

User Guide
Technical Reference
for
ioWave 5.7 GHz
Radio Frequency Unit



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Welcome

Congratulations on selecting the **ioWave** 5.7 GHz RF Unit.

We value your working with our company, which is now ISO 9001 certified, and encourage you to call us with your comments and suggestions. We look forward to serving you.

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PRELIMINARY

Table of Contents

Welcome	i
Table of Contents	ii
Table of Figures	ii
Table of Tables	ii
 SECTION 1 ioWave 5.7 PRODUCT DESCRIPTION	 1-1
1.1 Key Features and Benefits of ioWave	1-1
1.2 RF Unit (Outdoor) Description	1-2
1.3 Operation of the ioWave 5.7 RF Unit	1-4
1.4 How to Contact Us	1-5
 SECTION 2 INSTALLING THE ioWave 5.7 SYSTEM	 2-1
2.1 Site Survey and Path Analysis	2-1
2.1.1 Suitable Antenna	2-1
2.2 Install the ioWave 5.7 GHz RF Unit	2-1
2.3 Connect the RF Cable	2-2
2.4 Grounding to an Antenna Tower	2-3
2.5 Connect the IF Cables	2-4
2.5.1 IF Cable Connecting Procedure	2-4
 APPENDIX A TECHNICAL SPECIFICATIONS FOR ioWave 5.7	 A-1
APPENDIX B IMPORTANT INFORMATION ABOUT YOUR ioWave SYSTEM	B-1
B.1 FCC Regulatory Notice	B-1
B.2 Warranty	B-1
B.3 Disclaimer	B-3
B.4 Use of ioWave Products Outside of the United States	B-3

Table of Figures

Figure 1-1. View of 5.7-GHz RF Unit Connectors	1-2
Figure 1-2. <i>ioWave</i> 5.7 GHz RF Unit Block Diagram	1-3
Figure 1-3. <i>ioWave</i> 5.7 GHz RF Unit System Overview	1-5
 Figure 2-1. RF Unit and RF Cable Installation	 2-2
Figure 2-2. Ground RF Unit to the Tower	2-3
Figure 2-3. Fasten IF Cables to the Tower	2-4

Table of Tables

Table 1-1. ioWave 5.7-GHz RF Unit Frequency Options	1-1
Table 1-2. Frequency Plan for 5.7-GHz RF Unit	1-4
Table A-1. Technical Specifications for ioWave 5.7-GHz RF Unit with ioLink 1	A-1
Table A-1. Technical Specifications for ioWave 5.7-GHz RF Unit with ioLink 4	A-2

SECTION 1 *ioWave* 5.7 PRODUCT DESCRIPTION

1.1 Key Features and Benefits of *ioWave*

The **ioWave 5.7** RF Unit provides many important features and benefits:

- Operates in the precertified 5.725-to-5.850 GHz ISM band.
- Provides clear and robust voice, video, and data communications for up to 25 miles.
- Operates unaffected by rain, snow, fog, and other climatic conditions.
- Simplifies troubleshooting IF signal, through separate receive and transmit cables.

Another important feature of *ioWave* products is their scalability. Once a link is installed, users can upgrade a single T1 or E1 link without changing RF Unit, existing cables, or Antenna in order to increase throughput.

1.2 *ioWave* 5.7 Description

The RF Unit is the part of several **ioWave** systems that transmit, and receive signals at the designated carrier frequency. Compact and weatherproof, is designed for mounting close to the Antenna.

The **ioWave 5.7** RF Unit is built to provide a single E1 or T1 connection or four multiplexed E1 or T1 connections depending on which modem is utilized. The RF Unit's three frequency pairs are identified in Table 1-1.

