

# RAD-Galaxy

Multi Active Tap, Media Converter and  
Network Interface for Automotive Ethernet and CAN FD



## User's Guide

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## Version History

Version Number	Date	Description / Major Changes
1.0	2016/12/23	Initial release.
1.1	2017/05/16	Corrected problem with pinout diagram for DB-25M connector on neoVI FIRE 2 Ethernet Cable Adapter.
1.2	2017/11/28	Corrected incorrect specification.

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# 1 Introduction and Overview

## 1.1 Introduction

Thank you for purchasing an Intrepid Control Systems RAD-Galaxy multi active tap and media converter for Automotive Ethernet (AE). The RAD-Galaxy allows you to seamlessly monitor communications between 6 IEEE 802.3 100BASE-T1 Ethernet nodes and a switch, or between 6 pairs of nodes. In its media converter mode, it can instead act as an interface between 12 independent nodes or switch ports and a PC, allowing the PC to talk to all nodes simultaneously. The RAD-Galaxy communicates at up to 1 Gb/s over its standard Gigabit Ethernet link, and also has a second Ethernet port for Diagnostics over IP (DoIP) operations with a connected vehicle.

In addition to its powerful Automotive Ethernet capabilities, the RAD-Galaxy can also be used to interface with standard vehicle networks. It includes support for 8 CAN channels with CAN FD support, 2 of which can be switched between Dual Wire CAN and Single Wire CAN. Support for one LIN channel and multiple channels of analog and/or PWM input/output are built into the hardware, and will be available in a future firmware update. The RAD-Galaxy can be used either attached to a PC or as a standalone logger. It also comes with a license for the full professional version of Intrepid's powerful Vehicle Spy software, providing a wide range of vehicle network analysis and simulation capabilities.

 **Note:** 100BASE-T1 Automotive Ethernet is also known as *BroadR-Reach* (sometimes abbreviated as *BroadR* or just *BR*) and *One Pair Ethernet* (*OPEN* or *OP*). Only minor differences exist between the 100BASE-T1 and BroadR-Reach specifications, and the RAD-Galaxy is compatible with both standards.

## 1.2 Package Contents

Your RAD-Galaxy package includes both hardware and software.

### **Hardware**

You should receive the following:

- The RAD-Galaxy device.
- One *RAD-Galaxy Ethernet Cable Adapter* (HD-26F to HD-26M + DB-9F + RJ-45F).
- One *neoVI FIRE 2 Ethernet Cable Adapter* (HD-26F to DB-25M + DB-9M + RJ-45F).

- Two standard four-pair 3' (~1m) Ethernet cables.
- Two TE Connectivity Nano MQS female plug housings and 28 TE Connectivity Nano MQS crimp contacts, for connecting to the BroadR-Reach network. (Section 2.4 provides details on the use of these components.)
- An Intrepid OBD cable of your choice, selected from these options:
  - *neoVI-OBD-1* (primarily for General Motors vehicles)
  - *neoVI-OBD-MULTI* (for most vehicles)
  - *neoVI-OBD-MULTI Right Angle* (for vehicles where an angled connector is required)
  - *neoVI FIRE/RED J1939* (for commercial vehicles)
  - *neoVI FIRE 2 OBD Cable with DoIP Support* (for DoIP through an OBD connector)

The box will also contain a handy Intrepid Automotive Ethernet poster, which allows you to quickly reference important AE concepts at a glance. Figure 1 shows a typical RAD-Galaxy package after removing the upper protective foam layer and the Automotive Ethernet poster.



**Figure 1: Contents of the RAD-Galaxy Package.** Top, various cables in plastic wrappers; lower left, the Nano MQS plug housings and contacts in bubble wrap; lower center, the RAD-Galaxy device and software/driver CD.

Upon receipt of the RAD-Galaxy package, please remove, unwrap and inspect all of its contents. If anything is missing or damaged, please contact Intrepid for prompt assistance, using the information at the end of this guide. Later in the document you will find detailed instructions for creating 100BASE-T1 cables and connecting them and the other included cables to the RAD-Galaxy and your vehicle networks.

## **Software**

In the RAD-Galaxy package you will find a software/driver CD containing:

- A copy of Intrepid's Vehicle Spy Professional vehicle network software.
- Drivers for the RAD-Galaxy.
- An API install kit containing the neoVI Explorer utility for configuring the device.
- Documentation materials.

Intrepid's Vehicle Spy (often abbreviated as *VSpy*) is the "Swiss army knife" of automotive networking tools. It allows you to easily monitor and transmit on multiple vehicle networks, and includes capabilities for ECU simulation, data acquisition, scripting, diagnostics, data analysis and much more.

The RAD-Galaxy and Vehicle Spy are designed to work together hand in hand, and a license for the full Professional version is included with your hardware purchase.

It is also possible to control the RAD-Galaxy from within other software using the Intrepid API supported by the device.

## **1.3 Operational Overview**

The RAD-Galaxy has a multitude of capabilities and can perform a number of different functions, many of them simultaneously. The device can function as an Automotive Ethernet multi active tap or media converter, or both at once. At the same time it can also act as an interface to conventional vehicle networks such as CAN and CAN FD, with support for LIN and analog or PWM I/O lines coming in the future.

### ***Operation as an Active Tap***

Due to the high performance and complexity of 100BASE-T1, typical approaches for interfacing to a network (such as attaching a probe to the bus) do not work. This problem is resolved by interposing a device called an *active tap* within an Automotive Ethernet network.

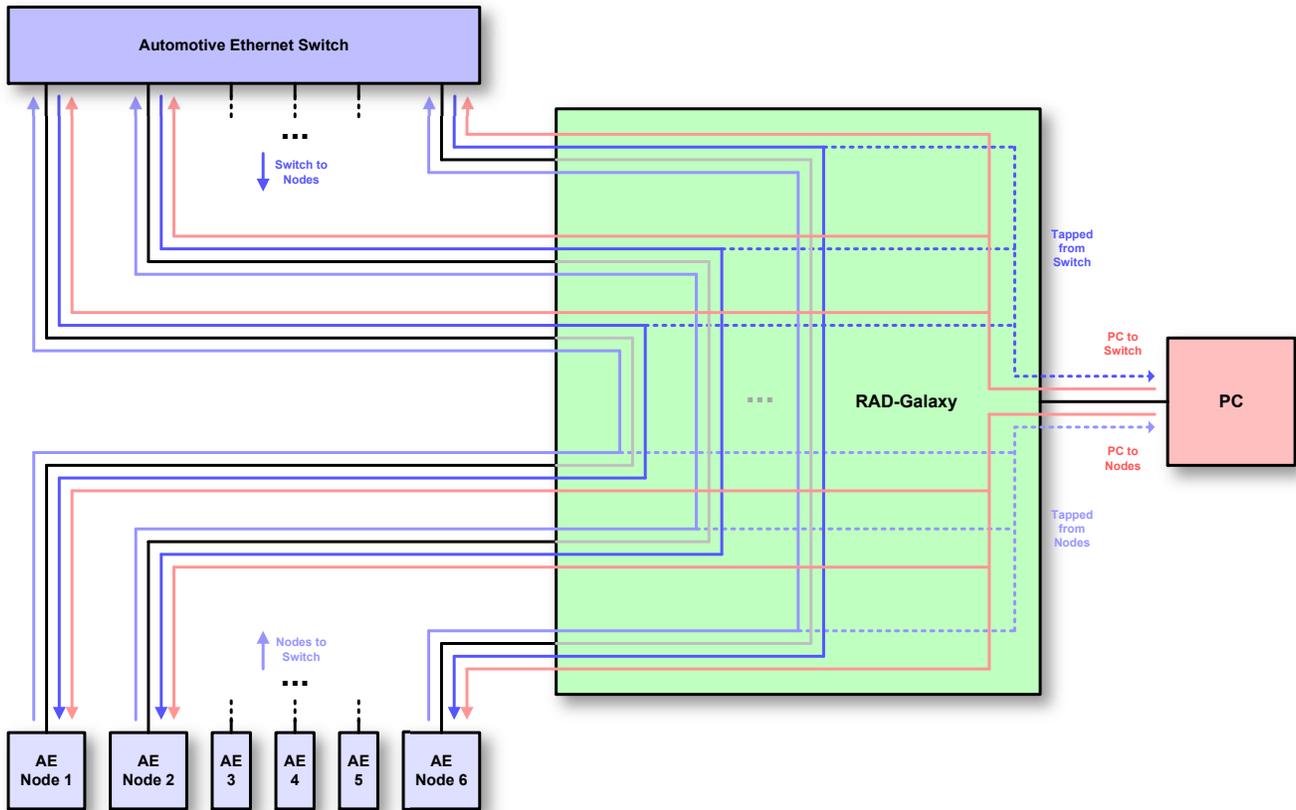
The RAD-Galaxy contains 12 100BASE-T1 transceiver chips (PHYs) configured into 6 pairs to create 6 active taps. These can be interposed between 6 pairs of BroadR-Reach nodes, or 6 nodes and 6 switch ports. The Gigabit Ethernet port of the RAD-Galaxy is connected to a laptop PC or similar conventional Ethernet device.

 **Note:** The term “tap” has a dual meaning: it refers to the act of tapping into a network (such as used in the phrase “wire tap”). It also is sometimes considered an acronym for “test access point”, since a tap does indeed act as an access point for testing, though you can do much more than that with the RAD-Galaxy. For simplicity, in this document we will just use the word “tap”.

Once configuration is complete, the RAD-Galaxy is set up as a “middle man” in the network, managed by a custom-designed processor within the unit. When a node or switch port transmits, the RAD-Galaxy receives the message and retransmits it to the device that the sending node or port was formerly directly connected to, with only a minor delay for processing. The processor also sends a copy of the message over the Gigabit Ethernet connection to the PC, so it can be viewed and analyzed within Vehicle Spy.

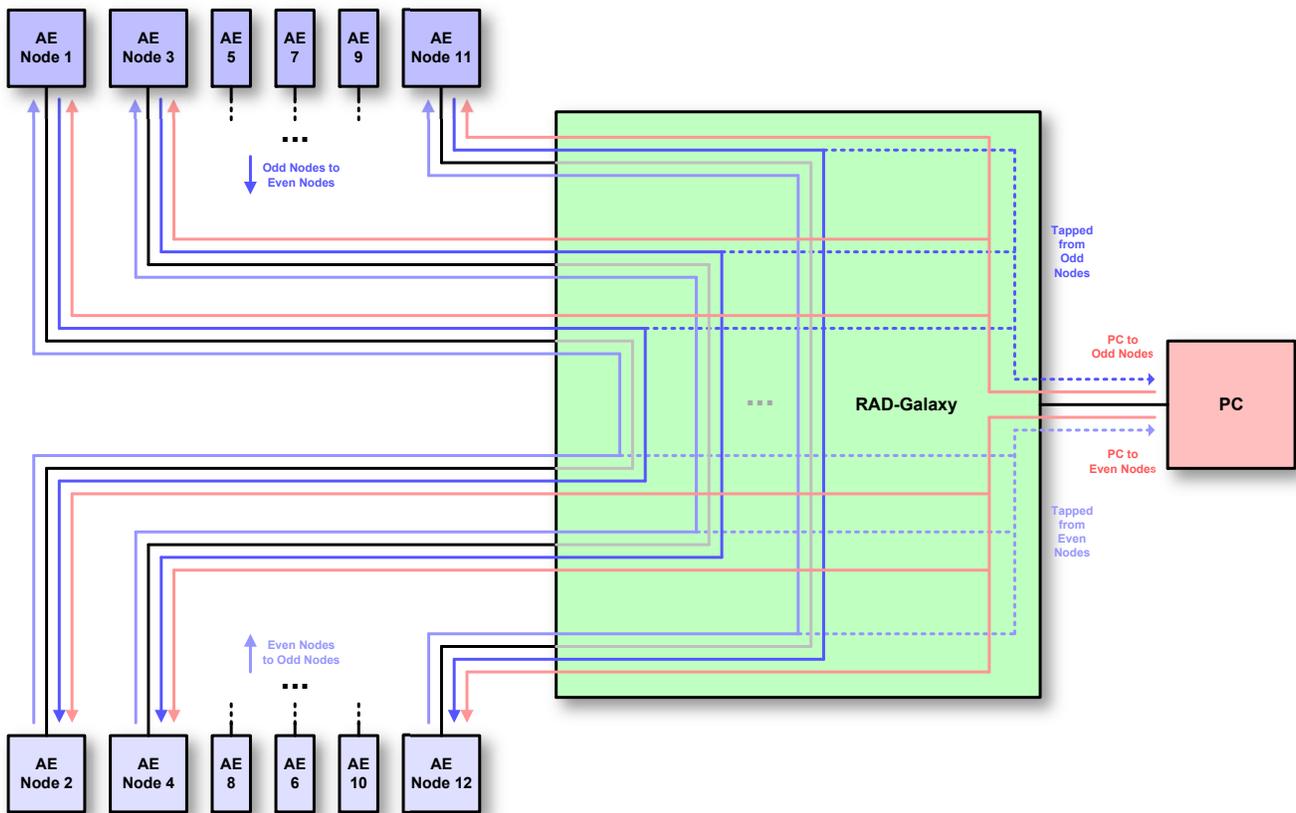
The interface provided by the RAD-Galaxy is full-duplex and bidirectional. This means that in addition to using the PC to monitor messages sent by the Automotive Ethernet nodes attached to it, you can create and send custom messages from the PC to the nodes as well. This allows you to query, test, configure and manage these nodes using Vehicle Spy.

Figure 2 depicts how the RAD-Galaxy functions when inserted into a typical Automotive Ethernet network with 6 AE nodes connected to a switch. (Note that in the diagram, 3 node connections are omitted for greater clarity).



**Figure 2: Using the RAD-Galaxy as an Active Tap Between AE Nodes and Switch.** Before inserting the RAD-Galaxy, Automotive Ethernet nodes 1 to 6 were directly connected to the switch at top left. Each connection was broken and the pairs connected to the appropriate ports on the RAD-Galaxy (black lines). Every transmission continues to be sent to its prior destination (blue arrow lines following the physical connections and the “virtual” internal connections shown in gray within the device). In addition, copies of each message are transmitted by the RAD-Galaxy to the attached PC (dashed lines). Optionally, messages from the PC may also be sent to any switch port or ECU (red arrow lines).

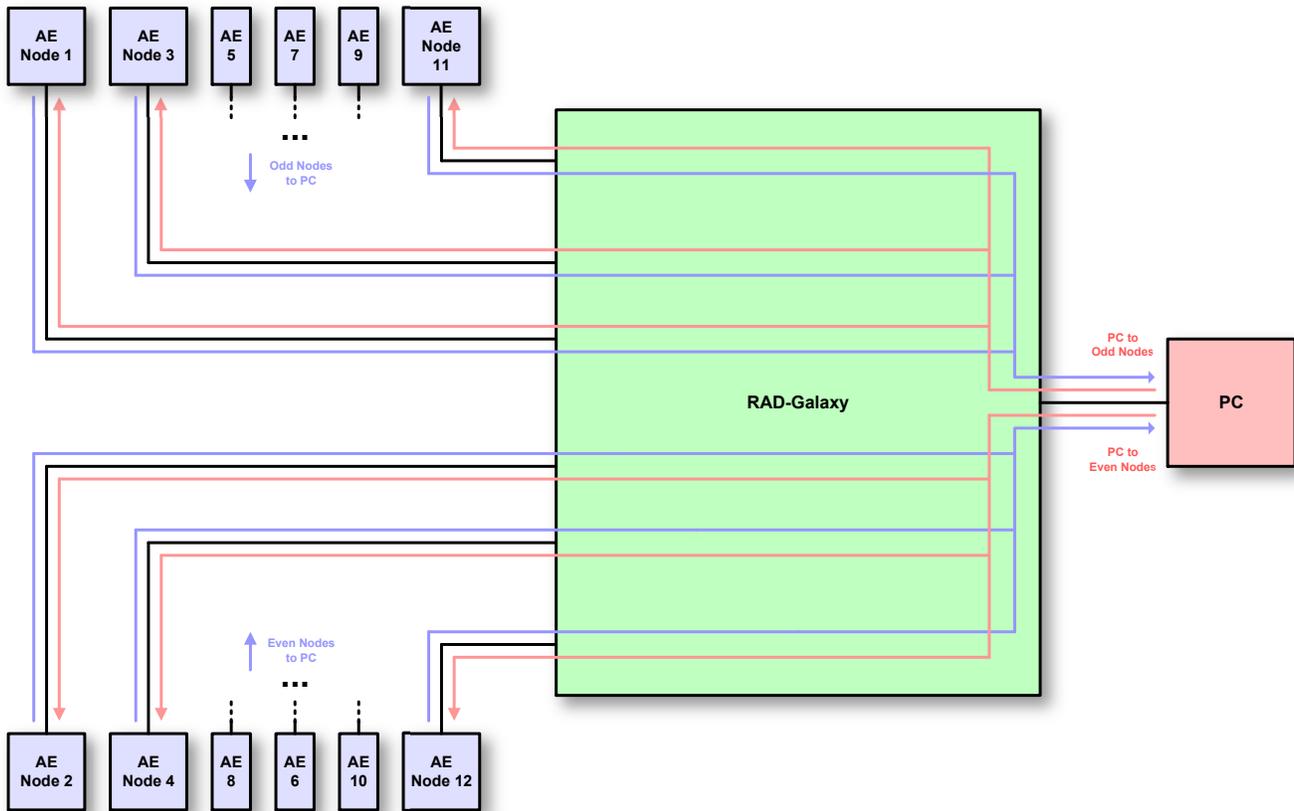
Figure 3 shows a similar setup to that of Figure 2, except with the RAD-Galaxy interposed between 6 pairs of Automotive Ethernet nodes, rather than between nodes and a switch. Note that the RAD-Galaxy has 12 connections, which are arranged into the following pairs: 1+2, 3+4, 5+8, 7+6, 9+10 and 11+12. This is explained further in Section 3.2.



**Figure 3: Using the RAD-Galaxy as an Active Tap Between AE Node Pairs.** In this application, 12 nodes were formerly connected to each other in pairs: Node 1 to Node 2, Node 3 to Node 4, and so on. The RAD-Galaxy has been inserted between each pair, allowing the pair connections to continue in virtual fashion (gray connecting lines) while allowing all traffic to be monitored by the PC, and additional messages from the PC to be sent to the nodes. The RAD-Galaxy connection pairs are 1+2, 3+4, 5+8, 7+6, 9+10 and 11+12.

### Operation as a Media Converter

Instead of being placed between 6 100BASE-T1 connections, the RAD-Galaxy can be configured to interface to 12 nodes independently. Any traffic received by a node will be converted from Automotive Ethernet to standard Ethernet and sent to the PC. Conversely, traffic from the PC will be converted from standard Ethernet to 100BASE-T1 and sent to the appropriate node. Since in this operating mode the RAD-Galaxy is converting between two Ethernet media (Automotive Ethernet and Gigabit Ethernet), it is said to be acting as a *media converter*. Figure 4 depicts the logical operation of the RAD-Galaxy when used in this manner.

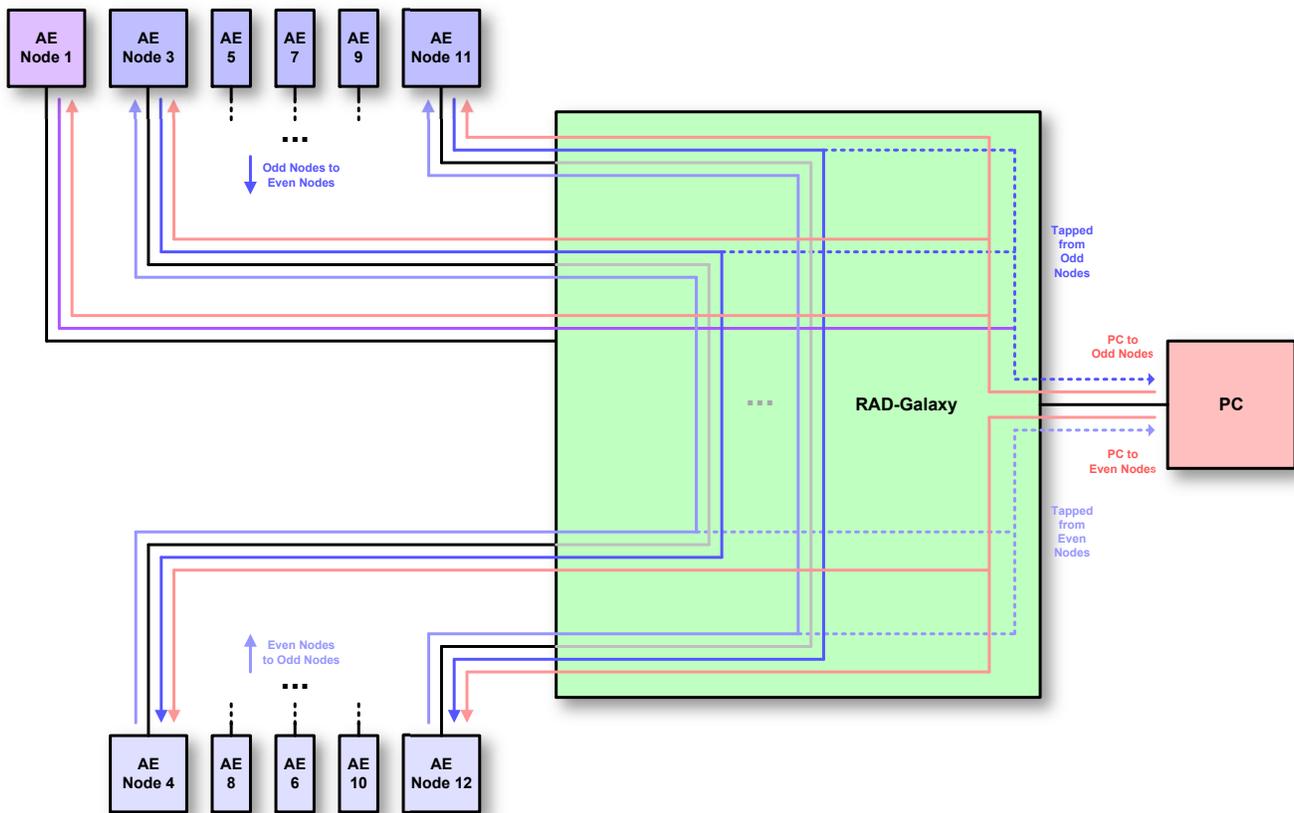


**Figure 4: Using the RAD-Galaxy as a Media Converter.** The RAD-Galaxy allows a PC to interact with up to 12 Automotive Ethernet nodes. Each node can send to the PC, and vice-versa, simultaneously.

### ***Mixed Topology Operation***

If the RAD-Galaxy is in active tap configuration, it is possible to connect a node to only one of the two connections of any of its six pairs. With only one device in the pair, the node will only be able to send and receive to and from the PC, effectively operating in media converter mode. This allows you to “mix and match” how you use the 6 pairs in the device: for example, you can use 5 pairs as active taps, and attach an addition device to the 6th pair by itself for use as a media converter. This is depicted in Figure 5, which is just a slight variation on Figure 3.

Any combination of 6 active taps and 6 media converter connections is possible in this manner. If you want to use the RAD-Galaxy as a media converter for more than 6 devices you must set it into media converter mode as described earlier, which precludes using it as an active tap at the same time.



**Figure 5: Using the RAD-Galaxy as Both an Active Tap and Media Converter.** In this variation on the configuration shown in Figure 3, we have removed AE Node 2. This leaves Node 1 as the only node on that pair, so it only talks to the PC, effectively now operating as if connected through a media converter. Meanwhile Nodes 3+4, 5+8, 7+6, 9+10 and 11+12 remain in pairs functioning in active tap mode.

### ***Timestamping and Frame Wrapping***

The RAD-Galaxy records the time that each message is received on any of its Automotive Ethernet ports. This hardware-level timestamp is then transmitted in a special *wrapper frame* over its conventional Ethernet links, encapsulating the original message. The wrapper frame contains its own Ethernet header and *Frame Check Sequence (FCS)* field, along with an extra header containing information specific to the RAD-Galaxy.

Ethernet controllers normally discard any frames received for which an error has been detected, and strip the FCS error-detection field even on valid frames. The RAD-Galaxy's special wrapping mechanism allows it to capture BroadR-Reach frames in their entirety, including the FCS field, and ensures that error frames are preserved so they can be analyzed.

### ***Conventional Vehicle Network Interfacing***

In addition to its Automotive Ethernet capabilities, the RAD-Galaxy can act as an interface to conventional vehicle networks. It includes hardware for 8 CAN channels, with CAN FD support,

2 of which can be switched between dual wire and single wire operation. All channels are captured simultaneously, and are hardware time-stamped with great accuracy. Non-Ethernet messages are encapsulated into Ethernet frames and transmitted to the PC over the same Ethernet connection used for BroadR-Reach data, where they are decoded and displayed by Vehicle Spy. The RAD-Galaxy also has hardware support for one LIN channel, which will be enabled in a future firmware update.

### ***Simulation and Scripting***

You can write intelligent scripts that implement arbitrary logic, and compile them into *CoreMinis* that run within the RAD-Galaxy itself. This functionality allows you to create specialized test scenarios, and to simulate devices such as ECUs.

### ***Standalone Logging***

The RAD-Galaxy can be used both as a bench tool and as a standalone logger. Vehicle Spy's powerful logging features allow you to easily describe exactly what data you want to record, and then automatically generate the appropriate CoreMini scripts for download to the RAD-Galaxy. You can install the device in a vehicle for independent capture and filtering of up to 128 GB of data, which can later be reviewed and analyzed within Vehicle Spy.

### ***Diagnostics over IP (DoIP)***

The RAD-Galaxy includes support for Ethernet-based DoIP applications. DoIP can be implemented either using a direct connection via a standard Ethernet cable terminated with RJ-45 plugs, or through OBD-II.

## **1.4 Block Diagram**

Figure 6 shows a simple block diagram of the RAD-Galaxy. All operations are controlled by the central processor, which is implemented as a custom System-on-a-Chip (SoC) integrated circuit. The various physical layer chips and network-specific controllers connect to the appropriate connectors on the device for attachment to vehicle networks.

