K A V A L
T E L E C O M   I N C.

LINK*net*™ USER MANUAL

INSTALLATION, OPERATION AND MAINTENANCE

P R O P R I E T A R Y   S T A T E M E N T

R E V I S I O N   R E C O R D

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0 Pre-release	All	Draft Issues.	Feb.2000
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T R A D E   M A R K   N O T I C E

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.

LINK*net*™ is a trademark of KAVAL TELECOM INC.

TABLE OF CONTENTS

See attached sections for individual models of **RF Modules***.*

1. PREFACE

Conventions Used In This Manual

Several text fonts have been used to indicate special words or terms. The meaning or definition of text appearing in **bold** type can be found in the glossary. Texts appearing in *italic* type are nouns - proper names of persons, companies, known registered trademarks, other manuals, or parts of the system. Text in **BOLD CAPITALS** refers to buttons, indicators or connectors on the operator console or the specifically indicated panel.

The exclamation mark icon appears next to text of critical importance. Failure to read these items *may* result in damage to equipment or personnel.

The STOP Icon appears next to critical steps in procedures. Failure to precisely follow these steps *will* cause damage to the equipment or personnel.

This icon appears next to examples.

This icon appears next to useful information.

Glossary of Terms

Term	Meaning
Back plane	Multi-layer electronic mounting board the forms the back of the Card-cage enclosure, and allows for a common interface for the plug in modules
Card-cage	Rack mounted sub-rack assembly, allows the modules to have a common interface
Control Port connector	Each RF Module has a communication/set-up port that feeds through the Back plane, and terminates with a control connector. This port can be used through a PC to communicate with the RF Module for set-up
Controller Module	Self contained Controller Module that stores, downloads, alters, and monitors all of the installed modules in the system. This module is optional.
Daisy chained	Multiple Card-cages may be cascaded, or joined to form a large system
Expansion cable	Custom wiring harness to interconnect multiple Card-cages
Hot swap	RF Modules may be inserted or removed while the system is operational
Power Supply Module	A Self contained Power Supply Module, specifically designed to be inserted into the LINK*net*™ platform Card-cage
PS	Public Service Channels
Trunking	A block of reserved channels, usually for public service use
RF Module	A self contained repeater that has been specifically designed to be inserted into the LINK*net*™ platform Card-cage
SMR	Acronym for "Special Mobile Radio".
Spacer Module	A 3 dimensional spacer specifically designed to be inserted into the LINK*net*™ platform Card-cage. The spacer ensures proper circulation in partial systems.
Threshold	The minimum signal level that can be detected

2 .   I N T R O D U C T I O N

Congratulations on your purchase of the **LINK*net*™** platform.

Successful operation of the LINK*net*™ in any installation depends upon sound system design. Service personnel should be aware that most problems experienced with LINK*net*™ systems are due to failures or inadequacies in equipment outside the LINK*net*™ platform.

Document Scope

This manual pertains to the LINK*net*™ Platform. It describes how the user should install, set-up and use the LINK*net*™ Card-cage, Power Supply Module, and Plug in RF and Controller modules, for proper operation and safety.

The scope of this manual is generally limited to the LINK*net*™ circuitry itself; no attempt is made to thoroughly discuss all aspects of system or applications design. *KAVAL TELECOM INC.* would be pleased to discuss the engineering aspects of LINK*net*™ installations and can undertake overall LINK*net*™ system design and installation.

What Is The LINK*net*™ Platform?

The LINK*net*™ encompasses the functionality of most of KAVAL TELECOM INC.'s current electronic product line. All OFR and BDA products are harmonized into a single modular and adaptable system. The intention is to incorporate the functionality of most or all of KAVAL TELECOM INC.'s product line into a single modular family. Newer technology allows implementation of additional features such as Digital Control, Self-alignment, and Extensive Diagnostics, which make the modules in this new generation of products more capable than their predecessors.

The product is made up of at least one Card-cage, RF Modules, and a Power Supply. The Modules in the Card-cage interconnect via a back plane that supplies power and digital control signals.

A single Card-cage can be mounted into a 6 unit standard EIA 19 inch rack, with multiple Card-cages interconnected using a Card-cage Interconnect Harness.

An optional Control Module may be used to program and monitor the independent RF Modules. By daisy chaining Card-cages together, a single control module can be used to run up to 110 **RF Modules** in a single, integrated, system.