Table 1-1. *ioWave* 5.7 RF Unit Frequency Options

<i>ioWave</i> 5.7 RF Unit Frequency Options		
5.7 GHz	Plan A	5738 MHz and 5798 MHz
5.7 GHz	Plan B	5818 MHz and 5758 MHz
5.7 GHz	Plan C	5838 MHz and 5778 MHz

The 5.7-GHz RF Unit consists of various circuit boards and a power supply placed in a 15 ¼ " High x 9 ½ " Wide x 2 ¼ " Deep NEMA-4 weatherproof enclosure. The RF Unit is usually mounted directly behind or below the Antenna, but may be mounted further away if good-quality RF Cables are used and the additional cable loss can be tolerated. It has two TNC-type jacks for connecting to the Modem Unit via the IF Cables and an N-type jack for connecting to the Antenna via the RF Cable. The connectors are shown in Figure 1-1. It also has dual grounding posts on the right side for better grounding to the support's structure using single- or dual- (recommended) hole grounding lugs.

Figure 1-1. View of 5.7-GHz RF Unit Connectors

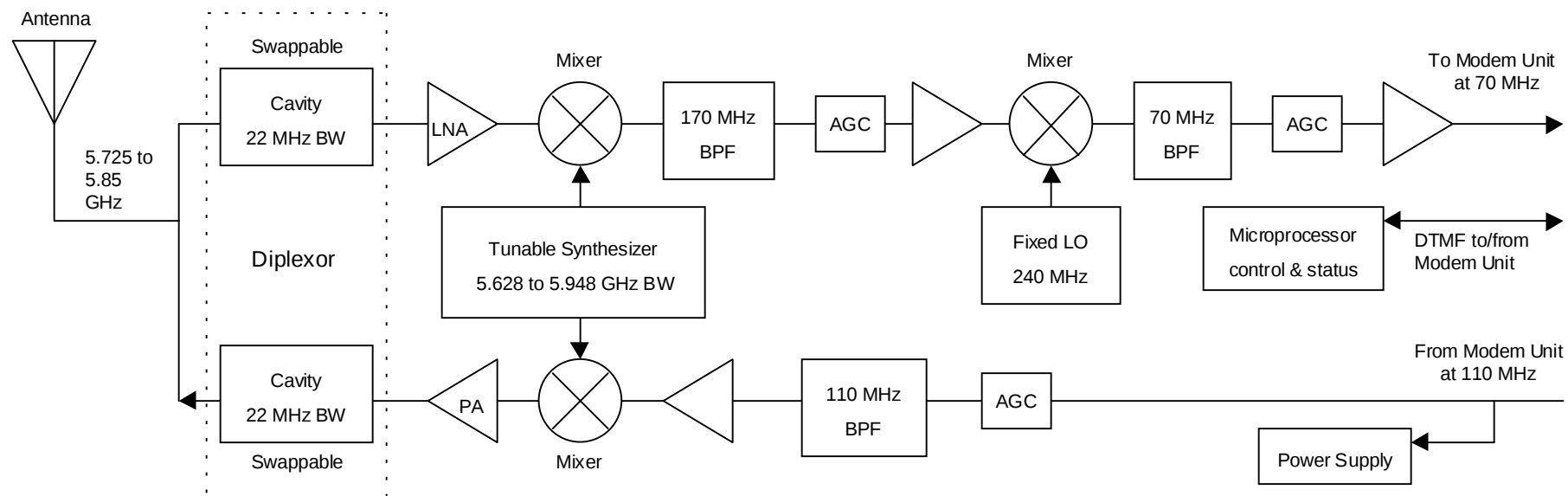


The 5.7-GHz RF Unit is used to transmit and receive a full-duplex Direct Sequence Spread Spectrum (DSSS) signal for use in communicating between two line-of-sight locations. The RF Unit consists of a diplexor, a tunable synthesizer, a Local Oscillator (LO), several Band Pass Filters (BPF), Automatic Gain Controls (AGC), a Power Amplifier (PA), a Low Noise Amplifier (LNA), and several other amplifiers.

The block diagram of the 5.7-GHz RF Unit is shown in Figure 1-2.

