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# **RAD-wBMS User Manual**

**ICS**

**Apr 20, 2023**

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**Note**

**FCC ID :** 2A923230117BMSE1

**IC ID :** 29961-230117BMSE1

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## **FCC/IC STATEMENTS**

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### **FCC Interference Statement**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference nearby equipment, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures.

- Reorient or relocate the product.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult Intrepid Control Systems, Inc. Customer Support.

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### **Note**

“Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.”

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### **RF Exposure**

To comply with FCC/IC RF exposure requirements for mobile transmitting devices, this transmitter should only be used or installed at locations where there is at least 20 cm separation distance between the antenna and all persons. Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This Device complies with Industry Canada License-exempt RSS standard(s). Operation is subject to the following two conditions:

1. this device may not cause interference, and
2. this device must accept any interference, including interference that may cause undesired operation of the device.

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### **RF Exposure**

Conformement aux normes d'Industrie Canada, ce transmetteur radio ne peut fonctionner qu'avec une antenne dont le type et le gain maximum sont approuvés par Industrie Canada. Pour réduire les risques d'interférences radio encourus par d'autres utilisateurs, le type et le gain de l'antenne doivent être choisis de façon que la puissance rayonnée isotrope équivalente (PIRE) ne soit pas supérieure à celle nécessaire pour établir une bonne communication. Cet appareil est conforme norme Industrie Canada RSS exempts de licence (s). Son fonctionnement est soumis aux deux conditions suivantes:

1. cet appareil ne doit pas provoquer d'interférences, et
  2. cet appareil doit accepter toute interférence, y compris les interférences pouvant provoquer un fonctionnement indésirable de l'appareil.
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## SAFETY AND OTHER IMPORTANT NOTICES

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### Safety Notices

1. Prior to using this product, read, understand, and follow the instructions for this device and any associated software. If you do not fully understand the instructions, contact [icssupport@intrepidcs.com](mailto:icssupport@intrepidcs.com) for support.
  2. Do not use this product if it has been used outside of the specified operating conditions or is suspected to be damaged.
  3. There are no operator serviceable parts inside this equipment. Should you suspect the device is not operating properly, please contact [icssupport@intrepidcs.com](mailto:icssupport@intrepidcs.com)
  4. The failure modes of this device should be carefully considered prior to using it to instrument safety critical systems. A single point of failure at this device should not prevent the safe operation of any vehicle system.
  5. Occasionally, hardware and software are released for testing and evaluation in a beta release. These releases are not subject to full Quality Assurance. They should be used only in a controlled environment with consideration of any impact the safety of the user and the surrounding people and environment. Data and test results from beta hardware and software should be appropriately scrutinized.
- 

### Intended Use

This hardware is intended for the use of developing automotive communication networks. It is suitable for operation in dry environments such as the passenger compartment or trunk area. Direct exposure to water or excessively damp environments may result in malfunction or damage to the device.

Deviating from the intended use of this product or operating outside of its specifications may cause malfunction or damage and will void the manufacturer's warranty.

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### Disclaimers

Every attempt is made to keep this documentation accurate and current. Intrepid Control Systems reserves the right to update this documentation without notice and assumes no liability from its use.

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## INTRODUCTION

Thank you for purchasing Intrepid Control Systems **RAD-wBMS**. You will find this a valuable tool for managing wireless and wired battery networks.



The RAD-wBMS is a state of the art battery cell measurement and network testing hardware using ADI's wBMS (Wireless Battery Management System) technology. The RAD-wBMS is an adaptor designed to interface between ADI's electric vehicle wBMS and legacy test platforms in a variety of use cases. It contains ADI's wBMS radios and isoSP™ interfaces (versions 1.1.1.5 and above) to control and configure the wireless and wired network components along with DW CAN-FD, 10/100Base-T and USB interfaces to connect to legacy test platforms.



## 3.1 Package Contents

Upon receipt, please remove, unwrap and inspect all its contents. If anything is missing or damaged, please contact Intrepid for prompt assistance. Contact information can be found at the end of this guide.

### General Device Specifications:

- 1 Year Limited Warranty
- Temperature ranges from -40°C to +85°C
- Dimensions: 5.41" × 3.43" × 1.43" (13.7 × 8.72 × 3.62 cm)
- Weight: 0.65 lb (295 g)
- ADI Wireless Interface Language (WIL) API (versions 1.1.1.5 and above)
- Royalty free configuration only version of Intrepid's Vehicle Spy 3 software

### 3.1.1 Hardware

Your package includes the following:

- RAD-wBMS - "E or P": Network Interface for ADI Wireless Battery Management System (ADI wBMS)
- CAT6-2: 4-pair Ethernet cable with RJ45 connectors, suitable for all 10/100 Mb/s conventional Ethernet applications
- IGRID-16-KIT: Cable and housing receptacle for isoSPI™ communication. iGrid Plug and Pin Kit, 16-position
- micro DB9 CABLE for adapting the micro DB9 to a standard DB9 connector, allowing easier access to the CAN networks and powering the RAD-wBMS
- USB-CABLE: USB 2.0 cable for interfacing with your RAD-wBMS
- 2x ANT-WIFI-MINI: Wi-Fi 2.4 GHz Miniature Antenna for use with RAD-wBMS and other WIFI products
- RAD-wBMS-E **FCC ID** 2A923230117BMSE1
- RAD-wBMS-E **IC ID** 29961-230117BMSE1

### 3.1.2 Software

Unless physical media was specifically requested, your box contains a reference card with instructions on where to download the device drivers and any other purchased software. If your media or reference card cannot be located, please contact Customer Support.

## 3.2 Operational Overview

A RAD-wBMS is used to monitor battery networks. This device includes a wireless cell monitoring controller (wCMC) unit for each battery module, and a wireless manager unit to control the communications network, which connects multiple battery modules wirelessly to the ECU.

### 3.2.1 Monitor Mode

The RAD-wBMS can be used as a receiver to receive data from up to 24 wBMS Nodes (12 cells per Node). The device can then send this data to a computer to view in Vehicle Spy. Additionally, the RAD-wBMS can be used to monitor traffic on two DW CAN / CAN FD channels. The RAD-wBMS's CoreMini can run scripts and playback from within the RAD-wBMS

### 3.2.2 Playback Mode

The RAD-wBMS comes built in with CoreMini that can run scripts and playback traffic from within the RAD-wBMS. In future versions of Vehicle Spy 3, scripts can be created using metrics from ADI's Wireless Interface Language (WIL).

The RAD-wBMS's storage uses EEPROM rather than an SD Card. EEPROM is a type of Read Only Memory (ROM) that can only be modified by a computer connected to the RAD-wBMS. The RAD-wBMS cannot change what is stored on its memory. Therefore, the RAD-wBMS does not support Standalone logging. Instead, the RAD-wBMS supports the use of adding, running, erasing, and reprogramming of a Script. A Script is loaded onto the RAD-wBMS through Vehicle Spy; however, the device does not need to be connected to Vehicle Spy 3 to run the Script.

## 3.3 Hardware Requirements

### 3.3.1 Device Power

Your device can be powered in multiple ways:

#### **USB**

The RAD-wBMS's power consumption is minimal, so it will automatically be powered by the USB-2.0 port when plugged into your computer. This device has a max rating of 30VAC and 1.5A.

#### **micro DB9 Connector**

The RAD-wBMS can be powered through power received on the VBATT channel of the micro DB9 port. See 3.3.3.

### 3.3.2 Computer Interface

Connection to a computer is needed both for RAD-wBMS configuration and monitoring. In future versions of Vehicle Spy, a computer will also be used for features included with Intrepid's API.

You can connect to the RAD-wBMS using the USB 2.0 port or the Ethernet port. Note that the RAD-wBMS must be powered by USB-2.0 or micro DB9 when using Ethernet to interface with the device.

## A TOUR OF RAD-WBMS HARDWARE

Let's now take a short tour of the RAD-wBMS hardware. 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 setup comes easier. Then, you will be ready to configure and use your device.