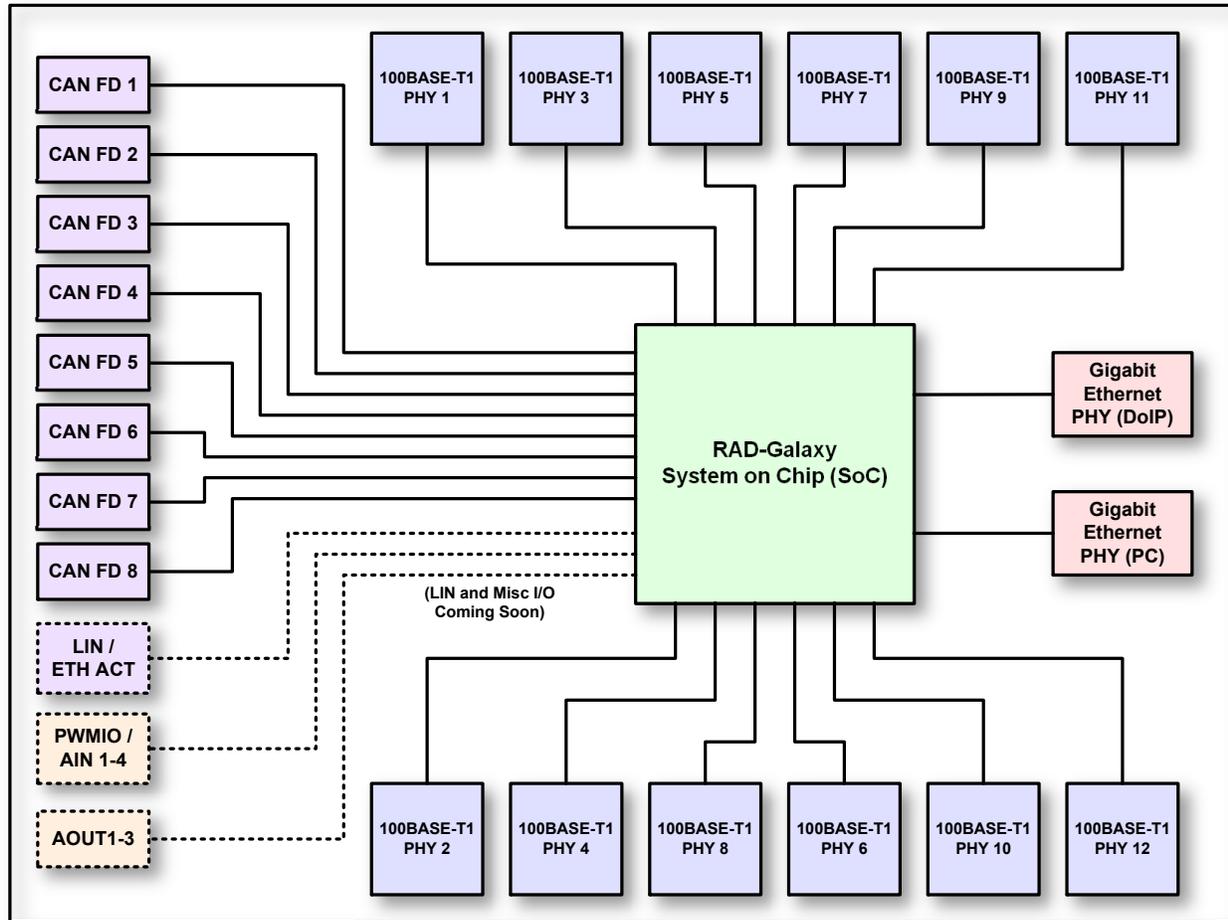


Figure 6: RAD-Galaxy Block Diagram.

## 1.5 Summary of Key Features

The RAD-Galaxy is one of the most powerful vehicle networking tools ever developed, providing extensive analysis and simulation options for both conventional and Automotive Ethernet networks. To give you an idea of how much you can do with the RAD-Galaxy, here's a summary of the device's most important design, construction, operational and performance features.

### ***Construction, Controls and Cabling***

- Compact design: 10.6" x 4.5" x 1.6" (27 x 11 x 4 cm).
- Light weight: about 1.4 lb (645 g).
- Solid anodized aluminum case.
- Thick rubber end boots for shock protection.

- Ruggedized metal connectors.
- Cable interfaces on sides for easier connections.
- Multiple LEDs for status output.
- Included cables and connector contacts for vehicle network interfacing, including Automotive Ethernet, DoIP, CAN and CAN FD.

### ***Power and Performance***

- Fourth-generation neoVI architecture, offering over ten times the performance of earlier devices.
- Field-upgradeable firmware.
- Support for 5V to 40V input power.
- Lower power consumption than earlier generation tools.
- Battery-backed real time clock (RTC).
- 64-bit timestamping with 10 ns accuracy on all Ethernet, CAN and LIN networks.
- Transmit message double-buffering to allow back-to-back message transmission.

### ***Automotive Ethernet Interfaces and Features***

- Custom-designed, high-speed FPGA processor.
- 12 100 BASE-T1 (BroadR-Reach) Automotive Ethernet PHYs.
- Two 10/100/1000 Gigabit Ethernet PHYs with industry standard RJ-45 jacks for PC interface and DoIP applications.
- Switchable between 6 active taps or 12 media converter ports, with hybrid operation possible.
- Full-duplex support for simultaneous data transmission and reception across all PHYs.

### ***Conventional Network Interfaces and Features***

- 6 dedicated Dual Wire (DW) CAN channels (ISO 11898-2).
- 2 selectable CAN channels: 2 additional DW CAN or 2 Single Wire (SW) CAN.
- All DW CAN channels have CAN FD support.
- Listen-only mode support.
- High Speed Mode, Test Tool Resistor, and High Voltage Wakeup support for SW CAN.

- 1 LIN channel (coming soon).
- 4 PWM / Analog Input and 3 Analog Output channels (coming soon).

### ***PC Interface and SD Card Support***

- All data communicated to the PC over standard Gigabit Ethernet connection.
- Support for removable, full-sized SD cards up to 128 GB in size.
- Download speeds of up to 3.2 MB/s.
- SD card protection cover.
- Firmware-based SD card presence and card door detector.

### ***Standalone Logging Support***

- Capable of fully independent operation within a vehicle.
- Log Automotive Ethernet at a rate up to 150 Mb/s, using filters to avoid capturing high-bandwidth or unwanted traffic.
- Logged data quantity limited only by the size of the installed SD card.

## **1.6 Hardware and Software Requirements**

You will need a small amount of support hardware to make use of your RAD-Galaxy:

- A vehicle network, either within an actual vehicle or in a test bench environment.
- A DC power supply capable of providing 5V to 40V of DC power, with a nominal current of 1.5A at 12V. Your network setup must include wiring capable of providing this power on pin 25 of a female DB-25 connector; see Chapter 6 for pinout details.
- A PC with an available Gigabit Ethernet port. Note that backward compatibility to slower Ethernet ports is supported, but 100 Mb/s Ethernet does not provide sufficient capacity for transmitting and receiving high-speed BroadR-Reach traffic on multiple links.
- Cables and/or connectors to connect to the BroadR-Reach nodes in your Automotive Ethernet network.
- A crimping tool to attach wires to the provided crimp contacts and secure them within the Nano MQS plug housings. See Chapter 3 for more details.

Additional cables may also be needed, depending on the nature of the network to which the RAD-Galaxy is being connected.

The only software needed to make full use of your RAD-Galaxy is Intrepid's Vehicle Spy Professional, which is included with the product. Installation instructions can be found in Chapter 3.

Please refer to the Vehicle Spy documentation for its more specific PC hardware and operating system requirements and recommendations. Note, however, that Vehicle Spy will run on most modern Windows-based PCs.

It is also possible to use Vehicle Spy with third-party or custom software, via the Intrepid API. The necessary drivers can also be set up using the API kit installer. All of this software comes with the RAD-Galaxy, or if necessary, can be downloaded from the Intrepid web site at <http://www.intrepidcs.com>. Installation instructions can be found later in this guide.

## 2 A Tour of RAD-Galaxy Hardware

Let's now take a quick tour of the RAD-Galaxy. We'll examine the device from all sides, showing its external components and explaining what each does. This will help you become more familiar with the unit so you can more easily set up, configure and use it.

Like many Intrepid products, the RAD-Galaxy is designed so that all of its connectors are located on its sides, making the device easier to use in cramped quarters. We'll refer to these as the *left side* and *right side* of the unit, as oriented when facing the device with its top label text readable.

 **Warning:** The RAD-Galaxy is a complex device that does not contain any user-serviceable parts. Do not attempt to open the case of the RAD-Galaxy unless specifically instructed to do so by an Intrepid Control Systems technician, or you risk possible injury or damage to the unit.

### 2.1 Case and Overall Design

The RAD-Galaxy is enclosed in a sturdy black-anodized metal case. The device has been designed and tested for in-vehicle use, and is operational in a temperature range from -40°C to +85°C. An overall view of the RAD-Galaxy can be seen in Figure 7.

Connectors and ports are often a point of failure with hardware devices. To ensure that the RAD-Galaxy provides you with years of reliable service, Intrepid has ruggedized the physical interfaces on the device by using reinforced metal connectors.

To further protect the device against bumps and drops, it has blue rubber bumpers on both ends. These bumpers are removable, but there is no need to do this under normal circumstances, and we recommend that you leave them in place.



Figure 7: Overview of the RAD-Galaxy.

The bottom of the RAD-Galaxy contains useful reference information, including the device serial number, pinouts of its HD-26 and Nano MQS BroadR-Reach connectors, and Intrepid's contact information (Figure 8). Pinouts for all RAD-Galaxy connectors and cables can be found in Chapter 6.

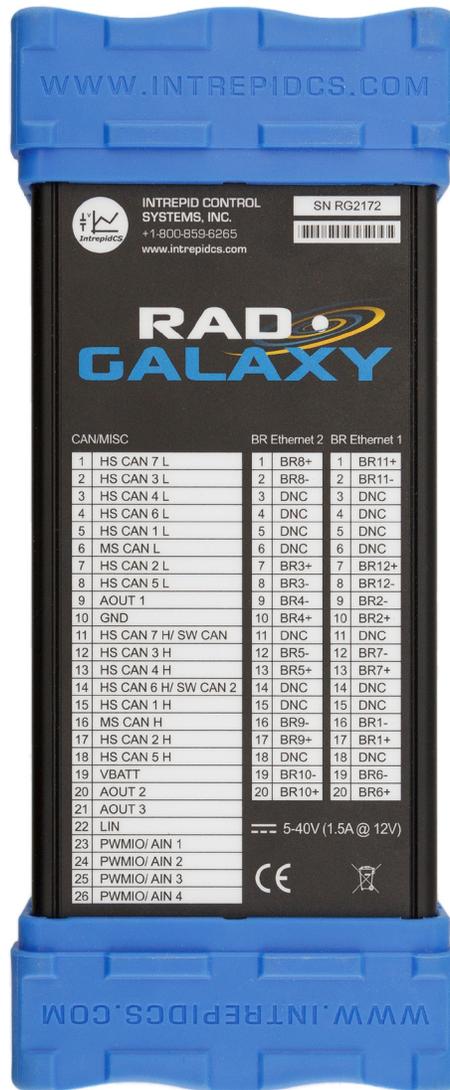


Figure 8: RAD-Galaxy Bottom View Showing Connector Pinouts.

## 2.2 Left Side Indicators and Connectors

The left side of the RAD-Galaxy contains several components: a set of USB connectors, a pair of RJ-45 Ethernet jacks, two LED arrays and a covered slot for the device's SD card (Figure 9).



Figure 9: RAD-Galaxy Left Side View.

### 8-LED Status Indicator Array

These LED indicators (bottom left) are used to convey status information.

#### LEDs #1 and #2

One or both of the left two LEDs (which we will call #1 and #2) will always be flashing, with their pattern indicating the mode of the device. The interpretation of the LEDs depends on whether or not a CoreMini script (which may be a VehicleScape standalone logging script) is present in the device. Table 1 shows the possible combinations.

LED #1	LED #2	CoreMini Present?	Description
Off	Off	--	RAD-Galaxy is powered off.
Off	Flashing	No	Device is offline (idle) with no CoreMini or standalone logging script active.
Flashing (Alternating)	Flashing (Alternating)	No	Device is online (for monitoring traffic or transmitting messages in Vehicle Spy) with no CoreMini or standalone logging script active.
Flashing	Off	Yes	A CoreMini script (including a possible VehicleScape logging script) is active, but logging is not taking place.
Flashing	Flashing	Yes	A VehicleScape logging script is running and actively logging data; the flash rate of LED #2 indicates how rapidly data is being logged.

Table 1: RAD-Galaxy Red LED #1 and #2 Flash Patterns.

### **LED #3**

This is the *Trigger* LED. When doing standalone logging with a CoreMini script, this LED will flash when a trigger event occurs.

### **Other LEDs**

The other 5 LEDs currently have no preprogrammed function. However, they can be employed by CoreMini scripts to convey arbitrary information to the user of the RAD-Galaxy.

### **Bootloader Mode**

You may occasionally see all 8 LEDs flashing synchronously. This means the device is in bootloader mode, which should only happen when flashing the RAD-Galaxy's firmware (see 4.2).

### **USB Connectors**

These connectors are currently reserved for internal and future use.

### **RJ-45 Jacks**

The lower jack, with the label "LAN", is the main link over which traffic flows between the RAD-Galaxy and the PC to which it is connected. The upper jack is used for DoIP.

Both sockets have activity LEDs that will flash when traffic is being sent or received by the RAD-Galaxy.

### **12-LED 100BASE-T1 (BroadR-Reach) Link/Activity LED Array**

On the right is a set of 12 green LEDs arranged in a 4x3 matrix and labeled from 1 to 12. Each LED lights up solid to indicate that the corresponding 100BASE-T1 channel in the RAD-Galaxy has made a connection to another node. While a connection is active the LED will flash, with the flash speed proportional to the rate at which data is being transferred.

### **SD Card Slot and Cover**

At the bottom right is an L-shaped metal cover secured by a Phillips-head screw. Removing the cover allows the preinstalled SD card to be removed or replaced.

## **2.3 Right Side Connectors**

This side of the RAD-Galaxy contains its vehicle network interface connectors (Figure 10).

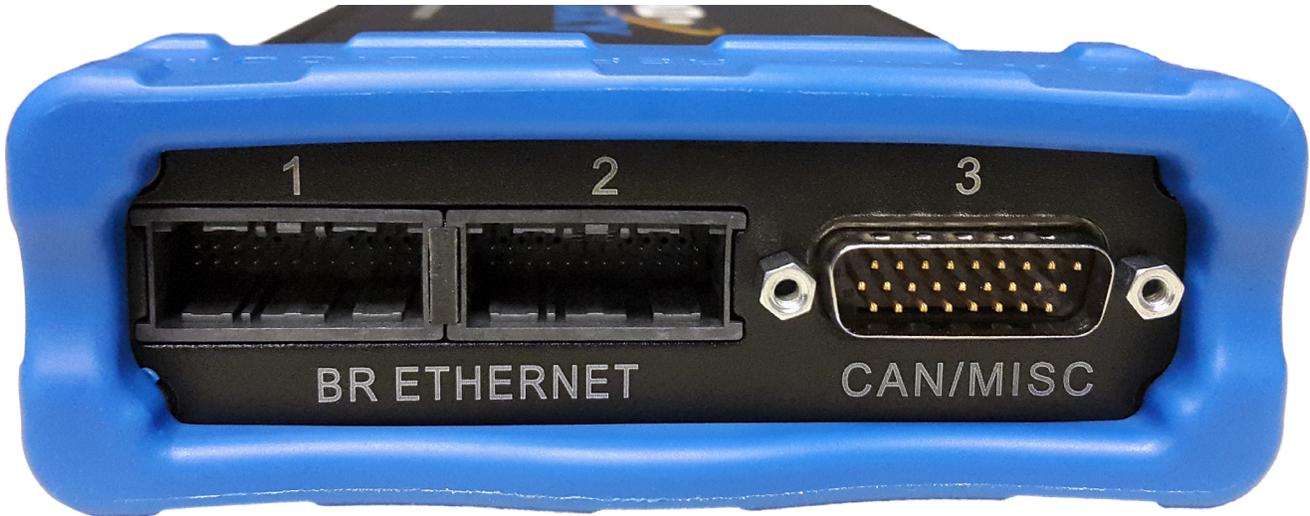


Figure 10: RAD-Galaxy Right Side View.

### ***BroadR-Reach Nano MQS Connector Sockets***

These two sockets are where the cables that connect to Automotive Ethernet networks are attached after they are assembled from the included Nano MQS socket plugs and crimp contacts.

Each connector interfaces 3 pairs (6 channels) of Automotive Ethernet to the RAD-Galaxy. The channels and pairs are distributed as follows:

- **Connector 1:** Pair 1 (Channels 1+2), Pair 4 (Channels 6+7), Pair 6 (Channels 11+12).
- **Connector 2:** Pair 2 (Channels 3+4), Pair 3 (Channels 5+8), Pair 5 (Channels 9+10).

### ***HD-26 Conventional Network Interface Connector (CAN/MISC)***

This male, high-density, 26-pin D-subminiature connector is the primary means by which the RAD-Galaxy interfaces with conventional vehicle networks, and also may provide the mechanism for its DoIP functionality. This connector provides primary power to the unit as well.

## **2.4 Included Cables and Cable Assembly**

The RAD-Galaxy ships with three cables for conventional vehicle networks, and the special components necessary to make the cable assemblies used for Automotive Ethernet networks. Depending on your vehicle network configuration, you may need to modify the included hardware, or supplement it to suit your needs.

This section briefly describes each of the cables and how they are used. More detailed instructions for hooking up the RAD-Galaxy, including these cables, is provided in Chapter 3. Full pinouts for all RAD-Galaxy connectors and cable connectors can be found in Chapter 6.

### ***RAD-Galaxy Ethernet Cable Adapter (HD-26F to HD-26M + DB-9F + RJ-45F)***

This is the RAD-Galaxy's primary breakout cable for conventional vehicle networks, and can be seen in Figure 11. It attaches to the male *CAN/MISC* HD-26M connector seen in Figure 10. The three connectors on the other end of the cable are used as follows:

- **HD-26M:** This connector is a conduit for attaching the *neoVI FIRE 2 Ethernet Cable Adapter* described below (and sometimes the *neoVI FIRE 2 OBD Cable with DoIP Support*).
- **DB-9F:** This connector carries the RAD-Galaxy's LIN traffic along with its miscellaneous I/O channels (coming soon). The LIN channel may also be used for Ethernet Activate for DoIP.
- **RJ-45F:** This Ethernet socket is used to attach a standard Ethernet cable that loops back to the RAD-Galaxy's DAQ port for use with DoIP. Note that even though this cable connects to the RAD-Galaxy's HD-26M connector, these Ethernet signals do not go through it; this is discussed further in Section 3.3.

DC input power is provided to the RAD-Galaxy through this cable, carried on pin 19 of the HD-26F and HD-26M connectors.



Figure 11: RAD-Galaxy Ethernet Cable Adapter (HD-26F to HD-26M + DB-9F + RJ-45F).

***neoVI FIRE 2 Ethernet Cable Adapter (HD-26F to DB-25M + DB-9M + RJ-45F)***

This secondary cable (Figure 12) attaches to the primary cable to make it easy to link the RAD-Galaxy to a vehicle network and provide power to it. As the name suggests, this cable is also used on Intrepid's neoVI FIRE 2 vehicle interface product; the RAD-Galaxy was designed to be compatible with it.

This cable also facilitates the connection of four of the conventional OBD-II cables and provides a conventional Ethernet link for DoIP using an RJ-45 connection. When the *neoVI FIRE 2 OBD Cable with DoIP Support* is used, that cable replaces this one rather than attaching to it, allowing DoIP through the OBD-II connector instead of RJ-45. (See below for details on the OBD cable options for the RAD-Galaxy.)

The HD-26F connector on this cable attaches to the HD-26M on the RAD-Galaxy Cable Adapter. The other three connectors are used as follows:

- **DB-25M:** The primary connection to conventional (non-Ethernet) vehicle networks, and the source of DC power to the RAD-Galaxy. This connector can also be used to attach an OBD-II cable if needed.
- **DB-9M:** This connector contains the RAD-Galaxy's LIN channel (coming soon). Note that it is not wired with miscellaneous I/O channels like the DB-9F on the RAD-Galaxy Cable Adapter. The LIN channel may also be used as an Ethernet activation line for DoIP.
- **RJ-45F:** Used to connect to an Ethernet port on the vehicle network, typically for DoIP. As mentioned above, the signals here are routed to the RJ-45F on the RAD-Galaxy Cable Adapter when the two cables are connected together.

DC power must be provided on pin 25 of the DB-25M connector for the RAD-Galaxy to function. See Chapter 6 for more details.



Figure 12: neoVI FIRE 2 Ethernet Cable Adapter (HD-26F to DB-25M + DB-9M + RJ-45F).

### **OBD Cables**

The RAD-Galaxy comes with your choice of one of five OBD cables, which can be used to interface the device to a vehicle or bench OBD-II port. Four of these cables attach to the DB-25 connector on the *neoVI FIRE 2 Ethernet Cable Adapter*, while the fifth actually takes the place of that cable, connecting directly to the RAD-Galaxy.

Section 3.3 contains hookup diagrams that show you how these cables fit together, as well as step-by-step instructions for connecting them to the RAD-Galaxy and your vehicle or bench.

### **neoVI-OBD-1 Cable**

This cable, which has a red OBD-II connector, is used primarily for General Motors vehicles. It can be seen in Figure 13.



Figure 13: neoVI-OBD-1 Cable.

### neoVI-OBD-MULTI Cable

This cable has a standard black OBD-II connector and is suitable for use with the vehicles of most OEMs. It is pictured in Figure 14.



Figure 14: neoVI-OBD-MULTI Cable.

### neoVI-OBD-MULTI Right Angle Cable

This is the same as the neoVI-OBD-MULTI cable but terminates with a right-angled OBD II connector for vehicles where this is required. A picture of the cable is shown in Figure 15.



Figure 15: neoVI-OBD-MULTI Right Angle Cable.

### neoVI FIRE/RED J1939 Cable

This cable terminates in a round 9-pin Deutsch connector for use in commercial vehicles (Figure 16).



Figure 16: neoVI FIRE/RED J1939 Cable.

### neoVI FIRE 2 OBD Cable with DoIP Support

This special cable attaches to the HD-26M connector on the *RAD-Galaxy Ethernet Cable Adapter* in place of the regular *neoVI FIRE 2 Ethernet Cable Adapter*. It contains DB-25M and DB-9 connectors for connection to vehicle networks, like the cable it replaces, but instead of an RJ-45 socket, has an OBD-II connector wired for DoIP use (including an Ethernet Activation line). It is illustrated in Figure 17.



Figure 17: FIRE 2 OBD Cable with DoIP Support.

### ***Automotive Ethernet (100BASE-T1 / BroadR-Reach) Cable Assemblies***

Specific cables for Automotive Ethernet are not included with the RAD-Galaxy for two reasons. First, Automotive Ethernet does not specify an industry-standard cable and connector type. Second, termination and connector requirements vary from one application to another, so it makes sense for each company to create the cables/harnesses needed for its own networks.

To support its 12 100BASE-T1 connections, the RAD-Galaxy uses a pair of 20-pin Nano MQS style connector sets made by TE Connectivity, which are designed for vehicle use. The part number of the male connector within the RAD-Galaxy is 2177367-3, while the matching female plugs (supplied) are TE Connectivity part number 2177588-1. The crimp contacts that fit into the plugs are TE part number 2-2112449-1; 28 of these are provided with the RAD-Galaxy (the 24 required for the 12 channels, plus 4 spares).

You will need to create two cable assemblies for the 100BASE-T1 connections using the supplied plugs and contacts. To secure the contacts within the plug, you will need a special Nano MQS crimping tool, TE Connectivity part number 4-1579014-0. This device can be purchased from various electronic component suppliers or directly from Intrepid Control Systems. Each of the two cable assemblies will have 12 connections for 6 AE channels, with the contacts arranged according to the pinout on the bottom of the RAD-Galaxy. This information is also provided for your convenience in Chapter 6. An example of an assembled Nano MQS plug with attached cables can be seen in Figure 18.

The other ends of the 12 wires coming from each of the Nano MQS plugs should be terminated according to the needs of your vehicle network or bench application.

Be sure to label each of the wires and/or termination connectors with the appropriate RAD-Galaxy 100BASE-T1 channel number. This will allow you to easily link the connectors to the correct devices in your network.



Figure 18: Nano MQS Plug with Attached Cables.

### ***Ethernet Cables***

Two standard Ethernet cables are provided to connect the RAD-Galaxy to the PC and to the DoIP jack on the RAD Galaxy Ethernet Cable Adapter. You will need to provide a third Ethernet cable of the appropriate length to connect to your vehicle or bench for DoIP use, if required by your application.

## 3 Hardware and Software Setup

In this chapter we will explain the steps necessary to set up your RAD-Galaxy to work with vehicle networks. This will include explaining how to install the required software and drivers, connect cables between the RAD-Galaxy and your vehicle networks, and link the unit to a PC.

Note that because vehicle and test bench setups will vary, we can only show typical cases here. You may need to alter these instructions to suit your particular needs.

### 3.1 Vehicle Spy and Driver Installation and Setup

It is possible to install your hardware and software in either order. However, the RAD-Galaxy requires special drivers to function properly, which are added to your system automatically by the included software setup programs. If you connect the hardware before the drivers are in place it will not work correctly. For this reason, we recommend installing the software first.

A full licensed version of Vehicle Spy is included with your RAD-Galaxy. The installer for the software will be included on the software disc that comes with the device.



**Note:** A separate driver installer is provided for those who will be interfacing to the RAD-Galaxy using its API, rather than using Vehicle Spy. Please see Section 3.2 for details.

Vehicle Spy 3 uses 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 or Flash Drive:** Insert the disc that came with your RAD-Galaxy into your computer. A few seconds later, the ICS software installation menu should appear on your computer screen, as shown in Figure 19.



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

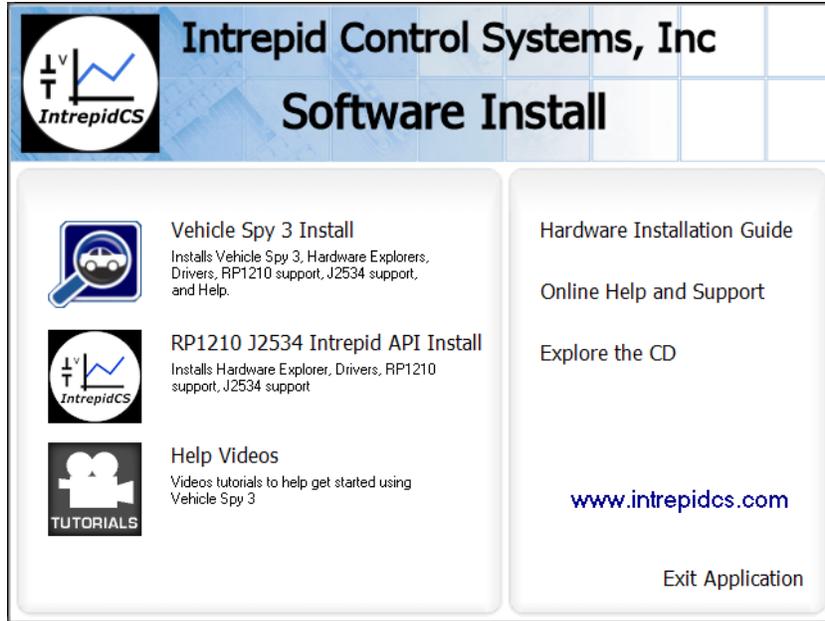


Figure 19: Software Install Dialog Box.

From this menu you can start installing Vehicle Spy 3, install API support files, and access videos, documentation and online support materials.

2. **Start Vehicle Spy 3 Installation:** Click *Vehicle Spy 3 Install*.
3. **Select Language:** Select your preferred language, and then click  to proceed. (For the remainder of these directions, 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 20 (though the exact version number is likely to differ from the one seen here).



Figure 20: 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 *I accept the agreement*, then click  (Figure 21).

