



WIRELESS TECHNOLOGIES

**LinkNet Satellite Unit (LSU)
RF - FIBER
Interface Modules
User Manual
Installation, Operation
And Maintenance**



KAVAL WIRELESS TECHNOLOGIES
60 Gough Road
Markham, Ontario, L3R 8X7
Telephone: (888) 86-KAVAL
Web: www.kaval.com
E-mail: info@kaval.com

Document #DCM00000052, Rev.5a
June 17, 2003

PROPRIETARY STATEMENT

© 2000 KAVAL WIRELESS TECHNOLOGIES All rights reserved.

No part of this publication, or any software included with it may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, including photocopying, electronic, mechanical, recording or otherwise, without the prior written permission of the copyright holder.

This document contains proprietary information of KAVAL WIRELESS TECHNOLOGIES. The contents are confidential and any disclosure to persons other than the officers, employees, agents or subcontractors of the owner or licensee of this document, without the prior written consent of KAVAL WIRELESS TECHNOLOGIES, is strictly prohibited.

KAVAL WIRELESS TECHNOLOGIES provides this document as is, without any warranty of any kind either expressed or implied including, but not limited to, the implied warranties of merchantability and fitness of a particular purpose. KAVAL WIRELESS TECHNOLOGIES may make changes or improvements in the equipment, software, or specifications described in this document at any time and without notice. These changes will be incorporated in new releases of this document.

This document may contain technical inaccuracies or typographical errors. KAVAL WIRELESS TECHNOLOGIES waives responsibility for any labour, materials, or costs incurred by any person or party as a result of using this document. KAVAL WIRELESS TECHNOLOGIES, and any of its affiliates shall not be liable for any damages (including, but not limited to, consequential, indirect or incidental, special damages or loss of profits or date) even if they were foreseeable and KAVAL WIRELESS TECHNOLOGIES has been informed of their potential occurrence, arising out of or in connection with this document or its use.

TRADE MARK NOTICE

This manual makes reference to trademarks that are the property of other companies. References are used only to refer to the products or services of the trademark owners.

LSU is a trademark of KAVAL WIRELESS TECHNOLOGIES

TABLE OF CONTENTS

1. LSU MODULES	4	MODULE SPECIFICATIONS	11
OVERVIEW	4	REMOTE MODULE PER-CARRIER DE-RATING.....	12
<i>Theory Of Operation</i>	4	OPERATION	13
MODELS.....	4	<i>Normal Operation</i>	13
BLOCK DIAGRAMS	5	<i>Configuration</i>	13
<i>LSU Head-End Module</i>	5	LASER SAFETY	14
<i>LSU Remote Module</i>	6	ANTENNA INSTALLATION.....	15
CONNECTIONS	7		
<i>LSU Head-End Module</i>	7		
<i>LSU Remote Module</i>	8		
<i>LSU Head-End to Remote Interconnects</i>	10		

1. LSU MODULES

Overview Theory Of Operation

The LSU RF to Fiber Modules provide a multi-band, multi-service link from a main distribution center to multiple local antennae. RF Signals are distributed in runs of three pairs of Single-Mode Fiber-Optic Distribution Lines, organized as...

- Fiber Pair #1:** 1.9 GHz PCS Services
- Fiber Pair #2:** 800 MHz Cellular Services
- Fiber Pair #3:** 800 MHz iDEN, Public Safety, & Paging Services

There are two models....

