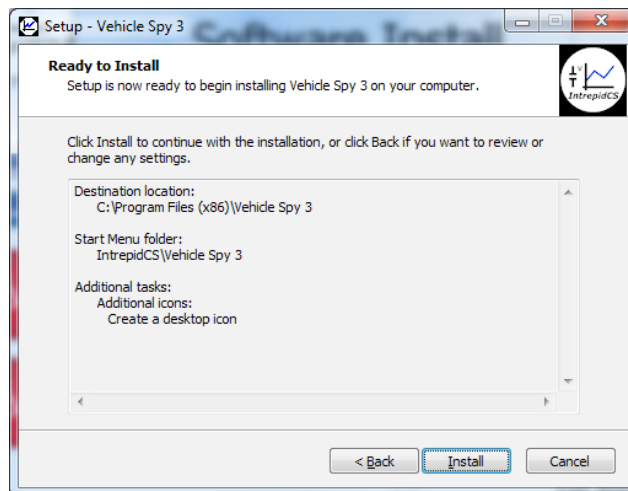


Figure 9: Installation Options Review.

- 11. Review Installation Options and Begin Installation:** Ensure that the options you have chosen are correct, and then click .

The wizard will now begin installing Vehicle Spy 3. A window will appear showing you the progress of the installation (Figure 10).

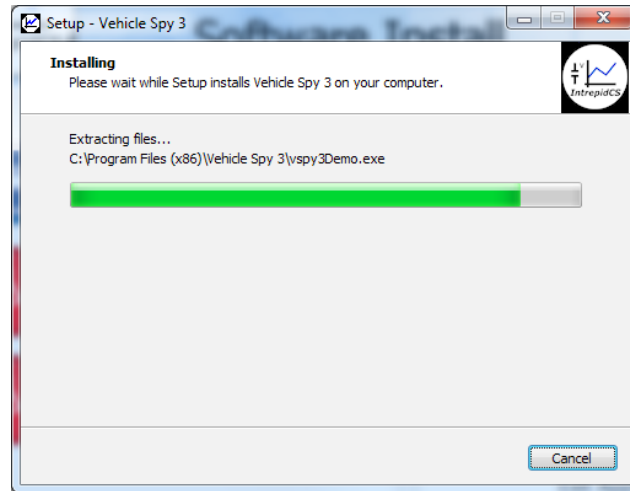


Figure 10: Installing Vehicle Spy 3.

After completing installation of the software itself, the wizard will automatically install various drivers required by Vehicle Spy 3 and the EEVB. The first install will be guided by the VCP Driver Installer.



- 12. Install VCP Drivers:** Click  to begin installing the first set of drivers. This will usually take only a few seconds, and when completed, a message will appear like the one in Figure 11. Click  to complete this initial driver installation process.



Figure 11: VCP Driver Installation Complete.

Next, support files for Microsoft Visual C++ 2010 and 2005 will be installed. This happens automatically without user intervention. Many systems already have these files installed, and if so, a message may appear telling you this; just hit  to continue.

The WinPcap installer will start next. This is a special support program that allows Ethernet traffic on a PC to be captured and displayed by Vehicle Spy 3. You will see a window similar to the one shown in Figure 12.

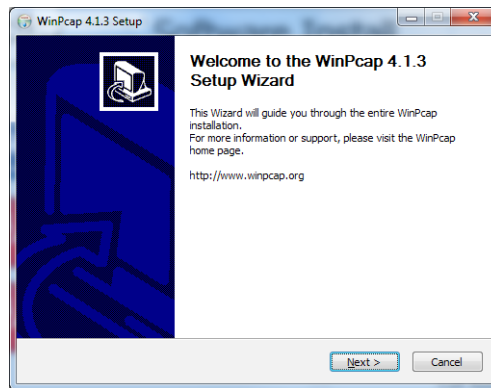


Figure 12: WinPcap setup wizard.

13. **Install WinPcap:** Click  to start the installation process. Review the WinPcap license agreement and click  if you are willing to abide by its terms. Leave the box on the next screen checked so that WinPcap starts automatically, and click . After a few seconds a message will appear saying that the installation is complete; click  to exit this installer.

The setup wizard will now install SMSC LAN9500 device drivers, which are used for the USB data connection between the EEVB and your PC. This only takes a few seconds and requires no user intervention; you may see a message on the screen like Figure 13.

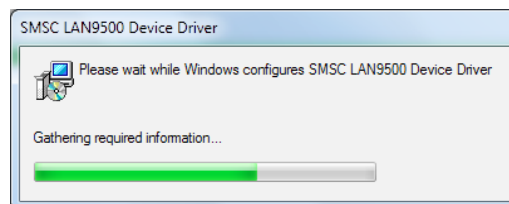


Figure 13: SMSC LAN9500 device driver installation.

Another ICS driver installer dialog box will appear next, similar to the first one.

14. **Install ICS Port Drivers:** Click  to begin installing the ICS port drivers.

At this point you may receive a prompt from Windows like the one shown in Figure 14. If you do, please click  to authorize driver installation.



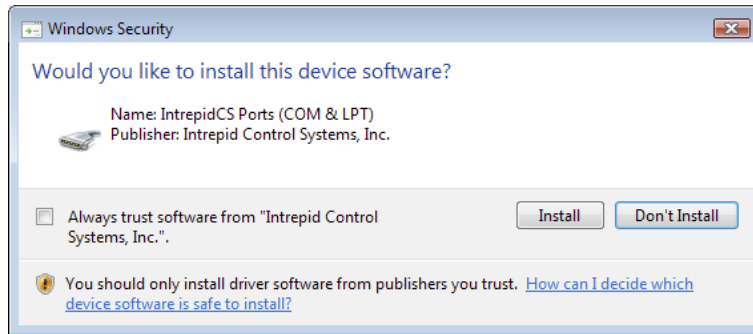


Figure 14: Windows Security Dialog Box.

Once installation begins, it will take only a few seconds, and when completed, a message will appear like the one in Figure 15.


- 15. Complete Port Driver Installation:** Click  to exit this part of the install.



Figure 15: Port Driver Installation Complete.

The installer will next set up the CrypKey server, which licenses the demo version of VSpy. You don't need to do anything except close the window that appears when this is done (Figure 16).

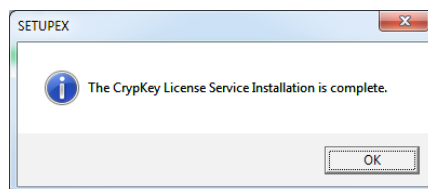
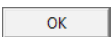


Figure 16: CrypKey Installation Complete.

- 16. Close CrypKey Setup Window:** Click  when the message appears saying that CrypKey setup is complete.

You will now see a window similar to Figure 17, indicating that the setup process is complete.



Figure 17: Vehicle Spy 3 Setup Complete.

**17. Exit the Setup Wizard:** Click .

You're done!

## 2.3 Ethernet EVB Hardware Setup

Now that we have VSpy installed, let's set up the EEVB hardware. Fortunately this is a pretty simple process, as illustrated in the hookup diagram in Figure 18.

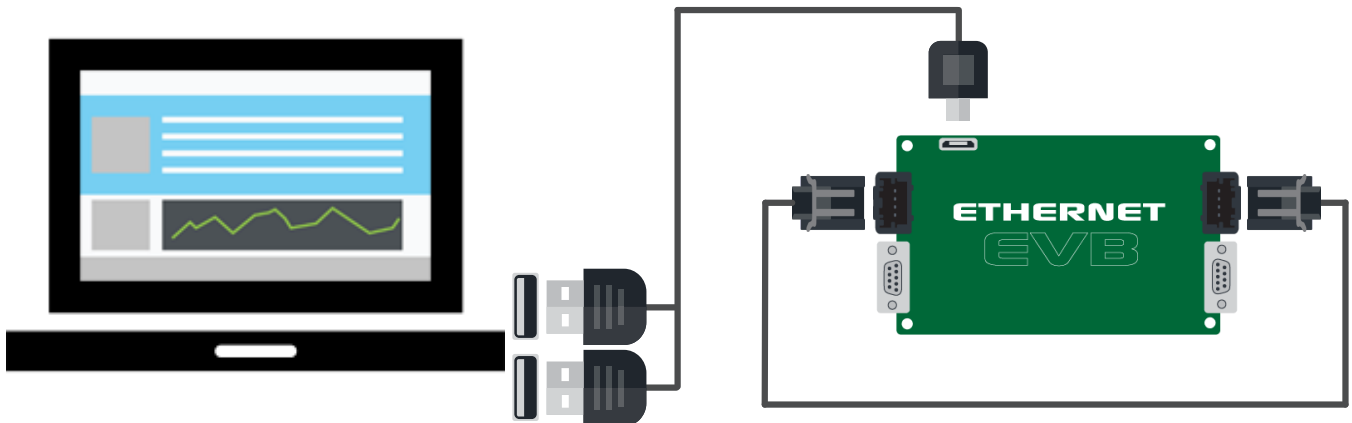


Figure 18: Ethernet EVB Hookup Diagram.

Assuming that you installed Vehicle Spy 3 as described in the previous section, you should have already removed all of the components from the EEVB package. Place them on a flat, open space on your desk or workbench near the computer that is running VSpy, and then follow these steps.

