OPERATION AND INSTALLATION MANUAL

SC130D(E)

SYNTHESIZED PATROLFONE

HF-SSB TRANSCEIVER

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SC130D(E)

Operation and Maintenance Manual

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General Information

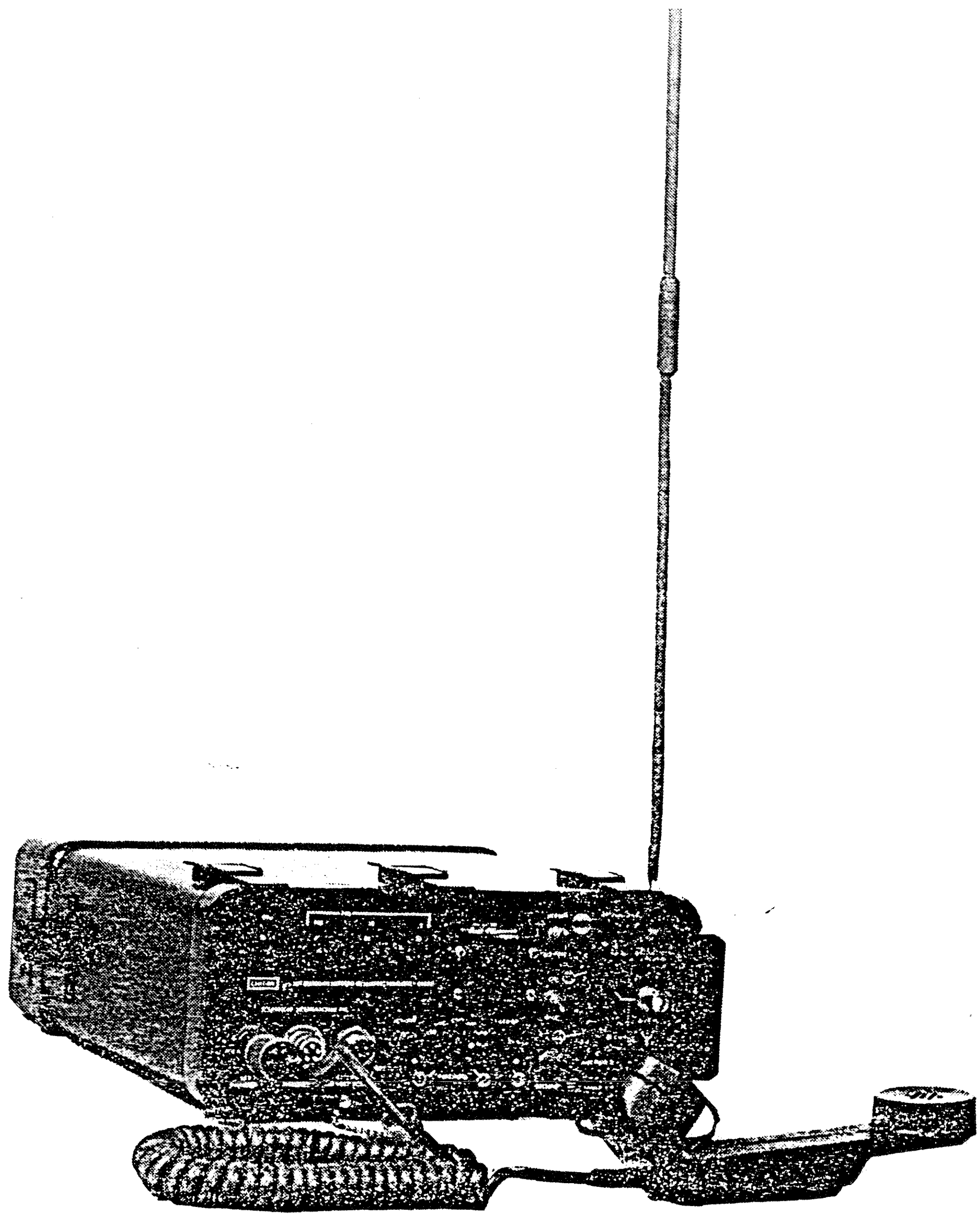


Figure 1.1. Typical SC130D(E) Transceiver Configuration

GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains information for the installation, operation and maintenance of the Southcom Model SC130D(E) "Patrolfone" HF Transceiver (hereafter referred to as the transceiver) and accessory equipment. The descriptions and instructions contained herein are sufficient to allow an experienced electronics technician perform all necessary operational, alignment, troubleshooting and maintenance procedures. No other documents or data are furnished or deemed necessary to comply with this basic purpose. Whenever ancillary test equipment is essential to the proper performance of a specific procedure, a list of such equipment is included within the section containing the subject procedure.

A list of available accessories is included in Table 1.1. Utilization of these accessories provides great flexibility in the selection of various system configurations and power sources.

1.2 GENERAL DESCRIPTION

The SC130D(E) Transceiver (see Figure 1.1) is a medium power unit which may be used for fixed, portable, manpack or vehicular operation. Transmission and reception of single sideband suppressed carrier (A3J), telegraphy (A1) and compatible amplitude modulation (A3H) signals is provided in the operational frequency range of 2.0 to 12.0 MHz. Incremental channel spacing is 1.0 KHz. Output power level is selectable from the front panel.

1.2 cont'd

The SC130D(E) Transceiver is a self-contained communications system, designed for satisfactory operation over a temperature range of -30°C to 60°C, and only requires connection to the appropriate antenna for immediate operation. It will withstand shock and vibration levels normally encountered in operation of equipment of this nature and the case is fully waterproofed. Thus, the transceiver may be safely and satisfactorily operated out of doors under all normal environmental conditions.

The built-in L-Section antenna tuner and VSWR bridge permits loading into a wide variety of antenna systems, including the center-loaded whip for manpack or vehicular operation. A Mobile Mounting Rack and Mobile Whip Antenna is also available for vehicular use. For this application, it should be noted that the connecting lead from the transceiver to the antenna should be unshielded, insulated wire (use of coaxial cable for this purpose is a common error) and the length of this lead must be kept to a minimum. Panel markings indicate the settings for standard 50 ohm antenna systems.

The transceiver may be powered from an internal battery pack (Nickel Cadmium or sealed, rechargeable Lead Acid) or from an external 12 volt vehicle battery in a mobile installation. A special connecting lead is provided for use with external sources. Table 1.1 is a list of all accessories available for typical system configurations.

1.2
cont'd

TABLE 1.1. List Of Accessories

DESCRIPTION	PART NUMBER	NOMENCLATURE
Transceiver/NiCad Battery Box	99137600	
Transceiver/Lead Acid Battery Pack	99138900	
Transceiver Only	99137500	SC130RT
Battery Box/NiCad	99130200	SC130BB(NC)
Handset	99130400	SC609
CW Key, Field	99130500	SC607A
CW Key, Base Station	99225000	SC607B
Carrying Rack	99130600	SC130RC
Antenna, Whip	99004800	SC130AW
Antenna, Dipole	99002100	SC503
Battery Set, NiCad	99005500	SC130BA(NC)
Carrying Bag, Nylon	90000400	SC130BC
Battery Pack/Lead Acid	99227300	SC130BA(LA)
Battery Charger (NiCad)	99001500	SC811
Battery Charger (Lead Acid)	99130800	SC807
Power Supply/Charger	99130900	SC804
Mounting Rack, Mobile	99002500	SC130MR
Connecting Lead (External Power)	99131000	SC130CL
Whip Antenna, Mobile	99004300	SC130MW
Hand Generator	99213600	SC806A
Hand Microphone	99133000	SC610
Solar Power Unit	99134100	SC805A
Operator's Manual	99138800	SC130D(E)OM
Maintenance Manual	99138300	SC130D(E)MA
Running Spares Kit	99210000	SC130D RSK
Operational Spares Kit	99138600	SC130D(E) OSK
Depot Maintenance Spares Kit	99138500	SC130D(E) DMSK

1.3 TYPICAL SYSTEM APPLICATIONS

The SC130D(E) Transceiver may be used for short, medium or long range communications, dependent upon numerous factors; e.g., the selection of antenna systems, nature of local terrain, atmospheric conditions, frequency of operation and time of the day, month and year. Thus, it is virtually impossible to specify a single range for the equipment over such a wide variety of circumstances and conditions. Further, the large number of possible combinations of circumstances and conditions prevent compilation of a meaningful list of typical range calculations. However, the design of the unit has been optimized to provide the best voice communications range available under any possible combination of conditions with equipment of this type. Table 1.2 lists some typical system applications.

TABLE 1.2. Typical System Applications

OPERATION	ANTENNA	POWER SOURCE	APPLICATION
Manpack	Whip	Internal	Infantry patrols or other operations requiring mobility in hand carried mode.
Portable	Whip/Long-Wire	Internal or 12V Battery	Field stations, exploration parties, surveyors, etc.
Mobile	Whip	12V Vehicle Battery	Vehicle operation, stationary or moving.
Base	Long-Wire/Dipole	AC Power Supply	Medium power base station operation.

1.4 COMPATIBILITY

The SC130D(E) Transceiver may be operated in conjunction with other SSB equipment including amplifiers such as the SC200. The transmitter is designed for freedom from spurious radiations and should not cause interference when operating in the vicinity of other communications equipment. The receiver is designed to operate in close proximity to powerful transmitters with minimum interference or overload. The range of the clarifier and agc (automatic gain control) systems provide for effective reception of all SSB (single sideband) signals. The SC130D(E) is also an efficient CW (Telegraphy) transceiver and may be used in conjunction with other CW equipment. The compatible AM mode is provided for communication with AM equipment not designed for SSB operation.

1.5 MECHANICAL DESCRIPTION

The general descriptions contained in this paragraph are only intended to identify unique or important physical features of the transceiver and accessory equipment. Refer to Table 1.3 for specific size and weight of the basic transceiver. Figure 1.1 shows a typical system configuration. Figure 1.2 is a pictorial montage of available accessories.

The SC130D(E) Transceiver consists of an aluminum chassis, mounted to a Lexan front panel. The chassis and panel fit into a one piece outer case. A silicon rubber gasket around the edge of the panel prevents entry of water into the interior. The outer case and front panel are secured with six (6) spring-loaded clips. These clips provide quick release for access to internal components but maintain constant pressure on the panel seal when fastened.

TABLE 1.3. Technical Characteristics

GENERAL

Power Source	10.5 to 15.0 VDC.
Polarity	Negative ground.
Frequency Range	2-12 MHz.
Channels	10,000 in 1 KHz steps from 2-11,999 MHz in either USB (upper sideband) or LSB (lower sideband) giving effectively 20,000 useable channels.
Modes	A3J (USB/LSB); A1 (CW); A3H (compatible AM) FSK (F1) with external modem (SC620) short messages only in high power.
Size (including battery box)	4.9 in. x 11.8 in. x 13.7 in. (12.5 cm x 30 cm x 34.8 cm)
Weight	Transceiver and Lead Acid Battery Pack - 18.75 lbs (8.5 kg); Transceiver and NiCad Battery Box with 2 sets of batteries - 16.5 lbs. (7.4 kg); typical operating weight with NiCad Battery, 2 sets, Whip Antenna, Carrying Bag and Handset - 19.9 lbs. (9.04 kg).
Temperature Range	-30°C to +60°C operating.
Environment	Fully waterproof, 3 foot immersion.

TRANSMITTER 12.6 VDC INPUT

Power Output	High Power: SSB - 20W nominal, 15W minimum (PEP); CW - 5W (adjustable); AM Carrier - 2.5W average (adjustable). SSB power output may be restricted by ALC adjustment. Low Power: 5W (adjustable) (PEP and AVE). CW - power output not to exceed that in the high power mode.
Intermodulation Distortion	Not more than -26 dB at not less than 15W PEP output at a supply voltage of 12.6 VDC.

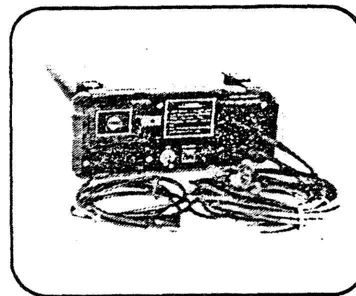
TABLE 1.3. Technical Characteristics-Continued

	TRANSMITTER 12.6 VDC INPUT-Cont.
Power Consumption	High Power: Average speech 800 ma - 1 ampere.
Sideband Suppression	-45 dB minimum at 1 KHz audio input.
Carrier Suppression	-40 dB minimum referenced to 15W PEP output.
Harmonic Suppression	-40 dB minimum with reference to 15W PEP output to 30 MHz, -50 dB minimum above 30 MHz.
Spurious Output	-30 dB minimum with reference to 15W PEP output.
ALC	Limits RF output and final peak voltage. Prevents interference to other stations. Protects final amplifier.
Whisper Audio Amplifier	Provides constant output from a whisper to full voice.
Frequency Stability	± 150 Hz maximum deviation over the range of 2-12 MHz and temperature extremes of 0°C to +60°C, and ± 150 Hz maximum deviation from 0°C to -13°C and -30°C.
Microphones	Dynamic, military type H-189/GR.
Monitoring	Waterproof meter reads transmitter power output, antenna matching and battery voltage.
	RECEIVER 12.6 VDC INPUT
Receiver Gain	0.5W audio output (S&N) for 1 microvolt input at 50 ohms.
Sensitivity	0.5 microvolts nominal, 0.7 microvolts maximum, for 10 dB minimum (S+N)/N.
Selectivity	2.5 KHz minimum at -6 dB and 6.05 KHz maximum at -60 dB.
Image Rejection	-60 dB minimum with respect to a 1 microvolt signal.

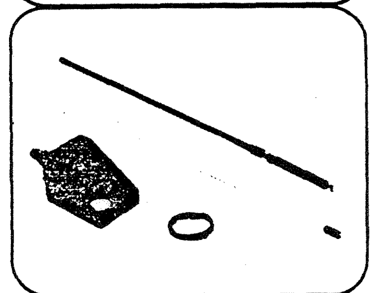
TABLE 1.3. Technical Characteristics-Continued

	RECEIVER 12.5 VDC INPUT-Cont.
I.F. Rejection	-60 dB minimum with respect to a 1 microvolt signal.
AGC	No greater than 14 dB change in audio output when the input signal is varied from 5 microvolts to 0.1 volts.
Spurious Responses (Receive)	Less than the equivalent of 1.0 microvolts signal on 99.6 percent of the 10,000 channels available.
Audio Output	Minimum 0.5W with not greater than 10 percent distortion.
Speaker	Internal in waterproof acoustical chamber. Turned on/off by front panel switch.
Clarifier Range	± 500 Hz nominal.
Power Consumption	Idle (no signal) - typical 160 ma; at 0.5 watts audio - typical 230 ma.

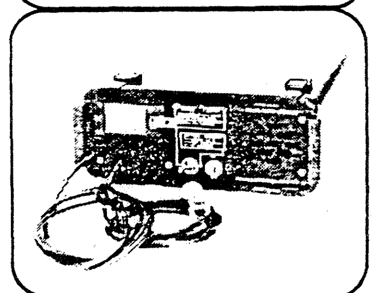
BATTERY CHARGER, SC807
Charges 4 SC130 lead acid battery packs.



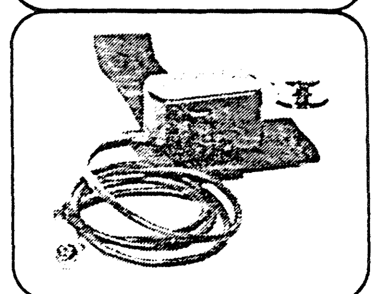
MOBILE WHIP ANTENNA, SC130MW
Consists of heavy duty base section, click turn loading coil, and spring whip.



POWER SUPPLY CHARGER, SC804
Provides 12 VDC operating power and includes built-in loudspeaker for better audio fidelity when the SC130D(E) is used as a fixed base station. Also recharges lead acid battery pack and NiCad batteries as installed in the radio. Has provision for charging NiCad batteries internally in a special holder. Operates from 115/230VAC, 50/60 Hz power source.



TELEGRAPH KEY, SC607A
For CW telegraph. Fully adjustable by operator with cord, connector, and quick disconnect leg strap.



MOBILE MOUNTING RACK, SC707
A heavy duty bracket for mounting to vehicular surfaces. Has sturdy tie-down straps to clamp the transceiver to the bracket. Grounding strap is also provided.

WHIP ANTENNA, SC130AW
The whip antenna consists of collapsible 3 section aluminum base, a high efficiency tunable ferrite center loading coil, a flexible steel tape type top section (which folds for storage) and an adjustable mounting assembly and connecting lead to the radio output connector.

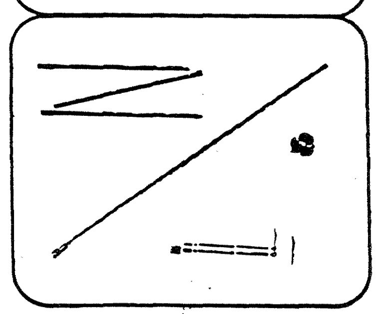
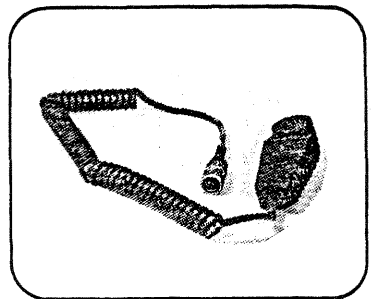
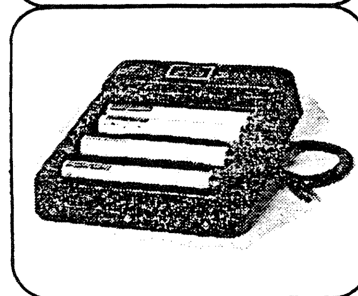


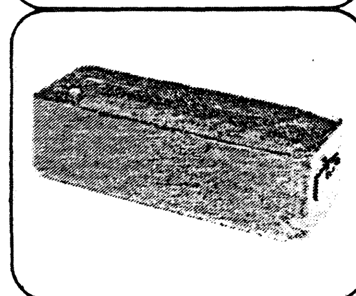
Figure 1.2. Accessories for SC130D(E) Transceiver



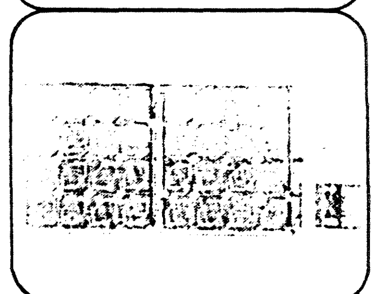
HAND MICROPHONE, SC610
Ruggedized dynamic microphone for fixed base operation when speaker can be used continuously.



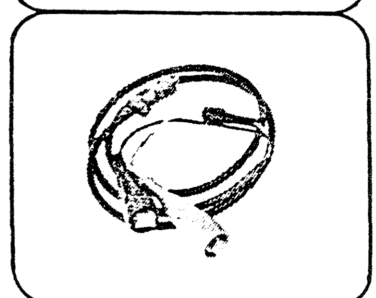
BATTERY CHARGER, SC811
Automatically charges 3 sets (6 sticks) of SC130BA(NC) batteries. The "sticks" drop into the case and make spring connection. A separate pilot lamp indicates correct charging for each stick. For 115/230V, 50/60 Hz operations.



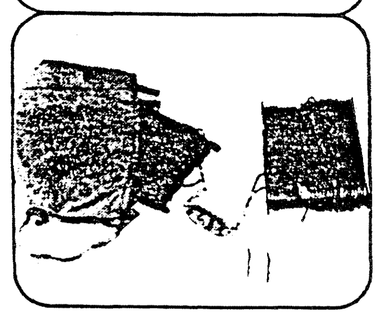
BATTERY PACK, LEAD ACID, SC130BP
Snap on aluminum box containing a sealed, rechargeable 12VDC, 6AH, lead acid battery pack.



SOLAR POWER UNIT, SC805A
Rugged array of solar cells provides power for simultaneous receiver operation and battery charging in the field. Adapter units available for use with other types of equipment.

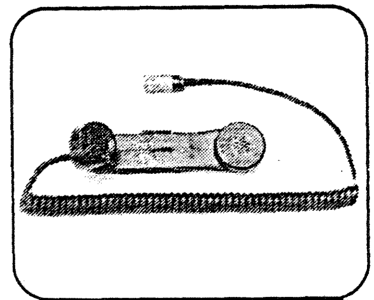


CONNECTING LEAD, SC130CL
Cable with insulated battery clips, in-line fuse, and connector. For operation of patrolfone from external 12 volt batteries.

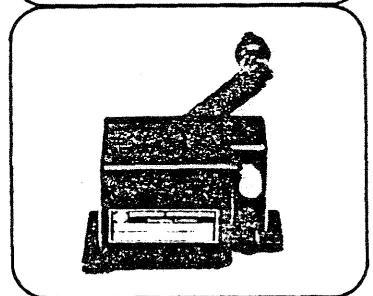


DIPOLE ANTENNA, SC503
Portable, adjustable frequency dipole antenna. May also be used as a long-wire antenna and counterpoise. Consists of two reel-wound high strength radiating elements; coaxial feed line with connectors; center insulator; nylon erecting ropes; and carrying bag.

Figure 1.2. Accessories for SC130D(E) Transceiver-Cont.

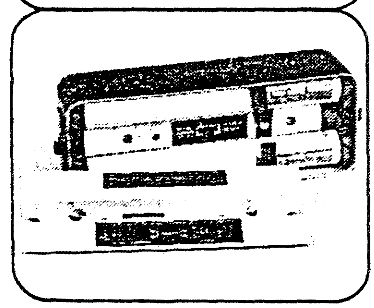


<u>HANDSET, SC609</u>
Military type H-189/GR complete with push-to-talk switch, coil cord, shoulder strap clip, and connector.



<u>HAND CRANK GENERATOR, SC806A</u>
Rugged, small, lightweight unit that provides a minimum of 8 watts at 12 VDC when cranked at approximately 85 RPM for battery charging and receiver operation.
Adapter cables are available for use with other types of equipment and for 24 VDC applications.

<u>CARRYING BAG, SC130BC</u>
Heavy duty olive drab nylon, fitted with adjustable shoulder straps for back pack operation. Pockets hold antennas, handsets, key, connecting leads and spare NiCad batteries.



<u>BATTERY BOX, SC130BB(NC)</u>
Snap-on drawn aluminum box with fittings to accommodate one or two sets of Nickel Cadmium batteries, SC130BA(NC).

<u>BATTERY SETS, SC130BA(NC)</u>
Consists of two rechargeable Nickel Cadmium sticks (6V, 2.2 AH each) for use in Battery Box, SC130BB(NC).

<u>NOT ILLUSTRATED BUT AVAILABLE:</u>

<u>RUNNING SPARES KIT, SC130D RSK</u> - Contains fuses, gaskets, and external hardware that can be readily replaced by the operator in the field. For 1 unit for 1 year.

<u>OPERATIONAL SPARES KIT, SC130D(E) OSK</u> - Contains plug-in relays and printed circuit boards that can be replaced by a competent technician to minimize "down time" of the unit. The printed circuit boards can then be repaired using the depot spares kit. For 10 units for 4 years.

<u>DEPOT SPARES KIT, SC130D(E) DSK</u> - Contains a complete range of spare parts (less OSK) for comprehensive maintenance by a competent technician at a maintenance facility. For 10 units for 4 years.

<u>OPERATORS MANUAL, SC130D(E)OM</u>

<u>MAINTENANCE MANUAL, SC130D(E)MA</u>

FIGURE 1.2. Accessories for SC130D(E) Transceiver-Cont.

1.5 cont'd All operational controls are on the front panel and feature waterproof glands to prevent entry of moisture. The front panel markings are engraved on an anodized aluminum insert.

The internal speaker is mounted in a sealed acoustical chamber integral to the panel. Should the transceiver be submerged, even for a short period of time, water may enter the outer speaker chamber. This water should be removed by tipping the front panel forward. It should be noted that a waterproof diaphragm protects the speaker. In the event this diaphragm is punctured, water may enter the inner speaker chamber, but the transceiver itself will not be damaged as this compartment remains sealed from the transceiver proper.

The battery housing is secured to the bottom of the outer case by two (2) separate clips. A meter which indicates forward and reflected RF power and battery condition is mounted inside the case and is viewed through a clear plastic insert in the front panel. Separate pressure proof plugs are provided for the Handset/Key and external power source connections. The connectors provide positive contact even under severe vibration.

The transceiver components are assembled on five (5) epoxy glass fiber printed circuit boards. Two (2) harnesses provide connection between the boards and the front panel controls. The printed circuit boards are marked with component symbols wherever possible to facilitate servicing. The Receiver/Exciter board is hinged so that it swings clear of the chassis to simplify certain operational maintenance and servicing procedures. The interior of the transceiver is completely enclosed and the cover plates are retained by machine screws threaded into stainless steel inserts.

SECTION II

Operation

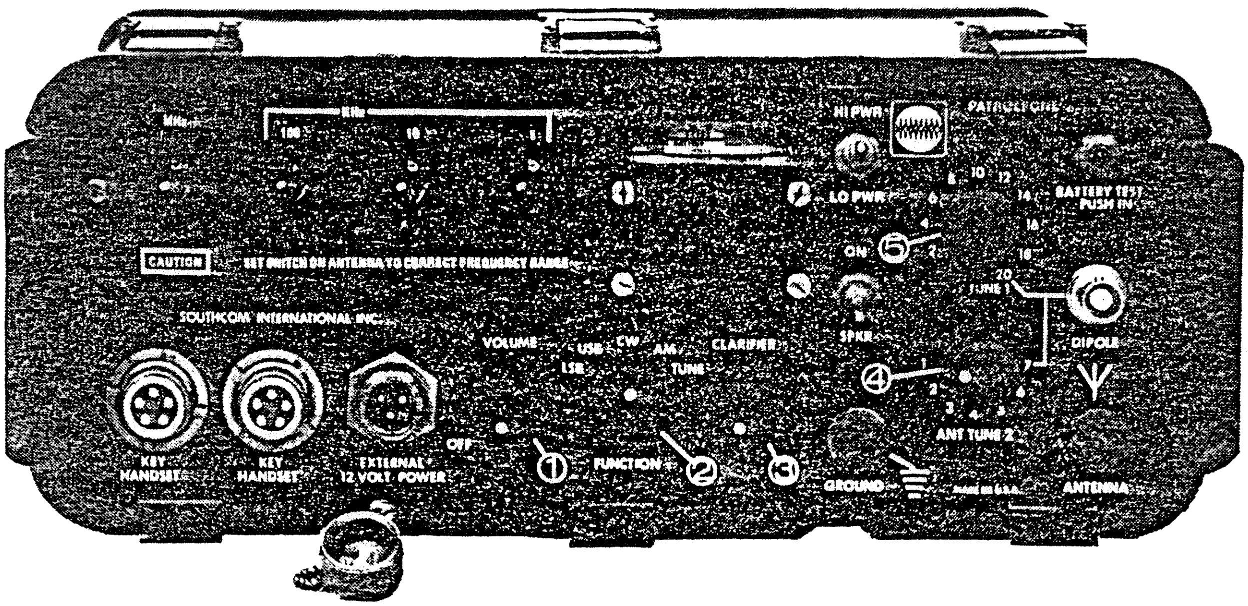


Figure 2.1. SC130D(E) Front Panel

OPERATION

2.1 INTRODUCTION

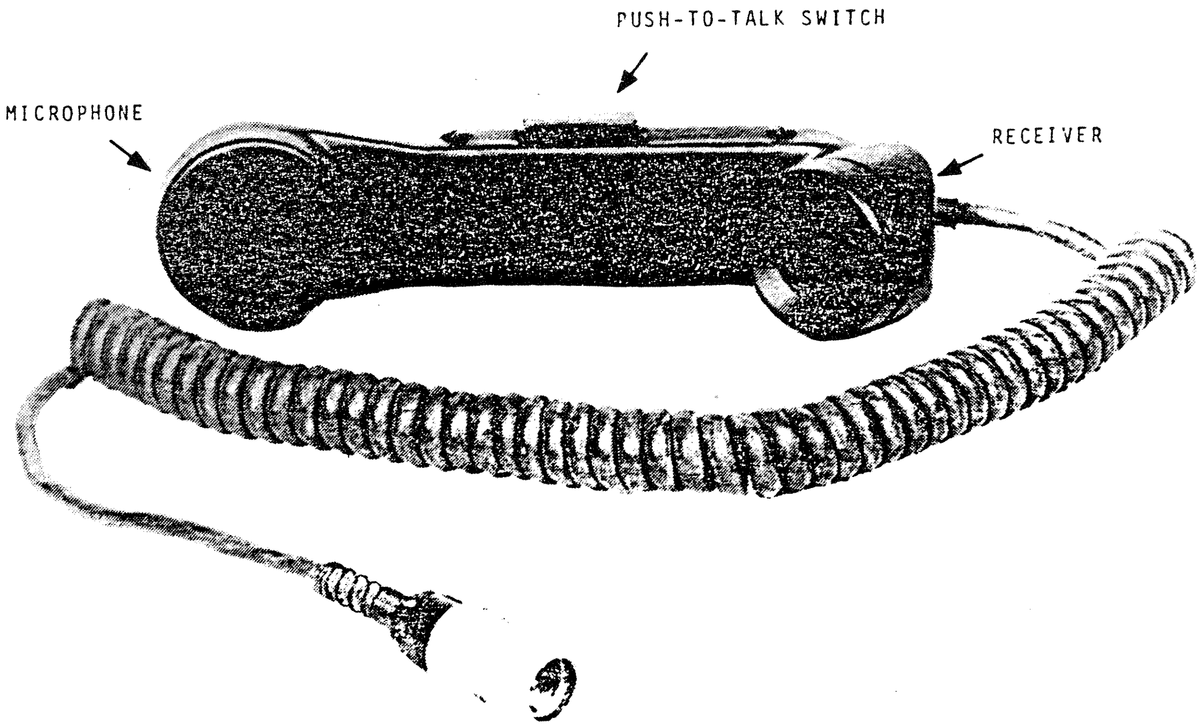
In order to realize the most satisfactory performance for the SC130D(E) Transceiver and to achieve the maximum communications efficiency, it is extremely important for the operator to have a basic understanding of the methods of high frequency signal propagation and the single side-band (SSB) mode of operation. Of equal importance is a thorough familiarization with the location and knowledge of the purpose and function of all controls, indicators and connections. The purpose of this section is to provide this vital information. Figure 2.1 provides identification of all of those functions which are incorporated on the front panel. Figure 2.2 illustrates the position of the handset push-to-talk switch.

2.2 CONTROLS AND INDICATORS

Table 2.1 provides a complete list of all external controls, indicators, connections and adjustments provided with the SC130D(E) Transceiver. Proper knowledge and use of these functions can be achieved through careful study of this list, Figure 2.1 (the front panel drawing), other illustrations provided, and the following operating procedures.

2.2.1 Operating Procedures

The following paragraphs describe general modes of operation and the proper methods and procedures associated with operational expertise.



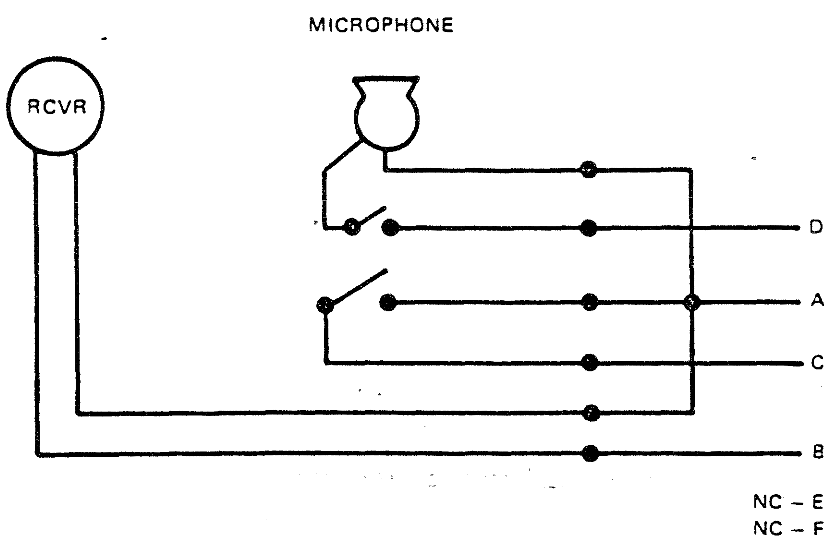


Figure 2.2. Handset and Push-to-Talk Switch

TABLE 2.1. Controls and Indicators

CONTROLS, INDICATORS AND CONNECTIONS	FUNCTION
1 VOLUME	Adjusts receiver volume and turns entire transceiver on and off.
2 FUNCTION SWITCH - LSB	Selects single sideband mode LSB.
USB	Selects single sideband mode USB.
CW	Selects CW (Telegraphy) mode.
AM	Selects compatible AM mode.
TUNE	Tune position for adjustment of antenna tuner.
3 CLARIFIER	Receiver vernier tuning.
5 ANT TUNE #1	Adjusts inductor, antenna coupler.
4 ANT TUNE #2	Adjusts capacitor, antenna coupler.
FREQUENCY SELECTOR CONTROLS (4) MHz, KHz x 100, KHz x 10, KHz	Controls read frequency directly left to right, in 1 KHz steps.
BATTERY TEST	Allows meter to read battery voltage when switch is pressed.
METER	Reads battery voltage when switch is pressed. Reads RF output in operating modes. Reads reflected power in TUNE position.
DIPOLE	Antenna connection, dipole.
ANTENNA	Antenna connection, long-wire and whip.
GROUND	Ground or counterpoise connection.
KEY/HANDSET (2)	Connector for key or handset.
EXTERNAL 12 VOLT POWER	Connector for external battery or power supply. Also has external audio connection.
SPKR	Actuates internal speaker when turned on.
LIGHT BAR	Illuminates frequency readout and meter whenever Battery Test is depressed or Function switch in Tune position.
PWR	Selects high or low transmit power.

2.2.2 Starting Procedure

The switch on the VOLUME control actuates the entire transceiver. The transceiver is disconnected from the battery or external power supply by turning to the extreme counterclockwise position. The transmitter and receiver are 100% solid-state and require no warm-up period. The transmitter is disconnected until the key or handset press-to-talk switch is actuated and no separate standby switch is required.

2.2.3 Channel Selection

The operating frequency is selected by setting the selector controls. Frequency is read from left to right, directly from the controls.

2.2.4 Function Selection

The Function switch has five positions for single sideband operation; LSB (lower sideband), USB (upper sideband), CW, AM, and TUNE.

The CW mode is selected for telegraph key operation. In this position, a single frequency signal is transmitted when the external key is closed. This signal is approximately 1300 Hz above the indicated carrier to provide the desired beat note at the receiver.

The AM mode is selected if it is necessary to communicate with a station not equipped for single sideband reception. In the AM mode, a carrier is provided and the signal may be received by a standard AM receiver. In the receive condition, the AM signal is converted to SSB after passing through the receive filters. The AM signal may be recognized

2.2.4 cont'd by the heterodyned signal (whistle) when the clarifier is detuned.

2.2.5 Receiver Operation

The receiver is adjusted for a comfortable listening level by rotating the VOLUME control 1. An internal speaker, mounted in a waterproof acoustical chamber is provided. The receiver is provided with an efficient automatic gain control system and it will not normally be necessary to adjust the volume control to compensate for strong or weak signals.

To operate the speaker, the SPKR switch is turned to the ON position. When the loudspeaker is not on, the signal is received only through the handset. The AC power supply (SC130PS) also has an internal speaker which is automatically connected when this supply is used.

The CLARIFIER control 3 provides vernier tuning to the received signal. For clarity of reception of an SSB signal, it is essential that the receiver be tuned to the exact frequency of the received signal. The control should be rotated slowly until the position of maximum clarity is found. It will be noted that on one side the signals will sound low pitched and on the other side high pitched. For CW, the clarifier may be used to adjust the signal to the desired pitch.

2.2.6 Transmitter Operation

The unique broadband circuitry of the transmitter allows operation with no adjustments or tuning. To operate the transmitter, the handset press-to-talk switch is actuated. The gain is automatically set to the correct level and

2.2.6 cont'd speaking directly into the microphone in a normal conversational voice will achieve satisfactory results.

In the CW mode, the key is depressed and the transmitter automatically switches to the transmit mode. A built-in time delay circuit holds the transmitter in the "ON" position between characters. A pause in the transmission permits the transceiver to return to the receive mode. Sidetone in the receiver is used for monitoring the CW transmission.

The ALC (automatic level control) automatically adjusts the gain of the transmitter. With weak voice input, the gain is set to maximum so that the transmitter is driven to full power output. Conversely, strong voice signals reduce the gain so that the equipment will not overload. The control voltages are derived from the transmitter output and limit the output to a preset level, preventing damage due to overvoltage if the unit is operated with the antenna disconnected, shorted or detuned.

High or low transmit power can be selected with the front panel PWR switch.

2.2.7 Metering

A pushbutton switch BATTERY TEST is provided on the front panel to measure battery voltage. When the switch is pressed, the meter should read close to 12 volts. Normally the receiver will operate until the battery is almost totally discharged. The battery voltage should be checked in the transmit mode. The meter is illuminated when the BATTERY TEST switch is pressed to facilitate reading the battery voltage under low light conditions.

2.2.7 cont'd If the voltage drops by more than 1 or 2 volts on voice peaks, it is a clear indication that the battery is almost discharged and should be replaced or recharged. The transceiver may be operated continuously on voltages as high as 14 volts and will not be damaged unless the voltage exceeds 16 volts. The transceiver will continue to operate at reduced output down to 10.5 volts. Lower voltages will not damage the equipment but may cause improper operation. For rated power output, the voltage must be a minimum of 12.6 volts.

In the transmit mode, the meter reads the relative output level. Under no circumstances should the antenna be tuned to indicate maximum RF power output, as a high reading on the meter may be the result of a mismatched antenna. The special VSWR bridge circuit is designed for precise tuning of the antenna when the transceiver is switched to the TUNE mode. In this position, a minimum reading is required.

2.3 ANTENNA TUNING

The importance of an efficient, properly tuned antenna system cannot be over-emphasized. The SC130D(E) Transceiver contains circuitry which operates automatically for the most part and the transmitter requires no operator tuning or adjustments. Thus, the performance is entirely dependent upon the efficiency of the antenna.

2.3.1 Antenna Bridge

The transceiver contains a VSWR (voltage standing wave radio) bridge which measures the forward power delivered to the antenna in all operational modes except "TUNE" and the power reflected back into the transmitter in the TUNE mode. When the antenna is properly tuned, all of the power

2.3.1 cont'd is delivered to the antenna and there is no reflected power. This permits very accurate matching of the antenna to the transmitter.

NOTE

The forward power amplitude reading may actually increase when there is an improper antenna match and, therefore, should never be utilized in the tuning procedure. (A high forward reading may also indicate a high reflected power component. The meter reads true power output only at zero reflected power).

2.3.2 TUNE Mode

In the "TUNE" position, the transmitter is keyed to provide 5 watts CW (less than maximum output) to reduce battery drain and to prevent incorrect readings from the ALC (automatic level control) action. The meter reads reflected power in this position and the antenna tuner should be set for minimum meter readings. All of the power is being delivered to the antenna when the meter indicates zero. The meter is illuminated when the Function switch is in the TUNE position to facilitate antenna tuning under low light conditions.

NOTE

Tuning time should be kept to a minimum to reduce battery consumption as the transmitter operates continuously in the "TUNE" position.

2.3.3 Dipole Antenna

The dipole antenna is the most efficient of the standard antennas available for the SC130D(E) Transceiver. It should

2.3.3 cont'd

always be used when maximum range is required. The dipole resonates at only one frequency and the length must be adjusted each time the channel frequency is changed by more than a few percent. The antenna tuner cannot be used to retune this antenna and both antenna tune controls must be set in the "DIPOLE" positions.

A chart inside the cover of the transceiver carrying case provides information relative to the length (turns off the spool) of the two (2) wires of the dipole versus the required channel frequency in megahertz. The proper number of turns is removed from the storage spool on each side of the antenna and is then clamped in the lock.

The dipole is now ready to be attached to the coaxial cable feed line and, in turn, to be connected to the coaxial connector on the front panel. Transceiver controls, ANT TUNE 1 and ANT TUNE 2, are next set to the 50 ohm (DIPOLE) positions as indicated on the front panel (position 20 for ANT TUNE 1 and position 7 for ANT TUNE 2). The transceiver is ready at this point to operate without further adjustments.

Best results are obtained when the antenna is resonant at the precise operating frequency. The actual length required is dependent upon several factors; e.g., antenna height above ground, soil conductivity, and proximity to surrounding objects. When the transceiver is set to the TUNE position, the resonant point (as determined by the VSWR bridge) is indicated by a very low or zero reading on the meter. Should a higher reflected power reading exist, the length of the dipole arms require adjustment. The length of both ends of the dipole elements should be adjusted together in the same direction and only by a few inches. If this results in a still higher meter reading, the length should be adjusted in the opposite direction and this process continued until the lowest possible reading is obtained.