3. CARD-CAGE

OFR1000 Card-cage Specifications

SPECIFICATION	VALUE
Basic Construction	19" Rack based Card-Cages
Card-Cage Features	Each Card-Cage may contain up to 7 RF Modules without a Controller Module, or up to 5 RF Modules with a Controller Module. Modules inserted into the Card-Cage are auto-identified as to type, and which card slot they are in. Card-cages are identified by a rear-panel switch setting (0-15).
Card-Cage Connections	DB-15 Connector provides for extra Card-Cages to be cascaded via an Expansion cable. The connector also provides a common Fault Relay.
Size	Standard 19" Rack Mount, 6U (10.5") High, 14.00" Deep
Weight	TBD

Card-cage Description

The LINK*net*™ Model OFR1000 card-cage is a standard 19-inch rack mounted box, 6U high (10.5"), and 14" deep. The unit comes with a Power Supply Module (PS400A), and will hold up to 7 modules. All modules slide in on pre-installed tracks, and their faceplates together with the front flange form the front cover when the system is assembled.

OFR000 Spacer (blank) modules must be used to fill un-used module slots. The surrounding flange completes the unit while protecting the mounting screws, allowing for an air grill, and covering any sharp edges.

Card-cage Drawing (Front View)

Front view of a card-cage showing from left to right: Four spacer modules, a RF module, one spacer module, another RF module and a power supply module.

Card-Cage Drawing
(Rear View)

Control Module or RF Modules 1 & 2

RF Module Slots 3 through 7 (Right to Left)

Power Supply Slot

Slot Control Ports
DB15 F

Control Module Connections
(If used)

RF Out
(SMA Connectors)

RF In
(SMA Connectors)

Card-cage Control and Expansion Ports DB15 F

AC Power Cord
(120VAC, 600VA)

Fuse, 8 Amps
1-1/4" Glass

Optional 24 VDC
Battery Backup
Power using Kaval
supplied cable.

Chassis' "ID", Battery Backup
Enable, and first and last
Chassis Termination.

SLOT 1 RF OUT
SLOT 2 RF OUT
SLOT 3 RF OUT
SLOT 4 RF OUT
SLOT 5 RF OUT
SLOT 6 RF OUT
SLOT 7 RF OUT

SLOT 1 CONTROL
SLOT 2 CONTROL
SLOT 3 CONTROL
SLOT 4 CONTROL
SLOT 5 CONTROL
SLOT 6 CONTROL
SLOT 7 CONTROL
SLOT 8 CONTROL

SLOT 1 RF IN
SLOT 2 RF IN
SLOT 3 RF IN
SLOT 4 RF IN
SLOT 5 RF IN
SLOT 6 RF IN

COMMON CONTROL & EXPANSION

OPTIONAL 24 VDC BATTERY

CHASSIS ADDRS
BATTERY
NOT USED
FIRST & LAST CHASSIS

OFR 1000 Card-cage Rear View

OFR000 Spacer Module

In installations where one or more module slots are not used, OFR000 Spacer Modules will be installed in the un-used slots. These modules close the front panel and ensure the proper flow of air around the heat sinks. Should additional modules be required at some future date, the spacer module(s) may be removed and the new module placed into the open space.

The power inside the card-cage is limited to low voltage. The spacer module is not intended as an electrical safety feature.

It is recommended that spacer modules remain installed while the system is operational, and that the preventative maintenance outlined in the maintenance section of this manual be followed.
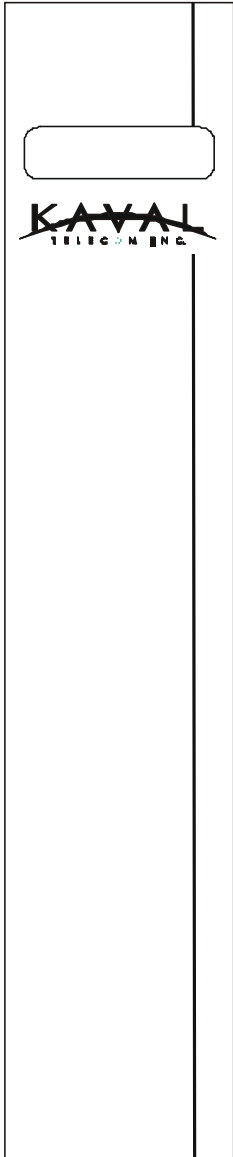
Card-Cage Maintenance

The LINK*net*™ card-cage requires little or no maintenance once it is assembled. During routine inspection of the system, it is recommended that excessive dust be removed, especially from all fans, filters, and cooling fins. It is also recommended that all external cables be inspected for damage.

