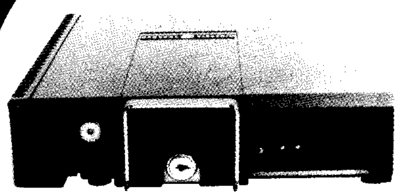
MOBILE RADIO

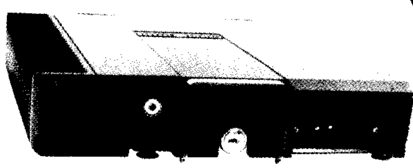
DELTA-S

(SYNTHESIZED)
TWO-WAY MOBILE COMMUNICATIONS
MAINTENANCE MANUAL LBI31345

THIS DOCUMENT INCLUDES:
- LBI-31346 SERVICE SHEET
- LBI-31347 TX/RX SYNTH
- LBI-31365 NOISE BLANKER
- LBI-31381 110W PA
- ADD 1 & 2 TO LBI-31381

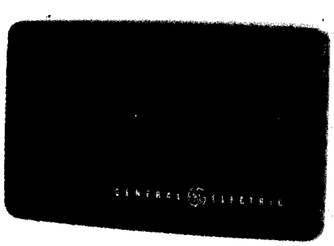


60 WATT
MOBILE RADIO



110 WATT
MOBILE RADIO

**29.7-50 MHZ
TWO-WAY FM
MOBILE
COMBINATIONS**



SPEAKER

GENERAL ELECTRIC

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ILLUSTRATIONS

FCC FILING NUMBER

RECEIVER	TRANSMITTER	POWER OUTPUT	FREQUENCY
ER-137-A ER-137-B ER-137-C	KT-211-A KT-211-B KT-211-C	60-WATTS 60-WATTS 60-WATTS	29.7-36 MHz 36-42 MHz 42-50 MHz
ER-137-A ER-137-B ER-137-C	KT-212-A KT-212-B KT-212-C	110-WATTS 110-WATTS 110-WATTS	29.7-36 MHz 36-42 MHz 42-50 MHz

UNDER U.S. LAW, OPERATION OF AN UNLICENSED RADIO TRANSMITTER WITHIN THE JURISDICTION OF THE UNITED STATES MAY BE PUNISHABLE BY A FINE UP TO $10,000, IMPRISONMENT UP TO TWO YEARS, OR BOTH!

WARNING

Although the highest DC voltage in Mobile Two-Way Radio equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. Keep away from these circuits when the transmitter is energized!

SYSTEM SPECIFICATIONS*

FREQUENCY RANGE	29.7-50 MHz
BATTERY DRAIN (Maximum)	
Receive	
Squelched	0.7 Amperes at 13.8 volts
Unsquelched	2.2 Amperes at 13.8 volts
Transmit	
60 Watts	13.0 Amperes at 13.6 Volts
110 Watts	22.0 Amperes at 13.4 Volts
FREQUENCY STABILITY	0.0005%
TEMPERATURE RANGE	-30°C (-22°F) to +60°C (140°F)
DUTY CYCLE	100% Receive, 20% Transmit (EIA)
DIMENSION, LESS ACCESSORIES (H X W X D)	
60 Watts	65 mm X 260 mm X 325 mm (2.5 X 10.2 X 12.7 inches)
110 Watts	65 mm X 290 mm X 325 mm (2.5 X 11.4 X 12.7 inches)
WEIGHT, LESS ACCESSORIES	
60 Watts	5.9 kg (13.0 pounds)
110 Watts	6.5 kg (14.5 pounds)

TRANSMITTER

CONDUCTED SPURIOUS	-85 dB
MODULATION	±4.5 kHz
AUDIO SENSITIVITY	65 to 120 Millivolts
AUDIO FREQUENCY CHARACTERISTICS	Within +1 dB to -4.5 dB of a 6 dB/octave pre-emphasis from 300 to 3000 Hz per EIA standards. Post limiter filter per FCC and EIA
DISTORTION	Less than 2% (1000 Hz) Less than 5% (300 to 3000 Hz)
DEVIATION SYMMETRY	0.5 kHz maximum
MAXIMUM FREQUENCY SEPARATION	2 MHz
MICROPHONE LOAD IMPEDANCE	600 ohms
POWER ADJUST RANGE	2:1 of rated power
RF OUTPUT IMPEDANCE	50 ohms
FM NOISE	-65 dB
CARRIER ATTACK TIME	25 milliseconds
AUDIO ATTACK TIME	25 milliseconds
CHANNEL GUARD TX TONE DISTORTION	<5%

RECEIVER

AUDIO OUTPUT (to 4.0 ohm speaker)	12 Watts with less than 3% distortion
SENSITIVITY	Standard
12 dB SINAD (EIA Method)	0.25 uV
20 dB Quieting Method	0.35 uV
Squelch <6 dB SINAD	0.25 uV
Channel Guard 8 dB SINAD	
SELECTIVITY EIA Two-Signal Method (@ 20 kHz channels)	-100 dB
SPURIOUS RESPONSE	-100 dB
INTERMODULATION	-85 dB
MODULATION ACCEPTANCE	±6.5 kHz

MAXIMUM FREQUENCY SEPARATION	No Center Tuning	Center Tuning	1 dB degradation with Center Tuning
29.7-36 MHz	0.5 MHz	1.0 MHz	1.5 MHz
36-42 MHz	0.625 MHz	1.25 MHz	1.75 MHz
42-50 MHz	0.75 MHz	1.5 MHz	2.0 MHz

FREQUENCY RESPONSE	Within +2 and -8 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz (1000 Hz reference)
RF INPUT IMPEDANCE	50 ohms
HUM/NOISE RATIO	
UNSQUELCHED	-50 dB
SQUELCHED	-70 dB
RECEIVER RECOVERY TIME	200 milliseconds
RECEIVER ATTACK TIME	150 milliseconds
CHANNEL SPACING	20 kHz

* These specifications are intended primarily for use of the serviceman. Refer to the appropriate Specifications Sheet for the complete specifications.

