LS-16C Intelligent RF Multicoupler
User's Manual

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Acronyms/Definitions

BAUD – Bits at Uniform Density

BER - Bit Error Rate

BERT - Bit Error Rate Test

Bps – Bits Per Second

BW – Bandwdith

dB – Decibel

dBm – Decibel milliwatts

DHCP – Dynamic Host Configuration Protocol

DSP - Digital Signal Processor or Digtial Signal Processing

FLASH – Electronically Eraseable Memory

GUI – Graphical User Interface

Hz - Hertz

IP - Internet Protocol

IPv4 – Internet Protocol Version 4

LED - Light Emitting Diode

MTU – Maximum Transmission Unit (1500 bytes for IPv4)

OS - Operating System

OSI – Open System Interconnect

TCP - Transmisson Control Protocol

UDP – User Datagram Protocol

1   Introduction

1.1   General

The following document contains information on the Lumistar 2nd Generation Intelligent RF Multicoupler. The intent is to familiarize the user with the device's mechanical, electrical, and interconnection aspects as well as introduce and train the user in the operations of the supplied software control applications provided as part of the device delivery.

This document is not intended to define and illustrate the detailed communications protocol of the LS-16C device for independent software development. This information is available via the example-code included with the installation software for the LS-16C. Lumistar has provided this example code as a Microsoft Visual Studio 2016 C++ Project. Please consult Lumistar customer service for additional information.

Always consult the web site for the most recent release of all related product documentation.

1.2   Document Outline

This document contains the following sections:

- Section 1 provides a document overview as well as a brief on the LS-16C design
- Section 2 provides information on the hardware interfaces of the device
- Section 3 provides information related to the device communications interface setup
- Section 4 provides documentation of the LS-16C User Application

The document will occasionally utilize document flags to highlight important factors.   These flags can appear in any location and relate to any topic. A document flag will always be placed near pertinent information. Document flag examples appear in Figure 1-1.

Warning:

(Critical Device Operational Information)

Caution:

(Cautionary Device Information)

Information:

(Emphasized Operational Information)
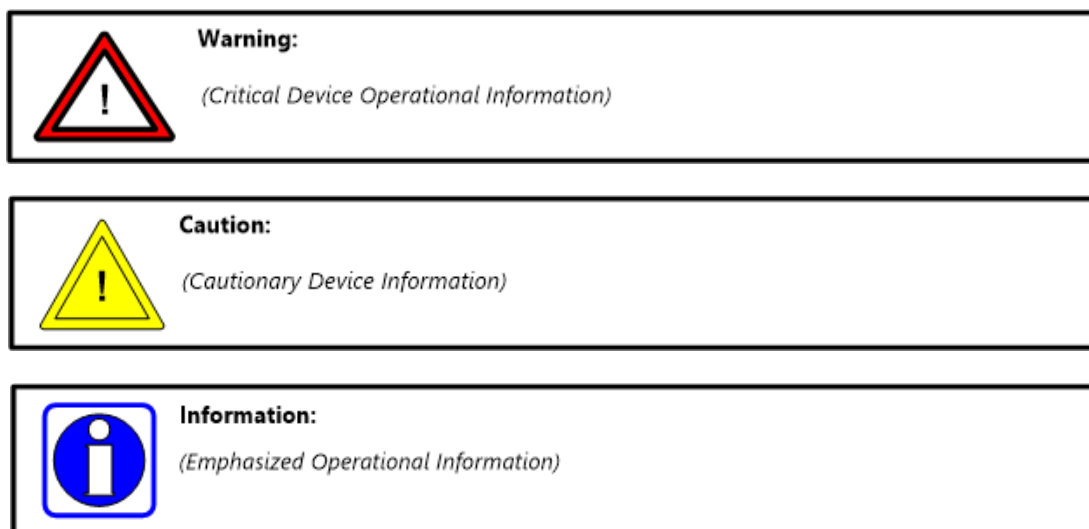
Figure 1-1 Document Flag Formats

1.3 Device Brief

The LS-16C is a sophisticated, 19-inch rack mount, multi-configuration, RF multicoupler.   The unit is intended to be operated remotely via a 100Mbps Ethernet interface for selections of RF bands being used. The unit has been designed in such a manner that precludes the necessity of a commercial operating system hosted within the device. The LS-16C supports multiple IRIG telemetry bands and provides the user with the ability to adjust individual outputs and inputs in 0.25dBm steps. The unit can operate in either 1:8 mode or 2:4 modes. A general LS-16C block diagram is shown in Figure 1-2.

The primary design objectives of the LS-16C product line versus other multicoupler designs was the provision of RF input and output balancing via software control. The unit is controlled and monitored via 100/10Mbps Ethernet using the provided Lumistar network application.