4. CONTROL MODULE

This module is optional.

5. POWER SUPPLY MODULE

Power Supply Specifications

SPECIFICATION	VALUE
Card-Cage Power Supply Module	Right-most Module, supplied with the Card-Cage. Rated at 400 Watts, providing +12V & +28V to the Modules. Requires 120/240 VAC 50/60 Hz.
Card-Cage Battery Backup	Optionally may provide a Battery-Backup Operation using two external 12V sealed lead-acid Batteries, and an optional Kaval CAB000000055 Battery Cable.
Size	Standard 19" Rack Mount, 6U (10.5") High, 14.00" Deep
Weight	TBD

Description

Each LINK*net*™ Card-cage comes with it's own Power Supply Module (model PS400A). The Power Supply Module is mounted in the extreme right slot of the Card-cage and supplies power to the installed modules via the Back plane connector.
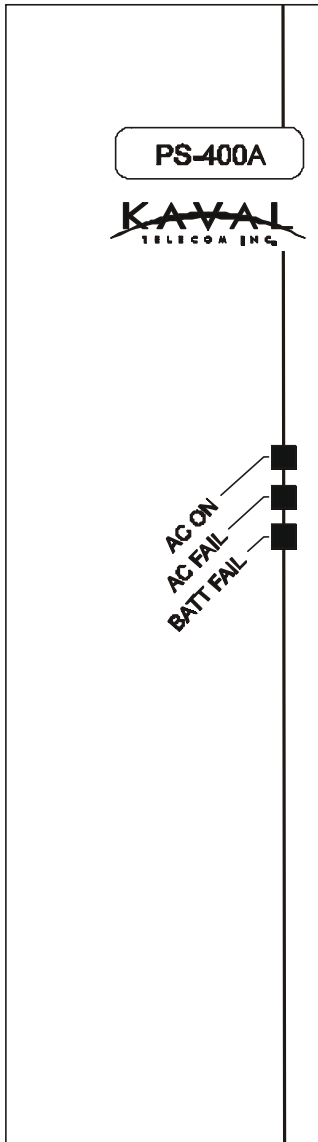
Normal Operation

LED	Colour	Status	Description
AC ON	Green	ON	Illuminated when AC Power Present
		OFF	Not illuminated when AC power absent
AC FAIL	Red	ON	Illuminated when AC absent, and platform is being powered externally
		OFF	
Battery FAIL	Red	ON	Illuminated when AC power present, but no external power source present. Note: this LED can be disabled if a secondary power source is not required
		OFF	

Under normal operation the "AC On" LED (Green) will illuminate and will remain on when power is connected. If there is a power disruption and there is a secondary power source the AC Fail LED will illuminate (RED).

One power supply module is always included with each card-cage. The power supply module also includes circuitry to support a battery backup system. Connecting a battery to the appropriate connection will automatically enable switching to the backup system whenever there is a disruption in AC power.

The module is designed for either 120 VAC 50/60 Hz (6 Amps) or 240 VAC 50/60 Hz (3 Amps) input, and is rated at 400-Watts, providing +12V and +28V output to the installed modules via the LINK*net*™ back plane. Replacement AC Power Cables are Kaval Model # CAB000000058.

Fuse

Location:

The Fuse is located on the upper left of the back plane board. .

⚠️

Replacement:

Replace the fuse with 1¼ x ¼-inch glass fuse 8 Amps fast blow.