2.3.4 Long-Wire Antenna

When dipole operation is impossible or otherwise inconvenient, long-wire operation may be advisable. The standard long-wire antenna is 23 meters long. It functions in conjunction with the antenna tuner and therefore may be used at any operational frequency without changing or adjusting the antenna length. Alternatively, the dipole antenna may be utilized as a long-wire antenna. One half of the dipole is removed from the antenna center insulator and connected to the antenna terminal. The long-wire should then be unreeled and supported as high as possible over the greater part of its length. The front panel ground terminal should be connected to a good ground, if available. If such a ground is not available, the second half of the dipole antenna, including the unused coaxial cable, should be connected to the ground terminal and laid on the ground (earth) under the antenna, forming a counterpoise ground. Matching of the long-wire antenna to the transceiver is now accomplished by adjusting the tuner (see paragraph 2.3).

2.3.5 Whip Antenna

The whip antenna loading coil is adjusted by lifting the top ring and rotating it until the indicator corresponds to the desired frequency range. A positive detent action indicates that the ring is in the proper position.

The whip is normally used with the base sections in place. However, for short range communications and while operating in jungles and similar environments, it is often permissible (for the sake of convenience) to operate with the loading coil and antenna top section plugged directly into the whip socket. However, some of the transceivers' efficiency will be lost with this type of operation.

2.3.5 cont'd

NOTE

The whip antenna is very selective and will be detuned by the proximity of nearby objects. A true ground connection, or a pseudo-ground connection through capacity to the operator's body, is also very necessary for satisfactory operation when using the whip antenna.

2.3.6 Antenna Tuner

The antenna tuner may be used to load many different antennas, including those listed in this document as standard accessories. The procedure in paragraph 2.3.7, TUNING PROCEDURE, applies to any type of antenna that may be employed, consistent with the usage and frequency range capabilities of the SC130D(E) Transceiver.

Tables 2.2 and 2.3 are tuning charts for use with the SC130AW Antenna Whip and a long-wire antenna. Use of these charts may be advisable when it is essential to become operational very quickly as they allow immediate setting of the controls near their optimum value.

Table 2.2 was compiled while operating the transceiver in the manpack configuration using the loading coil in its proper setting. The case was held by the operator during these operating adjustments.

NOTE

Actual settings are dependent upon the terrain and the type of ground connection.

TABLE 2.2

2.3.6
cont'd

SC130/AW Whip Antenna Tuning Chart

FREQUENCY (MHz)	ANT TUNE 1	ANT TUNE 2	FREQUENCY (MHz)	ANT TUNE 1	ANT TUNE 2
2.0	3	5	5.4	11	6
2.1	4	4	5.6	12	4
2.2	4	5	5.8	12	5
2.3	5	4	6.0	12	5
2.4	5	5	6.2	12	5
2.5	6	4	6.4	12	6
2.6	7	4	6.6	11	6
2.7	9	3	6.8	11	6
2.8	5	6	7.0	11	6
2.9	6	5	7.2	11	7
3.0	6	6	7.4	12	5
3.1	7	4	7.6	12	5
3.2	7	5	7.8	12	6
3.3	7	6	8.0	13	5
3.4	8	4	8.2	13	5
3.5	8	5	8.4	13	6
3.6	9	5	8.6	13	6
3.7	9	6	8.8	13	6
3.8	10	4	9.0	13	6
3.9	10	6	9.2	14	5
4.0	11	4	9.4	14	5
4.1	9	5	9.6	14	6
4.2	9	5	9.8	15	4
4.3	9	6	10.0	16	3
4.4	10	5	10.4	17	2
4.5	10	6	10.8	17	2
4.6	10	6	11.0	17	1
4.8	10	6	11.4	15	4
5.0	11	5	11.8	14	5
5.2	11	5	11.99	14	6

2.3.6 cont'd Table 2.3 was compiled using the standard 23 meter (75 feet) long-wire antenna and one element of the dipole antenna which is 36 meters or 117 feet long. The antennas were erected at a height of 3 meters (10 feet) and a ground connection was used.

NOTE

Final settings will vary in accordance with antenna height and the effectiveness of the ground connection.

2.3.7 Tuning Procedure

Please read the following note carefully before proceeding with the tuning procedure.

NOTE

The procedure for pretuning of the antenna (regardless of type) must be strictly adhered to prior to use of the antenna tuner. Once the dipole antenna is adjusted in accordance with paragraph 2.3.3 DIPOLE ANTENNA and the ANT TUNE 1 and ANT TUNE 2 controls set to the indicated DIPOLE positions, no further tuning is required. For long-wire operation, refer to paragraph 2.3.4 LONG-WIRE ANTENNA and for use of the whip antenna, please observe, in particular, the reference in paragraph 2.3.5 WHIP ANTENNA to adjustment of the loading coil ring. After these necessary antenna adjusments, the following tuning procedure is utilized.

a. Place the transceiver FUNCTION control in any of the receive positions (LSB, USB, CW, AM).

TABLE 2.3

SC130/AL Long-Wire Antenna Tuning Chart

2.3.7
cont'd

Freq. (MHz)	75 Feet (23 Meters)		117 Feet (36 Meters)		Freq. (MHz)	75 Feet (23 Meters)		117 Feet (36 Meters)	
	ANT TUNE 1	ANT TUNE 2	ANT TUNE 1	ANT TUNE 2		ANT TUNE 1	ANT TUNE 2	ANT TUNE 1	ANT TUNE 2
2.0	5	7	15	1	5.0	8	5	10	7
2.1	6	7	20	1	5.6	8	6	14	5
2.2	7	7	20	1	5.8	8	6	14	5
2.3	8	7	20	1	6.0	8	6	14	4
2.4	8	7	5	1	6.2	9	6	15	3
2.5	9	7	7	1	6.4	9	6	14	3
2.6	10	7	8	1	6.6	10	6	12	5
2.7	11	7	7	2	6.8	10	6	11	5
2.8	12	7	7	3	7.0	11	6	11	5
2.9	13	7	6	3	7.2	11	6	12	6
3.0	14	5	5	4	7.4	12	6	12	6
3.1	19	1	5	5	7.6	12	6	12	6
3.2	20	1	5	5	7.8	13	6	12	6
3.3	20	1	5	5	8.0	13	6	12	6
3.4	20	1	5	5	8.2	13	6	12	6
3.5	10	1	5	5	8.4	14	6	13	6
3.6	10	1	5	5	8.6	14	6	13	6
3.7	10	2	4	6	8.8	15	5	14	6
3.8	10	3	4	6	9.0	15	5	14	6
3.9	10	3	4	6	9.2	16	5	14	7
4.0	9	3	4	6	9.4	16	4	15	6
4.1	9	4	4	6	9.6	17	4	15	5
4.2	9	4	4	7	9.8	17	4	15	5
4.3	9	4	5	6	10.0	17	4	15	5
4.4	9	5	6	6	10.5	18	3	16	4
4.5	9	5	6	7	11.0	18	3	16	4
4.6	8	5	7	7	11.5	18	3	16	4
4.8	8	5	9	7	11.9	18	3	16	4

2.3.7 cont'd

b. Set the ANT TUNE 1 control to position 20 and ANT TUNE 2 to position 7.

c. Adjust ANT TUNE 1 for maximum noise output. (Proceed to Step d even if no change in noise level can be detected).

d. Turn the transceiver function switch to the TUNE position.

e. Begin moving the ANT TUNE 1 switch back, one position at a time, until a minimum (coarse) reading is observed on the meter.

f. Adjust ANT TUNE 2 for minimum reading on the meter. These readings should be well within the green portion of the meter scale.

g. If the meter reading following Step f is not within the green portion of the meter scale, turn the ANT TUNE 1 switch to one side and then the other of the setting obtained in Step e, while repeating Step f to obtain the settings resulting in the lowest possible reading.

h. Should the results remain unsatisfactory, refer to grounding information contained in paragraphs 2.3.8 GROUNDING SOLUTIONS and, after making any necessary corrections or adjustments, repeat the entire tuning procedure.

2.3.8 Grounding Solutions

If a satisfactory null in the green portion of the meter scale cannot be obtained from the above procedure, the ground system may be at fault.

2.3.8 cont'd The best results from whip and long-wire antennas are always obtained with a good ground connection. The small case of the SC130D(E) Transceiver provides a very small ground plane and, whenever possible, a direct ground connection should be made. When the transceiver is worn on the back, body capacity provides sufficient grounding. If the unit is tuned while setting on a table, boulder, dry ground, or other insulating surface, and no other ground connection is available, the operator should firmly grasp a metal part of the unit, e.g., the dipole antenna connector, while tuning adjustments are made. Some lengths of long-wire antenna may be highly reactive at a chosen operating frequency and cannot be tuned with the antenna tuner. This situation can usually be corrected by increasing or decreasing the length of the antenna.

WARNING

WHEN THE TRANSCEIVER ANTENNA IS TUNED TO A RESONANCE WITHOUT A GROUND, THE CASE ASSUMES A HIGH RF POTENTIAL TO GROUND. THIS RF VOLTAGE INCREASES AS THE CAPACITY TO GROUND IS DECREASED. THE SC130D(E) TRANSCEIVER HAS A POWER OUTPUT OF 20 WATTS AND THE VOLTAGES DEVELOPED CAN CAUSE RF BURNS WHEN THE EXPOSED METAL PARTS OF THE CASE OR FRONT PANEL ARE TOUCHED MOMENTARILY. THESE RF BURNS ARE HARMLESS AND ARE ONLY PRESENT WHEN AN INTERMITTENT CONTACT IS MADE TO THE CASE. HOWEVER, THE OCCURENCE CAN COME AS AN UNPLEASANT SURPRISE AND COULD CAUSE INVOLUNTARY ACTIONS BY THE OPERATOR WITH UNDESIRED RESULTS. THERE IS NO POSSIBILITY OF SUCH BURNS WHEN A GROUND OR DIPOLE ANTENNA IS USED. IN THE MANPACK MODE, A GROUND IS NOT PRACTICAL AND IT IS IMPORTANT TO FIRMLY HOLD AN EXPOSED METAL PORTION OF THE CASE OR PANEL

2.3.8 cont'd WHILE THE TUNING ADJUSTMENTS ARE MADE. THE INCREASED CAPACITANCE OF THE BODY TO GROUND REDUCES THE RF VOLTAGE TO A NEGLIGIBLE LEVEL (RF BURNS WILL NOT BE OBTAINED IF A METAL PORTION IS GRASPED FIRMLY.)

2.3.9 Alternate Tuning Procedure

The transmitter power consumption in the tune mode is considerably greater than in the receive mode. When maximum battery life is required, it is possible to tune the antenna in the receive condition. This tuning method is particularly useful with D cell batteries, which may have sufficient life to provide satisfactory communications on SSB, yet give insufficient output indication for tuning. The procedure for tuning the antenna in the receive mode is identical to the standard tuning procedure except that the receiver noise is used as the output indicator. The antenna tuning controls are peaked for maximum receiver noise instead of minimum reading on the meter. This method is not quite as accurate as the VSWR bridge. However, the broadband circuitry in the transceiver permits good power transfer even if there is a small mismatch in the antenna system. The alternate tuning procedure is also useful if a null cannot be obtained on the antenna bridge. Such a condition can occur in some mobile installations and other situations where the ground is unsatisfactory or reactive. Satisfactory communications will normally result if the tuner is peaked for maximum noise even if no meter null can be obtained in the tune mode.

SECTION III

Theory of Operation

THEORY OF OPERATION

3.1 INTRODUCITON

This section contains the overall functional description of the SC130D(E) Transceiver. Included is a general description of the major system elements; i.e., Receiver, Transmitter, Antenna Tuner, and Synthesizer. Following the system description is a detailed circuit description of each individual circuit contained on the five (5) printed circuit boards comprising the transceiver. These descriptions in conjunction with maintenance information contained on Section 4 and the troubleshooting and fault isolation information in Section 5, are intended to provide sufficient aid to the technician to adequately perform these functions.

3.2 SYSTEM FUNCTIONAL DESCRIPTION

For simplicity, two separate block diagrams are used to show the overall operation of the SC130D(E) Transceiver. Figure 3.1 illustrates the configuration of the transmit mode and Figure 3.2 shows the receive condition. Some stages are common to both the transmit and receive functions. These stages are denoted by an asterisk.

The circuitry of the transceiver is somewhat unique in that several relatively new principles have been employed. First, both the transmitter and the receiver are truly broadband; i.e., no tuned circuits are used to select either the receiver or transmitted signals. The required selectivity is obtained by using crystal filters. IF, Image and other out-of-band undesired responses are eliminated by the High and Low-Pass filters.

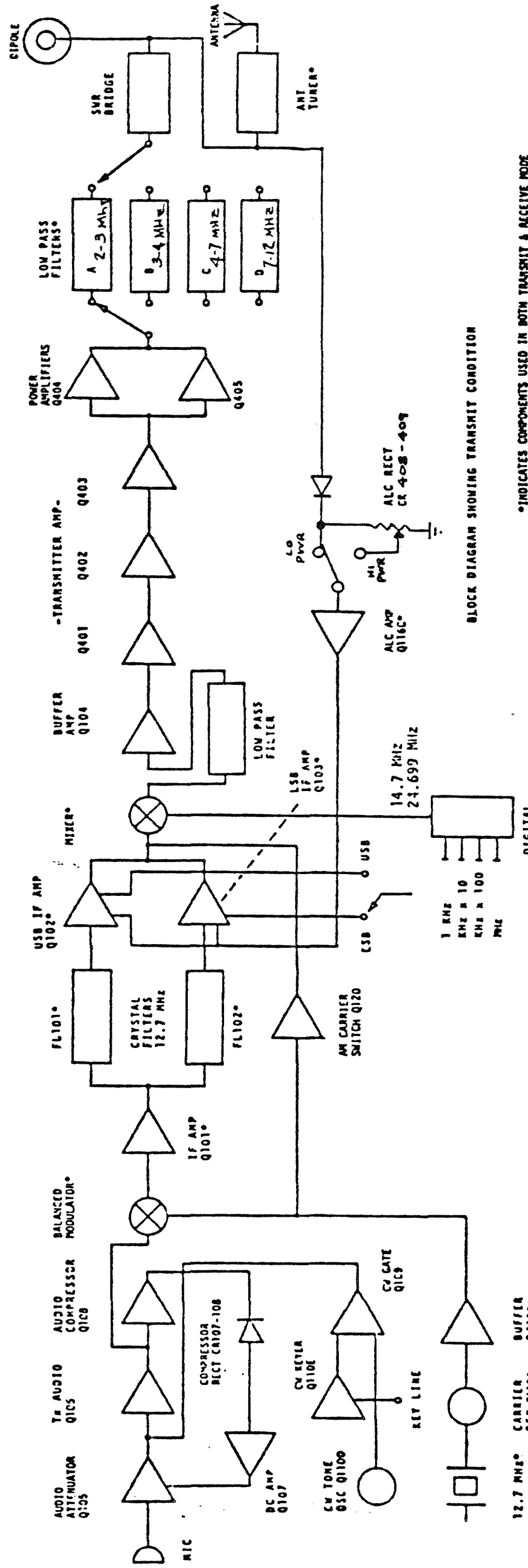


Figure 3.1. SC130D(E) In Transmit Mode

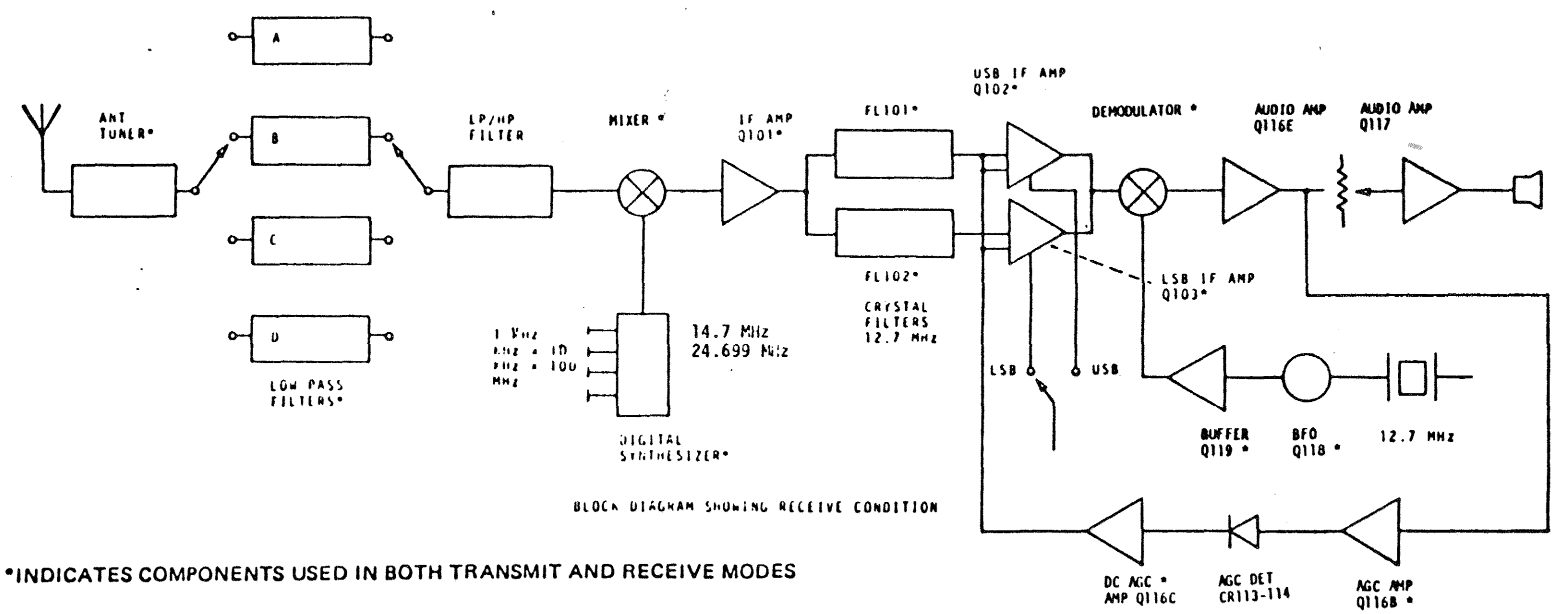


Figure 3.2. SC130D(E) In Receive Mode

3.2 cont'd Second, the transceiver switching circuitry is considerably simplified by a method which allows the 1st mixer to be used as a balanced modulator and the product detector as a mixer. Third, a very low current, high-stability digital synthesizer has been developed, utilizing a unique combination of CMOS and TTL integrated circuits.

3.3 TRANSMITTER

Depressing the handset push-to-talk button energizes the transmit relay which connects the transmitter circuits to the supply voltage and the SSB output signal to the antenna. Releasing the button returns the transceiver to the receive mode and removes power from the transmitter stages.

The audio voltage developed by the microphone is fed to a wide-range compressor circuit which provides a voltage of almost constant amplitude to the balanced modulator circuit. This feature allows "whisper" operation under combat conditions or circumstances requiring discretion. At the same time, this circuit prevents overload (saturation) when someone shouts directly into the microphone or a loud noise of any kind occurs in the immediate vicinity.

The double-balanced modulator circuit provides carrier suppression. The resultant double sideband, suppressed carrier signal is amplified by Q101 before being applied to the appropriate sideband filter through transformer L116. These filters are electronically switched depending on the desired mode (USB or LSB). The output of the crystal filter is then applied to individual IF amplifiers, the outputs of which are combined and fed to the mixer circuit. The front panel function switch applies power to either one or the other of the IF amplifiers

3.3 cont'd

and the crystal filter diode switch, dependent upon the desired mode of operation (USB or LSB). AM and CW utilize upper sideband.

The mixer subtracts the 12.7 MHz IF signal from the variable injection signal, (14.7 to 24.7 MHz) producing the desired 2.0 to 12.0 MHz output. The output from the mixer circuit is fed through a low-pass filter, which removes the image products, to the transmitter linear amplifier stages Q401 through Q405. Final amplifiers Q404 and Q405 are operated push/pull to reduce even order harmonic outputs.

One of the four low-pass filters is selected by a switch ganged to the synthesizer "MHz" control and serves to reduce transmitter harmonics developed in the final amplifier circuit. The low-pass filters are also used in the receive condition contributing greatly to receiver spurious signal rejection. An automatic level control system samples RF output from the transmitter and feeds back a DC voltage to the IF amplifier stage, thus preventing transmitter "flat topping". This is especially valuable when the antenna circuit has been improperly matched to the transmitter. Separate ALC lines are provided for the high-power and low-power modes.

A built-in oscillator, Q110D, provides CW "break-in" type keying. A time-constant circuit holds the transmitter on between letters but switches back to receive during longer pauses. AM operation (carrier plus upper sideband) is provided by transistor Q120 which reinserts the carrier at the output of the IF amplifiers.

Carrier oscillator voltage is developed by oscillator circuit Q118 (BFO in the receive mode) and is applied to the balanced modulator circuit through an electronic

3.3 cont'd double-pole, double-throw switch (Q111-114). Synthesizer output voltage is supplied to the mixer circuit through the same electronic DPDT switch, mixing with the 12.7 MHz IF signal and producing a difference signal in the 2-12 MHz frequency range. Note that the synthesizer output frequency is always 12.7 MHz higher in frequency than the outgoing signal.

The electronic double-pole, double-throw (DPDT) switch (Q111-114) connects the synthesizer to the FIRST MIXER/BALANCED MODULATOR in the receive mode, or to the PRODUCT DETECTOR/SECOND MIXER in the transmit mode. Simultaneously, the 12.7 MHz oscillator is connected to the PRODUCT DETECTOR/SECOND MIXER in the receive mode, or to the FIRST MIXER/BALANCED MODULATOR in the transmit mode. (See Figure 3.13.)

3.4 RECEIVER

The signal from the antenna first passes through the low-pass filter (paragraph 3.3) selected by the "MHz" control and the antenna tuner section. It then passes through a high-pass filter designed to provide "cut-off" for frequencies below 2.0 MHz. This filter is important in areas where strong, medium-wave broadcast stations are situated. A low-pass filter which attenuates signals above 12.0 MHz follows the high-pass filter.

A double balanced mixer circuit converts the incoming signal to the intermediate 12.7 MHz frequency.

Transistor Q101 gives sufficient amplification to overcome the losses of the antenna high and the low-pass filters, the mixer circuit and the crystal filters. The 2N3866 low noise transistor is capable of handling very large signals. The front end of the receiver has an exceptionally high dynamic range, yet excellent signal-to-noise ratio.

3.4 cont'd

Output of amplifier Q101 is coupled via a hybrid transformer to the upper and lower sideband crystal filters. Each filter is connected to separate IF amplifiers, the outputs of which are combined and fed to a double-balanced, product detector circuit. The FUNCTION switch selects either of the IF amplifiers and crystal filters, dependent upon the desired sideband (USB or LSB). The audio signal from the product detector is amplified by Q116E and Q117 and applied to an internal speaker or headphones as required.

Automatic gain control is obtained by further amplifying and rectifying the audio signal from Q116B and applying the resulting DC voltage back to the IF amplifiers. A dual time constant type AGC is used providing an effective fast attack, slow release system.

The 12.7 MHz injection signal is developed by Q118 and Q119. The signal is connected thru a DPDT electronic switch to the product detector circuit. Local oscillator voltage is provided by the synthesizer circuit and applied through the electronic DPDT switch to the mixer circuit.

3.5 ANTENNA TUNER

A low-pass antenna tuner is built directly into the transceiver. This tuner allows very precise matching to the whip antenna as well as long-wire antennas. Assuming a perfect ground connection, the transceiver will match the following antenna types:

a. Manpack Whip (SC130AW)

b. Vehicular Whip (SC130MW)

c. Dipole (SC503)

d. Long-Wire (SC503)

3.5 cont'd The VSWR bridge circuit is connected to the panel meter so as to indicate reflected power from the antenna when the FUNCTION switch is in the TUNE position. In other positions of the FUNCTION switch, the meter reads forward power.

NOTE

The antenna tuner is not required to match the dipole antenna (Item c above).

3.6 SYNTHESIZER

The synthesizer is a form of a specialized signal generator. It produces the necessary injection signals for the transceiver.

A stable reference oscillator, operating at a frequency of 1.024 MHz, is divided by an array of flip-flops until the output frequency is 1.0 KHz. Simultaneously, the output of a voltage controlled oscillator (VCO), which operates over a frequency range of 14.7 MHz to 24.7 MHz, is divided by a programmable counter. The actual division ratio is controlled by the front panel frequency selector knobs. The output of this divider or counter circuit is approximately 1.0 KHz.

Both the 1.0 KHz reference signal and the output of the programmable counter are fed to a discriminator. If the VCO signal is different from the 1.0 KHz reference frequency, the discriminator will develop a DC error voltage. This error voltage is then applied to a variable reactance diode which tunes the VCO circuit and moves the oscillator frequency until the difference frequency is zero. For example, if a VCO output of 14.7 MHz is required, the counter is set by the panel knobs to divide by 14,700. Assume that the VCO is operating at 15.0 MHz at this

3.6 cont'd particular time. Dividing by 14,700 will produce a difference frequency of 1.02040 KHz. The resultant error voltage, when applied to the VCO, will correct the frequency to the desired 14.7 MHz.

NOTE

An offset is designed into the counter so that the panel reading indicates the actual received or transmitted signal frequency. Thus a 14.700 MHz oscillator frequency will be generated when the panel settings are 2.000 MHz (the actual transmitted or received frequency) or 14.700 MHz minus 12.700 MHz.

3.7 DETAILED THEORY OF OPERATION

The following paragraphs describe each circuit in detail. It is important to understand that some circuits are common to both the receive and transmit modes. Since descriptions are included for each mode, circuits which fall in this category will be described only once in the receiver section. Approximate additional notations and descriptions are included in the transmitter section to identify differences in functional operation. The antenna tuner and the digital synthesizer are described separately.

Most of the circuits are mounted on one of five (5) printed circuit boards.

a. PC101 Receiver/Exciter

b. PC201 Synthesizer

c. PC301 VCO

d. PC401 Transmitter

e. PC501 Audio Input Filter

3.7 cont'd Schematics of integrated circuits on each board are included in these figures.

3.8 RECEIVER

The following paragraphs describe the transceiver while operating in the receive mode. (Refer to Figure 3.4 PC101 Schematic Diagram.)

3.9 INPUT NETWORK

Because the transceiver utilizes broadband circuitry throughout, it is necessary to provide a means of eliminating out-of-band signals at the receiver input. Otherwise, spurious signals and/or intermodulation products will be generated and these must be prevented or greatly reduced. This is accomplished through a filter composed of L101 through L110 and C101 through C110.

The first portion is a high-pass filter which is designed to greatly attenuate (cut off) all signals below 2.0 MHz, the lower limit of the receiver frequency range. This portion is comprised of L101 through L104 and C101, C102 and C103.

The second portion is a nine element low-pass filter designed to cut off frequencies above 12.0 MHz, the upper limit of the pass band. Thus, considerable attenuation to image and other spurious signals is provided. The low-pass filter consists of L107 through L110 and C107 through C110.

The fact that the intermediate frequency (IF) of the transceiver is only 0.7 MHz above the high end of the frequency band, gives rise to the possibility that IF

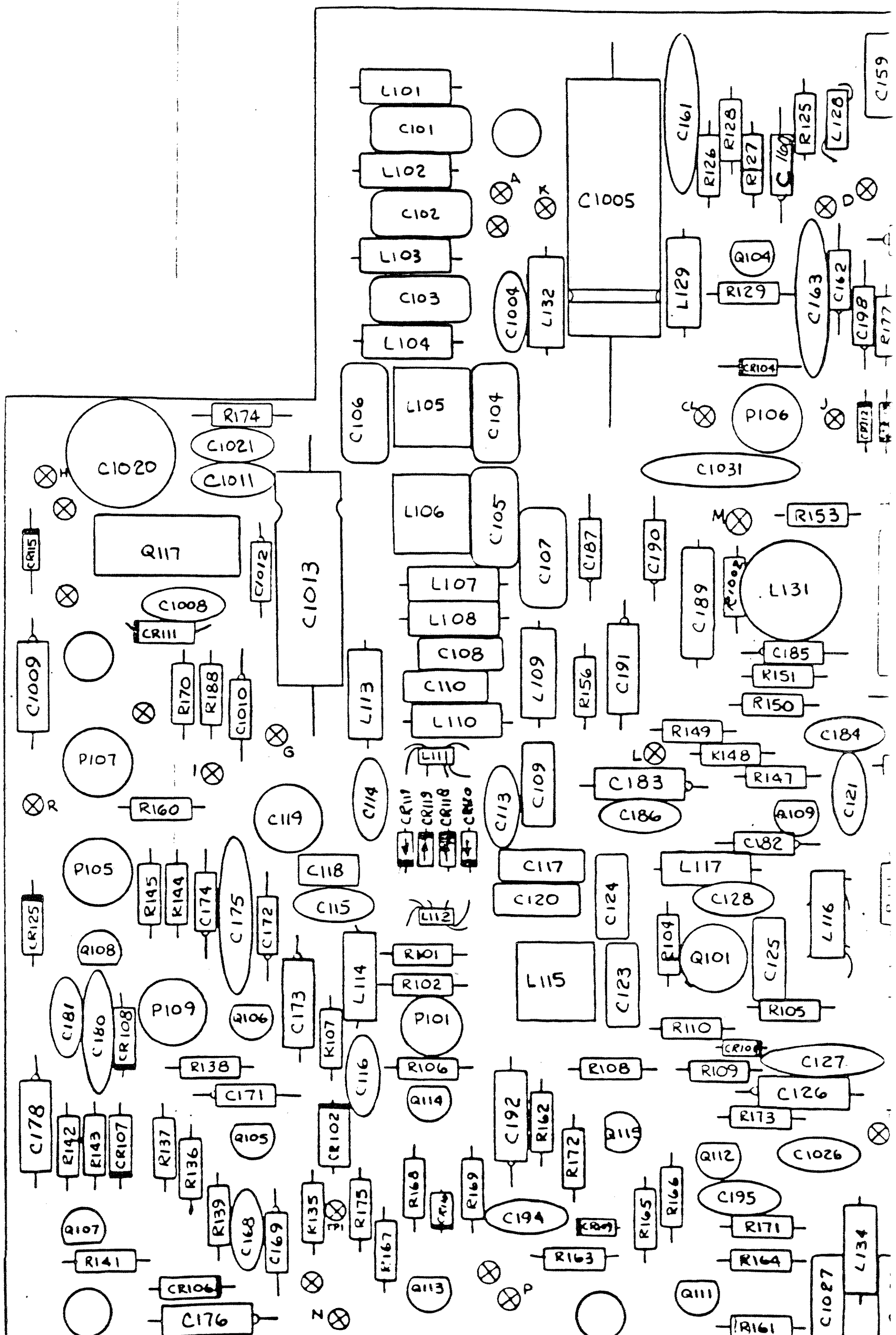
3.9 cont'd

signals could be radiated from the antenna or that a strong external 12.7 MHz signal could be coupled to the IF amplifiers. Either of the above contingencies would produce an undesired output. For this reason, two (2) parallel tuned (L105, C104 and L106, C105) 12.7 MHz notch filters are included with the high-pass and the low-pass sections as part of the low-pass sections.

3.10 DOUBLE BALANCED MIXER

The Double Balanced Mixer functions by switching the information bearing signal alternately across an IF transformer. The switching rate is made equal to the frequency of the local oscillator or injection signal. Referring to the Simplified Schematic, Figure 3.5, the injection signal I is impressed across the two halves Of T2 primary in parallel with respect to ground. For the negative going half cycle of I, diodes D2 and D3 will conduct and diodes D1 and D4 are biased off. As a result, Terminal A of T1 is connected to Terminal A of T2 and, likewise, the B Terminals are connected together. Any signal impressed across the primary of T1 appears at the secondary of T2 as long as the level of that signal is sufficiently low, so as not to change bias on any of the diodes.

During the positive going half cycle of I, D4 and D1 conduct while D2 and D3 are biased to cut off. This switches Terminal A of T1 to Terminal B of T2 and Terminal B of T1 to Terminal A of T2. This switches the phase relationship from input to output, which is the electrical equivalent of multiplying two sine waves. The result out of such multiplication is to produce new frequencies which are the sum and difference of the signals impressed across T1 and I.



L101
C101
L102
C102
L103
C103
L104
C1004
L132
C1005
C161
R126
R128
R127
R125
L128
C159
L129
R129
Q104
C163
C162
C198
CR104
R174
C1021
C1011
C1020
C106
L105
C104
P106
C1031
L106
C105
C107
C187
C190
R153
Q117
C1012
C1013
L107
L108
C108
C110
L110
L113
L109
R156
C191
C189
L131
C185
R151
R150
CR115
C1008
CR111
C1009
R170
R188
C1010
P107
R149
R148
R147
C184
C183
C186
Q109
C121
C182
R160
C119
C114
CR117
CR119
CR118
CR120
C113
C109
P105
R145
R144
C174
C175
C172
C118
C115
L112
C117
C120
C124
L117
C128
L116
CR125
Q108
R101
R102
L114
L115
C123
R104
Q101
C125
C181
C180
CR108
P109
Q106
C173
R107
P101
R105
R110
CR109
C127
R138
C116
R106
R108
R109
C126
C171
Q114
C178
R142
R143
CR107
R137
R136
Q105
CR102
C192
R162
R172
Q115
R173
Q112
C1026
R139
C168
C169
R135
R175
R168
R169
C194
R165
R166
C195
Q107
R171
R141
R167
R163
R164
L134
CR106
Q113
Q111
C1027
C176
R161

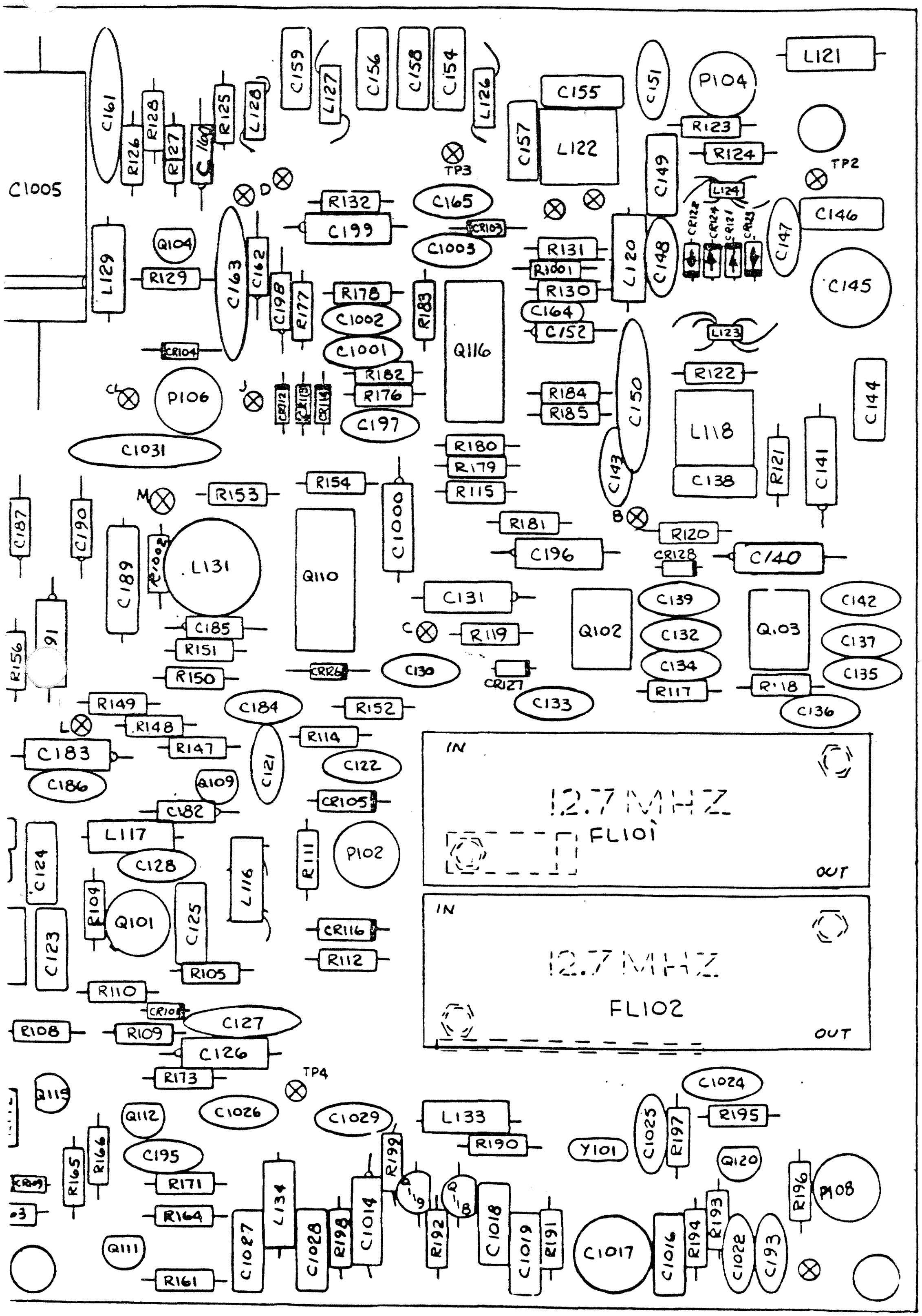
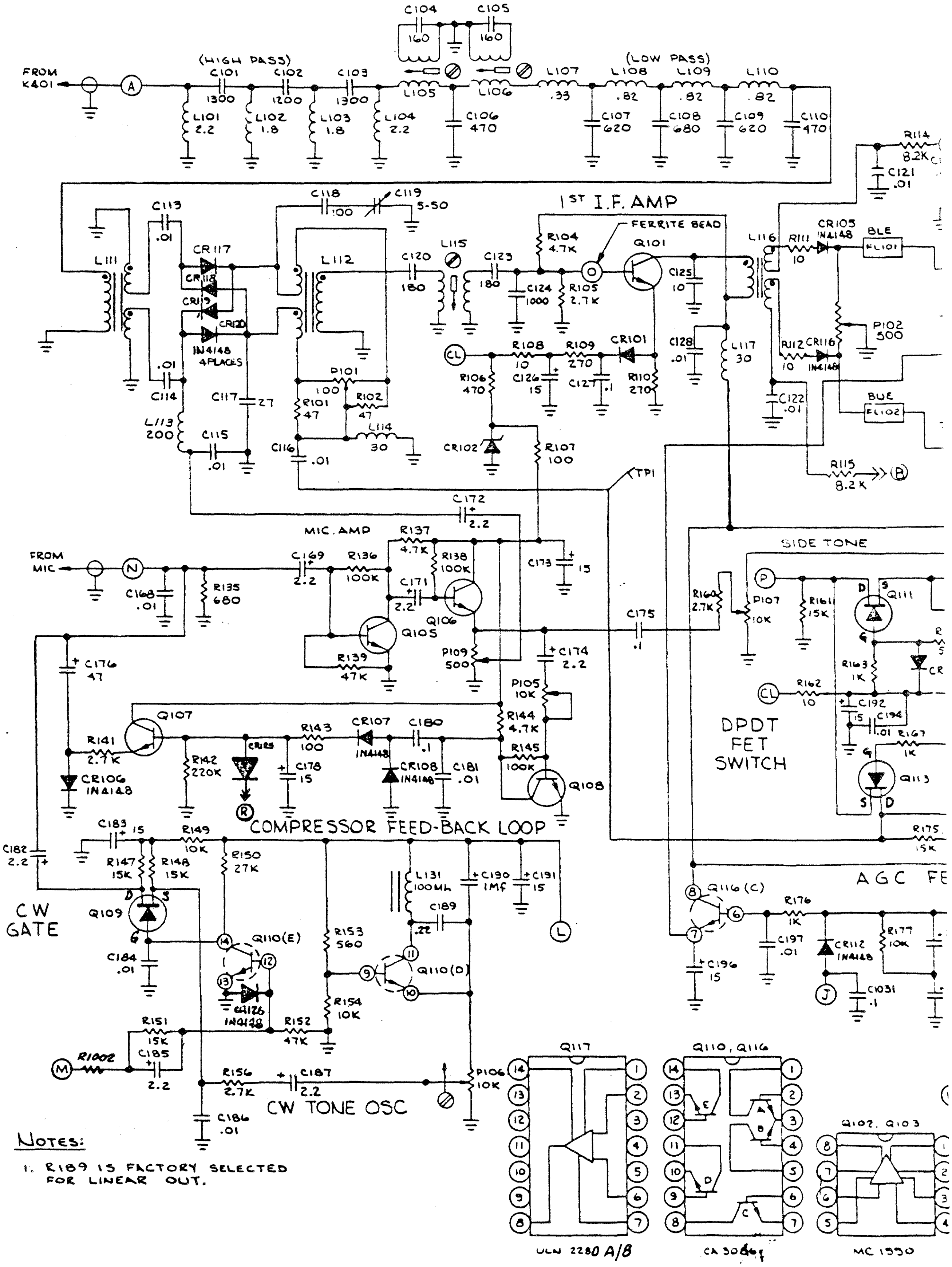
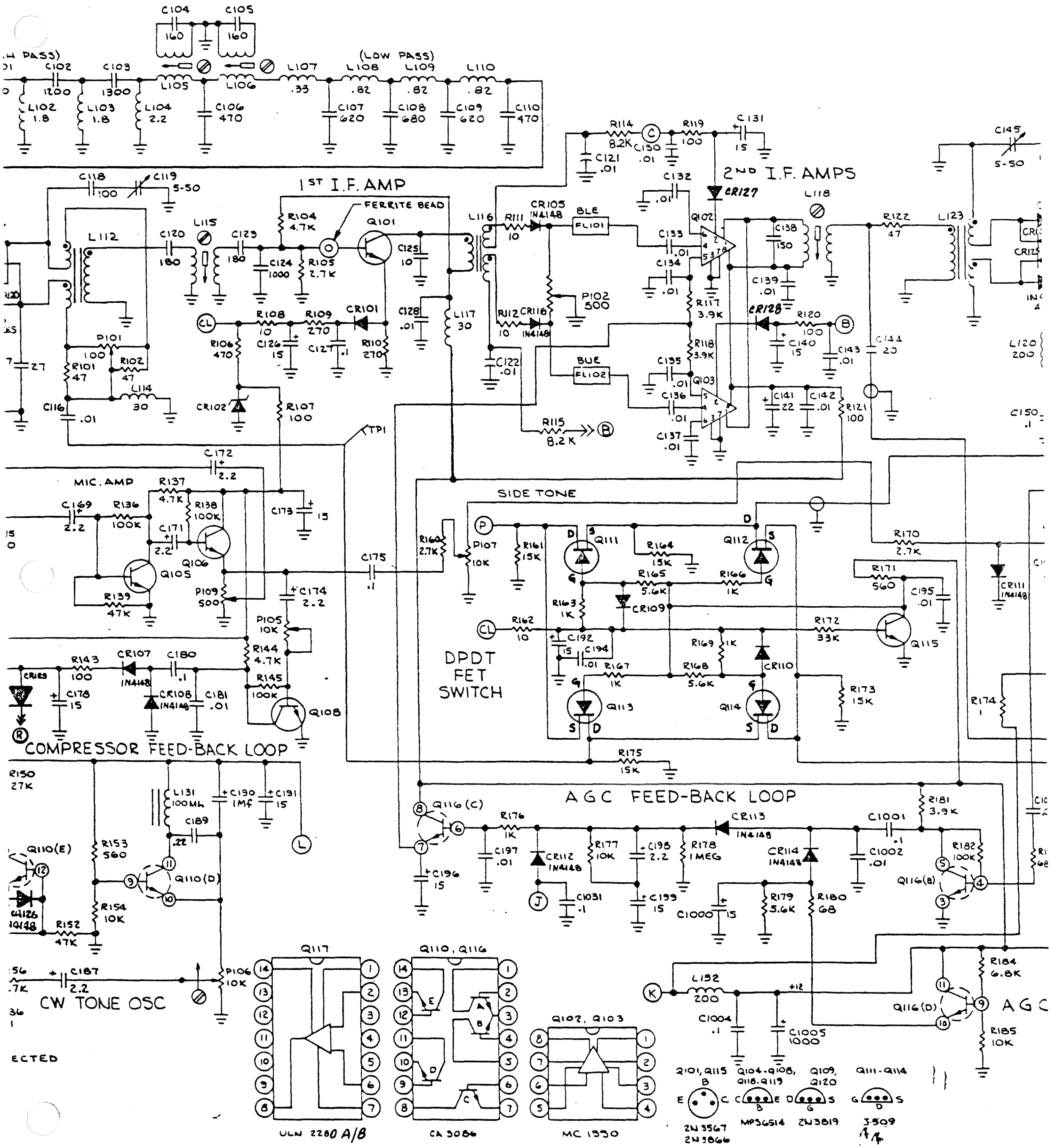


