

EtherWave WER2 User's Guide

Version 01



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Version History

Version	Description
V 01	Initial Release

Introduction

Thank you for your purchase of the EtherWave IP Addressable Outdoor 900 MHz Wireless Ethernet Transceiver. If you have any questions when configuring your ioSelect system, the best place to get answers is to visit www.ioselect.com. You will also find the latest updates there.

If more assistance is needed, send email to support@ioselect.com, or to speak to a live technician, please call technical support at the number below during normal business hours.

Overview

The EtherWave radio allows the user to create a long-range, wireless Ethernet network with up to 16 subscriber units per access point, 12 access points in a given RF area (1 per RF channel), and 64 routable MAC addresses per Access Point. So many Ethernet devices can be connected to a single subscriber unit as long as there are no more than 64 devices (MAC addresses) per access point.

Configuring a wireless link with the EtherWave requires the following elements:

- Each radio must know whether it is to be an access point (AP) or subscriber unit (SU).
- The AP must know how many SUs are expecting communication with it.
- The AP and any given SU must agree on which radio frequency channel they are using. This can be manually set or allowed to change automatically.
- The SU must be assigned a unique subscriber ID to specify which time division slot it will use when communicating with the AP.
- The AP and any given SU must share a common 128-bit encryption key.
- Each radio must have an IP address that is unique among all others on the same network. This assumes two things:
 1. You want to access the webpages of the various radios at some point
 2. You have a device connected to any radio that will have an address of *192.168.17.17* (Default shipped IP address of EtherWave radios)

If *NONE* of these things are true, then the radios can be deployed using the "Key Exchange Method" described later and everything will work fine.

EtherWave radios may be configured by two different methods:

- Key Exchange Method - Using Ethernet cable, DIP switches, and LEDs on the module.
- Web browser - Setting parameters via the built-in browser interfaces.

Any EtherWave configured as an access point (AP) automatically scans for the best of the 12 available radio frequency channels, encrypts Ethernet data received from the network, and transmits it wirelessly to the correct subscriber unit (SU). The AP is constantly monitoring the radio link and can automatically change the channel if performance is degraded due to interference. If two AP units are very close to one another, they may interfere if operating on adjacent frequency channels. Place them at least 10 feet apart or manually select non-adjacent channels for their operation. Also, the SU should be placed at least 10 feet from the AP to avoid overloading the radio's receiver.

Any 10/100 BaseT Ethernet client device (ECD) can be connected to an EtherWave subscriber unit. Each SU encrypts Ethernet traffic received from the attached ECD and transmits the data wirelessly to its AP. Each SU can be plugged directly into an ECD without adding drivers or loading software. Essentially, once the AP/SU pair is configured and running it behaves like a continuous Ethernet cable.

Hardware Setup

Before mounting the radio in its final location, you may want to perform the digital setup procedure described in the next section.

1. Mount the EtherWave securely to a piece of DIN rail.
2. Connect the EtherWave's RP-SMA connector to a suitable antenna. If in a lightning prone area a lightning arrestor should be used between the antenna and the radio, and the arrestor should be well grounded. A variety of antenna types are available and you may see them on our website at www.ioselect.com.
3. Power can be provide to the unit in two ways:
 - a. Pluggable terminal block on the sie of the unit (9 to 48 VDC)
 - b. Power over Ethernet (POE) – Via an Ethernet cable, allowing unit to be powered by a POE sourcing switch of other device.

LED Definitions

Name	Function	Color
Power	Unit has power and has successfully booted.	Red
RF TX	Radio transmission is occurring.	Green
RF RX	Radio reception is occurring.	Green
Eth Link	The Ethernet Port has a valid Ethernet connection	Green
1	By adding the numbers that are lit the user can determine the current radio channel.	Green
2		
4		
8		
16		
32		
Link Quality Meter - The more LEDs that are lit the higher the link quality.	Excellent link quality - No retransmissions	Green
	Very good link quality - Few retransmissions	Green
	Good link quality - Occasional retransmissions	Amber
	OR Fair link quality - Some retransmissions	Amber
"Key exchange mode" when blinking sequentially	Poor link quality - Many retransmissions	Red
	No link quality No link available	Red

DIP Switch Definitions

The DIP switched are really only used when using the Key Exchange configuration Method.

