INSTRUCTION MANUAL

RFL 9508D UCC
DIGITAL POWER LINE CARRIER
MULTIPLEXING SYSTEM

NOTICE

RFL Electronics Inc.
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WARRANTY

The RFL 9508D comes with a one-year warranty from date of shipment 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

The RFL9508D is 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. RFL warrants product repair from one-year from the date of repair or the balance of the original factory warranty, whichever is longer.

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.

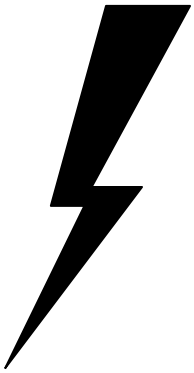
This warranty is in lieu of all other warranties, whether expressed, implied or statutory, including but not limited to implied warranties of merchantability and fitness for a particular purpose. In no event shall RFL be liable, whether in contract, in tort, or on any other basis, for any damages sustained 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

WARNING LABELS AND SAFETY 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 9508D 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 9508D 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 9508D 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 9508D CARRIER OUTPUT CONNECTOR MUST 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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When revisions are made to the RFL 9508D UCC Instruction Manual, the entire section where revisions were made is replaced. For the edition of this manual dated October 18, 2010, the sections are dated as follows:

Front Matter	October 18, 2010
Section 1	September, 2007
Section 2	July 1, 2007
Section 3	March 11, 2010
Section 4	March 11, 2010
Section 5	October 18, 2010
Section 6	October 14, 2010
Section 7	October 14, 2010
Section 8	March 11, 2010
Section 9	April 19, 2007
Section 10	July 1, 2007

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Rev.	Description	Date	Approval
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3-11-10	Updates to Section 3, 4, 5, 6 and 8 Ref. CAR 9508-0210	3-11-10	TG
10-18-10	Sections 5, 6 and 7 updated in accordance with ECO9508-113.	10-28-10	TG

Section 1. PRODUCT INFORMATION

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Section 2. APPLICATIONS

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

2.1 RFL 9508D 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) channel, one Data channel (Modem), and one speech channel transmitted through the digital link, Additionally it has integrated type F6 teleprotection.

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).

Modem signal is transmitted through a 2W or 4W E&M channel in the bandwidth from 300 to 3400Hz.

For this point-to-Point application, the speech channel provides the link for the PABX at each substation interconnecting them, so expanding the phone network.

Each 9508D 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 9508D terminal. The LTU also contains a surge arrestor to protect the equipment from voltage spikes, lightning or other faults. The coupling capacitor isolates the 9508D 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 the packetizing multiplexer of the 9508D at node A. The SCADA remote (Remote Terminal Unit or RTU) is shown connected to the packetizing multiplexer of the 9508 at node B. The SCADA master communicates with the RTU over the RFL 9508D power line carrier link at data rates of 9600 baud and higher depending only on the availability of bandwidth in the digital link..

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 9508D 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 B to 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 9508D 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.

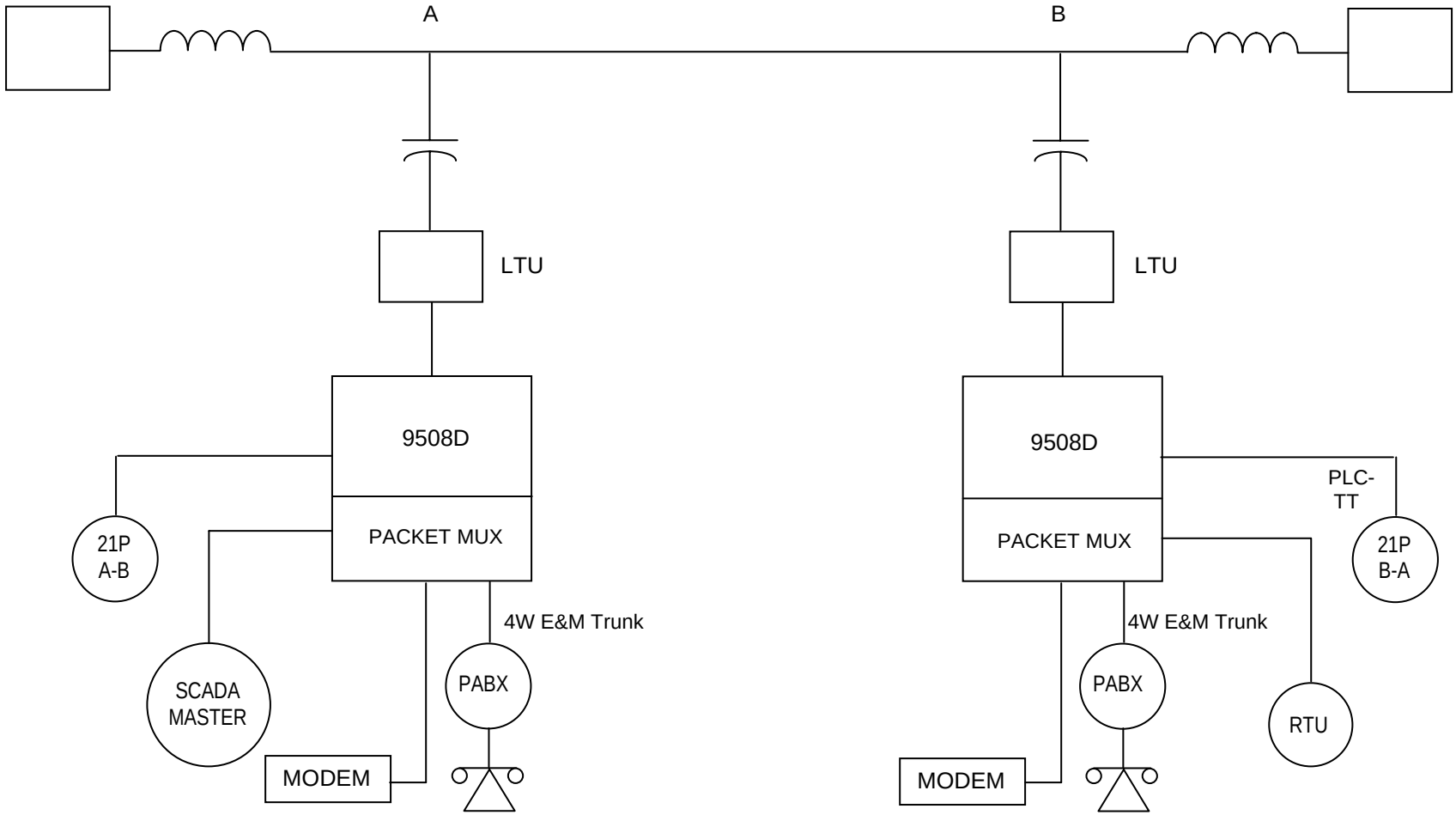

Figure 2-1. Typical point-to-point application

2.1.2 TANDEM LINK WITH INCORPORATED BRANCH EXCHANGE

Figure 2-2 illustrates two point-to-point applications connected together by an Ethernet link.

The link between nodes A and B one SCADA channel, integrated F6 teleprotection and a speech channel that communicates a PABX at node A which can be used to call subscriber at node B and also the subscriber at node C by using the incorporated features of Automatic Branch Exchange of the packetizing multiplexer.

The two 9508Ds at node B are connected together by Ethernet port, 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 FXO port at node A can be configured to 'Auto-Dial' the suscriber extension at node B or C, or can be used to access the multiplexer's branch exchange by using section dialing: First the PABX's FXO port extension number must be dialed to access the multiplexer's 2W port, then, the dial rules to follow are those configured in the multiplexer.

The 2W FXS port at node B can be used to call to node C or to access the PABX at node A. Also an Auto Ring Down voice channel is provided between nodes B and C (ARD), this can be configured as a point-to-point voice channel or as a autodial extension, so, other extensions (Node A for example) can dial to this locations.

Each 9508D 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 9508D 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 B to 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 9508D 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.

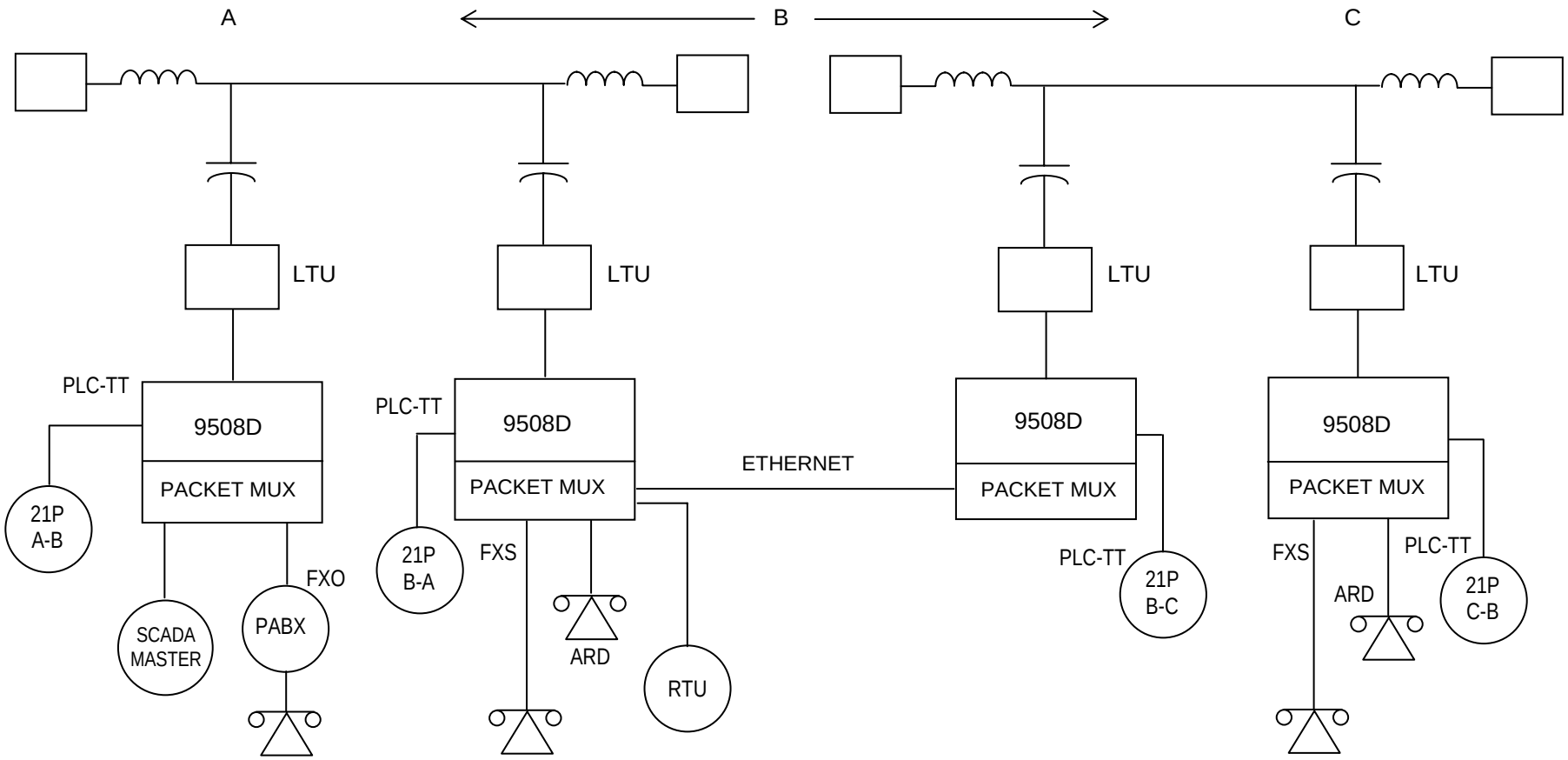

Figure 2-2. Concatenated Point-to-Point Links with incorporated branch exchange

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.

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

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

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

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

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

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

Table 2-3. Preset Frequencies

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

2.2.2 TYPICAL APPLICATIONS

Figure 2-3a shows a typical PLC-TT application using four inputs and four outputs. Two input modules are also available. Figure 2-3b 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.

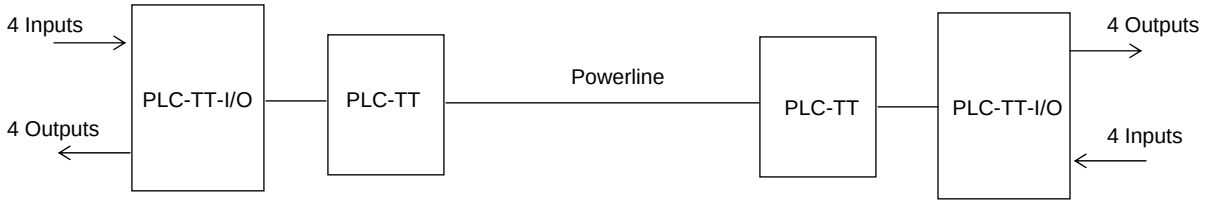

Figure 2-3a. Typical Configuration

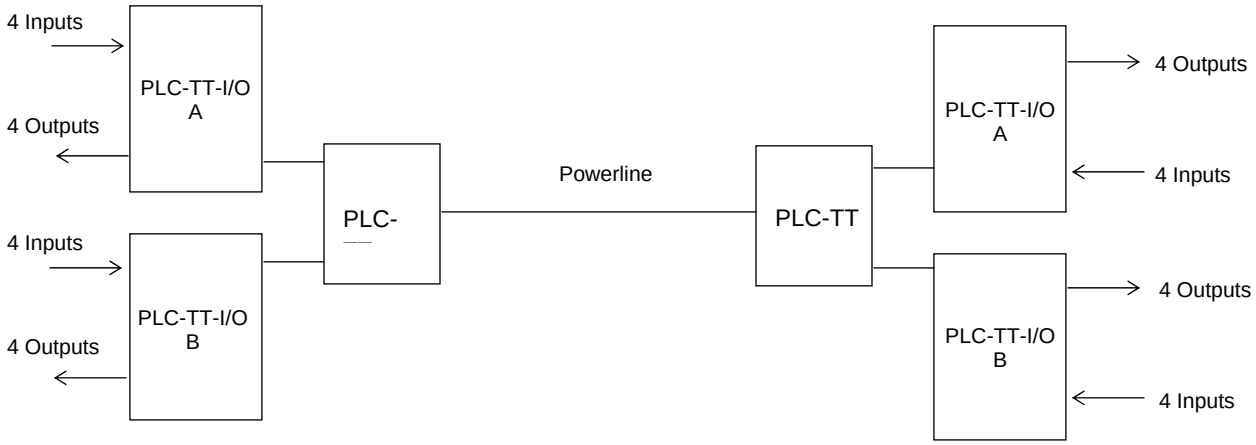

Figure 2-3b. Dual I/O Configuration

Note 1. In Figures 2-3a and 2-3b, the outputs can be Inverted or Not Inverted using NMS.
Note 2. In Figure 2-3b the "A" Inputs and the "B" Inputs can be AND'ed or OR'ed using NMS.

Figure 2-3. PLC-TT Applications

2.3 FREQUENCY PROGRAMMING CAPABILITY

The 9508D 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 and 8.0 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.

2.4 SUPERPOSED /SEPARATED CHANNEL OPERATION

The 9508D can be arranged for separated band operation or superposed bands possible due to the ECO canceller feature, decreasing this way the bandwidth requirements by half.

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.

2.5 RFL 9508D UCC FILTERING

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

Digital

The 9508D 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.

Analog RX

RFL has included as in the 9508, an analog RX filter in the design of the 9508D to limit the band of signals seen by the DSP for channel overloading reasons, not for selectivity. 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 9508D can be set to two channel widths. 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 selectivity.

Analog TX

The TX filter of the 9508D 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, 4 or 8 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.

2.6 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 5.3.2.6. The Bandwidth can be set to 8 KHz or 16 KHz. The Center Frequency can be set from 24 kHz to 496 KHz in 4 KHz increments. The Rx frequency must also be programmed in the RF Setup section of the NMS as shown in Figures 4-22 and 4-24. For the standard applications the RX filter is set to 8 KHz.

2.7 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 5.3.2.2. The Bandwidth can be set to 8 kHz or 16 kHz. The Center Frequency can be set from 24 kHz to 496 kHz in 4 kHz increments. The Tx frequency must also be programmed in the RF Setup section of the NMS as shown in Figures 4-22 and 4-24. For the standard applications the RX filter is set to 8 KHz

2.8 LINE BOARD

The Line Board is the interface between the RFL 9508D UCC and the line coupling equipment. It has several jumpers and other controls that must be set for proper system operation. Refer to paragraph 5.3.2.4 for additional information.

2.9 SETTING LEVELS ON THE RFL 9508D UCC

Setting the levels on an RFL 9508D UCC is important for proper functionality. 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.

2.9.1 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. For an 8 KHz system, the signaling, voice and data attenuation are typically set to 6 dB below the level of teleprotection tone.

   Note: The signaling tone performs the functions of a guard tone or pilot tone.

2. The test tone generator runs at +3 dBm0 and is controlled by the voice attenuator setting.

2.9.2 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. 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, for that reason, the peak-to-average relation of a QAM signal must be considered when setting the amplifier gain.

2.9.3 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 pilot tone in an 8 KHz system is -20 dBm @ 50 Ohms.

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 should be set to -1,5 for a better performance of the teleprotection function.

2.9.4 ALARM LEVEL SETTING

1. The current gain should be entered as the nominal gain in the Rx Screen of the RFL 9508D 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.

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Section 3. INSTALLATION

WARNING

ALL RFL 9508D UCC 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 9508D UCC, 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 9508D UCC.

3.2 UNPACKING

RFL 9508D UCC equipment is supplied in sets of at least three 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 9508D UCC 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 9508D UCC 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 9508D UCC equipment must be securely mounted, following the instructions in paragraphs 3.3.1 through 3.3.3.

3.3.1 INDIVIDUAL CHASSIS

RFL 9508D UCC terminals housed in individual chassis have two mounting ears (one on each side). Hole sizes and spacings conform with EIA standards, so the RFL 9508D UCC 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

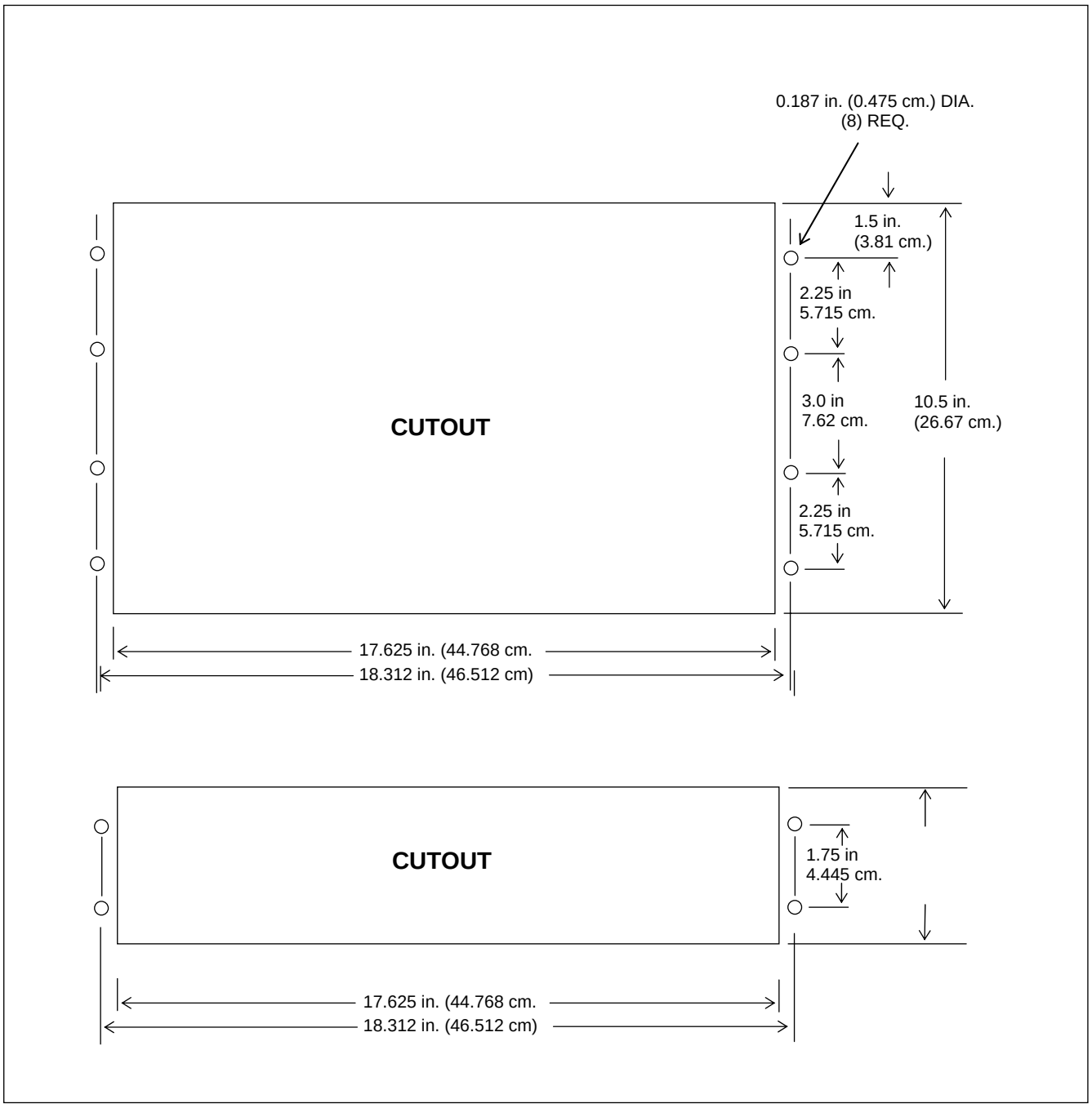

Figure 3-1. Mounting dimensions for 50W system, RFL 9508D UCC Digital PLC, lower shelf is the multiplexing unit

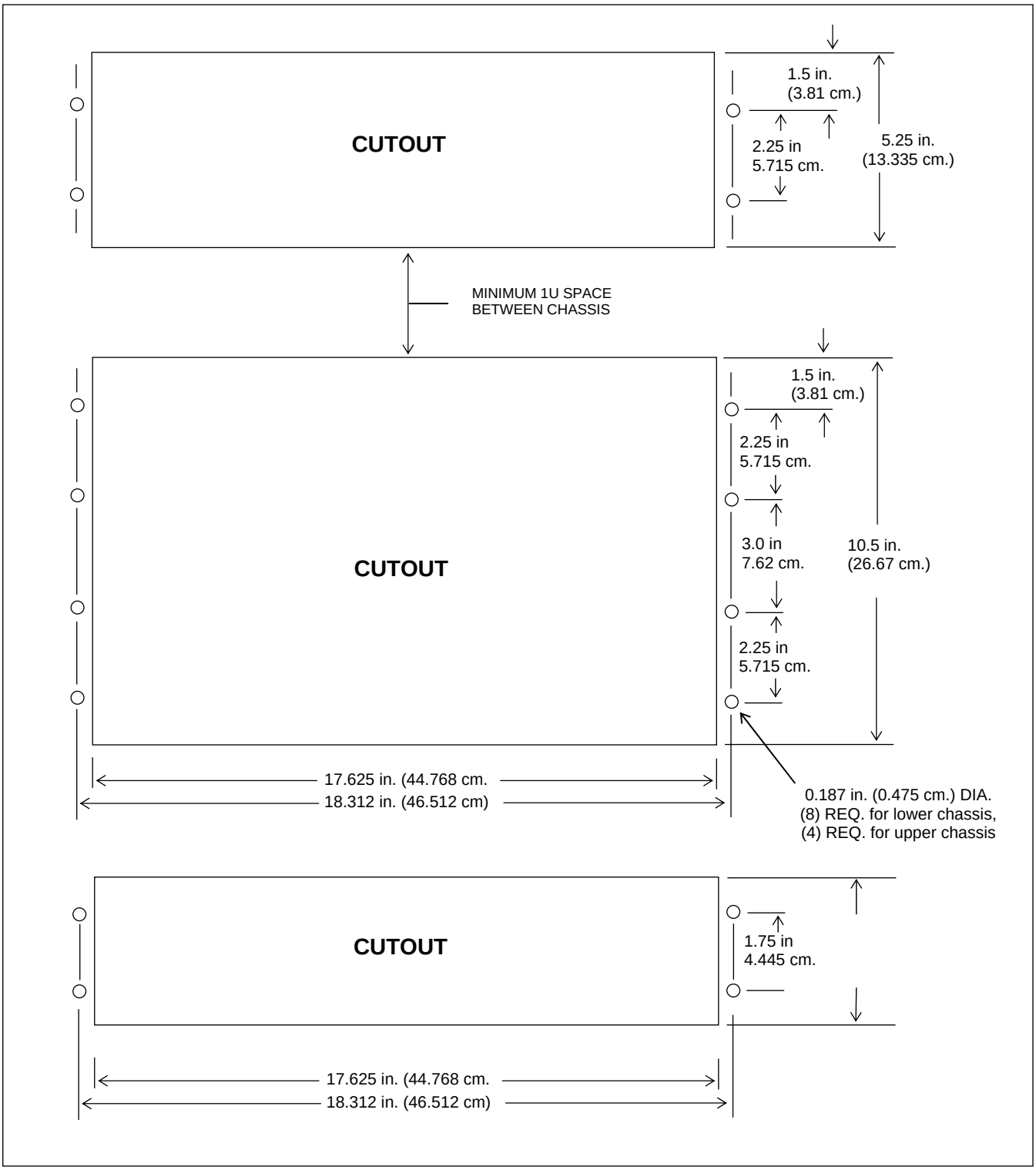

Figure 3-2. Mounting dimensions for 100W system, RFL 9508D UCC digital powerline Carrier

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 9508D UCC equipment is -20^{o}C to +65^{o}C (-4^{o}F to +149^{o}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 9508D UCC 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 9508D UCC chassis through the terminal blocks and connectors on the chassis rear panel. The rear panel of a typical RFL 9508D UCC 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 9508D UCC 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 5.3.1.2, 5.3.1.3, 5.3.1.5, and 5.3.1.8.

The terminal blocks on the rear of the RFL 9508D UCC 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.

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 9508D UCC and the Line Coupling Equipment.

Signal Name	From	To
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 9508D UCC and the Line Coupling Equipment.

Signal Name	From	To
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	To
Low Level RX	RX OUT on RF Chassis	RX on MA-470
Low Level TX	TX on MA-470	TX IN on RF Chassis

3.5.4 EXTERNAL CONNECTIONS FROM DIGITAL CHASSIS TO MULTIPLEXING UNIT

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

Signal Name	From	To
V.35 data	V.35 on MA-xxx	Serial Port on Mux Unit

3.5.5 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

3.5.6 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 9508D UCC 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.

3.5.7 CHASSIS GROUND CONNECTIONS

A ground stud at the lower right rear of the RFL 9508D UCC chassis is the main ground for the RFL 9508D UCC 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.

Before attempting to make power connections, make sure the RFL 9508D UCC 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.

3.5.8 FIBER OPTIC CONNECTIONS

If your RFL 9508D UCC is equipped with Fiber Optic Modules, fiber optic connectors must be connected to the fiber optic heads on the rear panel of the 9508D 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.

3.5.9 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.

3.5.10 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**	**To**
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)

3.5.11 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:

From	To
+RF of the Digital Chassis	V+ of the RF Chassis
- RF of the Digital 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:

From	To
V+ of the lower RF Chassis	V+ of the upper RF Chassis
V- of the lower RF Chassis	V- of the upper RF Chassis

3.5.12 STATION BATTERY CONNECTIONS

After all other connections have been made to the RFL 9508D UCC, 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.

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

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)

1. To prevent damage to the equipment, the source connected to this input must be externally fused or current-limited.

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 -
C	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)

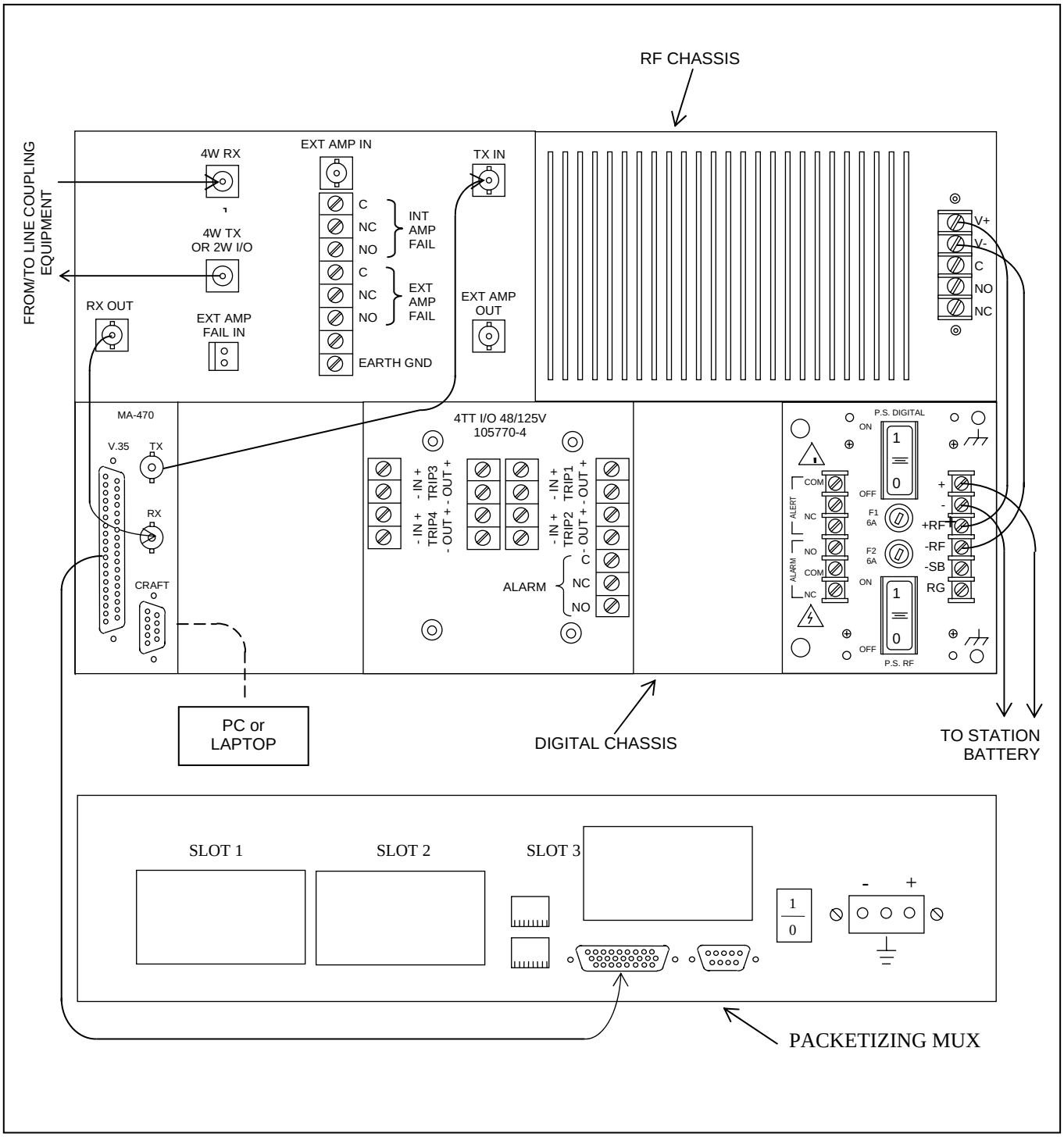

Figure 3-3. Rear Panel Wiring Of Typical RFL 9508D UCC, 4W System, 50W Chassis

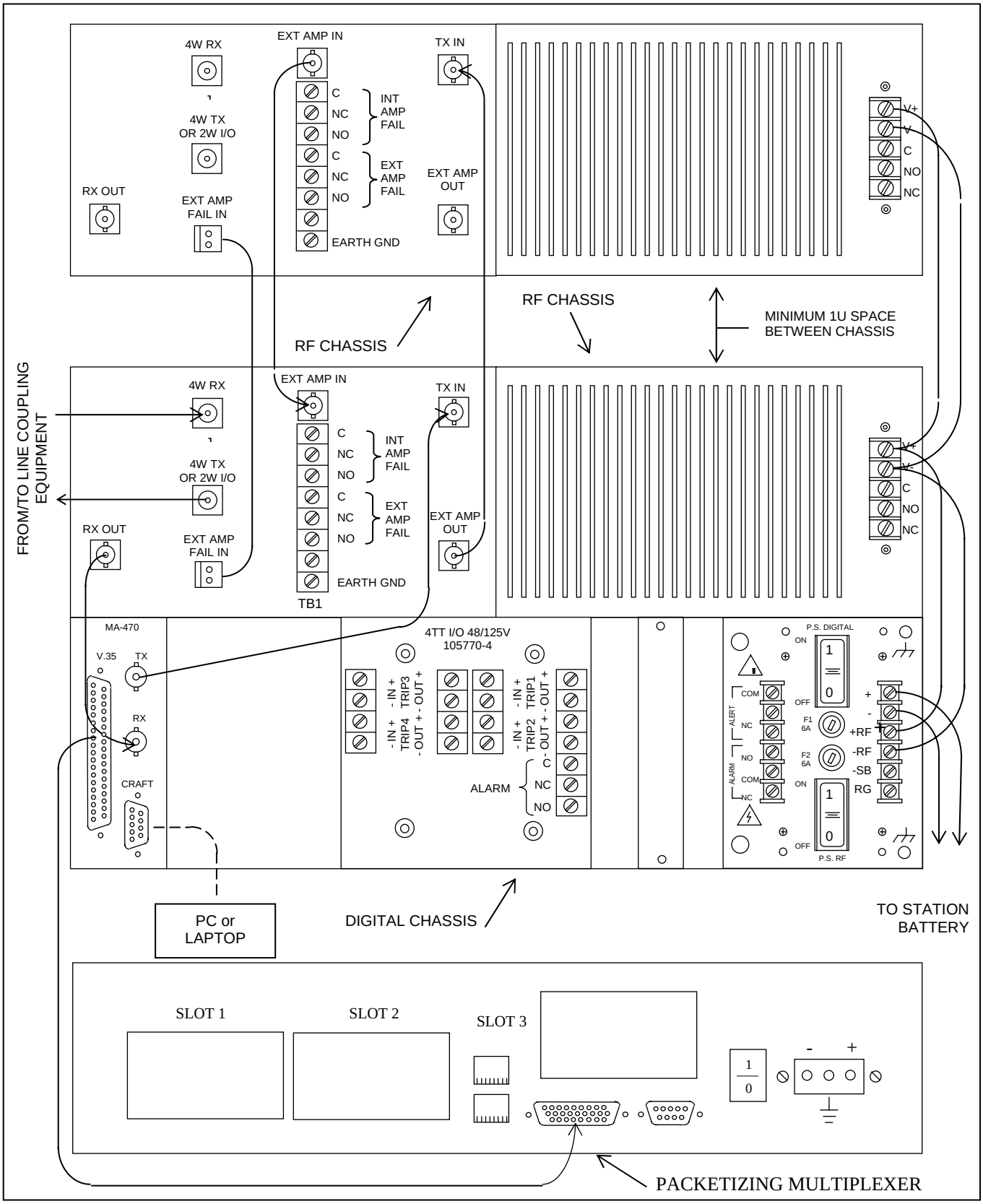

Figure 3-4. Rear Panel Wiring Of Typical RFL 9508D UCC, 4W System, 100W Chassis

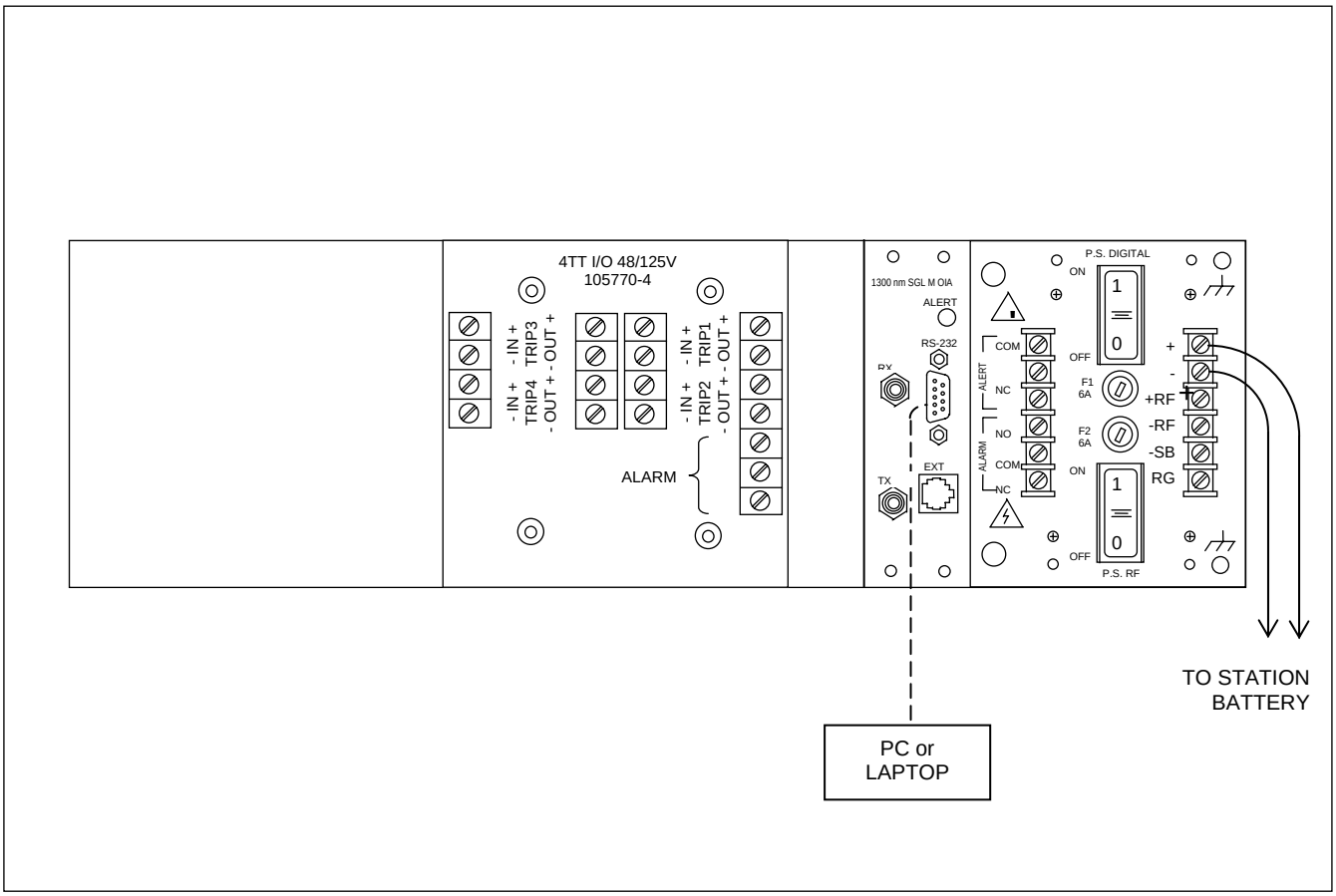

Figure 3-5. Rear panel wiring Of Typical RFL 9508 RT Remote Teleprotection Chassis

Table 3-4. RFL 9508D modules, general information

Module Description	Assy. Number	Located in Digital or RF Chassis?	Chassis location Front or Rear	For Additional Information see Paragraph:
Power Supply	9547-840 9547-965	D	F	5.2.1.1, 8.10
Power Supply Alarm I/O	9547-18801, -04, -09	D	R	5.2.1.3, 8.11
CM4 Module	9547-15886	D	F	5.2.1.4, 5.3.1.1, 8.1
PLC-TT Module	105720-2	D	F	5.2.1.6, 5.3.1.4, 8.4
Test Panel	106190	D	F	5.2.1.8, 8.9
Analog Teleprotection Transceiver	107830	D	F	5.2.1.9, 5.3.1.6, 8.6
Digital Transceiver		D	F	5.2.1.10, 5.3.1.7, 8.7
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
PLC-TT Module Adapter	105740-2 to -5 105770-2 to -5	D	R	5.2.1.7, 5.3.1.5, 8.5
MA-470 (Transceiver Module Adapter)	107905	D	R	5.2.1.11, 5.3.1.8, 8.8
Digital Motherboard	105590-2	D	Center	8.12
50W Power Amp	103085	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	RF	F	5.2.3.4, 5.3.2.4, 7.6
Attenuator	107810	RF	F	5.2.3.6, 5.3.2.5, 7.8
Rx Filter	107820	RF	F	5.2.3.5, 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

Section 4. RFL NETWORK MANAGEMENT SOFTWARE

4.1 GENERAL INFORMATION

The RFL 9508D 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 9508D 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 9508D terminals located in a network.

2. 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 9508D 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 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 "SW9508DNMSxxx", 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; 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.

4.2.1 INSTALLING THE NMS SOFTWARE

(The executable Installation file for the NMS is: RFL9508D_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:\RFL9508D_setup.exe ("d:\" is considered as the name given by the operating system to the drive where the installation files are located, this letter drive must vary from system to system)

   d. Then click on OK.

4. Click on Next to continue with the setup.

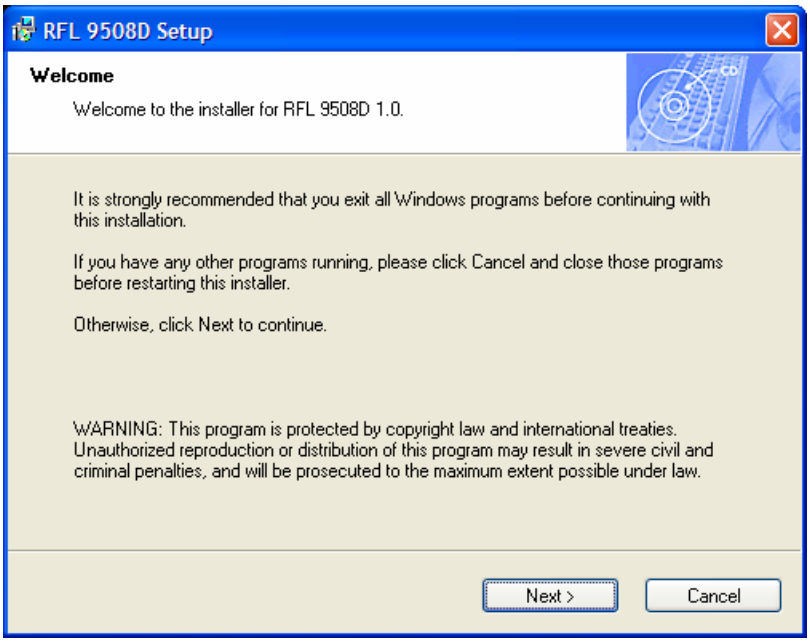

Figure 4-1. RFL 9508D NMS initial installation window

5. Follow the on screen instructions, the default values given by the prompt will guide to a complete installation. The installation folder name can be changed if needed.
6. When installation is complete, the 9508DSetup.exe is added to the programs folder in the start menu.

To run the RFL NMS Software double click on the 9508D Setup Icon on your desktop, or go to the Start menu and select Programs/RFL 9508D/RFL9508DSetup.exe. Refer to paragraph 4.4 for information on how to use the Network Management Software.

