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INSTRUCTION MANUAL

RFL 9745 Teleprotection Channel

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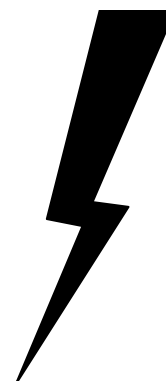
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SAFETY WARNINGS AND SUMMARY

CAUTION

FOR YOUR SAFETY

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



WARNING:

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

WARNING:

YOUR 9745 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.

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

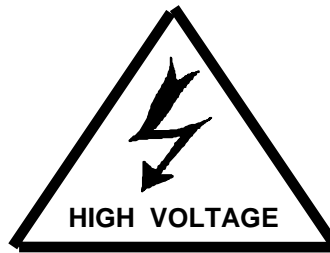


Operators should read this manual before attempting to use the equipment, to learn how to use it properly and safely. Service personnel must be properly trained and have the proper tools and equipment before attempting to make adjustments or repairs.

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!



High voltages are generated within the equipment.

Before carrying out any maintenance or repair work, ensure that the equipment is isolated from the electrical supply.

When the electrical supply cannot be isolated for specific reasons, testing, maintenance and/or repair tasks are to be undertaken only by competent technicians who are aware of the dangers involved, and have taken all the necessary safety precautions.

WARNING!

**POWER MUST BE TURNED OFF BEFORE
REMOVING OR INSTALLING ANY RFL 9745
MODULES. FAILURE TO DO SO MAY RESULT
IN COMPONENT DAMAGE.**

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10-24-94	Revised in accordance with ECO number 9745-052	11-07-94	CS
12-21-94	Revised in accordance with ECO number 9745-064 Revised in accordance with ECO number 9745-047	01-10-95	CS
03-02-95	Revised in accordance with ECO number 9745-075 Effected pages: i, v → xvii, 1-1, 13-1, 13-2	03-06-95	CS
09-15-95	Revised in accordance with ECO number 9745-103 Effected pages: i → xvii, 2-1 → 2-46, 3-1 → 3-34, 7-28 → 7-30, 8-1 → 8-13, 9-1, 9-2 10-1 → 10-14, 11-1 → 11-9, 12-1 → 12-23	09-22-95	CS
09-15-95	Revised in accordance with RFA number 2649 Effected pages: 12-11 → 12-23	09-22-95	CS
03-18-96	Revised in accordance with ECO number 9745-123 Effected sections: 0, 1, 2, 3, 5, 6, 8, 9, 12, 13	05-03-96	CS
05-16-97	Revised in accordance with ECO numbers 9745-111, 113, 114, 116, 121, 122, 129, 131, 134, 135, 137, 138, 139, 141, 144, 147, 149 Revised in accordance with RFA numbers 4137, 4181, 4613, 4614, 4638, 4645, 4646, 4686, 4706, 4707, 4795, 5092, 5126, 5139	06-27-97	CS
07-22-97	Revised in accordance with RFA number 5122	07-22-97	CS
07-15-98	Revised in accordance with RFA number 5794 Added information on new Audio Communications Module	07-15-98	CS
11-10-98	Revised manual to include information on both the narrow band and wide band Audio Communications modules.	11-12-98	CS
01-28-99	Revised in accordance with ECO number 9745-167 and RFA number 6383. Upgraded figures in Section 3, Added new wide range power supply (170-300VDC), added wide band installation instructions, and added a new schematic to Section 12.	1-28-99	CS

REVISION RECORD - continued

Rev	Description	Date	Approval
05-25-99	Miscellaneous corrections	07-07-99	CS
12-02-99	Miscellaneous corrections	12-02-99	CS
03-08-00	Revised in accordance with ECO No. 9745-198 (software upgrade)	03-08-99	CS
10-24-00	Miscellaneous corrections	10-24-00	CS
12-22-00	Replaced G.703 Co-directional I/O module (105065-3) with G.703 Co-directional I/O module with programmable octet timing (105065-11). Added digital commissioning procedure. Revised in accordance with ECO numbers 9745-184, 187, 189 and 201 Effected sections: 0, 2, 3, 12	12-22-00	CS
01-29-01	Added paragraph 3.9 to Section 3 (Converting an Audio Tone 9745 to a Digital 9745)	01-29-01	CS
03-27-01	Added High Speed Relay I/O	03-27-01	CS
05-25-01	Revised in accordance with RFA number 7208: Added Section 10 on UCA Interface, and moved existing Sections 10 through 12 up by one section number.	05-25-01	CS
6-14-01	Revised in accordance with RFA number 7630: Added warning to page vi to prevent battery discharge. Revised in accordance with RFA number 7640: Added several definitions to Section 11, Glossary. Revised in accordance with CAR No. 9745-0001: Added “NOP” and “END” commands to Sections 2 and 6. Revised Tables 2-7 and 2-8, and added notes to Table 2-8.	07-24-01	CS
11-5-01	Revised Section 3 in accordance with CAR 9745-0008. Revised warning on page vi and added battery replacement schedule to paragraph 8.6	11-05-01	CS

REVISION RECORD – continued

Rev	Description	Date	Approval
6-1-02	Revised in accordance with CAR No. 9745-0047 Revised in accordance with CAR No. 9745-0054 Revised in accordance with CAR No. 9745-0055 Revised in accordance with ECO No. MISC-489 Revised in accordance with ECO No. 9745-210 Revised in accordance with ECO No. 9745-218 Revised in accordance with ECO No. 9745-224	6-1-02	CS
7-18-02	Revised in accordance with ECO No. 9745-227 (Removed lithium battery from CPU and replaced with capacitors). Revised in accordance with ECO No. 9745-231 (Added E1 Serial Interface Adapter to Section 3).	7-18-02	CS
10-15-02	Revised in accordance with ECO No. 9745-235 (new CPU module) Revised in accordance with CAR No. C9745-0100 (+/- 85 Hz shift) Revised in accordance with CAR No. C9745-0101 (ping-pong) Revised E1 interface in Section 3	10-15-02	CS
12-18-02	Included two CPU modules in Section 2, one with battery and one with caps Added battery information to Maintenance Section 8 Revised in accordance with ECO No. 9745-241 (new label, Figure 3-7) Revised in accordance with CAR No. C9745-0125 (updated event triggers, paragraph 6.13.5) Revised in accordance with CAR No. C9745-0127 (revised modem channel settings in paragraph 5.5) Revised in accordance with CAR No. C9745-0130 (added information on selecting event trigger levels to paragraph 6.13.5) Revised Section 12 (Index)	12-18-02	CS

REVISION RECORD – continued

Rev	Description	Date	Approval
6-29-04	<p>Revised in accordance with CAR No. C9745-0177 Change figure numbers 3-8 & 3-9 to 3-12 & 3-13.</p> <p>Incorporated errata sheet MC 9745-001 dated 10-14-03.</p> <p>Incorporated errata sheet MC 9745-002 dated 11-10-03.</p> <p>Incorporated errata sheet MC 9745-003 dated 12-19-03, in accordance with ECO No. 9745-260.</p> <p>Incorporated errata sheet MC 9745-004 dated 5-10-04, in accordance with CAR# C9745-0189.</p> <p>Incorporated errata sheet MC 9745-005 dated 6-1-04, in accordance with ECO No. MISC-505.</p>	6-29-04	CS
6-1-06	<p>Incorporated errata sheet MC 9745-006 dated 11-12-04</p> <p>Incorporated errata sheet MC 9745-007 dated 10-24-05</p> <p>Revised in accordance with CAR # 9745-0241 which updated Sections 2, 3, 4, 5, 6, 9 and 11.</p> <p>Added index to make pdf and hard copy common.</p> <p>Updated section 13.</p>	6-9-06	TG
12-22-06	<p>Updated manual in accordance with CAR # 9745-0266. This covered the inclusion of APRIL LITE software to the manual in Sections 4,5,6 and 9</p> <p>Incorporated errata sheet MC 9745-008 dated 10-30-06</p>	12-22-06	TG
3-1-07	<p>Update manual in accordance with CAR # 9745-0292. This improved the layout of logic input/output signal descriptions in Section 2.</p>	3-1-07	TG
10-1-07	<p>Incorporated errata sheet MC 9745-009 dated 5-3-07 and CAR#9745-0327. Updates to section 2, 3, 4, 5, 6 and 12.</p>	10-1-07	TG

REVISION RECORD – continued

Rev	Description	Date	Approval
4-7-08	Incorporated Errata Sheet MC9745-010 dated 1-29-08, changes to Section 3 as per ECO 9745-303.	4-7-08	TG
7-1-08	Correct errors in Section 3 as per CAR#9745-0355. Add note as per CAR#9745-0351.	7-1-08	TG
2-24-09	Updates and corrections to Section 2, 3, 5 and 8. Schematics updated in Section 13.	2-24-09	TG

Section 1. PRODUCT INFORMATION

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RFL 9745

Teleprotection Channel



Description

The RFL 9745, is a fully programmable Teleprotection Channel suitable for Direct Transfer Trip, Permissive Transfer Trip, Blocking and Unblocking applications. Flash memory and remote RS-232 communications allows new firmware to be loaded making field programming possible without having to open the chassis. The communications interface can be converted in the field to adapt to different types of media. An unprecedented level of diagnostic information is available and easily accessible with the RFL 9745. RFL's sequence-of-events, diagnostics package provides a convenient method for evaluating communications system performance during the fault clearing process.

Features

- One product for audio, digital or fiber applications
- Up to four independent functions per audio system, seven for digital/fiber
- Sequence-of-events recording
- Address and checkback testing
- Bi-directional channel delay measurement
- Trip output failure detection
- User-defined teleprotection logic and alarms
- Remote RS-232 setup and diagnostics
- Diagnostics and setup of remote RFL 9745 through the local RFL 9745
- Three year warranty
- Optional Ethernet/Telnet adapter for remote LAN/WAN access



Applications

The RFL 9745 communications interface can be configured for audio, digital or fiber optic media. It is well suited for all standard and non-standard pilot protections schemes such as:

- Permissive Transfer Trip
- Direct Transfer Trip
- Blocking and Unblocking

Diagnostics and Testing

Diagnostic information is available and easily accessible with the RFL 9745. RFL's diagnostic package takes the guesswork out of power system fault analysis and evaluating communications system performance during the fault-clearing process. The RFL 9745 provides the following standard features:

- Two RS-232 ports for local and remote access
- Optional Ethernet/Telnet adapter for remote LAN/WAN access
- Trip output circuit failure detection
- 100 Sequence-of-events records
- Internal real-time system clock
- IRIG-B Clock sync input
- Six-digit cumulative operations counters
- System outage timer
- Current status of all system parameters
- Diagnostic information about the remote end
- Checkback testing either locally or remotely initiated
- Automatic checkback by interval time between tests
- Channel propagation delay measured and reported

- Channel delay in each direction available with IRIG-B
- Commissioning can be accomplished remotely or from a single terminal

Figure 1 shows the record number, the name of the parameter that changed state to trigger the event, and the date and time the event occurred. Below this, the status of all inputs, outputs, and alarm outputs at the time of the event are listed. This information can be used to analyze the system conditions at the precise instant the event occurred.

Programmability

Changes in field are no longer necessary for logic functions can be changed or fine-tuned remotely through the RFL 9745's RS-232 port or optional Ethernet/Telnet adapter.

User Programmable Logic Functions

Change timer values, logic states and logic functions without ever removing a module or opening the chassis.

User Programmable Inputs and Outputs

The RFL 9745 can be supplied with two Input/Output modules. Each module provides optically isolated inputs, solid-state or dry relay contact outputs, as well as form "C" alarm contacts. The function of all of these inputs and outputs can be individually programmed to meet the application requirements.

Create your own alarm conditions

The RFL 9745 can be equipped with either three or six fully-programmable alarm/annunciator relays.

Record 003		Event Trigger: Annunc Relay 1A Inactive			
		Event Time: 01/01/98, 00:07:06.260			
Input 1A	|	Output 1A	|	Rx Freq High Ch1	|
Input 2A	|	Output 2A	|	Rx Freq High Ch2	A
Input 3A	|	Output 3A	|	Rx Freq High Ch3	|
Input 4A	|	Output 4A	|	Rx Freq High Ch4	A
Input 1B	|	Output 1B	|	Rx Freq Low Ch1	A
Input 2B	|	Output 2B	|	Rx Freq Low Ch2	|
Input 3B	|	Output 3B	|	Rx Freq Low Ch3	A
Input 4B	|	Output 4B	|	Rx Freq Low Ch4	|
Annunc Relay 1A	|	Annunc Output 1	|	Tx Function Ch1	|
Annunc Relay 2A	|	Annunc Output 2	|	Tx Function Ch2	A
Annunc Relay 3A	A	Annunc Output 3	|	Tx Function Ch3	|
Annunc Relay 1B	|	Annunc Output 4	|	Tx Function Ch4	A
Annunc Relay 2B	|	Annunc Output 5	|	Address Test Fail	|
Annunc Relay 3B	|	Annunc Output 6	|	Autotest Timeout	|
Run Auto Test	|	Channel Delay	|	Bus Error	|
FM Noise Ch1	|	AM Noise Ch1	|	Left Power Low	|
FM Noise Ch2	|	AM Noise Ch2	|	Right Power Low	A
FM Noise Ch3	|	AM Noise Ch3	|	Battery Failure	A
FM Noise Ch4	|	AM Noise Ch4	|	RS232 Active	A
Comms CPU Failure	|	Outage Timer Active	|	Test in Progress	|
Autotest Complete		|			

Figure 1. Typical individual event record display for the Audio System



Programming

The RFL 9745 is programmed using RFL's **Asynchronous Programming and Remote Interrogation Language (PC APRIL)**. PC APRIL provides the user with a verbose man/machine interface in an ASCII format. It is accessible using any standard terminal emulation or communication software on a personal computer.

All functions that require adjustments during normal installation and maintenance are also available by using the front-panel display and push-button switches. All programming levels available over the RS-232 (or Telnet adapter) interface are password-protected.

Every RFL 9745 is supplied pre-programmed with a default operating program. On the audio tone version, after the standard program is uploaded into the system, all the user needs to do is enter the operating frequencies and bandwidths. Figure 2 shows the parameter settings for the audio tone version, Figure 3 shows the parameter settings required for RFL 9745's configured with any of the several digital interfaces available.

A Windows version of the RFL 9745 April Lite software package is supplied with every order. This version allows the

application engineer to save revised programming parameters to a disk file for future downloading to the RFL 9745.

A specialized software, the RFL Expert System, has been developed to allow graphical design of the system logic by using a specialized symbols library. The RFL Expert System is a WINDOWS™-based application software package which allows the user to develop his own protection schemes. This software is intended for customers who want to create, modify, or simulate applications for their RFL 9745 without having the hardware in front of them.

The RFL Expert System consists primarily of an OrCAD™ Schematic Capture Program coupled with an RFL designed WINDOWS™-based editing system and RFL's easy-to-use PC APRIL programming language. This system includes a digital simulator which allows the user to simulate logic inputs to the newly designed system logic and verify the expected results prior to uploading.

OrCAD™ Software is used to design RFL 9745 alarm logic and primitive logic diagrams. The RFL Expert System software is used to run simulations on the logic diagrams and to combine the primitive and alarm logic diagrams into one set of files for the RFL 9745. These files are then used to program the RFL 9745 using PC April Software.

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	sec/dep			
001	Channel 1	Single			
002	Tone 1 Tx Freq	1540 Hz 1690 Hz			
003	Transmit Level	0.00 dBm	004	Boost Level	0 dB
005	Tone 1 Rx Freq	1540 Hz 1690 Hz			
006	Rx Bandwidth	225 Hz	007	Rx Level	0 dBm
008	Rx Alarm	-40 dBm	009	AM Noise (SNR)	9 dB
010	FM Noise	15 %			
016	Channel 2	Single			
017	Tone 2 Tx Freq	1200 Hz 1350 Hz			
018	Transmit Level	0.00 dBm	019	Boost Level	0 dB
020	Tone 2 Rx Freq	1200 Hz 1350 Hz			
021	Rx Bandwidth	225 Hz	022	Rx Level	0 dBm
023	Rx Alarm	-40 dBm	024	AM Noise (SNR)	9 dB
025	FM Noise	15 %			
031	Channel 3	Single			
032	Tone 3 Tx Freq	2220 Hz 2370 Hz			
033	Transmit Level	0.00 dBm	034	Boost Level	0 dB
035	Tone 3 Rx Freq	2060 Hz 2370 Hz			
036	Rx Bandwidth	225 Hz	037	Rx Level	0 dBm
038	Rx Alarm	-40 dBm	039	AM Noise (SNR)	9 dB
040	FM Noise	15 %			
046	Channel 4	Single			
047	Tone 4 Tx Freq	1880 Hz 2030 Hz			
048	Transmit Level	0.00 dBm	049	Boost Level	0 dB
050	Tone 4 Rx Freq	1880 Hz 2030 Hz			
051	Rx Bandwidth	225 Hz	052	Rx Level	0 dBm
053	Rx Alarm	-40 dBm	054	AM Noise (SNR)	9 dB
055	FM Noise	15 %			
060	Opt Status Board	No	061	EE Pot J10	B
062	Chan delay alarm	8 ms	063	Year	1998
064	Date	01/01	065	Time	02:07:38
066	Hour Adjust	-1	067	Local Address	0
068	Remote Address	0	069	Reset Log	

Figure 2. Typical Audio System parameter settings display



System Specifications

Audio Communications

Audio tone versions of the RFL 9745 can be supplied with two or four FSK audio tone transceivers. All transceivers are bidirectional and can be programmed for any operating frequency or bandwidth between 300 and 4,000 Hz. Channel one can be set to operate as a modem channel. This channel provides a communication link to the remote terminal for remote interrogation, setting changes or system testing from the local terminal.

Audio Interface Configurations

Single Two-Wire Terminals
 Dual Two-Wire Terminals
 Single Four-Wire Terminals
 Dual Four-Wire Terminals

Recommended Channel Frequencies

Range: 300 Hz to 4000 Hz
 Resolution: 1Hz

Transmit Level

Adjustable from -40 dBm +10 dBm in 0.25 dB steps

Receiver Sensitivity

Minimum Input Level: -40 dBm
 Maximum Input Level: 0 dBm

Receiver Dynamic Range (referenced to center point)

-17 dB to + 11 dB

Adjacent Channel Rejection

40 dB

60-Hz Rejection

A received tone at -30 dBm will not be affected by a 50 Hz or 60 Hz signal as great as 40 Vrms with optional 50/60 Hz blocking filter.

Amplitude Stability

The Transmit level will vary by no more than ± 1 dB.

Spurious Output

All harmonics and spurious outputs are at least 40 dB lower than the carrier.

Transmitter Stability

The transmitter frequency is stable within 0.02 percent over the full range of temperature and input power variations.

Trip Boost

Amplitude: Adjustable from zero to +12 dB in 1 dB steps.
 Duration: Adjustable from zero to 30 seconds in .5ms steps.

Input and Output Impedance

600 Ohms

Digital Communications

The RFL 9745 is available with five types of serial digital interfaces: 56Kbps/RS-449, 64Kbps/G.703 Codirectional and Contra-directional interfaces, 64Kbps/X.21, and 2.048Mbps/G.703.

The digital interfaces conform to the standards set forth in their respective specifications (RS-449, CCITT G.703, X.21). Figure 3 represents a typical parameter settings display for the digital system.

Fiber Optic Communications

Fiber Optic Communications Interfaces and System Gains are as follows:

Wavelength & Emitter Type	Fiber Type	Connector Type	Output Level	Receiver Sensitivity	System Gain
850nm LED	Multimode	ST	-24 dBm	-49 dBm	25 dB
1300nm LED	Multimode	ST	-13 dBm	-36 dBm	23 dB
1300nm LED	Singlemode	ST	-17 dBm	-36 dBm	19 dB
1300nm Laser	Singlemode	ST	0 dBm	-36 dBm	36 dB
1550nm Laser	Singlemode	ST	-3 dBm	-36 dBm	33 dB
850nm LED (short haul)	Multimode	ST	-19dBm	-32 dBm	13 dB

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	sec/dep			
011	Functions 1-7	Digital			
012	Major Data Error	6, 500			
013	Minor Data Error	400, 200000			
014	Alarm BER	1E-04			
060	Opt Status Board	No	062	Chan delay alarm	8 ms
063	Year	2000	064	Date	01/01
065	Time	00:00:21	066	Hour Adjust	-1
067	Local Address	0	068	Remote Address	0
069	Reset Log				

Figure 3. Typical parameter settings display for the Digital System.

Specifications subject to change without notice.



850 nm Short Haul Fiber Interface

The RFL 9745 is typically located close to the protective relaying equipment. The communications equipment, could be located in a different room or building in the substation. The RFL 9745 when configured with the Short Haul Fiber Interface, eliminates the ground potential rise and induced voltage concerns associated with routing a copper communications cable between two sites. A pair of 850 nm multimode fiber optic cables are routed between the two locations. The fibers can be up to 1 kilometer (3,280 feet) long and terminated with ST type connectors.

There are two ways to implement short haul fiber communications between the RFL 9745 and a multiplexer. The Short Haul Fiber Interface for the RFL 9745 is compliant to the ANSI C37.94 Short Haul Fiber Standard and will directly communicate to a multiplexer with a compliant interface. If the multiplexer does not support the standard, RFL can provide a remote Fiber Optic Service Unit that converts the optical signal into an electrical signal that will be accepted by the multiplexer.

The digital output of the Fiber Optic Service Unit is connected to the communications equipment by a short elec-

trical cable as shown in Figure-4. If the communications equipment supports the ANSI 37.94 Short Haul Fiber Interface standard the fiber optic cables can be interfaced directly to it as shown in Figure 5.

Short Haul Service Unit Fiber Optic Transceivers

Compliant to ANSI C37.94 Short Haul Fiber Standard

Fiber Type: 50 Micron core, 850 NM Multimode
62.5 Micron core, 850 NM Multimode

Optical Budget: 9db for 50 Micron core
13db for 62.5 Micron core

Fiber Connector: ST

Digital Connector:
RS-449, 64kbps, DB37 Male Connector
V.35, 64kbps, DB37 Male Connector
X.21, 64 Kbps, DB15 Male Connector
G.703, 64-768 Kbps, DB15 Male Connector

Input Power

Less than 5W with a 38-150VDC power supply input.

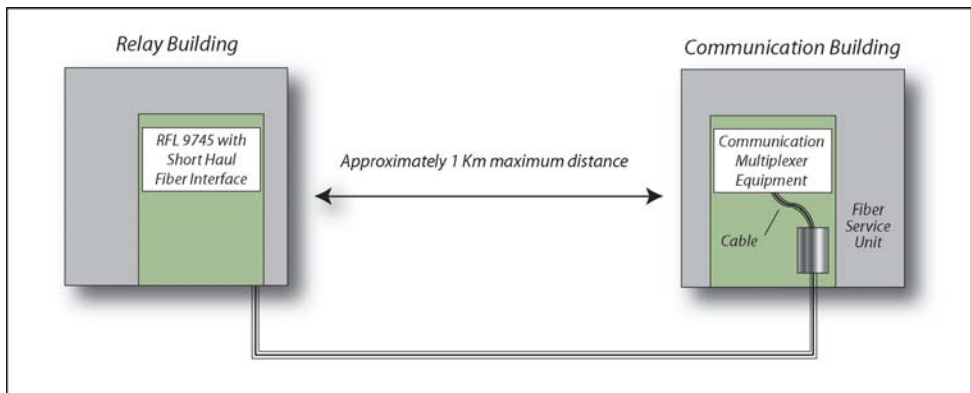


Figure 4. Typical RFL 9745 Short Haul Fiber Optic Application with Fiber Service Unit

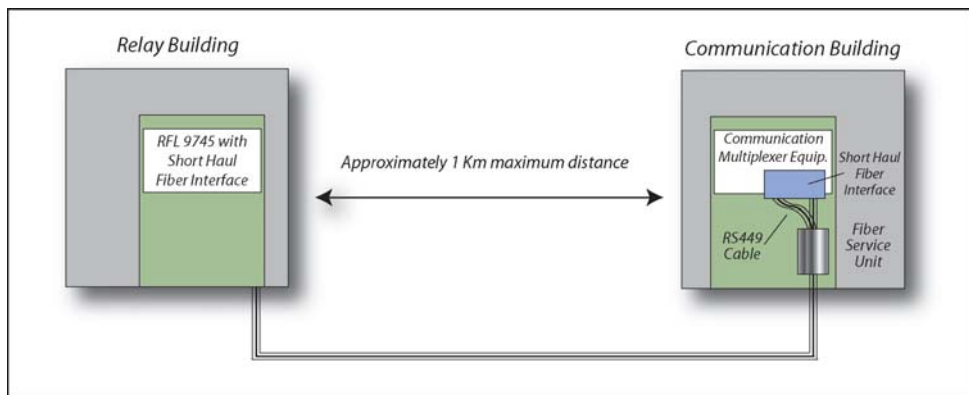


Figure 5. Typical RFL 9745 Short Haul Fiber Interface Application direct to multiplexer with C37.94 compliant I/O

Specifications subject to change without notice.



Real Time Clock

IRIG-B

The RFL 9745 accepts the IRIG-B Standard Time Code on a 1kHz modulated carrier. Nominal signal levels are 3.3 volts peak-to-peak ($\pm 0.5v$) for a logic "1" and 1 volt peak-to-peak ($\pm 0.2v$) for a logic "0". The IRIG-B input presents a 3.7k ohm impedance and is transformer isolated.

Resolution

1 ms

Accuracy

Free Running: Within 1 minute per month
Under IRIG-B Control $\pm 1msecs$

Reset

Manual or by IRIG-B code

Isolation

The RFL 9745's RS-232 ports (front and rear panel) are isolated from circuit common and chassis ground to a surge withstand level of 500 Vdc.

Events Storage

The Sequence of Events Recorder can store up to 100 events. After this limit is reached, older events are overwritten. The Log Counters keep a running tally of the number of times each function, input, output and alarm is active. Up to 1,000,000 counts can be stored for each item.

RS-232 Interrogation Ports

The 9745 provides two RS-232 Ports, located on the front and rear of the chassis. The RS-232 Port located on the front of the chassis has priority. The front of the RS-232 port is configured as a DCE Interface. The rear RS-232 port is configured as a DTE Interface.

Data Rates

300 bps, 1200 bps, 2400 bps, 9600 bps or 19.2 Kbps. Selection is made using front panel switches.

Communication Parameters:

Number of Data Bits: Eight
Number of Stop Bits: One
Parity: None
Flow Control: XON/XOFF

Ethernet Telnet Adapter

For applications where a telnet link is required, the RFL 9745 can be equipped with the optional Telnet Adapter module. This adapter contains one Ethernet port and two RS232 serial ports. The basic function is to pass Ethernet messages into a serial port, and to pass RS232 messages in an Ethernet port. The adapter allows the carrier set to be integrated

into a 10 Base-T Ethernet network that is becoming very common in a substation environment.

The adapter is plugged into the right options bay of the RFL 9745. One of the two serial ports is called the Craft port and the other is the Data port. These RS232 ports are three-wire RS232 ports with a DB9 connector. The Craft power is used to set up the TCP/IP and Data port parameters.

I/O Options

The RFL 9745 can be configured with a maximum of two I/O modules. There is a Solid-State, a Relay/Solid-State, and a HS Relay version available. All versions provide four optically isolated keying inputs and three independent form "C" alarm output contacts. The Solid-State version provides four independent solid-state outputs. The Relay/Solid State version provides three independent jumper selectable form "A" or form "B" output contacts and one solid-state output and the HS Relay version provides four independent jumper selectable form "A" or form "B" output contacts.

Solid-State I/O

Optically Isolated Inputs

Quantity: Four per module

Required Operation Range:

24 Volt Units: 14.6 to 60 Vdc, Nominal Input
Current 8.8 mA

48 Volt Units: 31 to 60 Vdc, Nominal Input
Current 5.8 mA

125 Volt Units: 75 to 150 Vdc, Nominal Input
Current 4.6 mA

250 Volt Units: 155 to 280 Vdc, Nominal Input
Current 5.25 mA

Input Current: 10 mA maximum

Minimum Acceptable Pulse Width: 100 micro-seconds

Solid-State Outputs

Quantity: Four per solid-state I/O module

Output Current: Maximum 1 ampere continuous,
2 amperes for one minute, or 10 amperes for 100 msec

Open-Circuit Voltage: 280 Vdc maximum

S/S Pick-up Time: 0 msec

Alarm Relays

Quantity: Three per I/O module

Contact Configurations: SPDT (Form C)

Maximum Output Current: 1 ampere continuous

Maximum Breaking Current: 1 ampere (non-inductive)

at 125 Vdc; derated to 0.25 amperes at 280 Vdc

Open Circuit Voltage: 280 Vdc Maximum

Specifications subject to change without notice.



Relay/Solid-State I/O

Optically Isolated Inputs

Quantity: Four per module.

Required Operation Range:

24 Volt Units: 14.6 to 60 Vdc, Nominal Input
Current 8.8 mA

48 Volt Units: 31 to 60 Vdc, Nominal Input
Current 5.8 mA

125 Volt Units: 75 to 150 Vdc, Nominal Input
Current 4.6 mA

250 Volt Units: 155 to 280 Vdc, Nominal Input
Current 5.25 mA

Input Current: 10 mA maximum

Minimum Acceptable Pulse Width: 100 micro-seconds

Solid-State Outputs

Quantity: One per relay/solid-state I/O Module

Output Current: Maximum 1 ampere continuous, 2 amperes for one minute, or 10 amperes for 100 ms.

48 Volt Units: Open-Circuit Voltage: 150 Vdc maximum

250 Volt Units: Open-Circuit Voltage: 280 Vdc maximum

S/S Pick-up Time: 0 msec

Relay Output

Quantity: Three per module

Contact Configuration: SPST Form A or Form B - Jumper Selectable

Relay Pick-up Time: 7 msec

Output Current Rating: 5 amperes continuous

Surge: 30 amperes for 200 msec

Alarm Relays

Quantity: Three per I/O Module

Contact Configurations: SPDT (Form C)

Maximum Output Current: 1 ampere continuous

Maximum Breaking Current: 1 ampere (non-inductive) at 125 Vdc; derated to 0.25 amperes at 280 Vdc Open-Circuit Voltage: 280 Vdc maximum.

HS Relay I/O

Optically Isolated Inputs

Quantity: Four per module

Required Operation Range:

24 Volt Units: 14.6 to 60 Vdc, Nominal Input
Current 8.8 mA

48 Volt Units: 31 to 60 Vdc, Nominal Input
Current 5.8 mA

125 Volt Units: 75 to 150 Vdc, Nominal Input
Current 4.6 mA

250 Volt Units: 155 to 280 Vdc, Nominal Input
Input Current: 10mA maximum

Minimum Acceptable Pulse Width: 100 micro-seconds

Relay Output

Quantity: Four per module

Contact Configuration: SPST Form A or Form B - Jumper Selectable

Relay Pick-up Time: 5 msec

Output Current Rating: 5 amperes continuous

Surge: 30 amperes for 200 msec

Alarm Relays

Quantity: Three per I/O Module

Contact Configurations: SPDT (Form C)

Maximum Output Current: 1 ampere continuous

Maximum Breaking Current: 1 ampere (non-inductive) at 125 Vdc; derated to 0.25 amperes at 280 Vdc

Open-Circuit Voltage: 280 Vdc maximum

Annunciator Chassis

The RFL 9745 can be supplied with an optional one rack unit Annunciator Chassis. This additional chassis is mounted below the standard Three Rack Unit Chassis and provides six programmable solid-state outputs. Each output can be individually programmed to provide specific output annunciation, such as Trip Sent, Trip Received, RS-232 Port Active, etc.

Output Ratings

Maximum Output Current: 1 A continuous

Breaking Current: 100 mA (non-inductive)

Auxiliary Trip Relays

The RFL 9745 can be configured with up to two auxiliary high speed trip relays which are mounted in either the primary or redundant power supply I/O module. The relays are typically controlled by one of the solid-state function outputs and provide two normally open and one normally closed contact each.

Relay Ratings:

Pick-up Time: 4 msec

Contact Rating: 5 amperes continuous, 30 amperes for 200 msec

Specifications subject to change without notice.



General Specifications

Displayed Level Accuracy

The levels displayed on the front panel and through remote access using PC APRIL will be within 1 dB of the actual values.

Operate Time

Audio-Tone Units (average trip times—Dual-Tone System):

± 30 Hz Shift:	26.47 ms
± 42.5 Hz Shift:	20.57 ms
± 60 Hz Shift:	14.78 ms
± 75 Hz Shift:	12.65 ms
± 120 Hz Shift:	11.05 ms
± 150 Hz Shift:	10.12 ms
± 240 Hz Shift:	9.22 ms

Digital and Fiber systems: 3 ms maximum in the most secure mode. "Operate Time" is defined as the time from the receipt of a command input to the response of a solid-state output, less any channel propagation time.

Pre-Trip Timer

Adjustable in 0.5 ms steps

Trip Hold Timer

Adjustable in 0.5 ms steps

Command Extend Timer

Adjustable in 0.5 ms steps

Non-Volatile Storage

All parameters relating to system operation are stored in electric erasable non-volatile RAM. All parameters related to event logging are stored in battery-backed RAM.

RFI Susceptibility

ANSI PC37.90.2 (35 Volts/Meter)
IEC 255-22-3 (RFI Class III)

Interface Dielectric Strength

All contact inputs, solid-state outputs, power supply inputs and relay outputs meet the following specifications:

- ANSI C37.90-1989 (Dielectric)
- ANSI C37.90.1-1989 (SWC and Fast Transient)
- IEC 255-5 (1500 Vrms Breakdown Voltage and Impulse Withstand)
- IEC 255-22-1 (SWC Class III)
- IEC 255-22-2 (ESD Class III)
- IEC 255-22-4 (Fast-Transient Class III)
- IEC 834-1

Input Power Requirements (per IEC 834-1)

24Vdc Supply:	19 to 29 Vdc (1500 mA Typical)
48/125 Vdc Supply:	38 to 150 Vdc (750/325 mA Typical)
250Vdc Supply:	170 to 300 Vdc (150 mA Typical)

Power Supply

A single or redundant power supply can be provided depending on the reliability of the application. For example a DTT application for a higher voltage level line may demand the dependability of a redundant power supply.

Temperature

Operating: -30° C to +65° C (-22° F to +149° F)
Storage: -40° C to +75° C (-40° F to +165° F)

Relative Humidity

Up to 95 percent at +40° C (+104° F), non-condensing

Chassis Dimension

The RFL 9745 chassis mounts in a standard 19-inch rack or cabinet and is three rack-units high (5.25 inches or 13.3 cm). Front and rear views, cutout dimensions, and terminal block locations are illustrated in fold Figures 6 and 7. A system block diagram for the RFL 9745, including available options, is shown in fold-out Figure 8. The RFL 9745 can be supplied with plug-in connectors for the Solid-State I/O, Relay/Solid-State I/O and the HS Relay I/O Module. These connectors can accept #14 AWG wire and proved a convenient method to add or replace I/O modules in the field.

Warranty Statement

RFL's standard warranty for the RFL 9745 is *thirty-six* months from date of shipment for replacement or repair of any part which fails during normal operation or service.

Ordering Information

RFL 9745 ordering information can be found on the back page.

Specifications subject to change without notice.

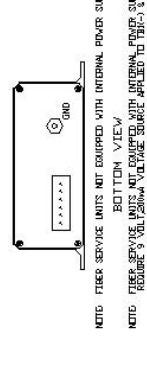
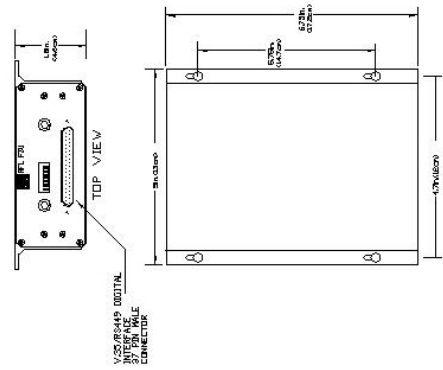
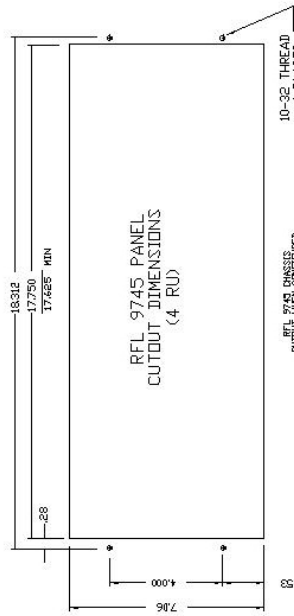
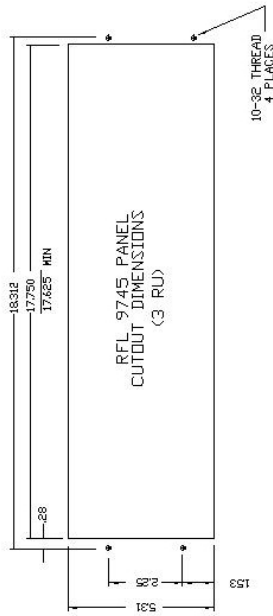
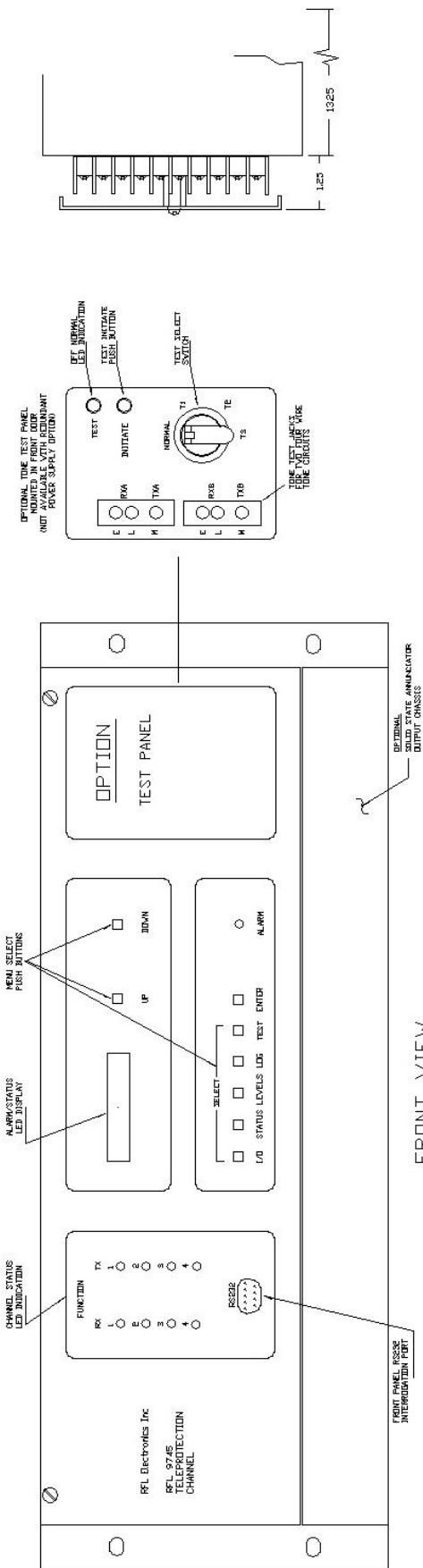


Figure 5. (FOLDOUT) RFL 9745 FRONT VIEW AND CUT OUT.

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1				

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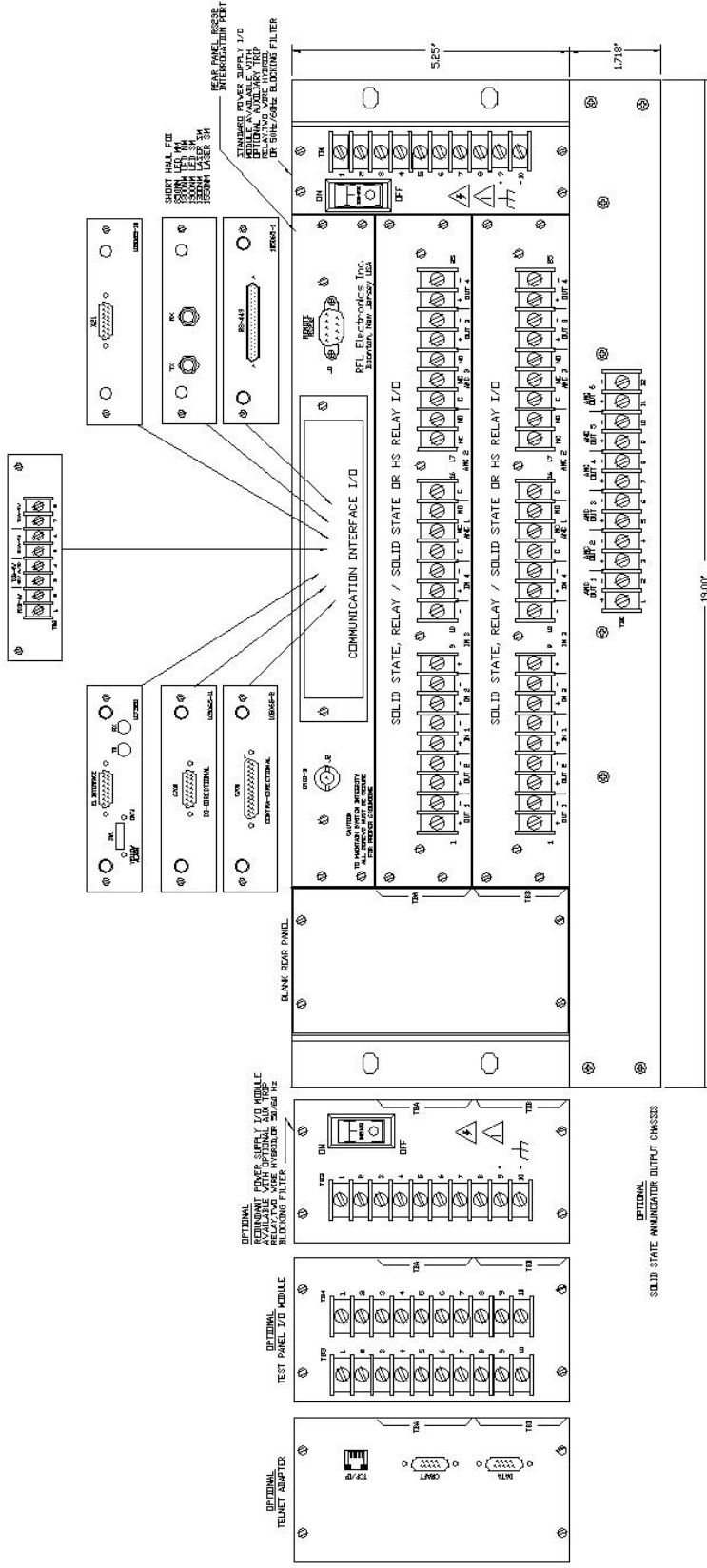


Figure 7. (FOLDDOUT) RFL 9745 REAR VIEW

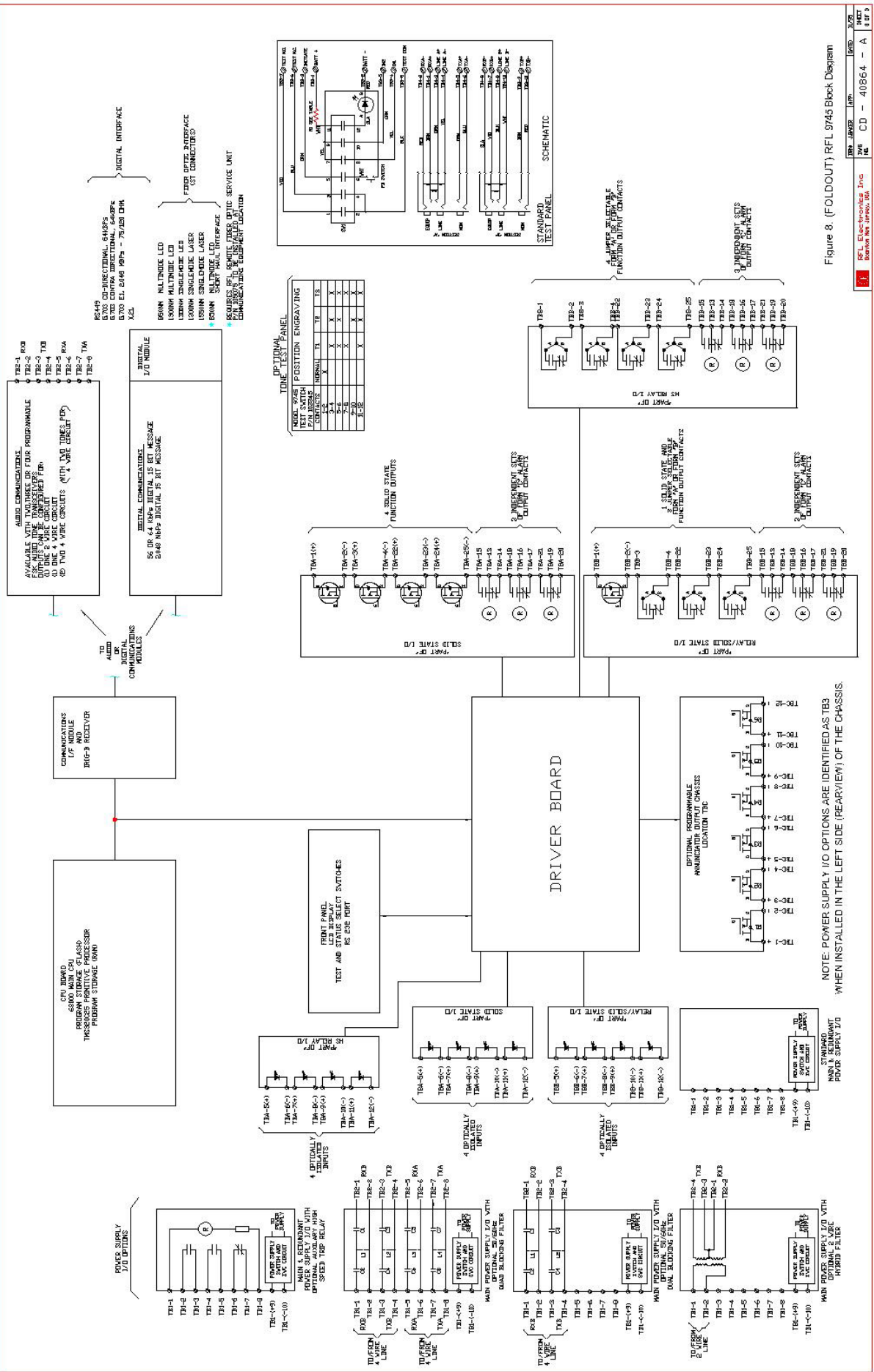


Figure 8. (FOLDOUT) RFL 9745 Block Diagram

RFL 9745 Teleprotection Channel Ordering Information

RFL Part Number (fill in blanks):	Base System	TSH						
COMMUNICATIONS								
2 Tone Audio Wide Range K=terminal block, M=compression block			K-M					
4 Tone Audio Wide Range N=terminal block, W=compression block			N-W					
56/64 Kbps Digital RS-449			A					
64 Kbps G.703 Co-Directional			B					
64 Kbps G.703 Contra-Directional			C					
2.048 Mbps, G.703 75/120 Ohm			Q					
850 nm Short Haul ANSI C37.94 Compliant (Ref. Note 1)			P					
850 nm Multimode			E					
1300 nm Multimode			F					
1300 nm Singlemode			G					
1300 nm Singlemode LASER			H					
1550 nm Singlemode LASER			J					
64Kbps Digital X.21			X					
PRIMARY POWER SUPPLY								
19-36 Vdc				4				
38-150 Vdc				6				
170-300 Vdc				7				
REDUNDANT POWER SUPPLY, TEST PANEL or Telnet I/O								
None					0			
19-36 Vdc (Redundant PS I/O included)					4			
38-150 Vdc (Redundant PS I/O included)					6			
170-300 Vdc (Redundant PS I/O included)					7			
Front Door with Test Panel					5			
Telnet I/O					8			
I/O BOARD (TOP) Choose From Below								
I/O BOARD (BOTTOM) Choose From Below								
None						0		
24-Vdc Solid State A = terminal block, C = compression block						A or C		
48/125-Vdc Solid State I = terminal block, 3 = compression block						1 or 3		
250-Vdc Solid State 2 = terminal block, 4 = compression block						2 or 4		
24-Vdc Relay/SS B = terminal block, D = compression block						B or D		
48/125-Vdc Relay/SS 5 = terminal block, 7 = compression block						5 or 7		
250-Vdc Relay/SS 6 = terminal block, 8 = compression block						6 or 8		
24-Vdc HS Relay E = terminal block, F = compression block						E or F		
48/125-Vdc HS Relay G = terminal block, H = compression block						G or H		
250-Vdc HS Relay J = terminal block, K = compression block						J or K		
OPTIONAL 1 RU ANNUNCIATOR CHASSIS								
None						0		
6 solid-state 48/125 Vdc 2=terminal block, 4=compression block						2 or 4		
6 solid-state 250 Vdc 3=terminal block, 5=compression block						3 or 5		
POWER SUPPLY I/O OPTIONS								
None						0		
One 48-Vdc Aux relay (4ms) 3 Contacts						1		
One 125-Vdc Aux relay (4ms) 3 Contacts						2		
Two 48-Vdc Aux relay (4ms) 3 Contacts each (Ref. Note 2)						3		
Two 125-Vdc Aux relay (4ms) 3 Contacts each (Ref. Note 2)						4		
Dual Four Wire 50/60 Hz Blocking Filter (Quad Filter)						5		
Four Wire 50/60 Hz Blocking Filter (Dual Filter)						6		
Two Wire Hybrid						7		

- NOTES: 1. If a fiber service unit is required it must be ordered as a stand alone item. P/N-107460-1, RS449 (38-150 Vdc); P/N-107460-2, V.35 (38-150 Vdc); P/N-107460-3, G.703 (38-150 Vdc); P/N-107460-4, X.21 (38-150 Vdc); P/N-107460-5, E1 (38-150 Vdc).
2. If a test panel or Telnet is selected, the two Aux Relay option is not available.

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Section 2. SYSTEM OVERVIEW

2.1 INTRODUCTION

This section provides a basic overview of how the RFL 9745 Teleprotection Channel works. Each module is described, and the relationships between modules are discussed. A block diagram of a typical RFL 9745 terminal appears in Figure 2-1.

2.2 RFL 9745 MODULES

The RFL 9745 system contains six main modules as follows: the CPU module, Driver module, Communications module, SWC I/O module, Front panel module, and Power supply module. The RFL 9745 can be configured with either an Audio or Digital Communications module, but not both, with up to two SWC I/O modules, and with up to two power supply modules, one main and one redundant. Each of these modules is described later in this section.

The RFL 9745 can be configured with the following options: the Status output module, Quad filter module, Dual filter module, Filter/hybrid module, and Precision relay option. In addition to this the 9745 Digital terminal can be configured with one of nine different types of Interface modules. Each of these options is described later in this section.

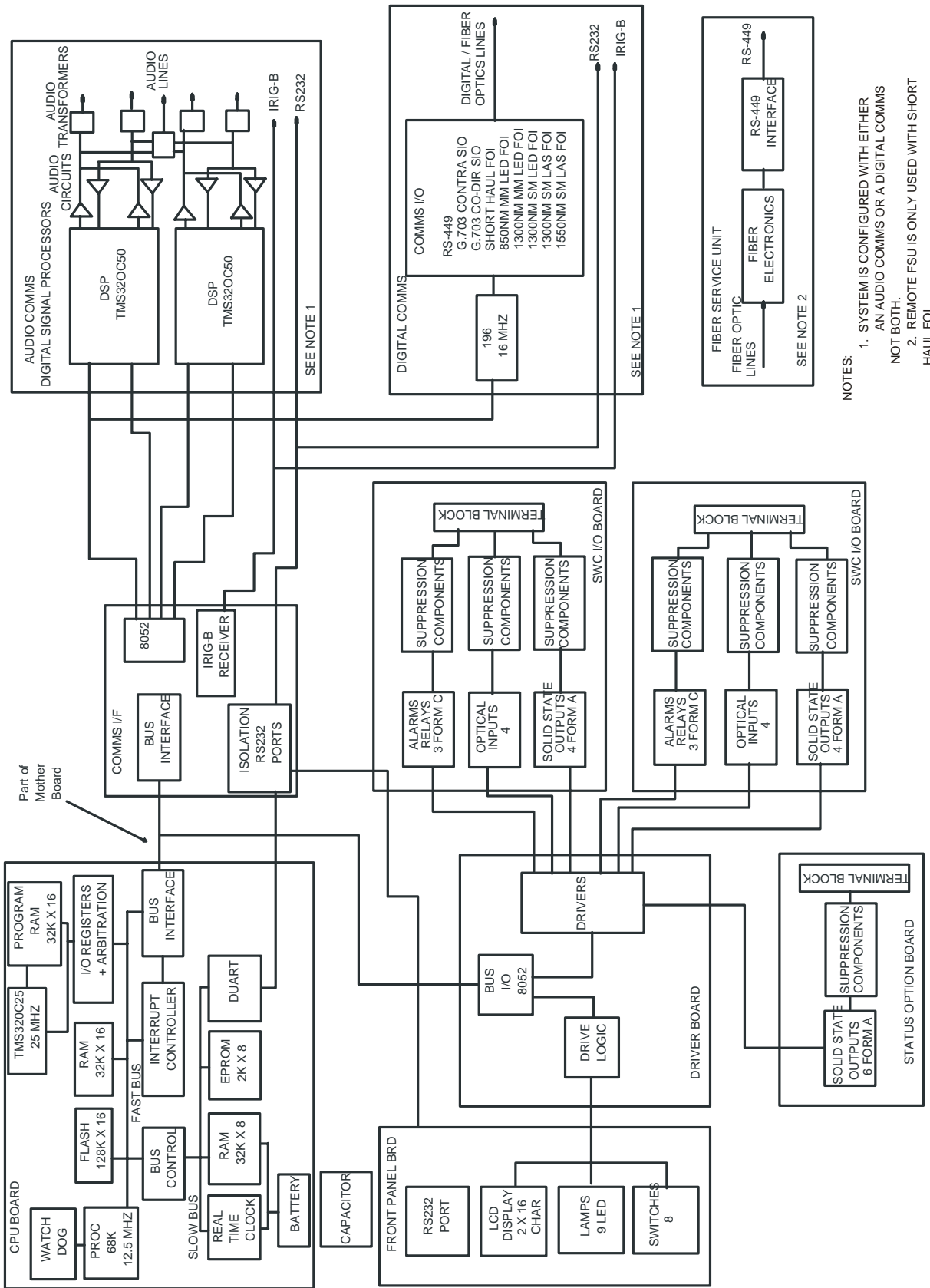
Refer to Table 2-1 for additional information.

2.2.1 CPU MODULE (Audio and Digital Systems)

The CPU Module is the heart of the RFL 9745 system. It is a full-featured computer with a full complement of peripheral devices. The CPU Module processes all the available information regarding inputs, outputs, system conditions, and functions. In addition, the CPU Module makes all trip decisions.

The CPU Module uses a bi-directional parallel bus to communicate with the Driver Module and the Communications Module. This bus contains data, address, and control lines. The CPU Module controls the other modules and receives all of its inputs from this bus.

The CPU Module has RAM, FLASH, EEROM, capacitor-backed RAM, and a Real-Time Clock. The Module uses a 32-bit Motorola 68000 processor. To provide the processing power for the high-speed computations required to make trip decisions, the CPU Module also has a Texas Instruments TMS320C25 16-bit (DSP) Digital Signal Processor. This device is normally used to process analog signals digitally; the CPU Module uses it as a high-speed general-purpose computer. It processes what is later described as the "Logic Table."



- NOTES:
1. SYSTEM IS CONFIGURED WITH EITHER AN AUDIO COMMS OR A DIGITAL COMMS NOT BOTH.
 2. REMOTE FSU IS ONLY USED WITH SHORT HAUL FOI.

Figure 2-1. Functional block diagram of typical RFL 9745 terminal

Table 2-1. RFL 9745 Modules, general information

Module	Assembly Number	Refer to the following paragraphs for additional information
RS-449 Interface module	105065-1	3.5.2.1, 3.6.5.1
G.703 Interface module (contra-directional)	105065-2	3.5.2.1, 3.6.5.2
G.703 Interface module (co-directional)	105065-11	3.5.2.1, 3.6.5.4
X.21 Interface module	105065-10	3.5.2.1, 3.6.5.3
Fiber I/O module 850nm mm LED	105065-5	2.2.5
Fiber I/O module 1300nm mm LED	105065-6	2.2.5
Fiber I/O module 1300nm sm LED	105065-7	2.2.5
Fiber I/O module 1300nm sm Laser	105065-8	2.2.5
Fiber I/O module 1550nm sm Laser	105065-9	2.2.5
Short Haul Fiber interface	107310	3.5.2.3
Fiber Service Unit	107460-1	3.5.2.3
	107460-2	
	107460-3	
	107460-4	
E1 Serial Interface module	107320	3.6.5.5
Power Supply 19-36 Vdc	105905-1	2.2.9
Power Supply 38-150 Vdc	105905	2.2.9
Power Supply 170-300 Vdc	105930	2.2.9
CPU module	107330-1	2.2.1, 3.6.1
	105025-1	2.2.1, 3.6.1
Driver module	105030	2.2.2, 3.6.2
Communications Interface module	105050	3.6.3
Front Panel module	105055	2.2.8, 3.6.6
Audio Communications modules (narrowband)	105040-3	2.2.3, 3.5.7, 3.6.4, 3.6.4.1
	105040-4	
	105040-5	
	105040-6	
	105040-7	
	105040-8	
Audio Communications modules (wideband)	105920-3	2.2.3, 3.5.7, 3.6.4, 3.6.4.2
	105920-4	
	105920-1	
	105920-2	
Digital Communications module	105070	2.2.4, 3.6.5
Solid-State SWC I/O module	105005	2.2.7, 3.6.7.1
Relay Solid-State SWC I/O module	105010	2.2.7, 3.6.7.2
High Speed Relay SWC I/O module	105955-1	2.2.7, 3.6.7.3
	105955-12	
	105955-13	
	105955-14	
	105955-3	
	105955-4	
	105955-5	
	105955-6	
UCA Interface module	105950	10.1

2.2.2 DRIVER MODULE (Audio and Digital Systems)

The Driver Module allows the CPU Module to interface with the high-current signals generated by external equipment. It communicates with the CPU Module over the bi-directional parallel bus, and it directly drives the SWC I/O Modules. Inputs from the SWC I/O Modules are translated into logic signals and then sent over the bus to the CPU.

The Driver Module also provides the interface between the CPU Module and the display and pushbutton switches on the front panel. An Intel 80C52 single-chip microcontroller performs all the Driver Module's required functions.

2.2.3 AUDIO COMMUNICATIONS MODULE

2.2.3.1 GENERAL INFORMATION

The Audio Communications Module interfaces the RFL 9745 to audio circuits. It consists of a Communications I/F Board and an Audio Communications Board.

The Audio Communications Board contains up to two audio transceivers. Each transceiver is digitally created using a Texas Instruments TMS320C50 which performs the DSP manipulations. Figures 2-2 through 2-5 are block diagrams for the RFL 9745's DSP circuits.

The Audio Communications Board also contains the audio interface circuits, and the circuits required to provide two isolated RS-232 ports into the CPU. The Audio Communications Board only communicates with the Communications I/F Board.

The Communications I/F Board performs two functions. First, it controls the access of the two TMS320C50 processors on the Audio Communications Board to the bus, preventing conflicts between the processors. Second, it acts as an IRIG-B receiver. IRIG-B is a form of code that is used by satellite time receivers to transmit the exact time to other devices. By having an IRIG-B receiver, the RFL 9745 can tag events with a standard time. The Communications I/F Board uses an Intel 80C52 single chip microcontroller to perform its functions.

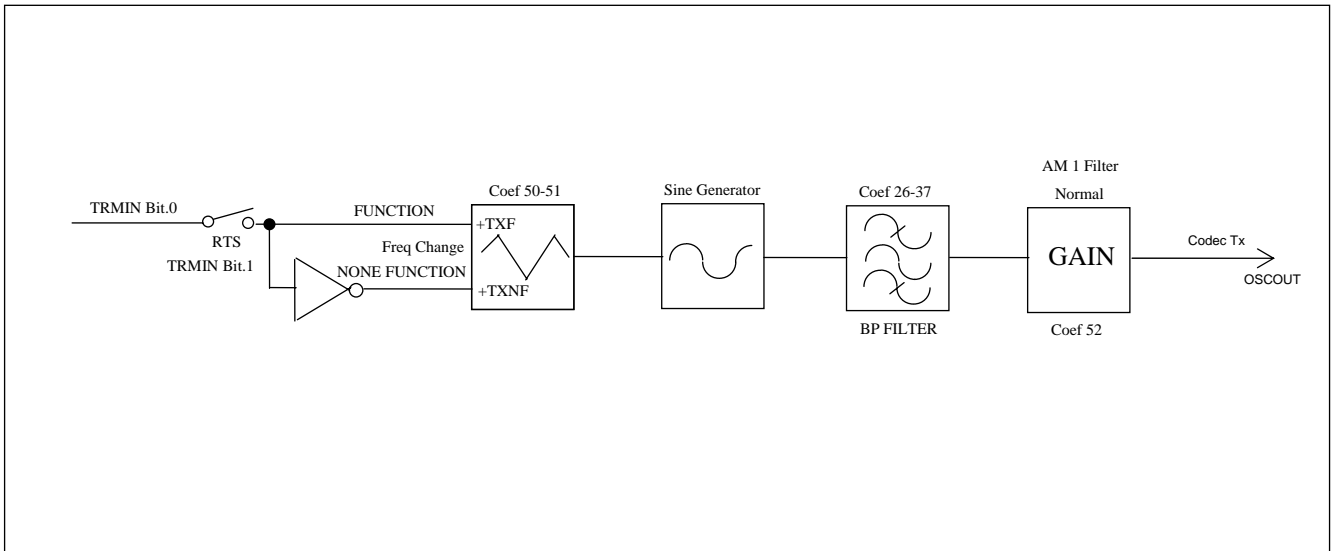


Figure 2-2. Block diagram, RFL 9745 analog DSP modem channel transmitter

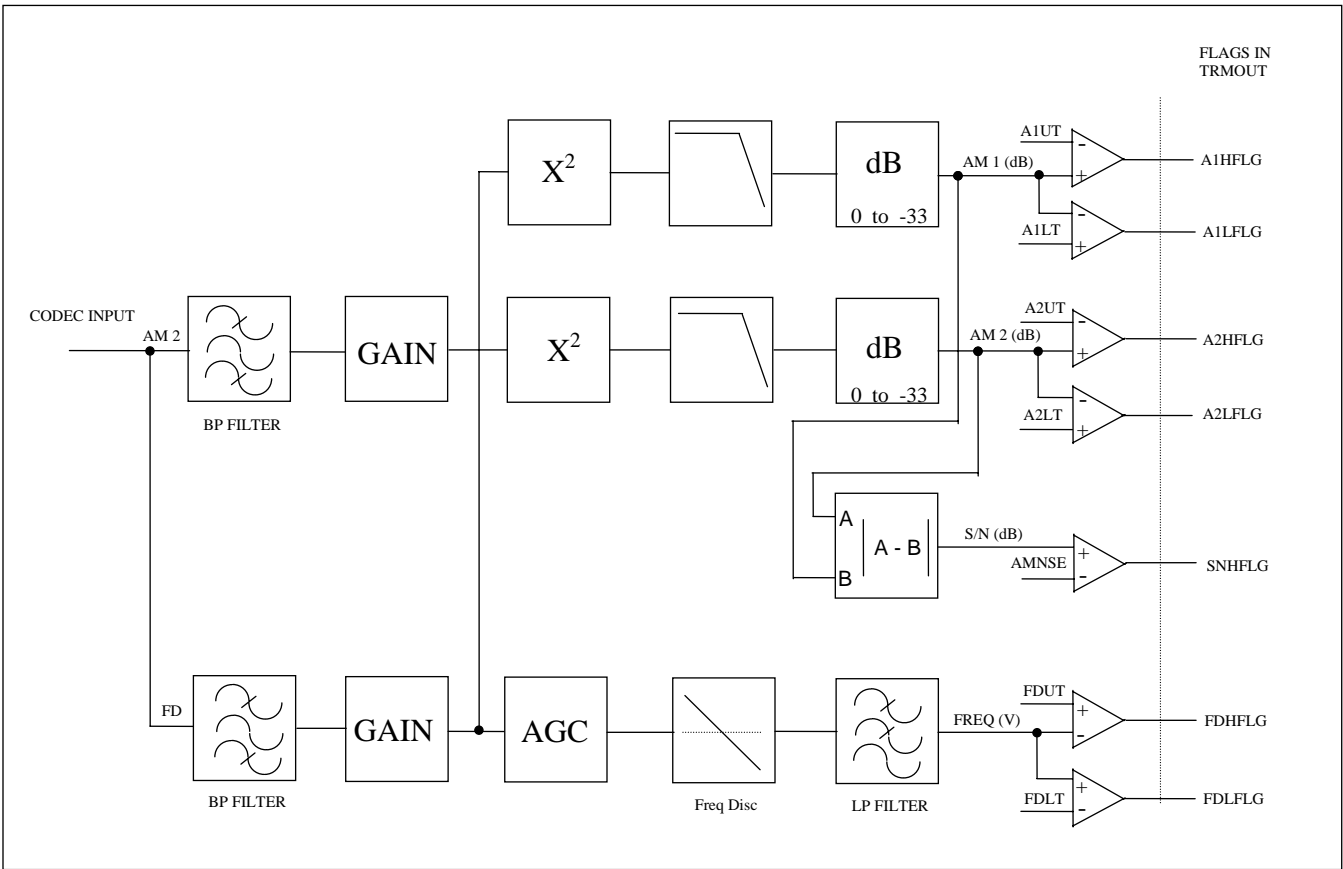


Figure 2-3. Block diagram, RFL 9745 analog DSP modem channel receiver

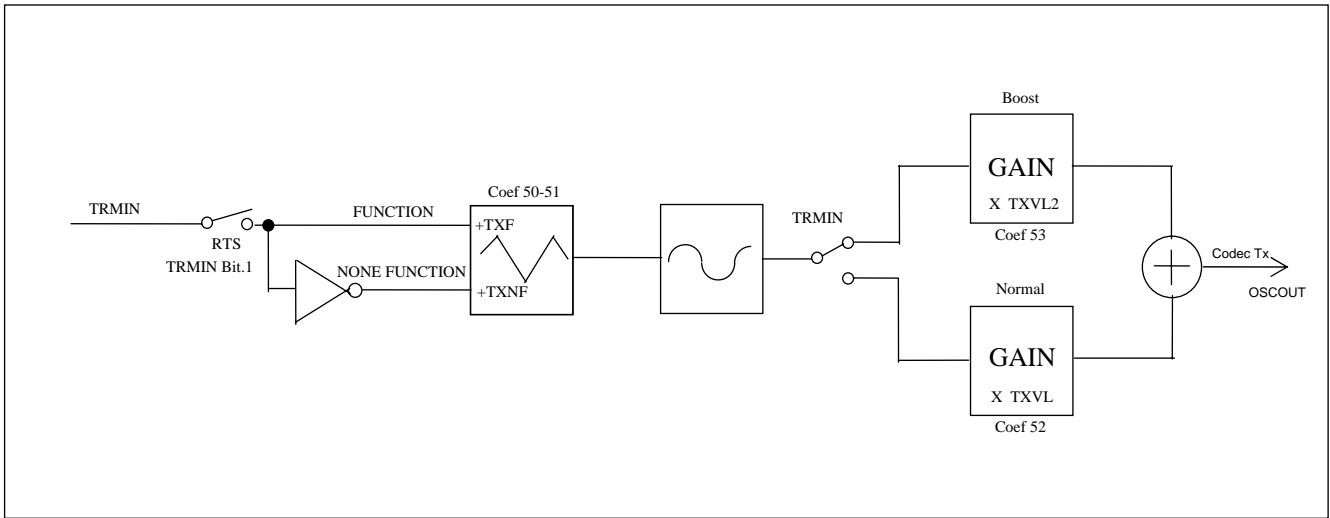


Figure 2-4. Block diagram, RFL 9745 analog DSP function channel transmitter

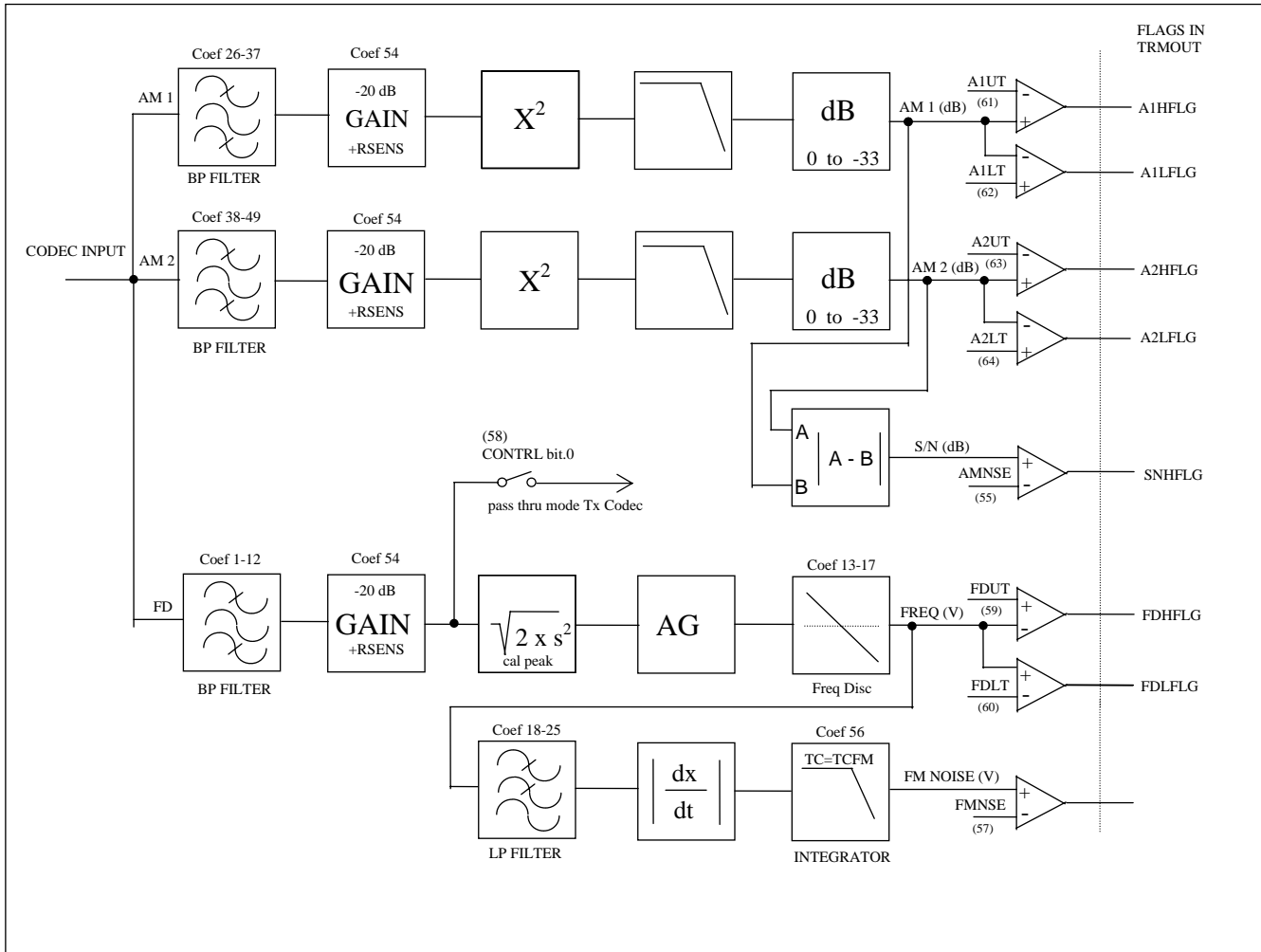


Figure 2-5. Block diagram, RFL 9745 analog DSP function channel receiver

2.2.3.2 THEORY OF OPERATION (IN-BAND NOISE DETECTION SYSTEM)

The RFL Model 9745 Teleprotection System when equipped with the Audio Communications module is capable of generating and receiving up to four Frequency Shift tones. Because the primary application of this product is for protective relaying communications a very high level of security against false outputs due to the effects of noise is required. The 9745 utilizes two basic noise detection schemes which operate in-band to the user selected operating frequency. Although the application of the 9745 system can utilize multiple frequency shift tones to generate a single trip function, the example shown in this section utilizes a single frequency shift tone.

The two noise detection systems use Amplitude Modulated (AM) and Frequency Modulated (FM) information to determine the presence of Noise. A simplified block diagram of the basic 9745 receiver is shown in Figure 2-6. As shown in the figure, the received frequency is fed into three bandpass filters which are labeled AM1, AM 2 and FD. The AM noise filters are only used in the AM noise detection process. The FD filter feeds the Frequency Discriminator whose output is used to determine receipt of high or low frequency and to drive the FM noise detection section.

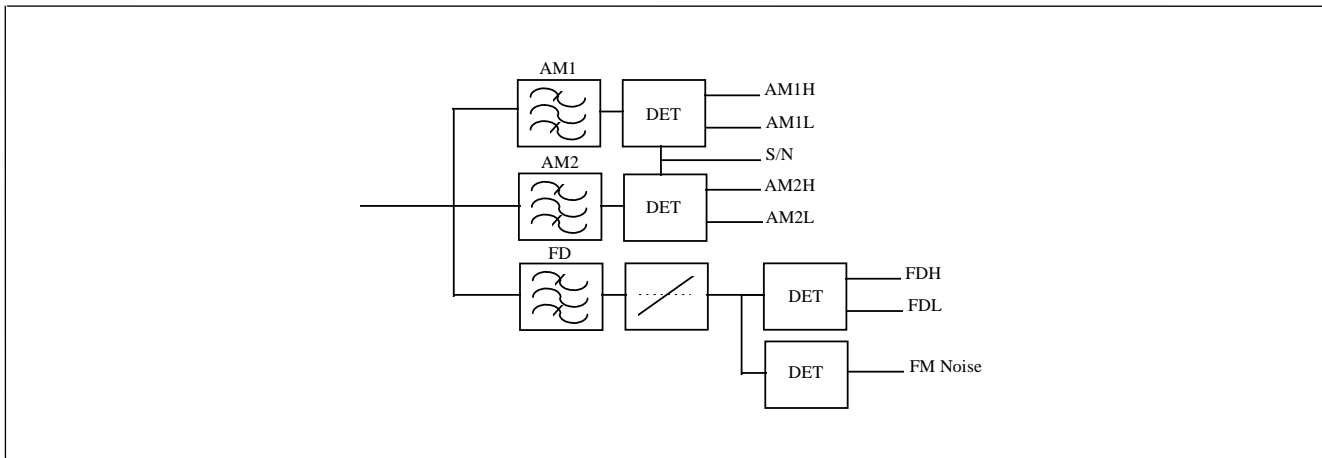


Figure 2-6. Block diagram of basic 9745 receiver

Although the AM, FD and FM systems all operate simultaneously, for ease of discussion each of these systems will be discussed and explained separately.

AM Noise Detection

The two AM noise detector bandpass filters are centered around the programmed high and low frequencies. For this explanation the high frequency (2360Hz) will be the trip frequency and the low frequency (2060Hz) will be the guard frequency. The frequencies given in this example represent a +/- 150 Hz shift from center frequency which for this example would be 2210Hz. The center frequency in the 9745 is calculated by the 9745 and is not a programming option.

In Figure 2-7 the bandpass for all three filters is shown relative to the frequencies stated above.

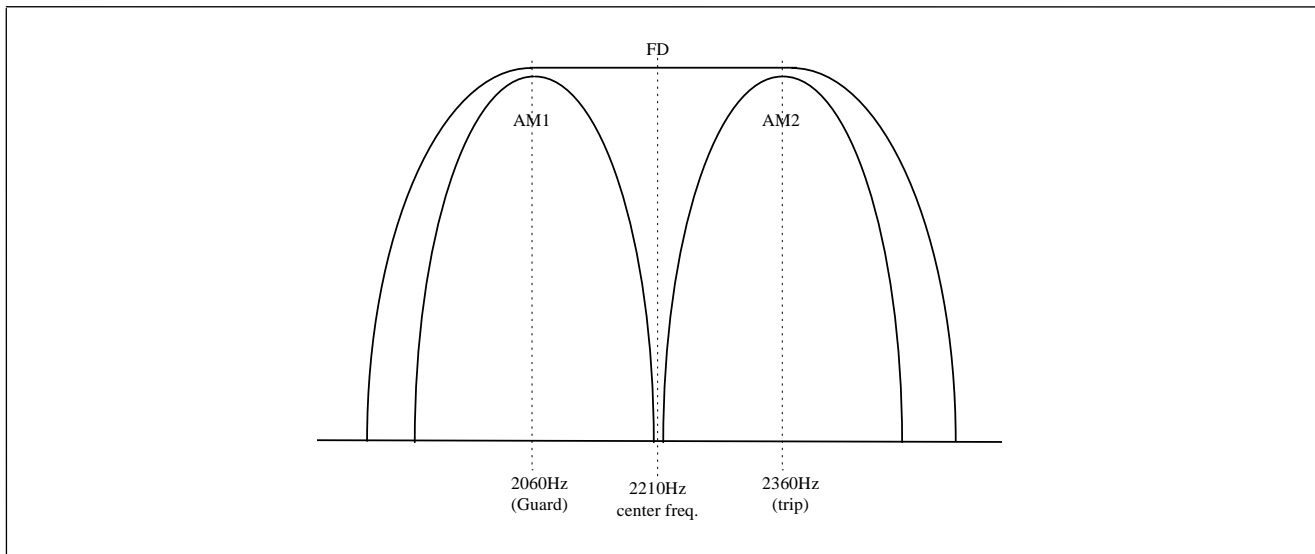


Figure 2-7. Relative frequencies of bandpass filters

In order to fully understand how the AM noise detection system in the 9745 operates, it is important to understand how the user programmed parameters are used as the basis for system calculations. In Figure 2-8 the AM filter curves are displayed in greater detail along with the user selected and system calculated threshold levels. The shaded areas indicate the range in which four of the 9745 primitive logic input sources become active. The actual syntax used for programming these sources in the 9745 is used in this example. The following is a brief description of these logic sources:

- AM1H_CH1 - This is the AM High level threshold for the lower frequency (guard) of Channel 1.
- AM1L_CH1 - This is the AM Low level threshold for the lower frequency (guard) of Channel 1.
- AM2H_CH1 - This is the AM High level threshold for the upper frequency (trip) of Channel 1.
- AM2L_CH1 - This is the AM Low level threshold for the upper frequency (trip) of Channel 1.

The 9745 allows the user to select the High (trip) and Low (guard) frequencies along with the nominal Receiver Level. From this information the system calculates the upper and lower operating thresholds which make up the Dynamic Operating Range of the receiver.

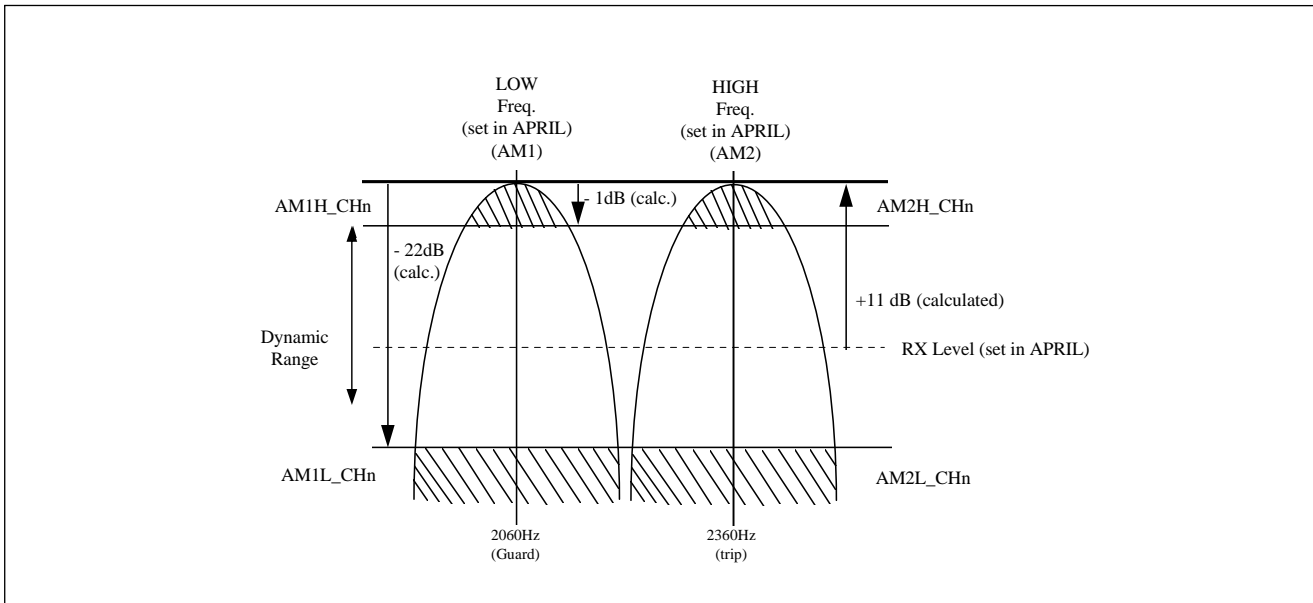


Figure 2-8. AM filter curves showing threshold levels

The determination of in band noise is a logical process which is performed in the 9745 primitive application logic. In Figure 2-9 a simplified version of the previous figure is used. In this example the vertical lines represent the actual levels which are expected when a system is receiving a Low frequency (guard). The logical process for this example is during the reception of a Low frequency (guard) signal falling within the dynamic range of the receiver. Therefore, neither AM1H_CH1 or AM1L_CH1 will be active. In addition AM2L_CH1 should be active, indicating that no energy is being detected in the High frequency (trip) band. This is an example of a normal channel condition. During the reception of a High frequency (trip) the same rules apply.

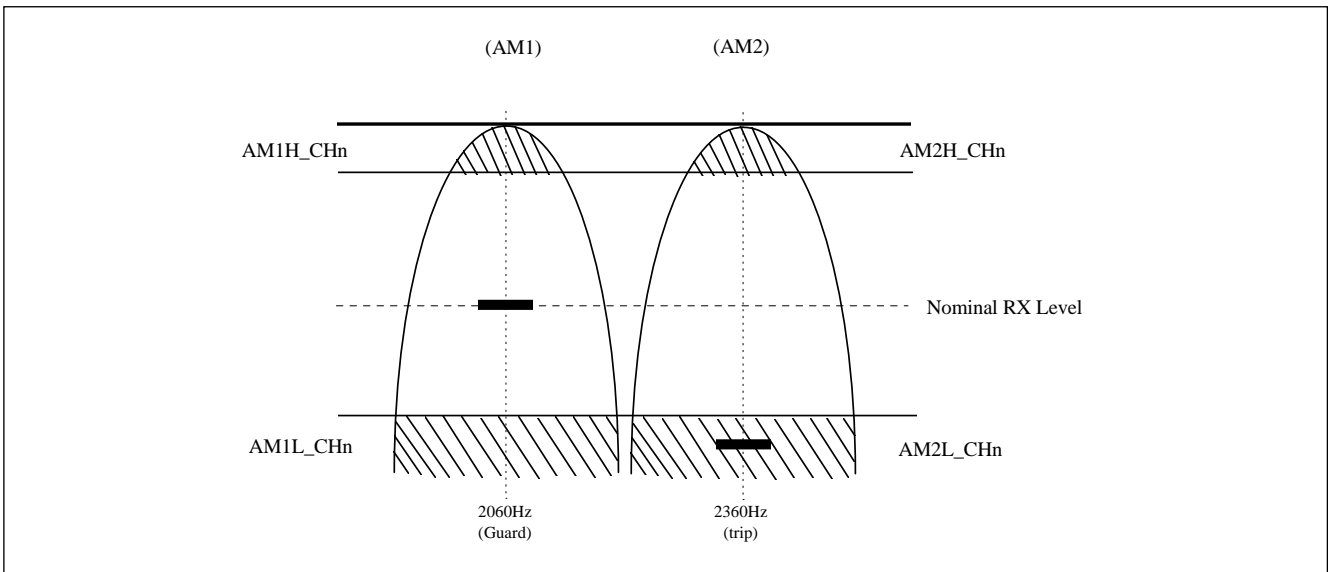


Figure 2-9. Simplified version of AM filter curves showing threshold levels

When noise is present on the communications channel it is not desirable to squelch the receiver until the noise is interfering with the frequency of interest. In Figure 2-10 the example is similar to that of Figure 2-9 except in this instance energy is detected in the High frequency (trip) band. In the channel programming parameters of the 9745 there is a Signal To Noise (S/N) setting which is set in decibels (dB). For the frequencies selected in this example 8 dB is the recommended factory setting for the S/N parameter. This means that when the energy level in each of these filters is within 8 dB or less of each other a S/N output is declared. The S/N output is also a logic input source to the 9745 primitive logic and is used to squelch the logic tripping path.

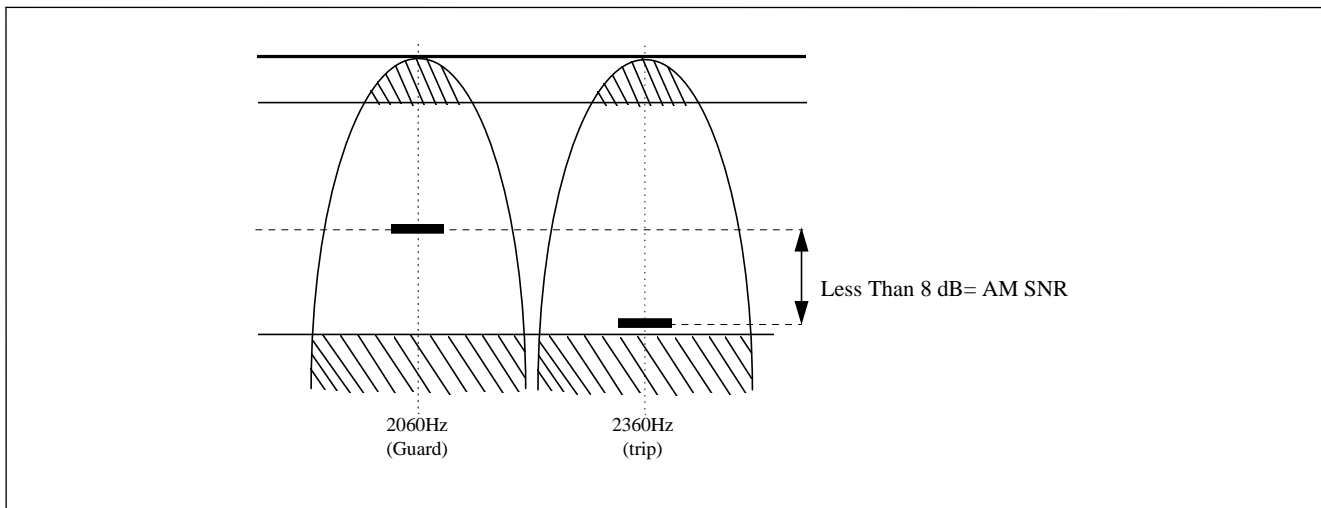


Figure 2-10. AM filter curves showing energy detected in the high frequency (trip) band

FM Noise Detection

The FM noise detection circuit uses the output voltage of the frequency discriminator as its input source. The concept of FM noise is that under normal channel conditions the discriminator output voltage will be constant. The voltage level out of the discriminator will be equivalent to that of a guard or trip frequency. When in-band frequency noise is present along with the expected trip or guard frequency the discriminator output voltage is effected. One of the methods used in the 9745 to prevent false discriminator outputs due to the effects of alien frequencies is the use of dual slicers. These slicers only allow low frequency (guard) and high frequency (trip) outputs when the discriminator voltage is at fairly precise levels. Voltages which fall outside of these levels are considered to be in the “Block Zone” or no output zone. Figure 2-11 depicts the frequency discriminator output voltage with the Block Zones over laid.

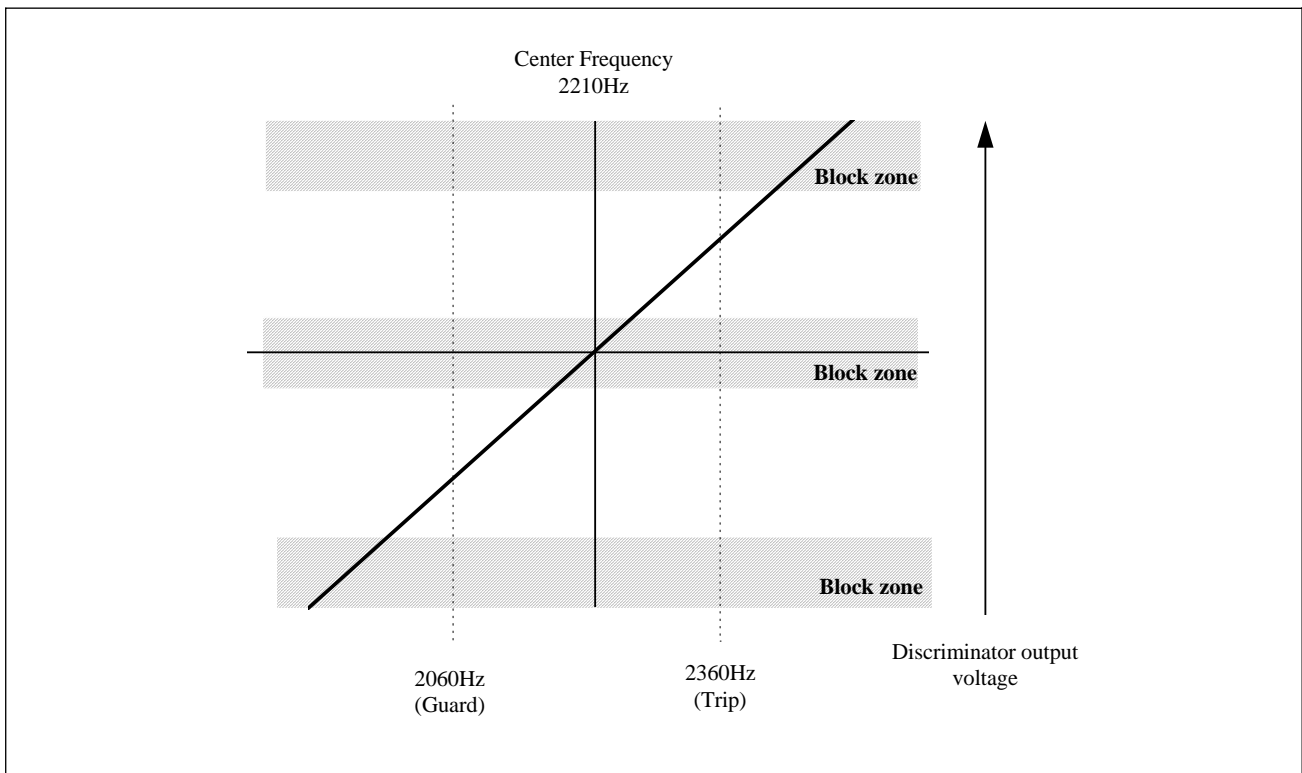


Figure 2-11. Frequency discriminator output voltage

In the 9745 one of the audio tone settings is “FM noise” this setting is entered as a percent. This is a concept which on the surface is difficult to grasp although once explained is simple to understand. Because the primary function of the 9745 is to send trip and guard information as opposed to high speed data. By application the system is predominately receiving a guard frequency and shifts to the trip frequency only when required.

With this understanding FM noise percent is the percent of frequency discriminator output voltage change from DSP sample to sample. Although DSP operates very similar to older discrete analog tone circuits, it is a digital circuit. The sampling rate at which the DSP calculates its output is 8 KHz. The discriminator output voltage is plotted at this rate. For the frequencies selected for this example the recommended FM Noise % is 30. This means that an FM Noise condition is declared when the discriminator output voltage changes greater than 30% between samples. When a system shifts from a Guard frequency to a Trip Frequency this will cause an FM Noise output for about one sample period, however this condition does not last long enough to effect the overall system performance.

2.2.4 DIGITAL COMMUNICATIONS MODULE

2.2.4.1 GENERAL INFORMATION

The Digital Communications Module interfaces the RFL 9745 to digital circuits. It contains a Digital Communications Board and a Communications I/F Board.

The Digital Communications Board contains a single digital channel with an embedded 80C196 processor. Interfaces to any one of eight I/O boards are controlled by 3 programmable logic controllers. These are programmed to recognize which I/O board is plugged into the Digital Communications Board. The Digital Communications Board also contains digital interface circuits, circuits required to provide two isolated RS-232 ports into the CPU, and a PLL (phase locked loop) to recover the clock when the Co-Directional G.703 or Fiber Optics boards are used.

The Communications I/F Board performs two functions. First, it acts as an interface between the CPU and the 80C196 on the Digital Communications Board. Second, it acts as an IRIG-B receiver. IRIG-B is a form of code that is used by satellite time receivers to transmit the exact time to other devices. By having an IRIG-B receiver, the RFL 9745 can tag events with a standard time. The Communications I/F Board uses an Intel 80C52 single chip microcontroller to perform its functions.

2.2.4.2 THEORY OF OPERATION

The Digital Communications Module connects the RFL 9745 to digital communications media. This module contains the digital communications board and the same communications interface board that is used on the RFL 9745 audio tone unit.

The 9745 digital communication is in the form of a 15 bit binary message which repeats continuously at the rate of 64 Kb/s (kilobits/second). At this rate the message repeats approximately once every 234 microseconds. The 15 bit message is made up of one sync bit which alternates with every message, 8 data bits, and 6 CRC (cyclic redundancy check) code bits, as shown in Figure 2-12.

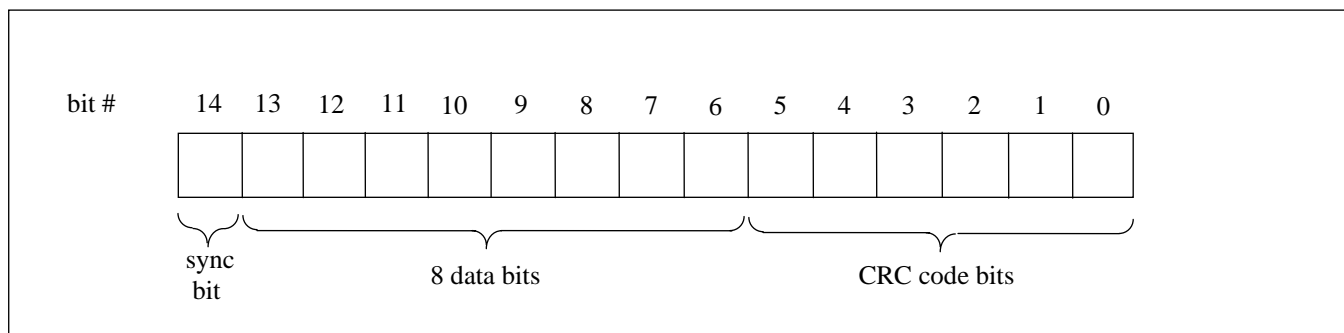


Figure 2-12. 15 bit digital message

The 8 data bits make up an 8 bit data word which can be either a command word or a modem word, depending the value of bit 13 of the data message. Modem words are sent only when required.

When bit 13 of the message is “0”, the data word is a command word which carries the trip or guard information. Bits 6 through 12 of the command word are function bits F1 through F7. When a function bit is low, it represents a guard state; when a function bit is high, it represents a trip state. To avoid consecutive “low” data bit transmission, the message is “XOR’ed” with a Hex 55 to form the final message. See Figure 2-13 for the format of the command word.

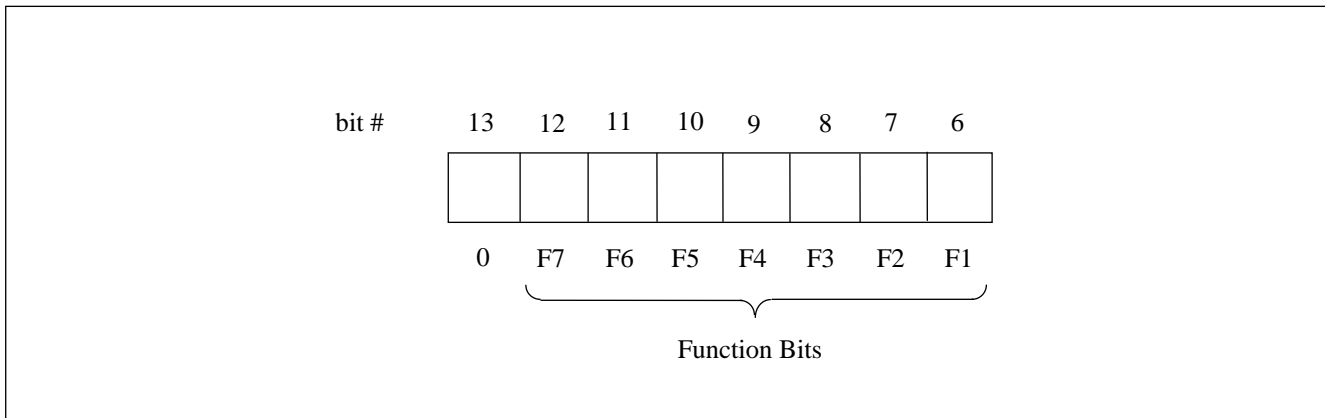


Figure 2-13. Format of command word

When bit 13 of the message is “1”, the data word is a modem word which carries the ASCII information requested through the RS232 port for remote status or diagnostic operations. If bits 13,12,11 and 10 are “1001”, then bits 9,8,7 and 6 of the modem word are the lower 4 bits (or low nibble) of the modem data. If bits 13,12,11 and 10 are “1010”, then bits 9,8,7 and 6 of the modem word are the higher 4 bits (or high nibble) of the modem data. The 8 modem data bits M0 through M7 are sent 4 bits at a time, first (M0 - M3) and then (M4 - M7). Therefore it takes two consecutive 15 bit data messages to send eight bits of modem data. See Figure 2-14 for the format of the modem word.

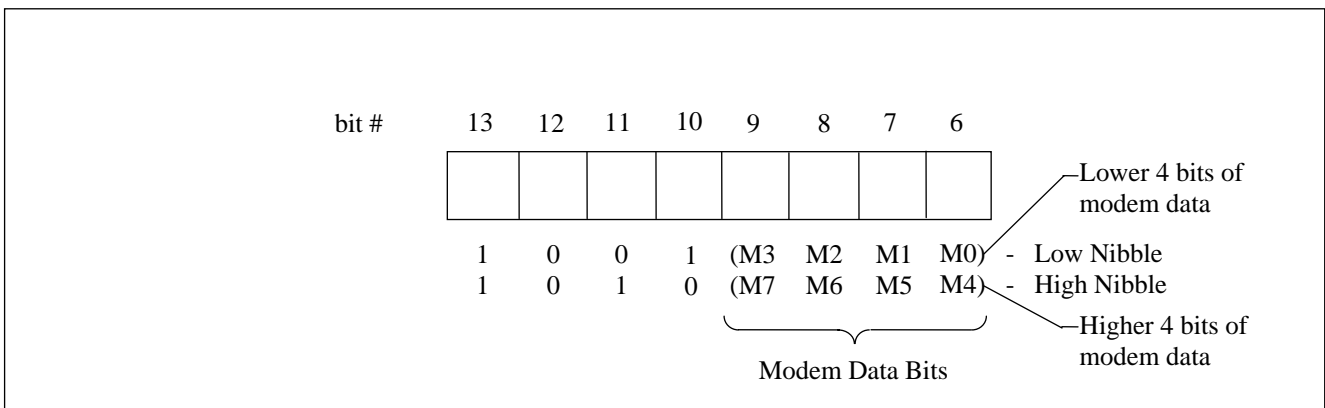


Figure 2-14. Format of modem word

The 15 bit message is constantly transmitted from one circuit-end Equipment to the opposite circuit-end Equipment. A trip command is accepted by the Equipment if two consecutive trip messages are received. If a message fails the CRC tests, it is discarded and one CRC failure is counted. When a predefined count is reached, a "Data Error" is generated. It will be reset when an additional 30 consecutive correct CRC messages are received. In addition to the CRC checks, clock errors are also monitored against pre-selected levels to provide squelching and alarming as well.

Two of the functions of the digital communications module are the same as the audio tone version. The RS232 remote interrogation port is unchanged from the audio version. It provides a link from an external asynchronous serial device to the CPU of the 9745. The digital communications module provides for level conversion and isolation of the RS232 signal. The IRIG-B input path is also provided by the digital communications module. An AM modulated signal is demodulated and interpreted by the communications interface processor. This is unchanged from the audio version.

The main function of the digital communications module is to provide a synchronous serial path from the 9745 bus to the input/output module. Depending on the input/output module installed many different media can be supported, such as fiber, RS449 or G.703. The same digital communications module is used for all input/output modules.

The operation of the digital communications module is as follows. A byte containing seven function bits is received from the CPU. The byte of data has a 6 bit CRC code added to it and is followed by a sync bit. This forms a 15 bit message. The polarity of the sync bit alternates with every message. The CRC code is generated through the use of a look up table stored in ROM. This data is placed in a shift register and shifted out by the transmit clock.