COMBINATION NOMENCLATURE

DIGITS 1 & 2	DIGIT 3	DIGIT 4	DIGIT 5	DIGIT 6	DIGITS 7-9	DIGITS 10	DIGITS 11
Product Code	Transmit Frequency Range	Receive Frequency Range	Channel Spacing	Type	RF Power Output	Model/ Channel Capacity	Oscillator Stability
N3 DELTA S	**B** 29.7-36 MHz	**B** 29.7-36 MHz	**3** 20 kHz	**N** Narrowband	**060** 60 Watts	**T** A Mode 16 Channel	**B** ±5 PPM
	C 36-42 MHz	**C** 36-42 MHz			**110** 110-Watts	**Z** A/B Mode 32 Channel	
	D 42-50 MHz	**D** 42-50 MHz					

STRUCTURED OPTIONS

DIGIT A	DIGIT C	DIGIT D	DIGIT J	DIGIT M	DIGIT N	DIGIT P	DIGIT R
Program-ming	Option	Channel Guard	Carrier Control Timer	Mounting	Antenna	Squelch	Receiver Type
0 Test Program	**0** None	**0** None	**0** None	**0** Std. Frame & Mtg Hdwe	**0** None	**0** Fixed	**0** None
1 Custom Program	**N** MII Interface	**B** Tone/ Digital	**1** CCT (1-minute)	**N** None	**A** Whip	**V** Variable	**B** Noise Blanker

DESCRIPTION

General Electric synthesized DELTA-S 29.7-50 MHz 60 and 110 watt mobile radio combinations are completely solid state utilizing microcomputer technology and integrated circuits to provide high quality - high reliability radios. The DELTA-S is designed to military specification MIL-STD-810C. Standard combinations may be equipped with:

- Microcomputer Controlled Frequency Synthesizer
- Up to 32 channels
- .0005% frequency stability
- Noise Blanker
- Tone and Digital Channel Guard, optional
- Other structured options

The radio set is housed in a weather resistant case only 2 1/2 inches high. The radio is secured to the vehicle by a bottom mounting plate, and is tamperproof when locked into the plate. When unlocked, the handle can be pulled down and the radio pulled out of the mounting plate or the top cover removed for servicing. When pulled down, the handle can be used to carry the radio.

Excluding option boards, the basic radio consists of two printed wiring boards mounted in a cast aluminum frame. The two boards are the transmitter-receiver-system (TRS) board and the power amplifier board (See Figure 1). Option boards include the channel guard board and MII Interface board.

The PA board is inserted into the radio from the top of the frame, while the TRS board is inserted from the bottom. There are no wires used in the basic radio. Interconnections are provided by pins on the TRS board that mate with connectors on the PA assembly. A power bus connects A+ and A- from the front connector to the PA assembly.

The radio is of single-layer construction with all major modules and tuning adjustments easily accessible from the top of the radio.

Centralized metering jacks for the transmitter, receiver and system functions are provided to facilitate alignment and troubleshooting.

