

Encoded Solutions, LLC NMEA-to-WIFI Multiplexer



Users Guide

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Installing the Multiplexer

Mounting

The multiplexer is designed to be mounted on a vertical surface with the connector at the bottom. It can be mounted using one of each of the two supplied mounting screws in the open slot on each side of the multiplexer. We recommend that you drill 7/64 pilot holes in the mounting surface for the screws. The multiplexer should be mounted:

- in a clean, dry, protected location without excess heat
- where large metallic objects will not block the WIFI signals
- where there is room for the connector and the wires attached to it
- where the light can be seen and the buzzer can be heard
- where there is access to the incoming and outgoing NMEA data wires
- where it is not close to high voltage wires
- where it is not co-located with other transmitting devices or receivers

Wiring

The multiplexer has a pluggable connector in order to facilitate making the wire connections. To remove the connector, loosen the two screws that hold it to the multiplexer and pull gently to separate it from the multiplexer. The connectors have a snug fit, so you might find it more convenient to dismount the multiplexer in order to remove the connector (or just make the connections). After you've connected all the wires and re-plugged the connector, don't forget to gently snug up the two screws that hold the connector to the multiplexer.

The connections are as follows:

1	2	3	4	5	6	7	8	9	0	-	+
AIS In		NMEA 3 In		NMEA 2 In		NMEA In		NMEA Out		Ground	12 to 30 V DC+
-	+	-	+	-	+	-	+	-	+	-	+

To make wire connections, *completely* loosen the set screw for the desired connection location, insert the stripped wire end into the hole below the screw, and tighten the screw. Do not over-tighten the screws! Ensure that the bare stripped end of the wire, not the insulation, is clamped in the connector.

When making your NMEA connections to the multiplexer, if you get the wires reversed (negative to positive) you won't do any damage, it just won't work.

Setting Up the Multiplexer

Connecting Your Computer to the Multiplexer via WIFI

When the multiplexer has not been initialized it will start in setup mode. The red light will be on steady, indicating that the multiplexer requires setup before it will function as a multiplexer. In setup mode the multiplexer's network name is "nmea2wifi" and it is unsecured, meaning it does not require a password. Connect your computer to the multiplexer like you connect to any other WIFI network. After you connect your computer to the multiplexer you can access the setup page to configure the multiplexer.

When the multiplexer is not in setup mode you must use the Network Name and Password that you specified in the setup to connect to the multiplexer. The multiplexer supports up to four simultaneous WIFI connections.

Accessing the Setup Page

The multiplexer setup page is accessed using a web browser on a computer that is connected to the multiplexer via WIFI. The setup page is accessed by typing 10.11.12.1 into the browser's address field of a computer connected to the multiplexer. The address field is where you would normally type a web address, such as www.encodedsolutions.com.

NOTE: If you have previously changed the "Network IP Address", then you must type that IP address instead of 10.11.12.1 to access the setup page.

When the multiplexer is a client of a remote network and the option to "Allow Setup from Remote Network" is enabled, the setup page can also be accessed from a computer connected to the remote network. To access the setup page from a computer connected to the remote network, use the IP address that the multiplexer was assigned by the remote network when it connected to that network instead of 10.11.12.1.

Multiplexer Parameters

The multiplexer parameters section of the setup page contains parameters that apply to operation of the multiplexer as a WIFI access point. The parameters are described in detail below.

Multiplexer IP Address

The “Multiplexer IP Address” is the IP address the multiplexer will use when it operates as a WIFI access point. It is also used by the multiplexer to determine what IP addresses will be assigned to computers that are connected via WIFI directly to the multiplexer.

The default IP address of the multiplexer is 10.11.12.1 . Computers connecting directly to the multiplexer will be assigned an IP address in the range of 10.11.12.2 to 10.11.12.254.

Under normal circumstances, you should not need change the multiplexer IP address. In the unusual circumstance that you are using the multiplexer to attach to another network, and the multiplexer’s IP address conflicts with the network IP address of the other network, you can change the IP address of the multiplexer. The multiplexer IP address is restricted as follows:

- the first octet must be 10, 172, or 192
- if the first octet is 10, the second octet must be 0 to 255 inclusive
- if the first octet is 172, the second octet must be 16 to 31 inclusive
- if the first octet is 192, the second octet must be 168
- the third octet must be 0 to 255 inclusive
- the fourth octet must be 1

So, valid address ranges are in the ranges shown below:

- 10 . <0 to 255 >. <0 to 255> . 1
- 172 . <16 to 31> . <0 to 255> . 1
- 192 . 168 . <0 to 255> . 1

If you change the multiplexer’s IP address you will need to use the new IP address instead of the default IP address to access the setup page.