Power Supply Slot   RF Module Slots 3 through 7 (Right to Left)   Control Module or RF Modules 1 & 2

Fuse, 8 Amps
1-1/4" Glass Fast Blow

Control Module Connections
(If used)

Card-cage Control and Expansion Ports DB15 F
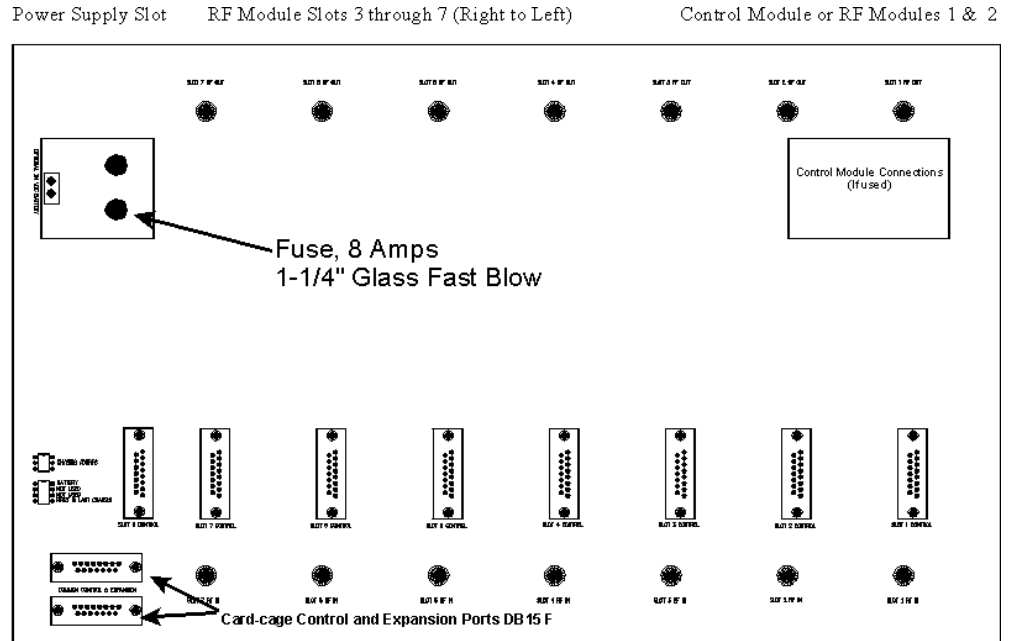
OFR 1000 Card-cage Rear View

Batteries

Operation without batteries

If the LINK*net*™ is being used without a Battery the switch on the lower left of the back plane must be set for "Battery Absent" (See Back plane Drawing below). Failure to do this will cause the Battery Fail LED to remain on at all times.

Note: Without a battery connected to the LINK*net*™ Card-cage, the system will shut down or reset with any disruption to the AC power. When power is re-established the system will restart automatically.

Operation with batteries

⚠️

External batteries may be connected to the LINK*net*™ Card-cage, by using the appropriate cable assembly. When batteries are used, the selector switch on the back plane must be set for Battery Present (See Back plane Drawing above). When this is done, the Power Supply Module will automatically switch to battery when AC power is disrupted. The battery charger will automatically recharge the attached battery.

Battery Requirements:

● One 24V Battery is required for each Card-cage (usually consisting of two 12V batteries).

● The battery must be a Sealed Lead Acid type (often called Gel Cell).

● Batteries must be installed in a ventilated area in accordance with the manufacturer's instructions.

● If a longer cable assembly is required, contact the KAVAL TELECOM INC. factory by E-mail: info@kaval.com.

● For battery capacity in Amp Hours (A-H) see section "Battery Sizing" below.

● For charging time for batteries, in hours, see chart below.

● If batteries are stored (not connected to the system) they should not be left in a low state (discharged) for more than a few days, or they will permanently lose capacity, and no longer be able to run the system.

● If it is desired to be able to recharge the batteries at a rate faster than is inherent in the power supplies internal system, then it is possible to use an external charger. Consult the KAVAL TELECOM INC. factory for details at E-mail: info@kaval.com

Battery Sizing

The size or capacity of the external lead acid batteries is dependent on two variables: The number of modules installed in the Card-cage and the desired back up period in hours. The relationship is defined by the following equation:

$$C = \frac{T \times (5 + p1 + p2 + p3 + ...)}{15}$$

Where:

C	IS	The required battery capacity in Amp Hours (A-H)
		Note: the calculation is for each of the two 12V batteries required to make up the 24V requirement
T	IS	The desired back up period in hours
Px	IS	The power consumption in watts for each plug in module in the Card-cage,
		(Not counting the Power Supply Module)

Example of calculating the battery capacity:

To find the capacity in Amp Hours (C) for a system with three OFR800 modules, where a 3-Hour reserve (T) is required.