The RF Unit provides three transmit/receive frequency channel pairs in the 5.725 to 5.850 GHz range. The unit transmit-side up converts the 110 MHz input Intermediate Frequency (IF) from the Modem Unit to the selected transmit frequency channel. A transmitter cavity filter rejects the LO feed through and the third lobe of the spread spectrum transmit signal. A single tunable synthesizer is shared by transmit and receive paths. The receive-side down converts the selected receive frequency channel to a final 70 MHz Intermediate Frequency.

Control and status collection are performed by an on-board microprocessor which receives control from the Modem Unit via a Dual Tone Multiple Frequency (DTMF) signal. Status information collected is sent back to the **ioLink 4** Modem Unit and displayed on its front panel.

**Figure 1-2. ioWave 5.7 GHz RF Unit Block Diagram**

The microprocessor can receive interrupts from the DTMF modem, the transmit power detector, and the RF and IF phase locked loops.

The three selectable transmit/receive frequency channel pairs in the 5.7-GHz RF Unit are A1 & A2, B1 & B2, and C1 & C2. If several **ioWave** links emanate from one site, all links at that site should have either the “*1” or the “*2” RF channel names, but not a mixture.

The six 22 MHz Band center frequencies are shown in Table 1-2.

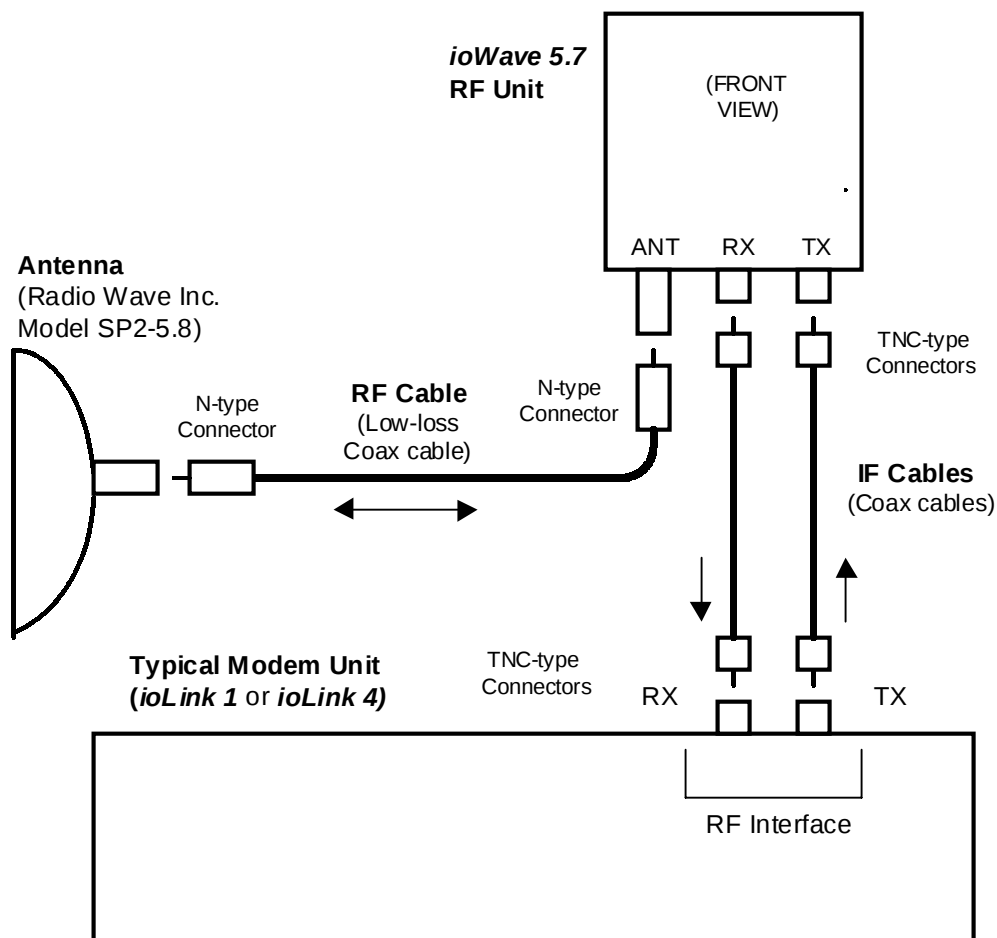
Table 1-2. Frequency Plan for 5.7-GHz RF Unit