1. **Remove Board from Anti-Static Wrapping:** Take the EEVB board out of its protective anti-static bubble wrap and place it on the surface you have chosen.

**⚠ Warning:** The EEVB is a bare circuit board with exposed contacts on the bottom. Do not use it on a conductive surface, or damage to the board and/or surface may occur. We also do not recommend operating it on top of its anti-static packaging.

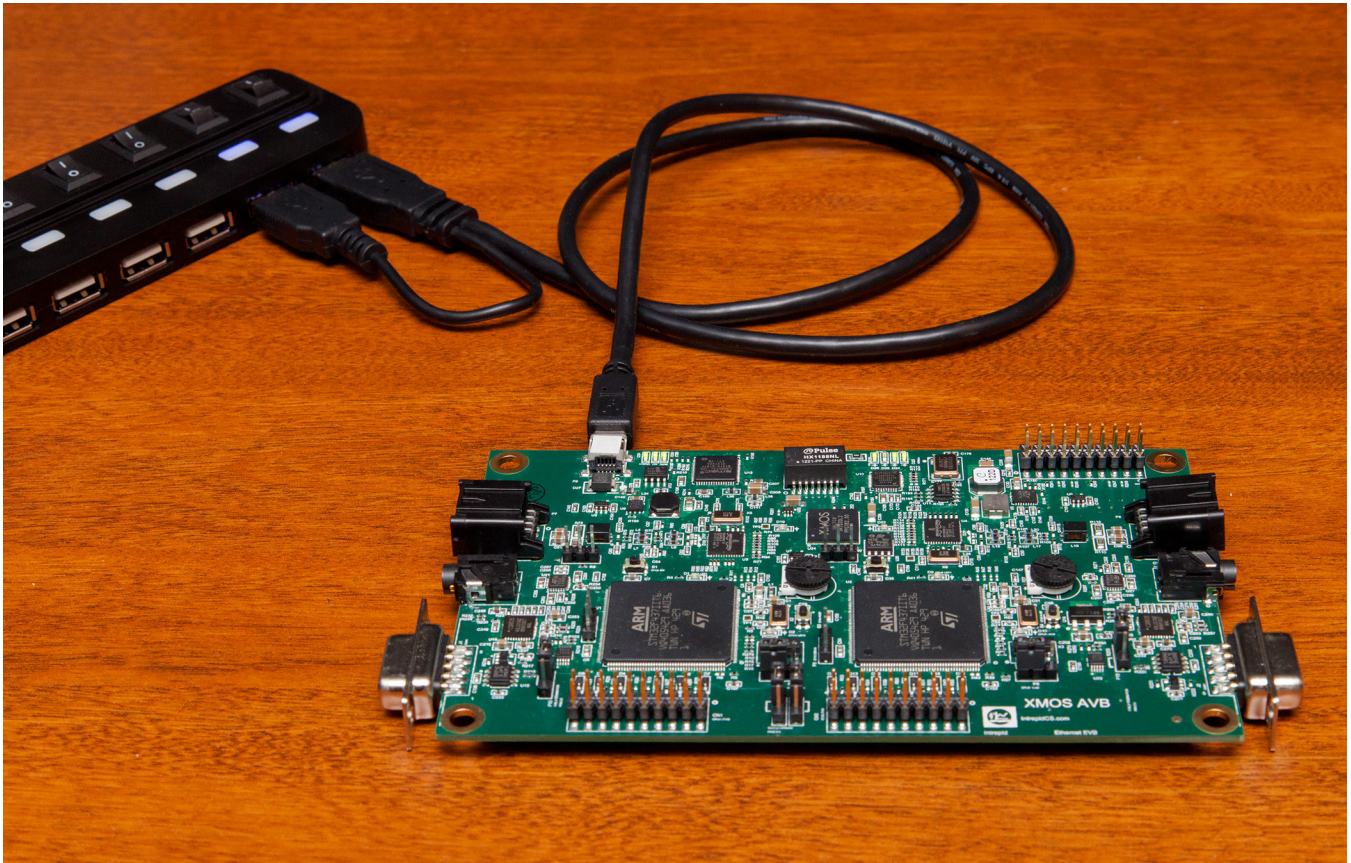
2. **Connect USB Cable to PC or USB Hub:** Attach the two standard USB connectors on one end of the special USB cable to the PC. You can connect them either directly to a pair of USB ports on the machine, or use a hub as shown in Figure 19.



**Figure 19: Connecting the USB Cable to a USB Hub.** Plug the “two-headed” USB cable into a pair of USB ports on your PC or a USB hub.

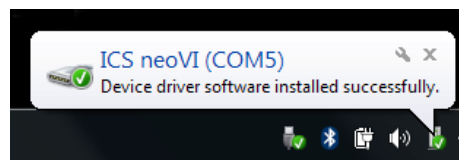


3. **Connect USB Cable to EEVB:** Connect the mini-USB connector on the other end of the cable to the Ethernet EVB, as shown in Figure 20.



**Figure 20: Connecting the USB Cable to the Ethernet EVB.** Attach the mini-USB connector to the EEVB's USB port (component 208 on the board layout diagram in Figure 2).

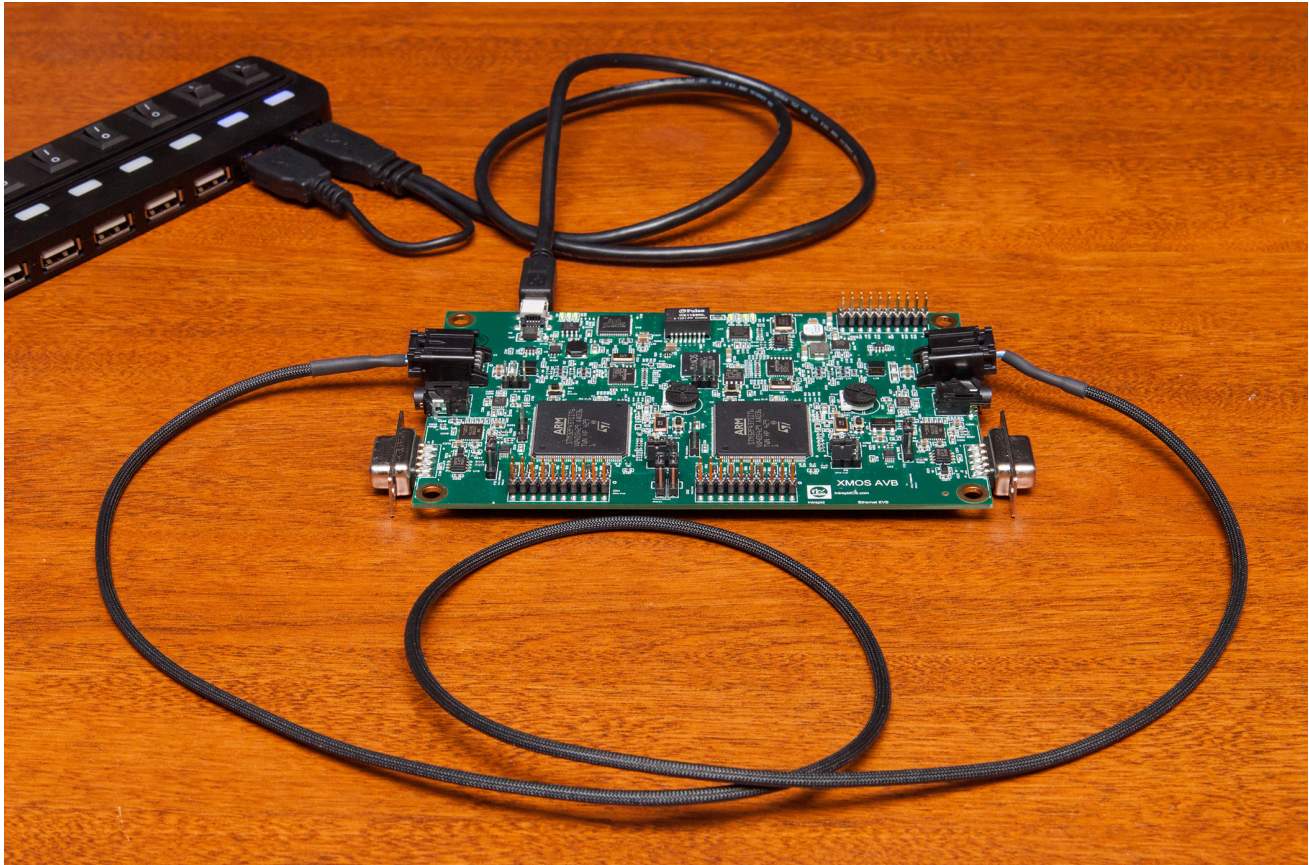
Upon completing the USB connection to the EEVB, the board will power up, and you should see several of its indicator LEDs illuminate, some solid and some flashing. The board will also be recognized in Windows, and if this is the first time you have connected it, you may see a message saying that device drivers are being installed. You actually installed the necessary drivers when you installed Vehicle Spy 3, so this is just Windows configuring those drivers for use. When complete, you should see a message similar to that shown in Figure 21.



**Figure 21: Windows Device Driver Installation Message.** Note that the number next to “COM” may vary.



4. **Connect BroadR-Reach Cable:** Attach one end of the BroadR-Reach cable to each of the Mini50 jacks on the left and right edges of the board (components A01 and B01) as seen in Figure 22.