### 4.1 Case Design

The RAD-wBMS 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 (-40°F to 185°F).

Connectors and ports are often a point of failure with hardware devices. To ensure that the RAD-wBMS 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, the RAD-wBMS has green-colored 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.

The bottom of the RAD-wBMS contains useful reference information, including the device serial number, pinouts of its wBMS SPI port and Intrepid's contact information.

## 4.2 Left Side Interfaces and Connectors

The left side of the RAD-wBMS contains 3 components:



- RF-1 socket (left)
- isoSPI™ interface (middle)
- RF-2 socket (right)

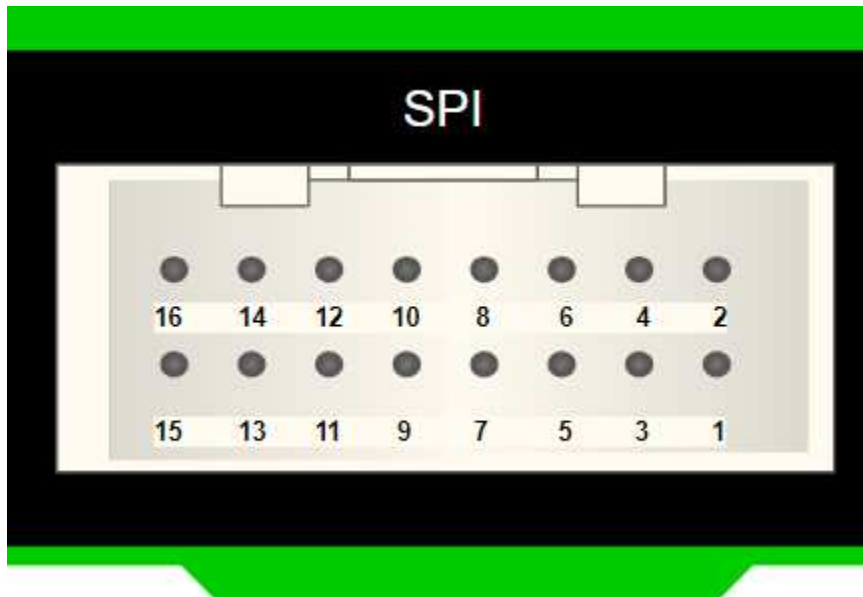
### 4.2.1 isoSPI™ Interface

This port holds a Molex connector receptacle (Molex Part No. 5016461600) to interface with isoSPI™. The connector receptacle measures 18mm x 11.05mm x 8.2mm, and the pinout can be found below. In addition, Crimp terminals are 2.00mm Pitch, iGrid Female Crimp Terminal, Tin (Sn) Plating, 22-26 AWG, Reel (Molex Part No. 5016471000)

SPI is a synchronous, full duplex, main-subNode-based interface which is used to connect to a wired Battery Node network. IsoSP™ consists of two isolated bidirectional SPI communication channels through a single-twisted pair connection which creates network redundancy.

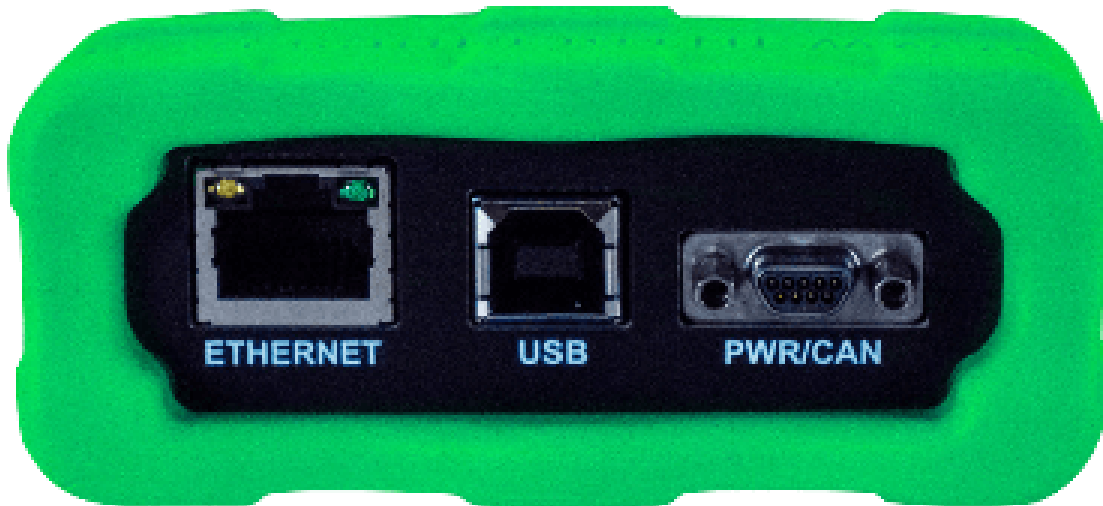
#### **RAD-wBMS SPI Pinout:**

1	No Connection (NC)	2	No Connection (NC)
3	No Connection (NC)	4	isoSPI™ 02H
5	No Connection (NC)	6	isoSPI™ 02L
7	No Connection (NC)	8	No Connection (NC)
9	No Connection (NC)	10	No Connection (NC)
11	No Connection (NC)	12	isoSPI™ 01H
13	No Connection (NC)	14	isoSPI™ 01L
15	No Connection (NC)	16	No Connection (NC)



### 4.3 Right Side Interfaces and Connectors

The right side of the RAD-wBMS contains 3 components:



- RJ45 (Ethernet) Port (left)
- USB 2.0 Interface (middle)
- Micro DB-9 Connector (right)

### 4.3.1 RJ45 (Ethernet) Port

The RAD-wBMS has one Megabyte Ethernet (10/100Base-TX) port. Ethernet is used to interface with your computer, DoIP, XCPoE and more. The Ethernet port also has an LED at the top left and top right corner.

#### **Orange Activity LED (Top Left)**

This LED flashes when traffic is passing in either direction over the attached Ethernet cable. If no traffic is passing through the cable, the LED will not light up.

### Green Link LED (Top Right)

This LED indicates that a valid link has been established between your device and another 10/100 Ethernet device. If this LED does not light up, there is either an invalid connection with the wire or the Ethernet port may be dysfunctional, contact Intrepid support if needed.

### 4.3.2 USB 2.0 Interface

This USB port serves as the connection to a host computer for configuration, data transfer, and power. The RAD-wBMS has an isolated USB 2.0 (240Mb/s) interface. This port is used to connect the RAD-wBMS to a computer for configuration and monitoring.

### 4.3.3 Micro DB-9 Connector

This port allows the RAD-wBMS to transmit and receive messages on two CAN/CAN-FD channels. The pinout is listed below and can also be found on the back of the RAD-wBMS.

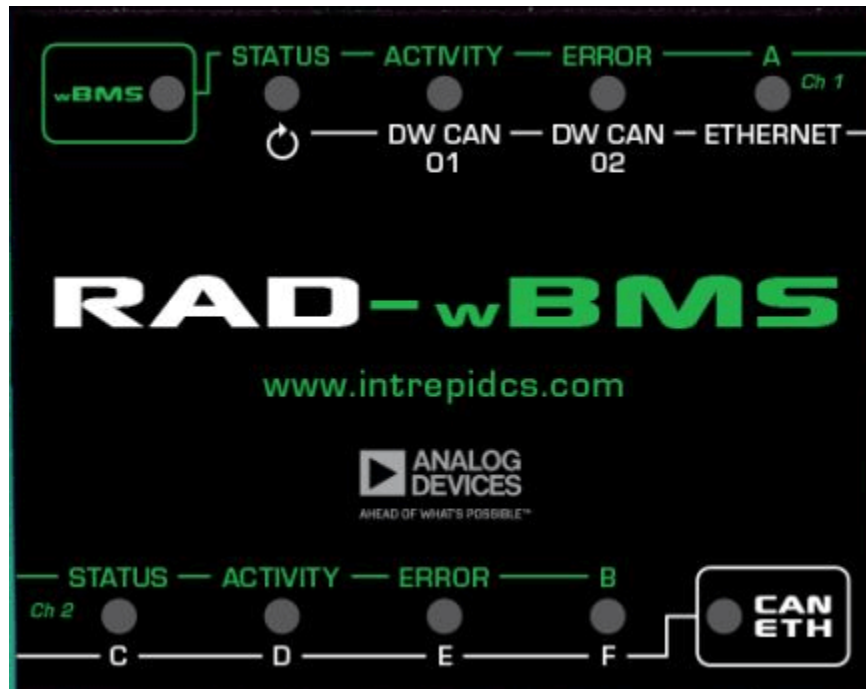
#### RAD-wBMS Micro DB-9 Pinout:



1	No Connection (NC)
2	DW CAN 01L
3	Do Not Connect (DNC)
4	DW CAN 02 L
5	CHASSIS GND
6	Ground (GND)
7	DW CAN 01 H
8	DW CAN 02 H
9	Vehicle Battery (VBATT)



## 4.4 Membrane LED Display and Keypad



The membrane contains 10 LEDs that provide immediate visual feedback about the status of the device, and two keypad buttons that can be used to toggle the indicator mode and for other functions.

### Keypad Buttons and LEDs

There are two keypad buttons on the RAD-wBMS's top membrane: one that says wBMS in green near the top left, and one that says CAN ETH in white near the bottom right. Pressing either button changes the meaning of the 8 LEDs. Whichever button's LED is flashing signifies the meaning of the other 8 LEDs.

#### 4.4.1 wBMS (Green Button)

When pressed, "activates" the green set of LED labels: each LED corresponds to the green label above the LED. The meanings of the labels are described below from left to right, top to bottom.

The LED above wBMS the button flashes white when the white labels are selected and the RAD-wBMS is offline. The LED alternates between green and blue when the blue labels are selected and the RAD-wBMS is online signifying that the RAD-wBMS is ready to receive and transmit messages.

Label	Description
wBMS	<ul style="list-style-type: none"> <li>• <b>Flashing Orange</b> when the Green set of labels is “activated” (See above) but the RAD-wBMS is not connected to a computer</li> <li>• <b>Flashing White</b> when the Green set of labels is “activated” (See above) and the RAD-wBMS is connected to a computer but offline in Vehicle Spy 3</li> <li>• <b>Alternating Blue and Green</b> when the Green set of labels is “activated” (See above) and the RAD-wBMS is online in Vehicle Spy 3</li> <li>• <b>Flashing Magenta</b> when the Blue set of labels is “activated” and the RAD-wBMS is running but not connected to a computer (standalone)</li> <li>• <b>Off</b> when the CAN ETH button is flashing. If neither LED is flashing, the device is not powered</li> </ul>
Status	<ul style="list-style-type: none"> <li>• <b>Solid Green</b> Connected to Managers and all the nodes are connected in the ACL (see 4.2.2.6)</li> <li>• <b>Solid Orange</b> Connected to Managers but still waiting for all nodes to connect in the ACL</li> <li>• <b>Solid Red</b> Failed to connect to managers</li> <li>• <b>Off</b> WIL is not Initialized</li> </ul>
Activity	<ul style="list-style-type: none"> <li>• <b>Flashing Orange [Slow Blink]</b> when the RAD-wBMS is connected to the first Manager and network is set to Standby</li> <li>• <b>Flashing Blue [Short Pulse]</b> when connected to first Manager and network is set to Commissioning</li> <li>• <b>Flashing Green [Fast Blink]</b> when connected to first Manager and network is set to Active</li> <li>• <b>Flashing Pink [Mid Blink]</b> when the network is in monitoring mode</li> <li>• <b>Off</b> when not connected to the Managers</li> </ul>
Error	<ul style="list-style-type: none"> <li>• <b>Solid Red</b> a Fault was reported from the WIL or Managers where not able to connect successfully</li> <li>• <b>Off</b> WIL is not Initialized or no errors</li> </ul>

A	General purpose, user-programmable
Status	<ul style="list-style-type: none"> <li>• <b>Solid Green</b> Connected to Managers and all the nodes are connected in the ACL (see 4.2.2.6)</li> <li>• <b>Solid Orange</b> Connected to Managers but still waiting for all nodes to connect in the ACL</li> <li>• <b>Solid Red</b> Failed to connect to managers</li> <li>• <b>Off</b> WIL is not Initialized</li> </ul>
Activity	<ul style="list-style-type: none"> <li>• <b>Flashing Orange [Slow Blink]</b> when the RAD-wBMS is connected to the first Manager and network is set to Standby</li> <li>• <b>Flashing Blue [Short Pulse]</b> when connected to first Manager and network is set to Commissioning</li> <li>• <b>Flashing Green [Fast Blink]</b> when connected to first Manager and network is set to Active</li> <li>• <b>Flashing Pink [Mid Blink]</b> when the network is in monitoring mode</li> <li>• <b>Off</b> when not connected to the Managers</li> </ul>
Error	<ul style="list-style-type: none"> <li>• <b>Solid Red</b> a Fault was reported from the WIL or Managers where not able to connect successfully</li> <li>• <b>Off</b> WIL is not Initialized or no errors</li> </ul>
B	General purpose, user-programmable

#### 4.4.2 CAN ETH (White Button)

When pressed, “activates” the white set of LED labels: each LED corresponds to the white label below the LED. The meanings of the labels are described below from left to right, top to bottom.

The LED above the button flashes white when the white labels are selected and the RAD-wBMS is offline. The LED alternates between green and blue when the white labels are selected and the RAD-wBMS is online signifying that the RAD-wBMS is ready to receive and transmit messages.


##### LED Color Meanings

For networks, different colors indicate different statuses:

- **Green:** Device is transmitting messages on this channel.
- **Blue:** Device is receiving messages on this channel.
- **Red:** Device is detecting errors on this channel.

It is possible for more than one LED component to be lit, producing the following results:

- **Green+Blue (Cyan):** Device is transmitting and receiving on this channel.
- **Green+Red (Yellow):** Device is transmitting and detecting errors on this channel.
- **Blue+Red (Magenta):** Device is receiving and detecting errors on this channel.
- **Green+Blue+Red (White):** Device is transmitting, receiving and detecting errors on this channel.

Label	Description
CAN ETH	<ul style="list-style-type: none"> <li>• <b>Flashing Orange</b> when the White set of labels is “activated” (See above) but the RAD-wBMS is not connected to a computer</li> <li>• <b>Flashing White</b> when the White set of labels is “activated” (See above) and the RAD-wBMS is connected to a computer but offline in Vehicle Spy 3</li> <li>• <b>Alternating Blue and Green</b> when the White set of labels is “activated” (See above) and the RAD-wBMS is online in Vehicle Spy 3</li> <li>• <b>Flashing Magenta</b> when the White set of labels is “activated” and the RAD-wBMS is running but not connected to a computer (standalone)</li> <li>• <b>Off</b> when the wBMS button is flashing. If neither LED is flashing, the device is not powered</li> </ul>
	CoreMini Script active
DW CAN 01	Status of CAN Channel 1, see above
DW CAN 02	Status of CAN Channel 2, see above
Ethernet	Status of Ethernet Channel, see above
C	General purpose, user-programmable
D	
E	
F	

### 4.4.3 Miscellaneous LED Indicators

- Depending on which set of labels is “selected”, that button’s LED will flash yellow when the RAD-wBMS is connected to power but not a computer
- The aforementioned button will flash white once the RAD-wBMS is offline and has successfully connected to power and a computer
- All 10 buttons will be solid red when the RAD-wBMS is in bootloader mode
- When entering bootloader mode, the RAD-wBMS’s 5 LEDs on the top and bottom row will alternate flashing Green, once the device has begun reflashing, the LEDs will be solid Red. After the RAD-wBMS has finished flashing firmware, the device will reconnect to the computer. For more information on updates see 5.3.3

## RAD-WBMS SETUP

### 5.1 Vehicle Spy 3 Overview

Your RAD-wBMS has arrived with the software necessary to use it. If the media containing this software is no longer available, the software can be found at the following link.