4.2.2 UN-INSTALLING THE NMS SOFTWARE

If for any reason you want to remove the RFL 9508 NMS Software from your computer system, go to the Start menu and select Programs/RFL 9508D/ then press on the 'Uninstall' or 'change/remove' button. This will cause the Uninstall program to permanently erase all of the programs, icons, directories and files related to the RFL 9508D Network Management Software from your hard drive.

NOTE

If you want to save the existing configuration files which are listed below, copy these files to a diskette or other storage media 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.

A file with a .map extension contains all the configuration settings for a single node. To save the configuration of the complete network, one .map file should be saved for each 9508D terminal. Additionally, the file 'equipment.ini' contains the inventory of all units in a given network.

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, either directly using a direct connection RS-232 cable as shown in Figure 4-3, or a remote connection over a public or private phone line as shown in Figure 4-4. Either of the two ways of connection to the equipment lets the user to read the configuration and change specific settings on the remote PLC terminal by fsk-modulating the pilot tone on the PLC link.

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 4-6. The communication cable must be less than three meters in length or must be shielded to meet SWC requirements.

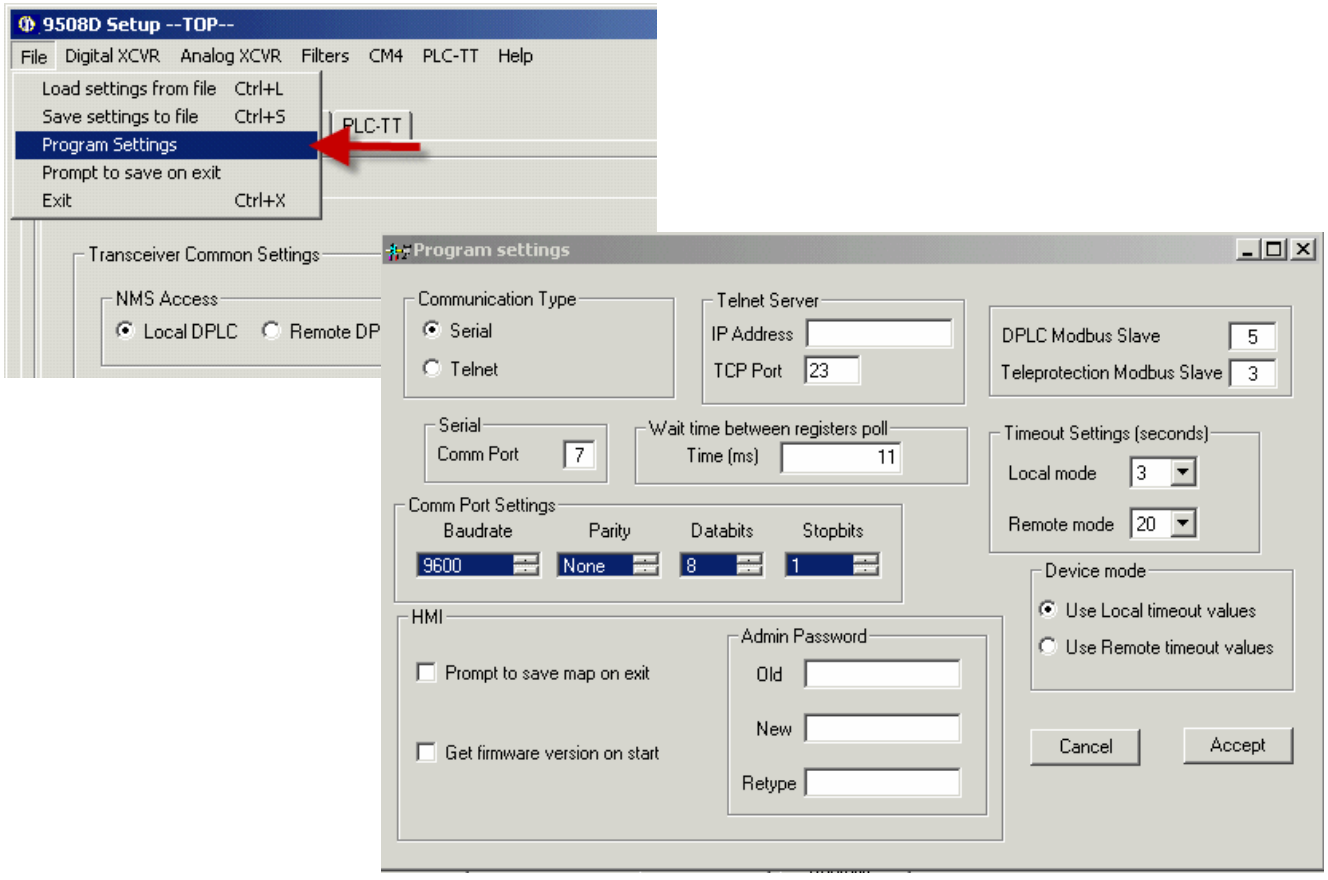

Figure 4-2. Program Settings

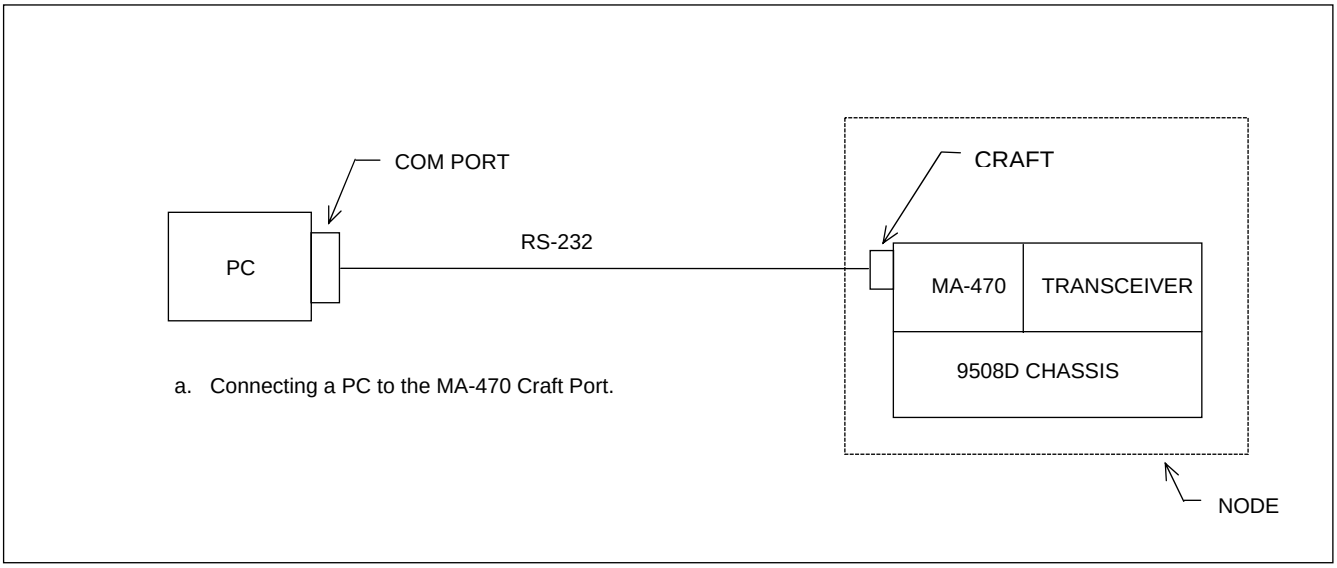

Figure 4-3. PC directly connected to a node using an RS-232 cable

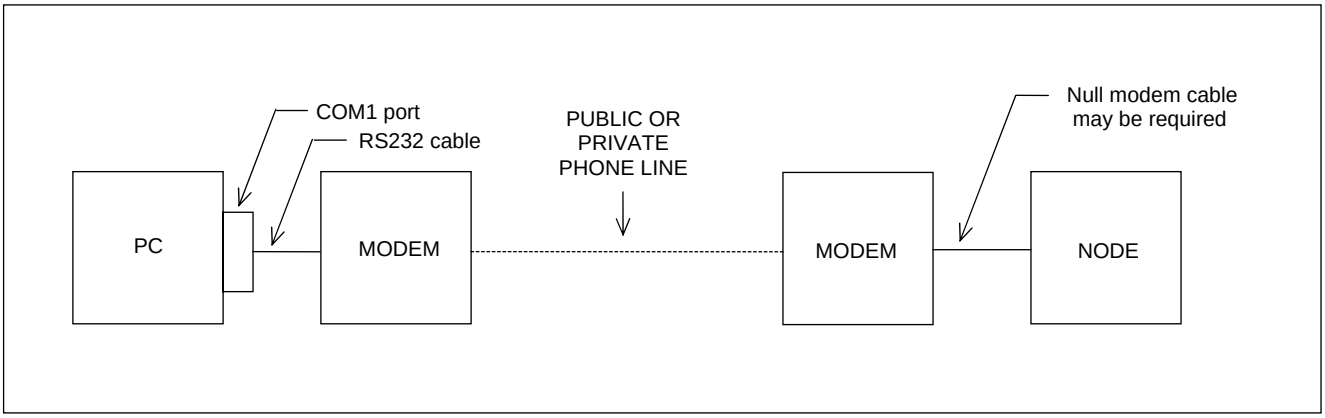

Figure 4-4. PC connected to a node from a remote location

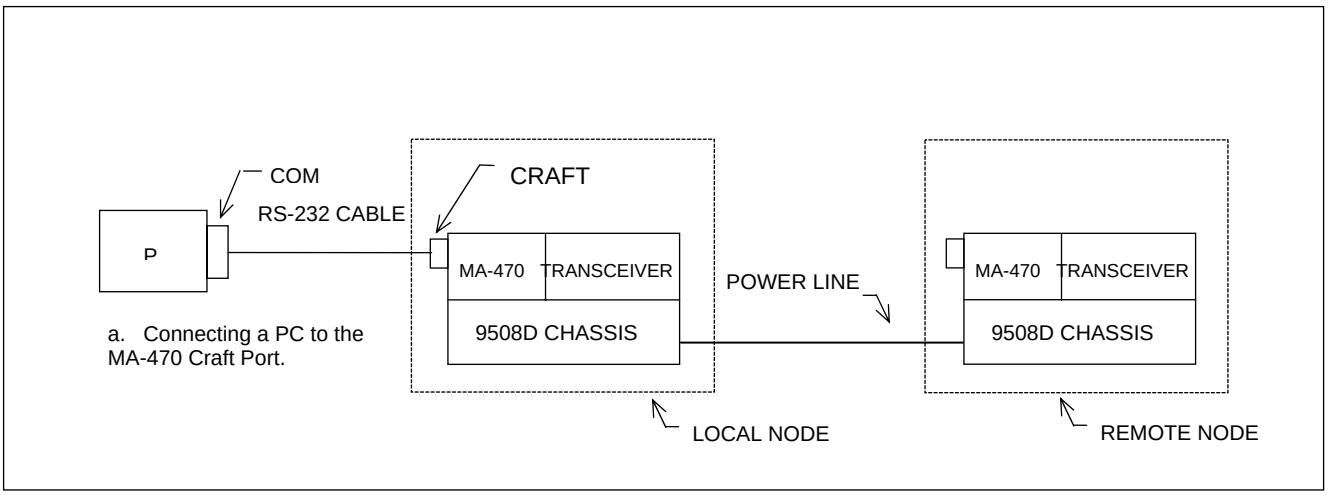

Figure 4-5. Remote configuration of a PLC terminal

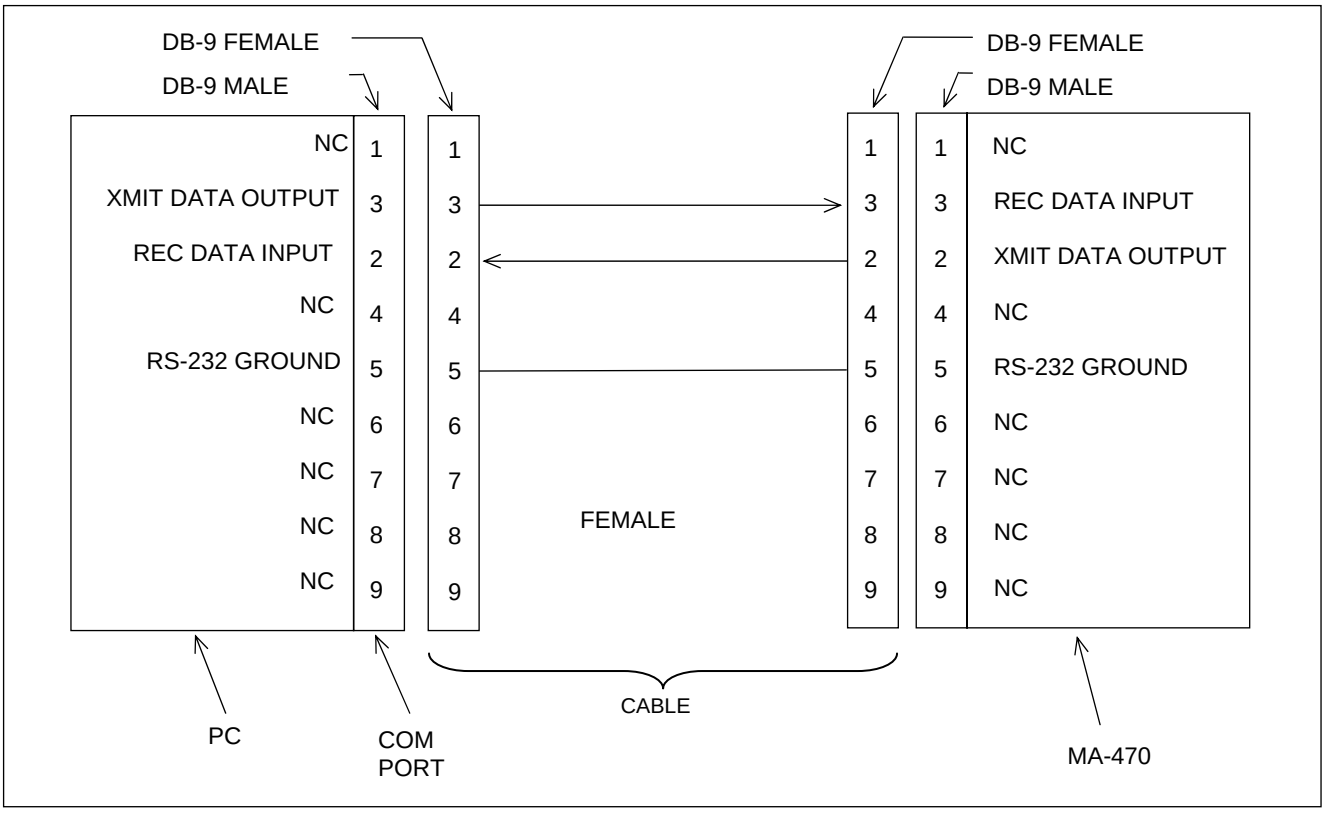

Figure 4-6. Construction of a typical RS-232 cable between the PC and a MA470

Figure 4-7 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 4-8 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.

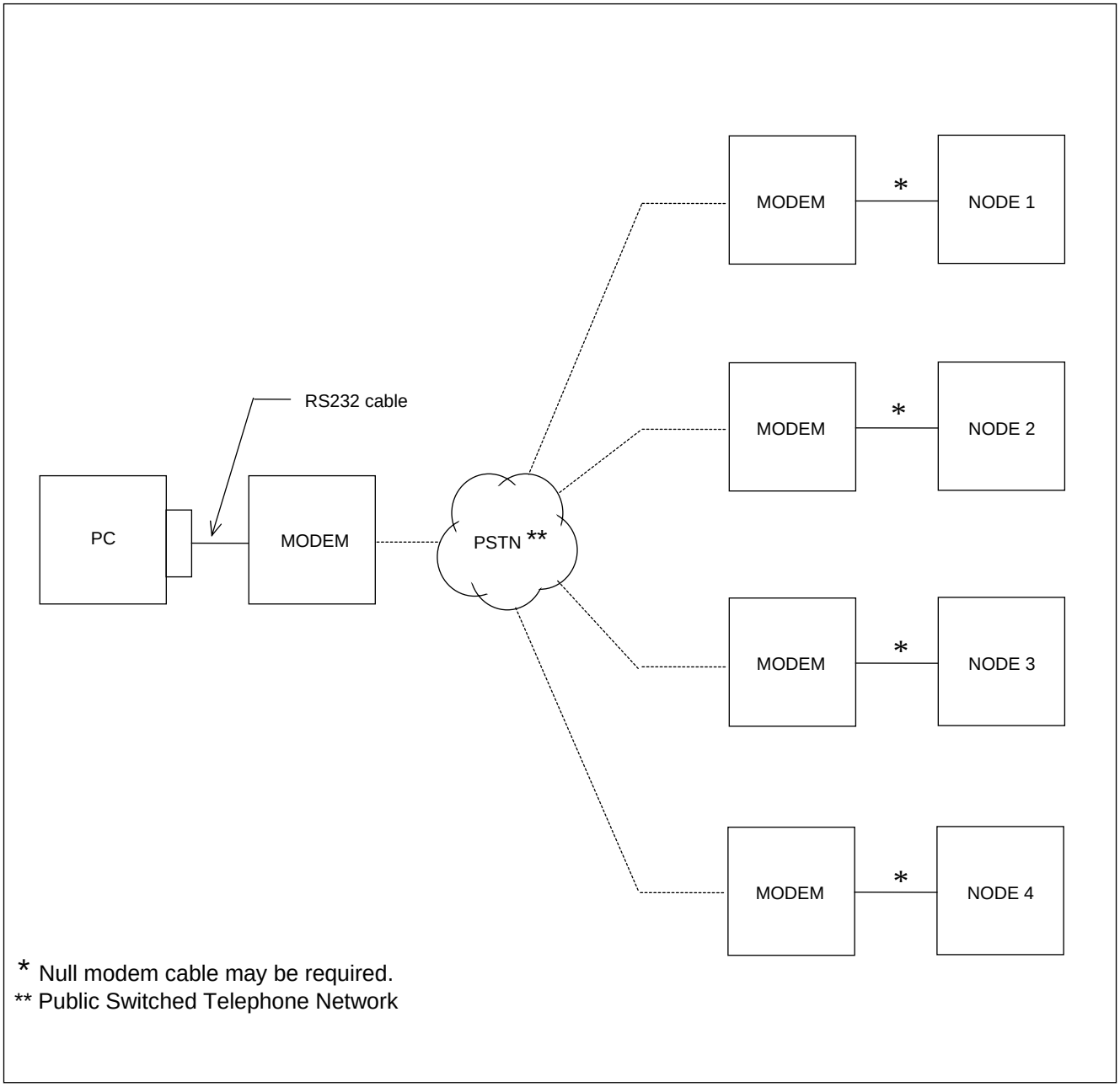

Figure 4-7. PC at a remote location connected to 4 nodes, where each node is a different network

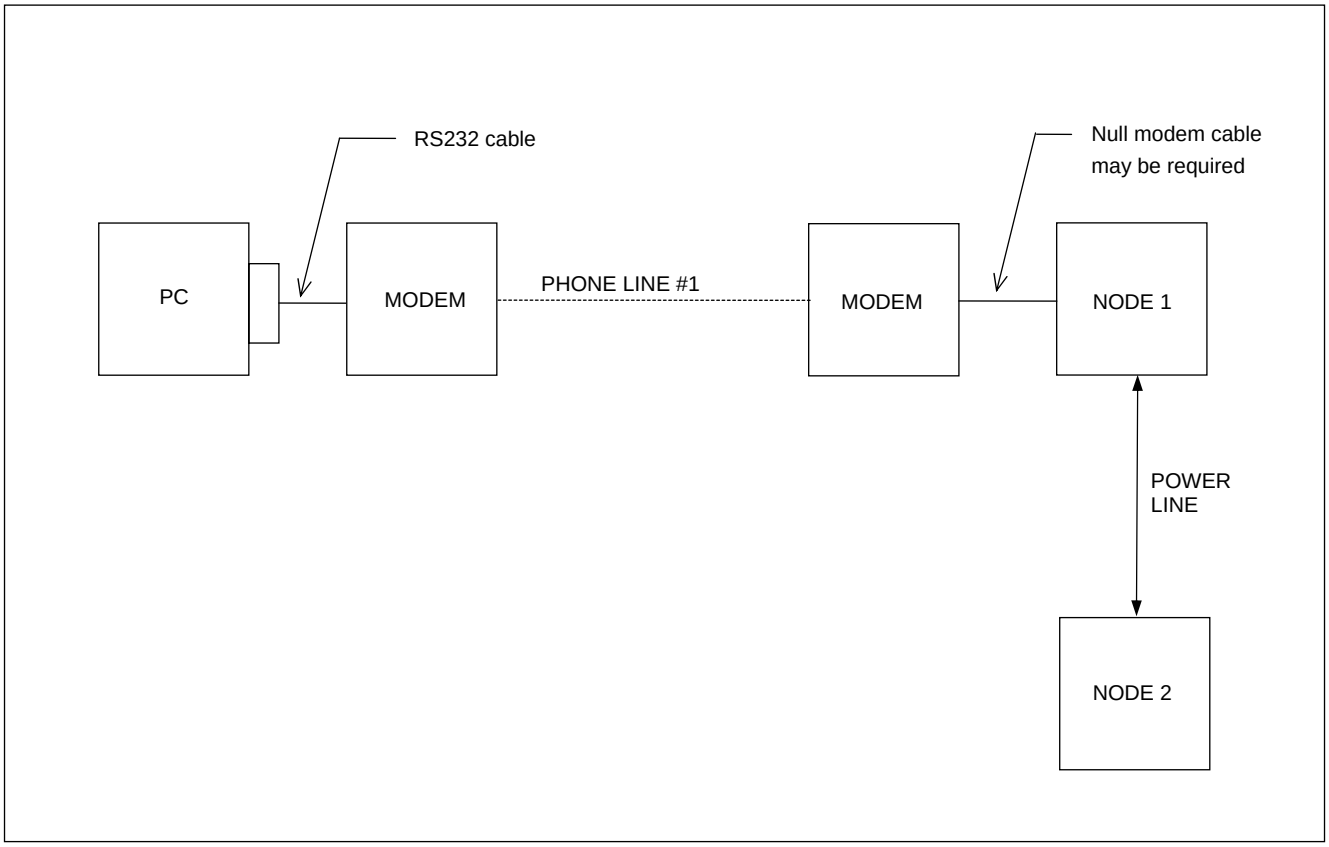

Figure 4-8. PC at a remote location connected to 2 nodes, where all nodes are in the same network

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 4-9. 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.

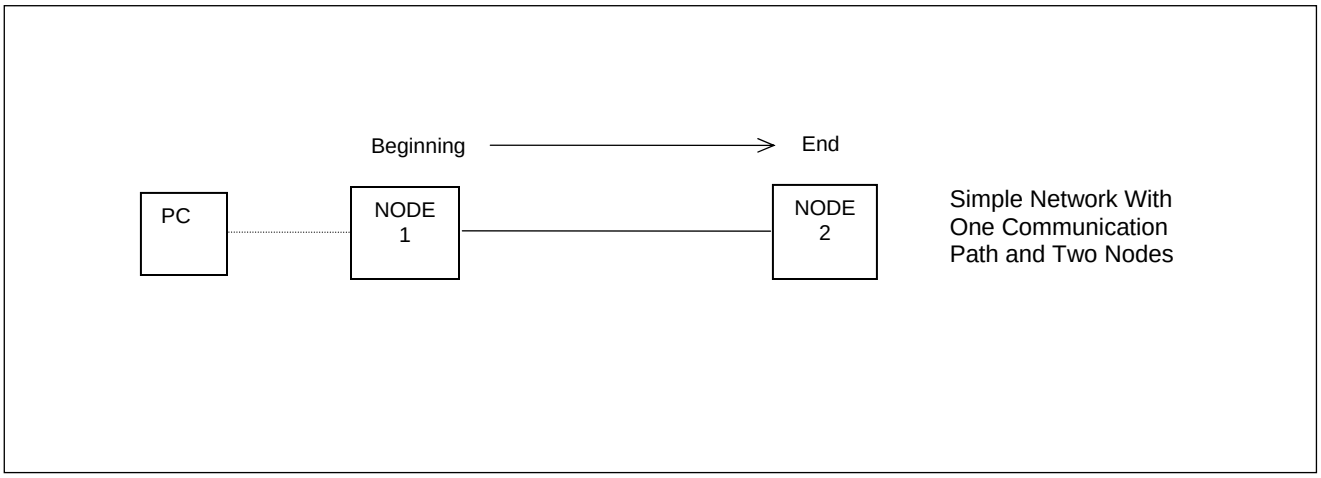

Figure 4-9. Typical network and communication path

4.4 USING THE NETWORK MANAGEMENT SOFTWARE

The network management software for the RFL9508D equipment is structured according to the hardware organization of the equipment, therefore the software has a tab for each of the following cards: CM4 (digital controller), PLC-TT, analog transceiver (F6 modulator) and digital transceiver (QAM Modulator).

Table 4-1. List of cards that can be configured through NMS

Node 1 (Local Terminal)	Node 2 (Remote Terminal)
CM4 PLC-TT Transceiver 9508D Terminal	CM4 PLC-TT Transceiver 9508D Terminal

4.4.1 STARTING THE NETWORK MANAGEMENT SOFTWARE

To start the Network Management Software, click on the RFL9508D UCC NMS Icon on your desktop.

A window will appear asking the user to choose between a standard user session or an administrator session. Normally a standard user session will let the user to configure a complete system; an admin setup will be needed only for some settings used when commissioning and servicing the equipment.

When first installed, the password for administrator session is “OK”. This window, shown in figure 4-10, also let to choose between local 9508D configuration and remote 9508D configuration through the PLC channel.

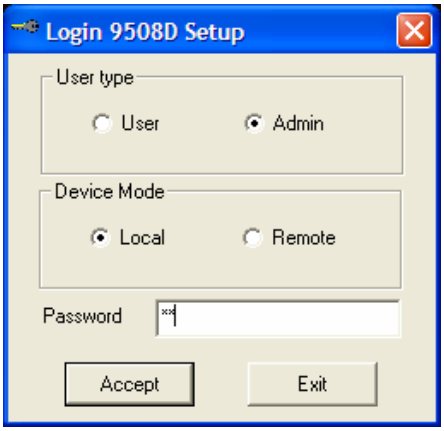

Figure 4-10. 9508D NMS starting window

After pressing the ACCEPT button, you will be brought to a unit selection window as shown in Figure 4-11.

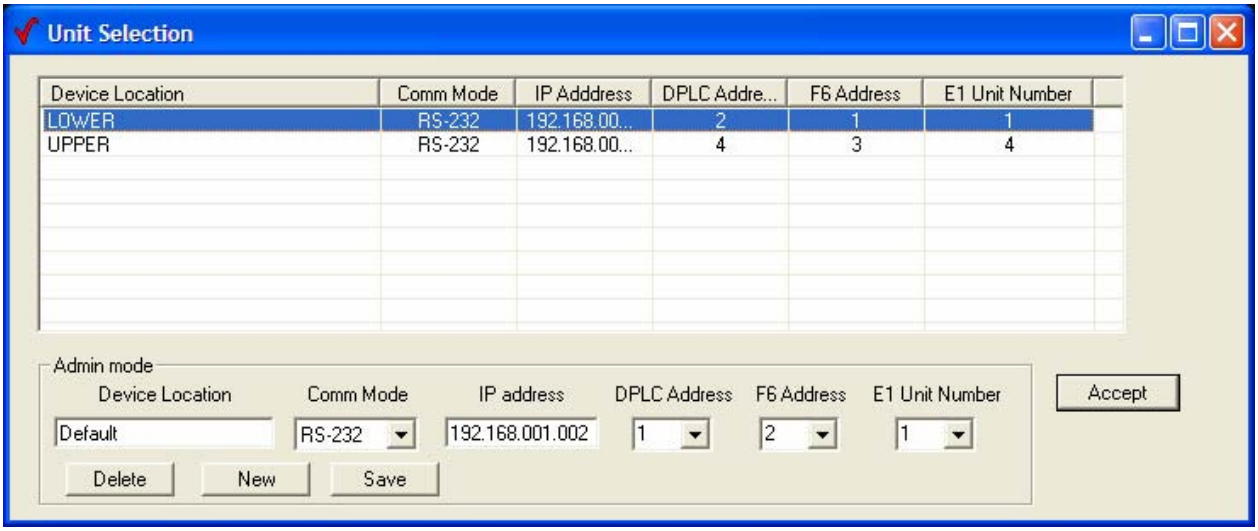

Figure 4-11. Terminal Unit selection window

This window shows a list of a number of units that can be selected for configuration, this windows let the user select between different units previously saved in the register. After selecting a terminal, the program will load the addresses of the CM4, analog and digital transceiver just to avoid the process of discovering the address of each card every time the user wants to access the configuration. This will be discussed later in this chapter.

4.4.1.1 ENTERING AND SAVING A NEW TERMINAL EQUIPMENT IN THE START REGISTER

To save information regarding a new terminal:

1. - Type in a name for the unit in the 'device location' field.
2. - Select a communications mode from the available options in the pull down box.
3. - If necessary type in an IP address (used when configuring by telnet)
4. - Select the address for the digital transceiver (dplc), analog transceiver (F6 channel) and E1 Unit (CM4).
5. - Press the NEW button. At this point a new record for this terminal PLC will be added to the list.
6. - Press the SAVE button to store the changes.

It's not necessary to save the information about dplc, F6 transceiver and CM4 prior to configuring a system, indeed, the first attempt to communicate to a terminal it's common not to know this addresses, nevertheless, this start register helps save time and work when accessing the terminal PLC on repeated occasions.

To enter the configuration window, select the desired PLC terminal (if displayed in the window) and press the ACCEPT button or simply press the button while selecting any record and then proceed to discover the address of every card.

4.4.1.2 CONFIGURING PARAMETERS OF RFL9508D'S DIGITAL CHASSIS CARDS

The configuration window is shown in figure 4-12:

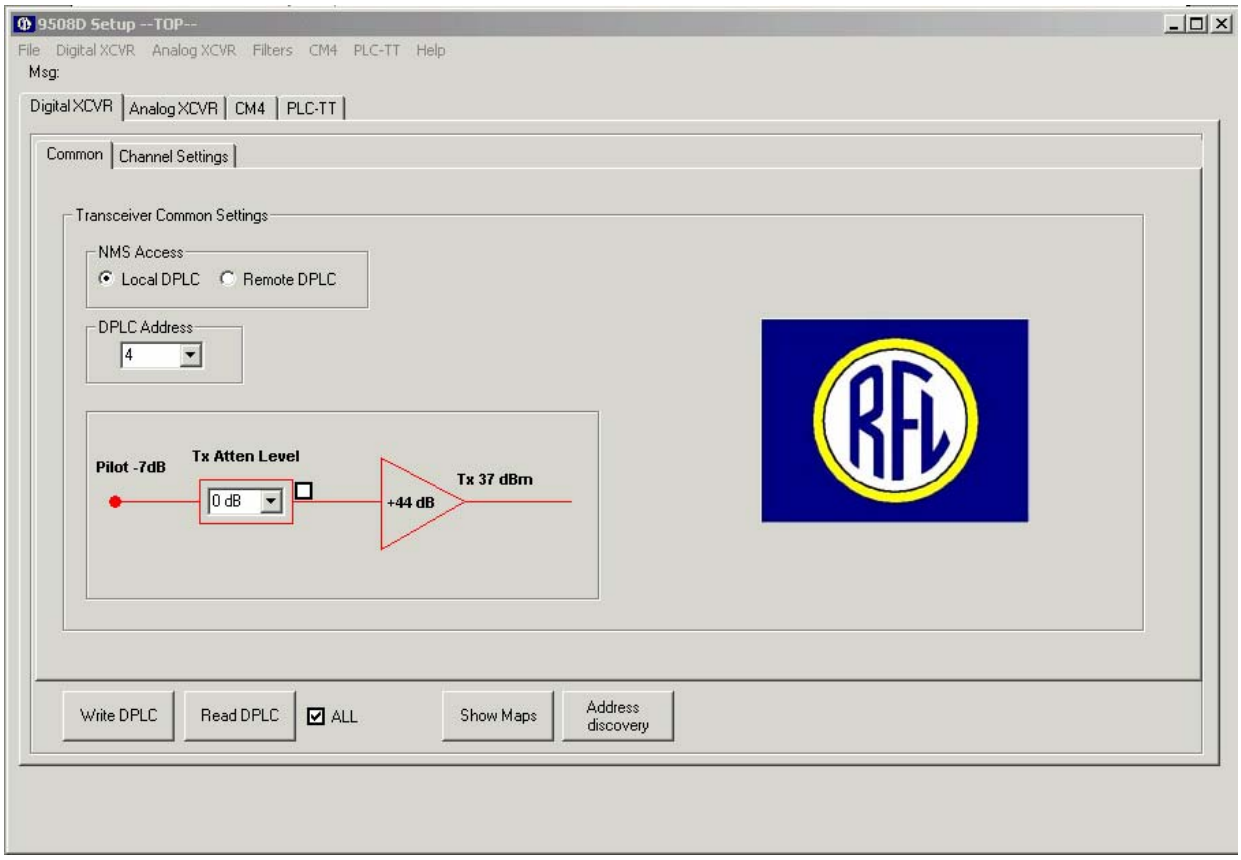

Figure 4-12. RFL9508D UCC NMS presentation window

Note that this window has four top-level pages selected by tabs near the top of the window as follows: Digital XCVR, Analog XCVR, CM4, and PLC-TT

The digital transceiver had two sub-tabs (as shown above) for configuration; the "Common" and "Channel Setting" tabs.

CM4 and PLC-TT contain parameters to configure the CM-4 controller card and teleprotection parameters (PLC-TT card) respectively.

The following discussion covers the settings on the "Common" page of the Digital XCVR.

1. NMS Access
The read and/or write operations will be performed over the local or remote DPLC as selected by the radio buttons. When remote DPLC is selected, the read and write operations will be redirected to the remote end through the PLC link by modulating the pilot.

2. DPLC Address
This pull down box indicates the current DPLC address which can take values from 1 to 127. This pull down box shows the current DPLC address after performing an 'address discovery' as explained further in this chapter.

3. Tx Attenuation Level
This setting attenuates the level of the signal coming out of the digital transceiver in 5dB increments from 0dB to 35dB.

At the bottom of the window there are four buttons, three of them are available in a standard user session as discussed in the following paragraphs:

1. Write DPLC
This button is used to start a write operation of all the parameters in the Common and Digital channel tabs to the DPLC transceiver.

2. Read DPLC
This button is used to read the parameters from the digital channel tab and common tab from the DPLC transceiver.

3. ALL Checkbox
When checked all settings in the Digital XCVR will be read as shown in Figure 4-11 and 4-12. Normally this box will be checked.

4. Show Maps
Through this button you can see the value of the register to be written to the transceiver and/or read from it. This option can also be found in the menu: transceiver/show memory maps and teleprotection/show memory maps.
Note: This button is only available when logged as an administrator.

5. Address Discovery
Pressing this button the software will start an address scan from 0 to 127, to find the address of the DPLC transceiver. After discovering the addresses, the corresponding values on the program settings window located at menu 'file/program settings' will be updated, as shown on figure 4-12.

On the following page is a description of the parameters in the Channel Settings window:

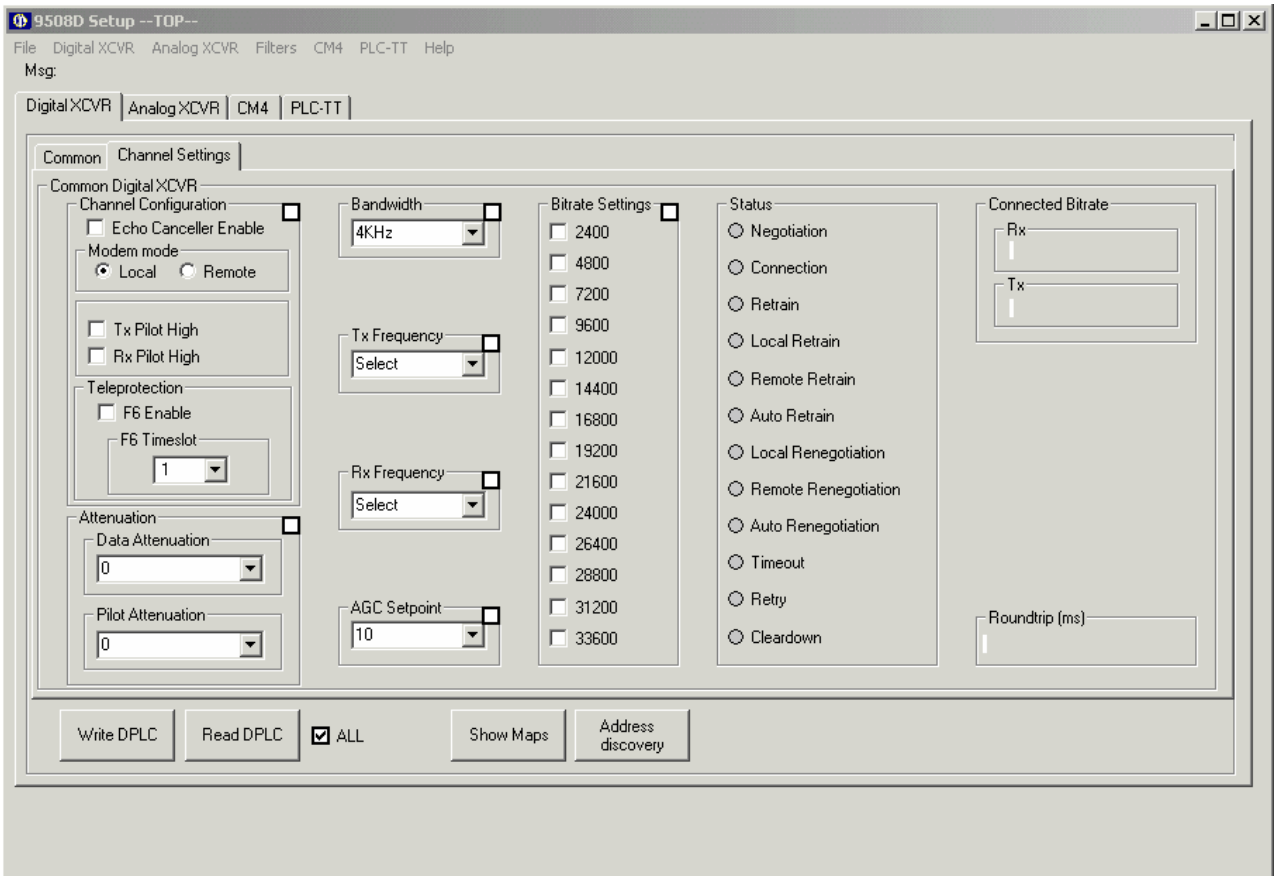

Figure 4-13. Digital XCVR Channel Settings Window

1. Echo Canceller

It's used to activate the echo canceller function, which is used for the transceiver when configured for superimposed bands (transmit and receive in the same frequency band).

2. Local/Remote mode

Each time this button is pressed, it toggles between local and remote mode; for a link to be established, one end must be configured as 'local' and the other end as 'remote'.

3. Tx Pilot High and Rx pilot High

To setup a digital channel using superimposed bands it's necessary to set the transmitted pilot and received pilot separated at the upper and lower edges of the QAM band. These two checkboxes are used to indicate which pilot, either the transmitted or received one, is to be located in the high edge of the digital bandwidth.

4. F6 enable

This parameter is activated when F6 teleprotection is used. Activating this checkbox causes the dplc to monitor when a trip is sent to squelch the QAM spectrum.

5. F6 Time Slot
This box contains the time slot number used to communicate the teleprotection information inside the digital chassis.

6. Data Attenuation
This pull down box is used to select the attenuation of the QAM spectrum, in a default application this attenuation should be set to 6 dB.

7. Pilot Attenuation
This pull down box is used to select the pilot level attenuation. When the analog transceiver is transmitting the pilot tone, this value is set to the maximum attenuation of 256 dB.

8. Bandwidth
This pull down box let the user select among 2 KHz, 4 KHz or 8 KHz operating ranges. The maximum bit rate, at which the equipment will communicate, depends on this bandwidth selection.
For a 62.4 KHz bit rate operation, 8 KHz bandwidth must be selected.

9. Tx Frequency
This pull down box is used to specify the transmit band's lower edge frequency.
For example, if the transmit stream occupies form either 200 to 204 KHz or 200 to 208 KHz; this parameter is set to 200 KHz.

10. Rx Frequency
Through this pull down box you can select the receive band's lower edge frequency
For example, if the receive stream occupies from either 104 to 108 KHz or 104 to 112 KHz, the Rx Frequency is set to 104 KHz.

11. AGC Setpoint
This parameter indicates a reference point for the Automatic Gain Control to work properly, for the default application, the AGC setpoint should be set to 20.

12. Bit Rate Settings
Using this group of check boxes, the user can select the desired bit rates at which the 9508D will connect, according to the transmission line quality conditions (attenuation, noise level, etc); the link will be established at the most suitable bit rate among the group of options selected.

13. Status
This is a group of status parameters indicated as checked checkboxes when active. They indicate the status of the negotiation between both end equipment. Once the link has been established, 'connection' is the only status that is active.

14. TX/RX Connected Bit rate
This status boxes will show the current TX and RX bit rates once the link is established and a read operation have been performed.

15. Round Trip
This is a status value which indicates the delay in milliseconds of the data from the local to the remote equipment and back. This parameter is available after a read operation has been performed.

The second top-level page of the RF setup is the 'Analog XCVR' tab; it contains two pages, one called 'channel settings' shown below, and the second one available only on administrator sessions shown in Figure 4-15.