Device specifications for the LS-16C are listed in Table 1-1. Consult the factory for ordering information.
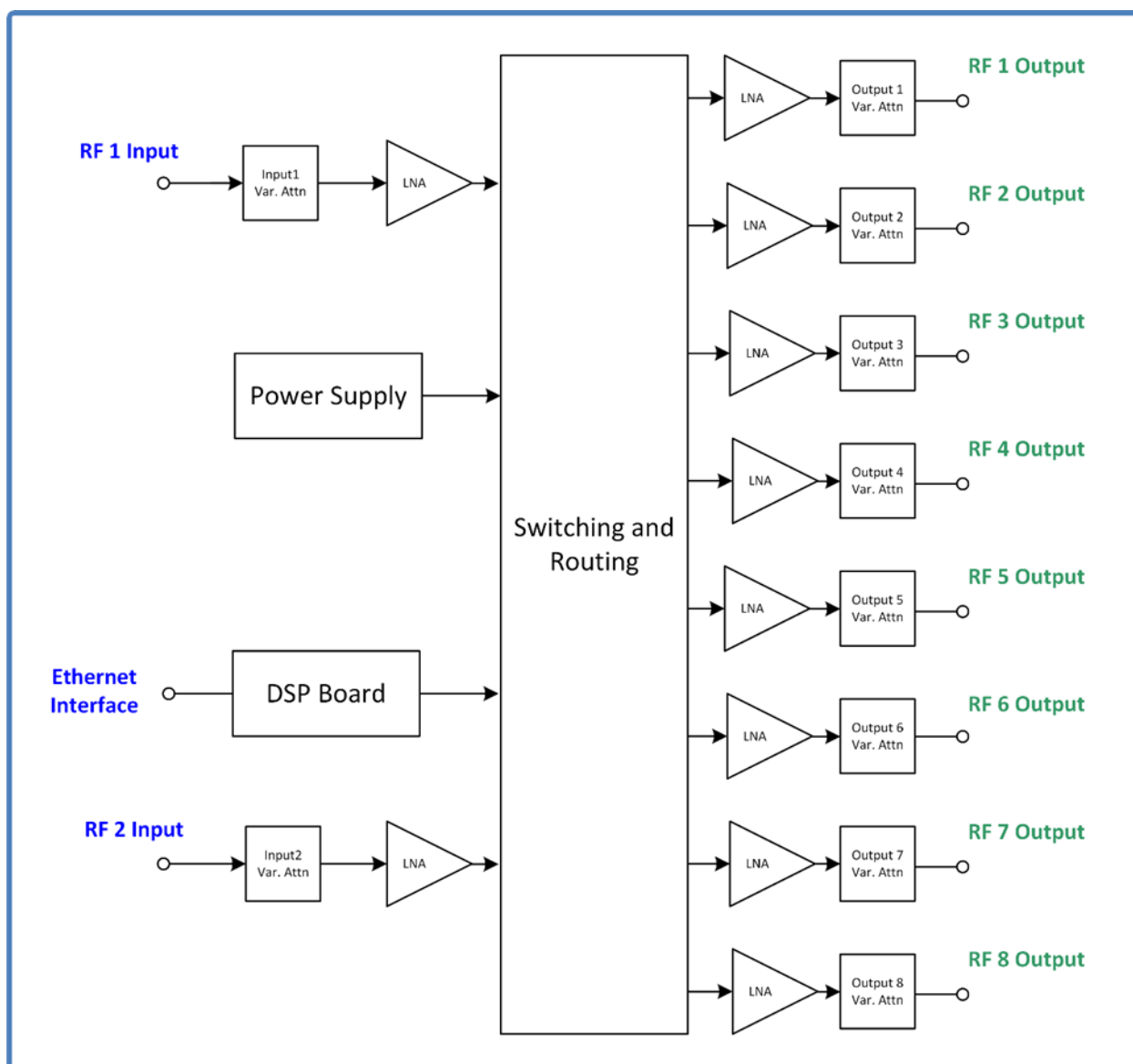
Figure 1-2 General Block Diagram: LS-16C

Category:	Specifications:	Details:
Mechanical		
	Envelope Dimensions (all slices)	12.5 (317.5) L x 18.94 (481) W x 1.732 (44.0) H
	Form Factor	1U 19" Rack Mount
	Weight	11.0lbs. (5.0kgs.)
Electrical		
	Power Input	90-264VAC, 47-63Hz, 115VAC @ 0.125A
	Total Power (all streams)	~ 12 Watts
Performance		
	Input/Output Switching	1:8 and 2:4 Software Selectable
	VSWR	1.2:1 or better
	Isolation	>38dB
	Channel-to-channel Balance	+/-0.25dBm
	Input P1dB	0 dBm
	Adjustability	Inputs/Outputs: +/-3dBm in 0.25dBm Steps
Connectors		
	RF I/O Connector	(10) N-Style Female Connectors
	SW Control Connector	(1) RJ45 Ethernet Interface
Environmental		
	Temperature, Operational	-40 to 85 C (Industrial)
	Temperature, Storage	-40 to 125 C
	Humidity, non-condensing	<40C 0-90%, >40C 0-75%
Safety and EMC	Emissions and Immunity	EN55011 Class B, FCC CFR 47 Part 18; IEC-61000-3-2, 3; IEC61000-4-2 thru 6, 8, 11
	Safety	IEC60601-1: 2005+A1: 2012, EN60601-1:2006+A11:2011+A1+A12, UL ANSI/AAMI ES60601-1

Table 1-1 General LS-16C Device Specifications Table

2 Hardware Interface

This document section will examine hardware design aspects including physical mounting of the device, electrical interface standards involved with the user connections, power and cooling of the device, and cabling options.

2.1 Mechanical Outline: 1U 12" Chassis

The Lumistar LS-16C, is delivered in a standard 1U 19-Inch Rackmount format. Figure 2-1 provides a diagram of the front and rear panels of the LS-16C.

The device can be mounted using four 19-Inch rackmount lugs. Total device height does not exceed 1.73 inches. Power status is provided by the LED surrounding the power ON/OFF switch. If the LED is illuminated, the unit is on and will be available for communications via the Ethernet connection within six seconds of power up.

The front panel of the LS-16C contains a mode selection switch. Units which contain Ethernet interfaces do not utilize this switch and disregard its state.

Figure 2-1 LS-16C Chassis: With Callouts

1: Airflow Vent
2: Airflow Vent
3: Power Button
4: Ethernet Port

5: AC Power Inlet (96-264VAC)
6: Mode A Input
7: Mode A Outputs
8: Mode B Outputs 1-4

9: Mode B Outputs 5-8
10: Mode B Input 1-4
11: Mode B Input 5-8
12: Manual Mode Switch
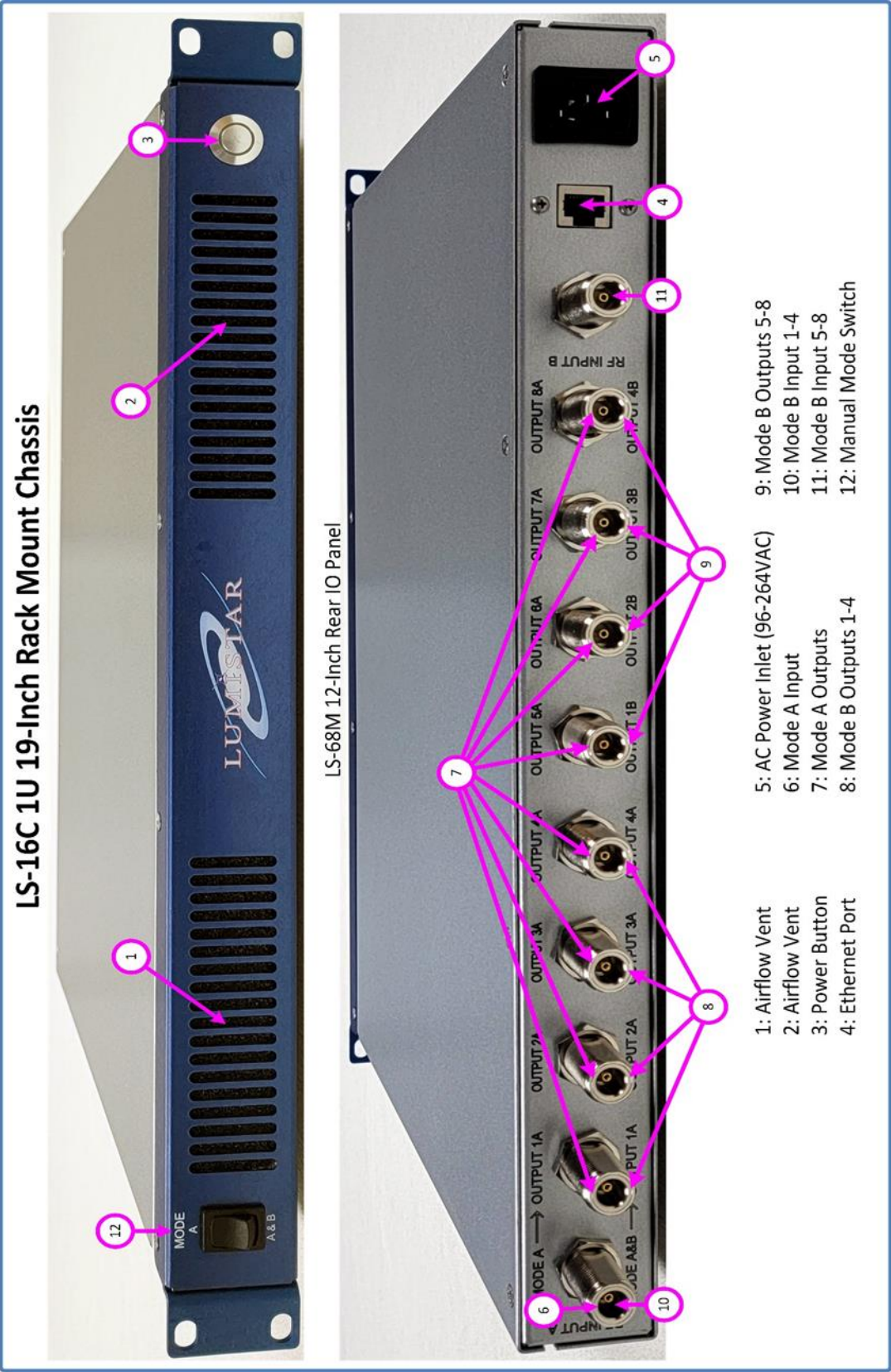
3   Communications Interface