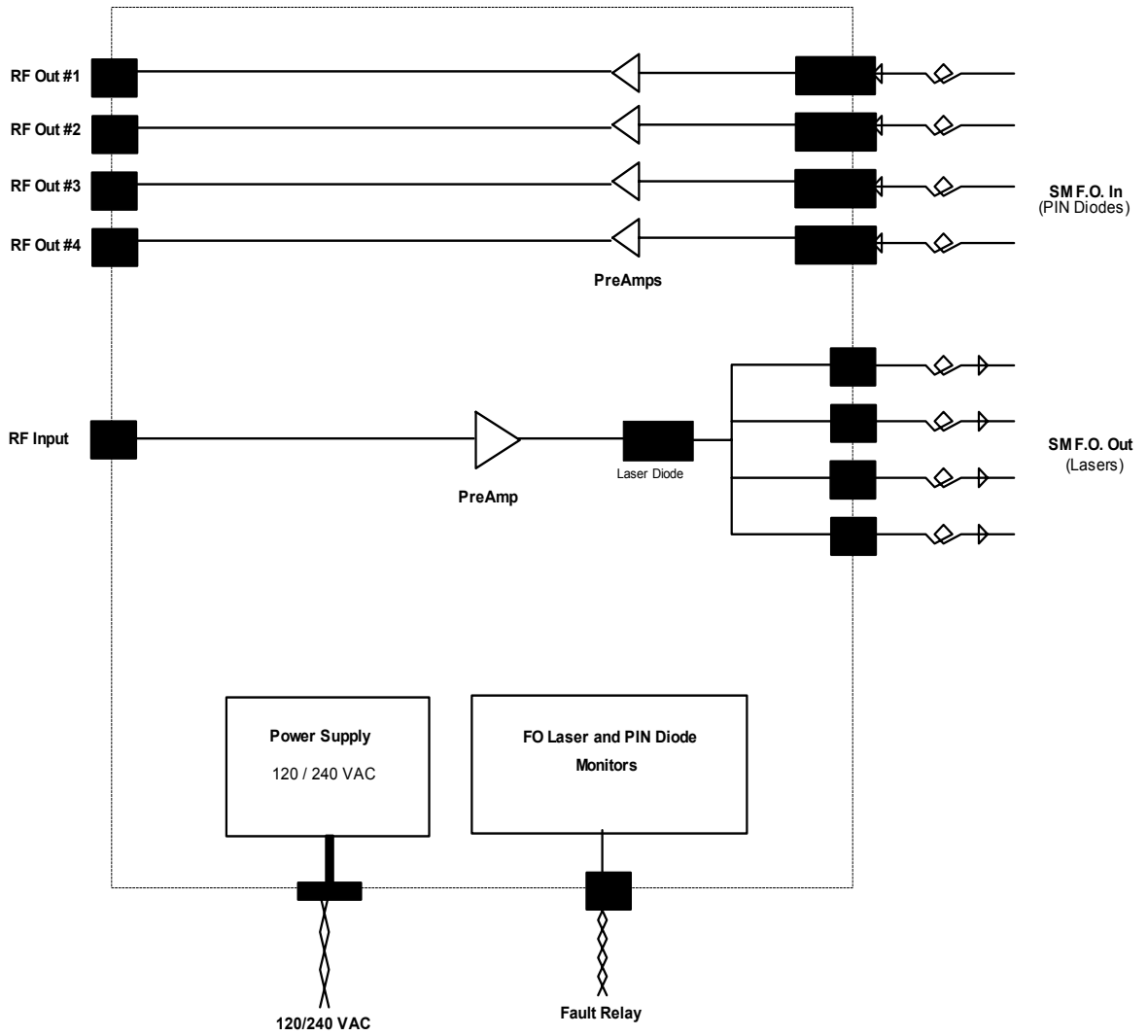
Models

LSU MODEL	DESCRIPTION
LNKFIB-H01	This is a 1U high, 19" Rack-Mount Module providing low signal level interfacing between Head-End RF Modules and Single-Mode Fiber-Optic Distribution Lines. One is used for each of the three Fiber Pair Groups, and can service up to four Remote Modules.
LNKFIB-R01	This is a Wall-Mounted Remote Module that connects to the Single-Mode Fiber-Optic Distribution Lines and provides eight local Distribution Antennae for Signal Extension.