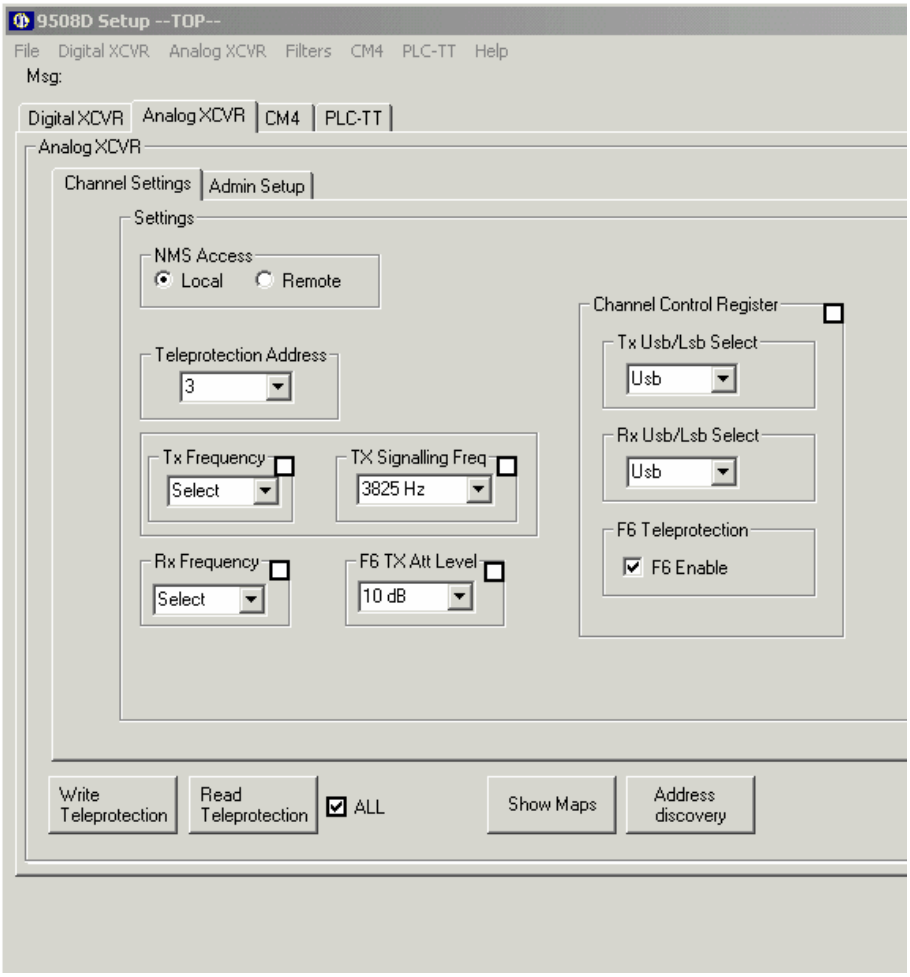

Figure 4-14. Analog XCVR Channel settings window

The settings configured at this window are described below:

1. NMS Access

The read and/or write operations will be performed over the local or remote teleprotection transceiver as selected by the radio buttons. When remote Analog XCVR is selected, the read and write operations will be redirected to the remote end through the PLC link by modulating the pilot.

2. Teleprotection Address

This pull down box indicates the current teleprotection address which can take values from 1 to 127. This pull down box shows the current teleprotection address after performing an 'address discovery' as explained further in this chapter.

3. Tx Frequency
This pull down box sets the receive band's lower edge frequency of the teleprotection channel. The teleprotection channel is always 4 KHz wide; therefore this TX frequency should be set consistently according with the Digital Channel Tx Frequency. For example:
If the digital channel Tx stream occupies a bandwidth from 92 KHz to 100 KHz (8 KHz Bandwidth), the Digital channel Tx Frequency is set to 92 KHz and the teleprotection channel Tx frequency is set to 96 KHz, thus coinciding the upper edges of both frequency bands (100KHz).
If the digital channel occupies a bandwidth of 4 KHz, let's say from 212 KHz to 216 KHz, both, the digital channel and teleprotection channel Tx frequencies are set to 212 KHz, thus coinciding the upper edges of both frequency bands.

4. Tx Signalling Frequency
Through this pull down box, three signaling frequencies are available for selection: 3825 Hz, 3600 Hz and 2325 Hz. For 4 and 8 KHz operation, 3825 Hz should be selected; 2325Hz is for 2.5 kHz channel operation. This setting selects the center frequency of the signaling band.

5. Rx Frequency
Through this pull down box you can select the receive band's lower edge frequency of the teleprotection channel. The teleprotection channel is always 4 KHz wide; therefore this RX frequency should be set consistently according with the Digital Channel RX Frequency. For example:
If the digital channel Rx stream occupies a bandwidth from 192 KHz to 200 KHz (8 KHz Bandwidth), the Digital channel Rx Frequency is set to 192 KHz and the teleprotection channel Rx frequency is set to 200 KHz, thus coinciding the upper edges of both frequency bands (200 KHz).
If the digital channel occupies a bandwidth of 4 KHz, let's say from 212 KHz to 216 KHz, both, the digital channel and teleprotection channel Tx frequencies are set to 212 KHz, thus coinciding the upper edges of both frequency bands.

6. F6 TX Att level
This is a digital attenuator which controls the output level of the analog transceiver.

7. Channel Control Register
Selects Tx and Rx on either USB (Upper Side Band) or LSB (Lower Side Band) of the pilot and teleprotection commands. Transmission and reception can be configured the same or different (USB in a given direction and LSB in the opposite direction) depending on the channel configuration required.

8. F6 Teleprotection
Check to enable the PLC-TT Teleprotection Module.

At the bottom of the window there are four buttons similar to those present at the common tab: these buttons are:

1. Write Teleptrotection
This button is used to start a write operation of all the parameters in the Common and Digital channel tabs to the Teleprotection transceiver.

2. Read Teleprotection
This button is used to read the parameters from the digital channel tab and common tab from the Teleprotection transceiver.

3. Show Maps
Through this button you can see the value of the register to be written to the transceiver and/or read from it. This option can also be found in the menu: *transceiver/show memory maps* and *teleprotection/show memory maps*.
Note: This button is only available when logged as an administrator.

4. Address Discovery
Pressing this button the software will start an address scan from 0 to 127, to find the address of the Analog XCVR transceiver and teleprotection transceiver. After discovering the addresses, the corresponding values on the window shown through the menu *file/program settings* will be updated.

The second page inside the teleprotection window is the 'admin setup' which is shown below.
Note: this page is visible only when logged in an administrator session.

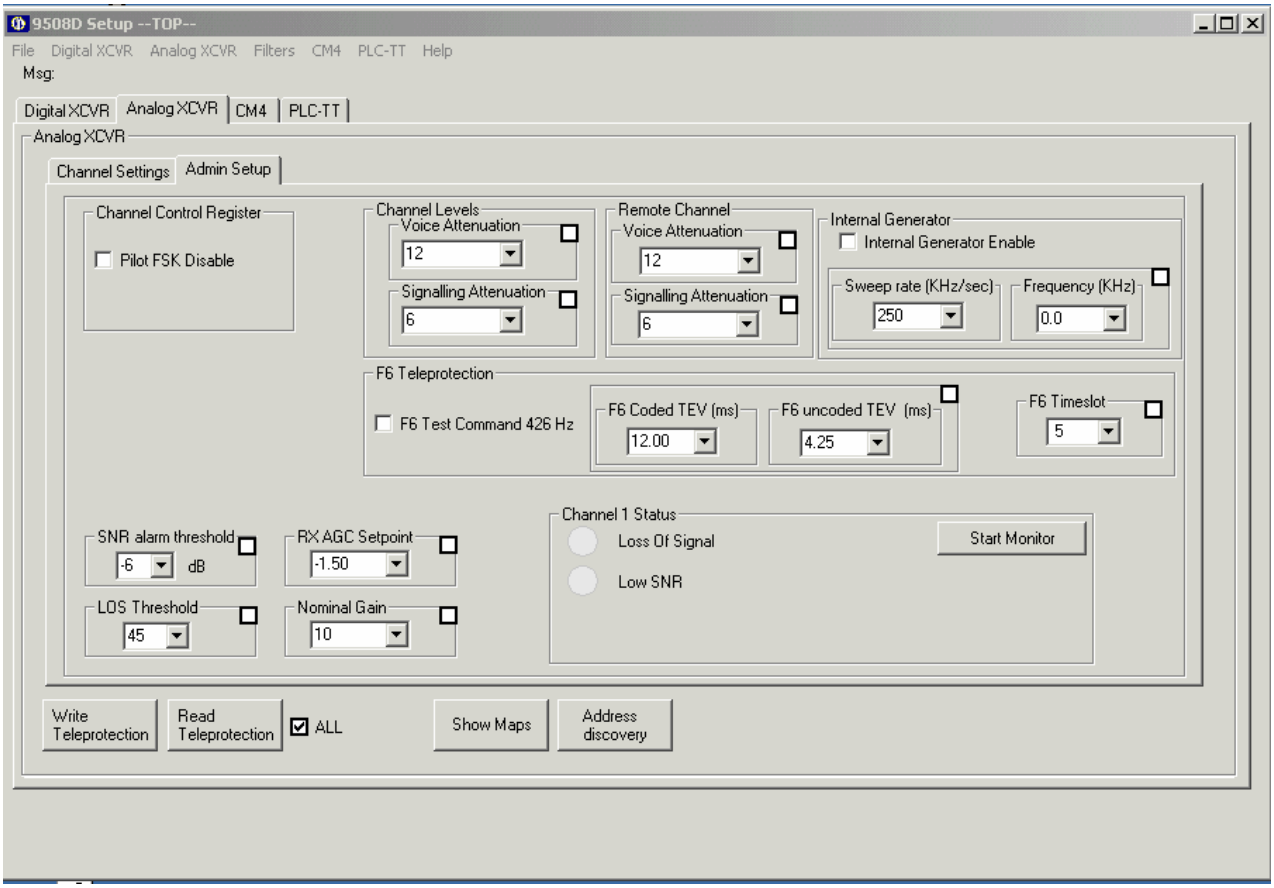

Figure 4-15. Analog XCVR channel administrator settings window

The parameters configured in this window are:

1. 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.

2. SNR Alarm Threshold
When the Signal to Noise Ratio falls below the value set in this pull down box, the SNR alarm is activated.

3. LOS Threshold
The LOS (Loss Of Signal) Threshold setting affects both channels. It can be set from 0dBm to 55dBm in 5dB steps. When the signal level drops by more than the selected LOS Threshold, the LOS alarm is activated. By default this parameter is set to 40dB.

4. RX AGC Setpoint
This level is the starting point when setting up the RX Automatic Gain Control level. In a default configuration this parameter is set to -1.5

5. Nominal Gain
Can be set from 0 to 100 dB. This value should be set during commissioning to the same value of the current transceiver gain obtained through the monitoring function incorporated in the software.

Channel Level Boxes:

6. Voice Attenuation
Can be set from 42 dB to 0 dB in 2 dB steps. In the 9508D this parameter is set to 12 dB of attenuation by default.

7. Signaling Attenuation
Can be set from -42 dB to 0 dB in 2 dB 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. This parameter is set at 6 dB of attenuation by default.

Remote Channel Boxes:

8. Remote Voice Attenuation
Enter the value set on the ‘Voice Attenuation’ field in the remote RFL 9508D unit into this box.

9. Remote Signaling Attenuation
Enter the value set on the ‘Signaling Attenuation’ field in the remote RFL 9508D unit into this box.

Internal Generator:

10. Internal Generator Enable
This box must be checked for the internal generator to be enabled. The amplitude of the tone generated is attenuated by the value indicated in voice attenuation pull down box.

11. 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.

12. 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.

F6 Teleprotection:

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

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

15. 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.

16. 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.

17. F6 Timeslot
Can be set from timeslot 1 to 30. Set to the time slot that the PLC-TT module is set to.

Channel 1 Status box:

As shown in Figure 4-14, the 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 Channel 1 Status box. An example of a message in the Channel 1 Status box is as follows:

Current Gain = 18dB
Nominal Gain Reference = 10dB
Rx Signal variation from nominal = -8dB

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.

The following tab will allow the user to access a window to configure parameters of the CM4 when used in a 9508D terminal. This window is shown below.

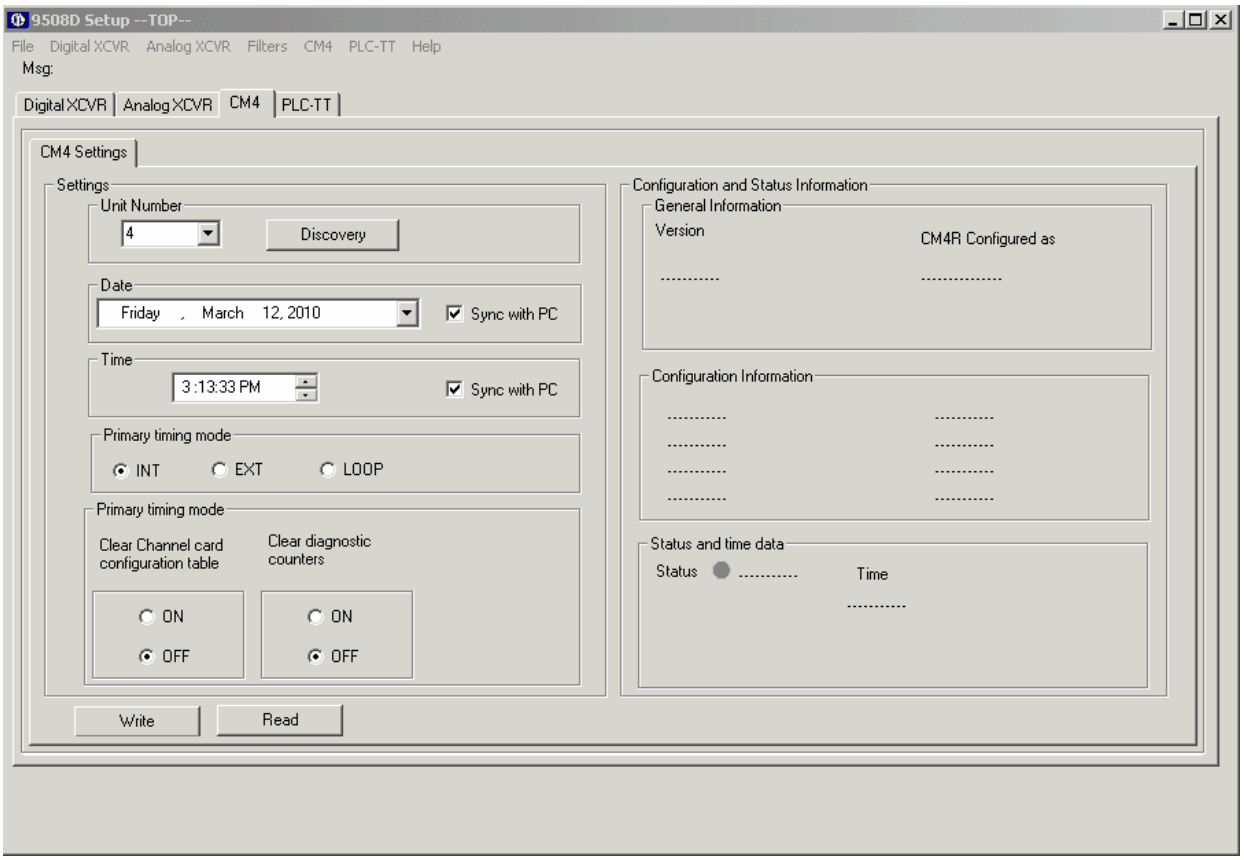

Figure 4-16. CM4 configuration window

1. Unit Number
It's the address that identifies the CM4 card, when a read or write operation to the CM4 or the teleprotection card are to be done, this address must be set first.

2. Discovery Button
When this button is pressed the software initiates a scan of address to find the address of the CM4 card.

3. Date and Time
It permits to enter a new date and time in the internal registers of the CM4. If the current date and time are not correct, check the box named 'sync with PC' and after a Write operation the date and time will be updated in the CM4 with the date and time settings from the PC where the configuration software is running. The module uses this date and time to "time stamp" SOE events.

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

5. Clear Channel configuration
For normal operation, Clear Channel Configuration should be set to OFF. This clears the CM4 SCB channel configuration.

6. Clear diagnostic counters
Is used to reset the internal diagnostic counters.
For normal operation, Clear Diagnostic Counters should be set to OFF.

The last top level tab is the teleprotection tab, which contains configuration settings and status values of the PLC-TT card as described below.

Figure 4-17 shows the configuration window for PLC-TT:

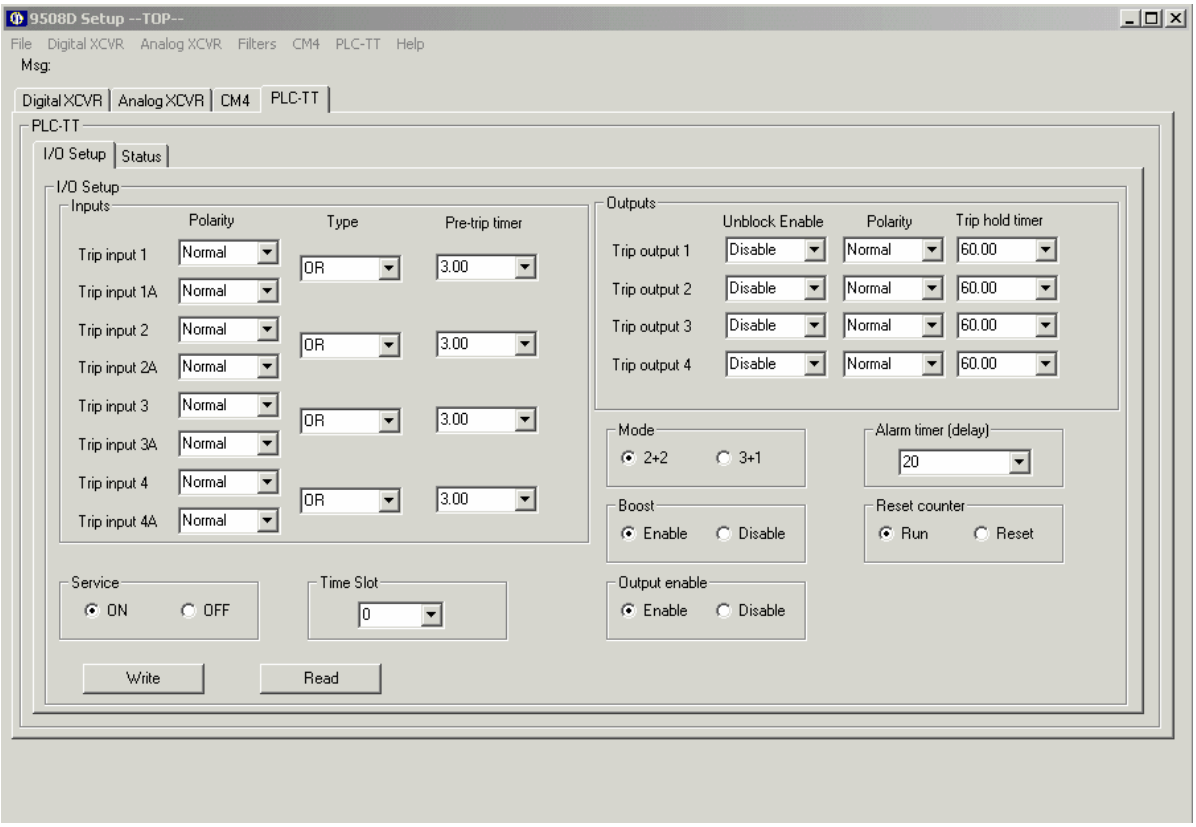

Figure 4-17. Configuration parameters for PLC-TT card

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

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

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

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

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

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

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

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

9. Input Type 1
Input Type 1 can be set to OR or AND. This is used when a second I/O module is installed to have double input and output per teleprotection command.

10. Input Type 2
Input Type 2 can be set to OR or AND. This is used when a second I/O module is installed to have double input and output per teleprotection command.

11. Input Type 3
Input Type 3 can be set to OR or AND. This is used when a second I/O module is installed to have double input and output per teleprotection command.

12. Input Type 4
Input Type 4 can be set to OR or AND. This is used when a second I/O module is installed to have double input and output per teleprotection command.

13. 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. (0.25ms to 4.00ms are valid)

14. 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. (0.25ms to 4.00ms are valid)

15. 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. (0.25ms to 4.00ms are valid)

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. (0.25ms to 4.00ms are valid)

17. 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.

18. Func 2 unblock enable
The Function 2 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. 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.

20. 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.

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

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

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

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

25. Func 1 triphold timer (ms)
When a trip is received, it will extend the trip 1 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.

26. Func 2 triphold timer (ms)
When a trip is received, it will extend the trip 2 by the time selected. 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.

27. Func 3 triphold timer (ms)
When a trip is received, it will extend the trip 3 by the time selected. 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.

28. Func 4 triphold timer (ms)
When a trip is received, it will extend the trip 4 by the time selected. 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.

29. Mode
Mode can be set to 2+2 or 3+1. The first number is the number of uncoded commands and the second one is the number of coded commands for a total of 4. Thus with operation mode 3+1, commands 1, 2 and 3 are uncoded commands and command 4 is a coded command.

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

31. Output enable
When enabled, all outputs are enabled. When disabled, all outputs are disabled.

32. 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.

33. 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.

34. 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. In 9508D only E1 internal frame is used.

35 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.

That is the whole list of configurable parameters for the PLC-TT card, if a 'read' or 'write' operation is to be performed, the CM4's address must be configured correctly either by discovering the address or placing it manually at the correct value. Figure 4-17 below shows the status parameters and information values for the PLC-TT card:

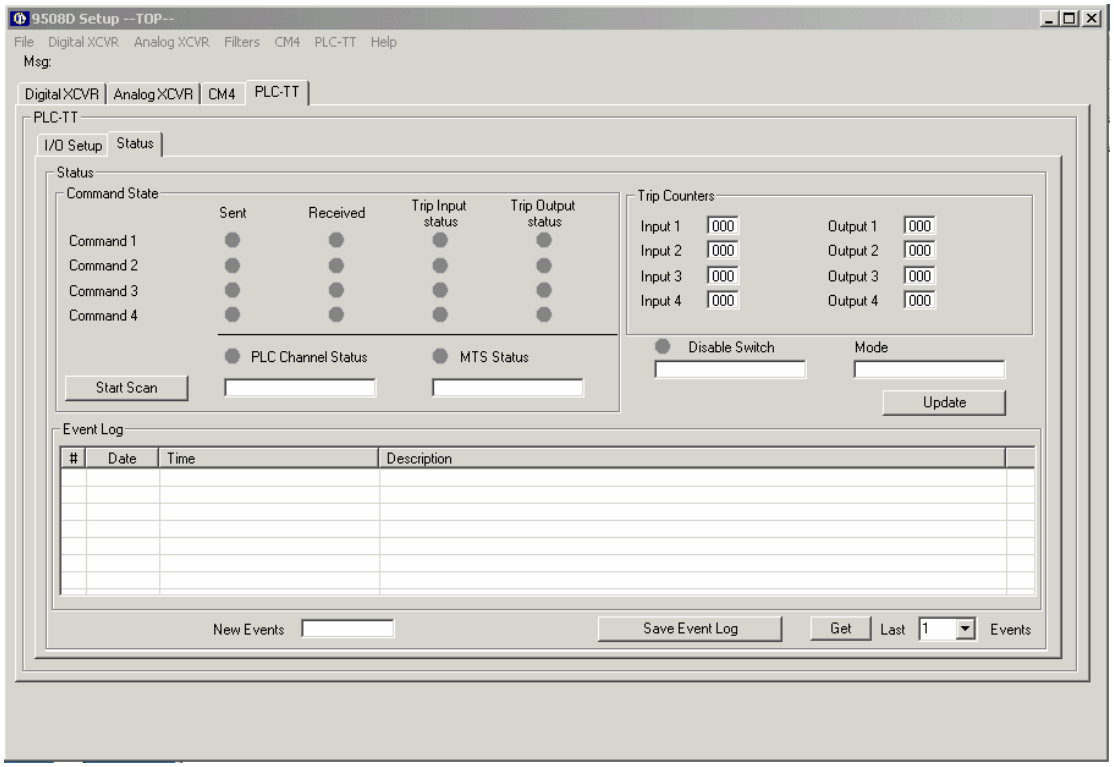

Figure 4-18. PLC-TT card's status window

When the 'update' button is pressed, the window is refreshed with status values from the PLC-TT card, these values include the Trip input/output counters and a list of the new events since last read.
To see the number of 'Last Events' displayed, just put the number of events required in the pull down box located at the right bottom corner of the window and press the 'GET' button.

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Section 5. CONFIGURATION

5.1 INTRODUCTION

This section describes the procedure required to put the RFL 9508D 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 9508D chassis are in place. Figure 5-1 shows the location of the RFL 9508D front panel controls and indicators. Table 5-1 describes the functions of the controls and indicators.

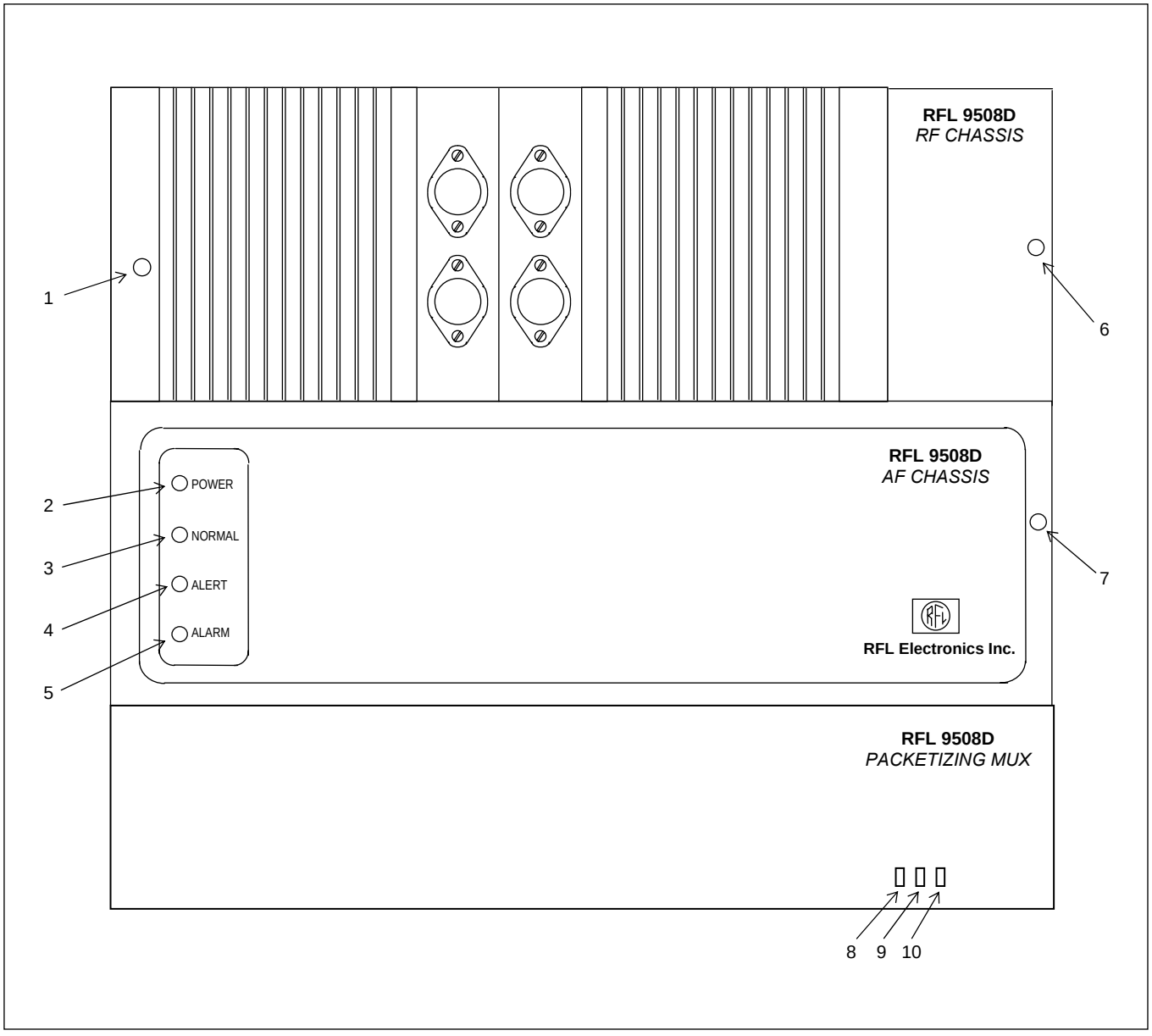


Figure 5-1. Front View Of RFL 9508D Chassis Showing Controls And Indicators

Table 5-1. Description of RFL 9508D Front Panel Controls and Indicators

Reference Designation	Description	Function
1	LED (green)	LED is ON when power amplifier is transmitting.
2	Power LED (green)	LED is ON when the 9508D AF chassis has power.
3	Normal LED (green)	LED is ON when there are no system ALERT or ALARM conditions in the AF chassis.
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	RF Chassis Thumbscrew	Locks RF Chassis when turned clockwise.
7	AF Chassis Thumbscrew	Locks AF Chassis when turned clockwise.
8	Power LED (green)	Lights ON when the packetizing multiplexer has power.
9	Status LED (green/amber/red)	Indicates which program is operating on the packetizing multiplexer.
10	Alarm LED (green/amber/red)	Indicates several states, including a system alarm in the packetizing multiplexer when a software reset occurs.

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.

Table 5-2. Module Placement in Digital Chassis

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
PLC Transfer Trip	5.2.1.6	One or two PLC Transfer Trip I/O modules	5.2.1.7
CM4 Main Module	5.2.1.4	None	
Test Panel	5.2.1.8	None	
Teleprotection Transceiver	5.2.1.9	MA-470	5.2.1.11
Digital Transceiver	5.2.1.10		

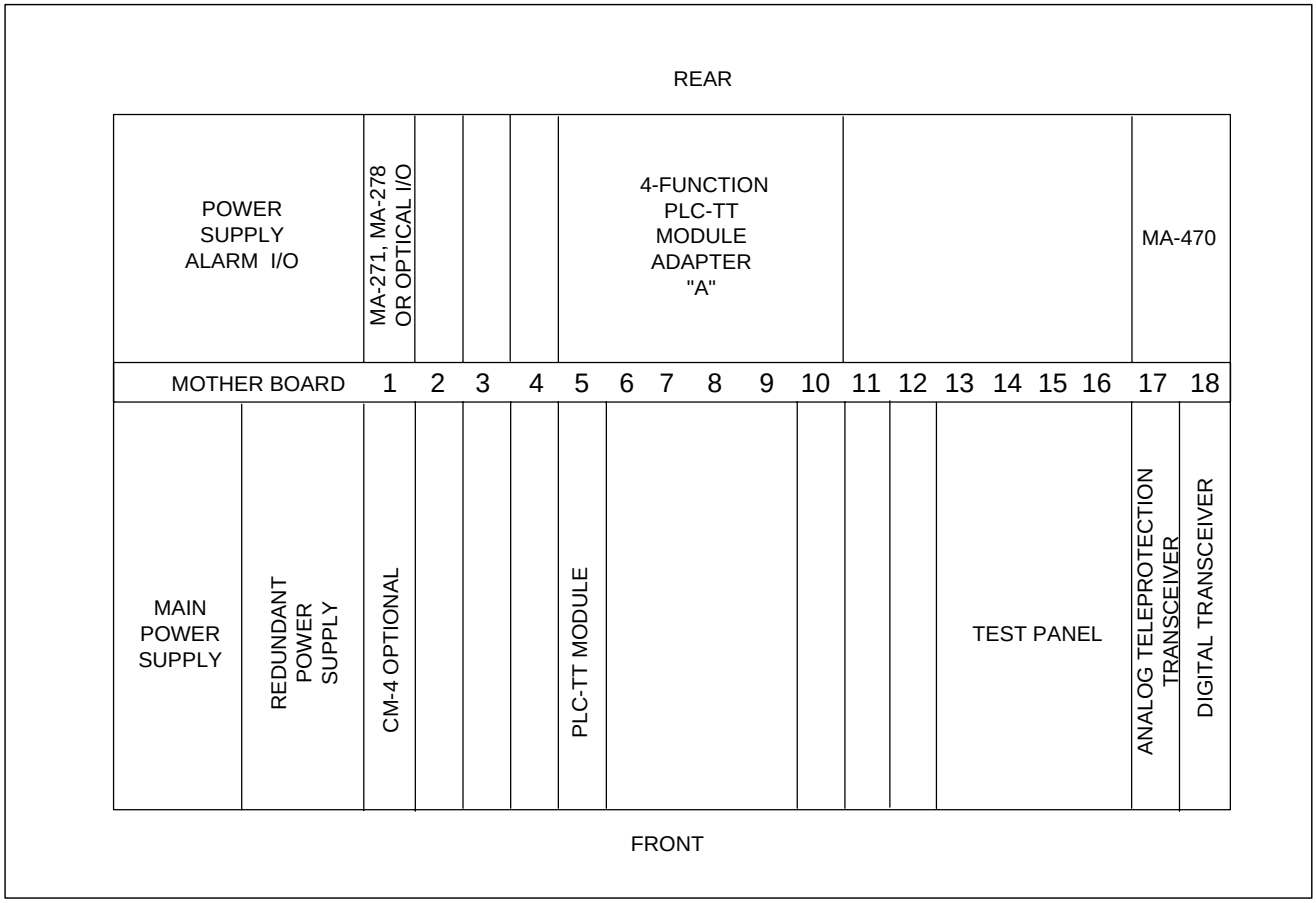


Figure 5-2. Module Placement in a Typical RFL 9508D Digital Chassis (Top View)

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 PLC-TT TELEPROTECTION MODULE

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

5.2.1.7 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.

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

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.

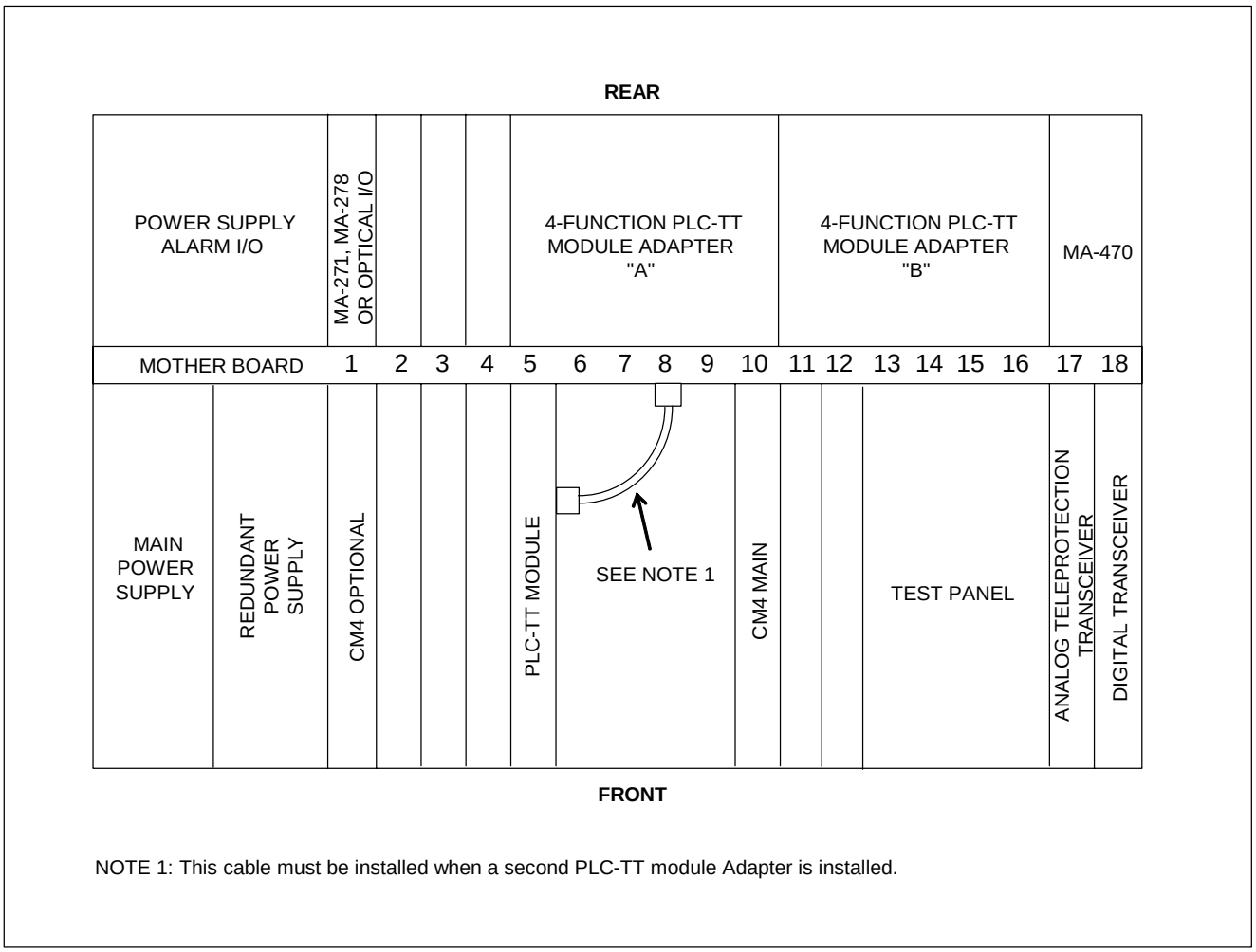


Figure 5-3. Digital chassis showing the installation of two PLC-TT Module Adapters

5.2.1.8 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.

5.2.1.9 TELEPROTECTION TRANSCEIVER

The Digital Chassis requires two Transceiver Modules. One of them is the teleprotection transceiver which manages the F6 modulation for the teleprotection when included in the system, this module must be mounted at the front of the chassis in slot 17.

5.2.1.10 DIGITAL TRANSCEIVER

The Digital Transceiver performs the QAM modulation, this module must be mounted at the front of the chassis in slot 18.

5.2.1.11 TRANSCEIVER MODULE ADAPTER

The Transceiver module requires a Module Adapter. The Module Adapter used with the Transceiver Modules is the MA-470, which is mounted at the rear of the chassis directly behind the Transceiver Modules.

5.2.1.12 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 5-8 and Table 5-7 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 two chassis, one of 6U high and the packetizing multiplexer chassis which is 2U high. The upper part of the 6U chassis is the RF Section, and the lower part of the same 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.

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

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		

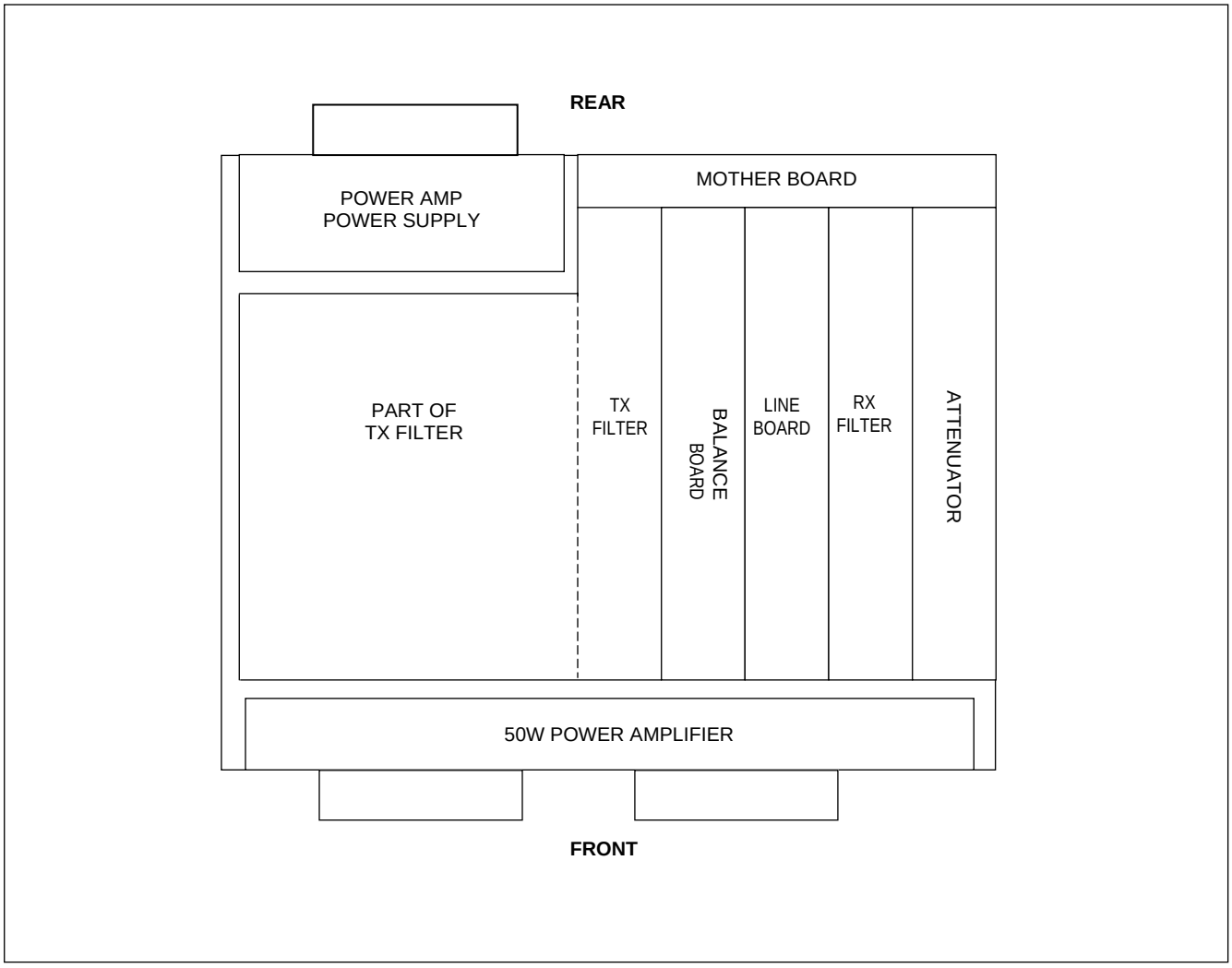


Figure 5-4. Module Placement in a Typical RFL 9508D RF Chassis (Top View)

5.2.3.1 50W POWER AMPLIFIER

The 50 Watt power amplifier is mounted to the upper part of the front door of the 9508D 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 9508D 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.

Table 5-5. 9508 RF Chassis Cables

RFL cable part number	From	To	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

* If the coax is connected to J4, then J5 is unused. If the coax is connected to J5, then J4 is unused.

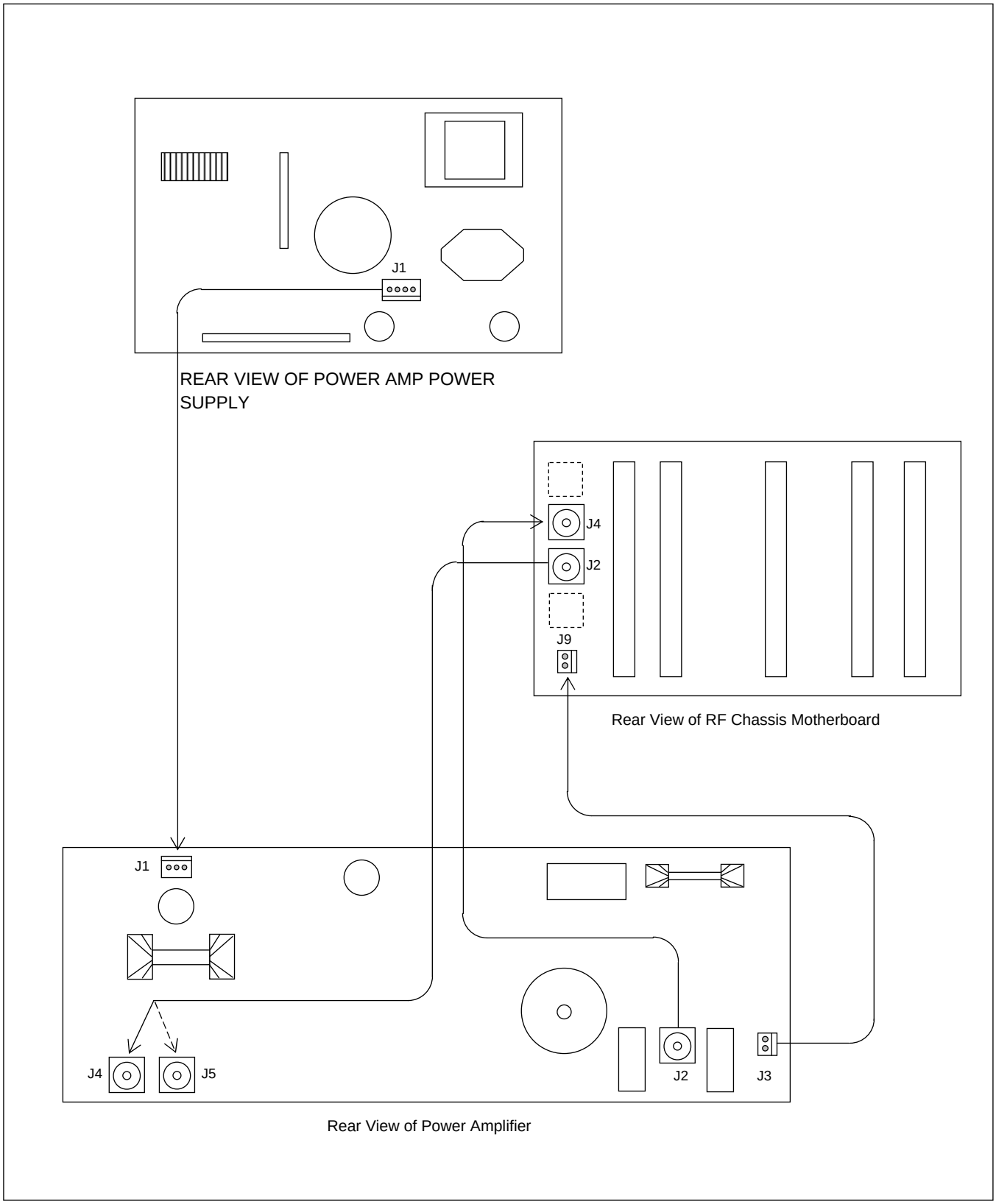


Figure 5-5. Cable connections in the RF Chassis

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

100 Watt systems will comprise of a 50 Watt system as described in paragraph 5.2.3, 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.

