MICROLITE RECEIVER

HD/SD COFDM Dual Diversity Receiver
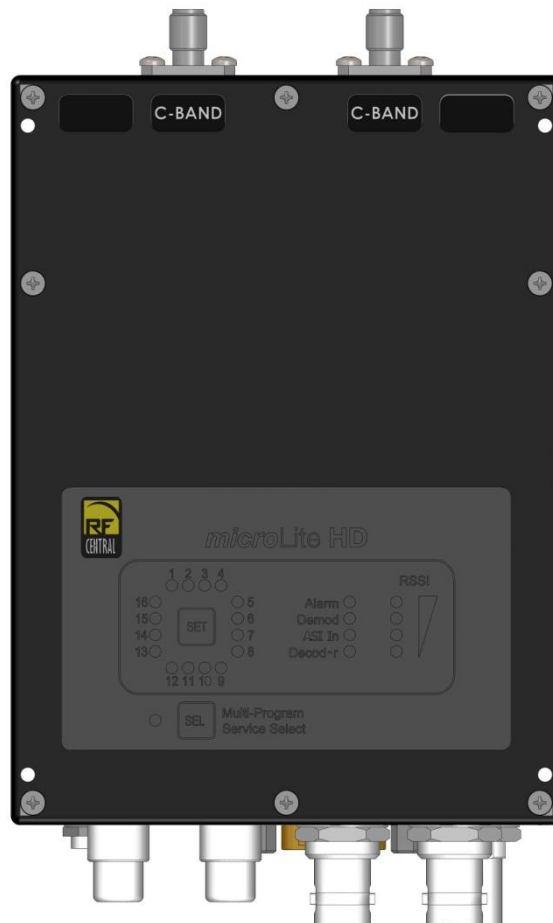
User Manual

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Revision History

Date	Revision	Modified by	Description
May 16, 2011- June 13, 2011	0.0D	Dave Anderson (Mike Hardy)	Initial Writing
August 8th. 2011	0.1D	Mike Hardy	Ongoing updates and clarifications
October 12, 2011	0.2D (BETA)	Mike Hardy	Clarified future dual-band option
11/05/2011	.3D	Sean Van	Added Theory of Operation and Description
11/27/2011	.4D	Sean Van	Added Formats, formatting, and Specifications
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MicroLite Receiver
User Manual
Publication: M23-0005-00A

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We make every effort to ensure our documentation is as accurate and as complete as possible. In the event that you find any errors or omissions, please contact Customer Tech Support at (908) 852-3700, or via email at service@nucomm.com.

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NOTICE

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation."

microLite Receiver
User Manual

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Chapter One

Introduction

1 Introduction

This document is a user manual for RF Central's *microLite* Receiver [*MLR*]. The *MLR* is a compact, narrowband COFDM microware receiver that utilizes dual antenna diversity for robust, error free signal reception. The *MLR* is ideal for applications requiring a full featured high performance HD or SD receiver housed in a compact enclosure. ASI, HD-SDI, SD-SDI, Composite video, User Data and streaming video outputs are available from the *MLR*. The *MLR* uses industry standard output connectors for compatibility with a wide range of AV equipment.

1.1 Manual Overview

Throughout this manual, the product is referred to as the "*microLite*", the "*microLite* Receiver", the "*MLR*", "*microLite* RX", or simply the "receiver."

The contents of this manual are as follows:
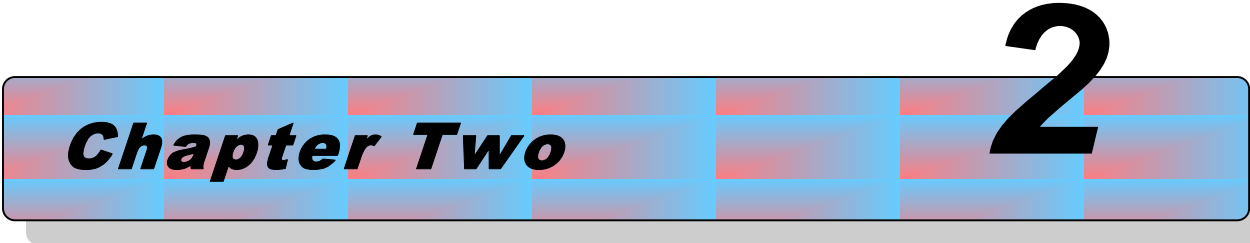
Chapter 2 – Describes the features and theory of operation of the *MLR* receiver.