Let:

T	=	3 hours
Px	=	45 watts (the power requirements of the OFR800 Module from its spec sheet)

Therefore the required battery capacity in A-H would be:

$$C = \frac{T \times (5 + p1 + p2 + p3)}{15}$$

$$C = \frac{3 \times (5 + 45 + 45 + 45)}{15}$$

$$C = \frac{3 \times (140)}{15}$$

C = 28 A-H

This system example would require two 12V (in series for 24V) batteries rated at 28 A-H each

Battery Cable
The Battery Cable required is the Kaval Model # CAB000000055.

Battery Charge Time

The time required to charge the batteries using the internal battery charger, is dependant on the capacity (C) of the battery connected to the system.

To calculate the Recharge time in hours (T), multiply 1.2 times the Amp Hour Capacity (C):

$$T = 1.2 \times C$$

Example of calculating the recharge time:

The time required charging the batteries in the example system above,

Where:

C   =   28 AH From the above example

Therefore: the required time to recharge the batteries in hours would be:

$$T = 1.2 \times C$$

$$T = 1.2 \times 28$$

$$T = 33.6 \text{ Hours}$$

It would take 33.6 hours (33 hours and 36 minutes) to recharge a system that had three OFR800 modules, and required a 3-hour battery power reserve.

Battery Maintenance

In order to ensure the proper functioning of your LINK*net*™ system, it is very important to follow the battery manufacturer's instructions for routine and preventative maintenance. KAVAL TELECOM INC. recommends that all sealed lead acid batteries be replaced at least once every 5 years.

6. PHYSICAL INSTALLATION

Card-cage (Enclosure)

Install the LINK*net*™ card-cage into an EIA 19" rack using 4 screws. Ensure that no cables or other equipment rests on top of the LINK*net*™ and places an excessive downward force on the rear of the unit.

The RF Antenna connections are designed for the specific RF unit. They may be different for each RF module, so they are described in the chapter specific to each RF module. These instructions must be followed precisely in order to ensure the safe functioning of the radio transmitter.

Ensure that airflow around the rear panel heat sink is unobstructed. In high duty cycle installations, it is recommended that one rack unit of clear space be left both above and below the LINK*net*™. If several units are installed in the same rack, an external fan blowing air past the heat sinks is recommended.

The LINK*net*™ is intended for indoor use only, in an environment suitable for electronic equipment. Do not expose to excess humidity

Power Supply

Slide the power supply module into the right hand slot of the LINK*net*™ rack. Make sure that the Module is aligned with the guide tracks on the Card-cage, and sliding in straight. The edge connector at the rear of the module must be seated securely and evenly. Tighten the retaining screws to secure the module, and connect the AC power to the appropriate connector in the upper left of the Card-cage back plane.

ALERT: Do not force the module into position. It should slide in with little or no force. If the module resists, remove it and inspect the slides and the connectors. If still unable to insert the module contact KAVAL TELECOM INC.

AC Power Connection
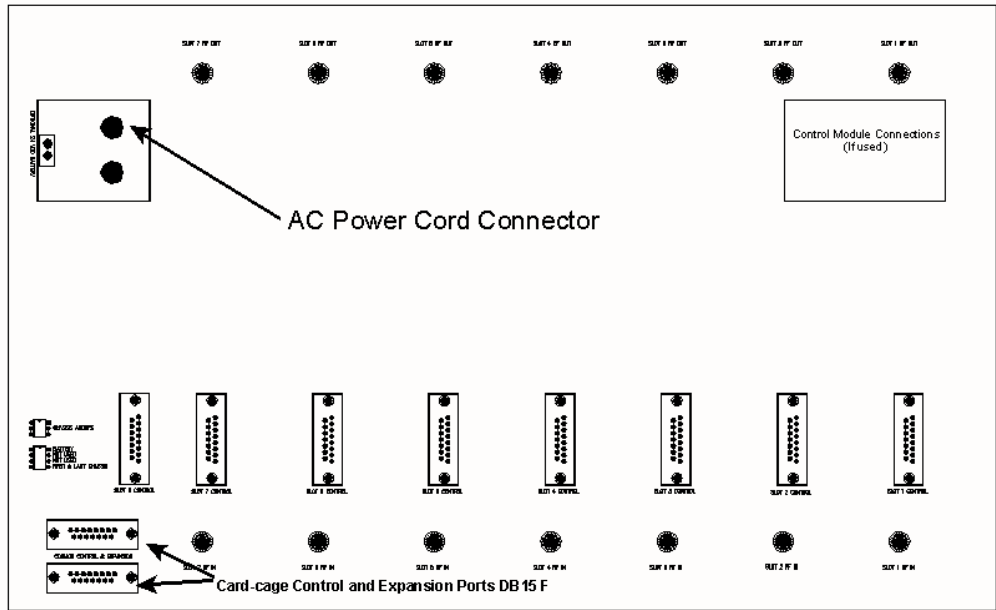
OFR 1000 Card-cage Rear View

