Section 1. GENERAL INFORMATION

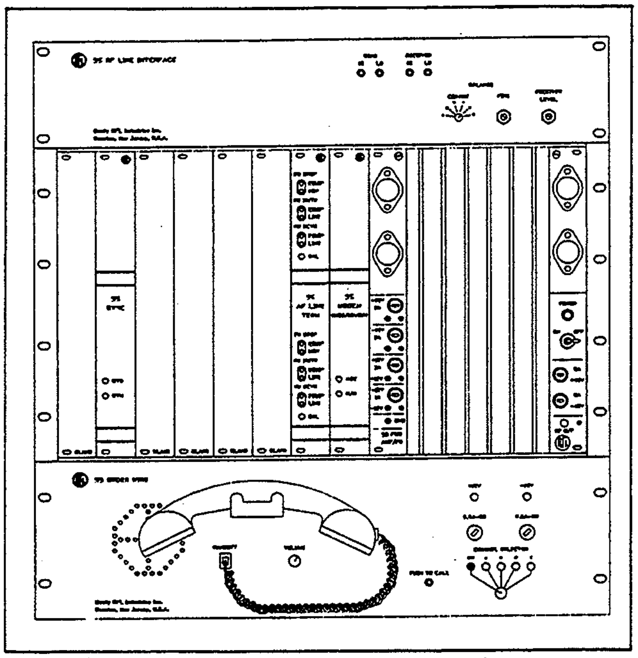


Figure 1-1. RFL 9505 Programmable Powerline Carrier System

1.1. PURPOSE OF THIS MANUAL

This manual provides operation and maintenance information for the RFL 9505 Programmable Powerline Carrier System, shown in Figure 1-1. Included are an overall description of the equipment and its purpose, a physical description, complete specifications, installation instructions, operating instructions, a detailed theory of operaton discussion, maintenance procedures and information on replaceable parts.

1.2. PURPOSE OF EQUIPMENT

The RFL 9505 provides multiplexed voice-grade channels for the transmission of speech or audio tones over high-voltage transmission lines and insulated static lines. The transmitted audio tones can be used for telemetering, supervisory control, protective relaying, data, or other purposes. Low-pass filter cutoff frequencies can be supplied for "speech-plus" operation (simultaneous transmission of speech and audio tones). When used for data only, each channel can typically carry up to twenty-four 50-baud telegraph channels, or a smaller number of data channels at higher baud rates.

Elements of the system may also be used for cable transmission, open-wire lines, and radio multiplex applications.

1.3. FEATURES

a. Chassis Programming. By programming all the modem positions in the chassis itself, rather than programming each individual modem, modems can be easily replaced, with reduced system downtime and spare module requirements.

b. Efficiency. Single-sideband (SSB) suppressed carrier technique results in efficient use of frequency spectrum and longer transmission ranges.

c. Flexibility. Each terminal is available as either a single- or multi-channel unit.

d. Voice-Grade Connections. Each channel provides a bi-directional voice-grade circuit over the transmission medium, and occupies a separate 4-kHz band in either direction of transmission.

e. Choice Of Output Levels. Terminals are supplied with either 10-watt or 50-watt PEP rf output amplifiers. Amplifiers can be combined for outputs up to 100 watts PEP.

f. Simplified Servicing. Test jacks and operator controls are placed along the front edge of each module to simplify measurements and adjustments.

g. Proven Design Techniques. Results in low power consumption, improved reliability, and high performance.

1.4. PHYSICAL DESCRIPTION

The RFL 95 CHAS double-Euro chassis serves as the housing for all RFL 9505 subassemblies except the order wire and rf line interface assemblies, which are housed separately. It accepts double-Euro sized cards (233.4 x 220 mm, or 9.2 x 8.7 inches) and optional accessories such as relays and hybrids in a bookshelf-style arrangement. The RFL 95 CHAS fits into a standard EIA 19-inch relay rack and occupies six rack units of vertical space (267 mm, or 10 1/2 inches).

Interconnections between circuit card modules in the chassis are made by two printed circuit backplanes within the chassis, which contain the mating connectors for all the circuit card modules. Connections between the chassis and all external circuits are made through connectors and barrier-type terminal blocks which are part of two I/O modules mounted to the rear panel of the chassis. These modules provide isolation for the input and output lines, and drive circuits for alarm relays.

The RFL 95 CHAS, the order wire assembly, and the rf line interface assembly may be supplied as individual units, or they may be mounted, interconnected and tested as a complete system. Systems can be mounted on shipping rails, an open relay rack, or in an enclosed cabinet with either a fixed or movable rack. The RFL 9505 may also be combined with other Dowty equipment to form a fully integrated system.

1.5. TYPICAL APPLICATIONS

Figure 1-2 illustrates the application of a four-channel RFL 9505 system in a point-to-point powerline carrier configuration. One channel is used for transmitting teleprotection signals for line or equipment protection, the second carries 1200-baud data for telecontrol, and the third supports a selective calling voice system. The fourth channel is reserved for future use.

Figure 1-3 illustrates the use of a single-channel in a tandem configuration. A single speech-plus channel is shown with voice repeating via an audio bridge with a local drop at the intermediate station. Transmit filters are included so that the low-speed data is bypassed at the intermediate station.

1.6. SYSTEM SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the entire RFL 9505 system, when used in accordance with IEC standards. For specifications on individual modules or subassemblies, refer to Sections 5 through 12 of this manual. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change withiout notice.

RF SECTION:

Operating Mode: Amplitude modulation, single-sideband, suppressed carrier.

Output Frequency Range: 20 kHz to 500 kHz in 4-kHz steps. Modem is functional from 4 kHz to 500 kHz.

Channel Bandwidth: 4 kHz.

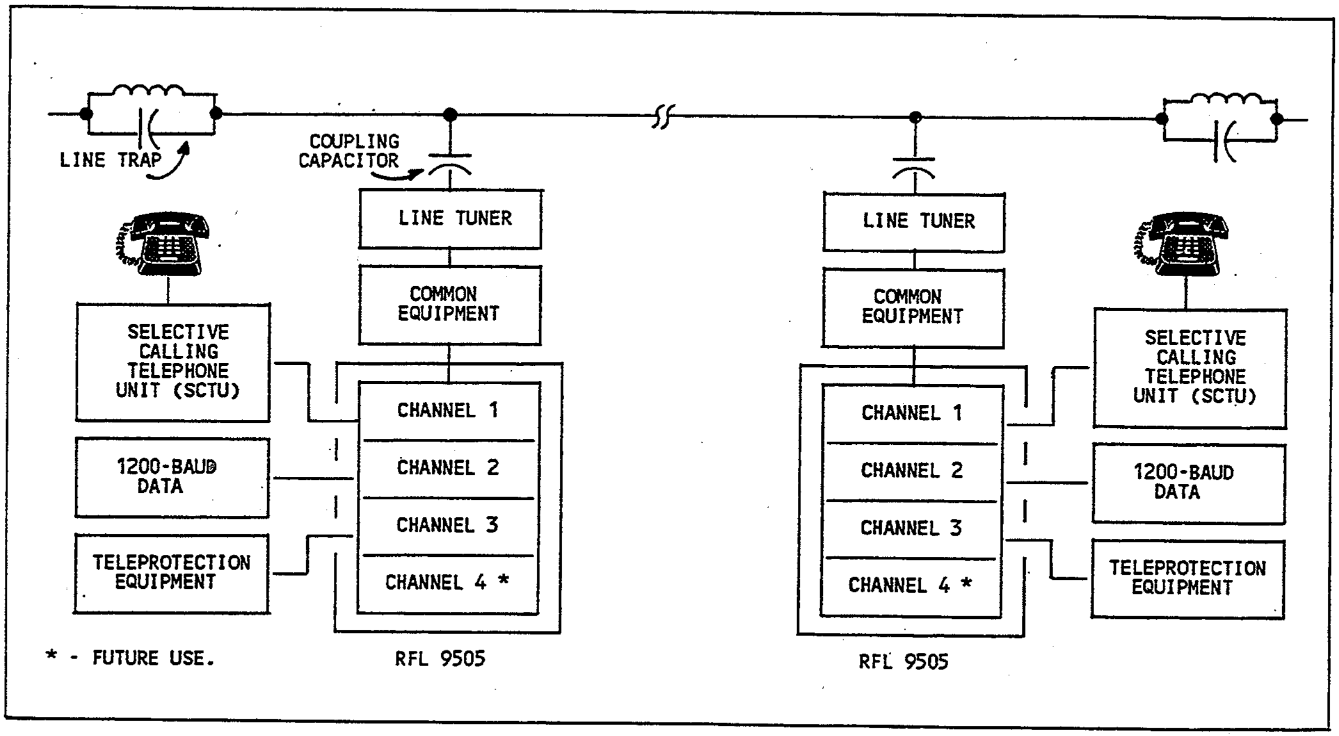


Figure 1-2. Four-channel RFL 9505 system supporting teleprotection, telecontrol, and data communications

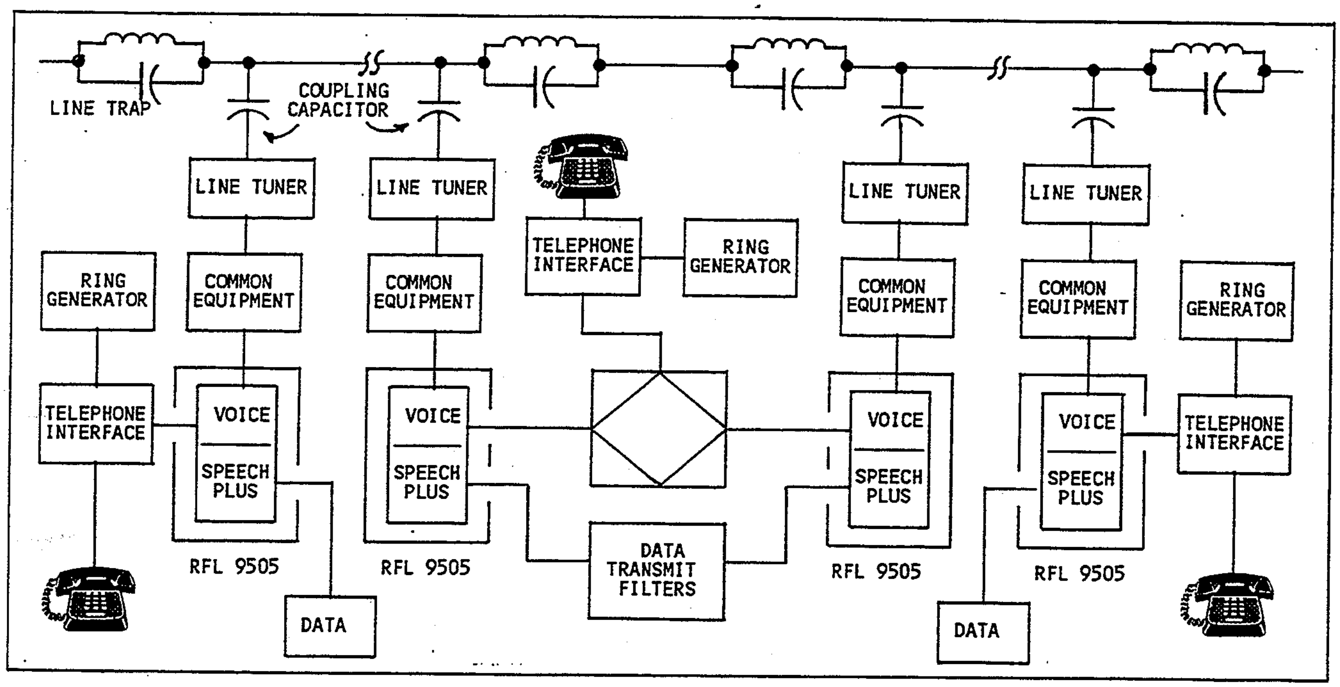


Figure 1-3. Single-channel RFL 9505 system with audio repeater for speech-plus applications

Impedance: 50 ohms standard; 75 ohm, 140 ohm, and other impedances available on special order.

Return Loss: 12 dB or greater.

Output Power: 10 or 50 watts PEP, measured at the amplifier output and depending on the amplifier/power supply being used. Amplifiers can be combined for outputs up to 100 watts PEP.

Frequency Stability: ±5 parts per million (ppm). Each modem may be frequency-locked, using the optional synchronizer.

Spurious Outputs:
Harmonic: Less than -50 dB.
Carrier: Less than -50 dB.
Intermodulation: Less than -50 dB.
Unwanted Sideband: Less than -60 dB.
All Others: Less than or equal to -80 dB.

Receiver Sensitivity: -40 dBm.

Receiver Selectivity: 105 dB or greater 4 kHz from either side of the operating channel, measured at the audio output.

AF SECTION:

Input/Output Levels and Impedances:
Four-Wire Send:
Factory-Set Level: -16 dBm.
Adjustment Range: -16 dBm to +15 dBm.
Impedance: 600 ohms, balanced.
Two-Wire Send:
Factory-Set Level: 0 dBm.
Adjustment Range: -11.5 dBm to +19.5 dBm.
Impedance: 600 ohms, balanced.
Four-Wire Receive:
Factory-Set Level: +7 dBm.
Adjustment Range: -24 dBm to +7 dBm.
Impedance: 600 ohms, balanced.
Two-Wire Receive:
Factory-Set Level: -4 dBm.
Adjustment Range: -26 dBm to +3 dBm.
Impedance: 600 ohms, balanced.

Bandwidth:
Normal Operation: 300 Hz to 3400 Hz standard; other bandwidths available on special order.
Speech-Plus Operation: 300 Hz to 3400 Hz.

Frequency Response: See Figure 1-4.

Distortion: 1 percent maximum for an 800-Hz test tone below limiting.

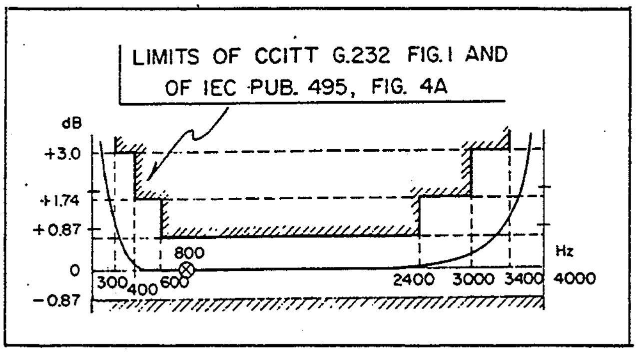


Figure 1-4. Frequency response, RFL 9505 Programmable Powerline Carrier System

Automatic Gain Control (AGC): Less than 1 dB change in audio output for an rf variation of ±20 dB.

Return Loss: 26 dB or greater.

Idle Noise: -60 dBmop or less.

Longitudinal Balance: 60 dB or greater.

Signaling:

Frequency: 3825 Hz FSK ±30-Hz shift standard; others available on special order.
Interface:
Input: Optical isolator.
Output: Relay, mercury-wetted Form C contacts.
Rate: 20 pulses/second for less than 10 percent bias distortion.

GENERAL:

Standards Compliance: The RFL 9505 is designed to meet applicable requirements of IEEE, CCITT, and IEC standards.

Operating Temperature: -20°C to +55°C (-4°F to +131°F)

Power Requirements: Determined by the specific amplifier/power supply module(s) being used. All amplifier/power supply modules provide complete isolation between the system and the power source. The following input voltages are standard; other voltages can be accommodated:

24-Volt Systems: 21 to 28 Vdc.
48-Volt Systems: 42 to 56 Vdc.
129-Volt Systems: 105 to 140 Vdc.

1.7. SYSTEM CONFIGURATION

Each RFL 9505 terminal contains at least one modem, an amplifier/power supply, and one af line termination module for every two modems. An rf line interface assembly is used to connect the terminal to the line coupling equipment. Optional equipment can also be used with each terminal. Model numbers, power consumption, and space requirements for each part of the RFL 9505 system are given in Table 1-1.

Paragraphs 1.7.1 through 1.7.8 describe the various parts of a typical RFL 9505 terminal, shown in block diagram form in Figure 1-5. This terminal contains one modem, an amplifier/power supply, an af line termination module, and an optional synchronizer, all mounted in a RFL 95 CHAS double-Euro chassis. This typical terminal also contains an rf line interface assembly and an optional order wire assembly, which are mounted outside the main chassis.

1.7.1. Modem

The RFL 95 MODEM contains the modulator and demodulator for PLC applications, and is fully programmable from 20 kHz to 500 kHz in 4-kHz steps. The RFL 95 MODEM incorporates a signaling transceiver with an optical isolator to accept current inputs; the output of this transceiver is the Form-C contacts of a mercury-wetted relay. Speech input/output ports are balanced four-wire circuits. A compandor circuit provides selectable signal compression or expansion.

The RFL 95 MODEM contains an automatic gain control (AGC) and alarms for pilot tone and signal-to-noise ratio, which can be wired together as inputs to a master alarm. Frequency programming is accomplished on the chassis for each modem position. Any modem module inserted into a particular position will operate at that programmed frequency without re-programming - this reduces system downtime and spare module requirements. Modem positions can also be easily re-programmed on site without special tools or accessories.

The RFL 95 MODEM-1 is designed for use as the master modem in systems containing the optional RFL 95 SYNC synchronizer card. Additional information on both modem cards can be found in Section 5 of this manual.

Table 1-1. Space and power requirements for RFL 9505 assemblies

Assembly Description	Model Number	Assy. Number	Current draw in milliamperes[1]						Module Spaces Req'd.	Additional Information
			+12V	-12V	+15V	-15V	+45V	-45V		
Modem [2]	95 MODEM	100805	400	125	...	...	...	...	1	Section 5
AF line termination module [3]	95 AF LINE TERM	100860	...	...	...	...	...	...	1	Section 6
Amplifier/Power Supplies: [4]										
10-Watt Rf Output:										
24-Volt Input	95 AMP/PS-1	102735-1								
48-Volt Input	95 AMP/PS-2	102735-2	3000	1000	(5)	(5)	...	...	6	Section 7
129-Volt Input	95 AMP/PS-3	102735-3								
50-Watt Rf Output:										
24-Volt Input	95 PWR AMP/PS-1	102745-1								
48-Volt Input	95 PWR AMP/PS-2	102745-2	3000	1000	(5)	(5)	(6)	(6)	6	Section 7
129-Volt Input	95 PWR AMP/PS-3	102745-3								
Chassis, double-Euro:										
For 1 or 2 channels	95 CHAS-1	102780-1	...	...	...	...	...	...	(7)	Section 8
For 3 or 4 channels	95 CHAS-2	102780-2	...	...	...	...	...	...	(7)	Section 8
RF line interface assembly	95 RF LINE INTERFACE	100870	...	...	...	...	...	...	(8)	Section 9
Synchronizer [10]	95 SYNC	100810	200	20	...	...	...	...	1	Section 10
Service Phone assembly [10]	95 ORDER WIRE	100820	...	...	350	50	...	...	(9)	Section 11

NOTES:

1. Assemblies with no current draws shown are passive (no active components).
2. One modem required for each channel.
3. One af interface module required for every two modems.
4. One amplifier/power supply required for each RFL 95 CHAS chassis.
5. Because the 12-volt supplies are derived from the 15-volt supply output, the sum of the 12-volt current draw and the 15-volt current draw must not exceed 3.33 amperes.
6. For use in amplifier section of amplifier/power supply (not distributed to other modules).
7. Occupies 10.5 inches (26.7 cm) of vertical space in rack or cabinet (6 rack units).
8. Occupies 3.5 inches (88.9 cm) of vertical space in rack or cabinet (2 rack units).
9. Occupies 5.25 inches (133.4 cm) of vertical space in rack or cabinet (3 rack units).
10. Optional.

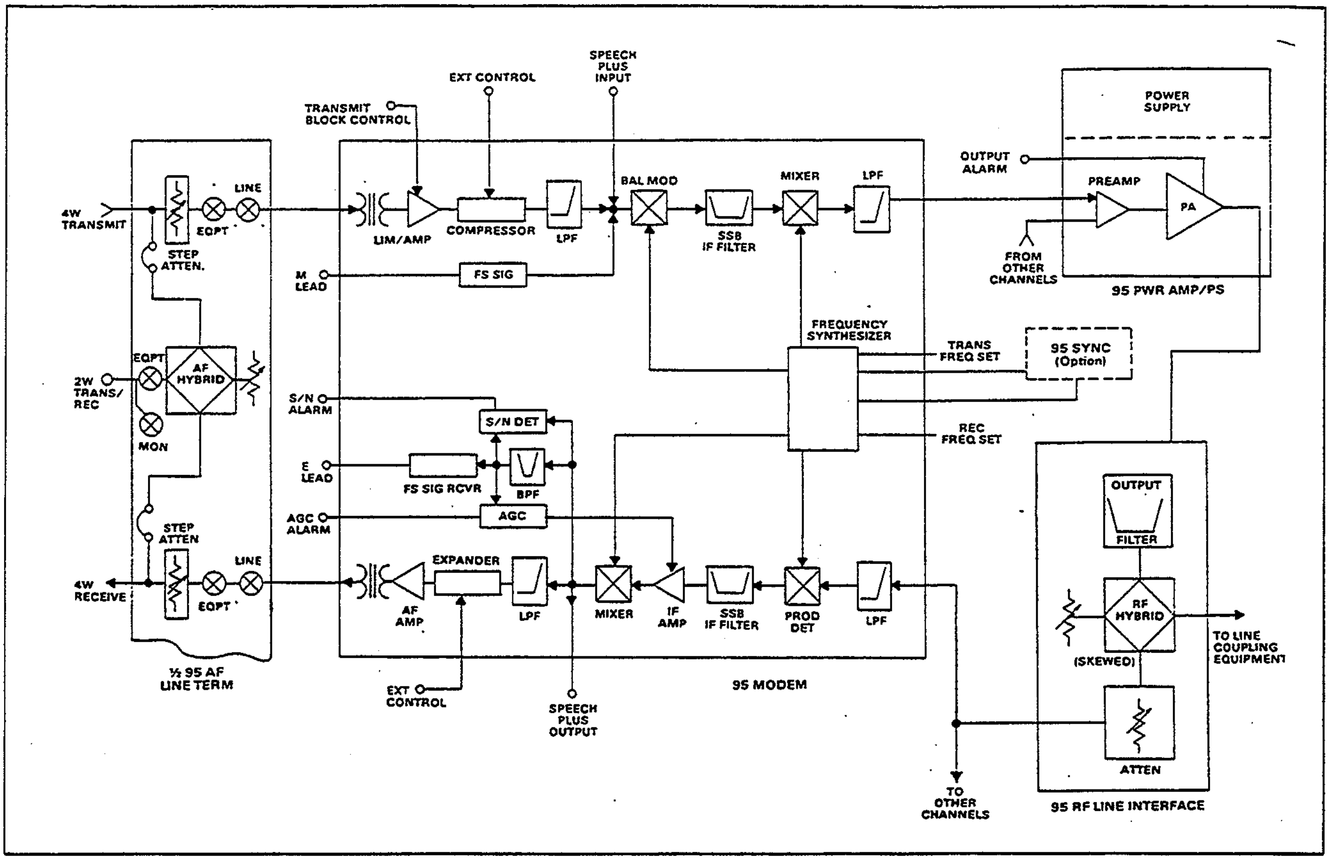


Figure 1-5. Block diagram, typical RFL 9505 terminal

1.7.2. Audio Termination Module

Each RFL 95 AF LINE TERM audio termination module is used to connect two modems to the audio interface. It supplies each modem with a pair of two-wire/four-wire hybrids, a jackfield, and two attenuators, which are adjustable in 1-dB steps from 0 dB to 31 dB. Section 6 of this manual contains additional information on the RFL 95 AF LINE TERM.

1.7.3. Amplifier/Power Supply

Two different amplifier/power supplies are available for each RFL 9505 terminal. Three different versions of each amplifier/power supply are available, for use with nominal dc inputs of 24, 48, or 129 volts. All provide complete isolation from the power source.

The RFL 95 AMP/PS has a maximum output of 10 watts PEP and the RFL 95 PWR AMP/PS has a maximum output of 50 watts PEP, both from 20 kHz to 500 kHz. Both amplifier/power supplies are described in detail in Section 7 of this manual.

1.7.4. Chassis And Backplanes

The RFL 95 CHAS Double-Euro Chassis provides a housing for the different RFL 9505 modules, and also interconnects all the modules electrically. Terminal blocks on the rear panel of the chassis provide connection points between the RFL 9505 and external equipment.

Two different chassis are available: the RFL 95 CHAS-1 for stations containing one or two modems, and the RFL 95 CHAS-2 for stations containing three of four modems. Additional information on both chassis and the backplane and I/O circuit boards inside them can be found in Section 8 of this manual.

1.7.5. Rf Line Interface Assembly

The RFL 95 RF LINE INTERFACE contains an output filter, an rf hybrid, SWC protector, coax connector, and a receiver attenuator. The interface assembly is housed in a separate 19-inch rack-mountable cabinet, and is fully described in Section 9 of this manual.

To assure compliance with IEC standards, terminals with an output filter in the rf line interface assembly may require filter replacement if the transmit frequency is changed.

1.7.6. Synchronizer

The optional RFL 95 SYNC synchronizer (Section 10) provides a precise 102.4-KHz clock frequency. This clock signal is derived from the selected input frequency, which is a multiple of 4 kHz. One RFL 95 SYNC synchronizes all the modems mounted in the chassis, and can also synchronize all the modems at the far end of the communication line as well.

1.7.7. Service Phone Assembly

The optional RFL 95 ORDERWIRE Service Phone Assembly (Section 11) contains a telephone handset, a hook switch, and a loudspeaker. An unused signaling transceiver can be used for remote signaling, or an optional internal signaling channel may be used. Either bridging or terminating connections may be made. The RFL 95 ORDERWIRE is housed in a separate 19-inch rack-mountable chassis.

1.7.8. Accessory Equipment

In addition to the equipment described above, other optional accessory items may be ordered for use with your RFL 9505 terminal, to enhance its operation or adapt it to specific applications. If your terminal was equipped with any accessory equipment at the factory, additional information will be found in Section 12 of this manual.

Section 2. INSTALLATION

2.1. INTRODUCTION

This section contains installation instructions for the RFL 9505, including unpacking, mounting, and interconnect wiring.

2.2. UNPACKING

RFL 9505 equipment may be supplied as individual chassis or interconnected with other chassis or assemblies at the factory as part of a system. Paragraph 2.2.1 provides unpacking instructions for individual chassis, and paragraph 2.2.2 provides instructions for interconnected chassis.

2.2.1. Individual Chassis

RFL 9505 equipment 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.

2.2.2. Interconnected Chassis

RFL 9505 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.

2.3. MOUNTING

After unpacking, RFL 9505 equipment must be securely mounted, following the instructions in paragraphs 2.3.1 through 2.3.3.

2.3.1. Individual Chassis

All RFL 9505 equipment housings have two mounting ears (one on each side). Hole sizes and spacings conform with EIA standards, so RFL 9505 equipment can be mounted in any standard 19-inch rack or cabinet. Complete mounting dimensions are given in Figure 2-1.

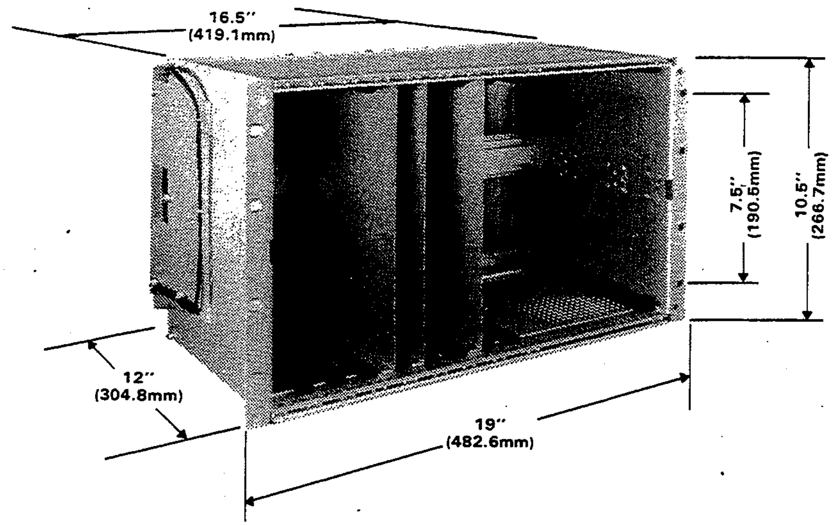
CAUTION

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.

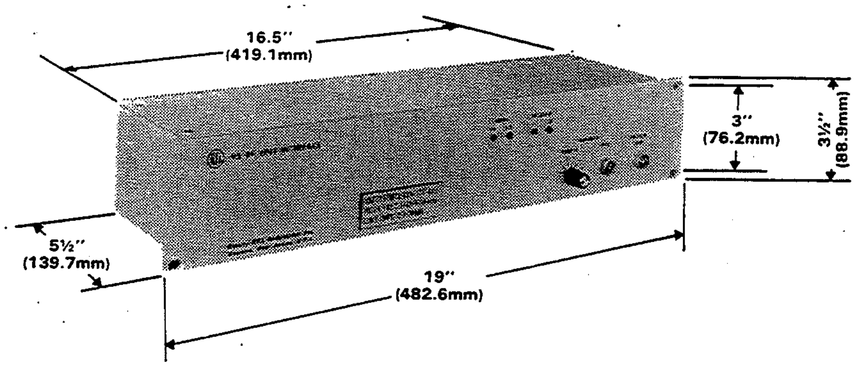
2.3.2. Interconnected Chassis Installed In Rack Or Cabinet

Systems mounted in racks or cabinets at the factory are to be placed in position and then bolted to the floor or wall, to secure the equipment in place.

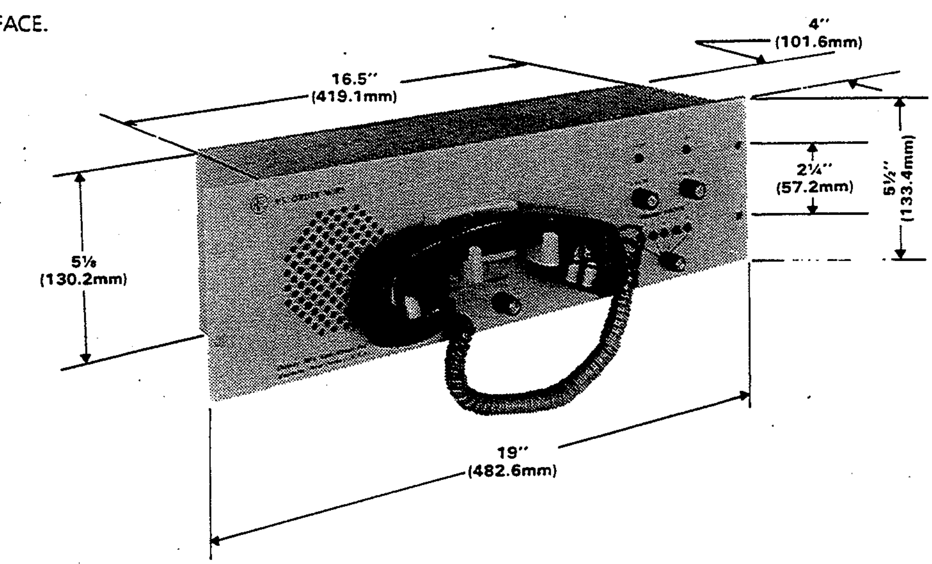
The type of hardware used will depend upon the particular surface to which the rack or cabinet is being mounted. Because of this, mounting hardware is not supplied with the rack or cabinet.



a. RFL 95 CHAS.



b. RFL 95 RF LINE INTERFACE.



c. RFL 95 ORDER WIRE.

Figure 2-1. Mounting dimensions, RFL 9505 equipment

2.3.3. 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.

2.4. VENTILATION

The specified operating temperature range for RFL 9505 equipment is -20°C to +55°C (-4°F to +131°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.

2.5. CONNECTIONS

Electrical connections are made to RFL 9505 equipment through the terminal blocks and connectors on the rear panel of each equipment housing. For an overall wiring diagram of a typical RFL 9505 system, refer to Section 8 of this manual or the "as supplied" drawings furnished with your equipment.

Section 3. OPERATING INSTRUCTIONS

3.1. INTRODUCTION

Operating instructions for the RFL 9505 Programmable Powerline Carrier System are given in this section. The controls and indicators used during operation are shown and described. Also included are procedures setting up and aligning individual RFL 9505 terminals.

3.2. CONTROLS AND INDICATORS

The modules and subassemblies in each RFL 9505 station contains controls and indicators, which are used to prepare the terminal for use and monitor its functions during normal operation. Many controls and indicators are located on the front panels, and can be used without removing the module or subassembly from the chassis. Other controls are on the circuit boards, which will require removal of the module or subassembly for access. Still other controls are located on circuit boards inside some assemblies, and the subassembly may have to be disassembled to gain access to these controls.

Figures 3-1 through 3-13 shows where the controls and indicators are located on each module and subassembly. Tables 3-1 through 3-13 describe the function of each control and indicator.

3.3. JUMPER SETTINGS

Before an RFL 9505 station can be placed into continuous service, jumpers must be set on some of the modules, on the two interconnection boards at the rear of the 95 CHAS Chassis, and in the 95 RF LINE INTERFACE Rf Line Interface Assembly. Paragraphs 3.3.1 through 3.3.5 describe the jumper settings that must be made.

NOTE

All RFL 9505 terminals have their jumpers set at the factory, if operating conditions are specified at time of purchase. Jumpers will only have to be set in the field if operating conditions were not specified, if a change in operating parameters is desired, or if a replacement module is being installed.

3.3.1. 95 MODEM Modulator/Demodulator Modules

There are two jumpers on the 95 MODEM Modulator/Demodulator Module, which are used while testing or aligning the demodulator section of the module. Figure 3-2 on page 3-4 shows the location of these jumpers. Jumper J101 selects the source for the AGC voltage. Position A is the testing position; it allows potentiometer R198 to manually adjust the AGC voltage. For normal AGC operation, place J101 in Position B.

Jumper J104 determines whether or not the voltage produced by the AGC circuit will be present at pin B5 of connector P2. For normal operation, the IN position is selected.

Additional jumpers on the interconnect and interface boards in the 95 CHAS chassis affect the performance of the 95 MODEM. These jumpers are described in paragraph 3.3.4.

3.3.2. 95 AF LINE TERM Audio Termination Module

There are two sets of jumpers on the 95 AF LINE TERM module for each channel: one set for switch mode selection, and one set for balance network selection. Figure 3-3 on page 12-6 shows the location of these jumpers.

NOTE

One 95 AF LINE TERM module is used with two 95 MODEM modules. It is mounted in the chassis between the modem modules. The term "Channel 1" refers to the modem mounted to the right of the 95 AF LINE TERM; "Channel 2" refers to the modem to the left, as viewed from the front of the chassis.

<u>a. Switch Mode Selection Jumpers</u>. Jumpers J1 through J4 determine whether or not Channel 1 can be externally switched between two-wire and four-wire operation. Jumpers J13 through J16 perform the same function for Channel 2.

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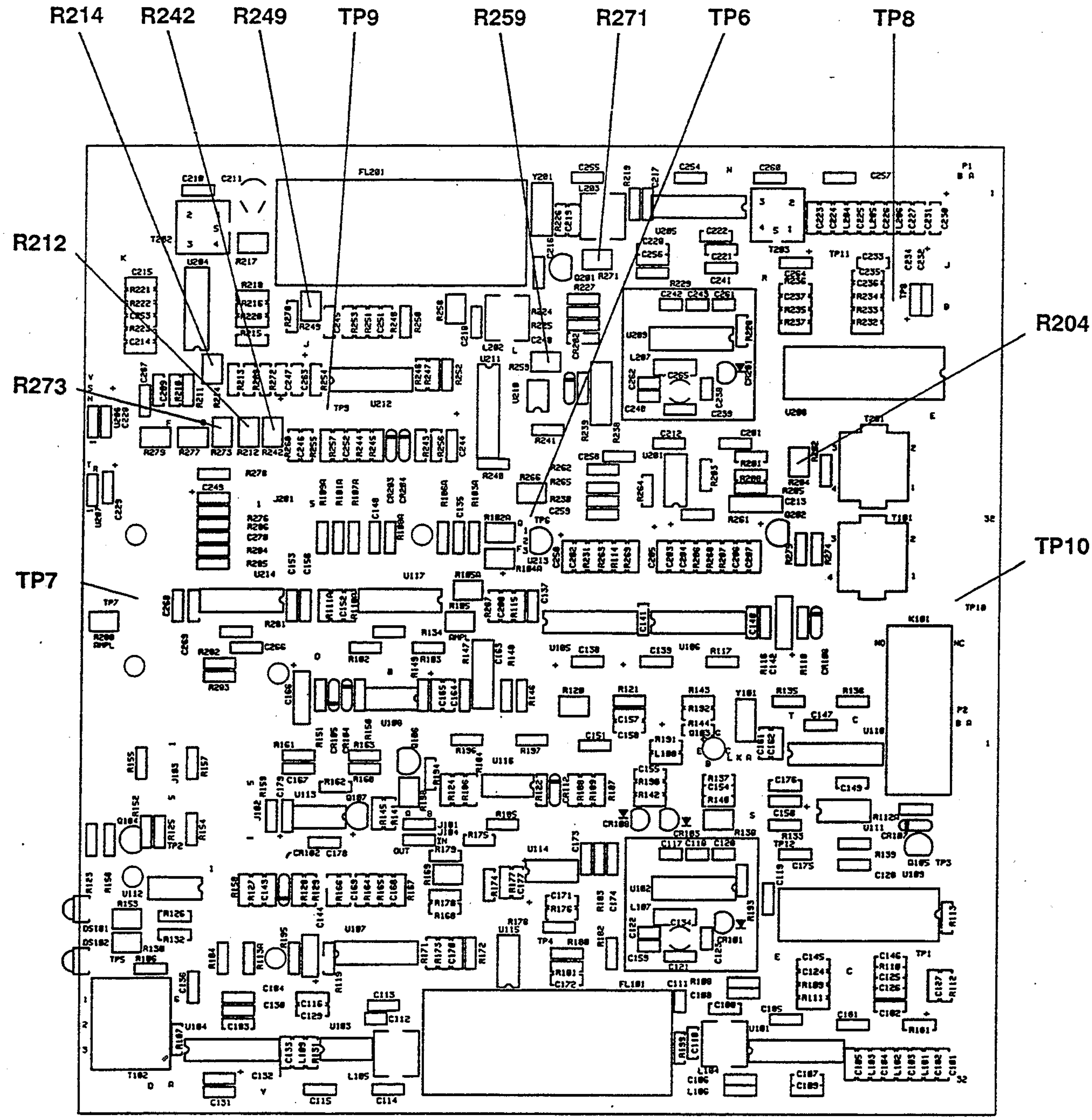


Figure 3-1. Modulator section controls and indicators, 95 MODEM Modulator/Demodulator Module

Table 3-1. Modulator section controls and indicators, 95 MODEM Modulator/Demodulator Module

CAUTION

The controls listed in this table and in Table 3-2 are the only ones on the 95 MODEM that can be adjusted in the field. All other controls on the 95 MODEM are not field-adjustable; they have been set and sealed at the factory, and cannot be re-adjusted in the field. Any attempt to re-adjust a control that is not field-adjustable may result in system malfunctions.

Circuit Symbol	Description, Marking (if any)	Functional Description
R204	Potentiometer	Sets clipping level.
R212	Potentiometer	Sets speech level for proper channel rf output level.
R214	Potentiometer	Adjusts carrier balance.
R242	Potentiometer	Sets output level for signaling transmitter.
R249	Potentiometer	Sets signaling transmitter frequency.
R259	Potentiometer	Adjusts carrier level when carrier is re-inserted.
R271	Potentiometer	Sets composite output level.
R273	Potentiometer	Controls SPEECH PLUS IN input level.
TP6	Test turret	Output of operational amplifier U201B.
TP7	Test turret	Output of operational amplifier U214B.
TP8	Test turret	Input to modulator section synthesizer.
TP9	Test turret	Output of signaling transmitter.
TP10	Test turret	Ground.

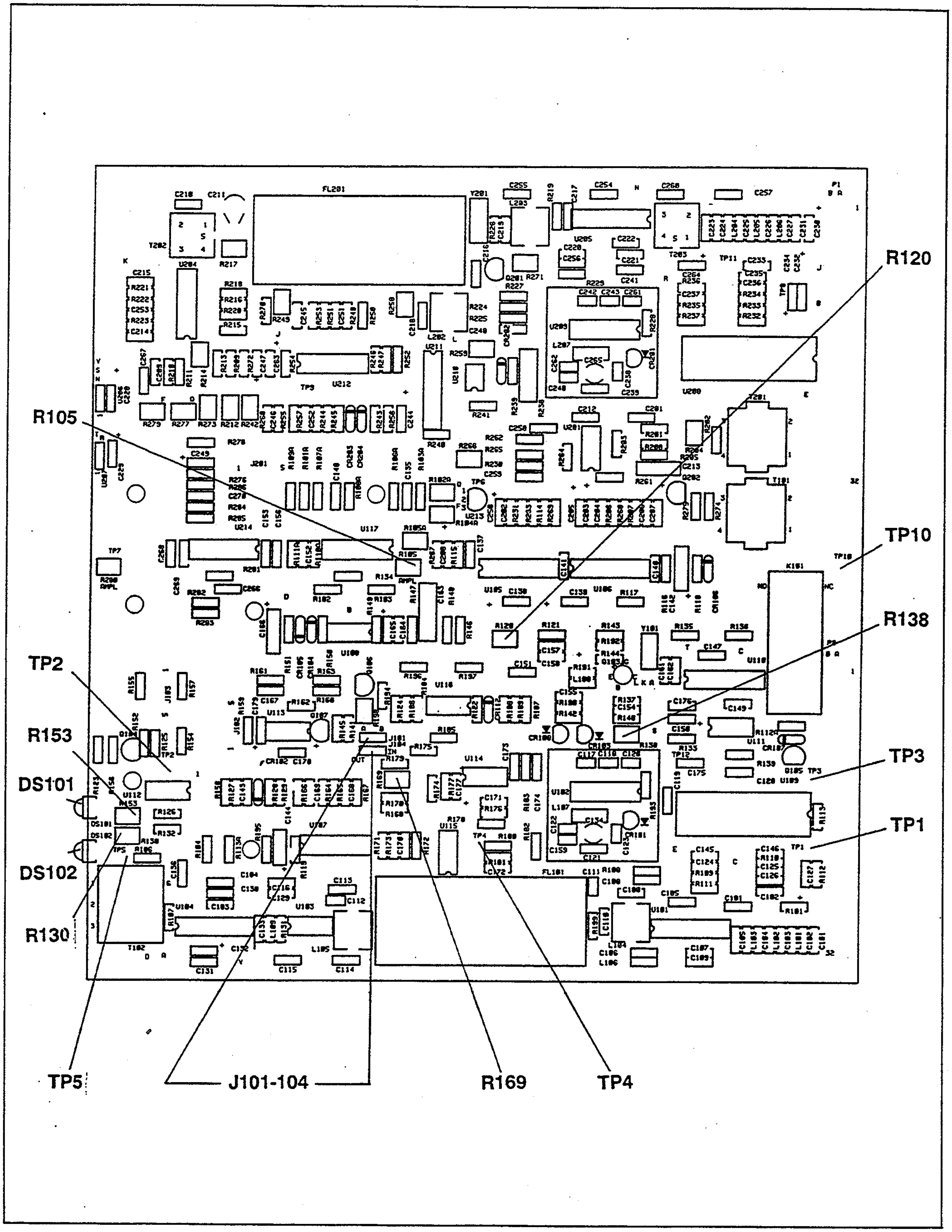


Figure 3-2. Demodulator section controls and indicators, 95 MODEM Modulator/Demodulator Module

Table 3-2. Demodulator section controls and indicators, 95 MODEM Modulator/Demodulator Module

CAUTION

The controls listed in this table and in Table 3-1 are the only ones on the 95 MODEM that can be adjusted in the field. All other controls on the 95 MODEM are not field-adjustable; they have been set and sealed at the factory, and cannot be re-adjusted in the field. Any attempt to re-adjust a control that is not field-adjustable may result in system malfunctions.

Circuit Symbol	Description, Marking (if any)	Functional Description
DS101	Indicator, AGC	Lights when incoming carrier level is below or above set limit.
DS102	Indicator, S/N	Lights when incoming s/n ratio is below set limit.
J101,104	. . .	See paragraph 3.3.1.
R105	Potentiometer	Sets speech-plus output level.
R120	Potentiometer, CARRIER ALARM	Sets carrier alarm trip point.
R130	Potentiometer, AGC	Adjusts audio output.
R138	Potentiometer, FREQ ADJ	Sets nominal carrier oscillator frequency.
R153	Potentiometer	Sets S/N Alarm trip point.
R169	Potentiometer, BIAS DISTORTION	Sets FSK receiver center frequency.
TP1	Test turret	Input to demodulator section synthesizer.
TP2	Test turret	Bias input to S/N ratio alarm circuit.
TP3	Test turret	EXT SYNCH signal.
TP4	Test turret	Output of phase detector circuit in signaling receiver.
TP5	Test turret	Input to FSK bandpass filter.
TP10	Test turret	Signal ground.

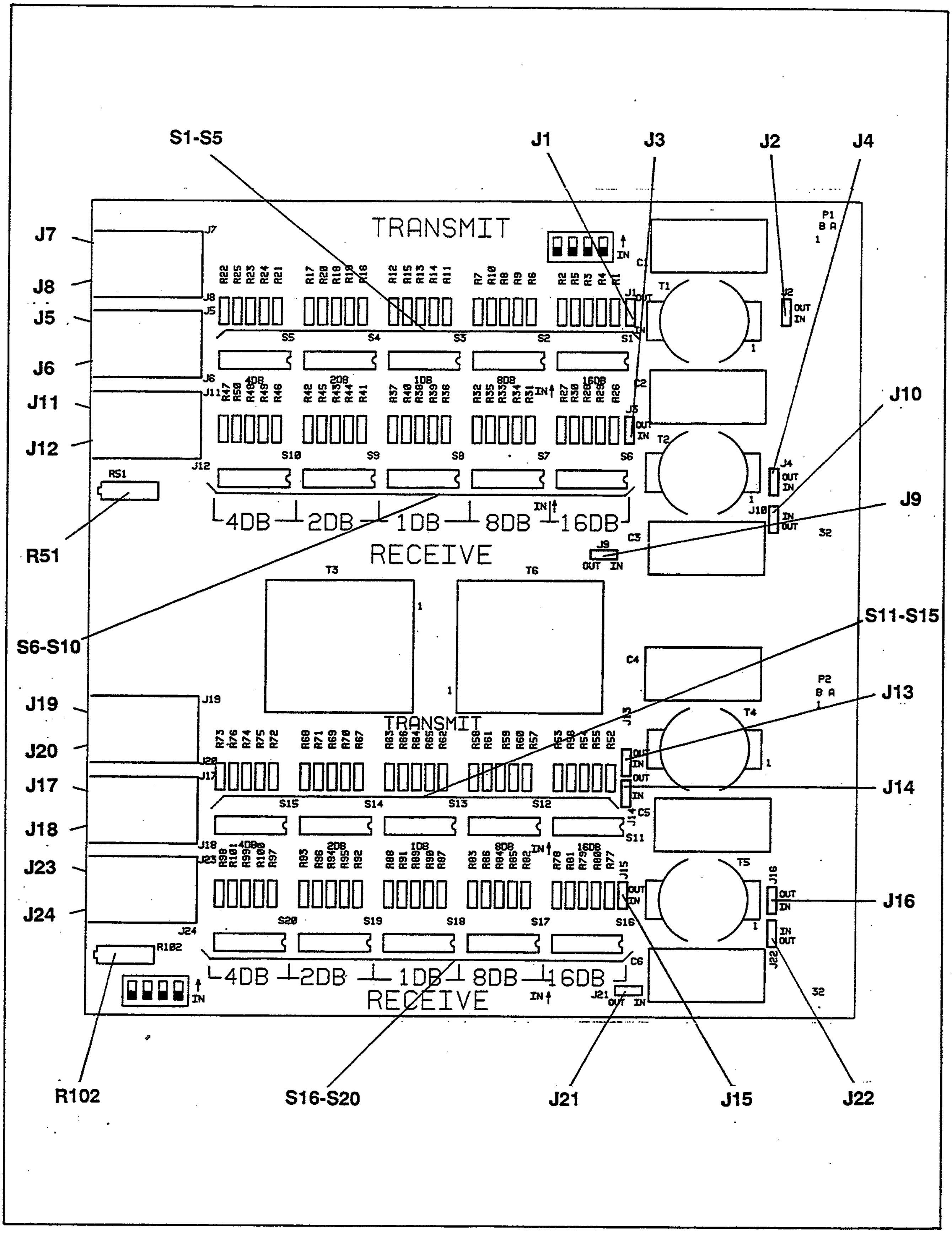


Figure 3-3. Controls and indicators, 95 AF LINE TERM Audio Termination Module

Table 3-3. Controls and indicators, 95 AF LINE TERM Audio Termination Module

NOTE

One 95 AF LINE TERM module is used with two 95 MODEM modules, and is mounted in the chassis between the modem modules. The term "Channel 1" refers to the modem mounted to the right of the 95 AF LINE TERM, and "Channel 2" refers to the modem mounted to the left, as viewed from the front of the chassis.

Circuit Symbol	Description, Marking (if any)	Functional Description
J1-J4	Jumpers	Select Channel 1 switch mode. (See paragraph 3.3.2.)
J5	Telephone jack, 4W XMTR EQUIP	Monitoring point for signal applied to Channel 1 modem input by external equipment.
J6	Telephone jack, 4W XMTR LINE	Allows test signal to be injected into the Channel 1 communications equipment with the line disconnected.
J7	Telephone jack, 2W DROP EQUIP	Allows test signal to be applied to Channel 1 two-wire drop.
J8	Telephone jack, 2W DROP MON	Monitoring point for signal applied to Channel 1 two-wire drop.
J9,J10	Jumpers	Determine whether internal or external balance network is used for Channel 1. (See paragraph 3.3.2.)
J11	Telephone jack, 4W RCVR EQUIP	Allows a test signal to be applied to the Channel 1 external equipment.
J12	Telephone jack, 4W RCVR LINE	Allows the output of the Channel 1 modem to be checked while disconnected from the external equipment.
J13-J16	Jumpers	Select Channel 2 switch mode. (See paragraph 3.3.2.)
J17	Telephone jack, 4W XMTR EQUIP	Monitoring point for signal applied to Channel 2 modem input by external equipment.
J18	Telephone jack, 4W XMTR LINE	Allows test signal to be injected into the Channel 2 communications equipment with the line disconnected.
J19	Telephone jack, 2W DROP EQUIP	Allows test signal to be applied to Channel 2 two-wire drop.
J20	Telephone jack, 2W DROP MON	Monitoring point for signal applied to Channel 2 two-wire drop.
J21,J22	Jumpers	Determine whether internal or external balance network is used for Channel 2. (See paragraph 3.3.2.)
J23	Telephone jack, 4W RCVR EQUIP	Allows a test signal to be applied to the Channel 2 external equipment.
J24	Telephone jack, 4W RCVR LINE	Allows the output of the Channel 2 modem to be checked while disconnected from the external equipment.
R51	Potentiometer, INT BAL --->	Adjusts the internal balance network for Channel 1.
R102	Potentiometer, INT BAL <---	Adjusts the internal balance network for Channel 2.
S1-S5	Switches	Control the Channel 1 transmit attenuators. (See paragraph 3.4.)
S6-S10	Switches	Control the Channel 1 receive attenuators. (See paragraph 3.4.)
S11-S15	Switches	Control the Channel 2 transmit attenuators. (See paragraph 3.4.)
S16-S20	Switches	Control the Channel 2 receive attenuators. (See paragraph 3.4.)

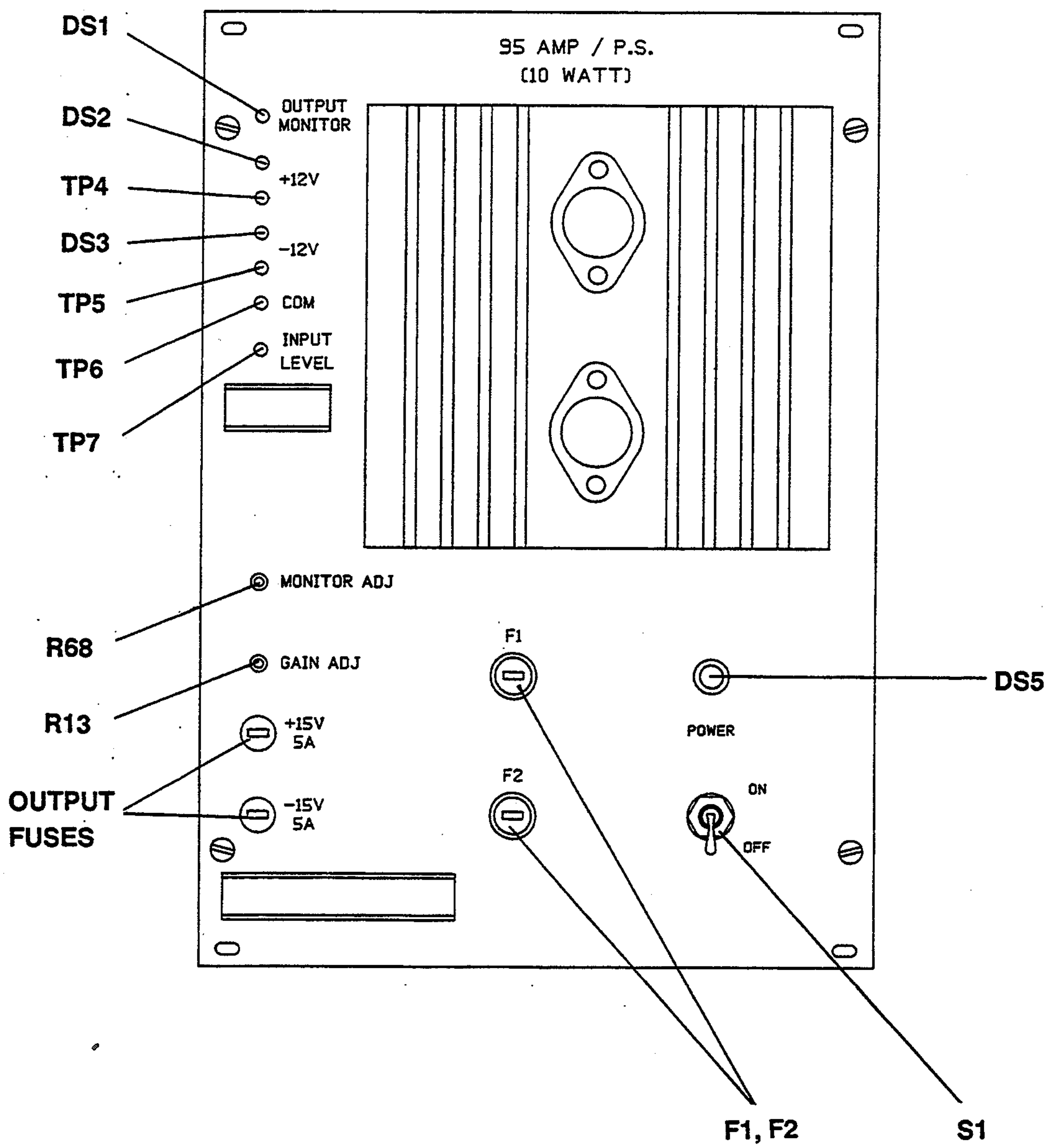


Figure 3-4. Front panel controls and indicators, 95 AMP/PS 10-Watt Amplifier/Power Supply

Table 3-4. Front panel controls and indicators, 95 AMP/PS 10-Watt Amplifier/Power Supply

Circuit Symbol	Description, Marking (if any)	Functional Description
DS1	Indicator, OUTPUT MONITOR	Lights when output alarm circuit trips.
DS2	Indicator, +12	Lights when +12-volt supply is working.
DS3	Indicator, -12	Lights when -12-volt supply is working.
DS5	Indicator, POWER	Lights when station battery voltage is applied.
F1,F2	Fuses	Input current protection.
R13	Potentiometer, GAIN ADJ	Controls gain of second stage of preamplifier.
R68	Potentiometer, MONITOR ADJ	Sets output alarm trip point.
S1	Switch, POWER ON/OFF	Applies station battery voltage to power supply section.
TP4	Test point, +12V	Output of +12-volt supply.
TP5	Test point, -12V	Output of -12-volt supply.
TP6	Test point, COMM	Chassis ground.
TP7	Test point, INPUT LEVEL	Input to power amplifier.
. . .	Output fuses	Current protection for $\pm$15-volt dc-dc converter outputs.

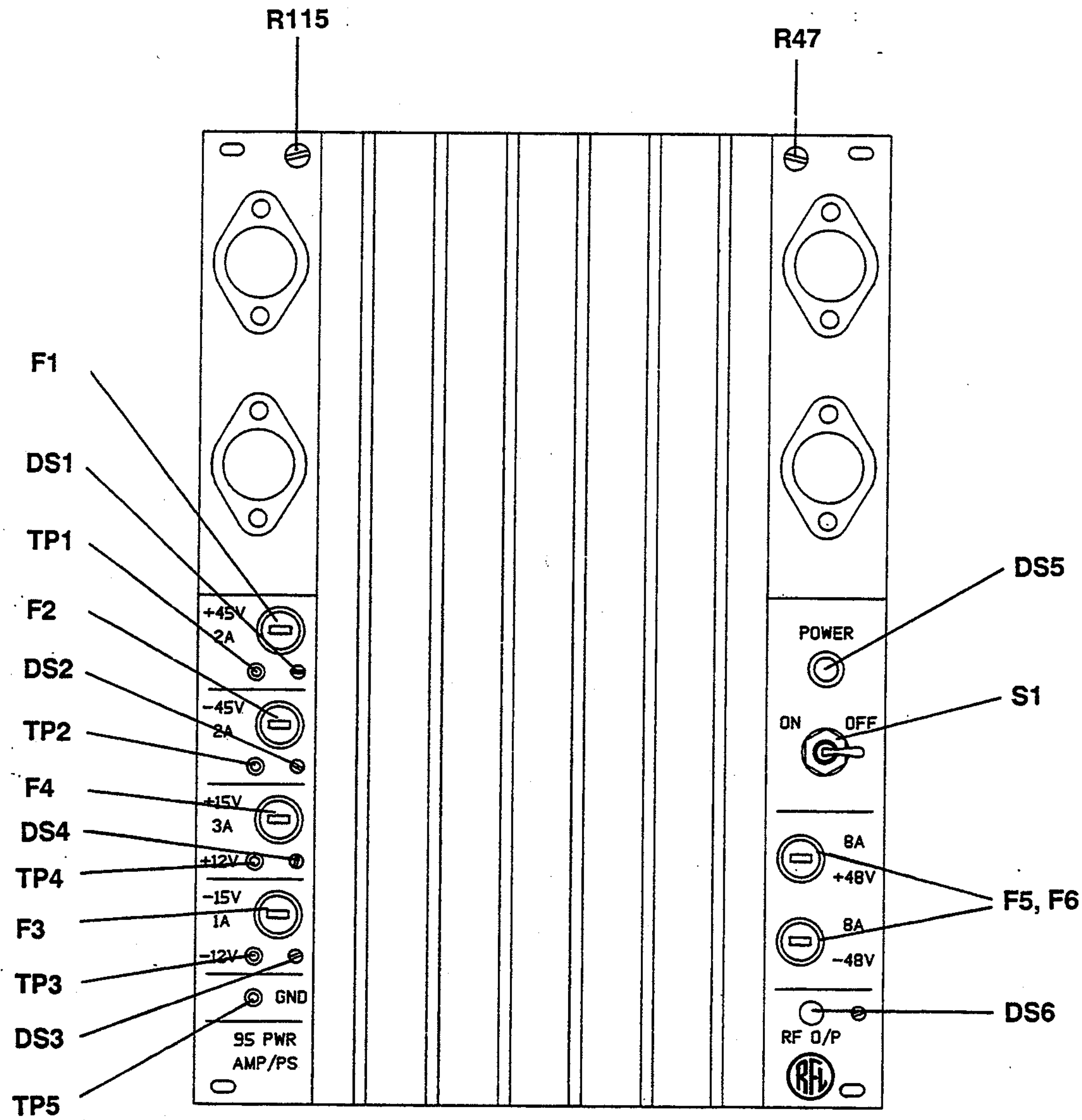


Figure 3-5. Front panel controls and indicators, 95 PWR AMP/PS 50-Watt Amplifier/Power Supply

Table 3-5. Front panel controls and indicators, 95 PWR AMP/PS 50-Watt Amplifier/Power Supply

Circuit Symbol	Description, Marking (if any)	Functional Description
DS1	Indicator, +45V	Lights when +45-volt supply is working.
DS2	Indicator, -45V	Lights when -45-volt supply is working.
DS3	Indicator, -12V	Lights when -12-volt supply is working.
DS4	Indicator, +12V	Lights when +12-volt supply is working.
DS5	Indicator, POWER	Lights when station battery voltage is applied.
DS6	Indicator, RF O/P	Lights when amplifier output is OK.
F1	Fuse, +45V/2A	Current protection for +45-volt supply.
F2	Fuse, -45V/2A	Current protection for -45-volt supply.
F3	Fuse, -12V/3A	Current protection for -12-volt supply.
F4	Fuse, +12V/3A	Current protection for +12-volt supply.
F5,F6	Fuses, **V/2A	Input current protection.
R47	Potentiometer	Determines trip point for output alarm circuit.
R115	Potentiometer	Controls gain of second stage of preamplifier.
S1	Switch	Applies station battery voltage to power supply section.
TP1	Test point, +45V	Output of +45-volt supply.
TP2	Test point, -45V	Output of -45-volt supply.
TP3	Test point, -12V	Output of -12-volt supply.
TP4	Test point, +12V	Output of +12-volt supply.
TP5	Test point, GND	Chassis ground.

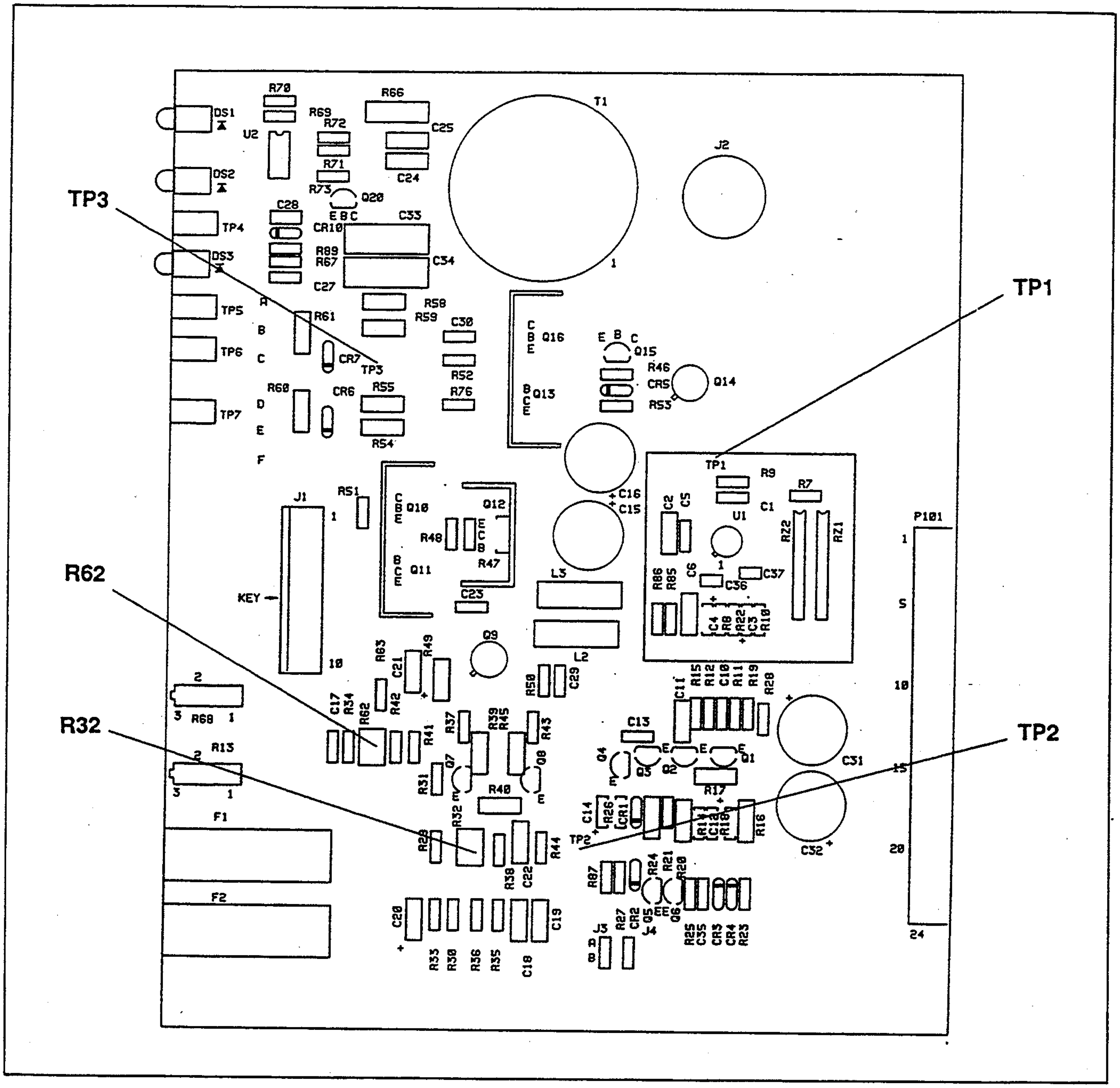


Figure 3-6. Controls and indicators, 10-watt amplifier assembly for 95 AMP/PS 10-Watt Amplifier/Power Supply

Table 3-6. Controls and indicators, 10-watt amplifier assembly for 95 AMP/PS 10-Watt Amplifier/Power Supply

Circuit Symbol	Description, Marking (if any)	Functional Description
R32	Potentiometer, DC OFFSET NULL	Controls dc offset voltage from power amplifier.
R62	Potentiometer	Controls output impedance of power amplifier.
TP1	Test turret	Output of first stage.
TP2	Test turret	Output of second stage.
TP3	Test turret	Output of power stage.

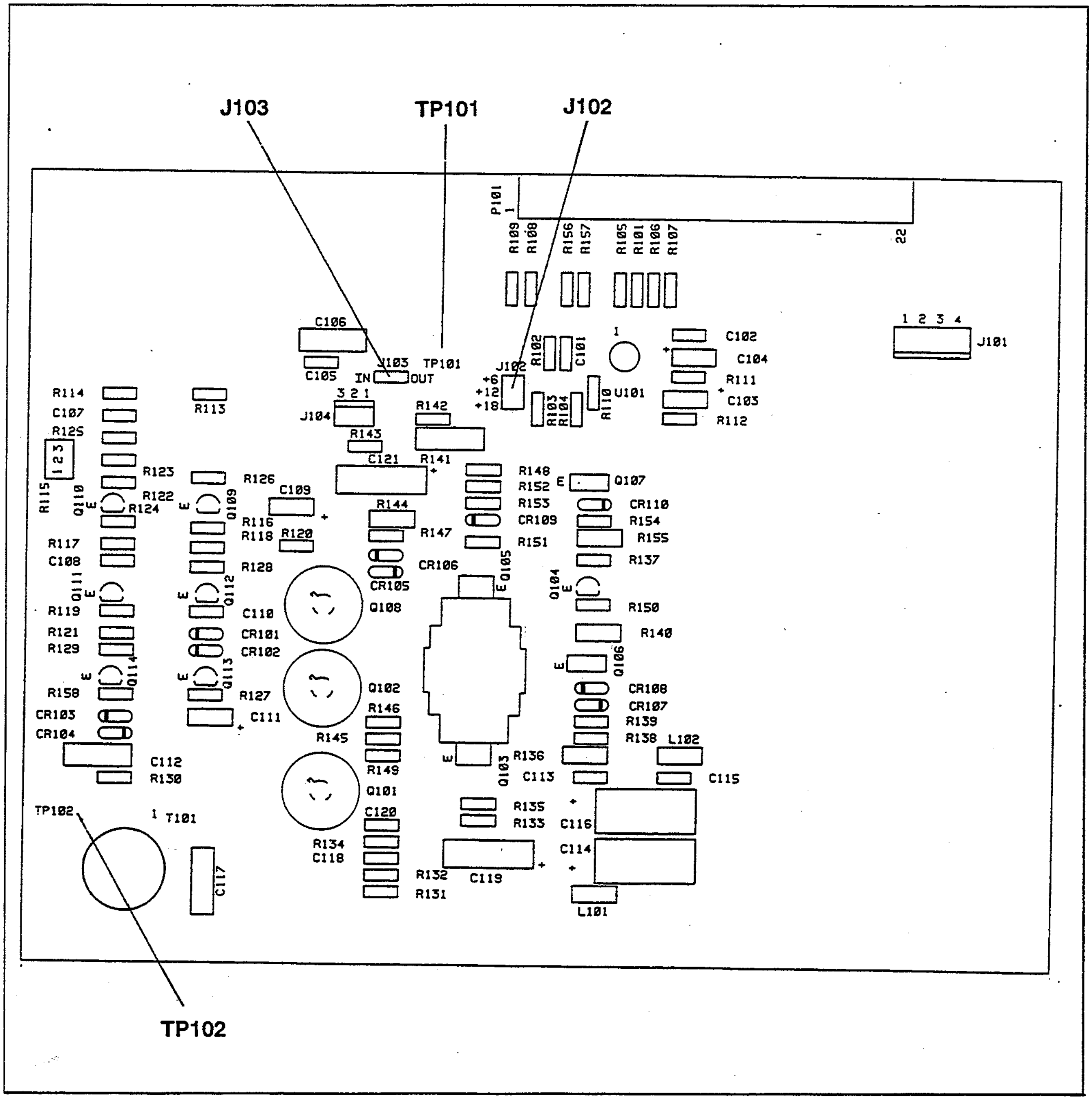
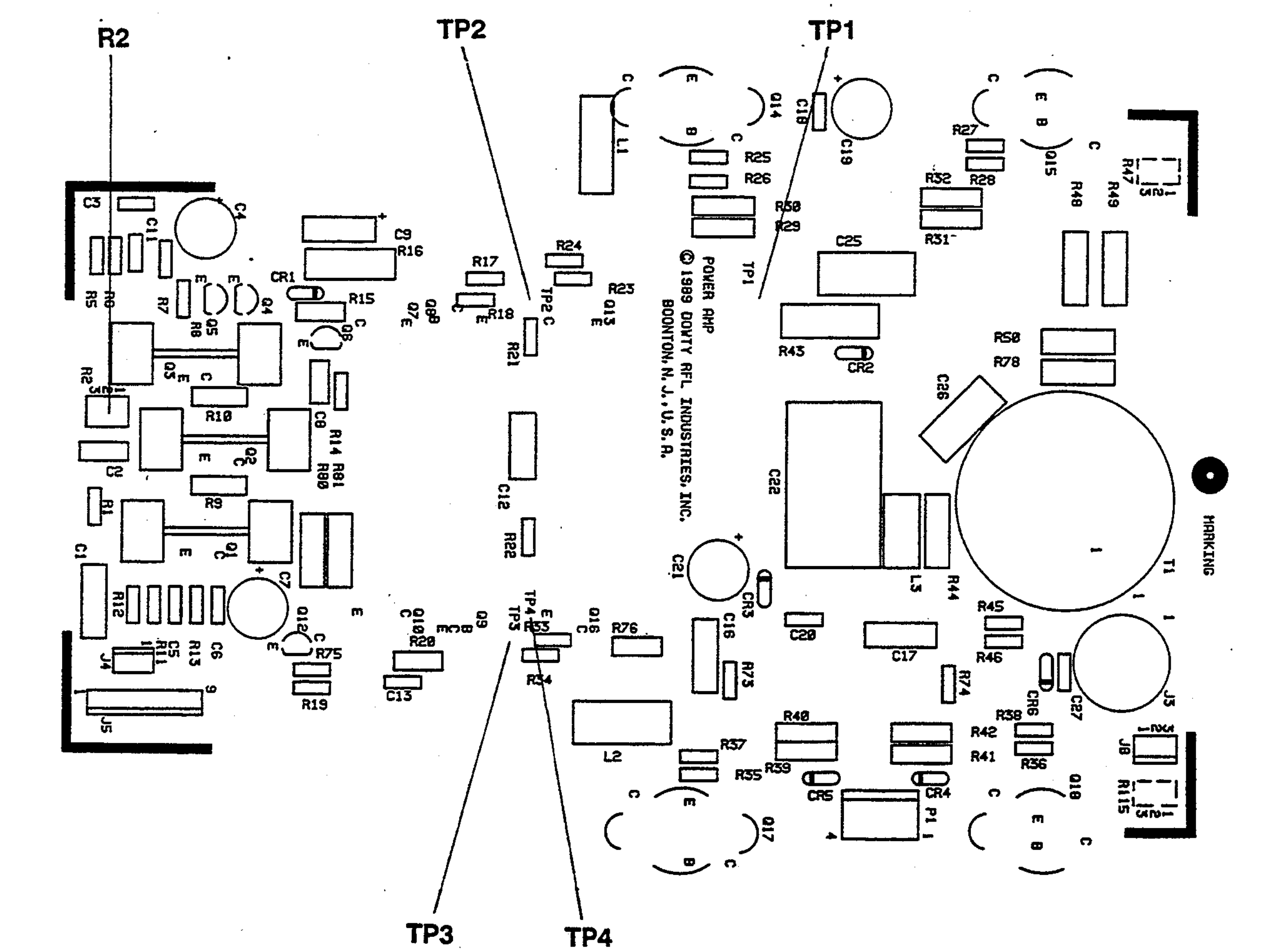


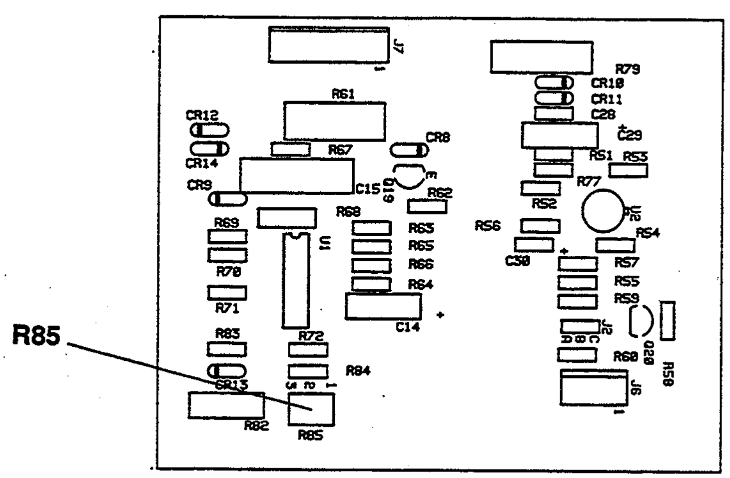
Figure 3-7. Controls and indicators, driver module for 95 PWR AMP/PS 50-Watt Amplifier/Power Supply

Table 3-7. Controls and indicators, driver module for 95 PWR AMP/PS 50-Watt Amplifier/Power Supply

Circuit Symbol	Description, Marking (if any)	Functional Description
J102	Jumper, +6/+12/+18	Sets gain of first stage to +6 dB, +12 dB, or +18 dB.
J103	Jumper, IN/OUT	Enables or disables auxiliary output line.
TP101	Test turret	Output of first stage.
TP102	Test turret	Output of second stage.



a. Primary board.



b. Secondary board.

Figure 3-8. Controls and indicators, 50-watt amplifier assembly for 95 PWR AMP/PS 50-Watt Amplifier/Power Supply

Table 3-8. Controls and indicators, 50-watt amplifier assembly for 95 PWR AMP/PS 50-Watt Amplifier/Power Supply

Circuit Symbol	Description, Marking (if any)	Functional Description
R2	Potentiometer	Limits power amplifier input level.
R85	Potentiometer	Controls maximum power output limit.
TP1	Test turret	Dc output of amplifier.
TP2	Test turret	Bias voltage on base of transistor Q13.
TP3	Test turret	Bias voltage on base of transistor Q16.
TP4	Test turret	Ground point.

NOTE

If a multimeter is connected from TP2 to TP4, the base bias voltage on transistor Q13 can be measured; connecting the multimeter from TP3 to TP4 will provide this measurement for Q16. If the multimeter is connected from TP2 to TP3, the zero-crossing bias voltage across transistors Q8 and Q9 can be measured.

