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Chapter 2
iolink Product Description

The iolink 1.0 is a full duplex Direct Sequence Spread Spectrum (DSSS) device for Tl/El rate wireless communications between two line of sight (LOS) locations. It can be connected to many types of interfaces to meet various communication needs. The technologies incorporated in the iolink 1.0 give you an efficient, minimal interference, error-resistant link Compare to other services and a superior carrier-to-interference (C/1) performance ratio.

A. Key Features & Benefits

Here are some of the important features and benefits of the iolink 1.0 system:

Offers quick turnaround an investment and savings vs. recurring leased line charges Does not require user licensing (complies with FCC regulation Part 15) Provides clear and robust communications over a range of distances is capable of voice, video and data transmissions Operates in precertified 5725 to 5850 Mhz range with 3 channel plans which is virtually immune to atmospheric interference such as rain or snow
Provides full duplex Tl (1.544 Mbps) or El (2.048 Mbps) capacity with DSX-1 or G.703 interfaces, respectively
Provides forward error correction (FEC), Tl only, for advance warning of potential errors in communication, and alerts the user of changes in the environment that may not have been present during installation which could impact the transmission path Is fully compliant with the simple network management protocol (SNMP) Provides configuration management via the front panel or a PC

B. Advanced Features

The iolink 1.0 system provides several unique features:

Performance monitoring
Diagnostic testing
The ability to place multiple links in the same area without interference

These features allow the user to keep the link up and running with little effort while giving the user a powerful set of diagnostics and statisbcs to detect or troubleshoot potential problems.

1. Performance Monitoring

Per-formance monitoring is an important quality control tool. The various statistics the user can obtain from the front panel menus or via a PC can inform how the system is performing. Even though the link is functioning properly, the ability to keep track of link performance allows the user to see changes in the link, which may degrade communications over time.

The iolink 1.0 wireless system is fully compliant with the simple network management protocol (SNMP) and provides the user with a performance monitoring system. The system

allows the user or system manager to not only obtain the latest information on link performance, but also allows link performance to be observed over time. The iolink 1.0 management information base (MIB) enables the user to monitor link performance through the network management system (NMS) as well as from the front panel. Statistics for errored seconds, severely errored seconds, unavailable seconds and degraded minutes are automatically tracked. The modem keeps track of these statistics internally for 24 hours at 15 minute intervals. This can help the system manager see if there is anything affecting the link as well as the ability to track times of day when there are more errors in the communication link.

2. Forward Error Correction Alert (Tl Only)

As various alarms alert the user of errors in communication or of link failure, the system also provides an alert via forward error correction (FEC). The FEC corrects bit errors, which provides the user with error free performance even when bit errors are occurring during transmission. The system monitors the transmission errors and alerts the user when the rate reaches a preset limit. The user can set this alert to be triggered at a desired level to provide advance warning of potential errors and interference in the link. If the link transmission has a Bit Error Rate (BER) worse than the preset threshold, the system will give a warning. This warning can alert the user to changes in the environment that may not have been present during installation such as new interference, growth of trees, or obstructions that may impact the transmission path so the user can take corrective action.

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CHAPTER 3
INS-FALLING YOUR iolink 1.0 SYSTEM

This chapter contains everything necessary to get the iolink 1.0 up and running quickly and easily.

EQUIPMENT CHECKLIST

Your shipment from iowave should include the following components:

- The Radio Frequency Unit (also called the "RF unit'@
- The Modem Unit, which acts as the interface between the iolink 1.0 and your existing communications network
- The antenna, used to transmit the iolink signal to the other end of the wireless link
- The Intermediate Frequency Cable (also called the "IF cable". which connects the modem to the Radio Frequency Unit)
- The Radio Frequency Cable (also called the "RF cable". which connects from the Radio Frequency unit and the antenna)

If any of the above components is missing from the shipment, please contact iowave customer service at 1-202-333-9283.

COMPONENT DESCRIPTIONS

RADIO FREQUENCY UNIT

The RF unit is the core of the iolink 1.0 system, transmitting and receiving signals at the designated carrier frequency. Compact and weatherproof, the RF unit is designed to be mounted close to the antenna, with flanges on the sides to facilitate mounting on the antenna support structure. The unit is equipped with a grounding stud, which should be used in conjunction with

the mounting structure's lightning protection system.

The unit communicates with the modem via the Intermediate Frequency (IF) (see below) and is connected to the antenna via the Radio Frequency (RF) Cable (see below).

MODEM UNIT
The modem unit acts as the interface between the iolink 1.0 and your existing communications network, as well as providing power to the RF unit via the transmit cable. The modem's baseband processor uses iowave's spread spectrum technology to process inbound and outbound signals. iowave's SNMP-compliant network management agent is fully embedded within the modem unit, and industry-standard interfaces are provided for Tl and El connections, allowing the iolink 1.0 to interact easily with the existing communications network management system.

ANTENNA
The aligned antennas at either end of the point-to-point link provide the necessary signal amplification for your iolink 1.0 units to communicate effectively with each other. The type of antenna to use with the iolink 1.0 depends largely on the individual requirements of the site you have chosen, and will probably have been determined during the site assessment process.

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If a site assessment has not taken place, contact iowave or an iowave certified reseller before proceeding.

INTERMEDIATE FREQUENCY CABLE
This component of the iolink 1.0 is the conduit by which the modem and the RF unit communicate. It also carries the power from the modem unit to the RF unit via the transmit cable. Typically, the IF cable is a flexible dual or single coaxial 50 ohm cable. The distance of the cable depends largely on the DC resistance and grade of cable chosen. A good rule of thumb is the total DC resistance should not exceed 3 ohms. For standard practice, iowave recommends RG-59 dual siamese for lengths of 0-125 ft., Times Mircrowave LMR240 for lengths of 0-250 ft, and Andrews FS]l for lengths 0-1000 ft. It plugs into F-type connector jacks on the modem and TNC-type connector

jacks on the RF units.

RADIO FREQUENCY CABLE

This cable connects the RF unit and the antenna, and consists of a single, low-loss 50 ohm coaxial cable. For standard practice, iowave recommends a 5 ft. N-type male to N-type male Andrews LDF4-50 cable. This cable should be as short as possible in order to minimize decibel (dB) loss and the resultant signal deterioration. Longer cable lengths may be used as long as the resultant decibal loss is accounted for in the path calculation. iowave also recommends that the RF cable be carefully secured to the antenna support structure, to minimize cable stress in the event of high winds.

INSTALLATION

To help ensure that the iolink 1.0 installation goes as smoothly as possible, we have broken down the process into the following steps:

Testing the iounk 1.0
Pre-Installation CheckJist
Installing the Equipment
Verifying the Link

1 - Testing the iolink 1.0

iowave manufactures all of its equipment with the utmost attention to quality and durability, and tries to ensure that all equipment is trouble-free before it goes out the door. Nevertheless, components can be damaged during shipping. Therefore, it is recommended that you test your iolink 1.0 system prior to field installation by using the following "bench testing" procedure.