5.7-GHz RF Unit's Frequency Plan						
Channels	A1	A2	B1	B2	C1	C2
Receive Input	5.738	5.798	5.758	5.818	5.778	5.838
Transmit Output	5.798	5.738	5.818	5.758	5.838	5.778

The 5.7-GHz RF Unit's NEMA-4 enclosure can operate at temperatures between -40° C and +60° C without damage to the internal circuitry. A vent device on the enclosure allows pressure equalization without compromising the environmental seal. This RF Unit must be mounted so that vent immersion is not possible. To help protect against lightning strikes, the unit should be grounded to a support structure via the unit's grounding stud. In lightning susceptible installations, a lightning arrestor is recommended where the RF Cable enters the RF Unit. This is especially important if the RF Unit is not located close to the Antenna, but some distance away, such as at the bottom of the tower. The 5.7-GHz RF Unit may be stored in a temperature range of -40° C to +70° Centigrade.

1.3 Operation of the **ioWave 5.7** RF Unit

The control and monitoring of the **ioWave 5.7** RF Unit's status is performed by several different **ioWave** Modem Units. The two major Modem Units in operation at this time are the **ioLink 1** and the **ioLink 4**. The way the **ioWave 5.7** RF Unit connects to the Antenna and to the Modem Units is shown in Figure 1-3.

Figure 1-3. ioWave 5.7 RF Unit System Overview

1.4 How to Contact Us

Troubleshooting recommendations are provided in the User Guides for the **ioLink 1** and the **ioLink 4**. If a problem persists after troubleshooting, or the specific problem does not appear in any of our charts, contact our Technical Support personnel at **ioWave**.

Any problems due to component failure are addressed in the warranty and service agreement. Any product that must be returned to **ioWave** must have the proper Returned Material Authorization (RMA) number obtained prior to shipping. See warranty and service guidelines provided in Appendix B for more information.

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SECTION 2 INSTALLING THE *ioWave* 5.7 RF Unit

2.1 Site Survey and Path Analysis

When requested, **ioWave** will perform a site survey and/or path analysis. The site survey typically consists of a detailed set of notes taken during an initial site visit. These notes include recommendations on Antenna type, Antenna Mount type, IF Cable tie down procedures as well as Antenna placement specifications on the supporting structure to insure the absence of interferors. **ioWave**'s path analysis is performed using "in house" path calculation software for determining the acceptable geographic location and height of the Antennas. For more information, refer to the **ioWave** web site, <http://www.iowave.com> or call **ioWave** Technical Support.

2.1.1 Suitable Antenna

The **ioWave** 5.7 RF Unit may be used with the following Antenna: Radio Waves Inc., Model SP2-5.8, Plane Polarized.

Note: For detailed instructions on mounting the Antennas, consult the documentation by the Antenna manufacturer.