DIP 1

Access point or subscriber unit

- By selecting DIP 1 ON the radio will operate as an access point
- By selecting DIP 1 OFF the radio will operate as a subscriber unit

DIP 3 to 8

Automatic frequency selection mode (DIP 3-8 OFF for automatic mode)

The EtherWave is designed to automatically select and continuously optimize the performance of its radio channel. The radio channel is monitored to ensure it is providing low error rates necessary for successful data transmission. In the event that the error rate rises, the access point will autonomously change to a new channel. There are 12 non-overlapping channels.

Manual frequency selection mode

The operation of the EtherWave can be restricted to a specific channel within the 900 MHz band by setting DIP switches 3-8 on the access point as shown in the table below. The subscriber unit responds to the access point's choice of channel and its DIP switches have no effect and do not need to be selected.

Channel Frequencies

Channel	DIP Setting	Center Frequency
1	3 On / 4 Off / 5 Off / 6 Off	903.12500 MHz
2	3 Off / 4 On / 5 Off / 6 Off	905.20833 MHz
3	3 On / 4 On / 5 Off / 6 Off	907.29167 MHz
4	3 Off / 4 Off / 5 On / 6 Off	909.37500 MHz
5	3 On / 4 Off / 5 On / 6 Off	911.45833 MHz
6	3 Off / 4 On / 5 On / 6 Off	913.54167 MHz
7	3 On / 4 On / 5 On / 6 Off	915.62500 MHz
8	3 Off / 4 Off / 5 Off / 6 On	917.70833 MHz
9	3 On / 4 Off / 5 Off / 6 On	919.79167 MHz
10	3 Off / 4 On / 5 Off / 6 On	921.87500 MHz
11	3 On / 4 On / 5 Off / 6 On	923.95833 MHz
12	3 Off / 4 Off / 5 On / 6 On	926.04167 MHz

Radio Configuration

The EtherWave radios can be setup via different two methods.

Key Exchange Method

The radios use electronic network keys that allow the user to group radios together to form a network. Network keys are shared between radios by connecting an Ethernet cable between the RJ45 ports while the radios are in "key exchange mode" (radios that are in "key exchange mode" display the 6 LINK QUALITY LEDs blinking sequentially back and forth).

To share the keys and to create the network, the user first selects which radio will be the access point (AP) by setting DIP switch 1 ON. The other radios will function as subscriber units (SUs) and do not require any DIP settings. The user then connects an Ethernet cable from the AP to each SU to transfer the network keys. Any standard Ethernet cable will work (does not need to be a crossover cable). Key exchange will not work through a switch or hub.

Once the key sharing is complete the AP and SU change their LED displays in confirmation of the successful programming:

- The SU blinks one of the Green Link Quality LEDs.
- The AP illuminates the LED labeled RF RX and the AP remains in "key exchange mode."

If the user's needs change:

- Additional SUs can be added to the network
- An SU can be reprogrammed to join a different network
- An SU can be changed into an AP
- An AP can be changed into a SU.

The radios cannot be damaged by incorrect programming. If DIP 1 is accidentally toggled then DIP 1 can be turned back and the radio still retains all the network associations it had in its previous mode (assuming that the radio had not yet successfully key exchanged with a new network). An AP can be reset by programming it as a SU to a new AP and then turning it back into an AP again.

SUs that have not yet received a network key boot up in "key exchange mode" and wait to receive a key. SUs that have received a network key will boot up for 5 seconds in "key exchange mode" and will look to see if a new AP is present. If a new AP is present, then the SU exchanges keys with the AP, otherwise the SU begins normal operation after the 5 seconds.

APs that have not yet issued network keys boot up in "key exchange mode" until they have issued network keys to at least 1 SU. Once the AP has issued keys it will only boot up for 5 seconds in "key exchange mode." If a SU is present during the 5 seconds, then the AP will issue new keys to the SU and will then remain in "key exchange mode," waiting for more SUs to be attached. Once all new SUs have been attached, the AP must be power cycled. The AP will boot up and will enter normal operation after 5 seconds of "key exchange mode."