A. Bench Test Procedure

1. Equipment Check List

a.) Antennas (2)
b.) RF Units (outdoor) (2)
c.) Modem Units (indoor) (2)
d.) IF cables
e.) RF cables
f.) Bit Error Rate Tester (BERT) (1) (customer supplied)

g.) Attenuator (1)

2) Procedure

Follow the "bench test" procedure card included with the iolink system, record all measurements, if there are problems or confusion with the bench test setup, please call iowave customer service at 1-202-333-9283.

3) Return to iowave

a.) Attenuator (1)
b.) Copy of link test verification

· - Pre-Installation Checklist

Now that it has been determined that the iolink 1.0 equipment is functioning properly, you should make sure that all is in order with the proposed site, and that you are prepared to move forward with the installation. To this end, we have compiled the following checklist of items that should be double-checked before commencing with the installation:

A) Equipment
Zi Modem Units (2)
LI RF Units (2)
LI IF Cables
LI RF Cables
LI Antennas (2)

B) Materials
LI Tie wraps (heavy duty, outdoor)
LI Weatherproofing (vapo-wrap & electrical tape)
LI Ground wire (from RF unit to mounting structure)
LI Mounting clamps for antenna mount pipe (if required)
LI Two lengths of galvanized pipe to mount antenna (if required)
zi

3-Installing the Equipment

Having ascertained that both the site and the equipment are ready, you can

now move on to the actual physical installation.

Step 1 - Mounting the Antenna

A.) Rooftop Site
   1.) Assemble and install sled style mount
   2.) Mount antenna and RF unit to sled mount with U-bolt provided
   3.) Install and weatherproof coaxial jumper from antenna to RF unit
   4.) Run IF cable

B.) Tower Site (see ill.)
   1.) Install tower leg clamps

   2.) Install mounting pipe to clamps and level pipe
   3.) Mount antenna to pipe
   4.) Mount RF unit to leg
   5.) Install and weatherproof coaxial jumper from antenna to RF unit
   6.) Ground RF unit to tower structure with ground wire provided
   7.) Connect IF cable and tie wrap to tower every four feet to ground

C.) Monopole Site
   1.) Order appropriate dish collar mount from pole manufacturer

2.) Install collar mount and antenna pipe and level
3.) Mount antenna and RF unit
4.) Connect and weatherproof coaxial jumper
5.) Connect IF cable and tie wrap to step bolts to ground

Mount the antenna so that you will be able to adjust the angle and position as needed, and so that you can lock it in place once it is properly aligned. For now, simply place the antenna in its approximate position on the support structure, and ensure that it is pointed in the proper direction. The alignment can be corrected and flne-tuned later, once the link is up and running.

For detailed instructions on how to mount the antenna, you will need to consult the documentation provided by the antenna manufacturer.

Step 2 - Installing the RF Unit

1. The RF unit should be securely affixed, with the connector side down, to the antenna support structure. IoWave recommends using U-bolts to secure the unit to the structure, though of course the fasteners you use will depend on the requirements of your specific site.

2. Tighten the RF unit fasteners so that they are snug and secure. Avoid overtightening the fasteners, as this may deform the mounting panel of the RF unit.

Step 3 - Installing the Modem Unit

1. Mount the modem unit in a standard 19" equipment rack or on a tabletop.
2. Place the unit close to a power source, and in an area where the front and back panels are easily accessible.

Step 4 - Connecting the Cables

STOP!
Before connecting the cables, make sure that the modem unit is turned OFF.

1. Connect the IF cable to the RX jack on the modem unit.
2. Connect the other end of the IF cable to the RX jack on the RF unit.
3. Connect the remaining IF cable connector to the modem's TX jack.
4. Connect the other end of the IF cable to the TX jack on the RF unit.
5. Ensure that the connectors are fastened tightly.
6. Plug one end of the RF cable to the N-connector socket on the RF unit.
7. Connect the other end to the antenna.

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8. Again, check to ensure that the connectors are tightly fastened.
9. Connect the grounding stud on the RF unit to the mounting structure's lightning protection grounding system.

Step 5 - Aligning the Antennas

Once all of the iol!nk system components are installed and cables have been connected properly, you can align the antennas more precisely. This phase should be performed by at least two installers (one at each antenna), using walkie-talkies or other communication devices to coordinate their movements.

1. Power up both modem units.
2. Disconnect the IF cable from the modem unit's RX socket.
3. Connect the IF cable to a voltage meter.
4. Set the volt meter at 20 volts. It should read between 0 and 2.5 volts.
S. Alter the first antenna's position and angle as needed to minimize the absolute value of the voltage meter reading, adjusting the horizontal displacement if necessary. Typical readings should should be between 0.5 and 1.5 volts. Compare against the included graph in order to estimate received signal strength.
6. Repeat for the second antenna.
7. Continue alternately adjusting the two antennas until you are satisfied with the alignment.
S. Seal all outdoor connections with a silicon rubber compound, weather tape, heat shrink tubing, or other weatherproofing material.
9. Connect the modem units to your existing communications network and other equipment.

4- Verifying the Link

Once the physical installation is complete, all that remains is to make sure the link between your two points is functioning properly. To verify the link, complete the steps below:

1. Turn both modems off and then on again.
2. Wait while the modem completes its initialization cycle. [SCREEN SHOTS OF LCD]

3. If you have not already done so during a prior phase, the modem will request that you enter the RF unit channel, which you recorded on your pre-instaflation checklist. Enter it now. [WILL NEED MORE DETAILED INSTRUCTIONS, SCREEN SHOTS, FOR THIS]
4. After the initialization cycle is complete, examine the LED panel on the front of the modem unit. The LED indicators for "Power,"RX Data" and "TX Data" should be lit.
5. Examine the LCD screen on the modem unit. It should be displaying the "Signal Levels" screen [SCREEN SHOT].
6. If the Signal Levels are above 40%, the link is functioning properly.

If the "RF Fault" LED or the "Gen Alarm" LED are illuminated, or if the LCD Screen indicates that the signal levels are below 40%, there is a problem with the link. To diagnose and rectify the problem, consult Section IV of this Guide, "Troubleshooting the iolink 1".

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INSTALLATION TROUBLESHOOTING THE IOLINK 1

This section provides a simple set of checks and solutions for commonly occurring difficulties during the installation of the iolink 1.0 system. If you don't find the problem you are encountering in this section, please refer to the more comprehensive Troubleshooting section in the iolink 1.0 Technical Reference, which contains more extensive methods for troubleshooting various difficulties.

I turn the modem unit on, but nothing seems to happen.

1. Make sure that the modem is properly plugged into a working power source.
2. Check the power cord for damage.
3. Consult the Troubleshooting section of the iolink 1.0 Technical Reference.

The modem is on, but the "RX Data" and "TX Data" LEDs don't light up.

1. Make sure that the IF cable is properly connected to both the modem and the RF unit.
2. Make sure that the RF cable is properly connected to both the antenna and the RF unit.
3. Check the connection between the modem and your existing equipment.
4. Check the antenna alignment.
5. Make sure that the modem, cables and user equipment at the other end of the link are functioning properly.
6. Consult the Troubleshooting section of the iolink 1.0 Technical Reference.

I've tried to improve the antenna alignment, but I can't get the Signal Level above 40%.