Tech Note: The multiplexer’s network address is the same as the multiplexer IP address except that it ends in 0 instead of 1. IP’s assigned to computers connecting directly to the multiplexer will be the same as the multiplexer IP address except that they will end in 2 to 254. The network mask for the multiplexer is always 255.255.255.0

Network Name (SSID)

The “Network Name” field, also known as SSID, is the name used to identify a wireless network access point. This is the name that you will use when you connect your computer via WIFI to the multiplexer.

The network name must be from 1 to 32 characters long and it can contain any printable characters from the ASCII character set (ASCII characters with values 32 to 126 inclusive).

New Password

The “New Password” field is used to set or change the password you will use to connect to the multiplexer via WIFI. You should only enter a password in this field when you want to change the multiplexer’s password. Otherwise, leave this field blank.

The password must be from 8 to 64 characters and it can contain any printable characters from the ASCII character set (ASCII characters with values 32 to 126 inclusive).

WIFI Channel

Using the “WIFI Channel” field you can select the WIFI channel that the multiplexer uses. If the multiplexer is located within close proximity to another WIFI, or if it is connecting to a remote network, the multiplexers will interfere less with each other if the WIFI channels on the two multiplexers are different.

UDP Send Port

The multiplexer uses the User Datagram Protocol (UDP) to send and receive the NMEA sentences via WIFI. The “UDP Send Port” field is used to specify which UDP port the multiplexer will use to send the NMEA sentences. In order to receive the sentences on a connected computer it is necessary to specify that the computer receive UDP data on the same port as you specify for the UDP send port on the multiplexer.

The default UDP Send Port is 10110. This is the official port assigned by the Internet Assigned Numbers Authority for the transmission of NMEA0183 data.

UDP Receive Port

The “UDP Receive Port” field is used to specify which port the multiplexer will use to receive the NMEA sentences that are sent by computers connected to the multiplexer via WIFI. In order for the multiplexer to receive the sentences sent by a connected computer, the UDP receive port of the multiplexer must be the same as the port that the remote computer uses to send the UDP data.

The default value for UDP Receive Port is 10111. This is an available port that is directly adjacent to the official port (10110) that is assigned by the Internet Assigned Numbers Authority for the transmission of NMEA0183 data.

AIS Port Speed

The multiplexer has three standard NMEA0183 ports which operate at at a speed of 4,800 baud, which is the specification for NMEA0183 data. It also has a fourth NMEA port which can be used for either NMEA or AIS data. AIS data is sent at a speed of 38,400 baud.

Use the “AIS Port Speed” selector to choose the speed of the AIS data port. If you are using the port to receive standard NMEA data, select 4,800 Baud. If you are using the port to receive AIS data, select 38,400 baud.

Send to NMEA Output

When the multiplexer receives NMEA data on its four wired NMEA ports, it sends this data via WIFI to computers connected to the multiplexer. In addition, the multiplexer can forward the NMEA data received on any or all of its wired NMEA input ports directly to its wired NMEA output port.

To enable direct input/output port forwarding, select “Yes” from the selection box in front of the port(s) you want forwarded directly to the wired NMEA output port.

Note that if you are receiving AIS data on the AIS port at 38,400 baud and you forward that port to the NMEA output, you will overflow the NMEA output port when receiving AIS data because AIS data is sent at 8 times the speed of NMEA data.

Remote Network Parameters

While it is serving as an access point, the multiplexer can also connect via WIFI as a client to another network (a “remote network”). The remote network parameters apply to the operation of the multiplexer as a client on the other network. When the multiplexer is connected to another network you can set its remote network parameters so that all of the capabilities to send and receive NMEA data and to perform setup functions on the multiplexer are available to computers connected to the other network. Each remote network parameter field is described below.

Connect to a Remote Network

Use this selector to specify whether the multiplexer can connect to a remote network or not. If you select “Yes”, you must also specify a Remote Network Name for the network you want to connect to, and its Remote Network Password (if it has one).