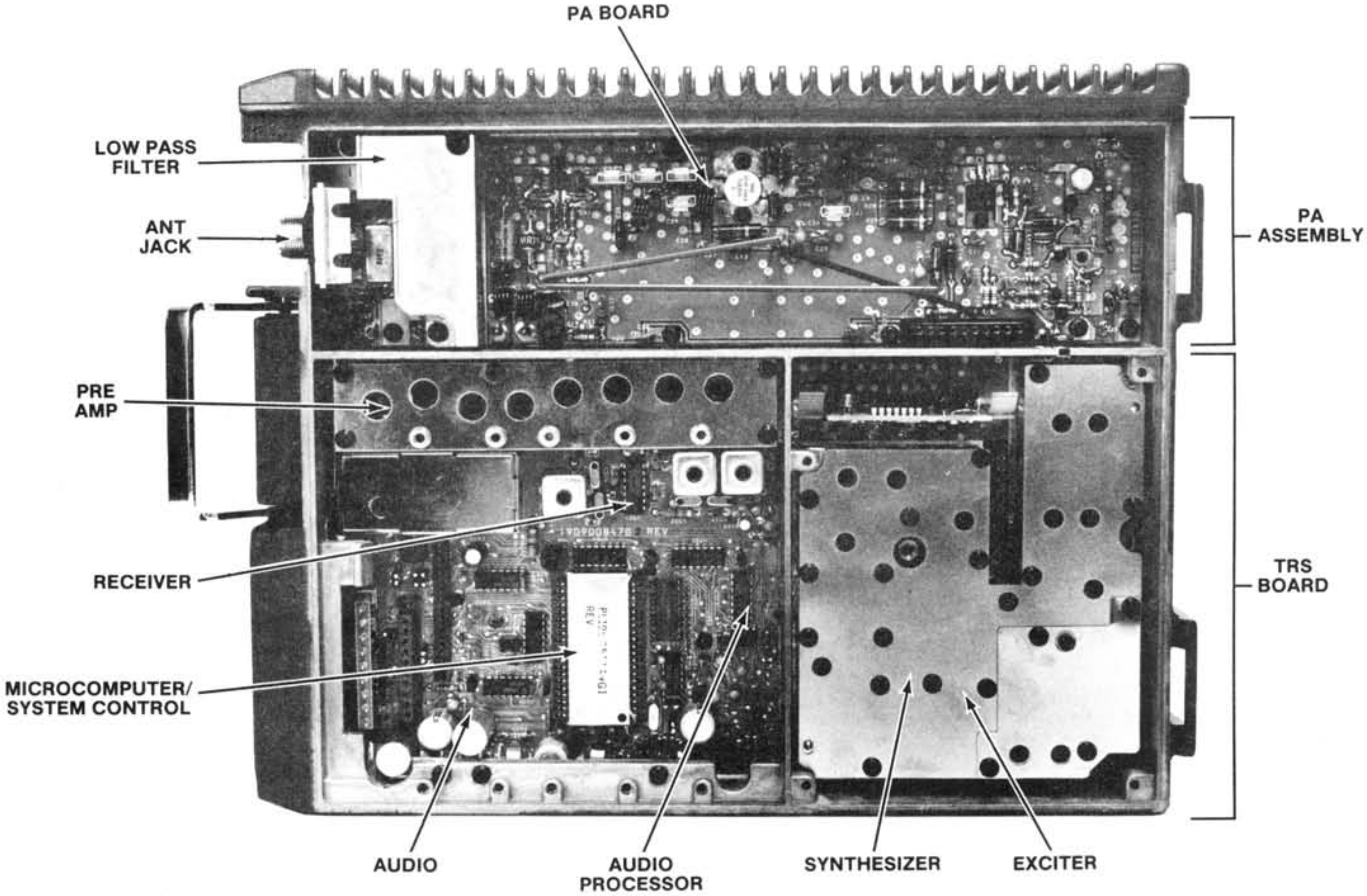


Figure 1 - Typical Module Layout

Both the transmitter and receiver are electrically isolated from the radio chassis to permit operating in 12 Volt, positive or negative ground vehicles without the use of a polarity converter.

Simply changing power leads to the control unit and reversing the power leads in the main connector allows the radio to be used in negative or positive ground vehicles. No changes are required in the radio. Refer to the Installation Manual for details.

SYNTHESIZER/INTERCONNECT

The synthesizer consists of a microcomputer, electrically erasable PROM(S) (EE PROM), a frequency synthesizer IC, transmit and receive VCO's, and associated circuitry. The frequency synthesizer under control of the microcomputer generates all transmit and receive RF frequencies.

The EE PROM stores binary data for all RF frequencies, Channel Guard tones/digital codes, and the timing function of the carrier control timer (CCT). The microcomputer accesses the EE PROM and provides the correct WALSH bits to the Channel Guard board to generate the correct Channel Guard tone or digital code on a per channel basis.

Depending on the configuration of the radio, one or two EE PROMS may be provided. Radios not equipped with a MODE A/B switch will have one EE PROM. Radios with more than 16 channels and those with the MODE switch will have two EE PROMS.

PROGRAMMING

The EE PROM allows the radio to be programmed or reprogrammed as needed to adapt to changing system requirements. RF frequencies, Channel Guard tones and digital codes, and the CCT function can be reprogrammed.

The EE PROMS can be reprogrammed through the radio front connector using the General Electric Universal PROM Programmer Model TQ2310. This programmer allows all information to be loaded simultaneously.

NOTE

> When programming, remember that all RF frequencies must be divisable by 5 kHz.

Alternatively, a single channel Programmer Model 4EX22A10 allows the user to reprogram the radio on a per channel basis. Use of this programmer requires that the radio top cover and any option boards present be removed. A special programming jack, J711, is provided in the radio for interconnections.

Programming instructions are provided in the respective Programmer Maintenance Manuals.

Two labels describing the radio's personality are located on the radio bottom cover (Mode B) and PA cover (Mode A). The information contained on the labels provide the serviceman with a quick reference to the operating characteristics of the radio. Information identified on the labels include the PROM Kit number, the radio serial number, all transmit and receive channel numbers and frequencies, Channel Guard, tones/codes, and carrier control timer information for each channel.

If the personality of the radio is changed (EE PROM reprogrammed) all information relating to the radio's new personality should be recorded either on the old label, if space is available, or on a new label. The part number of the label is 19C850828P1 and may be ordered from General Electric Service Parts in Lynchburg, Va.

TRANSMITTER

The transmitter consists of the exciter, frequency synthesizer, transmit VCO, and a power amplifier assembly. The PA assembly consists of a PA board mounted along the side of the radio next to the heat sink assembly. The PA board also contains a hermetically sealed antenna relay and a low pass filter. The broad band PA requires no tuning.

RECEIVER

The single conversion receiver consists of the frequency synthesizer, RX VCO, injection amplifiers, front end, IF and limiter detector. In radios equipped with the optional noise blanker, a noise blanker board is plugged into J406 on the TRS board. Audio and squelch circuitry for the receiver is located in the system section of the TRS board. Jacks for the Channel Guard and other structured options are also located in the system area.

CONTROL UNITS

Two "S" series control units, the S500 and the S600, may be used directly with DELTA-S radio combinations.

The S500 control unit contains an on-off volume control switch, a rotary channel selector switch for 1, 8, or 16 channels, a MODE A/B switch (optional) to expand the channel select capability to 32, seven segment channel indicator(s), a red transmit indicator, channel busy indicator (optional), and a tone option jack. Options that may be used with this control unit include Type 90 and 99 tone, squelch operated relay SOR, GE-STAR encoder, and public address. An interface board is required in the radio. The S500 control unit uses the same power/control cables as the C500 control unit.