The LS-16C communicates through a 10/100 Mbps Ethernet serial interface. For best performance on a given RF band, it is highly recommended to utilize the application software to control the unit and select proper RF bands.

3.1   TCP/IP Connectivity

The TCP/IP IPv4 protocol suite requires a 5-tuple of values to establish a connection or reply to a message from a remote host.

- Transport Layer Protocol (UDP or TCP, typically).
- Local IP Address.
- Local Port Number
- Remote IP Address
- Remote Port Number

The Ethernet enabled Lumistar LS-16C device will all have an IP Address and port value prior to shipment. All units will be assigned a static IP address of **192.168.16.220** and a port number of **5000**. The connection will always use the TCP protocol. Both the Lumistar device and the host computer on which application software is running must be in the same IPv4 subnet. Ethernet enabled Lumistar devices follow the Client/Server paradigm, with the Lumistar device filling the Server role and the application program acting as the Client.

It is highly unlikely that the user network and the factory network settings will be directly compatible. In the installation software, Lumistar provides a configuration tool that allows the IP address and port number to be changed.

3.1.1   Ethernet Network Interface

The *WIZ107SR Configuration Tool* installation is located in the ***c:\lumistar\LS16C\ConfigTool*** directory. This tool allows the user to discover and alter network configuration information of the LS-16C Lumistar device on the local subnet. Install the *WIZ107SR Configuration Tool* by executing the "setup.exe" program located in this directory. After installing, select the "Config Tool" item from the Windows Start Menu.

The *WIZ107SR Configuration Tool* requires the installation of version 2.0 Microsoft .NET framework. Most PC installations will contain some version of the .NET framework. However, if there is no .NET framework installed on the host PC, Lumistar has provided the Version 4.8 .NET framework installation in the ***c:\lumistar\LS16C\MicrosoftDotNet*** directory.   To install this version of the .NET framework, run the "ndp48-web.exe" application. You may be prompted with an installation error if the .NET framework has previously been installed. If so, ignore this error and continue as described below.

Windows 10 requires that the .NET 3.5 and older version be specifically allowed to run on the user's host PC. To enable this specific version of .NET, select the Windows Search function and enter the following:

Windows Features. This will bring up an option to enable additional features. Run this selection and ensure that the .NET 3.5 Framework is enabled as shown in Figure 3-1.
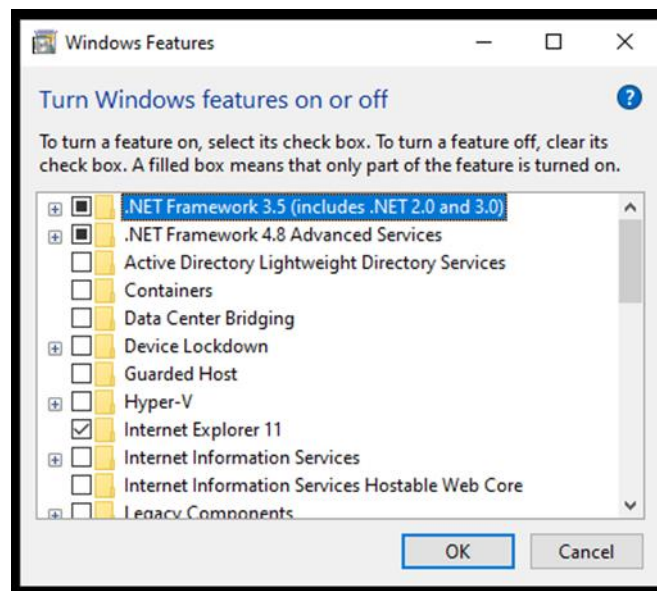