Figure 3.3. PC101 Ass



NOTES:

1. R189 IS FACTORY SELECTED FOR LINEAR OUT.



(LOW PASS)
C102 1200
C103 1300
C104 160
C105 160
L102 1.8
L103 1.8
L104 2.2
L105
L106
L107 .33
L108 .82
L109 .82
L110 .82
C106 470
C107 620
C108 680
C109 620
C110 470
C118 100
C119 5-50
L112
C120 180
L115
C129 180
C124 1000
1ST I.F. AMP
FERRITE BEAD
R104 4.7K
R105 2.7K
Q101
C125 10
C128 .01
L117 30
R108 10
R109 270
CR101
R106 470
C126 15
C127 .1
R110 270
CR102
R107 100
P101 100
R101 47
R102 47
L114 30
C116 .01
C27 27
TP1
L116
R111 10
CR105 1N4148
BLE FL101
BUE FL102
R112 10
CR116 1N4148
P102 500
C122 .01
R115 8.2K
R114 8.2K
C121 .01
C130 .01
R119 100
C131 15
C132 .01
CR127
2ND I.F. AMPS
Q102
C133 .01
C134 .01
R117 3.9K
R118 3.9K
C135 .01
C136 .01
Q103
C137 .01
CR128
R120 100
C140 15
C143 .01
C144 20
C138 150
C139 .01
L118
R122 47
L123
C145 5-50
C141 22
C142 .01
R121 100
L120 200
C150 .1
MIC. AMP
C172 2.2
C169 2.2
R136 100K
R137 4.7K
R138 100K
C171 2.2
Q106
Q105
R139 47K
P109 500
C173 15
C174 2.2
C175 .1
P105 10K
R144 4.7K
R145 100K
Q108
R143 100
CR107 1N4148
C180 .1
CR129
C178 15
CR108 1N4148
C181 .01
COMPRESSOR FEED-BACK LOOP
SIDE TONE
R160 2.7K
P107 10K
R161 15K
Q111
R164 15K
Q112
R165 5.6K
R166 1K
R163 1K
CR109
R162 10
C192 15
C194 .01
R167 1K
R168 5.6K
R169 1K
CR110
DPDT FET SWITCH
Q113
Q114
R173 15K
R175 15K
R170 2.7K
CR111 1N4148
R171 560
C195 .01
R172 33K
Q115
R174
AGC FEED-BACK LOOP
Q116 (C)
R176 1K
C197 .01
C196 15
CR112 1N4148
C1031 .1
R177 10K
C198 2.2
C199 15
R178 1MEG
CR113 1N4148
CR114 1N4148
C1000 15
R179 5.6K
R180 68
C1001 .1
C1002 .01
R181 3.9K
R182 100K
Q116 (B)
R150 27K
L131 100mh
C190 1mf
C191 15
C189 .22
R153 560
Q110 (E)
Q110 (D)
R154 10K
R152 47K
CR126 1N4148
C187 2.2
P106 10K
CW TONE OSC
Q117
ULN 2280 A/B
Q110, Q116
CA 3086
Q102, Q103
MC 1350
L132 200
+12
C1004 .1
C1005 1000
R184 6.8K
Q116 (D)
R185 10K
AGC
Q101, Q115
2N3567
2N3866
Q104-Q108, Q118, Q119
MPS6514
Q109, Q120
2N3819
Q111-Q114
3509

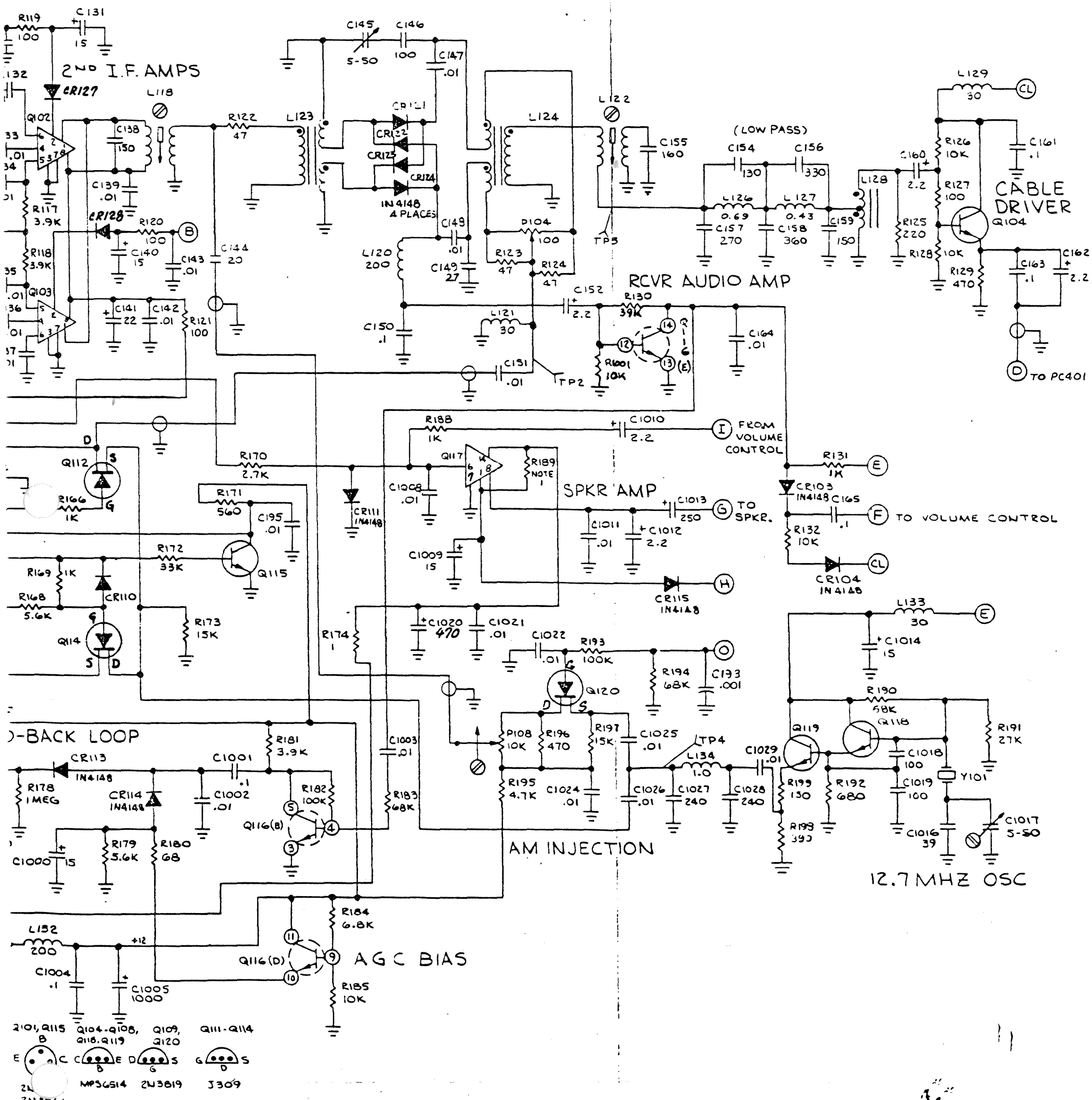


Figure 3.4. PC101 Schematic Diagram

3.11 IF PREAMPLIFIER

Collector voltage for Q101 is decoupled by RF choke L117 and capacitor C128. Emitter bias is developed across resistor R110. In the receive mode, the control line is grounded, causing diode CR101 to be forward biased through resistor R108 and R109. This effectively bypasses R110 through capacitor C127. In the transmit mode, the control line is raised +12 VDC. CR101 is back biased so that R110 is no longer bypassed by C127. This unbypassed emitter resistor reduces the stage gain and improves linearity over a wider dynamic range.

Transformer L116 couples output of Q101 to both sideband filters, FL101 and FL102. Potentiometer P102 is factory adjusted to equalize the signal levels between the separate upper and lower sideband circuits. A diode switch (CR105, CR116) effectively removes the other to reduce loading. Operation of this switch is automatically controlled by the Front Panel Function Switch setting. Coupling capacitor C133 and C136 isolate the filter from the IF amplifiers.

NOTE

Each crystal filter is designed for a specific sideband, upper or lower. Due to the heterodyne conversion process used, an inversion of sidebands occur. That is, when the signal is passed through the lower sideband filter, the output of the transceiver will be upper sideband and vice versa. Therefore, when replacing a sideband filter, it is important to replace it with one of the same part number.

3.12 IF AMPLIFIERS

Monolithic integrated circuits (IC) are utilized for the IF amplifiers. Their use reduces circuit complexity and increases reliability. Two separate amplifiers, Q102 and Q103 are employed, one for upper and one for lower sideband operation. Power is applied to the appropriate amplifier when the FUNCTION switch is set to the desired mode of operation. Since these amplifiers are identical, the operation of only Q102 and its external components are referenced for purposes of this discussion.

The input signal from the crystal filter is applied to pin 4 of IC Q102, while the output is taken from pin 1. Other input and output connections are provided, but are not required in this application. The unused input, pin 6, is bypassed to ground through capacitor C132. The unused output, pin 8, is connected to the 12 volt supply through a decoupling network consisting of resistor R121 and capacitors C141 and C142.

The supply voltage from the FUNCTION switch to pin 2 of the device is decoupled by the R120 resistor and C140 capacitor network. A similar network, consisting of resistor R118 and capacitor C135 provides decoupling for the AGC voltage which is applied to pin 5.

The outputs of both amplifiers (only one of which is energized) are paralleled and connected to IF transformer L118 which is tuned by capacitor C138. Capacitor C139 simply bypasses the supply voltage side of the L118 primary.

3.13 PRODUCT DETECTOR/MIXER

The Product Detector/Mixer circuit is identical to the mixer/modulator described in paragraph 3.10. The selected signal from the IF amplifier is coupled to a wideband transformer through resistor R122. The combination of the secondary step-down winding of IF transformer L118 and R122 ensures proper impedance matching to the mixer input. Operation is identical to the input mixer previously described. The input signal is the 12.7 MHz IF, the injection is a 12.7 MHz BFO signal and the output, the received audio which is the difference frequency. Since audio is the desired output, it is picked off ahead of the blocking capacitor C148. Low-pass network L120 and C150 further separates the audio output from the IF signals. The audio signal is coupled to the audio amplifier through C152.

3.14 FIRST AUDIO AMPLIFIER

The detected audio output from the detector/mixer circuit is applied to the base of a single transistor amplifier in integrated circuit Q116. Base bias voltage is supplied by resistor R130 and the regulated +8 VDC applied to resistor R131, the collector load. High frequencies, which might cause self-oscillation, are bypassed by capacitor C164. The amplified output of this transistor is simultaneously fed to the AGC amplifier (another part of the IC array contained in Q116) through capacitor C1003 and resistor R183 and to the front panel mounted volume control through capacitor C165.

3.15 AUDIO POWER AMPLIFIER

The audio signal is returned from the wiper of the volume control via capacitor C1010 and resistor R188. If amplifier Q117 is overdriven, self-rectification of the signal occurs which causes a large positive voltage to be developed. This, in turn, changes the operating point of the following direct coupled stage and causes considerable signal distortion. Diode CR111 prevents this voltage from exceeding 0.6 volts. Since this is a high-gain, direct-coupled stage, bypass capacitors C1008, C1011 and C1012 are required to prevent self-oscillation. Capacitor C1009 filters the supply voltage.

In TUNE mode, amplifier Q117 is disabled by grounding pin 1 through switching diode CR115. For all other modes, audio sidetone is coupled from the mike amplifier to the power amplifier input through capacitor C175 and resistor R160. This allows the operator to monitor his own transmission. P107 is an internal sidetone level adjustment. The final audio output requires no impedance matching transformer and is coupled through capacitor C1013 directly to the front panel speaker switch and the speaker voice coil or handset connectors.

3.16 AGC AMPLIFIERS

The audio signal from Q116E is applied to the base of Q116B. Base bias is provided by resistor R182. Positive voltage is applied to the collectors by resistor R181. Amplified audio is then applied through C1001 to voltage doubler circuit, diodes CR113 and CR114. Capacitor C1002 removes unwanted RF. Due to the fact that IF amplifier AGC input ports are above ground by approximately 5 volts, it is necessary to maintain the rectifier system above

3.16 cont'd ground by approximately this amount. The threshold voltage is provided by Q116D. The voltage is fed to R180 and R179. Capacitor C1000 provides a bypass to ground for the audio signal. The positive going DC output from the rectifier system is fed to a dual time constant storage system which allows a fast attack, slow release automatic gain control. When a signal arrives at the rectifier, the initial DC voltage generated charges C198 quickly, but capacitor C199 charges slowly through resistor R177. If capacitor C199 was to charge quickly, its low internal impedance would load the rectifier system heavily and slow the attack time. Discharge time is controlled by resistor R178

Transistor Q116C is a simple emitter follower circuit. DC voltage is applied to the base from the time constant circuit. The internal resistance of the IF amplifiers Q102 and Q103 together with resistors R118 and R117 function as the emitter resistor for the emitter follower. Resistors R117 and R118 effectively allow the drive to Q102 and Q103 to be constant voltage, variable current. Capacitor C196 tends to further smooth the AGC voltage against audio variations without affecting the time constant of the AGC system.

3.17 <u>BFO/CARRIER GENERATOR</u>

The BFO/carrier generator consists of a transistor Q118 which forms a crystal controlled Colpitts oscillator. Capacitors C1018 and C1019 form the Colpitts capacitive divider network. Resistor R192 is the usual emitter resistor. Base bias is provided by resistors R190 and R191. A trimmer capacitor (C1017) in series with the 12.7 MHz crystal (Y101) allows the crystal to be "pulled" exactly to frequency. The emitter of the oscillator unit is direct coupled to the base of Q119, which stage functions

3.17 cont'd as an emitter follower. Capacitor C1014 adds filtering to the regulated positive supply. Resistor R198 is the normal emitter resistor. Capacitors C1027, C1028 and inductor L134 constitute a low-pass filter to attenuate oscillator harmonics. C1029 is a DC blocking capacitor. Output from the BFO/carrier generator is fed to the product detector/mixer via an electronic DPDT switch in the receive condition and to the double balanced modulator/mixer in the transmit condition. The BFO crystal (Y101) has been specially matched with crystal Y301, the frequency synthesizer reference oscillator crystal, to provide a drift cancelling characteristic, resulting in better frequency stability.

3.18 DETAILED TRANSMITTER DESCRIPTION

The following paragraphs describe the transceiver while operating in the transmit mode. (Refer to Figure 3.4, PC101 Schematic Diagram and Figure 3.7, PC401 Schematic Diagram.)

3.19 TRANSMITTER AUDIO AMPLIFIERS

The microphone audio section is designed to accept the input voice signal which may range in volume from a whisper to a shout, and condition it to a level which will properly modulate the transmitter. To accomplish this, it is necessary to incorporate a very wide-range compressor circuit. The microphone audio signal is applied across load resistor R135. This signal is coupled through blocking capacitor C169 to Q105. Q105 and Q106 serve as a two-stage high gain audio amplifier, with a low impedance emitter follower output. P109 is the emitter load for Q106. It provides audio amplifier gain adjustment, set at the factory for normal microphone input levels.

3.19 cont'd The full audio output is also connected through C175 and R160 to P107. This path provides the sidetone input to the speaker amplifier, Q117. P107 permits sidetone level adjustment independent of the transmitter audio setting.

A third output from Q106 is used to supply a control signal for the audio compressor. This path is through C174 to amplifier Q108. The output of Q108 is rectified by CR107 and CR108, and the filtered DC voltage (proportional to the audio amplitude) provides a variable bias for DC amplifier Q107. The emitter of Q107 is connected in series with R141 and CR106. As the emitter current through Q107 increases, the resistance of diode CR106 decreases. Similarly, as Q107 emitter current approaches zero, the forward resistance of CR106 becomes very large. In this fashion, CR106 functions as a variable resistance, controlled by the emitter current of Q107.

CR106 is connected in series with C176 across the audio input of Q105. When the resistance of CR106 is high, the full microphone input is applied to the base of Q105. As the resistance of CR106 is decreased below the impedance of C169, only a portion of the input level is connected to the base of Q105. Since the resistance of CR106 is set by the audio output, the effect of the closed circuit is to maintain the audio level constant for varying inputs after a threshold input level is reached. This threshold can be adjusted by P105.

3.20 BALANCED MODULATOR/MIXER

The same circuit that was used in the receive mode as a balanced mixer is now utilized as a balanced modulator in the transmit mode. Instead of the synthesizer local

3.20 cont'd oscillator (LO) signal, the 12.7 MHz BFO frequency is applied and audio from the microphone amplifier replaces the received signal. Operation of the circuit is similar to that in the receive mode. Potentiometer P101 and trimmer capacitor C119 are most effective in this mode, enabling a very precise carrier balance setting.

3.21 IF AMPLIFIERS

The double sideband signal is amplified by Q101, the appropriate sideband selected by crystal filters FL101 or FL102, and further amplification of the selected sideband provided by Q102 or Q103. Instead of an AGC voltage, an ALC (automatic level control) circuit now determines the gain of these stages. The ALC voltage is derived at the transmitter output, thereby maintaining a constant transmitter output over a wide range of input.

3.22 BALANCED MIXER/PRODUCT DETECTOR

The circuit which served as a product detector in the receive mode is now used as a mixer. The selected sideband signal is delivered from the IF amplifier as before but is now mixed with the synthesizer (LO) signal instead of the BFO signal. Again, both sum and difference frequencies are generated. The synthesizer signal is balanced out in the mixer, providing attenuation of approximately 30 dB. The IF, sum frequency and synthesizer signals are further reduced by notch and low-pass filter circuits.

When the transmission of compatible AM (A3H) is required, carrier voltage is reinjected between IF amplifiers Q102 or Q103 and the mixer/product detector. This carrier voltage is derived from the output of Q119 and fed to the Q120 FET switching device. When in the AM transmit mode, a positive control voltage applied to the gate causes the

3.22 cont'd switch to conduct and the carrier is injected. When receiving AM transmission, the control line is grounded, preventing conduction. Actually, the supply voltage is removed from Q120 when the FUNCTION switch is not in either the AM or TUNE mode. In this case, the gate is held at ground potential by resistor R194. Potentiometer P108 adjusts the amplitude of injected carrier.

3.23 FILTER NETWORK

A parallel tuned trap (notch filter) consisting of inductor L122 and capacitor C155 further attenuates the 12.7 MHz IF signal. Since the output of the mixer contains both sum and difference frequencies and only the difference frequency is desired, a means of eliminating the sum (image) frequency is necessary. This is accomplished by a low-pass filter comprised on inductors L126 and L127 and capacitors C154 and C156 through C159.

3.24 TRANSMITTER PREAMPLIFIER

The output from the low-pass filter is applied to the base of transistor amplifier Q104 through step-up transformer L128, and blocking capacitor C160 and resistor R127. Resistor R125 properly terminates the low-pass filter network. Base bias is supplied by resistors R128 and R126. Collector voltage (+12 volts) is derived from the control line through inductor L129. Capacitor C161 bypasses the collector to ground. This stage operates as an emitter follower and the output is developed across resistor R129. Blocking capacitors C162 and C163 couple the output to the next amplifier stage, located on printed circuit board PC401.

3.25 TRANSMITTER AMPLIFIERS/DRIVER

The remaining transmitter amplifiers are located on printed circuit board PC401. (Refer to Figure 3.7, Schematic Diagram.) The output of amplifier Q104 is transferred to PC401 by a coaxial cable. Three (3) intermediate stages of amplification are provided prior to the final amplifier by transistors Q401, Q402 and Q403. Step-up transformer L401 at the input to PC401 is terminated by resistor R401.

Base bias for transistor Q401 is provided by resistors R402 and R403. The series combination of resistors R406, R407 and R408 in the emitter circuit, with the latter two bypassed by capacitors C405 and C406, supplies degenerative current feedback to the circuit while R403 supplies degenerative voltage feedback. The frequency selective qualities of the RF network serves to stabilize the gain of this stage over the 2.0 to 12.0 MHz bandwidth by decreasing the feedback as the frequency increases. Compensation for the fall-off in frequency response of the transistor at higher frequencies is thus achieved. Resistor R404 is the collector load resistor with the combination of resistor R405 and capacitors C404 and C441 serving as the decoupling network.

The output of transistor Q401 is coupled to the base of transistor Q402 by capacitor C407. This transistor is a conventional common emitter amplifier. Base bias is provided by resistors R409 and R410. Again, the arrangement of resistors R413 and R414 and capacitor C408 in the emitter circuit accomplishes the task of stabilizing gain over the full frequency range by degenerative current feedback, while R410 applies voltage feedback. Resistor R411 is the conventional collector load resistor. Further decoupling for Q401 and Q402 is provided by resistor R412 and capacitor C411. The tantalum capacitor C411, because of its high RF

3.25 cont'd impedance, necessitates the addition of capacitor C410 as an RF bypass. The signal is fed to the driver stage via capacitor C409.

Heavy degenerative feedback (voltage and current) is supplied by the base biasing arrangement of resistors R415 and R416 and the unbypassed emitter resistor R417. A wideband toroidal transformer, L404, presents a push-pull signal to the class AB final power amplifier stage. Decoupling is accomplished by capacitor C412 and RF choke L403.

3.26 FINAL POWER AMPLIFIER

Output transistors Q404 and Q405 operate in a class AB condition. Transformer L404 supplies the drive signal in a push-pull mode. Transformer L405 combines the push-pull output into a 50 ohm output.

Diodes CR401 and CR402 sample heat generated by the output transistors and adjust the bias to the output stage accordingly. As the heat increases, the diode resistance and thus the voltage drop across the diodes, decreases. RF choke L418 isolates the bias supply from L404. Resistor R418 constitutes a load for the bias regulator and also serves to damp the choke L418 against unwanted spurious ocillations. Resistor R426 is intended to limit the load on the stage preventing non-linear performance when the transmitter is operated without an antenna. Capacitor C433 is intended to tune out leakage reactance in the inductor L405.

RF choke L406 filters the positive voltage to the stage and is damped by resistor R419 to prevent spurious oscillations

3.27 BIAS REGULATOR

Transistor Q406 functions as an emitter follower. Its purpose is to regulate the bias applied to the output stages; a nonregulated bias source would otherwise be varied by the incoming signal. Bias is adjusted by potentiometer P401. Capacitor C414 prevents unwanted oscillation of Q406. Resistor R421 limits the possible current flow through P401. As the heat increases, the resistance, and consequently the voltage drop across the diodes decreases. Thus the base bias is adjusted proportionally, allowing the push-pull output stage to continue operating in the linear region.

Jumper J3 is opened and a milliameter inserted during final alignment for setting final amplifier bias.

The output of toroidal transformer L405 is connected by keying relay K401 to the "MHz" selector, SW401, which automatically determines the appropriate harmonic suppression filter for the frequency of operation.

3.28 HARMONIC FILTERS

A series of five-element harmonic filters, located on printed circuit board PC401, attenuate harmonics of the output frequency in the transmit mode and aid in the rejection of unwanted siganls in the recieve mode. The filter switch, SW401, is ganged to the synthesizer "MHz" switch SW402 so that the selected output frequency is automatically connected to the proper filter. Table 3.1 indicates the band of coverage for each filter and identifies the elements which comprise them.

3.28 cont'd

TABLE 3.1

Harmonic Filters

REF	FREQUENCY BAND	ELEMENTS
A	2.0 to 3.0 MHz	L410, L411 C415 through C418
B	3.0 to 5.0 MHz	L412, L413 C419 through C421
C	5.0 to 7.0 MHz	L414, L415 C422 through C424
D	7.0 to 12.0 MHz	L416, L417 C425 through C427, C439, C440

3.29 ALC DETECTOR

Automatic level control (ALC) is necessary to insure operating the final amplifier at peak power capability without overload or attendant distortion. To accomplish the required control, the transmitter output is sampled by a capacitive voltage divider comprised of capacitors C436 and C437. Capacitor C436 is variable to allow an adjustment of the sample level applied to the ALC system. Voltage doubler diodes CR408 and CR409 rectify the output sample. After being filtered by capacitor C438 and RF choke L407, the DC voltage is applied to P402. The HI/LO PWR switch selects which of the two ALC outputs will be applied to Q116C. This voltage is substituted for the receiver AGC voltage in all transmit modes. Diode gate CR112 prevents loading of the AGC system by the ALC circuit during operation in the receive mode.

3.30 CW TONE OSCILLATOR AND KEYER

When the FUNCTION switch is set for CW operation, an audio tone is generated by a single transistor oscillator implemented through integrated circuit Q-110 (refer to Figure 3.4).

Another transistor, Q110E, in the same array serves as the keyer switch. The oscillator operates continuously only in the CW mode. In other modes, the supply voltage is removed from the stage. When the key is actuated, the tone is switched into the audio system by Q110E and Q109. This arrangement prevents the "chirp", or variation in tone frequency, that is experienced when a CW oscillator is keyed directly.

Since the carrier has been completely balanced out, only a pure, single-frequency signal will appear at the output of the transmitter. However, the tone will be displaced 1300 Hz higher in frequency than the original carrier. This means that a receiver normally tuned to a carrier frequency, as it would be for SSB or AM operation, will automatically receive the 1300 Hz tone.

NOTE

> Transmission of the CW tone occurs only on upper sideband. Therefore, the FUNCTION switches on both the transmitting and the receiving units should be set to CW.

The frequency of the tone oscillator is determined by the Colpitts configuration of inductor L131 and capacitors C189 and C190. Base bias is supplied at the junction of resistors R153 and R154. The circuit is connected as an emitter follower.

3.30 cont'd Supply voltage filtering is obtained from capacitor C191. The output is fed to potentiometer P106 which provides CW level adjustment.

The CW KEYER switch utilizes Q110E as a switching stage. The emitter is connected directly to ground. Resistor R150 is the collector load resistance. This stage is normally biased into saturation through resistor R151 with the 12 volts present at PC101 connector pin M. When the CW key is depressed, pin M is grounded, forcing the transistor out of saturation. The collector voltage at pin 14 rises, thereby controlling CW gate Q109 which is in series with the 1300 Hz keyer tone. Capacitor C185 provides a low impedance path for high speed keying signals.

When the gate of Q109 is made positive, the stage conducts, connecting the CW tone to the audio amplifier circuit. Conversely, when the CW key is released, the gate of Q109 is returned to ground potential and disconnects the CW tone from the audio amplifier circuit. Capacitor C187 is a DC blocking device while resistor R156 and capacitor C186 form an RF filter circuit. Positive supply voltage is furnished to the CW switch by resistors R147 and R148.

3.31 ANTENNA TUNER

(Refer to Figure 3.15). The antenna tuner is located in a shielded enclosure behind the front panel. It consists of a simple L network consisting of L1, L2 and C1. This loading network allows the transceiver to match a variety of non-resonant long-wire and whip antennas. T1 is a 4:1 balun transformer which allows the antenna tuner to match the antenna to 12.5 ohms resistive. This impedance is then transformed up to the desired 50 ohms by T1. Front

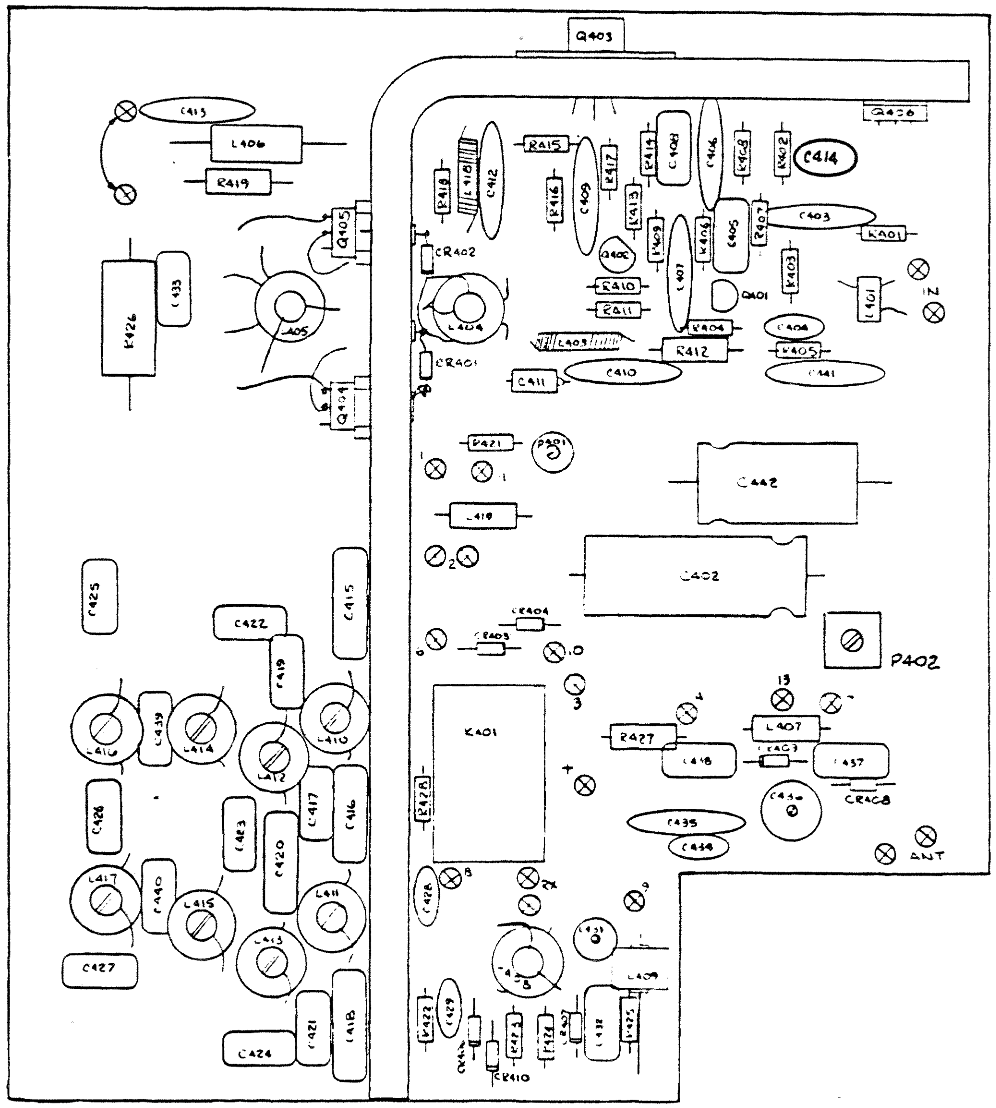
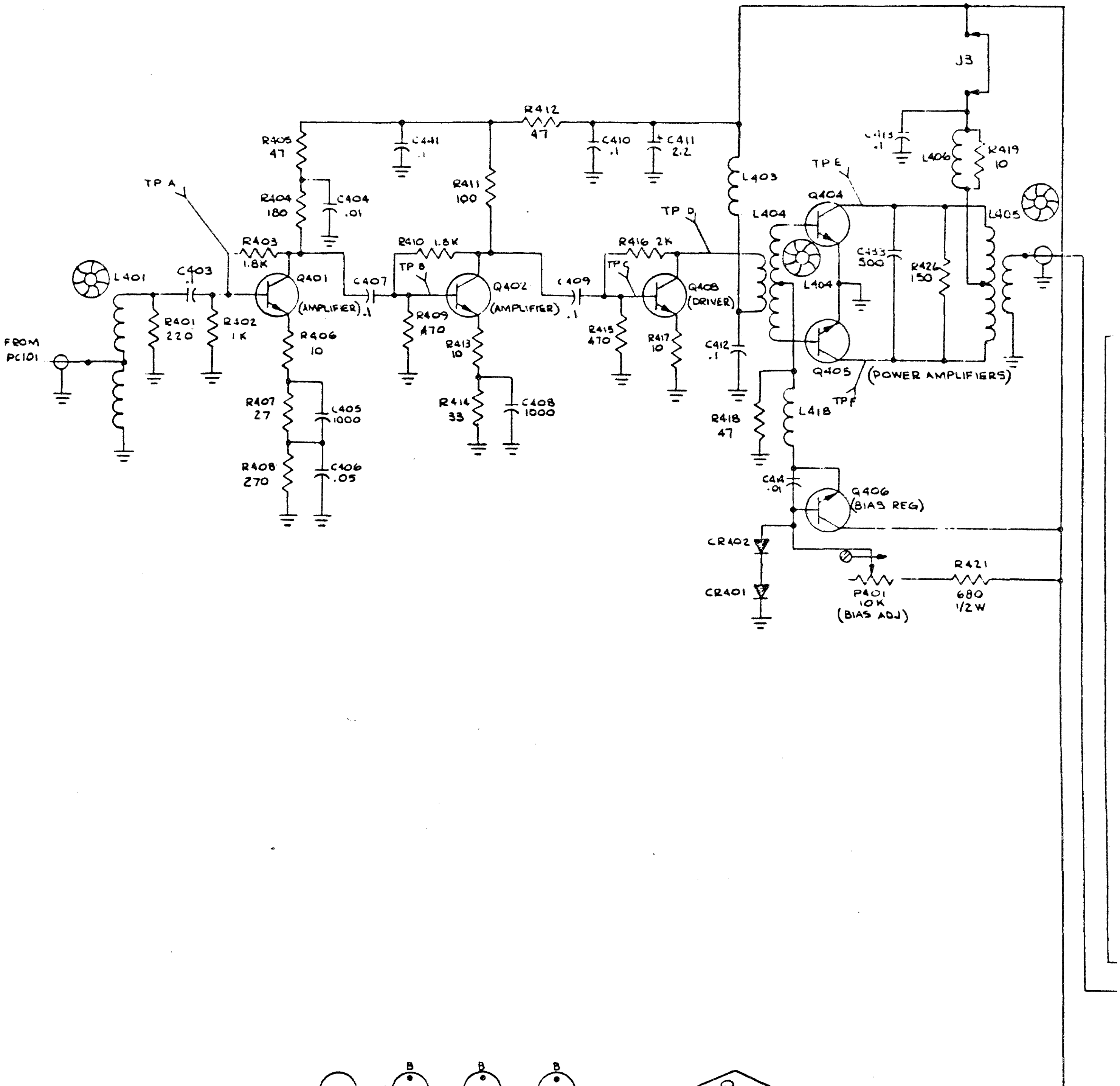
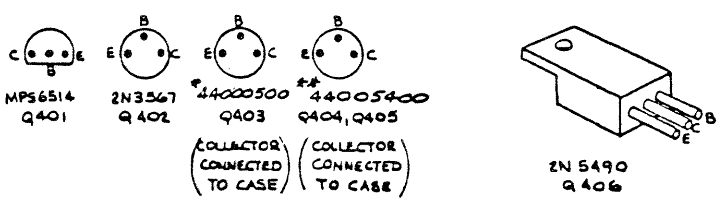


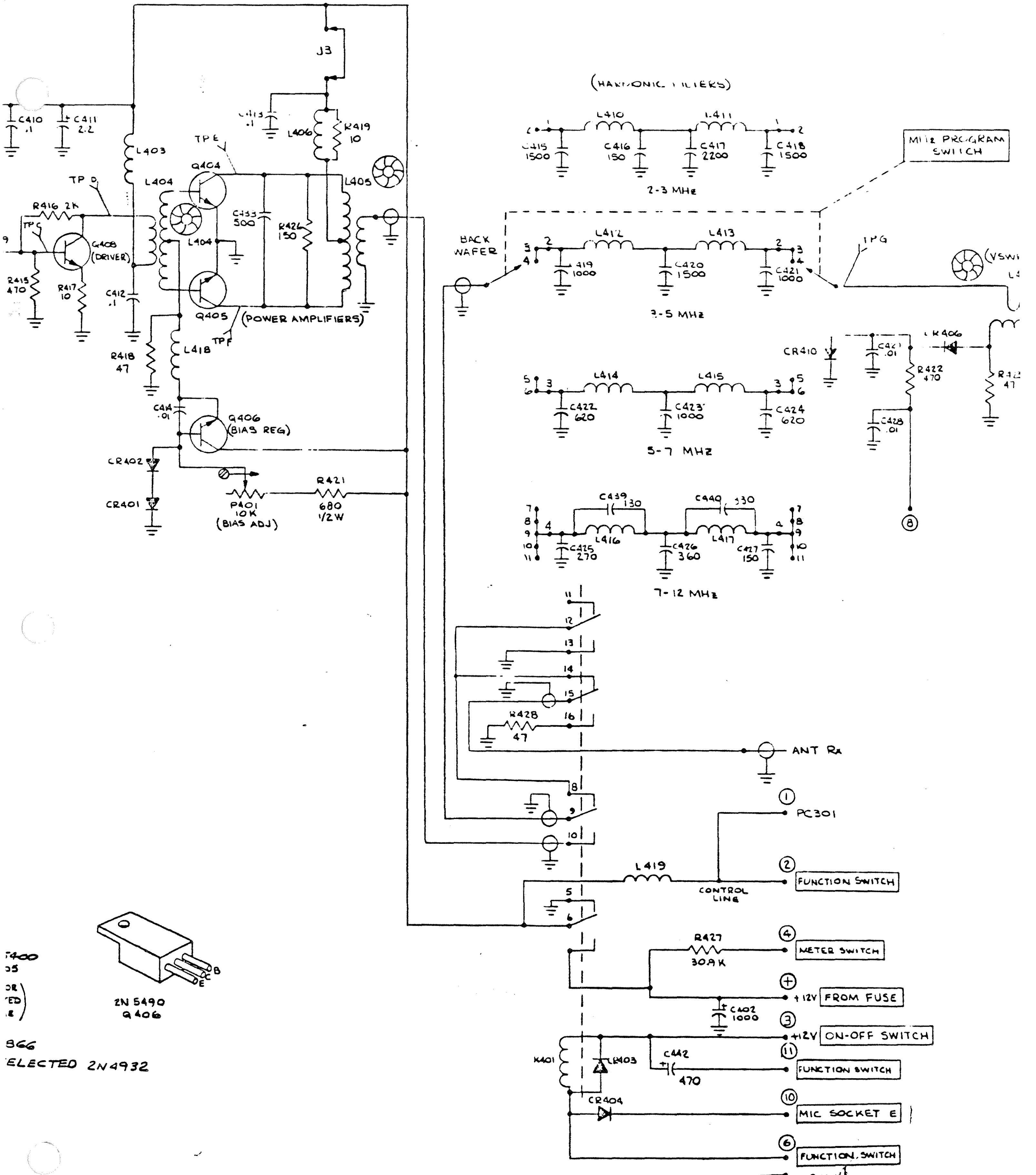
Figure 3.6. PC401 Assembly





*SELECTED 2N3866
**MATCHED PAIR-SELECTED 2N4932

2. ALL INDUCTORS ARE IN MICRO HENRYS.
1. ALL POLARIZED AND DECIMAL CAPACITOR ARE IN MFD ALL OTHERS ARE IN PF.
NOTES: UNLESS OTHERWISE SPECIFIED



ALL OTHERS ARE IN PF.

