

INSTRUCTION MANUAL

RFL 9508 ANALOG SINGLE SIDEBAND POWERLINE CARRIER

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RFL Electronics Inc.

WARRANTY

Except where noted, all RFL Electronics Inc. products come with a one-year warranty from date of delivery for replacement of any part, which fails during normal operation. RFL will repair or, at its option, replace components that prove to be defective at no cost to the Customer. All equipment returned to RFL Electronics Inc. must have an RMA (Return Material Authorization) number, obtained by calling the RFL Customer Service Department. A defective part should be returned to the factory, shipping charges prepaid, for repair or replacement FOB Boonton, N.J.

RFL Electronics Inc. is not responsible for warranty of peripherals, such as printers and external computers. The warranty for such devices is as stated by the original equipment manufacturer. If you have purchased peripheral equipment not manufactured by RFL, follow the written instructions supplied with that equipment for warranty information and how to obtain service.

WARRANTY STATEMENT

RFL Electronics Inc. products are warranted against defects in material and workmanship for one year from the date of shipment. During the warranty period, RFL will repair or, at its option, replace components that prove to be defective at no cost to the customer, except the one-way shipping cost of the failed assembly to the RFL Customer Service facility in Boonton, New Jersey.

This warranty does not apply if the equipment has been damaged by accident, neglect, misuse, or causes other than performed or authorized by RFL Electronics Inc.

This warranty specifically excludes damage incurred in shipment to or from RFL. In the event an item is received in damaged condition, the carrier should be notified immediately. All claims for such damage should be filed with the carrier.

NOTE

If you do not intend to use the product immediately, it is recommended that it be opened immediately after receiving and inspected for proper operation and signs of impact damage.

This warranty is in lieu of all other warranties, whether expressed, implied or statutory, including but not limited to implied warranties of merchantability and fitness for a particular purpose. In no event shall RFL be liable, whether in contract, in tort, or on any other basis, for any damages sustained by the customer or any other person arising from or related to loss of use, failure or interruption in the operation of any products, or delay in maintenance or for incidental, consequential, indirect, or special damages or liabilities, or for loss of revenue, loss of business, or other financial loss arising out of or in connection with the sale, lease, maintenance, use, performance, failure, or interruption of the products.

RFL Electronics Inc. 353 Powerville Road Boonton Township, NJ 07005-9151 USA

SAFETY WARNINGS AND SUMMARY

CAUTION

FOR YOUR SAFETY

THE INSTALLATION, OPERATION, AND MAINTENANCE OF THIS EQUIPMENT SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONS.



WARNING:

The equipment described in this manual contains high voltage. Exercise due care during operation and servicing. Read the safety summary on the reverse of this page.

SAFETY SUMMARY

The following safety precautions must be observed at all times during operation, service, and repair of this equipment. Failure to comply with these precautions, or with specific warnings elsewhere in this manual, violates safety standards of design, manufacture, and intended use of this product. RFL Electronics Inc. assumes no liability for failure to comply with these requirements.

GROUND THE CHASSIS



The chassis must be grounded to reduce shock hazard and allow the equipment to perform properly. Equipment supplied with three-wire ac power cables must be plugged into an approved three-contact electric outlet. All other equipment is provided with a rear-panel ground terminal, which must be connected to a proper electrical ground by suitable cabling. Refer to the wiring diagram for the chassis or cabinet for the location of the ground terminal.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE OR IN WET OR DAMP AREAS

Do not operate the product in the presence of flammable gases or fumes, or in any area that is wet or damp. Operating any electrical equipment under these conditions can result in a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS



Operating personnel should never remove covers. Component replacement and internal adjustments must be done by qualified service personnel. Before attempting any work inside the product, disconnect it from the power source and discharge the circuit by temporarily grounding it. This will remove any dangerous voltages that may still be present after power is removed.

DO NOT SUBSTITUTE PARTS OR MODIFY EQUIPMENT

Because of the danger of introducing additional hazards, do not install substitute parts or make unauthorized modifications to the equipment. The product may be returned to RFL for service and repair, to ensure that all safety features are maintained.



READ THE MANUAL

Operators should read this manual before attempting to use the equipment, to learn how to use it properly and safely. Service personnel must be properly trained and have the proper tools and equipment before attempting to make adjustments or repairs.

Service personnel must recognize that whenever work is being done on the product, there is a potential electrical shock hazard and appropriate protection measures must be taken. Electrical shock can result in serious injury, because it can cause unconsciousness, cardiac arrest, and brain damage.

Throughout this manual, warnings appear before procedures that are potentially dangerous, and cautions appear before procedures that may result in equipment damage if not performed properly. The instructions contained in these warnings and cautions must be followed exactly.

WARNING!

POWER MUST BE TURNED OFF BEFORE REMOVING OR INSTALLING ANY RFL 9508 MODULES. FAILURE TO DO SO MAY RESULT IN COMPONENT DAMAGE.

WARNING!

ON INITIAL INSTALLATION, ENSURE THAT ALL MODULES ARE FULLY SEATED INTO CONNECTORS BEFORE POWERING ON UNIT.

CAUTION

THE RFL 9508 CONTAINS STATIC SENSITIVE DEVICES. PERSONS WORKING ON THIS EQUIPMENT MUST OBSERVE ELECTRO STATIC DISCHARGE (ESD) PRECAUTIONS BEFORE WORKING ON THIS EQUIPMENT. AS A MINIMUM YOU MUST DO THE FOLLOWING: USE ANTI-STATIC DEVICES SUCH AS WRIST STRAPS AND FLOOR MATS, AND LEAVE MODULES IN THEIR ANTI-STATIC BAGS UNTIL THEY ARE READY TO BE INSTALLED.

WARNING!

YOUR RFL 9508 TERMINAL MAY BE EQUIPPED WITH FIBER OPTIC INPUT/OUTPUT MODULES THAT HAVE FIBER OPTIC EMITTER HEADS. FIBER OPTIC EMITTER HEADS USE A LASER LIGHT SOURCE THAT PRODUCE INVISIBLE RADIATION. FIBER OPTIC COMMUNICATION SYSTEMS ARE INHERENTLY SAFE IN NORMAL OPERATION BECAUSE ALL RADIATION IS CONTAINED IN THE SYSTEM. IT IS POSSIBLE DURING MAINTENANCE TO EXPOSE THE RADIATION BY REMOVING OR BREAKING THE FIBER. STARING DIRECTLY INTO THE LIGHT BEAM MAY RESULT IN PERMANENT EYE DAMAGE AND/OR BLINDNESS. NEVER LOOK DIRECTLY INTO THE LIGHT BEAM AND BE CAREFUL NOT TO SHINE THE LIGHT AGAINST ANY REFLECTIVE SURFACE.

THE LASER SOURCE IS A CLASS I LASER PRODUCT WHICH COMPLIES WITH APPLICABLE FDA, OSHA AND ANSI STANDARDS.

WARNING!

THE 9508 CARRIER OUTPUT CONNECTOR <u>MUST</u> BE TERMINATED PROPERLY BEFORE BEING ENERGIZED. FAILURE TO DO THIS MAY RESULT IN COMPONENT DAMAGE. SEE SECTION 6 FOR THE CORRECT COMMISSIONING PROCEDURE.

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LIST OF EFFECTIVE PAGES

When revisions are made to the RFL 9508 Instruction Manual, the entire section where revisions were made is replaced. For the edition of this manual dated September 7, 2012, the sections are dated as follows:

Front Matter	September 7, 2012
Section 1	June 2005
Section 2	September 29, 2005
Section 3	January 29, 2009
Section 4	October 1, 2010
Section 5	May 16, 2011
Section 6	October 14, 2010
Section 7	October 14, 2010
Section 8	March 11, 2010
Section 9	September 29, 2005
Section 10	December 1, 2009
Section 11	October 14, 2010
Section 12	September 7, 2012
VF-5C	March 1, 2010
VF-5XP	January20, 2006
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VF-15C-1	April 1, 2009
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REVISION RECORD

Rev.	Description	Date	Approval
1-4-05	New Document Release	1-4-05	CS
1-14-05	Replace DS-TT with PLC-TT Revise paragraph 4.3 regarding communication cable	1-14-05	CS
4-4-05	Incorporated errata sheet MC9508-001 dated 2-1-05 Incorporated comments from TZ dated 3-22-05. Incorporated comments from TZ dated 4-5-05. Incorporated ECO No. 9508-011 (new Power Supply I/O: 9547-18809) Replaced VF-15C with VF-15C-1 Replaced VF-16B with VF-16B-1	4-20-05	CS
9-29-05	Revised to include 2.5kHz operation and Remote Trip Operation. Incorporated errata sheet MC9508-003 dated 6-29-05, which added new Application Note 2 dated 6-29-05 to Section 9. Revised paragraph 4.5.3.5 to use Method 2 only for 9508. Added CM4 menu table and LED definitions to Section 8.1.7. Revised paragraphs 2.1.3 and 2.10.1 through 2.10.4. Added paragraph 7.5 for External Amp Connection Board. Revised Tx Tuning procedure in paragraph 5.3.2.2. Revised Rx Tuning procedure in paragraph 5.3.2.6. Added new Figure 2-7, Level Calculation Sheet. Revised Section 6, Commissioning Procedure.	9-29-05	CS
4-20-06	Incorporate errata sheet MC9508-004 (ECO 9508-044) Incorporate errata sheet MC9508-005 (CAR 9508-0084)) Incorporate errata sheet MC9508-006 (CAR 9508-0107) Add Jumper Settings for the RF Motherboard in Section 5. Add 9547-18810 Power Supply I/O module to Section 8 list. Update Section 6 Commissioning (CAR PROC-0731) and Section 7. Update schematics in Section 10. Minor corrections to entire manual per marketing review.	4-20-06	TG
6-5-07	Updated manual in accordance with ECO9508-90 (PLC-TT) Incorporate errata sheet MC9508-007 in section 5.	6-5-07	TG
12-1-09	Changed manual in accordance with ECO-9508-104, wrong relay markings. PS 9547-920 removed PS 9547-965 added. (ECO-9508-105) Update Data Sheets	12-1-09	TG

Description Rev. Date Approval 10-14-10 Updates to Section 4, 5 (ECO9508-113) and 7, 8 Data 10-14-10 TG Sheets updated. Section 11 Index added. Section 11 Data Sheets now Section 12. TG 12-1-10 Additional important updates to Sections 5. 12-22-10 6-14-11 Changes to Section 5 as per ECO9508-129 RF Chassis 6-14-11 TG Power Amp Settings Changes. 9-7-12 9-7-12 TG Zone Extension feature added to PLC-TT Data Sheet.

Revision Record Continued.....

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Section 1. PRODUCT INFORMATION

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RFL 9508 DSP Powerline Carrier System



Key Features and Benefits

- Interconnection between a Power Line Carrier and any existing or new T1/E1 Network.
- IEC-495 and G.703 standards exceeded.
- Up to four voice channels in one system.
- Programmable for 2.5 kHz or 4 kHz operation.

The RFL 9508 is a highly integrated and state of the art PLC terminal which incorporates Digital Signal Processing technology (DSP) to increase reliability and flexibility, while reducing physical size. Furthermore, the mechanical arrangement has been simplified for easier installation and maintenance.

These terminals offer a choice of two power output levels, and a wide range of options which include the choice of PLC, E1 or T1. Plug-in teleprotection modules are available to complete an integrated communication system design.

All channels are capable of Drop and Insert operation at the analog or digital T1/E1 level. These features make for a unique product that is ultimately flexible.

- 50 or 100 Watt PEP output power.
- AF and RF functionality 100% programmable through a Windows® Interface.
- Up to 8 independent commands of integrated transfer trip.
- 20 kHz 500 kHz frequency range with no components to change in the field.

The frequency range of the equipment is 20 kHz to 500 kHz. Single Side Band (SSB) modulation is used for the RFL 9508 where the use of the spectrum is optimized with high quality adjacent channel selectivity. Idle channel noise, cross-talk and spurious outputs are minimized and high frequency stability over the specified temperature range is achieved.

The equipment is designed to operate in the harsh environment of electric utility substations and is based, in part, on the successful and proven RFL IMUX 2000 T1/E1 multiplexer family of products.

An integrated orderwire service channel is included in the standard system. It features an adjustable volume control and audible ARD tone at the far end when the handset is taken off the hook at the near end.

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General Specifications

The equipment consists of the following stages:

Stage 0:

This level comprises the I/O cards, such as the VF Channel Card, Power Supply, and Teleprotection card (MTS).

Stage 1:

DSP Transceiver, loaded with the firmware to produce SSB analog PLC and Multitone F6 Teleprotection.

Stage 2:

Power Amplifier, RX Filter, TX Filter, Hybrid, PA Power Supply.



Figure 1 - Equipment Stages

Modulation Scheme

The most recent improvements asserted in the RFL 9508 are oriented to the practical and easy frequency planning and customization of the PLC equipment on site, involving full RF & Audio field programming. The latest digital devices such as the DUC (Digital Up Converter) allow one step modulation from audio level to RF; the DDC (Digital Down Converter) allows one step demodulation from RF to the audio level with a bandwidth of 2.5 kHz or 4.0 kHz, as shown in the example for the modulation scheme in Figure 2.

Each 0-2.5 or 0-4 kHz block in Figure 2 represents a single audio channel, and each channel can be utilized in many different ways as covered under Application Notes. To conserve spectrum, each channel is positioned side by side in the frequency spectrum.

A versatile Windows® GUI (Graphics User Interface), allows the user to configure the system requirements, mapping 64kbps channels from the T1/E1 frame into the frequency spectrum.



Figure 2 - Modulation Scheme

Channel Utilization

Figure 3 shows some of the combinations of functions that can be applied within each 0 to 2.5 kHz or 0 to 4 kHz channel in a PLC system. It is obvious from these diagrams that many other combinations are possible, which gives considerable flexibility in the utilization of the RFL 9508.

The RFL 9508 channels share both voice and telecontrol signals. The telecontrol signals are representative of a Multitone system. Note in figure 3-D, that the trip signals are located in the voice spectrum of the PLC channel, and the voice and telecontrol tones are blocked during transmission of the trip signals.

The Transceiver includes a user programmable low pass filter to separate the speech and speech-plus bands. The filter has a programmable cut-off frequency from 1800 to 3400 Hz. The VF-5XP voice module contains a 4 wire interface for speech and a 4 wire interface for speech-plus. Up to four VF-5XP modules can be used in a RFL 9508. The available bandwidth for speech-plus is 300Hz to 3,700Hz.

A low delay audio path is included to allow the use of RFL 9745 Audio Teleprotection.

RFL Electronics Inc. June 2005 Specifications subject to change without notice.



An integrated F6 four function teleprotection system is also available. Up to two four-function modules can be used with the RFL 9508 providing a maximum of eight transfer trip functions.

The 4W E&M signaling is supported end to end via the PLC signaling tones.

Applications

The RFL 9508 has been designed to satisfy all the requirements for a Power Line Carrier System, and by means of the Drop and Insert feature the RFL 9508 can integrate a Power Line Carrier channel with a Digital T1 or E1 frame using either a Fiber Optic or an Electrical Interface.

Figures 4 and 5 show a typical application of an RFL 9508 in a system. This illustrates a power line carrier system with the use of T1 or E1 and digital repeaters. In this case a three-way repeater is depicted. Any combination can be used together in a system to provide excellent communication quality over long distances with many repeats.

This illustration also describes baseband repeating. Repeating can also be accomplished by bringing all channels down to audio frequencies and repeating them on this basis, which is the more common practice.

Digital repeaters offer distinct economic and technical advantages over audio repeaters because a digital repeater is made digitally at 1.54 or 2 Mbps; consequently, an audio repeater always requires two repeaters per channel and an increase in the Group Delay.





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Figure 3 - Channel Utilization



Figure 4 - Typical Application

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Block Diagrams

System Architecture

The modularity of the RFL 9508 allows high flexibility to comply with different requirements; the main modules are:

- Transceiver: Communications Unit, digital processing and converting the audio frequency signals either to SSB or T1/E1.
- Power Amplifier, 50 or 100 Watts Peak Envelope Power (PEP.)
- Coupling: RF Filters, Hybrid, Dummy Load, Loop Back Test



Figure 6 - RFL 9508 System Architecture

Detailed Functionality

Transceiver

The Power Line Carrier Transmitter and Receiver module, includes the Modulator and Demodulator, Digital Filtering, Numerical Control Oscillator (NCO), Analog and Digital Channel Mapping and RS232 interface for configuration. This module has many functions as follows:

- Translate and convert the digital baseband source from the T1/E1 digital frame into the frequency range from 20 to 500 kHz.
- Translate and convert the Line Frequencies into digital baseband or the T1/E1 digital frame.
- Communicate with other T1/E1 modules using the CM-4 to provide a multichannel system.
- Perform line frequency programming, setting of the speech plus filters, configuration, RS232 Network Management System (NMS) Interface, diagnostics, impedance matching and level adjustment for SSB Transmission and Reception.
- Automatic Gain Control (AGC) to compensate for variations in signal level caused by line attenuation changes. If the received signal level varies more than 40 dB from normal in the regulation range of -20 to +20 dB or -26 to +14 dB, a relay and LED will indicate an alarm. Additionally the AGC functions to perform the signal-to-noise squelch which disables the system and initiates an alarm under excessive noise conditions.

Architecture of AF Chassis

The Transceiver and the IMUX Common Module are mounted in a 19" wide chassis. The connection between the two is an E1 or T1 link with shared RS232 port and power. The CM4 common card, MTS card and voice speech plus card are in the IMUX side of the chassis while the transceiver is on the PLC side of the chassis.

Programmable RF Test Generator

The Transceiver can generate an RF test tone between 20 and 500 kHz to be transmitted over the SSB path.

RF Chassis

The RF chassis comprises the RF Hybrid, RF Impedance Adapter, Loop Back Test Module, Dummy Load, Power Monitor, and 50W power amp.

The RF Interface is located at the top in the RF chassis. Test points are found inside the front panel: Line TX (after transmit filter), Line RX (before front-end filter) and Line (after the Hybrid). These signals facilitate equipment testing and commissioning.

The Skewed Hybrid efficiently separates the send and receive frequencies. Use of a skewed hybrid keeps losses in the send direction very low (0.5 to 1 dB).

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Analog and Digital Interfaces

The RFL 9508 has many interfaces that are also used with the RFL IMUX 2000 family of T1/E1 multiplexers. The following interfaces are available:

Analog Interface Modules:

VF-5XP Voice Module

This module provides either one or two voice grade channels, with high quality voice characteristics and extended range input/output level adjustments. The VF-5XP uses Pulse Code Modulation (PCM) coding with each voice channel occupying from 1 to 3 64 kbps* time slots for transmission over the powerline by the PLC transceiver in the RFL 9508. Jumpers on the module allow the user to select E&M Type I, II, III, and V signaling, with front panel status indicators and front panel bantam jacks to provide test access.

There are a variety of I/O module adapters available that include the following:

MA-301A	Surge Isolated 4W Terminal Block I/O
MA-301B	Screw Compression I/O

The module can be configured as follows:

- Two Channels of 300 Hz 2,200 Hz (or 300Hz 3,400Hz) Voice Grade Channels. If the PLC application is only a single channel system, the second channel will not be available.
- One Channel of Speech and Speech-Plus, the audio range of each is programmable to suit the application need.

*1 - 64 kbs time slot for a 300 Hz - 2,200 Hz (or 300-3,400 Hz) voice channel or 3 - 64 kbs time slots if the channel is to be divided into a Speech and Speech-Plus channel.

VF-6I Single Channel Four-Wire Order Wire Module

The RFL VF-6I Orderwire Module provides multi-drop (party line) communications link between facilities using a single time slot. The module may be used in a RFL 9508 when it is configured as an end terminal, or as a drop and insert terminal connected electrically or optically to an IMUX 2000 T1/E1 multiplexer. The unit uses m-Law companding and may be configured to transmit in either or both bus directions. The signaling is either CAS (E1) or RBS (T1), or, the signaling may be disabled.

The module may be configured for E&M Type I, II, or III signaling, or a proprietary (VF-6 compatible) format. The unit may be configured in four transmit modes: continuous transmit, hook switch activated, voice activate (VOX), or, receive only. The calibrated extended-range audio input and output level adjustments make it easy to integrate into any system.

There are two I/O module adapters available that include the following:

MA-301A-1One-channel 4W Term Block I/OMA-301BScrew Compression I/O

VF-8A Selective Calling Module

The RFL VF-8A Selective Calling Unit is a two-wire selective calling order wire module designed for use in the RFL 9508 and IMUX 2000 T1/E1 multiplexer. The VF-8A provides a very reliable means of voice communications between multiple locations using a single DS0 time slot. It accepts a single voice channel as input, and converts it into a 64kbps signal that can be transmitted over the RFL-9508 and the IMUX 2000 T1/E1 when interfaced via an electrical or optical interface.

The VF-8A allows the use of standard Dual-Tone Multi-Frequency (DTMF) telephones to selectively place a call between any or all locations within the RFL orderwire network. The three levels DTMF signaling include "Unique", "Group", and "All" call. Call progress tones are provided to indicated phone ringing, circuit busy, circuit available, and phone out-of-service. These give the VF-8A the "feel" of a real telephone instead of a party line. Three busy circuit modes are available. The level of privacy that the local extension maintains depends on the setting of each remote extension. A "time-out" feature is included to free up the network for other calls if a phone is inadvertently left in the off-hook condition for a period exceeding 50 seconds.

All of the VF-8A settings can be configured via local switches or remotely with the use of NMS.

The VF-8A uses the MA-306 module adapter.

VF-15C-1 Dual Channel 2-Wire Foreign Exchange Office End (FXO) Module

The VF-15C is a voice frequency module used to connect a standard 2-wire telephone line from a central office or PBX to the RFL-9508 or IMUX 2000 T1/E1 multiplexer. The module may be used in conjunction with the RFL VF-16 (FXS) Module to provide an off premise ex-

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tension. The module may be configured to use one or both of the available channels. Each enabled channel utilizes one 64 Kbps time slot. The module uses the MA-303 module adapter, which provides two RJ-11 jacks (with input protection circuits and bantam jacks for testing).

VF-16B-1 Dual Channel 2-Wire Foreign Exchange Station End (FXS) Module

The VF-16 is a voice frequency module used to connect a standard 2-wire telephone to the RFL 9508 or IMUX 2000 T1/E1 multiplexer. The module may be used in conjunction with the RFL VF-15C (FXO) Module to provide an off premise extension. Two VF-16s may be used with Automatic Ring Down (ARD) to provide a direct node-tonode telephone link without requiring a PBX or Key system. The module may be configured to use one or both of the available channels. Each enabled channel utilizes a 64 Kbps time slot.

The module uses the MA-303 module adapter. The MA-303 provides two RJ-11 jacks (with input protection circuits and bantam jacks for testing).

DIGITAL Interface Modules:

MA-490 Diagnostic Ethernet Interface

The RFL MA-490, is an RS232/Telnet I/O adapter module used in RFL 9508 for Telnet link capability. This module contains one Ethernet port and two RS-232 ports. The basic function of this module is to provide connectivity to the RFL 9508 via an Ethernet network.

RFL 9850 Programmable FSK Tone Modules

The RFL 9850 TX/RX contains transmitter and receiver sections fully independent of each other. They can be individually programmed for any center frequency from 300 to 3200Hz, with frequency shifts up to 300Hz and at speeds up to 600 Baud (2F operation only).

RFL 9840 TMX/TMR Programmable Telemetry Transmitter and Receiver

Each module contains the features of a programmable FSK tone channel with a programmable telemetry channel to produce a low-cost telemetry system of unequaled versatility, flexibility, and accuracy. The RFL 98 TMX Programmable Telemetry Transmitter has a wide input span; it can be programmed to accept telemetry inputs as small as 100mV or as large as 10 volts. Its output level can be set anywhere from -40dBm to 0 dBm, in 0.25dBm increments. It can set to produce fixed levels for test purposes (0, 10, 50, 90, or 100 percent of full scale).

User Interface

Man Machine Interface

A Windows® (W95, W98, ME, W2000, NT and XP) program allows the user to configure all RFL 9508 parameters; the channel mapping for the SSB/E1/T1, load the carrier frequency to the NCO, adjust output power level, as well as to measure the SNR, alarms, etc. See figure 7 for typical setup screen.

Modbu: Help				
ontrol Register	Tx Bx			
Channel Enable	Tx	- Filters	Time Slot	
Companding Enable	SubChannels	300-3700 Hz Bandpass -	1	1
Companding Type	Tu Signal Slat	200-3700 Hz Bendpasa	1 5	ā.
Signalling	1 TX Signal Siot	300-3700 Hz Bandpass	1	1
Internal Generator Enable	Tx Att Level	300-3700 Hz Bandpass 💌	1	
Freeze Rx AGC	0 dB	300-3700 Hz Bandpisst	1	1
Voice Level	Tx Frequency	Tx SubChannels		
Signalling Level				
Signalling Frequency		0		4KHz

Figure 7 - Typical Setup Screen

Slow speed communication with remote terminal via FSK modulation of guard tone

The system is able to project its serial user interface to the far end of the link using the guard or pilot tone as a narrow band FSK modem to provide a 75 Baud link.

Both the IMUX and Transceiver user interfaces can be remotely accessed by this link.

RFL 9508 Integrated or RFL 9508 RT External Teleprotection

Overview

The RFL 9508 is available with either integrated teleprotection or with an external distant teleprotection system known as RFL-9508 RF. Both systems use a four function plug-in Modular Transfer Trip System (MTS) based on the proven F6 protection scheme.

The system is suitable for Direct Transfer Trip (DTT), Permissive Transfer Trip (PTT), Blocking and Unblocking applications. RFL 9508 and RFL 9508 RT comply to the IEC-60834 teleprotection standard.

The MTS system is comprised of two parts, the MTS module and the I/O modules. Together these modules work with the balance of the RFL 9508 system to provide four-function teleprotection. Up to two MTS modules can be used in each system to provide up to eight functions of teleprotection.

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The MTS module senses the inputs, de-bounces them, applies a small amount of logic, and passes them in a timeslot on the E1/T1 link to the transceiver. The MTS limits commands to 2 seconds, returning to the guard states after that time, even if the inputs remain keyed. The MTS user interface is in the IMUX NMS. Two and four function relay and solid-state I/O's are available. Additional I/O for providing parallel contacts is also supported.

The PLC transceiver DSP decodes the message from the MTS and creates the necessary tones to transfer the command to the other end. The other end receives the tones, performs the necessary actions to generate the needed security and dependability, and sends the information to the MTS via the E1/T1 link.

RFL 9508 RF Distant Teleprotection via Optic Link

Many times the protective relays are not located in the same building as the communications systems that are used to transmit the relaying signals. A unique feature of the RFL 9508 is that the teleprotection modules can be housed in a separate chassis and communicate with the RFL 9508 via fiber optic cable The teleprotection chassis can be located up to 113km (70 miles) from the RFL 9508 depending on the type of fiber optic transceiver selected. This chassis is know as the RFL 9508 RT. (See Figure 8)

General Specification

F6 teleprotection is a single tone system that sends only one tone at a time, making it ideal for PLC. Different combinations of inputs use a priority scheme to generate the correct tone and the correct output on the receiving side. This system can have two, four or eight inputs and outputs, which are programmable. Each input can be optionally inverted or not and if 8 inputs are employed, paired inputs can be AND'ed or OR'ed to form each of the 4 command inputs.

Once the input commands have been determined, the trans-

mitted command is determined according to the priority chart. Two charts are available, based on the mode setting, "2+2" or "3+1". The 2+2 mode is typically used for parallel line applications, while the 3+1 mode is typically used for single pole trip applications. (See Figures 9 and 10.)

The transmitted command is sent to the PLC transceiver after an appropriate de-bounce period.

Depending on the mode and the command, the transceiver sends one frequency for the entire time or switches back and forth between two frequencies. The single frequency is considered un-coded operation. Un-coded is less secure and is used for permissive or blocking applications. Coded transmission consists of two frequencies sent one after the other for a specified time. The receiver must receive each tone for a specified time period before declaring a valid trip reception.

Once the receiving DSP has determined that a valid trip has been received, the RX trip command is sent to the MTS where it is decoded into output contacts according to a user setup similar to that for the inputs.

Additional Features:

Selectable Unblock Logic

In the event that the receiver enters an alarm state, the outputs programmed for unblocking will go active after 20 ms and will remain active for 150 ms.

Integrated SOE

The MTS stores up to 100 events including; Time/Date, and Input/Output contact status.

Trip Counters

Trip counters record how many times each command is sent or received. The counters roll over after 255 counts.



Figure 8 - Distant Teleprotection via Optic Link

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Integrated Test Switch

The MTS module supports the connection of an internal test panel. The test panel can be mounted inside the door of the chassis and connect to the MTS via an 8 wire cable. The test panel has a 10 position rotary switch, a push-button, and two-toggle switches. The rotary switch has Normal, Input #1, Input #2, Input #3, and Input #4 positions. The test switch can accommodate 2 MTS cards.

Selecting input 1 through 4 positions will not do anything until the push-button is pressed. Pressing the push-button will send the command corresponding to the selected position.

The toggle switch disables the local outputs. The RFL 9508 can accommodate 2 MTS units.

Teleprotection Electrical Specifications Optically Isolated Inputs:

Operating Voltage Range: 48 Vdc 38-60 Vdc 125 Vdc 88-150 Vdc 250 Vdc 200-280 Vdc Input threshold 1/2 normal station battery.

Solid-State Outputs:

Maximum continuous output current	1 A
Minimum output current	20 mA
Maximum open circuit voltage	280 Vdc
Maximum turn on delay	100 µs

Optional Relay Outputs:

Maximum continuous output current	2 A (inductive)
Maximum surge current (100ms)	30 A
Maximum breaking current	1 A (resistive)
Maximum open circuit voltage	280Vdc
Maximum operate time	5 ms

ESD Withstand
RFI Withstand
SWC Withstand
Dielectric Withstand

IEC-610004-2, ANSI C37.90.3 IEC-60834, ANSI C37.90.2 IEC-801-4, ANSI C37.90.1 2500 Vdc per IEC-60255-22-1 and IEC-60834-1

Alarm Relay

_

Output Form **Open Circuit Voltage** Current (continuous) **Breaking Current**

"C" (spdt) 300 Vdc 1 A 1 A, Non-inductive

Technical Specifications

RF Band

Frequency range
Full duplex Channels
Channel Bandwidth
Selectivity

20 to 500 kHz 1, 2, 3, or 4 SSB Channels 2.5 kHz, 4 kHz

Overall (4 kHz from Bandedge) <= -75 dBmO Channel (0.3 kHz from Bandedge) <= -65 dBmO 50, 75, 100 or 150 Ohms Impedance

unbalanced or balanced

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AF Band

AGC dynamic range **Background Noise** Harmonic Distortion

Group Delay Frequency Stability Tx Line Filters Rx Line Filters Minimum sensitivity

Signaling (Pilot)

Frequency Type of modulation Frequency shift

+14 to -26 dB, or + 20dB <= -55 dBmOp (IEC 495 recomm) <= -40 dBmO F=400 Hz (IEC 495 recomm) (IEC 495 recomm) ± 0.5 Hz at 250 kHz (±2 ppm) Adjustable from 20 to 500 kHz Adjustable from 20 to 500 kHz -30 dBm

3825 Hz, 3600 or 2385 FSK ± 30 Hz from channel center frequency

0 to 95% non condensing

-20 to + 65°C

Environmental Conditions

Ambient Temperature Range Relative Humidity

Weight

50W RFL 9508 100W RFL 9508 38 lbs / 17.3 kg 54 lbs / 24.6 kg

Input Command	TX Command (actual TX)	Frequency (2 / coded)	Receiver outputs
No input	None	Pilot	None
Α	А	F3	A
В	В	F5	В
A&B	A&B	F7	A&B
С	С	F2,F4	С
D	D	F2,F6	D
C&D	C&D	F4,F6	C&D
A&D	A&D	F6,F8	A&D
B&C	B&C	F4,F8	B&C
A&C	С	F2,F4	С
B&D	D	F2,F6	D
A&B&C	B&C	F4,F8	B&C
A&B&D	A&D	F6,F8	A&D
A&C&D	C&D	F4,F6	C&D
B&C&D	C&D	F4,F6	C&D
A&B&C&D	C&D	F4,F6	C&D

Figure 9 - Command Priority Table for "2+2" Mode

Input Command	TX Command (actual TX)	Frequency (2 / coded)	Receiver outputs
No input	None	Pilot	None
А	A	F3	А
В	В	F5	В
A&B	D	F2,F6	D
С	С	F7	С
D	D	F2,F6	D
C&D	D	F2,F6	D
A&D	D	F2,F6	D
B&C	D	F2,F6	D
A&C	D	F2,F6	D
B&D	D	F2,F6	D
A&B&C	D	F2,F6	D
A&B&D	D	F2,F6	D
A&C&D	D	F2,F6	D
B&C&D	D	F2,F6	D
A&B&C&D	D	F2,F6	D

Figure 10 - Command Priority Table for "3+1" Mode

RFL 9508

Specifications subject to change without notice.





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DEL 0500 DI C

Ordering Information		
RFL Part Number (fill in blanks): 9508		
Base System		
Chassis		
Power Supply		
38-150 Vdc		
200-300 Vdc B		
RF Power Options		
50W 0		
100W 1		
Integral Teleprotection Modules		
None		
One 1		
Two 2		
Teleprotection I/O (Select 2)		
None or External (if External choose Drop and Insert Mode)		
MTS w/2 function Solid State 48/125 Vdc		
MTS w/2 function Solid State 250 Vdc 2		
MTS w/4 function Solid State 48/125 Vdc 3		
MTS w/4 function Solid State 250 Vdc		
MTS w/2 function Relay 48/125 Vdc 5		
MTS w/2 function Relay 250 Vdc 6		
MTS w/4 function Relay 48/125 Vdc 7		
MTS w/4 function Relay 250 Vdc 8		
Drop and Insert Mode		
None		
Electrical T1/E1 (MA-278)		
Electrical E1 75 ohm (MA-271) B		
Fiber 820 nm Multimode		
Fiber 1300 nm LED singlemode D		
Fiber 1300 nm Laser singlemode		
Fiber 1550 nm Laser singlemode		
PLC Audio Options (Select 2) Note: If orderwire is required a VF-5XP must be selected.		
None	0	
Speech Plus with comp. blocks(VF-5XP, MA-301B)	A	
Speech Plus with screw terminals (VF-5XP, MA-301A)	В	
Speech with comp. blocks (VF-5C, MA-301B)	С	
Speech with 50 Pin telco (VF-5C, MA-301)	D	
Speech with screw terminals (VF-5C, MA-301A)	E	
FXO with Modular Jacks (VF-15C, MA-303)	F	
FXS with Modular Jacks (VF-16B, MA-303)	G	
Orderwire with comp. blocks (VF-6I, MA-301B)	н	
Orderwire with screw terminals (VF-6I, MA-301A-1)	J	
Selective Calling Module (VF-8A, MA-306)	к	
Special Options		
N 100 C	1	0
None		
Special Configuration		X

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June 2005

Because RFL[™] and Hubbell[®] have a policy of continuous product improvement, we reserve the right to change designs and specifications without notice.



RFL 9508 Remote Trip Chassis PLC Ordering Information	
RFL Part Number (fill in blanks): 9508RT	
Base System	
Chassis	
Power Supply	
38-150 Vdc	
200-300 Vdc B	
Remote Teleprotection Modules	
One 1	
Two 2	
Teleprotection I/O (Select 2)	
None	
MTS w/2 function Solid State 48/125 Vdc	
MTS w/2 function Solid State 250 Vdc	
MTS w/4 function Solid State 48/125 Vdc 3	
MTS w/4 function Solid State 250 V/dc	
MTS w/2 function Relay 48/125 Vdc	
MTS w/2 function Relay 250 V/dc	
MTS w/4 function Relay 48/125 Vdc 7	
MTS w/4 function Relay 250 V/dc	
Remote Interface	
Electrical T1/E1 (MA-278)	
Electrical E1 75 ohm (MA-271)	
Electrical E 175 offin (MA-271)	
Fiber 1300 pm I ED singlemode	
Fiber 1300 nm Leos singlemode	
Fiber 1500 mm Laser singlemode	
Pile Audio Options (Salast 2) Note: If orderwise is required a VE 5VP must be selected	
FLC Audio Options (Select 2) Note: If order wire is required a VF-SAF must be selected.	
None Speech Blue with comp. blocks()/E.EVD. MA 2018)	
Speech Plus with comp. blocks(VF-5XP, MA-301B)	A
Speech Plus with screw terminals (VF-SAP, MA-30TA)	D
Speech with COMP. DIOCKS (VF-DC, MA-301B)	
Speech with 50 Pin telco (VF-5C, MA-301)	D
Speech with screw terminals (VF-5C, MA-301A)	E
EXO with Modular Jacks (VF-15C, MA-303)	F
FXS with Modular Jacks (VF-16B, MA-303)	G
Orderwire with comp. blocks (VF-6I, MA-301B)	н
Orderwire with screw terminals (VF-6I, MA-301A-1)	J
Selective Calling Module (VF-8A, MA-306)	K
Special Options	1
None	0
Special Configuration	X
Ethernet remote access (MA-490)	1

95RT Rev. AL 4/05

RFL Electronics Inc.



Section 2. APPLICATIONS

This section discusses typical RFL 9508 applications, PLC-TT and VF-5XP applications and Tx and Rx Filter performance. It also discusses Line Board applications and Analog Level considerations and calculations.

2.1 TYPICAL RFL 9508 APPLICATIONS

2.1.1 POINT-TO-POINT APPLICATION

Figure 2-1 illustrates a typical point-to-point application with one SCADA (Supervisory Control And Data Acquisition) RF channel, one slow speed data channel, and one speech channel with integrated type F6 teleprotection. RF channel 1 provides the SCADA link while RF channel 2 provides the speech, slow speed data, and teleprotection links. Two VF-5XP modules provide the audio circuits. In addition, an "orderwire" maintenance voice circuit is "bridged" on to RF channel 1. This is also referred to as the Service Channel. It is not shown in Figure 2-1.

When RF channel 2 is configured for speech plus operation, the speech band is terminated at 2000Hz (programmable), and the bandwidth above 2100Hz (programmable), can be used for one (as shown) or more slow speed data channels using external modem(s).

Each 9508 terminal at nodes A and B is connected to the power line via an LTU (Line Tuning Unit) and coupling capacitor (CC). The LTU matches the characteristic (surge) impedance of the power line to the impedance of the 9508 terminal. The LTU also contains a surge arrestor to protect the equipment from voltage spikes, lightning or other faults. The coupling capacitor isolates the 9508 from the high voltage of the power line.

The SCADA master is used to monitor and manage electrical power distribution facilities. It is shown connected to RF channel 1 of the 9508 at node A. The SCADA remote (Remote Terminal Unit or RTU) is shown connected to RF channel 1 of the 9508 at node B. The SCADA master communicates with the RTU over the RFL 9508 power line carrier link at data rates up to 9600 baud.

A 21P device is shown at nodes A and B. The 21 indicates that the device is a distance (under impedance) relay. The P indicates that there is a pilot channel communication link. In this example the RFL 9508 equipment provides the pilot channel. The A-B indicates that the communication channel is from node A to node B. Conversely, the B-A indicates that the communication channel is from node A.

When the overreaching 21P distance relay detects a fault in the forward direction, it provides a contact closure to the PLC-TT module at the local end. The PLC-TT module sends the contact closure information to the remote end PLC-TT module over the 9508 power line carrier link. The PLC-TT module can support up to four bi-directional transfer trip functions (two permissive and/or two direct) between two terminals or can support DCB (Directional Comparison Blocking) in addition to two transfer trip functions.

This example shows a PABX (Private Automatic Branch Exchange) with a 4W E&M trunk circuit from RF channel 2 of node A to RF channel 2 of node B. Communication is over the 9508 power line carrier link. The 4W E&M trunk circuit could be replaced with a 2W FXO/FXS subscriber circuit. In this case there would not be a PABX at the remote end (node B), the second VF-5XP module at the office end (node A) would be replaced with a VF-15C-1 (FXO) module, and the second VF-5XP at the subscriber end (node B) would be replaced with a VF16B-1 (FXS) module.

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	A		В	
	Channel Module	I/O	Channel Module	I/O
Ch1	VF-5XP #1 (4W E&M)	MA-301 B #1	VF-5XP #1 (4W E&M)	MA-301 B #1
Ch2	VF-5XP #2 (4W E&M)	MA-301 B #2	VF-5XP #2 (4W E&M)	MA-301 B #2
	PLC-TT	PLC-TT I/O	PLC-TT	PLC-TT I/O

Figure 2-1.	Typical	point-to-	point a	pplication
1 igui c #-1.	I y picai	pome-to-	pomi a	ppncation

2.1.2 TANDEM LINK APPLICATION WITH ONE PARTY LINE CHANNEL

Figure 2-2 illustrates a typical tandem link application with one SCADA channel, one speech channel and integrated type F6 teleprotection. In the tandem link application the two 9508s at node B are connected together at the T1/E1 level using either a fiber optic or electrical interface. Traditionally the two links were connected together at the audio level, which increased group delay distortion. This severely limited the number of links that could be connected together in tandem. The SCADA master station is located at Substation A, with RTU remotes located at Substations B and C. Typical data rates are between 1200 and 9600 baud.

Each 9508 terminal is connected to the power line via an LTU (Line Tuning Unit) and coupling capacitor (CC). The LTU matches the characteristic (surge) impedance of the power line to the impedance of the 9508 terminal. The LTU also contains a surge arrestor to protect the equipment from voltage spikes, lightning or other faults. The coupling capacitor isolates the 9508 from the high voltage of the power line.

RF channel 1 is used in a "party line" configuration to carry the SCADA traffic. A polling scheme is used that allows only the addressed remote to respond. The two Model 9508 terminals at Substation B are connected together to digitally repeat the channel 1 signal from Substation A to Substation C and vice versa. A VF-6I "Orderwire" speech module, which transmits in both directions, is equipped at Substation B to achieve the local "party line" connection. The standard "Orderwire" maintenance speech channel cannot be used with this configuration because the maintenance speech channel is only supported by a VF-5XP module, which is not present at node B.

RF channel 2 is used as a point-to-point link between Substations A and B. It supports both speech (FXO/FXS) and teleprotection.

Channel 3 is used as a point-to-point link between Substations B and C. It supports an ARD (Automatic Ring Down) speech channel and up to 4 teleprotection commands. The channel #2 time slot is thereby re-used.

A 21P device is shown at nodes A and B. The 21 indicates that the device is a distance (under impedance) relay. The P indicates that there is a pilot channel communication link. In this example the RFL 9508 equipment provides the pilot channel. The A-B indicates that the communication channel is from node A to node B. Conversely, the B-A indicates that the communication channel is from node A.

A 21P device is also shown at nodes B and C. The B-C indicates that the communication channel is from node B to node C. Conversely, the C-B indicates that the communication channel is from node C to node B.

When the 21P distance relay at node A detects a fault in the forward direction, it provides a contact closure to the PLC-TT module at the local end (node A). The PLC-TT module sends the contact closure information to the remote end (node B) PLC-TT module over RF Channel 2 of the 9508 power line carrier link. The PLC-TT module can support up to four bi-directional transfer trip functions between two terminals, or can support DCB (Directional Comparison Blocking) in addition to two transfer trip functions. Teleprotection between nodes B and C is provided in a similar manner.



	A		B (Left)		B (Right)		C	
	Channel	I/O	Channel	I/O			Channel	I/O
	Module		Module				Module	
Ch1	VF-5XP	MA-301B	VF-6I (OW)	MA-			VF-5XP	MA-301B
	(4W E&M)			301A-1			(4W E&M)	
Ch2	VF-15C-1	MA-303	Port 1 of	MA-303				
	(FXO)		VF-16B-1(FXS)	(Port 1)				
	PLC-TT	PLC-TT	PLC-TT	PLC-TT				
		I/O		I/O				
Ch3			Port 2 of	MA-303			VF-16B-1	MA-303
			VF-16B-1(FXS)	(Port 2)			(FXS)	
					PLC-TT	PLC-TT	PLC-TT	PLC-TT I/O
						I/O		

Figure 2-2. Typical tandem link application with one party line channel
2.1.3 TANDEM LINK WITH TWO PARTY LINE CHANNELS

Figure 2-3 illustrates another typical tandem link application with two "party line" channels for speech / data, and with integrated type F6 teleprotection. The RF channel 1 application is the same as previously discussed for Figure 2-2. RF channel 2 is now configured to support a private selective calling telephone system using a SCU (Selective Calling Unit). Any Model 9508 location can call any other Model 9508 location in the same system by using DTMF (Dual Tone Multi-Frequency) signaling. The teleprotection is configured to use trip frequencies between 300 and 2000 Hz for the link between Substations A & B, while trip frequencies between 2400 and 3700 Hz are used for the link between Substations B & C. Separate "guard" tones are used for each link. The 3825Hz pilot tone of the 9508 serves as the guard tone for the link between substations A & B. Since two PLC-TT modules are employed on the same channel, a different guard tone is required for the link between substations B & C. This second guard tone will be 2350Hz.

The standard "Orderwire" maintenance speech channel cannot be used with this configuration for the reason given in paragraph 2.1.2.

Each 9508 terminal is connected to the power line via an LTU (Line Tuning Unit) and coupling capacitor (CC). The LTU matches the characteristic (surge) impedance of the power line to the impedance of the 9508 terminal. The LTU also contains a surge arrestor to protect the equipment from voltage spikes, lightning or other faults. The coupling capacitor isolates the 9508 from the high voltage of the power line.

A 21P device is shown at nodes A and B. The 21 indicates that the device is a distance (under impedance) relay. The P indicates that there is a pilot channel communication link. In this example the RFL 9508 equipment provides the pilot channel. The A-B indicates that the communication channel is from node A to node B. Conversely, the B-A indicates that the communication channel is from node A.

A 21P device is also shown at nodes B and C. The B-C indicates that the communication channel is from node B to node C. Conversely, the C-B indicates that the communication channel is from node C to node B.

The RFL VF-5XP is a dual-channel 4-wire E&M voice-frequency module, specifically designed for use in the RFL 9508. It has one speech channel (300-3400 Hz) and one speech plus channel (300-3700 Hz)

The RFL VF-6I is a single-channel 4-wire voice-frequency module. It accepts one voice channel as input and uses u-law PCM encoding to convert the analog voice signal into a companded 8-bit, 64-Kbps digital signal. The RFL VF-6I can be used in both terminal and drop/insert multiplexers.

The RFL VF-8A Selective Calling Unit is a 2-wire selective calling "party line" module. It accepts a single voice channel as input, and converts it into a 64kbps signal, which can be transmitted over T1, E1 or other digital communications facilities. It does this using μ -law PCM encoding and decoding for both T1 and E1 systems. The VF-8A automatically detects if the system is T1 or E1 and configures itself appropriately.



	A		B (Lef	t)	B (F	Right)		С
	Channel Module	I/O	Channel Module	I/O			Channel Module	I/O
Ch1	VF-5XP (4W E&M)	MA- 301A/B	VF-6I (OW)	MA- 301A-1			VF-5XP (4W E&M)	MA-301A/B
Ch2	VF-8A (SCT)	MA-306	VF-8A (SCT)	MA-306			VF-8A (SCT)	MA-306
	PLC-TT	PLC-TT I/O	PLC-TT	PLC-TT I/O	PLC-TT	PLC-TT I/O	PLC-TT	PLC-TT I/O

Figuro 2-3	Typical	tondom	link on	nlication	with t	wo nort	v lino	channels
r igui e 2-3.	, i ypicai	tanuem	шпк ар	рпсацоп	with t	wu part	y mie	channels

2.1.4 STAR APPLICATION

Figure 2-4 illustrates a star application with Substation B as the central location. The SCADA Master Station and a PABX are located at the central location. Powerline Carrier provides the communication links to Substations A and C. Optical fiber is used for the communication link to Substation D. An RFL, 8-Port redundant DACS (Digital Access and Cross-Connect System) at substation B is used to distribute the individual T1/E1 channels to the correct location.

The protective relays at Substation A are located in the Relay room which is a few hundred feet distant from the Communication room, which is the location of the powerline carrier equipment. A Model 9508RT Remote Trip chassis is installed in the Relay room. The Model 9508 terminal end is effectively converted to a drop & insert terminal. Optical fiber is used to make the secure connection between the two sets of equipment. RF Channel 2 carries the protective relaying signal to Substation B.

The standard "Orderwire" maintenance speech channel is available for emergency communication between Substations A and B, and also between Substations B and C.



	Α	В	С	D
	Modules	Modules	Modules	Modules
Ch1	VF-5XP/MA-301B	VF-6I/MA-301A-1		VF-5XP/MA-301B
Ch2	VF-16B-1/MA-303B	Port 1 of VF-15C-1/MA-303B		
	PLC-TT/PLC-TT I/O	PLC-TT/PLC-TTI/O		
Ch3		Port 2 of VF-15C-1/MA-303B		VF-16B-1/MA-303B
Ch4		VF-5XP/MA-301B	VF-5XP/MA-301B	
Ch5		PLC-TT/PLC-TTI/O		PLC-TT/PLC-TT I/O
Ch6		VF-15C-1/MA-303B	VF-16B-1/MA-303B	
		PLC-TT/PLC-TT I/O	PLC-TT/PLC-TTI/O	

Figure 2-4. Star application

2.2 F6 TELEPROTECTION

2.2.1 OVERVIEW

The PLC-TT module uses type F6 teleprotection, which is a single tone system that only sends one tone at a time from one end of the protected line to the other. Different combinations of inputs use priority tables to generate the correct tone and the correct output at the receiving end. This system has two, four or eight inputs and outputs. Each input can be inverted or not, and if eight inputs are used, two inputs can be AND'ed or OR'ed to form each of four command inputs. The transmitted command is determined by two priority tables; one based on 2+2 mode and the other based on 3+1 mode. 2+2 mode means 2 uncoded signal transmissions and 2 coded signal transmissions. 3+1 mode means 3 uncoded signal transmissions and 1 coded signal transmissions. Uncoded signal transmissions are single tone only and are typically used for blocking or permissive underreach or permissive overreach. Coded signal transmissions have two alternating tone frequencies and are typically used for increased security.

The input command is sent to the PLC transceiver. Depending on the mode and the command, the PLC transceiver sends one frequency for the entire time or sends two alternating frequencies for a specified time. The receiver must receive each tone for a specified period before declaring a trip reception. Once the receiver has determined that a valid trip has been received, the RX trip command is sent to the PLC-TT module where it is decoded into output contacts in accordance with a user setup similar to that used for the inputs.

Input Command*	Frequency	Receiver Output
-	(1 for uncoded, 2 for coded)	-
No input	Pilot	None
No input	F1	Test
А	F3	А
В	F5	В
A&B	F7	A&B
С	F2,F4	С
D	F2,F6	D
C&D	F4,F6	C&D
A&D	F6,F8	A&D
B&C	F4,F8	B&C
A&C	F2,F4	С
B&D	F2,F6	D
A&B&C	F4,F8	B&C
A&B&D	F6,F8	A&D
A&C&D	F4,F6	C&D
B&C&D	F4,F6	C&D
A&B&C&D	F4,F6	C&D

Table 2-1.	. Input Comm	and Priority '	Table for	"2+2" Mode

* A, B, C, and D correspond to Trip Inputs/Outputs 1, 2, 3 and 4 on the PLC-TT I/O adapter module.

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Input Command*	Frequency	Receiver Output
-	(1 for uncoded, 2 for coded)	-
No input	Pilot	None
No input	F1	Test
А	F3	А
В	F5	В
A&B	F2, F6	D
С	F7	С
D	F2, F6	D
C&D	F2, F6	D
A&D	F2, F6	D
B&C	F2, F6	D
A&C	F2, F6	D
B&D	F2, F6	D
A&B&C	F2, F6	D
A&B&D	F2, F6	D
A&C&D	F2, F6	D
B&C&D	F2, F6	D
A&B&C&D	F2, F6	D

 Table 2-2. Input Command Priority Table for "3+1" Mode

* A, B, C, and D correspond to Trip Inputs/Outputs 1, 2, 3 and 4 on the PLC-TT I/O adapter module.

F number	Frequency	Notes
F1	427Hz	Test signal frequency
F2	640Hz	Trip signal frequency
F3	853Hz	Trip signal frequency
F4	1067Hz	Trip signal frequency
F5	1280Hz	Trip signal frequency
F6	1493Hz	Trip signal frequency
F7	1707Hz	Trip signal frequency
F8	1920Hz	Trip signal frequency

 Table 2-3. Preset Frequencies

2.2.2 TYPICAL APPLICATIONS

Figure 2-5a shows a typical PLC-TT application using four inputs and four outputs. Two input modules are also available. Figure 2-5b shows a typical PLC-TT application consisting of 2 I/Os, each with four inputs and four outputs. The four inputs can be AND'ed or OR'ed in various combinations using NMS. In both examples, the outputs can be inverted or non-inverted.



Figure 2-5. PLC-TT Applications

2.3 VF-5XP

The RFL VF-5XP is a dual-channel four-wire E&M voice-frequency module used in the RFL 9508. It has one speech channel (300-3400Hz) and one speech plus channel (300Hz-3700Hz). For 2.5kHz operation the VF-5XP is limited to 300Hz-2200Hz. Every 9508 must have at least one VF-5XP at each end to support the Service Channel. The Service Channel allows users to communicate using the Service Channel handsets. When the service channel is on, it overrides any audio on that channel, however, the service channel does not override F6 teleprotection. The Service Channel can be enabled or disabled using NMS. All VF-5XP parameters must be programmed using NMS with the exception of E&M signaling which is set up using jumpers, and the module address, which is set up using jumpers. Refer to the VF-5XP Instruction Data sheet located in Section 11 of this Instruction Manual for additional information.

2.4 FREQUENCY PROGRAMMING CAPABILITY

The 9508 can be set for operation in the range of 20 KHz to 500 KHz without component changes. The transceiver can be set to any transmit or receive frequency from 20 to 500 KHz in steps of 125 Hz. The signaling frequencies are selectable between 2325 Hz (2.5 KHz operation) and 3825 Hz (4.0 KHz operation)

The analog filters are fully adjustable in this range in 2 KHz steps. As their bandwidths are significantly wider than the channel bandwidth, they do not need finer adjustment.

2.5 ADJACENT CHANNEL / MULTI-CHANNEL OPERATION

The 9508 can be arranged for fully adjacent or separated band operation. It can also be set up for low level combining of up to 4 adjacent channels. This provides superior operation over high level combining of two dual channel units.

The transmit and receive functions of the 9508 can be set for any center frequency without regard for the frequency of the other function. The only limitations are on multi-channel operation where the two transmit channels must fit within the bandwidth of the transmit filter and the same for receive channels. The bands of the 9508 can be set for Erect (upper side band), or Inverted (lower side band) operation.

The following diagrams show some of the possible arrangements. Many more are possible. **Single 2.5 KHz arrangements**



Erect & Adjacent



Erect & Non-Adjacent



Inverted & Adjacent



Erect & Inverted, Adjacent

Dual 2.5 KHz arrangements



Erect & Adjacent



Erect & Non-Adjacent

4 channel 2.5 KHz arrangements



Erect & Adjacent (four channel 9508 required for this application)

All of the same configurations are available for 4 KHz systems as well.

The 9508 can be used in parallel operation with other PLC terminals. In this application, the transmit filter unloads the line outside of band to limit the effect on other terminals. As there is some loading effect, RFL does not recommend paralleling units closer than 12 KHz (band edge to band edge) without using combiners.



Inverted & Adjacent

2.6 RFL 9508 FILTERING

There are three filter sections in the 9508, Analog TX, Analog RX, and Digital.

Digital

The 9508 gains nearly all of its selectability from the Digital filtering. The analog receive filter is present purely to prevent extraneous signals from overloading the input of the DSP. The analog TX filter is present purely to eliminate amplifier harmonics and reduce loading of adjacent transmitters.

The Digital filters in the 9508 take two forms, the down converter filtering and the audio filtering. The down converter filter is a 4 KHz wide 65 tap FIR filter. It provides performance roughly equal to an 12th order analog filter with a roll off of about 70 dB per octave. The audio filters are 256 tap FIR filters that can be set for many frequency bands. For 2.5 KHz operation, the filter is set to one of the following 300-1700, 300-2200, 300-2400 Hz. When set to a 2.4 KHz limit, this filter rolls off 70 dB by 2.6 KHz.

Analog RX

Many of RFL's existing installations of programmable SSB PLC do not use separate receive filters. RFL has included an analog RX filter in the design of the 9508 to limit the band of signals seen by the DSP for channel overloading reasons, not for selectability. Selectivity tests required by IEC 60495 call for interfering tones within the bandwidth of the RX filter so it does not provide any additional rejection.

The RX filter in the 9508 can be set to single or dual channel width. For single channels, RFL recommends the use of a filter which is about 8 KHz wide and for dual adjacent RX channels, a filter 16 KHz wide. This does not vary for 2.5 or 4 KHz operation as the purpose of the filter is not selectability.

Analog TX

The TX filter of the 9508 exists for two purposes. Its first purpose is to reduce the harmonic distortion that may be introduced by the amplifier to an acceptable level. This does not vary with a bandwidth of 2.5 or 4 KHz.

The second purpose of the filter is to eliminate loading of adjacent transceivers. For one or two 2.5 KHz channels, RFL recommends using the filter on its narrow (8 KHz) bandwidth. The adjacent channel loading of the RFL TX filter at that width is less than 1.5 dB @12 KHz from the center. If parallel operation of multiple terminals closer than 8 KHz (band edge to band edge) is required, RFL recommends the use of high power combiners or a multi-channel 9508.



Figure 2-6. 9508 Filtering

2.7 RX FILTER PERFORMANCE

The Center Frequency and Bandwidth of the Rx Filter are set using programmable jumpers on the Rx Filter module as described in paragraph 5.2.2.6. The Bandwidth can be set to 8kHz or 16kHz. The Center Frequency can be set from 24kHz to 496kHz in 4kHz increments. The Rx frequency must also programmed in the RF Setup section of the NMS as shown in Figure 4-23. The Rx Filter should be set to 8kHz for dual/single channel 4kHz or dual/single 2.5 kHz operation. For more channels set to 16kHz.

2.8 TX FILTER PERFORMANCE

The Center Frequency and Bandwidth of the Tx Filter are set using programmable jumpers on the Tx Filter module as described in paragraph 5.2.2.2. The Bandwidth can be set to 8kHz or 16kHz. The Center Frequency can be set from 24kHz to 496kHz in 4kHz increments. The Tx frequency must also programmed in the RF Setup section of the NMS as shown in Figure 4-22. The Tx Filter should be set to 8kHz for dual/single channel 4kHz or dual/single 2.5 kHz operation. For more channels set to 16kHz.

2.9 LINE BOARD

The Line Board is the interface between the RFL 9508 and the line coupling equipment. It has several jumpers and other controls that must be set for proper system operation. Refer to paragraph 5.2.2.4 for additional information.

2.10 SETTING LEVELS ON THE RFL 9508

Setting the levels on an RFL 9508 is important for proper functionality. For the following discussion refer to Figure 2-7. The levels are set up in four stages.

Relative Levels Of Transmit Tones Absolute Level Of Transmit Tone Absolute Receive Level Alarm level setting

They should be set in the following manner.

2.10.1 RELATIVE LEVELS OF TRANSMIT TONES

The output level from the transceiver is relative to a peak of +3 dBm0. The teleprotection tone is always sent at this level. Even if teleprotection is not installed or used, this reference should be used.

- 1. Set the input level on the VF-5XP so that the peak level of the expected incoming signal equals the setting. This will set the peak level to 0 dBm0 or one digital milliwatt. This will allow 3 dB of headroom in the digital portion of the path. For a single tone, peak and average are the same. For 2 equal tones, the peak is 6 dB above the average of each tone.
- 2. The levels for voice signals (step 3) and signaling (step 4) should be calculated to ensure that the combined peak composite level does not exceed +3 dBm0. The "Graphical Levels Spreadsheet" should be used for this. It is on the CD in a file named "Graphical levels.xls".
- 3. Set the voice attenuator to place the tone where it should be relative to the peak output.
- 4. Set the signaling (pilot)attenuator for the desired signaling level relative to the peak. A setting of 0 would generate a signaling tone the same level as the teleprotection tone or +3 dBm0. Typically this is set to 6 to give a signaling tone 6 dB below the peak level, or -3dBm0. Note: The signaling tone performs the functions of a guard tone or pilot tone. In the RFL 9508 there is only one tone per channel for these functions.
- 5. The test tone generator runs at +3 dBm0 and is controlled by the voice attenuator setting. When the generator is enabled, the speech and speech plus inputs are disabled.

For Example:

Consider a single channel, 50 Watt system with a -16 dBm audio signal placed 6 dB below the teleprotection tone and the signaling (pilot) tone placed 6 dB below the teleprotection tone. Therefore, the desired levels into the adder are:

Teleprotection	+3 dBm0
Test tone	-3 dBm0
Signalling	-3 dBm0

This would provide a peak composite level of the combined signals of 3dBm0 which complies with the 3.0 dBm0 limit.

The VF-5XP should be set for -16 dBm input The voice attenuator should be set for -3 dB The signaling (pilot) attenuator should be set for -6 dB

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2.10.2 ABSOLUTE LEVEL OF TRANSMIT TONE

- 1. The absolute level coming out of the transceiver and going to the amplifier is not that critical because the gain of the amplifier is set to give the correct level out of the amplifier. The typical peak level out of the transceiver is +12.75 dBm @ 50 Ohms.
- 2. In a single RF channel system an F6 tone will be at +12.75 dBm @ 50 Ohms at the output of the transceiver.
- 3. If two channel operation is enabled, the system will automatically adjust the signals in the up converter down 6 dB to accommodate the second channel.
- 4. The gain of the amplifier is set using pot R83. This must be adjusted to ensure that the transmitted level will not exceed the maximum output compliance of the amplifier, which is +47 dBm into 50 ohms or 50 Vrms for a 50 Watt system.

2.10.3 ABSOLUTE RECEIVE LEVEL

- 1. After the hybrid is balanced, the absolute receive level into the transceiver should be adjusted using R10 on the line board. It should be set so the F6 test tone in a single channel system is -11 dBm @ 50 Ohms, or in a two channel system is -17 dBm @ 50 Ohms. This allows for 10dB of headroom.
- 2. In order for the Xcvr to properly calculate the receive levels, the remote Xcvr Voice level and Signaling level must be manually entered into the RF Setup section of the NMS software prior to a write operation.
- 3. The RX AGC set point can be used to make adjustments to the absolute level of the signal fed to the voice cards. Start from the setting from the Graphical Level Spread Sheet while measuring the desired tone. The voice card should already be set to the desired output level.

2.10.4 ALARM LEVEL SETTING

1. The current gain should be entered as the nominal gain in the Rx Screen of the RFL 9508 NMS. It can be in the range of 0 to 75 dB. The current gain value, which can be seen using the monitor feature, should be reentered as the nominal gain in order to set the alarm threshold. The low signal alarm will occur when the current gain has exceeded the LOS threshold.

Please refer to the next page for:

Figure 2-7. RFL 9508 Level Calculation Sheet



Power at Amp (dBm)

RF Channel 1	Level	% Mod.		
Tone A	44.00	70.79		
Tone B	None			
Tone C	None			
Tone D	None			
Tone E	None			
Tone F	None			
Tone G	None			
Tone H	None			
Tone I	None			
Tone J	None			
Pilot	33.00	19.95		
Composite w/o test tone	46.16			
Audio Test Tone	47.00			
RF Channel 2	Level	% Mod.		
Taxa A	Mana			

RE Channel 2		% Mod
Tone A	None	70 1000.
Tone B	None	
Tone C	None	
Tone D	None	
Tone E	None	
Tone F	None	
Tone G	None	
Tone H	None	
Tone I	None	
Tone J	None	
Pilot	None	
Composite w/o test tone	None	
Audio Test Tone	None	





System Setting

Channel 1, VF-5 port 1, TX Level Setting	-16
Channel 2, VF-5 port 2, TX Level Setting	-16
Channel 2, VF-5 port 1, TX Level Setting	-16
Channel 2, VF-5 port 2, TX Level Setting	-16
Channel 1, Voice Level Setting	0
Channel 1, Signalling Level Setting	-14
Channel 2, Voice Level Setting	-1
Channel 2, Signalling Level Setting	-14
TX Attenuator Setting	0
Amplifier Gain Setting (Potentiometer)	44.00
Far End Channel 1 RX AGC Setting	-13.57
Far End Channel 2 RX AGC Setting	-13.57

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Section 3. INSTALLATION

WARNING

ALL RFL 9508 TERMINALS ARE EQUIPPED WITH A PROTECTIVE COVER THAT EXTENDS ACROSS THE REAR OF THE CHASSIS. THIS COVER IS INTENDED TO PROTECT THE OPERATOR FROM POTENTIALLY HAZARDOUS VOLTAGES WHICH MAY BE PRESENT ON THE REAR-PANEL TERMINAL BLOCKS. THIS COVER MUST ONLY BE REMOVED BY QUALIFIED SERVICE PERSONNEL WHEN ACCESS TO THE REAR PANEL IS REQUIRED. IT MUST BE REPLACED BEFORE PLACING THE 9508 TERMINAL IN SERVICE.

3.1 INTRODUCTION

This section contains installation instructions for the RFL 9508, including unpacking, mounting, and interconnection wiring. Refer to Table 3-4 at the end of this section for a list of modules used in the RFL 9508.

3.2 UNPACKING

RFL 9508 equipment is supplied in sets of at least two chassis, which may be interconnected with other chassis or assemblies as part of a system. Paragraph 3.2.1 provides unpacking instructions for individual chassis, and paragraph 3.2.2 provides instructions for interconnected chassis.

3.2.1 INDIVIDUAL CHASSIS

RFL 9508 terminals supplied as individual chassis are packed in their own shipping cartons:

- 1. Open each carton carefully to make sure the equipment is not damaged.
- 2. After the chassis is removed from the carton, carefully examine all packing material to make sure no items of value are discarded.
- 3. Carefully remove any packing materials inserted into the chassis to hold circuit cards in place during transit.

3.2.2 INTERCONNECTED CHASSIS

RFL 9508 terminals ordered as part of a larger system may be interconnected with other chassis and mounted in a relay rack or cabinet, or on shipping rails for installation into a rack or cabinet at the customer's site. In such cases, the entire assembly is enclosed in a wood crate or delivered by air-ride van:

- 1. If the equipment is crated, carefully open the crate to avoid damaging the equipment.
- 2. Remove the equipment from the crate and carefully examine all packing materials to make sure no items of value are discarded.
- 3. Carefully remove any packing materials that were inserted into the individual chassis to hold circuit cards in place during transit.

3.3 MOUNTING

After unpacking, RFL 9508 equipment must be securely mounted, following the instructions in paragraphs 3.3.1 through 3.3.3.

3.3.1 INDIVIDUAL CHASSIS

RFL 9508 terminals housed in individual chassis have two mounting ears (one on each side). Hole sizes and spacings conform with EIA standards, so the RFL 9508 can be mounted in any standard 19-inch rack or cabinet. Complete mounting dimensions are shown in Figures 3-1 and 3-2.

CAUTION

ANY INSTALLATION USING AN ENCLOSED CABINET WITH A SWING-OUT RACK MUST BE SECURELY FASTENED TO THE FLOOR. THIS WILL PREVENT THE CABINET FROM FALLING FORWARD WHEN THE RACK IS MOVED OUTWARD



Figure 3-1. Mounting dimensions for 50W system, RFL 9508 Analog Single Sideband Powerline Carrier



Figure 3-2. Mounting dimensions for 100W system, RFL 9508 Analog Single Sideband Powerline Carrier

3.3.2 INTERCONNECTED CHASSIS INSTALLED IN RACK OR CABINET

Systems mounted in racks or cabinets at the factory are to be placed in position and then bolted to the floor or wall, as appropriate, to secure the equipment in place. The type of hardware used will depend upon the particular surface to which the rack or cabinet is being mounted. Because of this, mounting hardware is not supplied with the rack or cabinet.

3.3.3 INTERCONNECTED CHASSIS MOUNTED ON SHIPPING RAILS

Equipment to be installed in a rack or cabinet at the customer's site is mounted on shipping rails at the factory. To remove the shipping rails and mount the equipment, proceed as follows:

- 1. Place the equipment as close to the front of the rack or cabinet as possible, with the rear panels of the equipment facing the front of the rack or cabinet.
- 2. Remove all the screws securing the shipping rails to the equipment.
- 3. Slide the equipment into the rack or cabinet.
- 4. Install and tighten screws to all panels to secure the equipment in place

3.4 VENTILATION

The specified operating temperature range for RFL 9508 equipment is -20° C to $+65^{\circ}$ C (-4° F to $+149^{\circ}$ F). Operation at higher temperatures may affect system reliability and performance. Systems installed in enclosed cabinets should be ventilated to keep the temperature inside the cabinet within limits.

When installing the 100W system, there must be a 1U minimum space between the 6U chassis and the 3U chassis for convection cooling as shown in Figures 3-2 and 3-4.

CAUTION

DURING NORMAL SYSTEM OPERATION, THE SWITCHING OF RELAY CONTACTS CAN PRODUCE VOLTAGE SPIKES. THESE SPIKES CAN TRAVEL DOWN THE RELAY OUTPUT LEADS AND INDUCE CURRENTS IN OTHER LEADS. THESE INDUCED CURRENTS CAN RESULT IN FALSE TRIPS. TO REDUCE THIS POSSIBILITY, USE A SHIELDED TWISTED PAIR FOR EACH INPUT LEAD, AND GROUND THE SHIELD AT THE RFL 9508 CHASSIS ONLY. AS AN ADDED PRECAUTION, DO NOT BUNDLE INPUT, OUTPUT, AND POWER LEADS INTO THE SAME HARNESS, AND KEEP THEM AS FAR APART AS POSSIBLE

3.5 CONNECTIONS

Electrical connections are made to each RFL 9508 chassis through the terminal blocks and connectors on the chassis rear panel. The rear panel of a typical RFL 9508 terminal is shown in Figure 3-3 for a 50W system, and in Figure 3-4 for a 100W system. Paragraphs 3.5.1 through 3.5.10 provide basic descriptions of all the connections that must be made. Refer to the "as supplied" drawings furnished with your RFL 9508 for more detailed descriptions of the connections that must be made to your system.

