

***LinkNet™ LNKA100, LNKF400,  
LNKA800 RF BROADBAND  
AMPLIFIER MODULES***

*User, Installation, Operation,  
and Maintenance Manual*

DCM000000054 Rev Q

October 2005



© 2005 Powerwave Technologies Incorporated. All rights reserved.

Powerwave Technologies, and the Powerwave logo are registered trademarks.

This Powerwave product is intended only for installation in a RESTRICTED ACCESS LOCATION and is designed to operate within the Normal Operating (typical operating) ranges or conditions specified in this document. Operation of this equipment beyond the specified ranges in this document may cause:

1. Spurious emissions that violate regulatory requirements.
2. The equipment to be automatically removed from service when maximum thresholds are exceeded.
3. The equipment to not perform in accordance with its specifications.

It is the Operator's responsibility to ensure this equipment is properly installed and operated within Powerwave operating specifications to obtain proper performance from the equipment and to comply with regulatory requirements.



### **Warnings, Cautions, and Notes**

Warnings, cautions, and notes are found throughout this manual where applicable. The associated icons are used to quickly identify a potential condition that could result in the consequences described below if precautions are not taken. Notes clarify and provide additional information to assist the user.



**Warning**

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical and RF circuitry and be familiar with standard practices for preventing accidents.



**Caution**

This caution symbol means *reader be careful*. In this situation, the user might do something that could result in equipment damage or loss of data.



**Note**

This note symbol means *reader take note*. Notes contain helpful suggestions or references to material not covered in the document. Procedures are not contained in notes.

### Revision Record

Revision Letter	Date of Change	Reason for Change
Q	October 2005	Added 700 MHz models, misc. corrections
P	July 2005	Converted Kaval Rev 14 to Powerwave Format

# TABLE OF CONTENTS

## Chapter 1 Theory of Operation

<b>1</b>	<b>Introduction .....</b>	<b>1-1</b>
1.1	OVERVIEW .....	1-1
1.2	MODELS .....	1-1
1.3	BLOCK DIAGRAM .....	1-2
1.4	MODULE SPECIFICATIONS.....	1-3

## Chapter 2 - Operation

<b>2</b>	<b>Introduction .....</b>	<b>2-1</b>
2.1	SOFTWARE SET-UP.....	2-1
2.2	CONFIGURATION .....	2-1
2.3	DERATING CHART .....	2-2
2.4	POWER ON SELF TEST (POST).....	2-2
2.5	FAULT INDICATIONS .....	2-3
2.6	NORMAL OPERATION .....	2-3

## Chapter 3 - Antenna Installation

<b>3</b>	<b>Introduction .....</b>	<b>3-1</b>
3.1	ANTENNA INSTALLATION .....	3-1
3.2	FCC INFORMATION TO USERS .....	3-2

## Chapter 4 - Return for Service

<b>4</b>	<b>Introduction .....</b>	<b>4-1</b>
4.1	RETURN FOR SERVICE PROCEDURE .....	4-1
4.1.1	Obtaining An RMA .....	4-1
4.1.2	Repackaging For Shipment .....	4-1
4.2	PARTS AND ACCESSORIES .....	4-1

## TABLE OF FIGURES

Figure 1 Block Diagram LNKA RF Module.....	1-2
Figure 2 LNKA Faceplate .....	2-3

## TABLE OF TABLES

Table 1 LNKA Module Family.....	1-1
Table 2 LNKA Module Specifications .....	1-3
Table 3 LNKA Factory Set Options .....	2-1

# Chapter 1

## Theory of Operation

### 1 Introduction

This manual contains information and procedures for installation, operation, maintenance, and troubleshooting of the LNKA Modules. The manual is organized into the following chapters:

<b>Chapter 1</b>	Theory of Operation	<b>Chapter 3</b>	Antenna Installation
<b>Chapter 2</b>	Operation	<b>Chapter 4</b>	Return for Service

### 1.1 Overview

A LinkNet Amplifier Module is a Broad-Band Digitally Controlled Class-A Amplifier. The most common LinkNet Amplifier Module applications are the extension of above ground signals into buildings, tunnels, vehicles or the extension of radio coverage patterns into outdoor shaded areas such as deep valleys.