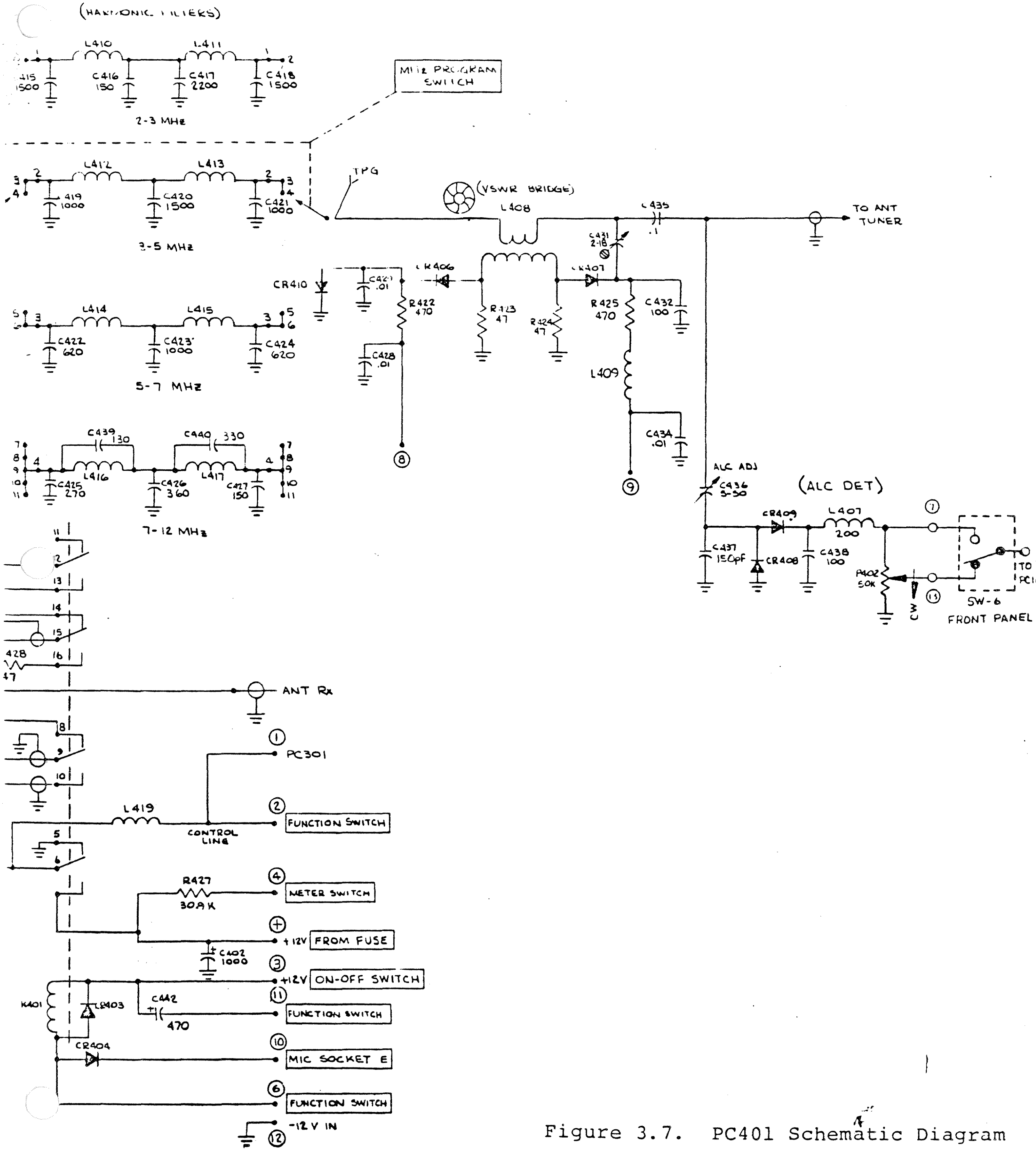


Figure 3.7. PC401 Schematic Diagram

3.31 cont'd panel control is provided for C1 (ANT TUNE 2) and SW4 (ANT TUNE 1). Control C1 is a variable air spaced capacitor. The inductors L1 and L2 are air wound over ferrite cores and are progressively tapped, the taps being selected by SW4. Best operation is obtained when the antenna is 50 ohms resistive and 0 ohms reactive. Some losses are experienced in the loading network at other values of resistance and reactance. (Refer to paragraphs 2.3 ANTENNA TUNER through TUNING PROCEDURE for specific procedures and information concerning the use of the antenna tuner).

NOTE

> When the FUNCTION switch is set to the TUNE position, the transmitter operates in the AM mode. The front panel meter reads reflected power (VSWR). In all other transmit modes, the meter indicates forward transmitted power.

3.32 VSWR BRIDGE

The VSWR bridge is located on printed circuit board PC401 (Figure 3.7) and is connected between the harmonic filters, and the antenna tuner circuit. (The ALC detector input is derived from the junction of the VSWR bridge and the antenna tuner.) The bridge is a simple reflected power type which utilizes wide-band transformer L408 to derive a sample of the power being reflected back to the harmonic filters from the antenna.

Capacitor C431 samples line voltage. Transformer L408 is in series with the transmission line. Line current is applied to rectifier diode CR406 and diode CR407. Rectified voltage output from diode CR407 is available only when the phase of the currents and voltage samples allow addition. For example, when the C431 samples the transmission line, 3.32 cont'd the phasing is such that reflected components are additive but forward components cancel. Thus, in the presence of reflected power components, CR407 produces a rectified voltage which is indicated on the front panel meter as reflected power in TUNE mode. In all other modes, the meter is connected to the output of diode CR406 which provides a DC voltage proportional to line current. Consequently, after an antenna has been tuned, the meter indicates the magnitude of the line current which is proportional to power output.

Capacitors C429 and C432 are part of the antenna bridge divider circuit. Bridge impedance is established and a DC return is provided for the diode currents by resistors R423 and R424. Resistors R422 and R425 and RF choke L409 establish the proper voltage levels for the meter and isolate it from the RF circuits. Capacitors C428 and C434 are RF bypasses.

3.33 DIGITAL SYNTHESIZER

The digital synthesizer system is comprised of the following basic elements.

a. Voltage Controlled Oscillator (VCO) and Buffer

b. Mute Switch

c. Reference Oscillator and Divider

d. Phase/Frequency Comparator

e. Programmable Counters

f. Prescaler and KHz Dacade

Most of the circuitry and components associated with the above functions are contained on printed circuit boards PC201 and PC301.

3.34 VOLTAGE CONTROLLED OSCILLATOR

The voltage controlled oscillator is wholly contained in integrated circuit Q301 (Figure 3.9) and is a pair of emitter coupled feedback transistors (pin 1 through 5) driving an emitter follower (pins 6, 7 and 8). Frequency of oscillation is determined by inductor L301 and varactor diode CR301 in series with C303. Base bias for the oscillator proper is provided by diodes CR302, CR303, CR304 and CR305 in series.

Positive supply decoupling is obtained from inductor L304 and capacitors C307 and C338. The control voltage provided by the frequency/phase comparator, Q305 (pin 13) is fed to varactor diode CR301 via the filter network, R325, R326, R327, R328, C320, C321, C322 and C323. This important part of the circuit supplies a voltage which corrects the frequency of the oscillator when it is not phase locked to the reference oscillator.

3.35 BUFFER AMPLIFIER

The purpose of amplifier Q301 pins 6, 7, 8, and those contained within Q302 is to provide amplification and buffering of the VCO output. Output from the VCO is directly coupled to emitter follower Q301 pins 6, 7 and 8. The purpose of this stage is to provide buffering of the VCO output. The output of this stage, Q301 pin 7 is coupled through C304 to the base of amplifier Q302 pins 1, 2, and 3. The amplified output at pin 1 is directly coupled to two emitter follower stages Q302 pins 6 to 11. The output at the emitter pin 10 is divided into two branches, one branch is fed through C311 to the base of common emitter amplifier Q302 pins 12, 13, and 14. L302 provides a load for this amplifier and steps the output impedance down to drive the counter of the PC201 board. The amplified output is coupled through C314 to the PC201 dividers. The second output at

3.35 cont'd Q302 pin 10 is coupled through C312 to the base of amplifier Q303. L303 is the load for this stage and also steps the output impedance down to drive the transceiver mixer stages. The output of Q303 is coupled through C316 to the mute switch. Supply voltage for all the buffer amplifier, except the two output stages, is provided by the +5 volt regulator Q308. Supply for the two output stages is supplied by the unregulated +12 volts.

3.36 MUTE SWITCH

Mute switch Q304 is used to switch off oscillator output voltage to the transceiver when the frequency of the synthesizer is being changed. The switching voltage actuating Q304 is provided by part of integrated circuit Q307. Resistors R320 and R321 supply +8 volts to Q304. Capacitors C316 and C317 are blocking capacitors. Note that the action of this stage is not that of an amplifier but merely that of a switch. When the voltage at the gate is made positive, the device conducts and becomes a very low resistance. When the voltage is zero, the device becomes a high resistance and does not conduct. The voltage which controls this stage is obtained in the following manner. The switching voltage is initially derived from pin 1 of Q305. When the VCO is in a locked condition, there is no output from this pin. If the oscillator is in an unlocked condition, a series of pulses appear and are rectified by diodes CR307 and CR308. The resultant DC voltage is applied to pins 12 and 13 of Q307 which, in turn, causes pin 11 to reduce from approximately +8 volts to 0 volts, thus biasing Q304 to switch off the output.

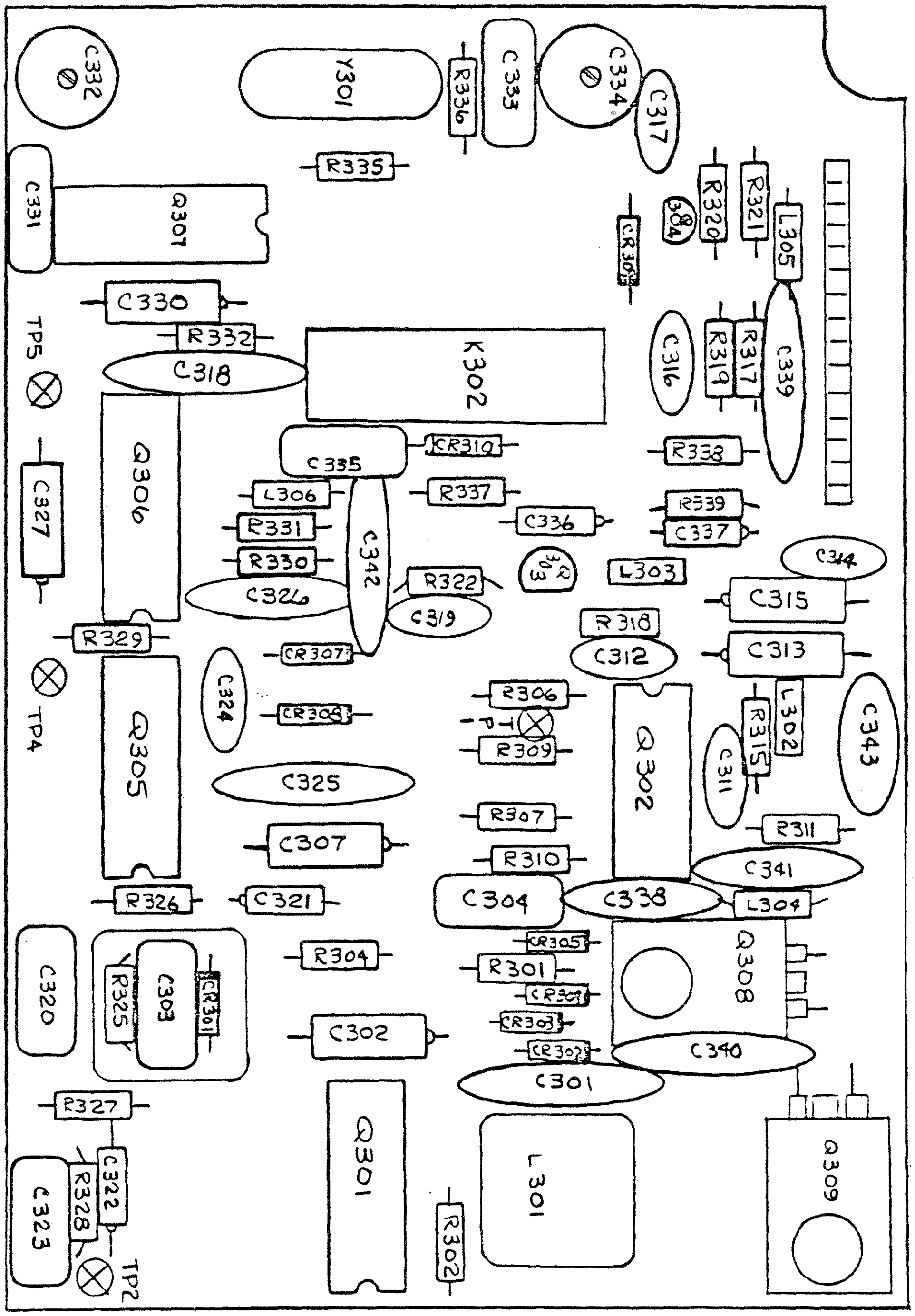
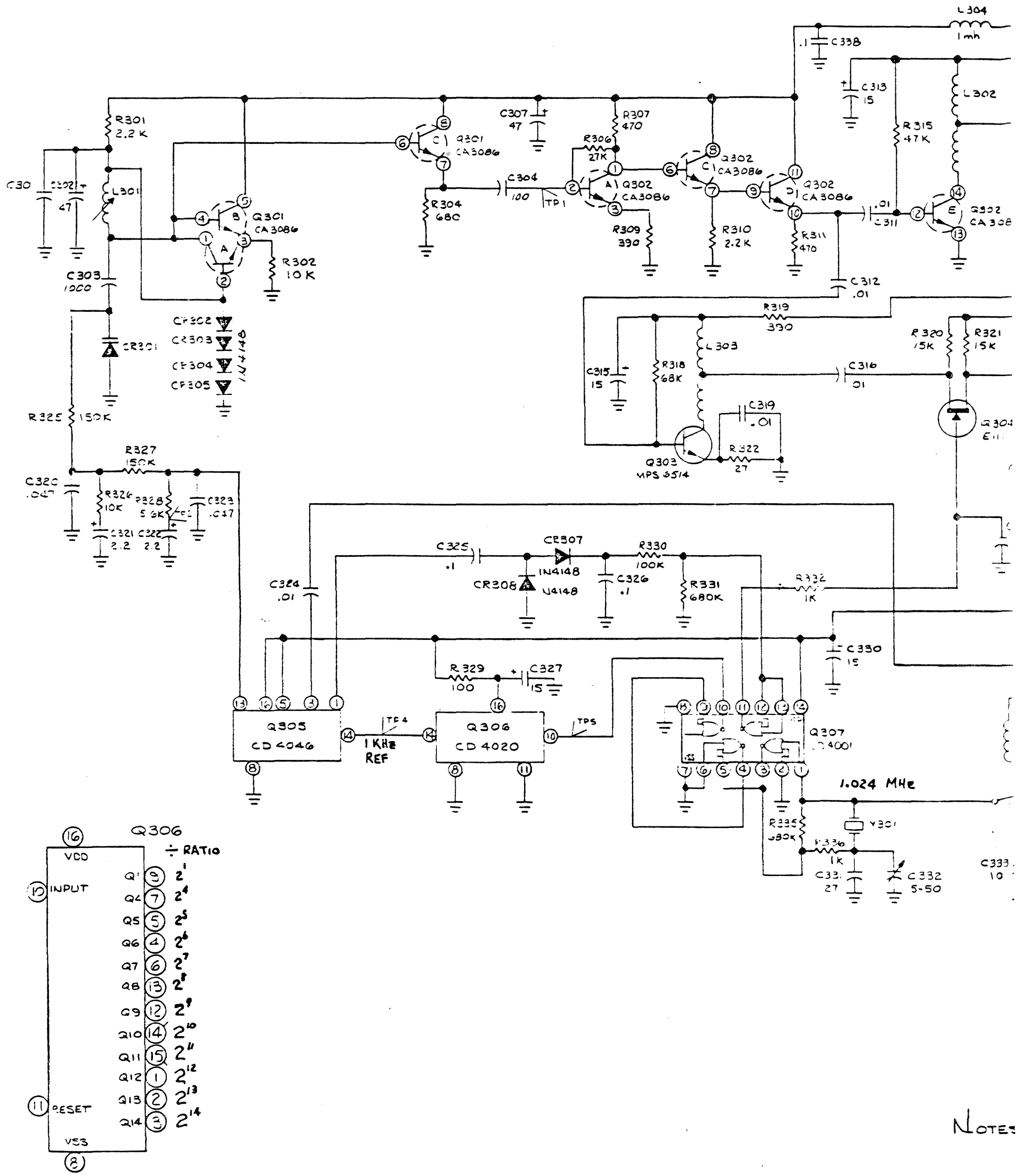
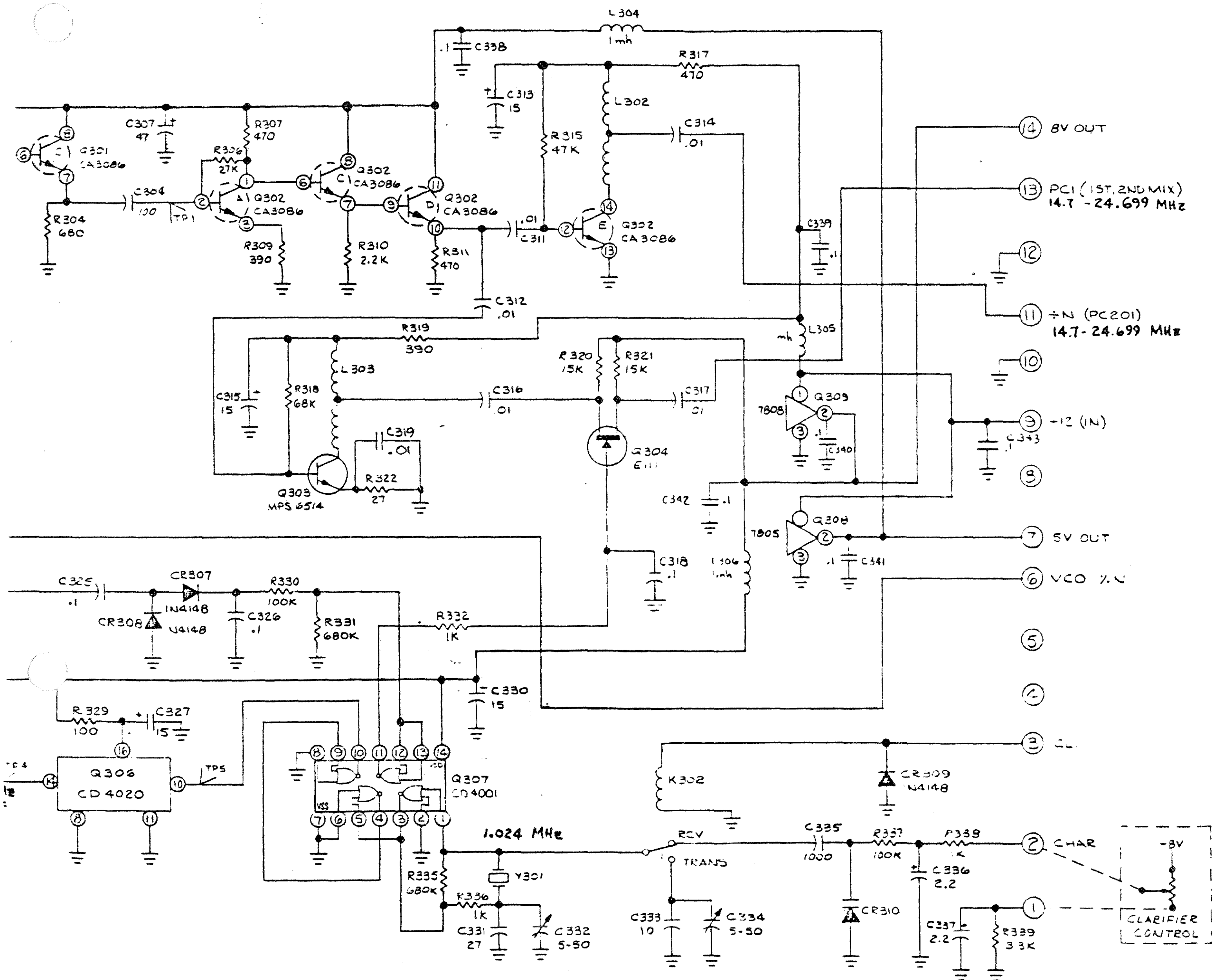
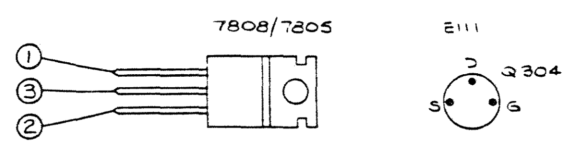


Figure 3.8. PC301 Assembly


L304
1mh
C338
C313
15
L302
R315
47K
R301
2.2K
C307
47
R307
470
R306
27K
Q301
CA3086
Q302
CA3086
C304
100
TP1
R304
680
R309
390
R310
2.2K
R311
470
C311
.01
L301
C303
1000
R302
10K
CR301
CR302
CR303
CR304
CR305
1N4148
C312
.01
R319
390
R320
15K
R321
15K
L303
C315
15
R318
68K
C316
.01
C319
.01
R322
27
Q303
MPS 6514
R325
150K
R327
150K
C320
.047
R326
10K
R328
5.6K
C323
.047
C321
2.2
C322
2.2
C325
.1
CR307
1N4148
CR308
R330
100K
C326
.1
R331
680K
C324
.01
R332
1K
C330
15
R329
100
C327
15
Q305
CD4046
TP4
1 KHz
REF
Q306
CD 4020
TP5
Q307
1.024 MHz
R335
680K
R336
1K
Y301
C332
5-50
C333
10
Q306
VDD
INPUT
RESET
VSS
÷ RATIO
Q1
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
NOTES





NOTES:

1. ALL POLARIZED & DECIMAL CAPACITORS ARE IN MFD, ALL OTHERS ARE IN PF.
2. ALL INDUCTORS ARE IN MICRO HENRIES UNLESS OTHERWISE SPECIFIED.

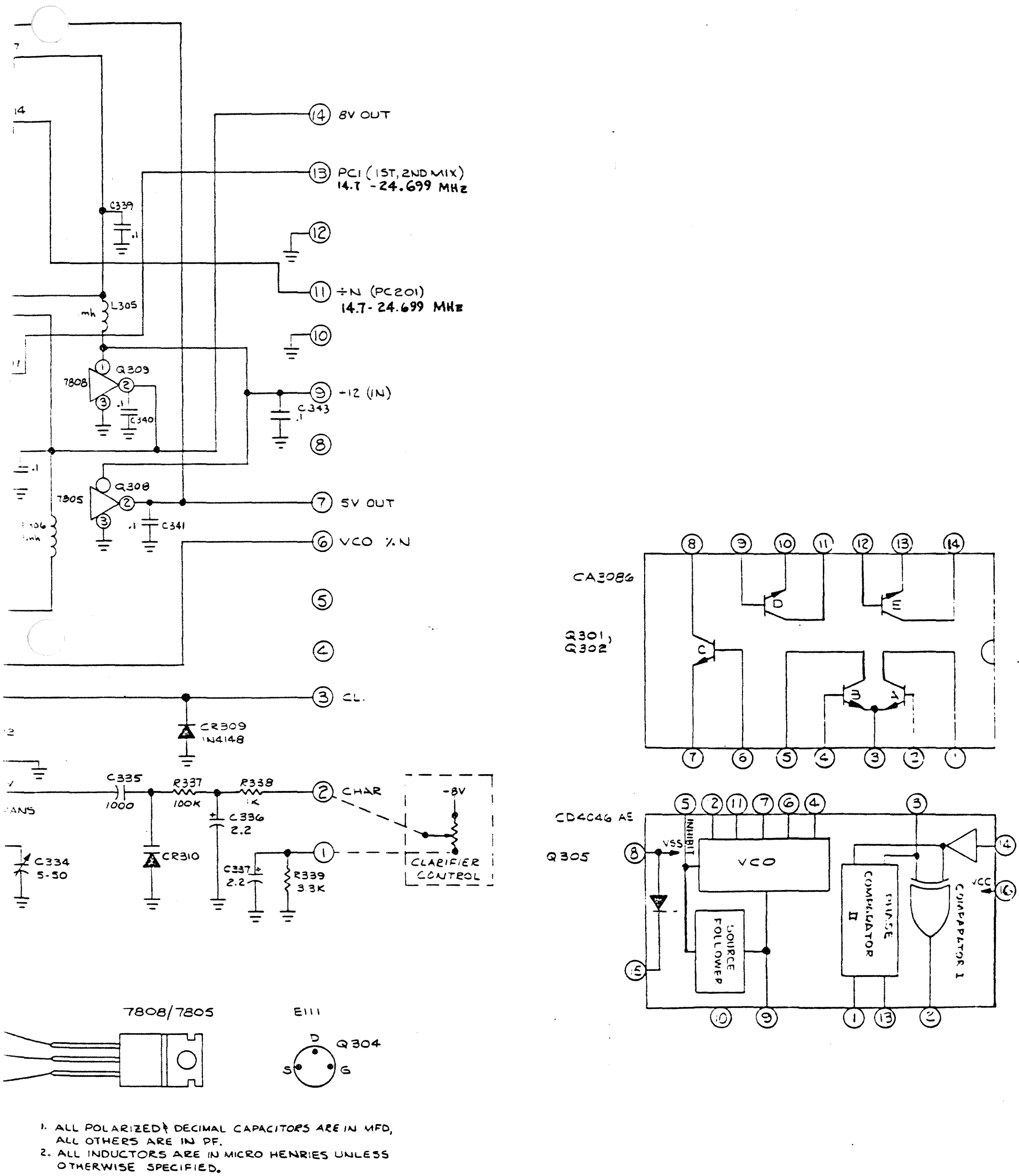


Figure 3.9. PC301 Schematic Diagram

3.37 REFERENCE OSCILLATOR

The reference oscillator is a crystal-controlled oscillator operating at a frequency of 1.024000 MHz. Q307 serves as the oscillator stage, the output of which is connected to Q306, the reference divider. In the receive mode, varactor CR310 acts as a variable capacitor used to "pull" the crystal Y301 ± 500 Hz from nominal. This is accomplished by varying the DC bias across CR310 by means of the CLARIFIER control on the front panel. Variable capacitor C332 is initially adjusted so that the ± 500 Hz clarifier range is centered around nominal. In the transmit mode, variable capacitor C334 replaces the varactor CR310 and so is adjusted to set the reference oscillator exactly on frequency.

3.38 REFERENCE DIVIDER

Refer to schematic diagram (Figure 3.9). Integrated circuit Q306 contains a number of flip-flop circuits which divide the 1.024000 MHz oscillator signal down to 1 KHz. This 1 KHz signal becomes the reference applied to the phase/frequency comparator circuit, Q305, from pin 14.

3.39 PHASE/FREQUENCY COMPARATOR

As stated in 3.38 above, reference signal from the reference divider Q306 is applied to pin 14 of Q305. Simultaneously, the signal from the programmable divider circuits, controlled fron the front panel frequency controls, is applied to pin 3 through C324. If the divided down signal arriving at pin 3 is higher in frequency than that at pin 14, pin 13 of Q305 falls to zero voltage and this causes the DC voltage applied to the VCO varactor diode, CR301, to decrease the frequency

3.39 cont'd until absolute phase lock occurs. In the event that the divided VCO frequency is lower in frequency than the reference frequency, pin 13 of Q305 increases to +8 volts and the opposite action takes place in the VCO unit.

3.40 REGULATORS

Regulators Q308 and Q309 are complex integrated circuit regulators giving a high degree of regulation to the VCO and associated circuits. The VCO otherwise would be readily modulated by extraneous signals on the supply line. Integrated circuits Q305, Q306, and Q307 are powered by +8 volt regulator, Q309. Output from the regulator also supplies some of the transceiver circuitry located on printed circuit board PC101. Regulator Q308 supplies the VCO and buffer stages and a portion of the circuitry on printed circuit board PC201, the programmable counter module.

3.41 DIVIDE BY N COUNTER

The proper operation of the digital synthesizer is dependent upon the divide by N counter as this segment of the circuit determines which multiple of the reference frequency will be selected for the output. The divide by N counter is located on printed circuit board PC201. The SC130 synthesizer counter utilizes two types of integrated circuit logic devices, TTL (Transistor-to-Transistor Logic) and CMOS (Complementary Symmetry Metal Oxide Semiconductor). The TTL units are high speed, relatively high current devices and used only for the "KHz" decade (Prescaler). The CMOS devices are utilized for the remaining decades - i.e., "KHz x 10", "KHz x 100" and "MHz" as well as to control the prescaler - as slower switching speeds are required and, thus, the advantage of reduced power drain

3.41 cont'd can be realized. Since TTL and CMOS devices operate at different signal levels, it is necessary to provide special interface circuitry between the two types. This circuit is described in paragraphs 3.44.

The divide by N counter will be segregated into four (4) sections for purposes of this discussion. They are as follows:

a. Prescaler (TTL "KHz" Decade)

b. KHz x 10 - MHz Counters (CMOS)

c. Interface Circuitry

d. Preset Enable and Output Gating

For greater clarity of presentation, the "KHz x 10" through "MHz" decades will be discussed prior to introduction of the prescaler. Figure 3.11, schematic diagram of PC201, should be followed carefully in review of the operation of this portion of the SC130D(E) synthesizer. Information relating to basic digital theory, i.e., gates, flip-flops, and counters, is included in Appendix A of this document, to assist in a more complete understanding of these complex circuits.

3.42 KHz x 10, KHz x 100, and MHz DECADES

These three decades are basically comprised of integrated circuits Q203, Q205 and Q206. The devices are MSI (medium scale integrated circuit) counters, made up of individual flip-flops and gates which are internally connected so as to achieve the proper counting ratio. (Refer to tne schematic of IC CD4018 in Figure 3.11). These internal gating functions, with additional inputs at pins 2, 3, 7, 9, and 12, allow the counter (flip-flops) to be preset or

3.42 cont'd forced into a desired condition by the front panel frequency knobs. Hence, these IC's are properly described as "programmable" counters.

The number selected by the front panel knob represents a corresponding count of the MSI device. It then becomes unnecessary to proceed through the entire counting sequence to arrive at the desired number. In conventional operation, the CD4018 counts up, i.e., from 0 to 1, 2, 3, etc., in accordance with the standard Johnson Code. However, in the SC130D(E) synthesizer, these counters are utilized in a count-down mode, i.e., 9, 8, 7, etc. The resultant modified Johnson Code is shown in Table 3.2.

TABLE 3.2

MODIFIED JOHNSON CODE

DIAL SETTING (Decimal)	COUNTER INPUTS				
0	1	1	1	1	1
1	1	1	1	1	0
2	1	1	1	0	0
3	1	1	0	0	0
4	1	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	1
7	0	0	0	1	1
8	0	0	1	1	1
9	0	1	1	1	1

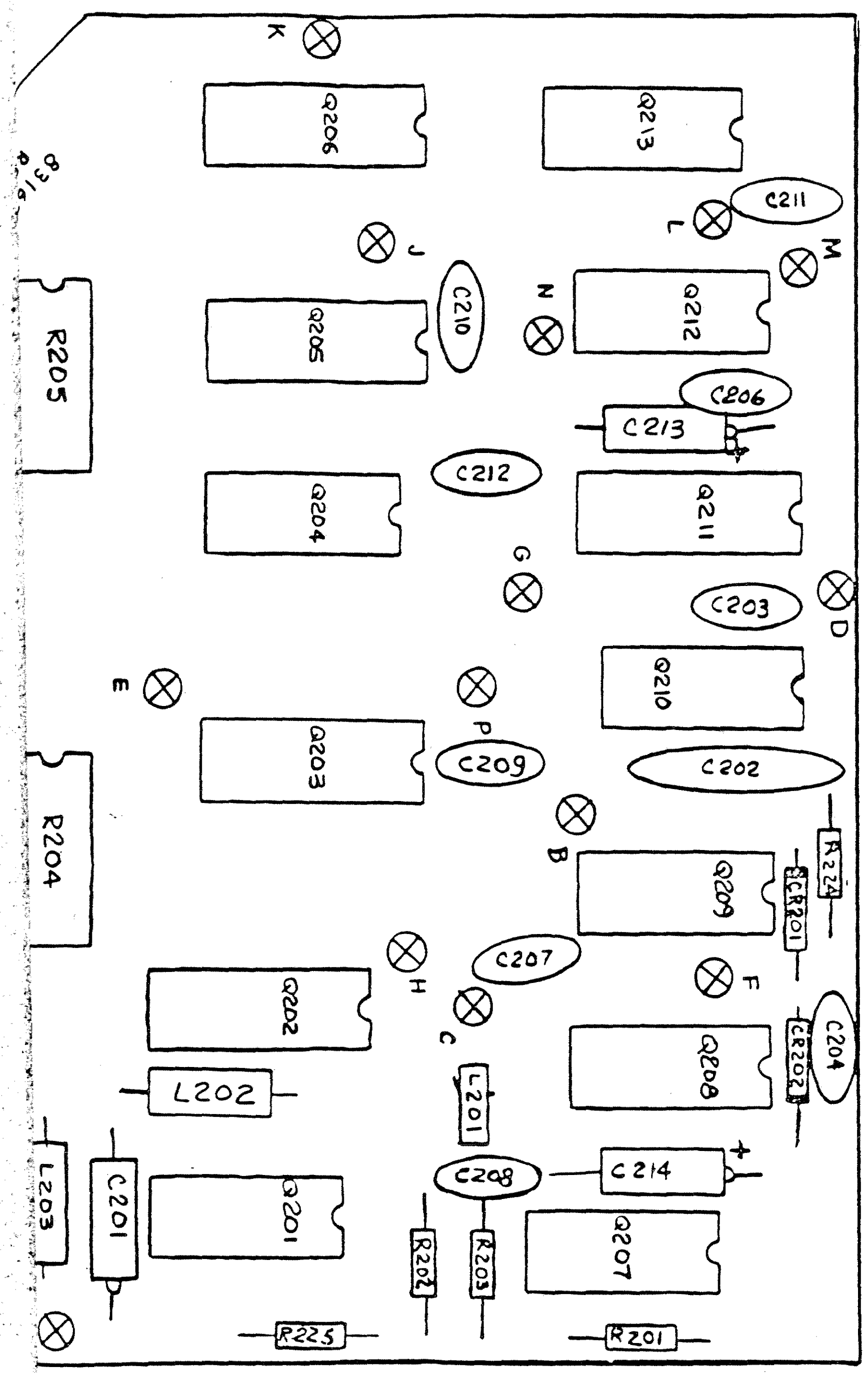
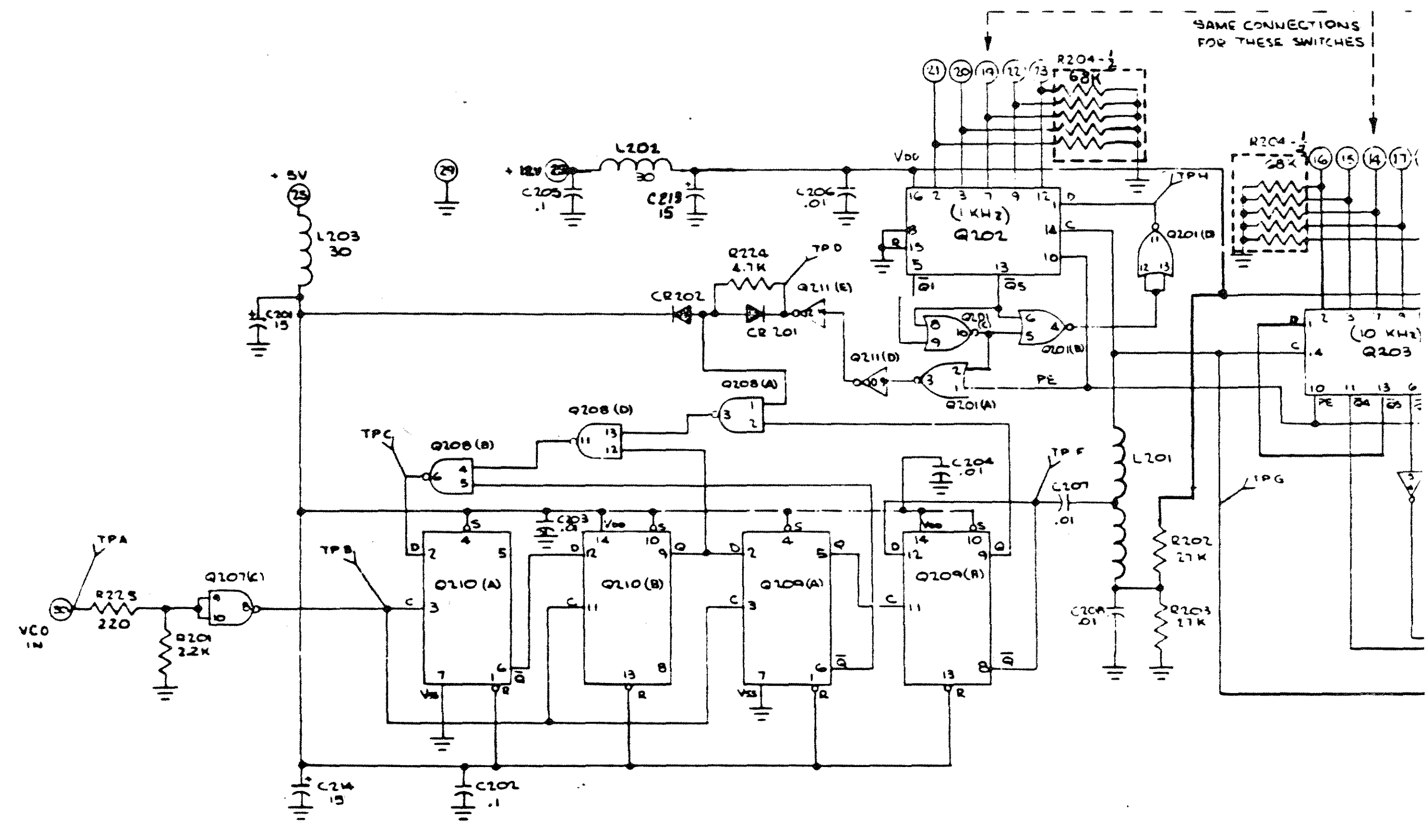
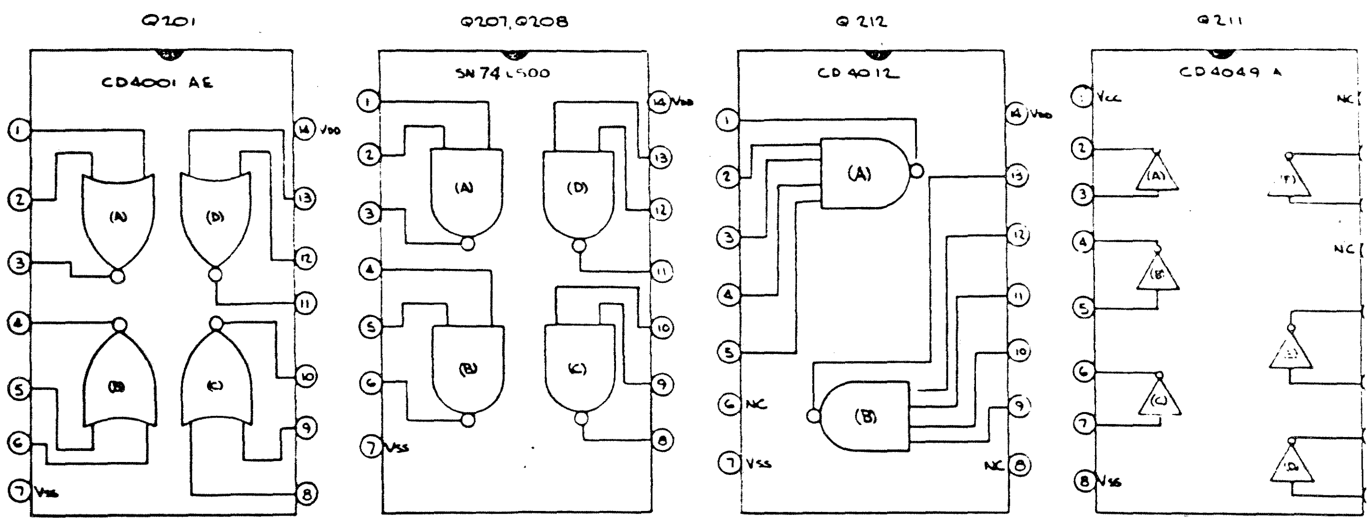
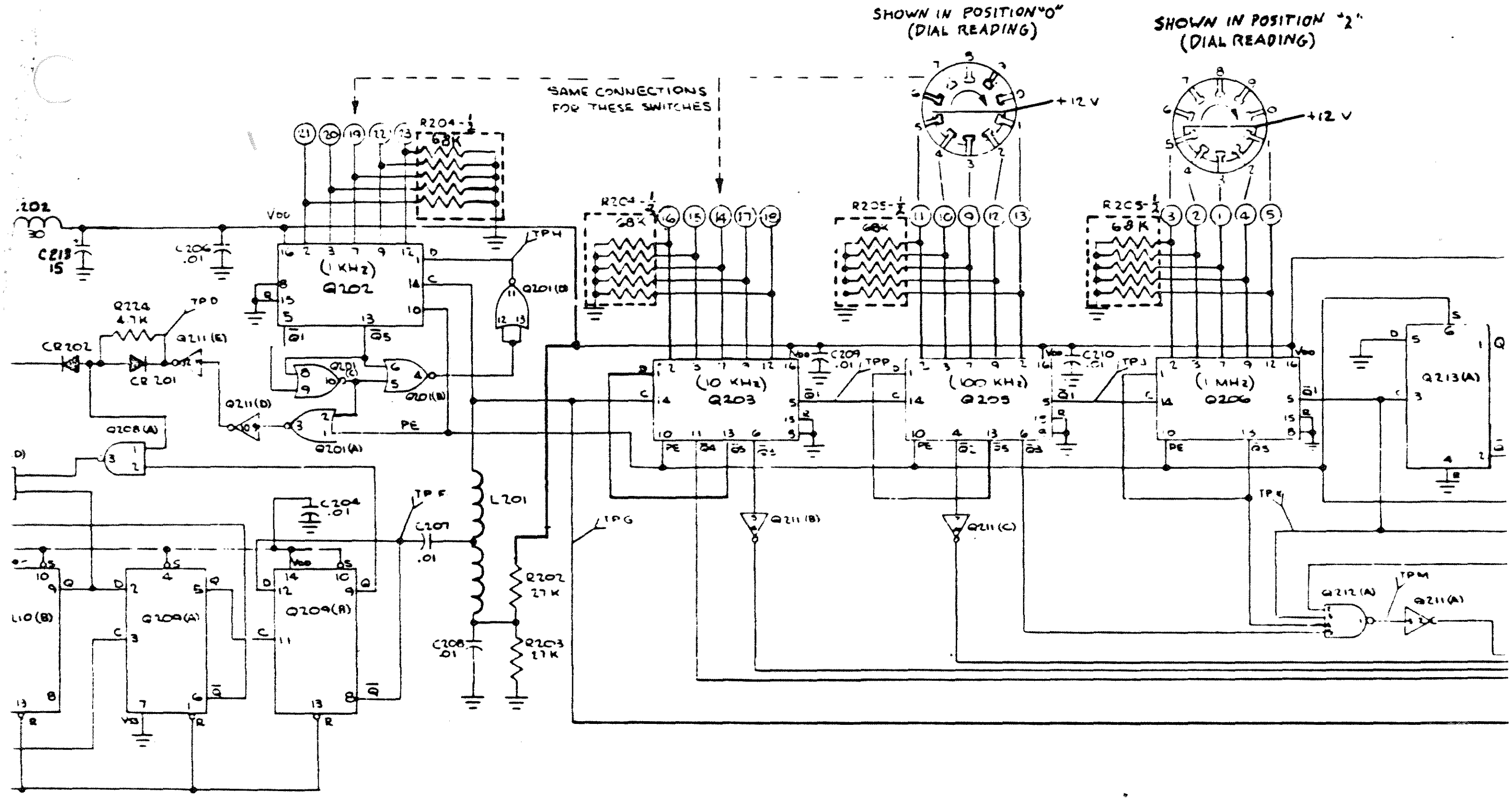
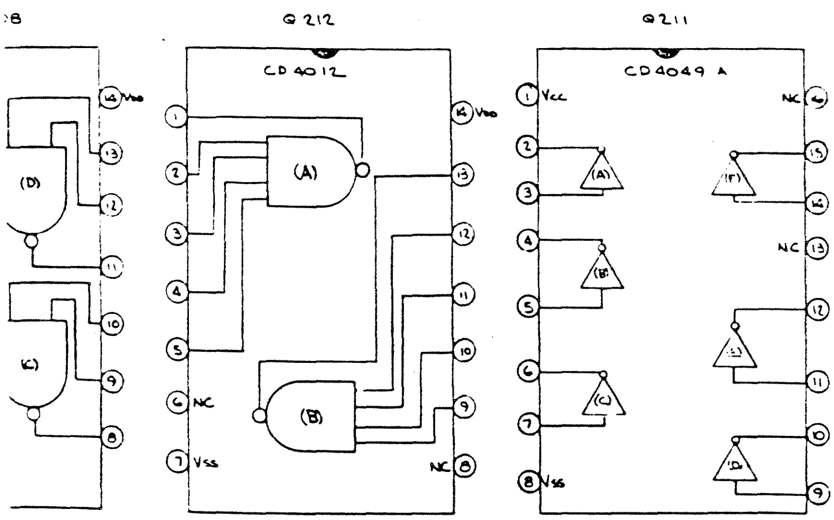