Chapter 3 – Contains a list of product specifications. The specifications include the receiver's frequency bands, channels, demodulator specifications, decoding specifications, size, power requirements, environmental specifications, and I/O specifications.

Chapter 4 – Explains how to install the product.

Chapter 5 – Describes operating procedures for the receiver using the push button user interface built into the unit.

The rear of the manual contains warranty and repair information.

Chapter Two

2

Description

2 *MICROLITE* Description

This chapter describes the *MLR* features and theory of operation. It also includes a block diagram of the *MLR* and a description of the internal circuits.

2.1 *microLite* Features and Benefits

Table 2-1 summarizes key features and benefits of the *MLR*.

The *microLite* Receiver is a receiver that utilizes advanced silicon tuners and dual antenna inputs for robust, error free signal reception. The MLR can receive either HD or SD video transmissions using COFDM modulated microwave signals. The MLR uses maximal-ratio combining to take advantage of its dual antennas.

The silicon tuners employed in the *microLite* Receiver includes low noise amplification, automated gain control, mixing, tuning, and demodulation functions on one integrated circuit. This facilitates low power, high performance, and space savings.

The *microLite* Receiver contains a built-in, industry compliant, MPEG4 (H.264 part 10) decoder. The *MLR* can output ASI, HD-SDI, SD-SDI, or Composite video, as well as User Data. Stereo audio is included on the ASI and SDI outputs, and the *MLR* has left and right audio output jacks.

The *MLR* features a 100 Mbps Ethernet LAN interface for streaming video over IP. This feature uses UDP/IP and allows received video to be viewed remotely using MPEG4 decoder software on a personal computer. A compatible MPEG4 decoder that runs on your remote host PC is required for this application.

The top panel of the *microLite* Receiver has signal strength, status, and monitoring LEDs that provide useful information at a glance. The user interface also features a selector button for choosing between 16 pre-programmed configurations called "Presets".

Though the unit ships pre-configured, a graphical user interface that runs on a Windows PC is available to modify the operating parameters.

IMT has the ability, should the need ever arise, to provide the user with firmware files and instructions for local firmware installation, such as for feature upgrades, etc.

Table 2-1: MICROLITE RECEIVER - Summary of Features and Benefits

Feature	Benefit
COFDM HD and SD Microwave Receiver	COFDM facilitates high data rates and robust signal reception. Receives both high definition and standard definition video transmissions.
Dual Antenna Diversity Using Maximal-Ratio Combining	Best aspects of the transport stream received using either antenna is used, yielding robust, error free reception.
MPEG4 (H.264 part 10) Video Decoder	Industry standard video decoding. Integrated with IMT maximal-ratio combining scheme.
ASI, HD-SDI or SD-SDI, and Composite Video Outputs	Compatible with industry standard A/V equipment. SDI format switches automatically between HD and SD.
User Data Channel	An RS-232 data channel is received along with the program streams.
Stereo Audio Line Outputs	Line audio outputs for connection to headphones, an amplifier, or recorder. Audio is also available in ASI and SDI outputs.
Remote Control Via RS-232 Serial Interface	The *MLR* is pre-programmed for its operating environment using a built-in web GUI via LAN or optional Remote Control Windows PC GUI.
Faceplate User Interface with Presets and Status LED's	Users can quickly select one of 16 pre-programmed preset configurations. This is through the programmable serial interface or by using the optional front panel user interface. Status and Alarm information is available at a glance.
Rugged, Compact Housing	Integrated in small form factor.

2.2 Frequency Bands

The *microLite* Receiver is available in the following bands:

Table 2-2: *MLR* Frequency Bands

Base Part Number	Frequency (GHz)
21MLR	2.025-2110
23MLR	2.200-2.400
58MLR	5700-6000

2.3 *microLite* Receiver Theory of Operation

Major blocks in the *MLR* diagram include:

- Dual Antenna Inputs
- Dual Microwave Receiver and COFDM Demodulator Circuits
- Dual Input Maximal Ratio Combining Circuit
- MPEG4 Video Decoding Circuit
- Video Output Interfaces: ASI, SDI, and Composite Video
- Left and Right Audio Output Interfaces
- Preset Selection and Status Monitoring User Interface (Optional)
- Programmable Serial Interface and Internal Control CPU With Flash Memory
- Interface For Firmware Upgrades
- Power Circuitry