The S600 control unit contains an on-off volume control switch, squelch disable switch, red transmit indicator, and a 7 segment channel indicator. A rotary channel select switch permits selection of up to eight channels. A white power on indicator is used for back lighting the front panel. Space is provided for two optional pushbutton switches and two optional indicators. The S600 control unit uses the same power/control cables as the C600 control unit.

BINARY CONVERTER

Standard control units such as the C500, C800 and C900 may also be used but require the use of a binary converter (contained in a short interconnecting power/control cable) when three or more channels are provided or when the radio is equipped with PSLM. Standard C series control unit power/control cables are used to interconnect the radio and binary converter. The Binary Converter is available as an option.

CHANNEL SELECTION

Depending on the control unit used, a single rotary or pushbutton selector switch will select up to 16 channels. In radios equipped with more than 16 channels, the control unit will contain a MODE A/B switch. The MODE switch allows the user to select a second set of 16 channels (17-32).

The MODE A/B switch may be used to provide mobile-to-mobile communications through an intermediate repeater (repeated path) or direct mobile-to-mobile communications. For example: channel 1 Mode A may be programmed for the repeater frequency (repeated path) while channel 1 Mode B would be programmed for the mobile receive frequency (direct path). Judicious programming will allow selection of repeated or direct communications paths on selected channels.

MICROPHONE AND HANDSET

A hand held microphone with a built-in transistorized microphone preamplifier is available for use with the radio. The microphone is housed in a sturdy two piece case, and the extendable coiled cord plugs into the microphone jack at the back of the control unit. The plug is secured to the jack by a retaining screw.

An optional telephone-type handset is also available. The handset uses a dynamic microphone with a built-in microphone preamplifier. The extendable coiled cord plugs into the microphone jack on the back of the control unit, and is secured to the jack by a retaining screw.

HOOKSWITCHES

In Channel Guard or other tone applications, a microphone or handset hookswitch is supplied with the radio. The hookswitches are equipped with a Channel Guard disable switch.

Placing the switch in the "up" position (towards the small speaker symbol) disables the Channel Guard decoder. With the switch in the "down" position, the Channel Guard is disabled when the microphone or handset is removed from the hookswitch.

SPEAKER

A three by five-inch speaker contained in a molded plastic housing provides an audio output of 12 watts with a speaker impedance of four ohms. The speaker leads are terminated in Vehicle Systems Plug P3 which connects to J1-A on the rear of the control unit.

INITIAL ADJUSTMENT

After the radio has been installed (as described in the Installation Manual), the following adjustments should be made by an electronics technician who holds an appropriate FCC Radiotelephone license (where required).

TRANSMITTER ADJUSTMENT

The transmitter adjustments include measuring the forward and reflected power and optimizing the antenna length, then setting the transmitter to rated power output (or to the specific output or input which may be required by the FCC station authorization). Next, measuring the frequency and modulation and entering these measurements on the FCC-required station records. For the complete transmitter adjustment, refer to the Alignment Procedure in the Service Manual.

RECEIVER ADJUSTMENT

There are no initial adjustments for the receiver.

OPERATION

Complete operating instructions for the Two-Way Radio are provided in the Operator's Manual. The basic procedures for receiving and transmitting messages in mobile combinations are as follows:

TO RECEIVE A MESSAGE

1. Turn the radio on by turning the OFF-VOLUME control halfway to the right.
2. Turn the SQUELCH control clockwise (to the right) as far as possible. A noise will be heard from the speaker
3. Adjust the VOLUME control until the noise is easily heard, but is not annoyingly loud.
4. Turn the SQUELCH control counter-clockwise (to the left).

NOTE

In radios equipped with the variable squelch option, turn the squelch control clockwise as far as possible then set the VOLUME control to the desired listening level. Now, slowly turn the squelch control counterclockwise until the noise just cuts off.

5. In multi-frequency radios, select the proper frequency.

The radio is now ready to receive messages from other radios in the system.

TO TRANSMIT A MESSAGE

1. Turn the radio on and select the proper channel.
2. If a lengthy message (or several messages) are to be sent, the vehicle engine should be running to maintain the battery charge.
3. Pick up the microphone and listen briefly to the speaker to make sure that no one else is using the channel.
4. Press the Push-to-Talk (PTT) switch on the microphone and send the message. The red transmit light on the control unit will glow each time the PTT switch is pressed.

MAINTENANCE

The use of microcomputer technology allows self diagnostic maintenance routines to be incorporated in the microcomputer software. These routines are easy to run and provide a quick analysis of microcomputer and frequency synthesizer operation.

The service section of this manual contains the diagnostic routines, and other maintenance information to service this radio. The service section includes:

- System interconnections
- Mechanical layout
- Disassembly procedures
- Replacement of IC's, chip capacitors, and resistors
- Service tips
- Microcomputer self diagnostics
- Alignment procedures for the transmitter and receiver
- Troubleshooting Procedure and waveforms

NOISE SUPPRESSION

After completing the initial adjustment of the transmitter and receiver, the serviceman should determine whether additional noise suppression is required. The following information should assist the serviceman in identifying and elimating undesirable noise interference (See Figure 2).

Ignition Noise

Ignition noise sounds like a "popping" sound in the speaker, whose frequency varies with engine speed while a weak signal is being received. This type of interference is generated by the spark plugs, distributor and any poor connections in the high-voltage system which might cause arcing. Ignition noise may be identified by noting that the noise disappears as soon as the ignition switch is turned off.

1. If the vehicle does not have a resistance lead from the coil to the center of the distributor cap, disconnect the lead at the distributor and cut the lead so that a Cable-Type Suppressor may be inserted in it close to the distributor. Screw the cut ends of the lead into the suppressor.