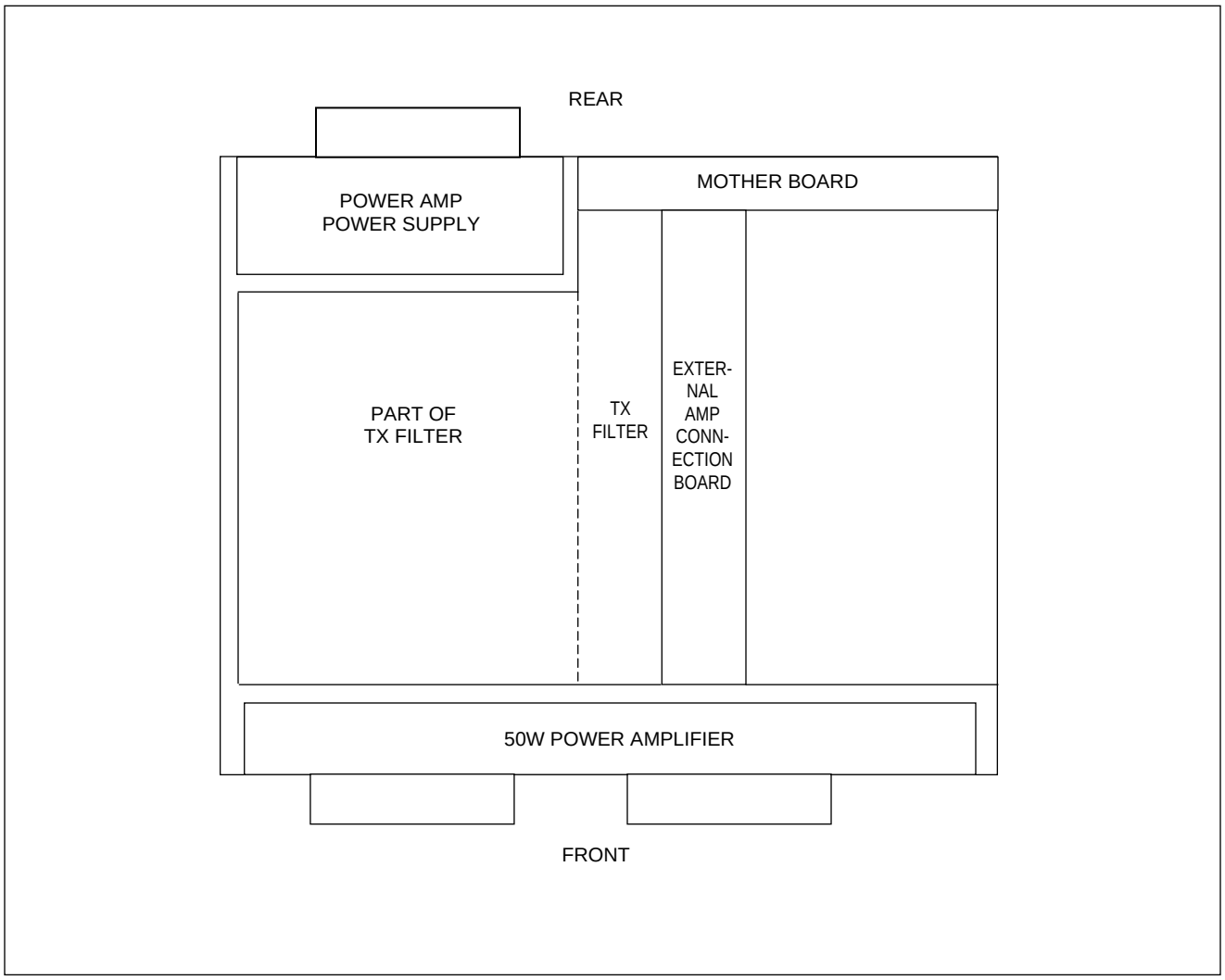


Figure 5-6. Module placement in auxiliary 3U RF Chassis for 100W Systems (Top View)

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

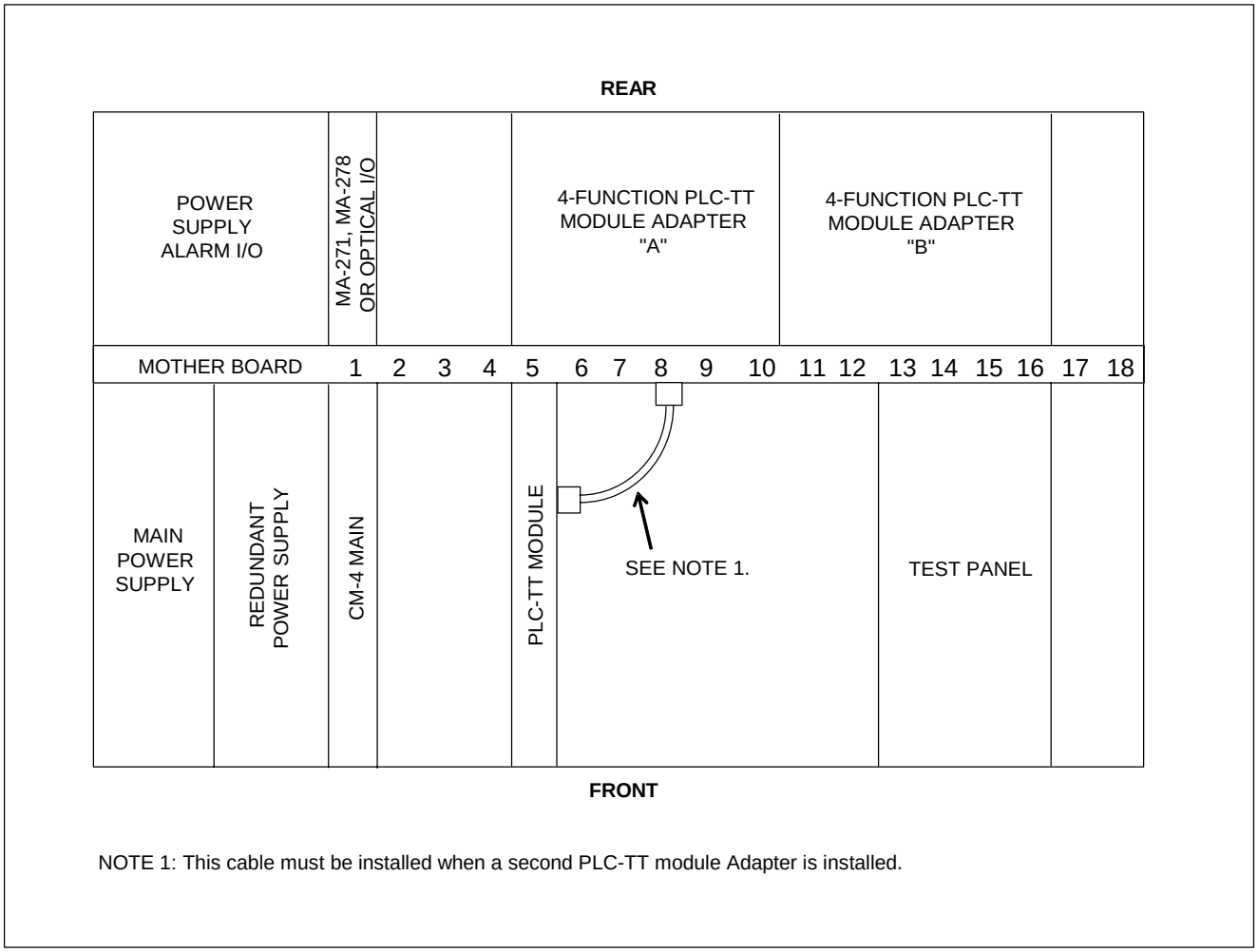


Figure 5-7. Module placement for 9508RT

5.2.7 MODULE PLACEMENT IN THE PACKETIZING MULTIPLEXER

The packetizing multiplexer is a 2U high chassis which contains the different interfaces and channel cards that can be required in a system. Figure 5-8 shows the rear view of the chassis; the unit has three slots where cards are plugged in to provide for different interfaces of voice and data channels.

Table 5-6 list the different channel cards available to use on the packetizing multiplexer.

Any of the interface cards can be placed in any of the available slots, nevertheless, some interface cards can not be placed in more than one any slot.

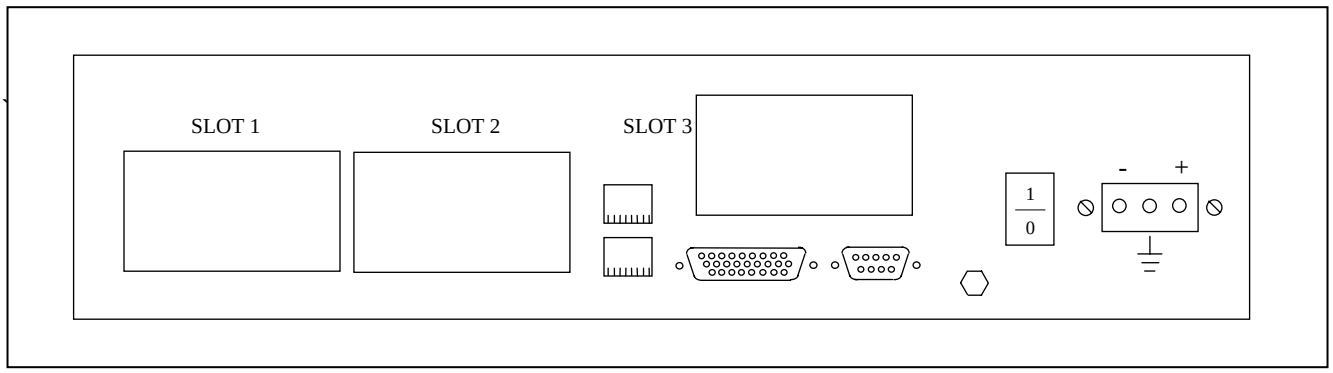


Figure 5-8. Packetizing unit rear view

Table 5-6. List of the packetizing multiplexer interface cards

Interface Cards	
Dual/Quad FXS Interface Card	5.2.7.1
Dual/Quad FXO Interface Card	5.2.7.2
E&M Interface Card	5.2.7.3
T1 Interface Card	5.2.7.4
E1 Interface Card at 75 Ohms	5.2.7.5
E1 Interface Card at 120 Ohms	5.2.7.6
T1/E1 Interface Card	5.2.7.7
T1/E1 Interface Card at 75 Ohms	5.2.7.8
ISDN-BRI S/T Interface Card	5.2.7.9
Dual Serial Port Interface Card	5.2.7.10

5.2.7.1 DUAL/QUAD FXS INTERFACE CARD

It provides a subscriber line connection to a conventional two-wire analog telephone. With two or four RJ-11 female connectors, up to 3 FXS Interface cards can be installed, providing up to 12 analog FXS voice ports.

5.2.7.2 DUAL/QUAD FXO INTERFACE CARD

It provides a subscriber line connection to a central office or the station side of an analog PBX. With two or four RJ-11 female connectors, up to 3 FXS Interface cards can be installed, providing up to 12 analog FXS voice ports.

5.2.7.3 E&M INTERFACE CARD

It provides a local E&M tie-line connection to an analog PBX. This card has four RF-45 female connectors; up to three E&M interface cards can be installed providing up to 12 analog E&M voice ports.

5.2.7.4 T1 INTERFACE CARD

It supports digital voice and data at 100 Ohms. It has a single port interface with one RJ-48 female connector. Up to 3 cards can be installed providing a maximum of 72 voice/data channels.

5.2.7.5 E1 INTERFACE CARD AT 75 OHMS

It supports digital voice and data at 75 Ohms. It has a single port interface with two coaxial BNC connectors. Up to 3 cards can be installed providing a maximum of 90 voice channels or 93 data channels.

5.2.7.6 E1 INTERFACE CARD AT 120 OHMS

It provides a 2048 Mbps channelized digital connection with up to 32 timeslots. It has a single port interface with one RJ-48 Female connector. Up to 3 cards can be installed providing a maximum of 90 voice channels or 93 data channels.
NOTE: This card cannot be installed on a unit that has a T1 Interface card installed in another slot; a T1/E1 interface card can be installed in place of the T1 Interface card, then, the T1/E1 card can be configured for T1 operation.

5.2.7.7 T1/E1 INTERFACE CARD

This is a dual port interface card with two RJ-48 female connectors. Provides a 1544 Mbps channelized digital connection at 100 Ohms with up to 24 timeslots and a 2048 Mbps channelized digital connection with up to 32 timeslots, software selectable at 75 or 120 Ohms. Up to three cards can be installed, providing a maximum of 120 voice channels and 124 data channels.
NOTE: This card cannot be installed on a unit that has a T1 Interface card installed in another slot; a T1/E1 interface card can be installed in place of the T1 Interface card, then, the T1/E1 card can be configured for T1 operation.

5.2.7.8 T1/E1 INTERFACE CARD AT 75 OHMS

It supports digital voice/data at 75 Ohms. It has two RJ-48 female ports; up to three cards can be installed providing a maximum of 120 voice channels or 124 data channels.
NOTE: This card cannot be installed on a unit that has a T1 Interface card installed in another slot; a T1/E1 interface card can be installed in place of the T1 Interface card, then, the T1/E1 card can be configured for T1 operation.

5.2.7.9 ISDN-BRI S/T INTERFACE CARD

It supports digital voice and data using ISDN-BRI, QSIG, transparent and customized signaling. It has two RJ-48 female connectors; 2 B-channels at 64 kbps and one D-channel at 16 kbps on each physical port. Up to three interface cards can be installed, providing a maximum of 6 ports and 12 B-channels for voice or data.

5.2.7.10 DUAL SERIAL PORT (WAN) INTERFACE

The dual serial port interface card provides the capacity to increase the number of serial ports on the packetizing multiplexer, according to data traffic needs. It has 2 universal serial ports per interface card, supporting V.35/V.11,TIA-232 (V.24), X.21, X.21 CE, TIA-449 (V.36) and TIA-530 interfaces. The connector used is the HD-26 Female that provide auto detect of interface and gender according to the custom cable installed.

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 9508D system. These modules are listed in Table 5-6.

Table 5-7. Digital Chassis Jumper Configurations.

Module	**See Paragraph:**
CM4 Module	5.3.1.1
CM4 Module Adapters: MA-271, MA-278	5.3.1.2
CM4 Optical Interface Adapter	5.3.1.3
PLC-TT Transfer Trip	5.3.1.4
PLC-TT Transfer Trip Module Adapters	5.3.1.5
Teleprotection Transceiver Module	5.3.1.6
Digital Transceiver Module	5.3.1.7
Transceiver Module Adapter: MA-470	5.3.1.8

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.

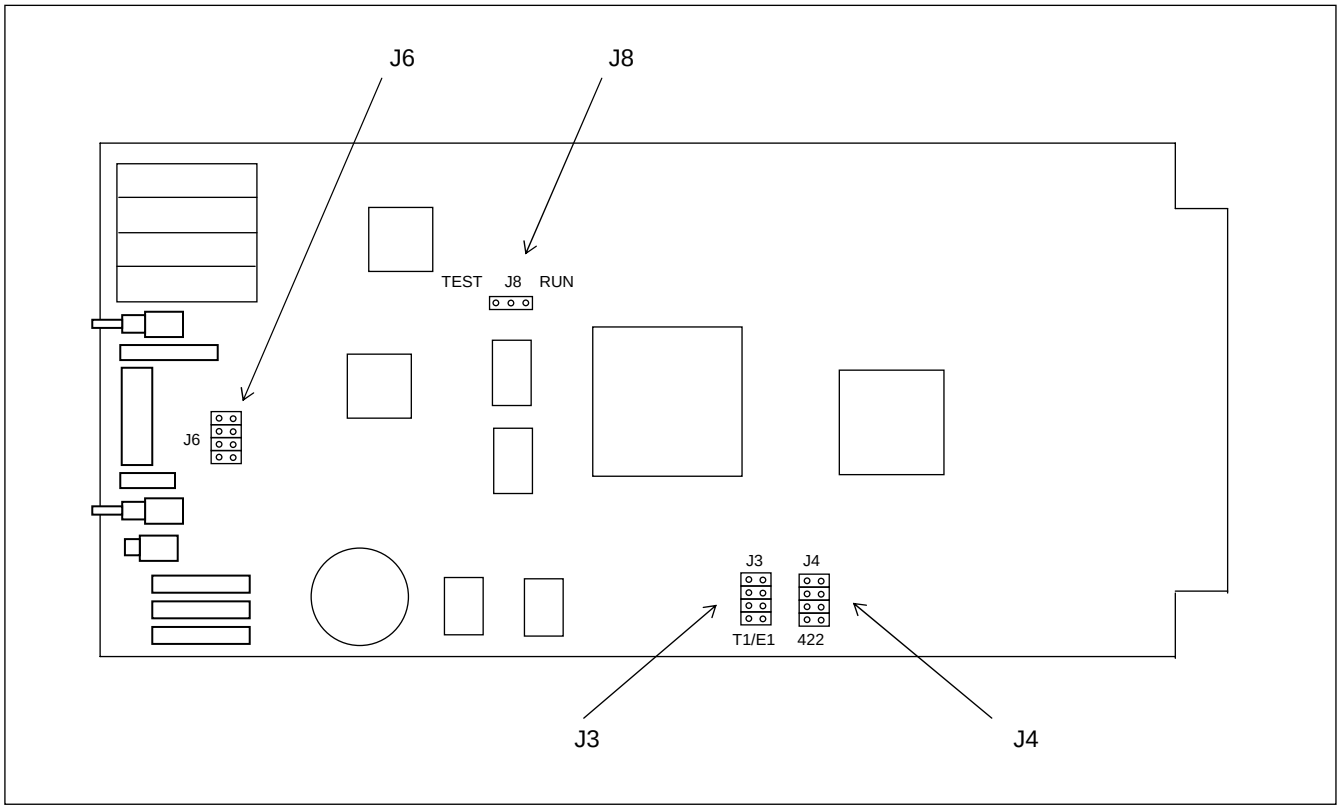
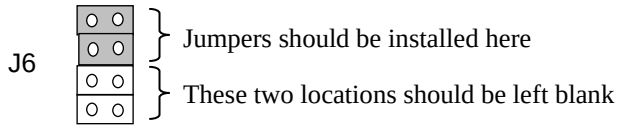


Figure 5-9. Location of jumpers on CM4 common module

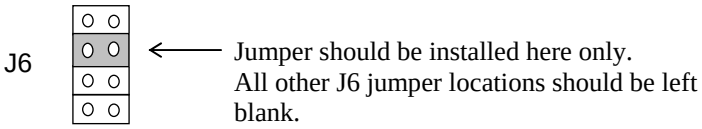
Table 5-8. Setting CM4 jumpers

<table>
<tr><th>Jumper</th><th>Function</th></tr>
<tr><td>J3</td><td>Place all four J3 jumpers in T1/E1 position to select external timing input in T1/E1 format.</td></tr>
<tr><td>J4</td><td>Place all four J4 jumpers in 422 position to select external timing input in RS422 format.</td></tr>
<tr><td>J6</td><td>Used to select DI-A or TERMINAL, or DI-B, in 9508D 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.

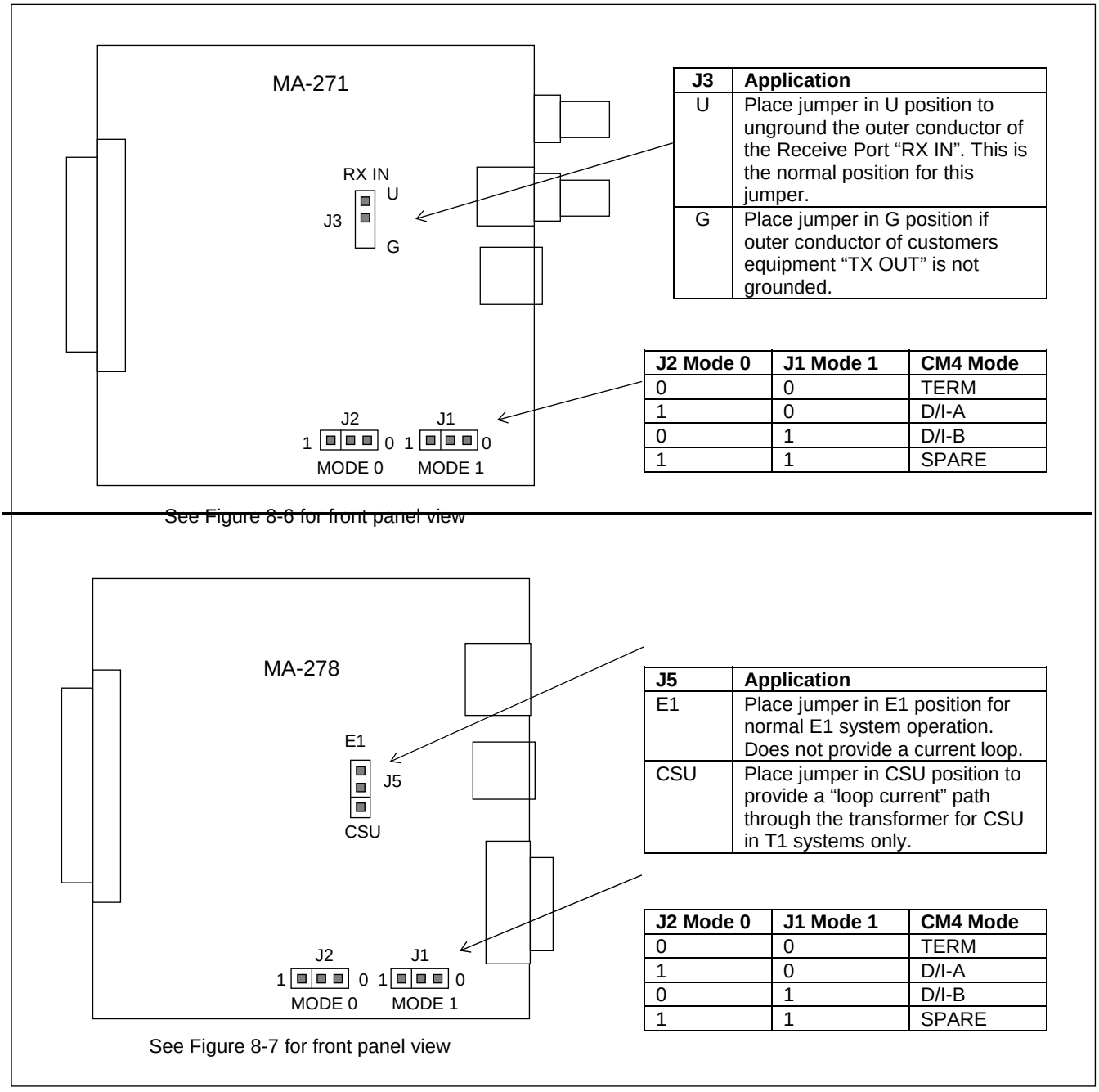
If the CM4 you are setting up is for DI-B, the J6 upper location, and the lower two jumper locations should be left blank. The second from the top J6 jumper should be installed.

 
</td></tr>
<tr><td rowspan="2">J8</td><td>Place jumper J8 in RUN position for normal system operation.</td></tr>
<tr><td>Place jumper J8 in TEST position for factory testing only.</td></tr>
</table>

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.



J3	Application
U	Place jumper in U position to unground the outer conductor of the Receive Port "RX IN". This is the normal position for this jumper.
G	Place jumper in G position if outer conductor of customers equipment "TX OUT" is not grounded.

J2 Mode 0	J1 Mode 1	CM4 Mode
0	0	TERM
1	0	D/I-A
0	1	D/I-B
1	1	SPARE

J5	Application
E1	Place jumper in E1 position for normal E1 system operation. Does not provide a current loop.
CSU	Place jumper in CSU position to provide a "loop current" path through the transformer for CSU in T1 systems only.

J2 Mode 0	J1 Mode 1	CM4 Mode
0	0	TERM
1	0	D/I-A
0	1	D/I-B
1	1	SPARE

Figure 5-10. Location and use of setup jumpers on MA-271 and MA-278 Module Adapters.

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.

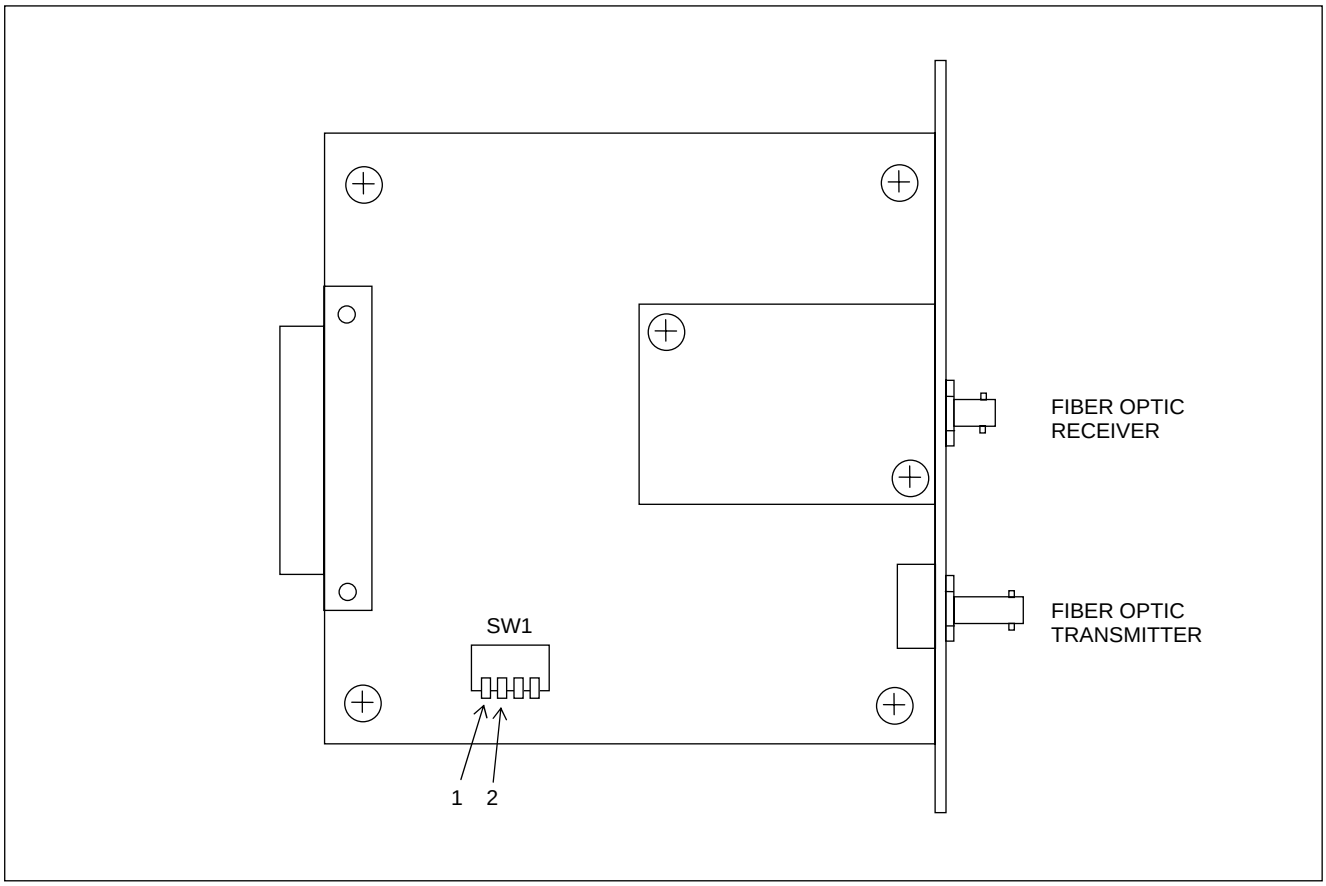


Figure 5-11. Location of DIP switch SW1 on typical Optical Interface Adapter

Table 5-9. Switch settings, DIP switch SW1 on typical Optical Interface Adapter

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

5.3.1.4 SETTING JUMPERS ON THE PLC-TT MODULE

The PLC-TT Module has three jumpers that must be set for proper system operation. These are J2, J3, and J4, and are shown in Figure 5-11. Refer to Table 5-10 for information on how to set these jumpers.

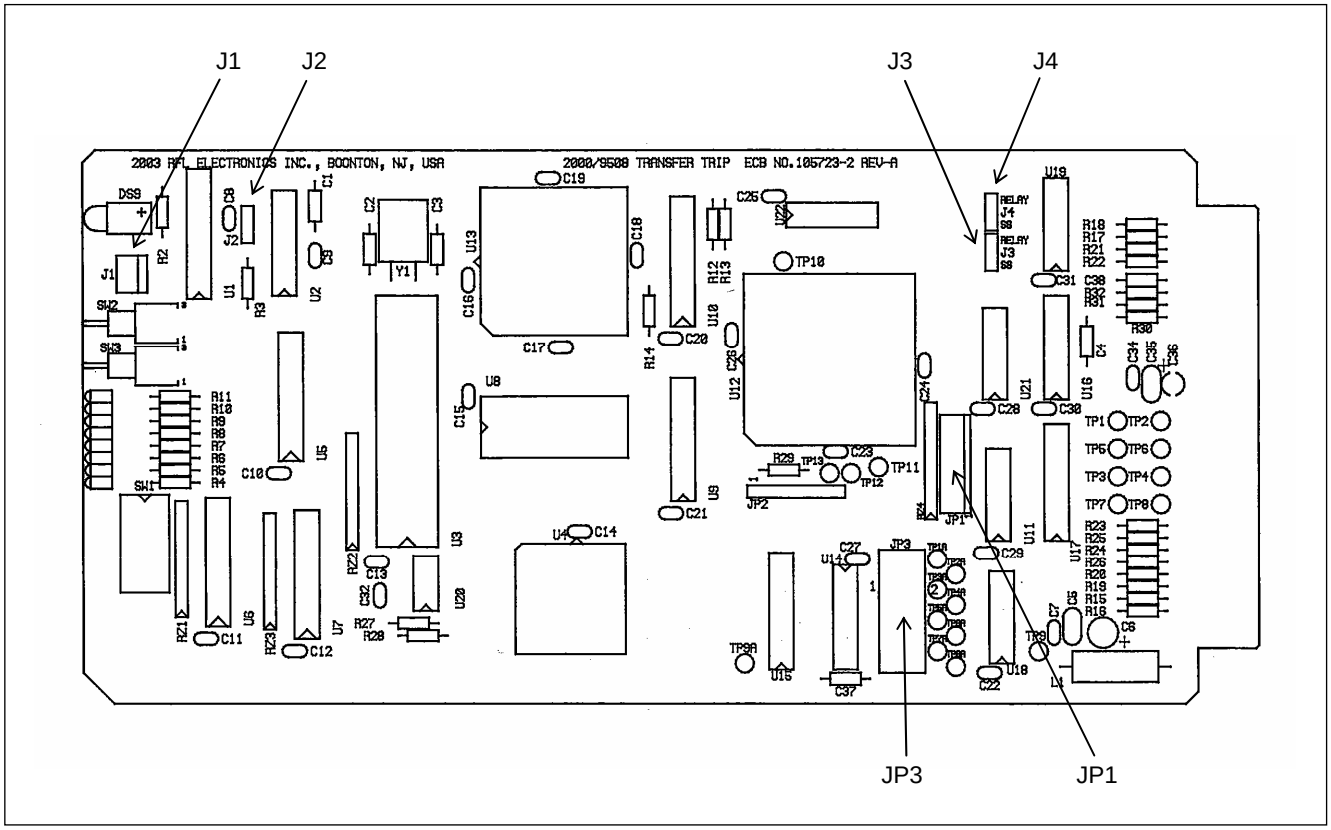


Figure 5-12. Location of jumpers on PLC-TT module.

Table 5-10. Setting Jumpers on the PLC-TT module

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

5.3.1.5 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 5-12. Refer to Table 5-11 for information on how to set these jumpers.

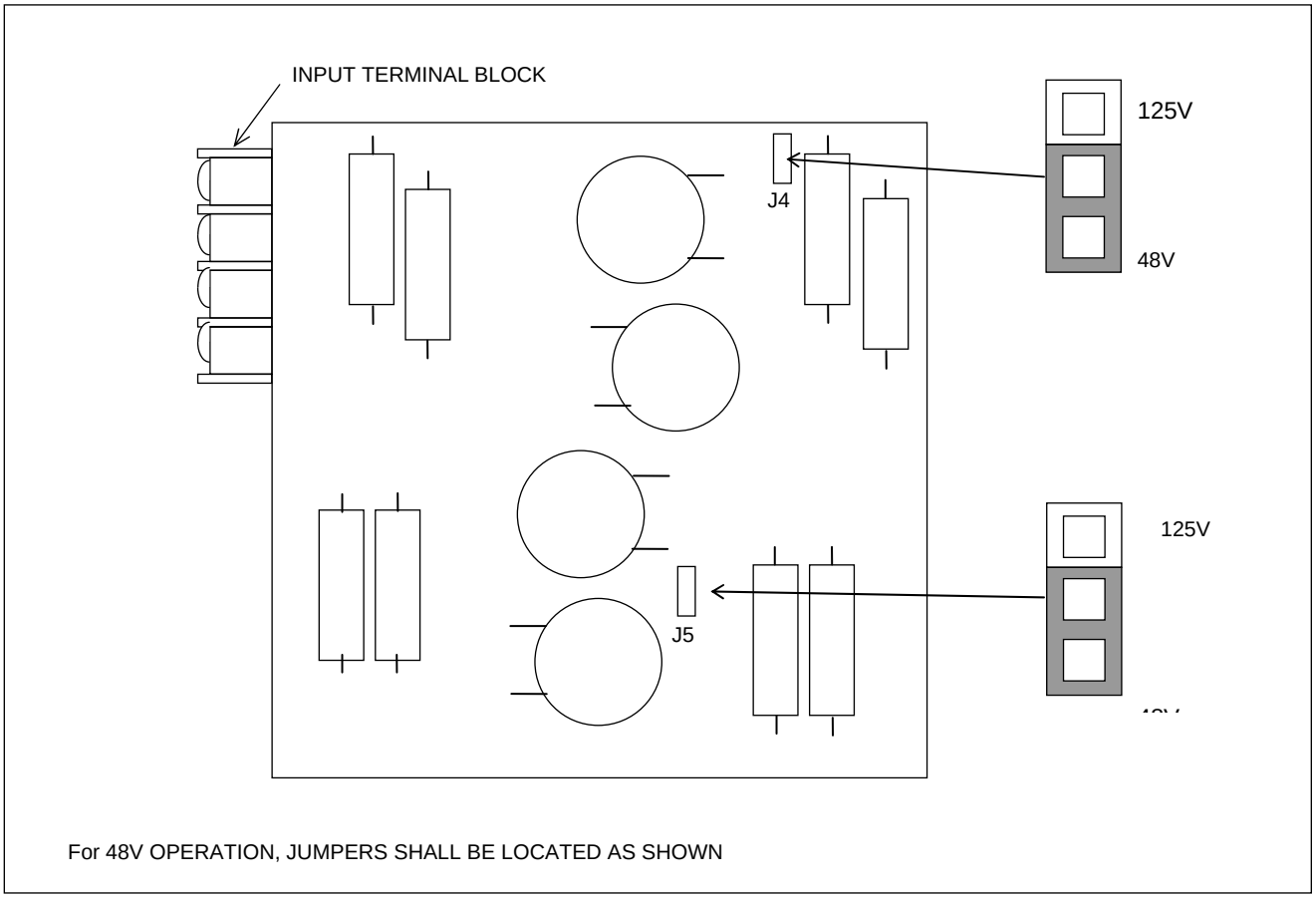


Figure 5-13. Location and use of voltage control jumpers on a typical I/O adapter module input board

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 5-12 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 5-12.

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.

Table 5-11. Voltage control jumper settings on module adapter Input Board

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	

5.3.1.6 SETTING JUMPERS ON THE TELEPROTECTION 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 5-13. The function of the LEDs is shown in Table 5-12.

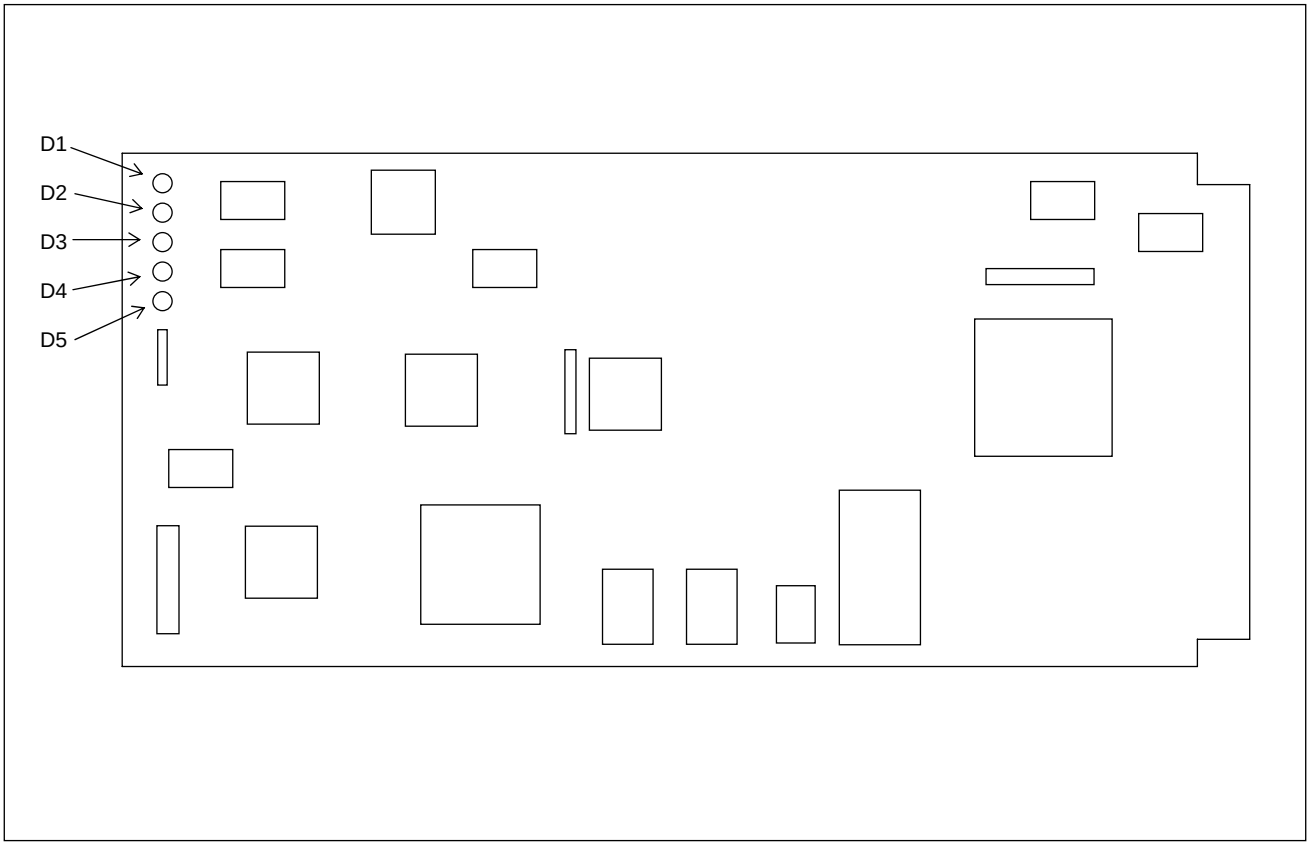


Figure 5-14. Location of LEDs on Transceiver module.