1. Make sure that the IF cable is properly connected to both the modem and the RF unit.
2. Make sure that the RF cable is properly connected to both the antenna and the RF unit.
3. Check the antenna alignment.
4. Check the possible sources of noise.
5. Make sure that the modem and cables at the other end of the link are functioning properly.
6. Consult the Troubleshooting section of the iolink 1.0 Technical Reference.

The iolink 1.0 seems to be working correctly, but my other equipment doesn't seem to be communicating across the link.

1. Make sure that the user equipment is functioning properly.
2. Make sure that the data cable connecting the modem unit to the user equipment is not damaged and is connected properly.
3. Make sure that the user equipment at the far end of the link is functioning properly.
4. Consult the Troubleshooting section of the iolink 1 Technical Reference.

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CHAPTER 4
SYSTEM COMPONENTS

Each end of the iolink 1.0 point-to-point system is comprised of the following components:

- Modem Unit
- RF Unit
- Antenna
- IF Cable
- RF Cable

The following descriptions will provide in-depth information regarding the construction and capabilities of the various components.

MODEM UNIT

The modem unit measures 17"W x 1.75"H x 13"D. Its metal housing allows it to be rackmounted in a standard 19" equipment rack or you may place it on a flat surface such as a table or desktop. It is designed for indoor use in normal office or electronics equipment room conditions. The suggested operational temperature range is from OOC to +600C. Provide adequate ventilation to ensure that the unit stays well within the operating temperature range. The modem unit can operate in up to 95% humidity (non-condensing). The modem unit may
be stored in a temperature range of -400C to +600C. Features of the modem

unit include:

- A spread spectrum, which spreads, modulates, demodulates and despreads the user Tl/El signal. The modem board also contains an embedded microprocessor which is used to control the link configuration. You may adjust settings via a front panel keypad or an P,S232 interface. Default values are entered when the modem unit is manufactured. You may store configuration changes in non-volatile memory or you can restore the original default factory settings. The non-volatile RAM stores the current configuration settings and the firmware that controls the system; if there is a power loss to the unit, this information will not be lost.
- A power supply which powers both the modem unit and the RF unit.

- A four-key keypad and a liquid crystal display (LCD) that is used to configure and monitor the system. (All the settings in the configuration menu have default values that should be adequate for most system setups.)
- Five light-emitting diodes (LEDs) that indicate if the unit is transmitting and receiving normally or if there is an error preventing the system from working properly.
- Connections to the RF unit and Customer Premise Equipment (CPE).
- Circuitry for Forward Error Correction (FEC) on iowave's Tl version only.

Front Panel

The front panel of the modem unit features an LCD display and a keypad consisting of four directional arrow keys which are used to navigate through the various menus that can be viewed on the LCD screen. For detailed discussion of these menus and the options contained therein, see the "CONFIGURING AND OPERATING THE MODEM" Chapter.

[FRONT PANEL DIAGRAM]

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The front panel also includes LED indicators for POWER, TX DATA, RX DATA, RF FAULT and ALARM. When the iolink 1 is operating properly, the green POWER, TX DATA and RX DATA indicators will be illuminated; to find out what to do if these indicators are not lit, or if the red RF FAULT or ALARM are illuminated, consult the "TROUBLESHOOTING" chapter of this manual.

Rack Panel

The connectors an the rear panel are used for coupling the modem unit to:

- The RF unit, through two female coaxial connectors.
- A "hot-standby" switch, through a terminal block.
- A remote control device (e.g. terminal, PC, modem), through a male DE-9 connector.
- An El input device, through two BNC connectors.
- A Tl input device, through an RJ-48C connector.
- A three-prong EIA connector for supplying AC power to the modem unit.

[BACK PANEL DIAGRAM]

The following sections explain, in detail, the function of each connector.

1. RF Interface

The connection to the RF unit is made by attaching a dual coaxial cable to the TNC-type connectors labeled TX (transmit) and RX (receive).

A 48 V DC offset on the TX cable supplies power to the RF unit. When the modem unit is on, the center pin of the TX connector is at +48 V relative to the (grounded) outer conductor. Because of this, when configuring the cables be sure the power to the modem unit is off. Also, avoid plugging the RX cabfe into the TX connector even though the RF unit has circuitry to protect against this mistake. In addition to the received signal from the RF unit, the RX cable is used to transmit a DC signal to the modem unit that is used to determine the received signal level of the RF unit.

2. FAULT

The FAULT connector is a removable terminal block that is supplied to allow you to connect the modem unit to a switch for hot-standby redundancy. The terminal block is connected to Normally-Open and Normally-Closed FORM-C contacts. Pin 4 (the rightmost pin when facing the rear panel) of the terminal block is normally open, pin 3 is normally closed, pin 2 is the common and pin 1 is the ground. If the modem unit fails, the contacts reverse sense.

3. Remote Control

The DE-9 connector is used to interact with the SNMP-compliant agent embedded into the modem unit. This feature allows user SNMP software to interface with the iowave SNMPcompliant agent. The Rev 1.1.1 version of the embedded software includes a serial interface that communicates via User Datagram Packets (UDP). Future versions will have a Point-toPoint Protocol (PPP) interface.

4. El/G.703 Interface

The two female BNC connectors, labeled TX and RX, are used to connect an El device to the modem unit. You may also connect the El device to the modem unit using the R3-48C

connector. There is a two-pin jumper inside the modem unit to provide an (optional) ground to the outer conductors of the TX and RX connector.

Note: The termination impedance is selected via an internal jumper, 3P319. Units shipped as El are terminated at 75 ohms Uumper installed).

5. Tl Interface

This female PJ-48C connector, labeled DSX-1, is a standard DS1 input. The connector is wired as a "network" device, expecting to receive the signal to be transmitted on pins 1 and 2, and supplying the received signal on pins 4 and 5. Alternatively, you may connect the DS1 input device to the modem unit via the female BNC connectors labeled TX and RX. These BNC connectors are tied directly to the pins of the RJ-48C connector, with TX connected to pins 1 and 2, and the RX connected to pins 4 and S.

There are fuses, diodes and transformers between these connectors and the circuitry of the modem unit to protect the DS1 input device against voltage and current surges.

Note: The termination impedance is selected via an internal jumper, JP319. Units shipped as Tl are terminated at 100 ohms Uumper removed).

6. Power Connector

The power-input module is a combination male three-prong EIA interface, AC inlet, and a rocker on/off switch. A standard grounded power cable is sufficient for connecting to an AC power source (e.g., any common wall-mounted receptacle). As indicated in the Technical Specifications in Section I of this document, the modem unit uses less than 250 mA AC. The ground for the internal power supply is attached to the enclosure of the modem unit

The DC Input module is a combination rocker switch and terminal block as shown below.

The unit will accept DC input from 36 - 72 volts. The chassis of the modem unit and the grounding of the internal power converters are connected to the ground pins on the terminal block. As indicated in the Technical Specifications, the current draw is 450 mA at 48V input; this is used to power both the modem unit and the 5.7 GHz RF unit.