NOTE

A resistance lead operates as a very effective noise suppressor as long as there are no breaks anywhere along its length. Never cut a resistance lead to insert a suppressor. A loose knot is often tied in the lead to prevent excess flexing, which might break the conductor.

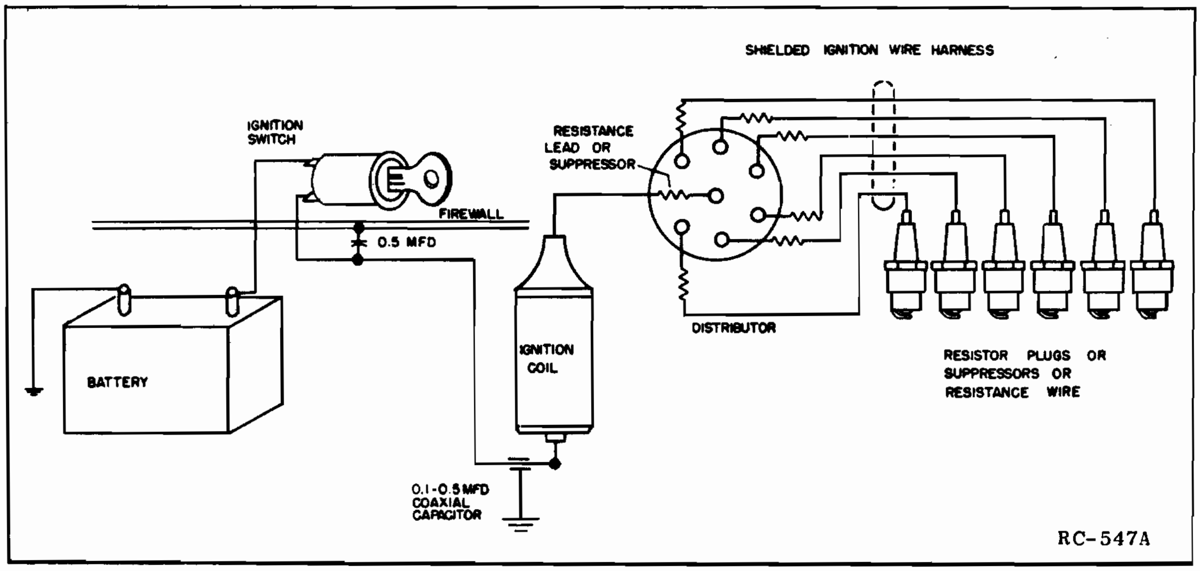


Figure 2 - Ignition Circuit with Noise Suppression Components

2. Check to see that:

   - the distributor points and condenser are in good condition.
   - the high-voltage leads from the distributor are not broken and are making good contact at each end.
   - the spark plugs have clean, dry insulators and their electrodes are clean and properly adjusted.
   - the timing has been properly adjusted.

3. Use a 0.5-mFd by-pass capacitor to bypass the battery lead to the ignition coil. Mount the capacitor under a screw which will provide a good ground and connect the capacitor lead to the terminal of the coil which is connected to the ignition.

4. Remove the ignition coil and its mounting bracket. Clean paint from coil (where the bracket mounts), from the bracket and from the engine block. Remount the coil so as to obtain a good ground for the coil case.

5. If the vehicle has been driven 30,000 or 40,000 miles or more, the cap and rotor of the distributor will probably need replacing. This will not only reduce ignition noise, but also improve the overall performance of the engine.

6. High-voltage ignition wires can become capacitively coupled to the low-voltage systems, causing ignition noise to appear in the low-voltage system. This coupling can be minimized by separating the high- and low-voltage leads, or if necessary, separately shielding the leads.

7. If one of the ignition leads happens to have the critical length for radiating at the receiver's frequency, the noise can be reduced by changing the length of the lead. A noise source of this type is not common and can only be found by using a noise meter or by trial and error.

8. If the preceding steps fail to reduce ignition noise to a satisfactory level, it may be necessary to install resistance-type spark plugs, individual suppressors on each spark plug, or a shielded ignition wire harness.