In an RS449, Short Haul Fiber, or G.703 Contra-directional system the transmit clock comes from the SIO module and to there from the communications media. The SIO makes level adjustments and performs loopback connections if desired. At the receiving end the reverse happens. The CRC code is checked against the lookup table and if no errors are found it is passed on to the CPU.

The operation of the transmit clock in the G.703 Co-directional and long haul fiber optics unit is more complex. With either scheme the 64 Kb/s transmit clock is generated by the 9745 and is encoded with the data into a data stream which is actually 256 Kb/s. The data stream is then either level adjusted for G.703 or converted to an optical signal for fiber transmission. At the receiving station the signal is level and media corrected and then the clock is recovered by a 256 kHz PLL. From that point it is treated as above. When using G.703 Co-directional, if J1 is inserted the module will generate octet timing, and the external equipment can be strapped to accept octet timing.

The processor on the module receives set up information from the CPU and checks for clock errors, frame errors and data errors. This is all passed to the CPU via the bus.

2.2.5 DIGITAL INTERFACE MODULES

Each RFL 9745 can be configured with one of eleven different types of digital interface modules. Five of these are Serial Input/Output (SIO) modules which are listed in Table 2-2, and six of these are Fiber Input/Output (FIO) modules which are listed in Table 2-3. Each of these modules plugs directly into the upper rear panel of the RFL 9745. See section 3 of this manual for detailed installation instructions and wiring information.

Table 2-2. Characteristics of Serial Input/Output modules

Model Designation	Part Number	Data Rate	Rear Panel D-subminiature Connector
RS-449 SIO	105065-1	56/64 Kbps	37 pin male
G.703 Contra-Directional SIO	105065-2	64 Kbps	25 pin male
X.21 SIO	105065-10	64 Kbps	15 pin male
G.703 Co-Directional SIO with programmable octet timing	105065-11	64 Kbps	15 pin male
E1 Serial Interface Adapter	107320	2.048 Mbps	15 pin male and 2 BNC connectors

Table 2-3. Characteristics of Fiber Input/Output modules

Model Designation	Part Number	Wavelength	Fiber Type	Light Source	Fiber Connector Type
Short Haul FIO	107310	850 nm	Multimode	LED	ST
850 NM MM LED FIO	105065-5	850 nm	Multimode	LED	ST
1300 NM MM LED FIO	105065-6	1300 nm	Multimode	LED	ST
1300 NM SM LED FIO	105065-7	1300 nm	Singlemode	LED	ST
1300 NM SM LAS FIO	105065-8	1300 nm	Singlemode	Laser	ST
1550 NM SM LAS FIO	105065-9	1550 nm	Singlemode	Laser	ST

2.2.6 FIBER SERVICE UNIT

The function of the Fiber Service Unit (107460-x) is to provide the RFL 9745 with a remote port using dual fiber cables. The remote port can be RS-449, G.703, V.35 or X.21. The Fiber Service Unit can be located up to 2km away from an RFL 9745 equipped with a Short Haul Fiber I/O module (107310). Refer to the Fiber Service Unit Instruction Data sheet (publication number: ID C37.94FSU) for more information..

2.2.7 SWC I/O MODULES

The SWC I/O Modules convert the high-voltage, high-current signals received from external equipment to logic-level inputs that can be processed by the RFL 9745. They also provide high-voltage output contacts to interface the RFL 9745 to external equipment.

There are three different SWC I/O Modules: a Solid-State I/O Module, a Solid-State/Relay I/O Module and a High Speed Relay I/O Module. One or two boards can be installed in a chassis. All signals to and from the SWC I/O Modules originate on the Driver Module.

Solid-State I/O Module	The Solid-State I/O Module provides four solid-state outputs, three low current relay contacts, and four inputs.
Solid-State/Relay I/O Module	The Solid-State/Relay I/O Module provides one solid-state output, three high current relay contacts, three low current relay contacts, and four inputs.
High Speed Relay I/O Module	The High Speed Relay I/O Module provides four high current relay contacts, four low current relay contacts, and four inputs.

Each output on the SWC I/O module contains a circuit to sense the condition of the output circuit. This forms an input to the logic table which can be used to cause an alarm if so desired.

The solid state outputs are sensed to determine if more than 150 ma is flowing through the contacts. If the system has closed the output and not more than 150 ma is sensed, then an FTT (Fail To Trip) input is raised to the alarm logic. If the system has not closed the output and more than 150 ma is sensed, then an Output Short input is raised to the alarm logic.

Note that the 150 ma threshold is suitable only for high current devices such as lockout relays and trip coils. Interposing relays and solid state inputs will not usually draw sufficient current to detect. In these cases either the FTT input should not be used in the alarm logic or a shunt resistor can be used to increase the current drawn.

The trip relay outputs are sensed to determine if the relay coil is receiving current. Due to the higher current ratings the actual trip current is not measured.

2.2.8 FRONT PANEL MODULE

The Front Panel Module contains an LCD display that reports various system conditions. It has eight pushbutton switches to call up information for display. LED indicators report the status of the transmitted and received functions. An RS-232 connector is also available on the front panel.

2.2.9 POWER SUPPLY MODULE

The Power Supply Module converts the station battery voltages to the levels required by the RFL 9745. It uses a flyback switching topology, with an efficiency of 70 percent. The Power Supply Module is configured for redundant operation. It also has an undervoltage monitor for alarm purposes.

2.2.10 STATUS OUTPUT MODULE (optional)

The Status Output Module is housed in an extension to the bottom of the RFL 9745 chassis. It supplies six additional solid-state annunciator outputs when required. The Status Output Module is attached to and driven by the Driver Module.

2.2.11 GEC TYPE PRECISION RELAYS (optional)

As an option, one or two GEC Type precision relays can be added to the RFL 9745. Each relay is chassis mounted at the rear of the power supply module and is wired to the existing power supply terminal block on the rear panel. This allows for access to the coil leads and up to three pairs of contacts. If your RFL 9745 has this relay option, a product information sheet for the relay will be included in section 12 of this manual. A wiring diagram of the relay contacts and how it interfaces with the RFL 9745 is shown in Figure 12-1.

2.2.12 60HZ FILTERS AND HYBRID (optional)

In some applications, the 9745 system is required to operate with a 40 volt rms 50/60 Hz signal on the audio line terminals. This signal must be attenuated before reaching the Audio Communications board to avoid overdriving the isolation transformer and various input circuits. A 600 Hz high pass filter is added, when needed, to attenuate the 50/60 Hz signal by more than 48 dB on all 4-wire circuits. For 2-wire applications, a hybrid is also included in the 9745 Power I/O module along with the filter. Additional filtering is also done on the Audio Communications board for frequencies below 300 Hz.

Filters and Hybrid: Frequency Response and Rejection Characteristics.

Filter Modules:

Frequency Response:

Narrowband: +/-0.5 dB from 600 to 3400 Hz.

Wideband: +/-0.5 dB from 600 to 4000 Hz.

Rejection: >48 dB at 60 Hz or greater.

Filter/Hybrid Module:

Frequency Response:

Narrowband: +/-0.5 dB from 600 to 3400 Hz.

Wideband: +/-0.5 dB from 600 to 4000 Hz.

Rejection: >48 dB at 60 Hz or greater.

Trans-hybrid loss:

Narrowband: >25 dB from 600 to 3400 Hz.

Wideband: >25 dB from 600 to 4000 Hz.

2.2.12.1 QUAD FILTER MODULE (optional)

The quad filter I/O module contains filters for all four ports on the Audio Communications board. The filters are third order 600 Hz high pass LC designs using 26mm pot cores for the inductors. These inductors can handle the 50/60 Hz input signals without producing any distortion products. All four filters are identical. The signal lines on the rear panel terminal block (pins 1-8) are connected to one side of the filters. A wire cable connects the other side of the filters to TB1 on the Audio Communications Board.

The channel frequencies are limited to the 600 to 3400 Hz range in these applications. Frequencies below 600 Hz can still contain a fairly high level of 50/60 Hz harmonics appearing on the input line along with the fundamental frequency. These could interfere with channel signals in this band if they were used. See Figure 12-2 for wiring information.

2.2.12.2 DUAL FILTER MODULE (optional)

The dual filter I/O module contains only two filters for use with a single channel 4-wire system. The filters are identical to those in the quad filter I/O module. See Figure 13-3 for wiring information.

2.2.12.3 FILTER/HYBRID MODULE (optional)

The two-wire filter hybrid I/O module is used for a single channel 2-wire application. The 50/60 Hz interference signal is attenuated by the same 600 Hz high pass filter that is used on the other modules. The line side of the filter is connected to pins 1 and 2 of the rear panel terminal block. The other side of the filter drives a hybrid transformer.

The hybrid transformer consists of a transformer and a balancing network. This network represents a portion of the impedance seen by the line side of the hybrid transformer, and is required to maintain balance at all operating frequencies. A cable connects the equipment side of the hybrid to 4-wire transmit and receive ports on the Audio Communications board. See Figure 13-4 for wiring information.

2.3 SYSTEM OPERATION (AUDIO-TONE UNITS ONLY)

While the hardware inputs and outputs have been detailed above, little comment has been made about how the system processes the inputs to generate outputs. The resident software is in place to present the inputs to a Logic Table. The Primitive Processor uses this Logic Table to produce outputs based on the inputs. These outputs are then used to trigger the RFL 9745's hardware outputs.

The inputs, outputs, and tone transceivers can be tied together and controlled in any desired manner. The I/O and tone transceivers are chosen for their suitability for creating an audio teleprotection channel. The Logic Table makes the RFL 9745 into what is required by the customer. The default Logic Table included in the RFL 9745 causes the unit to act as a teleprotection channel. A different Logic Table would be required for applications other than teleprotection.

There are two default logic tables included in the embedded code of the 9745. These are the 9745 and the 6750 default logic tables. The 6750 default logic table provides a dual tone functionality compatible with an RFL 6750. If requested by the customer there will be custom logic tables provided with the PC_APRIL disk (see section 9). There may also be custom logic tables preloaded into the system for a specific application. The alarm default provides generic audio and hardware alarms.

An example of typical system operation is as follows. In this example, an input is applied to Input 1A of the local RFL 9745. Its Logic Table shifts Tone 1 to its high state if Input 1A is active. A remote RFL 9745 receives the high tone. The remote's Logic Table directs the remote RFL 9745 to close Output 1A if Transceiver #1 receives a high tone. The following steps produce this result, as shown on Figures 2-15 and 2-16. Expected results or comments are indented and appear in **boldface** type.

1. At the local RFL 9745, a voltage is applied to Input 1A (SWC I/O Module A Input 1).
2. A signal is relayed to the driver processor that Input 1A is active.
3. The Driver processor sends a message to the CPU that Input 1A is active.
4. The 68000 receives this message and tells the TMS320C25 that Input 1A is active.
5. The TMS320C25 processes the Logic Table using this new input value.
For the purposes of this example, this input should cause the tone to shift.
6. The 68000 reads the results of the Logic Table from the TMS320C25.
The results have Tone 1 shifted up in frequency.
7. The 68000 sends a message to the Communications I/F to shift Tone 1 up.

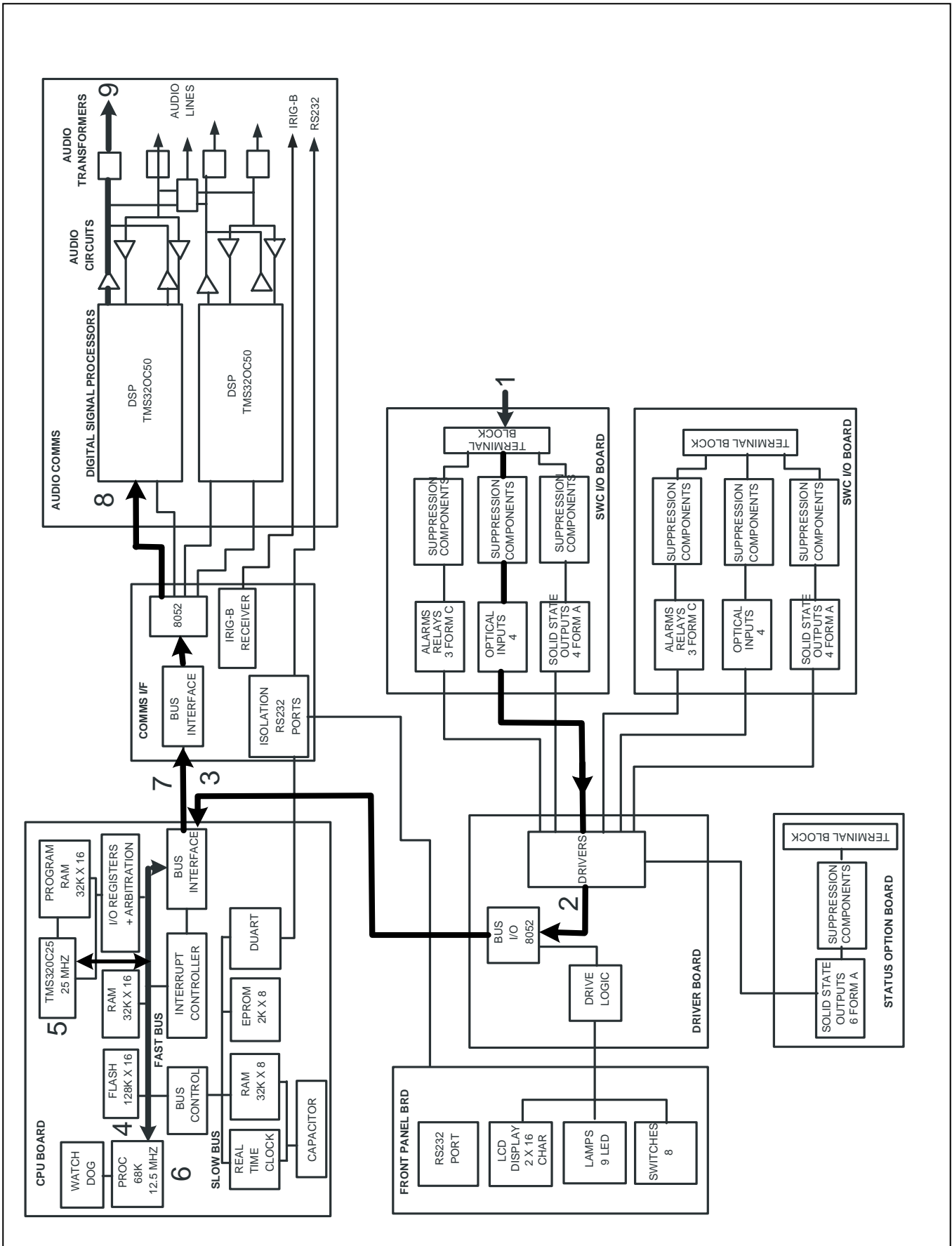


Figure 2-15. Example of typical system operation in the local RFL 9745 terminal

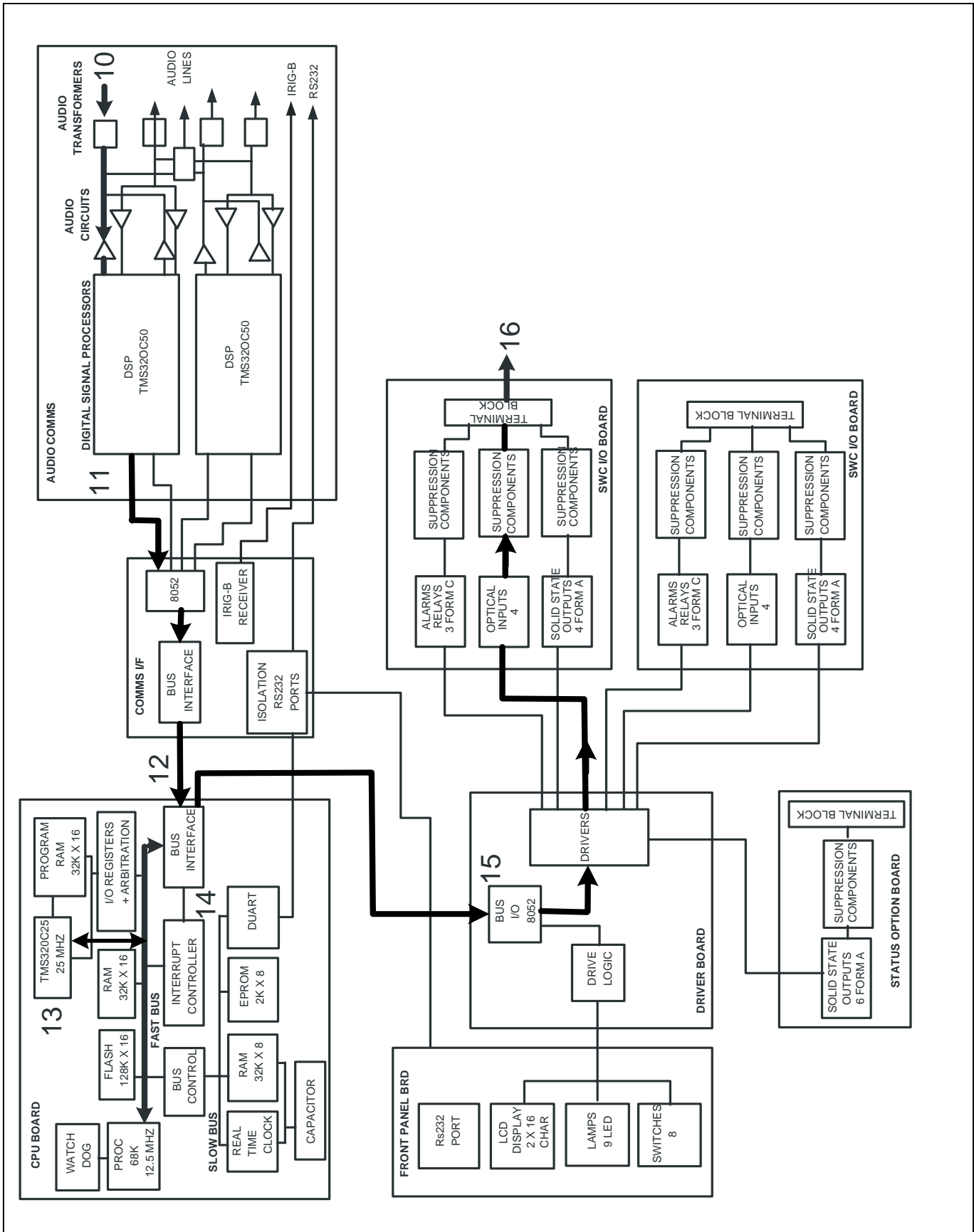


Figure 2-16. Example of typical system operation in remote RFL 9745 terminal

8. The Communications I/F passes the message through to Transceiver #1 on the Audio Communications Module.
9. The DSP processor in Transceiver #1 generates a high-frequency tone.
10. At the remote RFL 9745, the tone is received by Transceiver #1.
11. Transceiver #1 sends a high-frequency received message to the Communications I/F processor.
12. The Communications I/F processor send this message down to the CPU.
13. The 68000 processor receives the message from the Communications I/F processor. The message is then sent to the TMS320C25 on the CPU Module which processes the Logic Table using this new input value. From the TMS320C25 the message is sent back to the 68000 processor.
For the purposes of this example, a high-frequency received on Channel 1 causes Output 1A to close.
14. The output of the Logic Table causes Output 1A to close.
15. The 68000 sends a message to the Driver Module to close Output 1A.
16. The Driver Module sends a signal to SWC I/O (A) that closes Output 1.

2.4 SPECIAL FEATURES

The RFL 9745 system offers the following special features:

1. If Transceiver #1 is not used for any other function, it can provide a serial link to the remote RFL 9745. This is done by selecting the transceiver as a modem. The serial connection can serve several purposes. It can be used to do checkback or address-type tests. The round-trip delay can also be measured by performing ping-pong tests. These tests can be done manually or automatically. The values available on the RS-232 port of the remote unit can be read through the modem.
2. The Real-Time Clock (either set manually or through an IRIG-B link) can be used to time-tag the change-in-state of any of the inputs or outputs. Up to 100 events can be recorded and displayed. The front panel gives a constant readout of system time.
3. The DSP nature of the audio transceivers allows their operating parameters (such as frequencies, filters, levels, and gains) to be easily re-programmed. The shifts and bandwidths are also programmable to tailor the system to the exact requirements of each application.

4. The current flowing through the eight solid-state outputs is sensed. This allows the RFL 9745 to detect and report if any output is shorted or failed. These reports can be used to generate alarms if desired.
5. The front panel display can be used to call up information about the system, including the following:
 - o The status of all inputs, outputs, and functions.
 - o Transmit and receive levels.
 - o The state of all alarms.

User text can be added to most of the displays to clarify the application.

6. Any of the RFL 9745's four channels can be configured to operate as a transfer filter as shown in Figure 2-17. (This is also referred to as the "pass-through" mode.) When operating in this mode, the RFL 9745's programmable parameters can be used to define the filter's bandwidth and amplification factors.

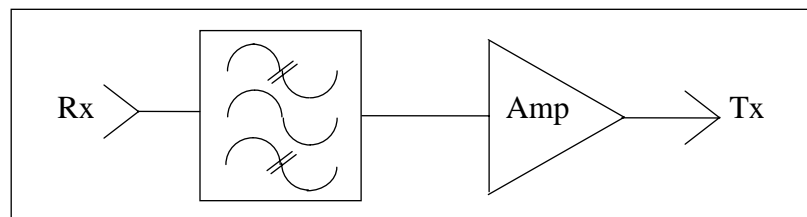


Figure 2-17. Transfer Filter

2.5 ADDRESS TESTING OR CHECKBACK TESTING (AUTOTEST)

The RFL 9745 uses Autotest to check its address or checkback functions. Autotest is the initiation of an Address Test or a Checkback Test and depends on how the system is configured. Autotest can be initiated by any one of the following actions:

- o By forcing Autotest with alarm logic. This requires a modification to the alarm logic table.
- o The user initiates Autotest using an RS-232 terminal or PC (APRIL). (Section 6 of this manual provides more information on initiating tests using an RS-232 terminal.)
- o The user initiates Autotest from the front panel. (Section 7 of this manual provides more information on initiating tests from the front panel.)
- o The RFL 9745 automatically initiates Autotest, based on its "next test start" setting. See paragraph 6.11.3 for more information.

To perform this test, the local RFL 9745 sends an address request to the remote RFL 9745. Based on the communications channel and the setup of the remote RFL 9745, either no response is made or the remote address is returned. Three possible results can occur:

**RECEIVED ADDRESS
MATCHES PROGRAMMED
ADDRESS**

This means the local and remote RFL 9745s pass both the address test and the checkback test. If the tests were initiated from the front panel, the display would read:

CHECKBACK TEST
PASS X4094 R4094
(X denotes the expected address)
(R denotes the received address)

**RECEIVED ADDRESS AND
PROGRAMMED ADDRESS
DO NOT MATCH**

This means the local and remote RFL 9745s fail the address test, but pass the checkback test. If the tests were initiated from the front panel, the display would read:

CHECKBACK TEST
FAIL X4094 R3085
(X denotes the expected address)
(R denotes the received address)

**THE LOCAL RFL 9745
DOES NOT RECEIVE
A VALID RESPONSE**

This means the local and remote RFL 9745s fail the checkback test and the address test is inconclusive. If the tests were initiated from the front panel, the display would read:

CHECKBACK TEST
TEST TIMEOUT

The "CHECKBACK FAIL" flag is an input to the RFL 9745's alarm logic. The "ADDRESS FAIL" flag is an input to the RFL 9745's primitive logic and alarm logic.

In all cases, when a Checkback Test is initiated, the tests performed count is incremented. The Tests Pass/Tests Failed counts are incremented according to the test result.

2.6 PING PONG TESTING

The RFL 9745 uses ping pong testing to measure channel delay between a local 9745 and a remote 9745. In an audio system, channel 1 must be selected as a modem at both sites for ping pong testing to be functional. The channel delay can be set by the user in the read settings menu (Parameter #062, Chan delay alarm) as shown in Figure 6-10. If the measured channel delay exceeds the programmed value, the Channel Delay (Parameter #093) in the alarms display will be set to A (Active) as shown in Figure 6-2. Otherwise, Parameter #093 will be reset to I (Inactive). Parameter #093 (Channel Delay) indicates the result of the last ping pong test run. The ping pong test can be activated by any one of the following actions:

- The user initiates ping pong using RFL 9745 front panel controls. (See paragraph 2.6.1 and Section 7 for more information.)
- The user initiates ping pong using an RS-232 terminal or PC April. (See paragraph 2.6.2 and Section 6 for more information.)
- The RFL 9745 automatically performs the ping pong test every 10 minutes.

2.6.1 RUNNING PING PONG TEST FROM FRONT PANEL

At the RFL 9745 front panel press the TEST button to view the first entry of the TEST menu. Press the DOWN button to scroll down the TEST menu list until PING PONG is displayed. PING PONG will appear only if channel 1 is configured as a modem in an audio system. Press the ENTER button to run the PING PONG test and view the results.

When the ENTER button is pressed, the local 9745 sends a ping pong signal to the remote 9745. Based on the communication channel and the setup of the remote 9745, either no response is made or the ping pong signal is returned.

If the local 9745 does not receive a response from the remote 9745 within three seconds, the ping pong test has failed and the words “TEST FAILURE” will be displayed.

If the local 9745 receives a response from the remote 9745 which is over 77.5 ms and less than 3 seconds, the words “TEST TIMEOUT” will be displayed.

If the local 9745 receives a valid response from the remote 9745 (77.5 ms or less), the 9745 display will indicate the following: “TIME XX.X mSec”, where XX.X can be 00.0 to 77.5 mSec. The resolution of the display is 0.5 mSec. A typical ping pong response is 2.0 to 8.0 ms for a digital system and 8.0 to 12.0 ms for an audio system. The time displayed is the round trip delay divided by two.

2.6.2 RUNNING PING PONG TEST FROM RS-232

Connect your PC to the 9745 RS-232 port, either directly or through an RFL 9660 digital switch. Press the [W] key, then press the [ENTER] key twice. The 9745 will send the following prompt to your PC:
!9745>

Press the [H] key, and then press the [ENTER] key. The April command list will now be visible on your PC. Press [T] and then [ENTER] to view the test parameters list.

Press [1, 4] and then press [ENTER] to run the PING PONG test and view the results.

2.7 LOGIC/ALARM PROGRAMMING LANGUAGE

The RFL 9745's logic/alarm programming language is used to transform a diagram of the logic desired by the user into a form the RFL 9745 can use. The basic primitives used in logic design are used by this language. Once the primitives and syntax are understood, any logic diagram can be easily converted. As in most logic design, the terms "true," "positive," "high," and "1" all refer to the same state. Also, the terms "false," "negative," "low," and "0" all refer to the same state. In the following paragraphs, the terms "true" and "false" will be used to describe these logic states.

2.7.1 AND GATE

An AND gate has two inputs and one output, as shown in Figure 2-18. If both inputs are true, the output is true. If either input is false, the output is false.

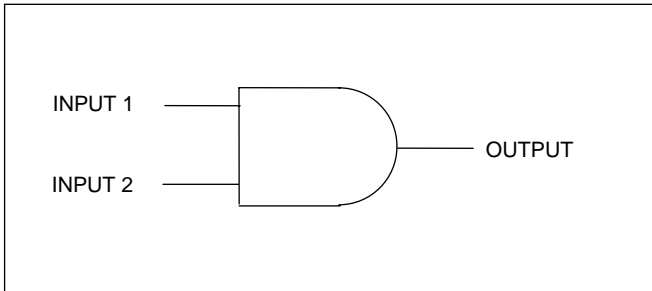


Figure 2-18. AND gate

Table 2-4. Truth table for AND gate

Input 1	Input 2	Output
False	False	False
False	True	False
True	False	False
True	True	True

2.7.2 OR GATE

An OR gate has two inputs and one output, as shown in Figure 2-19. If both inputs are false, the output is false. If either input is true, the output is true.

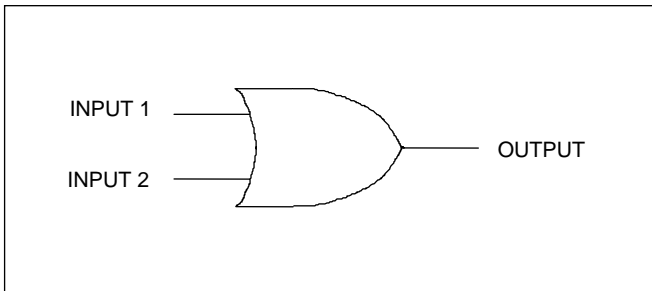


Figure 2-19. OR gate

Table 2-5. Truth table for OR gate

Input 1	Input 2	Output
False	False	False
False	True	True
True	False	True
True	True	True

2.7.3 NOT GATE

A NOT gate (or inverter) has one input and one output, as shown in Figure 2-20. The output is always the opposite of the input.

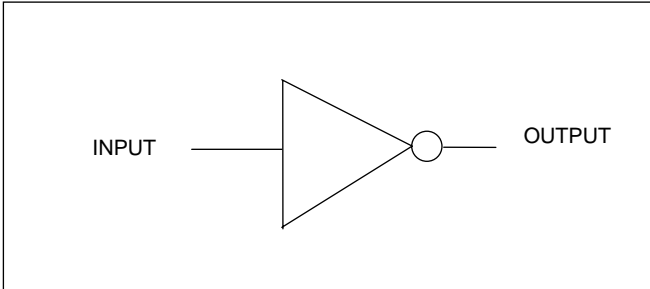


Figure 2-20. NOT gate

Table 2-6. Truth table for NOT gate

Input	Output
False	True
True	False

NOTE

The logic/alarm programming language assumes that all gates have two inputs. Since the NOT gate has only one input, the user must set the non-existing second input to “#0”, as shown in the following example:

NOT, input 1 of the gate, #0

Also refer to line 1 of Figure 2-25.

2.7.4 XOR GATE

An XOR (or Exclusive-OR) gate has two inputs and one output, as shown in Figure 2-21. If one input is true and the other is false, the output is true. If both inputs are the same state (either true or false), the output is false.

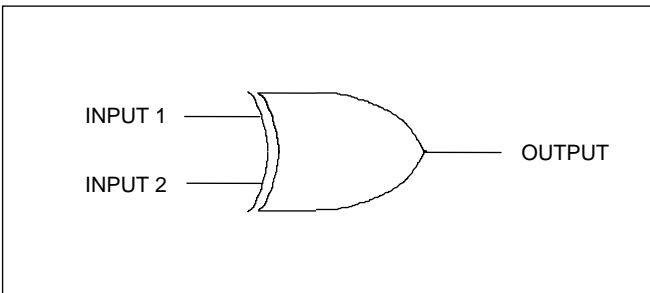


Figure 2-21. XOR gate

Table 2-7. Truth table for XOR gate

Input 1	Input 2	Output
False	False	False
False	True	True
True	False	True
True	True	False

2.7.5 USING THE “NOP” COMMAND

If a line of code in the logic table is not going to be used, use the “NOP” command to bypass that line of code.

2.7.6 USING THE “END” COMMAND

After the last line of code, the “END” command is used to indicate the end of the logic table. When the logic table is viewed by using the “V” command, “END” is not displayed.

2.7.7 TIMER

A timer has one input and one output, as shown in Figure 2-22. The output tracks the input after a given time delay. Each timer has two settings: "attack time" and "decay time." If the input goes true, the output will go true after a time delay equal to the attack time, as long as the input is still true; if the input is not true at the end of the attack time, the output will not change. If the input goes from true to false after the attack time has been satisfied, the output will go false after a time delay equal to the decay time. If the input remains false less than the decay time, the output will not go false.

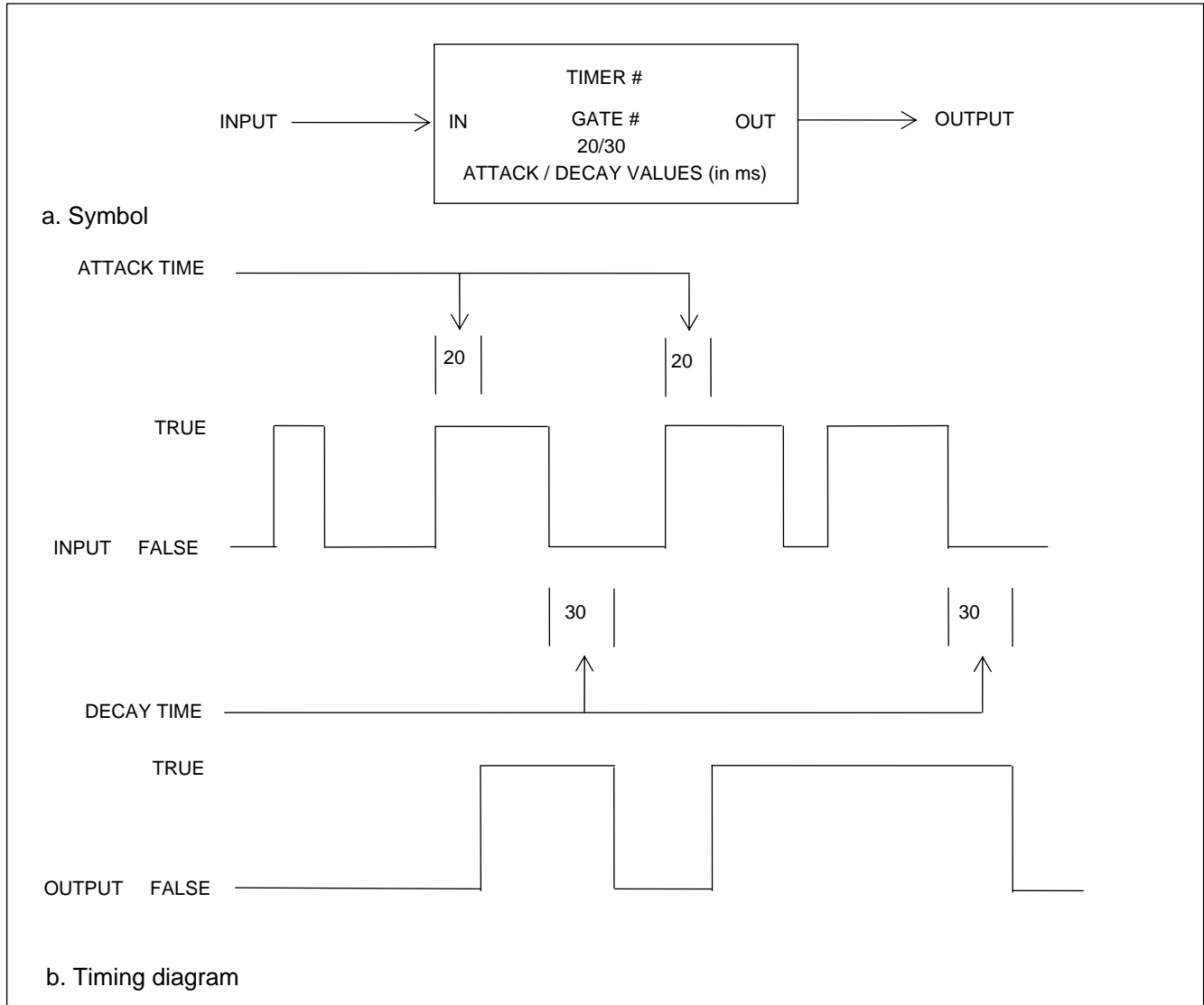


Figure 2-22. Timer

2.7.8 LATCH

A latch has two inputs and one output, as shown in Figure 2-23. One input is called "SET," and the other is "RESET". The SET input is active true and the RESET input is active false. The latch starts out in a false state. If the RESET input goes false, the output goes false. If the SET input goes true, the output goes true and stays true unless the RESET is false.

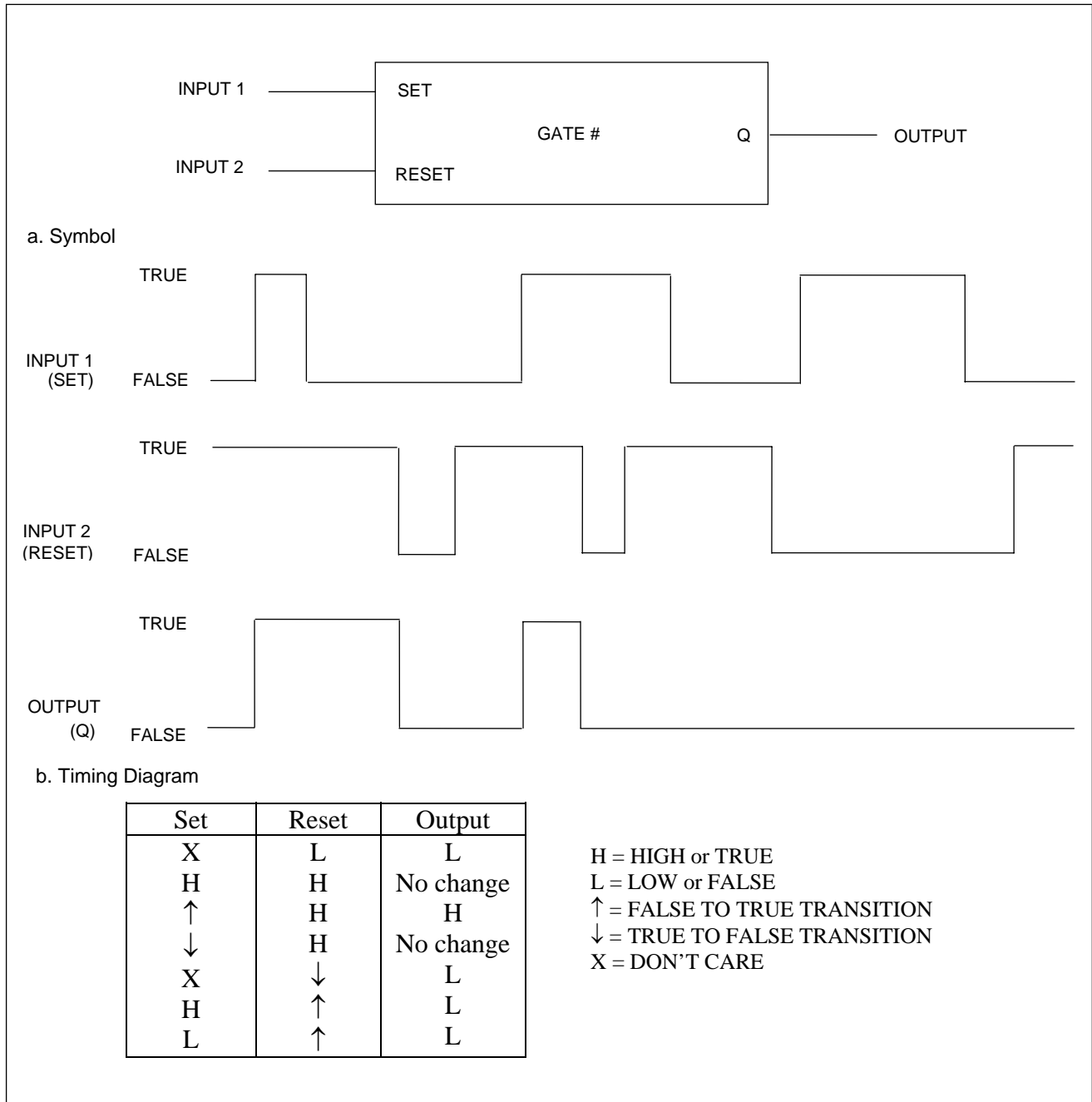


Figure 2-23. Latch

2.7.9 LOGIC TABLE SYNTAX

The syntax used in the RFL 9745's logic table is very simple. Every connection point in the logic diagram is called a "node." Each node has one gate that causes it to be either true or false; the node is said to be "driven" by that gate. The RFL 9745's hardware inputs drive gates, which in turn drive other nodes. The final nodes in a logic expression may be used to drive the RFL 9745's hardware outputs. (A typical logic diagram appears in Figure 2-24. Figure 2-25 shows how this logic diagram is converted into a logic table.)

Each node is described by a single line in the RFL 9745's logic table. When complete, a logic table will have the same number of lines as there are nodes in the diagram. Each line contains four or five items: the node number, the gate type, the first input to the gate, the second input to the gate, and any output attached to this node. If the output is an input to another gate, then you don't list the output.

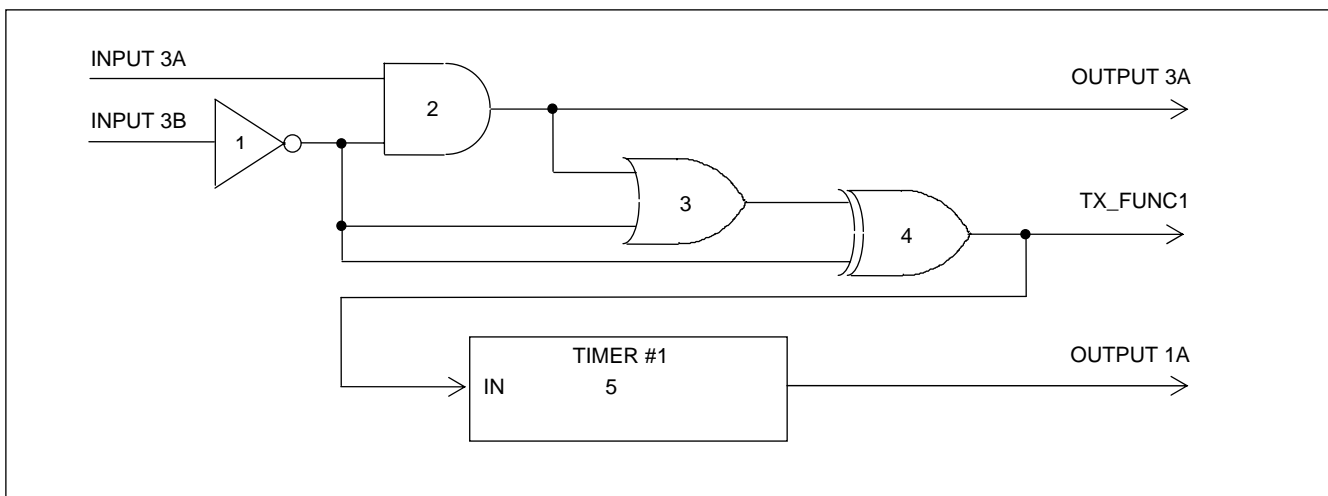


Figure 2-24. Typical logic diagram

#	Gate:	Input 1:	Input 2:	Output:
001	NOT	INPUT3B	#0	
002	AND	INPUT3A	NODE1	OUTPUT3A
003	OR	NODE1	NODE2	
004	XOR	NODE3	NODE1	TX_FUNC1
005	TIMER	NODE4	TIMER1	OUTPUT1A

Figure 2-25. Logic table for logic diagram in Figure 2-24

2.8 9745 FILE DESCRIPTIONS

The RFL 9745 uses batch files, logic files, schematic files and system files. Each of these files is described below.

2.8.1 BATCH FILES

RFL 9745 files with a .BAT extension are referred to as batch files. Batch files contain parameter tables, alarm name tables and timer value tables. There are three generic batch files supplied on the PC_APRIL diskette as follows:

6750.BAT
9745.BAT
Digital.BAT

6750.BAT provides the parameters necessary to program the RFL 9745 so that it can operate with an RFL 6750 audio tone transfer trip chassis.

9745.BAT contains the default program parameters for the audio tone version of the RFL 9745.

Digital.BAT contains the default program parameters for both the digital and optical versions of the RFL 9745.

If a users RFL 9745 is programmed with customer specific application software, a custom batch file with a file name similar to S00254PA.BAT, will be supplied. This batch file will contain the custom parameter tables for the system, and is pre-loaded into the RFL 9745 at the factory. A copy of this file will also be supplied on the CUSTOM LOGIC diskette. This file can be uploaded from a PC to the RFL 9745 as working parameter software.

2.8.2 LOGIC FILES

RFL 9745 files with an .MHX extension are referred to as logic files. Logic files contain primitive logic and alarm logic tables for the RFL 9745. There are four generic logic files supplied on the PC_APRIL diskette as follows:

6750.MHX
9745.MHX
Digital.MHX
OPTIC.MHX

If a users RFL 9745 is programmed with customer specific application software, a custom logic file with a file name similar to S00254PA.MHX, will be supplied. This logic file will contain the custom tables for the system, and is pre-loaded into the RFL 9745 at the factory. A copy of this file will also be supplied on the CUSTOM LOGIC diskette. A customer specific logic drawing will also be supplied, which will be located in the accessory section of the instruction manual. This file can be uploaded from a PC to the RFL 9745 as working logic software.

2.8.3 SCHEMATIC FILES

RFL 9745 files with an .DXF extension are referred to as schematic files. There are two files with this extension provided on the CUSTOM LOGIC diskette. These are schematics generated from ORCAD. ORCAD is a computer aided development tool which is run on a workstation and is used to edit the logic graphically as a schematic representation of the logic. Logic files with the .MHX extension are then derived from these schematics. The schematic files do not run with PC_APRIL and do not run on the RFL 9745 itself. There are usually two schematic files supplied on the PC_APRIL diskette which have file names similar to the following:

S00254AA.DXF	(Alarm logic)
S00254PA.DXF	(Primitive logic)

These schematic files correspond to the custom logic files discussed in paragraph 2.7.2.

2.8.4 SYSTEM FILE

The system file is located on the diskette labeled “RFL 9745 SYSTEM DOWNLOAD SOFTWARE SW9745SY026”. This file contains the main operating program for the RFL 9745. A typical system file name on this diskette is S9745RXX.MHX, where XX is the latest revision. In the event the basic operating program in the RFL 9745 is revised or is erroneously lost, the system can be reprogrammed using this diskette by following the instructions provided in Section 9 of this instruction manual.

2.9 INPUTS AND OUTPUTS

During normal system operation, the RFL 9745 uses many signal inputs to make its logic decisions. Based on these decisions, the RFL 9745 produces many output signals. All of the Primitive and Alarm Processor input and output signals used for the Audio and Digital Systems are shown in Section 2.9.1 and 2.9.2.

Typical Primitive and Alarm logic diagrams appear in Figures 2-26 through 2-30. For diagrams that are specific to your system, refer to Section 12 of this manual or the "as supplied" drawings furnished with the equipment.

Not all of the input and output signals listed in Section 2.9.1 and 2.9.2 are used in the logic diagrams shown in Figures 2-26 through 2-30. However, they can be used if the logic diagrams are edited by the user to satisfy a special requirement.

The logic diagrams shown in Figures 2-26 through 2-30 do not physically exist, but are schematic representations of how the logic is configured in the RFL 9745 software, which can be edited by the user. A list of these logic diagrams is shown below.

<u>Figure</u>	<u>Logic Diagram</u>
2-26	9745 Audio default primitive logic diagram
2-27	9745 Audio default alarm logic diagram
2-28	6750 Audio default primitive logic diagram
2-29	9745 Digital default primitive logic diagram
2-30	9745 Digital default alarm logic diagram

2.9.1 PRIMITIVE AND ALARM LOGIC INPUTS (For Audio and Digital Systems)

The following inputs are accepted by the Primitive and Alarm logic in the RFL 9745 units equipped for Audio or Digital communications.

PRIMITIVE & ALARM INPUTS	ALARM INPUTS ONLY	Analog 9745	Digital 9745	Definition
#0		X	X	This input is used as a standard false input to any gate.
#1		X	X	This input is used as a standard true input to any gate.
ADR_FAIL		X	X	An address test was performed with the remote unit. The remote unit did respond to the test but the wrong return address was received. This indicates that communications with another 9745 is functioning, but the wrong 9745 is connected to the remote end.
	ALRM_BER		X	In Digital System, active when the BER (bit error rate) exceeds the value set by the user in the programming menu. In Audio System, always inactive.
AMIH_CH1		X		Each FSK channel has two bandpass filters associated with it. One, AM1, has a pass band from the low edge of the band passed by the channel filter to the center frequency. AM2 goes from the center frequency to the upper band edge. AM1H becomes active when the signal level in that filter has exceeded a preset upper limit. This limit is fixed at 11 dB more than nominal.
AMIH_CH2		X		
AMIH_CH3		X		
AMIH_CH4		X		
AMIL_CH1		X		Each FSK channel has two bandpass filters associated with it. One, AM1, has a pass band from the low edge of the band passed by the channel filter to the center frequency. AM2 goes from the center frequency to the upper band edge. AM1L becomes active when the signal level in that filter has not exceeded a preset lower limit. This limit is fixed at 10 dB less than nominal.
AMIL_CH2		X		
AMIL_CH3		X		
AMIL_CH4		X		
AM2H_CH1		X		Each FSK channel has two bandpass filters associated with it. One, AM1, has a pass band from the low edge of the band passed by the channel filter to the center frequency. AM2 goes from the center frequency to the upper band edge. AM2H becomes active when the signal level in that filter has exceeded a preset upper limit. This limit is fixed at 11 dB more than nominal.
AM2H_CH2		X		
AM2H_CH3		X		
AM2H_CH4		X		
AM2L_CH1		X		Each FSK channel has two bandpass filters associated with it. One, AM1, has a pass band from the low edge of the band passed by the channel filter to the center frequency. AM2 goes from the center frequency to the upper band edge. AM2L becomes active when the signal level in that filter has not exceeded a preset lower limit. This limit is fixed at 10 dB less than nominal.
AM2L_CH2		X		
AM2L_CH3		X		
AM2L_CH4		X		
	BATTERY	X	X	Not used on units with capacitor-backed RAM.
	BOOST1	X		This alarms input is the result of the appropriate channels boost going active.
	BOOST2	X		
	BOOST3	X		
	BOOST4	X		
	BUS_ERR	X	X	A bus error has occurred involving one of the RFL 9745's buses.

PRIMITIVE & ALARM INPUTS	ALARM INPUTS ONLY	Analog 9745	Digital 9745	Definition
	CH_DLY	X	X	The measured channel delay is longer than the program value (See Figure 6-10).
	CHKBK	X	X	Checkback test failure
CLK_ERR			X	This input becomes active when the variation in the timing for an entire message exceeds the preset limit of 30 microseconds. This calculates out to 2 unit intervals or 12.8 percent.
CONF_ERR			X	This input becomes active when a digital comms module is installed but no digital SIO is installed.
	CPUFAIL	X	X	An error has occurred involving the CPU.
FDH_CH1		X		The frequency discriminator for channel 1, 2, 3 or 4 has determined that a tone which is higher than the center frequency and lower than the highest frequency allowed by the bandpass filter is being received. There is a slight dead zone around the center frequency that is proportional to the distance between the programmed high and low frequencies
FDH_CH2		X		
FDH_CH3		X		
FDH_CH4		X		
FDL_CH1		X		The frequency discriminator for channel 1, 2, 3 or 4 has determined that a tone which is lower than the center frequency and higher than the lowest frequency allowed by the bandpass filter is being received. There is a slight dead zone around the center frequency that is proportional to the distance between the programmed high and low frequencies.
FDL_CH2		X		
FDL_CH3		X		
FDL_CH4		X		
FM_CH1		X		This input goes active when the rate of change of the input frequency exceeds the programmable limit. The limit is set in percent in April. The setting refers to how much the discriminator output is allowed to change in 125 microseconds.
FM_CH2		X		
FM_CH3		X		
FM_CH4		X		
FRM_ERR			X	This error is active whenever the digital comms board on the receiving end is unable to detect the framing pattern embedded in the digital data stream.
	FTT1A	X	X	Fail To Trip - According to the system conditions, The Output should be in its trip state, but less than 150 ma is being sensed through its contacts.
	FTT1B	X	X	
	FTT2A	X	X	
	FTT2B	X	X	
	FTT3A	X	X	
	FTT3B	X	X	
	FTT4A	X	X	
	FTT4B	X	X	

Continued.....

PRIMITIVE & ALARM INPUTS	ALARM INPUTS ONLY	Analog 9745	Digital 9745	Definition
INPUT1A		X	X	The hardware input has detected sufficient voltage to declare input 1A, 2A, 3A, 4A, 1B, 2B, 3B, or 4B active. (See Section 6 for more information on input labels).
INPUT1B		X	X	
INPUT2A		X	X	
INPUT2B		X	X	
INPUT3A		X	X	
INPUT3B		X	X	
INPUT4A		X	X	
INPUT4B		X	X	
	LPWR	X	X	The output of the RFL 9745's left (main) power supply module is low.
MAJR_ERR			X	This input goes active when the digital receiver has detected enough messages with CRC errors to declare that the major error setting in the programming has been exceeded.
MINR_ERR			X	This input goes active when the digital receiver has detected enough messages with CRC errors to declare that the minor error setting in the programming has been exceeded.
	OSPARE0	X	X	This primitive input is a logic gate path to connect primitive logic to alarm logic.
	OSPARE1	X	X	
	OSPARE2	X	X	
	OSPARE23	X	X	
	OSPARE3	X	X	
	OSPARE31	X	X	
	OSPARE4	X	X	
	OSPARE5	X	X	
	OSPARE6	X	X	
	OSPARE7	X	X	

Continued.....

PRIMITIVE & ALARM INPUTS	ALARM INPUTS ONLY	Analog 9745	Digital 9745	Definition
	OUTPUT1A	X	X	These alarm inputs are driven from the primitive outputs to be used for an alarm condition.
	OUTPUT2A	X	X	
	OUTPUT3A	X	X	
	OUTPUT4A	X	X	
	OUTPUT1B	X	X	These alarm inputs are driven from the primitive outputs to be used for an alarm condition.
	OUTPUT2B	X	X	
	OUTPUT3B	X	X	
	OUTPUT4B	X	X	
	RPWR	X	X	The output of the RFL 9745's right (redundant) power supply module is low.
	RS232	X	X	The RFL 9745's RS-232 port is active.
	RSE_CH1	X		These alarm inputs are driven from the primitive outputs to be used for an alarm condition.
	RSE_CH2	X		
	RSE_CH3	X		
	RSE_CH4	X		
	RSE_FUNC1		X	In the digital system, these seven primitive outputs can be used as an alarm input to trigger an alarm condition. Seven received bits are available. Each one refers to the receipt of a valid transmitted function bit. RX_FUNC1, 2, 3, 4, 5, 6, or 7 means that the receiver is detecting that the given bit is received in a high state.
	RSE_FUNC2		X	
	RSE_FUNC3		X	
	RSE_FUNC4		X	
	RSE_FUNC5		X	
	RSE_FUNC6		X	
	RSE_FUNC7		X	
	RTS_CH1	X		This primitive output enables the appropriate channel transmitter.
	RTS_CH2	X		
	RTS_CH3	X		
	RTS_CH4	X		

Continued.....

PRIMITIVE & ALARM INPUTS	ALARM INPUTS ONLY	Analog 9745	Digital 9745	Definition
RX_FUNC1			X	In the digital system, seven received bits are available. Each one refers to the receipt of a valid transmitted function bit. RX_FUNC1, 2, 3, 4,5, 6, or 7 means that the receiver is detecting that the given bit is received in a high state.
RX_FUNC2			X	
RX_FUNC3			X	
RX_FUNC4			X	
RX_FUNC5			X	
RX_FUNC6			X	
RX_FUNC7			X	
	RXALARM1	X		In the Audio System, active when the received signal level for channels 1, 2, 3 or 4 is lower than the programmed Rx Alarm Level in the alarms display.
	RXALARM2	X		
	RXALARM3	X		In Digital System, always inactive.
	RXALARM4	X		
S/N_CH1		X		This input goes active when the absolute value of the difference between the energy in the AM1 filter and the AM2 filter is less than the programmable limit (AM noise).
S/N_CH2		X		
S/N_CH3		X		
S/N_CH4		X		
	SHORT1A	X	X	Output Shorted - According to the system conditions, These Outputs should be open. However, a current greater than 150 mA is being sensed through their contacts.
	SHORT1B	X	X	
	SHORT2A	X	X	
	SHORT2B	X	X	
	SHORT3A	X	X	
	SHORT3B	X	X	
	SHORT4A	X	X	
	SHORT4B	X	X	
TEST_ACT		X	X	The Auto Test Active parameter is active for the duration of an auto test.
	TEST_RUN	X	X	Set after address test performed, cleared on boot-up or outage.
TX_FAIL			X	This input goes active when the fiber optic transmitter has failed.

Continued.....

PRIMITIVE & ALARM INPUTS	ALARM INPUTS ONLY	Analog 9745	Digital 9745	Definition
	TX_FUNC1	X	X	These primitive outputs can be used as alarm inputs to drive an alarm condition. This bit goes active when the appropriate channel is transmitting.
	TX_FUNC2	X	X	
	TX_FUNC3	X	X	
	TX_FUNC4	X	X	
	TX_FUNC5		X	
	TX_FUNC6		X	
	TX_FUNC7		X	

The following LOGIC INPUTS are used in the PRIMITIVE LOGIC only.

PRIMITIVE & ALARM INPUTS	ALARM INPUTS ONLY	Analog 9745	Digital 9745	Definition
ASPARE1		X	X	This primitive input is a logic gate path to connect alarm logic to primitive logic.
ASPARE2		X	X	
ASPARE3		X	X	
ASPARE4		X	X	

2.9.2 PRIMITIVE AND ALARM LOGIC OUTPUTS (For Audio and Digital Systems)

The following outputs are produced by the Primitive and Alarm logic in RFL 9745 units equipped for Audio or Digital communications.

PRIMITIVE OUTPUTS ONLY	ALARM OUTPUTS ONLY	Analog 9745	Digital 9745	Definition
	A_OUTPUT1	X	X	The appropriate Optional Annunciator (Optional solid state output)
	A_OUTPUT2	X	X	
	A_OUTPUT3	X	X	
	A_OUTPUT4	X	X	
	A_OUTPUT5	X	X	
	A_OUTPUT6	X	X	
	A_RELAY1A	X	X	The appropriate Annunciator Relay (Form C electro-mechanical relay. Inactive state is energized)
	A_RELAY1B	X	X	
	A_RELAY2A	X	X	
	A_RELAY2B	X	X	
	A_RELAY3A	X	X	
	A_RELAY3B	X	X	
	ASPARE1	X	X	This alarm output is a logic gate path to connect alarm logic to primitive logic.
	ASPARE2	X	X	
	ASPARE3	X	X	
	ASPARE4	X	X	
	AUTO_TEST	X	X	Run auto test (Causes an automatic test to be run if the system is configured to run tests). Typical uses are after an outage goes inactive or if AUTO_TEST is linked to an external input.
BOOST1		X		This primitive output causes the appropriate channel to output a higher level from its transmitter. The added level in dB is programmed in APRIL.
BOOST2		X		
BOOST3		X		
BOOST4		X		

Continued.....

PRIMITIVE OUTPUTS ONLY	ALARM OUTPUTS ONLY	Analog 9745	Digital 9745	Definition
OSPARE0		X	X	This primitive output is a logic gate path to connect primitive logic to alarm logic.
OSPARE1		X	X	
OSPARE2		X	X	
OSPARE23		X	X	
OSPARE3		X	X	
OSPARE31		X	X	
OSPARE4		X	X	
OSPARE5		X	X	
OSPARE6		X	X	
OSPARE7		X	X	
	OUTAGE	X	X	Increment outage timer (If this output is active, the cumulative outage timer runs).
OUTPUT1A		X	X	These outputs drive a solid state device in the upper and lower I/O modules. When the TRUE output of a gate, timer or latch in the primitive logic is programmed to feed one of the outputs, the contacts are closed, if the output is TRUE.
OUTPUT1B		X	X	
OUTPUT2A		X	X	
OUTPUT2B		X	X	
OUTPUT3A		X	X	
OUTPUT3B		X	X	
OUTPUT4A		X	X	
OUTPUT4B		X	X	
RELAY-2A		X	X	These outputs drive the contact closure FORM A relay outputs in the upper and lower I/O module. When the TRUE output of a gate, timer or latch in the primitive logic is programmed to feed one of the outputs, the contacts are closed, if the output is TRUE.
RELAY-2B		X	X	
RELAY-3A		X	X	
RELAY-3B		X	X	
RELAY-4A		X	X	
RELAY-4B		X	X	

Continued.....

PRIMITIVE OUTPUTS ONLY	ALARM OUTPUTS ONLY	Analog 9745	Digital 9745	Definition
RSE_CH1		X		This primitive output enables the receiver for the appropriate channel.
RSE_CH2		X		
RSE_CH3		X		
RSE_CH4		X		
RSE_FUN1			X	This primitive output when active enables the corresponding function to be received.
RSE_FUN2			X	
RSE_FUN3			X	
RSE_FUN4			X	
RSE_FUN5			X	
RSE_FUN6			X	
RSE_FUN7			X	
RTS_CH1		X		This primitive output enables the transmitter for the appropriate channel.
RTS_CH2		X		
RTS_CH3		X		
RTS_CH4		X		
	RX_LED1	X	X	Used to override the default setting of the four front panel RX LEDs.
	RX_LED2	X	X	
	RX_LED3	X	X	
	RX_LED4	X	X	

Continued.....

PRIMITIVE OUTPUTS ONLY	ALARM OUTPUTS ONLY	Analog 9745	Digital 9745	Definition
TX_FUNC1		X	X	For the Audio System, this primitive output causes the appropriate channel to transmit its upper frequency. For the Digital System, this primitive output causes the appropriate Function to be transmitted.
TX_FUNC2		X	X	
TX_FUNC3		X	X	
TX_FUNC4		X	X	
TX_FUNC5			X	For the Digital System, this primitive output causes the appropriate Function to be transmitted.
TX_FUNC6			X	
TX_FUNC7			X	
	TX_LED1	X	X	Used to override the default setting of the four front panel TX LEDs.
	TX_LED2	X	X	
	TX_LED3	X	X	
	TX_LED4	X	X	

Timer Number	Timer Name	Timer attack and decay values with Flash Timers T4, T5 and T6 disabled (See Figure 2-26)	Timer attack and decay values with Flash Timers T4, T5 or T6 enabled
T14, T16	Guard Before Trip/ Trip After Guard	100/40	20/40
T15, T17	Trip Hold Timer	0/20	0/40
T11, T13	Block Timer	100/12	12/12

Notes:

1. Timer value changes are required when a flash timer in the default logic is enabled. The only timer values that must be changed are those that correspond to the flash timer that is enabled. For example, if Flash Timer T6 (Channel 2) is enabled by setting jumper J1 to the A position, only timers T13, T16 and T17 must be changed in accordance with the table since only these timers correspond to Channel 2.
2. Timers T11, T14 and T15 are dual timers for Channels 3 and 4.
3. Timers T13, T16 and T17 are single timers for Channel 2 only.

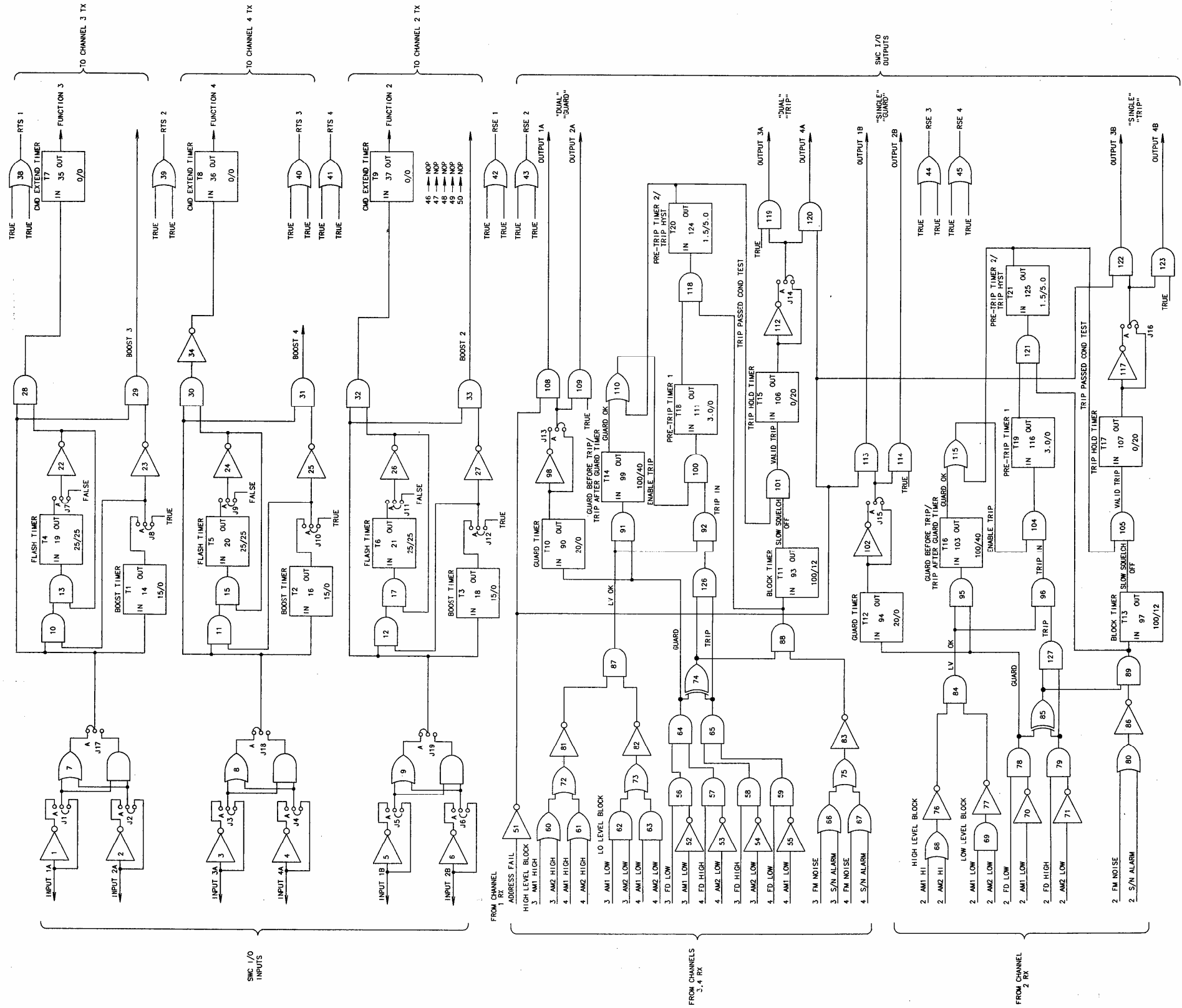


Figure 2-26. 9745 Audio default primitive logic diagram

Flasher Alarm Decay must be less than Flasher Timer

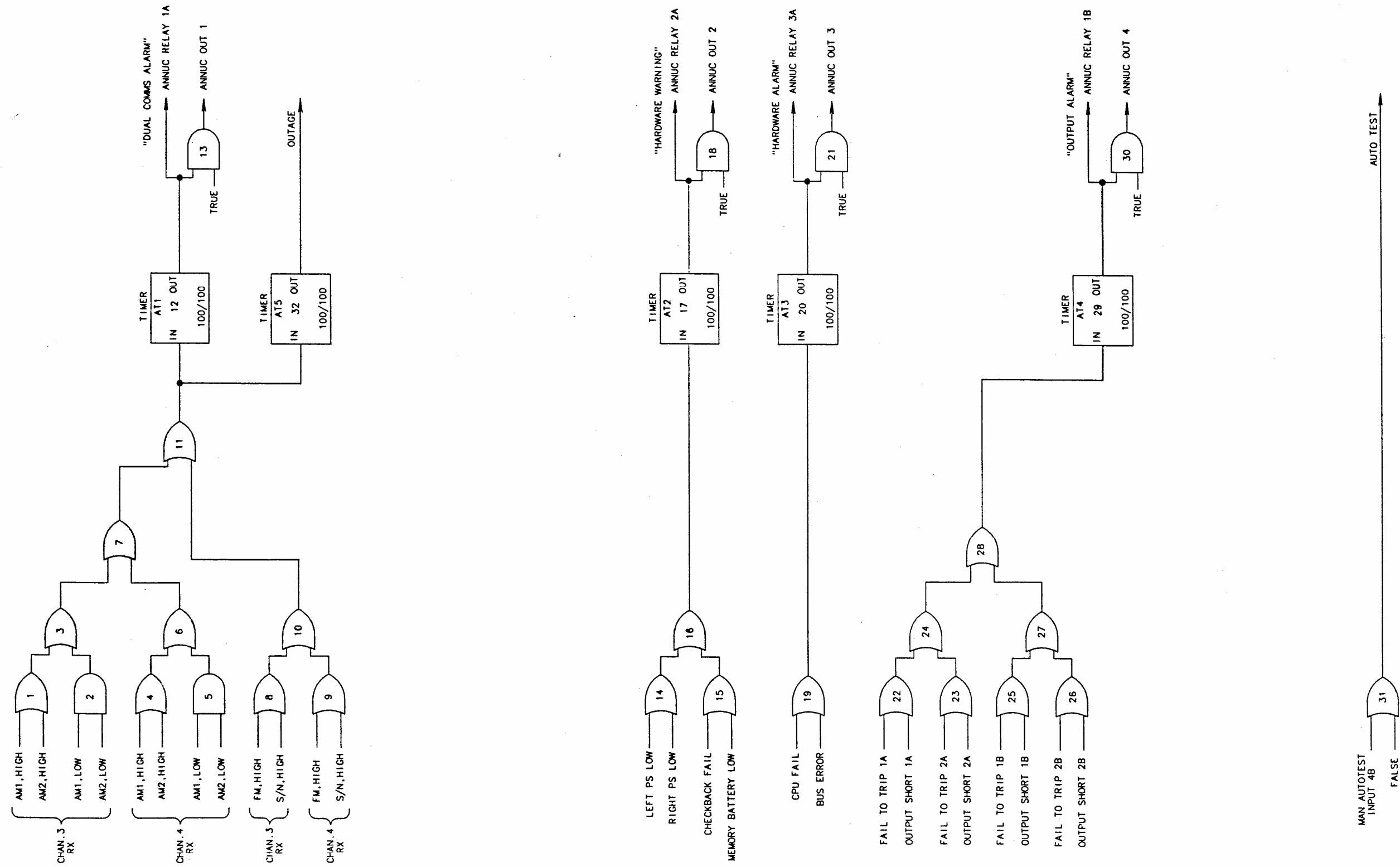


Figure 2-27. 9745 Audio default alarm logic diagram

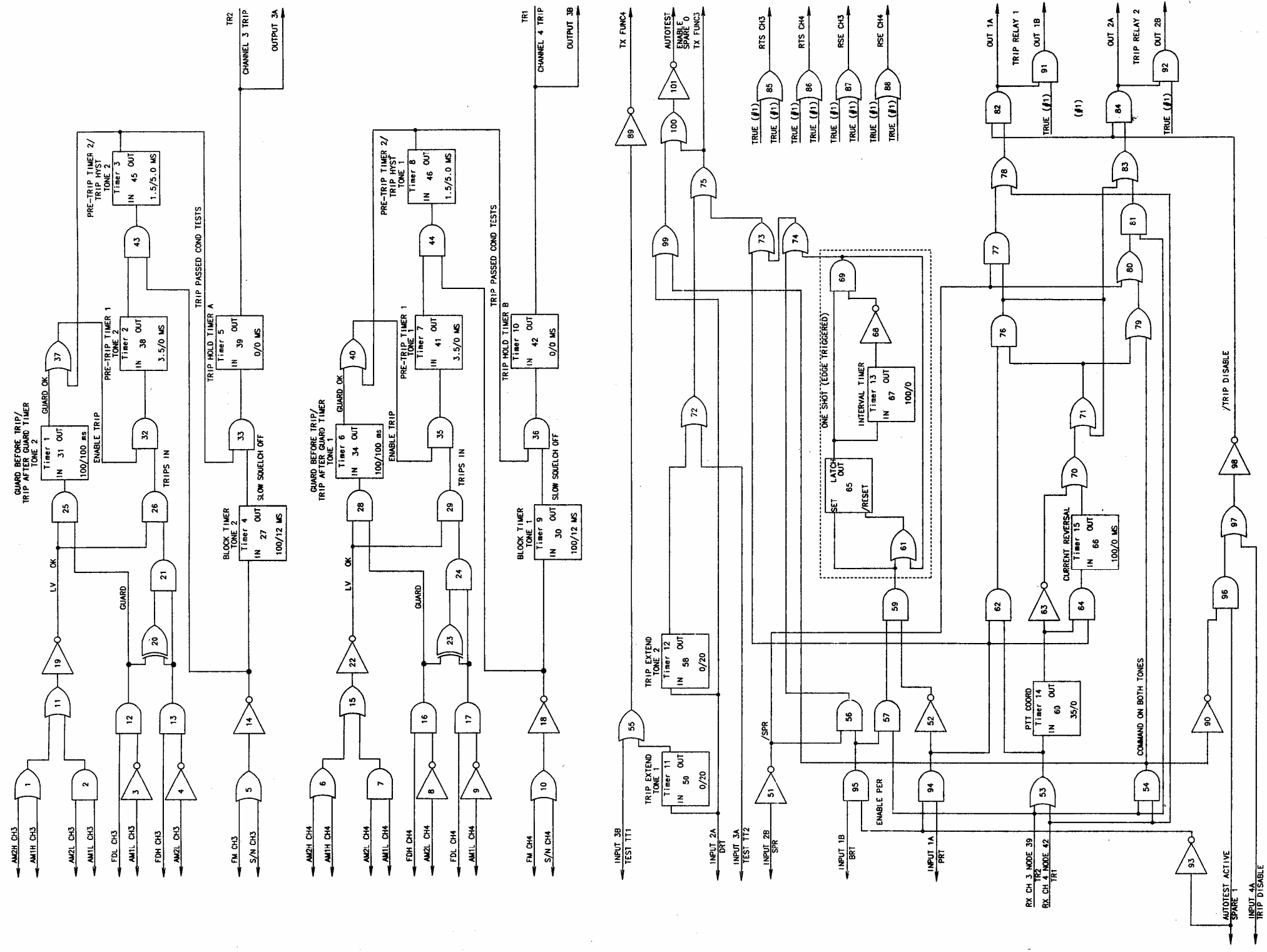


Figure 2-28. 9745 Audio default primitive logic diagram

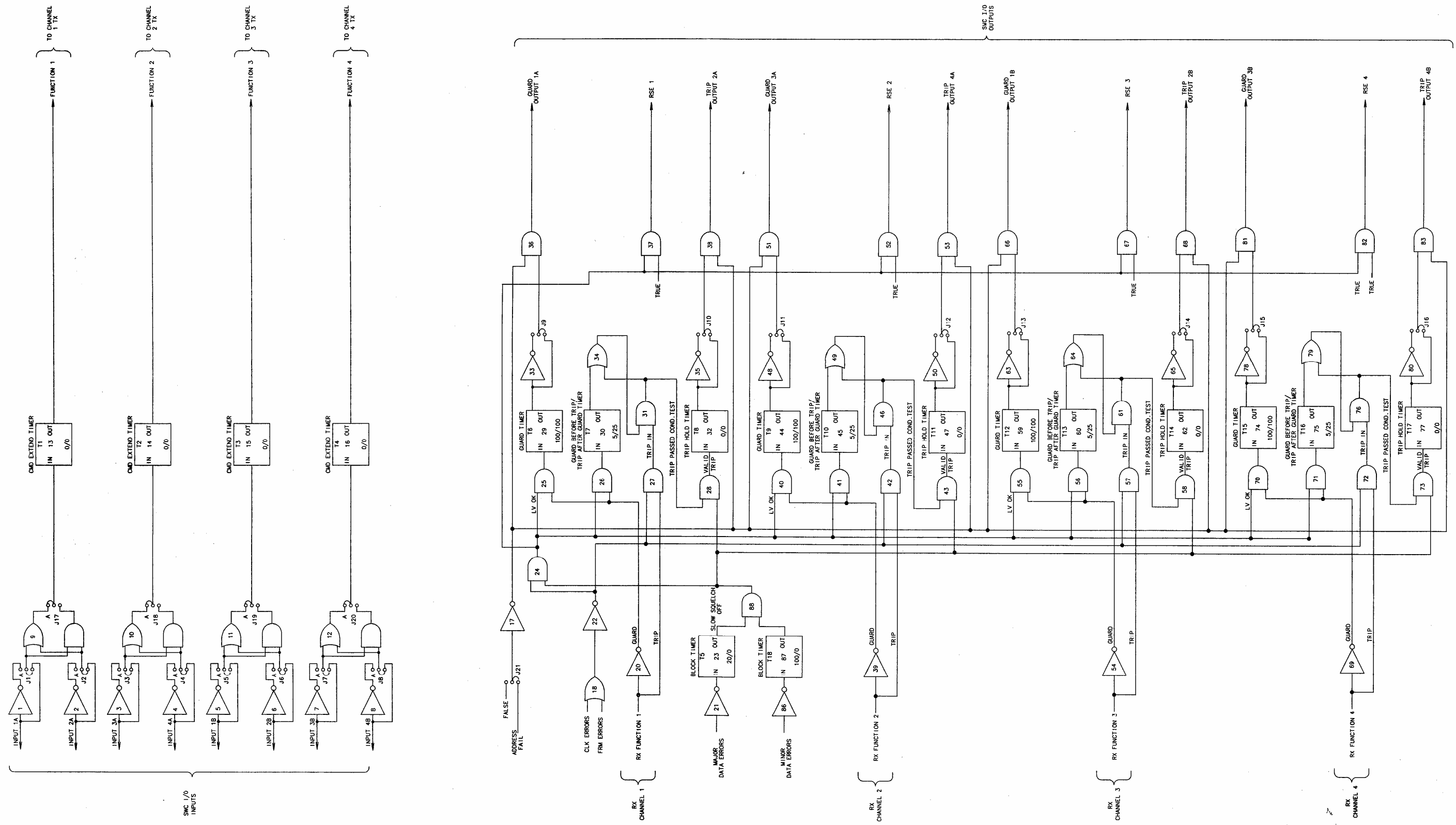


Figure 2-29. 9745 Digital Default primitive logic diagram

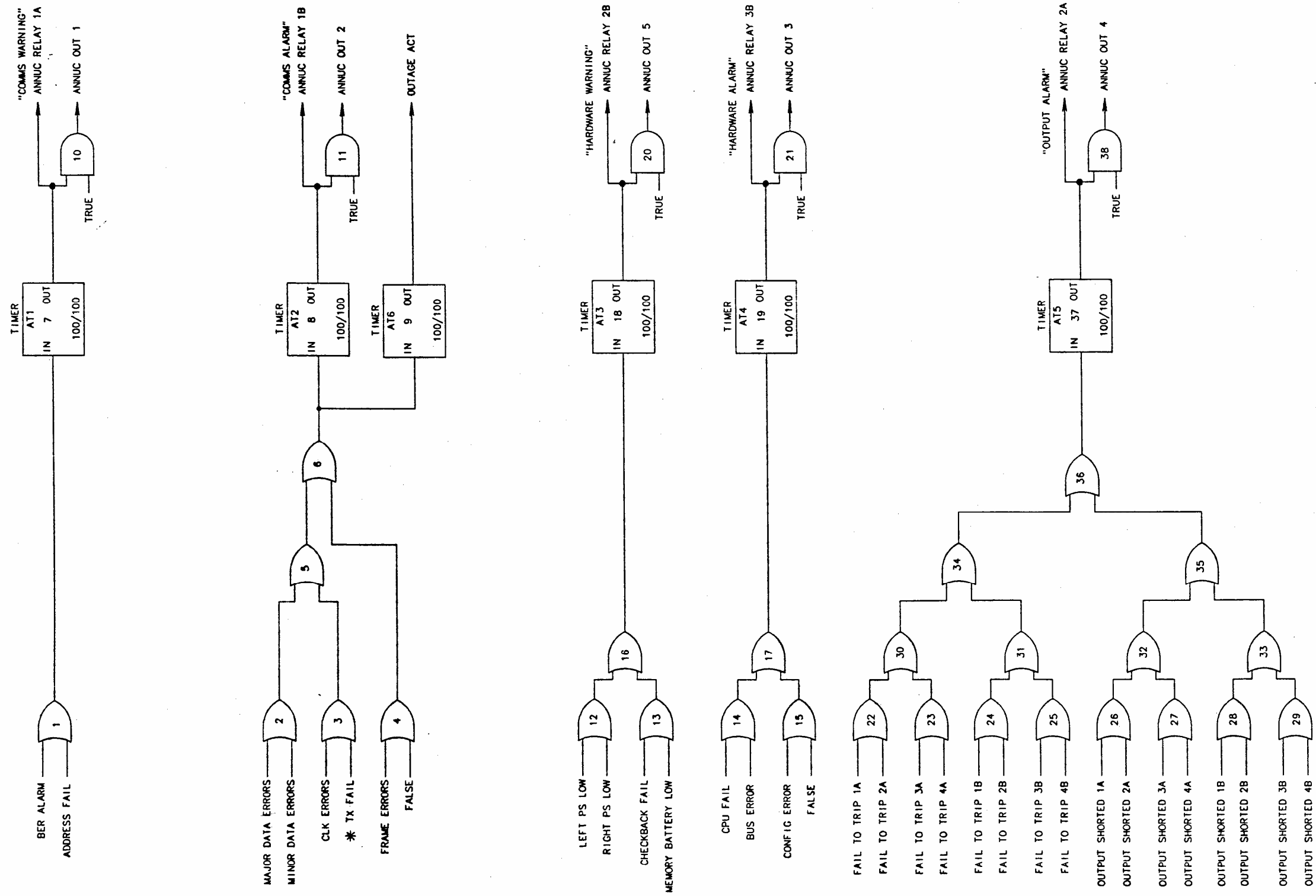


Figure 2-30. 9745 Digital default alarm logic diagram

Section 3. INSTALLATION

3.1 INTRODUCTION

This section contains installation instructions for the RFL 9745 and the Fiber Service Unit, including unpacking, mounting, and interconnection wiring.

3.2 UNPACKING

RFL 9745 equipment may be supplied as individual chassis or interconnected with other chassis or assemblies as part of a system. The following paragraphs provide unpacking instructions for individual chassis and interconnected chassis; use the procedure that suits your equipment.

3.2.1 INDIVIDUAL CHASSIS

RFL 9745 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.
4. Make sure all modules are fully seated in the chassis. The machine screws securing all I/O modules to the rear of the chassis should be fully tightened.

If you notice any signs of shipping damage, immediately notify RFL Customer Service at the phone number at the bottom of this page. Save all the packing material and the shipping carton, in case a damage claim needs to be filed with the shipping company that delivered the unit.

3.2.2 INTERCONNECTED CHASSIS

RFL 9745 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.
4. Make sure all modules are fully seated in the chassis. The machine screws securing all I/O modules to the rear of the chassis should be fully tightened.

If you notice any signs of shipping damage, immediately notify RFL Customer Service at the phone number at the bottom of this page. Save all the packing material and the shipping carton, in case a damage claim needs to be filed with the shipping company that delivered the unit.

3.3 MOUNTING

After unpacking, RFL 9745 equipment must be securely mounted, following the instructions in the following paragraphs. Procedures are provided for individual chassis, interconnected chassis installed in racks or cabinets, and interconnected chassis mounted on shipping rails; use the procedure that suits your equipment.

3.3.1 INDIVIDUAL CHASSIS

RFL 9745 terminals housed in individual chassis have two mounting ears (one on each side). Hole sizes and spacings conform with EIA standards, so the RFL 9745 can be mounted in any standard 19-inch rack or cabinet. Complete chassis dimensions are shown in Figure 3-1.

The Fiber Service Unit (107460-x) is housed in a small rugged metal box, which has mountings for a variety of unistrut and DIN rail applications. Refer to the Fiber Service Unit Instruction Data sheet (publication number: ID C37.94FSU) for installation instructions.

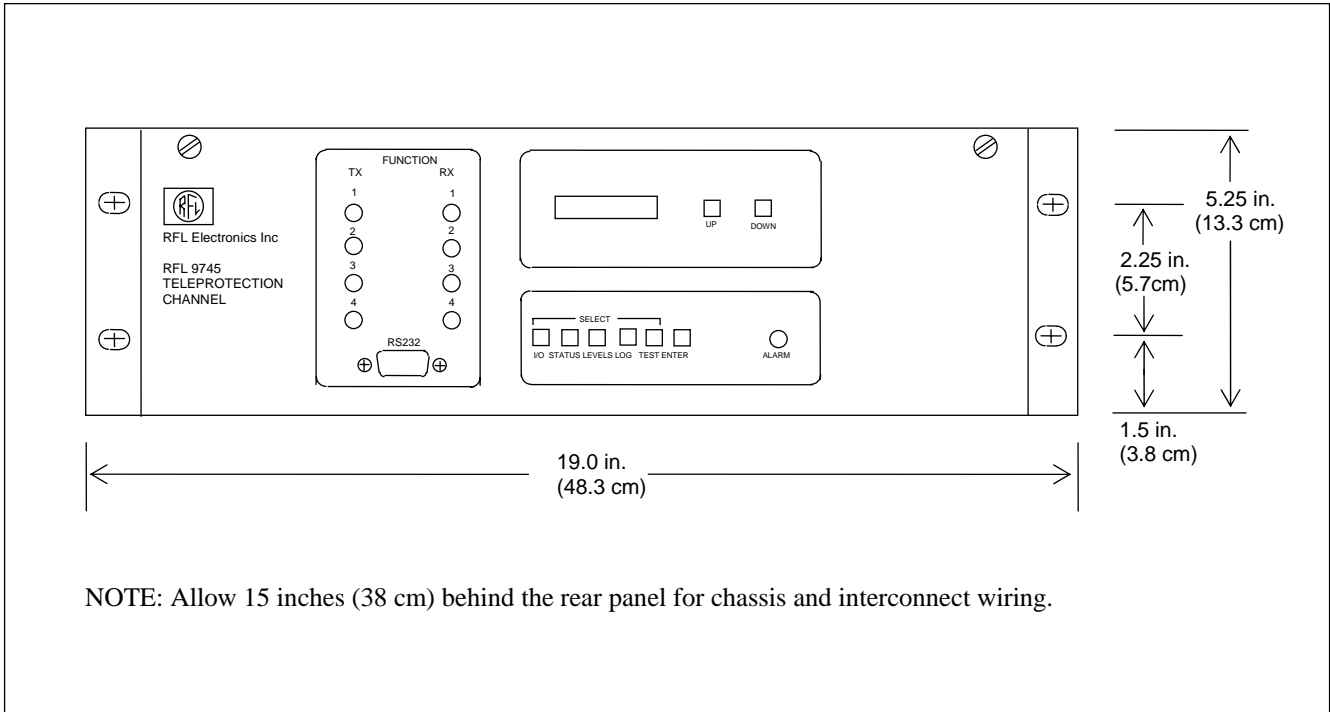


Figure 3-1. Mounting dimensions, RFL 9745 Teleprotection Channel

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.

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 9745 equipment is -30°C to +65°C (-22°F to +149°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.

3.5 CONNECTIONS

Electrical connections are made to each RFL 9745 chassis through the terminal blocks and connectors on the chassis rear panel. The rear panel of a typical RFL 9745 terminal is shown in Figure 3-2.

The following paragraphs provide basic descriptions of all the connections that must be made. A diagram showing these typical connections appears in Figure 3-3. Refer to the "as supplied" drawings furnished with your RFL 9745 for more detailed descriptions of the connections that must be made to your system.

NOTE

Specific terminals on the rear panel terminal blocks are noted by the terminal block number followed by a dash and the terminal number (TB1-1, TB1-2, TB1-3).

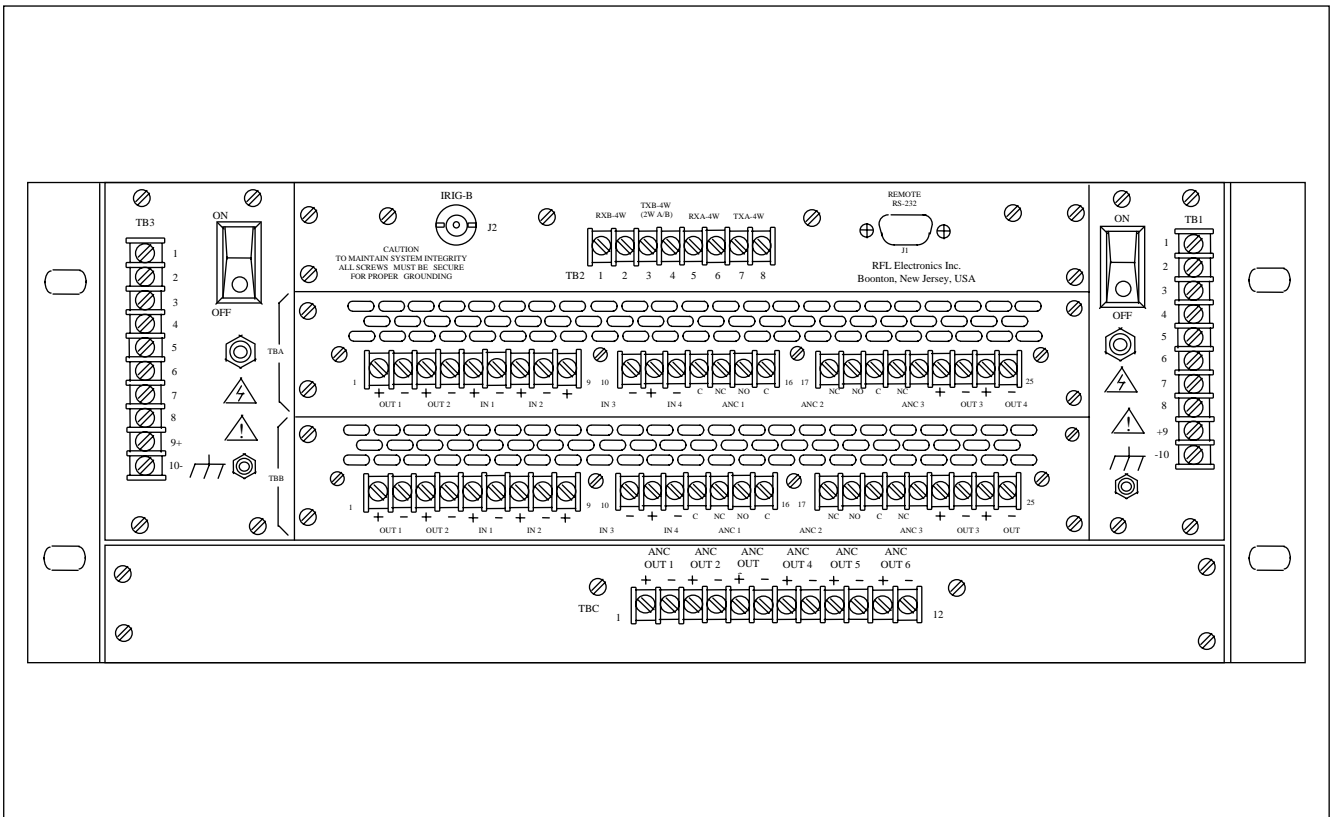


Figure 3-2. Typical Rear view, RFL 9745 Teleprotection Channel, Audio System with Status Option

3.5.1 MAKING CONNECTIONS TO TERMINAL BLOCKS

Most of the terminal blocks on the rear of the RFL 9745 are conventional screw-type barrier blocks. As an option, SWC I/O Modules and Audio Communications Modules can be fitted with compression-type terminal blocks with a quick-disconnect feature that simplifies servicing.

Screw-Type Terminal Blocks

With conventional screw-type barrier blocks, a retaining screw is loosened, a wire is slipped under the screw head, and the screw is re-tightened to secure the wire in place. Wires can either be stripped or terminated in spade lugs, depending on local practice.

Compression-Type Terminal Blocks

The RFL 9745's SWC I/O Modules and Audio Communications Modules can be optionally fitted with compression-type terminal blocks. With these blocks, individual wires are pushed into each terminal position, where a pressure screw closes a set of gripping jaws to clamp the wire in place. Wires can either be tinned or untinned, depending on local practice.

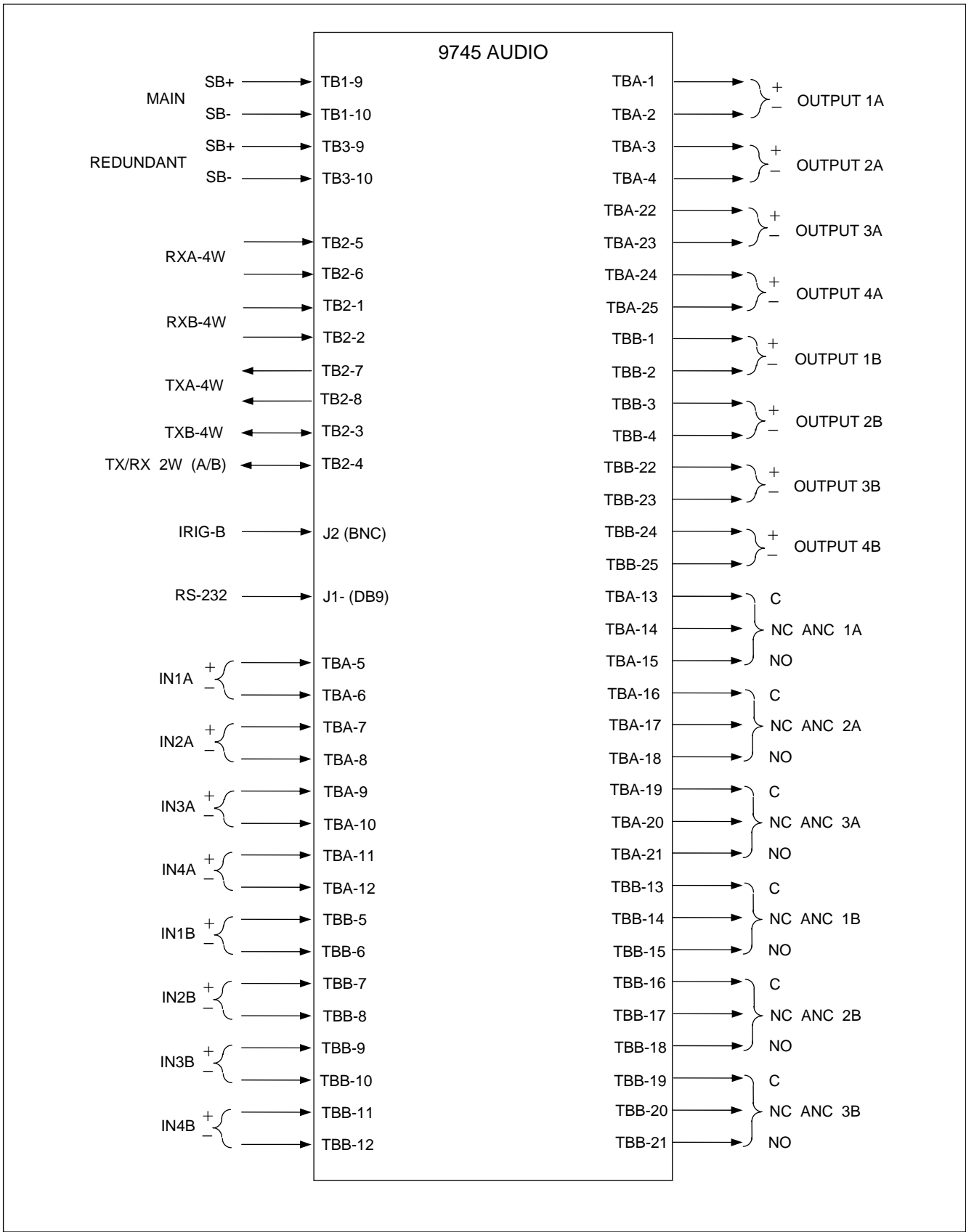


Figure 3-3. Typical rear panel connection diagram, RFL 9745 Teleprotection Channel, Audio System

3.5.2 CONNECTIONS TO INTERFACE MODULES AND FIBER SERVICE UNIT

3.5.2.1 CONNECTIONS TO RS-449, G.703, X.21 AND E1 INTERFACE MODULES

If your Digital RFL 9745 is equipped with an RS-449 interface module (105065-1), there will be a 37-pin D-type male connector on the rear of the chassis that mates with any standard female RS-449 connector. Table 3-1 shows the signal names and pin numbers on this connector that are supported by the RFL 9745.

If your Digital RFL 9745 is equipped with a G.703 Contra-Directional interface module (105065-2), there will be a 25-pin D-type male connector on the rear of the chassis that mates with any standard female G.703 Contra-Directional connector. Table 3-1 shows the signal names and pin numbers on this connector that are supported by the RFL 9745. When using this module, octet timing in the external equipment must be disabled.

If your Digital RFL 9745 is equipped with a G.703 Co-Directional interface module (105065-11), there will be a 15-pin D-type male connector on the rear of the chassis that mates with any standard female G.703 Co-Directional connector. Table 3-1 shows the signal names and pin numbers on this connector that are supported by the RFL 9745. This module will generate octet timing if the J1 jumper is inserted.

If your Digital RFL 9745 is equipped with an X.21 interface module (105065-10), there will be a 15-pin D-type male connector on the rear of the chassis that mates with an standard female X.21 connector. Table 3-1 shows the signal names and pin numbers on this connector that are supported by the RFL 9745.

If your Digital RFL 9745 is equipped with an E1 serial interface adapter (107320), refer to paragraph 3.6.5.5 for installation instructions. Refer to Table 3-1 for interface connections.

When fastening mating connectors to the D-subminiature connectors, make sure that the screws on both ends of the mating connector are tightened to secure the connector to the panel.

NOTE

All cabling to and from RS-449, G.703, X.21 and 120 Ohm E1 interfaces must utilize shielded twisted pair cable to minimize crosstalk and interference from external sources. All cabling to and from 75 Ohm E1 interfaces must utilize 75 Ohm coaxial cable.

Table 3-1. RS-449, G. 703, X.21 and E1 Interface connections, RFL 9745

RS 449		G.703 Contra-directional		G.703 Co-directional		X.21		E1	
Signal	Pin No.	Signal	Pin No.	Signal	Pin No.	Signal	Pin No.	Signal	Pin No.
RD-	24	Chassis	1	Chassis	1	Chassis	1	TX Data+	9
RD+	6	Tx Data (A)	2	Tx Data(A)	2	Tx Data (A)	2	TX Data-	1
RT+	8	Rx Data (A)	3	Rx Data(A)	4	Rx Data (A)	4	RX Data+	11
RT-	26	Tx Data (B)	9	Tx Data(B)	9	Tx Data (B)	9	RX Data-	3
SD-	22	Rx Data(B)	16	Rx Data(B)	11	Rx Data (B)	11	Chassis	7
SD+	4	Rx Timing (A)	12			Sig Timing (B)	13		
ST+	5	Rx Timing (B)	13			Sig Timing (A)	6		
ST-	23	Tx Timing (B)	14			DGND B	8		
SG	19	Tx Timing (A)	15			Control A ⁽¹⁾	3		
Chassis	1					Control B ⁽²⁾	10		

(1) Connect to +5 Vdc, (2) Connect to DGND B

3.5.2.2 CONNECTIONS TO FIBER OPTIC INTERFACE MODULES

WARNING

YOUR 9745 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 9745 is equipped with a Fiber Optic Module, fiber optic connectors must be connected to the fiber optic heads on the rear panel of the RFL 9745 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 FIO 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.

3.5.2.3 SHORT HAUL FIBER INTERFACE MODULE

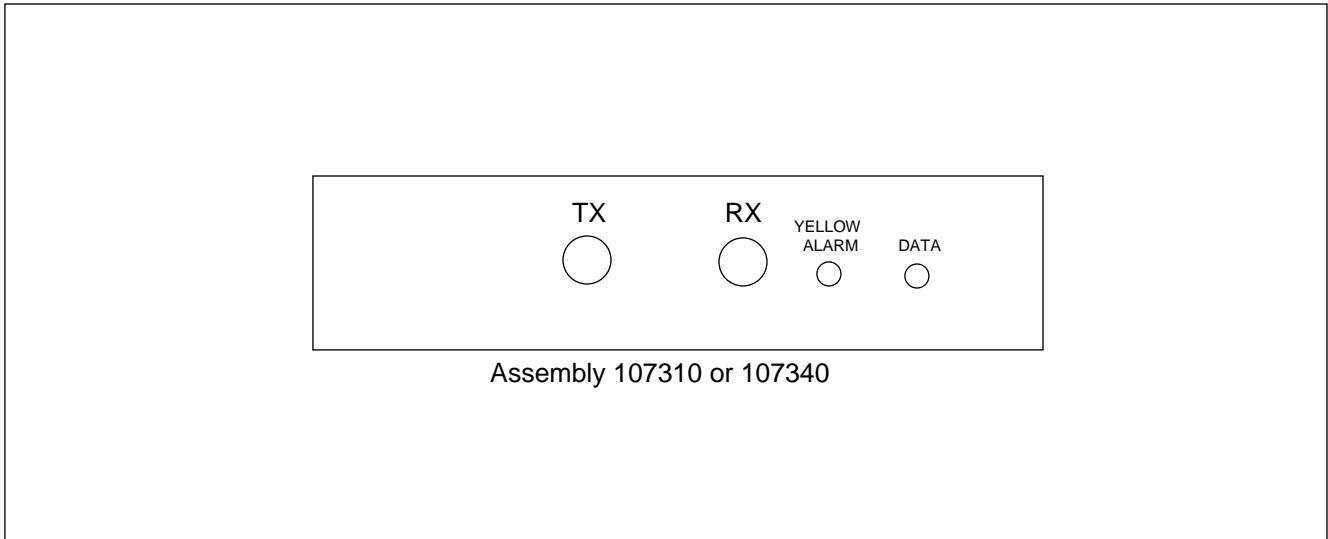


Figure 3- 4. Front panel view of RFL 9745 Short Haul Fiber Interface module

The RFL 9745 Short Haul Fiber Interface module (Figure 3-4) is used in applications where the communications equipment is remotely located from interconnecting equipment. Data cables routed through cable troughs in a substation environment can be subjected to induced voltages from adjacent cables, producing intermittent loss of communications. To eliminate this problem the RFL 9745 Short Haul Fiber Interface module provides immunity by using a fiber optic communication path between the RFL 9745 and interconnecting equipment. The module operates in accordance with IEEE Standard: C37.94 for N times 64 kilobit per second Optical Fiber Interfaces between teleprotection and multiplexer equipment.