3.5.1 MAKING CONNECTIONS TO TERMINAL BLOCKS

NOTE

Before making connections to terminal blocks, check the configuration of all rear panel modules. It is easier to configure the rear panel modules prior to connecting field wiring. The configuration of these modules usually requires the setting of programmable jumpers and DIP switches as described in paragraphs 5.2.1 and 5.2.2.

The terminal blocks on the rear of the RFL 9508 chassis are conventional screw-type barrier blocks. Wires can either be stripped or terminated in spade lugs, depending on local practice. To connect wires to the terminal blocks, proceed as follows:

- 1. Remove the transparent protective cover from the rear of the chassis by loosening the mounting screws and sliding the panel up and off of the standoffs holding it in place.
- 2. Using strippers, remove about 1/4 inch (10 cm) of insulation from the end of the wire to be connected.
- 3. If local practice calls for lugged wires, crimp a spade lug onto the stripped end of the wire.
- 4. Locate the terminal to which the wire is to be connected.

All terminals blocks are numbered. Terminal numbers appear on the rear panel, directly below the terminal block. Terminal block numbers are directly below the terminal numbers.

- 5. Using a screwdriver, turn the screw at that position counterclockwise until the wire or lug can be slipped underneath the screw head.
- 6. If the wire is lugged, slip the lug under the screw head. If lugs are not being used, use a pair of needle-nose pliers to bend the stripped end of the wire into a hook, and slip this hook under the screw head so that the hook surrounds the screw.
- 7. Using a screwdriver, turn the screw clockwise until tight to secure the wire in place.
- 8. Repeat steps 2 through 8 for all other wires to be connected.
- 9. Line up the mounting holes in the rear panel protective cover with the standoffs on the rear of the chassis, and push in and down on the protective cover until it is secured in place. Then tighten the mounting screws.

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NOTE All relay contacts are labeled in the de-energized position.

3.5.2 CONNECTIONS FROM/TO LINE COUPLING EQUIPMENT

For 4-Wire systems, the following connections are made between the RFL 9508 and the Line Coupling Equipment.

Signal Name	From	То
High Level Power Out	4W TX	Line Coupling Equipment
High Level Power In	Line Coupling Equipment	4W RX

For 2-Wire systems, the following connection is made between the RFL 9508 and the Line Coupling Equipment.

Signal Name	From	То
High Level Power I/O	2W I/O	Line Coupling Equipment

3.5.3 EXTERNAL CONNECTIONS FROM RF CHASSIS TO DIGITAL CHASSIS

The following connections must be made between the RF Chassis and The Digital Chassis.

Signal Name	From	То	
Low Level RX	RX OUT on RF Chassis	RX on MA-650	
Low Level TX	TX on MA-650	TX IN on RF Chassis	

3.5.4 EXTERNAL AMPLIFIER CONNECTIONS

In 50W systems, the External 50W Amplifier is not used. For this reason, connections are not made to the following three connectors at the rear of the RF Chassis.

Connector Label

EXT AMP IN EXT AMP OUT EXT AMP FAIL IN

3.5.5 ALARM OUTPUT CONNECTIONS

The user has the option to make the following Alarm output connections.

Type of Alarm	Chassis	
Internal Amp Fail	RF	
External Amp Fail (100W systems only)	RF	
Power Amp Power Supply Fail	RF	
Digital Chassis Power Supply	Digital	
TT Fail	Digital	

All alarm relays are normally energized.

WARNING

THE RFL 9508 CHASSIS MUST BE PROPERLY GROUNDED AS DESCRIBED IN THE FOLLOWING PARAGRAPH BEFORE ATTEMPTING TO CONNECT INPUT POWER. IMPROPER GROUND CONNECTIONS MAY RESULT IN SYSTEM MALFUNCTIONS, EQUIPMENT DAMAGE, OR ELECTRICAL SHOCK.

3.5.6 CHASSIS GROUND CONNECTIONS

A ground stud at the lower right rear of the RFL 9508 chassis is the main ground for the RFL 9508 terminal. This can be seen in Figures 3-3 and 3-4. Grounding is accomplished by connecting a wire 6AWG or larger between this ground stud and rack ground. The grounding wire should be kept as short and straight as possible, to keep its resistance and inductance to a minimum. At TB1-8 on the RF Chassis Mother Board Rear Panel a ground wire should be connected. Ideally this wire should go directly to the sub-station ground bar, if this is not feasible, shorting the wire to TB1-7 (Chassis ground) is an alternate method. This will cause surge currents to pass through the Mother Board and chassis before exiting to ground. Connecting directly to the sub-station ground bar is preferred.

Before attempting to make power connections, make sure the RFL 9508 terminal is equipped with a power supply designed to operate at the available input supply voltage. This can be determined by checking the model designator on the module handle. If an external power supply is being used, check the markings on the external power supply. If the wrong voltage is connected to the power supply, component damage will result.

3.5.7 FIBER OPTIC CONNECTIONS

If your RFL 9508 is equipped with Fiber Optic Modules, fiber optic connectors must be connected to the fiber optic heads on the rear panel of the 9508 chassis. Type ST series bayonet fiber optic connectors (or their equivalent) are used with both singlemode and multimode fibers. The exact mating connector used will depend upon the head that is installed in the fiber optic module, and the specific optic cable being used. When connecting fiber optic cables, make sure the connectors are properly aligned before tightening and then fully tighten them. This will help minimize losses in the connector.

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3.5.8 CONNECTIONS TO TRANSFER TRIP I/O MODULE

If your system has a Transfer Trip module, connections must be made to this module at the rear of the Digital Chassis. A typical 4-function Transfer Trip I/O module is shown in Figures 3-3 and 3-4.

3.5.9 CONNECTIONS TO A SECOND 50W AMPLIFIER

In 100W systems, a second 50W amplifier is used. In this configuration, connections must be made between the external (upper) 50W chassis, and the internal (lower) 50W chassis as shown in Figure 3-4.

Signal Name	From	То
EXT AMP FAIL	EXT AMP FAIL IN (on upper RF chassis)	EXT AMP FAIL IN (on lower RF chassis)
EXT AMP IN	EXT AMP IN (on upper RF chassis)	EXT AMP IN (on lower RF chassis)
EXT AMP OUT	EXT AMP OUT (on lower RF chassis)	TX IN (on upper RF chassis)

3.5.10 POWER CONNECTIONS BETWEEN DIGITAL AND RF CHASSIS

As shown in Figures 3-3 and 3-4, make the following power connections between the Digital Chassis and the RF Chassis:

<u>From</u> +RF of the Digital Chassis -RF of the Digital Chassis $\frac{\text{To}}{\text{V+}}$ of the RF Chassis V- of the RF Chassis

If your system has a second RF Chassis as shown in Figure 3-4, include the following power connections:

<u>From</u> V+ of the lower RF Chassis V- of the lower RF Chassis To V+ of the upper RF Chassis V- of the upper RF Chassis

3.5.11 STATION BATTERY CONNECTIONS

After all other connections have been made to the RFL 9508, station battery connections can be made. The station battery is connected to the terminal block on the right side of the Power Supply I/O as shown in Figures 3-3 and 3-4. Station battery positive goes to the "+" terminal and station battery negative goes to the "-" terminal. Depending on the dc-dc converter power supply installed in the chassis, either 48-Volt, 125-Volt, or 250-Volt station batteries can be used.

Refer to Tables 3-1 and 3-2 for Digital Chassis Power Supply terminal assignments.

Terminal Label	Description (Refer to Figures 3-2 and 3-3)
+ (+BAT)	Station battery positive. Voltage must match input requirements of power supply module.
- (-BAT)	Station battery negative. Voltage must match input requirements of power supply module.
+RF (+BAT)	For connection to RF chassis.
-RF (-BAT)	For connection to RF chassis.
-SB (SIG BAT)	For connection to an external signaling voltage source when signaling voltage is required by one or more channel modules. SIG BAT is normally jumpered to NEGATIVE BAT when the dc power voltage is the same as the desired signaling voltage. The SIG BAT input may also be connected to an external loop current generator. ⁽¹⁾
RG (RING GEN)	For connection to an external ring generator referenced to SIG BAT. Connect one side of the ring generator to the RING GEN terminal, and the other side to the SIG BAT terminal. ⁽¹⁾

Table 3-1. Digital Chassis Terminal assignments, input power terminal strip

1. To prevent damage to the equipment, the source connected to this input <u>must</u> be externally fused or currentlimited.

Table 3-2. Digital Chassis Terminal assignments, Alert and Alarm contacts terminal strip

Terminal Label	Description
ALERT NO	ALERT relay N.O. contact (normally-open).
ALERT COM	ALERT relay COM contact (common).
ALERT NC	ALERT relay N.C. contact (normally-closed).
ALARM NO	ALARM relay N.O. contact (normally-open).
ALARM COM	ALARM relay COM contact (common).
ALARM NC	ALARM relay N.C. contact (normally-closed).

Table 3-3. RF Chassis Terminal assignments, power connections and Alarm contacts

Terminal Label	Description
V+	Station battery input +
V-	Station battery input -
С	RF power supply fail relay COMMON contact.
NO	RF power supply fail relay NORMALLY OPEN contact. (Normally open with RF power supply ON)
NC	RF power supply fail relay NORMALLY CLOSED contact. (Normally closed with RF power supply ON)



Figure 3-3. Rear Panel Wiring Of Typical RFL 9508, 4W System, 50W Chassis



Figure 3-4. Rear Panel Wiring Of Typical RFL 9508, 4W System, 100W Chassis

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Figure 3-5. Rear panel wiring Of Typical RFL 9508 RT Remote Teleprotection Chassis

Module Description	Assy. Number	Located in Digital or RF Chassis?	Chassis location <u>F</u> ront or <u>R</u> ear	For Additional Information see Paragraph:
Power Supply	9547-840 9547-965	D	F	5.2.1.1, 8.11
Power Supply Alarm I/O	9547-18801, -04, -09	D	R	5.2.1.3, 8.12
CM4 Module	9547-15886	D	F	5.2.1.4, 5.3.1.1, 8.1
VF-5XP	107635	D	F	5.2.1.6, 5.3.1.4, 8.4, Section 11
PLC-TT Module	105720-2	D	F	5.2.1.8, 5.3.1.6, 8.6, Section 11
Test Panel	106190	D	F	5.2.1.10, 8.10
Transceiver	107830	D	F	5.2.1.11, 5.3.1.8, 8.8
MA-271 I/O	107295	D	R	5.2.1.5, 5.3.1.2, 8.2
MA-278 I/O	107475	D	R	5.2.1.5, 5.3.1.2, 8.2
Optical I/O	107455-201 to -601	D	R	5.2.1.5, 5.3.1.3, 8.3
MA-301B (VF-5XP Module Adapter)	9547-16354	D	R	5.2.1.7, 5.3.1.5, 8.5
PLC-TT Module Adapter	105740-2 to -5 105770-2 to -5	D	R	5.2.1.9, 5.3.1.7, 8.7
MA-650 (Transceiver Module Adapter)	107640	D	R	5.2.1.12, 5.3.1.9, 8.9
Digital Motherboard	105590-2	D	Center	8.13
50W Power Amp	105085	RF	F	5.2.3.1, 5.3.2.1, 7.1
Tx Filter	107825	RF	F	5.2.3.2, 5.3.2.2, 7.3
Balance Board	107815	RF	F	5.2.3.3, 5.3.2.3, 7.4
External Amp Connection Board	107870	RF	F	7.5
Line Board	103090, 103090-1	RF	F	5.2.3.4, 5.3.2.4, 7.6
Attenuator	107810	RF	F	5.2.3.5, 5.3.2.5, 7.8
Rx Filter	107820	RF	F	5.2.3.6, 5.3.2.6, 7.7
RF Mother Board	103095	RF	R	5.2.3.8, 7.9
Power Amplifier Power Supply	107250-4, -5	RF	R	5.2.3.7, 7.2

Table 3-4. RFL 9508 modules, general information

Section 4. RFL NETWORK MANAGEMENT SOFTWARE

4.1 GENERAL INFORMATION

The RFL NMS is a software program which uses the Microsoft Windows operating system. It enables the user to perform several different tasks related to the RFL 9508 when in a network configuration. A brief description of these tasks is listed below. A more detailed description of how these tasks can be implemented is discussed later in this section.

- 1. Enables the user to communicate with all 9508 terminals located in a network.
- 2. Enables the user to communicate with all intelligent channel cards located in each 9508 chassis.
- 3. Enables the user to view a graphical picture of the network from any node.
- 4. Enables the user to access information regarding the configuration of any node in the network.
- 5. Enables the user to customize the software for specific requirements.
- 6. Enables the user to change card parameters in real time.
- 7. Enables the user to perform network troubleshooting and maintenance.
- 8. Enables the user to set up RFL 9508 RF parameters.

4.1.1 SYSTEM REQUIREMENTS

In order to use the Network Management Software (NMS) your PC must meet the following minimum requirements:

- 1. The PC must be IBM compatible with a hard disk drive and a CD ROM drive.
- 2. The PC must use an Intel Pentium microprocessor or higher.
- 3. The PC must have a minimum of 8MB of RAM (16MB of RAM preferred).
- 4. The PC must have Windows 98, 2000, NT, or XP.
- 5. The hard disk must have at least 40 megabytes of free disk space for the Network Management Software (NMS)

4.2 SOFTWARE INSTALLATION

This section describes how the NMS and PLC software is installed into your PC. The following procedure can also be used to install updated NMS or PLC programs into your PC as they are released. Before attempting to install the software into your PC, there are some important facts that must be considered:

- 1. The software is shipped from the factory on one CD, labeled "SW2020NMxxx", where xxx can be 001 to 999.
- 2. Before loading the software make a working copy of the CD. Store the original CD in a safe place, and use the working copy to load the software into the PC.
- 3. Before installing the software, it is recommended that you run CHKDSK or SCANDISK to verify that no problems exist on your hard disk, and to verify available disk space. You will need about 40 megabytes free for a complete installation.
- 4. As you are installing the software, several lists of choices will appear on the screen; the exact lists displayed will depend on whether you are installing the software for the first time or replacing an existing version. Read the instructions below each list carefully before making your choice.
- 5. If this is a new installation, proceed as described in paragraph 4.2.1.

CAUTION

If you are upgrading to a new RFL NMS version, un-install the old RFL NMS version as described in paragraph 4.2.2, install the new RFL NMS version as described in paragraph 4.2.1, and then use the "Update Config in Memory to New Version" option as described in Help.

4.2.1 INSTALLING THE NMS SOFTWARE

(The Installation Software for the NMS is: setup.exe)

- 1. Insert the CD into the CD ROM drive.
- 2. Check to see if there is a readme.txt file in the root directory of the CD. If there is, it may contain more up to date instructions for installing the software.
- 3. In most cases, a setup window will appear on the screen. If not, do the following:
 - a. From the Start Menu, select Run.
 - b. The Run window will appear on the screen.
 - c. Type the following in the command line: d:\setup.exe
 - d. Then click on OK.
- 4. Click on Next to continue with the setup.
- 5. From this point on the Installation Software will prompt you to enter the information it needs to install the software into your system. When the installation is complete, the RFL NMS 10.6 PLC Icon will be displayed in the Program Manager window.
- 6. This completes the installation of the RFL NMS Software.

After the installation is complete, your desktop will be similar to the one shown in Figure 4-1. This window is the starting point for running the RFL NMS Software. To run the RFL NMS Software double click on the RFL NMS 10.6 PLC Icon on your desktop, or go to the Start menu and select Programs/RFL NMS 10.6 PLC. Refer to paragraph 4.4 for information on how to use the Network Management Software. Refer to paragraph 4.5 for an example showing how to configure a typical network using the Network Management Software. Refer to paragraph 4.6 for information on the Network Management Software help screens.



Figure 4-1. Typical desktop showing the RFL NMS 10.6 PLC Icon

4.2.2 UN-INSTALLING THE NMS SOFTWARE

If for any reason you want to remove the RFL NMS Software from your computer system, go to the Start menu and select Programs/RFL NMS/Uninstall RFL NMS. This will cause the Uninstall program to permanently erase all of the programs, icons, directories and files related to the RFL NMS Network Management Software from your hard drive.

NOTE

If you want to save the existing nine network configuration files which are listed below, copy these files to a diskette prior to using the un-install program. Otherwise they will be lost. Then copy the diskette files to the new network management directory after installing the new version of the Network Management Software.

name.ALR	The log of alarms for that network
name.NET	Network information (name, date, communication path)
name.NOD	Information on each node in the network
name.SLT	The cards in each node
name.VAL	The settings of each card
name.EVT	The log of sequence of events for that network
name.TSC	The settings of ethernet port
name.FPT	The table memo file
4.3 CONNECTING YOUR PC TO THE NETWORK

In order to use the Network Management Software your PC must be connected to a node in the network. There are two ways a user can do this. A direct connection can be made using an RS-232 cable as shown in Figure 4-2, or a remote connection can be made over a public or private phone line as shown in Figure 4-3. The user activates a Com Port connection and sets the baud rates of the PC and the CM4 to the same value. The minimum suggested baud rate is 9600. The construction of a typical RS-232 cable can be seen in Figure 4-4. The communication cable must be less than three meters in length or must be shielded to meet SWC requirements.



Figure 4-2. PC directly connected to a node using an RS-232 cable



Figure 4-3. PC connected to a node from a remote location



Figure 4-4. Construction of a typical RS-232 cable between the PC and an MA-650

Figure 4-5 shows a PC at a remote location connected to 4 nodes through a Public Switched Telephone Network. Each of the four nodes is connected via a different communication path.

Figure 4-6 shows a PC at a remote location connected to 2 nodes, where all nodes are in the same network. The nodes communicate Network Management configuration information via the Facility Data Link.



Figure 4-5. PC at a remote location connected to 4 nodes, where each node is a different network



Figure 4-6. PC at a remote location connected to 2 nodes, where all nodes are in the same network

4.3.1 NETWORK COMMUNICATION PATH

Each node in a network is connected to another node, allowing communication to pass from one node to another. The communication path must have a beginning and an end as shown in Figure 4-7. Each box represents a node in the network. When using the Network Management Software, the PC can be connected to any node in the network.



Figure 4-7. Typical network and communication path

4.4 USING THE NETWORK MANAGEMENT SOFTWARE ICONS

To enter the Network Management Software, double click on the RFL NMS 10.6 PLC Icon on your desktop. Then enter your user ID and password in accordance with paragraph 4.8. This will bring you to the Main window as shown in Figure 4-8. This window has eighteen functions which correspond to the Icons listed below.



Figure 4-8. Network Management Software Main Window

	<u>Icon</u>	Function
1.	New	Allows the user to create a new network file to enable the configuration of a network yet to be installed.
2.	Open	Allows the user to open an existing network file for the purpose of altering the file or to download the file to a network.
3.	Save	Allows the user to save a network file.
4.	Exit	Allows the user to exit the Network Management Software.
5.	Modify NMS Setup	Allows the user to select the communication path(s), parity, baud rate, and connection type (direct or phone)
6.	Net Vw	Network View provides the user with a graphical representation of the network. The nodes are shown as boxes and the connections are shown as lines. Each node has a site name and address which are also displayed.
7.	Cn Vw	Connection View provides a table view of all possible connections in a network. It provides the user with the information required to assign time slots to channel cards and modules.
8.	NMS Status	Provides the user with information about the network file setup.
9.	Reports	Allows the user to view network reports.
10.	Help	Provides the user with Network Management Software help.
11.	Play Macro	Allows a user to play a macro which has been previously recorded and edited. To play a macro the user selects the Play Macro icon on the main screen then selects the macro by name, and it runs. This function can only be used in real time mode. More information on Play Macro can be found later in this section.
12.	Read Net	Read Network causes the network to be read to a file. This function can only be used in batch mode.
13.	Write Net	Write Network causes a file to be written to the network. This function can only be used in batch mode.
14.	Alarms	Allows the user to gather alarm data and then go to Reports to view the alarm data. This function can only be used in batch mode, however, an autopolling option is available in real time mode. More information on auto polling can be found later in this section.

15. Events	Causes the Sequence Of Events buffer to be read by the Network Management Software and allows the user to view or print the Sequence Of Events buffer.
16. Terminal	Causes the software to enter Terminal Emulation mode.
17. Real Time	Allows a user to change the configuration parameters of any card in the network in real time which means that any change that is made will be written to the network immediately. Real time mode is used when you have only a few (1 or 2) changes to make in the network.
18. Batch	Allows a user to change the configuration parameters of all nodes in the network or of just one node in the network in one operation. The change does not take place immediately. The user must select either a network write or an individual node write in order to implement the change. NOTE: Batch is the default mode.

4.5 EXAMPLE OF CONFIGURING A NETWORK

4.5.1 INTRODUCTION

This section contains an example of how to configure a new network using the Network Management Software. The example gives step by step instructions showing all windows and settings. The information provided here will enable you to configure more advanced networks to suit your own requirements.

4.5.2 STEPS REQUIRED TO CONFIGURE A NETWORK

		See paragraph
1.	Setup the hardware at each node including all cards, modems and cables as required.	4.5.3.1
2.	Connect the PC or laptop to the network either directly or remotely using a modem.	4.5.3.2
3.	Start the RFL Network Management Software from the desktop.	4.5.3.3
4.	Select NEW to start a new configuration. Complete the network setup screen. Enter all communication path information.	4.5.3.4
5.	Select the READ option. Then select Auto-configuration Method 3.	4.5.3.5
6.	Select Network View.	4.5.3.6
7.	Enter Display/Change Node window. For each node, add cards, settings for all cards.	4.5.3.7 thru 4.5.3.10
8.	Set up RF Parameters	4.5.3.11
9.	Enter Network View window. Connect lines to nodes.	4.5.3.12
10.	Use Network Write to configure the cards. When the writing is done the program will return to the main menu.	4.5.3.13
11.	View Network Reports.	4.5.3.14
12.	Use Poll For Alarms to look for errors.	4.5.3.15 thru 4.5.3.16
13.	Save Settings in a file	4.5.3.17

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4.5.3 GETTING STARTED

Figure 4-9 shows a simplified drawing of the network that will be used for this example. Figure 4-10 shows a more detailed drawing of the network showing all RFL 9508 components, modules, cards and cables used in the network example.



Figure 4-9. Basic drawing of the network used in the example

The network used in this example has 2 nodes, node 1 and node 2, each with one terminal end 9508. Voice frequency and transfer trip circuits are established between the nodes using VF-5XP and PLC-TT modules respectfully. Table 4-1. lists the modules and cards in each node that must be configured into the network.

Node 1 (Terminal)	Node 2 (Terminal)
CM4	CM4
VF-5XP	VF-5XP
PLC-TT	PLC-TT
Transceiver	Transceiver
9508 Terminal	9508 Terminal



Figure 4-10. RFL 9508 Network Example

4.5.3.1 SETTING UP THE HARDWARE

Since this is an example, we will not be setting up actual hardware. However, you should study Figure 4-10 carefully to familiarize yourself with which modules plug into which chassis, with the cabling at each node, and with the settings of the cards at each node. Set up all intelligent cards for "remote" mode. Refer to Sections 14 through 19 of the IMUX 2000 Instruction Manual for Instruction Data sheets for IMUX cards beyond the PLC-TT and VF-5XP.

Note that each channel module that plugs into the front of the 9508 chassis has a module adapter associated with it, which plugs into the rear of the chassis. For example, the 9508 chassis at node one has the following two channel modules plugged into the front of the chassis: the VF-5XP, and the PLC-TT. The MA301B is the module adapter for the VF-5XP, and the PLC-TT I/O is the module adapter for the PLC-TT. The Transceiver and the CM4 are not channel modules, but do have a common module adapter which is the MA-650.

4.5.3.2 CONNECTING THE PC TO THE NETWORK

The next step is to connect your PC to the network. It can be connected to any node, and can be either directly connected with an RS-232 cable, or remotely connected over a public or private phone line using a modem. In this example we will connect the PC directly to node 1. Connect one end of the RS-232 cable to the communication port at the rear of your PC and connect the other end of the cable to the Craft Connector of the MA-650 module adapter at the rear of the 9508 chassis at node 1. See Paragraph 4.3 for more information related to the RS-232 cable.

4.5.3.3 STARTING THE NETWORK MANAGEMENT SOFTWARE

To start the Network Management Software, click on the NMS 10.6 PLC Icon on your desktop. Then enter your user ID and password in accordance with paragraph 4.8.1. This will bring you to the Main window as shown in Figure 4-11. See paragraph 4.4 for information regarding this window.

4.5.3.4 STARTING A NEW NETWORK CONFIGURATION

Since this is a new network configuration, you should click on the NEW Icon. This will bring you to the Edit Network Information window as shown in Figure 4-12. Enter the network name, created by, and comments at the top of the window. This information is optional and does not have to be entered.

Note that this window has the following default values entered for communication path 1: baud rate = 9600, data bits = 7, parity = 2, stop bits = 1, connection type = direct. All of these default values can be used for this example with the exception of the parity bit. You must change the parity bit shown in the window from 2 to 0, since the values shown in the window must match the values that the Remote Port operates at. Also make sure that the CM4 at node 1 is set to 9600 baud, and that its parity is space.

<< text continues on page 4-20 >>



Figure 4-11. Network Management Software Main window

rier vetwork Coupled Edit Sector Point Point Peter	IMUX 2000 NM5 : *new*		_D×
Created: 04/05/200E 16:15:08 Saved: 7 / Comm. Path> One Two Connection: Com1 None Baud rate: 9600 9600 Data bits: 7 7 Parity: 2 2 Stop bits: 1 1 Connect Type: Direct Direct Phone#: One 0k Connect String: It It It It 0k Cancel It It Version 10.6 Version 10.6	Retwork Couput Ealt Setup Administration	Time:	
INVION 2000 - INCLUSION INITIALIAGE Initial Content Version 10.6	Created: Comm. Path> Connection: Baud rate: Data bits: Parity: Stop bits: Connect Type: Phone#: Connect String: (use {Site ID} for multi-co Network Grid:	Image: second	
	Network Name (optional)		

Figure 4-12. Edit Network Information Window

There are two network grids and a network list available. The 8 x 11 grid has more spaces available, but screen updates take time. The 4 x 10 grid has less spaces available, but screen updates are quicker. You can switch from the 4 x 10 grid to the 8 x 11 grid at any time.

Since this example has only 2 nodes, you can select the 4 x 10 network grid at the bottom of the window. The grid that is selected will be highlighted light gray. A phone number is not required in this example since we are directly connected to node 1. A connect string is not required in this example since we are not using a substation switch (such as an RFL 9660). You can now click on OK to return to the main window.

NOTE

In this example the PC is directly connected to Node 1 as shown in Figure 4-10. This connection is shown in more detail in Figure 4-2. Since this is a direct connection, "Direct" is selected in Figure 4-12, and the Phone# and Connect String boxes are left blank.

4.5.3.5 SELECTING NETWORK READ

From the Main window, select the Network Read Icon. This will open a sub-window asking you which communication path(s) to read from, as shown in Figure 4-13. This window has a default for communication path 1, which is correct for this example. You must select the node number that you are physically connected to in the pull down menu shown in Figure 4-13. The "ALL" option should not be used in RFL 9508 systems. Click on Auto-configuration. This will bring you to the Auto-Configure Options window as shown in Figure 4-14. The Auto-Config Option, Method 2 will allow the user to "build" a new network. It will automatically read the current network setup which consists of the nodes, the cards and modules at each node, and either the factory default or user assigned configuration settings of each card and module. Click on Method 2. Then click on OK to read the network.

NOTE

Method 1: NOT used with RFL 9508 systems.

Selecting Method 2 will delete information about the <u>cards</u> in the selected node, and then it will read all the information of the network.

Method 3: NOT used with RFL 9508 systems.

At 57.6K baud it takes about two and one-half minutes to read each node in the network. In this example, if we were actually reading the network, it would take about five minutes to read the network. While the network is being read, two pop-up windows will get superimposed over the window shown in Figure 4-13. One of these will be a Communications window and the other will be an Auto Cfg/Nodes window.

The network is read into a temporary file which contains the following information:

- 1. The shelf address of each node in the network (1-500 for CM4)
- 2. The cards that are in each node
- 3. The card configuration settings (either default settings, or user assigned settings at the time of hardware installation)

Before the user leaves the Network Management Software, the network configuration information must be saved in a network file with a .NET extension in the form of netname.NET, where netname is selected by the user. If this is not done, the network configuration information will be lost. A description of how to do this will be described later in this Section.

After the network read is complete you will be returned to the main window.



Figure 4-13. Read Network Setup Window

NOTE

When reading a new network configuration into memory the Network Management Software should be in batch mode since all settings must be read for all nodes. After the network has been read you can change the setting to real time mode. This will allow you to change the configuration parameters of any card in the network in real time, which will nominally take under 30 seconds.



Figure 4-14. Auto-Configure Options Window

4.5.3.6 SELECTING NETWORK VIEW

The Network View window is the first window in a set of several windows that tells the user what nodes are in the network. The information in these windows was read from the network and stored in a temporary file. The Network View window is where the user can configure card and module settings. You get to the Network View window by clicking on the Network View Icon. If this network example actually existed, and the network was read as described in paragraph 4.5.3.5, a Network View window similar to the one shown in Figure 4-15 would be seen. To make changes to the card settings, first click on the <u>C</u>hange button at the bottom left of the window and then click on node 1 which is located at the upper left of the Network View window. This will bring you to the Display/Change Node window for node 1 as shown in Figure 4-16.

IMUX 20 File Netwo	100 NMS : demo rk Output Edit Se	tup Admin Use	Help					
	***Network Desig							
	1:Node 1 Term	2:M Tex	lode 1 m					
		<u>A</u> dd Node	Delete Node	<u>M</u> ove Node	Add <u>L</u> ine	<u>R</u> emove Line	Print Exit	
				Version 10.6	;			_
Select here to	Change (1:Node	:1)						

Figure 4-15. Network View Window

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4.5.3.7 THE DISPLAY/CHANGE NODE WINDOW

The Display/Change Node window shown in Figure 4-16 is entered from the Network View window as described in the previous paragraph. As its name implies, the Display/Change Node window has two main functions. First, it displays the node number, node address, IP address, communication path used, node type, common module types, and a list of all cards and modules at the node. In addition to this the user can enter a Site ID name at the top of the window. Its second function is to allow the user to change card settings by going into a sub-window for each card or module, and allows the user to enter "RF Setup". This button brings up the RF Setup section of the software, and is where a user tunes the Tx and Rx filters in the Transceiver module.

To view the settings of the CM4, click on the CM "TERM" button. This will bring you to the CM4 Configuration and Status window as shown in Figure 4-17.

demoIMUX 2000 NMS File Network Output Edit Setup	Admin Use Help	
New Oper New Oper CRC4 1:TEF * 0K FROM CM4P 1:TEF * 0K FROM CM4P CHAN 1:TEF * 0K FROM CM4P CHAN 1:TEF * 0K FROM CHAN 1:TEF	Node #: 1 Address: 1 Address: 1 Pass through port 1 Comm Path: 0 0 0 Comm Path: 0 0	
Ľ	READ Hit any key to pause or stop	
IN Enter site name here (20 characters	/IUX 2000 - Network Management Version 10.6	

Figure 4-16. Display/Change Node window for node 1

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4.5.3.8 CM4 CONFIGURATION AND STATUS WINDOW

The CM4 Configuration and Status window is shown in Figure 4-17. This is where the user can view or change CM4 settings. The user can change parameters by making selections in the pull down boxes. The following discussion covers the settings on the CM4 module.

		4 🔄 🦕	
Node 1 (Shelf Address 1): CM4R (Config (TERM) X	Node 1 (Shelf Address 1) General Curr-Counter): CM4R Status (TERM) Accu-Counter Redundancy
Frame Type Line Code	FRAMING=CAS CODE=HDB3	Shelf Status	SHELF NORMAL
T1/E1 Type Fast Reframing	FRAMER=E1 OFF	Fallback Timing	FTIME=INT (FALLBACK TIMING)
Primary Timing INT _ CSU Mode RFL _	INT RFL	Payload Loopback	Not Active
Pre-Squeich (ms) DISA] DISA DISA	Line Loopback Equipment Loopback	Not Active Not Active
I/O Type (CMI, ohm)	120		
Time Use PC Time	4-18-04		
Card Read Write	All Pages 💌 🛛 Exit		

Figure 4-17. CM4 Configuration And Status Window

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CM4 Configuration Settings:

1. Frame Type

For T1 systems the frame type can be set to SF (Superframe) or ESF (Extended Superframe). For the 9508 this should be set to ESF. For E1 systems the frame type can be set to CCS (Common Channel Signaling) or CAS (Channel Associated Signaling). For the 9508 this should be set to CAS.

2. Line Code

For T1 systems the line code can be set to AMI (Alternate Mark Inversion) or B8ZS (Bipolar with 8-Zero Substitution).For the 9508 this should be set to B8ZS. For E1 systems the line code can be set to AMI (Alternate Mark Inversion) or HDB3 (High Density Bipolar of order 3).For the 9508 this should be set to HDB3.

3. T1/E1 Type

The 9508 can be set to T1 system type or E1 system type. For T1 systems this should be set to T1. For E1 systems this should be set to E1.

4. Fast Reframing

Fast reframing can be set to ON or OFF. In normal operation fast reframing should be set to OFF

5. Primary Timing

Primary timing can be set to Internal, Loop, or Thru. In normal operation primary timing should be set to Loop.

6. CSU Mode

CSU mode can be set to RFL, ANSI or ATT. In normal operation CSU should be set to RFL

7. Pre-Squelch (ms)

The pre-squelch timer can be set to: DISA, 0, 0.66, 1.3, 2.0, 2.7, 3.3, 4.0, 4.6, 5.3, 6.0, 6.6, 7.3, 8.0, 8.6, or 9.3. In normal operation the pre-squelch timer should be set to DISA (Disabled).

8. Post Squelch (ms)

The post-squelch timer can be set to: DISA, 0, 0.66, 1.3, 2.0, 2.7, 3.3, 4.0, 4.6, 5.3, 6.0, 6.6, 7.3, 8.0, 8.6, or 9.3. In normal operation the post-squelch timer should be set to DISA (Disabled).

9. I/O Type (CMI, ohm)

The I/O type can be set to CMI or Ohm. For the 9508 the I/O type should be set to 100 (100 Ohms electrical interface).

10. Line LPBK

For normal operation the line loopback should be set to OFF.

11. Payload LPBK

For normal operation the payload loopback should be set to OFF.

12. Equipment LPBK

For normal operation the equipment loopback should be set to OFF.

13. Main ON/OFF

For normal operation the Main CM4 should be set to ON.

14. Alert at Standby

If there is a redundant common Module, Alert at Standby should be set to ON

15. Switch Control

Switch control can be set to Auto, Main or Standby. For normal operation, Switch Control should be set to Auto.

16. Swap Timer (seconds)

Swap Timer can be set to: 0.6, 1.2, 2.4, 4.8, 9.6, or 19. For normal operation, Swap Timer should be set to 1.2 seconds.

17. Clear Counters

For normal operation, Clear Counters should be set to OFF (box not checked).

18. Clear Chan Config

For normal operation, Clear Channel Configuration should be set to OFF (box not checked).

19. Clear DACS Config

For normal operation, Clear DACS Configuration should be set to OFF (box not checked).

20. Clear ILS Config

For normal operation, Clear ILS Configuration should be set to OFF (box not checked).

21. Local SNMP Trap

For normal operation, Local SNMP Trap should be disabled (box not checked).

22. Remote SNMP Trap

For normal operation, Remote SNMP Trap should be disabled (box not checked).

When finished with either viewing or changing the CM4 settings, click on <u>Exit</u> to return to the Display/Change Node window as shown in Figure 4-16. To view the settings of the VF-5XP card, first click on VF-5XP and then click on <u>V</u>iew. This will bring you to the Configuration and Status window for the VF-5XP card as shown in Figure 4-18.

4.5.3.9 VIEW OR CHANGE A CARD WINDOW FOR THE VF-5XP

The View or Change a Card Window for the VF-5XP is shown in Figure 4-18. The user can change parameters by making changes in the control boxes. The actual values appear immediately to the right of the control boxes. Refer to the VF-5XP Instruction Data sheet in Section 16 of the IMUX 2000 instruction manual for additional information on the VF-5XP module. The following discussion covers the settings on the VF-5XP module.





VF-5XP Configuration Settings:

1. In/Out of Service

The VF-5XP can be set to be In Service, or Out Of Service. For the VF-5XP module to be in service, select ON (Service ON). For the VF-5XP module to be out of service, select OFF (Service OFF).

2. Time Slot

The Time Slot can be set from 1-24 for T1 systems and from 1-31 for E1 systems. Click on the desired time slot in the pull down box to make the selection.

3. Chan 1 ON/OFF

Channel 1 can be set to ON or OFF. When set to ON, Channel 1 is enabled (ON). When set to OFF, Channel 1 is disabled (OFF).

4. Bus Direction

The Bus Direction can be set to TXA or TXB. When set to TXA, Channel 1 transmits in the A direction and receives from the B direction. When set to TXB, Channel 1 transmits in the B direction and receives from the A direction. In a typical RFL9508 system, this is set to TXA.

5. Tx1 Level Adjust Sign

The Tx1 Level can be set from -23dBm to +10dBm in 0.5dBm steps. First select the sign by clicking on the (+ or -), then select the level as described in step 6 below

6. Tx1 Level Volume (dB)

The Tx1 Level can be set from -23dBm to +10dBm in 0.5dBm steps. Select the level by clicking on the level you want, in the pull down box

7. Rx1 Level Adjust Sign

The Rx1 Level can be set from -31.5dBm to +10dBm in 0.5dBm steps. First select the sign by clicking on the (+ or -), then select the level as described in step 8 below

8. Rx1 Level Volume (dB)

The Rx1 Level can be set from -31.5dBm to +10dBm in 0.5dBm steps. Select the level by clicking on the level you want, in the pull down box

9. Chan 1 Signaling

When set to enabled, Chan 1 Signaling is active (in use). When set to disabled, Chan 1 Signaling is inactive (not in use).

10. Chan 1 Busy/Not Busy

The Chan 1 Busy/Not Busy parameter allows the user to activate or deactivate the Busy function by selecting Busy, or Not Busy.

11. Chan 1 1kHz Test Tone

The Chan 1 1kHz Test Tone can be turned On by selecting Enable, or turned Off by selecting Disable.

12. Chan 1 Loopback

In normal operation, all loopbacks are disabled. Loopback settings are used for troubleshooting purposes. There are three loopback settings as follows: None (disable all loopbacks), Local (enable local loopback), Remote (enable remote loopback).

13. Chan 2 ON/OFF

Channel 2 can be set to ON or OFF. When set to ON, Channel 2 is enabled (ON). When set to OFF, Channel 2 is disabled (OFF).

14. Tx2 Level Adjust Sign

The Tx2 Level can be set from -23dBm to +10dBm in 0.5dBm steps. First select the sign by clicking on the (+ or -), then select the level as described in step 15 below.

15. Tx2 Level Volume (dB)

The Tx2 Level can be set from -23dBm to +10dBm in 0.5dBm steps. Select the level by clicking on the level you want, in the pull down box.

16. Rx2 Level Adjust Sign

The Rx2 Level can be set from -31.5dBm to +10dBm in 0.5dBm steps. First select the sign by clicking on the (+ or -), then select the level as described in step 17 below.

17. Rx2 Level Volume (dB)

The Rx2 Level can be set from -31.5dBm to +10dBm in 0.5dBm steps. Select the level by clicking on the level you want, in the pull down box.

18. Chan 2 Signaling

When set to enabled, Chan 2 Signaling is active (in use). When set to disabled, Chan 2 Signaling is inactive (not in use).

19. Chan 2 Busy/Not Busy

The Chan 2 Busy/Not Busy parameter allows the user to activate or deactivate the Busy function by selecting Busy, or Not Busy.

20. Chan 2 2kHz Test Tone

The Chan 2 2kHz Test Tone and be turned On by selecting Enable, or turned Off by selecting Disable.

21. Chan 2 Loopback

In normal operation, all loopbacks are disabled. Loopback settings are used for troubleshooting purposes. There are three loopback settings as follows: None (disable all loopbacks), Local (enable local loopback), Remote (enable remote loopback).

When finished with either viewing or changing the VF-5XP settings, click on <u>E</u>xit to return to the Display/Change Node window as shown in Figure 4-16 To view the settings of the PLC-TT card, first click on PLC-TT and then click on <u>V</u>iew. This will bring you to the View or Change a Card window for the PLC-TT card as shown in Figure 4-19.

4.5.3.10 VIEW OR CHANGE A CARD WINDOW FOR THE PLC-TT

The View or Change a Card window for the PLC-TT is shown in Figure 4-19. This is where the user can view or change PLC-TT settings. The "Actual" column is what the PLC-TT module is actually set to, and the "Set to" column contains settings the user can change. The following discussion covers the settings on the PLC-TT module.

g View or Change a Lard		Setup				
		C Performance				
hannel: C5 <u>Card</u> TT		O <u>A</u> ll			Play Macro	
		🔿 Char <u>t</u>			- Z	
Type Description	Set to	/	Actual		→ 一般 F Bood	
Setting : In/Out of Service	ON		ON	_	-rieau	
Setting : Func 1 triphold timer(ms)	0.50		0.50		N	
Setting : Func l pretrip timer (ms)	0.50		0.50		A F	
Setting : Func 1 output polarity	NORMAL		NORMAL		write	
Setting : Func 1 unblock enable	DISABLE		DISABLE			
Setting : Func 2 triphold timer(ms)	0.50		0.50			
Setting : Func 2 pretrip timer (ms)	0.50		0.50		Alarms	
Setting : Func 2 output polarity	NORMAL		NORMAL	s		
Setting : Func 2 unblock enable	DISABLE		DISABLE	c		
Setting : Func 3 triphold timer(ms)	0.50		0.50	а	EVENTS	
Setting : Func 3 pretrip timer (ms)	0.50		0.50	n		
Setting : Func 3 output polarity	NORMAL		NORMAL			
Setting : Func 3 unblock enable	DISABLE		DISABLE		Terminal	
Setting : Func 4 triphold timer(ms)	0.50		0.50			
Setting : Func 4 pretrip timer (ms)	0.50		0.50			
Setting : Func 4 output polarity	NORMAL		NORMAL	•		
Licking a setting will retrieve the actual values. Chan	ges are immediate	e. Exit		5	Batch	
<u>Herresh</u> <u>Comm Prer.</u> <u>Macro.</u>				<u> </u>		
<u>11</u>				·	_	
IMUX 2	000 - N	Jetwork	Mana	nement		
	000 .		mana	gomom	•	
	1	ersion 10.6				

Figure 4-19. View or Change a Card Window for the PLC-TT

1. Date and Time

The Date and Time can be set in the format shown in the following example: 04/06/04 01:10:55 The module uses this date and time to "time stamp" SOE events

2. In/Out of Service

The PLC-TT module can be set to be In Service, or Out Of Service.

For the PLC-TT module to be in service, select ON (Service ON).

For the PLC-TT module to be out of service, select OFF (Service OFF). Service OFF turns the whole card OFF.

3. Func 1 triphold timer (ms)

When a trip is received, it will extend the trip by the time selected. The Function 1 triphold timer can be set from 0.00ms to 64.00ms in 0.25ms increments. Select the triphold timer value that you want from the pull down box.

4. Func 1 pretrip timer (ms)

The Function 1 pretrip timer can be set from 0.00ms to 4.00ms in 0.25ms increments. Select the pretrip timer value that you want from the pull down box.

5. Func 1 output polarity

The Function 1 output polarity can be set to normal or inverted.

6. Func 1 unblock enable

The Function 1 unblock enable can be set to enable or disable. When set to enable, if you lose communication for 20ms, the trip output will go active for 150ms.

7. Func 2 triphold timer (ms)

The Function 2 triphold timer can be set from 0.00ms to 64.00ms in 0.25ms increments. Select the triphold timer value that you want from the pull down box.

8. Func 2 pretrip timer (ms)

The Function 2 pretrip timer can be set from 0.00ms to 4.00ms in 0.25ms increments. Select the pretrip timer value that you want from the pull down box.

9. Func 2 output polarity

The Function 2 output polarity can be set to normal or inverted.

10. Func 2 unblock enable

The Function 1 unblock enable can be set to enable or disable. When set to enable, if you lose communication for 20ms, the trip output will go active for 150ms.

11. Func 3 triphold timer (ms)

The Function 3 triphold timer can be set from 0.00ms to 64.00ms in 0.25ms increments. Select the triphold timer value that you want from the pull down box.

12. Func 3 pretrip timer (ms)

The Function 3 pretrip timer can be set from 0.00ms to 4.00ms in 0.25ms increments. Select the pretrip timer value that you want from the pull down box.

13. Func 3 output polarity

The Function 3 output polarity can be set to normal or inverted.

14. Func 3 unblock enable

The Function 3 unblock enable can be set to enable or disable. When set to enable, if you lose communication for 20ms, the trip output will go active for 150ms.

15. Func 4 triphold timer (ms)

The Function 4 triphold timer can be set from 0.00ms to 64.00ms in 0.25ms increments. Select the triphold timer value that you want from the pull down box.

16. Func 4 pretrip timer (ms)

The Function 4 pretrip timer can be set from 0.00ms to 4.00ms in 0.25ms increments. Select the pretrip timer value that you want from the pull down box.

17. Func 4 output polarity

The Function 4 output polarity can be set to normal or inverted.

18. Func 4 unblock enable

The Function 4 unblock enable can be set to enable or disable. When set to enable, if you lose communication for 20ms, the trip output will go active for 150ms.

19. Shelf alert extension

This function is not presently used and should be set to disabled.

20. Alarm time delay (ms)

The alarm is delayed by the selected time. The Alarm time delay can be set from 10.00ms to 2550.00ms in 10ms increments. Select the Alarm time delay that you want from the pull down box.

21. Bus Direction

The Bus Direction can be set to TXA or TXB.

When set to TXA, Channel 1 transmits in the A direction and receives from the B direction. When set to TXB, Channel 1 transmits in the B direction and receives from the A direction. In a typical RFL9508 system, this is set to TXA.

22. Timeslot

The Time Slot can be set from 1-24 for T1 systems and from 1-31 for E1 systems. Click on the desired time slot in the pull down box to make the selection.

23. Input Type 1

Input Type 1 can be set to OR or AND. See paragraph 2.2.1 for additional information.

24. Input Type 2

Input Type 2 can be set to OR or AND. See paragraph 2.2.1 for additional information.

25. Input Type 3

Input Type 3 can be set to OR or AND. See paragraph 2.2.1 for additional information.

26. Input Type 4

Input Type 4 can be set to OR or AND. See paragraph 2.2.1 for additional information.

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27. Boost

This function is not presently used and should be set to disable.

28. Mode

Mode can be set to 2+2 or 3+1. See paragraph 2.2.1 for additional information.

29. Trip Reset Counter

The Trip Reset Counter can be set to Run or Reset. When set to Reset, all trip counters will be reset to zero and will be held at zero. When set to Run, all trip counters will be allowed to count events.

30. Output Enable

Output Enable can be set to enable or disable. When enabled, all outputs are enabled. When disabled, all outputs are disabled.

31. Input 1 Polarity

Input 1 Polarity can be set to Normal or Inverted.

32. Input 1A Polarity

Input 1A Polarity can be set to Normal or Inverted.

33. Input 2 Polarity Input 2 Polarity can be set to Normal or Inverted.

34. Input 2A Polarity Input 2A Polarity can be set to Normal or Inverted.

35. Input 3 Polarity

Input 3 Polarity can be set to Normal or Inverted.

36. Input 3A Polarity

Input 3A Polarity can be set to Normal or Inverted.

37. Input 4 Polarity

Input 4 Polarity can be set to Normal or Inverted.

38. Input 4A Polarity

Input 4A Polarity can be set to Normal or Inverted.

When finished with either viewing or changing the PLC-TT settings, click on $\underline{E}xit$ to return to the Display/Change Node window as shown in Figure 4-16.

4.5.3.11 RF SETUP

RF Setup is entered from the Display/Change Node window shown in Figure 4-16. To enter RF Setup, click on the RF Setup button. This will bring you to the transceiver "Common" window shown in Figure 4-20. Note that this window has three top-level pages selected by tabs near the top of the window as follows: Common, RF Channel 1 and RF Channel 2. The transceiver "Common" page has five pull down boxes and three check boxes. The following discussion covers the settings on the "Common" page.

L9508 Setup (Firmware version N/A)	
Transceiver View Help	
rmemory map nie not round ()	
mon RF Channel 1 RF Channel 2	
Transceiver Common Settings	1
Remote IMUX Addr Line Mode Select	
- Bemote Xver Addr - 1.05 Threshold	
E Freeze widehand ABC	
Freeze Sample Rate Loop Disable Alarms	
Write Bead Show Map View IX Filter settings View BX Filter set	tings

Figure 4-20. Transceiver Common Window in RF Setup

This window has four pull down boxes as follows:

1. Remote IMUX Address

The Remote IMUX Address is set to the address of the common module at the far end 9508. The address can be set from 1 to 100.

2. Remote Transceiver Address

Can be set from 1 to 255, and is set to the remote transceiver address at the far end 9508

3. Line Mode Select

Can be set to T1 or E1 as applicable in your system.

4. LOS Threshold

The LOS (Loss Of Signal) Threshold setting affects both channels. It can be set from 0dBm to 75dBm in 5dB steps. When the signal level drops by more than the selected LOS Threshold, the LOS alarm is activated.

5. Tx Attenuation Level

This setting attenuates the level of the signal coming out of the transceiver in 5dB increments from 0dB to -30dB.

This window has three check boxes as follows:

1. Freeze Wideband AGC

Under normal conditions this box should be unchecked. Check the box to freeze the transceiver wideband AGC for transceiver troubleshooting

2. Freeze Sample Rate Loop

Under normal conditions this box should be unchecked. Check the box to freeze the transceiver sample rate loop for transceiver troubleshooting.

3. Disable Alarms

The Disable Alarms "check box" refers to two alarms which are 1. Signal To Noise Ratio alarm, and 2. Loss Of Signal alarm. The Signal To Noise Ratio alarm is a user settable threshold. When the Signal To Noise Ratio goes below the threshold, a "yellow alarm" is issued to the CM4. It also causes LED D3 on the transceiver to flash RED, as described in Table 5-11. The Loss Of Signal alarm is also a user settable threshold. When a loss of signal is detected by the transceiver it causes LED D3 on the transceiver to illuminate solid RED, as described in Table 5-11. Alarms for both channels are detected by the transceiver and are sent to the CM4 module and the Transfer Trip card. Both of these alarms can be disabled by checking the Disable Alarms box.

After all settings are made on the transceiver "Common" window shown in Figure 4-20, click on the "RF Channel 1" button. This will bring you to the "RF Channel 1" window shown in Figure 4-21. the following discussion covers the settings on the "RF Channel 1" page.

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RFL9508 Setup (Firmware version N/A)	<u>_ ×</u>
File Transceiver View Help Msg:Memory Map file not found ()	
Common RF Channel 1 Recommon RF Channel 2 Channel Settings Tx Rx Service Channel Channel 1 Control Register Image: Channel 1 Isvels F6 Coded TEV (ms) Image: Channel Enable Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Freeze Rx AGC Companding Type Image: Signalling Level F6 uncoded TEV (ms) Image: F6 Test Command Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels Image: F6 Test Command Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels Image: F6 Test Command Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels Image: F6 Test Command Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels Image: F6 Test Command Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels Image: F6 Test Command Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels Image: F6 Test Command Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels Image: Channel 1 Isvels	
Write Read Show Map View TX Filter settings View RX Filter settings	

Figure 4-21. Transceiver RF Channel 1 Window in RF Setup

The "RF Channel 1" window is shown in Figure 4-21. Note that this window has four top-level pages selected by tabs near the top of the page as follows: Channel Settings, Tx, Rx, and Service Channel. The Channel Settings page has seven check boxes and twelve pull down boxes. The following discussion covers the settings on the RF Channel 1 "Channel Settings" page.

RF Channel 1 Control Register "check" boxes:

1. Channel Enable

Enables or disables RF Channel 1. RF Channel 1 is enabled when box is checked.

2. Freeze Rx AGC

Freezes Rx AGC when box is checked. This box is normally unchecked.

3. F6 Enable

Enables or disables F6 teleprotection. If your system uses PLC-TT modules on this channel, this box should be checked.

4. F6 Test Command

Enables or disables the F6 Test Command. Refer to paragraph 2.2 for additional information on F6 teleprotection.

5. Pilot FSK Disable

When this box is checked, the Pilot FSK is disabled (signaling, remote interrogation, and carrier synchronization). These three features need the pilot to be FSKing to work. This is generally used for troubleshooting, and the box is normally unchecked.

6. Freeze Synchronizer

Freezes the carrier synchronizer when this box is checked. This is generally used for troubleshooting, and the box is normally unchecked.

7. Internal Generator Enable

This box must be checked for the internal generator to be enabled.

RF Channel 1, Channel Settings, "pull down boxes":

1. Companding Type

Can be set to "mu Law" or "a Law" as applicable in your system. A Law is used in E1 systems, mu Law is used in T1 systems.

2. Tx Usb/Lsb Select

Usb is the default setting. Usb (upper side band) is from the carrier frequency, to the carrier frequency +4kHz. Lsb (lower side band) is from the carrier frequency -4kHz, to the carrier frequency.

3. Rx Usb/Lsb Select

Usb is the default setting. Usb (upper side band) is from the carrier frequency, to the carrier frequency +4kHz. Lsb (lower side band) is from the carrier frequency -4kHz, to the carrier frequency.

4. RF Channel 1 Voice Level

Can be set from -42dBm to 0dBm in 2dBm steps. Sets the peak of the transmitted audio signal(s) relative to the peak of the channel.

5. RF Channel 1 Signaling Level

Can be set from -42dBm to 0dBm in 2dBm steps.

Sets the level of the signaling tone relative to the peak of the channel. The signaling tone is also referred to as the Pilot Tone or the Guard Tone.

6. F6 Coded TEV (ms)

Can be set from 0.00ms to 63.00ms in 0.25ms steps. This is also referred to as the signal evaluation time. The signal evaluation time should be set to factory recommended value of 12.00ms (direct transfer trip). Changing the setting will affect security and dependability. Increasing the value will decrease dependability and increase security. Decreasing the value will increase dependability and decrease security.

7. F6 uncoded TEV (ms)

Can be set from 0.00ms to 63.00ms in 0.25ms steps. This is also referred to as the signal evaluation time. The signal evaluation time should be set to factory recommended value of 4.25ms (blocking) or 8.25ms (permissive). Changing the setting will affect security and dependability. Increasing the value will decrease dependability and increase security. Decreasing the value will increase dependability and decrease security.

8. F6 Timeslot

Can be set from timeslot 1 to 30. Set to the time slot that the PLC-TT module is set to.

9. Internal Generator Sweep Rate (kHz/sec)

Can be set to 0kHz/sec, 250kHz/sec or 875 to 63,375kHz/sec in 625kHz/sec steps. Sets the sweep rate of an internal generator used for system troubleshooting. The enable box must be checked for the internal generator to be active.

10. Internal Generator Frequency (kHz)

Can be set from 8.0kHz to 0.0kHz in 0.5kHz steps. Sets the frequency of an internal generator used for system troubleshooting. The frequency setting is relative to the carrier frequency. The enable box must be checked for the internal generator to be active.

11. Remote Xcer Voice Level

Enter the "Channel N levels, Voice Level" value set on the remote RFL 9508 unit into this box.

12. Remote Xcer Signal Level

Enter the "Channel N levels, Signaling Level" value set on the remote RFL 9508 unit into this box.

After all settings are made on the transceiver "Channel Settings" page shown in Figure 4-21, click on the "Tx" button. This will bring you to the "Tx" window shown in Figure 4-22.
RFL9508 Setup (Firr	mware version N/A)		
File Transceiver View Msc:	Help		
Common BE Channel 1	BE Channel 2		
Channel Settings T>	Rx Service Channel		
_ Tx Channel 1			
SubChannels	Filters	Time Slot G.162 Comp Wideband	Time Slot
0 💌	300-3700 Hz Bandpass 🛛 🔽		1 💌
Tx Signal Slot	300-3700 Hz Bandpass 🔽		
1 🔽	300-3700 Hz Bandpass 🔽		
Tx Frequency	300-3700 Hz Bandpass		
24 KHz. 💌	300-3700 Hz Bandpass 🔽		
	Tx Channel 1 SubChan	nels	
	1		
Signalling Freque	ncy-	4/1-	
13023112	1	41/112	
Write Read	Show Map View TX Filter se	ttings View RX Filter settings	

Figure 4-22. Transceiver RF Channel 1, Tx Window in RF Setup

The Tx page is shown in Figure 4-22. Note that the Tx page has four pull down boxes, and five Filter Settings. The following discussion covers the settings on the Tx RF Channel 1 page.

RF Channel 1, Tx Page, "pull down boxes":

1. Sub Channels

Can be set from 0 to 5. Selects the number of audio sources to be transmitted to the far end 9508.

2. Tx Signal Slot

Can be set from 1 to 30.

This setting selects the signaling timeslot. The signaling associated with the selected timeslot will be transmitted to the far end.

3. Tx Frequency

Can be set from 24kHz to 500kHz in 2kHz steps. A user can also type in a Tx Frequency in 500Hz increments. This setting selects the transmitted carrier frequency.

4. Signalling Frequency

Can be set to 3825Hz, 3600Hz, or 2325Hz. (Note: 2325Hz is for 2.5kHz channel operations) This setting selects the center frequency of the signaling band.

RF Channel 1, Tx Page, Filter Settings:

Selects Tx Filter characteristics as indicated below:

300-1700Hz Bandpass* 300-2000Hz Bandpass* 300-2200Hz Bandpass* 300-2400Hz Bandpass 300-2700Hz Bandpass 300-3400Hz Bandpass 300-3700Hz Bandpass 2400-3700Hz Bandpass 2200-3500Hz Bandpass 2600-3700Hz Bandpass 1900-2400Hz Bandpass 1700Hz Highpass 2200Hz Highpass 2400Hz Highpass 2600Hz Highpass 2900Hz Highpass * Acceptable filters for 2.5kHz operation

For each audio source selected in step 1 above, the user must select the filter characteristics, time slot, and enable or disable companding. If the source is a wideband source (VF-5XP channel 2 only), the wideband box must be checked. When wideband is selected, the second timeslot must also be selected. On a VF-5XP the second timeslot is for the wideband channel (channel 2). The second timeslot selected must be the next consecutive timeslot. In E1 systems, timeslot 16 is automatically skipped since it is reserved for CAS signaling. For example if the VF-5XP is set up for a starting timeslot of 14, channel 1 (narrowband) will use timeslot 14, and Channel 2 (wideband) will use timeslots 15 and 17. After all settings are made on the transceiver "Tx" page shown in Figure 4-22, click on the "Rx" button. This will bring you to the "Rx" page shown in Figure 4-23.

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ORFL9508 Setup	p (Firmware version M	(/A)					<u>_ ×</u>
File Transceiver	View Help						
DE Ch-							
Lommon Hr Cha	RF Channel 2						1
Channel Setting	gs Tx Rx Serv	ice Channel					
- Rx Channel	1						_
SubChannel	s Filters		Time Slot	G.162 Comp	Wideband	Time Slot	
0 💌	300-3700 Hz Ba	ndpass 💌	1 💌		Г	1 💌	
- Rx Signal S	Slot 300-3700 Hz Ba	ndpass 💌	1 -		Г	1 💌	
1	300-3700 Hz Ba	ndpass 🔽	1 💌		Γ	1 💌	
AGC Setpo	oint 300-3700 Hz Ba	indpass 🔽	1 💌			1 💌	
By Freque	300-3700 Hz Ba	ndpass 🗾 🔽	1 🔻		Г	1 💌	
20 KHz	Chann	el O Status					
Newinal C		Loss Of Signal			Start Mo	nitor	
		Low SNR					
5NR alarm	T dB						
						1	
Write	Read Show Map	View TX Filter se	ettings	View RX Fil	ter settings		

Figure 4-23. Transceiver RF Channel 1, Rx Window in RF Setup

The Rx page is shown in Figure 4-23. Note that the Rx page has six pull down boxes, five Filter settings, and a RF Channel 1 Status box. The following discussion covers the settings on the RF Channel 1 "Rx" page.

RF Channel 1, Rx Page, pull down boxes:

1. Sub Channels

Can be set from 0 to 5.

Selects the number of destinations of the audio received from the far end. For example, a system with speech and speech plus will have two destinations.

2. Rx Signal Slot

Can be set from 1 to 30. This setting selects the signaling timeslot. The signaling received from the far end will be retransmitted onto the selected Rx Signaling timeslot.

3. AGC Setpoint

The RFL 9508 Transmit Level Calculator spreadsheet has a calculated Far End Rx AGC Setpoint setting. This calculated level is the starting point when setting up the RX AGC level. Once the system is setup, this value may need to be tweaked to get the desired RX levels. If a number other than the ones available on the pull-down is desired, it may be typed in. This is useful for changing the levels by less than 0.5dB. This setting affects all audio sub channels in the corresponding RF channel.

4. Rx Frequency

Can be set from 20kHz to 500kHz in 4kHz steps. A user can also type in an Rx Frequency in 500Hz increments. This setting selects the received carrier frequency.

5. Nominal Gain

Can be set from 0 to 100.

6. SNR Alarm Threshold

Can be set from 0dB to 40dB in 1dB increments.

RF Channel 1, **Rx** Page, Filter Settings:

Selects Rx Filter characteristics as indicated below:

300-1700Hz Bandpass* 300-2000Hz Bandpass* 300-2200Hz Bandpass* 300-2400Hz Bandpass 300-2700Hz Bandpass 300-3400Hz Bandpass 300-3700Hz Bandpass 2400-3700Hz Bandpass 2200-3500Hz Bandpass 2600-3700Hz Bandpass 1900-2400Hz Bandpass 1700Hz Highpass 2200Hz Highpass 2400Hz Highpass 2600Hz Highpass 2900Hz Highpass * Acceptable filters for 2.5kHz operation

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For each audio source selected in step 1 above, the user must select the filter characteristics, time slot, and enable or disable companding. If the source is a wideband source (VF-5XP channel 2 only), the wideband box must be checked. When wideband is selected, the second timeslot must also be selected. On a VF-5XP the second timeslot is for the wideband channel (channel 2). The second timeslot selected must be the next consecutive timeslot. In E1 systems, timeslot 16 is automatically skipped since it is reserved for CAS signaling. For example if the VF-5XP is set up for a starting timeslot of 14, channel 1 (narrowband) will use timeslot 14, and Channel 2 (wideband) will use timeslots 15 and 17.

RF Channel 1 Status box:

As shown in Figure 4-23, the RF Channel 1 Status box has two indicators, and one Monitor button. These are described below.

Loss of Signal indicator (can be gray, green or red) Gray = No hardware connected Green = No loss of signal Red = Loss of signal

Low SNR indicator (can be gray, green or red) Gray = No hardware connected Green = SNR is ok Red = Low SNR

Start/Stop Monitor button Start Monitor = Start to monitor the hardware Stop Monitor = Stop monitoring the hardware

When the Start Monitor button is pressed, a message will be displayed in the RF Channel 1 Status box. An example of a message in the RF Channel 1 Status box is as follows:

Current Gain = 43dB Nominal Gain Reference = 12dB Rx Signal variation from nominal = -31dB

After all settings are made on the transceiver "Rx" page shown in Figure 4-23, click on the "Service Channel" button. This will bring you to the "Service Channel" page shown in Figure 4-24.

	l×
File Transceiver View Help	
Common RF Channel 1 RF Channel 2	
Channel Settings Tx Rx Service Channel	
Service Channel Control Register Image: Companding Enable Tx Filter Time Slot Image: Companding Enable Time Slot	
Companding Type mu Law Sevice Channel Frequencies	
Write Read Show Map View TX Filter settings View RX Filter settings	

Figure 4-24. Transceiver RF Channel 1, Service Channel Window in RF Setup

The Service Channel page is shown in Figure 4-24. Note that the Service Channel page has one Service Channel Control Register "display box", one "check" box, six pull down boxes, and a Service Channels frequency diagram. The following discussion covers the settings on the RF Channel 1 "Service Channels" page.

RF Channel 1, Service Channel:

1. Service Channel Control Register

Will display the status of the Service Channel, for example "channel disabled".

2. Companding Enable Check Box

Enables or disables ITU-T G.162 companding.

RF Channel 1, Service Channel, pull down boxes:

1. Companding Type

Can be set to "mu Law" or "a Law" as applicable in your system. A Law is used in E1 systems, mu Law is used in T1 systems.

2. Tx Signal Slot

Can be set from 1 to 30.

This setting selects the signaling timeslot used for the service channel. The signaling associated with the selected timeslot will be transmitted to the far end and used to determine the status of the service channel.

3. Tx Filter

Selects Tx Filter characteristics for the service channel as indicated below:

300-1700Hz Bandpass* 300-2000Hz Bandpass* 300-2200Hz Bandpass* 300-2400Hz Bandpass 300-2700Hz Bandpass 300-3400Hz Bandpass 300-3700Hz Bandpass 2400-3700Hz Bandpass 2200-3500Hz Bandpass 2600-3700Hz Bandpass 1900-2400Hz Bandpass 1700Hz Highpass 2200Hz Highpass 2400Hz Highpass 2600Hz Highpass 2900Hz Highpass

* Acceptable filters for 2.5kHz operation

4. Tx Time Slot

Can be set from 1 to 30.

The audio on the selected Tx timeslot will be transmitted to the far end when the service channel is active (when both ends are OFF hook).

5. Rx Filter

Selects Rx Filter characteristics for the service channel as indicated below:

300-1700Hz Bandpass* 300-2000Hz Bandpass* 300-2200Hz Bandpass* 300-2400Hz Bandpass 300-2700Hz Bandpass 300-3400Hz Bandpass 300-3700Hz Bandpass 2400-3700Hz Bandpass 2200-3500Hz Bandpass 2600-3700Hz Bandpass 1900-2400Hz Bandpass 1700Hz Highpass 2200Hz Highpass 2400Hz Highpass 2600Hz Highpass 2900Hz Highpass * Acceptable filters for 2.5kHz operation

6. Rx Timeslot

Can be set from 1 to 30.

The audio received from three far end will be re-transmitted onto the selected Rx timeslot when the service channel is active.

After all settings are made on the transceiver "Service Channel" page shown in Figure 4-24, click on the "RF Channel 2" button. This will bring you to the "RF Channel 2" page shown in Figure 4-25.

RFL9508 Setup (Firmware version N/A)	_ 🗆 🗙
File Transceiver View Help	
Msg:Memory Map file not found ()	
Common RF Channel 1 RF Channel 2	
Channel Settings Tx Rx	
Channel 2 levels	
Channel 2 Control Register	
F6 uncoded TEV (ms)	
4.25	
▼ F6 Enable a Law ▼ Remote Xver	
F6 Test Command Tx Usb/Lsb Select	
Pilot FSK Disable Rx Usb/Lsb Select	
□ Freeze Synchronizer Usb	
Internal Generator Enable	
Sweep rate (KHz/sec)	
Write Read Show Map View TX Filter settings View RX Filter settings	

Figure 4-25. Transceiver RF Channel 2 Window in RF Setup

The "RF Channel 2" window is shown in Figure 4-25. Note that this window has three top-level pages selected by tabs near the top of the page as follows; Channel Settings, Tx and Rx. The Channel Settings page has seven check boxes and twelve pull down boxes. This window is identical to the RF Channel 1 window in Figure 4-21 and is set up the same way. The same is true for the RF Channel 1 Tx window and the RF Channel 1 Rx window. Note that the RF Channel 2 window does not have a Service Channel window.

After all RF setup selections have been made they must be written to the transceiver card. This is done by using the "WRITE" button. This button causes all of the settings to be written to the transceiver module.

After the RF setup has been completed, close the RF Setup window. This completes the configuration of all cards and modules for node 1. This will bring you to the Display/Change Node window as shown in Figure 4-16.

From the Display/Change Node window click on <u>E</u>xit. This will return you to the Network View window shown in Figure 4-15. To complete this example, proceed to configure all cards and modules for Node 2. The list of modules and cards that must be configured for Node 2 are listed in Table 4-1.

4.5.3.12 CONNECTING LINES TO NODES

After the entire network has been configured return to the Network View window, and connect the lines between nodes in accordance with Figure 4-15. To make the Network View more readable the nodes can be moved to different locations by using the <u>Move Node button</u>. Then use the Add <u>Line button to add connecting lines between nodes</u>. When you are finished connecting lines to nodes, your Network View window should be similar to the one shown below in Figure 4-26.

IMUX 2000 NM5 : demo
1:Node 1 Term
<u>Change</u> <u>Add Node</u> <u>Delete Node</u> <u>Move Node</u> <u>Add Line</u> <u>Remove Line</u> <u>Print</u> <u>Exit</u>
Version 10.6
Select here to Add Line (1:Node 1)

Figure 4-26. Network View window after connecting lines to nodes

4.5.3.13 WRITING TO THE NETWORK

The next step in this example is to write the network configuration to the network. Up to this point in time, all of the network configuration data has been saved in a temporary file in the Network Management Software. To write this data to the network you must return to the main window shown in Figure 4-11, and then click on the Write NET Icon. Writing to the network takes approximately six minutes per node. For this example the writing will take approximately 12 minutes. The Network Management Software first writes to the network and then reads it back to verify any errors that might have occurred. The user can look at a difference report to verify that all settings were written correctly, and then read back correctly. While the data is being written a window will appear similar to the one shown in Figure 6-13 with two additional pop-up windows at the bottom. After the network writing is complete you will be returned to the main window. The network is now operating.

4.5.3.14 VIEWING REPORTS

The Network Management Software provides the user with five network reports which are made up of information from various sources. These reports and a description of each is listed below. An example of what these reports look like is shown in figures 4-27 through 4-31. In addition to these reports, an event log is provided which lists the Sequence Of Events for each node in the network. This is shown in Figure 4-32. Note that these reports are not related to the network example shown earlier in this section.

<u>Report Name</u>	Description	<u>See</u> Figure
Alarm Log Report	Lists all alarms found in the network	4-27
Complete Network Information Report	Lists all settings of all cards in the network	4-28
Connection View Report	Lists which cards are in which time slots for each node	4-29
Difference Report	Lists the actual versus the configured setup	4-30
Network View Report	Lists the nodes and the cards in each node	4-31

Note that the Difference Report compares the "Set to" column to the "Actual" column for all cards and modules in the network. It then displays only the ones that are different. To see the Difference Report, click on the Reports Icon in the Main window. A Report Description window will be displayed. Click on Difference Report and then click on <u>Ok</u>. The Difference Report will then be displayed.