**Card-cage Rear View
Switch Detail:**

CHASSIS ADDRESS

BATTERY
NOT USED
NOT USED
FIRST & LAST CHASSIS

Battery   If Batteries are not to be installed with this unit, set the "Battery DIP Switch" to the ON position. The switch is located on the lower left hand side of the back plane. (See diagram below)

Battery connection
If Batteries are to be installed:

● Set the "Battery DIP Switch" to the OFF position. The switch is located on the left hand side of the back plane. (See diagram below)

● Make sure the batteries have been correctly sized, (See section on sizing Batteries)

● Make sure that the batteries have been properly mounted (See Battery Manufacturer's Installation Instructions)

● Connect the Battery Connect Wiring Harness to the Battery end, and then connect the other end to the plug in the upper left of the rear of the Card-Cage (See diagram below)

● Calculate the required Charging Time to ensure the Batteries will be charged prior to system testing. (See section on sizing Batteries)

RF Modules   Slide the modules into any of the vacant card-cage slots. Make sure that the module is aligned with both of the upper and lower guide tracks on the card-cage, and that the module is sliding in straight. The edge connector and the antenna connectors at the rear of the module must be seated securely and evenly. Tighten the retaining screws to secure the module. The Module is now ready for testing. (See Power On Self-Test)

It is not necessary to power down the system to insert or remove RF modules, as each module is designed with "**Hot Swap**" capabilities.

Do not force the module into position. It should slide in with little or no force. If the module resists, remove it and inspect the slides and the connectors. If still unable to insert the module contact KAVAL TELECOM INC.
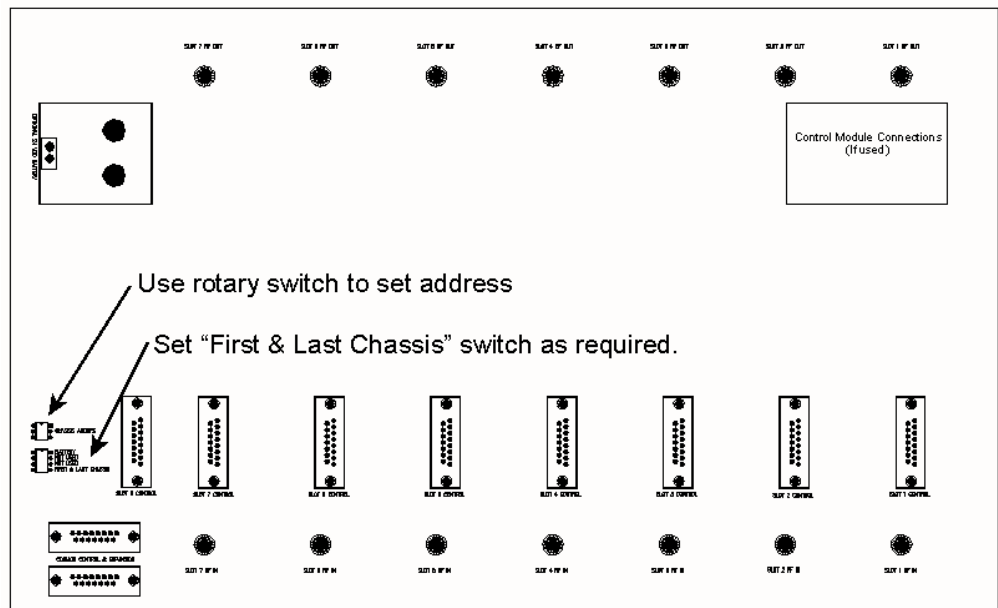
Expanding the System   **Additional Modules**

Additional modules may be added to the LINK*net*™ card-cage at any time. It is not necessary to power down the system to insert or remove modules.