The Short Haul Fiber Interface module is housed in a single 1.3 inch high module, which is installed at the rear of the 9745 chassis. The module consists of an input section (detector) and an output section (emitter). Table 3-2 contains general information related to the RFL 9745 Short Haul Fiber Interface module.

Table 3-2. General Information, 9745 Short Haul Fiber Interface module characteristics at 25°C

Assembly Number	Type	Wavelength/Mode	Connector Type	Receiver Sensitivity (minimum)	TX Level (average)	Typical Distance
107310	LED Emitter/ Detector	830 (+/-40 nm) multimode	ST	-11dBm to -32dBm	-14dBm to -21dBm Average into 50µm fiber -11dBm to -18dBm Average into 62.5µm fiber	Up to 2km (1.2mi)
107340	LED Emitter/ Detector	1300 (+/- 30 nm) Single mode	ST	-35dBm	-19.5dBm to -26 dBm Average into 62.5µm fiber	Up to 10km (6.2mi)

A typical application of the RFL 9745 Short Haul Fiber Interface module is shown in Figure 3-5, where the RFL 9745 is connected to an IMUX 2000. In this application there are no jumpers or settings on the 107310 or the MA-620, however, SW4-2 and SW4-3 on the DS562I must be set to the ON position.

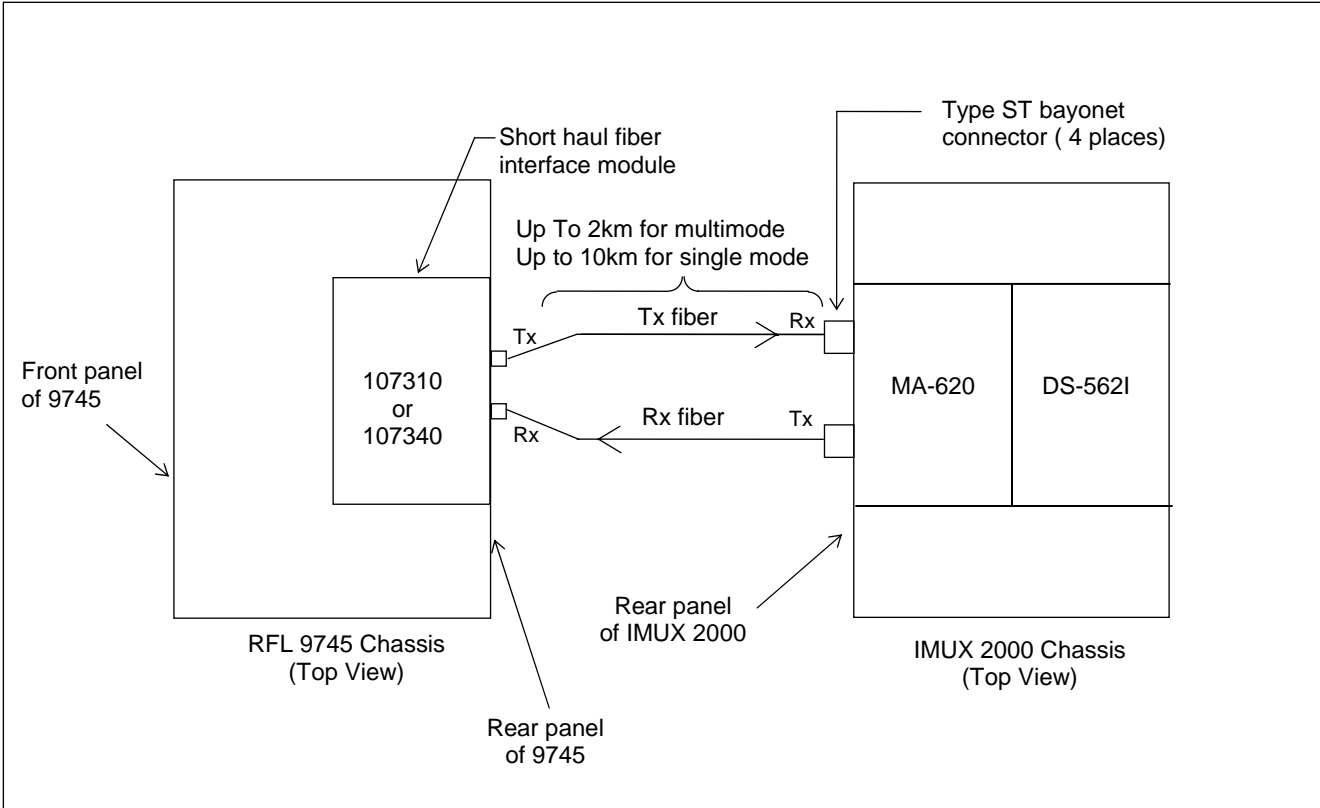


Figure 3-5. Typical Installation of an RFL 9745 Short Haul Fiber Interface module connected to an IMUX 2000

3.5.2.3.1 CONTROLS AND INDICATORS

Figure 3-6 shows the location of all controls and indicators on the RFL 9745 Short Haul Fiber Interface module. These controls and indicators are described below.

Controls

- DS9 Fiber optic emitter
- U7 Fiber optic detector
- J1 Digital Communications board connector

Indicators

- D1 Data LED (Green): Loss of signal when not illuminated. Active when fiber data is valid with no bit errors. Extinguished indicates loss of signal. Pulsing indicates bit errors.
- D2 Yellow Alarm LED (Amber): Yellow alarm when illuminated. Indicates that the remote fiber has failed and the remote transmitter is sending yellow code detected by the local fiber receive channel.

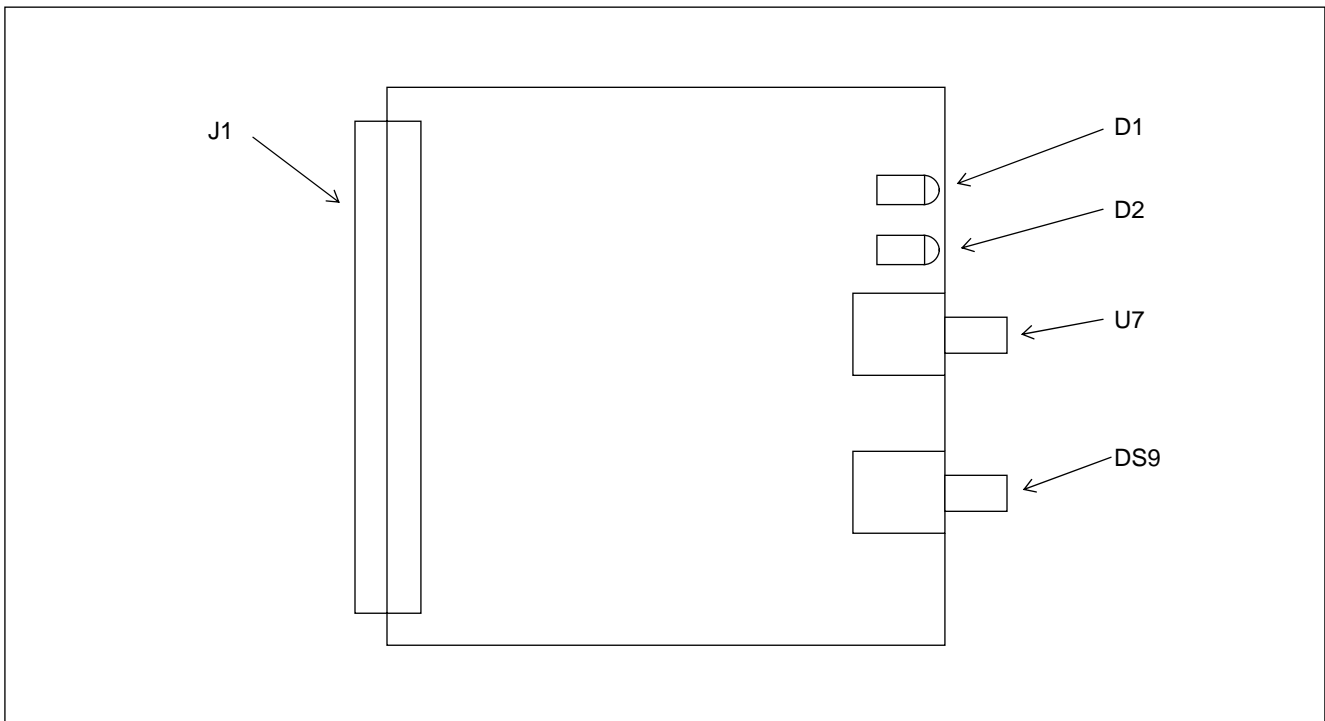


Figure 3-6. Controls and Indicators, RFL 9745 short haul interface module

3.5.2.4 FIBER SERVICE UNIT

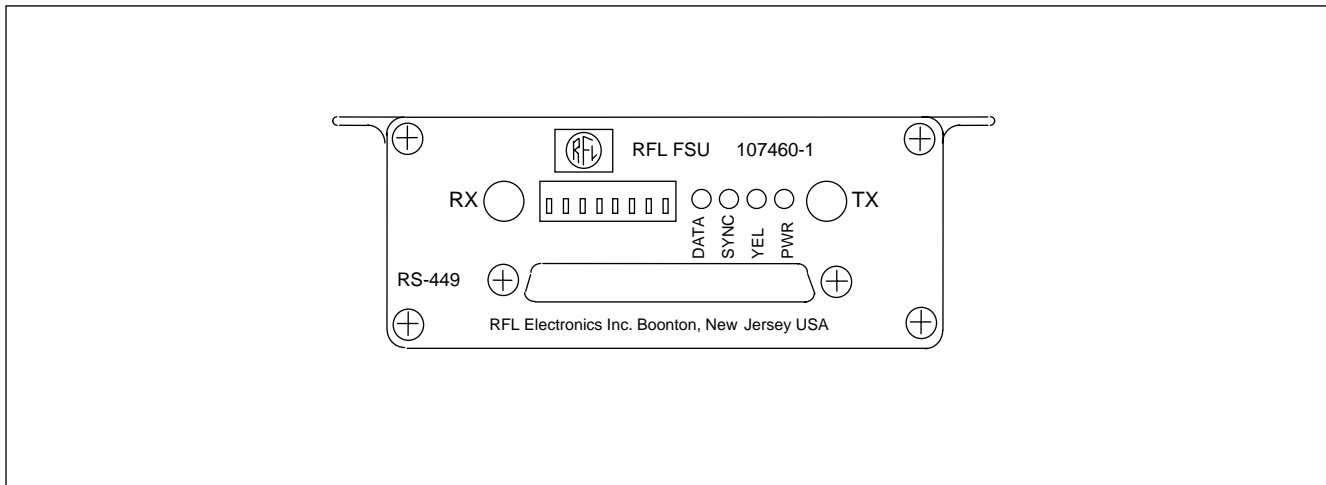


Figure 3-7. Fiber Service Unit, front panel view

The RFL FSU Fiber Service Unit (Figure 3-7) is used with the RFL 9745 Short Haul Fiber Interface module (Figure 3-4). The FSU consists of an input section (detector) and an output section (emitter) and is housed in a black anodized aluminum box. There are four types of Fiber Service Units, providing RS-449, G.703, V.35 or X.21 inputs and outputs on the non-fiber side of the connection. The FSU can be located up to 2km away from the RFL 9745.

The RFL FSU Fiber Service Unit has a 15-pin or 37-pin male D-subminiature connector on its front panel depending on the application. During installation, make sure that the screws on both ends of the mating connector are tightened to secure the connector to the FSU panel. Fiber optic cables with type ST series bayonet fiber optic connectors (or their equivalent) must be connected to the fiber optic heads on the rear panels of the RFL FSU module and the RFL 9745 Short Haul Fiber Interface module. The exact mating connectors used will depend upon the heads that are installed in these modules and the specific optic cable being used. When connecting fiber optic cables, make sure the connectors are properly aligned before tightening, and then fully tighten them. This will help minimize losses in the connector. Figure 3-8 shows a typical Fiber Service Unit installation.

Refer to the Fiber Service Unit Instruction Data sheet (publication number: ID C37.94FSU) for additional information.

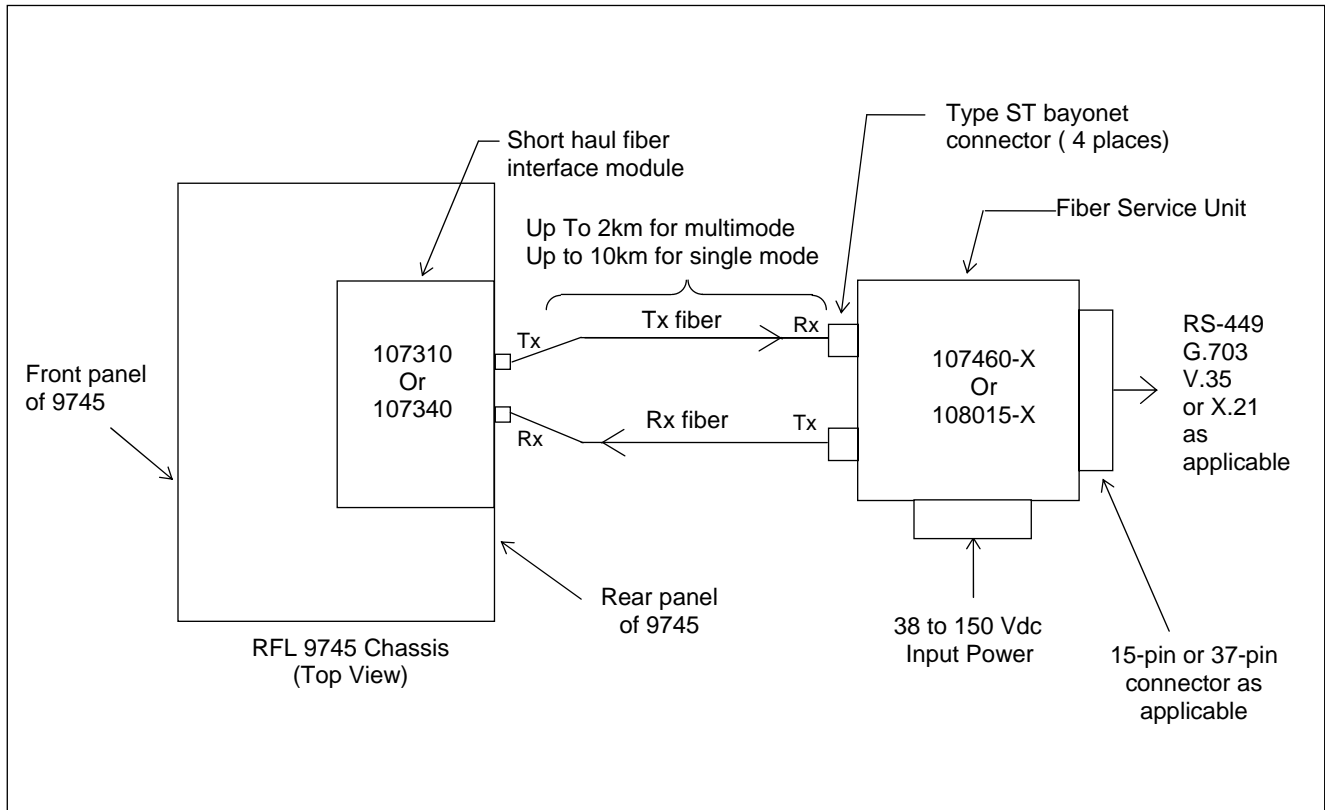


Figure 3-8. Typical Installation of Fiber Service Unit

Switch	Position
SW1	1 – 6 DOWN
	7 UP
	8 N/A

Both Digital Modules set to 64k, J6 set to 'B'

3.5.3 KEYING INPUT CONNECTIONS

Keying input connections are made to the following terminals on rear-panel terminal blocks TBA and TBB. Additional information can be found in Figures 3-2 and 3-3 and in the "as supplied" drawings furnished with the equipment.

INPUT 1A

Positive	TBA-5
Negative	TBA-6

INPUT 2A

Positive	TBA-7
Negative	TBA-8

INPUT 3A

Positive	TBA-9
Negative	TBA-10

INPUT 4A

Positive	TBA-11
Negative	TBA-12

INPUT 1B

Positive	TBB-5
Negative	TBB-6

INPUT 2B

Positive	TBB-7
Negative	TBB-8

INPUT 3B

Positive	TBB-9
Negative	TBB-10

INPUT 4B

Positive	TBB-11
Negative	TBB-12

Each input can be assigned a unique name or label that will appear on the RFL 9745's front-panel display and menus during system operation. Section 6 of this manual contains more information on how to label the inputs.

3.5.4 OUTPUT CONNECTIONS

Trip output connections are made to the following terminals on rear-panel terminal blocks TBA and TBB. Additional information can be found in Figures 3-2 and 3-3 and in the "as supplied" drawings furnished with the equipment.

OUTPUT 1A

Positive	TBA-1
Negative	TBA-2

OUTPUT 2A

Positive	TBA-3
Negative	TBA-4

OUTPUT 3A

Positive	TBA-22
Negative	TBA-23

OUTPUT 4A

Positive	TBA-24
Negative	TBA-25

OUTPUT 1B

Positive	TBB-1
Negative	TBB-2

OUTPUT 2B

Positive	TBB-3
Negative	TBB-4

OUTPUT 3B

Positive	TBB-22
Negative	TBB-23

OUTPUT 4B

Positive	TBB-24
Negative	TBB-25

These are one-ampere, solid-state outputs. Each output can be assigned a unique name or label that will appear on the RFL 9745's front-panel display and menus during system operation. Section 6 of this manual contains more information on how to label the outputs.

3.5.5 ANNUNCIATOR OUTPUT CONNECTIONS

Annunciator output connections are made to the following terminals on rear-panel terminal blocks TBA and TBB. Additional information can be found in Figures 3-2 and 3-3 and in the "as supplied" drawings furnished with the equipment.

ANC 1A

Common	TBA-13
Normally-Closed (N.C.)	TBA-14
Normally-Open (N.O.)	TBA-15

ANC 2A

Common	TBA-16
Normally-Closed (N.C.)	TBA-17
Normally-Open (N.O.)	TBA-18

ANC 3A

Common	TBA-19
Normally-Closed (N.C.)	TBA-20
Normally-Open (N.O.)	TBA-21

ANC 1B

Common	TBB-13
Normally-Closed (N.C.)	TBB-14
Normally-Open (N.O.)	TBB-15

ANC 2B

Common	TBB-16
Normally-Closed (N.C.)	TBB-17
Normally-Open (N.O.)	TBB-18

ANC 3B

Common	TBB-19
Normally-Closed (N.C.)	TBB-20
Normally-Open (N.O.)	TBB-21

If the RFL 9745 is equipped with the status option, six additional solid-state annunciator outputs are available. Connections to these outputs are made at 12-position terminal block TBC on the rear panel of a 1U chassis mounted directly below the RFL 9745, as shown in Figure 3-9. Additional information can be found in the "as supplied" drawings furnished with the equipment.

ANC OUT 1

Positive	TBC-1
Negative	TBC-2

ANC OUT 2

Positive	TBC-3
Negative	TBC-4

ANC OUT 3

Positive	TBC-5
Negative	TBC-6

ANC OUT 4

Positive	TBC-7
Negative	TBC-8

ANC OUT 5

Positive	TBC-9
Negative	TBC-10

ANC OUT 6

Positive	TBC-11
Negative	TBC-12

Each annunciator output can be assigned a unique name or label that will appear on the RFL 9745's front-panel display and menus during system operation. Section 6 of this manual contains more information on how to label the annunciator outputs.

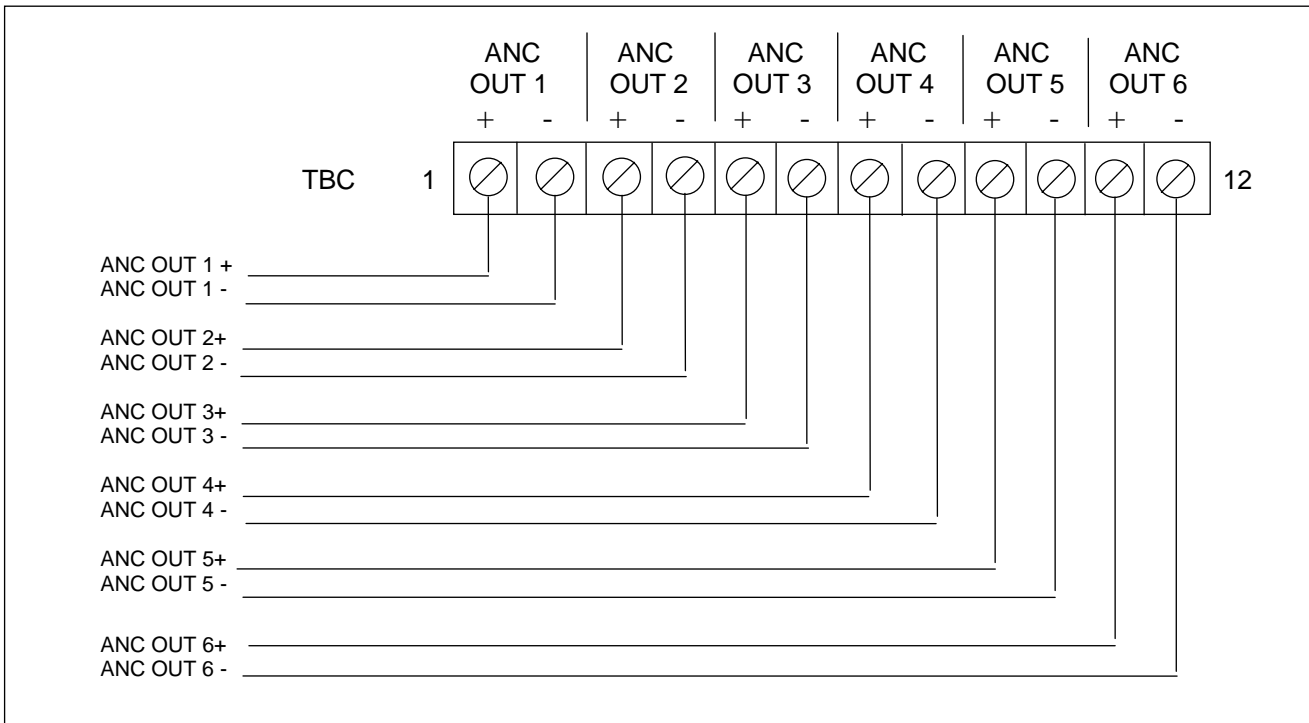


Figure 3-9. Typical connection diagram for RFL 9745 status option

3.5.6 IRIG-B CONNECTIONS

If an IRIG-B signal is to be used to synchronize the RFL 9745's clock, it must be connected to rear-panel BNC connector J2 as shown in Figure 3-2.

The user has the option of connecting the IRIG-B clock to the local, remote or to both of the 9745's. If the IRIG-B clock is connected to just one of the 9745's, for example the local unit, the IRIG-B clock will be transmitted to the remote unit automatically on the modem. For an audio system, this requires that channel 1 be configured as a modem. Software in the remote unit will automatically compensate for the channel delay between the two units by adding the actual measured channel delay to the IRIG-B time received from the local unit. This insures that the local and remote units are running off of the same IRIG-B clock. This provides very accurate time stamping of the sequence of events logs at both the local and remote units. For even more accurate time stamping of the sequence of events logs at the local and remote units, the IRIG-B clock should be connected to both the local and remote 9745's.

Since the IRIG-B signal only provides hours, minutes, seconds, and date, but not the year, the year parameter must be programmed by the user by accessing parameter number 063 in the parameter settings display as shown in paragraph 6.7.4, Example 3. If the 9745 is connected to an IRIG-B source, the user only has to program the year parameter. The 9745 will then automatically set the day/month and time parameters (hours, minutes, seconds). If a user manually sets the 9745 day/month parameter incorrectly, this parameter will be automatically corrected during the next IRIG-B update, if the year is set correctly.

If the user attempts to change the time setting of a 9745 running on an IRIG-B clock, the time will change to the new setting but will be overridden by the IRIG-B clock when the 9745 system clock is updated, which is about every 10 minutes. The following message: "IRIG-B will override" will alert the user of this fact.

3.5.7 CONNECTIONS TO THE AUDIO COMMUNICATIONS MODULE

If the RFL 9745 is equipped with the Audio Communications module, connections to the communications channel(s) are made to the rear-panel terminal block TB2. Refer to Table 3-3 for rear panel connections to the narrowband Audio Communications module. Refer to Table 3-4 for rear panel connections to the wideband Audio Communications module.

Table 3-3. Rear panel connections to the narrowband Audio Communications module

Type of Connection	Number of Communication Channels	Channel	Rear Panel Connections
Two-wire	Single	B	Transmit/Receive: TB2-3 and TB2-4
Four-wire	Single	B	Transmit: TB2-3 and TB2-4 Receive: TB2-1 and TB2-2
		A	Transmit: TB2-7 and TB2-8 Receive: TB2-5 and TB2-6
	Dual	B	Transmit: TB2-3 and TB2-4 Receive: TB2-1 and TB2-2

Table 3-4. Rear panel connections to the wideband Audio Communications module.

Type of Connection	Number of Communication Channels	Channel	Rear Panel Connections
Two-Wire	Single	B	Transmit/Receive: TB2-3 and TB2-4
		A	Transmit/Receive: TB2-7 and TB2-8
	Dual	B	Transmit/Receive: TB2-3 and TB2-4
Four-Wire	Single	B	Transmit: TB2-3 and TB2-4 Receive: TB2-1 and TB2-2
		A	Transmit: TB2-7 and TB2-8 Receive: TB2-5 and TB2-6
	Dual	B	Transmit: TB2-3 and TB2-4 Receive: TB2-1 and TB2-2

3.5.8 REAR-PANEL RS-232 CONNECTIONS

A remote terminal (or a PC with terminal emulation software) may be connected to rear-panel RS-232 connector J1. The following pins are supported:

2	RECEIVE DATA (RxD)
3	TRANSMIT DATA (TxD)
5	COMMON (COM)
7	REQUEST-TO-SEND OUT (RTS)
8	CLEAR-TO-SEND OUT (CTS)

J1 is a male 9-pin D-subminiature connector (DB-9P). You must use a female 9-pin D-subminiature connector (DB-9S) to connect to it. The rear-panel RS-232 connector is disabled if an RS-232 device is connected to the front-panel RS-232 connector. This is done to allow a device such as the 9660 to be permanently wired to the rear panel connector, yet still allow access through the front panel connector. The change over occurs because any device connected to the front-panel port must drive the DTR line (pin 4) high. (See Section 4 for more information about the front-panel RS-232 connector.)

WARNING

THE RFL 9745 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.

3.5.9 CHASSIS GROUND CONNECTIONS

The ground studs next to terminal blocks TB1 and TB3 on the rear panel are the main grounding points for the RFL 9745 terminal. (See Figure 3-10 for location.) Grounding is accomplished by connecting a wire 16 AWG or larger between the ground stud and a solid earth ground. The grounding wires should be kept as short and straight as possible.

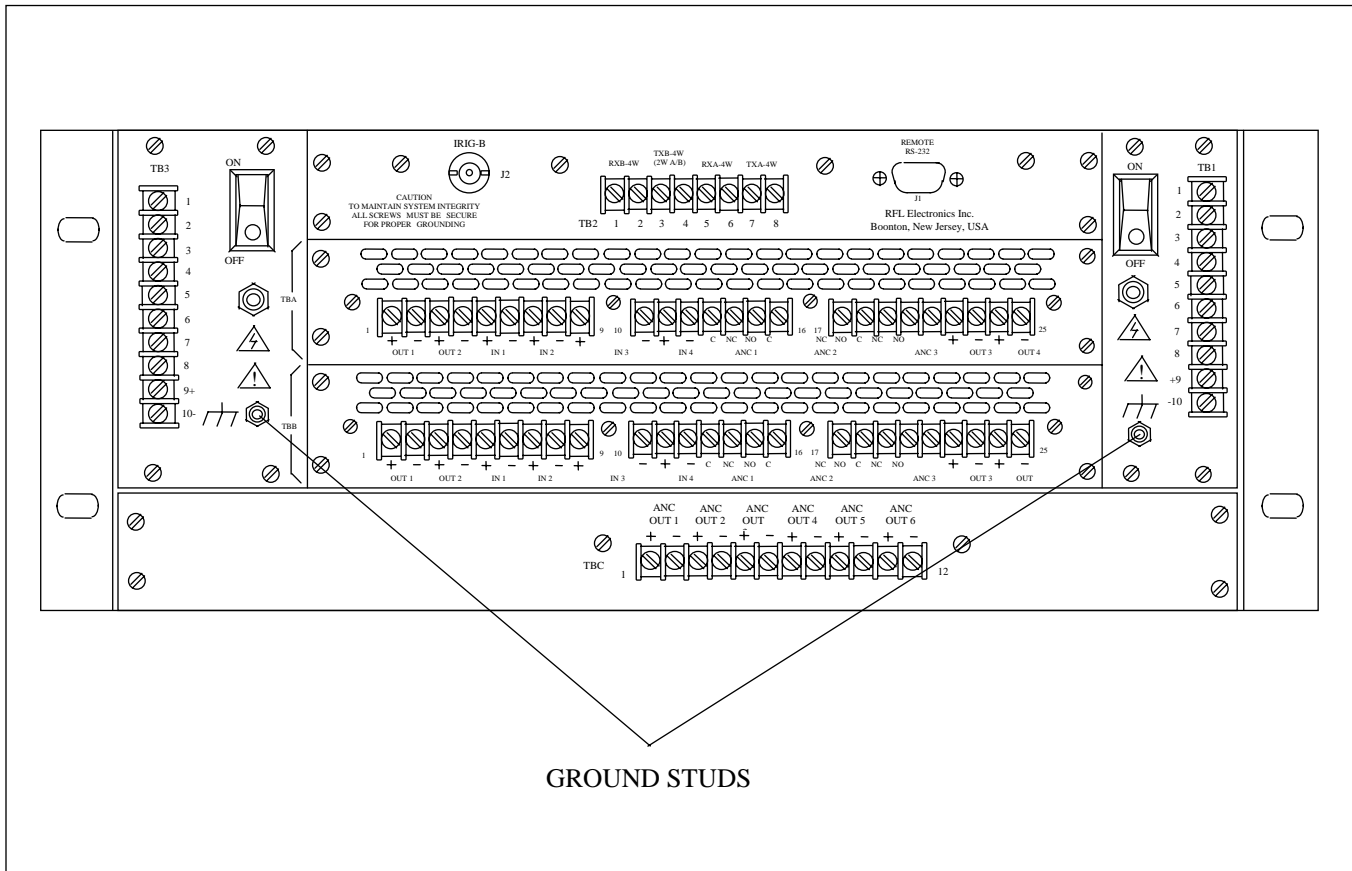


Figure 3-10. Location of ground studs on rear panel of RFL 9745, Audio System

CAUTION

Before attempting to make power connections, you must make sure the power supply module(s) installed in the RFL 9745 will operate at the available input supply voltage. If the power supply is set for the wrong voltage, component damage may result.

3.5.10 RFL 9745 INPUT POWER CONNECTIONS

There are three types of power supply modules that can be used in the RFL 9745:

<u>Model Designation</u>	<u>Part Number</u>	<u>Input Voltage</u>
RFL 9745 19-36 VDC	105905-1	19-36 Vdc
RFL 9745 38-150VDC	105905	38-150 Vdc
RFL 9745 170-300DC	105930	170-300 Vdc

NOTE

There is a label on the inside of the RFL 9745's front door. (See Figure 3-11.) This label is marked to indicate the input voltage the RFL 9745 was set to accept before it left the factory. If you replace the power supply module with a different model, you must change the markings on this label to reflect the change.

Input power connections are made to the following terminals on rear-panel terminal block TB1:

Positive	TB1-9
Negative	TB1-10

If the RFL 9745 is equipped with a Redundant Power Supply Module, input power connections are also made to the following terminals on rear-panel terminal block TB3:

Positive	TB3-9
Negative	TB3-10

THIS SYSTEM LEFT THE FACTORY CONFIGURED AS FOLLOWS:

LEFT POWER SUPPLY	19-36V	38-150V	250V		
RIGHT POWER SUPPLY	19-36V	38-150V	250V		
SWC I/O INPUTS	24V	48V	110/125V	220/250V	
AUDIO CHANNELS	4W(1)	4W(2)	2W(1)	2W(2)	
DIGITAL COMM	RS-449	G.703	FIBER	X.21	E1

SWC I/O MODULES MARKED 48/110V OR 48/125V CAN BE CONFIGURED FOR EITHER VOLTAGE BY CHANGING JUMPER POSITIONS

SEE THE MANUAL FOR FURTHER INFORMATION

Figure 3 11. Label on front door for recording input voltage settings

3.6 JUMPER SETTINGS AND SWITCH SETTINGS

Many RFL 9745 modules contain programmable jumpers and/or DIP switches. Most of these jumpers and switches are used for factory testing, and are properly set before the RFL 9745 leaves the factory. The function of each programmable jumper or DIP switch is given below, in case they have to be reset in the field.

3.6.1 CPU MODULE

There are two types of CPU modules that can be used in the RFL 9745. One type has battery backed RAM (105025-1) with three programmable jumpers labeled JP1, JP6 and JP7. See Figure 3-12 for jumper locations. The other has capacitor backed RAM (107330-1) with four programmable jumpers labeled JP1, JP2, JP6 and JP7. See Figure 3-13 for jumper locations.

The RFL 9745 CPU capacitors C12A and C12B are used to power the real time clock and to maintain the sequence of events log during a power outage. During a power failure the caps can keep the clock running for one week and maintain the SOE for one month. The RFL 9745 must be on for at least 30 minutes to fully charge the caps. Since there is significant energy in the caps, as a safety measure, do the following before removing the CPU from the 9745 chassis.

1. Turn 9745 power OFF.
2. Place jumper JP2 into DISCHARGE position.
3. Wait at least 5 minutes for the caps to fully discharge.
4. Remove the CPU board from the chassis.
5. Place jumper JP2 back into the NORMAL position.

The act of doing this will stop the clock and will cause the loss of SOE.

The CPU board can be removed from the chassis without discharging the caps, but care must be taken to prevent shorting the cap leads. Shorting the leads of a fully charged cap may be a hazard but is not life threatening. Avoid touching the cap terminals or shorting the terminals during removal or installation. Do not place the board on a metallic surface.

No damage will occur if the RFL 9745 is powered up with the JP2 jumper in the DISCHARGE position.

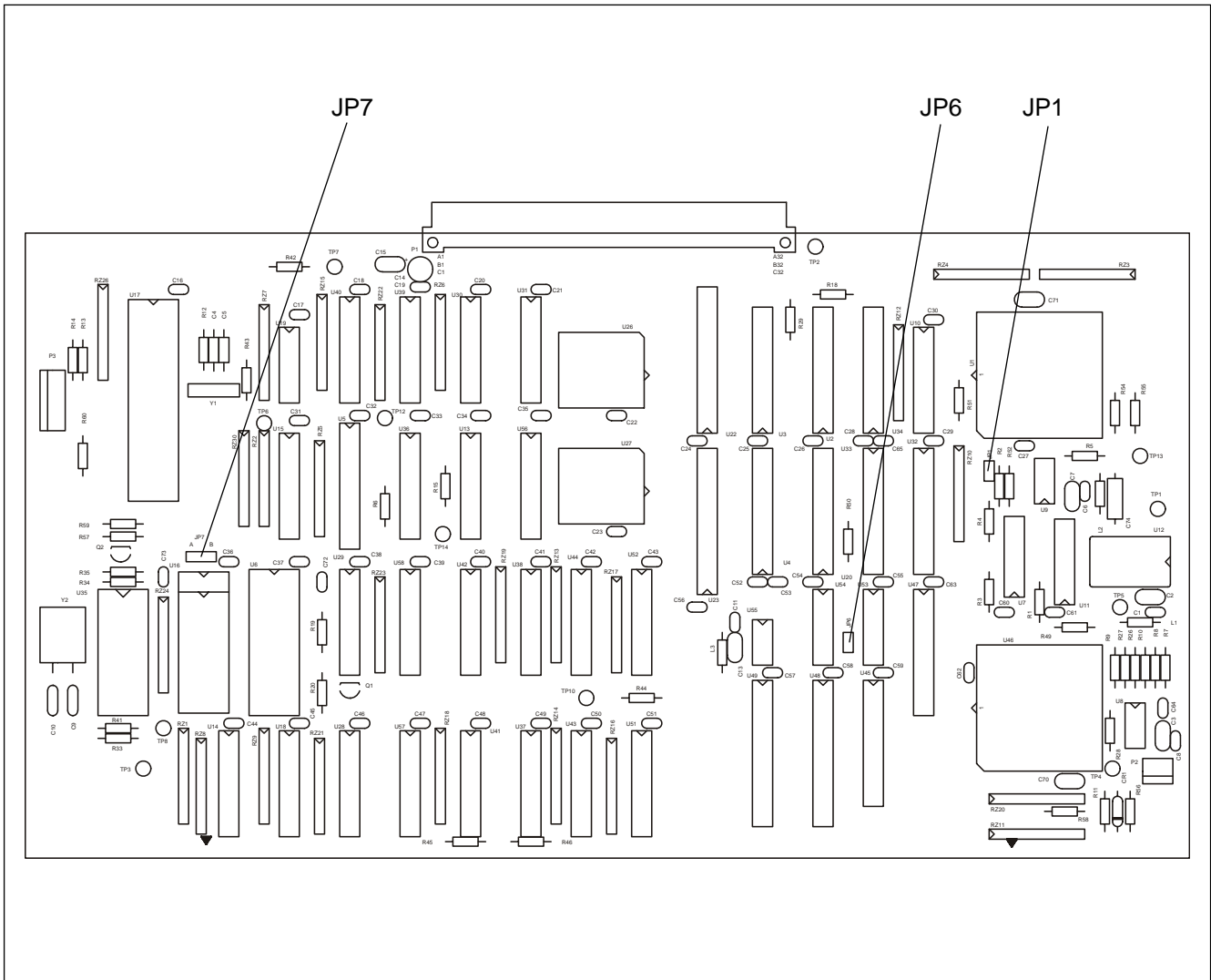


Figure 3-12. Location of jumpers on a CPU Module with battery backed RAM

- JP1** JP1 enables watchdog timer U9 when installed, and disables U9 when removed. This jumper is set at the factory, and should not be changed in the field.
- JP6** JP6 enables watchdog timer U55 when installed, and disables U55 when removed. This jumper is set at the factory, and should not be changed in the field.
- JP7** JP7 allows the selection of a 2K x 8 EEROM when in position A, or an 8K x 8 EEROM when in position B. These are factory settings and should not be changed in the field.

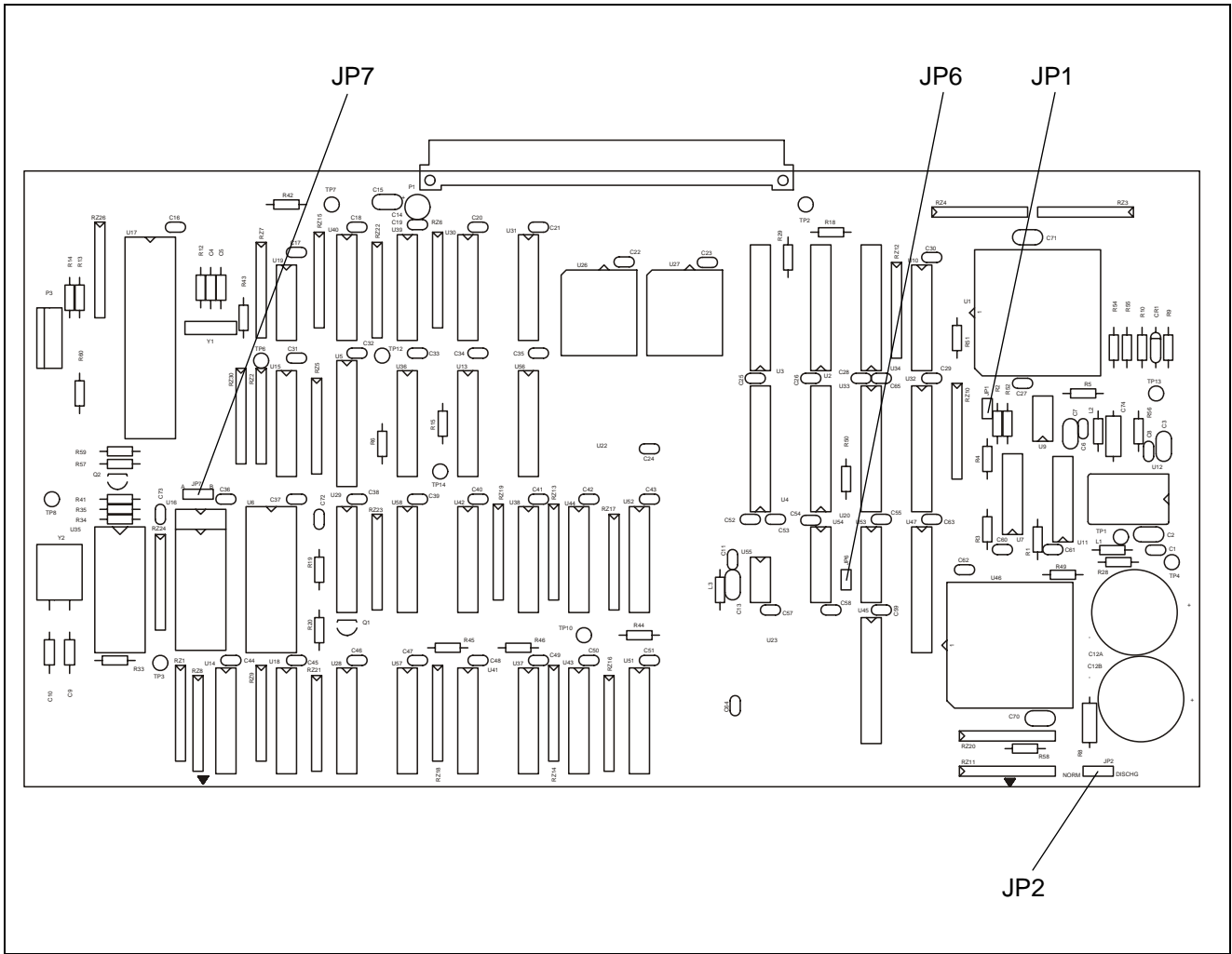


Figure 3-13. Location of jumpers on a CPU Module with capacitor backed RAM

- JP1** JP1 enables watchdog timer U9 when installed, and disables U9 when removed. This jumper is set at the factory, and should not be changed in the field.
- JP2** JP2 allows the selection of NORMAL mode or DISCHARGE mode for the capacitors used to back up the on-board RAM.
- JP6** JP6 enables watchdog timer U55 when installed, and disables U55 when removed. This jumper is set at the factory, and should not be changed in the field.
- JP7** JP7 allows the selection of a 2K x 8 EEROM when in position A, or an 8K x 8 EEROM when in position B. These are factory settings and should not be changed in the field.

3.6.2 DRIVER MODULE

The Driver Module (Assy. No. 105030) has a single programmable jumper, labeled "J2." (See the Figure below.) J2's TEST position is used for factory testing only. It must be placed in the NORM position for normal operation.

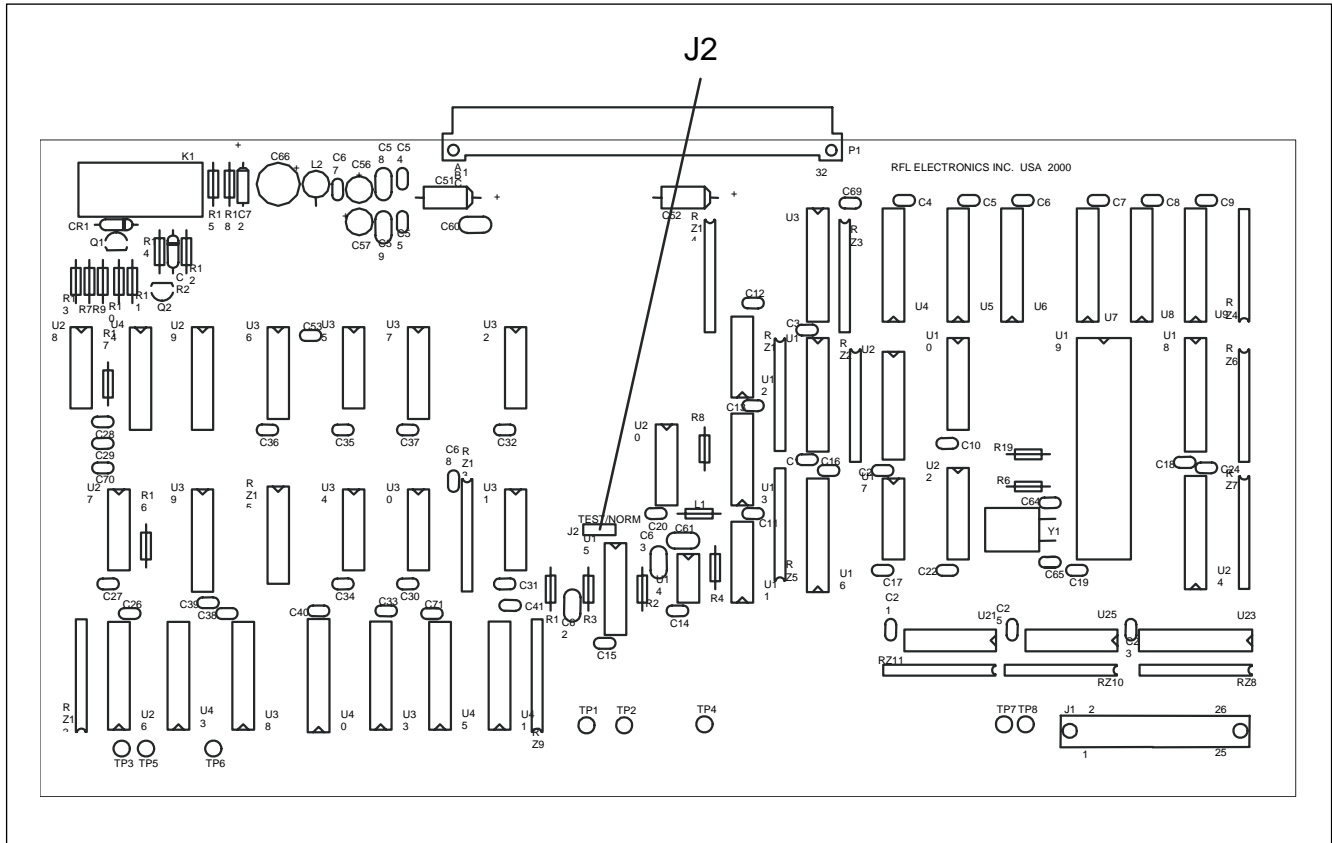


Figure 3-14. Location of jumper J2 on Driver Module

3.6.3 COMMUNICATIONS INTERFACE MODULE

The Communications Interface Module (Assy. No. 105050) has a single programmable jumper, labeled "JMP1." (See the Figure below) JMP1 has two positions: A and B. It must be placed in Position A for normal operation. Position B disables the 1.6-second watchdog timer on the microprocessor supervisor, and is used for test purposes only.

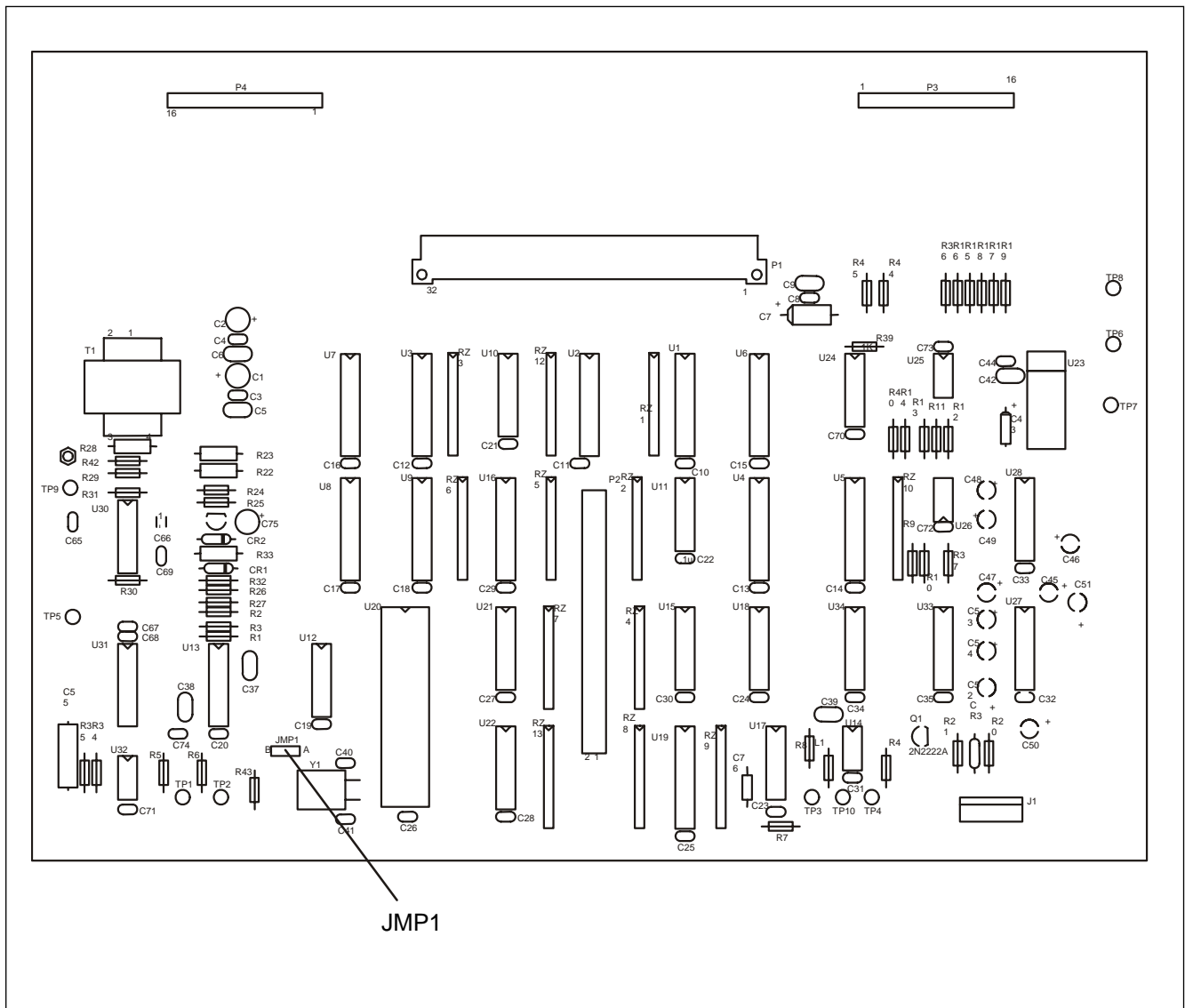


Figure 3-15. Location of jumper JMP1 on Communications Interface Module

3.6.4 AUDIO COMMUNICATIONS MODULE

There are two types of Audio Communications modules. They are referred to as the narrow band module and the wide band module. Table 3-5 describes the differences between the two modules.

If you're not sure which audio communications module your RFL 9745 has, you can find out by doing the following:

1. If you have access to the RFL 9745, open the front panel and check the audio communications module assembly number. Narrow band modules have 105040 series part numbers, and wide band modules have 105920 series part numbers.
2. If the RFL 9745 is remotely located you can determine which audio communications module the unit has by using APRIL as follows:
 - a. Go to the "main" menu as shown in Figure 6-1.
 - b. Go to the configuration and software version display by selecting "F" as shown in figures 6-11a and 6-11b.
 - c. The term "audio" in parameter numbers 079 through 082 indicates the presence of a narrow band audio communications module. The term "audio – C50" in parameter numbers 079 through 082 indicates the presence of a wide band audio communications module.

Upgrading a system from narrow band to wide band, requires new software (system software, logic, and audio parameters) in addition to the wide band module. Contact the RFL Customer Service department for the RFL 9745 wide band audio upgrade kit which includes a wide band audio communications module, all of the required software, and installation instructions.

If you have a wideband module and system software, refer to paragraph 3.8 for Installation Instructions.

Table 3-5. Differences between narrow band and wide band audio communications modules

Module Type	Frequency Range	Number Of Tones	Assembly Number	Rear Panel Connection Type
Narrow band	300 Hz to 3400 Hz	4 tones	105040-3	screw type terminal block
		3 tones	105040-4	screw type terminal block
		2 tones	105040-5	screw type terminal block
		4 tones	105040-6	compression type terminal block
		3 tones	105040-7	compression type terminal block
		2 tones	105040-8	compression type terminal block
Wide band	300 Hz to 4000 Hz	4 tones	105920-3	compression type terminal block
		2 tones	105920-4	compression type terminal block
		4 tones	105920-1	screw type terminal block
		2 tones	105920-2	screw type terminal block

3.6.4.1 NARROW BAND AUDIO COMMUNICATIONS MODULE

There are three versions of the narrow band Audio Communications Module. Each version uses the same basic printed circuit board but only certain portions of each board are populated with components. The two-tone version of the module has one programmable jumper as shown in Figure 3-16. The three-tone version of the module has three programmable jumpers as shown in Figure 3-17. The four-tone version of the module has four programmable jumpers as shown in Figure 3-18. Each version can be supplied with screw type terminal blocks or plug-in compression type terminal blocks. Refer to Table 3-6 for additional information.

J9 - J12 J9 through J12 must be set to position A or position B in accordance with the wiring configuration of the RFL 9745 as shown below:

Table 3-6. Narrow Band Audio Comms Module Wiring Configuration with RFL9745

Jumpers ↓	Wiring Configuration		
	Single-Channel Four-Wire (TB2-1, 2, 3, 4)	Single-Channel Two-Wire (TB2-3, 4)	Dual-Channel Four-Wire (TB2-1, 2, 3, 4, 5, 6, 7, 8)
J9	Position A	Position A	Position B
J10*	Position A*	Position A*	Position B*
J11	Position A	Position A	Position B
J12	Position B	Position A	Position B

* Parameter 061 as shown in Figure 5-1 must be set to match the J10 jumper setting on the Audio Communications module (See Figures 3-17 or 3-18 for location). If jumper J10 is in position A, set Parameter 061 to “A”. If jumper J10 is in position B, set Parameter 061 to “B”. If the audio board has only two tones, jumper J10 cannot be set by the user since it is hard wired at the factory. In this case, Parameter 061 must be set to “B”.

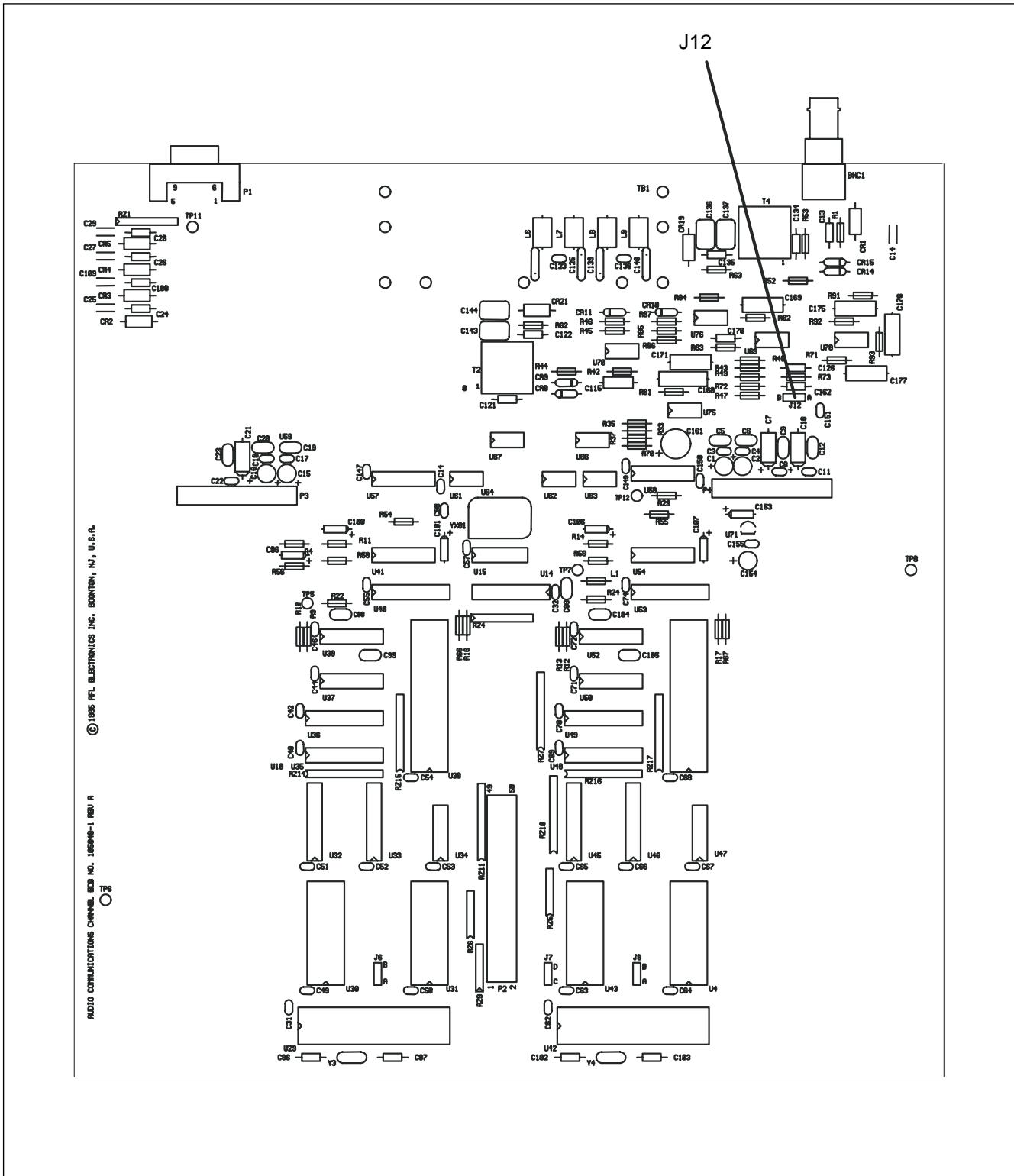


Figure 3-16. Location of jumper on the two-tone narrow band Audio Communications Module

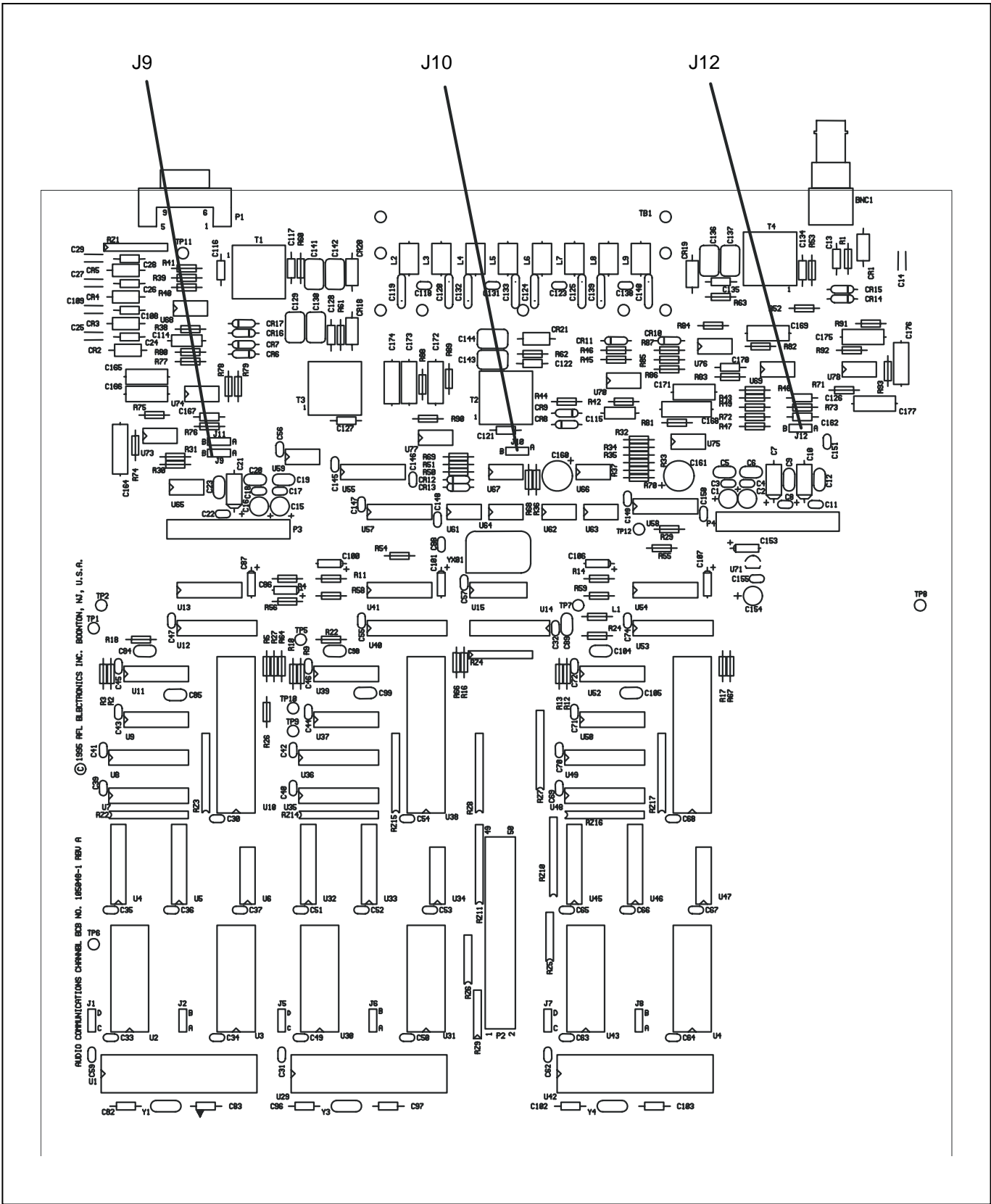


Figure 3-17. Location of jumpers on the three-tone narrow band Audio Communications Module

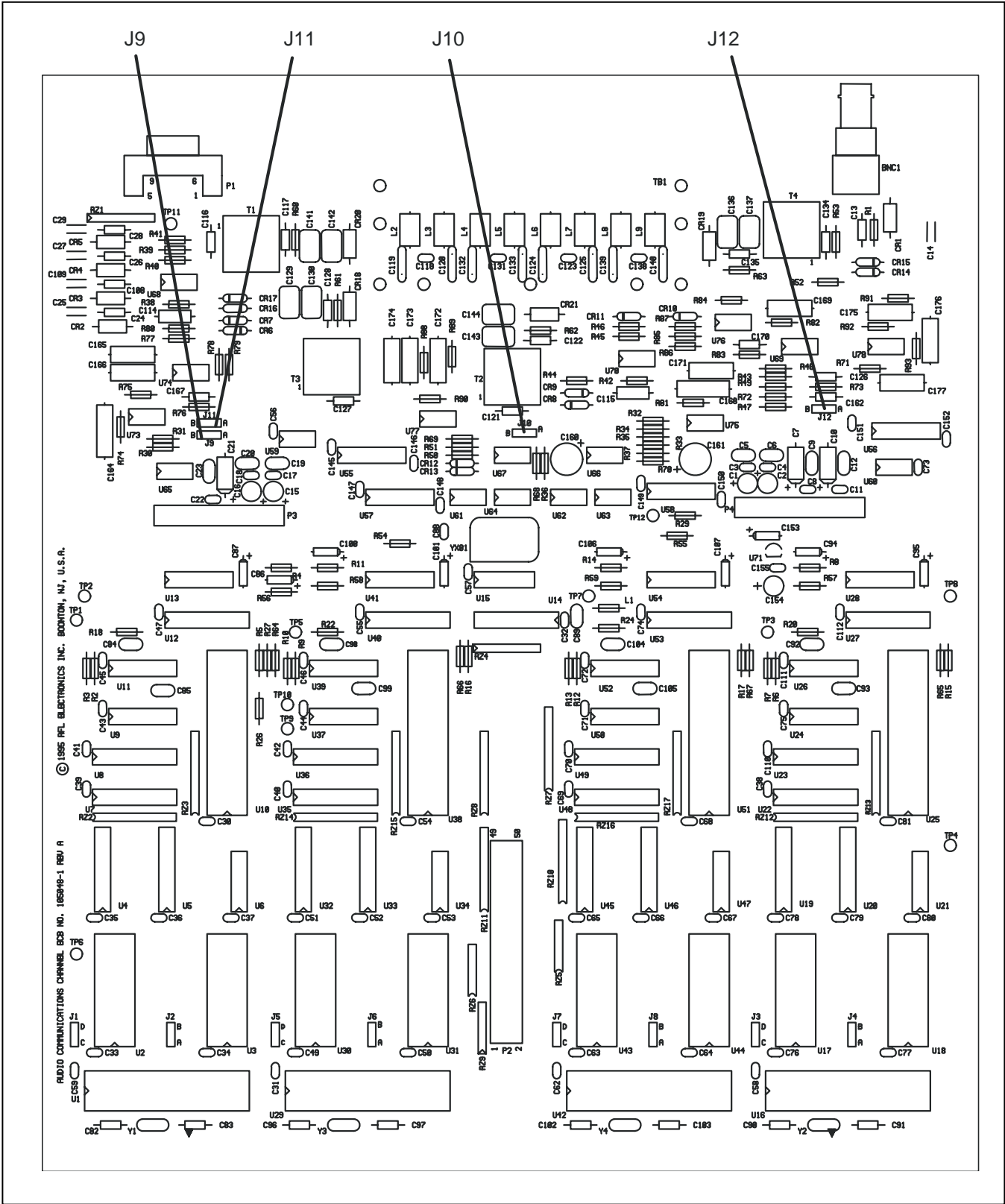


Figure 3-18. Location of jumpers on the four-tone narrow band Audio Communications Module

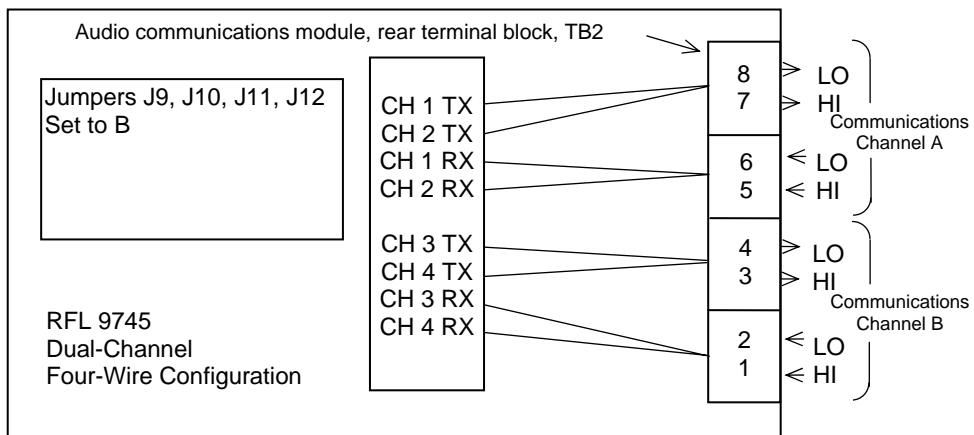
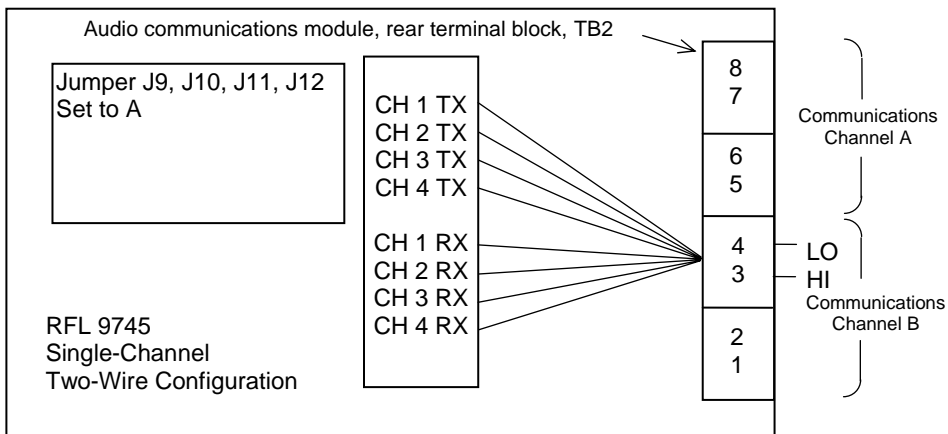
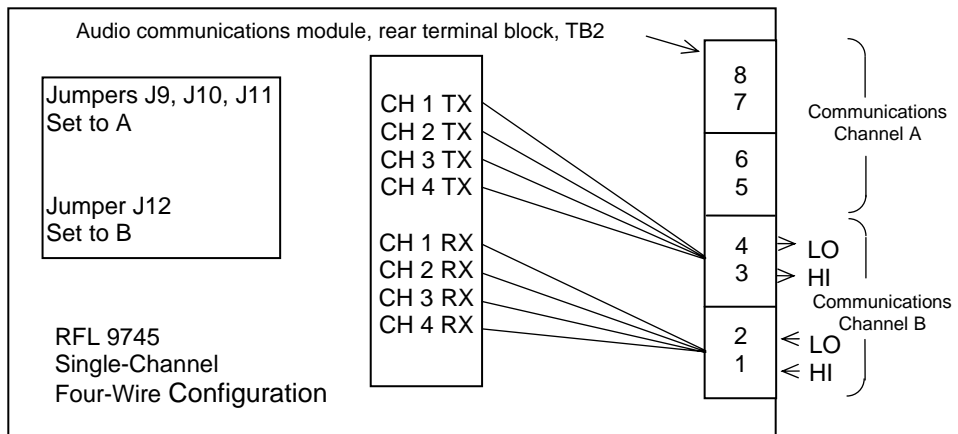


Figure 3-19. RFL 9745 Narrow band Audio Communications module, typical configurations

3.6.4.2 WIDE BAND AUDIO COMMUNICATIONS MODULE

There are two versions of the wide band Audio Communications Module. Each version uses the same basic printed circuit board but only certain portions of each board are populated with components. The two-tone version of the module has five programmable jumpers as shown in Figure 3-20. The four-tone version of the module has eleven programmable jumpers as shown in Figure 3-21. Each version can be supplied with screw type terminal blocks or compression type terminal blocks. Refer to Table 3-7 for additional information.

- J1** J1 is set for the type of AC power being used for the RFL 9745. It is set to position 50 for 50 Hz power, or position 60 for 60 Hz power. This jumper is set at the factory, but can be changed in the field.
- J2** J2 is set for the type of AC power being used for the RFL 9745. It is set to position 50 for 50 Hz power, or position 60 for 60 Hz power. This jumper is set at the factory, but can be changed in the field.
- J12** J12 selects the Test or Run mode of the RFL 9745. The Test mode disables the watchdog timer and is used for factory testing only. The Run mode is used when the RFL 9745 is in service. This jumper is set at the factory, and should not be changed in the field.
- J13** J13 selects or bypasses the Channel 1 and Channel 2 programmable filter. When J13 is in the IN position, the programmable filter is in the circuit. When J13 is set to the OUT position, the programmable filter is bypassed. This jumper is set at the factory but can be changed in the field.
- J14** J14 selects or bypasses the Channel 3 and Channel 4 programmable filter. When J14 is in the IN position, the programmable filter is in the circuit. When J14 is set to the OUT position, the programmable filter is bypassed. This jumper is set at the factory but can be changed in the field.
- J15** J15 is used for factory testing only. This jumper is installed at the factory, and should not be removed in the field.
- J16** J16 is used for factory testing only. This jumper is installed at the factory, and should not be removed in the field.

J3, 5, 10, 11 J3, J5, J10 and J11 must be set to position A, B, 2W or 4W as applicable, in accordance with the wiring configuration of the RFL 9745 as shown below:

Table 3-7. Wide Band Audio Comms Module Wiring Configuration with RFL9745

↓ Jumpers	Wiring Configuration			
	Single-Channel Four-Wire (TB2-1, 2, 3, 4)	Single-Channel Two-Wire (TB2- 3, 4)	Dual-Channel Four-Wire (TB2-1, 2, 3, 4, 5, 6, 7, 8)	Dual-Channel Two-Wire (TB2- 3, 4, 7, 8)
J3	Position A	Position A	Position B	Position B
J5	Position 4W	Position 2W	Position 4W	Position 2W
J10*	Position A*	Position A*	Position B*	Position B*
J11	Position 4W	Position 2W	Position 4W	Position 2W

* Parameter 061 as shown in Figure 5-1 must be set to match the J10 jumper setting on the Four Tone Audio Communications module (See Figures 3-21 for location).

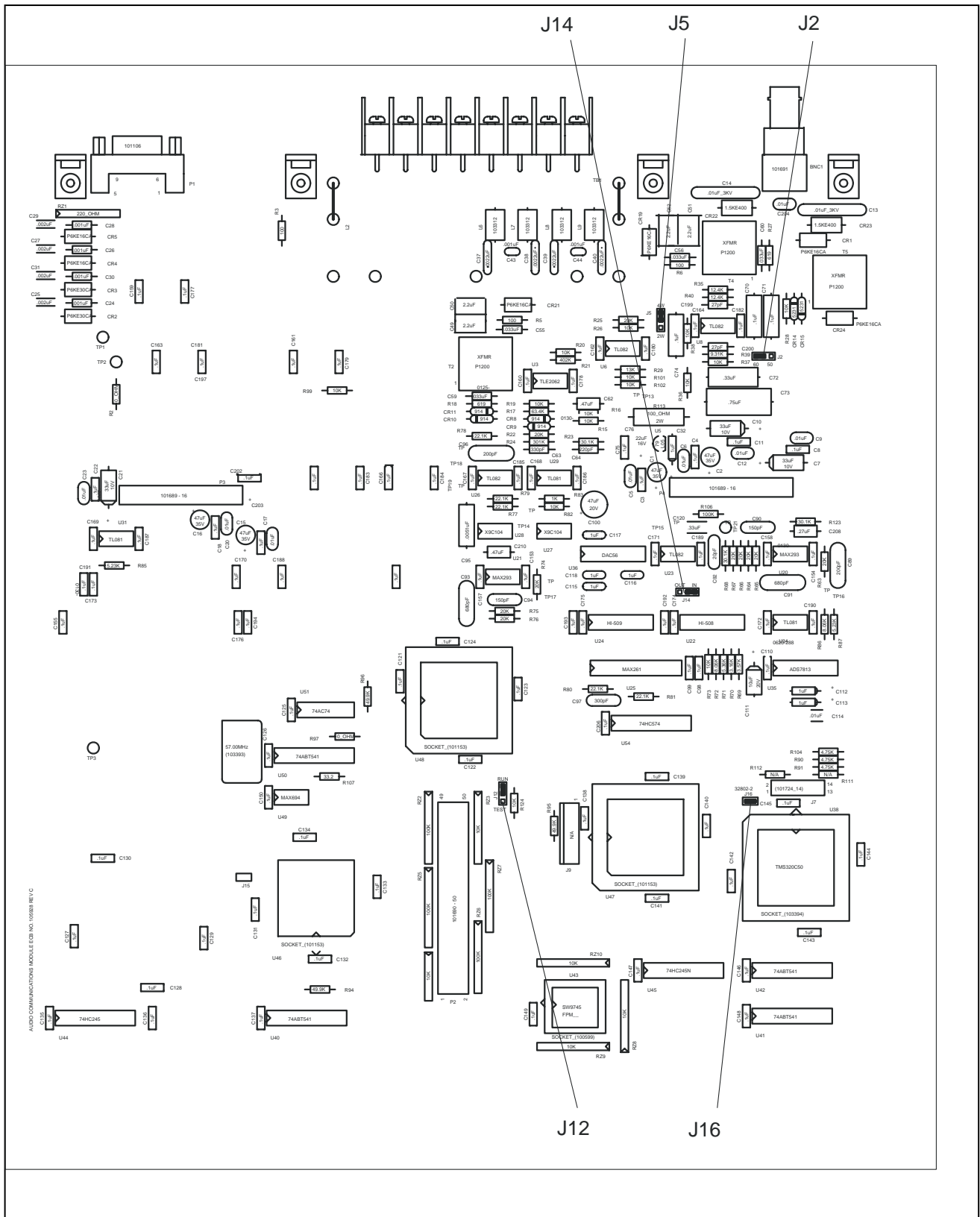


Figure 3-20. Location of jumpers on the two-tone wide band Audio Communications Module

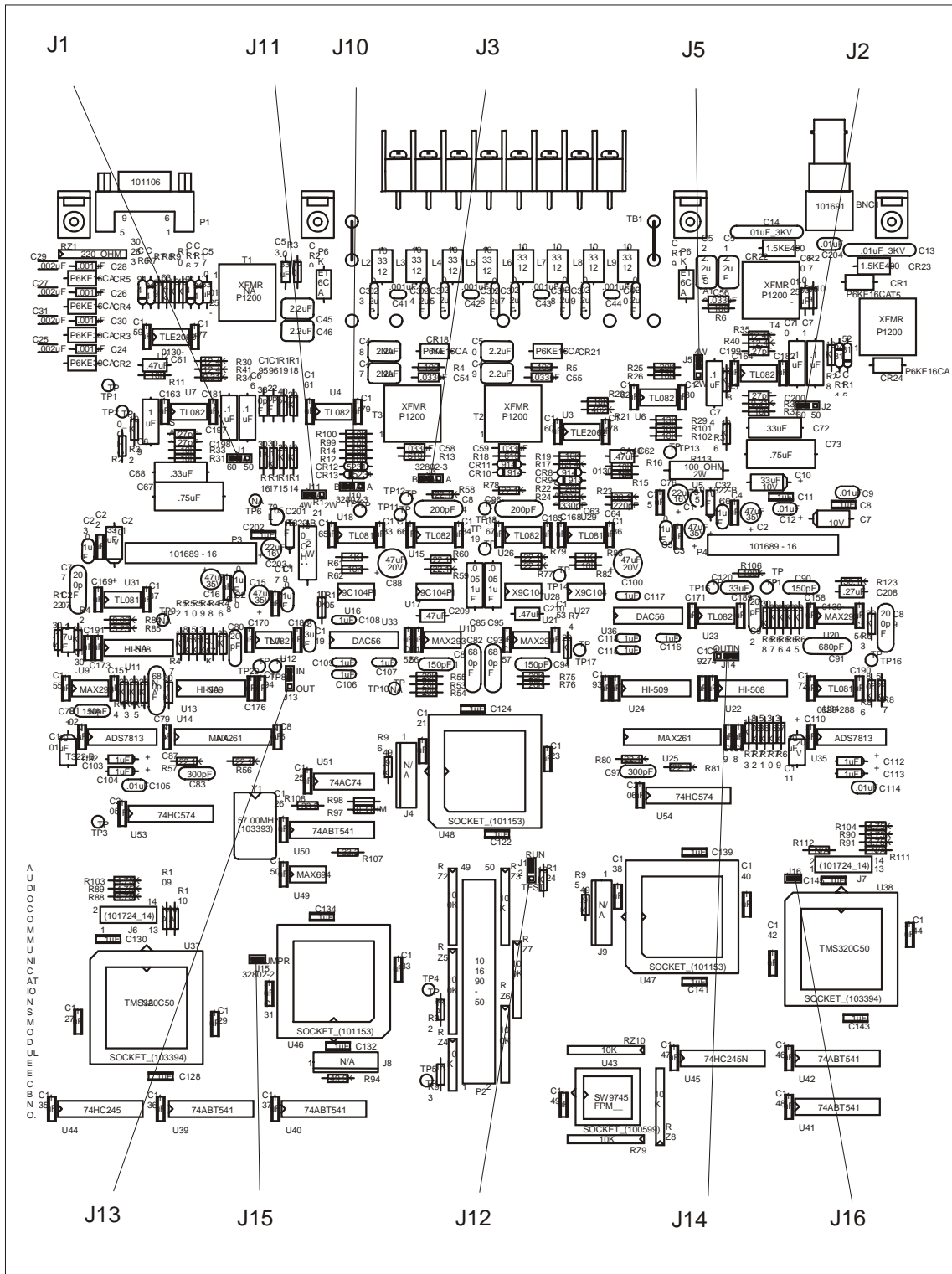


Figure 3-21. Location of jumpers on the four-tone wide band Audio Communications Module

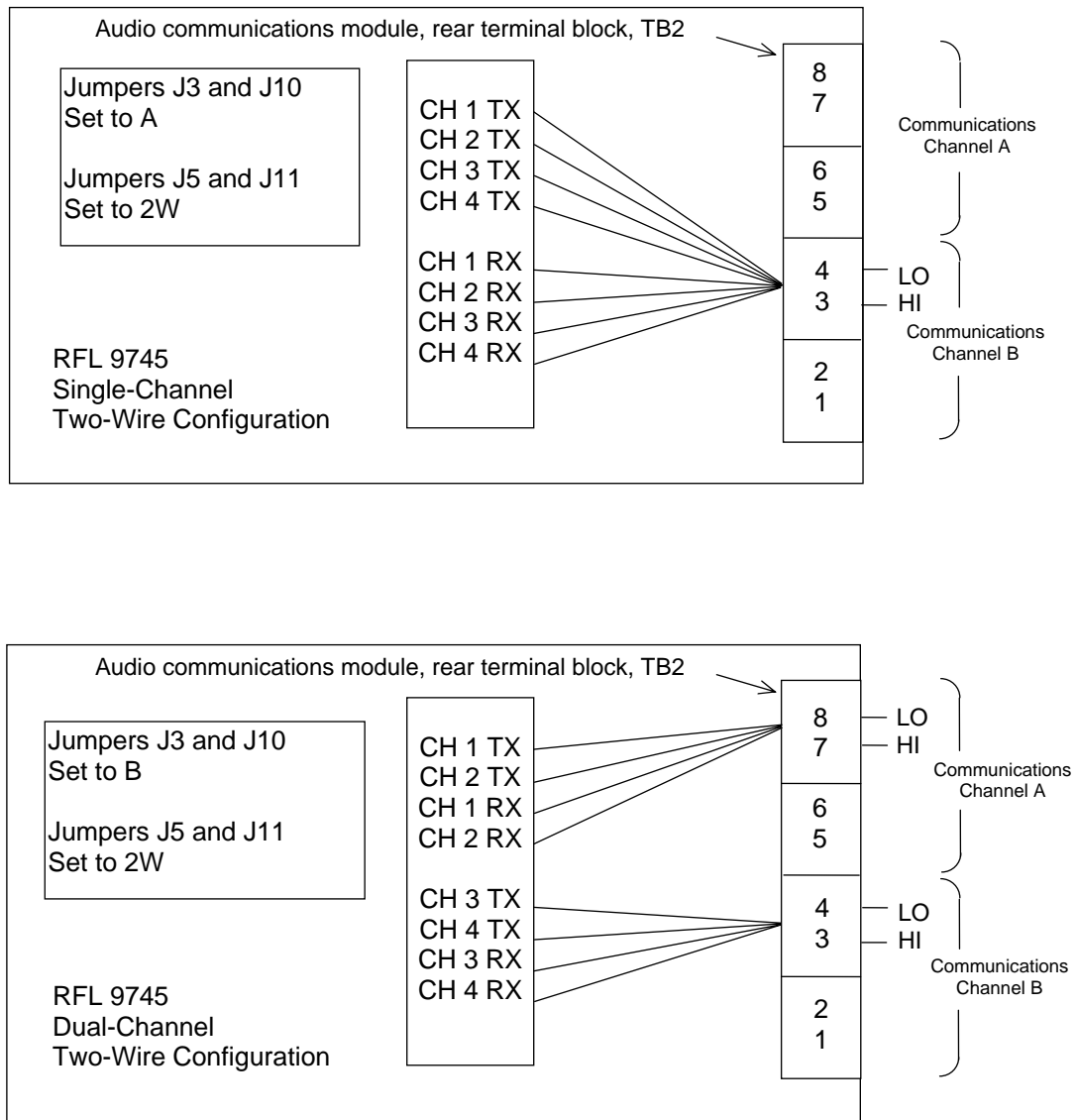


Figure 3-22. RFL 9745 Wide band Audio Communications Module, typical two-wire configurations

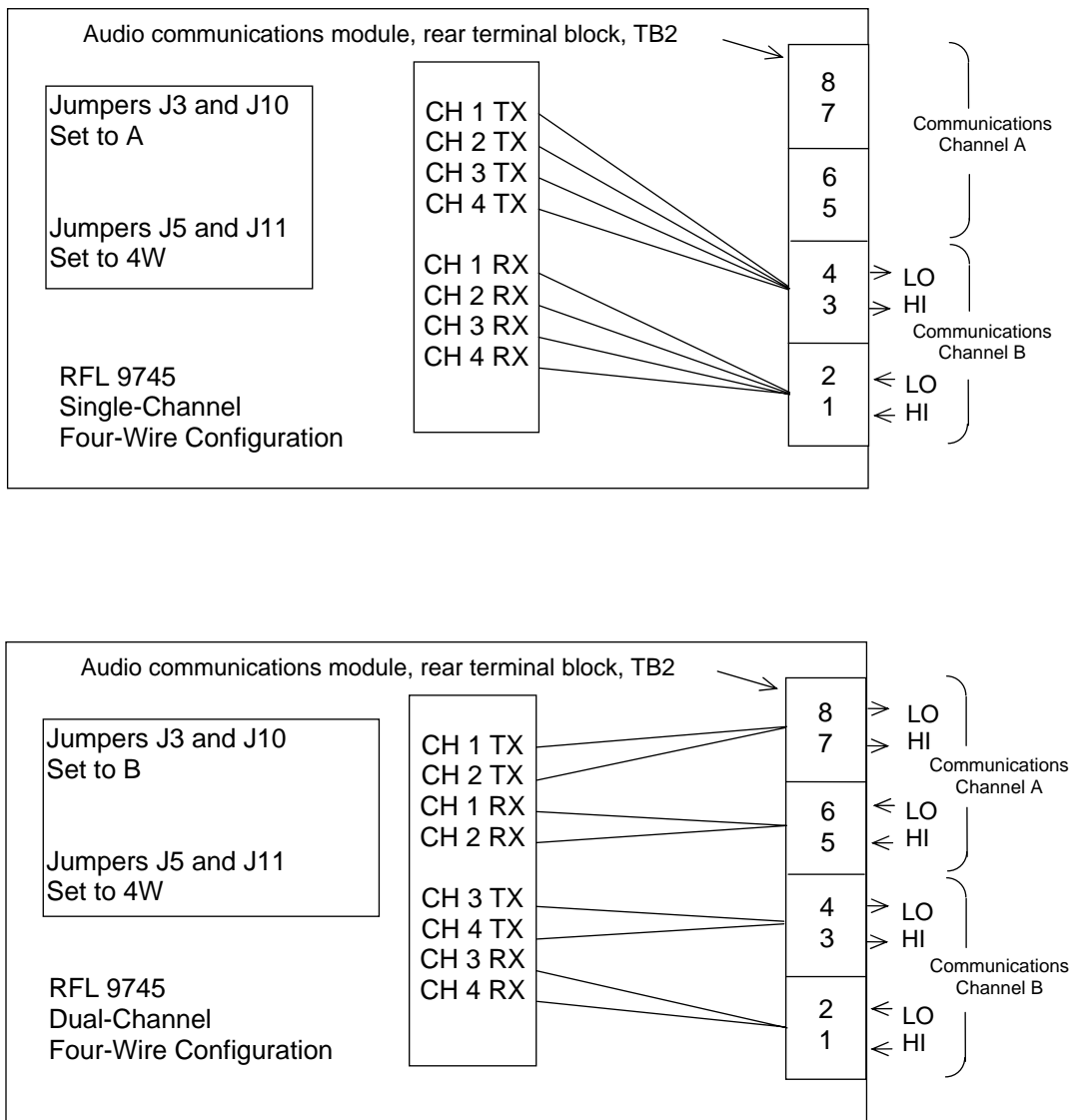


Figure 3-23. RFL 9745 Wide band Audio Communications Module, typical four-wire configurations

3.6.5 DIGITAL COMMUNICATIONS MODULE

The Digital Communications Module (Assy. No. 105070) has 6 programmable jumpers, labeled "J1" through "J6" (See Figure 3-24 for jumper locations).

- J1** J1 is set for the type of memory that is being used. It is set to Position A for 27C64/27C128 devices, or to Position B for 27C256 devices. This jumper is set to position B at the factory, and should not be changed in the field.
- J2** J2 is set for the type of memory that is being used. It is set to Position A for 27C64/27C128 devices, or to Position B for 27C256 devices. This jumper is set to position B at the factory, and should not be changed in the field.
- J3** J3 is set for the communication medium data rate. It can be set to a 56K data rate, or to a 64K data rate. This jumper is set to 56K or 64K for the 449 Interface, and to 64K for the G.703 Interface.
- J4** J4 is set to either enable or disable the 80C196 processor watchdog timer. It is set to Position B to disable the watchdog timer, or to Position A to enable the watchdog timer. This jumper is set to Position A at the factory, and should not be changed in the field.
- J5** J5 is set to Position A to allow the received data bit stream to be routed to the PLL (Phase Locked Loop), or is set to position B to ground the detector input to the PLL. This jumper is set to Position A at the factory, and should not be changed in the field.
- J6** Below are the settings for J6 on both 9745 units. J6 is also used to set-up the 9745 for end to end and loop back testing with the G.703 interface. The factory default setting is 'A' except for the G.703 interface which is set to 'B.'

Table 3-8. J6 Jumper Settings

Interface	Jumper Position 1st 9745	Jumper Position 2nd 9745
All direct fiber including C37.94	A	A
RS-449 (See Note 1.)	A	A
X.21 (See Note 1.)	A	A
G.703 (See Note 2.)	B	B
E1 (See Note 3.)	A	A

Clocking is embedded with the RS-449, X.21 and all direct fiber connections. J6 **MUST** be set to “A” regardless of any external clock provided by an external device such as a multiplexer.

Note 1: For bench testing (back to back) using an electrical connection (RS-449 or X.21) clocking must be set on one side to “**Clock Source Enable.**” This is done on the 9745 via the front panel push-buttons.

Note 2: For bench testing (**back to back only**) on the G.703 interface one 9745 jumper **MUST** be set to “A” and the other to “B.”

Note 3: When using the E1 Serial Interface Adapter, dip switch SW1-4 on the adapter can be set as follows:

	UP	DOWN
SW1-4	Loop Timing	Internal Timing (Transmit a Clock)

See Section 3.6.5.5 for further information on the E1 Serial Interface Adapter.

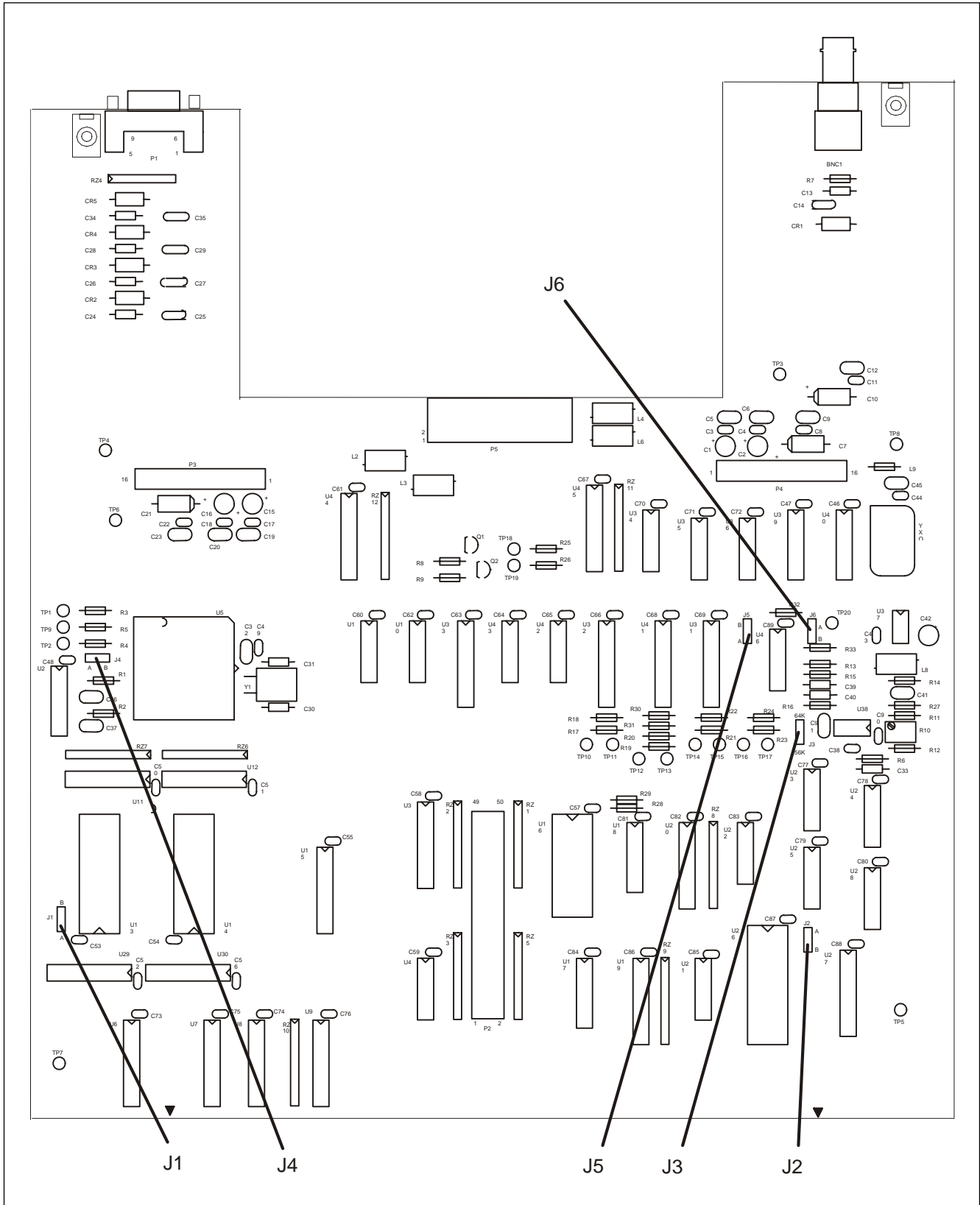


Figure 3-24. Location of jumpers on the Digital Communications Module

3.6.5.1 RS-449 INTERFACE MODULE

The RS-449 interface module (Assembly No. 105065-1) has two programmable jumpers labeled “J1” and “J2”. See the Figure below for jumper locations. If the RFL 9745 is interfaced with an IMUX 2000 refer to paragraph 3.6.5.1.1.

J1 J1 is set to NORM position to select a normal TX Clock, or to INV position to select an inverted TX Clock. This jumper is set to INV position at the factory.

J2 J2 is set to NORM position to select a normal Rx Clock, or to INV position to select an inverted Rx Clock. This jumper is set to INV position at the factory.

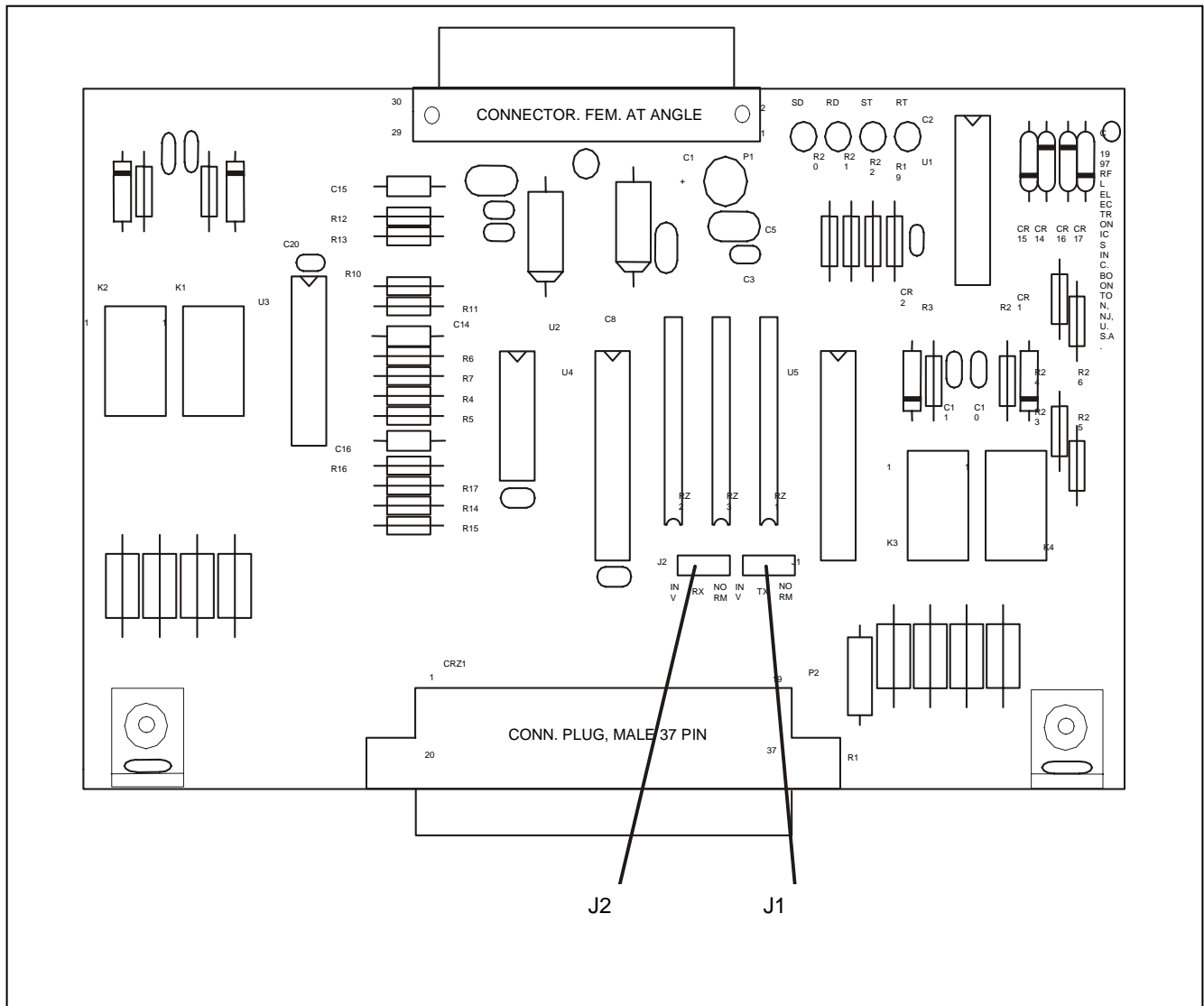


Figure 3-25. Location of jumpers on the RS-449 Interface Module

3.6.5.1.1 INTERFACING THE RFL 9745 WITH AN IMUX 2000 (RS-449)

Interfacing an RFL 9745 with an IMUX 2000 can be accomplished as follows:

- A. The programmable jumpers on the RFL 9745 RS-449 interface module, as shown in Figure 3-25, shall be positioned as follows:

J1 (Send Timing) should be set to select the inverted TX clock.

J2 (Receive Timing) should be set to select the inverted Rx clock.

- B. The Configuration of the IMUX 2000 RS-449 Channel Card shall be as follows:

1. If a DS-562I is used with an MA-406IA I/O (DCE Mode), set switch 4 as follows:

Switch 4-2 (Receive Clock Polarity) set to Normal - ON (Right)

Switch 4-3 (Transmit Clock Polarity) set to Normal - ON (Right)

- C. Confirm Clock and Data Transitions to insure proper system operation as follows:

1. RFL 9745

RS-449 I/O - The positive edge of the Rx Clock (TP4 or RT) must be in the center of the Rx Data bit (TP2 or RD).

2. IMUX 2000

DS-562I - The positive edge of the TX Clock (TP3) must be in the center of the TX Data bit (TP1).

If more information is needed refer to the IMUX 2000 Instruction Manual.

3.6.5.2 G.703 CONTRA-DIRECTIONAL INTERFACE MODULE

The G.703 Contra-Directional Interface module (Assembly No. 105065-2) has two programmable jumpers labeled “J1” and “J2”. See the Figure below for jumper locations.

- J1** J1 is set to Position A to select a normal TX Clock, or to Position B to select an inverted TX Clock. This jumper is set to position A at the factory.
- J2** J2 is set to Position A to select an inverted Rx Clock, or to Position B to select a normal Rx Clock. This jumper is set to position B at the factory.