Alarm Log $\$ Alarms logged from 03/01/01 15:24:01 to 03/01/01 15:25:05

Report Name	AlarmLog					
Page	1					
Date/Time	03/01/01 15:31:30					

03/01/01	15:24:01	2: AutoCfg Net	DI-A	CM4	New Common logic module	Shelf status (alert)
	15:24:08		DI-B			Shelf status (alert)
	15:24:16		DAC	DACSR	Digital Access Cross	Loss of frame on port 2
					Connect	
	15:24:16					Bit error rate exceeded port4
	15:24:16					Loss of data on port 4
	15:24:16					Alert on the dacs
	15:24:16					Bit error rate exceeded port2
	15:24:16					Loss of frame on port 4
	15:24:16					Loss of data on port 4
	15:24:58	3: AutoCfg Net	TER	CM4	New Common logic module	Shelf status (alert)
	15:25:05		C11	DS-64NC	Wide band data channel	Configuration Error
					card	

Comment	Version 14, 3	3 nodes with dacs & 9 ch cards
Create Date	03/01/01	11:28:00
Last Saved	03/01/01	15:26:59

Figure 4-27. Typical Alarm Log report

Date

Time

Node

										ł	Report Name Page Date/Time	NetLis 03/20/02 10:09:2:
Туре	Address	Node	DACS	ILS	CM-1	CM-2	Chanr	nel Card/Des	cription		Set To	Actual
Term	1	1	•	0	R	-	AutoCfg	Net Address1				
		I		1 1	I		TERM	CM4	New	Commo	n Logic modu	e
								Date and	Time	01/	11/01 15:59:04	01/11/01 16:01:04
								CSU Perf. – AN	ISI Local	<n< td=""><td>o/none></td><td>01/11/01 10:01:04</td></n<>	o/none>	01/11/01 10:01:04
								CSU Perf – AN	ISI Remo	te <n< td=""><td>o/none></td><td></td></n<>	o/none>	
								AT&T Performa	ance Repo	ort <n< td=""><td>o/none></td><td></td></n<>	o/none>	
								Framing (ESF o	r SF)	ES	F	
								E1 Code		CC	DE = AMI	
								Primary Timing	Mode	LO	OP	LOOP
								E1 Line Loopba	ick	OF	F	OFF
								E1 Payload Loo	pback	OF	F	OFF
								E1 Equipment L	loopback	OF	F	OFF
								Fast Reframing		ON	I	ON
								Clear Channel C	Card Conf	ïg. OF	F	OFF
								Clear DACS Co	nfig.	OF	F	OFF
								Clear ILS Confi	g.	OF	F	OFF
								Local SNMP Tr	ap	ON	I	ON
								Remote SNMP	Trap	ON	1	ON
								Force Main ON	or OFF	ON	I	ON
								Redundant Swit	ch Contro	ol AU	TO	AUTO
								CSU Mode Con	trol	RF	L	RFL
								Reset CSU		OF	F	OFF
								Report Alert at S	Stby	OF	F	OFF
								Pre-Squelch Tin	ner (ms)	DI	SA	DISA
								Post-Squelch Ti	mer (ms)	DI	SA	DISA
								Shelf is Normal		SH	ELF NORMAL	
								Fallback timing		FT	IME= INT (FALI	BACK TIMING)
								Payload loopbac	ck status	<n< td=""><td>o/none></td><td></td></n<>	o/none>	
								Line loopback s	tatus	<n< td=""><td>o/none></td><td></td></n<>	o/none>	
								Equipment loop	back statu	us <ne< td=""><td>o/none></td><td></td></ne<>	o/none>	
								Curr unframed a	all ones ci	nt 0		
								Curr remote alar indication cnt	rm	0		
								N	letwork 1	Name	Demo E1 ne	etwork
								A	uthor's l	Name	Frank Luo	
								C	omment		* Created by	/ Auto Cfg
								C	reate Da	ie	5/19/02	11:39:07

Figure 4-28. Page 1 of typical Complete Network Information Report

Connection View

Report Name	ConnView
Page	1
Date/Time	03/06/01 15:31:18

Site ID	AutoCfg Net	AutoCfg Net		AutoC	fg Net	Auto	Cfg Net	AutoCfg Net	
Shelf Addr	1		2		3		4	5	
Term / D&I	Term	D & I		D & I		D & I		Term	
DACS / ILS	DACS-R	DACS-R		DACS-R		DACS-R			
Direction	TXA >	<txb txa=""></txb>		<txb 7<="" td=""><td colspan="2"><txb txa=""></txb></td><td>TXA></td><td>< TXA</td></txb>	<txb txa=""></txb>		TXA>	< TXA	
Tslot. 1	VF5C			VF5C					
2				VF16B-	l				
3	DS-562I			DS-562I					
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30							I		
31	NCM	NCM	NCM	NCM	NCM	NCM	NCM		

Network Name	Demo E1 network						
Author's Name	Frank Luo						
Comment	Created by Auto Cfg						
Create Date	03/06/01 12:30:51						
Last Saved	03/06/01 15:00:54						



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	ifferenc	e Rep	ort									
									Report Na Pa Date/Ti	ame ge	03/01/01	NetList 1 13:13:10
Type Actual	Address	Node	DACS	ILS	CM-1	CM-2	C	'hannel Card/De	scription		Set To	
D&I	2	2	•	0	•	•	AutoCfg	g Net Address2				
							C14	VF5C	Dual-Ch	annel 4 wi	re E&M Vo	oice Module
								Time Slot		10		5
							C15	VF16B-1	Dual-Cł	nannel Fore	eign Excha	nge Voice Module
						I		Time Slot		11		7

Figure 4-30. Typical Difference Report

		<u></u>		100)% 🔻		3				
Netv	vork Vi	iew								Report Name Page Date/Time 01	NetView 1 /16/04 15:57:12
Ton	Address	Node	DACS	ILS	CM-1	CM-2	Channel Node 1	Card	Card Description		
len			•		<u> </u>	-	DACS-R	E1DACS-R	8 Port DACS module		
							TERM	CM4R	NewCommon logic modul	le	
							C1	VF5C	Dual Channel 4 wire voice	-E &M	
							C2	VF16B	Dual Channel 2 wire F.E.S	Stat.	
							СЗ	DS-562I	Synchronous Data Module	,	
							C4	NCM	Network Comm. Module		
r Iview				Reco	d: EOF/	6	Exclus	ive			<u> </u>

Figure 4-31. Typical Network View Report

					Report Name	EventLog
Date	Time	Node			Page Date/Time	1 03/01/01 15:31:30
03/02/01	15:24:01	2:AutoCfgNet	END OF EVENT	03/02/01 15:31:4	9	
		CM4R DI-A: RECEIVER OUT OF TRANSMITTER TIM TRANSMITTER CLO	FRAME IING NOT CORRECT ICK DOES NOT LOC	K RECEIVER CLOCK		
		CM4R DI-B: TRANSMITTER USI TRANSMITTER TIM TRANSMITTER CLC	NG FALLBACK TIM ING NOT CORRECT ICK DOES NOT LOC	ING K RECEIVER CLOCK	í.	
		CM4R DI-A DIAG: CRBL=00000 CRCL=00000 CBPV=00000 CMF0S=00000	CRYEL=00000 CRLOS=00016 CBER=00000			
		CM4R CRBL=00000 RCL=00000 CRLOS= CBPV=00000 CMFOS=00000	DI-B CRYEL=00000 00000 CBERS=00000	DIAG:		
Date 03/02/01	Time 15:22:01	CM4R CRBL=00000 RCL=00000 CRLOS= CBPV=00000 CMFOS=00000 Node	DI-B CRYEL=00000 00000 CBERS=00000	DIAG: 03/02/01 15:21:4	14	
Date 03/02/01	Time 15:22:01	CM4R CRBL=00000 RCL=00000 CRLOS= CBPV=00000 CMFOS=00000 2:AutoCfgNet 2:AutoCfgNet CPU POWER UP CM4R DI-A DIAG: CRBL=00000 CRCL=00000 CRCL=00000 CMFOS=00000	DI-B CRYEL=00000 CBERS=00000 END OF EVENT CRYEL=00000 CRLOS=00016 CBER=00000	DIAG: 03/02/01 15:21:4	14	
Date 03/02/01	Time 15:22:01	CM4R CRBL=00000 RCL=00000 CRLOS= CBPV=00000 CMFOS=00000 2:AutoCfgNet 2:AutoCfgNet CPU POWER UP CM4R DI-A DIAG: CRBL=00000 CMFOS=00000 CMFOS=00000 CMFR CRBL=00000 CM4R CRBL=00000	DI-B CRYEL=00000 CBERS=00000 CBERS=00000 END OF EVENT CRYEL=00000 CRLOS=00016 CBER=00000 DI-B CRYEL=00000 CRLOS=00000	DIAG: 03/02/01 15:21:4 DIAG:	14	
Date 03/02/01	Time 15:22:01	CM4R CRBL=00000 RCL=00000 CRLOS= CBPV=00000 CMFOS=00000 2:AutoCfgNet 2:AutoCfgNet CPU POWER UP CM4R DI-A DIAG: CRBL=00000 CRCL=00000 CMFOS=00000 CM4R CRBL=00000 CM4R CRBL=00000 CRCL=00000	DI-B CRYEL=00000 CBERS=00000 CBERS=00000 CRYEL=00000 CRLOS=00006 CRYEL=00000 CRLOS=00000	DIAG: 03/02/01 15:21:4 DIAG:	14	
Date 03/02/01	Time 15:22:01	CM4R CRBL=00000 RCL=00000 CRLOS= CBPV=00000 CMFOS=00000	DI-B CRYEL=00000 CBERS=00000 CBERS=00000 CRYEL=00000 CRLOS=00016 CBER=00000 DI-B CRYEL=00000 CRLOS=00000	DIAG: 03/02/01 15:21:4 DIAG:	I4 CM3C3NS net	
Date 03/02/01	Time 15:22:01	CM4R CRBL=00000 RCL=00000 CRLOS= CBPV=00000 CMFOS=00000 Node 2:AutoCfgNet CPU POWER UP CM4R DI-A DIAG: CRBL=00000 CMFOS=00000 CMFOS=00000 CMFOS=00000 CMFR CRBL=00000 CMFR	DI-B CRYEL=00000 CBERS=00000 CBERS=00000 CRYEL=00000 CRLOS=00016 CBER=00000 DI-B CRYEL=00000 CRLOS=00000	DIAG: 03/02/01 15:21:4 DIAG: Network Name Author's Name	I4 CM3C3NS.net Frank Luo	

Figure 4-32. Page 1 of a typical Event Log Report

4.5.3.15 POLLING FOR ALARMS IN BATCH MODE

The next step in this example is to poll the network for alarms, which causes the Network Management Software to look for network failures. It polls every card in every node in the network. You can then look at an alarm report for a list of failures. To activate this feature, click on the Alarms Icon in the Main window. A sub-window will be displayed called Poll The Network For Alarms. Click on Com Path 1 and then click on <u>S</u>tart. If failures are detected, they can be viewed by clicking on the Reports Icon in the Main window and then selecting Alarm Log Report. After polling is completed you will be returned to the Main window.

4.5.3.16 AUTO POLLING

Auto polling is an option selected from the Communications Preferences window which determines whether or not the network will be polled for alarms while in Real Time mode. This feature is normally selected when a user is troubleshooting a network and is looking for alarms. To select this option, click on Auto polling ON.

4.5.3.17 SAVE SETTINGS IN A FILE

The last step in this example is to save the settings in a file. Click on the Save Icon in the Main window. An Open window will be displayed which contains a file directory. The file will be saved with a .NET extension in the form of filename.NET. Type the filename in the box under the words "Save Untitled As". Then click on the <u>Save button</u>. The file is now saved. To exit the Network Management Software click on the <u>Exit button</u>.

4.5.3.18 SEQUENCE OF EVENTS

The Sequence Of Events feature of the Network Management Software allows a user to view network events (alerts or alarms) in the order in which they have occurred. Each event has a date and time stamp associated with it. There is one icon on the main screen for accessing Sequence Of Events. This causes the sequence of events buffer to be read by the Network Management Software, and allows the user to view or print the sequence of events buffer.

Page one of a typical Event Log Printout can be seen in Figure 4-32.

4.5.3.19 USING MACROS

The macro feature of the Network Management Software will enable a user to make multiple settings on several cards for a specific network. To play a macro the user simply hits the PLAY icon on the main screen (or selects PLAY from the MACROS menu under SETUP). The user then selects the macro by name and it runs. You can only run macros in Real Time mode. To set up macros (a feature that will be used only by RFL or advance users) perform the following steps:

- 1. Go into Real Time mode.
- 2. Start macro recording: From SETUP select MACROS and then RECORD.
- 3. Give the macro a name, up to twenty characters (including spaces) are allowed.
- 4. Make the required settings. Each setting will be recorded.
- 5. At any time you can pause and then resume the recording, use the options in the MACRO menu under SETUP.
- 6. At the conclusion of recording, select the STOP RECORDING option from the MACRO MENU.
- 7. You can edit the macro, including merging two macros together by selecting the EDIT option under MACROS.

To merge two macros, edit the second one, and copy the commands, then edit the first macro and paste the commands at the end.

There is a MACRO button on the View or Change Card screen that allows you to start recording a macro, stop it, or pause/resume it. You can not play a macro from this screen. Also, after recording a macro you can remove some redundant lines (caused by Pn=settings that repeat over and over). Also, you can add comments to the macro by adding a /* */ at the end of any line. For example, you can have a macro line that reads:

1:TERM:SET:EQPT-LB=OFF; /* Turn Equip off */

4.5.3.20 EMERGENCY EXIT

The Network Management Software has an Emergency Exit key sequence. If for some reason the user gets "stuck" or a screen freezes, hit <CTRL> <PgDn> then X, and the DMI session will terminate.

4.6 NETWORK MANAGEMENT SOFTWARE HELP

4.6.1 INTRODUCTION

The Network Management Software has a help system that is common to all other programs using the Microsoft Windows operating system. A description of how it is used is explained below.

4.6.2 USING NETWORK MANAGEMENT SOFTWARE HELP

Network Management Software Help is activated by clicking on <u>H</u>elp in the Network Management Software main menu bar, or by clicking on the Help Icon. This will get you into a sub-window giving you the following four choices:

- 1. <u>C</u>ontents
- 2. <u>S</u>earch
- 3. <u>H</u>ow
- 4. <u>A</u>bout

Clicking on <u>C</u>ontents will give you a list of the Network Management Software Help Topics. Clicking on <u>S</u>earch will give you an alphabetized list of Help Topics to choose from. Clicking on <u>H</u>ow will give you an alphabetized list of how to use Help. Clicking on <u>A</u>bout will give you the nomenclature and version number of the Network Management Software, and a telephone number and fax number for Network Management Software support.

The most useful of the four choices is <u>C</u>ontents, which will display a list of all topics relevant to Network Management Software help. When you are in the Help contents, and when you move the mouse pointer to any of the "green underlined" topics shown, the mouse pointer will change into a hand with a pointing finger. Click once to select help for that topic.

When you are finished using help, you can close the help window by double-clicking on the Icon in the upper left of the help window, or by clicking on <u>F</u>ile and then <u>E</u>xit. As a reference to the user, para. 4.6.3 has been included which contains the Network Management Software Help Topics as it actually appears on the PC terminal.

Network Management Software Help, can also be activated by pressing F1 twice from any sub-menu. This feature will take you to a help screen that is associated with the sub-menu that you were in immediately before F1 was pressed.

4.6.3 NETWORK MANAGEMENT SOFTWARE HELP TOPICS

The following is a list of Help Topics contained in this section. Click on the desired topic for more information.

What is the IMUX 2000? Hardware Required Description of Cards IMUX 2000 Program Group Learning to use the Menu Options Communication Paths Using the IMUX 2000 Network Management Software Answers to Common Questions

4.7 MODULES SUPPORTED BY THE NETWORK MANAGEMENT SOFTWARE

The following modules are supported by the Network Management Software. The parameters for each of these modules can be found in Section 8 and 11 of this manual or in the IMUX 2000 Instruction Manual.

Module	Description
CM4	Common Logic Module*
ILS	Intelligent Line Switch Module*
DA-91I	Asynchronous Data Channel Module*
DA-121I	Asynchronous Data Channel Module*
DS-562NC	Multi-Baud Synchronous Data Module*
DS-562I	Synchronous Data Module (RS-449, CCITT V.35, G.703, X.21 or
	Short Haul Optical Fiber Interface)*
DS-961DE	Five-Port Multi-Rate Synchronous Data Module*
OCUDP	Office Channel Unit Data Port Module*
VF-5C	Dual-Channel Four-Wire E&M Voice Module
VF-5XP	Dual-Channel Four-Wire E&M Voice Module
VF-6I	Single-Channel Orderwire Voice Frequency Module
VF-8A	Selective Calling Unit
VF-15C	Dual-Channel Foreign Exchange Voice Module (office end)*
VF-16B	Dual-Channel Foreign Exchange Voice Module (station end)*
PLC-TT	9508 Transfer Trip Module
Status Module	Status Module*
TMX/TMR	Telemetry Transmitter/Telemetrey Receiver Module*
VVS	Variable Video System*
MA-490	Telnet I/O
NCM	Network Communication Module*
VF-15C-1	Dual-Channel Foreign Exchange Voice Module (office end)
VF-16B-1	Dual-Channel Foreign Exchange Voice Module (station end)

* Not supported in 9508

4.8 PASSWORD PROTECTION

NOTE

This is the only page where the user ID and password are discussed. This page can be removed from the Instruction Manual for added security.

Password protection is used in this system to prevent unauthorized persons from gaining access to the Network Management Software settings and parameters.

4.8.1 ENTERING THE NETWORK MANAGEMENT SOFTWARE

Upon starting the Network Management Software the user will be presented with a sign on screen. The user must enter a user ID and a password to continue. Enter the word "control" for the user ID, then hit the "enter" key. Enter the word "password" for the password, then click on "OK". This will allow the main window to be displayed.

4.8.2 CHANGING THE PASSWORD

The user ID or password can be changed by entering the security file window. This window is entered from the main window by clicking on Setup and then clicking on Setup User ID. In this window, other user ID's can be setup as "Master" which means they can setup or change other users (including other "masters" or "users"). A "user" class can not set up other users or see other passwords.

4.8.3 BYPASSING THE SIGN ON SCREEN

Two keywords in the INI file are used in conjunction with security. If the user enters the INI file and then enters a value for USERID and for PASSWORD, and these are valid values the sign on screen will be bypassed. A user that is not interested in security can change their INI file after the first sign on and then not have to enter the sign on screen to get into the main Network Management Software window. At a later date the security can be reactivated.

From the main window click on Setup, and then click on Edit INI. This will bring you to the software settings window. Click on the Expert Mode button. This will bring you to the rfl.ini file. Scroll down to the [SECURITY] section and type in the following two lines:

USERID=CONTROL PASSWORD=PASSWORD

Then exit the rfl.ini window and click on the Yes buttons to get back to the main window. The sign on screen will now be bypassed.

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Section 5. CONFIGURATION

5.1 INTRODUCTION

This section describes the procedure required to put the RFL 9508 system into service in the field. It is assumed that the installation procedures described in Section 3 of this manual have been performed, and the 9508 chassis are in place. Figure 5-1 shows the location of the RFL 9508 front panel controls and indicators. Table 5-1 describes the functions of the controls and indicators.



Figure 5-1. Front View Of RFL 9508 Chassis Showing Controls And Indicators

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5-1

Reference Designation	Description	Function
1	LED (green)	LED is ON when power amplifier is transmitting.
2	Power LED (green)	LED is ON when the 9508 chassis has power.
3	Normal LED (green)	LED is ON when there are no system ALERT or ALARM conditions.
4	Alert LED (amber)	LED is ON (See Table 8-2 Item 5)
5	Alarm LED (red)	LED is ON (See Table 8-2 Item 6)
6	Service Channel Handset	Used for voice communication with the far end 9508.
7	Service Channel Handset Jack	Connects handset to 9508 chassis .
8	RF Chassis Thumbscrew	Locks RF Chassis when turned clockwise.
9	AF Chassis Thumbscrew	Locks AF Chassis when turned clockwise.

Table 5-1. Description Of RFL 9508 Front Panel Controls And Indicators

5.2 MODULE PLACEMENT AND CABLING

5.2.1 MODULE PLACEMENT, DIGITAL CHASSIS

For module placement in the Digital Chassis, refer to Table 5-2, and Figures 5-2 and 8-1. A Typical Digital Chassis will have the modules installed as indicated in Table 5-2.

Front Panel Modules		Corresponding Rear Panel Modules	
Main Power Supply	5.2.1.1	Power Supply Alarm I/O	5.2.1.3
Redundant Power Supply	5.2.1.2		
CM4 Optional Module	5.2.1.4	MA-271, MA-278 or Optical I/O	5.2.1.5
VF-5XP	5.2.1.6	MA301B	5.2.1.7
PLC Transfer Trip	5.2.1.8	One or two PLC Transfer Trip I/O modules	5.2.1.9
CM4 Main Module	5.2.1.4	None	
Test Panel	5.2.1.10	None	
Transceiver	5.2.1.11	MA-650	5.2.1.12

Table 5-2. Module Placement in Digital Chassis



Figure 5-2. Module Placement in a Typical RFL 9508 Digital Chassis (Top View)

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5.2.1.1 MAIN POWER SUPPLY

The Digital Chassis requires a Main Power Supply, which is mounted in the front of the chassis at the extreme far left slot.

5.2.1.2 REDUNDANT POWER SUPPLY

As an option the Digital Chassis can have a Redundant Power Supply. When used, this supply is mounted in the front of the chassis immediately to the right of the Main Power Supply.

5.2.1.3 POWER SUPPLY ALARM I/O

The Digital Chassis requires a Power Supply Alarm I/O. This module is located at the rear of the chassis directly behind the Main Power Supply.

5.2.1.4 CM4 COMMON MODULES

The Digital Chassis can have either one or two CM4 modules installed. If only one CM4 is installed, it must be installed at the front of the chassis in slot 10. This is referred to as the CM4 Main Common Module. The CM4 in slot 10 does not require a Module Adapter since it is connected to the Transceiver Module through the motherboard. The CM4 in slot 10 is used for Terminal End or Drop and Insert-A (DI-A) applications.

If a second CM4 is used it must be installed in the front of the chassis in slot 1. This is the Optional Common Module. The CM4 in slot 1 is used for Drop and Insert-B (DI-B) applications.

5.2.1.5 CM4 MODULE ADAPTERS

The CM4 in slot 1 requires a Module Adapter, which can be an MA-271, an MA-278 or an Optical I/O. The MA-271 is used for E1 only, and uses BNC connectors. The MA-278 is used for T1 or E1 applications and uses an RJ48C connector. The Optical I/O is used for optical fiber installations.

5.2.1.6 VF-5XP MODULE

Voice modules can be installed in any unused slots provided there is room for an I/O at the rear of the chassis. A typical voice module that is used in the RFL 9508 chassis is the VF-5XP.

5.2.1.7 VF-5XP MODULE ADAPTERS

The VF-5XP requires a module adapter. There are five different types of module adapters that can be used with the VF-5XP. The module adapter that is normally used is the MA-301B, which is located at the rear of the chassis directly behind the VF-5XP.

5.2.1.8 PLC-TT TELEPROTECTION MODULE

In chassis that require teleprotection, an PLC-TT module can be installed in the front of the chassis in slots 5 or 11 only.

5.2.1.9 PLC-TT MODULE ADAPTER

The PLC-TT module requires a module adapter. There are four types of 2-function module adapters, and four types of 4-function module adapters that can be used with the PLC-TT module. The 2-function module adapters occupy three module slots at the rear of the chassis, and the 4-function module adapters occupy six module slots at the rear of the chassis. Most installations will have only one PLC-TT Module Adapter installed at the rear of the chassis. Some installations will have two PLC-TT Module Adapters installed at the rear of the chassis. Refer to Table 5-3 to determine where these module adapters must be placed.

Chassis configuration	Required rear slot locations	Notes
One, 2-function module adapter	Slots 5 through 7.	
Two, 2-function module adapters	One in slots 5 through 7. The other in slots 11 through 13.	A cable is required from slot 8 of the motherboard to JP3 of The PLC-TT Module.
One, 4-function module adapter	Slots 5 through 10.	See Figure 5-2 for a view of this configuration.
Two, 4-function module adapters	One in slots 5 through 10. This is referred to as module adapter "A". The other in slots 11 through 16. This is referred to as module adapter "B".	A cable is required from slot 8 of the motherboard to JP3 of The PLC-TT Module. See Figure 5-3 for a view of this configuration.

Table 5-3.	Placement	of PLC-TT	' Module	Adapters.
			1.100000	

POW SUPF ALARN	ER PLY // I/O	MA-271, MA-278 OR OPTICAL I/O		MA-301B		Γ	4-I MODU	func Plc- Jle A "A'	TION TT DAP	N TER		I	4-F F MODU	UNC ⁻ PLC-1 ILE D "B"	TION IT DAPTER		MA-650	
MOTHER	BOARD	1	2	3	4	5	6	7	8	9	10	11	12	13	14 15	16	17	18
Main Power Supply	REDUNDANT POWER SUPPLY	CM4 OPTIONAL		VF-5XP MODULE		PLC-TT MODULE		SEE N	NOTE	1	CM4 MAIN				TEST PANE	L	TRANSCEIVER MODULE	
							F	RON	Г									

Figure 5-3. Digital chassis showing the installation of two PLC-TT Module Adapters

5.2.1.10 TEST PANEL

The Test Panel is an optional module that can be installed in slots 14 through 16. It has a cable which plugs into JP1 of the PLC-TT Module. The Test Panel is used to test the Transfer Trip function.

5.2.1.11 TRANSCEIVER MODULE

The Digital Chassis requires a Transceiver Module. This module must be mounted at the front of the chassis in slot 17.

5.2.1.12 TRANSCEIVER MODULE ADAPTER

The Transceiver module requires a Module Adapter. The Module Adapter used with the Transceiver Module is the MA-650, which is mounted at the rear of the chassis directly behind the Transceiver Module.

5.2.1.13 DROP & INSERT APPLICATIONS

In Drop and Insert applications the Digital Chassis will have two CM4s installed, one in slot 10 and another in slot 1. The CM4 in slot 10 is for Terminal End or Drop and Insert A (DI-A), and the CM4 in slot 1 is for Drop and Insert B (DI-B). The CM4 in slot 10 has jumpers at location J6 that must be installed to select either Terminal or DI-A, or DI-B. Refer to Figure 5-7 and Table 5-6 for instructions on how to set the J6 jumpers.

5.2.2 CABLING IN DIGITAL CHASSIS

In most RFL 9508 installations there will be no cables inside the Digital Chassis. The only time a cable will be installed in the Digital Chassis is when two PLC-TT Transfer Trip module adapters are installed at the rear of the chassis. In this case, a small cable is installed from slot 8 of the mother board to JP3 of the PLC-TT Transfer Trip module. The location of this cable can be seen in Figure 5-3.

5.2.3 MODULE PLACEMENT IN THE RF CHASSIS (50W SYSTEMS)

50 Watt systems are housed in a 6U high chassis. The upper part of the chassis is the RF Section, and the lower part of the chassis is the Digital Section. Module placement in the RF Chassis is shown in Table 5-4, and Figures 5-4, and 7-1. A Typical RF Chassis will have modules installed as indicated in Figure 5-4.

Front Panel Modules		Rear Panel Modules	
50W Power Amplifier	5.2.3.1	Mother Board	5.2.3.8
Tx Filter	5.2.3.2	Power Amplifier Power Supply	5.2.3.7
Balance Board	5.2.3.3		
Line Board	5.2.3.4		
Rx Filter	5.2.3.5		
Attenuator	5.2.3.6		

Table 5-4. Module Placement In RF Chassis (50W System)



Figure 5-4. Module Placement in a Typical RFL 9508 RF Chassis (Top View)

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5.2.3.1 50W POWER AMPLIFIER

The 50 Watt power amplifier is mounted to the upper part of the front door of the 9508 chassis as shown in Figure 5-4. It has two sets of cooling fins mounted to the front panel, which provide for heat dissipation.

5.2.3.2 TX FILTER

The Tx Filter is a module, which plugs into the left-most slot of the Mother Board. This module occupies approximately the left half of the RF Chassis as shown in the Figure 5-4.

5.2.3.3 BALANCE BOARD

The Balance Board is a module, which plugs into a slot in the RF Mother Board immediately to the right of the Tx Filter. There are two types of Balance Boards, one with components, and one without components. The Balance Board with components is installed in the 6U chassis, and the Balance Board without components is installed in the 3U chassis for 100W operation.

5.2.3.4 LINE BOARD

The Line Board is a module, which plugs into a slot in the RF Mother Board immediately to the right of the Balance Board.

5.2.3.5 RX FILTER

The Rx Filter is a module, which plugs into a slot in the RF Mother Board immediately to the right of the Balance Board.

5.2.3.6 ATTENUATOR

The Attenuator is a module, which plugs into a slot in the RF Mother Board immediately to the right of the Rx Filter. This slot happens to be the right-most slot of the RF Mother Board.

5.2.3.7 POWER AMPLIFIER POWER SUPPLY

The Power Amplifier Power Supply is mounted at the rear of The RF Chassis, immediately behind the Tx Filter, as shown in Figure 5-4. It has a set of cooling fins mounted to the rear panel, which provide for heat dissipation.

5.2.3.8 MOTHER BOARD

The RF Mother Board is mounted to the extreme right rear side of the chassis as viewed from the front. It has five connectors on the front for plug-in modules, and several connectors and an eight-position terminal strip, which protrude through the rear to allow for connections to other modules in the chassis.

5.2.4 CABLING IN THE RF CHASSIS

The interior of the 9508 RF chassis will have four cables installed. The cable part numbers and from-to connections are shown in Table 5-5 and are shown pictorially in Figure 5-5.

RFL cable part number	From	То	Function
107806 (2 of 2)	J1 of Power Amp Power Supply	J1 of Power Amp	3-conductor cable which provides dc power for Power Amp
107854-17	J2 of Power Amp	J4 of Motherboard	Coax (high level output)
107854-27	J2 of Motherboard	J4 or J5 of Power Amp *	Coax (low level input)
107806 (1 of 2)	J3 of Power Amp	J9 of Motherboard	2-conductoir cable for Amplifier Fail function

Table 5-5	. 9508 RF	Chassis	Cables
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* If the coax is connected to J4, then J5 is unused. If the coax is connected to J5, then J4 is unused.



Figure 5-5. Cable connections in the RF Chassis

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5.2.5 MODULE PLACEMENT IN THE RF CHASSIS (100W SYSTEMS)

100 Watt systems will comprise of a 50 Watt system in a 6U high chassis as described in paragraph 5.1.2?, and will have an additional 3U high chassis mounted directly above the 6U chassis. There must be a minimum 1U space between the lower 6U chassis and the upper 3U chassis for convection cooling. The 3U chassis will contain a 50W Power Amplifier, a Power Amp Power Supply, a Tx Filter, an External Amp Connection Board and a Motherboard. The External Amp Connection Board has no components and consists only of a PC board and a motherboard connector. A top view of the additional 3U chassis is shown in Figure 5-6. A front view of this chassis is shown in Figure 7-5.



Figure 5-6. Module placement in auxiliary 3U RF Chassis for 100W Systems (Top View)

5.2.6 MODULE PLACEMENT IN THE 9508RT CHASSIS (WHEN SUPPLIED)



Figure 5-7. Module placement for 9508RT
5.3 JUMPERS AND ADJUSTMENTS

5.3.1 SETTING JUMPERS IN DIGITAL CHASSIS

The Digital Chassis has several modules which have jumpers or switches that must set to configure the RFL 9508 system. These modules are listed in Table 5-6.

Module	See Paragraph:
CM4 Module	5.2.1.1
CM4 Module Adapters: MA-271, MA-278	5.2.1.2
CM4 Optical Interface Adapter	5.2.1.3
VF-5XP Module	5.2.1.4
VF5-XP Module Adapter: MA-301B	5.2.1.5
PLC-TT Transfer Trip	5.2.1.6
PLC-TT Transfer Trip Module Adapters	5.2.1.7
Transceiver Module	5.2.1.8
Transceiver Module Adapter: MA-650	5.2.1.9

5.3.1.1 SETTING JUMPERS ON THE CM4 MODULE

The CM4 Common Module has four sets of jumpers that must be set for proper system operation. These are J3, J4, J6 and J8, and are shown in Figure 5-8. Refer to Table 5-7 for information on how to set these jumpers.



Figure 5-8. Location of jumpers on CM4 common module

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Jumper	Function
J3	Place all four J3 jumpers in T1/E1 position to select external timing input in T1/E1 format.
J4	Place all four J4 jumpers in 422 position to select external timing input in RS422 format.
J6	Used to select DI-A or TERMINAL, or DI-B, in 9508 chassis.
	If the CM4 you are setting up is located in chassis slot 1, NO jumpers should be installed in J6.
	If the CM4 you are setting up is located in chassis slot 10, J6 jumpers should be installed as
	follows:
	If the CM4 you are setting up is for DI-A or Terminal, the two upper J6 jumpers should be installed. The two lower J6 jumper locations should be left blank.
	$ J6 \begin{cases} \circ \circ \\ \end{cases} \\ J6 best wo locations should be left blank $
	If the CM4 you are setting up is for DI-B, the J6 upper location, and the lower two
	jumper locations should be left blank. The second from the top J6 jumper should be installed.
	J6 $\bigcup_{\substack{0 \ 0 \ 0 \ 0}}^{\circ}$ \longleftrightarrow Jumper should be installed here only. All other J6 jumper locations should be left blank.
J8	Place jumper J8 in RUN position for normal system operation.
	Place jumper J8 in TEST position for factory testing only.

Table 5-7. Setting CM4 jumpers

Note: All other jumpers on the CM4 are used for FACTORY TESTING only.

5.3.1.2 SETTING JUMPERS ON CM4 MODULE ADAPTERS

The CM4 requires a module adapter when installed in slot 1 of the Digital Chassis. This can be an MA-271, MA-278, or an optical interface adapter. The MA-271 and MA-278 have three sets of jumpers that must be set for proper system operation. These settings are described below in Figure 5-9. The CM4 installed in slot 10 does not use a module adapter since it is connected to the transceiver module through the motherboard. See Figures 8-7 and 8-8 for panel views and pinouts.





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5.3.1.3 SETTING SWITCHES ON CM4 OPTICAL INTERFACE ADAPTERS

The CM4 requires a module adapter when installed in slot 1 of the Digital Chassis. This can be an MA-271, MA-278, or an optical interface adapter. The Optical Interface adapters have two switches that must be set for proper system operation. These are shown in Figure 5-10 and described Table 5-8 below. See Figure 8-9 for a panel view and pinouts. The CM4 installed in slot 10 does not use a module adapter since it is connected to the transceiver module through the motherboard.



Figure 5-10. Location of DIP switch SW1 on typical Optical Interface Adapter

Table 5-8	Switch settin	os DIP swite	h SW1 on	typical O	ntical Inter	rface Adanter
1 able 5-0.	Switch settin	igs, DIF Switc	II 2 M I OI	i typicai O	pucai miei	Tace Auapter

SW1-1	SW1-2	Mode
Down	Down	Terminal
Up	Down	DI-A
Down	Up	DI-B
Up	Up	Spare

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5.3.1.4 SETTING JUMPERS ON THE VF-5XP MODULE

The VF-5XP Module has six sets of jumpers that must be set for proper system operation. These are J7, J8, J9, J10, J11 and J12, and are shown in Figure 5-11. Jumpers J7, J8 and J11 are used to select CH1 E&M signaling type, and Jumpers J9, J10 and J12 are used to select CH2 E&M signaling type. Refer to Table 5-9 for information on how to set these jumpers.



Figure 5-11. Location of jumpers on VF-5XP module.

Table 5-9. Setting	g VF-5XP	jumpers
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Jumper	Function
J7	Jumpers J7, J8 and J11 are used to set the Channel 1 E&M Signaling Type as follows:
	Channel 1 Signaling Type
J8	Jumper Type I Type II Type III Type V
	J7 B B A
J11	J8 B B A
	J11 B A B B
J9	Jumpers J9, J10 and J12 are used to set the Channel 2 E&M Signaling Type as follows:
110	Channel 2 Signaling Type
J10	<u>Jumper Type I Type II Type III Type V</u>
110	J9 B B A
J12	J10 B B A
	J12 B A B B

Note: All other jumpers on the VF-5XP are used for FACTORY TESTING only.

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5.3.1.5 VF-5XP MODULE ADAPTER

The VF-5XP requires a Module Adapter. The Module Adapter plugs into the rear of the chassis directly behind the VF-5XP and provides the appropriate connections for the desired interface. There are five Module Adapters compatible with the RFL VF-5XP: the MA-301, MA-301A, MA-301B, MA-322 and MA-324. The MA301B is the standard module adapter for the RFL 9508 chassis.

The MA-301B provides plug-in terminal block connections for a single VF-5XP module. Audio and signaling connections are available at the terminal block. No SWC or fast transient protection is provided on this I/O. Refer to Figure 5-12 for a rear panel view and terminal connections for the MA-301B. This module adapter occupies one rear chassis slot.



Figure 5-12. MA-301B Module Adapter, rear panel view and pinouts

5.3.1.6 SETTING JUMPERS ON THE PLC-TT MODULE

The PLC-TT Module has three of jumpers that must be set for proper system operation. These are J2, J3, and J4, and are shown in Figure 5-13. Refer to Table 5-10 for information on how to set these jumpers.



Figure 5-13. Location of jumpers on PLC-TT module.

Table 5-10	. Setting	Jumpers	on the	PLC-TT	module
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Jumper	Function
J1	For factory use only.
(connector)	
J2	Enables or disables the watchdog timer. Used for factory testing only. Should always be in "RUN"
(jumper)	(DOWN) position.
J3	Selects Relay or Solid-State output for PLC-TT Module Adapter "A" located in slots 5 through10.
(jumper)	
J4	Selects Relay or Solid-State output for PLC-TT Module Adapter "B" located in slots 11 through 16.
(jumper)	(This is the second module adapter used in some applications)
JP1	Used to connect cable from optional test panel.
(connector)	
JP3	Used to connect a cable (RFL part number 107890) from JP3 of PLC-TT module to connector located
(connector)	at slot 8 of mother board, when a second PLC-TT Module Adapter is installed.

5.3.1.7 SETTING JUMPERS ON THE PLC-TT MODULE ADAPTER

The PLC-TT Transfer Trip Module requires a Module Adapter. The Module Adapter provides the appropriate interface for the desired application. The PLC-TT Module Adapter has two jumpers that must be set for proper system operation. These are J4 and J5 on the module adapter Input Board, as shown in Figure 5-14. Refer to Table 5-11 for information on how to set these jumpers.



Figure 5-14. Location and use of voltage control jumpers on a typical I/O adapter module input board

Once the I/O adapter module has been selected, check the settings of the voltage control jumpers located on the I/O adapter module input board(s). All eight versions of the I/O module input boards shown in Figure 5-13 are identical, with the exception of the placement of the two voltage control jumpers J4 and J5. Note the location of these jumpers in Figure 5-13.

For 48V operation both jumpers must be in the 48V position. For 125V operation both jumpers must be in the 125V position. The 250V modules should have both jumpers in the 125V position. See Table 5-11.

I/O Adapter Module part number	I/O Adapter Module type	J4 and J5 jumper position
105770-2	2 function 48/125V solid state	48V position
105770-4	4 function 48/125V solid state	for 48V operation,
105740-2	2 function 48/125V relay	125V position
105740-4	4 function 48/125V relay	for 125V operation
105770-3	2 function 250V solid state	
105770-5	4 function 250V solid state	125V position
105740-3	2 function 250V relay	for 250V operation
105740-5	4 function 250V relay	

Table 5-11. Voltage contro	l jumper settings (on module adapter	Input Board
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5.3.1.8 SETTING JUMPERS ON THE TRANSCEIVER MODULE

The Transceiver Module has several jumpers that must be set for proper system operation. All of these jumpers are set at the factory and should not be changed by the user. In addition to this, all test points are for factory use only. The Transceiver Module has 5 LEDs as follows: D1 through D5. The location of these LEDs is shown in Figure 5-15. The function of the LEDs is shown in Table 5-12.



Figure 5-15. Location of LEDs on Transceiver module.

LED	Function
D1	Presently unused, normally GREEN (LED is ON when power is applied to transceiver module)
D2	Channel 0 Status
	Has three states as follows:
	GREEN: No alarms detected on Channel 0.
	Flashing RED: Signal to Noise ratio is below the threshold. The threshold is user settable in the RF Setup section of NMS.
	Solid RED: Loss of Signal. This is a user threshold which is user settable in the RF Setup section of NMS
D3	Channel 1 Status
	Has three states as follows:
	GREEN: No alarms detected on Channel 1.
	Flashing RED: Signal to Noise ratio is below the threshold. The threshold is user settable in the RF Setup section of NMS.
	Solid RED: Loss of Signal. This is a user threshold which is user settable in the RF Setup section of NMS
D4	T1/E1 Status
	Has two states as follows:
	GREEN: Incoming signal from the CM4 is OK
	RED: Problem detected with incoming signal from CM4.
D5	Power LED
	GREEN when transceiver module power is ON

Table 5-12. Function of LEDs on the Transceiver module

5.3.1.9 SETTING JUMPERS ON TRANSCEIVER MODULE ADAPTER

The Transceiver Module requires an MA-650 Module Adapter. The MA-650 plugs into the rear of the chassis directly behind the Transceiver Module and provides the appropriate connections to the line coupling equipment. This Module Adapter has one jumper (JP1) that must be set to either T1 or E1. Refer to Figure 5-16 for a rear panel view and terminal connections for the MA-650. This module adapter occupies one rear chassis slot.



Figure 5-16. MA-650 Module Adapter, rear panel view and pinouts

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5.3.1.10 SETTING JUMPERS FOR DROP AND INSERT APPLICATIONS

In T1/E1 applications, the RFL 9508 can be either Terminal/DI-A or DI-B. Several of the modules in the 9508 chassis have jumpers that must be set to select Terminal or Drop-and-insert operation. The list below indicates which modules have jumpers that must be set for D&I applications.

Module	See paragraph
CM4	5.3.1.1
MA-271	5.3.1.2
MA-278	5.3.1.2
Optical Interface Adapter	5.3.1.3

5.3.2 SETTING JUMPERS AND SWITCHES IN THE ANALOG CHASSIS

The Analog Chassis has several modules, which have jumpers or switches that must be set, and adjustments that must be made, to configure the RFL 9508 system for proper operation. These modules are listed below.

Module	See Paragraph:		
50W Power Amplifier	5.3.2.1		
Tx Filter	5.3.2.2		
Balance Board	5.3.2.3		
Line Board	5.3.2.4		
Attenuator	5.3.2.5		
Rx Filter	5.3.2.6		

Table 5-13. Analog Chassis Jumper Configurations And Other Settings

5.3.2.1 SETTING JUMPERS AND SWITCHES ON 50W POWER AMPLIFIER

The 50W Power Amplifier has a circuit board which contains two programmable jumpers, J6 and J7. In addition to this, the board has five connectors (J1, J2, J3, J4, J5), and five potentiometers (R8, R14, R69, R74, R83) that must be set for proper system operation. These components can be seen in Figure 5-18 on the following page. Table 5-14 describes the functions of these components and indicates how the jumpers and potentiometers must be set.

Effective October 2010, two DIP Switch banks SW1 and SW2 have been added to the Power Amp Circuit Board. These switches are factory set for optimum operation but can be changed in the field if required. See Table 5-15 for a description of the switch functions and their settings.



Figure 5-17. Power Amp location

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Figure 5-18. Circuit board of the 50W Power Amp showing locations of jumpers, switches, connectors, potentiometers.

As shown above; effective October 2010, two switch blocks have been added to the Power Amplifier Circuit Board. These DIP switches are factory set to protect the circuit board from overvoltage or excessive phase angle situations. See Table 5-15 for a description of the switch settings.

If the protective circuits are activated the Power Amplifier will shut down for approximately 2.5 seconds and then come up for 25ms. This pattern will continue until the safety parameters are met and the condition cleared.

Reference Designation	Component	Function		
DS1	LED (green)	This LED is located on the front left panel of the Power Amplifier. The LED is lit when the Power Amplifier is transmitting.		
J1	connector	Provides input dc voltage from power supply, +92Vdc and +30Vdc.		
J2	connector	Power output to Tx Filter Module.		
J3	connector	Power amplifier failure alarm output signal. Signal goes to alarm relay on balance board, which provides form-C contacts on back of RF chassis. Output is +12Vdc when power amp fails.		
J4	connector	Tx In (RF input signal from back of MA-650)		
J5	connector	Spare Tx In (not used)		
J6 & J7	jumpers	These are Phase Jumpers used in 100W applications, which set the outputs of the two 50W amplifiers 180 deg out of phase. This will insure that the total output power is additive. In 50W applications, J6 and J7 can be set either way. In 100W applications, one 50W amp must be set to "A" and the other 50W amp must be set to "B". As a standard, set the Main 50W amplifier to "A" and the Auxiliary 50W amplifier to "B" as shown below.		
		Setting "A" Setting "B"		
J8*	jumpers	For factory use only. Should always be set to position B.		
J9*	jumpers	For factory use only. Determines if output disconnect relay is used. For use with ON-OFF carrier set to B. For all other applications set to A.		
J10*	jumpers	For factory use only. Should always be set to Insert.		
R8	potentiometer	Sets the low input RF signal threshold at J4		
R14	potentiometer	Sets the idle current, which is the power that the power amp draws from the power supply with no load and no input signal.		
R69	potentiometer	Balances the RF output signal		
R74	potentiometer	Over current RF output adjustment		
R83	potentiometer	RF output power level adjustment.		
R163*	potentiometer	For factory use only.		

 Table 5-14. Function of jumpers, connectors and potentiometers on Power Amp.

* Effective October 2010

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Note: All jumper and potentiometer settings are made at the factory and should not need field adjustment, except the gain potentiometer R83, and the threshold potentiometer R8.

For DIP Switch settings SW1 and SW2 see below. Set to ON to enable the DIP Switch, unused DIP switches must be set to OFF. **The table below is effective May 2011.**

	Phase Limit Setting: The 50W Power Amplifier will shut down if a preset Phase Angle is exceeded. The factory set threshold is 60 degrees. SW1-1 through SW1-8 can be set as follows: Note that SW1-2, SW1-4, SW1-5 and SW1-6 are not used.			
	DIP Switch	Phase Angle in Degrees		
SW1	SW1-1	30		
	SW1-3	45		
	SW1-7	60 Default setting		
	SW1-8	90		
	Phase Detector Set Point: These DIP switches set the voltage threshold for the Phase Limit Setting. The Phase limit circuit will not operate if the voltage falls below the preset. SW2-1 through SW2-4 can be set as follows:			
SW2-1 thru SW2-4	DIP Switch	Setting		
	SW2-1	Not used		
	SW2-1 SW2-2	Not used 40V		
	SW2-1 SW2-2 SW2-3	Not used 40V 30-35V Default		
	SW2-1 SW2-2 SW2-3 SW2-4	Not used 40V 30-35V Default 20-25V		
	SW2-1 SW2-2 SW2-3 SW2-4 Overvoltage Detect The 50W Power Am preset threshold. SW	Not used 40V 30-35V Default 20-25V or Set Point: plifier will shut down if the output voltage exceeds the /2-5 through SW2-8 can be set as follows:		
	SW2-1 SW2-2 SW2-3 SW2-4 Overvoltage Detect The 50W Power Am preset threshold. SW DIP Switch	Not used 40V 30-35V Default 20-25V or Set Point: plifier will shut down if the output voltage exceeds the /2-5 through SW2-8 can be set as follows: Setting		
SW2-5 thru SW2-8	SW2-1 SW2-2 SW2-3 SW2-4 Overvoltage Detect The 50W Power Am preset threshold. SW DIP Switch SW2-5	Not used 40V 30-35V Default 20-25V or Set Point: plifier will shut down if the output voltage exceeds the /2-5 through SW2-8 can be set as follows: Setting 90V		
SW2-5 thru SW2-8	SW2-1 SW2-2 SW2-3 SW2-4 Overvoltage Detect The 50W Power Am preset threshold. SW DIP Switch SW2-5 SW2-6	Not used 40V 30-35V Default 20-25V or Set Point: plifier will shut down if the output voltage exceeds the /2-5 through SW2-8 can be set as follows: Setting 90V 85V		
SW2-5 thru SW2-8	SW2-1 SW2-2 SW2-3 SW2-4 Overvoltage Detect The 50W Power Am preset threshold. SW DIP Switch SW2-5 SW2-6 SW2-7	Not used 40V 30-35V Default 20-25V or Set Point: plifier will shut down if the output voltage exceeds the /2-5 through SW2-8 can be set as follows: Setting 90V 85V 70V Default		

Table 5-15. Function of DIP Switches SW1 and SW2 on Power Amp Board.

Note that the Phase Detector circuit will also shut down the Power Amplifier if the output voltage is above the set threshold and the output current is very low (well below 200ma).

5.3.2.2 SETTING JUMPERS ON Tx FILTER AND Tx FILTER TUNING

The Tx Filter consists of two PC boards that are mounted at right angles to each other and are supported by an aluminum frame. The Tx Filter has a total of 44 jumpers that must be configured for proper system operation. Two of these jumpers (J1 and J45) are used to select the bandwidth of the filter which can be either 8kHz or 16kHz. Jumper J44 is used for system testing, and the other 41 jumpers are used to tune the center frequency of the filter from 24kHz to 496kHz. The outer edges are 20kHz and 500kHz. Tuning the filter is done from the RF Section of the NMS software.

NOTE

For single 4kHz or single/dual 2.5kHz operation, set this filter to 8kHz wide. For more channels, set it to 16kHz wide.

27 of the jumpers are located on the 107828-2 board. This is the board with the two large air core inductors. The location of these jumpers is shown in Figure 5-18. The remaining 17 Jumpers are located on the 107828-1 board. The location of these jumpers is shown in Figure 5-19. Refer to Table 5-15 for information on how to configure the jumpers on the Tx Filter.

Jumper	Function
J1 and J45	Used to select 8kHz or 16kHz Tx Filter bandwidth. Both jumpers must be set to 8kHz to select 8kHz bandwidth. Both jumpers must be set to 16kHz to select 16kHz bandwidth.
J44	Used to select Normal or Test operation. Set to Normal position for normal system operation. Set to Test position to move the T1 Test Point from one coil to another during system testing. Used for tuning the air core inductors L1 and l2.
J1 to J13, and J15 to J43	Used to tune the center frequency of the Tx Filter from 24kHz to 496kHz. The outer edges are 20kHz and 500kHz. Tuning the filter is done from the RF section of the NMS software. For example, for a center frequency of 90kHz, the following jumpers should be installed: J3, 5, 6, 8, 10, 11, 18, 20, 23, 24, 34, 35, 37 and 38

Table 5-16. Tx Filter Setup Jumpers

Be sure to loosen the inductor fixing screws before making an adjustment, and to tighten them after the adjustment is completed.

5.3.2.2.1 TX FILTER TUNING PROCEDURE

Required Equipment:

- Frequency Selective Voltmeter with high impedance input
- 50 Ohm non-inductive load (50 Watt minimum rating)
- PC with 9508 NMS, and RS-232 9-pin female connection.
- 11/32" hexagonal nut driver
- Philips head screwdriver

Tx Filter Tuning Procedure:

- 1. Use RFL 9508 NMS software to generate a list of appropriate jumper settings. Refer to section 4 of the manual for more information on RFL 9508 NMS.
- 2. Remove the Tx Filter from the chassis and open the hood, by removing the two screws on the top. Also loosen the two screws that lock the air core coils L1 and L2 in place.
- 3. Set the Tx Filter jumpers for center frequency according to your configuration. If needed, spare jumpers are shipped with each unit.
- 4. Set the 8kHz/16kHz bandwidth jumper to the appropriate position.
- 5. Using the RFL 9508 NMS software set the Transceiver to generate a tone using the internal generator with a frequency equal to center frequency of the filter.
 - a. Enable RF Channel 1 and disable RF Channel 2.
 - b. Set Channel 1 to upper side band (USB).
 - c. Enable the Internal Generator in RF Channel 1, set sweep rate to 0 kHz/sec, and set the frequency to 2kHz.
 - d. Enable one (1) subchannel in RF Channel 1 Tx section, set subchannel filter to 300-3700 Hz pass band.
 - e. Set RF Channel 1 Voice Atten. level for 0dB, Set RF Channel 1 Signaling level to -42dB.
 - f. Set RF Channel 1 TX Frequency to TX filter center frequency 2 kHz For example:
 - •Tx Filter Center Frequency = 300 kHz
 - •Set TX Frequency = 300 2 = 298 kHz
 - g. Set "TX Att Level" to 0 dB.
 - h. Click on the write button. Do not save this configuration.
- 6. On the Tx Filter board, set Jumper J44 in the "NORM" position.
- 7. Connect a Frequency Selective Voltmeter (FSVM) to TP1 "Input" and TP2 "Common".

- 8. Connect a 50 Ohm non-inductive load (50W minimum rating) across TP1 "Input" and TP2 "Common".
- 9. Remove either the Balance Board or the External Amp Connection Board depending on which is present in the RF Chassis).
- 10. Adjust L1 (right coil) for a minimum level on the meter. The coil is adjusted by turning the plastic nut accessible from the front of the module. If a null is not seen, the lowest value of the first series capacitance may have to be varied, use the schematic as a guide.
- 11. Set Jumper J44 in the "TEST" position.
- 12. Adjust L2 (left coil)for a minimum level on the meter. The coil is adjusted by turning the plastic nut accessible from the front of the module. If a null is not seen, the lowest value of the second series capacitance may have to be varied, use the schematic as a guide.
- 13. Set Jumper J44 back to the "normal" position.
- 14. Tighten the screws to lock the air core coils L1 & L2 into position.
- 15. Reattach the hood with the two screws that were removed earlier.
- 16. Reinstall the Balance Board or the External Amp Connection Board that was removed earlier.
- 17. Verify that all modules are seated securely.
- 18. Using RFL 9508 NMS write the original configuration back.
- 19. Your Tx Filter is now tuned.



Figure 5-19. Location of jumpers on Tx Filter, PC Board 107828-2

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Figure 5-20. Location of jumpers on Tx Filter, PC Board 107828-1

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5.3.2.3 BALANCE BOARD SETTINGS

The Balance Board has three jumpers J2, J3 and J4 that must be set for proper system operation. The jumper settings select either 50W or 100W operation and must be set in accordance with Table 5-16. The jumper locations are shown in Figure 7-9, and are accessible only when the Balance Board is removed from the chassis.

Number Of Amplifiers	J2 Jumper Settings	J3 Jumper Settings	J4 Jumper Settings
One (50W)	1-2	2-3	2-3
Two (100W)	2-3	1-2	1-2

Table 5-17. Setting Jumpers On Balance Board

5.3.2.4 SETTING JUMPERS AND CONTROLS ON LINE BOARD

The Line Board has 26 jumpers that must be set for proper system operation. Two of these jumpers, J10 and J20, are for impedance matching, 12 jumpers are used for balancing the line impedance, and 4 jumpers are used to select 2W or 4W operation. The location of these jumpers is shown in Figure 5-20. Refer to Table 5-17 for information on how to configure these jumpers on the Line Board.



Figure 5-21. Location of Jumpers on Line Board

Reference Designation	Component	Function		
J10	Jumper	Used to set Rx Impedance of 4W systems.		
		Can be set to 50, 75, 100 or 130 Ohms for 103090 module.		
100	T	Can be set to 50, 75, 100 or 150 Ohms for 103090-1 module.		
J20	Jumper	Used to set Tx Impedance of 4W systems or the Tx & Rx Impedance of 2W systems		
		2 w systems. Can be set to 50, 75, 100 or 130 Ohms for 103090 module		
		Can be set to 50, 75, 100 or 150 Ohms for 103090 module.		
J1-J9	Jumper	Adjusts capacitive component of line impedance.		
	1	Refer to the Hybrid Tuning procedure in paragraph 6.2???.		
J13-J15,	Jumper	Adjusts inductive component of line impedance		
J17-19, J21	_	Refer to the Hybrid Tuning procedure in paragraph 6.2.		
and J22				
R1	Potentiometer	Adjusts resistive component of line impedance.		
		Refer to the Hybrid Tuning procedure in paragraph 6.2.		
S1	Switch	A 6-position rotary switch, which allows the selection of various resistors to		
		adjust the resistive component of the line impedance.		
		Refer to the Hybrid Tuning procedure in paragraph 6.2.		
J28	Jumper	Install this jumper in the TOP position if the attenuator module is not		
		equipped. Install it in the BOTTOM position if the attenuator module is		
105		equipped.		
J25	Jumper	Selects 4W mode or Loopback mode.		
J11, J12 and	Jumper	All three of these jumpers must be set to 2W to select 2W mode.		
J23		All three of these jumpers must be set to 4W to select 4W mode.		
R10	Potentiometer	Adjusts the Rx Output level. See paragraph 6.2 for adjustment procedure.		
TP1	Test point	Connect the low or common side of test equipment to this test point when		
		monitoring TP2 or TP3.		
172	Test point	1 x monitor high, test point.		
TP3	Test point	Rx monitor high, test point.		
	_			
J16	Jumper	Used for factory testing. In normal operation this jumper is not installed.		

Table 5-18. Line Board Setup Jumpers and Switch Setting

5.3.2.5 ATTENUATOR BOARD SETTINGS

The Attenuator Board has one toggle switch (SW1) that must be set for proper system operation. The toggle switch SW1 selects either Normal or Loopback operation. In Normal operation, set the switch to the DOWN position. In Loopback operation set to switch to the UP position, there is a 40dB drop from the original Tx signal in Loopback Mode. The switch location is shown in Figure 7-13, and is accessible when the Attenuator Board is plugged into the chassis.

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Note that Jumper J28 must be in the BOTTOM position on the Line Board and the Tx and Rx frequencies must be the same.

5.3.2.6 SETTING JUMPERS ON Rx FILTER AND Rx FILTER TUNING

The Rx Filter has a large number of jumpers (about 100) that must be configured for proper system operation. These jumpers allow a user to select the bandwidth, which can be either 8kHz or 16kHz, and to tune the center frequency, which can be from 24kHz to 496kHz (the outer edges are 20kHz and 500kHz). The location of these jumpers is shown in Figure 5-22. Tuning the filter is done from the RF Section of the NMS software.

NOTE For single 4kHz or single/dual 2.5kHz operation, set this filter to 8kHz wide. For more channels, set it to 16kHz wide.

5.3.2.6.1 RX FILTER TUNING PROCEDURE

Table 5-19 Filter Parameters

8kHz Bandwidth	16kHz Bandwidth
Attenuation at +/- 4Khz<0.35 dB	Attenuation at +/- 8Khz<0.35 dB
Attenuation at +/- 12Khz>9.5 dB	Attenuation at +/- 18Khz>9.5 dB

Useful tips:

L2 controls the balance of the filter (flat response at both sides of center frequency)

L1 controls the attenuation at the upper side of center frequency.

L3 controls the attenuation at the lower side of center frequency.

WARNING

The adjusters are very easy to brake and care must be used when turning them

Required Equipment:

Frequency Selective Voltmeter with high impedance input 50 Ohm non-inductive load PC with 9508 NMS, and RS-232 9-pin female connection Phillips head core alignment tool for L1, L2, and L3 9508 RF Extender Card

RX Filter Tuning Procedure:

- 1. Turn Power OFF to the RF and AF Chassis of the 9508.
- 2. Use RFL 9508 NMS software to generate a list of appropriate jumper settings. Refer to Section 4 of the manual for more information on RFL 9508 NMS.
- 3. Set the RX Filter jumpers for Center Frequency according to your configuration.
- 4. Disconnect the BNC cable from the MA-650 Rx input. With the same cable terminate the RF chassis' RX output into a 50 ohm non-inductive load.
- 5. Connect a frequency selective voltmeter (FSVM) to the load.
- 6. Arrange a loopback connection between Transmitter TX OUT and Receive Filter RX IN following these steps.
 - a. Bypass the Transmit Filter by placing J44 on the rear of the filter to the "Test" position and removing J45.
 - b. Place the loopback switch on the Attenuator Module for the Test position (UP).
 - c. On the Line Board set J25 to "Loop" and J23 to "4W".
 - d. Place RX Filter Board on an extender card for adjustment.
 - e. Turn power ON to the AF & RF Chassis.

- 7. Using the RFL 9508 NMS software set the Transceiver to generate a tone using the internal generator with a frequency equal to center frequency of the filter.
 - a. Enable RF Channel 1 and disable RF Channel 2.
 - b. Set Channel 1 to upper side band (USB).
 - c. Enable the Internal Generator in RF Channel 1, set sweep rate to 0 kHz/sec, and set the frequency to 2kHz.
 - d. Enable one (1) subchannel in RF Channel 1 Tx section, set subchannel filter to 300-3700 Hz pass band.
 - e. Set RF Channel 1 Voice Atten. level for 0dB, Set RF Channel 1 Signaling level to -42dB.
 - f. Set RF Channel 1 TX Frequency to the desired frequency -2kHz: For example:To generate a 300kHz tone set TX Frequency = 300 - 2 = 298 kHz
 - g. Set "TX Att Level" to 0 dB.
 - h. Click on the write button. Do not save this configuration.
- 8. Adjust L2 first, followed by L1 and L3 to have minimum loss at center frequency. The final level measurement is called the OFFSET.
- 9. Set TX Frequency according to step 7 to RX filter center frequency ± 4 kHz for 8kHz bandwidth, or ± 8 kHz for 16kHz bandwidth.
 - a. To balance the response adjust L2 to have the same level at ± 4 kHz for 8kHz bandwidth, or ± 8 kHz for 16kHz bandwidth.
 - b. The levels should be the OFFSET level ± 0.35 dB.
- 10. Set TX Frequency according to step 7 to RX filter center frequency ± 12 kHz for 8kHz bandwidth, or ± 18 kHz for 16kHz bandwidth.
 - a. Adjust L1 to get the desired attenuation at -12 kHz or -18 kHz for 16kHz bandwidth
 - At least 9.5 dB below the OFFSET level
 - b. Adjust L3 to get the desired attenuation at +12 kHz or +18 kHz for 16kHz bandwidth
 - At least 9.5 dB below the OFFSET level.
- 11. Verify the ripple in the passband is < 0.35 dB.
- 12. Turn off power to the AF & RF Chassis.
- 13. Put the jumpers and switched back in their normal configuration for the line board, TX filter, attenuator.
- 14. Remove the RX filter from the extender and install the RX filter back into the chassis.
- 15. Verify that all modules are seated securely.
- 16. Using RFL 9508 NMS write the original configuration back.
- 17. Your RX Filter is now tuned.



Figure 5-22. Location of Jumpers on Rx Filter Board, showing jumper groupings

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Figure 5-23. Location of Jumpers on RF Motherboard

5.3.2.7 SETTING JUMPERS ON THE RF MOTHERBOARD

There are two jumpers on the RF Mother Board, J13 and J14. Set to 'A' for unbalanced (tied to ground) and set to 'B' for balanced (open position).

5.3.2.7.1 FOUR WIRE SYSTEMS

Four-Wire systems require the following jumpers to be set to 4W position on the Line board: J11, J12, J23, and J25. Refer to paragraph 5.3.2.4 and Figure 5-20 for the location of these jumpers.

5.3.2.7.2 TWO WIRE SYSTEMS

Two-Wire systems require the following jumpers to be set to 2W position on the Line board: J11, J12, and J23. Refer to paragraph 5.3.2.4 and Figure 5-20 for the location of these jumpers.

5.3.2.7.3 50W SYSTEMS

50Watt systems require jumpers to be set on the Balance Board as follows: J2 must be set to the 1-2 position. J3 must be set to the 2-3 position. J4 must be set to the 2-3 position. Refer to paragraph 5.3.2.3 and Figure 7-9 for the location of these jumpers.

5.3.2.7.4 100W SYSTEMS

100Watt systems require jumpers to be set on the Balance Board as follows:J2 must be set to the 2-3 position.J3 must be set to the 1-2 position.J4 must be set to the 1-2 position.Refer to paragraph 5.3.2.3 and Figure 7-9 for the location of these jumpers.

5.3.3 CHANGING THE RF FREQUENCY BAND

The RFL9508 is typically shipped from the factory preprogrammed for the desired RF frequency band. In the event that the user wishes to change the operating band The following steps must be taken.

Tune the TX filter to the proper band (section 5.3.2.2) Tune the RX filter to the proper band (section 5.3.2.6) Set the transceiver Transmit and receive frequencies (section 4.5.3.11) Perform the commissioning procedure (section 6)

Section 6. COMMISSIONING PROCEDURE

6.1 REQUIRED EQUIPMENT

- o 9508 Manual/CD (as required).
- o PC with 9508 NMS Installation Disk (as required).
- Copy of the NMS Network File (supplied with system CD).
- o RS232 strait-through Cable 9-Pin Female to Female
- o FSVM-Frequency Selective Voltmeter & Cabling for test set
- o 50 or 100-Watt Dummy Load
- RF Board Extender Card (Part No.107885)
- Hex adjustment tool

WARNING!

THE 9508 CARRIER OUTPUT CONNECTOR MUST BE TERMINATED PROPERLY BEFORE BEING ENERGIZED. FAILURE TO DO THIS MAY RESULT IN DAMAGE TO THE TX FILTER. SEE STEP 4. BELOW.

CAUTION

THE POWER AMPLIFER WILL SHUTDOWN IF NOT PROPERLY TERMINATED CONDUCT LINE TUNING PROCEDURES AT REDUCED POWER LEVELS. (FSK – Guard, ON/OFF – Reserve Key)

6.2 COMMISSIONING PROCEDURE

6.2.1 AF CHASSIS INITIAL POWER UP

- 1. Before turning power on, verify proper Input Voltage and voltage polarity connections.
- 2. Verify proper Ground connections for both AF & RF Chassis utilizing GND studs on Power Supply IO.
- 3. Remove coax from chassis to line tuner.
- 4. Connect 50 Ohm non inductive dummy load of sufficient wattage to the carrier output connector (4W Tx or 2 W I/O). Reference Paragraph 6.2.7.1
- 5. Seat all modules firmly in the chassis.
- 6. Turn on the TOP AF Power Supply Switch only.



6.2.2 9508 NMS SOFTWARE PC INSTALLATION (AS REQUIRED)

1. Locate the Installation Disk. The Disk should contain: NMS Installation Software, Factory created Network file, Excel tone level spread sheet.

2. Follow NMS Software Installation Procedure 4.2.1 in 9508 Manual

3. After download, click on the created NMS ICON. A security window will appear.

4. Type in for USER ID: [CONTROL], and PASSWORD: [PASSWORD] as depicted below. Enter twice. Note: The user Password will not be visible when typed in the field.

6.2.3 9508 NMS SOFTWARE ACCESS



- 1. Copy Configuration files from the system CD supplied with the equipment.
- 2. If the system CD is not available, do the following:
 - a. Select "new" icon.
 - b. Enter network information, and also "9600, 8, 0(N), 1".
 - c. Enter "OK"
 - d. Select "Save"icon.
 - e. Enter file name
 - f. Enter "save".
 - g. Select "net vw" icon.
 - h. Select node (dot).
 - i. Enter "site ID".
 - j. Check CM4R for address.
 - k. Enter "address".
 - l. PC "Comm path".
 - m. Select Node type "terminal"
 - n. Select DACS/ILS "none".

o. "Exit"

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p. "Exit" q. "Exit" r. Select "Batch" icon. s. Select "Net read" icon. t. Select node number.u. Select "Auto Config" v. Select "Method 2". w. Select "Ok". x. Select "Ok". y. Select "Yes". z. Select "real time" icon aa. Select "net vw" icon. bb. Select change toolbar. cc. Select "terminal". dd. Select "RF setup". ee. Select "Files" toolbar ff. Select "program settings". gg.Change "modbus slave" to "99". hh. Select "accept". ii. Select "Read" toolbar. jj. Close session. kk. Enter "yes". ll. Select "yes". mm. Enter "OK". nn. Select "exit". oo. Repeat steps 5 through 38 for the second node.

6.2.4 9508 NETWORK SESSION

1. Click on the OPEN Icon from the main screen and choose system file from list.

2. The File will open with this EDIT NETWORK INFORMATION window. The user may have to set the PC Communication Port. Confirm the DATA Bits, Parity, Stop Bits are 9600, 8, N (0) and 1.

3. After the Connection Com Port has been selected Click OK.

4. Connect RS-232 cable between PC and Com Port selected.

- 5. Select "REAL TIME" to enter an active NMS Session.
- 6. Click on Net Vw Icon, as required.



7. "Net Vw" (terminals) window will appear. The user must Click on the Local node (the one directly connected to the comms port). The software will automatically attempt to Read the CM4 card.

ESSOS DI		Locytion B				
Change	Add Node	Delete Node	Move Node	Add Line	Remove Line	Print Egit 2

8. Ensure all channel cards are listed.



6.2.5 RF SOFTWARE PARAMETER VERIFICATION

Display/Chai	nge Node	
Site ID: Nodo #:	9508	
Address:	1	VF5XP (3)
IP Address	:	TT (5) VE5XP (11)
Pass throu Comm Path:	gh port <u>0 ∰</u> © 1 C 2 C 3 C 4	
Node Type:	C <u>T</u> erminal C <u>S</u> tand alone	
DACS/ILS : (select button to change values)	© None C⊇acs C⊇acs-R C∥LS C∥LS-R	Add Delete View
CM : Stan	DI-A DI-B dby Main Standby Main	All Timeslots ?
	E ACTIVE NONE ACTIVE	RF Setup

- 1. Select "RF Setup" option.
- 2. Select "read".



6.2.6 ENABLE F6 TEST TONE



1. Select "Channel 1" tab.

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- 2. Select 'F6 enable" as required.
- 3. Select "F6 Test Command".
- 4. "Write" to terminal.
- 5. Repeat steps 1 through 4 for channel 2 as required.
- 6. Close session.
- 7. Select "yes".
- 8. Select "save".
- 9. Select "OK".
- 10. Select "exit".
- 11. Refresh all RF parameters for second node (terminal) repeating steps III to VI, as required.