Table 5-12. Function of LEDs on the 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 GREEN when transceiver module power is ON
D4	T1/E1 Status Always OFF
D5	Power LED GREEN when transceiver module power is ON

5.3.1.7 SETTING JUMPERS ON THE DIGITAL TRANSCEIVER MODULE

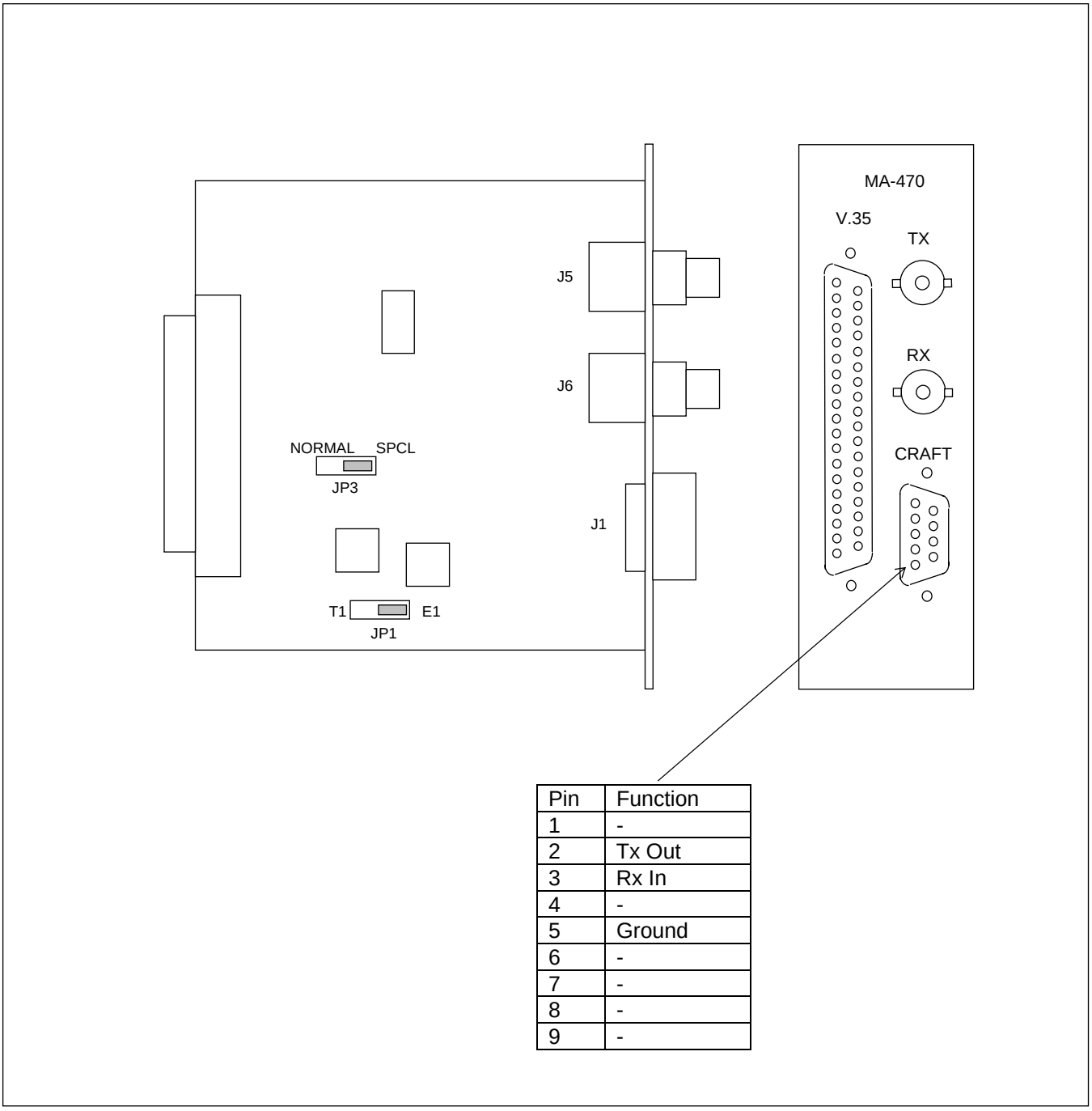
The digital transceiver is quite similar to the teleprotection transceiver; the components placement is the same, and also the jumper placement and LEDs as shown in figure 5-13 is the same. All of the jumpers are set at the factory for proper system operation, and should not be changed by the user. In 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 5-13. The function of the LEDs is shown in Table 5-13

Table 5-13. Function of LEDs on the Transceiver module

LED	Function
D1	Link status Has two states as follows: GREEN: Digital link is established Flashing RED: The transceivers are in training process.
D2	Presently unused, normally GREEN (LED is ON when power is applied to transceiver module)
D3	Presently unused, normally GREEN (LED is ON when power is applied to transceiver module)
D4	Boot Status Has two states as follows: RED: The transceiver is booting OFF: The Transceiver is operating and running.
D5	Power LED GREEN when transceiver module power is ON

5.3.1.8 SETTING JUMPERS ON TRANSCEIVER MODULE ADAPTER

The Transceiver Modules require an MA-470 Module Adapter. The MA-470 plugs into the rear of the chassis directly behind the Transceiver Modules and provides the appropriate connections to the line coupling equipment and the packetizing multiplexer. This Module Adapter has two jumpers, one jumper (JP1) that must be set to either T1 or E1; and JP3 that must be set to SPCL side. Refer to Figure 5-14 for a rear panel view and terminal connections for the MA-470. This module adapter occupies two rear chassis slot.



Pin	Function
1	-
2	Tx Out
3	Rx In
4	-
5	Ground
6	-
7	-
8	-
9	-

Figure 5-15. MA-470 Module Adapter, rear panel view and pinouts

5.3.1.9 SETTING JUMPERS FOR DROP AND INSERT APPLICATIONS

In T1/E1 applications, the RFL 9508D can be either Terminal/DI-A or DI-B. Several of the modules in the 9508D 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 9508D system for proper operation. These modules are listed below.

Table 5-14. Analog Chassis Jumper Configurations And Other Settings

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

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 5-17 on the following page. Table 5-15 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 5-16 for a description of the switch functions and their settings.

.

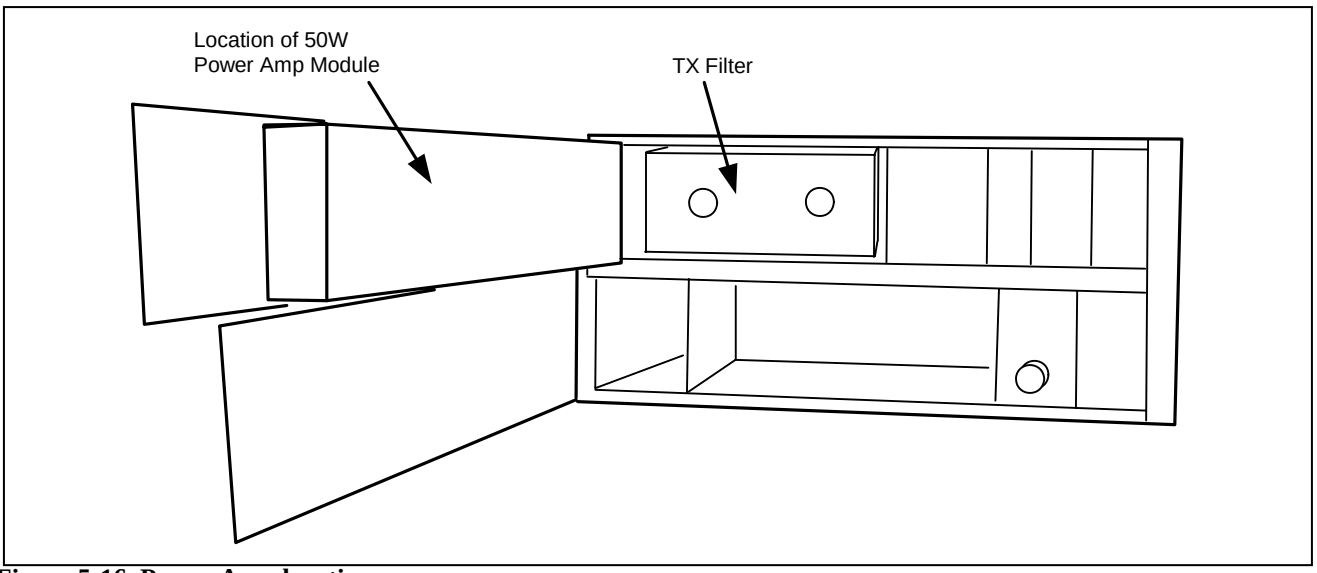


Figure 5-16. Power Amp location

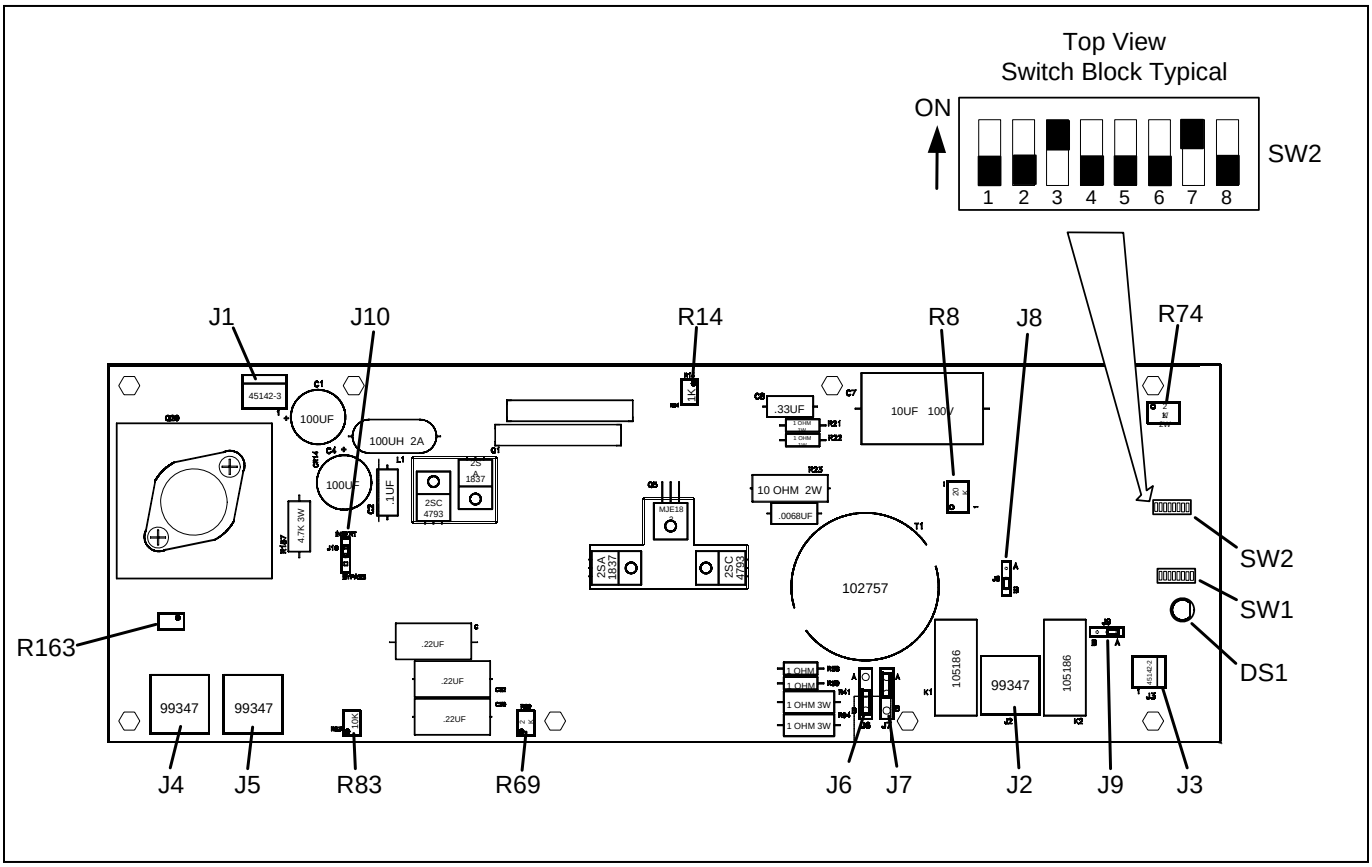
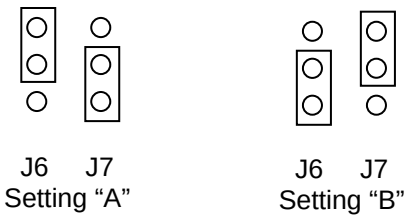


Figure 5-17. Circuit board of the 50W Power Amp showing locations of jumpers, switches, connectors, potentiometers.

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 5-16 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.

Table 5-15. Function of jumpers, connectors and potentiometers on Power Amp.

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.  J6 J7 Setting "A" J6 J7 Setting "B"
J8*	jumpers	For factory use only. Should always be set to position A.
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 Enable.
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.

* Effective October 2010

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.

Table 5-16. Function of DIP Switches SW1 and SW2 on Power Amp Board.

<table>
<tr><td rowspan="6">SW1</td><td colspan="4">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 SW1-7 are not used.</td></tr>
<tr><td>DIP Switch</td><td colspan="3">Phase Angle in Degrees</td></tr>
<tr><td>SW1-1</td><td colspan="3">30</td></tr>
<tr><td>SW1-3</td><td colspan="3">45</td></tr>
<tr><td>SW1-6</td><td colspan="3">60 Default setting</td></tr>
<tr><td>SW1-8</td><td colspan="3">90</td></tr>
<tr><td rowspan="7">SW2-1 thru SW2-4</td><td colspan="4">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:</td></tr>
<tr><td rowspan="2">DIP Switch</td><td colspan="3">Frequency (KHz)</td></tr>
<tr><td>30-50</td><td>51-99</td><td>100-500</td></tr>
<tr><td>SW2-1</td><td>Not used</td><td>Not used</td><td>Not used</td></tr>
<tr><td>SW2-2</td><td>40V</td><td>45V</td><td>50V</td></tr>
<tr><td>SW2-3</td><td>30-35V Default</td><td>37V Default</td><td>40V Default</td></tr>
<tr><td>SW2-4</td><td>20-25V</td><td>28V</td><td>30V</td></tr>
<tr><td rowspan="7">SW2-5 thru SW2-8</td><td colspan="4">Overvoltage Detector Set Point:
The 50W Power Amplifier will shut down if the output voltage exceeds the preset threshold. SW2-5 through SW2-8 can be set as follows:</td></tr>
<tr><td rowspan="2">DIP Switch</td><td colspan="3">Frequency (KHz)</td></tr>
<tr><td>30-50</td><td>51-99</td><td>100-500</td></tr>
<tr><td>SW2-5</td><td>Not used</td><td>Not used</td><td>Not used</td></tr>
<tr><td>SW2-6</td><td>85V</td><td>N/A</td><td>N/A</td></tr>
<tr><td>SW2-7</td><td>70V Default</td><td>85V</td><td>N/A</td></tr>
<tr><td>SW2-8</td><td>60V</td><td>70V Default</td><td>75V Default</td></tr>
</table>

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 5-17. The remaining 17 Jumpers are located on the 107828-1 board. The location of these jumpers is shown in Figure 5-18. Refer to Table 5-16 for information on how to configure the jumpers on the Tx Filter.

Table 5-17. Tx Filter Setup Jumpers

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

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 9508D NMS, and RS-232 9-pin female connection.
- 11/32" hexagonal nut driver
- Philips head screwdriver

Tx Filter Tuning Procedure:

1. Use RFL 9508D NMS software to generate a list of appropriate jumper settings. Refer to section 4 of the manual for more information on RFL 9508D 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 9508D 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 9508D NMS write the original configuration back.

19. Your Tx Filter is now tuned.

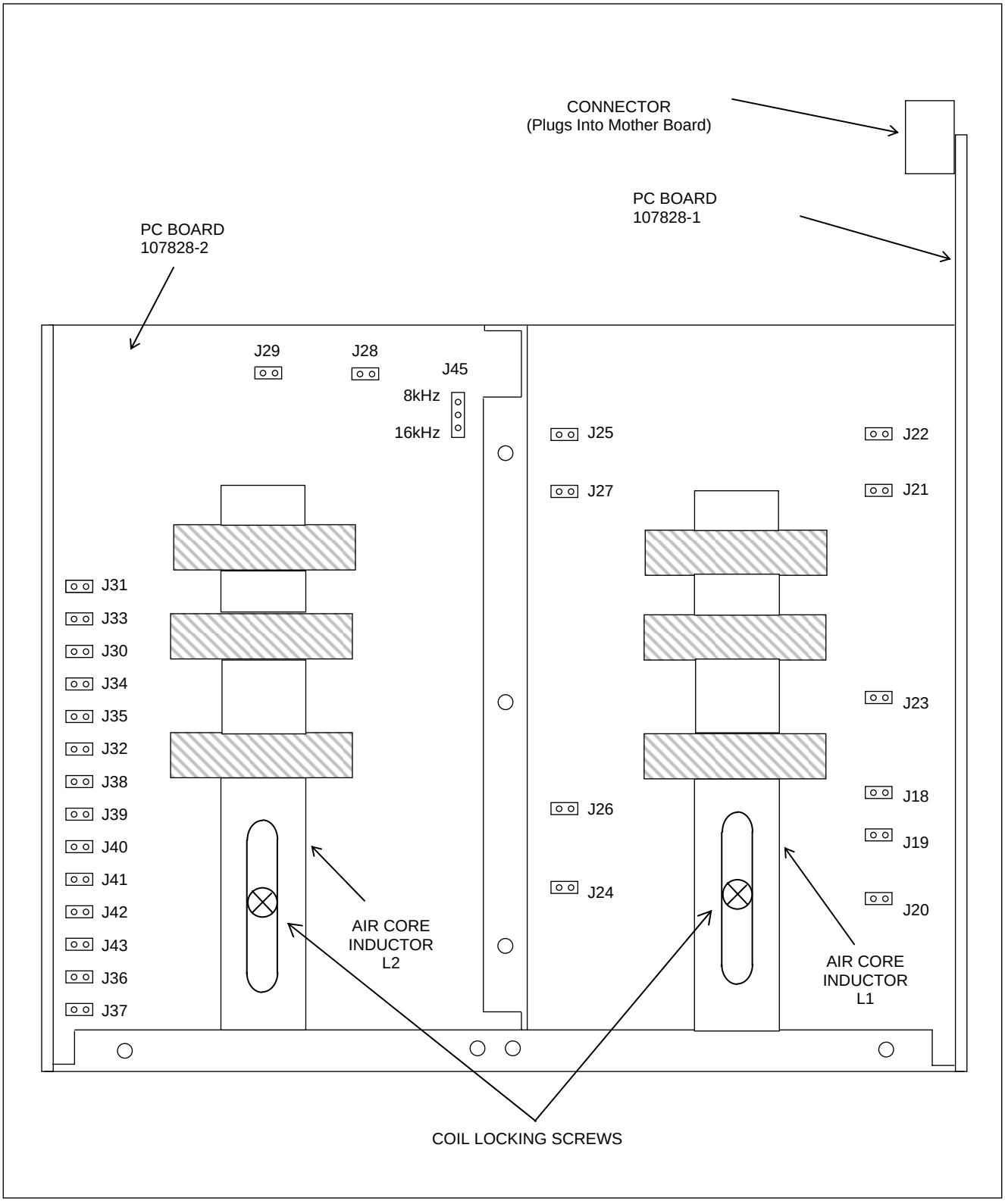


Figure 5-18. Location of jumpers on Tx Filter, PC Board 107828-2

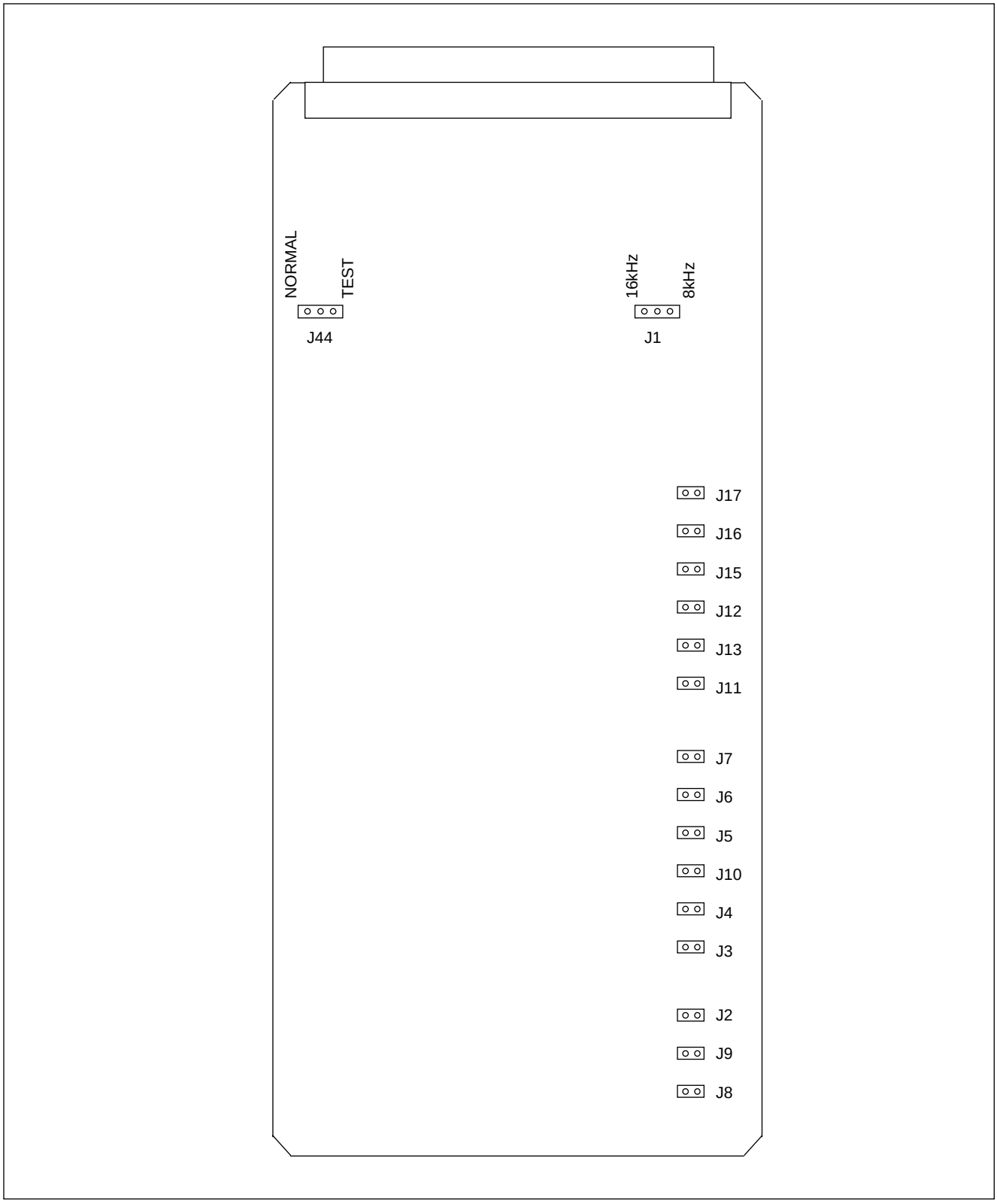


Figure 5-19. Location of jumpers on Tx Filter, PC Board 107828-1

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 5-17. The jumper locations are shown in Figure 7-9, and are accessible only when the Balance Board is removed from the chassis.

Table 5-18. Setting Jumpers On Balance Board

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

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 5-19. Refer to Table 5-18 for information on how to configure these jumpers on the Line Board.

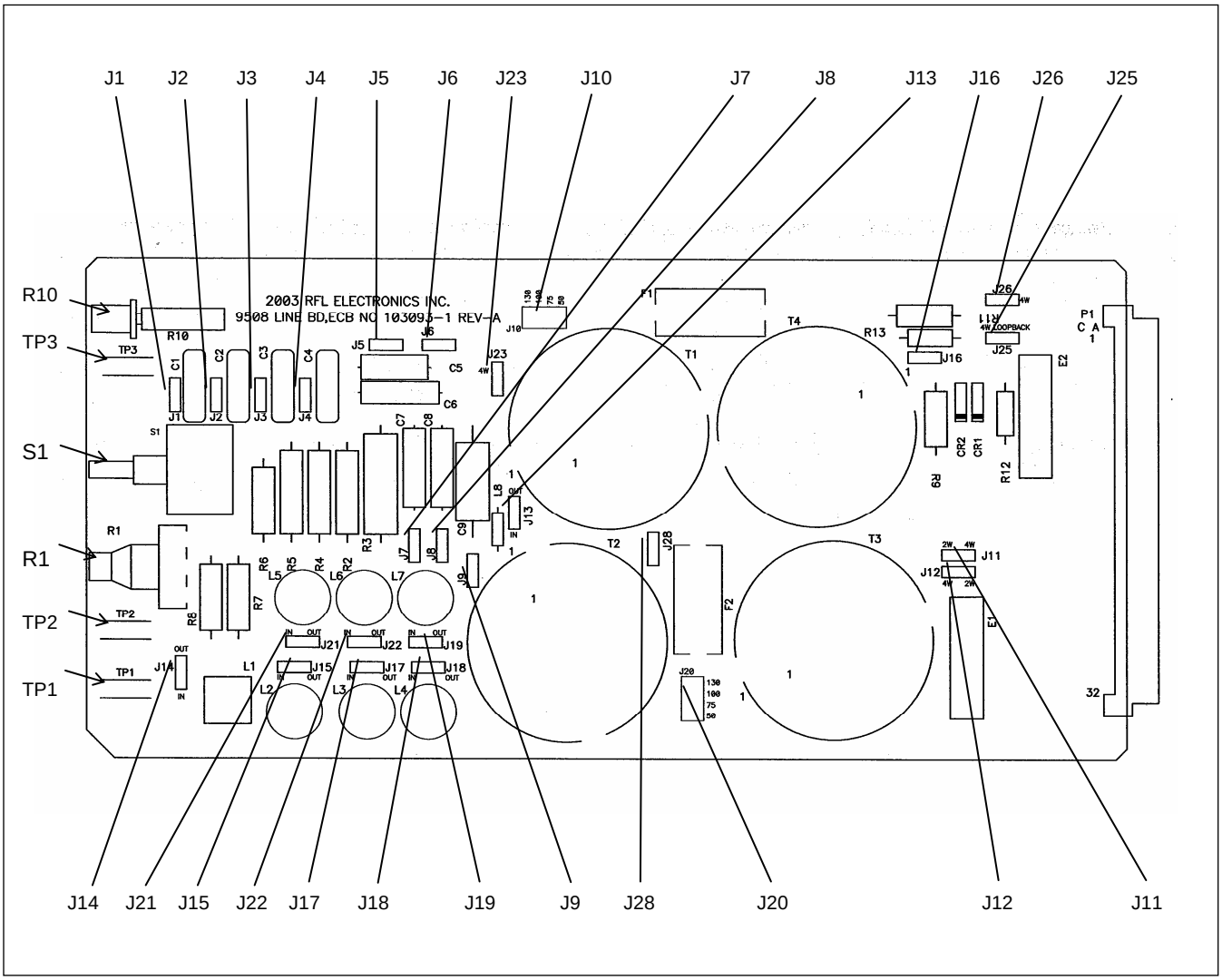


Figure 5-20. Location of Jumpers on Line Board

Table 5-19. Line Board Setup Jumpers and Switch Setting

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. 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. Can be set to 50, 75, 100 or 130 Ohms for 103090 module. Can be set to 50, 75, 100 or 150 Ohms for 103090-1 module.
J1-J9	Jumper	Adjusts capacitive component of line impedance. Refer to the Hybrid Tuning procedure in paragraph 6.2.5.1
J15-J17, J18-19, J21 and J22	Jumper	Adjusts inductive component of line impedance Refer to the Hybrid Tuning procedure in paragraph 6.2.5.1
R1	Potentiometer	Adjusts resistive component of line impedance. Refer to the Hybrid Tuning procedure in paragraph 6.2.5.1
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 6.2.5.1
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 equipped.
J25	Jumper	Selects 4W mode or Loopback mode.
J11, J12 and J23	Jumper	All three of these jumpers must be set to 2W to select 2W mode. 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.
TP2	Test point	Tx 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.

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. The switch location is shown in Figure 7-13, and is accessible when the Attenuator Board is plugged into the chassis.

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 5-20. 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 5-20 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, take care when turning.

Required Equipment:

Frequency Selective Voltmeter with high impedance input
50 Ohm non-inductive load
PC with 9508D 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 9508D.
2. Use RFL 9508D NMS software to generate a list of appropriate jumper settings. Refer to Section 4 of the manual for more information on RFL 9508D NMS.
3. Set the RX Filter jumpers for Center Frequency according to your configuration.
4. Disconnect the BNC cable from the MA-470 Rx input. With the same cable terminate the RF chassis's 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 9508D 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 ±8kHz for 16kHz bandwidth.
   a. To balance the response adjust L2 to have the same level at ±4kHz 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 ±18kHz 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 9508D NMS write the original configuration back.

17. Your RX Filter is now tuned.

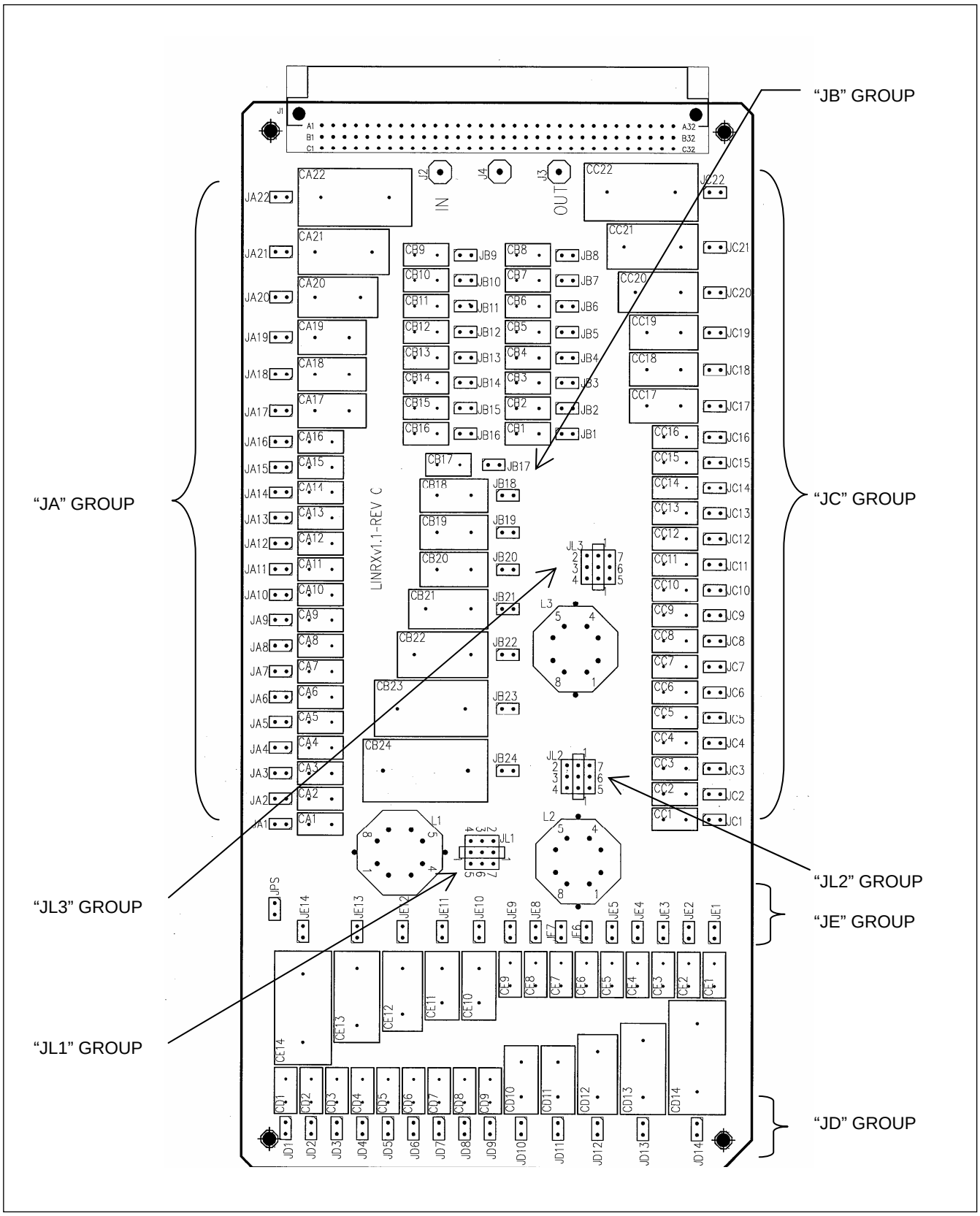


Figure 5-21. Location of Jumpers on Rx Filter Board, showing jumper groupings

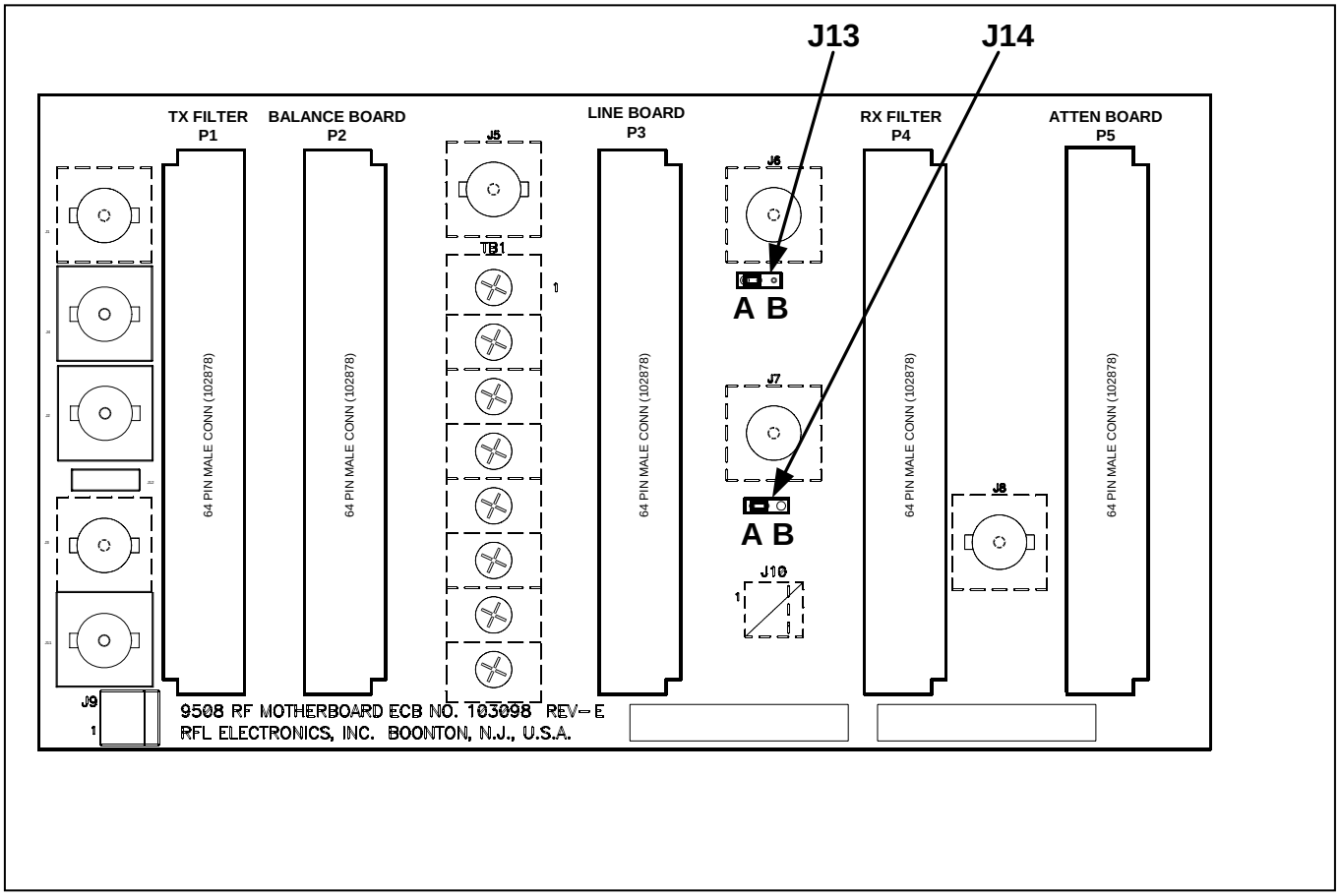


Figure 5-22. Location of Jumpers on RF Motherboard

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).

5.3.2.8 '4' 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 5-19 for the location of these jumpers.

5.3.2.9 '2' 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 5-19 for the location of these jumpers.

5.3.2.10 ‘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.

5.3.2.11 ‘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 RFL9508D 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 4.5.3.10)
Perform the commissioning procedure (section 6)

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Section 6. COMMISSIONING PROCEDURE

6.1 REQUIRED EQUIPMENT

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

WARNING!

THE 9508D 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.

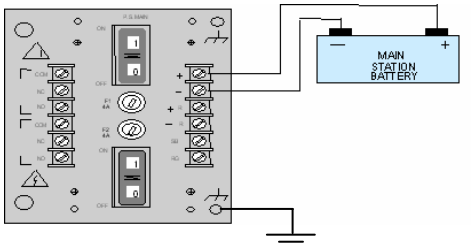
2. Verify proper Ground connections for all the chassis AF, RF and packetizing multiplexer chassis utilizing GND studs on Power Supply IO.

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 6.2.5.1**

5. Seat all modules firmly in the chassis.

6. Turn on the TOP AF Power Supply Switch only.



6.2.2 9508D NMS SOFTWARE PC INSTALLATION (AS REQUIRED)

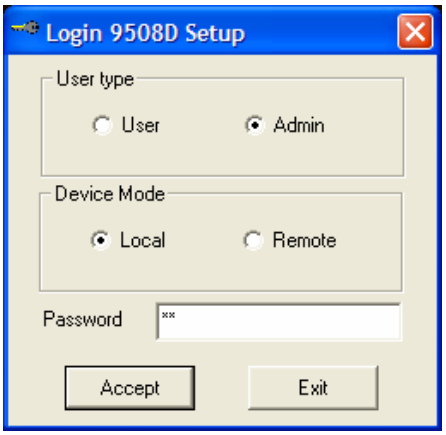
1. Locate the Installation Disk. The Disk should contain: NMS Installation Software, Factory Created Parameters file.

2. Follow NMS Software Installation Procedure 4.2.1 in 9508D Manual

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

4. An user session won't need a password, for administrator privileges type in 'ok' and press ENTER.

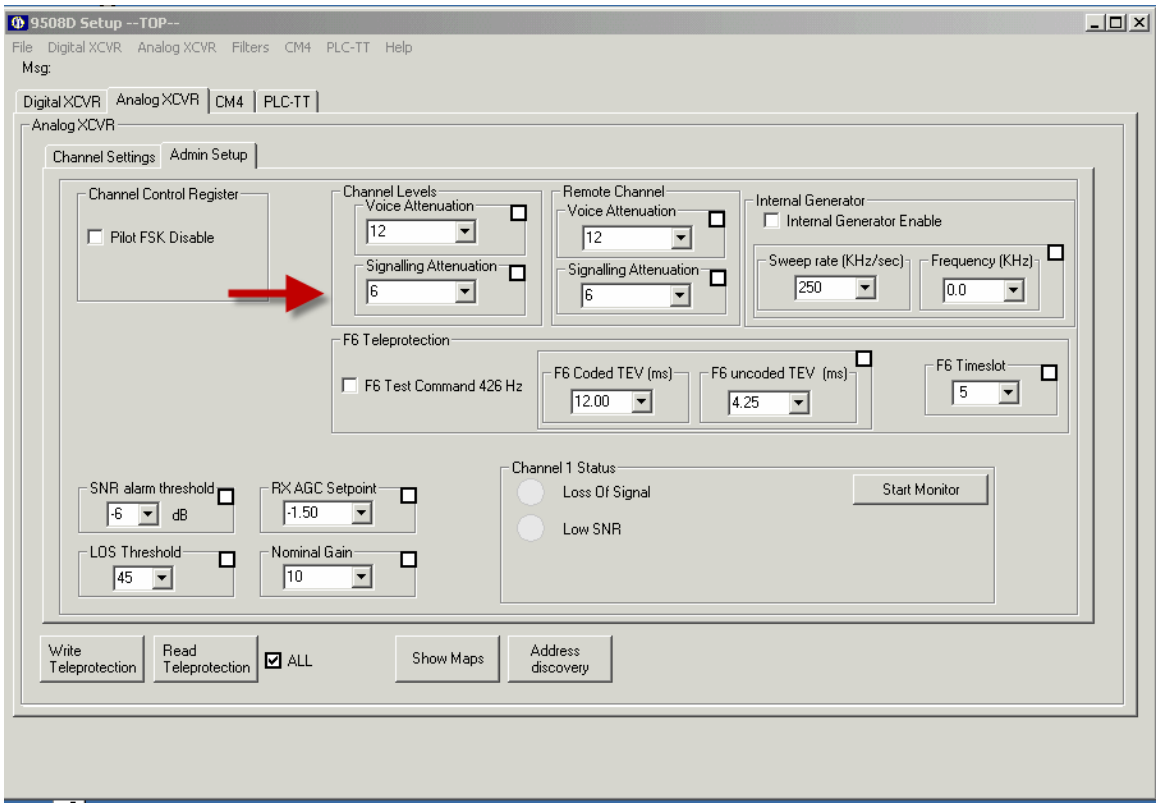
6.2.3 9508D NMS SOFTWARE ACCESS



1. Copy Configuration files from the system CD supplied with the equipment.
2. Load the parameters file by doing the following:
    a. Select 'File' Toolbar.
    b. Select 'Load Settings From File'
    c. Locate and select the parameters file by browsing in the directory
    d. Press 'Open'
3. If the system CD is not available, do the following:
    a. Select 'File' Toolbar.
    b. Select 'Program Settings'
    c. Select the appropriate COM port and port settings: 9600, None, 8, 1
    d. Press 'Accept'
    e. On the main windows press 'Address Discovery' to discover he address of the digital transceiver.
    f. Press the 'Read' Button
    g. Select the 'Analog XCVR' tab.

h. Press the 'Address Discovery' button to discover the address of the analog transceiver
i. Press the 'Read' button.
j. Select the 'CM4'tab
k. Press the 'Discovery' button at the top of the page.
l. Press the 'Read' button at the Bottom of the page.
m. Select the 'PLC-TT' Tab.
n. Press the 'Read' button.
o. Select the 'File' Toolbar.
p. Select 'Save Settings to file'.
q. Type in a name to the file and press 'Save'

6.2.4 SET THE SIGNALLING LEVEL



1. Select "Analog XCVR" and select the "Admin Setup" tab.

2. Signaling attenuation default value should be 6 dB.

3. "Write" to terminal.

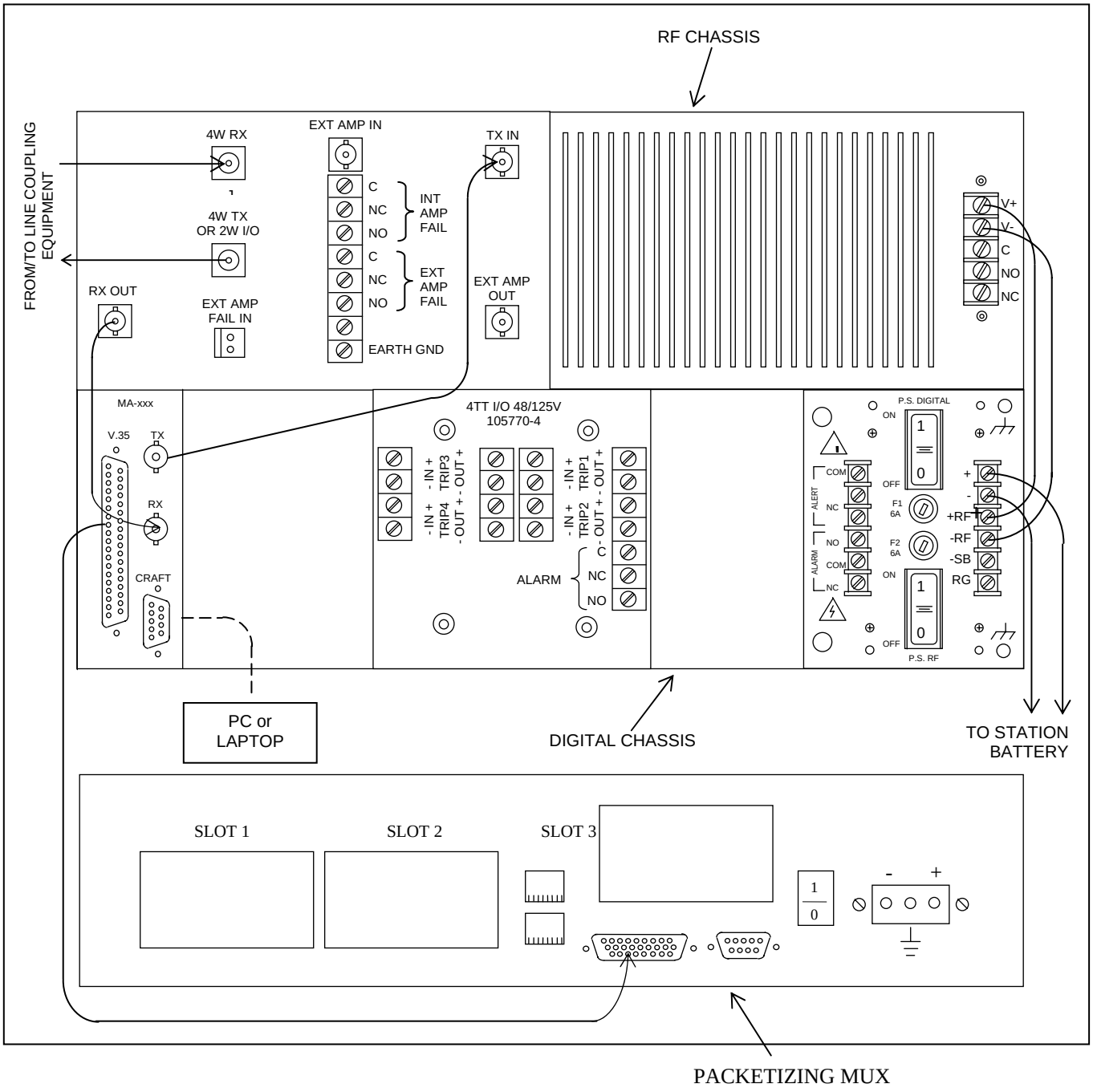
4. Refresh all RF parameters for second node (terminal) repeating all above steps.