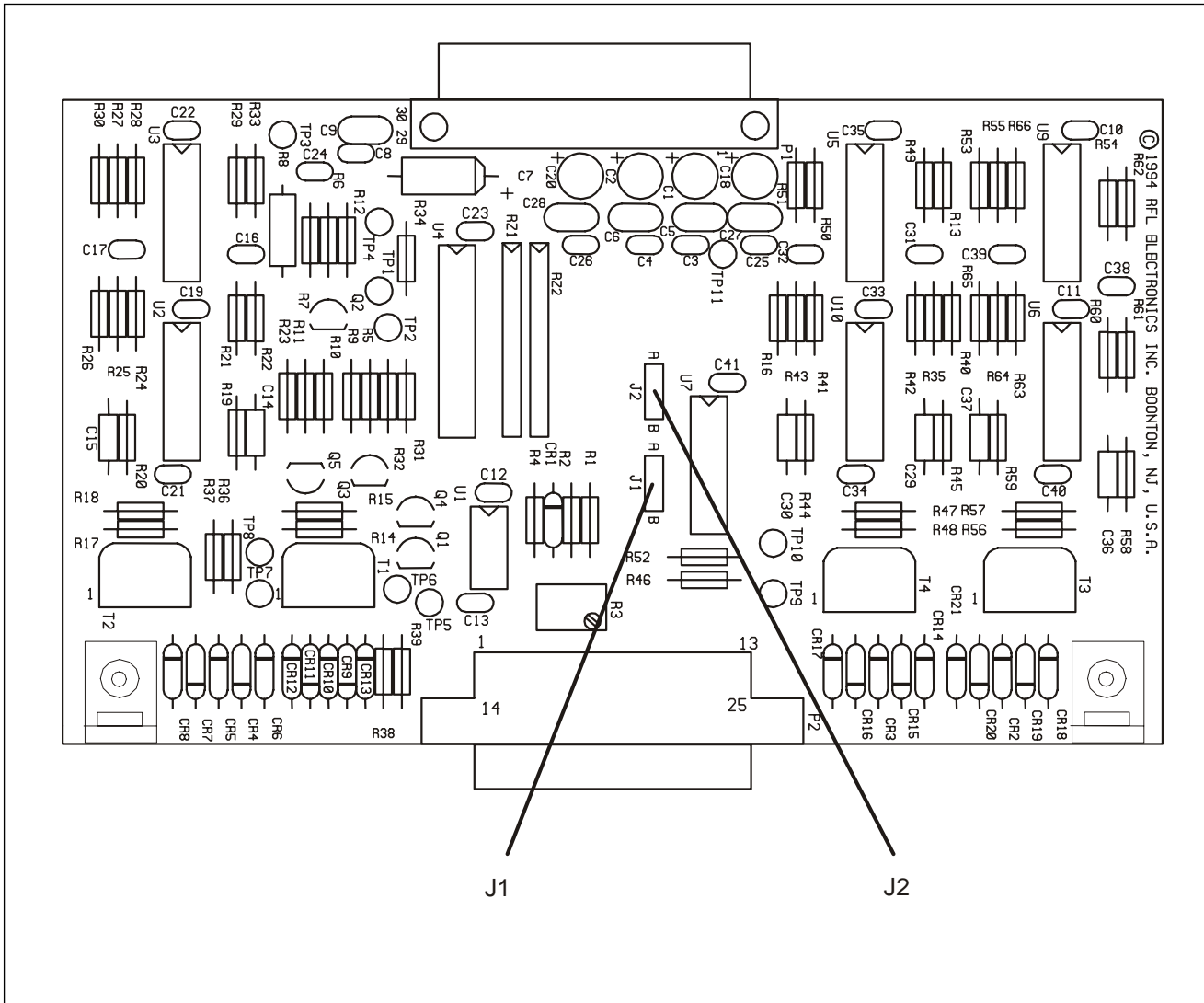


Figure 3-26. Location of jumpers on the G.703 Contra-Directional Interface Module

3.6.5.3 X.21 INTERFACE MODULE

The X.21 Interface module (Assembly No. 105065-10) has two programmable jumpers labeled “J1” and “J2”. See the Figure below for jumper locations.

- J1** J1 is set to NORM position to select a normal TX Clock, or to INV Position to select an inverted TX Clock. This jumper is set to NORM position at the factory.
- J2** J2 is set to NORM position to select a normal Rx Clock, or to INV position to select an inverted Rx Clock. This jumper is set to NORM position at the factory.

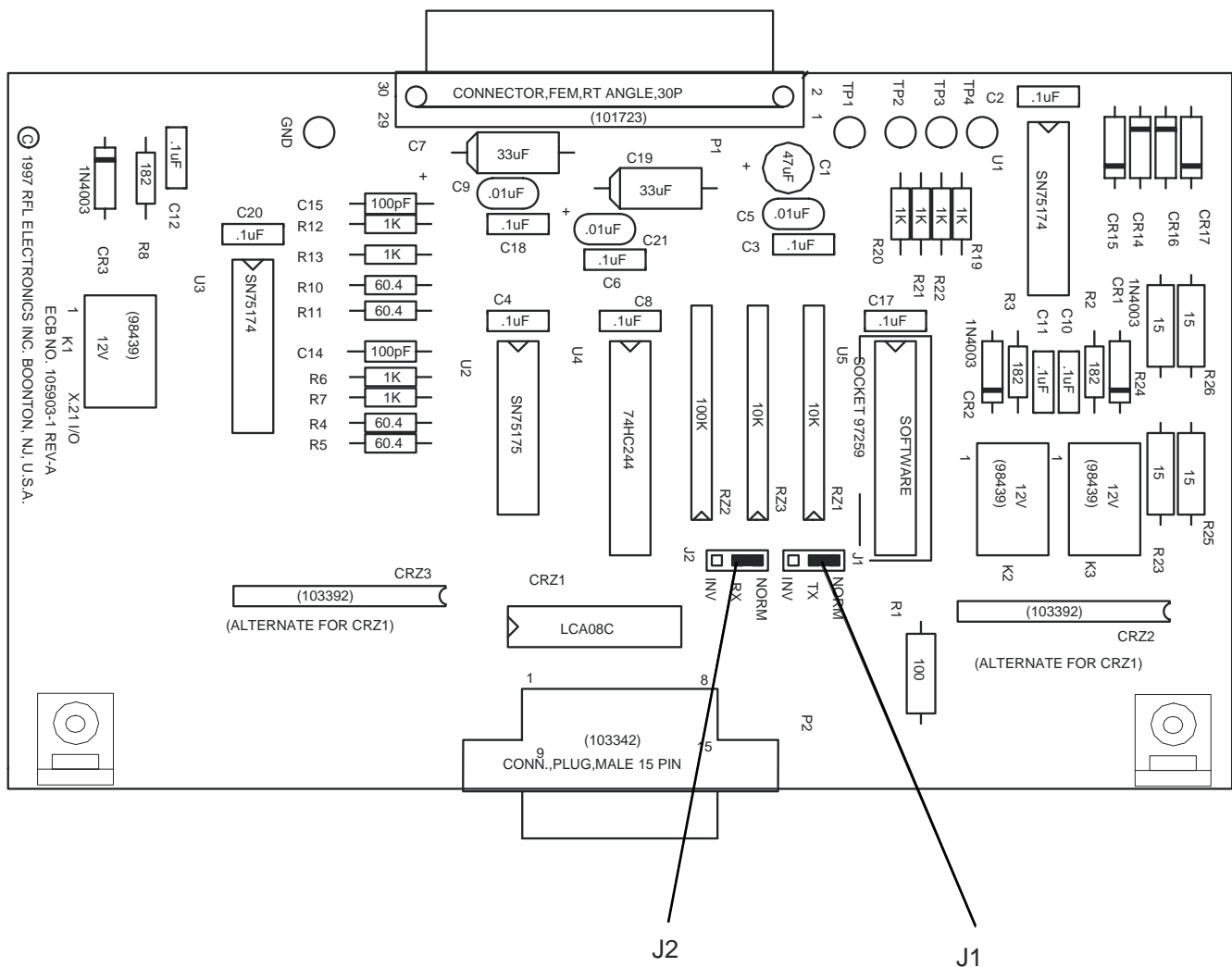


Figure 3- 27. Location of jumpers on the X.21 Interface Module

3.6.5.4 G.703 CO-DIRECTIONAL INTERFACE MODULE

The G.703 Co-Directional Interface module (Assy. No. 105065-11) has one programmable jumper, labeled "J1". See the Figure below for the jumper location. When this jumper is installed the module will generate octet timing.

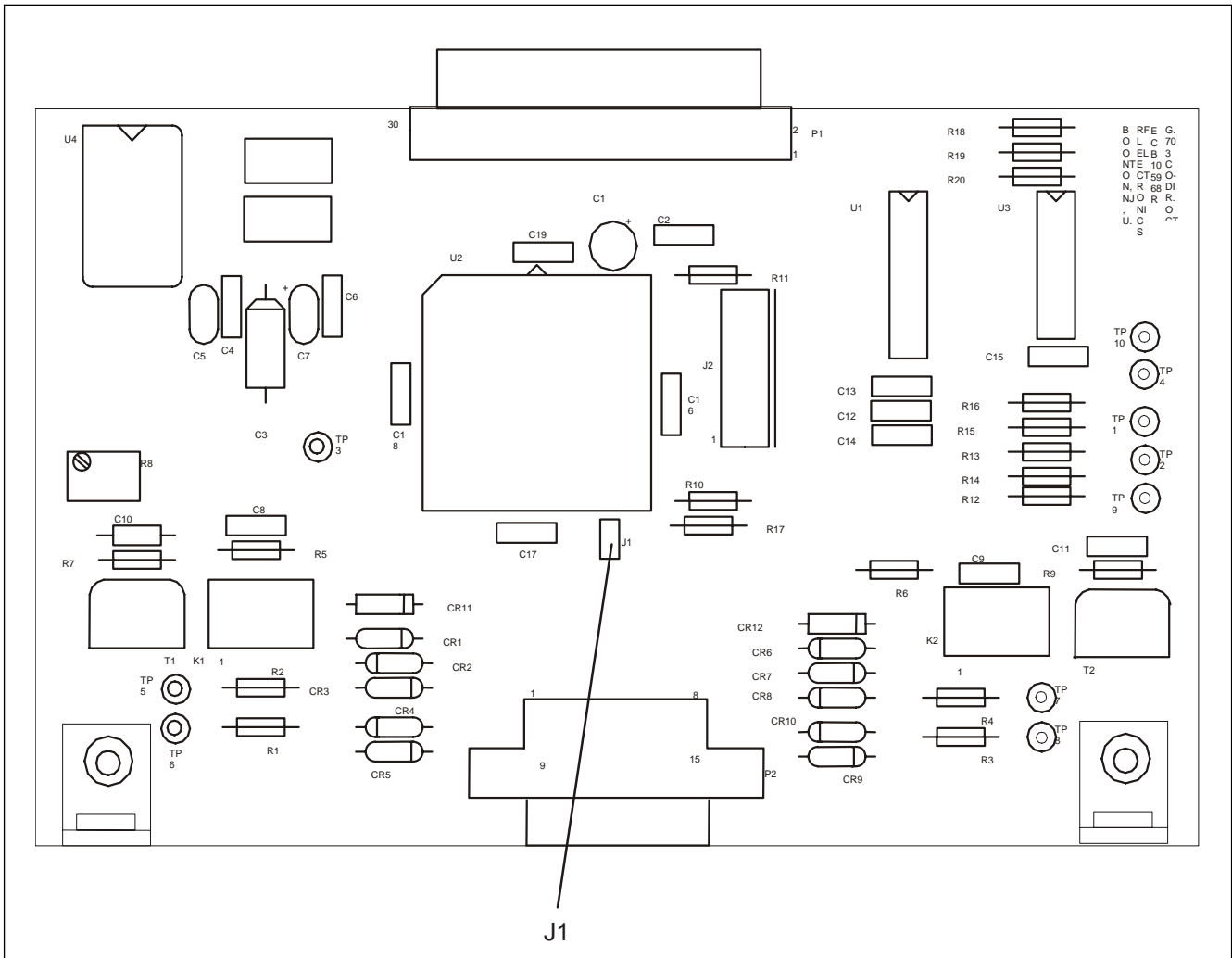


Figure 3- 28. Location of jumper on the G.703 Co-Directional Interface Module

3.6.5.5 E1 SERIAL INTERFACE ADAPTER

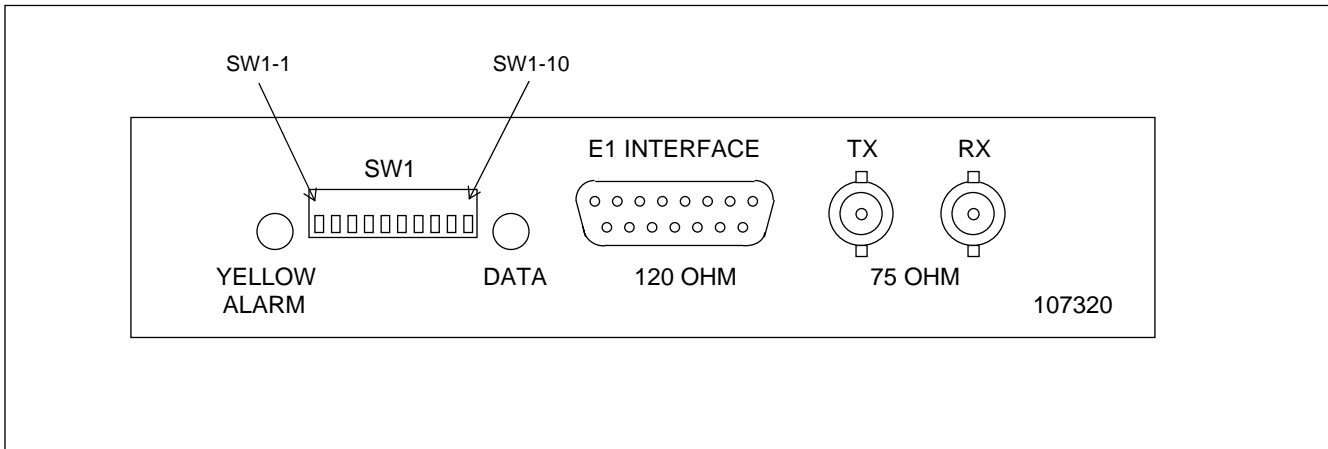


Figure 3- 29. E1 Serial Interface Adapter Front Panel

The 9745 Serial Interface Adapter (107320) allows the 9745 to plug directly into a 2.048 Mb/s G.704 & G.703 compliant port on a higher order multiplexer. A 15 pin D-subminiature connector and two 75 Ohm BNC connectors are provided for this connection. A bank of DIP switches, a slide switch, and two programmable jumpers are provided for setting up the interface adapter. Loss of Sync and Yellow Alarm indicators are provided to assist the user with setup of the module. When this interface adapter is used with the 9745, all performance criteria is the same as specified for any other digital version of the 9745 when run at 64 kb/s. Trip times are unchanged from 64 Kb/s. When this interface is installed, the 9745 reports the interface type as “Short Haul Fiber”.

Connectors

The interface uses either a 15-pin D-subminiature connector or two BNC connectors for connection to the network. J3 is a 15-pin D-subminiature connector that provides a 120 ohm interface using dual shielded-twisted-pair E1 cable. J4 and J5 are BNC connectors that provide a 75 ohm interface using RG-59 coax cables. J4 is the transmit output and should be connected to the receive input of the multiplexer. J5 is the receive input and should be connected to the transmit output of the multiplexer.

Indicators

There are two LED indicators on the unit. Their functions are as follows:

DATA – If this indicator is illuminated, then the interface is properly receiving a valid framed E1 signal from the multiplexer.

YELLOW ALARM - If this indicator is illuminated then the interface is receiving a yellow alarm from the multiplexer. This is the G.704 remote alarm indication. The remote alarm may be generated by the multiplexer or from the remote 9745 depending on the multiplexer set up. In either event, it is an indication that the transmit signal from the 9745 with the yellow alarm indicator illuminated is not getting to the device generating the yellow alarm.

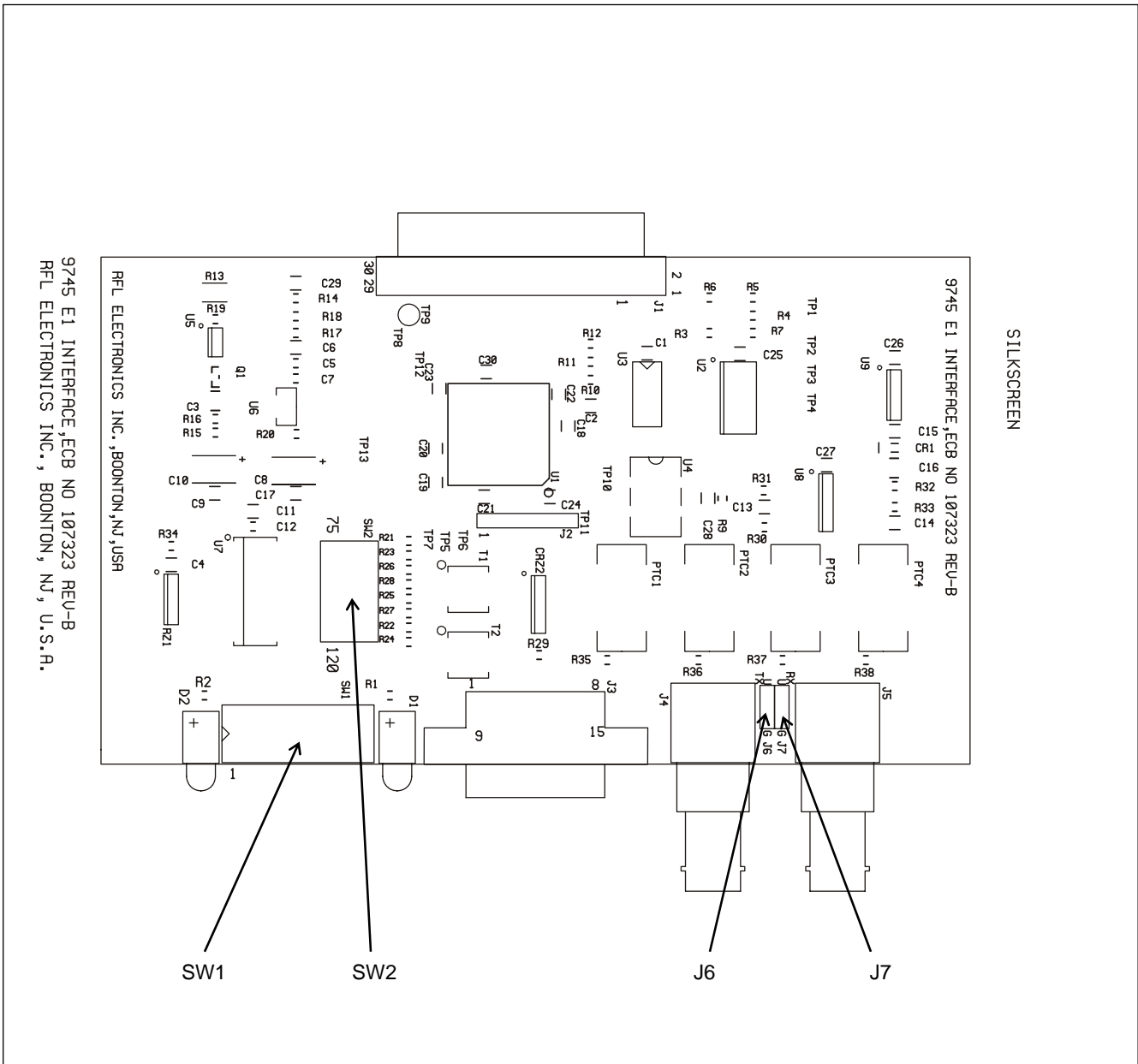


Figure 3- 30. Location of jumpers and switches on E1 serial interface adapter

Switches

SW1 is a 10 position DIP switch mounted facing the rear panel. The switches are numbered 1 to 10 from left to right. The operation of the switches is shown in the table below.

SW2 is a slide switch mounted on the printed circuit board. It is used to select the impedance of the I/O connectors. When using the 120 ohm D-subminiature connector, SW2 is set in the position labeled “120”. When using the 75 ohm BNC connectors, SW2 is set in the position labeled “75”.

Table 3-9. E1 Serial Interface Adapter Switch Settings

Switch SW1-	Function	Description	Typical Setting
1	CRC Generation	UP- Generate CRC-4 DOWN – do not generate CRC-4	UP-Generate CRC-4
2	Digital Loop-back	UP – Normal operation DOWN – Enable Digital Local Loop-back	UP-Normal Operation
3	Data Encoding	UP – HDB3 encoding and decoding DOWN – AMI encoding	UP-HDB3 Encoding
4	Timing Mode	UP – Loop Timing DOWN – Internal Timing	No Default
5	Receive All Ones	UP – Receive All Ones DOWN – Normal operation	DOWN-Normal Operation
6	Transmit All Ones	UP – Transmit All Ones DOWN – Normal operation	DOWN-Normal Operation
7	Local Loop-back	UP – Normal operation DOWN – Enable Local Loop-back	UP-Normal Operation
8	Jitter Attenuator	UP – Enable Jitter Attenuator DOWN – Disable Jitter Attenuator	UP-Enable Jitter Attenuator
9	Remote Loop-back	UP – Normal operation DOWN – Enable Remote Loop-Back	UP-Normal Operation
10	Jitter Attenuator Selection	- With SW1-8 UP (Jitter Attenuator enabled): UP – Jitter Attenuator in the transmit path DOWN – Jitter Attenuator in the receive path - With SW1-8 DOWN (Jitter Attenuator disabled): SW1-10 must be DOWN	DOWN-Jitter Attenuator in RX

Programmable Jumpers

Jumpers J6 and J7 are used to ground the outer conductors of BNC connectors J4 and J5 respectively. When in the position labeled “G”, the outer conductor of the corresponding BNC connector is grounded by connecting it to chassis. When in the position labeled “U” the outer conductor of the corresponding BNC connector is ungrounded. When using the 15 position d-sub connector, J6 and J7 should be in the position labeled “U”. This leaves all the TX and RX connectors floating which is required since the 120 ohm twisted pair is a balanced connection. When using the BNC connectors, J6 should be in the position labeled “G” and J7 should be in the position labeled “U”. This configuration grounds the outer conductor of the TX connection and leaved the RX connection ungrounded.

3.6.5.6 INTERFACING THE RFL 9745 (107310) WITH AN IMUX 2000 (MA620)

An RFL 9745 equipped with a 107310 (Short Haul Fiber module) can be connected to an IMUX 2000 as shown in Figure 3-31. There are no jumpers or settings on the 107310 or the MA620, however SW4-2 and SW4-3 on the DS562I must be set to the ON position.

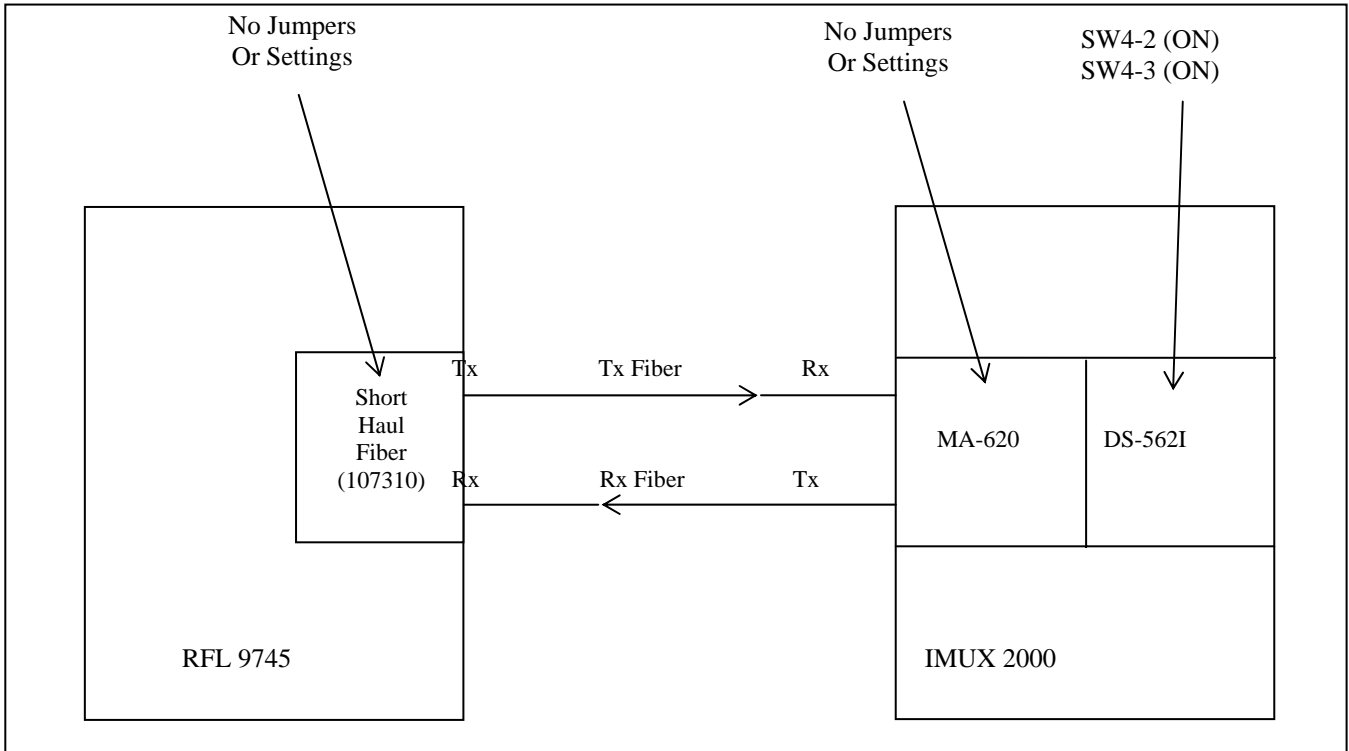


Figure 3-31. Interfacing the RFL 9745 (107310) with an IMUX 2000 (MA-620)

3.6.6 FRONT PANEL MODULE

The Front Panel Module (Assy. No. 105055) has two programmable jumpers, labeled "JP1" and "JP2." See the Figure below for jumper locations. These jumpers are set at the factory according to the type of front panel display being used:

- JP1** JP1 has three possible settings: A-B, B-C, and C-D. If an Optrex display is being used, jumpers are placed in Positions A-B and C-D at the factory. If a Seiko display is being used, a jumper is placed in Position B-C at the factory.
- JP2** JP2 has two possible settings: E and F. If an Optrex display is being used, JP2 is placed in Position E at the factory. If a Seiko display is being used, JP2 is placed in Position F at the factory.

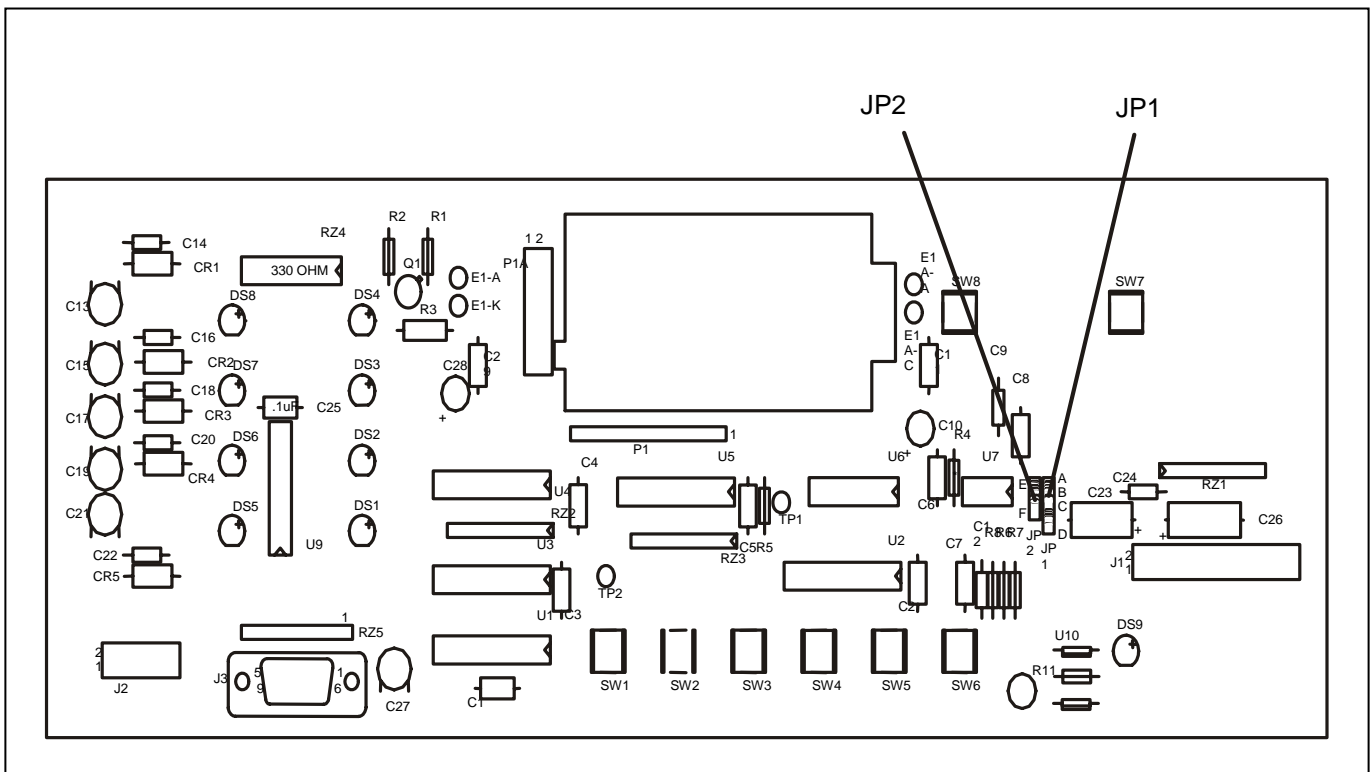


Figure 3- 32. Location of jumpers on the Front Panel Module

3.6.7 SWC I/O MODULES

There are three types of RFL 9745 SWC I/O Modules. They can be solid-state (Assy. No. 105005), relay/solid-state (Assy. No. 105010), or high speed relay (Assy. No. 105955). These modules have jumpers as shown in Figure 3-33. The input controlled by jumpers J1 through J4 will depend on whether the SWC I/O Module is installed in the top slot (serving as terminal block TBA) or the bottom slot (serving as terminal block TBB):

3.6.7.1 SOLID STATE SWC I/O MODULE

When Installed In Top Slot:

- J1** Selects input voltage for INPUT 1A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J2** Selects input voltage for INPUT 2A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J3** Selects input voltage for INPUT 3A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J4** Selects input voltage for INPUT 4A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)

When Installed In Bottom Slot:

- J1** Selects input voltage for INPUT 1B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J2** Selects input voltage for INPUT 2B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J3** Selects input voltage for INPUT 3B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J4** Selects input voltage for INPUT 4B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)

3.6.7.2 RELAY/SOLID STATE SWC I/O MODULE

When Installed In Top Slot:

- J1** Selects input voltage for INPUT 1A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J2** Selects input voltage for INPUT 2A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J3** Selects input voltage for INPUT 3A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J4** Selects input voltage for INPUT 4A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J5** J5 has two possible settings: A and B. When in position A, the relay contacts for K1 are normally open (NO). When in position B, the relay contacts for K1 are normally closed (NC).
- J6** J6 has two possible settings: A and B. When in position A, the relay contacts for K2 are normally open (NO). When in position B, the relay contacts for K2 are normally closed (NC).
- J7** J7 has two possible settings: A and B. When in position A, the relay contacts for K3 are normally open (NO). When in position B, the relay contacts for K3 are normally closed (NC).

When Installed In Bottom Slot:

- J1** Selects input voltage for INPUT 1B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)

- J2** Selects input voltage for INPUT 2B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)

- J3** Selects input voltage for INPUT 3B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)

- J4** Selects input voltage for INPUT 4B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)

- J5** J5 has two possible settings: A and B. When in position A, the relay contacts for K1 are normally open (NO). When in position B, the relay contacts for K1 are normally closed (NC).

- J6** J6 has two possible settings: A and B. When in position A, the relay contacts for K2 are normally open (NO). When in position B, the relay contacts for K2 are normally closed (NC).

- J7** J7 has two possible settings: A and B. When in position A, the relay contacts for K3 are normally open (NO). When in position B, the relay contacts for K3 are normally closed (NC).

NOTE

J5 - J7 are set to position A at the factory or according to customer specifications.

3.6.7.3 HIGH SPEED RELAY SWC I/O MODULE

There are eight types of High Speed Relay SCI I/O modules as shown in the table below. The part number of the board is stamped in black ink on the non-component side of the board.

Table 3-10. High Speed Relays

RFL Part Number	Connection Type	Input Voltage
105955-1	Terminal block	48/125 Vdc
105955-12	Compression plug	48/125 Vdc
105955-13	Compression plug	250 Vdc
105955-14	Compression plug	24 Vdc
105955-3	Terminal block	250 Vdc
105955-4	Terminal block	24 Vdc
105955-5	Terminal block	48/110 Vdc
105955-6	Terminal block	220 Vdc

When Installed In Top Slot:

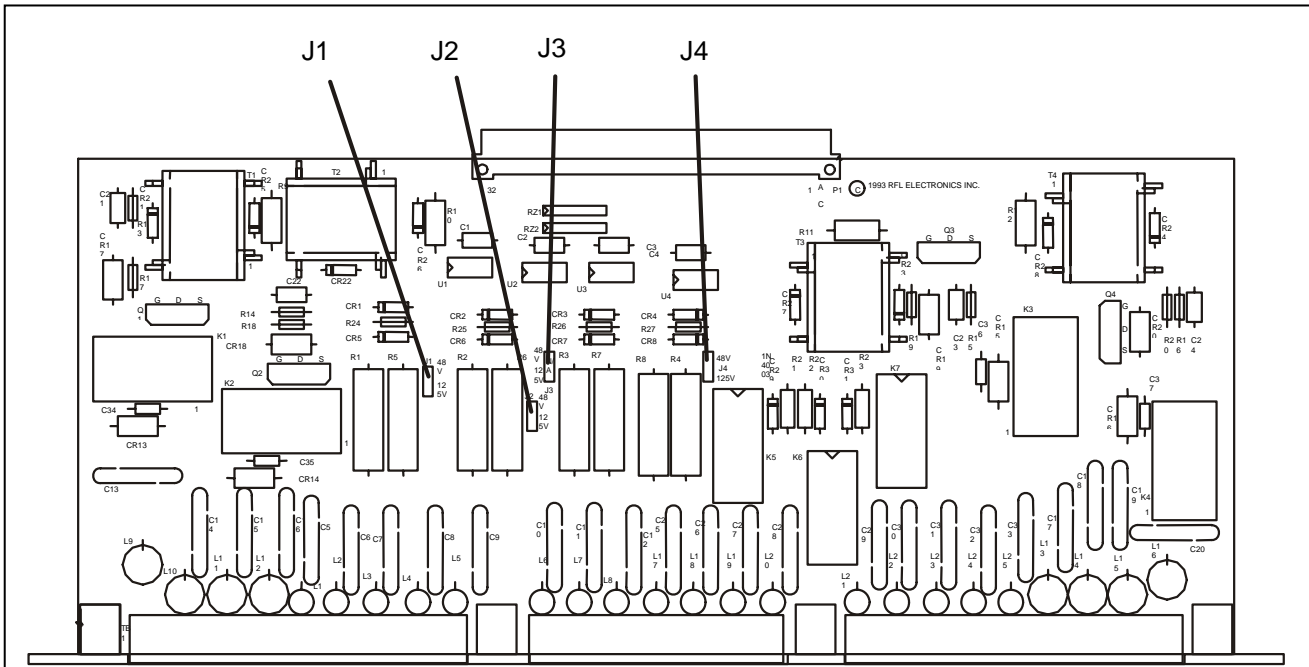
- J1** Selects input voltage for INPUT 1A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J2** Selects input voltage for INPUT 2A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J3** Selects input voltage for INPUT 3A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J4** Selects input voltage for INPUT 4A. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J5** J5 has two possible settings: A and B. When in position A, the relay contacts for K1 are normally open (NO). When in position B, the relay contacts for K1 are normally closed (NC).
- J6** J6 has two possible settings: A and B. When in position A, the relay contacts for K2 are normally open (NO). When in position B, the relay contacts for K2 are normally closed (NC).
- J7** J7 has two possible settings: A and B. When in position A, the relay contacts for K3 are normally open (NO). When in position B, the relay contacts for K3 are normally closed (NC).
- J8** J8 has two possible settings: A and B. When in position A, the relay contacts for K4 are normally open (NO). When in position B, the relay contacts for K4 are normally closed (NC).

When Installed In Bottom Slot:

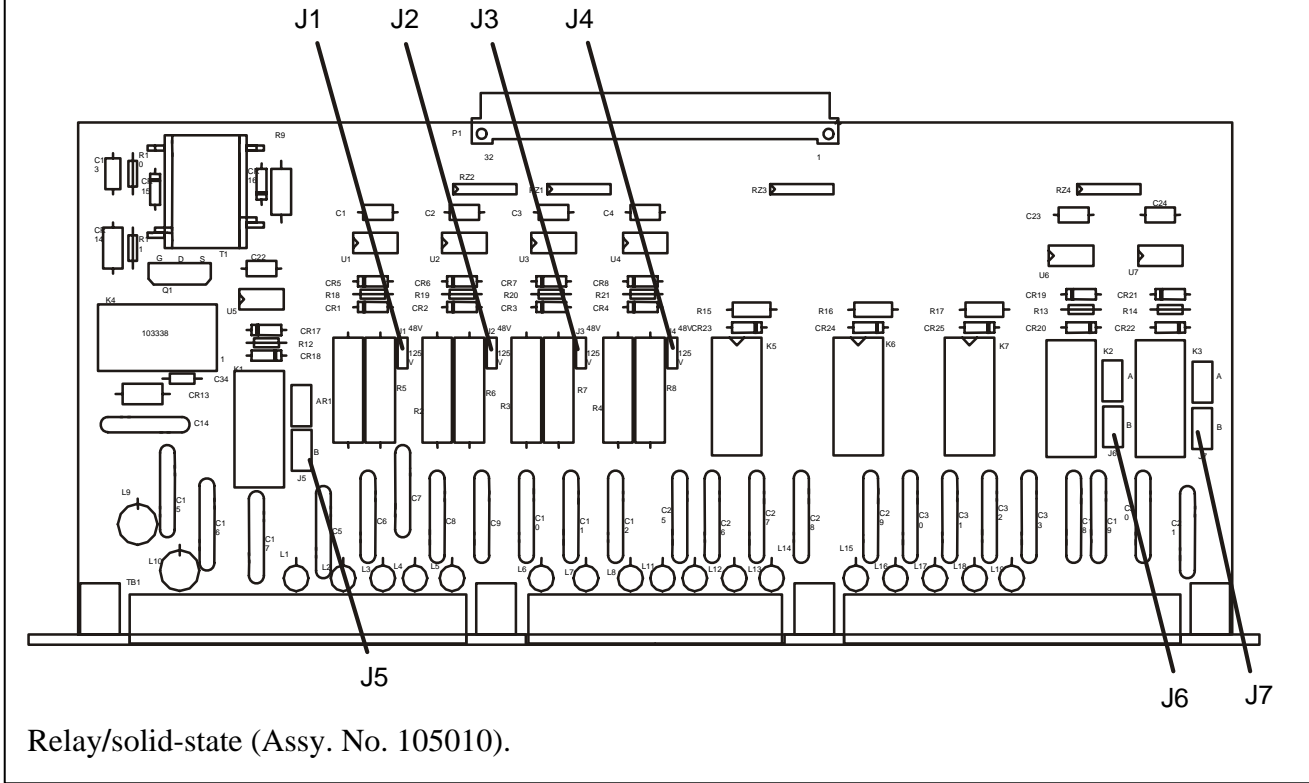
- J1** Selects input voltage for INPUT 1B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J2** Selects input voltage for INPUT 2B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J3** Selects input voltage for INPUT 3B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J4** Selects input voltage for INPUT 4B. Place in 48V position to accept 48-volt inputs, or 125V position for 110/125-volt inputs. (250-volt units have fixed jumpers that are not field-selectable.)
- J5** J5 has two possible settings: A and B. When in position A, the relay contacts for K1 are normally open (NO). When in position B, the relay contacts for K1 are normally closed (NC).
- J6** J6 has two possible settings: A and B. When in position A, the relay contacts for K2 are normally open (NO). When in position B, the relay contacts for K2 are normally closed (NC).
- J7** J7 has two possible settings: A and B. When in position A, the relay contacts for K3 are normally open (NO). When in position B, the relay contacts for K3 are normally closed (NC).
- J8** J8 has two possible settings: A and B. When in position A, the relay contacts for K4 are normally open (NO). When in position B, the relay contacts for K4 are normally closed (NC).

NOTE

J5 – J8 are set to position A at the factory or according to customer specifications.

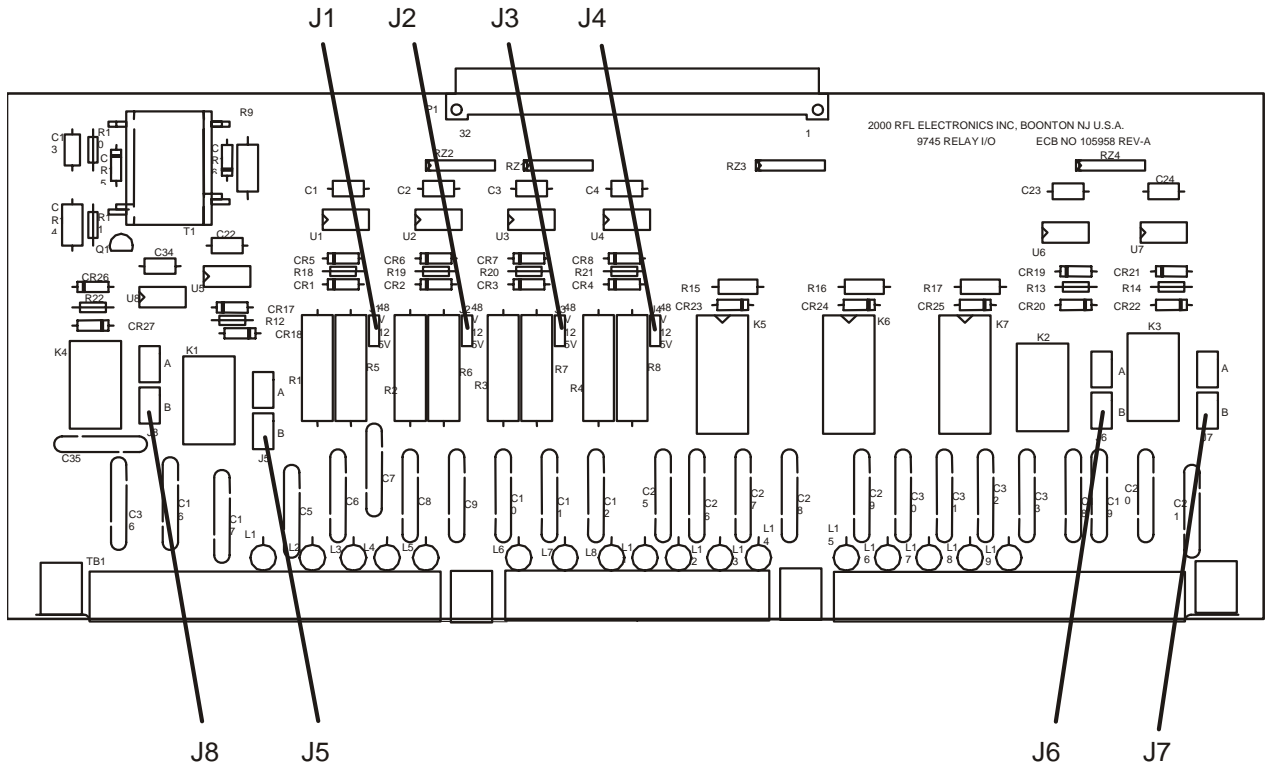


Solid-state (Assy. No. 105005).



Relay/solid-state (Assy. No. 105010).

Figure 3- 33. Location of jumpers on the SWC I/O Modules



High speed relay (Assy. No. 105955).

Figure 3-33. continued. Location of jumpers on the SWC I/O Modules

3.7 COMMISSIONING PROCEDURES

3.7.1 RFL 9745 AUDIO TONE COMMISSIONING PROCEDURE

3.7.1.1 EQUIPMENT REQUIRED

1. PC or Laptop computer
2. 9 pin straight through cable with male and female connector.
3. Selective Voltmeter (optional)

3.7.1.2 JUMPER SETTINGS

The jumper settings are performed at RFL per customer application. Follow the list below for confirmation of the jumper settings. Refer to paragraph 3.6 for additional information.

Wide Band Audio Comms module:

- for 4 wire single: set J3, J10 to A, J5 and J11 to 4W.
- for 4 wire dual: set J3, J10 to B, J5 and J11 to 4W.
- for 2 wire single: set J3, J10 to A, J5 and J11 to 2W.
- for 2 wire dual: set J3, J10 to B, J5 and J11 to 2W.

CPU module: Ref. Section 3.6.1

Driver module: check for jumper J2-NORM.

I/O modules: select J1, J2, J3 and J4 for proper input keying voltage 48/125 Vdc. For the 24 Vdc and the 250 Vdc modules there is no jumper selection. For outputs Ref. 3.6.7

Power Supply module: No user settings:

Front Panel module: No user settings:

3.7.1.3 WIRING

Specific CD drawings are supplied with each order. Connect all external wiring to the unit in accordance with the rear view chassis wiring drawing, and Primitive and Alarm logic drawings supplied with the chassis.

3.7.1.4 POWER

Turn the unit on by pressing the rocker switch at the rear of the unit. Check Station Battery voltage at TB1-9 (+) and TB1-10 (-) for proper voltage. The green LED on the Power Supply should be lit. On the Driver module check the positive 5 and 15 Vdc. TP1 is common, TP6 is +15Vdc (14.25 to 15.75Vdc), and TP2 is +5Vdc (4.75 to 5.75Vdc).

3.7.1.5 9745 BAUD RATE

On the front panel of the unit press the “LEVELS” button, then press the “UP” button. The unit should display the baud rate. If it does not display 9600 press the “ENTER” button, then press the “UP” button to change the baud rate to 9600. Then press the “ENTER” button again.

3.7.1.6 RS-232 COMMUNICATIONS

Set up the RS-232 communications by using the following procedure:

1. Connect a Laptop or PC computer to the front RS-232 port via a straight through 9 pin cable.
2. Click on the PC APRIL LITE icon on your desktop and go to “Setup.”
3. Set up your COM Options, then click on “Terminal.”
4. Hit the “ENTER” key to display a “9745>” prompt.
5. When you see the “9745>” prompt, you are receiving data from the 9745.
6. On your PC turn the Caps Lock on.

3.7.1.7 LOADING THE LOGIC AND BATCH FILES

If RFL is supplying custom logic at the time of shipment of the chassis, the logic will be loaded and tested in the units at the factory. If the RFL 9745 does not contain the operating logic and parameters required for your application, you must load the proper custom logic files by following the steps below:

1. Click on “Upload to 9745.”
2. Click on “Upload Logic File.”
3. Browse to the location of the MHX file.
4. Click on “Send.”
5. When completed click on “OK” then “Exit.”

To load the BAT file, do the following:

1. Click on “Upload to 9745.”
2. Click on “Upload Parameter File.”
3. Browse to the location of BAT file.
4. Click on “Send.”
5. When completed click on “OK” then “Exit.”

3.7.1.8 SYSTEM SETTINGS (PROGRAMMING MENU)

1. On the PC type the letter “P” to enter the Programming menu.
2. Enter the password.
3. Type the letter “D” to display the current settings.
4. Set the Transmit level for all active channels; lines 3, 18, 33 and 48.
5. On the front panel press the “LEVELS” button, then press the “DOWN” button until you get to Receive 1, Receive 2, Receive 3 and Receive 4. Record the levels displayed for each channel. In the programming menu set the Receive level settings for each channel on lines 7, 22, 37 and 52 to match the values from the Levels display.
6. If it is necessary to change the frequencies, bandwidth, channel shift, or FM or AM noise, refer to pages 5-10 and 5-11 of the 9745 instruction manual for suggested settings.
7. Set the RX ALARM detectors, lines 8, 23, 38 and 53 to 8 dB below the receiver level set in step 5 above.
8. If you set the Audio communications module to operate as a dual channel four wire system, then line 61 EE POT J10 should be set to “B”.
9. Set line 62 CHANNEL DELAY to the maximum communications channel delay your protection scheme can tolerate.
10. Set line 63 YEAR to the current year.
11. Set line 64 DATE to the current date.
12. Set line 65 TIME to the current time.
13. Set line 67 LOCAL ADDRESS to a user preferred value. This value must match the value of line 68 REMOTE ADDRESS on the remote chassis.
14. Set line 68 REMOTE ADDRESS to a user preferred value. This value must match the value of line 67 LOCAL ADDRESS on the remote chassis.
15. Type “SV” to save all the changes made in the programming menu.
16. Type “Q” to quit the programming menu.

3.7.1.9 INPUT, OUTPUT, AND ALARM RELAY LABELS

If you would like to apply labels to the inputs, outputs or the alarm relays, use the following procedure:
(Refer to Section 6 for more information)

1. Type “K” and “ENTER” to enter the Logic programming menu.
2. Enter the password.
3. Type “A” to go to the Alarm and I/O name menu.
4. Enter the line number of the item you would like to change.
5. Enter the label information.
6. Type “SV” to save the new labels, prior to leaving this menu.

3.7.1.10 MODEM TESTING

If you are using channel 1 in the modem mode, perform the following steps:

1. From the main menu enter the Test menu by typing “T” and “ENTER”.
2. Enter the password.
3. Set line 6 TESTS/RESETS FROM THE FRONT PANEL to “ENABLED”.
4. From the front panel press the “TEST” button. Press “UP” or “DOWN” until you get to CHECKBACK TEST. Press “ENTER” to run a checkback and address test.
5. On the front panel press “UP” or “DOWN” until you get to PING PONG. Press “ENTER” to run the ping pong (channel delay) test.

3.7.1.11 END TO END TESTING

Using the Primitive Logic drawing apply voltage to the keying inputs at the local end. On the remote end observe that the appropriate trip outputs energize. The TX and RX front panel LEDs should illuminate for all tripped channels. Exercise all aspects of the primitive and alarm logic observing all outputs for their correct response.

3.7.1.12 RESETTING RECORDS

To reset the Log Counters from the front panel, do the following:

1. On the front panel press “LOG”, then press “UP” to access “RESET”.
2. Press “ENTER”, “UP” and “ENTER” to reset the log counters.

To reset the Sequence of Events Log with a PC, do the following:

1. From the main menu type “S” and “ENTER” to enter the Sequence of Events menu.
2. Type “R” to select reset.
3. Type “Y” to select yes.
4. Press “ENTER” to reset the Sequence of Events Log.

To disable the front panel with a PC, do the following:

1. From the main menu enter the Test menu by typing “T” and “ENTER”.
2. Enter the password.
3. Set line 6 TESTS/RESETS FROM THE FRONT PANEL to “DISABLED”.
4. Type “Q” to quit the test menu.

3.7.1.13 EXITING THE 9745 (Refer to Section 9 for more information)

1. On your PC click on “Terminal” then “Disconnect.”
2. Click on “OK.”
3. Then click “File” and “Exit” (no save necessary) to exit PC April Lite.

3.7.2 RFL 9745 DIGITAL COMMISSIONING PROCEDURE

3.7.2.1 EQUIPMENT REQUIRED

1. PC or Laptop computer
2. 9 pin straight through cable with male and female connector.

3.7.2.2 JUMPER SETTINGS

The jumper settings are performed at RFL per customer application. Follow the list below for confirmation of the jumper settings. Refer to paragraph 3.6 for additional information.

Digital Communications module:

- Set J1 to B.
- Set J2 to B.
- Set J3 to 56K or 64K (Refer to paragraph 3.6.5).
- Set J4 to A.
- Set J5 to A.
- Set J6 to B (Refer to paragraph 3.6.5).

CPU module: check for jumpers J1-installed, J6-installed, and J7 in A position.

Driver module: check for jumper J2-NORM.

I/O modules: select J1, J2, J3 and J4 for proper input keying voltage 48/125 Vdc. For the 24 Vdc and the 250 Vdc modules there is no jumper selection.

Power Supply module: If a 48/125 Vdc power supply is being used (105020-2) set SW1 to the 48V position if 48Vdc is being used, or set SW1 to the 125V position if 125 Vdc is being used. All of the other power supplies have no user settings.

Front Panel module: no user settings:

3.7.2.3 WIRING

Specific CD drawings are supplied with each order. Connect all external wiring to the unit in accordance with the rear view chassis wiring drawing, and Primitive and Alarm logic drawings supplied with the chassis.

3.7.2.4 POWER

Turn the unit on by pressing the rocker switch at the rear of the unit. Check Station Battery voltage at TB1-9 (+) and TB1-10 (-) for proper voltage. The green LED on the Power Supply should be lit. On the Driver module check the positive 5 and 15 Vdc. TP1 is common, TP6 is +15Vdc (14.25 to 15.75Vdc), and TP2 is +5Vdc (4.75 to 5.75Vdc).

3.7.2.5 9745 BAUD RATE

On the front panel of the unit press the “LEVELS” button, then press the “UP” button. The unit should display the baud rate. If it does not display 9600 press the “ENTER” button, then press the “UP” button to change the baud rate to 9600. Then press the “ENTER” button again.

3.7.2.6 RS-232 COMMUNICATIONS

Set up the RS-232 communications by using the following procedure:

1. Connect a Laptop or PC computer to the front RS-232 port via a straight through 9 pin cable.
2. Click on the PC APRIL LITE icon on your desktop and go to “Setup.”
3. Set up your COM Options, then click on “Terminal.”
4. Hit the “ENTER” key to display a “9745>” prompt.
5. When you see the “9745>” prompt, you are receiving data from the 9745.
6. On your PC turn the Caps Lock on.

3.7.2.7 LOADING THE LOGIC AND BATCH FILES

If RFL is supplying custom logic at the time of shipment of the chassis, the logic will be loaded and tested in the units at the factory. If the RFL 9745 does not contain the operating logic and parameters required for your application, you must load the proper custom logic files by following the steps below:

1. Click on “Upload to 9745.”
2. Click on “Upload Logic File.”
3. Browse to the location of the MHX file.
4. Click on “Send.”
5. When completed click on “OK” then “Exit.”

To load the BAT file, do the following:

1. Click on “Upload to 9745.”
2. Click on “Upload Parameter File.”
3. Browse to the location of BAT file.
4. Click on “Send.”
5. When completed click on “OK” then “Exit.”

To enable hidden parameters, do the following:

1. Type "T" and press "ENTER" to access the Test Menu.
2. Type in the password.
3. Type "99" and then press "ENTER".
4. Type "E" to enable "DEBUG INFORMATION" and then press "ENTER".

3.7.2.8 SYSTEM SETTINGS (PROGRAMMING MENU)

1. On the PC type the letter "P" to enter the Programming menu.
2. Enter the password.
3. Type the letter "D" to display the current settings.
4. Set line 63 YEAR to the current year.
5. Set line 64 DATE to the current date.
6. Set line 65 TIME to the current time.
7. Set line 67 LOCAL ADDRESS to a user preferred value. This value must match the value of line 68 REMOTE ADDRESS on the remote chassis.
8. Set line 68 REMOTE ADDRESS to a user preferred value. This value must match the value of line 67 LOCAL ADDRESS on the remote chassis.
9. Type "SV" to save all the changes made in the programming menu.
10. Type "Q" to quit the programming menu.

3.7.2.9 INPUT, OUTPUT, AND ALARM RELAY LABELS

If you would like to apply labels to the inputs, outputs or the alarm relays, use the following procedure: (Refer to Section 6 for more information)

1. Type “K” and “ENTER” to enter the Logic programming menu.
2. Enter the password.
3. Type “A” to go to the Alarm and I/O name menu.
4. Enter the line number of the item you would like to change.
5. Enter the label information.
6. Type “SV” to save the new labels, prior to leaving this menu.

3.7.2.10 MODEM TESTING

1. From the main menu enter the Test menu by typing “T” and “ENTER”.
2. Enter the password.
3. Set line 6 TESTS/RESETS FROM THE FRONT PANEL to “ENABLED”.
4. From the front panel press the “TEST” button. Press “UP” or “DOWN” until you get to CHECKBACK TEST. Press “ENTER” to run a checkback and address test.
5. On the front panel press “UP” or “DOWN” until you get to PING PONG. Press “ENTER” to run the ping pong (channel delay) test.

3.7.2.11 END TO END TESTING

Using the Primitive Logic drawing apply voltage to the keying inputs at the local end. On the remote end observe that the appropriate trip outputs energize. The TX and RX front panel LEDs should illuminate for all tripped channels. Exercise all aspects of the primitive and alarm logic observing all outputs for their correct response.

3.7.2.12 RESETTING RECORDS

To reset the Log Counters from the front panel, do the following:

1. On the front panel press “LOG”, then press “UP” to access “RESET”.
2. Press “ENTER”, “UP” and “ENTER” to reset the log counters.

To reset the Sequence of Events Log with a PC, do the following:

1. From the main menu type “S” and “ENTER” to enter the Sequence of Events menu.
2. Type “R” to select reset.
3. Type “Y” to select yes.
4. Press “ENTER” to reset the Sequence of Events Log.

To disable the front panel with a PC, do the following:

1. From the main menu enter the Test menu by typing “T” and “ENTER”.
2. Enter the password.
3. Set line 6 TESTS/RESETS FROM THE FRONT PANEL to “DISABLED”.
4. Type “Q” to quit the test menu.

3.7.2.13 EXITING THE 9745

(Refer to Section 9 for more information)

1. On your PC click on “Terminal” then “Disconnect.”
2. Click on “OK.”
3. Then click “File” and “Exit” (no save necessary) to exit PC April Lite.

3.8 WIDEBAND AUDIO COMMUNICATIONS MODULE UPGRADE INSTALLATION INSTRUCTIONS

The instructions in this section describe how to upgrade an RFL 9745 terminal from one using a narrowband audio communications module to one using a wideband audio communications module.

Equipment Required

1. Wideband Audio Communications Module (Assembly No. 105920-1, -2, -3 or -4)
2. RFL 9745 PC April Lite software CD (Part No. SW9745PALXX)*
3. RFL 9745 Wideband system software CD (Part No. SW9745SY0XX)*

* XX = Revision level.

Basic Steps

1. Remove narrowband module
2. Set jumpers on wideband module
3. Install wideband module
4. Install new April software
5. Install wideband system software

3.8.1 REMOVING THE NARROWBAND MODULE

The Audio Communications Module is mounted at the front of the RFL 9745 chassis, and extends to the rear where it is attached to a plate along the top of the chassis. To remove the narrowband audio communications module, proceed as follows:

1. On the RFL 9745 rear panel, place the POWER switch on the power supply I/O module behind the Main Power Supply Module to the OFF position.
2. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the power supply I/O module behind the Redundant Power Supply Module to the OFF position.
3. Open the door on the front of the RFL 9745 by loosening the two thumbscrews that hold it closed, and lower the door to its opened position.
4. Disconnect the ribbon cables from the front edge of the Communications module.
5. Disconnect all cables from the connectors on the plate behind the Communications module. (Rear RS-232 connector)
6. Disconnect all wires from terminal blocks (TB2) on the plate behind the communications module. Tag all wires before removing them if they aren't already labeled. This will simplify reassembly.
7. Using a cross blade screwdriver, remove all screws near the connectors and terminal blocks on the plate behind the communications module. **Do not remove the screws in the corners of the plate. These hold the plate in position.**
8. Pull the communications module out of the front of the chassis.

3.8.2 SETTING THE JUMPERS ON THE WIDEBAND MODULE

Before installing the wideband audio communications module, jumpers must be set as described below.

There are four versions of the wide band Audio Communications Module. Each version uses the same basic printed circuit board but only certain portions of each board are populated with components. The two-tone version of the module has five programmable jumpers as shown in Figure 3-20. The four-tone version of the module has eleven programmable jumpers as shown in Figure 3-21. Refer to the table below for additional information.

Table 3-11. Commissioning – Audio Comms Module Part Numbers

Part Number	Application	Notes
105920-3	four-tone	compression-type terminal block
105920-4	two-tone	compression-type terminal block
105920-1	four-tone	screw-type terminal block
105920-2	two-tone	screw-type terminal block

- J1** J1 sets the notch on the power supply frequency rejection filter. It is set to position 50 for 50 Hz power, or position 60 for 60 Hz power. This jumper is set at the factory, but can be changed in the field.
- J2** J2 sets the notch on the power supply frequency rejection filter. It is set to position 50 for 50 Hz power, or position 60 for 60 Hz power. This jumper is set at the factory, but can be changed in the field.
- J12** J12 selects the Test or Run mode of the RFL 9745. The Test mode disables the watchdog timer and is used for factory testing only. The Run mode is used when the RFL 9745 is in service. This jumper is set at the factory, and should not be changed in the field.
- J13** J13 selects or bypasses the Channel 1 and Channel 2 programmable filter. When J13 is in the IN position, the programmable filter is in the circuit. When J13 is set to the OUT position, the programmable filter is bypassed. This jumper is set at the factory but can be changed in the field.
- J14** J14 selects or bypasses the Channel 3 and Channel 4 programmable filter. When J14 is in the IN position, the programmable filter is in the circuit. When J14 is set to the OUT position, the programmable filter is bypassed. This jumper is set at the factory but can be changed in the field.
- J15** J15 is used for factory testing only. This jumper is installed at the factory, and should not be removed in the field.
- J16** J16 is used for factory testing only. This jumper is installed at the factory, and should not be removed in the field.

J3, 5, 10, 11 J3, J5, J10 and J11 must be set to position A, B, 2W or 4W as applicable, in accordance with the wiring configuration of the RFL 9745. Determine the wiring configuration your system requires and then set the jumpers in accordance with the table below.

Table 3-12. Commissioning - Wide Band Audio Comms Module Wiring Configuration with RFL9745

Jumpers ↓	Wiring Configuration			
	Single-Channel Four-Wire (TB2-1, 2, 3, 4)	Single-Channel Two-Wire (TB2- 3, 4)	Dual-Channel Four-Wire (TB2-1, 2, 3, 4, 5, 6, 7, 8)	Dual-Channel Two-Wire (TB2- 3, 4, 7, 8)
J3	Position A	Position A	Position B	Position B
J5	Position 4W	Position 2W	Position 4W	Position 2W
J10*	Position A*	Position A*	Position B*	Position B*
J11	Position 4W	Position 2W	Position 4W	Position 2W

* Parameter 061 as shown in Figure 5-1 must be set to match the J10 jumper setting on the Audio Communications module (See Figures 3-17 or 3-18 for location). If jumper J10 is in position A, set Parameter 061 to “A”. If jumper J10 is in position B, set Parameter 061 to “B”. If the audio board has only two tones, jumper J10 cannot be set by the user since it is hard wired at the factory. In this case, Parameter 061 must be set to “B”.

3.8.3 INSTALLING THE WIDEBAND MODULE

After the jumpers have been set in accordance with paragraph 3.8.2, install the wideband module as follows:

1. Line up the edges of the wideband audio communications module circuit board with the card guides at the top of the chassis.
2. Slide the communications module into the chassis until its rear panel is firmly seated in the chassis.
3. Using a cross-blade screwdriver, install and tighten the screws near the connectors and terminal blocks on the plate behind the communications module to secure the module to the plate.
4. Using the tags or labels on the wires as a guide, reconnect all wires to the terminal blocks on the plate behind the communications module.
5. Reconnect all cables to the connectors on the plate behind the communications module.
6. Reconnect the ribbon cable from the front panel to the front edge of the communications module.
7. Close the door on the front of the RFL 9745, and tighten the two thumbscrews to hold it closed.

3.8.4 INSTALLING THE NEW SOFTWARE

Install the new PC April Lite software (SW9745PCXXX) in accordance with paragraph 9.2.1 and then upload the new system software, new logic, and new parameters as described below. Refer to Section 9 of the RFL 9745 Instruction Manual for information on using PC April Lite.

3.8.4.1 UPLOADING NEW SYSTEM SOFTWARE TO THE RFL 9745

New system software (SW9745SYXXX) was supplied with the wideband audio communications upgrade kit in the form of a file on a CD. The file name is S9745R00.mhx. This software must be installed in the RFL 9745 in order for wideband module to work correctly. Upload the new system software in accordance with paragraph 9.5.2.3 of the RFL 9745 Instruction Manual.

3.8.4.2 UPLOADING NEW LOGIC TO THE RFL 9745

It is not essential that new logic be used with the new module. If new logic was supplied with your upgrade kit, install it now. Upload new Logic Software in accordance with paragraph 9.5.2.2 of the RFL 9745 Instruction Manual.

3.8.4.3 UPLOADING NEW PARAMETERS TO THE RFL 9745

Several audio parameter settings have been optimized for use with the wideband audio communications module. You may have been supplied with a new parameter file unique to your application. If so, upload the new Parameter Software in accordance with paragraph 9.5.2.1 of your RFL 9745 Instruction manual. If a new parameter file was not supplied, make the appropriate changes as described in paragraph 3.8.5 of this section.

3.8.5 CONSIDERATIONS WHEN UPGRADING FROM PREVIOUS VERSIONS

The wideband audio system for the RFL 9745 is very similar to the narrow band system. Certain minor changes have been made to the recommended settings when the wideband system is used. These are described below.

3.8.5.1 NEW PARAMETER RECOMMENDATIONS

The recommended audio parameter values have been modified for optimum balance between speed, security, and dependability. If a batch file prepared for the wideband system is uploaded, then these values are automatically changed. If the parameter values being used in a given application were originally generated for the narrow band audio board, the values should be changed as follows. Instructions on how to change parameter values are given in Section 6 of the 9745 manual.

Table 3-13. Audio Parameter Recommendations

Shift	Spacing (Hz)	RX BW (Hz)	FM Noise (%)	AM Noise (dB)
+/- 30 Hz	120	73	10	6
+/- 42.5 Hz	170	95	11	8
+/- 60 Hz	240	150	15	9
+/- 75 Hz	340	225	15	9
+/- 85 Hz	375	250	15	9
+/- 120 Hz	480	310	16	12
+/- 150 Hz	680	360	19	14
+/- 240 Hz	960	510	35	14

3.8.5.2 NEW HIDDEN AUDIO SYSTEM PARAMETERS

Two of the hidden audio parameters in the RFL 9745 need to be changed from the default settings when the system is upgraded. If a batch file prepared for the wideband system is uploaded, then these parameters are automatically changed if the hidden parameters have been made accessible in the 9745.

The hidden parameters are made accessible by entering the test menu and modifying selection 99 (which is not a visible selection) from disable to enable. Once this is changed, the values can be seen and changed in the programming menu.

If the parameter list was originally generated for the narrow band system then the changes need to be made manually. The two hidden parameters that must be changed are shown in the table below.

Table 3-14. Hidden Audio Parameter Settings

Parameter No.	Parameter Name	Narrowband	Wideband
181	FD Upper Thresh	0.33	0.275
183	AM Lower Thresh	-28	-38

3.8.5.3 LOGIC/TIMER DIFFERENCES

No logic differences are required to operate the wide band audio system. The pretrip timer values for certain shifts have been modified for optimum balance between speed, security, and dependability. If a batch file prepared for the wide band system is uploaded, then these timer values are automatically changed. If the timer values being used in a given application were originally generated for the narrow band board, the values should be changed as shown in the table below. Instructions on how to change timer values are given in section 6.10.5.

Table 3-15. Pretrip Timer Values

Shift	Pretrip Timer 1 (ms)	Pretrip Timer 2 (ms)
+/- 30 Hz	4.5	5.0
+/- 42.5 Hz	3.0	3.5
+/- 60 Hz	3.0	2.0
+/- 75 Hz	3.0	2.0
+/- 85 Hz	3.0	2.0
+/- 120 Hz	Unchanged	Unchanged
+/- 150 Hz	Unchanged	Unchanged
+/- 240 Hz	Unchanged	Unchanged

3.8.5.4 TRANSMISSION TIME DIFFERENCES

The transmission times for standard arrangements with the new recommended parameters are slightly different than previous versions. The following table gives the average trip times for default logic and recommended settings.

Table 3-16. Average Trip Times

Shift	Trip Time (ms)
+/- 30 Hz	26.47
+/- 42.5 Hz	20.57
+/- 60 Hz	14.78
+/- 75 Hz	12.65
+/- 85 Hz	12.30
+/- 120 Hz	11.05
+/- 150 Hz	10.12
+/- 240 Hz	9.22

3.9 CONVERTING AN AUDIO TONE 9745 TO A DIGITAL 9745

3.9.1 EQUIPMENT REQUIRED

Digital Communication Module (Assembly No. 105060)
Digital Interface Module. Refer to section 2.2.5.
Custom logic for Digital applications.

3.9.2 BASIC STEPS

Remove Audio Module
Set jumpers on Digital Module and Interface Module
Install Digital Module with Interface Module.
Reprogram for Digital applications.

3.9.3 INSTRUCTIONS

3.9.3.1 REMOVING AUDIO MODULE

The Audio Communications Module is mounted at the front of the RFL 9745 chassis, and extends to the rear where it is attached to a plate along the top of the chassis. To remove the Audio communications module, proceed as follows.

On the RFL 9745 rear panel, place the POWER switch on the power supply I/O module behind the Main Power Supply Module to the OFF position.

If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the power supply I/O module behind the Redundant Power Supply Module to the OFF position.

Disconnect all cables from connectors on the plate behind the Communications module. (Rear RS-232 connector)

Disconnect all wires from terminal blocks (TB2) on the plate behind the communications module.

Using a cross blade screwdriver, remove all 4 screws near the connectors and terminal blocks on the plate behind the communications module. **Do not remove the screws in the corners of the plate. These hold the plate in position.**

Open the door on the front of the RFL 9745 by loosening the two thumbscrews that hold it closed, and lower the door to its opened position.

Disconnect the 6-wire cable from the front left edge of the Communications module.

Pull the communications module out of the front of the chassis.

3.9.3.2 SETTING THE JUMPERS ON THE DIGITAL MODULES

Before installing the Digital Modules, jumpers must be set as described in sections 3.6.5. through 3.6.5.4. Note that your particular Digital Interface Module may not have jumpers.

3.9.3.3 INSTALLING THE DIGITAL MODULE WITH INTERFACE MODULE

After the jumpers have been set in accordance with the above step, install the Digital Modules as follows:

1. Line up the edges of the Digital Communications module circuit board with the card guides at the top of the interior of the chassis.
2. Slide the communications module into the chassis until its rear panel is firmly seated in the chassis.
3. Reconnect the 6-wire cable from the front panel to the front left edge of the communications module.
4. Close the door on the front of the RFL 9745, and tighten the two thumbscrews to hold it closed.
5. Using a cross-blade screwdriver, install and tighten the 2 outer screws near the connectors on the plate behind the communications module.
6. Line up the Digital Interface Module and insert it into the rear of the chassis. Be sure it is properly seated into the Digital Communications Module.
7. Using a cross-blade screwdriver, install and tighten the screws into the Digital Interface plate.

3.9.3.4 REPROGRAM FOR DIGITAL APPLICATIONS

1. Copy the Custom Logic disk into the directory containing PC April Lite.
2. Start PC April Lite and load the MHX file into the RFL 9745 following the instructions in Section 9.2.
3. When the logic file has finished loading, refer to Section 6.1.4 Advanced Parameters Option. **Insure that all “hidden” parameters (186 through 193) are set to their default values.** See paragraph 6.1.4.
4. When the logic file is finished loading, refer to section 6.14. Advanced Parameters option. **Insure that all “hidden” digital parameters (186 through 193) are set to default values. See paragraph 6.14.**
5. Refer to section 9.2 to load the parameter file (BAT).

Section 4. USING THE RS-232 PORTS TO ACCESS THE RFL 9745

4.1 INTRODUCTION

This section provides information on how to use the RFL 9745's RS-232 ports to access the RFL 9745 and configure it to suit your application.

4.2 ACCESSING THE RFL 9745 FROM A PC OR TERMINAL

You can use the RS-232 connector on the front (DTE, data terminal equipment) or rear (DCE, data communication equipment) of the RFL 9745 to access it from a dumb terminal or a personal computer equipped with terminal emulation software. Hardware priority is given to the front port. Once connected, you can use APRIL (Asynchronous Programming and Remote Interrogation Language) LITE to do any of the following:

1. View a list of parameter settings.
2. Change parameter settings as required.
3. Monitor RFL 9745 operation.
4. Review lists of alarms.
5. Review the sequence of events log.

Because APRIL is menu-based, you do not have to memorize the commands. Help screens can always be displayed by pressing the **[H]** key.

To use APRIL, you will have to connect a terminal to the RS-232 connector on the front or rear of the RFL 9745. The terminal can be a dumb RS-232 terminal, or a PC or laptop computer with an RS-232 port running a terminal emulation program or the supplied PC APRIL LITE software. (See Section 9 for a description of the PC APRIL LITE software). The emulation mode must be either ANSI or VT-100. You could also connect the RFL 9745's RS-232 port to one of the ports on an RFL 9660 Digital Switch or a stand-alone modem, and access the RFL 9745 with APRIL from a remote site.

There is a difference between APRIL and PC APRIL. APRIL is software that is in the RFL 9745 chassis. PC APRIL LITE is software in the PC that communicates with APRIL via the RS-232 port.

With a dumb RS-232 terminal, or with a PC or laptop loaded with terminal emulation software, a user can do the following:

1. Communicate with an RFL 9745
2. Load (upload) files (System files, Batch files or MHX files)

With a PC or laptop loaded with PC APRIL LITE software, a user can do the following:

1. Communicate with an RFL 9745
2. Load (upload) files (System files, Batch files or MHX files)
3. Retrieve (download) files (Batch files or MHX files)

4.2.1 COMMUNICATION INFORMATION

The serial port on your terminal or computer must be configured the same as the RFL 9745's serial port. Settings are as follows:

Data Bits	8
Stop Bits	1
Parity	None
Baud Rate	300, 1200, 2400, 9600, or 19,200 baud
Flow Control: (Handshaking)	XON/XOFF

4.2.1.1 BAUD RATE SELECTION

"Baud rate" determines how fast data is sent through the RS-232 port. To set the baud rate, use the following procedure:

1. On the rear panel, make sure the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module is in the ON position.
2. If the RFL 9745 is equipped with a redundant power supply, make sure the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module is in the ON position.
3. There are five pushbutton switches on the front panel, bracketed under the word "SELECT," with a switch labeled "ENTER" next to it. Press the switch labeled "LEVELS".
"TRANSMIT 1" will appear on the top line of the front-panel display, with a number on the bottom line.

4. Press the "UP" pushbutton switch next to the display.
The following prompt will appear on the display:

APRIL LITE BAUD RATE
(any one of the following numbers: 300, 1200, 2400, 9600, 19200)

5. Press the "ENTER" pushbutton switch to select this parameter, then press the "UP" and "DOWN" pushbutton switches until the desired baud rate appears on the bottom line of the display.
6. Press the "ENTER" pushbutton switch to select this baud rate.

The RFL 9745's RS-232 ports are now set to the desired baud rate.

4.2.1.2 FLOW CONTROL (HANDSHAKING)

"Handshaking" is a protocol used by RS-232 devices to establish connections. The RFL 9745 uses "XON/XOFF" software handshaking. It uses characters sent through the port to control data flow, and requires no additional cable connections.

4.2.1.3 FRONT-PANEL RS-232 CONNECTIONS

Figure 4-1 shows the connections that are required between your terminal or PC and the RS-232 connector on the front panel of the RFL 9745.

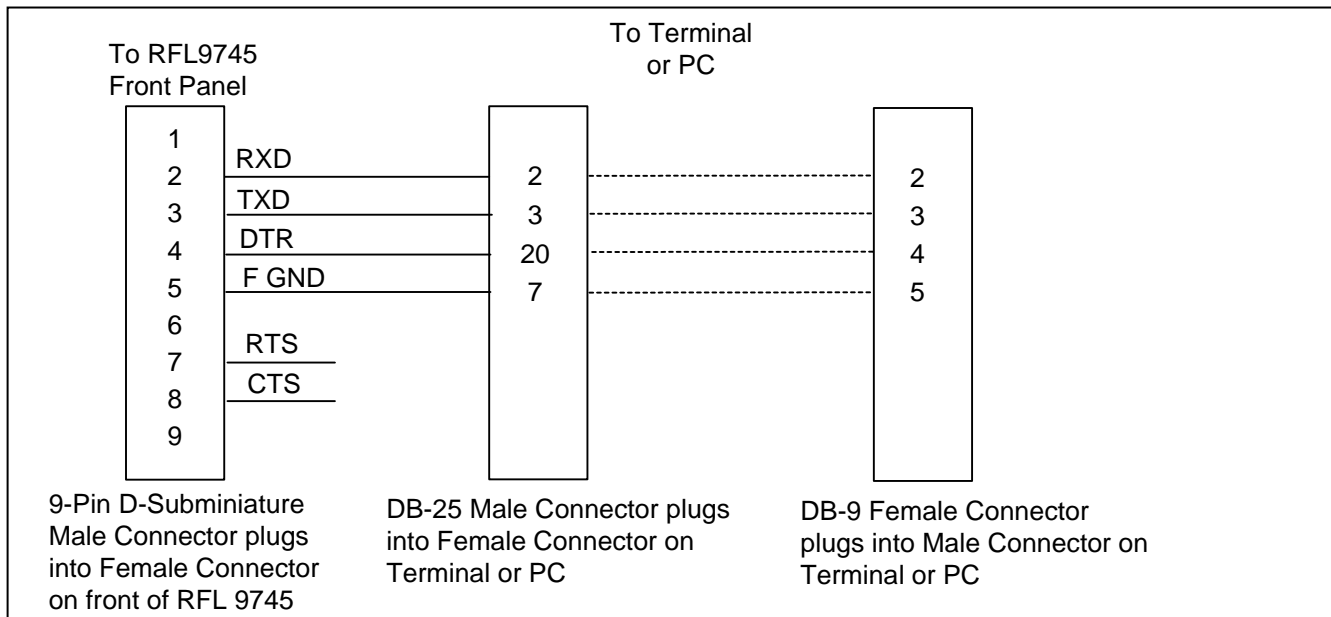


Figure 4-1. Cable connections between RFL 9745 and PC or terminal

4.2.1.4 NULL MODEM CABLE CONNECTIONS

Figure 4-2 shows the null modem cable connections between the RFL 9745 rear panel connector and the RS-232 connector on the rear panel of your terminal or PC.

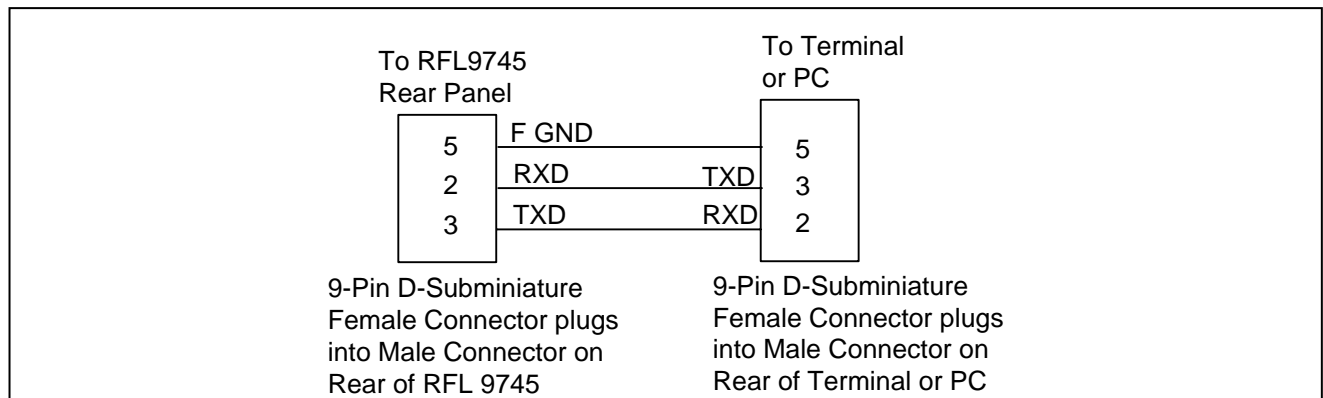


Figure 4-2. Null modem cable connections.

4.2.1.5 REAR-PANEL RS-232 CONNECTIONS

Figure 4-3 shows the connections that can be made between the RFL 9745 rear panel connector and the RS-232 connector on the rear panel of the RFL 9660.

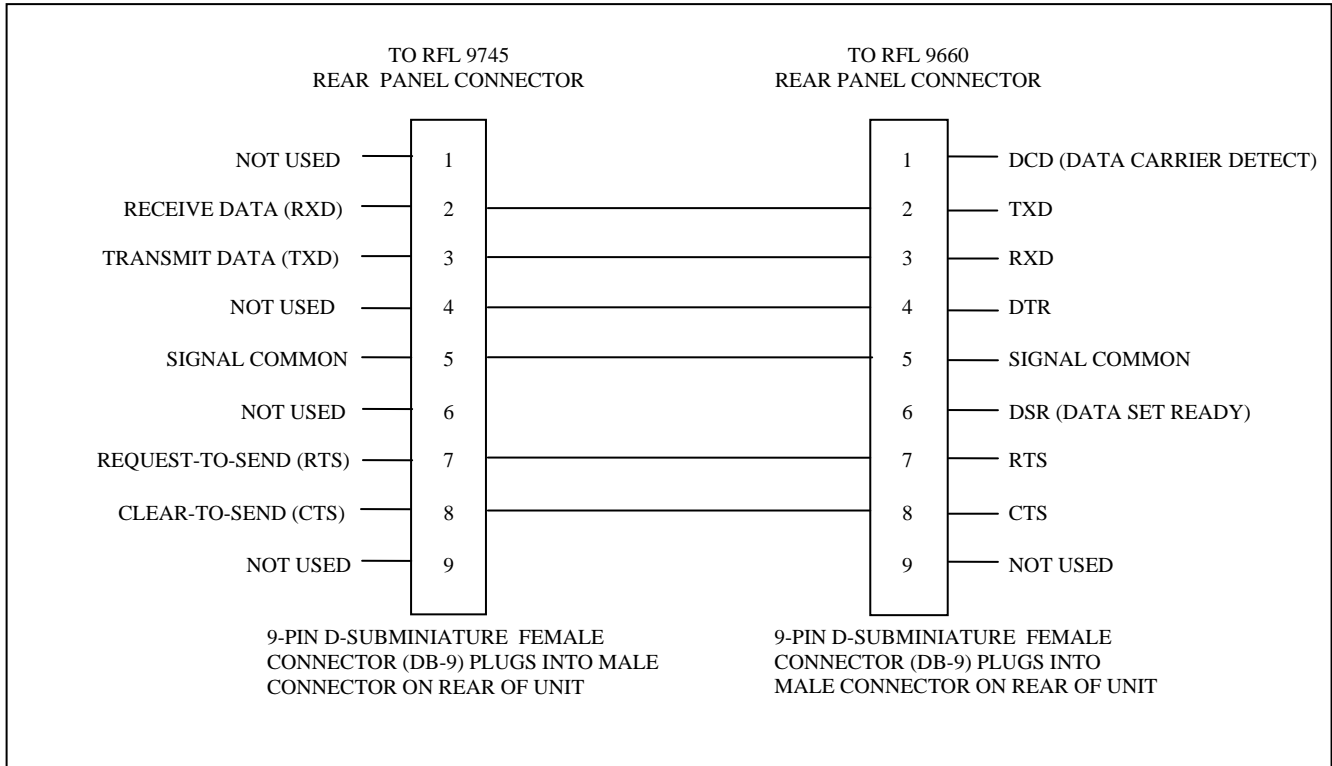


Figure 4-3. Cable connections between RFL 9745 and RFL 9660 Digital Switch.

NOTE

Any device connected to the front-panel RS-232 connector must drive the DTR line high. This will disable the rear-panel RS-232 port, eliminating any conflict that may arise from two users attempting to access the RFL 9745 at the same time. Most serial ports drive the DTR line high.

4.2.1.6 CONNECTING A REMOTELY LOCATED PC TO THE RFL 9745 USING MODEMS

To connect a remotely located PC to the 9745 using modems, refer to Figures 4-4a or 4-4b as applicable. The modems used in Figure 4-4a must have the S64 parameter.

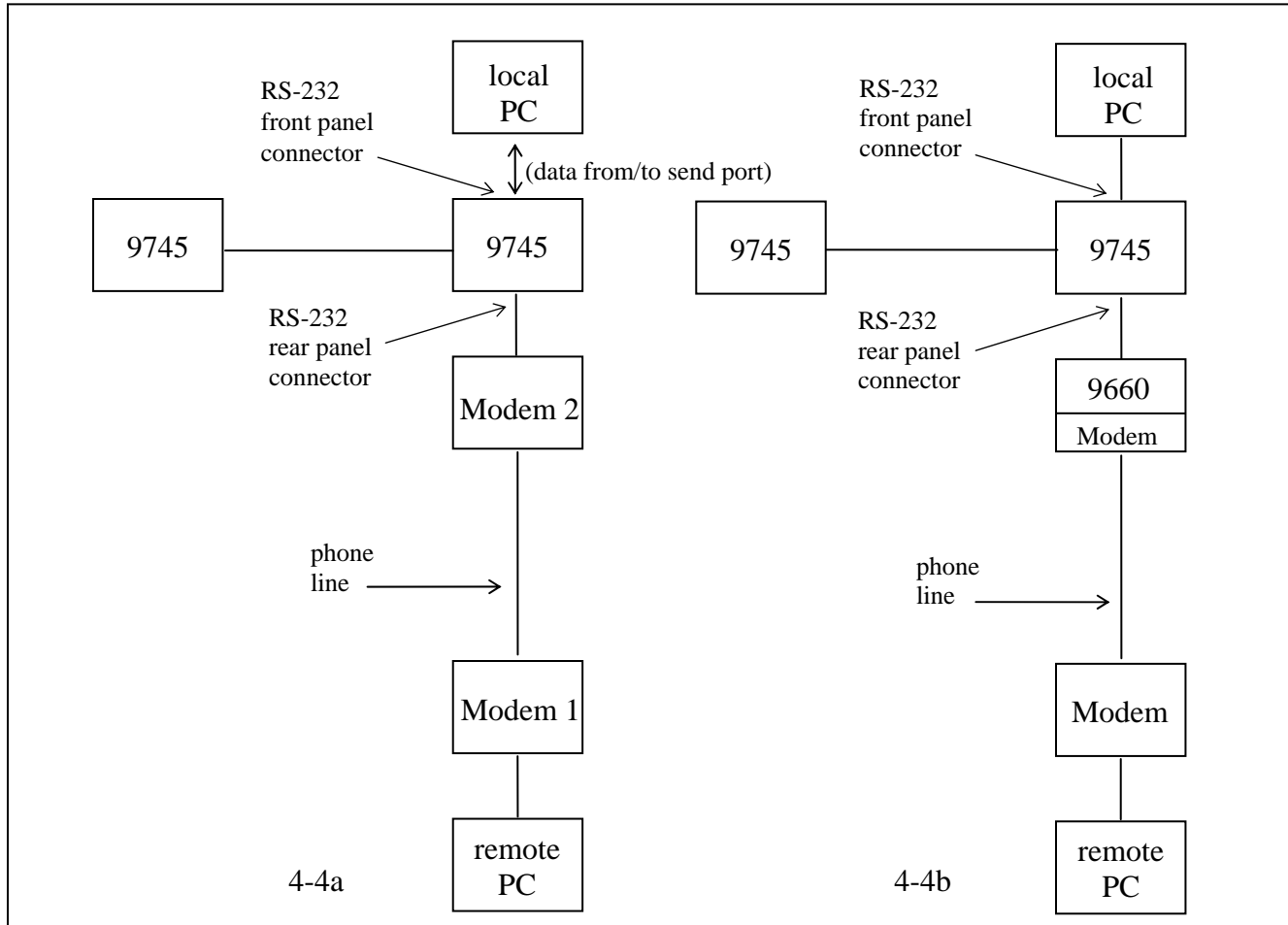


Figure 4-4. Connecting a remote PC to the RFL 9745 using modems

The 9745 transmits data from its send port at all times since the CTS (clear to send) line is always active. When modem 1 tries to dial up modem 2, modem 2 will go offhook momentarily. Modem 2 will see the data from the 9745 and will fail to connect since this data disrupts the handshaking between the two modems. Both modems must have the S64 parameter which is the Dial/Answer Sequence Abort parameter, which has a default of 0. The S64 parameter controls whether or not the modem aborts a dialing or answering sequence if characters are transmitted by the local DTE (the 9745) before a connection is established. In the 0 position, the modem aborts the dialing or answering sequence if characters are transmitted before a connection is established. In the 1 position, the modem will ignore any characters sent by the local DTE (the 9745) while dialing or answering a call. In order to function properly both modems must have their S64 parameters enabled.

This is not a problem when using a 9660 switch as shown in Figure 4-3b since the modems make their connections before the connection is made between the 9745 and the 9660.

4.2.2 TESTING RS-232 ACCESS

Once you have connected a terminal to the RFL 9745 (either directly or through an RFL 9660 Digital Switch), and have configured the serial port of your terminal or computer the same as the RFL 9745's serial port, then press the **[ENTER]** key. The RFL 9745 will send the following prompt to your terminal:

```
9745>
```

This means that you have accessed the RFL 9745, and can now use APRIL commands to view lists of parameter settings, alarm conditions, and other information. To view a list of the APRIL commands, press the **[H]** and **[ENTER]** keys:

```
9745>H [ENTER]
```

This tells the RFL 9745 to send a list of APRIL commands to your terminal. A typical APRIL command list appears in Figure 4-5.

```
RFL Electronics APRIL(t) Remote Communications, Version 2.0 (c) 1993, 1994
System Label
H - Display the main menu
A - Go to the alarms display
V - Go to the values display
P - Go to the programming menu (password required)
D - Go to the read settings menu
F - Go to the configuration and software version display
K - Go to the logic programming menu (password required)
T - Go to the test menu
U - Enter the update mode
X - Exit the update mode
S - Go to sequence of events menu
W - Window remote April
9745>
```

Figure 4-5. APRIL commands for use with RFL 9745

Once you have accessed the RFL 9745, use the procedures in Section 5 to set up the RFL 9745. Then you can use the procedures in Section 6 to program the RFL 9745 to suit your application, perform tests, and view the sequence-of-events log.

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Section 5. RFL 9745 AUDIO AND DIGITAL SYSTEM PARAMETERS

5.1 INTRODUCTION

This section contains descriptions of all programmable RFL 9745 Audio and Digital system parameters. It also contains procedures to be used when setting up the RFL 9745 for your specific application. See Tables 5-1 thru 5-9 for recommended parameter settings, recommended channel frequency settings, system performance trends, and parameter setup worksheets.

5.2 RFL 9745 AUDIO SYSTEM PARAMETERS

The following paragraphs provide descriptions of all RFL 9745 Audio system parameters. The parameters are listed in numerical order for easy reference. The parameter numbers appear on the screen when you access the RFL 9745 using APRIL LITE. A typical 9745 Audio system parameters display is shown in Figure 5-1.

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	SYSTEM LABEL			
001	Channel 1	Modem			
002	Tone 1 Tx Freq	700 Hz 1000 Hz			
003	Transmit Level	-15.00 dBm	004	Boost Level	0 dB
005	Tone 1 Rx Freq	700 Hz 1000 Hz			
006	Rx Bandwidth	380 Hz	007	Rx Level	-15 dBm
008	Rx Alarm	-33 dBm	009	AM Noise (SNR)	8 dB
010	FM Noise	75 %			
016	Channel 2	Single			
017	Tone 2 Tx Freq	1380 Hz 1680 Hz			
018	Transmit Level	-15.00 dBm	019	Boost Level	0 dB
020	Tone 2 Rx Freq	1380 Hz 1680 Hz			
021	Rx Bandwidth	380 Hz	022	Rx Level	-15 dBm
023	Rx Alarm	-33 dBm	024	AM Noise (SNR)	8 dB
025	FM Noise	28 %			
031	Channel 3	Single			
032	Tone 3 Tx Freq	2060 Hz 2360 Hz			
033	Transmit Level	-15.00 dBm	034	Boost Level	0 dB
035	Tone 3 Rx Freq	2060 Hz 2360 Hz			
036	Rx Bandwidth	380 Hz	037	Rx Level	-15 dBm
038	Rx Alarm	-33 dBm	039	AM Noise (SNR)	8 dB
040	FM Noise	28 %			
046	Channel 4	Single			
047	Tone 4 Tx Freq	2740 Hz 3040 Hz			
048	Transmit Level	-15.00 dBm	049	Boost Level	0 dB
050	Tone 4 Rx Freq	2740 Hz 3040 Hz			
051	Rx Bandwidth	380 Hz	052	Rx Level	-15 dBm
053	Rx Alarm	-33 dBm	054	AM Noise (SNR)	8 dB
055	FM Noise	28 %			
060	Opt Status Board	Yes	061	EE Pot J10	A
062	Chan delay alarm	8 ms	063	Year	1994
064	Date	08/09	065	Time	13:47:06
066	Hour Adjust	0	067	Local Address	456
068	Remote Address	888	069	Reset Log	
9745>					

Figure 5-1. Typical narrow band Audio System parameters display

CHANNEL/PARAMETER #

1 2 3 4

001 016 031 046 **CHANNEL 1, 2, 3, 4**

Parameters 001, 016, 031, 046 set the configuration for Channels 1, 2, 3, and 4 respectively. Five settings are possible for Channel 1, and three settings are possible for Channels 2, 3, and 4. The setting choices are listed below:

Single The channel will be configured to function as a single-tone transceiver.

Modem The channel will be configured to function as a 300-baud modem. This setting is required if the RFL 9745's addressing or checkback features will be used, or if you plan to communicate with a remote terminal using APRIL.

(This setting can be selected for channel 1 only.)

6750 Modem The channel will be configured to emulate an RFL 6750 Integrated Transfer Trip System (ITTS).

(This setting can be selected for channel 1 only.)

Pass The channel will be configured to function as a transfer filter with programmable bandwidth and amplification.

None This setting disables the channel. The parameters display will indicate "not defined".

To select a configuration, enter the first character of your choice ("S" for single, "M" for modem, "6" for 6750 Modem, "P" for pass, and "N" for none).

002 017 032 047 **TONE 1, 2, 3, 4 TX FREQ**

Parameters 002, 017, 032, 047 set the transmit frequencies for Tones 1, 2, 3, and 4 respectively. They are set by entering two numbers separated by a comma:

0000,0000

The first number is the lower frequency. For the narrow band comms module it can be any frequency from 300 Hz to 3399 Hz. For the wide band comms module it can be any frequency from 300 Hz to 3999 Hz.

The second number is the higher frequency. For the narrow band comms module it can be any frequency from 301 Hz to 3400 Hz that is higher than the lower frequency. For the wide band comms module it can be any frequency from 301 Hz to 4000 Hz that is higher than the lower frequency.

CHANNEL/PARAMETER #

1	2	3	4	
003	018	033	048	TRANSMIT LEVEL Parameters 003, 018, 033, 048 set the transmit level for Tones 1, 2, 3, and 4 respectively. They can be set to any value from -40 dBm to +10 dBm, in 0.25-dB steps. In the factory-default configuration, all of these parameters are set for a transmit level of -15.00 dBm.
004	019	034	049	BOOST LEVEL Parameters 004, 019, 034, 049 set the boost level for Tones 1, 2, 3, and 4 respectively. They can be set to any value from 0 dB to +12 dB, in 1-dB steps. In the factory-default configuration, all of these parameters are set for a boost level of 0 dB (no boost).
005	020	035	050	TONE 1, 2, 3, 4 RX FREQ Parameters 005, 020, 035, 050 set the receive frequencies for Tones 1, 2, 3, and 4 respectively. They are set by entering two numbers separated by a comma: 0000,0000 The first number is the lower frequency. For the narrow band comms module it can be any frequency from 300 Hz to 3399 Hz. For the wide band comms module it can be any frequency from 300 Hz to 3999 Hz. The second number is the higher frequency. For the narrow band comms module it can be any frequency from 301 Hz to 3400 Hz that is higher than the lower frequency, and which adheres to the formula below. For the wide band comms module it can be any frequency from 301 Hz to 4000 Hz that is higher than the lower frequency, and which adheres to the formula below. $Rx \text{ Freq High} < 2.33 \times Rx \text{ Freq Low}$
006	021	036	051	RX BANDWIDTH Parameters 006, 021, 036, 051 set the receive bandwidth for Tones 1, 2, 3, and 4 respectively. They can be set to any value from 50 Hz to 1000 Hz, in 1-Hz steps. The Rx Bandwidth shall be equal to or less than the center frequency divided by 2.
007	022	037	052	RX LEVEL Parameters 007, 022, 037, 052 set the input levels for the Tone 1, 2, 3, and 4 receivers respectively. They can be set to any value from -40 dB to 0 dB, in 1-dB steps. In the factory-default configuration, all of these parameters are set for a receiver level of -15 dB.

CHANNEL/PARAMETER #

1	2	3	4	
008	023	038	053	RX ALARM Parameters 008, 023, 038, 053 set the level at which the Tone 1, 2, 3, and 4 receiver alarms will activate. They can be set to any value from -70 dBm to 0 dBm, in 1-dB steps. In the factory-default configuration, all of these parameters are set for a receiver alarm level of -33 dBm.
009	024	039	054	AM NOISE (SNR) Parameters 009, 024, 039, 054 set the S/N ratio for the Tone 1, 2, 3, and 4 receivers respectively. They can be set to any value from -20 dB to +20 dB, in 1-dB steps.
010	025	040	055	FM NOISE Parameters 010, 025, 040, 055 set the FM noise value for the Tone 1, 2, 3, and 4 receivers respectively. They can be set to any value from zero to 100 percent, in 1-percent steps. The larger the FM noise setting, the more noise that can be accepted before the FM noise output is activated.

PARAMETER #

061				EE POT J10 Parameter 061, as shown in Figure 5-1, must be set to match the J10 jumper setting on the Audio Communications Module (See Figure 5-2 for jumper location). If jumper J10 is in Position A, set Parameter 061 to "A." If jumper J10 is in Position B, set Parameter 061 to "B."
-----	--	--	--	--

NOTE

Parameters 11 through 15 are not used when the RFL 9745 is configured for audio communications. If you try to select one of these parameters, the following error message will appear:

226 No entry for this configuration

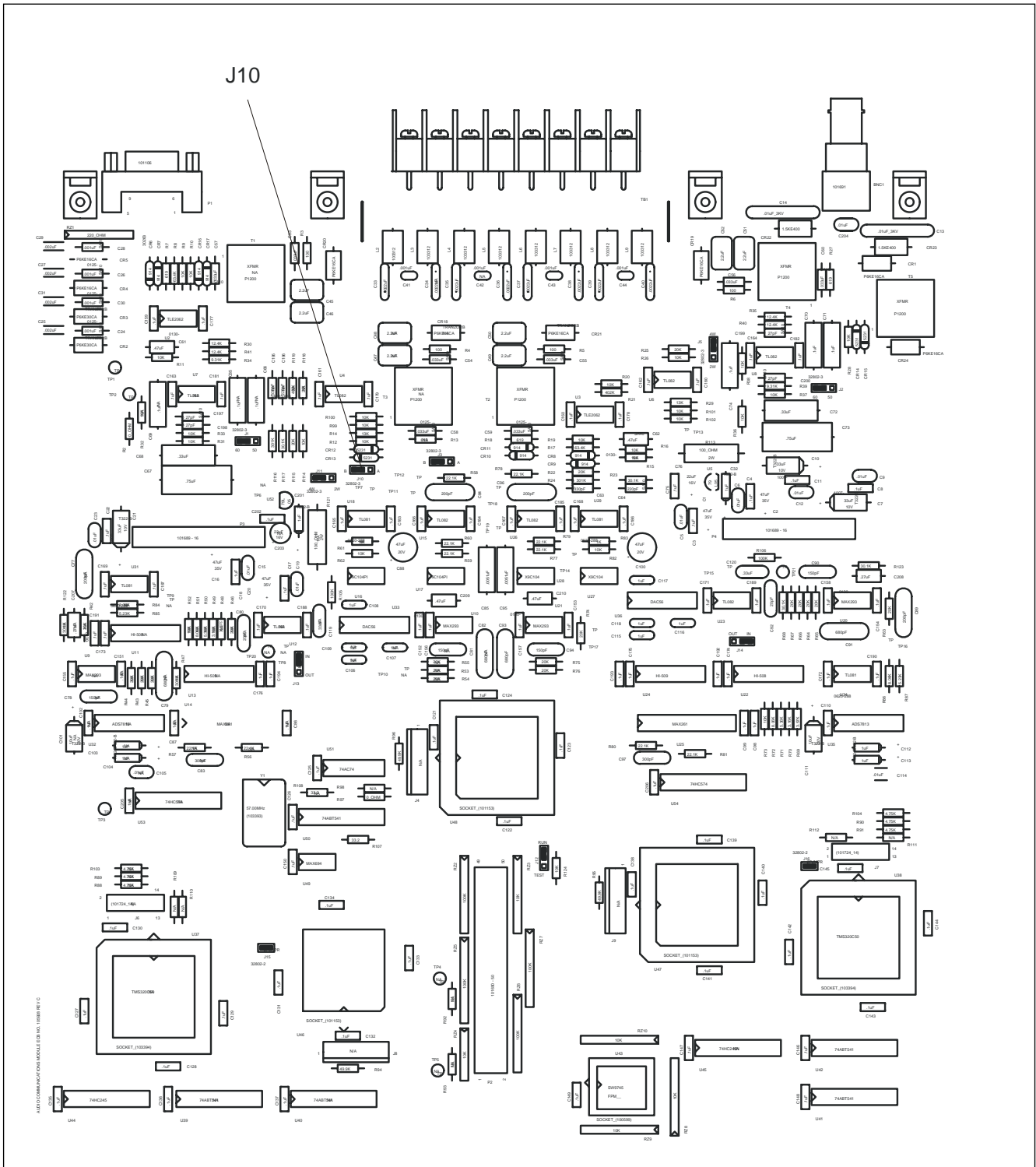


Figure 5-2. Location of jumper J10 on the Audio Communications Module

5.3 RFL 9745 DIGITAL SYSTEM PARAMETERS

The following paragraphs provide descriptions of all RFL 9745 Digital system parameters. The parameters are listed in numerical order for easy reference. The parameter numbers appear on the screen when you access the RFL 9745 using APRIL. A typical 9745 Digital system parameters display is shown in Figure 5-3.