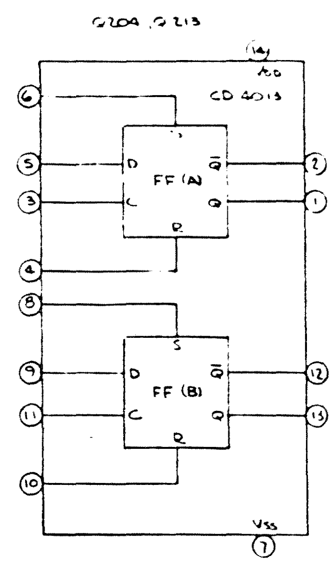
Figure 3.10. PC201 Assembly

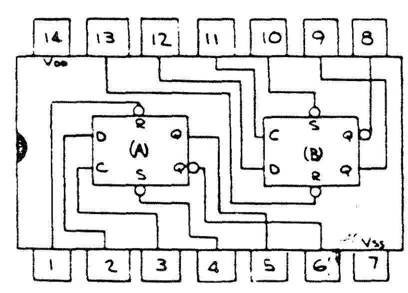

SAME CONNECTIONS FOR THESE SWITCHES
R204-1/2 68K
R204-1/2 68K
L202 30
+12V
C205 .1
C219 15
C206 .01
VDD
(1 KHz) Q202
TP H
Q201(D)
(10 KHz) Q203
+5V
L203 30
C201 15
R224 4.7K
TP D
Q211(E)
CR202
CR201
Q201(C)
Q201(B)
Q211(D)
Q201(A)
PE
Q208(A)
Q208(D)
Q208(B)
TP C
TP F
C204 .01
C207 .01
L201
TP G
TP A
TP B
R225 220
Q207(C)
VCO IN
R201 2.2K
C203 .01
Q210(A)
Q210(B)
Q209(A)
Q209(B)
R202 27K
R203 27K
C208 .01
C214 15
C202 .1


Q201
CD4001 AE
Q207, Q208
SN 74 LS00
Q 212
CD 4012
Q211
CD4049 A









Q209
Q210 : SN7474

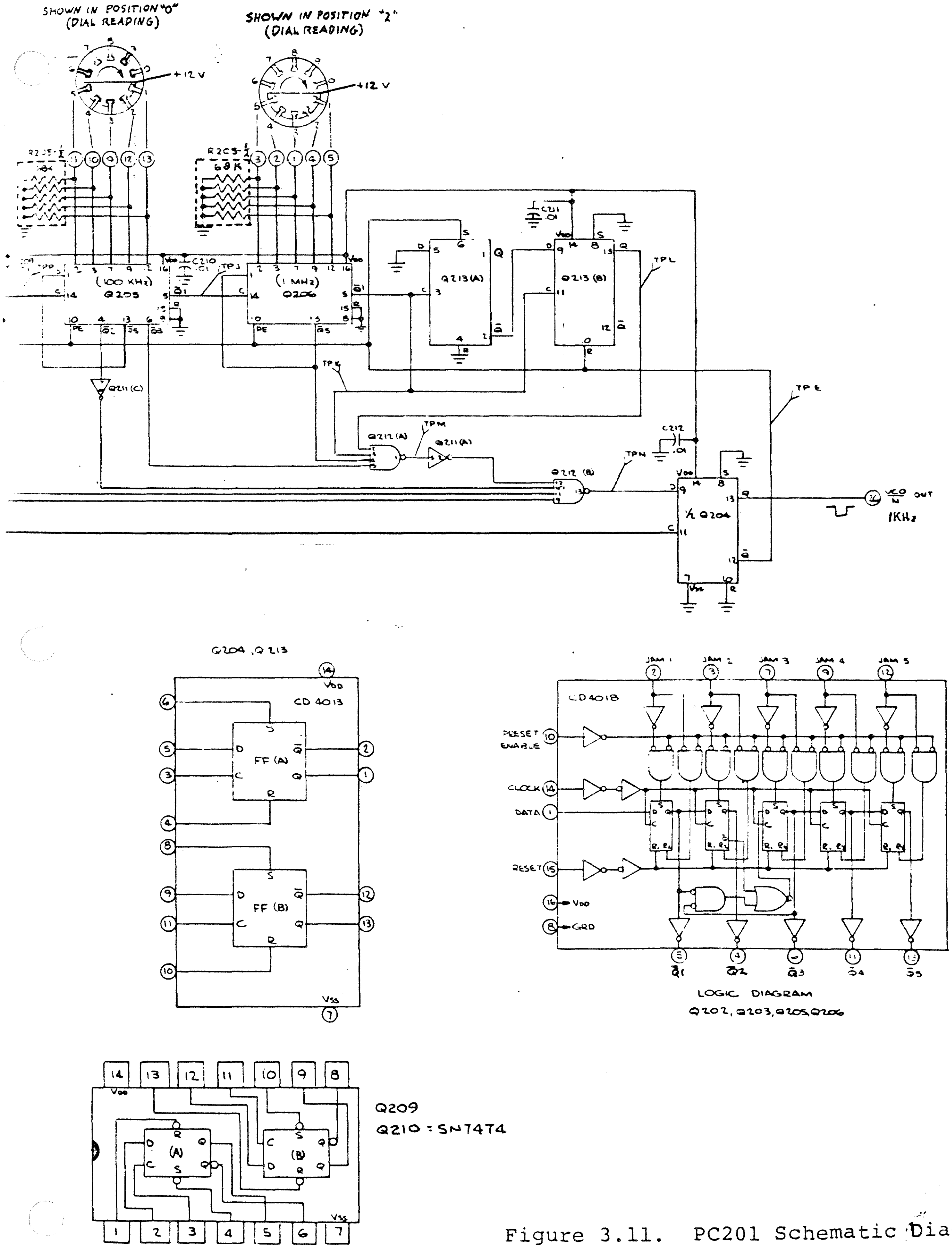


Figure 3.11. PC201 Schematic Diagram

3.42 cont'd With the counters designed for a basic modulus of 10 and used in the count-down mode, the preset number is counted down to zero. The counter then changes to a divide by 10 modulus until the next preset enable pulse is applied. When two of these counters are cascaded, as they are in the SC130D(E) synthesizer design, one output pulse is generated for a pre-determined number of input pulses which is the sum of the count-down sequence instead of the product of the divide ratios of the two decades as in a conventional counter. (Examples of the counting sequence for both types are provided in Appendix A.) In this manner, the counting sequence is determined by any desired setting of the front panel frequency controls. An offset is introduced into the "MHz" decade counting sequence by the addition of integrated circuit Q213, a dual flip-flop device. Implementation of these devices adds 2 to the "MHz" decade count, causing it to sequence from 11 to 2 instaed of 9 to 0.

3.43 PRESCALER (KHz DECADE)

The purpose of the prescaler is to add one extra pulse to the divide by N counter ratio for each digit set into the KHz dial. This allows a frequency setting in 1 KHz increments utilizing the high-speed TTL logic elements contained in integrated circuits Q208, Q209 and Q210. (Refer to the schematics of the IC in Figure 3.11.) However, the control signal is derived from the low-power CMOS "KHz" decade programmable counter. Conversely, the output of the prescaler drives the inputs of both the "KHz" and "KHz x 10" decades. It is this interface of input and output signals that necessitates the special interface circuitry previously mentioned in paragraph 3.41, i.e., translation from CMOS operating levels to TTL levels, and vice versa.

3.43 cont'd The combination of flip-flop Q210A, Q210B and Q209A, if connected in the classic counter configuration and without additional feedback, would operate continuously in a divide by six mode - or one pulse out for every six pulses in. However, for the desired operation, feedback is provided from pin 9 (Q output) of Q210B to the data (D) input of Q210A at pin 2. The conventional feedback from the $\overline{Q}$ output (pin 6) of Q209 is also fed back to the D input of Q210A. Logic gate Q208B is utilized to provide the isolation and gating function for the feedback input. Additionally, the Q output signal (pin 9 of Q209B) from the fourth and final flip-flop in the prescaler circuit is introduced into the feedback path via logic gate Q208A. The control signal from the "KHz" decade drives the other input of Q208A.

The combination of gating functions provided by Q208A, Q208D and Q208B allows the control signal to determine whether the prescaler is to divide by 10 or by 11. Thus, the circuit may be given the nomenclature of a 10/11 prescaler. Without the control input, the circuit would divide alternately by 5 and 6, or an overall divide ratio of 11. Specifically, when the second input (pin 1) of Q208A is a logic zero the prescaler is forced into a divide ratio of 10. A logic one at this input causes the divide ratio to revert to 11.

When the "KHz" dial is set at any value other than zero, the prescaler is locked in the divide by 11 mode and the "KHz" and the "KHz x 10" decades sequence down one step, from their respective preset values for each prescaler output pulse. As soon as the "KHz" counter reaches zero, this condition is detected by gates Q201B and Q201C. This output at Q201B (pin 4) is fed back through inverter Q201D to the D input of the "KHz" decade, thus disabling the control counter until the next preset enable pulse is

3.43 cont'd applied. Simultaneously, the detected output at pin 10 of Q201C is applied to one input of logic gate Q201A with the preset enable line connected to the other input. The output at pin 3 is double-inverted through Q211D and Q211E to provide buffering prior to application to the CMOS-to-TTL interface circuit comprised of resistor R224, diodes CR201 and CR202, inductor L203 and capacitor C201. The translated zero signal at the anode junction of these diodes becomes the control signal applied to one input of gate Q208A which changes the modulus of the prescaler to a divide by 10 mode. Logic gate Q201A ensures that the prescaler remains in the divide by 10 mode until the next preset enable pulse is completed.

The VCO input to the prescaler is fed through logic gate Q207C which serves a dual function as buffer and a driver. Resistors R225 and R201 provide isolation and a ground return, respectively, for the input to the gate. The circuit comprised of capacitors C207 and C208, resistors R202 and R203, and transformer L201 is the TTL-to-CMOS interface. The function of this circuit, together with CMOS-to-TTL interface is discussed in the following paragraphs.

3.44 INTERFACE CIRCUITRY

As previously indicated, TTL and CMOS devices operate at different signal levels. Therefore, it becomes necessary to provide special interface circuitry since the control signal from the "KHz" decade (CMOS) is fed to the prescaler (TTL). Likewise, the output of the TTL prescaler must drive both the CMOS "KHz" and "KHz x 10" decades.

Source voltages for TTL devices are 5 VDC while 12 VDC is required for the CMOS elements. A logic zero in the TTL circuitry is represented by a voltage of approximately

3.44 cont'd 0.8 volts or less while a voltage of 2 volts or more is considered a logic one. In CMOS circuitry, a logic zero is represented by any voltage of about 1/3 or less of the source voltage (4 volts or less) while a voltage of about 2/3 or more of the source voltage (8 volts or more) is considered a logic one. The chart below, Figure 3.12, graphically illustrates this divergence.

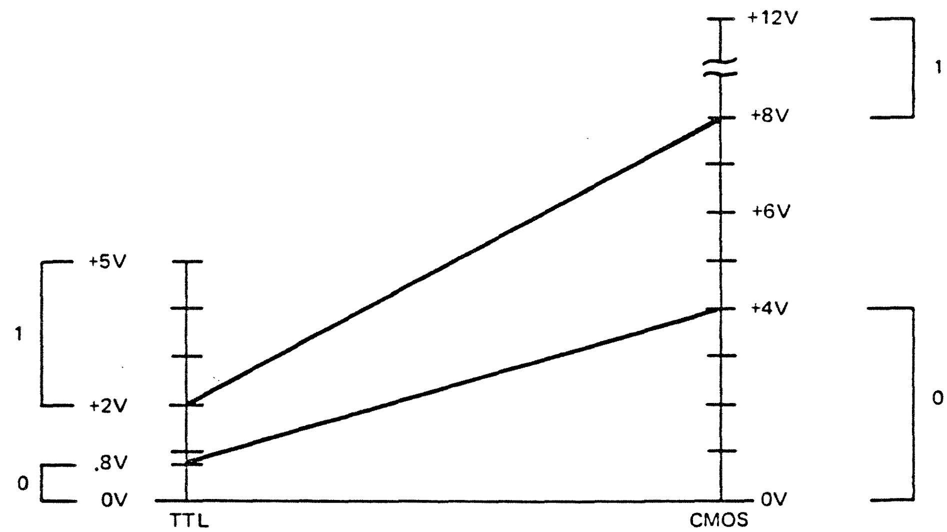


Figure 3.12. TTL Vs. CMOS Logic Levels

In the interface circuit from TTL levels to CMOS levels, resistors R202 and R203 form a voltage divider to provide a DC bias. Autotransformer L201, wound on a wideband toroid core, steps up the normal TTL voltage swing sufficiently to ensure reliable triggering of the CMOS elements. Capacitor C207 provides DC isolation and couples the prescaler output to the center of L201 while capacitor C208 simply bypasses the end of the lower segment to ground.

3.44 cont'd The CMOS-to-TTL interface circuitry must ensure that the control voltage from the CMOS Q202 counter and associated logic which is presented to pin 1 of Q208A does not rise above the +5V TTL source voltage. When the CMOS output is low, diode CR201 is forward-biased, assuring a TTL logic zero level at this gate. Diode CR201 is a hot-carrier diode which is selected for its' rapid switching characteristics. When the CMOS level is high, the diode is back-biased but a current path to the +5 volt supply is provided by the combination of diode CR202 and resistor R224. Since the CR202 cathode is connected to this supply through inductor L203, the voltage at its anode cannot rise above +5 volts.

3.45 OUTPUT GATING AND PRESET ENABLE

The purpose of the preset enable pulse is to return all counters to the various values determined by the dial settings at the appropriate time. The $\overline{Q}$ output (pin 12) of IC flip-flop Q204B is utilized for this purpose. The Q output at pin 13 becomes the signal (VCO/N) which is fed to the phase comparator for the necessary frequency corrections. It should be noted again that the synthesizer output frequency is offset (increased) by the amount of the intermediate frequency or 12.7 MHz. Hence, the counters are implemented to stop the count and generate another preset enable pulse before all decades have sequenced down to zero.

The following example is utilized to clarify the effect of the frequency offset and preset dial setting upon the counter. Assume that it is desired to operate the transceiver at 2.000 MHz. Thus, the selector switches are set to 2000, in that order, reading from left to right. This programs the synthesizer for an actual division ratio of 20,000, i.e., Q213 is set for 2 and the remaining decades

3.45 cont'd (Q206, Q205, Q203 and Q202) are set to zero. If the counter is stopped by generating a preset enable pulse before all decades have reached zero, the output frequency would be raised by an amount equal to the actual count at which it is stopped.

Since the synthesizer output frequency must be 12.7 MHz higher than the dial setting, the counter must be reset (for the 2.000 MHz example) when it reaches a count of 20,000 minus 14,700 or 05300. To accomplish this, the outputs of each decade are measured (decoded) through IC gate Q212 so that when Q213 is at a count of 0, Q206 is at a count of 5, Q205 is at a count of 3, etc., an output is obtained from Q212B, pin 13. This output is coupled to Q204 which produces the preset enable pulse at pin 12 ($\overline{Q}$) when the next low-speed clock (output of prescaler) arrives. As soon as the preset enable pulse is applied to the counters, they are reset (no longer at a count of 05300) to their original condition, the output of Q212B disappears, and the next low-speed clock pulse turns the preset enable off. At this point, it should be noted that two low-speed clock pulses (20 input pulses to the prescaler) have been required to turn Q204 on and off again. These pulses are "missed" by the counter chain and, without compensation, would result in an incorrect division ratio. This compensation is provided by generating the preset enable pulse at an actual count of 05320 instead of 05300. This feature is designed into the circuit by connecting Q203 so that it is decoded at a count of 2 instead of 0. No adjustment of the front panel setting is required to accomplish this.

Logic gates Q212A and Q212B serve as decoders for decade counters Q203, Q205, Q206 and Q213. Inverters Q211A, Q211B and Q211C are used to obtain the proper phase for the decoding gates. The counter is stopped when it

3.45 cont'd reaches a count equal to the selected division ratio (dial setting) minus the sum of the IF frequency and the desired operating frequency. Thus, when this count is achieved, an output pulse is obtained at pin 13 of Q212B and coupled to the data input (pin 9) of Q204B.

It should also be noted that the "KHz" decade (Q202) is not included in the preset enable gating function. It is unnecessary since this decade is already locked in the divide by 10 mode by the time the preset enable pulse is generated and the last digit is always a zero.

3.46 SWITCHING CIRCUITS

The following paragraphs describe the purpose and functions of all switching functions associated with the SC130D(E) Transceiver.

3.47 ELECTRONIC SWITCH (DPDT). (Refer to Figure 3.13)

Since both the receiver and the transmitter utilize the same IF amplifiers and filter, it is necessary to switch the LO to the first mixer/balanced modulator and the BFO to the product detector/second mixer while operating in the receive mode, and vice versa in the transmit mode. A mechanical switch for this function would not allow proper rejection of unwanted signals due to capacitive coupling between switch sections and interconnecting wires. Additionally, such an arrangement would be cumbersome and subject to a relatively short failure rate cycle. To eliminate these problems, an electronic double-pole, double-throw switch with excellent isolation performs this function. This switch is located on printed circuit board PC101 and operates automatically from the control line which is grounded in the receive mode and at the +12 volt supply potential in the transmit mode.

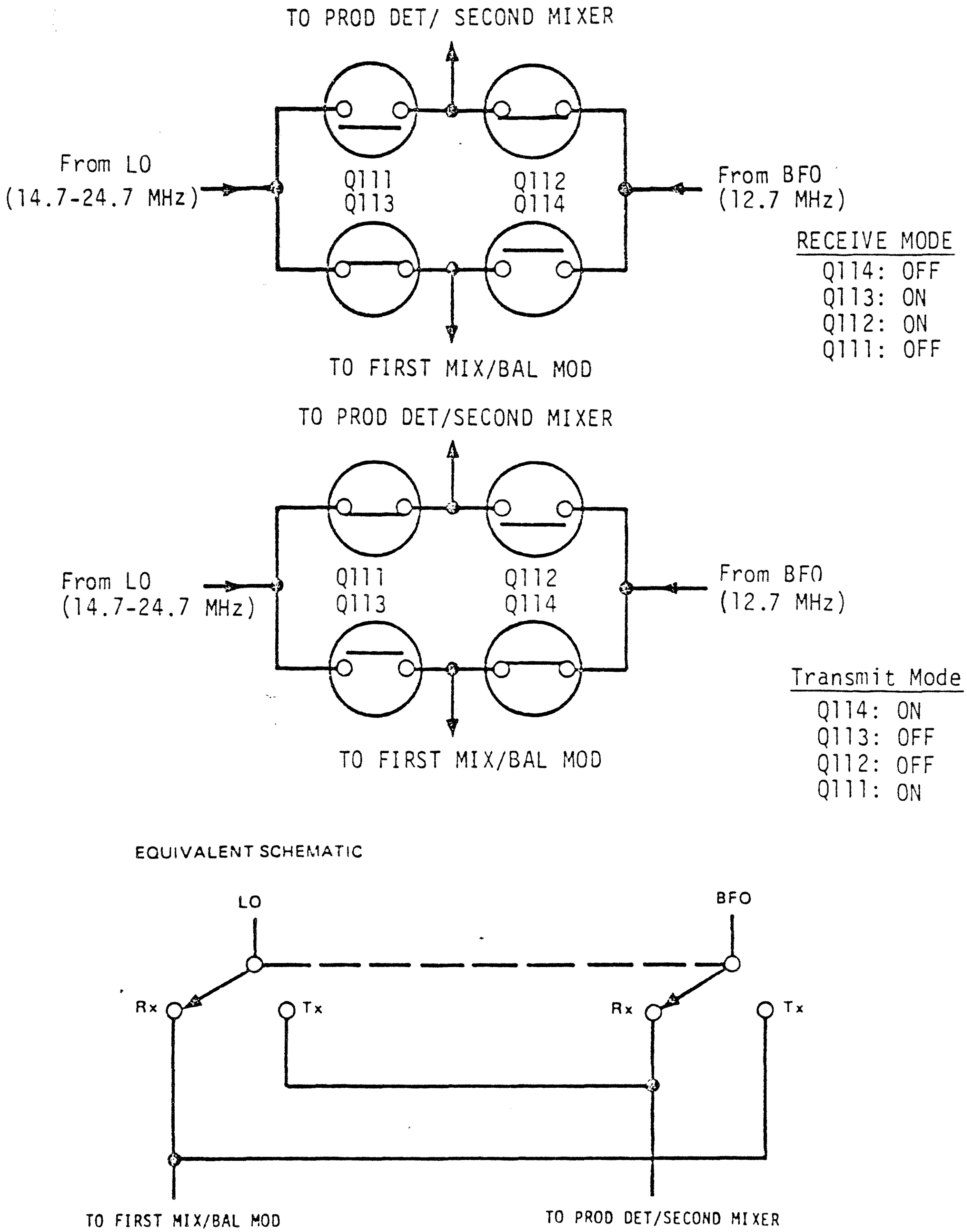


Figure 3.13. Simplified Schematic Diagram, Electronic Double Pole-Double Throw Switch

3.47 cont'd In the receive mode, the gates of FET transistors Q111 and Q114 are simultaneously grounded through diodes CR109 and CR110. In this condition, no conduction occurs between the source and gate of either transistor. Thus, the BFO and the LO signals are isolated from the first mixer and the product detector, respectively. The base of transistor Q115 is grounded at the same time, causing its collector to rise to +12 volts. This collector voltage is applied simultaneously to the gates of FET transistors Q112 and Q113 through resistors R166 and R167. In this condition, both transistors conduct, connecting the BFO and the LO signals to the product detector and the first mixer, respectively.

In the transmit mode, the positive control line back biases CR109 and CR110, effectively removing them from the circuit. The positive voltage is applied to the gates of Q111 and Q114 through resistors R163 and R169, causing them to conduct and connecting the BFO and the LO signals to the first mixer and the product detector, respectively. Since Q115 now conducts heavily, the gates of Q112 and Q113 are grounded, preventing conduction of either transistor. Thus the BFO and the LO signals are isolated from the product detector and the first mixer, respectively.

3.48 <u>CONTROL LINE</u>

The control line performs the following instructions:

a. Applies +12 volts to transmitter amplifier circuits Q401 through Q406.

b. Applies +12 volts to the electronic switch transistors Q111, Q114 and Q115 located on printed circuit board PC101.

3.48 cont'd

c. Opens diode CR101, reducing the gain of transistor amplifier Q101.

d. Actuates relay K302 which is located on printed circuit board PC301. This disconnects the front panel CLARIFIER control, P2 from the circuit and replaces varactor CR310 with variable capacitor C334.

e. Actuates transistor Q120, carrier insertion switch, when in the AM or TUNE condition as set by the front panel FUNCTION switch.

f. Actuates transistor Q104, located on printed circuit board PC101. This emitter follower stage drives the transmitter amplifiers Q401, Q402, Q403, Q404 and Q405.

g. Applies +12 volts to the microphone amplifiers.

3.49 RELAY K401

When the push-to-talk button is pressed, relay K401, located on printed circuit board PC401, is actuated. Relay K401 performs the following functions:

a. The antenna is disconnected from the receiver and applied to the transmitter.

b. The control line, which in the receive mode is grounded, is connected to the +12 volt source.

3.50 KEY LINE

When the microphone push-to-talk button is pressed, pin C of both microphone sockets, S01 and S02, is grounded. In the receive condition, these pins receive approximately

3.50 cont'd +12 volts through the coil of relay K401. The wire controlling pin C is designated as KEY LINE and is used to perform the following functions:

a. Actuates relay K401.

b. Actuates the CW keyer stage (Q110E) when in the CW mode, thus gating the CW tone oscillator, when the CW key is pressed.

3.51 <u>SUPPLY VOLTAGE ON/OFF SWITCH SW1</u>

This switch is part of the P1 audio gain (VOLUME) control. It switches the supply voltage between the batteries (or external supply voltage) and the transceiver.

3.52 <u>SUPPLY VOLTAGE METER SWITCH SW3</u>

When pressed, switch SW3 removes the front panel meter from the VSWR bridge and places it across the supply voltage. The meter light is also turned on. Thus, the operator is allowed to check the battery (or external supply) voltage.

NOTE

> Battery voltage should be checked only during the transmit mode to obtain a true indication of battery condition.

3.53 <u>SPEAKER ON/OFF SWITCH SW5</u>

When set to the ON position, switch SW5 actuates the built-in speaker and disables all external speaker or headset connections.

3.54 FUNCTION SWITCH SW2

The FUNCTION switch provides five (5) positions, as follows:

a. LSB, lower sideband.

b. USB, Upper sideband.

c. CW, transmitted 1300 Hz above carrier frequency.

d. AM, reinserted carrier with upper sideband transmission.

e. TUNE, transmit carrier only for tuning purposes.

When the FUNCTION switch SW2 is placed in the LSB position, IF amplifier Q103 is actuated, allowing lower sideband operation.

When FUNCTION switch SW2 is placed in the USB position, IF amplifier Q102 is actuated, allowing upper sideband operation.

When FUNCTION switch SW2 is placed in the CW position, the following functions are performed:

a. Q102 is actuated.

b. CW tone oscillator Q110D is actuated.

c. Supply voltage is connected to the CW keyer stage (Q110E). This stage is thus permitted to operate when the CW key is pressed.

d. Connects capacitor C442 across relay coil K401. This capacitor stores voltage after the CW key is lifted,

3.54 cont'd

holding K401 closed between CW characters, performing CW break-in operation.

When the FUNCTION switch SW2 is placed in the AM position, the following functions are performed:

a. IF amplifier Q102 is actuated, allowing upper sideband to be transmitted.

b. Carrier switch, Q120 is actuated, allowing the passage of the carrier from the output of the BFO/carrier generator (Q119) to the junction of the IF amplifier and the product detector/mixer stage. Carrier amplitude is controlled by potentiometer P108.

When the FUNCTION switch SW2 is placed in the TUNE position, the following functions are performed:

a. Relay K401 is actuated, placing the transceiver in the transmit position.

b. Both IF amplifiers Q102 and Q103 are disabled.

c. Carrier is inserted as outlined in the AM mode.

d. The panel meter, which in the transmit condition normally reads forward transmitted power, is switched to read reflected power.

e. The meter light is turned on.

3.55 HI/LOW PWR SWITCH SW6

In the LO power position, full ALC voltage from the PC401 board is connected to the PC101 board. In the HI position, the ALC voltage is reduced by potentiometer P402.

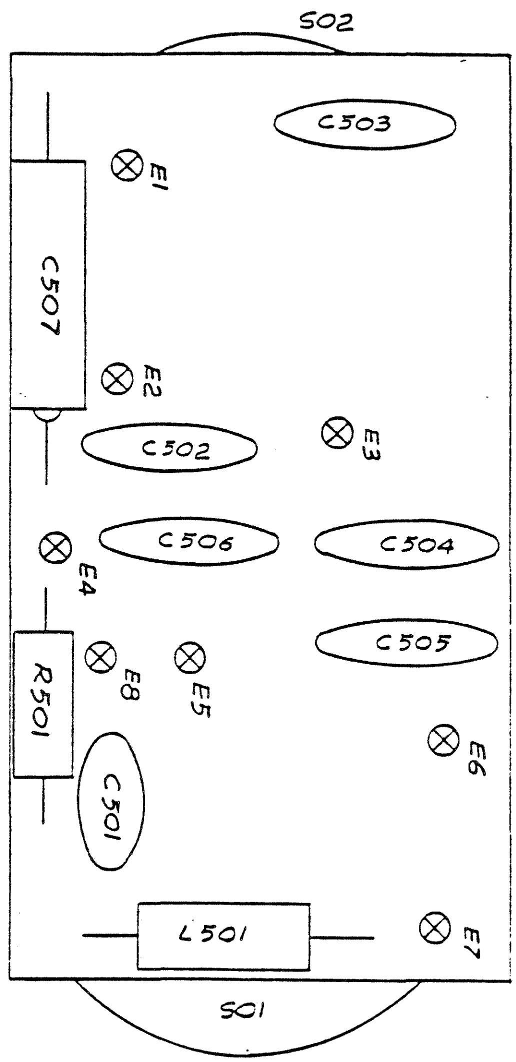
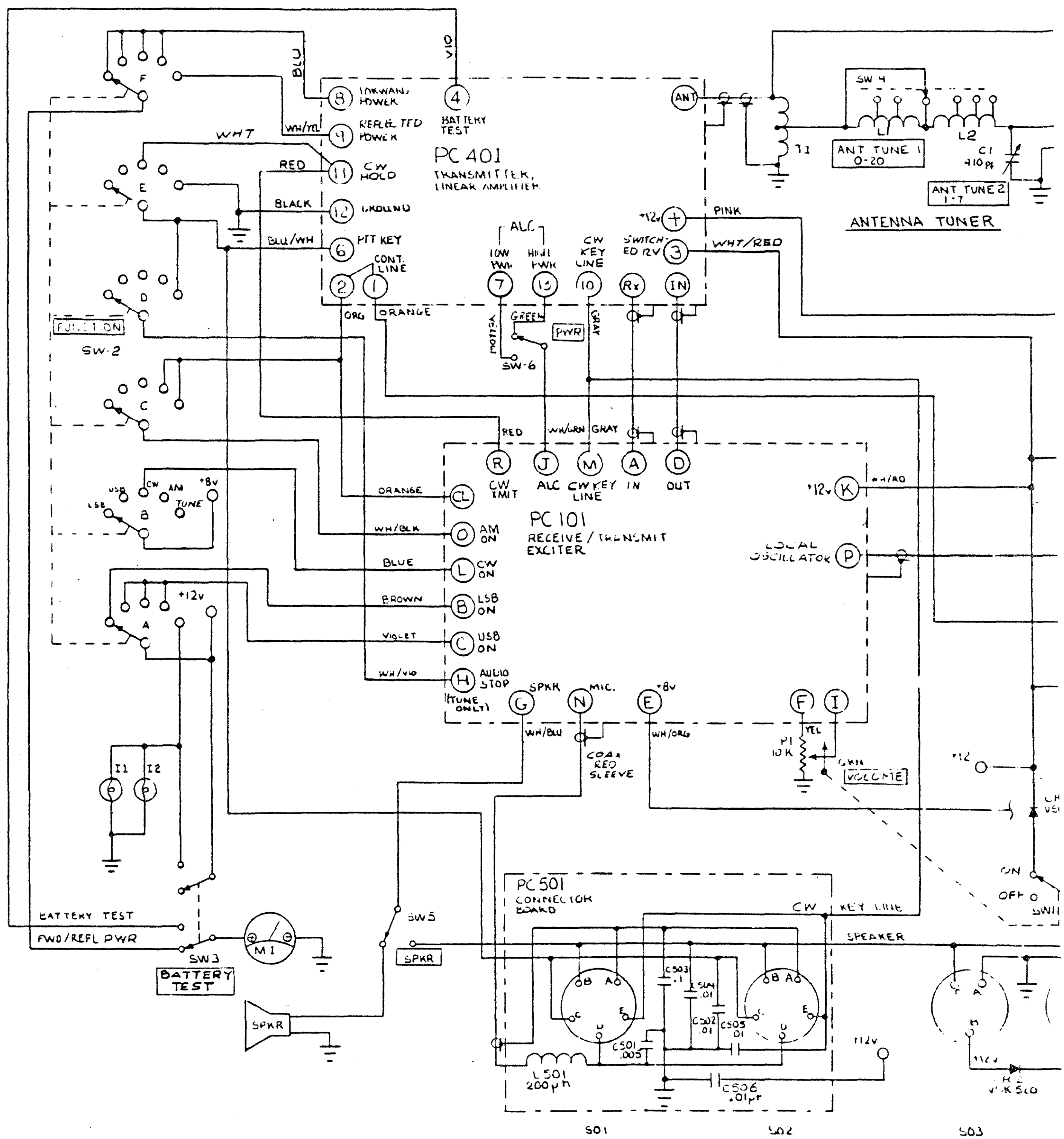
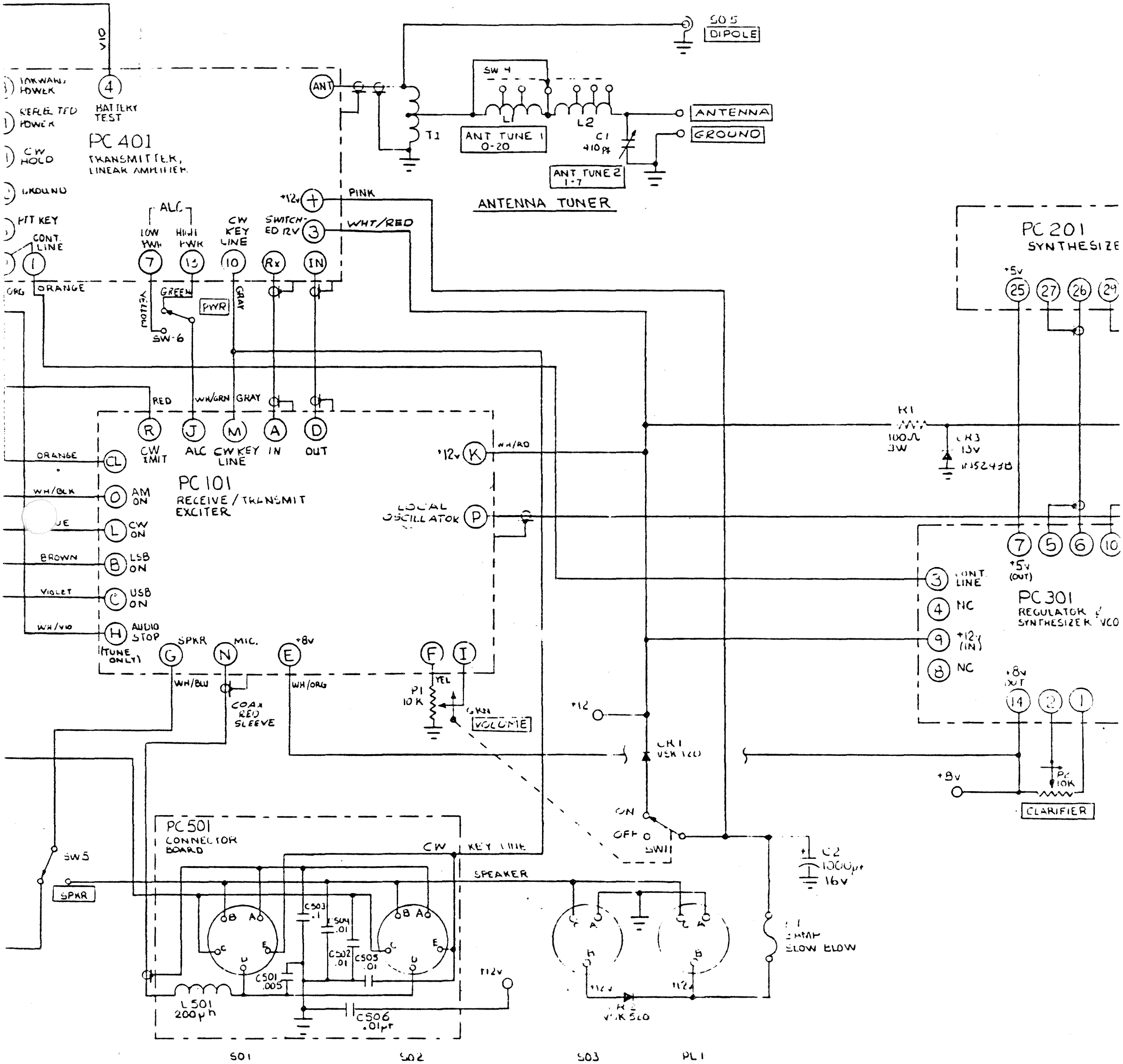
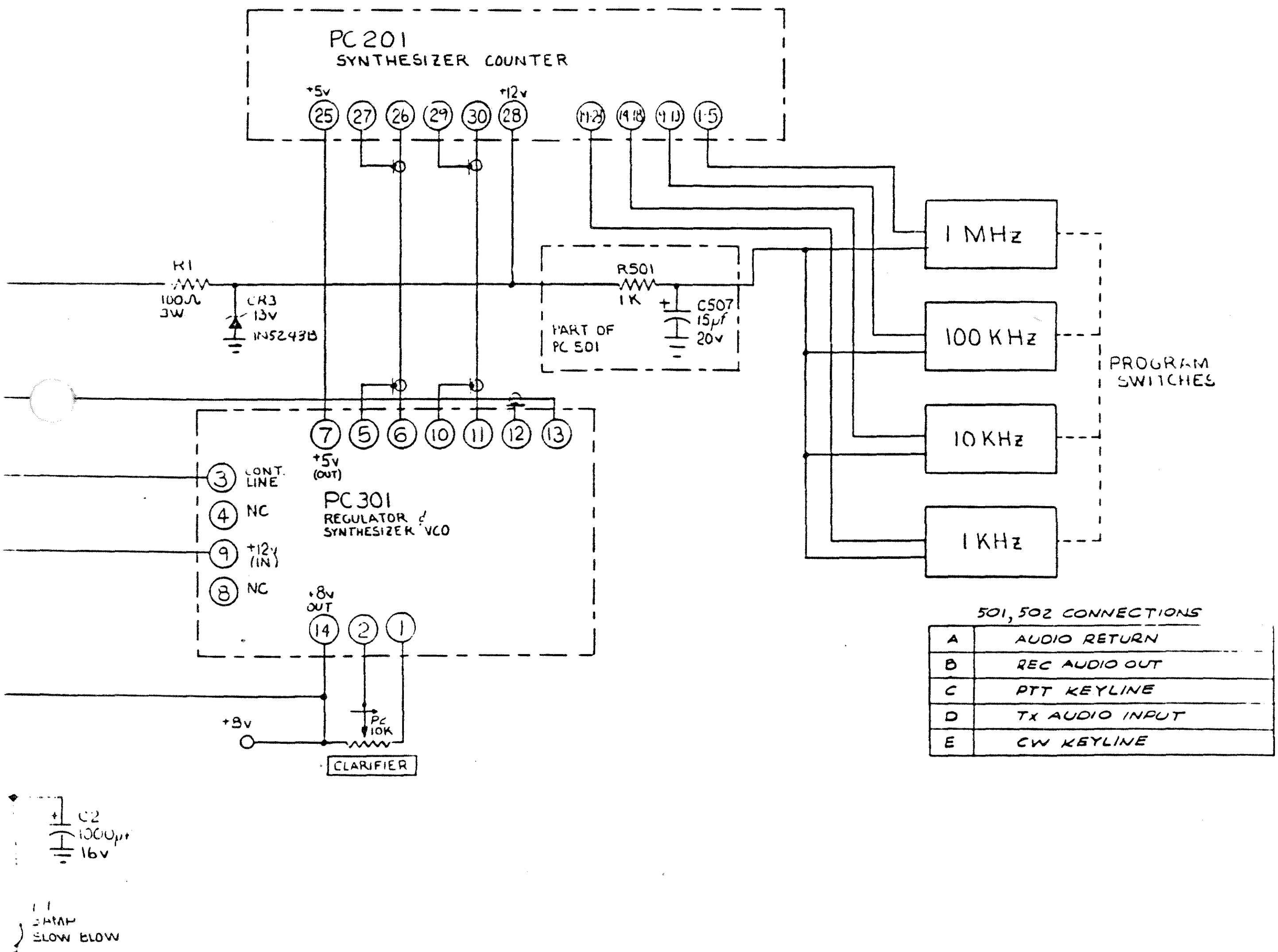