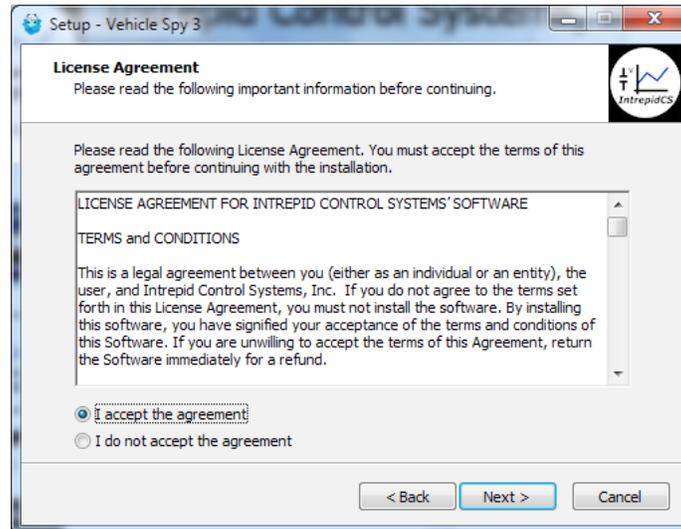


Figure 21: Vehicle Spy 3 License Agreement.

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 22). We normally recommend using the default location. Click .

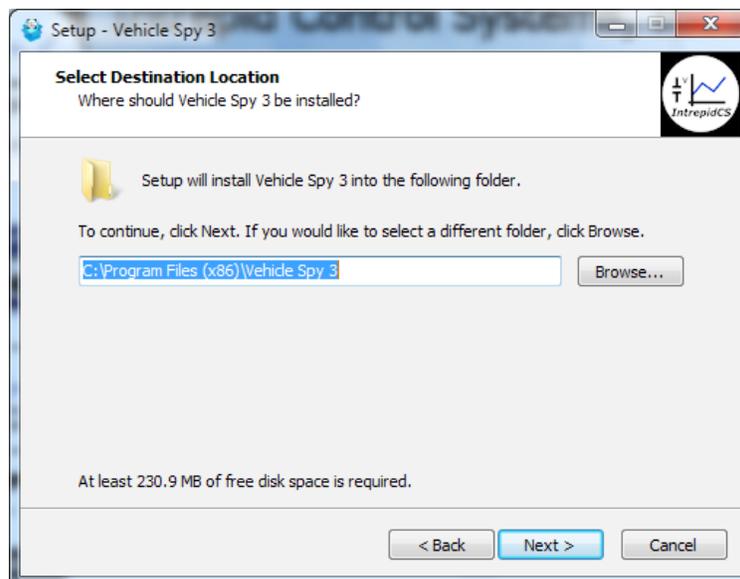


Figure 22: Choosing the Destination Location.

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 23). Click  to continue.

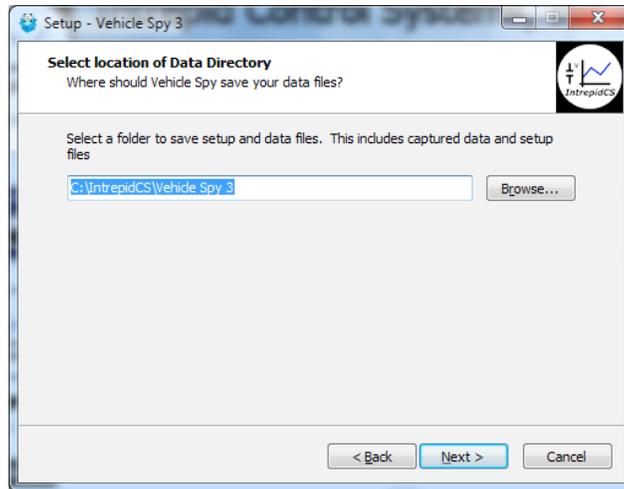


Figure 23: Selecting the Data Directory Location.

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  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 .

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 24.

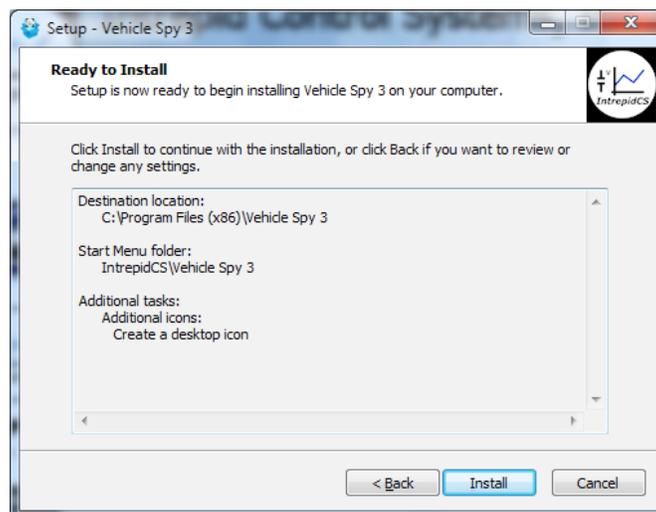


Figure 24: Installation Options Review.

- 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 25).

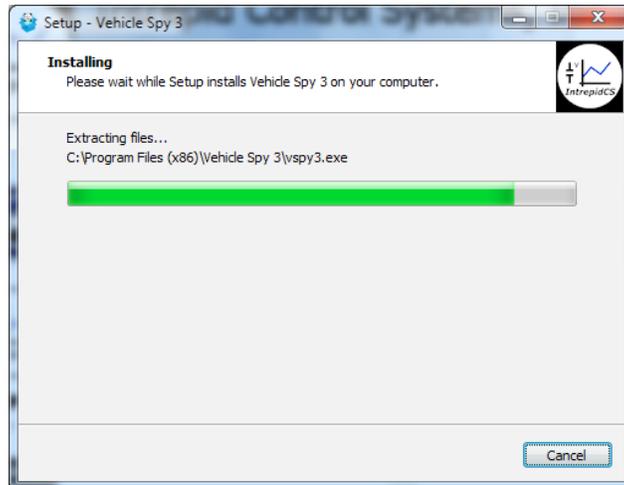
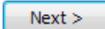
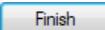


Figure 25: Installing Vehicle Spy 3.

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

- 12. Install Hardware 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 26. Click  to complete this initial driver installation process.

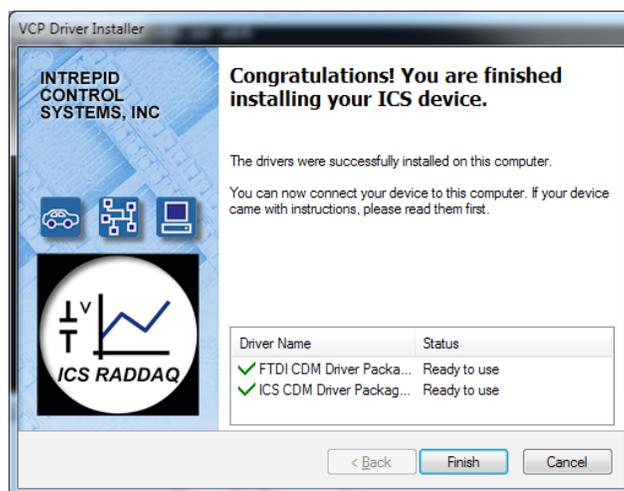


Figure 26: Hardware Driver Installation Complete.

Next, support files for Microsoft Visual C++ 2010 and 2005 will be installed, if they are not already on the computer. This happens automatically, and you may briefly see a dialog box like the one in Figure 27. Many systems already have these files, however; if that is the case, a message may appear telling you that they are already present; just hit  to continue.

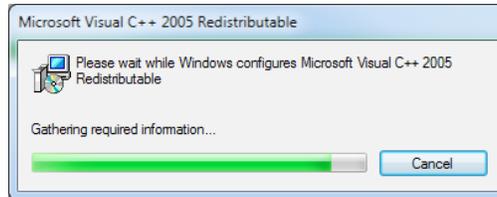


Figure 27: Installing Support Files for Microsoft Visual C++ 2005.

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 28.

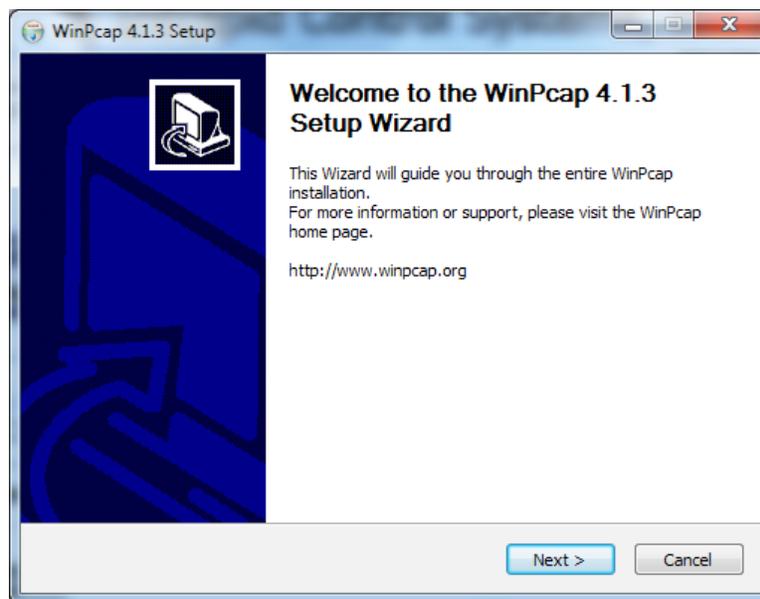


Figure 28: WinPcap setup wizard.

- 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. This only takes a few seconds and requires no user intervention; you may see a dialog box on the screen like the one in Figure 29.

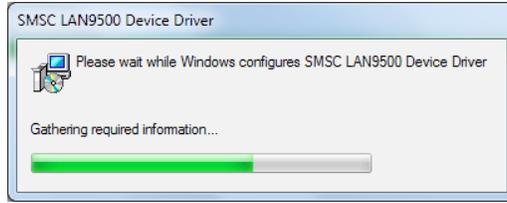


Figure 29: SMSC LAN9500 device driver installation.

Another ICS driver installer dialog box will now appear, 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 30. Please click  to authorize driver installation.

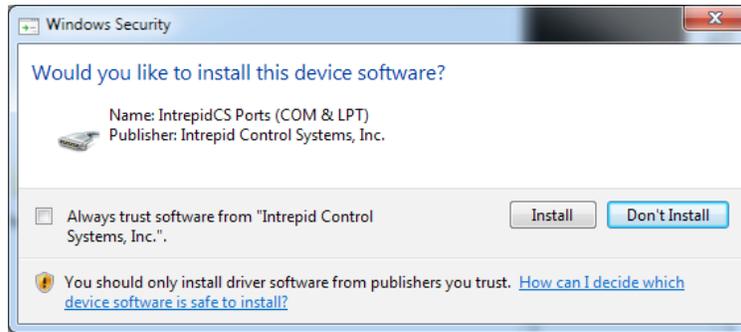


Figure 30: Windows Security Dialog Box.

Once installation begins, it will take only a few moments, and when completed, a message will appear like the one in Figure 31.

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

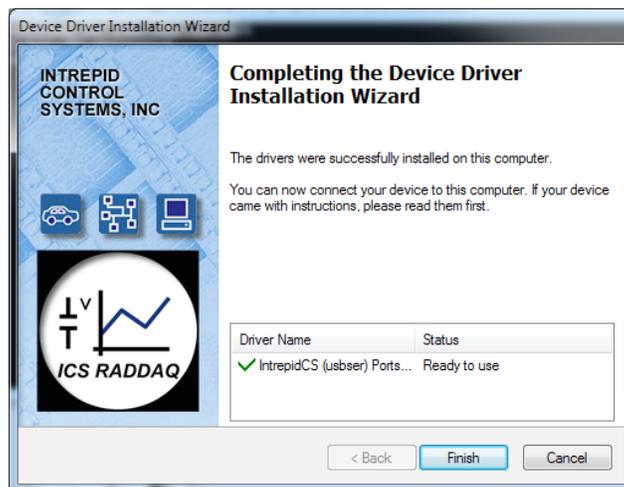


Figure 31: Port Driver Installation Complete.

You will now see a window similar to Figure 32, indicating that the setup process is complete.

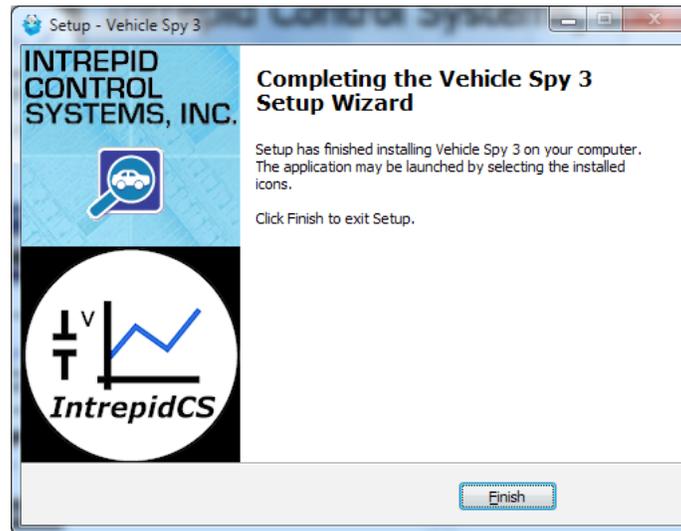
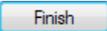


Figure 32: Vehicle Spy 3 Setup Complete.

- 16. Exit the Setup Wizard:** Click .

Congratulations, you're done!

### 3.2 Driver and API Support File Installation and Setup

If you plan to use the RAD-Galaxy without Vehicle Spy 3, you will need to install drivers and support files to allow the hardware to be accessed via its API. Please follow the steps below.

All of these files are installed automatically with Vehicle Spy 3, so if you followed the instructions in Section 3.1, you can skip the directions here.

- 1. Load the Software and Documentation Disc or Flash Drive:** Insert the disc or flash drive that came with your RAD-Galaxy into your computer. A few seconds later, the ICS software installation menu should automatically appear on your computer screen, as shown in Figure 33.

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



Figure 33: Software Install Dialog Box.

2. **Start Support File Installation:** Click *RP1210 J2534 Intrepid API Install*.
3. **Select Language:** Select your preferred language, and then click  to proceed. (We will assume that English has been used.)

The setup wizard for the ICS API and driver kit will now start, displaying a welcome screen as shown in Figure 34. (The version number you see may be different from the one shown here.)



Figure 34: API and Driver Setup Wizard Welcome Screen.

4. **Start API and Driver 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 *I accept the agreement*, then click  (Figure 35).

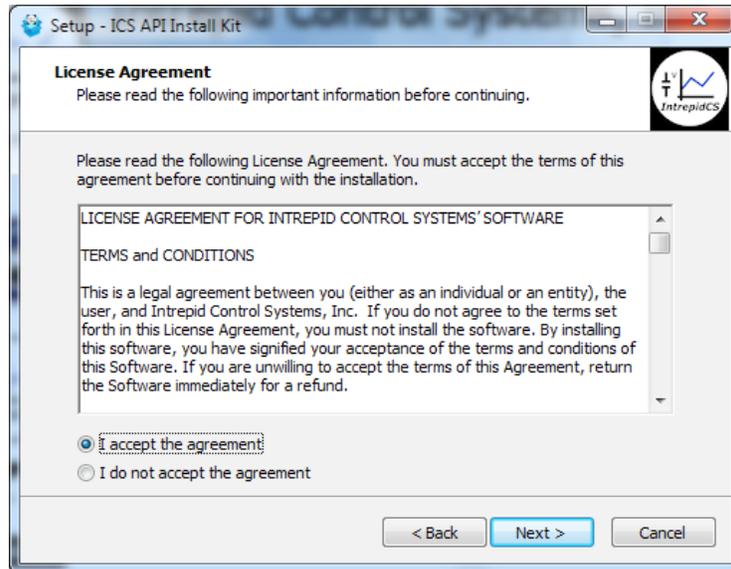


Figure 35: API and Driver File License Agreement.

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 36). We normally recommend keeping the default location. Click .

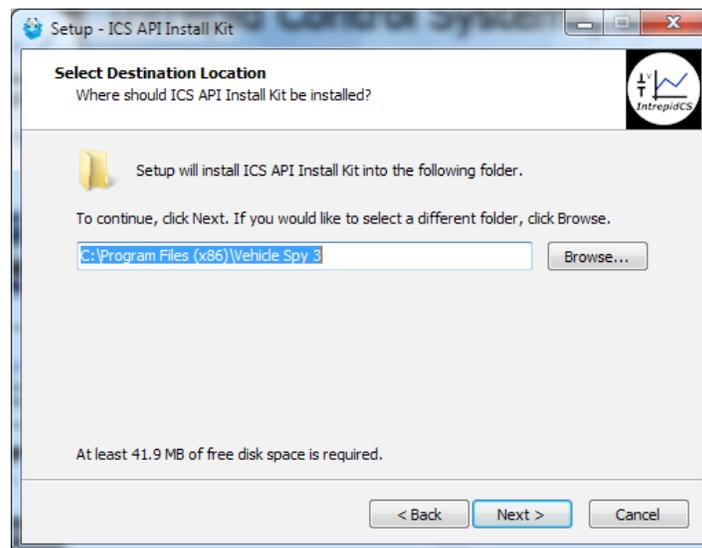


Figure 36: Choosing the API Kit Destination Location.

You have now provided all of the information the wizard needs, and it will display a summary as shown in Figure 37.

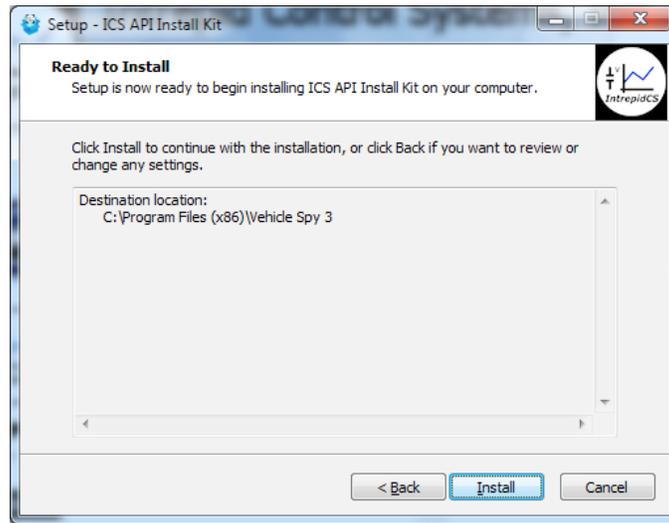


Figure 37: API Installation Options Review.

- 8. 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 38).

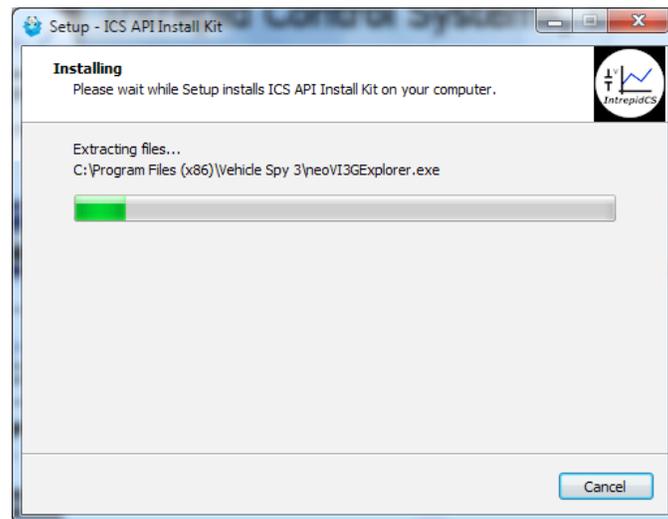


Figure 38: Installing API and Drivers.

After completing the basic setup, the wizard will automatically install various drivers required by the RAD-Galaxy. The first install will be done by the Hardware Driver Installer.

9. **Install Hardware Drivers:** Click  to begin installing the first set of drivers. When completed, a message will appear like the one in Figure 39. Click .



Figure 39: Hardware Driver Installation Complete.

Next, support files for Microsoft Visual C++ 2010 and 2005 will be automatically installed, if they are not already on the computer. You may briefly see a dialog box like the one in Figure 40. If a prompt appears saying the files are already installed, hit  to continue.

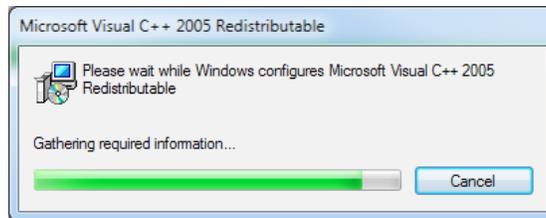


Figure 40: Installing Support Files for Microsoft Visual C++ 2005.

Another ICS driver installer dialog box will appear now.

10. **Install ICS Port Drivers:** Click  to begin installing the ICS port drivers. If you see a Windows dialog like the one in Figure 41, click  to authorize installation.



Figure 41: 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 42.

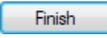
- 11. Complete Port Driver Installation:** Click  to exit this part of the install.



Figure 42: Port Driver Installation Complete.

You will now see a dialog box like the one shown in Figure 43, indicating that the setup process is complete.



Figure 43: Vehicle Spy 3 Setup Complete.

- 12. Exit the Setup Wizard:** Click .

Congratulations, you're done!

### 3.3 Hardware Hookup Diagrams

The hookup diagrams below show you at a glance how to physically connect your RAD-Galaxy to vehicle networks and your PC. There are three possible configurations depending on which OBD cable you are using, if any.

#### **Basic Hardware Hookup Diagram (No OBD Cable)**

Figure 44 illustrates the basic hookup of components for the RAD-Galaxy without an OBD cable. It shows the use of two fully-populated Nano MQS connectors for 100BASE-T1 (BroadR-Reach), the chained *RAD-Galaxy Ethernet Cable Adapter* and *neoVI FIRE 2 Ethernet Cable Adapter*, and two Ethernet cables connected for DoIP. We have shown the Nano MQS cable assemblies terminated with Molex Mini50 connectors, which are often used with 100BASE-T1; your cables may look different, depending on your application.

Note that the Ethernet Activation line for DoIP is shared with the LIN channel. It can be accessed through the DB-25M and DB-9M connectors on the *neoVI FIRE 2 Ethernet Cable Adapter*.

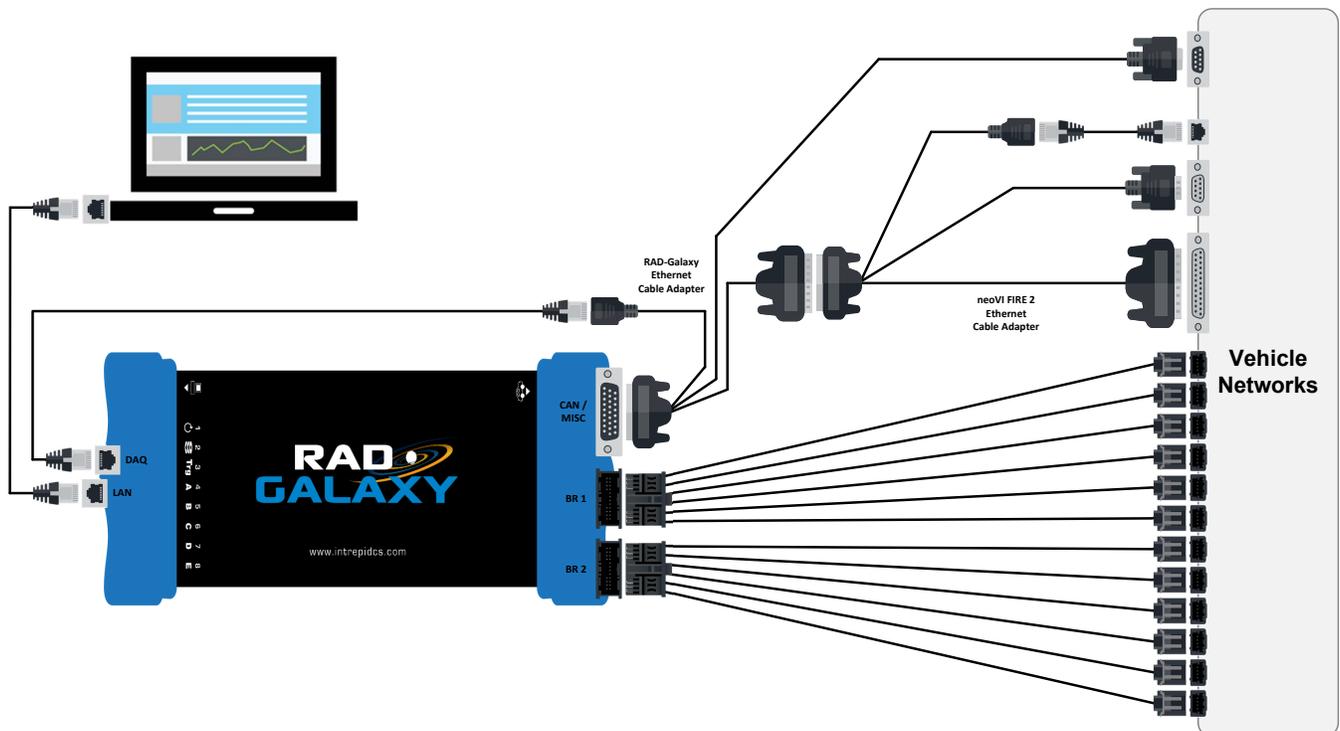


Figure 44: RAD-Galaxy Basic Hookup Diagram.

### ***OBD Hardware Hookup Diagram (neoVI-OBD-1 / neoVI-OBD-MULTI / neoVI-OBD-MULTI Right Angle / neoVI FIRE/RED J1939)***

Figure 45 is the same as Figure 44 but with the addition of an OBD cable, which connects to the DB-25M connector of the *neoVI FIRE 2 Ethernet Cable Adapter*. Note that the appearance of the OBD cable may vary depending on what option you selected when ordering the RAD-Galaxy.

Again here, the Ethernet Activation line for DoIP is shared with the LIN channel. Since the DB-25M connector is used for the OBD cable, the signal can be accessed through the DB-9M connector on the *neoVI FIRE 2 Ethernet Cable Adapter*.