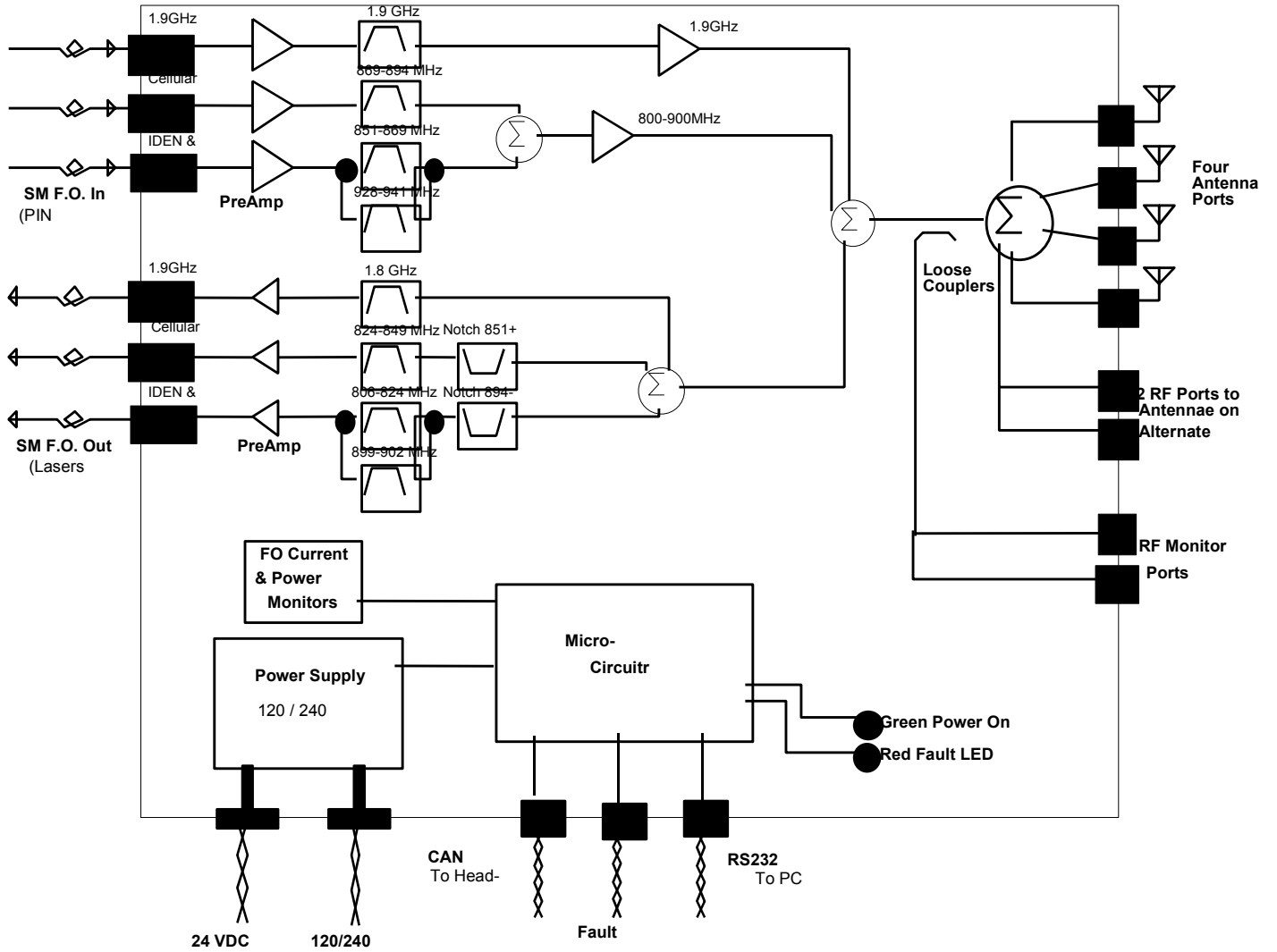
NOTE:

With these Modules, there is always a grouping of three (3) of LNKFIB-H01's to every four (4) LNKFIB-R01's.