All necessary drivers are installed with the Vehicle Spy installation. If you do not intend to use Vehicle Spy, you will have to install a package containing the necessary drivers. This same package will also install support files to allow the hardware to be accessed through APIs hosted here:

In order to use Vehicle Spy 3, a license must be purchased for each device you wish to use. Unlike most licenses, Vehicle Spy licenses are perpetual, meaning you can use them forever. Once the maintenance on your license expires, you will no longer be able to update Vehicle Spy. However, you can renew maintenance on your license to continue receiving new features and bug fixes in later versions.

If you are having trouble finding or installing the software, please contact our customer support at [icssupport@intrepidcs.com](mailto:icssupport@intrepidcs.com)

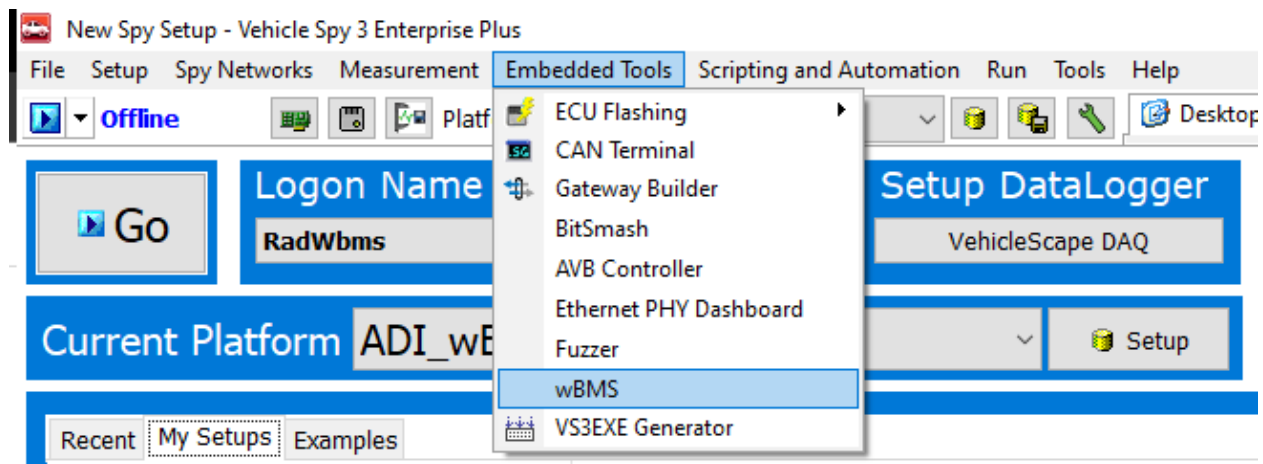
#### 5.1.1 Wired vs Wireless Connection

Your RAD-wBMS can be used in two different ways: connecting to a wired Node and connecting to a wireless Node. In neoVI explorer, you can change how you wish to connect to the Node. If you would like to know more about neoVI explorer see Section 5.5.5.

When connecting to the Node using the isoSPI™ interface (wired connection), ensure that **External (isoSPI™)** is selected in the wBMS Bridge page in neoVI Explorer. When connecting to the Node using wBMS (wireless connection), ensure that **OnBoard** is selected. Make sure to **Write Settings** after making any changes to the RAD-wBMS settings.



### 5.1.2 wBMS Embedded Tool



In Vehicle Spy 3, there is a tool dedicated to interfacing with your RAD-wBMS. On this page, there are three tabs: Network Topologies, ACL Configuration, and Load Files. However, this tool is not available to all users. This tool is hidden until a RAD-wBMS license file is loaded into Vehicle Spy 3. After adding your license file to

#### C:\IntrepidCS\Vehicle Spy 3\Licenses

Vehicle Spy 3 needs to be restarted for the tool to appear. Brief descriptions of each page on the wBMS Embedded Tool are included below:

## Network Topologies

This tab contains information about each Node connected to the RAD-wBMS. This information includes:

<b>Connected</b>	CoreMini Script active
<b>MAC Address</b>	Status of CAN Channel 1, see above
<b>Total Voltage</b>	Status of CAN Channel 2, see above
<b>RSSI</b>	Status of Ethernet Channel, see above
The following data sections will be supported in future versions of Vehicle Spy 3:	
<b>PDR</b>	The Packet Data Rate (PDR) calculates the number of packets received per second
<b>Container Type</b>	What is loaded on the Nodes (i.e. the RAD-wBMS)
<b>Faults</b>	Counts the number of new issues that occur on the network

## ACL Configuration

This page is used to configure the Access Control List (ACL). Here, you can edit the list of MAC addresses of Battery Nodes that the RAD-wBMS will attempt to connect to

## Load Files

This page is used to communicate with onboard and external managers. Here, you can load configuration files to and download logs from the managers the RAD-wBMS is connected to.



## 5.2 RAD-wBMS Setup Directions

### Initial Configuration

The RAD-wBMS requires some configuration in neoVI Explorer before it is ready to connect with battery cells. For more information on neoVI Explorer, see Section 5.

1. Open neoVI Explorer by clicking the Setup Hardware icon



2. On the General Settings tab, verify the firmware version is up to date. If the firmware is out of date, it will be listed in red; however, a firmware version that is up to date will be listed in black

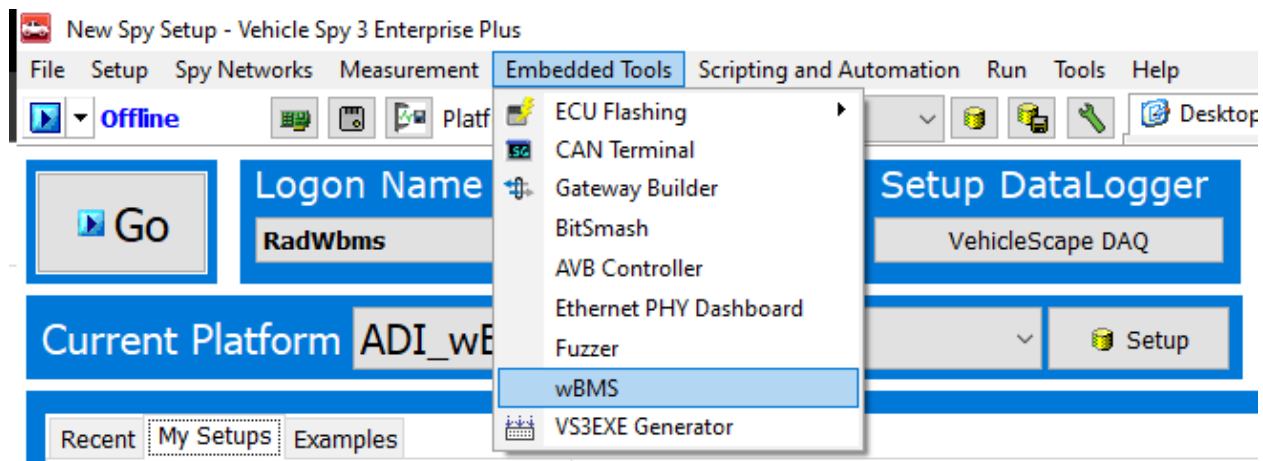


3. On the wBMS Bridge/SPI Configuration tab, ensure the correct Manager SPI Switch for whether you're connecting to a Wireless or Wired Battery Node. (See 4.2.1 for more information)