6.2.5 RF TRANSMITTER POWER LEVEL VERIFICATION.

6.2.5.1 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).



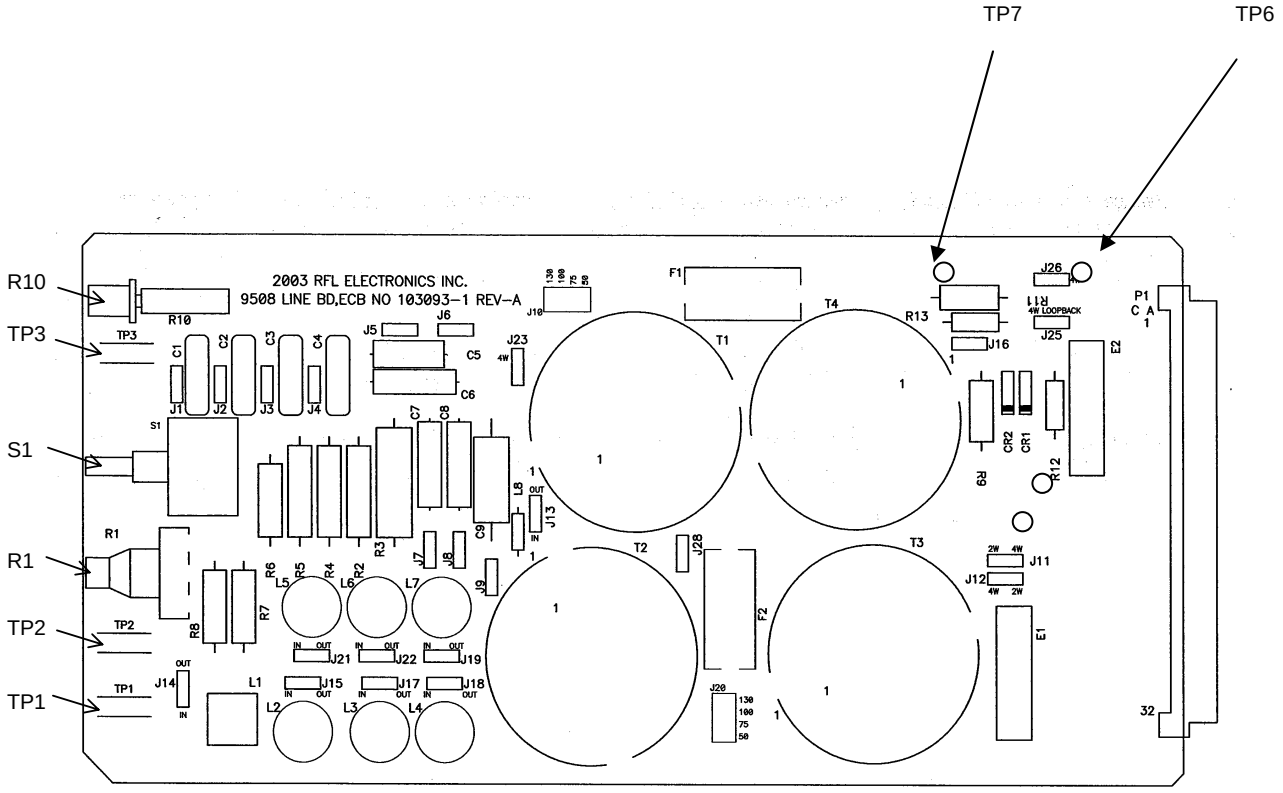
3. Turn On Power to RF Top chassis.

4. Tune the Frequency Selective voltmeter (FSVM) at the local analog Tx carrier frequency plus 3825 Hz (The pilot tone).

5. Place the Frequency Selective voltmeter (FSVM) leads across the dummy load, and verify the following approximate levels as applicable for your system:

50 Watts system	+38 dBm ±2 dB
100 Watts system	+41 dBm ±2 dB

6. Adjust using R83 on the amplifier card if necessary.
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, and turn the equipment on.

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.

10. Using a FSVM, monitor the local Tx carrier frequency plus 3825 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 11 above until lowest level is attained.

15. Repeat steps 1 to 15 in Section 6 for opposite 9508D end.

6.2.5.2 ADJUSTING THE RECEIVER LEVEL

1. Using a FSVM, monitor the local Rx carrier frequency plus the pilot frequency (normally 3825 Hz) at RX OUT connector from RF to AF chassis – Terminate the connection on a 50 ohm dummy load.

2. Adjust Rx level potentiometer R10 for a pilot level of –20 dBm.

3. Turn equipment off, remove extender card and re-install Line Board in the chassis

4. Return NMS settings to match those on the RFL parameters file.

5. Test all system functions.

Section 7. MODULE DESCRIPTIONS, RFL 9508D RF SECTION

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

Table 7-1. Modules included in 9508 RF Section

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

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

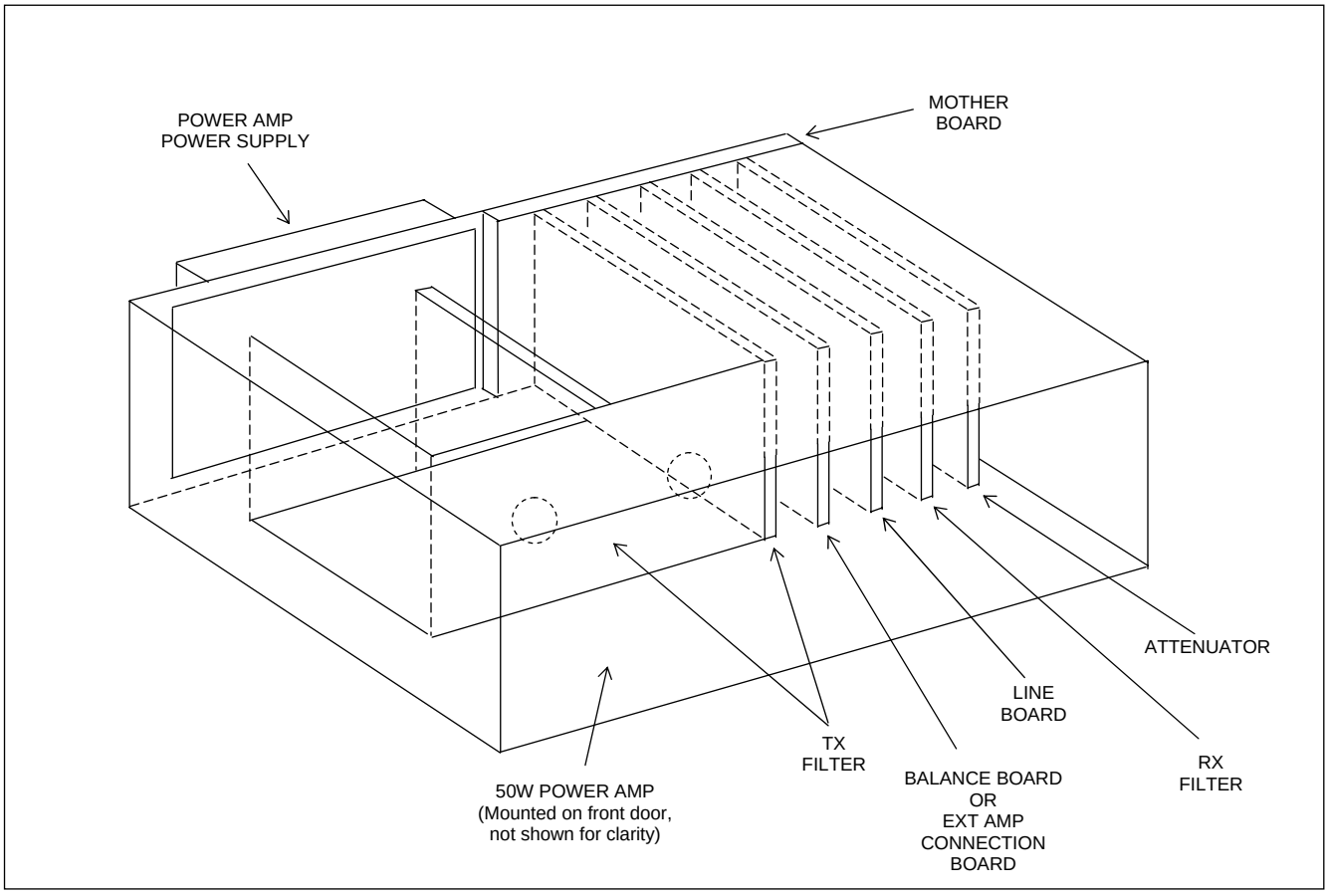


Figure 7-1. Front View of RFL 9508 Analog Section

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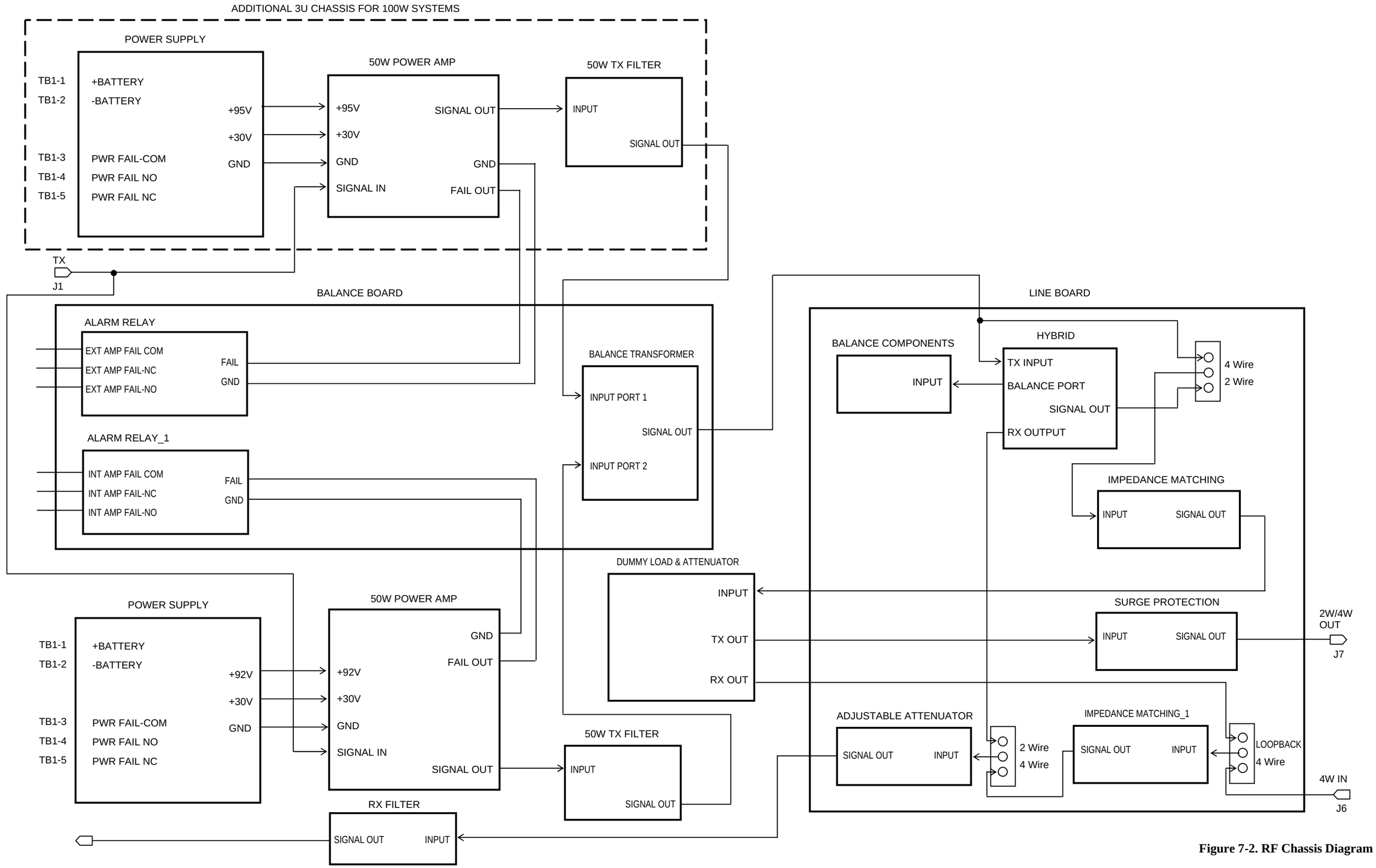


Figure 7-2. RF Chassis Diagram

7.1 POWER AMPLIFIER

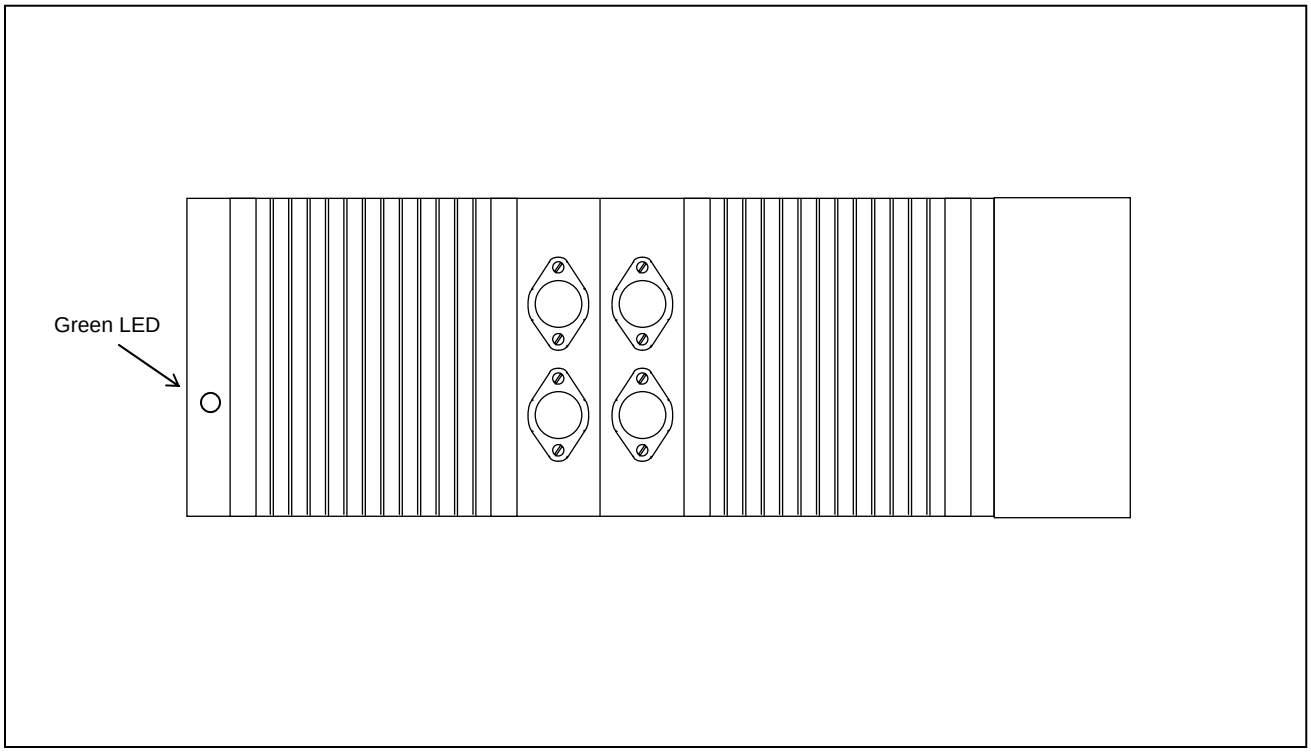


Figure 7-3. RFL 9508 Power Amplifier

7.1.1 DESCRIPTION

The Power Amplifier is mounted on the upper portion of the front cover of the RFL 9508D chassis. The function of the Power Amplifier is to amplify the RF outputs of the RFL 9508D 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 9508D 6U 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^{o}C to +65^{o}C (-4^{o}F to +149^{o}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)

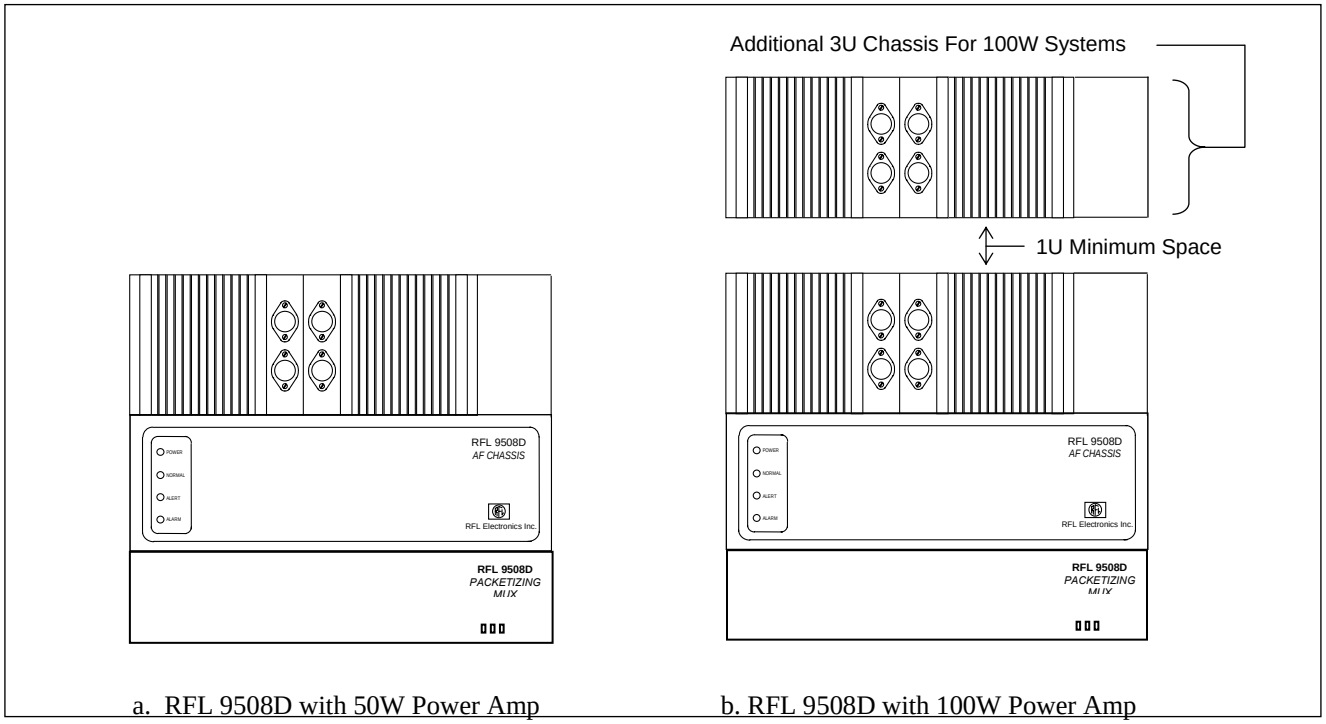


Figure 7-4. Chassis configurations for RFL 9508D with 50W Amp and with 100W Amp

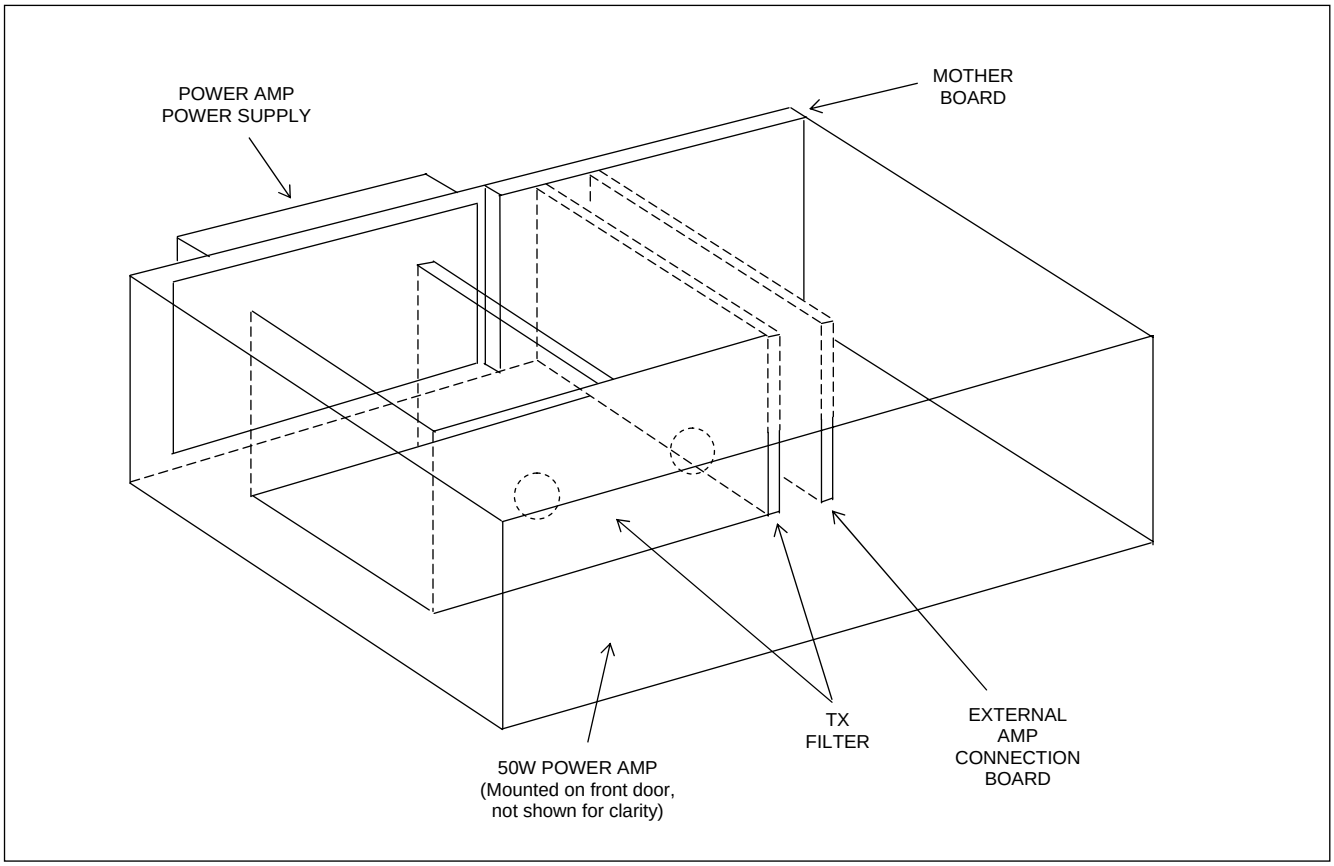


Figure 7-5. Front View of Additional 3U Chassis for 100W Systems

7.2 POWER AMPLIFIER, POWER SUPPLY

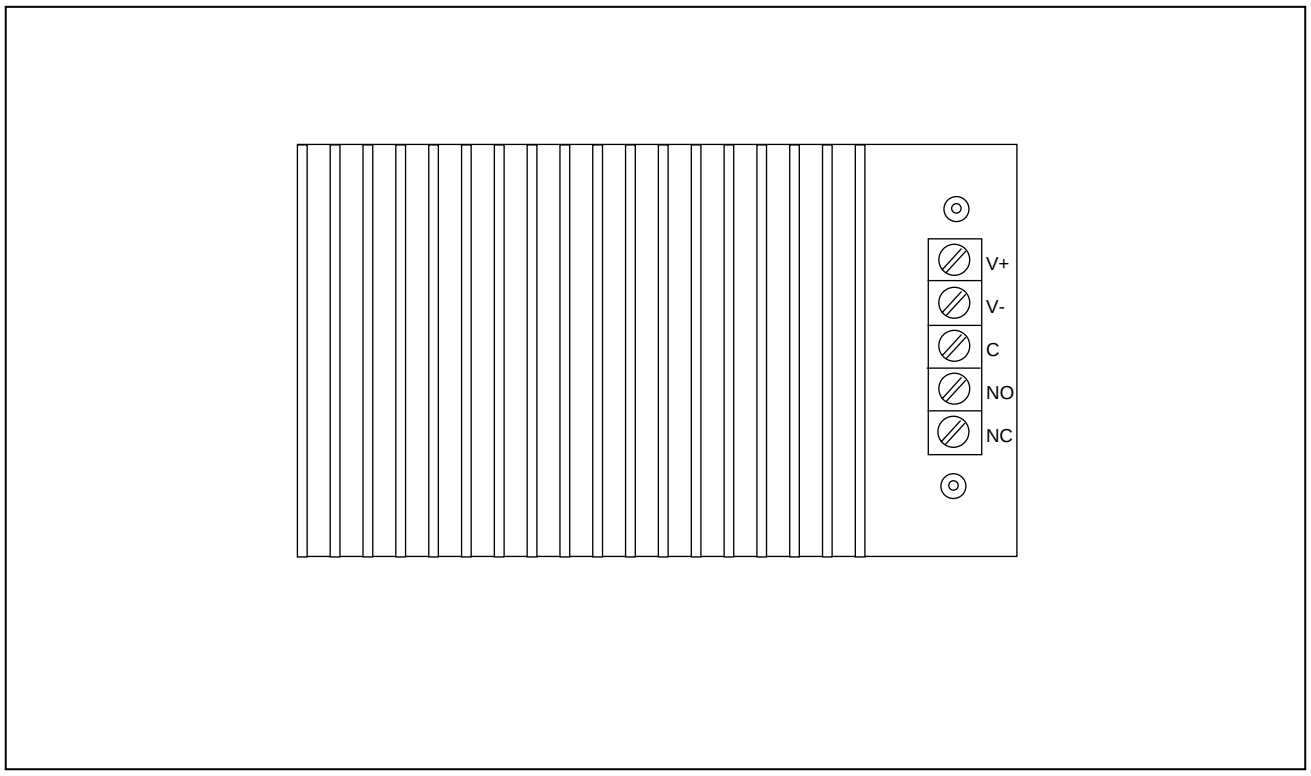


Figure 7-6. RFL 9508D Power Amplifier, Power Supply

7.2.1 DESCRIPTION

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

The 9508D 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 +95 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.

Table 7-2. Input Voltage Ranges of Power Amplifier Power Supplies.

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

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°C (-4°F to +149°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

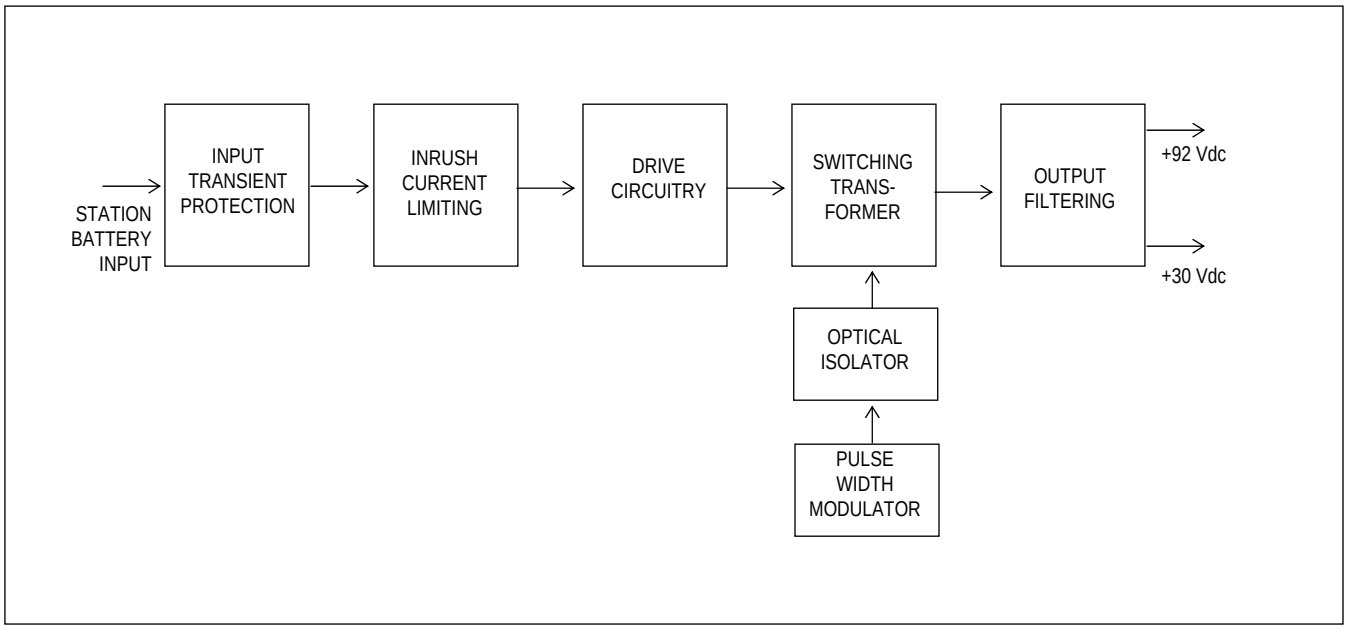


Figure 7-7. 9508 Power Amplifier Power Supply, Block Diagram

7.3 TX FILTER

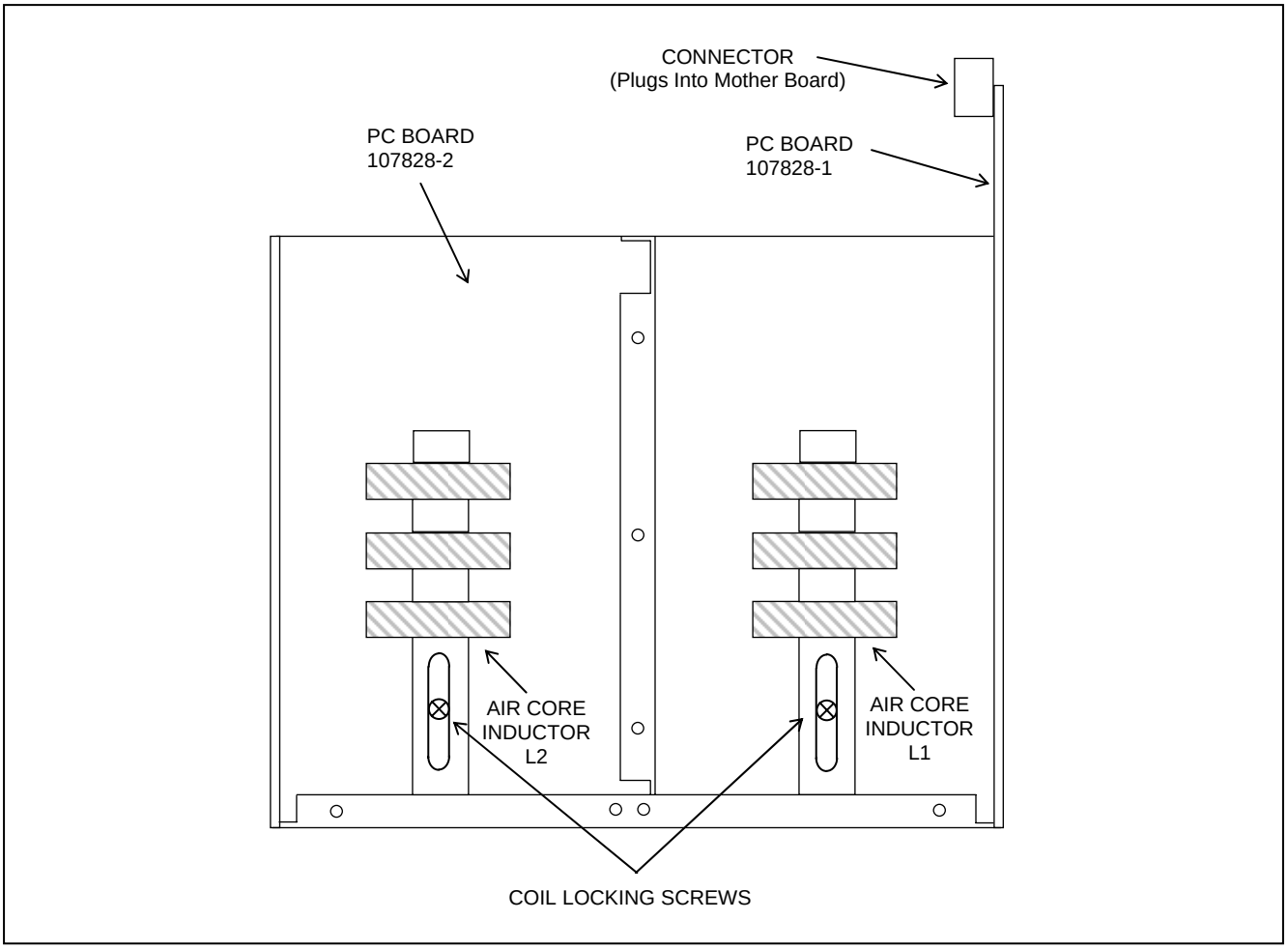


Figure 7-8. Tx Filter, Top View

7.3.1 DESCRIPTION

The RFL 9508D 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 for 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

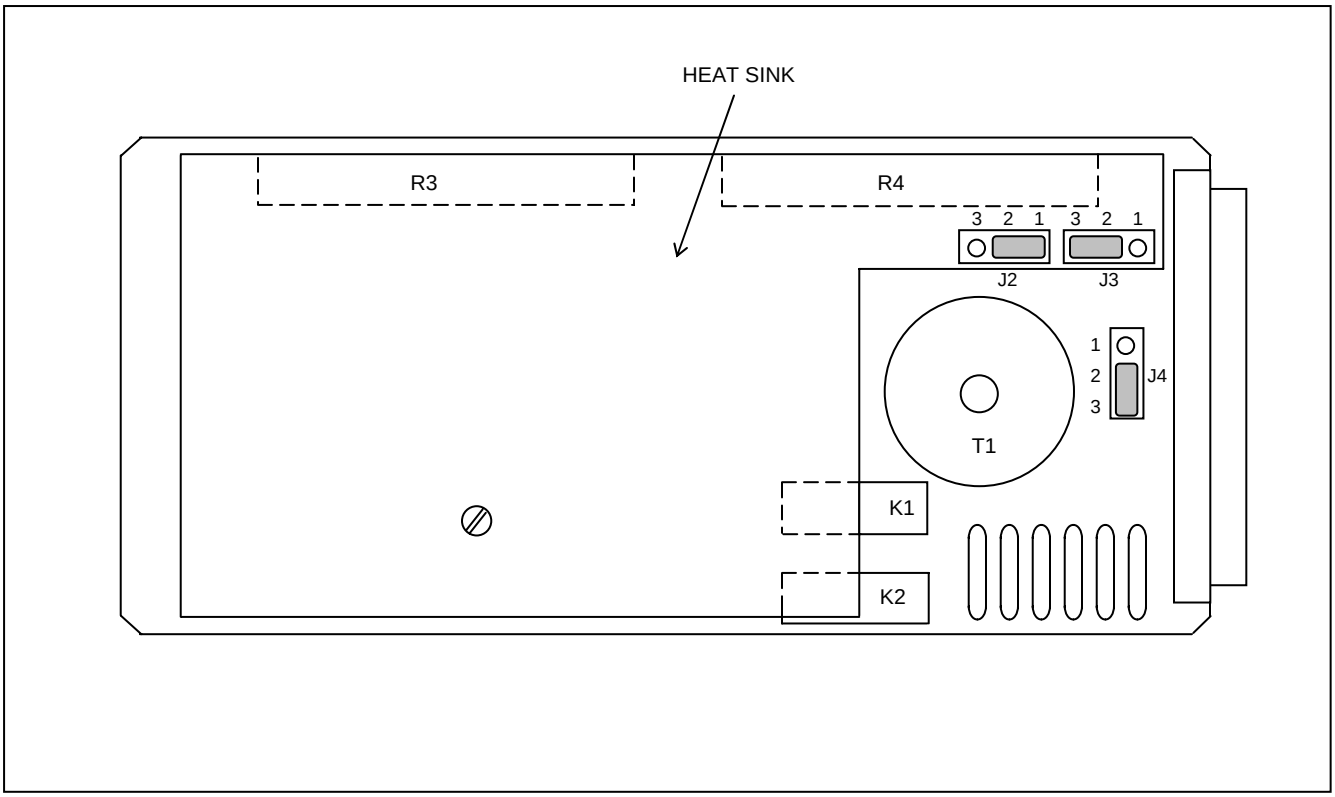


Figure 7-9. Balance Board

7.4.1 DESCRIPTION

The RFL 9508D 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 9508D 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

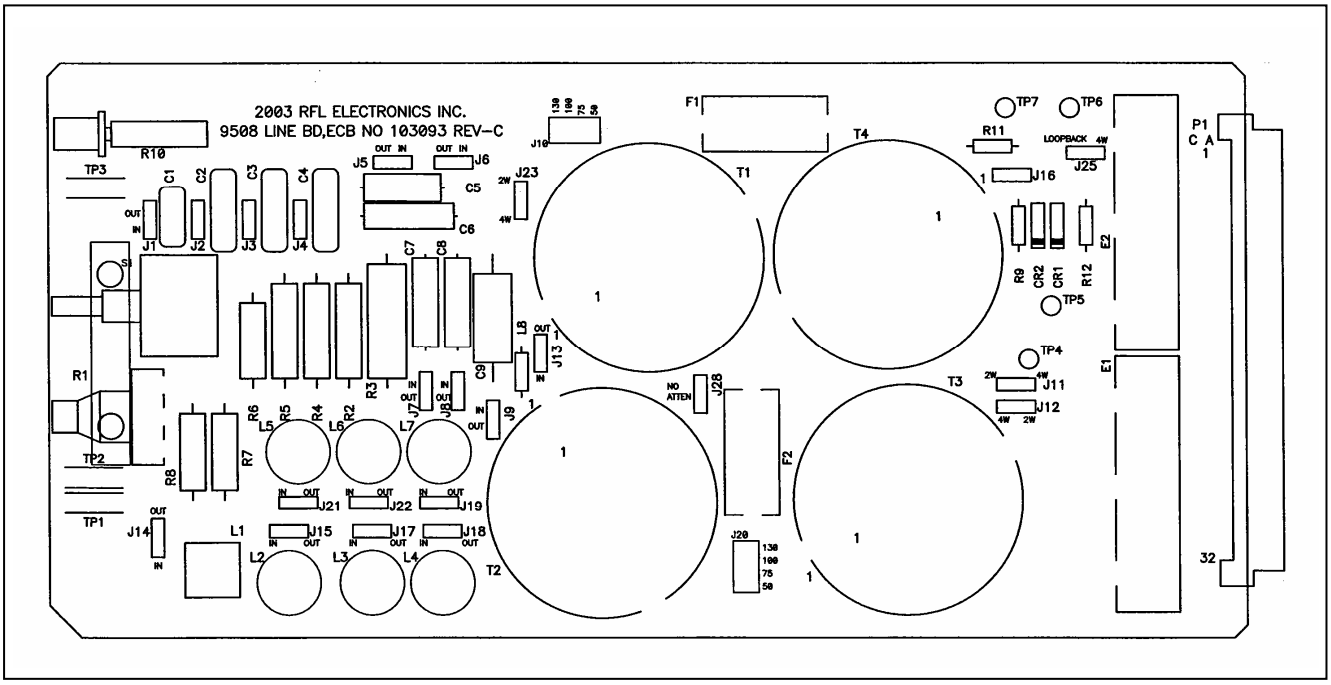


Figure 7-10. Line Board

7.6.1 DESCRIPTION

The RFL 9508D Line Board serves as the connection point between the RFL 9508D 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).

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 9508D 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 9508D 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.