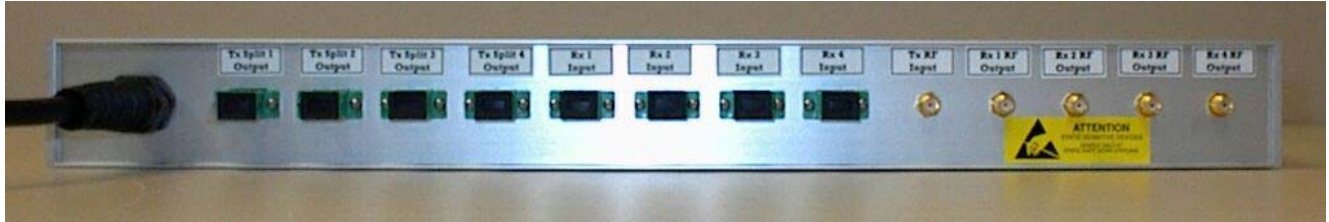
Block Diagrams LSU Head-End Module



LSU Remote Module

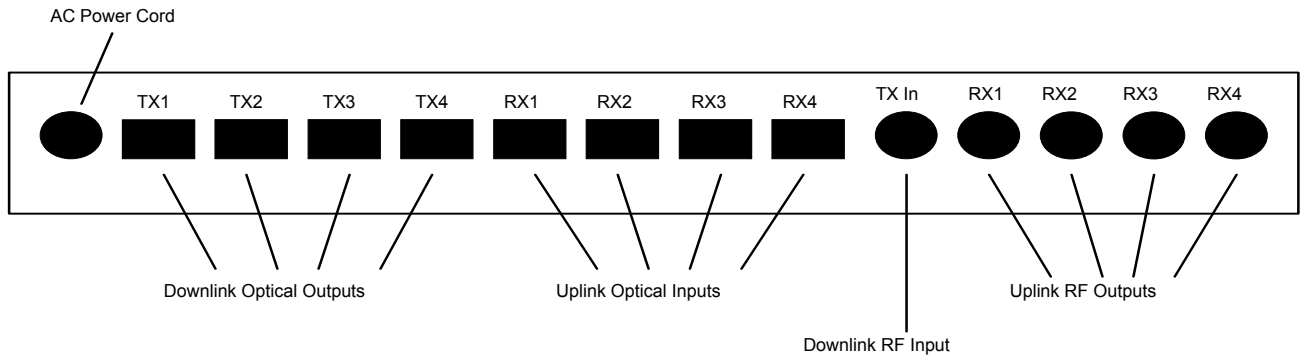


Connections LSU Head-End Module



Head-End Connections

SC/APC SingleMode Fiber-Optic & SMA RF Connectors

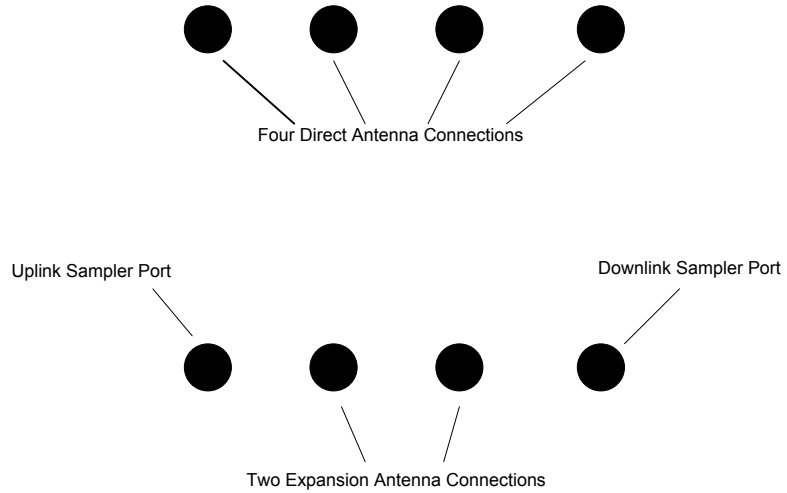


The Head-End has one Downlink RF Input providing the signal for four Downlink Optical Outputs, thus each Head-End Module services one and only one of the three Fiber-Pairs (PCS, Cellular, or iDEN/Trunking).

LSU Remote Module

Antenna Port Connections

SMA Connections



The Remote Module has 8 SMA RF Connections..