Figure 3-1 Windows Features Control Box

Once installed correctly, launching the configuration tool will result in the window shown in Figure 3-2
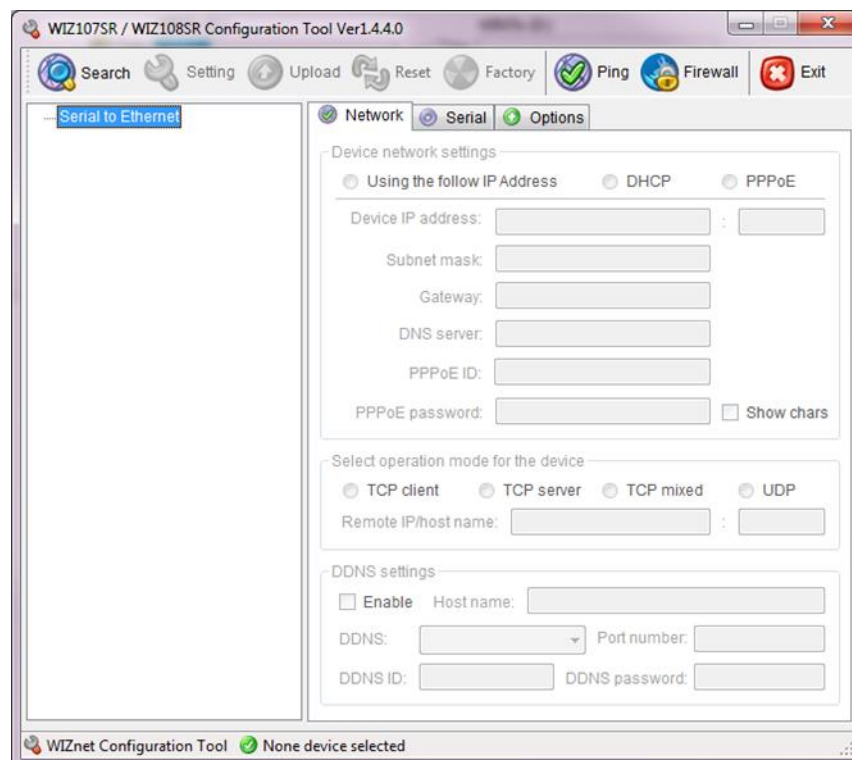

Figure 3-2 Configuration Tool – Initial Window

Press the "Search" button in the upper left-hand corner of the initial dialogue box. This will bring up an additional search box as shown in Figure 3-3.
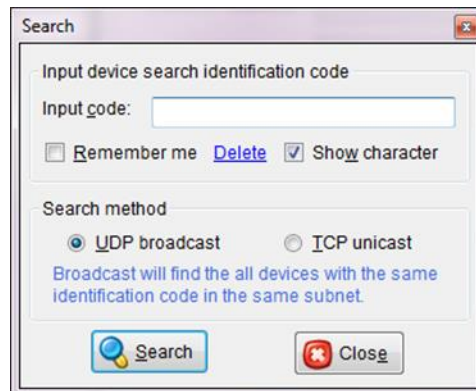
Figure 3-3 Configuration Tool – UDP Broadcast Search Box

Select "Search" again, there is no need to modify any other values. This will result in the dialogue box shown in Figure 3-4.
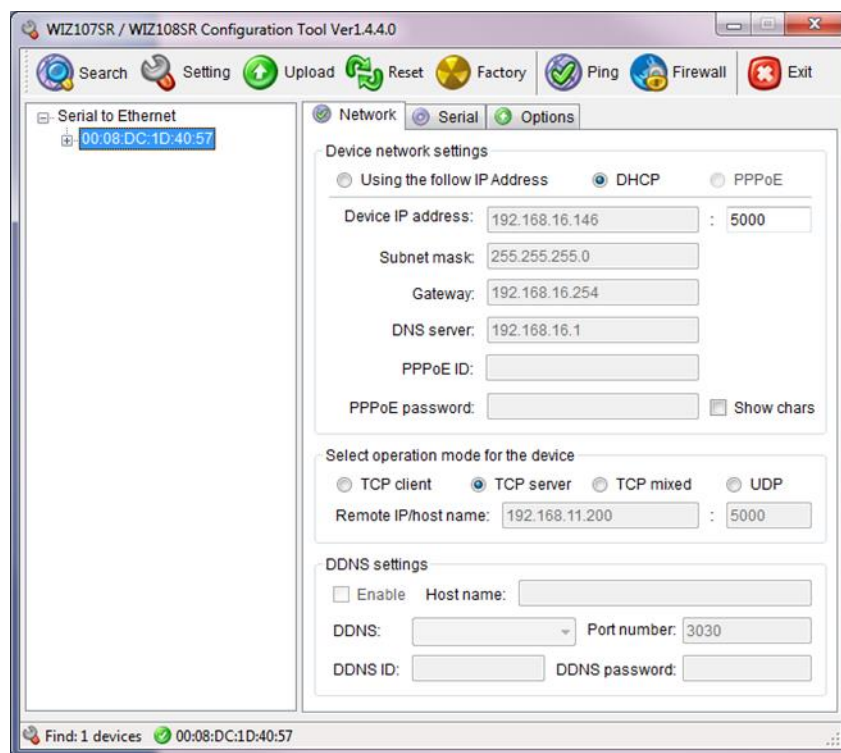
Figure 3-4 Configuration Tool – Network Tab

If the search finds a Lumistar device with appropriate Ethernet Interface device, there will be at least one entry in left hand list tree control. The items listed in this control will display the device's Ethernet MAC Address. Select the device of interest. Its configuration information will be displayed in the tab control on the right.

If the search does not find a device, select the SEARDH from the main menu bar and this time select the TCP Unicast selection and enter the default IP address of 192.168.16.220 and select Search from the bottom of the dialog window. Leave the port address filed blank as shown below in Figure 3-5.
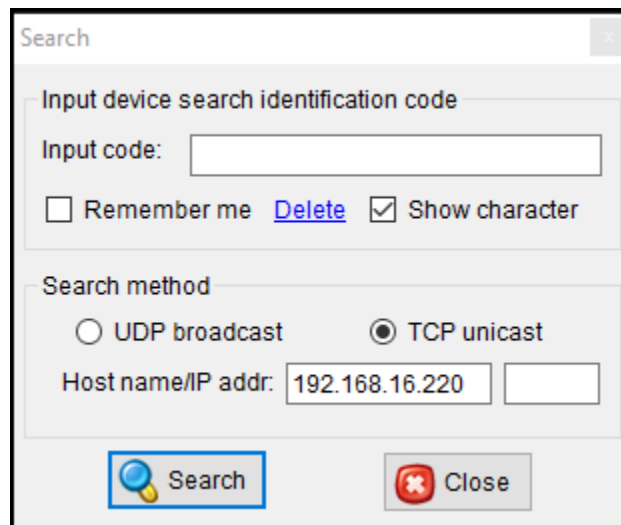

Figure 3-5 Configuration Tool – TCP Unicast Search Box

In general, there are two options for setting the TCP/IP network values. The user may select "Using the follow IP Address" and manually enter the IP Address and other settings. The 5000 entry represents the Port Number that the Lumistar device will listen on and must remain 5000. The second option is to select the "DHCP" radio button. On a network with a DHCP server, the Lumistar device will be able to ask the DHCP server for IP Address and other settings programmatically, without the need for manual intervention. This is the default setting that the Lumistar device will ship from the factory in. The "PPPoE" option is not supported.   In the "Select operation mode for the device" group, always select "TCP Server".   "DDNS settings" should always have "Enable" unselected.

After making all selections, press the "Setting" button in the upper row next to the "Search" button. The modified settings will be saved into the Lumistar device. Power cycle the Lumistar device to allow it to restart using the new settings.

