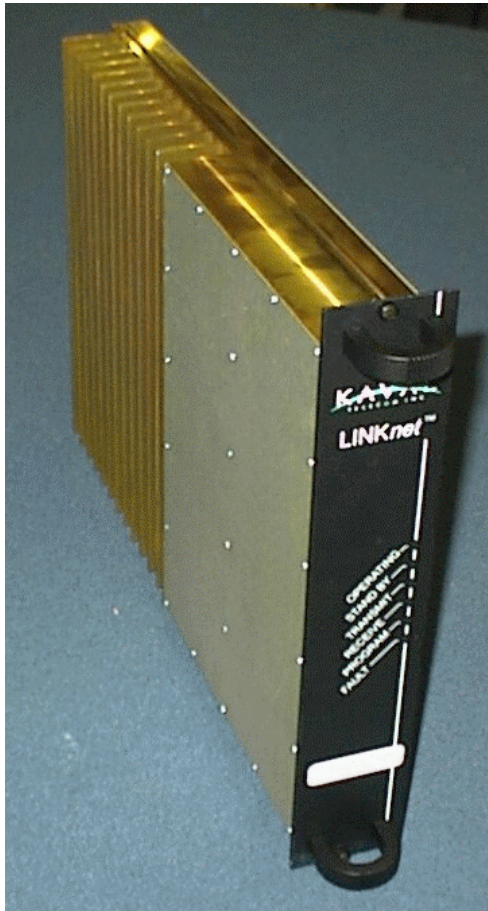




LINKnet™  
OFR400 RF MODULES  
USER MANUAL  
INSTALLATION, OPERATION AND  
MAINTENANCE



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# 1. OFR400 MODULES

## Overview Theory Of Operation

An OFR, or On Frequency Repeater, is a radio repeater that simultaneously receives and transmits a single narrow band radio channel on exactly the same frequency.

The OFR accomplishes its repeater function without store and forward circuitry, or expensive conventional simulcasting techniques. The fact that the same frequency is retransmitted by an OFR means that additional frequency allocations are not required in situations where an existing radio coverage pattern needs to be extended. The most common OFR 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, an OFR is very similar to a regular two-way radio repeater. On Frequency Radio Repeaters 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 OFR systems is that of input to output antenna isolation. This must be carefully engineered for each installation.

Standard On Frequency Radio Repeaters are designed for indoor use only and are intended for mounting in a standard EIA 19 inch rack. Modular design of OFR circuitry allows for easy servicing, stocking of spares, adaptability and upgrade ability.

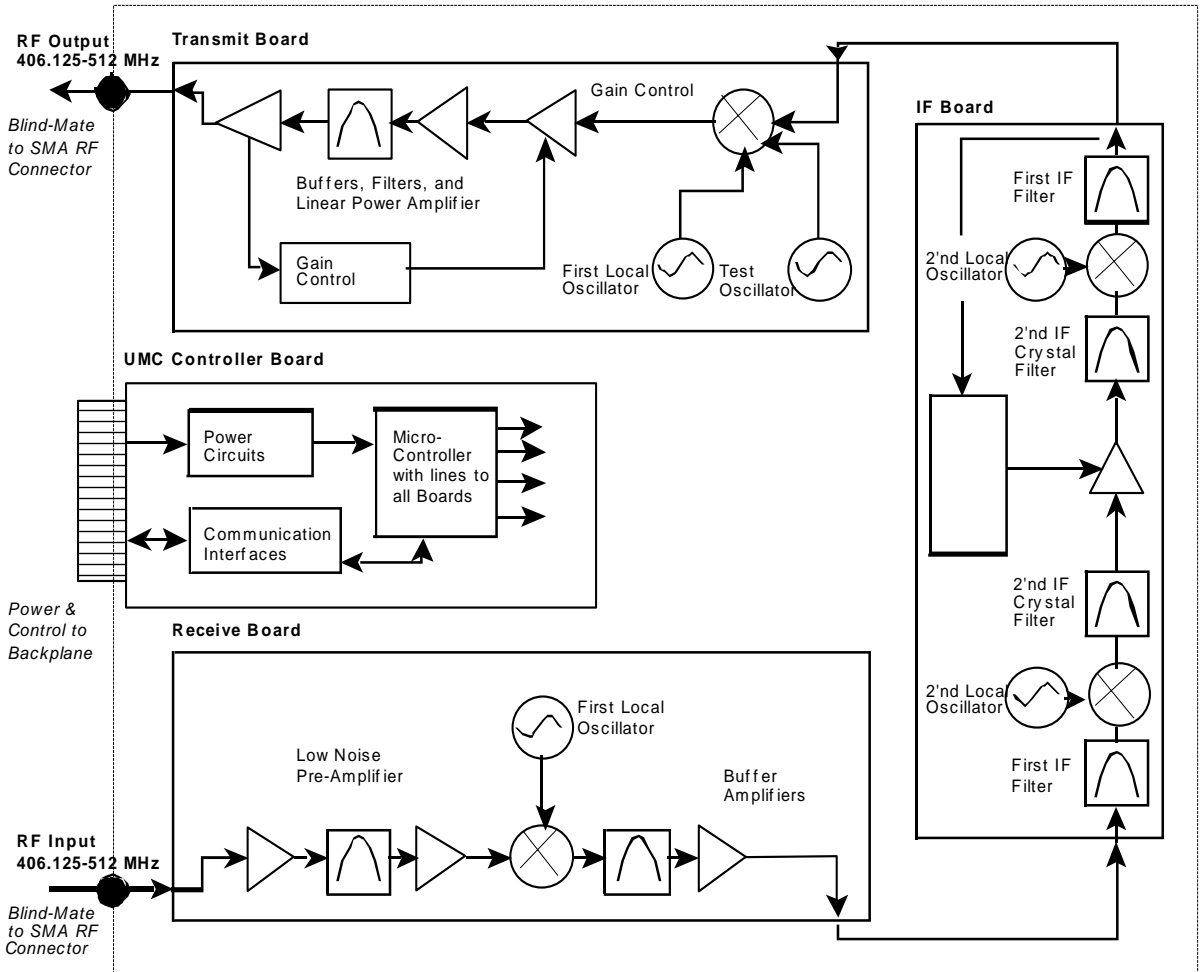
**IMPORTANT NOTE: The OFR400 UHF LINKnet FM Modules described in this Manual draw about 50% more current than the OFR800 FM Modules. A Maximum of five may be used in a LINKnet OFR1000 Card-Cage with no other modules. With other Modules the maximums are...**