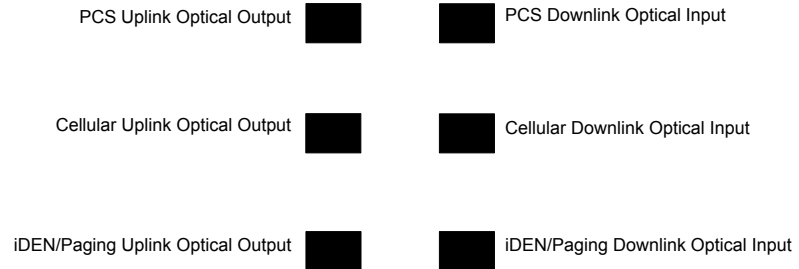
Main Antenna Ports (4): Used to connect to four identical distributed indoor antenna systems.

Expansion Antenna Ports (2): Connected to a secondary location via 2 of two-way combiners, and in turn provide connections to four more identical distributed indoor antenna systems.

Sampler Ports (2): Optionally allow an operator to monitor the Uplink and Downlink RF activity at approx. 30dB below the actual levels.

Fiber Optic Port Connections

SC/APC SingleMode Fiber-Optic Connectors



The Remote Module has 6 SC/APC Single-Mode Fiber-Optic Connections for cabling to the Head-End...

PCS Up & Downlink: Used for the PCS Fiber-Optic Pair connection to the Head-End.

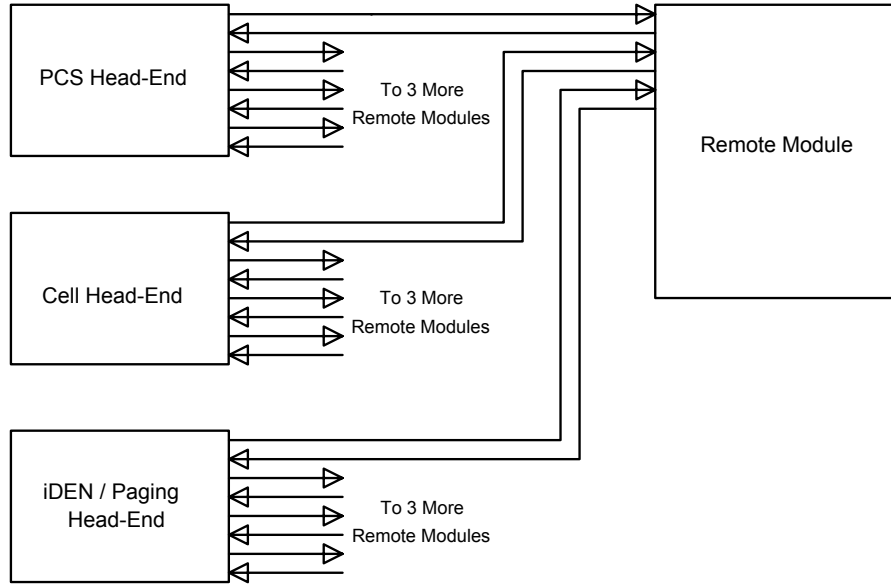
Cellular Up & Downlink: Used for the Cellular Fiber-Optic Pair connection to the Head-End.

iDEN/Paging Up & Downlink: Used for the combined iDEN / Paging Fiber-Optic Pair connection to the Head-End.

LSU Head-End to Remote Interconnects

Head-End to Remote Fiber-Optic Connections

Groupings of 3 Head-Ends to every 4 Remotes



The Single-Mode Fiber-Optic interconnections between the Head-End and Remote Modules are based upon the Head-Ends being organized on a "per Fiber-Pair" system. This fundamentally means that an installation requires three Head-Ends for every four Remote Modules. It also means that if you have a fully optimized system with all Head-End ports in use, and you add one more Remote Module, then another three Head-End Modules are required.