Refer to **Figure 2-1: Internal Block Diagram** for following discussion.
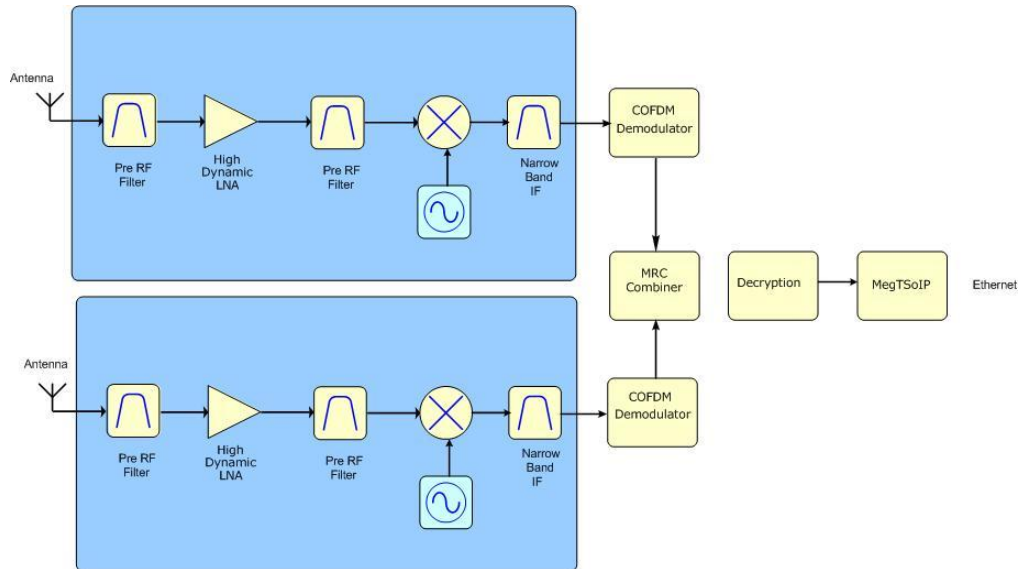
Figure 2-1: Internal Block Diagram

2.3.1 Dual Antenna Inputs

The *MLR* has two SMA antenna input connectors. The input impedance of the antenna connectors are 50 ohms.

The frequency band supported by the antenna connectors are labeled next to the antenna inputs.

2.3.2 Dual Microwave Receiver COFDM Demodulator Circuits

The *MLR* is capable of receiving COFDM transmissions from compatible products in multiple bands. The receiver standards supported by the *MLR* support high data rates with low error rates.

Each antenna input is filtered and amplified by a low noise amplifier. The output of the amplifier is filtered again at the input of the RF receiver circuit. The receiver mixer down converts the received signals to the internal IF frequency.

The COFDM demodulator is programmable to support transmission modes offering different data rates (Refer to Chapter 5 for more information). The output of the COFDM demodulator circuits contains transport streams carrying audio, video, and user data.

2.3.3 Maximal-Ratio Combining Circuit

This feature enhances the robustness of the receiver when line of site obstructions occur in the transmission path.

2.3.4 MPEG4 Decoder

The *MLR* contains a built-in MPEG4 (H.264 part 10) compliant decoder. The decoder audio and video output is available on the SDI output jack. Both HD-SDI and SD-SDI are output on the SDI jack.

2.3.5 Video Outputs

Video output jacks include:

- ASI – MPEG4 encoded transport stream
- SDI – HD-SDI and SD-SDI audio and video
- Composite Video – The *MLR* composite video output circuit automatically outputs either NTSC or PAL, per the user specified settings.

2.3.6 Audio Outputs

The *MLR* has left and right audio line output jacks. Stereo audio is also part of the ASI and SDI video outputs. The Audio output jacks are 75 Ohm RCA connectors.

2.3.7 User Data Output

A data channel is transmitted with the audio and video information. Access of the data channel is through the RS-232 serial interface output connector. The baud rate and other RS-232 parameters are programmable.

2.3.8 Video over IP Encapsulation for Streaming Video

The *MLR* features a 100 Mbps Ethernet LAN interface for streaming video over IP. This feature allows received video to be viewed remotely using MPEG4 decoder software on a personal computer.

2.3.9 Faceplate Status Display and Preset User Interface

If you commonly use several configurations in the field, the faceplate LED preset settings and "Set" selector button provide a quick way to change pre-programmed configurations. Status information is also presented by LED's. Refer to Chapter 5 for more information.