3.1.1 Initial setup of the Network Interface for the LS-16C

The LS-16C is delivered configured with a **Static IP Address**. The default address is **192.168.16.220**. If the user desires that the unit be switched to a different static IP address or to Dynamic Host Configuration Protocol (DHCP) mode, a controlling host set to the same sub-net mask will be required so the setup can be completed.

Configuring hosts communication between various network configurations is operating system dependent and will be generally outlined below. Slight operating system variations in functional screens may exist and will be up to the user to interpret. An example of how to configure a common Windows network Host

Controller to operate in either Static mode which is necessary to change the delivered mode of operation is described in section 3.1.1.1. An example of how to set a Windows network host to DHCP mode follows in section 3.1.1.2.

Information:

Network configuration, connection and security typically require consent and access privileges from a network system administrator. The sections that follow attempt to describe the necessary steps that need to be taken in a rather "Open" network environment. Specific requirements in terms of network security and connection routing are the user's responsibility. Please contact your system administrator before going further.

3.1.1.1   Modification of a Windows Host controller to Static IP mode

To modify the controlling host's network configuration to static IP mode, perform the following steps:

Step 1: Connect the LS-16C to the target host machine either directly with an Ethernet crossover cable or by connecting both the device and the host to an Ethernet switch using standard Ethernet cables.

Step 2: On the target host application machine, access the Windows Control Panel.

Step 3: From Windows Control Panel, select the Network and Sharing Center.

Step 4: From Network and Sharing Center, select the "Change adapter settings" option from the left-hand menu. See Figure 3-6.

Figure 3-6 Windows Network and Sharing Page

Step 5: The Network Connections window shows the available connections the target host can use. Right-click on the local area connection attached to the LS-16C and select "Properties". See Figure 3-7.

Figure 3-7 Windows Network Connections Page

Step 6: From the Local Area connection Properties window, double-click on "Internet Protocol Version 4 (TCP/IPv4)". See Figure 3-8.
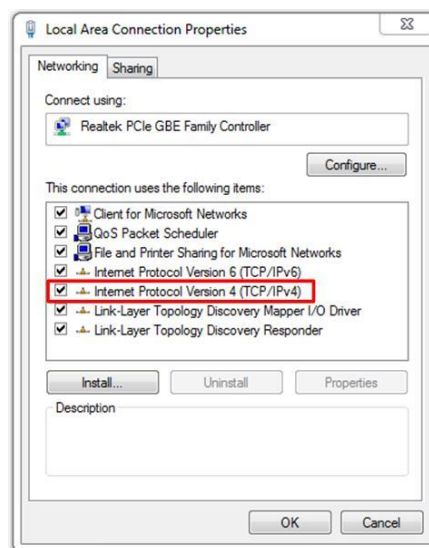
Figure 3-8 Windows Network Connections properties page

Step 7: To set the unit to a static IP address, select the "Use the following IP address:" option. Then enter the desired IP address in the designated field. A suggestion is to use the IP address 192.168.16.200 as shown below. Once the IP address is filled, the Subnet mask field will automatically populate. See Figure 3-9.

Warning:

The static IP address of the host machine cannot be set identically to any device on the connected network.

Figure 3-9 Windows Network Connections IPv4 properties page –Static IP

Step 8: From the Internet Protocol Version 4 (TCP/IPv4) Properties window, click "OK".

Step 9: From the Local Area Connection Properties window, click "OK".

3.1.1.2   Modification of a Windows Host controller to DHCP Mode

To modify the controlling hosts to the DHCP network configuration, perform the following steps:

Step 1: Connect the target host to a DHCP enabled network.

Step 2: On the target host application machine, access the Windows Control Panel.

Step 3: From Windows Control Panel, select the Network and Sharing Center.

Step 4: From Network and Sharing Center, select the "Change adapter settings" option from the left-hand menu. See Figure 3-6.
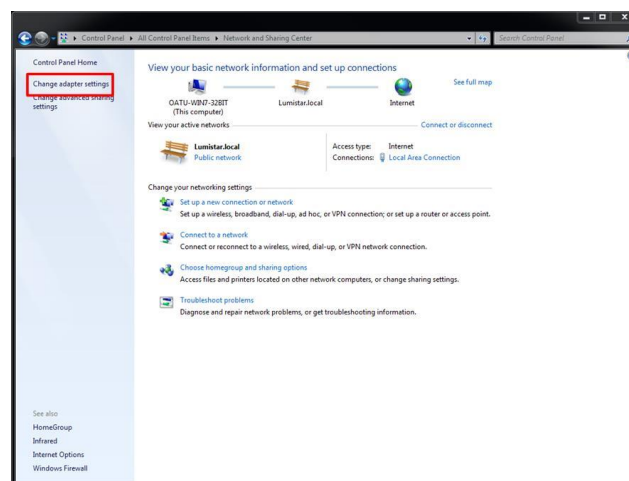
Step 5: The Network Connections window shows the available connections the target host can use. Right-click on the local area connection connected to the DHCP enabled network and select "Properties". See figure 3-3.
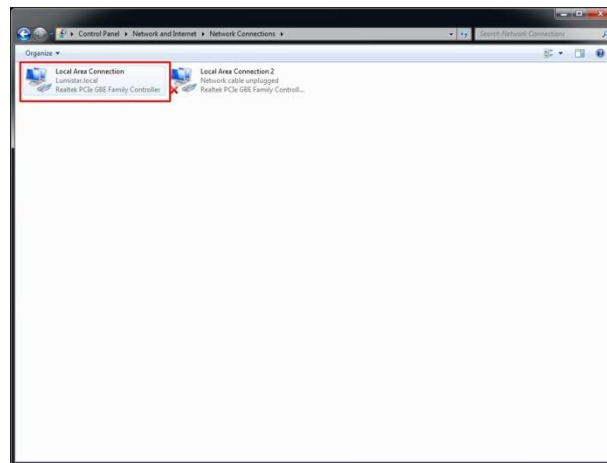
Step 6: From the Local Area connection Properties window, double-click on "Internet Protocol Version 4 (TCP/IPv4)". See Figure 3-8.