From an applications standpoint, a LinkNet Amplifier Module is very similar to a regular two-way radio repeater. LinkNet Amplifier Modules can be combined using regular two-way radio multicoupling or duplexing equipment and have input and output signal characteristics to those of regular transmitters and receivers. The one special consideration in LinkNet Amplifier Module systems is that of input to output antenna isolation. This must be carefully engineered for each installation.

LinkNet Amplifier Modules are designed for indoor use only and are intended for mounting in a standard EIA 19 inch rack. The Modular design of LinkNet Amplifier Module circuitry allows for easy servicing, stocking of spares, adaptability and upgrade ability.

### 1.2 Models

**Table 1 LNKA Module Family**

<b>LNKA MODULE FAMILY</b>		
<b>MODEL</b>	<b>TYPE</b>	<b>FREQUENCY</b>
LNKA100-A	Broadband Amplifier	136-155 MHz (FCC) 138-155 MHz(Industry Canada)
LNKA100-B	Broadband Amplifier	150-174 MHz
LNKA400-A	Broadband Amplifier	403-430 MHz
LNKA400-B	Broadband Amplifier	450-512 MHz
LNKA700-A	Broadband Amplifier	762-776 MHz
LNKA700-B	Broadband Amplifier	792-806 MHz
LNKA800-A	Broadband Amplifier	806-824 MHz
LNKA800-B	Broadband Amplifier	851-869 MHz
LNKA800-C	Broadband Amplifier	824-849 MHz
LNKA800-D	Broadband Amplifier	869-894 MHz
LNKA800-E	Broadband Amplifier	896-902 MHz Capable 896-901 FCC Approved
LNKA800-F	Broadband Amplifier	928-941 MHz Capable 929-930 / 935-940 FCC Approved
LNKA800-G	Broadband Amplifier	935-941 MHz
LNKA900-A	Broadband Amplifier	890-915 MHz Future Release
LNKA900-B	Broadband Amplifier	935-960 MHz Future Release

### 1.3 Block Diagram

LNKA RF Module:

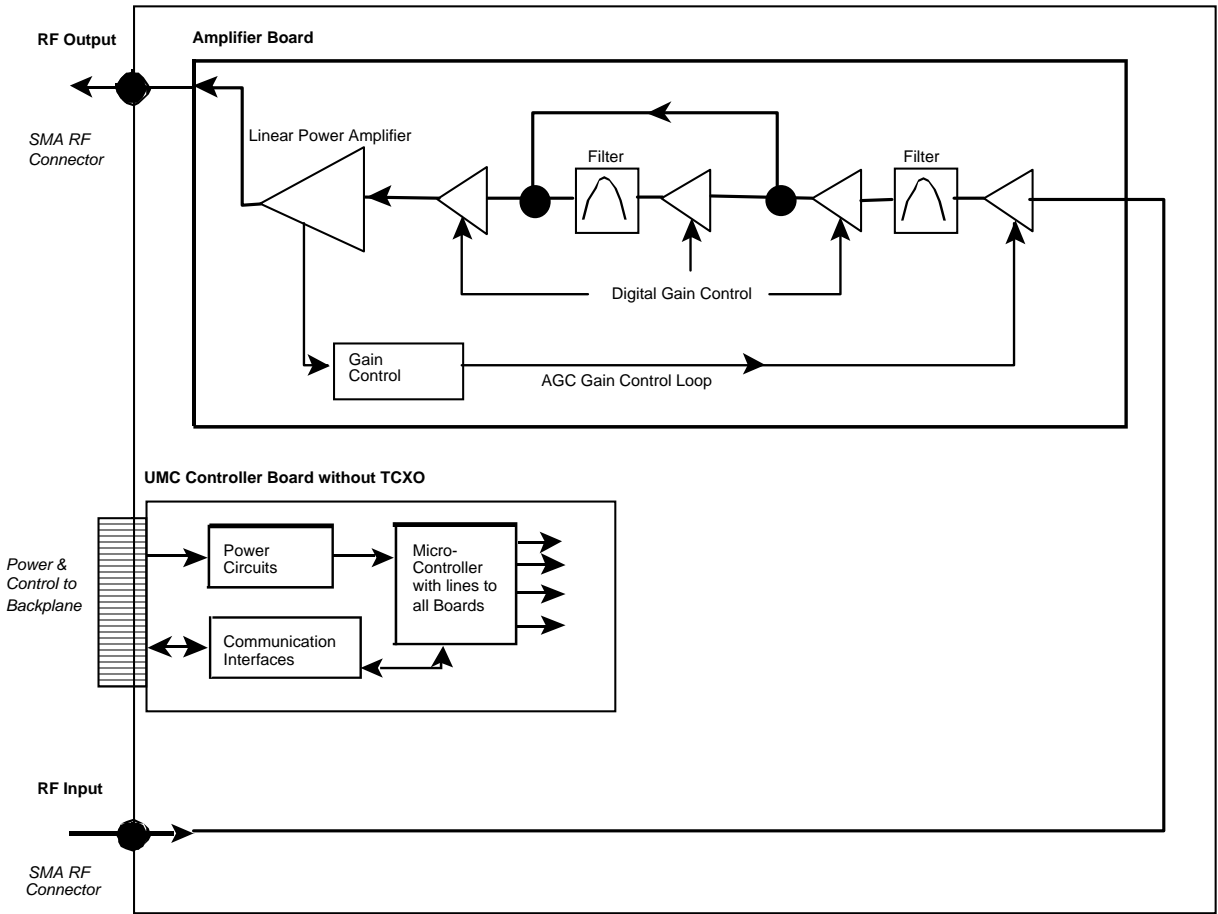


Figure 1 Block Diagram LNKA RF Module



## 1.4 Module Specifications

**Table 2 LNKA Module Specifications**

Frequency Bands	See Model Chart
Modulation & Channel Spacing	Broadband Amplifiers
RF Output Power Capability	1dB Compression Point = +37 dBm Typical IP3 Intermodulation = +47 dBm
AGC Control Adjustment Range	+15 to +30 dBm or Disabled
AGC Attack Time (10%-90%) AGC Decay Time (90%-10%)	0.5 - 5 mS Typical 50 - 200 mS Typical
RF Gain Adjustment Range	+34 to +84 dB in 1 dB Steps
Gain Variation over Passband	2 dB Maximum
Max RF Input, no damage	+10 dBm with Min Gain & Max RF Out
Noise Figure	<8 dB, 5 dB Typical
Maximum RF Input	Output Level from De-rating Chart minus the Gain. As an example, for 1 FM Carrier (+33 dBm) at minimum Gain (+34 dB) the Maximum RF Input is -1 dBm.
Transmit Duty Cycle	Continuous
Transmit Spurious	-13 dBm max
Receive Conducted Spurious	-57 dBm Max
Group Delay	< 200 nS (< 100 nS Variation across Passband)
Input Return Loss	>14 dB
RF Connectors	SMA (50Ω) Connectors
Module Power Supply Requirements	40 Watts Maximum
Connections	Edge Connector & 2 SMA RF Connectors, DB-15 Connector on back of Card-Cage provides per-Module Fault Relay, Interconnect to other Modules, & RS-232 Connection
Front Panel Indicators	Operating, Stand by, Fault, Program Mode
Configuration Options	RF Modules may be configured either via the optional Controller Module, or via a PC and an RS-232 Connection via the Card-Cage.
Operating Temperature Range	-10 to +50°C; consult Manual <b>DCM000000008</b> for cooling requirements
Operating Humidity Range	10 to 90% RH, Non-Condensing
Size & Weight	9.11" High, 2.00" Wide, 14.00" Deep, 10 lbs, 4.5 kg Max
FCC Identifiers	FCC: H6M-LNKA100 VHF H6M-LNKA400 UHF H6M-LNKA800 800-900MHz E675JS0080 700-900 MHz (pending)
Industry Canada Certifications	IC: 1541A-LNKA100 VHF 1541A-LNKA400 UHF 1541311246A 800-900MHz 2868C-5JS0080 700-900 MHz (pending)

Also consult the main LinkNet™ Manual DCM000000008.