6.2.7 RF TRANSMITTER POWER LEVEL VERIFICATION.

6.2.7.1 TRANSMITTER COMMISSIONING: VERIFICATION OF THE CARRIER OUTPUT LEVEL.

- 1. Remove the coax from carrier output to the Line Tuner (if previously connected)
- 2. Connect a 50-ohm non-inductive dummy load of sufficient wattage 50/100 to the carrier output connector (4W Tx or 2W I/O). RF CHASSIS



- 3. Turn On Power to RF Top chassis.
- 4. Via software, Activate the F6 test tone, and F6 enable in one or both channels at the Local terminal, as required. Reference steps in VI 1-11.
- 5. Tune the Frequency Selective voltmeter (FSVM) for the local Tx carrier frequency plus 427Hz.
- 6. Place the Frequency Selective voltmeter (FSVM) leads on the Line Board TP1 (-) and TP2 (+), and verify the following approximate levels as applicable for your system:

50 Watts single RF channel45 dBm100 watts single RF channel48 dBm50 Watts dual RF channel39 dBm100 Watts dual RF channel42 dBm

7. Turn Power Off, and disconnect the dummy load and re-connect the coax that feeds to the Line Tuner.



- 8. Place the Line Board on an Extender Board.
- 9. Verify jumpers J1 through J9, J15, J17, J18, J19, J21 and J22 are in the OUT position and J14 is in the IN position.

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- 10. Using a FSVM, monitor the local Tx carrier frequency plus 427 Hz at TP7 (-) and TP6 (+).
- 11. Adjust switch S1, Resistor R1 and Inductor L1 for a minimum reading on the FSVM.
- 12. Reposition jumpers J1 through J9 IN until a combination of capacitance provides a minimum reading on the FSVM.
- 13. Reposition jumpers J15, J17, J18, J19, J21, and J22 IN until a combination of inductance provides a minimum reading on the FSVM.
- 14. Repeat steps in 5 above until lowest level is attained.
- 15. Repeat steps 1 to 5 in Section VI for Opposite 9508 end.

6.2.7.2 ADJUSTING THE RECEIVER LEVEL

- 1. Using a FSVM, monitor the local Rx carrier frequency plus 427 Hz at Line Board TP7 (-) and TP6 (+). While Remote 9508 is Transmitting F6 Tone.
- 2. Adjust Rx level potentiometer R10 for -13 dBm for a single RF channel or -19 dBm for a dual RF channel at 75 ohms impedance.
- 3. Remove extender module and re-install Line Board in the chassis
- 4. Return NMS settings to match those on the RFL CD drawing.
- 5. Test all system functions.

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Section 7. MODULE DESCRIPTIONS, RFL 9508 RF SECTION

The RF section is located in the upper portion of the 9508, 6U chassis The following eight modules are included in the RF section of the RFL 9508 chassis.

Module	Assembly Number	For Additional Information Refer To The
		Following Paragraphs:
50W Power Amplifier	105085	7.1
Power Amp Power Supply	107250-4, -5	7.2
Tx Filter	107825	7.3
Balance Board	107815	7.4
External Amp Connection Board	107870	7.5
Line Board	103090, 103090-1	7.6
Rx Filter	107820	7.7
Attenuator Board	107810	7.8
RF Mother Board	103095	7.9

Table 7-1. Modules in	ncluded in	9508 RH	Section
-----------------------	------------	---------	---------

Refer to Figure 7-1 for module locations. The 50W Power Amp is mounted on the 9508 front door and is not shown for clarity. Refer to Figure 7-2 for the RF chassis block diagram.



Figure 7-1. Front View of RFL 9508 Analog Section

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7.1 POWER AMPLIFIER



Figure 7-3. RFL 9508 Power Amplifier

7.1.1 DESCRIPTION

The Power Amplifier is mounted on the upper portion of the front cover of the RFL 9508 chassis. The function of the Power Amplifier is to amplify the RF outputs of the RFL 9508 terminal before these signals are passed to the line coupling equipment. The Power Amplifier develops an RF output of 50 Watts. A green LED is located on the left side of the Power Amplifier front panel as shown in Figure 7-3. The LED is ON when the power amplifier is transmitting.

In those applications that require 100 Watts of RF output, two 50 Watt Power Amplifiers are added together by the balance transformer on the Balance Board. The second 50 Watt Power Amplifier is mounted in a 3U chassis directly above the RFL 9508 chassis as shown in Figure 7-4. There must be a 1U minimum space between these chassis for convection cooling. This additional 3U chassis will contain a total of five modules as follows: a Power Amplifier, a Power Amplifier Power Supply, a Mother Board, a Tx Filter and an External Amp Connection Board, as shown in Figure 7-5.

7.1.2 SPECIFICATIONS

As of the date this manual was published, the following specifications apply to all RFL 9508 Power Amps, unless otherwise noted. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Number Of Inputs: Two.

Input Level:

+10 dBm@75 Ohms - single input, +4 dBm@75 Ohms - two inputs.

Input Impedance: 50 Ohms nominal.

Idle Noise: -65 dBmO, measured in a 3-kHz bandwidth.

Frequency Response: Flat within +/-2.0dB from 20kHz to 500 kHz

Third Order Intermodulation Distortion:

From 60 to 350 kHz: -60 dBmO. Below 500kHz: -50 dBmO.

Harmonic Distortion: -40 dB.

Maximum Output: 50 Watts PEP

Output Resistance: 50 Ohms nominal.

Input Power:

+92Vdc@ 2.0 Amps +30 Vdc@ 0.2 Amps

Operating Temperature: -20° C to $+65^{\circ}$ C (-4° F to $+149^{\circ}$ F).

Dimensions:

5.2 inches (13.2 cm)high 17.1 inches (43.4 cm)wide 4.3 inches (10.9 cm)deep

Weight: 11 lbs 9 oz (5.3 kg)



Figure 7-4. Chassis configurations for RFL 9508 with 50W Amp and with 100W Amp



Figure 7-5. Front View of Additional 3U Chassis for 100W Systems

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7.2 POWER AMPLIFIER, POWER SUPPLY



Figure 7-6. RFL 9508 Power Amplifier, Power Supply

7.2.1 DESCRIPTION

As it's name implies, the Power Amplifier, Power Supply supplies power to the RFL 9508 Power Amplifier. There are two different types of Power Amplifier, Power Supplies available as shown in Table 7-2.

The 9508 Power Amplifier, Power Supply is a dual output, dc to dc converter. It is a switching power supply using pulse width modulation. The 107254-4 operates from 38 Vdc to 150 Vdc, and the 107254-5 operates from 200 Vdc to 300 Vdc. Each supply has two outputs, +30 Vdc @ 0.25 Amps and +92 Vdc @ 2.4 Amps. Both outputs are connected to a common ground. A block diagram of the Power Supply is shown in Figure 7-7.

Assembly Number	Input Voltage Range
107250-4	38 Vdc to 150 Vdc
107250-5	200 Vdc to 300 Vdc

Table 7- 2. I	nput Voltage	Ranges of Power	Amplifier Power	Supplies.
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7.2.2 SPECIFICATIONS

As of the date this manual was published, the following specifications apply to all 9508 Power Amplifier, Power Supply modules, except where indicated. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Input Voltage Range:

107250-4:	38 Vdc to 150 Vdc
107250-5	200 Vdc to 300 Vdc

Output Power:

30 Vdc@ 0.25 Amps 92 Vdc@ 2.4 Amps

Operating Temperature: -20° C to $+65^{\circ}$ C (-4° F to $+149^{\circ}$ F).

Humidity: +95% @ +40°degC.

Isolation: 2500 Vdc isolation from input terminals to ground, output terminals to ground, input terminals to output terminals, relay contacts to ground, and relay contacts to coil.

Dimensions:

5.2 inches (13.2 cm)high 8.8 inches (22.4 cm)wide 3.7 inches (9.4 cm)deep



Figure 7-7. 9508 Power Amplifier Power Supply, Block Diagram

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7.3 TX FILTER





7.3.1 DESCRIPTION

The RFL 9508 Tx Filter is a plug-in module consisting of two PC boards and two air core inductors. It plugs into the left side of the RF chassis as shown in Figure 7-1.

The primary function of the Tx Filter is to filter out harmonics that are out of the bandwidth of the filter. The bandwidth of the filter can be set to either 8kHz or 16kHz using two programmable jumpers, J1 and J45. The filter center frequency is tunable from 24kHz to 496kHz using programmable jumpers. The outer edges are 20kHz and 500kHz. The 8kHz bandwidth is used for one or two RF channel operation and the 16kHz bandwidth is used for three or four RF channel operation.

The secondary function of the Tx Filter is to allow parallel connection of additional PLC terminals by providing a high impedance to RF frequencies that are out of band.

7.4 BALANCE BOARD



Figure 7-9. Balance Board

7.4.1 DESCRIPTION

The RFL 9508 Balance Board is a plug-in module consisting of a PC board, a transformer, two power resistors, two relays, three jumpers (J2, J3 and J4) and various other components. It has an aluminum heat sink covering a portion of the board as shown in Figure 7-9. It plugs into the RF chassis just to the right of the Tx Filter as shown in Figure 7-1.

The function of the Balance Board is to provide the capability of connecting two 50W Amplifiers together for 100W applications. In the event that one of the 50W Amps fails, the remaining power amp will continue to run, with half of the power reaching the line, and the other half dissipated by the balance board. The jumpers are used to select 50W or 100W operation as described in paragraph 5.2.2.3.

7.5 EXTERNAL AMP CONNECTION BOARD

The RFL 9508 External Amp Connection Board is a plug-in module consisting of a PC board with wire jumpers only and uses the same PC board as the Attenuator Board. It is used in place of the Balance Board in the external RF Chassis for 100W applications as shown in Figure 7-5.

7.6 LINE BOARD



Figure 7-10. Line Board

7.6.1 DESCRIPTION

The RFL 9508 Line Board serves as the connection point between the RFL 9508 RF Chassis and the Line Coupling equipment. Because it contains no active components, the Line Board does not require any dc input voltage.

7.6.2 SPECIFICATIONS

Power Capability: 100 watts maximum.

Frequency Range: 103090: 20 - 500 kHz

Impedances:

Transmit Input:	50 ohms.
Receive Output:	75 ohms.
Line:	Adjustable to 50, 75, 100, or 130 ohms for 103090.
	Adjustable to 50, 75, 100, or 150 ohms for 103090-1.

Insertion Loss:

Transmit:1.5 dB maximum.Receive:14 dB typical.

Input Power Requirements: None: passive components only (no active components).

Operating Temperature: -20°C to +65°C (-4°F to +149°F).

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7.6.3 THEORY OF OPERATION

For the following discussion, refer to the schematic diagram of the Line Board in Section 9 .The RF Line board connects the RFL 9508 to the line coupling equipment. It contains two hybrid transformers, a receive attenuator, a complex balance network, two impedance matching transformers, and two surge arrestors. A block diagram of the Line Board appears in Figure 7-11.

7.6.3.1 HYBRID TRANSFORMERS

The RFL 9508 Line Board contains two hybrid transformers, T3 and T4. The primary winding of T3 accepts the transmit input signal, and the primary winding of T4 develops the receive output signal that is passed to the Rx Filter.

Both hybrid transformers have two secondary windings, and are interconnected so that one secondary of T3 is in series with a secondary of T4. One set of secondaries is connected across the complex balance network, and the other set of secondaries is connected to the line coupling equipment through line matching transformer T2. Fuses F1 and F2 provide overcurrent protection, and surge arrestors E1 and E2, protect the equipment against an overvoltage condition. For four wire applications, the signal going to the line coupling equipment can be monitored at TP2, and the signal coming from the line coupling equipment can be monitored at TP3. For two wire applications the signal going to or coming from the line coupling equipment can be monitored at TP2.

7.6.3.2 RECEIVE ATTENUATOR

Resistors R9, R11, R12 and dual-section Receive Level potentiometer R10 are connected across the primary of T4 to form an attenuator. The amount of signal sent to the Rx Filter is controlled by the setting of R10. Zener diodes CR1 and CR2 clamp the signal to a safe level. The signal being sent to the RX Filter can be monitored at test points TP6 and TP7.

7.6.3.3 COMPLEX BALANCE NETWORK

Inductors L1 through L8, capacitors C1 through C9, Coarse Switch S1, fine potentiometer R1 and resistors R2 through R8 form an internal reactive balance network. This network is connected across one set of secondaries of the hybrid transformers. Jumper J13 can be used to enable or disable the internal balance network. The balance network is adjusted to match the line impedance. To adjust the network, a frequency selective voltmeter (FSVM) is connected across test points TP6 and TP7 on the Line Board, and S1 and R1 are adjusted to the lowest possible transmitter signal level. S1 provides a rough adjustment of the resistance across the hybrid secondaries by determining how many resistors in the network are connected in series. R1 provides a fine resistance adjustment that allows the resistive balance to be precisely set.

Inductors L1 through L8 and capacitors C1 through C9 form the reactive portion of the balance network. All components in the reactive portion can be jumpered in or out to balance out local line reactance. L1 through L8 can be enabled or disabled by jumpers J13 through J19. Jumper J1 controls C1, J2 controls C2, and so on. If no reactive balancing is required, J1 through J9, and J14 through J19 must be placed in the out position.

7.6.3.4 DUMMY LOAD

An external Dummy Load and Attenuator Board are provided as described in Paragraph 7-7. To observe the signal going to the line coupling equipment use test points TP1 and TP2.

7.6.3.5 IMPEDANCE MATCHING TRANSFORMERS

Impedance matching transformers T1 and T2 match the impedance of the Line Board to that of the line. Jumper J10 selects one of T1's four impedance settings: 50, 75, 100, or 130/150 ohms. Fuse F1 provides current protection, and surge arrestor E2 protects the equipment against an overvoltage condition. Jumper J20 selects one of T2's four impedance settings: 50, 75, 100, or 130/150 ohms. Fuse F2 provides current protection, and surge arrestor E1 protects the equipment against an overvoltage condition. In 2 wire applications, the signal going to or coming from the line coupling equipment can be monitored at test point TP2. In 4 wire applications, the signal going to the line coupling equipment can be monitored at test point TP2, and the signal coming from the line coupling equipment can be monitored at test point TP3.



Figure 7-11. Block diagram, RFL 9508 Line Board

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7.7 RX FILTER



Figure 7-12. RFL 9508 Rx Filter Board

7.7.1 DESCRIPTION

The function of the Rx Filter is to prevent harmonics and noise from the power line that is out of the bandwidth of the filter from coming into RFL 9508. The bandwidth of the Rx Filter can be set to either 8kHz or 16kHz using two programmable jumpers on the board. The filter center frequency is tunable from 24kHz to 496kHz using programmable jumpers. The outer edges are 20kHz and 500kHz. The 8kHz bandwidth is used for one or two RF channel operation and the 16kHz bandwidth is used for three or four RF channel operation.

This filter does not provide the majority of selectability for the 9508. It removes only some of the undesirable signal spectrum. As such, it does not need to be set any narrower than 8kHz, even for single channel 2.5kHz operation.

7.8 ATTENUATOR BOARD



Figure 7-13. RFL 9508 Attenuator Board

7.8.1 DESCRIPTION

The RFL 9508 Attenuator Board consists of five 10 watt power resistors, several other smaller resistors, a two-position toggle switch, and two test points.

The function of the attenuator board is to provide 40dB of attenuation during loopback testing. Toggle switch SW1 is used to select either Normal or Loopback operation. Test points TP1 and TP2 allow the user to monitor the output of the attenuator.

7.9 RFL 9508 RF MOTHER BOARD



Figure 7-14. RFL 9508 RF Motherboard, rear view

7.9.1 DESCRIPTION

The RFL 9508 RF Motherboard is a 4.5 x 8 inch assembly, which is mounted on the rear right side of the 9508 chassis as viewed from the front. It provides interconnections for the five RF modules that plug into it from the front of the chassis, which are the TX Filter, Balance Board, Line Board, Attenuator Board, and Rx Filter. Figure 7-14 shows the rear view of the motherboard. Connectors J6 and J7 are TNC connectors which provide connections to the line coupling equipment. J4, J5, J8 and J9 are BNC connectors, J10 is a two pin plug-in connector, and TB1 is an eight position terminal block.

Board Label	Reference	Connector type	Application
	Designation		
TX IN	J1	BNC	Tx In from MA-650
EXT AMP IN	J5	BNC	Input signal from external amp
EXT AMP OUT	J3	BNC	Output signal to external amp
4W RX	J6	TNC	4W Input from line coupling equipment
4WTX OR 2WI/O	J7	TNC	4W Output to line coupling equipment or 2W Input/Output
RX OUT	J8	BNC	Rx Out to MA-650
EXT AMP FAIL IN	J10	Two-pin plug-in type	External Amp Fail input
INT AMP FAIL	TB1	8-position terminal block	Power Amplifier Fail, Relay Contacts
EXT AMP FAIL			(See Table 7-4 for TB1 terminal assignments)

Table 7-3.	Motherboard	Rear Panel	Connector	Assignments
I able / Ci	1110 mer bour a	Iteur I unter	connector	1 10015 milentes

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Terminal Numbers	Terminal Assignments
TB1-1	Internal Amp Fail Relay COM
TB1-2	Internal Amp Fail Relay NO
TB1-3	Internal Amp Fail Relay NC
TB1-4	External Amp Fail Relay COM
TB1-5	External Amp Fail Relay NO
TB1-6	External Amp Fail Relay NC
TB1-7	Chassis Ground
TB1-8	Earth Ground

Table 7-4. TB1 Terminal Assignments

Table 7-5. RF Mother Board Jumpers

Jumper	Balanced	Unbalanced
J13	B	A
J14	B	A

Section 8. MODULE DESCRIPTIONS, RFL 9508 DIGITAL SECTION

The Digital Section is located in the lower portion of the RFL 9508, 6U chassis. The modules in a typical 9508 Digital Section are listed in Table 8-1.

Module	Assembly Number or	For Additional Information
	Module Designation	See Paragraph:
CM4	9547-15886	8.1
CM4 Electrical Interface Adapters	MA-271, MA-278	8.2
CM4 Optical Interface Adapters	107455-201, -301, -401, -501	8.3
VF-5XP	107635	8.4
VF-5XP Module Adapter	MA-301B	8.5
PLC-TT Module	105720-2	8.6
PLC-TT Module Adapters	105740-2 to -5, 105770-2 to -5	8.7
Transceiver	107830	8.8
Transceiver Module Adapter	MA-650	8.9
Test Panel	106190	8.10
Power Supply	9547-840, 9547-920	8.11
Power Supply I/O	9547-18801, -18804, -18809	8.12
Motherboard	105590-2	8.13

Table 8-1. Modules included in a typical 9508 Digital Section

Refer to Figure 8-1 for module locations. The front, hinged cover is not shown for clarity. Refer to Figure 8-2 for a block diagram of a typical 9508 digital chassis.



Figure 8-1. Front View of RFL Digital Section

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8-2

8.1 CM4 COMMON MODULE

The CM4 Common Module is a microprocessor-controlled module that performs all of the T1/E1 multiplexing, demultiplexing and user interface functions in the 9508. In most applications, each 9508 terminal contains one CM4 Common Module located in slot 10, while in drop/insert applications the 9508 contains two CM4 Common Modules, one in slot 10 and one in slot 1.

8.1.1 CM4 OPERATIONAL FUNCTIONS

The CM4 is the standard T1/E1 Common Module for the RFL 9508 Terminal, and provides the following operational functions.

- 1. T1/E1 line receiver (input)
- 2. T1/E1 line driver (output)
- 3. Demultiplexing of the T1/E1 aggregate to individual channels
- 4. Multiplexing of channels to form T1/E1 aggregate
- 5. Multiplexer/demultiplexer bus interface to channels.
- 6. Transmit timing functions.
- 7. Loopback configurations.
- 8. Microprocessor control
- 9. User interface.
- 10. Sequence of events
- 11. Time and Date Settings
- 12. Download function
- 13. NCM Module Adapter

8.1.2 T1/E1 LINE INTERFACE

The CM4 receives its T1/E1 line input from a Module Adapter in 9508 chassis with electrical T1/E1 interfaces, or from an OIA (optical interface adapter) in 9508 chassis with fiber optic T1/E1 interfaces. The line coding can be either B8ZS/HDB3 or AMI.

Equipment and monitor test jacks on the front of the Common Module accept miniature bantam plugs. Plugging a T1/E1 transmission test set or the output of another 9508 chassis into the "T1/E1 EQUIP IN" jack breaks the connection to the incoming T1/E1 line. The terminating impedance should be 100 ohms (balanced). The "T1/E1 MON IN" jack permits test access to the line input without breaking the T1/E1 line connection. Equipment connected to this jack should also provide a 100 ohm termination impedance. The signal level at this point is approximately 20 dB below the input.

The test jacks handle the T1/E1 signal originating or terminating at the module on which they are located.

The line receiver accepts the input signal, recovers receive timing, and decodes the bipolar signal. A jitter buffer is used to smooth out the timing jitter usually present on incoming signals.

The T1/E1 line output connection is made through a Module Adapter in 9508 chassis with electrical T1/E1 interfaces, or from the OIA in 9508 chassis with fiber optic interfaces. The "T1/E1 EQUIP OUT" and "T1/E1 MON OUT" jacks function like the input test jacks described above. All equipment connected to them should provide 100 ohms of termination. The "T1/E1 EQUIP OUT" jack breaks the connection to the T1/E1 line output. The "T1/E1 MON OUT" jack does not break the connection, but the signal level at this jack is about 20 dB below the output level.

8.1.3 T1/E1 MULTIPLEXING/DEMULTIPLEXING

The decoded line receive signal feeds the demultiplexer circuitry where it achieves frame synchronization. The mean time to lose frame in the presence of a high random bit error rate (10^{-3}) exceeds several hours.

Once frame synchronization is achieved, the demultiplexer develops the proper demultiplexer bus signals and feeds them to all the channels cards plugged into the shelf. Bus signals include demultiplexed channel data, demultiplexer synchronization status, and synchronization signals necessary for proper decoding by the channel modules.

The CM4 develops backplane bus synchronization signals. The transmit section of each channel module synchronizes to these signals, and places its data onto the selected bus. The CM4 then forms the aggregate signal, using the selected framing format.

8.1.4 MULTIPLEXER/DEMULTIPLEXER BACK PLANE INTERFACE

The CM4 uses tri-state bus drivers and receivers to permit routing the demultiplexer and multiplexer bus signals to either of two backplane buses (Bus A or Bus B). This versatile bus capability enables simple configuration of a multiplexer as either "terminal" or "drop/insert."

Bus A/B nomenclature is used to set channel modules to transmit and receive through a desired dropand-insert port. In order to transmit out of drop-and-insert A, or out of a terminal shelf, a channel module is set to operate on Bus A. In order to transmit out of drop-and-insert B, a channel module is set to operate on Bus B. This can be seen in Figure 8-3.



Figure 8-3. The meaning of Bus A and Bus B channel module settings

8.1.5 CHANNEL MODULES

All payload circuits connect to the RFL 9508 through channel modules. RFL offers a family of channel modules that support a wide range of circuit types: voice, synchronous and asynchronous data, polling data, office-end/station end, and time slot access. Instruction Data sheets for all channel modules appear in Sections 14 through 19 of the IMUX 2000 Instruction Manual.

8.1.6 MODULE ADAPTERS

Each channel module must be used with a Module Adapter, either its own or one that is shared with another channel module. The RFL 9508 chassis provides 18 rear-access Module Adapter slots, one corresponding to each of the 18 front-access module slots. All 9508 Module Adapters have the same connector on their front edge to mate with the back plane. However, different Module Adapters have different rear edge connectors, providing a variety of interfaces. The insertion of modules and module adapters is shown in Figure 8-4.



Figure 8-4. Side view of 9508 Digital Chassis, showing insertion of modules and module adapters

8.1.7 9508 DIGITAL CHASSIS, FRONT-PANEL SWITCHES, INDICATORS, AND JACKS

Figure 8-5 is a front view of the RFL 9508 Digital Chassis with its front door open. A drop/insert chassis will look the same, except for the addition of a second CM4 common module in slot 1. The main power supply module and the CM4 common module are expanded to show the location of all front panel switches, indicators, and jacks. A functional description of switches, indicators, and jacks for the Main Power Supply module appears in Table 8-2. The numbers in the item column of this table refers to the numbers in the boxes shown in Figure 8-5.





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8.1.8 SYSTEM STATUS INDICATORS AND THE ACO SWITCH

When the RFL 9508 front door is closed, four LED indicators are visible. These LEDs are labeled: POWER, NORMAL, ALERT, and ALARM, as shown in Figure 8-6, and indicate the operational status of the 9508 chassis at a glance. Table 8-2 gives a description of these indicators and also includes a description of the power supply fail indicator and the alarm cutoff switch.



Figure 8-6. Front view of 9508 chassis with door closed, showing the system status indicators

Item (Fig. 8-5)	Module	Module Label	Multiplexer Front Panel Label	Description
1	Power supply	PS		Power Supply Module Fail LED. Lights when power supply module has failed.
2	Power supply	PWR	POWER	Power LED. Lights when the 9508 is powered. If the 9508 is equipped with a redundant power supply, this indicator will remain on if one of the power supplies has failed and the remaining supply has enough capacity to power the 9508 by itself.
3	Power supply	DIS/EN		 Alarm Cut-Off Switch (Disable/Enable). When this switch is in the Disabled position and no alarms are active, the alert indicator will light. When this switch is in the Enabled position the ALERT and ALARM relays are on line and will activate in response to system fault conditions. NOTE: If the 9508 contains two power supply modules, the ACO switches on <u>both</u> power supply modules must be placed in the DIS position to disable the ALERT and FAIL relays.
4	Power supply	NORM	NORMAL	Normal LED. Lights when neither an ALERT or an ALARM condition exists.
5	Power supply	ALERT	ALERT	 Alert LED. Lights when one or more of the following conditions exists: ⁽¹⁾ EXCESSIVELY LOW RECEIVE SIGNAL (RX IN indicator off) REC YELLOW ALARM (RX IN indicator blinking) LOOPBACK ACTIVATED (LPBK indicator on) FALLBACK TIMING ACTIVATED (The TIMING indicator for the programmed timing mode will be blinking) SINGLE POWER SUPPLY FAILURE (when two power supplies are installed) ACO ON
6	Power supply	FAIL	ALARM	 Fail LED. Lights when one or more of the following conditions exists: ⁽²⁾ CPU FAILED (CPU indicator on) SIGNAL PRESENT BUT OUT-OF-FRAME (RX IN and FRM indicators on) NO TRANSMIT OUTPUT (TX OUT indicator off)

Table 8-2.	System status	indicators and	the ACC) switch
1 abic 0-2.	System status	mulcator 5 and) Switch

1. An unframed "all ones" is a E1 Alarm Indication Signal (AIS).

2. This indicator also lights briefly at power-on.

8.1.9 T1 TEST JACKS

Each CM4 has two pairs of bantam jacks (**T1 IN** and **T1 OUT**) to provide test access to the T1 input and output signals. Each pair consists of one equipment (**EQUIP**) jack and one monitor (**MON**) jack.

The two **EQUIP** jacks are used for out-of-service testing. The two **MON** jacks are designed for inservice testing, so they are equipped with isolation resistors. Because of these resistors, the T1 signals received and transmitted by the multiplexer can be monitored without significantly affecting their levels. When terminated by 100 ohms, the signal level at the output of each **MON** jack, is about 20 dB below that of the corresponding T1 input or output signal. T1 test sets are designed to automatically adjust for this attenuation when operated in their monitor (MON) mode.

Item (Fig. 8-5)	Module	Label	Description
7	CM4	T1 OUT EQUIP	Provides out-of-service test access to the CM4's T1 output. When in use, this jack disconnects the CM4's T1 transmitter from the T1 I/O connector on its MA-270R Module Adapter.
		T1 OUT MON	Used for in-service, non-intrusive (resistor-isolated) monitoring of the CM4's T1 output.
8	CM4	T1 IN EQUIP	Provides out-of-service test access to the T1 signal received by the CM4. When in use, this jack disconnects the CM4's T1 receiver from the T1 I/O connector on its MA-270R Module Adapter.
		T1 IN MON	Used for in-service, non-intrusive (resistor-isolated) monitoring of the T1 signal received by the CM4.

Table 8-3. T1 test and monitor bantam jacks

NOTE

In redundant applications, test equipment should be connected to the jacks of the currently active common module. The inactive module is looped onto itself and its test jacks provide access only to that looped-back signal.

NOTE

If your system uses fiber optic I/Os, the data at the bantam jacks is CMI encoded data and not T1 or E1 encoded data. Monitoring the T1 or E1 signals via the test jacks labeled "T1 OUT MON" or "T1 IN MON" on the front of the CM4 requires an RFL CMI Converter. Refer to the CMI Converter Instruction Data Sheet for additional information.

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8.1.10 INDICATORS AND TOGGLE SWITCHES USED TO DISPLAY AND SET T1 COMMON MODULE FUNCTIONS

Table 8-4 describes the controls and indicators which display and set CM4 setup and status functions. Table 8-5 lists CM4 functions, organized by group. Table 8-6 lists CM4 Supplementary Functions, organized by group. Figure 8-7 is an overview of all CM4 groups and functions.

Item (Fig. 8-5)	Module	Label	Description
9	CM4	GROUP	This two-position momentary contact toggle switch selects the CM4 function group
10	CM4	CONFIG BRD OK ACTIVE	Redundant Mode Activity indicator consisting of three green LEDs ACTIVE: When lit, this CM4 is the active board. BRD OK: When lit, this CM4 module is functional. CONFIG: When lit, this CM4 is fully configured.
11	CM4	FUNCTION	This four-character alphanumeric display lists CM4 function group names and individual function names. (See Tables 8-5 and 8-6 for more information)
12	CM4	ON/OFF	This bi-color LED indicator shows the status of the currently- displayed function. The LED will light GREEN if the function is ON or has been set. The LED will light RED if the function is OFF or has not been set.
13	CM4	SET/NEXT	This switch is a three position, center-off, momentary contact toggle switch. This toggle switch displays and sets CM4 function groups.
14	CM4		3-position Redundancy Control slide switch: Up (Right) = Main Center (Center) = Auto Down (Left) = Standby Main Auto Standby

TT 1 1 0 4	T 1 ⁰ / 1 / 1	• • • • •		4 17 1 10	
Table 8-4.	Indicators and toggi	e switches used to) display and se	et 11 Commor	Module functions

NOTE: When you are facing the front of the multiplexer, the "up" position of each toggle switch or slide switch is to the right, and its "down" position is to the left.

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Group Name	Group Description	Function Name	Function Description
TIME	Transmitter timing mode set-up functions	Loop (1)	Loop timing.
		Int (1)	Internal timing.
		Ext (1)(2)	External timing.
		Thru (2)	Through timing.
TSEL	T1 Set-up functions	SF	Superframe format.
		ESF	Extended Superframe format.
		AMI	Alternate Mark Inversion.
		B8ZS	Bipolar with 8-Zero Substitution.
		RFL	Not CSU mode
		ANSI	ANSI CSU mode
		ATT	AT&T CSU mode
		CRC4	Cyclic Redundancy Check (not used in T1)
LPBK	T1 loopback setup functions.	LnLB	Line loopback.
		PaLB	Payload loopback.
		EqLB	Equipment loopback.
BLNK	Blink status functions	RxYl	Receiving yellow alarm.
	(Reasons for blinking RX IN LED or	Rx11	Receiving all unframed ones.
	transmit timing LEDs)	FTIM	Fallback timing is in effect.
DIJUI	(See Tables 8-7 & 8-8 for more details)	XsJt	Excessive jitter (buffer depth exceeded).
RVUI	Review 1 status functions	IXKX	I ransmit and receive bus clock lock status.
	(See Tables 9.7 & 9.9 for more details)	KCLS Valt	Receiver carrier loss.
DIAC	(See Tables 8-7 & 8-8 for more details)	ASJI T1	Excessive juler.
DIAG	Diagnostic functions.	11	Common modulo firmulara revision
		#.## Foty	When set returns Common Module to
		rety	factory-default setup (Int ESE B8ZS)
ADDR	Multiplexer address	ddd	A three-digit number (001 to 500)
SIO	Remote port serial parameters	BAUD	Baud rate: 110 bps to 115 000 bps
510	remote por serial parameters	PAR	Parity: Mark, Space, Even, or Odd.
		Lock	Lock: Locks/unlocks the remote port.
		Univ	Universal addressing
FAST	Fast Reframing	Disa	Disable fast reframe
		Enab	Enable fast reframe
MAIN	Main module forced-switch configuration	Off	Force to report an on-board trouble
	parameters	On	Do not force to report an on-board trouble
SWCH	Standby module forced-switch	Auto	Allow automatic switch operation
	configuration parameters	Main	Activate main module
		Stby	Activate standby module
SQEL	RDATA Squelch setup function	PRSQ	Pre-squelch timer (0ms, 0.66ms, 1.3ms, 2.0ms, 2.7ms,
			3.3ms, 4.0ms, 4.6ms, 5.3ms, 6.0ms, 6.6ms, 7.3ms,
			8.0ms, 8.6ms, 9.3ms) or DISA
		POSQ	Post-squelch timer (0ms, 0.66ms, 1.3ms, 2.0ms, 2.7ms,
			3.3ms, 4.0ms, 4.6ms, 5.3ms, 6.0ms, 6.6ms, 7.3ms,
CWAD	Barrier and the Origin Theory to at	0.62 1.22 2.42	8.01118, 8.01118, 9.31118) OF DISA
SWAP	Programmable Swap Time dealy	4.8s, 9.6s, 19s	Swap Time deray in seconds (0.08, 1.28, 2.48, 4.88, 9.08, 19s)
INTF	Interface Specifications	TYPE	System Type: T1 or E1
		HEAD	CMI (for optical interfaces)
			75 or 120 (equates to 100Ω for T1 electrical interfaces)
		TLBO	Transmit line buildout:
			0x00 (DSX standard, 0 to 133 feet)
			0x01 (133 to 266 feet)
			0x02 (266 to 399 feet)
			0x03 (399 to 533 teet) 0x04 (522 to 655 foot
			0x04 (355 to 055 feet 0x05 (7.5 dB)
			0x06 (-15 dB)
			0x07 (-22.5 dB)

Table 8-5.	T1	Common	Module	Standard	groups and	functions
					0 1	

Notes: (1) Active on terminal multiplexers only. (2) Active on drop/insert multiplexers only.

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Group Name	Group Description	Function Name	Function Description
FTIM	Fallback Timing	FLoo	Set fallback timing Loop
		FInt	Set fallback timing to Internal
		FExt	Set fallback timing to External
		FThru	Set fallback timing to Through
		exit	exit
JBUF	Jitter Buffer	Joff	No jitter buffer
		J32	Set jitter buffer to 32 bits
		J128	Set jitter buffer to 128 bits
		exit	exit
TXYL	T1 Yellow Alarm	Off	Yellow alarm off
		On	Yellow alarm on
		Auto	Automatic activate
		exit	exit
Rfrm	Reset framer chip	NA	NA
Rcht	Reset channel configuration table	NA	NA
Rcpu	Reset cpu	NA	NA

Table 8-6. T1 Common Module Supplementary groups and functions

Table 8-7. T1 receive status functions

Group	Function	Description
BLNK	RxYl	Received Yellow. When included in the BLNK group, indicates that a Yellow Alarm Signal is detected at the T1 input.
	Rx11	Received All Ones. When included in the BLNK group, indicates that an All-Ones Signal (framed or unframed) is detected at the T1 input.
	XsJt	Excessive Jitter. When included in the BLNK group, indicates that the receiver jitter buffer has overflowed. This may indicate that the receive signal contains excessive jitter.
RVU1	RcLs	Receiver Carrier Loss. When the Receiver Carrier Loss function is displayed, the bi-color ON/OFF indicator will light to indicate the status of the T1 receiver carrier: GREEN: The receiver has not lost carrier. RED: The receiver has lost carrier.

Table 8-8. T1 timing status functions

Group	Function	Description
BLNK	FTIM	Fallback Timing. When included in the BLNK group, indicates that the transmitter is in its fallback timing mode.
RVU1	TxRx	Transmit/Receive Lock. When the Transmit/Receive Lock function is displayed, the bi- color ON/OFF indicator will show whether the transmitter timing is synchronized to the received T1 signal timing: GREEN: The transmitter and receiver timing clocks are locked. RED: The transmitter and receiver timing clocks are not locked.


Figure 8-7. Overview of CM4 Groups and Functions RFL 9508 March 11, 2010

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8.1.11 FRONT PANEL LED INDICATORS

8.1.11.1 LOOP, INT and EXT Indicators

The CM4 timing source selected by the user is called the **primary** timing source. Common modules set up for External, Looped, or Through timing also have a **fallback** timing mode. Upon loss of primary timing, they undergo a smooth, carefully controlled switch to Internal timing.

Three LED indicators on the CM4 (LOOP, INT, and EXT) indicate the current T1 transmitter timing configuration. Table 8-9 explains the function of each of these indicators. If the CM4 is in its fallback timing mode, one of these three indicators will be on, while another will be blinking. The blinking indicator shows the primary timing mode set by the user. The indicator that is on continuously indicates the fallback timing mode, which is now in effect.

The meaning of the LOOP indicator depends on the multiplexer type. In terminal multiplexers, the LOOP indicator indicates loop timing. In drop/insert multiplexers, the LOOP indicator indicates through (THRU) timing.



 Table 8-9.
 Loop, Internal and External Indicators

Item (Fig. 8-5)	Module	Label	Description	
15	CM4	LOOP	Loop or Through Timing Mode indicator (green). Its actions	
			will depend upon the multiplexer configuration:	
			Terminal Multiplexers:	
			ON: The CM4 transmitter is loop timed.	
			BLINKING: Loop is the primary timing mode, but the CM4	
			module is currently in fallback timing mode.	
			Drop/Insert Multiplexers:	
			ON: The CM4 transmitter is through timed.	
			BLINKING: Thru is the primary timing mode, but the CM4	
			module is currently in fallback timing mode.	
		INT	Internal Timing Mode indicator (green). Lights when the CM4	
			E1 transmitter is internally timed.	
		EXT	External Timing Mode indicator (green). Lights when the CM4	
			E1 transmitter is externally timed. Blinks when EXT is the primary	
			timing mode, but the CM4 module is in fallback timing mode.	

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8.1.11.2 TX, LPBK and ERR Indicators

Three LED indicators on the CM4 module (TX, LPBK and ERR) indicate transmitter output status, loopback status, and error status. The meaning of each of these indicators appears in Table 8-10.



Table 8-10.	TX, LPBK	and ERR	Indicators
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Item (Fig. 8-5)	Module	Label	Description	
15	CM4	TX	Transmit Output indicator (green); indicates transmit status:	
			ON: Transmission signal is normal. It can be either data, or all ones if the shelf is idle.	
			OFF: No signal is being transmitted, indicating a hardware failure.	
		LPBK	Loopback indicator (yellow). Lights when one or more of the CM4's three T1 loopbacks have been activated. View the LPBK group to determine	
			The active loopback(s):	
			LNLB: Line Loopback	
			PaLB: Payload Loopback	
			EqLB: Equipment Loopback	
		ERR	Error indicator (red). When frame format is set to ESF, this indicator flashes once each time a CRC-6 error is detected, and remains on continuously above a random bit error ratio of about 10 ⁻⁵ .	
			When frame format is set to SF, this indicator flashes once each time a frame error is detected, and remains on continuously above a random bit error ratio of about 10^{-3} .	

8.1.11.3 RX, BPV and FRM Indicators

Three LED indicators on the CM4 module (RX, BPV and FRM) indicate the status of the received T1 signal. The meaning of each of these indicators appears in Table 8-11.



Table 8-11.	RX, BPV	and FRM	Indicators
-------------	---------	---------	------------

Item (Fig. 8-5)	Module	Label	Description		
15	CM4	RX	Receive Input indicator (green); indicates receive status:		
			ON: A valid T1 data signal is detected at the CM4 T1 receiver input.		
			OFF: No receive signal is detected.		
			BLINKING: One of the following signals or conditions is detected.		
			(View the BLNK group, Paragraph 5.9, to determine		
			which condition is causing the blinking.)		
			Rx11: All ones produced by an idle shelf at the far end, framed or		
			unframed.		
			RxY1: Remote alarm, indicating a loss of receive signal at the far		
			end, if the equipment at the far end is set up to generate		
			a yellow alarm.		
			XsJt: Excessive jitter, indicating that the jitter buffer depth has		
			ETIM The CM4 transmitter is in fallback internal timing mode		
		BD M	Pinolar Variations indicator (vallow). Elashas once each time a hinolar		
		Dr v	violation is datasted, and remains on continuously above a random PDV		
			(bipolar variations) array ratio of about $10-5$		
		EDM	Out of Frame in director (red) Lights when the CM4 T1 measurer is not in		
		FKM	Out-OI-Frame indicator (red). Lights when the CM4 11 receiver is not in		
			irane synchronization. This can indicate either a high bit error ratio, or		
			Improper CM4 configuration.		

8.2 CM4 ELECTRICAL INTERFACE ADAPTERS

Each CM4 must be equipped with an interface adapter to connect it to the T1/E1 network. There are two basic types of interface adapters, electrical interface adapters and optical interface adapters. This section discusses CM4 electrical interface adapters. CM4 Optical Interface adapters are discussed in paragraph 8.3.

Electrical interface adapters are used to connect the 9508 electrically to a T1/E1 network. There are two types of electrical interface adapters available. These are the MA-271 and MA-278. These are also referred to as module adapters, and are shown in Figures 8-8 and 8-9.



Figure 8-8. MA-271 panel view and pinouts



Figure 8-9. MA-278 panel view and pinouts

8.3 CM4 OPTICAL INTERFACE ADAPTERS

8.3.1 INTRODUCTION

Optical Interface Adapters (OIAs) are used to provide a optical fiber interface between 9508 terminals in a network. Input and output external timing, and RS-232 communication are also provided. Figure 8-10 shows the panel view and pinouts of a typical OIA. Table 8-12 summarizes the characteristics of the various OIAs. These OIAs can only be used with CM4 Modules that support CMI encoding.

WARNING

YOUR RFL 9508 TERMINAL MAY BE EQUIPPED WITH FIBER OPTIC INPUT/OUTPUT MODULES THAT HAVE FIBER OPTIC EMITTER HEADS. FIBER OPTIC EMITTER HEADS USE A LASER LIGHT SOURCE THAT PRODUCE INVISIBLE RADIATION. FIBER OPTIC COMMUNICATION SYSTEMS ARE INHERENTLY SAFE IN NORMAL OPERATION BECAUSE ALL RADIATION IS CONTAINED IN THE SYSTEM. IT IS POSSIBLE DURING MAINTENANCE TO EXPOSE THE RADIATION BY REMOVING OR BREAKING THE FIBER. STARING DIRECTLY INTO THE LIGHT BEAM MAY RESULT IN PERMANENT EYE DAMAGE AND/OR BLINDNESS. NEVER LOOK DIRECTLY INTO THE LIGHT BEAM AND BE CAREFUL NOT TO SHINE THE LIGHT AGAINST ANY REFLECTIVE SURFACE.

THE LASER SOURCE IS A CLASS I LASER PRODUCT WHICH COMPLIES WITH APPLICABLE FDA, OSHA AND ANSI STANDARDS.

If your RFL 9508 is equipped with a Fiber Optic Module, fiber optic connectors must be connected to the fiber optic heads on the rear panel of the 9508 chassis. Type ST series bayonet fiber optic connectors (or their equivalent) are used with both singlemode and multimode fibers. The exact mating connector used will depend upon the head that is installed in the fiber optic module, and the specific optic cable being used.

When connecting fiber optic cables, make sure the connectors are properly aligned before tightening and then fully tighten them. This will help minimize losses in the connector.



Figure 8-10. Typical CM4 Optical Interface Adapter (OIA), showing panel view and pinouts

Assembly Number	Туре	Wavelength/ Mode	Connector Type	Receiver Sensitivity (average)	TX Power (average)	System Gain	Typical Distance (3dB margin)
107455-201	LED Emmitter/ Detector	1300 nm Singlemode	ST	-39dBm	-17dBm	22dB	17 mi (28 km)
107455-301	LED Emmitter/ Detector	1300 nm Multimode	ST	-39dBm	-13dBm	26dB	11 mi (18 km)
107455-401	Laser Emmitter/ Detector	1300 nm Singlemode	ST	-39dBm	0dBm	39dB	36 mi (59 km)
107455-501	Laser Emmitter/ Detector	1500 nm Singlemode	ST	-39dBm	-3dBm	36dB	56 mi (90 km)

 Table 8-12.
 Characteristics Of Optical Interface Adapters

*Light levels are emitter outputs for fiber optic I/O modules, and detector inputs for fiber optic I/O modules.

8.4 RFL VF-5XP

8.4.1 DESCRIPTION

The RFL VF-5XP is a dual-channel four-wire E&M voice-frequency module, designed for use in the RFL 9508. It accepts two voice channels (one speech channel and one speech plus channel) as inputs and digitizes them. Channel one uses one 64-Kbps time slot, and Channel two uses two 64-Kbps time slots.

The RFL VF-5XP provides high-quality voice characteristics, and allows E&M signaling of Type I, II, III and V, with front-panel busy indicators. It has extended-range input and output signal level settings to facilitate interfaces in most four-wire applications.

The VF-5XP is remote-controllable when installed in an RFL 9508 chassis. User-adjustable settings allow the configuration of the following parameters:

- o One-channel or two-channel operation.
- o Selectable Type I, II, III or V signaling.
- o Individual channel enable/disable.
- o Signaling on or off selection.
- o Busy settings.
- o Extended range input/output level settings
- o Time slot assignment
- o Two loopback modes (Local, Remote).
- o Remote control configuration and status reporting.
- o Test tone generation (1kHz for Channel 1 and 2kHz for Channel 2)

An edge view of the card is shown in Figure 8-11.



Figure 8-11. Edge View of VF-5XP Module Showing Functions of Switches and LEDs

8.4.2 SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL VF-5XP module. Because all of RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Configuration: Two independent voice channels per module.

Time Slots Required:

Channel One: Requires one user-selectable 64-Kbps time slot. Channel Two: Requires two 64-Kbps time slots. (Must be after channel 1's time slot)

Remote Interface:

All settings can be changed in remote mode using NMS, except E&M signaling type. Access to status registers, including board and firmware revision levels, is also provided through NMS.

Signal Levels:

- CH1: TLP transmit range: -23 dBm to +10 dBm nominal (+13 dBm peak) TLP receive range: -31.5 dBm to +10 dBm nominal (+13 dBm peak) Level control resolution: 0.5 dB Absolute level accuracy: 0.5 dB
- CH2: TLP transmit range: -23 dBm to +10 dBm nominal (+13 dBm peak) TLP receive range: -22 dBm to +10 dBm nominal (+13 dBm peak) Level control resolution: 0.5 dB Absolute level accuracy: 0.5 dB

Input Impedance: 600Ω nominal

Output Impedance: 600 Ω nominal

Frequency Response relative to 1004 Hz:

CH1: 300 to 3000 Hz, ±0.3 dB (bidirectional) CH2: 300 to 4000 Hz, ±0.3 dB (bidirectional)

Idle Channel Noise: Less than 23 dBrnc0

Impulse Noise:

Maximum counts per 30-minute interval. (Input level -13dbm0(-29dbm) @ 1004 Hz. Level Adjustment set to -16dBm in, +7dBm out.

Threshold Level (dBrnc) Counts/30 minutes -61 0

Signaling Format (Digital interface):

T1 systems: RBS (Robbed-Bit Signaling) AT&T PUB 43801 E1 systems: CAS (Channel Associated Signaling) Transmission Only

E&M Signaling Types: Jumper selectable, E&M Type I, II, III and V

M Lead INPUT:

Input Impedance: Greater than 3.5K ohms to ground Current limited to less than 6ma Type I, II, III

Busy: -20 to -60 volts

Idle: 0 to -10 volts or open

Type V

Busy: 0 to -35 volts Idle: Open

E Lead Output:

Busy: Less than 35 ohms to ground Idle: -42 to -60 volts or open

Module Adapters:

MA-301, MA-301A, MA-301B, MA-322 or MA-324

Power Consumption:

TBD mA max from +5V supply TBD mA max from +15V supply TBD mA max from -15V supply 0 mA max from -48V supply*

*Note: The VF-5XP itself draws no current from the –48Volt supply. However SB-Lead outputs are provided for each channel for external wiring of E&M signaling. There is a 1k-ohm ½ watt resistor in series with each output. No more than 20mA should be drawn from any SB-Lead output at any time.

Operating Temperature: -20°C to +65°C

Relative Humidity: Zero to 90 percent, non-condensing

8.5 VF-5XP MODULE ADAPTERS

The VF-5XP requires a Module Adapter. The Module Adapter provides the appropriate connector for the desired interface. As shown in Table 8-4, there are five types of Module Adapters that can be used with the VF-5XP. See the VF-5XP Instruction Data Sheet for additional information.

Module Adapter	Connector Type	Application
MA301	50-pin Telco	Up to 6 voice channels
MA301A	8-position terminal block	2 channels with SWC surge protection
MA301B	16-position terminal block	2 channels with pluggable terminal block
MA322	50-pin Telco	Converts Channel 1 and Channel 2 from 4-wire to 2-wire
MA324	50-pin Telco	Converts Channel 1 from 4-wire to 2-wire
		Channel 2 remains 4-wire

Table 8-13. VF-5XP Module Adapters

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8.6 PLC TRANSFER TRIP MODULE

8.6.1 DESCRIPTION

The PLC Transfer Trip Module is a bi-directional module designed for use in RFL 9508 chassis. It transmits and receives data via the T1/E1 serial link and generates and receives trip commands via an I/O adapter module. The PLC Transfer Trip Module can support up to four bi-directional transfer trip functions between two 9508 terminals, or can support DCB (Directional Comparison Blocking) in addition to two transfer trip functions. These modules can operate point to point between two 9508 terminal nodes in a network. The terminal nodes can be configured as point-to-point or drop and insert terminals and can be installed at different locations in the network either at adjacent or nonadjacent nodes. This module has eight LEDs on the front to indicate the condition of the trip inputs and outputs.



Figure 8-12. Edge View Of PLC Transfer Trip Module Showing Functions Of Switches And LEDs

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8.6.2 FEATURES

TRIP HOLD

This is a timer function which extends the length of time that a trip output is activated after a valid trip condition occurs. For this function to engage, a valid trip condition must exist long enough to satisfy the pretrip timer. The length of time is programmable independently for each function.

INPUT DE-BOUNCE

This is a timer function which requires that a trip input be present for a certain length of time before a trip command is transmitted. The length of time is not programmable by the user, but is set at the factory to 100μ s.

ALARM TIMER

This is a timer function which requires that an alarm condition exists for a certain length of time before an alarm output is generated. The length of time is programmable by the user.

PRE-TRIP TIMER

This is a timer function which requires that a trip be present for a certain length of time before an output is generated. The length of time is programmable independently for each function.

COMMUNICATION CHARACTERISTICS

This module communicates using a single bi-directional DS0. The communication includes programmable addressing to prevent misconnections. One of 32 addresses are selectable.

PROGRAMMABLE LOGIC

Trip hold Output Form Alarm timer (delay) Pre-trip timer Unblocking Sequence of events log Operational modes 0.25 – 63.75 ms (0.25 ms increments) normal/invert 0 - 2.5 Sec. (10 ms increments) 0 - 3.75 ms (0.25 ms increments) Enable/Disable 100 records Transfer Trip/DCB

8.6.3 SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL PLC-TT module. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

ENVIRONMENTAL

(service conditions)
-20° C to $+65^{\circ}$ C
-40° C to $+75^{\circ}$ C
95% @ 40°C non-condensing

SWC/ FAST TRANSIENT

ANSI C37.90	(dielectric)
ANSI C37.90.1	(SWC & fast transient)

RFI SUSCEPTIBILITY

ANSI C37.90.2 35 V/M

OPTICAL INPUT SPECIFICATIONS

Operating voltage range:	
48 Vdc	38-60 Vdc
125 Vdc	88-150 Vdc
250 Vdc	200-280 Vdc
Input threshold	1/2 nominal station battery

SOLID STATE OUTPUT SPECIFICATIONS

Maximum continuous output current	1 Amp
Maximum surge current (100 ms)	10 Amps
Minimum output current	20 ma
Maximum open circuit voltage	280 Vdc

OPTIONAL RELAY OUTPUTS

Maximum continuous current	2 A (inductive)
Maximum surge current (100 ms)	30 A
Maximum breaking current	1 A resistive
Maximum open circuit voltage	280 Vdc
Maximum operate time	5 ms

ALARM RELAY SPECIFICATIONS

Maximum continuous current Maximum breaking current Maximum open circuit voltage Maximum operate time 1 A (inductive) 1 A (resistive) 280 Vdc 10 ms

OPERATING MODES

Full duplex (transmit and receive)

POWER CONSUMPTION

2.0 watts maximum

DIMENSIONS

		2 Function I/O	8.6.3.1.1.1.1 <u>4 Function</u>
	Transfer Trip Module	Adapter Module	<u>I/O</u>
			Adapter Module
Length:	9.8 in (24.8 cm)	4.7 in (11.9 cm)	4.7 in (11.9 cm)
Width:	0.6 in (1.5 cm)	2.1 in (5.3 cm)	4.2 in (10.6 cm)
Height:	4.5 in (11.4 cm)	5.0 in (12.7 cm)	5.0 in (12.7 cm)
WEIGHT			

	Transfer Trip Module	2 Function I/O Adapter Module	4 Function I/O <u>Adapter Module</u>
Net:	0.62 lb (0.28 kg)	0.7 lb (0.32 kg)	1.22 lb (0.55 kg)
Shipping:	1 lb (0.45 kg)	1 lb (0.45 kg)	1.5 lb (0.68 kg)

8.7 PLC TRANSFER TRIP MODULE ADAPTERS

The PLC-TT module requires a Module Adapter. The Module Adapter plugs into the rear of the digital chassis directly behind the PLC-TT module and provides the appropriate connections for the desired interface. There are eight types of Module Adapters available for use with the PLC-TT module. These are listed in Table 8-14. Rear panel views of a typical two-function and four-function PLC-TT module adapter is shown in Figure 8-13.

Part Number	Module Adapter Type	Output Type
105740-2	2 function 48/125V	relay
105740-3	2 function 250V	relay
105740-4	4 function 48/125V	relay
105740-5	4 function 250V	relay
105770-2	2 function 48/125V	solid state
105770-3	2 function 250V	solid state
105770-4	4 function 48/125V	solid state
105770-5	4 function 250V	solid state

The 2-function module adapter occupies three module slots at the rear of the chassis (slots 5 through 7). The 4-function module adapter occupies six module slots at the rear of the chassis (slots 5 through 10). If a second 2-function module adapter is used, it must be installed in slots 11 through 13. If a second 4-function module adapter is used, it must be installed in slots 11 through 16. When a second module adapter is installed, a ten conductor ribbon cable must be connected from slot 8 of the motherboard to JP3 of the PLC-TT module. Using a second module adapter allows the logical "OR-ing" or "AND-ing" of trip inputs, which must be configured by the user using NMS. See Figure 8-14 for a view of this installation.



a. Typical 2-function Module Adapter



b. Typical 4-function Module Adapter

Figure 8-13. Rear panel view of typical 2-function and 4-function PLC-TT Module Adapters

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Figure 8-14. Digital chassis showing the installation of two, 4-function, PLC-TT Module Adapters

8.8 PLC TRANSCEIVER



Figure 8-15. PLC Transceiver

8.8.1 DESCRIPTION

The PLC Transceiver is the Power Line Carrier Transmitter and Receiver. This module includes a modulator and demodulator, digital filtering, a numerical control Oscillator, analog and digital channel mapping, and an RS232 interface for configuration.

The PLC Transceiver module performs the following functions:

- Translates and converts the digital baseband source from the T1/E1 digital frame into the frequency range from 20 kHz to 500 kHz.
- Translates and converts the Line Frequencies into digital baseband or the T1/E1 digital frame.
- Communicates with other T1/E1 modules using the backplane to provide a multi-channel system.
- Accomplishes Line Frequency programming, setting of speech plus filters, configuration, RS232 NMS interface, and diagnostics.
- Has automatic Gain Control (AGC) to compensate for variations in signal level caused by line attenuation variations. If the received level varies by more than 40dB in the regulation range of -20 to +20 dB or -26 to +14 dB from normal, a relay and LED will indicate an alarm. Additionally, the AGC functions to perform the signal-to-noise squelch, which disables the system and initiates an alarm under excessive noise conditions.

8.9 TRANSCEIVER MODULE ADAPTER (MA-650)

The Transceiver Module requires an MA-650 Module Adapter. The MA-650 plugs into the rear of the chassis directly behind the Transceiver Module and provides the appropriate connections to the line coupling equipment. A rear panel view of the MA-650 is shown in Figure 8-16.

The MA-650 has a Craft port, and two BNC connectors labeled TX and RX. The Craft Port is a threewire RS-232 port with a DB9 connector. The Craft Port parameters are 9600 baud, no parity, 8 data bits, and 1 stop bit. It is used to communicate with the CM4 module or the Transceiver module using a PC or laptop. Through the Craft port, a user can change or view the configuration of any channel cards in the local 9508 using NMS software for the CM4, or PLC Transceiver Interface software for the Transceiver. It can also be used interrogate a remote 9508. The TX connector is the low level RF output to the "TX IN" connector on the RF chassis, and the RX connector is the low level RF input from the "RX OUT" connector on the RF chassis.



Figure 8-16. Rear panel view of Transceiver Module Adapter (MA-650).

8.10 TEST PANEL



Figure 8-17. RFL 9508 Test Panel

The Test Panel is used to test all circuits related to the Transfer Trip function, at both ends of the 9508 system. It does this by sending a "test trip command" from the 9508 at the near end, to the 9508 at the far end, where an observer can verify the reception of the trip command by looking at LEDs on the PLC-TT front panel, or by using NMS or SOE. The Test Panel is only installed when an PLC-TT module is installed. The Test Panel has an eight conductor cable which plugs into JP1 of the PLC-TT module.

When the Test Panel is not in test mode, the rotary switch must be in the NORMAL position, and the toggle switch must be in the ENABLE position. To perform a test, the operator must place the rotary switch to TEST 1 position, for Transfer Trip function 1, and the toggle switch to DISABLE position, to disable local outputs. The INITIATE TEST pushbutton is then pressed. An observer at the far end can observe the LED for Transfer Trip function 1. The rotary switch can then be placed in positions 2, 3, and 4 to test Transfer Trip functions 2, 3 and 4 of the PLC-TT module.

8.11 POWER SUPPLY MODULE

8.11.1 DESCRIPTION

The 2000 PS series of power supply modules are the power source for all logic circuits in the RFL 9508, and are available in both dc-input and ac-input versions. 50 watts of output power is available. The high power model will give 75 watts of output power.

Input fusing and output overcurrent protection are provided as safety features. In addition the supplies are designed to meet the Oscillatory, and Fast-Transient tests specified in IEEE C37.90.1-2002.

There are two types of power supplies that can be used with the 9508 Digital Chassis, as shown in Table 8-15. The 9508 Digital Chassis can be powered with either one or two Power Supply modules. The first power supply is inserted into the "P.S. MAIN" slot. The second, optional, power supply is inserted into the "P.S. REDUNDANT" slot. The second power supply, if installed, provides power supply redundancy. If the main power supply fails, the redundant supply automatically comes on-line with no interruptions.

If you are adding modules to an existing system equipped with dual power supplies, always verify that total power consumption does not exceed the capacity of a single supply. This will insure power supply redundancy.

Unit	Model Designation	Part Number	Input Voltage
Power Supply	2000 PS 250DC	9547-840	250 Vdc
Power Supply	2000 PS 48/125DC	9547-965	48 Vdc or125 Vdc

Table 8-15. RFL 9508 Power Supply Modules, General Information

8.11.2 SPECIFICATIONS

As of the date this manual was published, the specifications shown in Table 8-16 apply to all 2000 PS power supply modules, except where indicated. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Power Supply→ Specifications ↓	9547-840	9547-965
Input Voltage Range	200 to 300 Vdc	38 to 150 Vdc
Max Output Current:		
+5V	5.00A	6.00A
+15V	0.75A	1.75A
-15V	0.75A	1.00A
-48V	0.10A	0.10A
Adjustments:		
R44	NA	NA
R49	NA	NA
R50	NA	NA
R61	Output adjust	Output adjust +5V/+15V/-15V
R76	+5V output adjust	NA
Test Points:		
TP1	+15 Volt output	Output circuit common
TP2	Output circuit common	+5Volt output
TP3	-15 Volt output	+15 Volt output
TP4 TD5	+5 Volt output	-15 Volt output
	NA Innut singuit sommon	
	EFT gete drive	NA NA
	Supply voltage (Vec) to PWM	NA NA
	Input to 15Vdc regulator	NA NA
TP10	-48Vdc output	NA NA
1110	-48 v de Output	NA NA
Indicators	DS1 – Normal (Green)	DS1 – Normal (Green)
	DS2 – Alert (Yellow)	DS2 – Alert (Yellow)
	DS3 – Fail (Red)	DS3 – Fail (Red)
	DS4 – Power (Green)	DS4 – Power (Green)
	DS5 – Supply Fail (Red)	DS5 – Supply Fail (Red)
Alarm Disable Switch SW1	Enables "dropout" of relays K51 & Keeps relays K51 & K52 on Power	K52 on Power Supply Alarm I/O module when in the ENABLE position. Supply Alarm I/O module "pulled in" when in the DISABLED position.
Operating Temperature	-20° C to $+65^{\circ}$ C	-20° C to $+65^{\circ}$ C
Humidity	$95\% @ +40^{\circ}C$	95% @ +40°C
	95% e 140 C	2370 e 140 c
Isolation	2500 Vdc isolation from input	2500 Vdc isolation from input terminals to ground, output terminals to
	terminals to ground, output	ground, input terminals to output terminals, relay contacts to ground,
	terminals to ground, input	and relay contacts to coil.
	terminals to output terminals,	
	relay contacts to ground, and	
	relay contacts to coll.	
L		

Table 8-16. IMUX 2000 Power Supply Specifications

8.12 POWER SUPPLY ALARM I/O MODULE

8.12.1 DESCRIPTION



Figure 8-18. Power Supply Alarm I/O, rear panel view

The function of the Power Supply Alarm I/O module is to respond to fault conditions on the CM4, on channel modules, or on the power supply module itself. The Power Supply Alarm I/O module consists of an EMI filter, an SWC filter, an alarm relay and an alert relay, and relay logic.

There are four types of Power Supply Alarm I/O modules that can be used with the RFL 9508 chassis. Some of the characteristics of these modules are listed in Table 8-17. A rear panel view of the 9547-18809 Power Supply Alarm I/O module is shown in Figure 8-18.

When a Main Shelf is equipped with a main power supply and a redundant power supply it will have only one Power Supply Alarm I/O module. The relays on the Power Supply Alarm I/O module will respond to alarm and alert conditions from both power supply modules. This insures that Alarm and/or Alert monitoring continues even if one or the other supply is removed. Note that because the corresponding relay contacts on the Main and Redundant supplies are connected in parallel, the ACO switches on both must be switched "on" to activate the alarm cut-off, and both must be switched "off" to de-activate the alarm cut-off.

Each Alarm I/O module operates with a specific Power Supply module. Refer to Table 8-18 for Power Supply Alarm I/O application information. Only one Power Supply Alarm I/O module is used per chassis.

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Model Designation	Part Number	Application
2000 PS ALARM I/O DC 9547-18801 Used in chassis ed		Used in chassis equipped with 250Vdc power supplies
2000 PS ALARM I/O 48/125 DC 9547-18804		Used in chassis equipped with 48/125 Vdc power supplies
2000 PS ALARM I/O 48/125 DC 9547-1880		Used in chassis equipped with 48/125 Vdc power supplies, and also provides switched power to the RF chassis.
2000 PS ALARM I/O DC	9547-18810	Used in chassis equipped with 250 Vdc power supplies, and also provides switched power to the RF chassis.

Table 8-17. Types Of Power Supply Alarm I/O Modules

 Table 8-18. Power Supply Alarm I/O Application Information

Power Supply \rightarrow	9547-840	9547-965
Alarm I/O ↓		
9547-18801	Х	
9547-18804		Х
9547-18809		Х
9547-18810	Х	

8.13 MOTHERBOARD



Figure 8-19. RFL 9508 Motherboard, Digital Chassis

8.13.1 DESCRIPTION

The Digital Motherboard is mounted near the center of the digital chassis as shown in Figure 8-1. It has connectors on both sides to allow modules to be plugged into the front and rear of the digital chassis. The motherboard has a total of eighteen card slots as shown in Figure 5-2, but slots 8 and 16 are not used for modules. Slot 8 has a special connector used when two PLC-TT I/O modules are plugged into the rear of the chassis as shown in Figure 5-3. When viewed from the front of the chassis, the two connectors on the extreme left are for the main and redundant power supplies. The two corresponding connectors at the rear are for the power supply I/Os. At the rear of the chassis on the right side is a JP40 connector, which is used for expansion power. A schematic diagram of the Digital Motherboard is shown is Section 10.

Section 9. APPLICATION NOTES

This section contains application notes, which are intended to assist users in configuring RFL 9508 systems. The following application notes are included in this section:

Application Notes App. Note 1. Local and remote teleprotection / voice configurations	Pages 4	Revision 10-13-04
App. Note 2. Local and remote communications for network management	4	6-29-05
App. Note 3. Converting between E1 and T1	1	12-18-04



RFL Electronics, Inc.

RFL 9508 Application Note 1.

Rev. 10.13.2004 wgh

RFL 9508

Local and remote teleprotection / voice configurations

INTRODUCTION.

The RFL 9508 power line carrier system is based largely on the RFL IMUX 2000 T1/E1 intelligent multiplexer. As such, it can easily be expanded beyond the power line terminal in a drop and insert configuration. The most common of these configurations is the remote trip chassis "9508 RT". In this configuration, the F6 teleprotection module does not reside in the RFL 9508 chassis but in another chassis connected by fiber. This allows the teleprotection module and its I/O to be mounted in a relay rack in a different area or even a different building from the power line carrier terminal. Voice cards associated with the 9508 can be remotely located in a similar fashion.

DESCRIPTION.

The standard RFL 9508 is configured as a terminal end unit with a single CM-4 common module operating in terminal mode. The MTS-PLC is plugged into the backplane of that chassis and communicates directly through the CM-4 to the RF section of the RFL 9508. The following drawing illustrates this connection.



The CM-4 in location 1 is configured as a terminal end unit and the channel cards (MTS-PLC and VF-5XP) are configured to communicate in that direction. The CM-4 is set to be E1 with a 75 ohm head. It's timing mode is set to internal.

Setting	
CM-4 Mode	TERM
Interface Type	E1
Head	75 ohm
Timing	Internal

Note that the CM-4 mode is set via a selection of jumpers on the CM-4 module according to the following table:

Mode	J6-1	J6-2	J6-3	J6-4
Terminal	On	On	Off	Off
D&I-A	Off	On	Off	Off
D&I-B	On	Off	Off	Off

(J6 is a 2 x 4 header near the front of the CM-4, J6-1 is the top 2 pins, J6-4 is the bottom 2 pins)

In the remote tripping application, the IMUX part of the RFL 9508 is converted to a drop and insert and a second terminal unit is connected via fiber. See below:



In the above example, both the MTS-PLC and VF-5XP were moved to the remote chassis but either one could have remained in the RFL 9508 chassis if desired.

In this example, the CM-4 in location 1 is now configured as Drop and Insert for direction A (D&I-A) and location 2 is configured as Drop and Insert for direction B (D&I-B). In this arrangement, any payload coming into D&I-B via the optical fiber will be retransmitted out of D&I-A unless it is dropped out by channel cards in this channel. Sinces there are no channel cards in this chassis, all of the payload from the remote terminal passes directly to the RF section.

The remote terminal is configured as a terminal end shelf. The optical heads (OIA) can be any of the type provided by RFL for the IMUX. They range from multimode short distance heads to laser devices capable of reaching more than 50 kilometers.

In order to make this conversion, the CM-4 in location 1 is moved to 3 and its communication head type is changed to CMI. The MTS-PLC and VF-5XP are moved to the new chassis along with their I/O and the test panel. A CM-4 is inserted in location 1 and it is set as D&I-A, E1, 75 ohm head. It's timing mode is set to "thru". A second CM-4 is inserted in location 2 and it is set as D&I-B, E1, CMI head. It's timing mode is set to "thru" as well. No other setting changes should need to be made. The following table summarizes the relevant settings.

Setting	Location 1	Location 2	Location 3
CM-4 Mode	D&I-A	D&I-B	TERM
Interface Type	E1	E1	E1
Head	75 ohm	CMI	CMI
Timing	Thru	Thru	Internal

More complex communications schemes can be provisioned if the need arises. The IMUX section of the RFL 9508 is capable of all of the same functions as a standard RFL IMUX, albeit with fewer card slots supported. An example of such a complex scheme is shown below.



In this example, a two channel RFL 9508 system is fed voice and teleprotection signals from two remote IMUX locations. At the same time, an RS232 channel (DA-191I) is run from the farthest IMUX to the RFL 9508 location.



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RFL 9508 Application Note 2.

Rev. 06-29-2005 mgt

Local and remote communications for network management

INTRODUCTION

The RFL 9508 power line carrier system is capable of being managed locally and remotely via the RFL Network management program. This program allows configuration and monitoring of local and remote RFL 9508 units. Locally, the software is run on a Windows based PC and connected to the unit via an RS232 or Ethernet connection. Remotely, the RFL 9508 will exchange information over the power line by frequency shift keying the pilot tone. As this is a very low bandwidth channel, the communications is quite slow. It is however, quite useful in situations where the remote station is unmanned or inaccessible. Of course, good PLC communications must be established with the remote end before remote access is possible.

The RFL 9508 consists of two main processing units, the CM-4 and the Transceiver. Both are accessed with the RFL NMS, albeit with different sections of the program. The RFL NMS for PLC is an extension of the RFL NMS for IMUX. Much of the program is the same, and users familiar with the IMUX should have little trouble making the transition.

NMS Files

The NMS system uses nine files unique to any network for storing the configuration. The settings related to the CM-4 in both terminals are stored in a single file. This file has a .net extension i.e. "demo.net". This file should be opened when NMS is started to bring up the proper parameters. There are other associated files but this is the file name used to access them all.

The settings for each transceiver are stored in separate files with .map extensions. Each file is automatically named with the filename used for the CM-4 and then the address of the terminal i.e. "demo1.map" and "demo2.map". These filenames should not be changed or the program will not know where to find the files.

When starting from an empty NMS file, you must save the NMS file before using the RF-Setup section otherwise the filenames used for RF-Setup will be unknown1.map.