Step 7: To set the unit to DHCP mode, select the "Obtain an IP address automatically" option.   See Figure 3-10.
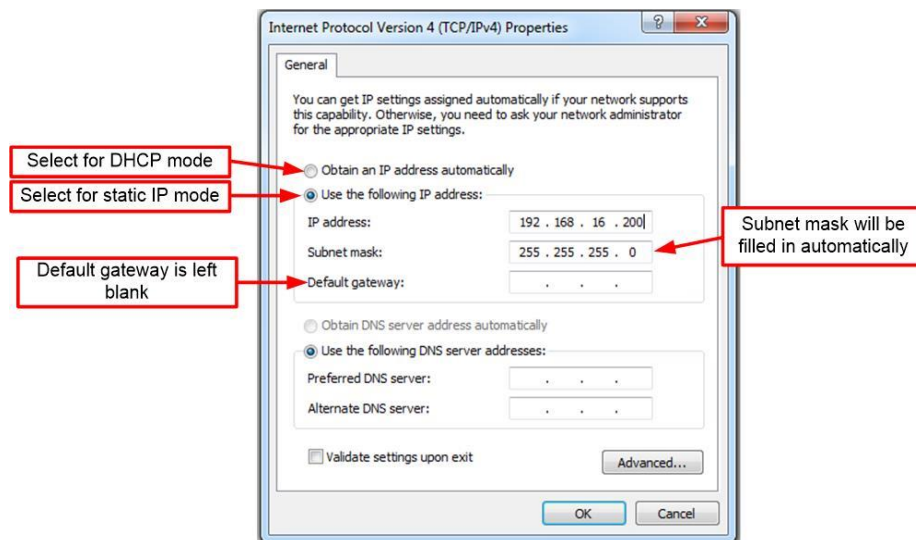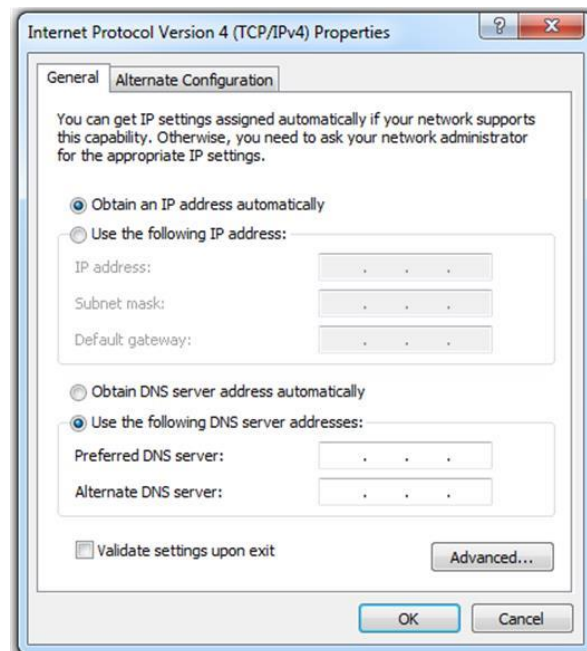
Figure 3-10 Windows Network Connections IPv4 properties page - DHCP

Step 8: From the Internet Protocol Version 4 (TCP/IPv4) Properties window, click "OK".

Step 9: From the Local Area Connection Properties window, click "OK".

Settings can be entered in the provided spaces and then updated by clicking the UPDATE button.

The DHCP check-box allows the DHCP mode to be enabled and disabled. If the DHCP mode is enabled, the fixed IP address fields will be ignored and addressing will be assigned by another controlling network source. **If no such host is available to assign the unit an address, all network communications will cease.**

Deselecting the DHCP box will place the device in static IP mode using the address field setting set on this tab. Be sure to press the UPDATE button prior to closing this page to make the settings active. Settings will be retained between power cycles.

> ⚠ **Warning:**
> If the DHCP mode is selected, the unit will not contain an IP address, subnet or gateway setting. If set to this mode, a DHCP network controller **MUST** be present to assign network interface settings. If the unit is set to DHCP mode, the **ONLY** means to change network control settings is to attach the unit to a network which contains a DHCP controller.

4 Software Application: LS-16C

The LS-16C application is the primary software deliverable for the LS-16C. This application provides a user interface to all functions of the device that can be run on most Windows platforms.

4.1 General Application Operations

There are several aspects of the user network application that are related to the overall operation of the connected device or devices. It may be necessary, depending on the operating system of the host PC and loaded support files, to add specific Microsoft Visual C++ redistributables to the host computer for proper operation of the application software. If the user experiences errors indicating missing Microsoft files at application launch, the necessary Microsoft files are located in the *c:\lumistar\LS16C\MicrosoftCRedist* directory.   If the installed host OS is 32-bits, install only the x86 redistributables. If the host OS is 64-bits, install both provided redistributables.

Aspects of the software application will be described in paragraphs that follow.

4.1.1 LS-16C User Application: Setup Tab 1:8 Mode

The LS-16C is specifically designed to control and status a single LS-16C multicoupler.

When the application is launched, a window like that shown in Figure 4-1 will be presented. This window is broken into several sub-panes as described in the following paragraphs.
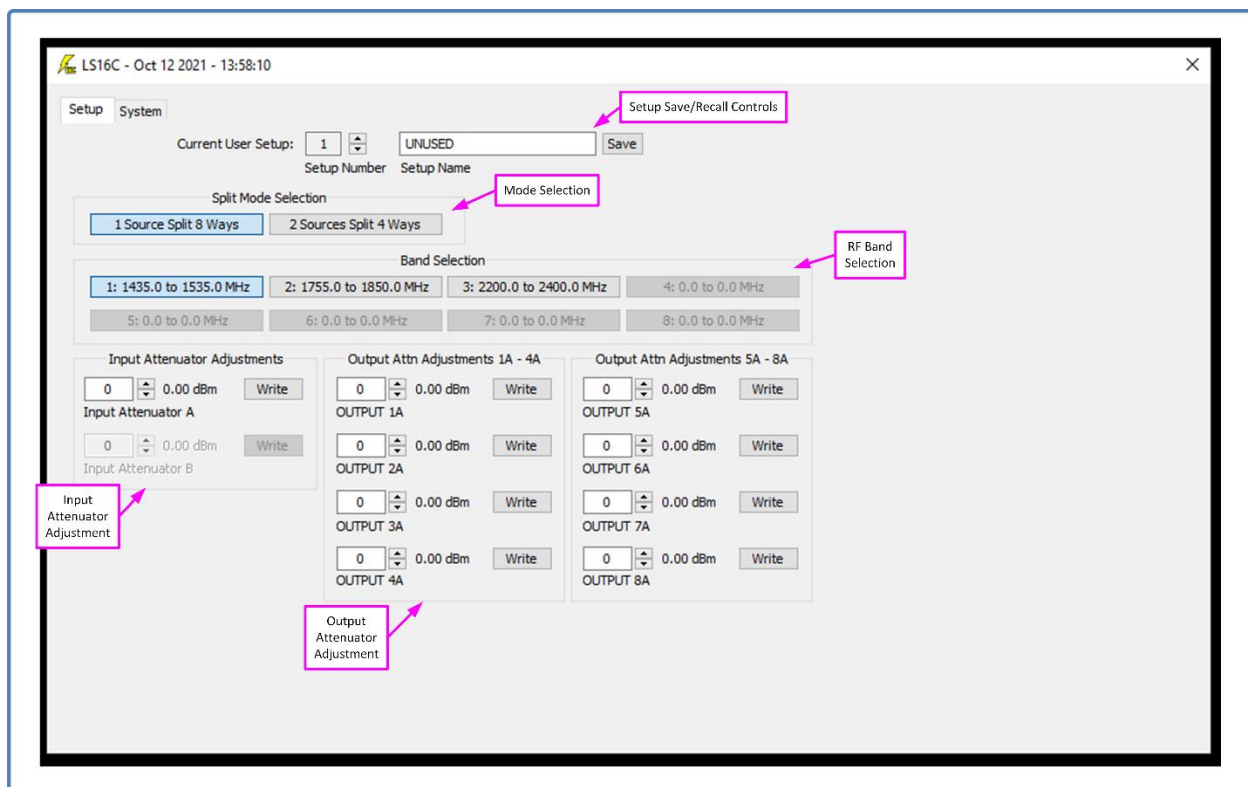