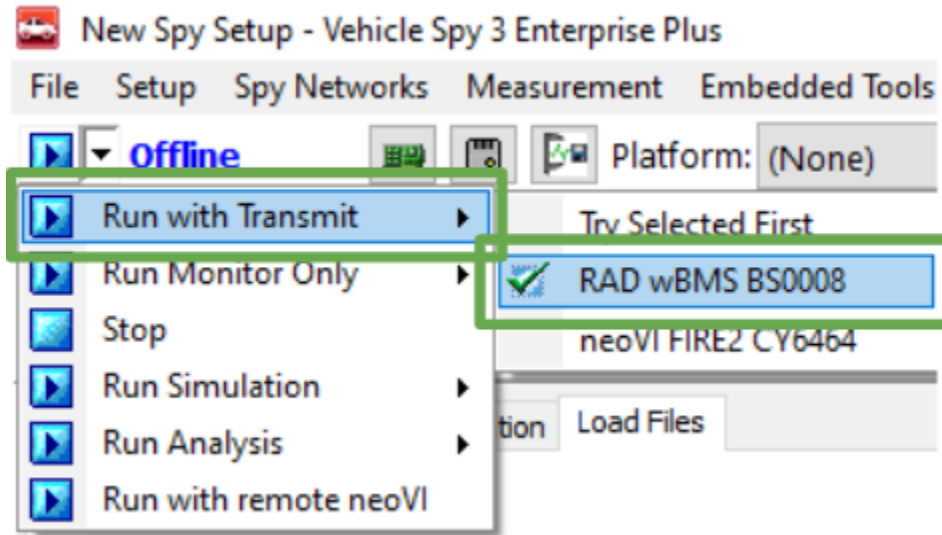


### Configuring Manager(s)

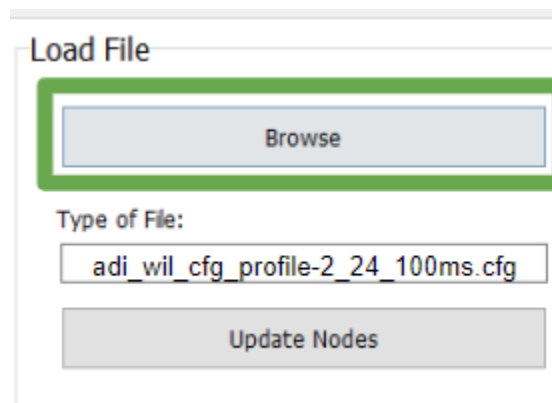
1. Open the wBMS tool. Go to Embedded Tools -> wBMS. If the wBMS tool does not appear, see 4.1.3.



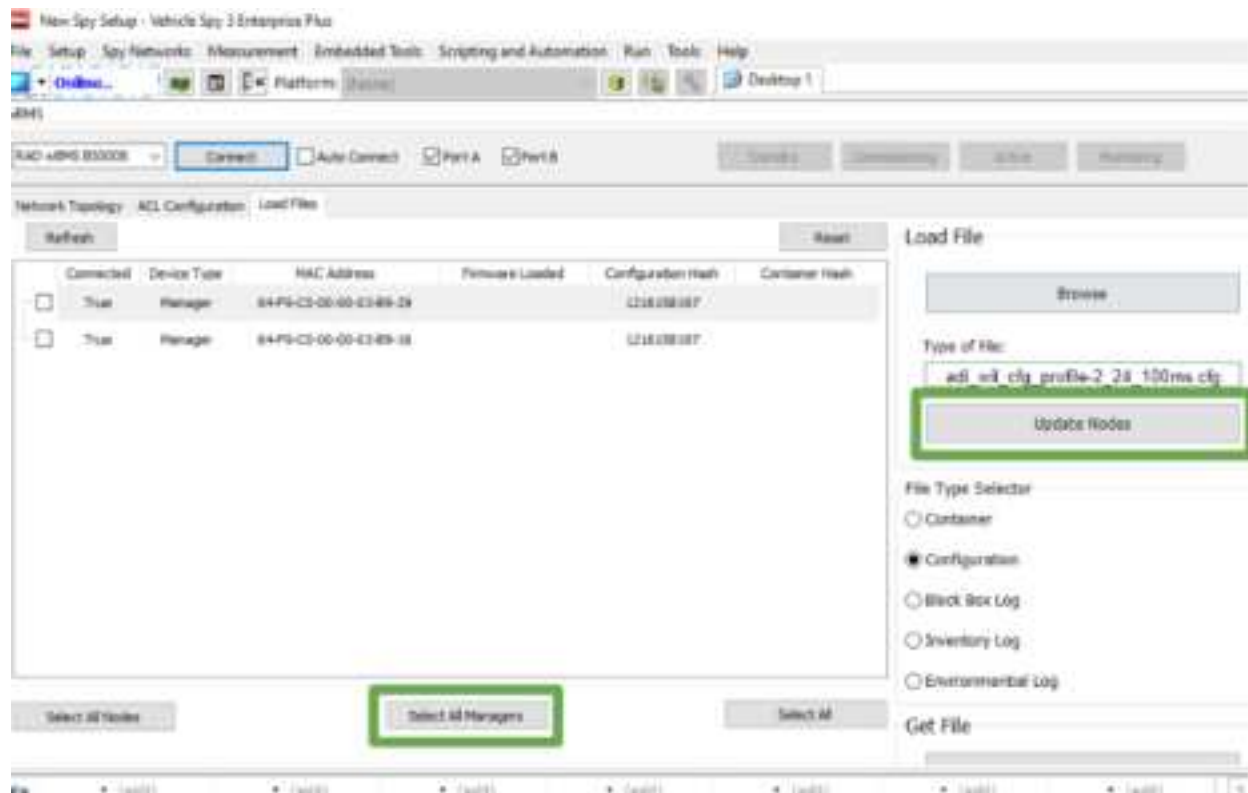
2. Some information (i.e. the bit rate) must be provided to the Managers in order to function. Information like this is provided in configuration files (.cfg) that are loaded to the Managers. Open the Load Files tab and follow the directions below to load the configuration file
3. To establish communication with the RAD-wBMS, Vehicle Spy 3 must be online with the RAD-wBMS. **Run with Transmit** and ensure the RAD-wBMS is selected



4. On the Load Files tab, your RAD-wBMS can be selected using the dropdown menu while Vehicle Spy 3 is online. Ensure that you are connected by confirming you are connected to the managers.
5. All discovered Managers (Onboard or External depending on Manager SPI Switch setting) will be listed with Configuration Hash 0
6. Now, we will load a new configuration file. You can use the provided file, `adi_wil_cfg_profile-2_24_100ms.cfg`, or use ADI's free configuration tool to configure your Managers as desired
7. Click **Browse** and select the desired configuration file



8. Set the **File Type Selector** to Configuration
9. Click **Select All Managers**
10. Click **Update Nodes**

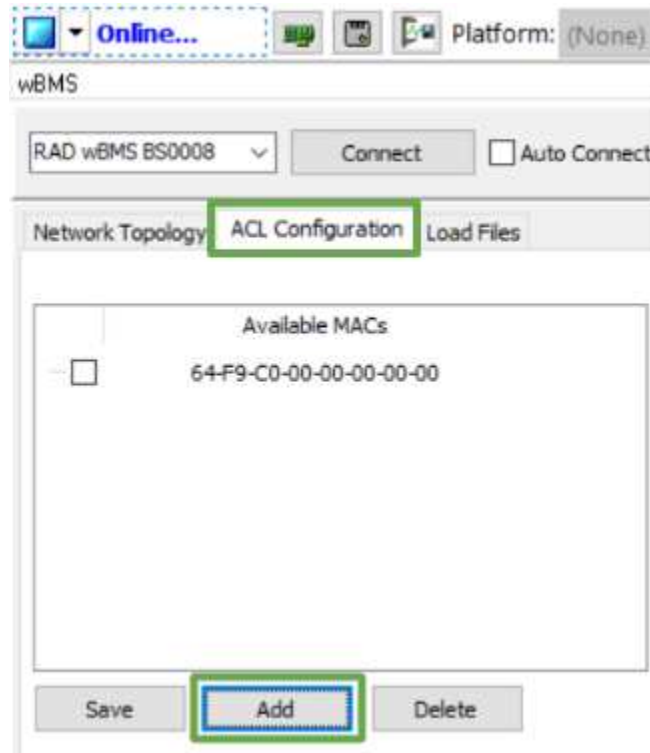


11. The Configuration Hash on existing managers will update based on the configuration once the Nodes have been updated
12. In some cases, Vehicle Spy may need to be restarted after updating the configuration for the existing managers to update

## Adding Nodes

The Access Control List (ACL) is configured to tell your RAD-wBMS which Nodes to connect to. The RAD-wBMS can connect to up to 24 Nodes with up to 12 cells in each Node.

