

FreeWave Technologies, Inc.

2.4 GHz Wireless Modem Installation Guide

This installation guide covers all models of the FreeWave Technologies 2.4 GHz spread spectrum transceiver sold under FCC ID KNY2920513513419.

FCC Notification

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 must be operated as supplied by FreeWave Technologies, Inc. Any changes or modifications made to the device without the express written approval of FreeWave Technologies may void the user's authority to operate the device.

CAUTION: This device has a maximum transmitted output power of 500mW. It is recommended that the transmit antenna be kept at least 36 cm away from nearby persons to satisfy FCC RF exposure requirements.

Note: 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 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 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.

Note: Whenever any FreeWave Technologies module is placed inside an enclosure a label **must** be placed on the outside of that enclosure which includes the module's FCC ID.

A. Transceiver installation steps

To install the FreeWave 2.4GHz transceiver, follow the basic steps given below.

1. Mount the transceiver to the flat, stable surface using mounting holes in the corners of the transceiver.
2. Install the antenna and connect the antenna feedline to the transceiver. If you are installing a directional antenna, preset the antenna's direction appropriately.
3. Connect a computer to the transceiver's RS232 port (please refer to the part C of this addendum for more information about the transceiver's pin assignment). This computer will be used to set the radio's configurations.
4. Install the power for the radio.
5. Set the radio configuration according to the system topology and data terminal equipment requirements. Default transceiver settings allow user to do a quick installation without major changes in transceiver's configuration. But there is one parameter that ***must be considered for a new installation – transceiver's power output settings.***

Transceiver output power level *must be* set according to the tables given below to satisfy FCC maximum EIRP requirement. Per FCC regulations, any antenna used with FreeWave transceivers must either be one of the approved antennas shown below or an antenna with comparable performance parameters. FreeWave Technologies offers a variety of omnidirectional and directional external antennas, with both bracket and magnetic mounts. The complete list of antennas available from FreeWave Technologies including antenna gains, antenna manufacturer's information and antenna's characteristics is shown below:

The following antennas are approved for use with FreeWave 2.4GHz transceivers:

2.4GH Directional Antennas

Gain	Manufacturer	Manufacturer Model Number	FreeWave Model Number
14dB	Mobile Mark	SCR14-2400	EAN2414CR

2.4 GHz Omnidirectional Antennas

Gain	Manufacturer	Manufacturer Model Number	FreeWave Model Number
5dB	Maxrad	MAXC24505	EAN2405WC
2.5dB	Mobile Mark	PSTN3-2400N	EAN2400NH

WARNING: Any antennas placed outdoors must be properly grounded. Use extreme caution when installing antennas and follow all instructions included with the antennas.

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Table 1 below provides the maximum output power settings for FreeWave 2.4GHz transceivers at given antenna gain (14 dB and 5 dB antennas are given as an example in Point to Point and Point to Multipoint systems) and cable loss combinations. Please note that ***it is installer's responsibility to assure that the emission limits are not exceeded.***

Table 1: Output Power Settings at given Antenna Gain & Cable Loss combination.

Antenna Gain	Cable Loss			
	1dB	2dB	3dB	4dB
14dB, Point-to-Point	6	8	9	9
14 dB, Point-to-Multipoint	5	5	6	8
5dB	9	9	9	9

Table 2 below shows how the RFXmitPower settings on the radio correspond to the EIRP of the transceiver-cable-antenna combination for the 14 dB Yagi antenna at different cable loss values for the Point-to-Point system architecture.

Table 2: FreeWave Technologies 2.4GHz EIRP for 14dB Corner Reflector Antenna, Point-to-Point system architecture, Cable loss vs RF Xmit Power Setting.

RF Xmit Power	Cable Loss			
	1dB	2dB	3dB	4dB
9	39.43	38.43	37.43	36.43
8	38.98	37.98	36.98	35.98
7	38.17	37.17	36.17	35.17
6	36.93	35.93	34.93	33.93
5	34.96	33.96	32.96	31.96

Shaded area indicates combinations where EIRP limitations exceed FCC regulations and RF Xmit Power must be reduced.

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Table 3 below shows how the RFXmitPower settings on the radio correspond to the EIRP of the transceiver-cable-antenna combination for the 14 dB Yagi antenna at different cable loss values for Point-to-Multipoint systems.

Table 3: FreeWave Technologies 2.4GHz EIRP for 14dB Corner Reflector Antenna, Point-to-MultiPoint systems, Cable loss vs RF Xmit Power Setting.

		Cable Loss			
		1dB	2dB	3dB	4dB
RF Xmit Power	9	39.43	38.43	37.43	36.43
	8	38.98	37.98	36.98	35.98
	7	38.17	37.17	36.17	35.17
	6	37.93	36.93	35.93	34.93
	5	34.96	33.96	32.96	31.96

Shaded area indicates combinations where EIRP limitations exceed FCC regulations and RF Xmit Power must be reduced.

The table below shows the RF loss at various cable lengths at 2.4GHz.

Table 4: Cable loss at 2.4GHz

Length in Feet	LMR240	LMR400
10	1.3dB	.7dB
20	2.6dB	1.4dB
25	3.2dB	1.7dB
30	3.9dB	2.1dB
50	6.5dB	3.4dB
100	12.9dB	6.8dB

Follow the steps below to configure the Power Output Level:

- ✓ Start HyperTerminal or any other terminal emulation program on the computer connected to the transceiver's RS232 port (refer to the User Manual for the HyperTerminal setup instructions).
- ✓ Invoke the setup menu on the transceiver.
- ✓ Choose option number "3" from the Main Menu which appeared on the "Hyper Terminal" window.

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- ✓ Choose option number “5” from the “Radio Modem Parameters” menu followed by the settings an appropriate RFXmitPower value, which was defined from the previous transceiver installation procedure.

6. Repeat the steps above for each transceiver in the network.

Networks using the FreeWave 2.4GHz transceiver that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

This excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the FreeWave 2.4GHz transceiver or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations.

Please contact FreeWave Technologies at 303-444-3862 with any questions regarding this matter.

B. Transceiver Location

Placement of the FreeWave transceiver is likely to have a significant impact on its performance. In general the rule of thumb with FreeWave is that the higher the placement of the antenna the better the communication link - height is everything! In practice you should also place the transceiver away from computers, telephones, answering machines, and other similar equipment. To improve the data link, FreeWave Technologies offers directional and omnidirectional antennas with cable lengths ranging from 3 to 200 feet.

When using an external antenna, placement of that antenna is critical to a solid data link. Other antennas in close proximity are a potential source of interference; use the Radio Statistics or Diagnostics software to help identify potential problems. It is also possible that slight adjustments in antenna placement (as little as 2 feet) will solve noise problems.