Module Specifications

Frequency Bands	<p>Downlink: 851-869 MHz iDEN & Pub Safety 869-894 MHz Cellular 928-941 MHz Paging 1930-1990 MHz PCS</p> <p>Uplink: 806-824 MHz iDEN & Pub Safety 824-849 MHz Cellular 896-902 MHz Paging 1850-1910 MHz PCS</p>
Maximum Power from any one of eight Remote Module Antenna Ports	<p>iDEN/Cell/Paging Combined: +35 dBm IP3 Typical</p> <p>PCS Combined: +33 dBm IP3 Typical</p>
Gains from any one of eight Remote Module Antenna Ports referenced to Head-End Unit, assuming 0dB Fiber-Optic Link	<p>Downlink: +28 dB Maximum (7 dB Gain Reduction Adjustment Range per Band)</p> <p>Uplink: -4 to +2 dB</p>
Max RF Input To Head-End Unit	0 dBm , assuming 2 carriers, Min Downlink Gain, & 1 dBo Fiber Loss. Refer to De-Rating Charts.
Uplink Noise at Head-End Unit from any of eight Remote Module Antenna Ports assuming 0dB Fiber-Optic Link	< -130 dBm/Hz (Spec. Goal)
Uplink Isolation from any one of eight Remote Module Antenna Ports to the Head-End Unit RF output assuming 0dB Fiber-Optic Link	<p>Any to Any Band: -60 dB Max, -70dB Typ. except...</p> <p>iDEN to Cell: -37 dB Max, -65dB Typ.</p> <p>Cell to Paging: -45 dB Max, -70dB Typ.</p> <p>PCS to PCS: -45 dB Max, -65dB Typ.</p>
Downlink Isolation	Not Spec., Relies upon Head-End Filtering
Duty Cycle	Continuous
Spurious Outputs	-13 dBm max per Remote Module Antenna Port when operated as per De-rating Chart
Optical Power Level	Laser Warning: Invisible Laser Radiation emitting from optical connector. Avoid direct exposure to beam. 150 mW max. @1300nm. Class IIIb. Product complies with 21 CFR 1040.10 and 1040.11.
Optical Path Loss	2 dBO Maximum
Group Delay	<8uS (Spec. Goal) NOT including Fiber-Optic Link
Connectors	SC/APC Fiber-Optic, SMA (50 Ω) RF D-Sub Data & Control, 3-Pin AC Power
Head-End Module Power Supply Requirements	120 VAC, 50/60 Hz 120 VA Typical, 200 VA Maximum
Remote Module Power Supply Requirements	120/240 VAC, 50/60 Hz 120 VA Typical, 200 VA Maximum
Configuration Options	May be configured either via the LSU network and the Head-End Control Module, or via a PC and an RS-232 Connection.
Operating Temperature Range	-10 to +40°C
Operating Humidity Range	5 to 90% RH, Non-Condensing
Head-End Module Size & Weight	1U High 19" Rack Unit, 14" Deep, 16 lbs Max
Remote Module Size & Weight	24" High, 24" Wide, 9" Deep, NOT incl. mounting tabs, 85 lbs Max
FCC Identifier	H6M-LNKFIB-RA
Industry Canada Certification	IC: 1541311245A

Remote Module Per-Carrier De-Rating

All signals that fall within a given Pass-Band range will “share” power amongst them. A multiple channel effect is Intermodulation - signals produced from non-linear effects between the intended channel signals. This intermodulation may cause interference to receiving equipment. In order to minimize Intermodulation signals, Power de-rating must be applied. In the USA there are FCC Intermodulation Specifications published in the EIA Standard PN2009. The Tables below gives the maximum per channel Output Levels allowed as a function of the number of channels. Note that depending on the actual input levels, the gain may need to be reduced to comply with the above regulations.

iDEN / Cellular / Paging (effective IP3 per Antenna = +35dBm) (the power is shared in these 3 bands)			1.9 GHz PCS (effective IP3 per Antenna = +33dBm)		
Number of Carriers	Power per Carrier per Antenna Port (dBm)	Total Power per Antenna Port (dBm)	Number of Carriers	Power per Carrier per Antenna Port (dBm)	Total Power per Antenna Port (dBm)
2	+18.7	+21.7	2	+17.4	+20.4
3	+16.0	+20.7	3	+14.6	+19.4
4	+14.0	+20.0	4	+12.7	+18.7
5	+12.5	+19.5	5	+11.2	+18.2
6	+11.3	+19.1	6	+10.0	+17.8
7	+10.3	+18.8	7	+9.0	+17.5
8	+9.5	+18.5	8	+8.2	+17.2
9	+8.7	+18.3	9	+7.4	+16.9
10	+8.1	+18.1	10	+6.7	+16.7
15	+5.5	+17.3	15	+4.2	+16.0
20	+3.8	+16.8	20	+2.4	+15.4
25	+2.4	+16.4	25	+1.1	+15.1
30	+1.3	+16.1	30	0.0	+14.8



Note: The above levels are for Analog Narrowband FM. For CDMA, TDMA, GSM Signals the levels must be typically 3 to 5 dB lower than those shown. Consult Kaval Wireless Technologies for further information.