Pin Outs for Rear Panel Connectors

The modem unit of the iolink 1.5 has several connectors on its back panel for the user to connect to a given network. The following diagrams show the pin assignments of the jacks from the perspective of looking at the back panel of the modem unit:

Remote Control (DE-9 - male, wired as DTE):

[GRAPHIC 4 - DE-9]

DSX-1 (PJ-48C - female):

[GRAPHIC 5 - DSX-1]

Terminal block (Form-C contacts):

[GRAPHIC 6 - TERMINAL BLOCK]

RF UNIT

The RF unit consists of two circuit boards, a power supply (PS) board and an RF board, placed in a 2.326"H x 9.46"W x 15.26"D NEMA-4 weatherproof enclosure. The RF unit is usually mounted directly behind the antenna and has mounting holes in its base-plate flange enabling easy attachment to a tower or pole. It has two TNC-type jacks for connecting to the modem unit via the IF cable and an N-type jack for connecting to the antenna via the RF cable.

The PS board contains cavity filters, an isolator, circulator and a DC-DC converter, which supplies the various voltages needed in the RF unit.

The RF board contains oscillators and amplifiers, including the Power Amplifier (PA), Voltage Controlled Oscillator (VCO), the Low Noise Amplifier (LNA), ceramic filters, a mixer and synthesizer chip. The RF board also contains the connections to the modem unit as well as to the antenna (see the following RF unit block diagram).

[GRAPHIC 3 - RF BLOCK DIAGRAM]

The RF unit has a NEMA-4 enclosure to protect the unit from harsh environmental conditions. The enclosure is sealed to be weatherproof and can operate at temperatures between -400C and +60'C without damage to the internal circuitry. A vent device on the enclosure allows pressure equalization without compromising the environmental seal. The 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. The RF unit may be stored in a temperature range of -400C to +600C.

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ANTENNA

The aligned antennas at either end of the point-to-point link provide the necessary signal amplification for your iolink 1 units to communicate effectively with each other. The type of antenna to use with the iolink 1 depends largely on the individual requirements of the site you have chosen, and will probably have been determined during the site assessment process. If a site assessment has not taken place, you should contact iowave or your iowave-certified reseller before proceeding.

IF CABLE

The IF ("Intermediate Frequency) cable connects the modem unit to the RF unit. This cable allows the information to pass between the modem and RF unit and carries power to the RF unit from the power supply in the modem unit enclosure. The maximum length of the IF cable is 500 feet. If a longer cable length is required, contact iowave's sales or customer support personnel.

RF CABLE

THE RF ("Radio Frequency'@ cable connects the RF unit and the antenna, and consists of a single, low-loss 50 ohm coaxial cable. This cable should be as short as possible in order to minimize decibel (dB) loss and the resultant signal deterioraton. IoWave also recommends that the RF cable be carefully secured

to the antenna support structure, to minimize cable stress in the event of high winds.

CHAPTER 5

NETWORK MAINTENANCE AND PERFORMANCE MONITORING

This chapter will discuss the various tools incorporated into the iolink 1 system for tracking performance levels and keeping your iolink 1 network operating at peak efficiency. The major tools for maintaining your iolink network are the modem unit, with its easy-to-use LCD and keypad interface, and the embedded SNMP-compliant network management agent that enhances network management functionality either through the modem itself and via a remote network management station. In the sections below we will explore the performance monitoring functionality of the iolink 1, system, as well the maintenance and management capabilities of the modem's local interface and the embedded network management agent.

PERFORMANCE MONITORING

Performance monitoring is an important quality control tool. The various statistics the user may obtain from the LCD menus or via a PC tell you how well the system is performing. Even though the link is functioning properly, the ability to keep track of link performance allows you to see changes in the link, which may cause problems in communication over time. This saves money and prevents downtime by allowing the user to correct problems in their early stages and keep the link functioning at maximum performance. For example, the iolink 1.5 features alarm status, signal power indicators and monitors performance to provide the number of errored seconds and unavailable seconds.

iowave's wireless systems are fully compliant with the Simple Network Management Protocol (SNMP) and readily interface with existing user software. The system allows the user or system manager to not only obtain the latest information on link performance, but it also allows them to observe link performance over a period of time. Even though the link may be up and running, there could be factors degrading it that probably wouldn't be noticed without this monitoring capability. The system allows for early detection of possible problems, preventing downtime.

Early detection of system problems is a key feature of the system. iolinws Management Information Base (MIB) enables the user to monitor link performance through the NMS as well as from the front panel. Statistics for errored seconds, severely errored seconds, unavailable seconds and degraded minutes are automatically tracked. The system keeps track of these internally for 24 hours at 15 minute intervals. This helps the system manager to see if there is anything degrading the link and allows him/her to track times of day when there are more errors (if any) in the communication.

This information can be tracked by the system manager over an extended period of time so that he/she can observe link performance on a larger scale. This helps immensely in detecting potential problems very early so that they can be corrected before they become serious.

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Forward Error Correction Alert (TI Version Only)

As our various alarms alert the user of errors in communication or of link failure, the system also provides an alert via Forward Error Correction (FEC).

The FEC corrects bit errors, which provides the user with error-free performance even when bit errors occur during transmission. The iolink monitors the transmission errors and alerts the user when the rate reaches a pre-set limit. The user can set this alert to be triggered at a desired level to provide advance warning of potential errors in communications. If the link transmission has a Bit Error Rate (BER) worse than the preset threshold, the system will give a warning. This warning can alert the user to changes in the environment that were not present at installation that may impact the transmission path, so the user can take corrective action.

Circuitry for Forward Error Correction (FEC)

Once the link is established, the FEC works in the following manner:

All user data bits are encoded by the transmitting side's modem unit and sent to the receiver. The receiving modem unit uses an algorithm along with the previously received set of bits to determine the possible valid configurations for the current set of bits. If the current set of bits are not of a valid form, an alarm is registered (see "FEC decoder not locked" in section V. Network Management). Since the receiving modem unit knows all the possibilities of what the current set of bits should be, it can then use this information along with the FEC algorithm to correct most bit errors that may have been introduced during transmission.

Influence of FEC on BER

Forward Error Correction is used in the jolink 1.5 to reduce the number of bit errors encountered in normal wireless transmission. To do this, the transmitting unit uses the previous block of data to predict what form the current data signal should have so that the receiver may use the redundant signal to find any errors in the original signal and correct them. Depending on the nature and periodicity of the errors, FEC may not always detect and correct every error that is introduced into the signal. If the errors are singular in the signal, it is easier for the error detection circuitry to find and correct the errors. If the errors are introduced in large bursts, it is more likely that the circuitry will be unable to correct all of the errors.

The following example shows the difference between the two cases. Both link A and link B may be experiencing a total of 3,600 uncorrected errors every hour, but the post-FEC BER for the two links may be quite different. If link A receives 1 error every second, the FEC circuitry should be able to correct all of the errors since there are few errors at any point in time. If link B receives a burst of 1,200 errors every half-hour on the half-hour, the FEC circuitry will have more difficulty correcting the errors because of the high volume of errors introduced. Notice that both links get an average of 3,600 errors per hour, but the distribution in which they get them affects the ability of the FEC to

find and correct those errors. Link A will have a post-FEC BER of nearly zero with Link Bs post-FK BER being around 10(-7).

As mentioned in the Advanced Menu section, the iolink 1.5 has a menu item that displays the Pre-FEC BER. This gives the user an indication of how many errors the unit receives prior to the signal going to the FEC circuitry in the modem unit,

This menu item does not display the BER once the signal is corrected for errors, since the postFEC BER cannot be determined very accurately by the very nature of how FEC works. The BER

that the user equipment sees is much better than that displayed on the Pre-FEC BER menu

item.