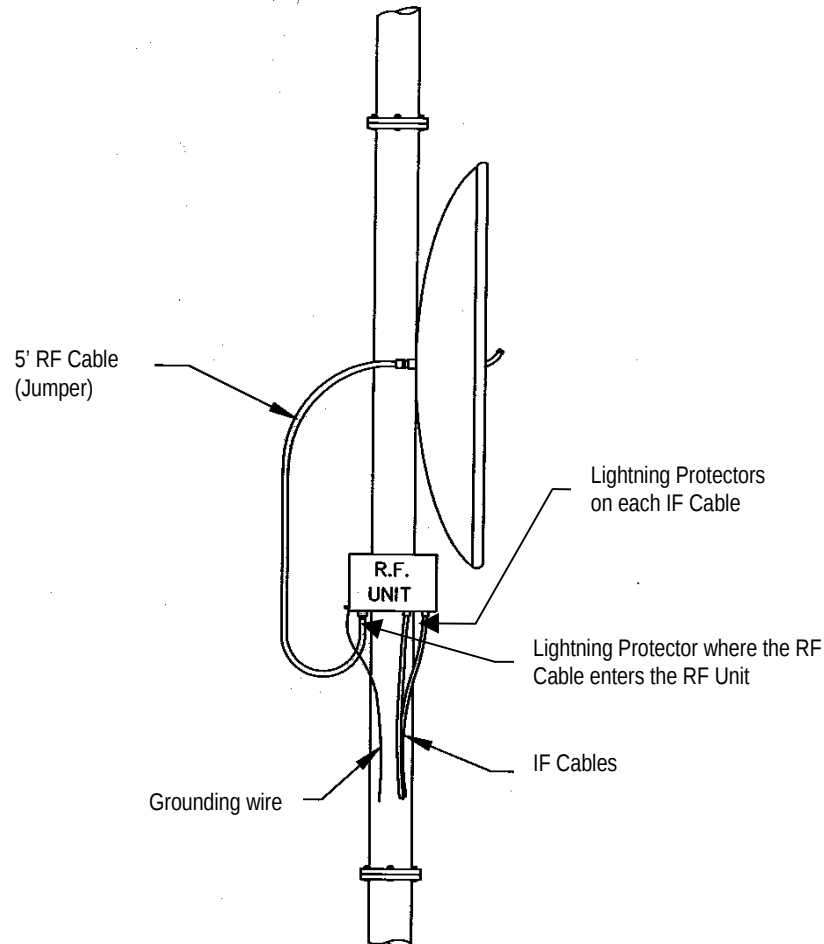
2.2 Installing the *ioWave* 5.7 RF Unit

1. The RF Unit should be securely affixed to the Antenna support structure, with the IF and RF connectors end pointing down, as in Figure 2-1. **ioWave** recommends using U-bolts to secure the unit to the structure, though the fasteners used will depend on the requirements of the specific site.
2. Tighten the RF Unit mounting hardware so it is snug and secure. However, avoid over tightening the fasteners, as it may deform the mounting panel of the RF Unit.
3. Ground the RF Unit via the twin ground pegs located on the side of the unit. The ground wire, shown in Figure 2-1, is generally a coated #6 strand wire. This ground wire should use a double hole lug for attachment to the twin ground pegs.
 - a. Rooftop Location.
Use the ground wire to connect the grounding stud on the RF Unit to the mounting structure's lightning-protection and grounding system.
 - b. Tower Location.
The RF Unit can either be grounded to the tower, or to a grounding cable if installed. If a grounding cable is installed as part of the installation, securely fasten it to the tower grounding system at the base of the tower, etc.



Note: Tower grounding and lightning protection are not covered in these instructions. Be sure to comply with all applicable codes and applicable grounding practices.

Figure 2-1. RF Unit and RF Cable Installation



Note: The bottom of the RF Unit should not be allowed to rest in water. Ensure the RF Unit is mounted above any water that may accumulate from a rain storm.

2.3 Connect the RF Cable

After mounting the RF Unit directly behind or below the Antenna, install the RF Cable between the dish and the RF Unit. Refer to Figure 2-1. Do not weatherproof the RF Cable until after the Antenna alignment.

If the Antenna does not have integral grounding of the center conductor or other lightning protector, or if the RF Unit is mounted more than 20 feet from the Antenna, **ioWave** recommends installing a lightning surge arrestor between the RF Cable and the RF Unit. The lightning surge arrestor should be grounded at the same point as the RF Unit.