When the multiplexer is trying to connect to a remote network, the LED will blink blue. While the LED is blinking blue the multiplexer will not respond to any communication, including attempts to connect to it via WIFI and attempts to access the setup page. It is not processing NMEA data.

If the remote network is not found, or the multiplexer could not connect for some reason other than the password being wrong, the LED will blink green. The multiplexer will continue to try to find the remote network and to connect to it when it is available. You can connect to the multiplexer and access the setup page while the LED is blinking green, but it will not process NMEA data.

If the multiplexer finds the remote network but the network declines the connection because the password provided for the remote network was incorrect, the multiplexer will stop trying to connect to

the remote network. The LED will blink red and the connection status on the setup page will show “Wrong Password”. The multiplexer will not process NMEA data until you change the remote network parameters.

If the multiplexer loses connection with the remote network during operation, there will be a beep and the LED will begin to blink green. In this condition, the multiplexer will not process NMEA data, but it will serve the setup page from computers connected directly to the multiplexer. If the remote network becomes available again, the multiplexer will detect this and try to reconnect to the remote network.

Allow Setup from Remote Network

This selector controls whether computers that are attached to the same remote network as the multiplexer can access the multiplexer’s setup page. If this is “Yes”, any computer connected to the remote network, as well as any computer connected directly to the multiplexer, can access the multiplexer’s setup page. If it is “No”, only computers connected directly to the multiplexer can access it’s setup page.

Remote Network Name (SSID)

The “Remote Network Name” field is used to specify the name of the remote network to which you want the multiplexer to connect. The remote network name must be from 1 to 64 characters long and it can contain any printable characters from the ASCII character set (ASCII characters with values 32 to 126 inclusive).

Remote Network Password

The “Remote Network Password” field is used to specify the password of the remote network to which you want the multiplexer to connect. The remote network password may be empty for an unprotected network, or up to 64 characters for a protected network. This field can contain any printable characters from the ASCII character set (ASCII characters with values 32 to 126 inclusive).

Send-to IP Address

The “Send-to IP Address” field is applied only when the multiplexer is operating as a client on a remote network. If this field is blank, NMEA sentences will NOT be sent to the remote network. In order to have NMEA sentences sent to the remote network, you must put a valid IP address in this field.

In this field, you can specify any IP address that is **not** in the same network segment as the IP address of the multiplexer. For example, if the multiplexer IP Address is 10.11.12.1 then you cannot specify a “Send-to IP Address” that begins with 10.11.12.

Generally, you will put either the IP address of a single computer on the remote network, or the broadcast address of the remote network. If you specify an IP address of a single computer on the remote network then only the device with that IP address will receive the NMEA sentences. If you specify the broadcast IP address of the remote network, any device connected to the remote network will be able to receive the NMEA sentences.

The broadcast address of the remote network is the last IP address in the network, and is dependent upon the IP address of the network and its network mask. If the network mask for the remote network is 255.255.255.0, as is usually the case, then the broadcast address will be the IP address having the same value for the first three octets as that assigned to the multiplexer by the remote network, and the last octet being 255. For example, when connected to a remote network, the setup page of the multiplexer will show the “IP Address of Remote Network” just above the “Send-to IP Address” field. If this IP address is 192.168.0.105 then the broadcast IP address will be 192.168.0.255.

NOTE: The broadcast address may be different if the broadcast mask of the remote network is not 255.255.255.0. This depends upon how the remote network is set up.

This field does not affect devices that are connected directly to the multiplexer; those devices can always receive the NMEA sentences.

Receive-from IP Address

The “Receive-from IP Address” field is applied only when the multiplexer is operating as a client on a remote network, and only applies to computers connected to the remote network. The multiplexer will only accept NMEA sentences from computers that are connected to the same remote network that the multiplexer is connected if their IP address matches the IP address in the “Receive-from IP Address” field.

This field does not affect devices that are connected directly to the multiplexer; the multiplexer will always accept NMEA sentences from those devices.

If this field is blank, the multiplexer will not accept any NMEA sentences from computers that are not directly connected to the multiplexer. You can enter the IP address of a single computer and the multiplexer will only accept NMEA data from that single computer. You can also specify the first three octets of the IP address of the remote network and use 255 for the last octet to specify that any computer on that network can send NMEA data to the multiplexer.