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	Test Unit #1			
011	Functions 1-7	Digital			
012	Major Data Error	6, 500			
013	Minor Data Error	400, 200000			
014	Alarm BER	1E-04			
060	Opt Status Board	No	062	Chan delay alarm	4 ms
063	Year	1994	064	Date	08/09
065	Time	13:47:06	066	Hour Adjust	0
067	Local Address	0	068	Remote Address	888
069	Reset Log				
9745>					

Figure 5-3. Typical Digital system parameters display

PARAMETER #

- 011 **FUNCTIONS 1-7**
Parameter 011 indicates to the user that this is a Digital system. This parameter is for information purposes only and cannot be changed by the user.
- 012 **MAJOR DATA ERROR (Y, Z)**
Parameter 012 can be set by the user to detect a given number of errors out of a given number of messages. The Major Data Errors are bits used in the primitive logic to inhibit tripping. The Major Data Error bit is set when Y bits are in error out of Z bits (Where $Z > 15Y$). If during an interval of Z bits, if more than Y bits have been detected to be in error, the Major Data Error bit is set. The next interval of Z bits will begin at the point at which the Major Data Error bit was set. It will then take another interval of Z bits with less than Y bits in error to reset the Major Data Error bit.
- 013 **MINOR DATA ERROR (W, X)**
Parameter 013 can be set by the user to detect a given number of errors out of a given number of messages. The Minor Data Errors are bits used in the primitive logic to inhibit tripping. The Minor Data Error bit is set when W bits are in error out of X bits (Where $X > 15W$). If after an interval of X bits, if more than W bits were in error, the Minor Data Error bit will be set. It will then take another interval of X bits with less than W bits in error to reset the Minor Data Error bit.
- 014 **ALARM BER**
The Alarm BER (bit error rate) is the rate that will set the BER Alarm bit in the Alarm logic. The BER calculation is performed over a 1 second period.

NOTE

Parameters 26-30, 41-45, and 56-59 are for future use, and are not valid. If you try to select one of these parameters, the following error message will appear:

004 invalid number

5.4 RFL 9745 COMMON PARAMETERS (FOR AUDIO AND DIGITAL SYSTEMS)

The following paragraphs provide descriptions of all RFL 9745 common parameters for Audio and Digital Systems. The parameters are listed in numerical order for easy reference. The parameter numbers appear on the screen when you access the RFL 9745 using APRIL. Figures 5-1, and 5-3 show typical Audio and Digital system parameter displays. The common parameters can be seen in each of these displays.

PARAMETER

060

OPT STATUS BOARD

Parameter 60's setting will depend on whether the RFL 9745 is equipped with the optional status output board. (This board is mounted in an extension of the RFL 9745 chassis below the main chassis, and is accessed through a 12-position terminal block at the rear of the unit.) If the optional status output board is present, Parameter 60 **must** be set to "Yes." If the status output board is not present, this parameter **must** be set to "No."

062

CHAN DELAY ALARM

Parameter 62 determines the amount of channel delay that will trigger a delay alarm. It can be set to any value from 1 ms to 50 ms, in 1-ms steps. In the factory-default configuration, Parameter 62 is set for a delay of 8 ms for the Audio System. For the Digital System the default value is 4 ms.

063

YEAR

Parameter 63 displays the current year. (If the year needs to be changed, use the procedure shown in paragraph 6.7.4 example 3).

064

DATE

Parameter 64 displays the current date in digital format (MM/DD). (If the date needs to be changed, use the procedure shown in paragraph 6.7.4 example 3).

065

TIME

Parameter 65 will display the current time in 24-hour format (HH:MM:SS). (If the time needs to be changed, use the procedure shown in paragraph 6.7.4 example 3).

PARAMETER #

066

HOUR ADJUST

Parameter 66 can be used to offset the real-time clock from the IRIG-B value. It can be set to any value from -23 (23 hours behind) to +23 (23 hours ahead), in 1-hour steps. In the factory-default configuration, Parameter 66 is set for an hour adjust of zero hours (no offset).

067

LOCAL ADDRESS

Parameter 67 is used to store a unique address for the RFL 9745. This will be used to identify the unit during system address tests. The local address can be any whole number from 1 to 4095. If the local address is set to "0", address tests will not be performed - only checkback tests. It is recommended that unique addresses are set for both directions in each system.

068

REMOTE ADDRESS

Parameter 68 is used to store the address the RFL 9745 expects to receive from the remote RFL 9745 during system address tests. The remote address can be any whole number from 1 to 4095. If the remote address is set to "0", address tests will not be performed - only checkback tests. It is recommended that unique addresses are set for both directions in each system.

069

RESET LOG

Parameter 69 is a command used to reset all of the RFL 9745's event registers. To reset all registers, set Parameter 69 to "Yes." To keep the contents of all counters intact, set Parameter 69 to "No."

5.5 RECOMMENDED PARAMETER SETTINGS

Table 5-1 lists the recommended channel parameter settings for the RFL 9745 Audio System using the standard Audio Communications module. Table 5-2 lists the recommended channel parameter settings for the RFL 9745 Audio System using the wideband Audio Communications module. Note that interaction between the variables in the table can cause certain performance trends to occur in the RFL 9745 Audio System. Table 5-3 lists these performance trends, and is intended to help the user in selecting channel parameter settings that will most closely satisfy specific system performance requirements.

Table 5-4 lists recommended channel frequencies, minimum channel spacing between center frequencies, and frequency shifts for each channel spacing for the RFL 9745 Audio System.

Table 5-5 lists timer values versus equipment performance. Refer to Figure 2-26 for more information on timers and timer values.

Table 5-6 lists recommended tone frequencies for interfacing the RFL 9745 with the RFL 6750 Integrated Transfer Trip System.

Table 5-7 is a parameter setup worksheet for the RFL 9745 Narrowband Audio system.

Table 5-8 is a parameter setup worksheet for the RFL 9745 Wideband Audio system.

Table 5-9 is a parameter setup worksheet for the RFL 9745 Digital system.

NOTE

For Modem Channels, parameter number 6 in Tables 5-7 and 5-8 should always be set to 380 Hz for narrowband, and 360 Hz for wideband. These are the recommended settings for Modem Channels only. In addition, parameter numbers 9 and 10 in Tables 5-7 and 5-8 should be set to the default settings recommended in order to reduce bus traffic between processors. For Single Channel settings refer to Tables 5-1 or 5-2 as applicable.

Table 5-1. Recommended channel parameter settings for an Audio System using the *narrow band* Audio Communications Module

Frequency Shift (Hz)	Channel Spacing (Hz)	RX BW (Hz)	FM Noise (%)	AM Noise (dB)	Pre-Trip Time (ms)	Solid State Relay Avg Trip Time (ms)
+/- 30	120	70	22	5	6	23.2
+/- 42.5	170	85	15	9	6	20.4
+/- 60	240	145	21	9	4.5	15.2
+/- 75 *	340	225	30	5	4.5	12.5
+/- 85	375	250	30	6	4.5	12.3
+/- 120	480	300	30	7	4.5	11.4
+/- 150	680	380	28	8	4.5	10.7
+/- 240	960	540	36	9	4.5	10.0

* If your narrowband system has 3 or 4 channels and all channels have a frequency shift of +/-75 Hz, use an RX BW of 200 Hz instead of 225 Hz or increase the channel spacing from 340 Hz to 440 Hz.

Table 5-2. Recommended channel parameter settings for an Audio System using the *wide band* Audio Communications Module

Frequency Shift (Hz)	Channel Spacing (Hz)	RX BW (Hz)	FM Noise (%)	AM Noise (dB)	Pre-Trip Time (ms)	Solid State Relay Avg Trip Time (ms)
+/- 30	120	73	10	6	9.5	26.47
+/- 42.5	170	95	11	8	6.5	20.57
+/- 60	240	150	15	9	5.0	14.78
+/- 75	340	225	15	9	5.0	12.65
+/- 85	375	250	15	9	5.0	12.30
+/- 120	480	310	16	12	4.5	11.05
+/- 150	680	360	19	14	4.5	10.12
+/- 240	960	510	35	14	4.5	9.22

Table 5-3. System performance trends versus parameter settings for the Audio System

Parameter	Trend	Trip Time	Security	Dependability
RX Bandwidth	Increase	Decrease	Decrease	Increase
	Decrease	Increase	Increase	Decrease
FM Noise	Increase	Decrease	Decrease	Increase
	Decrease	Increase	Increase	Decrease
AM Noise	Increase	Increase	Increase	Decrease
	Decrease	Decrease	Decrease	Increase

Table 5-4. Recommended channel frequencies for the Audio System¹

Spacing ²	Shift ³	Center Frequencies (Hz)
120 Hz	+/-30 Hz	1260, 1380, 1500, 1620, 1740, 1860, 1980, 2100, 2220, 2340, 2580, 2700
170 Hz	+/-42.5 Hz	1275, 1445, 1615, 1785, 1955, 2125, 2295, 2465, 2580, 2635, 2805, 2975
240 Hz	+/- 60 Hz	960, 1200, 1440, 1680, 1920, 2160, 2400, 2640, 2880
340 Hz	+/-75 Hz	935, 1190, 1275, 1530, 1615, 1870, 1955, 2210, 2295, 2550, 2635, 2890, 2975, 3240, 3315
375 Hz	+/-85 Hz	1275, 1615, 1955, 2295, 2635, 2975
480 Hz	+/-120 Hz	1080, 1560, 2040, 2520, 3000
680 Hz	+/-150 Hz	935, 1615, 2295, 2975
960 Hz	+/-240 Hz	1320, 2280

NOTE 1. Refer to paragraph 5.6 for channel grouping recommendations.

NOTE 2. Minimum channel spacing between center frequencies.

NOTE 3. Shifts shown indicate the frequency shift for each channel spacing.

Table 5-5. Timer values versus Equipment Performance

Timer	Trend	Trip Time	Security	Dependability
Pre-Trip	Increase	Increase	Increase	Decrease
	Decrease	Decrease	Decrease	Increase
Trip Hold	Enable	No effect	Decrease	Increase
	Disable	No effect	Increase	Decrease
Block / attack	Increase	No effect	Increase	Decrease
	Decrease	No effect	Decrease	Increase
Block / decay	Increase	No effect	Decrease	Increase
	Decrease	No effect	Increase	Decrease
Guard Before Trip	Increase	No effect	Increase	Decrease
	Decrease	No effect	Decrease	Increase
Trip After Guard	Increase	No effect	Decrease	Increase
	Decrease	No effect	Increase	Decrease

Table 5-6. Recommended tone frequencies for the interfacing the RFL 9745 Teleprotection Channel to the PRF 6750 Integrated Transfer Trip System (ITTS)

Group ⁽¹⁾	Subchannel	Center Frequency	Mode	Frequency
1	A	935	Trip	860
			Guard	1010
	B	1275	Guard	1200
			Trip	1350
2	A	1275	Trip	1200
			Guard	1350
	B	1615	Guard	1540
			Trip	1690
3 ⁽²⁾	A	1615	Trip	1540
			Guard	1690
	B	1955	Guard	1880
			Trip	2030
4 ⁽²⁾	A	1955	Trip	1880
			Guard	2030
	B	2295	Guard	2220
			Trip	2370
5 ⁽²⁾	A	2295	Trip	2220
			Guard	2370
	B	2635	Guard	2560
			Trip	2710
6	A	2635	Trip	2560
			Guard	2710
	B	2975	Guard	2900
			Trip	3050
7	A	2975	Trip	2900
			Guard	3050
	B	3315	Guard	3240
			Trip	3390
8	A	935	Trip	785
			Guard	1085
	B	1615	Guard	1465
			Trip	1765
9	A	1615	Trip	1465
			Guard	1765
	B	2295	Guard	2145
			Trip	2445
10	A	2295	Trip	2145
			Guard	2445
	B	2975	Guard	2825
			Trip	3125

1. Groups 1 through 7 have 340-Hz subchannel spacings, and a nominal bandwidth of 170-Hz. Groups 8 through 10 have 680-Hz subchannel spacings, and a nominal bandwidth of 340-Hz.
2. Preferred for minimum noise and to avoid roll-off at lower or upper end of communications channel.

Table 5-7. Parameter setup worksheet, RFL 9745 Audio Teleprotection Channel (Narrow band system)

No.	Parameter Name (description)	Settings Or Range	Default Setting	Required Setting
001	Channel 1 (Channel 1 configuration)	Single Modem 6750 Modem Pass None	Modem	
002	Tone 1 Tx Freq (Tone 1 transmit frequency)	LF: 300 Hz to 3399 Hz	700 Hz	
		HF: 301 Hz to 3400 Hz	1000 Hz	
003	Transmit Level (Tone 1 transmit level)	-40 to +10 dBm	-15 dBm	
004	Boost Level (Tone 1 boost level)	0 to 12 dB	0 dB	
005	Tone 1 Rx Freq (Tone 1 receive frequency)	LF: 300 Hz to 3399 Hz	700 Hz	
		HF: 301 Hz to 3400 Hz	1000 Hz	
006	Rx Bandwidth (Tone 1 receive bandwidth)	50 to 1000 Hz	380 Hz	
007	Rx Level (Tone 1 receive level)	-40 to 0 dB	-15 dB	
008	Rx Alarm (Tone 1 receive alarm level)	-70 dBm to 0 dBm	-33 dBm	
009	AM Noise (SNR) (Minimum Tone 1 S/N ratio)	-20 to +20 dB	+5 dB	
010	FM Noise (Minimum Tone 1 FM noise)	0% to 100%	75%	
016	Channel 2 (Channel 2 configuration)	Single Pass None	Single	
017	Tone 2 TX Freq (Tone 2 transmit frequency)	LF: 300 Hz to 3399 Hz	2900 Hz	
		HF: 301 Hz to 3400 Hz	3050 Hz	
018	Transmit Level (Tone 2 transmit level)	-40 to +10 dBm	-15 dBm	
019	Boost Level (Tone 2 boost level)	0 to 12 dB	0 dB	
020	Tone 2 Rx Freq (Tone 2 receive frequency)	LF: 300 Hz to 3399 Hz	2900 Hz	
		HF: 301 Hz to 3400 Hz	3050 Hz	
021	Rx Bandwidth (Tone 2 receive bandwidth)	50 to 1000 Hz	225 Hz	
022	Rx Level (Tone 2 receive level)	-40 to 0 dB	-15 dB	

Table 5-7. Parameter setup worksheet, RFL 9745 Audio Teleprotection Channel (Narrowband System) - continued.

No.	Parameter Name (description)	Settings Or Range	Default Setting	Required Setting
023	Rx Alarm (Tone 2 receive alarm level)	-70 dBm to 0 dBm	-33 dBm	
024	AM Noise (SNR) (Minimum Tone 2 S/N ratio)	-20 to +20 dB	+5 dB	
025	FM Noise (Minimum Tone 2 FM noise)	0% to 100%	30%	
031	Channel 3 (Channel 3 configuration)	Single Pass None	Single	
032	Tone Tx Freq (Tone 3 transmit frequency)	LF: 300 Hz to 3399 Hz	2145 Hz	
		HF: 301 Hz to 3400 Hz	2445 Hz	
033	Transmit Level (Tone 3 transmit level)	-40 to +10 dBm	-15 dBm	
034	Boost Level (Tone 3 boost level)	0 to 12 dB	0 dB	
035	Tone 3 Rx Freq (Tone 3 receive frequency)	LF: 300 Hz to 3399 Hz	2145 Hz	
		HF: 301 Hz to 3400 Hz	2445 Hz	
036	Rx Bandwidth (Tone 3 receive bandwidth)	50 to 1000 Hz	380 Hz	
037	Rx Level (Tone 3 receive level)	-40 to 0 dB	-15 dB	
038	Rx Alarm (Tone 3 receive alarm level)	-70 dBm to 0 dBm	-33 dBm	
039	AM Noise (SNR) (Minimum Tone 3 S/N ratio)	-20 to +20 dB	+8 dB	
040	FM Noise (Minimum Tone 3 FM noise)	0% to 100%	28%	
046	Channel 4 (Channel 4 configuration)	Single Pass None	Single	
047	Tone 4 Tx Freq (Tone 4 transmit frequency)	LF: 300 Hz to 3399 Hz	1465 Hz	
		HF: 301 Hz to 3400 Hz	1765 Hz	
048	Transmit Level (Tone 4 transmit level)	-40 to +10 dBm	-15 dBm	
049	Boost Level (Tone 4 boost level)	0 to 12 dB	0 db	
050	Tone 4 Rx Freq (Tone 4 receive frequency)	LF: 300 Hz to 3399 Hz	1465 Hz	
		HF: 301 Hz to 3400 Hz	1765 Hz	

Table 5-7. Parameter setup worksheet, RFL 9745 Audio Teleprotection Channel (Narrowband System) - continued.

No.	Parameter Name (description)	Settings Or Range	Default Setting	Required Setting
051	Rx Bandwidth (Tone 4 receive bandwidth)	50 to 1000 Hz	380 Hz	
052	Rx Level (Tone 4 receive level)	-40 to 0 dB	-15dB	
053	Rx Alarm (Tone 4 receive alarm level)	-70 dBm to 0 dBm	-33 dBm	
054	AM Noise (SNR) (minimum Tone 4 S/N ratio)	-20 to +20 dB	+8 dB	
055	FM Noise (Minimum Tone 4 FM noise)	0% to 100%	28%	
060	Opt Status Board (presence of status word)	Yes or No	...	
061	EE Pot J10 (Jumper J10 setting)	A or B	...	
062	Chan Delay Alarm (Channel delay alarm setting)	5 ms to 50 ms	8 ms	
063	Year	...	...
064	Date	...	...
065	Time	...	...
066	Hour Adjust (clock offset)	...	...
067	Local Address	0 to 4095	...	
068	Remote Address	0 to 4095	...	

Table 5-8. Parameter setup worksheet, RFL 9745 Audio Teleprotection Channel (Wideband system)

No.	Parameter Name (description)	Settings Or Range	Default Setting	Required Setting
001	Channel 1 (Channel 1 configuration)	Single Modem 6750 Modem Pass None	Modem	
002	Tone 1 Tx Freq (Tone 1 transmit frequency)	LF: 300 Hz to 3999 Hz	700 Hz	
		HF: 301 Hz to 4000 Hz	1000 Hz	
003	Transmit Level (Tone 1 transmit level)	-40 to +10 dBm	-15 dBm	
004	Boost Level (Tone 1 boost level)	0 to 12 dB	0 dB	
005	Tone 1 Rx Freq (Tone 1 receive frequency)	LF: 300 Hz to 3999 Hz	700 Hz	
		HF: 301 Hz to 4000 Hz	1000 Hz	
006	Rx Bandwidth (Tone 1 receive bandwidth)	50 to 1000 Hz	360 Hz	
007	Rx Level (Tone 1 receive level)	-40 to 0 dB	-15 dB	
008	Rx Alarm (Tone 1 receive alarm level)	-70 dBm to 0 dBm	-33 dBm	
009	AM Noise (SNR) (Minimum Tone 1 S/N ratio)	-20 to +20 dB	+5 dB	
010	FM Noise (Minimum Tone 1 FM noise)	0% to 100%	75%	
016	Channel 2 (Channel 2 configuration)	Single Pass None	Single	
017	Tone 2 TX Freq (Tone 2 transmit frequency)	LF: 300 Hz to 3999 Hz	2900 Hz	
		HF: 301 Hz to 4000 Hz	3050 Hz	
018	Transmit Level (Tone 2 transmit level)	-40 to +10 dBm	-15 dBm	
019	Boost Level (Tone 2 boost level)	0 to 12 dB	0 dB	
020	Tone 2 Rx Freq (Tone 2 receive frequency)	LF: 300 Hz to 3999 Hz	2900 Hz	
		HF: 301 Hz to 4000 Hz	3050 Hz	
021	Rx Bandwidth (Tone 2 receive bandwidth)	50 to 1000 Hz	225 Hz	
022	Rx Level (Tone 2 receive level)	-40 to 0 dB	-15 dB	

Table 5-8. Parameter setup worksheet, RFL 9745 Audio Teleprotection Channel (Wideband System) - continued.

No.	Parameter Name (description)	Settings Or Range	Default Setting	Required Setting
023	Rx Alarm (Tone 2 receive alarm level)	-70 dBm to 0 dBm	-33 dBm	
024	AM Noise (SNR) (Minimum Tone 2 S/N ratio)	-20 to +20 dB	+9 dB	
025	FM Noise (Minimum Tone 2 FM noise)	0% to 100%	15%	
031	Channel 3 (Channel 3 configuration)	Single Pass None	Single	
032	Tone Tx Freq (Tone 3 transmit frequency)	LF: 300 Hz to 3999 Hz	2145 Hz	
		HF: 301 Hz to 4000 Hz	2445 Hz	
033	Transmit Level (Tone 3 transmit level)	-40 to +10 dBm	-15 dBm	
034	Boost Level (Tone 3 boost level)	0 to 12 dB	0 dB	
035	Tone 3 Rx Freq (Tone 3 receive frequency)	LF: 300 Hz to 3999 Hz	2145 Hz	
		HF: 301 Hz to 4000 Hz	2445 Hz	
036	Rx Bandwidth (Tone 3 receive bandwidth)	50 to 1000 Hz	360 Hz	
037	Rx Level (Tone 3 receive level)	-40 to 0 dB	-15 dB	
038	Rx Alarm (Tone 3 receive alarm level)	-70 dBm to 0 dBm	-33 dBm	
039	AM Noise (SNR) (Minimum Tone 3 S/N ratio)	-20 to +20 dB	+14 dB	
040	FM Noise (Minimum Tone 3 FM noise)	0% to 100%	19%	
046	Channel 4 (Channel 4 configuration)	Single Pass None	Single	
047	Tone 4 Tx Freq (Tone 4 transmit frequency)	LF: 300 Hz to 3999 Hz	1465 Hz	
		HF: 301 Hz to 4000 Hz	1765 Hz	
048	Transmit Level (Tone 4 transmit level)	-40 to +10 dBm	-15 dBm	
049	Boost Level (Tone 4 boost level)	0 to 12 dB	0 db	
050	Tone 4 Rx Freq (Tone 4 receive frequency)	LF: 300 Hz to 3999 Hz	1465 Hz	
		HF: 301 Hz to 4000 Hz	1765 Hz	

Table 5-8. Parameter setup worksheet, RFL 9745 Audio Teleprotection Channel (Wideband System) - continued.

No.	Parameter Name (description)	Settings Or Range	Default Setting	Required Setting
051	Rx Bandwidth (Tone 4 receive bandwidth)	50 to 1000 Hz	360 Hz	
052	Rx Level (Tone 4 receive level)	-40 to 0 dB	-15dB	
053	Rx Alarm (Tone 4 receive alarm level)	-70 dBm to 0 dBm	-33 dBm	
054	AM Noise (SNR) (minimum Tone 4 S/N ratio)	-20 to +20 dB	+14 dB	
055	FM Noise (Minimum Tone 4 FM noise)	0% to 100%	19%	
060	Opt Status Board (presence of status word)	Yes or No	...	
061	EE Pot J10 (Jumper J10 setting)	A or B	...	
062	Chan Delay Alarm (Channel delay alarm setting)	1 ms to 50 ms	8 ms	
063	Year	...	...
064	Date	...	...
065	Time	...	...
066	Hour Adjust (clock offset)	...	...
067	Local Address	0 to 4095	...	
068	Remote Address	0 to 4095	...	

Table 5-9. Parameter setup worksheet, RFL 9745 Digital Teleprotection Channel

No.	Parameter Name (description)	Settings Or Range	Default Setting	Required Setting
011	Functions 1-7	...	Digital	
012	Major Data Error	[0-10,000], [1-1,000,000]	6, 500	
013	Minor Data Error	[1-10,000], [1-1,000,000]	400, 200000	
014	Alarm BER	[mantissa:1 to 9], [exponent:-6 to -2]	1E-04	
060	Opt Status Board (presence of status word)	Yes or No	...	
062	Chan Delay Alarm (Channel delay alarm setting)	1 ms to 50 ms	4	
063	Year	...	...
064	Date	...	...
065	Time	...	...
066	Hour Adjust (clock offset)	...	...
067	Local Address	0 to 4095	...	
068	Remote Address	0 to 4095	...	
069	Reset Log			

5.6 RECOMMENDED CHANNEL GROUPINGS FOR SINGLE-PORT FOUR-CHANNEL SYSTEMS

Channels should be grouped in accordance with Figure 5-4 in single-port four-channel systems. Note that channel group 1 and 2 should be either above or below channel group 3 and 4. This will insure optimum system performance by maximizing system dynamic range.

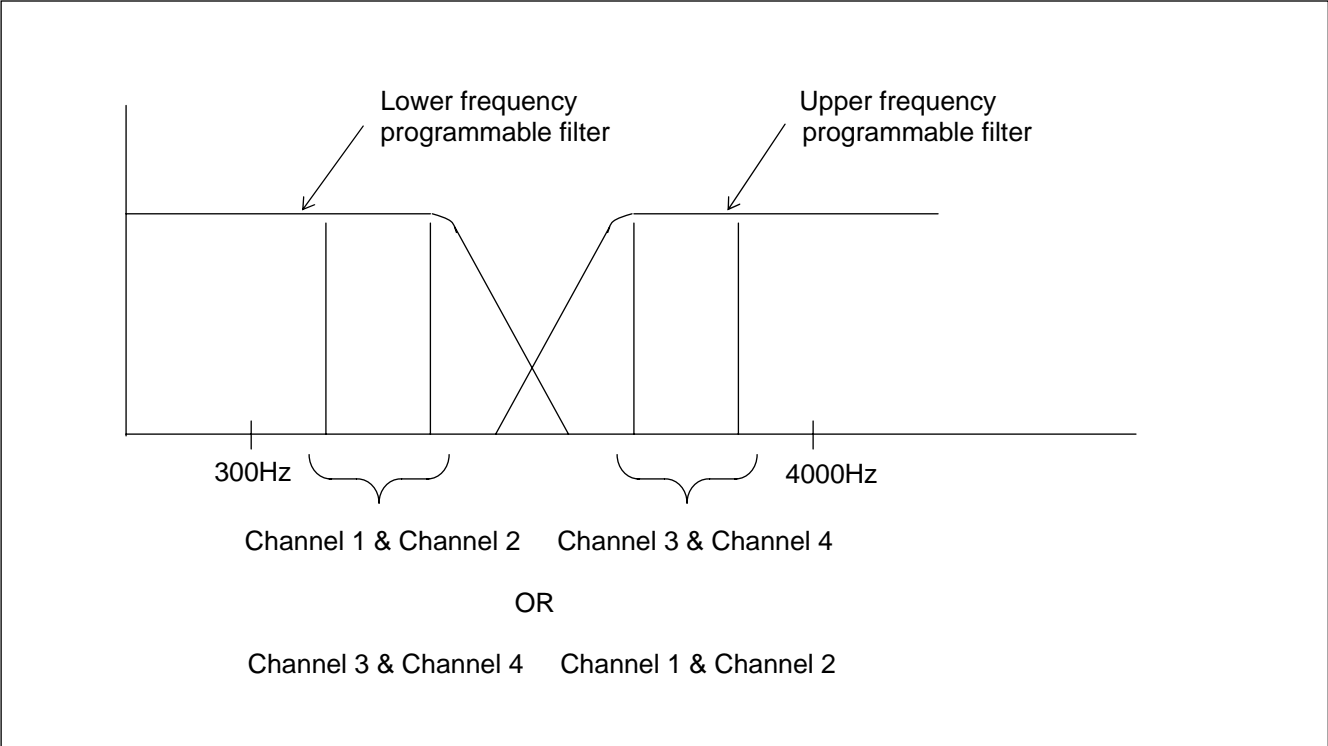


Figure 5-4. Recommended channel groupings for single-port four-channel systems

5.7 RECEIVER OFFSET FOR BOOST APPLICATIONS

For leased telephone channel applications a “Trip Boost” feature is available to increase the transmitted level of the trip signal. This will improve the signal to noise ratio and override noise that may be induced on the telephone line, coincident with a transmission line fault. When the trip boost feature is enabled the receiver sensitivity is skewed by 50% of the selected boost level, this will maintain an adequate receiver dynamic range. The chart below indicates the receive level setting for different levels of Trip Boost. Table 5-10 is a list of typical boost levels.

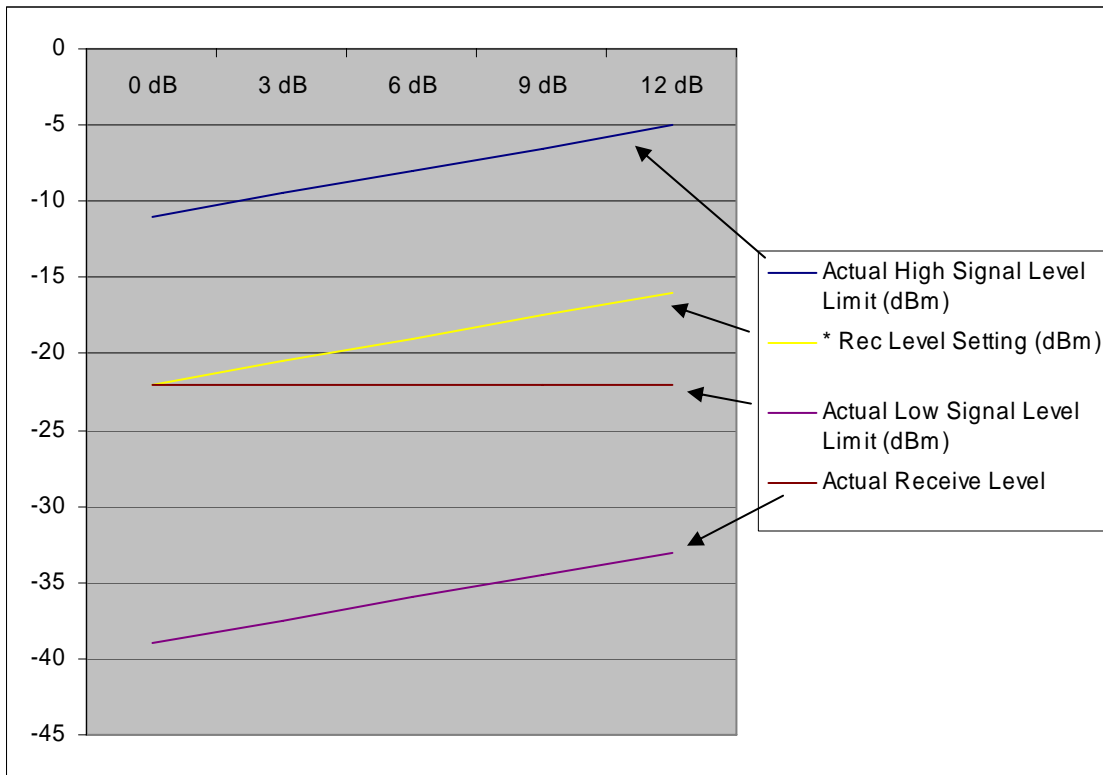


Figure 5-5. Receive Level Settings (Boost Applications)

Table 5-10. Receiver Level Settings for Boost Applications

Boost Level	0 dB	3 dB	6 dB	9 dB	12 dB
Actual High Signal Limit (dBm)	-11	-9.5	-8	-6.5	-5
Effective Dynamic Range Upper Limit (dB)	11	12.5	14	15.5	17
*RX Level Setting (dBm)	-22	-20.5	-19	-17.5	-16
Effective Dynamic Range Lower Limit (dB)	17	15.5	14	12.5	11
Actual Low Signal Level Limit (dBm)	-39	-37.5	-36	-34.5	-33
Dynamic Range	28	28	28	28	28
Actual Receive Level	-22	-22	-22	-22	-22

Note: Based on a nominal receive level of -22 dB

* Receive level setting offset positively by 1/2 the value of the boost level.

Section 6. USING THE RS-232 PORTS TO PROGRAM AND OPERATE THE RFL 9745

6.1 INTRODUCTION

This section contains information on how to program, test, and control the sequence-of-events log of the RFL 9745 using the RS-232 ports. Before attempting to use the information in this section, the RFL 9745 must be accessed through APRIL using the information in Section 4 of this manual.

6.2 VIEWING APRIL COMMANDS

Once you have connected a terminal or PC to the RFL 9745 (either directly or through an RFL 9660 Digital Switch), press the [ENTER] key on your keyboard. The RFL 9745 will send the following prompt to your terminal:

```
9745>
```

This means that you have accessed the RFL 9745, and can now use APRIL commands to view lists of parameter settings, alarm conditions, and other information. To view a list of the APRIL commands, press the [H] and [ENTER] keys:

```
9745>H [ENTER]
```

This tells the RFL 9745 to send a list of APRIL commands called the "main menu" to your terminal. A typical main menu for the Audio or Digital system appears in Figure 6-1.

```
RFL Electronics APRIL(t) Remote Communications, Version 2.0 (c)1993,1994
System Label
H - Display the main menu
A - Go to the alarms display
V - Go to the values display
P - Go to the programming menu (password required)
D - Go to the read settings menu
F - Go to the configuration and software version display
K - Go to the logic programming menu (password required)
T - Go to the test menu (password required)
U - Enter the update mode
X - Exit the update mode
S - Go to sequence of events menu
W - Window remote April
9745>
```

Figure 6-1. Typical APRIL main menu for the Audio or Digital System

For more information on each APRIL command, refer to the paragraph numbers listed below.

Command	Meaning	Paragraph
H	Display the main menu	6.3
C	Changing the password	6.4.2
A	Go to the alarms display	6.5
V	Go to the values display	6.6
P	Go to the programming menu (password) . .	6.7
D	Go to the read settings menu	6.8
F	Go to the configure and software version display .	6.9
K	Go to logic programming Menu (password) . .	6.10
T	Go to the test menu (password)	6.11
U	Enter the update mode	6.12
X	Exit the update mode	6.12
S	Go to sequence-of-events menu	6.13
W	Window remote April	6.15

6.3 DISPLAYING APRIL HELP

Any time you need to see a list of all the APRIL commands while the "9745>" prompt is displayed, use the "H" command.

9745>H [ENTER]

When you invoke the "H" command, the APRIL command main menu shown in Figure 6-1 will re-appear on your screen.

6.4 PASSWORD PROTECTION

NOTE

This is the only page where the superuser password is discussed and can be removed for added security.

Password protection is required to prevent unauthorized personnel from gaining access to the RFL 9745 settings and parameters. The three menus that are password protected are the Programming Menu, Logic Programming Menu, and the Test Menu.

6.4.1 ENTERING THE PROGRAMMING, LOGIC PROGRAMMING OR TEST MENUS

When you invoke the "P", "K", or "T" command, the following prompt appears:

enter password:

Enter either the super-user password ("BCELNR") or the password that has been stored in the RFL 9745's memory. The RFL 9745 gives you three chances to enter the correct password. After the third incorrect password is entered, the RFL 9745 enters a lock-out mode. This mode will last for about five minutes, during which you will not be able to enter the programming mode.

6.4.2 CHANGING THE PASSWORD

You can use the "C" command to change the password that can be used to enter the programming, logic programming, or test modes.

9745-P>C [ENTER]

When you invoke the "C" command, the RFL 9745 sends the following prompt to your terminal:

enter super-user:

Enter the super-user password ("BCELNR"), and then press [ENTER]. The following prompt will appear:

**Current password is (current password)
enter new password:**

Enter the new password, and then press [ENTER]. The following prompt will appear:

repeat new password:

Enter the new password again, and then press **[ENTER]**. The following prompt will appear:

password modified

The new password is now stored in the RFL 9745's non-volatile memory.

The password can have a maximum of six alphanumeric characters including spaces. The same password is used for all three menus ("P" program menu, "K" logic menu and "T" test menu). When you change the password in one menu it automatically changes the password for the other two menus.

The software only allows one password. If a new password is entered it will write over the old password.

6.5 VIEWING THE ALARMS DISPLAY

To view the current status of all RFL 9745 alarms, enter the "A" command.

9745>A [ENTER]

The "A" command tells the RFL 9745 to send a copy of the alarms display to your terminal. This display is for viewing only and cannot be changed by the user. Typical alarms displays for the Audio and Digital systems are shown in Figures 6-2 and 6-3 respectively.

# ALARM	STATUS (I/A)	# ALARM	STATUS (I/A)
085 Comms CPU Error	I	086 Bus Error	I
087 Left PS Low V	I	088 Right PS Low V	A
089 Battery Low	I	091 Address Failure	I
093 Channel Delay	I		
	1 2 3 4		1 2 3 4
094 Fail to Trip A	A I A I	095 Fail to Trip B	A I A I
096 Output Shorted A	I I I I	097 Output Shorted B	I I I I
101 Signal to Noise	I I A I	102 FM Noise	I I A I
103 AM Filter 1 High	I I I I	104 AM Filter 2 High	I I I I
105 AM Filter 1 Low	I I A I	106 AM Filter 2 Low	I I A I
107 Low Signal	A D A A		
Programmable Alarms:			
120 COMMS WARNING	A	121 OUTPUT ALARM	I
122 NOT USED	I	123 COMMS ALARM	A
124 HARDWARE WARNING	A	125 HARDWARE ALARM	I
126 ANNUNC1 OUT TEST	A	127 ANNUNC2 OUT TEST	A
128 ANNUNC3 OUT TEST	I	129 ANNUNC4 OUT TEST	I
130 ANNUNC5 OUT TEST	A	131 ANNUNC6 OUT TEST	I
9745>			

Figure 6-2. Typical alarms display for the Audio System

In Figures 6-2 and 6-3, parameters 126 through 131 are displayed only when parameter 060 (optional status board) shown in the menu of Figure 6-7 is set to "yes". This parameter should be set to "yes" only if your 9745 has the optional status board installed.

# ALARM	STATUS (I/A)	# ALARM	STATUS (I/A)
085 Comms CPU Error	I	086 Bus Error	I
087 Left PS Low V		088 Right PS Low V	A
089 Battery Low		091 Address Failure	I
093 Channel Delay	I		
	1 2 3 4		1 2 3 4
094 Fail to Trip A	A I A I	095 Fail to Trip B	A I A I
096 Output Shorted A	I I I I	097 Output Shorted B	I I I I
111 Major Data Error	I	112 Minor Data Error	I
113 Config Error	I	114 Clock Errors	I
115 Frame Errors	I	116 TX Fail	I
117 BER Warning	I		
Programmable Alarms:			
120 COMMS WARNING	A	121 OUTPUT ALARM	I
122 NOT USED	I	123 COMMS ALARM	A
124 HARDWARE WARNING	A	125 HARDWARE ALARM	I
126 ANNUNC1 OUT TEST	A	127 ANNUNC2 OUT TEST	A
128 ANNUNC3 OUT TEST	I	129 ANNUNC4 OUT TEST	I
130 ANNUNC5 OUT TEST	A	131 ANNUNC6 OUT TEST	I
9745>			

Figure 6-3. Typical alarms display for the Digital System

Parameters 085 through 117 are conditions that exist in the unit. The alarm logic programming will determine if these conditions result in alarms 120 through 131.

The alarms displays shown in Figures 6-2 and 6-3 show the parameter number for each alarm, a brief description of its meaning, and its status. "I" indicates that the alarm is "inactive" or that there is no alarm. "A" indicates that the alarm is "active" or that there is an alarm. "D" indicates that the channel is "disabled" (This applies only to item 107, which is the Low Signal Alarm for channels 1,2,3 and 4). Full descriptions for each alarm are as follows:

- 085 - Comms CPU Error** Active when an error has occurred involving the communications CPU.
- 086 - Bus Error** Active when an error has occurred involving one of the RFL 9745's buses.
- 087 - Left PS Low V** Active when the output of the left (main) power supply module is below the preset level.
- 088 - Right PS Low V** Active when the output of the right (redundant) power supply module is below the preset level.

089 - Battery Low	Not used on units with capacitor backed RAM.
091 - Address Failure	Active when an address test has returned an incorrect address from the remote end.
093 - Channel Delay	Active when the measured channel delay is greater than the programmed value.
094 - Fail to Trip A	Active when Output 1A, 2A, 3A or 4A should be in its trip or closed state, but less than 150 ma is being sensed through its contacts.
095 - Fail to Trip B	Active when Output 1B, 2B, 3B, or 4B should be in its trip or closed state, but less than 150 ma is being sensed through its contacts.
096 - Output Shorted A	Active when Output 1A, 2A, 3A, or 4A should be open, but a current greater than 150 ma is being sensed through its contacts.
097 - Output Shorted B	Active when Output 1B, 2B, 3B, or 4B should be open, but a current greater than 150 ma is being sensed through its contacts.
101 - Signal to Noise	Active when there is too much amplitude-modulated noise on the incoming signal.
102 - FM Noise	Active when there is too much frequency-modulated noise on the incoming signal.
103 - AM Filter 1 High	Active when a narrow filter centered at the lower frequency of channel 1, 2, 3, and 4 is measuring an energy level above the maximum acceptable limit.
104 - AM Filter 2 High	Active when a narrow filter centered at the upper frequency of channel 1, 2, 3, and 4 is measuring an energy level above the maximum acceptable limit.
105 - AM Filter 1 Low	Active when a narrow filter centered at the lower frequency of channel 1, 2, 3, and 4 is measuring an energy level below the minimum acceptable limit.
106 - AM Filter 2 Low	Active when a narrow filter centered at the upper frequency of channel 1, 2, 3, and 4 is measuring an energy level below the minimum acceptable limit.
107 - Low Signal	Active when the received signal level for channel 1, 2, 3, or 4 is lower than the programmed Rx Alarm Level shown in parameters 008, 038 and 053 of Figure 6-10.

- 111 - Major Data Error** Active when the number of errors exceeds the Major Data Error limit set in the programming menu by the user.
- 112 - Minor Data Error** Active when the number of errors exceeds the Minor Data Error limit set in the programming menu by the user.
- 113 - Config Error** Active when a Digital I/O module is not installed.
- 114 - Clock Errors** Active when the variation in the received word exceeds the min/max frequency limits or the max jitter setting.
- 115 - Frame Errors** Active when the receiver has lost synchronization with the incoming bit stream.
- 116 - TX Fail** Active when a hardware failure has been detected on the optic I/O board.
- 117 - BER Warning** Active when the BER exceeds the value set in the programming menu.

The following alarms have programmable names or labels. Their factory-default names are given below. You can use the procedure given in Section 5 of this manual to rename them to suit your application. Space is provided below for you to write in what each of these alarms means in your system:

- 120 - COMMS WARNING** _____
(Announce Relay 1A)
- 121 - OUTPUT ALARM** _____
(Announce Relay 2A)
- 122 - NOT USED** _____
(Announce Relay 3A)
- 123 - COMMS ALARM** _____
(Announce Relay 1B)
- 124 - HARDWARE WARNING** _____
(Announce Relay 2B)
- 125 - HARDWARE ALARM** _____
(Announce Relay 3B)

Items 126 through 131 are displayed only when parameter 060 (optional status board) is set to “yes”.
See parameter 060 in the menu of Figure 6-7.

126 - ANNUNC1 OUT _____

127 - ANNUNC2 OUT _____

128 - ANNUNC3 OUT _____

129 - ANNUNC4 OUT _____

130 - ANNUNC5 OUT _____

131 - ANNUNC6 OUT _____

6.6 VIEWING THE VALUES DISPLAY

To view a list of all measured parameter values, enter the "V" command.

9745>V [ENTER]

The "V" command tells the RFL 9745 to send a copy of the most recently measured values to your terminal. This display is for viewing only and cannot be changed by the user. Typical values displays for the Audio and Digital Systems are shown in Figures 6-4 and 6-5 respectively.

NAME		VALUE		#	NAME		VALUE	
140	Tx Chan Delay	6 ms		141	Next Auto Test	N/A		
142	Rx Chan Delay	6 ms		143	Last Reset Date	16:38:59 03/03/94		
144	Cum Outage Time	00:00:00.000		145	Current Time	00:32:56 03/15/94		
		(I/A)	LOG			(I/A)	LOG	
154	Input 1A	I	1	162	Output 1A	A	0	
155	Input 1B	I	0	163	Output 1B	A	2	
156	Input 2A	I	4	164	Output 2A	A	0	
157	Input 2B	I	0	165	Output 2B	A	2	
158	Input 3A	I	0	166	Output 3A	I	0	
159	Input 3B	I	1	167	Output 3B	I	2	
160	Input 4A	I	0	168	Output 4A	I	0	
161	Input 4B	I	0	169	Output 4B	I	2	
	Function	#1	#2	#3	#4			
170	Rcvd Signal Lvl	-19	-15	-15	-15 dBm			
171	Tx Function	I	I	I	A			
172	Tx Squelch	I	I	I	I			
173	Rx High Freq	I	I	I	A			
174	Rx Low Freq	I	A	I	I			
9745>								

Figure 6-4. Typical values display for the Audio System

#	NAME	VALUE	#	NAME	VALUE
140	Tx Chan Delay	127.5 ms	141	Next Auto Test	N/A
142	Rx Chan Delay	127.5 ms	143	Last Reset Date	16:38:59 03/03/98
144	Cum Outage Time	02:08:48.579	145	Current Time	00:32:56 03/15/98
146	Data Rate	N/A			
147	Bit Error Rate	Max Error	148	Word Errors	501757
149	Clock Errors	6	150	Frame Errors	1
151	Minor Data Error	1	152	Major Data Error	1
		(I/A) LOG			(I/A) LOG
154	Input 1A	I 1	162	Output 1A	A 0
155	Input 1B	I 0	163	Output 1B	A 2
156	Input 2A	I 4	164	Output 2A	A 0
157	Input 2B	I 0	165	Output 2B	A 2
158	Input 3A	I 0	166	Output 3A	I 0
159	Input 3B	I 1	167	Output 3B	I 2
160	Input 4A	I 0	168	Output 4A	I 0
161	Input 4B	I 0	169	Output 4B	I 2
	Function	#1 #2 #3 #4 #5 #6 #7			
175	Rx Function	SQ SQ SQ SQ SQ SQ SQ			
176	Tx Function	I I I I I I I			

9745>

Figure 6-5. Typical values display for the Digital System

The values displays shown in Figures 6-4 and 6-5 show the code number for each measured parameter, a brief description of its meaning and its measured value. “A” indicates that the parameter is “active” or connected. “I” indicates that the parameter is “inactive” or not connected. “SQ” indicates that the parameter is “squelled”. Full descriptions for each of these measured values are as follows:

- 140 - Tx Chan Delay** Measured transmit channel delay, in milliseconds.
- 141 - Next Auto Test** Amount of time until next scheduled test, in hours and minutes.
- 142 - Rx Chan Delay** Measured receive channel delay, in milliseconds.
- 143 - Last Reset Date** Time and date of last system reset.
- 144 - Cum Outage Time** Total amount of time that the system has been interrupted (cumulative outage) in hours, minutes, and seconds since the last reset. This timer is active whenever the “OUTAGE” alarm logic output is active.
- 145 – Current Time** Current time in 24-hour format, followed by the current date.
- 146 - Data Rate** The number of data bits received per second.

147 - Bit Error Rate	A ratio of the number of bit errors received over the total number of bits received, in a one second period. N/A if the data rate is zero. If there are zero bit errors, the number will be 0E-6.
148 - Word Errors	The number of word errors received since the last reset.
149 - Clock Errors	The number of clock errors received since the last reset.
150 - Frame Errors	The number of frame errors received since the last reset.
151 - Minor Data Errors	A ratio of the number of data errors received out of a given number of messages received, as defined by the user. See parameter 013 on page 5-7, and page 6-21 for more information.
152 - Major Data Errors	A ratio of the number of data errors received out of a given number of messages received, as defined by the user. See parameter 012 on page 5-7, and page 6-20 for more information.

Lines 154 through 169 on the values display lists the RFL 9745's eight programmable inputs and outputs. The status of each input or output is listed (Active or Inactive), followed by how many times each input or output has been activated since the last reset (the LOG value). See Section 5 for information on how to label each of these inputs and outputs.

154 to 161 - Inputs	Indicates status and count of how many times that input has gone active.
162 to 169 - Outputs	Indicates status and count of how many times that output has gone active.

Lines 170 through 174 on the RFL 9745 Audio System values display, lists the status of each of the four audio communications channels:

170 - Rcvd Signal Lvl	The signal level being received on each channel (in dBm). If the signal is below the dynamic range, "LOS" will be displayed to indicate a loss of signal.
171 - Tx Function	For an Audio system, indicates whether each channel's transmit function is active or inactive. Tx Function active means the transmitter is sending its high frequency.
172 - Tx Squelch	Indicates whether the squelch feature on each channel's transmitter is active or inactive.
173 - Rx High Freq	Indicates whether each channel's high frequency is being received.
174 - Rx Low Freq	Indicates whether each channel's low frequency is being received.

175 - Rx Function For a Digital system, indicates whether the received bits in the data word are active or inactive. This function can be programmed by the user to be squelched.

176 - Tx Function For a Digital system, indicates whether the received bits in the data word are active or inactive. This function can be programmed by the user to be squelched.

6.7 THE PROGRAMMING MODE

You can use APRIL and your terminal to program the RFL 9745. All programming functions that are normally done using the keypad on the RFL 9745's display module can be done using a terminal. To use your PC or terminal to program the RFL 9745, use the "P" command.

9745>P [ENTER]

The "P" command tells the RFL 9745 to send a list of all programming commands to your terminal. Since using the programming commands will affect how the RFL 9745 operates, the "P" command is password-protected.

If the proper password is entered, a programming menu similar to the one shown in Figure 6-6 will appear.

```
H - Display programming help
Q - Leave programming menu
SV - Save new settings
C - Change password (superuser authorization required)
D - Display present settings and parameter numbers
## - Edit this specific number parameter
9745-P> _
```

Figure 6-6. Typical programming menu for the Audio or Digital System

You are now in the programming mode, as indicated by the "9745-P>" prompt on your screen. You may now use the programming commands to re-program the RFL 9745. For more information on each programming command, refer to the paragraph numbers listed below.

Command	Meaning	Paragraph
H	Display programming help	6.7.1
Q	Leave programming menu	6.7.2
SV	Save new settings	6.7.3
C	Change password	6.4.2
D	Display current settings and parameter numbers	6.7.4

6.7.1 DISPLAYING PROGRAMMING HELP

Any time you need to see a list of all the programming commands, use the "H" command.

9745-P>H [ENTER]

When you invoke the "H" command, the programming menu shown in Figure 6-6 will re-appear on your screen.

6.7.2 LEAVING THE PROGRAMMING MODE

NOTE

Before leaving the Programming Mode, if you don't use the "SV" command your changes will be lost.

Whenever you are finished programming the RFL 9745, use the "Q" command:

9745-P>Q [ENTER]

The "Q" command tells the RFL 9745 to leave the programming mode and return to the normal "9745>" prompt. If you changed any setting while in the programming mode, be sure to use the "SV" command described above to save the changes before invoking the "Q" command; otherwise, your changes will be lost.

6.7.3 SAVING NEW PROGRAMMING SETTINGS

The "SV" command saves any new settings you made while in the programming mode:

9745-P>SV [ENTER]

The "SV" command tells the RFL 9745 to store all the changes in its non-volatile memory. Once the changes are stored, the "9745-P>" prompt will re-appear.

Before you enter the "SV" command, the RFL 9745 operates according to the old parameter settings. Once the "SV" command is entered, the new settings will be in effect. The 9745 will go out of service during command execution.

The new parameter settings can be verified by re-issuing the "D" command to display the parameter settings list. (For more information on the "D" command, go to paragraph 6.7.4.)

6.7.4 DISPLAYING AND EDITING PARAMETER SETTINGS

To view a list of all current parameter settings, use the "D" command.

9745-P>D [ENTER]

When you invoke the "D" command, the RFL 9745 sends a list of all current parameter settings to your terminal. A typical parameter settings display for the Audio system with no channels defined is shown in Figure 6-7. Refer to paragraph 5.5 for recommended parameter settings.

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label				
001	Channel 1	Single			
002	Tone 1 Tx Freq	0 Hz 0 Hz			
003	Transmit Level	0.00 dBm	004	Boost Level	0 dB
005	Tone 1 Rx Freq	0 Hz 0 Hz			
006	Rx Bandwidth	0 Hz	007	Rx Level	0 dBm
008	Rx Alarm	0 dBm	009	AM Noise(SNR)	0 dB
010	FM Noise	0 %			
016	Channel 2	Single			
017	Tone 2 Tx Freq	0 Hz 0 Hz			
018	Transmit Level	0.00 dBm	019	Boost Level	0 dB
020	Tone 2 Rx Freq	0 Hz 0 Hz			
021	Rx Bandwidth	0 Hz	022	Rx Level	0 dBm
023	Rx Alarm	0 dBm	024	AM Noise(SNR)	0 dB
025	FM Noise	0 %			
031	Channel 3	Single			
032	Tone 3 Tx Freq	0 Hz 0 Hz			
033	Transmit Level	0.00 dBm	034	Boost Level	0 dB
035	Tone 3 Rx Freq	0 Hz 0 Hz			
036	Rx Bandwidth	0 Hz	037	Rx Level	0 dBm
038	Rx Alarm	0 dBm	039	AM Noise(SNR)	0 dB
040	FM Noise	0 %			
046	Channel 4	Single			
047	Tone 4 Tx Freq	0 Hz 0 Hz			
048	Transmit Level	0.00 dBm	049	Boost Level	0 dB
050	Tone 4 Rx Freq	0 Hz 0 Hz			
051	Rx Bandwidth	0 Hz	052	Rx Level	0 dBm
053	Rx Alarm	0 dBm	054	AM Noise(SNR)	0 dB
055	FM Noise	0 %			
060	Opt Status Board	No	061	EE Pot J10	A
062	Chan delay alarm	0 ms	063	Year	0000
064	Date	11/04	065	Time	13:46:26
066	Hour Adjust	0	067	Local Address	0
068	Remote Address	0	069	Reset Log	

9745-P>

Figure 6-7. Typical parameter settings display for the Audio System with no parameters set

A typical parameter settings display for the Audio System with channel 1 set for modem operation is shown in Figure 6-8. A typical parameter settings display for the Digital System is shown in Figure 6-9.

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	CPU BOARD 3			
001	Channel 1	Modem			
002	Tone 1 Tx Freq	700 Hz 1000 Hz			
003	Transmit Level	-5.00 dBm	004	Boost Level	0 dB
005	Tone 1 Rx Freq	700 Hz 1000 Hz			
006	Rx Bandwidth	450 Hz	007	Rx Level	-5 dBm
008	Rx Alarm	-35 dBm	009	AM Noise (SNR)	8 dB
010	FM Noise	75 %			
016	Channel 2	not defined			
031	Channel 3	not defined			
046	Channel 4	not defined			
060	Opt Status Board	Yes	061	EE Pot J10	A
062	Chan delay alarm	8 ms	063	Year	1994
064	Date	03/15	065	Time	09:45:19
066	Hour Adjust	1	067	Local Address	456
068	Remote Address	123	069	Reset Log	
9745-P>					

Figure 6-8. Typical parameter settings display for the Audio System with Channel 1 set for modem operation

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	Test Unit #1			
011	Functions 1-7	Digital			
012	Major Data Error	6, 500			
013	Minor Data Error	400, 200000			
014	Alarm BER	1E-04			
060	Opt Status Board	No	062	Chan delay alarm	4 ms
063	Year	1994	064	Date	08/09
065	Time	13:47:06	066	Hour Adjust	0
067	Local Address	0	068	Remote Address	888
069	Reset Log				
9745>					

Figure 6-9. Typical parameter settings display for the Digital System

To re-program any of the values shown on the parameter settings displays, type in the number in the "#" column, and then press [ENTER]. The parameter will be displayed, with information about its setting below it. Type in the new setting, and then press [ENTER].

The following are several examples of editing Audio or Digital system parameter settings:

Example 1: Editing the System Label Parameter Setting. (Audio or Digital systems)

1. Enter the number for the System Label parameter (999) on your terminal or PC keyboard, and then press the [ENTER] key.

The System Label parameter will be displayed, with information about its setting below it.

**999 System Label SUBSTATION 2
[any string]> _**

2. Type in what you want the new system label to be.
The system label can be any combination of letters or numbers up to 16 characters long.
3. When you are finished entering the new system label, press the [ENTER] key.
The System Label parameter will be re-displayed, set to the new value.
4. Enter the "Q" command to return to the main menu:

9745-P>Q

Example 2: Editing the channel 1 mode parameter setting. (Audio system only)

1. To configure Channel 1 for FSK modem operation, type in the following:

9745-P>1 [ENTER]

2. The Channel 1 parameter will be displayed, with information about its setting below it.

**001 Channel 1 not defined
[Single, Modem, 6750 Modem, Pass, None]> _**

3. There are five settings for this parameter, as listed in the brackets beneath it. To set Channel 1 for modem operation, type in the first letter of "modem" ("M"), and then press [ENTER]. The Channel 1 parameter will be re-displayed, set to the new value.

001 Channel 1 Modem

Example 3: Editing the system time and date parameter settings. (Audio or Digital system)

If your RFL 9745 is connected to an IRIG-B generator, its system clock is being automatically synchronized to the IRIG-B time clock, and no manual setting is required. If you are not using an IRIG-B generator, use the following procedure to set the RFL 9745's system clock:

1. Enter the number for the Year parameter (63) on your terminal or PC keyboard, and then press the [ENTER] key.

The Year parameter will be displayed, with information about its setting below it.

063 Year
[any year]> _

2. Type in the current year, and then press the [ENTER] key.

The Year parameter will be re-displayed, set to the new value.

3. Enter the number for the Date parameter (64) on your terminal or PC keyboard, and then press the [ENTER] key.

The Date parameter will be displayed, with information about its setting below it.

064 Date
[mm/dd]> _

4. Type in the current date, and then press the [ENTER] key.

The Date parameter will be re-displayed, set to the new value.

5. Enter the number for the Time parameter (65) on your terminal or PC keyboard, and then press the [ENTER] key.

The Time parameter will be displayed, with information about its setting below it.

065 Time
[hh:mm:ss]> _

6. Type in the current time (in 24-hour format), and then press the [ENTER] key.

The Time parameter will be re-displayed, set to the new value.

7. Enter the "SV" command to save your new system time:

9745-P>SV

NOTE

If you are using IRIG-B and channel 1 is set as a modem, the remote unit will be synchronized through the modem to the same IRIG-B time and date unless it has an IRIG-B input as well.

Example 4: Editing the Major Data Error setting (Digital System only)

The Major Data Errors (Y, Z), are bits used in the primitive logic to inhibit tripping. The Major Data Error bit is set when Y bits are in error out of Z bits (where $Z > 15Y$). Parameter # 012 in Figure 6-9 is presently set for 6 bits in error out of 500 (6, 500). This means that if **during** an interval of 500 bits if more than 6 bits have been detected to be in error, the Major Data Error bit will be set. The next interval of 500 bits will begin at the point at which the Major Data Error bit was set. It will then take another interval of 500 bits with less than 6 bits in error to reset the Major Data Error bit. Since the errors are detected **during** the interval, the Major Data Errors are fast acting.

To change the setting of the Major Data Error, do the following:

1. Enter the number for the Major Data Error parameter (12) on your terminal or PC keyboard, and then press the [ENTER] key.

The Major Data Error parameter will be displayed, with information about its setting below it.

**012 Major Data Error 6, 500
[0-10000 errors out of], [1-1000000 total]>_**

2. Type in Y, Z where Y can have any value from 0 to 10000 and where Z can have any value from 1 to 1000000. For example, type in 8, 800 and then press the [ENTER] key.

The Major Data Error parameter will be re-displayed, set to the new value as follows:

012 Major Data Error 8, 800

3. Enter the "SV" command to save the new Major Data Error setting.

9745-P>SV

Example 5: Editing the Minor Data Error setting (Digital System only)

The Minor Data Errors (W, X), are bits used in the primitive logic to inhibit tripping. The Minor Data Error bit is set when W bits are in error out of X bits (where $X > 15W$). Parameter # 013 in Figure 6-9 is presently set for 400 bits in error out of 200000 (400, 200000). This means that if **after** an interval of 200000 bits if more than 400 bits were in error, the Minor Data Error bit will be set. The next interval of 200000 bits will begin at the point at which the Minor Data Error bit was set. It will then take another interval of 200000 bits with less than 400 bits in error to reset the Minor Data Error bit. Since the errors are detected **after** the interval, the Minor Data Errors are slow acting.

To change the setting of the Minor Data Error, do the following:

1. Enter the number for the Minor Data Error parameter (13) on your terminal or PC keyboard, and then press the [ENTER] key.

The Minor Data Error parameter will be displayed, with information about its setting below it.

**013 Minor Data Error 400, 200000
[0-10000 errors out of], [1-1000000 total]>_**

2. Type in W, X where W can have any value from 0 to 10000 and where X can have any value from 1 to 1000000. For example, type in 400, 200000 and then press the [ENTER] key.

The Minor Data Error parameter will be re-displayed, set to the new value as follows:

013 Minor Data Error 400, 200000

3. Enter the "SV" command to save the new Minor Data Error setting.

9745-P>SV

Example 6: Editing the Alarm BER (Digital System only)

The Alarm BER (Alarm Bit Error Rate) is the ratio of error bits to received bits. When this rate is exceeded the BER Alarm bit in the alarm logic will be set. The BER calculation is performed over a one second period.

The Alarm BER notation is 1E-02, where the mantissa can be any whole number from 1 to 9 and where the exponent can be any negative whole number from -6 to -2. In the above example, 1E-02 is equivalent to $1 \times 10^{-2} = 1/10^{+2}$ which indicates one bit error out of 100 transmitted bits.

To change the setting of the Alarm BER, do the following:

1. Enter the number for the Alarm BER parameter (14) on your terminal or PC keyboard, and then press the [ENTER] key.

The Alarm BER parameter will be displayed, with information about its setting below it.

014 Alarm BER 1E-04
[mantissa:1 to 9], [exponent: -6 to -2]>_

2. Type in the mantissa, and then the exponent. For example, type in 2, -4 and then press the [ENTER] key.

The Alarm BER parameter will be re-displayed, set to the new value as follows:

014 Alarm BER 2E-04

This is equivalent to 2 bit errors out of 10000 transmitted bits.

3. Enter the "SV" command to save the new Alarm BER setting.

9745-P>SV

Clears at 0E-06.

6.8 READING PARAMETER SETTINGS

The "D" command tells the RFL 9745 to send a list of all parameter settings to your terminal. This list of settings is called the "read settings" menu.

9745>D [ENTER]

A typical read settings menu for the Audio System appears in Figure 6-10. All the settings described in Section 5 of this manual are shown, but you can't change the displayed values. To change these values, you will have to enter the programming mode. (See paragraph 6.7 for more information.) The programming mode is password-protected, so only authorized persons can change the RFL 9745's parameter settings.

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	SYSTEM LABEL			
001	Channel 1	Modem			
002	Tone 1 Tx Freq	700 Hz 1000 Hz			
003	Transmit Level	-15.00 dBm	004	Boost Level	0 dB
005	Tone 1 Rx Freq	700 Hz 1000 Hz			
006	Rx Bandwidth	380 Hz	007	Rx Level	-15 dBm
008	Rx Alarm	-33 dBm	009	AM Noise (SNR)	8 dB
010	FM Noise	75 %			
016	Channel 2	not defined			
031	Channel 3	Single			
032	Tone 3 Tx Freq	2145 Hz 2445 Hz			
033	Transmit Level	-15.00 dBm	034	Boost Level	0 dB
035	Tone 3 Rx Freq	2145 Hz 2445 Hz			
036	Rx Bandwidth	380 Hz	037	Rx Level	-15 dBm
038	Rx Alarm	-33 dBm	039	AM Noise (SNR)	8 dB
040	FM Noise	28 %			
046	Channel 4	Single			
047	Tone 4 Tx Freq	1465 Hz 1765 Hz			
048	Transmit Level	-15.00 dBm	049	Boost Level	0 dB
050	Tone 4 Rx Freq	1465 Hz 1765 Hz			
051	Rx Bandwidth	380 Hz	052	Rx Level	-15 dBm
053	Rx Alarm	-33 dBm	054	AM Noise (SNR)	8 dB
055	FM Noise	28 %			
060	Opt Status Board	Yes	061	EE Pot J10	A
062	Chan delay alarm	8 ms	063	Year	1994
064	Date	08/09	065	Time	13:47:06
066	Hour Adjust	0	067	Local Address	456
068	Remote Address	888	069	Reset Log	
9745>					

Figure 6-10. Typical read settings menu, for the Audio System, with three channels active and one channel not defined

6.9 VIEWING CONFIGURATION AND SOFTWARE INFORMATION

The "F" command tells the RFL 9745 to send a configuration and software version display to your terminal. This display tells you how the RFL 9745 is configured, and what software versions are being used. These parameters cannot be changed by the user in this display, however some of the parameters can be changed by going to other menus. For the Audio System, parameters 076 through 082 can be changed by going to the parameter settings display shown in Figure 6-8. For the Digital System, parameters 076 through 078 can be changed by going to the parameter settings display shown in Figure 6-9.

Format: 9745>F [ENTER]

Typical configuration and software version displays for the narrowband and wideband Audio Systems are shown in Figures 6-11 and 6-12 respectively. A typical configuration and software version display for the Digital System is shown in Figure 6-13.

```
9745 Configuration:
070 Software ID          5.2; (c) 2000 RFL Electronics
071 BIOS ID             3.1; (c) 1994 RFL Electronics
072 System Date         12/10/2002 11:21
073 BIOS Date           03/26/1997 14:02
074 Primitive ID        DEFAULT 9745 AUDIO PRIMITIVE CODE
075 Alarm Logic ID      DEFAULT AUDIO ALARM FUNCTION
076 Annunc Outputs      Not Installed
077 Local Address       888
078 Remote Address      888
079 Channel 1           audio
080 Channel 2           audio
081 Channel 3           audio
082 Channel 4           audio
9745>
```

Figure 6-11. Typical configuration and software version display for the narrow band Audio System

```

9745 Configuration:
070 Software ID          5.2; (c) 2000 RFL Electronics
071 BIOS ID             3.1; (c) 1994 RFL Electronics
072 System Date         12/10/2002 11:21
073 BIOS Date           03/26/1997 14:02
074 Primitive ID        DEFAULT 9745 AUDIO PRIMITIVE CODE
075 Alarm Logic ID      DEFAULT AUDIO ALARM FUNCTION
076 Annunc Outputs      Not Installed
077 Local Address        888
078 Remote Address      888
079 Channel 1           audio – wideband
080 Channel 2           audio – wideband
081 Channel 3           audio – wideband
082 Channel 4           audio – wideband
9745>

```

Figure 6-12. Typical configuration and software version display for the wide band Audio System

```

9745 Configuration:
070 Software ID          5.2; (c) 2000 RFL Electronics
071 BIOS ID             3.1; (c) 1994 RFL Electronics
072 System Date         12/10/2002 11:21
073 BIOS Date           02/26/1997 14:02
074 Primitive ID        DEFAULT 9745 DIGITAL PRIMITIVE CODE
075 Alarm Logic ID      DEFAULT DIGITAL ALARM FUNCTION
076 Annunc Outputs      Not Installed
077 Local Address        888
078 Remote Address      888
083 Channel Type        Digital: RS 449 or X.21
084 Data Rate           No Clock
9745>

```

Figure 6-13. Typical configuration and software version display for the Digital System

The configuration and software version display shows the code number for each item, a brief description of its meaning, and its value. Full descriptions for each item are as follows:

- 070 - Software ID** The version number of the system software installed in your RFL 9745, or the PC April software version when in stand alone mode.
- 071 - BIOS ID** The version number of the BIOS software (basic input/output software) installed in your RFL 9745.
- 072 - System Date** The release date and time of the system software revision in your system, and not the date and time that the software was loaded into the 9745.
- 073 - BIOS Date** The release date and time of the BIOS software revision in your system, and not the date and time that the software was loaded into the 9745.
- 074 - Primitive ID** The name of the primitive logic table active in your system. The user can expect to see the following variations of Primitive ID:
1. DEFAULT 9745 AUDIO PRIMITIVE CODE
 2. DEFAULT 6750 AUDIO PRIMITIVE CODE
 3. DEFAULT 9745 DIGITAL PRIMITIVE CODE
 4. EDIT DEFAULT PRIMITIVE CODE
 5. DOWNLOADED PRIMITIVE CODE
 6. EXPERT SYSTEM PRIMITIVE CODE
 7. DEFAULT 9745 OPTIC PRIMITIVE CODE
- 075 - Alarm Logic ID** The name of the alarm logic table active in your system. The user can expect to see the following variations of Alarm Logic ID:
1. DEFAULT AUDIO ALARM FUNCTION
 2. EDIT DEFAULT ALARM FUNCTION
 3. DOWNLOADED ALARM FUNCTION
 4. 9745 ALARM LOGIC
- 076 - Annunc Outputs** This will indicate either "Installed" or "Not Installed," depending on whether or not the annunciator outputs are installed.
- 077 - Local Address** This is the address assigned by the user to the local RFL 9745. This address can be changed by editing the parameter settings shown in Figures 6-8 and 6-9.

- 078 - Remote Address** This is the address assigned by the user to the remote RFL 9745. This address can be changed by editing the parameter settings shown in Figures 6-8 and 6-9.
- 079 - Channel 1** This will indicate either “audio” or “none” depending on whether Channel 1 is an audio channel, or not installed.
- 080 - Channel 2** This will indicate either “audio” or “none” depending on whether Channel 2 is an audio channel, or not installed.
- 081 - Channel 3** This will indicate either “audio” or “none” depending on whether Channel 3 is an audio channel, or not installed.
- 082 - Channel 4** This will indicate either “audio” or “none” depending on whether Channel 4 is an audio channel, or not installed.
- 083 - Channel Type** This will indicate the type of Digital I/O card that is installed in the system. The user can expect to see any one of the following variations:
1. Digital: RS449 or X.21
 2. Digital: Fiber Optics
 3. Digital: G.703 Codirectional
 4. Digital: G.703 Contradirectional
 5. Digital: Short Haul Fiber
 6. Digital: Unknown media
 7. Digital card not installed
- 084 - Data Rate** This will display the actual measured data rate rounded off to the nearest thousand bits/second (for example: “64 K bits/second”), or will display “No Clock” if data is not present.

NOTE

The RFL 9745's communication channels cannot be mixed. The channels will be either audio, digital, fiber optic, or not installed.

CAUTION

The RFL 9745 has powerful logic programming capabilities. This allows persons with extensive programming experience to modify the logic inside the RFL 9745 so that it can respond to conditions that exist in your system. Improper logic settings may result in system malfunctions, false trips, or other undesirable conditions. Be sure to read and fully understand the paragraphs describing the logic/alarm programming language in Section 2 of this manual before attempting to enter the logic programming mode.

6.10 THE LOGIC PROGRAMMING MODE

The logic programming mode allows you to use the RFL 9745's powerful logic programming capabilities to tailor its logic to suit your specific application. To enter the logic programming mode, use the "K" command.

9745>K [ENTER]

The "K" command tells the RFL 9745 to send a list of all logic programming commands to your terminal. To prevent use by unauthorized persons, the "K" command is password-protected.

```
Logic Programming Menu
H - Display logic menu help
A - Go to Alarm and I/O Name menu
C - Change Password (superuser authorization required)
D - Go to Timer Parameter menu
E - Download Embedded Logic
F - Restore Default Logic
G - Output Primitive Logic Table
M - Output Alarm Logic Table
Q - Leave Logic Programming menu
R - Go to Default Logic Configuration menu
S - Edit Primitive Processor Logic Table
T - Edit Alarm Logic Table
## - Edit this specific number parameter
SV - Save Programming and Assemble Default Logic
9745-L>
```

Figure 6-14. Typical logic programming menu for the Audio or Digital System

You are now in the logic programming mode, as indicated by the "9745-L>" prompt on your screen. You may now use the logic programming commands to modify how the RFL 9745 operates. For more information on each logic programming command, refer to the paragraph numbers listed below.

Command	Meaning	Paragraph
H	Display logic menu help	6.10.1
A	Go to Alarm and I/O Name menu	6.10.2
C	Changing the Password	6.4.2
D	Go to Timer Parameter menu	6.10.5
E	Download Embedded Logic	6.10.6
F	Restore Default Logic	6.10.7
G	Output Primitive Logic Table	6.10.8
M	Output Alarm Logic Table	6.10.9
Q	Leave Logic Programming menu	6.10.10
R	Go to Default Logic Configuration menu	6.10.11, 12
S	Edit Primitive Processor Logic Table	6.10.13
T	Edit Alarm Logic Table	6.10.14
SV	Save Programming and Assemble Default Logic	6.10.15

6.10.1 DISPLAYING LOGIC PROGRAMMING HELP

Any time you need to see a list of all the logic programming commands, use the "H" command.

9745-L>H [ENTER]

When you invoke the "H" command, the logic programming menu shown in Figure 6-13 will re-appear on your screen.

6.10.2 CHANGING ALARM AND I/O NAMES

You can assign new names to each of the RFL 9745's alarm outputs, inputs, and outputs. These names will appear on the screens you will see while using APRIL, and on the RFL 9745's front-panel display. To change these names, use the "A" command.

9745-L>A [ENTER]

When you invoke the "A" command, an Alarm and I/O Name menu similar to the one shown in Figure 6-15 will appear, which is for a 9745 System equipped with the status option. For 9745 Systems not equipped with the status option, parameters 126-131 will not be shown on the menu. If your system has the status option, you must set the Opt Status Board to "yes" in the parameters display in order to view these outputs. See parameter 060 in the menu of Figure 6-7.

#	ALARM #	NAME			
120	Annunc Relay 1A	ALARM RELAY 1A	|	DUAL COMMS ALARM	
121	Annunc Relay 2A	ALARM RELAY 2A	|	HARDWARE WARNING	
122	Annunc Relay 3A	ALARM RELAY 3A	|	HARDWARE ALARM	
123	Annunc Relay 1B	ALARM RELAY 1B	|	OUTPUT ALARM	
124	Annunc Relay 2B	ALARM RELAY 2B	|	NOT USED	
125	Annunc Relay 3B	ALARM RELAY 3B	|	NOT USED	
126	Annunc Output 1	AUX OUTPUT 1	|	DUAL COMMS ALARM	
127	Annunc Output 2	AUX OUTPUT 2	|	HARDWARE WARN	
128	Annunc Output 3	AUX OUTPUT 3	|	HARDWARE ALARM	
129	Annunc Output 4	AUX OUTPUT 4	|	OUTPUT ALARM	
130	Annunc Output 5	AUX OUTPUT 5	|	NOT USED	
131	Annunc Output 6	AUX OUTPUT 6	|	NOT USED	
140	Input 1A	KEY CH 3	141	Input 1B	KEY CH 2
142	Input 2A	KEY CH 3	143	Input 2B	KEY CH 2
144	Input 3A	KEY CH 4	145	Input 3B	NOT USED
146	Input 4A	KEY CH 4	147	Input 4B	NOT USED
150	Output 1A	DUAL GUARD	151	Output 1B	SINGLE GUARD
152	Output 2A	DUAL GUARD	153	Output 2B	SINGLE GUARD
154	Output 3A	DUAL TRIP	155	Output 3B	SINGLE TRIP
156	Output 4A	DUAL TRIP	157	Output 4B	SINGLE TRIP
160	Tx Func 1 LED	High	161	Rx Func 1 LED	High
162	Tx Func 2 LED	High	163	Rx Func 2 LED	High
164	Tx Func 3 LED	High	165	Rx Func 3 LED	High
166	Tx Func 4 LED	Low	167	Rx Func 4 LED	Low
168	Seal-in Func LED	No			
9745-L>					

Figure 6-15. Typical Alarm and I/O Name menu for the Audio or Digital System equipped with the status option

6.10.3 LABELING INPUTS, OUTPUTS, AND ALARMS

Each of the RFL 9745's inputs and outputs can be assigned a name or label up to 16 characters long. Annunciator outputs can be assigned a two-line name, with up to 16 characters in each line. This name will appear on many of the APRIL menus, and will also appear on the RFL 9745's front-panel display.

To label the RFL 9745's inputs, outputs, and alarms, use the following procedure:

1. Press the [A] and [ENTER] keys on your terminal or PC keyboard to view a list of all current alarm and I/O names.

A list of current alarm and I/O names will appear on your screen.

2. Enter the number of the first input or output name to be changed, and press the [ENTER] key on your terminal or PC keyboard.

The selected input or output name and its current setting will be displayed. For example, if Parameter 140 (Input 1A) is selected, the following will appear on your screen:

**140 Input 1A KEY CH 3
[line 1]**

3. Enter the new name for the input or output (up to 16 characters), and then press the [ENTER] key.

The parameter will be redisplayed, showing the new name.

4. Enter the number of the first alarm output name to be changed, and press the [ENTER] key on your terminal or PC keyboard.

The selected alarm output name and its current setting will be displayed. For example, if Parameter 120 (Input 1A) is selected, the following will appear on your screen:

**120 Annunc Relay 1A DUAL COMMS ALARM RELAY 1A
[line 1 |line 2]**

5. Alarm outputs can have two-line names, with 16 characters in each line. Enter the name that you want displayed on the first line, a vertical line (|), and the name that want displayed on the second line. Once the text for both lines is entered, press the [ENTER] key.

The parameter will be redisplayed, showing the new name.

6. Once you have made all the changes you need to make, enter the "SV" command to save your changes:

9745-L>SV

6.10.4 FRONT-PANEL FUNCTION INDICATORS

The eight FUNCTION indicators on the RFL 9745's front panel show the status of the four tone channels. Each indicator can be set to light when a low-frequency tone is being sent or received, or when a high-frequency tone is being sent or received. They normally are set to light on the trip frequency.

6.10.4.1 SETTING FRONT PANEL FUNCTION INDICATORS

To set the FUNCTION indicators, use the following procedure:

1. Press the [A] and [ENTER] keys on your terminal or PC keyboard to view a list of all current alarm names, I/O names, and indicator functions.

A list of current alarm names, I/O names, and indicator functions will appear on your screen.

2. Enter the number for the first TX FUNCTION indicator (160), and then press the [ENTER] key on your terminal or PC keyboard.

The selected indicator name and its current setting will be displayed. For example, if Parameter 160 (Tx Func 1) is selected, the following will appear on your screen:

**160 Tx Func 1 LED High
[High,Low Frequency/Function]>_**

3. If you want the TX FUNCTION 1 indicator to light when Channel 1 is transmitting its high frequency, press the [H] and [ENTER] keys on your terminal or PC keyboard. If you want the indicator to light when Channel 1 is transmitting its low frequency, press the [L] and [ENTER] keys on your terminal or PC keyboard.

The indicator name will be re-displayed, along with its new setting. For example, if an "L" was entered for Parameter 160, the following will appear on your screen:

160 Tx Func 1 LED Low

4. Enter the number for the first RX FUNCTION indicator (161), and then press the [ENTER] key on your terminal or PC keyboard.

The selected indicator name and its current setting will be displayed. For example, if Parameter 161 (Rx Func 1) is selected, the following will appear on your screen:

**161 Rx Func 1 LED High
[High,Low Frequency/Function]>_**

5. If you want the RX FUNCTION 1 indicator to light when Channel 1 is receiving its high frequency, press the [H] and [ENTER] keys on your terminal or PC keyboard. If you want the indicator to light when Channel 1 is receiving its low frequency, press the [L] and [ENTER] keys on your terminal or PC keyboard.

The indicator name will be re-displayed, along with its new setting. For example, if an "L" was entered for Parameter 161, the following will appear on your screen:

161 Rx Func 1 LED Low

6. Repeat steps 2 through 5 for the other TX FUNCTION indicators.
7. Once all the FUNCTION indicators have been set, enter the "SV" command to save your changes:

9745-L>SV

6.10.4.2 SEALING-IN FRONT PANEL FUNCTION INDICATORS

The Seal-in function is a diagnostic tool used to “lock on” any Tx or Rx LED that might flicker or flash on momentarily. The Seal-in function has a default of No (or not Sealed-in). To cause the Tx and Rx LEDs to Seal-in (or lock on), the Yes selection must be made, by typing a Y for Yes, and then pressing [ENTER]. After the Yes selection is made, enter the “SV” command to save your change. The Sealed-in LEDs can only be cleared from the front panel by using the Reset button as described in paragraph 7.5.4.

For example, if a "Y" was entered for parameter 168, the following will appear on your screen:

168 Seal-in Func LED Yes

6.10.5 SETTING TIMER PARAMETERS

The RFL 9745 has several software timers that help control its logic decisions. These timers are defined and named in the logic tables. To set these timers, use the "D" command.

9745-L>D [ENTER]

When you invoke the "D" command, a Timer Parameter menu similar to the one shown in Figure 6-16 will appear.

Timer Parameters				
#	Timer	Attack	Decay	Name
001	Prim Timer 1	15.0	0.0	Dual Boost Timer, Channel 3
002	Prim Timer 2	15.0	0.0	Dual Boost Timer, Channel 4
003	Prim Timer 3	15.0	0.0	Single Boost Timer, Channel 2
004	Prim Timer 4	25.0	25.0	Dual Flash Timer, Channel 3
005	Prim Timer 5	25.0	25.0	Dual Flash Timer, Channel 4
006	Prim Timer 6	25.0	25.0	Single Flash Timer, Channel 2
007	Prim Timer 7	0.0	0.0	Command Extend, Function Ch 3
008	Prim Timer 8	0.0	0.0	Command Extend, Function Ch 4
009	Prim Timer 9	0.0	0.0	Command Extend, Function Ch 2
010	Prim Timer 10	20.0	0.0	Dual Guard Timer
011	Prim Timer 11	100.0	12.0	Dual Block Timer
012	Prim Timer 12	20.0	0.0	Single Guard Timer
013	Prim Timer 13	100.0	12.0	Single Block Timer
014	Prim Timer 14	100.0	10.0	Dual Guard Before Trip/TAG
015	Prim Timer 15	0.0	20.0	Dual Trip Hold Timer
016	Prim Timer 16	100.0	40.0	Single Guard Before Trip/TAG
017	Prim Timer 17	0.0	20.0	Single Trip Hold Timer
018	Prim Timer 18	3.0	0.0	Dual Pre-Trip Timer 1
019	Prim Timer 19	3.0	0.0	Single Pre-Trip Timer 1
020	Prim Timer 20	1.5	5.0	Dual Pre-Trip Timer 2/Trip Hyst
021	Prim Timer 21	1.5	5.0	Single Pre-Trip Timer 2/Trip Hyst
041	Alarm Timer 1	100.0	100.0	Dual Comms Alarm Timer
042	Alarm Timer 2	100.0	100.0	Hardware Warning Timer
043	Alarm Timer 3	100.0	100.0	Hardware Fail Timer
044	Alarm Timer 4	100.0	100.0	Output Alarm Timer
045	Alarm Timer 5	100.0	100.0	Pre-Outage Active Timer
9745-L>				

Figure 6-16. Typical Timer Parameter menu for the Audio or Digital System

To set a timer, enter its line number from the Timer Parameter Menu, and then press the **[ENTER]** key:

1 [ENTER]

The following prompt will appear on your screen:

001 Prim Timer 1 15.0 0.0 Guard Before Trip/TAG Tone 2
[attack,decay (0-30000 msec in 0.5 inc)]>_

Enter the desired attack and decay values, separated by a comma. The prompt will be re-displayed, with the new settings shown.

NOTE

The new timer values you enter will not be placed in effect unless the "SV" command is used to save all new logic programming settings. Refer to paragraph 6.10.15 for more information on the "SV" command.

6.10.6 DOWNLOADING EMBEDDED LOGIC

Logic tables can be passed between a PC running PC APRIL LITE and a 9745. Tables generated via PC APRIL LITE or tables supplied by RFL on the PC APRIL CD can be downloaded to the 9745. See section 9 for information on this process.

6.10.7 RESTORING DEFAULT LOGIC

If you want to return the RFL 9745's logic tables to RFL default logic, use the "F" command:

9745-L>F [ENTER]

When you invoke the "F" command, the following prompt will appear on your screen for an Audio System:

**089 Logic Tables Primitive: Downloaded, Alarm: Downloaded
[9745,6750,Alarm]>_**

The following two default Primitive Logic Tables are available for an audio system:

9745 Audio - This default provides one single channel function and one dual channel function.
(See Figure 2-26)

6750 Audio - This default gives the same functionality as the 6750.
(See Figure 2-27)

The following default Primitive Logic Table is available for a digital system:

9745 Digital - This default provides four digital functions.
(See Figure 2-29)

The following default Alarm Logic Table is available for an audio system:

9745 - Audio alarms (See Figure 2-28)

The following default Alarm Logic Table is available for a digital system:

9745 - Digital alarms (See Figure 2-30)

To reset the primitive to the desired default, enter the appropriate default name: **9745**, **6750**, or **Alarm**, and then press **[Enter]**.

NOTE

The Logic Tables will not return to their default values unless you use the "SV" command to save all new logic programming settings. Refer to paragraph 6.10.15 for more information on the "SV" command.

6.10.8 THE PRIMITIVE LOGIC TABLE

The Primitive Logic Table controls all logic decisions made by the RFL 9745. Normally, It is set at the factory according to the default logic diagram supplied with the equipment. A copy of this diagram can be found in Section 2 of this manual, or in the "as supplied" drawings furnished with the equipment. The user has the option to generate his own primitive logic diagram and primitive logic table to satisfy a particular requirement.

To output (view) the Primitive Logic Table, use the "G" command.

9745-L>G [ENTER]

When you invoke the "G" command, a Primitive Logic Table will appear, similar to the portion shown in Figure 6-17. You will be able to view the table, but you won't be able to make any changes. If you want to change the Primitive Logic Table, use the "S" command described in paragraph 6.10.13.

#	Gate:	Input 1:	Input 2:	Output:
001	OR	AM2H_CH3	AM1H_CH3	
002	AND	AM2L_CH3	AM1L_CH3	
003	NOT	AM1L_CH3	#0	
004	NOT	AM2L_CH3	#0	
005	OR	FM_CH3	S/N_CH3	
...
...
...
097	OR	NODE96	INPUT1A	
098	NOT	NODE97	#0	
099	OR	INPUT2A	NODE54	
100	OR	NODE99	NODE75	
101	NOT	NODE100	#0	
9745-L>				

Figure 6-17. Portion of a typical Primitive Logic Table for the Audio System

6.10.9 THE ALARM LOGIC TABLE

The Alarm Logic Table controls all the logic decisions the RFL 9745 makes to produce its alarm outputs. Normally, it is set at the factory according to the default alarm logic diagram supplied with the equipment. A copy of this diagram appears in Section 2 of this manual, or in the "as supplied" drawings furnished with the equipment. The user has the option to generate his own alarm logic diagram and alarm logic table to satisfy a particular requirement.

To output (view) the Alarm Logic Table, use the "M" command.

9745-L>M [ENTER]

When you invoke the "M" command, an Alarm Logic Table similar to the portion shown in Figure 6-18 will appear. You will be able to view the table, but not make any changes. If you want to change the Alarm Logic Table, use the "T" command as described in paragraph 6.10.14.

#	Gate:	Input 1:	Input 2:	Output:
001	OR	AM1H_CH3	AM2H_CH3	
002	AND	AM1L_CH3	AM2L_CH3	
003	OR	NODE1	NODE2	
004	OR	AM1H_CH4	AM2H_CH4	
005	AND	AM1L_CH4	AM2L_CH4	
...
...
...
044	TIMER	NODE43	TIMER5	
045	AND	NODE44	#1	A_OUTPUT3
046	OR	ADD_FAIL	CHKBK	
047	TIMER	NODE46	TIMER6	A_RELAY3A
048	AND	NODE47	#1	A_OUTPUT4

9745-L>

Figure 6-18. Portion of a typical Primitive Logic Table for the Audio System

6.10.10 LEAVING THE LOGIC PROGRAMMING MODE

NOTE

Before leaving the Logic Programming Mode, if you don't use the "SV" command your changes will be lost.

When you are finished programming the RFL 9745's logic, use the "Q" command:

9745-L>Q [ENTER]

The "Q" command tells the RFL 9745 to leave the logic programming mode and return to the normal "9745>" prompt. If you changed any setting while in the programming mode, be sure to use the "SV" command described above to save the changes before invoking the "Q" command; otherwise, your changes will be lost.

6.10.11 THE DEFAULT LOGIC CONFIGURATION MENU (For Audio System)

The Default Logic Configuration Menu for the audio system consists of item numbers 091 through 109 as shown in Figure 6-19. These item numbers correspond to jumpers J1 through J19 on the Audio Default Primitive Logic Diagram shown in Figure 2-26. The Audio Default Primitive Logic Diagram is also represented as a logic diagram which can be viewed by the user by using the "G" command in the logic programming menu.

The Audio Default Logic can be reconfigured by the user in three different ways. These are as follows:

1. By manually changing the jumper settings on the Default Logic Configuration Menu shown in Figure 6-19. This is equivalent to moving the jumpers on the Audio Default Primitive Logic Diagram shown in Figure 2-26.
2. By editing the logic table using the "S" command in the Logic Programming Menu.
3. By loading a new logic table from a PC to the 9745 using PC APRIL as described in Section 9.

This section of the manual is concerned with manually changing the jumper settings using the Default Logic Configuration Menu shown in Figure 6-19, and is described as follows:

To view and edit the Default Logic Configuration Menu, use the "R" command:

9745-L>R [ENTER]

When you invoke the "R" command, a Default Logic Configuration Menu similar to the one shown in Figure 6-19 will appear. This command will allow the menu to be displayed only with the Default Logic. If the Default Logic has been edited, the menu will not be displayed and the following message will appear:

Primitive logic table has been manually edited

If your system has custom logic installed, the following message will appear:

231 Expert System Logic Table Installed

Default Configuration Selections - 9745 Chs 3 & 4 Dual, CH 2 Single

Transmitter:

#	Function	Setting	#	Function	Setting
091	Input 1A Form	Pos	092	Input 2A Form	Pos
093	Input 3A Form	Pos	094	Input 4A Form	Pos
095	Input 1B Form	Pos	096	Input 2B Form	Pos
097	Relation 1A/2A	OR	098	Relation 3A/4A	OR
099	Relation 1B/2B	OR	100	Ch3 Flash Timer	No
101	Ch3 Boost Timer	No	102	Ch4 Flash Timer	No
103	Ch4 Boost Timer	No	104	Ch2 Flash Timer	No
105	Ch2 Boost Timer	No			

Receiver:

#	Function	Setting	#	Function	Setting
106	Dual Guard Form	Pos	107	Dual Trip Form	Pos
108	Sing Guard Form	Pos	109	Sing Trip Form	Pos

9745-L>

Figure 6-19. Typical Default Logic Configuration Menu for the Audio System

Each item on the Default Logic Configuration Menu is numbered. To edit an item, enter its number and press the [ENTER] key. The item will be displayed, along with its present setting and its possible settings.

Items 91 through 96 control input forms. Each input can be set to "Pos" (positive) or "Neg" (negative).

091 Input 1A Form Pos
[Pos,Neg]>_

Items 97 through 99 control input relationships. Each of these can be set to "AND" (both must be active) or "OR" (only one needs to be active).

097 Relationship 1A/2A OR
[AND,OR]>_

Items 100 through 105 control the flash and boost timers. These timers enable or disable the RFL 9745's flash and boost functions. Each timer can be set to "Yes" (enabled) or "No" (disabled).

101 Ch3 Boost Timer Yes
[Yes,No]>_

Items 106 through 109 control guard and trip forms. Each can be set to "Pos" (positive) or "Neg" (negative).

106 Dual Guard Form Pos
[Pos,Neg]>_

6.10.12 THE DEFAULT LOGIC CONFIGURATION MENU (For Digital System)

The Default Logic Configuration Menu for the digital system consists of item numbers 071 through 078 and 179 through 191 as shown in Figure 6-20. These item numbers correspond to jumpers J1 through J21 on the Digital Default Primitive Logic Diagram shown in Figure 2-29. The Audio Default Primitive Logic Diagram is also represented as a logic diagram which can be viewed by the user by using the "G" command in the logic programming menu.

The Digital Default Logic can be reconfigured by the user in three different ways. These are as follows:

1. By manually changing the jumper settings on the Default Logic Configuration Menu shown in Figure 6-20. This is equivalent to moving the jumpers on the Digital Default Primitive Logic Diagram shown in Figure 2-29.
2. By editing the logic table using the "S" command in the Logic Programming Menu.
3. By loading a new logic table from a PC to the 9745 using PC APRIL as described in Section 9.

This section of the manual is concerned with manually changing the jumper settings using the Default Logic Configuration Menu shown in Figure 6-20, and is described as follows:

To view and edit the Default Logic Configuration Menu, use the "R" command:

9745-L>R [ENTER]

When you invoke the "R" command, a Default Logic Configuration Menu similar to the one shown in Figure 6-20 will appear. This command will allow the menu to be displayed only with the Default Logic. If the Default Logic has been edited, the menu will not be displayed and the following message will appear:

Primitive logic table has been manually edited

Default Configuration Selections - Digital Default Logic					
Transmitter:					
#	Function	Setting	#	Function	Setting
171	J1 Input 1A Form	Pos	172	J2 Input 2A Form	Pos
173	J3 Input 3A Form	Pos	174	J4 Input 4A Form	Pos
175	J5 Input 1B Form	Pos	176	J6 Input 2B Form	Pos
177	J7 Input 3B Form	Pos	178	J8 Input 4B Form	Pos
187	J17 Func 1A/2A	OR	188	J18 Func 3A/4A	OR
189	J19 Func 1B/2B	OR	190	J20 Func 3B/4B	OR
Receiver:					
#	Function	Setting	#	Function	Setting
179	J9 Guard 1A	Pos	180	J10 Trip 2A	Pos
181	J11 Guard 1A	Pos	182	J12 Trip 4A	Pos
183	J13 Guard 1A	Pos	184	J14 Trip 2B	Pos
185	J15 Guard 1A	Pos	186	J16 Trip 4B	Pos
191	J21 Address Fail	Yes			
9745-L>					

Figure 6-20. Typical Default Logic Configuration Menu for the Digital System

Each item on the Default Logic Configuration Menu is numbered. To edit an item, enter its number and press the [ENTER] key. The item will be displayed, along with its present setting and its possible settings.

Items 171 through 178 control input forms. Each input can be set to "Pos" (positive) or "Neg" (negative).

171 J1 Input 1A Form Pos
[Pos,Neg]>_

Items 187 through 190 control function relationships. Each of these can be set to "AND" (both must be active) or "OR" (only one needs to be active).

187 J17 Func 1A/2A OR
[AND,OR]>_

Items 179 through 186 control the guard and trip functions. These functions enable or disable the RFL 9745's guard and trip functions. Each function can be set to "Pos" (positive) or "Neg" (negative).

179 J9 Guard 1A Pos
[Pos,Neg]>_

Item 191 controls the address fail function. This function can be set to "Yes" (enabled) or "No" (disabled).

191 J21 Address Fail Yes
[Yes,No]>_

NOTE

The new values you enter on the Default Logic Configuration Menus will not go into effect unless you use the "SV" command to save all new logic programming settings. Refer to paragraph 6.10.15 for more information on the "SV" command.

6.10.13 EDITING THE PRIMITIVE LOGIC TABLE

The Primitive Logic Table controls how the RFL 9745's primitive logic nodes are interconnected. Editing this table will change the way the RFL 9745 operates. To edit the Primitive Logic Table, use the "S" command.

9745-L>S [ENTER]

When you invoke the "S" command, an Edit Primitive Table menu similar to the one shown in Figure 6-21 will appear.

```

Edit Primitive Table Menu
Q - Leave edit menu
V - View table
H - Display help
## - Edit this record
SV - Save Programming and Assemble Logic
9745-E>
```

Figure 6-21. Typical Edit Primitive Table Menu for the Audio or Digital System

You are now in the RFL 9745's editing mode, as indicated by the "9745-E>" prompt on your screen. You may now use the editing commands to re-program the RFL 9745. For more information on each editing command, refer to the paragraph numbers listed below.

Command	Meaning	Paragraph
Q	Leave edit menu	6.10.13.1
V	View table	6.10.13.2
H	Display help	6.10.13.3
SV	Save Programming and Assemble Logic	6.10.13.4

6.10.13.1 LEAVING THE EDITING MODE

When you are finished editing the Primitive Logic Table, use the "Q" command:

Format: 9745-E>Q [ENTER]

The "Q" command tells the RFL 9745 to leave the editing mode and return to the "!9745-L>" prompt. If you changed any setting while in the programming mode, be sure to use the "SV" command described in paragraph 6.10.13.4 to save the changes before invoking the "Q" command; otherwise, your changes will be lost.

6.10.13.2 VIEWING AND EDITING THE PRIMITIVE LOGIC TABLE

To view the Primitive Logic Table, use the "V" command.

9745-E>V [ENTER]

When you invoke the "V" command, a Primitive Logic Table similar to the portion shown in Figure 6-18 will appear for the Audio System (Figure 6-19 for the Digital System), except that it will have a "9745-E>" prompt at the bottom.

To change a line on the Primitive Logic Table, enter its line number and then press the [ENTER] key.

9745-E>12 [ENTER]

The selected line from the Primitive Logic Table will appear on the screen. Below it will be a prompt listing the entries that can be made:

124 TIMER NODE118 TIMER20
[Primitive],[Input 1],[Input 2 or Timer #],[Output (opt)]

Entries are made to the line as follows:

- | | |
|---------------------------|---|
| Primitive | The type of gate at the node (AND, OR, NOT, XOR, TIMER, or LATCH). Definitions of each gate type can be found in Section 2 of this manual. |
| Input 1 | The name of the input or node that drives input 1 of the gate. This should be the exact spelling of the input or "nodeX" where X is the node number. |
| Input 2 or Timer # | The name of the input or node that drives input 2 of the gate. This should be the exact spelling of the input or "nodeX" where X is the node number. If the gate is a NOT gate, then this input should be "#0". If the gate is a timer, then this input should be "X" where X is the timer number. If the wrong Timer # is entered, the 9745 logic will change timers and cause misoperation. |
| Output | The name of the hardware output that is produced by this node. |

6.10.13.3 CHANGING A TIMER NAME

When editing a timer in the logic, after enter is pressed you will see the following:

Old timer name: Dual Pre-Trip Timer 2/Trip Hyst
[New Timer Name]

Enter the new timer name, press enter, and then enter the "SV" command. You can view the new timer name in the Setting Timer Parameters as described in paragraph 6.10.5.

6.10.13.4 DISPLAYING EDITING HELP

Any time you need to see a list of all the editing commands, use the "H" command.

9745-E>H [ENTER]

When you invoke the "H" command, the Edit Primitive Table Menu shown in Figure 6-21 will re-appear on your screen.

6.10.13.5 SAVING THE EDITED PRIMITIVE LOGIC TABLE

The "SV" command saves any changes you made to the Primitive Logic Table. The 9745 will go out of service during command execution.

9745-E>SV [ENTER]

The "SV" command tells the RFL 9745 to store all the changes in its non-volatile memory. Once the changes are stored, the "9745-E>" prompt will re-appear.

6.10.13.6 Using The "NOP" Command

If a line of code in the logic table is not going to be used, use the "NOP" command to bypass that line of code.

6.10.13.7 Using The "END" Command

After the last line of code, the "END" command is used to indicate the end of the logic table. When the logic table is viewed by using the "V" command, "END" is not displayed.

6.10.14 EDITING THE ALARM LOGIC TABLE

The Alarm Logic Table controls how the RFL 9745's alarm logic nodes are interconnected. Editing this table will change the way the RFL 9745 generates alarms. To edit the Alarm Logic Table, use the "T" command.

Format: 9745-L>T [ENTER]

When you invoke the "T" command, an Edit Alarm Table menu similar to the one shown in Figure 6-22 will appear.

```

Edit Alarm Table Menu
Q - Leave edit menu
V - View table
H - Display help
## - Edit this record
SV - Save Programming and Assemble Logic
9745-E>
```

Figure 6-22. Typical Edit Alarm Table Menu for the Audio or Digital System

You are now in the RFL 9745's editing mode, as indicated by the "9745-E>" prompt on your screen. You may now use the editing commands to re-program the RFL 9745. For more information on each editing command, refer to the paragraph numbers listed below.

Command	Meaning	Paragraph
Q	Leave edit menu	6.10.14.1
V	View table	6.10.14.2
H	Display help	6.10.14.3
SV	Save Programming and Assemble Logic	6.10.14.4

6.10.14.1 LEAVING THE EDITING MODE

Whenever you are finished editing the Alarm Logic Table, use the "Q" command:

9745-E>Q [ENTER]

The "Q" command tells the RFL 9745 to leave the editing mode and return to the "9745-L>" prompt. If you changed any setting while in the programming mode, be sure to use the "SV" command described above to save the changes before invoking the "Q" command; otherwise, your changes will be lost.

6.10.14.2 VIEWING AND EDITING THE ALARM LOGIC TABLE

To view the Alarm Logic Table, use the "V" command.