Although the post-FEC BER cannot be exactly determined, it can be estimated. The following chart shows approximately how the BER is improved by the particular FEC scheme that is used in the modem unit. This chart assumes that the errors are introduced into the signal periodically rather than in bursts. For example, this chart may represent BER improvement given a uniform average of 300 errors per minute (i.e. 5 errors every second). The chart would look different for bursts of 300 errors every minute (i.e. all 300 errors occur at the end of each minute).

[GRAPHIC 14 - FEC IMPROVEMENT OF BER CHART]

Note: This chart does not represent the actual performance of FEC in every situation. It is meant to show that the addition of FEC circuitry in the iolink 1.5 improves BER as seen by the user equipment.

THE iolink MODEM UNIT: YOUR TOOL FOR LOCAL MONITORING AND MAINTENANCE

The functionality of the iolink 1 modem unit is such that all essential monitoring and link management functions can be performed using the

keypad and the LCD menus on the modem's front panel to communicate with the iolink's embedded SNMP-compliant network management agent.

Five menus are available to you via the keypad and LCD panel:

- STATUS MENU - The STATUS menu contains general information about your iolink system, including some real-time performance data. The selections in this menu cannot be changed by the user; their purpose is to provide information only.

- CONFIG MENU - The CONFIG menu allows the user to specify certain basic parameters to customize the iolink l's performance and optimize it for the specific characteristics of your site.

- TEST MENU - The TEST menu is the interface for access the iolink l's built-in diagnostic modes, and is used in monitoring the performance of specific segments of the network, as well as isolating and identifying problem areas.

- ALARM MENU - The ALARM menu is a dynamic listing area for network errors that require immediate attention. When a significant network errors occur, the GEN ALARM LED on the front panel will light up, and the specific error condition that the iolink 1 has detected will appear on this menu.

- ADVANCED MENU - The ADVANCED menu provides access to a variety of user-definable settings that are helpful in troubleshooting a malfunctioning link and in further optimizing network performance to your site's specifications.

Navigating between the five menu headers is accomplished using the left and right arrows on the keypad. The up and down arrows allow you to scroll from the header to the available menu selections. Within a given menu selection, the left and right arrows allow you to change settings between the available options. Please note that both the menu headers and the menus themselves are cyclical in arrangement: pressing the down key at the bottom of a menu will take you back to the top of the menu, for example, and pressing the right arrow at the ADVANCED menu header will take you back to the STATUS menu. Furthermore, pressing the up and down arrows simultaneously will bring you back to the

header for the current menu.

On the next page is a "map" of the iolink l's menu structure, followed by detailed descriptions of the menu selections themselves

5.7 Ghz DPA.FT

STATUS **CONFIG** **TEST** **ALARM*** **ADVANCED**

Status Menu	Config Menu	Test Menu	Alarm Menu	Advanced Menu
<- Next Menu -	<- Next Menu	<- Next Menu -	<- Next Menu -	<- Next Menu -
RF Signal Level	Encoding	Full Loopback	Alarm 1.....	BER Threshold
xx%	(B8ZS) AMI	(Off) On		2.0 E-7
Signal Level	Tl Data Cable	Far-end	Alarm 2..	BER Interval
xx%	(133) 266 399	Loopback		100 s
	533655	(Off) On		
Pre-FEC BER	TX Code	Source Loopback		Jitter Atten
x.x E-x	1234	(Off) On		(RX) TX None
Data Rate	RX Code	Set Factory Def		Acquire Thresh
Tl	1234	(No) Yes		050H
	Channel Plan			
	(Al) A2			
Software Version	Store Config			Symbol Thresh
1.1.0	(No) Yes			010H
Firmware Version		Set Factory		FEC BEP
2.1.0	Def			Off (On)
	(No) Yes			

-§eri'al Number

MUXX>=

FEC Loopback

(Off) On

Channel Plan

Al .. A2

LIU Loopback

(Off)Loc RM Net

BER Threshold

E-7

BER Interval

100 s

When there are active Alarms, they will be displayed via this menu.

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STATUS MENU

RF Signal Level

The relative strength (arbitrary normalization) of the power received by the RF unit from the antenna. Typical values are from 83% to 100%.

Signal Level

The relative strength (arbitrary normalization) of the power received at the baseband processor. This is a measure of whether the signal received by the antenna is from the other end of the link or from a noise source. Typical values are 40% to 70%.

Pre-FEC BER

This is the rate of bit errors that are received from the link, before correction by the Forward Error Correction (FEC) circuitry. In usual operation, the FEC circuitry corrects most of the bit errors so that the error rate of the data sent to the user's equipment is smaller than this rate. See Advanced Menu section for

details.

Data Rate This will read either El or TI, depending on how the modem was configured at the factory.

Software Version

Firmware Version Displays the version numbers of the software and firmware that are installed in the modem unit.

Serial Number Displays the serial number of the modem unit.

Channel Plan The RF channel plan for the link. The possible options are Al..A2 and A2..Al, where the first value is that of the local RF unit and the second that of the far-end RF unit.

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CONFIG MENU

Encoding

For modems configured as Tl, the user may choose between AMI or the default B8ZS. For modems configured as El, the user may choose between AMI or the default HDB3. B8ZS and HDB3 are zero-suppression encoding algorithms.

TI Data Cable

This is the approximate length of cable between the modem unit and the user's data source. Changing this parameter will change the pulse shape of the DSX-1 signal transmitted from the DSX port. The

	cable lengths correspond to the standard Line Build Out (LBO) settings from +0.6 dB to +3.0 dB. This menu item is only present for Tl modems.
TX Code **RX Code**	There are four choices for the PN (pseudo-random noise) sequence used to spread and de-spread the signal. For the link, the RX code for each modem must match the TX code for the other modem, but different codes may be used for transmission in the two directions. See section V. Network Management for more details on selecting PN codes.
Store Config	This menu item allows the user to store the present configuration parameters in EEPROM so that the modem will return to the same configuration at the next power-up. When the units are shipped from the factory, the default parameters are stored in EEPROM. If the user changes the configuration stored in EEPROM, the factory defaults may be restored by the

	Set Factory Default menu item (see below).
Set Factory Default	Selecting YES at this menu item sets the modem to the default configuration (indicated by the parentheses in the above table).

TEST MENU

This menu contains selections for the iolink l's three built-in diagnostic modes: Full Loopback, Far-End Loopback and Source Loopback.

For detailed discussion of these modes and when they should be activated, consult Chapter 6 DIAGNOSTICS AND TROUBLESHOOTING.

ALERT MENU

This menu dynamically lists active alarm conditions as they occur. Therefore, this menu will contain no selections when the iolink network is functioning

properly. If an error condition occurs, this menu will provide an error code to identify the nature of the problem.

For a detailed listing of error codes, what they signify and how to correct them, refer to Chapter 6 - DIAGNOSTICS AND TROUBI FSHOOTING.

ADVANCED MENU

BER Threshold This threshold is used to monitor the PreFEC BER of the link. If this threshold is exceeded for the specified BER Interval (see below), the FEC BER alarm is given in the ALARM menu. The BER Threshold defaults to 2.0 E-7.