Local Communications

In order to communicate with the local 9508, you must have a windows based PC attached to the unit. This connection must be RS232 at the craft port of the 9508. Modems, private networks, telnet servers, etc can all be used just so that the interface to the 9508 is RS232. The RFL 9508 supports the MA-490 Telnet interface for connections to Ethernet networks. This is covered in more detail in the RFL IMUX 2000 operators manual.

The following configuration will allow local access to the RFL 9508 as depicted in the figure that follows:

- 1. The CM-4 in the 9508 **must** be set for 9600 baud, space parity, lock = off, universal = off.
- 2. The network communications setup in NMS **must** be set for 9600 baud, parity = 0, stop bits = 1.
- 3. The NMS communications preference parameter "assume communications works..." **must** be set to "yes" (this tells NMS not to do a "who" command before going into real time mode)
- 4. In the RF setup common screen, the "Remote IMUX Addr" and Remote XVER Addr **must** be set to the proper value (address 2). The following figure should clarify the address settings.
- 5. The Local CM-4 **must** be set to the proper SIO address (address 1)
- 6. The remote CM-4 **must** be set to the proper SIO address (address 2)
- 7. The cable from a typical laptop is straight thru to the RFL 9508.
8. Ideally, the user should use the network files provided with the system by RFL as a starting place. This will ensure the addresses and other setup parameters are correct.



Once the setup is correct, the user can proceed with the following steps to ensure that communications is operating as expected:

- 1. Open NMS and open the network setup file. "demo.net"
- 2. Go into real time mode
- 3. Go to network view and click on the local node to go into node view.
- 4. Click on the CM-4 and confirm that the unit can communicate with the CM-4. Close the CM-4 window and return to node view.
- 5. Click on the RF setting button to open the portion of the program that communicates with the transceiver. This section will automatically read and display the setting file for that transceiver from the hard disk i.e. "demo1.map".
- 6. The "READ" button will cause the software to read and display the settings from the transceiver. This can be done if the settings in the transceiver are preferred over the settings in the .map file.
- 7. The "WRITE" button will cause the software to write the displayed settings to the transceiver, overwriting whatever settings may have been present.
- 8. A successful read or write will prove that communications to the transceiver are operating correctly.
- 9. Another operation that communicates with the transceiver is the monitor section. In the RX setup section there is a monitor. This communicates continually with the transceiver and displays receive SNR and LOS alarms and RX levels. If the monitor is running, it uses the port so it must be stopped before reading or writing can take place.
- 10. When the RF program section is closed, the settings that are currently being displayed will typically be stored to the hard disk, overwriting the existing file. This can be bypassed but typically it is best to write them so that the file is up to date.

By this point, successful communications with the local CM-4 and Transceiver have been proven.

RFL 9508	
September 29, 2005	

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Remote Communications

Once local communications have been established and RF communications are operating, the user can access the remote unit while connected via RS232 to the local unit. For the purposes of this discussion, we will assume the local unit is address 1 and the remote unit is address 2. The following setup (in addition to the proper local configuration) must be confirmed.

- 1. In the RF setup screen, the Pilot FSK disable setting should not be checked
- 2. The NMS communications preference parameter "ms to wait after sending command..." should be set to 99000. (this gives a 99 second timeout on any command)

Once the setup is correct, the user can proceed with the following steps to ensure that communications is operating as expected:

- 1. Open NMS and open the network setup file. "demo.net"
- 2. Go into real time mode
- 3. Go to network view and click on the remote node (2) to go into node view.
- 4. Click on the CM-4 and confirm that the unit can communicate with the CM-4. Close the CM-4 window and return to node view.
- 5. Click on the RF setting button to open the portion of the program that communicates with the transceiver. This section will automatically read and display the setting file for that transceiver from the hard disk i.e. "demo2.map".
- 6. A successful read or write will prove that communications to the transceiver are operating correctly.

By this point, successful communications with the remote CM-4 and Transceiver have been proven.

Troubleshooting

If you are having trouble establishing communications to a local Transceiver it is most likely caused by an invalid communication parameter. Double check your settings in NMS, the CM-4, and the XCVR.

If you still can't establish communication, it may be caused by the remote IMUX address, and/or remote XCVR address (of the unit you are locally connected to) being set to the actual address you are attempting to communicate with. To work around this case, use NMS in batch mode, and enter the RF-Setup section. Click on Menu -> Program Settings. In the pop-up change the modbus slave address to 99 (or any address that has not been used). This will cause the Transceiver to respond locally and not attempt to fetch a response from the far end. At this point you should be able to READ/WRITE settings.



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RFL 9508 Application Note 3.

Rev. 12.08.2004 mgt

RFL 9508

Converting between E1 and T1

The RFL 9508 power line carrier system can be operated in either T1 or E1 line modes. To convert the system several settings must be changed in the Transceiver, CM-4 and the RF I/O.

Changes on RF I/O:

Place the jumper into the T1 or E1 position as needed.

Changes on CM-4:

Using the front switches on the CM-4, under the "INTF" menu change the type to E1 or T1 as desired. In T1 mode the CM-4 must be configured for ESF, B8ZS, and CRC4 enabled. In E1 mode the CM-4 must be configured for HDB3, CAS, and CRC4 enabled.

Changes in Transceiver:

In the RFL 9508 setup software, on the common tab change the Line Mode Select to either T1 or E1 as desired. Under each RF channel's Channel Settings tab change the companding type to mu Law for T1 and a Law for E1. Once you click on the write button the transceiver module will reboot into the new line mode.

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Section 10. SCHEMATICS

The following RFL 9508 schematics are included in this section.

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Figure 10-1. Line Board Schematic	В-103094-Е	1	10-3
Figure 10-2. Tx Filter Schematic	D-107829-D	1	10-5
Figure 10-3. Rx Filter Schematic	PLCI-LINRxV1.1.DSN	1	10-7
Figure 10-4. RF I/O Schematic (MA-650)	D-107644-C	1	10-9
Figure 10-5. Attenuator Board Schematic	B-107814-B	1	10-11
Figure 10-6. Balance Board Schematic	PLCI (B-107819-A)	1	10-13
Figure 10-7. RF Motherboard Schematic	В-103099-С	1	10-15
Figure 10-8. Digital Motherboard Schematic	D-105594-2-B	5	10-17

Table 10-1. Table of RFL 9508 Schematics

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Figure 10-1. 9508 Line Board (B-103094-E)

RFL Electronics Inc. 10-3 (10-4 Blank) (973) 334-3100







Figure 10-3. 9508 RX Filter (PLCI- LINRXV1.1.DSN)



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Figure 10-4. 9508 RF I/O (MA-650), (D-107644-C)

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Figure 10-5. 9508 Attenuator Board (B-107814-B)

RFL Electronics Inc. (973) 334-3100 10-11 (10-12 Blank)



- R1, R2 Resistor, 162 Ohms 1/2 W
- R3, R4 Resistor Pacific 50 Ohms 70 W Non Inductive 100CHN J2, J3, J4- JUMPER HARWIN #PART D3086-97, Socket #PART H3183-01

J2	J3	J4
1-2	2-3	2-3
2-3	1-2	1-2

Figure 10-6. 9508 Balance Board, PLCI (B-107819-A)

RFL Electronics Inc. 10-13 (10-14 Blank) (973) 334-3100



NOTE: ALL ROWS OF P1- P5 ARE CONNECTED TOGETHER. IE: A1 & C1 OF P1 ARE CONNECTED TOGETHER, THEN A2-C2, ETC.

•

ATTENUATOR
P5

		-	
	-A1	C1-	
_	-A2	C2-	
	-A3	C3-	F
-	-A4	C4-	
Ē	A5	C5	F
	-A6	C6-	
	-A7	C7	F
	-A8	C8-	
E	-A9	C9-	F
	-A10	C10-	F
-	-A11	C11-	F
	-A12	C12-	-
-	-A13	C13-	F
2	-A14	C14-	
-1-	-A15	C15-	
	-A16	C16-	
	-A17	C17-	
	-A18	C18-	
	-A19	C19-	
	-A20	C20-	
Ι	-A21	C21-	_
1	-A22	C22-	-
Γ	-A23	C23-	
+	-A24	C24-	
	-A25	C25-	
ļ	-A26	C26-	
	-A27	C27-	Ξ.
	-A28	C28-	
1[-A29	C29-	5
1	-A30	C30-	
	-A31	C31-	
	-A32	C32-	
1 '			1

Figure 10-7. 9508 RF Mother Board (B-103099-C)



Figure 10-8. 9508 Digital Mother Board (D-105594-2-B) Sheet 1 of 5



Figure 10-8. 9508 Digital Mother Board (D-105594-2-B) Sheet 2 of 5



Figure 10-8. 9508 Digital Mother Board (D-105594-2-B) Sheet 3 of 5

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Figure 10-8. 9508 Digital Mother Board (D-105594-2-B) Sheet 4 of 5

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Figure 10-8. 9508 Digital Mother Board (D-105594-2-B) Sheet 5 of 5

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Section 12. CHANNEL MODULES

This section contains Instruction Data Sheets for channel modules available for use with the RFL 9508 Analog Single Sideband Powerline Carrier system, as of the date this manual was printed:

0	RFL VF-5C Dual-Channel Two/Four-Wire E&M Voice Module
0	RFL VF-5XP Dual-Channel Four-Wire E&M Voice Module
0	RFL VF-6I Single-Channel Four-Wire Orderwire Voice Frequency Module
0	RFL VF-8A Selective Calling Unit
0	RFL VF-15C-1 Dual-Channel Foreign Exchange Voice Module (Office End)
0	RFL VF-16B-1 Dual-Channel Foreign Exchange Voice Module (Station End)

o RFL PLC-TT Transfer Trip Module

Additional schematics, wiring diagrams, or other documents specific to your application may also be placed in this section.

For information on other modules that may be available for use with your system, contact the factory or an RFL Sales Representative.

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RFL Electronics Inc.

INSTRUCTION DATA

RFL VF-5C Dual-Channel Four-Wire E&M Voice Module For RFL IMUX 2000 Intelligent T1 And E1 Multiplexers

DESCRIPTION

The RFL VF-5C is a dual-channel four-wire E&M voice-frequency module, designed for use in IMUX 2000 T1 and E1 multiplexers. It accepts two voice channels as input and digitizes them; each channel occupies one 64-Kbps time slot. The RFL VF-5C can be used in both terminal and drop/insert IMUX 2000 multiplexers.

The RFL VF-5C provides high-quality voice characteristics, compatible with AT&T Publication 43801. It allows E&M signaling of Type I, II, III and V, with front-panel busy indicators. It has extended-range input and output signal level settings to facilitate interfaces in most four-wire applications.

The VF-5C is remote-controllable when installed in an RFL IMUX 2000 remote-controllable shelf. User-adjustable switches and jumpers allow the configuration of the following parameters:

- o One-channel or two-channel operation.
- o Selectable Type I, II, III or V signaling.
- o Individual channel enable/disable.
- o Signaling on or off selection.
- o FXS/FXO signaling modes.
- o Busy out settings.
- o Independent selectable transmit/receive direction for each channel.
- o Extended range input/output level settings
- o Independent time slot assignment for each channel
- o Three loopback modes (Local, Remote, 2713 Hz detect).
- o Remote control configuration and status reporting.
- o Addressing enable/disable
- o Tx and Rx addresses for each channel
- o 1kHz test tone generation

SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL VF-5C module. Because all of RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Configuration: Two independent voice channels per module.

Time Slots Required:

One-Channel Operation: Requires one user-selectable 64-Kbps time slot. Two-Channel Operation: Requires any two user-selectable 64-Kbps time slots.

Remote Interface:

All settings can be changed in remote mode using NMS, except E&M signaling type. Access to status registers, including board and firmware revision levels, is also provided through NMS.

Signal Levels:

TLP transmit range: -23 dBm to +10 dBm nominal (+13 dBm peak) TLP receive range: -31.5 dBm to +10 dBm nominal (+13 dBm peak) Level control resolution: 0.5 dB Absolute level accuracy: 0.5 dB

Input Impedance: 600Ω nominal

Output Impedance: 600Ω nominal

Frequency Response relative to 1004 Hz: 300 to 3000 Hz, ±0.5 dB (bidirectional)

Idle Channel Noise: Less than 21 dBrnc0

Signal-To-Distortion (1004 Hz Input, 0 to -30 dBm0): Greater than 36 dB

Peak-To-Average Ratio (PAR): Greater Than 94

Impulse Noise:

Maximum counts per 30-minute interval. (Input level -13dbm0(-29dbm) @ 1004 Hz. Level Adjustment set to -16dBm in, +7dBm out.

Threshold Level (dBrnc) -61 Counts/30 minutes

Signaling Format (Digital interface):

T1 systems: RBS (Robbed-Bit Signaling) AT&T PUB 43801 E1 systems: CAS (Channel Associated Signaling) Transmission Only *Signaling is unavailable when using addressing feature.

E&M Signaling Types: Jumper selectable, E&M Type I, II, III and V

M Lead INPUT:

Input Impedance: Greater than 3.5K ohms to ground Current limited to less than 6ma Type I, II, III

Busy: -20 to -60 volts

Idle: 0 to -10 volts or open

Type V

Busy: 0 to -35 volts Idle: Open

E Lead Output:

Busy: Less than 35 ohms to ground Idle: -42 to -60 volts or open

Module Adapters:

MA-301, MA-301A, MA-301B, MA-301D, MA-322, MA-324 or MA-350.

Address Range: 1 to 127

Addressing Sync Time:

9ms max (measured from channel card's receipt of valid data)

Addressing Loss of Sync Time:

7ms max (measured from channel card's receipt of invalid data)

2713 Hz Detect Thresholds:

Detect frequency range: 2691 to 2736 Hz Non-detect frequency range: Less than 2680 Hz or greater than 2742 Hz Nominal T1 minimum amplitude: -34dBm0 Nominal E1 minimum amplitude: -31dBm0 Turn on time: 2 seconds Turn off time: 1 second Auto turn-off time: 2 minutes

Power Consumption:

120 mA max from +5V supply 70 mA max from +15V supply 50 mA max from -15V supply 0 mA max from -48V supply*

*Note: The VF-5C itself draws no current from the –48Volt supply. However SB-Lead outputs are provided for each channel for external wiring of E&M signaling. There is a 1k-ohm ½ watt resistor in series with each output. No more than 20mA should be drawn from any SB-Lead output at any time.

Operating Temperature: -20° C to $+55^{\circ}$ C (-4° F to $+131^{\circ}$ F).

Relative Humidity: Zero to 90 percent, non-condensing.

INSTALLATION

Before the RFL VF-5C can be placed in service, it must be installed in a multiplexer shelf. Installation involves determining the module slot in the Main Shelf or Repeater Shelf where the module will be installed, inserting a Module Adapter into the rear of the shelf behind the module slot, connecting all signal wiring to the Module Adapter, checking the settings of all switches and jumpers, and inserting the module into the front of the shelf.

NOTE

Power supply and time slot considerations may affect the installation of this module into an existing multiplexer shelf. Refer to the multiplexer manual for more information.

The following instructions are provided for installing RFL VF-5C modules into existing systems. If the module was included as part of a system, installation was done at the factory. Otherwise, proceed as follows:

- 1. Carefully inspect the module for any visible signs of shipping damage. If you suspect damage to the module, immediately call RFL Customer Service at the number listed at the bottom of this page.
- 2. Determine the module slot in the Main Shelf or Repeater Shelf where the module will be installed.

The RFL VF-5C module occupies one module slot in the Main Shelf or Repeater Shelf.

- 3. Determine which Module Adapter will be used to make connections to the RFL VF-5C module. Each module in the IMUX 2000 multiplexer requires a Module Adapter. The module adapter provides the appropriate connector for the desired interface. There are six Module Adapters compatible with the RFL VF-5C:
 - MA-301The MA-301 accepts a 50-pin Telco connector (Amphenol 57-30500 or equivalent,
as shown in Figure 1.) One MA-301 Module Adapter can be used to connect up to
three RFL VF-5C modules, for a total of up to six voice channels. If you will be
using more than one module with the MA-301, they must be inserted into adjacent
slots in the multiplexer. Ribbon cables are provided with the MA-301 to make
connections to it from the second and third module locations as shown in Figure 2.
 - MA-301AThe MA-301A is used to isolate the VF-5C from SWC type surges
sometimes present on 4-wire voice lines. This module adapter occupies two rear
slots in the IMUX 2000 chassis. A terminal strip is provided for hard wire
connections to the voice circuit for Channel 1 and Channel 2, as shown in Figure 3.
E&M signaling connections are not available when using the MA-301A.

- MA-301BThe MA-301B provides pluggable terminal block connections for a single VF-5C
module. Audio and signaling connections are available at the terminal block. No
additional SWC or fast transient protection is provided on this I/O. Refer to Figure
4 for panel view and terminal connections.
- MA-301DThe MA-301D provides pluggable terminal block connections for a single VF-5C
module. Tip and Ring test points are available for the inputs and outputs of
channels 1 and 2. Audio and signaling connections are available at the terminal
block. No additional SWC or fast transient protection is provided on this I/O. Refer
to Figure 5 for panel view and terminal connections.
- MA-322The MA-322 accepts a 50-pin Telco connector (Amphenol 57-30500 or equivalent,
as shown in Figure 6.) One MA-322 Module Adapter is used for each RFL VF-5C
module, and occupies two rear slots in the IMUX 2000 chassis. The MA-322 is used
to convert both of the 4-wire outputs (Channel 1 and 2) from 4-wire to 2-wire. The
impedance is 600 Ohms, the frequency response is ±2dB from 200Hz to 3000Hz,
and the transformer loss (hybrid loss) is ≅ 4.0dB. Refer to Application Note No.14
in the IMUX 2000 Instruction Manual for additional information on using this I/O.
- MA-324The MA-324 accepts a 50-pin Telco connector (Amphenol 57-30500 or equivalent,
as shown in Figure 6.) One MA-324 Module Adapter is used for each RFL VF-5C
module and occupies two rear slots in the IMUX 2000 chassis. The MA-324 is used
to convert one of the 4-wire outputs (Channel 1) from 4-wire to 2-wire. The other
4-wire output (Channel 2) remains 4-wire. The impedance is 600 Ohms, the
frequency response is ±2dB from 200Hz to 3000Hz, and the transformer loss
(hybrid loss) is ≅ 4.0dB. Refer to Application Note No.14 in the IMUX 2000
Instruction Manual for additional information on using this I/O.
- MA-350The MA-350 is a special adapter capable of accepting up to 12 VF-5C voice
modules. The MA-350 occupies 12 rear slots in the IMUX 2000 chassis
and can handle a maximum of 24 voice channels. Connections are made to four 50-
pin Telco connectors (Amphenol 57-30500) on the rear of the adapter. See Figure 7
and 8.

O MA301							
MASUT	CHANNEL#	VF IN	VF OUT	E&	M SIGNAI	LING LEAD	DS
		R, I	R, I	SG	E	SB	М
	1 2	1, 26 5, 30	2, 27 6, 31	3 7	28 32	4 8	29 33
	3 4	9, 34 13, 38	10, 35 14, 39	11 15	36 40	12 16	37 41
	5 6	17, 42 21, 46	18, 43 22, 47	19 23	44 48	20 24	45 49
	LL		1	4	<u>.</u>	Į	L1

Figure 1. MA-301 Module Adapter



Figure 2. Connecting up to three RFL VF-5C modules to a single MA-301 Module Adapter.



Figure 3. MA-301A, SWC rated 4-wire Module Adapter



Figure 4. MA-301B Module Adapter



Figure 5. MA-301D Module Adapter

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Note: All unlisted pins are not used. See Application Note No.14 in the IMUX 2000 Instruction Manual for additional information on using these I/Os.

Figure 6. MA-322/MA-324 Module Adapters



Figure 7. MA-350 Module Adapter, side view



Figure 8. MA-350 Module Adapter, rear view

J1 (XMT T/R)	J2 (EM)	J3 (RCV T1/R1)	J4 (EG MB)
Pin 1 thru Pin 24	Pin 1 thru Pin 24	Pin 1 thru Pin 24	Pin 1 thru Pin 24
XMT-R-CH1 thru XMT-R-CH24	M-CH1 thru M-CH24	RCV-R1-CH1 thru RCV-R1-CH24	MB-CH1 thru MB-CH24
Pin 26 thru Pin 49	Pin 26 thru Pin 49	Pin 26 thru Pin 49	Pin 26 thru Pin 49
XMT-T-CH1 thru XMT-T-CH24	E-CH1 thru E-CH24	RCV-T1-CH1 thru RCV-T1-CH24	EG-CH1 thru EG-CH24

Note: Pin 25 and 50 not used.

4. Insert the desired Module Adapter into the rear of the slot which will hold the RFL VF-5C module and make all connections to the Module Adapter.

If an MA-301, MA-322 or MA-324 Module Adapter is being used, plug the 50-pin Telco connector into its 50-pin connector.

If an MA-301A Module Adapter is being used, connect all signal wiring to the terminal strip at the rear of the MA-301A using Figure 3 as a guide.

If an MA-301B or MA-301D Module Adapter is being used, connect all signal wiring to the terminal strip at the rear of the module using Figures 4 and 5 as a guide.

If an MA-350 Module Adapter is being used proceed as follows: This is a large module adapter; care should be taken when inserting into the rear of the IMUX chassis. Carefully align the 30 pin connectors with their respective mating connectors on the Backplane and insert the adapter, do not use excessive force as this may damage the pins. Make connections to the 50-pin Telco connectors for 4-wire or signaling as required (See Figure 7 and 8). Note: Pull rings are provided for adapter removal.

- 5. Refer to Figure 10 and Table 1 for the location of switches, controls and indicators on the VF-5C.
- 6. Set DIP switches SW1-1 through SW1-6 for the desired remote access address.
 For remote access, each channel module in the IMUX 2000 must have a distinct module address. Valid module addresses are the numbers 1 to 36. In most installations, the address will be set to the slot number of the shelf the module is occupying. Table 2 shows the switch settings for the module address.
- 7. Set the position of SW1-7 to enable or disable Channel 1.
 When SW1-7 is in the OFF position, Channel 1 is enabled. When SW1-7 is in the ON position, Channel 1 is disabled.

Set the position of SW1-8 to enable or disable Channel 2. When SW1-8 is in the OFF position, Channel 2 is enabled. When SW1-8 is in the ON position, Channel 2 is disabled.

The setting of these two switches will determine whether the module will be used for either one-channel or two-channel operation.

- 8. Set jumpers J7, J8 and J11 to select the type of E&M signaling required for Channel 1. Set jumpers J9, J10 and J12 to select the type of E&M signaling required for Channel 2.
 There are four signaling types: Type I, Type II, Type III and Type V. Refer to Table 1 on page 19 for jumper assignments for each of these signaling types.
- Select any unused time slot for Channel 1 using DIP switches SW2-1 to SW2-5.
 SW2-1 through SW2-5 select the transmit timeslot assignment for Channel 1, in accordance with Table 3.
Select any unused time slot for Channel 2 using DIP switches SW3-1 to SW3-5. SW3-1 through SW3-5 select the transmit timeslot assignment for Channel 2, in accordance with Table 3.

Select Channel 1 bus direction using DIP switch SW2-6.

Place SW2-6 in the DOWN position to transmit in the A direction and receive from the B direction. Place SW2-6 in the UP position to transmit in the B direction and receive from the A direction.

Select Channel 2 bus direction using DIP switch SW3-6. Place SW3-6 in the DOWN position to transmit in the A direction and receive from the B direction. Place SW3-6 in the UP position to transmit in the B direction and receive from the A direction.

10. Select Channel 1 loopback mode by using DIP switches SW2-7, SW2-8, and SW1-9

There are four loopback modes: None, Local Loopback, Remote Loopback and 2713 Hz Loopback. As its name implies, None indicates that no loopbacks are selected. Local Loopback, when selected, is used to test TX and RX analog circuitry at the near end as shown in Figure 10a. Remote Loopback, when selected, is used to test TX and RX analog circuitry at the far end as shown in Figure 10b.

The 2713Hz Loopback mode, as shown in Figure 10c, is normally used if remote control of the VF-5C via NMS is not available. To use this mode you must first enable the "2713 Hz feature" and then select manual deactivation or automatic deactivation.

To use 2713 Hz loopback with manual deactivation do the following:

- 1. Enable the "2713 Hz feature" by setting SW2-7 and SW2-8 to ON, and SW1-9 to OFF.
- 2. Activate remote loopback at the remote end VF-5C by injecting a 2713 Hz signal into the Input Equipment jack (from the master end towards the remote end) for at least two seconds using a "TIM" set or equivalent.
- **3.** The VF-5C at the remote end will stay in remote loopback mode until it is manually deactivated.

If the 2713 Hz signal is still connected, remote loopback is deactivated, by removing the 2713 Hz signal and then momentarily reconnecting it for at least one second.

If the 2713 Hz signal is not connected, remote loopback is deactivated by momentarily connecting it for at least one second.

To use 2713 Hz loopback with automatic deactivation do the following:

- 1. Enable the "2713 Hz feature" by setting SW2-7 and SW2-8 to ON, and SW1-9 to ON.
- 2. Activate the remote loopback at the remote end VF-5C by injecting a 2713 Hz signal into the Input Equipment jack (from the master end towards the remote end) for at least two seconds using a "TIM" set or equivalent.
- 3. The VF-5C at the remote end will stay in remote loopback mode as long as the 2713 Hz signal is present at the master end. If the 2713 Hz signal is removed, the loopback at the

remote end will automatically de-activate after two minutes. Any time during the two minute time out period you can manually deactivate the remote loopback by momentarily injecting the 2713 Hz signal for at least one second.

- 12. Select Channel 2 loopback mode by using DIP switches SW3-7, SW3-8 and SW1-10.
- 13. Set DIP switches SW4-1 through SW4-7 (Channel 1), and DIP switches SW8-1 through SW8-7 (Channel 2) to the nominal transmit level. The valid range is +10dBm to -23dBm. See Table 4 for reference.

For example if the nominal incoming audio (analog) TLP is -16dBm, then the Switches should be set for -16dBm. This will provide a nominal 0dBm0 on the DS0, which leaves approximately 3dB of headroom. In this case the peak transmit TLP would be -13dBm. The factory default is -16dBm transmit (analog in)

DIP switches SW4-1 to SW4-7 are labeled as follows:

SW4-1	+/-
SW4-2	16
SW4-3	8
SW4-4	4
SW4-5	2
SW4-6	1
SW4-7	0.5

The switch settings are cumulative. For example, to set the nominal transmit level to -16dBm, set the switches as follows:

Section	Value	<u>Setting</u>	<u>Set Value</u>
SW4-1	+/-	ON	-
SW4-2	16	ON	16
SW4-3	8	OFF	0
SW4-4	4	OFF	0
SW4-5	2	OFF	0
SW4-6	1	OFF	0
SW4-7	0.5	OFF	0

Nominal transmit level setting = -16dBm

Set DIP switches SW5-1 through SW5-7 (Channel 1), and DIP switches SW9-1 through SW9-7 (Channel 2) to the nominal receive level. The valid range is +10dBm to -31.5dBm. See Table 5 for reference.

For example if the nominal incoming PCM data is 0dBm0 and the desired output level is +7dBm then the switches should be set for +7dBm. This will provide a nominal +7dBm0 at the receive TLP, and leaves approximately 3dB of headroom. In this case the peak receive TLP would be +10dBm. The factory default is +7dBm receive (analog out).

DIP switches SW5-1 to SW5-7 are labeled as follows:

SW5-1	+/-
SW5-2	16
SW5-3	8
SW5-4	4
SW5-5	2
SW5-6	1
SW5-7	0.5

The switch settings are cumulative. For example, to set the nominal receive level to +7dBm, set the switches as follows:

Section	Value	<u>Setting</u>	Set Value	
SW5-1	+/-	OFF	+	
SW5-2	16	OFF	0	
SW5-3	8	OFF	0	
SW5-4	4	ON	4	
SW5-5	2	ON	2	
SW5-6	1	ON	1	
SW5-7	0.5	OFF	0	

Nominal receive level setting = +7dBm

15. Set the position of SW4-8 to enable or disable Channel 1 signaling. Place SW4-8 to the ON position to enable Channel 1 signaling. Place SW4-8 to the OFF position to disable Channel 1 signaling.

Set the position of SW8-8 to enable or disable Channel 2 signaling. Place SW8-8 to the ON position to enable Channel 2 signaling. Place SW8-8 to the OFF position to disable Channel 2 signaling.

16. Set the position of SW7-8 and SW7-9 to enable or disable FXS/FXO modes for Channel 1 in accordance with Table 1 on page 18 as applicable.

Set the position of SW11-8 and SW11-9 to enable or disable FXS/FXO modes for Channel 2 in accordance with Table 1 on page 18 as applicable.

17. Set the position of SW5-8 to activate or deactivate the Channel 1 Busy Function. This switch is used to force the off-hook condition to be either Busy or Not Busy.

Place SW5-8 to the ON position to activate the Channel 1 Busy Function (Busy). Place SW5-8 to the OFF position to deactivate the Channel 1 Busy Function (Not Busy)

Set the position of SW9-8 to activate or deactivate the Channel 2 Busy Function. This switch is used to force the off-hook condition to be either Busy or Not Busy.

Place SW9-8 to the ON position to activate the Channel 2 Busy Function (Busy). Place SW9-8 to the OFF position to deactivate the Channel 2 Busy Function (Not Busy)

18. Set the position of SW7-10 to activate or deactivate the Channel 1 1kHz Test Tone.
 Place SW7-10 to the ON position to activate the Channel 1, 1kHz Test Tone.
 Place SW7-10 to the OFF position to deactivate the Channel 1, 1kHz Test Tone

Set the position of SW11-10 to activate or deactivate the Channel 2 1kHz Test Tone. Place SW11-10 to the ON position to activate the Channel 2, 1kHz Test Tone Place SW11-10 to the OFF position to deactivate the Channel 2, 1kHz Test Tone

Set the position of SW6-8 to enable or disable Channel 1 addressing.
 Place SW6-8 to the ON position to enable Channel 1 addressing.
 Place SW6-8 to the OFF position to disable Channel 1 addressing.

Set the position of SW10-8 to enable or disable Channel 2 addressing. Place SW10-8 to the ON position to enable Channel 2 addressing. Place SW10-8 to the OFF position to disable Channel 2 addressing.

20. Set the position of SW6-1 to SW6-7 to select the Channel 1 TX Address. The switches are labeled as follows:

SW6-1	64
SW6-2	32
SW6-3	16
SW6-4	8
SW6-5	4
SW6-6	2
SW6-7	1

The switch settings are cumulative. For example, to set the Channel 1 TX Address = 117, set the switches as follows:

Section Value		Setting Set Value			
SW6-1	64	ON	64		
SW6-2	32	ON	32		
SW6-3	16	ON	16		
SW6-4	8	OFF	0		
SW6-5	4	ON	4		
SW6-6	2	OFF	0		
SW6-7	1	ON	1		

Channel 1 TX Address setting = 117

(Note: legal TX addresses are 1 to 127)

>> text continues on page 24 <<



Figure 9. Controls and indicators, VF-5C module

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Figure 10. VF-5C loopback configurations

Table 1. Controls and indicators, RFL VF-5C module

Item	Name/Description	Function						
1	Equipment jacks	Allow channel signals to be equipped:						
		CH1 IN Equipment point for Channel 1 input signal.						
		CH1 OUT Equipment point for Channel 1 output signal.						
		CH2 IN Equipment point for Channel 2 input signal.						
		CH2 OUT Equipment point for Channel 2 output signal.						
2	DS1 LED	Channel 1 Addressing LED (has three states)						
		Off: Addressing feature is turned OFF.						
		Green: Addressing feature is turned ON and the module is receiving the						
		correct address from the far end						
		Red: Addressing feature is turned ON and the module is not receiving						
		the correct address from the far end. This condition causes muting of CH1 OUT.						
	DS2 L FD	Channel 1 "F-I ead" I FD (has two states)						
		Off: Signaling is OFF or signaling is ON and "E-Lead" output is inactive.						
		Green: Signaling is ON and "E-Lead" output is active.						
	DS3 LED	Channel 1 "M-Lead" LED (has two states)						
		Off: Signaling is OFF or signaling is ON and "M-Lead" input is inactive.						
		Green: Signaling is ON and "M-Lead" input is active.						
3	DS4 LED	Channel 2 Addressing LED (has three states)						
-		Off: Addressing feature is turned OFF.						
		Green: Addressing feature is turned ON and the module is receiving the						
		correct address from the far end						
		Red: Addressing feature is turned ON and the module is not receiving						
		the correct address from the far end. This condition causes muting of CH2 OUT.						
	DS5 LED	Channel 2 "E-Lead" LED (has two states)						
		Off: Signaling is OFF or signaling is ON and "E-Lead" output is inactive.						
		Green: Signaling is ON and "E-Lead" output is active.						
	DOCLED	Channel 2 "M Lead" LED (has two states)						
	DS6 LED	Channel 2 "M-Lead" LED (has two states)						
		Green: Signaling is ON and "M-L ead" input is active						
		Green. Signaning is orv and wi-Lead input is active.						
4	DS7 LED	Channel 1 Loopback LED (has four states)						
		Off: No loopbacks are active						
		Red: Remote loopback is active						
		Green: Local loopback is active						
		Flashing Red: Remote loopback is active and was activated by 2/13 Hz from Master end.						
	DS8 LED	Channel 2 Loopback LED (has four states)						
		Off: No loopbacks are active						
		Red: Remote loopback is active						
		Green: Local loopback is active						
		Flashing Red: Remote loopback is active and was activated by 2713 Hz from Master end.						
	DS9 LED	Service On/Off LED (has four states)						
		Off: Service is OFF.						
		Green: Service is ON and module configuration is valid.						
		Red: Service is OFF due to CH1 and CH2 being set to same timeslot and bus direction.						
		Amber: Service is ON but either CH1 or CH2 is set to an invalid timeslot.						
		Red: Service is OFF due to CH1 and CH2 being set to same timeslot and bus direction. Amber: Service is ON but either CH1 or CH2 is set to an invalid timeslot.						

Item	Name/Description	Function					
5	DIP Switch SW1	SW1-1 to SW1-6 Selects SCB address in accordance with Table 2.					
		SW1-7: Enables or disables Channel 1					
		ON: Channel 1 disabled					
		OFF: Channel 1 enabled					
		SW1-8: Enables or disables Channel 2					
		ON: Channel 2 disabled					
		OFF: Channel 2 enabled					
		SW1-9: Selects automatic or manual deactivation of 2713 Hz loopback for Channel 1					
		ON: Selects automatic mode					
		SW1 10 Selects automatic or manual deactivation of 2712 Hz loophock for Channel 2					
		Sw 1-10 Selects automatic or manual deactivation of 2/15 Hz toopback for Channel 2 ON: Selects automatic mode					
		OFF: Selects manual mode					
6	DIP Switch SW2	SW2-1 to SW2-5 Selects Channel 1 timeslot in accordance with Table 3					
0	DI Switch SW2	SW2-6 Selects Channel 1 bus direction as follows:					
		DOWN: Terminal or DI-A (Transmits in A direction, receives from B direction)					
		UP: DI-B (Transmits in B direction, receives from A direction)					
		SW2-7 & SW2-8 Selects Channel 1 Loopback Mode as follows:					
		Loopback Mode SW2-7 SW2-8					
		None OFF OFF					
		Local OFF ON					
		Remote ON OFF					
		2713 Hz induced loopback (1) ON ON					
7	DIP Switch SW3	SW3-1 to SW3-5 Selects Channel 2 timeslot in accordance with Table 3.					
		SW3-6 Selects Channel 2 bus direction as follows:					
		UP: DI-B (Transmits in B direction, receives from B direction)					
		SW3-7 & SW3-8 Selects Channel 2 Loopback Mode as follows:					
		Loopback Mode <u>SW3-7</u> <u>SW3-8</u>					
		None OFF OFF					
		Local OFF ON Remote ON OFF					
		Remote ON OFF					
		SW3-9 Selects remote or local mode as follows:					
		DOWN: Remote mode					
		UP: Local mode					
		SW3-10 Selects service ON or OFF as follows:					
		DOWN: Service OFF					
8	DIP Switch SW4	SW4-1 Selects polarity $(+ \text{ or }_{-})$ of Channel 1 Tx level					
0	(CH1 TX LVL)	SW4-2 to SW4-7 Selects magnitude of Channel 1 Tx level (See Note 2)					
	(SW4-8 Enables or disables Channel 1 signaling as follows:					
		ON: Signaling enabled					
		OFF Signaling disabled					
9	DIP Switch SW5	SW5-1 Selects polarity (+ or -) of Channel 1 Rx level					
	(CHI KX LVL)	SW5-2 to SW5-7 Selects magnitude of Channel I Rx level (See Note 2)					
		5 w 3-6 Activates or deactivates the Channel 1 Busy Function. Identical in function to the trunk circuit activating the M lead. Use this switch to force the off-hook condition as					
		follows:					
		ON: Busy (Off-Hook equivalent)					
		OFF Normal (Follows actual ON/Off-Hook input)					

Table 1. continued - Controls and indicators, VF-5C module

Notes:

1. When SW2-7 and SW2-8 are both down, the 2713Hz loopback function is enabled. Then set SW1-9 and SW1-10 as required.

2. The value of these switches is additive, see the examples in steps 13 and 14 of Installation Instructions. The factory default setting is -16dBm in and +7dBm out. (See Tables 4 and 5 for Tx and Rx Level Settings)

Table 1. continued - Controls and indicators,	VF-5C module
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Item	Name/Description	Function					
10	DIP Switch SW6	SW6-1 to SW6-7 Selects Channel 1 Tx address					
	(CH1 TX ADDR)	SW6-8 Enables or disables Channel 1 addressing as follows:					
		ON: Channel I addressing enabled					
11	DID Switch SW7	SW7.1 to SW7.7 Selects Channel 1 By address					
11	(CH1 PX ADDP)	SW7.9 & SW7.0 Engline or display EVS/EVO modes for Channel 1 as follows:					
	(CIII KA ADDK)	Mode SW7-8 SW7-9					
		Normal mode OFF ON or OFF					
		FXS mode ON ON					
		FXO mode ON OFF					
		SW7-10 Activates or deactivates 1kHz, 0dBm0 test tone (G.711 digital mW), in Tx path for					
		Channel 1 as follows:					
		ON: Lest tone ON					
12	DIP Switch SW8	SW8-1 Selects polarity $(\pm \sigma_{-})$ of Channel 2 Ty level					
12	(CH2 TX LVL)	SW8-1 Selects polarity (+ 01-) of Channel 2 Tx level (See note 2 on page 19)					
		SW8-8 Enables or disables Channel 2 signaling as follows:					
		ON: Signaling enabled					
		OFF Signaling disabled					
13	DIP Switch SW9	SW9-1 Selects polarity (+ or -) of Channel 2 Rx level					
	(CH2 RX LVL)	SW9-2 to SW9-7 Selects magnitude of Channel 2 Rx level(See note 2 on page 19)					
		SW9-8 Activates or deactivates the Channel 2 Busy Function. Identical in function to the					
		trunk circuit activating the M lead. Use this switch to force the off-hook condition as					
		Iollows: ON: Bucy (Off Hook)					
		OFF Not busy (On-Hook)					
14	DIP Switch SW10	SW10-1 to SW10-7 Selects Channel 2 Tx address					
	(CH2 TX ADDR)	SW10-8 Enables or disables Channel 2 addressing as follows:					
		ON: Channel 2 addressing enabled					
		OFF Channel 2 addressing disabled					
15	DIP Switch SW11	SW11-1 to SW11-7 Selects Channel 2 Rx address					
	(CH2 RX ADDR)	Sw11-0 & Sw11-9 Enables of disables FAS/FAU modes for Unannel 2 as follows: Mode SW7.8 SW7.9					
		<u>Mode SW7-6 SW7-9</u> Normal mode OFF ON or OFF					
		FXS mode ON ON					
		FXO mode ON OFF					
		SW11-10 Activates or deactivates 1kHz, 0dBm0 test tone(G.711 digital mW), in Tx path for					
		Channel 2 as follows:					
		ON: Test tone ON					
16		OFF Test tone OFF					
10	JI	Programming header (for factory use only)					
17	I7 Jumper	Jumpers 17, 19 and 111 are used to get the Channel 1 E C.M. Chan-line Terrer (11)					
	s, sumper	Jumpers J7, Jo and J11 are used to set the Channel 1 E&M Signaling Type as follows: Channel 1 Signaling Type					
18		Jumper Type I Type II Type III Type V					
	J8 Jumper	J7 B B B A					
10		J8 B B A					
19	J11 Jumper	J11 B A B B					
	· · · · ·						
20	10 I						
	J9 Jumper	Jumpers J9, J10 and J12 are used to set the Channel 2 E&M Signaling Type as follows:					
21		Unannei 2 Signaling Type Jumper Type II Type III Type V					
	J10 Jumper	J9 B B B A					
L	_	J10 B B B A					
22	112 Jummer	J12 B A B B					
	J12 Jumper						

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Module Address	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	ON	ON	ON	OFF
15	OFF	ON	ON	ON	ON	ON
16	OFF	ON	OFF	OFF	OFF	OFF
17	OFF	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON	OFF
19	OFF	ON	OFF	OFF	ON	ON
20	OFF	ON	OFF	ON	OFF	OFF
21	OFF	ON	OFF	ON	OFF	ON
22	OFF	ON	OFF	ON	ON	OFF
23	OFF	ON	OFF	ON	ON	ON
24	OFF	ON	ON	OFF	OFF	OFF
25	OFF	ON	ON	OFF	OFF	ON
26	OFF	ON	ON	OFF	ON	OFF
27	OFF	ON	ON	OFF	ON	ON
28	OFF	ON	ON	ON	OFF	OFF
29	OFF	ON	ON	ON	OFF	ON
30	OFF	ON	ON	ON	ON	OFF
31	OFF	ON	ON	ON	ON	ON
32	ON	OFF	OFF	OFF	OFF	OFF
33	ON	OFF	OFF	OFF	OFF	ON
34	ON	OFF	OFF	OFF	ON	OFF
35	ON	OFF	OFF	OFF	ON	ON
36	ON	OFF	OFF	ON	OFF	OFF

Table 2. Remote access address selection, VF-5C module

Switch Code	Physi	ical Switcl	al Switch Settings SW2- or SW3-		T1	E1	
(Decimal)	1	2	3	4	5	Time Slot	Time Slot
0	D	D	D	D	D	*	*
1	D	D	D	D	U	1	1
2	D	D	D	U	D	2	2
3	D	D	D	U	U	3	3
4	D	D	U	D	D	4	4
5	D	D	U	D	U	5	5
6	D	D	U	U	D	6	6
7	D	D	U	U	U	7	7
8	D	U	D	D	D	8	8
9	D	U	D	D	U	9	9
10	D	U	D	U	D	10	10
11	D	U	D	U	U	11	11
12	D	U	U	D	D	12	12
13	D	U	U	D	U	13	13
14	D	U	U	U	D	14	14
15	D	U	U	U	U	15	15
16	U	D	D	D	D	16	16****
17	U	D	D	D	U	17	17
18	U	D	D	U	D	18	18
19	U	D	D	U	U	19	19
20	U	D	U	D	D	20	20
21	U	D	U	D	U	21	21
22	U	D	U	U	D	22	22
23	U	D	U	U	U	23	23
24	U	U	D	D	D	24**	24
25	U	U	D	D	U	*	25
26	U	U	D	U	D	*	26
27	U	U	D	U	U	*	27
28	U	U	U	D	D	*	28
29	U	U	U	D	U	*	29
30	U	U	U	U	D	*	30
31	U	U	U	U	U	*	31***

Table 3. Time slot selection by remote access

D = down, U = up.

Notes: * This setting is not allowed . Setting switches to this code will cause the channel to be disabled.

**A T1 network utilizing fast reframing cannot utilize this time slot for voice channel.

*** An E1 network utilizing inter-node communications (NMX) cannot use timeslot 31 for voice channel.

**** An E1 network utilizing CAS cannot use Time Slot 16 for voice channel.

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	Nominal Level at		ТΧ	Digital
	L	ine	Switch	(T1)
			Setting*	
	Vrms	dBm	dBm	dBm
	2.449	+10	+10	0
	2.183	+9	+9	0
	1.946	+8	+8	0
	1.734	+7	+7	0
	1.546	+6	+6	0
	1.377	+5	+5	0
	1.228	+4	+4	0
	1.094	+3	+3	0
	0.975	+2	+2	0
(4)	0.869	+1	+1	0
(1)	0.775	+0	+0	0
	0.690	-1	-1	0
	0.615	-2	-2	0
	0.548	-3	-3	0
	0.489	-4	-4	0
	0.436	-5	-5	0
	0.388	-6	-6	0
	0.346	-7	-7	0
	0.308	-8	-8	0
	0.275	-9	-9	0
	0.245	-10	-10	0
	0.218	-11	-11	0
	0.195	-12	-12	0
	0.173	-13	-13	0
	0.155	-14	-14	0
(2)	0.138	-15	-15	0
(~)	0.123	-16	-16	0
	0.109	-17	-17	0
	0.098	-18	-18	0
	0.087	-19	-19	0
	0.077	-20	-20	0
	0.069	-21	-21	0
-	0.062	-22	-22	0
	0.055	-23	-23	0
	*Use SW4	-2 to SW4-7	for CH1 Tx	setting

Use SW8-2 to SW8-7 for CH2 Tx setting

Table 4. TX Level Settings

Table 5. RX Level Settings

Digital	RX	Nominal Level at]
(11)	Switch	Line		
dPm	dPm	dPm	\/rmc	
			2.440	
0	+10	+10	2.449	
0	+9	+9	2.103	
0	+0	+0	1.940	(2)
0	+7	+7	1.734	(2)
0	+0	+0	1.340	
0	+3	+3	1.377	
0	++ +3	++	1.220	
0	+3	+3	0.975	
0	+1	+1	0.869	
0	+0	+1	0.005	(1)
0	-1	-1	0.690	_ ``
0	-2	-2	0.000	
0	-3	-3	0.548	
0	-4	-4	0.010	
0	-5	-5	0.436	
0	-6	-6	0.388	
0	-7	-7	0.346	
0	-8	-8	0.308	
0	-9	-9	0.000	
0	-10	-10	0.245	
0	-11	-11	0.218	
0	-12	-12	0.195	
0	-13	-13	0.173	
0	-14	-14	0.155	
0	-15	-15	0.138	
0	-16	-16	0.123	
0	-17	-17	0.109	
0	-18	-18	0.098	
0	-19	-19	0.087	
0	-20	-20	0.077	
0	-21	-21	0.069	
0	-22	-22	0.062	
0	-23	-23	0.055	
0	-24	-24	0.049	
0	-25	-25	0.044	
0	-26	-26	0.039	
0	-27	-27	0.035	
0	-28	-28	0.031	
0	-29	-29	0.027	
0	-30	-30	0.024	
0	-31	-31	0.022	
0	-31.5	-31.5	0.021	

*Use SW5-2 to SW5-7 for CH1 Rx setting Use SW9-2 to SW9-7 for CH2 Rx setting

Notes:

- 1. Settings shown on these lines are for 0dBm in and 0dBm out.
- 2. Settings shown on these lines are for -16dBm in and +7dBm out (factory default)
- 3. Setting the switches for levels outside the range of these tables will cause signal degradation.

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- 21. Set the position of SW7-1 to SW7-7 to select the Channel 1 RX Address. The settings for SW7 are the same as SW6.
- 22. Set the position of SW10-1 to SW10-7 to select the Channel 2 TX Address. The settings for SW10 are the same as SW6.
- 23. Set the position of SW11-1 to SW11-7 to select the Channel 2 RX Address. The settings for SW11 are the same as SW6.
- 24. If you plan to operate the RFL VF-5C module under <u>local</u> control, first perform steps 1 through 23, then perform the following steps; otherwise go to step 25.
 - a. Set to local control by placing DIP switch SW3-9 in the UP position.
 - b. Turn service on by placing DIP switch SW3-10 in the UP position.
 - c. Slide the module into the selected slot until it is firmly seated and the module front panel is flush with the top and bottom of the shelf.
 - d. Go to step 26.
- 25. If you plan to operate the RFL VF-5CB module under <u>remote</u> control, first perform steps 1 through 26, then perform the following steps:
 - a. Set to local control by placing DIP switch SW3-9 in the UP position.
 - b. Turn service off by placing DIP switch SW3-10 in the DOWN position.
 - c. Slide the module into the selected slot until it is firmly seated and the module front panel is flush with the top and bottom of the shelf.
 - d. Wait 15 seconds for the module's parameter settings to be loaded into the shelf Common Module.
 - e. Pull the module out of the shelf, and place DIP switch SW3-9 in the DOWN position. **Do not move SW3-10.**
 - f. Slide the module back into the shelf.
 - g. Verify the module configuration through remote control by using NMS.
 - h. Turn service on through remote control by using NMS.

The operating parameters of the RFL VF-5C can now be changed by remote control. See page 31 of this Instruction Data Sheet for more information on remote control using NMS.

- i. Go to step 26.
- 26. On the Module Record Card (located to the right of the shelf) record the channel bank type, time slot, and any other pertinent information.

The RFL VF-5C is now installed. If your multiplexer is set up for remote access and control, you can now change the operating parameters of the module by using NMS. For more information on remote access and control, consult your multiplexer operation manual.

FUNCTIONAL DESCRIPTION

For the following discussion, refer to the functional block diagram of the VF-5C shown in Figure 11, and typical applications shown in Figures 12, 13 and 14.

Overview

The VF-5C is a 4-wire voice frequency module for an IMUX E1 or T1 multiplexer. It is designed as a direct replacement for the VF-5A and VF-5AE. Typical applications are transmission only (Figure 12), push to talk (Figure 13), audio teleprotection tone transmission (Figure 14), etc. The VF-5C accepts (per channel) a voice frequency 600 ohm referenced input and uses μ -law (in T1) or A-law (in E1) PCM encoding to convert the analog voice into an 8-bit, 64 kbps digital signal. On the output side of the VF-5C, the digital DS0 data is decoded into the appropriate analog voice frequency output, referenced to 600 ohms. The VF-5C can be configured locally via switches or remotely via NMS software. All settings can be configured and/or monitored remotely except the signaling type selection which is done with jumpers.

Transmit section

An analog voice input signal is fed into the VF-5C through the module adapter being used. The audio signal then passes through a balanced input transformer. The transformer output feeds the gain section which includes a level control IC digitally controlled by the FPGA. The signals are then encoded by the codec, sent to the FPGA and finally transmitted to the far end through the backplane drivers and common module.

Receive section

The FPGA receives the appropriate PCM data through the backplane receivers and then passes it along to the codec. The codec then converts this PCM signal to an audio signal. The output of the codec feeds the level control stage, where the signal is adjusted to the appropriate signal level and through a transformer sent to the I/O.

Addressing

The VF-5C has addressing capabilities. The addressing feature uses the least significant bit (LSB) of the DS0 to transmit the TX address to the far end, where it is compared to the RX address of the far end. If the address matches, the channel operates normally. However, if the addresses don't match the RX channel mutes the output of the channel. This can be used to increase the security of an audio teleprotection channel.

The address is transmitted as part of a 16-bit message that includes the 7 address bits, 5 checksum bits, and 4 alignment bits. This structure ensures that no combination of mismatched addresses will be considered a match. Valid addresses range from 1 to 127. It is recommended that the TX and RX addresses on a channel be different. The use of the LSB decreases the signal to noise ratio from approximately 41dB to approximately 35dB.

>> text continues on page 28 <<



Figure 11. Functional block diagram, RFL VF-5C

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Figure 12. Typical transmission only "TO" application using VF-5C



Figure 13. Typical "push to talk" application using VF-5C



Figure 14. Typical audio teleprotection scheme using VF-5C

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E&M Signaling

The VF-5C supports four types of E&M Signaling as shown in Figure 15: Type I, Type II, Type III and Type V. The E&M signaling jumpers are set according to the type of E&M signaling being used. Refer to the bottom of page 20 in Table 1 for information on how to set these jumpers.

Type I. Type I signaling is a two-wire scheme, normally encountered in electromechanical switching systems. The trunk circuit M lead provides the ground (on hook) and the battery –48V (off hook) toward the model VF-5C module. The signaling from the VF-5C to the trunk circuit is on the E lead with open circuit (on hook) and ground (off hook).

Type II. Type II signaling is a four-wire scheme, normally encountered in electronic switching systems. An on hook (idle) condition is indicated by open circuits on both E and M leads and a closure for off-hook (busy).

Type III. Type III signaling is a partially looped four-wire scheme. It provides better protection against interference, and is used with electronic switching systems. An on hook (idle) condition is indicated by an open circuit on the E lead and ground on the M lead. Signaling over the M lead is the same as type I, except that battery and ground for M lead signaling are provided to the trunk circuit over the MB and EB leads. A distinction of the Type III interface is that three conductors are used for M lead signaling.

Type V. Type V signaling is a two-wire scheme normally encountered outside North America. The trunk circuit M lead provides the ground (off-hook), and an open (on-hook) toward the VF-5C module. The signaling from the VF-5C to the trunk circuit is on the E lead with open circuit (on-hook) and ground (off-hook).



Figure 15. E&M signaling types

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ALERTS AND ALARMS

The RFL VF-5C reports no module-level ALERT or ALARM signals to the shelf Common Module.

VF-5C COMPATIBILITY WITH PREVIOUS RFL VF-5 MODULES

The RFL VF-5C module is compatible with the VF-5, VF-5A and VF-5AE modules, however, many new features have been added to the VF-5C. The key differences and incompatibilities are as follows:

- 1. On the VF-5C, all settings other than signaling type are remotely programmable. Previous designs were much more limited.
- 2. The VF-5C supports type V signaling, which was previously unsupported.
- 3. An addressing feature has been added to the VF-5C. The addressing mode is not supported in older models.
- 4. Individual time slot and bus direction selection for each channel has been added. The previous designs require consecutive time slot selection, and the same bus direction.
- 5. The VF-5C has three loopback modes: local, remote, and 2713 Hz detect. These modes are not available with the previous designs, but they will function properly on a VF-5C when connected to one of these previous designs.
- 6. FXO/FXS modes are now switch selectable on every VF-5C. In the past this was only available with a custom modification.
- 7. A 1-kHz test tone can be injected into the transmit and receive paths to the VF-5C. This is a new feature and does not affect the functionality of the earlier designs.

REMOTE CONTROL USING NMS

PROGRAMMING THE VF-5C MODULE

There are two ways to program the VF-5C module, locally using DIP switches, or remotely using NMS (Network Management Software) version 10.3 or later. Refer to the IMUX 2000 or IMUX 2000E Instruction Manual for information on using NMS. To program the VF-5C module using NMS go to the VF-5C General Configurations Window and Status Window for Node 1, as shown in Figure 16. The General Configuration window is on the left and the General Status window is on the right. Note that the configuration window has five top-level pages selected by tabs at the top of the window as follows: General, Chan 1, Chan 1 continued, Chan 2 and Chan 2 continued. The following discussion covers the settings on the "General" page.

1. Module Enable

The Module Enable box can be checked or unchecked. For the VF-5C module to be in service, check the Module Enable box (Service ON). For the VF-5C module to be out of service, uncheck the Module Enable box (Service OFF).

After this setting is made, click on the "Chan 1" tab to get to the "Chan 1" window as shown in Figure 17.

IMUX 2000 NM5 : untitled File Network Output Edit Setup Admin Use Help	
Image: Second state sta	X
Module Enable ??? Module Alert ???	
Configuration Remote/Local ??? Configured/Not ???	
ECB ??? Actel Chip ??? Board Mod ???	
Read Write This Page Actual as Setting Exit IMUX 2000 - Network Management	
Version 10.3	

Figure 16. Typical VF-5C General Configurations and Status Window for Node 1

IMUX 2000 NM5 : untitled						
File Network Output Edit Setup Admin Use Help						
Image: Status With Status (C1) Image: Status With Status	×					
General Chan 1 Chan 1 contd. Chan 2 Chan 2 contd. General Chan 1 Chan 2						
Overall Status						
Time Slot 0 ÷ ??? Module Alarm ???						
Channel ON/OFF ON ??? Module Alert ???						
Bus Direction TXA ??? Configuration						
Sign Minus (-) ??? Remote/Local ???						
(-23 to +10) dB 16.0 - ???						
Sign Revision						
Rx Level ECB ???						
(-31.5 to +10) UB 7.0 + ??? Actel Chip ???						
Board Mod ???						
Read Write This Page Actual as Setting Exit						
IMUX 2000 - Network Management						
View or change card setting						

Figure 17. Typical VF-5C "Chan 1" Window for Node 1

The "Chan 1" window has five selections as follows: Time Slot, Channel On/Off, Bus Direction, Tx Level (-23 to +10) and Rx Level (-31.5 to +10). The following discussion covers the settings on the "Chan 1" page.

1. Time Slot

The Time Slot can be set from 1-24 for T1 networks and from 1-31 for E1 networks. Click on the spinner control (up and down arrows) to make the selection.

2. Channel On/Off

The Channel On/Off parameter can be set to ON or OFF. When set to ON, Channel 1 is enabled (ON). When set to OFF, Channel 1 is disabled (OFF).

3. Bus Direction

The Bus Direction can be set to TXA or TXB. When set to TXA, Channel 1 transmits in the A direction and receives from the B direction. When set to TXB, Channel 1 transmits in the B direction and receives from the A direction.

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4. Tx Level (-23 to +10)

The Tx Level can be set from -23dBm to +10dBm in 0.5dBm steps, by clicking on the sign (+ or -) and then clicking on the dBm combo boxes (up and down arrows).

5. Rx Level (-31.5 to +10)

The Rx Level can be set from -31.5dBm to +10dBm in 0.5dBm steps, by clicking on the sign (+ or -) and then clicking on the dBm combo boxes (up and down arrows).

After all settings are made on the "Chan 1" page (Figure 17), click on the "Chan 1 continued" tab to go to the "Chan 1 continued" window as shown in Figure 18.

🛞 IMUX 2000 NM5 : untitled						
File Network Output Edit Setup Admin Use	File Network Output Edit Setup Admin Use Help					
Node 1 (Shelf Address 1): VF5C Config (C1) Node 1 (Shelf Address 1): VF5C Status (C1)						
General Chan 1 Chan 1 contd. Chan 2 Chan 2 contd. General Chan 1 Chan 2						
Addressing Disable 💌	??? Overall St	tatus				
Signaling Enable 💌	??? Module Alarr	n ???				
Tx Address 0 🗧	??? Module Alert	???				
Rx Address 0 🗧	??? Configura	tion				
FX Mode Enable Disable 💌	??? Remote/Loc	al ???				
FXS/FXO FXS	??? Configured/I	Not ???				
Busy Not Busy 💌	??? Revision					
1KHz Tone Disable 💌	??? ECB	???				
2713Hz Auto Off Disable 💌	??? Actel Chip	???				
Loopback Mode Off 💌	??? Board Mod	???				
Read Write This Page Actual as Setting Exit						
IMUX 2000 - Network Management						
ew or change card setting						

Figure 18. Typical VF-5C "Chan 1 continued" Window for Node 1

The "Chan 1 continued" window has ten selections as follows: Addressing, Signaling, Tx Address, Rx Address, FX Mode Enable, FXS/FXO, Busy, 1 kHz Tone, 2713 Hz Auto Off and Loopback Mode. The following discussion covers the settings on the "Chan 1 continued" page.

1. Addressing

The Addressing parameter can be enabled or disabled. When set to enabled, Channel 1 Addressing is active (in use). When set to disabled, Channel 1 Addressing is inactive (not in use).

2. Signaling

If the Addressing parameter is disabled, the Signaling parameter can be enabled or disabled. If Addressing is enabled, the Signaling parameter is automatically disabled. When set to enabled, the Signaling parameter is active (in use). When set to disabled, the Signaling parameter is inactive (not in use).

3. Tx Address

The Tx Address parameter can be set from 1 to 127 using the spinner control (up and down arrows).

4. Rx Address

The Rx Address parameter can be set from 1 to 127 using the spinner control (up and down arrows).

5. FX Mode Enable

The "FX Mode Enable" parameter can be set to enabled or disabled. When set to enabled, the "FX Mode Enable" parameter is active (enabled). When set to disabled, the "FX Mode Enable" parameter is inactive (disabled).

6. FXS/FXO

The "FXS/FXO" parameter allows the user to select either FXS mode or FXO mode using the combo box (up and down arrows).

7. Busy

The "Busy" parameter allows the user to activate or deactivate the Busy function using the combo box (up and down arrows). This is identical in function to the trunk circuit activating the M lead. Use this setting to force the off-hook condition as follows:

When set to Busy, the parameter is active (Busy).

When set to Not Busy the parameter is inactive (Not Busy).

8. 1 kHz Tone

The 1 kHz Tone parameter can be enabled or disabled

When set to enabled, the 1 kHz, 0dBM0 test tone in the Tx path is active (enabled).

When set to disabled, the 1 kHz, 0dBm0 test tone in the Tx path is inactive (disabled).

9. 2713 Hz Auto Off

The 2713 Hz Auto Off parameter selects either manual or automatic deactivation of the 2713 Hz loopback signal.

When set to enabled, the "2713 Hz Auto Off" parameter is active (manual deactivation of the 2713 Hz loopback signal).

When set to disabled, the "2713 Hz Auto Off" parameter is inactive (automatic deactivation of the 2713 Hz loopback signal).

10. Loopback Mode

In normal operation, all loopbacks are disabled. Loopback settings are used for troubleshooting purposes. There are four loopback settings as follows:

- 1. None (disable all loopbacks)
- 2. Local (enable local loopback)
- 3. Remote (enable remote loopback)
- 4. 2713 Hz (enable 2713Hz induced loopback)

After all settings are made in the "Chan 1 continued" window, set the parameters in the "Chan 2" window and "Chan 2 continued" window.

After all VF-5C parameter selections have been made they must be written to the VF-5C card in the network. This is done by using the "WRITE" operation as described in Section 7 of The IMUX 2000 Instruction Manual.

REMOTE CONTROL USING SCL COMMANDS

When installed in an IMUX 2000 remote controllable shelf, the RFL VF-5C module can be operated under local or remote control. When under remote control, certain configuration parameters can only be changed through the RS-232 remote port on the multiplexer. The remote interface for these modules involves two codes: a "P" (parameter) code, and an "S" (status) code. See the IMUX 2000 instruction manual for more information on the remote control interface.

The RFL VF-5C reports itself as a "Type 183" module.

"P" CODES

"P" codes, when used in the parameter field on a "SET" command, allow the user to set certain parameters on the module by remote control, just like setting the switches on a module under local control. "P" codes also appear in the response to a "CONFIG?" query, showing the current parameter settings on the module.

There are thirteen "P" codes for the RFL VF-5C, P1 through P13. Each of these P codes can be a decimal number from 0 to 255, which can also be represented as an eight-digit binary number (in parenthesis). The binary representation is more useful for setting and interpreting the "P" codes, since each binary digit (0 or 1) corresponds to the ON or OFF setting for a particular switch on the module. Table 6 describes the meanings of the "P" codes for the RFL VF-5C.

A typical RFL VF-5C response to a "CONFIG?" query looks like this:

```
* OK
CHANNEL CARD 3, TYPE 183
UNDER REMOTE CONTROL
SVCE = ON
P01 = 3 (B00000011)
P02 = 3 (B00000011)
P03 = 28 (B00011100)
P04 = 28 (B00011100)
P05 = 1 (B00000001)
P06 = 1 (B0000001)
P07 = 28 (B00011100)
P08 = 28 (B00011100)
P09 = 1 (B00000001)
P10 = 1 (B00000001)
P11 = 1 (B00000001)
P12 = 0 (B00000000)
P13 = 0 (B0000000);
```

NOTE

When using binary numbers with a SET command, they must be preceded by the letter "B" as shown in the following example:

<MULTIPLEXER ADDRESS>:<CARD ADDRESS>:SET:P1 = B00000011;

Besides using the P code, it is also possible to turn module service on or off by sending one of the following in the parameter field with a SET command:

 $\begin{aligned} \mathbf{SRVC} &= \mathbf{ON} \\ \mathbf{SRVC} &= \mathbf{OFF} \end{aligned}$

Table 6. Remote configuration settings ("P" codes)

P Code	Digit(s) And Switch Equivalent	Value (1)	Description
P1	в 0 0 0 0 0 0 0 0	00	OFF
	↑ ↑	01	Remote
	CH1 LOOPBACK MODE	10	Local
		11	2713 Hz mode
	B 0 0 0 0 0 0 0 0 ↑	0	Ch1 = DI-B
	CH1 TERMINAL	1	Ch1 = Terminal/DI-A
	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ ↑ CH1 TIMESLOT	00001 to 11000 T1 Settings	From left to right, these five bits represent the binary value of the desired time slot between 1 through 24 in a T1 network. See Table 8 for a complete list of these values.
		00001 to 11111 E1 Settings	From left to right, these five bits represent the binary value of the desired time slot between 1 through 31 in an E1 network. See Table 8 for a complete list of these values.
P2	в 0 0 0 0 0 0 0 0	00	OFF
	↑ ↑ <i></i> -	01	Remote
	CH2 LOOPBACK MODE	10	Local
		11	2713 Hz mode
	B 0 0 0 0 0 0 0 0 ↑	0	Ch2 = DI-B
	CH2 TERMINAL	1	Ch2 = Terminal/DI-A
	B 0 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ ↑ CH2 TIMESLOT	00001 to 11000 T1 Settings	From left to right, these five bits represent the binary value of the desired time slot between 1 through 24 in a T1 network. See Table 8 for a complete list of these values.
		00001 to 11111 E1 Settings	From left to right, these five bits represent the binary value of the desired time slot between 1 through 31 in an E1 network. See Table 8 for a complete list of these values.

>> table continues on next page <<

1. These are the only legal values for setting the parameters. Setting any parameter to a value outside its specified range will produce an unpredictable result.

Table 6. continued	- Remote	configuration	settings	(" P "	codes)
--------------------	----------	---------------	----------	---------------	--------

P Code	Digit(s) And Switch Equivalent	Value ⁽¹⁾	Description
P3	в 0 0 0 0 0 0 0 0	0	(+) Positive
	↑		
	CH1 TRANSMIT LEVEL SIGN	1	(-) Negative
	В 0 0 0 0 0 0 0 0	From 000000	Range is from –23dB to +10dB
	$- \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow -$	to 101110	Resolution is 0.5dB. For example $+7dB = 001110$,
	CH1 TRANSMIT LEVEL		and set sign to (+). For example $-16dB = 100000$, and set sign to (-).
	В 0 0 0 0 0 0 0 0	0	Ch1 Signaling Disabled
	1		
	CH1 SIGNALING ENABLE	1	Ch1 Signaling Enabled
P4	B 0 0 0 0 0 0 0 0 0	0	(+) Positive
	$\uparrow \neg \neg$		
	CH1 RECEIVE LEVEL SIGN	1	(-) Negative
	В 0 0 0 0 0 0 0 0	From 000000	Range is from –22dB to +10dB
	$- \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow -$	to 101100	Resolution is 0.5dB. For example $+7dB = 001110$,
	CH1 RECEIVE LEVEL		and set sign to (+). For example $-16dB = 100000$, and set sign to (-).
	B 0 0 0 0 0 0 0 0 0 1	0	Ch1 Not Busy
		1	Ch1 Dura
		1	Chi Busy
P5	воооооо	From 0000000	0 = 0000000
	$\uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow -$	To 1111111	127 = 1111111
	CH1 TRANSMIT ADDRESS		See description of addressing for more details.
	B 0 0 0 0 0 0 0 0 0	0	Ch1 Addressing Disabled
	CH1 ADDRESSING ENABLE	1	Ch1 Addressing Enabled
P6	воооооо	From 0000000	0 = 0000000
	$\uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow -$	To 1111111	127 = 1111111
	CH1 RECEIVE ADDRESS		See description of addressing for more details.
	B 0 0 0 0 0 0 0 0 0 ↑	0	Ch1 FX Mode Disabled
	CH1 FX MODE ENABLE	1	Ch1 FX Mode Enabled

>> table continues on next page <<

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Fable 6. continued - Remote	configuration	settings ("P"	codes)
------------------------------------	---------------	---------------	--------

P Code	Digit(s) And Switch Equivalent	Value ⁽¹⁾	Description
P7	в 0 0 0 0 0 0 0 0	0	(+) Positive
	↑		
	CH2 TRANSMIT LEVEL SIGN	1	(-) Negative
	В 0 0 0 0 0 0 0 0	From 000000	Range is from -23dB to +10dB
	$- \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow -$	to 101110	Resolution is 0.5dB. For example $+7dB = 001110$,
	CH2 TRANSMIT LEVEL		and set sign to (+). For example $-16dB = 100000$, and set sign to (-).
	в 0 0 0 0 0 0 0 0	0	Ch2 Signaling Disabled
	1		
	CH2 SIGNALING ENABLE	1	Ch2 Signaling Enabled
P8	B 0 0 0 0 0 0 0 0	0	(+) Positive
	$\uparrow \uparrow$		
	CH2 RECEIVE LEVEL SIGN	1	(-) Negative
	B 0 0 0 0 0 0 0 0	From 000000	Range is from -22dB to +10dB
	$- \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow -$	to 101100	Resolution is 0.5dB. For example $+7dB = 001110$,
	CH2 RECEIVE LEVEL		and set sign to (+). For example $-16dB = 100000$, and set sign to (-).
	B 0 0 0 0 0 0 0 0 0	0	Ch2 Not Busy
	CH2 BUSY	1	Ch2 Busy
P9	в 0 0 0 0 0 0 0 0	From	0 = 0000000
	$\uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow -$	0000000	127 = 1111111
	CH2 TRANSMIT ADDRESS	To 1111111	See description of addressing for more details.
	В 0 0 0 0 0 0 0 0	0	Ch2 Addressing Disabled
	1		
	CH2 ADDRESSING ENABLE	1	Ch2 Addressing Enabled
P10	в 0 0 0 0 0 0 0 0	From	0 = 0000000
	$\uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow -$	0000000	127 = 1111111
	CH2 RECEIVE ADDRESS	To 1111111	See description of addressing for more details.
	B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	Ch2 FX Mode Disabled
	CH2 FX MODE ENABLE	1	Ch2 FX Mode Enabled

>> table continues on next page <<

P Code	Digit(s) And Switch Equivalent	Value (1)	Description
P11	в 0 0 0 0 0 0 0 0	0	Ch1 Disabled
	↑		
	CH1 DISABLE	1	Ch1 Enabled
		0	Ch2 Disabled
	CH2 DISABLE	1	Ch2 Enabled
		-	
	в 0 0 0 0 0 0 0 0	0	Ch1 = FXO
	↑		
	CH1 (FXS or FXO)	1	Ch1 = FXS
		0	Cn2 TkHz Tone Disabled
	CH1 1kHz TONE ENABLE	1	Ch2 1kHz Tone Enabled
	в 0 0 0 0 0 0 0 0	0	Ch2 = FXO
	CH2 (FXS or FXO)	1	Ch2 = FXS
	в 0 0 0 0 0 0 0 0	0	Ch2 1kHz Tone Disabled
	^		
	CH1 1kHz TONE ENABLE	1	Ch2 1kHz Tone Enabled
	B 0 0 0 0 0 0 0 0 0	0	Ch1 2713 Auto Turn Off Disabled
	CH1 2713 AUTO TURN OFF ENABLE	1	Ch1 2713 Auto Turn Off Enabled
	в 0 0 0 0 0 0 0 0	0	Ch2 2713 Auto Turn Off Disabled
	1		
	CH2 2713 AUTO TURN OFF ENABLE	1	Ch2 2713 Auto Turn Off Enabled
P12	в 0 0 0 0 0 0 0 0		For future use.
			Do not write to this byte.
P13	в 0 0 0 0 0 0 0 0		For future use.
			Do not write to this byte.