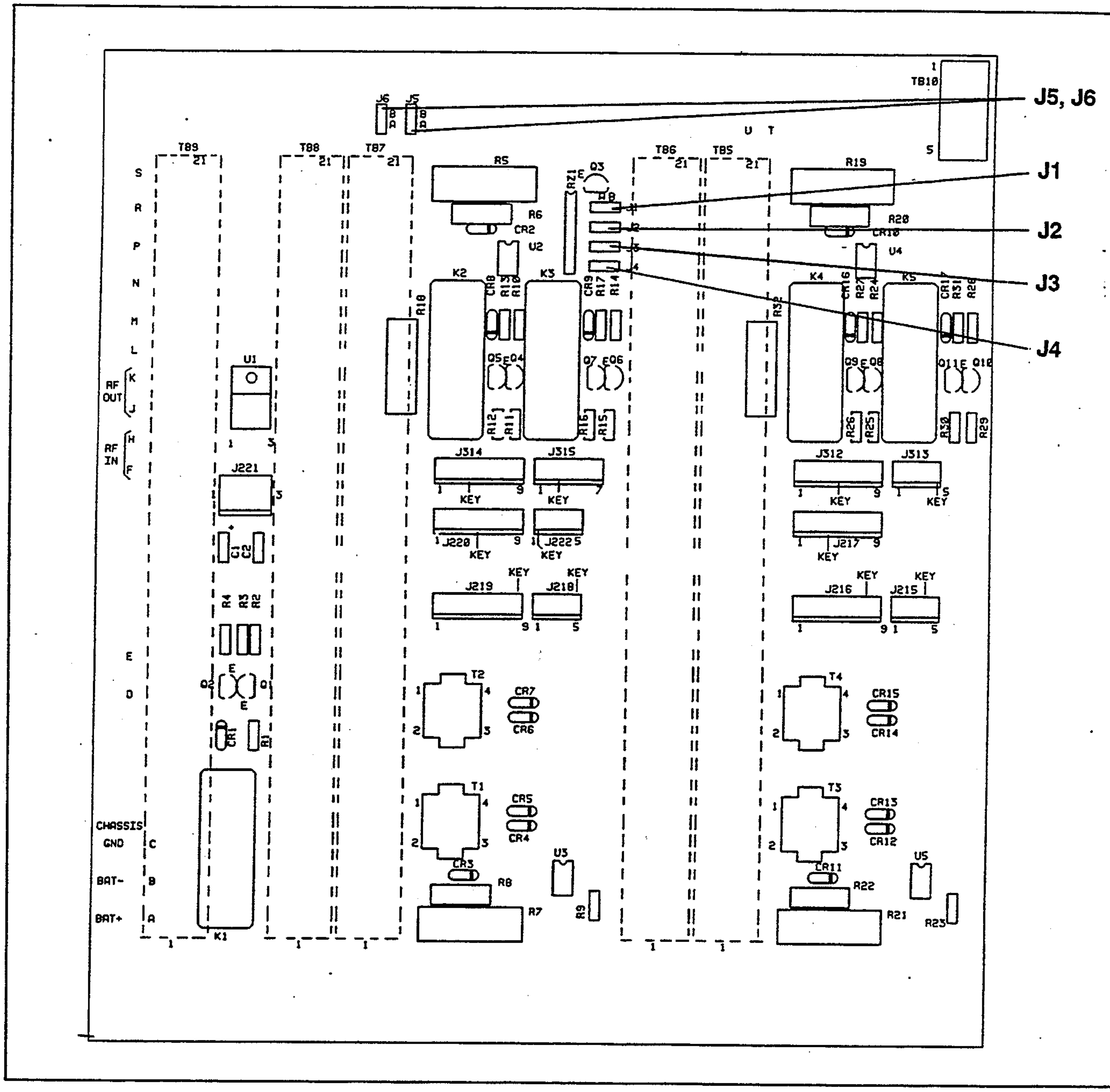


Figure 3-9. Controls and indicators, RFL 9505 chassis interface boards

Table 3-9. Controls and indicators, RFL 9505 chassis interface boards

Circuit Symbol	Description, Marking (if any)	Functional Description
J1	Pilot kill jumper	Enables or disables the pilot kill feature. (See para 3.3.4.2.)
J2	Speech kill jumper	Enables or disables the speech kill feature. (See para 3.3.4.2.)
J3	Exalt jumper	Enables or disables the exalt feature. (See para 3.3.4.2.)
J4	Kill jumper	Enables or disables the kill feature. (See para 3.3.4.2.)
J5,J6	Talk battery jumper	Installed when RFL 9505 is used with an external talk battery. (See para 3.3.4.2.)

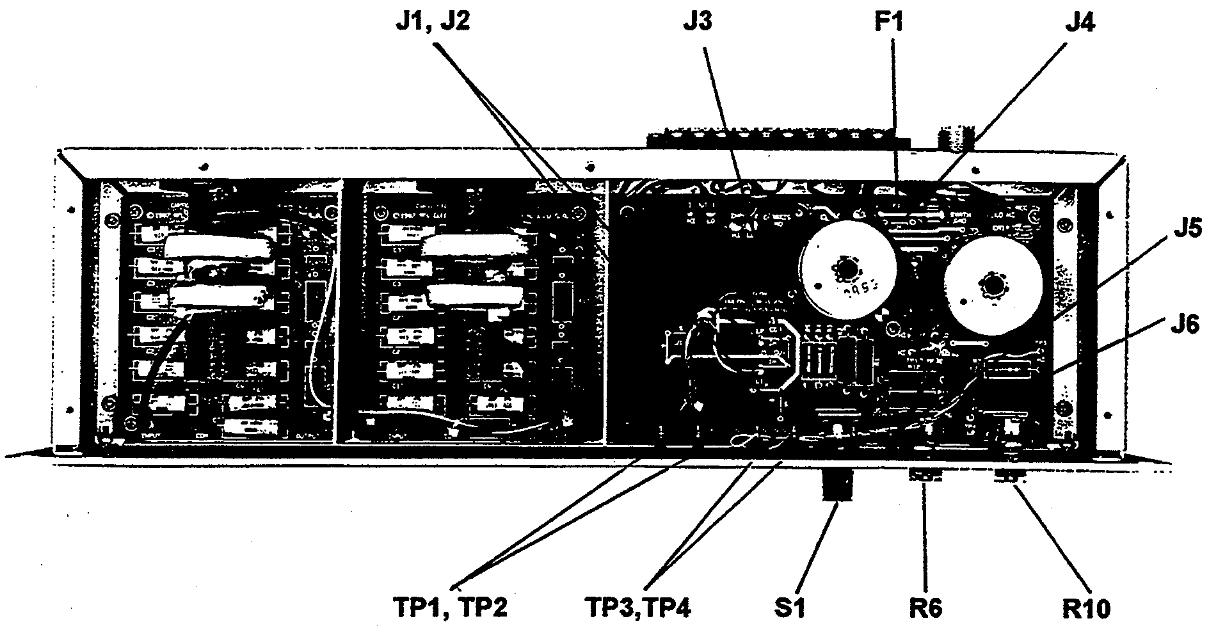


Figure 3-10. Controls and indicators, 95 RF LINE INTERFACE Line Interface Assembly

Table 3-10. Controls and indicators, 95 RF LINE INTERFACE Line Interface Assembly

Circuit Symbol	Description, Marking (if any)	Functional Description
F1	Fuse	Current protection for rf output signal.
J1,J2	Transmit input connection jumpers	Determine whether secondaries of transmit input signal transformers T1 and T4 are connected in parallel (both jumpers in position P) or series (both jumpers in position S).
J3	Filter enabling jumpers	Used to connect high-power bandpass filter in series with transmit input or bypass the filter.
J4	Fuse bypass jumper	When in place, fuse F1 is bypassed.
J5	Balance network jumpers	Enables or disables the internal balance network.
J6	SENS jumper	Coarse adjustment of receive signal input sensitivity (HI or LOW).
R6	Potentiometer, FINE BALANCE	Fine adjustment of balance network.
R10	Potentiometer, RECEIVER LEVEL	Fine adjustment of receive signal input sensitivity.
S1	Switch, COARSE BALANCE	Coarse adjustment of balance network.
TP1,TP2	Test points, SEND HI/LO	Allow rf output signal to be monitored.
TP3,TP4	Test points, RECEIVE HI/LO	Allow rf input signal to be monitored.

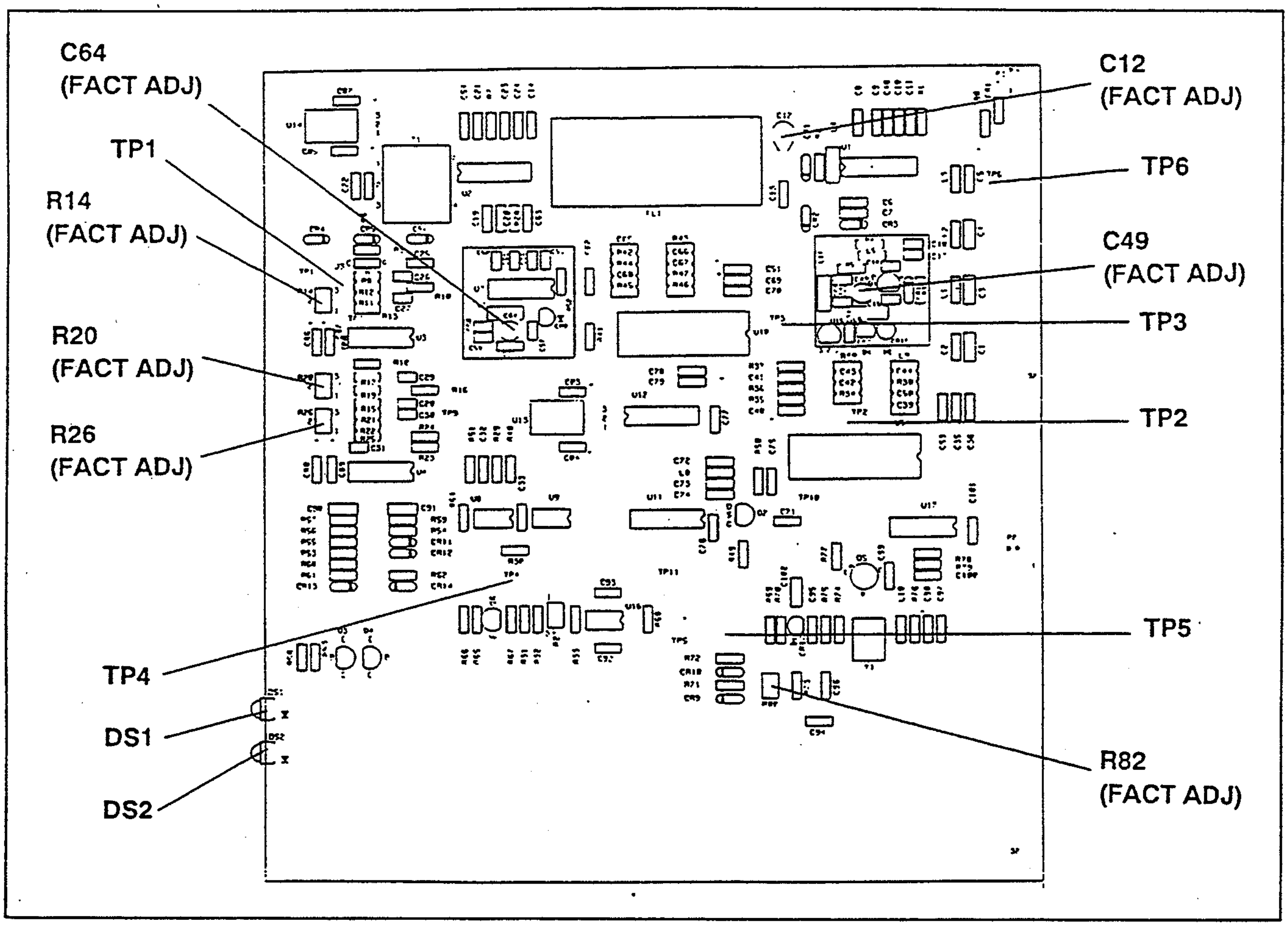


Figure 3-11. Controls and indicators, 95 SYNC Synchronizer Module

Table 3-11. Controls and indicators, 95 SYNC Synchronizer Module

CAUTION

The controls in Figure 3-9 labeled FACT ADJ are set at the factory, and cannot be readjusted in the field. Any attempt to adjust these controls in the field may result in system malfunctions.

Circuit Symbol	Description, Marking (if any)	Functional Description
DS1	Indicator, SIG LOSS	Lights when synthesizers on 95 SYNC card are not phase-locked.
DS2	Indicator, SYNC LOSS	Lights when modems in chassis are not synchronized.
TP1	Test turret	Input to narrow bandpass filter.
TP2	Test turret	Output of phase detector U5.
TP3	Test turret	Output of phase detector U10.
TP4	Test turret	Input to phase comparator U9.
TP5	Test turret	Output of phase comparator U9.
TP6	Test turret	Ground point.

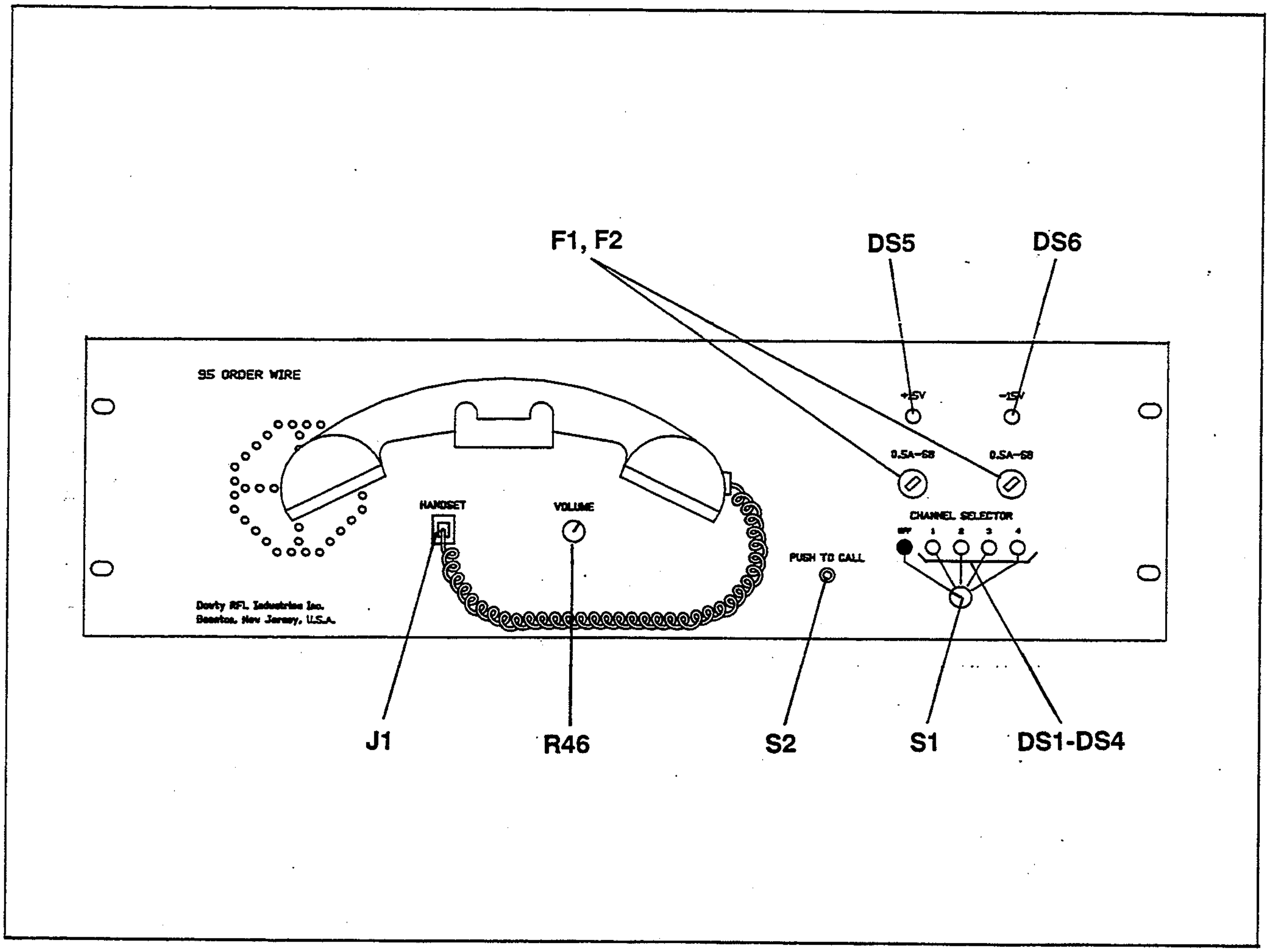


Figure 3-12. Controls and indicators, 95 ORDERWIRE Service Phone Assembly

Table 3-12. Controls and indicators, 95 ORDERWIRE Service Phone Assembly

Circuit Symbol	Description, Marking (if any)	Functional Description
DS1-DS4	Call indicators	Light when calls are received. One indicator is provided for each channel.
DS5	Indicator, +15V	Lights when +15-volt input is applied to unit.
DS6	Indicator, -15V	Lights when -15-volt input is applied to unit.
F1,F2	Fuses	Input current protection for unit.
J1	Modular connector	Mating connector for handset.
R46	Potentiometer, VOL CONT	Volume control for loudspeaker.
S1	Switch, CHANNEL SELECTOR	Selects the channel to be used for voice communication.
S2	Switch, PUSH TO CALL	Sends signaling tone to distant station.
...	Handset	Allows operator to talk and listen.
...	Hookswitch	Cradle for handset; call is terminated when handset is placed in cradle.
...	Loudspeaker	Allows operator to listen without holding handset.

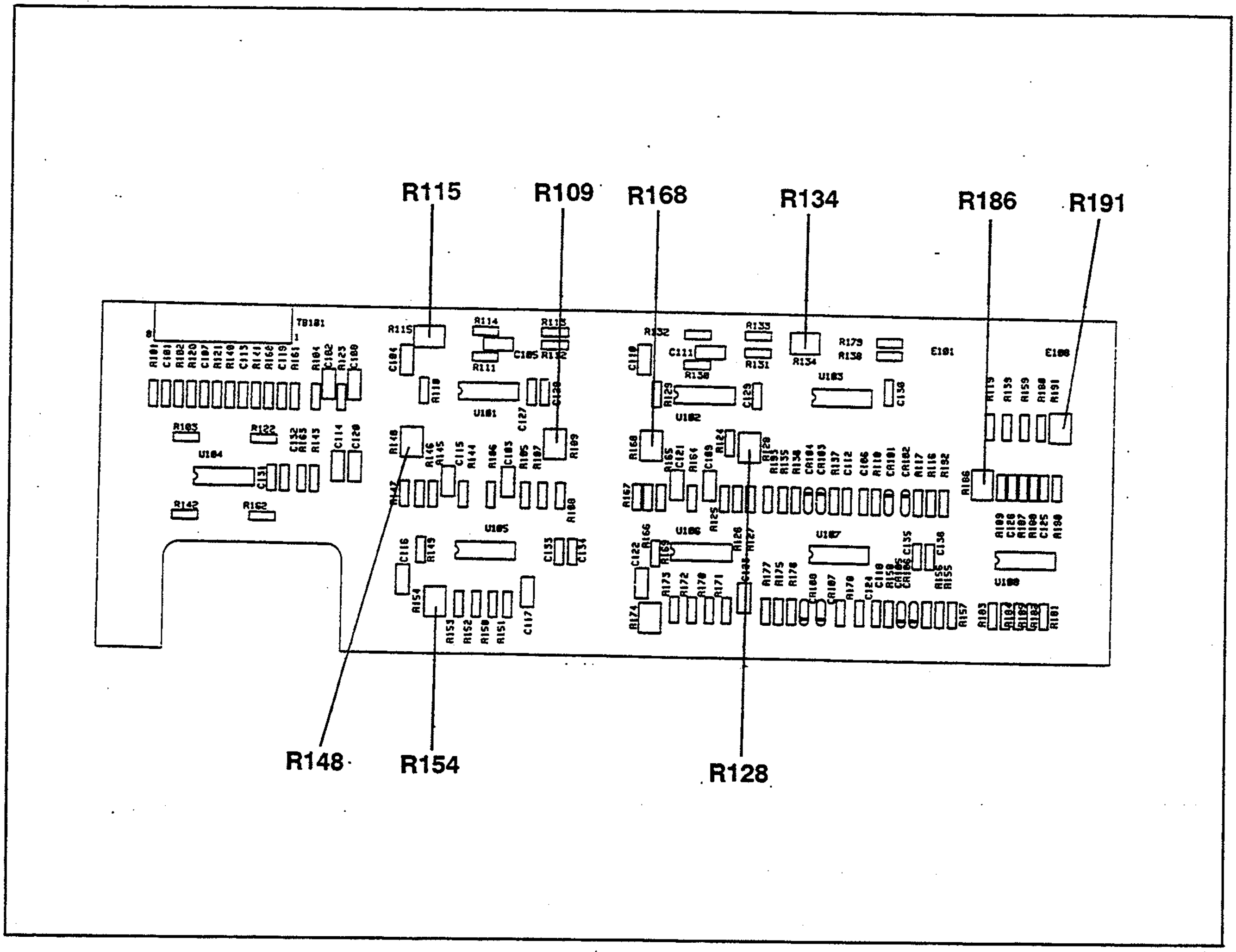


Figure 3-13. Controls and indicators, ring option for 95 ORDERWIRE

Table 3-13. Controls and indicators, ring option for 95 ORDERWIRE

Circuit Symbol	Description, Marking (if any)	Functional Description
R109	Potentiometer	First-stage gain adjustment for call input #1.
R115	Potentiometer	Second-stage gain adjustment for call input #1.
R128	Potentiometer	First-stage gain adjustment for call input #2.
R134	Potentiometer	Second-stage gain adjustment for call input #2.
R148	Potentiometer	First-stage gain adjustment for call input #3.
R154	Potentiometer	Second-stage gain adjustment for call input #3.
R168	Potentiometer	First-stage gain adjustment for call input #4.
R174	Potentiometer	Second-stage gain adjustment for call input #4.
R186	Potentiometer	Frequency adjustment for 3.6-kHz oscillator.
R191	Potentiometer	Call signal output level adjustment.

b. Balance Network Selection Jumpers. Jumpers J9 and J10 determine which balance network is used for Channel 1; jumpers J21 and J22 perform this function for Channel 2. With these jumpers in the IN position, the internal balance network mounted on the module is used; when they are in the OUT position, an external balance network is used.

3.3.3. 95 PWR AMP/PS

There is a jumper on the driver module in the 95 PWR AMP/PS 50-Watt Amplifier/Power Supply, labeled J102. Figure 3-7 on page 3-13 shows where J102 is located. J102 sets the first stage's gain to one of three ranges: low (+6 dB), medium (+12 dB), or high (+18 dB). Once a range is selected, GAIN potentiometer R115 on the front panel of the 95 PWR AMP/PS is adjusted to set the gain to the exact amount required.

3.3.4. 95 CHAS

Jumpers on the chassis interconnecting boards (para 3.3.4.1) and the interface boards (para 3.3.4.2) will have to be set before the RFL 9505 is placed in continuous service.

3.3.4.1. Interconnecting Boards

Jumpers are placed on the mating connectors for the modems and the optional synchronizer module to program each module position for the desired operation parameters.

a. Modem Position Programming. Each modem position in the 95 CHAS chassis is programmed by the placement of jumpers on its mating connectors on the chassis interconnecting boards. (See Figure 3-14.) Once this is done, any modem module inserted into a particular position will adapt itself to the programming of that position.

(1) Frequency Selection. Each 95 MODEM can be programmed to transmit and receive on any frequency from 4 kHz to 512 kHz that is evenly divisible by 4 kHz (4 kHz, 8 kHz, 16 kHz, etc). Pins A14/B14 through A21/B21 of the top mating connector control the transmit frequency, and A14/B14 through A21/B21 on the bottom connector control the receive frequency.

Each pin pair equals a specific frequency. By removing jumpers from across pairs of pins and adding together the frequencies they represent, any frequency from 4 kHz to 512 kHz can be selected. The selected frequency bands are all upper sideband (USB).

	A21/ B21	A20/ B20	A19/ B19	A18/ B18	A17/ B17	A16/ B16	A15/ B15	A14/ B14
	512	256	128	64 -	32	16	8	4
Examples:								
	1	1	0	0	1	0	1	1
				(128 + 64 + 16) = 208 kHz				
	1	0	0	1	0	1	0	1
				(256 + 128 + 32 + 8) = 424 kHz				

1 = Jumper installed
0 = No jumper installed

(2) Audio Balance Selection. If a jumper is placed between pins A32 and B32 of the top connector, the modem installed in that position will have balanced audio outputs. With the jumper removed, an unbalanced output can be used.

(3) Phase Lock Enabling/Disabling. A jumper is placed between pins B6 and B7 of the bottom mating connector for the master modem in systems equipped with the optional 95 SYNC synchronizer; this jumper must be left off all other modem positions throughout the system. If the system does not contain a synchronizer module, this jumper must not be installed on any modem position.

(4) External Sync Enabling/Disabling. If the system is equipped with an optional 95 SYNC synchronizer module, a jumper must be placed between pins A11 and B11 of the bottom mating connector for all modem positions except the master modem. If the system does not contain a synchronizer module, this jumper must not be installed on any modem position.

b. Synchronizer Module Programming. There are no jumpers to be set on the optional 95 SYNC Synchronizer Module itself. However, jumpers will have to be set on the top mating connector in the chassis to determine which incoming frequency the 95 SYNC will monitor.

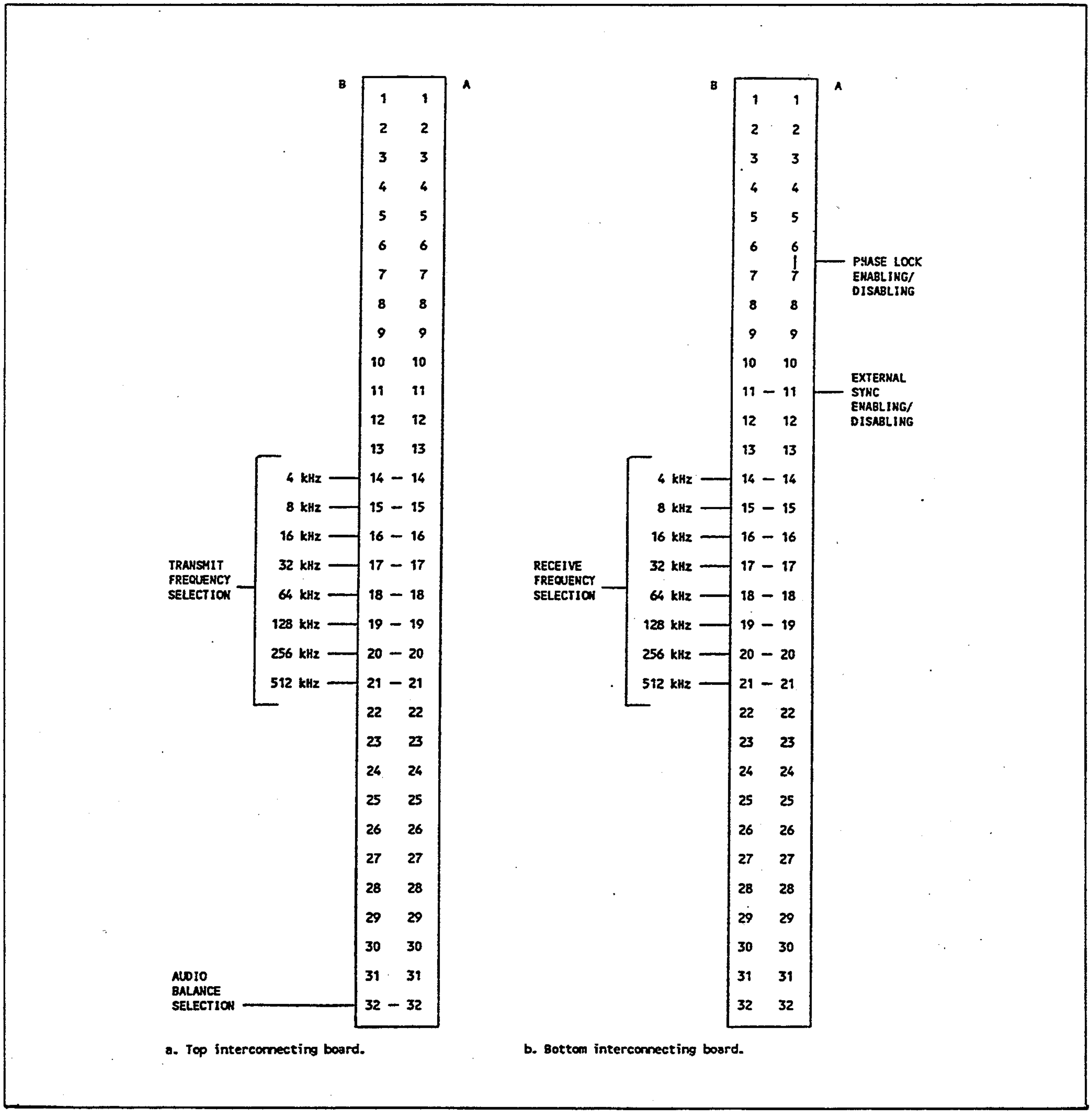


Figure 3-14. Jumper locations on mating connectors for 95 MODEM modules

In order for synchronization to work, the lowest-frequency modems in the RFL 9505 station at the far end of the communication link is designated the "master", and all the other modems must be phase-locked to its reference output. The RF OUTPUT of the master modem's modulator section (at the virtual carrier frequency) will have to be set to -15 dBmo, which is equal to the FS signaling level. (This is done at the factory, or as part of the modem alignment procedure in paragraph 3.8 in this section.) Connect a jumper between B6 and B7 on the master modem's bottom mating connector (PHASE LOCK ENABLE ON/OFF); on all other modems, connect a jumper between A11 and B11 on the lower mating connector (EXTERNAL SYNC ENABLE ON/OFF).

In the RFL 9505 station where the 95 SYNC is installed, a jumper must be connected between A11 and B11 on the lower mating connector for each modem (EXTERNAL SYNC ENABLE ON/OFF). Once this is done, the jumpers across pins A14/B14 through A21/B21 on the 95 SYNC's top mating connector must be set for the master modem's carrier frequency. The method used is the same as for the modem modules themselves; refer to paragraph 3.3.4 for further information.

Each pin pair equals a specific frequency. By removing jumpers from across pairs of pins and adding together the frequencies they represent, any frequency from 4 kHz to 512 kHz can be selected.

3.3.4.2. Interface Boards

There are two interface boards at the rear of each RFL 9505 chassis: the 95 I/O INT Interface Board, and the 95 PWR I/O INT Power Interface Board. There are six jumpers on the 95 PWR I/O INT (J1 to J6) and two on the 95 I/O INT (J5 and J6). Figure 3-9 on page 3-16 shows the location of these jumpers.

a. Pilot Kill Jumper. Jumper J1 on the 95 PWR I/O INT controls pilot kill on stations equipped with this feature. With this jumper placed in Position A, the pilot signal produced by the modems in the RFL 9505 will be disabled when an external PILOT KILL command is received. This feature is disabled when J1 is placed in Position B.

b. Speech Kill Jumper. Jumper J2 on the 95 PWR I/O INT controls the speech kill function. With this jumper placed in Position A, the speech port will be disabled when an external SPEECH KILL command is received. This feature is disabled when J2 is placed in Position B.

c. Exalt Jumper. Jumper J3 on the 95 PWR I/O INT controls the exalt function on stations equipped with this feature. With this jumper placed in Position A, the rf gain of the station will be increased when an external EXALT command is received. At the same time, all other signals are disabled; this is used in teleprotection applications when a trip signal is to be sent. The exalt feature is disabled when J3 is placed in Position B.

d. Kill Jumper. Jumper J4 on the 95 PWR I/O INT controls the speech-plus kill function on stations equipped with this feature. With this jumper placed in Position A, the speech-plus port will be disabled when an external KILL command is received. This feature is disabled when J4 is placed in Position B.

e. Talk Battery Jumpers. Jumpers J5 and J6 are used together to set the RFL 9505 station for use with an external talk battery. With these jumpers placed in Position A, the station can be used with an external talk battery. If a talk battery is not being used, place both jumpers in Position B; this will connect the talk battery lines to the ±15-volt output of the amplifier/power supply.

J5 and J6 on the 95 I/O INT board must be set the same as J5 and J6 on the 95 PWR I/O INT board.

CAUTION

Jumpers J3 and J4 on the 95 RF LINE INTERFACE are for temporary emergency use only. They are used to allow the RFL 9505 station to operate without a bandpass filter or without rf output current protection. If these jumpers must be used to bypass these components, correct the problem as soon as possible and then remove the jumpers to return the terminal to normal operation.

3.3.5. 95 RF LINE INTERFACE

The 95 RF LINE INTERFACE assembly has six jumpers that are used to control its operation. Figure 3-10 on page 3-17 shows where these jumpers are located.

a. Transmit Input Connections. Jumpers J1 and J2 determine whether the secondaries of transmit input signal transformers T1 and T4 are connected in parallel (position P) or series (position S). For proper operation, both jumpers must be set to the same position.

b. Bandpass Filter Enabling. Jumper J3 determines whether the transmit input signal is passed through the high-power bandpass filter (two jumpers in the IN positions) or whether the filter is bypassed (one jumper in the OUT position).

c. Output Fuse Bypass. Fuse F1 is provided for current protection of the rf output. If jumper J4 is installed, F1 is bypassed, and there is no current protection.

d. Balance Network Control. When jumper J5 is in the IN position, the internal balance network is enabled. Switch S1 and potentiometer R6 can then be used to adjust the network for optimum operation. If J5 is placed in the OUT position, the internal balance network is disabled, and an external network must be used.

3.4. SWITCH SETTINGS

There are twenty four-pole, single-throw (4PST) DIP switches on each 95 AF LINE TERM Audio Termination Module, labeled "S1" through "S20." (See Figure 3-3 on page 3-6 for location.) These switches are used to adjust the transmit and receive attenuators.

Each attenuator has five parts, each with a fixed value of attenuation (1, 2, 4, 8, and 16 dB), and one DIP switch is used to control each part. Each part can be switched into the circuit when all the sections of its DIP switch are placed in the IN position, or bypassed when all the sections are placed in the OUT position. The values of the sections that are switched in are then added to determine the total attenuation value. (For example, if the 1, 4, and 16-dB sections are switched in, the total attenuation would be 1 + 4 + 16, or 21 dB.)

DIP switches S1 through S5 control the transmit attenuator for Channel 1 (the modem mounted to the right of the 95 AF LINE TERM in the chassis:

- S1 controls the 16-dB attenuator.
- S2 controls the 8-dB attenuator.
- S3 controls the 1-dB attenuator.
- S4 controls the 2-dB attenuator.
- S5 controls the 4-dB attenuator.

DIP switches S6 through S10 control the receive attenuator for Channel 1:

- S6 controls the 16-dB attenuator.
- S7 controls the 8-dB attenuator.
- S8 controls the 1-dB attenuator.
- S9 controls the 2-dB attenuator.
- S10 controls the 4-dB attenuator.

DIP switches S11 through S15 control the transmit attenuator for Channel 2 (the modem mounted to the left of the 95 AF LINE TERM in the chassis:

- S11 controls the 16-dB attenuator.
- S12 controls the 8-dB attenuator.
- S13 controls the 1-dB attenuator.
- S14 controls the 2-dB attenuator.
- S15 controls the 4-dB attenuator.

DIP switches S16 through S20 control the receive attenuator for Channel 2:

- S16 controls the 16-dB attenuator.
- S17 controls the 8-dB attenuator.
- S18 controls the 1-dB attenuator.
- S19 controls the 2-dB attenuator.
- S20 controls the 4-dB attenuator.

3.5. FREQUENCY-DETERMINING COMPONENTS

Because each 95 MODEM uses digital techniques to determine its operating frequencies, components and subassemblies do not have to be replaced if an operating frequency is to be changed. The jumpers on the interconnect boards in the 95 CHAS Chassis control the frequency at which each modem will transmit and receive. As long as the new frequency is within the frequency limits of the output filter in the 95 RF LINE INTERFACE unit, no hardware changes are required.

If the new frequency is beyond the limits of the output filter, the filter will have to be replaced to assure compliance with IEC standards. Contact the factory for further information.

3.6. CALCULATING TRANSMIT LEVELS

Before attempting the initial startup procedures starting in paragraph 3.7, the required transmit levels must be calculated. Transmit levels are determined by three factors:

1. The PEP output rating of the amplifier/power supply installed in the terminal.

2. The number and type of functions being performed by the terminal (such as speech, data, tones, and signaling).

3. The relative amount of power allocated to each function.

The total amount of power allocated to all of a terminal's functions cannot exceed the total that can be produced by its amplifier/power supply. A voltage factor method is used to determine the power levels for each function. This is done so that if all functions are activated at the same time, the amplifier/power supply will not be overloaded. Voltage factors are then converted to dB to simplify adjustments.

To determine the transmit levels for a terminal, voltage factors are assigned to each function, as shown in Table 3-14. Once voltage factors are assigned, they are totaled. The maximum voltage output of the amplifier/power supply (in rms volts) is calculated, and then converted to dBm. Signal levels are then assigned to each function, based on the power levels listed in Table 3-14.

Table 3-14. Recommended voltage factors for RFL 9505 equipment

Function	Power Level Relative To Test Tone	Voltage Factor
Channel test tone	. . .	1.0
1200-baud data	-5 dBmO	0.562
600-baud data	-10 dBmO	0.316
Narrowband tones	-15 dBmO	0.178
Signaling tones	-15 dBmO	0.178
Synchronization tone	-15 dBmO	0.178

Some of the more common voltage factors are listed in Table 3-15. Custom loading and other special power allocations can be accommodated by adjusting the voltage factors for each function, using the following formula:

Voltage factor = $\log^{-1}$ (-dB below test tone / 20)

Once you have performed all calculations described above, complete the Transmit Level Worksheet in Figure 3-15. The worksheet is then used as a guide when performing the initial startup procedures, which start in paragraph 3.7.

Figure 3-16 shows the worksheet completed for a typical dual-channel terminal with a 50-watt amplifier/power supply and an output impedance of 50 ohms. Channel 1 of this typical system has a channel test tone, a signaling tone, and two speech-plus tones, and Channel 2 has a 1200-baud data tone and a signaling tone.

Table 3-15. Common voltage factors for RFL 9505 functions

Desired Signal Level *	Voltage Factor	Desired Signal Level *	Voltage Factor
0	1.000		
1	0.891	11	0.282
2	0.794	12	0.251
3	0.708	13	0.224
4	0.631	14	0.199
5	0.562	15	0.178
6	0.501	16	0.158
7	0.447	17	0.141
8	0.398	18	0.126
9	0.355	19	0.112
10	0.316	20	0.100

* - In dB below test tone.

3.7. INITIAL STARTUP PROCEDURES

All RFL 9505 terminals are checked and adjusted at the factory. Once all electrical connections have been made and all jumpers and switches have been set, the following procedures are used to start up the terminals at each end of the communication circuit. These procedures can also be performed any time system operation needs to be verified.

Before attempting any of the initial startup procedures, you must know the following information:

1. The available station battery voltage.
2. The audio signal levels that are produced by the external equipment connected to the RFL 9505's input terminals.
3. The audio signal input requirements for the external equipment connected to the RFL 9505's output terminals.
4. The number of functions (tones) being transmitted on each channel, and their frequencies.
5. The required transmit level for each tone, as calculated on the worksheet in Figure 3-15.

The initial startup procedures must be performed in the following order:

1. Power supply verification at the local terminal (para 3.7.2).
2. Transmit attenuator adjustment at the local terminal (para 3.7.3).
3. Modulator adjustment at the local terminal (para 3.7.4).
4. Hybrid adjustment and rf output verification at the local terminal (para 3.7.5).
5. Power supply verification at the remote terminal (para 3.7.2).
6. Demodulator adjustment at the remote terminal (para 3.7.6).
7. Receive attenuator adjustment at the remote terminal (para 3.7.7).

RFL 9505 Transmit Level Worksheet

STEP 1: Determine the maximum available output voltage (Vmax) from Chart 1:

CHART 1	Output Impedance (ohms)		
PEP Output	50	75	140
50 watts	50.00	61.23	83.67
10 watts	22.36	27.38	37.41

To determine Vmax for power and impedance values not listed in Chart 1, use the following formula:

$$V_{max} = \sqrt{\text{PEP Output (watts)} \times \text{Impedance (ohms)}}$$

Vmax = ________________ Vrms

STEP 2: Complete Chart 2.

CHART 2	Function						
	Voice Test Tone	1200-Baud Data	600-Baud Data	Narrow-band Tones	Signal-ing Tones	Sync Tone	Other ________
Channel 1							
Channel 2							
Channel 3							
Channel 4							
Line A: Function Totals (Add for each function)							
Line B: Voltage Factors	1.000	0.562	0.316	0.178	0.178	0.178	
Line C: Weighted Voltage Factor (Multiply Line A by Line B)							

Line D: Total Voltage Factor (Add all values on Line C)	
Line E: Test Tone Level (in volts) (Divide Vmax by Line D)	
Line F: Test Tone Level (in dBm) (Use formula shown below)	

	Voice Test Tone	1200-Baud Data	600-Baud Data	Narrow-band Tones	Signal-ing Tones	Sync Tone	Other
Line G: Power Levels (See Table 3-14.)	0 dB	-5 dB	-10 dB	-15 dB	-15 dB	-15 dB	-15 dB
Line H: Output Levels (Subtract Line G from Line F)							

$$\text{Test Tone Level (dBm)} = 10 \log [(\text{Line E Value})^2 / 0.001 (\text{Rf line impedance})]$$

NOTE: Output levels in Line H do not include the losses in the high-power bandpass filter. Subtract 2 dB from each value in Line H when setting levels.

Figure 3-15. Worksheet for calculating transmit levels

RFL 9505 Transmit Level Worksheet.

STEP 1: Determine the maximum available output voltage (Vmax) from Chart 1:

CHART 1	Output Impedance (ohms)		
PEP Output	50	75	140
50 watts	50.00	61.23	83.67
10 watts	22.36	27.38	37.41

To determine Vmax for power and impedance values not listed in Chart 1, use the following formula:

$$\mathrm{Vmax} = \sqrt{\underset{\text{(watts)}}{\text{PEP Output}} \times \underset{\text{(ohms)}}{\text{Impedance}}}$$

Vmax = 50.00 Vrms

STEP 2: Complete Chart 2.

CHART 2	Function						
	Voice Test Tone	1200-Baud Data	600-Baud Data	Narrow-band Tones	Signal-ing Tones	Sync Tone	Other
Channel 1	1			2	1		
Channel 2		1			1		
Channel 3							
Channel 4							
Line A: Function Totals (Add for each function)	1	1		2	2		
Line B: Voltage Factors	1.000	0.562	0.316	0.178	0.178	0.178	
Line C: Weighted Voltage Factor (Multiply Line A by Line B)	1.000	0.562	—	0.356	0.356	—	

Line D: Total Voltage Factor (Add all values on Line C)	2.274
Line E: Test Tone Level (in volts) (Divide Vmax by Line D)	21.98
Line F: Test Tone Level (in dBm) (Use formula shown below)	+39 dBm

	Voice Test Tone	1200-Baud Data	600-Baud Data	Narrow-band Tones	Signal-ing Tones	Sync Tone	Other
Line G: Power Levels (See Table 3-14.)	0 dB	-5 dB	-10 dB	-15 dB	-15 dB	-15 dB	-15 dB
Line H: Output Levels (Subtract Line G from Line F)	+39dBm	+34dBm	—	+24dBm	+24dBm	—	

$$\text{Test Tone Level (dBm)} = 10 \log [(\text{Line E Value})^2 / 0.001 \text{ (Rf line impedance)}]$$

NOTE: Output levels in Line H do not include the losses in the high-power bandpass filter. Subtract 2 dB from each value in Line H when setting levels.

Figure 3-16. Worksheet completed for a typical system

8. Transmit attenuator adjustment at the remote terminal (para 3.7.3).

9. Modulator adjustment at the remote terminal (para 3.7.4).

10. Hybrid adjustment and rf output verification at the remote terminal (para 3.7.5).

11. Demodulator adjustment at the local terminal (para 3.7.6).

12. Receive attenuator adjustment at the local terminal (para 3.7.7).

The initial startup procedures are based on a typical four-channel terminal (one containing four 95 MODEM modules.) If your terminal has fewer channels, skip the steps that apply to channels that are not present. Before attempting the initial startup procedure, all terminal ports must be terminated with their proper impedance.

Perform all the steps within each procedure in the order presented, unless directed otherwise. Expected results and comments are indented and appear in **boldface** type.

3.7.1. Equipment Requirements

The following equipment will be required to perform the initial startup procedures:

1. Multimeter, digital with dB function, Fluke Model 8050A or equiv.

2. Signal generator, 10 Hz to 100 kHz, sine and square wave, 600-ohm impedance, Philips Model PM 5110 or equiv.

3. Frequency-selective ac voltmeter (FSVM), Rycom Model 6021A or equiv.

4. Oscilloscope, 150 MHz, dual-trace, Tektronix Model 2445 or equiv.

5. Cable, coaxial, 3-foot, bantam plug to double banana jack (2 required), Pomona 4281-36 or equiv.

6. Cable, coaxial, 3-foot w/male UHF connector at each end, Pomona UHF-C-36 or equiv.

7. Test leads, double banana jack to 0.080-inch pin tips, Pomona 2BC-PP-36 or equiv.

8. Card extender, RFL 95 CARD EXT (Dowty P/N 100275).

9. 600-ohm terminator, type dependent upon termination requirements of the FSVM being used.

10. Dummy load, non-inductive, impedance equal to that of the 95 RF LINE INTERFACE, as indicated on the rear panel directly below J7. The dummy load must also be capable of handling the PEP output rating of the power amplifier; 10 watts for the 95 AMP/PS, 50 watts for the 95 PWR AMP/PS, or more if other amplifiers are used or if amplifiers are cascaded. To allow an adequate safety factor, the dummy load's power rating should be at least twice the PEP output rating of the power amplifier.

NOTE

Throughout the initial startup and alignment procedures, the following conventions have been established:

1. Panel-mounted test points are called "test jacks;" if they are located on the circuit board, they are called "test turrets."

2. Edge connector pins are noted by the connector number, followed by a dash and the pin number (P1-1, P1-2, etc).

3. 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, etc).

3.7.2. Power Supply Verification

The following procedure is used to check the power supply section of the amplifier/power supply for proper operation. Proceed as follows:

1. Turn on all test equipment and allow it to warm up.

2. Set the multimeter for dc voltage measurements. Select a measurement range that is adequate for the station battery voltage being used (24, 48, or 129 volts).

3. Connect the multimeter leads across the station battery input terminals on the rear of the chassis, observing proper polarity. (Refer to the wiring diagram in Section 8 or the "as supplied" drawings furnished with the equipment.)

4. Note the multimeter reading.

   The multimeter reading will vary according to the incoming station battery voltage:

   24-Volt Terminals - 21 to 28 volts
   48-Volt Terminals - 42 to 56 volts
   129-Volt Terminals - 105 to 145 volts

5. Place the POWER switch on the amplifier/power supply (95 AMP/PS or 95 PWR AMP/PS) in the ON position.

6. On the front of the amplifier/power supply, connect the negative multimeter lead to the GND or COM test jack.

7. Connect the positive multimeter lead to the +12V test jack. Note the multimeter reading.

   The multimeter reading should be between +11.5 and +12.5 volts.

8. Connect the positive multimeter lead to the -12V test jack. Note the multimeter reading.

   The multimeter reading should be between -11.5 and -12.5 volts.

NOTE

For systems equipped with 95 AMP/PS 10-Watt Amplifier/Power Supplies, skip steps 9 and 10 and proceed to step 11.

9. Connect the positive multimeter lead to the +45V test jack. Note the multimeter reading.

   The multimeter reading should be between +42.75 and +47.25 volts.

10. Connect the positive multimeter lead to the -45V test jack. Note the multimeter reading.

    The multimeter reading should be between -42.75 and -47.25 volts.

11. Disconnect the multimeter leads from the amplifier/power supply.

If the above procedure was successfully completed, the power supply section of the amplifier/power supply is functioning properly. If any of the voltages were either not present or beyond limits, refer to Section 7 and determine the cause of the problem or replace the amplifier/power supply. Repeat the entire power supply verification procedure before going on.

3.7.3. Transmit Attenuator Adjustment Procedure

The transmit attenuators are adjusted by setting the DIP switches on the 95 AF LINE TERM modules. Each DIP switch contains four SPDT switches; when moving these switches, all four switches must be placed in the same position for proper circuit operation.

Before beginning this procedure, the speech input level expected to be present at the rear panel input terminals must be known. If the expected input level is greater than -16 dBm, the transmit attenuators will have to be adjusted to prevent clipping. To adjust the transmit attenuators, proceed as follows:

1. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

2. Remove the 95 AF LINE TERM module for Channels 1 and 2 from the chassis by loosening the two captive screws securing it to the chassis and pulling on the module handle.

3. Insert the card extender into the chassis, in the space vacated by the 95 AF LINE TERM module.

4. Insert the 95 AF LINE TERM module into the card extender.

5. Calculate the amount of transmit attenuation that should be required for Channel 1.

   For four-wire systems, this will be the difference in dB between the expected speech input level and the modem speech input level, which is -16 dBm for voice. Other tones will be below this, see Table 3-4 for amounts in dB below voice. For two-wire systems, subtract 4 dB from the expected speech input level before calculating the difference. This will compensate for the expected trans-hybrid loss.

6. Set the transmit attenuator switches to equal the difference calculated in step 5.

   DIP switches S1 through S5 control the transmit attenuator for Channels 1 and 3; the transmit attenuators for Channels 2 and 4 are controlled by DIP switches S11 through S15. (Refer to paragraph 3.4 for additional information on setting the DIP switches.)

7. Using a screwdriver, disconnect the speech input leads from the terminal blocks on the rear panel of the chassis.

   For four-wire systems, disconnect the wires leading to the following terminals:
   - **Channel 1: TB8-5 and TB8-7**
   - **Channel 2: TB6-5 and TB6-7**
   - **Channel 3: TB4-5 and TB4-7**
   - **Channel 4: TB2-5 and TB2-7**

   For two-wire systems, disconnect the wires leading to the following terminals:
   - **Channel 1: TB8-13 and TB8-14**
   - **Channel 2: TB6-13 and TB6-14**
   - **Channel 3: TB4-13 and TB4-14**
   - **Channel 4: TB2-13 and TB2-14**

   Tag the wires before disconnecting them, to simplify reassembly.

8. Using a screwdriver, connect the output of the signal generator to the terminals that wires were removed from during step 7.

9. Adjust the signal generator's output controls for an 800-Hz sine wave, at the level expected to be present at the RFL 9505's rear panel speech input terminals.

10. Set the multimeter for dB measurements. Connect the multimeter to the 4W XMTR EQUIP jack for the channel being adjusted.

    The multimeter must be terminated in 600 ohms to obtain accurate readings.

11. Note the multimeter indication.

    The multimeter should indicate -16 dBm; if not, reset the transmit attenuator switches until an indication of -16 dBm is obtained.

12. Using a screwdriver, disconnect the output of the signal generator from the rear panel speech input terminals.

13. Using a screwdriver, reconnect the speech input leads to the terminal blocks on the rear panel of the chassis.

    Use the tags placed on the wires during step 7 as a guide when reattaching the wires.

14. Repeat steps 5 through 13 to adjust the Channel 2 transmit attenuator.

15. Pull the 95 AF LINE TERM module for Channels 1 and 2 out of the card extender.

16. Pull the card extender out of the chassis.

17. Insert the 95 AF LINE TERM module for Channels 1 and 2 into the chassis. Tighten the two captive screws on its front panel to secure the module in place.

18. Remove the 95 AF LINE TERM module for Channels 3 and 4 from the chassis by loosening the two captive screws securing it to the chassis and pulling on the module handle.

19. Insert the card extender into the chassis, in the space vacated by the 95 AF LINE TERM module.

20. Insert the 95 AF LINE TERM module into the card extender.

21. Repeat steps 5 through 13 to adjust the Channel 3 transmit attenuator.

22. Repeat steps 5 through 13 to adjust the Channel 4 transmit attenuator.

23. Pull the 95 AF LINE TERM module for Channels 3 and 4 out of the card extender.

24. Pull the card extender out of the chassis.

25. Insert the 95 AF LINE TERM module for Channels 3 and 4 back into the chassis. Tighten the two captive screws on its front panel to secure the module in place.

If the above procedure was successfully completed, the audio termination modules are functioning properly. If either of the 95 AF LINE TERM modules do not seem to be functioning properly, either refer to Section 6 and determine the cause of the problem or replace the suspect module. Repeat the entire transmit attenuator adjustment procedure before going on to the modulator adjustment procedure.

3.7.4. Modulator Adjustment Procedure

The following procedure is used to set all the signal levels in the modulator sections of all 95 MODEM modules in the RFL 9505 terminal. Proceed as follows:

1. Make sure that there are **no** external interface signals or keying inputs being applied to any of the terminal's inputs.

   The only signals being transmitted should be the signaling tone for each modem. All modems must be plugged into the chassis at this time to compensate for loading effects.

2. Connect a non-inductive dummy load to rf output jack J7 on the rear panel of the 95 RF LINE INTERFACE rf line interface assembly.

3. Connect the oscilloscope's vertical input probe across the dummy load. Adjust its controls to obtain a clear display of the rf output waveform.

4. Adjust the Channel 1 modem output and the amplifier/power supply rf output level as follows:

   a. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

   b. Remove the Channel 1 95 MODEM from the chassis by loosening the two captive screws securing it to the chassis and pulling on the module handle.

   c. Insert the card extender into the space vacated by the 95 MODEM.

   d. Insert the 95 MODEM into the card extender.

   e. Connect the output of the signal generator to the 4W XMTR LINE jack for Channel 1.

   f. Adjust the signal generator's output controls for an 800-Hz sine wave output at -16 dBm (600-ohm reference).

   g. Turn on the amplifier/power supply by placing the POWER switch in the ON position.

   h. Connect the FSVM across the output of the Channel 1 modem (high to P1-B12, low to P1-A12).

   i. Tune the FSVM to the Channel 1 test tone frequency (800 Hz above the lower limit of Channel 1).

      The FSVM is monitoring the Channel 1 test tone level. It should read -10 dBm @ 75 ohms; if not, adjust potentiometer R212 for a reading of -10 dBm.

   j. If the channel is used for data (no voice), adjust the signal generator for a level below test tone, dependent upon the type of data being sent.

      Table 3-14 lists the recommended settings for selected functions. For example, if 1200-baud data is being sent, Table 3-14 recommends that the signal generator be set to 5 dB below the test tone level.

   k. Connect the FSVM to the SEND test jacks on the 95 RF LINE INTERFACE.

   l. Note the output impedance of the 95 RF INTERFACE, as indicated on the rear panel.

      95 RF INTERFACE units can be supplied with many different output impedances. If the FSVM being used cannot be adjusted to match the output impedance of the 95 RF INTERFACE, a correction factor will have to be applied to all rf output readings.

   m. While monitoring the FSVM, adjust the GAIN ADJ control on the front of the amplifier/power supply until the FSVM indicates the proper voltage level for the Channel 1 test tone, as calculated on the worksheet in Figure 3-15.

      The high-power bandpass filter in the 95 RF INTERFACE will attenuate the signal level by 2 dB. To compensate for this, subtract 2 dB from the level calculated on the worksheet.

   n. Check the oscilloscope display to make sure the output signal is not being clipped.

      If clipping occurs, repeat steps 4h through 4m. If clipping still occurs, either replace the modem or align it by using the procedure in paragraph 3.8.

o. Tune the FSVM to the Channel 1 signaling frequency (normally 3795 above the lower limit of Channel 1). Note the FSVM reading.

   The FSVM reading should be whatever was calculated for the signaling tone on the worksheet in Figure 3-15; if not, adjust potentiometer R242 until the proper reading is obtained.

p. If speech-plus tones are being transmitted on Channel 1, tune the FSVM to the first speech-plus frequency. (The exact frequency will vary from installation to installation.) Note the FSVM reading.

   The FSVM reading should be whatever was calculated for the speech-plus tone on the worksheet in Figure 3-15.

q. Tune the FSVM to each of the other speech-plus frequencies on Channel 1. (The exact frequencies will vary from installation to installation.) Note the FSVM reading.

   The FSVM reading should be whatever was calculated for the speech-plus tone on the worksheet in Figure 3-15.

r. Repeat steps 4h through 4q, as there is some interaction between the controls.

   When steps 4h through 4q can be performed without having to readjust any control, go on to step 4s.

s. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

t. Pull the Channel 1 95 MODEM out of the card extender.

u. Pull the card extender out of the chassis.

v. Insert the Channel 1 95 MODEM into the chassis, in the space vacated by the card extender. Tighten the two captive screws on its front panel to secure the module in place.

5. Adjust the Channel 2 modem output as follows:

a. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

b. Remove the Channel 2 95 MODEM from the chassis by loosening the two captive screws securing it to the chassis and pulling on the module handle.

c. Insert the card extender into the space vacated by the 95 MODEM.

d. Insert the 95 MODEM into the card extender.

e. Connect the output of the signal generator to the 4W XMTR LINE jack for Channel 2.

f. Adjust the signal generator's output controls for an 800-Hz sine wave output at -16 dBm (600-ohm reference).

g. Turn on the amplifier/power supply by placing the POWER switch in the ON position.

h. Connect the FSVM across the output of the Channel 2 modem (high to P1-B12, low to P1-A12).

i. Tune the FSVM to the Channel 2 test tone frequency (800 Hz above the lower limit of Channel 2).

   The FSVM is monitoring the Channel 2 test tone level. It should read -10 dBm @ 75 ohms; if not, adjust potentiometer R212 for a reading of -10 dBm.

j. If the channel is used for data (no voice), adjust the signal generator for a level below test tone, dependent upon the type of data being sent.

   Table 3-14 lists the recommended settings for selected functions. For example, if 1200-baud data is being sent, Table 3-14 recommends that the signal generator be set to 5 dB below the test tone level.

k. Connect the FSVM to the SEND test jacks on the 95 RF LINE INTERFACE.

l. Note the FSVM indication.

   The FSVM indication should equal the Channel 2 test tone signal level calculated on the worksheet in Figure 3-15, minus 2 dB to compensate for losses in the rf output filter.

m. Check the oscilloscope display to make sure the output signal is not being clipped.

If clipping occurs, repeat steps 5h through 5l. If clipping still occurs, either replace the modem or align it by using the procedure in paragraph 3.8.

n. Tune the FSVM to the Channel 2 signaling frequency (normally 3795 Hz above the lower limit of Channel 2). Note the FSVM reading.

The FSVM reading should be whatever was calculated for the signaling tone on the worksheet in Figure 3-15; if not, adjust potentiometer R242 until the proper reading is obtained.

o. If speech-plus tones are being transmitted on Channel 2, tune the FSVM to the first speech-plus frequency. (The exact frequency will vary from installation to installation.) Note the FSVM reading.

The FSVM reading should be whatever was calculated for the speech-plus tone on the worksheet in Figure 3-15; if not, adjust potentiometer R273 until the proper reading is obtained.

p. Tune the FSVM to each of the other speech-plus frequencies on Channel 2. (The exact frequencies will vary from installation to installation.) Note the FSVM reading.

The FSVM reading should be whatever was calculated for the speech-plus tone on the worksheet in Figure 3-15.

q. Repeat steps 5h through 5p, as there is some interaction between the controls.

When steps 5h through 5p can be performed without having to readjust any control, go on to step 6r.

r. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

s. Pull the Channel 2 95 MODEM out of the card extender.

t. Pull the card extender out of the chassis.

u. Insert the Channel 2 95 MODEM into the chassis, in the space vacated by the card extender. Tighten the two captive screws on its front panel to secure the module in place.

6. Repeat step 6 for the Channel 3 and Channel 4 modems.

7. Disconnect all test equipment from the RFL 9505 terminal.

If the above procedure was successfully completed, the modulator sections of all the modem modules in the terminal are functioning properly. If any of the 95 MODEM modules do not seem to be functioning properly, either refer to Section 5 and determine the cause of the problem or replace the suspect module. Once the problem is corrected, repeat the entire modulator adjustment procedure before going on to the transmit attenuator adjustment procedure.

3.7.5. Hybrid Adjustment And Rf Output Verification

The following procedure is used to adjust the rf output of the RFL 9505 terminal being applied to the communication line. Proceed as follows:

1. Make sure the POWER switch on the amplifier/power supply is in the OFF position.

2. Disconnect the dummy load from J7 on the rear panel of the 95 RF LINE INTERFACE, and connect J7 to the line tuner.

3. Connect the FSVM to the RCVR test jacks on the 95 RF LINE INTERFACE.

4. Determine which channel is closest to the center of the band of frequencies in use.

5. Connect the output of the signal generator to the 4W XMTR LINE jack for the channel closest to the center of the band.

6. Adjust the signal generator's output controls for an 800-Hz sine wave output at -16 dBm (600-ohm reference).

7. Turn on the amplifier/power supply by placing the POWER switch in the ON position.

8. Tune the FSVM to the rf frequency of the channel closest to the center of the band.

9. Null the rf hybrid in the 95 RF LINE INTERFACE as follows:

   a. Adjust the sensitivity controls on the FSVM to obtain a usable meter reading.

   b. Set the FINE BALANCE control on the Model 95 RF LINE INTERFACE to its mechanical center.

   c. Place the COARSE BALANCE control on the 95 RF LINE INTERFACE in the position that produces the lowest reading on the FSVM.

   d. Readjust the FINE BALANCE control as needed to obtain the lowest possible reading on the FSVM.

      It may be necessary to readjust the sensitivity controls on the FSVM as you approach the null point, in order to maintain a useful meter reading.

      As the FINE BALANCE control is turned, the FSVM reading should decrease, stop, and then start increasing again. The point where the reading stops decreasing is the "null point". If the null point appears to occur when the FINE BALANCE control is at one end of its travel, return the FINE BALANCE control to its mechanical center, move the COARSE BALANCE control to the next position, and then readjust the FINE BALANCE control. Use the combination that produces the lowest possible reading on the FSVM.

10. Using its instruction manual as a guide, align the line tuner.

    A reflective wattmeter (or its equivalent) should be used to fine-tune and match the RFL 9505 to the line tuner. An alternate method would be to use a high-level generator set to the Geometric Mean Frequency (GMF) of the carrier frequency band being used. The line tuner should be tuned for maximum return loss (minimum reflected power).

11. Repeat steps 9 and 10, as there is some interaction between the rf hybrid and the line tuner.

    When steps 9 and 10 can be performed without having to readjust any control, go on to the next procedure.

3.7.6. Rf Input And Demodulator Adjustment Procedure

The following procedure is used to adjust the rf input level for the RFL 9505 station, and then adjust the demodulator sections of all 95 MODEM modules in the terminal for the signal levels that they will be receiving.

During this procedure, the terminal that is transmitting the test tone is the "sending" terminal, and the terminal where the demodulator adjustments are being performed is the "receiving" terminal. Since actual signals are used during this procedure, the modulator sections of all the modems in the sending terminal must be adjusted before attempting this procedure. In addition, the sending and receiving terminals must both be connected to the communications circuit. Proceed as follows:

1. Connect the signal generator to the 4W XMTR LINE jack for Channel 1 at the sending terminal.

2. Make sure the signal generator's controls are set for an 800-Hz signal at -16 dBm.
3. Connect the FSVM to the RECEIVE test jacks on the 95 RF LINE INTERFACE assembly at the receiving terminal. On terminals equipped with a receive filter use the test jacks on the receive filter instead of those on the 95 RF LINE INTERFACE.
4. Tune the FSVM to the Channel 1 test tone frequency (800 Hz above the lower limit of Channel 1).

5. Adjust RECEIVER LEVEL potentiometer R10 on the 95 RF LINE INTERFACE until the FSVM indicates 27 mV (-20 dBm @ 75 ohms).

6. Disconnect the FSVM from the 95 RF LINE INTERFACE assembly.

7. Turn off the receiving terminal's amplifier/power supply by placing the POWER switch in the OFF position.

8. Adjust the demodulator output level of the 95 MODEM module for Channel 1 as follows:

   a. Remove the Channel 1 95 MODEM from the receiving terminal by loosening the two captive screws securing it to the chassis and pulling on the module handle.

   b. Insert the card extender into the receiving terminal, in the space vacated by the 95 MODEM.

   c. Insert the 95 MODEM into the card extender.

   d. Turn on the receiving terminal's amplifier/power supply by placing the POWER switch in the ON position.

   e. Connect the multimeter to the 4W RCVR LINE jack for the channel being adjusted.
      The 4W RCVR LINE jacks for Channels 1 and 2 are on the 95 AF LINE TERM module between them; the jacks for Channels 3 and 4 are on the 95 AF LINE TERM module between them.

      The multimeter must be terminated in 600 ohms to obtain accurate readings.

   f. Note the multimeter reading.
      The multimeter should indicate +7 dBm; if not, adjust potentiometer R130 until the proper multimeter reading is obtained.

   g. Disconnect to the signal generator from the 4W XMTR LINE jack for Channel 1 at the sending terminal.

   h. Connect the multimeter across the four-wire speech-plus output terminals for the channel being adjusted.
      Connections are to be made as follows:

      Channel 1 - TB7-6 to TB7-7
      Channel 2 - TB5-6 to TB5-7
      Channel 3 - TB3-6 to TB3-7
      Channel 4 - TB1-6 to TB1-7

      If speech-plus equipment has been connected to these terminals, do not terminate the multimeter; the speech-plus equipment will provide the proper termination. If there is no equipment connected to these terminals, the multimeter must be terminated in 600 ohms in order to obtain accurate readings.

   i. If more than one speech-plus tone is being transmitted on the channel being adjusted, turn off all but one tone at the sending terminal.

   j. Note the multimeter indication.
      The multimeter should indicate the desired speech-plus output level for the channel. If not, adjust potentiometer R105 until the proper indication is obtained.

   k. If any tones were turned off during step 8i, turn off the first tone and turn one of the other tones back on. Note the multimeter indication.
      The multimeter should indicate the desired speech-plus output level for the channel.

   l. Repeat step 8k for all other speech-plus tones being transmitted on the channel being adjusted.

   m. Turn off the receiving terminal's amplifier/power supply by placing the POWER switch in the OFF position.

   n. Pull the 95 MODEM module out of the card extender.

   o. Pull the card extender out of the chassis.

   p. Insert the 95 MODEM module into the chassis. Tighten the two captive screws on its front panel to secure the module in place.

9. Connect the signal generator to the 4W XMTR LINE jack for Channel 2.

10. Repeat step 8 for the Channel 2 modem.

11. Connect the signal generator to the 4W XMTR LINE jack for Channel 3.

12. Repeat step 8 for the Channel 3 modem.

13. Connect the signal generator to the 4W XMTR LINE jack for Channel 4.

14. Repeat step 8 for the Channel 4 modem.

If the above procedure was successfully completed, all the demodulator sections are functioning and properly adjusted. If any of the 95 MODEM modules do not seem to be functioning properly, perform the modem alignment procedure in paragraph 3.8.

3.7.7. Receive Attenuator Adjustment Procedure

The receive attenuators are set by setting DIP switches S6 through S10 (Channels 1 and 3) and S16 through S20 (Channels 2 and 4). Each DIP switch contains four SPDT switches; when moving these switches, all four switches must be placed in the same position for proper circuit operation.

Before beginning this procedure, the desired output levels for each channel must be known. This will be determined by the speech equipment connected to each channel. You must also know whether each channel is to be set for four-wire or two-wire operation. To adjust the receive attenuators, proceed as follows:

1. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

2. Remove the 95 AF LINE TERM module for Channels 1 and 2 from the chassis by loosening the two captive screws securing it to the chassis and pulling on the module handle.

3. Insert the card extender into the chassis, in the space vacated by the 95 AF LINE TERM module.

4. Insert the 95 AF LINE TERM module into the card extender.

5. Turn on the amplifier/power supply by placing the POWER switch in the ON position.

NOTE

Step 6 is to be performed if the channel being adjusted is to be set for four-wire operation. If it is to be set for two-wire operation, skip step 6 and perform step 7.

6. Adjust the Channel 1 receive attenuator for four-wire operation as follows:

   a. Calculate the difference in dB between the demodulator speech output level (which is +7 dBm) and the desired channel output level.

   b. Set the receive attenuator switches to equal the difference calculated in step 6a.
      DIP switches S6 through S10 control the receive attenuator for Channels 1 and 3; the receive attenuators for Channels 2 and 4 are controlled by DIP switches S16 through S20. (Refer to paragraph 3.4 for additional information on setting the DIP switches.)

   c. At the sending terminal, connect the signal generator to the 4W XMTR LINE jack for the channel being adjusted.
      The 4W XMTR LINE jacks for Channels 1 and 2 are on the 95 AF LINE TERM module between them; the jacks for Channels 3 and 4 are on the 95 AF LINE TERM module between them.

   d. Connect the multimeter across the four-wire speech output terminals for the channel being adjusted.
      Connections to be made are as follows:
      Channel 1 (TB8-1 and TB8-3)
      Channel 2 (TB6-1 and TB6-3)
      Channel 3 (TB4-1 and TB4-3)
      Channel 4 (TB2-1 and TB2-3)

      In order to obtain accurate readings, the 600-ohm termination must be removed from the multimeter if external equipment is connected to the speech output terminals. If there is no external equipment connected to these terminals, the multimeter must be terminated in 600 ohms.

e. Note the multimeter indication.

The multimeter should indicate the desired speech output level. If not, readjust the receive attenuator switches until the desired level is indicated on the multimeter.

f. Go to step 8.

7. Adjust the Channel 1 receive attenuator for two-wire operation as follows:

a. Calculate the difference in dB between the modem output level (which is +7 dBm) and the desired Channel 1 output level.

Expect an additional 4 dB of trans-hybrid loss. This loss must be subtracted from the demodulator speech output level before calculating the difference.

b. Set the receive attenuator switches to equal the difference calculated in step 7a.

DIP switches S6 through S10 control the receive attenuator for Channels 1 and 3; the receive attenuators for Channels 2 and 4 are controlled by DIP switches S16 through S20.

Refer to paragraph 3.4 for additional information on setting the DIP switches.

c. At the sending terminal, connect the signal generator to the 4W XMTR LINE jack for the channel being adjusted.

The 4W XMTR LINE jacks for Channels 1 and 2 are on the 95 AF LINE TERM module between them; the jacks for Channels 3 and 4 are on the 95 AF LINE TERM module between them.

d. Connect the multimeter across the two-wire speech output terminals for the channel being adjusted.

Connections to be made are as follows:

Channel 1 (TB8-13 and TB8-14)
Channel 2 (TB6-13 and TB6-14)
Channel 3 (TB4-13 and TB4-14)
Channel 4 (TB2-13 and TB2-14)

In order to obtain accurate readings, the 600-ohm termination must be removed from the multimeter if external equipment is connected to the speech output terminals. If there is no external equipment connected to these terminals, the multimeter must be terminated in 600 ohms.

e. Note the multimeter indication.

The multimeter should indicate the desired speech output level. If not, readjust the receive attenuator switches until the desired level is indicated on the multimeter.

f. Connect the multimeter to the 4W SEND EQUIP jack of the receiving terminal for Channel 1.

The 4W SEND EQUIP jacks for Channels 1 and 2 are on the 95 AF LINE TERM module between them; the jacks for Channels 3 and 4 are on the 95 AF LINE TERM module between them.

The multimeter must be terminated in 600 ohms to obtain accurate readings.

g. Using a small screwdriver or potentiometer adjustment tool, adjust the INT BAL potentiometer for the channel being adjusted until the lowest possible multimeter reading is obtained.

For Channels 1 and 3, adjust INT BAL potentiometer R51; adjust INT BAL potentiometer R102 for Channels 2 and 4.

8. Repeat step 6 to adjust the Channel 2 receive attenuator for four-wire operation, or step 7 to adjust it for two-wire operation.

9. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

10. Pull the 95 AF LINE TERM module for Channels 1 and 2 out of the card extender.

11. Pull the card extender out of the chassis.

12. Insert the 95 AF LINE TERM module for Channels 1 and 2 into the chassis. Tighten the two captive screws on its front panel to secure the module in place.

13. Remove the 95 AF LINE TERM module for Channels 3 and 4 from the chassis by loosening the two captive screws securing it to the chassis and pulling on the module handle.

14. Insert the card extender into the chassis, in the space vacated by the 95 AF LINE TERM module.

15. Insert the 95 AF LINE TERM module into the card extender.

16. Turn on the amplifier/power supply by placing the POWER switch in the ON position.

17. Repeat step 6 to adjust the Channel 3 receive attenuator for four-wire operation, or step 7 to adjust it for two-wire operation.

18. Repeat step 6 to adjust the Channel 4 receive attenuator for four-wire operation, or step 7 to adjust it for two-wire operation.

19. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

20. Pull the 95 AF LINE TERM module for Channels 3 and 4 out of the card extender.

21. Pull the card extender out of the chassis.

23. Insert the 95 AF LINE TERM module for Channels 3 and 4 into the chassis. Tighten the two captive screws on its front panel to secure the module in place.

The RFL 9505 terminal is now ready for continuous operation.

3.8. MODEM ALIGNMENT

The modems in all RFL 9505 terminals are aligned at the factory. The following alignment procedures should only be performed in the field after a modem has been repaired, or if a malfunction is suspected.

a. Test Equipment Required. The following equipment will be required to align the 95 MODEM modules:

1. Multimeter, digital with dB function, Fluke Model 8050A or equiv.

2. Frequency-selective ac voltmeter (FSVM), Rycom Model 6021A or equiv.

   Alternate: Spectrum analyzer, 20 Hz to 40 MHz, Hewlett-Packard Model 3585B or equiv.

3. Oscilloscope, 150 MHz, dual-trace, Tektronix Model 2445 or equiv.

4. Signal generator, 10 Hz to 100 kHz, sine and square wave, 600-ohm impedance, Philips Model PM 5110 or equiv.

5. Frequency counter, 100 MHz, Hewlett-Packard Model 5315A or equiv.

6. 600-ohm terminator, type dependent upon termination requirements of frequency-selective voltmeter or spectrum analyzer being used.

7. Test leads, double banana plug to 0.080-inch pin tips, Pomona 2BC-PP-36 or equiv.

8. Cable, coaxial, 3-foot, bantam plug to double banana jack (2 required), Pomona 4281-36 or equiv.

9. Cable, coaxial, 3-foot, double banana plug to plunger-type test clips, Pomona 3786-C-36 or equiv.

10. Cable, coaxial, 3-foot, BNC male connector to plunger-type test clips, Pomona 3787-C-36 or equiv.

11. Patch cord, length not critical, plunger-type test clips at each end, Pomona Type 3781 or equiv.

12. Card extender, RFL 95 CARD EXT (Dowty P/N 100275).

b. Preparation for Alignment. Before attempting modem alignment, the initial start-up procedures starting in paragraph 3.7 must be performed. This will verify that the amplifier/power supply is working properly, and set all the input and output attenuators to the required levels.

Before the 95 MODEM can be aligned, it must be placed on a card extender. To do this, proceed as follows:

1. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

2. Remove the 95 MODEM from the chassis by loosening the two captive screws securing it to the chassis and pulling on the module handle.

3. Insert the card extender into the chassis, in the space vacated by the 95 MODEM.

4. Insert the 95 MODEM into the card extender.

5. Turn on the amplifier/power supply by placing the POWER switch in the ON position.

c. Modulator Section Alignment. The modulator section of the 95 MODEM converts the speech and/or data signals presented to it into a modulated rf output, which is transmitted along the communication line.

To align the modulator section, use the following procedure. Perform all alignment steps in the order presented. Expected results or comments are indented and appear in **boldface** type.

> **NOTE**
>
> Steps 1 and 2 are only performed on the master modem in systems that are synchronized, and all modems on non-synchronized systems. For all other modems in synchronized systems, skip steps 1 and 2 and start with step 3.

1. Connect the frequency counter across the 102.4-kHz output of the demodulator section (high to P2-B7, low to P2-A6).

2. Set the master crystal oscillator frequency by adjusting potentiometer R138 until the frequency counter indicates 102,400.0 Hz.

3. Connect the signal generator output to the 4W XMTR LINE jack of the 95 AF LINE TERM module for the modem being aligned.

4. Adjust the signal generator's output controls for an 800-Hz sine wave output at -16 dBm (600-ohm reference).

5. Connect the oscilloscope vertical input probe to test turret TP6. Connect the probe's ground clip to test turret TP10.
   Refer to Figure 3-1 for the location of these test turrets.

6. While monitoring the oscilloscope display, slowly turn potentiometer R204 clockwise until the signal stops increasing in magnitude.
   This is the point at which limiting begins. Any further increase in signal will cause the modem to go into limiting.

   The signal should not be clipped; if it is, slowly turn R204 counterclockwise until the clipping disappears.

7. Disconnect the oscilloscope from the 95 MODEM.

8. Connect the frequency counter input across the output of the signaling transmitter (high to test turret TP9, low to TP10).

9. While monitoring the frequency counter, adjust potentiometer R249 until the counter indicates the desired FSK signaling frequency (normally 3795 Hz).

10. Connect the patch cord between P1-B26 and test turret TP10.
    The frequency counter should now indicate the proper shift frequency (normally 3855 Hz).

11. Disconnect the frequency counter from the 95 MODEM.

12. Connect the input of the FSVM or spectrum analyzer across the rf output of the 95 MODEM (high to P1-B12, low to P1-A12).

13. If an FSVM is being used, set it to its 75-ohm bridging mode.

14. Tune the FSVM or spectrum analyzer to the channel test tone frequency (800 Hz above the lower frequency limit of the channel).

15. Turn potentiometer R271 fully clockwise.

16. Adjust potentiometer R212 until the FSVM or spectrum analyzer indicates -10 dBm.

17. Tune the FSVM or spectrum analyzer to the FSK signaling tone frequency of the modem being aligned (normally 3795 Hz above the lower frequency limit of the channel).

18. Adjust potentiometer R242 until the FSVM or spectrum analyzer indicates -25 dBm.

19. Connect the signal generator to the SPEECH PLUS 4W SEND terminals for the modem being aligned.
    Connections are to be made as follows:
    Channel 1 - TB7-4 to TB7-5
    Channel 2 - TB5-4 to TB5-5
    Channel 3 - TB3-4 to TB3-5
    Channel 4 - TB1-4 to TB1-5

20. Adjust the signal generator's output controls for an 2700-Hz sine wave output at -20 dBm (600-ohm reference).

21. Tune the FSVM or spectrum analyzer to the speech-plus tone frequency of the modem being aligned (normally 2700 Hz above the lower frequency limit of the channel).

22. Adjust potentiometer R273 until the FSVM or spectrum analyzer indicates -25 dBm.

23. Repeat steps 14 through 22, as there is some interaction between the controls.
    When steps 14 through 22 can be performed without having to readjust any control, go on to step 24.

24. Turn potentiometer R214 fully clockwise.

25. Turn potentiometer R259 fully clockwise.

26. Tune the FSVM or spectrum analyzer to the carrier frequency of the modem being aligned.

27. Slowly adjust potentiometer R214 for the lowest possible indication on the FSVM or spectrum analyzer.
    It may be necessary to readjust the sensitivity of the FSVM or spectrum analyzer while adjusting R214, since the lowest possible indication may be more than 50 dB below the normal carrier level.

NOTE

Steps 28 and 29 are only performed when the master modem is being aligned. A 95 MODEM-1 modem must be used as the master, in systems that contain the optional 95 SYNC synchronizer card. It must be set to operate at the lowest system channel frequency, and must not be located in the same station as the 95 SYNC card. Go on to step 30 for all other modems in systems using the optional 95 SYNC card, and all modems in non-synchronized systems.

28. Tune the FSVM or spectrum analyzer to the master modem's carrier frequency.

29. Adjust potentiometer R259 until the FSVM or spectrum analyzer indicates -25 dBm.

30. Disconnect all test equipment from the 95 MODEM.

The modulator section of the 95 MODEM is now adjusted. The controls in the modulator section not covered in the above procedure are adjusted at the factory, and should not be readjusted in the field. If necessary, R271 can be used to reduce the composite signal level; this reduction is necessary in some applications. Unless your application requires it, R271 should be left in the fully clockwise position.

d. Demodulator Section Alignment. The demodulator section of the 95 MODEM converts the modulated rf signal it receives from the communication line back into the speech and/or data signals that were presented to the modem at the transmitting end of the line.