BER Interval This is the interval of time, in seconds, that the BER Threshold must be exceeded to cause the FEC BER alarm to appear in the ALARM menu. Once the Pre-FEC BER exceeds the BER Threshold, the iolink begins timing. If the Pre-FEC BER falls back below the BER Threshold, the timer is reset to zero. Otherwise the timer

continues until the specified interval is surpassed, which then causes the FEC BER alarm to register in the ALARM menu. The BER Interval defaults to 100 seconds.

ADVANCED MENU (continued)

Jitter Atten Jitter attenuation is provided by an elastic store in the LIU. When enabled, data bits are clocked into the elastic store using the line clock and then clocked out using the

	de-jittered clock from the jitter attenuation loop. Insertion of jitter attenuation produces a delay of 16 bits.
Acquire Thresh	This is a threshold parameter that affects the initial synchronization process of the link. Typical values are from 30H to 60H (**H** = hex).
Tracking Thresh	This is a threshold parameter that affects the continuing synchronization process of the link. Typical values are from **OAH** to 12H (**H** = hex).
FEC BER	This menu item allows the user to turn the error rate testing on or off.

REMOTE MONITORING AND NETWORK MAINTENANCE WITH THE EMBEDDED AGENT The iolink 1.5 modem has an embedded agent for remote monitoring and control using a Network Management Station (NMS). Communication between the agent and the NMS is performed through an asynchronous serial connection at the male DE-9 connector labeled "Remote Control" on the back of the modem. Version 1.1.1 of the control software allows communication with a PC (or equivalent); later versions will allow dial-up connections via an external modem. To be SNMP-compliant, User Datagram Protocol (UDP) packets are used as

the communication protocol on the serial connection. Any NMS that can direct UDP packets through a serial port may communicate with the agent. As an alternate means of communicating with the embedded agent, a DOS-based console program that accepts keyboard entry of SNMP-type Set, Get and Next commands, and then communicates with the agent via UDP packets, is available from iowave.

FUNCTIONALITY

The agent is built to conform to the DS1 MIB outlined in RFC 1406. At the present time we do not have the ability to track all of the statistics, but this feature is under current development. Also, a proprietary MIB has been developed to allow the user to monitor and control other sections of the modem. This proprietary MIB is available from iowave. The proprietary MIB includes variables to implement, through SNMP, all of the non-test functionality that is available at the front panel (via the LCD and keypad).

There are four important areas of monitor or control that are available through either the DS1 MIB or the proprietary MIB are:

- Configuration
- Performance monitoring
- Test modes [discussed in Chapter 6 - DIAGNOSTICS AND TROUBLESHOOTING]

0, Error/Alarm Monitoring [discussed in Chapter 6 - DIAGNOSTICS AND TROUBLESHOOTING]

CONFIGURATION

RFC 1406 specifies several configuration parameters for DS)(-l devices. In addition to these, the iowave MIB includes several configuration parameters that correspond to features available at the control panel of the modem. The specific items that may be configured via the front
panel, and thus via the agent are:

- Line Encoding: The iolink 1.5 modem may be configured as either Tl or El. For modems configured as Tl, the user may choose between AMI and the default B8ZS. For modems configured as El, the user may choose between AMI and the default HDB3. (B8ZS and HDB3 are zero-suppression encoding algorithms).

- TX Code: There are four choices for the PN (pseudo-random noise) sequence used to spread and de-spread the signal transmitted by the RF unit. Links that are subject to interference from other spread-spectrum sources might perform better with a change of PN code. For the link, the RX code for each modem should match the TX code for the other modem, but different codes may be used for transmission in the two directions.

- Cable length: This is the maximum length of cable from the modem unit to the user's data source. Changing this parameter will change the pulse shape of the DSX-1 signal transmitted from the DSX port to the user's device. The cable lengths correspond to the standard Line Build Out (LBO) settings from +0.6 dB to +3.0 dB.

- Jitter Attenuation: For input devices with a significant amount of noise, the line interface unit may provide jitter attenuation. Jitter attenuation is provided by an elastic store (ES) which clocks in the received bits and then clocks them out of the ES using the clock from the internal jitter attenuation loop. Inclusion of jitter attenuation produces a delay of 16 bits. The options are to attenuate in the receive path (default), the transmit path or not at all.

- Symbol Threshold: This is a threshold parameter that affects the initial

synchronization process of the link. If the link is performing poorly, especially if it exhibits difficulty establishing synchronization, lowering this threshold may improve performance. However, too low a value might cause one end of the link to achieve synchronization to a noise signal. The default value is 5OH; values less than 28H are not recommended.

• Tracking Threshold: This is a threshold parameter that affects the continuing synchronization process of the link. If the link is performing poorly, especially if it loses synchronization, lowering this threshold may improve performance; however, too low a value might cause one end of the link to achieve synchronization to a noise signal. The default value is **1OH;** values less than OAH are not recommended.

PERFORMANCE MONITORING

There are several performance statistics for DS)(-l devices that are described in

RFC 1406. In addition to these, the iowave MIB provides performance-monitoring variables for features not included in RFC 1406. The additional features that may be monitored are:

Pre-FEC: This is a measure of the rate of bit errors that are received from the link. In usual operation, the FEC circuitry corrects most of the bit errors so that the error rate of the data sent to the user's equipment is smaller than this rate. As this is a feature of the FEC circuitry, it is not available for El modems.

RF Signal Level: The strength of the power received from the RF unit, as a percentage of that received for an ideal 1 mile link. If this value is 0%, there is a problem with the signal received from the RF unit; it is likely non-existent. In normal operation, this value should be greater than 83%.

Signal level: The strength of the power associated with the demodulated signal, as a percentage of that received for an ideal 1 mile link. This is a measure of whether the signal received from the RF unit is from the other end of the link or from a noise source. If this value is less than 25%, the signal being received by the RF unit is not correctly encoded, indicating that the RF unit is receiving a noise signal. The likely causes are either a problem with the other end of the link or the presence of a strong interference signal. In normal operation, this

value should be between 40% and 70%.

5.7 Ghz **DPLAFT** CHAPTER 6

DIAGNOSTICS AND TROUBLESHOOTING

This chapter deals with the problems you may encounter in the day-to-day operations of the iolink 1 system, and provides you with the information you will need to identify, isolate and correct the errors that may arise with your system. The following pages will discuss:

- The built-in diagnostic modes that you can use for "early warning" to help anticipate and identify problems before they happen, and to isolate problem

areas in a malfunctioning link.

- The error codes that correspond to General Alarm conditions that may arise, and specific steps you can take to correct these errors.

DIAGNOSTIC TESTING

The iolink system has several diagnostic tests and alarm indicators to pinpoint performance problems, which are accessible from the modem's TEST menu or by remote interaction with the Network Management Agent. By performing a few simple tests and noting the alarms, the user can isolate the source of the problem for diagnosis and correction or repair. Determining whether the communication error is in the jowave equipment or Customer Premise Equipment (CPE) simplifies troubleshooting and reduces unnecessary equipment returns.

The TEST menu permits the user to place the modem into configurations that enable the testing of the modem to confirm the operating status. These modes are useful when the data input device is capable of providing a bitstream that may be detected and checked for bit errors (e.g. a Bit Error Rate Tester).