Initial Setup Steps

- 1) Select the radio that will operate as the access point (AP) and set DIP switch 1 ON to enable AP operation.
- 2) Plug in the access point.
 - The LINK QUALITY LEDs will blink sequentially showing that the radio is hunting for a subscriber unit (SU) to share keys with.
- 3) Plug in a subscriber unit.
 - The LINK QUALITY LEDs will blink sequentially showing the radio is hunting for an AP to supply a network key.
- 4) Connect an Ethernet cable from the AP to the SU and the units will automatically exchange keys over the Ethernet cable (key exchange will not work through a switch or hub — crossover cables are not required).
 - On the AP, the LINK QUALITY LEDs will still show that the radio is still in "key exchange mode" and the RF TX LED will be lit showing that the keys exchanged successfully — ignore the other LEDs.

- On the SU, the LINK QUALITY LEDs no longer blink sequentially and will show that the radio has stopped hunting and now has a slowly blinking pulse on one of the GREEN LINK QUALITY LEDs — ignore the other LEDs.
- 5) Repeat steps 3 and 4 until all SUs are successfully programmed.
 - 6) Disconnect the Ethernet cable.
 - 7) Power cycle all radios for the new keys to take effect, and deploy the radios.

New SU to Existing AP Steps

- 1) Disconnect the AP from the network and disconnect power from the AP.
- 2) Connect an Ethernet cable from the AP to the SU (key exchange will not work through a switch or hub — crossover cables are not required).
- 3) Plug in the NEW SU, then plug in the AP. The units will automatically exchange keys over the Ethernet cable.
- 4) Repeat steps 2 and 3 until all SUs are successfully programmed.
- 5) Power cycle all radios for the new keys to take effect.
- 6) Reconnect the AP to the network and deploy the new SU radios.

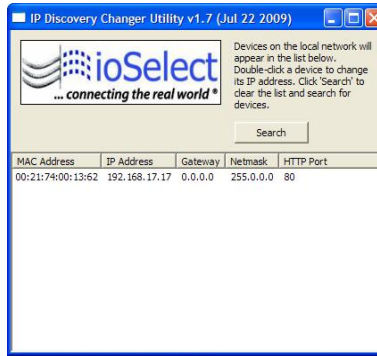
Existing SU to New SU Steps

- 1) Select the radio that will operate as the access point (AP) and set DIP switch 1 ON to enable access point operation.
- 2) Plug in the NEW AP.
- 3) Connect an Ethernet cable from the AP to the SU (key exchange will not work through a switch or hub — crossover cables are not required).
- 4) Plug in the SU.
- 5) Repeat steps 3 and 4 until all SUs are successfully programmed.
- 6) Power cycle all radios for the new keys to take effect and deploy the radios.

Web Browser Method

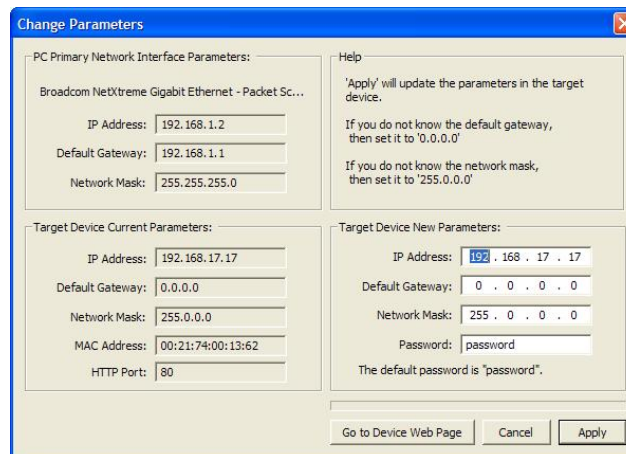
- 1) Web browser based configuration is done by means of the EtherWave's built in web interface. It should be powered on and connected at least temporarily to a network containing a computer that can run a conventional web browser (Default IP Address: *192.168.17.17*).
- 2) Download the EtherWave IP Utility from our website and extract the ipfinder.exe from the zip archive, placing it on your desktop or in a convenient folder.
 - *Advantage* - The utility should find and allow you to configure key EtherWave parameters *NO MATTER* what IP address setting your PC currently has (as long as the PC and the EtherWave are physically connected via a cable or Ethernet hub / switch), and it makes it easy to change settings.
 - *Disadvantage* - This utility only runs on MS Windows, not linux or MAC. If you must use a non-Windows computer for configuration then make sure your current IP settings (subnet mask, etc.) allows your computer to see *192.168.17.17* and connect to that default IP address with your web browser, continuing the setup procedure with step 6.