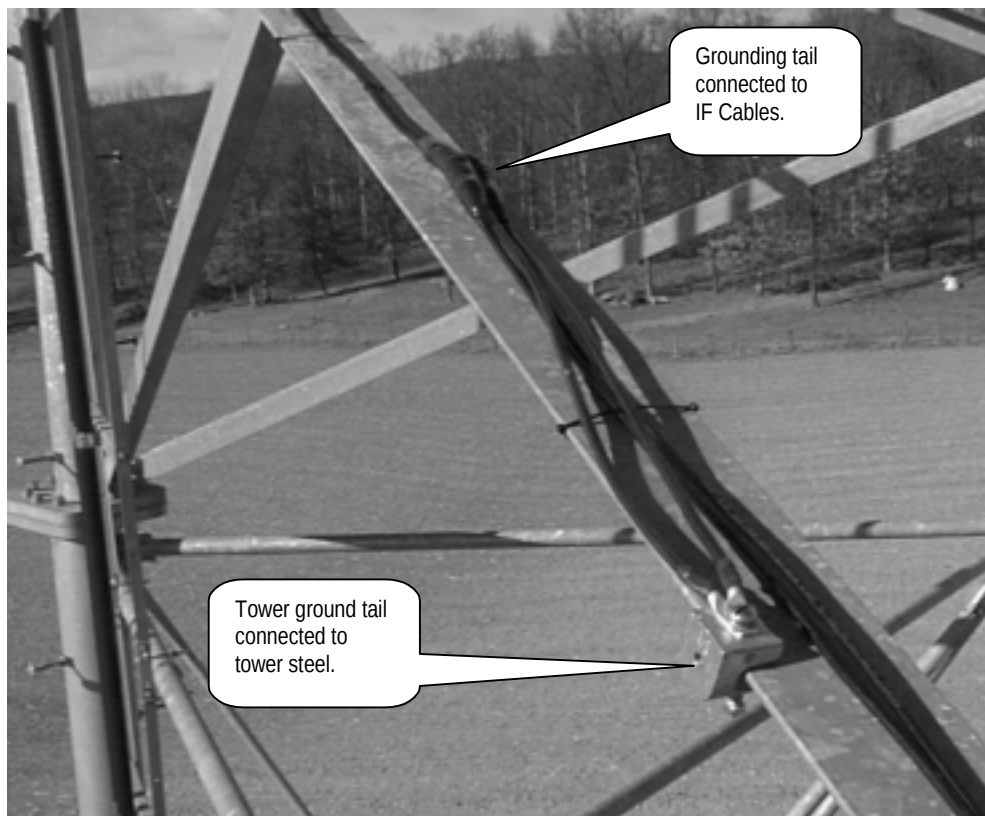
2.4 Grounding to an Antenna Tower

It is recommended that three grounding kits be installed in tower applications, one in each of the following locations:

- Just before the IF Cables make their descent down the tower (refer to Figure 2-2),
- Just before the IF Cables turn to go into the shelter, and
- Just before the IF Cables enter the shelter.

These ground tails should be securely attached to the tower's steel and to the shelter's bus bar at the entry port. Follow the directions included with the grounding kit.

Figure 2-2. Ground RF Unit to the Tower



When attaching the ground terminal with an angle adapter, carefully remove any aviation tower paint — but not the zinc coating underneath it — from the area of the tower member in contact with the angle adapter. This will insure good electrical contact. Also, apply the non-oxidizing grease around the mounting hole of the adapter and use the screw and lock washer from the adapter to fasten the ground terminal.

Note: Andrew produces superior lightning-protection grounding kits for its 1/4" coax cable, which can be installed any place on the tower.

2.5 Connect the IF Cables

STOP!

Before connecting IF Cables, make sure that the Modem Unit power switch is turned OFF. Mark the ends of each cable so they can be identified after mounting. An Ohm meter may help.

2.5.1 IF Cable Connecting Procedure:

Since the Transmit IF Cable has 24 Volts DC on it, it is important that the transmit and receive cables do not get reversed. Depending on the local installation conditions, cables may be connected in any order provided the above condition is observed.

Note: *ioWave* recommends using *heavy duty, outdoor* tie wraps to secure the IF Cables to the tower on which the link is installed. These tie wraps should be installed in four-foot intervals over the entire length of the cable run. Given the small diameter and low weight of the cables, *ioWave* recommends these cables be tied to a solid structure (i.e., tower leg or waveguide ladder side rail) in order to cut down on any movement that may occur due to strong winds. However, installing the cables on the tower's waveguide ladder (per Figure 2-3) in the traditional fashion is acceptable if the tower landlord requires all coaxial cables be installed in this manner.