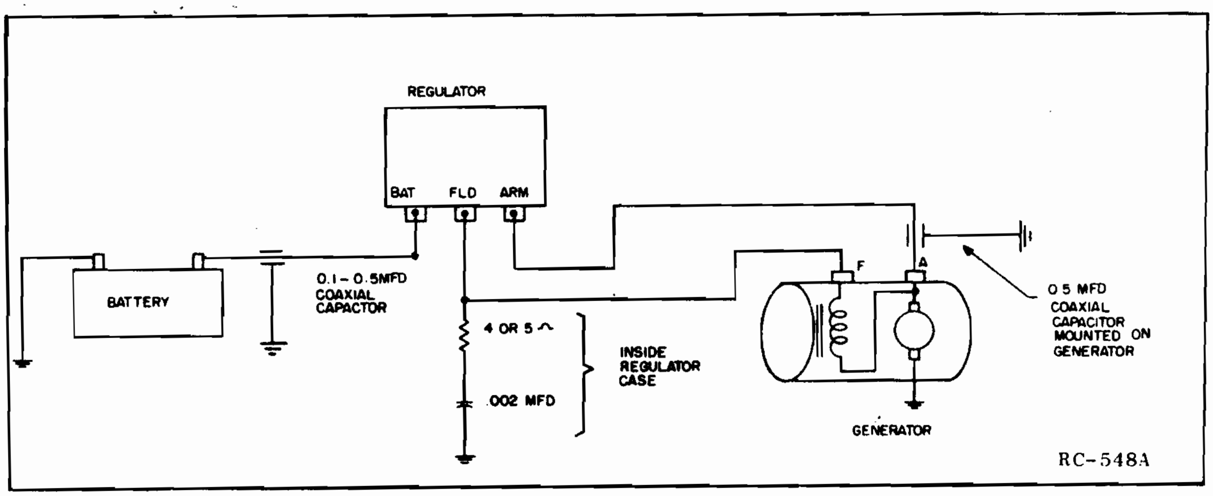


Figure 3 - Generator Circuit with Noise Suppression Components

Alternator Noise

Alternator noise shows up as a high-pitched "whine", whose pitch varies with engine speed. To check for this type of noise, run the engine at a moderate speed and then shut off the engine, while listening to the noise on the receiver. Alternator noise will continue as long as the engine turns, lowering in pitch as the engine slows down.

It may be necessary to install a coaxial type, 0.5 mFd filter capacitor from the ungrounded alternator terminal to ground.

CAUTION

> Do not install this capacitor on alternators that are equipped with a factory-supplied capacitor for protecting the rectifiers and suppressing noise.

Generator Noise

Generator noise shows up as a high-pitched "whine", whose pitch varies with engine speed. To check for this type of noise, run the engine at a moderate speed and then shut off the engine, while listening to the noise on the receiver. Generator noise will continue as long as the engine turns, lowering in pitch as the engine slows down (See Figure 3).

By-pass the armature terminal on the generator to ground with a 0.5-mFd, 40 or 50-amp coaxial capacitor. Be sure to scrape the area where the capacitor is to be mounted, so that its case will be well grounded.

CAUTION

> Do not by-pass the field terminal (F), as this will damage the voltage regulator contacts.

Generator Regulator Noise

Generator regulator noise shows up as a "raspy" sound which is generated by the contacts in the regulator and radiated by the leads coming out to the regulator. If suppression of regulator noise is necessary, connect a 5-ohm resistor in series with a .002-mFd capacitor from the field, terminal (F) of the regulator to ground. If possible, these components should be mounted inside regulator case. The battery terminal (BAT) and armature terminal (ARM) can be by-passed to ground with 0.5-mFd capacitors.

CAUTION

> If the regulator is opened to install the capacitor or resistor, remember that one wrong connection or shorted wire can damage the regulator or generator.

Gauge noise produces a "hissing" or "crackling" sound. Tapping the face of each gauge while the engine is running usually shows up which gauge is at fault. By-pass the gauge lead to ground with a 0.5-mFd capacitor, connected close to the sensing element.

Static and Arcing Noise

The following suggestions may help to cure other unusual types of interference:

1. Use bonding braid to electrically bond the hood and each corner of the engine block to the vehicle's frame. Scrape paint and dirt from bonding points to obtain a good ground.

2. Treat noisy tires with anti-static powder.

3. Use front-wheel static collectors for irregulator "popping" noise which disappears when the brakes are applied.

4. Use heavily graphited penetrating oil on the exhaust pipe and muffler supports if they are producing noise.

GENERAL ELECTRIC COMPANY• MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS• LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

MAINTENANCE MANUAL

60/110 WATT, 29.7-50 MHz SYNTHESIZED DELTA-S

TWO-WAY RADIO

SERVICE SECTION

TABLE OF CONTENTS

DESCRIPTION

This section contains information required to service the radio including disassembly procedures, procedures for replacing transistors, Integrated Circuits (IC's), and chip components. The section also includes alignment procedures and troubleshooting information (see Table of Contents).

MAINTENANCE

PREVENTIVE MAINTENANCE

To ensure optimum operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts at regular intervals. This preventive maintenance should include the checks as listed in the table of Maintenance Checks.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery-operated soldering iron may be used in place of the regular soldering iron.

MAINTENANCE CHECKS	INTERVAL	
	6 Months	As Required
CONNECTIONS - Ground connections and connections to the voltage source should be periodically checked for tightness. Loose or poor connections to the power source will cause excessive voltage drops and faulty operation. When ground connections are not made directly to the battery, the connection from the battery to vehicle chassis must be checked for low impedance. A high impedance may cause excessive voltage drops and alternator noise problems.	X	
ELECTRICAL SYSTEM - Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe and economical operating limits. Overvoltage is indicated when the battery loses water rapidly. Usage of 1 or 2 ounces of water per cell per week is acceptable for batteries in continuous operation. A weak battery will often cause excessive noise or faulty operation.		X
MECHANICAL INSPECTION - Since mobile units are subject to constant shock and vibration, check for loose plugs, nuts, screws and parts to make sure that nothing is working loose.	X	
ANTENNA - The antenna, antenna base and all contacts should be kept clean and free from dirt or corrosion. If the antennas or its base should become coated or poorly grounded, loss of radiation and a weak signal will result.	X	
ALIGNMENT - The transmitter and receiver meter readings should be checked periodically, and the alignment "touched up" when necessary. Refer to applicable Alignment Procedure and troubleshooting sheet for typical voltage readings.		X
FREQUENCY CHECK - Check transmitter frequency and deviation, as required by FCC. Normally, these checks are made when the unit is first put into operation, after the first six months and once a year thereafter.		X

DISASSEMBLY

- To gain access to the unit for servicing:
  1. Unlock the radio.
  2. Pull down the handle.
  3. Pull the radio forward and lift radio out of mounting place -- if desired.
  4. Pry up the front of top cover and lift the cover off.
  5. To gain access to the bottom side, pull the radio all the way out of the mounting frame and remove the four mushroom shaped feet using a 5mm allen wrench.