Figure 3.14. PC501 Assembly


PC 401
TRANSMITTER, LINEAR AMPLIFIER
FORWARD POWER
REFLECTED POWER
CW HOLD
GROUND
PTT KEY
CONT. LINE
BATTERY TEST
ALC
LOW PWR
HIGH PWR
CW KEY LINE
SWITCHED 12V
ANT
PINK
WHT/RED
ANTENNA TUNER
ANT TUNE 1 0-20
ANT TUNE 2 1-7
SW 4
L1
L2
C1 410 pf
T1
BLU
VIO
WH/YEL
WHT
RED
BLACK
BLU/WH
ORG
ORANGE
YELLOW
GREEN
GRAY
PWR
SW-6
FUNCTION
SW-2
F
E
D
C
B
A
USB
LSB
CW
AM
TUNE
+8v
+12v
I1
I2
PC 101
RECEIVE / TRANSMIT EXCITER
CW LIMIT
ALC
CW KEY LINE
IN
OUT
AM ON
CW ON
LSB ON
USB ON
AUDIO STOP (TUNE ONLY)
SPKR
MIC.
LOCAL OSCILLATOR
WH/GRN
WH/BLK
BLUE
BROWN
VIOLET
WH/VIO
WH/BLU
WH/ORG
COAX RED SLEEVE
P1 10K
YEL
GRN
VOLUME
BATTERY TEST
FWD/REFL PWR
SW3
BATTERY TEST
M1
SW5
SPKR
PC 501
CONNECTOR BOARD
CW KEY LINE
SPEAKER
C501 .005
C502 .01
C503 .1
C504 .01
C505 .01
C506 .01μf
L501 200μh
+12v
ON
OFF
SO1
SO2
SO3



SO 5
DIPOLE
ANT
T1
SW 4
L1
L2
ANT TUNE 1
0-20
C1
410 pf
ANT TUNE 2
1-7
ANTENNA
GROUND
ANTENNA TUNER
BATTERY TEST
PC 401
TRANSMITTER, LINEAR AMPLIFIER
FORWARD POWER
REFLECTED POWER
CW HOLD
GROUND
PTT KEY
CONT. LINE
ALC
LOW PWR
HIGH PWR
CW KEY LINE
SWITCHED 12V
PINK
WHT/RED
ORANGE
GREEN
YELLOW
GRAY
PWR
SW-6
RED
WH/GRN
PC 101
RECEIVE / TRANSMIT EXCITER
CW XMIT
ALC
CW KEY LINE
IN
OUT
WH/RD
LOCAL OSCILLATOR
AM ON
CW ON
LSB ON
USB ON
AUDIO STOP
(TUNE ONLY)
BROWN
VIOLET
WH/BLK
WH/VIO
SPKR
MIC.
+8v
WH/BLU
WH/ORG
COAX RED SLEEVE
P1
10 K
YEL
GRN
VOLUME
R1
100Ω
3W
CR3
13v
1N5243B
PC 201
SYNTHESIZER
+5v
PC 301
REGULATOR & SYNTHESIZER VCO
+5v (OUT)
CONT. LINE
NC
+12v (IN)
+8v OUT
CR1
VSK 120
ON
OFF
SW1
C2
1000μf
16v
F1
3 AMP
SLOW BLOW
P2
10K
CLARIFIER
SW 5
SPKR
PC 501
CONNECTOR BOARD
CW KEY LINE
SPEAKER
C503 .1
C504 .01
C502 .01
C505 .01
C501 .005
L501
200μh
C506
.01μf
+12v
CR2
VSK 520
SO1
SO2
SO3
PL1



501, 502 CONNECTIONS

A	AUDIO RETURN
B	REC AUDIO OUT
C	PTT KEYLINE
D	TX AUDIO INPUT
E	CW KEYLINE

Figure 3.15. Schematic - Chassis Wiring

SECTION IV

Maintenance

MAINTENANCE

4.1 INTRODUCTION

This section of the manual contains instructions for maintenance of the SC130D(E) Transceiver. Included are instructions for removal of the chassis from the case and removal of individual circuit boards. Alignment procedures are also supplied in this section.

Separate photographs of each board assembly with others showing installation in the chassis are provided. These photographs are inserted at the end of this section and are referenced in the test by Figure number.

4.2 TEST EQUIPMENT AND TOOLS

The following test equipment or equivalents are recommended for correct maintenance of the SC130D(E) Transceiver:

a. RF vacuum tube voltmeter, AC and DC ranges - Hewlett Packard 410B.

b. Oscilloscope - Tektronix 453.

c. Dummy load, 50 ohm - Bird 50W.

d. Frequency counter - Hewlett Packard 5326A.

e. Signal generator - Hewlett Packard 606B.

f. Two tone audio generator - Southcom SC350.

g. Multimeter (ohms, volts, current, etc.) - Simpson 260.

h. AC voltmeter - Hewlett Packard 400GL.

4.2 cont'd The following tools are necessary for correct maintenance of the SC130D(E) Transceiver:

a. Pliers, long nose, 6".

b. Side cutters, 4".

c. Screwdriver 6" x 3/10".

d. Screwdriver, Phillip's head No. 0 point.

e. Wrench, Allen .050" (provided with transceiver).

f. Wrench, Allen .0625" (provided with transceiver).

g. Soldering iron, pencil tip, 40 watt.

h. Solder wick.

4.3 SCHEDULED MAINTENANCE

No maintenance at regularly scheduled intervals is required for the transceiver. When reasonable care is exercised in the use of the unit, only the antenna tuning and grounding procedures described in Section 2 are necessary for normal use.

4.4 PREVENTIVE MAINTENANCE

The transceiver should be inspected on a periodic basis and serviced in accordance with the following recommendations and precautions.

4.5 CLEANING

The transceiver should be kept clean and dry. If the transceiver has been used under wet conditions, it should be dried before storage. The outside of the transceiver should be kept free from dirt and should be cleaned with a soft cloth. It is most important to keep the transceiver

4.5 cont'd from mineral oils and solvents as they may damage the waterproof glands and seals. The case and panel may be cleaned with a damp cloth.

4.6 SEALS

The SC130D(E) Transceiver is fully waterproof only if the glands and seals are in good condition. The seal around the edge of the panel should be kept clean and should be replaced if there are any cuts or nicks present. The case catches use internal springs and no tension adjustments are required. The seal around the rear battery box connecting area should be kept clean and should be replaced if damaged. The front panel controls pass through waterproof glands which seal both the shaft and the bushing. All control seals should be replaced at the first sign of wear or damage.

4.7 LUBRICATION

The SC130D(E) Transceiver does not normally require lubrication. In the event of any friction on metal to metal surfaces, a good quality silicon lubricant should be applied sparingly. The switch contacts should only be lubricated with a cleaner/lubricant specifically designed for electronic switches.

4.8 MECHANICAL

The transceiver should be inspected for loose nuts and bolts. The control knobs should be securely tightened and, if necessary, the control bushing hex nuts tightened. The internal shield securing bolts should all be secure and the fuse cap should be screwed into the holder.

4.8
cont'd

CAUTION

DO NOT OVERTIGHTEN BOLTS OR NUTS. DO NOT ADJUST ANY OF THE CONTROLS OR SCREWS INSIDE THE TRANSCEIVER. THESE CONTROLS AND ADJUSTMENTS ARE SET IN THE FACTORY AND SHOULD BE ADJUSTED BY QUALIFIED PERSONNEL USING THE PROPER TEST EQUIPMENT.

4.9 ACCESSORIES

Accessories should be checked to make sure that no parts or components are missing. Inspect all connecting cables for wear, damage and loose connections. Faulty connecting cables, plugs and sockets are one of the main causes of field faults and careful preventive maintenance will pay dividends in increased reliability.

4.10 WATER IN TRANSCEIVER

If a damaged seal or some other mishap has allowed water to enter the transceiver, it is most important to dry the transceiver as soon as possible. The transceiver should then be thoroughly washed in distilled water to remove any dirt or mineral deposits. The surplus water should then be removed with a compressed air hose. Finally, the transceiver should be dried in a warm air stream for at least 24 hours. The temperature should not exceed 75°C during the drying process. If these precautions are taken, no damage should occur.

CAUTION

DO NOT OPERATE TRANSCEIVER UNTIL IT IS COMPLETELY DRIED OUT.

4.11 REMOVAL FROM CASE

The following description applies to removal of the transceiver chassis from the outer case.

Removal of the transceiver from the case is accomplished by uncoupling the external retaining clips, as follows:

a. Pull upwards on the six metal latches along the two long sides of the case. Pull center of latch outward when latch does not lift sufficiently to clear panel.

b. Lift panel and transceiver from case holding the transceiver by the panel handles provided.

CAUTION

DO NOT SET TRANSCEIVER CHASSIS ON SPRING AT BASE OF CHASSIS. THE PURPOSE OF THE SPRING IS TO MAKE ELECTRICAL CONTACT BETWEEN THE CHASSIS AND THE HOUSING.

4.12 FUSE

The fuse is located on the rear panel of the transceiver. Use screwdriver to remove fuse cap. A spare fuse is located in the interior compartment on the right side of the chassis. It is important that only the correct fuse be used. Values other than that specified may cause equipment damage.

4.13 PRINTED CIRCUIT BOARD EXPOSURE

The following paragraphs describe methods of access and removal, when applicable, of the printed circuit boards. Additionally, identification and location of test points are provided.

4.13 cont'd — To expose the circuit boards, two covers must be removed. Remove the covers enclosing the radio by first removing the No. 4 x 3/16" retaining screws.

4.14 PRINTED CIRCUIT BOARD ASSEMBLY PC101

Refer to Figure 3.4. Printed circuit board assembly PC101 is the large printed circuit board occupying the right half of the chassis. This board contains the following stages:

a. Q101 - IF amplifier.

b. Q102 - IF amplifier, USB.

c. Q103 - IF amplifier, LSB.

d. Q104 - Signal frequency emitter follower.

e. Q105 - Microphone amplifier.

f. Q106 - Transmit Audio Amplifier.

g. Q107 - Microphone Audio Attenuator Control.

h. Q108 - Audio Compression Amplifier.

i. Q109 - CW gate.

j. Q110 - CW tone oscillator, CW keyer.

k. Q111, 112, 113, 114 - Electronic DPDT Switch.

l. Q115 - DPDT Switch Driver.

m. Q116 - AGC/ALC amplifiers, receiver audio amplifiers.

n. Q117 - Receiver audio output.

o. Q118 - BFO Oscillator.

p. Q119 - BFO Buffer.

q. Q120 - Carrier Switch.

4.15 REMOVAL OF PC101 (Refer to Figure 4.1)

Five retaining bolts hold PC101 to the chassis. When these are removed, the printed circuit board may be hinged clear of the chassis (see Figure 4.2). The radio may be operated in this position if an external power supply (SC804) is connected to the front panel connector. However, while this facility allows for easy service of the equipment, the supply voltage should be turned off when actual maintenance is performed.

4.16 PC101 TEST POINTS (Refer to Figure 3.3, 3.4 and 4.3)

Test points are brought out to easily accessible pins where AC waveforms may be monitored. These are shown on the schematics as 1, 2, etc. and correspond to the following:

1. Oscillator input to balanced modulator/first mixer.

2. Oscillator input to balanced demodulator/second mixer.

3. Output of second mixer (transmit condition).

4. BFO/Carrier generator output.

4.17 PRINTED CIRCUIT BOARD ASSEMBLY PC201 (Refer to Figure 3.11)

Printed circuit board PC201 is the printed circuit board in the upper left hand portion of the chassis. This board contains the following devices:

a. Q201 - 10/11 prescaler control gates.

b. Q202 - KHz decade, prescaler control counter.

c. Q203 - KHz x 10 decade counter.

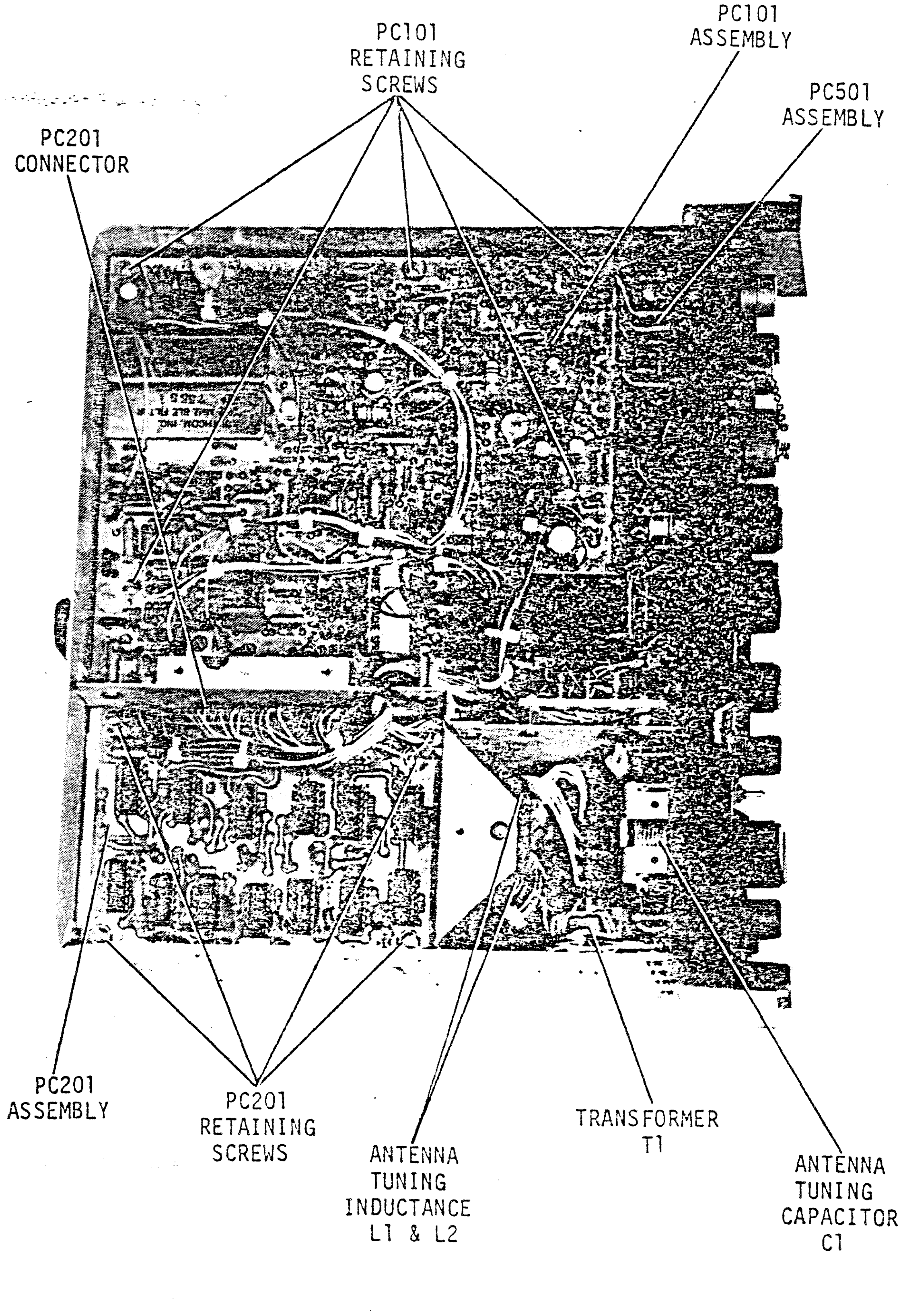


Figure 4.1. SC130D(E) Chassis, Bottom View

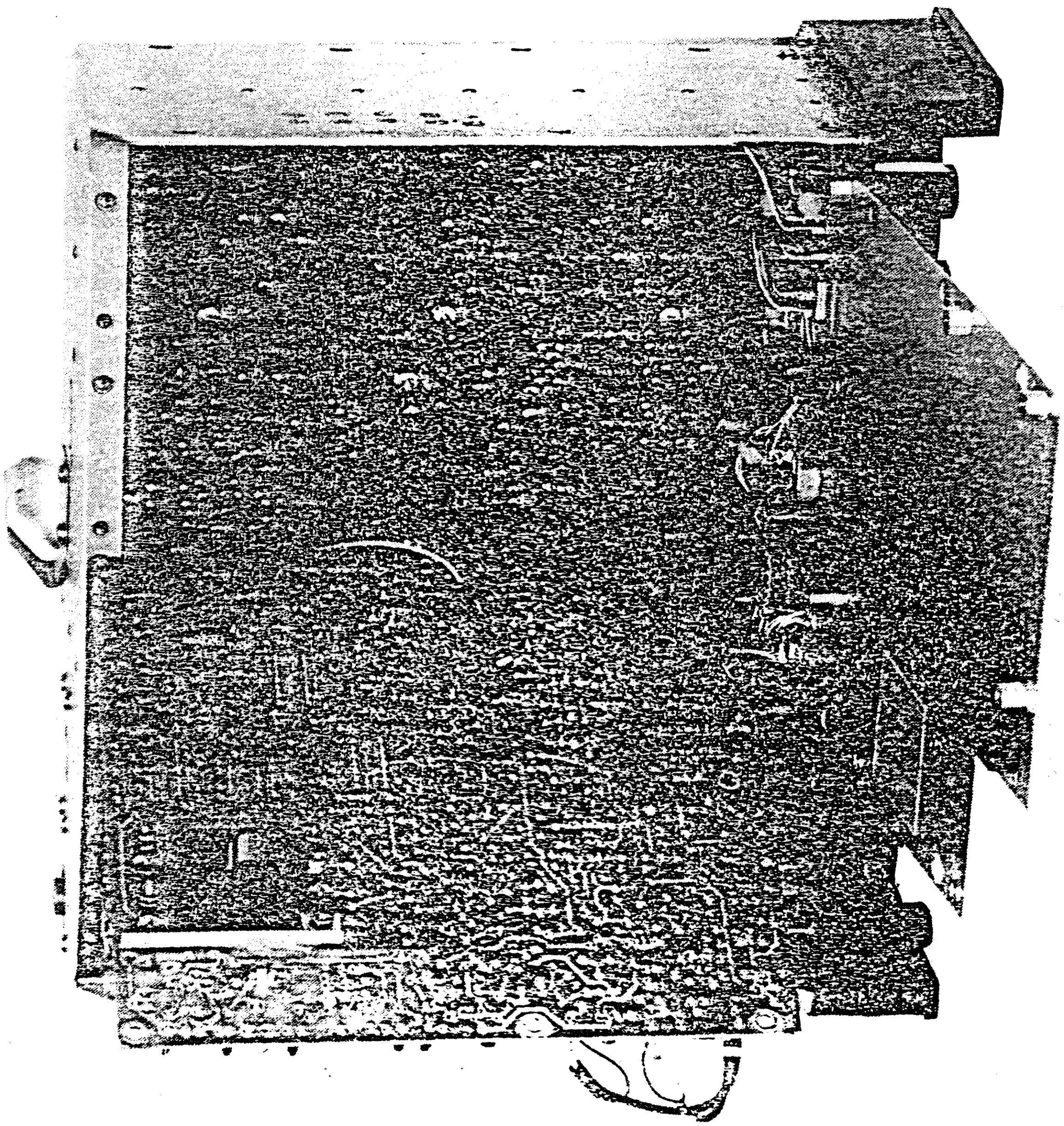


Figure 4.2. SC130D(E) Chassis, PC101 Hinged Up

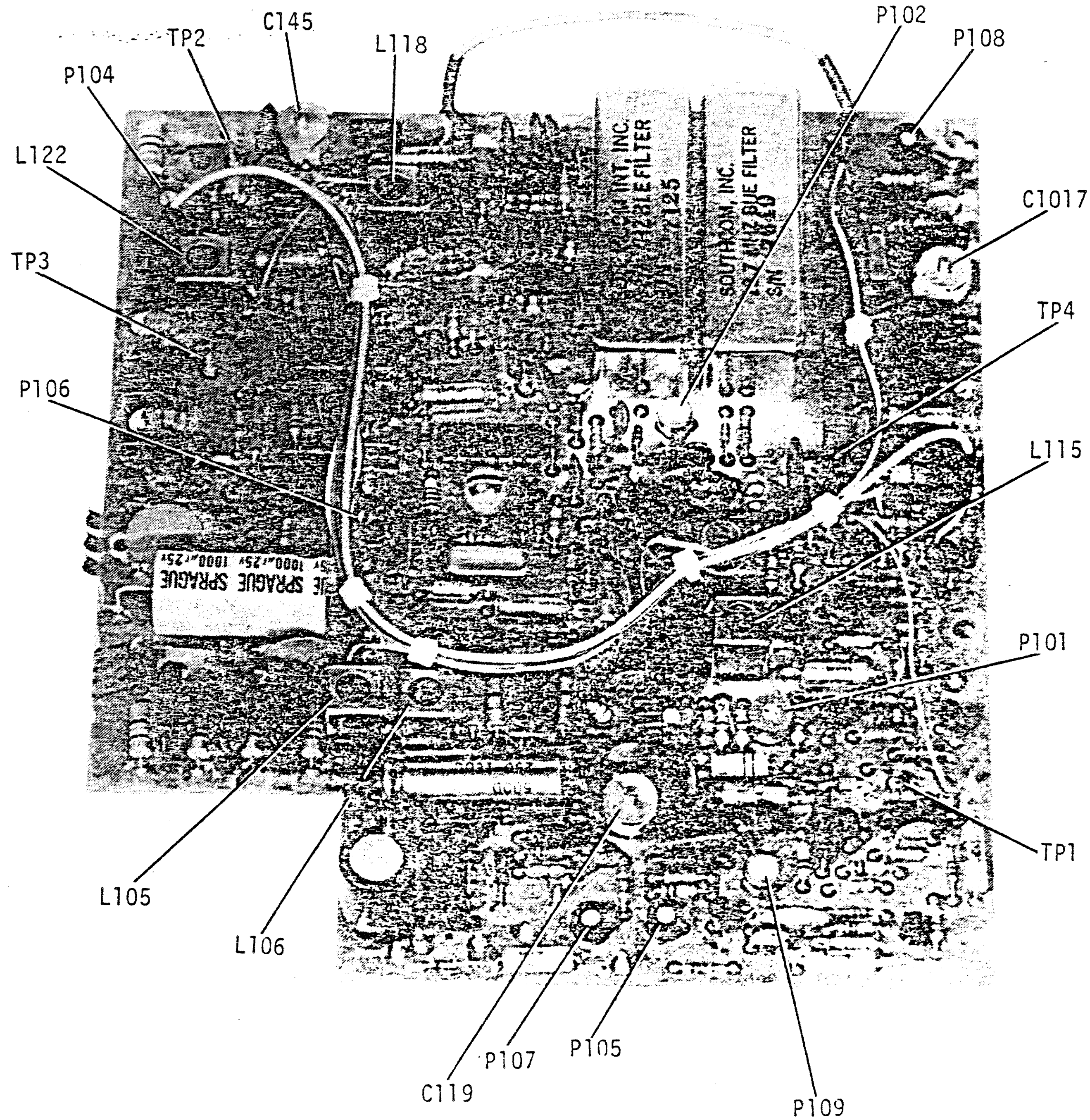


Figure 4.3. SC130D(E) PC101 Assembly

4.17 cont'd

d. Q204 - Output and preset-enable flip-flop.

e. Q205 - KHz x 100 decade counter.

f. Q206 - MHz decade counter.

g. Q207 - VCO signal buffer.

h. Q208 - 10/11 prescaler control gates.

i. Q209 - 10/11 prescaler (part of)

j. Q210 - 10/11 prescaler (part of)

k. Q211 - Inverters.

l. Q212 - End-of-count detector.

m. Q213 - MHz range extender counter.

4.18 REMOVAL OF PC201 (Refer to Figure 4.1)

Four retaining screws hold PC201 to the chassis. The printed circuit board may be lifted free of the chassis. This facility allows access to both sides of the printed circuit while the radio is operational. Additionally, a connector allows the board to be completely disconnected from the chassis cable (see Figure 4.4). A defective PC201 assembly may thus be replaced in the field.

4.19 PC201 TEST POINTS (Refer to Figure 3.11 and 4.4)

Test points are brought out to easily accessible pins where AC waveforms may be monitored. These are shown on the schematic as a, b, etc. and correspond to the following:

a. Input to VCO buffer.

b. Input to 10/11 prescaler (high-speed clock line).

c. 10/11 prescaler control gate output.

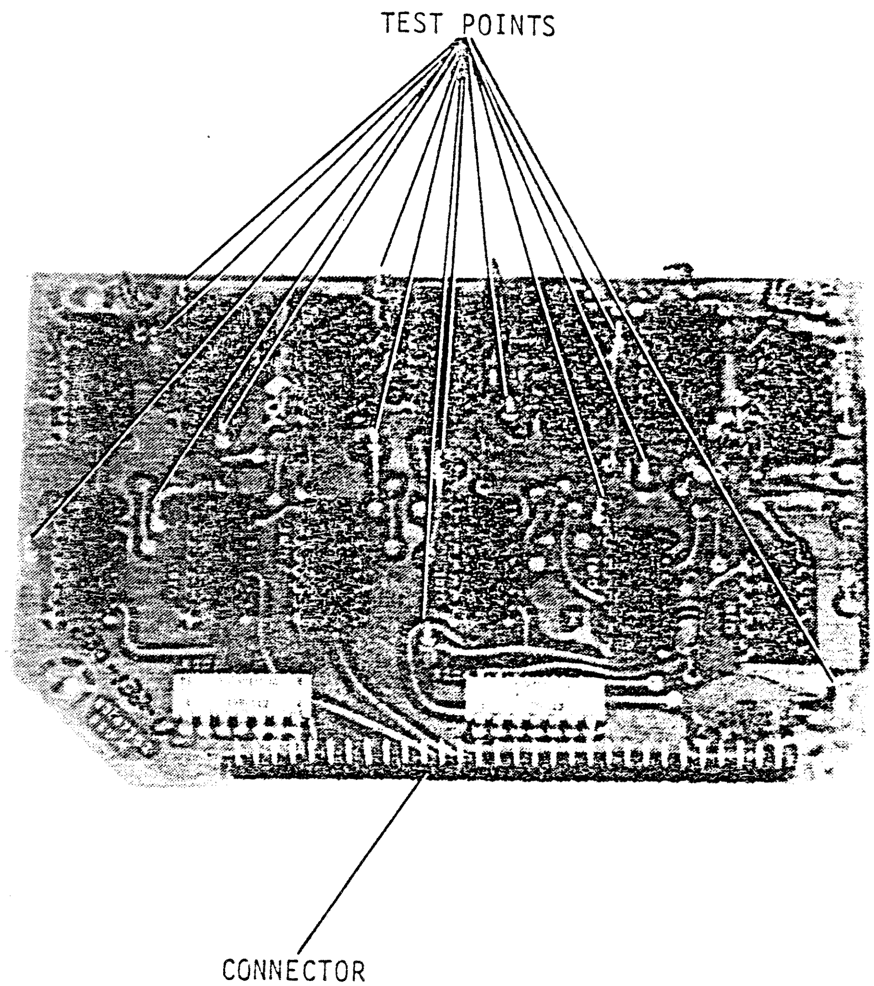


Figure 4.4. SC130D(E) PC201 Assembly

4.19 cont'd

d. Input to CMOS-to-TTL interface.

e. Preset enable line.

f. 10/11 prescaler output to TTL-to-CMOS interface.

g. Low-speed clock line.

h. Control gate output to KHz decade prescaler control counter.

j. Output of KHz x 100 decade counter.

k. Output of MHz decade counter.

l. Output of MHz range extender counter.

m. Output of end-of-count detector, gate A.

n. Output of end-of-count detector.

p. Output of KHz x 10 decade counter.

4.20 PRINTED CIRCUIT BOARD ASSEMBLY PC301 (Refer to Figures 3.9 and 4.5)

Printed circuit board assembly PC301 is the printed circuit board in the upper right hand corner of the chassis. This board contains the following devices:

a. Q301 - Voltage controlled oscillator and buffer stage.

b. Q302 - Buffer amplifiers.

c. Q303 - Mixer driver.

d. Q304 - Muting switch.

e. Q305 - Phase/frequency comparator.

f. Q306 - Reference oscillator divider.

g. Q307 - Reference oscillator and muting stage driver.

h. Q308 - Regulator, 5 volts DC.

i. Q309 - Regulator, 8 volts DC.

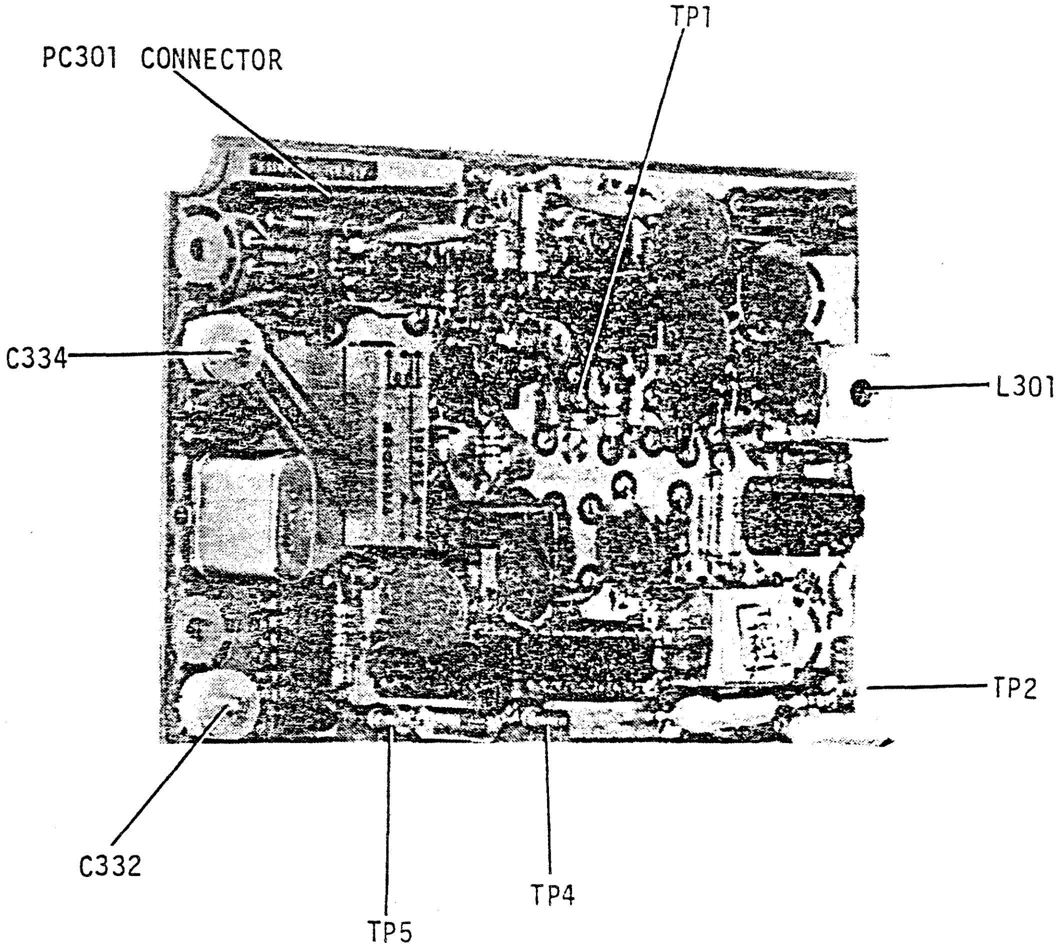


Figure 4.5. SC130D(E) PC301 Assembly

4.21 REMOVAL OF PC301 (Refer to Figure 4.6)

Four retaining bolts hold PC301 to the chassis. The printed circuit board may be lifted free of the chassis. This facility allows access to both sides of the printed circuit while the radio is operational. Additionally, a connector allows the board to be completely disconnected from the chassis cable. A defective PC301 assembly may thus be replaced in the field.

4.22 PC301 TEST POINTS (Refer to Figure 4.5)

Test points are brought out to easily accessible pins where waveforms can be monitored. These are shown on the schematic as 1, 2 etc. and correspond to:

1. Pin 2 Q302, Input to base of 2nd VCO buffer.
2. Junction of R328 and C322, VCO control line filter.
3. Pin 4 Q305, reference 1 KHz pulse.
4. Pin 10 Q306, 1024 KHz reference oscillator output.

4.23 PRINTED CIRCUIT BOARD ASSEMBLY PC401 (Refer to Figure 4.7)

Printed circuit board assembly PC401 is the PC board occupying the greater part of the chassis. This board contains the following devices:

a. Q401 - First transmitter linear amplifier.
b. Q402 - Second transmitter linear amplifier.
c. Q403 - Third transmitter linear amplifier.
d. Q404 - Transmitter final linear amplifier.
e. Q405 - Transmitter final linear amplifier.
f. Q406 - Bias regulator.

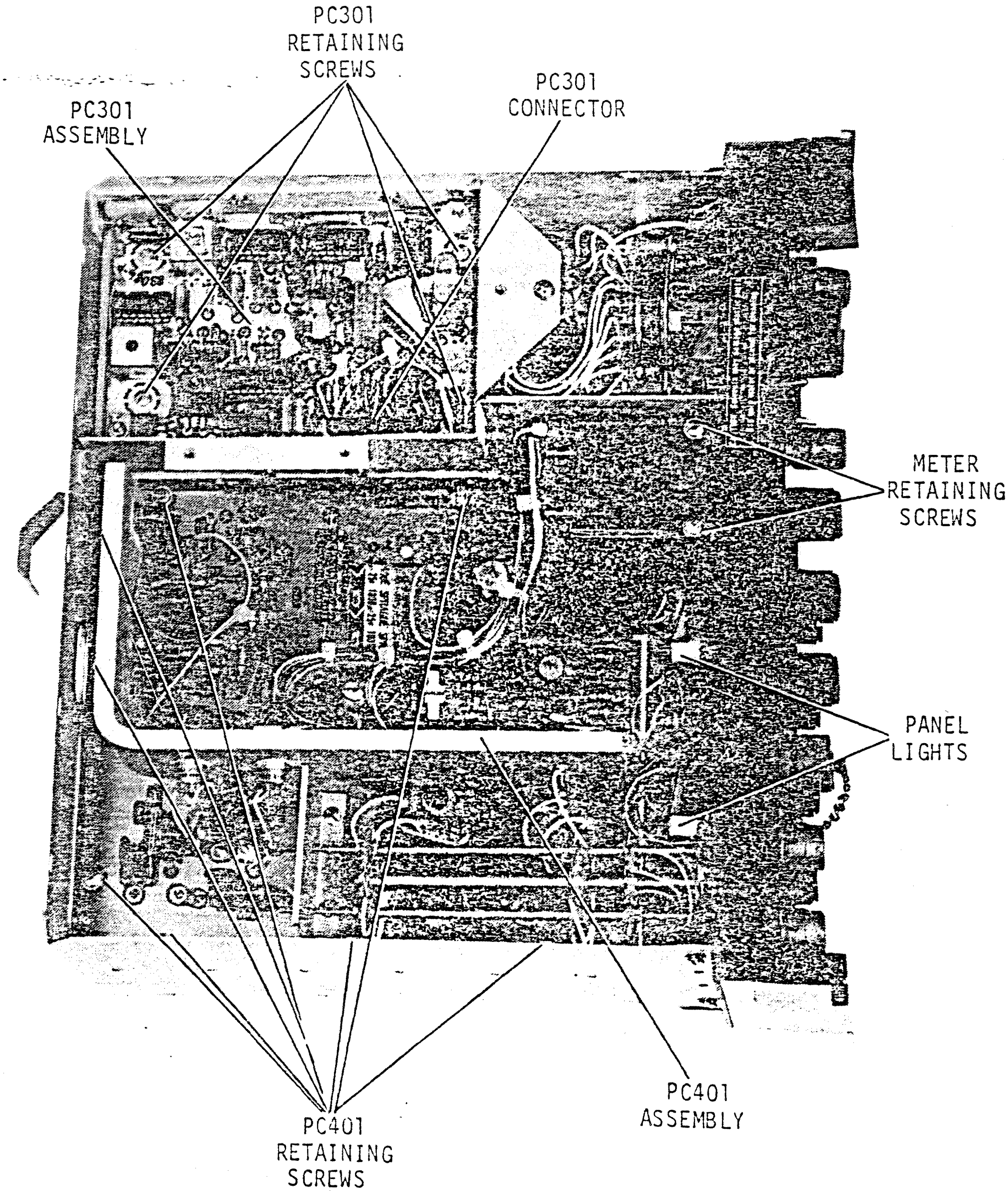


Figure 4.6. SC130D(E) Chassis Top View

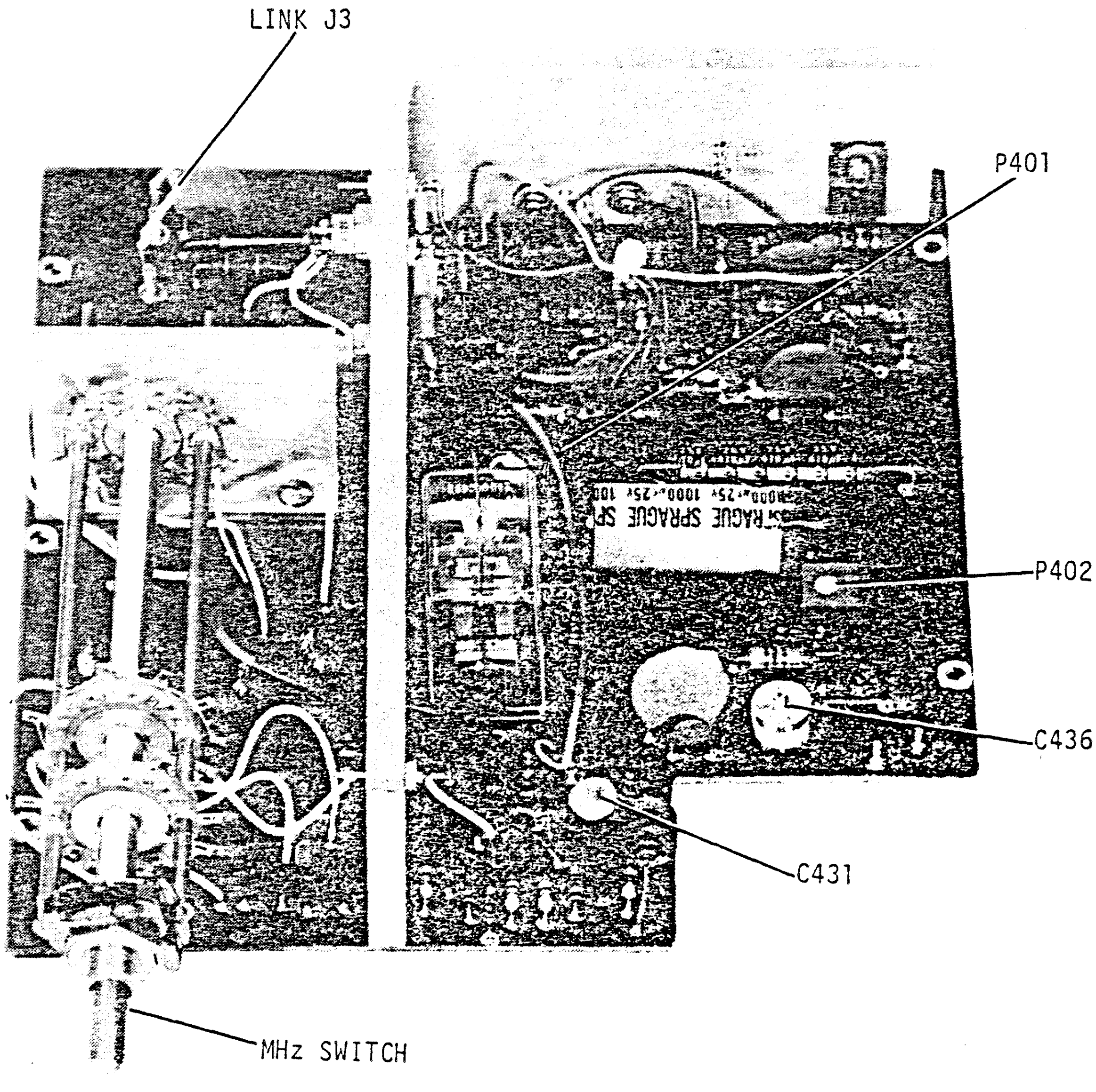


Figure 4.7. SC130D(E) PC401 Assembly

4.24 ACCESS TO PRINTED CIRCUIT BOARD PC401 (Refer to Figures 4.2, 4.6)

It should not normally be necessary to remove PC401. In the event of severe damage to the board requiring its replacement, it will be necessary to remove the 8 retaining screws around the perimeter and the knob and retaining nut which secures the MHz switch to the front panel.