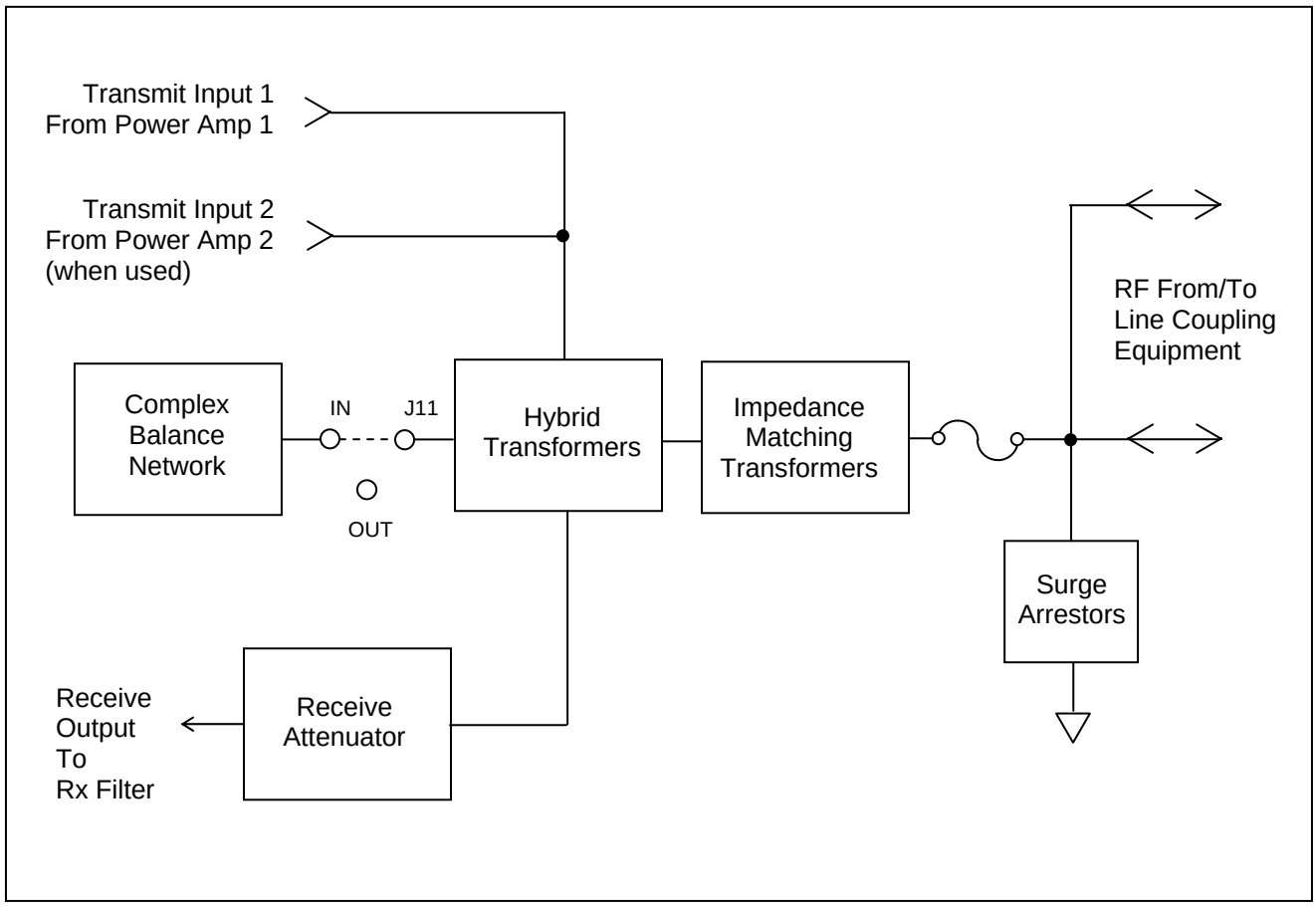


Figure 7-11. Block diagram, RFL 9508D Line Board

7.7 RX FILTER

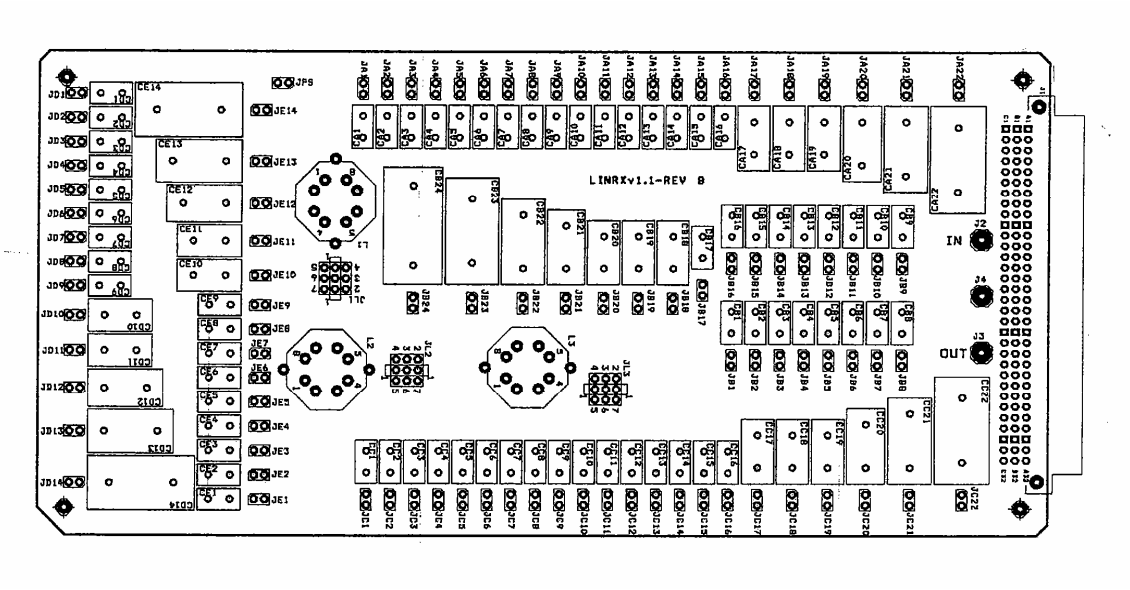


Figure 7-12. RFL 9508D Rx Filter Board

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 9508D. 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 9508D. 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

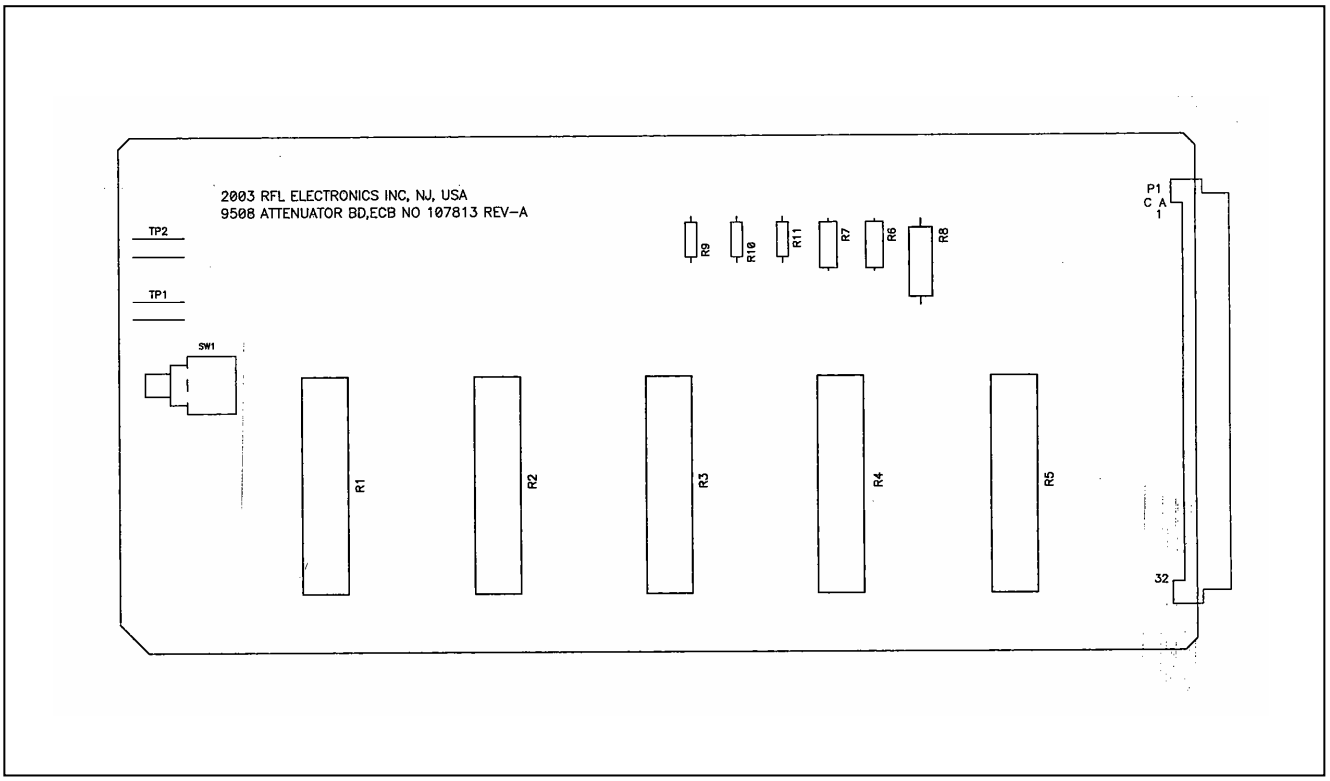


Figure 7-13. RFL 9508D Attenuator Board

7.8.1 DESCRIPTION

The RFL 9508D 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 9508D RF MOTHER BOARD

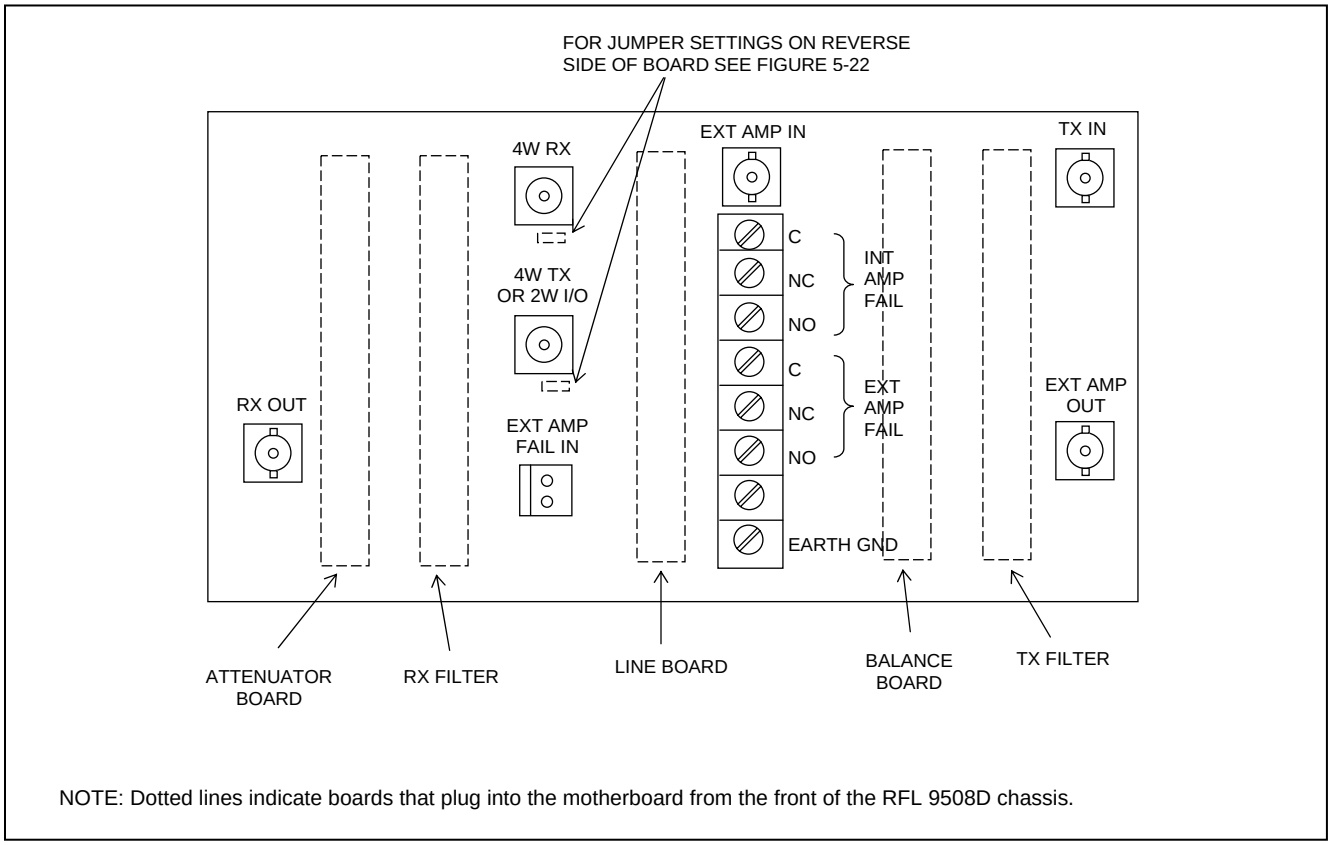


Figure 7-14. RFL 9508D RF Motherboard, rear view

7.9.1 DESCRIPTION

The RFL 9508D RF Motherboard is a 4.5 x 8 inch assembly, which is mounted on the rear right side of the 9508D 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.

Table 7-3. Motherboard Rear Panel Connector Assignments

Board Label	Reference Designation	Connector type	Application
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 EXT AMP FAIL	TB1	8-position terminal block	Power Amplifier Fail, Relay Contacts (See Table 7-4 for TB1 terminal assignments)

Table 7-4. TB1 Terminal Assignments

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 7-5. 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 9508D 6U chassis. The modules in a typical 9508D Digital Section are listed in Table 8-1.

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

Module	Assembly Number or Module Designation	For Additional Information 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
PLC-TT Module	105720-2	8.4
PLC-TT Module Adapters	105740-2 to -5, 105770-2 to -5	8.5
Teleprotection Transceiver	107830	8.6
Digital Transceiver		8.7
Transceivers Module Adapter	MA-470	8.8
Test Panel	106190	8.9
Power Supply	9547-840, 9547-920	8.10
Power Supply I/O	9547-18801, -18804, -18809	8.11
Motherboard	105590-2	8.12

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 9508D digital chassis.

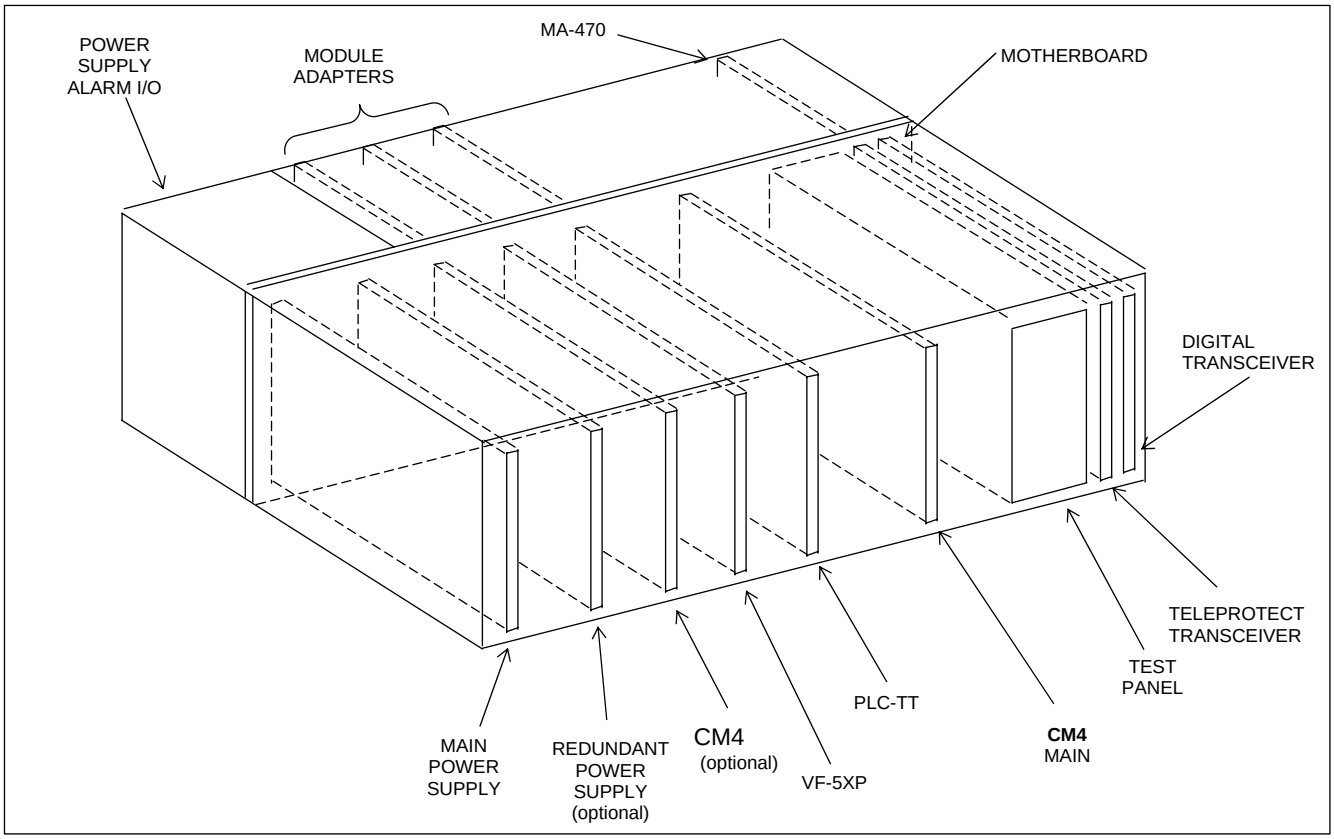


Figure 8-1. Front View of RFL Digital Section

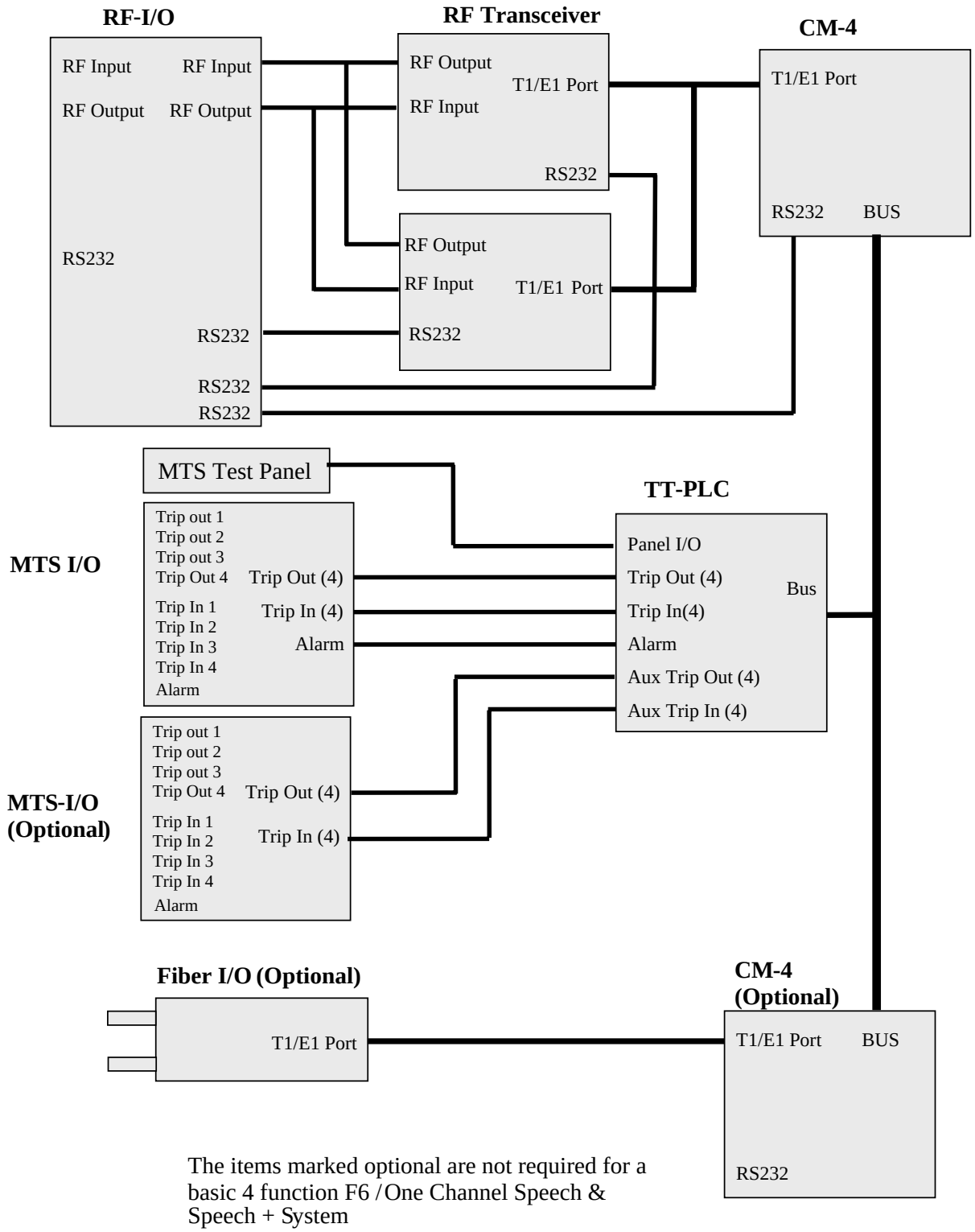


Figure 8-2. Typical 9508D Digital Chassis Block Diagram

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 9508D. In most applications, each 9508D terminal contains one CM4 Common Module located in slot 10, while in drop/insert applications the 9508D 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 9508D 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 9508D chassis with electrical T1/E1 interfaces, or from an OIA (optical interface adapter) in 9508D 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 9508D 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 9508D chassis with electrical T1/E1 interfaces, or from the OIA in 9508D 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 drop-and-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.

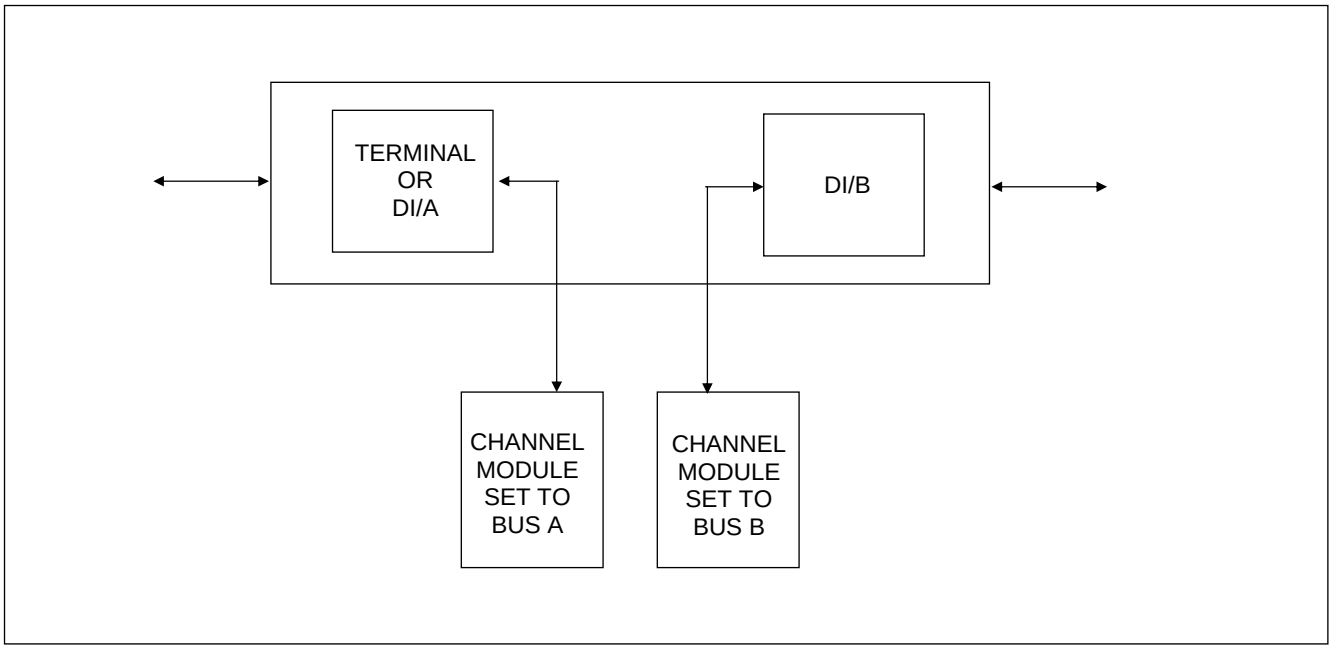


Figure 8-3. The meaning of Bus A and Bus B channel module settings

8.1.5 CHANNEL MODULES

All payload circuits connect to the RFL 9508D through channel modules. In the 9508D, the teleprotection channel module (PLC-TT) is used to provide for teleprotection commands to the PLC link.

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 9508D chassis provides 18 rear-access Module Adapter slots, one corresponding to each of the 18 front-access module slots. All 9508D 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.

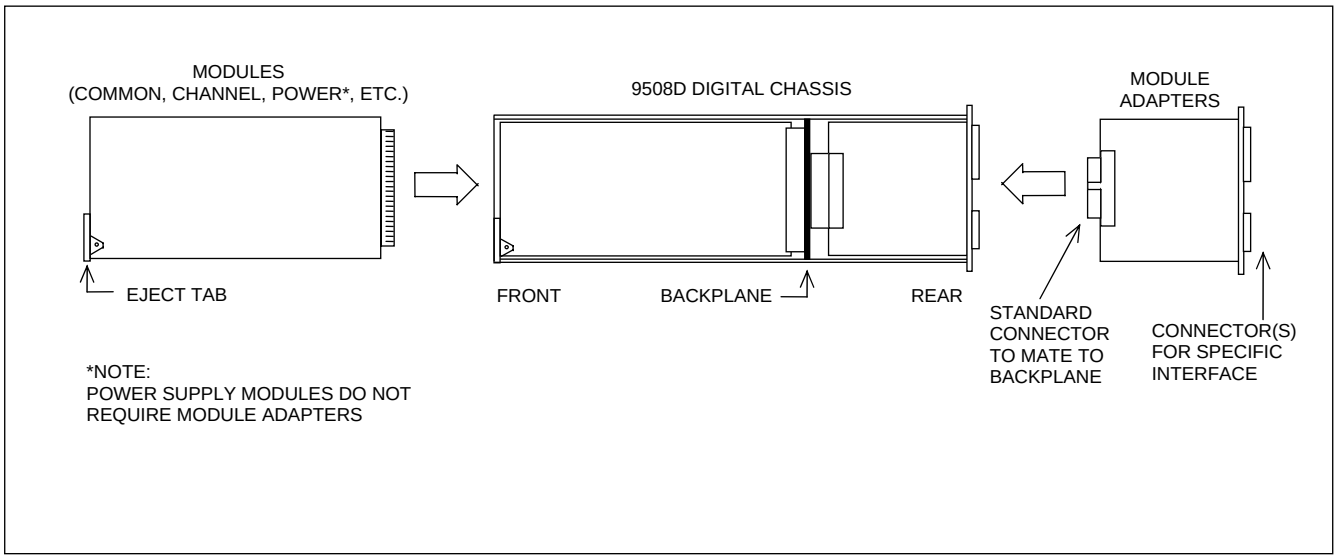


Figure 8-4. Side view of 9508D Digital Chassis, showing insertion of modules and module adapters

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

Figure 8-5 is a front view of the RFL 9508D 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.

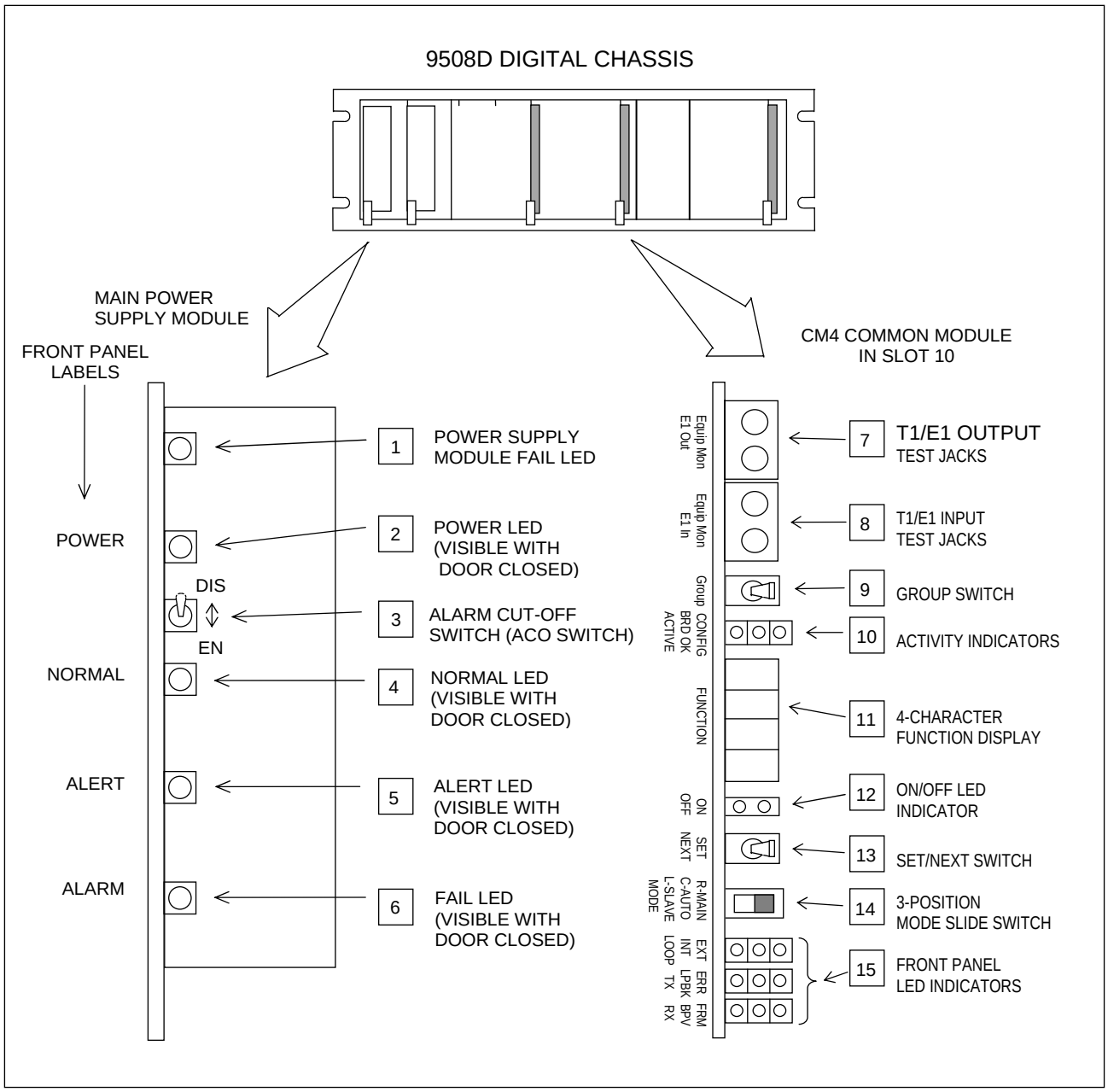


Figure 8-5. RFL 9508D Digital Chassis showing Power Supply and CM4 front panel switches, indicators and jacks

8.1.8 SYSTEM STATUS INDICATORS AND THE ACO SWITCH

When the RFL 9508D 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 9508D 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.

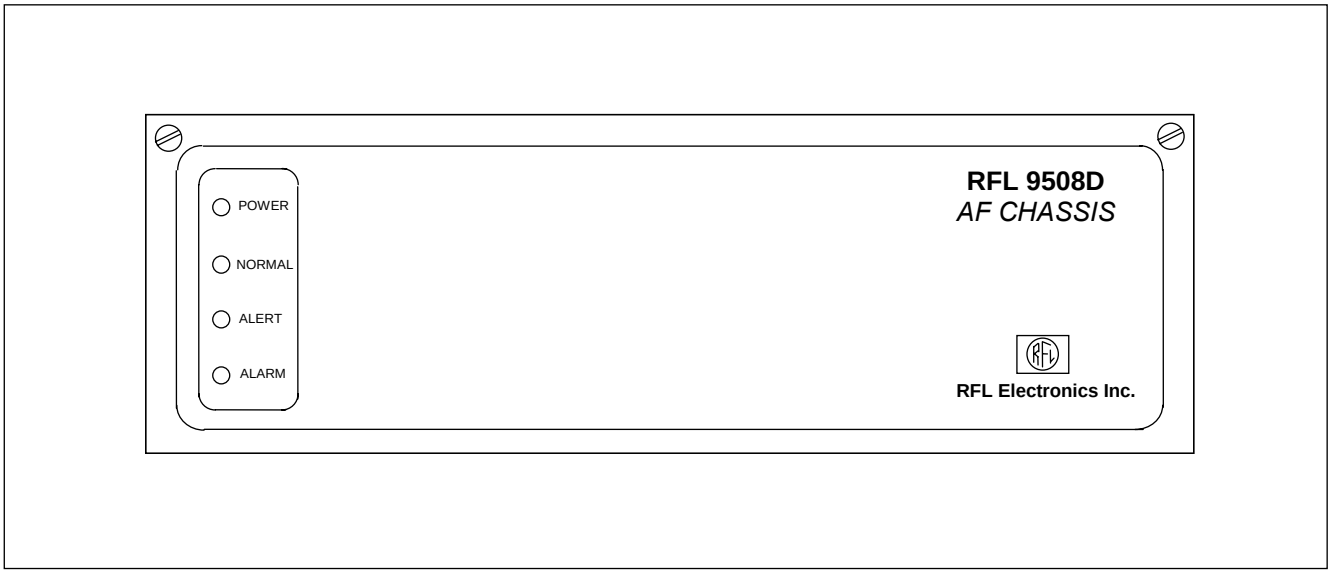


Figure 8-6. Front view of 9508D chassis with door closed, showing the system status indicators

Table 8-2. System status indicators and the ACO switch

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 9508D is powered. If the 9508D 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 9508D 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 9508D contains two power supply modules, the ACO switches on both 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)

1. An unframed "all ones" is an 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 in-service 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.

Table 8-3. T1 test and monitor bantam jacks

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.

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.

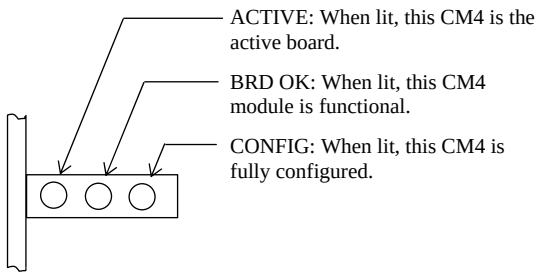
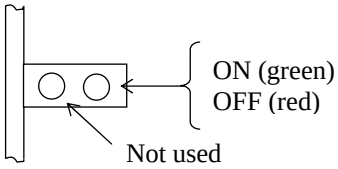
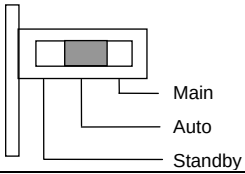
NOTE

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.

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.

Table 8-4. Indicators and toggle switches used to display and set T1 Common Module 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 
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 

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.

Table 8-5. E1 Common Module Standard groups and functions

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	E1 Set-up functions	CCS	Common Channel Signaling.
		CAS	Channel Associated Signaling.
		AMI	Alternate Mark Inversion.
		HDB3	High Density Bipolar of order 3.
		RFL	Not CSU mode (not used in E1)
		ANSI	ANSI CSU mode (not used in E1)
		ATT	AT&T CSU mode (not used in E1)
		CRC4	Cyclic Redundancy Check (not used in T1)
LPBK	E1 loopback setup functions.	LnLB	Line loopback.
		PaLB	Payload loopback.
		EqLB	Equipment loopback.
BLNK	Blink status functions (Reasons for blinking RX IN LED or transmit timing LEDs) (See Tables 8-7 & 8-8 for more details)	RxYl	Receiving yellow alarm.
		Rx11	Receiving all unframed ones.
		FTIM	Fallback timing is in effect.
		XsJt	Excessive jitter (buffer depth exceeded).
RVU1	Review 1 status functions (See Tables 8-7 & 8-8 for more details)	TxRx	Transmit and receive bus clock lock status.
		RcLs	Receiver carrier loss.
		XsJt	Excessive jitter.
DIAG	Diagnostic functions.	T1	Current T1 mode.
		#.##	Common module firmware revision.
		Fcty	When set, returns Common Module to factory-default setup (Int, ESF, 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.
		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 parameters	Off	Force to report an on-board trouble
		On	Do not force to report an on-board trouble
SWCH	Standby module forced-switch configuration parameters	Auto	Allow automatic switch operation
		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, 8.0ms, 8.6ms, 9.3ms) or DISA
SWAP	PROGRAMMABLE SWAP TIME DELAY	0.6s, 1.2s, 2.4s, 4.8s, 9.6s, 19s	Swap Time delay in seconds (0.6s, 1.2s, 2.4s, 4.8s, 9.6s, 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 feet) 0x04 (533 to 655 feet 0x05 (-7.5 dB) 0x06 (-15 dB) 0x07 (-22.5 dB)

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

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

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 8-7. 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.

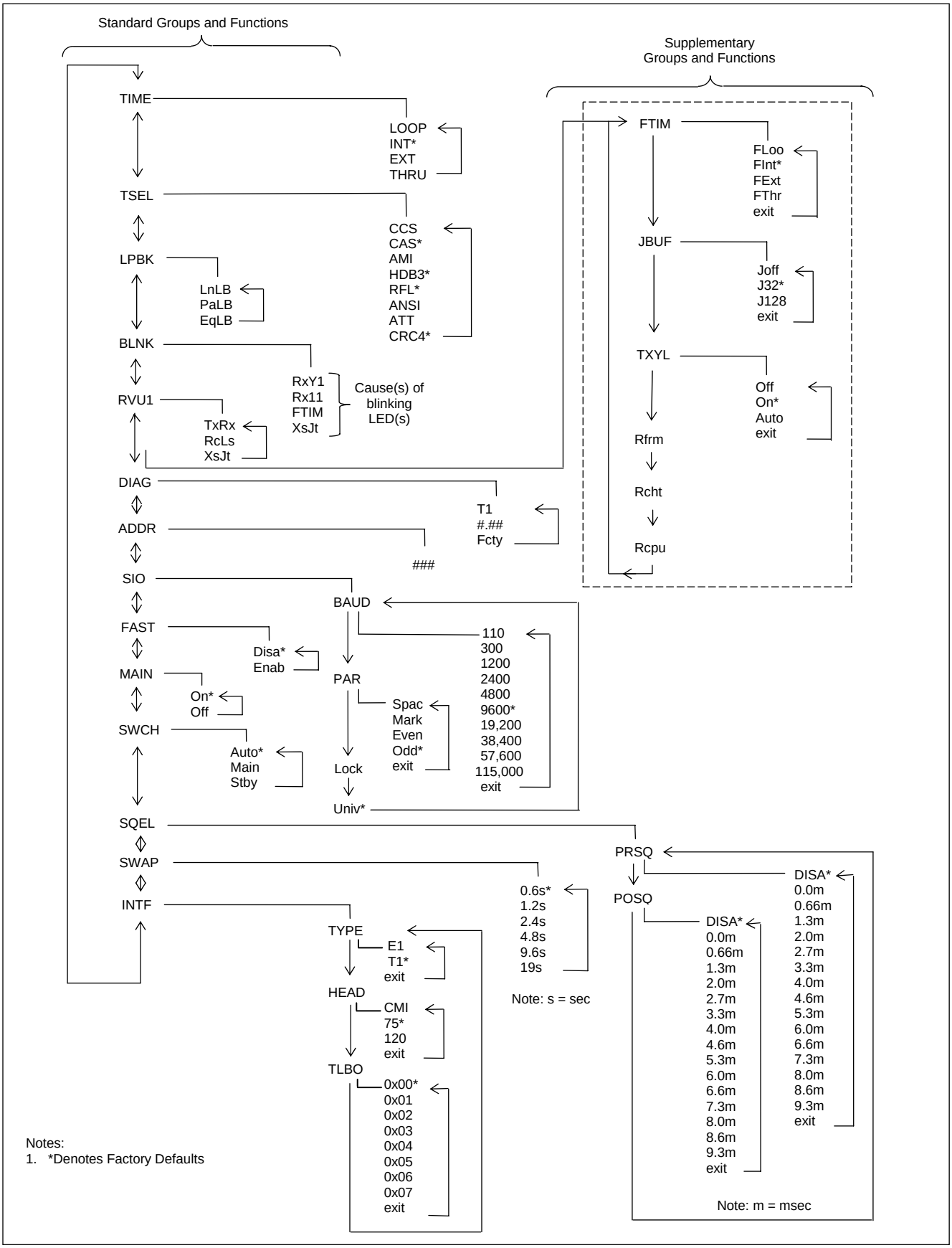


Figure 8-7. Overview of CM4 Groups and Functions

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.

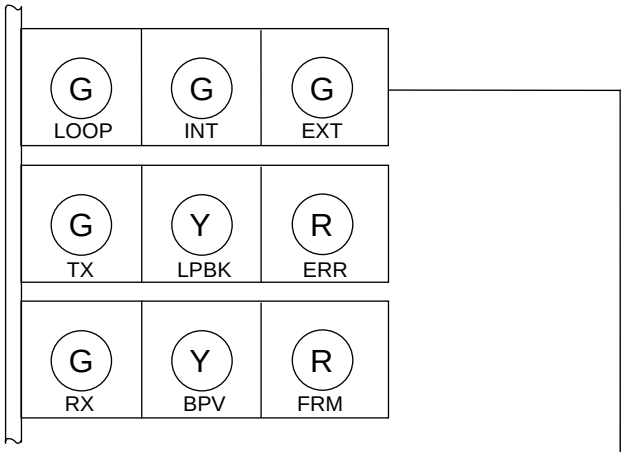


Table 8-9. Loop, Internal and External Indicators

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.

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.

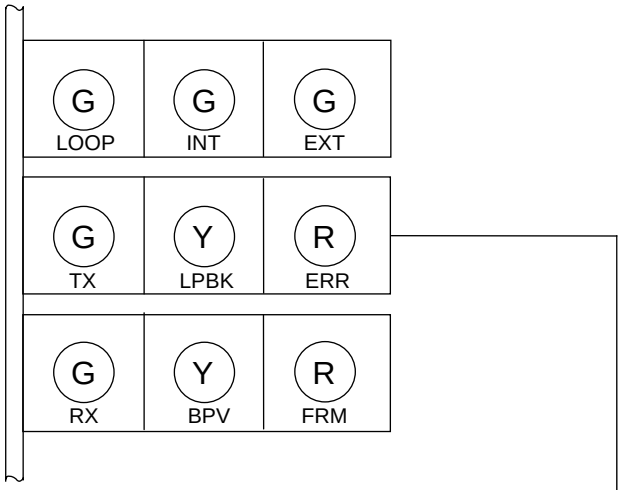


Table 8-10. TX, LPBK and ERR Indicators

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}.

8.1.12 FRONT PANEL LED INDICATORS

8.1.12.1 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.

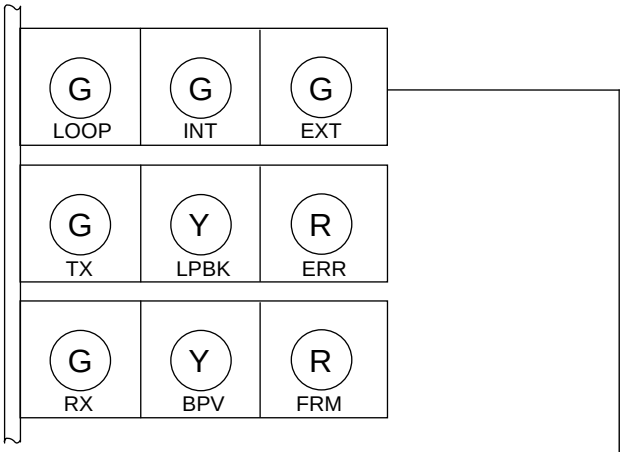


Table 8-11. Loop, Internal and External Indicators

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.

8.1.12.2 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.

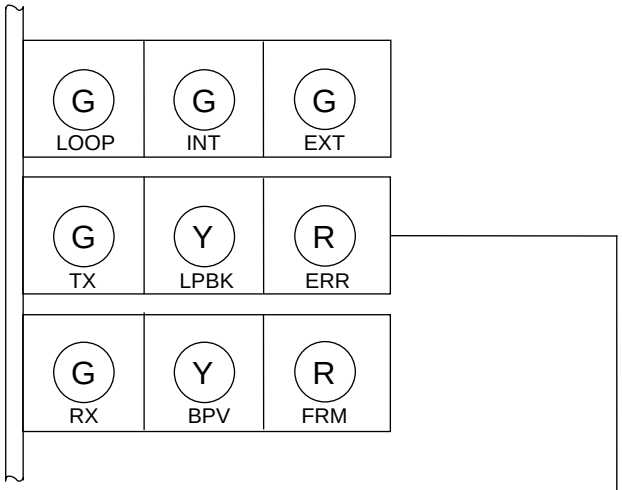


Table 8-12. TX, LPBK and ERR Indicators

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}.