With 1 other LINKnet Module: No more than 3 OFR400 UHF Modules  
 With 2 to 3 other LINKnet Modules: No more than 1 OFR400 UHF Modules  
 With 4 or more other LINKnet Modules: No OFR400 UHF Modules

## Models

| OFR400 MODULE FAMILY |                   |                      |
|----------------------|-------------------|----------------------|
| MODEL                | TYPE              | FREQUENCY            |
| OFR400-A1            | 25 KHz Channels   | 406.125-430 MHz (FM) |
| OFR400-A2            | 12.5 KHz Channels | 406.125-430 MHz (FM) |
| OFR400-C1            | 25 KHz Channels   | 450-470 MHz (FM)     |
| OFR400-D1            | 25 KHz Channels   | 470-490 MHz (FM)     |
| OFR400-E1            | 25 KHz Channels   | 490-512 MHz (FM)     |

**Block diagram OFR400 RF Module**



**Module Specifications**

|  |  |
|--|--|
| Frequency Bands  | See Model Chart  |
| Modulation & Channel Spacing                                 | Narrowband FM<br>25 or 12.5 KHz as per Model Chart   |
| RF Frequency Stability                                       | Tracks Input Signal Exactly  |
| Max. RF Output Power   | 37 dBm   |
| RF Output Power Range  | Power can be reduced 20 dB in 1 dB Steps<br>(AGC Controlled)   |
| RF Output Power Variation vs. Input<br>(over -90 to -30 dBm) | +/- 1 dB   |
| Input Dynamic Range  | -110 to -30 dBm  |
| Input Sensitivity Adjust Range                               | -110 to -50 dBm  |
| Input Hysteresis   | 1 to 10 dB   |
| Adjacent Channel Selectivity                                 | 60 dB Minimum  |
| Transmit Duty Cycle  | Continuous   |
| Transmit Spurious  | -13 dBm max  |
| Receive Conducted Spurious                                   | -57 dBm Max  |
| Maximum Gain   | 140 dB   |
| Audio Distortion & Noise                                     | <4% Increase   |
| Transmit Key-Up & Key-Down Times                             | <2 mS Key-Up, <1 mS Key-Down   |
| Group Delay  | <120 uS for 25 KHz,<br><160 uS for 12.5 KHz  |
| RF Connectors  | SMA (50Ω) Connectors on back of Card-Cage  |
| Module Power Supply Requirements                             | 45 Watts Maximum   |
| Connections  | Edge Connector & 2 Blind-Mate RF Connectors to Card-Cage, 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, Receive, Transmit  |
| 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 Kaval for installation specific forced-air cooling requirements  |
| Operating Humidity Range                                     | 10 to 90% RH, Non-Condensing   |
| Size & Weight  | 9.11" High, 2.00" Wide, 14.00" Deep,<br>10 lbs, 4.5 kg Max   |

**Operation**    Software Set-up

The OFR400 module is shipped pre-configured with the following factory set options:

| OPTION               | RANGE OF VALUES           | DEFAULT VALUE  |
|----------------------|---------------------------|----------------|
| Frequency            | See Model Chart           | Order Specific |
| Receive Threshold    | -110 to -50 dB            | -89 dB         |
| Receive Hysteresis   | 1 to 10 dB                | 2.5 dB         |
| Time Out             | 0 to 600 Seconds, or none | 300 Seconds    |
| Module Enabled       | On / Off                  | On             |
| Transmit Power Level | 20 to 37 dBm              | Order Specific |

In line with the versatility of the LINKnet™ Platform, it is possible to re-configure the OFR400 module in the field. For further information on the modification software and the PC adapter, contact KAVAL TELECOM INC. by E-mail: [info@kaval.com](mailto:info@kaval.com)