Additional LINK*net*™ card-cages

OFR 1000 Card-cage Rear View

Additional card-cages can be cascaded or "Daisy Chained" together with a Kaval Model # CAB000000056 Expansion cable. Up to 15 cables can be used to connect up to 16 LINK*net*™ card-cages. The nominal maximum cable length is 150 feet but, under certain conditions, a longer span may be possible, contact KAVAL TELECOM INC. for assistance.

If 16 LINK*net*™ card-cages are connected together the total system capacity is 110 RF modules without the optional Controller Module.

A separate power supply module (PS400A) and battery reserve (if desired) must be installed for each card-cage as well. Only one (optional) Controller Module per system is necessary.

Card-cage ID number

Each enclosure must have a unique Card-cage ID number; set by the rotary switch located on the lower left hand side of the back plane.

If the system has only one card-cage this switch can be left at the default setting (zero).

Group Termination

The first and last LINK*net*™ card-cages must have the termination switch set to ON. The switch is located in the lower left hand side of the back plane.

If the system has only one or two card-cages the switch can be left at the default setting (ON).

External fault indication

Pins 2 & 3 of the DB15 "Control Port connector & Expansion cable connector" connect to a dry, normally open, relay contact rated for 1 Amp at 28 Vdc. The contacts will close if any of the modules in any of the LINK*net*™ card-cages fault, and will remain closed until the fault is corrected.

Because the LINK*net*™ Expansion cable uses the same connector, this signal must be taken from the un-used connector on either the first or last panel.

Battery connection

Power Supply Slot   RF Module Slots 3 through 7 (Right to Left)   Control Module or RF Modules 1 & 2

Optional 24 VDC
Battery Backup
Power using Kaval
supplied cable.

Battery Backup Enable:
ON for NO battery,
OFF for battery

Control Module Connections
(If used)
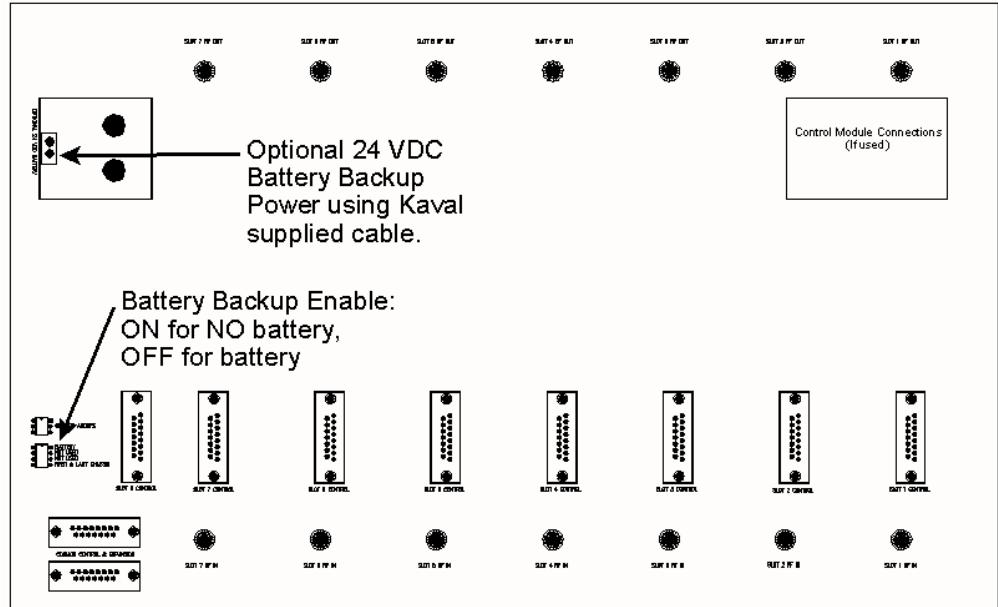
OFR 1000 Card-cage Rear View

System Configuration Programming

Installing the software

Each RF module has a number of built in changeable parameters that may be changed in the field directly by using the optional Controller Module. If the Controller Module is not used, then these parameters may be changed by running custom software on an external PC running Windows 95/98/NT, connected through the **CONTROL PORT CONNECTOR** for each module, on the rear of the LINK*net*™ card-cage. The software will be shipped on a disk, (optionally, it may be delivered electronically over the internet), with its own install program.

From the Windows **START** button's **RUN** Menu, Use the **BROWSE** button to find the **SETUP** program on the disk, and follow the on screen instructions. When set-up is complete, there will be a KAVAL TELECOM INC. icon on the desktop.