For example, if the remote network IP address is 192.168.0.0 and you specify 192.168.0.255 then the multiplexer will accept NMEA data from any computer connected to the remote network.

Note that when you specify the Receive-from IP Address, the first three octets are taken literally. The use of 255 in any of the first three octets of the IP address does NOT indicate a “wildcard” octet like it does in the “Send-to IP Address” field and the 255 must exactly match the IP of the computer.

However, in the last octet of the “Receive-from IP Address”, the value of 255 will be considered a

wildcard, and the multiplexer will receive and process data from any computer whose IP address matches the first three octets.

Current Password

In order to prevent unauthorized changes to the settings it is necessary to enter the current password in the “Current Password” field before pressing the “Save” button. If the multiplexer has not been initialized you will not be prompted for a current password.

LED Brightness for Normal Operation

During normal operation the green LED will be lit steady. During the night, you may wish to change the brightness so it does not disrupt your nighttime vision. You can change the brightness of the green “Normal Operation” LED by selecting the desired brightness in the “Green LED Brightness” field of the setup form and pressing the “Update Brightness” button. It is not necessary to enter the Current Password to change the brightness, and brightness changes will not be applied if you press the “Save” button. The setup page will be refreshed with the new brightness value.

Please note that the “Green LED Brightness” value only affects the brightness of the steady green LED when the multiplexer is operating normally. For alarms or when flashing or blinking, the all LED’s will be full bright.

It is also possible to change the brightness directly without using the setup page. To do this, you can use the following address format in the address bar of your browser:

10.11.12.1/bri=8:

Where 10.11.12.1 is the IP address of the multiplexer and 8 is any numeric value from 0 (off) to 10 (full bright). The format of the entry in the address bar is important:

- there are no spaces
- the IP address is followed by a /
- bri is lower case, followed by =
- the brightness value is 0 to 10
- the brightness value is followed by a colon

The multiplexer will respond by changing the brightness of the LED and sending your browser a page telling you that the brightness has been changed. If you do not want the multiplexer to send you a response page, you can append /n to the address like this:

10.11.12.1/bri=10:/n (for full brightness)

10.11.12.1/bri=0:/n (to turn the light off)

The only indication you have that this command was successful is that the brightness of the LED will change. Furthermore, your browser will wait for a while for the multiplexer to respond before eventually timing out, unless you cancel it or close your browser.

HINT: You can create shortcuts in your browser for the brightness setting commands and, with a single click, set the desired daytime or nighttime LED brightness.

Factory Reset

It is possible to reset the multiplexer to its factory defaults. (If you forget your password, for example, and can no longer get access to the multiplexer!) To perform a factory reset do the following steps:

- power the multiplexer down
- push and hold the reset button located inside the cover to the left of the connector
- while continuing to hold the reset button power up the multiplexer
- continue to hold the reset button until the multiplexer beeps and the red light comes on (about 3 seconds)

NOTE: when you power up the multiplexer while holding the reset button, the LED will not be lit until the multiplexer beeps and the red light comes on. If the LED is lit before the beep, the button was not properly pressed on power-up and the multiplexer will not reset. Power down and try again.

After doing a factory reset you must set up the multiplexer and assign it a password before the multiplexer will process your NMEA data. The network name will be “nmea2wifi” and there will be no password.