Perform all alignment steps in the order presented. Expected results or comments are indented and appear in **boldface** type.

1. At the sending terminal, connect the signal generator to the 4W XMTR LINE jack on the 95 AF LINE TERM module for the modem being aligned.

2. Adjust the signal generator's output controls for an 800-Hz sine wave at -16 dBm.

3. Back at the receiving terminal, make sure jumper J101 on the 95 MODEM being aligned is in position B.
    This will enable the modem's AGC circuit.

4. Connect the multimeter to the 4W RCVR LINE jack on the 95 AF LINE TERM module for the modem being aligned.

   The multimeter must be terminated in 600 ohms to obtain accurate readings.

5. Note the multimeter reading.

   The multimeter should read +7 dBm. If not, adjust AGC potentiometer R130 until the proper reading is obtained.

6. At the sending terminal, connect the signal generator to the SPEECH PLUS 4W SEND terminals for the channel being monitored by the modem being aligned.

   Connections are to be made as follows:
   Channel 1 - TB7-4 to TB7-5
   Channel 2 - TB5-4 to TB5-5
   Channel 3 - TB3-4 to TB3-5
   Channel 4 - TB1-4 to TB1-5

7. Adjust the signal generator's output controls for an 2700-Hz sine wave at -20 dBm.

8. Back at the receiving terminal, connect the multimeter to the SPEECH PLUS 4W REC terminals for the modem being aligned.

   Connections are to be made as follows:
   Channel 1 - TB7-6 to TB7-7
   Channel 2 - TB5-6 to TB5-7
   Channel 3 - TB3-6 to TB3-7
   Channel 4 - TB1-6 to TB1-7

   In order to obtain accurate readings, the 600-ohm termination must be removed from the multimeter if external equipment is connected to the speech output terminals., If there is no external equipment connected to these terminals, the multimeter must be terminated in 600 ohms.

9. Note the multimeter reading.

   The multimeter should read -20 dBm. If not, adjust potentiometer R105 until the proper reading is obtained.

10. Set the carrier alarm trip point as follows:

    a. Move jumper J101 on the 95 MODEM being aligned to position A.

       This will disable the AGC circuit.

    b. Set the multimeter for dc voltage measurements. Connect its positive input to point A on jumper J101, and its negative input to test turret TP10.

    c. Adjust potentiometer R198 until the multimeter reads +3.0 volts.

    d. Slowly adjust potentiometer R120 until CARRIER ALARM indicator DS101 just lights.

       This corresponds to a carrier alarm level of approximately -60 dBm.

    e. Disconnect the multimeter from point A on jumper J101.

    f. Return jumper J101 to position B (its normal position).

11. At the sending terminal, apply a 30-Hz square-wave signal (50/50 duty cycle) to the DC KEYING input of the modem generating the signal being monitored by the modem being aligned.

12. Connect the vertical input of the oscilloscope to P2-B4 on the modem being aligned; connect the probe's ground lead to test turret TP10 (ground).

13. Adjust the oscilloscope's vertical, horizontal, and triggering controls for a steady trace on the display.

14. Adjust potentiometer R169 for minimum bias distortion on the oscilloscope display.

    The waveform on the oscilloscope should be an exact replica of the waveform being produced by the signal generator at the sending terminal (30-Hz square wave, 50/50 duty cycle). Any variation in the waveform is considered bias distortion.

15. Connect the multimeter's positive input to test turret TP2, and its negative input to test turret TP10.

16. Adjust potentiometer R153 until the multimeter reads +0.5 volts.

    This sets the threshold of the S/N detector to approximately 10 dB of pilot-to-noise, and 25 dB of test tone (voice)-to-noise.

17. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

18. Pull the 95 MODEM out of the card extender.

19. Pull the card extender out of the chassis.

20. Insert the 95 MODEM into the chassis, in the space vacated by the card extender. Tighten the two captive screws on its front panel to secure the module in place.

The demodulator section of the 95 MODEM is now aligned.

e. Modulator Section Realignment For Use With Optional 95 SYNC Synchronizer Module. The following procedure should only be performed when a 95 SYNC synchronizer module is being added to an existing RFL 9505 system. Perform all steps in the order presented. Expected results and/or comments are indented and appear in **boldface** type.

1. Determine which modem will be used as the master modem.

   A Model 95 MODEM-1 modem must be used as the master. It must operate at the lowest system channel frequency, and cannot be located in the same station as the synchronizer card.

2. Make sure all jumpers have been set on the chassis interconnect boards to enable the use of the 95 SYNC module, as described in paragraph 3.3.4.1.

3. Place the master modem on a card extender as follows:

   a. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

   b. Remove the master modem from the chassis by loosening the two captive screws securing it to the chassis and pulling on the module handle.

   c. Insert the card extender into the chassis, in the space vacated by the master modem.

   d. Insert the master modem into the card extender.

   e. Turn on the amplifier/power supply by placing the POWER switch in the ON position.

4. Connect the input of the FSVM or spectrum analyzer across the rf output of the master modem (high to P1-B12, low to P1-A12).

5. If an FSVM is being used, set it to its 75-ohm bridging mode.

6. Tune the FSVM or spectrum analyzer to a frequency equal to the master modem's carrier frequency.

7. Adjust potentiometer R259 until the FSVM or spectrum analyzer indicates -25 dBm.

8. Connect the signal generator to the 4W XMTR LINE jack on the Model 95 AF LINE TERM module for the master modem.

9. Adjust the signal generator's output controls for an 800-Hz sine wave at -16 dBm.

10. Tune the FSVM or spectrum analyzer to the master modem's test tone frequency (800 Hz above the lower frequency limit of the channel).

11. Adjust potentiometer R212 until the FSVM or spectrum analyzer indicates -10 dBm.

12. Tune the FSVM or spectrum analyzer to the master modem's FSK signaling tone frequency (normally 3795 Hz above the master modem's lower frequency limit).

13. Adjust potentiometer R242 until the FSVM or spectrum analyzer indicates -25 dBm.

14. Connect the signal generator to the SPEECH PLUS 4W TX terminal for the modem being aligned.

    Connections are to be made as follows:

    Channel 1 - TB7-4 to TB7-5
    Channel 2 - TB5-4 to TB5-5
    Channel 3 - TB3-4 to TB3-5
    Channel 4 - TB1-4 to TB1-5

15. Adjust the signal generator's output controls for an 2700-Hz sine wave output at -20 dBm (600-ohm reference).

16. Tune the FSVM or spectrum analyzer to the master modem's speech-plus tone frequency (2700 Hz above the channel lower frequency limit).

17. Adjust potentiometer R273 until the FSVM or spectrum analyzer indicates -25 dBm.

18. Repeat steps 6 through 17, as there is some interaction between the controls.

    Continue repeating steps 6 through 17 until they can be performed without having to readjust any control.

19. Turn off the amplifier/power supply by placing the POWER switch in the OFF position.

20. Pull the master modem out of the card extender.

21. Pull the card extender out of the chassis.

22. Insert the master modem into the chassis, in the space vacated by the card extender. Tighten the two captive screws on its front panel to secure the module in place.

The master modem is now aligned.

Section 4. MAINTENANCE

WARNING

HAZARDOUS VOLTAGES CAN BE PRESENT INSIDE THE RFL 9505. DIRECT CONTACT WITH LIVE COMPONENTS CAN RESULT IN SERIOUS INJURY OR DEATH. 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.

4.1. INTRODUCTION

This section provides maintenance instructions for the RFL 9505 Programmable Powerline Carrier System. Topics discussed include preventive maintenance, removal and replacement procedures, and corrective maintenance information. Information is also provided on how to arrange for service by RFL personnel.

4.2. PREVENTIVE MAINTENANCE

An active preventive maintenance program helps reduce system downtime by correcting potential problems before they can cause system malfunctions. The following preventive maintenance procedure should be performed at least once every six months. Shorter intervals are recommended for RFL 9505 terminals that are located in harsh environments (such as where there are high levels of humidity or dust).

1. Turn off the terminal by placing the POWER switch on the amplifier/power supply in the OFF position.

2. Remove all modules from the chassis.
   Refer to paragraphs 4.3.1 and 4.3.2 for procedures.

3. Using a soft-bristled brush and/or low-pressure compressed air, remove all dust from each module and the chassis.

4. Clean the front of each module and the front of the chassis with a soft cloth, slightly moistened with a mild non-abrasive detergent solution.
   If any detergent solution gets into the chassis, dry it out using a dry cloth and/or the compressed air before proceeding to step 5.

5. Inspect each module for signs of overheating, corrosion, or any other condition that may result in premature component damage.
   If any abnormal conditions are found, determine the cause and correct it before returning the terminal to service.

6. Re-insert all modules into the chassis.
   Refer to paragraphs 4.3.1 and 4.3.2 for procedures.

7. Perform the initial startup procedure in Section 3 of this manual to make sure the equipment is working properly.
8. Turn the terminal on by placing the POWER switch on the amplifier/power supply in the ON position.

4.3. REMOVAL AND REPLACEMENT

Paragraphs 4.3.1 through 4.3.5 provide procedures to be used when removing and replacing RFL 9505 modules and subassemblies.

4.3.1. Plug-In Modules

Most RFL 9505 plug-in modules are held in place by screws on their front panels. To remove any of these modules from the chassis, proceed as follows:

1. Place the POWER switch on the amplifier/power supply in the OFF position.

2. Using a flat-blade screwdriver, turn the two screws on the front panel of the module counterclockwise, until they are loose.

3. Grab the handles on the front of the module and pull until the module is out of the chassis.

To replace the module, proceed as follows:

1. Determine the slot in the chassis where the module is to be installed.

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 and its front panel is against the horizontal rails at the front of the chassis.

4. Using a flat-blade screwdriver, turn the screws on the front panel of the module fully clockwise to secure it in place.

5. Place the POWER switch on the amplifier/power supply in the ON position.

4.3.2. Amplifier/Power Supply

RFL 9505 amplifier/power supplies are held in place by four quarter-turn fasteners (two at the top of the front panel, and two at the bottom). To remove an amplifier/power supply from the chassis, proceed as follows:

1. Place the POWER switch in the OFF position.

2. Using a flat-blade screwdriver, turn the four screws on the front panel counterclockwise, until they are loose.

3. Grab the handles (or the heatsink) on the front of the amplifier/power supply and pull until it is out of the chassis.

To replace the amplifier/power supply, proceed as follows:

1. Determine the slot in the chassis where the module is to be installed.

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 and its front panel is against the horizontal rails at the front of the chassis.

4. Using a flat-blade screwdriver, turn the screws on the front panel of the module fully clockwise to secure it in place.

5. Place the POWER switch on the amplifier/power supply in the ON position.

4.3.3. Rf Line Interface Assembly

The 95 RF LINE INTERFACE assembly is housed in its own cabinet, which in most installations is mounted above the 95 CHAS. To remove the rf line interface assembly, proceed as follows:

1. Tag all wires and cables leading to the rear panel terminal blocks.

   This will make it easier to reconnect the wires when replacing the interface assembly.

2. Using a flat-blade screwdriver, loosen the terminal screws on the terminal blocks and remove the wires and cables from each terminal.

3. Disconnect the coaxial cable from UHF connector J7 by turning the outer shell of the connector counterclockwise with your fingers until it is loose and then pulling the cable away from J7.

4. Using a pair of diagonal cutters, cut the cable ties securing the wires and cables to the cable clamps on the rf line interface assembly housing.

5. Remove the four screws securing the rf line interface assembly to the rack or cabinet.

6. Pull the rf line interface assembly out the front of the rack or cabinet.

To replace the rf line interface assembly, proceed as follows:

1. Slide the rf line interface assembly into position from the front of the rack or cabinet.

2. Install and tighten four screws to secure the rf line interface assembly to the rack or cabinet.

3. Following the information on the tags placed on them during removal, reconnect all wires and cables to the rear panel terminal blocks. Use a flat-blade screwdriver to tighten each terminal screws to secure the wires and cables in place.

4. Connect the coaxial cable to UHF connector J7 by inserting the connector into J7 and then turning the outer shell clockwise with your fingers until it is tight.

5. Secure the wires and cables to the cable clamps on the rf line interface assembly housing with new cable ties.

4.3.4. Orderwire Assembly

The optional 95 ORDERWIRE assembly is housed in its own cabinet, which in most installations is mounted below the 95 CHAS. To remove the orderwire assembly, proceed as follows:

1. Tag all wires and cables leading to the rear panel terminal blocks.
   This will make it easier to reconnect the wires when replacing the orderwire assembly.
2. Using a flat-blade screwdriver, loosen the terminal screws on the terminal blocks and remove the wires and cables from each terminal.
3. Using a pair of diagonal cutters, cut the cable ties securing the wires and cables to the cable clamps on the orderwire assembly housing.
4. Remove the four screws securing the orderwire assembly to the rack or cabinet.
5. Pull the orderwire assembly out the front of the rack or cabinet.

To replace the orderwire assembly, proceed as follows:

1. Slide the orderwire assembly into position from the front of the rack or cabinet.
2. Install and tighten four screws to secure the orderwire assembly to the rack or cabinet.
3. Following the information on the tags placed on them during removal, reconnect all wires and cables to the rear panel terminal blocks. Use a flat-blade screwdriver to tighten each terminal screws to secure the wires and cables in place.
4. Secure the wires and cables to the cable clamps on the orderwire assembly housing with new cable ties.

4.3.5. Chassis Interconnection Boards

Under normal conditions, the interconnection boards in the 95 CHAS chassis should not be removed; they contain no active components and are relatively trouble-free. If troubleshooting indicates that one of the chassis interconnection boards is defective, its replacement will require partial disassembly of the 95 CHAS. **Contact RFL Customer Service for assistance.**

CAUTION

Never attempt to remove or replace a fuse with the amplifier/power supply energized; component damage may result.

For continued safe operation, always replace a fuse with one having the same voltage and current ratings. (See parts list in Section 7 for proper replacements.)

4.4. FUSE REPLACEMENT

The fuses for both the 95 AMP/PS and 95 PWR AMP/PS amplifier/power supplies are mounted on the front panels. Fuses can be changed without removing the amplifier/power supplies from the chassis.

Each fuse is monitored by an indicator lamp or LED. As long as a fuse is good, its indicator will be lit; when a fuse blows, its indicator will go out. To replace a fuse, proceed as follows:

1. Determine which fuse needs to be replaced by noting which indicators are not lit.
   If none of the indicators are lit, one or both of the input fuses needs replacement.
2. Place the POWER switch on the amplifier/power supply in the OFF (down) position.
3. Using a flat-blade screwdriver, push in the cap of the fuseholder containing the fuse to be replaced and turn counterclockwise about one quarter-turn.
   The fuseholder cap and fuse are spring-loaded, and will pop out.

4. Remove the suspect fuse from the fuseholder cap and inspect for damage.

   If the fuse is bad, it must be replaced. If the fuse is good, check for presence of station battery voltage on the chassis input terminals. If voltage is present and the power supply does not function, troubleshoot the amplifier/power supply to determine the cause of failure. (See Section 7.)

5. Insert a fuse with the proper voltage and current ratings into the fuseholder cap and push until it is firmly seated.

6. Insert the fuse and fuseholder cap into the fuseholder. Using a flat-blade screwdriver, push in on the cap and turn clockwise about one quarter-turn.

   This will secure the fuse in place.

7. Place POWER switch S1 in the ON (up) position.

   If all indicators light, the amplifier/power supply is working properly. If one or more indicators do not light or if the fuse blows again, troubleshoot the amplifier/power supply. (See Section 7.)

4.5. CORRECTIVE MAINTENANCE

The RFL 9505 has been designed for years of trouble-free service. Should a malfunction occur involving the RFL 9505, use standard troubleshooting techniques to determine if the problem is in the RFL 9505, or in some other connected equipment. If the problem lies within the RFL 9505, use the schematics in Sections 5 through 11 to try and determine which module or subassembly is defective. Once the trouble is isolated to a particular module or subassembly, replace it; this should solve the problem.

Defective modules and subassemblies can be repaired locally, or they can be returned to RFL for repair (para 4.6).

4.6. HOW TO ARRANGE FOR SERVICING

If necessary, RFL 9505 modules and subassemblies may be returned to RFL for repair. Contact our Customer Service Department using the telephone number listed on the front cover of this manual. You will be given an authorization number and shipping instructions.

Section 5. MODEM

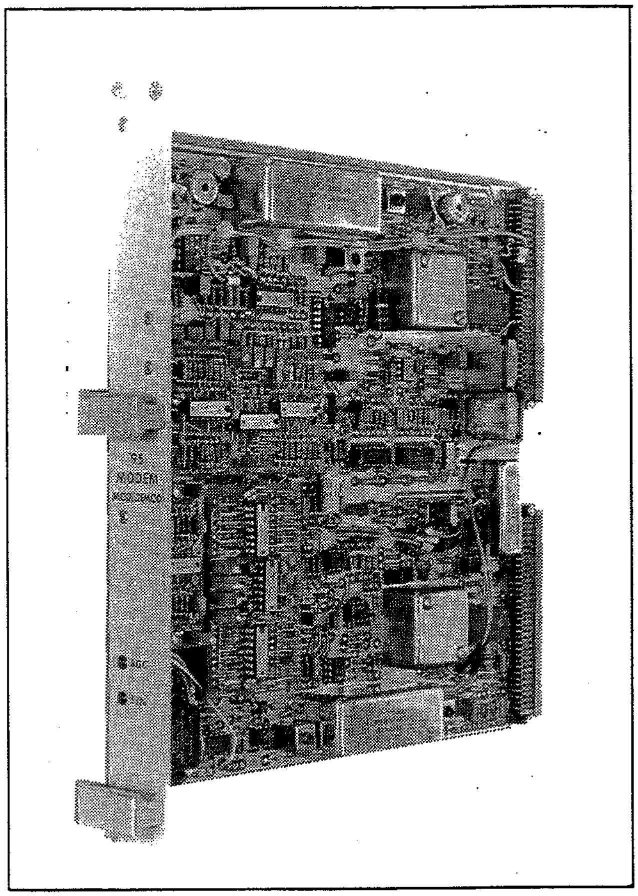


Figure 5-1. RFL 95 MODEM Modulator/Demodulator Module

5.1. DESCRIPTION

The RFL 95 MODEM Modulator/Demodulator Module (Fig. 5-1) contains a modulator circuit which converts audio tones into inputs for the line coupling equipment. It also contains a demodulator circuit, which converts signals received by the line coupling equipment back into audio tones. The modem is fully programmable from 20 kHz to 500 kHz; standard units are adjustable in 4-kHz steps.

The 95 MODEM incorporates a signaling transceiver with an optical isolator to accept current inputs. A Form C mercury-wetted relay serves as the output of this transceiver. Speech input/output ports are balanced four-wire circuits. A compandor circuit provides selectable switching of signal compression and expansion.

The 95 MODEM contains an automatic gain control (AGC) circuit, and alarms for pilot tone and signal-to-noise ratio, which can be wired together as inputs to a master alarm.

Each 95 MODEM module is programmed for operation at a specific frequency by jumpers on the chassis backplane. Once these jumpers are set, any modem module inserted into a particular position will operate at that position's programmed frequency. This reduces system downtime and spare module requirements in the event of modem failure. Modem positions can also be easily re-programmed on site without special tools or accessories.

The 95 MODEM-1 is identical to the 95 MODEM, except its wiring harness has been modified to configure it for use as the master modem in systems containing the optional RFL 95 SYNC synchronizer card (Section 10). The master modem cannot be installed in the same chassis as the synchronizer card, and must operate at the lowest channel frequency.

The 95 MODEM and the 95 MODEM-1 are designed for mounting in the 95 CHAS double-Euro chassis. Each modem module occupies six horizontal chassis spaces.

5.2. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the 95 MODEM. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

MODULATOR SECTION:

Input Range:
Speech: -27 dBm to +3 dBm for an rf output of 0 dBmO (-10 dBm).
Speech Plus: -42 dBm to -12 dBm.

Limiting Threshold: -14 dBm.

Input Impedance: 600 ohms nominal.

Signaling Tone:
Frequencies:
MARK: 3795 Hz ±5 Hz.
SPACE: 3855 Hz ±5 Hz.
Output Level: -25 dBm.
Output Impedance: 70 ohms nominal.

Maximum Rf Output: -9 dBm with an input 6 dB above limiting threshold.

Carrier Leakage: -65 dBmO.

Echo Return Loss: 26 dB minimum.

Longitudinal Balance: 60 dB minimum.

Out-Of-Band Third-Order Modulation: -70 dBmO.

Intermediate Frequency (i.f.): 5.12 MHz.

Output Impedance: 75 ohms.

DEMODULATOR SECTION:

Input Range: +5 dBm maximum.

Intermediate Frequency (i.f.): 5.12 MHz.

Frequency Response:
Speech: In compliance with IEC Standard 495, as shown in Figure 5-2.
Speech Plus: 300 Hz to 3400 Hz, ±1 dB.

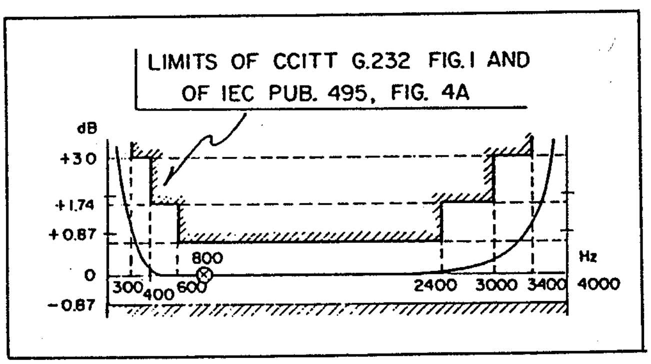


Figure 5-2. Demodulator section frequency response, RFL 95 MODEM

Output Range
Speech: -1 dBm to +9 dBm
Speech Plus: -19 dBm to -9 dBm

Output Distortion: 1% maximum with an input signal at -40 dBm.

Sensitivity: -50 dBm minimum for 12-dB SINAD.

Output Impedance: 600 ohms nominal.

Automatic Gain Control (AGC):
Dynamic Range: 30 dB minimum for less than 1-dB variation.
Total Range: 60 dB minimum.

GENERAL:

Signaling Rate: 25 Hz maximum, for both transmit and receive.

Bias Distortion: 10% maximum @ 20 Hz, adjustable.

Power Requirements:
+12-Volt Supply: 375 mA maximum
-12-Volt Supply: 100 mA maximum

Operating Temperature: -20°C to +55°C (-4°F to +131°F)

Dimensions: 10.305 inches high x 1.185 inches wide x 8.66 inches deep (260 mm x 30 mm x 220 mm); occupies three horizontal spaces in a double-Euro chassis.

5.3. THEORY OF OPERATION

The RFL 95 MODEM contains two basic sections: a modulator that converts audio signals into a SSB signal, and a demodulator that converts a received SSB signal back into an audio tone. Both sections use a 5.12-MHz intermediate frequency (i.f.), and are completely independent in their operation. Three voltage regulators are shared by both sections, and the crystal oscillator in the demodulator section also provides reference frequencies for some circuits in the modulator section.

5.3.1. Modulator Section

The modulator section is a single-conversion heterodyning transmitter with an i.f. of 5.12 MHz. It produces a double-sideband signal, which is converted to single sideband (SSB) by using conventional filtering techniques. The modulator section comprises a synthesizer, a speech amplifier, a high-pass filter, a compressor/ amplifier, an active low-pass filter, a balanced modulator, an i.f. filter, a mixer, an rf output filter, and a signaling transmitter. A block diagram of the modulator section can be found in Figure 5-3.

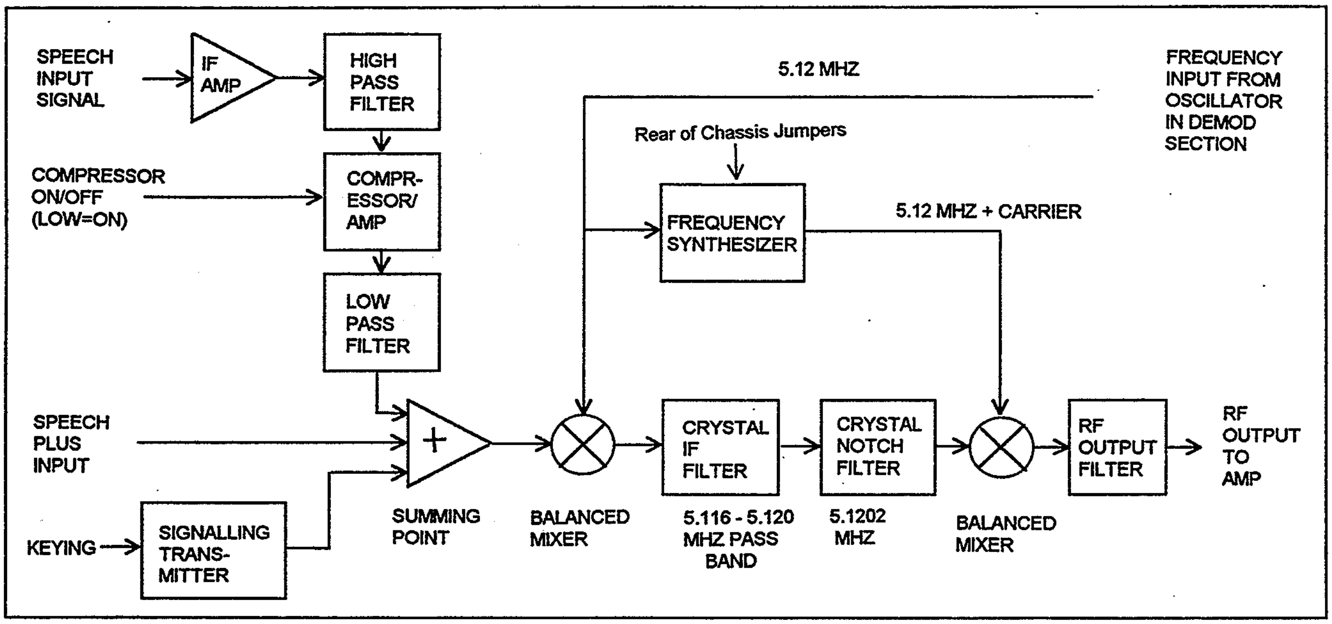


Figure 5-3. Block diagram, RFL 95 MODEM modulator section

a. Synthesizer. Synthesizer U208, voltage-controlled oscillator U209, and their associated components determine the modulator section output frequency. The FREQUENCY SET terminals of U208 (pins 11 through 18) are routed to pins B14 through B21 on edge connector P1 at the rear of the module. The transmit frequency is set by connecting jumpers across the pins of the mating connector in the chassis to pins A14 through A21, which are grounded.

U209's output frequency is controlled by varactor CR201, which serves as a tuner. Capacitor C234 and resistors R232 and R233 form a loop filter, and capacitors C235 through C237 and resistors R234 through R236 form a notch filter that is tuned to the reference frequency. These filters work together to reduce the reference sidebands. Capacitor C232 attenuates very-high-frequency noise, as well as harmonics of the reference frequency.

b. Speech Amplifier. Speech input signals are applied to the primary of coupling transformer T201. The secondary of T201 applies these signals to pin 2 of operational amplifier U201A, which serves as the speech amplifier. Potentiometer R204 sets the gain for U201A. The output of the speech amplifier (U201A pin 1) is passed on to the high-pass filter.

c. High-Pass Filter. Operational amplifier U201B and its associated components form a high-pass filter. It accepts the output from the speech amplifier, and limits the low-frequency components of the speech signal. This will prevent spurious outputs near the carrier. Signal limiting is achieved by driving U201B near saturation, as controlled by the setting of potentiometer R266. The output of the high-pass filter (U201B pin 7) is fed to the compressor/amplifier.

d. Compressor/Amplifier. Operational amplifier U106B and its associated components amplify the output of the high-pass filter. U106B is re-configured for signal compression when analog switch U105B is activated by the COMPRESSOR ON/OFF signal at pin B7 of connector P1. When this pin goes low, the circuit acts as a compressor; when the pin is high, it works like an amplifier.

e. Active Low-Pass Filter. The active low-pass filter is a plug-on assembly that contains no field-replaceable components. It is used to suppress all speech signals above a specific frequency (usually 3.4 kHz). This prevents interference with the 3825-Hz signaling tone that is produced by the signaling transmitter.

The output of the active low-pass filter is passed through an equalizer formed from operational amplifiers U214C and U214D, along with their associated components. FREQ ADJ potentiometer R279 and Q ADJ potentiometer R277 control the equalizer's characteristics. AMP ADJ potentiometer R280 controls the equalizer's output level, which is present at pin 7 of operational amplifier U214B. The output of the equalizer is sent to the balanced modulator.

f. Balanced Modulator. Modulator/demodulator U204 and its associated components accept the outputs from the active low-pass filter, speech plus and the signaling transmitter. It uses these signals to generate a 5.12-MHz signal with double sidebands and a suppressed carrier.

g. I.f. Filter. FL201 is a monolithic crystal filter, used to suppresses the upper sideband of the balanced modulator output. The lower sideband signal produced by FL201 is then amplified by transistor Q201. The filter formed from crystal Y201, inductor L203, capacitors C219 and C255, and resistor R226 removes close-in spurious signals from the output of Q201. This filtered signal is then fed to the mixer.

h. Mixer. Mixer U205 and its associated components combine the output of the i.f. filter with the local oscillator frequency generated by the synthesizer. The result is a SSB signal at the desired output frequency. Because of an inversion that takes place during the mixing process, the lower sideband signal applied to the mixer becomes an upper sideband signal at the output frequency. This SSB signal is applied to the primary of transformer T203, and the signal across the secondary of T203 is passed on to the rf output filter.

i. Rf Output Filter. The rf output filter is a low-pass filter that removes unwanted mixer products from the rf output before it is passed on to the amplifier/power supply through pin B12 of connector P1.

j. Signaling Transmitter. The signaling transmitter accepts either isolated or direct keying inputs, and produces a pilot tone which is applied to the balanced modulator.

The signaling transmitter comprises optical isolator U210, multiplexer/demultiplexer U211, quad operational amplifier U212, and their associated components. U210 allows isolated keying of the transmitter. U211 contains the electronic switch circuitry which provides the keying to the signaling transmitter, and U212 is connected as a free-running oscillator, with its oscillating frequency controlled by potentiometer R249.

U212 can also be frequency-shift keyed by having U211 determine its output frequency range. Normally, frequency-shift keying will occur at 3795 Hz and 3855 Hz; other frequencies can be set by changing the values of resistors R251 and R255. The output level of the signaling transmitter is controlled by potentiometer R242.

5.3.2. Demodulator Section

The demodulator section is a synthesized up-converting single-conversion receiver that uses the same 5.12-MHz i.f. as the modulator section (para 5.3.1). It contains a crystal oscillator, a synthesizer, an input low-pass filter, an input mixer, an i.f. filter, a product detector, a speech channel low-pass filter, an expander/output amplifier, an FSK bandpass filter, a signaling receiver, an AGC circuit, a carrier alarm circuit, and a signal-to-noise (S/N) ratio alarm. A block diagram of the demodulator section can be found in Figure 5-4.

a. Crystal Oscillator. Transistor Q103, crystal Y101, varactors CR103 and CR108, and their associated components form a crystal oscillator. This oscillator serves as the beat-frequency oscillator (BFO) for the product detector as well as the reference frequency for the frequency synthesizers in both sections of the 95 MODEM. FREQ ADJ potentiometer R138 adjusts the voltage applied to the junction of CR103 and CR108, and this voltage determines the output frequency of the oscillator. The voltage at the junction of CR103 and CR108 can also be varied by the application of an external voltage at pin B11 of connector P2.

b. Synthesizer. Synthesizer U109 sets the frequency at which the demodulator section will receive inputs. Its FREQUENCY SET terminals (pins 11 through 18) are routed to pins B14 through B21 on edge connector P2 at the rear of the module. The receive frequency is set by connecting jumpers across the pins of the mating connector in the chassis to pins A14 through A21, which are grounded.

The output of the crystal oscillator is also fed to pin 15 of decade counter U110. The output of U110 (pin 7) forms the 102.4 KHz OUTPUT signal present at pin B7 of connector P2. It is also applied to pin 3 of phase comparator U111, where it is compared with the EXT SYNCH INPUT signal from the optional synchronizer card to produce the EXT SYNCH signal at connector P2 pin A11.

c. Input Low-Pass Filter. The input signal is applied to a low-pass filter formed from capacitors C102 through C104 and inductors L101 through L103. This filter removes the image frequency from the receiver mixer.

d. Input Mixer. Mixer U101 takes the input signal and converts it to the 5.12-MHz i.f. by combining it with the output of the voltage-controlled oscillator (VFO) formed from U102 and its associated components. The VFO output is also fed to synthesizer U109. The VFO output frequency is controlled by varactor CR101, which serves as a tuner. Capacitor C127 and resistors R112 and R113 form a filter, which sets the dynamics of this loop.

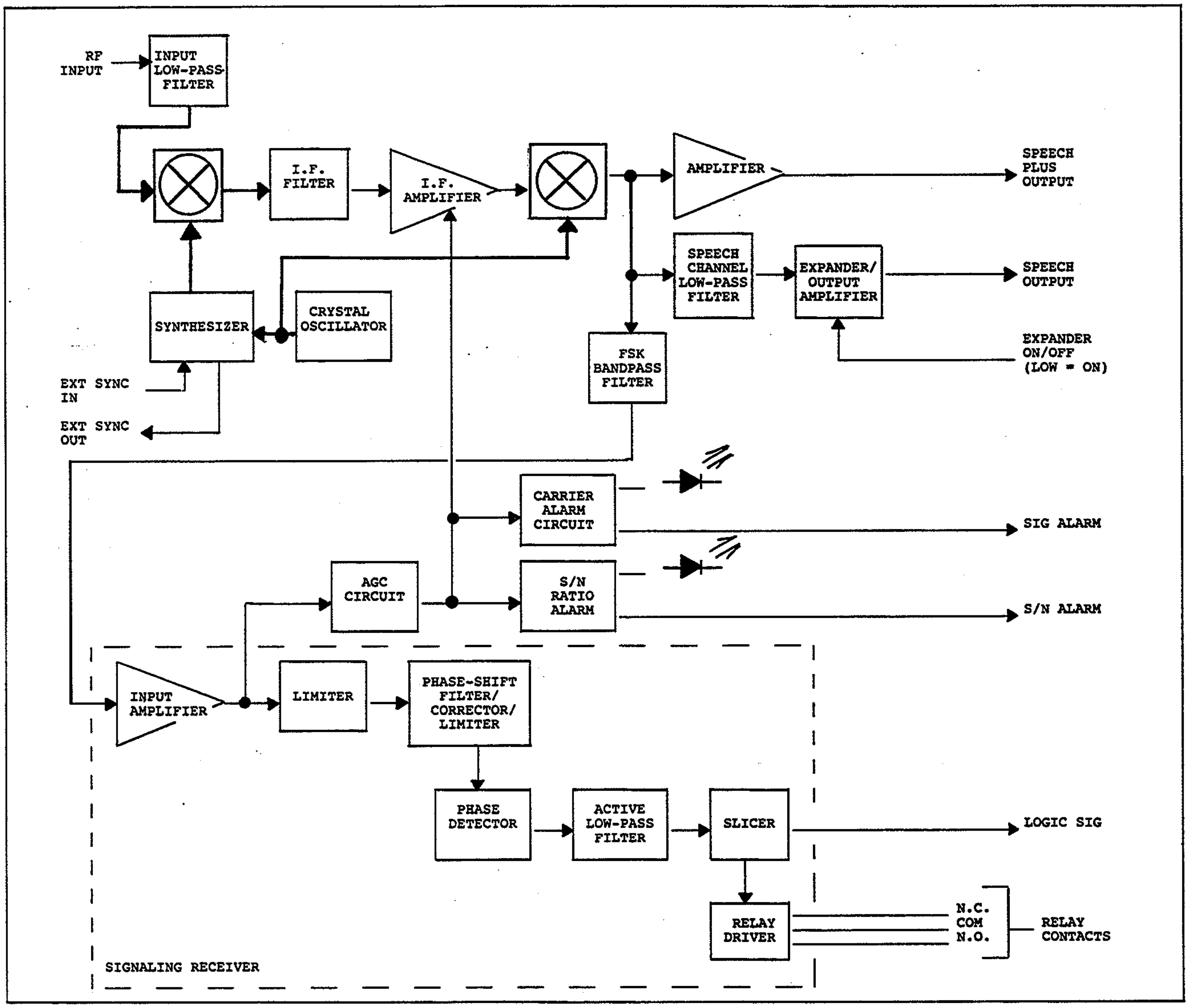


Figure 5-4. Block diagram, RFL 95 MODEM demodulator section

Capacitors C124 through C126 and resistors R109 through R111 form a notch filter that is tuned to the reference frequency. This notch filter reduces the reference sidebands. Capacitor C128 attenuates high-frequency noise, as well as harmonics of the reference frequency.

__e. I.f. Filter__. FL101 is a ten-pole monolithic crystal filter. It cleans up the output of the i.f. mixer before it is fed to the i.f. amplifier.

__f. I.f. Amplifier__. Operational amplifier U103 is a high-gain i.f. amplifier which amplifies the output of the i.f. filter. U103 supplies most of the gain in the demodulator section, and also provides automatic gain control (AGC) action through feedback from the carrier alarm circuit.

__g. Product Detector__. The output of the i.f. amplifier (U103 pin 8) is fed to pin 13 of mixer U104, which serves as a product detector. U104 combines the i.f. signal with the 5.12-MHz crystal oscillator output to produce an audio output signal. The output of the product detector is fed to audio transformer T102, which splits the signal into two parts. The first part is amplified by operational amplifier U117D to produce the SPEECH PLUS output at pin B6 of connector P1. The other half is fed to the inputs of the speech channel and FSK filters.

__h. Speech Channel Low-Pass Filter__. The speech channel low-pass filter is a plug-on filter used to reduce interference from signals above the audio passband. Signals that could cause interference include the 3825-Hz signaling tone and interference that may be received from an adjacent channel.

i. Expander/Output Amplifier. The output of the speech channel low-pass filter is amplified by operational amplifier U106. U106 can operate as an amplifier for normally modulated signals, or as an expander for processing compressed signals. The function of U106 is controlled by FET switch U105A.

j. FSK Bandpass Filter. The product detector output is also passed through the plug-on FSK bandpass filter. This filter separates the signaling subcarrier from the audio output, and passes the signaling subcarrier on to the signaling receiver.

k. Signaling Receiver. The signaling receiver processes the signaling subcarrier, which is about 3825 Hz above the carrier frequency. For low-speed data, this subcarrier is shifted from 30 Hz below its nominal value to 30 Hz above nominal. The amplitude of this subcarrier is used as a reference for the AGC circuit.

The signaling receiver contains an input amplifier, a limiter, a phase-shift filter/corrector/limiter, a phase detector, a low-pass filter, a slicer, and a relay driver.

(1) Input Amplifier. The output of the FSK bandpass filter is amplified by the input amplifier, formed from operational amplifiers U112B and U113B and their associated components. The output of this amplifier (U113B pin 7) serves as the input to the mixer as well as the input to the AGC circuit.

(2) Limiter. Operational amplifier U113A serves as a limiter for the signaling receiver. The output of U113A is held constant by resistors R160, R162, and R163.

(3) Phase Shift Filter, Corrector, And Limiter. The output of U113A is fed to an active bandpass filter, comprising operational amplifiers U107C and U107D, and their associated components. The output of this filter is a phase shift signal, which is applied to the phase corrector circuit formed from operational amplifier U107B and its associated components. The output of the phase corrector feeds operational amplifier U114B, which is connected as a limiter. The output of U114B (pin 1) is passed on to the phase detector.

(4) Phase Detector. The output of the phase-shift filter/corrector/limiter is fed to one input (pin 3) of Exclusive-OR gate U115, and the output of limiter U113A is fed to the other input (pin 6). U115 serves as a phase detector, producing an output that is relative to the phase angle difference between its two inputs. Since one output was passed through the bandpass filter, the dc output of the phase detector is a function of the input frequency. Capacitor C172 and resistors R180 and R181 form a filter that reduces ripple on the phase detector output.

(5) Active Low-Pass Filter. The phase detector output is passed through an active low-pass filter formed from operational amplifier U114 and its associated components. Because it is an active filter, it compensates for the signal loss incurred by the RC filter network at the output of the phase detector.

(6) Slicer. The output of the active low-pass filter drives operational amplifier U116, which serves as a slicer. The slicer's output (U116 pin 7) serves as the drive signal for the relay driver, as well as the LOGIC SIG output present at pin B4 of connector P2.

(7) Relay Driver. The slicer drives transistor Q105, which drives the coil of relay K101. When K101 energizes, its contacts move to signify that the signaling subcarrier is present. To prevent relay chatter when no signal is present, diode CR112 is connected to the output of the carrier alarm circuit. This forces U116B's output to go low when no signal is present.

l. AGC Circuit. The output of the signaling receiver's input amplifier provides the input signal for the AGC circuit. This rectified and amplified signal is applied to pin 2 of operational amplifier U107, which is connected as a comparator. The reference voltage applied to pin 3 of U107 is determined by the setting of AGC potentiometer R130. A change in the voltage at pin 2 of U107 will result in a change in the voltage at U107's output (pin 1), which is sent to the offset terminal (pin 5) of i.f. amplifier U103 as its AGC control voltage.

m. Carrier Alarm Circuit. The carrier alarm circuit monitors for the presence of AGC control voltage, which will be present as long as there is incoming carrier. If carrier is lost, the AGC control voltage will drop and operational amplifier U116A will change states. This will turn on transistors Q106 and Q107, lighting CARRIER ALARM indicator DS101 and producing a SIG ALARM output at pin B3 of connector P2.

n. Signal-To-Noise (S/N) Ratio Alarm. The amount of noise on the communication channel is determined by rectifying the low-frequency noise component of the AGC circuit's input signal, which will be proportional to the amount of noise on the received signal.

Operational amplifier U108A and its associated components form an active low-pass filter with a passband around 50 Hz. The output of this filter (U108A pin 1) is passed on to pin 6 of operational amplifier U108B, which is connected as a precision rectifier. The output of the rectifier is filtered by capacitor C166 and passed on to operational amplifier U112A, where it is compared to a reference voltage determined by the setting of potentiometer R153. If the noise on the AGC line is too high, pin 1 of U112A will go high, lighting S/N indicator DS102 and turning on transistor Q104, which produces the S/N ALARM signal at pin B5 of connector P2.

5.3.3. Voltage Regulators

The amplifier/power supply in the RFL 9505 chassis supplies the 95 MODEM with +12 and -12 volts. These voltages are filtered by capacitors C230 and C231 and routed as required throughout the module. Three three-terminal voltage regulators are then used to convert these voltages to the lower voltages required by some circuits on the module.

a. +8-Volt Supply. Voltage regulator U206 accepts the +12-volt input to the modem module, and converts it to +8 volts. Capacitor C228 provides filtering for the +8-volt line.

b. +5-Volt Supply. Voltage regulator U207 converts the +12-volt input to +5 volts, with filtering being performed by capacitor C229.

c. -5-Volt Supply. The -12-volt input is reduced to -5 volts by voltage regulator U213. The output of U213 is filtered by capacitor C250.

5.3.4. Plug-On Filters

The 95 MODEM uses three active plug-on filters: the active low-pass speech filter in the modulator section, and the speech channel low-pass filter and FSK bandpass filter in the demodulator section. These active filters each use a series of operational amplifiers and RC networks to achieve the desired filtering.

All the plug-on filters are adjusted at the factory, and cannot be readjusted in the field. If there is a problem with one of these filters, they are designed to be easily unplugged and replaced.

Table 5-1. Replaceable parts, RFL 9505 modulator/demodulator modules
RFL 95 MODEM - Assembly No. 100805
RFL 95 MODEM-1 (for use as master modem in synchronized systems) - Assembly No. 100805-1

Circuit Symbol (Figs. 5-5 & 5-6)	Description	Part Number
	CAPACITORS	
C101,106,114-116,119,126,147, 149,151,153,156,157,180,182, 183,204,210,214,215,220,235, 241,251-255,257,268,269	Capacitor,X7R ceramic,0.1µF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C102	Capacitor,ceramic,470pF,5%, 100V,AVX SA101A471JAA or equiv.	0125 14715
C103,104	Capacitor,ceramic,0.0012µF,5%,50V,AVX SA205A122JAA or equiv.	0125 51225
C105	Capacitor,ceramic,820pF,5%,50V,AVX SA305A821JAA or equiv.	0125 58215
C107,109,145,146,221,256,260	Capacitor,X7R ceramic,0.001µF,10%,100V,AVX SA101C102KAA or equiv.	0130 11021
C108,111,130,131,136,143,154, 167,209,217,222,225,226	Capacitor,X7R ceramic,0.01µF,10%,50V,AVX SA105C103KAA or equiv.	0130 51031
C110,129,133,152,181,184,216, 219,270	Capacitor,X7R ceramic,0.001µF,5%,100V,AVX SA201A102JAA or equiv.	0125 11025
C111	Capacitor,X7R ceramic,0.01µF,10%,100V,Kemet C320C103K1R5EA or equiv.	1007 1390
C112	Capacitor,X7R ceramic,0.0012µF,5%,50V,AVX SA205A122JAA or equiv.	0125 51225
C113	Capacitor,X7R ceramic,0.0039µF,5%,100V,AVX SA301A392JAA or equiv.	0125 13925
C117,122,240,242	Capacitor,ceramic,0.1µF,10%,50V,AVX SR205C104KAA or equiv.	1007 1667
C118,120,123,159,238,243, 261,262	Capacitor,ceramic,0.001µF,10%,50V,AVX SR205A102KAA or equiv.	1007 1666
C121,239	Capacitor,ceramic,33pF,5%,100V,AVX SA101A330JAA or equiv.	0125 13305
C124,125,236,237	Capacitor,X7R ceramic,0.047µF,10%,50V,AVX SA205C473KAA or equiv.	0130 54731
C127,132,138,139,158,165,171, 177-179,203,207,223,228-231, 234,247,250,263	Capacitor,tantalum,1µF,20%,35V,Kemet T322B105M035AS or equiv.	1007 496
C128,232	Capacitor,X7R ceramic,220pF,10%,100V,AVX SA101C221KAA or equiv.	0130 12211
C134,265	Capacitor,variable,ceramic,5-25pF,Johansen 9374 or equiv.	30129
C135,148,266,267	Capacitor,ceramic,0.01µF,5%,100V,AVX SR301A103JAA or equiv.	1007 1645
C137,140,202,206,259	Capacitor,Z5U ceramic,0.33µF,+80-20%,50V,Murata RPA3025U334Z50V or equiv.	0135 53348
C141,205	Capacitor,tantalum,0.1µF,20%,35V,Kemet T110A104M035AS or equiv.	1007 497
C150,208,244,249	Capacitor,tantalum,2.2µF,20%,25V,Kemet T322B225M025AS or equiv.	1007 645
C142,144,166	Capacitor,tantalum,10µF,10%,10V,Corning Components CCM-010-106-10 or equiv.	1007 1245
C155,175,233,248	Capacitor,ceramic,100pF,5%,100V,AVX SA101A101JAA or equiv.	0125 11015
C160,186-200	Not used.	
C161,162	Capacitor,ceramic,150pF,5%,100V,AVX SA101A151JAA or equiv.	0125 11515
C163	Capacitor,metallized polycarbonate,0.285µF,2%,100V,Wesco 32MPC or equiv.	1007 1423
C164	Capacitor,X7R ceramic,0.033µF,10%,50V,AVX SA205C333KAA or equiv.	0130 53331

Table 5-1. Replaceable parts - continued.

Circuit Symbol (Figs. 5-5 & 5-6)	Description	Part Number
	CAPACITORS - continued.	
C168-170,245,246	Capacitor,ceramic,0.0068µF,5%,100V,AVX SA401A682JAA or equiv.	0125 16825
C172,174	Capacitor,X7R ceramic,0.022µF,10%,50V,AVX SA105C223KAA or equiv.	0130 52231
C173,212	Capacitor,X7R ceramic,0.056µF,10%,50V,AVX SA205C563KAA or equiv.	0130 55631
C176	Capacitor,ceramic,0.0022µF,5%,100V,AVX SA301A222JAA or equiv.	0125 12225
C185,224,227,264	Capacitor,X7R ceramic,0.0056µF,5%,100V,AVX SA401A562JAA or equiv.	0125 15625
C201	Capacitor,ceramic,0.12µF,10%,50V,AVX SR305C124KAA or equiv.	1007 1649
C211	Capacitor,variable,ceramic,6-70pF,Sprague-Goodman GKF700000 or equiv.	45362
C213	Capacitor,ceramic,0.082µF,5%,50V,AVX SR505A823JAA or equiv.	1007 1648
C218	Capacitor,ceramic,56pF,5%,100V,AVX SA101A560JAA or equiv.	0125 15605
C258	Capacitor,ceramic,0.018µF,10%,50V,AVX SR305A183KAA or equiv.	1007 1646
C271	Capacitor, ceramic, 4.7µF	1007 711
	RESISTORS	
R101,104,229	Resistor,metal film,536Ω,1%,1/4W, Type RN1/4	0410 1262
R101A,103A,107A-110A,114, 121,122,124,145,151,152,155, 159-161,171,173,174,178,179, 203,225,240,243,244,250,253, 254,257,260,263,265,269,272, 274-276,278,282-285	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R102,112A,125,133,149,158, 184,220,222,223	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R102A,104A,105,204,212,259, 277,279	Resistor,variable,12-turn cermet,100KΩ,10%,1/4W,top adjust,Bourns 3266W-1-104 or equiv.	32999
R103,206,207,209,213	Resistor,metal film,33.2KΩ,1%,1/4W, Type RN1/4	0410 1434
R105A,120,138,153,198,214, 259,273,280	Resistor,variable,12-turn cermet,10KΩ,10%,1/4W,top adjust,Bourns 3266W-1-103 or equiv.	32996
R106	Resistor,metal film,511Ω,1%,1/4W, Type RN1/4	0410 1260
R106A,281	Resistor,metal film,78.7KΩ,1%,1/4W, Type RN1/4	0410 1470
R107,118,134,267,270	Resistor,metal film,604Ω,1%,1/4W, Type RN1/4	0410 1267
R108,139,140,192,237	Resistor,metal film,47.5KΩ,1%,1/4W, Type RN1/4	0410 1449
R109,110,234,235	Resistor,metal film,845Ω,1%,1/4W, Type RN1/4	0410 1281
R111,236	Resistor,metal film,422Ω,1%,1/4W, Type RN1/4	0410 1252
R111A,286	Resistor,metal film,3.09KΩ,1%,1/4W, Type RN1/4	0410 1335
R112,230,233	Resistor,metal film,7.15KΩ,1%,1/4W, Type RN1/4	0410 1370
R113,232	Resistor,metal film,4.12KΩ,1%,1/4W, Type RN1/4	0410 1347
R113A,132	Resistor,metal film,49.9KΩ,1%,1/4W, Type RN1/4	0410 1451
R115,135,136,142,150,163,177, 182,183,194	Resistor,metal film,100KΩ,1%,1/4W, Type RN1/4	0410 1480

Table 5-1. Replaceable parts - continued.

Circuit Symbol (Figs. 5-5 & 5-6)	Description	Part Number
	RESISTORS - continued.	
R116	Resistor,metal film,6.19KΩ,1%,1/4W, Type RN1/4	0410 1364
R117	Resistor, metal film,8.66KΩ,1%,1/4W, Type RN1/4	0410 1378
R119,141,143,187,189,197	Resistor,metal film,27.4KΩ,1%,1/4W, Type RN1/4	0410 1426
R123,226	Resistor,metal film,2.21KΩ,1%,1/4W, Type RN1/4	0410 1321
R126	Resistor,metal film,15KΩ,1%,1/4W, Type RN1/4	0410 1401
R127,188	Resistor,metal film,4.75KΩ,1%,1/4W, Type RN1/4	0410 1353
R128	Resistor,metal film,20KΩ,1%,1/4W, Type RN1/4	0410 1413
R129,196,241	Resistor,metal film,1MΩ,1%,1/4W,Mepco/Electra SPR5053YD1M000F or equiv.	1510 1813
R130	Resistor,variable,12-turn cermet,50KΩ,10%,1/4W,top adjust,Bourns 3266W-1-503 or equiv.	32998
R131	Resistor,metal film,226Ω,1%,1/4W, Type RN1/4	0410 1226
R137	Resistor,metal film,221KΩ,1%,1/4W, Type RN1/4	0410 1513
R144,156	Resistor,metal film,221Ω,1%,1/4W, Type RN1/4	0410 1225
R146	Resistor,metal film,16.2KΩ,1%,1/4W, Type RN1/4	0410 1404
R147	Resistor,metal film,11KΩ,1%,1/4W, Type RN1/4	0410 1388
R148	Resistor,metal film,32.4KΩ,1%,1/4W, Type RN1/4	0410 1433
R154,164	Resistor,metal film,2.2MΩ,1%,1/2W,Mepco/Electra 5053YD2M200F or equiv.	1510 2236
R157,239	Resistor,metal film,1.21KΩ,1%,1/4W, Type RN1/4	0410 1296
R162,185	Resistor,metal film,475KΩ,1%,1/4W, Type RN1/4	0410 1545
R165	Resistor,metal film,249KΩ,1%,1/4W, Type RN1/4	0410 1518
R166-168,172,251,255	Resistor,metal film,6.19KΩ,1%,1/4W, Type RN1/4	0410 1364
R169,249,271	Resistor,variable,12-turn cermet,1KΩ,10%,1/4W,top adjust,Bourns 3266W-1-102 or equiv.	32993
R170	Resistor,metal film,5.36KΩ,1%,1/4W, Type RN1/4	0410 1358
R175	Resistor,metal film,4.53KΩ,1%,1/4W, Type RN1/4	0410 1351
R176	Resistor,metal film,499KΩ,1%,1/4W, Type RN1/4	0410 1547
R180,181,190,195,245	Resistor,metal film,200KΩ,1%,1/4W, Type RN1/4	0410 1509
R186,191	Resistor,metal film,3.01KΩ,1%,1/4W, Type RN1/4	0410 1334
R193,228	Resistor,metal film,47.5Ω,1%,1/8W,Type RN55D	1510 707
R199	Resistor, metal film,383Ω,1%,1/4W, Type RN1/4	0410 1248
R200	Not used.	
R201	Resistor,metal film,2.15KΩ,1%,1/4W, Type RN1/4	0410 1320
R202	Resistor,metal film,825Ω,1%,1/4W, Type RN1/4	0410 1280
R205	Resistor,metal film,12.7KΩ,1%,1/4W, Type RN1/4	0410 1394

Table 5-1. Replaceable parts - continued.

Circuit Symbol (Figs. 5-5 & 5-6)	Description	Part Number
	RESISTORS - continued.	
R206,207	Resistor,metal film,51.1KΩ,1%,1/4W, Type RN1/4	0410 1452
R208	Resistor, metal film,75KΩ,1%,1/4W, Type RN1/4	0410 1468
R210	Resistor,metal film,301Ω,1%,1/4W, Type RN1/4	0410 1238
R211	Resistor,metal film,909Ω,1%,1/4W, Type RN1/4	0410 1284
R215,216	Resistor,metal film,402Ω,1%,1/4W, Type RN1/4	0410 1250
R217,258	Resistor,variable,12-turn cermet,5KΩ,10%,1/4W,top adjust,Bourns 3266W-1-502 or equiv.	32995
R218	Resistor,metal film,6.81KΩ,1%,1/4W, Type RN1/4	0410 1368
R219,221	Resistor, metal film,51.1Ω,1%,1/4W, Type RN1/4	0410 1164
R224	Resistor,metal film,44.2KΩ,1%,1/4W, Type RN1/4	0410 1446
R227	Resistor,metal film,100Ω,1%,1/4W, Type RN1/4	0410 1192
R231	Resistor,metal film,3.16KΩ,1%,1/4W, Type RN1/4	0410 1336
R238	Resistor,wirewound,1.8KΩ,5%,3.25W,Ohmite 4429 Style 995-3A or equiv.	1100 620
R242	Resistor,variable,12-turn cermet,25KΩ,10%,1/4W,top adjust,Bourns 3266W-1-253 or equiv.	32997
R246	Resistor,metal film,340KΩ,1%,1/4W, Type RN1/4	0410 1531
R247	Resistor,metal film,52.3KΩ,1%,1/4W, Type RN1/4	0410 1453
R248	Resistor,metal film,2KΩ,1%,1/4W, Type RN1/4	0410 1317
R252,256	Resistor,metal film,392KΩ,1%,1/4W, Type RN1/4	0410 1537
R261	Resistor,metal film,25.5KΩ,1%,1/4W, Type RN1/4	0410 1423
R262	Resistor,metal film,16.5KΩ,1%,1/4W, Type RN1/4	0410 1405
R264	Resistor,metal film,3.57KΩ,1%,1/4W, Type RN1/4	0410 1341
R266	Resistor,variable,12-turn cermet,2KΩ,10%,1/4W,top adjust,Bourns 3266W-1-202 or equiv.	32994
R268	Resistor,metal film,64.9KΩ,1%,1/4W, Type RN1/4	0410 1462
R290	Resistor, metal film, 23.7Ω, 1%. 1/4W, Type RN1/4	0410 1132
	SEMICONDUCTORS	
CR101,201	Diode,varactor,26-32pF,Motorola MV209 or equiv.	32509
CR102	Diode,Schottky barrier,Hewlett-Packard HSCH-1001	93631
CR103,108	Diode,varactor,400-520pF,Motorola MVAM109 or equiv.	32598
CR104-107,112	Diode,silicon,1N914B or 1N4448	26482
CR202	Diode,silicon,200 PIV,1N4003	30769
CR203,204	Diode,Zener,6.8V,10%,500mW,DO-7 case,1N5235	29228
DS101,102	Light-emitting diode,red,Dialight 550-0102 or equiv.	39568

Table 5-1. Replaceable parts - continued.

Circuit Symbol (Figs. 5-5 & 5-6)	Description	Part Number
	SEMICONDUCTORS - continued.	
Q101,102,108-200	Not used.	
Q103	Transistor,NPN Darlington,TO-92 case,2N918	46541
Q104,105,107,202	Transistor,NPN,plastic package,2N2222A	37445
Q106	Transistor,PNP,plastic package,2N2907A	37439
Q201	Transistor,NPN,TO-92 case,2N3903	21562
U101,104,205	Mixer,16-pin DIP,Plessey SL 6440C/DP or equiv.	0620 250
U102,209	Voltage-controlled oscillator,14-pin DIP,Motorola M1648P or equiv.	0690 3
U103	IF amplifier,8-pin DIP,Motorola MC1350P or equiv.	0620 251
U105,211	MOS triple 2-channel multiplexer/demultiplexer,16-pin DIP,RCA CD4053BE or equiv.	0615 243
U106	Linear compandor,16-pin DIP,Signetics NE570N or equiv.	0620 157
U107,117,212,214	Operational amplifier,JFET input,14-pin DIP,Texas Instruments TL084CN or equiv.	0620 151
U108,112,201	Operational amplifier,JFET input,8-pin DIP,Texas Instruments TL082CP or equiv.	0620 155
U109,208	MOS synthesizer,28-pin DIP,Motorola MC145151P or equiv.	0615 198
U110	MOS dual 4-bit decade counter,16-pin DIP,National Semiconductor MM74HC390N or equiv.	0615 252
U111,115	MOS phase comparator,8-pin DIP,National Semiconductor MM74C932N or equiv.	0615 244
U113,114	Operational amplifier/voltage comparator,8-pin DIP,National Semiconductor LM392N or equiv.	0620 245
U116	Voltage comparator,dual,low offset voltage,8-pin DIP,Motorola LM393N or equiv.	0620 144
U118-200,202,203	Not used.	
U204	Balanced modulator/demodulator,14-pin DIP,Motorola MC1496P or equiv.	0620 249
U206	Voltage regulator,+8-volt,3-terminal TO-220 package,Motorola MC7808CT or equiv.	0620 141
U207	Voltage regulator,+5-volt,3-terminal plastic package,Motorola MC7805CP or equiv.	0620 77
U210	Photo-coupled isolator,6-pin DIP,General Electric 4N35 or equiv.	47104
U213	Voltage regulator,-5-volt,3-terminal TO-92 package, National Semiconductor LM79L05ACZ or equiv.	0620 210
	MISCELLANEOUS COMPONENTS	
FL101,201	Filter,crystal,5.12 MHz	32523 1
FL102-200	Not used.	
J101,104	Jumper,programmable,Molex 90059-0009 or equiv.	98306
J102,103	Not used.	
K101	Relay,mercury-wetted SPDT,435Ω coil,Midtex 160-351N00 or equiv.	42226

Table 5-1. Replaceable parts - continued.

Circuit Symbol (Figs. 5-5 & 5-6)	Description	Part Number
	MISCELLANEOUS COMPONENTS - continued.	
L101-103	Inductor,rf,molded,180µH,10%,Gowanda 10/183 or equiv.	32505 2
L106,204-206	Inductor,molded,33µH,10%,130mA,ferrite core,Jeffers Electronics Type 09 1326-1K or equiv.	32868
L104,105,203	Inductor,variable,1.4µH nominal,Coilcraft SLOT TEN-5-01 or equiv.	32977
L107,207	Shielded inductor assembly	96955
L108	Inductor,rf,molded,100µH,10%,Gowanda 10/103 or equiv.	32505 1
L109-201	Not used.	
L202	Inductor,variable,15µH nominal,Toko America 154AN-T 1003Z or equiv.	32522
T101,201	Transformer,telephone-coupling,600Ω,Microtran T2104 or equiv.	32510
T102	Transformer,audio,4000Ω primary,600Ω center-tapped secondary, 200-15,000-Hz frequency response,PC mount,Microtran MMT11-M or equiv.	30134
T103-200	Not used.	
T202	Transformer	100858
T203	Transformer	100866
Y101	Crystal,quartz,5.12 MHz	93637
Y102-200	Not used.	
Y201	Crystal,quartz,5.1202 MHz	90199

FSK Bandpass Filter - Assembly No. 100875-X
Active Low-Pass Filter - Assembly No. 100880-X
Speech Channel Low-Pass Filter - Assembly No 100885-X

NOTE

The FSK bandpass filter, active low-pass filter, and speech channel low-pass filter are not field-repairable. Contact the factory for replacement information.

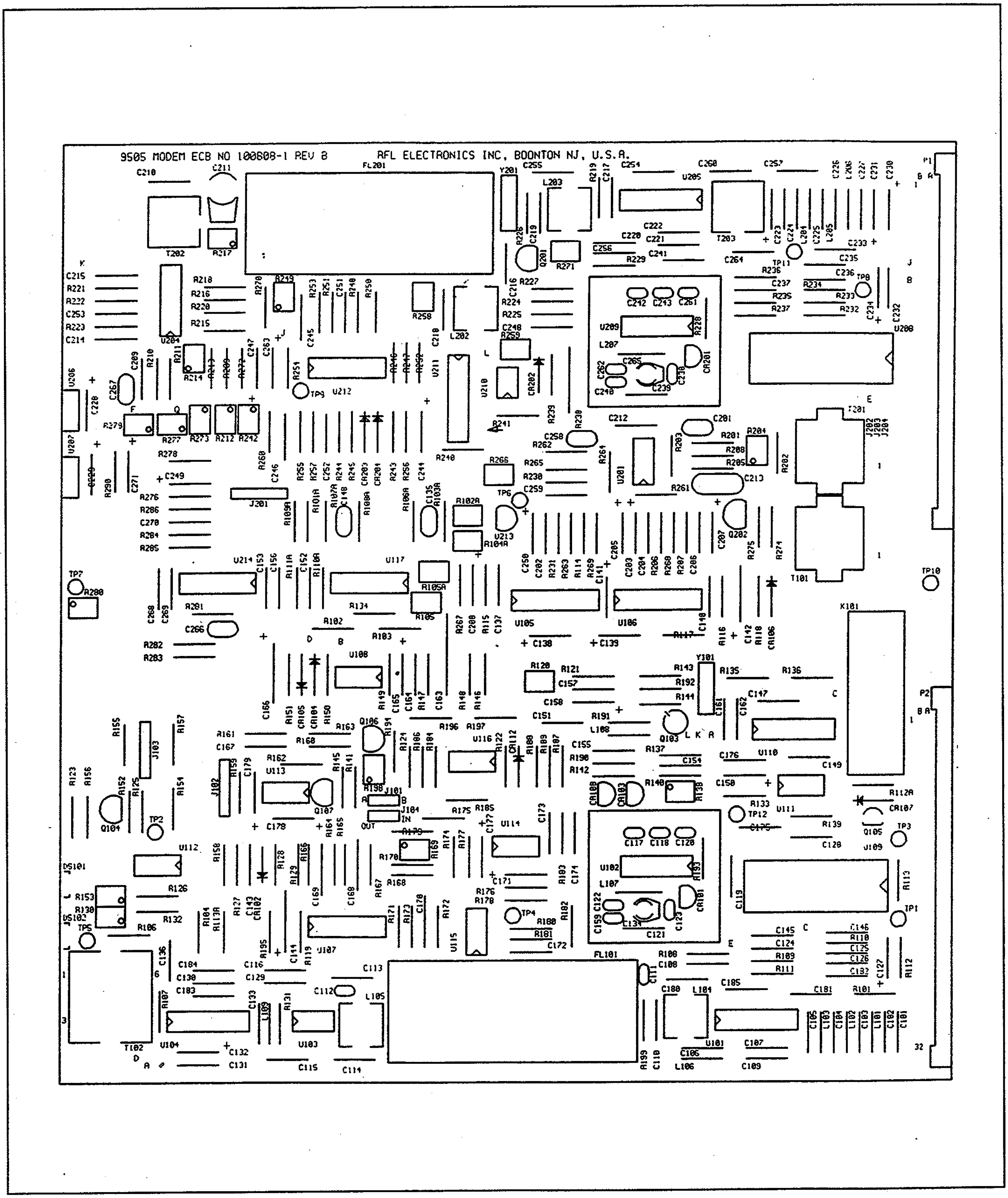


Figure 5-5. Component locator drawing, RFL 95 MODEM Modulator/Demodulator Module (Assembly No. 100805; Drawing No. 100808-1-B)

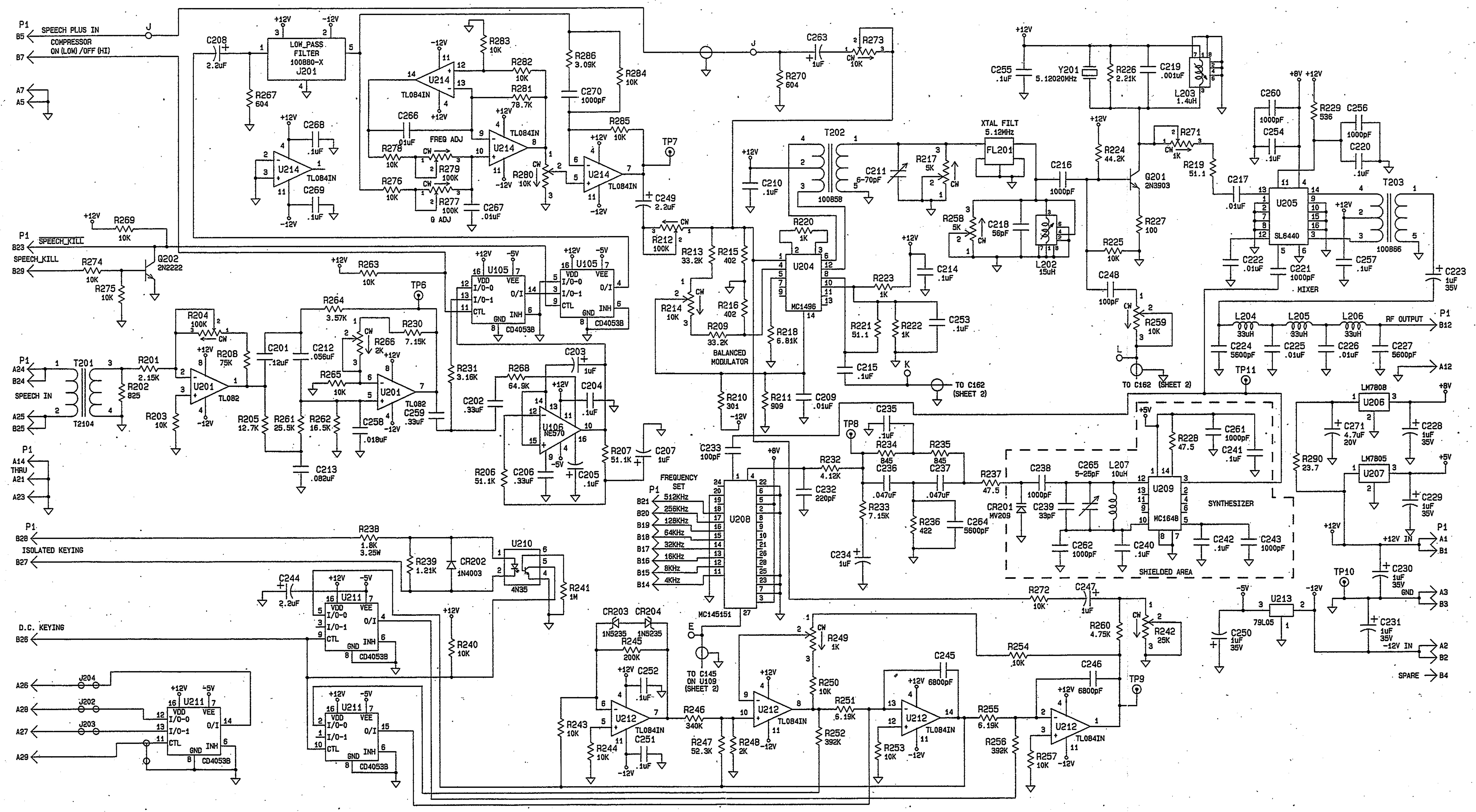


Figure 5-6. Schematic, RFL 95 MODEM Modulator/ Demodulator (Assembly No. 100805; Schematic No. D-100809-P) Sheet 1 of 3 - Modulator Section

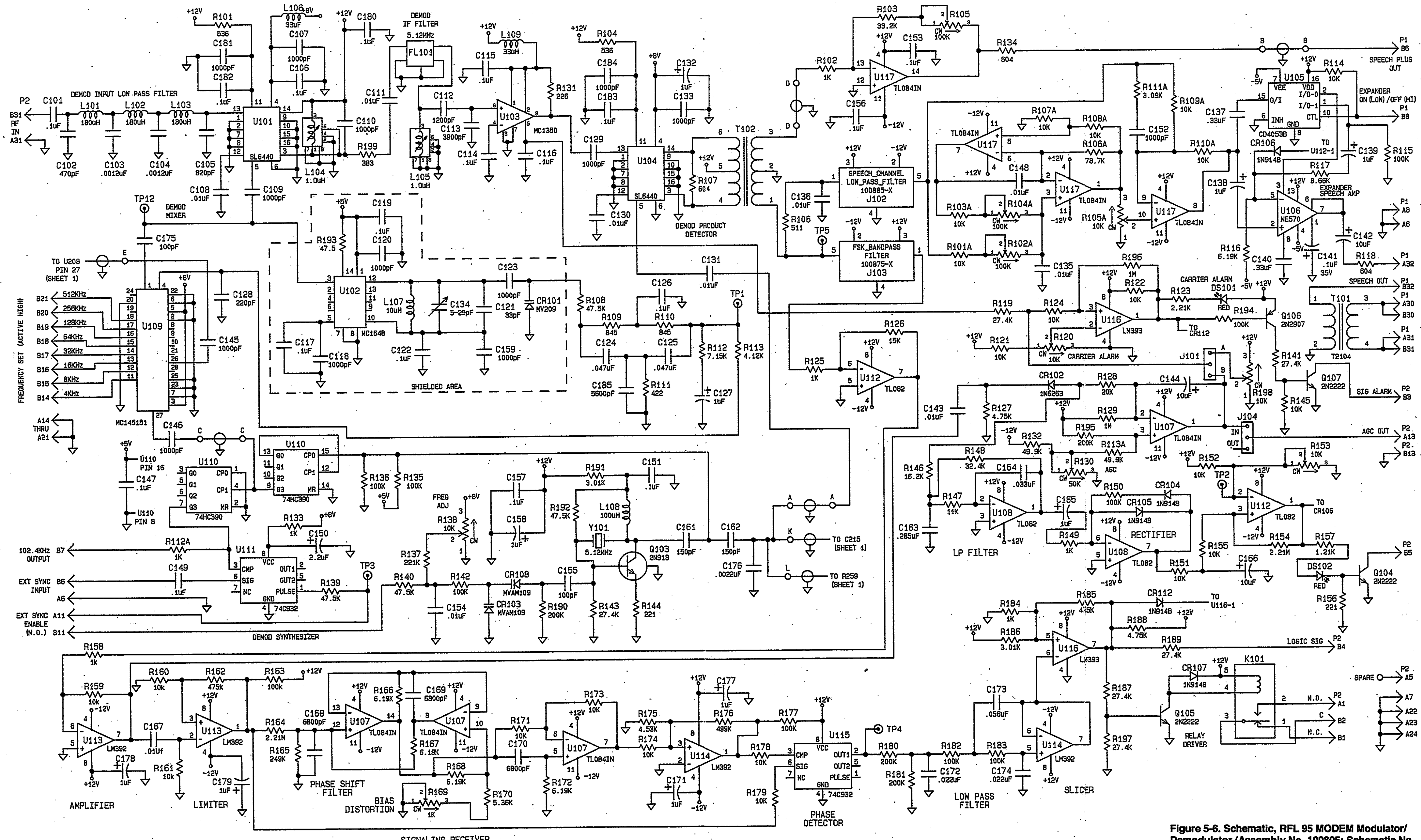


Figure 5-6. Schematic, RFL 95 MODEM Modulator/Demodulator (Assembly No. 100805; Schematic No. D-100809-P) Sheet 2 of 3 - Demodulator Section

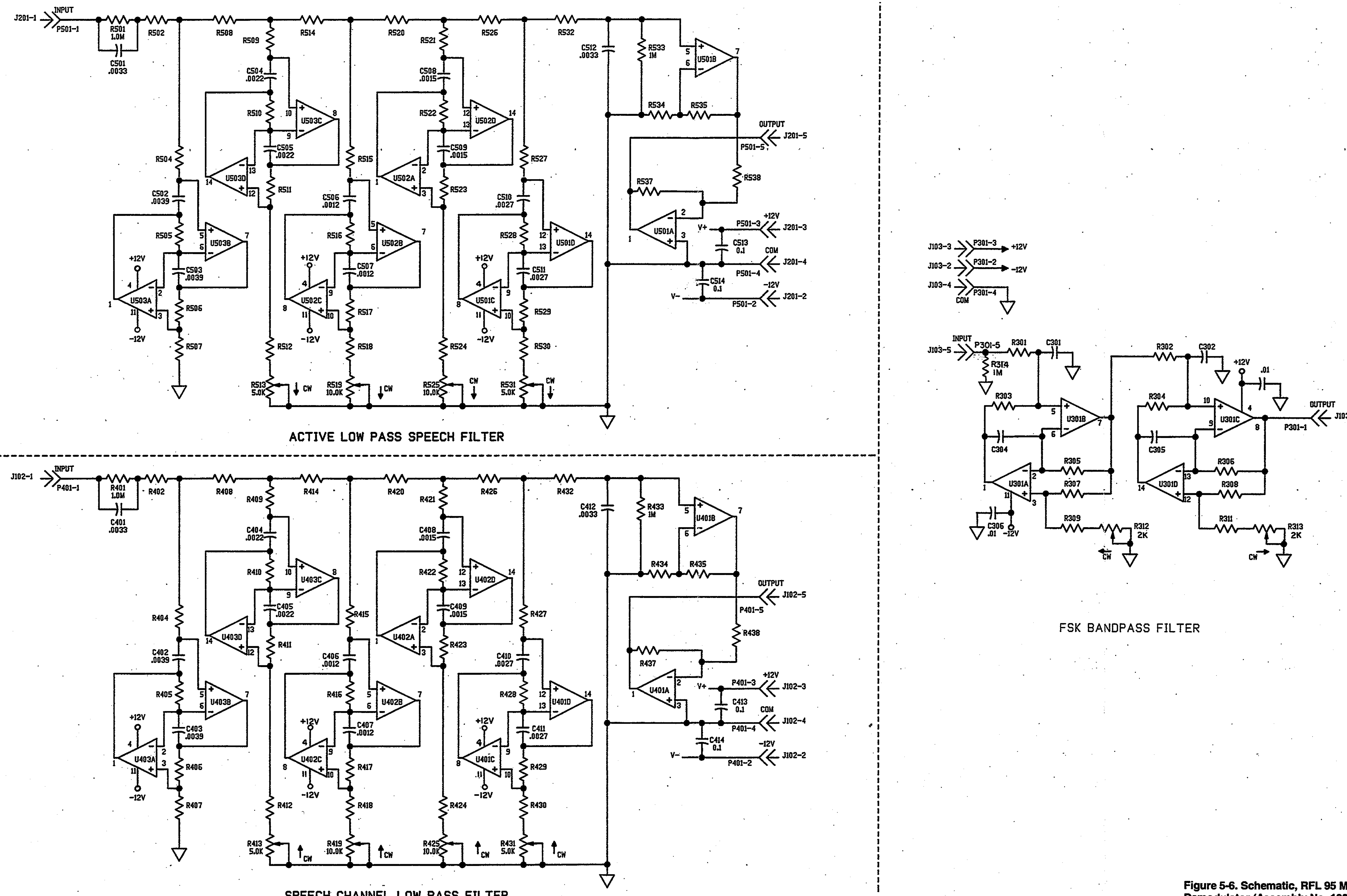


Figure 5-6. Schematic, RFL 95 MODEM Modulator/ Demodulator (Assembly No. 100805; Schematic No. D-100809-P) Sheet 3 of 3 - Plug-On Filters

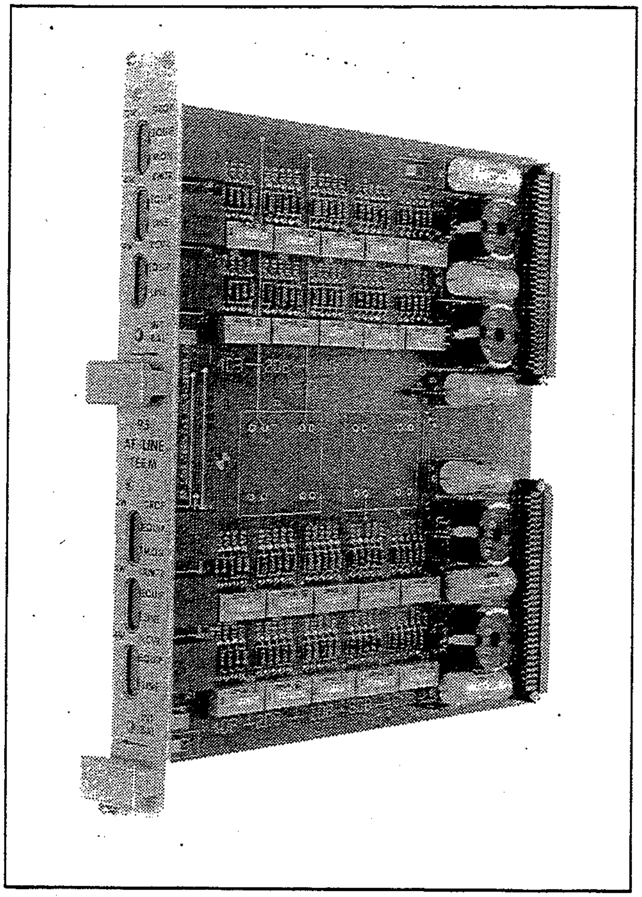


Figure 6-1. RFL 95 AF LINE TERM
Audio Line Termination Module

6.1. DESCRIPTION

The RFL 95 AF LINE TERM Audio Termination Module (Fig. 6-1) contains the termination circuits required to connect two RFL 95 MODEM Modulator/Demodulator Modules to the telephone line. Each channel contains two attenuators (one for send, one for receive), a two-wire to four-wire hybrid, and monitoring jacks for each input and output. The attenuators are a series of balanced H-pads, and a series of DIP switches are used to switch each individual pad in or out. An adjustable balance network is provided for the hybrid, or an external network may be used. An optional battery feed choke is available to supply talk current for the telephone interface.