The tests that are available in the TEST and ADVANCED menus are powerful tools for diagnosing many problems in the system. These tests are especially

helpful in determining where a problem may lie in the system (i.e. in the modem unit, user equipment, local or remote end, etc.). These tests must be performed with the use of a Bit Error Rate Tester (BERT). The BERT can be connected to either the DSX or G.703 interfaces on the back of the modem unit to read out the conditions of the test. The BERT can be used to provide bit streams for performing a test, or it can be used simply to test the signal already present in the system.

The following block diagrams are useful tools for visualizing what each test is doing and how they may be used in getting essential information to check the system. Items inside the dashed box denote modem unit sections. The arrows denote the signal path. An "X" in the path shows where the signal is terminated.

FULL LOOPBACK:

Selecting ON for this test mode places the modem into a loopback mode at the spreading chip in the baseband processing section. In this mode, the input data is processed by the LIU, FEC and spreading circuitry, then looped back through the de-spreading FEC and LIU circuitry and returned to the input device. This allows the user to determine whether the line interface, forward error correction and spreading sections of the modem are operating correctly.

[GRAPHIC 8 - FULL LOOPBACK FLOWCHART]

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FAR-END LOOPBACK:

Selecting ON for this test mode places the modem into an internal loopback mode at the line interfacechip.

Inthismode,thedatafromthefarendofthelinkisloopedbacktoit(aswell as passed through to the DSX or G.703 interface). Input from the DSX or G.703 interface is ignored. Thismodepermitsonetotestthewholelinkfromthefarside.

[GRAPHIC 9 - FAR-END LOOPBACK FLOWCHART]

SOURCE LOOPBACK:

Selecting YES for this test mode places the modem into a loopback mode at the line interface chip. In this mode, the data from the user device connected to the DSX or G.703 interface is looped back to it as well as passed through the modem to the far end of the link. Data from the far end of the link is ignored. This mode ensures that the input data source is operating correctly.

[GRAPHIC 10 - SOURCE LOOPBACK FLOWCHART]

FEC LOOPBACK:

Selecting ON for this test mode places the modem into a loopback mode at the FEC chip. In this mode, data from the input device is passed through the LIU and FEC, looped back through the FEC and LIU and returned to the input device. This mode allows the user to determine whether the line interface and forward error correction sections of the modem are operating correctly.

[GRAPHIC 11 - FEC LOOPBACK FLOWCHART]

LIU LOOPBACK:

There are three loopback modes available from this menu item, all of which are enabled within the line interface (LIU) section of the modem.

[GRAPHIC 12 - LIU LOOPBACK (Local) FLOWCHART]

Local - The data from the far end of the link is looped back to it as well as passed through to the DSX or G.703 interface. Input from the DSX or G.703 interface is ignored.

[GRAPHIC 13 - LIU LOOPBACK (Remote) FLOWCHART]

Remote - The data from the user device connected to the DSX or G.703 interface is looped back to it as well as passed through the modem to the far end of the link. Data from the far end of the link is ignored.

Network - The line interface chip looks at the data stream received from the DSX or G.703 interface for the NLOOP enable and disable data patterns. When the enable pattern is repeated for five seconds, the modem is placed into remote loopback (as above).

TROUBLESHOOTING ALARM CONDITIONS

Below is a list of General Alarm codes that may appear in the ALARM menu, followed by a list of corrective steps to take to resolve the problems indicated.

Near-end Related Alarms

Transmit LOS: This alarm is caused by a loss of signal from the user's device into the DSX or El interface. In addition to causing the Alarm LED to light, it will cause the TX Data LED to be extinguished. The likely causes of this alarm condition are that the user's input device has been turned off or disconnected from the modem.

Solutions:

1 Check connection to CPE.

· Verify that the CPE is connected to either the DSX or G.703 interface.

3 If connecting to the G.703 interface, make sure that TX on the Modem unit is connected to RX on the CPE and that RX on the Modem unit is connected to TX on the CPE.

4 Check the cable for continuity or visible damage.

· Check that CPE is configured correctly and working properly. Consult the documentation for the CPE for this.

LIU not responding: This alarm indicates an error with the communication between the control processor and the line-interface chip. This is generally a fatal alarm condition in that it indicates a component failure.

Solutions:

1 This is usually a fatal alarm condition that indicates a problem the user cannot fix. Call iowave Technical Support.

Firmware not responding: This alarm indicates an error with the communication between the control processor and the firmware controlling the FEC and spreading chips. This is generally a fatal alarm condition in that it indicates a component failure.

Solutions:

1 This is usually a fatal alarm condition that indicates a problem the user cannot fix. Call iowave Technical Support.

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RF or Far-end Related Alarms

FEC BER > x.x E-x:

1 Check that the RF Signal Level is acceptable (>83%). If it is below 83%, go to the section on troubleshooting the Low RF Power alarm.

· Check that the BB Signal Level is acceptable (>40%). If it is below 40%, go to the section on troubleshooting the RX Low Symbol Power Alarm.

3, Check the Pre-FEC BER in the STATUS menu:

If it has dropped back below the BER Threshold, note the time of day that the alarm occurred. This may allow you to track down the source of the fade if this alarm periodically appears. Some possible sources of fading could be noise, interfering signals, temporary obstructions (such as someone standing directly in front of the antenna) or the operation of a microwave oven in the vicinity.

If the Pre-FEC BER continues to remain above the BER Threshold, check the link for possible obstructions or interference. Obstructions could be anything

from new buildings or walls to growing trees or changes in the landscape. For example, if a stand of trees between the two antennas grows enough to sufficiently block the Fresnel zone, the PreFEC BER will increase. Also, if that same stand of trees is removed, there could be multipath fading effects causing a problem. To check for sources of interference, look for other similar systems in the area or use a spectrum analyzer to detect the noise floor and any other signals in the vicinity of the antennas that are in or near the ISM band. Note the frequency, power and direction of the interfering signal. This will help in adjusting the antenna direction or polarization to reduce the interference.

FEC decoder not locked: This alarm indicates that the forward error correction circuitry has discovered an error in the bit stream. If this is the only alarm condition, it is usually an indication that there is a problem with the far-end modem. A possible corrective action for this alarm is to power the far-end modem off and on.

Solutions:

1 Restarting the near end Modem unit attempts to bring the FEC back into sync with the other side.

- Restart the far end Modem unit. Since the far end Modem unit is the source of the problem and this alarm is not cleared by restarting the near end, restarting the far end Modem unit will fix the problem.

RX Low Signal Power: This alarm is caused by a low value of signal power being received from the RF unit. In addition to causing the Alarm LED to light, it will cause the RF Fault LED to light. The likely causes of this alarm condition are that the RF unit has been disconnected from the modem, the antenna has been disconnected from the RF unit, the RF unit has failed, or that the far-end of the link is turned off or has failed.

Solutions:

1 Check that the Modem units are configured properly:

2 Check that the encoding in the CONFIG menu for each unit is the same.

3 Check the TX code and RX code in the CONFIG menu. The near end TX code **must** be the same as the RX code of the far end and vice versa. If they are

not, the link most likely will not be able to establish a connection.