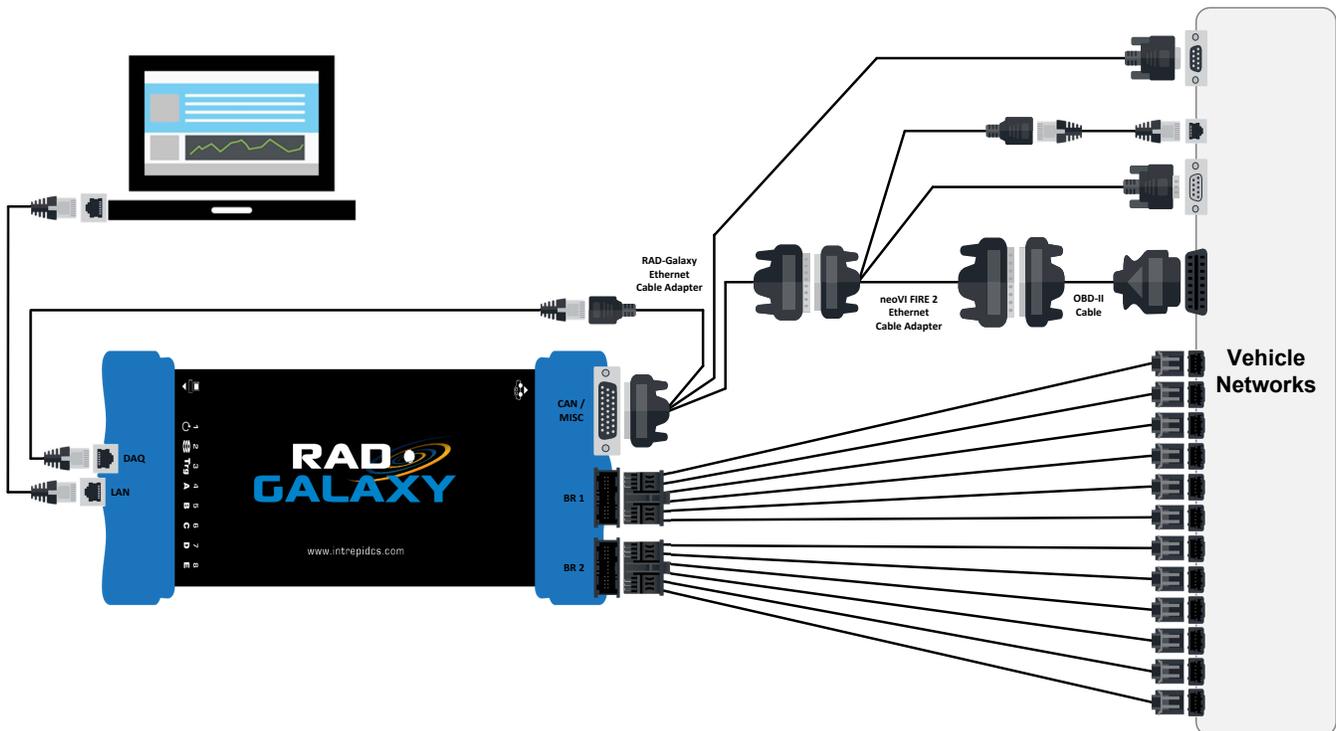


Figure 45: RAD-Galaxy Hookup Diagram with OBD (Most OBD Cables).

### ***OBD Hardware Hookup Diagram (neoVI FIRE 2 OBD Cable with DoIP Support)***

As mentioned earlier in the manual, when the *neoVI FIRE 2 OBD Cable with DoIP Support* is used it replaces the *neoVI FIRE 2 Ethernet Cable Adapter*. The result is as shown in Figure 46, which is the same as Figure 44 except that the RJ-45 socket and Ethernet cable have been replaced by an OBD-II connection that carries DoIP to the vehicle network.

In this configuration the DoIP Ethernet Activation line is conveyed directly to the vehicle network through the OBD-II port.

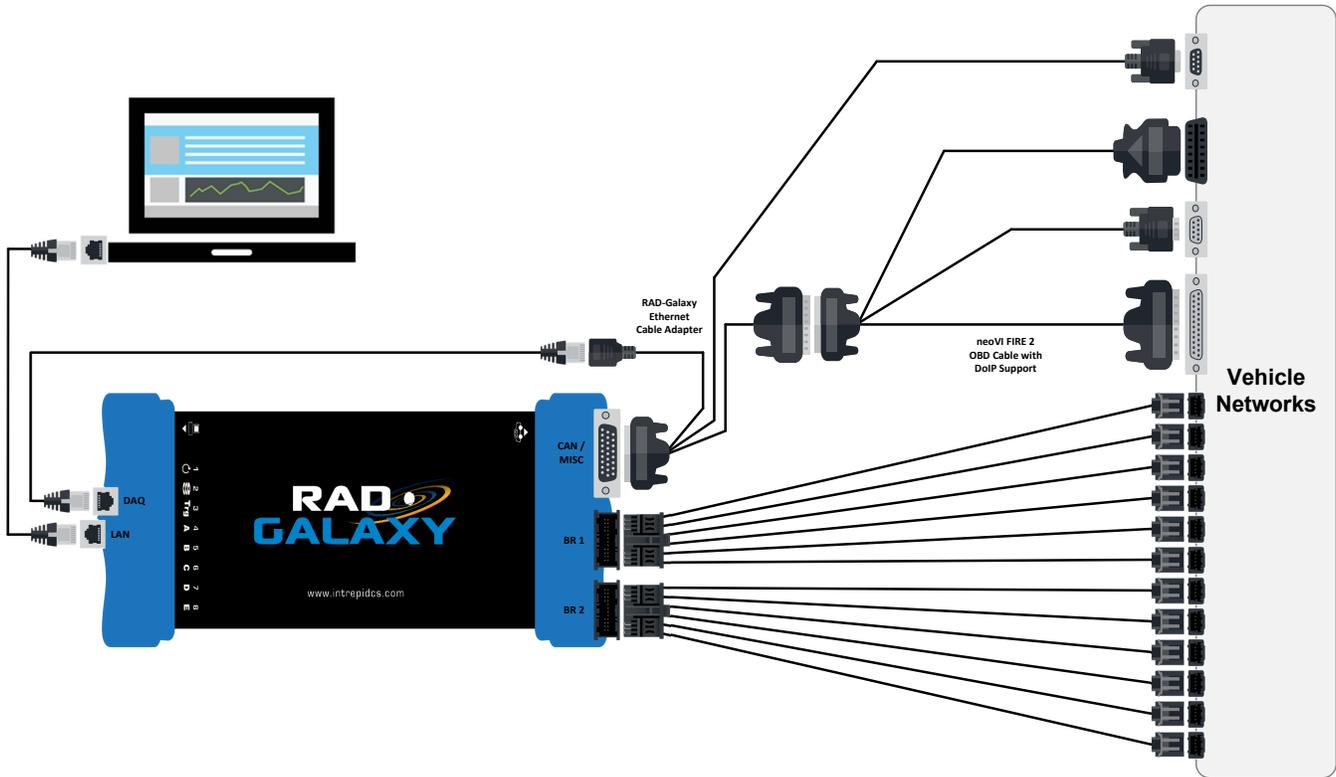


Figure 46: RAD-Galaxy Hookup Diagram with OBD (neoVI FIRE 2 OBD Cable with DoIP Support).

### Vehicle Network DoIP Ethernet Data Paths

A special path is used for the DoIP Ethernet connection on the RAD-Galaxy. It passes through the *neoVI FIRE 2 Ethernet Cable Adapter* (or *neoVI FIRE 2 OBD Cable with DoIP Support* if that is being used) and the *RAD-Galaxy Ethernet Cable Adapter*. However, data flows into and out of the RAD-Galaxy through its DAQ Ethernet port, rather than the CAN/MISC connector to which the *RAD-Galaxy Ethernet Cable Adapter* is attached.

Figure 47 shows the same basic hookup diagram from Figure 44 with the full DoIP Ethernet path highlighted in green, and Figure 48 shows the equivalent adaptation of Figure 46, applicable when using the *neoVI FIRE 2 OBD Cable with DoIP Support*.

As mentioned above, the Ethernet Activation line for DoIP is shared with the RAD-Galaxy's LIN channel. It can be accessed through the DB-25M and DB-9M connectors on the *neoVI FIRE 2 Ethernet Cable Adapter*. When using the *neoVI FIRE 2 OBD Cable with DoIP Support*, the Ethernet Activation line goes through the OBD-II connector.

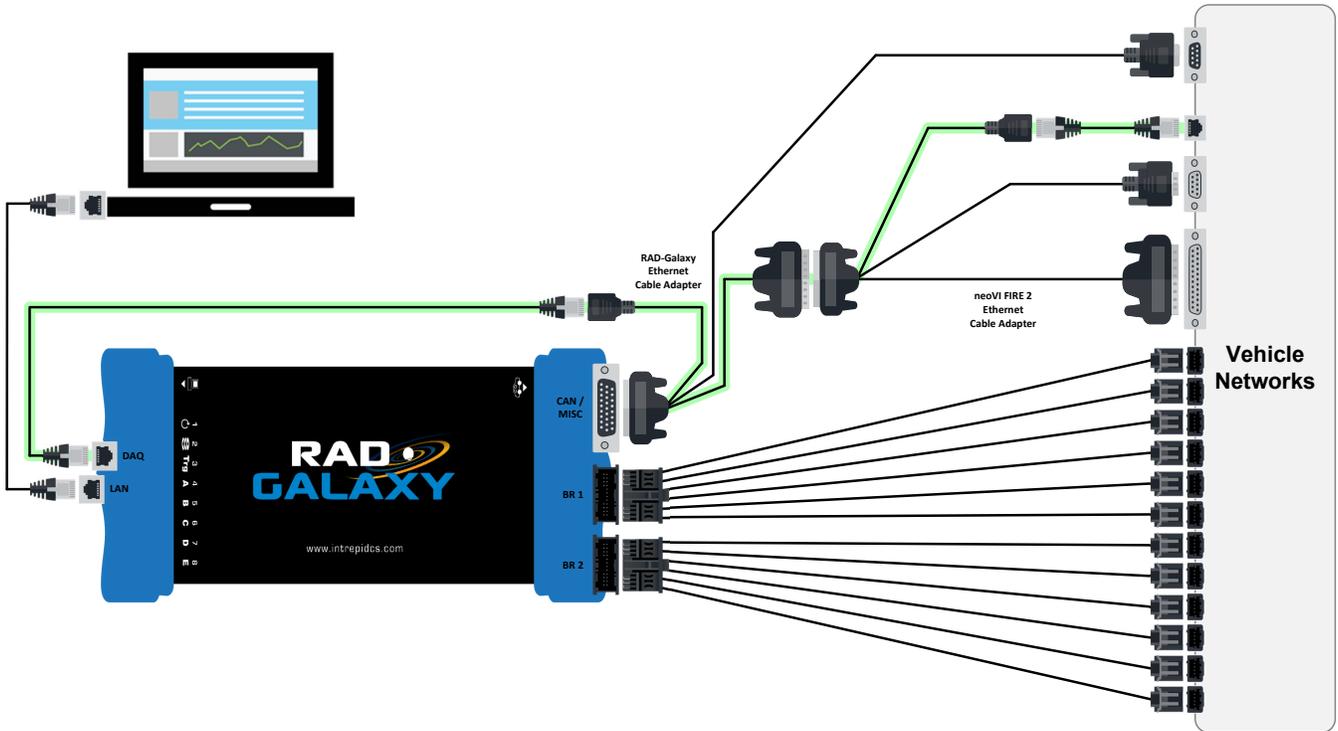


Figure 47: RAD-Galaxy Basic Hookup Diagram Showing Typical DoIP Ethernet Data Path.

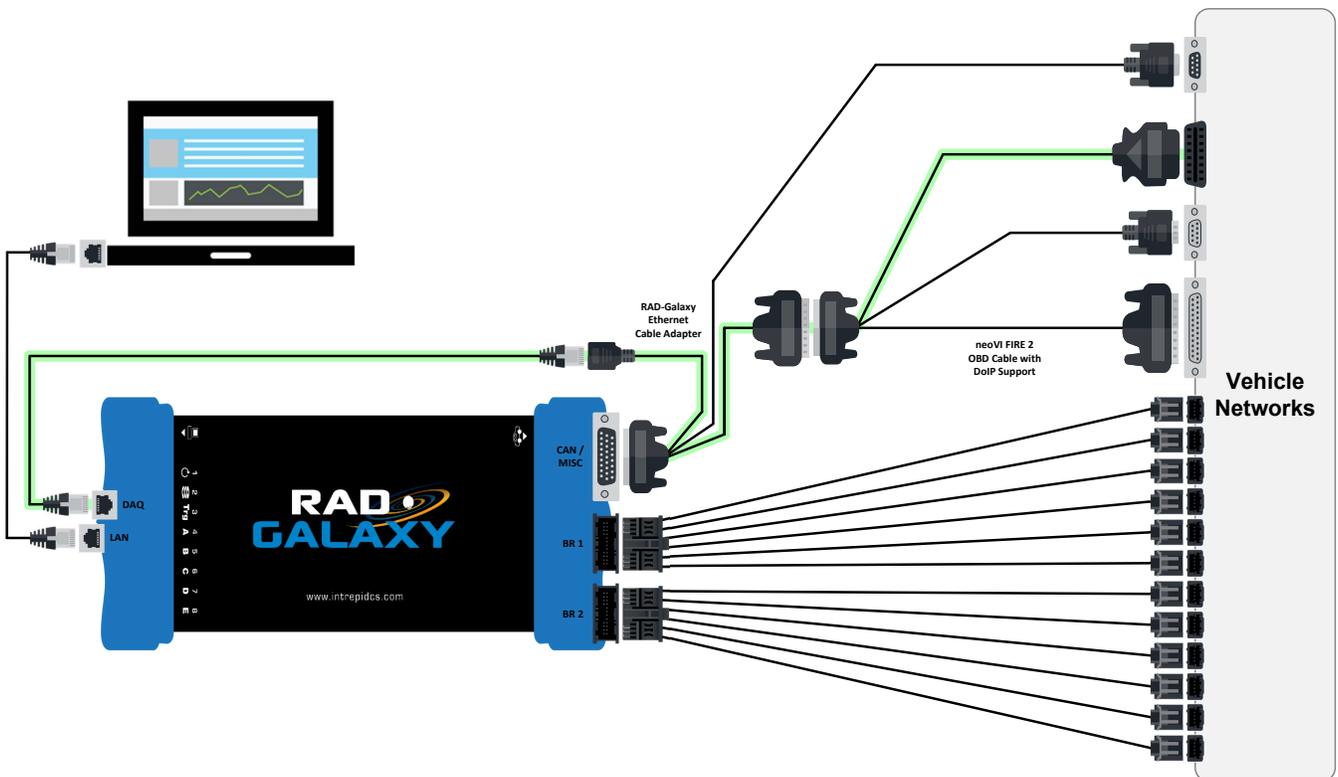


Figure 48: RAD-Galaxy Basic Hookup Diagram Showing DoIP Ethernet Data Path (When Using neoVI FIRE 2 OBD Cable with DoIP Support).

### 3.4 Conventional Vehicle Network and Power Connections

Let's start our hardware connections by attaching the conventional vehicle network cables to the RAD-Galaxy and our vehicle networks. This will also power up the device, since power input is provided via the HD-26M conventional vehicle network connector.

Please follow these steps.

1. **Attach the RAD-Galaxy Ethernet Cable Adapter to the RAD-Galaxy:** Attach the HD-26 female connector on the *RAD-Galaxy Ethernet Cable Adapter* to the HD-26 male connector on the RAD-Galaxy. Tighten the thumbscrews so the cable remains securely attached (Figure 49).



Figure 49: Connecting the RAD-Galaxy Ethernet Cable Adapter's HD-26M Connector to the RAD-Galaxy.

2. **Attach the neoVI FIRE 2 Ethernet Cable Adapter or neoVI FIRE 2 OBD Cable with DoIP Support to the RAD-Galaxy Ethernet Cable Adapter:** If using the *neoVI FIRE 2 OBD Cable with DoIP Support*, connect its HD-26F connector to the HD-26M of the cable you just connected in Step 1. Otherwise, connect the HD-26F of the *neoVI FIRE 2 Ethernet Cable Adapter*, as shown in Figure 50.



Figure 50: Connecting the neoVI FIRE 2 Ethernet Cable Adapter to the RAD-Galaxy Ethernet Cable Adapter.

3. **(Optional) Attach the DB-25F Connector of the OBD Cable to the neoVI FIRE 2 Ethernet Cable Adapter:** If you are using an OBD cable other than the *neoVI FIRE 2 OBD Cable with DoIP Support*, attach its DB-25 connector to the mating connector on the *neoVI FIRE 2 Ethernet Cable Adapter* (which you connected in Step 2).
4. **Attach the DB-25M or OBD-II Connector to the Vehicle Network:** If you attached an OBD cable in Step 2 or Step 3, connect its OBD-II connector to your vehicle network. If you are not using an OBD cable, instead attach the DB-25M of the *neoVI FIRE 2 Ethernet Cable Adapter* to your network.
5. **(Optional) Attach DB-9 Connectors to Vehicle Network:** If necessary, connect the DB-9 connectors from the *RAD-Galaxy Ethernet Cable Adapter* and/or *neoVI FIRE 2 Ethernet Cable Adapter* to the appropriate mating connectors within your vehicle or bench network.
6. **(Optional) Attach Ethernet Cables for DoIP:** If using DoIP, you will need to follow these additional steps:
  - Connect one of the included standard Ethernet cables between the RJ-45 socket on the *RAD-Galaxy Ethernet Cable Adapter* and the DAQ RJ-45 port on the RAD-Galaxy (see Figure 9).
  - If you are using the *neoVI FIRE 2 OBD Cable with DoIP Support*, you are done. Otherwise, use the other Ethernet cable to link the RJ-45 socket of the *neoVI FIRE 2 Ethernet Cable Adapter* and the RJ-45 connection of your vehicle network. You will also need to make the appropriate connection for the Ethernet Activation line (found on the DB-25M and DB-9M of the *neoVI FIRE 2 Ethernet Cable Adapter*).

As soon as you connect the DB-25 or OBD-II connector, the RAD-Galaxy should power up. You will recognize this by seeing LEDs light up on the left side of the device (again, see Figure 9). If you see no activity after making the power connection, double-check your power supply, and if the problem persists, please see Chapter 6 for assistance.

### 3.5 100BASE-T1 (BroadR-Reach) Network Connections

Now we will make the 100BASE-T1 (BroadR-Reach) connections between the RAD-Galaxy and our Automotive Ethernet network. Assuming that the correct cable assemblies have been made according to the instructions in Section 2.4, this is a straightforward process.

1. **Attach Nano MQS Connectors to RAD-Galaxy:** Carefully slide the Nano MQS plugs of the cable assemblies you created into the matching sockets on the RAD-Galaxy (Figure 51). The connectors are keyed, and you should hear a slight click when the plug is correctly seated. Notice the release tab, which you will use if you want to remove the connector later on.



Figure 51: Connecting a Nano MQS Cable Plug to the RAD-Galaxy.

2. **Connect 100BASE-T1 Cables to Vehicle Network:** Attach the terminated ends of the Nano MQS cable assemblies to your vehicle network. The exact means of doing this will depend on how the wires are terminated.

If you are planning to use the RAD-Galaxy as an active tap, remember to interpose the RAD-Galaxy connections between node and switch, or between two nodes, using matched pairs: 1+2, 3+4, 5+8, 7+6, 9+10 or 11+12. For example, if a node is connected to a switch port, then

if you attach BroadR-Reach channel 3 to the switch port, you should connect channel 4 to the node. For media converter operation, you can use any channel.

The RAD-Galaxy should now be fully connected to your vehicle or bench network.

### 3.6 PC Connection

Now we will connect the RAD-Galaxy to the PC. Since all data is conveyed over the same Ethernet link, this is actually very simple.

 **Note:** The RAD-Galaxy was designed to be connected directly to a PC Ethernet port. Intrepid does not support using a conventional Ethernet switch between the RAD-Galaxy and the PC.

Since each of the RAD-Galaxy's 12 Automotive Ethernet channels is capable of transporting up to 100 Mb/s of data bidirectionally, we strongly recommend using a PC with a Gigabit Ethernet controller. A 100 Mb/s Ethernet connection may be sufficient, however, for low-bandwidth applications.

1. **Attach an Ethernet Cable to RAD-Galaxy:** Connect one end of a standard Ethernet cable to the RAD-Galaxy's LAN port (Figure 52).



Figure 52: Connecting an Ethernet Cable to the RAD-Galaxy.

- 2. Attach the Ethernet Cable to the PC:** Attach the other end of the Ethernet cable to your PC's Ethernet port.

If the supplied Ethernet cables are too short for your application, you can use a longer one, as long as it is certified for Gigabit Ethernet operation.

## 4 Device Configuration

Your RAD-Galaxy ships from the factory ready to use with its default settings. However, its operation can also be customized to your exact needs by adjusting many parameters that control its internal hardware and firmware. In this chapter, we'll show you how to manage and fine-tune your RAD-Galaxy, including switching between active tap and media converter mode, enabling and disabling networks, turning on or off specific features, and much more.

### 4.1 Starting and Using neoVI Explorer

The *neoVI Explorer* utility allows you to connect to, manage and configure all of your Intrepid Control Systems hardware, including the RAD-Galaxy. It is supplied both as an integrated feature of Vehicle Spy, and as a standalone program.

This section will describe general features and the basics of using neoVI Explorer, so you will understand the utility when we get into settings specific to the RAD-Galaxy.

#### *Starting neoVI Explorer from within Vehicle Spy*

There are several ways to open neoVI Explorer from within VSpy. These are probably the two easiest, since they are accessible at all times:

- **Menu Item:** Click the *Setup* menu and then select *Hardware*.
- **Hardware Setup Button:** Click the  button located in the main Vehicle Spy toolbar just under its menu (Figure 53).



Figure 53: Starting neoVI Explorer from within Vehicle Spy.

Note that you cannot start neoVI Explorer when Vehicle Spy is online (even if in simulation mode). If you attempt to do so, VSpy will prompt you to either go offline and launch neoVI Explorer, or remain online and return to Vehicle Spy.

#### *Starting neoVI Explorer as a Standalone Program*

If you want to work with your RAD-Galaxy without opening Vehicle Spy, you can launch neoVI Explorer directly. Open the Start Menu, navigate to the *IntrepidCS* folder, then under the *Vehicle Spy 3* subfolder, select *neoVI Explorer* (Figure 54).

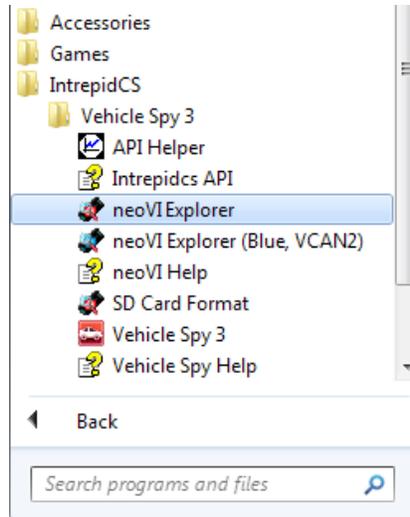


Figure 54: Starting neoVI Explorer Directly.

### ***Starting neoVI Explorer as a Standalone Program (API Kit Installed)***

If you installed the API kit and support files instead of Vehicle Spy, you can run neoVI Explorer from the Start Menu using the same basic process as described above. The only difference is the name of the subfolder, so you will navigate to the *IntrepidCS* folder, then open the *ICS API Install Kit* subfolder, and finally select *neoVI Explorer* (Figure 55).

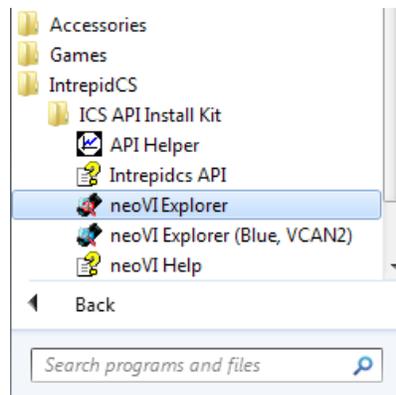


Figure 55: Starting neoVI Explorer as a Standalone Program from the API Kit.

### ***Connecting to the RAD-Galaxy***

When neoVI Explorer loads, it will start up with the first hardware device it can find selected in the menu pane on the left. You should see your RAD-Galaxy listed here, along with its serial number, which begins with “RG”. If you don’t see the RAD-Galaxy, but do see other Intrepid devices, be sure to scroll down to look for it. If it is still not visible, this means its drivers have not been installed correctly, it is not powered properly, or it is not connected to the PC’s Ethernet port. Please refer to Chapter 7 for assistance.

To manage your RAD-Galaxy, click on its entry in the navigation pane (if it is not already highlighted) and then press the *Connect* button. After successfully connecting to the device, you will see a “thumbs up” icon next to the device’s name, and checkmarks will appear next to currently-enabled networks in the explorer area on the left. You should also see a message in the message box on the right saying “RADGalaxy RGxxxx settings have been read”. This tells you that neoVI Explorer has loaded the current settings from the unit. The information in the upper right-hand part of the window is device-specific and described in Section 4.2. The screen as a whole should appear similar to that shown in Figure 56 (but note that the version number shown at the bottom may be different).

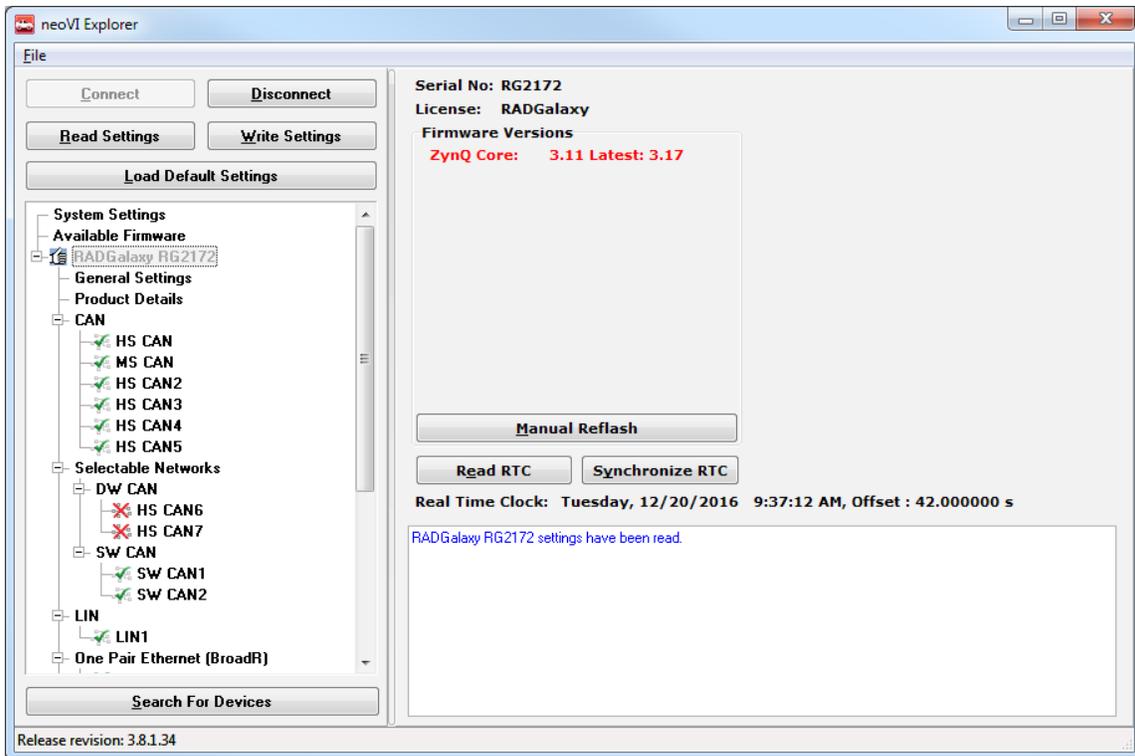


Figure 56: Typical neoVI Explorer Window After Initial Connection to the RAD-Galaxy.



**Note:** It is possible to click on various parameter groups at any time, but they will not show valid data until you connect to the device. Remember also to connect to the device before making changes, or they will be erased when you do connect and the settings in the hardware are loaded.

### Writing and Reloading Settings

To avoid potential problems, neoVI Explorer will not save any changes to device parameters until you instruct it to do so. This is done by pressing the *Write Settings* button, which will

update the parameters within the firmware in your RAD-Galaxy. If you make changes you do not want to keep, pressing the *Read Settings* button will reload the settings stored in the device, wiping out any modifications made in neoVI Explorer that had not yet been saved.