**Figure 22: Linking the Two BroadR-Reach Nodes.** Use the supplied BroadR-Reach cable to connect the two EEVB nodes to each other.

The final step above links the two BroadR-Reach nodes so they can communicate with each other directly. This is required for certain aspects of the board's operation; we will make use of this connection in our initial demo later in this guide, and employ it further in the Lab Manual.

Your EEVB is now ready for use. If you experience any issues setting up the hardware, please refer to the troubleshooting guide in Chapter 3.

## 2.4 Vehicle Spy 3 Configuration

We now have both Vehicle Spy 3 and the EEVB installed. However, there are a few additional steps that we need to take in order to ensure that the two work together correctly in an Automotive Ethernet environment.



## Starting Vehicle Spy and Adding a License File

Vehicle Spy 3 requires a hardware license file to operate. One is included on the software and documentation disc that comes with your EEVB; you just need to tell the program where it is.

Follow these steps:

1. **Start Vehicle Spy 3:** Launch Vehicle Spy 3 from your computer's start menu: select *All Programs ► IntrepidCS ► Vehicle Spy 3 ► Vehicle Spy 3*. Alternatively, you can click the red car icon on your desktop.

You will see an orange CrypKey splash screen appear for a few seconds; please ignore this for now.

Vehicle Spy 3 will automatically open its setup screen and prompt you to add a license file, as shown in Figure 23.

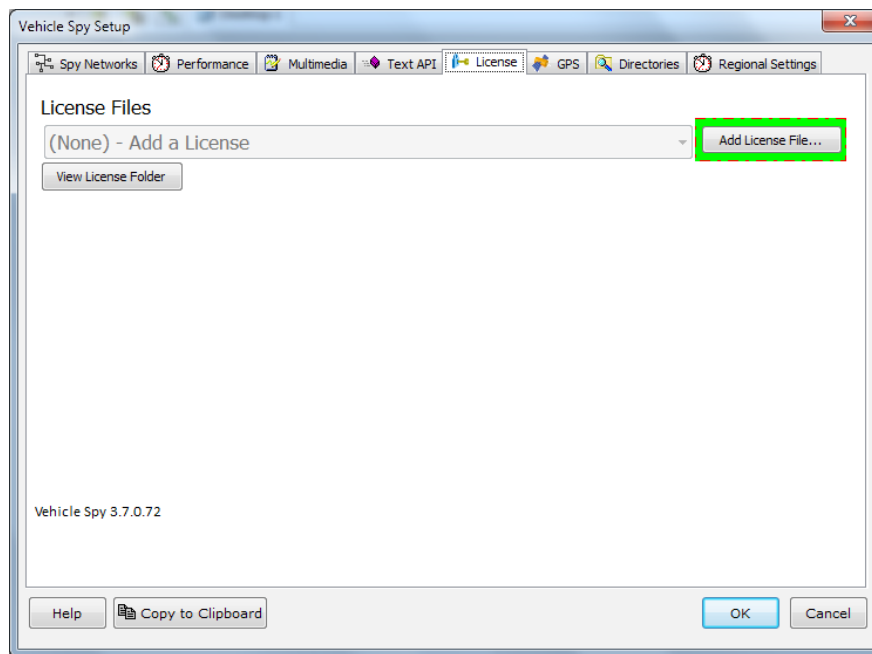
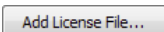
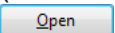
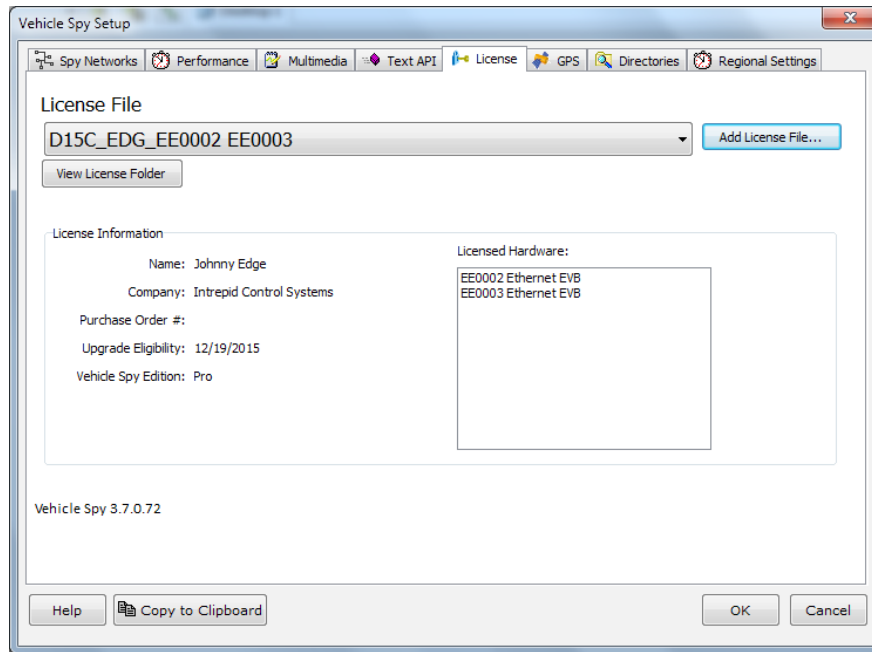


Figure 23: Vehicle Spy 3 License Area.

2. **Add License File:** Click . A file selection dialog box appears. Navigate to the root folder of the software and documentation disc, where you should see a “.lic” file. (If one is not present, please contact Intrepid for assistance.) Select the file, then click .

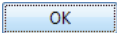
Vehicle Spy 3 will display a summary of your license information, similar to the example shown in Figure 24.



**Figure 24: Vehicle Spy 3 License Information Display.** Naturally, the values shown on your screen will differ from the ones seen here.

3. **Close the License Setup Tab:** Click  to complete adding the license.

You will now be prompted to restart the program.

4. **Restart Vehicle Spy 3:** Click  to close Vehicle Spy 3. Then start it again from the Start Menu or desktop.

Vehicle Spy 3 will now start up in its normal default window, known as the *Logon Screen* (Figure 25). You will see a white box in the middle of the display, above which are three tabs. The **Recent** tab is automatically populated by Vehicle Spy 3 with links to the setup files you have most recently used, while **My Setups** lists all of the setup files associated with this data directory. (Since we just installed the program, both will be empty.) The final tab, **Examples**, contains sample setup files that ship with VSpy, including one that we'll use shortly.

Near the bottom of the screen you should see a photo of the Ethernet EVB, which tells you immediately that VSpy sees your board. To the right is a list of Vehicle network interfaces, which should show two entries corresponding to the two EEVB nodes.

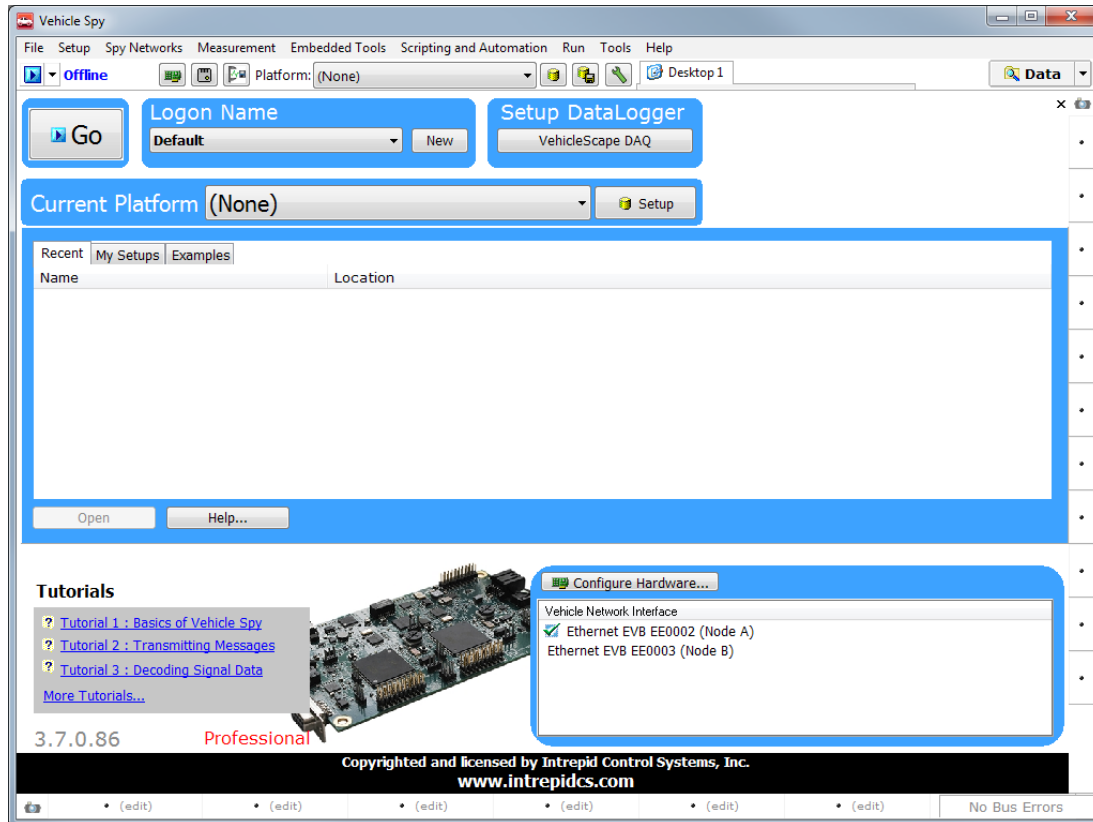


Figure 25: Vehicle Spy 3 Startup View.