Access to the under side of PC401 is accomplished by removing the retaining screws of PC101. PC101 will now be free to hinge clear of the chassis (Figure 4.2) exposing the shield tray separating PC101 from PC401. This tray is readily removed by removing the 7 screws around the perimeter. This facility allows ready access to both sides of PC401 while the radio is operational.

4.25 PC401 TEST POINTS

No actual test terminals are provided on PC401 due to the ease with which voltages and waveforms are monitored at various test points. (See Figures 3.7 and 4.7.) These are as follows:

a. Base of Q401.

b. Base of Q402.

c. Base of Q403 (end of R416).

d. Collector of Q403 (case of device).

e. Collector of Q404.

f. Collector of Q405.

g. Feedthru from switch SW401B into SWR bridge.

4.26 COMPONENT AND SUB-ASSEMBLY EXPOSURE

The following paragraphs describe access to the speaker, the antenna relay, and the antenna tuner.

4.27 REMOVAL OF SPEAKER

To remove the speaker, it is first necessary to remove the bezel on the front panel which contains the speaker grill and through which the frequency is read. The bezel is held by 5 screws. Under the bezel, immediately below the meter window, are 2 countersunk Phillip's-head screws which retain the speaker housing to the panel. These must be removed. Next, (see Figure 4.6) remove the two meter retaining screws and swing the meter clear. The speaker housing may now be lifted clear of the chassis.

NOTE

> Do not damage the rubber gasket between the speaker housing and the panel, and ensure that the gasket is correctly replaced when the radio is reassembled or the watertightness of the unit will be destroyed.

To remove the speaker from the housing merely undo the four screws holding the two pieces of the housing together. Likewise, this gasket must not be damaged.

4.28 REMOVAL OF ANTENNA RELAY K401 (See Figure 4.7)

A spring clip retains relay K401 in its socket. Move clip sideways free of the relay housing and pull relay from socket.

4.28 cont'd **Access to Antenna Tuner (See Figure 4.1)**

The antenna tuner is housed in front of PC201 and PC301. The side plate held to the chassis with 13 retaining screws may be removed to obtain access to the antenna tuner section consisting of the variable capacitor C1, the inductors L1 and L2, and the switch SW4. To remove C1, first remove the knob from the panel control ANT TUNE 2, then remove the retaining nuts from the ground terminal. Next, remove the BNC-type dipole antenna connector and draw the capacitor rearward. To remove the switch SW4, first remove the knob from panel control ANT TUNE 1. Next remove the retaining nut (under the knob) and withdraw the switch rearward. Two screws which retain the plastic ends supporting L1 and L2 to the chassis may be removed to better allow the withdrawal of SW4.

4.29 **ALIGNMENT**

The alignment procedures provided in this section may be utilized to adjust the transceiver at any time. However, the SC130D(E) is fully aligned at the factory and should not require further adjustment except following repair or after being subjected to excessive shock or vibration levels.

Refer to paragraph 4.2 for a list of recommended test equipment and tools required to properly align the transceiver. Paragraphs 4.11 through 4.13 provide information concerning removal of the chassis from the case and removal of the covers from the chassis. Information relative to the location of printed circuit board and test points are included in paragraphs 4.14 through 4.25.

4.30 RECEIVER ALIGNMENT

The following procedures should be carefully observed in alignment of the receiver section of the SC130D(E) Transceiver.

4.31 IF AMPLIFIER ALIGNMENT

Align the IF amplifier as follows:

a. Connect signal generator to antenna dipole BNC socket and AC voltmeter across the speaker terminals at the rear of the speaker housing.

b. Set ANT TUNE 1 and ANT TUNE 2 panel controls to positions 20 and 7 respectively which positions allow for 50 ohm output termination.

c. Set channel frequency knobs to desired frequency and FUNCTION switch (control 2) to upper sideband (USB).

d. Tune signal generator to required input frequency and move frequency until a beat note of approximately 1 KHz is heard in the speaker and is recorded on the AC voltmeter.

e. Adjust VOLUME (control 1) so that audio output is less than 1 volt rms and adjust signal generator output for minimum consistent with the signal being heard.

f. See Figure 4.3 for location of alignment controls.

g. Adjust IF transformers L115 and L118 on PC101 for maximum audio output.

4.31 cont'd

NOTE

Final IF amplifier adjustment is made with transceiver in the transmit condition (see paragraph 4.39).

4.32 12.7 MHz SIGNAL REJECTION

Adjust for rejection of the 12.7 MHz signal in the following manner:

a. Set channel frequency knobs to 7.000 MHz and tune signal generator to approximately 12.7 MHz. Advance generator output while sweeping the generator until a signal is heard at 12.7 MHz. Set the generator to give a 1 KHz beat note.

b. Adjust inductor traps (Figure 4.3) L105 and L106 on PC101 for MINIMUM output. Advance the signal generator output if required. This adjustment assures that the IF signal frequency rejection is at a maximum.

4.33 BFO FREQUENCY ADJUSTMENT

Adjust the BFO frequency as follows:

a. Connect the frequency counter to TEST POINT 2 on PC101, (see Figure 4.3).

b. Adjust capacitor C1017 on PC101 (see Figure 4.3) for 12.700 MHz. Adjustment of 12.700 MHz should be made to within 5 Hz of 12.700 MHz.

4.33 cont'd

NOTE

If frequency counter is connected to an output other than that provided at TP2 on PC101, an error in frequency measurement may be introduced.

4.34 CHECK OF AGC OPERATION

Proper operation of the AGC circuit may be determined by the following procedures.

a. Set channel frequency knobs to 7.000 MHz and tune signal generator to approximately 7 MHz sweeping the generator across the frequency until the signal is heard.

b. Set the generator for approximately 1 KHz beat note in the speaker. Reduce the generator output to 5 microvolts and connect the AC voltmeter across the speaker. Adjust audio volume control for approximately 0.1 volt output.

c. Advance signal generator to 0.1 volts output and check that receiver audio output does not increase more than 14 dB.

4.35 TRANSMITTER ALIGNMENT

The following procedures should be carefully observed in alignment of the transmitter section of the SC130D(E) Transceiver.

4.36 12.7 MHz REJECTION AND SECOND MIXER BALANCE

Second mixer balance and 12.7 MHz rejection is accomplished as follows:

a. Set ANT TUNE 1 and ANT TUNE 2 controls to positions 20 and 7 respectively (50 ohm position).

b. Connect oscilloscope to TEST POINT 3, PC101 (see Figure 4.3), oscilloscope set at maximum sensitivity (at least 5 mV per centimeter).

c. With transceiver in RECEIVE condition, adjust IF frequency trap L122 on PC101 (see Figure 4.3) for minimum oscilloscope deflection.

d. With transceiver in RECEIVE condition, adjust balance capacitor C145 and balance potentiometer P104 (see Figure 4.3) for minimum oscilloscope deflection, working back and forth between the two controls until no further improvement can be obtained.

e. Readjust IF frequency trap L122 as outlined in step c.

4.37 ADJUST BIAS FOR FINAL AMPLIFIER RESTING CURRENT

Adjust the bias in accordance with the following procedure.

a. Remove link wire J3 (Figure 4.7) and adjust BIAS ADJUST potentiometer P401 on PC401 (Figure 4.7) fully counterclockwise.

b. Connect milliameter (500 ma full scale) in place of J3.

4.37 cont'd

c. Remove PC301 connector (see paragraph 4.21) but do not remove the four retaining bolts. This action disables the entire transceiver so that transmitted drive signal does not give a false final amplifier collector current reading.

d. Set FUNCTION switch (CONTROL 2) to TUNE and adjust bias potentiometer P401 for a current reading of 85 ma. Return FUNCTION switch to LSB position. Turn transceiver off.

e. Remove milliameter, replace link wire J3 and replace connector on PC301 assembly.

4.38 CARRIER SUPPRESSION ADJUSTMENT

Carrier suppression is adjusted as follows:

a. Set controls ANT TUNE 1 and ANT TUNE 2 to positions 20 and 7 respectively (50 ohm positions).

b. Connect 50 ohm dummy load to dipole BNC connector located on front panel.

c. Connect oscilloscope and VTVM across dummy load.

d. Set FUNCTION switch to LSB.

e. Set the frequency to 10.000 MHz.

f. Depress microphone button but cover microphone to preclude the entry of extraneous noise.

g. Refer to Figure 4.3. Adjust carrier balance controls C119 and P101 on PC101 for minimum output on oscilloscope. Work back and forth between controls until

4.38 cont'd no further improvement is effected. Carrier should remain less than 0.5V rms as read on the VTVM.

4.39 ALC ADJUSTMENT

Adjust the automatic level control as follows:

a. Set auxiliary equipment and controls as in paragraph 4.38 a, b and c.

b. Set FUNCTION switch to LSB and frequency to 10.5 MHz.

c. Set P105 to max. CCW, P107 and P109 to mid position.

d. Connect the SC350 (two tone) audio generator to the audio input socket on panel.

e. Key the SC350 with both tones applied.

f. Refer to Figure 4.7. Adjust ALC ADJUST control C436 for minimum capacitance (minimum effect upon the output signal) and increase audio input signal until 15 volts rms is obtained on the VTVM.

g. Rotate the frequency through the 2-12 MHz settings to determine the lowest power output frequency. Then set the audio input for 3mV rms and adjust P109 for 27 volts rms output.

h. Reduce the audio input until the output reads 15 volts rms. Rotate the frequency controls through the 2-12 MHz range to determine the higher power output frequency. Set the audio input back to 3mV rms. Set the front panel PWR switch to the LOW PWR position and adjust C436 for 16 volts rms output or other

4.39 cont'd

desired power level. Set the front panel PWR switch to the HIGH PWR position and adjust P402 for 27 volts rms output.

i. Set the frequency control back to the lowest power output frequency. Set the audio input for 3mV rms. Adjust P105 until the output power is reduced by 0.5 volts rms.

j. Set P107 for 150 mV rms sidetone level at the speaker voice coil terminals with a 3mV rms input.

k. Remove the two tone test signal and speak into the microphone. Output should reach 27 volts rms at 5.000 MHz without visible "flat-topping" or distortion of the signal.

4.40 AM CARRIER LEVEL ADJUSTMENT (Adjust in High-Power Mode)

Utilize the following procedure to adjust the AM carrier level.

a. Set auxiliary equipment and controls as in paragraph 4.38 a, b and c.

b. Set FUNCTION switch to AM position.

c. Depress microphone button but cover microphone to preclude the entry of extraneous noises.

d. Refer to Figure 4.3. Adjust AM carrier level control (P108) for 11 volts rms output on the VTVM (2.5 watts).

NOTE

Output voltage will vary with channel setting and a nominal setting should be obtained.

4.41 CW LEVEL ADJUSTMENT (Adjust in High-Power Mode)

Observe the note below and employ the procedure following the note.

NOTE

The CW level control P106 on PC101 (see Figure 4.3) sets the CW power output to the desired output level. In the interests of battery drain, this level should be kept to a minimum consistent with good communications.

a. Set auxiliary equipment and controls as in paragraph 4.38 a, b and c.

b. Set FUNCTION switch to CW.

c. Depress CW keyer and observe CW output on VTVM.

d. Refer to Figure 4.3. Set CW level control P106 on P101 to a nominal output of 10 volts rms.

e. Refer to Figure 4.3. Readjust IF transformers L115 and L118 on PC101 for maximum output.

f. Readjust CW LEVEL control P106 for 16 volts output (equals 5 watts) or desired level.

NOTE

Output voltage will vary with channel setting and a nominal setting should be used.

4.42 REFLECTED POWER ADJUSTMENT (VSWR BRIDGE)

Reflected power for the VSWR bridge may be adjusted in the following manner.

a. Set auxiliary equipment and controls as in paragraph 4.38 a, b and c.

b. Set the frequency for 11.999 MHz.

c. Set FUNCTION switch to TUNE position.

d. Refer to Figure 4.7. Adjust reflected power adjustment capacitor C431 on PC401 for minimum reading on transceiver panel meter.

e. Check operation of VSWR bridge by removing dummy load. Meter should read near full scale.

4.43 CLARIFIER CONTROL

With the frequency set at 2.000 MHz and a frequency counter connected to TP1 on the PC101 board, adjust the clarifier control maximum CW and then maximum CCW and note the two end-point frequencies. The difference between the two frequencies should be at least 1000 Hz and centered around 14.7 MHz. If not centered around 14.7 MHz, adjust C332 on the PC301 board then adjust C334 per paragraph 4.45.

4.44 VCO RANGE ADJUSTMENT

If it should become necessary to adjust L301 the following procedure should be followed. Set the frequency at 2.000 MHz and connect an oscilloscope to TP2 on PC301. Adjust L301 for a 1.5 volt reading on the oscilloscope.

4.45 REFERENCE OSCILLATOR FREQUENCY ADJUSTMENT

Adjust the reference oscillator frequency as follows:

a. Set auxiliary equipment and controls as in paragraph 4.38 a and b.

b. Set frequency control knobs to 5.300 MHz.

c. Refer to Figure 4.3. Connect frequency counter to Test Point 2 on PC101.

d. Set FUNCTION switch to TUNE.

e. Refer to Figure 4.5. Adjust reference frequency capacitor C334 until counter reads 18,000.000 KHz. Set to within 5 Hz.

NOTE

This adjustment must only be made in the tune condition. (In the receive condition, the CLARIFIER control allows for a variable reference frequency dependent upon its setting).

4.46 BATTERY LIFE AND RECHARGING FACTORS

The following paragraphs provide maintenance and usage information for batteries available with the SC130D(E) Transceiver.

4.47 NICKEL CADMIUM BATTERIES

There are five nickel cadmium cells in series in each 6 volt stick used in the SC130D(E) nickel cadmium battery pack. Each cell has a nominal voltage of 1.25 volts.

4.47.1 Discharge Characteristics

The discharge curves are quite flat and will stay in the range of 1.20 to 1.25 volts per cell except during heavy drains. A heavy drain would be considered to be about 5 amps or greater.

NOTE

> Cells should not be discharged to an extremely low closed circuit voltage. Permanent damage may result if this is done. Best results will be obtained when recharging is started when volts per cell have reached about 1.1 volts under load.

4.47.2 Recharging

Recharging should normally be conducted at the rate in milliamperes which is equal to about 10% of the nominal milliampere hour capacity. Heavier charging rates than this are not recommended. For example, the recommended charging rate for a 450 ma hour cell would be about 45 milliamperes. Cells should be charged at this rate for about 14 to 16 hours. An occasional charge of as much as twice this amount will not be harmful to the cells.

NOTE

> Cell polarity must be observed or permanent damage may result to the cell. Connections must be made only by pressure contact unless the cell or battery is provided with special solder lugs. Soldering directly to a cell may damage the seal.

4.48 SEALED LEAD ACID BATTERY

There are six lead acid cells in series in each battery pack. Each cell has a nominal voltage of 2.12 volts. The cell voltage is sometimes lower for a severely discharged battery and sometimes higher for a cell that has just been taken off charge.

4.48.1 Recharging

The open circuit voltage of each cell of the sealed lead acid battery is approximately 2.12 volts. The cell voltage is sometimes lower for a severely discharged battery and sometimes higher for a battery that has just been taken off charge; but in all instances, it should adjust to about 2.12 volts after a period of time.

To recharge a sealed lead acid battery, apply a DC voltage, greater than the open circuit voltage of the battery, to the battery terminals.

Limit the initial charge current that flows into the battery to the values shown:

Battery Rating	Maximum Initial Charge Current
6.0 Amperes Hour	0.9 Ampere

As the battery begins to accept charge, its voltage will rise. Normal end-of-charge voltage is 2.4 volts per cell (measured while the current charge is flowing). A 6-volt battery, for example, should be charged to a voltage of 7.2 volts. Voltage is only one of two indicators that must be used to determine if a battery is fully recharged. The other is current. A battery is not fully charged

4.48.1 cont'd until the current, at 2.4 volts per cell, drops to the following values:

Sealed Lead Acid Battery Rating	Approximate Final Current
6.0 Amperes Hour	60-120 ma

When the current into the battery, at 2.4 volts per cell, reaches these values, the charger should be disconnected from the battery. This will prevent the battery from being over-charged and will ensure optimum battery performance and life. If it is not possible to disconnect the charger, refer to the following paragraphs.

4.48.2 "STAND-BY" Use (Maintaining Battery Under Continuous Charge)

If it is desired to maintain the battery "on charge" continuously and to allow the battery charger to remain plugged into the AC power line continuously, without ever disconnecting it, the charge voltage should be held at 2.25 volts per cell, not 2.4 volts.

NOTE

> If held at 2.4 volts continuously, battery life will be significantly reduced because of over-charging.

When held at the recommended float voltage of 2.25 volts per cell, the battery will seek its own current level and maintain itself in a fully charged condition. It will also fully recharge itself after a power interruption; but not quite as rapidly as when a higher voltage is used. There may be some reduction in total number of charge/discharge cycles when compared to using a higher

4.48.2 cont'd charge voltage, but the total length of battery life will not be affected.

A level of 2.25 volts per cell is considered a "float voltage". The term "float voltage" should not be confused with the term "trickle charge". "Float voltage" refers to the condition where the charging voltage is held constant and the charging current is free to vary. In contrast, "trickle charge" refers to the condition where the charging current is held constant and the voltage is free to vary.

4.48.3 "CYCLIC USE" (Repetitive Charge/Discharge Operation)

In order to obtain the maximum number of recharge cycles, it is important that the battery on-charge voltage be first brought up to 2.4 volts-per-cell and held there until the current drops to 60-120 ma. The SC807 battery charger automatically adjusts the charging rate and need not be turned off.

4.48.4 Battery Life

Using the "cyclic use" method of recharge, 200 to 400 or more complete "full charge/full discharge" cycles are possible. Of course, if the battery is only slightly discharged during each cycle instead of being totally discharged, literally thousands of cycles of operation are possible.

When the battery charge-voltage never exceeds 2.25 volts per cell (as in "stand-by" applications), there is the possibility of some reduction in battery cycle life. Optimum battery life, however, is assured. For "stand-by" applications, attaining the longest possible battery

4.48.4 cont'd battery life, in terms of years of service, is more important than achieving the largest possible number of charge/recharge cycles.

A new sealed lead acid battery has an initial capacity of 80-90% of its nominal rating. After several months of storage, or 30-40 complete charge cycles, the nominal capacity is reached. The capacity then remains at the nominal value up to 150-200 cycles. After 200 cycles or so, the battery capacity slowly falls. End of battery life occurs when the battery capacity is no longer suitable for its application.

An increase in the initial capacity of the battery can be obtained through several low rate (20 hours or longer) discharges before use. Partial discharges or discharges at a high rate of current will also accelerate the increase in capacity, but more slowly.

NOTES

Remember that whenever an end-of-charge voltage greater than 2.25 volts is used, the charger should be disconnected from the battery at the end of charge. This will keep the battery from being overcharged and will ensure optimum battery life.

Sealed lead acid batteries should not be stored in a discharged condition. They should be recharged as soon as possible after each use.

Batteries that are not recharged soon after discharge, or are stored in a discharged state, may appear to be "open circuited"

4.48.4 cont'd

when an attempt is made to recharge them or else will accept far less than normal current. When this condition is encountered, leave the charger connected to the battery. After a period of time, the battery will begin to accept normal current or will accept larger amounts of current until the normal current level is reached. On future recharges, the battery will behave in a normal manner unless it is again stored in a discharged state.

SECTION V

Troubleshooting And Fault Isolation

TROUBLESHOOTING AND FAULT ISOLATION

5.1 INTRODUCTION

This section presents a listing of some of the most probable types of component failures which may occur in the transceiver and describes the methods to be used in isolating these failures. A thorough knowledge of the function of the transceiver is an essential prerequisite to troubleshooting and fault isolation. With this understanding, a failure may be quickly isolated to the circuit board level and thus, logically, to the component level.

Also included in this section are voltage charts listing typical voltages which may be expected at the various test points and at each pin of specific transistors, IC's and connectors.

It is important to realize that a transceiver uses many components common to both receiver and transmit modes. Therefore, a malfunction in the receive mode may well affect operation in the transmit mode if the malfunction is in circuitry common to both modes.

5.2 TEST EQUIPMENT AND TOOLS

The same basic list of test equipment and tools are required for maintenance procedures are applicable to troubleshooting and fault isolation (see Section IV, paragraph 4.2).

5.3 SOLID STATE FAULT FINDING

The localization of the fault is the secret of successful maintenance of electronic equipment. Modern day equipment is contained principally upon printed circuit boards and requires a different method of servicing. Usually, it is no easy matter to break a lead to read the current flowing in the circuit. The following information will assist the technician to repair solid state equipment using printed circuit boards.

5.4 THE DIODE

The voltage drop across a silicon diode in conduction is always in the vicinity of 0.65 volts. The voltage drop across a germanium junction is approximately 0.25 volts. For this reason, a diode is often used as a low voltage regulator, since regardless of the current through the diode, the voltage will remain relatively constant. This phenomenon also allows the diode to be used as a switch. When forward biased, the diode acts as a conductor with a relatively constant voltage drop. When reversed biased, it does not conduct.

5.5 THE BIPOLAR TRANSISTOR

A bipolar transistor contains two diodes. One diode consists of the base to emitter junction and the other diode consists of the base to collector junction. Generally, the base to emitter diode is forward biased. If the transistor is silicon, there will be a difference of potential of 0.65 volts between the emitter and the base. If the transistor is germanium, there will be a difference of potential of 0.25 volts. The base to collector diode is normally reverse biased. The potential

5.5 cont'd across it will vary according to the circuit.

There are times when the practical rules do not apply. They do not always apply if the stage is an oscillator. An oscillator often develops self bias in the manner of a vacuum tube oscillator and this will tend to decrease or increase the voltage at the base depending upon the R-C time constants in the base circuit. To check an oscillator stage, it is necessary to stop it oscillating without upsetting the DC voltages. For example, if the crystal is removed, it will be found that the rules will apply. The same practical rules do not apply in the presence of an AGC voltage. In this instance, the bias at the base is deliberately changed with respect to the emitter in order to obtain control of the gain. The rule does not apply in a class B stage except with signal. In this instance, there is virtually no voltage applied to the base and the "diode" is barely forward biased.

If the transistor is an NPN, the voltage at the base will be positive with respect to the emitter. If the transistor is a PNP, the reverse will be true.

5.6 THE FIELD EFFECT TRANSISTOR

The field effect transistor is similar in many ways to a vacuum tube and many of the vacuum tube principles may be applied. The field effect transistor used in the SC130D(E) are N channel and, as they draw current in the absence of a gate voltage, they are known as the depletion type. The "enchantment" type of field effect transistor does not conduct until a bias voltage is applied to the gate.

5.6 cont'd Most tubes will draw current when operated without bias and therefore may be compared to the depletion field effect transistors. In the case of the field effect transistors used in the SC130D(E), bias is obtained by connecting a resistor in the source lead. This is equivalent to the vacuum tube cathode resistor. By measuring the voltage across the drain resistor and using ohms law, it is possible to calculate the drain current. However, it is not as practical to find the original design voltage and in fault isolation procedures it is necessary to refer to the voltage charts before making the measurement.

Generally, when using N channel field effect transistors, the source may be expected to be positive with respect to ground. In the case of field effect oscillators or in the presence of automatic gain control voltages, the gate may have a negative value.

5.7 THE INTEGRATED CIRCUIT

Integrated circuits are complex devices usually containing many diodes and transistors. Transistors may be field effect or bipolar and sometimes both types are used in one chip. In addition, integrated circuits often contain resistors. There is no practical method of fault isolation for an integrated circuit and it is therefore most usual to give all the voltages to be expected at the various pins.

It should be realized that the presence of a signal may change the static DC reading. The application of a test probe may also cause an incorrect reading.

5.7 cont'd CMOS devices should be handled with care. Be particularly careful that the body of the soldering iron is grounded.

CAUTION

TRANSISTORS IN GENERAL, AND FIELD EFFECT TRANSISTORS IN PARTICULAR, ARE READILY DESTROYED BY THE NON-PRUDENT APPLICATION OF METER LEADS. THE RESISTANCE OF THE METER IS OFTEN SUFFICIENTLY LOW TO CONDUCT A SUBSTANTIAL CURRENT TO THE TRANSISTOR ELEMENT, A CURRENT WHICH IS OFTEN SUFFICIENT TO DESTROY THE TRANSISTOR. THE INSULATED GATE TYPE FIELD EFFECT TRANSISTOR, AS USED IN CMOS INTEGRATED CIRCUITS, IS READILY DESTROYED BY STATIC ELECTRICITY INDUCED IN HANDLING THE COMPONENT. ALWAYS TOUCH THE CHASSIS FIRST BEFORE TOUCHING THESE DEVICES. A HIGH RESISTANCE VTVM SHOULD ALWAYS BE USED FOR THE SERVICING OF SOLID STATE CIRCUITRY.

5.8 TYPICAL SYMPTOMS & PROBABLE FAULTS

The following is offered only as a guide to the most probable cause of component failure.

5.9 LOW RECEIVER SENSITIVITY

a. Q101, Q102 or Q103 defective. Signal to noise will be seriously impaired if Q101 is defective. (Q102 or Q103 will affect one sideband only.)

b. Low local oscillator and beat frequency oscillator injection voltage.

c. Defective components in electronic DPDT switch assembly causing low oscillator voltage or incorrect switching of oscillators.

5.9 cont'd

d. Diode CR101 open circuit.

e. Open circuit inductor in front end low-pass filter L101-L110.

f. Shorted turns in L113 or L120 loading mixer heavily.

g. Relay K401 points not properly contacting.

h. Defective IF transformer L115 and L118.

i. Defective Q116.

j. Short circuit on input of one crystal filter FL101 or FL102. (The defective filter will load transformer L116.)

5.10 LOW RECEIVER SENSITIVITY, ONE SIDEBAND ONLY

a. Defective crystal filter FL101 or FL102.

b. Defective Q102 or Q103.

5.11 LOW RECEIVER AUDIO OUTPUT (RF SENSITIVITY SATISFACTORY)

a. Q117 defective.

b. Speaker defective. (Handset satisfactory.)

c. Speaker switch SW5 defective. (Handset satisfactory.)

d. Defective gain control, P1.

5.12 AGC SYSTEM, RECEIVE MODE

a. Low receiver sensitivity (see paragraph 5.9).

b. Defective AGC amplifiers Q116.

c. Defective IF amplifier Q102 or Q103.

5.13 BALANCED MODULATOR NOT BALANCING, TRANSMIT MODE

a. Defective diodes.

b. Defective potentiometer P101.

c. Defective capacitor C119.

5.14 LOW TRANSMITTER POWER OUTPUT, SSB MODE

a. As in paragraph 5.9, a, b, c, f, g, h and j.

b. As in paragraph 5.10; a and b.

c. Defective mixer diode.

d. Defective Q104, Q105, Q106, Q107, Q108, Q401, Q402, Q403, Q404 or Q405.

e. Defective inductors L122, L126 or L127.

f. Shorted ALC adjust capacitor C436.

5.15 LOW TRANSMITTER POWER OUTPUT, CW MODE

a. As in paragraph 5.14; a, b, c, d, e and f.

b. Defective Q110 or Q109.

c. Defective potentiometer P106.

5.16 LOW TRANSMITTER POWER OUTPUT, AM AND TUNE MODES

a. As in paragraph 5.9; b, c, f and g.

b. Defective Q104, Q120, Q401, Q402, Q403, Q404 or Q405.

c. Defective potentiometer P108.

5.17 CARRIER PRESENT, SSB TRANSMIT MODE

a. Defective carrier switch transistor Q120.

b. Defective balanced modulator component.

c. Carrier balance controls C119, P101 out of adjustment.

d. Leaky capacitor C172.

5.18 ANTENNA BRIDGE

a. No reflected power indication. Defective meter, CR407, L409 or C431.

b. No forward power indication. Defective meter or CR406.

5.19 TRANSMITTER BIAS

Bias will not adjust; defective diode CR401, CR402, transistor Q406 or potentiometer P401, or transmitter drive applied to final amplifiers.

5.20 CHANNEL FREQUENCY CONTROLS NOT GIVING CORRECT READING CHANGE PER STEP

This effect may only be noticeable on as few as two positions on any of the four frequency controls.

EXAMPLE: MHz switch may give 5 MHz output on both 5 and 6 MHz reading. Therefore, if this effect occurs on:

a. MHz range, check Q206 or Q213.

b. KHz x 100 range, check Q205.

c. KHz x 10 range, check Q203.

d. KHz x 1 range, check Q201, Q202, Q208, Q209, Q210 or Q211.

These causes are not necessarily the only reasons for the malfunction mentioned, especially in the case of the KHz x 1 position. In this position, Q201, Q202, Q208, Q209, Q210, Q211, CR201, CR202 or L201 may be in the chain.

5.21 SYNTHESIZER OUTPUT FREQUENCY ERRATIC

Any defect which causes an unstable frequency output will cause the synthesizer muting switch FET Q304 to open preventing synthesizer output to the transceiver. This facility is deliberate in order to prevent transmission when the synthesizer is changing frequency. Thus a defect

5.21 cont'd which causes unintended quick changes in frequency will cause the gate to oscillate open and shut quite rapidly. Quite often a popping sound will be heard in the receiver. Possible causes of above are:

a. RF feedback from transmitter into synthesizer possibly due to broken coaxial cable grounds.

b. Faulty variable capacitance diode CR301 or erratic control voltages thereto.

c. Faulty components Q305, Q306, Q307, C303, C320, C321, C322 or C323 causing erratic control voltage to CR301.

d. Defective oscillator Q301 or its associated components.

5.22 EXCESSIVE 1000 HZ TONE ON VCO OUTPUT (NOTICEABLE ON ALL CHANNELS)

Excessive 1000 Hz tone on the VCO output may be caused by any component which allows leakage of variable capacitance diode CR301 control voltage to ground: CR301 itself, C303, C320, C321, C322 or C323. Leakage may be caused by excessive moisture in the area of these components.

NOTE

PC boards are sprayed against the collection of moisture with "Humi-Seal" type 1B15, (Southcom part number 07001000 or equivalent). The area should be resprayed after repair.

SECTION VI

Parts List

PARTS LIST

6.1 INTRODUCTION

This section contains a complete listing of all replaceable components (electrical and mechanical) which comprise the five (5) printed circuit boards and the chassis assembly.

6.2 PARTS LIST

Tables 6.1 through 6.6 list all components used in the following assemblies:

a. Circuit Board PC101 P/N 99190100

b. Circuit Board PC201 P/N 99132100

c. Circuit Board PC301 P/N 99190200

d. Circuit Board PC401 P/N 99138100

e. Circuit Board PC501 P/N 99135900

f. Front Panel/Chassis Assembly

Information provided in the Parts List includes a reference designator for each component (whenever applicable), the part number and the name and description of each item.

TABLE 6.1

PC101, P/N 99190100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
C101	13513200	Capacitor, DM19, 1300 pfd, 500V
C102	13512200	Capacitor, DM19, 1200 pfd, 500V
C103	13513200	Capacitor, DM19, 1300 pfd, 500V
C104	12516100	Capacitor, DM15, 160 pfd, 500V
C105	12516100	Capacitor, DM15, 160 pfd, 500V
C106	12547100	Capacitor, DM15, 470 pfd, 300V
C107	12562100	Capacitor, DM15, 620 pfd, 300V
C108	12568100	Capacitor, DM15, 680 pfd, 300V
C109	12562100	Capacitor, DM15, 620 pfd, 300V
C110	12547100	Capacitor, DM15, 470 pfd, 300V
C113	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C114	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C115	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C116	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C117	12527000	Capacitor, DM15, 27 pfd, 500V
C118	12510100	Capacitor, DM15, 100 pfd, 500V
C119	16216000	Capacitor, Variable, Teflon, 3.5-60 pfd
C120	12518100	Capacitor, DM15, 180 pfd, 500V
C121	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C122	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C123	12518100	Capacitor, DM15, 180 pfd, 500V
C124	12510200	Capacitor, DM15, 1000 pfd, 100V
C125	12510000	Capacitor, DM15, 10 pfd, 500V
C126	15311500	Capacitor, Tantalum, 15 mfd, 20V
C127	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C128	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C130	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C131	15311500	Capacitor, Tantalum, 15 mfd, 20V
C132	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C133	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C134	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C135	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C136	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C137	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C138	12515100	Capacitor, DM15, 150 pfd, 500V
C139	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C140	15311500	Capacitor, Tantalum, 15 mfd, 20V
C141	15212200	Capacitor, Tantalum, 22 mfd, 15V
C142	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C143	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C144	12520000	Capacitor, DM15, 20 pfd, 500V
C145	16216000	Capacitor, Variable, Teflon, 3.5-60 pfd
C146	12510100	Capacitor, DM15, 100 pfd, 500V
C147	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V

TABLE 6.1 (Continued)

PC101, P/N 99190100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
C148	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C149	12527000	Capacitor, DM15, 27 pfd, 500V
C150	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C151	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C152	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C154	12513100	Capacitor, DM15, 130 pfd, 500V
C155	12516100	Capacitor, DM15, 160 pfd, 500V
C156	12533100	Capacitor, DM15, 330 pfd, 300V
C157	12527100	Capacitor, DM15, 270 pfd, 500V
C158	12536100	Capacitor, DM15, 360 pfd, 300V
C159	12515100	Capacitor, DM15, 150 pfd, 500V
C160	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C161	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C162	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C163	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C164	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C165	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C168	11101000	Capacitor, Disc., Ceramic, .01 mfd, 100V
C169	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C171	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C172	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C173	15311500	Capacitor, Tantalum, 15 mfd, 20V
C174	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C175	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C176	15114700	Capacitor, Tantalum, 47 mfd, 6V
C178	15311500	Capacitor, Tantalum, 15 mfd, 20V
C180	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C181	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C182	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C183	15311500	Capacitor, Tantalum, 15 mfd, 20V
C184	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C185	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C186	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C187	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C189	18100000	Capacitor, Foil, .22 mfd, 250W VDC
C190	15222100	Capacitor, Tantalum, 1 mfd, 25V
C191	15311500	Capacitor, Tantalum, 15 mfd, 20V
C192	15311500	Capacitor, Tantalum, 15 mfd, 20V
C193	11100100	Capacitor, Disc., Ceramic, .001 mfd, 100V
C194	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C195	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C196	15311500	Capacitor, Tantalum, 15 mfd, 20V
C197	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C198	15310200	Capacitor, Tantalum, 2.2 mfd, 20V

TABLE 6.1 (Continued)

PC101, P/N 99190100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
C199	15311500	Capacitor, Tantalum, 15 mfd, 20V
C1000	15311500	Capacitor, Tantalum, 15 mfd, 20V
C1001	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C1002	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1003	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1004	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C1005	14211000	Capacitor, Electrolytic, 1000 mfd, 25V
C1008	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1009	15311500	Capacitor, Tantalum, 15 mfd, 20V
C1010	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C1011	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1012	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C1013	14222500	Capacitor, Electrolytic, 250 mfd, 16V
C1014	15311500	Capacitor, Tantalum, 15 mfd, 20V
C1016	12539000	Capacitor, DM15, 39 pfd, 500V
C1017	16216000	Capacitor, Variable, Teflon, 3.5-60 pfd
C1018	12510100	Capacitor, DM15, 100 pfd, 500V
C1019	12510100	Capacitor, DM15, 100 pfd, 500V
C1020	14247102	Capacitor, Electrolytic, 470 mfd, 16V
C1021	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1022	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1024	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1025	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1026	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1027	12524100	Capacitor, DM15, 240 pfd, 500V
C1028	12524100	Capacitor, DM15, 240 pfd, 500V
C1029	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C1031	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
CR101	41000200	Diode, Silicon, BA182
CR102	43001200	Diode, Zener, 1N4735, 6V 1W
CR103	41000300	Diode, Silicon, 1N4148
CR104	41000300	Diode, Silicon, 1N4148
CR105	41000300	Diode, Silicon, 1N4148
CR106	41000300	Diode, Silicon, 1N4148
CR107	41000300	Diode, Silicon, 1N4148
CR108	41000300	Diode, Silicon, 1N4148
CR109	41000200	Diode, Silicon, BA182
CR110	41000200	Diode, Silicon, BA182
CR111	41000300	Diode, Silicon, 1N4148
CR112	41000300	Diode, Silicon, 1N4148
CR113	41000300	Diode, Silicon, 1N4148
CR114	41000300	Diode, Silicon, 1N4184
CR115	41000300	Diode, Silicon, 1N4148
CR116	41000300	Diode, Silicon, 1N4148

TABLE 6.1 (Continued)