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

**Power On Self Test (POST)**

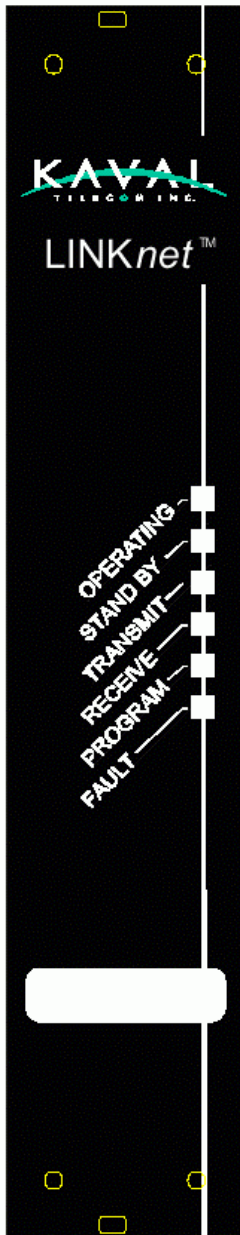
Each system module automatically performs a self-diagnostics when inserted into the system Card-cage. These tests determine that the unit is a) correctly installed in the Card-cage and b) not damaged in transit.

- 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 your KAVAL TELECOM INC. Service Representative, (See Warranty / RMA Procedures).



**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.**



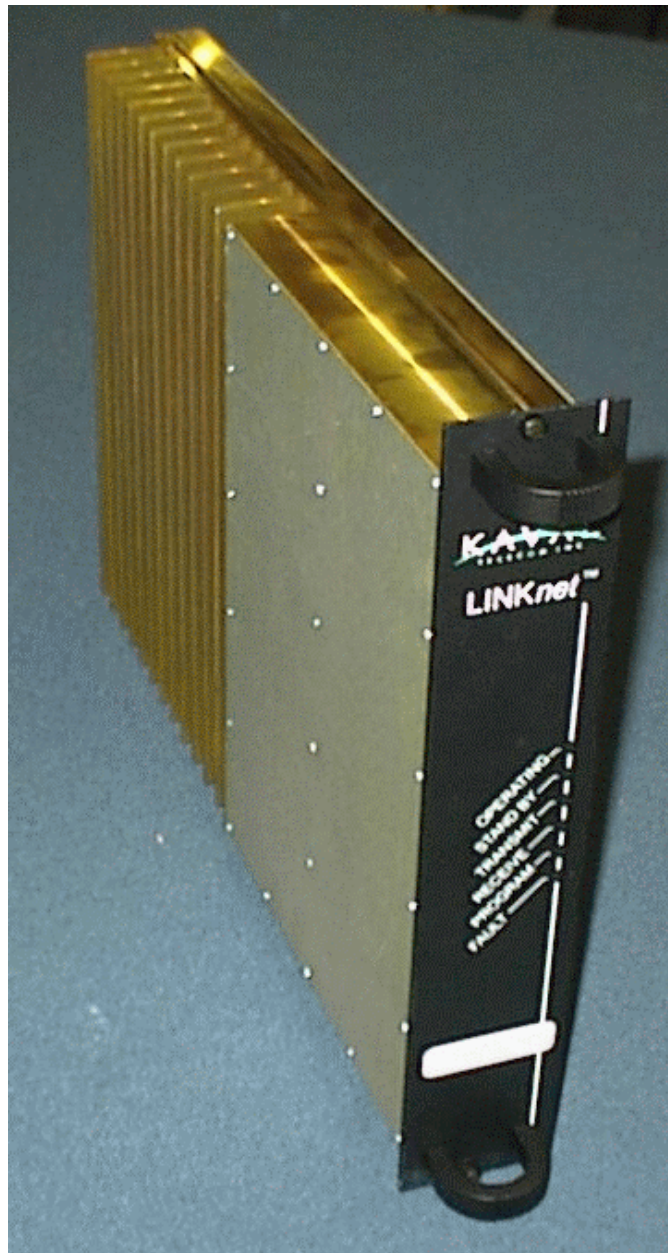


### Normal Operation

The OFR400 Module has six LED's on the faceplate:

1. OPERATING - Under normal operating conditions, this LED will flash GREEN when RF Data is present.
2. STAND BY – Under the control of the Controller Module, the OFR400 Module has the ability to act as a duplex transmitter, sitting perpetually in Stand by Mode waiting for the primary transmitter to fail. This LED should be constant Amber. If a Fault should occur with the primary module, the “Stand by” unit will immediately become the primary unit, at which time the Stand by LED will be turned off and the LED's will show an operating Module.
3. Transmit – This Green LED will be on when a signal is being transmitted
4. Receive – This Green LED will be on when a signal is being received
5. Program – This LED will be 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.
6. FAULT – Red LED, If the internal diagnostics for the module detect a problem, then this LED will remain on

OFR Module



## 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 that 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 10 dB. **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 100 Watts maximum.** Please consult Kaval Telecom for assistance as required. 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.
- 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 KAVAI TELECOM INC. 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. **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 Kaval Telecom 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 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.