Because RFL[™] and Hubbell[®] have a policy of continuous product improvement, we reserve the right to change designs and specifications without notice.

"S" CODES

"S" codes appear in response to a "STATUS?" query. There are six "S" codes for the RFL VF-5C. Like the "P" code, this number is displayed in both decimal and binary form. The seven most significant digits of the binary number represent the conditions shown in Table 7. The least significant digit is not used.

A typical response to a "STATUS?" query looks like this:

```
* OK
CHANNEL CARD 3, TYPE 78 (or 69)
S01 = 2 (B00000010)
S02 = 2 (B00000010)
S03 = 8 (B0000100)
S04 = 1 (B00000001)
S05 = 0 (B00000000)
S06 = 1 (B00000001);
```

S Code	Digit(s) And Switch Equivalent	Value ⁽¹⁾	Description
S1	B 0 0 0 0 0 0 0 0 0 ↑	0	Ch1 Config Valid
	CH1 CONFIG INVALID	1	Ch1 Config Invalid
	B 0 0 0 0 0 0 0 0 0 - ↑	0	Ch1 Disabled
	CH1 ENSABLED	1	Ch1 Enabled
	B 0 0 0 0 0 0 0 0 0 1	0	Ch1 E Lead Inactive
	CH1 E LEAD	1	Ch1 E Lead Active
	B 0 0 0 0 0 0 0 0 0 ↑	0	Ch1 M Lead Inactive
	CH1 M LEAD	1	Ch1 M Lead Active
	B 0 0 0 0 0 0 0 0 0 ↑	0	Ch1 2713 Loopback Inactive
	CH1 2713 LOOPBACK	1	Ch1 2713 Loopback Active
	B 0 0 0 0 0 0 0 0 0 ↑	0	Ch1 Address Mis-match
	CH1 ADDRESS MATCH	1	Ch1 Address Match
	B 0 0 0 0 0 0 0 0 0 ↑ -	0	Ch1 Addressing Disabled
	CH1 ADDRESSING	1	Ch1 Addressing Enabled
			Will always read zero.
	UNUSED BIT		

Table 7. Remote status messages ("S" codes	Table 7. R	emote	status	messages	("S"	codes
--	------------	-------	--------	----------	------	-------

>> table continues on next page <<

5 Code	Digit(s) And Switch Equivalent	Value ⁽¹⁾	Description
52	В 0 0 0 0 0 0 0 0	0	Ch2 Config Valid
	↑		
	CH2 CONFIG INVALID	1	Ch2 Config Invalid
	ΒΟΟΟΟΟΟΟ	0	Ch2 Disabled
		0	
	CH2 ENSABLED	1	Ch2 Enabled
	B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	Ch2 E Lead Inactive
		1	Ch2 E L and Active
	CH2 E LEAD	1	
	в 0 0 0 0 0 0 0 0	0	Ch2 M Lead Inactive
	↑		
	CH2 M LEAD	1	Ch2 M Lead Active
	B 0 0 0 0 0 0 0 0	0	Ch2 2713 Loopback Inactive
	↑		•
	CH2 2713 LOOPBACK	1	Ch2 2713 Loopback Active
	B 0 0 0 0 0 0 0 0	0	Ch2 Address Mis-match
	^		
	CH2 ADDRESS MATCH	1	Ch2 Address Match
	B 0 0 0 0 0 0 0 0	0	Ch2 Addressing Disabled
	CH2 ADDRESSING	1	Ch2 Addressing Enabled
	B 0 0 0 0 0 0 0 0		Will always read zero.
	1		
	UNUSED BIT		

Table 7. continued - Remote status messages ("S" codes)

>> table continues on next page <<

S Code	Digit(s) And Switch Equivalent	Value ⁽¹⁾	Description
S 3	в 0 0 0 0 0 0 0 0	00001 = A	The printed wiring board revision.
	$\uparrow \uparrow \uparrow \uparrow \uparrow \uparrow$	00010 = B	(Not the complete assembly)
	ECB REVISION LEVEL	00011 = C	
		etc.	
	в 0 0 0 0 0 0 0 0	000 to 111	Bit $0 = R110$
	↑ ↑ ↑		Bit 1 = R111
	BOARD MODIFICATION LEVEL		Bit 3 = R112
			If any resistor is installed, the corresponding bit will be zero. This is used to identify custom modifications to the assembly.
S4	в 0 0 0 0 0 0 0 0	From 00000001	The ACTEL firmware revision level
	$\uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow$	to 11111111	
	ACTEL REVISION LEVEL		
S5	в 0 0 0 0 0 0 0 0	0	For future use only.
	↑		
	SUB TYPE HIGH		
S6	В 0 0 0 0 0 0 0 0	1	For future use only.
	↑		
	SUB TYPE LOW		

Table 7. continued - Remote status messages ("S" codes)

TESTING

Once the RFL VF-5C Module has been configured and installed, it should be tested for proper operation before it is placed in service. There are two ways you can do the testing:

- 1. Local testing using T1 or E1 loopback with the system out of service.
- 2. End-to-end testing, with the system inservice but the channel being tested taken out of service.

Use the following procedure to test the RFL VF-5C:

- 1. If using T1 or E1 loopback testing, set up the multiplexer loopback following the instructions in multiplexer operation manual.
- 2. Test each channel separately. If using end-to-end testing, test each channel first from Site 1 to Site 2, then reverse the setup and test from Site 2 to Site 1.
- 3. If addressing is enabled, the address on the receiving end must match the address at the transmitting end.
- 4. Connect the output of a TIM set or equivalent to the equipment input jack for the channel being tested. Insert a 1004 kHz test tone at the TX level selected for that channel referenced to 600 ohms.

NOTE

For the following steps, check the output on the same RFL VF-5C module if you are using loopback testing, or on the module at the receive end if you are using end-to-end testing.

- 5. Measure the channel output at the equipment output jack.
 The output level should be the RX level selected for that channel referenced to 600 ohms, <u>+</u> 0.5 dB.
- 6. If signaling is enabled, activate the M-Lead and observe that the corresponding M indicator LED on the transmit module and the E indicator LED on the receive module both light up.
- Remove the test equipment and disconnect the loopback if one was used.
 The module is now available for operation.

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use. If using end-to-end testing, check that the transmit and receive configuration is compatible.

Problems may occur at the common equipment or facility level which affect the operation of this module. Refer to your multiplexer operation manual for system analysis procedures.

Notes

Notes
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RFL Electronics Inc.

INSTRUCTION DATA

RFL VF-5XP Dual-Channel Four-Wire E&M Voice Module For RFL 9508 Analog SSB Powerline Carrier System

DESCRIPTION

The RFL VF-5XP is a dual-channel four-wire E&M voice-frequency module, designed for use in the RFL 9508. It accepts two voice channels (one speech channel and one speech plus channel) as inputs and digitizes them. Channel one uses one 64-Kbps time slot, and Channel two uses two 64-Kbps time slots.

The RFL VF-5XP provides high-quality voice characteristics. It allows E&M signaling of Type I, II, III and V, with front-panel busy indicators. It has extended-range input and output signal level settings to facilitate interfaces in most four-wire applications.

All VF-5XP parameters must be programmed using NMS, with the exception of E&M Signaling which is set up using jumpers, and the Module Address which is set up using switches. The following is a list of VF-5XP parameters:

- o One-channel or two-channel operation.
- o Selectable Type I, II, III or V signaling.
- o Individual channel enable/disable.
- o Signaling on or off selection.
- o Busy settings.
- o Extended range input/output level settings
- o Time slot assignment
- o Two loopback modes (Local &Remote).
- o Remote control configuration and status reporting.
- o Test tone generation (1kHz for Channel 1 and 2kHz for Channel 2)
- o Module Address
- o Service Channel

SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL VF-5XP module. Because all of RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Configuration: Two independent voice channels per module.

Time Slots Required:

Channel One: Requires one user-selectable 64-Kbps time slot. Channel Two: Requires two 64-Kbps time slots. (Must be after channel 1's time slot)

Remote Interface:

All settings can be changed in remote mode using NMS, except E&M signaling type. Access to status registers, including board and firmware revision levels, is also provided through NMS.

Signal Levels:

- CH1: TLP transmit range: -23 dBm to +10 dBm nominal (+13 dBm peak) TLP receive range: -31.5 dBm to +10 dBm nominal (+13 dBm peak) Level control resolution: 0.5 dB Absolute level accuracy: 0.5 dB
- CH2: TLP transmit range: +10 dBm to -23 dBm nominal (+13 dBm peak) TLP receive range: +10 dBm to -22 dBm nominal (+13 dBm peak) Level control resolution: 0.5 dB Absolute level accuracy: 0.5 dB

Input Impedance: 600 Ω nominal

Output Impedance: 600 Ω nominal

Frequency Response relative to 1004 Hz:

CH1: 300 to 3000 Hz, ±0.3 dB (bidirectional) CH2: 300 to 4000 Hz, ±0.3 dB (bidirectional)

Idle Channel Noise: Less than 23 dBrnc0

Impulse Noise:

Maximum counts per 30-minute interval. (Input level -13dbm0(-29dbm) @ 1004 Hz. Level Adjustment set to -16dBm in, +7dBm out.

Threshold Level (dBrnc) -61 Counts/30 minutes 0

Signaling Format (Digital interface):

T1 systems: RBS (Robbed-Bit Signaling) AT&T PUB 43801 E1 systems: CAS (Channel Associated Signaling)

Transmission Only

E&M Signaling Types: Jumper selectable, E&M Type I, II, III and V

M Lead INPUT:

Input Impedance: Greater than 3.5K ohms to ground Current limited to less than 6ma

Type I, II, III

Busy: -20 to -60 volts

Idle: 0 to -10 volts or open

Type V

Busy: 0 to -35 volts Idle: Open

E Lead Output:

Busy: Less than 35 ohms to ground Idle: -42 to -60 volts or open

Module Adapters:

MA-301, MA-301A, MA-301B, MA-322 or MA-324.

Power Consumption:

120 mA max from +5V supply 70 mA max from +15V supply 50 mA max from -15V supply 0 mA max from -48V supply*

*Note: The VF-5XP itself draws no current from the –48Volt supply. However SB-Lead outputs are provided for each channel for external wiring of E&M signaling. There is a 1k-ohm ½ watt resistor in series with each output. No more than 20mA should be drawn from any SB-Lead output at any time.

Operating Temperature: -20° C to $+55^{\circ}$ C (-4° F to $+131^{\circ}$ F).

Relative Humidity: Zero to 90 percent, non-condensing.

INSTALLATION

Before the RFL VF-5XP can be placed in service, it must be installed in an RFL 9508 digital chassis. Installation involves determining the module slot in the digital chassis where the module will be installed, inserting a Module Adapter into the rear of the shelf behind the module slot, connecting all signal wiring to the Module Adapter, checking the module address settings and jumpers, inserting the module into the front of the chassis, and using UCC 2020 NMS software to configure the module.

NOTE

Power supply and time slot considerations may affect the installation of this module into an existing multiplexer shelf. Refer to the multiplexer manual for more information.

The following instructions are provided for installing RFL VF-5XP modules into existing systems. If the module was included as part of a system, installation was done at the factory. Otherwise, proceed as follows:

- 1. Carefully inspect the module for any visible signs of shipping damage. If you suspect damage to the module, immediately call RFL Customer Service at the number listed at the bottom of this page.
- 2. Determine the module slot in the RFL 9508 or multiplexer chassis where the module will be installed.

The RFL VF-5XP module occupies one module slot in the RFL 9508 or multiplexer chassis, however, in some cases the next highest front module slot must be left blank since some module adapters occupy two rear slots.

3. Determine which Module Adapter will be used to make connections to the RFL VF-5XP module.

The VF-5XP requires a Module Adapter. The module adapter provides the appropriate connectors for the desired interface. There are five Module Adapters compatible with the RFL VF-5XP:

- MA-301The MA-301 accepts a 50-pin Telco connector (Amphenol 57-30500
or equivalent, as shown in Figure 1.) One MA-301 Module Adapter
can be used to connect up to three RFL VF-5XP modules, for a total
of up to six voice channels. If you will be using more than one module
with the MA-301, they must be inserted into adjacent slots in the
9508. Ribbon cables are provided with the MA-301 to make
connections to it from the second and third module locations as
shown in Figure 2. This module adapter occupies one rear chassis
slot.
- **MA-301A** The MA-301A is used to isolate the VF-5XP from SWC type surges sometimes present on 4-wire voice lines. This module adapter occupies two rear chassis slots. A terminal strip is provided for hard wire connections to the voice circuit for Channel 1 and Channel 2, as shown in Figure 3. E&M signaling connections are not available when using the MA-301A.
- MA-301BThe MA-301B provides pluggable terminal block connections for a
single VF-5XP module. Audio and signaling connections are
available at the terminal block. No additional SWC or fast transient
protection is provided on this I/O. Refer to Figure 4 for panel view
and terminal connections. This module adapter occupies one rear
chassis slot.
- MA-322The MA-322 accepts a 50-pin Telco connector (Amphenol 57-30500
or equivalent, as shown in Figure 5.) One MA-322 Module Adapter
is used for each RFL VF-5XP module, and occupies two rear chassis
slots. The MA-322 is used to convert both of the 4-wire outputs
(Channel 1 and 2) from 4-wire to 2-wire. The impedance is 600
Ohms, the frequency response is ±2dB from 200Hz to 3000Hz, and
the transformer loss (hybrid loss) is ≅ 4.0dB. Refer to Application
Note No.14 in the IMUX 2000 Instruction Manual for additional
information on using this I/O.
- MA-324The MA-324 accepts a 50-pin Telco connector (Amphenol 57-30500
or equivalent, as shown in Figure 5.) One MA-324 Module Adapter
is used for each RFL VF-5XP module and occupies two rear chassis
slots. The MA-324 is used to convert one of the 4-wire outputs
(Channel 1) from 4-wire to 2-wire. The other 4-wireoutput (Channel
2) remains 4-wire. The impedance is 600 Ohms, the frequency
response is ±2dB from 200Hz to 3000Hz, and the transformer loss
(hybrid loss) is ≅ 4.0dB. Refer to Application Note No.14 in the
IMUX 2000 Instruction Manual for additional information on using
this I/O.

>> text continues on page 9 <<

SG E	SB N
1 1, 26 2, 27 3 28 2 5, 30 6, 31 7 32	4 2 8 3
3 9, 34 10, 35 11 36 4 13, 38 14, 39 15 40	12 3 16 4
5 17, 42 18, 43 19 44 6 21, 46 22, 47 23 48	20 4 24 4
5 17, 42 18, 43 19 44 6 21, 46 22, 47 23 48	20 24

Figure 1. MA-301 Module Adapter



Figure 2. Connecting up to three RFL VF-5XP modules to a single MA-301 Module Adapter.



Figure 3. MA-301A, SWC rated 4-wire Module Adapter



Figure 4. MA-301B Module Adapter



Note: All unlisted pins are not used. See Application Note No.14 in the IMUX 2000 Instruction Manual for additional information on using these I/Os.

Figure 5. MA-322/MA-324 Module Adapters

4. Insert the desired Module Adapter into the rear of the slot which will hold the RFL VF-5XP module and make all connections to the Module Adapter.

If an MA-301, MA-322 or MA-324 Module Adapter is being used, plug the 50-pin Telco connector into its 50-pin connector.

If an MA-301A Module Adapter is being used, connect all signal wiring to the terminal strip at the rear of the MA-301A using Figure 3 as a guide.

If an MA-301B Module Adapter is being used, connect all signal wiring to the terminal strip at the rear of the MA-301B using Figure 4 as a guide.

- 5. Refer to Figure 6 and Table 1 for the location of switches, controls and indicators on the VF-5XP.
- 6. Set DIP switches SW1-1 through SW1-6 for the desired remote access address.
 For remote access, each channel module in the RFL 9508 or IMUX 2000 must have a distinct module address. Valid module addresses are the numbers 1 to 36. In most installations, the address will be set to the slot number of the shelf the module is occupying. Table 2 shows the switch settings for the module address.
- Set jumpers J7, J8 and J11 to select the type of E&M signaling required for Channel 1. Set jumpers J9, J10 and J12 to select the type of E&M signaling required for Channel 2.
 There are four signaling types: Type I, Type II, Type III and Type V. Refer to Table 1 on page 18? for jumper assignments for each of these signaling types.
- 8. The RFL VF-5XP is now installed. You can now change the operating parameters of the module by using NMS as described on page 21 of this document. For more information on NMS, consult the RFL 9508 Instruction Manual.



Figure 6. Controls and indicators, VF-5XP module

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Figure 7. VF-5XP loopback configurations

Item	Name/Description	Function
1	Equipment jacks	Allow channel signals to be equipped:CH1 INEquipment point for Channel 1 input signal.CH1 OUTEquipment point for Channel 1 output signal.CH2 INEquipment point for Channel 2 input signal.CH2 OUTEquipment point for Channel 2 output signal.
2	DS1 LED	Channel 1 Enabled LED (has three states)Off:CH1 Disabled.Green:CH1 EnabledYellow:CH1 in Service Channel mode
	DS2 LED	Channel 1 "E-Lead" LED (has two states) Off: Signaling is OFF or signaling is ON and "E-Lead" output is inactive. Green: Signaling is ON and "E-Lead" output is active.
	DS3 LED	Channel 1 "M-Lead" LED (has two states) Off: Signaling is OFF or signaling is ON and "M-Lead" input is inactive. Green: Signaling is ON and "M-Lead" input is active.
3	DS4 LED	Channel 2 Enabled LED (has three states) Off: CH2 Disabled. Green: CH2 Enabled Yellow: CH2 in Service Channel mode
	DS5 LED	Channel 2 "E-Lead" LED (has two states) Off: Signaling is OFF or signaling is ON and "E-Lead" output is inactive. Green: Signaling is ON and "E-Lead" output is active.
	DS6 LED	Channel 2 "M-Lead" LED (has two states) Off: Signaling is OFF or signaling is ON and "M-Lead" input is inactive. Green: Signaling is ON and "M-Lead" input is active.
4	DS7 LED	Channel 1 Loopback LED (has four states) Off: No loopbacks are active Red: Remote loopback is active Green: Local loopback is active
	DS8 LED	Channel 2 Loopback LED (has four states) Off: No loopbacks are active Red: Remote loopback is active Green: Local loopback is active
	DS9 LED	Service On/Off LED (has four states) Off: Service is OFF. Green: Service is ON and module configuration is valid. Red: Service is OFF due to CH1 and CH2 being set to same timeslot and bus direction. Yellow: Service is ON but either CH1 or CH2 is set to an invalid timeslot.

Table 1. Controls and indicators, RFL VF-5XP module

Item	Name/Description	Function								
5	DIP Switch SW1	SW1-1 to SW1-6 Selects SCB address in accordance with Table 2.								
		SW1-7: AUX: Don't care								
		SW1-8: AUX: Don't care								
6	J1	Programming header (for factory use only)								
7	J7 Jumper	Jumpers J7, J8 and J11 are used to set the Channel 1 E&M Signaling Type as follows: Channel 1 Signaling Type								
8	J8 Jumper	Jumper Type I Type II Type III Type V J7 B B B A J8 D D A								
9	J11 Jumper	J10 B A B B A J111 B A B B								
10	J9 Jumper	Jumpers J9, J10 and J12 are used to set the Channel 2 E&M Signaling Type as follows:								
11	J10 Jumper	<u>Jumper Type I Type II Type III Type V</u> J9 B B B A 110 B B A								
12	J12 Jumper	J12 B A B B								
13	J13	Jumper inserted toward front of board = Sonalert Enabled Jumper inserted toward back of board = Sonalert Disabled								
14	J2	Used to connect to Service Channel harness on front door of 9508.								

Table 1. continued - Controls and indicators, VF-5XP module

Module Address	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	ON	ON	ON	OFF
15	OFF	ON	ON	ON	ON	ON
16	OFF	ON	OFF	OFF	OFF	OFF
17	OFF	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON	OFF
19	OFF	ON	OFF	OFF	ON	ON
20	OFF	ON	OFF	ON	OFF	OFF
21	OFF	ON	OFF	ON	OFF	ON
22	OFF	ON	OFF	ON	ON	OFF
23	OFF	ON	OFF	ON	ON	ON
24	OFF	ON	ON	OFF	OFF	OFF
25	OFF	ON	ON	OFF	OFF	ON
26	OFF	ON	ON	OFF	ON	OFF
27	OFF	ON	ON	OFF	ON	ON
28	OFF	ON	ON	ON	OFF	OFF
29	OFF	ON	ON	ON	OFF	ON
30	OFF	ON	ON	ON	ON	OFF
31	OFF	ON	ON	ON	ON	ON
32	ON	OFF	OFF	OFF	OFF	OFF
33	ON	OFF	OFF	OFF	OFF	ON
34	ON	OFF	OFF	OFF	ON	OFF
35	ON	OFF	OFF	OFF	ON	ON
36	ON	OFF	OFF	ON	OFF	OFF

Table 2. Remote access address selection, VF-5XP module

	Nomina	al Level at	TX	Digital		
	L	ine	Setting	(Ť1)		
	Vrms	dBm	dBm	dBm		
	2.449	+10	+10	0		
	2.183	+9	+9	0		
	1.946	+8	+8	0		
	1.734	+7	+7	0		
	1.546	+6	+6	0		
	1.377	+5	+5	0		
	1.228	+4	+4	0		
	1.094	+3	+3	0		
	0.975	+2	+2	0		
	0.869	+1	+1	0		
(4)	0.775	+0	+0	0		
(1)	0.690	-1	-1	0		
	0.615	-2	-2	0		
	0.548	-3	-3	0		
	0.489	-4	-4	0		
	0.436	-5	-5	0		
	0.388	-6	-6	0		
	0.346	-7	-7	0		
	0.308	-8	-8	0		
	0.275	-9	-9	0		
	0.245	-10	-10	0		
	0.218	-11	-11	0		
	0.195	-12	-12	0		
	0.173	-13	-13	0		
	0.155	-14	-14	0		
	0.138	-15	-15	0		
(2)	0.123	-16	-16	0		
(-)	0.109	-17	-17	0		
	0.098	-18	-18	0		
	0.087	-19	-19	0		
	0.077	-20	-20	0		
	0.069	-21	-21	0		
	0.062	-22	-22	0		
	0.055	-23	-23	0		

Table 4. TX Level Settings

Table 5. RX Level Settings

	Digital(T1)	RX	Nomina	al Level at	
		Setting	l	ine	
	dBm	dBm	dBm	Vrms	
	0	+10	+10	2.449	
	0	+9	+9	2.183	
	0	+8	+8	1.946	
	0	+7	+7	1.734	
	0	+6	+6	1.546	(2)
	0	+5	+5	1.377	
	0	+4	+4	1.228	
	0	+3	+3	1.094	
	0	+2	+2	0.975	
	0	+1	+1	0.869	
	0	+0	+0	0.775	
	0	-1	-1	0.690	(1)
	0	-2	-2	0.615	
	0	-3	-3	0.548	
	0	-4	-4	0.489	
	0	-5	-5	0.436	
	0	-6	-6	0.388	
	0	-7	-7	0.346	
	0	-8	-8	0.308	
	0	-9	-9	0.275	
	0	-10	-10	0.245	
	0	-11	-11	0.218	
	0	-12	-12	0.195	
	0	-13	-13	0.173	
	0	-14	-14	0.155	
	0	-15	-15	0.138	
	0	-16	-16	0.123	
	0	-17	-17	0.109	
	0	-18	-18	0.098	
	0	-19	-19	0.087	
	0	-20	-20	0.077	
	0	-21	-21	0.069	
	0	-22	-22	0.062	
	0	-23	-23	0.055	
-	0	-24	-24	0.049	-
	0	-25	-25	0.044	
	0	-26	-26	0.039	
	0	-27	-27	0.035	-
	0	-28	-28	0.031	1
	0	-29	-29	0.027	1
	0	-30	-30	0.024	-
	0	-31	-31	0.022	1
	0	-31.5	-31.5	0.021	-
_	-				

Channel 1 Only

Notes:

- 1. Settings shown on these lines are for 0dBm in and 0dBm out.
- 2. Settings shown on these lines are for -16dBm in and +7dBm out (factory default)
- 3. Setting the levels outside the range of these tables will cause signal degradation.

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FUNCTIONAL DESCRIPTION

For the following discussion, refer to the functional block diagram of the VF-5XP shown in Figure 8, and typical applications shown in Figures 9, 10 and 11.

Overview

The VF-5XP is a 4-wire voice frequency module for a 9508 SSB Power Line Carrier. Typical applications are transmission only (Figure 9), push to talk (Figure 10), audio teleprotection tone transmission (Figure 11), etc. The VF-5XP accepts (per channel) a voice frequency 600 ohm referenced input and uses A-law PCM encoding to convert the analog voice into an 8-bit, 64 kbps digital signal for Channel 1, and 128 kbps digital signal for Channel 2. On the output side of the VF-5XP, it decodes the digital data into the appropriate analog voice frequency output, referenced to 600 ohms. The VF-5XP can be configured via NMS software. All settings can be configured and/or monitored remotely except the signaling type selection which is done with jumpers.

Transmit section

An analog voice input signal is fed into the VF-5XP through the module adapter being used. The audio signal then passes through a balanced input transformer. The transformer output feeds the gain section which includes a level control IC digitally controlled by the FPGA. The signals are then encoded by the codec, sent to the FPGA and finally transmitted to the far end through the backplane drivers, common module, transceiver, and RF equipment.

Receive section

The FPGA receives the appropriate PCM data through the backplane receivers and then passes it along to the codec. The codec then converts this PCM signal to an audio signal. The output of the codec feeds the level control stage, where the signal is adjusted to the appropriate signal level and through a transformer sent to the I/O.

>> text continues on page 19 <<



Figure 8. Functional block diagram, RFL VF-5XP

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Figure 9. Typical transmission only "TO" application using VF-5XP



Figure 10. Typical "push to talk" application using VF-5XP



Figure 11. Typical audio teleprotection scheme using VF-5XP

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E&M Signaling

The VF-5XP supports four types of E&M Signaling as shown in Figure 12: Type I, Type II, Type III and Type V. The E&M signaling jumpers are set according to the type of E&M signaling being used. Refer to the bottom of page 18 in Table 1 for information on how to set these jumpers.

Type I. Type I signaling is a two-wire scheme, normally encountered in electromechanical switching systems. The trunk circuit M lead provides the ground (on hook) and the battery –48V (off hook) toward the model VF-5XP module. The signaling from the VF-5XP to the trunk circuit is on the E lead with open circuit (on hook) and ground (off hook).

Type II. Type II signaling is a four-wire scheme, normally encountered in electronic switching systems. An on hook (idle) condition is indicated by open circuits on both E and M leads and a closure for off-hook (busy).

Type III. Type III signaling is a partially looped four-wire scheme. It provides better protection against interference, and is used with electronic switching systems. An on hook (idle) condition is indicated by an open circuit on the E lead and ground on the M lead. Signaling over the M lead is the same as type I, except that battery and ground for M lead signaling are provided to the trunk circuit over the MB and EB leads. A distinction of the Type III interface is that three conductors are used for M lead signaling.

Type V. Type V signaling is a two-wire scheme normally encountered outside North America. The trunk circuit M lead provides the ground (off-hook), and an open (on-hook) toward the VF-5XP module. The signaling from the VF-5XP to the trunk circuit is on the E lead with open circuit (off-hook) and ground (on-hook).



Figure 12. E&M signaling types

ALERTS AND ALARMS

The RFL VF-5XP reports no module-level ALERT or ALARM signals to the shelf Common Module.

REMOTE CONTROL USING NMS

PROGRAMMING THE VF-5XP MODULE

The VF-5XP module must be programmed using NMS (Network Management Software) version 10.5 or later. Refer to the RFL 9508 Instruction Manual for information on using NMS. To program the VF-5XP module go to the View or Change a Card window for the VF-5XP as shown in Figure 13. In this window the user can change parameters by making changes in the control boxes. The actual values appear immediately to the right of the control boxes. The following discussion covers the settings on the VF-5XP module.

C Performance C All C Chart 222 222 222 222 222 222 222 222 222 2		Vay Macro
C All C Chart 222 222 222 222 222 222 222 222 222 2		Play Macro
C Chart C Chart 222 222 222 222 222 222 222 2		Read Write
Actual 222 222 222 222 222 222 222 222 222 2		Read Vrite
Actual 222 222 222 222 222 222 222 222 222		Read N Write
222 222 222 222 222 222 222 222		Write N
222 222 222 222 222		Write N
222 222 222		Write
222		
222		
		-
222		Alarms
222		
222	S	
222	a	
222	n -	Locard
222		
222		
222		Terminal
222		
222	•	
network		
EXIC	<u></u>	Batch
	222 222 222 222 222 222 222 222 222 22	222 222 222 222 222 222 222 222 222 22

Figure 13. View Or Change A Card Window for the VF-5XP

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VF-5XP Configuration Settings:

1. In/Out of Service

The VF-5XP can be set to be In Service, or Out Of Service. For the VF-5XP module to be in service, select ON (Service ON). For the VF-5XP module to be out of service, select OFF (Service OFF).

2. Time Slot

The Time Slot can be set from 1-24 for T1 systems and from 1-31 for E1 systems. Click on the desired time slot in the pull down box to make the selection.

3. Chan 1 ON/OFF

Channel 1 can be set to ON or OFF. When set to ON, Channel 1 is enabled (ON). When set to OFF, Channel 1 is disabled (OFF).

4. Bus Direction

The Bus Direction can be set to TXA or TXB.

When set to TXA, Channel 1 transmits in the A direction and receives from the B direction. When set to TXB, Channel 1 transmits in the B direction and receives from the A direction. In a typical RFL9508 system, this is set to TXA.

5. Tx1 Level Adjust Sign

The Tx1 Level can be set from -23dBm to +10dBm in 0.5dBm steps. First select the sign by clicking on the (+ or -), then select the level as described in step 6 below

6. Tx1 Level Volume (db)

The Tx1 Level can be set from -23dBm to +10dBm in 0.5dBm steps. Select the level by clicking on the level you want, in the pull down box

7. Rx1 Level Adjust Sign

The Rx1 Level can be set from -31.5dBm to +10dBm in 0.5dBm steps. First select the sign by clicking on the (+ or -), then select the level as described in step 8 below

8. Rx1 Level Volume (db)

The Rx1 Level can be set from -31.5dBm to +10dBm in 0.5dBm steps. Select the level by clicking on the level you want, in the pull down box

9. Chan 1 Signaling

When set to enabled, Chan 1 Signaling is active (in use). When set to disabled, Chan 1 Signaling is inactive (not in use).

10. Chan 1 Busy/Not Busy

The Chan 1 Busy/Not Busy parameter allows the user to activate or deactivate the Busy function by selecting Busy, or Not Busy.

11. Chan 1 1kHz Test Tone

The Chan 1 1kHz Test Tone can be turned On by selecting Enable, or turned Off by selecting Disable.

12. Chan 1 Loopback

In normal operation, all loopbacks are disabled. Loopback settings are used for troubleshooting purposes. There are three loopback settings as follows: None (disable all loopbacks), Local (enable local loopback), Remote (enable remote loopback).

13. Chan 2 ON/OFF

Channel 2 can be set to ON or OFF. When set to ON, Channel 2 is enabled (ON). When set to OFF, Channel 2 is disabled (OFF).

14. Tx2 Level Adjust Sign

The Tx2 Level can be set from -23dBm to +10dBm in 0.5dBm steps. First select the sign by clicking on the (+ or -), then select the level as described in step 15 below.

15. Tx2 Level Volume (db)

The Tx2 Level can be set from -23dBm to +10dBm in 0.5dBm steps. Select the level by clicking on the level you want, in the pull down box.

16. Rx2 Level Adjust Sign

The Rx2 Level can be set from -31.5dBm to +10dBm in 0.5dBm steps. First select the sign by clicking on the (+ or -), then select the level as described in step 17 below.

17. Rx2 Level Volume (db)

The Rx2 Level can be set from -31.5dBm to +10dBm in 0.5dBm steps. Select the level by clicking on the level you want, in the pull down box.

18. Chan 2 Signaling

When set to enabled, Chan 2 Signaling is active (in use). When set to disabled, Chan 2 Signaling is inactive (not in use).

19. Chan 2 Busy/Not Busy

The Chan 2 Busy/Not Busy parameter allows the user to activate or deactivate the Busy function by selecting Busy, or Not Busy.

20. Chan 2 2kHz Test Tone

The Chan 2 2kHz Test Tone and be turned On by selecting Enable, or turned Off by selecting Disable.

21. Chan 2 Loopback

In normal operation, all loopbacks are disabled. Loopback settings are used for troubleshooting purposes. There are three loopback settings as follows: None (disable all loopbacks), Local (enable local loopback), Remote (enable remote loopback).

After all VF-5XP parameter selections have been made they must be written to the VF-5XP card in the network. This is done by using the "WRITE" operation as described in Section 4 of the RFL 9508 Instruction Manual.

9508 SERVICE CHANNEL

The 9508 Service channel provides the means for voice communications over the power line. When active, the service channel audio uses the entire voice bandwidth (300 - 3000Hz) of channel 0 of the 9508. At this time any audio through channel 1 of the VF-5XP used for the service channel will be muted, and audio through channel 2 of the VF-5XP is optionally muted with the "MUTE CH2 IN SVC CHAN MODE" setting.

When the handset at the local end is taken off-hook, the far end VF-5XP will activate a sonalert. The VF-5XP at the far end will continue ringing until the phone is picked up or the near phone is hung up. When the far end phone is picked up the transceivers will activate service channel mode, which is indicated by the channel enabled LEDs turning amber. To exit this mode both phones must be hung up. If one end forgets to hang up the service channel will remain active and the sonalert will be activated after some delay.

TESTING

Once the RFL VF-5XP Module has been configured and installed, it should be tested for proper operation before it is placed in service. There are two ways you can do the testing:

- 1. Local testing using T1 or E1 loopback with the system out of service.
- 2. End-to-end testing, with the system inservice but the channel being tested taken out of service.

Use the following procedure to test the RFL VF-5XP:

- 1. If using T1 or E1 loopback testing, set up the multiplexer loopback following the instructions multiplexer operation manual.
- 1. Test each channel separately. If using end-to-end testing, test each channel first from Site 1 to Site 2, then reverse the setup and test from Site 2 to Site 1.
- 3. If addressing is enabled, the address on the receiving end must match the address at the transmitting end.
- 4. Connect the output of a TIM set or equivalent to the equipment input jack for the channel being tested. Insert a 1004 kHz test tone at the TX level selected for that channel referenced to 600 ohms.

NOTE

For the following steps, check the output on the same RFL VF-5XP module if you are using loopback testing, or on the module at the receive end if you are using end-to-end testing.

5. Measure the channel output at the equipment output jack.
 The output level should be the RX level selected for that channel referenced to 600 ohms, ± 0.5 dB.

- 6. If signaling is enabled, activate the M-Lead and observe that the corresponding M indicator LED on the transmit module and the E indicator LED on the receive module both light up.
- Remove the test equipment and disconnect the loopback if one was used.
 The module is now available for operation.

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use. If using end-to-end testing, check that the transmit and receive configuration is compatible.

Problems may occur at the common equipment or facility level which affect the operation of this module. Refer to your multiplexer operation manual for system analysis procedures.

NOTES

NOTES

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RFL Electronics Inc.

INSTRUCTION DATA

RFL VF-6I Single-Channel Four Wire Orderwire Voice Frequency Module

DESCRIPTION

The RFL VF-6I is a single-channel four wire voice-frequency module, designed for use in IMUX 2000 T1 and E1 multiplexers. It accepts one voice channel as input and uses u-law PCM encoding to convert the analog voice signal into a companded 8-bit, 64-Kbps digital signal. The RFL VF-6I can be used in both terminal and drop/insert multiplexers.

The RFL VF-6I provides high quality voice characteristics compatible with AT&T Publication 43801. It allows VF-6 compatible signaling control or E & M signaling of Type I, II, and III, with front panel busy indicators. It has calibrated extended-range input and output signal level adjustments to facilitate interfaces in most four-wire applications.

The VF-6I module is fully compatible with the RFL VF-6 module and is functionally compatible with the VF-5A module.

User-adjustable switches and jumpers allow the configuration of the following parameters:

- o Selectable signaling control (VF-6 compatible) or E&M Type I, II, and III signaling.
- o Signaling format CAS in E1, RBS in T1, or no signaling.
- o Busy out setting.
- o Selectable Bus A, Bus B, or Both (D&I).
- o Input/output attenuation.
- o Time slot selection.
- o Remote control configuration and status reporting.
- o Selectable transmit control (continuous transmit, hook-switch, voice activate (VOX) or receive only).
- o Selectable Bridge mode or Multi-drop (orderwire) mode.

SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL VF-6I module. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Configuration: One voice-frequency channel.

Frequency response: 300 to 3000 Hz (+/- 0.3 dB)

Input Level: -19.0 dBm to +5.0 dBm (-16 dBm nominal), adjustable in 0.1-dB steps.

Output Level: -14.0 dBm to +10.0 dBm (+7 dBm nominal), adjustable in 0.1-dB steps.

Input Impedance: 600 ohms.

Output Impedance: 600 ohms.

Idle Channel Noise: Less than 23 dBrnc0.

Signal-To-Noise: Greater than 38 dB.

Signaling: Selectable signaling control, E & M Type I, II, or III or transmission only (TO) mode.

Signaling control input:

Busy: ground Idle: open (pulled to Vcc through $4.7K\Omega$)

Hook-switch control input:

On-hook: open (pulled to Vcc through $4.7K\Omega$) Off-hook: ground

M-Lead Input:

Input Impedance: Greater than 20K ohms to ground Busy: -20 to -60 Volts Idle: Open or Ground

E-Lead Output:

Busy: Less than 50 ohms to ground Idle: Open

Time Slots Required:

One-Channel Operation: One selectable time slot. Two-Channel Operation: Two adjacent selectable time slots.

Remote Interface: Compatible with SCL remote command language; allows module configuration and status access.

Operating Temperature: -20° C to $+55^{\circ}$ C (-4° F to $+131^{\circ}$ F).

Relative Humidity: 0 to 90 %, non-condensing.

Input Power: 1.0 watt nominal.

INSTALLATION

Before the RFL VF-6I can be placed in service, it must be installed in a multiplexer shelf. Installation involves determining the module slot in the Main Shelf or Repeater Shelf where the module will be installed, inserting a Module Adapter into the rear of the shelf behind the module slot, connecting all signal and power wiring to the Module Adapter, checking the settings of all jumpers, and inserting the module into the front of the shelf.

NOTE

Power supply and time slot considerations may affect the installation of this module into an existing multiplexer shelf. Refer to the multiplexer manual for more information.

The following instructions are provided for installing RFL VF-6I modules into existing systems. If the module was included as part of a system, installation was done at the factory. Otherwise, proceed as follows:

- 1. Carefully inspect the module for any visible signs of shipping damage. If you suspect damage to the module, immediately call RFL Customer Service at the number listed at the bottom of this page.
- 2. Determine the module slot in the Main Shelf or Repeater Shelf where the RFL VF-6I will be installed.

RFL VF-6I modules occupy one module slot in the Main Shelf or Repeater Shelf.

3. Determine which Module Adapter will be used to make connections to the RFL VF-6I module.

Each module in the IMUX 2000 multiplexer requires a Module Adapter. The module adapter provides the appropriate connector for the desired interface. There are four Module Adapters compatible with the RFL VF-6I:

MA-301The MA-301 accepts a 50-pin Telco connector (Amphenol 57-30500
or equivalent, as shown in Figure 1.) One MA-301 Module Adapter
can be used to connect up to three RFL VF-6I modules, for a total
of up to three voice channels. If you will be using more than one
module with an MA-301, they must be inserted into adjacent slots in
the multiplexer. Ribbon cables are provided with the MA-301 to
make connections to it from the second and third module locations.
(See Figure 2.)

>> text continues on page 5 <<

O MA301											
	CKT #	VF IN R, T	VF OUT R, T	SIGNAL E	SIGNAL SG	SIGNAL M	SIGNAL SB	SIGNAL CONTROL	HOOK SWITCH	REMOTE OFF A GND, SIG	REMOTE OFF B GND, SIG
	1	1,26	2,27	28	3	7	32	4	29	5,30	6,31
	3	9,34	10,35	36	11	15	40	12	37	13,38	14,39
	5	17,42	18,43	44	19	23	48	20	45	21,46	22,47
0											

Figure 1. MA-301 Module Adapter



Figure 2. Connecting two RFL VF-6I modules to a single MA-301 Module Adapter.

MA-301A-1 The MA-301A-1 is used to isolate the VF-6I from SWC type surges sometimes present on 4-wire voice lines. A terminal strip is provided for hard wire connections to the voice circuit as shown in Figure 3. One MA-301A-1 must be used for each VF-6I module.



Figure 3. MA-301A-1, SWC rated 4-wire Module Adapter

MA-301B-2The MA-301B-2 provides pluggable terminal block connections for a
single VF-6I module. Audio and signalling connections are available
at the terminal block. No additional SWC or fast transient
protection is provided on this I/O. Refer to Figure 4 for panel view
and terminal connections.



Figure 4. MA-301B-2 Module Adapter

MA-324The MA-324 accepts a 50-pin Telco connector (Amphenol 57-30500
or equivalent, as shown in Figure 5.) One MA-324 Module Adapter
is used for each RFL VF-6I module and occupies two rear slots in
the IMUX 2000E chassis. The MA-324 is used to convert one of the
4-wire outputs (Channel 1) from 4-wire to 2-wire. The other 4-wire
output is not used. The impedance is 600 Ohms, the frequency
response is $\pm 2dB$ from 200Hz to 3000Hz, and the transformer loss
(hybrid loss) is $\cong 4.0dB$.



Figure 4. MA-324 Module Adapter
4. Insert the desired Module Adapter into the rear of the slot which will hold the RFL VF-6I module, and make all connections to the module Adapter.

If an MA-301 or MA-324 Module Adapter is being used, plug the 50-pin Telco connector into its 50-pin connector.

If an MA-301A-1 Module Adapter is being used, connect all signal wiring to the terminal strip at the rear of the MA-301A-1 using Figure 3 as a guide.

If an MA-301B-1 Module Adapter is being used, connect all signal wiring to the terminal strip at the rear of the MA-301B-1 using Figure 4 as a guide.

- 5. Refer to Figure 6 and Table 1 for the location of DIP switches on the VF-6I.
- 6. Set DIP switches SW1-1 through SW1-6 to the desired remote address (SCB address).
 For remote access, each channel module in the IMUX 2000 must have a distinct module address. Valid addresses are the numbers "1" to "36". In most installations, the address will be set to the slot number in the shelf the module is occupying. Table 2 shows the switch settings for the module address.
- Set DIP switches SW2-1 through SW2-5 to select the desired time slot.
 SW2-1 through SW2-5 select the time slot assignment, using the binary codes shown in Table 3 of this Instruction Data Sheet.
- 8. Set DIP switch SW2-6 to enable or disable bus A.

Place SW2-6 in the DOWN position to transmit on bus A and receive on bus B. Place SW2-6 in the UP position to disable bus A.

- 9. Set DIP switch SW2-7 to enable or disable bus B.
 Place SW2-7 in the DOWN position to transmit on bus B and receive on bus A.
 Place SW2-7 in the UP position to disable bus B.
- 10. Set DIP switch SW2-8 to select T1 or E1 operation. Place SW2-8 in the UP position for T1 operation. Place SW2-8 in the DOWN position for E1 operation.
- Set DIP switches SW3-1 & SW3-2 for transmit control modes.
 Place SW3-1 DOWN and SW3-2 DOWN for Continuous mode
 Place SW3-1 DOWN and SW3-2 UP for Hook Switch mode
 Place SW3-1 UP and SW3-2 DOWN for Voice Activate (VOX) mode
 Place SW3-1 UP and SW3-2 UP for Receive Only mode
- 12. Set DIP switch SW3-3 to enable or disable signaling. Place SW3-3 in the UP position to enable signaling Place SW3-3 in the DOWN position to disable signaling
- Set DIP switch SW3-4 to control the BUSY output.
 Place SW3-4 in the UP position for normal operation
 Place SW3-4 in the DOWN position to enable BUSY OUT (OFF HOOK)
- 14. Set DIP switch SW3-5 to select BRIDGE mode or MULTI-DROP (Orderwire) mode. Place SW3-5 in the UP position to select BRIDGE mode . Place SW3-5 in the DOWN position to select MULTI-DROP mode.
- 15. DIP switch SW3-6 is not used. Leave it in the DOWN position.
- 16. DIP switches SW3-7 & SW3-8 are used to set the threshold for voice activate mode if card is configured for voice activate mode.

Place SW3-7 DOWN and SW3-8 DOWN to set minimum threshold Place SW3-7 DOWN and SW3-8 UP to set higher than minimum threshold Place SW3-7 UP and SW3-8 DOWN to set lower than maximum threshold Place SW3-7 UP and SW3-8 UP to set maximum threshold

- Set DIP switch SW3-9 for either local or remote control.
 If you plan to access the RFL VF-6I remotely, place SW3-9 in the DOWN position.
 If you will be using the RFL VF-6I under local control, place SW3-9 in the UP position.
- Set DIP switch SW3-10 to turn service on or off.
 When SW3-10 is in the DOWN position, service is OFF. If the RFL VF-6I is under local control, the module is disabled. When SW3-10 is in the UP position, service is ON. If the RFL VF-6I is under local control, the module is enabled.



Figure 6. Controls and indicators, RFL VF-6I Four Wire Orderwire Voice Frequency Module

Item	Name/Description	Function			
1	Equipment jacks	Allow channel signals to be equipped:			
		IN Equipme	ent point for input s	ignal	
		OUT Equipme	ent point for output	signal	
2	DIP switch SW1	SW1-1 to SW1-6	Selects the remote	address (SCB address) using the codes	
		s	shown in Table 2.		
3	DIP switch SW2	SW2-1 to SW2-5	o SW2-5 Selects time slots using codes shown in Table 3.		
		SW2-6 ⁽³⁾	Bus A Selection:		
			DOWN:	Bus A enabled (TXA/RXB)	
			UP:	Bus A disabled	
		SW2-7 ⁽³⁾	Bus B Selection:		
			DOWN: Bus B enabled (TXB/RXA)		
			UP: Bus B disabled		
		SW2-8	Selects T1 or E1		
			UP:	Selects T1 operation	
			DOWN:	Selects E1 operation.	

Table 1 Controls and indicators	RFI	VF-6I Four	• Wire Or	derwire V	Voice Frequenc	v Module
Table 1. Controls and multators,	INI L		whe or		voice rrequenc	y mouule

Item	Name/Description	Function			
4	DIP switch SW3	SW3-1 & SW3-2 Transmit control modes			
		<u>TC1 (SW3-1)</u> <u>TC0 (SW3-2)</u>			
		DOWN DOWN Continuous mode			
		DOWN UP Hook Switch mode			
		UP DOWN Voice activate (VOX) mode			
		UP UP Receive only mode			
		SW3-3 Signaling control ⁽⁴⁾			
		UP: Enables CAS for E1 or Enables RBS for T1			
		DOWN: Disables signaling			
		SW3-4 Busy control			
		UP: Normal			
		DOWN: Busy out			
		SW3-5 Bridge mode/Multi-drop mode			
		UP (OFF): Bridge mode			
		DOWN (ON): Multi-drop mode (orderwire mode)			
		SW3-6 Spare			
		SW3-7 & SW3-8 Sets threshold for voice activate mode.			
		$\frac{VOX1(SW3-7)}{DOWN} = \frac{VOX0(SW3-8)}{DOWN}$			
		DOWN DOWN (minimum unresnoid)			
		DOWN UP UP DOWN			
		UP DOWN UP UP (maximum thrashold)			
		SW2.0 Demote/local control ⁽²⁾			
		5 w 5-7 Kemole/local control (
		DOWN: Remote operation			
		SW3 10 Service ON/OFF control			
		UP: Service ON			
		DOWN: Service OFF			
5	DIP switch SW4	Sets receive attenuator:			
5		SW4-1 0.1 dB			
		SW4-2 0.2 dB			
		SW4-3 0.4 dB			
		SW4-4 0.8 dB			
		SW4-5 1.5 dB			
		SW4-6 3.0 dB			
		SW4-7 6.0 dB			
		SW4-8 12.0 dB			
		Switch activities are even lative. For evenuels, to act the attenuation to 10.0 dD			
		turn on SW4.2 SW4.4 SW4.7 and SW4.8: to set attenuation to 7.6 dB			
		turn on SW4-1, SW4-2, and SW4-7, and SW4-0, to set attendation to 7.0 dB, turn on SW4-1 SW4-5 and SW4-7			
		The values shown above allow any setting from zero (no attenuation) to 24 dB,			
		in 0.1 dB increments. Set at the factory for 3 dB. (See Table 4 for a list of			
		attenuation calibration settings)			
6	DIP switch SW5	Sets transmit attenuator. Settings are the same as SW4 above			
7	M indicator (green)	Lights when M lead is active or signaling control input is active.			
8	E indicator (green)	Lights when signaling is turned on and E lead is active			
9	TX activity indicator	Lights when data is transmitted to remote equipment			
10	(green)				
10	RX activity indicator	Lights when data is received from remote equipment			
	(green)				

Table 1. Controls and indicators, RFL VF-6I Four Wire Orderwire Voice Frequency Module - continue

RFL VF-6I December 15, 2011

Item	Name/Description	Function	
11	Jumper J1 ⁽¹⁾	Controls signaling type:	
		In Place (normal):	Selects Type I signaling.
		Removed:	Selects Type II or Type III signaling.
12	J3	For factory use only	
13	Test point TP1	For factory use only	
14	Test point TP2	For factory use only	
15	Test point TP3	For factory use only	
16	Service indicator	Lights when module is in s	ervice.
	(green)		

Table 1. Controls and indicators, RFL VF-6I Four Wire Orderwire Voice Frequency Module - continued

1. When removing jumpers, attach them to one of the pins so that they are available for future use.

2. When the module is set for remote control (SW3-9 in DOWN position), SW3-10 is not used.

3. If the RFL VF-6I is being installed in a terminal multiplexer, set SW2-6 (DOWN) and SW2-7 (UP). If the RFL VF-6I is being installed in a drop/insert multiplexer, set SW2-6 (DOWN) to communicate via the DI-A common module and set SW2-7 (DOWN) to communicate via the DI-B common module.

- 4. If the card is set for E1 operation and signaling is enabled (CAS), the signaling bits are sent in time slot 16, per CCITT Recommendation G.704. The multiplexer must also be set to use CAS signaling.
- 5. If card is set for T1 operation and signaling is enabled (ROBBED BIT) the logic circuitry robs one bit from the PCMencoded voice transmission every eighth frame and replaces it with a signaling bit.

Module Address	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6
1	DOWN	DOWN	DOWN	DOWN	DOWN	UP
2	DOWN	DOWN	DOWN	DOWN	UP	DOWN
3	DOWN	DOWN	DOWN	DOWN	UP	UP
4	DOWN	DOWN	DOWN	UP	DOWN	DOWN
5	DOWN	DOWN	DOWN	UP	DOWN	UP
6	DOWN	DOWN	DOWN	UP	UP	DOWN
7	DOWN	DOWN	DOWN	UP	UP	UP
8	DOWN	DOWN	UP	DOWN	DOWN	DOWN
9	DOWN	DOWN	UP	DOWN	DOWN	UP
10	DOWN	DOWN	UP	DOWN	UP	DOWN
11	DOWN	DOWN	UP	DOWN	UP	UP
12	DOWN	DOWN	UP	UP	DOWN	DOWN
13	DOWN	DOWN	UP	UP	DOWN	UP
14	DOWN	DOWN	UP	UP	UP	DOWN
15	DOWN	DOWN	UP	UP	UP	UP
16	DOWN	UP	DOWN	DOWN	DOWN	DOWN
17	DOWN	UP	DOWN	DOWN	DOWN	UP
18	DOWN	UP	DOWN	DOWN	UP	DOWN
19	DOWN	UP	DOWN	DOWN	UP	UP
20	DOWN	UP	DOWN	UP	DOWN	DOWN
21	DOWN	UP	DOWN	UP	DOWN	UP
22	DOWN	UP	DOWN	UP	UP	DOWN
23	DOWN	UP	DOWN	UP	UP	UP
24	DOWN	UP	UP	DOWN	DOWN	DOWN
25	DOWN	UP	UP	DOWN	DOWN	UP
26	DOWN	UP	UP	DOWN	UP	DOWN
27	DOWN	UP	UP	DOWN	UP	UP
28	DOWN	UP	UP	UP	DOWN	DOWN
29	DOWN	UP	UP	UP	DOWN	UP
30	DOWN	UP	UP	UP	UP	DOWN
31	DOWN	UP	UP	UP	UP	UP
32	UP	DOWN	DOWN	DOWN	DOWN	DOWN
33	UP	DOWN	DOWN	DOWN	DOWN	UP
34	UP	DOWN	DOWN	DOWN	UP	DOWN
35	UP	DOWN	DOWN	DOWN	UP	UP
36	UP	DOWN	DOWN	UP	DOWN	DOWN

Table 2. SCB address settings, RFL VF-6I Four Wire Orderwire Voice Frequency Module

Each section of SW4 controls a specific amount of attenuation:

SW4-1	0.1 dB
SW4-2	0.2 dB
SW4-3	0.4 dB
SW4-4	0.8 dB
SW4-5	1.5 dB
SW4-6	3.0 dB
SW4-7	6.0 dB
SW4-8	12.0 dB

The switch settings are cumulative. For example, to set the attenuation to 19.0 dB, set the switches as follows:

Section	Value	<u>Setting</u>	<u>Set Value</u>
SW4-1	0.1 dB	OFF	0.0
SW4-2	0.2 dB	ON	0.2
SW4-3	0.4 dB	OFF	0.0
SW4-4	0.8 dB	ON	0.8
SW4-5	1.5 dB	OFF	0.0
SW4-6	3.0 dB	OFF	0.0
SW4-7	6.0 dB	ON	6.0
SW4-8	12.0 dB	ON	12.0
TOTAL			19.0

To set the attenuation to 7.6 dB, set the switches as follows:

Section	Value	<u>Setting</u>	<u>Set Value</u>	
SW4-1	0.1 dB	ON	0.1	
SW4-2	0.2 dB	OFF	0.0	
SW4-3	0.4 dB	OFF	0.0	
SW4-4	0.8 dB	OFF	0.0	
SW4-5	1.5 dB	ON	1.5	
SW4-6	3.0 dB	OFF	0.0	
SW4-7	6.0 dB	ON	6.0	
SW4-8	12.0 dB	OFF	0.0	
TOTAL			7.6	

See Table 4 for more information about attenuator settings.

- 20. Set DIP switches SW4-1 through SW4-8 for the desired amount of receive attenuation.
- 21. Set DIP switches SW5-1 through SW5-8 for the desired amount of transmit attenuation.

- 22. Slide the RFL VF-6I module into the selected module slot until it is firmly seated.
- 23. On the Module Record Card (located to the right of the shelf) record the channel bank type, time slot, and any other other pertinent information.

The RFL VF-6I is now installed.

T1	E 1		Switch Settings				
		SW2-1	SW2-2	SW2-3	SW2-4	SW2-5	
1	0*	UP	UP	UP	UP	UP	
2	1	UP	UP	UP	UP	DOWN	
3	2	UP	UP	UP	DOWN	UP	
4	3	UP	UP	UP	DOWN	DOWN	
5	4	UP	UP	DOWN	UP	UP	
6	5	UP	UP	DOWN	UP	DOWN	
7	6	UP	UP	DOWN	DOWN	UP	
8	7	UP	UP	DOWN	DOWN	DOWN	
9	8	UP	DOWN	UP	UP	UP	
10	9	UP	DOWN	UP	UP	DOWN	
11	10	UP	DOWN	UP	DOWN	UP	
12	11	UP	DOWN	UP	DOWN	DOWN	
13	12	UP	DOWN	DOWN	UP	UP	
14	13	UP	DOWN	DOWN	UP	DOWN	
15	14	UP	DOWN	DOWN	DOWN	UP	
16	15	UP	DOWN	DOWN	DOWN	DOWN	
17	16**	DOWN	UP	UP	UP	UP	
18	17	DOWN	UP	UP	UP	DOWN	
19	18	DOWN	UP	UP	DOWN	UP	
20	19	DOWN	UP	UP	DOWN	DOWN	
21	20	DOWN	UP	DOWN	UP	UP	
22	21	DOWN	UP	DOWN	UP	DOWN	
23	22	DOWN	UP	DOWN	DOWN	UP	
24	23	DOWN	UP	DOWN	DOWN	DOWN	
	24	DOWN	DOWN	UP	UP	UP	
	25	DOWN	DOWN	UP	UP	DOWN	
	26	DOWN	DOWN	UP	DOWN	UP	
	27	DOWN	DOWN	UP	DOWN	DOWN	
	28	DOWN	DOWN	DOWN	UP	UP	
	29	DOWN	DOWN	DOWN	UP	DOWN	
	30	DOWN	DOWN	DOWN	DOWN	UP	
	31	DOWN	DOWN	DOWN	DOWN	DOWN	

Table 3. Time slot selection, RFL VF-6I Four Wire Orderwire Voice Frequency Module

NOTE: Each active Time Slot on an RFL VF-6I module occupies one 64-Kbps digital time slot within the multiplexer's aggregate rate. Consult the IMUX 2000E instruction manual for guidelines on time slot selection. * Time Slot 0 is reserved for E1.

** Not valid if signaling is enabled in E1. Time Slot 16 is reserved for CAS.

RTU/MTU APPLICATION

This section describes how to configure the VF-6I for an RTU/MTU application. Signaling is not supported in Bridge Mode.

- 1. VF6I operating with an MTU.
 - a. The VF-6I transmits and receives data from both bus directions. The VF6I only transmits local data and does not pass data thru from either direction.

BUS A	ENABLED	SW2-6 DOWN (ON)
BUS B	ENABLED	SW2-7 DOWN (ON)
BRIDGE MODE	BRIDGE MODE ENABLED	SW3-5 UP (OFF)



Figure 7. VF6I configured for MTU operation in both bus directions (Bus A and Bus B enabled)

b. The VF-6I transmits only local data from the Terminal end (or D&I end) in one bus direction only.

BUS A or BUS B	ENABLED	SW2-6 or SW2-7 DOWN (ON)
MULTI-DROP MODE	MULTI-DROP MODE ENABLED	SW3-5 DOWN (ON)



Figure 8. VF6I configured for MTU operation in one bus direction (Bus B enabled)

- 2. VF6I operating with an RTU.
 - a. The VF-6I transmits local data in one bus direction, toward the Master (MTU), and passes received data in the same bus direction

BUS A OR BUS B	ENABLED	SW2-6 or SW2-7	DOWN (ON)
BRIDGE MODE	ENABLED	SW3-5	UP (OFF)



Figure 9. VF6I configured for RTU operation in one bus direction (Bus A enabled) in the middle of a chain of RTUs

b. The VF-6I transmits local data from the Terminal end (or D&I end) toward the Master (MTU). The VF6I does not pass received data thru.

BUS A OR BUS B	ENABLED	SW2-6 or SW2-	7 DOWN (ON)
MULTI-DROP MODE	MULTI-DROP MODE ENABLED	SW3-5	DOWN (ON)



Figure 10. VF6I configured for RTU operation in one bus direction (Bus A enabled) at the end of a chain of RTUs

FUNCTIONAL DESCRIPTION

SYSTEM OVERVIEW

The VF-6I is a 4-wire Orderwire Voice Frequency Channel Module designed for RFL IMUX 2000 T1 and E1 multiplexers. It is designed as a direct replacement for the RFL VF-6 and can communicate with the RFL VF-5A. The VF-6I can interconnect multiple locations (nodes) for applications involving voice or multiple voice grade modems for alarm and control applications.

In a bridge configuration, each mode hears the master node, and the addressed node responds back to the master. However, all nodes other than the master do not hear the response. In a multi-drop configuration, every node hears every other node, since there is no master.

One of four Transmit Modes can be selected: Continuous, Voice Activate (VOX), Hook-Switch, and Receive Only. In Continuous Mode the local audio signal is added to the transmit data stream regardless of signal level or any control input. In Voice Activate Mode (VOX) the local audio signal is added to the transmit data stream if the threshold set by the threshold level switches, VOX0 and VOX1, is exceeded. In Hook Switch Mode the local audio signal is only added to the transmit data stream when the hook-switch control input is externally grounded. In Receive Only Mode the local audio signal is never added to the transmit data stream regardless of the signal level or any control input. Data is only received.

The VF-6I accepts a single voice channel as input and uses μ -law PCM encoding to convert the analog voice into an 8-bit, 64-Kbps digital signal. The VF-6I can be configured via local switches (SW1 thru SW5) or remotely with the RFL SCL (Simple Command Language). However, the attenuator settings can only be set with the physical switches (SW4 & SW5).

Channel-Associated Signaling (CAS) is used in E1 applications, while Robbed-Bit Signaling (RBS) is used in T1 applications. Signaling can be disabled in T1 and E1.

Refer to the VF-6I Simplified Block Diagram shown in Figure 11.

BACKPLANE AND POWER CONNECTIONS

The VF-6I occupies a single physical slot in the multiplexer and conforms to the RFL IMUX 2000 backplane signal format. All T1 and E1 backplane signals in and out of the VF-6I are driven with 74HCT125 drivers except for the SCB clock, sync and data signals. All control signals passing through the backplane from the I/O module are pulled up to +5V through 4.7 K Ohm resistors.

The VF-6I requires +5V, +15V, -15V, -48V, and ground which are supplied by the IMUX 2000 backplane. The +5 volt input includes an inductor which lowers the inrush current to prevent interruption to the power during module insertion. TP2 is the +5V testpoint. TP3 is the ground testpoint. All pins which connect to the backplane except for voltages and grounds are cut back to prevent components from being driven by signals before the module is fully powered.

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Figure 11. Simplified block diagram, RFL VF-6I Four Wire Orderwire Voice Frequency Module

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TRANSMIT SECTION

An analog voice input signal is fed into the VF-6I module through the rear backplane connections which then goes to a balanced input transformer. The transformer output goes to an amplifier stage, and then passes through the transmit attenuator. The switches (SW5) allow attenuation settings from zero to 24.0 dB in 0.1 dB increments. The factory setting is +3 dB of attenuation for a -16 dBm input. The attenuator output then passes through a testpoint to the μ -law PCM CODEC where the analog voice is converted into an 8-bit, 64-Kbps digital signal. The maximum level at the testpoint is 5 Vp-p; above this clipping occurs. The digitized audio signal then goes to the Logic Array where it is processed before being transmitted to the proper timeslot. The equipment input jack in front of the card is used for injection of a test tone.

The RFL VF-6I offers a choice of one of two signaling inputs at the backplane: SIGCON (signal control) and M-LEAD.

SIGCON is compatible with the RFL VF-6. This input is pulled to +5V through a 4.7 K Ohm resistor. This signal goes directly into the Logic Array and is multiplexed into the transmitted data. When this input is grounded externally, the remote VF-6I is signaled and the local M Led is activated (BUSY). When this circuit is open, the signal is IDLE.

M-LEAD is compatible with RFL VF-5A. M-LEAD is used when E&M Signaling Types I, II, or III are desired. The M lead detector responds to an IDLE or BUSY signal from the external device. A level of -48 volts at the M-LEAD indicates BUSY. Open or grounded indicates IDLE. The output of M-LEAD goes into the Logic Array and is multiplexed in the TXDATA. The remote VF-6I is signaled and the local M Led is activated. The PTC Resettable Fuse protects the VF-6I Module if the MB-LEAD is accidentally shorted to ground.

RECEIVE SECTION

The VF-6I receives an 8-bit, 64-Kbps digital signal via the backplane from the appropriate timeslot. The input signals go to the Logic Array where it is processed and de-multiplexed. The 8-bit digital output of the Logic Array is then converted to an analog audio signal by the μ -law PCM CODEC and is passed to the receive attenuator. The switches (SW4) allow attenuation settings from zero to 24.0 dB in 0.1 dB increments. The factory setting is +3 dB of attenuation for a +7 dBm output. The attenuator output passes to an amplifier, and through the balanced output transformer to the rear backplane connections. The equipment output jack on the front of the board allows retrieval of a test tone.

The signaling portion of the received data from the Logic Array goes to the opto-coupler. Signaling is active (BUSY) when E-LEAD is low. Signaling is inactive (IDLE) when E-LEAD is high. When active in E&M Type I format, ground is BUSY and open is IDLE. In Type II or III, J1 is removed and EB-LEAD is used. The VF-6I must have J1 removed if to be used as a direct replacement of an RFL VF-6 module.

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ALERTS AND ALARMS

The RFL VF-6I reports no module-level ALERT or ALARM signals to the shelf Common Module.

COMPATIBILITY WITH OTHER RFL MODULES

RFL VF-6I modules are fully compatible with older RFL VF-6 modules. A circuit may consist of an RFL VF-6 at one end and an RFL VF-6I at the other end. However there are few differences between the two:

- 1. The RFL VF-6I is remote controllable; the RFL VF-6 is not.
- 2. THE VF-6I can be used in terminal mode.

RFL VF-6I modules are functionally compatible with the RFL VF-5A voice module with the following differences:

- 1. The VF-6I uses one time slot.
- 2. I/O pin designations for the M-lead and MB-leads are different.
- 3. Bus-A and Bus-B can be simultaneously enabled for VF-6I.

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ATTENUATOR SETTINGS

The RFL VF-6I module has two attenuators: Transmit and Receive. Factory settings for these attenuators are 3.0 dB on the transmit side and 3.0 dB on the receive side. This allows -16 dBm in, +7 dBm out with 3 dB of headroom.

Table 4 is an extended list of attenuator calibration settings. Set the attenuators based on the desired input and output levels listed in the table. These settings will permit a maximum signal level 3 dBm higher than the indicated level. For example, with -10 dBm input, the transmitter attenuator setting would be 9 dB and the maximum line input would be -7 dBm. Using these settings on the transmit side will place a signal of 1 digital mW into the transmission bit stream.

Transmit	Transmit Attenuator	Receive	Receive Attenuator
Level In	Setting	Level Out	Setting
+5 dBm	24 dB	-14 dBm	24 dB
+4 dBm	23 dB	-13 dBm	23 dB
+3 dBm	22 dB	-12 dBm	22 dB
+2 dBm	21 dB	-11 dBm	21 dB
+1 dBm	20 dB	-10 dBm	20 dB
0 dBm	19 dB ⁽¹⁾	-9 dBm	19 dB
-1 dBm	18 dB	-8 dBm	18 dB
-2 dBm	17 dB	-7 dBm	17 dB
-3 dBm	16 dB	-6 dBm	16 dB
-4 dBm	15 dB	-5 dBm	15 dB
-5 dBm	14 dB	-4 dBm	14 dB
-6 dBm	13 dB	-3 dBm	13 dB
-7 dBm	12 dB	-2 dBm	12 dB
-8 dBm	11 dB	-1 dBm	11 dB
-9 dBm	10 dB	0 dBm	$10 \text{ dB}^{(1)}$
-10 dBm	9 dB	+1 dBm	9 dB
-11 dBm	8 dB	+2 dBm	8 dB
-12 dBm	7 dB	+3 dBm	7 dB
-13 dBm	6 dB	+4 dBm	6 dB
-14 dBm	5 dB	+5 dBm	5 dB
-15 dBm	4 dB	+6 dBm	4 dB
-16 dBm	$3 dB^{(2)}$	+7 dBm	$3 dB^{(2)}$
-17 dBm	2 dB	+8 dBm	2 dB
-18 dBm	1 dB	+9 dBm	1 dB
-19 dBm	0 dB	+10 dBm	0 dB

Table 4 Attenuator calibration settings, RFL VF-61 Four Wire Orderwire Voice Frequency Modul								
	Fable 4. Attenuator calibration settings	. RFL	VF-6I Four	Wire O	rderwire	Voice Fred	uencv	^v Module

NOTES: (1) = Settings for 0 dBm in and 0 dBm out.

(2) = Settings for -16 dBm in and +7 dBm out.

REMOTE CONTROL INTERFACE

When installed in an IMUX 2000 T1 or E1 shelf, the RFL VF-6I module can be operated under local or remote control. When under remote control, most of the module setup parameters can only be changed through the RS-232 remote port on the shelf Common Modules. See the IMUX 2000 manual for details on the remote control interface.

"P" CODES AND "S" CODES

The RFL VF-6I reports itself as a "Type 121" module. Its remote control interface involves two sets of codes: "P" (parameter) codes, and "S" (status) codes.

"P" codes, when used in the parameter field on an "SCL SET" command, allow the user to set certain parameters on the module by remote control, just like setting the switches on the module under local control. "P" codes also appear in the response to a "CONFIG?" query, providing a list of the current settings on the module. A typical RFL VF-6I response to a "CONFIG?" query looks like this:

* OK CHANNEL CARD 3, TYPE 121 UNDER REMOTE CONTROL SVCE = ON P01 = 10 (B00001010) P02 = 0 (B0000000);

Each "P" code is displayed in both decimal and binary representation, however, the binary representation is generally more useful, as each of the eight digits corresponds to a specific switch or jumper on the module. Table 5 lists the meaning of the "P" codes for the RFL VF-6I.