### Creating a Logon Name and Data Directory

Vehicle Spy 3 stores the setup files and data you create in a special location called the *Vehicle Spy Data Directory*. By default this can be found in the folder **C:\IntrepidCS\Data Directory**. To keep files from different users and projects from interfering with each other, individual data directories are created within this central repository, each associated with a *logon name*.

The first time you run VSpy, it will create a default logon name, appropriately enough called **Default**. For clarity, we'll instead make a new logon specifically for use with the EEVB.

5. **Create a Logon Name:** Click the **New** button to the right of the drop-down box. In the dialog box that appears (see Figure 26) enter the name **EEVB** (you can choose a different name, but we recommend sticking with that one for simplicity, since the Lab Manual assumes it was used). Then either press the **Enter** key or click **OK**.

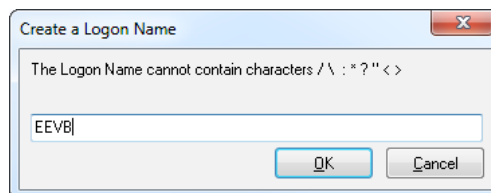



Figure 26: Creating a New Logon Name.

Vehicle Spy 3 will create the data directory for the logon name you provided, and will now show it as the selected data directory. You can access the current data directory at any time to examine or work with the files it contains.

6. **Explore Data Directory:** Click the  **Data** button, located near the top right of the screen.

A Windows Explorer window will open set to the location of the data directory; if you used the recommended name above, this will be **C:\IntrepidCS\Vehicle Spy 3\Data Directory\EEVB**. The only file that you will see here at present is **RecentPaths.ini**. Feel free to close this window when you are done looking at it.

## Enabling Ethernet Support

Since only some users require Ethernet support, Vehicle Spy 3 ships with it disabled by default. Fortunately, turning it on is a simple process, and only needs to be done once.

7. **Open Vehicle Spy 3 Options:** Select *Options...* from the *Tools* menu.

This is actually the same part of the program that we used in selecting a license file, except that this time it has opened to the left-most tab, which is where most network-specific options are located. The option to enable Ethernet support is at the bottom left (Figure 27).

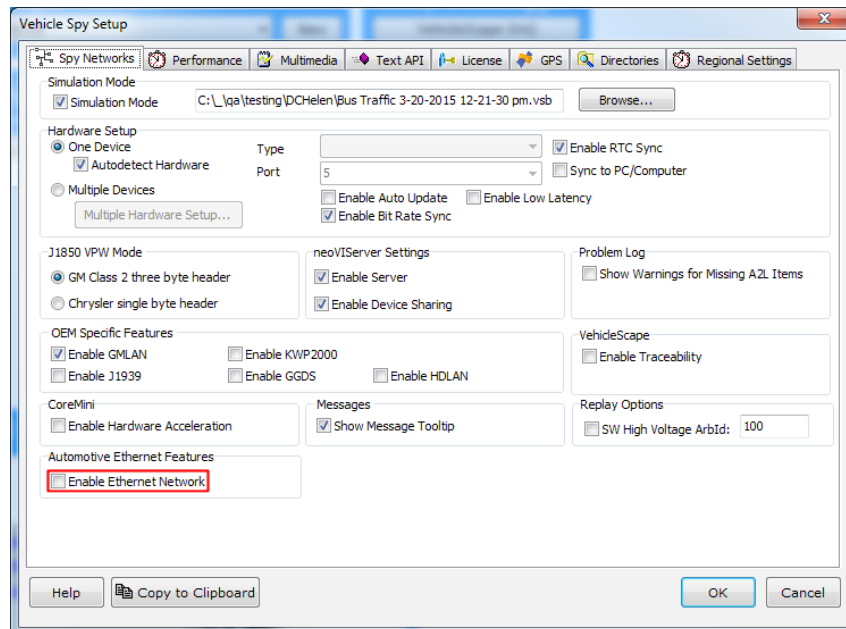

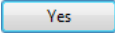


Figure 27: Vehicle Spy Network Options.

8. **Enable Ethernet Network:** Click the square checkbox next to **Enable Ethernet Network**, and then click .

A prompt will now appear suggesting that you restart the program.

9. **Restart Vehicle Spy 3:** Click  and VSpy will close. Start the program again from the Windows start menu or desktop.

When the program loads again you will now see a list of Ethernet interfaces at the bottom right. The Intrepid Ethernet EVB should be present and selected as the current interface (Figure 28).



**Note:** If the EVB does not appear in this list, please consult the troubleshooting information that can be found near the end of this guide.

Congratulations, the Ethernet EVB and Vehicle Spy are now ready for use!

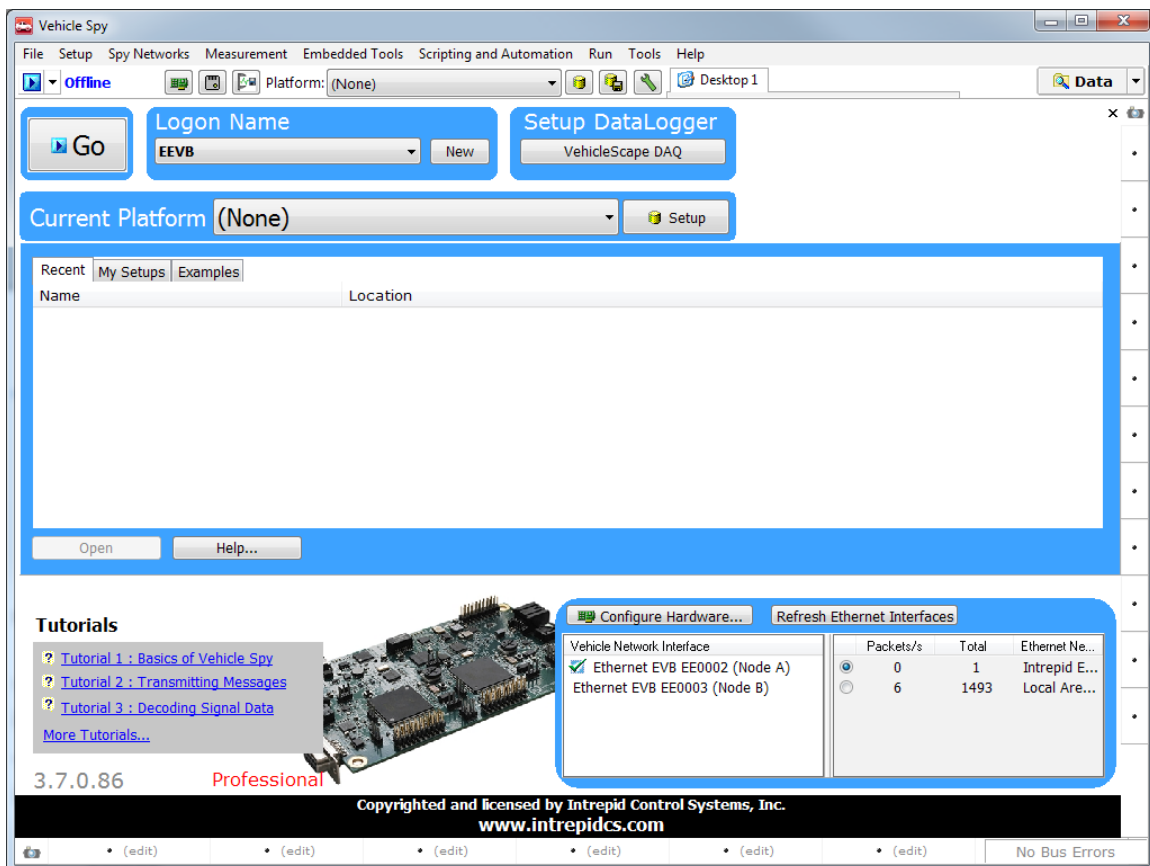


Figure 28: Vehicle Spy 3 with Ethernet Enabled.



## 2.5 Running Your First Ethernet EVB Demo

Vehicle Spy 3 comes with many example setup files that allow you to quickly and easily see how its many functions work. One of the included files is a setup specific to the EEVB, which we will use to demonstrate how to download a CoreMini script to the EEVB nodes, and illustrate how the board's input and output devices work.

Part of the purpose of this demo is to allow you to verify that your board and Vehicle Spy 3 are both correctly installed and working properly. If you encounter any difficulties running the demo, please check the troubleshooting section later in this guide, or contact ICS for assistance.



**Note:** A full description of Vehicle Spy 3 is beyond the scope of this guide. Please refer to the extensive online help and other documentation that comes with the software if you wish to learn more about VSpy's many features.

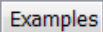
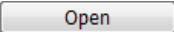
### *Initial Inspection of the Board*

After connecting your new EEVB, you will see that on each node LED2 is dark (components A10 and B10 in Figure 2) while LED1 is blinking at a rate of approximately 5 times per second (parts A14 and B14). This indicates that both node CPUs are active, but that no CoreMini is running on either.