NOTE

With the top cover removed all components on the PA and TRS board are accessible for tuning. The PA, IF, and synthesizer/exciter covers must be removed to expose components.

- To remove the TRS board:
  1. Remove the bottom cover.
  2. Remove the nine retaining screws (Figure 1) securing the circuit board to the main frame.

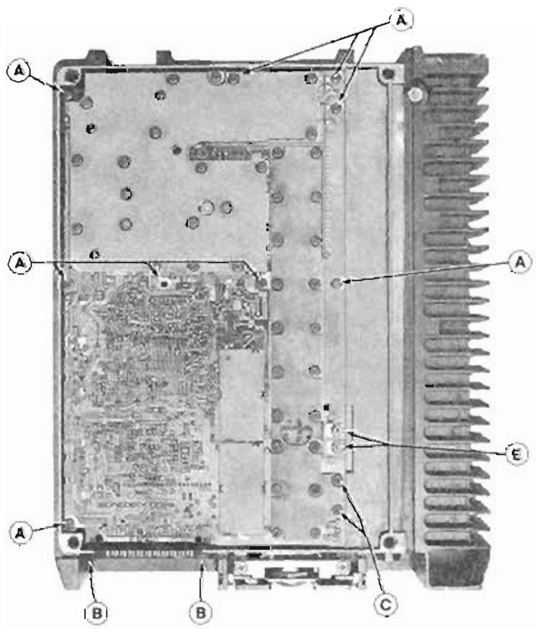


Figure 1 - Disassembly Procedure Bottom View

  3. Remove two retaining screws (B) securing systems connector J601 to front casting.
  4. Remove the two brass screws (C) securing the receiver RF shield to chassis.
  5. Unsolder the two feed through capacitor terminals (E) at holes H13 and H14 on printed wire pattern.
  6. Turn over the radio and remove the three retaining screws (D) (Figure 2) securing the audio bridge amplifier, U601 and U602, and the 5 and 9 volt regulators U701 and U702 to the side of chassis.

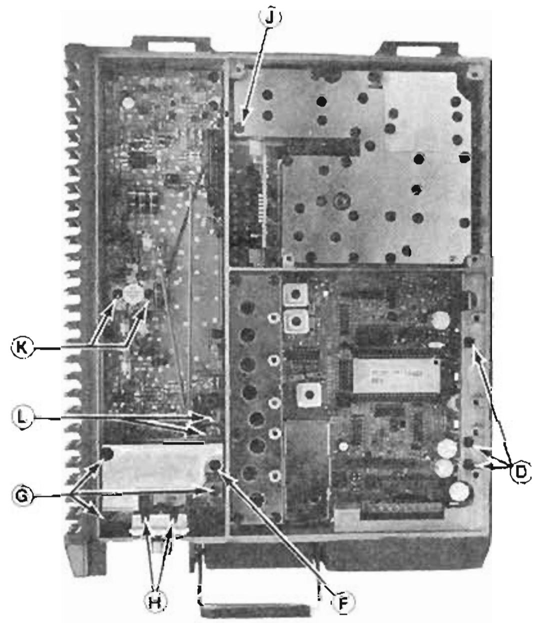


Figure 2 - Disassembly Procedure Top View

  7. To remove the front end shield, remove the 20 retaining screws securing the shield to the backplate and remove.

NOTE

When replacing front end shield tighten all retaining screws to 1.75 Newton Meters (15.5 inch pounds).

  8. To remove the synthesizer shield, remove the retaining screws securing the shield to the backplate.

- To replace TRS board:
  1. Perform above procedures in reverse order.

- To remove the PA board:
  1. Remove the eight retaining screws (F) from around the edge of the PA board.
  2. Remove the three retaining screws (G) securing the PA filter cover to the main frame.
  3. Remove the two retaining screws (H) securing the antenna connector to the main frame.

4. Loosen the retaining screw (J) securing the pass transistor to the side of the PA chassis compartment.
5. Remove the retaining screws (K) securing the PA transistors to the main frame.
6. Unsolder the two power feed through capacitors at (L).
7. Carefully lift the PA board up off the pins extending upward from the TRS board.

- To replace the PA board:

1. Perform the above procedures in reverse order, being careful to align all interconnecting pins and sleeves. Be sure the antenna gasket between the antenna jack and front casting is positioned properly.

PA TRANSISTOR REPLACEMENT

WARNING

The RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, the dust that escapes may be hazardous if inhaled. Use care in replacing transistors of this type.

- To replace the PA RF transistors:

1. Unsolder one lead at a time with a 50 watt soldering iron. Use a scribe or X-acto® knife to hold the lead away from the printed circuit board until the solder cools.
2. Lift out the transistor. Remove any old solder from the printed circuit board with a vacuum de-soldering tool. Special care should be taken to prevent damage to the printed circuit board runs because part of the matching network is included in the base and collector runs.
3. Trim the new transistor leads (if required) to the lead length of the removed transistor. The letter "C" on the top of the transistor also indicates the collector.
4. Apply a coat of silicon grease to the transistor mounting surface. Place the transistor in the mounting hole. Align the leads as shown on the Outline Diagram. Then replace the transistor mounting screws using moderate torque.
5. Solder the leads to the printed circuit pattern. Start at the inner edge of mounting hole and solder the remaining length of transistor lead to the board. Use care not to use excessive heat that causes the printed wire board runs to lift up from the board. Check for shorts and solder bridges before applying power.

CAUTION

Failure to solder the transistor leads as directed may result in the generation of RF loops that could damage the transistor or may cause low power output.