The Preset configurations are pre-programmed using the Remote Control Windows PC GUI or Web GUI interface. To program a preset, adjust any of the settings within the *MLR*, and then save the current group of settings by assigning a Preset number. The Presets are recalled by using either the faceplate user interface or the Remote Control PC GUI or the Web GUI interfaces.

2.4 Remote Control and Firmware

2.4.1 Remote Control via Ethernet

An Ethernet port allows remote control of all configuration options, as well as monitoring of internal status and settings.

The IMT NanoController GUI is available for controlling the unit via the Ethernet port. Any Windows compatible computer running Windows XP/Vista/7 with 500 MB of memory and 1 GHz Pentium or above can be used. Refer to Chapter 5, "Operation" for more information.

2.4.2 Remote Control via RS-232

An RS-232 command set is implemented to allow remote control of all configuration options, as well as monitoring of internal status and settings. Commands and responses are sent via the RS-232 serial interface on the 9-pin connector.

The IMT NanoController GUI is available for controlling the unit via the RS-232 serial interface. Any Windows compatible computer running Windows XP/Vista/7 with 500 MB of memory and 1 GHz Pentium or above can be used. Refer to Chapter 5, "Operation" for more information.
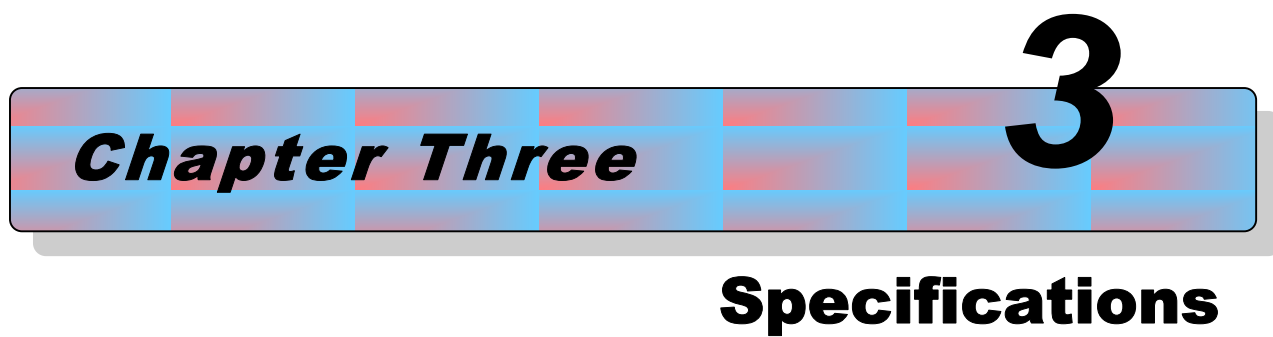
2.4.3 Firmware updates

Update unit firmware via the Ethernet interface. Contact IMT Tech Support for additional details.

3

Chapter Three

Specifications

3 Specifications

3.1 Frequency Bands and RF Performance

Base Part Number	Frequency (GHz)
23MLR	2.025-2.500
58MLR	5.725-5.850

- Tuning step size: 250 KHz
- Frequency stability: ± 10ppm

3.2 Modulation Modes

Modes are auto detected within modulation format
- Modulation Formats: COFDM (DVB-T)
- Carriers: 2K
- Constellation: QPSK, 16QAM, 64 QAM
- Code Rate: 1/2, 2/3, 3/4, 5/6, 7/8
- Guard Interval: 1/32, 1/16, 1/8, 1/4
- Bandwidth: 6 MHz, and 8 MHz

3.3 Diversity

- Dual Receivers
- Channels: 2 input Maximum Ratio Combining

3.4 MPEG 4 Decoder

3.4.1 Video

- Method: MPEG-4 Part 10/H.264
- Video Coding;   AVC
- Video Output;   Composite and SDI
- SD-SDI output: ANSI/SMPTE 259M
- HD-SDI output: ANSI/SMPTE 292M

3.4.2 Audio

- Audio Channels: 1 Stereo, 2 Mono
- Audio Coding: ISO/IEC 11172-3(Layer I/II)
- Audio Sample Rate: 48Khz
- Audio Output Levels: Direct line output or adjustable gain output.
- Embedded Audio: Available in SDI as embedded audio

3.5 System

- ASI Output: Auto output rate follows modulation or fixed output user selectable (PCR Retime stamp)

- User Data: RS232 Side channel; 300-115K Baud
- Latency   (*using MicroLite Transmitter):
  - 4 frames in Low Latency Mode for all formats except PSF
  - 5 frame in Low Latency Mode for PSF formats