4 Make sure that none of the tests in the TEST or ADVANCED menu are on.

· Check the antenna alignment. Make sure the antenna is aligned properly and that the RF cable is connected correctly and not damaged. Do this for both the near and far ends of the link.

6 Check that the IF cable is connected properly and not damaged.

7 Verify that the far end Modem unit is on and operating normally. If any alarm conditions exist, troubleshoot them first to see if that clears the "Low RF Power" alarm.

RX Low Symbol Power: This alarm is caused by a low value of demodulated symbol power being received from the RF unit. If this alarm condition exists and "RX Low Signal" does not exist, the likely causes of this alarm condition are that the far-end of the link is turned off or has failed.

Solutions:

1 Check the RF and BB Signal Level. If both are low (RF<83%, BB<40%) then see the steps in "RX Low Signal Power".

· Check for possible interference from noise or another system. If the BB Signal level is low (< 40%), but the RF Signal Level is good (> 83%), the system has either locked onto noise or another signal, or the ambient

noise has become too great for the system to receive signals from the other end. If there is still a signal level upon powering down the far end Modem unit, then the near end is picking up noise or another signal.

3 Restart the system. This may cause the system to lock back onto the far end's signal.

4 Check for possible sources of the interference. See if any other systems have been placed in the area and find out what frequency and power they are operating at.

No Acquisition: This alarm is caused by an acquisition failure by the de-spreading circuitry. The likely source of failure is the loss of signal from the far end of the link. In addition to causing the Alarm LED to light, it will cause the RX Data LED to be extinguished. If this alarm condition exists and "RX Low Signal Power" does not exist, the likely causes of this alarm condition are either that the far-end of the link is turned off (or has failed) or that the attenuation of the signal between the antenna has increased. A possible corrective action for this alarm condition is to decrease the Symbol Threshold on the "CONFIG Menu".

Solutions:

1 Spot check the antenna alignment. 3ust do a visual check to see that the

antenna is aligned correctly and doesn't appear damaged in any way. If getting to the antenna is not difficult, check the alignment as per the installation instructions and verify that the RF cable is connected properly and undamaged. If the antenna is out of alignment as well, there will most likely be an "RX Low Signal Power" or "RX Low Symbol Power" alarm as well (see above).

- Check the status of the Modem unit at the far end. Make sure it is powered on and in normal operating mode. If any other alarm conditions exist, troubleshoot that end of the link.

AIS: Alarm Indicator Signal. This is caused by the modem receiving "all ones" from the DSX or G.703 interface. This indicates that a failure of the "upstream," or user, device has occurred.

Solutions:

I Check that the Tl Data Cable length is set properly. This shouldn't be the entire cause of the alarm, but it may be part of the problem.

· Check that the CPE is configured and working properly. This alarm differs from the 'Transmit LOS" alarm in that there **is** a signal present at the DSX or G.703 interface. Consult the CPE documentation for this.

IF YOU CAN7 RESOLVE THE PROBLEM

If the 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 authorization number obtained prior to shipping. See warranty and service guidelines provided at the end of this guide for more information.

iowave, Inc.
1010 Wisconsin Avenue, NW
Suite 215 fax: (202) 333-0984
Washington, DC 20007

Tech Support:
phone: (202) 333-7031

phone: (202) 333-9283
fax: (202) 333-0984
http://www.iowave.com

UCT SPECIFICATIONS* FOR THE iolink" i - 5.7GHz

Electrical

Output Power	@@Oto +25 dBm
Frequency Range	5725 to 5850 GHz
Frequency Selection	----

Zi,5

c@,cl

5777.5 and 5837.5 GHz (Plan C)

Bandwidth	22 MHz
IF Transmit Frequency	I 10 MHz
JF Receive Frequency	70 MHz
Receive Level	-30 dBm (no error) to -89 dBm (I E-6 BER)
Max Receive Level fno damage)	0 dBm
Receive Sensitivity (at I E-6 BER)	-89 dBm
Processing Gain	>lOdB

Connector Interfaces

To Antenna	Type N Female
To Modem	Type TNC Female (2x)
Cable Length	0-500 ft.
	*lengths vary with chosen grade of cable

Electrical

Modulation	DQPSK
Spreading Method	Direct Sequence
Code Length	I O/Tl, 1]/El
Number of Stored Codes	*4*
Clock Source	4we",cd-
FEC	4/3 Rate@@,o@ oding for Tl only

Connector Interfaces

To RF Unit	Type TNC Female (2x)

User Data

DSX@L	RJ-48C, Female (I 00 ohms)
ITU G.703	Type BNC Female (75 ohms)(2x)(1 20 ohms factory ordered)

Monitor and Control

NMS	DB-9, Male (RS232)
Summary Fault	Form-C Relay

Data InteTlace

Interfaces	DSX-1 (TI), G.703 (El)
Data Rates	*1544* IT]), 2048 (El) kbps
Line Codes	AMI, B8ZS (TI), HDB3 (El)
Line Build-Out	0-655 ft.

Diag

F*ent-

NM& r@owv/cc4D@ RS2.4-,' *4@2@ 9'@* 7 -32

Power ot,,,-t

AC Connector	EIA 3 prong, Male
AC Voltage	Universal 90-260 VAC, 50/60 Hz

DC Connector Terminal Block 1 6 AWG (factory ordered)

DC Voltage +Z __7ZL Q@VDC (factor@y ordered)@@-,

Power Consumption

0 1 0 LIJI:C-l@

Operational Temperature	O'C to +55'C	-30'C to +55'C
Storage	-20'C to +700C	-40'C to +70'C
Humidity	0-95% Non-Condensing	0-95%, Non-Immersion, Rain (4 in/hr)
Width	16.8'(ii-4il@	4.2.@ 7,'i to"

Height	1.75'tiLA	2-@"
Depth	1 2.6'	W-394a 46.?L".

Weight	6 lb. (2.7 kg)	110 to @5

p,.d@@t @,@c f .tio@@ ..y be t. @*h..g@*

a W7 ***total digital wireless solutions***

IOIOVVsco@@i@A@e, NW S@ile2l5 Washi@9t,@, DC 20007 202 333.9263 pho,e 202.333.0984[m . *O.,...m*

5.7 Ghz DRAFT

APPENDIX C

IMPORTANT INFORMATION ABOUT YOUR SYSTEM

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. This device operates in the 5725 to 5850 MHz 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.

WARNING

In order to comply with the FCC adopted RF exposure requirements, this transmitter system will be installed by the manufacturer's resaler professional. Installation of the 2 ft. parabolic dish antenna must be performed in a manner that will provide at least 1 .26 meters clearance from the front side of the dish, to any personnel such as employee or member of the public.

5.7 Ghz DRAFT

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, !owave 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 defecbve 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 productsunderthiswarrantymustbeobtainedpriortoshipping. *iowavewillonlyaccept returnedgoods with theoroper authorization number.* 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.

Disclaimer

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

io ' Wave, 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).

Use of !owave Products Outside of the United States at the Time of Publishing

iowave, Inc. has not received approval or certification for the use of any its products in countries outside of the United States and Canada. iowave does not recommend use of its products in such areas, and accepts no responsibility for any consequences, legal or otherwise, resulting form the use of our products. The use of iowave products outside of the United States is solely the responsibility of the user.