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P Code	Digit(s) and Switch Equivalent	Value	Description
P1	B0000000 ↑↑↑↑↑	00001 to 11111 for E1 00001 to 11000 for T1	From left to right, these five bits represent the binary value of the desired time slot. See Table 7 for a
	TIME SLOT SELECT		complete list of these values.
	B0000000	0	Selects T1 system
	SYSTEM TYPE	1	Selects E1 system
	B0000000 ↑	0	Bus B disabled
	BUS B	1	Bus B enabled
	B0000000 ↑	0	Bus A disabled
	BUS A	1	Bus A enabled
P2	B0000000 ↑↑	00 to 11	Selects level of voice activate setting. 00 = minimum setting 11 = maximum setting
	VOICE ACTIVATE SETTINGS (VOX)		
	B00000000 ↑	0	Signaling enabled CAS for E1, RBS for T1
	SIGNALING	1	Signaling disabled
	B0000000	00	Receive only
	$\uparrow\uparrow$	01	Voice activate (VOX)
	TRANSMIT CONTROL MODES	10	Hook-switch Continuous
	TRANSMIT CONTROL MODES	11	Continuous
	B0000000 ↑	0	Bridge mode
	MODE	1	Multi-drop mode
	B0000000 ↑ ↑		Not currently used
	SPARE		

Table 5. Remote configuration settings ("P" codes)

NOTE

When using binary numbers with a SET command, they must be preceeded by the letter "B" as shown in the following example:

<MULTIPLEXER ADDRESS>:<CARD ADDRESS>:SET:P1 = B00000011;

In addition to the P code, it is also possible to turn service on or off for the card by sending SRVC = ON or SRVC = OFF in the parameter field of a SET command. The S code appears in response to a STATUS? query, in the format:

* OK CHANNEL CARD 3, TYPE 121 S01 = 00 (B0000000);

This format is similar to that of the P code, but instead of representing switches, the five least significant digits of the binary number represent the remote status messages as shown in Table 6. The three most significant digits are not used.

S Code	Digit(s) and Switch Equivalent	Value	Description
S 1	в00000000 ↑	0	M-Lead inactive
	SIGNALING/M-LEAD	1	Signaling on and M-Lead active
	в00000000 ↑	0	E-Lead inactive
	SIGNALING/E-LEAD	1	Signaling on and E-Lead active
B0000000 ↑		0	Not transmitting data to remote equipment
	TRANSMIT ACTIVITY	1	Transmitting data to remote equipment
	B0000000 ↑		Not receiving data from the remote equipment
	RECEIVE ACTIVITY		Receiving data from remote equipment
	B0000000 ↑	0	Invalid configuration - card disabled
	CONFIGURATION	1	Valid configuration

Table 6. Remote Status Messages (S Codes)

Time Slot	P1-5*	P1-4*	P1-3*	P1-2*	P1-1*
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16**	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1
24	1	1	0	0	0
25	1	1	0	0	1
26	1	1	0	1	0
27	1	1	0	1	1
28	1	1	1	0	0
29	1	1	1	0	1
30	1	1	1	1	0
31	1	1	1	1	1

Table 7. Time slot selection by remote access

* These positions represent the five least significant digits of P1, as shown in Table 5.

** Not valid if signaling is enabled in E1. Time Slot 16 is reserved for CAS.

TESTING

Once the RFL VF-6I Module has been configured and installed, it should be tested for proper operation before it is placed in service. There are two ways you can do the testing:

- 1. Local testing using T1 or E1 loopback with the system out of service.
- 2. End-to-end testing, with the system inservice but the channel being tested taken out of service.

Use the following procedure to test the RFL VF-6I:

- 1. If using T1 or E1 loopback testing, set up the multiplexer loopback following the instructions multiplexer operation manual.
- 2. Test each channel separately. If using end-to-end testing, test each channel first from Site 1 to Site 2, then reverse the setup and test from Site 2 to Site 1.
- 3. Connect the output of an audio signal generator (Hewlett-Packard model 4935A or equivalent) to the equipment input jack for the channel being tested. Insert a 1004 kHz test tone at -16 dBm referenced to 600 ohms.

NOTE

For the following steps, check the output on the same RFL VF-6I module if you are using loopback testing, or on the module at the receive end if you are using end-to-end testing.

- 4. Measure the channel output at the equipment output jack.
 The output should be +7 dBm referenced to 600 ohms, <u>+</u> 0.5 dB.
- 5. Measure the signal-to-noise (S/N) ratio with C Message weighing, This should be greater than 38 dB S/N
- 6. Activate the M-Lead and observe that the corresponding M indicator LED on the transmit module and the E indicator LED on the receive module both light up.
- Measure the idle channel noise.
 This should be less than 23 dBrnc0.
- 8. Remove the test equipment and disconnect the loopback if one was used. **The module is now available for operation.**

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use. If using end-to-end testing, check that the transmit and receive configuration is identical.

Problems may occur at the common equipment or facility level which affect the operation of this module. Refer to your multiplexer operation manual for system analysis procedures.

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RFL Electronics Inc.

INSTRUCTION DATA

RFL VF-8A Selective Calling Unit

DESCRIPTION

The RFL VF-8A Selective Calling Unit is a two-wire selective calling "party line" module designed for use in IMUX 2000 terminal and drop/insert multiplexers. It accepts a single voice channel as input, and converts it into a 64kbps signal which can be transmitted over T1, E1 or other digital communications facilities. It does this using μ -law PCM encoding and decoding for both T1 and E1 systems. The VF-8A automatically detects if the system is T1 or E1 and configures itself appropriately.

The VF-8A is remote-controllable when installed in an RFL remote controllable shelf. The following module parameters can be configured remotely via SCB or locally via DIP switches. A DIP switch setting will control whether the card is in remote or local mode.

- o Selectable time slot assignment
- o Selectable TX bus direction(s)
- o 3-digit Station ID
- o Number of ring attempts
- o Extended range transmit and receive level settings
- o Service on/off
- o Selectable Busy Circuit modes

SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL VF-8A Selective Calling Unit. Because all RFL products undergo constant improvement and refinement, these specifications are subject to change without notice.

Configuration:	One voice channel per module						
Timeslots:	Requires one user-selectable 64 kbps time slot						
Frequency Response:	300 Hz to 3400 Hz:	300 Hz to 3400 Hz: ±1.5 dB					
Signal Levels:	Input: -26 dBm to +9 Output: -26 dBm to +	Input: -26 dBm to +9 dBm Output: -26 dBm to +9 dBm					
Impedance:	600 ohms input/outpu	ıt					
Idle Channel Noise:	Less than 23 dBrnc0						
Peak-To-Average Ratio (I	P/AR): Greater than 94						
Signaling Format:	T1 systems: RBS (Robbed-Bit Signaling) E1 systems: CAS (Channel-Associated Signaling)						
Dialing Method:	DTMF for "station", "group", and "all" call						
Audio Encoding/Decoding	g: μ-law for both T1 and	d E1 systems					
Call Progress Tones:	Dial Tone: Frequencies: Timing:	350 + 440 Hz, nominal Continuous tone					
	Line Busy Tone: Frequencies: Timing:	480 + 620 Hz, nominal Cycles of 0.5 seconds ON and 0.5 seconds OFF					
	Reorder Tone: Frequencies: Timing:	480 + 620 Hz, nominal Cycles of 0.25 seconds ON and 0.25 seconds OFF					
	Audible Ring Tone: Frequencies: Timing:	440 + 480 Hz, nominal Cycles of 2 seconds ON and 4 seconds OFF					

SPECIFICATIONS - continued

I/O Interface:	Through MA	-306 mo	odule adapter		
Ringing Voltage:	Local (MA-306): External:		86 Vrms, 20 Hz 50-90 Vrms, 20 to 30 Hz		
Station ID:	3-digit (000 t	o 899)			
Power Requirements:	VF-8A with 1 +5V +15V -15V -48V	MA-306 <u>Idle</u> 68mA 30mA 25mA 1mA	: <u>Off Hook</u> 70mA 34mA 26mA 33mA	Ringing 90mA 32mA 25mA 1mA	
Operating Temperature:	-20° C to $+55^{\circ}$ C (-4° F to $+131^{\circ}$ F).				
Humidity:	0% to 90 %, non-condensing.				
RFI/EMI:	C.37.90.2				
MTBF:	Greater than	500,000	hours per Bellcore T	TR-332	

INSTALLATION

Before the RFL VF-8A can be placed in service, it must be installed in a multiplexer shelf. Installation involves determining the module slot in the Main Shelf or Expansion Shelf where the module will be installed, inserting a Module Adapter into the rear of the shelf behind the module slot, connecting all signal and power wiring to the Module Adapter, checking the settings of all switches, and inserting the module into the front of the shelf.

NOTES

Power supply and time slot considerations may affect the installation of this module into an existing multiplexer shelf. Refer to the multiplexer manual for more information.

The following instructions are provided for installing an RFL VF-8A module into an existing system. If the module was included as part of a system, installation was done at the factory. Otherwise, proceed as follows:

- 1. Carefully inspect the module for any visible signs of shipping damage. If you suspect damage to the module, immediately call RFL Customer Service at the number shown at the bottom of this page.
- 2. Determine the module slot in the Main Shelf or Expansion Shelf where the module will be installed.

RFL VF-8A module occupies one module slot in the Main Shelf or Expansion Shelf.

3. Determine which Module Adapter will be used to make connections to the RFL VF-8A module.

Each module in the IMUX 2000 multiplexer requires a Module Adapter. The module adapter provides the appropriate connector for the desired interface. The Module Adapter that is used with the RFL VF-8A is the MA-306.

MA-306 The MA-306 provides an RJ-11, FXS jack for the local phone connection, and an FXO jack for future use.

4. Insert the MA-306 Module Adapter into the rear of the slot which will hold the RFL VF-8A module, and make all connections to the module adapter.

Connect the RJ-11 plug for the local phone into the MA-306's FXS jack. The only electrical interface connections that have to be made to the RFL VF-8A are the RING and TIP connections, which are made to terminals 3 and 4 on the RJ-11 connector as shown in Figure 1.

5. Refer to Figure 2 and Table 1 for the location and function of DIP switches on the VF-8A.



Figure 1. MA-306 Module Adapter.

6. Set the module SCB address using DIP switches SW1-1 through SW1-6.

For remote access, each channel module in the IMUX 2000 must have a distinct module address. Valid addresses are the numbers "1" to "36". In most installations the address will be set to the number of the slot the module is occupying. Table 2 shows the switch settings for the module address. (Consult your multiplexer manual for details on using the remote access and configuration features of the system.)

7. Select an unused time slot using DIP switches SW2-1 to SW2-5. The voice channel uses one 64 kbps digital time slot within the multiplexer's aggregate rate. Set the time slot using direct binary coding as shown in Table 3. Refer to the multiplexer manual for guidelines on time slot selection.

Note that selecting an invalid time slot will disable the module. In T1 systems, only time slots 1 through 24 are allowed. Time slot 24 is not available for a T1 system using fast reframing.

In E1 systems, time slots 1 through 31 are allowed, however, time slots 0 and 16 are reserved and cannot be used. Time slot 30 is not available for an E1 system using fast reframing. Time slot 31 is not available if inter-node communications (NMX) is used.



Figure 2. Controls and indicators, RFL VF-8A Selective Calling Unit

- 8. Set DIP switch SW2-6 to enable or disable Bus A.
 Place SW2-6 in the DOWN position to transmit on Bus A and receive on Bus B.
 Place SW2-6 in the UP position to disable Bus A.
- 9. Set DIP switch SW2-7 to enable or disable Bus B.
 Place SW2-7 in the DOWN position to transmit on Bus B and receive on Bus A.
 Place SW2-7 in the UP position to disable Bus B.
- 10. The 16-position rotary DIP switch SW3 is used to select the desired number of ring attempts. Place SW3 to the desired setting in accordance with Table 4.

<< text continues on page 10 >>

Item	Name/Description	Function
1	Ring LED (yellow), DS1	Lights when local phone is ringing
2	Busy LED (green), DS2	Lights when circuit is busy (in use)
3	Service LED (green), DS3	Lights when module service is ON
4	DIP switch SW1	SW1-1 to SW1-6 sets the SCB address in accordance with Table 2
		SW1-7 selects local or remote mode as follows:
		UP: local mode (using switches)
		DOWN: remote mode (using SCB)
		SW1-8 turns module service ON or OFF as follows:
		UP: service ON
		DOWN: service OFF
5	DIP switch SW2	SW2-1 to SW2-5 selects the time slot in accordance with Table 3.
		SW2-6 enables or disables Bus A
		UP: disable Bus A
		DOWN: transmit on Bus A, receive on Bus B
		SW2-7 enables or disables Bus B
		UP: disable Bus B
		DOWN: transmit on Bus B, receive on Bus A
		SW2-8 (spare)
6	16 position rotary switch SW3	Selects the number of ring attempts (1 to 15, or unlimited) in accordance
		with Table 4.
7	10 position rotary switch SW4	Selects group # (100's position) of three number Station ID
8	10 position rotary switch SW5	Selects "tens position" of three number Station ID
9	10 position rotary switch SW6	Selects "units position" of three number Station ID
10	8 position DIP switch SW7	SW7-1 through SW7-5 (spare switches)
		SW7-6 selects Signaling delay as follows:
		UP: Signaling delay enabled
		DOWN: Signaling delay disabled
		SW7-7 and SW7-8 selects Busy Circuit Options in accordance with Table
11		5 (1)(0)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)
11	8 position DIP switch SW8	SW8-1 (spare) SW8-2 to SW8-8 colored To ottomore in accordance with Table (
10	9 marticles DID and the CWO	SW8-2 to SW8-8 selects 1x attenuation in accordance with Table 6
12	8 position DIP switch Sw9	SW9-1 (spare) SW0.2 to SW0.8 colored By attenuation in accordance with Table 6
12	11	Sw9-2 to Sw9-8 selects KX attenuation in accordance with Table 6
13		For future use
14	J2A J2D	For factory use only (jumper is always installed)
15	J2B	For factory use only (jumper is always installed)
10	J3	For future use
1/	JJ Track and TD1	For engineering use only (J5 is not installed)
18	Test point TP1	
19	Test point TP2	
20	Test point TP3	Analog +5 VDC
21	Test point TP4	Analog +5 VDC
22	Test point TP5	Analog +3 VDC
23	Test point TP7	Analog - J V DC
24	Test point TP?	DIVIF_CLAA (3.3/9343 MHZ)
25	Test point TP0	I A audio delore siereo volume control
20	Test point TP9	TX audio after stereo volume control
2/	Test point TP10	1 A audio after stereo volume control
28	Test point TP11	KA audio before stereo volume control
- 29	1 est point 1 P12	Dial tone, busy tone, or ring back tone

Table 1. Controls and indicators, RFL VF-8A Selective Calling Unit

Module Address	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	ON	ON	ON	OFF
15	OFF	OFF	ON	ON	ON	ON
16	OFF	ON	OFF	OFF	OFF	OFF
17	OFF	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON	OFF
19	OFF	ON	OFF	OFF	ON	ON
20	OFF	ON	OFF	ON	OFF	OFF
21	OFF	ON	OFF	ON	OFF	ON
22	OFF	ON	OFF	ON	ON	OFF
23	OFF	ON	OFF	ON	ON	ON
24	OFF	ON	ON	OFF	OFF	OFF
25	OFF	ON	ON	OFF	OFF	ON
26	OFF	ON	ON	OFF	ON	OFF
27	OFF	ON	ON	OFF	ON	ON
28	OFF	ON	ON	ON	OFF	OFF
29	OFF	ON	ON	ON	OFF	ON
30	OFF	ON	ON	ON	ON	OFF
31	OFF	ON	ON	ON	ON	ON
32	ON	OFF	OFF	OFF	OFF	OFF
33	ON	OFF	OFF	OFF	OFF	ON
34	ON	OFF	OFF	OFF	ON	OFF
35	ON	OFF	OFF	OFF	ON	ON
36	ON	OFF	OFF	ON	OFF	OFF

Table 2. Module SCB address settings, RFL VF-8A module

NOTE: For SW1, ON = UP and OFF = DOWN.

Switch	Physical Switch Settings		T1	E 1			
Code			SW2-				
(Decimal)	1	2	3	4	5	Time Slot	Time Slot
0	D	D	D	D	D	*	*
1	D	D	D	D	U	1	1
2	D	D	D	U	D	2	2
3	D	D	D	U	U	3	3
4	D	D	U	D	D	4	4
5	D	D	U	D	U	5	5
6	D	D	U	U	D	6	6
7	D	D	U	U	U	7	7
8	D	U	D	D	D	8	8
9	D	U	D	D	U	9	9
10	D	U	D	U	D	10	10
11	D	U	D	U	U	11	11
12	D	U	U	D	D	12	12
13	D	U	U	D	U	13	13
14	D	U	U	U	D	14	14
15	D	U	U	U	U	15	15
16	U	D	D	D	D	16	*
17	U	D	D	D	U	17	17
18	U	D	D	U	D	18	18
19	U	D	D	U	U	19	19
20	U	D	U	D	D	20	20
21	U	D	U	D	U	21	21
22	U	D	U	U	D	22	22
23	U	D	U	U	U	23	23
24	U	U	D	D	D	24**	24
25	U	U	D	D	U	*	25
26	U	U	D	U	D	*	26
27	U	U	D	U	U	*	27
28	U	U	U	D	D	*	28
29	U	U	U	D	U	*	29
30	U	U	U	U	D	*	30**
31	U	U	U	U	U	*	31***

Table 3. Time Slot Select for RFL VF-8A module

D = down, U = up.

Notes: * This setting is not allowed . Setting switches to this code will cause the module's service to be disabled. **A T1 or E1 network utilizing fast reframing cannot utilize this time slot for voice channel.

*** An E1 network utilizing inter-node communications (NMX) cannot use timeslot 31 for voice channel.

Table 4. Number of fing attempts selected by fotally switch 5005																
SW3																
Rotary	0	1	2	3	4	5	6	7	8	9	А	В	С	D	E	F
Switch																
Position																
Number Of Ping	unlim-	1	2	3	1	5	6	7	Q	0	10	11	12	13	14	15
Attempts	ited	1	2	5	4	5	0	/	0	7	10	11	12	15	14	13

Table 4. Number of ring attempts selected by rotary switch SW3

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Because RFL[™] and Hubbell[®] have a policy of continuous product improvement, we reserve the right to change designs and specifications without notice.

11. DIP switches SW4, SW5 and SW6 are used to select the 3-digit Station ID. Values from 000 to 899 are legal. Group number 9 is reserved.

Set SW4 to the desired group number (100's position) between 0 and 8. Set SW5 to the desired (10's position) between 0 and 9. Set SW6 to the desired (units position) between 0 and 9.

For example, to select a Station ID of 347, set SW4 to 3, SW5 to 4, and SW6 to 7. This Station ID belongs to group number 3.

- 12. Set DIP switch SW7-6 enable or disable signaling delay. **Place SW7-6 in the UP position to enable signaling delay. Place SW7-6 in the DOWN position to disable signaling delay.**
- 13. Set DIP switches SW7-7 and SW7-8 to select the desired Busy Circuit option in accordance with Table 5.
- 14. Select the Tx and Rx audio levels using DIP switches SW8-2 through SW8-8, and SW9-2 through SW9-8, in accordance with Table 6. These switches are used to alter the translation between analog signal levels and digital data.

The factory default level setting is 0 dBm IN and -6 dBm OUT (refer to Table 6). The input level setting was selected because high-level tones are generally produced by standard DTMF phones. The output level setting was selected so that a comfortable voice level is received at the local phone earpiece. It is recommended that these default settings be used.

The following information is useful if the level must be adjusted:

The switches are binary coded with a minimum step size of 0.5 dB. An offset of 32 dB is included to allow the signals to be attenuated or amplified. Table 6 shows the switch settings for both the Tx and Rx level adjustments. The table only includes full dB steps for clarity. Adjustments can be made in 0.5 dB increments by changing switch position 8 on the appropriate switch. A Tx or Rx level can be set 0.5 dB lower by placing switch SWX-8 to the UP position. For example, to set -25.5 dB, set SWX-2 through SWX-8 as follows: U, U, U, D, D, U, U. Note that the level used to determine the switch setting should allow for the maximum anticipated signal, or clipping may occur.

The RFL VF-8A is now installed. If your multiplexer is set up for remote access and control, you can now change the operating parameters of the module by using simple commands. For more information on remote access and control, consult your multiplexer instruction manual.

SW7-7	SW7-8	Mode	Function						
DOWN	DOWN	Party-Line Mode	When SW7-7 and SW7-8 are set to DOWN, if a local phone is picked up when a conversation is in progress, the local phone will be connected to the conversation.						
DOWN	UP	Break-In Mode	When SW7-7 is set to DOWN and SW7-8 is set to UP, if a local phone is picked up when a conversation is in progress, the local phone will get a busy tone. The local phone can break into the conversation by dialing any one of the following:						
			1. "*"	(example: *)					
			2. " group ID followed by the* "	(example: 3*)					
			3. " the local three digit extension "	(example: 312)					
UP	DOWN	Privacy Mode	When SW7-7 is set to UP and SW7-8 is set to DOWN, if a local phone is picked up when a conversation is in progress, the local phone will get a busy tone and cannot break into the conversation. Note: In this case, if the local phone is off-hook, another extension will not be						
			able to call that extension.						
UP	UP	Not Applicable	Not Used						

Table 5. Busy Circuit Modes for RFL VF-8A module

- 15. If you plan to operate the RFL VF-8A module under local control, perform the following steps; otherwise, go to step 16 for remote control.
 - a. Set to local control by placing DIP switch SW1-7 in the UP position.
 - b. Turn service on by placing DIP switch SW1-8 in the UP position.
 - c. Slide the module into the selected module slot until it is firmly seated and the module front panel is flush with the top and bottom of the shelf.
 - d. Go to step 17.

<< text continues on page 13 >>

Tx Input	Switch Code	Switch Code	Physical Switch Settings (Tx) SW8- / (Rx) SW9-								
(dBm) ⁽¹⁾	(Hex)	(Decimal)	2	3	4	5	6	7	8 ⁽²⁾	(dBm) ⁽¹⁾	
-26	74	116	U	U	U	D	U	D	D	-26	
-25	72	114	U	U	U	D	D	U	D	-25	
-24	70	112	U	U	U	D	D	D	D	-24	
-23	6E	110	U	U	D	U	U	U	D	-23	
-22	6C	108	U	U	D	U	U	D	D	-22	
-21	6A	106	U	U	D	U	D	U	D	-21	
-20	68	104	U	U	D	U	D	D	D	-20	
-19	66	102	U	U	D	D	U	U	D	-19	
-18	64	100	U	U	D	D	U	D	D	-18	
-17	62	98	U	U	D	D	D	U	D	-17	
-16	60	96	U	U	D	D	D	D	D	-16	
-15	5E	94	U	D	U	U	U	U	D	-15	
-14	5C	92	U	D	U	U	U	D	D	-14	
-13	5A	90	U	D	U	U	D	U	D	-13	
-12	58	88	U	D	U	U	D	D	D	-12	
-11	56	86	U	D	U	D	U	U	D	-11	
-10	54	84	U	D	U	D	U	D	D	-10	
-9	52	82	U	D	U	D	D	U	D	-9	
-8	50	80	U	D	U	D	D	D	D	-8	
-7	4E	78	U	D	D	U	U	U	D	-7	
-6	4C	76	U	D	D	U	U	D	D	-6 ⁽³⁾	
-5	4A	74	U	D	D	U	D	U	D	-5	
-4	48	72	U	D	D	U	D	D	D	-4	
-3	46	70	U	D	D	D	U	U	D	-3	
-2	44	68	U	D	D	D	U	D	D	-2	
-1	42	66	U	D	D	D	D	U	D	-1	
0 ⁽³⁾	40	64	U	D	D	D	D	D	D	0	
+1	3E	62	D	U	U	U	U	U	D	1	
+2	3C	60	D	U	U	U	U	D	D	2	
+3	ЗA	58	D	U	U	U	D	U	D	3	
+4	38	56	D	U	U	U	D	D	D	4	
+5	36	54	D	U	U	D	U	U	D	5	
+6	34	52	D	U	U	D	U	D	D	6	
+7	32	50	D	U	U	D	D	U	D	7	
+8	30	48	D	U	U	D	D	D	D	8	
+9	2E	46	D	U	D	U	U	U	D	9	

Table 6. Tx and Rx level settings, RFL VF-8A module

Notes for Table 6:

1. The maximum analog level for transmit and receive is +9dBm. Levels exceeding +9dBm are not recommended.

- 2. This switch position can be used to set 0.5 dB increments. See paragraph 14 for details.
- 3. Factory default level setting.

- 16. If you plan to operate the RFL VF-8A module under remote control, perform the following steps:
 - Set to local control by placing DIP switch SW1-7 in the UP position. a.
 - b. Turn service off by placing DIP switch SW1-8 in the DOWN position.
 - Slide the module into the selected module slot until it is firmly seated and the module c. front panel is flush with the top and bottom of the shelf.
 - Wait 15 seconds for the RFL VF-8A module's parameter settings to be loaded into the d. shelf Common Module.
 - Pull the module out of the shelf and place DIP switch SW1-7 in the DOWN position. e. Do not move SW1-8.
 - f. Slide the module back into the shelf.
 - Verify the module configuration through remote control by issuing a "CONFIG?" g. query. See the Remote Control Interface section of this Instruction Data Sheet for an explanation of the "CONFIG?" response.
 - Turn service on through remote control by issuing a "SRVC=ON" command. h. The RFL VF-8A's operating parameters can now be changed by remote control. See the Remote Control Interface section of this Instruction Data Sheet for more information.
 - Go to step 17. i.
- 17. On the Module Record Card located to the right of the shelf, record the channel bank type, time slot, and any other pertinent information.

FUNCTIONAL DESCRIPTION

SYSTEM OVERVIEW

The VF-8A is a two-wire Orderwire Voice Frequency Channel Module designed for RFL IMUX 2000 T1 and E1 multiplexers. The VF-8A provides a very reliable means of voice communication between multiple locations. Figure 3 is a simplified block diagram of the RFL VF-8A module.

The VF-8A accepts a single voice channel as input and uses u-law PCM (CODEC) encoding to convert the analog voice into an 8-bit, 64-Kbps digital signal. All of the VF-8A settings can be configured via local switches or remotely with use of the RFL SCL (Simple Command Language).

The VF-8A uses two signaling bits of the T1/E1 data stream. One is used to indicate a busy circuit, and the other is used to indicate ringing. Channel-Associated Signaling (CAS) is used in E1 applications, while Robbed-Bit Signaling (RBS) is used in T1 applications. A "signaling delay" is available for switching networks; i.e. containing RFL Mini-DACS module.

The VF-8A allows the use of Dual-Tone Multi-Frequency (DTMF) telephones to selectively place a call between any or all locations within the RFL orderwire network. The three levels of DTMF signaling include "Unique", "Group", and "All" call.

Call progress tones are provided to indicate phone ringing, circuit busy, circuit available, and phone out-of-service. These give the VF-8A the "feel" of a real phone instead of a party line.

Three busy circuit modes are available. The level of privacy that the local extension maintains depends on the setting of each remote extension.

A "timeout" feature is included to free up the network for other calls if a phone is inadvertently left in the off-hook condition for a period exceeding 50 seconds.

BACKPLANE AND POWER CONNECTIONS

The VF-8A occupies a single physical slot in the multiplexer and conforms to the RFL IMUX 2000 backplane signal format. All T1 and E1 backplane signals in and out of the VF-8A have drivers with hot-pluggable capability. Control signals passing through the backplane from the I/O to the VF-8A module are pulled up to +5V through 10 K Ohm resistors.

The VF-8A requires digital +5V, analog $\pm 15V$, -48V, and analog and digital ground. The IMUX 2000 Power Supply provides these. The –48V can be supplied by an optional external 48V talk battery. The +5 digital volt input includes an inductor which lowers the inrush current to prevent power interruption during module insertion, and also prevents high frequency noise to be injected into the VF-8A by other modules. The digital +5V supply is used to power the Actel FPGA and driver ICs. TP1 is the ground test point situated near the fingers of the module where digital and analog grounds are referenced to one another. The digital +5V and analog $\pm 15V$ from the backplane are routed to the Hot Swap Controller. This device, and surrounding circuitry control the ramp of the power to all of the ICs.



Figure 3. Functional block diagram, RFL VF-8A module.

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Voltage regulators step-down the +15V and -15V analog supplies to produce multiple +5V and -5V analog supplies. The analog +5V and -5V supplies are used to power all analog ICs including the audio amplifier, stereo volume control, analog switch, DTMF decoder, and the CODEC. Decoupling capacitors are used as required. The analog +5V supplies can be monitored at test points TP3-5. The analog -5V supply can be monitored at test point TP6.

All pins which connect to the backplane, except for voltages and grounds, are cut back to prevent components from being driven by signals before the module is fully powered.

TRANSMIT SECTION

An analog voice input is fed from the MA-306 I/O into the VF-8A module through the rear backplane connections via TIP and RING inputs. The TIP and RING are protected by a diode bridge and a bidirectional telecommunication transorb. These voice input signals go through the Subscriber Line Interface Circuit (SLIC), trans-hybrid circuit, unity-gain amplifier, stereo volume control, and analog switch. The voice input then feeds two inputs, the PCM CODEC and the DTMF decoder.

The u-law PCM CODEC converts the analog voice into an 8-bit, 64-Kbps digital signal. The digitized audio signal then goes to the [Actel] Logic Array, where it is processed before being routed to the appropriate bus, and into the proper timeslot.

The DTMF decoder monitors all tones generated by the local telephone keypad. If a valid DTMF tone is detected which lasts for the required interval, the STD A clock signal will clock out the BCD equivalent of the tone detected into the Logic Array. It is necessary to monitor local tones in order for the supporting DTMF logic to differentiate between "Unique" station and "All" or "Group" call initiated locally. The "break-in" feature also requires that local tones be monitored.

In addition to the TIP and RING inputs, locally generated tones are transmitted. TONE 0 and TONE 1 are generated by the Logic Array at specific frequencies, and pass through low-pass filters before being summed by an operational amplifier. An active TX TONE EN signal from the Logic Array applied to the analog switch selects the tone to be transmitted and <u>not</u> the local voice input signal. The CODEC and Logic Array process the tone similar to the local voice input. Transmitted tones include ring back and re-order.

Local "connection/no-connection" and "ringing/not ringing" conditions are also transmitted. A signal from the SLIC determines whether (Loop-start) loop current is flowing between TIP and RING. In the on-hook or ringing condition, the loop is open (idle). In the off-hook condition, the loop is closed (busy) allowing approximately 20ma of current to flow. The "Ring" mode of the SLIC is programmed by inputs provided by the Logic Array. The Logic Array qualifies the signal to prevent false off-hook detection when the phone is ringing. When the SLIC and Logic Array determine that the phone is off-hook, the SLIC is programmed for "Active" mode. Local "ring" and "connection" states are routed to the appropriate bus and into the proper timeslot.

RECEIVE SECTION

The VF-8A receives an 8-bit, 64-Kbps digital signal from the appropriate bus and timeslot. The input signals go to the Logic Array where they are processed and de-multiplexed. The 8-bit digital output of the Logic Array is then converted to an analog audio signal by the u-law PCM CODEC and is passed to the analog switch, and the DTMF decoder. If the RX TONE EN signal applied to the analog switch is inactive, the audio signal passes through the stereo volume control, trans-hybrid circuit, SLIC, and rear backplane to the MA-306 I/O. For any voice or audio tone to pass through the SLIC, the local phone must be off-hook and the SLIC must be programmed for "Active" mode by inputs C1 and C2.

The DTMF decoder monitors all tones received from the CODEC generated by the remote telephone keypads. If a valid DTMF tone is detected which lasts for the required interval, the STD signal will clock out the BCD equivalent of the tone detected, into the Logic Array. It is necessary to monitor remote tones in order for the supporting local DTMF logic to determine whether the "Unique" station, "All", and "Group" is a match. Once a DTMF match is determined by the logic, the SLIC is programmed for "Ring" mode by inputs C1 and C2. The amber RING LED will illuminate, corresponding to the ring cadence of 2 Sec ON and 4 Sec OFF.

In addition to audio tones and voice received from remote locations, locally generated tones are received. TONE 0 and TONE 1 digital signals are generated by the Logic Array at specific frequencies. These signals pass through low-pass filters before being summed by an operational amplifier. An active RX TONE EN signal from the Logic Array is applied to the analog switch which selects the tone to be received and <u>not</u> the remote voice input signal. The tone is passed through the stereo volume control, trans-hybrid circuit, SLIC, and rear backplane to the MA-306 I/O similar to the remote voice input. Received tones include ring back, dial, busy, and re-order.

Signaling information from remote VF-8As are also received. The remote "ring" and "connection" states are received from the appropriate bus(s) into the proper timeslot. If the local phone has dialed the remote phone(s), the received "ring" signal indicates the ring period. This is especially important as the locally generated ring back tone is used when a "group" or "all" call is initiated; the remote phones do not generate the ring tone. The first phone to be off-hook always makes "connection" by default. The green BUSY LED will illuminate at both local and remote locations. If that phone dials the remote phone(s), and a phone goes off-hook, it also has made "connection". The local phone in the off-hook condition will "timeout" after 50 seconds if neither "ring" nor "connection" are received. A local re-order tone will be generated and the circuit will be freed up for other calls. If local and remote phones are all on-hook, the SLIC(s) are programmed for "open circuit" mode by inputs C1 and C2.

ALERTS/ALARMS

The RFL VF-8A module reports no module level ALERT or ALARM signals to the shelf Common Module.

NETWORK OPERATION

In a network, if only one phone is off-hook it is automatically "connected" to the circuit, receives a local dial tone, and is able to place a call. The dial tone will remain until any key is pressed. A dial tone will not be present if more than one phone is "connected" to the network.

Phones that go off-hook to *answer* a call will also become "connected" to the network. For a conference call, all current parties remain "connected", and calls can be made to other stations. However, the period between calls must exceed five seconds. If more than one phone is "connected", a local ring-back tone will not be heard if "Group" or "All" call is initiated. A ring back will be heard by all "connected" parties if a "Unique" call is placed, and will remain until the phone is answered or the number of ring attempts at the called phone is qualified.

If a phone goes off-hook to place a call, but does not receive a dial tone, the network is busy. A local busy-tone may or may not be present, depending on the "Busy Circuit" setting described below.

Each station in a network can belong to one of nine "Groups". A "Group" can be called by dialing the "Group" number followed by the "*". Only the phones at stations having the same "Group" number (0-8) will ring for a pre-programmed number of times. Ringing at each station will cease when the phone goes off-hook, or the number of ring attempts is qualified. Phones already in the off-hook condition will not ring. The phone that dialed the "Group" will receive a local ring back tone until any other phone in the network is "connected".

A user can call "All" stations by dialing a "*". This will cause all phones in the network to ring for a pre-programmed number of times. Ringing will cease when any phone goes off-hook, or the number of ring attempts is qualified. Phones already in the off-hook condition will not ring. The phone that dialed "All" stations will receive a local ring back tone until any other phone in the network is "connected".

A user can call a "Unique" Station by dialing a 3-digit station ID within five seconds of one another. The phone at the "Unique" station will ring for a pre-programmed number of times. The ringing will cease if the receiving party goes off-hook, the calling party goes on-hook, or the number of ring attempts is qualified. The receiving phone will not ring if it was previously in the off-hook condition. The phone that dialed the "Unique" station, and any other connected phones will receive a ring back tone generated by the phone that was called. The tone will disappear once the "Unique" station goes off-hook, or the number of ring attempts has been qualified.

A 50-second timeout will release the circuit if a phone is inadvertently left off-hook. A local re-order tone will be heard to indicate a timeout. A phone selectively calling (Unique call) a phone that timed out, will also receive a re-order tone. A phone that has timed out must be placed on-hook to be back in service.

"Busy Circuit" Modes allow a level of privacy for calls already in progress as follows:

- "Party-line" The local handset picked up will be "connected" to any call in progress. The local extension does not required to be dialed to join or overhear a conversation.
- "Break-in" The local handset picked up receives a busy tone. If the nature of the call is not critical, simply hang-up, and try again later. However, if the nature of the call is critical, the local phone can break into any call in progress. This is accomplished by dialing the local "Unique" station ID, the local "Group" call, or "all" call. Note that the tones are only received locally, and not transmitted over the T1 data stream. This mode is recommended as the default setting; offering both local circuit accessibility for an emergency and a measure of privacy for remote phones.
- "Private" The local handset picked up receives a busy tone and cannot access the busy network. Break-in codes will not work; hang-up and try again later. As a rule, the local phone can only "connect" to the network when all other phones are on-hook, or if called by any "connected" phone while on-hook. Remaining off-hook when the circuit is busy may result in missed incoming calls.

REMOTE CONTROL INTERFACE

When installed in an IMUX 2000 remote controllable shelf, the RFL VF-8A module can be operated under local or remote control. When under remote control, certain configuration parameters can only be changed through the RS-232 remote port on the multiplexer. The remote interface for these modules involves two codes: a "P" (parameter) code, and an "S" (status) code. See the IMUX 2000 instruction manual for more information on the remote control interface.

The RFL VF-8A reports itself as a "Type 125" module when installed in a T1 or E1 system.

"P" CODES

"P" codes, when used in the parameter field on a "SET" command, allow the user to set certain parameters on the module by remote control, just like setting the switches on a module under local control. "P" codes also appear in the response to a "CONFIG?" query, showing the current parameter settings on the module.

There are six "P" codes for the RFL VF-8A: P1 through P6. Each of these P codes can be a decimal number from 0 to 255, which can also be represented as an eight-digit binary number (in parenthesis). The binary representation is more useful for setting and interpreting the "P" codes, since each binary digit (0 or 1) corresponds to the ON or OFF setting for a particular switch on the module. Table 7 describes the meanings of the "P" codes for the RFL VF-8A in normal mode. Table 6 describes the meanings of the "P" codes for the RFL VF-8A.

A typical RFL VF-8A response to a "CONFIG?" query of a T1 or E1 system in normal mode looks like this:

* OK CHANNEL CARD 3, TYPE 125 UNDER REMOTE CONTROL SRVC = ON P01 = 3 (B00000011)

NOTE

When using binary numbers with a SET command, they must be preceeded by the letter "B" as shown in the following example:

<MULTIPLEXER ADDRESS>:<CARD ADDRESS>:SET:P1 = B00000011;

Besides using the P code, it is also possible to turn module service on or off by sending one of the following in the parameter field with a SET command:

SRVC = ONSRVC = OFF

P Code	Digit(s) And Switch Equivalent	Value ⁽¹⁾	Description
P1	B 0 0 0 0 0 0 0 0 ↑↑↑↑↑ TIME SLOT SELECT	00001 to 11000 T1 Settings	From left to right, these five bits represent the binary value of the desired time slot between 1 through 24 in a T1 network. See Table 3 for a complete list of these values.
		00001 to 11111 E1 Settings	From left to right, these five bits represent the binary value of the desired time slot between 1 through 31 in an E1 network. See Table 3 for a complete list of these values.
	B00000000	0	Bus B disabled
	- ↑ BUS B ENABLE	1	Bus B enabled
	B00000000	0	Bus A disabled
	↑ BUS A ENABLE	1	Bus A enabled
P2	B 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ NUMBER OF RINGS	0000 to 1111	These four bits represent the binary value of the number of rings from 0 to 15. See Table 4 for more information.
	B 0 0 0 0 0 0 0 0 ↑ ↑ ↑ ↑ GROUP NUMBER OF 3-DIGIT STATION ID	0000 to 1000	These four bits represent the binary value of the group number of the 3-digit Station ID from 0 to 8 (100's position). Refer to P-Code P3 below for the tens position and units position
P3	B 0 0 0 0 0 0 0 0 0 $\uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow$ MSD LSD MSD = most significant digit, or value of tens position of 3-digit Station ID. LSD = least significant digit, or value of units position of 3-digit Station ID.	MSD = 0000 to 1001 LSD = 0000 to 1001	The four MSD bits represent the binary value of the tens position of the 3-position Station ID. The four LSD bits represent the binary value of the units position of the 3-position Station ID.

Table 7. Remote configuration settings ("P" codes) for T1/E1

1. These are the only legal values for setting the parameters. Setting any parameter to a value outside its specified range will produce an unpredictable result.

P Code	Digit(s) And Switch Equivalent	Value ⁽¹⁾	Description				
P4	B 0 0 0 0 0 0 0 0 ↑ SIGNALING DELAY	0	Signaling Delay disabled				
		1	Signaling Delay enabled				
	B00000000 ↑↑	00	Selects Party Line Mode. If a local phone is picked up when a conversation is in progress, the local phone will be connected to the conversation.				
	BUSY CIRCUIT MODE	01	Selects Break-in Mode. If a local phone is picked up when a conversation is in progress, the local phone will get a busy tone. The local phone can break into the conversation by dialing any one of the following:				
			 (example: *) (example: *) "group ID followed by the*" (example: 3*) "the local three digit extension" (example: 312) 				
		10	Selects Privacy Mode. If a local phone is picked up when a conversation is in progress, the local phone will get a busy tone and cannot break into the conversation.				
			extension will not be able to call that extension.				
		11	Selects Privacy Mode. Same as 10 above.				
P5	$\begin{array}{c} \mathbf{B} \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \\ . \ \uparrow \ \uparrow \ \uparrow \ \uparrow \ \uparrow \ \uparrow \\ \mathbf{TX} \ \mathbf{LEVEL} \end{array}$	0000000 to 1111111	Sets transmit level in 0.5dB increments/decrements From 0dB center at 1000000 (40H)				
			Increment for lower input levels. Decrement for higher input levels.				
P6	B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0000000 to 1111111	Sets receive level in 0.5dB increments/decrements From 0dB center at 1000000 (40H) Increment for lower output levels. Decrement for higher output levels.				

Table 7 - continued. Remote configuration settings ("P" codes) for T1/E1

"S" CODES

"S" codes appear in response to a "STATUS?" query. There is one "S" code for the RFL VF-8A when operated in T1 or E1 systems. Like the "P" code, this number is displayed in both decimal and binary form. The six least significant digits of the binary number represent the conditions shown in Table 8. The two most significant digits are not used.

A typical response to a "STATUS?" query looks like this:

* OK CHANNEL CARD 3, TYPE 125 S01 = 2 (B00000010);

S CODE	Position	Value	Description
S1	B00011010	0	Valid configuration
	↑	1	Invalid configuration
	B00000000	0	Local ringing
		1	Local not ringing
	B00000000	1	Remote connected
		0	Remote not connected
	B00000000	1	Local connected
	1	0	Local not connected
	B00000000	0	Remote ringing
		1	Remote not ringing
	B00000000	0	Timeout active (50 second timer exceeded)
	↑	1	Timeout not active

Table 8. Remote status messages ("S" codes) for T1/E1

TESTING

After the RFL VF-8A module has been configured and installed, it should be tested for proper operation before it is put into service. If a module is set up for two-channel operation, test each channel separately.

EQUIPMENT REQUIRED

- 1. Minimum of two (2) Telephone Sets, Type 2500 or equivalent; one for each VF-8A module.
- 2. External Ring Generator at each location. (optional)
- 3. External –48 Volt Battery at each location. (optional)

TEST PROCEDURE

- 1. Determine whether the -48V talk current battery is to be provided by the IMUX 2000 Power Supply or an external source for each location. Verify that the power supply is strapped accordingly at each location. If an external source is to be used, make the required connections to the IMUX Power Supply I/O at that location, as described in the Installation section of the multiplexer manual.
- 2. Determine whether the local ring generator (on the MA-306 I/O) or an external ring generator is to be used at each location. Verify that the MA-306 I/O is strapped accordingly at each location. If an external ring generator source is to be used, make the required connections to the IMUX Power Supply I/O at that location, as described in the Installation section of the multiplexer manual.
- 3. Connect the telephone to each MA-306 I/O of corresponding VF-8A module under test.
- 4. Check the setting of DIP switches SW2-1 through SW2-5 for each VF-8A module. Make sure that each VF-8A intended to be part of the same voice network are strapped for the same time slot.
- 5. Verify each VF-8A has a unique "Unique" 3-digit station ID. Visually inspect rotary switches SW4 through SW6.
- 6. Set each VF-8A module to local control by setting DIP switch SW1-7 in the UP position.
- 7. Set service ON for each VF-8A module by setting DIP switch SW1-8 in the UP position. The SRVC LED (DS3) should be ON, on each module. All other LEDs should be OFF for each module, indicating all phones are on-hook and voice circuit is in the idle condition.

- 8. Verify the Signaling Delay setting of SW7-6. This is set by default to the UP position for approximately 500 ms of signaling delay. This is required for switching networks having an RFL Mini-DACS. This is to prevent erroneous phone rings from occurring during a switch.
- 9. Take the phone connected to the local VF-8A module off-hook and observe the presence of a local dial tone.

The green BUSY LED (DS2) at each VF-8A (local and remote modules) should be ON indicating the voice circuit is busy.

10. Keep phone connected to local VF-8A module off-hook for approximately 50 seconds, so that the timeout feature times out.

> The green BUSY LED (DS2) at each VF-8A (local and remote modules) should be OFF indicating the voice circuit is not busy. A local re-order tone should be present at the local VF-8A's phone earpiece.

- 11. Dial the extension of the VF-8A that has timed out from any other remote extension. A remote re-order tone transmitted by the VF-8A that has timed out should be present at the remote VF-8A's phone earpiece.
- 12. Place the local phone on-hook while the remote phone remains off-hook. Take the local phone off-hook, and test the local phone's BUSY mode feature. Refer to Table5.
- 13. Place both phones on-hook. Using the local VF-8A extension, dial a * for an "All" [extension] call.

A local ringback tone should be heard in the local VF-8A earpiece until any remote phone is placed off-hook (or maximum number of rings has expired at all locations.)

14. Place both phones on-hook. Using the local VF-8A extension, dial the "Unique" ID of a remote VF-8A extension.

> The phone connected to the remote RFL VF-8A should ring 2 seconds ON, and 4 seconds OFF. While it is ringing, the amber RING LED (DS1) on the front of the VF-8A should correspond to the cadence of the ringing phone. The BUSY LEDs (DS2) at all VF-8A extensions will be ON.

A remote ringback tone should be heard in the local VF-8A earpiece.

- 15. Jump to step 18 if configured for an "unlimited" number of rings or if this feature was tested on this remote card during a previous pass.
- 16. If a "maximum" number of rings is configured for the remote VF-8A, count the number of rings until it ceases to ring. Verify that the counted number is what is expected. Skip this step if configured for an unlimited number of rings.

- 17. Place the local phone on-hook. Using the local VF-8A extension, dial the same "unique" ID of the remote VF-8A extension in step 14.
- 18. Answer the ringing phone and verify that the ringing stops and the voice quality is acceptable. The amber RING LED (DS1) on the front of the VF-8A will be OFF. The BUSY LEDs (DS2) at all VF-8A extensions will be ON.
- 19. If there is a problem with the audio signal at either end, the system may not be properly configured for the signal levels being applied. Low levels may be due to attenuation at either end of the circuit, i.e. long wire runs. Clipping (distortion of waveform) may be due to excessive gain at either end of the circuit. Refer to Step 14 on page 10 for additional information.
- 20. Repeat steps 14 thru 19 for each remote VF-8A.
- 21. Repeat steps 9 thru 20 until each VF-8A was tested as the local extension.
- 22. Change the settings on one or all of the modules, if necessary, to suit the desired circuit configuration. The circuit may now be placed in service.

TROUBLESHOOTING

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use, and that the transmit and receive configurations are identical.

Problems may occur at the common equipment or facility level that may affect the operation of this module. Refer to the "Maintenance" section in your multiplexer manual for system analysis procedures.

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RFL Electronics Inc.

INSTRUCTION DATA

Dual-Channel Foreign Exchange Voice Module For RFL 9508 Analog Single Sideband Powerline Carrier

RFL VF-15C-1 (Office End)

DESCRIPTION

The RFL VF-15C-1 is a Two-Wire Foreign Exchange Office End (FXO) module designed for use in the RFL 9508. It accepts one or two independent voice channels as input, and converts each channel into a 64 kbps digital signal, which can be transmitted over T1, E1 or other digital communications facilities. It does this using μ -law PCM coding for T1 systems and A-law PCM coding for E1 systems. The VF-15C-1 automatically detects if the system is T1 or E1 and configures itself appropriately.

A circuit with an RFL VF-15C-1 module at one end and an RFL VF-16B-1 module at the other end can provide a Foreign Exchange (FX) line or an Off-Premise Extension (OPX) line.

The VF-15C-1 is remote-controllable when installed in an RFL remote controllable shelf. Useradjustable switches allow local configuration of the following parameters:

- o One or two channel operation.
- o Loop start.
- o Service enable/disable.
- o Remote control configuration and status reporting.
- o Selectable transmit/receive direction.
- o Extended range input/output level compensation.
- o Selectable time slot assignment.
- o Signaling delay on/off.
- o Normal or enhanced mode.

SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL VF-15C-1 Dual-Channel Foreign Exchange Office End (FXO) Voice Module. Because all of RFL products undergo constant improvement and refinement, these specifications are subject to change without notice.

Configuration: One or two independent voice channels per module.

Time Slots:

One-Channel operation: Requires one user-selectable 64-Kbps time slot. Two-Channel operation: Requires any two adjacent 64-Kbps time slots.

Signal Levels:

Input: -26 dBm to 0 dBm Output: -26 dBm to 0 dBm

Frequency Response:

200 Hz to 300 Hz: +0.5 dBm to -2.0 dBm. 300 Hz to 3000 Hz: +0.5 dBm to -0.5 dBm. 3000 Hz to 3300 Hz: +0.5 dBm to -1.0 dBm.

Idle Channel Noise: Less than 23 dBrnC0.

Impulse Noise:

Maximum counts per 30-Minute Interval. (Input data level of -36 dBm @ 1004 Hz. Level adjustments set for 0 dBm IN and 0 dBm OUT.)

10.0 Counts
1.0 Count
0.1 Counts
0 Counts
0 Counts
0 Counts

Signal-to-Noise Ratio: Greater than 33 dB.

Signal-to-Distortion (1004 Hz input):

0 dBmO to -30 dBmO: Greater than 33 dB. -40 dBmO: Greater than 27 dB. -45 dBmO: Greater than 22 dB.

Near-end and Far-end Crosstalk (0 dBm0 @ 1004 Hz tone applied to any channel):

Less than -70 dBm0 @ 1004 Hz for adjacent channels.

Channel Differential Delay/Envelope Delay (900 Hz to 2800 Hz @ 1804 Hz ref.):

Less than $200\mu S$.

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Tracking (gain deviation for a 1004 Hz input):

0 dBm0 to -40 dbm0: 0.5 dB maximum. -40 dBm0 to -50 dBm0: 1.0 dB maximum.

Peak-to-Average Ratio (P/AR): Greater than 94.

Power Requirements:

+5V: 75mA +15V: 53mA -15V: 30mA -48V: <1ma (Ground-Start only)

Signaling Format:

T1 systems: RBS (Robbed-Bit Signaling) E1 systems: CAS (Channel-Associated Signaling)

Network Interface:

Loop-Start: Leakage current (Tip-Ring, On-Hook): Less than 10µA @ -50V. Loop Current (Off-Hook): 15 to 80mA.

Ringing Voltage Threshold: 30 Vrms, 20/30 Hz

Interface: MA-301, MA-301C, MA-303 or MA-303B Module Adapters.

Testing: Input and output level test points for each channel.

Operating Temperature: -20°C to +55°C (-4°F to +131°F).

Humidity: 0 to 90 %, non-condensing.

INSTALLATION

Before the RFL VF-15C-1 can be placed in service, it must be installed in a 9508 shelf. Installation involves determining the module slot in the 9508 AF chassis where the module will be installed, inserting a Module Adapter into the rear of the shelf behind the module slot, connecting all signal and power wiring to the Module Adapter, checking the settings of all switches, and inserting the module into the front of the shelf.

NOTES

Power supply and time slot considerations may affect the installation of this module into an existing multiplexer shelf. Refer to the multiplexer manual for more information.

The following instructions are provided for installing an RFL VF-15C-1 module into an existing system. If the module was included as part of a system, installation was done at the factory. Otherwise, proceed as follows:

- 1. Carefully inspect the module for any visible signs of shipping damage. If you suspect damage to the module, immediately call RFL Customer Service at the number listed at the bottom of this page.
- 2. Determine the module slot in the 9508 AF chassis where the module will be installed. RFL VF-15C-1 module occupies one module slot in the 9508 AF chassis.
- 3. Determine which Module Adapter will be used to make connections to the RFL VF-15C-1 module.

Each module in the 9508 AF chassis requires a Module Adapter. The module adapter provides the appropriate connector for the desired interface. There are four Module Adapters compatible with the RFL VF-15C-1:

Model	Voice		
<u>Numbe</u> r	Connections	<u>Application</u>	<u>Figure</u>
MA-301	50-pin Telco Connector	Used with multiple VF-15C-1 modules	1
MA-301C	50-pin Telco Connector	Used with multiple VF-15C-1 modules	1
MA-303	RJ-11 Jack	Used with VF-15C-1 module	3
MA-303B	Removable terminal block	Used with VF-15C-1 module	4

The MA-301 accepts a 50-pin Telco connector (Amphenol 57-30500 or equivalent, as shown in Figure 1.) One MA-301 Module Adapter can be used to connect up to three RFL VF-15C-1 modules, for a total of up to three voice channels. If you will be using more than one module with an MA-301, they must be inserted into adjacent slots in the multiplexer. Ribbon cables are provided with the MA-301 to make connections to it from the second and third module locations. (See Figure 2.) The MA-301 does not contain the input protection circuits that are on the MA-303. If the input signals are subject to transients, protection must be added prior to the MA-301.

The MA-301C is similar to the MA-301, except it has different connector pinouts.

The MA-303 provides two RJ-11 jacks for connection to the voice circuits, and two bantam jacks (Line and Drop) for each channel as shown in Figure 3. When used with the RFL VF-15C-1, only the connectors for Channel 1 are used. The bantam jacks may be used for test access. Each LINE jack provides access to the line from the equipment side.

The MA-303B, shown in Figure 4, is similar to the MA-303, except it has removable terminal blocks in place of the RJ-11 connectors for the voice connection.

Make sure the module adapter you are installing is correct for the desired application.

4. Insert the Module Adapter into the rear of the shelf directly behind the module slot where the RFL VF-15C-1 module will be installed, and make all connections to the module adapter.

If an MA-301 or MA-301C Module Adapter is being used, plug the 50-pin Telco cable end connector into its mating 50-pin connector on the module adapter.

If an MA-303 or MA-303B Module adapter is being used, plug in the RJ-11 connector or the removable terminal block, as applicable, into the Channel 1 jack on the module adapter. The only electrical interface connections that have to be made to the RFL VF-15C-1 are RING and TIP connections, which are made to terminals 3 and 4 on the RJ-11 connector, or to the screw terminals on the terminal block. TIP is the top terminal, and RING is the bottom terminal. Refer to Figures 3 and 4 as applicable.



Figure 1. MA-301 and MA-301C Module Adapters



Figure 2. Using an MA-301 Module Adapter with multiple RFL VF-15C-1 modules.

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Figure 3. MA-303 Module Adapter, used with RFL VF-15C-1 office-end module.



Figure 4. MA-303B Module Adapter, used with RFL VF-15C-1 office-end module.

6. Set the module address using DIP switches SW9-1 through SW9-6 for the desired remote address (SCB address).

For remote access, each channel module in the RFL 9508 must have a distinct module address. Valid addresses are the numbers "1" to "36". In most installation the address will be set to the number of the slot the module is occupying. Table 2 shows the switch settings for the module address. (Consult your multiplexer manual for details on using the remote access and configuration features of the system.)

Select normal or enhanced mode using DIP switch SW9-7.
 Place SW9-7 in the DOWN position for normal mode, or in the UP position for enhanced mode. In normal mode the VF-15C-1 emulates the parameters of the older VF-15 series of modules. Enhanced mode allows remote programming of Tx and Rx levels as shown in Table 3. It also allows a user to program signaling delay for each channel remotely.

- 8. Select one-channel or two-channel operation using "CH2 OFF" DIP switch SW9-8.
 Place SW9-8 in the UP position for two-channel operation, or in the DOWN position for one-channel operation (Channel 2 turned off). Unless otherwise specified at time of order, SW9-8 is set in the UP position at the factory for two-channel operation.
- Select the Tx and Rx audio levels using DIP switches SW1-2 through SW1-8, SW2-2 through SW2-8, SW3-2 through SW3-8, and SW4-2 through SW4-8. These switches are used to alter the translation between analog signal levels and digital data. Optimum performance is realized when full scale analog swings are converted to nearly full-scale digital swings. The VF-15C-1 designed to make this process simple if the analog input signal level and the desired analog output signal levels are known.

The switches are binary coded with a minimum step size of 0.5 dB. An offset of 32 dB is included to allow the signals to be attenuated or amplified. Table 3 shows the switch settings for both the Tx and Rx level adjustments. The table only includes full dB steps for clarity. Adjustments can be made in 0.5 dB increments by changing switch position 8 on the appropriate switch. A Tx or Rx level can be set 0.5 dB lower by placing switch SWX-8 to the UP position. For example, to set -25.5 dB, set SWX-2 through SWX-8 as follows: U, U, U, D, D, U, U. Note that the level used to determine the switch setting should allow for the maximum anticipated signal, or clipping may occur.

The switch encoding scheme is as follows;

- a. Take the negative of the signal level. Most signal levels will be negative.
- b. Multiply by two. This is to compensate for the 1/2 dB step size.
- c. Add 40 hex (64 decimal).
- d. Convert to binary, and then set the switches.

Note that for typical audio signals (for example -16 dBm) all that is required is to set the switches for 32 (20 hex) while leaving switch 2 up (adding 40 hex). To maintain consistency with earlier VF-15 modules, the factory default level setting is 0 dBm in and 0 dBm out (switches set for 40 hex).

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Figure 5. Controls and indicators, RFL VF-15C-1 Foreign Exchange Office-End Voice Module

10. Select an unused time slot for channel 1 using DIP switches SW10-1 through SW10-5. Each active voice channel uses one 64 Kbps digital time slot within the multiplexer's aggregate rate. Set the time slot using direct binary coding as shown in Table 4. Selecting a time slot for channel 1 will automatically cause a channel 2 time slot to be selected only if channel 2 is enabled. If enabled, the channel 2 time slot selected will be the next higher available time slot. For example, if a user selects time slot 8 for channel 1, then time slot 9 will be automatically selected for channel 2 is enabled. This can be seen by viewing the time slot columns for channels 1 and 2 in Table 4. Refer to the multiplexer manual for guidelines on time slot selection.

Note that selecting an invalid time slot will disable the module. In T1 systems, only time slots 1 through 24 are allowed. If channel 1 is set for time slot 24, channel 2 will automatically be disabled. Time slot 24 is not available for a T1 system using fast reframing.

In E1 systems, time slots 1 through 31 are allowed, however, time slots 0 and 16 are reserved and cannot be used. If time slot 15 is selected, channel 2, if enabled, will automatically be bumped up to time slot 17. This can be seen by viewing the time slot columns for channels 1 and 2 in Table 4. If time slot 31 is selected, channel 2 will be automatically disabled. Time slot 30 is not available for an E1 system using fast reframing. Time slot 31 is not available if internode communications (NMX) is used.

>> text continues on page 13 <<

Item	Name/Description	Function	Setting
1	DIP switch SW1	SW1-1 Sets chan 1 for loop start	UP: Not used
			DOWN: Loop Start
		(SW1-2 Sets chan 1 TX circuit audio level	See Table 3
		thru -8)	
2	DIP switch SW2	SW2-1 Enables/Disables chan 1 signaling delay *	UP: Signaling delay disabled
			DOWN: Signaling delay enabled
		(SW2-2 Sets chan 1 RX circuit audio level	See Table 3
		thru -8)	
3	DIP switch SW3	SW3-1 Sets chan 2 for loop start	UP: Not used
			DOWN: Loop Start
		(SW3-2 Sets chan 2 TX circuit audio level	See Table 3
		thru -8)	
4	DIP switch SW4	SW4-1 Enables/Disables chan 2 signaling delay *	UP: Signaling delay disabled
			DOWN: Signaling delay enabled
		(SW4-2 Sets chan 2 RX circuit audio level	See Table 3
		thru -8)	
5	DIP Switch SW9	(SW9-1 Selects the SCB address	See Table 2
		thru -6)	
		SW9-7 Selects Normal or Enhanced mode	UP: Enhanced Mode
			DOWN: Normal Mode
		SW9-8 Enables or Disables Channel 2	UP: Channel 2 Enabled
			DOWN: Channel 2 Disabled
6	DIP Switch SW10	(SW10-1 Time Slot Select	See Table 4
		thru -5)	
		SW10-6 Selects bus transmit direction	UP: "B" direction (D&I only)
			DOWN: "A" direction (required
			for terminal multiplexer)
		SW10-7 Selects Local or Remote control	UP: Local control
			(using switches)
			DOWN: Remote Control
		SW10.8 Turns module convice ON or OFF	(Over SCB)
		Sw10-8 Turns module service ON or OFF	UP: Service ON (over ridden if
			(over-fiddeff ff improperly configured)
			DOWN: Service OFF
			Down, Service of I
7	LED Indicator DS1	Lights when the line connected to Chan 1 is ringing	NA
8	LED Indicator DS2	Lights when the line connected to Chan 1 is busy (in use)	NA
9	LED Indicator DS3	Lights when the line connected to Chan 2 is ringing	NA
10	LED Indicator DS4	Lights when the line connected to Chan 2 is busy	NA
		(in use)	
11	LED Indicator DS5	Lights when the modules service is enabled	NA

Table 1. Controls and indicators, RFL VF-15C-1 Foreign Exchange Voice Module

* SW2-1 enables Signaling Delay for both channel 1 and channel 2 in an E1 system configured for normal mode. SW4-1 has no effect in E1 normal mode.

Module Address	SW9-1	SW9-2	SW9-3	SW9-4	SW9-5	SW9-6
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	ON	ON	ON	OFF
15	OFF	OFF	ON	ON	ON	ON
16	OFF	ON	OFF	OFF	OFF	OFF
17	OFF	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON	OFF
19	OFF	ON	OFF	OFF	ON	ON
20	OFF	ON	OFF	ON	OFF	OFF
21	OFF	ON	OFF	ON	OFF	ON
22	OFF	ON	OFF	ON	ON	OFF
23	OFF	ON	OFF	ON	ON	ON
24	OFF	ON	ON	OFF	OFF	OFF
25	OFF	ON	ON	OFF	OFF	ON
26	OFF	ON	ON	OFF	ON	OFF
27	OFF	ON	ON	OFF	ON	ON
28	OFF	ON	ON	ON	OFF	OFF
29	OFF	ON	ON	ON	OFF	ON
30	OFF	ON	ON	ON	ON	OFF
31	OFF	ON	ON	ON	ON	ON
32	ON	OFF	OFF	OFF	OFF	OFF
33	ON	OFF	OFF	OFF	OFF	ON
34	ON	OFF	OFF	OFF	ON	OFF
35	ON	OFF	OFF	OFF	ON	ON
36	ON	OFF	OFF	ON	OFF	OFF

Table 2. Module address settings, RFL VF-15C-1 module

NOTE: For SW-9, ON = UP and OFF = DOWN.

Tx Input	Switch	Switch		Physical Switch Settings SW1- / SW2- / SW3- / SW4-						
(dBm) ⁽¹⁾	(Hex)	(Decimal)	2	3	4	5	6	7	8 ⁽²⁾	(dBm) ⁽¹⁾
-26	74	116	Ū	Ŭ	U	D	Ŭ	D	D	-26
-25	72	114	Ŭ	Ŭ	Ŭ	D	D	U	D	-25
-24	70	112	Ŭ	Ŭ	Ŭ	D	D	D	D	-24
-23	6E	110	Ŭ	Ŭ	D	U	U	U	D	-23
-22	6C	108	Ŭ	Ŭ	D	U	U	D	D	-22
-21	6A	106	Ŭ	Ŭ	D	Ŭ	D	U	D	-21
-20	68	104	Ŭ	Ŭ	D	Ŭ	D	D	D	-20
-19	66	102	Ŭ	Ŭ	D	D	Ū		 D	-19
-18	64	100	Ŭ	Ŭ	D	D	Ŭ	D	D	-18
-17	62	98	Ŭ	Ŭ	D	D	D	 U	D	-17
-16	60	96	Ŭ	Ŭ	D	D	D	D	D	-16
-15	5F	94	Ŭ	D	U U		U	 U	D	-15
-14	5C	92	Ŭ	D	Ŭ	U	Ŭ	D	D	-14
-13	5A	90	Ŭ	D	Ŭ	U	D	Ū	D	-13
-12	58	88	Ŭ	D	Ŭ	U	D	D	D	-12
-11	56	86	Ŭ	D	Ŭ	D	U	U	D	-11
-10	54	84	Ű	D	U U	D	U		D	-10
_9	52	82	Ű	D	U U	D	D	 	D	-9
-8	50	80	U	D	U U	D	D	<u>ס</u>	D	-8
-7	4F	78	U	D	D	U U	U	U	D	-7
-6	40	76	U U	D	D		U		D	-6
-5	40	70	<u> </u>		D			 	D	-5
-4	48	72	<u> </u>		D		D		D	-4
	46	72	<u> </u>							-7
-3	44	68	<u> </u>				U U	<u>ס</u>	D	-3
	42	66	U U	D	D				D	
0 ⁽³⁾	40	64	U U	D	D		D	<u>ר</u>	D	∩ ⁽³⁾
1	3E	62				 		 	D	1
2	3C	60	D	U U	U U	 	U	<u>ס</u>	D	2
2	30	58		<u> </u>	<u> </u>	<u> </u>				2
4	38	56		<u> </u>	<u> </u>	<u> </u>		<u>ס</u>		<u> </u>
5	36	54		<u> </u>	<u> </u>					5
6	34	52		<u> </u>	<u> </u>		U	<u>ס</u>		6
7	32	50		<u> </u>	<u> </u>					7
7 9	30	18								7
0	- 30 2⊑	40								0
	20	40				U U				9 10
10	20	44				 				10
12	28	42		U U		 		<u>ס</u>		12
12	20	38		U U						12
14	20	36		U U				<u>ס</u>		14
14	24	34								14
15	22	32								15
17	20 1⊏	30								10
10	10	20				0				10
10	10	20				U		<u>ע</u>		10
19	10 10	20				U 11				19
20	10	24						<u>ע</u>		20
21	10	22								21
22	14	20				ע		U 11		22
23	12	10								23
24		10				U 11		ע וו		24
25		14				0		0		25
26	C	12	U	U	U	U	U	U	U	26

Table 3. Tx and Rx level settings, RFL VF-15C-1 module

See notes for Table 3 on top of next page. Notes for Table 3:

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Because RFL[™] and Hubbell[®] have a policy of continuous product improvement, we reserve the right to change designs and specifications without notice.

- 1. The maximum analog level for transmit and receive is 0dBm. The TX Input Level may be increased to a value greater than 0dBm to provide additional offset attenuation. The RX Input Level may be increased to a value greater than 0dBm to provide additional offset gain.
- 2. This switch position can be used to set 0.5 dB increments. See paragraph 7 on page 7 for details.
- 3. Factory default.

Switch	Physical Switch Settings					T	1	E1	
Code		-	SW10-			Channel 1	Channel 2	Channel 1	Channel 2
(Decimal)	1	2	3	4	5	Time Slot	Time Slot	Time Slot	Time Slot
0	D	D	D	D	D	*	*	*	*
1	D	D	D	D	U	1	2	1	2
2	D	D	D	U	D	2	3	2	3
3	D	D	D	U	U	3	4	3	4
4	D	D	U	D	D	4	5	4	5
5	D	D	U	D	U	5	6	5	6
6	D	D	U	U	D	6	7	6	7
7	D	D	U	U	U	7	8	7	8
8	D	U	D	D	D	8	9	8	9
9	D	U	D	D	U	9	10	9	10
10	D	U	D	U	D	10	11	10	11
11	D	U	D	U	U	11	12	11	12
12	D	U	U	D	D	12	13	12	13
13	D	U	U	D	U	13	14	13	14
14	D	U	U	U	D	14	15	14	15
15	D	U	U	U	U	15	16	15	17
16	U	D	D	D	D	16	17	*	*
17	U	D	D	D	U	17	18	17	18
18	U	D	D	U	D	18	19	18	19
19	U	D	D	U	U	19	20	19	20
20	U	D	U	D	D	20	21	20	21
21	U	D	U	D	U	21	22	21	22
22	U	D	U	U	D	22	23	22	23
23	U	D	U	U	U	23	24	23	24
24	U	U	D	D	D	24	N/A	24	25
25	U	U	D	D	U	*	*	25	26
26	U	U	D	U	D	*	*	26	27
27	U	U	D	U	U	*	*	27	28
28	U	U	U	D	D	*	*	28	29
29	U	U	U	D	U	*	*	29	30
30	U	U	U	U	D	*	*	30	31
31	U	U	U	U	U	*	*	31	N/A

Table 4. Time Slot Select for RFL VF-15C-1 module.

Notes: * This setting is not allowed . Setting switches to this code will cause the module's service to be disabled. D = down, U = up. 11. Select Signaling Delay or No Delay for each channel by using DIP switches SW2-1 and SW4-1.

T1/E1 enhanced mode or T1 normal mode:

For channel 1, set DIP switch SW2-1 to UP position for no delay, or set switch to DOWN position for Signaling Delay.

For channel 2, set DIP switch SW4-1 to UP position for no delay, or set switch to DOWN position for Signaling Delay.

E1 normal mode:

Set DIP switch SW2-1 to UP position for no delay on both channels, or set switch to DOWN position for Signaling Delay on both channels.

Signaling Delay is the factory default.

- 12. Select loop start for Channel 1 by using DIP switch SW1-1. The factory setting is DOWN for loop start.
- 13. Select loop start for Channel 2 by using DIP switch SW3-1. The factory setting is DOWN for loop start.
- 14. Select transmit direction by using DIP switch SW10-6.

Place SW10-6 in the UP position to transmit in the B direction and receive from the A direction. To transmit in the A direction and receive from the B direction, place SW10-6 in the DOWN position. Unless otherwise specified at time of order, SW10-6 is set in the DOWN position at the factory to transmit in the A direction, and receive from the B direction.