- Ethernet: 100 Mbps Ethernet interface.
- Streaming Video: Streaming MPEG-TS over UDP/RTSP
- Remote Control: Via LAN and/or PC GUI

3.6 Power Requirements

- Input range: DC: +9 to +32
- Power consumption: 9W Typical

3.7 Environmental

3.7.1 Temperature Range

- Full specification: -10° to 50°C Ambient
- Storage: -40° to 80°C
- Humidity: 0 to 95% non-condensing

3.7.2 Altitude
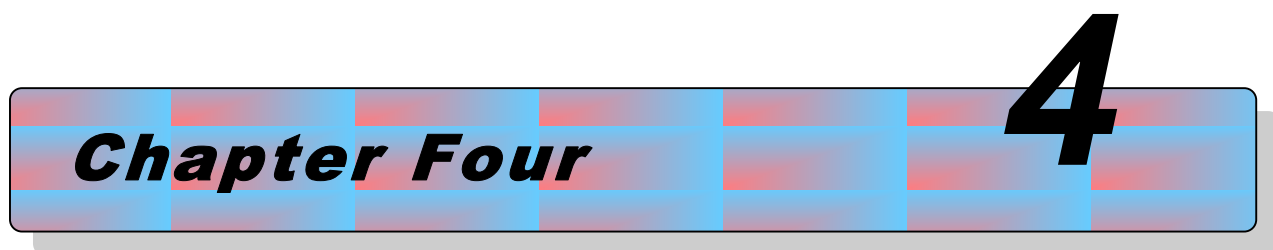
- Operating: 20,000ft (6,000 m)
- Storage: 50,000ft (15,000 m)

3.7.3 Physical Characteristics

- Size: 3.7" x 5" x 1.5"
- Weight: 620g/1.4lbs

3.8 User Interface and Remote Control

- One button control (16 user defined presets)
- Remote RS232
- WEB GUI

Chapter Four 4

Installation and Operation

4 Installation and Operation

4.1 Overview

This chapter contains steps for installing the MicroLite Receiver in typical environments where it may be used.

4.2 Identifying MLR Physical Features and Interfaces
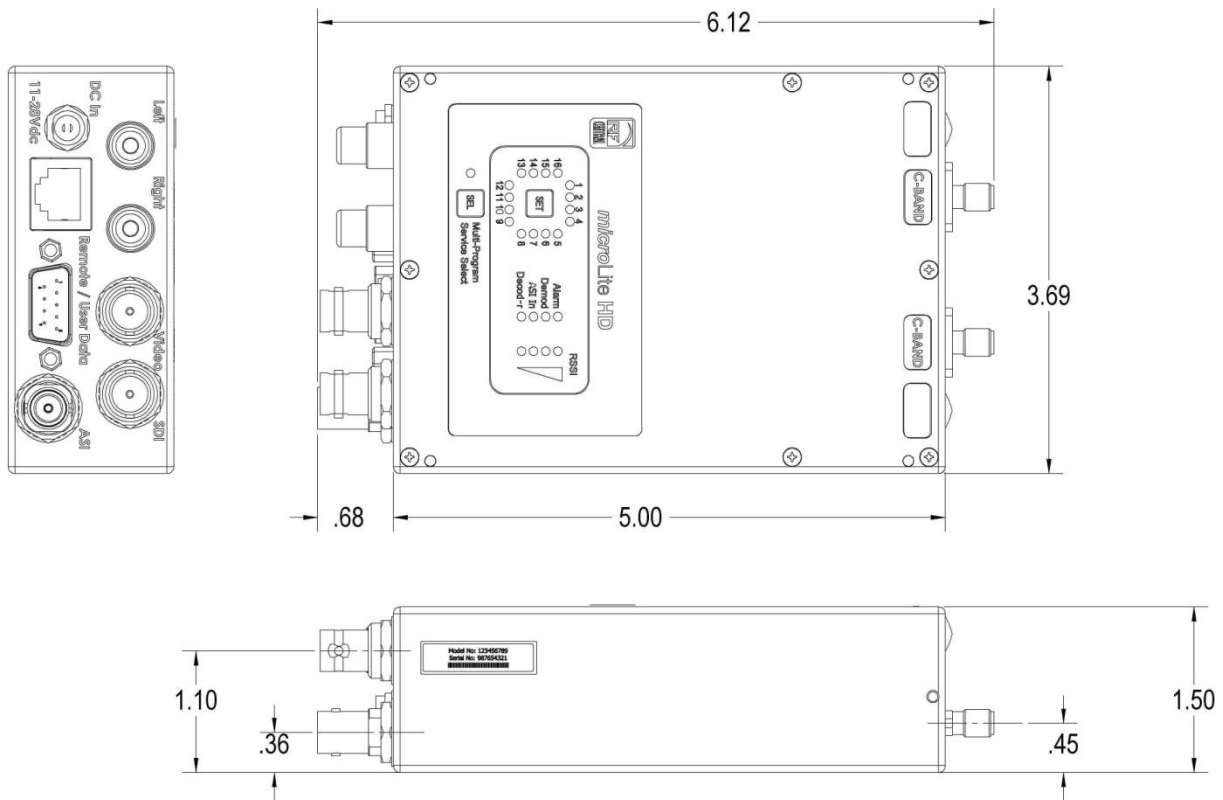
4-1: *microLite* **Outline Drawing**