You will also notice activity among the LEDs along the top row of the board. Components E01, E03, E04, E06 and E07 are connection status indicators and will normally all be illuminated. Components E02 and E05 are traffic activity indicators and will flicker on and off periodically.

### *Loading the Ethernet EVB Input Output Setup File*

Follow these steps to find and load the EEVB demo setup.

1. **Display the Vehicle Spy 3 Example Files:** Click the  tab on the *Logon Screen*. You will see a number of setup files listed in alphabetical order.
2. **Open the Ethernet EVB Setup File:** The file we are looking for is called **Ethernet EVB Input Output**; depending on your screen size, it may be visible immediately, or you may need to scroll down to find it. Once you do, either double-click it, or highlight it and click the  button just below the example list (Figure 29).

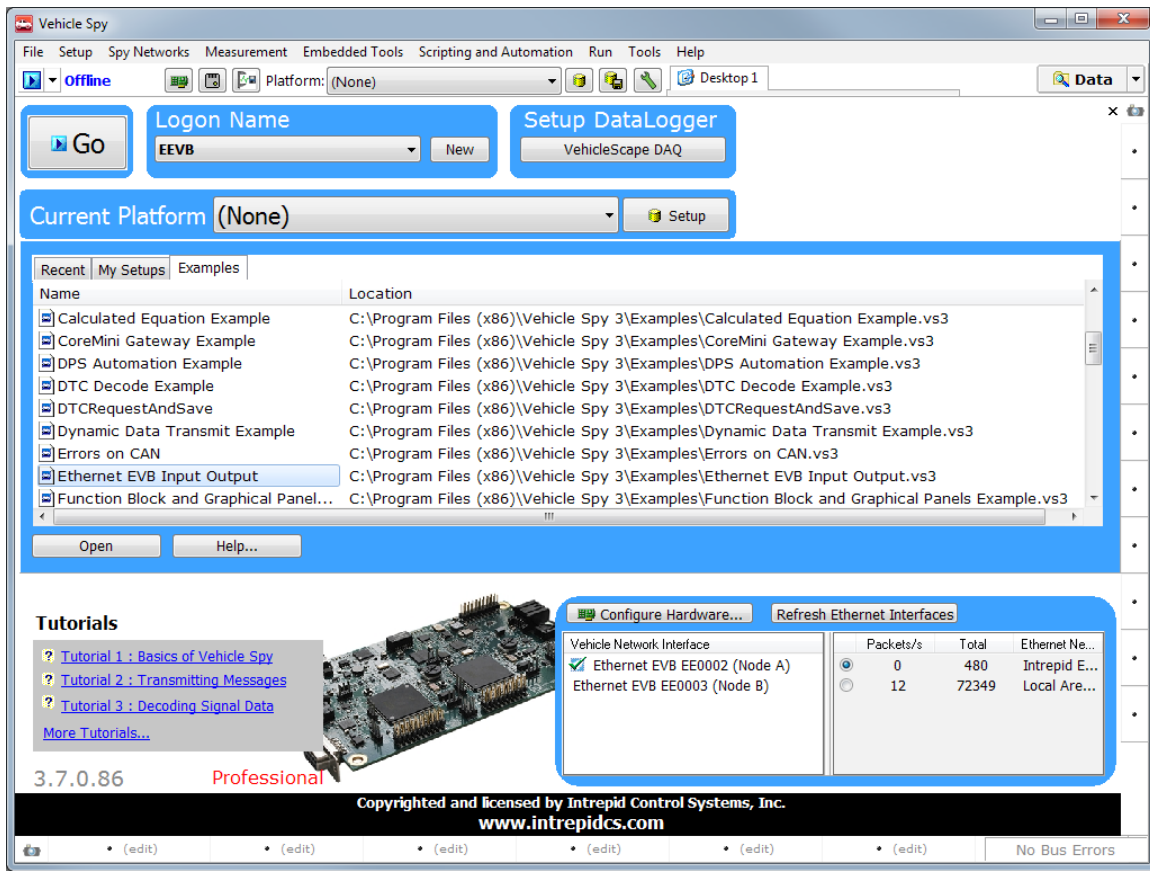
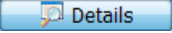


Figure 29: Selecting the Ethernet EVB Demo File in the Examples Tab.

The display will change immediately as Vehicle Spy 3 loads the demo setup file and switches to its primary display window, known as *Messages View*. You can see that there's a lot going on here, but don't worry—we'll explain all of it here and in the Lab Manual.

A sub-window known as *Details View* is enabled by default on new VSpy installs, and on smaller screens may obscure some of the information we want to display. We don't need this view active, so let's just turn it off.

- 3. Disable Details View:** Find the  button near the top of the screen and click it. The button will change from blue to gray, and you'll see part of the screen change.

You should now see a display similar to that shown in Figure 30.

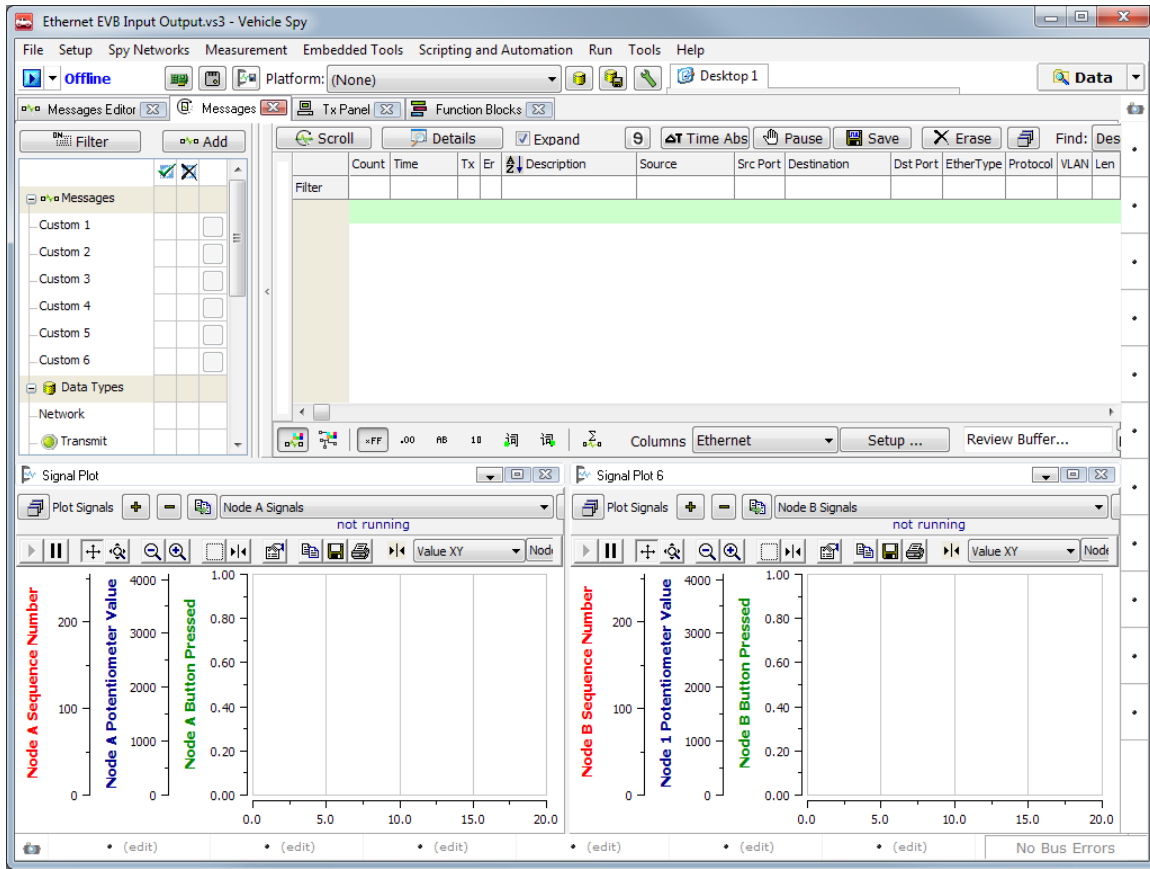


Figure 30: Messages View with Ethernet EVB Input Output Demo Loaded.