Cable connections

The rear of the LINK*net*™ card-cage has a **CONTROL PORT CONNECTOR** for each of the plug-in module bays. In order to change the parameters of a specific card, the **CONTROL PORT CONNECTOR** for that card must be located.

The optional KAVAL TELECOM INC. # CAB000000057 cable will connect the desired female DB15 **CONTROL** connector with the RS-232 Serial Port on the PC.

CONTROL connectors are *NOT DIRECTLY* RS-232 compatible. Use only KAVAL TELECOM INC. supplied cables to connect with them. Using standard RS232 adapters may cause damage to the module or PC.

CONTROL CONNECTOR PINOUT (FEMALE DB15)		
PIN	**USAGE**	**NOTES**
2 & 3	Normally Open Fault Relay Dry Contacts (1A, 28 VDC max.)	Per Module fault indication. Not the same as the signal on the expansion cable connector.
10	Transmit	RS-232 compatible signals for connection to a PC using CAB000000057 cable.
11	Receive	
15	Ground	
6	SIG	Module Interconnection for special application. Consult factory.
7	TX Disable	
8	Ground	
1,4,5,9,12,13,14	Reserved, Do Not Use.	

Running the program

The software allows a terminal emulation program to access the digital information stored in the module. This same program will be used to modify the parameters in every type of module in the system. Since not all modules will have the same types or values for parameters, it is very important that the user know the type of module to be changed, the types of parameters that may be changed, the range of values, the current values of the parameters, and finally the target or desired values for those parameters. To facilitate this, these values are included in this manual in the section for each type of module, and KAVAL TELECOM INC. recommends that any modified values be recorded in that section of the manual.

7.   M A I N T E N A N C E

Not yet approved for distribution

8. TROUBLE SHOOTING

Not currently available

9. WARRANTY INFORMATION

Product Warranty   The following is *KAVAL TELECOM INC.*'s standard warranty. Purchase agreements may stipulate additional or alternate conditions and terms. Any specific contractual warranties shall supersede the following section.

KAVAL TELECOM INC. products are warranted to be free from defects in workmanship or materials for a period of one (1) year from the date of shipment to the original purchaser. This warranty supersedes and voids any and all other warranties expressed or implied.

In no event shall *KAVAL TELECOM INC.* be liable for incidental or consequential damages arising from the use, misuse, failure to operate, or improper operation of any *KAVAL TELECOM INC.* product or product accessory. Specifically excluded from this warranty is any claim of merchantability or fitness for a particular purpose or application.

Because most radio communication systems are unique, rely upon equipment not manufactured by *KAVAL TELECOM INC.* and require proper system design, any of signal coverage, reliability of communications or other system performance is specifically and expressly excluded unless a separate expressed written agreement to such effect, executed by an authorized officer of *KAVAL TELECOM INC.*, has been entered into.

This warranty is void if the product has been subject to: misuse; neglect; accidental damage; damage of a purely cosmetic nature; misapplication; extreme environmental conditions; unauthorized repair or alteration.

If warranty repair is required, *KAVAL TELECOM INC.* will repair or replace the defective product, and *KAVAL TELECOM INC.*s liability will be limited to one of these remedies. *KAVAL TELECOM INC.* will endeavor to complete warranty performance within 14 working days.

RMA Procedure   All returns, including warranty returns, must have a valid Return Material Authorization (RMA) number.

Customers must contact *KAVAL TELECOM INC.* before shipping any product for warranty service and obtain a Returned Materials Authorization and detailed shipping instructions. Shipping charges, for shipment of product to *KAVAL TELECOM INC.* for warranty service, will be borne by *KAVAL TELECOM INC.* if a defect covered by warranty is found and warranty service is required. At *KAVAL TELECOM INC.*'s sole discretion, a service fee will be charged if a returned unit is found by *KAVAL TELECOM INC.* not to be defective, or defective for a reason that voids this warranty. Return shipping charges shall, in such case, be the responsibility of the customer.

Appendix A: Quick Reference

Part Numbers

Part Numbers referred to in this Manual	
Number	**Description**
CAB000000055	Battery Connect Cable
CAB000000056	Expansion Cable
CAB000000057	Control Connector
CAB000000058	AC Power Cable
DCM000000008	This Manual