The 95 AF LINE TERM is mounted in the RFL 95 CHAS chassis between the modems being interfaced, and occupies six horizontal chassis spaces.

6.2. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the RFL 95 AF LINE TERM. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Input Level: +15 dBm maximum into 600 ohms.

Attenuation Range: 0 to 31 dB.

Attenuation Accuracy: ±0.1 dB for each dB of attenuation.

Third-Harmonic Distortion: 51 dB minimum with 300-Hz signal @ +10 dB.

Transhybrid Loss (300 Hz to 3.4 kHz):
Without Battery Coil: 40 dB minimum.
With Battery Coil: 33 dB minimum.

Insertion Loss: 4.3 dB minimum.

Echo Return Loss:
Without Battery Coil: 27 dB.
With Battery Coil: 25 dB @ 100 mA.

SRL:
Without Battery Coil: 20 dB minimum.
With Battery Coil: 18 dB @ 100 mA.

Power Requirements: None; no active components are used.

Operating Temperature: -20°C to +55°C (-4°F to +131°F).

Dimensions: 10.3 inches high x 1.2 inches wide x 8.7 inches deep (260 mm x 30 mm x 220 mm); occupies six horizontal spaces in a double-Euro chassis.

6.3. THEORY OF OPERATION

The RFL 95 AF LINE TERM provides the interface between external equipment and two RFL 95 MODEM Modulator/Demodulator Modules. The module is divided into two identical halves, and each half provides the interfacing for one modem module. Each half contains a series of switchable attenuators, a set of front panel jacks, a two-wire to four-wire hybrid, and a balance network.

A block diagram for one half of the 95 AF LINE TERM appears in Figure 6-2; because both halves are identical, this block diagram is applicable to both halves of the module. Figure 6-3 is a component locator drawing for the 95 AF LINE TERM, and its schematic can be found in Figure 6-4.

6.3.1. Front Panel Jacks

Two sets of bantam-type jacks are provided on the front panel of the 95 AF LINE TERM. MON (monitor) jacks J8 and J20 can be used to monitor the signals present on the two-wire drop (if used); LINE jacks J6 and J18 can be used to inject signals into the 95 modem for testing purposes. LINE jacks J12 and J24 can be used to measure the signals present at the output of the modems. EQUIP jacks J5 and J17 can be used to measure signals present at the modem inputs. EQUIP jacks J11 and J23 can be used to inject signals into exterior equipment for testing purposes.

6.3.2. Transmit Attenuators

The transmit attenuators are placed in series with the modems' transmitter inputs. Each attenuator contains five sections (1 dB, 2 dB, 4 dB, 8 dB, and 16 dB), formed from resistors R1 through R25 for Channel 1 and 3, and resistors R52 through R76 for Channel 2 and 4.

Switches S1 through S5 set the Channel 1 and 3 transmit attenuator by either including a section of the attenuator or bypassing it; switches S11 through S15 perform the same function for the Channel 2 and 4 transmit attenuator. By using this method, each attenuator can be set in 1-dB steps anywhere from 0 dB to 31 dB.

6.3.3. Receive Attenuators

The receive attenuators are placed in series with the modems' receiver outputs. Each attenuator contains five sections (1 dB, 2 dB, 4 dB, 8 dB, and 16 dB), formed from resistors R26 through R50 for Channel 1 and 3, and resistors R77 through R101 for Channel 2 and 4.

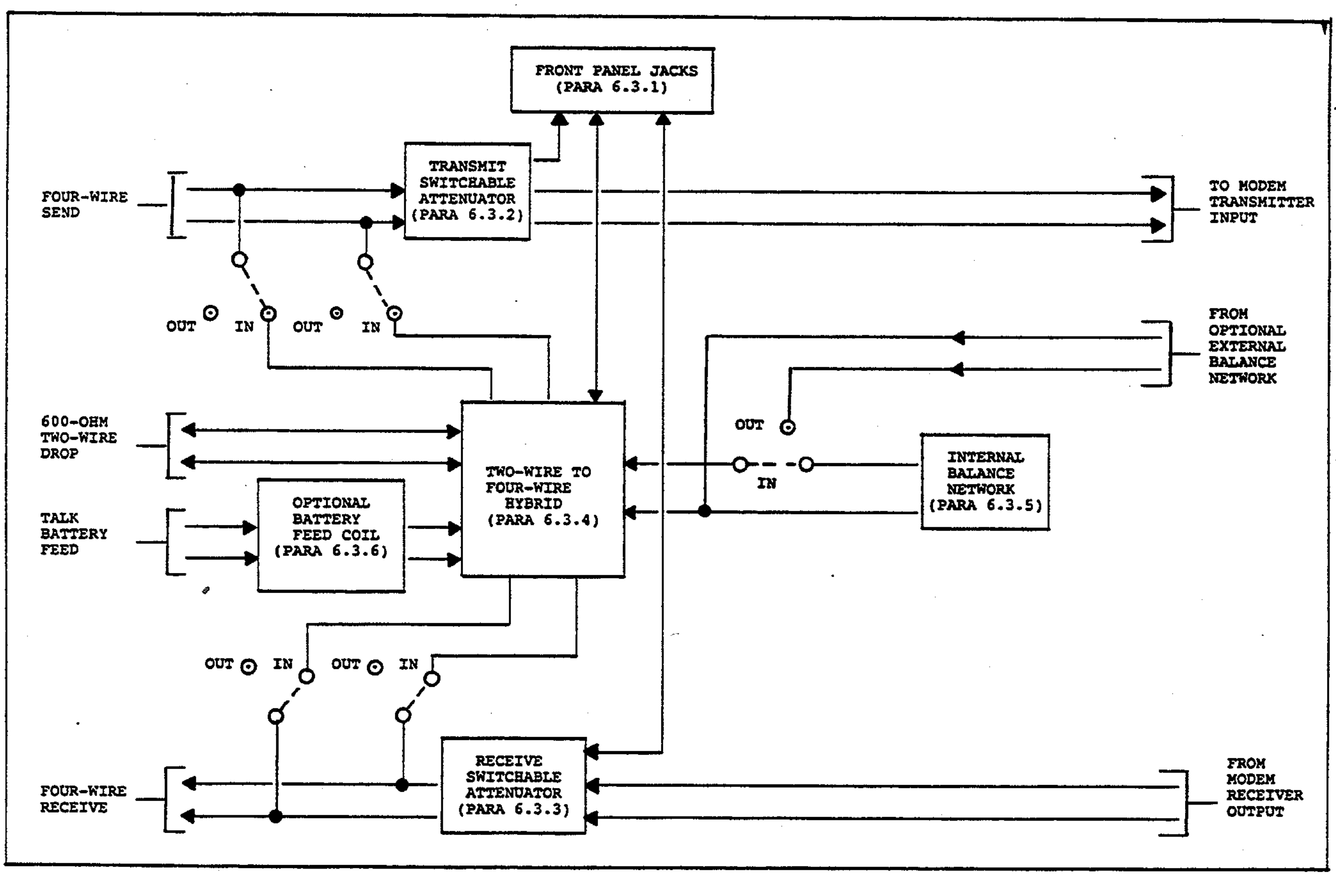


Figure 6-2. Block diagram, RFL 95 AF LINE TERM Audio Termination Module

Switches S6 through S10 set the Channel 1 and 3 receive attenuator by either including a section of the attenuator or bypassing it; switches S16 through S20 perform the same function for the Channel 2 and 4 receive attenuator. By using this method, each attenuator can be set in 1-dB steps anywhere from 0 dB to 31 dB.

6.3.4. Two-Wire To Four-Wire Hybrid

The 95 AF LINE TERM contains two audio-frequency hybrids (formed from transformers T1 and T2 for Channel 1 and 3, and transformers T4 and T5 for Channel 2 and 4). These hybrids allow either modem to be configured for either four-wire or two-wire operation.

6.3.5. Internal Balance Network

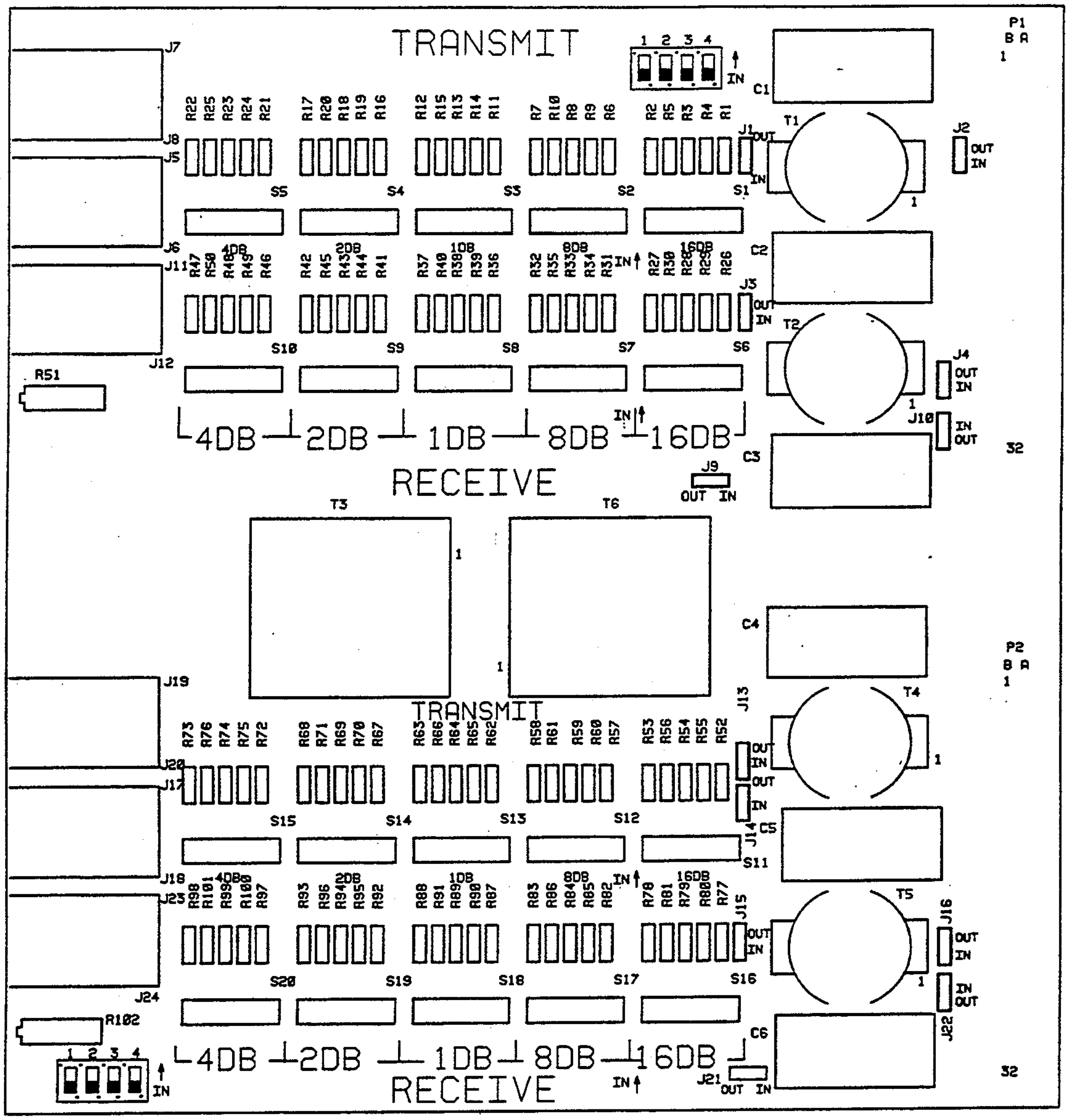
The internal balance networks are used to provide isolation between a modem's audio output and its own audio input through the hybrid. The internal networks can be used (resistor R51 and capacitor C3 for Channel 1 and 3, and resistor R102 and capacitor C6 for Channel 2 and 4), or optional external networks may be used, depending upon the placement of jumpers J9, J10, J21, and J22.

6.3.6. Battery Feed Coils (optional)

Provisions have been made on the 95 AF LINE TERM for optional battery feed coils T3 (Channel 1 and 3) and T6 (Channel 2 and 4). These coils provide an external source for talk current, which can increase system efficiency.

Table 6-1. Replaceable parts, RFL 95 AF LINE TERM Audio Termination Module
Assembly No. 100860

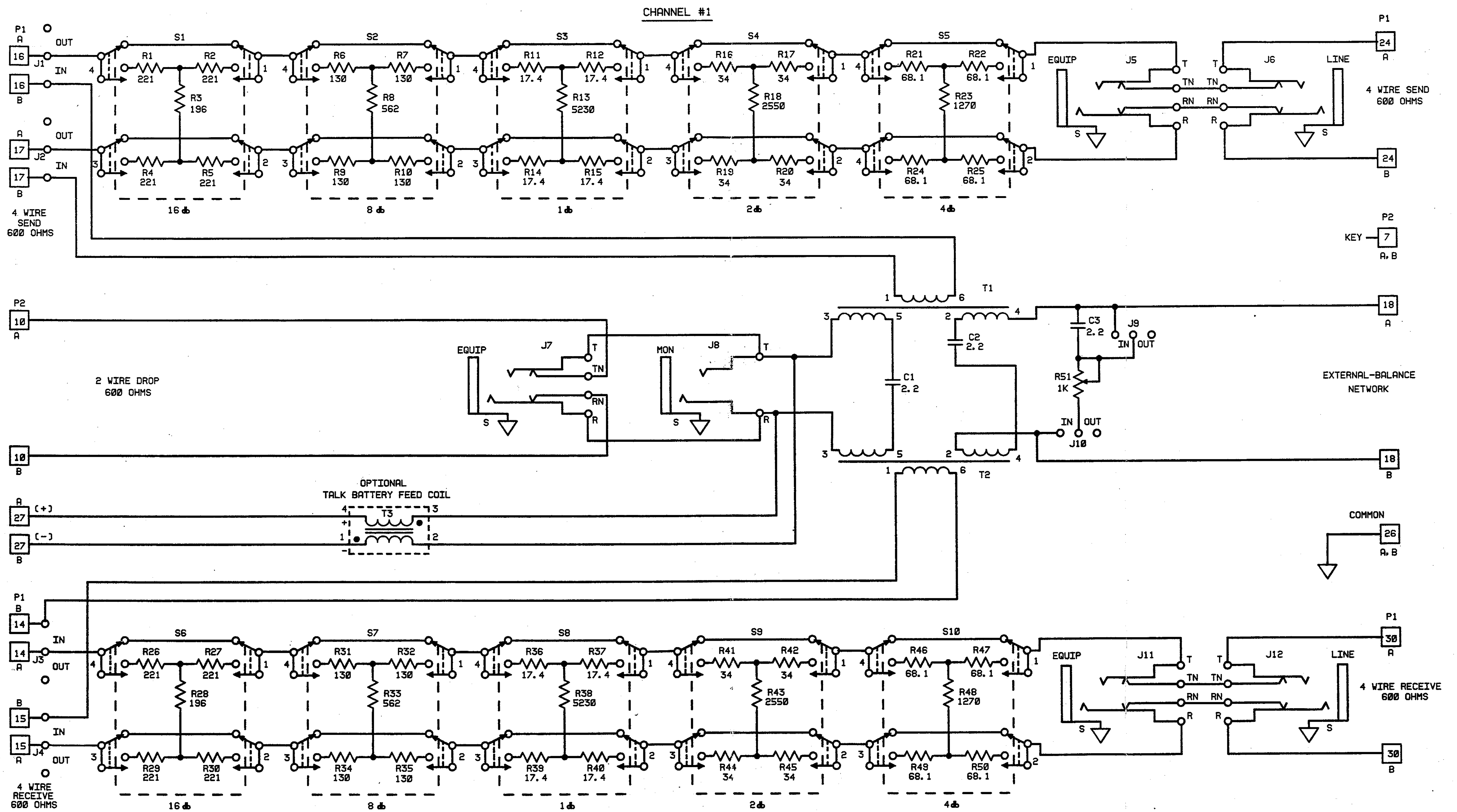
Circuit Symbol (Figs. 6-3 & 6-4)	Description	Part Number
C1-6	Capacitor,metallized mylar,2.2uF,5%,200V,Wesco 32MM or equiv.	1007 833
R1,2,4,5,26,27,29,30,52,53, 55,56,77,78,80,81	Resistor,metal film,221Ω,1%,1/4W, Type RN1/4	0410 1225
R3,28,54,79	Resistor,metal film,196Ω,1%,1/4W, Type RN1/4	0410 1220
R6,7,9,10,31,32,34,35,57,58, 60,61,82,83,85,86	Resistor,metal film,127Ω,1%,1/4W, Type RN1/4	0410 1203
R8,33,59,84	Resistor,metal film,562Ω,1%,1/4W, Type RN1/4	0410 1264
R11,12,14,15,36,37,39,40,62, 63,65,66,87,88,90,91	Resistor,metal film,17.4Ω,1%,1/8W,Type RN55D	1510 1309
R13,38,64,89	Resistor,metal film,5.23KΩ,1%,1/4W, Type RN1/4	0410 1357
R16,17,19,20,41,42,44,45,67, 68,70,71,92,93,95,96	Resistor,metal film,34Ω,1%,1/8W,Type RN55D	1510 1434
R18,43,69,94	Resistor,metal film,2.55KΩ,1%,1/4W, Type RN1/4	0410 1327
R21,22,24,25,46,47,49,50, 72,73,75,76,97,98,100,101	Resistor,metal film,68.1Ω,1%,1/4W, Type RN1/4	0410 1176
R23,48,74,99	Resistor,metal film,1.27KΩ,1%,1/4W, Type RN1/4	0410 1298
R51,102	Resistor,variable,15-turn cermet,1KΩ,10%,3/4W,Beckman Helipot 89PHR1K or equiv.	39574
S1-20	Switch,DIP,slide,SPDT,4-station,16-pin DIP,Grayhill 78J04S or equiv.	30481
T1,2,4,5	Transformer,hybrid,600-Ω primary,dual 300-Ω secondary	55597
T3,6 (optional)	Battery feed coil,3H,70mA,AIE Magnetics 417-0127 or equiv.	32981
---	Shorting bar,single,Molex 90059-0009 or equiv.	98306



NOTE

S1 thru S20 are DIP switches that each contain four (4) sections. All four (4) sections of each switch must be set in the same direction to obtain the proper dB setting for that switch.

Figure 6-3. Component locator drawing, RFL 95 AF LINE TERM Audio Termination Module (Assembly No. 100860; Drawing No. 100863, Rev. F)



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W 1%
ALL CAPACITORS ARE IN MICROFARADS

Figure 6-4. Schematic, RFL 95 AF LINE TERM Audio Termination Module (Assembly No. 100860; Schematic No. 100864, Rev. C- Sheet 1 of 2)

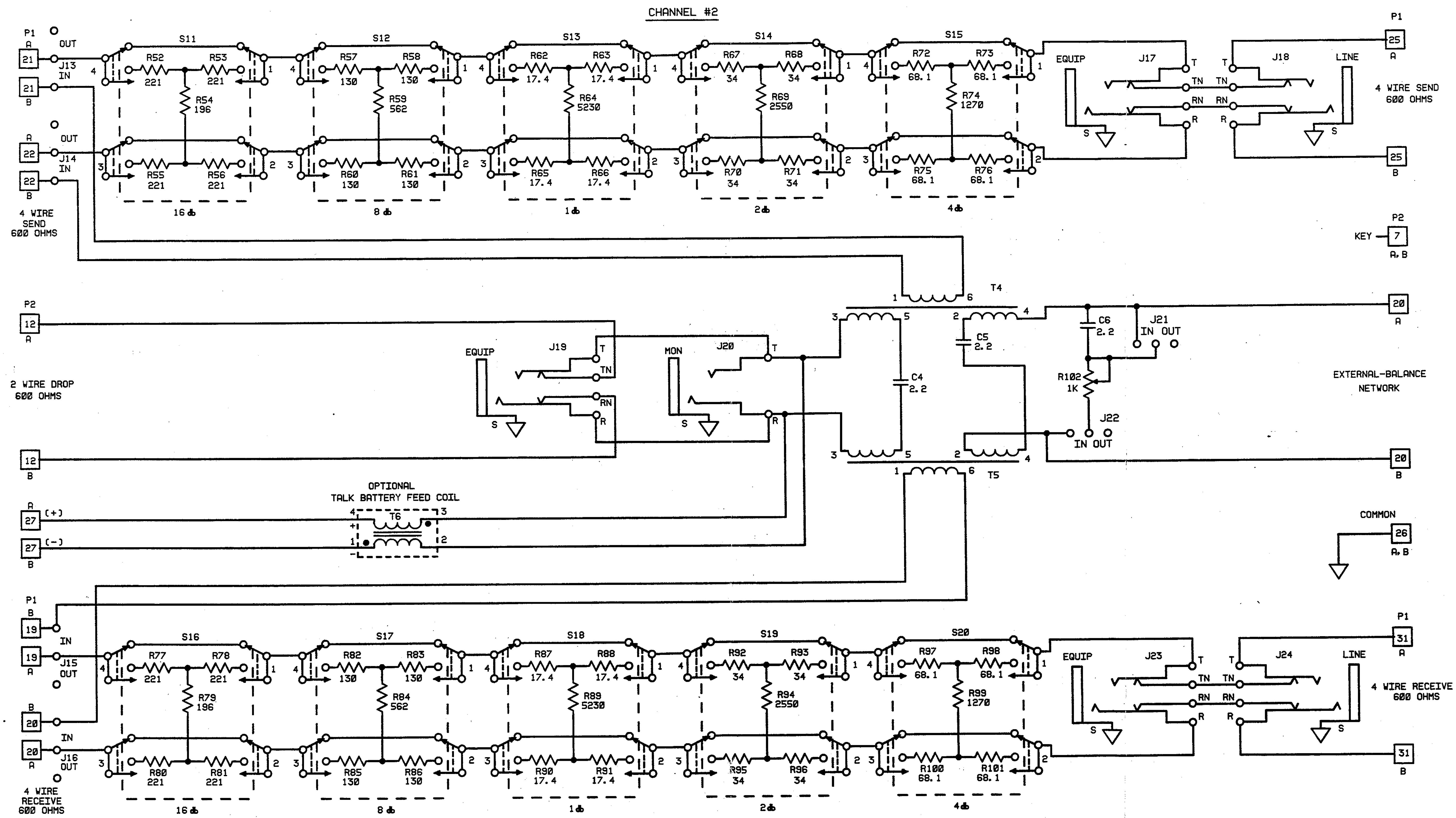
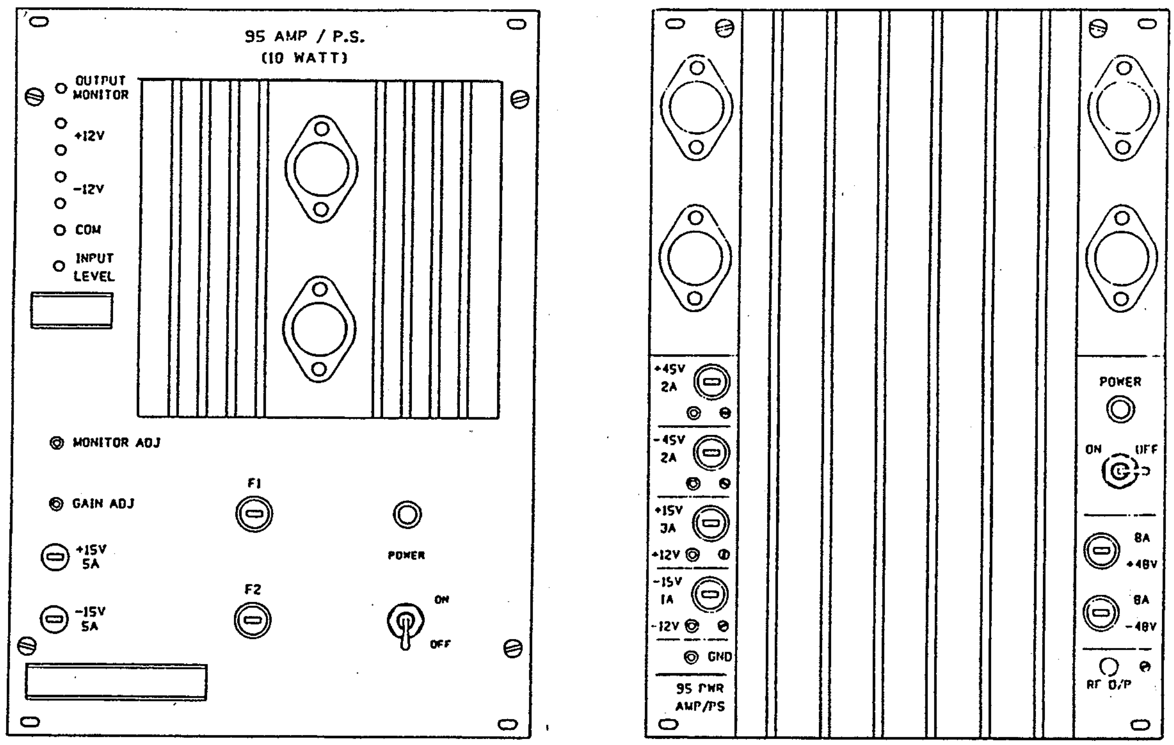


Figure 6-4. Schematic, RFL 95 AF LINE TERM Audio Termination Module (Assembly No. 100860; Schematic No. 100864, Rev. C- Sheet 2 of 2)

Section 7. AMPLIFIER/POWER SUPPLIES



a. RFL 95 AMP/PS 10-watt amplifier/power supply.

b. RFL 95 PWR AMP/PS 50-watt amplifier/power supply.

Figure 7-1. RFL 9505 amplifier/power supplies

7.1. INTRODUCTION

RFL 9505 amplifier/power supplies provide regulated dc power to all dc-powered assemblies in a RFL 9505 terminal, as well as amplify the rf outputs of all modems in the terminal before these outputs are passed on to the line coupling equipment. Two different amplifier/power supply assemblies are available: the RFL 95 AMP/PS (Fig. 7-1a), which develops an rf output of 10 watts PEP, and the RFL 95 PWR AMP/PS (Fig. 7-1b), which develops 50 watts PEP. Although all RFL 9505 amplifier/power supplies perform the same basic functions, the input voltages and output signal levels differ from model to model, and each model contains a different set of component subassemblies. Table 7-1 summarizes the differences between the various amplifier/power supply models.

Both amplifier/power supply assemblies are designed for mounting in the 95 CHAS double-Euro chassis (Section 8), and occupy 36 horizontal chassis spaces.

7.2. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to both RFL 9505 amplifier/power supplies, unless otherwise noted. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

AMPLIFIER SECTION:

Number Of Inputs: Four.

Input Level: -10 dBm for maximum rated output.

Input Impedance: 75 ohms nominal.

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

Table 7-1. Differences between RFL 9505 amplifier/power supplies

Model Designator	Assembly Number	Output Power (watts)	Input Voltage (Vdc)	Power Supply Assy. No.	Power Supply Schematic	Driver Module Assy. No.	Driver Module Schematic	Power Amplifier Assy. No.	Power Amplifier Schematic
95 AMP/PS-1	102735-1	10	24	102740-1	Fig. 7-6	...	...	102716	Fig. 7-11
95 AMP/PS-2	102735-2	10	48	102740-2	Fig. 7-6	...	...	102716	Fig. 7-11
95 AMP/PS-3	102735-3	10	129	102740-3	Fig. 7-6	...	...	102716	Fig. 7-11
95 PWR AMP/PS-1	102745-1	50	24	102740-4	Fig. 7-7	100845	Fig. 7-13	102775-1	Fig. 7-16
95 PWR AMP/PS-2	102745-2	50	48	102740-5	Fig. 7-7	100845	Fig. 7-13	102775-2	Fig. 7-16
95 PWR AMP/PS-3	102745-3	50	129	102740-6	Fig. 7-7	100845	Fig. 7-13	102775-3	Fig. 7-16

Frequency Response:
95 AMP/PS: Flat within ±1.0 dB from 20 kHz to 500 kHz.
95 PWR AMP/PS: Flat within ±2.0 dB from 20 kHz to 500 kHz.

Third Order Intermodulation Distortion:
From 60 To 350 kHz: -60 dBmO.
Below 500 kHz: -50 dBmO.

Harmonic Distortion: -40 dB.

Maximum Output:
95 AMP/PS: 10 watts PEP.
95 PWR AMP/PS: 50 watts PEP.

Output Resistance: 50 ohms nominal.

POWER SUPPLY SECTION:

Input Voltage:
24-Volt Units: 21 to 28 Vdc.
48-Volt Units: 42 to 56 Vdc.
129-Volt Units: 105 to 145 Vdc.

Typical Input Current:
95 AMP/PS:
- 24-Volt Units: 6.5 amperes.
- 48-Volt Units: 3.25 amperes.
- 129-Volt Units: 1.2 amperes.

95 PWR AMP/PS:
- 24-Volt Units: 8.3 amperes.
- 48-Volt Units: 4.2 amperes.
- 129-Volt Units: 1.6 amperes.

Maximum Output Current: 3.3 amperes total from all four supplies (+12, -12, +15, and -15).

GENERAL:

Operating Temperature: -20°C to +55°C (-4°F to +131°F).

Dimensions: 10.3 inches high x 7.2 inches wide x 8.7 inches deep (260 mm x 183 mm x 220 mm); occupies 36 horizontal spaces in a double-Euro chassis.

Weight:
95 AMP/PS: 5 lbs 10 oz (2.5 kg)
95 PWR AMP/PS: 11 lbs 9 oz (5.4 kg)

7.3. THEORY OF OPERATION

Each RFL 9505 amplifier/power supply contains two sections: an amplifier that boosts the output of all the modems installed in the chassis, and a power supply that converts the single station battery input voltage into the different dc voltages required by the amplifier section and other modules in the RFL 9505 system.

7.3.1. Amplifier Assemblies

The amplifier assemblies combine the outputs of all the modem modules in the chassis, and boost this summed output to a maximum of 10 watts PEP in the 95 AMP/PS, and 50 watts PEP in the 95 PWR AMP/PS. The amplification technique used in the 95 AMP/PS are slightly different from those used in the RFL 95 PWR AMP/PS. Because of this slight difference, the theory behind each amplifier assembly is discussed separately below. A block diagram for both amplifier assemblies appears in Figure 7-2.

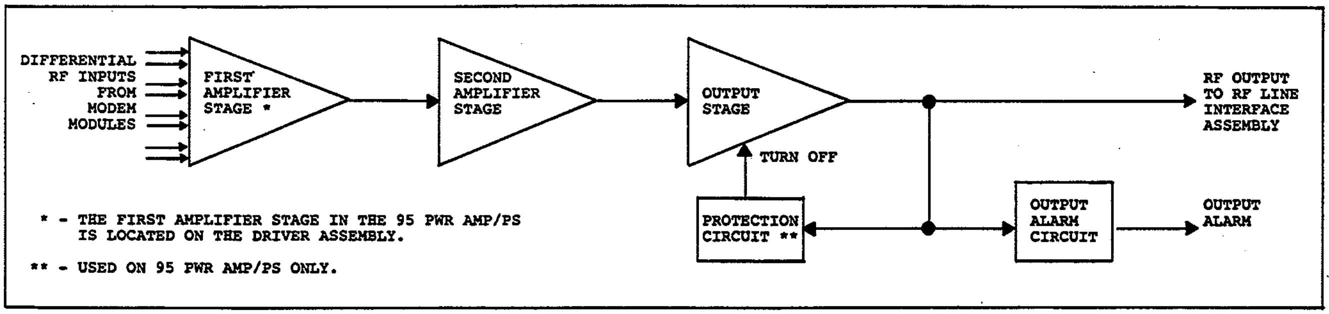


Figure 7-2. Block diagram, amplifier assemblies for RFL 9505 amplifier/power supplies

7.3.1.1. 10-Watt Amplifier Assembly

Three amplification stages are used in the 95 AMP/PS's 10-watt amplifier assembly, and an alarm circuit monitors the output in case of signal loss.

a. First Stage. The first stage uses operational amplifier U1 and its associated components to combine all the modem outputs and amplify the sum by about 17 dB.

b. Second Stage. The second stage is a differential amplifier. Transistors Q1 and Q2 are used to drive a direct-coupled cascaded true symmetrical complementary amplifier. Feedback is used in this stage, and potentiometer R13 is used to set the gain of this stage to about 14 dB.

c. Output Stage. The output stage provides a third level of amplification, to bring the rf output to the desired level. It comprises transistor Q7, Q8, and their associated components, forming differential amplifier used to drive transistor Q9. Transistors Q14 and Q15 form a current source for Q9, and transistor Q12 is a temperature-variable voltage source which sets the output quiescent current. Transistors Q11 and Q13 are connected as diodes for temperature compensation. Q9 supplies the drive for the symmetrical complementary amplifier formed form transistors Q10, Q16, Q17, Q18, and their associated components.

The total voltage gain provided by the output stage is 14 dB, when loaded into an open circuit. When operating into a 5.0-ohm load, the output voltage drops to 50 percent of the open circuit voltage; a correction factor of -6 dB will have to be applied.

The total gain of the amplifier section is determined by adding the gain of all three stages to the sum of the correction factors:

17.0 dB	First stage gain
14.0 dB	Second stage gain
14.0 dB	Output stage gain
5.0 dB	Sum of the output stage correction factors [(+11 dB) + (-6 dB)]
50.0 dB	

50 dB is enough gain to supply 10 watts PEP (+40 dBm) for a nominal first-stage input of -10 dBm.

d. Output Alarm Circuit. The output alarm circuit samples the output voltage and rectifies it. This rectified voltage is used to drive an output alarm if the output signals is lost.

7.3.1.2. 50-Watt Amplifier Assembly

The 50-watt amplifier assembly in the 95 PWR AMP/PS comprises two parts: a driver and a power output stage.

a. Driver. The driver for the 95 PWR AMP/PS contains three amplification stages, which supply a total gain of about 35 dB to the power output stage. The input stage consists of operational amplifier U101 and its associated components. Jumper J2 sets the gain of U101 so that it will not be overdriven when more than one modem is connected to its input; the settings of J2 will reduce the gain of U101 by about 6 dB for each modem in the station.

The second stage comprises transistors Q9 and Q10, which are connected as a differential pair, and Q11, which serves as a single-ended complementary output stage. Voltage feedback is provided by front panel potentiometer R15 and resistor R14.

The third stage comprises differentially-connected transistors Q1 and Q2, which drive a single-ended complementary output stage formed from transistors Q3 through Q7, and their associated components. This gives the third stage a high degree of common-mode rejection capability. The current flowing through diode

CR7, Q4, and its associated resistor network develops a crossover bias voltage for Q6 and Q7, which are a complementary pair. This allows a quiescent current to flow through these transistors, resulting in lower distortion and enhance stability.

For proper driver operation, potentiometer R15 is normally adjusted for a 4.5-Vrms output from the driver output when a -10-dBm signal is present at its input.

b. Power Output Stage. The 95 PWR AMP/PS's power output stage is located on two circuit boards: a primary board and a secondary board. Input signals are applied through level potentiometer R2. Transistor Q2 and Q3 form a differential input stage with a bias current supplied by current source Q1. Resistors R80 and R81 reduce power dissipation in transistor Q1.

Diode-connected transistors Q4 and Q5 form part of the load for the differential input stage, compensating for the base-emitter voltage drop of Q6. Cascaded transistors Q6 and Q7 are voltage amplifiers. Transistor Q10, configured as a current sink for the cascaded pair, also provides a high-impedance ac load. The output signal from this stage drives complementary-connected push-pull output transistors Q13 through Q18, which are driven by the bipolar 45-volt supply.

Transistors Q13 through Q18 have unity voltage gain but high current gain. Emitter-follower Q13 drives the Q14 and Q15, which are connected as paralleled emitter-followers.

The push-pull output stage is operated Class AB. Both the pull-up and pull-down sections are biased to allow a quiescent current flow of about 300 mA, eliminating crossover distortion. Current flowing between Q6 and Q7 and Q10 develops the voltage drop across Q8 and Q9; this establishes the bias for the output transistors.

Transistor Q9, connected as diode, develops a collector-emitter voltage drop of approximately 0.7 volts. The base-emitter voltage of Q8 determines the current flow through resistor R18. The current flowing through R18 will also flow through resistor R17, determining the collector-emitter voltage of Q8. R17 controls output stage quiescent current, and its value is selected at the factory.

Power from the output stage is coupled to output transformer T1 through dc blocking capacitor C22 and a high-frequency stabilization network comprising inductor L2 and resistor R44.

Negative feedback is used to reduce distortion while stabilizing the amplifier. Resistor R6 provides a voltage feedback path from the power output stage to the differential input stage. Reflected load current flows through the primary of transformer T1 and develops a voltage across resistors R48, R49, R50, and R78. This current-controlled feedback voltage is applied to the differential input stage through resistor R5.

The amplifier is protected against overcurrent conditions caused either by input overload or a short-circuited load. The protection circuit comprises comparator U1, transistor Q19, diodes CR8 and CR13 and all associated components. Diode CR8 provides the protection circuit with a regulated -12 volts from the -45-volt supply. During normal operation, transistor switch Q19 is always on, supplying bias voltage for both the differential input stage current source, Q1, and the driver stage current sink, Q10. If excessive output stage current is detected, Q19 will switch off, removing all drive current from the circuit. The switch will remain off for about 0.2 second before turning on again and re-energizing the amplifier. If the current is still too high, the switch will continue to switch on and off until the overload is removed.

Output transistors Q17 and Q18 have low-value resistors connected form their emitters to the -45-volt supply. The voltage developed across these resistors will be a function of amplifier load current. The voltage across the sense resistor in the emitter of Q17 is averaged by a low-pass filter formed from resistor R73 and capacitor C16 prior to being applied to comparator U1A, while the emitter-sense voltage of Q18 is applied to applied to comparator U1B after being averaged in the low pass filter formed from resistor R74 and capacitor C17. Zener diode CR13 provides a temperature-compensated voltage that is compared to these averaged values. This voltage is applied to the remaining comparator inputs through a voltage divider formed from resistors R83, R72, R84, and potentiometer R85. R85 is adjusted at the factory to shut down the amplifier when the output power level reaches approximately 55 watts.

If either comparator U1A or U1B senses an overcurrent condition, its output will be pulled low, causing a rapid discharge of capacitor C15 through diode CR9 and resistor R67. This will switch the output of comparator U1C high, switching transistor Q19 off and removing base drive from current source transistors Q1 and Q10. When this happens, the amplifier shuts down. Since the current through Q17 and Q18 will now drop to zero, the output of the overcurrent comparator will turn off. C15 will then begin to recharge through resistors R68 and R69. The charging time constant is much longer than the discharge time constant, and the amplifier will remain shut down until the voltage across C15 is high enough to turn U1C back on. Q19 will turn back on, and the power amplifier will once again become energized. If the overcurrent condition still exists, the cycle will repeat.

The transmitted signal level detector will indicate if the amplifier output level drops below a preset limit. The output signal at the primary of transformer T1 is rectified, filtered, and applied to the input of comparator U2A through level-control potentiometer R47. The output of U2A will be low if this signal is below the threshold. Comparator U2B will be low when the amplifier output signal is above threshold. Resistor R54 and capacitor C30 are used to filter short-term dropouts, which would otherwise be detected as faults. J2 can be set to connect U2B or Q20 to the alarm output pin. Q20 also drives a front panel indicator, which remains lit as long as the amplifier is above threshold.

7.3.2. Power Supply Section

The power supply section converts the incoming station battery voltage into several operating bipolar voltages: ±12 volts, ±15 volts, and, in 95 PWR AMP/PS units only, ±45 volts. The power supply section is configured to operate from one of three possible input levels: 24 Vdc, 48 Vdc, or 129 Vdc. The block diagram in Figure 7-3 illustrates the power supply section.

The input station battery voltage is applied to the inputs of 15-volt dc-dc converter PS201 and 45-volt dc-dc converter PS202. Both converters are switching-type power supplies using pulse-width modulation control and are of similar design. (See paragraph 7.3.3.)

PS201, used in all models, supplies regulated ±15-volts dc. These voltages are placed on buses on the chassis motherboard for distribution to other modules in the chassis. They are also fed to four 12-volt regulators: U201, U202, U203, and U204. Two regulators provide power for the 12-volt buses in the chassis, and the other two regulators provide ±12 volts for the amplifier assembly (para 7.3.1).

In 95 AMP/PS amplifier/power supplies, PS201 also supplies power to the output section of the 10-watt rf amplifier. In 95 PWR AMP/PS units, the output section of the 50-watt rf amplifier is powered by 45-volt dc-dc converter PS202.

7.3.3. Dc-dc Converters

Dc-dc converters PS201 and PS202 convert single dc input voltages into bipolar regulated output voltages. PS201 supplies ±15 volts, and PS202 supplies ±45 volts. The function of both circuits is similar; component values are changed to produce different output voltages. The following circuit theory discussion applied to both configurations; a block diagram for both dc-dc converters appears in Figure 7-4.

Both dc-dc converters use FET switching transistors and a pulse-width modulation controller. The pulse width controller contains drive transistors which provide gate potential for FET switches Q3 and Q4. As each FET alternately turns on, current flows from the positive supply connected to the center tap of transformer T2's primary, through the winding, and the FET. The induced secondary winding current is rectified and filtered, producing the new dc level. The output dc voltage level is sampled and used as the sense input for the pulse-width modulation control circuit. Voltage regulation is achieved by varying the pulse width; as output voltage increases, pulse width decreases.

Zener diode CR15 clamps the dc-dc converter input voltage, protecting against excessive input voltage. If the input voltage is reversed, it will be short-circuited by forward-biased diode CR15, protecting the converter. Capacitor C1 and common-mode choke L2 work together to filter ripple on the input lines, while capacitors C2 and C3 provide a source for the peak current demands and help stabilize the power supply.

To start operation, voltage is supplied to PWM controller U1 through resistor R1. This supplies enough current to make U1 operational. U1's internal 5-volt reference and a sampling of the input voltage obtained from a voltage divider formed from resistors R1, R2, and R3 are compared by one of the internal error amplifiers. When the divided voltage reaches 5 volts, the PWM begins to operate.

The PWM controller consists of a single active device (U1), and its associated components. U1 contains an oscillator, a 5-volt reference, two error amplifiers, and a dead-time control. U1 is powered by diode bridge CR14 and capacitors C4 and C5. Resistor R4 and C7 set the sawtooth oscillator frequency at 100 kHz. Output pulse widths are determined by the PWM comparator, which receives signals from the error amplifier and the sawtooth oscillator.

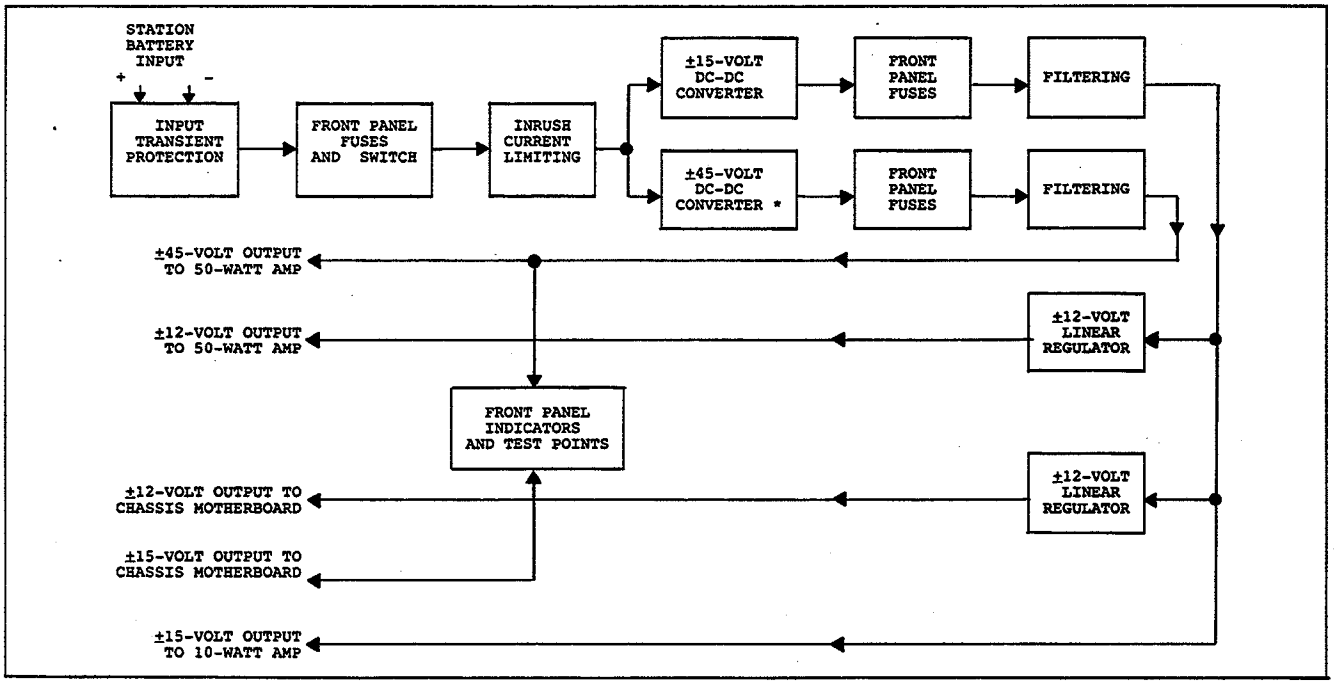


Figure 7-3. Power supply section block diagram, RFL 9505 amplifier/power supplies

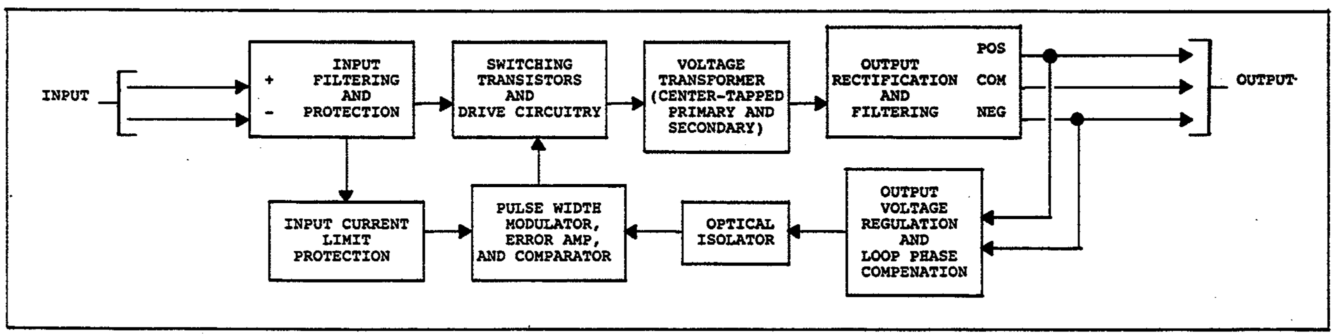


Figure 7-4. Block diagram, dc-dc converter for RFL 9505 amplifier/power supplies

Outputs are enabled whenever the sawtooth voltage is greater than the error amp output. The dead-time control disables the output during the beginning of the sawtooth waveform. Its input has an offset to create a minimum 3-percent dead time, during which there is no voltage at the control input. The dead time is the period between one transistor turning off and the other turning on.

Additional dead time can be imposed by applying a voltage to the input; a 3.3-volt level will result in 100-percent dead time. This input is used two ways by the supply: to provide a "soft start", and to serve as a current limit circuit.

The PWM controller contains two drive transistors which provide gate potential for FET switchers Q3 and Q4. As each FET turns on alternately, resistor R13 or R14 limit the current through the drive transistors. This current is created by the gate-to-source capacitance of the FET, which must be charged to turn on the FET. To turn the FET off quickly, the residual gate charge must be drained. When the drive transistor opens, resistor R11 or R12 provide a return path to the base of transistor Q1 or Q2. Since Schottky diodes CR9 or CR10 are reverse biased, positive potential remaining on the gates turns on Q1 or Q2; this provides a path for gate discharge. Protection from excessive gate voltage is provided by CR1.

Voltage regulation is accomplished by directly sampling the output and providing a voltage adjustment to the input of the error amplifier on the PWM. The PWM adjusts the duty cycle of the gate drive pulses. This results in a proportional change to the average voltage at the secondary of T2. The gate-drive pulse width will vary according to the voltage at the PWM input from 97 percent of the period for a 0.5-volt input to zero percent for a 3.5-volt input. Optical isolator U2 connects the loop from the output to the PWM. A signal ranging from zero to 4.5 volts is provided across resistor R10 at the PWM input. The current through the LED input of U2 is controlled by adjustable shunt regulator CR16. The current flow through CR16 is controlled by the voltage at its reference, which is nominally 2.5 volts. Within a very small window, voltages greater than 2.5 volts turn on the shunt, allowing current to flow; lower voltages decrease the current flow. The sensitivity of compensation is determined by resistor R24. Current through the LED is limited by resistor R26. On 45-volt units, Zener diode CR2 is added to limit the cathode-to-anode voltage on CR16; resistor R25 maintains the minimum Zener current for CR2. On 15-volt units, CR2 is replaced with a short circuit and R25 is not installed. Transistor Q5 is used to maintain loop stability under all load conditions; it provides a low impedance to the compensation network consisting of resistors R27 and R28, and capacitor C19. The reference voltage to CR16 is also derived from resistors R27 and R28.

The secondary winding current is rectified by a bridge formed from diodes CR12 and CR13. The rectified outputs are averaged by a filter formed from inductor L4 and capacitors C15 and C16. This provides effective filtering of the 100-kHz ripple but has little effect on the high-frequency components, which are filtered out at destination assemblies. A snubber consisting of R21 and C14 controls transient spike voltages across the rectifier. Transformer T2 utilizes a feedback winding; its current is rectified by diode bridge CR14 and averaged to supply voltage to the PWM.

The dc-dc converter is protected against excessive input current flow. Input current limit protection has been incorporated to protect the switching FET's. The input current is monitored; if excessive levels are detected, a control voltage is applied to the dead-time input. Current transformer T1 monitors the current flowing to the center tap of T2. The secondary of T1 generates a current equal to 1/30th of the input current. The secondary current is then rectified by diodes CR6 through CR8, and a voltage is developed across scaling resistor R17. Additional voltage is dropped across diode CR5 before reaching potentiometer R16 and capacitor C12. R16 provides a means to adjust the threshold of protection while C12 serves as an integrator. The result is a fast protection circuit which is set to start limiting at a specified input current. Once the set level is exceeded, the dead time increases; this effectively limits FET current.

When dc power is first applied to the dc-dc converter's input terminals, the output gradually climbs from zero to full voltage. After initial power is applied, an initializing pulse is generated by an RC network formed from capacitor C8 and resistors R7 and R8. This pulse is applied to the pulse width modulation controller dead-time input. Switching pulse widths start out narrow and then gradually widen, bringing converter output up to full voltage.

Table 7-2. Replacement fuse data, RFL 9505 amplifier/power supplies

CAUTION

Never attempt to remove or replace a fuse with the amplifier/power supply energized; component damage may result. For continued safe operation, always replace a fuse with one having the same voltage and current ratings.

Model Designator	Fuse Type And Ratings	Manufacturer's Part Number	Dowty Part Number
95 AMP/PS-1 (24-volt input, 10-watt output):			
F1,F2	3AG normal-blow,8A,250V	Littelfuse 312 008 or equiv.	44395 008
Output fuses	3AG slow-blow,5A,250V	Littelfuse 313 005 or equiv.	7715
95 AMP/PS-2 (48-volt input, 10-watt output):			
F1,F2	3AG quick-acting,5A,250V	Littelfuse 312 005 or equiv.	5211
Output fuses	Same as 95 AMP/PS-1.		
95 AMP/PS-3 (129-volt input, 10-watt output):			
F1,F2	3AG quick-acting,2A,250V	Littelfuse 312 002 or equiv.	1289
Output fuses	Same as 95 AMP/PS-1.		
95 PWR AMP/PS-1 (24-volt input, 50-watt output):			
F1,F2	3AG quick-acting,2A,250V	Littelfuse 312 002 or equiv.	1289
F3	3AG quick-acting,1A,250V	Littelfuse 312 001 or equiv.	3736
F4	3AG quick-acting,3A,250V	Littelfuse 312 003 or equiv.	1293
F5,F6	3AB normal-blow,15A,250V	Littelfuse 314 3 015 or equiv.	12943
95 PWR AMP/PS-2 (48-volt input, 50-watt output):			
F1,F2	Same as 95 PWR AMP/PS-1.		
F3	Same as 95 PWR AMP/PS-1.		
F4	Same as 95 PWR AMP/PS-1.		
F5,F6	3AG normal-blow,8A,250V	Littelfuse 312 008 or equiv.	44395 008
95 PWR AMP/PS-3 (129-volt input, 50-watt output):			
F1,F2	Same as 95 PWR AMP/PS-1.		
F3	Same as 95 PWR AMP/PS-1.		
F4	Same as 95 PWR AMP/PS-1.		
F5,F6	Same as F4.		

Table 7-3. Replaceable parts, power supply assemblies for RFL 9505 amplifier/power supplies
For 95 AMP/PS-1 - Assembly No. 100740-1
For 95 AMP/PS-2 - Assembly No. 100740-2
For 95 AMP/PS-3 - Assembly No. 100740-3
For 95 PWR AMP/PS-1 - Assembly No. 100740-4
For 95 PWR AMP/PS-2 - Assembly No. 100740-5
For 95 PWR AMP/PS-3 - Assembly No. 100740-6

Circuit Symbol (Figs. 7-5 to 7-7)	Usage	Description	Part Number
		CAPACITORS	
C201,202,219,220	All	Capacitor,ceramic disc,0.005µF,20%,3kV,Centralab DD30-502 or equiv.	1007 1264
C203	All	Capacitor,tantalum,22µF,20%,35V,Corning CCZ-035-226-20 or equiv.	1007 657
C204-206,221,222	All	Capacitor,tantalum,4.7µF,20%,20V,Kemet T322B475M020AS or equiv.	1007 711
C207	-1, -2, & -3 -4, -5, & -6	Not used. Same as C204.	
C208	-1, -2, & -3 -4, -5, & -6	Not used. Same as C203.	
C209-212	All	Capacitor,metallized polypropylene,0.47µF,5%,100V,Wesco 32MPL or equiv.	1007 1690
C213-216	-1, -2, & -3 -4, -5, & -6	Not used. Same as C209.	
C217,218	-1, -2, & -3 -4, -5, & -6	Not used. Same as C201.	
		RESISTORS	
R201,203,205,207	All	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R202,204	All	Resistor,metal film,10KΩ,1%,1/2W, Type RN1/2	0410 2384
R206,208	All	Resistor,metal film,2.21KΩ,1%,1/4W, Type RN1/4	0410 1321
R209	All	Resistor,wirewound,120Ω,5%,3.25W,Ohmite 4394 Style 995-3A or equiv.	1100 564
RT201	-1, -2, & -3 -4, -5, & -6	Not used. Same as RT202.	
RT202	All	Thermistor,5Ω @ +25°C,6A steady-state current, Keystone CL-40 or equiv.	30438
RT203	All exc. -6	Not used.	
	-6	Same as RT202.	
RT204	All exc. -3 & -6 -3 & -6	Not used. Same as RT202.	
		SEMICONDUCTORS	
CR201	All	Diode,silicon,200 PIV,1N4003	30769
U201	All	Linear voltage regulator,+12-volt/5A,3-terminal plastic package, Linear Technology LT1084-12CP or equiv.	0620 316
U202	All	Linear voltage regulator,-12-volt,3-terminal plastic package, National Semiconductor LM320T-12 or equiv.	0620 315

Table 7-3. Replaceable parts - continued.

Circuit Symbol (Figs. 7-5 to 7-7)	Usage	Description	Part Number
		SEMICONDUCTORS - continued.	
U203	-1, -2, & -3 -4, -5, & -6	Not used. Same as U202.	
U204	-1, -2, & -3 -4, -5, & -6	Not used. Same as U201.	
		MISCELLANEOUS COMPONENTS	
K201	All	Relay,general-purpose,DPDT,24 Vdc, 472Ω coil,10-amp contacts, AMF/Potter & Brumfield KUP11D15-24VDC or equiv.	91017
L201,202	All exc. -4 -4	Same as L203. Inductor,power line,10μH,17A,0.006Ω,Renco RL-1256-3-10 or equiv.	 99375
L203,204	All	Inductor,power line,10μH,9A,0.01Ω,Renco RL-1256-1-10 or equiv.	30458
L205,206	-1, -2, & -3 -4, -5, & -6	Not used. Same as L203.	

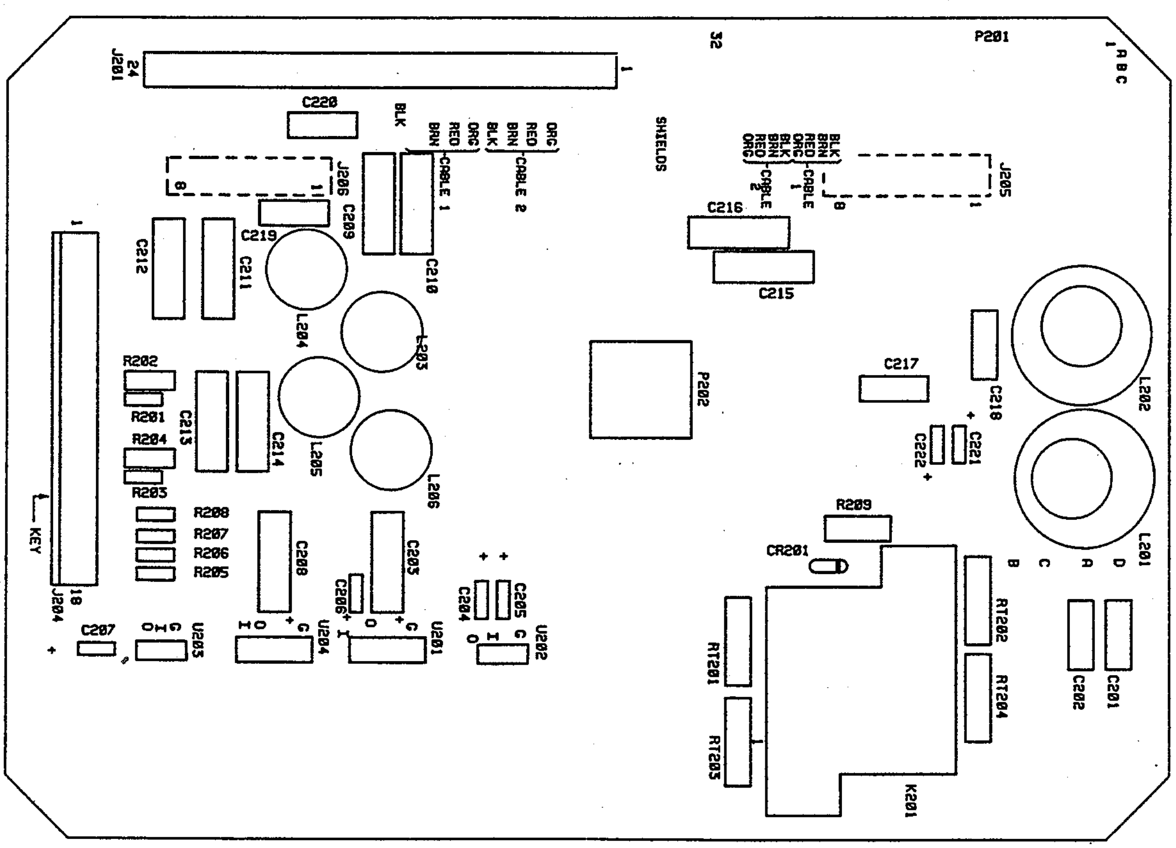
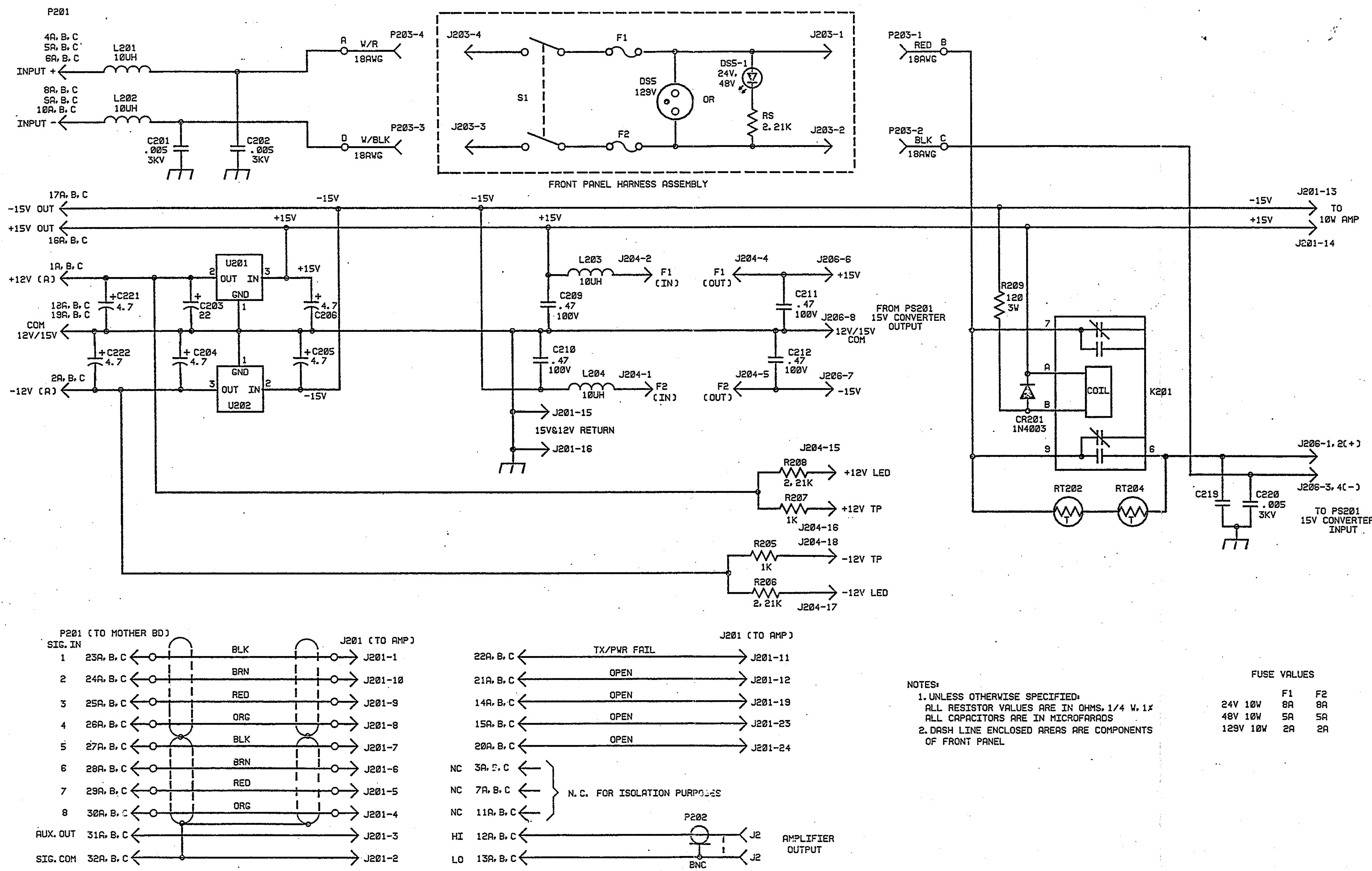


Figure 7-5. Component locator drawing, power supply assemblies for RFL 9505 amplifier/power supplies (Assembly No. 100740-X; Drawing No. 102743, Rev. C)

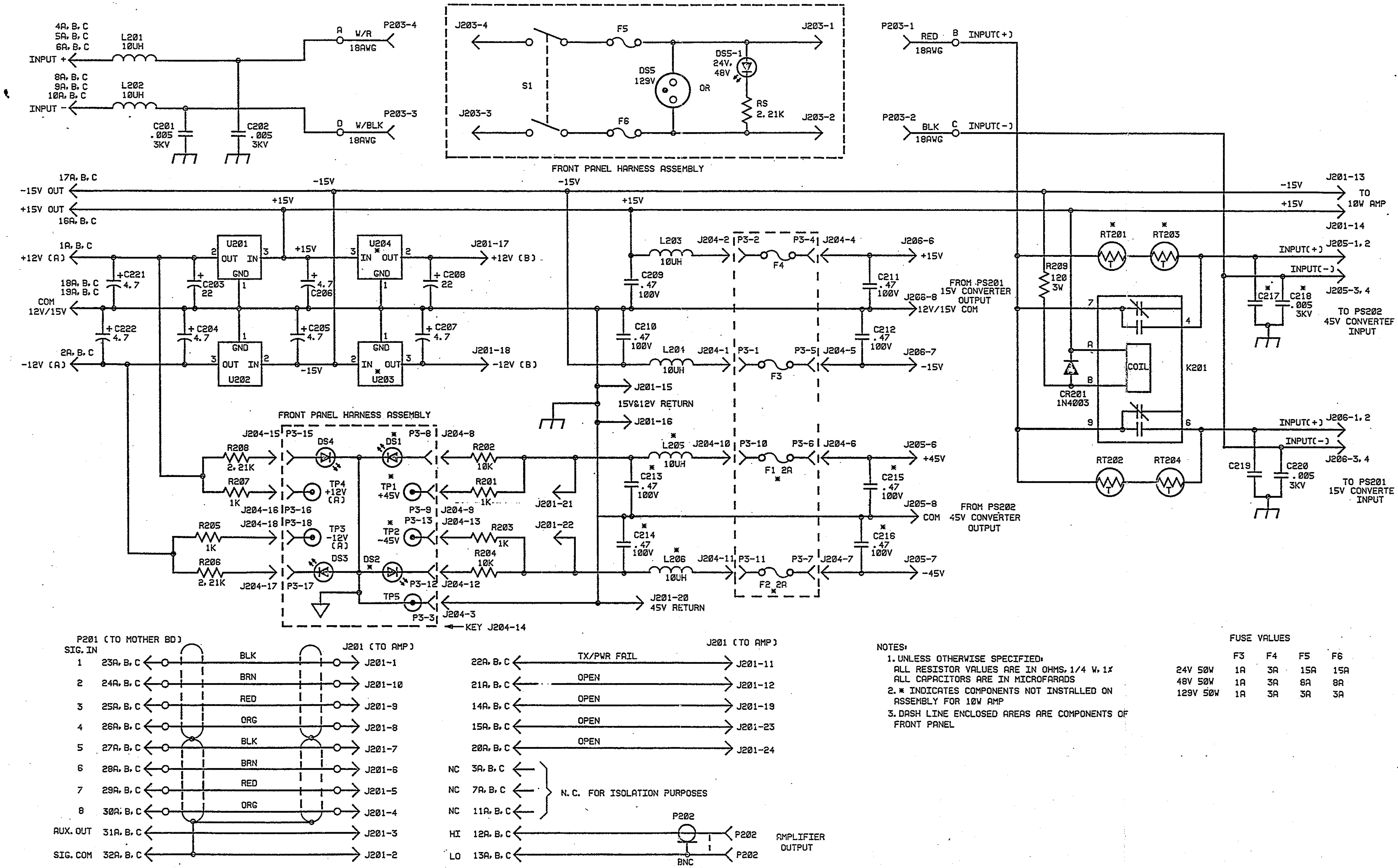


NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 1%
   ALL CAPACITORS ARE IN MICROFARADS
2. DASH LINE ENCLOSED AREAS ARE COMPONENTS OF FRONT PANEL

FUSE VALUES

	F1	F2
24V 10W	8A	8A
48V 10W	5A	5A
120V 10W	2A	2A

Figure 7-6. Schematic, power supply assemblies for RFL 95 AMP/PS 10-watt amplifier/power supplies (Assembly Nos. 100740-1 thru 100740-3; Schematic No. D-102744-1-A)



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 1%
   ALL CAPACITORS ARE IN MICROFARADS
2. * INDICATES COMPONENTS NOT INSTALLED ON ASSEMBLY FOR 10W AMP
3. DASH LINE ENCLOSED AREAS ARE COMPONENTS OF FRONT PANEL

FUSE VALUES

	F3	F4	F5	F6
24V 50W	1A	3A	15A	15A
48V 50W	1A	3A	8A	8A
129V 50W	1A	3A	3A	3A

Figure 7-7. Schematic, power supply assemblies for RFL 95 AMP/PS 50-watt amplifier/power supplies (Assembly Nos. 100740-4 thru 100740-6; Schematic No. D-102744-2-A)

Table 7-4. Replaceable parts, dc-dc converters for 10-watt and 50-watt power supply assemblies
24 Vdc In, ±15 Vdc Out (24/15) - Assembly No. 102765-1
48 Vdc In, ±15 Vdc Out (48/15) - Assembly No. 102765-2
129 Vdc In, ±15 Vdc Out (129/15) - Assembly No. 102765-3
24 Vdc In, ±45 Vdc Out (24/45) - Assembly No. 102770-1
48 Vdc In, ±45 Vdc Out (48/45) - Assembly No. 102770-2
129 Vdc In, ±45 Vdc Out (129/45) - Assembly No. 102770-3

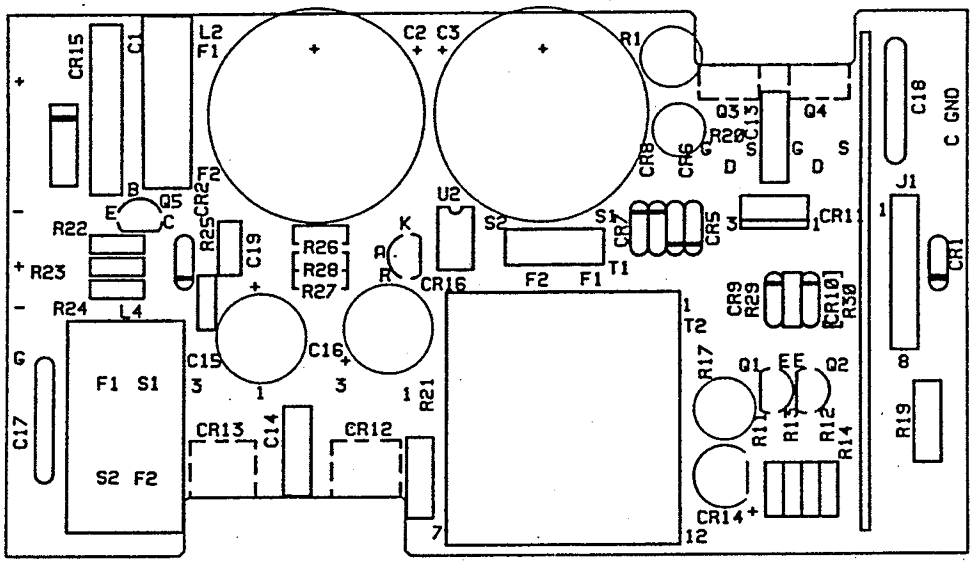
Circuit Symbol (Figs. 7-8 & 7-9)	Usage	Description	Part Number
		CAPACITORS	
C1	All units	Capacitor,metallized polypropylene,0.47µF,10%,250V,radial leads, Illinois Capacitor 474MPR250K or equiv.	1007 1693
C2,3	24/15 & 48/15 units	Capacitor,electrolytic,1200µF,+30-10%,63V,radial leads, Sprague 80D122P063JA5 or equiv.	1007 1709
	24/45 units	Not used.	
	48/45 units	Capacitor,electrolytic,330µF,20%,200V,radial leads, Illinois Capacitor 337LPR200M or equiv.	1007 1698
	129/15 & 129/45 units	Capacitor,electrolytic,100µF,20%,250V,radial leads, Illinois Capacitor 107LPR250M or equiv.	1007 1697
C4,8	All units	Capacitor,electrolytic,100µF,20%,25V,Nichicon ULB1E101M or equiv.	1007 1630
C5	All units	Capacitor,ceramic,0.47µF,+80/-20%,50V,Murata RE50-474M or equiv.	1007 939
C6	All units	Capacitor,dipped ceramic,0.1µF,10%,50V,AVX SR205C104KAA or equiv.	1007 1667
C7,11	All units	Capacitor,dipped ceramic,0.001µF,10%,50V,AVX SR205A102KAA or equiv.	1007 1666
C10,12	All units	Capacitor,X7R ceramic,0.01µF,10%,50V,AVX SA105C103KAA or equiv.	0130 51031
C13	All units	Capacitor,metallized polypropylene,0.033µF,10%,400V,radial leads, Illinois Capacitor 333MPR400K or equiv.	1007 1694
C14	All 15-volt units	Capacitor,dipped mica,510pF,2%,500V, Type DM19	16634
	All 45-volt units	Capacitor,X5F ceramic disc,100pF,20%,1000V,radial leads, Sprague 5GAT10 or equiv.	1007 1711
C15,16	All 15-volt units	Capacitor,electrolytic,470µF,20%,35V,radial leads, Sprague 513D477M035DK4 or equiv.	1007 1705
	All 45-volt units	Capacitor,electrolytic,100µF,20%,63V,radial leads, Illinois Capacitor 107RZS063M or equiv.	1007 1696
C17,18	All units	Capacitor,ceramic disc,0.005µF,20%,3kV,Centralab DD30-502 or equiv.	1007 1264
C19	All 45-volt units	Capacitor,ceramic,0.0039µF,5%,100V,AVX SA301A392JAA or equiv.	0125 13925
	24/15 & 48/15 units	Capacitor,X7R ceramic,0.033µF,10%,50V,AVX SA205C333KAA or equiv.	0130 53331
	129/15 units	Not used.	
		RESISTORS	
R1	24/15 & 24/45 units	Resistor,wirewound,1KΩ,5%,3.25W,Ohmite 4423 Style 995-3A or equiv.	1220 24
	48/15 & 48/45 units	Resistor,wirewound,4.3KΩ,1%,1/4W,Type 5013	1780 817
	129/15 & 129/45 units	Resistor,wirewound,330Ω,0.1%,1/4W,Type 5013	1780 818
R2,11,12,15	All units	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R3	All units	Resistor,metal film,30.1KΩ,1%,1/4W, Type RN1/4	0410 1430
R4	All units	Resistor,metal film,11KΩ,1%,1/4W, Type RN1/4	0410 1388
R7	All units	Resistor,metal film,100Ω,1%,1/4W, Type RN1/4	0410 1192

Table 7-4. Replaceable parts - continued.