PC101, P/N 99190100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
CR117	41002000	Diode Array, Mixer
CR118	41002000	Diode Array, Mixer
CR119	41002000	Diode Array, Mixer
CR120	41002000	Diode Array, Mixer
CR121	41000300	Diode, Silicon, 1N4148
CR122	41000300	Diode, Silicon, 1N4148
CR123	41000300	Diode, Silicon, 1N4148
CR124	41000300	Diode, Silicon, 1N4148
CR125	41000300	Diode, Silicon, 1N4148
CR126	41000300	Diode, Silicon, 1N4148
CR127	41000300	Diode, Silicon, 1N4148
CR128	41000300	Diode, Silicon, 1N4148
FL101	95233600	Filter, Crystal, LSB, BLE, 12.7 MHz
FL102	95233700	Filter, Crystal, USB, BUE, 12.7 MHz
L101	34001600	Inductor, RF Choke, 2.2 Micro H, Molded
L102	34001500	Inductor, RF Choke, 1.8 Micro H, Molded
L103	34001500	Inductor, RF Choke, 1.8 Micro H, Molded
L104	34001600	Inductor, RF Choke, 2.2 Micro H, Molded
L105	33131500	Inductor, IF
L106	33131500	Inductor, IF
L107	34001700	Inductor, RF Choke, .33 Micro H, Molded
L108	34001800	Inductor, RF Choke, .82 Micro H, Molded
L109	34001800	Inductor, RF Choke, .82 Micro H, Molded
L110	34001800	Inductor, RF Choke, .82 Micro H, Molded
L111	31219300	Inductor, Toroid Xfmr
L112	31219300	Inductor, Toroid Xfmr
L113	34000700	Inductor, RF Choke, 200 Micro H, Molded
L114	34000500	Inductor, RF Choke, 30 Micro H, Molded
L115	33131500	Inductor, IF
L116	31215200	Inductor, Toroid Xfmr
L117	34000500	Inductor, RF Choke, 30 Micro H, Molded
L118	33131500	Inductor, IF
L120	34000700	Inductor, RF Choke, 200 Micro H, Molded
L121	34000500	Inductor, RF Choke, 30 Micro H, Molded
L122	33131500	Inductor, IF
L123	31219300	Inductor, Toroid Xfmr
L124	31219300	Inductor, Toroid Xfmr
L126	31219100	Inductor, Toroid
L127	31219000	Inductor, Toroid
L128	31215500	Inductor, Toroid Xfmr
L129	34000500	Inductor, RF Choke, 30 Micro H, Molded
L131	35900000	Inductor, 100 Mil H, Cambion Cone
L132	34000700	Inductor, RF Choke, 200 Micro H. Molded
L133	34000500	Inductor, RF Choke, 30 Micro H, Molded

TABLE 6.1 (Continued)

PC101, P/N 99190100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
L134	34001400	Inductor, RF Choke, 1 Micro H, Molded
P101	27001000	Potentiometer, 100 ohm, Lin., Mini.
P102	27001900	Potentiometer, 500 ohm, Lin., Mini.
P104	27001000	Potentiometer, 100 ohm, Lin., Mini.
P105	27001100	Potentiometer, 10K ohm, Lin., Mini.
P106	27001100	Potentiometer, 10K ohm, Lin., Mini.
P107	27001100	Potentiometer, 10K ohm, Lin., Mini.
P108	27001100	Potentiometer, 10K ohm, Lin., Mini.
P109	27001900	Potentiometer, 500 ohm, Lin., Mini.
Q101	44001600	Transistor, Silicon, NPN, 2N3866
Q102	46000700	IC, MC1350P, IF Amp
Q103	46000700	IC, MC1350P, IF Amp
Q104	44000800	Transistor, Silicon, NPN, MPS6514
Q105	44000800	Transistor, Silicon, NPN, MPS6514
Q106	44000800	Transistor, Silicon, NPN, MPS6514
Q107	44000800	Transistor, Silicon, NPN, MPS6514
Q108	44000800	Transistor, Silicon, NPN, MPS6514
Q109	45001500	Transistor, J309
Q110	46001100	IC, CA3086
Q111	45001500	Transistor, J309
Q112	45001500	Transistor, J309
Q113	45001500	Transistor, J309
Q114	45001500	Transistor, J309
Q115	44000400	Transistor, Silicon, NPN, 2N3567
Q116	46001100	IC, CA3086
Q117	46007000	IC, ULN 2281B/ULN 3784B
Q118	44000800	Transistor, Silicon, NPN, MPS6514
Q119	44000800	Transistor, Silicon, NPN, MPS6514
Q120	45001500	Transistor, J309
R101	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
R102	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
R104	21547200	Resistor, Carbon, 4.7K ohm, 5%, 1/4W
R105	21527200	Resistor, Carbon, 2.7K ohm, 5%, 1/4W
R106	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R107	21510100	Resistor, Carbon, 100 ohm, 5%, 1/4W
R108	21510000	Resistor, Carbon, 10 ohm, 5%, 1/4W
R109	21527100	Resistor, Carbon, 270 ohm, 5%, 1/4W
R110	21527100	Resistor, Carbon, 270 ohm, 5%, 1/4W
R111	21510000	Resistor, Carbon, 10 ohm, 5%, 1/4W
R112	21510000	Resistor, Carbon, 10 ohm, 5%, 1/4W
R114	21582200	Resistor, Carbon, 8.2K ohm, 5%, 1/4W
R115	21582200	Resistor, Carbon, 8.2K ohm, 5%, 1/4W
R117	21539200	Resistor, Carbon, 3.9K ohm, 5%, 1/4W
R118	21539200	Resistor, Carbon, 3.9K ohm, 5%, 1/4W

TABLE 6.1 (Continued)

PC101, P/N 99190100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
R119	21510100	Resistor, Carbon, 100 ohm, 5%, 1/4W
R120	21510100	Resistor, Carbon, 100 ohm, 5%, 1/4W
R121	21510100	Resistor, Carbon, 100 ohm, 5%, 1/4W
R122	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
R123	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
R124	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
R125	21522100	Resistor, Carbon, 220 ohm, 5%, 1/4W
R126	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R127	21510100	Resistor, Carbon, 100 ohm, 5%, 1/4W
R128	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R129	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R130	21539300	Resistor, Carbon, 39K ohm, 5%, 1/4W
R131	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R132	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R135	21568100	Resistor, Carbon, 680 ohm, 5%, 1/4W
R136	21510400	Resistor, Carbon, 100K ohm, 5%, 1/4W
R137	21547200	Resistor, Carbon, 4.7K ohm, 5%, 1/4W
R138	21510400	Resistor, Carbon, 100K ohm, 5%, 1/4W
R139	21547300	Resistor, Carbon, 47K ohm, 5%, 1/4W
R141	21527200	Resistor, Carbon, 2.7K ohm, 5%, 1/4W
R142	21522400	Resistor, Carbon, 220K ohm, 5%, 1/4W
R143	21510100	Resistor, Carbon, 100 ohm, 5%, 1/4W
R144	21547200	Resistor, Carbon, 4.7K ohm, 5%, 1/4W
R145	21510400	Resistor, Carbon, 100K ohm, 5%, 1/4W
R147	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R148	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R149	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R150	21527300	Resistor, Carbon, 27K ohm, 5%, 1/4W
R151	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R152	21547300	Resistor, Carbon, 47K ohm, 5%, 1/4W
R153	21556100	Resistor, Carbon, 560 ohm, 5%, 1/4W
R154	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R156	21527200	Resistor, Carbon, 2.7K ohm, 5%, 1/4W
R160	21527200	Resistor, Carbon, 2.7K ohm, 5%, 1/4W
R161	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R162	21510000	Resistor, Carbon, 10 ohm, 5%, 1/4W
R163	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R164	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R165	21556200	Resistor, Carbon, 5.6K ohm, 5%, 1/4W
R166	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R167	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R168	21556200	Resistor, Carbon, 5.6K ohm, 5%, 1/4W
R169	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R170	21527200	Resistor, Carbon, 2.7K ohm, 5%, 1/4W

TABLE 6.1 (Continued)

PC101, P/N 99190100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
R171	21556100	Resistor, Carbon, 560 ohm, 5%, 1/4W
R172	21533300	Resistor, Carbon, 33K ohm, 5%, 1/4W
R173	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R174	21501000	Resistor, Carbon, 1 ohm, 5%, 1/4W
R175	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R176	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R177	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R178	21510500	Resistor, Carbon, 1 meg ohm, 5%, 1/4W
R179	21556200	Resistor, Carbon, 5.6K ohm, 5%, 1/4W
R180	21568000	Resistor, Carbon, 68 ohm, 5%, 1/4W
R181	21539200	Resistor, Carbon, 3.9K ohm, 5%, 1/4W
R182	21510400	Resistor, Carbon, 100K ohm, 5%, 1/4W
R183	21568300	Resistor, Carbon, 68K ohm, 5%, 1/4W
R184	21568200	Resistor, Carbon, 6.8K ohm, 5%, 1/4W
R185	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R188	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R189	- - - -	Resistor, Carbon, Test Select
R190	21568300	Resistor, Carbon, 68K ohm, 5%, 1/4W
R191	21527300	Resistor, Carbon, 27K ohm, 5%, 1/4W
R192	21568100	Resistor, Carbon, 680 ohm, 5%, 1/4W
R193	21510400	Resistor, Carbon, 100K ohm, 5%, 1/4W
R194	21568300	Resistor, Carbon, 68K ohm, 5%, 1/4W
R195	21547200	Resistor, Carbon, 4.7K ohm, 5%, 1/4W
R196	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R197	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R198	21539100	Resistor, Carbon, 390 ohm, 5%, 1/4W
R199	21515100	Resistor, Carbon, 150 ohm, 5%, 1/4W
R1001	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R1002	21522200	Resistor, Carbon, 2.2K ohm, 5%, 1/4W
Y101	* 95151100	Crystal, Quartz, 12.700 MHz
	81430200	Socket, Crystal
	37002400	Bead, Ferrite
	61001500	Pin, Male, Amp
	81140800	Nut, Hex, 4-40 x 1/4
	81203600	Washer, Interlock, #4, Cres
	82182000	Shield
	82188000	Spring, Ground

* Part of 95151200, Matched Set

NOTE: CRYSTALS MUST REMAIN IN MATCHED SETS WHEN REPLACEMENT IS NEEDED.

TABLE 6.2

PC201 P/N 99132100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
C201	15311500	Capacitor, Tantalum, 15 mfd, 20V
C202	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C203	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C204	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C205	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C206	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C207	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C208	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C209	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C210	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C211	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C212	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C213	15311500	Capacitor, Tantalum, 15 mfd, 20V
C214	15311500	Capacitor, Tantalum, 15 mfd, 20V
CR201	41000400	Diode, Hot Carrier, HP5082-2800
CR202	41000300	Diode, Silicon, 1N4148
L201	31217500	Inductor, Toroid Xfmr
L202	34000500	Inductor, RF Choke, 30 Micro H, Molded
L203	34000500	Inductor, RF Choke, 30 Micro H, Molded
PL201	61002101	Connector, Straight Header, 30 Pin
Q201	46002200	IC, HD4001-9 CMOS
Q202	46001200	IC, CD4018
Q203	46001200	IC, CD4018
Q204	46001300	IC, CD4013
Q205	46001200	IC, CD4018
Q206	46001200	IC, CD4018
Q207	46002700	IC, SN74LS00
Q208	46002700	IC, SN74LS00
Q209	46001800	IC, SN7474
Q210	46001800	IC, SN7474
Q211	46002300	IC, CD4049
Q212	46001600	IC, CD4012
Q213	46001300	IC, CD4013
R201	21522200	Resistor, Carbon, 2.2K ohm, 5%, 1/4W
R202	21527300	Resistor, Carbon, 27K ohm, 5%, 1/4W
R203	21527300	Resistor, Carbon, 27K ohm, 5%, 1/4W
R204	20000100	Resistor, Pack, 68K ohm, 5%, 1/8W
R205	20000100	Resistor, Pack, 68K ohm, 5%, 1/8W
R224	21547200	Resistor, Carbon, 4.7K ohm, 5%, 1/4W
R225	21522100	Resistor, Carbon, 220 ohm, 5%, 1/4W
	61001500	Pin, Male, Amp

TABLE 6.3

PC301, P/N 99190200

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
C301	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C302	15114700	Capacitor, Tantalum, 47 mfd, 6V
C303	12510200	Capacitor, DM15, 1000 pfd, 100V
C304	12510100	Capacitor, DM15, 100 pfd, 500V
C307	15114700	Capacitor, Tantalum, 47 mfd, 6V
C311	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C312	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C313	15311500	Capacitor, Tantalum, 15 mfd, 20V
C314	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C315	15311500	Capacitor, Tantalum, 15 mfd, 20V
C316	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C317	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C318	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C319	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C320	18200500	Capacitor, Mylar, .047 mfd, 100V
C321	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C322	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C323	18200500	Capacitor, Mylar, .047 mfd, 100V
C324	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C325	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C326	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C327	15311500	Capacitor, Tantalum, 15 mfd, 20V
C330	15311500	Capacitor, Tantalum, 15 mfd, 20V
C331	12527000	Capacitor, DM15, 27 pfd, 500V
C332	16216000	Capacitor, Variable, Teflon, 3.5-60 pfd
C333	12510000	Capacitor, DM15, 10 pfd, 500V
C334	16216000	Capacitor, Variable, Teflon, 3.5-60 pfd
C335	12510200	Capacitor, DM15, 1000 pfd, 100V
C336	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C337	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C338	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C339	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C340	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C341	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C342	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C343	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
CR301	42001100	Diode, Silicon, Varactor, Select
CR302	41000300	Diode, Silicon, 1N4148
CR303	41000300	Diode, Silicon, 1N4148
CR304	41000300	Diode, Silicon, 1N4148
CR305	41000300	Diode, Silicon, 1N4148
CR307	41000300	Diode, Silicon, 1N4148
CR308	41000300	Diode, Silicon, 1N4148
CR309	41000300	Diode, Silicon, 1N4148

TABLE 6.3 (Continued)

PC301, P/N 99190200

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
CR310	42001000	Diode, Silicon, Varactor, MV1404
K302	73000300	Relay, Reed, SPDT
L301	33131900	Inductor, Shielded, VCO
L302	31219200	Inductor, Toroid Xfmr
L303	31219200	Inductor, Toroid Xfmr
L304	34000600	Inductor, RF Choke, 1 Mil H, Molded
L305	34000600	Inductor, RF Choke, 1 Mil H, Molded
L306	34000600	Inductor, RF Choke, 1 Mil H, Molded
Q301	46001100	IC, CA3086
Q302	46001100	IC, CA3086
Q303	44000800	Transistor, Silicon, NPN, MPS6514
Q304	45000700	Transistor, FET, Siliconix E111
Q305	46001400	IC, CD4046AE
Q306	46001700	IC, CD4020
Q307	46001500	IC, CD4001B
Q308	46002800	IC, UA7805
Q309	46002900	IC, UA7808
R301	21522200	Resistor, Carbon, 2.2K ohm, 5%, 1/4W
R302	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R304	21568100	Resistor, Carbon, 680 ohm, 5%, 1/4W
R306	21527300	Resistor, Carbon, 27K ohm, 5%, 1/4W
R307	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R309	21539100	Resistor, Carbon, 390 ohm, 5%, 1/4W
R310	21522200	Resistor, Carbon, 2.2K ohm, 5%, 1/4W
R311	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R315	21547300	Resistor, Carbon, 47K ohm, 5%, 1/4W
R317	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R318	21568300	Resistor, Carbon, 68K ohm, 5%, 1/4W
R319	21539100	Resistor, Carbon, 390 ohm, 5%, 1/4W
R320	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R321	21515300	Resistor, Carbon, 15K ohm, 5%, 1/4W
R322	21527000	Resistor, Carbon, 27 ohm, 5%, 1/4W
R325	21515400	Resistor, Carbon, 150K ohm, 5%, 1/4W
R326	21510300	Resistor, Carbon, 10K ohm, 5%, 1/4W
R327	21515400	Resistor, Carbon, 150K ohm, 5%, 1/4W
R328	21556200	Resistor, Carbon, 5.6K ohm, 5%, 1/4W
R329	21510100	Resistor, Carbon, 100 ohm, 5%, 1/4W
R330	21510400	Resistor, Carbon, 100K ohm, 5%, 1/4W
R331	21568400	Resistor, Carbon, 680K ohm, 5%, 1/4W
R332	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R335	21568400	Resistor, Carbon, 680K ohm, 5%, 1/4W
R336	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R337	21510400	Resistor, Carbon, 100K ohm, 5%, 1/4W
R338	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W

TABLE 6.3 (Continued)

PC301, P/N 99190200

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
R339	21533200	Resistor, Carbon, 3.3K ohm, 5%, 1/4W
Y301	* 95151000	Crystal, Quartz, 1024.00 KHz
	81430200	Socket, Crystal
	61001500	Pin, Male, Amp
	61002201	Connector, 14 Pin Header, Straight
	81052300	Screw, PH, PHL 4-40 x 1/4, Cres
	81052200	Screw, PH, PHL 4-40 x 5/16, Cres
	81140700	Nut, Hex, 4-40 x 3/16, Cres
	81203600	Washer, Interlock, #4, Cres
	81210400	Washer, Fiber, #4

* Part of 95151200, Matched Set

NOTE: CRYSTALS MUST REMAIN IN MATCHED SETS WHEN REPLACEMENT IS NEEDED.

TABLE 6.4

PC401, P/N 99138100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
C402	14211000	Capacitor, Electrolytic, 1000 mfd, 25V
C403	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C404	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C405	12510200	Capacitor, DM15, 1000 pfd, 100V
C406	11105000	Capacitor, Disc., Ceramic, .05 mfd, 50V
C407	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C408	12510200	Capacitor, DM15, 1000 pfd, 100V
C409	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C410	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C411	15310200	Capacitor, Tantalum, 2.2 mfd, 20V
C412	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C413	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C414	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C415	13515200	Capacitor, DM19, 1500 pfd, 500V
C416	13522200	Capacitor, DM19, 2200 pfd, 500V
C417	12515100	Capacitor, DM15, 150 pfd, 500V
C418	13515200	Capacitor, DM19, 1500 pfd, 500V
C419	12510200	Capacitor, DM15, 1000 pfd, 100V
C420	13515200	Capacitor, DM19, 1500 pfd, 500V
C421	12510200	Capacitor, DM15, 1000 pfd, 100V
C422	12562100	Capacitor, DM15, 620 pfd, 300V
C423	12510200	Capacitor, DM15, 1000 pfd, 100V
C424	12562100	Capacitor, DM15, 620 pfd, 300V
C425	12527100	Capacitor, DM15, 270 pfd, 500V
C426	12536100	Capacitor, DM15, 360 pfd, 300V
C427	12515100	Capacitor, DM15, 150 pfd, 500V
C428	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C429	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C431	16211800	Capacitor, Variable, Teflon, 18 pfd
C432	12510100	Capacitor, DM15, 100 pfd, 500V
C433	12550100	Capacitor, DM15, 500 pfd, 300V
C434	11101000	Capacitor, Disc., Ceramic, .01 mfd, 50V
C435	11110100	Capacitor, Disc., Ceramic, .1 mfd, 100V
C436	16216000	Capacitor, Variable, Teflon, 3.5-60 pfd
C437	12515100	Capacitor, DM15, 150 pf, 500V
C438	12510100	Capacitor, DM15, 100 pfd, 500V
C439	12513100	Capacitor, DM15, 130 pfd, 500V
C440	12533100	Capacitor, DM15, 330 pfd, 300V
C441	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C442	14224000	Capacitor, Electrolytic, 470 mfd, 25V
CR401	42000800	Didoe, Silicon, S2M, 200V PIV
CR402	42000800	Diode, Silicon, S2M, 200V PIV
CR403	41999800	Diode, Silicon, SI05, 50V PIV
CR404	41999800	Diode, Silicon, SI05, 50V PIV

TABLE 6.4 (Continued

PC401, P/N 99138100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
CR406	41000100	Diode, Germanium, 1N541
CR407	41000100	Diode, Germanium, 1N541
CR408	41000300	Diode, Silicon, 1N4148
CR409	41000300	Diode, Silicon, 1N4148
CR410	41000300	Diode, Silicon, 1N4148
K401	73000700	Relay, 4 PDT, 12V, 450 ohm
L401	31215500	Inductor, Toroid Xfmr
L403	34136000	Inductor, RF Choke
L404	31217700	Inductor, Toroid Xfmr
L405	31217600	Inductor, Toroid Xfmr
L406	34000400	Inductor, RF Choke
L407	34000700	Inductor, RF Choke, 200 Mirco H, Molded
L408	31208800	Inductor, Toroid Xfmr
L409	34000000	Inductor, RF Choke, 2.5 Mil H, PI Wound
L410	31209800	Inductor, Toroid, 3.15 UH
L411	31209800	Inductor, Toroid, 3.15 UH
L412	31209900	Inductor, Toroid, 1.90 UH
L413	31209900	Inductor, Toroid, 1.90 UH
L414	31210000	Inductor, Toroid, 1.4 UH
L415	31210000	Inductor, Toroid, 1.4 UH
L416	31219100	Inductor, Toroid
L417	31219000	Inductor, Toroid
L418	34136000	Inductor, RF Choke
L419	34000700	Inductor, RF Choke, 200 Micro H, Molded
P401	27001100	Potentiometer, 10K, Lin. Mini.
P402	26002200	Potentiometer, 50K
Q401	44000800	Transistor, Silicon, NPN, MPS6514
Q402	44000400	Transistor, Silicon, NPN, 2N3567
Q403	44000500	Transistor, Silicon, NPN, Selected 2N3866
Q404	44005400	Transistor, Silicon, Matched Pair
Q405	44005400	Transistor, Silicon, Matched Pair
Q406	44000200	Transistor, Silicon, NPN, 2N5490
R401	21522100	Resistor, Carbon, 220 ohm, 5%, 1/4W
R402	21510200	Resistor, Carbon, 1K ohm, 5%, 1/4W
R403	21518200	Resistor, Carbon, 1.8K ohm, 5%, 1/4W
R404	21518100	Resistor, Carbon, 180 ohm, 5%, 1/4W
R405	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
R406	21510000	Resistor, Carbon, 10 ohm, 5%, 1/4W
R407	21527000	Resistor, Carbon, 27 ohm, 5%, 1/4W
R408	21527100	Resistor, Carbon, 270 ohm, 5%, 1/4W
R409	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R410	21518200	Resistor, Carbon, 1.8K ohm, 5%, 1/4W
R411	21510100	Resistor, Carbon, 100 ohm, 5%, 1/4W
R412	22547000	Resistor, Carbon, 47 ohm, 5%, 1/2W

TABLE 6.4 (Continued)

PC401, P/N 99138100

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
R413	21510000	Resistor, Carbon, 10 ohm, 5%, 1/4W
R414	21533000	Resistor, Carbon, 33 ohm, 5%, 1/4W
R415	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R416	21520200	Resistor, Carbon, 2K ohm, 5%, 1/4W
R417	21510000	Resistor, Carbon, 10 ohm, 5%, 1/4W
R418	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
R419	23510000	Resistor, Carbon, 10 ohm, 5%, 1W
R421	22568100	Resistor, Carbon, 680 ohm, 5%, 1/2W
R422	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R423	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
R424	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
R425	21547100	Resistor, Carbon, 470 ohm, 5%, 1/4W
R426	24515100	Resistor, Carbon, 150 ohm, 5%, 2W
R427	21231300	Resistor, Film, 30.9K ohm, 1%, 1/4W
R428	21547000	Resistor, Carbon, 47 ohm, 5%, 1/4W
S0401	64002300	Socket, Relay, PB All-2
SW401	72002000	Switch, Rotary, 10 Pos, 3 Wafer, 36 Deg
	00008400	Mica Insulator for TO-220 Package
	61001500	Pin, Male, Amp
	62001200	Connector Pin, Female
	62005200	Connector Pin, Female, Right Angle
	81021200	Screw, Nylon, Toroid Hold-down
	81210600	Washer, Fiber, #4
	82276402	Bracket, MHz Switch
	81241800	Standoff, Hex, 6-32 x 3/4 x 1/4
	82377601	Heatsink
	81053500	Screw, PH, PHL 4-40 x 1/2, Cres
	81052200	Screw, PH, PHL 4-40 x 5/16, Cres
	81071400	Screw, PH, PHL 6-32 x 1/4, Cres
	81071900	Screw, PH, PHL 6-32 x 5/8, Cres
	81100600	Nut, Hex, 10-32 x 1/4, Cres
	81140700	Nut, Hex, 4-40 x 3/16, Cres
	81140800	Nut, Hex, 4-40 x 1/4, Cres
	81160300	Nut, Hex, 6-32 x 1/4, Cres
	81213600	Washer, Flat #6
	81203600	Washer, Interlock, #4, Cres
	81204300	Washer, Interlock, #10, Cres
	81210400	Washer, Flat, Composition, #4
	81210900	Washer, Shoulder, Fiber #6
	81211800	Washer, Interlock, #6, Cres
	81300700	Clamp, Cable
	81301100	Tie, Cable
	81611500	Lug, Locking Terminal, #10
	81630500	Post. Feedthru, Teflon, White
	82187100	Heatsink, Diode

TABLE 6.5

PC501, P/N 99135900

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
C501	11100500	Capacitor, Disc., Ceramic, .005 mfd, 100V
C502	11101000	Capacitor, Disc., Ceramic, .01 mfd, 100V
C503	11110000	Capacitor, Disc., Ceramic, .1 mfd, 25V
C504	11101000	Capacitor, Disc., Ceramic, .01 mfd, 100V
C505	11101000	Capacitor, Disc., Ceramic, .01 mfd, 100V
C506	11101000	Capacitor, Disc., Ceramic, .01 mfd, 100V
C507	15311500	Capacitor, Tantalum, 15 mfd, 20V
L501	34000700	Inductor, 200 Micro H. Molded
R501	21510200	Resistor, Comp., 1K ohm, 5%, 1/4W
S01	61003000	Connector, Panel, 5 Pin
S02	61003000	Connector, Panel, 5 Pin
	61001500	Pin, Male, Amp

TABLE 6.6

Panel/Chassis Assembly

SYMBOL	SOUTHCOM PART NUMBER	DESCRIPTION
C1	17124400	Capacitor, Variable 15-326 mfd
C2	14235000	Capacitor, Electrolytic, 1000 mfd, 16V
CR1	42001300	Diode, VSK 120
CR2	42001400	Diode, VSK 520
CR3	43002500	Diode, Zener, 1N5243B, 13V
F1	53103100	Fuse, Slo-Blo, 3 Amp, 250V
I1	52000900	Indicator Lamp, 14V
I2	52000900	Indicator Lamp, 14V
L1	32900500	Inductor, Antenna Tuner #1
L2	32900400	Inductor, Antenna Tuner #2
M1	96000100	Meter
P1/SW1	26000600	Potentiometer, 10K, SPST, 125V
P2	27001700	Potentiometer, 10K, Linear Sealed
PL1	61001901	Connector, Panel
R1	25510000	Resistor, 100 ohm, WW, 3W, 5%
S03	62001601	Connector, Chassis, 3 Pin
S04	62001501	Connector, Chassis, 3 Pin
S05	62001300	Connector, BNC, Female
SW2	72137301	Switch, Function
SW3	70002000	Switch, Push Button, DPDT
SW4*	72137501	Switch, Antenna Tuner
SW5	71000800	Switch, Toggle, SPDT
T1	82705900	Transformer, Impedance
	91000100	Speaker, 2 inch, 8 ohm
	72001900	Switch, Rotary, 10 pos, 1 Wafer, 36 Deg

*Order spare as Antenna Tuner Assembly 82702001

SECTION VII

Installation

INSTALLATION

7.1 INTRODUCTION

This section contains information relative to initial use of the SC130D(E) Transceiver and familiarization with accessories and functions. Since the transceiver is portable, no procedures for fixed installation are required.

7.2 UNPACKING

The SC130D(E) and accessories are packed in a corrugated cardboard container and are protected against damage and shock. Carefully cut the container seals and remove the transceiver from packaging. Do not damage or discard packing materials which should be retained in case the equipment is reshipped.

7.3 CHECK LIST

Check that all accessories are present and have not been discarded with the packing.

Inspect the transceiver to ensure that no damage has occurred to the transceiver or accessories. All controls should turn without binding, although it should be remembered that the waterproof glands will cause some drag when the controls are rotated.

Uncouple the six retaining clips and remove the transceiver from the outer case. Remove any interior packing that may be present. Inspect interior for damage or loose screws. It is not necessary to remove the chassis covers during

7.3 cont'd the inspection. The transceiver is replaced in the outer case. If a carrying bag is used, the transceiver should be placed in the bag and the retaining strap secured.

7.4 SERIAL NUMBER LOCATION

The serial number is located on the front of the transceiver panel. The serial number should be quoted in all correspondence with the factory.

7.5 SITE SELECTION

The location of the antenna is one of the most important factors in ensuring effective radio communications. The antenna should be located as high as possible and clear of obstructions. Forests, undergrowth, buildings, cliffs, and operating in depressions in the ground will severely restrict the range of the transceiver. SSB is the most effective means of voice communication under jungle or forest conditions; nevertheless, the range will be very restricted and every effort should be made to erect the antenna clear of vegetation for long range communications. The best location is usually on the top of a rise or on flat unobstructed terrain. Manmade power sources can cause severe interference and the antenna should always be located as far away from power lines, factories, and vehicular traffic as possible.

7.6 SELECTION OF ANTENNA

7.6.1 SC130AW Whip Antenna

The whip antenna is used for communications on the move, both on foot and in a vehicle. The whip antenna is always less efficient than either the long-wire antenna or dipole.

7.6.1 cont'd These antennas should always be used in preference to the whip antenna. The whip antenna is short in relationship to the correct antenna length, and the other antennas will radiate more efficiently even in poor installations.

7.6.2 Long-Wire Antenna

A long-wire antenna is used at fixed or portable locations where it is not practical to use the dipole antenna. The long-wire antenna may be used on any frequency in the 2-12 MHz range. In an emergency, the SC130D(E) Transceiver may be operated into almost any piece of wire that is insulated from the ground. For best results with long antennas, a good ground connection is required. Direction of maximum radiation varies with antenna length and operating frequency. For short antennas and low operating frequencies (antenna less than 1/2 wavelength long), maximum radiation will be broadside to the wire and minimum off the ends.

The dipole antenna (SC503) can be used as a long-wire antenna. One half of the dipole radiating element is disconnected from the center insulator and used as a long-wire. The second half, which may include the coaxial ground, should be connected to the ground terminal post, extended under the antenna, placed on the ground, and used as a counterpoise.

7.6.3 SC503 Dipole Antenna

The dipole antenna is the most efficient antenna normally used with the SC130D(E) Transceiver and should be used when maximum range is required. The antenna should be located so that it is broadside to the desired direction of operation. The dipole antenna length must be adjusted

7.6.3 cont'd each time the frequency is changed, and this should be remembered when multiple frequency operation is required. In base stations, several dipole antennas, each adjusted for a particular operating frequency, are often used. When the dipole antenna is used, the transceiver requires no antenna tuning or adjustment and can be operated by an unskilled operator.

7.6.4 Other Antennas

Many different antennas are used for HF communications. Under some circumstances, the use of directional arrays or special antenna systems may be desirable. Modern antennas are normally designed to operate with a 50 ohm coaxial feed line and may be connected directly to the SC130D(E) Transceiver.

7.7 INSTALLATION OF WHIP ANTENNA

The whip antenna consists of three pieces; the base section, the loading coil and the top section. The base section is first assembled by plugging the sections together. They will be held in place by the nylon cord and spring running through the center of the individual sections. The antenna loading coil is plugged into the top of the base section. The top whip section is finally fitted in place on the top of the loading coil. Connection is made by the jumper wire from the front panel antenna connector to the whip mount. For back-pack or portable operation, the whip is placed in the whip antenna mount on the right side of the transceiver case. The antenna mount will rotate with respect to the transceiver and the whip may be adjusted to the vertical position. The knob and spring on the antenna mount are used to adjust the tension on the rotating section. Do not over-tighten

7.7 cont'd as the antenna should be free to rotate if it strikes an obstruction.

The SC130D(E) may be used with any standard vehicle whip antenna or with the SC130MW mounted on any convenient part of the vehicle. The connection between the transceiver and antenna should be kept to the absolute maximum. If there is a distance of more than approximately 1 meter (3 feet) between the whip and the transceiver, it will be necessary to use a resonant whip fed with 50 ohm coaxial cable. The SC130D(E) antenna tuner cannot then be used. It is extremely important that a short low resistance ground connection is made between the transceiver and the vehicle body.

The SC130AW whip antenna loading coil is provided with a rotatable ring. This ring lifts and drops into four click stop positions which, as shown on the instruction label fitted to the loading coil, should be set to the frequency range in use.

NOTE

The SC130D(E) Transceiver will load into incorrect settings of the rotatable ring but antenna efficiency will be considerably reduced. Whenever possible, a good ground connection should be provided as this will substantially increase the radiation efficiency.

7.8 INSTALLATION OF LONG-WIRE ANTENNA

The antenna is erected as high as possible with the feeder running vertically to the transceiver. The antenna is oriented broadside to the directions where best covered

7.8 cont'd is required. A good ground system is required for best results. The ground spike is preferably buried in moist soil. A water pipe or similar connection to a buried metallic object makes an excellent ground connection. When the antenna is erected vertically, the signal is vertically polarized and provides best efficiency when communicating with stations using vertical antennas. For communications with mobile or portable using whips, the antenna should be erected as close to the vertical plane as practical.

It should always be remembered that the optimum efficiency with an end-fed antenna is achieved when the length approaches a quarter wavelength. The mobile or portable whip is a small fraction of a wavelength and for this reason, the long-wire antenna can be expected to give a much greater communications range. If satisfactory results cannot be achieved with the whip antenna, the long-wire antenna should be used even if it is only possible to erect the antenna a few feet above the ground.

7.9 INSTALLATION OF DIPOLE ANTENNA

The standard SC503 Dipole Antenna is provided with a 15 meter (50 ft) length of RG-58A/U cable that connects directly to the antenna outlet. The dipole antenna operates correctly only at the resonant frequency and should be adjusted to the correct length as shown in the antenna tuning instructions. The antenna should be erected as high as possible with coaxial feed line running at right angles to the antenna. Maximum radiation is in the broadside plane and the antenna should be erected broadside to the favored direction of operation.

7.9 cont'd The normal method of erecting a dipole antenna is to suspend it horizontally with both ends and the center as far above the ground as practical. Optimum heights range from 10 to 20 meters (30 to 60 feet). The dipole will also give excellent results when erected as an "inverted V". The center is raised as high as possible from the ground and the two ends slope down to supports 2-3 meters (6-10 feet) above ground. The "inverted V" gives excellent results when used for mobile or portable contacts, as well as for long distance communications.

7.10 GROUND SYSTEM

The long-wire and whip antennas require a ground system while the dipole antenna is balanced and a ground is not essential for efficient operation. The efficiency of the long-wire or whip is directly related to the effectiveness of the ground. If no ground connection is made, the case of the transceiver becomes the ground plane. The size of the case is extremely small in relation to the wavelength and the efficiency of the system will be poor. The case will also be at high RF potential above ground and minor RF burns will be felt if the case is touched while the transmitter is operating. Holding the case improves the ground system and simplifies tuning; however, some form of ground should be used whenever practical. The ground spike should preferably be pushed into moist ground. There are many alternate ground connections such as water pipes, metal fence posts, or a piece of metal going into the ground. On dry soil or other locations where a ground connection is impossible, a counterpoise should be used. The counterpoise is a length of wire connected to the ground terminal and spread out on the ground to form an artificial ground plane. The ground is particularly important if the

7.10 cont'd equipment is operated above ground level on the roof of a building, or similar elevation.

7.11 SELECTION OF POWER SOURCE

The SC130D(E) Transceiver operates directly from a 12 volt power source without the use of a high voltage converter. The average current is less than 2 amperes and the isolation of the supply voltage means that the transceiver may be operated from virtually any reasonably "stiff" 12 volt DC power source. Polarity reversal protection is provided so that no damage will occur if supply connections are accidentally reversed.

The power source is selected in accordance with the type of operation involved. For portable operation as a man-pack transceiver, the internal nickel cadmium or sealed lead acid batteries are used. The nickel cadmium batteries are designed to provide 8 to 12 hours of continuous operation with a 1:10 transmit receive cycle. This represents frequent use of the transmitter and up to 16 hours operation is usually obtained. The sealed lead acid batteries will provide as much as three times the operational ability of the equipment. The carrying bag will hold two spare sets of batteries, giving a total of 24 to 48 hours of continuous operation. Under normal service conditions, this represents 1 week of field operations. In an emergency, eight type "D" flashlight cells may be substituted for each two 6 volt sticks of nickel cadmium batteries.

For portable operations, it is often practical to provide a 12 volt automobile battery. A typical 12 volt 50 ampere hour battery will provide power for one week's continuous operation (24 hours per day). For most portable applications, 7.11 cont'd continuous operation is not required and an automobile battery operates the transceiver for a month or more. For lengthy field operations, the separate automobile battery is the preferred power source as this saves the additional work of daily charging the internal batteries.

In a mobile installation, the transceiver operates directly from the vehicle battery. If the vehicle has a 24 volt electrical system, the transceiver may be connected to the 12 volt point on the batteries. The low power consumption of the transceiver will not cause any serious unbalance in the electrical system. The SC130D(E) Transceiver is designed to withstand peak voltages of 16 volts. A faulty voltage regulator can cause peak voltages in excess of 16 volts. To prevent damage to the transceiver, the vehicle charging system should be checked before installation.

For base station use, the transceiver is normally operated from the AC power supply. If continuous operation, independent of the AC power mains is desired, the transceiver may be operated from a small automobile battery. A small trickle charger (0.5 amps) will keep the battery fully charged.

7.12 INSTALLATION OF POWER SUPPLY

Batteries are changed by lifting the clips and unplugging the battery pack. The nickel cadmium batteries are charged by removing the battery sticks from the battery box and placing them in the battery charger, SC811. The sealed lead acid battery pack is charged directly with the SC807 charger.

7.12
cont'd

CAUTION

AS THE CHARGE CURRENT ON BOTH TYPE BATTERIES MUST BE STRICTLY CONTROLLED, ONLY THE SOUTHCOM CHARGERS (DESIGNATED ABOVE) SHOULD BE USED.

CAUTION

REMOVE BATTERIES BEFORE CONNECTING EXTERNAL POWER SUPPLIES.

To operate the transceiver from an external 12 volt battery, the batteries must first be removed. If this is not done, the batteries may be overcharged and damaged. Connection is made to the battery with the connecting lead, SC130CL. This lead is plugged into the external battery socket on the front panel. The outer shell of the plug locks in place. The leads are then connected to the battery using the two battery clips provided. Make sure that the positive lead is connected to the positive terminal and the negative lead to the negative terminal. The battery terminals should be cleaned to ensure low resistance contacts. In a permanent mobile installation, the battery clips may be removed and the wire connected directly to the battery terminals.

The AC Power Supply, SC804, should first be connected for the correct supply voltage. Most AC power mains are either 115V or 230V. A switch is provided to connect the power supply for either 115V or 230V operation. A switch is also provided to select for operation as a power supply, NiCad charger, or lead acid charger. If used in the "Power Supply" position, THE BATTERIES MUST BE REMOVED, (remove the battery box). If batteries are left installed, the switch should be set for the type of batteries installed.

7.12 cont'd The connector is inserted in the front panel connector labeled "External Power". When connected, the loudspeaker contained in the power supply charger will be activated.

7.13 INSTALLATION OF TRANSCEIVER

For manpack operation, the transceiver is placed in the carrying bag, the batteries are installed, the whip antenna fitted and the handset connected. The transceiver is then ready for operation.

For portable installations, the transceiver is normally operated in the carrying bag and is placed on any convenient flat surface. If the whip antenna is used, the mount may be rotated so that the whip remains vertical. The connections are then made to the antenna, ground, microphone or key, and battery (if an external power source is used). The transceiver is then ready for operation.

In a mobile installation, the location of the transceiver and the whip antenna should be carefully selected. It is preferable that the connecting lead from the transceiver to the base of the whip does not exceed 1 meter (3 feet) in length and should be spaced as far as possible from metallic surfaces.

The mobile mounting rack is bolted in place using the mounting holes provided. The transceiver is then placed in the mounting rack and the mounting adjusted to the correct angle. A direct connection is made from the earth terminal of the transceiver to the nearest point on the vehicle body. The metal surface should be scraped free of paint, dirt and rust at the point of connection. The battery leads are connected to the 12 volt battery, observing correct polarity when making the connections.

7.13 cont'd The antenna and handset are connected, completing the mobile installation. If interference from the vehicle electrical system is present, it will be necessary to install a vehicle noise suppression kit.

In a base station, the transceiver is placed on a convenient operating surface and the connections are made to the antenna, ground, power source, and handset or key. The transceiver is then ready for operation.

The SC130D(E) Transceiver is designed for operation in almost any climatic condition, over the temperature range -30°C to 60°C. Although this means that the equipment may be installed almost anywhere, it is recommended, as far as practical, that the equipment is protected from dust, dirt, shock, vibration, moisture, and temperature extremes. This will extend the service life of the equipment and reduce maintenance.

7.14 CONNECTIONS

There are four front panel connectors on the SC130D(E) Transceiver. The connectors are water and pressure proof and can withstand the U.S. Government salt spray and immersion tests.

BNC and binding post antenna connectors are provided. A male BNC connector is provided with the dipole antenna. The whip or long-wire antennas should be connected to the binding post. The dipole antenna should be connected to the BNC connector.

The SC609 Handset and the SC607A and SC607B Keys plug into the key/handset connectors on the left side of the chassis. The guides in the connectors ensure that the pins align correctly.