Figure 4-2: Output Connectors

Table 4-1: Output Connectors

Item	Description	Connectors
Left, Right	Audio Line Outputs	75 Ohm RCA
SDI	HD-SDI or SD-SDI Output	BNC
Video	Composite Video (PAL or NTSC)	BNC
ASI	Encoded Video Output	BNC
DC In	Power Supply Input	2.5mm jack
Ethernet Port	100mbps LAN Interface	RJ45
Remote / User Data	RS-232 Connector	DB-9

_____

! WARNING – DO NOT OPEN THE MICROLITE!

The MicroLite contains no user serviceable parts. Do not open the
MicroLite housing. Failure to comply will result in voiding of the
warranty.
_____

4.3 Physical Installation

- Remove *microLite Receiver (MLR)* from the case. The mounting bracket with *MLR* is preassembled.
- Attach *MLR* to the Magic Arm using tripod mount bracket.
- Connect Video output as needed (BNC connector).
- Connect audio output as needed (RCA jacks).
- Connect RX antennas (larger sector directional) to the RF Inputs (N-Type).
- Aim directional sector antennas in the general area of *MLT* operation.
- Connect power source to the *MLR* using the power cable supplied.
- Select *MLR* preset using the set button.

4.4 Connect External Signals

The *microLite* Receiver has the following major output interfaces:

- Power Interface
- RS-232 Serial Port
- Left and Right Audio Outputs
- Composite Video Output (not down converted from HD)
- ASI Video Output
- SDI Output for HD-SDI and SD-SDI Video
- User Data

4.4.1 Audio and Video

Connect the desired Audio and Video outputs to A/V monitoring devices with appropriate cables. The *MLR* has RCA jacks for audio and 75ohm BNC connectors for Composite Video, SDI and ASI.

4.4.2 Power

Connect an appropriate DC power source to the DC in connector. The power source requirements are listed in Chapter 3, Specifications. Power supplies and cables are supplied with the unit.

4.4.3 RS232 Control and User Data

If desired, connect a suitable cable to the 9 pin D Remote/User Data connector per the pinout below. Cables are available from *IMT*.

Table 4-2: Remote Control / User Data Pinout

Pin	Function	Notes
1	N/C	
2	RX / IN A	Remote Control
3	TX / OUT A	Remote Control
4	N/C	
5	Ground	Ground
6	TX / OUT B	User Data
7	RX / IN B	User Data
8	N/C	
9	N/C	

4.4.4 ASI Out

If required, connect a suitable ASI output cable (75Ω BNC).
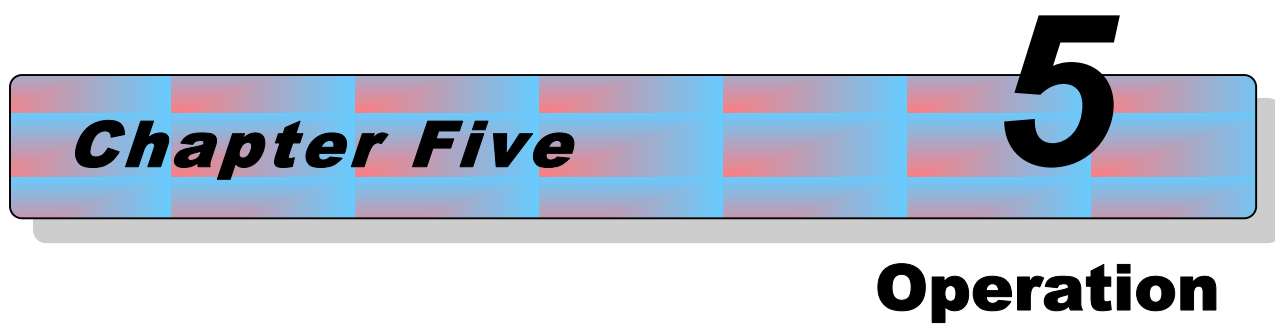
4.5 Connect Antennas

Connect antennas directly to the N RF input connectors, or via 50-Ohm cables.