### ***Reloading Device Defaults***

To return all settings to factory defaults, press the *Load Default Settings* button. This is convenient if many changes have been made and written to the firmware in the past, and you want to start over with a clean slate.

Note that pressing this button actually writes the defaults to the device first, and then reloads them automatically, so you do not need to also press *Write Settings*. You will see messages in the message area telling you that defaults have been sent to the device and then read from it.

### ***Disconnecting from the RAD-Galaxy***

Press the *Disconnect* button to tell neoVI Explorer that you are done working with the RAD-Galaxy. This step is actually optional, because neoVI Explorer will disconnect from any connected devices when you exit the program.

### ***Searching for Devices***

If you attach new hardware to your PC after starting neoVI Explorer, press the *Search For Devices* button at the bottom left of the dialog box to prompt the program to scan for new hardware you can manage.

### ***Exiting neoVI Explorer***

Like any Windows program, you can close neoVI Explorer by clicking the “X” in the top right corner, or pressing the Alt+F4 key combination.

## **4.2 System Settings and Firmware Updates**

The top two entries in the explorer window on the left side of neoVI Explorer contain system-wide settings that apply to all hardware devices, and information related to firmware updates.

### ***System Settings***

Click here, and in the right-hand pane you will see three settings that you can enable or disable (Figure 57):

- **Enable Server:** Turns on the neoVI Server feature, a background program that allows your hardware to be used by multiple applications at the same time.
- **Enable Low Latency:** This is an advanced setting for applications where fast response is needed after transmission.

- **Enable Auto Update:** When enabled, both neoVI Explorer and Vehicle Spy will automatically update firmware. If this box is not checked, firmware must be updated manually. (See below for details.)

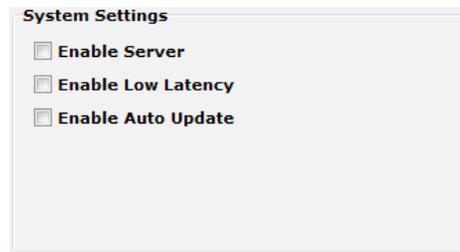


Figure 57: neoVI Explorer System Settings Pane

### ***Available Firmware***

This is an informational page that shows which firmware versions are available in this version of neoVI Explorer for various Intrepid products. Some devices have multiple firmware programs that control different aspects of their operation; in the case of the RAD-Galaxy, there is only one, called *ZynQ Core*.

You normally won't need to look in this area, because as we'll see in Section , neoVI Explorer shows you the current and available firmware versions for your RAD-Galaxy when you connect to it.

### ***Automatic and Manual Firmware Updates***

Firmware is essentially software that runs hardware, and is required to enable the many capabilities of your RAD-Galaxy. New versions of firmware are created regularly by Intrepid's engineers to implement new features and correct problems that have been identified.

If you have *Enable Auto Update* on—which is the default, and is recommended—then you don't really need to worry about firmware updates. Each time you connect to your RAD-Galaxy in neoVI Explorer or go online with it in Vehicle Spy, the firmware will be checked, and if a newer version is available, the device will immediately be updated.

If you do not have automatic updates enabled, you control when your firmware is updated. When new firmware is available, you will be notified on the initial connection screen, as shown in Figure 58. Simply press the *Manual Reflash* button to update the firmware.

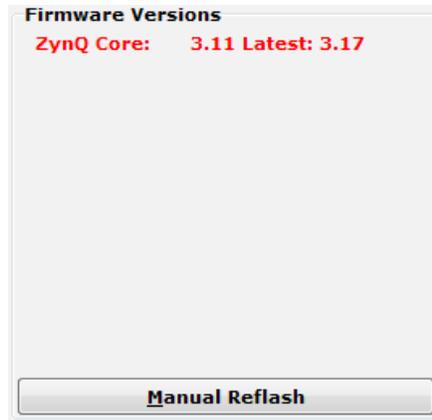


Figure 58: neoVI Explorer Firmware Message Box and Manual Reflash Button.

### The Firmware Update Process

During the firmware update process, the RAD-Galaxy will be placed into *bootloader mode*, indicated by all 8 red LEDs on its left side flashing synchronously. The normal LED flash patterns will resume when the update is complete and the device reboots.

You will see a dialog box on the screen showing you the progress of the firmware update operation, which takes about a minute; an example is shown in Figure 59. You will also see messages in the message box on the right side of neoVI Explorer as the ZynQ Core firmware program is sent to the device. When the process is complete the dialog box will disappear and another message will appear in neoVI Explorer to confirm that the update has finished.

If you receive any error messages or experience any other problems updating your RAD-Galaxy's firmware, please contact Intrepid for assistance (see Chapter 7).

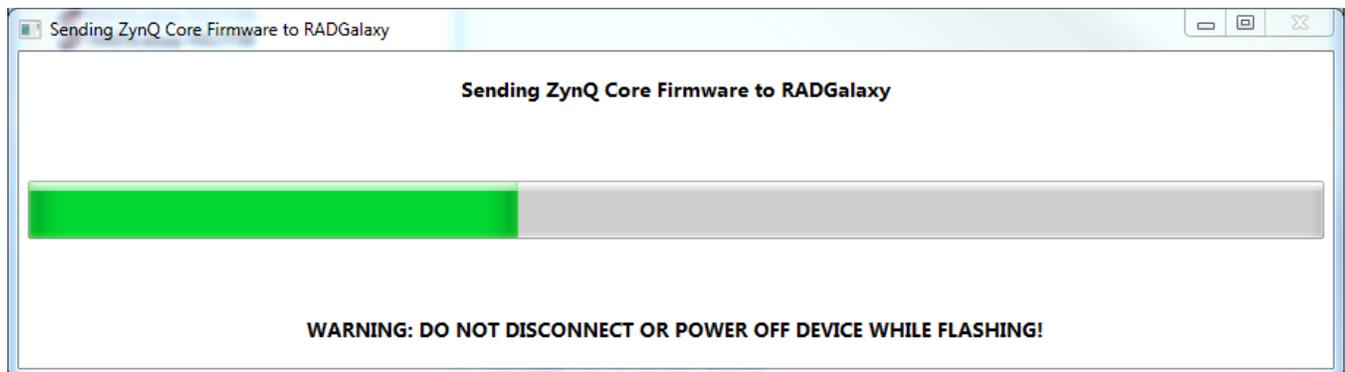


Figure 59: RAD-Galaxy Firmware Update Message Box.

**Warning:** Please take heed of the warning on the firmware update dialog box: leave the RAD-Galaxy connected and powered on for the entire firmware update process to avoid possible problems with the device.

### 4.3 General Settings and Product Details

These two areas of the RAD-Galaxy's parameter setup provide information about the device and allow you to perform a few basic maintenance tasks.

#### General Settings

After connecting to the device you will see basic information about it in the right-hand pane of the window (Figure 60):

- The device's serial number.
- The firmware versions currently in the device, and an indication if new firmware is available.
- A message showing that the hardware license for the device was recognized.
- A current readout of the RAD-Galaxy's real-time clock.

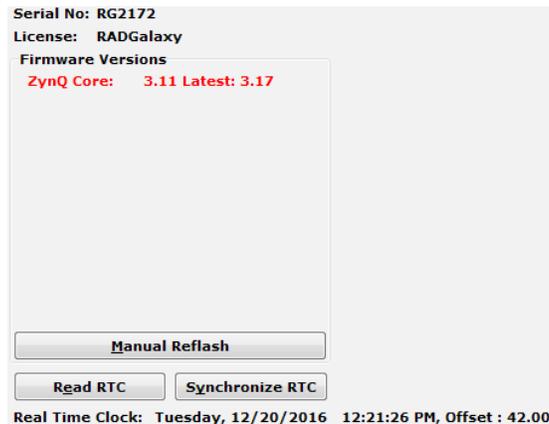


Figure 60: neoVI Explorer RAD-Galaxy General Settings

This information can be displayed again at any time by clicking the RAD-Galaxy's name in the explorer navigation window, or the *General Settings* entry immediately below it.

The version of the ZynQ Core firmware for the RAD-Galaxy will be shown in black if it matches the firmware version within neoVI Explorer. If not, the current version and the newest available

version will be shown in red to help you notice that an update is available, as seen in Figure 60 (as well as Figure 58). Section 4.2 provides more information on firmware updates.

There are three buttons on this screen. *Manual Reflash* was described in Section 4.2. The *Read RTC* button will reload the device's internal time clock, while *Synchronize RTC* will set the device's clock to the same value as that of the PC.

### Product Details

This is an informational area that provides technical data on the RAD-Galaxy's hardware and internal setup. You will generally only need this if requested by Intrepid in order to facilitate support or troubleshooting. You can use the *Copy To Clipboard* button to copy all of the information to the Windows Clipboard, so you can then paste it into an email or file.

## 4.4 Standard CAN Networks (HS CAN 1-5 and MS CAN)

This area of neoVI Explorer is used to enable, disable and configure the six standard dual wire CAN networks in the FIRE 2: High Speed CAN channels 1 to 5 (HS CAN and HS CAN2-5) and the Medium Speed CAN channel (MS CAN). Each channel has an entry under the "CAN" group (which cannot be clicked itself). The current status of each channel is shown next to its name; a green checkmark indicates that the channel is enabled, while a red X means it is disabled. Figure 61 shows an example of the CAN channels area, with MS CAN and HS CAN4 currently disabled, and the other channels enabled.

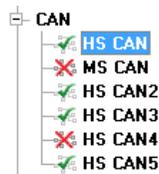


Figure 61: neoVI Explorer CAN Group.

All six of these channels have the same parameters, which can be configured using the controls in the right-hand pane; the default settings are shown in Figure 62.

Figure 62: neoVI Explorer Standard CAN Parameters with Default Settings.

## **Enabled**

Place a checkmark in this box to enable the channel, or clear the checkmark to disable it. When disabled, all of the other parameter controls are disabled (grayed out).

## **HS CAN Settings**

The settings on the left side of the parameter area are for normal (non-FD) CAN operation.

### **Specify by Baud**

This is a master control that determines whether the operation of the channel is controlled by a numeric baud rate, or is calculated from lower-level timing parameters. When checked, the *Baud Rate* drop-down boxes for both CAN and CAN FD are enabled and the relevant *TQ*, *Sync* and *BRP-1* entries are disabled. When unchecked, this is reversed.

Specifying by baud rate is the default, and is recommended except for advanced users with special requirements.

### **Baud Rate**

When *Specify by Baud* is selected, choose a baud rate for the channel from the drop-down box below. The default value is 500000.

### **CAN Timing Settings**

When *Specify by Baud* is deselected, the operation of the CAN channel is based on these five settings: *TQ SEG1*, *TQ SEG2*, *TQ Prop*, *Sync*, *BRP-1*. These settings are for advanced users and normally should be left at their default values.

### **Mode**

The operating mode of the channel; choose from one of these four options:

- **Normal:** Normal operation (default).
- **Disable:** Channel is disabled.
- **Listen Only:** This channel only receives messages, with no transmissions, and also no error frames generated nor acknowledgments sent.

### **Transceiver**

The operating mode of the CAN transceiver:

- **Auto:** The transceiver is automatically controlled by the CAN logic for the channel (default).

- **Enabled:** The transceiver is always enabled.
- **Disabled:** The transceiver is disabled.

### Bit Rate Calculator

Press this button to launch the Intrepid Bit Timing Calculator.

### CAN FD Settings

The settings on the right side of the parameter area control CAN FD operation.

### CAN FD Baud Rate

When *Specify by Baud* is selected, choose a baud rate for the data phase of CAN FD messages. The default value is 2000000.

### CAN FD Timing Settings

When *Specify by Baud* is deselected, use these settings (*TQ SEG1*, *TQ SEG2*, *TQ Prop*, *Sync*, *BRP-1*) for the data phase of CAN FD messages. These parameters are for advanced users and normally should be left at their default values.

### ISO

Check this box to enable ISO-compliant CAN FD operation.

## 4.5 Selectable CAN Networks

The 7th and 8th of the RAD-Galaxy's CAN channels are user-selectable: they can be set as additional High Speed (dual wire) CAN channels (HS CAN6 and HS CAN7) or as Single Wire CAN channels (SW CAN and SW CAN 2). Both channels must be set to the same mode (so you cannot have HS CAN6 and SW CAN at the same time, for example). The selectable CAN channel group in neoVI Explorer can be seen in Figure 63.

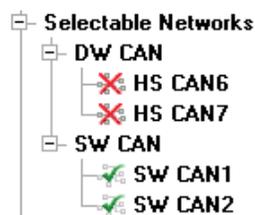


Figure 63: neoVI Explorer Selectable CAN Group.

## Selectable CAN Mode

The master control for these channels can be found by clicking on *Selectable CAN*. On the right hand side you will find a drop-down box; choose *DWCAN* or *SWCAN* depending on which CAN variant you want for these two channels (Figure 64). The default for these channels is *SWCAN*.

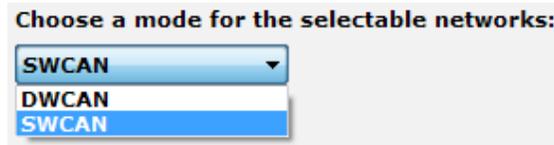


Figure 64: neoVI Explorer Selectable CAN Mode Control.

Based on your selection, neoVI Explorer will automatically enable the corresponding two channels in this group and disable the other two. You can manually override the enabled channels if, for example, you only want one of the two. You cannot, however, override the disabled channels, as they are physically disconnected within the device when your selection is made. (To make this more clear, disabled channels will have the *Enabled* checkbox grayed out and renamed to *Disabled in Selectable Networks*.)

## DW CAN (HS CAN 6 / HS CAN 7)

When *DWCAN* is selected, two additional High Speed CAN channels are turned on. Their parameters are identical to the six standard CAN channels described in Section 4.4, and are configured in the same way.

## SW CAN (SW CAN / SW CAN 2)

With *SWCAN* chosen under *Selectable CAN*, the Single Wire CAN channels are enabled. These have the same settings as the standard CAN channels, with these changes (Figure 65):

- No CAN FD section (CAN FD is not supported on these channels).
- The default baud rate is 33333.

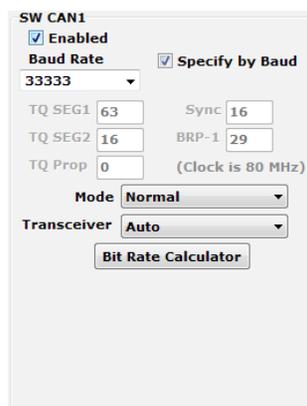


Figure 65: neoVI Explorer SW CAN Parameters with Default Settings.

## 4.6 LIN Network (LIN1)

This section will be detailed in a future version of the manual, once the LIN channel on the RAD-Galaxy is functional.

## 4.7 Automotive Ethernet (100BASE-T1 / BroadR-Reach) Networks

This section of neoVI Explorer provides parameters to control the operation of the RAD-Galaxy's 100BASE-T1 (BroadR-Reach) Ethernet channels. Overall control parameters are found within the parent *One Pair Ethernet (BroadR)* entry, while those for individual 12 channels are located in the subordinate *OP (BR) ETHxx* entries, where *xx* varies from 1 to 12. The group as a whole can be seen in Figure 66.

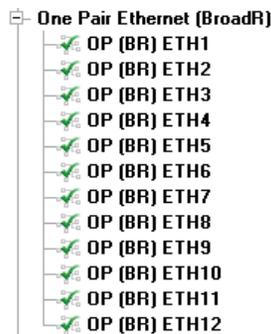


Figure 66: neoVI Explorer Automotive Ethernet Parameter Group.

### *One Pair Ethernet (BroadR)*

This area contains a small number of parameters that affect the overall operation of the RAD-Galaxy's Ethernet channels (see Figure 67).

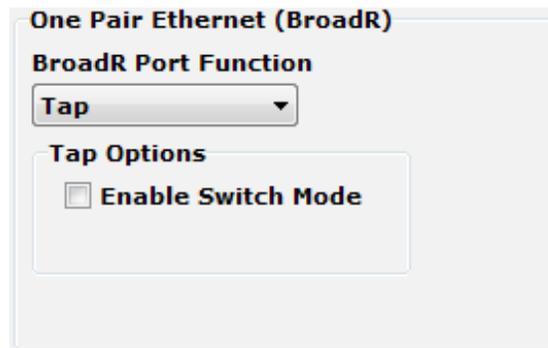


Figure 67: neoVI Explorer One Pair Ethernet (BroadR) General Parameters.

### BroadR Port Function

Use this dropdown box to swap the RAD-Galaxy between tap and media converter operation.

## Tap Options - Enable Switch Mode

This is present only when the parameter above is set to *Tap*. It is reserved for future functionality and currently does not affect the operation of the device. (Note specifically that this does not cause the RAD-Galaxy to behave as an Ethernet switch.)

## OP (BR) ETH1 - OP (BR) ETH12

Each of these entries contains the same parameters and controls the corresponding 100BASE-T1 channel on the RAD-Galaxy (Figure 68).



Figure 68: neoVI Explorer OP (BR) Automotive Ethernet Channel Parameters.

### Enabled

Placing a checkmark in this box enables the channel, while clearing the checkmark disables it. When disabled, the *Link Mode* parameter is disabled (grayed out).

### Link Mode

Provides control over link negotiation for the channel. Automotive Ethernet requires each link to have one device configured as master and the other as slave: the PHY of the master device generates a shared clock signal for the channel, and the slave device's PHY synchronizes to it.

By default, the RAD-Galaxy will automatically adjust to complement the other devices connected to its channels. However, if necessary, you can use these settings to manually override this behavior:

- **Auto:** The RAD-Galaxy will automatically configure itself as master or slave as required to establish a link to the other device on this channel.
- **Master:** This channel will always act as a master device.
- **Slave:** This channel will always act as a slave device.

Note that the designation of a device as master or slave only matters for low-level clock synchronization as described above. Aside from this, the devices are peers on the network; the master does not control operation of the slave.

## 4.8 Network Enables

This area provides more options for controlling the enabling and disabling of individual networks within the RAD-Galaxy (Figure 69). The main display contains a scrollable list with checkboxes that can be set or unset to enable or disable each network. These are equivalent to the Enable checkboxes found in the parameter areas for the corresponding networks.

This list contains all of the networks supported by all Intrepid devices. By default, networks not present on the RAD-Galaxy are disabled. In addition, the selectable networks that have been enabled will appear as enabled here, while the disabled networks will show as disabled (see Section 4.5).

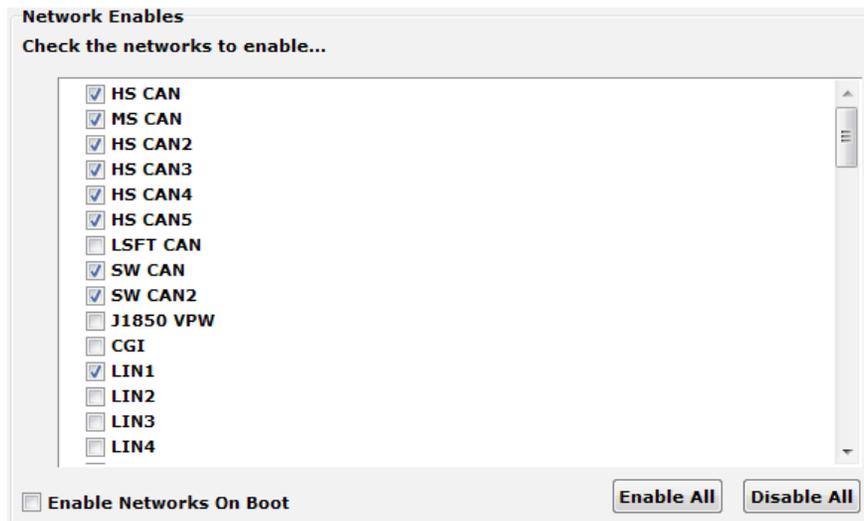


Figure 69: neoVI Explorer Network Enable/Disable Parameters.

### Enable Networks on Boot

Normally, the RAD-Galaxy will not acknowledge messages on a network unless it is online with that network or running a CoreMini script. When this option is enabled, the device always acknowledges frames on all enabled networks.

### Enable All

Enables all networks. Pressing this button will attempt to set checkmarks for all networks; if you use it, be sure to disable networks that should be off, so the device remains in a valid configuration.

### Disable All

Disables all networks.

## 5 Core Feature Operation

Now that we have completed installing and configuring our hardware and software, we are ready to use the RAD-Galaxy. As discussed at the start of this guide, you can do a lot with this little box, and in this chapter we show you just some of the unit's many applications.

The goal of this chapter is specifically to assist those who are new to Intrepid hardware and software, and so simplified examples are provided. Advanced users may wish to skim or even skip this chapter. Note that some sections of this chapter will be written in future updates of the manual.

Each of the sections contains an example application, step-by-step instructions for those who wish to duplicate the results on their own device. Even if you cannot perform the operations outlined (perhaps due to a lack of ECUs for connection to the RAD-Galaxy), you will learn more about using your Intrepid hardware and software by reading the instructions.

The examples use Intrepid's Vehicle Spy 3 Professional, the ideal tool for working with your RAD-Galaxy. Due to the complexity of Vehicle Spy, we only describe the basics necessary for the examples; for full details on this powerful software tool, please see the separate Vehicle Spy documentation.

 **Note:** The Ethernet examples make use of a sample client/server application that we created on two BroadR-Reach nodes for demonstration purposes. Your application will be different, but you should be able to adjust the example steps to suit any similar client/server exchange on your own network.

 **Note:** The first three sections of this chapter build upon each other and are intended to be completed in sequence.

### 5.1 Using the RAD-Galaxy as an Active Tap to Monitor Ethernet Traffic

Let's start with the most common use of the RAD-Galaxy: as an active tap for Automotive Ethernet. As mentioned earlier, the RAD-Galaxy can tap up to six pairs of BroadR-Reach nodes, but for simplicity, we will show an example using only one.

In this sample application we have configured two BroadR-Reach devices to send messages back and forth to emulate a client/server data exchange. The client sends a message every 100 ms that contains a single 8-bit data field with a counter that goes up by 1 on each transmission. The server looks for these messages, and when one is received it reads the

counter, multiplies its value by 3, stores the result in a 16-bit data field and transmits the product back to the client.

To actively tap this communication, we disconnect the client and server nodes from each other, and then attach the client node to BroadR-Reach channel 1 of the RAD-Galaxy and the server node to BroadR-Reach channel 2. We could of course do this the opposite way (client to channel 2 and server to channel 1) and it would work the same. We could also have used a different pair of channels (such as 3 and 4) but not channels from different pairs (such as 2 and 3).

If you want to duplicate this exercise, then set up any sort of client/server exchange using two Automotive Ethernet nodes, and then connect them to the RAD-Galaxy in the same way we have. After correctly tapping the link using channels 1 and 2, you should see the green activity LEDs below the numbers 1 and 2 on the left side the device flashing. You can now go online to monitor the traffic exchange using the RAD-Galaxy and Vehicle Spy.

Here are the steps to follow:

1. **Launch Vehicle Spy:** Start Vehicle Spy by double-clicking its icon or selecting it from the Windows Start Menu.
2. **Select the RAD-Galaxy:** On the *Logon Screen*, select the RAD-Galaxy if it does not already have a checkmark next to it. To do so, right-click the device name and choose *Select Hardware* (Figure 70).

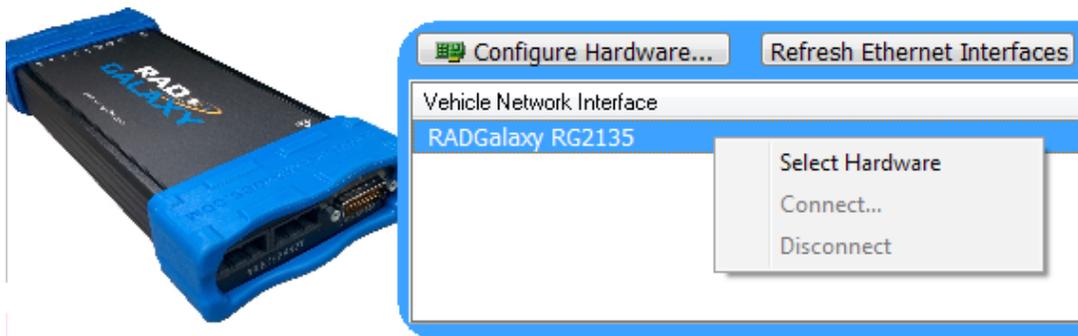


Figure 70: Selecting the RAD-Galaxy from the Logon Screen of Vehicle Spy.

3. **Open Messages View:** Select *Messages* from the *Spy Networks* menu.
4. **Adjust Messages View:** Select the “Ethernet” column set from the drop-down box near the bottom of the screen. Also press the  **Scroll** button, located near the top left of *Messages View*, so messages show up in chronological order.
5. **Go Online:** Press the blue arrow button in the top left corner of Vehicle Spy.

Vehicle Spy will now go online and begin showing you traffic coming from the RAD-Galaxy. You will see two messages appear every 100 ms or so on the networks OP (BR) ETH01 and OP (BR) ETH02, which are the messages our nodes are sending. There may be other traffic that

we aren't interested in, so let's filter that out by using the network filter list on the left side of *Messages View*.

- Set Network Filters:** In the left hand column, click in the boxes next to *OP (BR) ETH01* and *OP (BR) ETH02* so that a checkmark appears for each.

You should now see only the messages on RAD-Galaxy channels 1 and 2, arriving in pairs (Figure 71).