- 15. If you plan to operate the RFL VF-15C-1 module under local control, perform the following steps; otherwise, go to step 16 for remote control.
 - a. Set to local control by placing DIP switch SW10-7 in the UP position.
 - b. Turn service on by placing DIP switch SW10-8 in the UP position.
 - c. Slide the module into the selected module slot until it is firmly seated and the module front panel is flush with the top and bottom of the shelf.
 - d. Go to step 17.
- 16. If you plan to operate the RFL VF-15C-1 module under remote control, perform the following steps:
 - a. Set to local control by placing DIP switch SW10-7 in the UP position.
 - b. Select normal or enhanced mode using DIP switch SW9-7.
 - c. Turn service off by placing DIP switch SW10-8 in the DOWN position.
 - d. Slide the module into the selected module slot until it is firmly seated and the module front panel is flush with the top and bottom of the shelf.

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- Wait 15 seconds for the RFL VF-15C-1 module's parameter settings to be loaded into e. the shelf Common Module.
- f Pull the module out of the shelf and place DIP switch SW10-7 in the DOWN position. Do not move SW10-8.
- Slide the module back into the shelf. g.
- h. Verify the module configuration through remote control by issuing a "CONFIG?"
- query. See the Remote Control Interface section of this Instruction Data Sheet for an i.
- explanation of the "CONFIG?" response. j.
- i. Turn service on through remote control by issuing a "SRVC=ON" command. The RFL VF-15C-1's operating parameters can now be changed by remote control. See the Remote Control Interface section of this Instruction Data Sheet for more information.
- j. Go to step 17.
- 17 On the Module Record Card located to the right of the shelf, record the channel bank type, time slot, and any other pertinent information.
- 18. Verify that the signal levels are set for optimum performance as follows: If the input signal level and desired output signal level are known, the level setting switches can be easily set as described in step 9 on page 7. If the levels are not known, this paragraph will aid the user in selecting the appropriate settings.

The two major purposes of the level switches is to:

- make the best use of the dynamic range in the digital domain and 1.
- 2. set the desired output level.

The VF-15C-1 allows for low-level audio signals to be amplified prior to their conversion to digital signals (A/D). Setting the level controls as described in Step 9 on page 7 will make use of most of the available dynamic range in the digital domain. With maximum signal applied to the unit, the signal level at TP-4 and TP-8 for channel 1 and channel 2 respectively should be approximately 2.6 Vpp.

With the actual signal applied, measure the level at TP-4 for channel 1 or TP-8 for channel 2. The objective is to provide a nominal 2.6 Vpp signal into the A/D. Therefore, the required change in level setting is:

Level adjustment change (dB) = $20 \log (2.6 \text{ Vpp/Vpp} \text{ measured at TP-4 or TP-8})$

Make the required adjustment to the Tx level setting and re-check the test point voltage.

After setting the transmit level, the receive side level adjustment can be varied to achieve the desired output level.

The RFL VF-15C-1 is now installed. If your multiplexer is set up for remote access and control, you can now change the operating parameters of the module by using simple commands. For more information on remote access and control, consult your multiplexer operation manual.

FUNCTIONAL DESCRIPTION

Figure 5 is a simplified block diagram of the RFL VF-15C-1 module. The module consists of two independent audio circuits which share digital interface and control logic circuitry. Each of the audio circuits contains a Data Access Arrangement (DAA) hybrid circuit which serves as the interface to the telephone line. The hybrid contains circuitry for combining the transmit and receive audio, controlling loop current, and ring voltage detection. The hybrid also provides the required isolation of the external signals.

The audio signals (both transmit and receive) are processed by a volume control circuit to adjust levels. The analog-to-digital (A/D) and digital-to-analog (D/A) conversions and companding are performed by CODECs.

The interface to the multiplexer backplane is performed by bus drivers and receivers. All of the controlling logic functions are contained in the logic array. This custom device reads the local switches, controls the LEDs and audio circuits, and interfaces to the bus and common logic module.



Figure 5. Functional block diagram, RFL VF-15C-1 module.

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LOOP START CIRCUITS

Loop start circuits are normally used where the circuit operates a telephone controlled by a person. Examples of this include an Off-Premise Extension (OPX) circuit from a PBX, and some Foreign Exchange (FX) circuits. Loop start is the most commonly used type of circuit.

Note: The VF-15C-1 will not support ground start.

ALERTS/ALARMS

The RFL VF-15C-1 module reports no module level ALERT or ALARM signals to the shelf Common Module.

REMOTE CONTROL USING NMS

Refer to the RFL 9508 Instruction Manual for information on using NMS. Go to the VF-15 module using NMS. Then go to the VF-15 General Configurations and Status window for node 1.

The VF-15 General Configurations and Status window for node 1 is shown in Figure 8. The General Configurations window is on the left and the Status window is on the right. The General Configurations window is where the user can change the VF-15 configuration parameters.

Note that there is one check box and five parameters that must be set. The box can be checked or unchecked and each of the five parameters must be set. The selections for each parameter can be viewed by using the up and down arrows. Then click on the desired parameter to make your selection.

After all VF-15 parameter selections have been made they must be written to the VF-15C-1 card in the network. This is done by using the "WRITE" operation as described in Section 4 of The RFL 9508 Instruction Manual.

🚯 IMUX 2000 NM5 : untitled		×
File Network Output Edit Setup Admin Use Help		
Node 1 (Shelf Address 1): VF15 Config (C1)	Node 1 (Shelf Address 1): VF15 Status (C1)	
General	General	
Module Enable 🔽 ???	Configuration	
Time Slot	Remote/Local ???	
Time Slot 0 🗧 ???	Configuration ???	
Direction TXA ???	Channel 1	
Channel 1	Idle/Busy ???	
Loop/Ground Start LOOP ???	Ring/Not Ring ???	
Channel 2	Channel 2	
Channel 2 ON/OFF ON ???	Idle/Busy ???	
Loop/Ground Start LOOP ???	Ring/Not Ring ???	
Read Write Actual as Setting Exit	twork Managamant	
	sion 10.6	
View or change card setting		//.

Note: The NMS treats the VF-15C-1 as a VF-15.

Figure 8. Typical NMS VF-15C window

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TESTING

After the RFL VF-15C-1 module has been configured and installed, it should be tested for proper operation before it is put into service. If a module is set up for two-channel operation, test each channel separately.

EQUIPMENT REQUIRED

- 1. Telephone Set, Type 2500 or equivalent (for RFL VF-16B-1 module).
- 2. PBX Station Line (RFL VF-15C-1 only).

FXO/FXS TEST PROCEDURE

- 1. Connect the PBX line to the channel under test on the RFL VF-15C-1 module.
- 2. Connect the telephone to the channel under test on the RFL VF-16B-1 module.
- 3. Check the setting of DIP switches on the VF-16B-1 module. Check the setting of DIP switches on the VF-15C-1 module. Make sure that both modules are set appropriately.
- 4. Take the phone connected to the RFL VF-16B-1 module off-hook and observe the presence of
- a dial tone from the PBX.

The busy LEDs at the VF-16B-1 and VF-15C-1 should be ON, indicating an Off-Hook condition.

- 5. Dial an extension and verify that the extension rings.
- 6. Answer the extension and verify that the voice level is adequate in both directions, and that the noise level is acceptably low.
- 7. Place both phones back on hook. Using the extension, dial the number of the line connected to the RFL VF-16 under test.

The phone connected to the RFL VF-16B-1 should ring 2 seconds on, and 4 Seconds off. While it is ringing, the amber LED on the front of the VF-15C-1 (DS1 For channel 1, or DS3 for channel 2) should light.

- 8. Answer the ringing phone and verify that ringing stops and voice quality is acceptable. The green LEDs at the VF-16B-1 (DS5 for channel 1, or DS6 for channel 2) and VF-15C-1 (DS2 for channel 1 or DS4 for channel 2) should both be ON. The amber LED on the VF-15C-1 will be OFF.
- 9. If there is a problem with the audio signal at either end, the system may not be properly configured for the signal levels being applied. Low levels may be due to too much attenuation at either end. Clipping (distortion of the waveform) may be due to excessive gain at either end. Refer to step 18 on page 14 for additional information.
- 10. Change the settings on both modules, if necessary, to suit the desired circuit configuration. The circuit may now be placed in service.

TROUBLESHOOTING

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use, and that the transmit and receive configurations are identical.

Problems may occur at the common equipment or facility level that may affect the operation of this module. Refer to the "Maintenance" section in your multiplexer manual for system analysis procedures.
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RFL Electronics Inc.

INSTRUCTION DATA

Dual-Channel Foreign Exchange Voice Module For RFL 9508 Analog Single Sideband Powerline Carrier

RFL VF-16B-1 (Station End)

DESCRIPTION

The RFL VF-16B-1 is a Two-Wire Foreign Exchange Station End (FXS) module. It is designed for use in the RFL 9508, and other RFL network interface products. It accepts one or two independent voice channels as input, using PCM coding to convert each channel into a 64-Kbps digital signal. The digital signal is then transmitted over T1/E1 or other digital communication facilities.

A circuit with an RFL VF-16B-1 module at one end and an RFL VF-15, 15C or 15E module at the other end can provide a Foreign Exchange (FX) line or an Off-Premise Extension (OPX) line. An Automatic Ring Down (ARD) line can be set up by using RFL VF-16B-1 modules at both ends of the circuit, or by using a VF-16B-1 at one end and a VF-16, VF-16A or VF-16E at the other end. The RFL VF-16B-1 does not require an external ring generator or a -48 Volt supply.

These modules are remote-controllable when installed in an RFL 9508 remote-controllable shelf. Useradjustable switches and jumpers allow the configuration of the following parameters:

- o One-channel or two-channel operation
- o Automatic Ring Down (ARD)
- o Individual channel enable/disable
- o Remote control configuration and status reporting
- o Independent selectable transmit/receive direction for each channel
- o Extended range input/output level compensation
- o Independent selectable time slot assignment for each channel
- o Variable signaling delay
- o Ring voltage level
- o Ring voltage dc offset
- o Loop current level
- o Line fault detection

SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to all RFL VF-16B-1 Dual-Channel Foreign Exchange Station End Voice Modules. Because all of RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Configuration: Two independent voice channels per module.

Time Slots:

One-Channel Operation: Requires one user-selectable 64-Kbps time slot. Two-Channel Operation: Requires any two user-selectable 64-Kbps time slots.

Signal Levels:

Nominal System Gain: 0 dB Transmit and Receive Level Adjust: +/- 9.5 dBm Maximum Signal Level (analog or digital): 3.14 dBm

Frequency Response:

300 to 3000 Hz: +0.3 to -0.6 dB 3000 to 3300 Hz: +0.0 to -1.5 dB

Idle Channel Noise: Less than 15 dBrnco

Impulse Noise Threshold Level (Maximum Counts Per 30-minute Interval):

41 dBrnco: 10.0 counts 51 dBrnco: 1.0 count 58 dBrnco: 0.1 counts

Signal-To-Distortion (1004 Hz to1020 Hz input):

0 to -30 dBm0: Greater than 35.5 dB -40 dBm0: Greater than 31 dB -45 dBm0: Greater than 25 dB

Nominal Impedance: 600 Ω standard

Crosstalk Coupling:

400 Hz: 49 dB 700 - 1100 Hz: 59 dB 1100 - 3000 Hz: 58 dB 3700 Hz: 49 dB

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Tracking (gain deviation for a 1004-Hz input):

+3 to -37 dBm0: 0.5 dB maximum -37 to -50 dBm0: 1.0 dB maximum -50 to -60 dBm0: 2.0 dB maximum

Peak-To-Average Ratio (PAR): Greater Than 94

Power Consumption:

- Both Channels On-Hook with one phone per channel (factory default settings): 160mA@5V, 35mA@15V
- Both Channels Off-Hook with one phone per channel (factory default settings): 210mA@5V, 95mA@15V
- Both Channels Ringing with one phone per channel (factory default settings): 157mA@5V, 110mA@15V

Note 1: When connected to multiple phones and/or set to non-default settings, the board can draw up to a total of 255mA@5V, and 225mA per channel @15V.

Note 2: When determining the power capacity in any given RFL 9508 shelf, the power consumption of the VF-16B-1 is based on both channels ringing one phone per circuit with an REN=1. If multiple phones are interconnected on each channel, please consult the factory for proper power consumption that could impact the channel card capacity.

Signaling Format:

T1 systems: RBS (Robbed-Bit Signaling) E1 systems: CAS (Channel Associated Signaling)

Nominal Off-Hook Detection Threshold: 4.75 kΩ

Nominal Ringing Voltage: Vtip to Vring

Vrms	Optional Vdc Offset	Frequency	MAX REN @ ≤100 ft.
40.5	+30	20 Hz +/- 1%	5
45	+20	20 Hz +/- 1%	5
53	+10	20 Hz +/- 1%	5
63.5	NA	20 Hz +/- 1%	3.2

- Automatic Ring Down (ARD): Requires RFL VF-16, VF-16A, VF-16B-1 or VF-16E FXS modules on each end of circuit. Ring 1.5 seconds on, 4.5 seconds off, with a ringback tone of 440 Hz. If VF-16B-1s are on both ends, ringback is dual tone 440 Hz and 480 Hz.
- Interface: MA-301, MA-301C, MA-303, MA-303B, MA-304 or MA-304B module adapters. (See page 5 for more information.)

Testing: Two Bantam jacks (Drop/Line) provided for each channel.

Operating Temperature: -20°C to +55°C (-4°F to +131°F).

Relative Humidity: Zero to 90 percent, non-condensing.

INSTALLATION

Before the RFL VF-16B-1 can be placed in service, it must be installed in a multiplexer shelf. Installation involves determining the module slot in the Main Shelf or Expansion Shelf where the module will be installed, inserting a Module Adapter into the rear of the shelf behind the module slot, connecting all signal wiring to the Module Adapter, checking the settings of all switches, and inserting the module into the front of the shelf.

NOTES

- 1. Power supply and time slot considerations may affect the installation of this module into an existing multiplexer shelf. Refer to the multiplexer manual for more information.
- 2. The RFL VF-16B-1 module has an on-board ring generator which you must use. This means that ring generators external to the chassis are not required, and the ring generators on the MA-304 and MA-304B module adapters, if used, will be automatically disabled by the VF-16B-1.

The following instructions are provided for installing RFL VF-16B-1 modules into existing systems. If the module was included as part of a system, installation was done at the factory. Otherwise, proceed as follows:

- 1. Carefully inspect the module for any visible signs of shipping damage. If you suspect damage to the module, immediately call RFL Customer Service at the number listed at the bottom of this page.
- 2. Determine the module slot in the Main Shelf or Expansion Shelf where the module will be installed.

The RFL VF-16B-1 module occupies one module slot in the Main Shelf or Repeater Shelf.

3. Determine which Module Adapter will be used to make connections to the RFL VF-16B-1 module.

Each module in the RFL 9508 requires a Module Adapter. The module adapter provides the appropriate connector for the desired interface.

There are six Module Adapters that are compatible with the RFL VF-16B-1:

Model	Voice		
<u>Numbe</u> r	Connections	Application	<u>Figure</u>
MA-301	50-pin Telco Connector	Used with multiple VF-15 or VF-16 modules	1 & 2
MA-301C	50-pin Telco Connector	Used with multiple VF-15 or VF-16 modules	1 & 2
MA-303	RJ-11 Jack	Used with all VF-16B-1 modules	3
MA-303B	Removable terminal block	Used with all VF-16B-1 modules	4
MA-304	RJ-11 Jack	Used with all VF-16B-1 modules (MA-304 ring generator will be automatically disabled)	3
MA-304B	Removable terminal block	Used with all VF-16B-1 modules (MA-304 ring generator will be automatically disabled)	4

The MA-301 accepts a 50-pin Telco connector (Amphenol 57-30500 or equivalent, as shown in Figure 1.) One MA-301 Module Adapter can be used to connect up to three RFL VF-15 or RFL VF-16 modules, for a total of up to six voice channels. If you will be using more than one module with the MA-301, they must be inserted into adjacent slots in the multiplexer. Ribbon cables are provided with the MA-301 to make connections to it from the second and third module locations. (See Figure 2.)

The MA-301C is similar to the MA-301, except it has different connector pinouts.

The MA-303 Module Adapter is designed for use with all RFL VF-16B-1 station-end modules. Each MA-303 provides two RJ-11 jacks for connection to the voice circuits for channel 1 and channel 2, and two bantam jacks (Line and Drop) for each channel. (See Figure 3.) Each Line jack provides access to the equipment from the line side, and each Drop jack provides access to the line from the equipment side.

The MA-303B is similar to the MA-303, except it has removable terminal blocks in place of the RJ-11 connectors for the voice connection. (See Figure 4.)

The MA-304 is similar to the MA-303, but it has a built-in ring generator. It can be used with all RFL VF-16B-1 modules, but the MA-304 ring generator will be automatically disabled.

The MA-304B is similar to the MA-304, except it has removable terminal blocks in place of the RJ-11 connectors for the voice connection.

Make sure the module adapter you are installing is correct for the desired application.



Figure 1. MA-301 and MA-301C Module Adapters



Figure 2. Using MA-301or MA-301C Module Adapters with multiple RFL VF-16B-1 modules



Figure 3. MA-303 Module Adapter, used with all RFL VF-16B-1 station end modules. The MA-304 Module Adapter is similar in appearance.



Figure 4. MA-303B Module Adapter, used with all RFL VF-16B-1 station end modules. The MA-304B Module Adapter is similar in appearance.

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4. Insert the Module Adapter into the rear of the shelf directly behind the module slot where the RFL VF-16B-1 module will be installed, and make all connections to the Module Adapter. If an MA-301 or MA-301C Module Adapter is being used, plug the 50-pin Telco cable end connector into its mating 50-pin connector on the module adapter.

> If an MA-303, MA-303B, MA-304 or MA-304B Module Adapter is being used, plug the RJ-11 connectors for the Channel 1 and Channel 2 voice circuits into the corresponding RJ-11 jacks. The only electrical interface connections that have to be made to the RFL VF-16B-1 are RING and TIP connections, which are made to terminals 3 and 4 on the RJ-11 connector, or to the screw terminals on the terminal block, (TIP is the top terminal, and RING is the bottom terminal) as shown in Figures 3 and 4 as applicable.

- 5. Refer to Figure 5 and Table 1 for switch locations.
- 6. Set the address for the module using DIP switch SW1.

For remote access, each channel module in the shelf must have a distinct module address. Valid module addresses are the numbers 1 to 36, as shown in Table 2 of this Instruction Data Sheet. In a full-size shelf, this is usually set to the number of the physical slot the module will occupy. (Consult your multiplexer manual for details on using remote access and configuration features of the system.)

- 7. Set the position of SW2-6 to enable or disable channel 1.
 Place SW2-6 in the UP position to enable channel 1. Place SW2-6 in the DOWN position to disable channel 1.
- Set the position of SW3-6 to enable or disable channel 2.
 Place SW3-6 in the UP position to enable channel 2. Place SW3-6 in the DOWN position to disable channel 2.
- 9. Set transmit/receive level switches SW4, SW5, SW7 and SW8 if settings other than factory standard are desired.

The transmit and receive levels can be set from - 9.5dB to +9.5dB, in 0.5dB steps. The values for these switch positions are shown in Table 3.

Switch settings are cumulative. For example, to set the level to +9dB, turn off switch position 1 to select "+" and turn on switch positions 2 and 5 to select 9dB. To set the level to -7.5dB, turn on switch position 1 to select "-" and turn on switch positions 3, 4, 5, and 6 to select 7.5dB.

The switches are set at the factory to provide a transmit level of 0dB, and a receive level of 0dB.

10. Select any unused time slot for channel 1 using SW2-1 through SW2-5.

The digitized voice signal of each RFL VF-16B-1 module occupies one 64-Kbps digital time slot within the multiplexer's aggregate rate. Use the settings shown in Table 7 to select which time slot the module uses. Consult your multiplexer manual for guidelines on time slot selection.



Figure 5. Controls and indicators, RFL VF-16B-1

11. Select any unused time slot for channel 2 using SW3-1 through SW3-5.

The digitized voice signal of each RFL VF-16B-1 module occupies one 64-Kbps digital time slot within the multiplexer's aggregate rate. Use the settings shown in Table 7 to select which time slot the module uses. Consult your multiplexer manual for guidelines on time slot selection.

12. Select Channel 1 transmit direction using SW2-7.

Place SW2-7 in the UP position to transmit in the B direction and receive from the A direction. Place SW2-7 in the DOWN position to transmit in the A direction and receive from the B direction. Unless otherwise specified at time of order, SW2-7 is set in the DOWN position at the factory.

13. Select Channel 2 transmit direction using SW3-7.

Place SW3-7 in the UP position to transmit in the B direction and receive from the A direction. Place SW3-7 in the DOWN position to transmit in the A direction and receive from the B direction. Unless otherwise specified at time of order, SW3-7 is set in the DOWN position at the factory.

Enable or disable Automatic Ringdown (ARD) on Channel 1 by using DIP switch SW6-4.
 Place SW6-4 in the OFF position for normal operation, or in the ON position for ARD operation. Unless otherwise specified at time of order, SW6-4 is set in the OFF position at the factory.

>> Text continues on page 14 <<

Item	Name/Description	Function
1	LED indicator (red)	Channel 1 busy (off hook). [See NOTE at the end of this table]
	LED indicator (yellow)	Channel 1 ringing. [See NOTE at the end of this table]
	LED indicator (green)	Channel 1 enabled.
2	LED indicator (red)	Channel 2 busy (off hook). [See NOTE at the end of this table]
	LED indicator (yellow)	Channel 2 ringing. [See NOTE at the end of this table]
	LED indicator (green)	Channel 2 enabled.
3	LED indicator (green)	Top indicates module service is ON.
	LED indicator (green)	Middle not used.
	LED indicator (green)	Bottom not used.
4	DIP Switch SW1	SW1-1 to SW1-6: Sets SCB address (Table 2)
		SW1-7 and SW1-8: Spare
5	DIP Switch SW2	SW2-1 to SW2-5: Sets Channel 1 Timeslot (Table 7)
		SW2-6: Channel 1 enable/disable
		UP: Channel 1 enabled
		DOWN: Channel 1 disabled
		SW2-7: Sets Channel 1 bus transmit direction
		UP: "B" direction (D & I only)
		DOWN: "A" direction (required for terminal multiplexer)
		SW2-8: Enables or disables Channel 1 loopback
		UP: Channel I loopback disabled
		DOWN: Channel I loopback enabled
6	DIP Switch SW3	SW3-1 to SW3-5: Sets Channel 2 Timeslot (Table 7)
		SW3-6: Channel 2 enable/disable
		UP: Channel 2 enabled
		DOWN: Channel 2 disabled
		SW3-7: Sets Channel 2 bus transmit direction
		UP: "B" direction (D & I only) DOUDL " A " I' (i () i 1 () i 1 () i ()
		DOWN: A direction (required for terminal multiplexer)
		SW3-8: Enables or disables Channel 2 loopback
		DOWN: Channel 2 loopback disabled
7	DIP Switch SWA	SWA-1 to SWA-6 Sets Channel 1 Ty level (Table 3)
/	DII Switch Sw4	SW4-7 and SW4-8 Spare
8	DIP Switch SW5	SW5-1 to SW5-6 Sets Channel 1 Ry level (Table 3)
0		SW5-7 and SW5-8 Snare
9	DIP Switch SW6	SW6-1 and SW6-2 Channel 1 Ring Voltage (Table 4)
,	DI Switch Swo	SW6-3 Channel 1 Ring DC Offset
		ON [•] enables DC offset (Table 4)
		OFF: disables DC offset
		SW6-4 Channel 1 Automatic Ring Down
		ON: enables ARD
		OFF: disables ARD
		SW6-5 Channel 1 Loop Current
		ON: Loop current = 41 mA
		OFF: Loop current = 20 mA
		SW6-6 and SW6-7 Channel 1 Ring Delay (Table 5)
		SW6-8 Spare
10	DIP Switch SW7	SW7-1 to SW7-6 Sets Channel 2 Tx level (Table 3)
		SW7-7 and SW7-8 Spare

Table 1. Controls and indicators, RFL VF-16B-1 modules

Item	Name/Description	Function
11	DIP Switch SW8	SW8-1 to SW8-6 Sets Channel 2 Rx level (Table 3)
		SW8-7 and SW8-8 Spare
12	DIP Switch SW9	SW9-1 and SW9-2 Channel 2 Ring Voltage (Table 4)
		SW9-3 Channel 2 Ring DC Offset
		ON: enables DC offset (Table 4)
		OFF: disables DC offset
		SW9-4 Channel 2 Automatic Ring Down
		ON: enables ARD
		OFF: disables ARD
		SW9-5 Channel 2 Loop Current
		ON: Loop current = 41 mA
		OFF: Loop current = 20 mA
		SW9-6 and SW9-7 Channel 2 Ring Delay (Table 5)
		SW9-8 Spare
13	DIP Switch SW10	SW10-1 and SW10-2 Loopback Mode (Table 6)
		SW10-3 Selects Local or Remote mode
		UP: Local mode
		DOWN: Remote mode
		Swite-4 Turns module service ON of OFF
		DOWN: Service is OFF
14	J1	U3 programming header (for factory use only)
15	J2	For factory use only (not included)
16	J3	U9 programming header (for factory use only)
17	J4	Channel 1 drop/line
18	J5	Channel 2 drop/line
19	Test point 1	Ground
20	Test point 2	+5V
21	Test point 3	+3.3V
22	Test point 4	+2.5V
23	Test point 5	+15V
24	Test point 6	+VPIC
25	Test point 7	For factory use only
26	Test point 8	For factory use only
27	Test point 9	Tip 2
28	Test point 10	Ring 2
29	Test point 11	CH1 VBAT
30	Test point 12	Tip 1
31	Test point 13	Ring 1
32	Test point 14	CH2 VBAT

Table 1. continued - Controls and indicators, RFL VF-16B-1 module

NOTE

If a self diagnosed line fault is detected on Channel 1, the tip-ring lines of Channel 1 will enter a high impedance state and all three Channel 1 (DS1) LEDs (off-hook[red], ringing [yellow], and CH enable [green]) will illuminate. NMS will also report off-hook and ringing for Channel 1. To exit this state, power must be cycled off and on for the board, or the channel must be disabled and then enabled, or the service to the card must be switched off and then on. The same line fault detection feature is present on Channel 2 (LEDs, DS2).

Module Address	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	ON	ON	ON	OFF
15	OFF	ON	ON	ON	ON	ON
16	OFF	ON	OFF	OFF	OFF	OFF
17	OFF	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON	OFF
19	OFF	ON	OFF	OFF	ON	ON
20	OFF	ON	OFF	ON	OFF	OFF
21	OFF	ON	OFF	ON	OFF	ON
22	OFF	ON	OFF	ON	ON	OFF
23	OFF	ON	OFF	ON	ON	ON
24	OFF	ON	ON	OFF	OFF	OFF
25	OFF	ON	ON	OFF	OFF	ON
26	OFF	ON	ON	OFF	ON	OFF
27	OFF	ON	ON	OFF	ON	ON
28	OFF	ON	ON	ON	OFF	OFF
29	OFF	ON	ON	ON	OFF	ON
30	OFF	ON	ON	ON	ON	OFF
31	OFF	ON	ON	ON	ON	ON
32	ON	OFF	OFF	OFF	OFF	OFF
33	ON	OFF	OFF	OFF	OFF	ON
34	ON	OFF	OFF	OFF	ON	OFF
35	ON	OFF	OFF	OFF	ON	ON
36	ON	OFF	OFF	ON	OFF	OFF

Table 2. Module address settings, VF-16B-1 module

Channel 1		Chanı	Value	
Transmit Level	Receive Level	Transmit Level	Receive Level	
SW4-1	SW5-1	SW7-1	SW8-1	+/-
SW4-2	SW5-2	SW7-2	SW8-2	8dB
SW4-3	SW5-3	SW7-3	SW8-3	4dB
SW4-4	SW5-4	SW7-4	SW8-4	2dB
SW4-5	SW5-5	SW7-5	SW8-5	1dB
SW4-6	SW5-6	SW7-6	SW8-6	0.5dB

Table 5. ITalishill/Icceive level settings, KFL v F-10D-1 hibuule

Table 4. Ring Voltage switch settings, RFL VF-16B-1 modules

Cha	nnel 1	Cha	nnel 2	AC	Channel 1		Channel 2	
				Ring	Ring Ring Voltage Offset Ring Voltage Offs		ige Offset	
SW6-1	SW6-2	SW9-1	SW9-2	Voltage	SW6-3 OFF	SW6-3 ON	SW9-3 OFF	SW9-3 ON
OFF	OFF	OFF	OFF	40.5	0 Vdc	30 Vdc	0 Vdc	30 Vdc
OFF	ON	OFF	ON	45	0 Vdc	20 Vdc	0 Vdc	20 Vdc
ON	OFF	ON	OFF	53	0 Vdc	10 Vdc	0 Vdc	10 Vdc
ON	ON	ON	ON	63.5	0 Vdc	0 Vdc	0 Vdc	0 Vdc

Table 5. Ring Delay switch settings, RFL VF-16B-1 modules

Channel 1		Chan	nel 2	Off-Hook	On-Hook
SW6-6	SW6-7	SW9-6	SW9-7	Ring Delay	Ring Delay
OFF	OFF	OFF	OFF	No Delay	No Delay
OFF	ON	OFF	ON	200ms	400ms
ON	OFF	ON	OFF	300ms	600ms
ON	ON	ON	ON	400ms	800ms

Note: Ring Delay is used to avoid erroneous ringing during network disturbances. For this reason, several settings have been made available in order to maintain compatibility with certain phone system features (e.g. distinctive ringing).

Table 6 I	aanhaak	Mode	Sottings	DFI	VE 16R 1	modulos
I able 0. I	лоорраск	wide	settings,	NL	V F-10D-1	mounes

SW10-1	SW10-2	Loopback Mode
UP	UP	Analog
UP	DOWN	Full Analog
DOWN	UP	Digital
DOWN	DOWN	Dual Analog

Note: See page 14 and Figure 6 for a description of loopback modes.

VF-16B-1 LOOPBACK MODES

The VF-16B-1 has four loopback modes. Each of these is described below. Refer to Figure 6 for a pictorial description of loopback modes. See page 21 for more information on NMS. See page 22 for more information on SCL commands.

Digital Loopback

Digital loopback turns around data received from the bus, and transmits it right back onto the bus. The near end phone will still receive the signal from the bus. This is done in the digital section of the SLIC. This loopback can be activated at the near end by switch, NMS, or SCL commands.

Analog Loopback

Analog loopback exercises the VF-16B-1 up to the SLIC's analog section. The phone connected directly to this channel will be looped onto itself. The near end phone will still transmit to the far end receiving equipment. This loopback can be activated at the near end by switch, NMS, or SCL commands.

Full Analog Loopback

Full analog loopback exercises the VF-16B-1 up to the SLIC's digital section. The phone connected directly to this channel will be looped onto itself. The near end phone will still transmit to the far end receiving equipment. This loopback can be activated at the near end by switch, NMS, or SCL commands.

Dual Analog Loopback

Dual analog loopback connects the phone on channel one to the phone on channel two. This is done at the FPGA logic IC. If ARD is selected on for both channels, the phone will ring if the other is picked up. If only one channel has this loopback enabled it will eavesdrop on the other channel, while the other channel functions normally. The near end phones will still transmit to the far end receiving equipment. This loopback can be activated at the near end by switch, NMS, or SCL commands.

- Enable or disable Automatic Ringdown (ARD) on Channel 2 by using DIP switch SW9-4.
 Place SW9-4 in the OFF position for normal operation, or in the ON position for ARD operation. Unless otherwise specified at time of order, SW9-4 is set in the OFF position at the factory.
- 16. Select the Loopback Mode by using DIP switches SW10-1 and SW10-2.
 - The four types of Loopback that can be selected are Analog, Full Analog, Digital and Dual Analog. Refer to Table 6 to determine how the switches are set for each of these modes. Unless otherwise specified at time of order, SW10-1 and SW10-2 are set in the UP position at the factory to select Analog Mode. The Loopback mode selected must be enabled or disabled by completing steps 17 and 18.
- 17. Enable or disable Channel 1 Loopback by using DIP switch SW2-8.

Place SW2-8 in the UP position to disable Channel 1 Loopback, or in the DOWN position to enable Channel 1 Loopback. Unless otherwise specified at time of order, SW2-8 is set in the UP position at the factory.

>> Text continues on page 17 <<



Figure 6. Pictorial description of Loopback Modes

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Switch Code	Physical Switch Settings SW2- or SW3-			SW3-	T1	E1	
(Decimal)	1	2	3	4	5	Time Slot	Time Slot
0	D	D	D	D	D	*	*
1	D	D	D	D	U	1	1
2	D	D	D	U	D	2	2
3	D	D	D	U	U	3	3
4	D	D	U	D	D	4	4
5	D	D	U	D	U	5	5
6	D	D	U	U	D	6	6
7	D	D	U	U	U	7	7
8	D	U	D	D	D	8	8
9	D	U	D	D	U	9	9
10	D	U	D	U	D	10	10
11	D	U	D	U	U	11	11
12	D	U	U	D	D	12	12
13	D	U	U	D	U	13	13
14	D	U	U	U	D	14	14
15	D	U	U	U	U	15	15
16	U	D	D	D	D	16	*
17	U	D	D	D	U	17	17
18	U	D	D	U	D	18	18
19	U	D	D	U	U	19	19
20	U	D	U	D	D	20	20
21	U	D	U	D	U	21	21
22	U	D	U	U	D	22	22
23	U	D	U	U	U	23	23
24	U	U	D	D	D	24**	24
25	U	U	D	D	U	*	25
26	U	U	D	U	D	*	26
27	U	U	D	U	U	*	27
28	U	U	U	D	D	*	28
29	U	U	U	D	U	*	29
30	U	U	U	U	D	*	30
31	U	U	U	U	U	*	31***

Table 7. Time slot selection by remote access

D = down, U = up.

Notes: * This setting is not allowed . Setting switches to this code will cause the module's service to be disabled.

**A T1 network utilizing fast reframing cannot utilize this time slot for voice channel.

*** An E1 network utilizing inter-node communications (NMX) cannot use timeslot 31 for voice channel.

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Because RFL™ and Hubbell® have a policy of continuous product improvement, we reserve the right to change designs and specifications without notice.

- 18. Enable or disable Channel 2 Loopback by using DIP switch SW3-8.
 Place SW3-8 in the UP position to disable Channel 2 Loopback, or in the DOWN position to enable Channel 2 Loopback. Unless otherwise specified at time of order, SW3-8 is set in the UP position at the factory.
- Select Channel 1 Loop Current by using DIP switch SW6-5.
 Place SW6-5 in the ON position to select a loop current of 41 mA, or in the OFF position to select a loop current of 20 mA. Unless otherwise specified at time of order, SW6-5 is set in the OFF position at the factory.
- 20. Select Channel 2 Loop Current by using DIP switch SW9-5.
 Place SW9-5 in the ON position to select a loop current of 41 mA, or in the OFF position to select a loop current of 20 mA. Unless otherwise specified at time of order, SW9-5 is set in the OFF position at the factory.
- 21. Select the Channel 1 Ring Delay by using switches SW6-6 and SW6-7.
 There are four types of Ring Delay that can be selected. Refer to Table 5 to determine how the switches are set for each of type of Ring Delay. Unless otherwise specified at time of order, SW6-6 and SW6-7 are set in the OFF position at the factory to select No Ring Delay.
- 22. Select the Channel 2 Ring Delay by using switches SW9-6 and SW9-7.
 There are four types of Ring Delay that can be selected. Refer to Table 5 to determine how the switches are set for each of type of Ring Delay. Unless otherwise specified at time of order, SW9-6 and SW9-7 are set in the OFF position at the factory to select No Ring Delay.
- 23. Select the Channel 1 Ring Voltage by using switches SW6-1 and SW6-2.
 There are four levels of Ring Voltage that can be selected. Refer to Table 4 to determine how the switches are set for each level of Ring Voltage. Unless otherwise specified at time of order, SW6-1 and SW6-2 are set in the OFF position at the factory to select a Ring Voltage of 40.5 volts.
- 24. Select the Channel 2 Ring Voltage by using switches SW9-1 and SW9-2. There are four levels of Ring Voltage that can be selected. Refer to Table 4 to determine how the switches are set for each level of Ring Voltage. Unless otherwise specified at time of order, SW9-1 and SW9-2 are set in the OFF position at the factory to select a Ring Voltage of 40.5 volts.
- 25. Select the Channel 1 Ring Voltage Offset by using switch SW6-3. There are two levels of Ring Voltage Offset that can be selected. Refer to Table 4 to determine how the switches are set for each level of Ring Voltage Offset. Unless otherwise specified at time of order, SW6-3 is set in the OFF position at the factory to select a Ring Voltage Offset of 0 Vdc.
- 26. Select the Channel 2 Ring Voltage Offset by using switch SW9-3. There are two levels of Ring Voltage Offset that can be selected. Refer to Table 4 to determine how the switches are set for each level of Ring Voltage Offset. Unless otherwise specified at time of order, SW9-3 is set in the OFF position at the factory to select a Ring Voltage Offset of 0 Vdc.

- 27. If you plan to operate the RFL VF-16B-1 module under **local** control, first perform steps 1 through 26, then perform the following steps; otherwise go to step 28.
 - a. Set to local control by placing DIP switch SW10-3 in the UP position.
 - b. Turn service on by placing DIP switch SW10-4 in the UP position.
 - c. Slide the module into the selected slot until it is firmly seated and the module front panel is flush with the top and bottom of the shelf.
 - d. Go to step 29.
- 28. If you plan to operate the RFL VF-16B-1 module under <u>remote</u> control, first perform steps 1 through 26, then perform the following steps:
 - a. Set to local control by placing DIP switch SW10-3 in the UP position.
 - b. Turn service off by placing DIP switch SW10-4 in the DOWN position.
 - c. Slide the module into the selected slot until it is firmly seated and the module front panel is flush with the top and bottom of the shelf.
 - d. Wait 15 seconds for the module's parameter settings to be loaded into the shelf Common Module.
 - e. Pull the module out of the shelf, and place DIP switch SW10-3 in the DOWN position. **Do not move SW10-4.**
 - f. Slide the module back into the shelf.
 - g. Verify the module configuration through remote control by using NMS.
 - h. Turn service on through remote control by using NMS.
 The operating parameters of the RFL VF-16B-1 can now be changed by remote control. See page 21 of this Instruction Data Sheet for more information.
 - i. Go to step 29.
- 29. Verify that the voice levels are adequate. If not, adjust the levels in accordance with Table 3.
- 30. On the Module Record Card (located to the right of the shelf) record the channel bank type, time slot, and any other pertinent information.

The RFL VF-16B-1 is now installed. If your multiplexer is set up for remote access and control, you can now change the operating parameters of the module by using simple commands. For more information on remote access and control, consult your multiplexer operation manual.

FUNCTIONAL DESCRIPTION

Figure 7 is a functional block diagram of the RFL VF-16B-1. The module uses a Subscriber Line Interface Circuit (SLIC). At the RFL VF-16B-1 (station end), the SLIC simulates a Central Office, supplying loop current and ringing voltage to the external phone circuit.



Figure 7. Functional block diagram, RFL VF-16B-1 module

The PCM output from the SLIC is passed to a logic array. This array multiplexes the voice bits together with signaling bits provided by the microcontroller (On-Hook, Off-Hook, Ringing, No Ringing). Once multiplexed, this combined information is placed into the user-selected time slot of the transmit bus on the multiplexer's backplane.

On the receive side, the logic array takes the incoming data from the selected time slot, demultiplexes it, and passes the voice bits to the SLIC and the signaling bits to the microcontroller.

The SLIC is a highly integrated device that combines the functions of a SLIC, volume control, CODEC, DC-to-DC converter, ring generator, call progress tone generator, and loop supervision circuit. The SLIC is configured and controlled by the microcontroller.

The Logic Array interfaces with the local switches, the remote control functions, and the IMUX data bus. This configuration and control information (volume settings, ring voltage, on-/off-hook, ring control, etc) is continually sent between the Logic Array and the microcontroller. The microcontroller also continually exchanges data with the SLIC.

The audio Pulse Code Modulation (PCM) data is time critical, and is transferred directly between the Logic Array and the SLIC. The microcontroller has no contact with the PCM data.

The Logic Array provides an interface with the IMUX data bus, inserts and extracts PCM and signalling data into the appropriate time slot(s), and automatically detects if the VF-16B-1 is installed in a T1 or E1 chassis and configures the board appropriately. It also verifies some basic signals on the data bus and checks for improper configuration information. If the Logic Array detects invalid backplane signals or the timeslots for channel 1 and 2 are the same, the service LED will blink. If a channel has an invalid timeslot configured, that channel's enable LED will blink. The other channel's operation will not be affected.

ALERTS/ALARMS

The RFL VF-16B-1 module does not report any card-level ALERT or ALARM signals to the shelf Common Module.

REMOTE CONTROL USING NMS

Refer to the RFL 9508 Instruction Manual for information on using NMS. While in NMS, select the "View or Change a Card" screen for the VF-16B-1 module. An NMS window will be seen similar to the one shown in Figure 8. You must scroll down the parameter list to see all of the parameters. Select and set each parameter as required by double clicking on the desired parameter name. For example, double click on the "Timeslot" parameter, and a dialog box will appear with all available time slot choices. Click on the desired time slot number to make your selection. Then click on "OK" to confirm your selection. This will return you to the parameter window.

After all VF-16B-1 parameter selections have been made they must be written to the VF-16B-1 card in the network. This is done by using the "WRITE" operation as described in Section 4 of The RFL 9508 Instruction Manual.

🚯 View or Change a Card			
Site ID: AutoCfg Not Address170		Setup Setup	
		C <u>P</u> erformance	
Channel: C15 <u>Card</u> VF16B		O <u>A</u> ll	
		C Char <u>t</u>	
Type Description	Set to	Actual	
Setting : In/Out of Service	ON	ON	<u> </u>
‡Setting : Chan l Time Slot	1	0	
Setting : Chan 1 ON/OFF	ON	ON	
Setting : Chan 1 Bus Direction	TXB	TXB	
Setting : Chan l Loopback	ENABLED	ENABLED	
Setting : Chan 2 Time Slot	0	0	
Setting : Chan 2 ON/OFF	ON	ON	
Setting : Chan 2 Bus Direction	TXA	TXA	8
Setting : Chan 2 Loopback	DISABLED	DISABLED	0
Setting : Txl Level Adjust Sign	PLUS (+)	PLUS (+)	а
Setting : Txl Level Setting	0	0	п
Setting : Rxl Level Adjust Sign	PLUS (+)	PLUS (+)	
Setting : Rxl Level Setting	0	0	
Setting : Tx2 Level Adjust Sign	PLUS (+)	PLUS (+)	
Setting : Tx2 Level Setting	0	0	
Setting : Rx2 Level Adjust Sign	PLUS (+)	PLUS (+)	-
Values reflect last read, changes will be made v	when you write the netw	ork	
Refresh Comm Pref. Macro.		E <u>x</u> it	얼

Note: The NMS treats the VF-16B-1 as a VF-16B.

Figure 8. Typical NMS VF-16B window

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TESTING

When the RFL VF-16B-1 module has been configured and installed, it should be tested for proper operation before it is put into service. If a module is set up for two-channel operation, test each channel separately.

EQUIPMENT REQUIRED

- 1. Telephone Set, Type 2500 or equivalent (one for each RFL VF-16B-1 channel being tested).
- 2. PBX Station Line (one for each RFL VF-15C-1 channel being tested).

FXO/FXS TEST PROCEDURE



- 1. Connect the PBX line to the channel under test on the RFL VF-15C-1 module.
- 2. Connect the telephone to the channel under test on the RFL VF-16B-1 module.
- 3. Check DIP switch settings and NMS settings to make sure that both modules are set properly.
- 4. Set service on for both modules.
- 5. Take the phone connected to the RFL VF-16B-1 off-hook and observe the presence of a dial tone from the PBX.
- 6. Dial an extension and verify that the extension rings.
- 7. Answer the extension and verify that the voice level is adequate in both directions, and that the noise level is acceptably low.
- 8. Place both phones back on hook. Using the extension, dial the number of the line connected to the RFL VF-16B-1 under test.

The phone connected to the RFL VF-16B-1 should ring 2 seconds on, and 4 seconds off.

- 9. Answer the ringing phone and verify that ringing stops and the voice quality is acceptable.
- 10. Change the settings on both modules, if necessary, to suit the desired circuit configuration. The circuit may now be placed in service.

ARD TEST PROCEDURE



- 1. Connect telephones to the channel under test on the modules at both Location 1 and Location 2.
- 2. Check DIP switch settings and NMS settings to make sure that both modules are set properly.
- 7. Lift the handset on the phone at location 2.
 The phone connected to the VF-16B-1 at location 1 will ring (1.5 seconds on, and 4.5 seconds off).
- 8. Listen to the handset on the phone connected to location 2. **A ringback tone will be heard.**
- 9. Answer the phone connected to the VF-16B-1 at location 1. **The phone will stop ringing.**
- 10. Verify that the voice level is adequate in both directions, and that the noise level is acceptably low.
- 11. Hang up the phones and repeat Steps 7 through 10 in the other direction.
- 12. Change the settings on both modules, if necessary, to suit the desired circuit configuration.

The circuit may now be placed in service.

TROUBLESHOOTING

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use, and that the transciever configurations are correct.

Problems may occur at the common equipment or facility level that may affect the operation of this module. Refer to the "Maintenance" section in your multiplexer manual for system analysis procedures.

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RFL Electronics Inc.

INSTRUCTIONDATA

RFL 9508 Powerline Carrier Transfer Trip Module

DESCRIPTION

The RFL Powerline Carrier, Transfer Trip module (PLC-TT) is a bi-directional Type F6 teleprotection module designed for use in RFL 9508 PLC systems. It transmits and receives data via the T1/E1 serial link and generates and receives trip commands via an I/O adapter module. The PLC-TT can support up to eight bi-directional transfer trip functions between two locations, or can support DCB (Directional Comparison Blocking) in addition to two transfer trip functions. These terminals can operate point to point between two RFL 9508 terminal nodes in a network. These terminal nodes can be configured as point-to-point or drop and insert terminals and can be installed at different locations in the network either at adjacent or nonadjacent nodes. The RFL PLC-TT module has eight LEDs on the front to indicate the condition of the trip inputs and outputs.

PLC-TT parameters must be programmed using NMS with the exception of the module address, which is set up using switches. The following is a list of some of the PLC-TT parameters.

- Trip Hold timers
- Pre-Trip timers
- Output Polarity
- Unblock enable
- Alarm Timer delay
- Logical OR'ing or AND'ing of Inputs and Aux Inputs
- Module Address
- Time slot assignment
- Remote control configuration and status reporting

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FEATURES

TRIP HOLD TIMER

This timer function extends the length of time that a trip output is activated after a valid trip condition occurs. For this function to engage, a valid trip condition must exist long enough to satisfy the pretrip timer. The length of time is programmable independently for each function.

INPUT DE-BOUNCE

This timer function requires that a trip input be present for a certain length of time before a trip command is transmitted. The length of time is not programmable by the user, but is set at the factory to 100μ s.

ALARM TIME DELAY

This timer function requires that an alarm condition exists for a certain length of time before an alarm output is generated. The length of time is programmable by the user.

PRE-TRIP TIMER

This timer function requires that a trip be present for a certain length of time before an output is generated. The length of time is programmable independently for each function.

ZONE EXTENSION

A continuous trip signal can be sent by means of zone extension. (A periodic code sent from the transmitting side to maintain a latched trip on the receiving side).

COMMUNICATION CHARACTERISTICS

This module communicates using a single bi-directional DS0.

PROGRAMMABLE LOGIC

Trip hold:	0.25 - 63.75 ms (0.25 ms increments)
Output Form:	normal/invert
Alarm timer (delay):	0 - 2.5 Sec. (10 ms increments)
Pre-trip timer:	0-3.75 ms (0.25 ms increments)
Unblocking:	Enable/Disable
Sequence of events log:	100 records
Operational modes:	Transfer Trip/DCB

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SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL PLC-TT module. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

ENVIRONMENTAL

ANSI C37.90 – 1989:	(service conditions)
Operating temperature:	- 20oC to + 65oC
Storage temperature:	- 40oC to + 75oC
Humidity:	95% @ 40oC non-condensing

SWC/ FAST TRANSIENT

ANSI C37.90:	(dielectric)
ANSI C37.90.1:	(SWC & fast transient)

RFI SUSCEPTIBILITY

ANSI C37.90.2 3.	5 V/M
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OPTICAL INPUT SPECIFICATIONS

Operating voltage range	
48 Vdc	38-

48 Vdc:	38-60 Vdc
125 Vdc:	88-150 Vdc
250 Vdc:	200-280 Vdc
Input threshold:	1/2 nominal station battery

SOLID STATE OUTPUT SPECIFICATIONS

Maximum continuous output current:	1 Amp
Maximum surge current (100 ms):	10 Amps
Minimum output current:	20 ma
Maximum open circuit voltage:	280 Vdc

OPTIONAL RELAY OUTPUTS

Maximum continuous current:	2 A (inductive)
Maximum surge current (100 ms):	30 A
Maximum breaking current:	1 A resistive
Maximum open circuit voltage:	280 Vdc
Maximum operate time:	5 ms

ALARM RELAY SPECIFICATIONS

Maximum continuous current Maximum breaking current Maximum open circuit voltage Maximum operate time 1 A (inductive) 1 A (resistive) 280 Vdc 10 ms

OPERATING MODES

Full duplex (transmit and receive)

POWER CONSUMPTION

2.0 watts maximum

DIMENSIONS

Transfer Trip	Module	2 Function I/O Adapter Module	4 Function I/O Adapter Module
Length: Width:	9.8 in (24.8 cm) 0.6 in (1.5 cm)	4.7 in (11.9 cm) 2.1 in (5.3 cm)	4.7 in (11.9 cm) 4.2 in (10.6 cm)
Height:	4.5 in (11.4 cm)	5.0 in (12.7 cm)	5.0 in (12.7 cm)

WEIGHT

Transfer Trip N	<u>Iodule</u>	2 Function I/O Adapter Module	4 Function I/O Adapter Module
Net:	0.62 lb (0.28 kg)	0.70 lb (0.32 kg)	1.22 lb (0.55 kg)
Shipping:	1 lb (0.45 kg)	1 lb (0.45 kg)	1.5 lb (0.68 kg)

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INSTALLATION

Before the PLC-TT module can be placed in service, it must be installed in a 9508 chassis. Installation involves determining the module slot in the chassis where the module will be installed, inserting an I/O adapter module into the rear of the shelf behind the module slot, connecting all signal wiring to the I/O adapter module, checking the settings of all switches and jumpers, and inserting the module into the front of the shelf.

NOTE

Power supply and time slot considerations may affect the installation of RFL PLC-TT modules into an existing 9508 chassis. Refer to the portions of your system operation manual covering "Channel Module Configuration Guidelines" and "Adding More Channel Modules To Existing Systems" for more information.

The following instructions are provided for installing RFL PLC-TT modules into existing systems. If the module was included as part of a system, installation was done at the factory, otherwise, proceed as follows:

1. Carefully inspect the RFL PLC-TT and its I/O adapter module for shipping damage.

If you suspect damage to the module or its Module Adapter, immediately contact RFL's Customer Service Department at the number shown at the bottom of this page.

2. Determine which module slot in the 9508 chassis the RFL PLC-TT will be installed in.

The RFL PLC-TT module occupies one module slot in the 9508 chassis. Refer to the "as supplied" drawings furnished with the equipment for more information.

3. Determine which I/O Adapter Module will be used to make connections to the RFL PLC-TT module.

Each RFL PLC-TT module installed in a 9508 chassis requires an I/O Adapter Module. The I/O Adapter Module provides the appropriate connections for the desired interface.

There are eight I/O Adapter Modules that can be used with the RFL PLC-TT. These are listed below:

I/O Adapter Module Type	Part Number	Output Type	Figure
*2 function 48/125V	105770-2	solid state	3
*2 function 250V	105770-3	solid state	3
*2 function 48/125V	105740-2	relay	3
*2 function 250V	105740-3	relay	3
4 function 48/125V	105770-4	solid state	4
4 function 250V	105770-5	solid state	4
4 function 48/125V	105740-4	relay	4
4 function 250V	105740-5	relay	4

* On 2 Function Systems, Function 3 and 4, pre-trip timers must be set to 3ms.

Make sure the I/O Module Adapter you are installing is the correct one for the desired application.

>> text continues on page 8 <<

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Figure 1. Controls and indicators, RFL PLC-TT Transfer Trip Module.

Item	Name/Description	Function
1	DIP Switch SW1	SW1-1 to SW1-5: Sets the SCB Address in accordance with Table 3.
		SW1-6: For factory use only (Always leave in the UP position)
2	Switch SW2	Disable Switch. Is used to disable the module. It disables all trip outputs and all communications via the T1/E1 system. UP = ENABLE, DOWN = DISABLE
3	Switch SW3	Not Used
4	LED indicator (red)	Lights when function 4 trip is received
5	LED indicator (red)	Lights when function 3 trip is received
6	LED indicator (red)	Lights when function 2 trip is received
7	LED indicator (red)	Lights when function 1 trip is received
8	LED indicator (red)	Lights when function 4 trip is transmitted
9	LED indicator (red)	Lights when function 3 trip is transmitted
10	LED indicator (red)	Lights when function 2 trip is transmitted
11	LED indicator (red)	Lights when function 1 trip is transmitted
12	LED indicator (red)	Lights during Alarm conditions and during programming
13	Connector J1	For factory use only
14	Jumper J2	Enables or disables the watchdog timer. Used for factory testing only. Should
		always be in "RUN" (DOWN) position.
15	Jumper J3	Selects Relay or Solid-State output
16	Jumper J4	Selects Relay or Solid-State output

Table 1.	Controls and	indicators,	RFL PI	LC-TT	Transfer	Trip	Module
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Figure 2. Rear panel view of typical 2 function RFL PLC-TT Adapter Module



Figure 3. Rear panel view of typical 4 function RFL PLC-TT Adapter Module

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For 48V OPERATION, JUMPERS SHALL BE LOCATED AS SHOWN

Figure 4. Location and use of voltage control jumpers on a typical I/O adapter module input board

4. Once the I/O adapter module has been selected, check the settings of the voltage control jumpers located on the I/O adapter module input board(s). All eight versions of the I/O module input boards shown in Figure 4 are identical, with the exception of the placement of the two voltage control jumpers J4 and J5. Note the location of these jumpers in Figure 4.

For 48V operation both jumpers must be in the 48V position. For 125V operation both jumpers must be in the 125V position. The 250V modules should have both jumpers in the 125V position. See Table 2.

I/O Adapter Module part number	I/O Adapter Module type	J4 and J5 jumper position		
105770-2	2 function 48/125V solid state*	48V position		
105770-4	4 function 48/125V solid state	for 48V operation		
105740-2	2 function 48/125V relay*	125V position		
105740-4	4 function 48/125V relay	for 125V operation		
105770-3	2 function 250V solid state*			
105770-5	4 function 250V solid state	125V position for 250V		
105740-3	2 function 250V relay*	operation		
105740-5	4 function 250V relay	-		

Fable 2.	Voltage	control	jumper	settings
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* On 2 Function Systems, Function 3 and 4, pre-trip timers must be set to 3ms.

RFL 9508 PLC-TT September 5, 2012 5. Insert the I/O Adapter Module into the rear of the shelf directly behind the module slot where the PLC-TT will be installed.

The I/O Adapter Module will take up three slots for the 2 function version, and six slots for the 4 function version. This must be taken into consideration when selecting module slots.

- 6. Connect all signal wiring to the rear panel of the I/O Adapter Module.
- 7. Using DIP switches SW1-1 to SW1-5, set the PLC-TT module address.

For remote access, each channel module in a 9508 chassis must have a distinct module address. For this module, valid module addresses are the numbers "1" to "31", using the code shown in Table 3. The module address is usually set to the number of the physical slot in the shelf that the module will occupy; it can be set to any number from 1 to 31 that is not already being used by another module in the same 9508 chassis.

8. Check the setting of DIP switch SW1-6.

This switch is for factory use only and should always be set to the UP position.

- 9. Set toggle switch SW2 to the DOWN position to disable the module.
- 10. Check the setting of jumper J2. It should be in the RUN position. This will enable the watchdog timer.
- 11. Check the setting of jumper J3. It should be in RELAY position if the I/O Adapter Module has a relay output. It should be in SOLID STATE position if the I/O Adapter Module has a solid state output.
- 12. Slide the module into the selected module slot until it is firmly seated.
- 13. Program the module parameters using local or remote interface as applicable.
- 14. Turn service on by placing the SW2 toggle switch to the UP position.
- 15. On the module record card (located to the right of the shelf), record the time slot number and other pertinent information.

The RFL PLC-TT module is now installed.

Module Address	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5
1	DOWN	DOWN	DOWN	DOWN	UP
2	DOWN	DOWN	DOWN	UP	DOWN
3	DOWN	DOWN	DOWN	UP	UP
4	DOWN	DOWN	UP	DOWN	DOWN
5	DOWN	DOWN	UP	DOWN	UP
6	DOWN	DOWN	UP	UP	DOWN
7	DOWN	DOWN	UP	UP	UP
8	DOWN	UP	DOWN	DOWN	DOWN
9	DOWN	UP	DOWN	DOWN	UP
10	DOWN	UP	DOWN	UP	DOWN
11	DOWN	UP	DOWN	UP	UP
12	DOWN	UP	UP	DOWN	DOWN
13	DOWN	UP	UP	DOWN	UP
14	DOWN	UP	UP	UP	DOWN
15	DOWN	UP	UP	UP	UP
16	UP	DOWN	DOWN	DOWN	DOWN
17	UP	DOWN	DOWN	DOWN	UP
18	UP	DOWN	DOWN	UP	DOWN
19	UP	DOWN	DOWN	UP	UP
20	UP	DOWN	UP	DOWN	DOWN
21	UP	DOWN	UP	DOWN	UP
22	UP	DOWN	UP	UP	DOWN
23	UP	DOWN	UP	UP	UP
24	UP	UP	DOWN	DOWN	DOWN
25	UP	UP	DOWN	DOWN	UP
26	UP	UP	DOWN	UP	DOWN
27	UP	UP	DOWN	UP	UP
28	UP	UP	UP	DOWN	DOWN
29	UP	UP	UP	DOWN	UP
30	UP	UP	UP	UP	DOWN
31	UP	UP	UP	UP	UP

	Table 3.	SCB	address setti	ings, RFL	PLC-TT	Transfer	Trip Module
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FUNCTIONAL DESCRIPTION

The following is a basic description of how the RFL PLC-TT module operates. A simplified block diagram of the module appears in Figure 5.

SYSTEM OVERVIEW

The PLC-TT module is a channel card for use in the RFL 9508 system. It transmits and receives data via the T1/E1 serial link and generates and receives trip commands via an I/O adapter module. Up to four trip inputs and four trip outputs can be supported. The module can be setup and interrogated remotely via the SCB of the 9508. Front panel LEDs indicate the status of the trip inputs and outputs. A real time clock with sequence of events storage is also available.

The module consists of three major sections. The microcontroller section contains an 80C320 embedded microcontroller and associated support devices. The trip FPGA (field programmable gate array) and its associated circuits handles all T1/E1 communication and trip I/O. The SCB FPGA connects the processor with the SCB of the 9508. Miscellaneous other circuits are present to handle other functions. A switch is provided to disable the card for removal and insertion, and a jumper is provided to select between relay and solid state outputs.

MICROCONTROLLER CIRCUIT

The heart of the microcontroller circuit is an 80C320 8 bit embedded microcontroller. Its main purpose is to control the setup and interrogation functions of the transfer trip module. It does not do any processing of the T1/E1 data and trip signals. A PSD312 programmable device provides 2KB of RAM, 64KB of ROM, and port reconstruction for the 80C320. It is connected to ports 0 and 2 of the microcontroller. A DS1642 device provides non volatile RAM, a real time clock function, and contains an embedded clock and battery. A MAX691 device provides a reset pulse on power turn on and a watchdog timer function.

TRIP FPGA CIRCUIT

The trip FPGA interfaces directly with the T1/E1 bus of the 9508 chassis. It is also connected to the trip inputs and outputs.

SCB FPGA CIRCUIT

The SCB FPGA circuit is used to communicate with the CM4 via the SCB. The transfer trip module type ID of 118 is encoded into the SCB FPGA device.


Figure 5. Transfer Trip module block diagram

RFL 9508 PLC-TT September 5, 2012 **RFL Electronics Inc.** (973) 334-3100

MISCELLANEOUS CIRCUITS

The transfer trip module has eight LEDs on the front to indicate the condition of the trip inputs and outputs. These LEDs are driven by a latch which is memory mapped off the processor. An additional LED indicates an alarm condition. This LED and a local alarm relay are directly driven by the processor. A five position DIP switch is provided to allow the user to set the SCB address of the module. The processor reads the switch to setup the SCB FPGA.

I/O ADAPTER MODULE(S)

The transfer trip module must be used with one of eight I/O Adapter Modules. There are two and four function versions, and relay and solid state versions. See Figures 2 and 3, and Table 2. The two function version is assembled from two PCBs; one for inputs and alarms, and the other for outputs. The four function version uses the same two boards as the two function version but has an additional input and output board. The boards are interconnected via a series of short cables.

INPUT BOARD

The input board contains circuitry for two optically isolated inputs and one form C alarm relay. The components consist mainly of dropping resistors, a zener diode, and an optoisolator. An LC filter is also provided to prevent SWC from triggering an input. The dropping resistors are sized to allow a safe level of current to be drawn from the keying input. The zener diode and resistors prevent any voltage less than half the nominal keying voltage from causing an input. The optoisolator provides galvanic isolation from the keying circuits.

OUTPUT BOARD

The output board can be configured for either solid state or relay outputs. Each output board provides two outputs. The solid state output takes the oscillating trip signal and feeds it across a transformer to isolate it and then rectifies and smoothes the result. This feeds the gate of a FET transistor. The transistor is rated to carry many times the rated load for short periods but thermal limitations prevent it from carrying a large load indefinitely. An LC filter protects the FET from damage caused by surges on the outputs. The relay version of the output board has two output relays with LC filters. The relays have diodes to prevent the flyback effect from creating spurious noise.

DIRECTIONAL COMPARISON BLOCKING MODE

All PLC-TT modules are capable of being used in directional comparison blocking applications. The functionality of the PLC-TT is transformed into that of a typical single function carrier system. Inputs one and two are used as start and stop inputs. Outputs one and two are block outputs. Functions three and four remain normal transfer trip functions. Figure 6 illustrates how the unit works.

Software settable jumpers J1 and J2 allow for optional inversion of the start and stop inputs. They are controlled by the settings described below. The start input will cause function 1 trip to be sent if the stop input is not active. When Function 1 is sent, the block outputs (outputs 1 and 2) are made active. If Function 1 is received the outputs go active as well.



Figure 6. Directional Comparison Blocking, block diagram

The PLC-TT module retains all of its existing functionality and operates in DCB mode only if commanded to. Otherwise the four functions operate as independent transfer trip commands. DCB mode is invoked by setting P13 bit 6 to a 1. This can be done directly or via NMS.

Once in DCB mode the meaning of P7 bit 0 and P7 bit 1 change. In normal mode these bits set the polarity of outputs 1 and 2. In DCB mode P7 bit 0 now selects the polarity of the start input and P7 bit 1 selects the polarity of the stop input. Both polarities are normal if the bit is a zero and inverted if the bit is a one. To set these bits in NMS one should select "output polarity" for output 1 or 2 and change it appropriately.

ALERTS AND ALARMS

If there is a loss of signal, or if the disable switch is down, the transfer trip module will issue a module alert signal to the shelf common module.

ZONE EXTENSION FUNCTION

The zone extension feature allows an indefinitely-long trip to be transferred over PLC, even though the internal 2-second timeout prevents long signaling. Only function 1 (input 1 /output 1) is affected by this function.

A continuously-active input generates periodic codes (code-2) that maintain the active output at the receiver. The activate code is sent for approximately 400 ms and is repeated based on the repetition (extension) timer (1-126 minutes). Once the output is active, it remains active until either the deactivation code is received or a sufficiently long time occurs without receiving another activation code. The timeout for not seeing the activation code is twice the repetition rate. (2-246 minutes)

When input becomes inactive, it immediately sends a code to deactivate output (code-1). This causes the output to become inactive immediately.

The priority logic is such that the activation of any arrangement of inputs will cause the proper outputs to be activated although only function 1 will be extended. When function 1 input is deactivated however, all outputs will be deactivated.

REMOTE CONTROL USING NMS

PROGRAMMING THE PLC-TT MODULE

The PLC-TT module must be programmed using NMS (Network Management Software) version 10.5 or later. Refer to the IMUX 2000 Instruction Manual for information on using NMS. To program the PLC-TT module go to the PLC-TT View or Change a Card Window, as shown in Figure 7. This is where a user can view or change PLC-TT settings. The "Actual" column is what the PLC-TT is actually set to, and the "Set to" column contains settings the user can change. Refer to Table 4 for a list of PLC-TT card settings, and Table 5 for a card status listing. When finished with either viewing or changing the PLC-TT settings, click on Exit to return to the Display/Change Node window.

After all PLC-TT parameter selections have been made they must be written to the PLC-TT card in the network. This is done by using the "WRITE" operation as described in the IMUX 2000 Instruction Manual.

AND	the second secon
File Network Output Edit Setup Admin Use Help	
View or Change a Card	11
Site ID: Cerformance	
Channel: C1 Card TT C All Play Mac	ro
Chart N	
Type Description Set to Actual	
≠Setting : Date and Time 04/06/96 01:10:55 *R ??? ▲ Read	
#Setting : In/Out of Service ON ???	
≠Setting : Func 1 triphold timer(ms) .5 2?2	
+Setting : Func 1 pretrip timer (ms) .25 ??? - Write	
+Setting : Func 1 output polarity NORMAL ???	
*Setting : Func 1 unblock enable DISABLE ???	8
+Setting : Func 2 triphold timer(ms) .5 ???	2
+Setting : Func 2 pretrip timer (ms) .25 2??	
+Setting : Func 2 output polarity NORMAL 2??	
#Setting : Func 2 unblock enable DISABLE ???	
+Setting : Func 3 triphold timer(ms) .5 ???	
+Setting : Func 3 pretrip timer (ms) .25 2??	1
#Setting : Func 3 output polarity NOPMAL 222	
+Setting : Func 3 unblock enable DISABLE 2??	2. I
<pre>#Setting : Func 4 triphold timer(ms) .5 ???</pre>	al 1
≠Setting : Func 4 pretrip timer (ms) .25 ??? ▼	
Values refect last read, changes will be made when you write the network: Exit Befresh Comm Pref. Macro. Batch Comm Pref. Macro.	1
UCC 2020 - Network Management Version 10,5	
Select which settings to display/show	

Figure 7. View or Change a Card Window for the PLC-TT module

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Table 4. PLC-TT Card Settings

Description	Value	Notes
Output 1 Triphold Timer Output 2 Triphold Timer Output 3 Triphold Timer Output 4 Triphold Timer	0.25-63.75ms	In 0.25ms steps
Output 1 Pretrip Timer Output 2 Pretrip Timer Output 3 Pretrip Timer Output 4 Pretrip Timer	0-3.75ms	In 0.25ms steps
Output 1 Polarity Output 2 Polarity Output 3 Polarity Output 4 Polarity	Inverted/Not Inverted	
Output 1 Unblock Enable Output 2 Unblock Enable Output 3 Unblock Enable Output 4 Unblock Enable	Enable/Disable	
Shelf Alert Extension		
Alarm Time Delay	0ms-2550ms	In 10ms steps
Bus Direction	Terminal D&I-A/D&I-B	
Timeslot	1-24 for T1 1-31 for E1	
Read	Standard Status/ Trip Input Counters/ or Trip Output Counters	
Input Type 1 Input Type 2 Input Type 3 Input Type 4	OR'ed/AND'ed	
Boost	Boost/No Boost	
Mode	2+2 mode/3+1 mode	
Reset Counter	Enable Counters/ Reset Counters	
Output Enable	Enable/Disable	
Input 1 Polarity Input 2 Polarity Input 3 Polarity Input 4 Polarity	Inverted/Not Inverted	
Aux Input 1 Polarity Aux Input 2 Polarity Aux Input 3 Polarity Aux Input 4 Polarity	Inverted/Not Inverted	

Table 4. PLC-TT Card Status

Description	Value	Notes
Card Not Configured		
Remote/Local Control		
Trip Input 1	Active/Inactive	
Trip Input 2		
Trip Input 3		
Trip Input 4		
Trip Output 1	Active/Inactive	
Trip Output 2		
Trip Output 3		
Trip Output 4		
Command Sant 1	A stive/Incestive	
Command Sent 1	Active/Inactive	
Command Sent 2		
Command Sent 3		
Command Bent 4		
Command Received 1	Active/Inactive	
Command Received 2		
Command Received 3		
Command Received 4		
PLC Channel Status	Good Channel/ Transcoiver Hardware	
r Le Chaimer Status	Alarm/ PLC Channel Fail	
Actual Mode	2+2/3+1	
Receive Status	Channel Good/ MTS Channel Fail	
	Chamer Good, MTD Chamer I an	
Trip Input Counter 1	0-255	
Trip Input Counter 2		
Trip Input Counter 3		
Trip Input Counter 4		
Trip Output Counter 1	0-255	
Trip Output Counter 2	·	
Trip Output Counter 3		
Trip Output Counter 4		
	0.255	
Number of events since last	0-255	
Disable switch	Active/Inactive	
Event #1 to Event #100		
Event #1 to Event #100		
Zone Extension	Enable/Disable	Repetition (extension) time setting is
Extension Time (min)	2-127	2-127 (equivalent to approx. 1-126
		minutes). Setting values 0 and 1 are
	Setting value equals desired repetition	not allowed.
	(extension) time plus 1.	

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TESTING

When the RFL PLC-TT modules have been configured and installed, they should be tested for proper operation before they are placed in service.

EQUIPMENT REQUIRED

A serial terminal capable of accessing the RFL 9508 system

A source of keying voltage equal to the keying voltage to be used in service An indicator capable of

detecting operation of the trip outputs

TEST PROCEDURE

Once the module has been installed in an operating RFL 9508 system, the disable switch can be placed in the enable position. The connections to any trip outputs should be disconnected before proceeding with this test.

The status values of the PLC-TT should indicate that the module is not in CRC or Address alarm and that the ping pong value is less than the alarm limit.

The alarm LED on the front panel should be off.

When a keying voltage is applied to any input, the appropriate LEDs on the local and remote units should illuminate. The trip output contacts should close.

If the appropriate LEDs and trip outputs respond as expected, the module is ready to put into service.

NOTES

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