WARNING
If cabling the *MLR* directly to a transmitter (e.g. for testing) you must use
in-line RF attenuators. 50dB minimum recommended.

Figure 4-3: MLR Antenna Connectors

Chapter Five 5

Operation

5 Operation

While this chapter contains basic information about the operation of the *microLite* Receiver, the programming of the unit (including preset configuration) via the NanoController GUI is not covered. Please refer to the NanoController manual (IMT Publication: M27-0001-00A) for detailed information on how to program and configure the unit.

In this section, you will find information on how to use the *MLR* to receive video, audio, and user data, and how to stream video to a PC or network.

5.1 Power up the MicroLite Receiver

Turn on the power to the overall system.

The MLR requires up to 20 seconds to complete the power up sequence. Supply current will jump up in steps as internal circuits are powered. The final DC supply current will settle after 20 seconds.

The *MLR* contains flash memory, which retains all stored preset configuration settings when the unit is not powered.

5.2 Pre-Configure the *MLR* user options

The *MLR* has a wide range of programmable settings. Before using the *MLR* in your application, you should pre-configure it to for the settings you want to use in your application. Settings are selected and configured using the NanoController software, or a third party alternative. Please refer to the NanoController documentation for details, or contact IMT Technical Support.
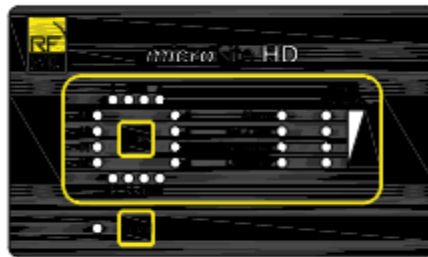
5.3 Control and LED Interface

Figure 5-1: Front Panel Controls and Indicators

The *MLR* has several Buttons and LED's on the front panel, to perform basic operation and view unit status. Any changes made via a remote control interface will be reflected by the front panel LED's.

The MLR can be pre-configured using the programmable serial interface and then quickly changed between preset modes using the "Set" pushbutton.

5.3.1 Buttons:

- Set Button - Advances the unit through the presets. The 1-12 LED's indicate in GREEN, which preset is currently active.
- SCAN(future Feature) **-** Scan available presets until it locks on an incoming signal.

5.3.2 Status Indicators:

- Alarm - Normally OFF. If an Alarm is present, the LED will be RED.
- Rx Lock - When YELLOW, the demodulator is locked.
- Streaming - Indicates that the unit is streaming video through the Ethernet port.
- Decoder – Decoder Operating
- RSSI - LED's will light to provide a Received Signal Strength Indicator.

5.4 Using the *MLR* to Receive Audio and Video

The MLR receives and demodulates COFDM radio signals from the *microLite* Transmitter. It then decodes the MPEG4 transport stream for output.

The dual antenna diversity feature of the *MLR* is used to maximize the robustness of video reception. The primary goal of dual antenna diversity is to enable the user to prevent line of site obstruction on the transmission path from causing receiver errors to occur. By separating the antennas, the user has two chances to receive the signal properly, regardless of obstructions between the transmitter and *MLR* antennas. Properly directing your antenna to the transmit source is key obtaining the best range possible.

Video may be viewed on a monitor, which accepts SD Composite video, or SDI. MPEG4 encoded video is also included in the transport stream on the ASI output, and must be decoded using an MPEG4 decoder prior to viewing on a monitor.

Audio can be output to a recorder or amplifier. Audio is also embedded in SDI outputs, and included in the transport stream on the ASI output.

Streaming video and audio can be output via a laptop or PC with a compatible MPEG4 decoder program.

5.5 Verify Operation

After installing the *MLR*, turn on the power to the receiver and your overall system. The LED's on presets 1-4 will sequentially illuminate until boot up is complete.