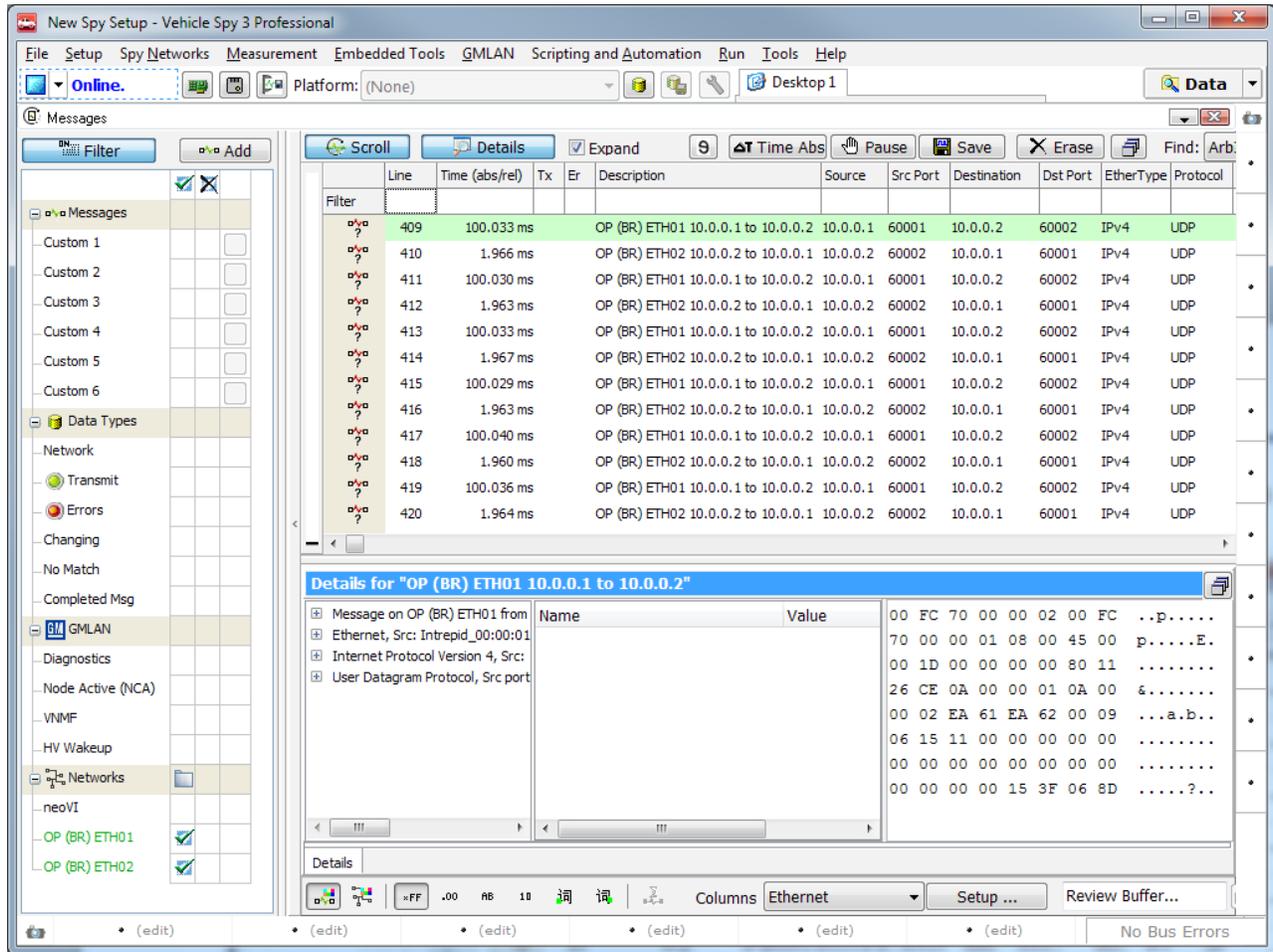


Figure 71: Monitoring Tapped Message Traffic in Vehicle Spy using the RAD-Galaxy.

These messages are shown in their raw form because we have no message definitions loaded for them. We can create receive messages to decode the messages and fields, however, so they are easier to see.

- Go Offline.**
- Load the Messages Editor:** Select *Messages Editor* from the *Spy Networks* menu.
- Select RAD-Galaxy Channel 1 Network:** Select "OP (BR) ETH01" from the *on Network* drop-down box in the blue header. (It will be near the bottom.)

**10. Create a Receive Message:** To the right of the drop-down box click the **+** button.

Vehicle Spy will generate a new default Ethernet receive message called “Message OP (BR) ETH01 1”, set as a raw Ethernet frame. Let’s customize this to match what is being sent.

**11. Rename the Message:** Double-click the name of the message and change it to “Client Request”.

**12. Change the EtherType and Protocol:** Check the *EtherType* setting from “Raw” to “IPv4”. Then change the *Protocol* field from “Raw” to “UDP”.

For this message, the default values for *Source* and *Destination* addresses and ports can be left as is.

**13. Add a Signal:** In the middle of the screen, find *Signals in Message*; just below this,v click the **+** button. A signal called “Signal 22” is created.

**14. Rename the Signal:** Double-click “Signal 22” and change it to “Request Counter”.

This message is now fully defined. The program window should now appear similar to Figure 72.

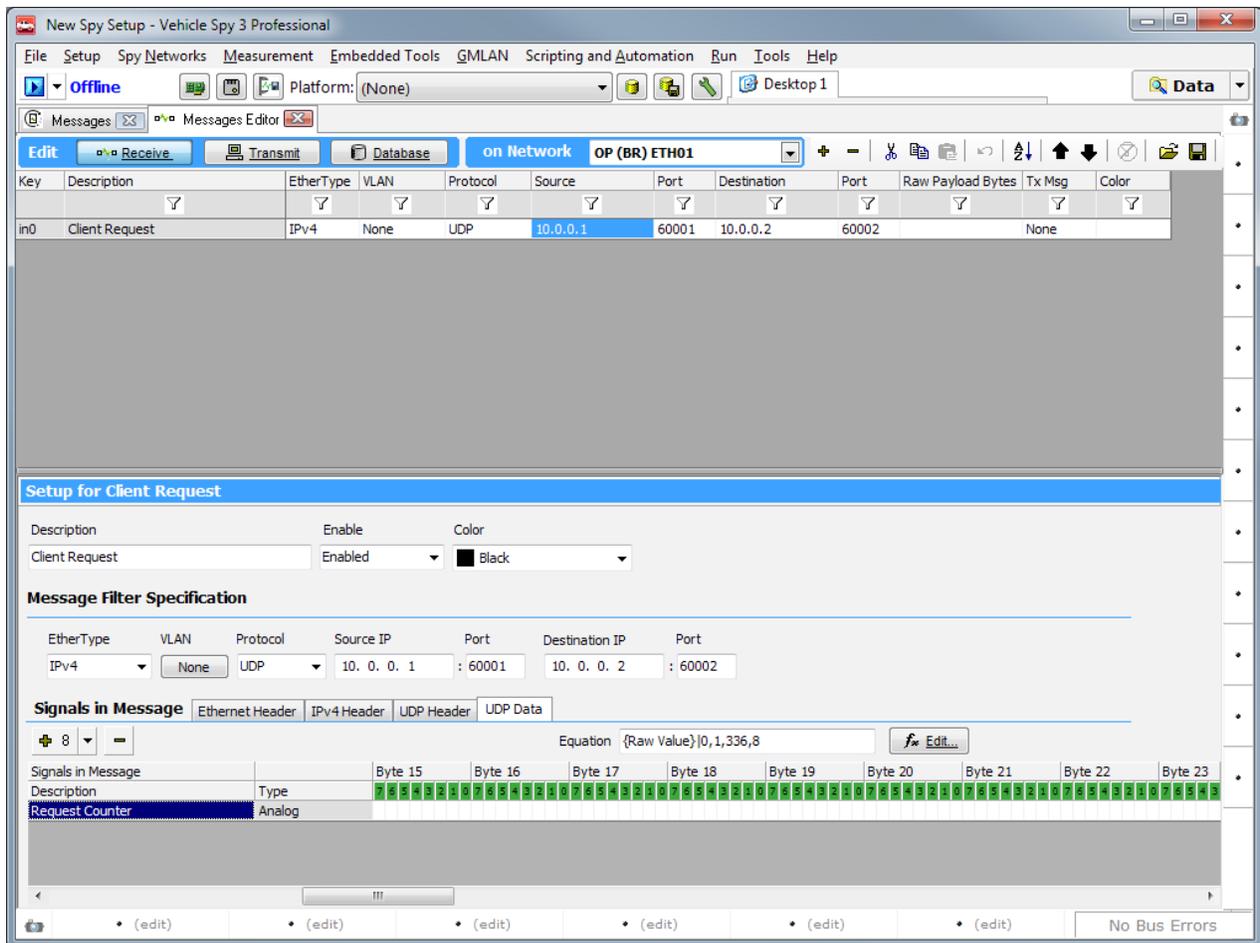


Figure 72: Vehicle Spy Receive Message Definition for Client Request on Channel 1.

Now we will repeat this same basic process for the server response on channel 2.

15. **Select RAD-Galaxy Channel 2 Network:** Select “OP (BR) ETH02” from the *on Network* drop-down box.
16. **Create a Receive Message:** To the right of the drop-down box click the  button.
17. **Rename the Message:** Double-click the default message name and change it to “Server Response”.
18. **Change the EtherType and Protocol:** Check the *EtherType* setting from “Raw” to “IPv4”. Then change the *Protocol* field from “Raw” to “UDP”.

We want to define the Server Response message so that it will decode any reply from the server’s address and port. So we will use the IP address and port that the server node is using for the *Source* fields, but set the *Destination* fields to wildcards.

19. **Change the Source and Destination Address and Port Fields:** Change *Source* to “10.0.0.2”, *Source Port* to “60002”, *Destination* to “X.X.X.X”, and *Destination Port* to blank (delete the “60002” value in the field).
20. **Add a Signal:** Click the arrow next to the  8 button and select “Add 16 Bit Signal”.
21. **Rename the Signal:** Rename signal to “Response Value”.

The server receive message is now done. Let’s take a look at the results of our message definitions.

22. **Switch to Messages View.**
23. **Go Online.**

The result will be a display similar to Figure 73. Notice how the decoding allows us to more clearly see the client/server nature of the exchange.

The server only transmits when it responds to client requests it receives. The fact that this continues to happen with the RAD-Galaxy tap in place demonstrates that messages are still being sent between the two nodes even as they are copied over to Vehicle Spy.

24. **Go Offline.**

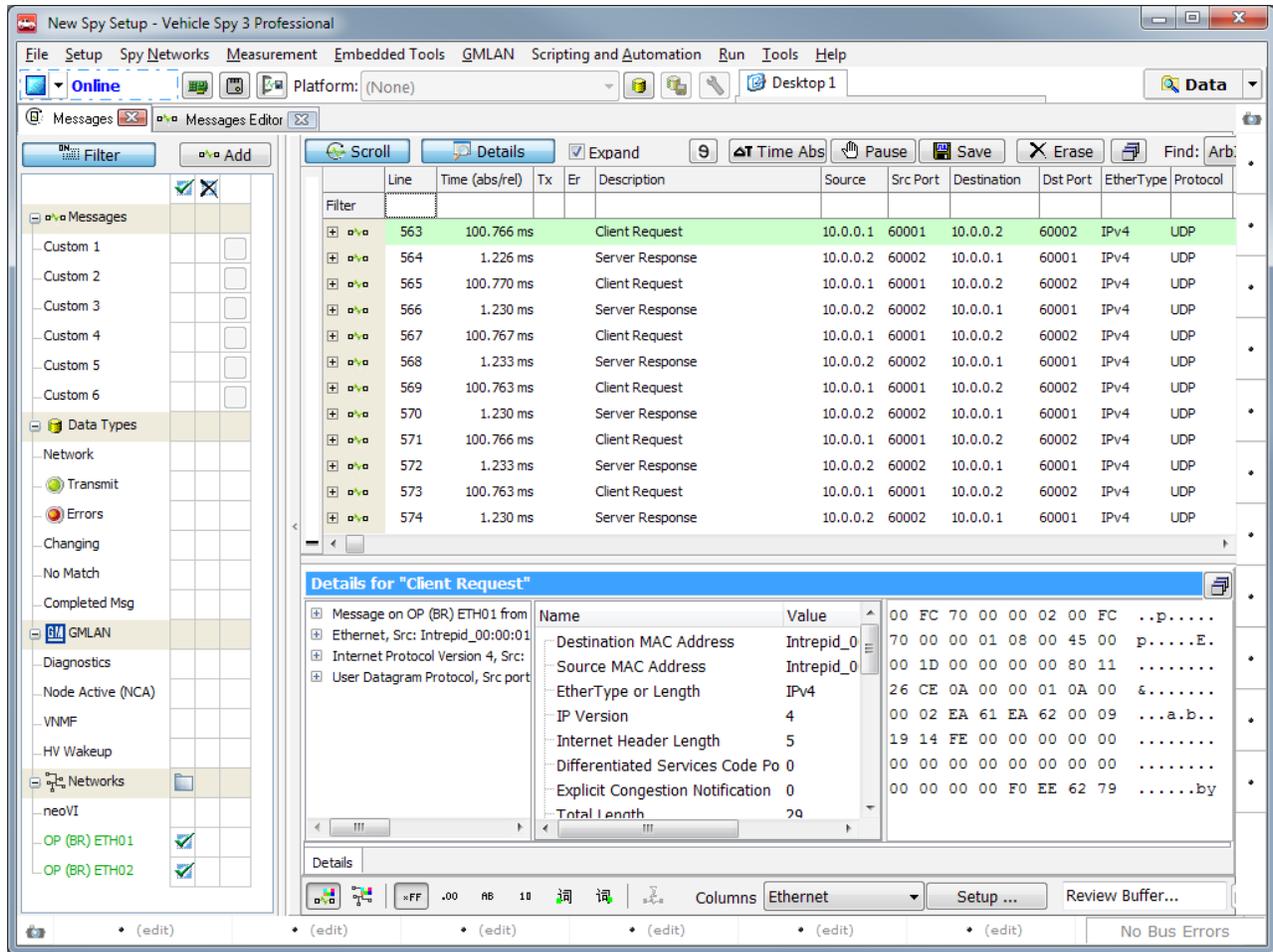


Figure 73: Decoding Tapped Message Traffic in Vehicle Spy with the RAD-Galaxy.

## 5.2 Transmitting to a Node on a Tapped Ethernet Link

The RAD-Galaxy not only allows you to monitor the two-way traffic on a link that it is tapping, but to participate in the discussion by transmitting to either of the nodes. We'll now continue with the example from the previous section, extending it by creating a custom message within Vehicle Spy that we'll send to the device acting as a server. That device will respond back in the same manner that it does for requests from the BroadR-Reach client node.

Assuming we still have the same setup from Section 5.1, this is actually very easy to do, because we can simply copy the receive message we previously created to the transmit side of the *Messages Editor* and tailor it to our needs.

1. **Switch to the Messages Editor:** Select *Messages Editor* from the *Spy Networks* menu, or click the *Messages Editor* tab from the tab list near the top of VSpy.
2. **Select RAD-Galaxy Channel 1 Network:** Select "OP (BR) ETH01" from the *on Network* drop-down box, if it is not already selected.

3. **Copy the Client Request Message:** Click on the *Client Request* message, then right-click it and select “Copy” from the context menu that appears.
4. **Select RAD-Galaxy Channel 2 Network:** Select “OP (BR) ETH2” from the *on Network* drop-down box.
5. **Switch to the Transmit Side of the Messages Editor:** Click the  button, which will change to have blue highlighting.
6. **Paste the Client Request Message:** Right-click anywhere in the gray area on the screen and select “Paste”. A copy of the *Client Request* message now appears as a transmit message.
7. **Tailor the Message to be Sent by Vehicle Spy:** Change the name of the message to “VSpY Client Request”, the *Source Address* to “10.0.0.99” and the *Source Port* to “60099”.
8. **Adjust the Signal Name:** Change the name of the signal to “VSpY Request Value”.

Our message is now defined. Let’s now set a simple static value for the signal, and tell Vehicle Spy to send our message periodically through the RAD-Galaxy to the server node.

9. **Switch to the Tx Panel:** Select *Tx Panel* from the *Spy Networks* menu.
10. **Select the Message:** Click on the *VSpY Client Request* message on pane on the left.
11. **Adjust Tx Panel Window Panes:** Select the vertical divider that splits the *Tx Panel* into two panes and drag it to the left so we can see the message signals and values.
12. **Change VSpY Request Value:** Click under the *Value* field for the *VSpY Request Value* signal in the pane on the right, and enter the value “207”.
13. **Set the Transmission Rate:** Now return to the left-hand pane. You can see that under the *Auto Tx* column, our message is already set to send periodically, but the *Rate* field for it says “None”. Double-click in this box and enter “0.250”, or select that value from the drop-down box that appears.

After completing these steps, the Tx Panel should appear similar to the screenshot in Figure 74.

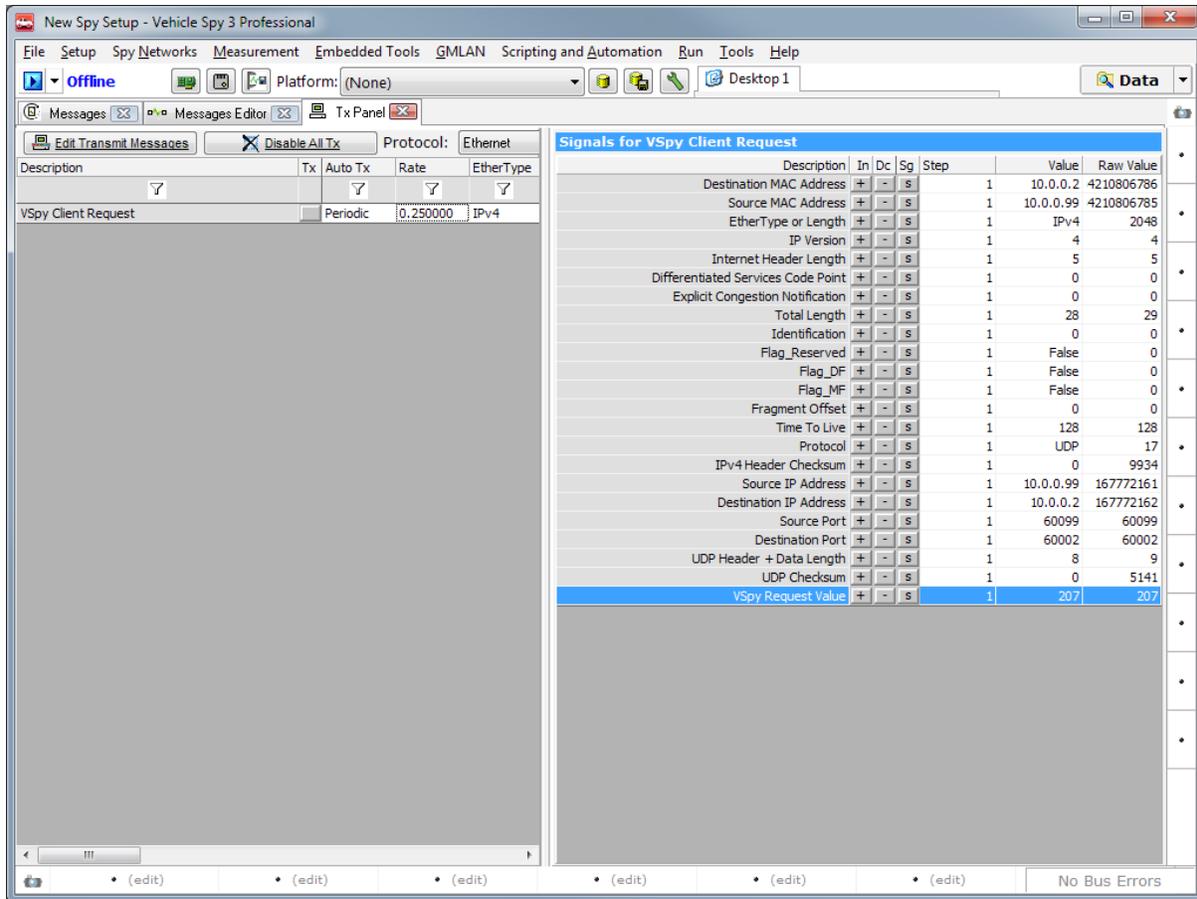


Figure 74: Vehicle Spy Tx Panel After Setting Up Signal Value and Transmit Rate.

Finally, let's copy this transmit message to the receive side so that it is decoded correctly.

**14. Switch to the Messages Editor.**

- 15. Copy the VSPy Client Request to Receive Messages:** Click the *VSPy Client Request* message, then right-click it, select *Copy To* and then *Receive*.

When we go online, Vehicle Spy will transmit requests to the Ethernet node acting as server, which will reply back to it. The requests from the Ethernet client node will continue to be sent, however, so the server will respond to those messages as well. The server will always reply back to the port number from which the request was sent. This means we can differentiate between the replies sent to the client node and those sent to VSPy by creating two receive message definitions with different port numbers.

Let's do that now. You should still be in the *Messages Editor* from the previous step, so we can continue from there.

- 16. Change the Server Response Message to Be Specific to Ethernet Node Requests:** Change the name of the message to "Node Server Response". Now change *Destination Address* from "X.X.X.X" to "10.0.0.1" and *Destination Port* from blank to "60001".

17. **Duplicate Server Response Message:** Right-click the *Node Server Response* message, then right-click it, select *Copy To* and then *Receive*.
18. **Change the Second Response Message to Be Specific to Vehicle Spy Requests:** Change the name of the new message to “VSpY Server Response”. Change its *Destination Address* from to “10.0.0.99” and *Destination Port* to “60099”.

We now have our separate server response messages set up. Let’s go see how the message exchanges look now.

19. **Switch to Messages View.**
20. **Go Online.**
21. **Go Offline:** After a couple of seconds, go offline so we can more easily see the message transactions.

Your Vehicle Spy should show a display similar to that seen in Figure 75. Notice that the *Client Request* messages continue to come into the RAD-Galaxy from the connected client node, and each receives a *Node Server Response* from the server node. About every 250 ms, a *VSpY Client Request* is sent from Vehicle Spy on the PC, and the node acting as server responds to that as well with a *VSpY Server Response*. These two responses are the same except for their destination address and port numbers, which again is how we can differentiate them with our two receive message definitions so they appear with distinct message names.

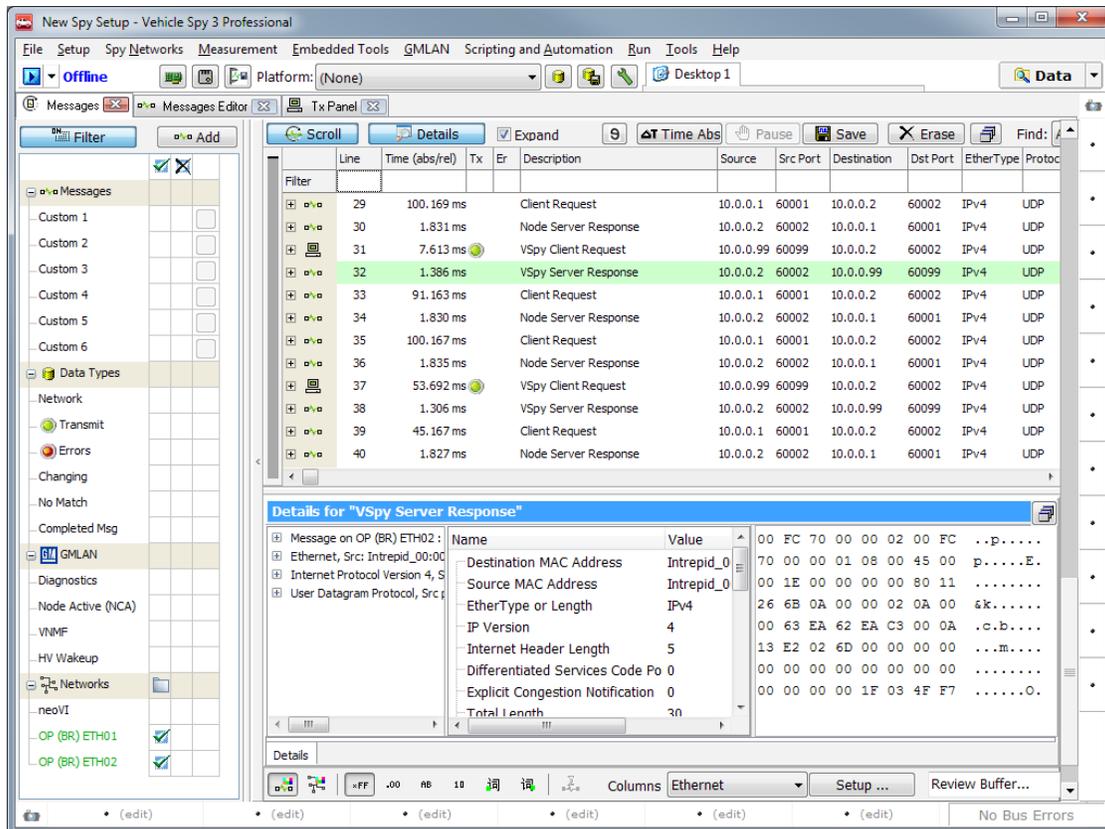


Figure 75: Connected Server Node Responding to Both Client Node and Vehicle Spy Request Messages.

### 5.3 Using the RAD-Galaxy as an Ethernet Media Converter

When set to media converter mode, the RAD-Galaxy treats each connected device independently, rather than as tapped pairs. To see how this works, we'll demonstrate the difference in behavior when this mode is activated, using the same setup we created in Section 5.2.

Upon completing the previous section, you will have both an Ethernet client node and Vehicle Spy sending requests to a server node, which replies with a response to each request. Let's see what happens if we switch the RAD-Galaxy from tap to media converter operation.

1. **Start neoVI Explorer:** Click the  button located in the main Vehicle Spy toolbar just under its menu; the neoVI Explorer window appears. (If you require assistance with using neoVI Explorer, please refer back to Chapter 4).
2. **Connect to the RAD-Galaxy:** Click the RAD-Galaxy in the hardware list and then press the *Connect* button.
3. **Change to Media Converter Mode:** Select *One Pair Ethernet (BroadR)* in the parameter group tree, then click the drop-down box on the right and change its selection from "Tap" to "Media Converter".
4. **Save Changes:** Press the *Write Settings* button to update the RAD-Galaxy.
5. **Exit neoVI Explorer.**
6. **Switch to Messages View.**
7. **Go Online.**
8. **Go Offline.**

Notice the differences now when you examine *Messages View*. You will still see *Client Request* messages from the Ethernet client device attached to RAD-Galaxy channel 1, and *VSpy Client Request* messages coming from Vehicle Spy on the PC. Each *VSpy Client Request* will have a *VSpy Server Response* message right after it as before. However, the *Client Request* messages will not have prompted the sending of *Node Server Response* messages by the server device on channel 2. Since the RAD-Galaxy is in media converter mode, traffic from channel 1 is not forwarded to channel 2 (and vice versa) so the Ethernet device acting as a server does not see the *Client Request* messages sent by the Ethernet device acting as a client. It only sees the *VSpy Client Request* messages from the PC.

### 5.4 Monitoring Conventional Vehicle Network Traffic

The RAD-Galaxy can be easily used to view all of the messages on your conventional CAN networks, and support for LIN will be forthcoming in a future firmware update. If you've used Intrepid vehicle network tools before, the process will be very familiar, and requires very little setup.

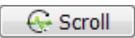
To demonstrate the process, we set up an Intrepid neoVI FIRE 2 to transmit two messages on the HS CAN channel using one copy of Vehicle Spy:

- A regular CAN message with an 11-bit Arbitration ID and 8 bytes of data, transmitted at a rate of one message every 250 ms.
- A CAN FD message with a 29-bit Arbitration ID and 16 bytes of data, transmitted every 500 ms.

To monitor this traffic, we then need only follow these steps:

1. **Start a Second Instance of Vehicle Spy:** Launch Vehicle Spy a second time. The two copies of the program will run independently, allowing us to view on this new instance what is being sent from the other one.
2. **Select the RAD-Galaxy:** On the *Logon Screen*, select the RAD-Galaxy as the device to be used for monitoring.
3. **Go Online.**

That's all that is required: Vehicle Spy will automatically switch to *Messages View* and show the messages coming into the RAD-Galaxy. However, let's add a couple of additional steps to make it easier to see what we are interested in here.

4. **Show Only HS CAN Messages:** You may have traffic from other networks, such as the Ethernet channels, coming into the display at the same time. For now let's only look at HS CAN traffic by clicking in the checkmark column in the left-hand Filter area next to *HS CAN*.
5. **Enter Scroll Mode:** By default Vehicle Spy will start in static mode, grouping together messages with the same Arbitration ID. To show the messages in chronological order, press the  button, located near the top left of *Messages View*.