Figure 4-1 LS-16C User Application: 1:8 Mode

Setup Save/Recall Controls: This area of the application allows the user to save and recall previously stored custom configurations. After making changes to the split mode selection, band selection and attenuator settings, the user can then save this setting given a setup name in one of up to sixteen storage memory locations. Simply provide a name for file and select the SAVE button to store a custom configuration.

It is important to note that upon power-up, that last settings from the previous operation will be recovered, whether previously saved or not.

Split Mode Selection: The split mode selection allows the user to select between the 1:8 operational mode and the 2:4 operational mode. Figure 4-1 represents the 8:1 mode selection. This selection box overrides the front panel settings.

Band Selection: Factory calibration will be performed based on RF bands specified prior to order. By selecting the appropriate bands, the user will receive a closely calibrated output that will be 3dB greater than the input value and matched in power level from channel to channel.

Input Attenuator Adjustments: This control allows the customer to control the input attenuation of a very powerful input level. It is suggested to leave these settings in their factory configured locations unless the expected input level is greater than 0dBm. The factory calibration will allow for a 0dB 0.1dB input compression. Adding large amounts of input attenuation will negatively affect the noise figure of the multicoupler.   Input attenuator steps will be allowed for +/- 3dB in 0.25dB steps.

Output Attenuator Adjustments: This control allows the customer to control the output attenuation of each of the multicoupler outputs, allowing the user to match each of the channel output levels. For most use scenarios, it is suggested to leave these settings in their factory configured locations for a given band. Output attenuator steps will be allowed for +/- 3dB in 0.25dB steps.
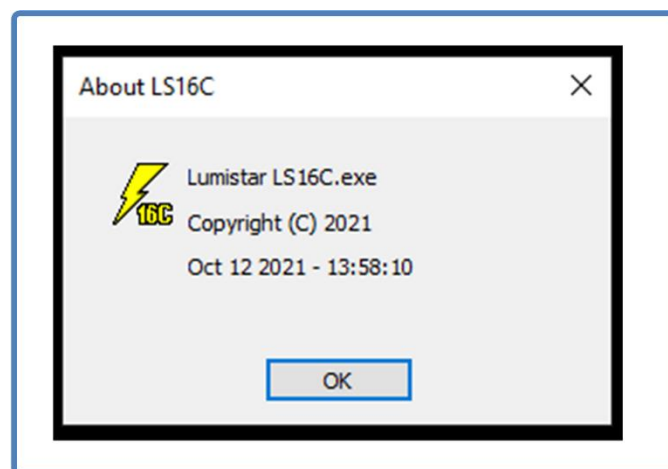

Figure 4-2 LS-16C ID Tag

If the user right-clicks the yellow thunderbolt in the upper left-hand and selects the "About LS16C…" menu option, an application identification window will appear like the one shown in Figure 4-2.

4.1.2 LS-16C User Application: Setup Tab 2:4 Mode

When the application is launched, a window like that shown in Figure 4-1 will be presented. This window is broken into several sub-panes as described in the following paragraphs.
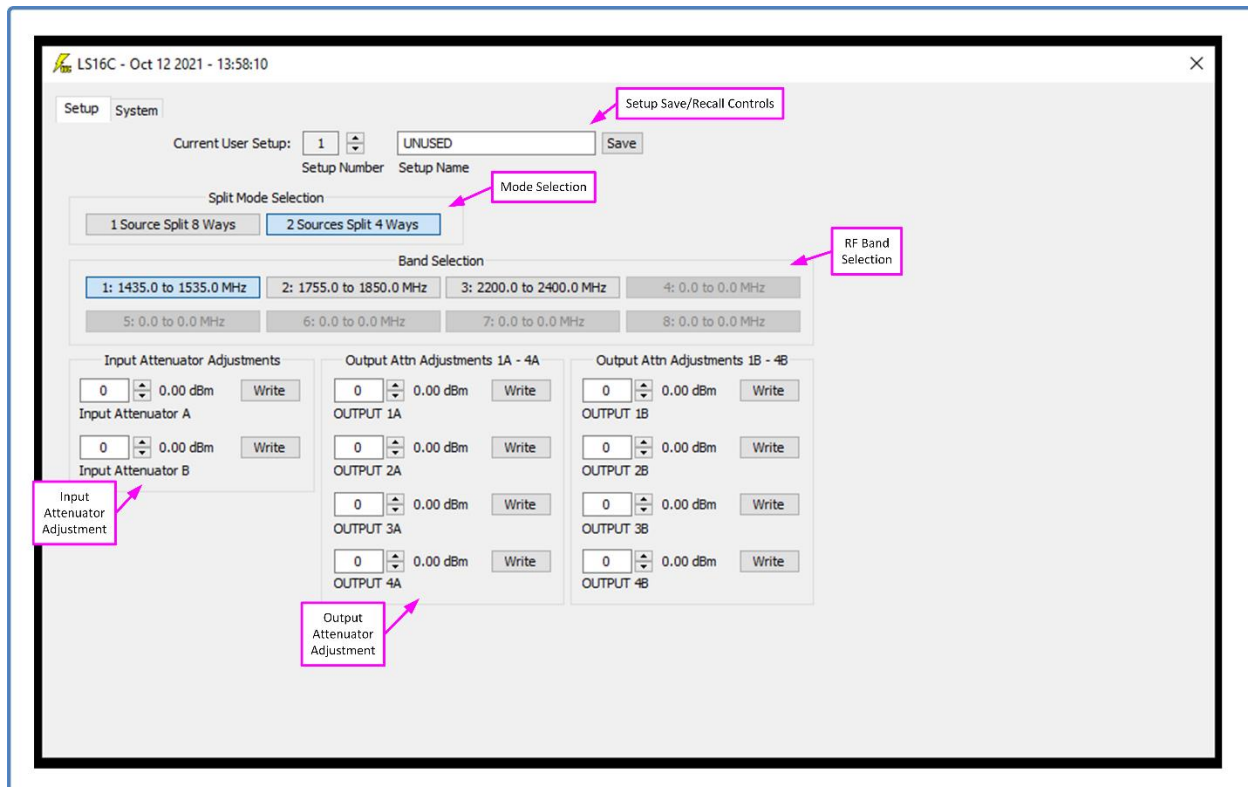