Figure 2-3. Fasten IF Cables to the Tower



Note: Attach the grounding wire terminal to any of the following:

- Vertical or horizontal tower member,
- Bus bar,
- Angle adapter attached to a tower member, or
- Tower down conductor.

The use of hose clamps to attach ground terminals is not recommended.



PRELIMINARY

APPENDIX A TECHNICAL SPECIFICATIONS FOR *ioWave* 5.7

The specifications for the **ioWave** 5.7-GHz RF Unit depend on which **ioWave** Modem Unit it uses.

Table A-1. Technical Specifications for *ioWave* 5.7 RF Unit for use with *ioLink* 1

Electrical	
Transmitter	
Output Power	+10 dBm to + 25 dBm (adjustable at the factory)
Frequency Range	5738 and 5798 GHz (Plan A) 5818 and 5758 GHz (Plan B) 5838 and 5778 GHz (Plan C)
Channel Bandwidth	22 MHz
IF Frequency	110 MHz
Modulation	Differential Quadrature Phase Shift Keying (DQPSK)
Spreading Method	Direct Sequence
Code Length	10/T1, 11/E1
Number of Stored Codes	4
Receiver	
Receive Level	-30 dBm (no error) to -90 dBm (1E-6 BER)
Max Receive Level (no damage)	0 dBm
Receive Sensitivity (at 1E-6 BER)	-90 dBm, T1 FEC (-87 dBm, E1 no FEC)
IF Frequency	70 MHz
Processing Gain	>10dB

RF Unit: Connector Types	
To Antenna	Type N Female
To Modem	Type TNC Female (2x)

Environmental	RF Unit
Operational Temperature	-40° C to +60° C
Storage	-40° C to +70° C
Humidity	0-95%, Non-immersion, Rain (4 in/hr)

Mechanical	RF Unit
Width	9.46"
Height	2.326"
Depth	15.26"
Weight	10 lb. (4.5 kg)

* Product specifications may be subject to change



Table A-2. Technical Specifications for *ioWave 5.7* RF Unit for use with *ioLink 4*

Electrical	
Transmitter	
Output Power	+10 dBm to + 25 dBm (adjustable at the factory)
Frequency Range	5738 and 5798 GHz (Plan A) 5818 and 5758 GHz (Plan B) 5838 and 5778 GHz (Plan C)
Channel Bandwidth	22 MHz
IF Frequency	110 MHz
Modulation	Differential Quadrature Phase Shift Keying (DQPSK)
Spreading Method	Direct Sequence
Code Length	12/T1, 12/E1
Number of Stored Codes	4
Receiver	
Receive Level	-30 dBm (no error) to -83 dBm
Max Receive Level (no damage)	0 dBm
Receive Sensitivity (at 1E-6 BER)	-83 dBm for T1 -81 dBm for E1
IF Frequency	70 MHz
Processing Gain	>10dB

RF Unit: Connector Types	
To Antenna	Type N Female
To Modem	Type TNC Female (2x)

Environmental	RF Unit
Operational Temperature	-40° C to +60° C
Storage	-40° C to +70° C
Humidity	0-95%, Non-immersion, Rain (4 in/hr)

Mechanical	RF Unit
Width	9.46"
Height	2.326"
Depth	15.26"
Weight	10 lb. (4.5 kg)

* Product specifications may be subject to change

APPENDIX B IMPORTANT INFORMATION ABOUT YOUR SYSTEM**B.1 FCC Regulatory Notice**

This equipment complies with FCC Regulation 15.247, which specifies the license-free operation of direct sequence, spread-spectrum wireless communications devices. The **ioWave 5.7** RF Unit operates in the 5.725 to 5.850 GHz frequency band reserved for industrial, scientific, and medical applications. Since this device generates radio frequency waves, it may interfere with other radio signals in the same area unless the proper installation and operations procedures are followed. It has been proven in testing that this device complies within the limits of FCC Regulations that are designed to provide reasonable protection against such interference in a commercial environment.