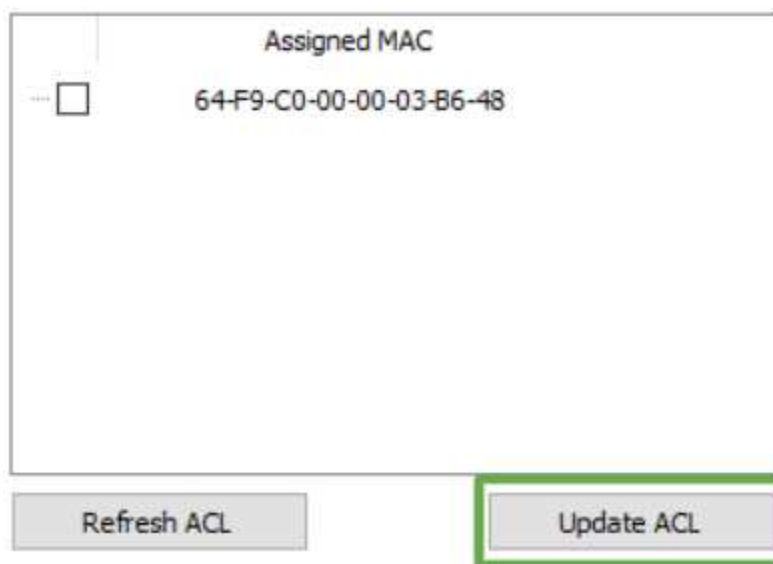
1. Under the ACL Configuration tab, click **Add**



2. A MAC address will appear which has the first three bytes (OUI) of the MAC filled in, and the remaining bytes filled in with zeroes. For the RAD-wBMS-E, the OUI will be 64-F9-C0 (Analog Devices's OUI), but for the RAD-wBMS-P, the OUI will match the OUI for your OEM. Fill in the remaining bytes to match the MAC address found on the Battery Node
3. Do this for all Battery Nodes you wish to connect to
4. Click >> to move the address to Assigned MAC



5. Click **Update ACL**. This sends the Assigned MACs in the ACL to the Managers



6. Under the Load Files tab, the MAC address will be displayed as a Node. The RAD-wBMS's Current Network Mode is Standby, so Connected will be False for the added Node
7. Finally, click Connect and allow up to 90 seconds for the managers to connect to the Nodes

### Connecting to Battery Nodes

Once Battery Nodes have been added to the Access Control List, you can connect to them by choosing one of three connecting modes:

#### Commissioning

This mode is used to connect to a Node for the first time. After Commissioning, the Node will automatically be connected

#### Active

This mode is used to connect to Nodes and receive the data that is being transmitted

Monitoring

This mode is like Active; however, it is optimized for monitoring Nodes over a long period of time (i.e. days or weeks)



Note

In order to access other Modes (i.e. Commissioning or Monitoring), the RAD-wBMS must first be in Standby Mode. This is why the Mode defaults to Standby each time the RAD-wBMS is connected

## THE NEOVI EXPLORER CONFIGURATION UTILITY

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### Note

No firmware changes will modify the settings parameters of the device radios

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The neoVI Explorer utility allows you to connect, manage and configure all of your Intrepid Control Systems hardware. 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 your device.

## 6.1 Starting and Using neoVI Explorer

The neoVI Explorer utility is available as an integrated feature of Vehicle Spy, and as a standalone program.

### 6.1.1 Starting neoVI Explorer from within Vehicle Spy

There are several ways to open neoVI Explorer from within Vehicle Spy 3. These are the most common ways since they are accessible at all times:

- **Menu Item:** At the top menu bar, under Setup, select Hardware
- **Setup Hardware Button:** Click the button located in the main Vehicle Spy toolbar just under its menu (Figure below).



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### Note

neoVI Explorer cannot be launched when Vehicle Spy is online (even 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.

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## 6.1.2 Starting NeoVI Explorer as a Standalone Program

If you want to work with your device without opening Vehicle Spy, you can launch neoVI Explorer directly. neoVI Explorer is installed when you download Vehicle Spy 3 and is located at

C:\Program Files (x86)\Vehicle Spy 3\neoVI3GExplorer.exe

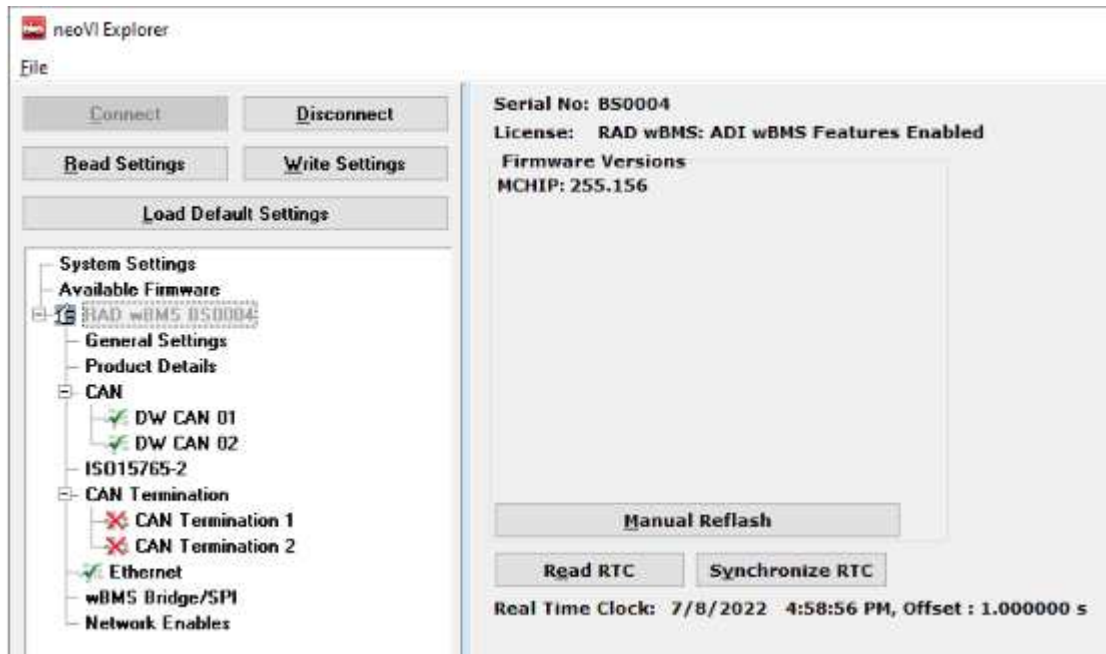
## 6.2 Using neoVI Explorer

### 6.2.1 Connecting to Your Device

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 device listed here, along with its serial number. If you don't see the device you wish to connect to, but 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 there is a problem with the USB connection. After double checking your setup, click **Search For Devices** located at the bottom of the device selection panel. Sometimes it may take a few seconds for your device(s) to register.

To manage your device, click on its entry in the navigation pane (if it is not already highlighted) and then select **Connect**. After successfully connecting to the device, you will see a "thumbs up" icon next to the device's name, and check marks 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 "<Your Device and Serial Number> settings have been read". This tells you that neoVI Explorer has loaded the current settings from the unit.

The screen as a whole should appear similar to the screen shown below (but note that the device and version number shown below may be different).



## 6.2.2 Device Configuration

### Writing and Reloading Settings

To avoid potential problems, neoVI Explorer will not save any changes to device parameters unless you instruct it to do so. This is done by clicking **Write Settings** which will update the parameters within the firmware in your device. If you make changes you do not want to keep, click **Read Settings** to reload the settings stored in the device which will undo any modifications made in neoVI Explorer that had not yet been written.