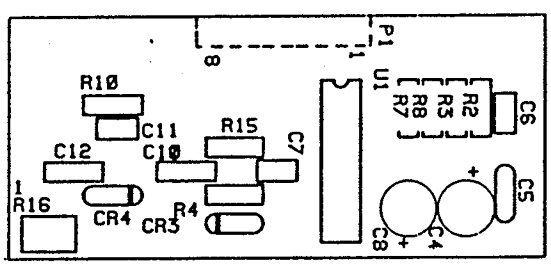
Circuit Symbol (Figs. 7-8 & 7-9)	Usage	Description	Part Number
		RESISTORS - continued.	
R8,10	All units	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R13,14,24	All units	Resistor,metal film,15Ω,1%,1/8W,Type RN55D	1510 1317
R16	All units	Resistor,variable,12-turn cermet,2KΩ,10%,1/4W,side adjust, Bourns 3266X-1-202 or equiv.	32732
R17	24/15 & 24/45 units	Resistor,wirewound,100Ω,5%,5W,Ohmite 4592 Style 995-5B or equiv.	1100 293
	129/15 & 129/45 units	Resistor,wirewound,150Ω,5%,3.25W,Ohmite 4396 Style 995-3A or equiv.	1100 566
	48/15 & 48/45 units	Resistor,wirewound,100Ω,5%,3.25W,Ohmite 4392 Style 995-3A or equiv.	1220 33
R19	All units	Resistor,metal film,1KΩ,1%,1/2W, Type RN1/2	0410 2288
R20	24/15 & 24/45 units	Same as R1.	
	48/15 & 48/45 units	Resistor,wirewound,5KΩ,5%,3.25W,Ohmite 4442 Style 995-3A or equiv.	1100 460
	129/15 & 129/45 units	Resistor,wirewound,25KΩ,5%,5W,Ohmite 4664 Style 995-5B or equiv.	1100 480
R21	All 15-volt units	Resistor,wirewound,75Ω,5%,1.5W,Ohmite 4087 Style 995-1A or equiv.	1100 688
	All 45-volt units	Resistor,wirewound,200Ω,5%,1.5W,Ohmite 4099 Style 995-1A or equiv.	1100 427
R22	48/45 & 129/45 units	Resistor,metal film,34.8KΩ,1%,1/4W, Type RN1/4	0410 1436
	All other units	Resistor,metal film,2.49KΩ,1%,1/4W, Type RN1/4	0410 1326
R23	All 15-volt units	Resistor,metal film,1.62kΩ,1%,1/4W, Type RN1/4	0410 1308
	All 45-volt units	Same as R2.	
R25	All 15-volt units	Not used.	
	All 45-volt units	Same as R2.	
R26	All 15-volt units	Resistor,metal film,1.05KΩ,1%,1/4W, Type RN1/4	0410 1290
	All 45-volt units	Resistor,metal film,1.96KΩ,1%,1/4W, Type RN1/4	0410 1316
R27	All 15-volt units	Resistor,metal film,499Ω,1%,1/4W, Type RN1/4	0410 1259
	All 45-volt units	Resistor,metal film,2KΩ,1%,1/4W, Type RN1/4	0410 1317
R28	All 15-volt units	Resistor,metal film,1.78KΩ,1%,1/4W, Type RN1/4	0410 1312
	All 45-volt units	Resistor,metal film,13.3KΩ,1%,1/4W, Type RN1/4	0410 1396
R29,30	All units	Resistor,metal film,20Ω,1%,1/8W,Type RN55D	1510 1412
		SEMICONDUCTORS	
CR1	All units	Diode,Zener,18V,5%,1W,1N4746A	29757
CR2	All 15-volt units	Not used; zero-ohm resistor in its place.	
	All 45-volt units	Same as CR1.	
CR3,4	All units	Diode,silicon,1N914B or 1N4448	26482
CR5	24/15 & 24/45 units	Diode,Zener,10V,5%,1W,1N4740A	33342
	All other units	Diode,Zener,6.2V,5%,1W,1N4735A	29751
CR6,7	All units	Diode,silicon,200 PIV,1N4003	30769
CR8	All units	Diode,Zener,43V,5%,1W,1N4755A	34877
CR9,10	All units	Diode,Schottky,60V,1A,DO-41 case,International Rectifier 11DQ06 or equiv.	96365

Table 7-4. Replaceable parts - continued.

Circuit Symbol (Figs. 7-8 & 7-9)	Usage	Description	Part Number
		SEMICONDUCTORS - continued.	
CR11	129/15 & 129/45 units	Rectifier,common-cathode,2-diode,500V,16A,50-ns TRR, 3-terminal TO-220 case,General Instrument FEP16HT or equiv.	30460
	All other units	Rectifier,common-cathode,2-diode,200V,16A,35-ns TRR, 3-terminal TO-220 case,General Instrument FEP16DT or equiv.	30490
CR12	All 15-volt units	Rectifier,common-cathode,2-diode,200V,16A,35-ns TRR, 3-terminal TO-220 case,General Instrument FEP16DT or equiv.	30490
	All 45-volt units	Rectifier,common-cathode,2-diode,500V,16A,50-ns TRR, 3-terminal TO-220 case,General Instrument FEP16HT or equiv.	30460
CR13	All 15-volt units	Rectifier,common-anode,2-diode,200V,16A,35-ns TRR, 3-terminal TO-220 case,General Instrument FEN16DT or equiv.	30489
	All 45-volt units	Rectifier,common-anode,2-diode,500V,16A,50-ns TRR, 3-terminal TO-220 case,General Instrument FEN16HT or equiv.	30461
CR14	All units	Bridge rectifier,100V,1.5A,General Instrument RW01M or equiv.	30497
CR15	24/15 & 24/45 units	Transient suppressor,unipolar,31.4- to 34.7-volt breakdown, General Semiconductor 1.5KE33A or equiv.	30447
	48/15 & 48/45 units	Transient suppressor,unipolar,64.6- to 71.4-volt breakdown, General Semiconductor 1.5KE68A or equiv.	30448
	129/15 & 129/45 units	Transient suppressor,180-220V breakdown, General Instrument 1.5KE180A or equiv.	32727
CR16	All units	Linear adjustable precision shunt regulator,3-terminal TO-92 case, Motorola TL431ILP or equiv.	0620 320
Q1,2	All units	Transistor,PNP,high-speed switching,40-volt VCEO,TO-92 case,2N4402	29099
Q3,4	24/15 & 24/45 units	Transistor,N-channel MOSFET,100V,27A,TO-220AB plastic case, International Rectifier IRF540 or equiv.	0715 26
	48/15 & 48/45 units	Transistor,N-channel FET,200V,18A,TO-220AB plastic case, International Rectifier IRF640 or equiv.	0715 27
	129/15 & 129/45 units	Transistor,N-channel FET,400V,10A,TO-220AB plastic case, International Rectifier IRF740 or equiv.	0715 28
Q5	All units	Transistor,NPN,TO-92 case,2N4124	18862
U1	All units	Linear power control circuit,16-pin DIP,Motorola TL494IN or equiv.	0620 313
U2	All units	Optical isolator,transistor output,6-pin DIP,Motorola MOC8101 or equiv.	99392
		MISCELLANEOUS COMPONENTS	
L1,3	All units	Not used.	
L2	All units	Choke,input,11μH,6A,common mode	32722
L4	All 15-volt units All 45-volt units	Choke,output,155mH,3.3A Choke,output,1.55mH,1A	32725 32724
T1	All units	Transformer,current	32726
T2	24/15 units 48/15 units 129/15 units 24/45 units 48/45 units 129/45 units	Transformer,24-volt primary,15-volt secondary Transformer,48-volt primary,15-volt secondary Transformer,129-volt primary,15-volt secondary Transformer,24-volt primary,45-volt secondary Transformer,48-volt primary,45-volt secondary Transformer,129-volt primary,45-volt secondary	32719 32720 32721 32716 32717 32718

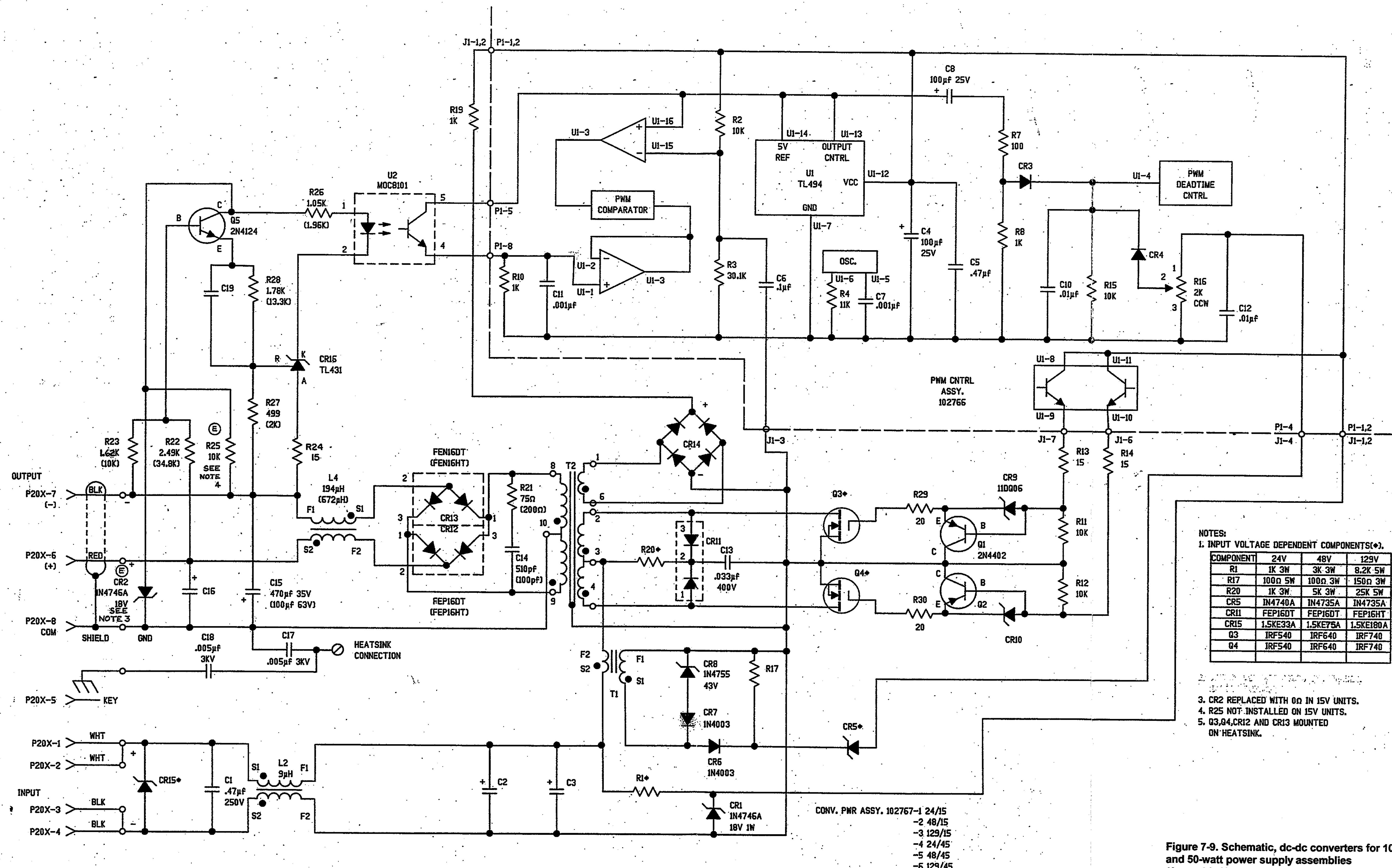


a. Power converter board (Drawing No. 102768, Rev. C).



b. PWM controller board (Drawing No. 102773, Rev. C).

Figure 7-8. Component locator drawing, dc-dc converters for 10-watt and 50-watt power supply assemblies (Assembly Nos. 102765-1 thru 102765-3, and 102770-1 thru 102770-3)



NOTES:

1. INPUT VOLTAGE DEPENDENT COMPONENTS(◆).

COMPONENT	24V	48V	129V
R1	1K 3W	3K 3W	8.2K 5W
R17	100Ω 5W	100Ω 3W	150Ω 3W
R20	1K 3W	5K 3W	25K 5W
CR5	IN4740A	IN4735A	IN4735A
CR11	FEP16DT	FEP16DT	FEP16HT
CR15	1.5KE33A	1.5KE75A	1.5KE180A
Q3	IRF540	IRF640	IRF740
Q4	IRF540	IRF640	IRF740

3. CR2 REPLACED WITH 0Ω IN 15V UNITS.
4. R25 NOT INSTALLED ON 15V UNITS.
5. Q3,Q4,CR12 AND CR13 MOUNTED ON HEATSINK.

Figure 7-9. Schematic, dc-dc converters for 10-watt and 50-watt power supply assemblies (Assembly Nos. 102765-1 thru 102765-3, and 102770-1 thru 102770-3; Schematic No. D-102774-F)

Table 7-5. Replaceable parts, 10-watt amplifier assembly for RFL 95 AMP PS Amplifier/Power Supplies
Assembly No. 100847

Circuit Symbol (Figs. 7-10 & 7-11)	Description	Part Number
	CAPACITORS	
C1,10,17	Capacitor,ceramic,5pF,10%,100V,Murata RPA10COG050K100V or equiv.	0125 10501
C2	Capacitor,mica,3pF ±0.5pF,500V,Type DM-15	16502
C3,4,12,14	Capacitor,tantalum,1µF,20%,35V,Kemet T322B105M035AS or equiv.	1007 496
C5,23	Capacitor,ceramic,47pF,5%,100V,AVX SA101A470JAA or equiv.	0125 14705
C6	Capacitor,Z5U ceramic,0.47µF,20%,50V,AVX SA405E474MAA or equiv.	0135 54742
C7-9,26	Not used.	
C11,22	Capacitor,mica,140pF,2%,500V,Type DM-19	16607
C13	Capacitor,ceramic,22pF,5%,100V,AVX SA101A220JAA or equiv.	0125 12205
C15,16,31,32	Capacitor,electrolytic,1000µF,+50/-10%,25V,Siemens 85209/1000/25 or equiv.	1007 1633
C18,19,24,25	Capacitor,X7R ceramic,0.27µF,10%,50V,Murata RPA40X7R274K50V or equiv.	0130 52741
C20,21	Capacitor,tantalum,3.3µF,20%,35V,Kemet T322C335M035AS or equiv.	1007 1260
C26	Capacitor,tantalum,15µF,5%,20V,Kemet T322D156J020AS or equiv.	1007 1473
C27	Capacitor,X7R ceramic,0.01µF,10%,50V,AVX SA105C103KAA or equiv.	0130 51031
C28	Capacitor,X7R ceramic,0.1µF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C29,30	Capacitor,Z5U ceramic,0.33µF,+80-20%,50V,Murata RPA3025U334Z50V or equiv.	0135 53348
C33,34	Capacitor,metallized polycarbonate,3µF,5%,50V,Wesco 32MPC or equiv.	1007 1287
C36,37	Capacitor,ceramic,0.1µF,20%,50V,Centralab CZ20C104M or equiv.	1007 1574
	RESISTORS	
R1-6,56,57,64,65,74, 75,77-84	Not used.	
R7	Resistor,metal film,301Ω,1%,1/4W, Type RN1/4	0410 1238
R8,10	Resistor,metal film,499Ω,1%,1/8W,Type RN1/4	0410 1259
R9	Resistor,metal film,2.8KΩ,1%,1/4W, Type RN1/4	0410 1331
R11	Resistor,metal film,3.16KΩ,1%,1/4W, Type RN1/4	0410 1336
R12	Resistor,metal film,3.32KΩ,1%,1/4W, Type RN1/4	0410 1338
R13	Resistor,variable,15-turn cermet,20KΩ,10%,3/4W,Beckman Helipot 89PHR20K or equiv.	39504
R14,21	Resistor,metal film,200Ω,1%,1/4W, Type RN1/4	0410 1221
R15,29,30,38,41,67, 73,89	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R16,17,20,24,39,40,45,49	Resistor,metal film,10Ω,1%,1/4W,Type RN60D	1510 1015
R18	Resistor,metal film,1.78KΩ,1%,1/4W, Type RN1/4	0410 1312
R19,28,42,50	Resistor,composition,2.7Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 900
R22,23,44,46,51,52	Resistor,metal film,2.21KΩ,1%,1/4W, Type RN1/4	0410 1321

Table 7-5. Replaceable parts - continued.

Circuit Symbol (Figs. 7-10 & 7-11)	Description	Part Number
	RESISTORS - continued.	
R25	Resistor,metal film,147Ω,1%,1/4W, Type RN1/4	0410 1209
R26,27,53	Resistor,composition,24Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 827
R31,33	Resistor,metal film, 6.65KΩ, 1%, 1/4W, Type RN1/4	0410 1367
R32,62	Resistor,variable,18-turn cermet,1KΩ,10%,1/2W,Beckman Helipot 68WR1K or equiv.	49995
R34,71	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R35, 72	Resistor,metal film,1.5KΩ,1%,1/4W, Type RN1/4	0410 1305
R36	Resistor,metal film,6.49KΩ,1%,1/4W, Type RN1/4	0410 1366
R37,43	Resistor,metal film,182Ω,1%,1/4W, Type RN1/4	0410 1217
R47	Resistor,metal film,750Ω,1%,1/4W, Type RN1/4	0410 1276
R48	Resistor,metal film,1.21KΩ,1%,1/4W, Type RN1/4	0410 1296
R54,55,58,59	Resistor,metal film,15Ω,1%,1/4W,Type RN60D	1510 1023
R60,61	Resistor,wirewound,0.10Ω,1%,1W,Mills Resistor MRP-1 or equiv.	1100 801
R63	Resistor,metal film,402Ω,1%,1/4W, Type RN1/4	0410 1250
R66	Resistor,non-inductive wirewound,0.25Ω,5%,3W,C.T.Gamble Type CGN-6 or equiv.	1100 743
R68	Resistor,variable,15-turn cermet,100KΩ,10%,3/4W,Beckman Helipot 89PHR100K or equiv.	47540
R69	Resistor,metal film,47.5KΩ,1%,1/4W, Type RN1/4	0410 1449
R70	Resistor,metal film,715Ω,1%,1/4W, Type RN1/4	0410 1274
R76	Resistor,composition,33Ω,5%,1/4W, Allen-Bradley CB Series or equiv.	1009 829
R85	Resistor,metal film,1.78KΩ,1%,1/4W, Type RN1/4	0410 1312
R86	Resistor,metal film,681Ω,1%,1/4W, Type RN1/4	0410 1272
R87	Resistor,metal film,100Ω,1%,1/4W, Type RN1/4	0410 1192
RZ1	Resistor network,nine 82Ω 5% resistors,1.25W total,10-pin SIP, Bourns 4310R-101-820 or equiv.	99380
RZ2	Resistor network,nine 680Ω 2% resistors,2.7W total,10-pin SIP, TRW/IRC Resistors 810-1-681-G or equiv.	300530
	SEMICONDUCTORS	
CR1-5	Diode,silicon,1N914B or 1N4448	26482
CR6,7	Diode,silicon,200 PIV,1N4003	30769
CR8,9	Not used.	
CR10	Diode,germanium,1N100A	28507
DS2,3	Light-emitting diode,green,right-angle panel mount,Schroff 69004.122 or equiv.	30472
DS1	Light-emitting diode,red,panel mount,Dialight 559-0101-001 or equiv.	91114

Table 7-5. Replaceable parts - continued.

Circuit Symbol (Figs. 7-10 & 7-11)	Description	Part Number
	SEMICONDUCTORS - continued.	
DS5	Light-emitting diode,red,cartridge type w/2700Ω resistor, Littelfuse 900-160L-031RN or equiv.	300760
Q1,2,4,6,15	Transistor,NPN,plastic package,2N2222A	37445
Q3,5,20	Transistor,PNP,plastic package,2N2907A	37439
Q7,8	Transistor,NPN,TO-92 case,2N3903	21562
Q9	Transistor,PNP,TO-5 case,2N2905A	39567
Q10	Transistor,NPN,Type 152-02 case,Motorola MPS-U07 or equiv.	101449
Q11-13	Transistor,NPN,60V,4A,15W,Type 77-03 case,Motorola MJE-223 or equiv.	34756
Q14	Transistor,NPN,TO-5 case,2N2219A	39569
Q16	Transistor,PNP,Type 152-02 case,Motorola MPS-U57 or equiv.	101451
Q17-19	Not used.	
U1	Operational amplifier,wideband,high-performance,8-pin TO-99 case, Harris Semiconductor HA2-2625-5 or equiv.	0620 140
U2	Voltage comparator/buffer,8-pin DIP,National Semiconductor LM311N or equiv.	0620 188
	MISCELLANEOUS COMPONENTS	
K1	Relay,SPDT,12-volt coil,2-amp/28-volt contacts, AMF/Potter & Brumfield R50-E2-Y1-12 or equiv.	38383
L1	Not used.	
L2,3	Inductor,molded,10μH,5%,4A,resonant frequency greater than 10 MHz, Stanwyck ER-3114 or equiv.	92620
T1	Transformer,output	102726

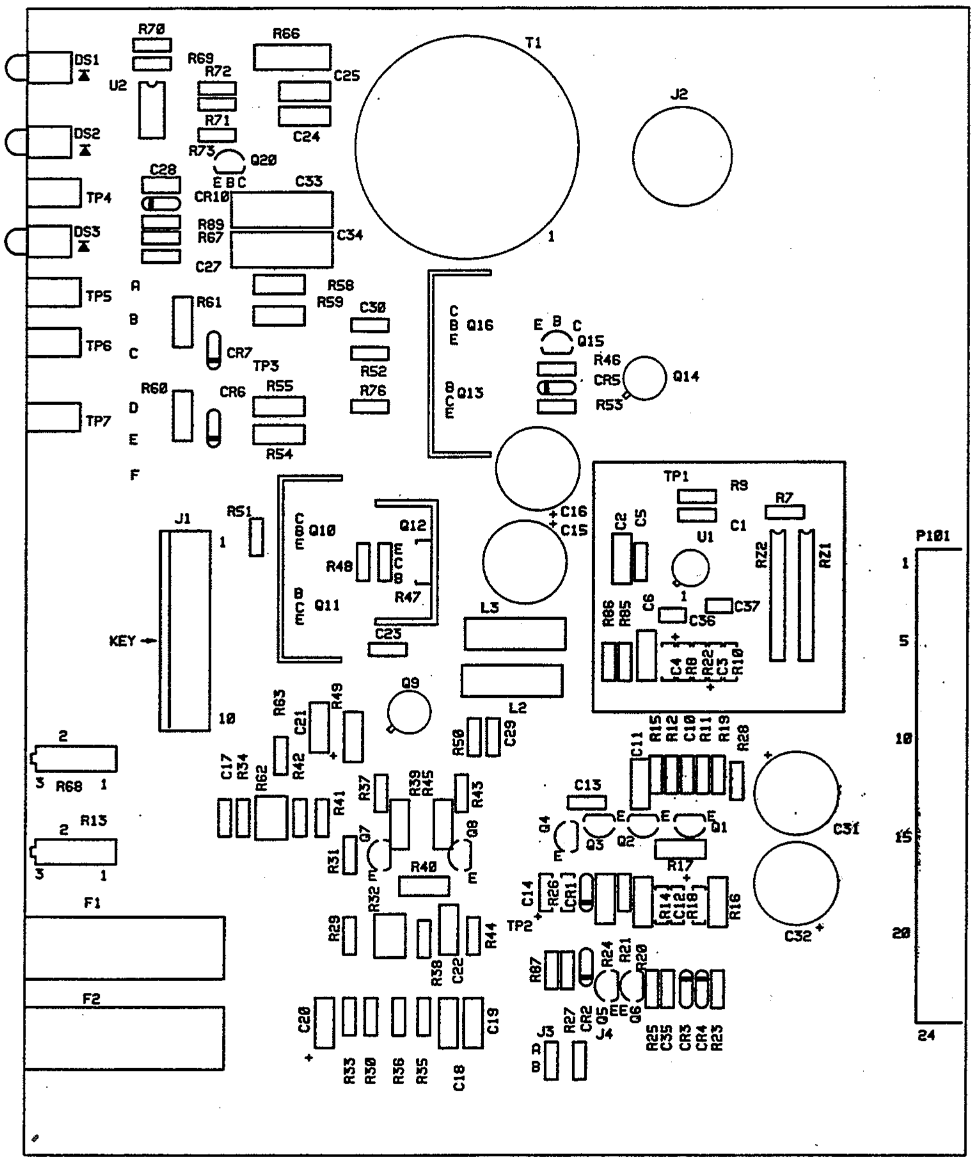


Figure 7-10. Component locator drawing, 10-watt amplifier board for RFL 95 AMP PS Amplifier/Power Supplies
(Assembly No. 100847; Drawing No. 102718, Rev. D)

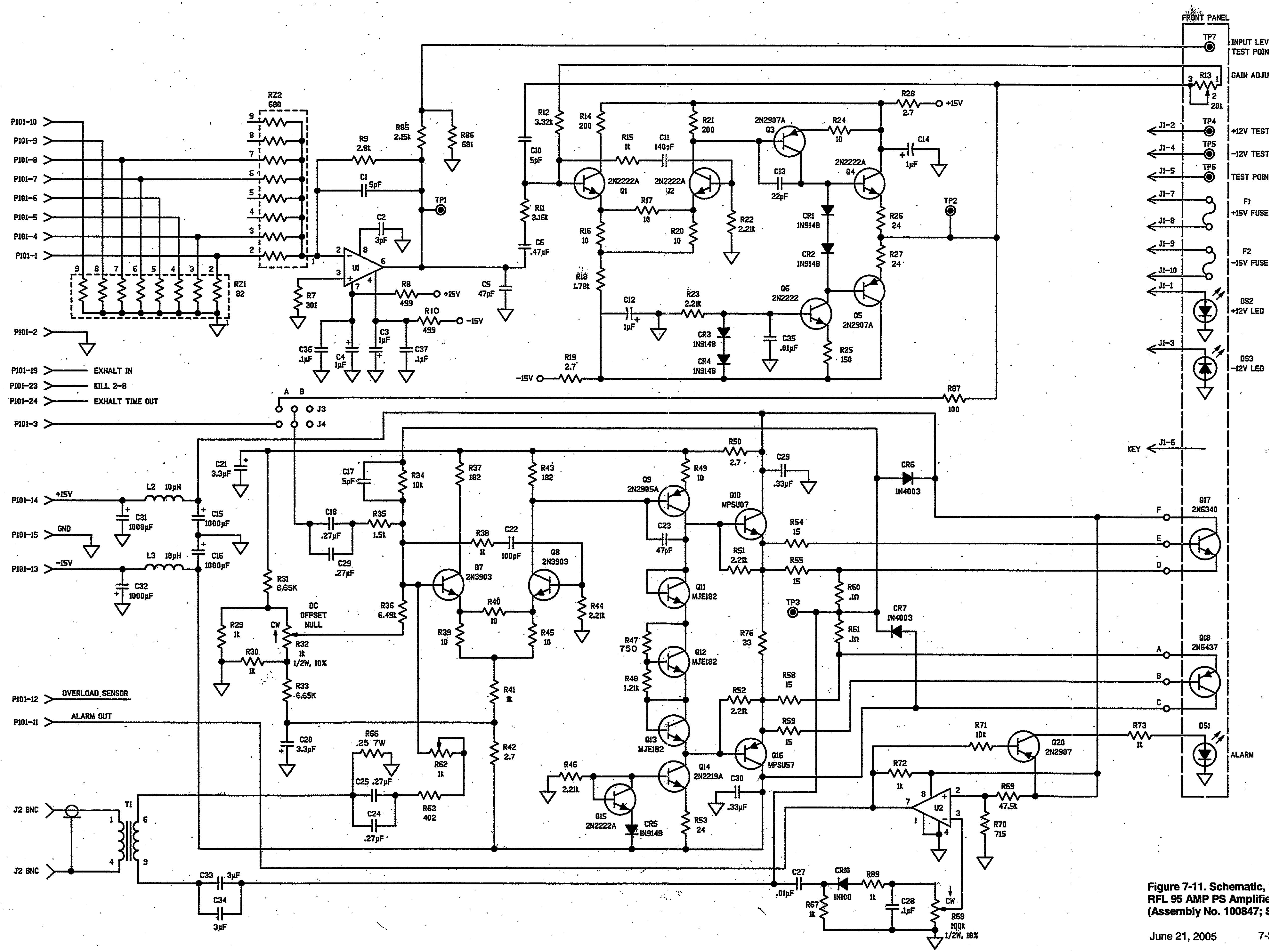


Figure 7-11. Schematic, 10-watt amplifier board for RFL 95 AMP PS Amplifier/Power Supplies (Assembly No. 100847; Schematic No. D-102719-E)

Table 7-6. Replaceable parts, driver module for RFL 95 PWR AMP/PS 50-Watt Amplifier/Power Supplies
Assembly No. 100845

Circuit Symbol (Figs. 7-12 & 7-13)	Description	Part Number
	CAPACITORS	
C101,102,118	Capacitor,ceramic,5pF,10%,100V,Murata RPA10COG050K100V or equiv.	0125 10501
C103,104,109,111	Capacitor,tantalum,1µF,20%,35V,Kemet T322B105M035AS or equiv.	1007 496
C105	Capacitor,ceramic,47pF,5%,100V,AVX SA101A470JAA or equiv.	0125 14705
C106,112,117	Capacitor,metallized polycarbonate,0.47µF,10%,100V,Wesco 32MPC or equiv.	1007 1624
C107	Capacitor,ceramic,10pF,10%,100V,AVX SA101A100KAA or equiv.	0125 11001
C108,120	Capacitor,ceramic,120pF,5%,100V,AVX SA101A121JAA or equiv.	0125 11215
C110	Capacitor,ceramic,22pF,5%,100V,AVX SA101A220JAA or equiv.	0125 12205
C113,115	Capacitor,X7R ceramic,0.1µF,10%,100V,AVX SA401C104KAA or equiv.	0130 11041
C114,116	Capacitor,electrolytic,47µF,+100-10%,100V,Stettner-Trush EB47/100 or equiv.	1007 1350
C119,121	Capacitor,electrolytic,22µF,+100-10%,15V,Stettner-Trush EB 22/100 or equiv.	1007 1429
	RESISTORS	
R101,106,108,156	Resistor,metal film,665Ω,1%,1/4W, Type RN1/4	0410 1271
R102,103	Resistor,metal film,2.67KΩ,1%,1/4W, Type RN1/4	0410 1329
R104	Resistor,metal film,5.23KΩ,1%,1/4W, Type RN1/4	0410 1357
R105,107,109,157	Resistor,metal film,84.5Ω,1%,1/4W, Type RN1/4	0410 1185
R110,137	Resistor,metal film,301Ω,1%,1/4W, Type RN1/4	0410 1238
R111,112	Resistor,composition,47Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 832
R113	Resistor,metal film,3.16KΩ,1%,1/4W, Type RN1/4	0410 1336
R114,118,134,152	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R115	Resistor,variable,22-turn cermet,1KΩ,10%,1W,hooked leads,Bourns 3059J-1-102 or equiv.	30131
R116,117	Resistor,metal film,221Ω,1%,1/4W, Type RN1/4	0410 1225
R119,122-124	Resistor,composition,10Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 823
R120,126,138,148	Resistor,composition,2.7Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 900
R121,129	Resistor,composition,24Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 827
R125	Resistor,metal film,1.78KΩ,1%,1/4W, Type RN1/4	0410 1312
R127,128,149	Resistor,metal film,2.21KΩ,1%,1/4W, Type RN1/4	0410 1321
R130,142,143	Resistor,metal film,100Ω,1%,1/4W, Type RN1/4	0410 1192
R131	Resistor,metal film,1.91KΩ,1%,1/4W, Type RN1/4	0410 1315
R132	Resistor,metal film,7.5KΩ,1%,1/4W, Type RN1/4	0410 1372
R133,135	Resistor,metal film,280Ω,1%,1/4W, Type RN1/4	0410 1235
R136,140,155	Resistor,composition,33Ω,5%,1/2W,Allen-Bradley EB Series or equiv.	1009 611

Table 7-6. Replaceable parts - continued.

Circuit Symbol (Figs. 7-12 & 7-13)	Description	Part Number
	RESISTORS - continued.	
R139,145,146,154	Resistor,composition,15Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 825
R141	Resistor,composition,27Ω,5%,1W,Allen-Bradley GB Series or equiv.	1009 929
R143	Resistor,metal film,7.5KΩ,1%,1/4W, Type RN1/4	0410 1372
R144	Resistor,metal film,8.25KΩ,1%,1/2W, Type RN1/2	0410 2376
R147	Resistor,metal film,806Ω,1%,1/4W, Type RN1/4	0410 1279
R150	Resistor,metal film,1.21KΩ,1%,1/4W, Type RN1/4	0410 1296
R151	Resistor,metal film,30.1KΩ,1%,1/4W, Type RN1/4	0410 1430
R153	Resistor,metal film,68.1Ω,1%,1/4W, Type RN1/4	0410 1176
R158	Resistor,metal film,150Ω,1%,1/4W, Type RN1/4	0410 1209
	SEMICONDUCTORS	
CR101-105,107,109	Diode,silicon,1N914B or 1N4448	26482
CR106	Diode,Zener,6.2V,5%,400mW,1N753A	37498
CR108,110	Diode,silicon,200 PIV,1N4003	30769
Q101,102,108	Transistor,NPN,TO-18 case,2N2896	92675
Q103,107	Transistor,PNP,Type 152-02 case,Motorola MPS-U57 or equiv.	101451
Q104,109,110,112,113	Transistor,NPN,plastic package,2N2222A	37445
Q105,106	Transistor,NPN,Type 152-02 case,Motorola MPS-U07 or equiv.	101449
Q109,110	Transistor,NPN,TO-92 case,2N4124	18862
Q111,114	Transistor,PNP,plastic package,2N2907A	37439
U101	Operational amplifier,wideband,high-performance,8-pin TO-99 case, Harris Semiconductor HA2-2625-5 or equiv.	0620 140
	MISCELLANEOUS COMPONENTS	
L101,102	Inductor,molded,390µH,5%,200mA,Stanwyck ESA-390 or equiv.	92267
T101	Transformer,isolation,high-frequency,100/200Ω	55630
---	Shorting bar,single,Molex 90059-0009 or equiv.	98306

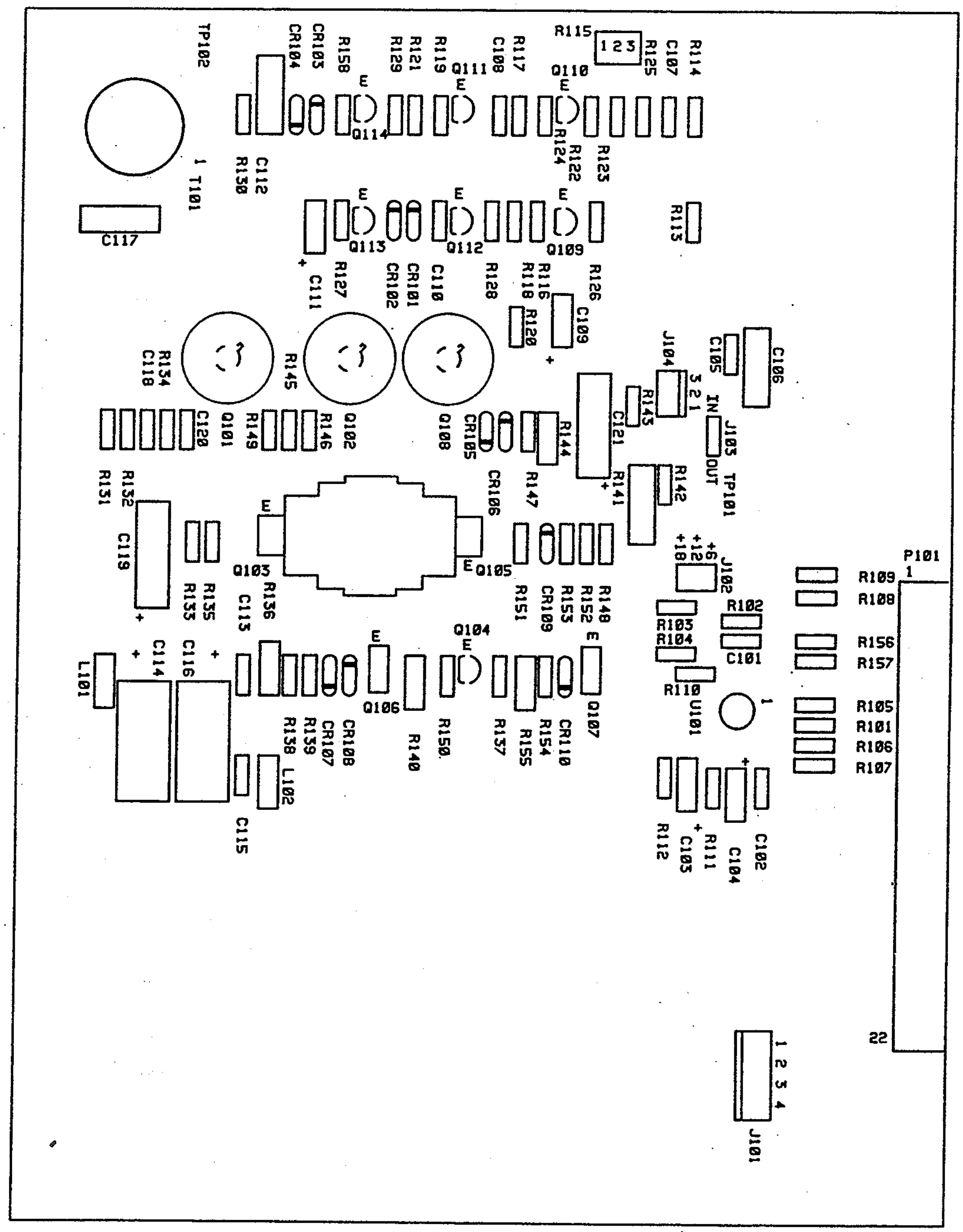


Figure 7-12. Component locator drawing, 50-watt driver module for RFL 95 PWR AMP/PS 50-Watt Amplifier/Power Supplies (Assembly No. 100845; Drawing No. 100848, Rev. F)

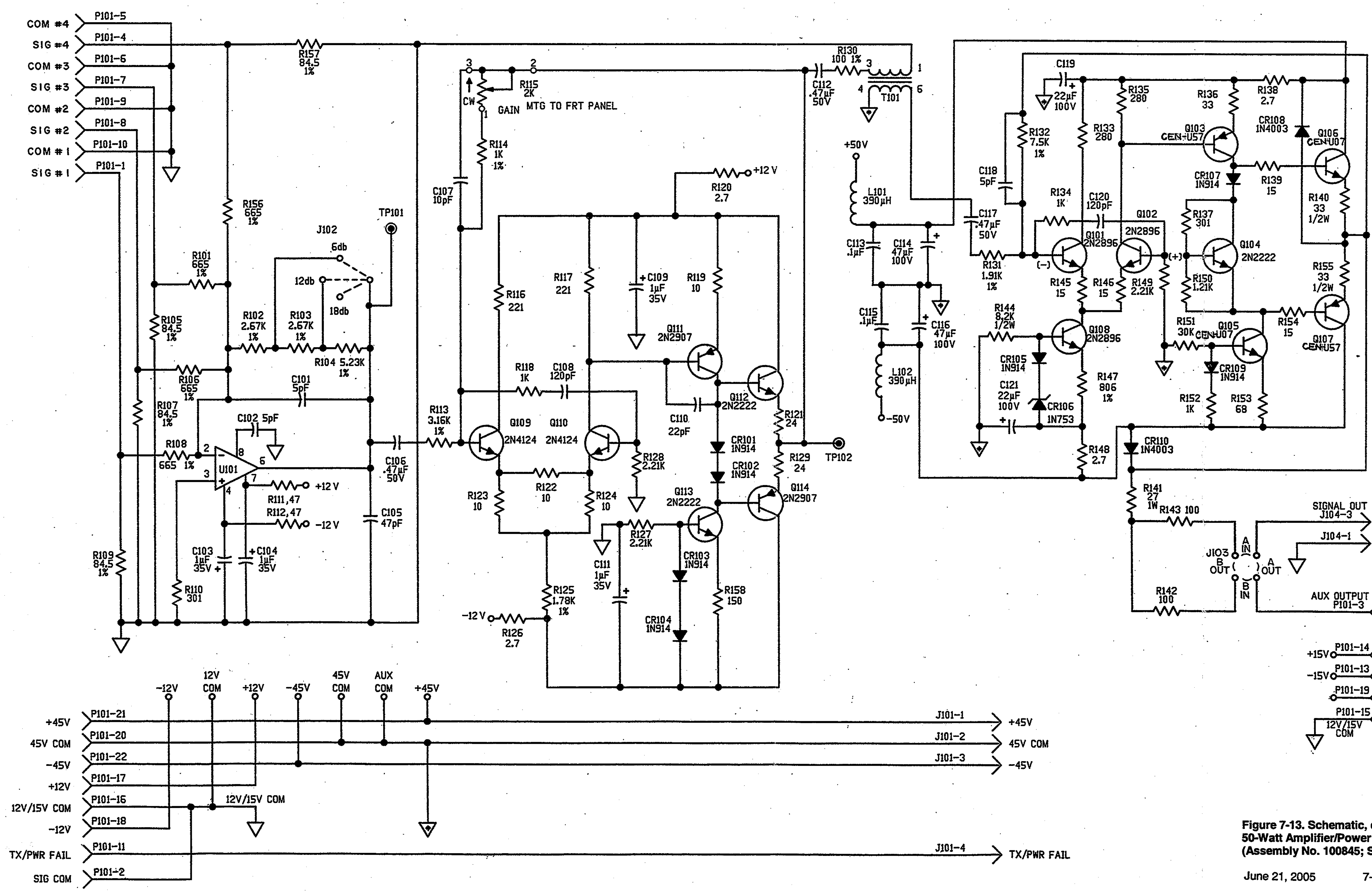


Figure 7-13. Schematic, driver module for RFL 95 PWR AMP/PS 50-Watt Amplifier/Power Supplies (Assembly No. 100845; Schematic No. D-100849-D)

Table 7-7. Replaceable parts, 50-watt power amplifier assemblies for RFL 95 PWR AMP/PS 50-Watt Amplifier/Power Supplies
For 95 PWR AMP/PS-1 (24-Volt Input) - Assembly No. 102775-1
For 95 PWR AMP/PS-2 (48-Volt Input) - Assembly No. 102775-2
For 95 PWR AMP/PS-3 (129-Volt Input) - Assembly No. 102775-3

Circuit Symbol (Figs. 7-14 to 7-16)	Description	Part Number
	CAPACITORS	
C1,16,17	Capacitor,metallized mylar,0.1µF,2%,200V,Wesco 32MM or equiv.	1007 1140
C2	Capacitor,dipped mica,220pF,2%,500V, Type DM10	1080 393
C3,6,18,20,27	Capacitor,X7R ceramic,0.1µF,10%,100V,AVX SA401C104KAA or equiv.	0130 11041
C4,7,19,21	Capacitor,electrolytic,100µF,20%,63V,radial leads,Illinois Capacitor 107RZS063M or equiv.	1007 1696
C5,13	Capacitor,Z5U ceramic,0.33µF,+80/-20%,50V,Murata RPA3025U334Z50V or equiv.	0135 53348
C8	Capacitor,dipped mica,39pF,5%,100V, Type DM10	1080 385
C9	Capacitor,tantalum,4.7µF,20%,35V,Kemet T310B475M035AS or equiv.	1007 1609
C11	Capacitor,dipped mica,5pF ±0.5pF,500V, Type DM15	16503
C12	Capacitor,metallized polycarbonate,0.33µF,2%,100V,Wesco 32MPC or equiv.	1007 1438
C22	Capacitor,metallized polypropylene,10µF,10%,100V,axial leads,Wesco 32MPL-1005-K1 or equiv.	1007 1713
C25	Capacitor,polyester,0.0068µF,2%,100V,Wesco 32P or equiv.	5115 27
	RESISTORS	
R1,5	Resistor,metal film,499Ω,1%,1/4W, Type RN1/4	0410 1259
R2	Resistor,variable,18-turn cermet,500Ω,10%,1/2W,Beckman Helipot 68WR500 or equiv.	94296
R6	Resistor,metal film,13KΩ,1%,1/4W, Type RN1/4	0410 1395
R7,8	Resistor,metal film,100Ω,1%,1/4W, Type RN1/4	0410 1192
R11	Resistor,metal film,200Ω,1%,1/4W, Type RN1/4	0410 1221
R12	Resistor,metal film,931Ω,1%,1/4W, Type RN1/4	0410 1285
R13	Resistor,metal film,1.3KΩ,1%,1/4W, Type RN1/4	0410 1299
R14	Resistor,zero-ohm,1/4-watt size,Corning OMA07 or equiv.	1510 2217
R15,20	Resistor,metal film,30.1Ω,1%,1/4W,Type RN60D	1510 877
R16	Resistor,composition,2.7KΩ,5%,2W,Allen-Bradley HB Series or equiv.	1009 1062
R17	Resistor,metal film,factory-selected value,Type RN1/4	Contact factory
R18	Resistor,metal film,365Ω,1%,1/4W, Type RN1/4	0410 1246
R19	Resistor,metal film,1.91KΩ,1%,1/4W, Type RN1/4	0410 1315
R21,22	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R23,34	Resistor,composition,7.5Ω,5%,1/4W,Allen-Bradley GB Series or equiv.	1009 1044
R24,33,45	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288

Table 7-7. Replaceable parts - continued.

Circuit Symbol (Figs. 7-14 to 7-16)	Description	Part Number
	RESISTORS - continued.	
R25,27,35,36	Resistor,composition,5.6Ω,5%,1/4W,Allen-Bradley GB Series or equiv.	1009 965
R26,28,37,38	Resistor,composition,15Ω,5%,1/4W, Allen-Bradley CB Series or equiv.	1009 825
R29-32,39-42	Resistor,metal film,1Ω,5%,1W,KOA Resistor MO1B-1OHM-5%(J) or equiv.	1510 2266
R43	Resistor,composition,10Ω,5%,2W, Allen-Bradley HB Series or equiv.	1009 110
R44	Resistor,composition,4.7Ω,5%,1W,Allen-Bradley GB Series or equiv.	1009 1111
R46	Resistor,metal film,3.01KΩ,1%,1/4W, Type RN1/4	0410 1334
R48,49	Resistor,non-inductive wirewound,0.25Ω,5%,3W,C.T.Gamble Type CGN-6 or equiv.	1100 743
R50,78	Resistor,composition,3.6Ω,5%,1W,Allen-Bradley GB Series or equiv.	1009 1112
R73,74	Resistor,metal film,4.75KΩ,1%,1/4W, Type RN1/4	0410 1353
R75	Resistor,metal film,301Ω,1%,1/4W, Type RN1/4	0410 1238
R76	Resistor,composition,1Ω,5%,1/2W, Allen-Bradley EB Series or equiv.	1009 978
R80,81	Resistor,composition,470Ω,10%,1W,Allen-Bradley GB Series or equiv.	1009 662
	SEMICONDUCTORS	
CR1	Diode,Zener,3.9V,5%,400 mW,1N748A	37403
CR2,3-5	Diode,silicon,200 PIV,1N4003	30769
CR6	Diode,silicon,1N914B or 1N4448	26482
DS5	Indicator,type dependent upon model:	
	24V & 48V Units: Light-emitting diode,red,cartridge type w/2700Ω resistor,Littelfuse 900-160L-031RN or equiv.	300760
	129V Units: Lamp,neon,red w/22K resistor,100-125Vac, Dialight 507-4538-0931-610 or equiv.	48143
Q1-3	Transistor,NPN,120V,152-02 case,Motorola MPS-U03 or equiv.	101452
Q4-6	Transistor,PNP,plastic package,2N2907A	37439
Q7,16	Transistor,PNP,Type 152-02 case,Motorola MPS-U57 or equiv.	101451
Q8,9	Transistor,NPN,60V,4A,15W,Type 77-03 case,Motorola MJE-223 or equiv.	34756
Q10,13	Transistor,NPN,Type 152-02 case,Motorola MPS-U07 or equiv.	101449
Q12	Transistor,NPN,plastic package,2N2222A	37445
Q14,15,17,18	Transistor,NPN,TO-3 case,2N6354	92621

Table 7-7. Replaceable parts - continued.

Circuit Symbol (Figs. 7-14 to 7-16)	Description	Part Number
	MISCELLANEOUS COMPONENTS	
L1,2	Choke,ferrite,100μH,10%,2A,0.103Ω,Caddell-Burns 6310-8 or equiv.	41074
L3	Coil,air core	30359
S1	Switch,toggle,type dependent upon model: 24V & 48V Units: DPDT,ON-NONE-ON,10A @ 120 Vac or 28 Vdc, 5A @ 250 Vac,bat handle,C&K Components 9221-T-Z4-Q or equiv. 129V Units: DPST,ON-NONE-ON,125V/6A,250V/3A,wire leads, Cutler-Hammer 8371K107 or equiv.	 96846 99376
T1	Transformer,output,50W	102757

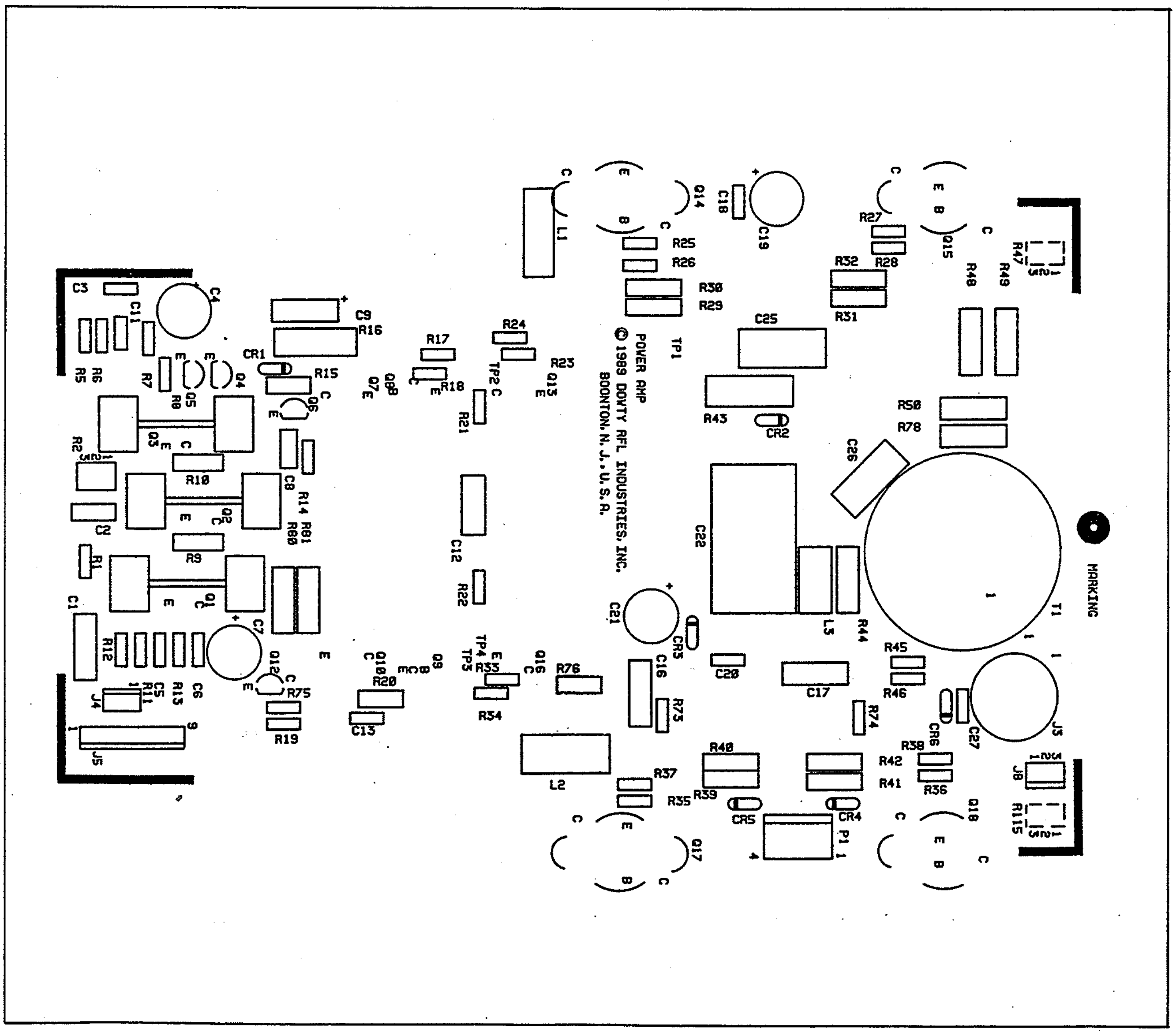
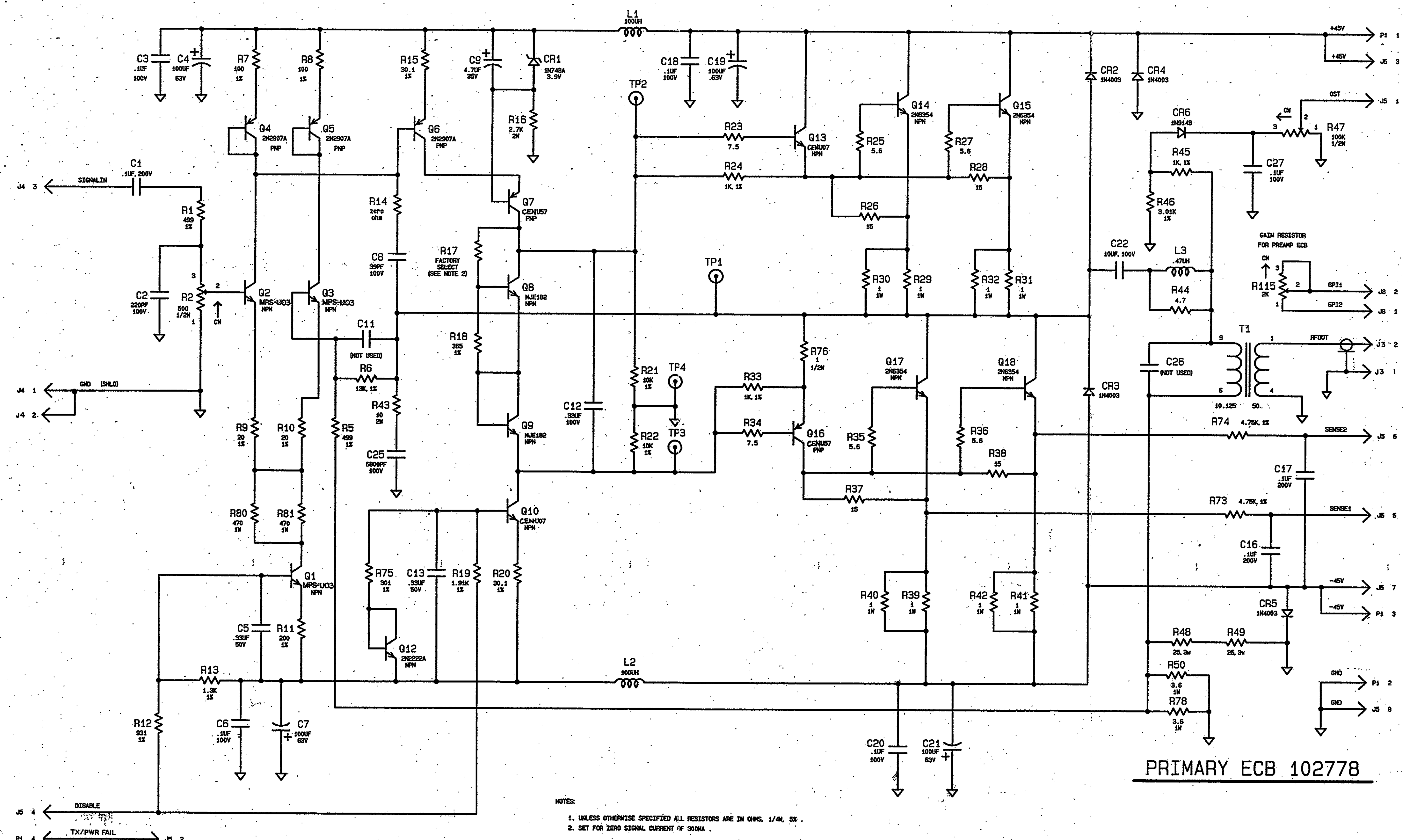


Figure 7-14. Component locator drawing, primary board for 50-watt power amplifier assemblies (Assembly No. 102775-X; Drawing No. 102778, Rev. C)



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
2. SET FOR ZERO SIGNAL CURRENT OF 300MA.

Figure 7-15. Schematic, 50-watt power amplifier assemblies for RFL 95 PWR AMP/PS 50-Watt Amplifier/Power Supplies (Assembly No. 102775-X; Schematic No. D-102779-G, Sheet 1 of 2 – Primary board)

Table 7-8. Replaceable parts, 50-watt power amplifier assemblies for RFL 95 PWR AMP/PS 50-watt Amplifier/ Power Supplies (Assembly No. 102775-X, Secondary board)

Circuit Symbol (Fig . 7-16)	Description	Part Number
	CAPACITORS	
C14,29	Capacitor, tantalum, 4.7µF, 20%, 35V	1007 1609
C15	Capacitor, mylar, 0.33µF, 2%, 100V	1007 575
C28	Capacitor, ceramic, 0.1µF, 10%, 100V	0130 11041
C30	Capacitor, tantalum, 1µF, 5%, 35V	1007 1475
	RESISTORS	
R51	Resistor, metal film, precision, 28K, 1%, 1/4W	0410 1427
R52, 58, 60, 72, 84	Resistor, metal film, precision, 1K, 1%, 1/4W	0410 1288
R53, 69	Resistor, metal film, precision, 10K, 1%, 1/4W	0410 1384
R54, 55, 56, 64, 66	Resistor, metal film, precision, 200K, 1%, 1/4W	0410 1509
R57, 65	Resistor, metal film, precision, 100K, 1%, 1/4W	0410 1480
R59	Resistor, metal film, precision, 2.21K, 1%, 1/4W	0410 1321
R61, 79	Resistor, fixed composition, 1K, 5%, 2W	1009 118
R62	Resistor, metal film, precision, 1.21K, 1%, 1/4W	0410 1269
R63	Resistor, metal film, precision, 3.92K, 1%, 1/4W	0410 1345
R67	Resistor, metal film, precision, 2.49K, 1%, 1/4W	0410 1326
R68	Resistor, metal film, precision, 750K, 1%, 1/4W	1510 499
R70	Resistor, metal film, precision, 464K, 1%, 1/4W	0410 1544
R71	Resistor, metal film, precision, 24.3K, 1%, 1/4W	0410 1421
R77	Resistor, metal film, precision, 221K, 1%, 1/4W	0410 1513
R82	Resistor, fixed composition, 4.7K, 5%, 1W	1009 248
R83	Resistor, metal film, precision, 13.7K, 1%, 1/4W	0410 1397
R85	Resistor, variable, metal film, 2K, 10%, 0.5W	90392
	SEMICONDUCTORS	
CR8, 11	Diode, Zener, 12v, 5%, 1W, IN4742A	29755
CR9, 10	Diode, silicon, 1N914B/1N4448	26482
CR12, 14	A diode selected (1N914B)	103012
CR13	Diode, Zener, 6.2V, 400mW, 1N825A	29523
Q19, 20	Transistor, silicon, PNP, 2N2907A	37439
U1	IC, linear, quad comparator, National LM239AJ	0620 241
U2	IC, linear, dual comparator, National LM293AH	0620 319
	MISCELLANEOUS COMPONENTS	
J2	Jumper connector, programmable	98306
J6	Connector, wafer assy, 3 circuit	45142 3
J7	Connector, wafer assy, 9 circuit	97223 9

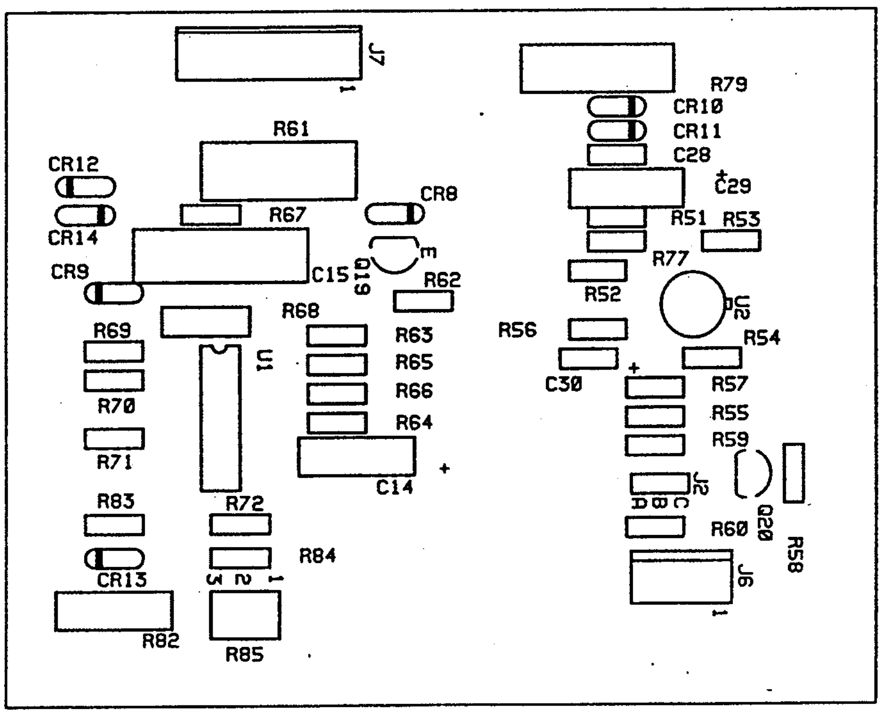
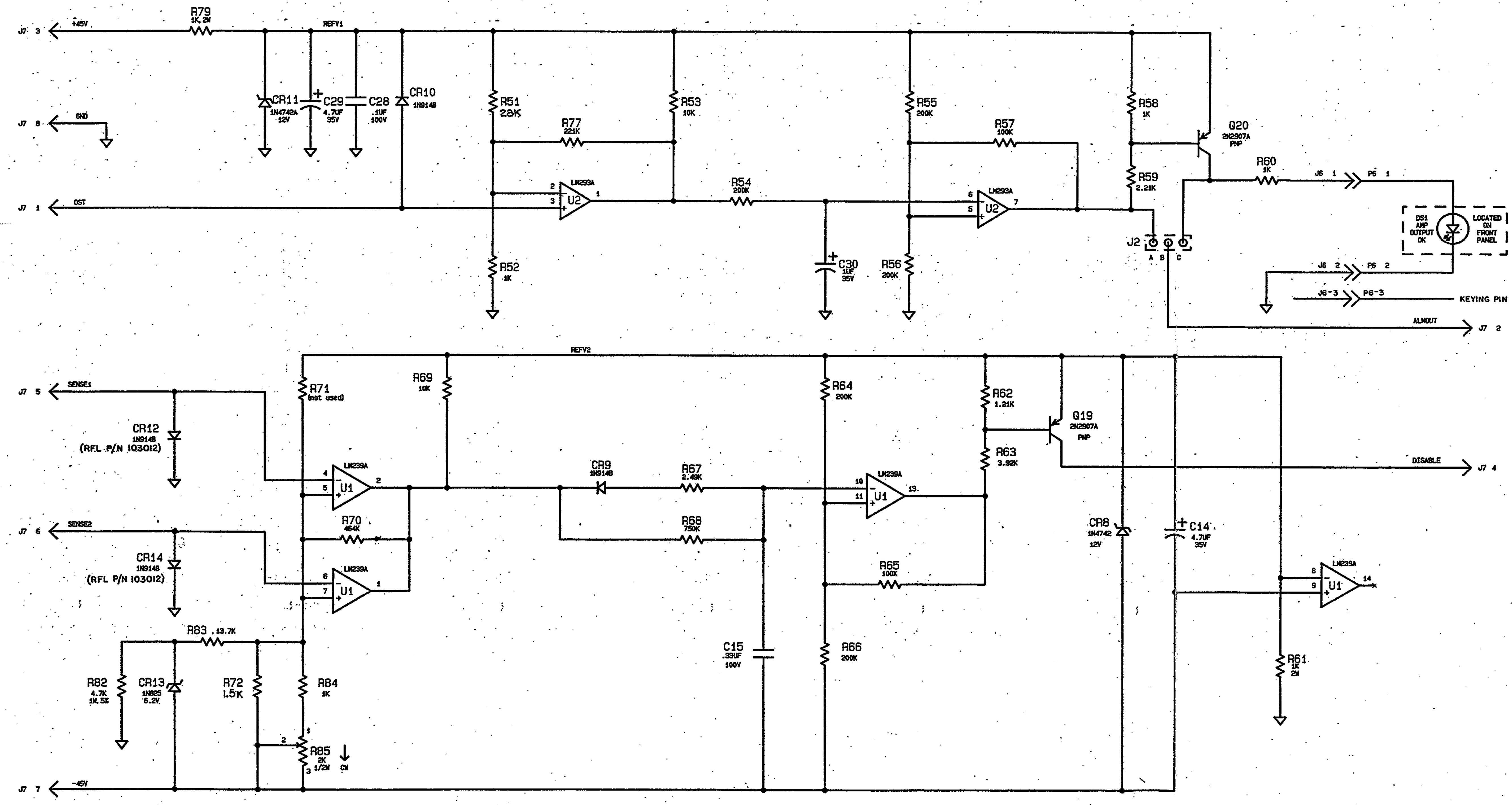


Figure 7-16. Component locator drawing, secondary board for 50-watt power amplifier assemblies (Assembly No. 102775-X; Drawing No. 102763, Rev. C)



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE 1/4W, 1%.

SECONDARY ECB 102763

POWER CONNECTION TABLE					
REF DESIG	DEVICE	GND	REFV1	REFV2	-45V
U1	LM239A			3	12
U2	LM293A	4	8		

Figure 7-17. Schematic, 50-watt power amplifier assemblies for RFL 95 PWR AMP/PS 50-Watt Amplifier/Power Supplies (Assembly No. 102775-X; Schematic No. D-102779-G, Sheet 2 of 2 – Secondary board)

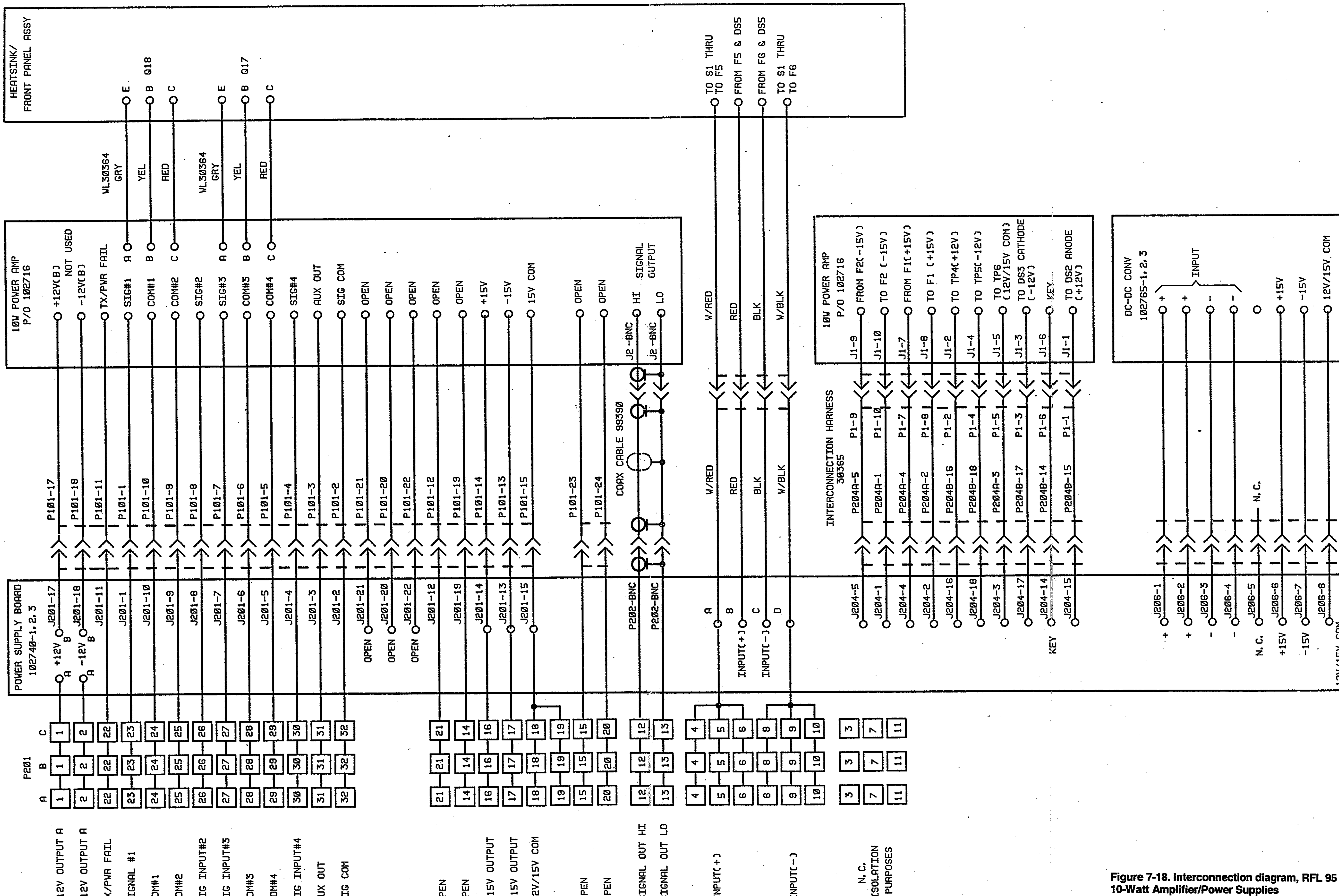


Figure 7-18. Interconnection diagram, RFL 95 AMP/PS 10-Watt Amplifier/Power Supplies (Assembly No. 102735-X; Schematic No. D-102739-A,

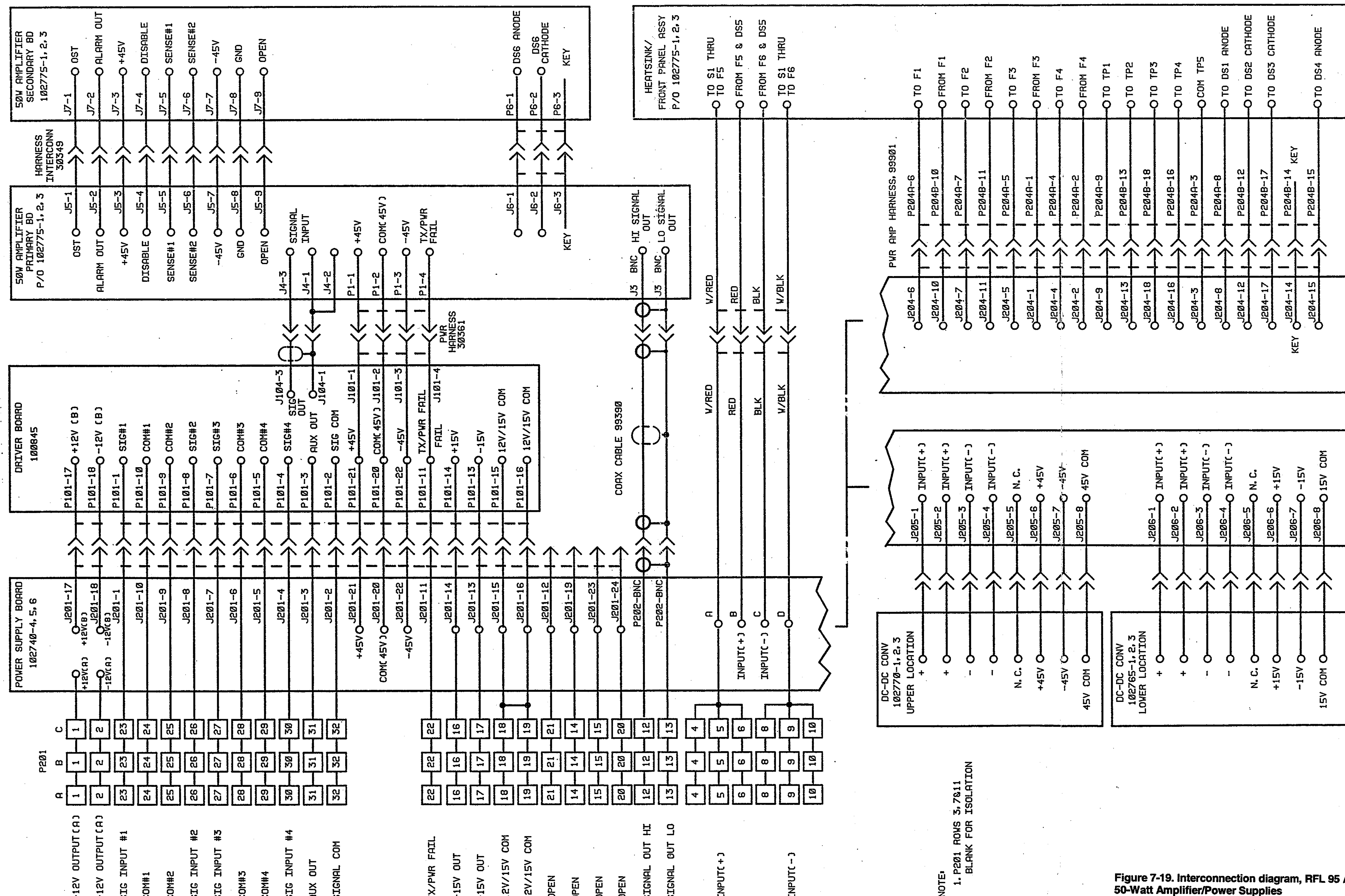


Figure 7-19. Interconnection diagram, RFL 95 AMP/PS 50-Watt Amplifier/Power Supplies (Assembly No. 102745-X; Schematic No. D-102749-A,

Section 8. CHASSIS AND BACKPLANE

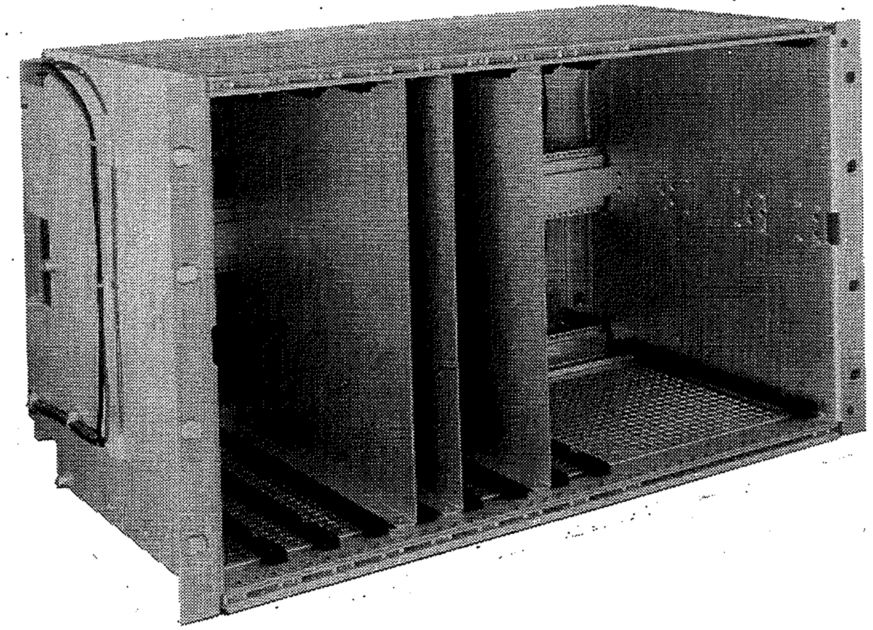


Figure 8-1. Typical RFL 9505 chassis

8.1. DESCRIPTION

RFL 9505 chassis serve as the main housing for the RFL 9505 terminal. All modem modules, audio termination modules, the amplifier/power supply assembly, and the optional synchronizer module are housed in the 95 CHAS chassis. Two interconnection boards provide connections between the modules housed in the chassis, and terminal blocks on the rear panel provide connections to other equipment. Two interface modules are located at the rear of the chassis for added SWC protection and input isolation: the RFL 95 I/O INT I/O Interface Module, and the RFL 95 PWR I/O INT Power Interface Module. A typical RFL 9505 chassis is shown in Figure 8-1.

Jumpers are placed on the interconnect board mating connectors for each modem module to program the module in that position for specific operating conditions. The same method is used to set the optional synchronizer module. Additional information on these jumper settings can be found in Section 3 of this manual.

Two different chassis are available for RFL 9505 equipment: the RFL 95 CHAS-1 for terminals containing one or two modems, and the RFL 95 CHAS-2 for terminals containing three or four modems.