- 3) Run the EtherWave IP Utility and you should see a window similar to this:



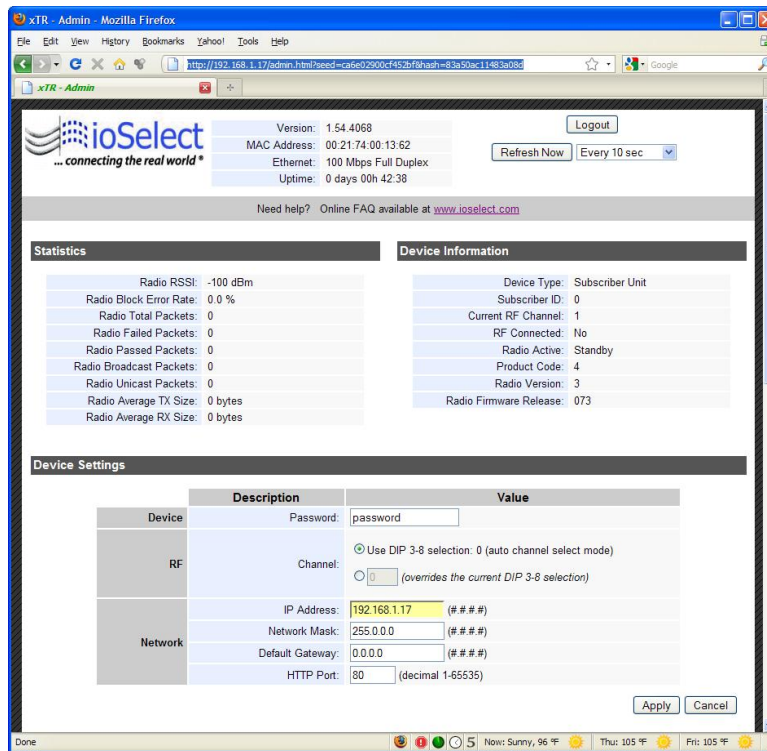
The EtherWave should appear in the list at the default IP address of *192.168.17.17*. If it does not, click "Search" to regenerate the list. If it still does not appear, you have a connection issue and need to re-examine the cabling or you may have a firewall issue on your computer.

- 4) Double click the list item that refers to the EtherWave being configured. You should see a second window that is similar to this:



The information on the left is the current status of the radio, while the boxes on the right allow you to change it. It is important that the IP address of the EtherWave is in the same subnet as your computer. For example, if the subnet mask is 255.255.255.0 (a class C network), the first three number groups of the IP address must match. Choose your desired parameters and click "Apply."

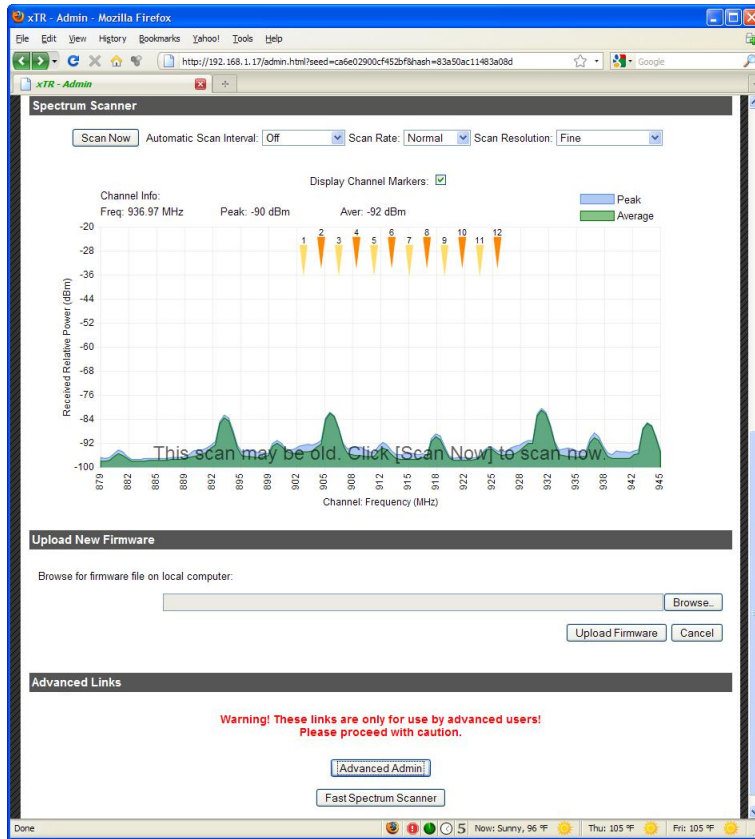
- 5) Make note of the chosen IP address and password, then click "Go to Device Web Page." This will cause your default web browser to launch with the device IP address in the browser address bar. Or you may launch the browser on your own and enter the web page address manually: [http://\[the IP address you just set\]](http://[the IP address you just set]).
- 6) The browser page ([http://\[the address of the unit\]](http://[the address of the unit])) that loads first shows the current device information and QoS statistics and provides a login at the upper right. Log in using the password you just specified (or "password" if you kept the default). If the login succeeds, you will see an admin page similar to this:



7) The admin page has sections similar to the login page showing radio statistics and device information plus it adds several new sections. The Device Settings section allows setting the network information and choosing an RF frequency channel. The default is to allow the radio to choose its own frequency based on minimizing interference. If you set a fixed channel, make sure the AP and all SUs use the same one. References to DIPs on this and the next web page refer to switches inside the radio that are used in the legacy method of configuration and may be ignored when using the browser method.

If you scroll down in the Admin browser page, you will come to three more sections:

- A graphical spectrum analyzer display that may help you to select radio channels that avoid interference
- A section to be used if an update to the units firmware is required
- An Advanced Links section with a warning about advanced users only



Despite the warning, you will need to click the “Advanced Admin” button in order to set the device type, ID and encryption key. You should then see a page similar to this:

	Description	Value
Device:	Type:	<input type="radio"/> Access Point (override DIP 1 selection) <input checked="" type="radio"/> Subscriber Unit (DIP 1 selection)
	Subscriber ID:	Every SU must have a unique ID. Valid IDs are from 1 to 63. 0 (decimal 1-63)
Encryption:	Network Name (32-bit):	XXXX-XXXX 0000-04e4 (hex)
	Encryption Key (128-bit):	XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX (hex)

Buttons: Apply, Cancel, Reset Device

On the Advanced Admin page, set the parameters as follows:

- Choose Device Type: Access Point or Subscriber Unit.
- For Subscriber Units, assign unique ID numbers in numeric order from 1 to 63.
- For an Access Point, enter the number of Subscriber Units that will be communicating with it.
- Click the box labeled "Enable User Specified Keys."
- Choose an 8-digit hex (0-9 and A-F) Network Name that will be common among the AP and its SUs and enter it. The hyphen is required.
- Choose a 32-digit hex encryption key and enter it. Again, the hyphens are required. This key must match between the AP and the SU so make a note of it as well.

After entering the parameters, click the "Apply" button to save them to the radio. When all of the radios are keyed and operating, connect them to your network and Ethernet devices as desired and cycle the radio's power to begin normal operation. Now, browser management of the SUs can be performed over the wireless network.

- 8) Avoid plugging actively linked radios into the same switch because this will corrupt its routing table and may cause network problems just as if you had plugged a CAT5 cable directly between two ports of a switch.

General Specifications

RF transmission rate	1.536 Mb/s
Ethernet throughput	935 Kb/s
Output power	+21 dBm (4 Watts EIRP used with 15 dBi antenna)
Receive sensitivity	-97 dBm at 10e-4 BER (-112 dBm with 15 dBi antenna)
Radio link budget	148 dB with 15 dBi antennae
Range	40 miles LOS with 15 dBi antenna
Radio channels/bandwidth	12 non-overlapping with 2.0833 MHz spacing and 1.75 MHz occupied bandwidth
Manual frequency select	Channel selected with DIP switch
Connector types	RF SMA Female / Ethernet RJ45 10BaseT / Pluggable Terminal Block (2 pos)
Status LEDs	Power, Ethernet Link, RF RX, RF TX, 4/Channel, and 6/Link Quality
Error correction technique	Sub-block error detection and retransmission
Adjacent-band rejection	SAW receiver filter attenuates cellular and pager interference
Power consumption	Transmit: 1.25 W Receive: 0.6 W
Voltage	9 to 48 VDC Power over Ethernet Pins 4/5 positive and 7/8 ground
Temperature range	-40°C to 70°C
Transmit current draw	150 mA at 9 VDC 110 mA at 12 VDC 32 mA at 48 VDC
Size	2.2" x 2.7" x 3.5" (56 x 69 x 89 mm)

More Information or Support

Please contact ioSelect directly.



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Thank You