Verify operation of the *MLR* by using the following methods:

- Use the Remote Control Interface and/or the Web GUI interface to verify the status of the *MLR*.
- Use a video monitor to view SD Composite video (NTSC or PAL, as appropriate).
- Display video on equipment with ASI or SDI input connectors. This may include video analysis equipment or PC's with ASI or SDI input cards used for video storage and editing.
- To stream video over IP use the Ethernet connection to a PC or laptop running a compatible MPEG4 audio and video decoder program.

   Note: When operating in low latency, external MPEG4 software/hardware decoders may not work.

5.6 Streaming Video over IP/Ethernet

The MLR is pre-configured to stream video over IP on its Ethernet port. To stream video over IP use the Ethernet connection to a PC or laptop running a compatible MPEG4 audio and video decoder program.
.

5.7 Using the *MLR* to Receive User Data

View User Data by using a laptop PC with a Terminal program. The User Data is through the RS-232 (DB-9) connector. Refer to Table 2-1 for pin-out. Contact IMT for details.

5.8 Maintenance Information

Follow these procedures when maintaining the device:
- Dry the device immediately if it comes into contact with water or other liquids. Warranty does not cover liquid damage.
- Do not submerge the device or use it directly in rain.
- Do not open the device. This voids the warranty.
- Keep the device clean by wiping with a soft, dry cloth. If necessary, dampen only using a solution suitable for cleaning electronic devices. Warranty does not cover cleaning damage.

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Warranty

Equipment manufactured by IMT, LLC is warranted to meet all published specifications and to be free from defects in material and workmanship within a period of two years from date of original shipment.   The company's liability under this warranty is limited to:

- Servicing or adjusting equipment.
- Replacement of defective parts.

Any equipment returned to the factory shall have the freight paid for by the buyer.

Equipment showing damage by misuse, abnormal conditions of operation, or attempts to repair by other than authorized service personnel shall be excluded from this warranty. IMT shall in no event be responsible for incidental injury or property damage. Since IMT has no control over conditions of use, no warranty is made or implied as to suitability for the customer's intended use, beyond such performance specifications as are made part of the purchase order.   There are no warranties expressed or implied, except as stated herein.   This limitation on warranties shall not be modified by verbal representations.

Shipping Damage

Equipment shipped FOB IMT shall become the property of buyer upon delivery and receipt from carrier. Any damage in shipment should be handled by the buyer directly with the carrier. Immediately request the carrier's inspection upon evidence of damage in shipment.

Field Service

IMT products are designed with easy access to components to facilitate service. However, some modules cannot be service in the field. To prevent voiding of the warranty, please contact Tech Support before servicing or making any repairs. The user is cautioned to read all module descriptions in this manual. Warnings are included in the circuit descriptions and on certain modules themselves.

Replacement Modules
Troubleshooting to the component level is often not cost-effective and frequently impossible. Often the practical method of effecting repairs is to substitute known good spare modules for suspect units. Replacement modules for our standard product line are usually available.

Technical Support Information

Technical Support personnel are available to extend technical assistance to customers while installing, operating, or troubleshooting IMT equipment. Please have your model number and serial number available.

Telephone
      During IMT business hours, 8:30am - 5:30pm EST (-5 Hours, GMT), call:
            US 908-852-3700
            International 001-1-908-852-3700
      After hours, call:
            US or International.................................888-531-3892
Email
      Email address ....service@nucomm.com
Internet
      Web address ....www.imt-solutions.com

Equipment Returns
If equipment cannot be successfully restored through telephone consultation, return to the factory may be required. Loaner items may be available until the repaired items are returned.

For out-of-warranty equipment only: We evaluate all returned units, and then confers with the client on corrective action. If no fault is found, or no corrective action is authorized, a diagnostic fee may be charged.

Prior to returning products to the factory, please obtain a return material authorization (RMA) number and shipping instructions from Tech Support.

When returning equipment, it is very helpful to enclose a note containing the following:
- RMA number.
- Serial number.
- A detailed description of the problem.
- Name of an engineer or technician we may contact regarding problems encountered.
- A "ship to" and "bill to" address.

Ship all returns to:
      IMT, LLC
      Attn: RMA# (your RMA number)
      200 International Drive
      Mt. Olive, NJ, 07828, USA
      (908) 852-3700

For International returns:
In addition to the instructions above, when shipping internationally we recommend the use of a courier such as Federal Express, UPS, etc, and that the goods be shipped DOOR-TO-DOOR PRE-PAID. This will reduce Customs costs, handling charges and delays. Enclose all the information above, plus a statement that the equipment was manufactured in the United States (*the latter is needed to expedite customs processing*).

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