8.2. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to all 9505 chassis, unless otherwise specified. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

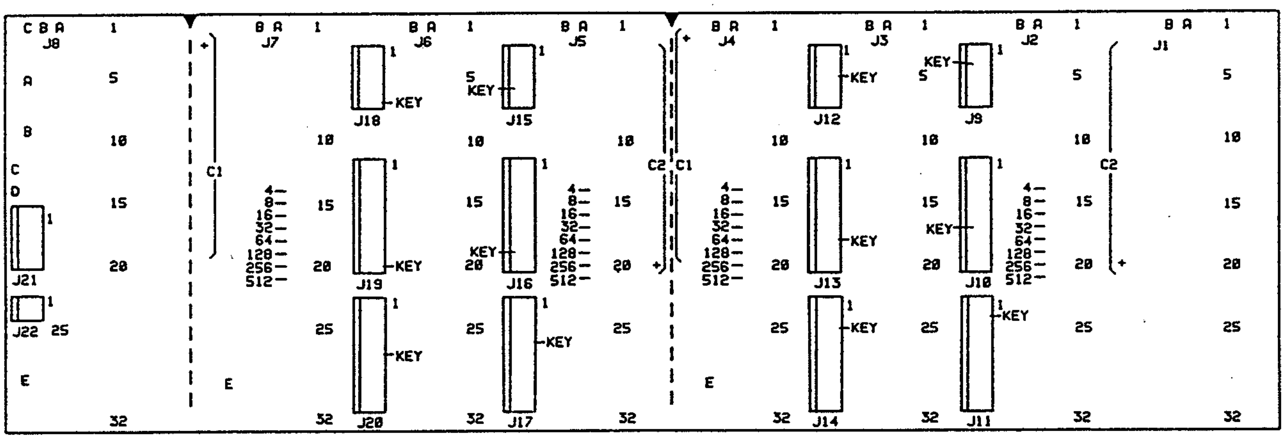
Operating Temperature: -20°C to +55°C (-4°F to +131°F)

Dimensions:
Height: 10.47 inches (26.6 cm)
Width: 19 inches (48.3 cm)
Depth: 11.95 inches (30.4 cm)

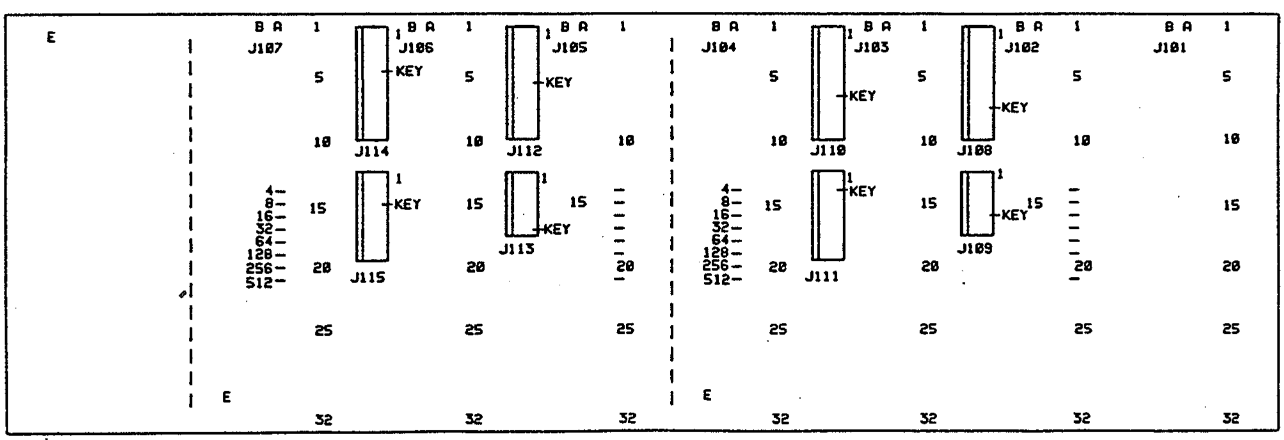
Weight (w/o modules installed) : 9 lbs 15 oz (4.5 kg)

Table 8-1. Replaceable parts, RFL 9505 chassis assemblies
RFL 95 CHAS-1 (For One or Two Modems) - Assembly No. 102780-1
RFL 95 CHAS-2 (For Up to Four Modems) - Assembly No. 102780-2

Circuit Symbol (Figs. 8-2 to 8-4)	Description	Part Number
C1,2	Capacitor, electrolytic, 4700µF, +/-20%, 16V, Stettner-Trush EG4T/16 or equiv.	1007 1762
...	Shorting bar, single, Molex 90059-0009 or equiv.	98306

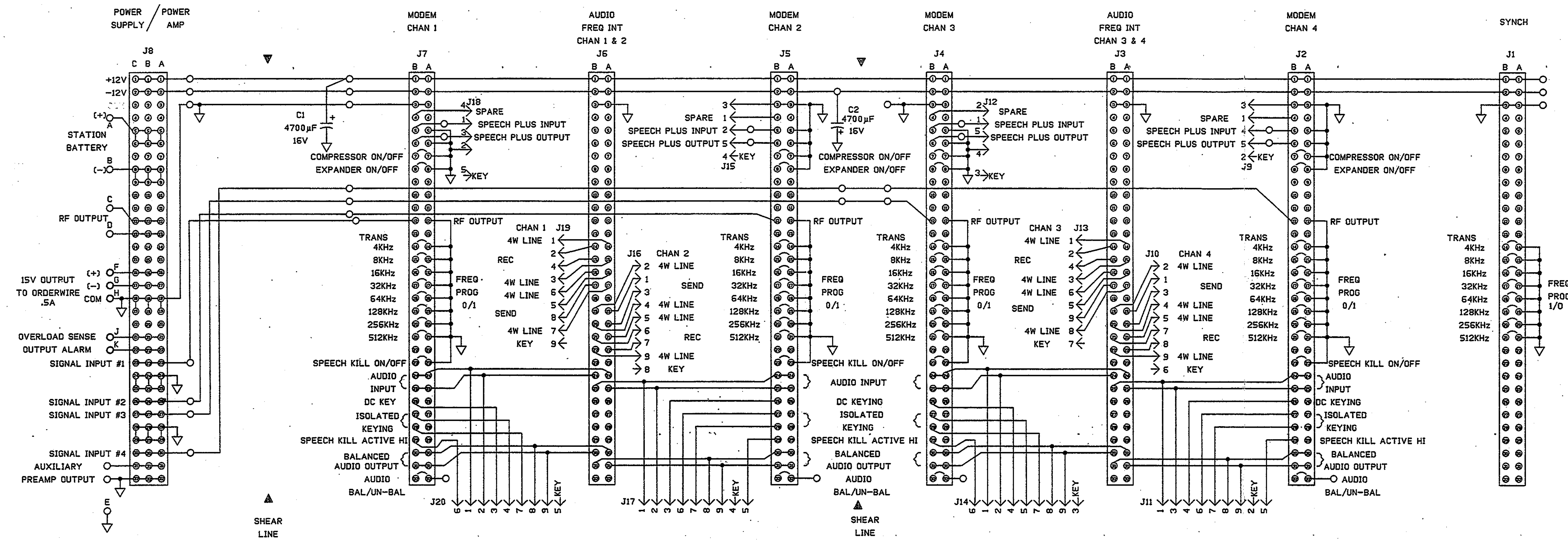


a. Top interconnection board (Drawing No. 100803-1, Rev. E).



b. Bottom interconnection board (Drawing No. 100802, Rev. E).

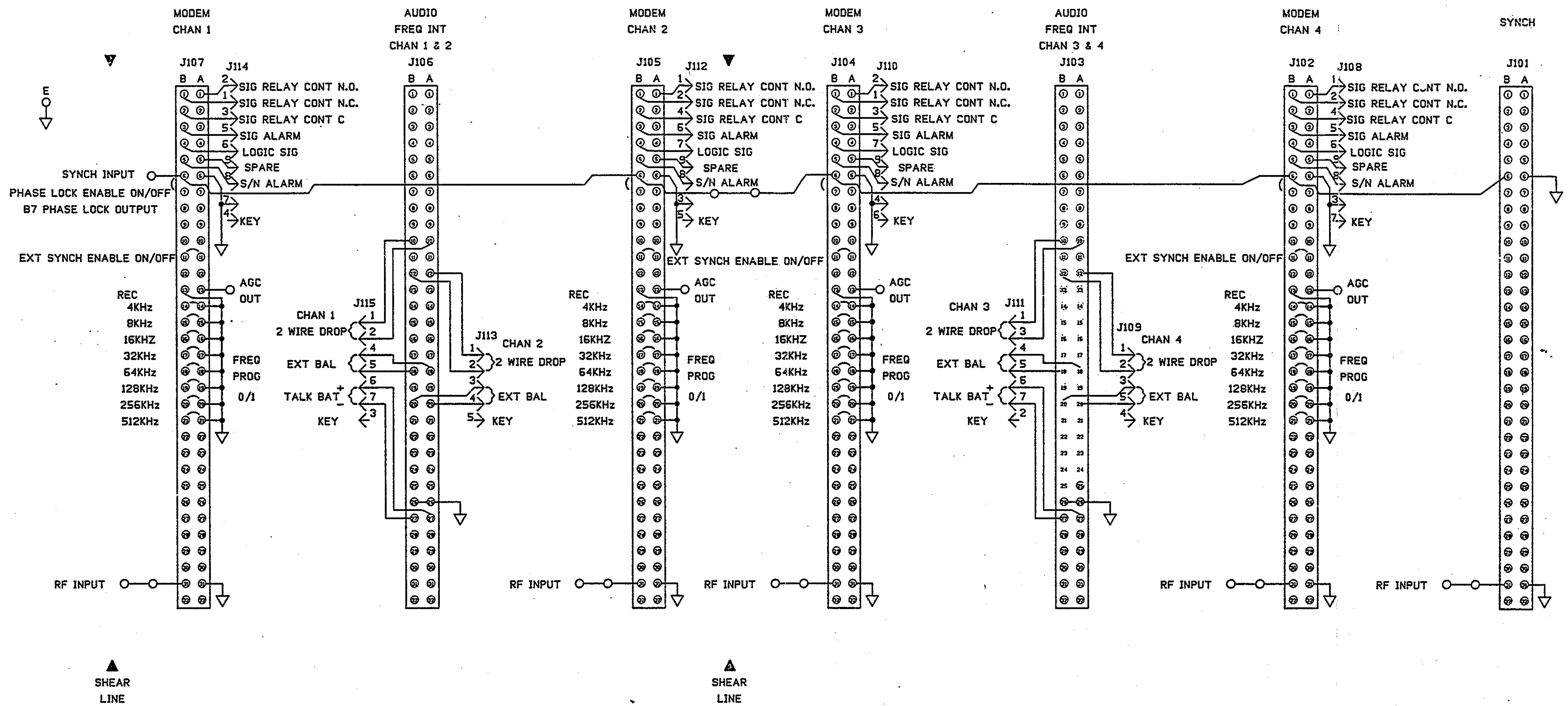
Figure 8-2. Component locator drawings, RFL 95 CHAS interconnection boards



NOTES:

1. JUMPERS POSITIONING IN/OUT . O⁀O.
2. J8 IS DELIBERATELY INSTALLED WITH PINS 32A,B & C AT THE TOP. THEREFORE, THE PIN NUMBERS INDICATED ON THE CONNECTOR DO NOT CORRESPOND TO THOSE SHOWN HERE AND ON ECB 100803.

Figure 8-3. Schematic, top interconnection board for RFL 9505 chassis (Schematic No. D-100882-F)



NOTES:
1. JUMPERS POSTIONING IN/OUT O⌒O .

Figure 8-4. Schematic, bottom interconnection board for RFL 9505 chassis (Schematic No. D-100804-E)

Table 8-2. Replaceable parts, interface modules for RFL 9505 chassis
RFL 95 PWR-I/O INT Power Interface Module - Assembly No. 102750
RFL 95 I/O INT I/O Interface Board - Assembly No. 102755

Circuit Symbol (Figs. 8-5 to 8-8)	Description	Part Number
	CAPACITORS	
C1	Capacitor,tantalum,value dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: 0.33µF,10%,35V,Kemet T322A334K035AS or equiv.	1007 1281
C2	Capacitor,X7R ceramic,value dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: 0.1µF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
	RESISTORS	
R1,2	Resistor,metal film,value dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: Same as R10.	
R3	Resistor,metal film,value dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: Same as R12.	
R4	Resistor,metal film,value dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: Same as R13.	
R5,7,19,21	Resistor,wirewound,22KΩ,5%,6 1/2W, Clarostat VC5E PFD or equiv.	1100 800
R6,8,20,22	Resistor,composition,2.4KΩ,5%,1W, Allen-Bradley GB Series or equiv.	1009 161
R9,23	Resistor,metal film,3.01KΩ,1%,1/4W, Type RN1/4	0410 1334
R10,11,14,15,24,25,28,29	Resistor,metal film,100KΩ,1%,1/4W, Type RN1/4	0410 1480
R12,16,26,30	Resistor,metal film,18.7KΩ,1%,1/4W, Type RN1/4	0410 1410
R13,17,27,31	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R18,32	Resistor,wirewound,12.5KΩ,5%,6 1/2W, Clarostat VC5E PFD or equiv.	1100 731
RZ1	Resistor network,type dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: Four 10KΩ 2% resistors,1.1W total,8-pin SIP, CTS of Berne 750-83-R10K or equiv.	91185
	SEMICONDUCTORS	
CR1	Diode,type dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: Same as CR2.	
CR2,3,8-11,16,17	Diode,silicon,1N914B or 1N4448	26482
CR4-7,12-15	Diode,Zener,5.1V,5%,1W,1N4733A	29759
Q1	Transistor,type dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: Same as Q4.	
Q2,3	Transistor,type dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: Same as Q5.	

Table 8-2. Replaceable parts - continued.

Circuit Symbol (Figs. 8-5 to 8-8)	Description	Part Number
	SEMICONDUCTORS - continued.	
Q4,6,8,10	Transistor,PNP,plastic package,2N2907A	37439
Q5,7,9,11	Transistor,NPN,plastic package,2N2222A	37445
	MISCELLANEOUS COMPONENTS	
K1	Relay,type dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: Same as K2.	
K2-5	Relay,mercury-wetted SPDT,435Ω coil,Midtex 160-351NOO or equiv.	42226
T1-4	Transformer,telephone-coupling,600Ω,Microtran T2104 or equiv.	32510
U1	Linear voltage regulator,type dependent upon model: 95 I/O INT: Not used. 95 PWR-I/O INT: +12-volt,3-terminal TO-220 case, National Semiconductor LM340T-12 or equiv.	 0620 69
U2-5	Optically-isolated coupler,6-pin DIP,Motorola MOC8021 or equiv.	90271

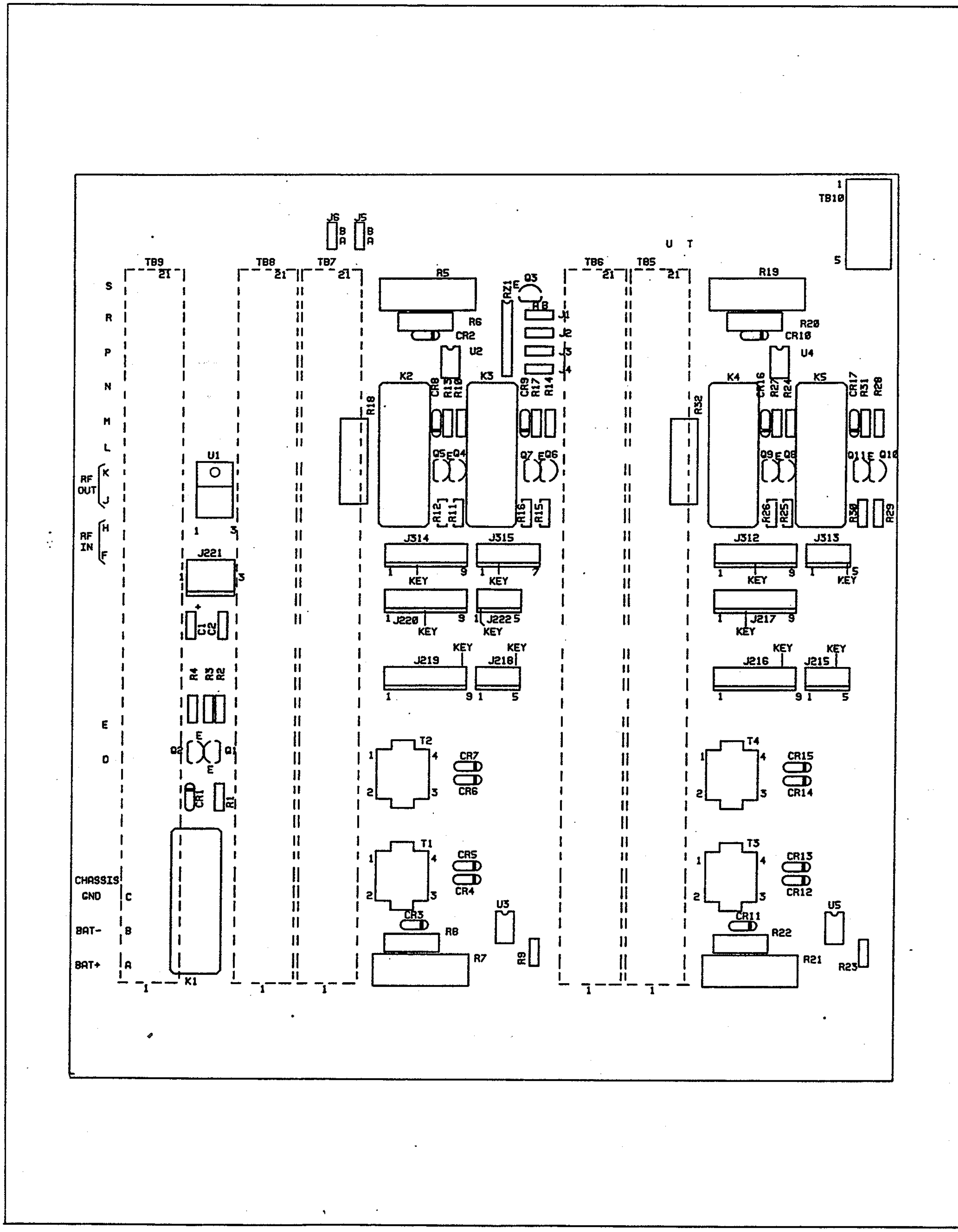


Figure 8-5. Component locator drawing, RFL 95 PWR I/O INT Power Interface Module
(Assembly No. 102750; Drawing No. 102753, Rev. B)

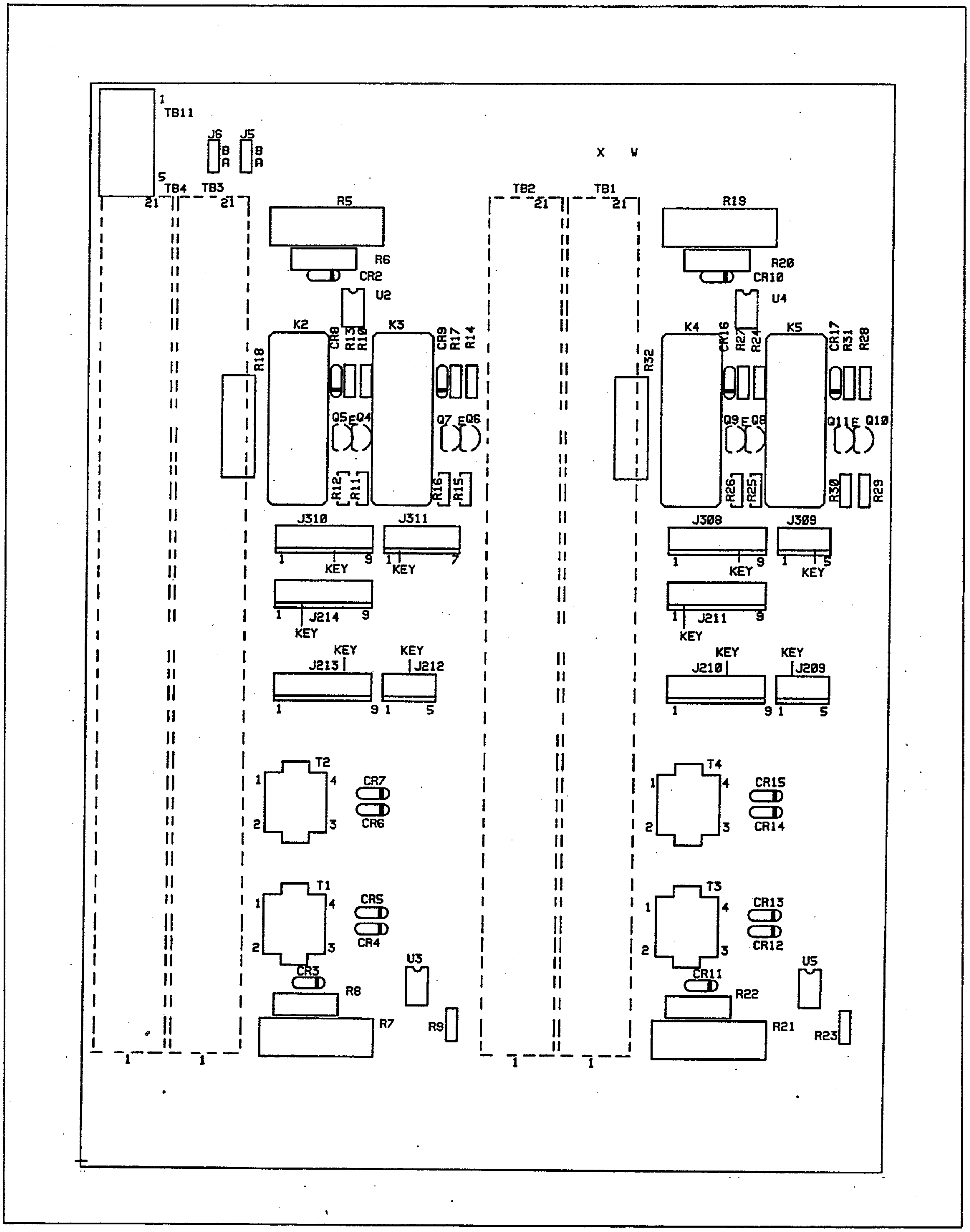
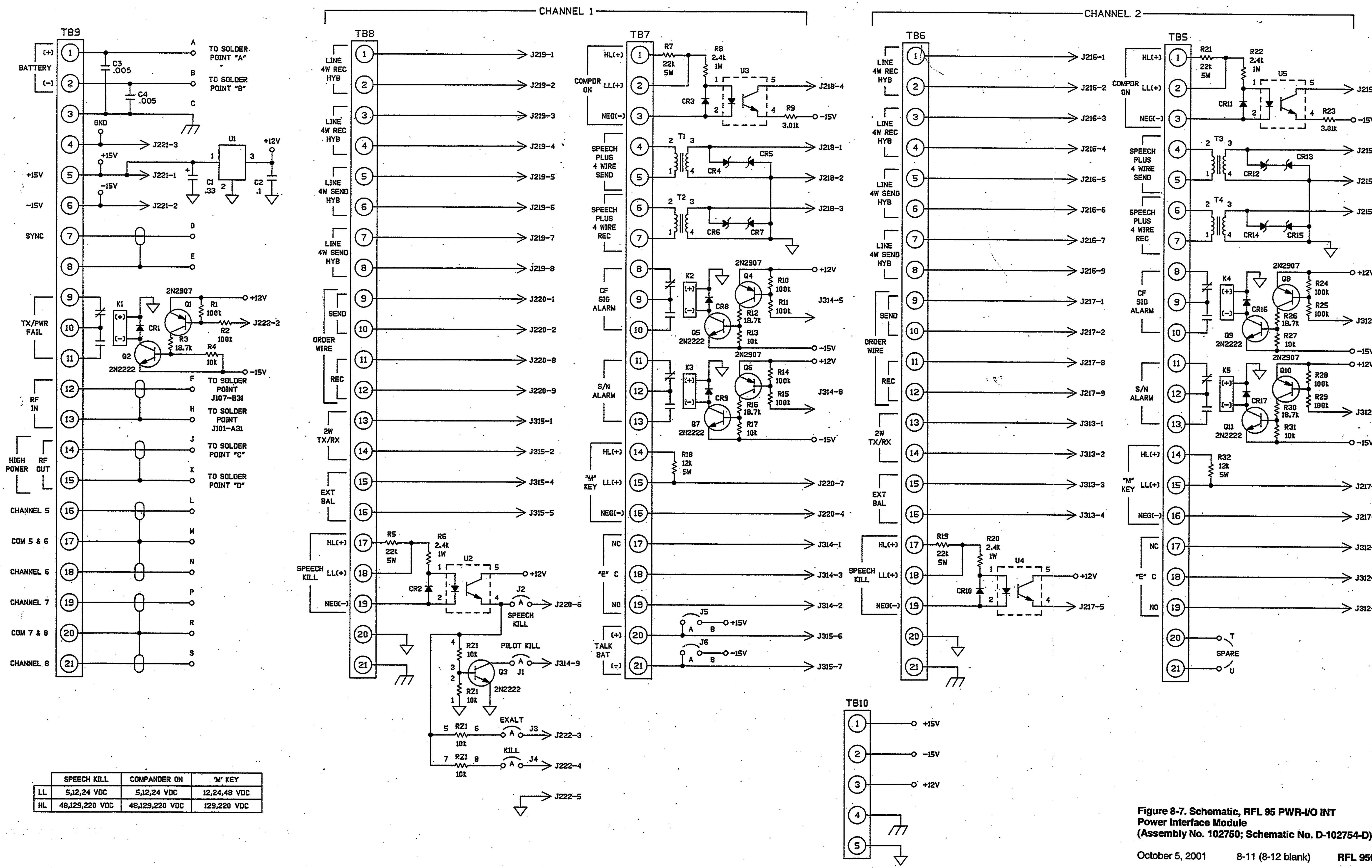
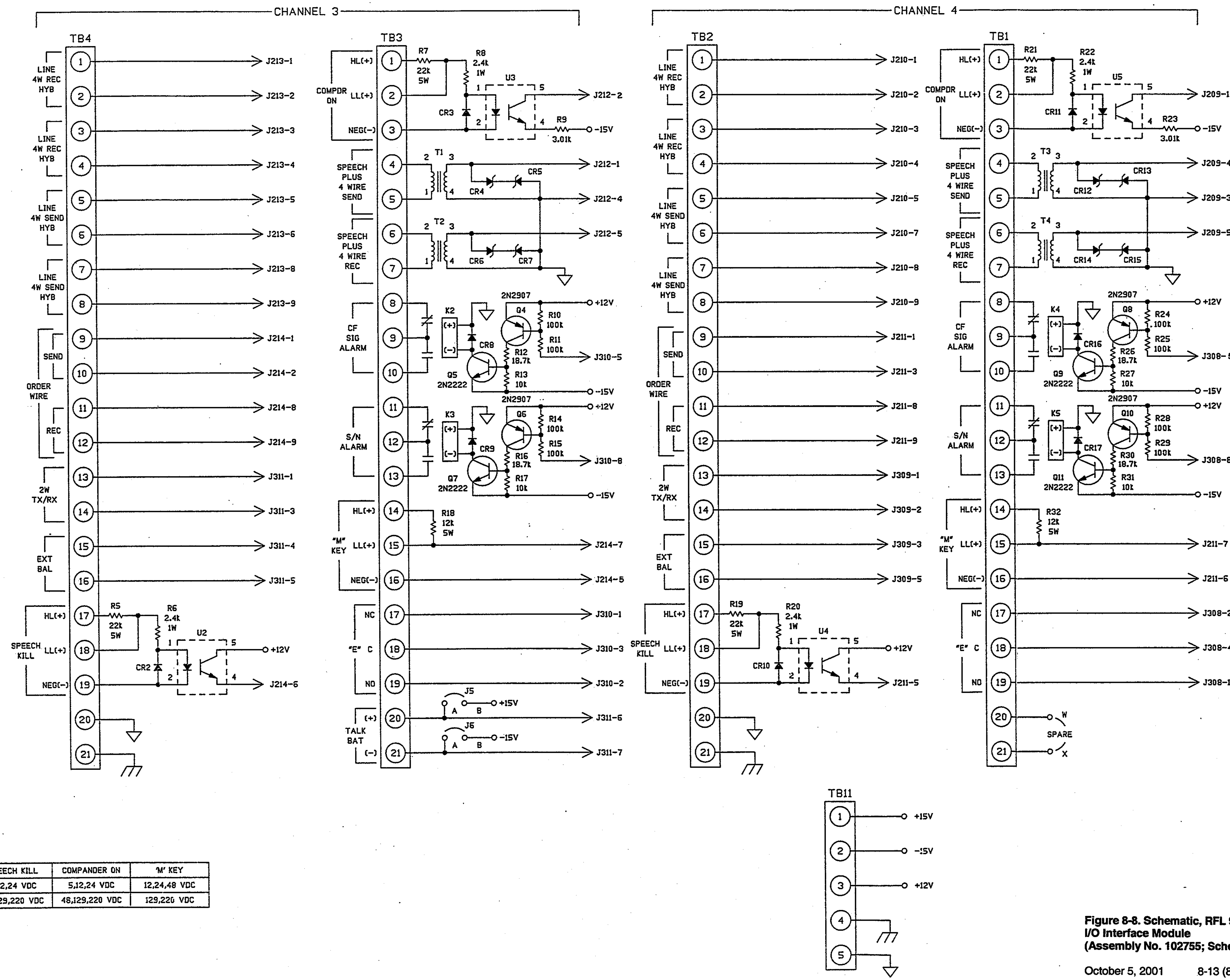


Figure 8-6. Component locator drawing, RFL 95 I/O INT Interface Module
(Assembly No. 102755; Drawing No. 102758, Rev. B)



	SPEECH KILL	COMPANDER ON	'M' KEY
LL	5,12,24 VDC	5,12,24 VDC	12,24,48 VDC
HL	48,129,220 VDC	48,129,220 VDC	129,220 VDC

Figure 8-7. Schematic, RFL 95 PWR-I/O INT Power Interface Module (Assembly No. 102750; Schematic No. D-102754-D)



	SPEECH KILL	COMPANDER ON	'M' KEY
LL	5,12,24 VDC	5,12,24 VDC	12,24,48 VDC
HL	48,129,220 VDC	48,129,220 VDC	129,220 VDC

Figure 8-8. Schematic, RFL 95 I/O INT I/O Interface Module (Assembly No. 102755; Schematic No. D-102759-C)

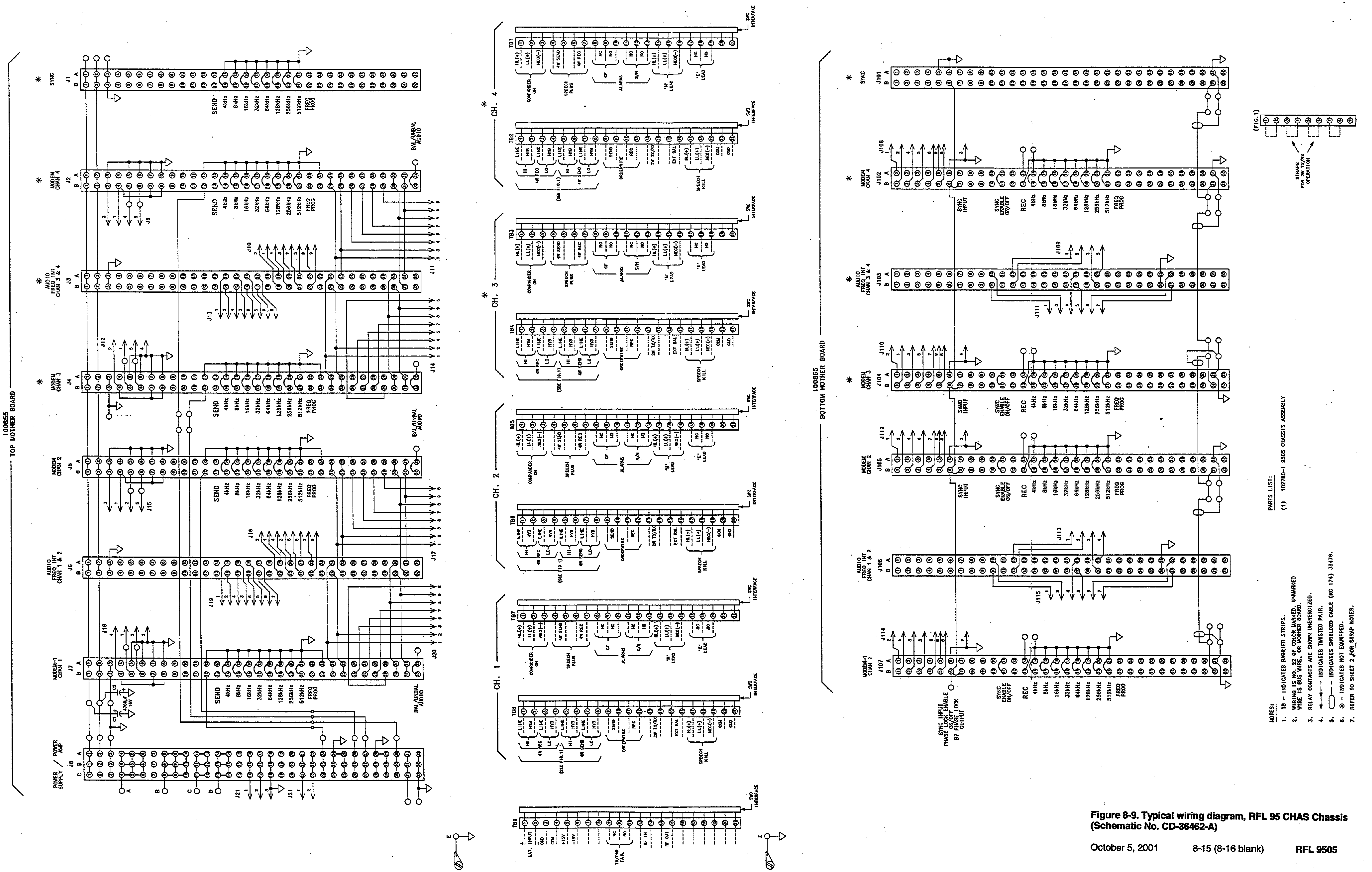


Figure 8-9. Typical wiring diagram, RFL 95 CHAS Chassis (Schematic No. CD-36462-A)

8.3. SWC INTERFACE BOARD

The SWC Interface Board provides additional filtering and protection for several of the RFL 9505's input and output lines. This board is mounted to the rear panel of the RFL 9505 chassis, and has four terminal blocks: TB1 through TB4. Connections to the RFL 9505 are made through TB1 and TB2. Connections to external equipment are made through TB3 and TB4, as shown below:

	Connections To RFL 9505	Connections To External Equipment
CHANNEL 1 SPEECH REC +	TB2-1	TB1-1
CHANNEL 1 SPEECH REC -	TB2-2	TB1-2
CHANNEL 1 SPEECH SEND +	TB2-3	TB1-3
CHANNEL 1 SPEECH SEND -	TB2-4	TB1-4
CHANNEL 2 SPEECH REC +	TB2-6	TB1-6
CHANNEL 2 SPEECH REC -	TB2-7	TB1-7
CHANNEL 2 SPEECH SEND +	TB2-8	TB1-8
CHANNEL 2 SPEECH SEND -	TB2-9	TB1-9
CHANNEL 3 SPEECH REC +	TB2-11	TB1-11
CHANNEL 3 SPEECH REC -	TB2-12	TB1-12
CHANNEL 3 SPEECH SEND +	TB2-13	TB1-13
CHANNEL 3 SPEECH SEND -	TB2-14	TB1-14
CHANNEL 4 SPEECH REC +	TB2-16	TB1-16
CHANNEL 4 SPEECH REC -	TB2-17	TB1-17
CHANNEL 4 SPEECH SEND +	TB2-18	TB1-18
CHANNEL 4 SPEECH SEND -	TB2-19	TB1-19
4W REC HI	TB3-1	TB4-1
4W REC LO	TB3-2	TB4-2
4W SEND HI	TB3-4	TB4-4
4W SEND LO	TB3-5	TB4-5
SPEECH KILL +	TB3-7	TB4-7
SPEECH KILL -	TB3-8	TB4-8
COMPDR SW +	TB3-10	TB4-10
COMPDR SW -	TB3-11	TB4-11
"M" KEY +	TB3-13	TB4-13
"M" KEY -	TB3-14	TB4-14
"E" RELAY N.C.	TB3-16	TB4-16
"E" RELAY COM	TB3-17	TB4-17
"E" RELAY N.O.	TB3-18	TB4-18
SYSTEM COMMON	TB3-20	TB4-20
EARTH GROUND	TB3-21	TB4-21

Table 8-3. Replaceable parts, SWC Interface Board for RFL 9505 Programmable Powerline Carrier System (Assembly No. 103030)

Circuit Symbol (Figs. 8-10 & 8-11)	Description	Part Number
C1-30	Capacitor,ceramic disc,0.005μF,20%,3kV,Centralab DD30-502 or equiv.	1007 1264
CR1-6,10-17	Voltage suppressor,15.2- to 16.8-kV breakdown, General Semiconductor 1.5KE16CA or equiv.	44982
CR7-9	Transient suppressor,237- to 263-volt breakdown, General Semiconductor 1.5KE250A or equiv.	101994
L1-10	Inductor,rf,10μH,5%,J.W. Miller 4622 or equiv.	30285

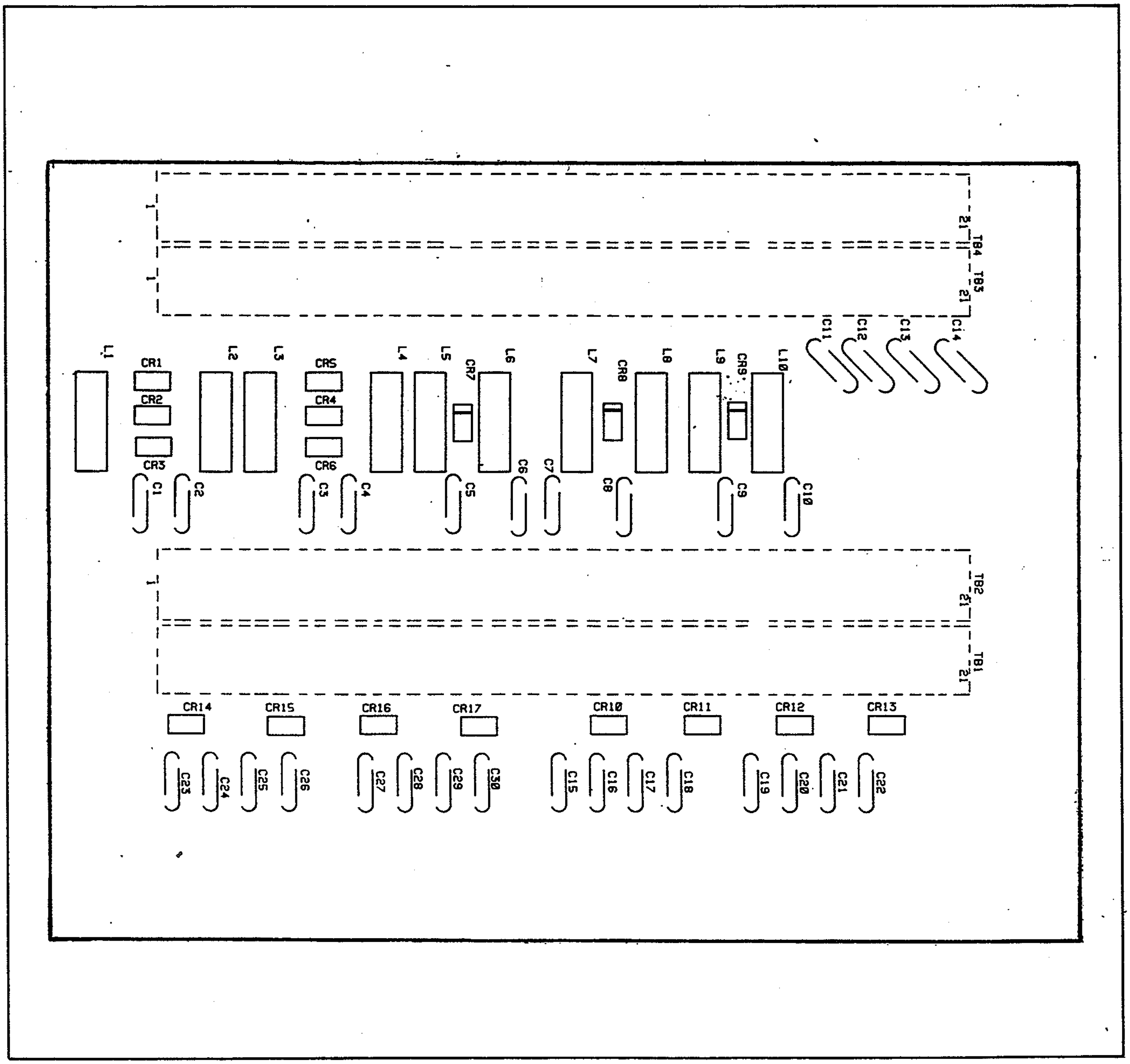
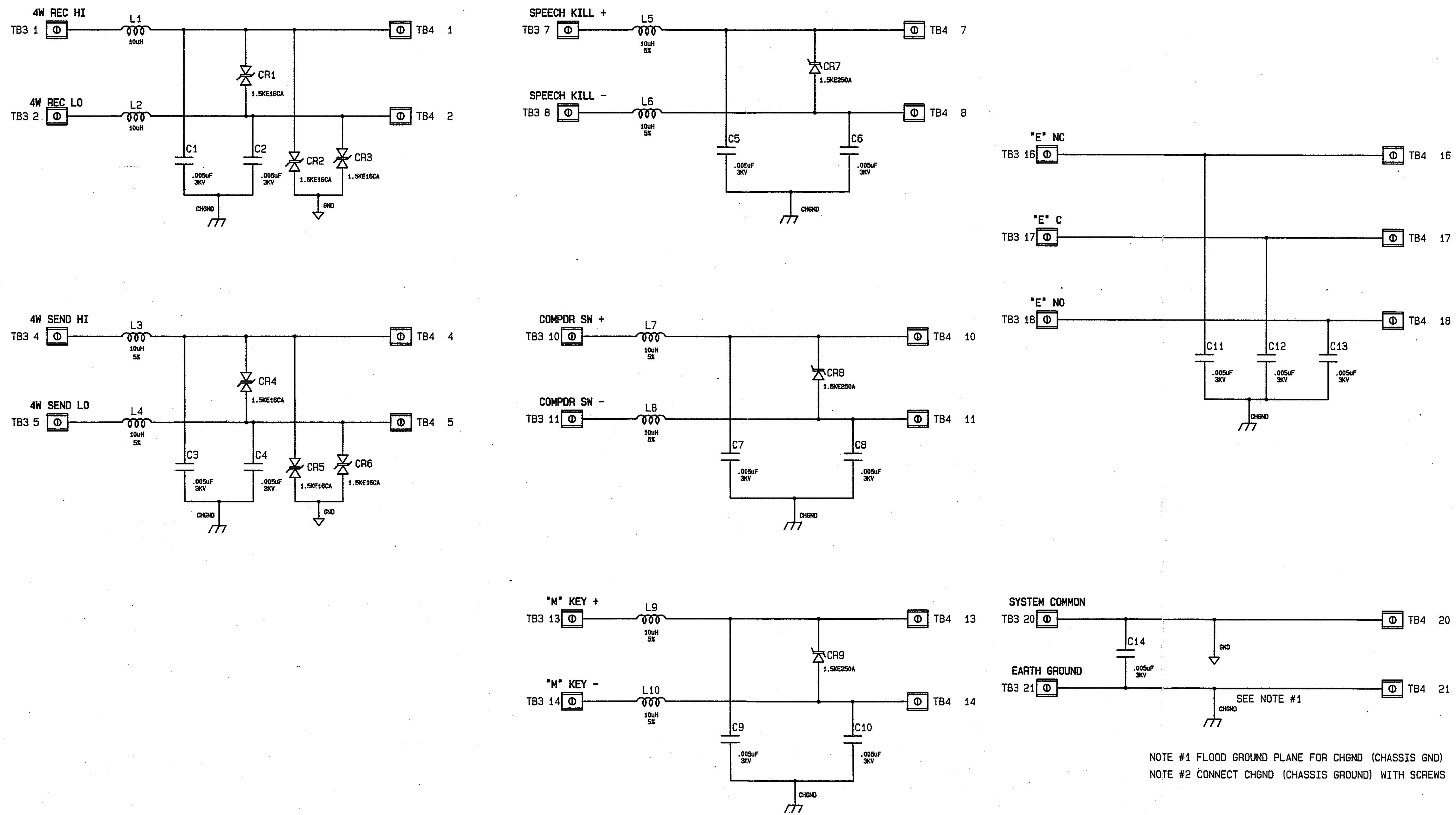


Figure 8-10. Component locator drawing, SWC Interface Board for RFL 9505 Programmable Powerline Carrier System (Assembly No. 103030; Drawing No. D-103033, Rev. A)



NOTE #1 FLOOD GROUND PLANE FOR CHGND (CHASSIS GND)
NOTE #2 CONNECT CHGND (CHASSIS GROUND) WITH SCREWS

Figure 8-11. Schematic, SWC Interface Board for RFL 9505 Programmable Powerline Carrier System (Assembly No. 103030; Schematic No. D-103034-A, Sheet 1 of 2)

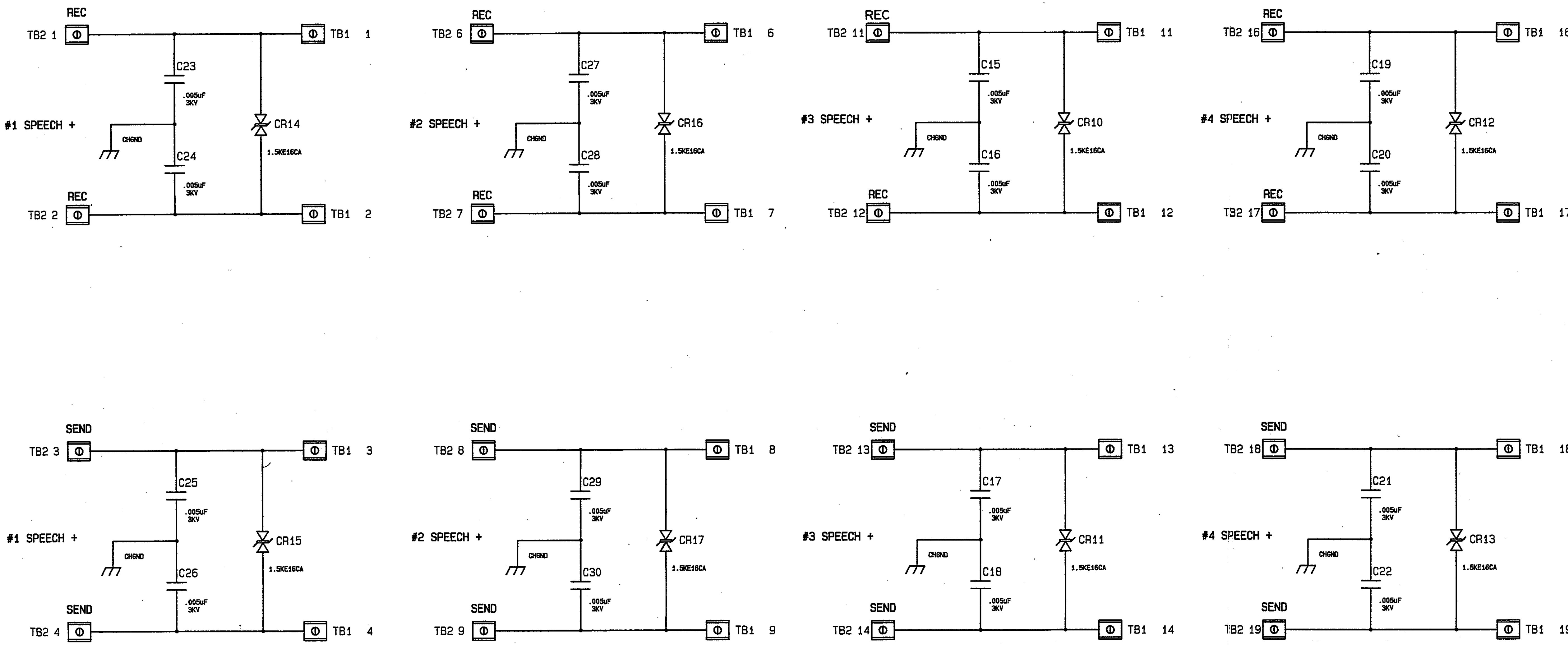


Figure 8-11. Schematic, SWC Interface Board for RFL 9505 Programmable Powerline Carrier System (Assembly No. 103030; Schematic No. D-103034-A, Sheet 2 of 2)

SECTION 9. LINE INTERFACE UNITS

Table 9-1. Characteristics of the various types of Line Interface Units

FEATURES→ / LINE INTERFACE UNITS ↓	SKEWED HYBRID TRANS-FORMER	HIGH POWER BAND-PASS FILTER	RECEIVE ATTEN-UATOR	40 dB DUMMY LOAD	SURGE ARRES-TOR	RECEIVE FILTER	RESISTIVE BALANCE NETWORK	COMPLEX BALANCE NETWORK	IMPED-ANCE MATCH-ING XFMR
95 RF LINE INTERFACE	✓	✓	✓		✓		✓		
95 4-WIRE RF LINE INTERFACE		✓	✓		✓				
95 HIGH POWER COMBINER	✓				✓		✓		
95 INTL LINE INTERFACE	✓	✓	✓		✓			✓	✓
95A INTL LINE INTERFACE	✓		✓	✓	✓			✓	✓
95B INTL LINE INTERFACE			✓	✓	✓	✓			✓

9.1. INTRODUCTION

There are presently six different types of Line Interface Units that can be used with the RFL 9505. The names of these units and the features of each, are shown in Table 9-1.

The check marks in the boxes in Table 9-1 indicate which features are applicable to each of the Line Interface Units. These features are described in more detail later in this section.

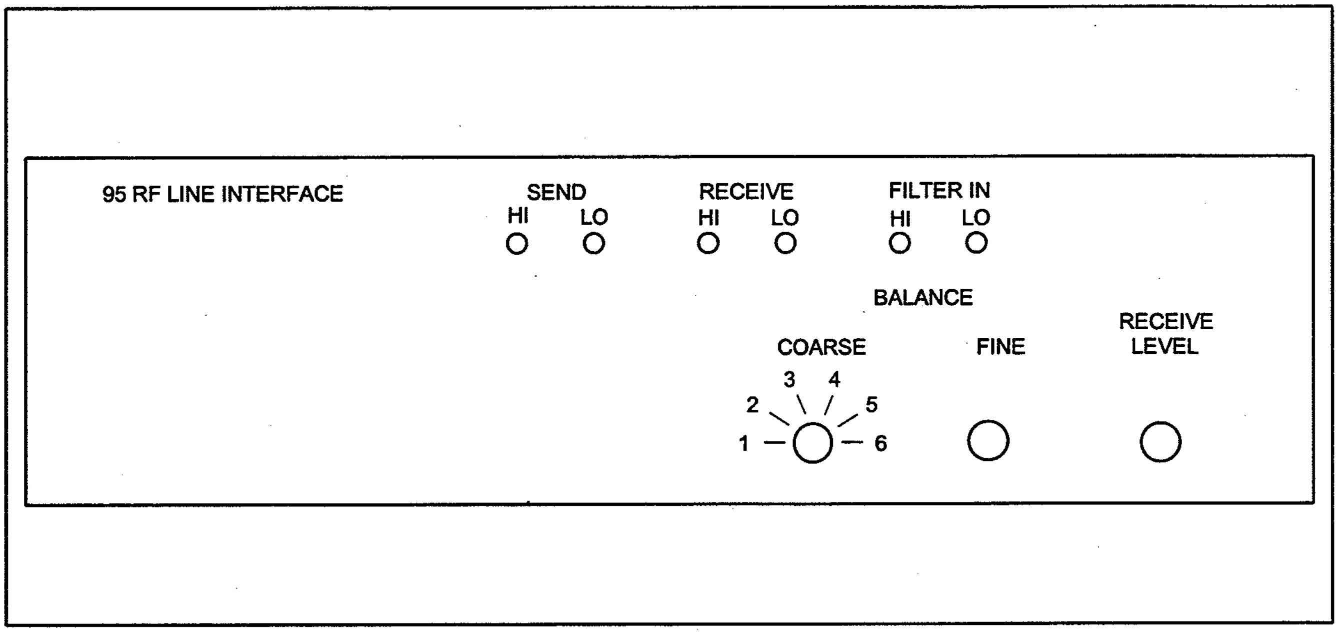


Figure 9-1. RFL 95 RF LINE INTERFACE, Rf Line Interface Assembly

9.2. RFL 95 RF LINE INTERFACE

The RFL 95 RF LINE INTERFACE, Rf Line Interface Assembly (Fig. 9-1) serves as the connection point between the RFL 9505 main chassis and the line coupling equipment.

The 95 RF LINE INTERFACE is housed in its own cabinet, and occupies 3 1/2 inches of vertical space in a standard 19-inch rack or cabinet. Because it contains no active components, the 95 RF LINE INTERFACE does not require any dc input voltage.

9.2.1. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the RFL 95 RF LINE INTERFACE. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Power Capability: 100 watts maximum.

Input Impedance (Filter In):
Transmit : 50 ohms (single input units)
25 ohms (dual input units)

Output Impedance (Receive):
75 ohms

Line Impedance(Send):
50 ohms standard.
75 ohms optional.
Other impedances available on special order.

Insertion Loss:
Transmitting: 1.5 dB typical.
2.0 dB maximum.
Receiving: 14 dB typical.

Passband Ripple: ±0.1 dB maximum.

Second Harmonic Rejection: -80 dB.

Third Order Intermodulation: -60 dB.

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

Operating Temperature: -20°C to +55°C (-4°F to +131°F).

Dimensions:
Width: 19 inches (48.3 cm)
Height: 3 1/2 inches (8.9 cm)
Depth: 5 1/2 inches (14.0 cm), from back of front panel to connectors on rear panel.

Weight: 4 lbs 7.7 oz (2.03 kg).

9.2.2. THEORY OF OPERATION

The 95 RF LINE INTERFACE connects the RFL 9505 main chassis to the powerline coupling equipment. It contains a high-power transmit bandpass filter, two hybrid transformers, a receive attenuator, a surge arrestor, and a resistive balance network.

A block diagram of the 95 RF LINE INTERFACE appears in Figure 9-2, a component locator drawing appears in Figure 9-3, and a schematic diagram appears in Figure 9-4.

9.2.2.1. High-Power Bandpass Filter

The high-power bandpass fiter reduces harmonic frequencies that may be present in the output of the power amplifier.

The high-power bandpass filter is a dual-section filter that is not field-repairable. When jumper J3 is placed in the IN position, both sections are placed in series with the transmit input signal. When J3 is in the OUT position, both sections of the bandpass filter are bypassed, and the transmit input signal is not filtered by the 95 RF LINE INTERFACE Unit.

9.2.2.2. Hybrid Transformers

The hybrid transformers are arranged to form a skewed hybrid for the purpose of isolating the 95 modem receive circuit from the output of the 95 power amplifier.

The 95 RF LINE INTERFACE contains two hybrid transformers, T2 and T3. The primary winding of T2 accepts the transmit output signal, and the primary winding of T3 develops the receive input signal that is passed on to the modems.

Both hybrid transformers have two secondary windings, and are interconnected so that one secondary of T2 is in series with a secondary of T3. One set of secondaries is connected across the balance network . The other set is connected to the line coupling equipment through connector J7 at the rear of the cabinet. Fuse F1 provides current protection, and surge arrestor E1 protects the equipment against an overvoltage condition due to lightning strikes. The signal going to or coming from the line coupling equipment can be monitored at the SEND test points on the front panel.

9.2.2.3. Receive Attenuator

The receive attenuator is used to reduce the input rf signal level to the 95 modem test tone operating level of -20dBm. Resistor R7 and RECEIVER LEVEL potentiometer R10 are connected across the primary of T3 to form an attenuator. The amount of signal sent on to the modems is controlled by the setting of R10. Zener diodes CR1 and CR2 clamp the signal to a safe level. The signal being sent to the modems can be monitored at the RECEIVE test points on the front panel.

9.2.2.4. Resistive Balance Network

When in use, the resistive balance network is adjusted to achieve maximum transhybrid loss. For very long transmission lines, the resistive balance network may not provide sufficient transhybrid loss. In this instance, an external reactive hybrid balance network may be applied across the rear panel terminals provided for this purpose.

Resistors R1 through R6, R11, and R12 form the internal balance network, which is connected across one set of secondaries in the hybrid transformers. COARSE BALANCE control S1 provides coarse adjustment of the resistance across these secondaries, by determining how many resistors are connected in series. FINE BALANCE potentiometer R6 provides a fine adjustment, which allows the balance to be precisely set. Jumper J5 is used to enable or disable the internal balance network. When J5 is in the OUT position, the internal network is disabled and an external network can be used for hybrid balancing.

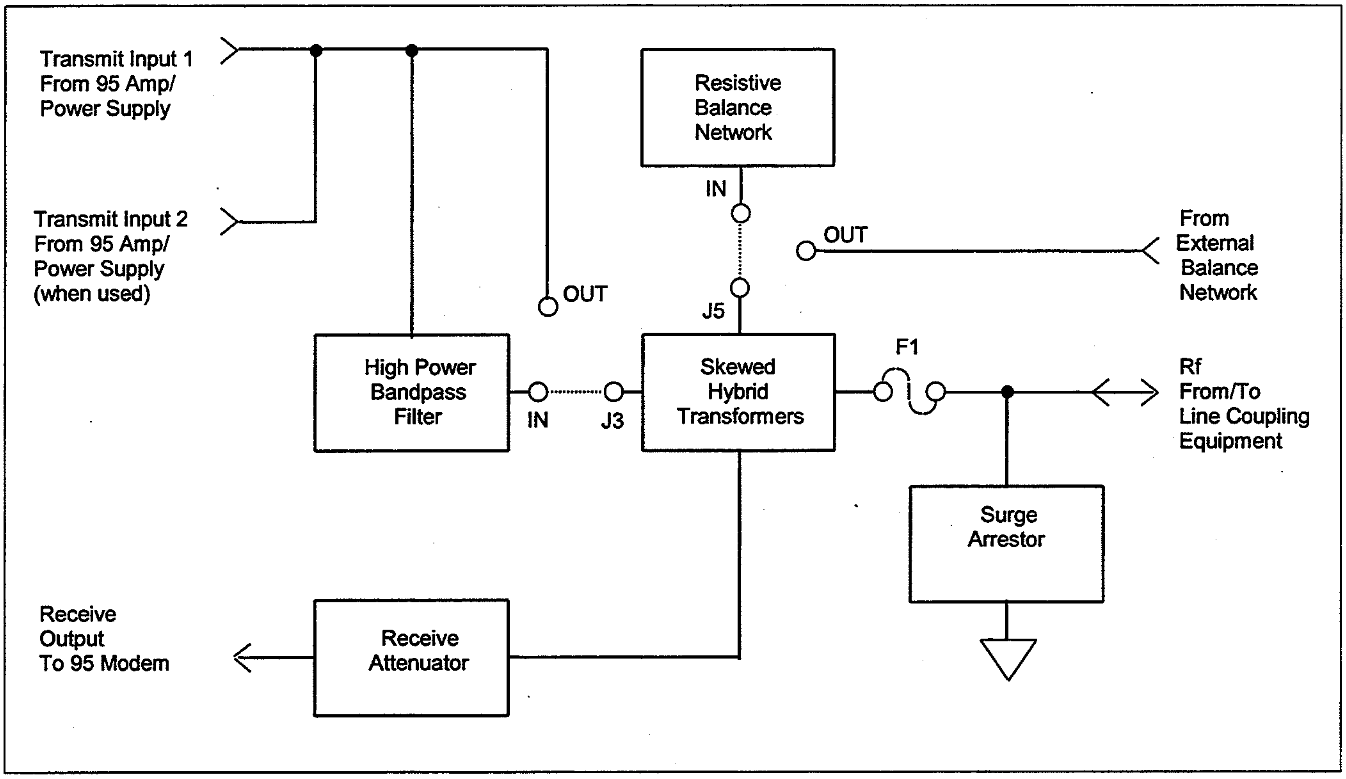


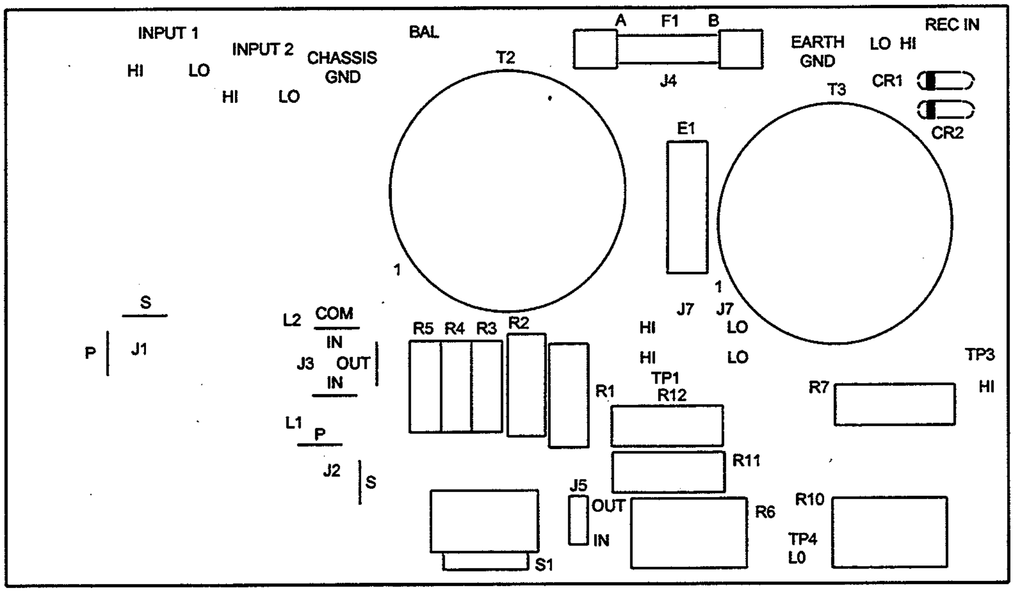
Figure 9-2. Block diagram, RFL 95 RF LINE INTERFACE, Rf Line Interface Assembly

Table 9-2. Replaceable parts, RFL 95 RF LINE INTERFACE, Rf Line Interface Assembly
Assembly No. 100870 - X

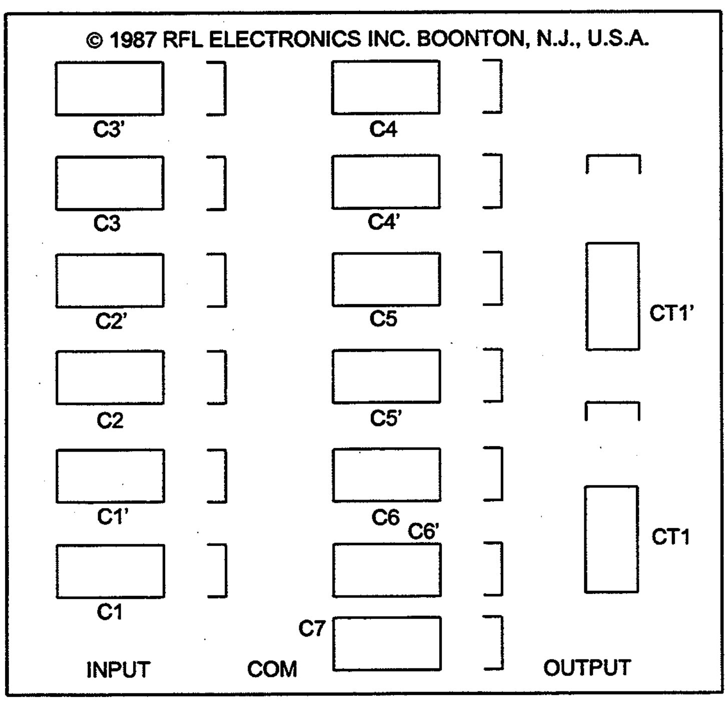
Circuit Symbol (Figure 9-4)	Description	Part Number
CR1,2	Diode,Zener,5.1V,5%,1W,1N4733A	29759
E1	Surge arrestor,gas-tube,150-300 Vdc,TII Industries TII-12A or equiv.	92627
F1	Fuse,3AG slow-blow,10A,32V,Littelfuse 313 010 or equiv.	10758
J7	SO-239A female coax connector, Amphenol 83-798	43819
R1,2	Resistor,non-inductive wirewound,12Ω,5%,2.5W,C.T.Gamble Type CGN-6 or equiv.	1100 745
R3-5	Resistor,metal film,12.1Ω,1%,1/2W,Type RN65D	1510 2109
R6,10	Resistor,variable,single-turn cermet,100Ω,10%,2W,screwdriver adjust, CTS Series X550LT or equiv.	44356
R7	Resistor,composition,5.1Ω,5%,1W, Allen-Bradley GB Series or equiv.	1009 925
R8, 9	Not used.	
R11	Resistor,non-inductive wirewound,50Ω,5%,2.5W,C.T.Gamble Type CGN-4 or equiv.	1100 747
R12	Resistor,non-inductive wirewound,50Ω,5%,5W,C.T.Gamble Type CGN-8 or equiv.	1100 748
S1	Switch,rotary,single-deck,6-position	44357
T1,4	Not used.	
T2,3	Transformer,rf hybrid	79835-X
—	Shorting bar,single,Molex 90059-0009 or equiv.	98306

NOTE

The components on the capacitor board (Assembly No. 79830-X) form the two-stage high-power bandpass filter, shown within the dashed lines on the schematic in Figure 9-4. All components on this board are factory-selected for the desired operating frequency. Repair of this board should not be attempted in the field; if a component is defective, replace the entire board. Contact the factory for filter replacement information.

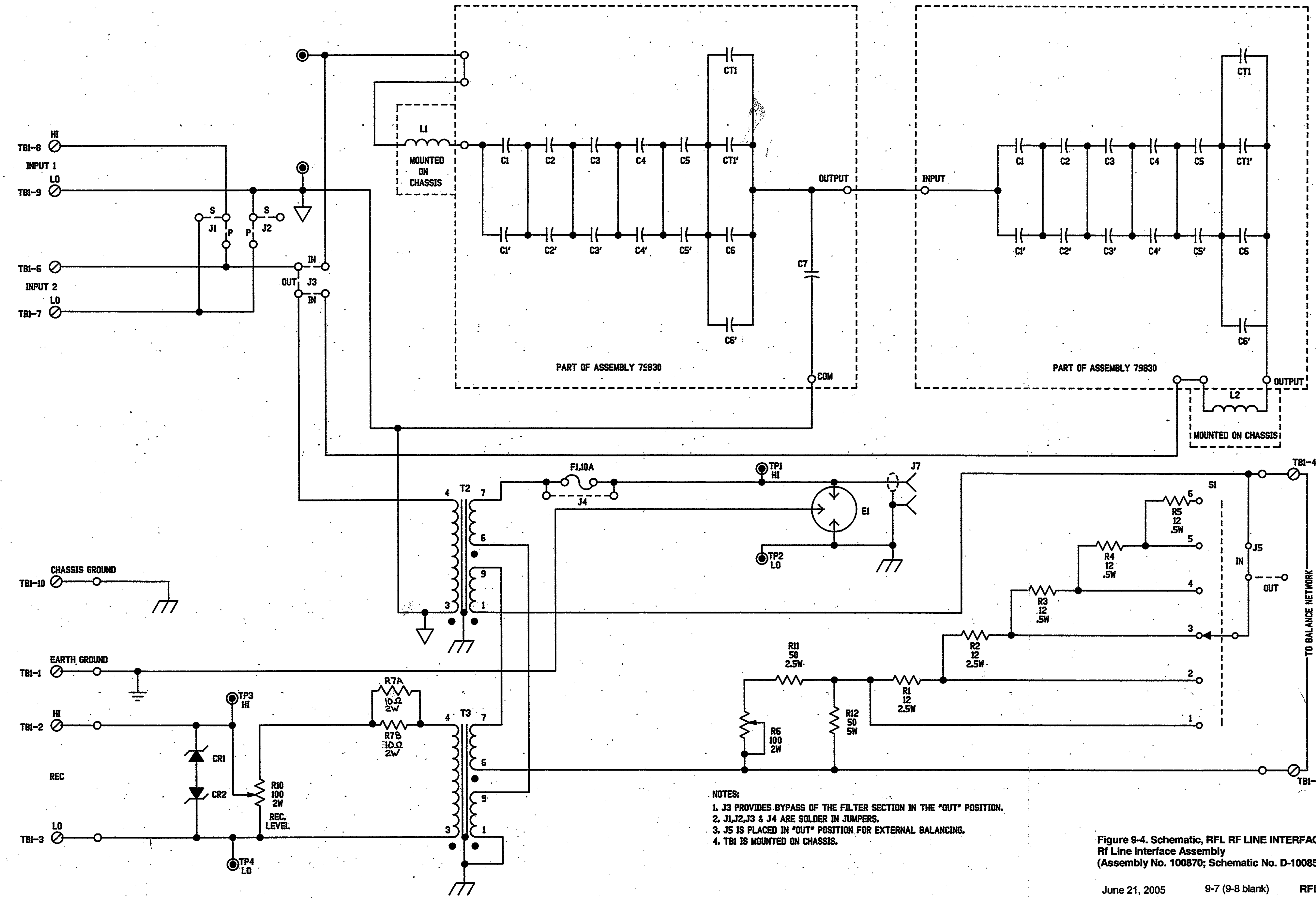


Main board (Drawing No. C-100853, Rev. J).



Capacitor board (Assembly No. 79830, 2 boards per assembly; Drawing No. C-100868, Rev. D).

Figure 9-3. Component locator drawings, RFL 95 RF LINE INTERFACE, Rf Line Interface Assembly



NOTES:

1. J3 PROVIDES BYPASS OF THE FILTER SECTION IN THE "OUT" POSITION.
2. J1,J2,J3 & J4 ARE SOLDER IN JUMPERS.
3. J5 IS PLACED IN "OUT" POSITION FOR EXTERNAL BALANCING.
4. TB1 IS MOUNTED ON CHASSIS.

Figure 9-4. Schematic, RFL RF LINE INTERFACE
Rf Line Interface Assembly
(Assembly No. 100870; Schematic No. D-100854-G)

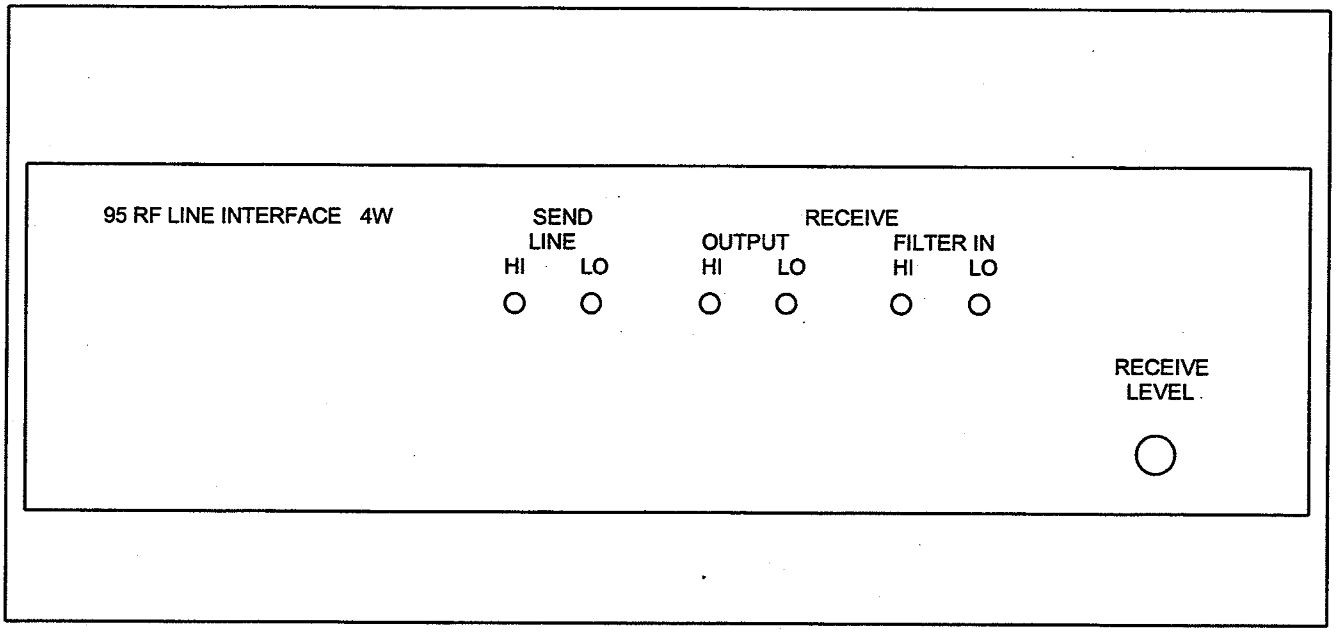


Figure 9-5. RFL 95 4-WIRE RF LINE INTERFACE, Rf Line Interface Assembly

9.3. RFL 95 4-WIRE RF LINE INTERFACE

The RFL 95 4-WIRE RF LINE INTERFACE Assembly (Fig. 9-5) serves as the connection point between the RFL 9505 main chassis and the 95 High Power Combiner Hybrid.

The 95 4-WIRE RF LINE INTERFACE is housed in its own cabinet, and occupies 3 1/2 inches of vertical space in a standard 19-inch rack or cabinet. Because it contains no active components, the 4-WIRE RF LINE INTERFACE does not require any dc input voltage.

9.3.1. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the 95 4-WIRE RF LINE INTERFACE. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Power Capability: 100 watts maximum.

Input Impedance (Filter In):
Transmit: 50 ohms (Single input unit)
25 ohms (Dual input unit)

Output Impedance (Send Line):
Same as input impedance

Input Impedance (Receive Line):
50 ohms standard
75 ohms optional
other impedances available on special order

Output Impedance (Receive Output):
Same as input impedance

Insertion Loss:
Transmit Input: 1.5 dB maximum.

Passband Ripple: ±0.1 dB maximum

Second Harmonic Rejection: -80 dB

Third Order Intermodulation: -60 dB

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

Operating Temperature: -20°C to +55°C (-4°F to +131°F).

Dimensions:
Width: 19 inches (48.3 cm)
Height: 3 1/2 inches (8.9 cm)
Depth: 5 1/2 inches (14.0 cm), from back of front panel to connectors on rear panel.

Weight: 4 lbs 7.7 oz (2.03 kg).

9.3.2. THEORY OF OPERATION

The 4-WIRE LINE INTERFACE connects the RFL 9505 main chassis to the 95 High Power Combiner Hybrid. It contains a high-power bandpass filter, a receive attenuator, and two surge arrestors.

A block diagram of the 4-WIRE LINE INTERFACE appears in Figure 9-6, a component locator drawing appears in Figure 9-7, and a schematic diagram appears in Figure 9-8.

9.3.2.1. High-Power Bandpass Filter

The high-power bandpass filter is a dual-section filter that is not field-repairable. Both sections are connected in series with the send input signals, which are then routed to the send line. Surge arrestor E1 protects the send input signals against an overvoltage condition. The signal going to the High Power Combiner Hybrid can be monitored at the SEND LINE test points on the front panel.

9.3.2.2. Receive Attenuator

Resistor R7 and RECEIVE LEVEL potentiometer R10 are connected across the REC LINE to form an attenuator. The level of signal passed on to the RECEIVE OUTPUT is controlled by the setting of R10. Surge arrestor E2 protects the REC LINE against an overvoltage condition and Zener diodes CR1 and CR2 clamp the output signal to a safe level. The RECEIVE OUTPUT signal can be monitored at the RECEIVE OUTPUT test points on the front panel.

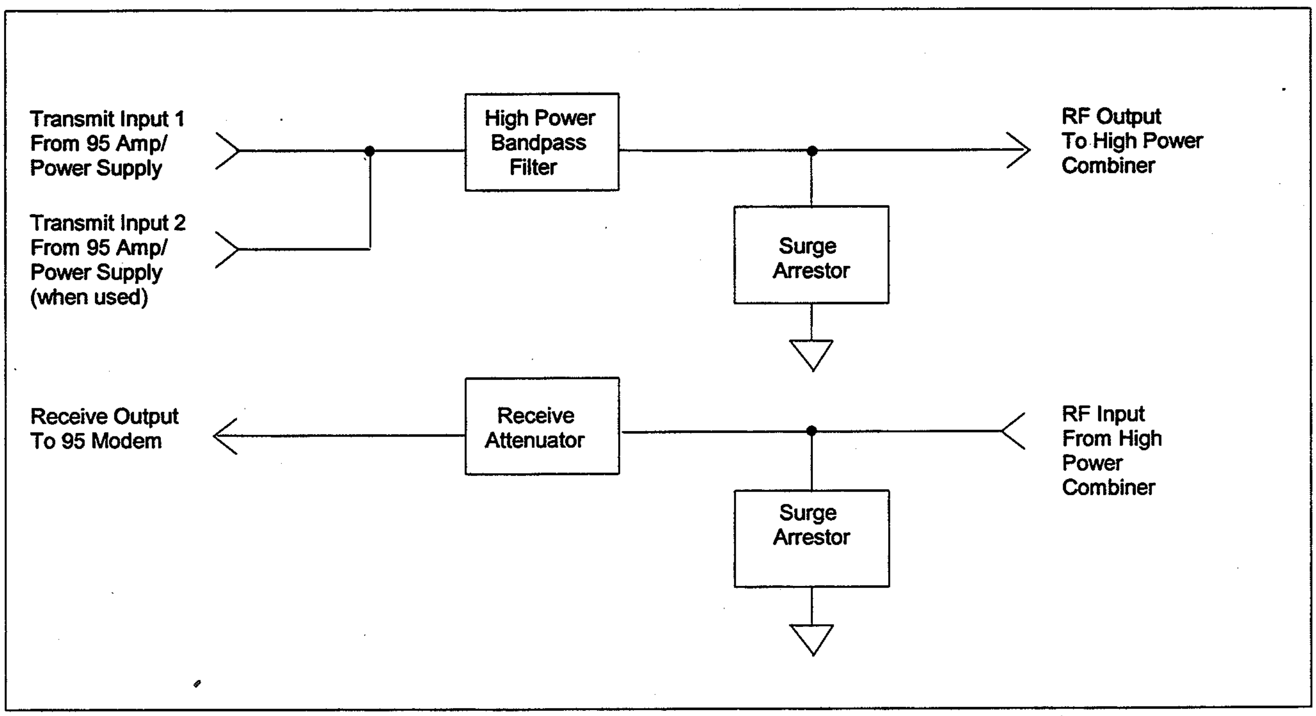


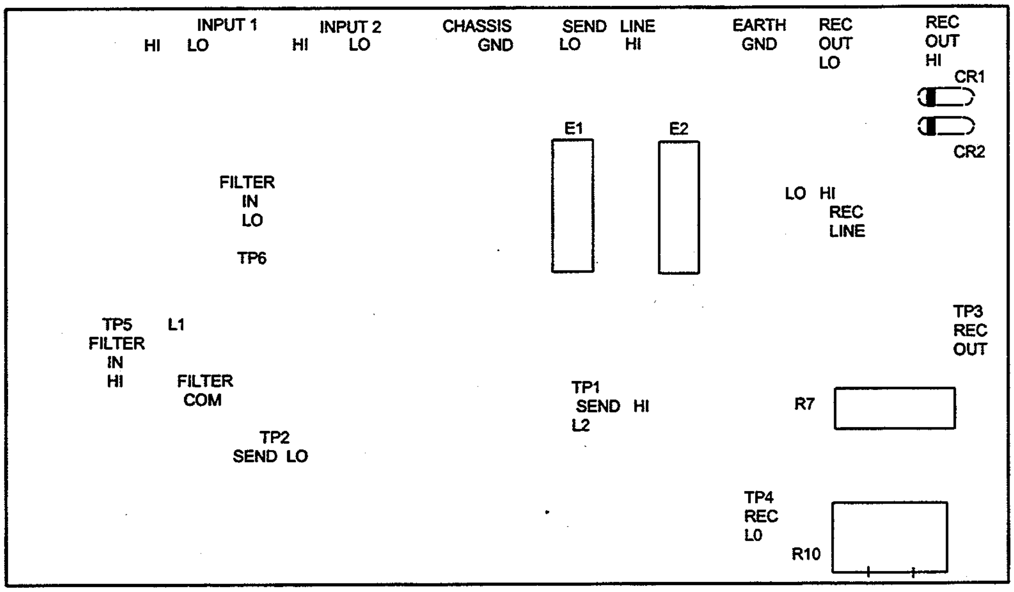
Figure 9-6. Block diagram, RFL 95 4-WIRE RF LINE INTERFACE, Rf Line Interface Assembly

Table 9-3. Replaceable parts, RFL 4-WIRE RF LINE INTERFACE, Rf Line Interface Assembly
Assembly No. 102710

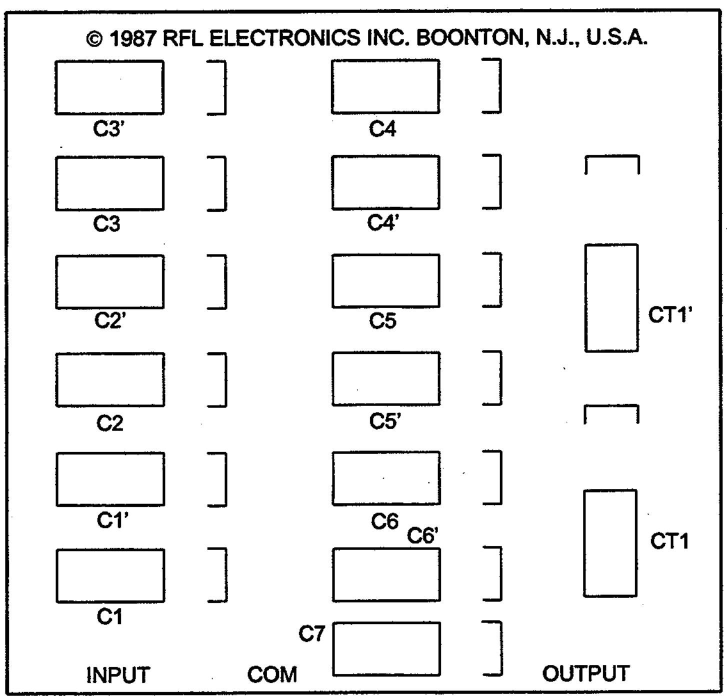
Circuit Symbol (Figure 9-8)	Description	Part Number
CR1, 2	Diode, Zener, 5.1V, 5%, 1W, 1N4733A	29759
E1, 2	Arrestor, 3-electrode, gas tube	92627
J1,2	Connector, jack, coax, female, Type UHF, Amphenol 83-1R	3731
R7	Resistor, fixed composition, 5.1Ω, 5%, 1W	1009 925
R10	Resistor, variable, metal film, 100Ω, 10%, 2W	44356

NOTE

The components on the capacitor board (Assembly No. 79830-X) form the two-stage high-power bandpass filter, shown within the dashed lines on the schematic in Figure 9-8. All components on this board are factory-selected for the desired operating frequency. Repair of this board should not be attempted in the field; if a component is defective, replace the entire board. Contact the factory for filter replacement information.