---

(This page intentionally left blank)

# Chapter 2 Operation

## 2 Introduction

This chapter contains information for the standard operation of the LNKA Modules.

### 2.1 Software Set-Up

The LNKA modules is shipped with the following factory set options:

**Table 3 LNKA Factory Set Options**

OPTION	RANGE OF VALUES	DEFAULT VALUE
Frequency	See Model Chart	Order Specific
Gain	+34 to +84 dB	+34 dB
AGC	+15 to +30 dBm or Disabled	+30 dBm
Module Enabled	On / Off	On

Default values may be changed when an order is placed. Check your order confirmation (shipped with modules) for customized values.

### 2.2 Configuration

In line with the versatility of the LinkNet™ Platform, it is possible to reconfigure the LNKA module in the field, either with a Personal Computer (PC) or via the optional Control Module. To use a PC it is necessary to have a Powerwave CAB00000057 control cable to connect between the appropriate module's DB15 connector on the back of the card-cage and the 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.
- GAIN ###:** Displays or sets the module gain (in tenths of a dB).
- AGCTHRESH ###:** Displays or sets the AGC level (in tenths of a dBm).
- AGCEN 1 or 0:** Enables or disables AGC.

Please consult Powerwave Technologies Inc. for further support.

## 2.3 Derating Chart

To maintain the FCC Spurious Emissions limit of -13 dBm maximum, for multiple carriers it is necessary to derate their power level. For FM carriers, they need to be derated as shown:

**Table 4 Power Derating Chart**

Number of Carriers	Power per Carrier
1	+33 dBm
2	+26 dBm
3	+24 dBm
4	+22 dBm
5	+20 dBm
6	+19 dBm
7	+18 dBm
8	+17 dBm
9	+16 dBm
10	+15 dBm
15	+13 dBm
20	+11 dBm
25	+10 dBm
30	+9 dBm

NOTE: The rated mean output power for Industry Canada RSS131 is +29 dBm.

For complex CDMA, TDMA, GSM, etc. carriers, typically de-rate by a further 3 to 5 dB. Consult Powerwave Technologies for more information.

## 2.4 Power On Self Test (POST)

Each module automatically performs a self-diagnostics when inserted into the system card-cage. These tests determine that the unit is correctly installed in the card-cage and not damaged in transit.

- All six of the LED's on the front panel will flash 3 times.
- If the LED's do NOT flash three times, then remove the module, check the power source, and re-insert the module, (See Installation Instructions).
- If the card is "OK" the LED's will continue normally (See Normal Operation).
- If there is a fault, then the Red Fault LED will remain on. If this occurs, contact Powerwave Technologies Inc. (Refer to Chapter 4 Return for Service).

**Note!** The Power On Self Test is *Not* an RF test, it only verifies that there is power to the unit and that the logical circuitry is functioning.

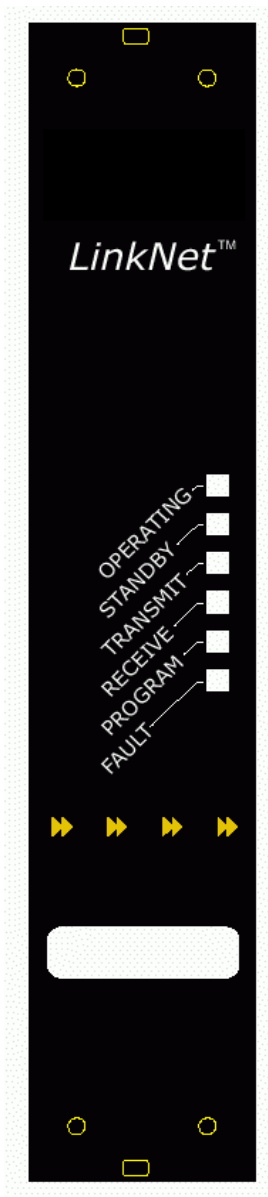
## 2.5 Fault Indications

Each module continuously performs internal diagnostics. If a problem is detected it will activate its Red Fault LED and Fault Relay. Faults detected include:

- Over Temperature
- Misc. Internal Faults

Detailed faults are detected by the optional gateway module. Details may also be determined via the module's control port connector and an RS232 connected Terminal Emulator using the **LIST** command.