### Downloading CoreMini Scripts to the EEVB Nodes

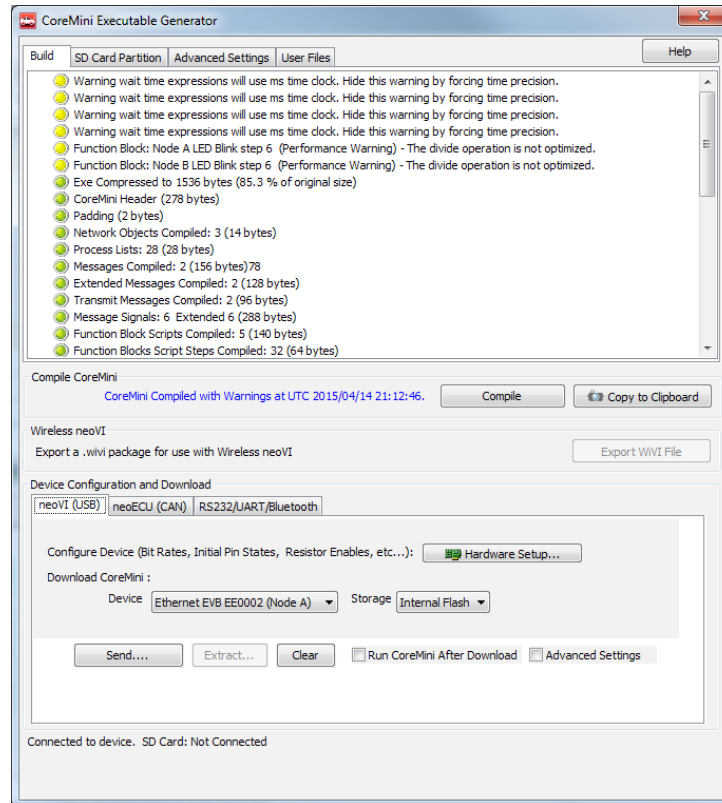
The demo setup file we loaded contains message definitions and scripts that instruct the two EEVB nodes to take the following actions:

- Transmit a set of three data elements 10 times per second (every 100 ms).
- Flash one of their LEDs at a rate determined by their potentiometer dial setting.

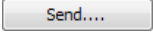
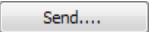

Let's download these scripts to the EEVB nodes now.

4. **Open the CoreMini Console:** Click the *Tools* menu, hover the mouse over *Utilities*, and then select *CoreMini Console*....

A large dialog box will appear, as shown in Figure 31. Notice the drop-down box next to the word **Device**, which in the figure shows that the console is currently set to download to Node A of the Ethernet EVB.



**Figure 31: Vehicle Spy 3 CoreMini Console.** The serial number shown in the drop-down box will be different from that shown here.

5. **Set CoreMinis to Run When Downloaded:** Check the box next to Run CoreMini After Download. This will ensure that your scripts run automatically as soon as you send them to the EEVB.
6. **Send CoreMini to Node A:** Press the  button to start the process of downloading to Node A of the EEVB. The message **Sending CoreMini.** will appear in green text, followed a few seconds later by **neoVI updated (Time nnnn ms) - Success**, where **nnnn** is the number of milliseconds that was required.
7. **Send CoreMini to Node B:** Click the drop-down box and select Node B. Press the  button again to send the CoreMini to Node B. You will see messages similar to the ones you received when sending to Node A.
8. **Close CoreMini Console:** Press the *Esc* key or click the  button top right to close the console.

The scripts will begin running on the board as soon as you complete sending the CoreMinis over to it. (If they do not, be sure you remembered step 5!)

### ***Using the EEVB's Input and Output Features***

Let's now examine the Ethernet EVB again, where we will notice a few changes to its behavior now that the CoreMinis are running. First, the two activity LEDs for the BroadR-Reach PHYs (components A04 and B04 in Figure 2) are rapidly flashing. This indicates that both nodes are actively transmitting frames, as we instructed them to do in our scripts.

Next, take a look at LED1 on Node A (component A10) and LED2 on Node B (component B14). You should see that these are flashing, at a rate that may range from very fast to very slow. The CoreMini is set to vary their flash rate based on the setting of the potentiometer for each node, so you can actually change this yourself.

- 9. Change Node A Potentiometer Setting:** Find the small round potentiometer dial for Node A (component A12) and turn it all the way clockwise until it stops. Then turn it all the way counterclockwise until it stops.


As you adjust the dial clockwise, you will see that the flash rate of LED1 on that node slows down; when it reaches the limit of its travel, the LED will turn on and off about every 4 seconds. Turning the dial the other way speeds up the flash rate, which will blink very quickly when it is all the way at the other end of travel.

- 10. Change Node B Potentiometer Setting:** Repeat the previous step for the Node B potentiometer (component B12)

You should now see the same behavior in LED2 on Node B.

### ***Viewing Messages Transmitted from the EEVB***

Now let's return to Vehicle Spy 3. With the setup file still loaded, we'll now go online to look at the messages that the EEVB nodes are transmitting.

- 11. Go Online:** Find the  button near the top left of the screen and click it to set Vehicle Spy 3 to "online mode".

In online mode, VSpy will actively capture and display messages from the network it is monitoring. Your screen should now look something like Figure 32.

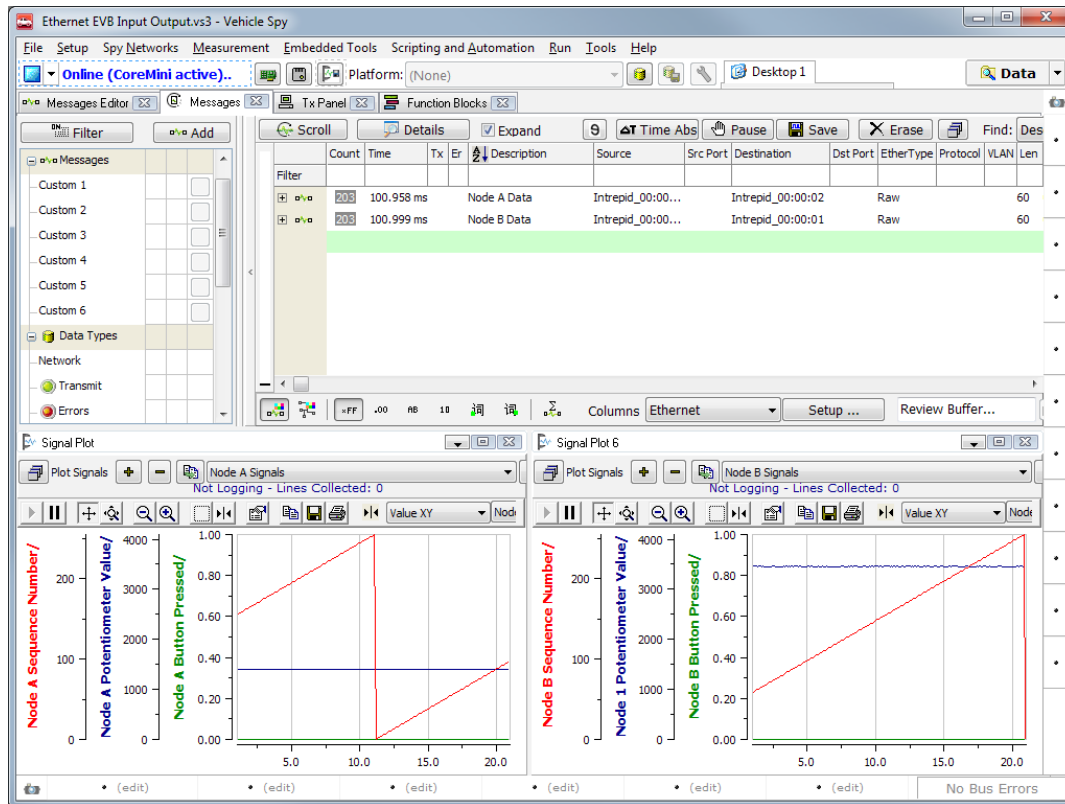


Figure 32: Online View of Ethernet EVB Input Output Demo.

Let's take a closer look at some of what's going on here:

- **Messages View:** The upper half of the display shows messages coming into VSpy. Here you will see the two custom messages being sent by the two EEVB nodes: Node A is sending *Node A Data*, while Node B sends *Node B Data*. Notice that the *Time* column is about 100 ms, since that's how often we told each node to transmit.
- **Signal Plots:** On the bottom of the display are signal plots that show the current value of the three custom fields each message contains.



**Note:** You may see some other messages also appear. These are generated automatically by the EEVB and can be ignored.

Let's look at those data fields in more detail.

12. **Show Message Signals:** Click on the  icon to the left of the *Node A Data* message.



You will see six signals displayed (Figure 33). The first three are standard Ethernet fields, which can be ignored for the purposes of this demo. Next come three data fields that we have told the EEVB to send, which are also displayed in the signal plot bottom left.

	Count	Time	Tx	Er	Description	Source	Src Port	Destination	Dst Port	EtherType	Protocol	VLAN	Len
Filter													
207	100.983 ms				Node A Data	Intrepid_00:00:02		Intrepid_00:00:02		Raw			60
Destination MAC Address					=	Intrepid_00:00:02		[FC70000002]					
Source MAC Address					=	Intrepid_00:00:01		[FC70000001]					
EtherType or Length					=	Raw Ethernet		[0]					
Node A Potentiometer Value					=	2840		[818]					
Node A Sequence Number					=	100		[64]					
Node A Button Pressed					=	0		[0]					

Figure 33: Node A Data Signals.

Of course, Node B sends similar signals, but with a “Node B” prefix. You can see these if you expand the **+** next to the *Node B Data* message, or view them in the other signal plot, bottom right.

The three data fields are as follows (with their signal plot color):

- **Potentiometer Value (Blue):** The analog position of the node’s potentiometer converted to an integer from 0 to 4,095.
- **Sequence Number (Red):** An 8-bit counter that is incremented each time a message is sent, wrapping around to 0 after it hits 255.
- **Button Pressed (Green):** A binary value that is 1 if the node’s pushbutton is held down (component A09/B09) and 0 otherwise.