### Reloading Device Default Settings

To return all settings to factory defaults, click **Load Default Settings**. This is convenient if many changes have been made, and you want to start over. Note that clicking this button loads and saves the settings, so you do not need to click **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 device

Click **Disconnect** to tell neoVI Explorer that you are done working with the device. This step is optional, because neoVI Explorer will disconnect from any connected devices when you exit the program.

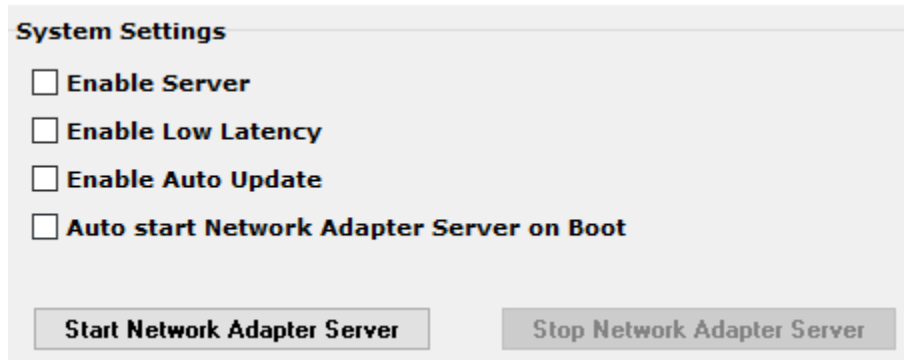
### Exiting neoVI Explorer

You can close neoVI Explorer by clicking the “X” in the top right corner, or by pressing Alt+F4 on Windows.

## 6.3 System Settings and Firmware Updates

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

### 6.3.1 System Settings



In the top branch of the tree in the left pane of neoVI Explorer you will see several settings that you can enable or disable.

#### 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 each device's firmware. If this box is not checked, firmware must be updated manually. (See 5.3.3 for more details about updates)

#### Network Adapter Server

This is a feature that is used with Intrepid products having Ethernet ports. With this feature enabled, the Ethernet ports on your RAD-wBMS will enumerate as network interfaces in the operating system of your host computer. This server can be started and stopped in this window. There is also a checkbox to configure the server to start after booting your computer.

### 6.3.2 Available Firmware

This is an informational page that shows which firmware versions are available in this version of neoVI Explorer for various Intrepid products. Note that some devices have multiple firmware programs that control different aspects of their operation; You normally won't need to look in this area, because as we'll see in the next section, neoVI Explorer shows you the current and available firmware versions for your device when you connect to it.

### 6.3.3 Automatic and Manual Firmware Updates

Essentially, firmware is the software that runs hardware and is required to enable many capabilities of your device. 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 recommended—then you don't need to worry about firmware updates. Each time you connect to your device 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 automatically 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. Simply click **Manual Reflash** to update the firmware.

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#### Warning

While your device may appear to operate with incompatible firmware, proper and reliable operation cannot be guaranteed unless the version of firmware matches what is listed in Vehicle Spy

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### 6.3.4 Bootloader Mode

When an Intrepid device enters bootloader mode, all firmware is removed from the device. This can occur when power is removed during a firmware update or, in future versions of Vehicle Spy 3, can be activated by simultaneously pressing and holding the wBMS and CAN ETH buttons.

To exit bootloader mode, firmware must be loaded onto your RAD-wBMS. Plug your device into your computer, select the device, and click **Connect**. If the device does not appear in the left panel, click Search For Devices This will refresh the devices pane and **search for your device**. If the device still does not connect, a fault may have been caused in the hardware. If the device connects but does not begin reflashing, check the messages box to see if any errors occurred.

If assistance is needed for this situation please contact Intrepid's support department, you can find information regarding how to contact support at the end of this manual or on the back of your device.

### 6.3.5 The Firmware Update Process

During the firmware update process, the device will be placed into bootloader mode, indicated by all LEDs on the top label flashing synchronously. Normal LED flash patterns will resume when the update is complete and the device reconnects. You will see a dialog box on the screen showing you the progress of the firmware update operation. You will also see messages in the message box on the right side of neoVI Explorer as the 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 device's firmware, please contact Intrepid for assistance.

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#### Warning

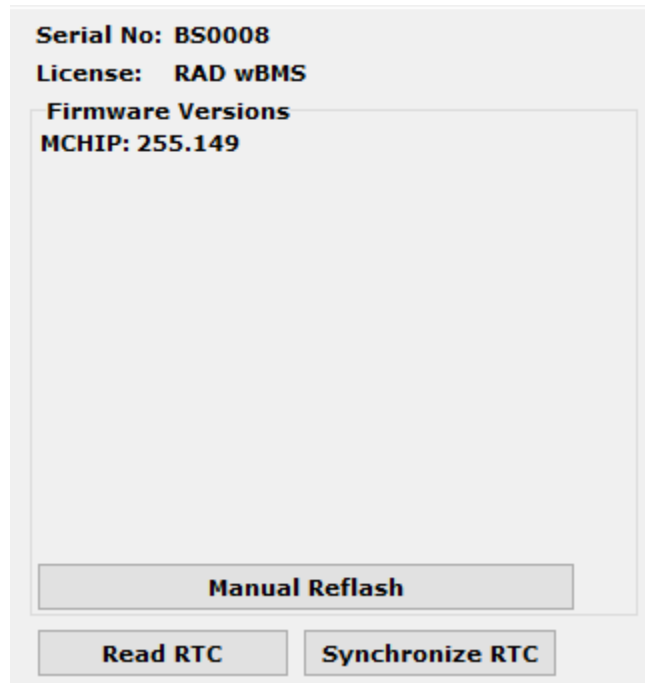
Please take heed of the warning on the firmware update dialog box: leave the device connected and powered on for the entire firmware update process to avoid possible problems with the device.

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## 6.4 General Settings and Product Details

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

### 6.4.1 General Settings



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

- 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 device's real-time clock.

This information can be displayed again at any time by clicking the device's name in the explorer navigation window.

The version(s) of the firmware for the device 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 notify you that an update is available. (See 5.3.3. for more information about the update process).

There are three buttons on this screen:

#### **Manual Reflash**

See 5.3.3.

#### **Read RTC**

Display the internal clock on the RAD-wBMS

#### **Synchronize RTC**

Set the device's clock to the same value as that of the PC

## 6.4.2 Product Details

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

## 6.5 RAD-wBMS Port Configurations

This section provides information about neoVI Explorer settings specific to the RAD-wBMS.

### 6.5.1 CAN

RAD-wBMS has 2 channels of CAN/CAN-FD, where two of those are dedicated to ISO 11898 Dual wire CAN physical layers (TJA1043T). ISO 11898 is considered high speed, real time control and multiplexing for use cases of road vehicles. The software is switchable between ISO CAN FD and non-ISO CAN-FD versions. You can make these changes after connecting to the device through neoVI Explorer.

This area of neoVI Explorer is used to enable, disable and configure the two standard dual wire CAN networks in the RAD-wBMS. 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.

*DW CAN 01/CAN 02*

The screenshot displays the configuration interface for two CAN channels. On the left, the 'DW CAN 01' section has a checked 'Enabled' box, a 'Specify by Baud' checkbox, a 'Baud Rate' dropdown set to '500000', and a 'Bit Rate Calculator' button. Below these are input fields for 'TQ SEG1' (63), 'TQ SEG2' (16), 'TQ Prop' (0), 'Sync' (16), 'BRP-1' (1), and a note '(Clock is 80 MHz)'. The 'Mode' dropdown is set to 'Normal'. On the right, the 'CAN FD' section has a checked 'Enabled' box, a checked 'ISO' box, a 'Baud Rate' dropdown set to '2000000', and input fields for 'TQ SEG1' (15), 'TQ SEG2' (4), 'TQ Prop' (0), 'Sync' (4), 'BRP-1' (1), and 'TDC' (32).