9745-E>V [ENTER]

When you invoke the "V" command, an Alarm Logic Table similar to the portion shown in Figure 6-17 will appear, except that it will have a "9745-E>" prompt at the bottom.

To change a line on the Alarm Logic Table, enter its line number and then press the [ENTER] key.

9745-E>12 [ENTER]

The selected line from the Alarm Logic Table will appear on the screen. Below it will be a prompt listing the entries that can be made:

012 TIMER NODE11 TIMER1 A_RELAY1A
[Primitive],[Input 1],[Input 2 or Timer #],[Output (opt)]

Entries are made to the line as follows:

- | | |
|---------------------------|--|
| Primitive | The type of gate at the node (AND, OR, NOT, XOR, TIMER, or LATCH). Definitions of each gate type can be found in Section 2 of this manual. |
| Input 1 | The name of the input or node that drives input 1 of the gate. This should be the exact spelling of the input or "nodeX" where X is the node number. |
| Input 2 or Timer # | The name of the input or node that drives input 2 of the gate. This should be the exact spelling of the input or "nodeX" where X is the node number. If the gate is a NOT gate, then this input should be "#0". If the gate is a timer, then this input should be "X" where X is the timer number. |
| Output | The name of the hardware output that is produced by this node. |

6.10.14.3 DISPLAYING EDITING HELP

Any time you need to see a list of all the editing commands, use the "H" command.

9745-E>H [ENTER]

When you invoke the "H" command, the Edit Alarm Table Menu shown in Figure 6-21 will re-appear on your screen.

6.10.14.4 SAVING THE EDITED ALARM LOGIC TABLE

The "SV" command saves any changes you made to the Alarm Logic Table. The 9745 will go out of service during command execution.

9745-E>SV [ENTER]

The "SV" command tells the RFL 9745 to store all the changes in its non-volatile memory. Once the changes are stored, the "9745-E>" prompt will re-appear.

6.10.15 SAVING NEW LOGIC SETTINGS

The "SV" command saves any new settings you made while in the logic programming mode:

9745-L>SV [ENTER]

The "SV" command tells the RFL 9745 to store all the changes in its non-volatile memory. Once the changes are stored, the "9745-L>" prompt will re-appear.

Before you enter the "SV" command, the RFL 9745 operates according to the old logic parameter settings. Once the "SV" command is entered, the new settings will be in effect.

6.11 THE TEST MODE

You can use APRIL and your terminal to verify RFL 9745 operation. All test functions that are normally done using the keypad on the RFL 9745's front panel can be done using a terminal. To use your PC or terminal to test the RFL 9745, use the "T" command.

9745>T [ENTER]

The "T" command tells the RFL 9745 to send a list of all test commands to your terminal. To prevent testing by unauthorized persons, the "T" command is password-protected.

If the proper password is entered, a test menu similar to the one shown in Figure 6-23 will appear.

```
H - Display test menu help
Q - Leave test menu
C - Change password (superuser authorization required)
T - Redisplay tests
## - Run this test
9745-T>
```

Figure 6-23. Typical test menu for the Audio or Digital System

You are now in the test mode, as indicated by the "9745-T>" prompt on your screen. You may now use the test commands to verify the RFL 9745. For more information on each test command, refer to the paragraph numbers listed below.

Command	Meaning	Paragraph
H	Display test menu help	6.11.1
Q	Leave test menu	6.11.2
C	Changing the password	6.4.2
T	Redisplay tests	6.11.3

The 9745 Digital system has an advanced parameters option which can be used for system testing and which can be enabled or disabled. See paragraph 6.14 for further instructions.

6.11.1 DISPLAYING TEST MENU HELP

Any time you need to see a list of all the test menu commands, use the "H" command.

9745-T>H [ENTER]

When you invoke the "H" command, the test menu shown in Figure 6-22 will re-appear on your screen.

6.11.2 LEAVING THE TEST MODE

When you are finished testing the RFL 9745, use the "Q" command:

9745-T>Q [ENTER]

The "Q" command tells the RFL 9745 to leave the test mode and return to the normal "9745>" prompt.

6.11.3 DISPLAYING RFL 9745 TESTS

To view a list of all RFL 9745 test parameters, use the "T" command.

9745-T>T [ENTER]

When you invoke the "T" command, the RFL 9745 sends a list of all test parameters to your terminal. Typical test parameter lists for the Audio and Digital systems are shown in Figures 6-24 and 6-25 respectively.

TEST MENU					
001	Subchannel Test				
002	Disable Tx of Function	Ch 1:E	Ch 2:E	Ch 3:E	Ch 4:E
004	Operations Since Reset	Ch 1:0	Ch 2:0	Ch 3:4	Ch 4:0
005	Cumulative Outage Time	02:20:30.282			
Checkback:					
006	Tests/Reset on Front Panel	Disabled			
007	Auto Tests	Disabled			
008	Time Between Tests	N/A			
009	Next Test Start	10:09			
010	Tests Run Since Reset	10			
011	Tests Passed	1			
012	Tests Failed	9			
013	Run Auto Test				
014	Run Ping Pong Test				
015	Reset Log				
9745-T>					

Figure 6-24. Typical test parameter list for the Audio System

NOTE

Channel 1 must be set to *6750 modem* or *modem* to program parameters 7 through 14.

TEST MENU							
003	Override of Function	Fn 1:X	2:X	3:X	4:X	5:X	6:X 7:X
004	Operations Since Reset	Fn 1:0	2:0	3:0	4:0		
		Fn 5:0	6:0	7:0			
005	Cumulative Outage Time	02:20:30.282					
006	Tests/Reset on Front Panel	Disabled					
007	Auto Tests	Disabled					
008	Time Between Tests	N/A					
009	Next Test Start	10:09					
010	Tests Run Since Reset	10					
011	Tests Passed	1					
012	Tests Failed	9					
013	Run Auto Test						
014	Run Ping Pong Test						
015	Reset Log						
016	Internal Clock Source	Disabled					
017	Local Loopback	Disabled					
9745-T>							

Figure 6-25. Typical test parameter list for the Digital System

The test parameter list shows the code number for each item, and a brief description of its meaning. Most items also have their values listed. Full descriptions for each item on the test parameter list are as follows:

CAUTION

Running Subchannel Tests or Override Function Tests on in-service units may result in unwanted operations such as causing a trip or losing guard. Extreme caution should be used in running these tests.

001 - Subchannel Test

For the Audio system, selecting this item from the test parameter list tells the RFL 9745 to start a subchannel test. This test allows the user to shift the transmitted frequency of channel 1, 2, 3 or 4 to the previously defined high or low value, regardless of the logic table. After 5 minutes, the subchannel test will automatically time out and the 9745 will go back to transmitting the frequency defined in the primitive logic. The user can also stop the test at any time by pressing any key on the keyboard. This test will not work on channel 1 if it is defined as a modem.

Example: Enter the Test Menu by typing **T[Enter]** after the 9745 prompt. Enter the password and then type **[Enter]**. Then type in **1[Enter]** to select Subchannel Test. Observe the following on the display:

Subchannel Test
[Channel#], [H,L]

To force the 9745 to transmit the lower frequency on channel 3 press the following keys:

[3], [L] [Enter]

Observe the following on the display:

Channel 3 forced low
Press any key to stop>

002 - Disable Tx of Function

For the Audio system, selecting this item from the test parameters list allows the user to individually enable or disable the RFL 9745's four channels. To do this, enter "E" for enable or "D" for disable for each channel, separated by commas:

Example: Type in **2[Enter]** to select Disable of Tx Function. Observe the following on the display:

Disable Tx of Function Ch 1:E Ch 2:E Ch 3:E Ch 4:E
[Enable, Disable], [E,D], [E,D], [E,D]

To enable Channels 1 and 2 and disable Channels 3 and 4, press the following keys:

[E] [,] [E] [,] [D] [,] [D] [Enter]

Observe the following on the display:

Disable Tx of Function Ch 1:E Ch 2:E Ch 3:D Ch 4:D
[Enable, Disable], [E,D], [E,D], [E,D]

If a "U" is displayed for any channel, there is a condition that exists that is preventing the channel from being initialized. The channel may not exist in your system. Two channel systems have channels 3 and 4, three channel systems have channels 1, 3 and 4, and four channel systems have channels 1, 2, 3 and 4. LED's will work normally.

003 - Override of Function

For the Digital system selecting this item from the test parameter list tells the RFL 9745 to start an Override of Function test. This test allows the user to individually override the RFL 9745's seven functions. To do this enter a "1" or a "0" if you want the 9745 to transmit a "1" or a "0" for that function. After 5 minutes the Override of Function test will automatically time out, and the 9745 will go back to transmitting the output functions defined in the primitive logic. The user can also stop the test at any time by pressing any key on the keyboard. An "X" means that there is no override for that function. This test can also be done in the remote mode.

Example: Enter the Test Menu by typing **T[Enter]** after the 9745 prompt. Enter the password and then type **[Enter]**. Then type in **3[Enter]** to select Override of Function. Observe the following on the display:

Override of Function Fn 1:X 2:X 3:X 4:X 5:X 6:X 7:X
[0,1,X]

To transmit a "1" for functions 1,2 and 3 and "0" for functions 4,5,6 and 7 press the following keys:

[1], [1], [1], [0], [0], [0], [0] [Enter]

Observe the following on the display:

Override of Function Fn 1:1 2:1 3:1 4:0 5:0 6:0 7:0
Press any key to stop>

You must enter a value for each of the seven functions.

- 004 - Operations Since Reset** This is a display item only. For the Audio system, this display shows how many times each channel has switched from a low to high frequency since the last time the RFL 9745 was reset. For the Digital system, this display shows how many times each function has gone from a “0” to a “1” since the last time the 9745 was reset.
- 005 - Cumulative Outage Time** This is a display item only. It lists the total amount of outage time since the last time the RFL 9745 was reset, in hours, minutes, seconds and milliseconds.
- 006 - Tests/Reset on Front Panel** This selection allows the user to either enable or disable test initiation at the front panel. If front panel tests are permitted, see Section 7 for information on how to run them.
- 007 - Auto Tests¹** This selection allows the user to either enable or disable local automatic testing. If automatic testing is permitted, the next two parameters ,008 and 009, will determine the time between tests, and when the test will be run.
- 008 - Time Between Tests** This item determines how long the RFL 9745 will pause between tests. It can be set by the user anywhere from 1 to 24 hours, in 1-minute steps.
- 009 - Next Test Start** This item can be set by the user, and determines when the next RFL 9745 test will occur. The test time is specified in hours and minutes; using 24-hour time (Add 12 hours to any time past 12:59 p.m.)
- 010 - Tests Run Since Reset** This is a display-only item. It shows how many tests have been run since the last time the RFL 9745 was reset.
- 011 - Tests Passed** This is a display-only item. It shows how many tests have passed since the last time the RFL 9745 was reset.
- 012 - Tests Failed** This is a display-only item. It shows how many tests have failed since the last time the RFL 9745 was reset.

013 - Run Auto Test (Checkback) Select this item to initiate an automatic checkback test. This test cannot be run in an audio system unless channel one is configured as a modem. In addition to this, test parameter 7 must be enabled.

014 - Run Ping Pong Test Select this item to immediately run a ping-pong test. This test cannot be run in an audio system unless channel one is configured as a modem. Test parameter 7 does not have to be enabled to run this test.

015 - Reset Log Select this item to reset the test log. When you do, the following prompt appears:

Are you sure? [Yes,No]

To answer "yes," press the [Y] key. The test log will be reset, and all tallies will return to zero.

If you decide you don't want to reset the test log, press the [N] key. All tallies will remain as they are, and the following message will appear:

Reset Log Cancelled

016 - Internal Clock Source Select this item to connect the 9745 to its internal clock.

017 - Local Loopback Select this item to connect the transmit output to the receive input, to allow testing of the 9745 off line. Only the RS449 and G.703 boards support this function.

NOTE 1.

On a digital system, if the unit is powered ON and the AUTO TEST is enabled but Parameter 008 is set to 0:00 time between tests, the system needs a Manual Checkback to clear the alarm.

6.12 THE UPDATE MODE

The update mode places a display on your terminal that is updated approximately every five seconds to show up-to-date information about RFL 9745 operation. This mode is entered by using the "U" command.

9745>U [ENTER]

When the "U" command is entered, the screen on your terminal will be cleared, and replaced by the UPDATE screen shown in Figures 6-26 or 6-27 as applicable. This is a display of all the measured parameter values. The displayed values are updated about once a second when operating at 2400 baud. This screen can be used to monitor RFL 9745 operation. The update display shows the parameter numbers for each item, a brief description of its meaning, and its status. "I" indicates that the parameter is "inactive". "A" indicates that the parameter is "active". To exit the update mode, press the [X] key, followed by the [ENTER] key. The screen on your terminal will be cleared, and the "9745>" prompt will re-appear.

Value Update - Type 'X<CR>' to Stop						
140	Tx Chan Delay	0.0 ms		141	Next Auto Test	N/A
142	Rx Chan Delay	0.0 ms		143	Last Reset Date	09:42:58 03/03/94
144	Cum Outage Time	01:01:37.196		145	Current Time	09:46:53 03/15/94
154	Input 1A	I	21	162	Output 1A	I 277
155	Input 1B	I	6	163	Output 1B	I 250
156	Input 2A	I	61	164	Output 2A	I 259
157	Input 2B	I	4	165	Output 2B	I 232
158	Input 3A	I	14	166	Output 3A	I 292
159	Input 3B	I	12	167	Output 3B	I 525
160	Input 4A	I	7	168	Output 4A	I 1
161	Input 4B	I	3	169	Output 4B	I 0
170	Revd Signal Lvl	-26	N/A	-27		-27 dBm
171	Tx Function	I	I	I	A	
172	Tx Squelch	I	A	I	I	
173	Rx High Freq	I	I	I	I	
174	Rx Low Freq	I	I	I	I	

Figure 6-26. Typical UPDATE screen for the Audio System

```

Value Update - Type 'X<CR>' to Stop
140 Tx Chan Delay      127.5 ms      141 Next Auto Test   N/A
142 Rx Chan Delay     127.5ms       143 Last Reset Date  23:41:08 01/11/99
144 Cum Outage Time   00:00:00.000  145 Current Time     23:41:16 01/11/99
146 Data Rate         0
147 Bit Error Rate    N/A           148 Word Errors      0
149 Clock Errors      0            150 Frame Errors     0
151 Minor Data Error  0            152 Major Data Error 0
154 Input 1A          I      0        162 Output 1A        I      0
155 Input 1B          I      0        163 Output 1B        I      0
156 Input 2A          I      0        164 Output 2A        I      0
157 Input 2B          I      0        165 Output 2B        I      0
158 Input 3A          I      0        166 Output 3A        I      0
159 Input 3B          I      0        167 Output 3B        I      0
160 Input 4A          I      0        168 Output 4A        I      0
161 Input 4B          I      0        169 Output 4B        I      0
175 Rx Function      SQ      I      I      SQ      I      I      I
176 Tx Function      I      A      A      I      I      A      A

```

Figure 6-27. Typical UPDATE screen for the Digital System

If the update screen does not display the parameters as shown in Figures 6-26 or 6-27, or displays the information erratically, your dumb terminal must be set up for VT100 emulation or the CONFIG.SYS file of your PC must be edited to recognize ANSI.SYS. If you have a PC running PC_APRIL, ANSI.SYS needs to be installed to emulate VT100. To do this proceed as follows:

1. Press **X** [**ENTER**] to stop the update mode.
2. Type in **DDD** to get out of windows mode.

4. At C:\ type **EDIT CONFIG.SYS**
5. Under the last device line add the following: **DEVICE=C:\DOS\ANSI.SYS**
6. Click on **FILE**, then click on **SAVE**.
7. Click on **FILE** again, then click on **EXIT**.
8. Reboot the computer.
9. Go back into PC_APRIL.
10. Enter the Update Mode.
11. This will correct the erratic display.

6.12.1 WINDOWS 95/98 SETUP FOR USE WITH RFL 9745 PC_APRIL SOFTWARE.

1. From Windows 95/98, open a DOS shell (double-click on **MSDOS** icon).
2. From the "C:\>" prompt, check for the existence of a file **april.bat**. If it exists, type **del april.bat**.
3. From the "C:\>" prompt, type **edit config.sys**.
4. After the last **DEVICE** line add the following line:
DEVICE=C:\WINDOWS\COMMAND\ANSI.SYS
5. Save the file and exit from the Editor.
6. At the "C:\>" prompt, make a directory called **\april**.
(example: **md\april**)
7. Enter the April directory (example: **cd \april**).
8. Once in the **april** directory, copy the PC_APRIL software from the RFL supplied diskette into the **april** directory.
9. Remain in the **april** directory and type **edit**.

10. The Editor will allow the creation of batch files that will directly correlate to the Comm port and baud rate previously set from the controls on the front panel of the RFL 9745.
11. The following command would be entered if Comm 2 and baud rate of 9600 was used:

pc_april /c2 /b9600

12. When finished entering information, save the file as **c2b9600.bat**.
13. Another batch file can be created using a different Comm port or baud rate.
14. Exit the Editor. At the “C:\” prompt, type **exit**.
15. The computer must be rebooted in order to acknowledge the change made to the **config.sys** file.
16. After Windows 95 has been rebooted, click on the right mouse button from the Windows 95 “desktop”. From the menu that appears, select **new**, then select **shortcut**.
17. In the space provided, type the following: **c:\april**.
18. Click on **next**.
19. Select a name for the shortcut (can be any name).
20. Click on **finish**.
21. Click on the folder icon that was just created, then click on the Batch file associated with the desired Comm port and baud rate for use with PC_April.

Example: **c2b9600**

22. PC April should now be functioning normally.
23. To exit PC_April, type **Z** and **Enter** key at the 9745 prompt.

Example: **9745>Z**

24. Manually close the MSDOS window using standard Win95/98 methodology.

NOTE

For Windows NT systems:
Device = C:\windows\system32\ANSI.sys

6.13 THE SEQUENCE-OF-EVENTS MODE

The sequence-of-events log is a data file that keeps track of every time one of the RFL 9745's inputs or outputs changes state, and the conditions that existed at that time. The sequence-of-events log is capacitor backed and can store up to 100 records. To view the sequence-of-events log, use the "S" command:

9745>S [ENTER]

When you use the "S" command, a sequence-of-events menu similar to the one shown in Figure 6-28 will appear.

```

H - Display sequence of events help
A - Toggle Labels On Event Display, Currently = Default Labels
D - Dump All Events To Port
E - See Directory of Events
L - Toggle Level of Event Triggers, Currently = Level One
R - Reset All Events
Q - Leave Sequence of Events Menu
## - View this Sequence of Events Record
9745-S>
    
```

Figure 6-28. Typical sequence-of-events menu for the Audio or Digital System

You are now in the sequence-of-events mode, as indicated by the "!9745-S>" prompt on your screen. You may now use the sequence-of-events commands to view the contents of the sequence-of-events log, toggle the event displays and event triggers, or reset the sequence-of-events log. For more information on each sequence-of-events command, refer to the paragraph numbers listed below.

Command	Meaning	Paragraph
H	Display sequence-of-events help	6.13.1
A	Toggle Labels On Event Display	6.13.2
D	Dump All Events To Port	6.13.3
E	See Directory Of Events	6.13.4
L	Toggle Level Of Event Triggers	6.13.5
R	Reset All Events	6.13.6
Q	Leave Sequence-of-Events menu	6.13.7
##	View an event record	6.13.8

6.13.1 DISPLAYING SEQUENCE-OF-EVENTS HELP

Any time you need to see a list of all the sequence-of-events menu commands, use the "H" command.

9745-S>H [ENTER]

When you invoke the "H" command, the sequence-of-events menu shown in Figure 6-27 will re-appear on your screen.

6.13.2 SELECTING LABELS ON EVENT DISPLAY

To determine how events will be labeled in the sequence-of-events log, use the "A" command:

9745-S>A [ENTER]

Each time you invoke the "A" command, the parts of the sequence-of-events log that have user-programmable labels will toggle between the factory-default labels and the labels that were programmed using the procedures in Section 6.10.2 of this manual.

6.13.3 DUMPING THE SEQUENCE-OF-EVENTS LOG TO A PC I/O PORT (PRINTER PORT)

To transfer the event records in the sequence-of-events log from the RFL 9745 to your terminal or PC, use the "D" command:

9745-S>D [ENTER]

When you invoke the "D" command, each record will appear as ASCII text on your screen as it is being transferred.

When all the events have been dumped, the "9745-S>" prompt will re-appear on your screen.

6.13.4 VIEWING THE DIRECTORY OF EVENTS

To view a list of the events presently stored in the sequence-of-events log, use the "E" command:

9745-S>E [ENTER]

When you invoke the "E" command, a Directory Of Events similar to the one shown in Figure 6-29 will appear.

The Directory Of Events lists each record in the sequence-of-events log, along with the date and time it occurred. It also lists which input changed state to trigger the event, and the state the input shifted to at the time of the event. More information about the Directory Of Events can be found in paragraphs 6.13.5 through 6.13.8.

040	08/09/94	13:47:09.735	Rx Freq High Ch2	Inactive
039	08/09/94	13:47:09.734	Rx Freq High Ch2	Active
038	08/09/94	13:45:05:755	RS232 active	Active
037	08/09/94	13:44:17:859	Rx Freq High Ch2	Inactive
036	08/09/94	13:44:17:858	Rx Freq High Ch2	Active
035	08/09/94	13:40:01:918	Rx Freq High Ch2	Inactive
034	08/09/94	13:40:01:917	Rx Freq High Ch2	Active
033	08/09/94	13:37:55:852	Rx Freq High Ch2	Inactive
032	08/09/94	13:37:55:851	Rx Freq High Ch2	Active
031	08/09/94	13:23:21.009	RS232 active	Inactive
030	08/09/94	13:20:55.076	Input 1A	Inactive
029	08/09/94	13:20:53.915	Input 2A	Inactive
028	08/09/94	13:20:53.396	Input 2A	Active
027	08/09/94	13:20:53.228	Input 1A	Active
026	08/09/94	13:20:52.802	Input 2A	Inactive
025	08/09/94	13:20:52.481	Input 2A	Active
024	08/09/94	13:20:52.292	Input 2A	Inactive
023	08/09/94	13:20:52.059	Input 2A	Active
022	08/09/94	13:20:51.856	Input 2A	Inactive
021	08/09/94	13:20:51.460	Input 2A	Active
020	08/09/94	13:20:50.562	Input 3B	Inactive
019	08/09/94	13:20:50.355	Input 3B	Active
018	08/09/94	13:20:49.704	Fail to trip 1B	Active
017	08/09/94	13:20:49.652	Output 3B	Inactive
016	08/09/94	13:20:49.650	Output 1B	Active
015	08/09/94	13:20:49.629	Rx Freq Low Ch2	Active
014	08/09/94	13:20:49.627	Rx Freq High Ch2	Inactive
013	08/09/94	13:20:49.441	Fail to trip 1B	Inactive
012	08/09/94	13:20:49.390	Output 3B	Active
011	08/09/94	13:20:49.383	Output 1B	Inactive
010	08/09/94	13:20:49.199	Fail to trip 1B	Active
009	08/09/94	13:20:49.147	Output 3B	Inactive
008	08/09/94	13:20:49.145	Output 1B	Active
007	08/09/94	13:20:49.123	Rx Freq High Ch2	Inactive
006	08/09/94	13:20:48.960	Fail to trip 1B	Inactive
005	08/09/94	13:20:48.909	Output 3B	Active
004	08/09/94	13:20:48.903	Rx Freq High Ch4	Active
003	08/09/94	13:20:48.901	Rx Freq High Ch3	Inactive
002	08/09/94	13:15:14.938	RS232 active	Active
001	08/09/94	13:15:05.005	RS232 active	Inactive

9745-S>

Figure 6-29. Typical Directory of Events for the Audio System

NOTE

If the same event trigger changes state within 0-3 ms, the first event may not be recorded in a Sequence Of Events record. Trip Logic events are always acted upon by the 9745 logic co-processor even though the recording of the event may not be in the Sequence Of Events record.

6.13.5 SELECTING LEVELS FOR EVENT TRIGGERS

To determine the levels that will trigger an event in the sequence-of-events log, use the "L" command:

9745-S>L [ENTER]

Each time you invoke the "L" command, the trigger levels will toggle between their Level 1 and Level Two values. As shown in the tables below Level 1 has four event triggers, Level 2 Analog has 27 event triggers, and Level 2 Digital has 31 event triggers. When the SOE is set to Level 2 the event log will fill up much faster than if the SOE was set to Level 1. This is because Level has more event triggers.

If your system has flasher logic, the increased activity tends to fill up the SOE log very fast. Systems that are inherently noisy have the same effect. For these situations you may want to set the SOE to Level 1. Level 2 is normally used for troubleshooting intermittent problems or for normal system monitoring. Level 2 will record noise events as they occur. Level 1 will record noise events only if they trigger an alarm. In Level 1 you will know that an alarm has occurred but you will not know what events led up to it.

6.13.5.1 LEVEL 1 EVENT TRIGGERS FOR ANALOG AND DIGITAL SYSTEMS.

A change of state of any of the following items will trigger the storage of an event.

Input	1A - 4B
Output	1A - 4B
Ann. Relay	1A - 3B
Ann. Output	1 - 6

6.13.5.2 LEVEL 2 EVENT TRIGGERS FOR ANALOG SYSTEMS.

A change of state of any of the following items will trigger the storage of an event.

Input	1A - 4B	RX Low	1 - 4	Boot-up in progress
Output	1A - 4B	RX Enable	1 - 4	Xmodem download
Ann. Relay	1A - 3B	Boost	1 - 4	Run Autotest
Ann. Output	1 - 6	Outage timer		Test in progress
Output FTT	1A - 4B	Left power supply low		Autotest complete
Output short	1A - 4B	Right power supply low		Autotest timeout
TX Enable	1 - 4	Bus Error		Address test fail (Checkback)
TX Func.	1 - 4	Comms CPU Fail		Channel delay fail (Ping-Pong)
RX High	1 - 4	Battery Fail		RS-232 Act

6.13.5.3 LEVEL 2 EVENT TRIGGERS FOR DIGITAL SYSTEMS.

A change of state of any of the following items will trigger the storage of an event.

Input	1A - 4B	Battery Fail		Minor Data Alarm
Output	1A - 4B	Boot-up in progress		Configuration Error
Ann. Relay	1A - 3B	Xmodem download		Alarm BER
Ann. Output	1 - 6	Run Autotest		Clock Error
Output FTT	1A - 4B	Test in progress		Frame Error
Output short		Autotest complete		TX Function 1-7
Outage timer		Autotest timeout		RX Function 1-7
Left power supply low		Address test fail (Checkback)		RX Enable
Right power supply low		Channel delay fail (Ping-Pong)		Optic TX Fail ⁽¹⁾
Bus Error		RS-232 Act		
Comms CPU Fail		Major Data Alarm		

Note 1. Only digital systems that are using fiber optics have an “Optic TX Fail” event.

6.13.6 ERASING THE SEQUENCE-OF-EVENTS LOG

To erase the sequence-of-events log, use the "R" command:

```
9745-S>R [ENTER]
```

When you invoke the "R" command, the following prompt appears:

```
Are you sure? [Yes,No]
```

To answer "yes," press the [Y] key. The sequence-of-events log will be erased.

If you decide you don't want to erase the sequence-of-events log, press the [N] key. The log will remain as it is, and the following message will appear:

```
Reset Sequence Cancelled
```

6.13.7 LEAVING THE SEQUENCE-OF-EVENTS MODE

To leave the sequence-of-events mode, use the "Q" command:

```
9745-S>Q [ENTER]
```

The "Q" command tells the RFL 9745 to leave the sequence-of-events mode and return to the normal "9745>" prompt.

6.13.8 VIEWING AN INDIVIDUAL EVENT RECORD

To view an individual record from the Directory Of Events, enter its record number. For example, to view Record #001, enter a "1":

```
9745-S>1 [ENTER]
```

An individual record similar to the one shown in Figure 6-30 or 6-31 will appear.

The individual event records shown in Figures 6-30 and 6-31 list the record number, the name of the input that changed state to trigger the event, the state the input shifted to at the time of the event, and the date and time the event occurred. Below this, the status of all inputs, outputs, and alarm outputs at the time of the event are listed. This information can be used to analyze the system conditions at the precise instant the event occurred. "A" indicates that the parameter is "active" or connected. "I" indicates that the parameter is "inactive" or not connected. "F" indicates Fail to trip. "SQ" indicates that the parameter is "squelched". "B" indicates Boost is active for that channel.

Record 001	Event Trigger: Rx Freq High Ch3		Inactive		
	Event Time: 01/11/99, 23:44:14.954				
Input 1A	I	Output 1A	I	Rx Freq High Ch1	I
Input 2A	I	Output 2A	I	Rx Freq High Ch2	I
Input 3A	I	Output 3A	I	Rx Freq High Ch3	I
Input 4A	I	Output 4A	I	Rx Freq High Ch4	I
Input 1B	I	Output 1B	I	Rx Freq Low Ch1	I
Input 2B	I	Output 2B	I	Rx Freq Low Ch2	I
Input 3B	I	Output 3B	I	Rx Freq Low Ch3	I
Input 4B	I	Output 4B	I	Rx Freq Low Ch4	I
Annunc Relay 1A	A	Annunc Output 1	I	Tx Function Ch1	I
Annunc Relay 2A	I	Annunc Output 2	I	Tx Function Ch2	I
Annunc Relay 3A	I	Annunc Output 3	I	Tx Function Ch3	I
Annunc Relay 1B	I	Annunc Output 4	I	Tx Function Ch4	A
Annunc Relay 2B	I	Annunc Output 5	I	Address Test Fail	I
Annunc Relay 3B	I	Annunc Output 6	I	Autotest Timeout	I
Run Auto Test	I	Channel Delay	I	Bus Error	I
FM Noise Ch1	I	AM Noise Ch1	I	Left Power Low	I
FM Noise Ch2	I	AM Noise Ch2	A	Right Power Low	A
FM Noise Ch3	I	AM Noise Ch3	A	Battery Failure	I
FM Noise Ch4	I	AM Noise Ch4	A	RS232 Active	A
Comms CPU Failure	I	Outage Timer Active	A	Test in Progress	I
Autotest Complete	I	XMODEM Download	I	Bootup in Progress	I
9745-S>					

Figure 6-30. Typical individual event record for the Audio System (using default labels)

Record 001	Event Trigger: Clock Error		Active		
	Event Time: 01/11/99, 23:40:45.066				
Input 1A	I	Output 1A	I	Rx Function 1	SQ
Input 2A	I	Output 2A	I	Rx Function 2	I
Input 3A	I	Output 3A	I	Rx Function 3	I
Input 4A	I	Output 4A	I	Rx Function 4	SQ
Input 1B	I	Output 1B	I	Tx Function 1	I
Input 2B	I	Output 2B	I	Tx Function 2	A
Input 3B	I	Output 3B	I	Tx Function 3	A
Input 4B	I	Output 4B	I	Tx Function 4	I
Annunc Relay 1A	I	Annunc Output 1	I	Major Data Error	I
Annunc Relay 2A	I	Annunc Output 2	I	Minor Data Error	I
Annunc Relay 3A	I	Annunc Output 3	I	Configuration Err	I
Annunc Relay 1B	I	Annunc Output 4	I	Alarm BER	I
Annunc Relay 2B	I	Annunc Output 5	I	Address Test Fail	I
Annunc Relay 3B	I	Annunc Output 6	I	Autotest Timeout	I
Run Auto Test	I	Channel Delay	I	Bus error	I
Rx Function 5	I	Tx Function 5	I	Left power low	I
Rx Function 6	I	Tx Function 6	A	Right power low	A
Rx Function 7	I	Tx Function 7	A	Battery failure	I
Frame Error	I	Clock Error	A	RS232 Active	I
Comms CPU Failure	I	Outage Timer Active	I	Test in Progress	I
Autotest Complete	I	XMODEM Download	I	Bootup in Progress	I
9745-S>					

Figure 6-31. Typical individual event record for the Digital System (using default labels)

Record 071	Event Trigger: Input 3B		Inactive		
	Event Time: 09/19/01, 11:32:13.691				
Input 1A	I	Output 1A	I	Rx Function 1	I
Input 2A	I	Output 2A	I	Rx Function 2	I
Input 3A	I	Output 3A	I	Rx Function 3	I
Input 4A	I	Output 4A	I	Rx Function 4	I
Input 1B	I	Output 1B	I	Tx Function 1	I
Input 2B	I	Output 2B	I	Tx Function 2	I
Input 3B	I	Output 3B	I	Tx Function 3	I
Input 4B	I	Output 4B	I	Tx Function 4	I
Annunc Relay 1A	I	Annunc Output 1	I	Major Data Error	I
Annunc Relay 2A	I	Annunc Output 2	I	Minor Data Error	I
Annunc Relay 3A	I	Annunc Output 3	I	Configuration Err	I
Annunc Relay 1B	I	Annunc Output 4	I	Alarm BER	I
Annunc Relay 2B	I	Annunc Output 5	I	Address Test Fail	I
Annunc Relay 3B	I	Annunc Output 6	I	Autotest Timeout	I
Run Auto Test	I	Channel Delay	I	Bus error	I
Rx Function 5	SQ	Tx Function 5	I	Left power low	I
Rx Function 6	SQ	Tx Function 6	I	Right power low	I
Rx Function 7	SQ	Tx Function 7	I	Battery failure	I
Frame Error	I	Clock Error	I	RS232 Active	I
Comms CPU Failure	I	Outage Timer Active	I	Test in Progress	I
Autotest Complete	A	XMODEM Download	I	Bootup in Progress	I
Optic Tx Fail	I				
9745-S>					

Figure 6-32. Typical individual event record for the Optical System (using default labels)

6.14 ADVANCED PARAMETERS OPTION

When selected by the user, the Advanced Parameters Option allows the 9745 digital system to display additional parameters in the Programming and Display menus, and to display received modem characters on the Values and Update screens. This option can be enabled from the Test menu as follows:

To enable the advanced parameters option, do the following:

1. Go to the test menu.
2. Enter the password.
3. Type in **99 [ENTER]**. The following information will be displayed:

```

9745-T>99
Debug Information      Disabled
[Enable, Disable]

```

4. Type in **E [ENTER]**. The following information will be displayed:

```

Debug Information      Enabled
9745-T>

```

5. Go back to the values display.

A typical parameter settings display for the Digital system (with the advanced parameters option disabled) is shown in Figure 6-32. A typical parameter settings display for the Digital system (with the advanced parameters option enabled) is shown in Figure 6-33. Note in Figure 6-33 that the advanced parameters are items 186 through 193. These are pre-programmed at the factory to the recommended values shown, however, they can be re-programmed by the user to suit a particular need.

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	Test Unit #1			
011	Functions 1-7	Digital			
012	Major Data Error	6, 500			
013	Minor Data Error	400, 200000			
014	Alarm BER	1E-04			
060	Opt Status Board	No	062	Chan delay alarm	4 ms
063	Year	1994	064	Date	08/09
065	Time	13:47:06	066	Hour Adjust	0
067	Local Address	0	068	Remote Address	888
069	Reset Log				
9745>					

Figure 6-33. Typical parameter settings display for the Digital System (with advanced parameters option disabled)

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	Test Unit #1			
011	Functions 1-7	Digital			
012	Major Data Error	6, 500			
013	Minor Data Error	400, 200000			
014	Alarm BER	1E-04			
060	Opt Status Board	No	062	Chan delay alarm	4 ms
063	Year	1994	064	Date	08/09
065	Time	13:47:06	066	Hour Adjust	0
067	Local Address	0	068	Remote Address	888
069	Reset Log				
186	#Oks Reset Minor	30	187	#Oks Reset Major	30
188	Maximum Jitter	30.0 uSec	189	#Drop Re-frame	3
190	#CRC out sync	30	191	#Accept Message	2
192	Upper Freq Limit	71000 bits/sec			
193	Lower Freq Limit	50000 bits/sec			
9745>					

Figure 6-34. Typical parameter settings display for the Digital System (with advanced parameters option enabled)

NOTE

The values shown for parameters 186 to 193 in Figure 6-33 above, are default values.

Definitions of the advanced parameters in the parameters display are as follows:

- 186 - #Oks Reset Minor** Number of good CRC (cyclic redundancy check) messages required to restart the Minor Data Error test after a failure.
- 187 - #Oks Reset Major** Number of good CRC messages required to restart the Major Data Error test after a failure.
- 188 - Maximum Jitter** The maximum variation allowed in a word (15 bits) before the Clock Errors alarm is set.
- 189 - #Drop Re-frame** Number of good CRC messages required to abort the re-framing algorithm when the receiver is out of synchronization.
- 190 - # CRC Out Sync** Number of bad CRC messages required to consider the receiver to be out of sync and invoke the re-framing algorithm.
- 191 - # Accept Message** # of consecutive messages required to trigger a trip.
- 192 - Upper Freq Limit** Maximum frequency allowed before the Clock Errors alarm is set.
- 193 - Lower Freq Limit** Minimum frequency allowed before the Clock Errors alarm is set.

A typical values display for the Digital system (with the advanced parameters option disabled) is shown in Figure 6-34. A typical values display for the Digital system (with the advanced parameters option enabled) is shown in Figure 6-35. Note in Figure 6-35 that the advanced parameters are items 146 through 152 and lines 199 and 200. The values display is for viewing only and cannot be changed by the user.

#	NAME	VALUE	#	NAME	VALUE
140	Tx Chan Delay	6 ms	141	Next Auto Test	N/A
142	Rx Chan Delay	6 ms	143	Last Reset Date	16:38:59 03/03/94
144	Cum Outage Time	00:00:00.000	145	Current Time	00:32:56 03/15/94
146	Data Rate	N/A	148	Word Errors	501757
147	Bit Error Rate	Max Error	150	Frame Errors	1
149	Clock Errors	6	152	Major Data Error	1
151	Minor Data Error	1			
		(I/A) LOG			(I/A) LOG
154	Input 1A	I 1	162	Output 1A	A 0
155	Input 1B	I 0	163	Output 1B	A 2
156	Input 2A	I 4	164	Output 2A	A 0
157	Input 2B	I 0	165	Output 2B	A 2
158	Input 3A	I 0	166	Output 3A	I 0
159	Input 3B	I 1	167	Output 3B	I 2
160	Input 4A	I 0	168	Output 4A	I 0
161	Input 4B	I 0	169	Output 4B	I 2
	Function	#1 #2 #3 #4 #5 #6 #7			
175	Rx Function	SQ SQ SQ SQ SQ SQ SQ			
176	Tx Function	I I I I I I I			
9745					

Figure 6-35. Typical values display for the Digital System (with advanced parameters option disabled)

The values displays shown in Figures 6-34 and 6-35 show the code number for each measured parameter, along with a brief description of its meaning and its measured value. “A” indicates that the parameter is “active” or connected. “I” indicates that the parameter is “inactive” or not connected. “SQ” indicates that the parameter is “squelched”. Full descriptions for each of these measured values can be found in paragraph 6.6.

#	NAME	VALUE	#	NAME	VALUE	
140	Tx Chan Delay	6 ms	141	Next Auto Test	N/A	
142	Rx Chan Delay	6 ms	143	Last Reset Date	16:38:59 03/03/94	
144	Cum Outage Time	00:00:00.000	145	Current Time	00:32:56 03/15/94	
146	Data Rate 0					
147	Bit Error Rate	N/A	148	Word Errors	0	
149	Clock Errors	9	150	Frame Errors	0	
151	Minor Data Error	0	152	Major Data Error	0	
		(I/A) LOG			(I/A) LOG	
154	Input 1A	I 1	162	Output 1A	A 0	
155	Input 1B	I 0	163	Output 1B	A 2	
156	Input 2A	I 4	164	Output 2A	A 0	
157	Input 2B	I 0	165	Output 2B	A 2	
158	Input 3A	I 0	166	Output 3A	I 0	
159	Input 3B	I 1	167	Output 3B	I 2	
160	Input 4A	I 0	168	Output 4A	I 0	
161	Input 4B	I 0	169	Output 4B	I 2	
	Function	#1 #2 #3 #4 #5 #6 #7				
175	Rx Function	SQ SQ SQ SQ SQ SQ SQ				
176	Tx Function	I I I I I I I				
	-- press any key--					
199	Modem Bytes	01 50.652	01 50.667	01 50.655	01 50.654	01 50.653
200		01 50.656	01 50.653	01 50.656	01 50.658	01 50.654
9745	>					

Figure 6-36. Typical values display for the Digital System (with advanced parameters option enabled)

Definitions of the advanced parameters in the values display are as follows:

199 & 200 - Modem Bytes A log of the modem messages sent between the local and remote 9745's. The modem byte consists of the modem data in hexadecimal format and can have any value from 00 to FF. The time tag is in seconds and milliseconds, and matches the time in the sequence of events display.

6.15 THE WINDOW REMOTE APRIL MODE

NOTE

The Window Remote APRIL mode cannot be entered in the audio version unless channel one of the RFL 9745's four channels is set to the modem configuration. If channel one is not configured as a modem, the "W" command will not appear in the main menu. Refer to Section 5 of this manual for more information on channel setup.

The Window Remote APRIL mode allows the user at one RFL 9745 to access the RFL 9745 at the other end of the communications link. To enter the Window Remote APRIL mode, use the "W" command

Format: 9745>W [ENTER]

When you invoke the "W" command, the remote RFL 9745's APRIL command main menu will appear on your screen. This is similar to the screen you would see by invoking the "H" (help) command, except the remote RFL 9745's system label will appear at the top of the screen and a "W_9745>" prompt will appear at the bottom. The screen will take longer to be displayed than other APRIL screens; this is because the modem link between the local and remote RFL 9745s operates at 300 baud, so it takes longer to send the information. (As discussed in Section 4, the APRIL baud rate for data transfer between the RFL 9745 and your terminal or PC is set to either 300, 1200, 2400, 9600, or 19,200).

If a PC is connected to a local 9745 and a user interrogates the remote 9745 which is in local use, the following message will be displayed: REMOTE IN LOCAL USE. There must be inactivity at the RS-232 port and front panel of the remote site for a minimum of five minutes before the remote site will respond to an interrogation from the local site. This prevents modifications to the remote site by two users at the same time.

The Window Remote APRIL mode has the same capabilities as the local APRIL mode, with the following two exceptions. A user cannot:

1. Invoke the "W" command (You cannot place the remote RFL 9745 in the Window Remote APRIL mode).
2. Upload or download files across the remote window path.

When you are finished accessing the remote RFL 9745, you can exit the Window Remote APRIL mode by entering three capital "X's":

Format: W_9745>XXX(do not press [ENTER] key)

The April command menu will re-appear on the screen, with the normal "!9745>" prompt. You will notice that the screen will be written at the regular speed again (either 300, 1200, 2400, 9600, or 19,200 baud).

NOTE

When you are using Window Remote April from a local RFL 9745, if the local or the remote 9745's are running AUTOTEST, you will be automatically exited from the Window Remote April mode. The W prompt will be replaced by the 9745 prompt. The user must reenter the Window Remote April mode. If you want to stay in the Window Remote April mode without being interrupted, make sure that AUTOTEST is disabled at both the local and remote 9745's.

6.16 RETURNING TO NORMAL RFL 9745 OPERATION

Once you are finished accessing the RFL 9745 using APRIL, make sure you have returned to the "9745>" prompt:

1. If you were in the Programming or Test Mode, press the **[Q]** and **[ENTER]** keys to return to the "9745>" prompt.
2. If you were in the Update Mode, press the **[X]** and **[ENTER]** keys to return to the "9745>" prompt.

When the "9745>" prompt is displayed, simply disconnect your PC or terminal from the RFL 9745's RS-232 connector. If you accessed the RFL 9745 through an RFL 9660 Digital Switch, type in the deselect code (normally "BYE") to deselect the port, and then enter the "Q" command to terminate the session. (Refer to the RFL 9660 Instruction Manual for more information.)

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Section 7. USING THE 9745 FRONT-PANEL CONTROLS

7.1 INTRODUCTION

This section provides information on how to view system activity, run system tests, and configure the system, using RFL 9745 front-panel controls. The RFL 9745's front panel is shown in Figure 7-1, and its controls and indicators are described in Table 7-1. See paragraph 7.7 for information on the Fiber Service Unit front and rear panel controls.

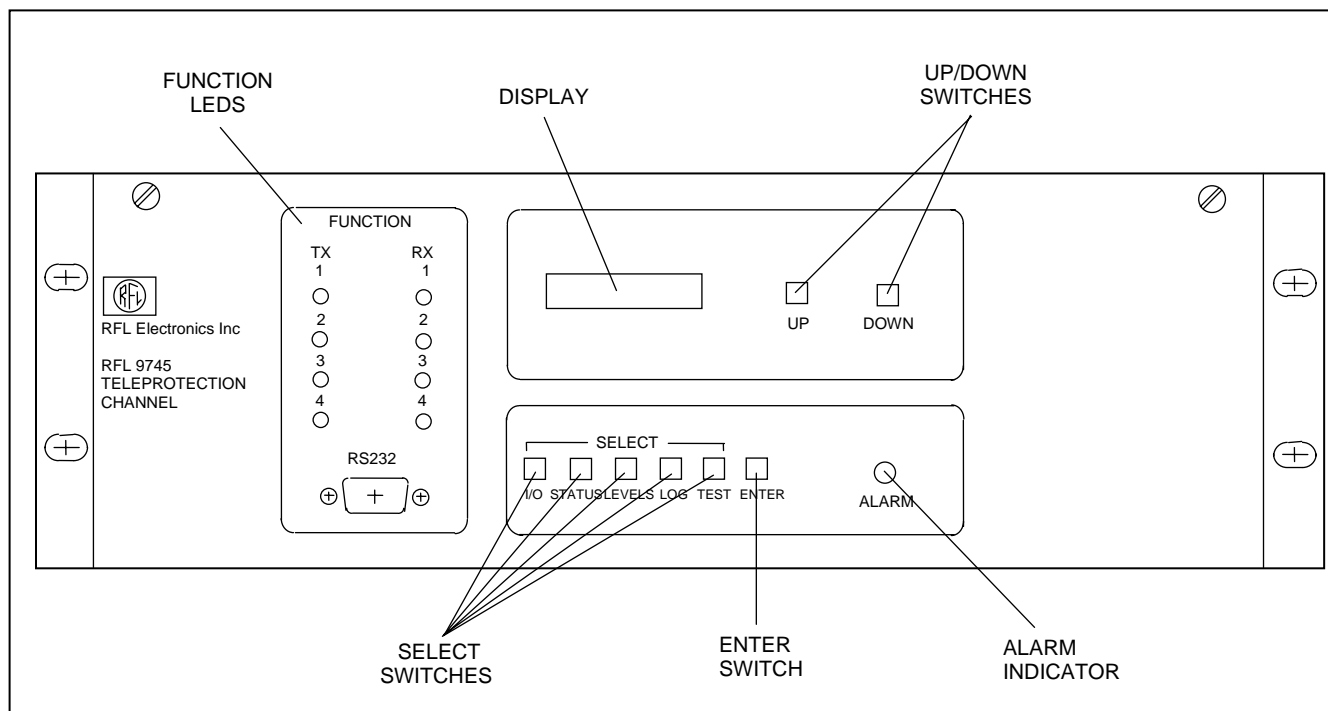


Figure 7-1. Controls and indicators, RFL 9745 Teleprotection Channel

Table 7-1. Controls and indicators, RFL 9745 Teleprotection Channel

Name/Description	Function
FUNCTION LED's	These LED's indicate the status of unprocessed channel data. They respond in accordance with the settings of parameters 160-168 in the Alarm and I/O name menu. (See paragraph 6.10.2)
Display	Displays system operating messages and alarms. Can also display parameters selected by SELECT switches.
UP/DOWN switches	Allows the user to scroll up or down the menu message list. Used along with ENTER switch to change the value of a displayed parameter, or to adjust the display contrast.
SELECT switches	Allows the user to select which menu to appear on the display.
ENTER switch	Places displayed parameter in edit mode (if it can be edited). Once the desired value is displayed, a second press will store the displayed value. Also used with UP and DOWN switches to adjust display contrast.
ALARM indicator	Lights green when there are no system alarms. Lights red when there is an alarm condition.

7.2 FRONT PANEL DISPLAY DURING NORMAL OPERATION

When the RFL 9745 is functioning normally (no active alarms, no tests in progress), the System Label and the current time indicating hours, minutes and seconds will appear on the front-panel display in the following format:

(system label)
HH:MM:SS

An example of a typical system label is as follows:

UNIT #2
06:08:51

7.3 FRONT PANEL DISPLAY WHEN ALARM(S) ARE ACTIVE

If the RFL 9745 is functioning while one alarm is active, the alarm name will appear on the front-panel display in place of the system label and current time, and the RED alarm indicator will be illuminated. An example of a typical display with one active alarm is as follows:

OUTPUT ALARM
ALARM RELAY 2A

If the RFL 9745 is functioning while two or more alarms are active, the words “MULTIPLE ALARMS” followed by the number of alarms, will appear on the front-panel display in place of the system label and current time, and the RED alarm indicator will be illuminated. An example of a typical multiple alarm display indicating that there are two alarms is as follows:

MULTIPLE
ALARMS 2

To see which two alarms are active, press the UP or DOWN switches next to the display. This will make the display scroll from one alarm to another. For example, the first time you press the UP switch, you may see a display similar to the following:

OUTPUT ALARM
ALARM RELAY 1A

The second time you press the UP switch, you may see a display similar to the following:

OUTPUT ALARM
AUX OUTPUT 2

You can always return to the system label and current time display by simultaneously pressing any two adjacent menu buttons.

7.4 ADJUSTING DISPLAY CONTRAST

The RFL 9745's display contrast can be adjusted to suit the ambient light conditions by using the following procedure:

1. Press and hold the ENTER switch below the display.
2. While holding down the ENTER switch, press and release the UP and DOWN switches until the desired contrast setting is obtained.
3. Release the ENTER switch.

7.5 SELECTING AND USING FRONT-PANEL MENUS

The RFL 9745 has five menus containing information that can be displayed on the front-panel display as described below. Each of these menus has a menu list which can be viewed by first pressing the button on the front panel corresponding to the desired menu. Then press the DOWN button to scroll down the menu list. For the Audio System the front panel menus and menu lists can be seen in Table 7-2. For the Digital System the front panel menus and menu lists can be seen in Table 7-3. Definitions of the items in the menu lists for the Audio and Digital Systems can be seen in sections 7.5.1 through 7.5.9.

I/O	Information about the current status of each RFL 9745 input, output, and annunciator output.
STATUS	Information about the RFL 9745's four communications channels and alarm outputs.
LEVELS	Information about transmit and receive levels, channel delay measurements, and RS-232 baud rate.
LOG	Information about how many times each significant event in RFL 9745 operation has occurred since the last system reset.
TEST	Information about the RFL 9745's test performance.

Most menu items are read-only, but some can be re-programmed by using the ENTER, UP, and DOWN switches. To select and use the front-panel menus, use the following procedure:

1. Press the SELECT switch for the desired menu (I/O, STATUS, LEVELS, LOG, or TEST).
2. Once the desired menu is selected, press the UP and DOWN switches on the front panel until the desired item appears on the display.
3. If the item on display can be edited, proceed as follows:
 - a. Press the ENTER switch to enter the edit mode.

A flashing cursor will appear on the bottom line of the display, next to the item value.

- b. Press the UP or DOWN switches until the desired value is displayed on the second line of the display.
- c. Press the ENTER switch to store the new value.
- d. Press the DOWN switch to go to the next item on the menu.

In Table 7-2, the menus shown in bold print appear as items on the front panel in the order shown. First press the button corresponding to the desired menu. Then press the DOWN button to scroll down the menu list.

Table 7-2. Audio System Front Panel menu (Default) entries

I/O MENU	STATUS MENU	LEVELS MENU	LOG MENU	TEST MENU
INPUT 1A	RX 1 HIGH	TRANSMIT 1 *	TX FUNCTION 1	TESTS RUN
INPUT 1B	RX 1 LOW	TRANSMIT 2 *	RX FUNCTION 1 HIGH	TIME BETWEEN
INPUT 2A	RX 2 HIGH	TRANSMIT 3 *	RX FUNCTION 1 LOW	TESTS PASSED
INPUT 2B	RX 2 LOW	TRANSMIT 4 *	TX FUNCTION 2	TESTS FAILED
INPUT 3A	RX 3 HIGH	RECEIVE 1	RX FUNCTION 2 HIGH	NEXT TEST START
INPUT 3B	RX 3 LOW	RECEIVE 2	RX FUNCTION 2 LOW	CHANNEL 1 SHIFT *
INPUT 4A	RX 4 HIGH	RECEIVE 3	TX FUNCTION 3	CHANNEL 2 SHIFT *
INPUT 4B	RX 4 LOW	RECEIVE 4	RX FUNCTION 3 HIGH	CHANNEL 3 SHIFT *
OUTPUT 1A	CHAN 1 TX	CHANNEL DELAY TX	RX FUNCTION 3 LOW	CHANNEL 4 SHIFT *
OUTPUT 1B	CHAN 2 TX	CHANNEL DELAY RX	TX FUNCTION 4	CHECKBACK TEST*
OUTPUT 2A	CHAN 3 TX	APRIL BAUD RATE *	RX FUNCTION 4 HIGH	PING PONG *
OUTPUT 2B	CHAN 4 TX		RX FUNCTION 4 LOW	AUTOTEST
OUTPUT 3A	FM NOISE CH1		INPUT 1A	
OUTPUT 3B	LOW SNR CH1		INPUT 1B	
OUTPUT 4A	FM NOISE CH2		INPUT 2A	
OUTPUT 4B	LOW SNR CH2		INPUT 2B	
ANNUNC 1A	FM NOISE CH3		INPUT 3A	
ANNUNC 1B	LOW SNR CH3		INPUT 3B	
ANNUNC 2A	FM NOISE CH4		INPUT 4A	
ANNUNC 2B	LOW SNR CH4		INPUT 4B	
ANNUNC 3A	BUS ERROR		OUTPUT 1A	
ANNUNC 3B	RS232 ACT		OUTPUT 1B	
STATUS 1	PS FAIL L		OUTPUT 2A	
STATUS 2	PS FAIL R		OUTPUT 2B	
STATUS 3	BATTERY LOW		OUTPUT 3A	
STATUS 4	OUT FAIL 1A		OUTPUT 3B	
STATUS 5	OUT SHORT 1A		OUTPUT 4A	
STATUS 6	OUT FAIL 2A		OUTPUT 4B	
	OUT SHORT 2A		ANNUNC 1A	
	OUT FAIL 3A		ANNUNC 1B	
	OUT SHORT 3A		ANNUNC 2A	
	OUT FAIL 4A		ANNUNC 2B	
	OUT SHORT 4A		ANNUNC 3A	
	OUT FAIL 1B		ANNUNC 3B	
	OUT SHORT 1B		STATUS 1	
	OUT FAIL 2B		STATUS 2	
	OUT SHORT 2B		STATUS 3	
	OUT FAIL 3B		STATUS 4	
	OUT SHORT 3B		STATUS 5	
	OUT FAIL 4B		STATUS 6	
	OUT SHORT 4B		LAST RESET	
			CUM OUTAGE TIME	
			RESET *	

* These parameters are programmable using front panel controls. All other parameters in this table are for display only.

In Table 7-3, the menus shown in bold print appear as items on the front panel in the order shown. First press the button corresponding to the desired menu. Then press the DOWN button to scroll down the menu list.

Table 7-3. Digital System Front Panel Menu (Default) Entries

I/O MENU	STATUS MENU	LEVELS MENU	LOG MENU	TEST MENU
INPUT 1A	RX FUNCTION 1	APRIL BAUD RATE *	TX FUNCTION 1	TESTS RUN
INPUT 1B	RX FUNCTION 2	CHANNEL DELAYTX	TX FUNCTION 2	TIME BETWEEN
INPUT 2A	RX FUNCTION 3	CHANNEL DELAY RX	TX FUNCTION 3	TESTS PASSED
INPUT 2B	RX FUNCTION 4		TX FUNCTION 4	TESTS FAILED
INPUT 3A	RX FUNCTION 5		TX FUNCTION 5	NEXT TEST START
INPUT 3B	RX FUNCTION 6		TX FUNCTION 6	AVG BER
INPUT 4A	RX FUNCTION 7		TX FUNCTION 7	WORD ERRORS
INPUT 4B	TX FUNCTION 1		RX FUNCTION 1	CLOCK ERRORS
OUTPUT 1A	TX FUNCTION 2		RX FUNCTION 2	FRAME ERRORS
OUTPUT 1B	TX FUNCTION 3		RX FUNCTION 3	MINOR DATA ERROR
OUTPUT 2A	TX FUNCTION 4		RX FUNCTION 4	MAJOR DATA ERROR
OUTPUT 2B	TX FUNCTION 5		RX FUNCTION 5	FUNCTION 1 TEST *
OUTPUT 3A	TX FUNCTION 6		RX FUNCTION 6	FUNCTION 2 TEST *
OUTPUT 3B	TX FUNCTION 7		RX FUNCTION 7	FUNCTION 3 TEST *
OUTPUT 4A	CLOCK ERRORS		KEY FNT 1	FUNCTION 4 TEST *
OUTPUT 4B	FRAME ERRORS		KEY FNT 3	FUNCTION 5 TEST *
ANNUNC 1A	MINOR DATA ERROR		KEY FNT 1	FUNCTION 6 TEST *
ANNUNC 1B	MAJOR DATA ERROR		KEY FNT 3	FUNCTION 7 TEST *
ANNUNC 2A	TRANSMIT FAIL		KEY FNT 2	CHECKBACK TEST *
ANNUNC 2B	BUS ERROR		KEY FNT 4	PING PONG *
ANNUNC 3A	RS232 ACT		KEY FNT 2	CLOCK SOURCE *
ANNUNC 3B	PS FAIL L		KEY FNT 4	LOCAL LOOPBACK*
STATUS 1	PS FAIL R		GUARD FNT 1	
STATUS 2	BATTERY LOW		GUARD FNT 3	
STATUS 3	OUT FAIL 1A		TRIP FNT 1	
STATUS 4	OUT SHORT 1A		TRIP FNT 3	
STATUS 5	OUT FAIL 2A		GUARD FNT 2	
STATUS 6	OUT SHORT 2A		GUARD FNT 4	
	OUT FAIL 3A		TRIP FNT 2	
	OUT SHORT 3A		TRIP FNT 4	
	OUT FAIL 4A		COMMS WARNING	
	OUT SHORT 4A		COMMS ALARM	
	OUT FAIL 1B		OUTPUT ALARM	
	OUT SHORT 1B		HARDWARE WARNING	
	OUT FAIL 2B		NOT USED	
	OUT SHORT 2B		HARDWARE ALARM	
	OUT FAIL 3B		LAST RESET	
	OUT SHORT 3B		CUM OUTAGE TIME	
	OUT FAIL 4B		RESET *	
	OUT SHORT 4B			

* These parameters are programmable using front panel controls. All other parameters in this table are for display only.

7.5.1 I/O MENU (For Audio and Digital Systems)

The following entries appear as items on the front-panel I/O menu in the order shown. Press the I/O button to view the first entry. Then press the DOWN button to scroll down the I/O menu list. The term “user text” indicates that the user has the option of inserting his own names for the various inputs, outputs, annunciator outputs, and status outputs on line one of the front panel display by using the Alarm and I/O Name Menu as described in Section 6.

(user text)

INPUT 1A I Current status of Input 1A ("I" for inactive, "A" for active).

(user text)

INPUT 1B I Current status of Input 1B ("I" for inactive, "A" for active).

(user text)

INPUT 2A I Current status of Input 2A ("I" for inactive, "A" for active).

(user text)

INPUT 2B I Current status of Input 2B ("I" for inactive, "A" for active).

(user text)

INPUT 3A I Current status of Input 3A ("I" for inactive, "A" for active).

(user text)

INPUT 3B I Current status of Input 3B ("I" for inactive, "A" for active).

(user text)

INPUT 4A I Current status of Input 4A ("I" for inactive, "A" for active).

(user text)

INPUT 4B I Current status of Input 4B ("I" for inactive, "A" for active).

(user text)
OUTPUT 1A **I** Current status of Output 1A ("I" for inactive, "A" for active).

(user text)
OUTPUT 1B **I** Current status of Output 1B ("I" for inactive, "A" for active).

(user text)
OUTPUT 2A **I** Current status of Output 2A ("I" for inactive, "A" for active).

(user text)
OUTPUT 2B **I** Current status of Output 2B ("I" for inactive, "A" for active).

(user text)
OUTPUT 3A **I** Current status of Output 3A ("I" for inactive, "A" for active).

(user text)
OUTPUT 3B **I** Current status of Output 3B ("I" for inactive, "A" for active).

(user text)
OUTPUT 4A **I** Current status of Output 4A ("I" for inactive, "A" for active).

(user text)
OUTPUT 4B **I** Current status of Output 4B ("I" for inactive, "A" for active).

(user text) ANNUNC 1A	I	Current status of Annunciator Output 1A ("I" for inactive, "A" for active).
(user text) ANNUNC 1B	I	Current status of Annunciator Output 1B ("I" for inactive, "A" for active).
(user text) ANNUNC 2A	I	Current status of Annunciator Output 2A ("I" for inactive, "A" for active).
(user text) ANNUNC 2B	I	Current status of Annunciator Output 2B ("I" for inactive, "A" for active).
(user text) ANNUNC 3A	I	Current status of Annunciator Output 3A ("I" for inactive, "A" for active).
(user text) ANNUNC 3B	I	Current status of Annunciator Output 3B ("I" for inactive, "A" for active).

Status 1-6 appear only with the 1U chassis option.

(user text) STATUS 1	I	Current status of Status Output 1 ("I" for inactive, "A" for active).
(user text) STATUS 2	I	Current status of Status Output 2 ("I" for inactive, "A" for active).
(user text) STATUS 3	I	Current status of Status Output 3 ("I" for inactive, "A" for active).
(user text) STATUS 4	I	Current status of Status Output 4 ("I" for inactive, "A" for active).
(user text) STATUS 5	I	Current status of Status Output 5 ("I" for inactive, "A" for active).
(user text) STATUS 6	I	Current status of Status Output 6 ("I" for inactive, "A" for active).

7.5.2 STATUS MENU (For Audio System)

The following entries appear as items on the front-panel STATUS menu in the order shown. Press the STATUS button to view the first entry. Then press the DOWN button to scroll down the STATUS menu list.

RX 1 HIGH	I	Indicates whether Channel 1 is receiving its high frequency or its low frequency. ("I" for inactive, "A" for active).
RX 1 LOW	I	
RX 2 HIGH	I	Indicates whether Channel 2 is receiving its high frequency or its low frequency. ("I" for inactive, "A" for active).
RX 2 LOW	I	
RX 3 HIGH	I	Indicates whether Channel 3 is receiving its high frequency or its low frequency. ("I" for inactive, "A" for active).
RX 3 LOW	I	
RX 4 HIGH	I	Indicates whether Channel 4 is receiving its high frequency or its low frequency. ("I" for inactive, "A" for active).
RX 4 LOW	I	
CHAN 1 TX	LO	Indicates the current status of the Channel 1 and Channel 2 transmitters ("LO" for low frequency, "SQ" for squelch, "HI" for high frequency).
CHAN 2 TX	SQ	
CHAN 3 TX	LO	Indicates the current status of the Channel 3 and Channel 4 transmitters ("LO" for low frequency, "SQ" for squelch, "HI" for high frequency).
CHAN 4 TX	SQ	
FM NOISE CH1	I	Indicates the status of Channel 1's FM noise and SNR alarms ("I" for inactive, "A" for active).
LOW SNR CH1	I	
FM NOISE CH2	I	Indicates the status of Channel 2's FM noise and SNR alarms ("I" for inactive, "A" for active).
LOW SNR CH2	I	
FM NOISE CH3	I	Indicates the status of Channel 3's FM noise and SNR alarms ("I" for inactive, "A" for active).
LOW SNR CH3	I	

FM NOISE CH4	I	Indicates the status of Channel 4's FM noise and SNR alarms ("I" for inactive, "A" for active).
LOW SNR CH4	I	
BUS ERROR	I	Indicates whether a bus error has occurred, or if there is activity on the RS-232 bus ("I" for inactive, "A" for active).
RS232 ACT	I	
PS FAIL L	I	Indicates whether a failure has been detected in either of the RFL 9745's power supply modules ("I" for inactive, "A" for active).
PS FAIL R	I	
BATTERY LOW	I	Not used on units with capacitor backed RAM.
OUT FAIL 1A	I	Indicates whether Output 1A has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 1A	I	
OUT FAIL 2A	I	Indicates whether Output 2A has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 2A	I	
OUT FAIL 3A	I	Indicates whether Output 3A has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 3A	I	
OUT FAIL 4A	I	Indicates whether Output 4A has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 4A	I	
OUT FAIL 1B	I	Indicates whether Output 1B has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 1B	I	
OUT FAIL 2B	I	Indicates whether Output 2B has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 2B	I	
OUT FAIL 3B	I	Indicates whether Output 3B has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 3B	I	
OUT FAIL 4B	I	Indicates whether Output 4B has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 4B	I	

7.5.3 LEVELS MENU (For Audio System)

The following entries appear as items on the front-panel LEVELS menu. Press the LEVELS button to view the first entry. Then press the DOWN button to scroll down the LEVELS menu list.

**TRANSMIT 1
xx dBm**

These four items show what transmitter output levels, channels 1, 2, 3 and 4 are set to; where xx= the output power level setting in dBm . These level settings can be changed via the front panel. To change the transmit output level proceed as follows:

**TRANSMIT 2
xx dBm**

1. Press the Enter switch to enter the edit mode.

**TRANSMIT 3
xx dBm**

A flashing cursor will appear on the bottom line of the display next to the item value.

2. Press the UP or DOWN switches until the desired transmit level is displayed on the bottom line of the display.

**TRANSMIT 4
xx dBm**

3. Press the ENTER switch to store the new transmit level. The new transmit level will not change until the ENTER switch is pressed.

4. Press the DOWN switch to go to the next item on the LEVELS menu.

NOTE

These are not actual readings of output levels. Their purpose is to show what the levels are set to.

When changing transmit levels for audio channels via the front panel, a TX function LED may momentarily light. This does not indicate a transmit function but rather a reconfiguration of the DSP logic which squelches the transmitter.

**RECEIVE 1
xx dBm**

These four items show Channel 1, 2, 3 and 4 receiver input levels, where xx=the input power level in dBm.

**RECEIVE 2
xx dBm**

**RECEIVE 3
xx dBm**

**RECEIVE 4
xx dBm**

CHANNEL DELAY TX 0 MS Indicates the current transmitted channel delay in milliseconds, based on the last ping pong test.

CHANNEL DELAY RX 0 MS Indicates the current received channel delay in milliseconds, based on the last ping pong test.

APRIL BAUD RATE 9600 Indicates the current baud rate setting for the RFL 9745's RS-232 ports. To change the baud rate proceed as follows:

1. Press the Enter switch to enter the edit mode.

A flashing cursor will appear on the bottom line of the display, next to the item value.

2. Press the UP or DOWN switches until the desired baud rate is displayed on the bottom line of the display.
3. Press the ENTER switch to store the new baud rate.
4. Press the DOWN switch to go to the next item on the LEVELS menu.

7.5.4 LOG MENU (For Audio System)

The following entries appear as items on the front-panel LOG menu. Press the LOG button to view the first entry. Then press the DOWN button to scroll down the LOG menu list. The term "or user text" indicates that the user has the option of inserting his own names in place of the various input, output, annunciator output, and status output names shown on line one of the front panel display, by using the Alarm and I/O Name Menu as described in Section 6.

TX FUNCTION 1 xxx Indicates how many times the Channel 1 transmitter has been active since the last system reset.

RX FUNCTION 1 HIGH xxx Indicates how many times the Channel 1 receiver has received its high frequency tone since the last system reset.

RX FUNCTION 1 LOW xxx Indicates how many times the Channel 1 receiver has received its low frequency tone since the last system reset.

TX FUNCTION 2 xxx	Indicates how many times the Channel 2 transmitter has been active since the last system reset.
RX FUNCTION 2 HIGH xxx	Indicates how many times the Channel 2 receiver has received its high frequency tone since the last system reset.
RX FUNCTION 2 LOW xxx	Indicates how many times the Channel 2 receiver has received its low frequency tone since the last system reset.
TX FUNCTION 3 xxx	Indicates how many times the Channel 3 transmitter has been active since the last system reset.
RX FUNCTION 3 HIGH xxx	Indicates how many times the Channel 3 receiver has received its high frequency tone since the last system reset.
RX FUNCTION 3 LOW xxx	Indicates how many times the Channel 3 receiver has received its low frequency tone since the last system reset.
TX FUNCTION 4 xxx	Indicates how many times the Channel 4 transmitter has been active since the last system reset.
RX FUNCTION 4 HIGH xxx	Indicates how many times the Channel 4 receiver has received its high frequency tone since the last system reset.
RX FUNCTION 4 LOW xxx	Indicates how many times the Channel 4 receiver has received its low frequency tone since the last system reset.
INPUT 1A (or user text) xxx	Indicates how many times Input 1A has been active since the last system reset.
INPUT 1B (or user text) xxx	Indicates how many times Input 1B has been active since the last system reset.
INPUT 2A (or user text) xxx	Indicates how many times Input 2A has been active since the last system reset.

INPUT 2B (or user text) xxx	Indicates how many times Input 2B has been active since the last system reset.
INPUT 3A (or user text) xxx	Indicates how many times Input 3A has been active since the last system reset.
INPUT 3B (or user text) xxx	Indicates how many times Input 3B has been active since the last system reset.
INPUT 4A (or user text) xxx	Indicates how many times Input 4A has been active since the last system reset.
INPUT 4B (or user text) xxx	Indicates how many times Input 4B has been active since the last system reset.
OUTPUT 1A (or user text) xxx	Indicates how many times Output 1A has been active since the last system reset.
OUTPUT 1B (or user text) xxx	Indicates how many times Output 1B has been active since the last system reset.
OUTPUT 2A (or user text) xxx	Indicates how many times Output 2A has been active since the last system reset.
OUTPUT 2B (or user text) xxx	Indicates how many times Output 2B has been active since the last system reset.
OUTPUT 3A (or user text) xxx	Indicates how many times Output 3A has been active since the last system reset.
OUTPUT 3B (or user text) xxx	Indicates how many times Output 3B has been active since the last system reset.
OUTPUT 4A (or user text) xxx	Indicates how many times Output 4A has been active since the last system reset.

- OUTPUT 4B (or user text)** Indicates how many times Output 4B has been active since the last system reset.
- ANNUNC 1A (or user text)** Indicates how many times Annunciator Output 1A has been active since the last system reset.
xxx
- ANNUNC 1B (or user text)** Indicates how many times Annunciator Output 1B has been active since the last system reset.
xxx
- ANNUNC 2A (or user text)** Indicates how many times Annunciator Output 2A has been active since the last system reset.
xxx
- ANNUNC 2B (or user text)** Indicates how many times Annunciator Output 2B has been active since the last system reset.
xxx
- ANNUNC 3A (or user text)** Indicates how many times Annunciator Output 3A has been active since the last system reset.
xxx
- ANNUNC 3B (or user text)** Indicates how many times Annunciator Output 3B has been active since the last system reset.
xxx
- STATUS 1 (or user text)** Indicates how many times Status Output 1 has been active since the last system reset. (Only displayed on units equipped with the optional Status Output Module.)
xxx
- STATUS 2 (or user text)** Indicates how many times Status Output 2 has been active since the last system reset. (Only displayed on units equipped with the optional Status Output Module.)
xxx
- STATUS 3 (or user text)** Indicates how many times Status Output 3 has been active since the last system reset. (Only displayed on units equipped with the optional Status Output Module.)
xxx
- STATUS 4 (or user text)** Indicates how many times Status Output 4 has been active since the last system reset. (Only displayed on units equipped with the optional Status Output Module.)
xxx

STATUS 5 (or user text) xxx	Indicates how many times Status Output 5 has been active since the last system reset. (Only displayed on units equipped with the optional Status Output Module.)
STATUS 6 (or user text) xxx	Indicates how many times Status Output 6 has been active since the last system reset. (Only displayed on units equipped with the optional Status Output Module.)
LAST RESET MM/DD HH:MM:SS	Indicates the date and time of last reset.
CUM OUTAGE TIME	Indicates how long the cumulative outage timer has been active since the last reset.
RESET	<p>This enables you to reset the counters and LEDs from the front panel. To RESET the log counters from the front panel proceed as follows:</p> <ol style="list-style-type: none"> 1. On the front panel press “LOG”, then press “UP” to access “RESET”. 2. Press “ENTER”, “UP” and “ENTER” to reset the log counters.

7.5.5 TEST MENU (For Audio System)

The following entries appear as items on the front-panel TEST menu. Press the TEST button to view the first entry. Then press the DOWN button to scroll down the TEST menu list.

TESTS RUN xxx	The number of autotests run since the last reset.
TIME BETWEEN xxx	The amount of time between autotests.
TESTS PASSED xxx	The number of autotests passed since the last reset.
TESTS FAILED xxx	The number of autotests failed since the last reset.
NEXT TEST START xxx	The amount of time until the next autotest.
CHANNEL 1 SHIFT	This causes the channel 1 transmitter to shift its frequency. This can be done from the front panel only if front panel testing is enabled. (See paragraph 6.11.3).
CHANNEL 2 SHIFT	This causes the channel 2 transmitter to shift its frequency. This can be done from the front panel only if front panel testing is enabled. (See paragraph 6.11.3).
CHANNEL 3 SHIFT	This causes the channel 3 transmitter to shift its frequency. This can be done from the front panel only if front panel testing is enabled. (See paragraph 6.11.3).
CHANNEL 4 SHIFT	This causes the channel 4 transmitter to shift its frequency. This can be done from the front panel only if front panel testing is enabled. (See paragraph 6.11.3).

To shift a channel frequency proceed as follows:

1. Press the ENTER switch to enter the edit mode.

A flashing cursor will appear on the bottom line of the display, next to the item value.

2. Press the UP or DOWN switches until the desired shift is displayed (LOW or HIGH).
3. After frequency shift tests are completed, press the ENTER switch to restore the unit to normal operation.

CHECKBACK AND ADDRESS TEST

This allows the user to execute a Checkback and Address Test (This is also referred to as Autotest). Press the ENTER button to run the test and view the results. This selection will appear only if channel one is configured as a modem.

PING PONG

This allows the user to execute a Ping Pong Test to measure the channel delay. Press the ENTER button to run the test and view the results. This selection will appear only if channel one is configured as a modem.

AUTOTEST

This causes the unit to execute an RFL 6750 autotest. This selection will appear only if channel one is configured as a 6750 modem.

The contents of the front panel menus for the digital system are shown in the following sections.

7.5.6 STATUS MENU (For Digital System)

The following entries appear as items on the front-panel STATUS menu. Press the STATUS button to view the first entry. Then press the DOWN button to scroll down the STATUS menu list.

RX FUNCTION 1 **I** Indicates whether Receive Function 1 or Receive Function 2 is active or
RX FUNCTION 2 **I** inactive ("I" for inactive, "A" for active).

RX FUNCTION 3 **I** Indicates whether Receive Function 3 or Receive Function 4 is active or
RX FUNCTION 4 **I** inactive ("I" for inactive, "A" for active).

RX FUNCTION 5 **I** Indicates whether Receive Function 5 or Receive Function 6 is active or
RX FUNCTION 6 **I** inactive ("I" for inactive, "A" for active).

RX FUNCTION 7 **I** Indicates whether Receive Function 7 or Transmit Function 1 is active or
TX FUNCTION 1 **I** inactive ("I" for inactive, "A" for active).

TX FUNCTION 2 **I** Indicates whether Transmit Function 2 or Transmit Function 3 is active
TX FUNCTION 3 **I** or inactive ("I" for inactive, "A" for active).

TX FUNCTION 4 **I** Indicates whether Transmit Function 4 or Transmit Function 5 is active
TX FUNCTION 5 **I** or inactive ("I" for inactive, "A" for active).

TX FUNCTION 6	I	Indicates whether Transmit Function 6 or Transmit Function 7 is active or inactive ("I" for inactive, "A" for active).
TX FUNCTION 7	I	
CLOCK ERRORS	A	Clock errors are active when the variation in the received word exceeds the min/max frequency limits of the max jitter setting. Frame errors are active when the receiver has lost sync. ("I" for inactive, "A" for active).
FRAME ERRORS	I	
MINOR DATA ERROR	I	Indicates whether the number of Minor Data Error bits or Major Data Error bits have exceeded the user defined settings. ("I" for inactive, "A" for active).
MAJOR DATA ERROR	I	
TRANSMIT FAIL	I	Indicates whether the fiber optic emitter has failed ("I" for inactive [emitter has not failed], "A" for active[emitter has failed]).
BUS ERROR	I	Indicates whether a bus error has occurred, or if there is activity on the RS-232 bus ("I" for inactive, "A" for active).
RS232 ACT	I	
PS FAIL L	I	Indicates whether a failure has been detected in either the left or right 9745 power supply module ("I" for inactive, "A" for active).
PS FAIL R	I	
BATTERY LOW	I	Not used on units with capacitor backed RAM.
OUT FAIL 1A	I	Indicates whether Output 1A has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 1A	I	
OUT FAIL 2A	I	Indicates whether Output 2A has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 2A	I	
OUT FAIL 3A	I	Indicates whether Output 3A has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 3A	I	
OUT FAIL 4A	I	Indicates whether Output 4A has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 4A	I	
OUT FAIL 1B	I	Indicates whether Output 1B has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 1B	I	
OUT FAIL 2B	I	Indicates whether Output 2B has failed or is shorted ("I" for inactive, "A" for active).
OUT SHORT 2B	I	

OUT FAIL 3B **I** Indicates whether Output 3B has failed or is shorted ("I" for inactive,
OUT SHORT 3B **I** "A" for active).

OUT FAIL 4B **I** Indicates whether Output 4B has failed or is shorted ("I" for inactive,
OUT SHORT 4B **I** "A" for active).

7.5.7 LEVELS MENU (For Digital System)

The following entries appear as items on the front-panel LEVELS menu. Press the LEVELS button to view the first entry. Then press the DOWN button to scroll down the LEVELS menu list.

APRIL BAUD RATE Indicates the selected April baud rate. See section 7.5.3 for instructions
19200 on how to change the baud rate.

CHANNEL DELAY Indicates the current transmit channel delay in milliseconds.
TX 0 MS

CHANNEL DELAY Indicates the current receive channel delay in milliseconds.
RX 0 MS

7.5.8 LOG MENU (For Digital System)

The following entries appear as items on the front-panel LOG menu. Press the LOG button to view the first entry. Then press the DOWN button to scroll down the LOG menu list.

TX FUNCTION 1 Indicates how many times Transmitted Function 1 has been active since
xxx the last system reset.

TX FUNCTION 2 Indicates how many times Transmitted Function 2 has been active since
xxx the last system reset.

TX FUNCTION 3 Indicates how many times Transmitted Function 3 has been active since
xxx the last system reset.

TX FUNCTION 4 xxx	Indicates how many times Transmitted Function 4 has been active since the last system reset.
TX FUNCTION 5 xxx	Indicates how many times Transmitted Function 5 has been active since the last system reset.
TX FUNCTION 6 xxx	Indicates how many times Transmitted Function 6 has been active since the last system reset.
TX FUNCTION 7 xxx	Indicates how many times Transmitted Function 7 has been active since the last system reset.
RX FUNCTION 1 xxx	Indicates how many times Received Function 1 has been active since the last system reset.
RX FUNCTION 2 xxx	Indicates how many times Received Function 2 has been active since the last system reset.
RX FUNCTION 3 xxx	Indicates how many times Received Function 3 has been active since the last system reset.
RX FUNCTION 4 xxx	Indicates how many times Received Function 4 has been active since the last system reset.
RX FUNCTION 5 xxx	Indicates how many times Received Function 5 has been active since the last system reset.
RX FUNCTION 6 xxx	Indicates how many times Received Function 6 has been active since the last system reset.
RX FUNCTION 7 xxx	Indicates how many times Received Function 7 has been active since the last system reset.

KEY FNT 1 (or user text) xxx	Indicates how many times Input 1A has been active since the last system reset.
KEY FNT 3 (or user text) xxx	Indicates how many times Input 1B has been active since the last system reset.
KEY FNT 1 (or user text) xxx	Indicates how many times Input 2A has been active since the last system reset.
KEY FNT 3 (or user text) xxx	Indicates how many times Input 2B has been active since the last system reset.
KEY FNT 2 (or user text) xxx	Indicates how many times Input 3A has been active since the last system reset.
KEY FNT 4 (or user text) xxx	Indicates how many times Input 3B has been active since the last system reset.
KEY FNT 2 (or user text) xxx	Indicates how many times Input 4A has been active since the last system reset.
KEY FNT 4 (or user text) xxx	Indicates how many times Input 4B has been active since the last system reset.
GUARD FNT 1 (or user text) xxx	Indicates how many times Output 1A has been active since the last system reset.
GUARD FNT 3 (or user text) xxx	Indicates how many times Output 1B has been active since the last system reset.
TRIP FNT 1 (or user text) xxx	Indicates how many times Output 2A has been active since the last system reset.

TRIP FNT 3 (or user text) xxx	Indicates how many times Output 2B has been active since the last system reset.
GUARD FNT 2 (or user text) xxx	Indicates how many times Output 3A has been active since the last system reset.
GUARD FNT 4 (or user text) xxx	Indicates how many times Output 3B has been active since the last system reset.
TRIP FNT 2 (or user text) xxx	Indicates how many times Output 4A has been active since the last system reset.
TRIP FNT 4 (or user text) xxx	Indicates how many times Output 4B has been active since the last system reset.
COMMS WARNING (or user text) xxx	Indicates how many times Annunciator Output 1A has been active since the last system reset.
COMMS ALARM (or user text) xxx	Indicates how many times Annunciator Output 1B has been active since the last system reset.
OUTPUT ALARM (or user text) xxx	Indicates how many times Annunciator Output 2A has been active since the last system reset.
HARDWARE WARNING (or user text) xxx	Indicates how many times Annunciator Output 2B has been active since the last system reset.
NOT USED (or user text) xxx	Indicates how many times Annunciator Output 3A has been active since the last system reset.
HARDWARE ALARM (or user text) xxx	Indicates how many times Annunciator Output 3B has been active since the last system reset.

LAST RESET MM/DD/YY,HH:MM	Indicates the date (month, day and year), and time (hour and minute) of the last reset.
CUM OUTAGE TIME HH:MM:SS or #Days,#Hrs	Indicates how long the cumulative outage timer has run since the last reset. If the Cumulative Outage Time is less than one day, the format is hours, minutes and seconds; If greater than one day the format is days and hours.
RESET	Enables the user to reset the counters and LEDs from the front panel. Press ENTER when this is displayed to initiate the resetting of these items. Then select YES(<u>Y</u>), or NO(<u>N</u>) using the UP or DOWN buttons. Press the ENTER button to execute the reset.

7.5.9 TEST MENU (For Digital System)

The following entries appear as items on the front-panel TEST menu. Press the TEST button to view the first entry. Then press the DOWN button to scroll down the TEST menu list.

TESTS RUN xxx	Indicates the number of tests run since last reset.
TIME BETWEEN HH:MM	Indicates the amount of time between automatic tests. The format is hours and minutes.
TESTS PASSED xxx	Indicates the number of autotests passed since last reset.
TESTS FAILED xxx	Indicates the number of autotests failed since last reset.
NEXT TEST START HH:MM	Indicates the amount of time until the next automatic test.
AVG. BER	Indicates the average Bit Error Rate.

WORD ERRORS	Indicates the number of Word Errors received since the last reset.
CLOCK ERRORS	Indicates the number of Clock Errors received since the last reset.
FRAME ERRORS	Indicates the number of Frame Errors received since the last reset.
MINOR DATA ERROR	Indicates the number of Minor Data Errors received since the last reset.
MAJOR DATA ERROR	Indicates the number of Major Data Errors received since the last reset.
FUNCTION 1 TEST	Allows the user to override Function 1 as specified in the logic table. Press ENTER, then use the UP and DOWN buttons to select active or inactive. ("I" for inactive, "A" for active).
FUNCTION 2 TEST	Allows the user to override Function 1 as specified in the logic table. Press ENTER, then use the UP and DOWN buttons to select active or inactive. ("I" for inactive, "A" for active).
FUNCTION 3 TEST	Allows the user to override Function 1 as specified in the logic table. Press ENTER, then use the UP and DOWN buttons to select active or inactive. ("I" for inactive, "A" for active).
FUNCTION 4 TEST	Allows the user to override Function 1 as specified in the logic table. Press ENTER, then use the UP and DOWN buttons to select active or inactive. ("I" for inactive, "A" for active).
FUNCTION 5 TEST	Allows the user to override Function 1 as specified in the logic table. Press ENTER, then use the UP and DOWN buttons to select active or inactive. ("I" for inactive, "A" for active).
FUNCTION 6 TEST	Allows the user to override Function 1 as specified in the logic table. Press ENTER, then use the UP and DOWN buttons to select active or inactive. ("I" for inactive, "A" for active).
FUNCTION 7 TEST	Allows the user to override Function 1 as specified in the logic table. Press ENTER, then use the UP and DOWN buttons to select active or inactive. ("I" for inactive, "A" for active).

CHECKBACK TEST This allows the user to initiate a Checkback Test to confirm the presence of a remote unit. Press the ENTER button to run the test and view the results.

PING PONG This allows the user to initiate a Ping Pong test to measure the channel delay. Press the ENTER button to run the test and view the results.

CLOCK SOURCE Use the ENTER button to select Enabled or Disabled. When “Enabled” is selected, causes the internal 9745 clock to be active. When “Disabled” is selected, causes the internal 9745 clock to be inactive. This parameter is valid only when the RS449 board is installed.

LOCAL LOOPBACK Allows the user to activate internal relays to connect the transmitter output to the receiver input, to facilitate off-line testing of the RFL 9745. Press the ENTER button to toggle the selection from Enabled to Disabled. Only the RS449 and G.703 boards support this function.

7.6 SHORT HAUL FIBER I/O MODULE FRONT PANEL INDICATORS

The Short Haul FIO module is used to enable the RFL 9745 to communicate with a remote RS-449 port using dual fiber cables in conjunction with the fiber service unit. The Short Haul FIO module front panel is shown in Figure 7-2, and its connectors and indicators are described in Table 7-4.

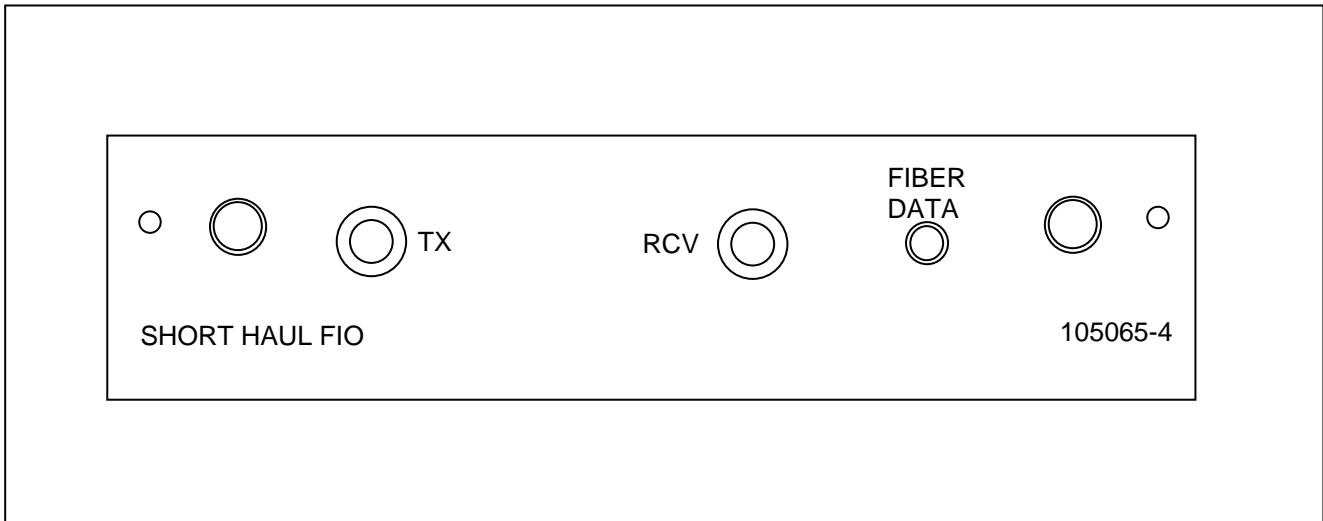


Figure 7-2. Short Haul FIO front panel

Table 7-4. Connectors and Indicators, Short Haul FIO module

Name/Description	Function
TX	Type ST bayonet connector for fiber optic transmitter
RCV	Type ST bayonet connector for fiber optic receiver
FIBER DATA LED (green)	When the green FIBER DATA LED is “on”, the Short Haul FIO is receiving data from the FIBER SERVICE UNIT.

7.7 FIBER SERVICE UNIT FRONT AND REAR PANEL INDICATORS

Refer to Fiber Service Unit Instruction Data Sheet (publication number: ID C37.94FSU) for information on FSU front and rear panel indicators and installation instructions.

Section 8. MAINTENANCE

WARNING

HAZARDOUS VOLTAGES CAN BE PRESENT INSIDE AN RFL 9745 TERMINAL. BEFORE ATTEMPTING MAINTENANCE, BE SURE TO READ AND COMPLY WITH THE HIGH VOLTAGE WARNING AND SAFETY SUMMARY INFORMATION ON PAGES iii AND iv OF THIS MANUAL.

8.1 INTRODUCTION

This section provides maintenance instructions for the RFL 9745 Teleprotection Channel. Topics discussed include using the RFL 9745's diagnostic features to pinpoint problems, a troubleshooting procedure, removal and replacement procedures for the circuit board modules and I/O modules, a procedure for checking and replacing fuses. Information is also provided on how to arrange for service by RFL personnel.

8.2 DIAGNOSTICS

8.2.1 GENERAL DIAGNOSTICS

The RFL 9745 Teleprotection Channel has been designed for years of trouble-free service, and does not require normal maintenance. In case of malfunction, its built-in diagnostics can detect a variety of internal system problems:

1. Each internal module constantly reports its status to the CPU Module. Alarms are generated based on this information.
2. Each power supply output feeds a comparator that constantly measures all three output levels. If a level goes above or below its set limits, an alarm is generated.
3. Transmit and receive levels are constantly monitored. Levels can be manually monitored through APRIL (as described in Section 6 of this manual), or by using the front-panel switches (as described in Section 7.)
4. Trip failures and shorted outputs are sensed and reported through APRIL. (Section 6 contains information on how to access this information.)
5. The RFL 9745 can be accessed and interrogated by the RFL 9745 at the other end of the communications link. Conversely, you can use the RFL 9745 to access and interrogate the remote RFL 9745 using the Windows Remote APRIL mode described in Section 6 of this manual.

6. The RFL 9745 maintains a sequence-of-events log. In this log, all important events are time-stamped, date-stamped, and stored. Events include alarms, trips sent, trips received, and system warnings. A log of the number of operations for each function and alarm is also maintained. (See Section 6 for more information about the sequence-of-events log.)
7. The RFL 9745 can be configured to do either manual or automatic checkback testing. To perform this test, the local RFL 9745 sends an address request to the remote RFL 9745. Based on the communications channel and the setup of the remote RFL 9745, either no response is made or the remote address is returned. Three possible results can occur:

Received Address

**Matches Programmed
Address**

The local and remote RFL 9745s pass both the address test and the checkback test.

Received Address

**And Programmed Address
Do Not Match**

The local and remote RFL 9745s fail the address test, but pass the checkback test.

The Local RFL 9745

**Does Not Receive
A Valid Response**

The local and remote RFL 9745s fail both the address test and the checkback test.

Should a malfunction occur involving the RFL 9745, use the diagnostics described above or standard troubleshooting techniques to determine if the problem is in the RFL 9745, or in some other connected equipment.

If the problem lies within the RFL 9745, try and determine which module or I/O module is defective. Once this is done, replacement should solve the problem. (Removal and replacement procedures can be found in paragraph 8.4.)

Defective modules can be returned to RFL for repair. (See paragraph 8.7 for more information.)

8.2.2 POWER UP TESTS

There are two versions of the start up diagnostics. One is very quick and is run on power up every time. The second takes more time and is only run if the test button on the front panel is pressed and held during power on. Each of these is described below.

The quick version includes the following tests:

1. SRAM Test 0xAAAA and 0x5555 are written and read from every SRAM location.
2. COMMS Register Test A bus test is run with the driver board.
3. Interrupt Register Test Tests the ability to receive and acknowledge interrupts.
4. NVRAM Test 0xAA and 0x55 are written and read from every NVRAM location.
5. DUART Test The ability to transmit and receive characters is tested by putting the DUART into loopback.
6. RTC Test The real time clock is written to and read from to verify its operation.
7. TMS 320 Code RAM Test 0xAAAAA and 0x5555 are written and read from every primitive processor code SRAM location.
8. TM S320 Interface Test Tests the ability of the primitive processor to run programs and respond to inputs.

The long version includes all of the above tests plus the following:

1. EEROM Test Tests the ability to write to and read from every location in the EEROM.
2. FLASH Test Tests the ability to erase and write to a sector of the FLASH memory.

8.2.3 CRASH CODES

The BIOS system puts out certain codes when there is a major system failure. These codes are generated by the MC68000 and a full understanding of this processor is required to make use of the codes. The following codes are common and may be of some assistance to the average user.

0x03	Address error.
0x10 or 0x11	Misalignment of the BIOS system software.
0x47	Driver queue overrun. The driver may not be functioning properly.
0x48	Comms queue overrun. The comms board may not be functioning properly.
0x49	System download complete, system restart commencing.
0x4A	System download failure, reattempt download.

8.3 TROUBLESHOOTING

Figure 8-1 is a 9745 troubleshooting procedure which provides information on how to isolate problems to a module level. When the faulty module is located, follow the removal and replacement instructions in paragraph 8.4

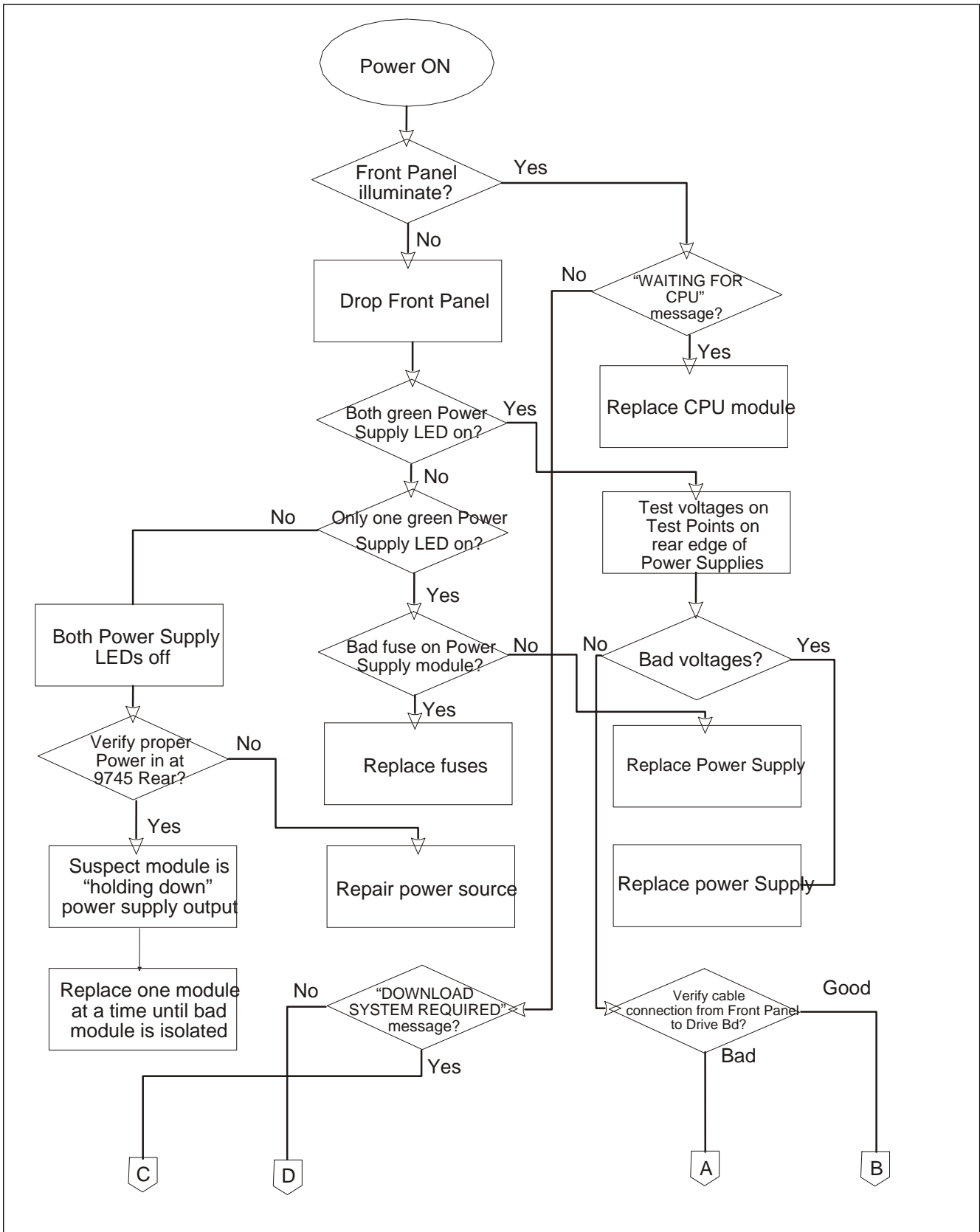


Figure 8-1. 9745 Troubleshooting procedure – Module level

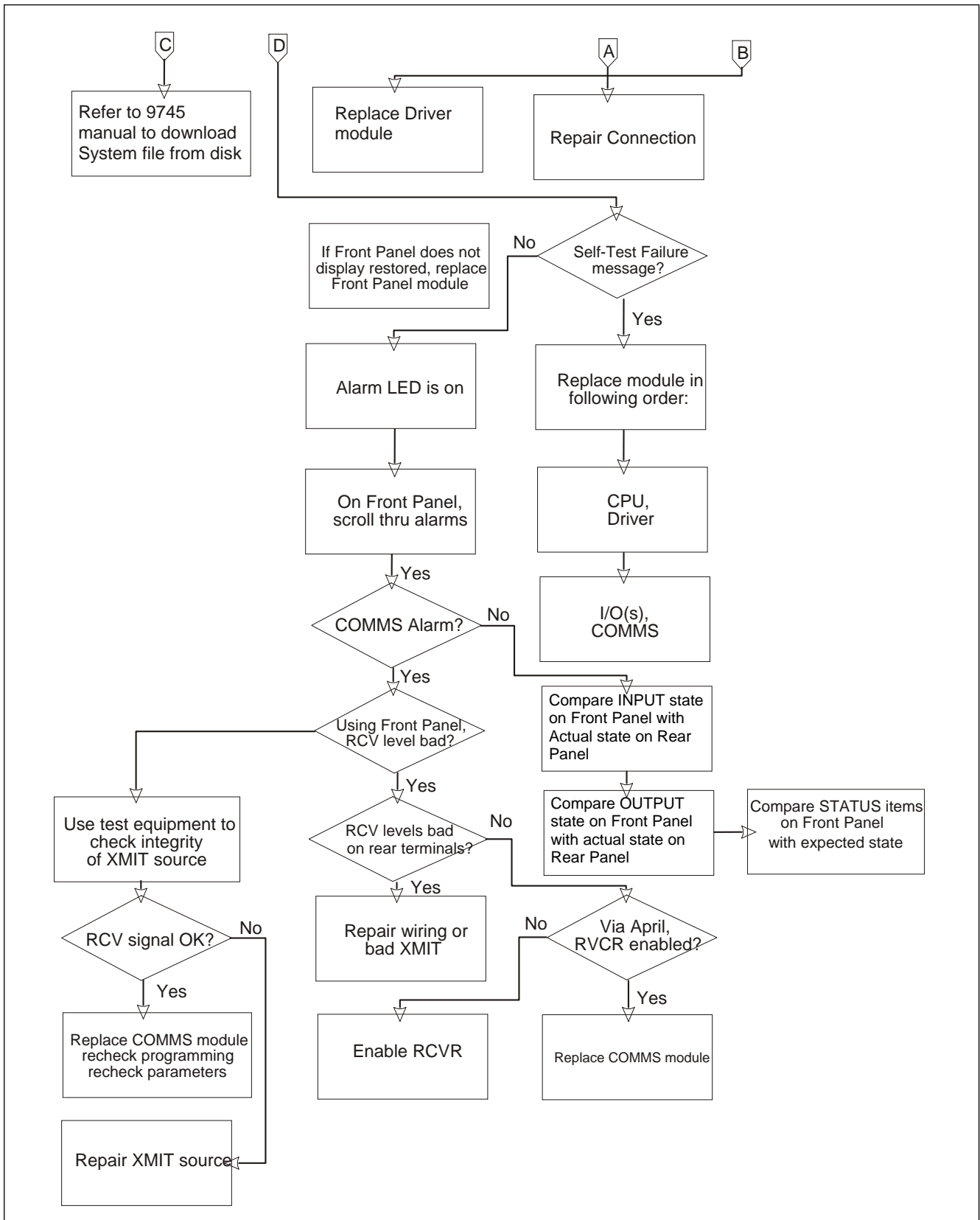


Figure 8-1 (continued). 9745 Troubleshooting procedure – Module level

CAUTION

Each module position in the RFL 9745 chassis is dedicated to a specific module type. Modules can suffer component damage if they are installed in the wrong chassis slot. When removing and replacing modules, make sure each module is placed in the proper slot before re-applying power.