Figure 4-3 LS-16C User Application: 2:4 Mode

Setup Save/Recall Controls: This area of the application allows the user to save and recall previously stored custom configurations. After making changes to the split mode selection, band selection and attenuator settings, the user can then save this setting given a setup name in one of up to sixteen storage memory locations. Simply provide a name for file and select the SAVE button to store a custom configuration.

It is important to note that upon power-up, that last settings from the previous operation will be recovered, whether previously saved or not.

Split Mode Selection: The split mode selection allows the user to select between the 1:8 operational mode and the 2:4 operational mode. Figure 4-3 represents the 4:2 mode selection. This selection box overrides the front panel settings.

Band Selection: Factory calibration will be performed based on RF bands specified prior to order. By selecting the appropriate bands, the user will receive a closely calibrated output that will be 3dB greater than the input value and matched in power level from channel to channel.

Input Attenuator Adjustments: This control allows the customer to control the input attenuation of a very powerful input level. It is suggested to leave these settings in their factory configured locations unless the expected input level is greater than 0dBm. The factory calibration will allow for a 0dB 0.1dB input compression. Adding large amounts of input attenuation will negatively affect the noise figure of the multicoupler. Input attenuator steps will be allowed for +/- 3dB in 0.25dB steps.

Output Attenuator Adjustments: This control allows the customer to control the output attenuation of each of the multicoupler outputs, allowing the user to match each of the channel output levels. For most use scenarios, it is suggested to leave these settings in their factory configured locations for a given band. Output attenuator steps will be allowed for +/- 3dB in 0.25dB steps.

4.1.3 LS-16C User Application: System Tab

The LS-16C System tab provides the user with status on overall system operations and provides utility controls for firmware updates. This window is broken into several sub-panes as described in the following paragraphs.
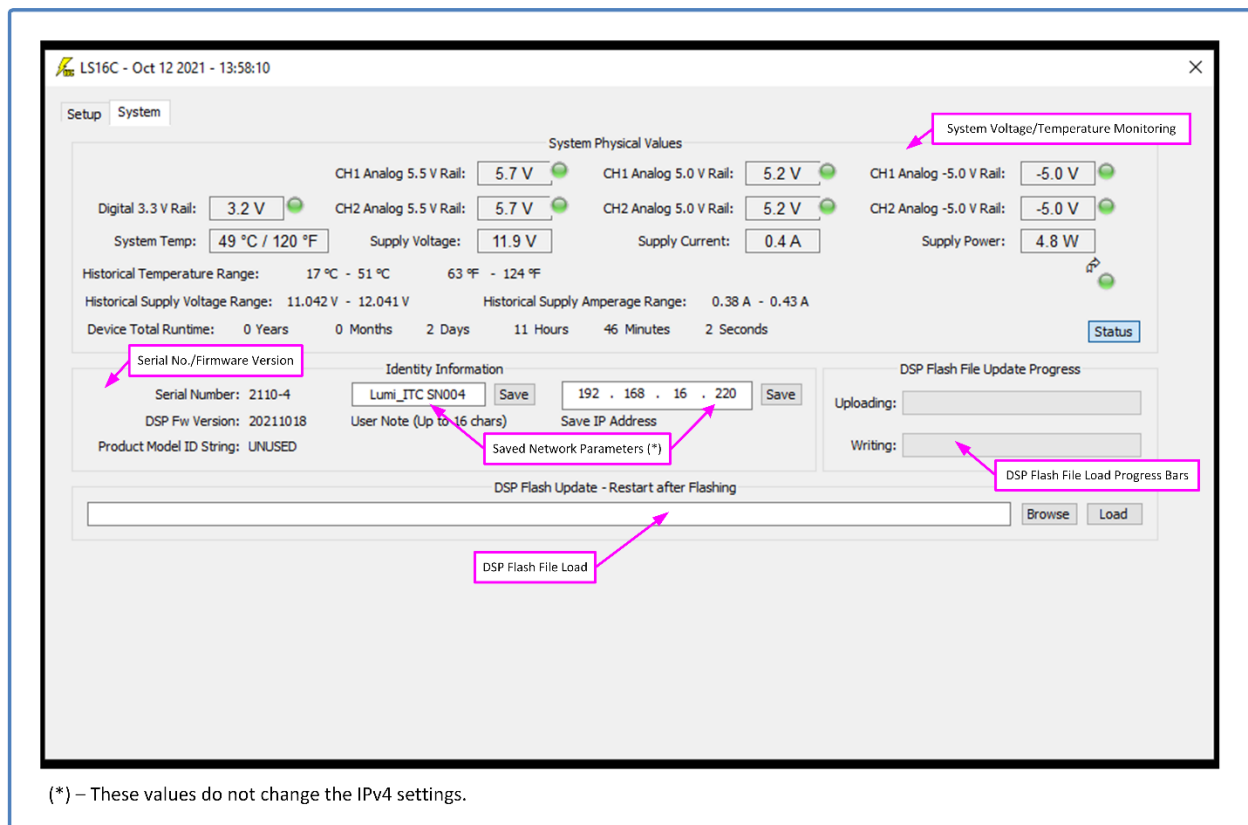

Figure 4-4 LS-16C User Application: System Tab

System Physical Values: This area contains status information on power supply rails, temperature history, and total device run time. Green LEDs indicate that the power rails are operating within tolerance range. If a rail is out of range, the LED will be illuminated yellow or red.

Identity Information: The device serial number, DSP firmware version, user notes and IP addresses are identified in this screen area. Note that setting the IP address in this area will not alter the IP address of the network. The IP address located in this area is just for information purposes.

DSP Flash File Update Progress: The bars in this screen sub-panel indicate the progress in the upload and writing process of DSP firmware updates. Follow screen messages carefully during the upgrade process and do not power off the unit.

DSP Flash File Update: This area allows the user to browse and start the loading process of a provided firmware file. Follow screen messages carefully during the upgrade process and do not power off the unit.