#### 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).

#### 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 and CAN FD Baud Rate drop-down boxes are enabled and the various 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:

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

#### Bit Rate Calculator

Click this button to launch the Intrepid Bit Timing Calculator

#### CAN FD

##### Enabled

Check this box to enable CAN FD on the RAD-wBMS. This enables the RAD-wBMS to automatically adjust message size and transmission rates. This should be enabled for CAN FD-supported ECU's

##### ISO

ISO is used in CAN FD to increase robustness in the network by verifying messages that are sent and received. ISO is enabled by default and should only be disabled in special cases

##### 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

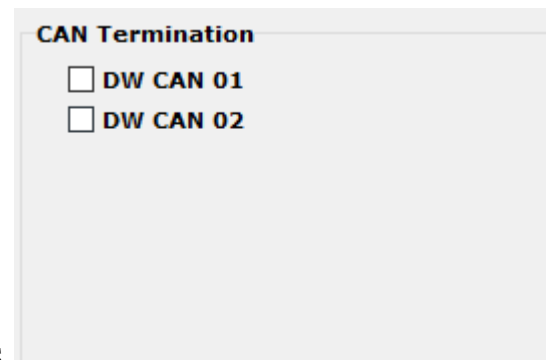
##### Timing Settings

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

## 6.5.2 ISO 15765-2

This value is added to the received Inner Frame Spacing for USDT frames transmitted from CoreMini. This is a shift amount where each increment represents 6.4 $\mu$ s.

## 6.5.3 CAN Termination

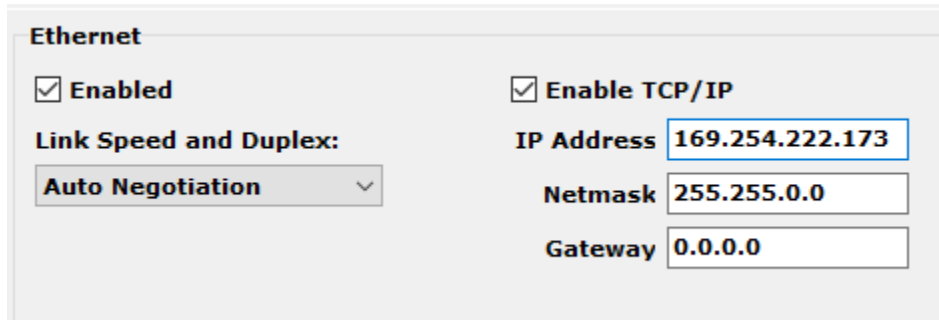


CAN Termination is a built-in feature included with your RAD-wBMS.

You can select CAN Termination for DW CAN 01 (CAN Channel 1) or DW CAN 02 (CAN Channel 2) to have the

RAD-wBMS include the 120Ω resistors needed for CAN in your circuit.

## 6.5.4 Ethernet



The Rad-wBMS has a 100 megabit Ethernet capable of 10/100Base-TX that is used with DOIP, XCPoE and more.

### Enabled

When checked, Enabled means that data can be transmitted and received on the Ethernet port

### Link Speed and Duplex

Only for advanced users, Vehicle Spy automatically detects and negotiates the speed and duplex

### Enable TCP/IP

Enables the communication protocol between the RAD-wBMS and the computer to transmit and receive data

### IP Address

The IP Address of the RAD-wBMS on the Ethernet network

### Netmask

Refers to the number of available addresses on the network. This should not be changed from 255.255.0.0 if using Ethernet to connect the RAD-wBMS to your computer

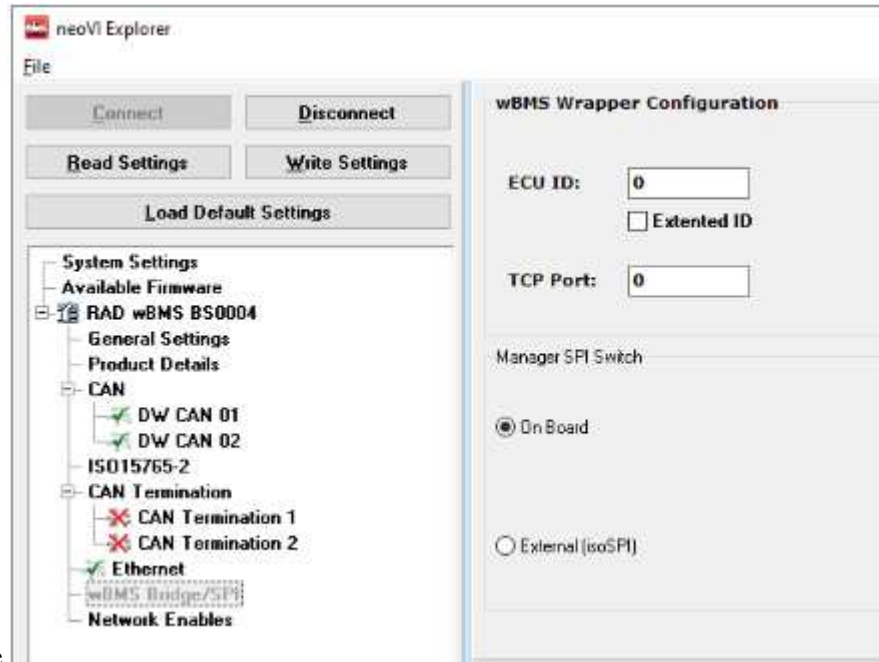
### Gateway

The Gateway is the IP address for the router. Since there is no router, the Gateway can remain 0.0.0.0



## 6.5.5 wBMS Bridge/SPI

### ECU ID



If the RAD-wBMS is wired to a physical Battery Node network, the ECU ID can be set to communicate with other Nodes

### Extended ID

Is used on networks where there are a large number of ECU's. The default setting of enabled is sufficient for most users

### TCP Port

Specifies which port on the network should be used to transmit and receive wBMS network messages

### Manager SPI Switch

If connecting to Wireless Nodes, the Managers must be configured on the RAD-wBMS (**OnBoard** should be selected). If connected to Wired Nodes, the Managers do not need to be configured by the RAD-wBMS (**External (isoSPI™)** should be selected). See 4.4.1. for more information on Wired versus Wireless Nodes.

### 6.5.6 Network Enables

Network Enables

Check the networks to enable... ☒ Hide Unsupported Networks

- ☒ DW CAN 01
- ☒ DW CAN 02
- ☒ Ethernet

☒ Enable On Boot ☐ Send Bus Traffic to Android Enable All Disable All

Network Enables displays a list of networks available on all Intrepid devices. By default, this page only displays networks that are supported by the RAD-wBMS. These networks are listed below.

- DW CAN 01
- DW CAN 02
- Ethernet

#### Hide Unsupported Networks

When checked, this feature hides all networks except for the networks supported by the RAD-wBMS. This feature is enabled by default, but can be disabled if you wish to see networks that are supported on other Intrepid devices

#### Enable On Boot

When checked, this feature will automatically enable compatible networks with your device. This may be turned off if one of your networks needs to be turned off for a project or assignment

#### Send Bus Traffic to Android

This setting is not applicable to the RAD-wBMS and can be ignored

#### Enable All

Enables all networks listed on the screen. Clicking this button will 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

When clicked, this feature disables all networks that are listed on the screen

## SUPPORT CONTACT INFORMATION

If you have questions on our products or your application, we are here to help. Feel free to contact ICS for assistance at one of our offices.

### 7.1 USA 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

Email: [icssupport@intrepidcs.com](mailto:icssupport@intrepidcs.com)

Intrepid's normal support hours are from 8 am to 8 pm, Monday to Friday, Eastern Standard/ Daylight Time (EST/EDT). 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

For support in other regions, please refer to our website which lists the latest info for our other offices:

<https://www.intrepidcs.com/worldwide/>

*Support is normally provided from 0900-1700 in the time zone of your local office. You can also contact our headquarters in the USA if your region is not listed.*