8.4 REMOVAL AND REPLACEMENT

The following paragraphs provide procedures to be used when removing and replacing RFL 9745 modules and I/O modules. Refer to Figure 8-2 for module locations.

WARNING!

POWER MUST BE TURNED OFF BEFORE REMOVING OR INSTALLING ANY RFL 9745 MODULES. FAILURE TO DO SO MAY RESULT IN COMPONENT DAMAGE.

8.4.1 CPU AND DRIVER MODULES (Audio and Digital Terminals)

The CPU Module and the Driver Module are mounted at the front of the RFL 9745 chassis. To remove either of these modules, proceed as follows:

1. On the rear panel, place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the OFF position.
2. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the OFF position.
3. Open the door on the front of the RFL 9745 by loosening the two screws that hold it closed, and lowering the door to its open position.
4. Disconnect any ribbon cables connected to the front edge of the module to be removed.
5. Pull on the handle on the front of the module, until the module is out of the chassis.

To replace a CPU Module or Driver Module, proceed as follows:

1. Determine the horizontal slot in the chassis where the module is to be installed.
There are three horizontal module slots in the front of the RFL 9745 chassis. The Communications Module is installed in the top horizontal slot. The CPU Module is installed in the middle slot, and the Driver Module is installed in the bottom slot.
2. Line up the edges of the module circuit board with the card guides in the chassis.

3. Slide the module into the chassis until it is firmly seated.
4. Reconnect any ribbon cables that were disconnected during module removal.
5. Raise the front door back into its closed position, and tighten the two thumbscrews to secure it in place.
6. On the rear panel, place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the ON position.
7. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the ON position.

8.4.2 POWER SUPPLY MODULES (Audio and Digital Terminals)

All RFL 9745 chassis are equipped with one Power Supply Module; some are equipped with a second redundant supply. To remove a Power Supply Module, proceed as follows:

1. On the rear panel, place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the OFF position.
2. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the OFF position.
3. Open the door on the front of the RFL 9745 by loosening the two thumbscrews that hold it closed, and lowering the door to its open position.
4. Loosen the #6 cross slot screw as shown in Figure 8-2.
5. Pull on the handle or the metal ring (as applicable) on the front of the Power Supply Module, until the Power Supply Module is out of the chassis.

To replace a Power Supply Module, proceed as follows:

1. Line up the edges of the Power Supply Module circuit boards with the card guides in the chassis.
2. Slide the Power Supply Module into the chassis until it is firmly seated in its mating connector.
3. Tighten the #6 cross slot screw as shown in Figure 8-2.
4. Raise the front door back into its closed position, and tighten the two thumbscrews to secure it in place.

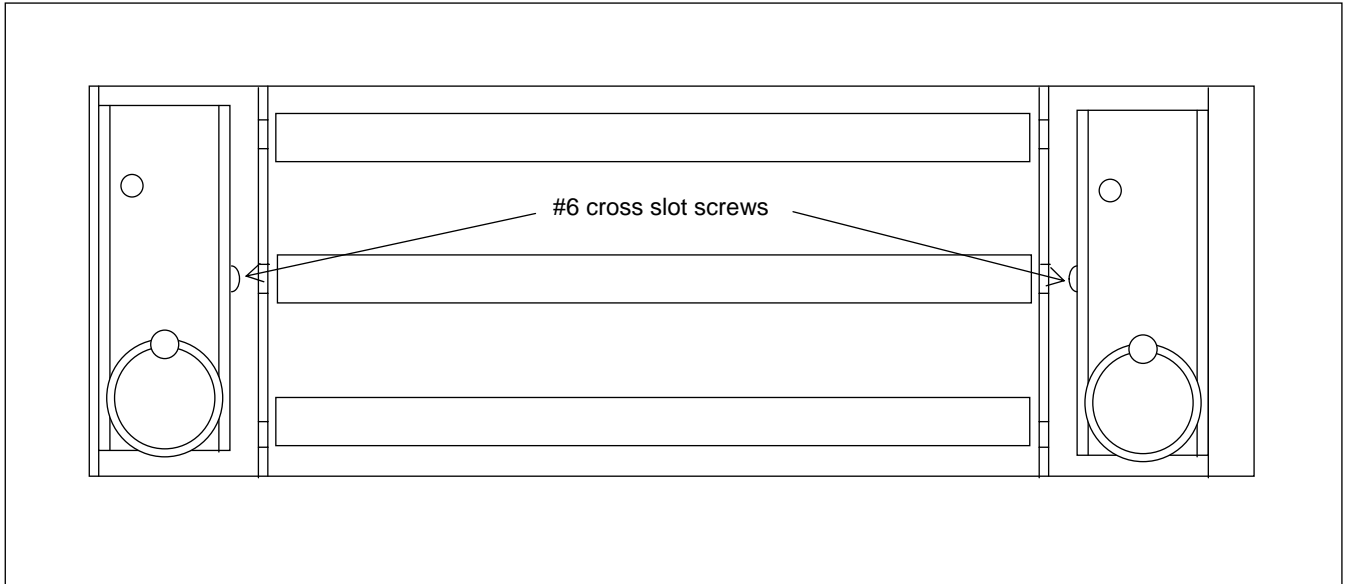


Figure 8-2. Front view of RFL 9745 with front cover folded over

5. On the rear panel, place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the ON position.
6. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the ON position.

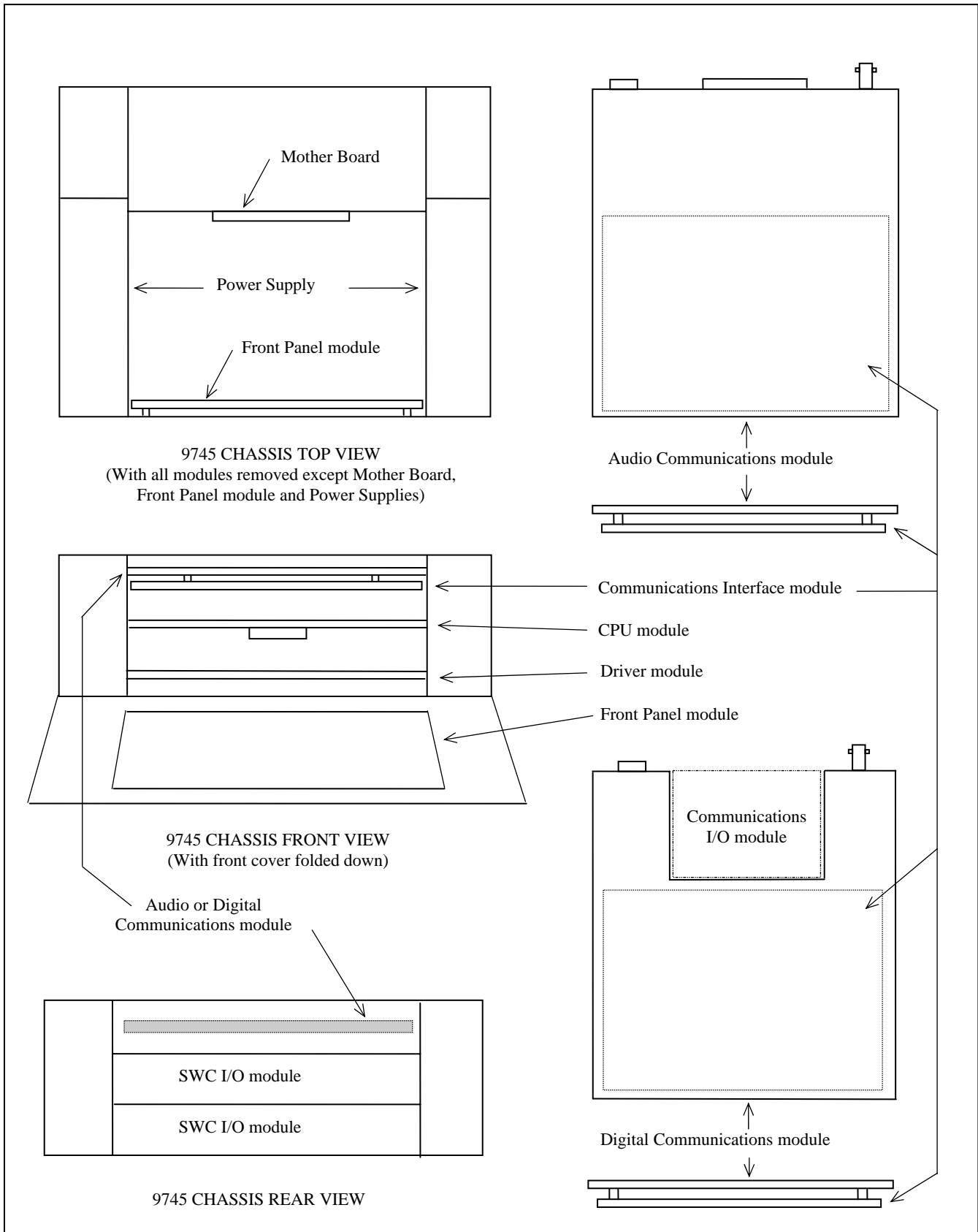


Figure 8-3. RFL 9745 Module Locations

8.4.3 COMMUNICATIONS MODULE (Audio and Digital Terminals)

The Communications Module is mounted at the front of the RFL 9745 chassis, and extends to the rear, where it is attached to a plate along the top of the chassis. To remove the Communications Module, proceed as follows:

1. On the rear panel, place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the OFF position.
2. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the OFF position.
3. Open the door on the front of the RFL 9745 by loosening the two thumbscrews that hold it closed, and lowering the door to its open position.
4. Disconnect any ribbon cables connected to the front edge of the Communications Module.
5. Disconnect all cables from the connectors on the plate behind the Communications Module.
6. Disconnect all wires from the terminal blocks on the plate behind the Communications Module.
Tag all wires before removing them, if they aren't already labeled. This will simplify reassembly.
7. Using a cross-blade screwdriver, remove all the screws near the connectors and terminal blocks on the plate behind the Communications Module.
Do not remove the screws in the corners of the plate; these hold the plate in position.
8. Pull the Communications Module out of the front of the chassis.

To replace a Communications Module, proceed as follows:

1. Line up the edges of the Communications Module circuit board with the card guides at the top of the chassis.
2. Slide the Communications Module into the chassis until its rear panel is firmly seated in the chassis.
3. Using a cross-blade screwdriver, install and tighten the screws near the connectors and terminal blocks on the plate behind the Communications Module to secure the module to the plate.
4. Using the tags or labels on the wires as a guide, reconnect all wires to the terminal blocks on the plate behind the Communications Module.
5. Reconnect all cables to the connectors on the plate behind the Communications Module.
6. Reconnect any ribbon cables to the front edge of the Communications Module.
7. Close the door on the front of the RFL 9745, and tighten the two thumbscrews to hold it closed.
8. Raise the front door back into its closed position, and tighten the two quarter-turn fasteners to secure it in place.
9. On the rear panel, place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the ON position.
10. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the ON position.

8.4.4 SWC I/O MODULES (Audio and Digital Terminals)

Each RFL 9745 terminal has two SWC I/O Modules that are mounted at the rear of the chassis and held in place by four captive screws. To remove an SWC I/O Module, proceed as follows:

1. Place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the OFF position.
2. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the OFF position.

3. If the SWC I/O Module to be replaced is equipped with conventional barrier-type terminal blocks, tag all wires leading to its terminal blocks and then disconnect all wires.
Tagging the wires will simplify reconnection when the I/O module is replaced.
4. If the SWC I/O Module to be replaced is equipped with compression-type terminal blocks, pull the quick-disconnect block out of each terminal block.
5. Using a cross-blade screwdriver, remove the four screws securing the SWC I/O Module in place.
6. Pull on the SWC I/O Module until it is out of the chassis.

To replace the SWC I/O Module, proceed as follows:

1. Line up the edges of the SWC I/O Module circuit board with the card guides in the chassis.
2. Slide the SWC I/O Module into the chassis until it is firmly seated and its rear panel is against the vertical rails at the rear of the chassis.
3. Using a cross-blade screwdriver, install and tighten the four screws to secure the SWC I/O Module in place.
4. If the SWC I/O Module to be replaced is equipped with conventional barrier-type terminal blocks, use the tags on the wires as a guide to reconnect all wires to the terminal blocks.
5. If the SWC I/O Module to be replaced is equipped with compression-type terminal blocks, push the quick-disconnect block back into each terminal block.
6. Place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the ON position.
7. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the ON position.

8.4.5 COMMUNICATIONS INTERFACE MODULES (Digital Terminal)

Each RFL 9745 Digital Terminal has a Communications Interface Module mounted to the top rear of the chassis and held in place with two screws. To remove the Communications Interface Module, proceed as follows:

1. Place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the OFF position.
2. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the OFF position.

3. Remove the connector(s) plugged into the rear of the Communications Interface Module.
4. Using a cross-blade screwdriver remove the two screws and lockwashers securing the module in place.
5. Pull on the two knurled thumbscrews at the rear of the module and remove the unit from the chassis.

To replace the Communications Interface Module, proceed as follows:

1. Line up the edges of the Communications Interface Module circuit board with the grooves at the rear of the 9745 chassis.
2. Carefully slide the module into the chassis making sure that the connector at the rear of the module circuit board lines up with its mating connector in the chassis.
3. When firmly seated, install the two screws and lockwashers, and tighten with a cross-blade screwdriver.
4. Plug in the connector(s) at the rear of the module and tighten any connector retaining screws if applicable.
5. Place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the ON position.
6. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the ON position.

CAUTION

- 1. Never attempt to remove or replace a fuse with Main or Redundant Power Supply Module energized; component damage may result.**
- 2. For continued safe operation, always replace a fuse with one having the same voltage and current ratings.**

8.5 FUSE REPLACEMENT

The RFL 9745's input fuses are located on the circuit board of the Main Power Supply Module. (Dc-powered supplies have two input fuses; ac-powered supplies have one.) There is also a fuse for the power supply module's isolated 10-volt output. If the RFL 9745 is equipped with a redundant power supply, there will also be fuses on the Redundant Power Supply Module.

To check the fuses in an RFL 9745 power supply (and replace if necessary), proceed as follows:

1. On the rear panel, place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the OFF position.
2. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the OFF position.
3. Open the door on the front of the RFL 9745 by loosening the two quarter-turn fasteners that hold it closed, and lowering the door to its open position.
4. Loosen the #6 cross slot screw as shown in Figure 8-2.
5. Pull on the metal ring on the front of the Main Power Supply Module, until the Main Power Supply Module is out of the chassis.
6. Using a flat-blade screwdriver or a fuse puller, remove the fuse on the Main Power Supply Module from its fuseholder clips and inspect it for damage.

If the fuse is bad, it must be replaced. If the fuse is good, check for presence of input voltage at terminal blocks TB1-9 and TB1-10 on the Main Power Supply I/O Module. If voltage is present and the power supply module does not function, the power supply module is defective and must be replaced.

7. Insert a fuse with the proper voltage and current ratings into the fuseholder clips, and push down on the fuse until it snaps into place.

Power Supply Part Number	Voltage Range	Fuse Reference Designation	Fuse Description	Fuse Manufacturer	MFR Part Number	RFL Part Number
105905-1	19-36 Vdc	F1	4A, 250V, slow-blow, 5x20mm	Littlefuse	218004	301122
105905	38-150 Vdc	F1	2A, 250V, slow-blow, 5x20mm	Littlefuse	218002	103389
105930	170-300 Vdc	F1	2A, 250V, slow-blow, 5x20mm	Littlefuse	218002	103389

8. Repeat steps 5 and 6 for the other fuses on the Main Power Supply Module.
9. Line up the edges of the Main Power Supply Module circuit boards with the card guides in the chassis.
10. Slide the Main Power Supply Module into the chassis until it is firmly seated in its mating connector.
11. Tighten the #6 cross slot screw on the Main Power Supply as shown in Figure 8-2.

NOTE

Steps 12 through 19 only have to be performed if your RFL 9745 is equipped with a redundant power supply module. If your RFL 9745 only has one power supply module, go to step 20.

12. Loosen the #6 cross slot screw on the Redundant Power Supply as shown in Figure 8-2.
13. Pull on the handle or the metal ring (as applicable) on the front of the Redundant Power Supply Module, until the Redundant Power Supply Module is out of the chassis.
14. Using a cross-blade screwdriver or a fuse puller, remove each fuse on the Redundant Power Supply Module from its fuseholder clips and inspect it for damage.
If the fuse is bad, it must be replaced. If the fuse is good, check for presence of input voltage at terminal blocks TB3-9 and TB3-10 on the Redundant Power Supply I/O Module. If voltage is present and the power supply module does not function, the power supply module is defective and must be replaced.

15. Insert a fuse with the proper voltage and current ratings into the fuseholder clips, and push down on the fuse until it snaps into place. See table on previous page for fuse part number.
16. Repeat steps 11 and 12 for the other fuses on the Redundant Power Supply Module.
17. Line up the edges of the Redundant Power Supply Module circuit boards with the card guides in the chassis.
18. Slide the Redundant Power Supply Module into the chassis until it is firmly seated in its mating connector.
19. Tighten the #6 cross slot screw on the Redundant Power Supply as shown in Figure 8-2.
20. On the rear panel, place the POWER switch on the Power Supply I/O Module behind the Main Power Supply Module in the ON position.
21. If the RFL 9745 is equipped with a redundant power supply, place the POWER switch on the Power Supply I/O Module behind the Redundant Power Supply Module in the ON position.
22. Look at the indicator on the front of the Main Power Supply Module.
If the indicator on the front of the Main Power Supply Module lights, the module is working properly. If it does not light or if one or more fuses blow again, the module is defective and must be replaced.
23. If the RFL 9745 is equipped with a redundant power supply, look at the indicator on the front of the Redundant Power Supply Module.
If the indicator on the front of the Redundant Power Supply Module lights, the module is working properly. If it does not light or if one or more fuses blow again, the module is defective and must be replaced.
24. Once the power supply indicator is lit, raise the front door back into its closed position, and tighten the two screws to secure it in place.

8.6 HOW TO ARRANGE FOR SERVICING

If necessary, RFL 9745 Modules and I/O Modules may be returned to RFL for repair. Contact our Customer Service Department using the telephone number listed at the bottom of this page. You will be given a return material authorization (RMA) number and shipping instructions.

Section 9. USING PC APRIL LITE

9.1 PC APRIL LITE FOR WINDOWS 2000 AND XP, OVERVIEW

The 9745 communication software was designed when MS DOS based programs were dominant over the Windows Platform. As Windows became more popular, MS DOS became a background program and was eventually dismissed from PCs and lap tops as Windows 2000 and XP no longer relied on a Dos shell. RFL kept pace with this change and developed PC APRIL LITE. This new version of APRIL has the look and feel of any other Windows based program and has automated the UPLOAD, DOWNLOAD and SYSTEM RESTORE functions. The one feature that could not be duplicated was the ability to emulate a 9745. Thus the STAND-ALONE mode was not incorporated into this new PC APRIL. Thus it was called PC APRIL LITE.

PC APRIL LITE can also be used to dial into a 9745 using a modem. Please reference Section 4.

The following section contains information on how to use PC APRIL LITE software. Two CD's are supplied with every RFL 9745 system. The first CD contains the RFL9745 Instruction Manual and the PC APRIL LITE software. The second CD contains the Custom Logic File. The official nomenclature of the PC April Lite Software Emulation is SW9745PAL0XX, where XX is the number of the current revision. The first CD contains the PC April Lite installation set-up file and three parameter files. The parameter files are listed below.

- | | |
|----------------|-------------------------------------|
| 1) 6750.bat | 6750 Analog parameter file |
| 2) 9745.bat | 9745 Analog default parameter file |
| 3) digital.bat | 9745 Digital default parameter file |

The 9745 system software can be downloaded from the RFL website at rflect.com. The official nomenclature of the system file is S9745RZZZ.MHX, where ZZZ is the number of the current revision. The system file name will change as new updated versions of the system software are released. This file will enable a user to upload the 9745 system software if the need arises. See paragraph 9.10.2.1 for loading instructions.

NOTE

The user is advised to copy the PC APRIL LITE parameter files (6750.bat, 9745.bat, and digital.bat) from the CD to the hard drive of a PC.

NOTE

The new system software versions should be used only with the latest RFL9745 CPU modules Part No. 107335-X.
Operating System Software SW9745SY201 (Version 7.0) or SW9745SY301 (Version 8.0 Australia) cannot be loaded into chassis's with the following CPU Part Numbers:
105025-X
107330-X

9.2 LOADING PC APRIL LITE

1. Insert the CD into your PC and browse to find the APRIL LITE.EXE (1.34MB)
2. Clicking on the file will start the installation. The program will prompt you during the set-up.

April Lite will create its own folder and ICON on your desktop.

Verify that the following files are in the APRIL LITE directory in drive C.

	6750.mhx
6750.bat	9745.mhx
9745.bat	digital.mhx
digital.bat	optic.mhx

PC APRIL LITE can also be obtained from the RFL web site. From the RFL home page click on 'Customer Service' then click on 'RFL Software Utilities.' You can then chose the file location as you would in any other downloaded program. The software can also be mailed to you on a disk, CD ROM or emailed from an RFL associate. However some firewalls will not permit the program to pass through and a temporary change to the extension might be required.

The opening screen for April Lite is shown below:

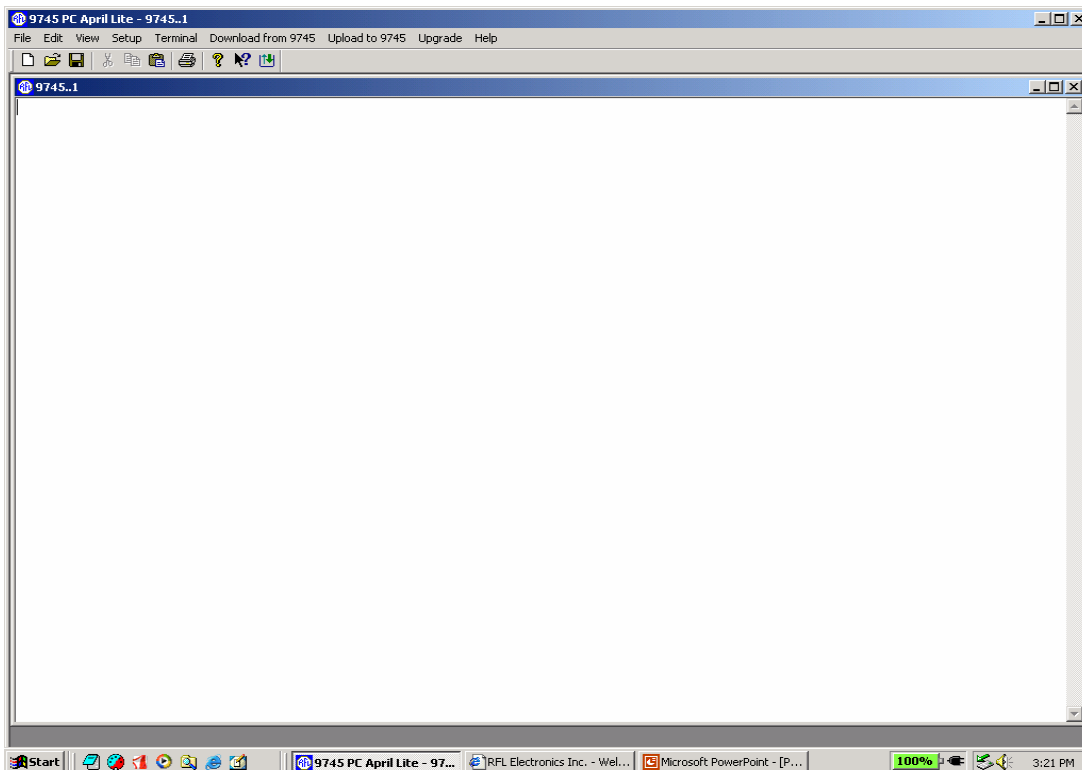


Figure 9-1. April Lite Opening Screen

9.3 PC APRIL LITE CAPABILITIES

1. Download a logic parameter file from the 9745 to a PC (See paragraph 9.5).
2. Upload a logic parameter file from a PC to the 9745 (See paragraph 9.6 and note below).
3. Upload a system file from a PC to the 9745. (See paragraph 9.6).
4. Upload a system file from a PC to the 9745 if the system file has crashed. (See paragraph 9.8).
5. Store the output from a 9745 in Log File. (See paragraph 9.9).

Each of these modes will be discussed in detail later in this section.

NOTE

If a logic file is uploaded, the corresponding parameter file must also be uploaded. The logic file must be uploaded first, followed by uploading the parameter file.

9.4 ESTABLISHING COMMUNICATIONS

Click on “Setup.” A “COM Options” button will appear as shown below.

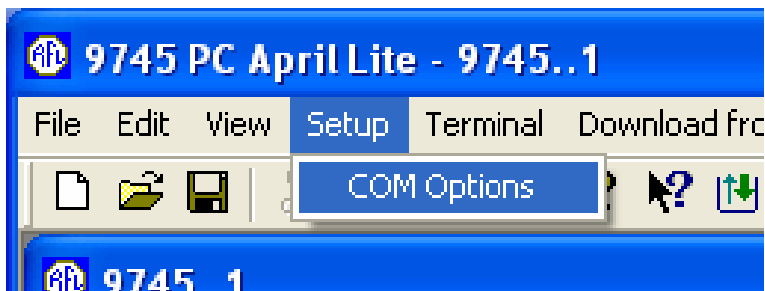


Figure 9-2. COM Options

Click on “COM Options” the following screen will appear.

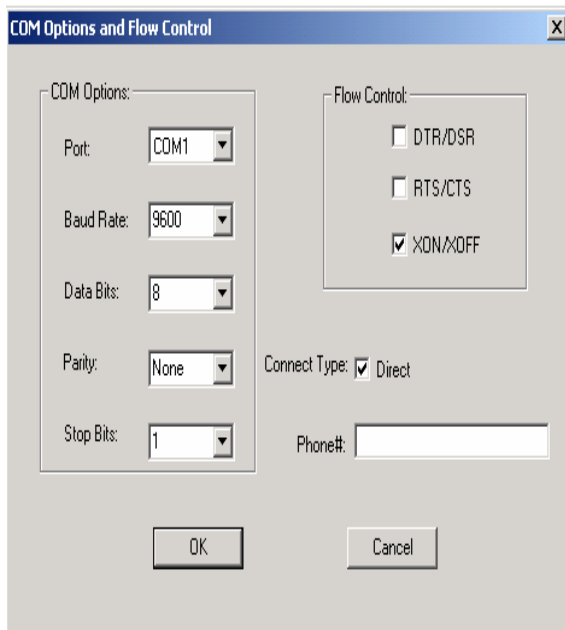


Figure 9-3. COM Options Set-up

Definitions:

Port

Most PC/Laptops will use COM 1, there are 8 ports to select from.

Baud Rate

There are 10 selectable baud rates, however the 9745 will **only** use the following: 300, 1200, 2400, 9600 and 19200.

Data Bits/Parity/Stop Bits

If not already set to the default values of 8, None and 1 respectively, they must be set now.

Flow Control (handshaking)

Check “XON/XOFF”

Connect Type

Only check “Direct” if using an RS-232 interface.

Phone#

Enter a phone number if a modem is being used. Note, this set-up only needs to be done once unless you are changing the “Connect Type.”

After the set-up is complete click the “OK” button.

After the COM Option and Flow Control dialog box has been completed connection to the 9745 must be made. Click on “Terminal” > “Connect” as shown below.

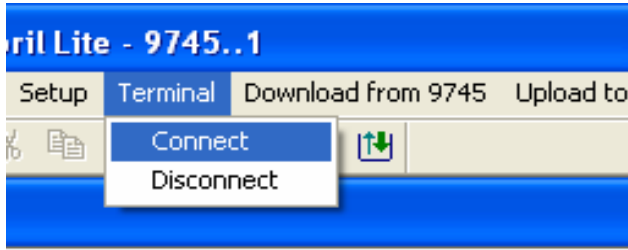


Figure 9-4. Making a Connection to the 9745

Once a connection is made a confirmation is displayed, click “OK.”

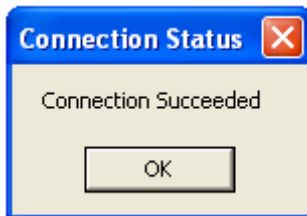


Figure 9-5. Connection Confirmation

At this point you should press the enter key on your PC and a ‘9745>’ prompt will appear. PC April Lite will now work exactly as PC April for DOS as outlined in Section 6 of the this Manual **with the exception of Stand Alone mode and the F1 commands (Upload/Download)** described in the following sections. The Upload/Download functions have been simplified in PC April Lite.

9.5 DOWNLOADING LOGIC AND PARAMETER FILES FROM THE 9745

Once you click on “Download from 9745” two options will appear. “Download Logic File” and “Download Parameter File.” It does not matter which one you do first. Both files are downloaded in the same manner.

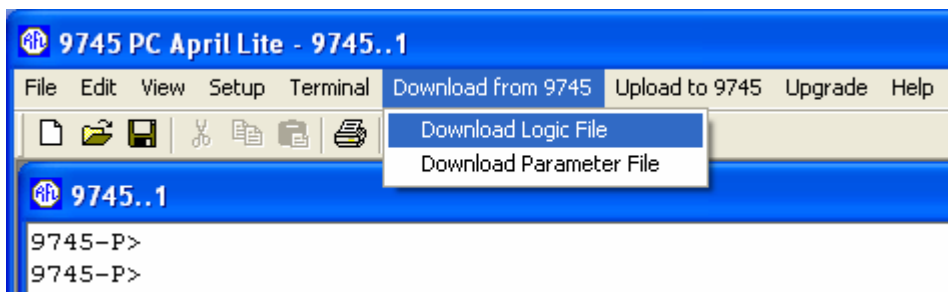


Figure 9-6. Downloading Logic and Parameter Files

If this is a digital system you must check “Digital System.” Then edit the logic name. The default is “FLASH.MHX.” You can browse to place the file in any folder you wish. The receiving protocol remains “APRIL commands.” Click on the “Receive” button.”

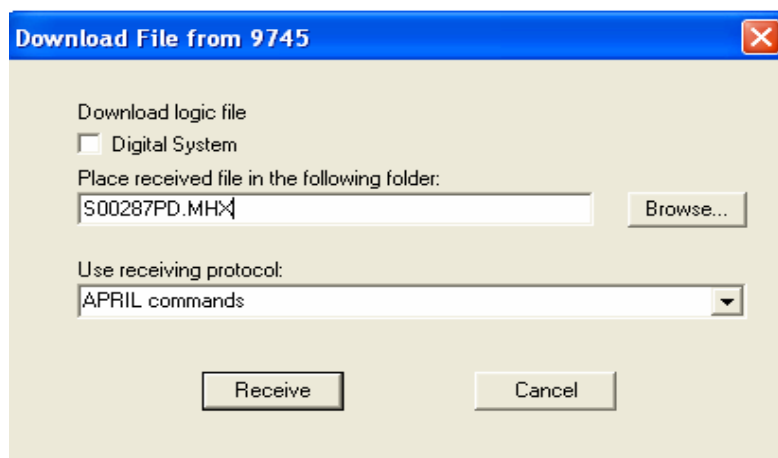


Figure 9-7. Downloading File from 9745

You will now see the download dialog box and the word “wait” will be shifting in the “Status” line for several seconds as shown below. If you choose a preexisting file, PC Lite will prompt you with a warning that the file will be replaced. Clicking “YES” will allow the process to continue. Clicking no will allow you to pick a different file name. If the file already exists April Lite will prompt you to either change the name or overwrite the file with “OK” and “YES” buttons.

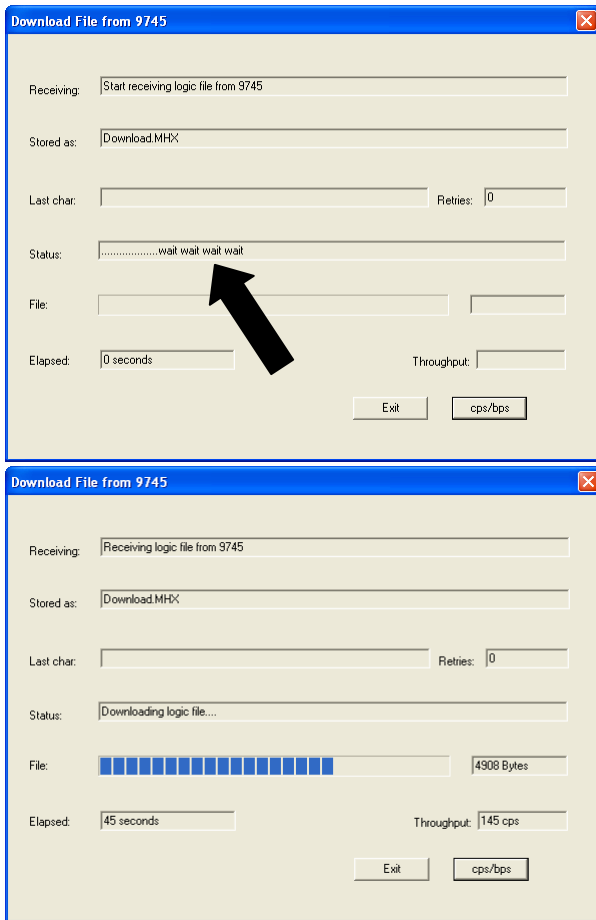


Figure 9-8. Downloading Process Dialog boxes

Once the download begins, the “File” line may refresh several times until the entire file is transferred.

Once the download is completed click the “OK” button, then “Exit” to continue.

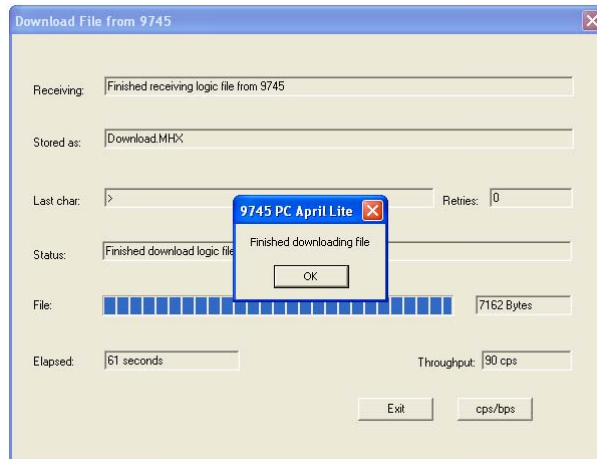


Figure 9-9. Downloading Confirmation

All downloaded files are stored in the April Lite folder.

9.6 UPLOADING LOGIC, PARAMETER AND SYSTEM FILES TO THE 9745

Clicking on “Upload to 9745” will give you four options as shown below.

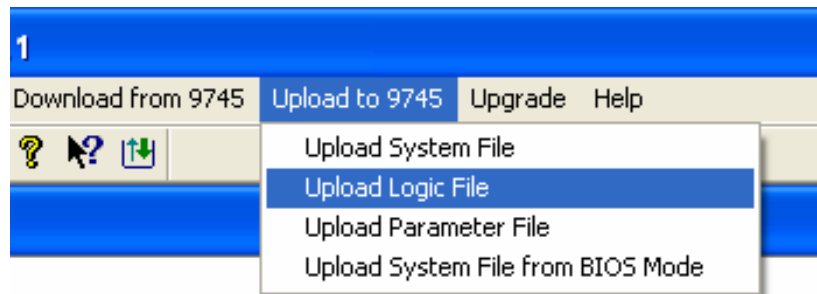


Figure 9-10. Uploading to 9745

An **“Upload Logic File”** must be performed before you can perform an **“Upload Parameter File.”** Uploading the System File, Logic, and Parameter Files are performed in the same manner. However it is recommended that the System file be done at a baud rate of 19200. For this you must go back to “COM options.”

Click on “Upload Logic File.” Then browse to/ or enter the MHX file name. The Protocol should be Xmodem. Then click send as shown below.

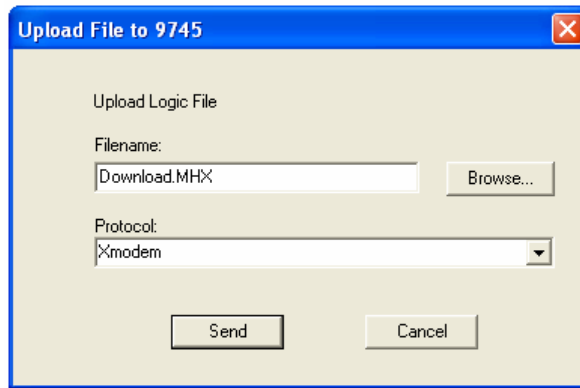


Figure 9-11. Uploading to 9745

In the “Last event” line the word “wait” will again shift for several seconds then begin the upload.

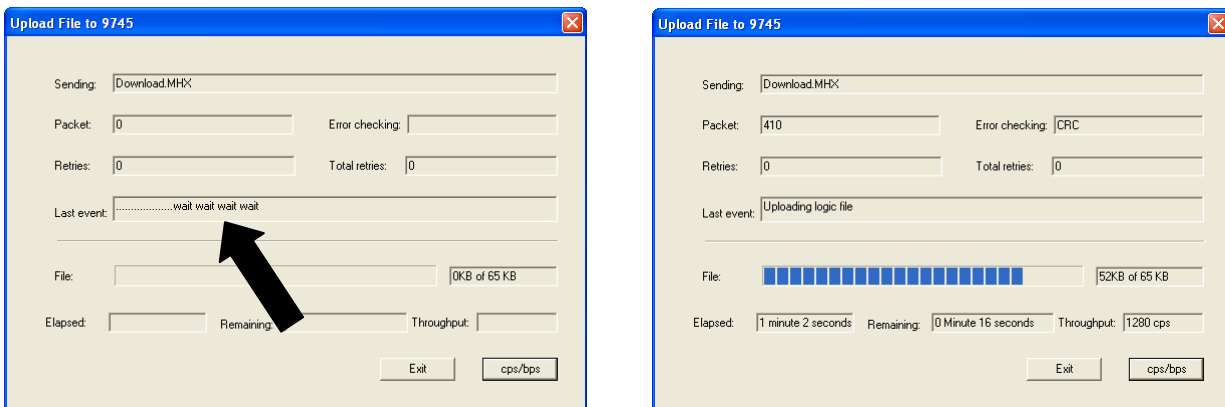


Figure 9-12. Uploading Process Dialog boxes

The upload will take just over 1 minute. You can track its progress by watching the “Elapsed” and “Remaining” time lines. When the upload is completed click on the “OK” button then “Exit.” As shown below.

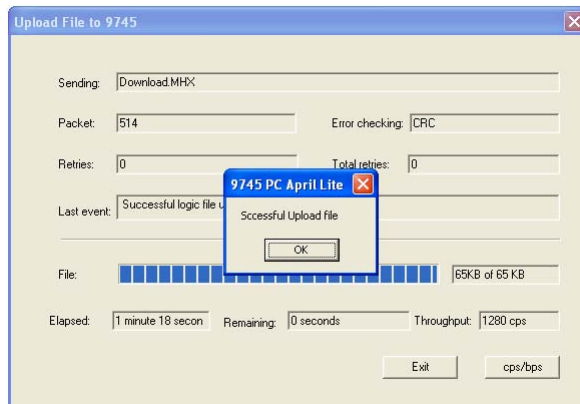


Figure 9-13. Uploading Confirmation

9.7 UPLOADING A CRASHED 9745

The “Upload System File from BIOS Mode” (See fig. 5-10) is only used when the 9745’s operating system “crashes.” The LCD of the 9745 will display “DOWNLOAD REQUIRED”. This can happen by :

- Accidentally loading a logic table MHX file rather than a System File.
- The System File was corrupted.
- The upload was disrupted during an upload of a System File, or during an upgrade.

The read out shown below will be the only response you will receive from a crashed 9745.

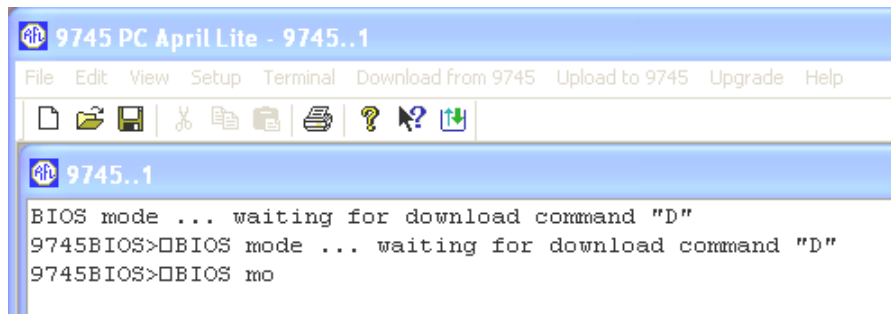


Figure 9-14. Uploading a Crashed 9745

When a 9745 crashes it will automatically boot down to a 2400 baud rate. You must reset the “COM Options” to 2400 baud and reconnect to the 9745. Click on “Upload to 9745” and select “Upload System File from BIOS Mode.” Select the proper file and continue with the restore. It will take approximately 64 minutes to restore. It is recommended that the logic and parameter files be reloaded to prevent possible logic/parameter damage. If you should choose to upgrade your 9745’s Operating System and do not have access to the original MHX or BAT Files, you may use the “Upgrade” button to Automatically step you through the downloading, upgrading and uploading of the MHX and BAT files.

9.8 SAVING 9745 DISPLAYS, EVENTS, AND LOGS

To save any information on the screen such as parameters, alarm status, configuration, etc... You can simply use your mouse to highlight and copy/paste to a word document. This takes the place of F6 in the original PC April for DOS version.

9.9 AUTOMATIC UPGRADE

This feature performs an automatic download of the logic and parameter files. It then uploads the System file (MHX), logic MHX and parameter BAT file. April Lite will prompt you to browse and name files as it steps through the process. This procedure is recommended when you do not have access to the original logic MHX file. Not uploading the original logic MHX file deletes the logic name and number (lines 74 and 75) in the Configuration display. Uploading the original logic file restores line 74 and 75.

9.10 PC APRIL DOS MODE

9.10.1 STAND-ALONE MODE

In the stand-alone mode the users PC is not connected to the RFL 9745. PC April can be used in stand-alone mode either as a training tool, or to create parameter files or logic files which can be downloaded to an RFL 9745 at a later time. In the stand-alone mode PC April for the RFL 9745 runs identically to the April software resident in the RFL 9745 itself.

9.10.1.1 USING PC APRIL AS A TRAINING TOOL

PC April allows the user to get familiar with the 9745 April menus and displays, but without being connected to the 9745. When used as a training tool, all that is needed is the PC April diskette and a PC. Once the contents of the PC April CD is loaded into drive C of the PC as described on page 9-2 of this section, proceed as follows. After the DOS prompt (C:\APRIL>), type PC_APRIL [enter], to view the PC April opening display as shown below.

```
C:\APRIL>PC_APRIL
*
* Begin RFL 9745 April for DOS
*
9745>
```

Figure 9-15. PC April opening display

Then type **H [enter]** to enter the main menu as shown in figure 9-16.

RFL Electronics APRIL(t) Remote Communications, Version 2.0 (c)1993, 1994

H - Display the main menu
A - Go to the alarms display
V - Go to the values display
P - Go to the programming menu (password required)
D - Go to the read settings menu
F - Go to the configuration and software version display
K - Go to the logic programming menu (password required)
T - Go to the test menu (password required)
U - Enter the update mode
X - Exit the update mode
S - Go to sequence of events menu
B - Load parameters from file (MSDOS only)
C - Save current parameters to file (MSDOS only)
N - Enter file name (MSDOS only)
Z - Exit to DOS (MSDOS only)
9745>

Figure 9-16. PC April main menu in stand-alone mode

From this point onward, the user can select April commands to view the alarms display, the values display, and other menus or displays by selecting the letter that corresponds to the command listed in Figure 9-16. The user can also make changes to parameters and tables in order to get familiar with the various PC April commands. Detailed instructions on how to use commands ‘H’ through ‘S’ are described in section 6 of this publication. Instructions on how to use commands ‘B’, ‘C’, ‘N’ and ‘Z’ are described below. The last page of this section contains the 9745 menu hierarchy which shows all of the PC April commands on one page in addition to the PC April menu structure.

<u>Command</u>	<u>Function</u>
B	Loads the parameter file from the hard disk or diskette to the RAM of the PC enable the user to edit the file.
C	Saves the parameter file from the RAM of the PC to the hard disk or diskette after the file has been edited by the user.
N	Allows the user to name the parameter file before using the ‘B’ or ‘C’ commands.
Z	Allows the user to return to DOS.

9.10.1.2 USING PC APRIL TO CREATE PARAMETER AND LOGIC FILES

PC April can also be used in the stand-alone mode to create parameter and logic files which can be downloaded to an RFL 9745 at a later time. In the stand-alone mode the user can perform the operations described below.

1. Creating and saving a parameter file:

A parameter file contains 9745 system parameter settings similar to those shown in figure 6-7. The user has the option to change these settings to meet his particular application. For example the user can change the system label, the channel setting, the time and date settings, or other parameter settings. A parameter file can be edited or created by the user through the programming menu. The user enters the main menu by selecting 'H' [enter], then enters the programming menu by selecting 'P' [enter], and then enters the password. The user can then display the present parameter settings and parameter numbers by selecting 'D' [enter]. The parameter settings can then be changed using the '##' command in the programming menu. Three examples of how to change parameter settings are shown in paragraph 6.7.4. When the parameter settings have been changed to the required values, the user selects 'SV' [enter] to save the new values. The user then selects 'Q' [enter] to return to the main menu, then selects 'N' [enter] to name the new parameter file (file name with path), and finally selects 'C' [enter] to save the new parameter file. Before creating or overwriting an existing parameter file, the system will verify the file name. If the user does not start off with a parameter file using the /R option in the PC April command string shown above, the parameters will all be initialized to zero. This may cause an error message to appear on the display. The user can ignore the error message, however the zeroed parameters will still be saved in the parameter file.

2. Loading a parameter file from the diskette or hard drive to PC April:

An existing parameter file can either be loaded on bootup when PC April is initialized by using the /R option in the command string, or by using the 'B' command in the PC April main menu. An example of a command string for loading an existing parameter file when PC April is first initialized is shown below:

```
C:\APRIL>PC_APRIL /Rfile [enter]
```

An existing parameter file can also be loaded by using the 'B' command from the PC April main menu. From the main menu select the 'N' command to name the existing parameter file, then select the 'B' command to load the existing parameter file.

3. Creating and saving a logic file (primitive and alarm):

A primitive logic table contains 9745 system logic settings similar to those shown in figure 6-16. An alarm logic table contains 9745 alarm logic settings similar to those shown in figure 6-17. The user has the option to change settings in any one or both of these tables to meet his particular application. A logic file (primitive and alarm) can be edited or created by the user through the logic programming menu. The user enters the main menu by selecting 'H' [enter], then enters the logic programming

menu by selecting 'K' [enter], and then enters the password. To edit the primitive logic table select 'S' [enter], and then 'V' [enter] to view the table. The primitive logic table can then be edited to the required values using the '##' command in the primitive logic edit menu. When satisfied, the user selects 'SV' [enter] to save the new values. The user then selects 'Q' [enter] to return to the logic programming menu.

To edit the alarm logic table select 'T' [enter], and then 'V' [enter] to view the table. The alarm logic table can then be edited to the required values using the '##' command in the alarm logic edit menu. When satisfied, the user selects 'SV' [enter] to save the new values. The user then selects 'Q' [enter] to return to the logic programming menu.

From the logic programming menu the user selects 'N' to name the new logic table file (primitive and alarm), and then 'SV' to save it. Before creating or overwriting the existing logic file, the system will verify the new file name. When the "SV" command is made in the logic programming menu, a file is automatically created which contains the primitive logic table, the alarm logic table, the compiled tables, and the timer names.

4. Loading a logic file (primitive and alarm) from the diskette or hard drive to PC April:

A logic file (primitive and alarm) can either be loaded on bootup when PC April is initialized by using the /F option in the command string, or by using the 'O' command in the PC April logic programming menu. An example of a command string for loading a logic file when PC April is first initialized is shown below:

```
C:\APRIL>PC_APRIL /Ffile [enter]
```

A logic file can also be loaded by using the 'O' command from the PC April logic programming menu. From the main menu select the 'K' command and enter the password to go to the logic programming menu. From the logic programming menu select the 'N' command to name the existing logic table file, then select the 'O' command to load the logic file.

9.10.2 WINDOW MODE

In window mode, PC April can be run on a PC that is connected to the front panel of an RFL 9745 via an RS232 cable. The RFL 9745 is DTE equipment, so there is no need for a null modem. The user activates either a COM1 or COM2 connection using the /C option and sets the baud rates of the PC and the RFL 9745 to the same value, using the front panel of the RFL 9745 (LEVELS then UP-ARROW) and the /B option for PC April. If the /B option is not selected, the default baud rate of 9600 will be automatically selected for the PC.

When the /C option is selected, PC April will display the 'W' (window) command in the main help menu as shown in figure 9-11. Selecting the 'W' command puts PC April into window mode, which allows the PC to communicate with the RFL 9745. An exclamation point (!) proceeds all information displayed (except for update mode). At this point, all keyboard entries are routed to the communication port on the RFL 9745, and all output from the RFL 9745 is displayed on the PC screen. The /C option must be selected to enable the PC to communicate with the RFL 9745. The number following the /C option must correspond to the communications port of the PC which is connected to the RFL 9745, or the user will not be able to access the window mode.

As an example, at the system prompt (C:\APRIL>), type **PC_APRIL /C1 [enter]** to start PC APRIL using the COM1 port.

Then type **H [enter]** to enter the main menu as shown in Figure 9-17.

```
RFL Electronics APRIL(t) Remote Communications, Version 2.0 (c)1993, 1994
```

```
H - Display the main menu
A - Go to the alarms display
V - Go to the values display
P - Go to the programming menu (password required)
D - Go to the read settings menu
F - Go to the configuration and software version display
K - Go to the logic programming menu (password required)
T - Go to the test menu (password required)
U - Enter the update mode
X - Exit the update mode
S - Go to sequence of events menu
W - Window remote April
B - Load parameters from file (MSDOS only)
C - Save current parameters to file (MSDOS only)
N - Enter file name (MSDOS only)
Z - Exit to DOS (MSDOS only)
9745>
```

Figure 9-17. PC April main menu where PC is connected to an RFL 9745

The user can access functions which interact between the PC and the RFL 9745 via the PC keyboard function keys. This is to allow the user to route files on the PC to the RFL 9745 and vice versa. The following function key commands are supported:

- F1 - Display this help
- F2 - Upload logic (TABLES) or SYSTEM file to RFL 9745 via XMODEM
- F3 - Upload parameter (batch) file to RFL 9745
- F4 - Download parameters from RFL 9745 and save in file
- F5 - Download logic from RFL 9745 and save in file
- F6 - Store output from RFL 9745 in a log file

When the user presses a function key command 'F2', 'F3', 'F4' or 'F5', a box appears on the PC screen with the file name to be read or written. The user can edit the file name including the path. If the user wishes to cancel the command, he can press 'Esc'. If the user presses 'Enter', a verify is run on the file. If a file is to be read but does not exist, a beep sounds and the command does not continue. If a file is to be written but already exists, the user is asked to confirm overwriting the file.

In this mode of operation (PC April connected to an RFL 9745) the user can perform the operations described in the following sections.

#	PARAMETER	SETTING	#	PARAMETER	SETTING
999	System Label	9745 DEMO UNIT			
001	Channel 1	Modem			
002	Tone 1 Tx Freq	700Hz 1000Hz			
003	Transmit Level	-15.00 dBm	004	Boost Level	0 dB
005	Tone 1 Rx Freq	700Hz 1000Hz			
006	Rx Bandwidth	380Hz	007	Rx Level	-15 dBm
008	Rx Alarm	-33 dBm	009	AM Noise (SNR)	5 dB
010	FM Noise	75%			
016	Channel 2	Single			
017	Tone 2 Tx Freq	2900Hz 3050Hz			
018	Transmit Level	-15.00 dBm	019	Boost Level	0 dB
020	Tone 2 Rx Freq	2900Hz 3050Hz			
021	Rx Bandwidth	380Hz	022	Rx Level	-15 dBm
023	Rx Alarm	-33 dBm	024	AM Noise (SNR)	8 dB
025	FM Noise	28%			
031	Channel 3	Single			
032	Tone 3 Tx Freq	2145Hz 2445Hz			
033	Transmit Level	-15.00 dBm	034	Boost Level	0 dB
035	Tone 3 Rx Freq	2145Hz 2445Hz			
036	Rx Bandwidth	380Hz	037	Rx Level	-15 dBm
038	Rx Alarm	-33 dBm	039	AM Noise (SNR)	8 dB
040	FM Noise	28%			
046	Channel 4	Single			
047	Tone 4 Tx Freq	1465Hz 1765Hz			
048	Transmit Level	-15.00 dBm	049	Boost Level	0 dB
050	Tone 4 Rx Freq	1465Hz 1765Hz			
051	Rx Bandwidth	380Hz	052	Rx Level	-15 dBm
053	Rx Alarm	-33 dBm	054	AM Noise (SNR)	8 dB
055	FM Noise	28%			
060	Opt Status Board	No	061	EE Pot J10	A
062	Chan delay alarm	8 ms	063	Year	2000
064	Date	10/12	065	Time	14:15:55
066	Hour Adjust	0	067	Local Address	0
068	Remote Address	0	069	Reset Log	

Figure 9-18. 9745.BAT Parameter File (Narrow)

9.10.2.1 HOW TO UPLOAD A SYSTEM FILE FROM THE PC TO THE 9745

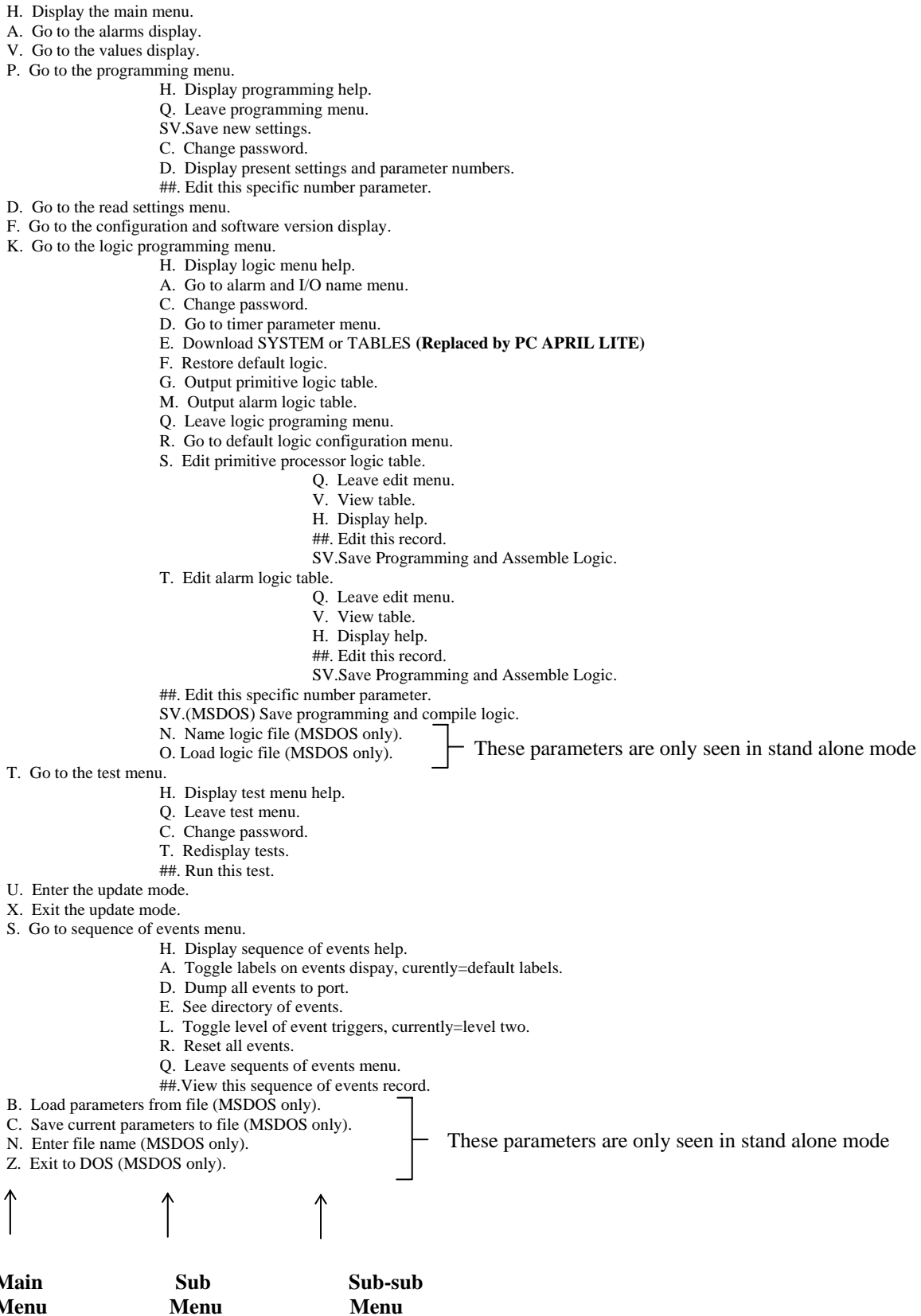
CAUTION

Before uploading the SYSTEM file, you must first determine the system software version (Software ID) by following the directions in paragraph 6.9.

NOTE

After you perform the “controlled system software upload” the RFL 9745 LCD will display the following message: **SETUP REQUIRED**. This means that the parameter file must be uploaded. You can do this by following the instructions in paragraph 9.6. If your software ID is 4.8, the baud rate of the 9745 may change to 2400 or may stay the same, after the system software upload is complete. If the baud rate changes you will get erroneous characters on your PC display such as: $\zeta\zeta\zeta\zeta$, $\uparrow\uparrow\uparrow\uparrow$, $\approx\approx\approx$, $\geq\leq$, or $\backslash\backslash\backslash\backslash$. If this happens you must change the baud rate of your PC to 2400 before loading the parameter file. If you are writing over a version other than 4.8 the baud rate of your 9745 will stay the same and you don't have to change the baud rate of the PC to match it.

Table 9-1. RFL 9745 Menu Hierarchy



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Section 10. UCA INTERFACE MODULE

10.1 INTRODUCTION

The RFL 9745 UCA Interface module is used to connect the RFL 9745 to a LAN. This allows a user to access the RFL 9745 via a 10Base-T or 10Base-FL Ethernet LAN using a web browser or any UCA based software package. The module is installed at the rear of the RFL 9745 chassis in place of the upper Solid-State I/O or Solid-State Relay I/O module, and is powered from the RFL 9745 chassis. The rear panel of the RFL 9745 UCA Interface module is shown in Figure 10-1.

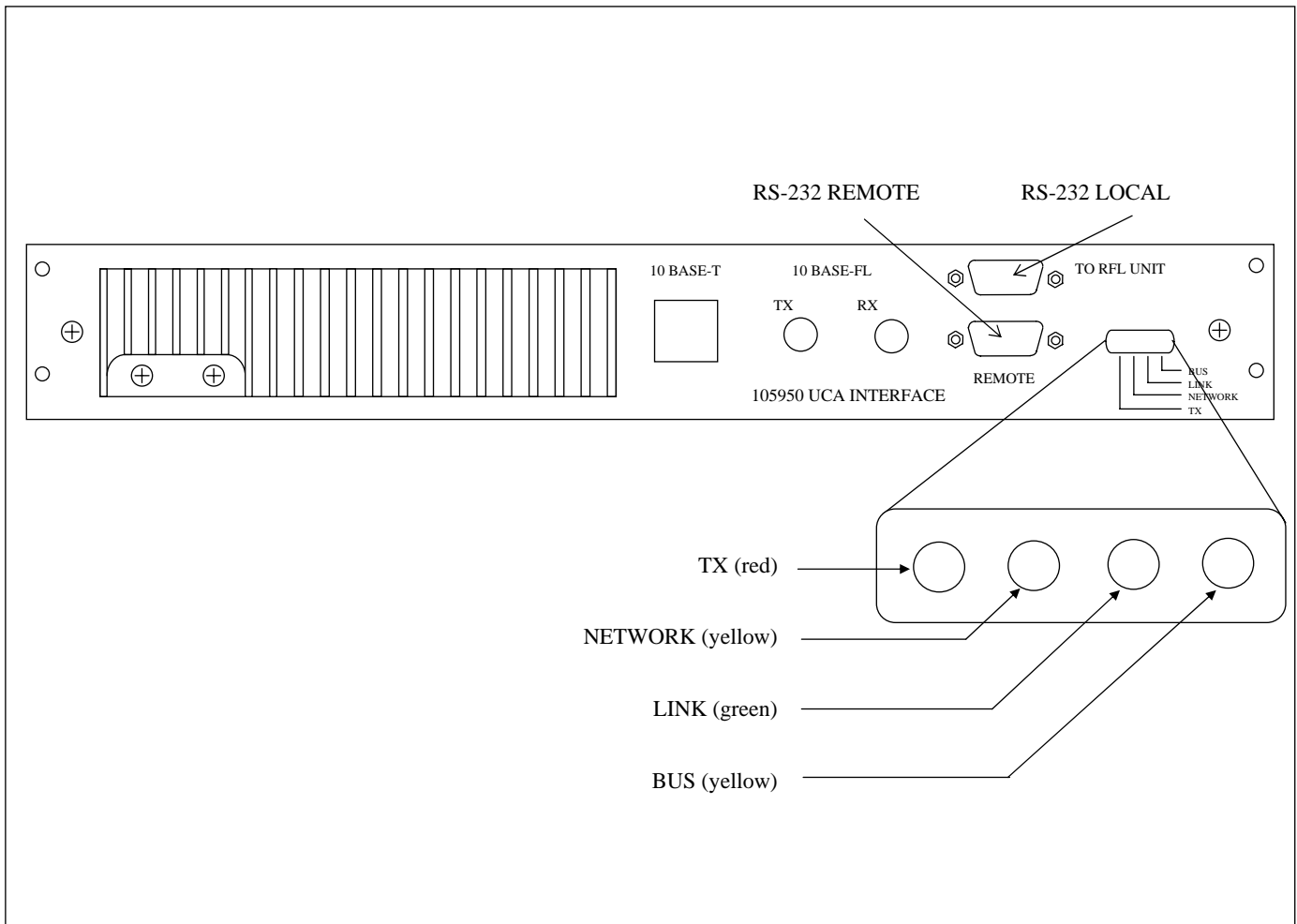


Figure 10-1. Rear panel view of RFL 9745 UCA Interface Module

10.2 INSTALLATION

The RFL 9745 UCA Interface module provides an RJ-45 jack on its rear panel for a Cat. 5 cable based network connection, two ST connectors (TX & RX) for multimode fiber based networks, and two DB-9 male RS-232 Com ports for serial communication as shown in Figure 10-1. On the ECB (inside the module), switch SW1 selects the mode for networking, 10Base-T or 10Base-FL. The unit's power must be cycled for a change of switch SW1 to take effect. The 9745 UCA Interface module is powered from the RFL 9745 chassis. There are four LEDs on the back panel of the 9745 UCA Interface module indicating the LAN communication status. Hardware connections are shown in Figure 10-2.

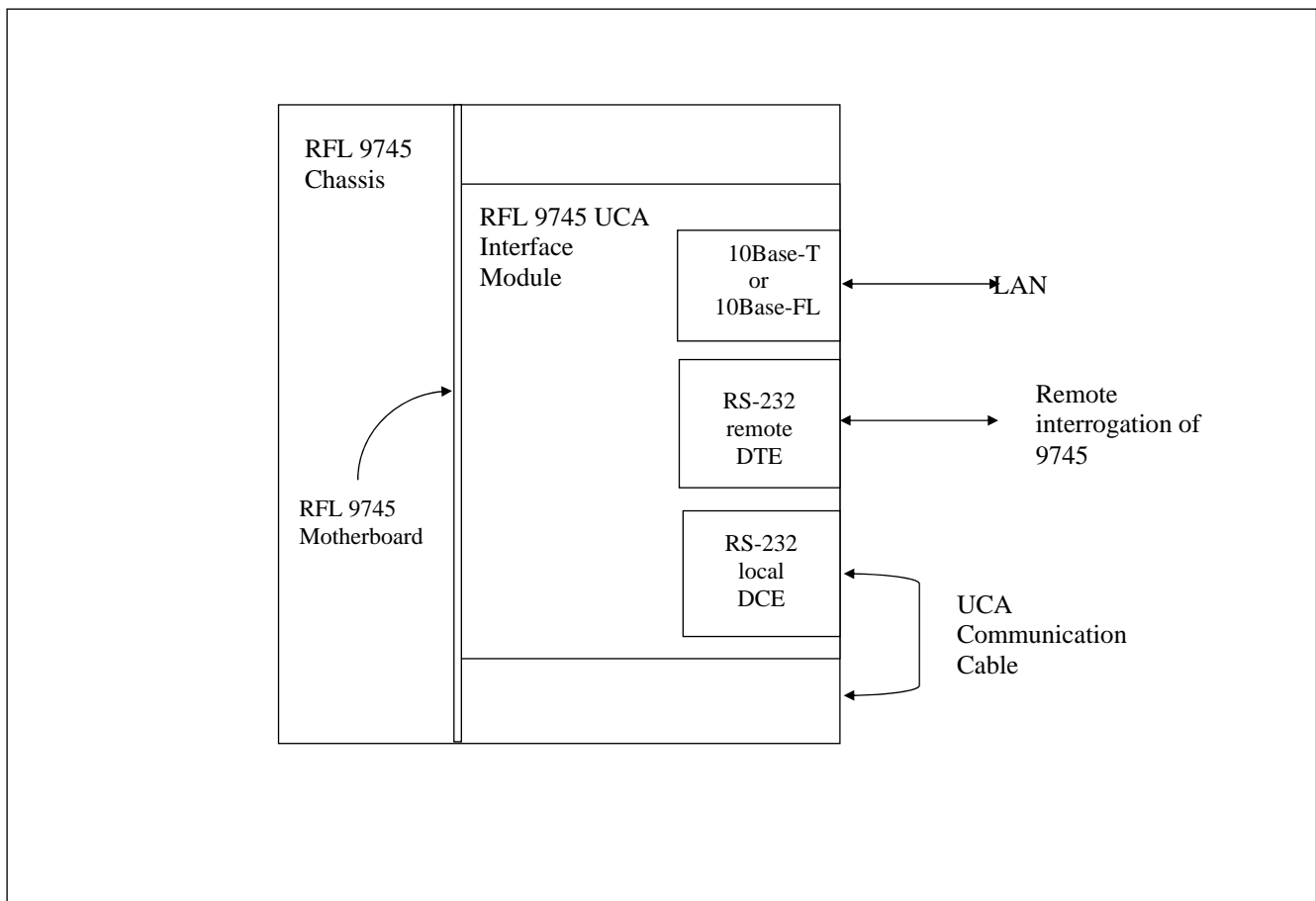


Figure 10-2. Hardware connections between the 9745 and the 9745 UCA Interface module

10.3 RS-232 CABLE CONNECTIONS

RS-232 cables are needed for the connection between the RFL 9745 UCA Interface module and the RS-232 Com port on the RFL 9745 rear panel, and from the RFL 9745 UCA Interface module to the DTE or DCE equipment. These cables are shown in Figures 10-3 through 10-5.

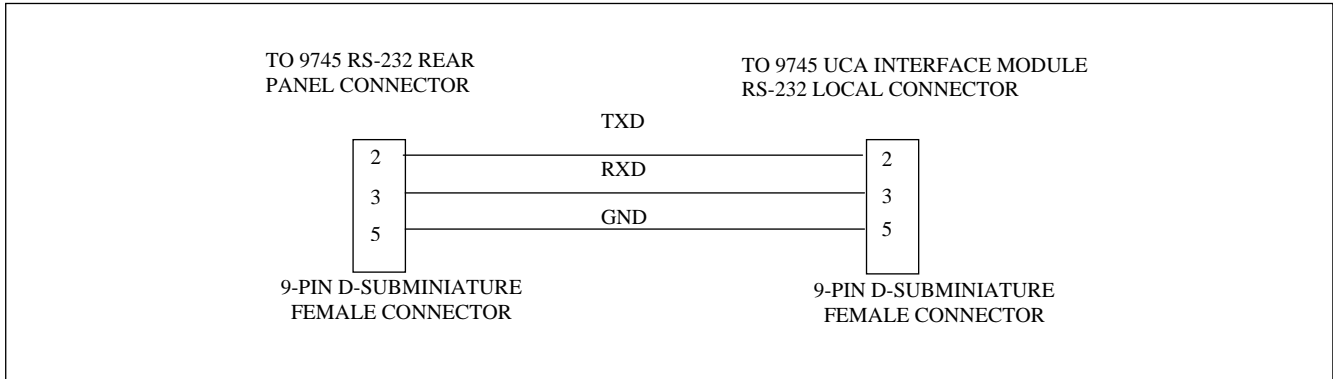


Figure 10-3. Cable between RFL 945 chassis and RFL 9745 UCA Interface Module

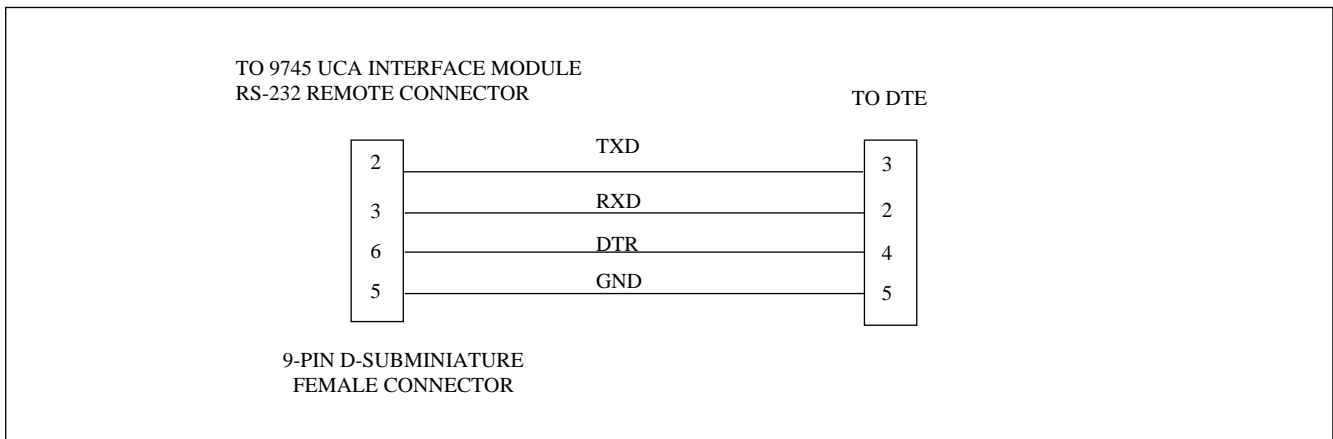


Figure 10-4. Cable between RFL 9745 UCA Interface module and remote port DTE equipment

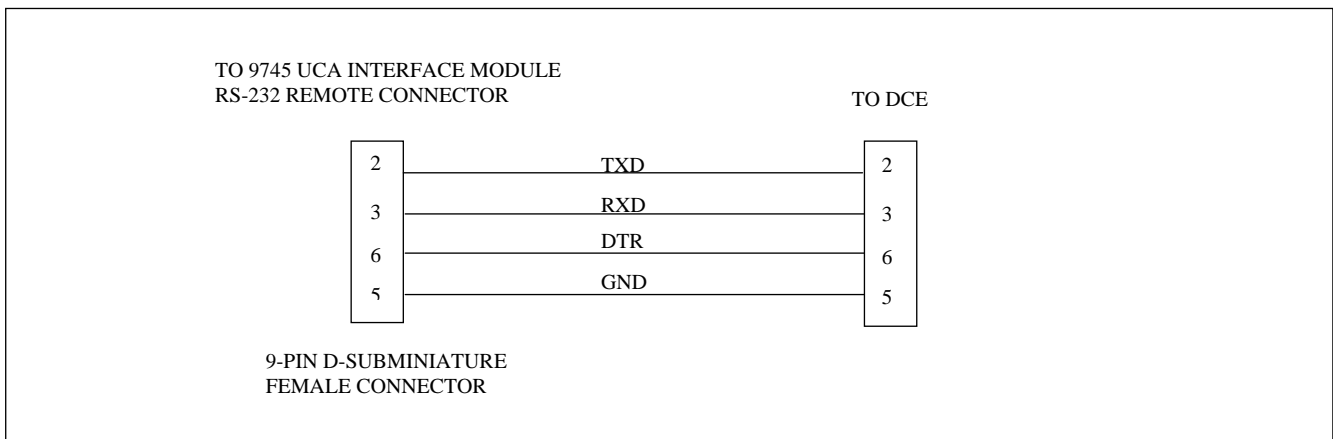


Figure 10-5. Cable between RFL 9745 UCA Interface module and remote port of DCE equipment

10.4 IP CONFIGURATION

UCA communication uses the Internet Protocol (IP). The RFL 9745 UCA Interface module gets its IP address from the 9745 through the serial RS-232 com port. Therefore the IP address is static and must be configured using the 9745's APRIL interface. The 9745 UCA Interface module does not support DHCP. The IP address can be modified only with 9745 firmware version 5.0 or later. To do this, connect a PC or laptop to the 9745's serial communications port. When you get a prompt enter the programming menu by typing P, and then enter the password. To change parameter 059 (IP address) type 059 and then type the IP address in dotted decimal form ([0-255].[0-255].[0-255].[0-255]). Once the 9745 accepts the new IP address you must save the changes by typing SV. Once the change is saved the UCA board will realize it and reboot. For a more detailed description of the APRIL interface consult the 9745 manual.

If during the boot process the communication link between the UCA interface and the 9745 fails the IP address of 111.111.111.151 is used by default. If more than one UCA interface in the network defaults to that IP address both may cease to function properly.

The default gateway IP address is changed via the built-in configuration Web server. The subnet mask is always 255.255.255.0 (Class C), and is not user configurable. See paragraph 10.8.2 for information on how to change the default gateway IP address. You must reboot the remote unit via the web server (paragraph 10.8.6) or by cycling power locally before the change is effective.

10.5 PORT REPLICATION

The RFL 9745 has two communication ports. One is in the front of the chassis and one in the rear. The rear port is connected to the “local” port on the UCA interface. When the front port is in use it overrides the rear port and therefore will stop all serial communication to the UCA interface. The “remote” port is a replication of the 9745’s rear port. If the “remote” com port is active the port will communicate with the 9745’s rear port through the UCA interface. This also stops the UCA interface from communicating with the 9745. The front port of the 9745 still has the highest priority.

10.6 UCA PARAMETERS

The 9745 UCA parameters can be accessed through the LAN by utilizing a UCA based software package. The 9745 Analog UCA Model variables cross-reference table is shown in Table 10-2.

10.7 FILE MANAGEMENT

The UCA interface supports a limited number of file transfer services. Supported services are the read (download) and write (upload) services. File delete, rename and directory are **not** supported.

10.7.1 SYSTEM FILE UPLOAD/DOWNLOAD

New versions of software for the RFL UCA Interface module can be uploaded remotely. You must use a fully qualified path i.e. “C:\rfl.exe” to read or write a system file. The old system file remains in effect until the UCA interface is rebooted. To update your code use the following basic procedure:

NOTE

This procedure will vary depending on the UCA file transfer software you use. (Object Explorer’s File Transfer Utility, etc.)

- Step 1. Obtain a copy of the new “RFL.EXE” file.
- Step 2. Using a web browser logon to the UCA interface’s web server, and enable file download.
(You can leave the web browser open for use in the last step)
- Step 3. Use your UCA file transfer software to send the file to the corresponding device’s C:\ directory.
- Step 4. Using the web browser, reboot the device.

10.7.2 SEQUENCE OF EVENTS DOWNLOAD

You can download the 9745's sequence of events using the same file transfer utility. When reading a file from the UCA interface, file download should not be enabled via the web server. The sequence of events file gets updated whenever the file download request happens. Hence the file transfer may seem to be longer than expected, but that is due to the limitation in the 9600 baud serial port. See Table 10-1 for a list of the downloadable Sequence of Events files.

Table 10-1. Downloadable sequence of events files

File Name	Description
soe_all	This contains all the events in detail.
soe_dir	This contains the directory of events.
1 through 100	These contain the individual events by number.

10.8 USING THE BUILT-IN WEB SERVER

Every UCA interface has a built-in web server for configuration. The IP address must already be known for the web server to function. The web may be used while the unit is using the default IP address, however it must be the only one on the network using the default IP address. You can use any HTML browser (Netscape Navigator or Internet Explorer) to view and use the web server. To access it type `http://{IP_address}` in the location or address field of your browser, where {IP_Address} is the IP address of the unit you want to configure. You will need to enter the Administrator password.

NOTE

The units are shipped with a default Administrator password of “rfl”.

Once you’ve entered the password you will see a welcome page. Click on the Continue button. You are now presented with the following options:

- Change Administrator Password
- Gateway IP Address
- NSAP Address
- GOOSE Transmit Parameters
- GOOSE Receive Parameters
- Enable Download
- Reboot

Each option will be discussed in the following paragraphs. Illustrations of most pages are shown in Figures 10-6 through 10-15 towards the end of this section. These illustrations are what you would see using Netscape Navigator. Your browser may have a slightly different appearance.

10.8.1 CHANGING ADMINISTRATOR PASSWORD

This option is used to change the Administrator password. The passwords are case sensitive and only have a minimum length of 1 character. Valid characters are [A-Z], [a-z], and [0-9]. Passwords are case sensitive. You will need to enter the new password twice. Once the password is entered the change is effective immediately.

10.8.2 CHANGING GATEWAY IP ADDRESS

This option is used to change the default gateway IP address. See section on IP configuration for more information on the gateway IP address. To change the Gateway IP address click on this option, enter the new address in the form field, and then click on done. The change only takes effect if the unit is rebooted.

10.8.3 CHANGING NSAP ADDRESS

This option is used to change the NSAP address, which is used for GOOSE messages. To change it, click on this option, enter the new NSAP address in the form field, and then click on done. The change only takes effect if the unit is rebooted.

10.8.4 CHANGING GOOSE TRANSMIT PARAMETERS

This option is used to change the GOOSE Transmit parameters. The user configurable settings are the multicast MAC address each packet is addressed to, and the IED. To change the parameters, click on this option, enter the new value in the form field, and then click on done. The change only takes full effect if the unit is rebooted.

10.8.5 CHANGING GOOSE RECEIVE PARAMETERS

This option is used to change the GOOSE Receive parameters. These parameters are used to map GOOSE inputs to the 9745 Trip Inputs. The user configurable settings are the multicast MAC address and the IED each Trip Input is “listening to”. The DNA index is selectable from 1-32. The bitpair value which sets each input to active or inactive can be set to 00, 01, 10, or 11. To change the parameters, click on this option, enter the new value in the form field, and then click on done. The change only takes effect if the unit is rebooted. Refer to Figure 10-13 for Goose Receive Parameters Setup.

10.8.6 ENABLE DOWNLOAD

The UCA interface supports UCA File services that write to the UCA interface itself. Certain system files cannot be overwritten until the download is enabled via the web. This adds password protection to the upload feature. To enable the upload, click on this link and then you will get an “Are you sure?” page to make sure you want to upload system files.

NOTE

System files uploaded in this manner are not effective until the next reboot.

10.8.7 REBOOT

This option is used to reboot the UCA interface’s computer. Here too you will get an “Are you sure?” question page. Once you confirm your intent to reboot, the unit will reboot after a delay of 2 seconds. The time it takes for the unit to reboot varies from unit to unit, but should not take longer than 1 minute.

Once you reboot you will have to re-enter the web server by typing the IP address of the unit in the location or address field of the browser. You will also have to enter the password again.

10.9 ILLUSTRATIONS OF THE UCA CONFIGURATION WEB SERVER

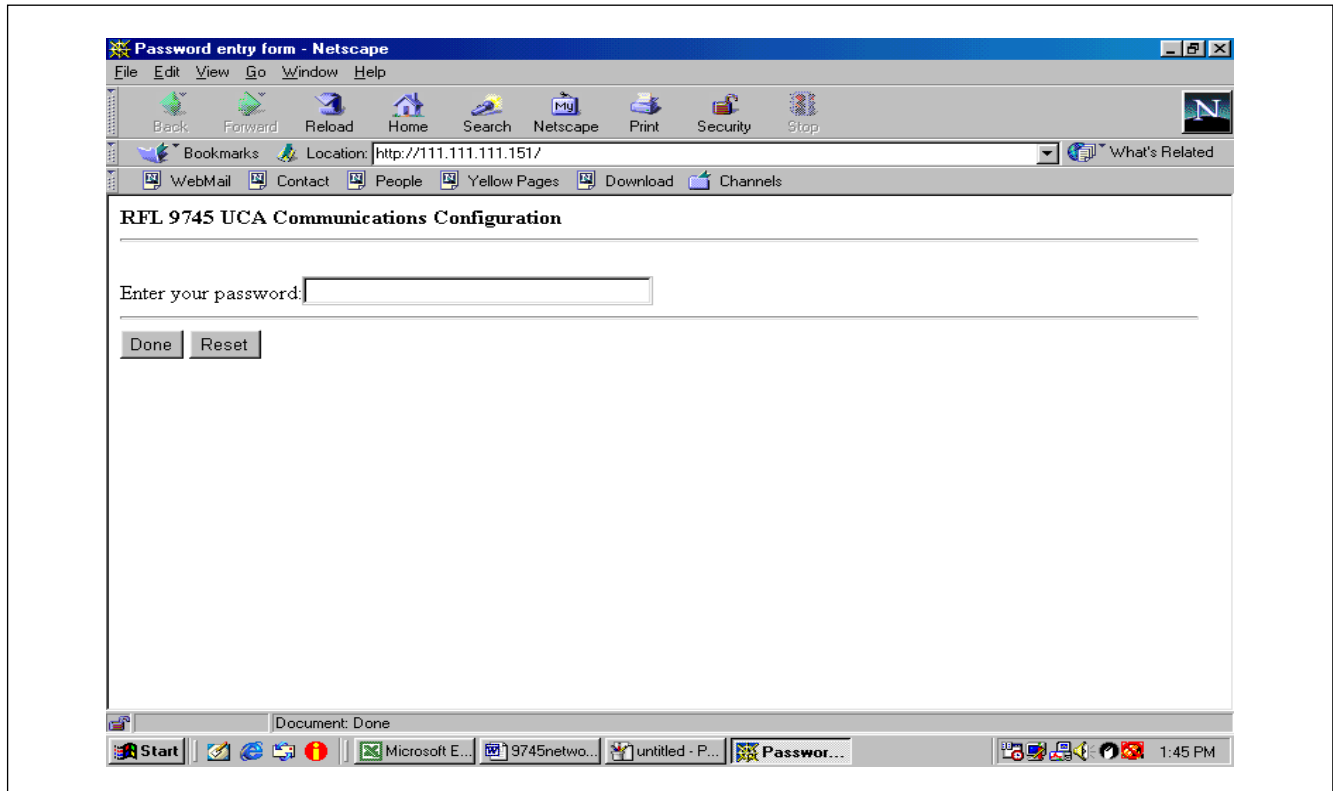


Figure 10-6. Password entry

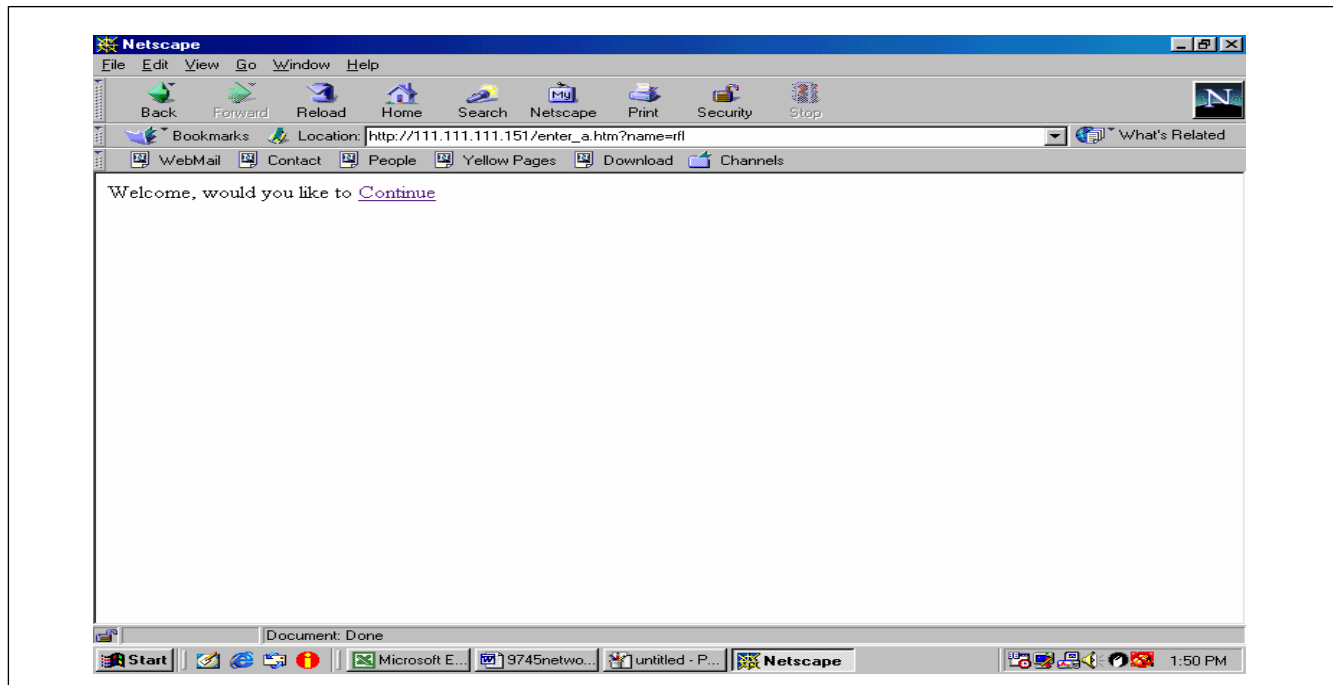


Figure 10-7. Welcome page

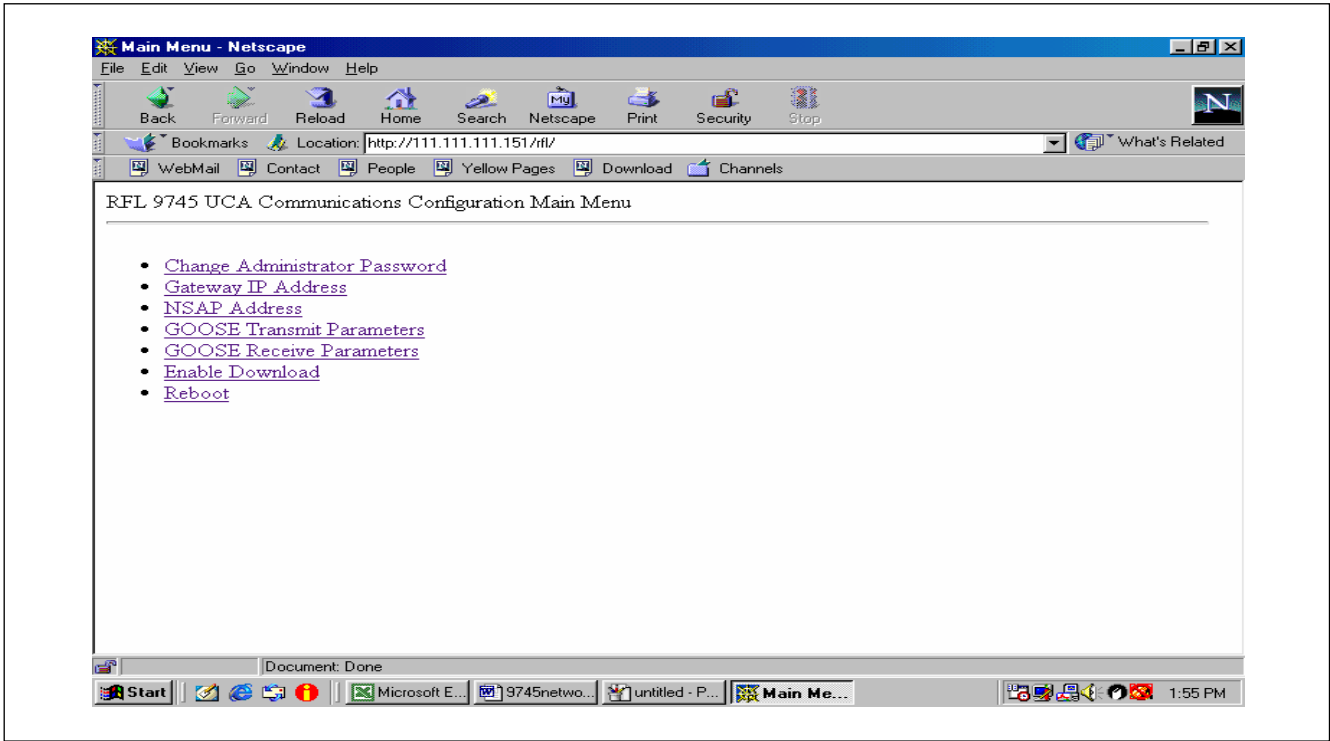


Figure 10-8. Main Menu

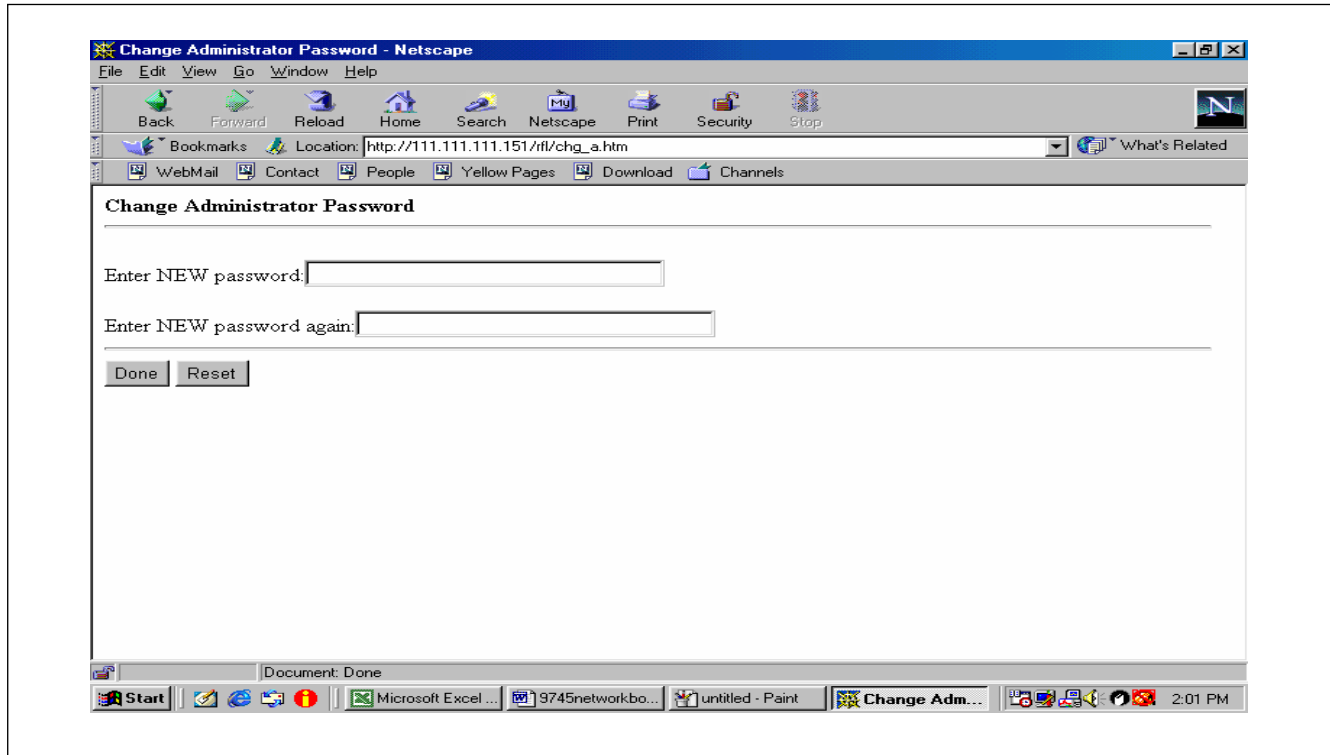


Figure 10-9. Change Administrator

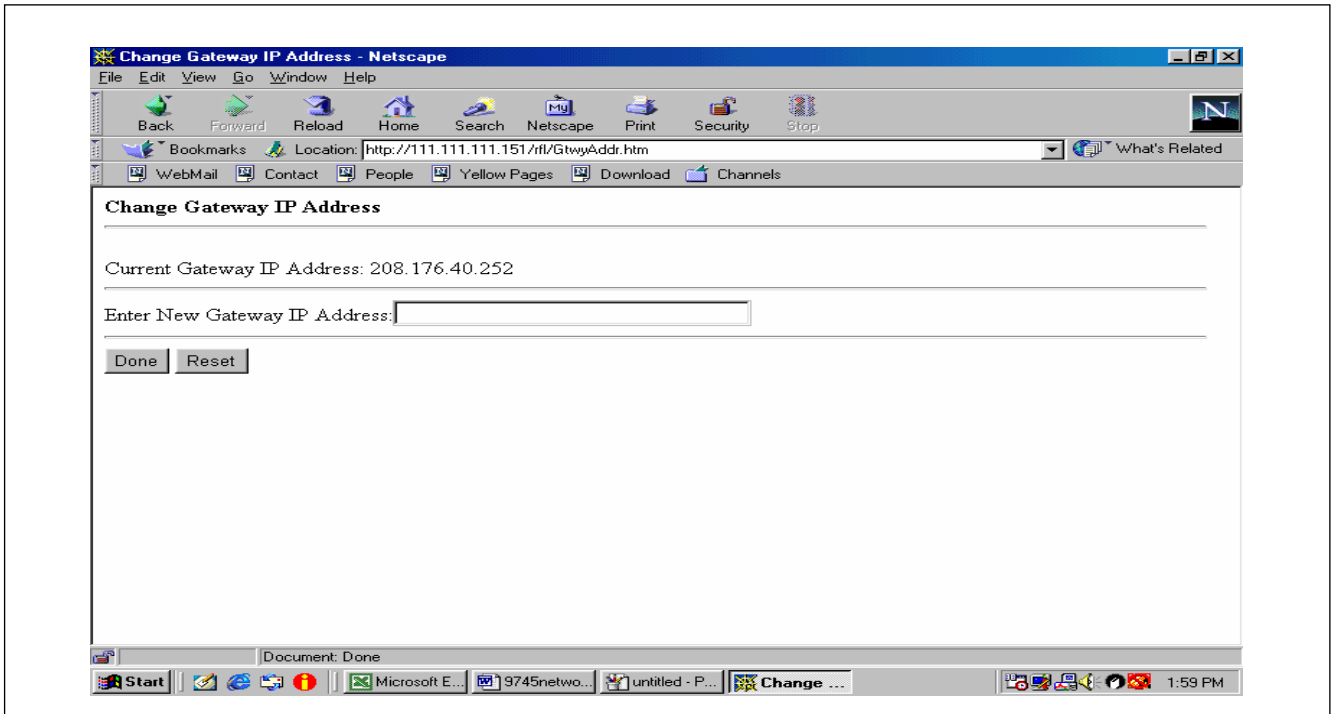


Figure 10-10. Change Gateway IP Address

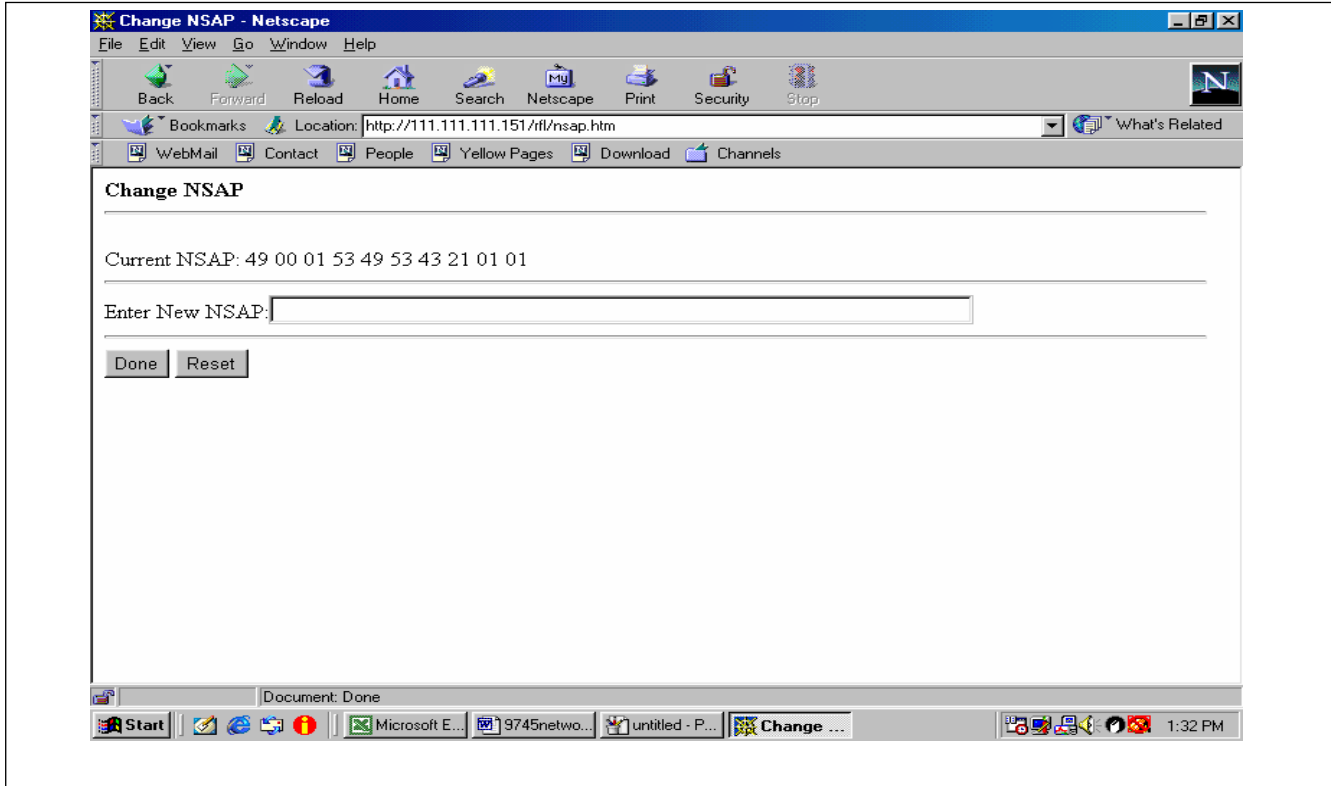


Figure 10-11. Change NSAP Address

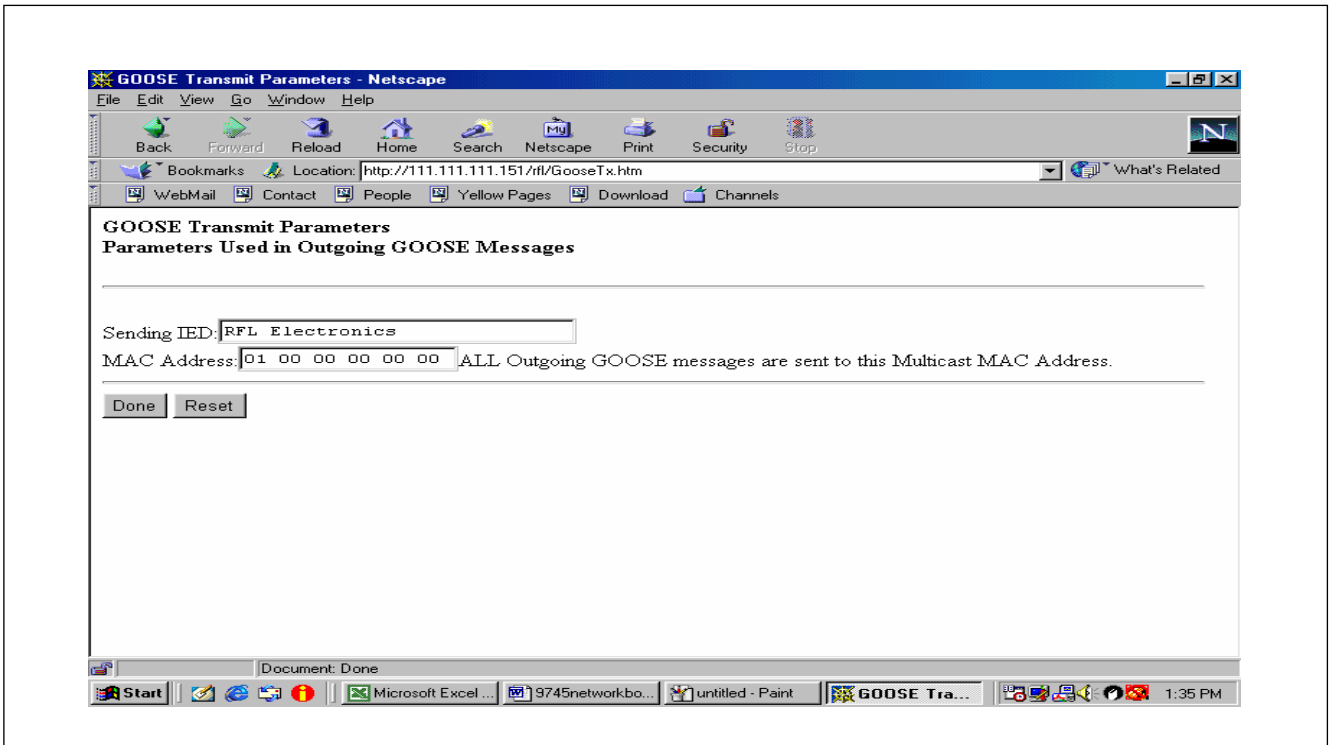


Figure 10-12. GOOSE Transmit Parameters Setup

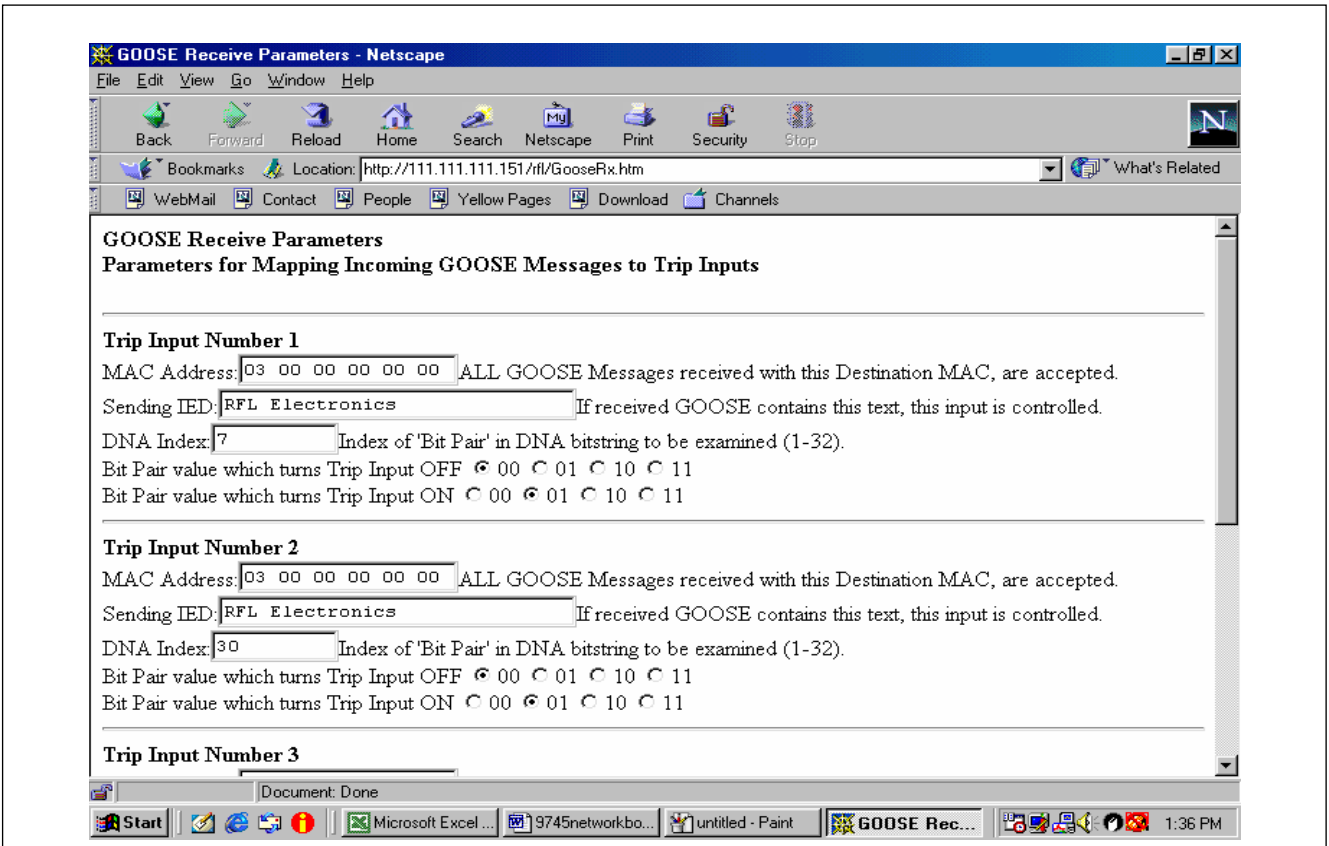


Figure 10-13. GOOSE Receive Parameters Setup

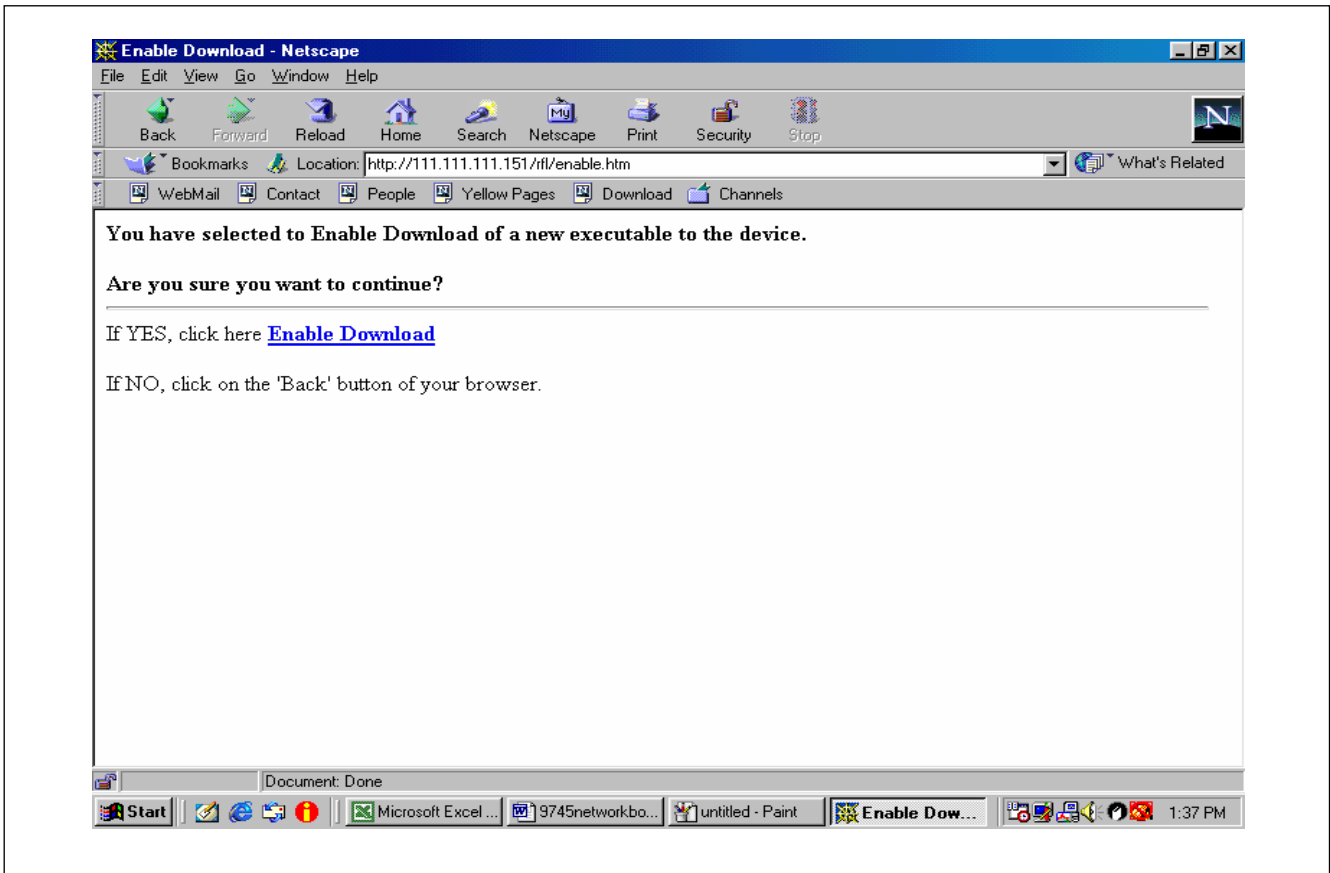


Figure 10-14. Enable Downloading files to the 9745

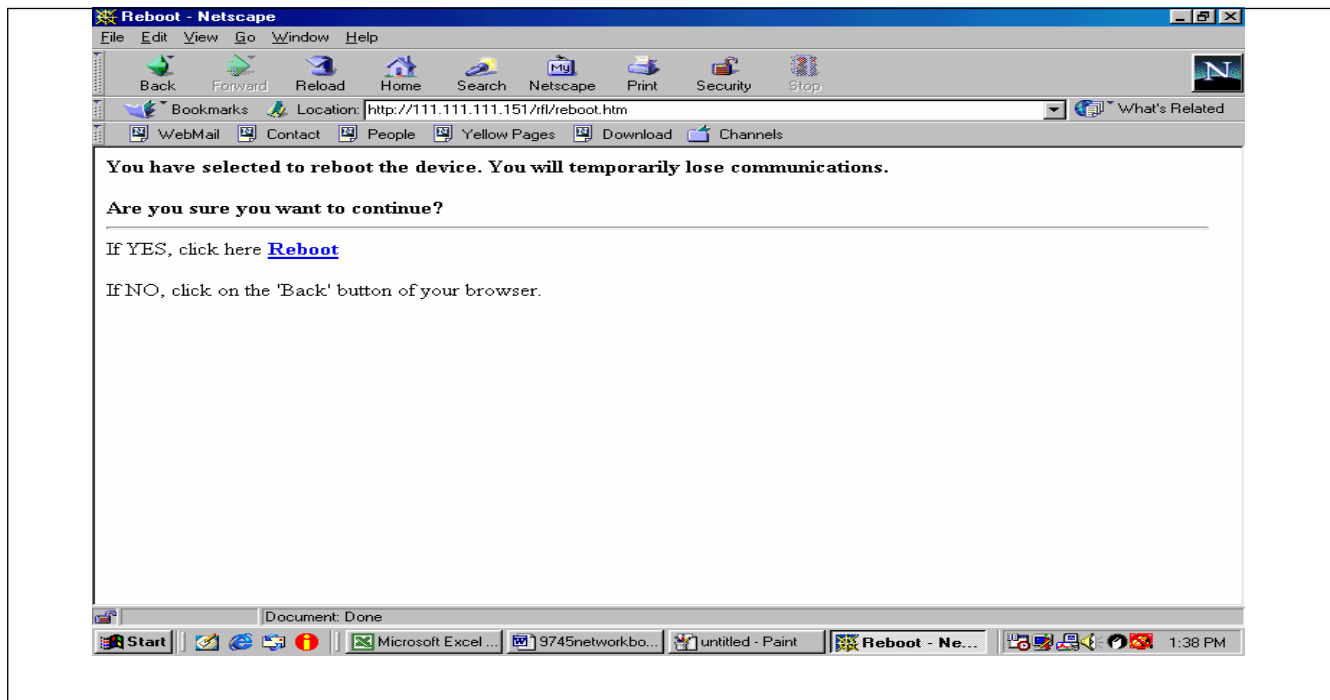


Figure 10-15. Reboot the 9745

Table 10-2. 9745 Analog UCA Model

Functional Category	Object Name	Class	Read/Write	Description
MX	TxChanDelay	FLT32	r	Transmit channel delay
MX	NextAutoTest	VSTR64	r	Time to next auto test
MX	RxChanDelay	FLT32	r	Receive channel delay
MX	LastResetDate	VSTR64	r	Date of last log reset
MX	CumOutageTime	VSTR64	r	Cumulative outage time
MX	CurrentTime	VSTR64	r	Current time
MX	Input1A	INP_OUTP	r	State of input 1A
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Input1B	INP_OUTP	r	State of input 1B
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Input2A	INP_OUTP	r	State of input 2A
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Input2B	INP_OUTP	r	State of input 2B
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Input3A	INP_OUTP	r	State of input 3A
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Input3B	INP_OUTP	r	State of input 3B
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Input4A	INP_OUTP	r	State of input 4A
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Input4B	INP_OUTP	r	State of input 4B
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Output1A	INP_OUTP	r	State of output 1A
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset

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Table 10-2- continued. 9745 Analog UCA Model

Functional Category	Object Name	Class	Read/Write	Description
MX	Output 1B	INP_OUTP	r	State of output 1B
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Output 2A	INP_OUTP	r	State of output 2A
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Output 2B	INP_OUTP	r	State of output 2B
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Output 3A	INP_OUTP	r	State of output 3A
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Output 3B	INP_OUTP	r	State of output 3B
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Output 4A	INP_OUTP	r	State of output 4A
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	Output 4B	INP_OUTP	r	State of output 4B
	Status	BSTR2	r	Input/output current state
	NumTrigger	INT32U	r	I/O state changes since reset
MX	RcvdSignalLvl	VSTR64	r	Received signal level
MX	TxFUNCTION	BSTR2 [4]	r	State of TX function (1-4)
MX	TxSquelch	BSTR2 [4]	r	State of TX squelch (1-4)
MX	RxHighFreq	BSTR2 [4]	r	Rx high frequency (chan 1-4)
MX	RxLowFreq	BSTR2 [4]	r	Rx low frequency (chan 1-4)
ST	CommsCPUErr	BSTR2	r	CPU error
ST	Bus error	BSTR2	r	Bus error
ST	LeftPSLowV	BSTR2	r	left PS fail

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Table 10-2- continued. 9745 Analog UCA Model

Functional Category	Object Name	Class	Read/Write	Description
ST	RightPsLowV	BSTR2	r	right power supply fail
ST	BatteryLow	BSTR2	r	Clock battery fail
ST	AddressFailure	BSTR2	r	Address test failure
ST	ChannelDelay	BSTR2	r	Channel delay exceeded
ST	FailToTripA	BSTR2 [4]	r	Output closed, no current
ST	FailToTripB	BSTR2 [4]	r	Output closed, no current
ST	OutputShortedA	BSTR2 [4]	r	Output open, current sensed
ST	OutputShortedB	BSTR2 [4]	r	Output open, current sensed
ST	SignalToNoise	BSTR2 [4]	r	Signal to noise exceeded
ST	FMNoise	BSTR2 [4]		Fm noise exceeded
ST	AMFilter1High	BSTR2 [4]	r	AM filter 1 high exceeded
ST	AMFilter2High	BSTR2 [4]	r	Am filter 2 high exceeded
ST	AMFilter1Low	BSTR2 [4]	r	AM filter 1 low not exceeded
ST	AMFilter2Low	BSTR2 [4]	r	AM filter 2 low not exceeded
ST	LowSignal	BSTR2 [4]	r	Low signal alarm
ST	AnnunceRelay1A	BSTR2	r	Alarm relay 1A state
ST	AnnunceRelay2A	BSTR2	r	Alarm relay 2A state
ST	AnnunceRelay3A	BSTR2	r	Alarm relay 3A state
ST	AnnunceRelay1B	BSTR2	r	Alarm relay 1B state
ST	AnnunceRelay2B	BSTR2	r	Alarm relay 2B state
ST	AnnunceRelay3B	BSTR2	r	Alarm relay 3B state
ST	Annunc1Out	BSTR2	r	Annunciator relay 1 state
ST	Annunc2Out	BSTR2	r	Annunciator relay 2 state
ST	Annunc3Out	BSTR2	r	Annunciator relay 3 state
ST	Annunc4Out	BSTR2	r	Annunciator relay 4 state
ST	Annunc5Out	BSTR2	r	Annunciator relay 5 state
ST	Annunc6Out	BSTR2	r	Annunciator relay 6 state
SG	SystemLabel	VSTR64	rw	Site label
SG	Chan1	ANALOG_CH AN	rw	Channel 1 configuration
	Type	VSTR64	rw	Channel Type
	TxFreq	INT32U (2)	rw	TX Frequencies (hi/low)

>> table continues on next page <<

Table 10-2- continued. 9745 Analog UCA Model

Functional Category	Object Name	Class	Read/Write	Description
	TransmitLevel	FLT 32	rw	TX Level
	BoostLevel	INT16S	rw	Boost Level
	RxFreq	INT32U (2)	rw	RX frequencies (hi/low)
	RxBandwidth	INT16S	rw	RX Bandwidth
	RxLevel	INT16S	rw	RX Level
	RxAlarm	INT16S	rw	RX alarm level
	AMNoise	INT16S	rw	AM Noise Level
	FMNoise	INT16S	rw	FM Noise Level
SG	Chan2	ANALOG_CH AN	rw	Channel 2 configuration
	Type	VSTR64	rw	Channel Type
	TxFreq	INT32U (2)	rw	TX Frequencies (hi/low)
	TransmitLevel	FLT 32	rw	TX Level
	BoostLevel	INT16S	rw	Boost Level
	RxFreq	INT32U (2)	rw	RX frequencies (hi/low)
	RxBandwidth	INT16S	rw	RX Bandwidth
	RxLevel	INT16S	rw	RX Level
	RxAlarm	INT16S	rw	RX alarm level
	AMNoise	INT16S	rw	AM Noise Level
	FMNoise	INT16S	rw	FM Noise Level
SG	Chan3	ANALOG_CH AN	rw	Channel 3 configuration
	Type	VSTR64	rw	Channel Type
	TxFreq	INT32U (2)	rw	TX Frequencies (hi/low)
	TransmitLevel	FLT 32	rw	TX Level
	BoostLevel	INT16S	rw	Boost Level
	RxFreq	INT32U (2)	rw	RX frequencies (hi/low)
	RxBandwidth	INT16S	rw	RX Bandwidth
	RxLevel	INT16S	rw	RX Level
	RxAlarm	INT16S	rw	RX alarm level
	AMNoise	INT16S	rw	AM Noise Level
	FMNoise	INT16S	rw	FM Noise Level
SG	Chan 4	ANALOG_CH AN	rw	Channel 4 configuration
	Type	VSTR64	rw	Channel Type
	TxFreq	INT32U (2)	rw	TX Frequencies (hi/low)

>> table continues on next page <<

Table 10-2- continued. 9745 Analog UCA Model

Functional Category	Object Name	Class	Read/Write	Description
	TransmitLevel	FLT 32	rw	TX Level
	BoostLevel	INT16S	rw	Boost Level
	RxFreq	INT32U (2)	rw	RX frequencies (hi/low)
	RxBandwidth	INT16S	rw	RX Bandwidth
	RxLevel	INT16S	rw	RX Level
	RxAlarm	INT16S	rw	RX alarm level
	AMNoise	INT16S	rw	AM Noise Level
	FMNoise	INT16S	rw	FM Noise Level
SG	OptStatusBoard	VSTR64	rw	Status board present?
SG	EEPotJ10		VSTR64	rw
SG	ChanDelay Alarm	INT16S	rw	Max chan delay time setting
SG	Year		VSTR64	rw
SG	Date		VSTR64	rw
SG	Time		VSTR64	rw
SG	HourAdjust	INT16S	rw	Hours from GMT
SG	Local Address	INT16U	rw	Transmit address
SG	Remote Address	INT16U	rw	Receive address
SG	ResetLog		VSTR64	rw
SG	FMAAlarmTC	FLT32	rw	FM alarm time constant
SG	FMUpperThresh	FLT32	rw	FM upper threshold
SG	AMUpperThresh	INT16S	rw	AM upper threshold
SG	AMLowerThresh	INT16S	rw	Am lower threshold
CO	DisableTxOfFunction	VSTR64	rw	Disable TX Func.on front panel
CO	OperationsSinceReset	VSTR64	r	Operations Since Reset
CO	CumulativeOutageTime	VSTR64	r	Cumulative Outage Time
CO	TestResetOnFrontPanel	VSTR64	rw	Test Reset On Front Panel
CO	AutoTests	VSTR64	rw	
CO	TimeBetweenTests	VSTR64	rw	Time Between Tests
CO	NextTestStart	VSTR64	rw	Next Test Start
CO	TestRunSinceReset	VSTR64	r	Test Run Since Reset
CO	TestsPassed	VSTR64	r	Tests Passed
CO	TestsFailed	VSTR64	r	Tests Failed

>> table continues on next page <<

Table 10-2. - continued. 9745 Analog UCA Model

Functional Category	Object Name	Class	Read/Write	Description
CO	RunAutoTest	VSTR64	r	Run Auto Test
CO	RunPingPongTest	VSTR64	r	Run Ping Pong Test
CO	ResetLog	VSTR64	rw	Reset test Log
CF	SoftwareID	VSTR64	r	Software ID number
CF	BiosID	VSTR64	r	Bios software ID number
CF	SystemDate	VSTR64	r	System software Date
CF	BiosDate	VSTR64	r	Bios software Date
CF	PrimitiveID	VSTR64	r	Primitive logic ID
CF	AlarmLogicID	VSTR64	r	Alarm Logic ID
CF	AnnounceOutputs	VSTR64	r	Annunciator Outputs
CF	Channel11	VSTR64	r	Channel type
CF	Channel12	VSTR64	r	Channel type
CF	Channel13	VSTR64	r	Channel type
CF	Channel14	VSTR64	r	Channel type
RP	brcbMX	BasRCB	rw	
RP	brcbST	BasRCB	rw	

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Section 11. GLOSSARY OF TERMS

10 Base-T	An ethernet local area network which works on twisted pair cable.
10 Base-FL	An ethernet local area network which works on a fiber link.
Address	A unique designation assigned to each RFL 9745 terminal. Addresses are used to identify RFL 9745 terminals during tests.
Adjacent Channel Rejection	An indication of channel separation. For example, the RFL 9745 is rated for an adjacent channel rejection of 40 dB. If the in-channel signal is at -40 dBm, a 0-dBm signal on an adjacent channel will not cause interference.
Alarm Logic Table	A list of logic decisions made by the RFL 9745 to produce its alarm outputs. It is set at the factory according to the default logic diagram supplied with the equipment. (See Section 2 for more information.)
Alarms Display	A display screen that shows the current status of all RFL 9745 alarms.
AM Noise	Unwanted amplitude modulations on a communications channel, usually caused by static, atmospheric conditions, or similar causes.
Amplitude Stability	An indication of how much the transmit level can be expected to vary due to temperature variations, input voltage variations, and other factors.
AND Gate	A logic primitive with two inputs and one output. If both inputs are true, the output is true. If either input is false, the output is false.
Annunciator Output	An output that can be programmed to indicate an alarm condition has occurred. Each annunciator output is a set of relay contacts that can drive external equipment.
APRIL	An acronym for <u>A</u> synchronous <u>P</u> rogramming and <u>R</u> emote <u>I</u> nterrogation <u>L</u> anguage. This is the language used by the RFL 9745 to communicate with a PC or terminal through its RS-232 ports.
Attack	A timer parameter that controls how long it will take the timer's output to go true after its input goes true.

Auto Test	An RFL 9745 test that is automatically initiated at set intervals.
Autotest Complete	The “Autotest Complete” parameter can be either Active or Inactive. It is set inactive upon bootup or when there is an outage, as defined in the alarm logic. It is set active at the completion of any attempt to run an Autotest, whether or not the test finished or ran successfully. Once active, it stays active until the next bootup or outage.
Autotest Timeout	The “Autotest Timeout” parameter can be either active or inactive. It is set active when an autotest fails to complete within a specified time. This could be caused by a misconnection or degraded communication between 9745s. When it is set inactive, the autotest completed, whether or not it passed. For example, if an address test has been run, and the wrong address returned, the “Autotest Timeout” parameter will be set to inactive, even though the “Address Test Fail” parameter is active.
Bandwidth	The distance between 3-dB points for a channel; signals outside the bandwidth will be attenuated.
Baud Rate	An indication of how fast data can be sent through the RFL 9745's RS-232 port. Five different settings are possible in the RFL 9745: 300 baud, 1200 baud, 2400 baud, and 9600 baud and 19,200.
BER	Abbreviation for "bit error rate," is the ratio of error bits to transmitted bits in a digital communication system.
Blocking	Directional Comparison Relaying System, utilizing communications, primarily on/off powerline carrier, to prevent circuit breaker tripping for faults located external to the protected line.
Boost	An RFL 9745 operating feature that forces the transmit level to increase by a set amount for a specified time interval when the output shifts to its trip frequency. Also called "Trip Boost."
Boost Timer	A timer that keys the transmitter to increase by a set amount for a specified time interval when the output shifts to its trip frequency.
Bus	A data path shared by several devices or modules, such as an address bus or data bus.
Bus Error	An error that has occurred involving one of the RFL 9745's buses.

CCITT	Abbreviation for Consultative Committee for International Telegraph and Telephone.
CCITT G.703	CCITT Recommendation for the physical and electrical characteristics of hierarchical digital interfaces.
Center Frequency	The nominal output frequency for an FSK channel; frequencies will be shifted above and below this frequency in equal amounts (± 30 Hz, ± 60 Hz, etc).
Channel	A path for transmission between two RFL 9745 terminals; may be a telephone line, a fiber optic cable, or a direct digital link.
Channel Propagation Delay	The amount of time it takes a signal to pass from one terminal to another.
Channel Setup	The act of setting the RFL 9745's programmable parameters for the customer's requested configuration. This is usually done at the factory, but it can also be done by using the information on Section 5 of this manual.
Channel Spacing	The amount of separation between the center frequencies of adjacent channels. For example, three channels with center frequencies of 1500 Hz, 1620 Hz, and 1740 Hz have a channel spacing of 120 Hz.
Checkback Testing	A testing method where a test signal is sent from one terminal to another. The receiving terminal sends the signal back to the transmitting terminal. If the received signal matches the transmitted signal, the checkback test is successful.
Clear To Send (CTS)	An RS-232 signal; indicates the DTE may begin transmitting.
Command Extend Timer	A timer that keeps a command output high for a specific interval, even if the command input ceases to exist.
CPU	Abbreviation for Central Processing Unit.
CPU Error	An error that has occurred involving the Central Processing Unit.
CRC	Abbreviation for Cyclic Redundancy Check, which is a code used to guarantee the accuracy of the 15-bit digital word.
Cumulative Outage	A display of the total amount of outage time (in seconds) since the last time the RFL 9745 was reset.

Data Bit	A logic one or zero; the smallest unit of information. In the RFL 9745, eight data bits are in each data word.
Data Rate	An indication of how fast the RFL 9745 can send signals, expressed in bits per second (bps).
Data Terminal Ready (DTR)	An RS-232 signal; indicates the DTE is ready for data transmission.
DB-25	A 25-pin D-subminiature connector.
DB-9	A 9-pin D-subminiature connector.
DCE	Data Communications Equipment
Decay	A timer parameter that controls how long the timer's output will remain true after its input goes false.
Default Logic	The logic decisions stated in the logic tables when the RFL 9745 left the factory. Can be used to return the RFL 9745 to its factory-default configuration.
Dependability	A measure of the ability of communications equipment to output valid trip signals in the presence of channel interference.
DHCP	Dynamic Host Configuration Protocol
Direct Transfer Trip (DTT)	The ability of a communications receiver to trip a circuit breaker directly and without the supervision of a protective relay.
Directory Of Events	See "Event Log."
DNA Index	Digital Network Architecture Index
DTE	Data Terminal Equipment
Dumb Terminal	A serial ASCII terminal as opposed to a PC with terminal emulation software.
Dynamic Range	See "Receiver Dynamic Range."
Event Log	A register that keeps a running tally of the number of times each function, input, output, and alarm is active. This information can be used to analyze system performance.

Failure Detector	A circuit that constantly monitors a trip output circuit for misoperation. If a misoperation is detected, it will trigger an alarm.
Failure To Trip	An alarm condition created when the logic indicates that a trip output should be active, but less than 150 ma is sensed through the contacts.
FIO	Abbreviation for Fiber Input/Output.
Flash Timer	A timer that keys the transmitter to rapidly switch between trip and guard frequencies when a valid trip input is received.
Flow Control	A method of controlling the transfer of data from one terminal to another to prevent loss of data when the receiving device's buffer is almost filled.
FM Noise	Unwanted frequency modulations on a communications channel, usually caused by static, atmospheric conditions, or similar causes.
Frequency Shift Keying (FSK)	A modulation technique in which one frequency indicates guard, and another frequency indicates trip.
FUNCTION Indicators	A group of eight LED indicators on the RFL 9745's front panel that show the status of the four tone channels. These indicators are normally programmed to light when a trip frequency is being transmitted or received.
GOOSE	Generic Object Oriented Substation Event
Guard	A tone or signal that is produced whenever the system is functioning normally (no trips, no active alarms).
Handshaking	A protocol used by RS-232 devices to establish connections. The RFL 9745 uses "XON/XOFF" handshaking, which is also called "software handshaking."
High Signal	An alarm condition created when an incoming tone is above a preset limit.
HTML	Hypertext Markup Language
IED	Intelligent Electronic Device

I/O Menu	A menu that lists information about the current status of each RFL 9745 input, output, and annunciator output. Viewed by pressing front-panel I/O switch.
I/O Module	An RFL 9745 subassembly that is installed at the rear of the chassis and has connectors or terminal blocks for making connections to external equipment.
IP Address	Internet Protocol Address
IRIG-B	A standard time code developed by the Inter-Range Instrumentation Group (IRIG) , Format B, is utilized in the RFL 9745.
Jitter	A tendency towards the lack of synchronization of digital pulses over a transmission medium.
Kbps	An abbreviation for "1,000 bits per second."
LAN	Local Area Network
Last Reset Date	The time and date that the system was last reset.
Latch	A logic primitive with two inputs (SET and RESET) and one output. If the SET input goes true, the output goes true unless the RESET input is false.
Leased Line	A telephone line reserved for the exclusive use of a leasing customer, with no inter-exchange switching arrangements. Leasedlines may be point-to-point or multipoint.
LEVELS Menu	A menu that lists information about transmit and receive levels, and channel delay measurements. Viewed by pressing front-panel LEVELS switch.
Lock-Out	A mode the RFL 9745 enters if the wrong password is entered after three tries. This mode will last about five minutes. During lock-out no one will be able to enter the mode that triggered the lock-out.
LOG Menu	A menu that lists information about how many times each significant vent in RFL 9745 operation has occurred since the last system reset. Viewed by pressing front-panel LOG switch.
Logic Programming	An RFL 9745 mode during which the RFL 9745's logic table can be tailored to suit a specific application.

Logic Table	See "Alarm Logic Table" and "Primitive Logic Table."
Low Signal	An alarm condition created when an incoming tone is below a preset limit.
MAC	Medium Access Control
Main Menu	A list of APRIL commands or parameters that allows an operator to enter any of the RFL 9745's operating modes.
Menu	A list of commands or parameters that will appear on a terminal or PC screen when communicating with the RFL 9745 using APRIL.
Microwave	A general term used to describe high-frequency point-to-point radio communications. For utility applications, microwave generally operates between 2 GHz and 23 GHz.
Modem	An abbreviation for " <u>mo</u> dulator/ <u>de</u> modulator;" a device that converts serial digital data into an audio signal for transmission over telephone lines, and converts incoming audio signals back into digital data.
Module	An RFL 9745 subassembly that is installed behind the door at the front of the chassis, or plugs into the rear of the chassis.
Next Auto Test	The amount of time until the next scheduled test will occur.
Node	Connection point (Gate) in a logic table, a node is "driven" by a gate or operator. A logic table has as many nodes as it has lines.
Non-Volatile Storage	Memory devices that are equipped with back-up batteries to retain data in the event of a power failure.
Noise	Unwanted signals on a communications channel, usually caused by static, atmospheric conditions, or similar causes.
NOT Gate	A logic primitive with one input and one output. The output is always the opposite of the input.
NOP Gate	Non operational gate, no inputs or outputs.
NSAP Address	Network Service Access Point Address
Operate Time:	The time from the receipt of a command input to the response of a solid-state output, less any channel propagation time.

Optic Power Budget	The nominal output level produced by the fiber optic module in fiber optic RFL 9745 terminals. For reliable operation, all the losses in the fiber optic line (such as coupling splicing losses, exit losses and fiber attenuation) must not exceed this value.
OR Gate	A logic primitive with two inputs and one output. If both inputs are false, the output is false. If either input is true, the output is true.
Outage	Is defined by the user in the Alarm Logic as a combination of alarm conditions.
Outage Timer Active	The “Outage Timer Active” parameter can be active or inactive depending on how the logic is programmed. The outage timer is a clock which starts when there is an “outage” condition and stops when the “outage” condition clears. The clock increments are: days, hours, minutes, seconds, and milliseconds. An “outage” condition is defined by how the logic table is configured. If a logic table does not have an outage output, the “Outage Timer Active” parameter will always be inactive. It is active if the “outage” logic output is active. This requires programming the alarm logic to include “outage” as one of its outputs. Refer to Figure 2-7 “9745 Audio Default Alarm Logic Diagram” for more information.
Output Short	An alarm condition created when the logic indicates that a trip output should be open, but a current greater than 150 mA is being sensed through its contacts.
Parity	Additional bits added to a data word to permit detection of single errors. (The RFL 9745 does not use parity bits.)
Password	A character string that must be entered before the RFL 9745 will grant a user access to a particular operating mode or menu display.
Permissive Transfer Trip (PTT)	The communications receiver trip output and the operation of a protective relay are both required to trip a circuit breaker.
Ping-Pong	A test that measures channel delay by sending a signal and timing how long it takes to receive it back.
PLL	Abbreviation for Phase Locked Loop.
Powerline Carrier	A communication technique in which a protection signal is injected onto the powerline that it is protecting. The line itself serves as the communications medium.

Pre-Trip Timer	A timer that requires a trip input to be received for a specific time period before it is accepted as valid. The pre-trip timer functions as a protection against noise-induced false trips.
Primitive Logic Table	A list of logic decisions made by the RFL 9745. It is set at the factory according to the default logic diagram supplied with the equipment. (See Section 2 for more information.)
Primitives	The basic building blocks that form the RFL 9745's logic table; gates, timers, and latches. (See Section 2 for more information.)
Private Network	A user-owned telephone system, such as the PABX systems used to connect the telephone extensions at many companies.
Programming Mode	An RFL 9745 mode during which parameter settings can be viewed and changed as required.
PROM	An abbreviation for " P rogrammable R ead- O nly M emory."
Rack Unit (RU)	A unit of vertical rack space, equal to 1.75 inches (4.4 cm). (The RFL 9745 is 5.25 inches high (13.3 cm); this equals 3 rack units.)
Radio	A general term used to describe low-frequency point-to-point radio communications. For utility applications, radio generally operates between 400 MHz and 1 GHz.
Read Settings	An RFL 9745 mode during which parameter settings can be viewed but not changed.
Receive Channel Delay	The amount of time it takes a receive signal to pass from one RFL 9745 to another; usually half the channel round trip delay, assuming the transmit and receive delays are equal.
Receiver	An RFL 9745 terminal that is configured to receive but not transmit.
Receiver Dynamic Range	The difference between the lowest and highest input signals that the receiver can accept.
Receiver Sensitivity	The lowest input signal that the receiver can accept and reliably produce valid outputs.
Redundant Power Supply	A second power supply module that is installed in the RFL 9745 to supply power in the event the main power supply fails.
Relay Output	An output that is provided by a set of dry relay contacts.

Request To Send (RTS)	An RS-232 signal; indicates that the DTE has data to transmit.
ROM	Abbreviation for Read Only Memory.
RS-232	An EIA standard commonly used to connect data processing devices. DB-25 connectors are usually used for making connections, but DE-9 connectors may also be used. RS-232 is functionally identical to CCITT V.24/V.28.
RS-422	An EIA standard for cable lengths that extends the 50-foot limit imposed by RS-232.
RS-449	An EIA standard for connectors; a companion standard to RS-422.
Security	A measure of the ability of communications equipment to prevent false trip outputs during the presence of channel interference.
Sequence-Of-Events Log	A register that contains information about system events such as trip inputs and alarm outputs. This information is stored in the order the events occurred, and can be used to analyze system performance.
Signal-To-Noise Ratio (S/N Ratio)	An indication of signal quality derived from the signal level divided by the amount of noise on the line. Circuits with high S/N ratio result in better communications than those with low S/N ratios.
SIO	Abbreviation for Serial Input/Output.
Solid-State Output	An output that is provided by an open-collector transistor or a solid-state output module.
Spurious Output	Unwanted frequencies on the communications medium that are by-products of the frequency of interest (such as harmonics).
Squelch	An RFL 9745 function that quiets the tone outputs when no input is being received.
STATUS Menu	A menu that lists information about the RFL 9745's four communications channels and alarm outputs. Viewed by pressing front-panel STATUS switch.
Stop Bit	A data bit that indicates the end of a data word. In the RFL 9745, each data word contains one stop bit.

Superuser Password	A character string that can be entered to gain access to any operating mode or menu display that requires a password. Refer to paragraph 6.4 for more information.
SWC	An abbreviation for Surge Withstanding Circuitry.
System Clock	A clock inside the RFL 9745 that time-stamps and date-stamps all event records. The system clock can be manually set, or connected to an IRIG-B generator for automatic synchronization.
System Label	A name assigned to a particular RFL 9745 terminal. The system label appears on the second line of the main APRIL command list, and also appears on the RFL 9745's front-panel display during normal RFL 9745 operation.
Terminal Emulation Software	A program that permits a personal computer to imitate an ASCII terminal.
Test In Progress	<p>The “Test In Progress” parameter can be either active or inactive. It is active if a checkback test or address test is currently in progress. Both of these tests require a small but finite time to be conducted. It is typically used to prevent tripping when “Test In Progress” is active. As an an example, refer to Figure 2-8 “6750 Audio Default Primitive Logic Diagram”.</p> <p>If the SOE trigger (See paragraph 6.1.3.5) is set to level 1, it is unlikely that the “Test In Progress” parameter will ever be captured as an active event record (See Figure 6-30). If the SOE trigger is set to level 2, Autotests are captured and the “test in progress” parameter will be active in those records.</p>
TEST Menu	A menu that lists information about the RFL 9745's test performance. Viewed by pressing front-panel TEST switch.
Test Mode	An RFL 9745 mode during which RFL 9745 operation can be verified.
Timer	A logic primitive with one input and one output. The output tracks the input after a given time delay.
Timer Parameters	A general term for parameter settings that control RFL 9745 timer performance. (See "Attack" and "Decay.")
Tone	An audio signal used by the RFL 9745 for communication.
Tone Parameters	The programmable parameters that control how the RFL 9745's audio signals are generated and processed.

Transceiver	An RFL 9745 terminal that is configured to transmit and receive.
Transfer Filter	An RFL 9745 operating mode in which the RFL 9745 acts as a filter, accepting an input signal, amplifying and bandwidth-limiting it, and re-transmitting it.
Transmit Channel Delay	The amount of time it takes a transmit signal to pass from one RFL 9745 to another; usually half the channel round trip delay, assuming the transmit and receive delays are equal.
Transmit Level	The amplitude of the signal produced by the RFL 9745's transmitter.
Transmitter	An RFL 9745 terminal that is configured to transmit but not receive.
Transmitter Stability	An indication of how much the output frequency can be expected to vary due to temperature variations, input voltage variations, and other factors.
Trip	A tone or signal that is produced whenever a valid trip input is received.
Trip Boost	An operating feature that forces the transmit level to increase by a set amount for a specified time interval when the output shifts to its trip frequency.
Trip Hold Timer	A timer that keeps the trip output high for a specific interval, even if the trip condition ceases to exist.
UCA	Utility Communications Architecture
Unblocking	A Directional Comparison Relaying System utilizing communications, primarily FSK powerline carrier, to permit circuit breaker tripping for faults located internal to the protected line.
Update Mode	An RFL 9745 mode during which a display screen appears on the user's terminal or PC screen that is constantly updated with current information about RFL 9745 operation. Updates occur about once a second when the RFL 9745 is operating at 2400 baud.
Values Display	A display screen that shows the most recently-measured values for all RFL 9745 measured parameters.
Windows Remote APRIL	An RFL 9745 mode that allows an operator at one RFL 9745 to access the RFL 9745 at the other end of the communications link.

XON/XOFF

The protocol used by the RFL 9745 to establish connections with another RS-232 device; also called "software handshaking."

XOR Gate

A logic primitive with two inputs and one output. If one input is true and the other is false, the output is true. If both inputs are the same (either true or false), the output is false.

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Section 13. ACCESSORY EQUIPMENT AND SYSTEM DRAWINGS

If any accessory equipment was furnished with your RFL 9745 terminal at the time of purchase, information on these items will be found immediately following this page. This may include Instruction Data Sheets, schematics, wiring diagrams, or other documents. Drawings that document the specific make-up of your system are also included in this section.

The following RFL 9745 drawings are included in this section:

Figure	Description	Drawing Number	Revision
13-1	Wiring Diagram, 9745 I/O, Optional Relay	D-105119	E
13-2	Schematic Diagram, 9745 Power I/O, Quad Filter Module	D-105154-1	D
13-3	Schematic Diagram, 9745 Power I/O, Dual Filter Module	D-105154-2	D
13-4	Schematic Diagram, 9745 Power I/O, Filter/Hybrid Module	D-105154-3	D
13-5	Schematic Diagram, 9745 Power Supply 170-300 VDC	D-105934	E
13-6	Schematic Diagram, 9745 Power Supply 19-36 VDC	D-105909-1	C
13-7	Schematic Diagram, 9745 Relay/Solid State I/O	D-105014-1	F
13-8	Schematic Diagram, 9745 Solid State I/O	D-105009	G
13-9	Schematic Diagram, 9745 Power Supply 38-150 VDC	D-105909	L
13-10	Schematic Diagram, 9745 High Speed Relay I/O	D-105959	B

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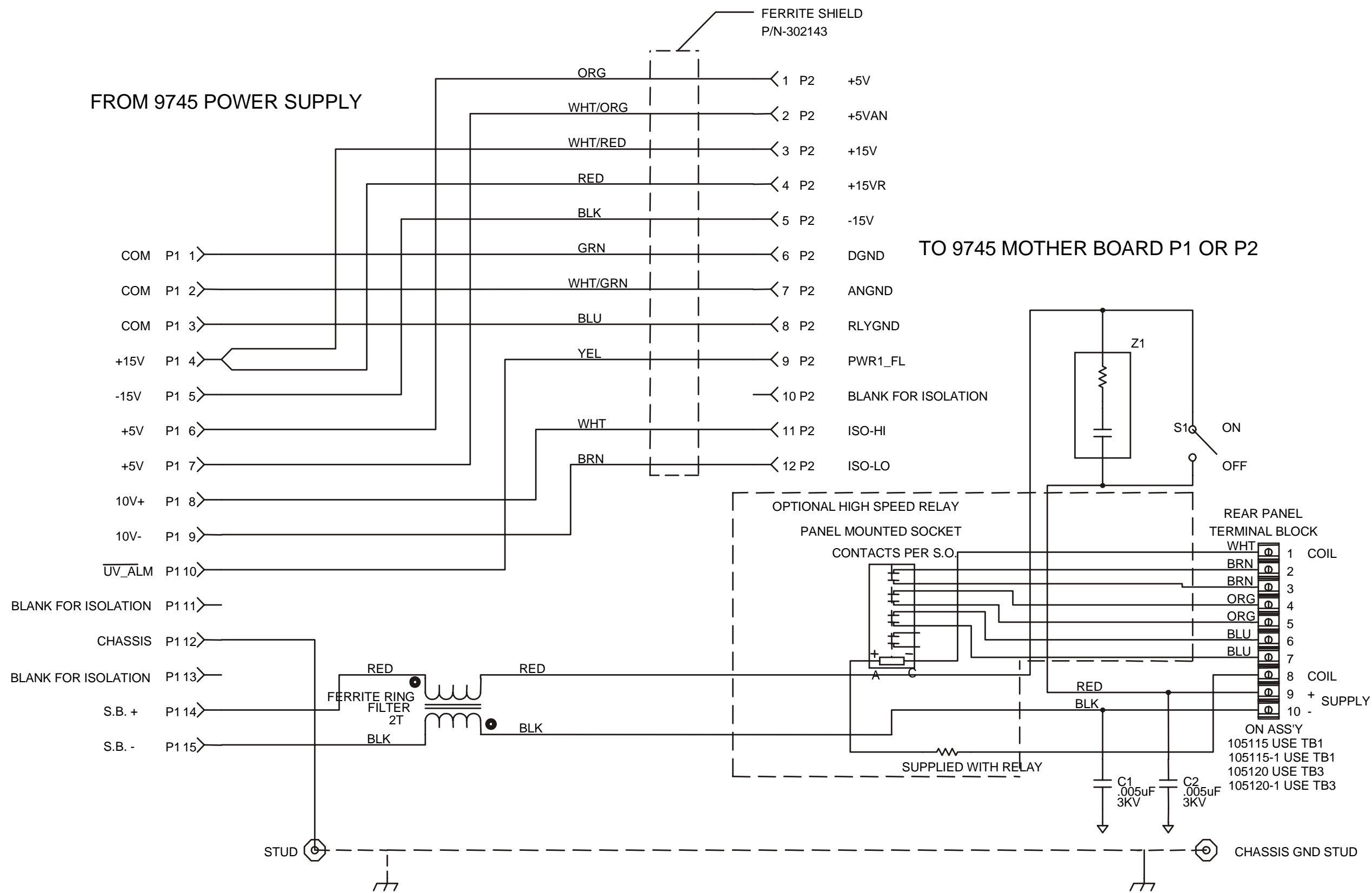


Figure 13-1. Wiring Diagram, 9745 Power I/O, Optional Relay (Drawing No. D-105119-E)

TO 9745 MOTHER BOARD P1

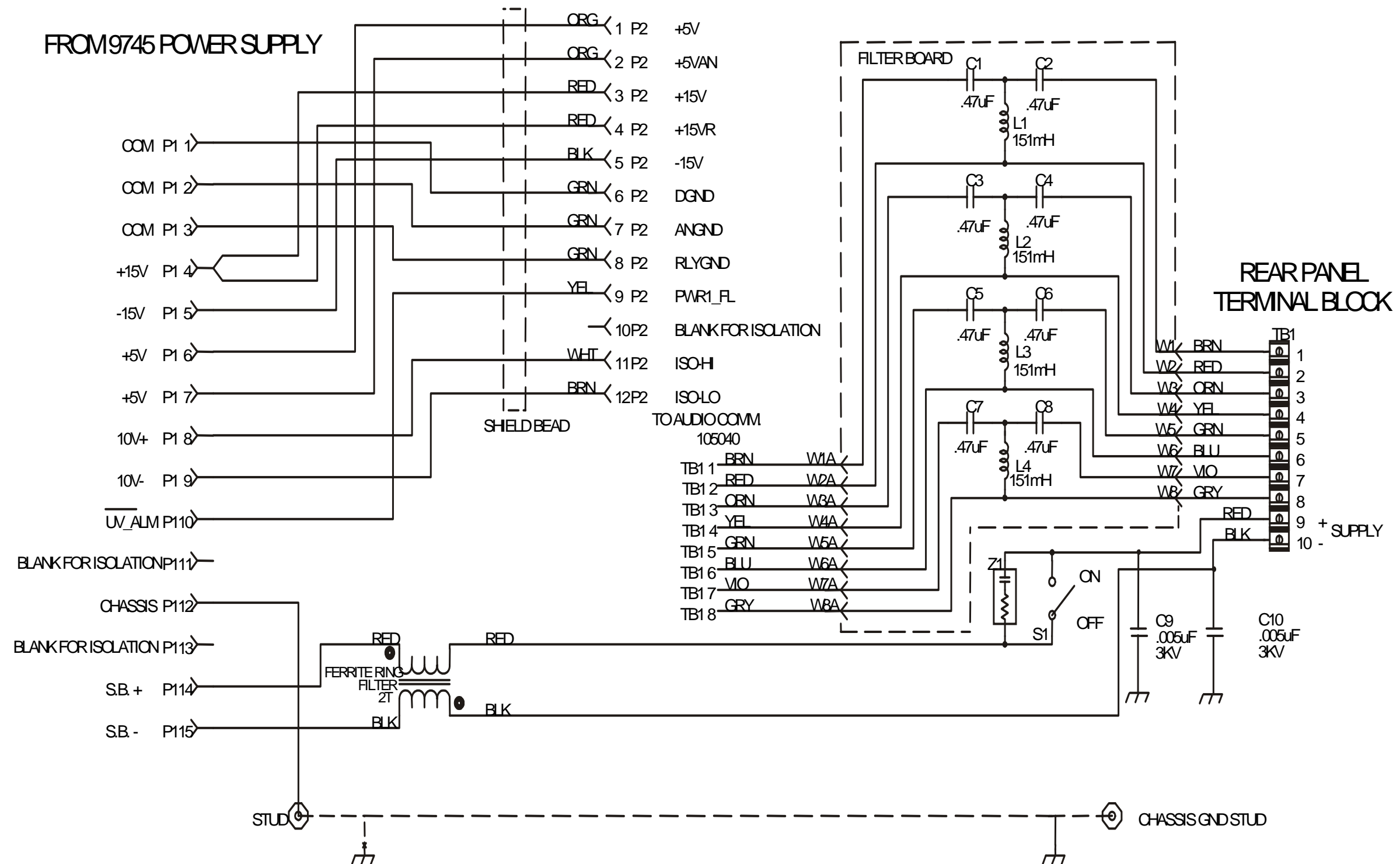


Figure 13-2. Schematic Diagram, 9745 Power I/O, Quad Filter Module (Drawing No. D-105154-1-D)

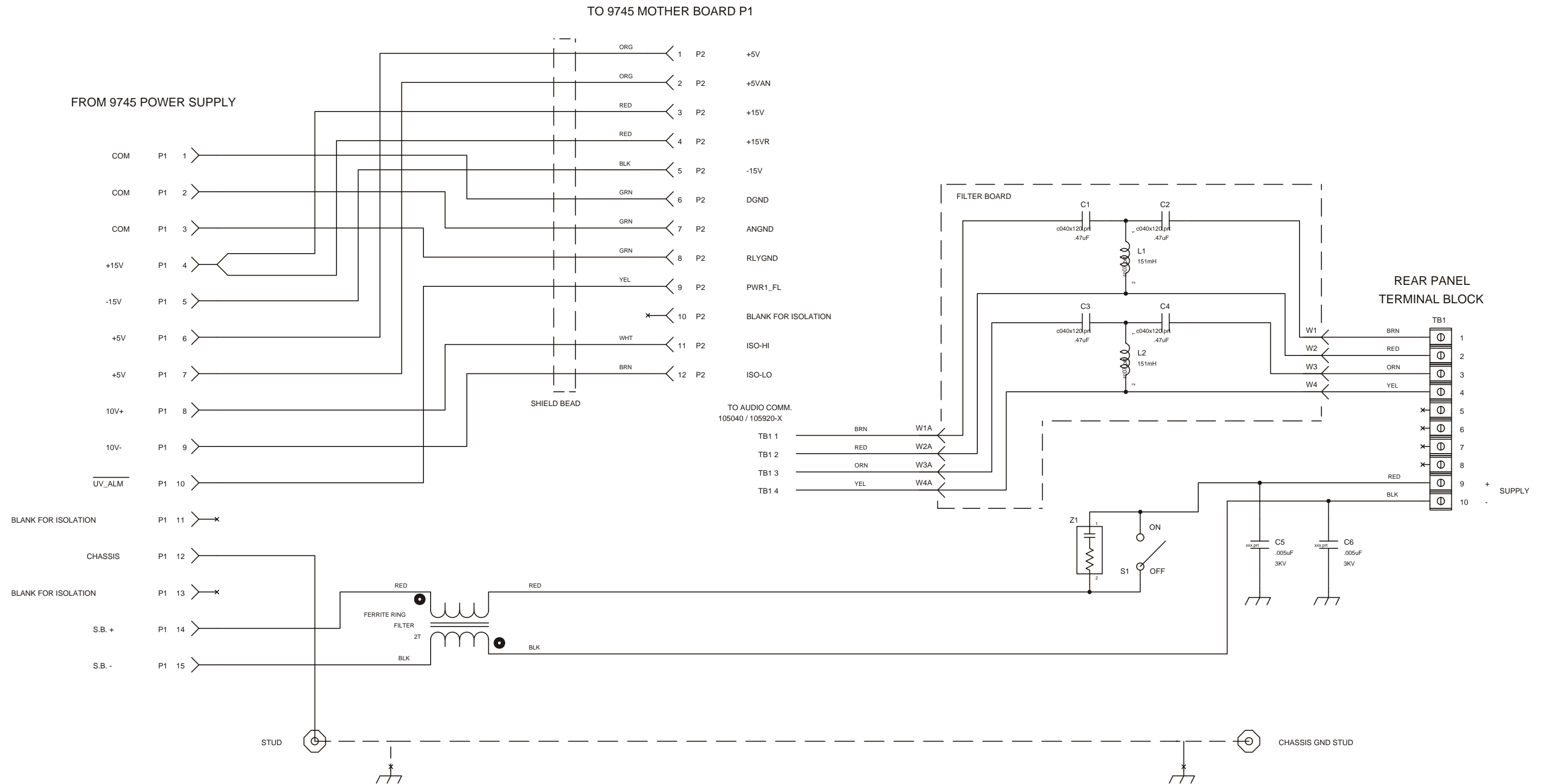


Figure 13-3. Schematic Diagram, 9745 Power I/O, Dual Filter Module (Drawing No. D-105154-2-D)

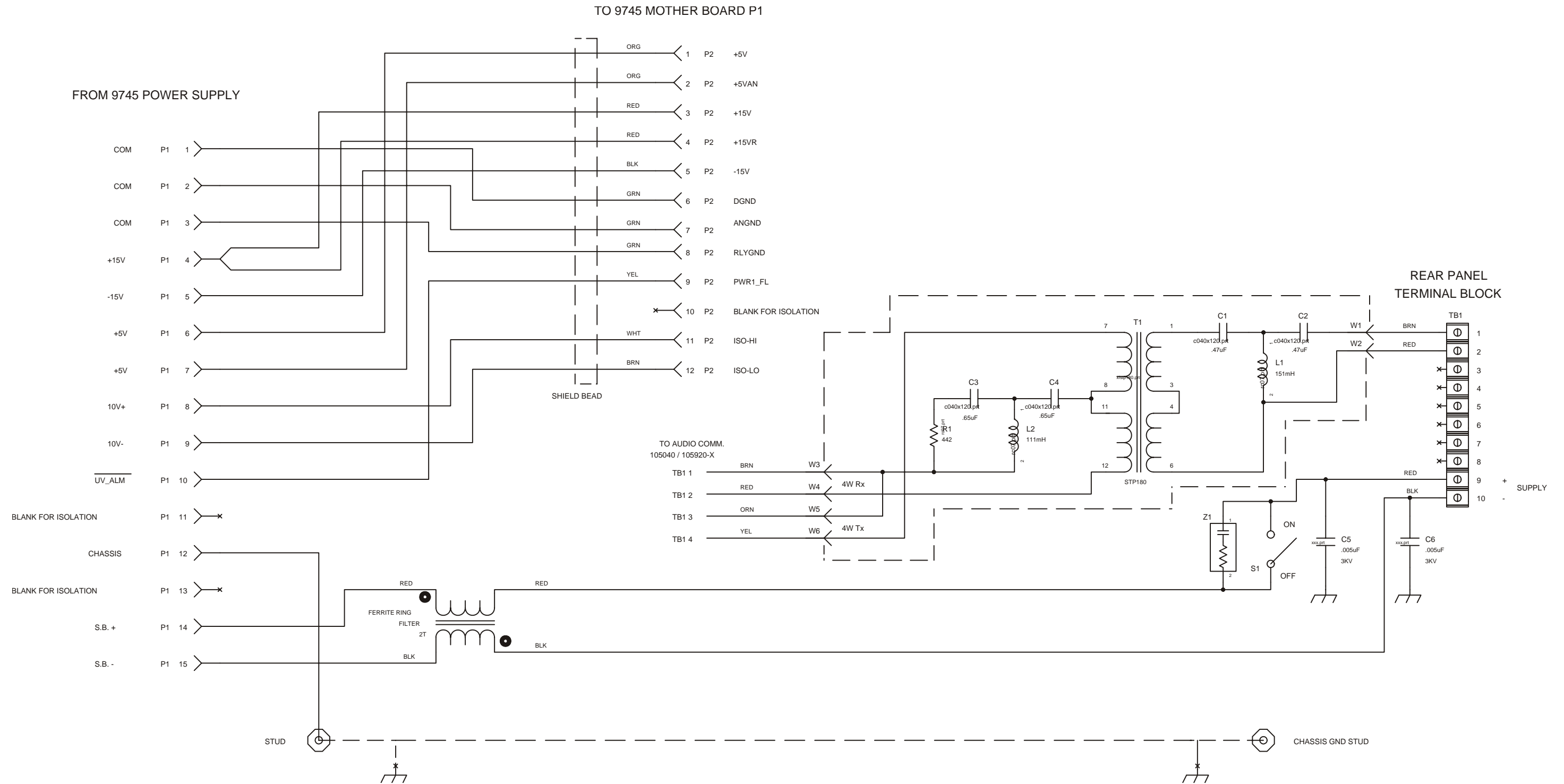


Figure 13-4. Schematic Diagram, 9745 Power I/O Filter/Hybrid Module (Drawing No. D-105154-3-D)

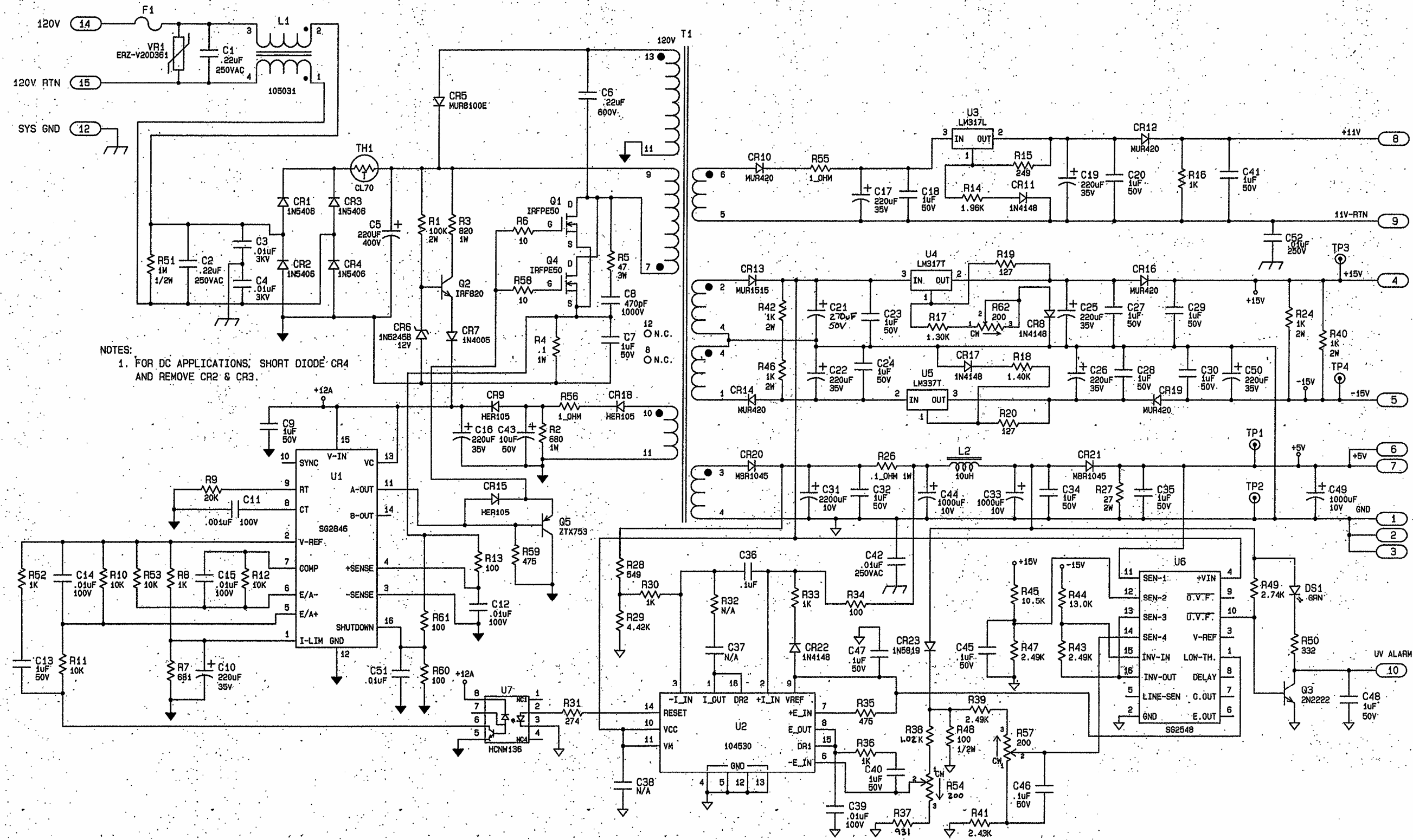


Figure 13-5. Schematic Diagram, 9745 Power Supply, 170-300 Vdc (Drawing No. D-105934-E)

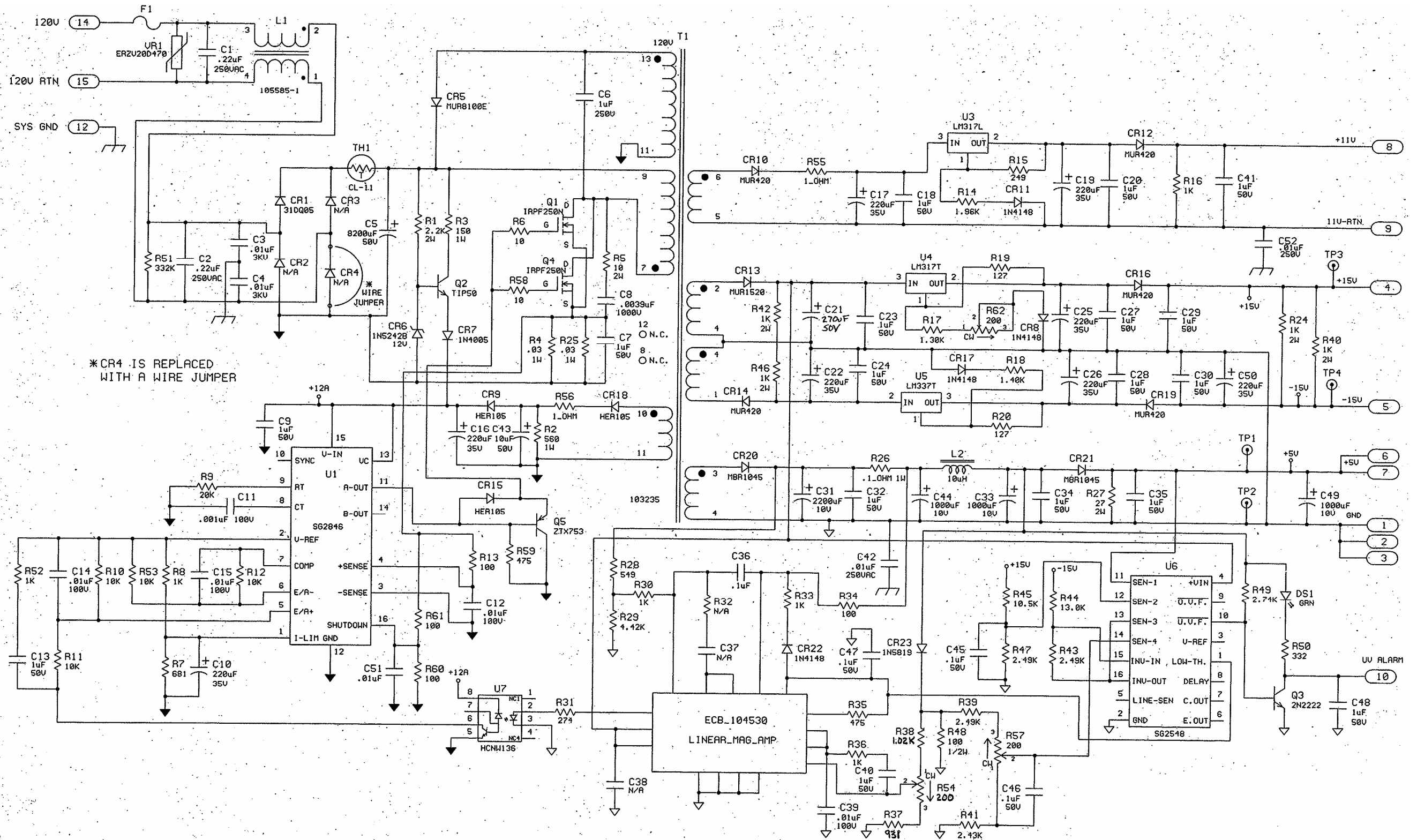
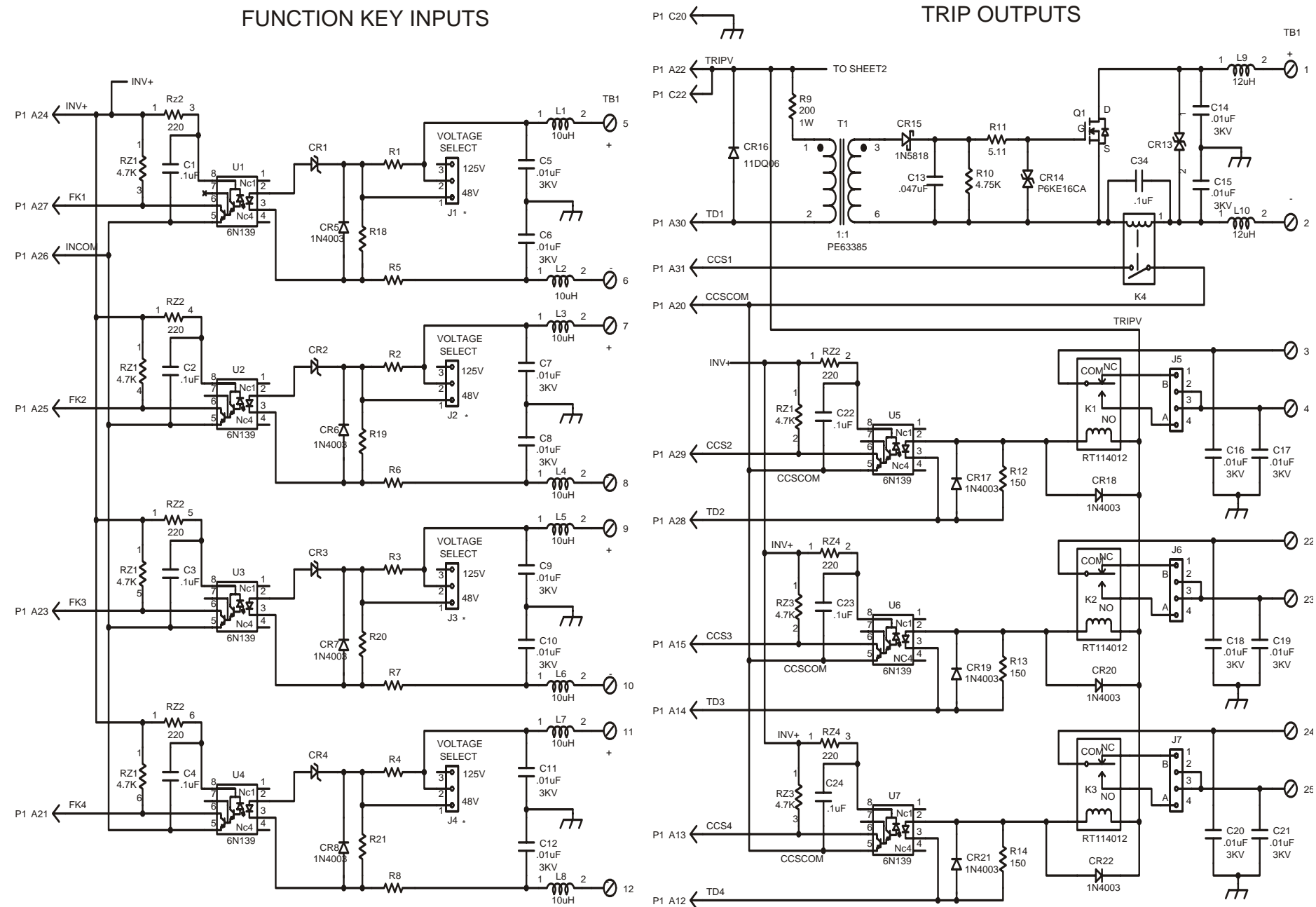


Figure 13-6. Schematic Diagram, 9745 Power Supply 19-36 Vdc (Drawing No. D-105909-1-C)



* = NOT USED ON 24V AND 250V UNITS

VOLTAGE RANGE	FUNCTION KEY INPUT				TRIP OUTPUTS	
	R1-R4	R5-R8	R18-R21	CR1-CR4	Q1	CR13
48V/125V	22K 5% 5W	5K 5% 3.25W	11.5K 1% 1/4W	1N4747A 20V 1W	IRFP254 20V 1W	1.5KE180CA
250V	20K 5% 5W	20K 5% 5W	47.5K 1% 1/4W	1N4761A 75V 1W	IRFP460 75V 1W	1.5KE350CA
24V	1.2K 5% 3.25W	50 5% 3.25W	7.68K 1% 1/4W	1N4742A 12V 1W	IRFP254 12V 1W	1.5KE180CA

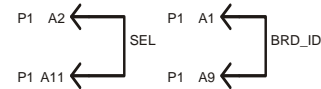


Figure 13-7. Schematic Diagram, 9745 Relay/Solid State I/O (Drawing No. D-105014-1-F) Sheet 1 of 2

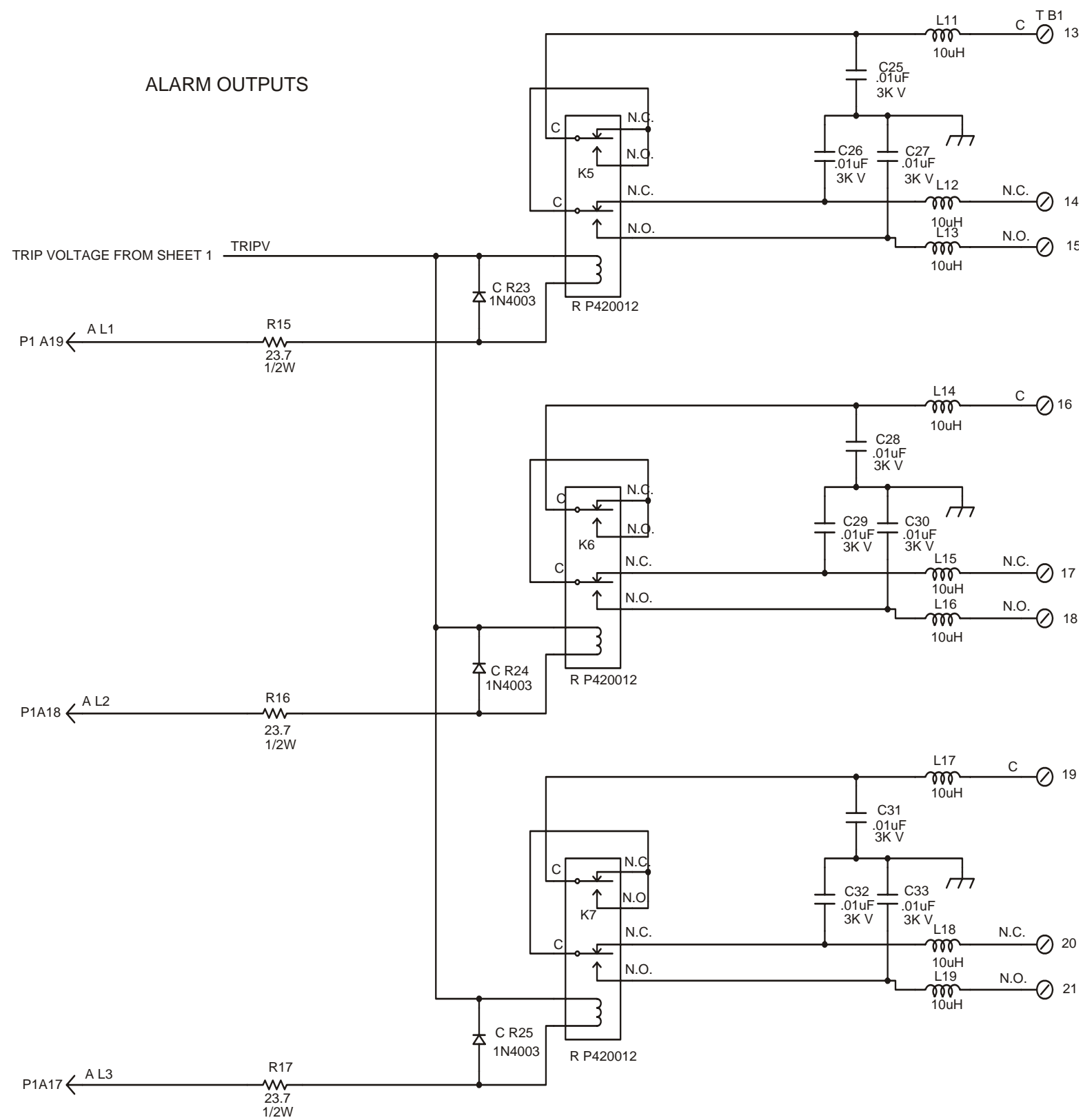
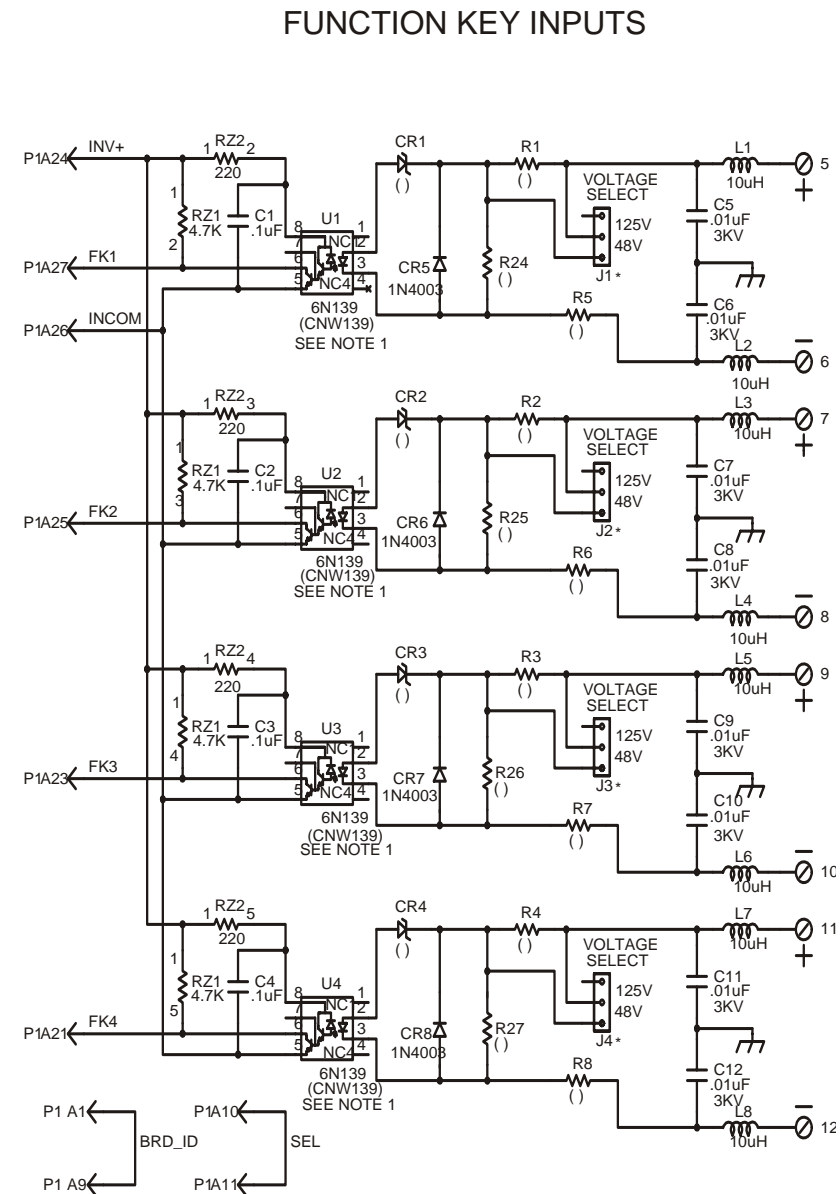
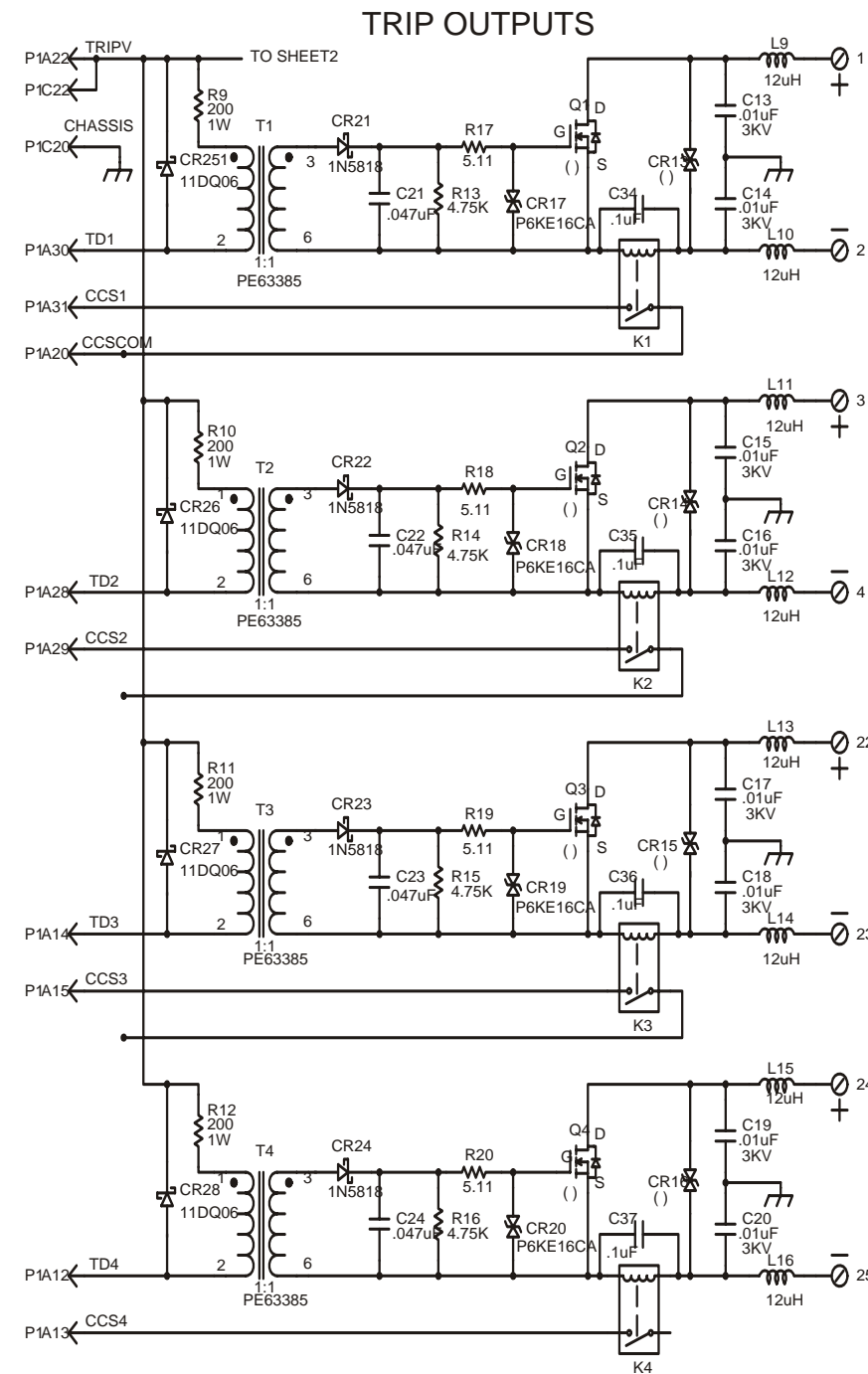


Figure 13-7. Schematic Diagram, 9745 Relay/Solid State I/O (Drawing No. D-105014-1-F) Sheet 2 of 2



() COMPONENT VALUES

VOLTAGE RANGE	R1-R4	R5-R8	R24-R27	CR1-CR4	Q1-Q4	CR13-CR16
48V/125V	22K 5% 5W	5K 5% 3.25W	11.5K 1% 1/4W	1N4747A 20V 1W	IRFP250	1.5KE180CA
250V	20K 5% 5W	20K 5% 5W	47.5K 1% 1/4W	1N4761A 75V 1W	IRFP460	1.5KE350CA
24V	1.2K 5% 3.25W	50 5% 3.25W	7.68K 1% 1/4W	1N4742A 12V 1W	IRFP250	1.5KE180CA

* = NOT USED ON 24V AND 250V UNITS.
 NOTES:
 1.) (CNW139) USED IN BABT VERSIONS.

Figure 13-8. Schematic Diagram, 9745 Solid State I/O (Drawing No. D-105009-G) Sheet 1 of 2)

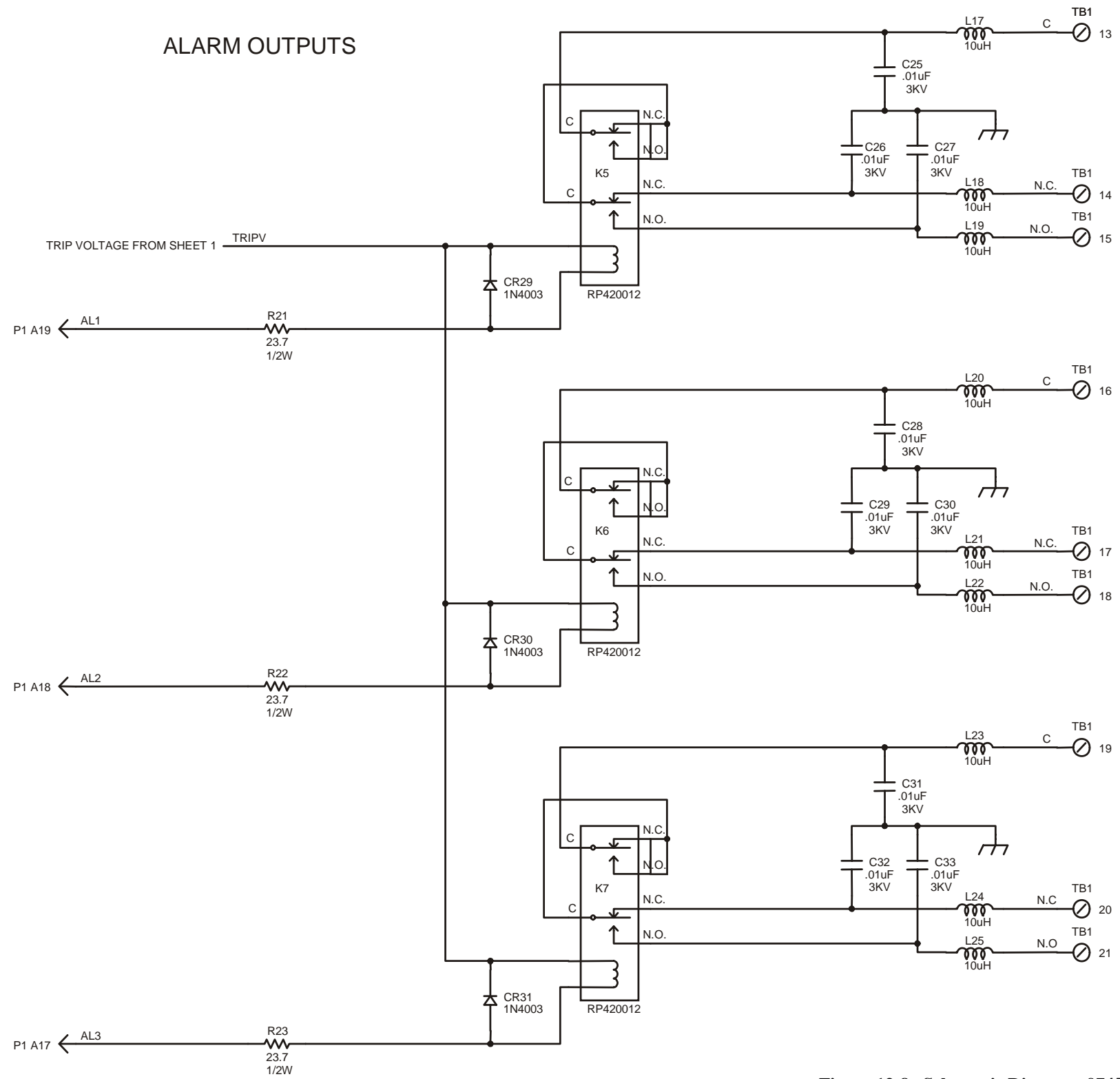


Figure 13-8. Schematic Diagram, 9745 Solid State I/O (Drawing No. D-105009-G) Sheet 2 of 2

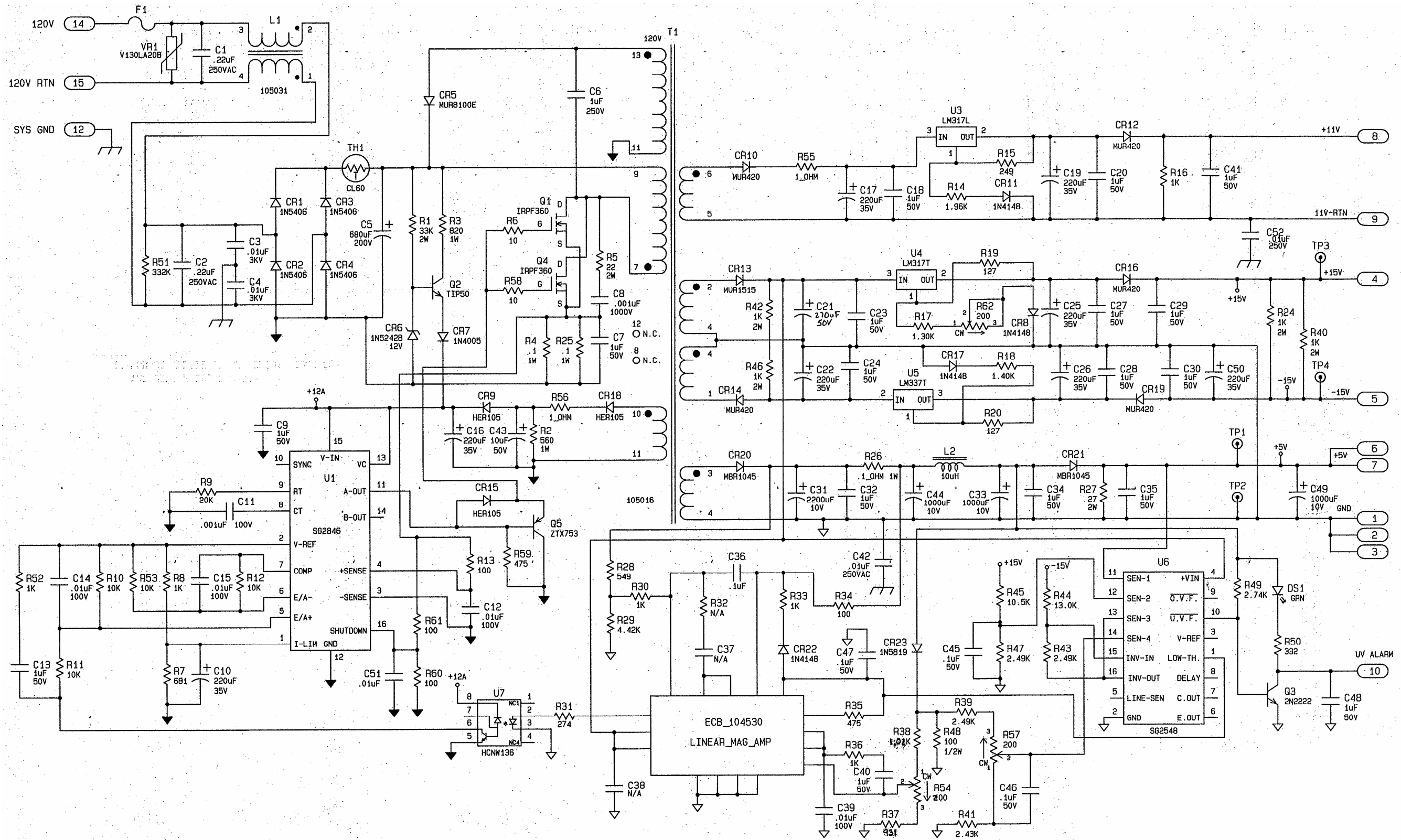
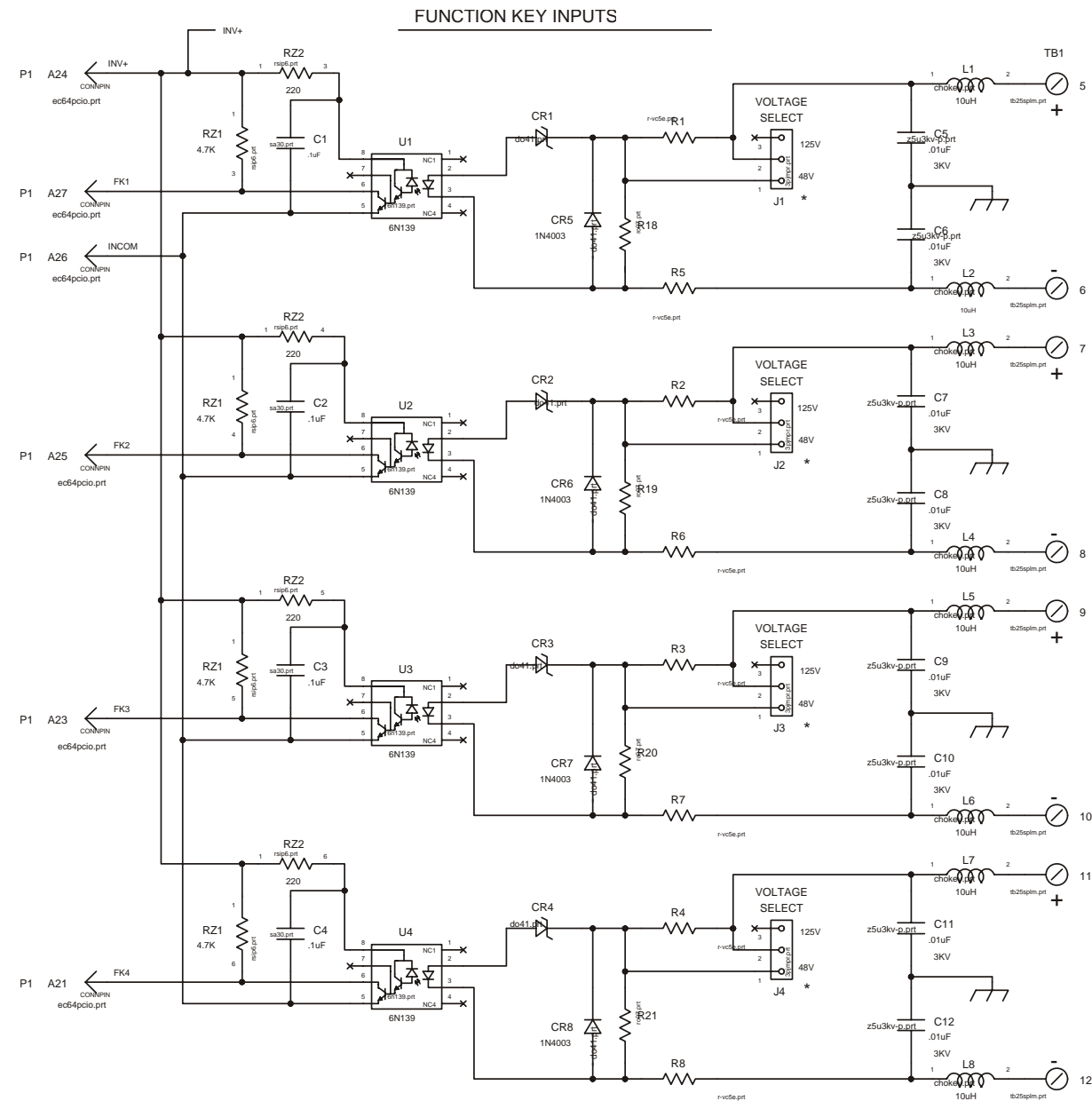


Figure 13-9. Schematic Diagram, 9745 Power Supply, 38-150 Vdc (Drawing No. D-105909-L)



* = NOT USED ON 220V UNITS

* = NOT USED ON 24V AND 250V UNITS

VOLTAGE RANGE	FUNCTION KEY INPUT			
	R1-R4	R5-R8	R18-R21	CR1-CR4
220V	20K 5% 5W	20K 5% 5W	69.8K 1% 1/4W	1N4761A 75V 1W
110/48V	22K 5% 5W	5K 5% 3.25W	15.4K 1% 1/4W	1N4747A 20V 1W

VOLTAGE RANGE	FUNCTION KEY INPUT			
	R1-R4	R5-R8	R18-R21	CR1-CR4
48V/125V	22K 5% 5W	5K 5% 3.25W	11.5K 1% 1/4W	1N4747A 20V 1W
250V	20K 5% 5W	20K 5% 5W	47.5K 1% 1/4W	1N4761A 75V 1W
24V	1.2K 5% 3.25W	50 5% 3.25W	7.68K 1% 1/4W	1N4742A 12V 1W

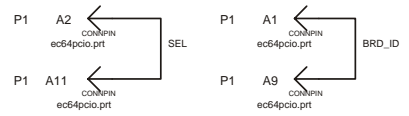
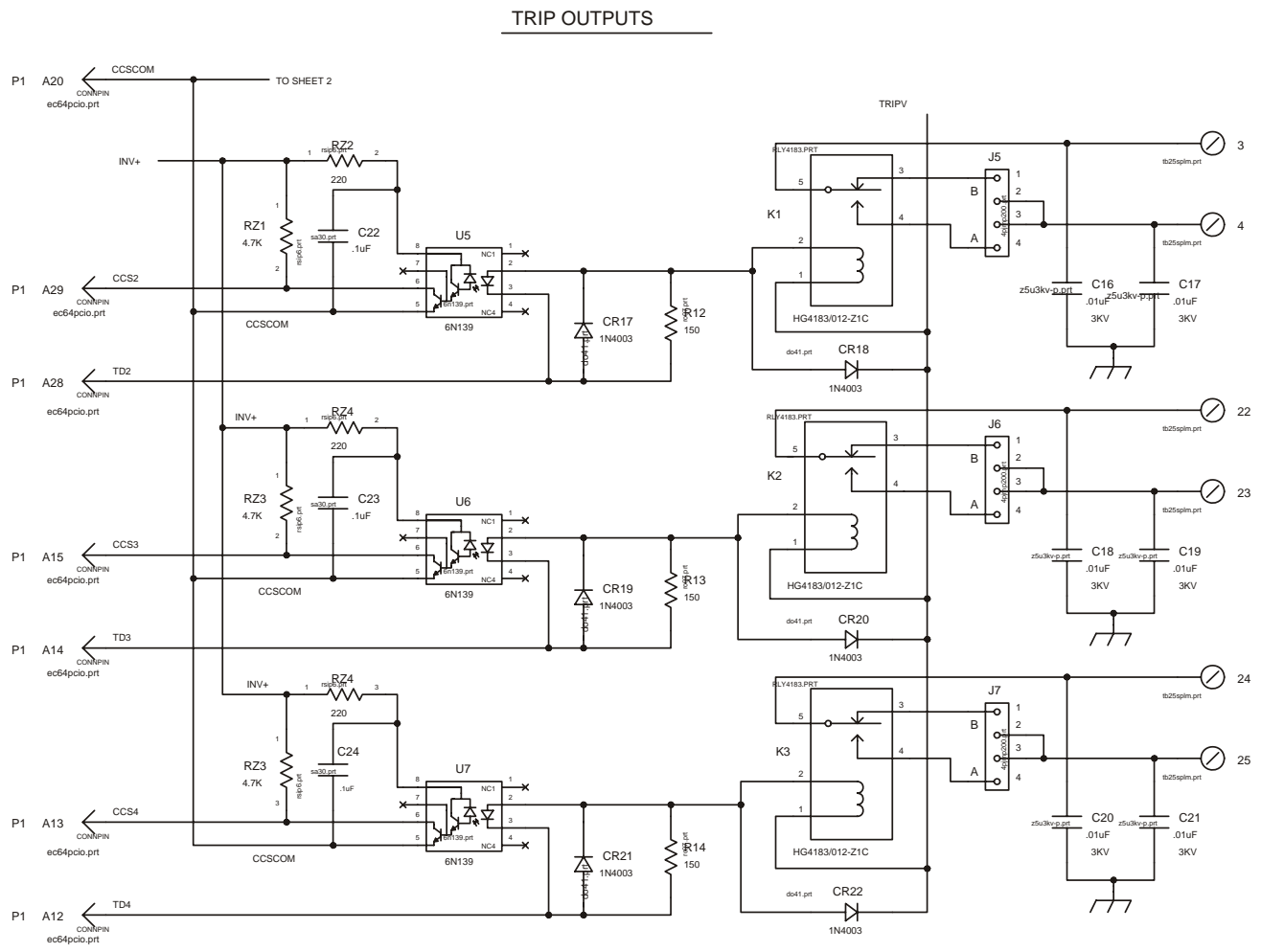


Figure 13-10. Schematic Diagram, 9745 High Speed Relay I/O (Drawing No. D-105959-B) Sheet 1 of 2

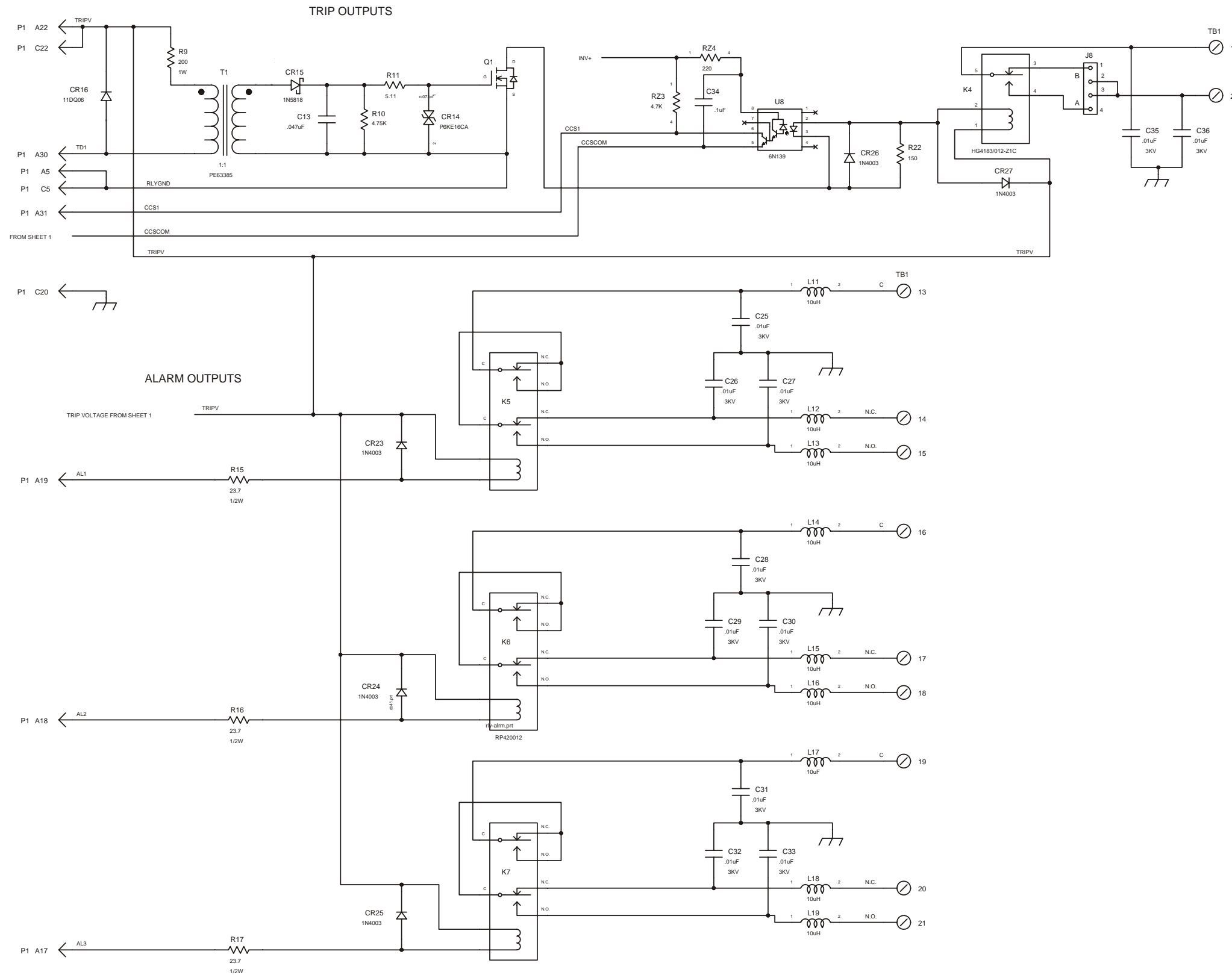


Figure 13-10. Schematic Diagram, 9745 High Speed Relay I/O (Drawing No. D-105959-B) Sheet 2 of 2