8.1.12.3 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.

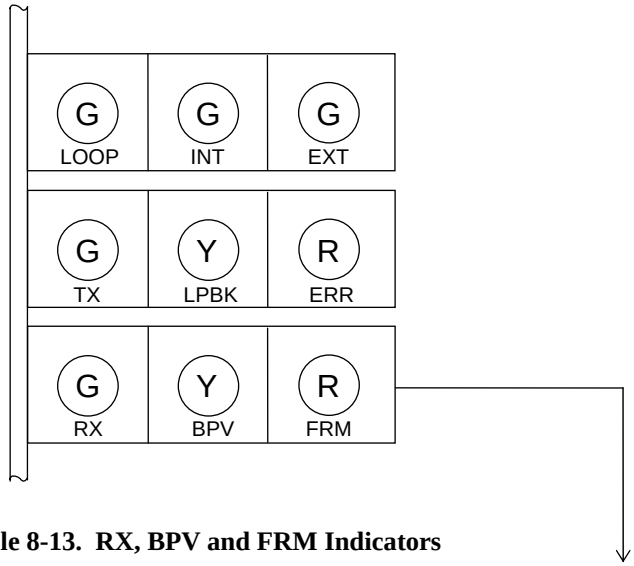


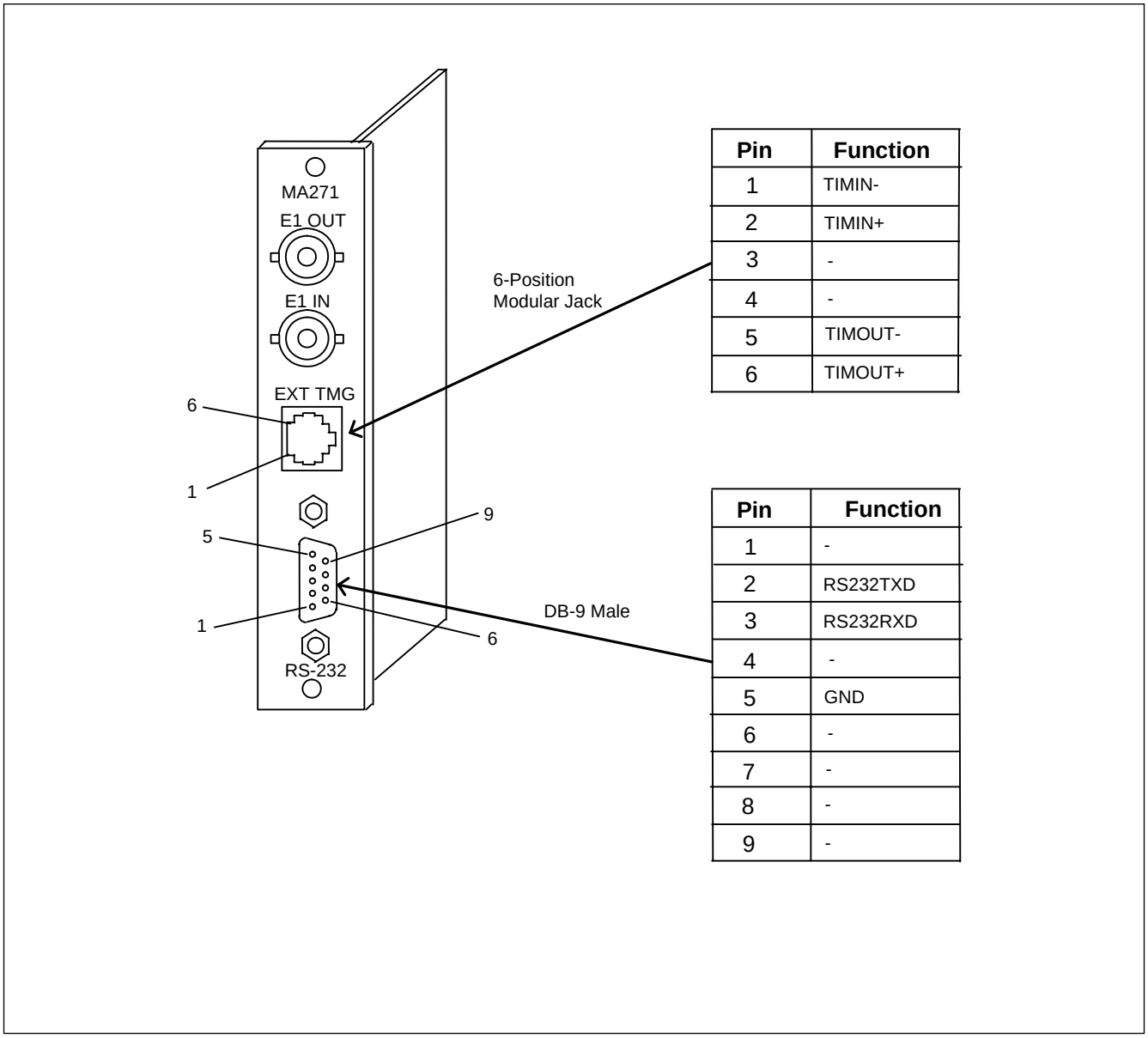
Table 8-13. RX, BPV and FRM Indicators

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 been exceeded. FTIM The CM4 transmitter is in fallback internal timing mode.
		BPV	Bipolar Variations indicator (yellow). Flashes once each time a bipolar violation is detected, and remains on continuously above a random BPV (bipolar variations) error ratio of about 10^{-5}.
		FRM	Out-Of-Frame indicator (red). Lights when the CM4 T1 receiver is not in frame 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.

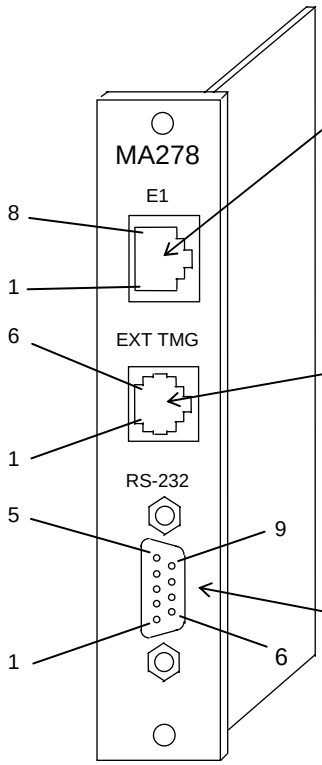
Electrical interface adapters are used to connect the 9508D electrically to a T1/E1 network. There are two types of electrical interface adapters available. These are the MA-271 and MA-278. These are also referred to as module adapters, and are shown in Figures 8-8 and 8-9.



Pin	Function
1	TIMIN-
2	TIMIN+
3	-
4	-
5	TIMOUT-
6	TIMOUT+

Pin	Function
1	-
2	RS232TXD
3	RS232RXD
4	-
5	GND
6	-
7	-
8	-
9	-

Figure 8-8. MA-271 panel view and pinouts



RJ48C

Pin	Function
1	E1-IN-
2	E1-IN+
3	-
4	E1-OUT-
5	E1-OUT+
6	-
7	GND
8	GND

6-Position Modular Jack

Pin	Function
1	TIMIN-
2	TIMIN+
3	-
4	-
5	TIMOUT-
6	TIMOUT+

DB-9 Male

Pin	Function
1	-
2	RS232TXD
3	RS232RXD
4	-
5	GND
6	-
7	-
8	-
9	-

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 9508D 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.

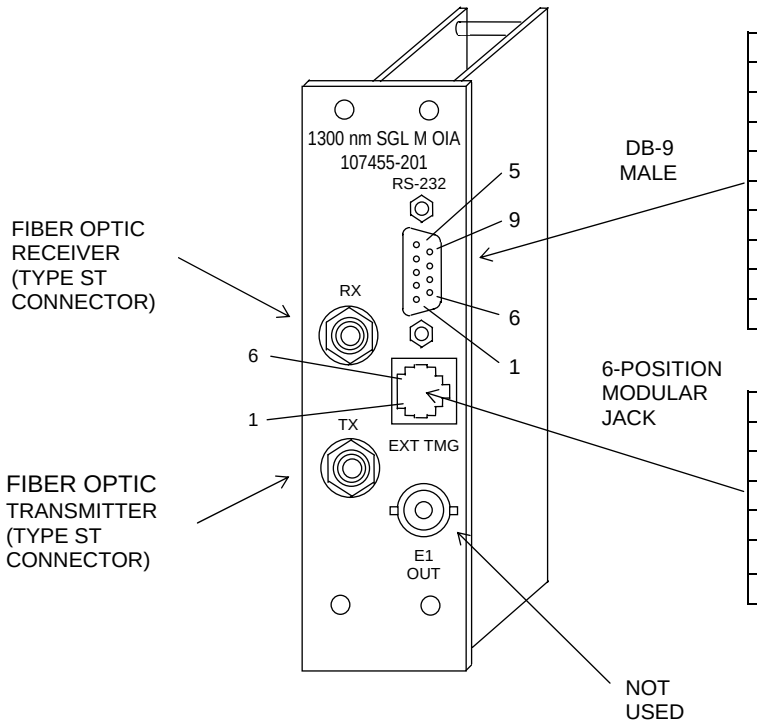
WARNING

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 9508D is equipped with a Fiber Optic Module, fiber optic connectors must be connected to the fiber optic heads on the rear panel of the 9508D 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.



Pin	Function
1	-
2	TXD_OUT
3	RXD_IN
4	-
5	GND
6	-
7	-
8	-
9	-

Pin	Function
1	TIMIN-
2	TIMIN+
3	-
4	-
5	TIMOUT-
6	TIMOUT+

Figure 8-10. Typical CM4 Optical Interface Adapter (OIA), showing panel view and pinouts

Table 8-14. Characteristics Of Optical Interface Adapters

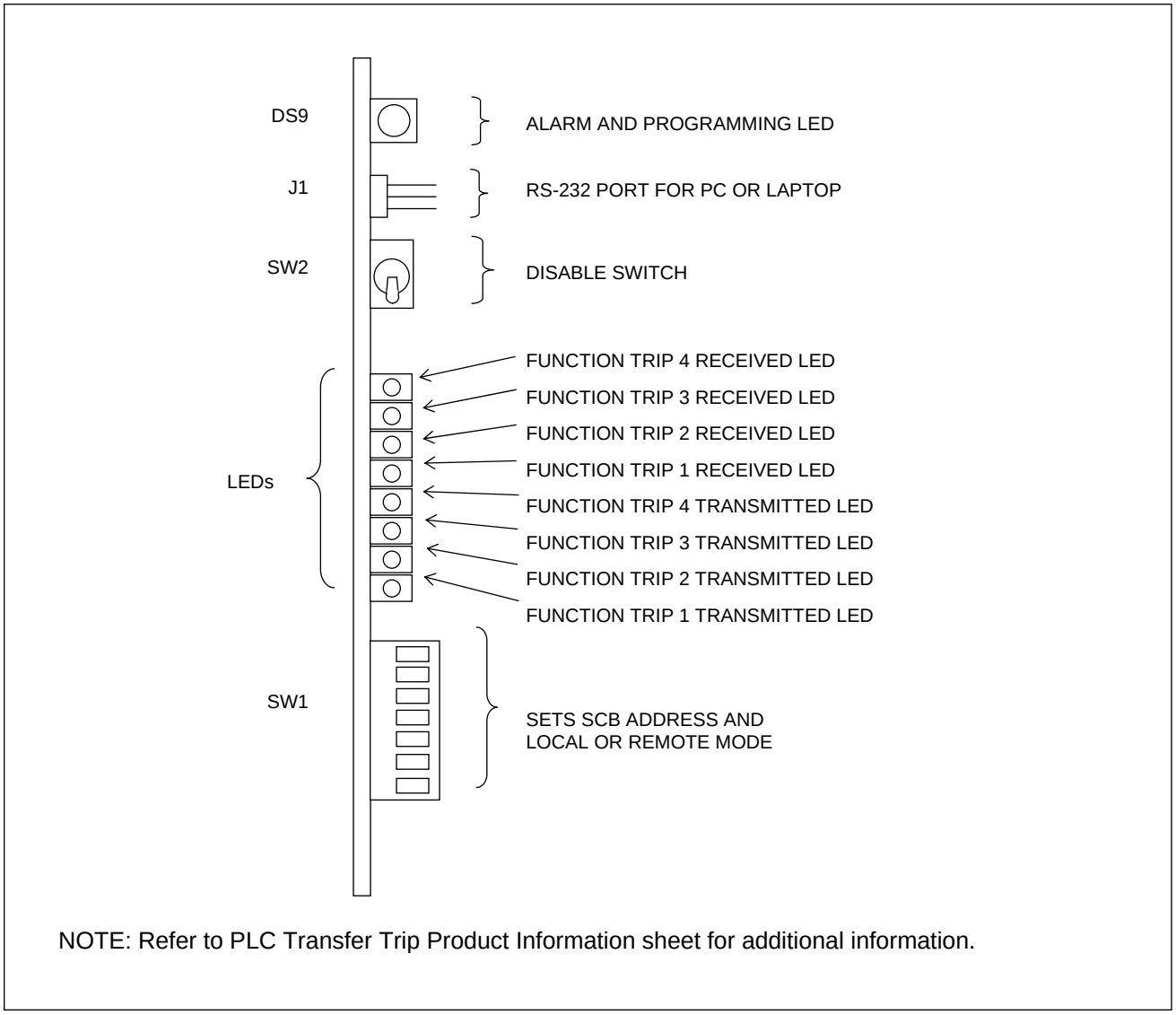
Model Designation	Part Number	Wavelength/ Mode	Peak Light Level*	Average Light Level*	Receiver Sensitivity (Lower Limit)	Receiver Sensitivity (Lower Limit With 3-dB Margin)	Typical Line Length
1300-nm SM LED OIA-R CM4	107455-201	1300 nm Singlemode	-14dBm	-17dBm	-40 dBm	-37 dBm	18 mi (29 km)
1300-nm MM LED OIA-R CM4	107455-301	1300 nm Multimode	-10dBm	-13dBm	-40 dBm	-37 dBm	11 mi (18 km)
1300-nm SM LASER OIA-R CM4	107455-401	1300 nm Singlemode	+3dBm	0dBm	-40 dBm	-37 dBm	36.5 mi (59 km)
1550-nm SM LASER OIA-R CM4	107455-501	1550 nm Singlemode	0dBm	-3dBm	-40 dBm	-37 dBm	56 mi (90 km)

*Light levels are emitter outputs for fiber optic I/O modules, and detector inputs for fiber optic I/O modules.

8.4 PLC TRANSFER TRIP MODULE

8.4.1 DESCRIPTION

The PLC Transfer Trip Module is a bi-directional module designed for use in RFL 9508D 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 9508D terminals, or can support DCB (Directional Comparison Blocking) in addition to two transfer trip functions. These modules can operate point to point between two 9508D 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.



NOTE: Refer to PLC Transfer Trip Product Information sheet for additional information.

Figure 8-11. Edge View of PLC Transfer Trip Module Showing Functions of Switches and LEDs

8.4.2 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 100μs.

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 is selectable.

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

8.4.3 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

ANSI C37.90 - 1989	(service conditions)
Operating temperature	- 20°C to + 65°C
Storage temperature	- 40°C to + 75°C
Humidity	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	1 A (inductive)
Maximum breaking current	1 A (resistive)
Maximum open circuit voltage	280 Vdc
Maximum operate time	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	8.4.3.1.1.1.1 4 Function I/O 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 Adapter Module
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)

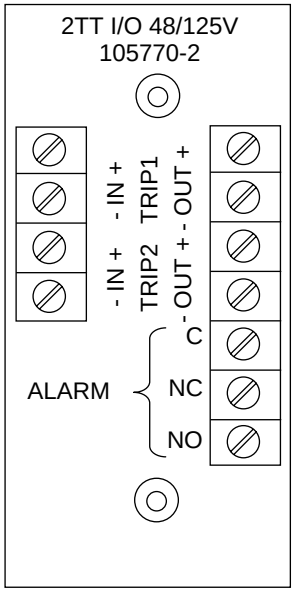
8.5 PLC TRANSFER TRIP MODULE ADAPTERS

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 8-13. Rear panel views of a typical two-function and four-function PLC-TT module adapter is shown in Figure 8-12.

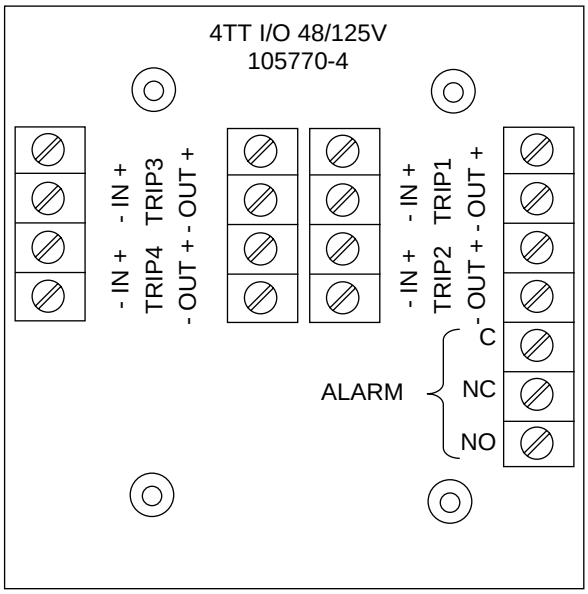
Table 8-15. PLC-TT Module Adapters

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 8-13 for a view of this installation.



a. Typical 2-function Module Adapter



b. Typical 4-function Module Adapter

Figure 8-12. Rear panel view of typical 2-function and 4-function PLC-TT Module Adapters

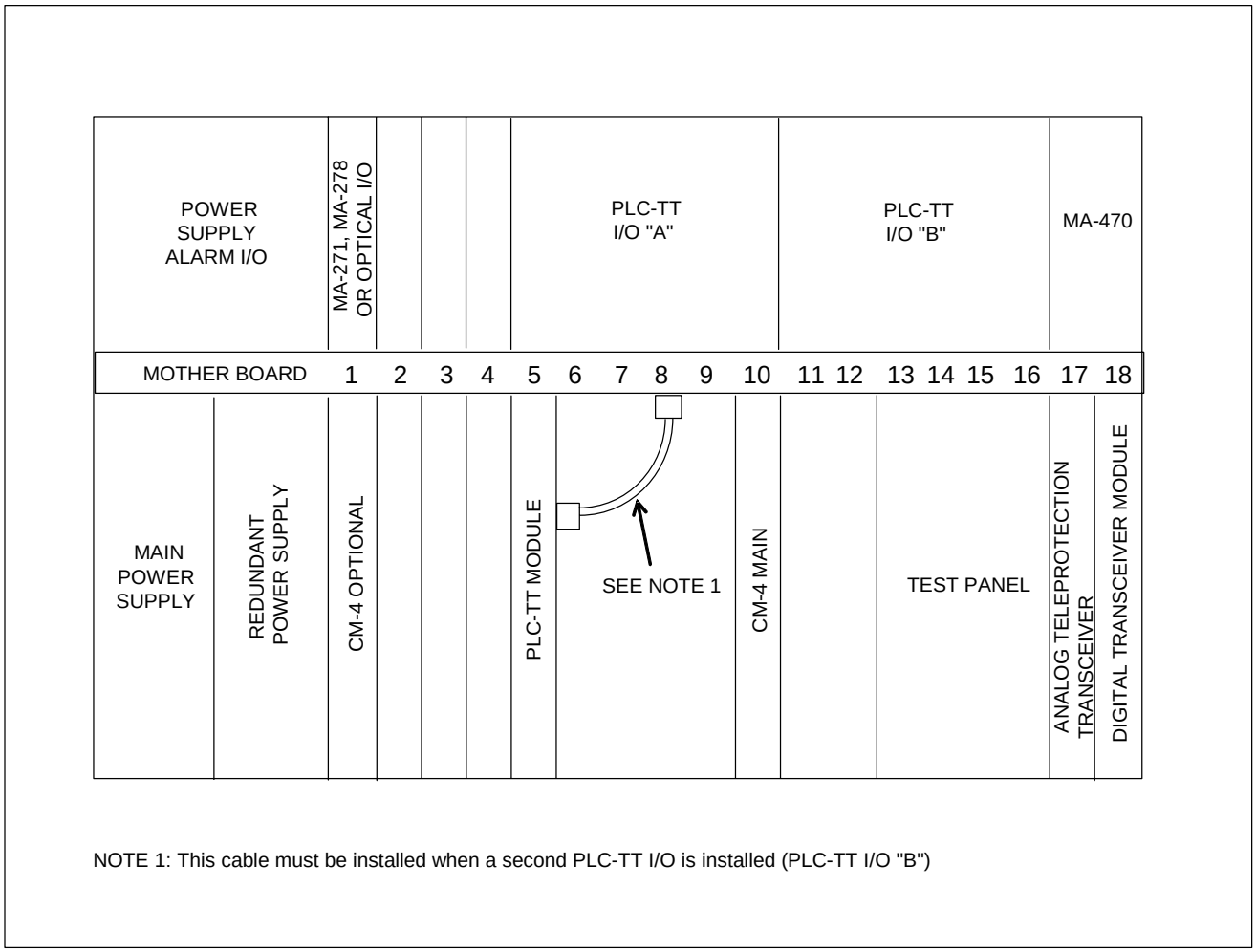


Figure 8-13. Digital chassis showing the installation of two, 4-function, PLC-TT Module Adapters

8.6 TELEPROTECTION ANALOG AND DIGITAL TRANSCEIVER

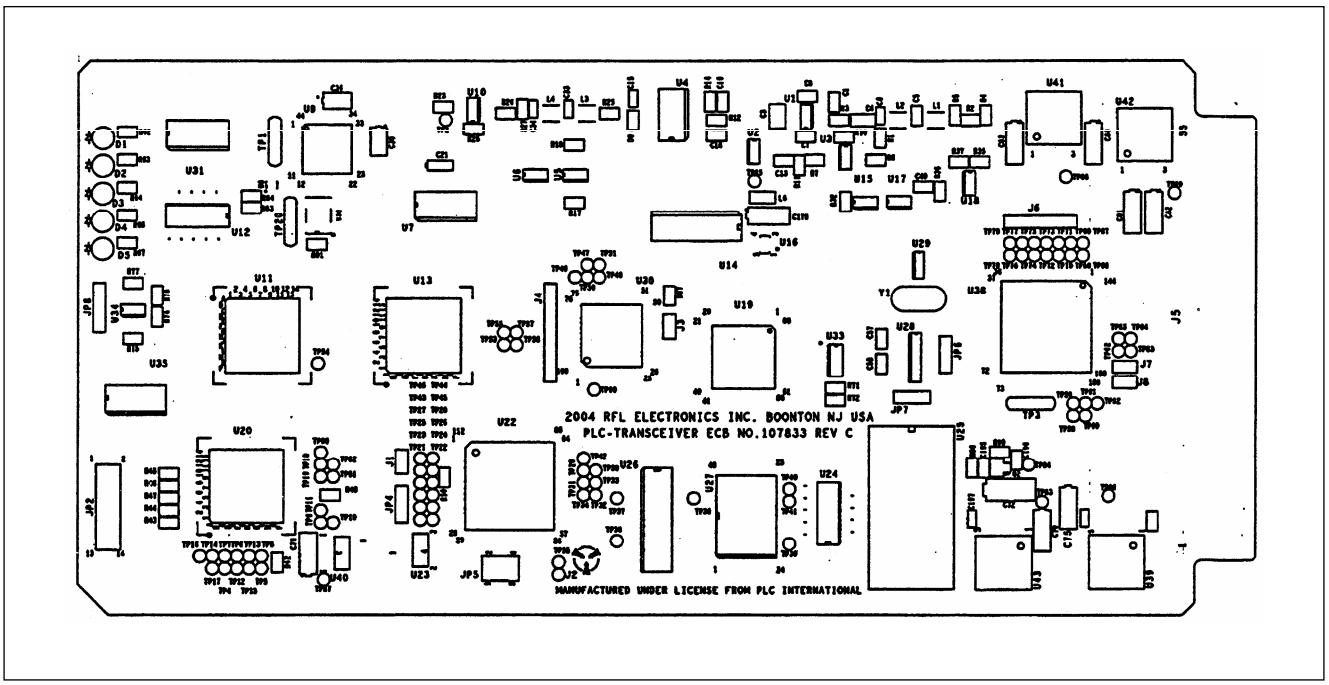


Figure 8-14. Physical Arrangement of the Analog and Digital Transceiver

8.6.1 ANALOG TRANSCEIVER DESCRIPTION

The Analog Teleprotection Transceiver is the Power Line Carrier Transmitter and Receiver for the teleprotection commands. 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 Analog Teleprotection 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 using Single Side Band modulation.
- 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, 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.

8.7 DIGITAL TRANSCEIVER (DPLC)

8.7.1 DESCRIPTION

The Construction of the Digital Transceiver Card (figure 8-14) has a few variations from the Analog Teleprotection Transceiver card to drive additional signals, the main difference is the digital QAM modulation code running inside the DSP and the code running inside the HC12 microcontroller to manage different and control signals and data.

The Digital Transceiver performs the following tasks:

1. - Performs the QAM modulation and demodulation of the data coming from/going to the V.35 interface. The bit rate is auto negotiated between the terminal ends according to the line quality. The TX and RX bit rates are negotiated according to the conditions present on the line at the TX and RX frequencies respectively, therefore the TX and RX connected bit rates can be different to each other.
After the bit rates are negotiated and the digital link established, the line quality is monitored continually, this is done with the purpose of increment the connected bit rate if the line quality is good enough to transmit at a higher bit rate; or to make a fallback if the bit errors exceed a predetermined threshold (line quality decreases).

2. - Translates and converts the Line Frequencies into digital baseband or the digital frame, and the inverse process (digital baseband source to line frequencies). This is done by implementing FIFO buffers for TX and RX data on the V.35 side and also FIFO buffers fed with samples of data from/to the line interface.

3. - Monitors status and events generated on the modulation process in the DSP by the use of an HC12 microcontroller, which also maintain the configuration parameters (such as TX/RX frequencies, permitted bit rates, etc.) to the DSP.

4. - Provides the interface to the V.35 interface through a FPGA which also manages the V.35 control signals and H100 signals.

5. - Monitors the F6 teleprotection commands received from the teleprotection transceiver trough the E1 interface, so that the modem output can be muted when required for teleprotection.

6. - Provides a port for configuration and monitoring of status and alarms. MODBUS protocol is implemented for this purpose, which is based on simple get/set messages where a configuration variable is identified by its address into a table of configuration variables. The MDB variables are contained in an array in RAM which is updated to an EEROM memory inside the HC12 to make this configuration non volatiles.

8.7.2 DATA TRANSMISSION CHARACTERISTICS

This transceiver is intended for use on connections on Power Line Carrier Systems on point-to-point, mesh, hierarchical or star topology. The principal characteristics of the transceiver are as follows:

a) Duplex operation mode.

b) Channel separation by echo canceller techniques.

c) Quadrature Amplitude Modulation (QAM) for each channel with synchronous line transmission at selectable symbol rates of 2400, 2743, 2800, 3000, 3200 and 3249 symbols/s with a 4KHz QAM spectrum bandwidth; and 4800, 5486, 5600, 6000, 6400 and 6498 symbols/s for an 8 KHz QAM spectrum bandwidth.

d) Depending on the Power Line Conditions, the following standard synchronous channel data bit rates can be achieved: 62400, 57600, 52800, 48000, 43200, 38400, 33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800 and 2400 bit/s.

e) Trellis coding for all data signaling rates.

f) Adaptive techniques that enable the modem to achieve close to the maximum data signaling rate the channel can support on each connection.

g) Exchange of rate sequences during start-up to establish the data signaling rate.

h) Modulation: It is an Adaptive Trellis Code Modulation with Multidimensional Error Correction resulting in fractional bits per symbol, from 4-QAM to 1024-QAM, depending on the Power Line Conditions and Bandwidth available.

8.8 TRANSCEIVER MODULE ADAPTER (MA-470)

The Transceiver Module requires an MA-470 Module Adapter. The MA-470 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-470 is shown in Figure 8-15.

The MA-470 has a Craft port, a V.35 port and two BNC connectors labeled TX and RX. The Craft Port is a three-wire 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, the teleprotection Transceiver module or the Digital 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 9508D using 9508D UCC NMS software for the CM4 and both the Teleprotection and Digital Transceiver. It can also be used to interrogate a remote 9508D.

The V.35 port uses a DB-37 connector to interface the digital synchronous signal to the packetizing multiplexer.

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.

DB37 pin No	Signal Name
22	Send Data B
4	Send Data A
23	Serial Clock Transmit B
5	Serial Clock Transmit A
26	Serial Clock Receive B
8	Serial Clock Receive A
24	Receive Data B
6	Receive Data A
9	Clear to Send
7	Request to Send
19	Signal Ground

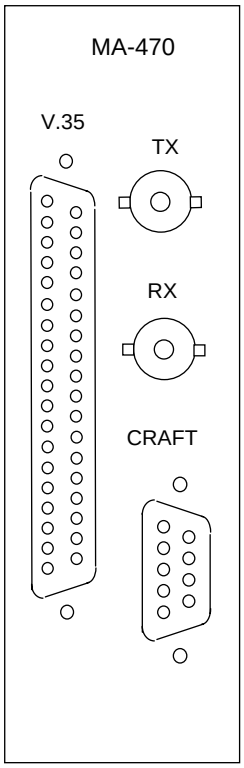


Figure 8-15. Rear panel view of Transceiver Module Adapter (MA-470).

8.9 TEST PANEL

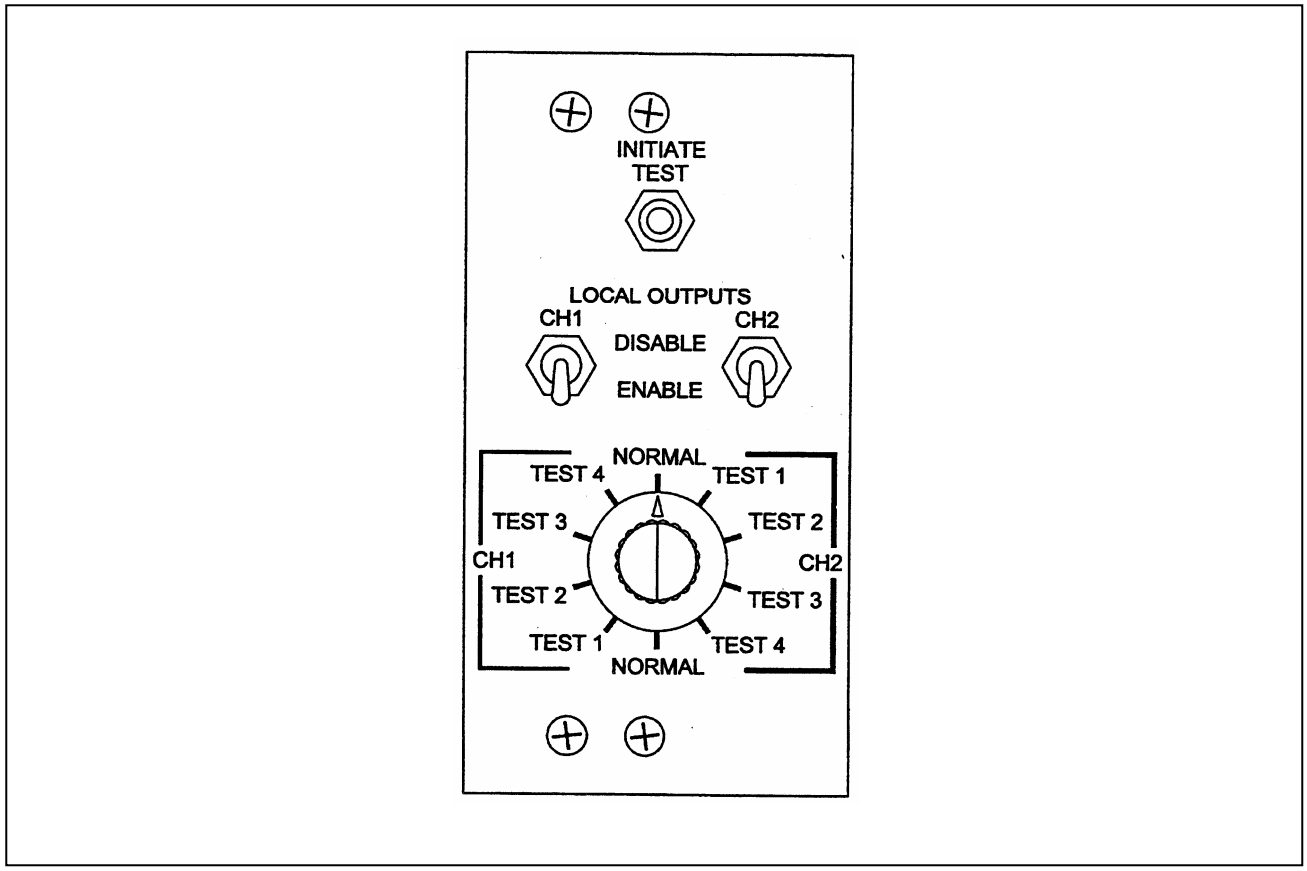


Figure 8-16. RFL 9508D Test Panel

The Test Panel is used to test all circuits related to the Transfer Trip function, at both ends of the 9508D system. It does this by sending a "test trip command" from the 9508D at the near end, to the 9508D 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 a 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.

8.10 POWER SUPPLY MODULE

8.10.1 DESCRIPTION

The 2000 PS series of power supply modules are the power source for all logic circuits in the RFL 9508D, 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 9508D Digital Chassis, as shown in Table 8-16. The 9508D 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.

Table 8-16. RFL 9508 Power Supply Modules, General Information

Unit	Model Designation	Part Number	Input Voltage
Power Supply	2000 PS 250DC	9547-840	250 Vdc
Power Supply	2000 PS 48/125DC High Power	9547-965	48 Vdc or125 Vdc

8.10.2 SPECIFICATIONS

As of the date this manual was published, the specifications shown in Table 8-17 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.

Table 8-17. IMUX 2000 Power Supply Specifications

Power Supply→ Specifications ↓	**9547-840**	**9547-965**
Input Voltage Range	200 to 300 Vdc	38 to 150 Vdc
Max Output Current: +5V +15V -15V -48V	 5.00A 0.75A 0.75A 0.10A	 6.00A 1.75A 1.00A 0.10A
Adjustments: R44 R49 R50 R61 R76	 NA NA NA Output adjust +5V output adjust	 NA NA NA Output adjust +5V/+15V/-15V NA
Test Points: TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10	 +15 Volt output Output circuit common -15 Volt output +5 Volt output NA Input circuit common FET gate drive Supply voltage (Vcc) to PWM Input to +15Vdc regulator -48Vdc output	 Output circuit common +5Volt output +15 Volt output -15 Volt output -48Vdc output NA NA NA NA NA
Indicators	DS1 – Normal (Green) DS2 – Alert (Yellow) DS3 – Fail (Red) DS4 – Power (Green) DS5 – Supply Fail (Red)	DS1 – Normal (Green) DS2 – Alert (Yellow) DS3 – Fail (Red) DS4 – Power (Green) DS5 – Supply Fail (Red)
Alarm Disable Switch SW1	Enables “dropout” of relays K51 & K52 on Power Supply Alarm I/O module when in the ENABLE position. Keeps relays K51 & K52 on Power Supply Alarm I/O module “pulled in” when in the DISABLED position.	
Operating Temperature	-20°C to +65°C	-20°C to +65°C
Humidity	95% @ +40°C	95% @ +40°C
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.	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.

8.11 POWER SUPPLY ALARM I/O MODULE

8.11.1 DESCRIPTION

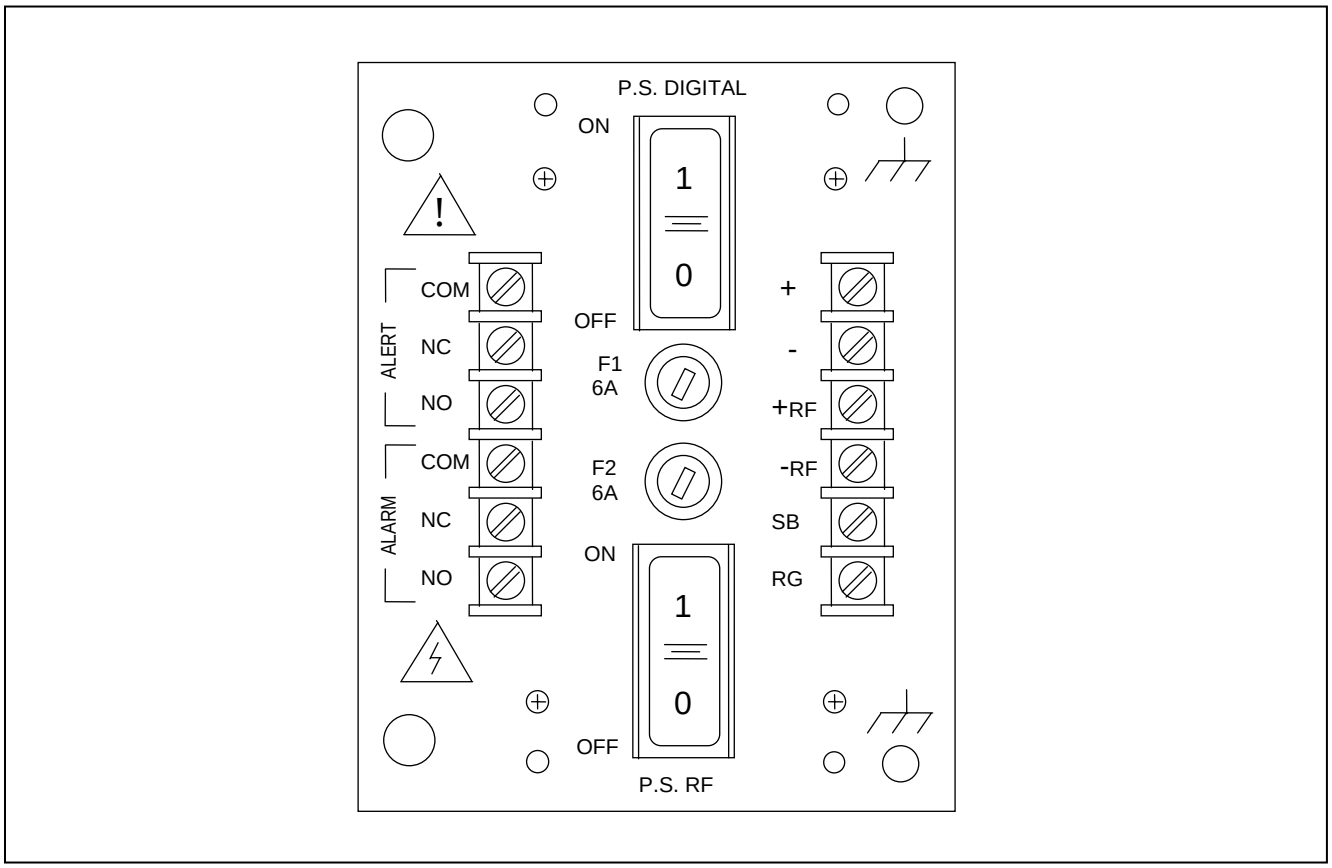


Figure 8-17. Power Supply Alarm I/O, rear panel view

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 9508D chassis. Some of the characteristics of these modules are listed in Table 8-18. A rear panel view of the 9547-18809 Power Supply Alarm I/O module is shown in Figure 8-17.

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 8-19 for Power Supply Alarm I/O application information. Only one Power Supply Alarm I/O module is used per chassis.

Table 8-18. Types Of Power Supply Alarm I/O Modules

Model Designation	Part Number	Application
2000 PS ALARM I/O DC	9547-18801	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	9547-18809	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 8-19. Power Supply Alarm I/O Application Information

Power Supply→ Alarm I/O ↓	9547-840	9547-965
9547-18801	X	
9547-18804		X
9547-18809		X
9547-18810	X	

8.12 MOTHERBOARD

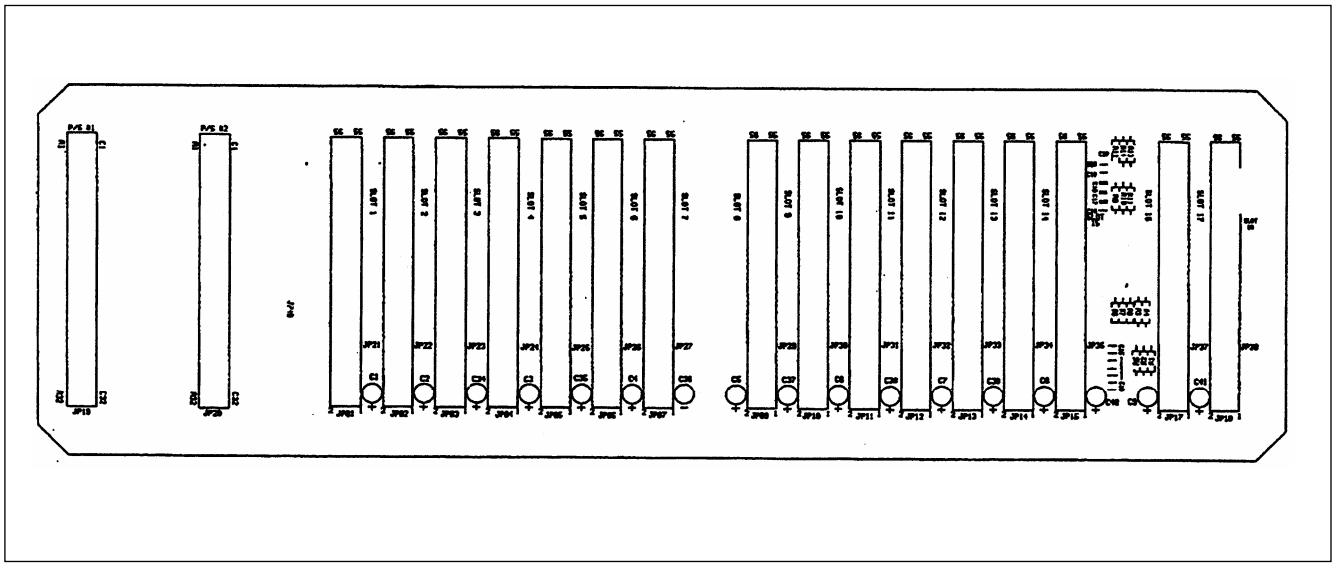


Figure 8-18. RFL 9508D Motherboard, Digital Chassis

8.12.1 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.

Section 9. CHANNEL MODULES

This section contains Instruction Data Sheets for channel modules available for use with the RFL 9508D UCC Digital Power Line Carrier Multiplexing System, as of the date this manual was printed:

- **RFL VF-5XP Dual-Channel Four-Wire E&M Voice Module**
- **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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Section 10. INDEX

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