NOTE: Installation and maintenance must be performed by authorized **ioWave** personnel or those persons properly trained and authorized to do such procedures. **ioWave** is not responsible for any damages, incidental or otherwise, in connection with use of this manual by anyone not described above.

In order to comply with FCC adopted RF exposure requirements, the 2 ft. dish antenna must be installed in a manner that will provide 1.26 meters clearance from the front side of the dish, to any personnel or member of the public.

B.2 Warranty

ioWave, Inc. manufactured products are warranted to be free from material defect in material and workmanship under normal use for a period of one (1) year from the date of shipment. This warranty extends only to products manufactured by **ioWave, Inc.** and is expressly conditioned upon the equipment having been installed in accordance with the standard installation and configuration practices recommended by **ioWave**, by authorized **ioWave** personnel or those persons certified and authorized to do such procedures, and the equipment having been maintained in accordance with **ioWave** recommended standard maintenance practices.



If any **ioWave** product is found to be defective while still under warranty, **ioWave** will, at **ioWave**'s option, repair or replace the defective product with another **ioWave** product at its own expense, or provide a refund of the purchase price. **ioWave** is not responsible for costs of labor or any other costs incurred by the customer's own employees or contractors in identifying the problem or replacing the defective product.

This warranty shall automatically terminate and **ioWave** will not be responsible, if the product is used in other than its normal and customary manner, and/or has been subject to neglect, misuse, accident, damage, abuse, improper or unauthorized assembly, disassembly or alteration. **ioWave** will not be responsible under this warranty and agreement if the defect results from the use or existence of non-**ioWave** equipment, software or hardware. Repair at **ioWave**'s option may include the replacement of parts or equipment and all replaced parts or equipment shall become the property of **ioWave**. The above constitutes the customer's sole and exclusive remedy in the event of breach of warranty.

In the event of a defect during the warranty period, Buyer must return item, freight pre-paid, to the **ioWave** repair facility for repair or replacement. Proper authorization from **ioWave** to return products under this warranty must be obtained prior to shipping. ***ioWave** will only accept returned goods with the proper Returned Material Authorization number (RMA).* All products will be returned to the customer after repair or replacement by method of delivery of **ioWave**'s choice within the continental United States of America. **ioWave** shall be responsible for return freight charges only on repaired and replaced products found to be defective under this warranty. If the customer desires a different method of delivery than that chosen by **ioWave**, or if the return location is beyond continental USA borders, then **ioWave** is not responsible for cost of return shipment.

This warranty shall extend only to the original purchaser of the products and is non-transferable to a third party. This warranty shall not cover any consequences or damages caused by Act of God and events of *Force Majeure*, including, but not limited to, third-party equipment, fire, flood, explosion, and war. Except as stated herein, **ioWave** makes no other warranties for the products, and the foregoing warranties are in lieu of all other warranties, express, implied or statutory, including but not limited to any implied warranties or merchantability or fitness for a particular purpose, or of any other warranty obligation.

B.3 Disclaimer

Only **ioWave** certified personnel shall install and perform maintenance on any **ioWave** product. **ioWave, Inc.** assumes no responsibility for any problems during or as a result of installations performed by non-**ioWave** certified personnel.

ioWave, Inc. also assumes no responsibilities for any incorrect information given by the customer about the site or network that the **ioWave** components will be placed in. Any alterations in structures on the site where the **ioWave** equipment is installed may void any warranties that exist for the structure (e.g., drilling holes in walls, floors, or ceilings may void leakage warranties).

B.4 Use of ioWave Products Outside of the United States

ioWave, Inc. has received selected approval for the use of its products in countries outside of the United States and Canada. For specific information regarding the approval status of **ioWave** products in your country, please contact your **ioWave** sales representative. **ioWave** does not recommend the use of its products in non-approved areas, and accepts no responsibility for any consequences, legal or otherwise, resulting from the use of our products in such area.