After completing these steps, we obtain the result shown in . Notice that we have two CAN messages for every CAN FD (since they are being transmitted at a faster rate) as well as the extended data display for the CAN FD messages.

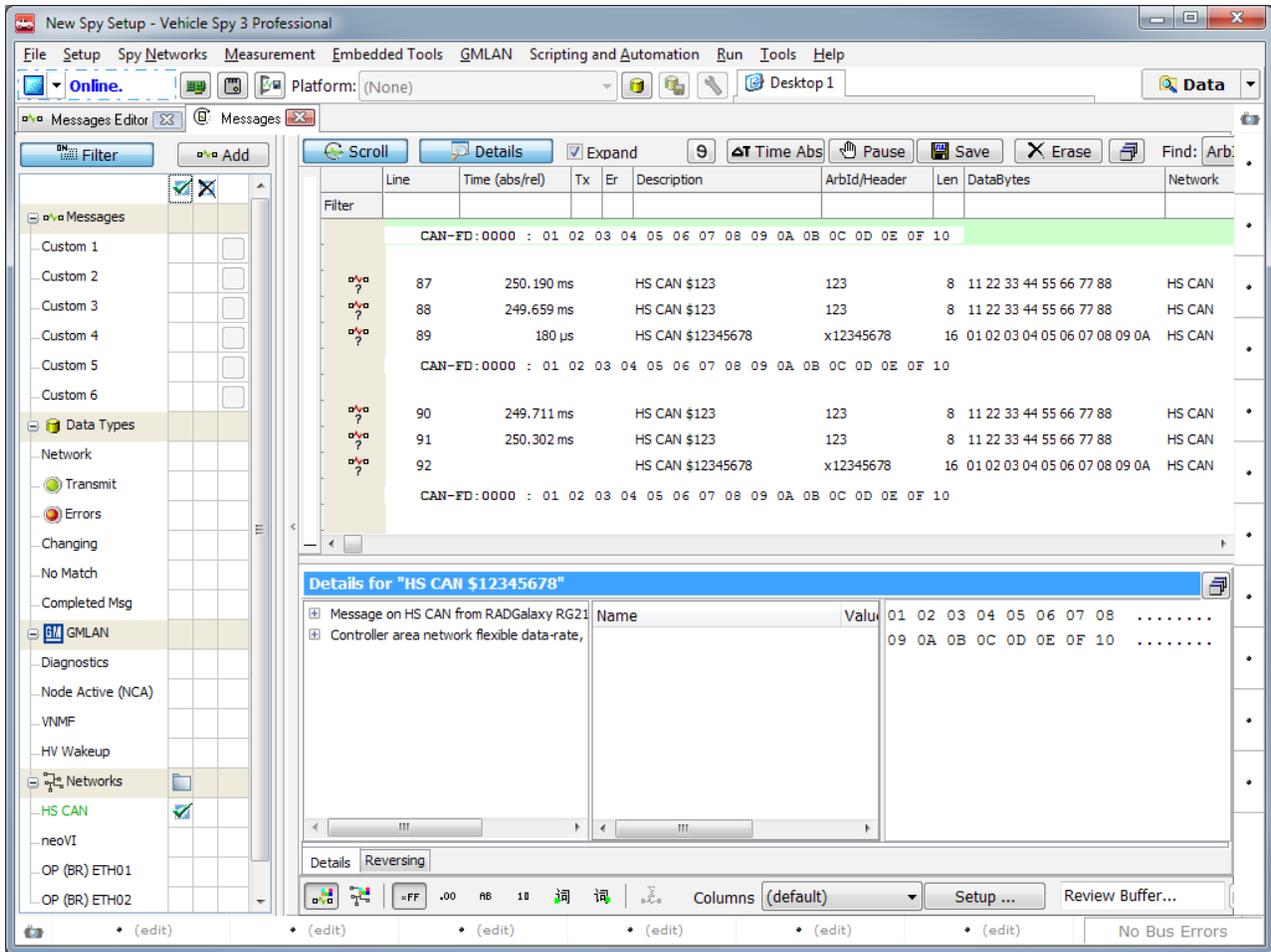
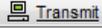


Figure 76: Monitoring CAN and CAN FD Messages in Vehicle Spy Using the RAD-Galaxy.

## 5.5 Transmitting on Conventional Vehicle Networks

We can transmit on CAN networks almost as easily as we can receive on them. All that is necessary is to create a transmit message and then tell Vehicle Spy to send it.

Here's the process, which is similar to the one we followed in Section 5.2 for transmitting on Ethernet networks:

1. **Switch to the Messages Editor:** Select *Messages Editor* from the *Spy Networks* menu, or click the *Messages Editor* tab from the tab list near the top of VSpy.
2. **Select the HS CAN Network:** Select "HS CAN" from the *on Network* drop-down box, if it is not already selected.
3. **Switch to the Transmit Side of the Messages Editor:** Click the  **Transmit** button, which will change to have blue highlighting.

4. **Create a Transmit Message:** Click the **+** button to the right of the drop-down box. A default message called "Tx Message HS CAN 1" will be created. You can rename this if you like but it's not necessary.
5. **Set the CAN Type:** Double-click in the *Type* column and change the setting, if desired. Here let's change it to "CAN FD Std 11 bit".
6. **Enter the Arbitration ID:** In the Arb ID box, enter "456".
7. **Enter CAN Data:** We could create signals as we did for Ethernet, but just do something different, let's enter data directly here. Put any data values you want in the B1 through B8 fields; we'll just use the values "01" through "08" for this demonstration.
8. **Switch to the Tx Panel:** Select *Tx Panel* from the *Spy Networks* menu.
9. **Select the Message:** Click on the message in the pane on the left.
10. **Set the Transmission Rate:** Double-click in the *Rate* box and either enter "0.100" or select that value from the drop-down box that appears.
11. **Switch to Messages View.**
12. **Go Online.**

You will now see your message being transmitted on the HS CAN network, approximately every 100 ms, as shown in Figure 77. Note the green circle in the *Tx* column that marks it as a transmitted message.

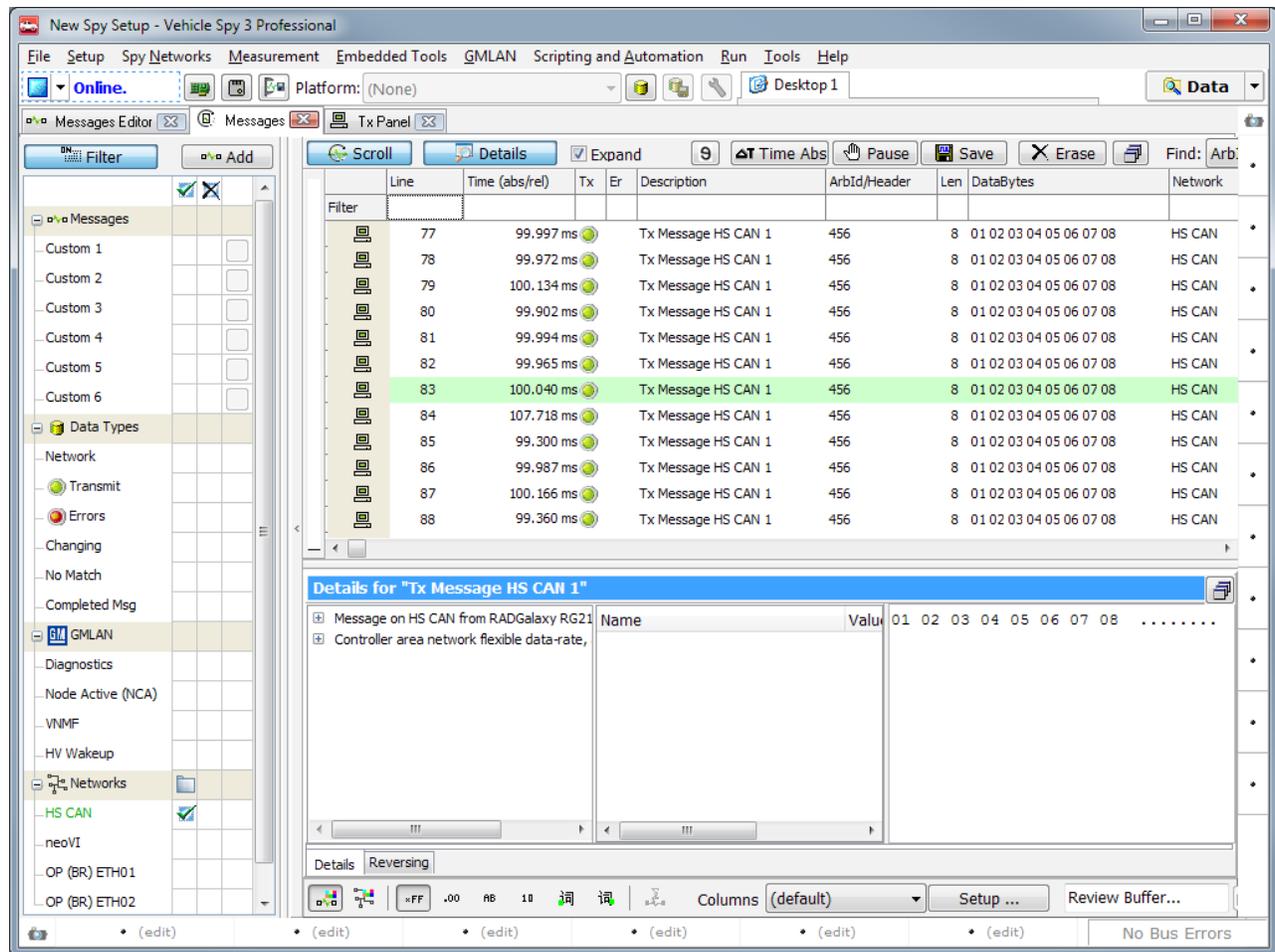


Figure 77: Transmitting CAN Messages Using Vehicle Spy and the RAD-Galaxy.

## 5.6 Standalone Logging

This section will be detailed in a future version of this manual.

## 5.7 Using the RAD-Galaxy with DoIP

This section will be detailed in a future version of this manual.

## 5.8 Using Miscellaneous I/O Channels

This section will be detailed in a future version of this manual.

## 6 Reference: Connector Pinouts and Cable Signal Mappings

This chapter contains complete pinouts for the connectors on the RAD-Galaxy, as well as those on the network interface cables used to attach to it. For your convenience, tables are also provided that show the mappings of signals between pin numbers on the connectors of each network cable. We've also created inter-cable signal mappings that show all of the signal flows on a configured device.

 **Note:** In most configurations, the LIN channel of the RAD-Galaxy is also used as the Ethernet Activation line for DoIP, the exception being when the neoVI FIRE 2 OBD Cable with DoIP support is used. Since this chapter is large and readers who reference individual cable pinouts may not see this note, a reminder has also been provided in places where relevant.

### 6.1 RAD-Galaxy Connector Pinouts

In this section we provide a complete list of the pinouts for the connectors on the RAD-Galaxy, as well as those on the network interface cables used to attach to it.

 **Note:** The RAD-Galaxy channels and device labels still use the term *BroadR-Reach (BR)* since the device predates the formal 100BASE-T1 specification. As mentioned earlier in the manual, the RAD-Galaxy supports devices meeting either standard.

#### ***RAD-Galaxy Nano MQS 100BASE-T1 (BroadR-Reach) Connector 1 Pinout Details***

A detailed description of the pinout of 100BASE-T1 (BroadR-Reach) Ethernet connector 1 can be found in Table 2. A close-up of the connector is shown in Figure 78.

Pin #	Label	Description
1	BR11+	BroadR-Reach connection 11, positive
2	BR11-	BroadR-Reach connection 11, negative
3	DNC	Do not connect
4	DNC	Do not connect
5	DNC	Do not connect
6	DNC	Do not connect
7	BR12+	BroadR-Reach connection 12, positive

Pin #	Label	Description
8	BR12-	BroadR-Reach connection 12, negative
9	BR2-	BroadR-Reach connection 2, negative
10	BR2+	BroadR-Reach connection 2, positive
11	DNC	Do not connect
12	BR7-	BroadR-Reach connection 7, negative
13	BR7+	BroadR-Reach connection 7, positive
14	DNC	Do not connect
15	DNC	Do not connect
16	BR1-	BroadR-Reach connection 1, negative
17	BR1+	BroadR-Reach connection 1, positive
18	DNC	Do not connect
19	BR6-	BroadR-Reach connection 6, negative
20	BR6+	BroadR-Reach connection 6, positive

Table 2: BroadR-Reach Connector 1 Pinout Details.



Figure 78: BroadR-Reach Ethernet Connector 1 with Pin Assignments.

### ***RAD-Galaxy Nano MQS 100BASE-T1 (BroadR-Reach) Connector 2 Pinout Details***

See Table 3 for the details on 100BASE-T1 (BroadR-Reach) Ethernet connector 2, and refer to Figure 79 for a close-up of the connector and its pin assignments.

Pin #	Label	Description
1	BR8+	BroadR-Reach connection 8, positive
2	BR8-	BroadR-Reach connection 8, negative
3	DNC	Do not connect
4	DNC	Do not connect
5	DNC	Do not connect
6	DNC	Do not connect

Pin #	Label	Description
7	BR3+	BroadR-Reach connection 3, positive
8	BR3-	BroadR-Reach connection 3, negative
9	BR4-	BroadR-Reach connection 4, negative
10	BR4+	BroadR-Reach connection 4, positive
11	DNC	Do not connect
12	BR5-	BroadR-Reach connection 5, negative
13	BR5+	BroadR-Reach connection 5, positive
14	DNC	Do not connect
15	DNC	Do not connect
16	BR9-	BroadR-Reach connection 9, negative
17	BR9+	BroadR-Reach connection 9, positive
18	DNC	Do not connect
19	BR10-	BroadR-Reach connection 10, negative
20	BR10+	BroadR-Reach connection 10, positive

Table 3: BroadR-Reach Connector 2 Pinout Details.

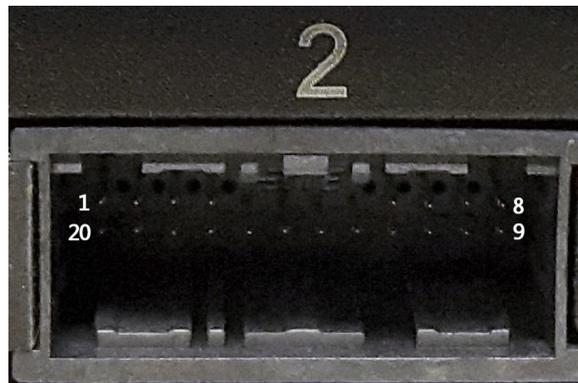


Figure 79: BroadR-Reach Ethernet Connector 2 with Pin Assignments.

### ***RAD-Galaxy HD-26M Conventional Network Interface Connector Pinout Details***

The details for the conventional network (CAN/MISC) DB-26M connector are shown in Table 4 and Figure 80.

Pin #	Label	Description
1	HS CAN 7 L	High Speed CAN channel 7, low
2	HS CAN 3 L	High Speed CAN channel 3, low
3	HS CAN 4 L	High Speed CAN channel 4, low
4	HS CAN 6 L	High Speed CAN channel 6, low
5	HS CAN 1 L	High Speed CAN channel 1, low

Pin #	Label	Description
6	MS CAN L	Medium Speed CAN channel, low
7	HS CAN 2 L	High Speed CAN channel 2, low
8	HS CAN 5 L	High Speed CAN channel 5, low
9	AOUT 1	Analog output 1
10	GND	Ground
11	HS CAN 7 H / SW CAN	High Speed CAN channel 7, high / Single Wire CAN channel 1
12	HS CAN 3 H	High Speed CAN channel 3, high
13	HS CAN 4 H	High Speed CAN channel 4, high
14	HS CAN 6 H / SW CAN 2	High Speed CAN channel 6, high / Single Wire CAN channel 2
15	HSCAN 1 H	High Speed CAN channel 1, high
16	MS CAN H	Medium Speed CAN channel, high
17	HS CAN 2 H	High Speed CAN channel 2, high
18	HS CAN 5 H	High Speed CAN channel 5, high
19	VBATT	DC power input
20	AOUT 2	Analog output 2
21	AOUT 3	Analog output 3
22	LIN	LIN channel (also Ethernet Activation for DoIP)
23	PWMIO/AIN 1	PWM I/O / Analog input 1
24	PWMIO/AIN 2	PWM I/O / Analog input 2
25	PWMIO/AIN 3	PWM I/O / Analog input 3
26	PWMIO/AIN 4	PWM I/O / Analog input 4

Table 4: HD-26M CAN/MISC Conventional Network Interface Connector Pinout Details.



Figure 80: HD-26M CAN/MISC Conventional Network Interface Connector with Pin Assignments.

## 6.2 RAD-Galaxy Ethernet Cable Adapter Connector Pinouts and Signal Mapping

This cable, which is described and illustrated in Section 2.4, is the RAD-Galaxy's primary attachment cable for all networks except 100BASE-T1. Its HD-26F connector attaches to the HD-26M on the RAD-Galaxy, and thus has the same pinout. Below are the pinouts for the

other three connectors on this cable (HD-26M, DB-9F and RJ-45F) as well as a mapping table that shows how the signals on the various connectors are aligned.

### HD-26M Connector

The HD-26M connector has the pin assignments shown in Table 14, with pin numbering the same as that shown in Figure 80.

Pin #	Name	Description
1	ETH TX+	Ethernet transmit channel, positive
2	HS CAN 4 L	High Speed CAN channel 4, low
3	HS CAN 5 L	High Speed CAN channel 5, low
4	HS CAN 1 L	High Speed CAN channel 1, low
5	MS CAN L	Medium Speed CAN channel, low
6	HS CAN 2 L	High Speed CAN channel 2, low
7	HS CAN 3 L	High Speed CAN channel 3, low
8	HS CAN 6 L	High Speed CAN channel 6, low
9	ETH TX-	Ethernet transmit channel, negative
10	GND	Ground
11	ETH RX+	Ethernet receive channel, positive
12	HS CAN 4 H	High Speed CAN channel 4, high
13	HS CAN 5 H	High Speed CAN channel 5, high
14	HSCAN 1 H	High Speed CAN channel 1, high
15	MSCAN H	Medium Speed CAN channel, high
16	HSCAN 2 H	High Speed CAN channel 2
17	HSCAN 3 H	High-Speed CAN channel 7, high
18	HS CAN 6 H / SW CAN 2	High Speed CAN channel 6, high / Single Wire CAN channel 2
19	VBATT	DC power input
20	ETH RX-	Ethernet receive channel, negative
21	HSCAN 7 L	High Speed CAN channel 7, low
22	LIN	LIN channel (also Ethernet Activation for DoIP)
23	DNC	Do not connect
24	DNC	Do not connect
25	LIN	LIN channel
26	HSCAN 7 H / SWCAN	High Speed CAN channel 7, high / Single Wire CAN channel 1

Table 5: RAD-Galaxy Ethernet Cable Adapter DB-26M Connector Pinout.

### DB-9F Connector

Table 6 shows the pin assignments for the DB-9F connector, with pin numbering illustrated in Table 19.

Pin #	Name	Description
1	LIN	LIN channel (also Ethernet Activation for DoLP)
2	PWMIO/AIN 1	PWM I/O / Analog Input 1
3	PWMIO/AIN 2	PWM I/O / Analog Input 2
4	PWMIO/AIN 3	PWM I/O / Analog Input 3
5	GND	Ground
6	PWMIO/AIN 4	PWM I/O / Analog Input 4
7	AOUT 1	Analog Output 1
8	AOUT 2	Analog Output 2
9	AOUT 3	Analog Output 3

Table 6: RAD-Galaxy Ethernet Cable Adapter DB-9F Connector Pinout.

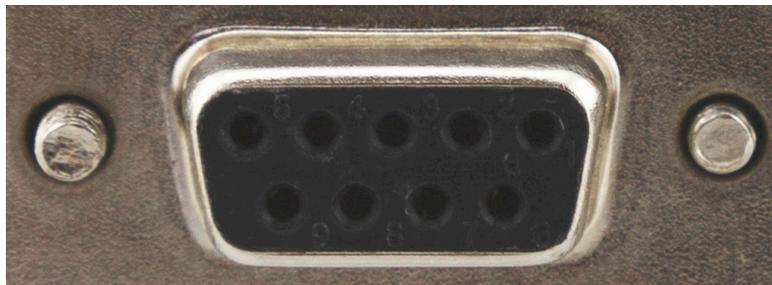


Figure 81: RAD-Galaxy Ethernet Cable Adapter DB-9F Connector with Pin Assignments. The pin numbers are printed right on this connector, but may be hard for some to see. Pin 1 is top right and the numbers increase going left in the top row to pin 5 top left. Pin 6 is bottom right and Pin 9 bottom left.

### RJ-45F Connector

The RJ-45 jack follows standard Ethernet wiring conventions, but we've provided the pinout anyway in case you need it, in Table 7.

Pin #	Name	Description
1	ETH TX+	Ethernet transmit channel, positive
2	ETH TX-	Ethernet transmit channel, negative
3	ETH RX+	Ethernet receive channel, positive
4	DNC	Do not connect
5	DNC	Do not connect
6	ETH RX-	Ethernet receive channel, negative
7	DNC	Do not connect
8	DNC	Do not connect

Table 7: RAD-Galaxy Ethernet Cable Adapter RJ-45F Connector Pinout.

## Cable Signal Mapping

For easy reference, Table 8 shows the mapping of signals for the *RAD-Galaxy Ethernet Cable Adapter*, by pin order on the HD-26F that connects to the RAD-Galaxy. Note that DoIP Ethernet signals are not carried on that connector and so have been added at the bottom of the table.

Signal Name	Signal Description	HD-26F Pin #	HD-26M Pin #	DB-9F Pin #	RJ-45F Pin #
HS CAN 7 L	High Speed CAN channel 7, low	1	21		
HS CAN 3 L	High Speed CAN channel 3, low	2	7		
HS CAN 4 L	High Speed CAN channel 4, low	3	2		
HS CAN 6 L	High Speed CAN channel 6, low	4	8		
HS CAN 1 L	High Speed CAN channel 1, low	5	4		
MS CAN L	Medium Speed CAN channel, low	6	5		
HS CAN 2 L	High Speed CAN channel 2, low	7	6		
HS CAN 5 L	High Speed CAN channel 5, low	8	3		
AOUT 1	Analog output 1	9		7	
GND	Ground	10	10	5	
HS CAN 7 H / SW CAN	High Speed CAN channel 7, high / Single Wire CAN channel 1	11	26		
HS CAN 3 H	High Speed CAN channel 3, high	12	17		
HS CAN 4 H	High Speed CAN channel 4, high	13	12		
HS CAN 6 H / SW CAN 2	High Speed CAN channel 6, high / Single Wire CAN channel 2	14	18		
HSCAN 1 H	High Speed CAN channel 1, high	15	14		
MS CAN H	Medium Speed CAN channel, high	16	15		
HS CAN 2 H	High Speed CAN channel 2, high	17	16		
HS CAN 5 H	High Speed CAN channel 5, high	18	13		
VBATT	DC power input	19	19		
AOUT 2	Analog output 2	20		8	
AOUT 3	Analog output 3	21		9	
LIN	LIN channel (also Ethernet Activation for DoIP)	22	22, 25	1	
PWMIO/AIN 1	PWM I/O / Analog input 1	23		2	
PWMIO/AIN 2	PWM I/O / Analog input 2	24		3	
PWMIO/AIN 3	PWM I/O / Analog input 3	25		4	
PWMIO/AIN 4	PWM I/O / Analog input 4	26		6	
ETH TX+	Ethernet transmit channel, positive		1		1
ETH TX-	Ethernet transmit channel, negative		9		2
ETH RX+	Ethernet receive channel, positive		11		3
ETH RX-	Ethernet receive channel, negative		20		6

Table 8: RAD-Galaxy Ethernet Cable Adapter Signal Mapping.

## 6.3 neoVI FIRE 2 Ethernet Cable Adapter Connector Pinouts and Signal Mapping

This secondary cable usually sits between the *RAD-Galaxy Ethernet Cable Adapter* and conventional networks, and is described further in Section 2.4. Its HD-26F connector attaches to the HD-26M on the *RAD-Galaxy Ethernet Cable Adapter*, and thus has the same pinout as shown in Table 5. Below are the pinouts for the other connectors on this cable (DB-25M, DB-9M and RJ-45F) as well as cable signal mapping table.

### **DB-25M Connector**

The DB-25M connector has the pin assignments shown in Table 9, with pin numbering for the connector illustrated in Figure 82.

Pin #	Name	Description
1	HS CAN 7 H / SW CAN	High Speed CAN channel 7, high / Single Wire CAN channel 1
2	N/C	No connection
3	HS CAN 6 H / SW CAN 2	High Speed CAN channel 6, high / Single Wire CAN channel 2
4	HS CAN 6 L	High Speed CAN channel 6, low
5	MS CAN H	Medium Speed CAN channel, high
6	MS CAN L	Medium Speed CAN channel, low
7	HS CAN 7 L	High Speed CAN channel 7, low
8	LIN	LIN channel (also Ethernet Activation for DoIP)
9	DNC	Do not connect
10	DNC	Do not connect
11	DNC	Do not connect
12	DNC	Do not connect
13	GND	Ground
14	HS CAN 1 H	High Speed CAN channel 1, high
15	HS CAN 1 L	High Speed CAN channel 1, low
16	HS CAN 2 H	High Speed CAN channel 2, high
17	HS CAN 2 L	High Speed CAN channel 2, low
18	HS CAN 4 H	High Speed CAN channel 4, high
19	HS CAN 3 H	High Speed CAN channel 3, high
20	HS CAN 3 L	High Speed CAN channel 3, low
21	HS CAN 5 H	High Speed CAN channel 5, high
22	HS CAN 5 L	High Speed CAN channel 5, low
23	HS CAN 4 L	High Speed CAN channel 4, low
24	DNC	Do not connect
25	V BATT	DC Input Power

Table 9: neoVI FIRE 2 Ethernet Cable Adapter DB-25M Connector Pinout.

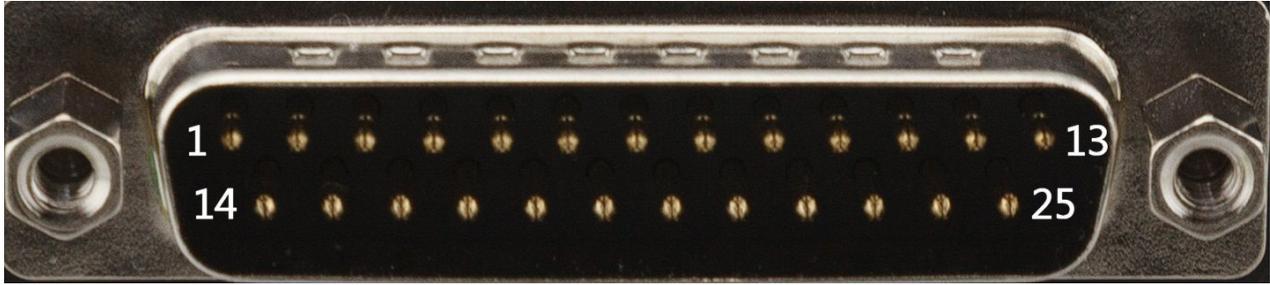


Figure 82: neoVI FIRE 2 Ethernet Cable Adapter DB-25M Connector with Pin Assignments.