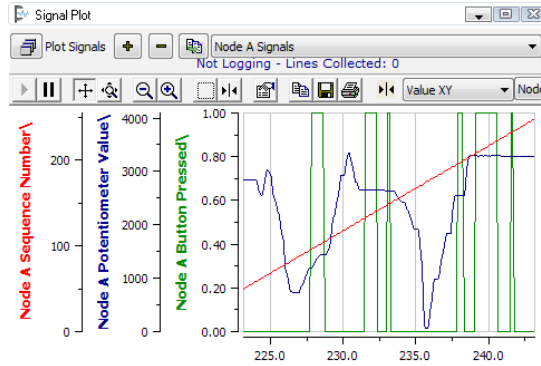
While online you can see some of these values changing. The sequence number steadily increases, taking about 25 seconds to count from 0 to 255 and then start over. The potentiometer value fluctuates even when the potentiometer is not being manipulated; this is due to natural random variation in sampling such a device. The pushbutton value of course does not change on its own.

### 13. Change the Node A Potentiometer Setting: Turn the dial in either direction.

You will see the value change in the text signal display, as well as in the signal plot (Figure 34).

### 14. Press and then Release the Node A Pushbutton: Hold it down for a few seconds, then let go.

The *Button Pressed* value changes in both the text display and plot. It can be hard to spot this at first in the signal plot since the value is binary; it’s more obvious if you do it a few times (again, see Figure 34).



**Figure 34: Node A Signal Plot Changes.** This example shows the effect of changing the potentiometer setting, as well as pressing and then releasing the node pushbutton several times.

Finally, since we will normally want to see *Details View*, let's turn it back on now.

- 15. Enable Details View:** Press the  button.

### ***You're Done!***

Congratulations on completing your first Ethernet EVB demo! You can now close Vehicle Spy 3, or feel free to continue to explore the demo on your own. When you're ready to do even more hand-on experimentation, be sure to check out the included EEVB Lab Manual.

## **2.6 Licensing Vehicle Spy 3**

The Ethernet EVB package includes a 90-day license for the full demo version of Vehicle Spy 3 Professional. When initially installed, the program will run for five days; it must be licensed to be used beyond this period. This requires a simple procedure, which is described below.

We recommend licensing the software as soon as possible after installing VSpy, to ensure that you experience no interruption in access to the program.

- 1. Open License Configuration Screen:** Launch Vehicle Spy 3 from the Windows start menu or desktop. A splash screen for CrypKey will appear and remain visible for about 5 seconds (Figure 35). Quickly click on the window, or press the *Enter* or *Space Bar* keys.



**Figure 35: CrypKey Splash Screen.**

A license configuration screen will appear similar to the one in Figure 36.

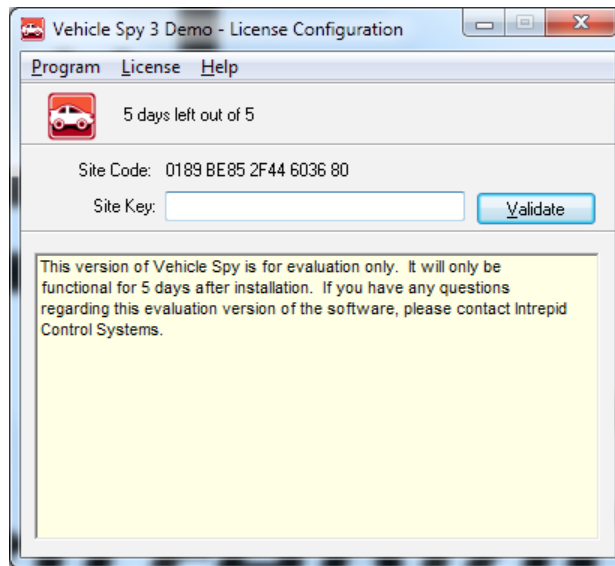


Figure 36: Vehicle Spy 3 License Configuration Screen.



**Note:** If the five-day grace period has expired, you will be taken directly to the license configuration screen automatically as soon as you run VSpy.

- 2. Copy and Email Site Code to Intrepid:** Click and drag the cursor over the entire site code shown in the configuration screen. Then email it to the following address: [icssitekey@intrepidcs.com](mailto:icssitekey@intrepidcs.com).

You should receive a reply back containing a site key within about one business day.

3. **Enter Site Key:** Copy the site key from the email you receive and paste it into the text box on the configuration screen (Figure 37). Then Click .

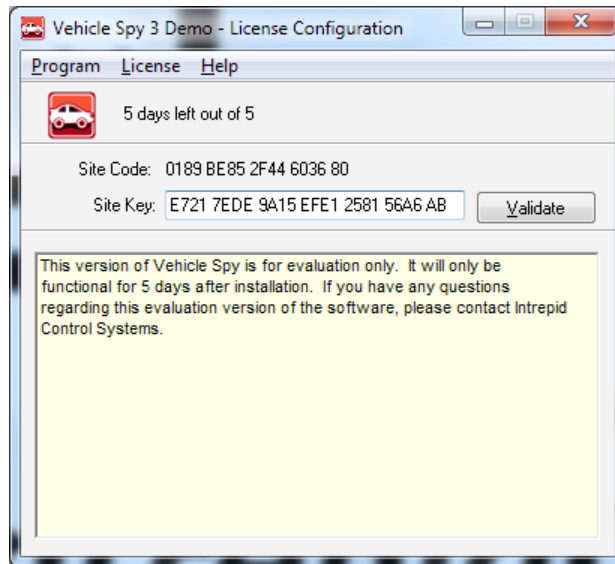


Figure 37: Vehicle Spy 3 License Configuration Screen with Site Key Entered.

After a few seconds, you should see a confirmation that the software is now licensed (Figure 38). You can now press *Enter* or click  to launch VSpy. When you run the program in the future, you will now see that the CrypKey splash screen says it is licensed for 90 days.

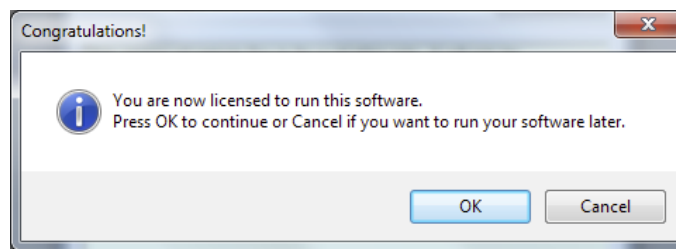


Figure 38: Vehicle Spy 3 Licensing Confirmation.

If the process is not successful, please double-check that the site key was entered correctly. If you still encounter problems, please contact ICS for assistance.

### 3 Intrepid Ethernet EVB Support

Like all Intrepid products, your EEVB has been designed, manufactured and tested to provide you with years of trouble-free service. However, like any complex engineered device, problems can occasionally arise. Fear not, for we are here to help! In this chapter we have provided tips to help you deal with common problems, or get assistance directly from ICS support.

#### 3.1 Firmware Updates

Firmware is essentially software that is built into a hardware device to control its operation. The Ethernet EVB contains firmware that implements its various features, such as allowing it to control its input and output devices, and managing the transmitting and receiving of messages. This firmware is periodically updated to implement enhancements and improvements, and to correct issues that have been detected during testing.

Firmware updates for the EEVB are included as part of the installation package for updates to Vehicle Spy 3. When updated EEVB firmware is included in a new VSpy version, it will be sent to the board automatically when the EEVB is accessed for the first time by the new version. On occasion, however, it may be necessary to update the board's firmware manually. This can be accomplished by following these steps.

1. **Open the Hardware Explorer:** Select *Hardware* from the *Setup* menu in Vehicle Spy 3.

A dialog box will appear showing all of the Intrepid hardware devices that Vehicle Spy 3 sees connected to the host computer. In the list you should see two entries for the EEVB, corresponding to the two Ethernet nodes on the board. These should appear as **Ethernet EVB** followed by a serial number starting with **EE** followed by 4 additional characters (Figure 39).

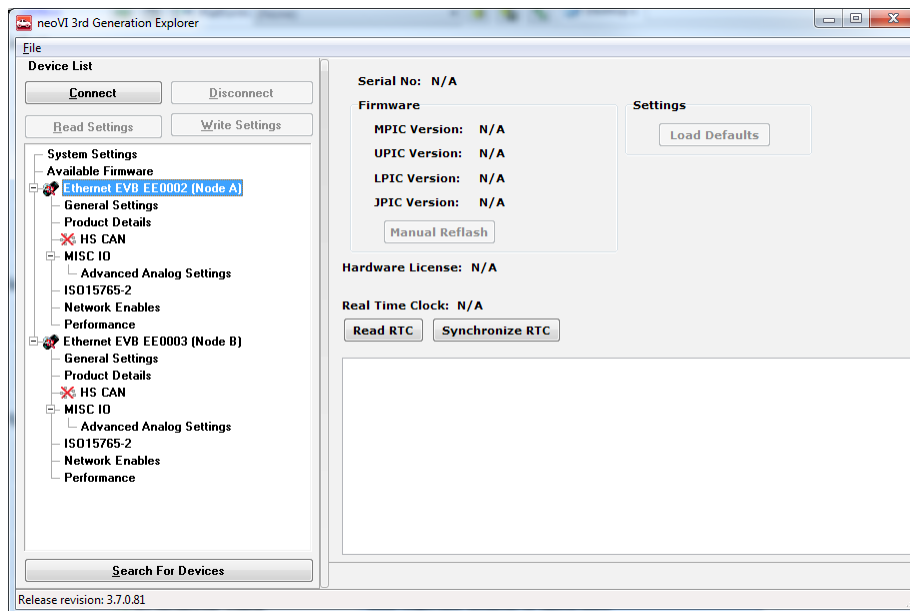



Figure 39: Vehicle Spy 3 Hardware Explorer.