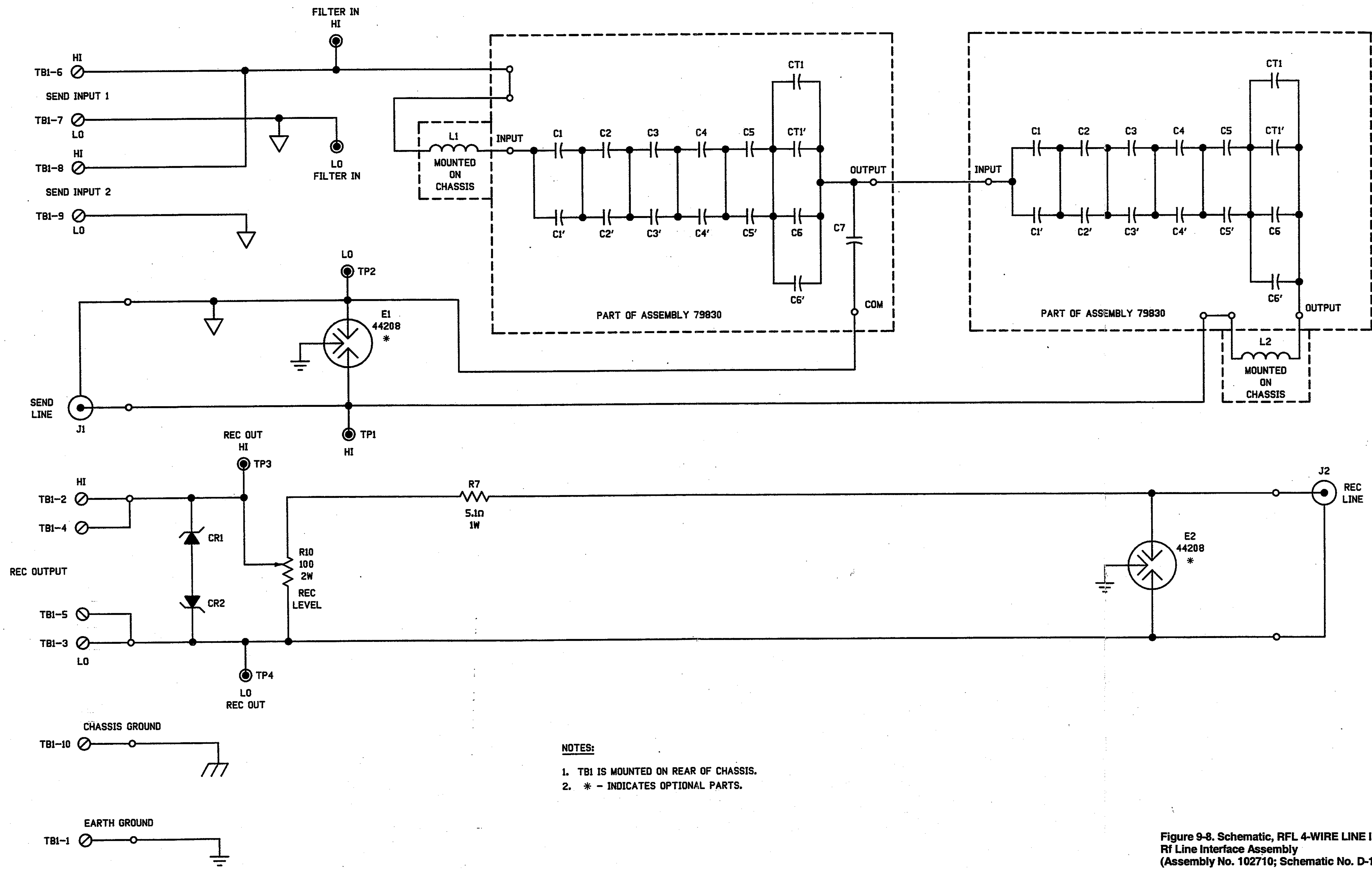


Main board (Drawing No. C-102713, Rev. C).



Capacitor board (Assembly No. 79830, 2 boards per assembly; Drawing No. C-100868, Rev. D).

Figure 9-7. Component locator drawings, RFL 4-WIRE RF LINE INTERFACE, Rf Line Interface Assembly



NOTES:

1. TB1 IS MOUNTED ON REAR OF CHASSIS.
2. * - INDICATES OPTIONAL PARTS.

Figure 9-8. Schematic, RFL 4-WIRE LINE INTERFACE Rf Line Interface Assembly (Assembly No. 102710; Schematic No. D-102714-C)

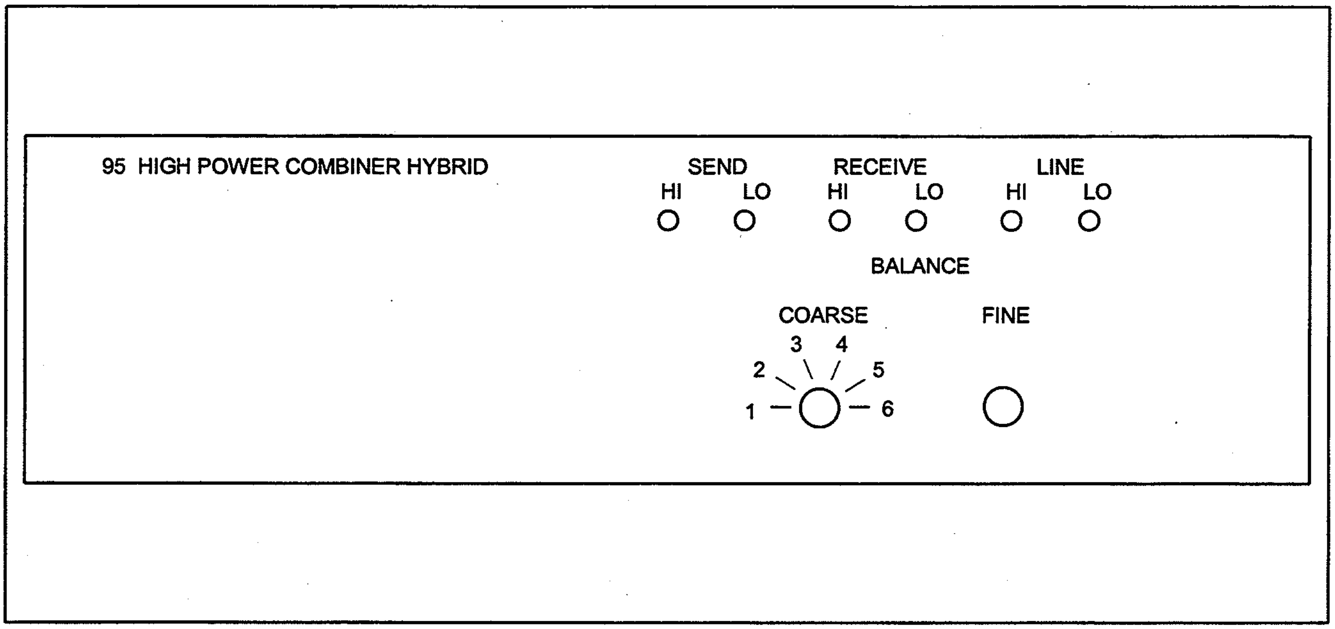


Figure 9-9. RFL 95 HIGH POWER COMBINER HYBRID Assembly

9.4. RFL 95 HIGH POWER COMBINER HYBRID

The 95 HIGH POWER COMBINER (Figure 9-9) is generally used in conjunction with one or more 95 4-WIRE RF LINE INTERFACE UNITS to connect multiple (up to 4) 9505 terminals to a common set of line coupling equipment. It can also be used for applications requiring a single high power output. It contains two hybrid transformers, one to connect the output of the 95 4-WIRE RF LINE INTERFACES to the line coupling equipment, and the other to connect incoming signals to the modem inputs via the 95 4-WIRE RF LINE INTERFACE units.

The 95 HIGH POWER COMBINER is housed in its own cabinet, and occupies 3 1/2 inches of vertical space in a standard 19-inch rack or cabinet. Because it contains no active components, the 95 HIGH POWER COMBINER does not require any dc input voltage.

9.4.1. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the 95 HIGH POWER COMBINER. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Power Capability: 200 watts maximum.

Input Impedance(Send):
Transmit: 50, 25, or 12.5 ohms.

Output Impedance(Receive):
75 ohms

Line Impedance (Line):
50 ohms standard
75 ohms optional
other impedances available on special order

Insertion Loss:
Transmit Input: 0.5 dB maximum.
Receive Input: 14 dB typical.

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

Operating Temperature: -20°C to +55°C (-4°F to +131°F).

Dimensions:
Width: 19 inches (48.3 cm)
Height: 3 1/2 inches (8.9 cm)
Depth: 5 1/2 inches (14.0 cm), from back of front panel to connectors on rear panel.

Weight: 4 lbs 7.7 oz (2.03 kg).

9.4.2. THEORY OF OPERATION

The 95 HIGH POWER COMBINER connects multiple RFL 9505 terminals to the power line coupling equipment. It contains two hybrid transformers, a resistive balance network, and a surge arrestor.

A block diagram of the 95 HIGH POWER COMBINER appears in Figure 9-10, a component locator drawing appears in Figure 9-11, and a schematic diagram appears in Figure 9-12.

9.4.2.1. Hybrid Transformers

The HIGH POWER COMBINER contains two hybrid transformers, T2 and T3. The primary winding of T2 accepts the transmit output signal, and the primary winding of T3 develops the receive input signal that is passed on to the modems via the 95 4-WIRE RF LINE INTERFACE units.

Both hybrid transformers have two secondary windings, and are interconnected so that one secondary of T2 is in series with a secondary of T3. One set of secondaries is connected across the balance network. The other set is connected to the line coupling equipment through connector J1 on the rear of the cabinet. Fuse F1 provides current protection, and surge arrestor E1 protects the equipment against an overvoltage condition. The signal going to or coming from the line coupling equipment can be monitored at the LINE test points on the front panel.

9.4.2.2. Resistive Balance Network

Resistors R1 through R6, R11, and R12 form the internal balance network, which is connected across one set of secondaries of the hybrid transformers. COARSE BALANCE control S1 provides coarse adjustment of the resistance across these secondaries, by determining how many resistors are connected in series. FINE BALANCE potentiometer R6 provides a fine adjustment, which allows the balance to be precisely set. Jumper J10 is used to enable or disable the internal balance network. When J10 is in position B, the internal network is disabled and an external network can be used for hybrid balancing.

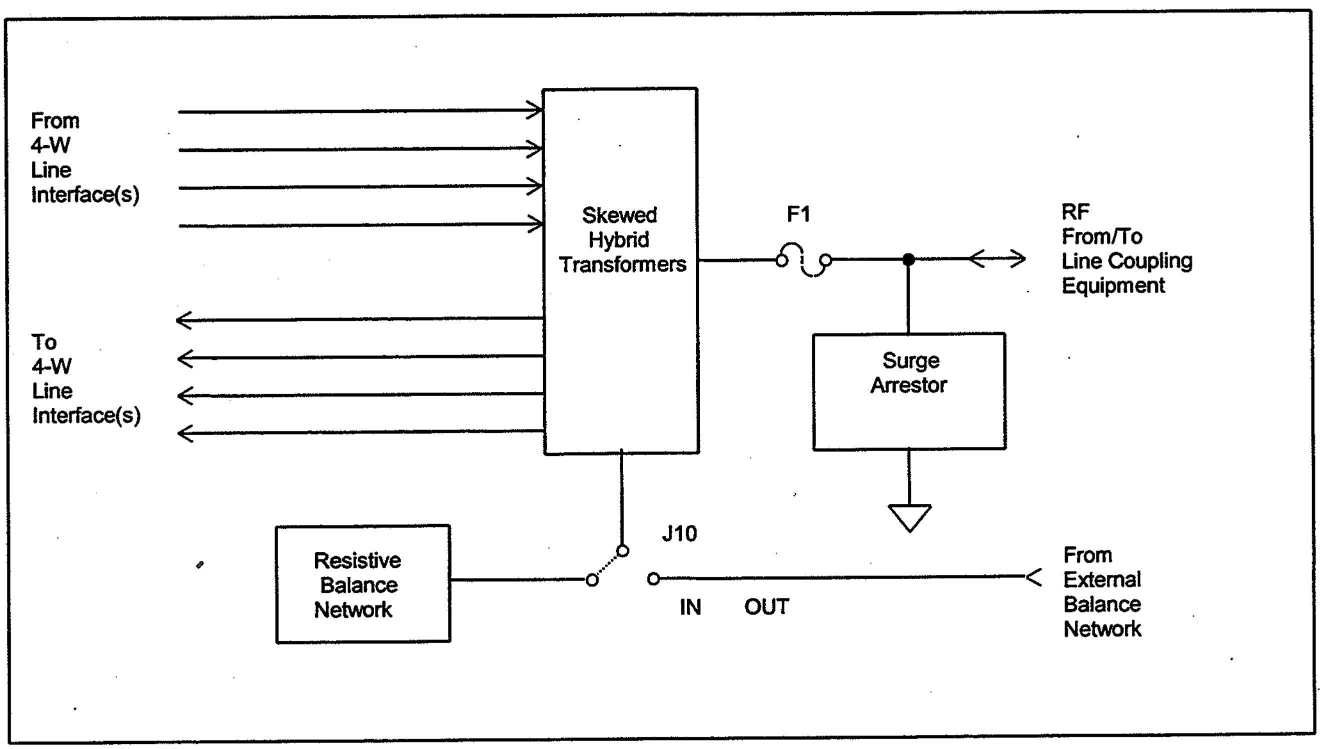
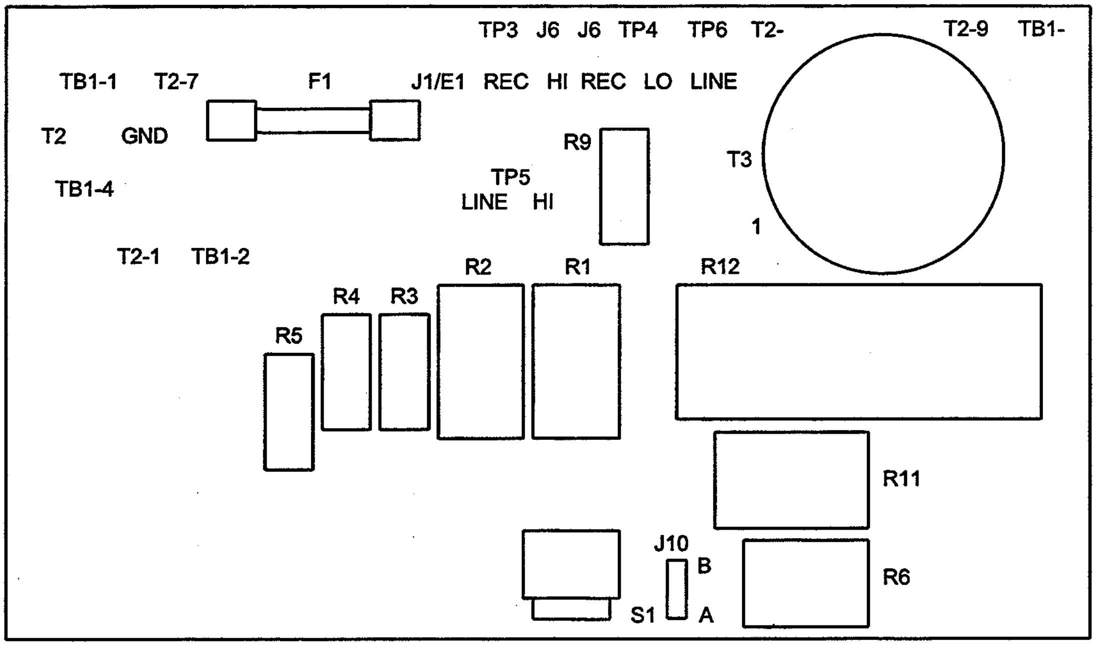


Figure 9-10. Block diagram, RFL 95 HIGH POWER COMBINER HYBRID Assembly

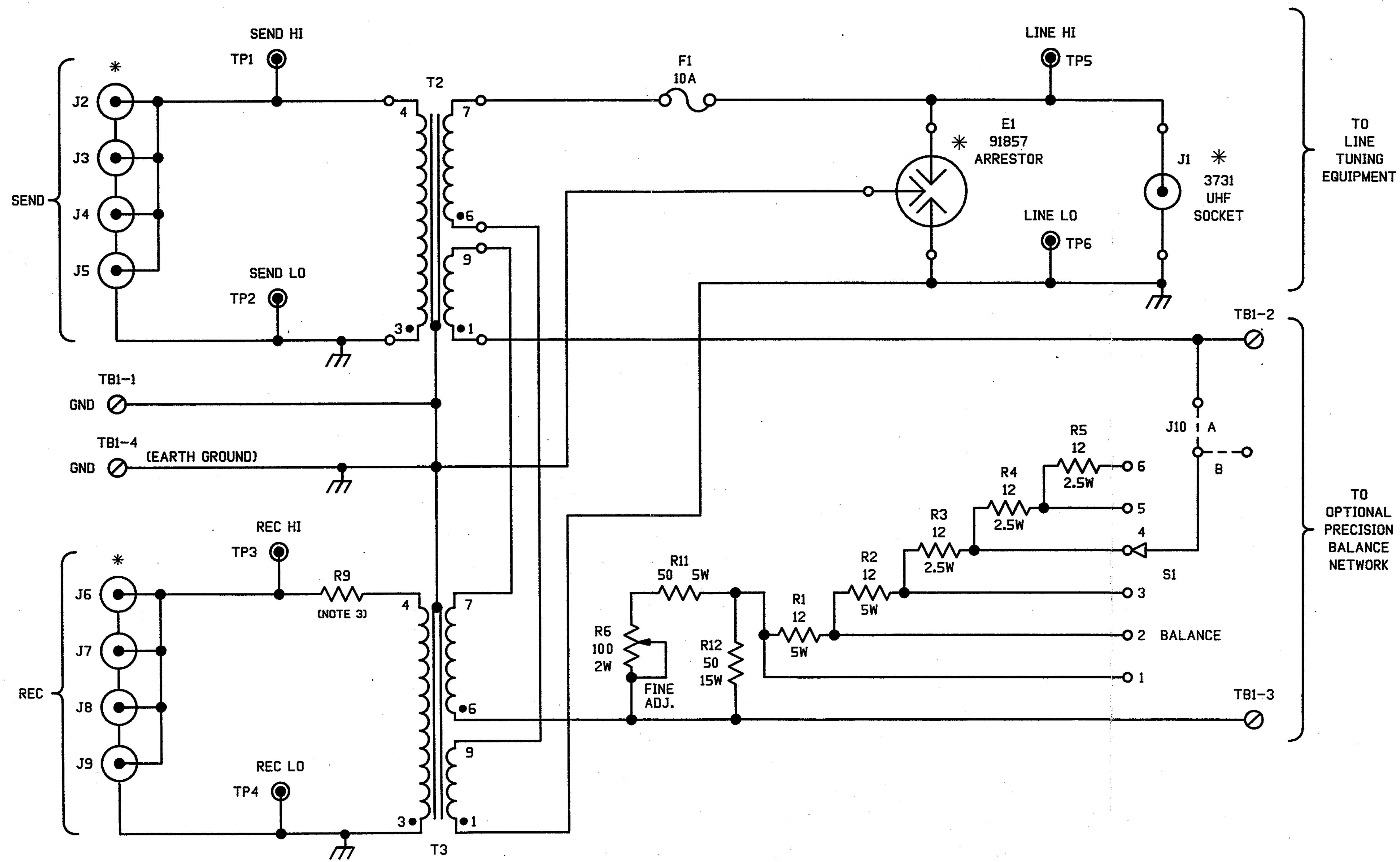
Table 9-4. Replaceable parts, RFL 95 HIGH POWER COMBINER HYBRID
Assembly No. 102705-X

Circuit Symbol (Figure 9-12)	Description	Part Number
E1	Arrestor, 3-electrode, gas tube	91857
F1	Fuse, slo-blow, 10A, 32V, 3Ag	10758
J1, 2, 3, 4, 5, 6, 7, 8, 9	Connector, jack, coax, female, Type UHF, Amphenol 83-1R	3731
J10	Jumper, connector, programmable	98306
R1, 2	Resistor wire-wond, 12Ω, 5%, 5W, non-inductive	1100 793
R3, 4 , 5	Resistor wire-wond, 12Ω, 5%, 2.5W, non-inductive	1100 745
R6	Resistor, variable, metal film, 100Ω 10%, 2W	44356
R7, 8	not used	
R9	Jumper wire, .600 x .250, T22	90787
S1	Switch, rotary, 1-deck, 1P/D 6P	44357
T2	Transformer, hybrid, part number dependent upon assembly	
	102705-1, 50 TX/75 line	55854
	102705-2, 50 TX/50 line	55862
	102705-3, 12.5 TX/50 line	55867
T3	Transformer, hybrid, skewed, 75Ω rec.	55669



TX/RX Balance Network (Assembly No. 102705; Drawing No. C-102708, Rev B)

Figure 9-11. Component locator drawing, RFL 95 HIGH POWER COMBINER HYBRID Assembly



NOTES:

1. ✳ – MOUNTED EXTERNAL ON REAR PANEL.
2. TP1 THRU TP6, R6 & S1 ARE MOUNTED ON FRONT PANEL.
3. R9 WILL CHANGE PER APPLICATION.

Figure 9-12. Schematic, RFL HIGH POWER COMBINER Rf Line Interface Assembly (Assembly No. 102705-1; Schematic No. D-102709-B)

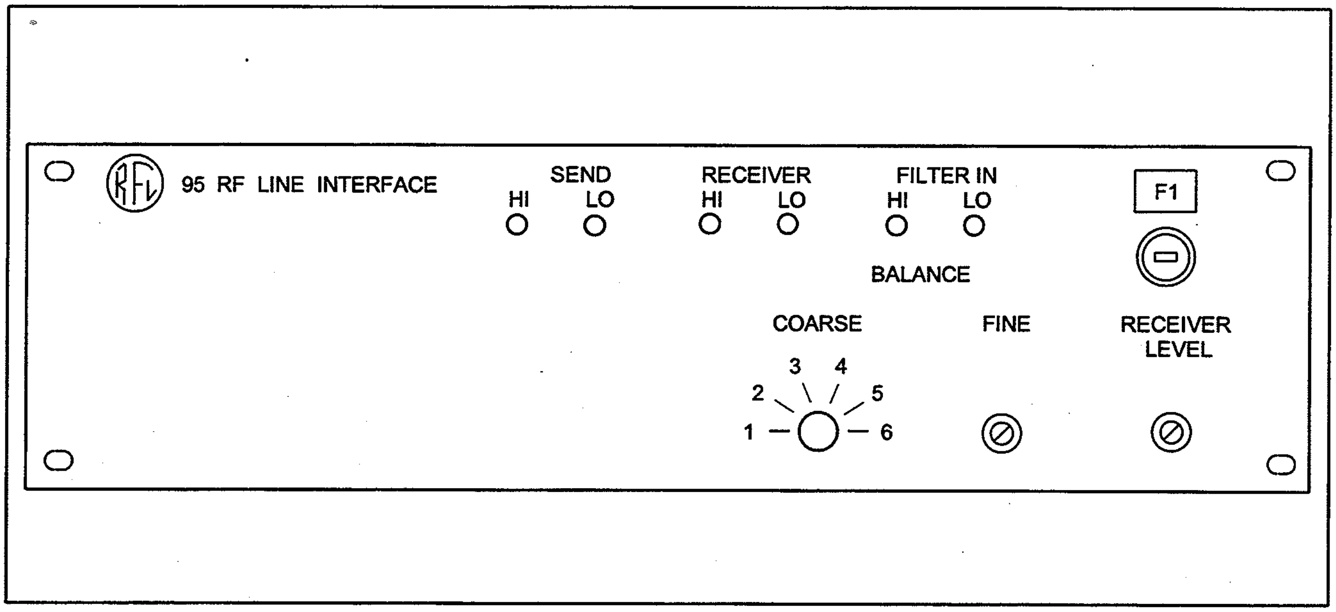


Figure 9-13. RFL 95 INTL RF LINE INTERFACE, International Rf Line Interface Assembly

9-5. RFL 95 INTL RF LINE INTERFACE International Rf Line Interface Assembly

The RFL 95 INTL RF LINE INTERFACE, International Rf Line Interface Assembly (Fig. 9-13) serves as the connection point between the RFL 9505 main chassis and the line coupling equipment for International applications requiring parallel operation with other powerline carrier terminals sharing the same line coupling equipment.

The 95 INTL RF LINE INTERFACE is housed in its own cabinet, and occupies 3 1/2 inches of vertical space in a standard 19-inch rack or cabinet. Because it contains no active components, the RFL 95 INTL RF LINE INTERFACE does not require any dc input voltage.

9.5.1. Specifications

As of the date this manual was published, the following specifications apply to the RFL 95 INTL RF LINE - INTERFACE. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Power Capability: 100 watts maximum.

Impedances:
Transmit Input: 50 (or 25) ohms.
Receive Output: 75 ohms.
Line: Adjustable to 50, 75, 100, or 130 ohms.

Insertion Loss (@ 50 ohms):
Transmit: 3.0 dB maximum.
Receive: 14 dB typical.

Passband Ripple: ±0.1 dB maximum.

Second Harmonic Rejection: -80 dB.

Third Order Intermodulation: -60 dB.

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

Operating Temperature: -20°C to +55°C (-4°F to +131°F).

Dimensions:
Width: 19 inches (48.3 cm)
Height: 3 1/2 inches (8.9 cm)
Depth: 5 1/2 inches (14.0 cm), from back of front panel to connectors on rear panel.

Weight: Approximately 4.5 lbs (2.0 kg).

9.5.2. THEORY OF OPERATION

The 95 INTL RF LINE INTERFACE connects the RFL 9505 main chassis to the powerline coupling equipment. It contains a high-power bandpass filter, two hybrid transformers, a receive attenuator, a complex balance network, an impedance matching transformer, and a surge arrestor.

A block diagram of the 95 INTL RF LINE INTERFACE appears in Figure 9-14, a component locator drawing appears in Figure 9-15, and a schematic diagram appears in Figure 9-16.

9.5.2.1. Hybrid Transformers

The 95 INTL RF LINE INTERFACE contains two hybrid transformers, T2 and T3. The primary winding of T2 accepts the transmit input signal, and the primary winding of T3 develops the receive output signal that is passed on to the modems. Both hybrid transformers have two secondary windings, and are interconnected so that one secondary of T2 is in series with a secondary of T3. One set of secondaries is connected across the complex balance network. The other set is connected to the line coupling equipment through line matching transformer T1.

9.5.2.2. High-Power Bandpass Filter

The high-power bandpass filter is a dual-section filter that is not field-repairable. Both sections are connected in series with the transmitter output, and filter out any harmonics before being applied to the impedance matching transformer.

9.5.2.3. Receive Attenuator

Resistors R7 and R8 and dual-section RECEIVER LEVEL potentiometer R9 are connected across the primary of T3 to form an attenuator. The level of signal passed on to the modems is controlled by the setting of R9. Zener diodes CR1 and CR2 clamp the incoming signal to a safe level. The signal being passed on to the modems can be monitored at the RECEIVER test points on the front panel.

9.5.2.4. Complex Balance Network

Inductor L1, capacitors C1 through C9, COARSE switch S1, FINE potentiometer R6, and resistors R1 through R5, R11, and R12 form an internal complex balance network. This network is connected across one set of secondaries in the hybrid transformers. Jumper J11 can be used to enable or disable the internal balance network.

The balance network is adjusted to match the line impedance. To adjust the network, a frequency-selective voltmeter (FSVM) is connected across the RECEIVER test points and S1 and R6 are adjusted for the lowest possible transmitter signal level. S1 provides a rough adjustment of the resistance across the hybrid secondaries by determining how many resistors in the network are connected in series. R6 provides a fine resistance adjustment that allows the resistive balance to be precisely set.

Inductor L1 and capacitors C1 through C9 form the reactive portion of the balance network. All components in the reactive portion can be jumpered in or out to balance out local line capacitive or inductive reactance.L1 can be enabled or disabled by jumper J10. Jumper J1 controls C1, J2 controls C2, and so on. If no reactive balancing is required, J1 through J10 must be placed in the OUT position.

9.5.2.5. Impedance Matching Transformer

Transformer T1 matches the impedance of the 95 INTL RF LINE INTERFACE to that of the line. Jumper J12 selects one of T1's four impedance settings: 50, 75, 100, or 130 ohms. Fuse F1 provides current protection, and surge arrestor E1 protects the equipment against an overvoltage condition. The signal going to or coming from the line coupling equipment can be monitored at the SEND test points on the front panel.

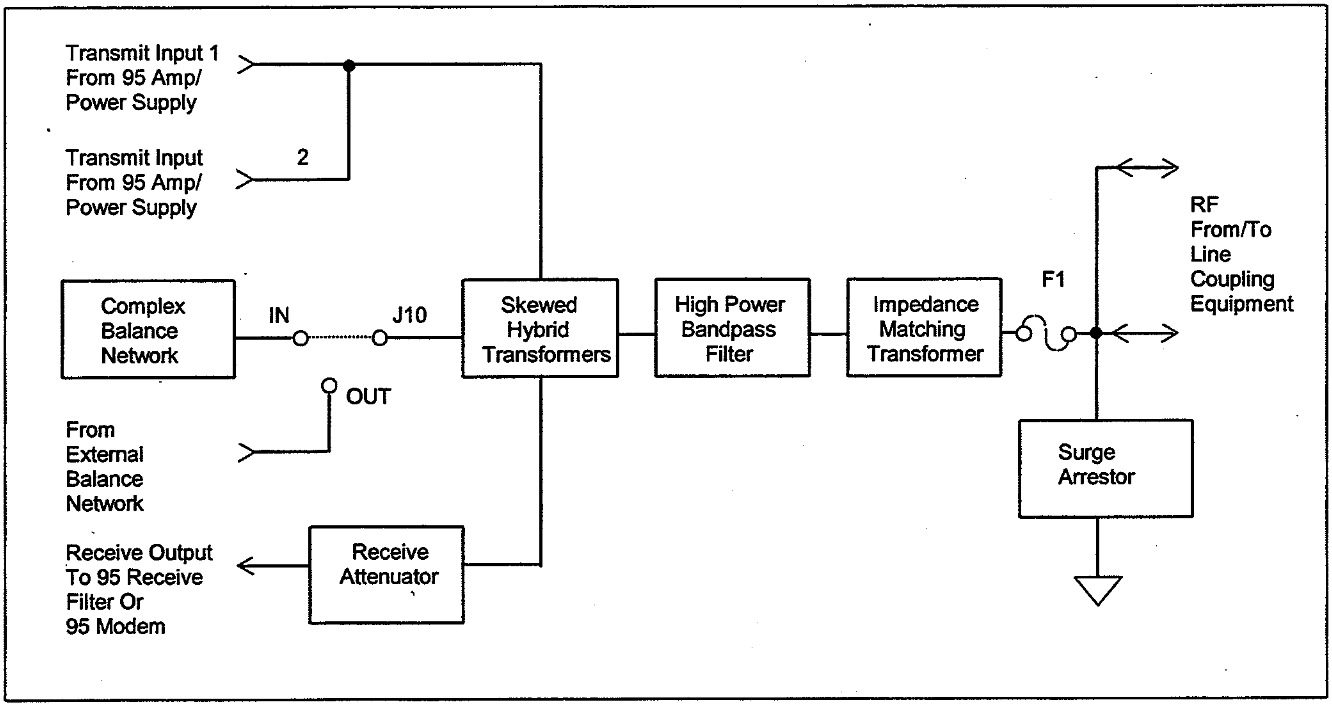


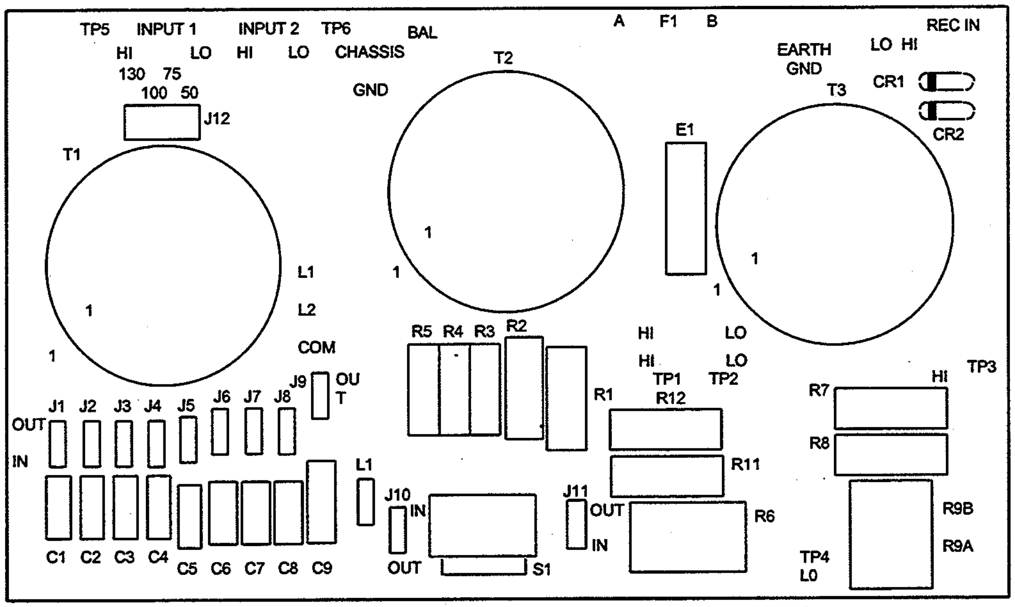
Figure 9-14. Block diagram, RFL 95 INTL RF LINE INTERFACE, International Rf Line Interface Assembly

Table 9-5. Replaceable parts, RFL 95 INTL RF LINE INTERFACE International Rf Line Interface Assembly
Assembly No. 103025-X

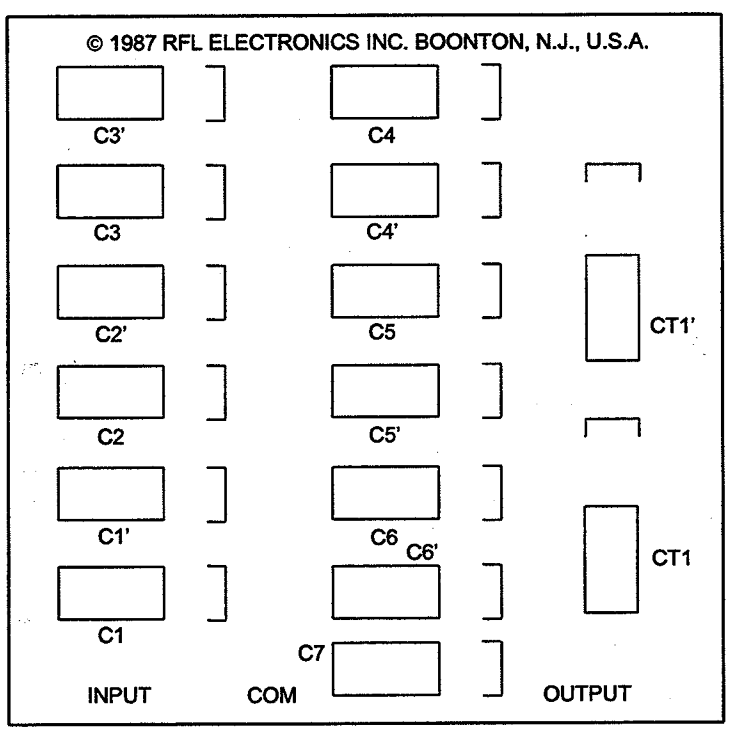
Circuit Symbol (Figure 9-16)	Description	Part Number
C1	Capacitor,dipped mica,100pF,2%,500V, Type DM15	16600
C2	Capacitor,dipped mica,200pF,2%,500V, Type DM19	16614
C3	Capacitor,dipped mica,300pF,2%,500V, Type DM19	16622
C4	Capacitor,dipped mica,410pF,2%,500V, Type DM19	16629
C5	Capacitor,polyester,0.001µF,2%,400V,F-Dyne PST-11-.001-400-2 or equiv.	5115 274
C6	Capacitor,polyester,0.002µF,2%,400V,Wesco 32P or equiv.	5115 101
C7	Capacitor,polyester,0.003µF,2%,400V,Wesco 32P or equiv.	5115 109
C8	Capacitor,polyester,0.0041µF,2%,400V,Wesco 32P or equiv.	5115 116
C9	Capacitor,polyester,0.01µF,2%,400V,Wesco 32P or equiv.	5115 135
CR1,2	Diode,Zener,5.1V,5%,1W,1N4733A	29759
E1	Surge arrestor,gas-tube,300-500 Vdc,pc-mount,TII Industries TII-12B or equiv.	92627
F1	Fuse,3AG quick-acting,2A,250V,Littelfuse 312002 or equiv.	1289
J1-11	Shorting bar,single,Molex 90059-0009 or equiv.	98306
L1	Inductor,rf,molded,180mH,10%,Gowanda 10/183 or equiv.	32505 2
R1,2	Resistor,non-inductive wirewound,12Ω,5%,2.5W,C.T.Gamble Type CGN-6 or equiv.	1100 745
R3-5	Resistor,metal film,12.1Ω,1%,1/2W,Type RN65D	1510 2109
R6	Resistor,variable,single-turn cermet,100Ω,10%,2W,screwdriver adjust, CTS Series X550LT or equiv.	44356
R7,8	Resistor,composition,75Ω,5%,1W, Allen-Bradley GB Series or equiv.	1009 994
R9	Attenuator,bridged T-pad,75Ω,15%,1/2W,Allen-Bradley 70P4M040S750N or equiv.	43136
R10		
R11	Not used.	1100 747
R12	Resistor,non-inductive wirewound,50Ω,5%,2.5W,C.T.Gamble Type CGN-4 or equiv.	1100 748
S1	Resistor,non-inductive wirewound,50Ω,5%,5W,C.T.Gamble Type CGN-8 or equiv.	44357
T1		
	Switch,rotary,single-deck,6-position	55868
	Transformer,rf,multi-tap,100W,part number dependent upon assembly:	55869
T2	Assembly Nos. 103025-1 & 103025-2: Low-frequency	
	All Others: High-frequency	55779
	Transformer,skewed hybrid,50W transmit,part number dependent upon assembly:	55688
T3	Assembly Nos. 103025-1 & 103025-2	55689
	All Others	
	Transformer,skewed hybrid,75Ω receive	

NOTE

The components on the capacitor board (Assembly No. 79830-X) form the two-stage high-power bandpass filter, shown within the dashed lines on the schematic in Figure 9-16. All components on this board are factory-selected for the desired operating frequency. Repair of this board should not be attempted in the field; if a component is defective, replace the entire board. Contact the factory for filter replacement information.



Main board (Drawing No. C-103023 , Rev. C)



Capacitor board (Assembly No. 79830, 2 boards per assembly; Drawing No. C-100868, Rev. D)

Figure 9-15. Component locator drawings, RFL 95 INTL RF LINE INTERFACE, Rf Line Interface Assembly

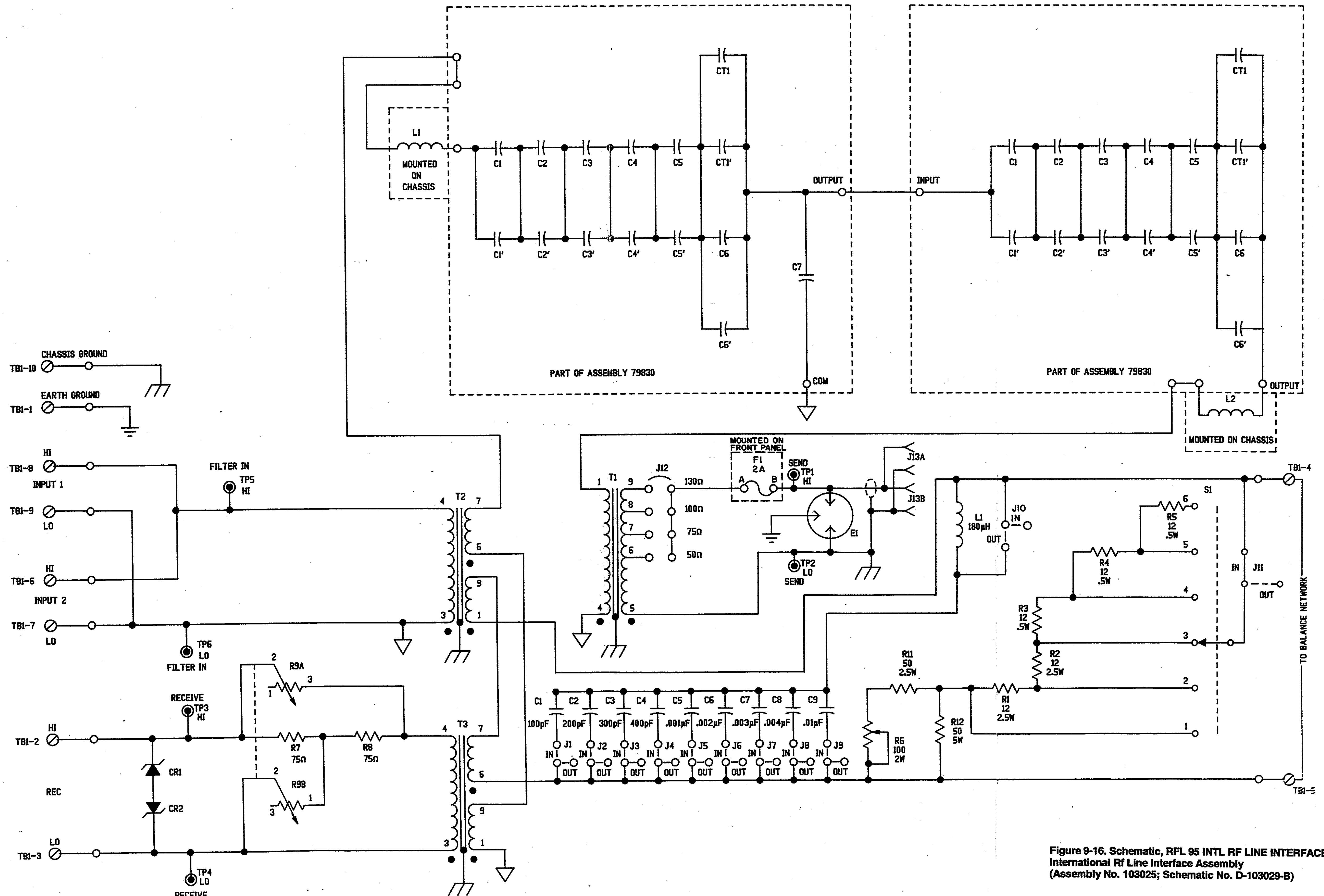


Figure 9-16. Schematic, RFL 95 INTL RF LINE INTERFACE
International Rf Line Interface Assembly
(Assembly No. 103025; Schematic No. D-103029-B)

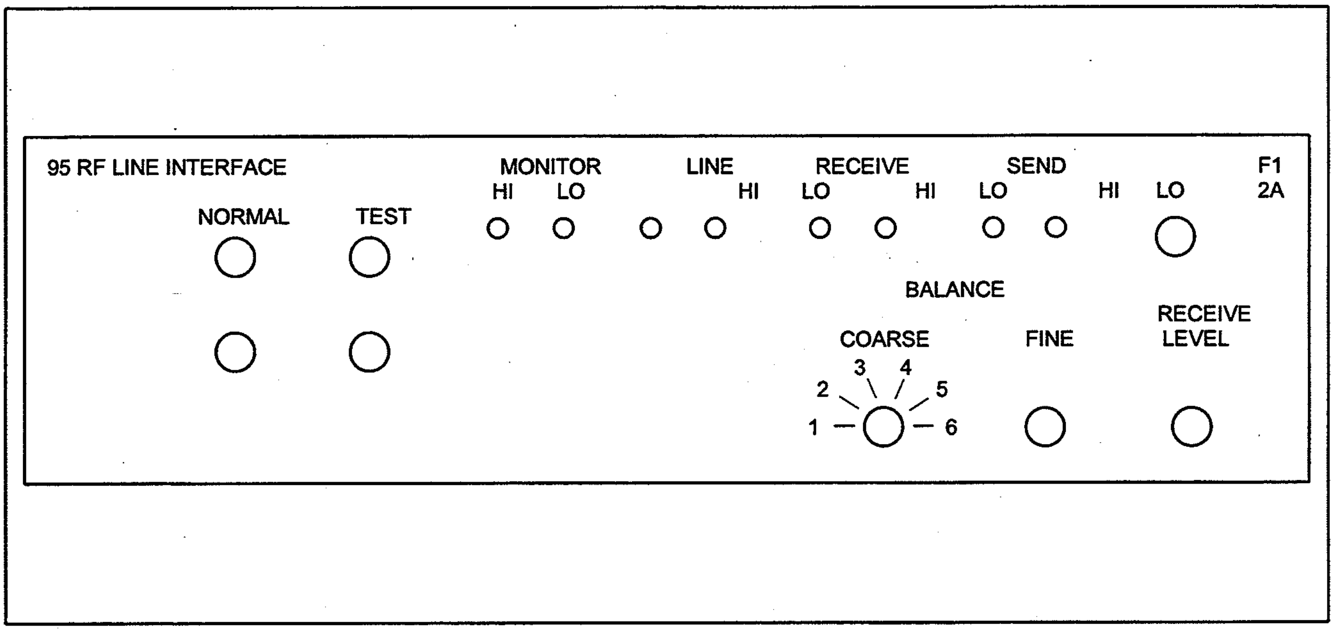


Figure 9-17. RFL 95A INTL RF LINE INTERFACE

9.6. RFL 95A INTL RF LINE INTERFACE

The RFL 95A INTL RF LINE INTERFACE (Fig. 9-17) serves as the connection point between the RFL 9505 main chassis and the line coupling equipment for International applications.

The 95A INTL RF LINE INTERFACE is housed in its own cabinet, and occupies 3 1/2 inches of vertical space in a standard 19-inch rack or cabinet. Because it contains no active components, the 95A INTL RF LINE INTERFACE does not require any dc input voltage.

9.6.1. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the 95A INTL RF LINE INTERFACE. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Power Capability: 100 watts maximum.

Impedances:
Transmit Input: 50 ohms.
Receive Output: 75 ohms.
Line: Adjustable to 50, 75, 100, or 130 ohms.

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

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

Operating Temperature: -20°C to +55°C (-4°F to +131°F).

Dimensions:
Width: 19 inches (48.3 cm)
Height: 3 1/2 inches (8.9 cm)
Depth: 5 1/2 inches (14.0 cm), from back of front panel to connectors on rear panel.

Weight: 4 lbs 7.7 oz (2.03 kg).

9.6.2. THEORY OF OPERATION

The 95A INTL RF LINE INTERFACE connects the RFL 9505 to the power line coupling equipment. It contains two hybrid transformers, a receive attenuator, a complex balance network, a 40 dB dummy load, an impedance matching transformer, and a surge arrestor. It uses an external 65 HP FIL high power bandpass filter which is described in an instruction data sheet in section 12.

A block diagram of the 95A INTL RF LINE INTERFACE appears in Figure 9-18, a component locator drawing appears in Figure 9-19, and a schematic diagram appears in Figure 9-20.

9.6.2.1. Hybrid Transformers

The 95A INTL RF LINE INTERFACE contains two hybrid transformers, T2 and T3. The primary winding of T2 accepts the transmit input signal, and the primary winding of T3 develops the receive output signal that is passed on to the modems.

Both hybrid transformers have two secondary windings, and are interconnected so that one secondary of T2 is in series with a secondary of T3. One set of secondaries is connected across the complex balance network. The other set is connected to the line coupling equipment through the external 65HP Filter and line matching transformer T1. Fuse F1 provides current protection, and surge arrestor E1 protects the equipment against an overvoltage condition. The signal going to or coming from the line coupling equipment can be monitored at the SEND test points on the front panel.

9.6.2.2. Receive Attenuator

Resistors R7 and R8 and dual-section RECEIVE LEVEL potentiometer R9 are connected across the primary of T3 to form an attenuator. The amount of signal sent on to the modems is controlled by the setting of R9. Zener diodes CR1 and CR2 clamp the signal to a safe level. The signal being sent to the modems can be monitored at the RECEIVE test points on the front panel.

9.6.2.3. Complex Balance Network

Inductor L1, capacitors C1 through C9, COARSE switch S1, FINE potentiometer R6, and resistors R1 through R5, R11, and R12 form an internal reactive balance network. This network is connected across one set of secondaries of the hybrid transformers. Jumper J11 can be used to enable or disable the internal balance network. The balance network is adjusted to match the line impedance. To adjust the network, a frequency selective voltmeter (FSVM) is connected across the RECEIVE test points and S1 and S6 are adjusted for the lowest possible transmitter signal level. S1 provides a rough adjustment of the resistance across the hybrid secondaries by determining how many resistors in the network are connected in series. R6 provides a fine resistance adjustment that allows the resistive balance to be precisely set.

Inductor L1 and capacitors C1 through C9 form the reactive portion of the balance network. All components in the reactive portion can be jumpered in and out to balance out local line reactance. L1 can be enabled or disabled by jumper J10. Jumper J1 controls C1, J2 controls C2, and so on. If no reactive balancing is required, J1 through J10 must be placed in the out position.

9.6.2.4. 40 dB Dummy Load

The 40 dB dummy load consists of R13 through R19. To observe the attenuated signal going to the line coupling equipment, the test link located on the front panel must be removed from the NORMAL position and plugged into the TEST position. The signal can then be observed across the MONITOR test points on the front panel. To resume normal operation the test link must be returned to its NORMAL position.

9.6.2.5 Impedance Matching Transformer

Transformer T1 matches the impedance of the 95 INTL RF LINE INTERFACE to that of the line. Jumper J12 selects one of T1's four impedance settings: 50, 75, 100, or 130 ohms. Fuse F1 provides current protection, and surge arrestor E1 protects the equipment against an overvoltage condition. The signal going to or coming from the line coupling equipment can be monitored at the SEND test points on the front panel.

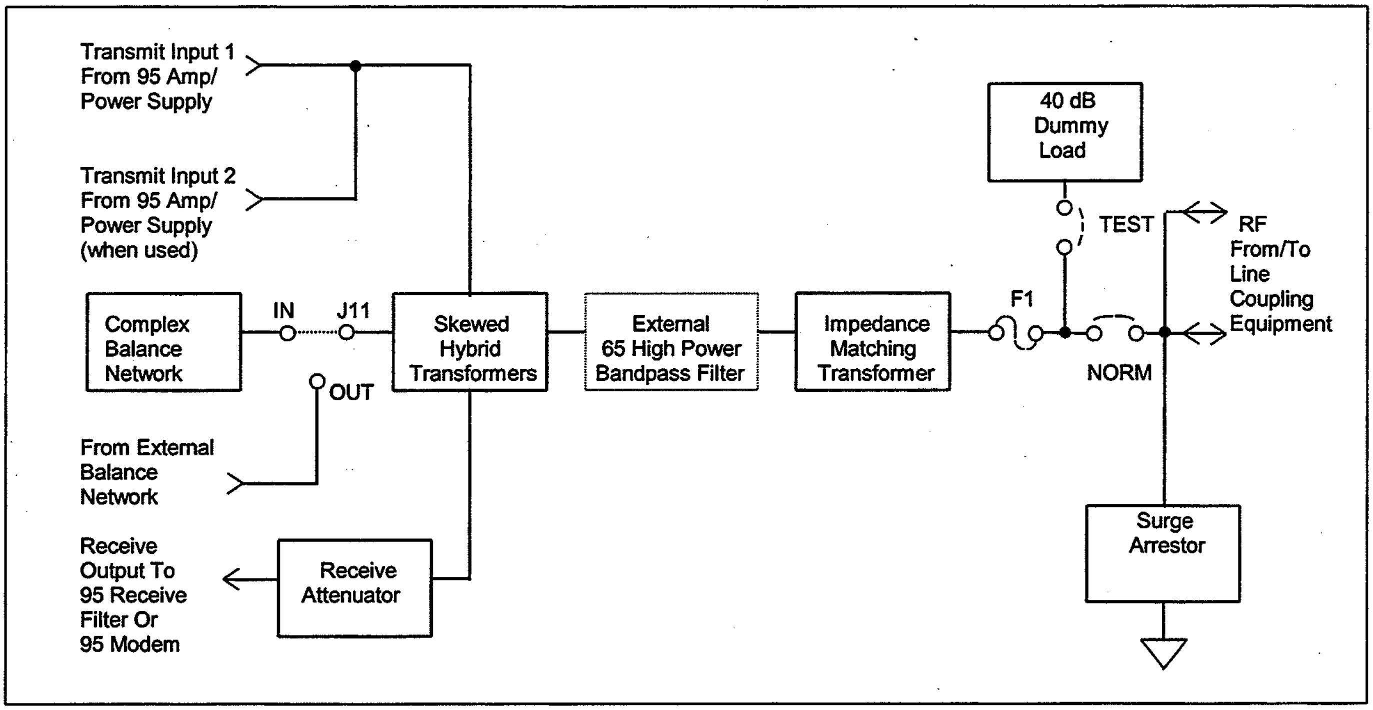
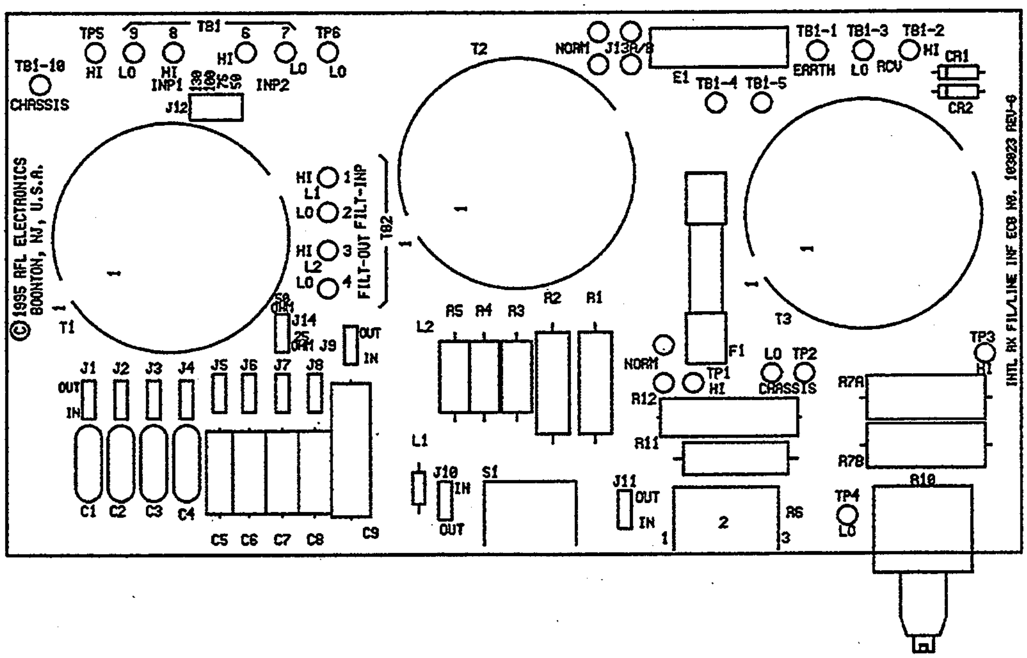


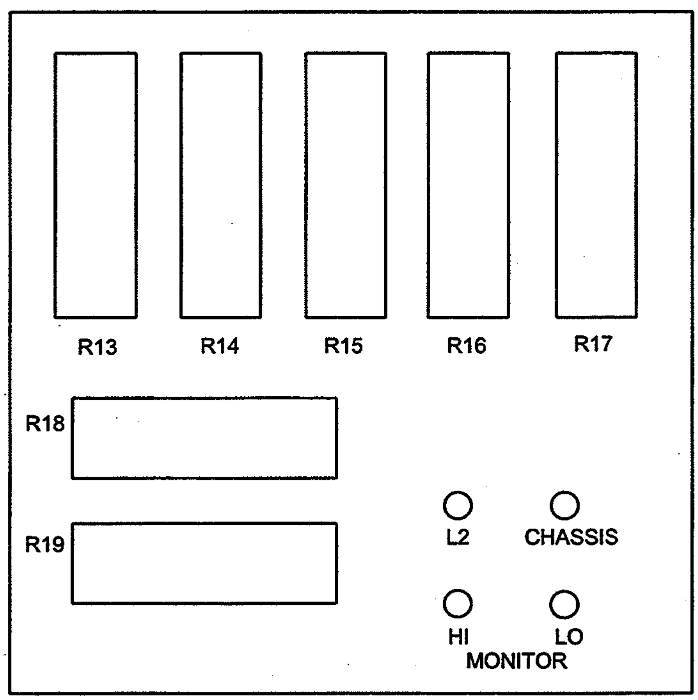
Figure 9-18. Block diagram, RFL 95A INTL RF LINE INTERFACE, Rf Line Interface Assembly

Table 9-6. Replaceable parts, RFL 95A INTL RF LINE INTERFACE
Assembly No. 103020

Circuit Symbol (Figure 9-20)	Description	Part Number
C1	Capacitor, dipped mica, 100pf, 2%, 500V	16600
C2	Capacitor, dipped mica, 200pf, 2%, 500V	16614
C3	Capacitor, dipped mica, 300pf, 2%, 500V	16622
C4	Capacitor, dipped mica, 410pf, 2%, 500V	16629
C5	Capacitor, poly, .001µf, 2%, 400V	5115 274
C6	Capacitor, poly, .002µf, 2%, 400V	5115 101
C7	Capacitor, poly, .003µf, 2%, 400V	5115 109
C8	Capacitor, poly, .0041µf, 2%, 400V	5115 116
C9	Capacitor, poly, .01µf, 2%, 400V	5115 135
CR1, CR2	Diode, Zener, 5.1V, 1W, 1N4733A	29759
E1	Arrestor, 3-electrode, gas tube	92627
F1	Fuse, 2 Amp, 3AG, 250V	1289
J1, 2, 3, 4, 5, 6, 7, 8 9, 10, 11, 14	Connector, header, single, 3-circuit	32802-3
J12	Connector, header, dual, 4/8-circuit	32599-8
L1	Inductor, molded, RF, 180µh, 10%	32505 2
R1, 2	Resistor, wirewound, 12Ω, 5%, 2.5W, non-inductive	1100 745
R3, 4, 5	Resistor, metal film, precision, 12.1Ω, 1%, 1/2W	1510 2109
R6	Resistor, variable, metal film, 100Ω, 10%, 2W	44356
R7A, 7B	Resistor, fixed composition, 75Ω, 5%, 1W	1009 994
R10	Resistor, variable, wirewound, 100Ω, 5%, 2W, 10 turn	103024
R11	Resistor, wirewound, 50Ω, 5%, 2.5W, non-inductive	1100 747
R12	Resistor, wirewound, 50Ω, 5%, 5W, non-inductive	1100 748
S1	Switch, rotary, 1-deck, 6-position	44357
T1, T2, T3	Transformer, Hybrid, part number(s) dependent upon assembly	

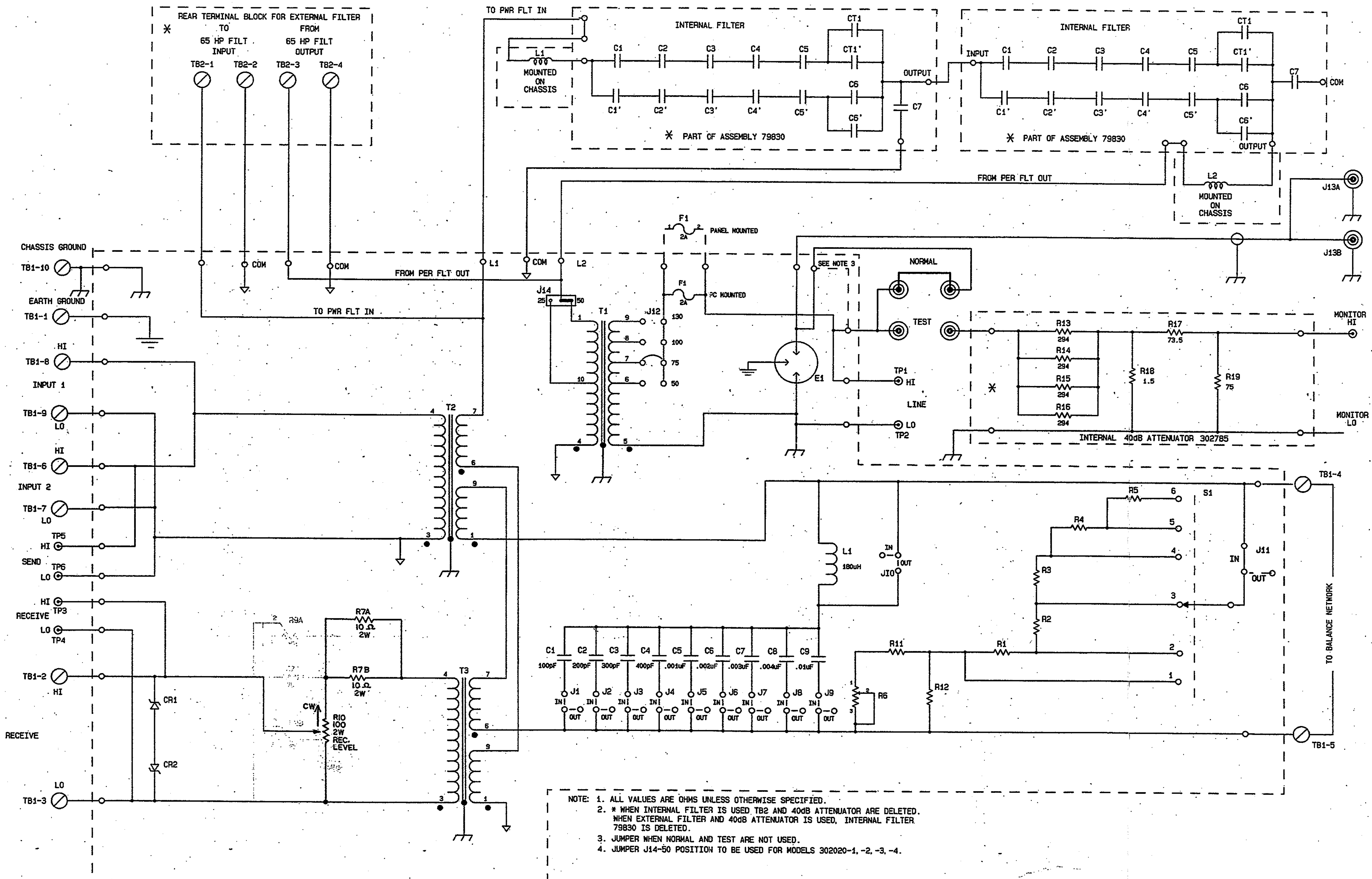


Main board (Assembly No. 103020; Drawing No. C-103023 , Rev. G).



40 dB Test Attenuator board (Assembly No. 302785; Drawing No. C-302788, Rev. B).

Figure 9-19. Component locator drawings, RFL 95A INTL RF LINE INTERFACE Assembly



NOTE: 1. ALL VALUES ARE OHMS UNLESS OTHERWISE SPECIFIED.
2. * WHEN INTERNAL FILTER IS USED TB2 AND 40dB ATTENUATOR ARE DELETED. WHEN EXTERNAL FILTER AND 40dB ATTENUATOR IS USED, INTERNAL FILTER 79830 IS DELETED.
3. JUMPER WHEN NORMAL AND TEST ARE NOT USED.
4. JUMPER J14-50 POSITION TO BE USED FOR MODELS 302020-1, -2, -3, -4.

Figure 9-20. Schematic, RFL 95A INTL RF LINE INTERFACE International Rf Line Interface Assembly (Assembly No. 302480-1, Schematic No. D-302484-D)

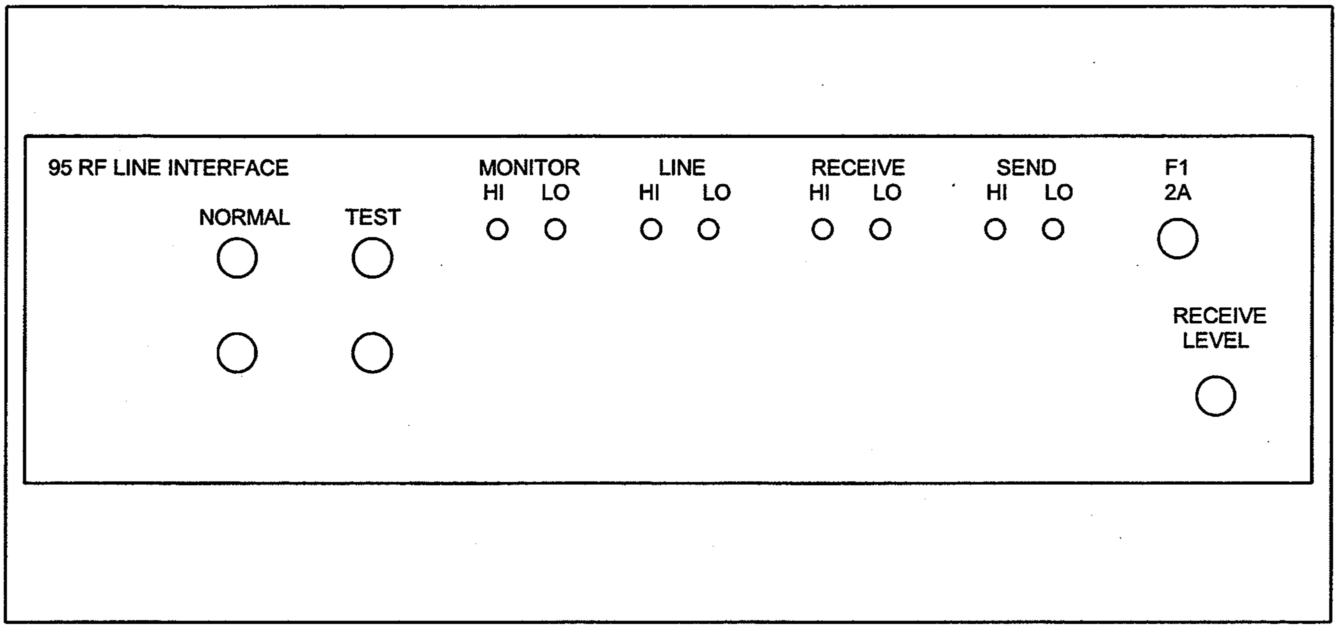


Figure 9-21. RFL 95B INTL RF LINE INTERFACE

9.7. RFL 95B INTL RF LINE INTERFACE

The RFL 95B INTL RF LINE INTERFACE (Fig. 9-21) serves as the connection point between the RFL 9505 and the line coupling equipment for International applications. Unlike the RF LINE INTERFACE units described earlier in this section, this unit does not employ hybrid transformers.

The 95B INTL RF LINE INTERFACE is housed in its own cabinet, and occupies 3 1/2 inches of vertical space in a standard 19-inch rack or cabinet. Because it contains no active components, the 95B INTL RF LINE INTERFACE does not require any dc input voltage.

9.7.1. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the 95B INTL RF LINE INTERFACE. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Power Capability: 100 watts maximum.

Impedances:
Transmit Input: 50 ohms.
Receive Output: 75 ohms.
Line: Adjustable to 50, 75, 100, or 130 ohms.

Insertion Loss:
Transmit: 1.0 dB maximum
Receive: 3.0 dB maximum

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

Operating Temperature: -20^{O}C to +55^{O}C (-4^{O}F to +131^{O}F).

Dimensions:
Width: 19 inches (48.3 cm)
Height: 3 1/2 inches (8.9 cm)
Depth: 5 1/2 inches (14.0 cm), from back of front panel to connectors on rear panel.

Weight: 4 lbs 7.7 oz (2.03 kg).

9.7.2. THEORY OF OPERATION

The 95B INTL RF LINE INTERFACE connects the RFL 9505 main chassis to the powerline coupling equipment. It contains a receive filter, a receive attenuator, a 40 dB dummy load, a line matching transformer, and a surge arrestor. It uses an external 65 HP FIL high power bandpass filter described in an application note in section 12.

A block diagram of the 95B INTL RF LINE INTERFACE appears in Figure 9-22, a component locator drawing appears in Figure 9-23, and a schematic diagram appears in Figure 9-24.

9.7.2.1. Receive Filter

The Receive Filter is used to isolate the 95 modem receive circuits from the output of its own 95 power amplifier and from any other powerline carrier transmitters which may be paralleled on the same transmission line. When separated from the nearest powerline carrier transmitter by at least 1.5 times its nominal bandwidth (band edge to band edge), it will provide at least 45 dB of rejection of that transmitters output frequencies. Therefore, no skewed hybrid is required when this International RF line interface is used.

The Receive Filter consists of L1 through L4 and C1 through C9. The Receive Filter is configured as an LC ladder network which selects the desired frequency signal from others that may be multiplexed on the same power line and rejects extraneous frequencies. The filter is tuned to the frequency at which the system is intended to receive from the powerline. Component values are not included on the schematic because each Receive Filter is customized to the required line frequency.

9.7.2.2. Receive Attenuator

Resistors R7 and R8, and dual-section RECEIVE LEVEL potentiometer R9 are connected across the primary of L4 to form an attenuator. The signal level passed on to the modem is controlled by the setting of R9. Zener diodes CR1 and CR2 clamp the signal to a safe level. The signal being passed to the modems can be monitored at the RECEIVE test points on the front panel.

9.7.2.3. 40 dB Dummy Load

The 40 dB dummy load consists of R13 through R19. To observe the attenuated signal going to the line coupling equipment, the test link located on the front panel must be removed from the NORMAL position and plugged into the TEST position. The signal can then be observed across the MONITOR test points on the front panel. To resume normal operation the test link must be returned to its NORMAL position.

9.7.2.4. Line Matching Transformer

Transformer T1 matches the impedance of the 95B INTL RF LINE INTERFACE to that of the line. Jumper J12 selects one of T1's four impedance settings: 50, 75, 100 or 130 ohms. Fuse F1 provides current protection, and surge arrestor E1 protects the equipment against an overvoltage condition. The signal going to or coming from the line coupling equipment can be monitored at the LINE test points on the front panel.

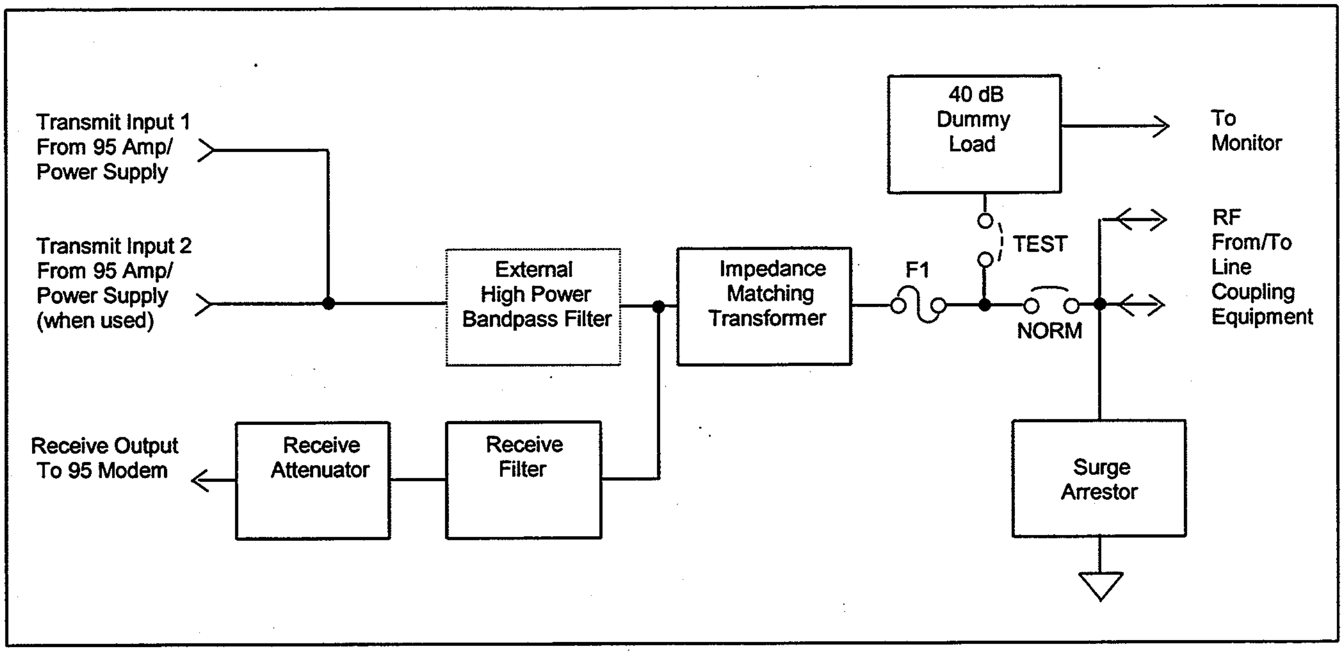
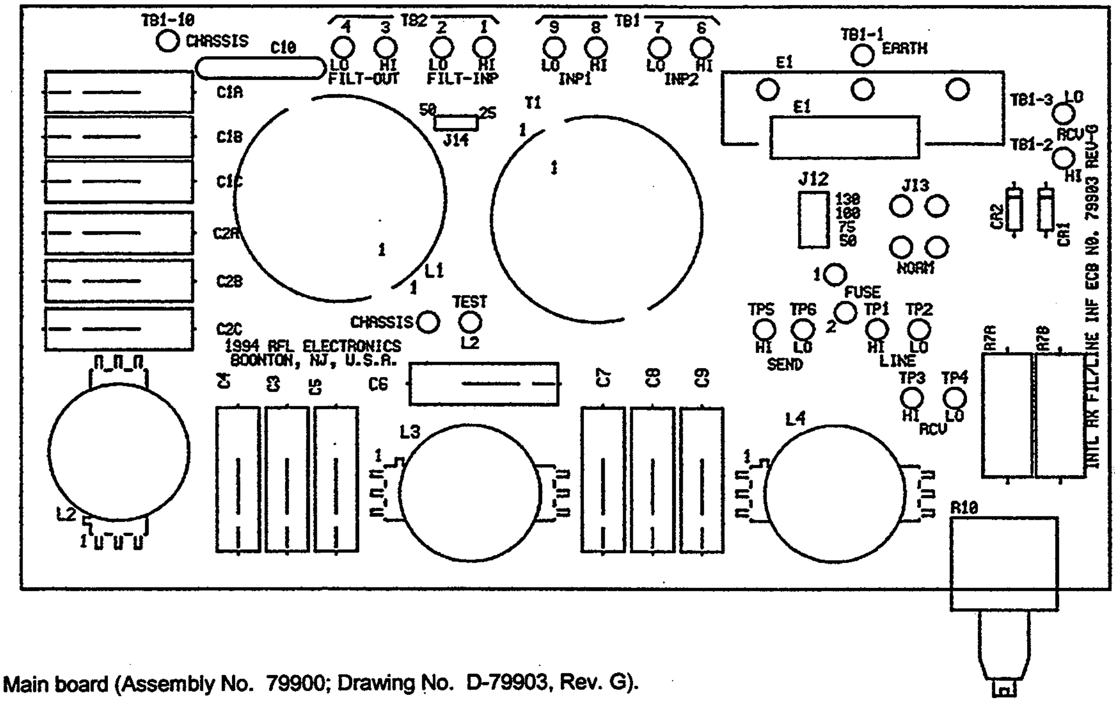


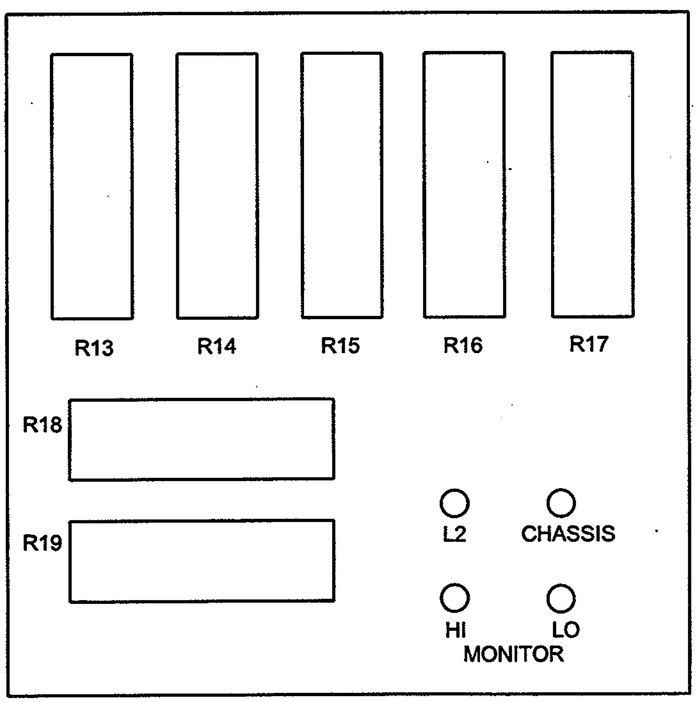
Figure 9-22. Block diagram, RFL 95B INTL RF LINE INTERFACE Line Interface Assembly

Table 9-7. Replaceable parts, RFL 95B INTL RF LINE INTERFACE
Assembly No. 79900-xxx

Circuit Symbol (Figure 9-24)	Description	Part Number
C10	Capacitor, ceramic disc, 0.01uF, 20%, 3KV	1007 1442
CR1,2	Diode, Zener, 5.1V, 5%, 1W, 1N4733A	29759
E1	Arrestor, 3-electrode, gas	96627
F1	Fuse, 2A, 3AG, 250V	1289
J12	Connector, header, dual, 4/8 circuit	32599
J13	Connector, coax, plug, male	3721
L1	Bar, shorting, insulated	302479
R7A, R7B	Resistor, fixed composition, 10Ω, 5%, 2W	1009 110
R10	Resistor, metal film, variable, 100Ω, 10%, 2W	44356
R13, 14, 15, 16	Resistor, wirewound, 294Ω, 1%, 15W, non-inductive	100 825
R17	Resistor, wirewound, 73.5Ω, 1%, 15W, non-inductive	1100 826
R18	Resistor, wirewound, 1.5Ω, 1%, 15W, non-inductive	1100 827
R19	Resistor, wirewound, 75Ω, 1%, 15W, non-inductive	1100 824

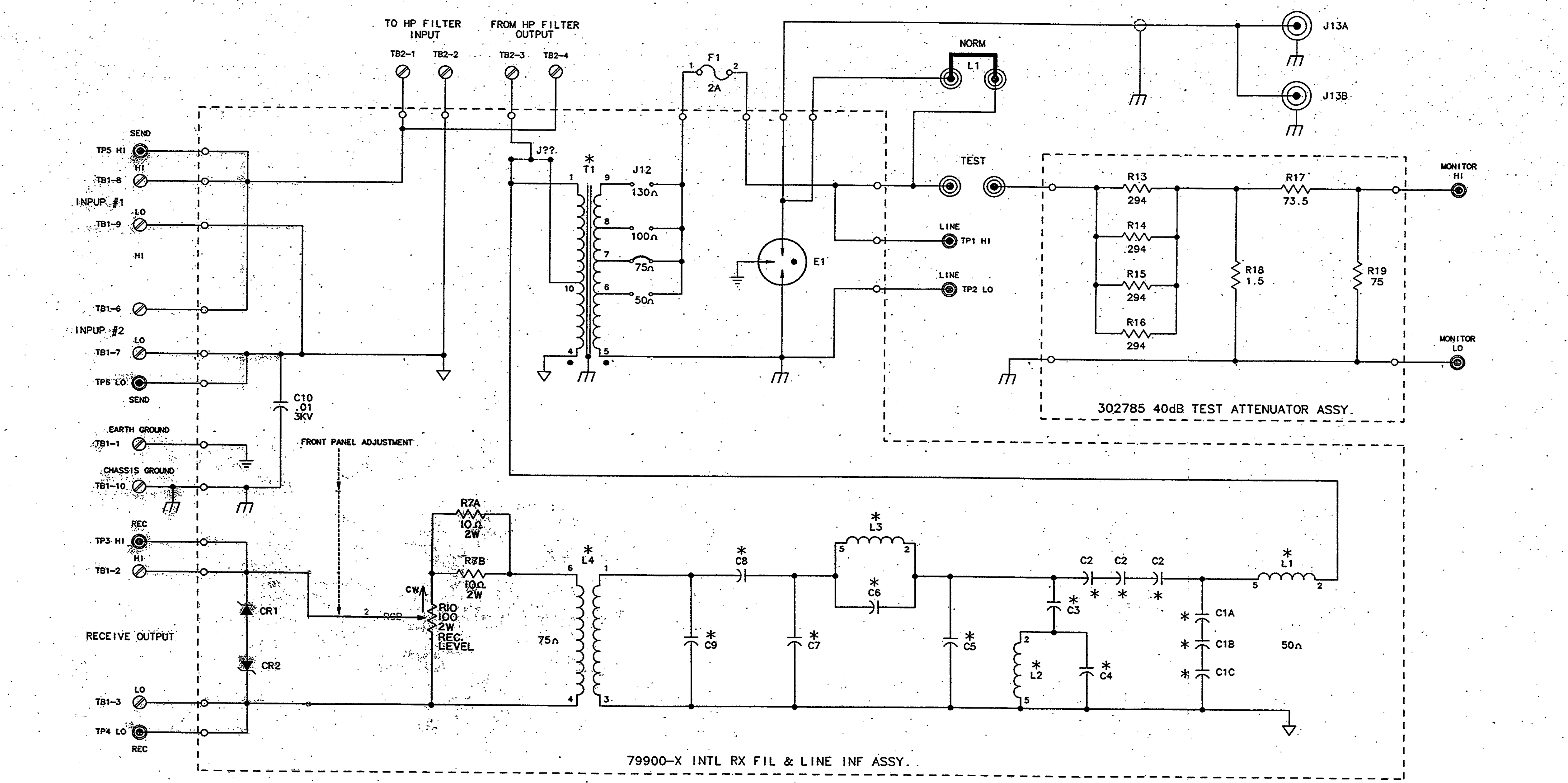


Main board (Assembly No. 79900; Drawing No. D-79903, Rev. G).