### DB-9M Connector

Table 10 shows the pin assignments for the DB-9M connector, with pin numbering illustrated in Figure 83.

Pin #	Name	Description
1	LIN	LIN channel (also Ethernet Activation for DoIP)
2	DNC	Do not connect
3	DNC	Do not connect
4	LIN	LIN channel (also Ethernet Activation for DoIP)
5	GND	Ground
6	DNC	Do not connect
7	DNC	Do not connect
8	DNC	Do not connect
9	DNC	Do not connect

Table 10: neoVI FIRE 2 Ethernet Cable Adapter DB-9M Connector Pinout.

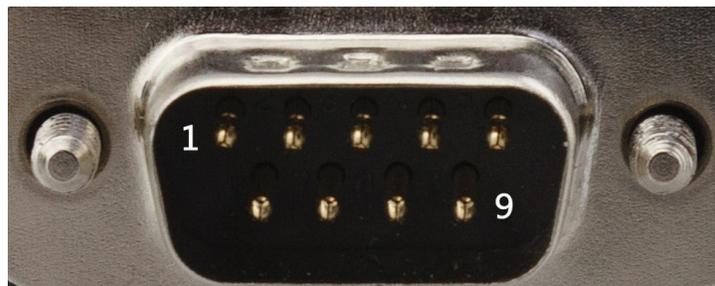


Figure 83: neoVI FIRE 2 Ethernet Cable Adapter DB-9M Connector with Pin Assignments.

### RJ-45F Connector

This is another standard Ethernet socket and uses the same pinout as that shown in Table 7.

## Cable Signal Mapping

Table 11 shows the mapping of signals for the *neoVI FIRE 2 Ethernet Cable Adapter*, by pin order on the HD-26F that connects to the *RAD-Galaxy Ethernet Cable Adapter*.

Signal Name	Signal Description	HD-26F Pin #	DB-25M Pin #	DB-9M Pin #	RJ-45F Pin #
ETH TX+	Ethernet transmit channel, positive	1			1
HS CAN 4 L	High Speed CAN channel 4, low	2	23		
HS CAN 5 L	High Speed CAN channel 5, low	3	22		
HS CAN 1 L	High Speed CAN channel 1, low	4	15		
MS CAN L	Medium Speed CAN channel, low	5	6		
HS CAN 2 L	High Speed CAN channel 2, low	6	17		
HS CAN 3 L	High Speed CAN channel 3, low	7	20		
HS CAN 6 L	High Speed CAN channel 6, low	8	4		
ETH TX-	Ethernet transmit channel, negative	9			2
GND	Ground	10	13	5	
ETH RX+	Ethernet receive channel, positive	11			3
HS CAN 4 H	High Speed CAN channel 4, high	12	18		
HS CAN 5 H	High Speed CAN channel 5, high	13	21		
HSCAN 1 H	High Speed CAN channel 1, high	14	14		
MS CAN H	Medium Speed CAN channel, high	15	5		
HSCAN 2 H	High Speed CAN channel 2	16	16		
HSCAN 3 H	High-Speed CAN channel 7, high	17	19		
HS CAN 6 H / SW CAN 2	High Speed CAN channel 6, high / Single Wire CAN channel 2	18	3		
VBATT	DC power input	19	25		
ETH RX-	Ethernet receive channel, negative	20			6
HSCAN 7 L	High Speed CAN channel 7, low	21	7		
LIN	LIN channel (also Ethernet Activation for DoIP)	22	8	1, 4	
DNC	Do not connect	23			
DNC	Do not connect	24			
LIN	LIN channel (also Ethernet Activation for DoIP)	25	8	1, 4	
HSCAN 7 H / SWCAN	High Speed CAN channel 7, high / Single Wire CAN channel 1	26	1		

Table 11: neoVI FIRE 2 Ethernet Cable Adapter Signal Mapping.

## 6.4 neoVI-OBOD-1 Cable Connector Pinouts and Signal Mapping

This OBD cable contains a DB-25 connector that mates to the DB-25 on the *neoVI FIRE 2 Ethernet Cable Adapter* and an OBD-II / J1962 connector for your vehicle or bench.

### DB-25 Connector Pinout

Table 12 shows the pinout of the DB-25 connector on the *neoVI-OBD-1* and signals when used with the RAD-Galaxy.

Pin #	Name	Description
1	SW CAN	Single Wire CAN channel
2	DNC	Do not connect
3	DNC	Do not connect
4	DNC	Do not connect
5	MS CAN H	Medium Speed CAN channel, high
6	MS CAN L	Medium Speed CAN channel, low
7	DNC	Do not connect
8	LIN	LIN channel (also Ethernet Activation for DoLP)
9	DNC	Do not connect
10	DNC	Do not connect
11	DNC	Do not connect
12	DNC	Do not connect
13	GND	Ground
14	HS CAN 1 H	High Speed CAN channel 1, high
15	HS CAN 1 L	High Speed CAN channel 1, low
16	HS CAN 2 H	High Speed CAN channel 2, high
17	HS CAN 2 L	High Speed CAN channel 2, low
18	DNC	Do not connect
19	HS CAN 3 H	High Speed CAN channel 3, high
20	HS CAN 3 L	High Speed CAN channel 3, low
21	DNC	Do not connect
22	DNC	Do not connect
23	DNC	Do not connect
24	DNC	Do not connect
25	V BATT	DC Input Power

Table 12: neoVI-OBD-1 Cable DB-25 Connector Pinout.

### OBD-II / J1962 Connector Pinout

Table 13 contains the standard pinout for the OBD-II / J1962 connector on this cable. Note that not all of the default signals are actually present when used with the RAD-Galaxy, such as J1850, but they are included for completeness.

Pin #	Name	Description
1	Discretionary (SW CAN)	Single Wire CAN channel
2	J1850 +	J1850 line, positive
3	Discretionary (MS CAN H)	Medium Speed CAN channel, high
4	Chassis GND	Chassis Ground
5	Signal GND	Signal Ground
6	Discretionary (HS CAN H)	High Speed CAN channel, high
7	ISO9141/K/LIN1	ISO 9141-2 K-Line / LIN channel 1
8	Discretionary	Discretionary
9	Discretionary (ALDL)	Assembly Line Diagnostics Link
10	J1850 -	J1850 line, negative
11	Discretionary (MS CAN L)	Medium Speed CAN channel, low
12	Discretionary	Discretionary
13	Discretionary	Discretionary
14	Discretionary (HS CAN L)	High Speed CAN channel, low
15	ISO L	ISO 9141-2 L-Line
16	VBATT	Unswitched Vehicle Battery Positive

**Table 13: neoVI-OBD-1 Cable OBD-II / J1962 Connector Pinout.** The table shows standard signals for the OBD-II connector; this includes protocols such as J1850 that are not supported by the RAD-Galaxy.

### Cable Signal Mapping

Table 14 contains the mapping of signals for the *neoVI-OBD-1* cable when used with the RAD-Galaxy. The signal names for both connectors are shown and the table is based on the OBD-II connector's pin order. Note that signals on the OBD-II connector that are not used have been omitted from this table.

OBD-II Pin #	OBD-II Signal	DB-25 Signal	DB-25 Pin #
1	Discretionary (SW CAN)	SW CAN	1
2	DNC	DNC	
3	Discretionary (MS CAN H)	MS CAN H	5
4	DNC	DNC	
5	Signal GND	GND	13
6	Discretionary (HS CAN H)	HS CAN 1 H	14
7	ISO9141/K/LIN1	LIN	8

OBD-II Pin #	OBD-II Signal	DB-25 Signal	DB-25 Pin #
8	DNC	DNC	
9	Discretionary (ALDL)	HS CAN 3 H	19
10	J1850 -	HS CAN 3 L	20
11	Discretionary (MS CAN L)	MS CAN L	6
12	Discretionary	HS CAN 2 H	16
13	Discretionary	HS CAN 2 L	17
14	Discretionary (HS CAN L)	HS CAN 1 L	15
15	DNC	DNC	
16	VBATT	VBATT	25

Table 14: neoVI-OBD-1 Cable Signal Mapping.

## 6.5 neoVI-OBD-MULTI (Regular and Right Angle) Cable Connector Pinouts and Signal Mapping

These two cables have the same pinouts and signal mappings, as they differ only in the physical construction of the OBD-II connector.

### ***DB-25 Connector Pinout***

Table 15 shows the pinout of the DB-25 connector on the *neoVI-OBD-MULTI* when used with the RAD-Galaxy.

Pin #	Name	Description
1	DNC	Do not connect
2	DNC	Do not connect
3	DNC	Do not connect
4	DNC	Do not connect
5	MS CAN H	Medium Speed CAN channel, high
6	MS CAN L	Medium Speed CAN channel, low
7	DNC	Do not connect
8	LIN	LIN channel (also Ethernet Activation for DoIP)
9	DNC	Do not connect
10	DNC	Do not connect
11	DNC	Do not connect
12	DNC	Do not connect
13	GND	Ground
14	HS CAN 1 H	High Speed CAN channel 1, high

Pin #	Name	Description
15	HS CAN 1 L	High Speed CAN channel 1, low
16	HS CAN 2 H	High Speed CAN channel 2, high
17	HS CAN 2 L	High Speed CAN channel 2, low
18	DNC	Do not connect
19	HS CAN 3 H	High Speed CAN channel 3, high
20	HS CAN 3 L	High Speed CAN channel 3, low
21	DNC	Do not connect
22	DNC	Do not connect
23	DNC	Do not connect
24	DNC	Do not connect
25	V BATT	DC Input Power

Table 15: neoVI-OBD-MULTI Cable DB-25 Connector Pinout.

### ***OBD-II / J1962 Connector Pinout***

The pinout for the OBD-II / J1962 connector on this cable can be found in Table 16. All signals are again included for completeness but note that signals such as J1850 are not supported on the RAD-Galaxy.

Pin #	Name	Description
1	Discretionary	Discretionary
2	J1850 +	J1850 line, positive
3	Discretionary	Discretionary
4	Chassis GND	Chassis Ground
5	Signal GND	Signal Ground
6	CAN H	High Speed CAN channel, high
7	ISO9141/K	ISO 9141-2 K-Line
8	Discretionary	Discretionary
9	Discretionary	Discretionary
10	J1850 -	J1850 line, negative
11	Discretionary	Discretionary
12	Discretionary	Discretionary
13	Discretionary	Discretionary
14	CAN L	High Speed CAN channel, low
15	ISO L	ISO 9141-2 L-Line
16	VBATT	Unswitched Vehicle Battery Positive

Table 16: neoVI-OBD-MULTI Cable OBD-II / J1962 Connector Pinout. The table shows standard signals for the OBD-II connector; this includes J1850, which is not supported by the RAD-Galaxy.

## Cable Signal Mapping

Table 17 contains the mapping of signals for the *neoVI-OBD-MULTI* regular and right angle cables. The signal names for both connectors are shown and the table is based on the OBD-II connector's pin order. Note that signals on the OBD-II connector that are not used have been omitted from this table.

OBD-II Pin #	OBD-II Signal	DB-25 Signal	DB-25 Pin #
1	Discretionary	HS CAN 3 H	19
2	DNC	DNC	
3	Discretionary	MS CAN H	5
4	DNC	DNC	
5	Signal GND	GND	13
6	CAN H	HS CAN 1 H	14
7	ISO9141/K	LIN	8
8	DNC	DNC	
9	Discretionary	HS CAN 3 L	20
10	DNC	DNC	
11	Discretionary	MS CAN L	6
12	Discretionary	HS CAN 2 H	16
13	Discretionary	HS CAN 2 L	17
14	CAN L	HS CAN 1 L	15
15	ISO L	ISO L	7
16	VBATT	VBATT	25

Table 17: neoVI-OBD-MULTI Cable Signal Mapping.

## 6.6 neoVI FIRE/RED J1939 Cable Connector Pinouts and Signal Mapping

This cable converts the neoVI DB-25 connector to a 9-pin Deutsch connector for use in commercial vehicles.

### DB-25 Connector Pinout

Table 18 contains the pinout of the DB-25 connector when used with the RAD-Galaxy.

Pin #	Name	Description
1	DNC	Do not connect
2	DNC	Do not connect
3	DNC	Do not connect
4	DNC	Do not connect

Pin #	Name	Description
5	MS CAN H	Medium Speed CAN channel, high
6	MS CAN L	Medium Speed CAN channel, low
7	DNC	Do not connect
8	DNC	Do not connect
9	DNC	Do not connect
10	DNC	Do not connect
11	DNC	Do not connect
12	DNC	Do not connect
13	GND	Ground
14	HS CAN H	High Speed CAN channel, high
15	HS CAN L	High Speed CAN channel, low
16	DNC	Do not connect
17	DNC	Do not connect
18	DNC	Do not connect
19	DNC	Do not connect
20	DNC	Do not connect
21	DNC	Do not connect
22	DNC	Do not connect
23	DNC	Do not connect
24	DNC	Do not connect
25	V BATT	DC Input Power

Table 18: neoVI FIRE/RED J1939 Cable DB-25 Connector Pinout.

### Deutsch 9-Pin Connector Pinout

The pinout for the Deutsch connector on this cable is found in Table 19. All signals are again included for completeness but note that J1708 is not supported on the RAD-Galaxy.

Pin #	Name	Description
1/A	Ground (-)	Ground
2/B	Battery (+)	Battery Power
3/C	CAN High (+)	High Speed CAN channel 1, high
4/D	CAN Low (-)	High Speed CAN channel 1, low
5/E	CAN Shield	CAN shield
6/F	J1708 (+)	J1708 channel, high
7/G	J1708 (-)	J1708 channel, low
8/H	CAN2 High (+)	High Speed CAN channel 1, high
9/J	CAN2 Low (-)	High Speed CAN channel 1, low

Table 19: neoVI FIRE/RED J1939 Cable Deutsch 9-Pin Connector Pinout. The table shows standard signals for the Deutsch 9-pin connector; this includes J1708, which is not supported by the RAD-Galaxy.

## Cable Signal Mapping

Table 20 contains the mapping of signals for the neoVI FIRE/RED J1939 cable. The signal names for both connectors are shown and the table is based on the Deutsch 9-pin connector's pin order. Note that signals on the Deutsch 9-pin that are not used have been omitted from this table.

Deutsch Pin #	Deutsch Signal	DB-25 Signal	DB-25 Pin #
1/A	Ground (-)	GND	13
2/B	Battery (+)	VBATT	25
3/C	CAN High (+)	HS CAN H	14
4/D	CAN Low (-)	HS CAN L	15
5/E	DNC	DNC	
6/F	DNC	DNC	
7/G	DNC	DNC	
8/H	CAN2 High (+)	MS CAN H	5
9/J	CAN2 Low (-)	MS CAN L	6

Table 20: neoVI FIRE/RED J1939 Cable Signal Mapping.

## 6.7 neoVI FIRE 2 OBD Cable with DoIP Support Connector Pinouts and Signal Mapping

This special OBD cable replaces the *neoVI FIRE 2 Ethernet Cable Adapter* and contains HD-26, DB-25, DB-9 and OBD-II connectors. The HD-26 connector mates to the HD-26 on the *RAD-Galaxy Ethernet Cable Adapter* and uses the same pinout shown in Table 4; the other connectors are described below, along with a signal mapping table.

### DB-25 Connector Pinout

Table 21 lists the pins of the DB-25 connector on this cable when used with the RAD-Galaxy. Note that the LIN channel pin does not need to be used for DoIP Ethernet Activate on this cable, though they are electrically connected.

Pin #	Name	Description
1	HS CAN 7 H / SW CAN	High Speed CAN channel 7, high / Single Wire CAN channel 1
2	DNC	Do not connect
3	HS CAN 6 H / SW CAN 2	High Speed CAN channel 6, high / Single Wire CAN channel 2
4	HS CAN 6 L	High Speed CAN channel 6, low
5	MS CAN H	Medium Speed CAN channel, high

Pin #	Name	Description
6	MS CAN L	Medium Speed CAN channel, low
7	HS CAN 7 L	High Speed CAN channel 7, low
8	LIN	LIN channel (also Ethernet Activation for DoIP)
9	DNC	Do not connect
10	DNC	Do not connect
11	DNC	Do not connect
12	DNC	Do not connect
13	GND	Ground
14	HS CAN 1 H	High Speed CAN channel 1, high
15	HS CAN 1 L	High Speed CAN channel 1, low
16	HS CAN 2 H	High Speed CAN channel 2, high
17	HS CAN 2 L	High Speed CAN channel 2, low
18	HS CAN 4 H	High Speed CAN channel 4, high
19	HS CAN 3 H	High Speed CAN channel 3, high
20	HS CAN 3 L	High Speed CAN channel 3, low
21	HS CAN 5 H	High Speed CAN channel 5, high
22	HS CAN 5 L	High Speed CAN channel 5, low
23	HS CAN 4 L	High Speed CAN channel 4, low
24	DNC	Do not connect
25	V BATT	DC Input Power

Table 21: neoVI FIRE 2 OBD Cable with DoIP Support DB-25 Connector Pinout.

### ***DB-9 Connector Pinout***

Table 22 contains the pinout for the DB-9 connector. Note that the LIN channel pins do not need to be used for DoIP Ethernet Activate on this cable, though they are electrically connected.

Pin #	Name	Description
1	LIN	LIN channel
2	DNC	Do not connect
3	DNC	Do not connect
4	LIN	LIN channel
5	GND	Ground
6	DNC	Do not connect
7	DNC	Do not connect
8	DNC	Do not connect
9	DNC	Do not connect

Table 22: neoVI FIRE 2 OBD Cable with DoIP Support DB-9 Connector Pinout.

### OBD-II / J1962 Connector Pinout

Table 23 shows the pinout for the OBD-II / J1962 connector on the cable.

Pin #	Name	Description
1	MS CAN H	Medium Speed CAN channel, high
2	DNC	Do not connect
3	ETH TX+	Ethernet transmit channel, positive
4	DNC	Do not connect
5	GND	Ground
6	HS CAN H	High Speed CAN channel, high
7	DNC	Do not connect
8	ETH ACTIVATE	Ethernet activation line
9	MS CAN L	Medium Speed CAN channel, low
10	DNC	Do not connect
11	ETH TX-	Ethernet transmit channel, negative
12	ETH RX+	Ethernet receive channel, positive
13	ETH RX-	Ethernet receive channel, negative
14	HS CAN L	High Speed CAN channel, low
15	DNC	Do not connect
16	VBATT	DC power input

Table 23: neoVI FIRE 2 OBD Cable with DoIP Support OBD-II / J1962 Connector Pinout.

### Cable Signal Mapping

Table 24 shows the mapping of signals for the *neoVI FIRE 2 OBD Cable with DoIP Support*, ordered by pin number on the HD-26 that connects to the *RAD Galaxy Ethernet Cable Adapter*.

Signal Name	Signal Description	HD-26 Pin #	DB-25 Pin #	DB-9 Pin #	OBD-II Pin #
ETH TX+	Ethernet transmit channel, positive	1			3
HS CAN 4 L	High Speed CAN channel 4, low	2	15		
HS CAN 5 L	High Speed CAN channel 5, low	3	6		
HS CAN 1 L	High Speed CAN channel 1, low	4			14
MS CAN L	Medium Speed CAN channel, low	5			9
HS CAN 2 L	High Speed CAN channel 2, low	6	17		
HS CAN 3 L	High Speed CAN channel 3, low	7	20		
HS CAN 6 L	High Speed CAN channel 6, low	8	4		
ETH TX-	Ethernet transmit channel, negative	9			11
GND	Ground	10	13	5	5
ETH RX+	Ethernet receive channel, positive	11			12
HS CAN 4 H	High Speed CAN channel 4, high	12	14		

Signal Name	Signal Description	HD-26 Pin #	DB-25 Pin #	DB-9 Pin #	OBD-II Pin #
HS CAN 5 H	High Speed CAN channel 5, high	13	5		
HS CAN 1 H	High Speed CAN channel 1, high	14			6
MS CAN H	Medium Speed CAN channel, high	15			1
HS CAN 2 H	High Speed CAN channel 2, high	16	16		
HS CAN 3 H	High Speed CAN channel 3, high	17	19		
HS CAN 6 H / SW CAN 2	High Speed CAN channel 6, high / Single Wire CAN channel 2	18	3		
V BATT	DC Input Power	19	25		16
ETH RX-	Ethernet receive channel, negative	20			13
HS CAN 7 L	High Speed CAN channel 7, low	21			
LIN	LIN channel (electrically connected to Ethernet activation line)	22	8	1, 4	8
DNC	Do not connect	23			
DNC	Do not connect	24			
ETH ACTIVATE	Ethernet activation line	25	8	1, 4	8
HS CAN 7 H / LSFT CAN 2 H / SW CAN	High Speed CAN channel 7, high / Low Speed Fault Tolerant CAN channel 2, high / Single Wire CAN channel 1	26	1		

Table 24: neoVI FIRE 2 OBD Cable with DoIP Support Signal Mapping.

## 6.8 Signal Flow Map for Attachment of RAD-Galaxy Ethernet Cable Adapter and neoVI FIRE 2 Ethernet Cable Adapter

The *RAD-Galaxy Ethernet Cable Adapter* and *neoVI FIRE 2 Ethernet Cable Adapter* are both somewhat complex due to the number of connectors and signals they use. Table 10 is intended to help make the signal flow across these connectors easier to understand. It shows a full mapping of signals from the RAD-Galaxy's CAN/MISC HD-26M connector when these two cables are attached. The color coding indicates the nature of the electrical connection (see legend that follows in Table 25).

RAD-Galaxy Signal Name	RAD-Galaxy Ethernet Cable Adapter				neoVI FIRE 2 Ethernet Cable Adapter			
	HD-26F Pin #	HD-26M Pin #	DB-9F Pin #	RJ-45F Pin #	HD-26F Pin #	HD-26M Pin #	DB-9F Pin #	RJ-45F Pin #
HS CAN 7 L	1	21			21	7		1
HS CAN 3 L	2	7			7	20		
HS CAN 4 L	3	2			2	23		
HS CAN 6 L	4	8			8	4		
HS CAN 1 L	5	4			4	15		
MS CAN L	6	5			5	6		
HS CAN 2 L	7	6			6	17		

RAD-Galaxy Signal Name	RAD-Galaxy Ethernet Cable Adapter				neoVI FIRE 2 Ethernet Cable Adapter			
	HD-26F Pin #	HD-26M Pin #	DB-9F Pin #	RJ-45F Pin #	HD-26F Pin #	HD-26M Pin #	DB-9F Pin #	RJ-45F Pin #
HS CAN 5 L	8	3			3	22		
AOUT 1	9		7					
GND	10	10	5		10	13	5	
HS CAN 7 H / SW CAN	11	26			26	1		
HS CAN 3 H	12	17			17	19		
HS CAN 4 H	13	12			12	18		
HS CAN 6 H / SW CAN 2	14	18			18	3		
HSCAN 1 H	15	14			14	14		
MS CAN H	16	15			15	5		
HS CAN 2 H	17	16			16	16		
HS CAN 5 H	18	13			13	21		
VBATT	19	19			19	25		
AOUT 2	20		8					
AOUT 3	21		9					
LIN	22	22, 25	1		22, 25	8	1, 4	
PWMIO/AIN 1	23		2					
PWMIO/AIN 2	24		3					
PWMIO/AIN 3	25		4					
PWMIO/AIN 4	26		6					
ETH TX+		1		1	1			1
ETH TX-		9		2	9			2
ETH RX+		11		3	11			3
ETH RX-		20		6	20			6

Table 25: Signal Flow Map for Attachment of RAD-Galaxy Ethernet Cable Adapter and neoVI FIRE 2 Ethernet Cable Adapter.

Color / Description
RAD-Galaxy CAN/MISC connector
Direct attachment to RAD-Galaxy CAN/MISC connector and RAD-Galaxy Ethernet Cable Adapter internal connection
RAD-Galaxy Ethernet Cable Adapter internal connection
RAD-Galaxy Ethernet Cable Adapter internal connection and mating to neoVI FIRE 2 Ethernet Cable Adapter
Mating to neoVI FIRE 2 Ethernet Cable Adapter and neoVI FIRE 2 Ethernet Cable Adapter internal connection
neoVI FIRE 2 Ethernet Cable Adapter internal connection

Table 26: Signal Flow Map Color Legend

## 6.9 Signal Flow Map for Attachment of RAD-Galaxy Ethernet Cable Adapter and neoVI FIRE 2 OBD Cable with DoIP Support

Table 27 shows the signal flow map when the *neoVI FIRE 2 OBD Cable with DoIP Support* is used instead of the *neoVI FIRE 2 Ethernet Cable Adapter*.

RAD-Galaxy Signal Name	RAD-Galaxy Ethernet Cable Adapter				neoVI FIRE 2 OBD Cable with DoIP			
	HD-26F Pin #	HD-26M Pin #	DB-9F Pin #	RJ-45F Pin #	HD-26F Pin #	DB-25M Pin #	DB-9M Pin #	OBD-II Pin #
HS CAN 7 L	1	21			21			
HS CAN 3 L	2	7			7	20		
HS CAN 4 L	3	2			2	15		
HS CAN 6 L	4	8			8	4		
HS CAN 1 L	5	4			4			14
MS CAN L	6	5			5			9
HS CAN 2 L	7	6			6	17		
HS CAN 5 L	8	3			3	6		
AOUT 1	9		7					
GND	10	10	5		10	13	5	5
HS CAN 7 H / SW CAN	11	26			26	1		
HS CAN 3 H	12	17			17	19		
HS CAN 4 H	13	12			12	14		
HS CAN 6 H / SW CAN 2	14	18			18	3		
HSCAN 1 H	15	14			14			6
MS CAN H	16	15			15			1
HS CAN 2 H	17	16			16	16		
HS CAN 5 H	18	13			13	5		
VBATT	19	19			19	25		
AOUT 2	20		8					
AOUT 3	21		9					
LIN	22	22, 25	1		22, 25	8	1, 4	8
PWMIO/AIN 1	23		2					
PWMIO/AIN 2	24		3					
PWMIO/AIN 3	25		4					
PWMIO/AIN 4	26		6					
ETH TX+		1		1	1			3
ETH TX-		9		2	9			11
ETH RX+		11		3	11			12
ETH RX-		20		6	20			13

Table 27: Signal Flow Map for Attachment of RAD-Galaxy Ethernet Cable Adapter and neoVI FIRE 2 OBD Cable with DoIP Support.

## 7 Support Contact Information

If you have a problem you cannot resolve on your own, feel free to contact ICS for assistance at one of our offices.

Note that problems with the device can sometimes be resolved through firmware updates, which are covered in Section 4.2.

### 7.1 ICS United States Headquarters

Our primary support personnel can be reached at our American headquarters in the Detroit area, 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.

### 7.2 ICS International Offices

#### *European Union Office*

For support in the EU, please contact Intrepid's Germany office:

- **Phone:** +49 721 6633703 -4.
- **Fax:** +49 721 6633703 -9.
- **Email:** [icsgermany@intrepidcs.com](mailto:icsgermany@intrepidcs.com)

#### *Japan Office*

Intrepid's office in Yokohama can be reached as follows:

- **Phone:** +81-(0)45- 263-9294.
- **Mobile Phone:** 080-8884-0111.
- **Fax:** 045-263-9296.
- **Email:** [kharukawa@intrepidcs.com](mailto:kharukawa@intrepidcs.com)

***Korea Office***

In Korea, use the following contact information:

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