- 2. Connect to the First EEVB Node:** Node A of the EEVB may already be selected, as shown in the example in Figure 39; if it is not, then click it. Once the node is selected, press the  button above the hardware list.

A message will appear in the status box saying **Ethernet EVB EExxxx (Node A) settings have been read..**

- 3. Update the Firmware on the First EEVB Node:** Click the  button.

A window will appear saying **Erasing Ethernet EVB EExxxx...**, which will then be replaced by the message **Sending Firmware to Ethernet EVB EExxxx...** (Figure 40). This process should take somewhere around 10 to 20 seconds. When it is complete, a message will appear in the status box indicating that the node has been flashed.

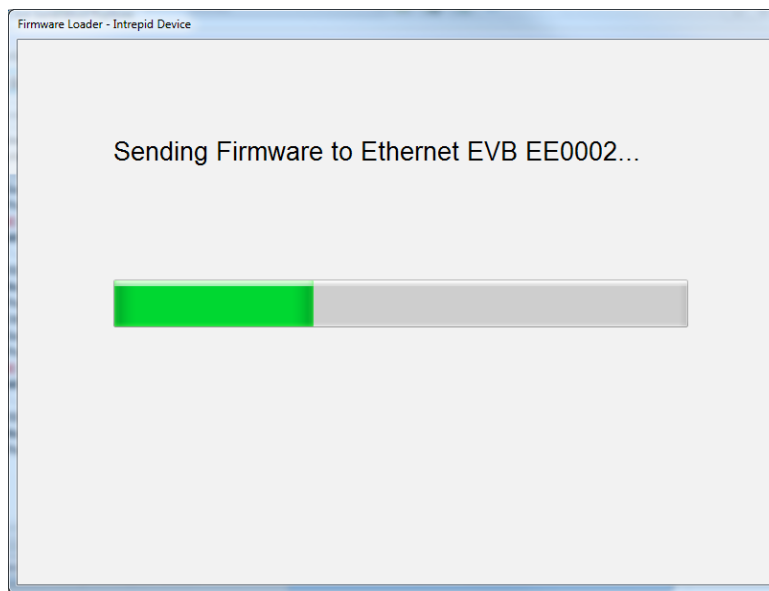


Figure 40: Firmware Flashing Message.

- 4. Repeat the Firmware Update with the Second EEVB Node:** Repeat steps 2 and 3 for the second EEVB node.

Note that a firmware update will remove any CoreMini script in the node. You can simply send the CoreMini again, following the instructions provided in Section 2.5.

The Ethernet EVB will not be damaged or put into an unusable state by an interrupted or failed firmware update; you can simply attempt the process again. If you continue to experience difficulties while performing an update, please contact Intrepid for assistance.



## 3.2 Troubleshooting

If you're having problems with your EEVB or Vehicle Spy 3, we recommend that you first peruse the troubleshooting ideas in this section. You may be able to solve the problem quickly this way, and even learn more about how the hardware and software works in the process.

### ***EEVB Hardware Problems***

Problems with the actual EEVB are rare, but here are a few suggestions if you encounter issues in this area.

#### **EEVB Has No Power (No LEDs Lit)**

Try the following:

- Ensure that the USB cable is properly plugged into the EEVB and to two USB 2.0 jacks on your PC.
- Try connecting the cable to different USB ports.
- If you are using a hub, connect the board to the PC directly. If this works, then the hub is not providing sufficient current to the board; use a powered hub or leave the board connected to the PC USB ports.

#### **Difficulty Removing BroadR-Reach Cable from Mini50 Jacks**

The Mini50 connectors can be difficult to use until you get accustomed to them. Be sure to press all the way down on the small tab in the middle of the cable connector before attempting to pull it out of the jack. Do not pull the plug out by the wires or you may damage the cable.

#### **Node LED2 Blinks Three Times, LED1 Blinks Once, Then Repeats**

This pattern indicates that the node is in a configuration state called "bootloader mode". Please contact Intrepid for assistance.

### ***Problems Related to EEVB Support in Vehicle Spy 3***

For general issues with Vehicle Spy 3, please refer to the program's own documentation. Here we will cover concerns dealing with the interface between Vehicle Spy 3 and the Ethernet EVB hardware.

#### **No Ethernet Interfaces Listed on Logon Screen**

This generally means that Ethernet support has not been turned on in Vehicle Spy 3. Please follow the steps for enabling Ethernet as described in Section 2.2.

## EEVB Not Shown in Ethernet Interface List on Logon Screen

This typically happens when Vehicle Spy 3 is started before the EEVB is connected to the PC, or when the board is disconnected while the software is running. Start by pressing the **Refresh Ethernet Interfaces** button on the *Logon Screen*; the EEVB interface should now appear.

If this does not work, sometimes you can fix the problem by resetting the packet filter driver, which is a Windows service that captures Ethernet messages for VSpy. Follow these steps (illustrated in Figure 41).

1. Be sure Vehicle Spy 3 is closed.
2. Open a Command Prompt in Windows as an administrator. This can be done by searching for **cmd** in the Start Menu. When you see *cmd.exe* appear, right-click it and choose *Run as administrator*.
3. Type **net stop npf** and press the *Enter* key. You should see the response **The NetGroup Packet Filter Driver service was stopped successfully..**
4. Type **net start npf** and press *Enter*. The reply will be **The NetGroup Packet Filter Driver service was started successfully..**
5. Restart Vehicle Spy 3.

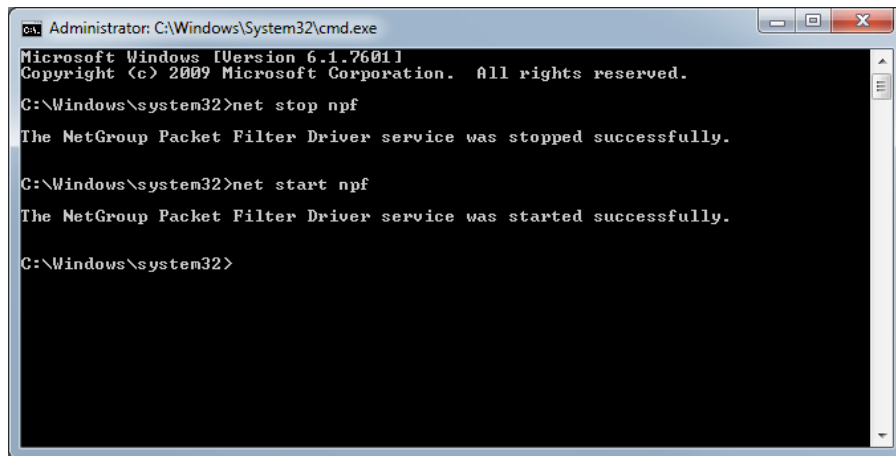


Figure 41: Restarting the NetGroup Packet Filter Driver Service.

## Problems With Running the Ethernet EVB Input/Output Demo on Vehicle Spy 3

Here are a few ideas for dealing with common issues associated with the demo described in Section 2.5.

## Unable to Locate Setup File

The setup file should be included in the Vehicle Spy 3 version that comes with the Ethernet EVB. If it is missing, you can also download it from the EEVB web page at <http://www.intrepidcs.com/ae/eevb/>.

## Can't See Messages Area in Messages View

This may happen on low-resolution screens if there isn't enough space to show everything. Be sure to disable *Details View* as described in the demo. You may also wish to shrink the height of the signal plots near the bottom of the view by dragging their top window bars downward.

## No Messages or Unexpected Messages Shown in Messages View

There are several possible causes for this problem. Please try the following:

- This most often occurs because the EEVB is not selected as the Ethernet interface on the *Logon Screen*. VSpy will select the EEVB by default if it detects it, but it's easy to change this by mistake. Please check this and change the selection if necessary.
- It's easy to accidentally enter something in a field that interferes with normal operation. Reload the example setup file and try the demo again; this often resolves the issue.
- Make sure that the CoreMinis have been successfully transferred to the EEVB.
- Try resetting the EEVB node CPUs by briefly pressing and releasing each one's reset button, found to the right of the large CPU chip (components A13 and B13 in Figure 2).

## Node A Stats Messages Appear, but not Node B Stats

This typically occurs if the BroadR-Reach cable connecting the two nodes is not securely connected. As shown in Figure 1, the X MOS active TAP only sends to the PC traffic it spies on Node A, so traffic from Node B must be sent to Node A for it to appear in Vehicle Spy 3.

## 3.3 Need More Assistance?

If you have a problem you cannot resolve on your own, feel free to contact ICS by phone or email using the following contact information:

- **Phone:** (800) 859-6265 or (586) 731-7950, extension 1.
- **Fax:** (586) 731-2274.
- **Email:** [icssupport@intrepidcs.com](mailto:icssupport@intrepidcs.com)

Intrepid's normal support hours are from 8 am to 5 pm, Monday to Friday, United States Eastern time. If you require assistance outside standard business hours, feel free to contact us and a member of our support team will get back to you as soon as possible.