Operation Normal Operation

The **LSU Head-End Module** has one LED on the faceplate:

1. OPERATING - Normally this LED will be GREEN.

The **LSU Remote Module** has three LED's on the faceplate:

1. OPERATING - Normally this LED will be GREEN.
2. FAULT – Red LED, If the internal diagnostics for the module detect a problem, then this LED will remain on
3. LASERS ON - This LED will be GREEN when any one of the three Lasers are operating.



Configuration

It is possible to re-configure the **LNKFIB-R01 Remote Module** in the field, either with a **Personal Computer (PC)** or via the optional **LinkNet Control Module**. To use a **PC** it is necessary to connect the DB9 RS-232 connector on the Module to a standard DB9 RS232 Connector on the PC. On the PC a terminal emulation program such as **HyperTerminal** is used to communicate to the LinkNet Module. The settings are 9600 baud, 8 bits, no parity, and 1 stop bit. Commands are one or two words followed by pressing *Return*. Commands may be given in upper or lower-case. Available commands are...

ACCESS USER:	Required as a simple password to gain access to customer settable parameters and diagnostics; This will time-out after 10 minutes, and may have to be re-typed.
HELP or ?:	Displays a list of Available Commands.
LIST:	Displays Current Settings and Status Faults, Etc.
VER:	Display the current Version of Software.
ENABLE 1 or 0:	Enables or Disables the Module.
GAINPCS ###:	Displays or Sets the PCS Transmit Gain (in tenths of a dB).
GAINCELL ###:	Displays or Sets the Cellular Transmit Gain (in tenths of a dB).
GAINPAGE ###:	Displays or Sets the iDEN and Paging Transmit Gain (in tenths of a dB).

Please consult Kaval Wireless Technologies for further support.

Laser Safety

- Both the Head-End and Remote Modules have **Class IIIb Laser Devices** as Fiber-Optic Transmitters.
- Under normal installation both Modules are intrinsically-safe (Class I) since the Fiber-Optic cabling will be installed.
- **Only qualified service personnel should remove / install the Fiber-Optic cabling!**



Antenna Installation

- All Antenna Installation to be performed by Qualified Technical Personnel only.
- Antenna Installation Instructions and locations below are for the purpose of satisfying FCC RF Exposure Compliance requirements.
- The *In-Building Antenna* connection is via a coaxial cable distribution system with Signal Taps at various points connected to the fixed-mounted *Indoor Antennae*. This is shown in the figure in the Introduction. The *Indoor Antennae* are simple 1/4 Wavelength (0 dB Gain) types. They are used with KAVAL WIRELESS TECHNOLOGIES 12, 16, or 20 dB Cable Taps. As such the maximum EIRP will be at the first Tapped Antenna, which will be 12 dB below the maximum signal level of the LSU (+40 dBm); +28 dBm, or 0.63 Watts EIRP. **If multiple LSU Modules are used with output combiners, then the composite power output of all Modules transmitting simultaneously must meet this maximum EIRP requirement.** Please consult Kaval Wireless for assistance as required. These Antennae are to be installed such that no person can touch the Antenna, or approach within 0.2 Meters.



ANTENNA INSTALLATION WARNING

ALL ANTENNA INSTALLATION IS TO BE PERFORMED BY QUALIFIED TECHNICAL PERSONNEL ONLY.

ANTENNA INSTALLATION INSTRUCTIONS AND LOCATIONS ARE FOR THE PURPOSE OF SATISFYING FCC RF EXPOSURE COMPLIANCE REQUIREMENTS, AND ARE NOT OPTIONAL.

ALL IN-BUILDING ANTENNAE INSTALLATIONS MUST BE SUCH THAT NO PERSON CAN TOUCH THE ANTENNAE, OR APPROACH CLOSER THAN 0.2 METERS.