## 2.6 Normal Operation



The LNKA Module has six LED's on the faceplate:

OPERATING - LED will flash GREEN when RF Data is present and unit is operating normally.

STANDBY – Under the control of the Gateway Module.

TRANSMIT – No function on these modules.

RECEIVE – No function on these modules.

PROGRAM – Constant Amber when the unit is being re-programmed by the controller module. This will signify that the unit is powered on but unavailable for use.

FAULT – Constant Red if the internal diagnostics for the module detects a problem.

Figure 2 LNKA Faceplate

---

(This page intentionally left blank)

# Chapter 3

## Antenna Installation

### 3 Introduction

This chapter contains antenna installation and warning information for the LNKA Modules.

#### 3.1 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.

**Note!** If multiple LinkNet™ Modules are used, the Instructions below apply to the composite power output of all Modules when transmitting simultaneously.

- The *Roof Top Antenna or Antennae* for linking to the *Donor Site(s)* is/are directional (high gain) Antennae, fixed-mounted physically on the side or top of a building, or on a tower. The Antenna Gain must be no more than 20 dBi.

**Note!** If multiple LinkNet™ Modules are used with output combiners into any one Antenna, and/or multiple Antennae are used on one Roof Top, then the sum of composite powers into all Roof Top Antennae must not exceed 20 Watts maximum.

- The *Roof Top Antennae* location should be such that only qualified technical personnel can access it, and that under normal operating conditions no other person can touch the antenna, or approach within 10 meters of the antenna.
- For the **Cellular Uplink Band** (824-849 MHz) the *Roof Top Antenna or Antennae* for linking to the *Donor Site(s)* has the added restriction that the Effective Radiated Power (ERP) must not exceed 7 Watts (+38 dBm). Thus, if the AGC is set (as per the Carrier Derating Chart) to +28 dBm as an example, the maximum allowed antenna gain must be no more than 10 dBi.
- 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*. The *Indoor Antennae* are simple 1/4 wavelength (0 dB Gain) types. They are used with Powerwave 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 LinkNet™ (+40 dBm); +28 dBm, or 0.63 Watts EIRP. These antennae are to be installed such that no person can touch the antenna, or approach within 0.2 Meters.

**Note!** If multiple LinkNet™ Modules are used with output combiners, then the composite power output of all Modules transmitting simultaneously must meet this maximum EIRP requirement.

Please consult Powerwave Technologies Inc. for assistance as required.



### **ANTENNA INSTALLATION CAUTION**

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 ROOF TOP ANTENNA INSTALLATION MUST BE SUCH THAT NO PERSON CAN TOUCH THE ANTENNA, OR APPROACH CLOSER THAN 10 METERS.

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

## **3.2 FCC Information to Users**

- This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.



### **CAUTION**

CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY POWERWAVE TECHNOLOGIES INC. COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.



# **Chapter 4**

## **Return for Service**

### **4 Introduction**

This chapter contains return for service and parts and accessories information for the LNKA Modules.

#### **4.1 Return For Service Procedure**

When returning products to Powerwave Technologies Inc., the following procedures will ensure optimum response.

##### **4.1.1 Obtaining An RMA**

A Return Material Authorization (RMA) number must be obtained prior to returning equipment to the factor for service. Please contact our Repair Department at +1 (714) 466-1000 to obtain this number, or FAX your request to +1 (714) 466-5816 or <mailto:RMA@PWAV.COM>. Failure to obtain this RMA number may result in delays in receiving repair service.

##### **4.1.2 Repackaging For Shipment**

To ensure safe shipment of the amplifier, it is recommended that the original package designed for shipping the amplifier be reused. If it is not available, contact Powerwave Technologies Inc. Customer Service Department for packing materials.

#### **4.2 Parts and Accessories**

Parts and Accessories for the LNKA Modules may be purchased by contacting Powerwave Technologies Inc. at 1-888-PWR-WAVE. When ordering a replacement part, please provide model number, serial number and software version number.