40 dB Test Attenuator board (Assembly No. 302785; Drawing No. C-302788, Rev. B).

Figure 9-23. Component locator drawings, RFL 95B INTL RF LINE INTERFACE Assembly



NOTES:

1. ALL VALUES ARE IN OHMS UNLESS OUTHERWISE SPECIFIED.
2. * - FREQUENCY DEPENDENT COMPONENTS.
3. ALL TEST POINTS,NORMAL,TEST,F1 & R9, ARE MOUNTED ON FRONT PANEL.
4. C1 & C2 LOCATION ON BOARD CAN USE (3)CAPACITORS IN SERIES FOR SPECIAL HIGHER VOLTAGE APPLICATION REQUIREMENTS.

Figure 9-24. Schematic, RFL 95B INTL RF LINE INTERFACE
International Rf Line Interface Assembly
(Assembly No. 79900, Schematic No. D-302784-F)

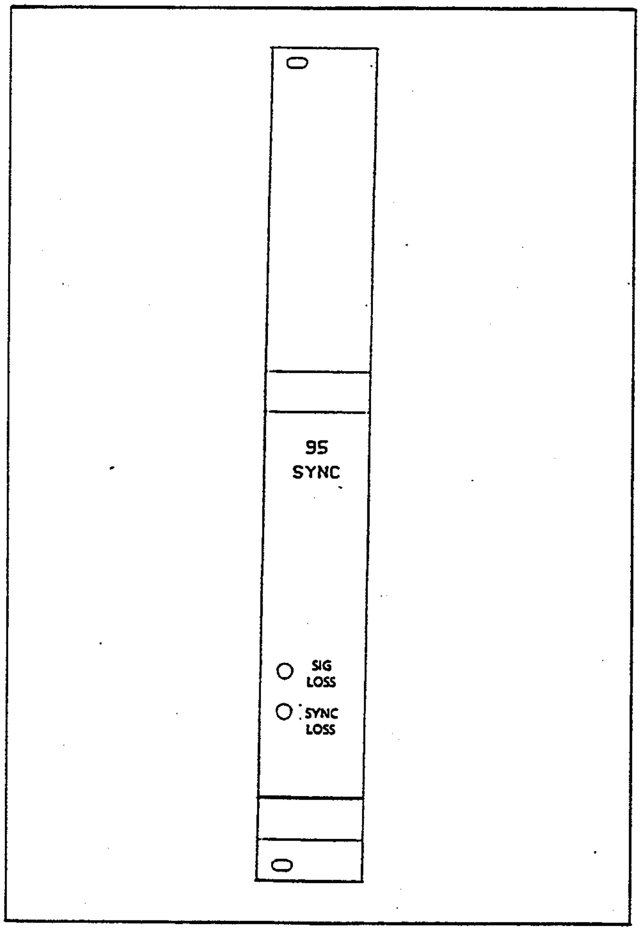


Figure 10-1. RFL 95 SYNC Synchronizer Module

10.1. DESCRIPTION

The RFL 95 SYNC Synchronizer Module (Fig. 10-1) is an optional component of the RFL 9505 system. It provides a precise 102.4-kHz clock signal, which can be used to synchronize all the modem modules installed in one RFL 9505 station to those in the RFL 9505 station at the far end of the communications link. The clock signal is derived from the selected input frequency, which is a multiple of 4 kHz.

The 95 SYNC is designed for mounting in the RFL 95 CHAS chassis (Section 8), and receives its input power from the chassis amplifier/power supply.

10.2. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the RFL 95 SYNC. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Input Signal:
- Frequency Range: 20 kHz to 500 kHz.
- Input Level:
  - Minimum: -60 dBm.
  - Maximum: -25 dBm.
- Impedance: 75 ohms.
- Maximum Variation: ±5 ppm from nominal frequency.

Selectivity: 30 dB minimum at closest adjacent channel pilot tone.

Output Signal: 102.4 kHz ±0.6 Hz @ 5 Vp-p.

Power Requirements:
- +12-Volt Supply: 200 mA maximum.
- -12-Volt Supply: 20 mA maximum.

Operating Temperature: -20°C to +55°C (-4°F to +131°F)

Dimensions: 10.305 inches high x 1.185 inches wide x 8.66 inches deep (260 mm x 30 mm x 220 mm); occupies one module space in the RFL 9505 chassis.

10.3. THEORY OF OPERATION

The 95 SYNC Synchronizer Module is used whenever it is necessary for all the modems at both ends of a communication link to be in phase. In order for synchronization to work, all the modems at the remote station must be phase-locked. This is done by designating one modem as the master, and phase-locking all the other modems to it. Once this is done, the 95 SYNC can monitor the carrier frequency generated by the master, and produce a reference frequency that is used to phase-lock all the modems at the local station.

A block diagram of the 95 SYNC appears in Figure 10-2. Figure 10-3 shows the location of all components, and the schematic for the 95 SYNC appears in Figure 10-4.

a. First Mixer. The input signal applied to the 95 SYNC is passed through a 500-kHz low-pass filter, and then to the input of mixer U1. The output of U1 is 7.168 MHz, which is the first i.f. signal.

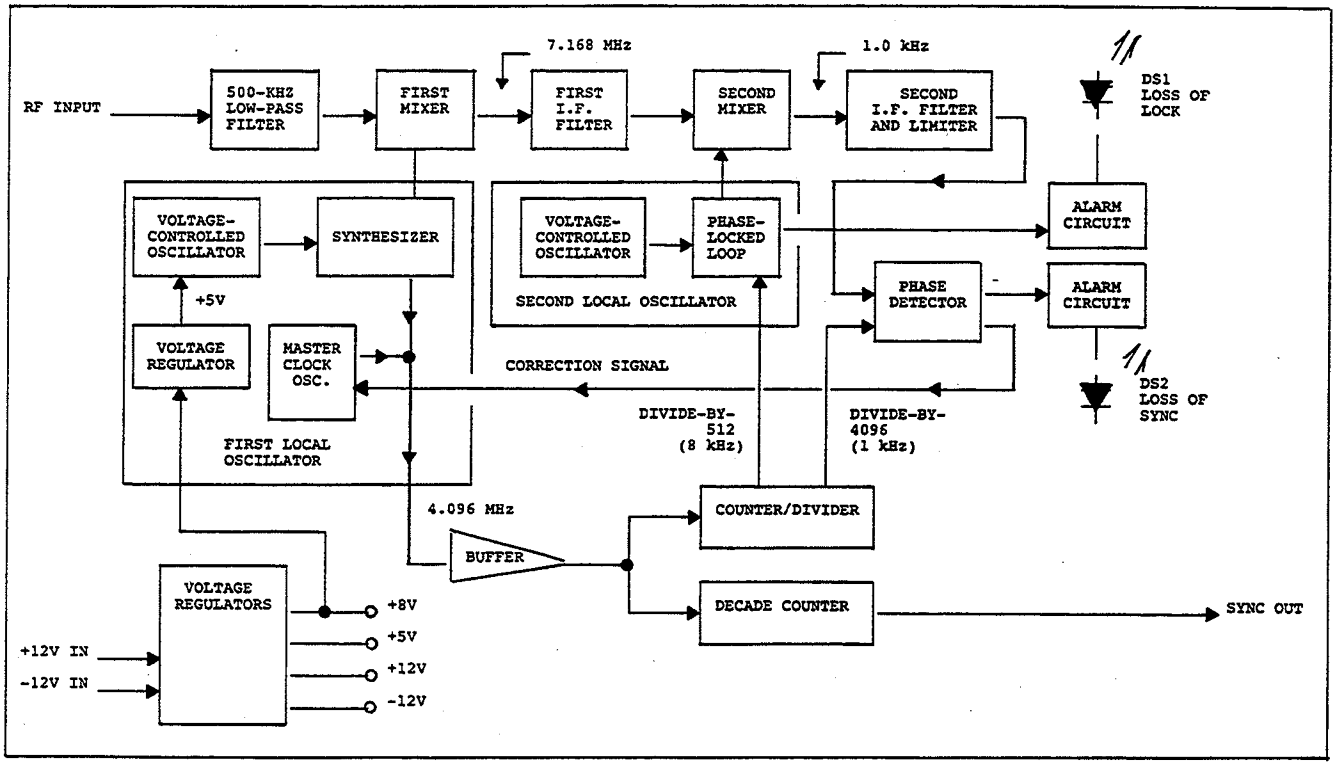


Figure 10-2. Block diagram, RFL 95 SYNC Synchronizer Module

b. First Local Oscillator. The local oscillator signal for the first mixer is provided by a synthesizer loop formed from synthesizer U5 and field-effect transistor Q1. U5 uses a 4.096-MHz master clock signal, which is provided by crystal X1, capacitors C37, C38, and C47, and varactors CR9 and CR10. Inside U5, this clock signal is divided down to 4 kHz. Q1 functions as a voltage-controlled oscillator (VCO). The drain voltage for Q1 is supplied by voltage regulator U15; by using a separate regulator, noise immunity is increased.

c. First I.f. Filter. The first i.f. signal is fed to i.f. filter FL1, which is a bandpass filter centered at 7.168 MHz with a 300-Hz bandwidth.

d. Second Mixer. After filtering, the first i.f. signal is applied to mixer U2. The output of U2 is 1 kHz, which is the second i.f. signal.

e. Second Local Oscillator. The local oscillator signal for U2 is supplied by a synthesizer loop formed from synthesizer U10 and voltage-controlled oscillator U7. The 8-kHz reference frequency for this loop is obtained by dividing the master clock signal by 512. This is done by passing it through transistor Q2 (which serves as a buffer) and counter U12. This is divided down further by U10 to produce a 1-kHz internal reference frequency.

f. Second I.f. Filter And Limiter. The second i.f. signal is applied to a filter formed from operational amplifiers U3A, U3B, U3C, U3D, U4A, and U4B and their associated components. These components form a narrow-band bandpass filter. The output of this filter is passed through limiter U8 and then on to the phase detector.

g. Phase Detector. Phase detector U9 accepts the limited second i.f. signal, along with the 1-kHz internal reference signal created by U10. The output of U9 is fed back to the master clock oscillator to make small corrections to its frequency which are directly related to the input signal being applied to the 95 SYNC.

h. Sync Output. The sync output signal is generated by applying the master clock signal to four-bit decade counter U11. Because the sync signal is derived from the master clock signal and the master clock signal will be varied by the phase detector to track any changes in the incoming signal, a change in the input will affect the sync output. This process keeps all the modems at both ends of the communications link in perfect synchronization.

i. Alarm Circuits. Operational amplifiers U4C and U4D and their associated components form alarm circuits, which will light front-panel indicators DS1 (LOSS OF

LOCK) and DS2 (LOSS OF SYNC) if either of these conditions exist.

j. Voltage Regulators. Dc voltage is applied to the 95 SYNC in the form of a bipolar 12-volt input. The -12-volt input is used as is, without any further processing. The +12-volt supply is used as is in some circuits, where other circuits require lower voltages. Voltage regulator U13 reduces the +12-volt input to +8 volts, and voltage regulator U14 reduces it to +5 volts. In addition, voltage regulator U15 produces an isolated +5-volt supply for field-effect transistor Q1 in the first local oscillator by reducing the +8-volt supply voltage.

Table 10-1. Replaceable parts, RFL 95 SYNC Synchronizer Module
Assembly No. 100810

Circuit Symbol (Figs. 10-3 & 10-4)	Description	Part Number
	CAPACITORS	
C1,7-9,11,13,14,19,21-23, 32,33,36,41,68,72,76-78, 92-94,96,97,101	Capacitor,X7R ceramic,0.1µF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C2	Capacitor,ceramic,470pF,5%,100V,AVX SA101A471JAA or equiv.	0125 14715
C3,4	Capacitor,ceramic,0.0012µF,5%,50V,AVX SA205A122JAA or equiv.	0125 51225
C5	Capacitor,ceramic,820pF,5%,50V,AVX SA305A821JAA or equiv.	0125 58215
C6,10,20,24,48,54,63,65,73,74	Capacitor,ceramic,0.001µF,5%,100V,AVX SA201A102JAA or equiv.	0125 11025
C12	Capacitor,variable,ceramic,6-70pF,Sprague-Goodman GKF700000 or equiv.	45362
C15,45,55,59,61	Capacitor,ceramic,0.001µF,10%,50V,AVX SR205A102KAA or equiv.	1007 1666
C16,17	Capacitor,ceramic,33pF,5%,100V,AVX SR151A330JAA or equiv.	1007 1639
C18	Capacitor,dipped ceramic,330pF,10%,100V,AVX SR151A331KAA or equiv.	1007 1672
C25,38,44,53,62	Capacitor,ceramic,100pF,5%,100V,AVX SA101A101JAA or equiv.	0125 11015
C26-31	Capacitor,ceramic,0.01µF,5%,100V,AVX SR301A103JAA or equiv.	1007 1645
C34,46,56,58,60	Capacitor,ceramic,0.1µF,10%,50V,AVX SR205C104KAA or equiv.	1007 1667
C35,40,69,79-89,98	Capacitor,tantalum,1µF,20%,35V,Kemet T322B105M035AS or equiv.	1007 496
C39,70,95	Capacitor,ceramic,220pF,5%,100V,AVX SA101A221JAA or equiv.	0125 12215
C42,43,66,67	Capacitor,X7R ceramic,0.047µF,10%,50V,AVX SA205C473KAA or equiv.	0130 54731
C47	Capacitor,ceramic,82pF,5%,100V,AVX SA101A820JAA or equiv.	0125 18205
C49,64	Capacitor,variable,ceramic,5-25pF,Johansen 9374 or equiv.	30129
C57	Capacitor,dipped ceramic,100pF,10%,100V,AVX SR151A101KAA or equiv.	1007 1671
C71	Capacitor,ceramic,27pF,5%,100V,AVX SA101A270JAA or equiv.	0125 12705
C75	Capacitor,X7R ceramic,0.01µF,10%,50V,AVX SA105C103KAA or equiv.	0130 51031
C90,91	Capacitor,ceramic,1µF,10%,50V,Type CK06	0110 6
C99,100	Capacitor,ceramic,150pF,5%,100V,AVX SA101A151JAA or equiv.	0125 11515
C102	Capacitor,ceramic,0.018µF,10%,50V,AVX SR305A183KAA or equiv.	1007 1646

Table 10-1. Replaceable parts - continued.

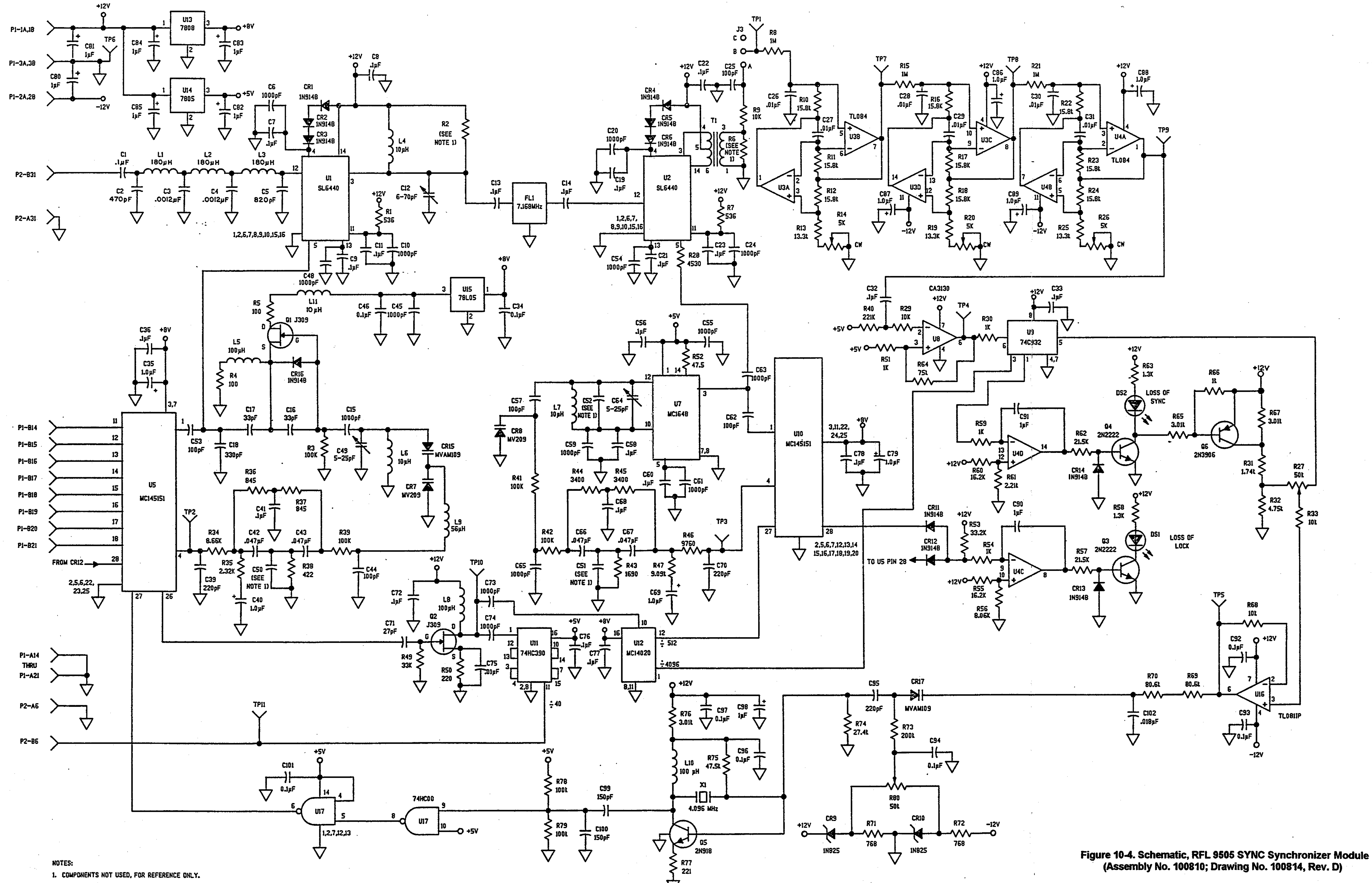
Circuit Symbol (Figs. 10-3 & 10-4)	Description	Part Number
	RESISTORS	
R1,7	Resistor,metal film,536Ω,1%,1/4W, Type RN1/4	0410 1262
R3,39,41,42,78,79	Resistor,metal film,100KΩ,1%,1/4W, Type RN1/4	0410 1480
R4,5	Resistor,metal film,100Ω,1%,1/4W, Type RN1/4	0410 1192
R8,15,21	Resistor,metal film,1MΩ,1%,1/4W,Mepco/Electra SPR5053YD1M000F or equiv.	1510 1813
R9,29,33,68	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R10-12	Resistor,metal film,15.8KΩ,1%,1/4W, Type RN1/4	0410 1403
R13,19,25	Resistor,metal film,13.3KΩ,1%,1/4W, Type RN1/4	0410 1396
R14,20,26	Resistor,variable,12-turn cermet,5KΩ,10%,1/4W,top adjust,Bourns 3266W-1-502 or equiv.	32995
R16-18	Resistor,metal film,15.8KΩ,1%,1/4W, Type RN1/4	0410 1403
R22-24	Resistor,metal film,15.4KΩ,1%,1/4W, Type RN1/4	0410 1402
R27,80	Resistor,variable,12-turn cermet,50KΩ,10%,1/4W,top adjust,Bourns 3266W-1-503 or equiv.	32998
R28	Resistor,metal film,4.53KΩ,1%,1/4W, Type RN1/4	0410 1351
R30,51,54,59,66	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R32	Resistor,metal film,4.75KΩ,1%,1/4W, Type RN1/4	0410 1353
R34	Resistor,metal film,8.66KΩ,1%,1/4W, Type RN1/4	0410 1378
R35	Resistor,metal film,2.32KΩ,1%,1/4W, Type RN1/4	0410 1323
R36,37	Resistor,metal film,845Ω,1%,1/4W, Type RN1/4	0410 1281
R38	Resistor,metal film,422Ω,1%,1/4W, Type RN1/4	0410 1252
R40	Resistor,metal film,221KΩ,1%,1/4W, Type RN1/4	0410 1513
R43	Resistor,metal film,1.69KΩ,1%,1/4W, Type RN1/4	0410 1310
R44,45	Resistor,metal film,3.4KΩ,1%,1/4W, Type RN1/4	0410 1339
R46	Resistor,metal film,9.76KΩ,1%,1/4W, Type RN1/4	0410 1383
R47	Resistor,metal film,9.09KΩ,1%,1/4W, Type RN1/4	0410 1380
R49,53	Resistor,metal film,33.2KΩ,1%,1/4W, Type RN1/4	0410 1434
R50,77	Resistor,metal film,221Ω,1%,1/4W, Type RN1/4	0410 1225
R52	Resistor,metal film,47.5Ω,1%,1/8W,Type RN55D	1510 707
R55	Resistor,metal film,16.2KΩ,1%,1/4W, Type RN1/4	0410 1404
R56,61	Resistor,metal film,8.06KΩ,1%,1/4W, Type RN1/4	0410 1375
R57,62	Resistor,metal film,21.5KΩ,1%,1/4W, Type RN1/4	0410 1416
R58,63	Resistor,metal film,1.3KΩ,1%,1/4W, Type RN1/4	0410 1299
R64	Resistor,metal film,75KΩ,1%,1/4W, Type RN1/4	0410 1468

Table 10-1. Replaceable parts - continued.

Circuit Symbol (Figs. 10-3 & 10-4)	Description	Part Number
	RESISTORS - continued.	
R65,67,76	Resistor,metal film,3.01KΩ,1%,1/4W, Type RN1/4	0410 1334
R69,70	Resistor,metal film,80.6KΩ,1%,1/4W, Type RN1/4	0410 1471
R71,72	Resistor,metal film,768Ω,1%,1/4W, Type RN1/4	0410 1277
R73	Resistor,metal film,200KΩ,1%,1/4W, Type RN1/4	0410 1509
R74	Resistor,metal film,27.4KΩ,1%,1/4W, Type RN1/4	0410 1426
R75	Resistor,metal film,47.5KΩ,1%,1/4W, Type RN1/4	0410 1449
	SEMICONDUCTORS	
CR1-6,11-14,16	Diode,silicon,1N914B or 1N4448	26482
CR7,8	Diode,varactor,26-32pF,Motorola MV209 or equiv.	32509
CR9,10	Diode,Zener,temperature-compensated,6.2V,5%,400mW,1N825	29523
CR15,17	Diode,varactor,400-520pF,Motorola MVAM109 or equiv.	32598
DS1,2	Light-emitting diode,red,Dialight 550-0102 or equiv.	39568
Q1,2	Transistor,N-channel JFET,VHF/UHF,TO-92 case,Siliconix J309 or equiv.	32531
Q3,4	Transistor,NPN,plastic package,2N2222A	37445
Q6	Transistor,PNP,2N3906	21565
U1,2	Linear mixer,16-pin DIP, Plessey SL 6440C/DP or equiv.	0620 250
U3,4	Linear operational amplifier,JFET input,14-pin DIP,Texas Instruments TL084IN or equiv.	0620 182
U5,10	MOS frequency synthesizer,28-pin DIP,Motorola MC145151P or equiv.	0615 198
U7	Voltage-controlled oscillator,14-pin DIP,Motorola M1648P or equiv.	0690 3
U8	Linear operational amplifier,BIMOS,8-pin DIP,RCA CA3160AE or equiv.	0620 264
U9	MOS phase comparator,8-pin DIP,National Semiconductor MM74C932N or equiv.	0615 244
U11	MOS dual 4-bit decade counter,16-pin DIP,National Semiconductor MM74HC390N or equiv.	0615 252
U12	MOS binary counter,14-stage ripple-carry,16-pin ceramic DIP, National Semiconductor CD4020BMJ or equiv.	0615 208
U13	Linear voltage regulator,+8-volt,3-terminal TO-220 package,Motorola MC7808CT or equiv.	0620 141
U14	Linear voltage regulator,+5-volt,3-terminal plastic package,Motorola MC7805CP or equiv.	0620 77
U15	Linear voltage regulator,+5-volt,3-terminal TO-92 package, National Semiconductor LM78L05ACZ or equiv.	0620 204
U16	Linear operational amplifier,JFET input,8-pin DIP,Texas Instruments TL081IP or equiv.	0620 228
U17	MOS quad 2-input NAND gate,14-pin DIP,National Semiconductor MM74HC00N or equiv.	0615 159

Table 10-1. Replaceable parts - continued.

Circuit Symbol (Figs. 10-3 & 10-4)	Description	Part Number
	MISCELLANEOUS COMPONENTS	
FL1	Crystal filter,7.168 MHz	96991 1
L1-3	Inductor,rf,molded,180µH,10%,Gowanda 10/183 or equiv.	32505 2
L5,8,10	Inductor,rf,molded,100µH,10%,Gowanda 10/103 or equiv.	32505 1
L4,6,7	Shielded inductor assembly	96955
L9	Inductor,molded,56µH,100mA,powdered iron core,Jeffers Electronics Type 09-1326-4K or equiv.	32824
L11	Inductor,molded,10µH,220mA,Jeffers Electronics 15S100K or equiv.	30128
T1	Transformer, audio, 50,000Ω primary, 600Ω center-tapped secondary, 200-Hz to 15-KHz frequency response, Microtran MMT4-M or equiv.	96992
Y1	Crystal,quartz,4.096 MHz	96967



NOTES:

1. COMPONENTS NOT USED, FOR REFERENCE ONLY.

Figure 10-4. Schematic, RFL 9505 SYNC Synchronizer Module (Assembly No. 100810; Drawing No. 100814, Rev. D)

Section 11. SERVICE PHONE ASSEMBLY

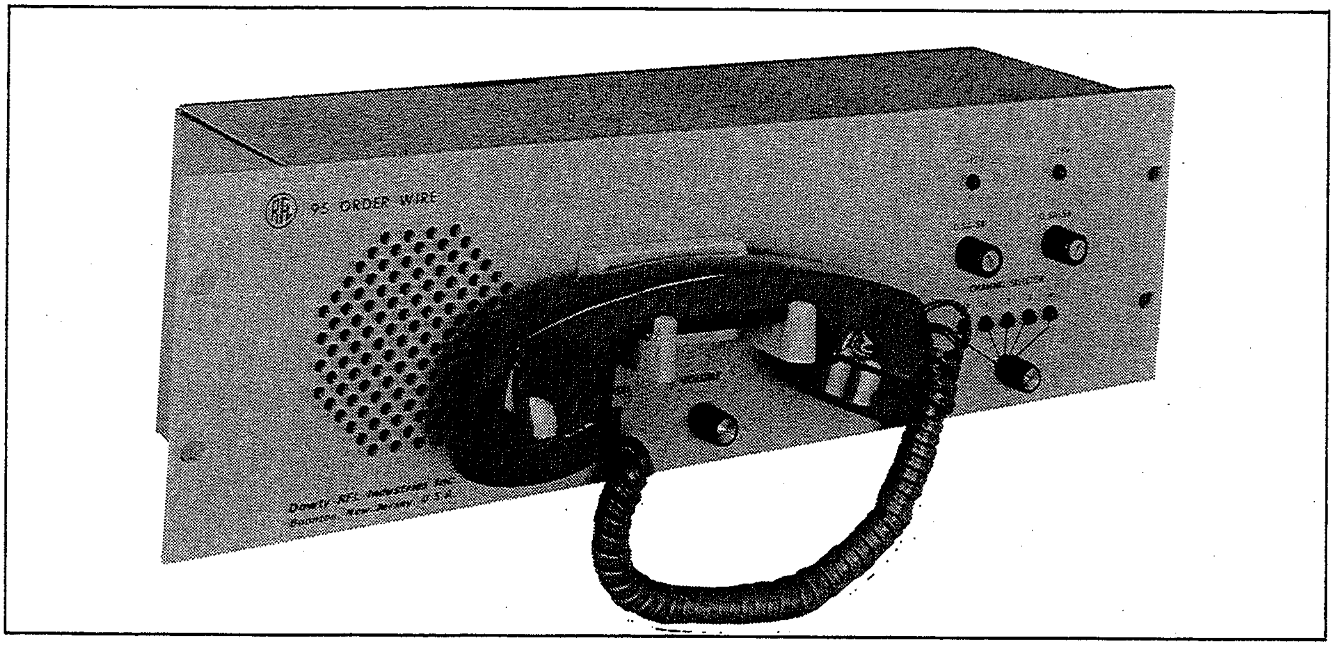


Figure 11-1. RFL 95 ORDERWIRE Service Phone Assembly

11.1. DESCRIPTION

The RFL 95 ORDERWIRE Service Phone Assembly (Fig. 11-1) allows voice communication to take place over the powerline carrier. A telephone handset is used for talking and listening, and a loudspeaker is also provided for hands-free listening. An unused modem module's signaling transceiver may be used for remote signaling, or an optional internal signaling channel (ring option) may be used.

The 95 ORDERWIRE is housed in a separate 19-inch rack-mountable chassis, and obtains its input power from the RFL 9505's amplifier/power supply assembly (Section 7).

11.2. SPECIFICATIONS

As of the date this manual was published, the following specifications apply to the RFL 95 ORDERWIRE. Because all RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

Audio Input Level: -10dBm, bridging.

Output Level:
Order Wire: -16 dBm, bridging.
Speaker: 5 watts maximum.

Output Distortion: 4% maximum.

Audio Activity Timer Range: 15 to 35 seconds.

Ring Option:
Signaling Transmit Frequency: 3570 to 3630 Hz.
Receive Frequency: 3560 to 3640 Hz.

Power Requirements:
+15-Volt Supply: 350 mA maximum.
-15-Volt Supply: 50 mA maximum.

Operating Temperature: -20°C to +55°C (-4°F to +131°F)

Dimensions: 19 inches wide x 5 1/2 inches high x 4 inches deep (48.3 cm x 14 cm x 10.2 cm); occupies three vertical spaces in an EIA-Standard 19-inch rack or cabinet.

11.3. THEORY OF OPERATION

The 95 ORDERWIRE Service Phone Assembly is used mainly during system maintenance. It allows a station operator to monitor the active audio lines of the RFL 9505 PLC system, or to talk to an operator at another station. The 95 ORDERWIRE bridges the incoming and outgoing lines, so that the normal operation of the system is not affected. A standard telephone handset is provided for talking and listening, or the built-in power amplifier and loudspeaker can be used for hands-off communications.

A block diagram of the 95 ORDERWIRE appears in Figure 11-2. Figure 11-3 is a component locator drawing for the 95 ORDERWIRE, and its schematic can be found in Figure 11-4. A component locator drawing for the ring option circuit board appears in Figure 11-5; its schematic appears as Figure 11-6.

a. Channel Selection. CHANNEL SELECTOR switch S1 determines which channel will be used for voice communications. Sections S1B and S1C select the desired receive line, and resistors R50 and R51 are in series with the wipers to hold the line impedance to 10,000 ohms. This allows the line to be bridged without any significant disturbances.

b. Line Connection Relay. Relay K1 controls whether the 95 ORDERWIRE is connected to the communication lines. When the 95 ORDERWIRE is not being used, K1 is de-energized and the unit is not connected to any of the lines. However, once the telephone handset is lifted out of its cradle, the hookswitch is closed and operational amplifier U1 energizes K1, closing its contacts and making the connections across the line.

c. Received Signal Processing. Signals received from a remote station through the selected communication line are applied to the primary of isolation/balance transformer T1. The secondary of T1 supplies the input signal for operational amplifier U2B, which drives operational amplifier U2A to provide the signal for the earphone in the handset, and audio amplifier U11 to provide the signal for driving the loudspeaker.

The speaker can be muted by the action of field-effect transistor Q8 and its associated components. The speaker is muted every time the press-to-talk switch on the handset is pressed. It is also muted whenever the handset is placed on the hook switch (the operator hangs up).

d. Voice Signal Processing. When the station operator talks into the handset, the microphone output is fed to operational amplifier U6A, where it is amplified before it is applied to operational amplifier U2A to become the side-tone for the earphone in the handset. The output of U6A is also fed to a bridge amplifier formed from operational amplifiers U5A and U5B. This bridge amplifier drives the primary of isolation/bridging transformer T2, which provides the signal for driving the line.

e. Time-Out Circuit. The time-out circuit is deactivated every time the station operator speaks into the handset. This time-out feature is provided so that an unattended station will not cause additional background noise to be injected onto the selected line.

Operational amplifiers U9A and U9B are connected as a comparator. This comparator monitors the output of the operational amplifier U6A to determine whether the operator has stopped talking. If the comparator detects no output from the microphone, it will turn on operational amplifier U6B. The output of U6B is used to activate timer U8. The output of U8 is applied to a series of NAND gates; U7B and U10B are interconnected to form a flip-flop, and U10C and U10D have their inputs connected together so they function as inverters.

As soon as U8 times out, pin 11 of U10D will generate the TIME OUT signal at terminal 21 at the rear of the 95 ORDERWIRE. At the same time, the flip-flop will change states, turning off transistor Q6; this shuts down operational amplifier U1 and de-energized relay K1, disconnecting the 95 ORDERWIRE from the line. If the operator starts talking again before U8 times out, the comparator will turn off U6B and U8 will be disabled before it can force the 95 ORDERWIRE to disconnect.

f. Ring Option. The ring option allows a station operator to send an audible tone to a remote station, to let the remote station operator know there is an incoming call. This tone will be produced at the remote station, regardless of the CHANNEL SELECTOR switch setting. This process is called "ringing down" the remote station. The ring option circuits are mounted on a separate circuit board, which plugs onto the main circuit board of the 95 ORDERWIRE.

Quad operational amplifier U108 forms a state-variable oscillator, which provides an out-of-band signaling tone (3600 Hz) to the selected channel. Potentiometer R186 adjusts the oscillation frequency, and potentiometer R191 sets the output level. The signaling tone will be sent over the selected line whenever PUSH TO CALL switch S2 on the front panel is pressed.

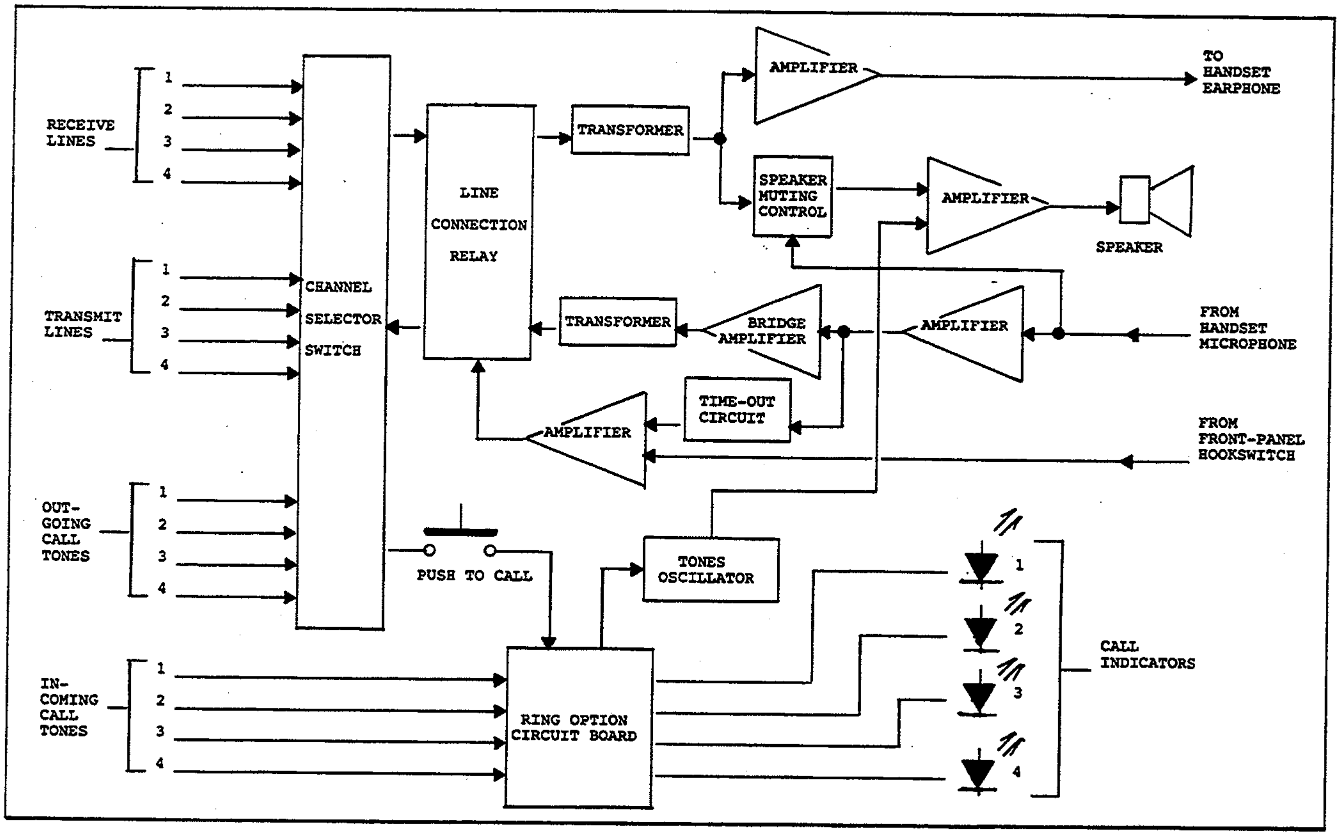


Figure 11-2. Block diagram, RFL 95 ORDERWIRE Service Phone Assembly

There are also four active filters (one for each channel), used to detect incoming 3600-Hz tones from another RFL 9505 station. These filters are formed from quad operational amplifiers U101, U102, U105, and U106, and their associated components. The bandwidths of these filters are adjusted by potentiometers R109, R115, R128, R134, R148, R154, R168, and R174.

Each section of quad operational amplifier U107 forms a precision half-wave rectifier, which uses the output of one of the filters to drive a comparator formed from one section of quad operational amplifier U103. The comparator outputs provide four independent outputs for driving the tones oscillator on the main circuit board (linear timer U4) and lighting the indicator lamps on the front panel.

Table 11-1. Replaceable parts, RFL 95 ORDERWIRE Service Phone Assembly
Assembly No. 100890

Circuit Symbol (Figs. 11-3 & 11-4)	Description	Part Number
	CAPACITORS	
C1,9	Capacitor,tantalum,1μF,20%,35V,Kemet T322B105M035AS or equiv.	1007 496
C2,26,	Capacitor,ceramic,0.001μF,5%,100V,AVX SA201A102JAA or equiv.	0125 11025
C3,14,15,27	Capacitor,X7R ceramic,0.01μF,10%,50V,AVX SA105C103KAA or equiv.	0130 51031
C4,6,10,13,17-23	Capacitor,X7R ceramic,0.1μF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C5,8	Capacitor, electrolytic, 470uF, +50-10%, 25V, United Chemi-com GX16T471T16X25LL or equiv.	1007 1760
C7	Capacitor,X7R ceramic,0.047μF,10%,50V,AVX SA205C473KAA or equiv.	0130 54731
C11,16	Not used.	
C12	Capacitor,tantalum,10μF,10%,10V,Corning Components CCM-010-106-10 or equiv.	1007 1245
C24,25	Capacitor,electrolytic,1000μF,+50-10%,25V,Siemens 85209/1000/25 or equiv.	1007 1633
	RESISTORS	
R1,4,7,10,23,36,40,65,66	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R2,3,5,6,8,9,11,12,16, 19-21,24,30-33,41,43, 44,48,49,54-58,61,64	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R13,22	Resistor,metal film,9.09KΩ,1%,1/4W, Type RN1/4	0410 1380
R14	Resistor,metal film,2.21KΩ,1%,1/4W, Type RN1/4	0410 1321
R15	Resistor,metal film,249Ω,1%,1/4W, Type RN1/4	0410 1230
R17,42,45,63,67-70	Resistor,metal film,100KΩ,1%,1/4W, Type RN1/4	0410 1480
R18,37,47	Resistor,variable,18-turn cermet,10KΩ,10%,1/2W,Beckman Helipot 68WR10K or equiv.	48548
R25,50-53	Resistor,metal film,4.75KΩ,1%,1/4W, Type RN1/4	0410 1353
R26	Resistor,composition,1Ω,5%,1/2W,Allen-Bradley EB Series or equiv.	1009 978
R27	Resistor,composition,39Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 831
R28	Resistor,composition,2.2Ω,5%,1/2W,Allen-Bradley EB Series or equiv.	1009 1059
R29	Resistor,metal film,221Ω,1%,1/4W, Type RN1/4	0410 1225
R34,38	Resistor,metal film,39.2KΩ,1%,1/4W, Type RN1/4	0410 1441
R35,39	Resistor,metal film,715Ω,1%,1/4W, Type RN1/4	0410 1274
R46	Resistor,variable,single-turn cermet,10KΩ,10%,2W,audio taper,PC mount, Bourns 81C1DE24C15 or equiv.	91835
R59,60	Resistor,metal film,47.5KΩ,1%,1/4W, Type RN1/4	0410 1449
R62	Resistor,metal film,1.5MΩ,1%,1/4W,Mepco/Electra SPR5053YD1M500F or equiv.	1510 1812

Table 11-1. Replaceable parts - continued.

Circuit Symbol (Figs. 11-3 & 11-4)	Description	Part Number
	SEMICONDUCTORS	
CR1-8	Diode,silicon,1N914B or 1N4448	26482
DS1-4	Light-emitting diode,red,panel mount,Dialight 559-0101-001 or equiv.	91114
Q1-4,6,7	Transistor,NPN,plastic package,2N2222A	37445
Q5	Transistor,PNP,plastic package,2N2907A	37439
Q8	Transistor,N-channel MOSFET,enhancement mode,60V,TO-52 case,Siliconix VN10LE or equiv.	0715 14
U1,3	Linear voltage comparator/buffer,8-pin DIP,National Semiconductor LM311N or equiv.	0620 188
U2,5,6	Linear operational amplifier,JFET input,8-pin DIP,Texas Instruments TL082CP or equiv.	0620 155
U4	Linear timer,8-pin DIP,National Semiconductor LM555CN or equiv.	0620 108
U7	MOS dual 4-input NAND gate,14-pin DIP,RCA CD4012BE or equiv.	0615 9
U8	MOS 14-stage ripple-carry binary counter/divider and oscillator,16-pin DIP, RCA CD4060BE or equiv.	0615 131
U9	Linear voltage comparator,dual,low offset voltage,8-pin DIP,Motorola LM393N or equiv.	0620 144
U10	MOS 14-stage ripple-carry binary counter/divider and oscillator,16-pin DIP, RCA CD4060BE or equiv.	0615 5
U11	Power amplifier,audio,6 watts into 4Ω load,National Semiconductor TDA-2003 or equiv.	32860
U12	Linear voltage regulator,+8-volt,3-terminal TO-220 package,Motorola MC7808CT or equiv.	0620 141
	MISCELLANEOUS COMPONENTS	
F1,F2	Fuse,3AG slow-blow,1/2A,250V,Littelfuse 313.500 or equiv.	6723
K1	Relay,4PDT,PC-mount,12-volt/720-ohm coil,Aromat DS4-S-12V or equiv.	95282
L1	Inductor,rf,molded,100µH,10%,Gowanda 10/103 or equiv.	32505 1
S1	Switch,rotary,5-deck,5-position,1 pole/deck,30° index, Stackpole Series 60 or equiv.	32865
S2	Switch,momentary pushbutton,4PDT,C&K Components 8425 or equiv.	46742
T1,2	Transformer,telephone-coupling,600Ω,Microtran T2104 or equiv.	32510
---	Handset,telephone,red w/push-to-talk switch and 5-foot coil cord with modular connector,Allied Telephone Products GB6947-4-5-M or equiv.	32935
---	Hookswitch assembly,gray,SPST contacts,Allied Telephone Products AT10784A-14 or equiv.	47668
---	Speaker,3 1/2-inch square,8Ω,4-watt,Quam-Nichols 3C1Z8 or equiv.	32954

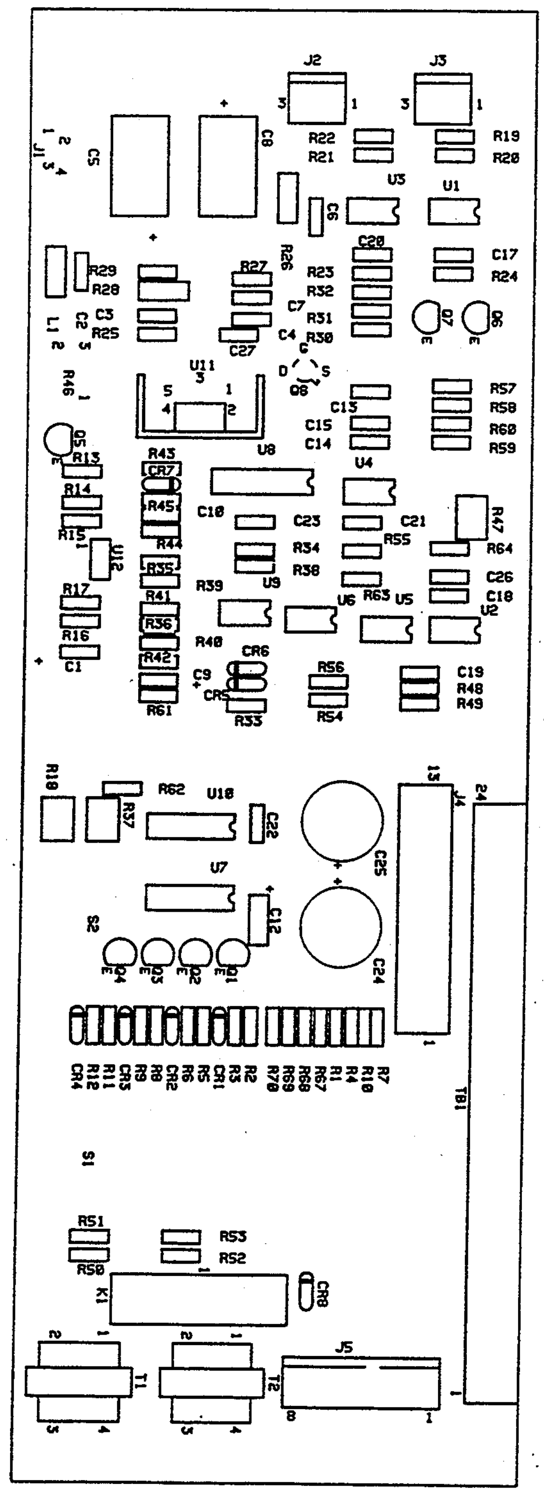
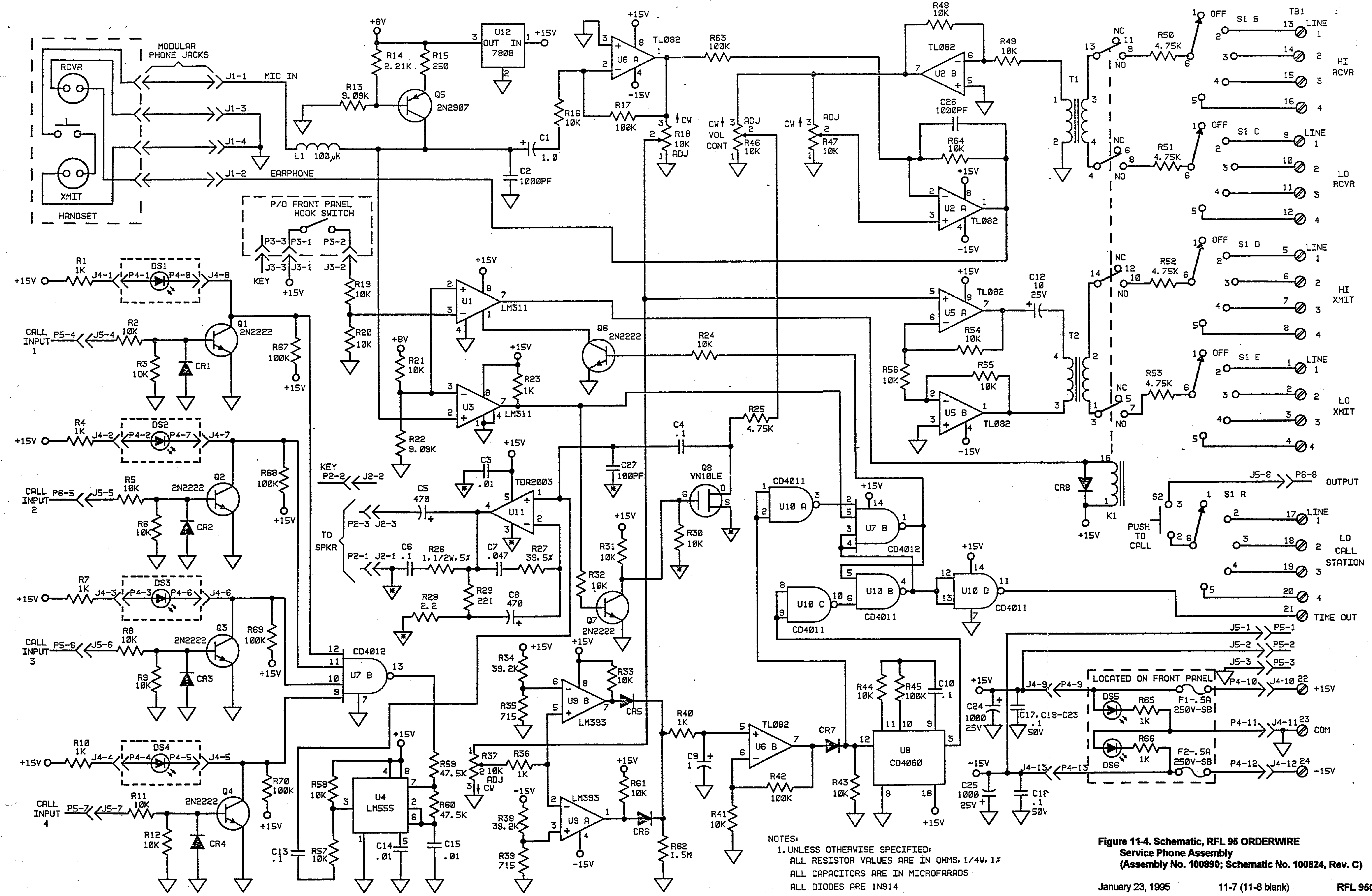


Figure 11-3. Component locator drawing, RFL 95 ORDERWIRE Service Phone Assembly (Assembly No. 100890; Drawing No. 100823, Rev. H)



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 1%
ALL CAPACITORS ARE IN MICROFARADS
ALL DIODES ARE 1N914

Figure 11-4. Schematic, RFL 95 ORDERWIRE Service Phone Assembly (Assembly No. 100890; Schematic No. 100824, Rev. C)

Table 11-2. Replaceable parts, ring option for RFL 95 ORDERWIRE
Assembly No. 100825

Circuit Symbol (Figs. 11-5 & 11-6)	Description	Part Number
	CAPACITORS	
C101,106,107,112,113,118,119, 124,127-136	Capacitor,X7R ceramic,0.1μF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C102-105,108-111,114-117, 120-123	Capacitor,ceramic,0.01μF,5%,100V,AVX SR301A103JAA or equiv.	1007 1645
C125,126	Capacitor,ceramic,470pF,5%,100V,AVX SA101A471JAA or equiv.	0125 14715
	RESISTORS	
R101,102,117,120,121,136,138, 140,141,156,157,160,161,176, 177,181,192,193	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R103,122,142,162	Resistor,metal film,47.5KΩ,1%,1/4W, Type RN1/4	0410 1449
R104,110,123,129,143,149, 163,169	Resistor,metal film,301KΩ,1%,1/4W, Type RN1/4	0410 1526
R105-107,111-113,124-126, 130-132,144-146,150-152, 164-166,170-172	Resistor,metal film,4.42KΩ,1%,1/4W, Type RN1/4	0410 1350
R108,114,127,133,147,153,167, 173	Resistor,metal film,3.92KΩ,1%,1/4W, Type RN1/4	0410 1345
R109,115,128,134,148,154,168, 174,	Resistor,variable,18-turn cermet,1KΩ,10%,1/2W,Beckman Helipot 68XR1K or equiv.	91952
R116,119,135,139,155,159,175, 179,180	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R118,137,158,178	Resistor,metal film,475KΩ,1%,1/4W, Type RN1/4	0410 1545
R182	Resistor,metal film,200KΩ,1%,1/4W, Type RN1/4	0410 1509
R183	Resistor,metal film,340KΩ,1%,1/4W, Type RN1/4	0410 1531
R184	Resistor,metal film,52.3KΩ,1%,1/4W, Type RN1/4	0410 1453
R185	Resistor,metal film,2KΩ,1%,1/4W, Type RN1/4	0410 1317
R188,190	Resistor,metal film,93.1KΩ,1%,1/4W, Type RN1/4	0410 1477
R187,189	Resistor,metal film,9.53KΩ,1%,1/4W, Type RN1/4	0410 1382
R191	Resistor,variable,18-turn cermet,100KΩ,10%,1/2W,Beckman Helipot 68XR100K or equiv.	49996
R186	Resistor,variable,18-turn cermet,2KΩ,10%,1/2W,Beckman Helipot 68XR2K or equiv.	49999
	SEMICONDUCTORS	
CR101-108	Diode,silicon,1N914B or 1N4448	26482
U101,102,104-108	Linear operational amplifier,JFET input,14-pin DIP,Texas Instruments TL084CN or equiv.	0620 151
U103	Linear comparator,quad,14-pin DIP,National Semiconductor LM399N or equiv.	0620 119

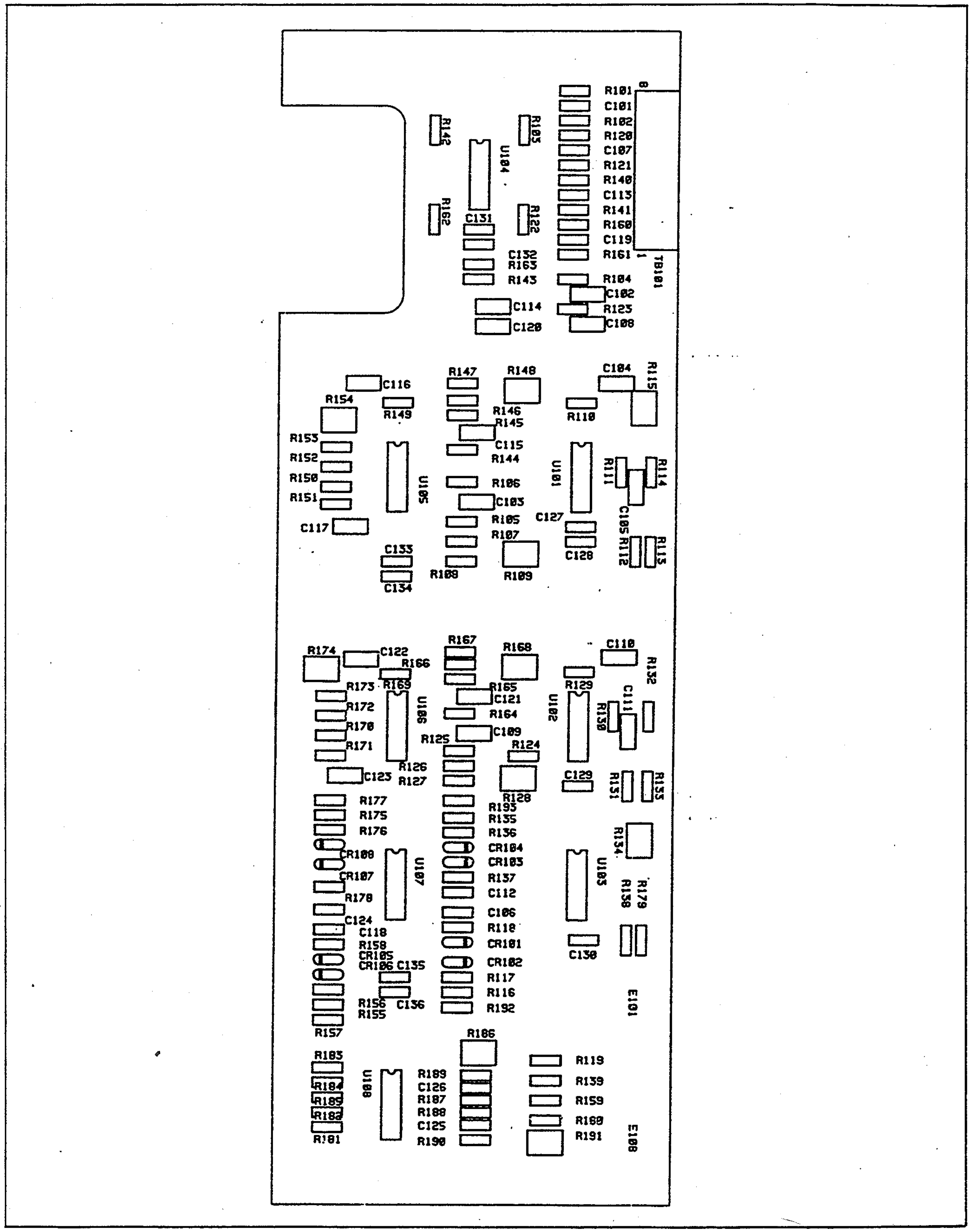
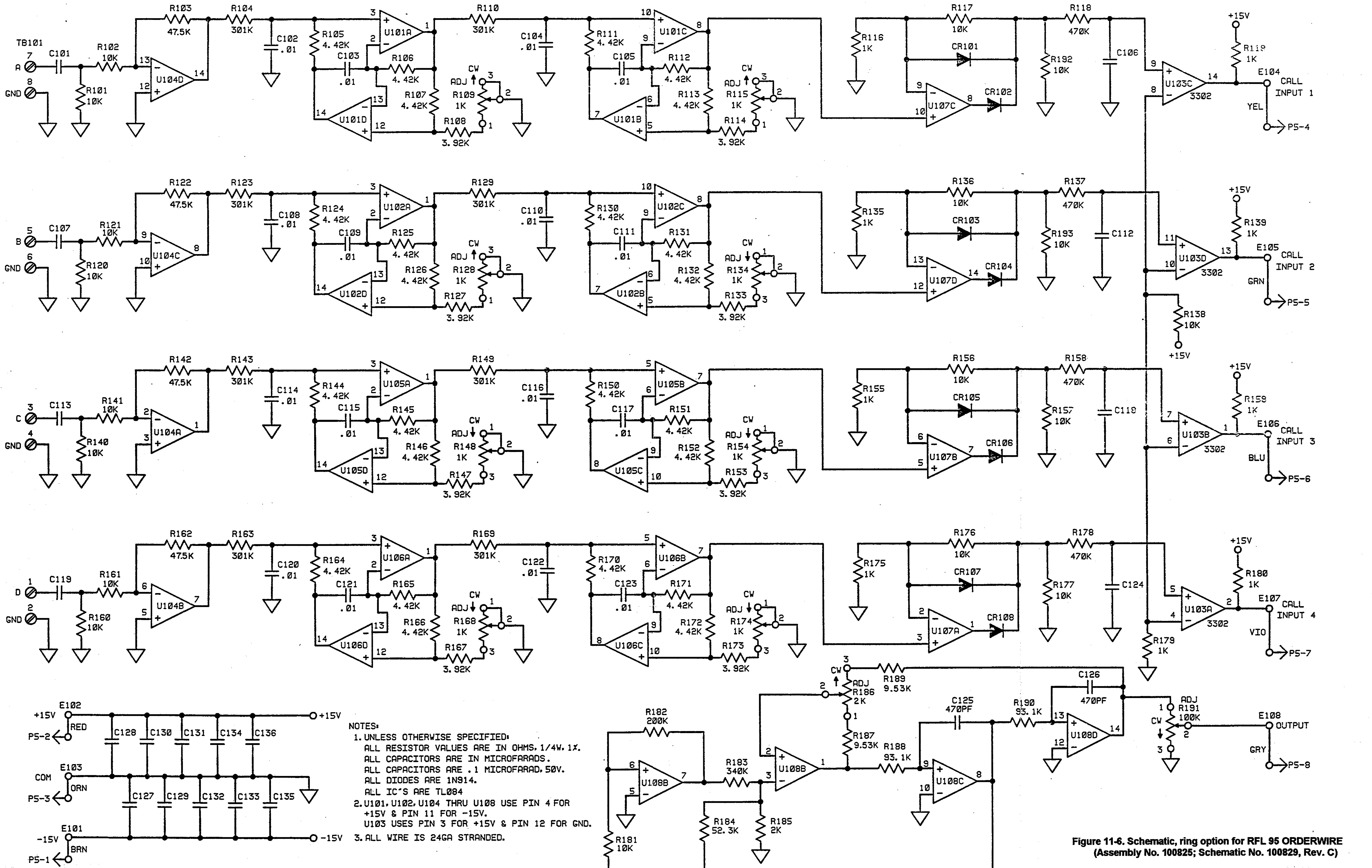


Figure 11-5. Component locator drawing, ring option for RFL 95 ORDERWIRE (Assembly No. 100825; Drawing No. 100828, Rev. F)



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 1%.
   ALL CAPACITORS ARE IN MICROFARADS.
   ALL CAPACITORS ARE .1 MICROFARAD, 50V.
   ALL DIODES ARE 1N914.
   ALL IC'S ARE TL084
2. U101, U102, U104 THRU U108 USE PIN 4 FOR +15V & PIN 11 FOR -15V.
   U103 USES PIN 3 FOR +15V & PIN 12 FOR GND.
3. ALL WIRE IS 24GA STRANDED.

Figure 11-6. Schematic, ring option for RFL 95 ORDERWIRE (Assembly No. 100825; Schematic No. 100829, Rev. C)

Section 12: ACCESSORY EQUIPMENT AND SYSTEM DRAWINGS

If any accessory equipment was furnished with your RFL 9505 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.

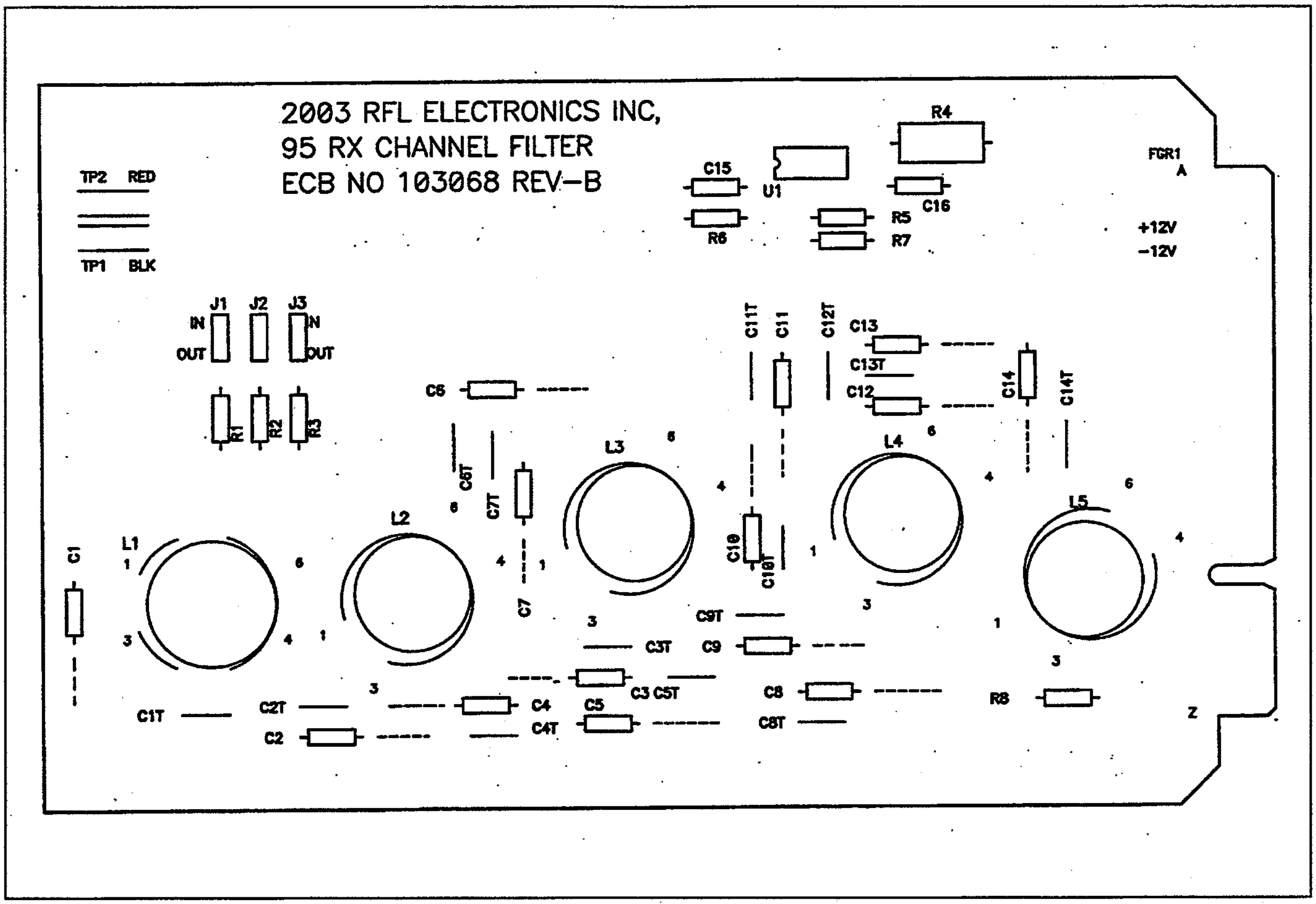


Figure 12-1. Component locator drawing, 95 RX Channel Filter (Drawing No. 103065-X)

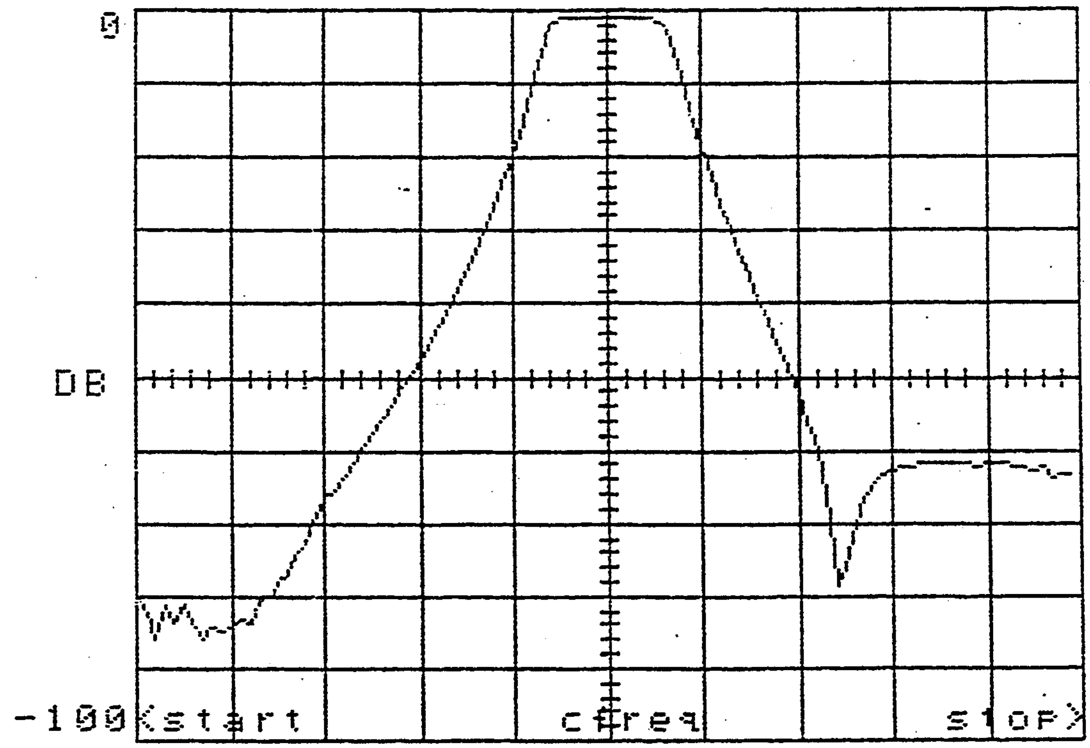
12.1 95 RX Channel Filter Description

In some installations, the RFL 9505 Programmable Powerline Carrier System requires the use of one or more 95 RX Channel Filters. Each filter consists of active and passive components mounted on a plug-in circuit board, which plugs into an RFL 68 CHAS (Auxiliary Chassis) which is three rack units high. Because the buffer is an active device, the board needs +12v and -12v connected to pins 3 and 4 respectively.

The 95 RX Channel Filter is a bandpass filter configured as an LC ladder network. It selects the desired frequency signal from others that may be multiplexed on the same power line and rejects extraneous frequencies. Each filter is tuned to the frequency at which the system is intended to receive from the powerline.

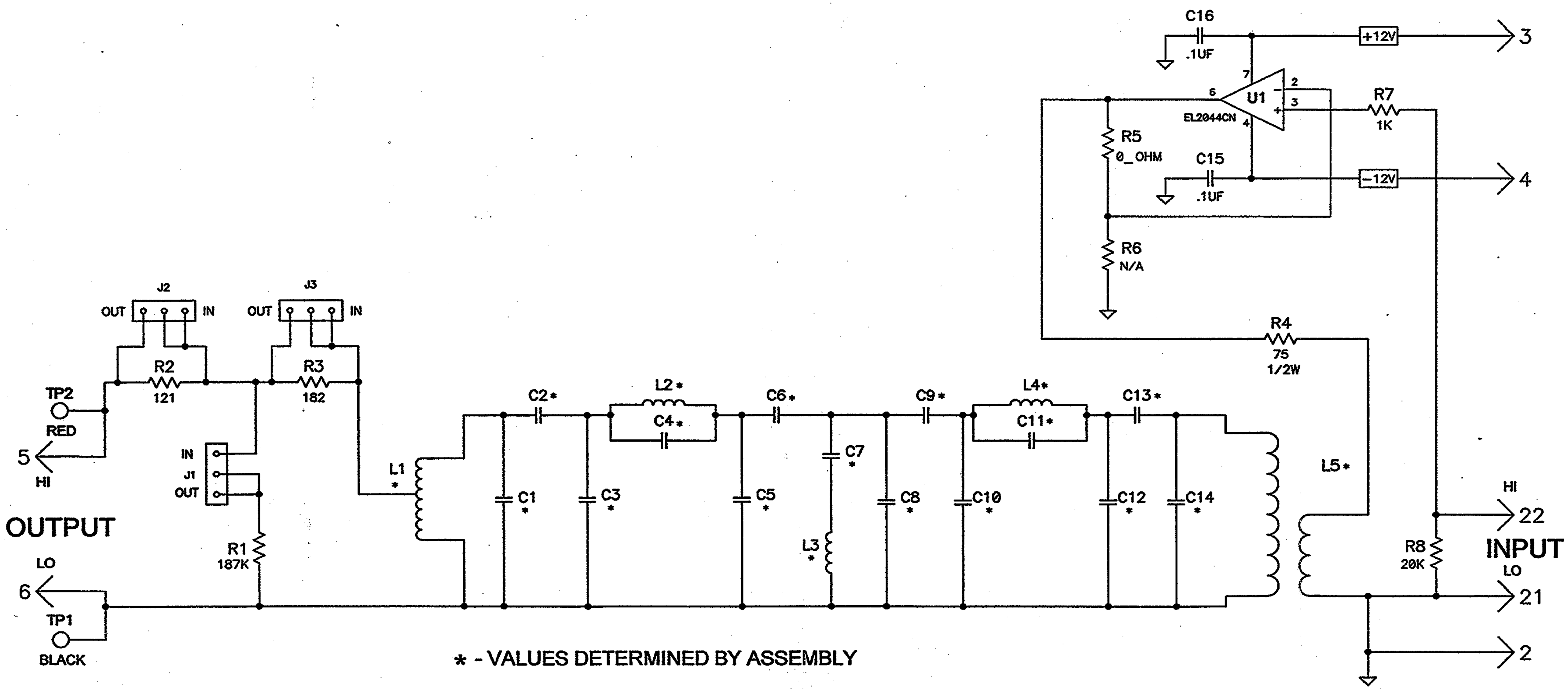
A component locator drawing for the 95 RX Channel Filter is shown in Figure 12-1, a typical frequency response curve is shown in Figure 12-2, and a schematic diagram is shown in Figure 12-3. Electrical values of the components are not given because each filter is customized to the required line frequency.

The Channel Filter input buffer provides a high impedance to the line and a 75 ohm impedance to the filter. The buffer has unity gain.



Vertical scale = 10 dB/division
Horizontal scale = 10 kHz/division
Cfreq = center frequency

Figure 12-2. Typical frequency response curve for the 95 RX Channel filter



APPLICATION NOTE:

J1,J2 AND J3 ARE SITE INSTALLED DEPENDING ON THE NUMBER OF MODEM AND/OR SYNCH CARDS INSTALLED IN THE SYSTEM.

	IN	OUT
1 MODEM	J1	J2, J3
2 MODEMS OR 1 MODEM AND 1 SYNCH CARD	J2	J1, J3
3 MODEMS OR 2 MODEMS AND 1 SYNCH CARD	J3	J1, J2

Figure 12-3. Schematic, RFL 95 RX Channel Filter (Assembly No. 78210-X, Schematic No. B-103069-B