Lights and Sounds

Green steady	<p>The multiplexer is operating normally.</p> <p>NMEA data is being processed and the setup page can be accessed.</p> <p>The “normal operation indicator” green LED can be turned off, so the multiplexer may be operating normally without any LED’s being lit.</p>
Green blinking	<p>The multiplexer has been set up as client on another network, but was unable to connect to the specified network. It will continue to try to make this connection without intervention.</p> <p>The setup page can be accessed by computers that are directly connected to the multiplexer. NMEA data is not being processed.</p>
Blue blinking	<p>The multiplexer is trying to connect to a remote network.</p> <p>The multiplexer will not respond to attempts to connect to it or attempts to access the setup page. NMEA data is not being processed.</p>
Red blinking	<p>The multiplexer has been set up as client on another network, but the remote network declined the connection because the password is wrong.</p> <p>It will not continue to try to make this connection; you must correct the password on the setup page.</p> <p>The setup page can be accessed by computers that are directly connected to the multiplexer. NMEA data is not being processed.</p>
Red steady	<p>Set-up is required before normal operation can begin.</p> <p>You must connect directly to the multiplexer using default parameters to access the setup page. NMEA data is not being processed.</p>
Alternating green and red	<p>The multiplexer is initializing.</p> <p>The setup page cannot be accessed. NMEA data is not being processed.</p>
Red flash and beep	<p>An overflow occurred on one of the three standard NMEA input ports.</p> <p>The NMEA sentence that caused the overflow is discarded and the multiplexer will continue to process NMEA data.</p>
Purple flash and beep	<p>An overflow occurred on the AIS/NMEA input port.</p> <p>The NMEA sentence that caused the overflow is discarded and the multiplexer will continue to process NMEA data.</p>
Blue flash and beep	<p>An overflow occurred on the NMEA output port.</p> <p>The NMEA sentence that caused the overflow is discarded and the multiplexer will continue to process NMEA data.</p>
Red pulsing and siren	<p>The multiplexer is locked and needs to be powered down and re-started.</p> <p>It will not serve the setup page or process NMEA data.</p>

Overflow Conditions

An overflow condition is indicated by a beep accompanied by a blue, red, or purple flash. A red flash indicates an overflow on one of the three standard NMEA ports. A purple flash indicates an overflow on the NMEA/AIS port. A blue flash indicates an overflow on the NMEA output port.

During normal operation, input port overflows should never occur. However, if you access the multiplexer's setup page while the multiplexer is processing NMEA data, it is likely that you will experience temporary overflows on the NMEA ports while the multiplexer sends the setup page; this is normal. If you leave your browser on the multiplexer setup page you may experience occasional overflows as the browser maintains its connection with the multiplexer. To avoid this simply close the multiplexer setup window in your browser.

If you are experiencing overflows on the input ports, the most common cause is that the multiplexer is receiving data that is not properly formatted. Properly formatted NMEA sentences cannot be longer than 82 characters, and must be terminated by the ASCII carriage return/line feed combination. The line feed characters are used to define the end of the sentence, so if a line feed character is missing an error will occur.

Improperly formatted sentences may be caused by reversed connections between the NMEA device and the multiplexer or by data loss between the two devices. Data loss can be caused by interference on the wires, broken wires, or bad connections.

The NMEA output port operates at 4800 baud; about 480 characters per second. Because of this limit, it is easy to overflow the NMEA output port by sending it too much data. Everything that is sent from your computer(s) to the multiplexer via WIFI is forwarded to the NMEA output port.

Furthermore, it is possible to specify that NMEA data from any of the incoming NMEA ports is sent directly to the NMEA output port too. If you send AIS data to the NMEA output connection, it will almost certainly overflow when AIS data is received because of the higher capacity of the high speed AIS connection.

Legal

Suitability for your use

The Encoded Solutions NMEA-to-WIFI multiplexer is designed to pass NMEA0183 sentences between WIFI devices and wired NMEA0183 devices aboard your boat. There is no other implied purpose. The reliability of the transmission of data between devices connected to the multiplexer is subject to a multitude of factors which can cause the multiplexer to fail to pass any or all NMEA sentences to or from devices that are connected to it at any time. We neither claim nor imply that this device is suitable for any particular application; it is entirely up to you to determine whether or not this device is suitable for your particular application.

Software Copyright and Licensing

The multiplexer contains copyrighted software. You may not copy or reproduce the copyrighted software in any form. In addition to the copyrighted software, the Encoded Solutions NMEA-to-WIFI multiplexer utilizes the avr-libc software libraries in an unmodified format.

The contents of avr-libc are licensed with a Modified BSD License.

All of this is supposed to be Free Software, Open Source, DFSG-free, GPL-compatible, and OK to use in both free and proprietary applications.

See the license information in the individual source files for details.

Additions and corrections to this file are welcome.

Portions of avr-libc are Copyright (c) 1999-2010

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FCC Statement

The Encoded Solutions NMEA-to-WIFI multiplexer contains the WIFI module FCC ID: 2AC7Z-ESPWROOM02. The following statement relates to this WIFI module only.

This device 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 device 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 device does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and the receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

Any changes or modifications to this device not expressly approved by Espressif may cause harmful interference and void the user's authority to operate this module. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

This device must not be co-located or operating in conjunction with any other antenna or transmitter.