REMOVING IC's

Removing IC's (and most other soldered-in components) can be easily accomplished by using a vacuum de-soldering tool. To remove an IC, heat each lead separately on the solder side and remove the old solder with the de-soldering tool.

REPLACING CHIP COMPONENTS

Replacement of chip components should always be done with a temperature-controlled soldering iron, using a controlled temperature of 700°F (371°C). However, do NOT touch black metal film of the resistors or the ceramic body of capacitors with the soldering iron.

NOTE

The metalized end terminations of the parts may be touched with the soldering iron without causing damage.

CAUTION

CMOS devices (Q1-60 Watt PA, Q1, Q5-110 Watt PA) used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery-operated soldering iron may be used in place of the regular soldering iron.

To Remove Chip Components

1. Grip the component with tweezers or needle nose pliers.

2. Alternately heat each end of the chip in rapid succession until solder flows, and then remove and discard the chip.

3. Remove excess solder with a vacuum solder extractor or Solder-wick®.

4. Carefully remove the epoxy adhesive and excess flux to prevent damage to the printed board.

To Replace Chip Components

1. Using as little solder as pos sible, "tin" one end of the component and one of the pads on the printed wiring board.

2. Place the "tinned" end of the component on the "tinned" pad on the board and simultaneously touch the component and the pad with a well "tinned" soldering iron while pressing the component down on the board.

3. Place the "tinned" soldering iron on the other end of the component and the pad simultaneously. Apply solder to the top of the end of the component until the solder starts to flow. Use as little solder as possible while getting a good joint.

4. After the component has cooled, remove all flux from the component and printed wiring board area with alcohol.

TEST AND TROUBLESHOOTING PROCEDURES

Maintenance of the radio is facilitated by use of the General Electric Test Set 4EX3A11, the built-in Self Test and Diagnostics routines, and servicing techniques unique to this radio. Typical voltage readings are provided on the Schematic Diagram for reference when troublshooting. Three metering jacks are provided for use with the Test Set to monitor radio operation: System jack J602, RF jack J101, and PA jack J1.

Except for the synthesizer control voltage all metering can be accomplished using the three metering connectors. One connector monitors the system functions such as audio and PTT. Another connector monitors receiver and exciter metering. The third connector monitors PA currents, power amp control voltage, and Exciter RF level. A standard MII test set, with a Delta adapter, can be used for metering.

The synthesizer control voltage can be monitored through a hole in the synthesizer bottom shield on the solder side of the PWB.

The LB Delta receiver is monitored at three points - the INJ amplifier, IF amplifier, and the detector. The INJ amplifier is monitored at the RF test metering jack. IF amplifier and detector are monitored on the systems test metering jack. The exciter amplifiers are monitored at 3 points. These three points are monitored by the RF test metering jack.

SERVICE TIPS

When servicing the transmit/receiver/synthesizer board, removing/relocating the MASTR II Interface and Channel Guard boards may be helpful.

MASTR II Interface Board

Generally, the functions on the MASTR II Interface board are not required to service the radio. However, if the MASTR II Interface board is removed, the VOL SQ HI signal level may be lower which may result in improper operation of some control unit options. If a higher signal level is needed the MASTR II Interface board may be reconnected to J603 via the interconnect cable (19C850936G1) in the radio.

CHANNEL GUARD BOARD

Both the Channel Guard board and Channel Guard extender may be removed and set aside during servicing. Again, the Channel Guard may be reconnected using the 19C850936G1 cable.

NOTE

If an external Channel Guard board is used in a control unit on the Public Address option is present, the MASTR II Interface Board must be connected. The Channel Guard Mod adjust is located on this board. Also, the PTT control line required for Public Address passes through.

BINARY CONVERTER

A binary converter (bump-in-line) is used in series with the power control cable when "C" series control units are provided and the radio has more than two channels or PSLM. The Advance Change Pulse is generated by the Binary Converter. However, F1, F2, F4 and F8 will operate without a binary converter.

When servicing the microcomputer/synthesizer circuitry it is sometimes to force the microcomputer into specific operating modes. Following are some tips that allow you to initiate these modes.

Microcomputer

- To force the microcomputer to continually try to reload the synthesizer. This mode will enable you to check the serial data, clock, advance change pulse and enable signals to the synthesizer. Enter this mode by grounding the lock detect line into the microcomputer at U703-8.
- To stop the microcomputer from running, disable the watchdog timer by shorting the collector and emitter of Q714 and grounding the single step line at U705-5.

Microphonics

Synthesized radios tend to be sensitive to shock and vibration, creating microphonics. The construction of the DELTA-S, radio with its die cast aluminum frame, cast shields, and multiple board mounting screws, provides a high degree of immunity. Note, when removing either printed circuit board or the shields, the location and position of all mounting hardware including rubber padding and bracket (if included).

When servicing the radio be sure that no solder build-up has occured on the chassis or shield.

To assure a high degree of resistance to microphonics be sure to replace exactly, all hardware removed. Be sure that all mounting screws are properly torqued and shields in place. Refer to Mechanical Layout Diagram.

NOTE

> Loose or rubbing parts, especially in the VCO area are particularly sensitive and can cause microphonics. Again be certain all hardware is properly installed and torqued.

MICROCOMPUTER DIAGNOSTICS

The microcomputer, in addition to operational programming, contains software for self diagnostic routines to aid in troubleshooting the radio. Since the radio can not function with a defective microcomputer, the self diagnostic routines include internal tests as well as input/output tests to verify proper operation. The internal tests include a ROM test which verifies that the proper program is stored in the microcomputer and a RAM test which checks for proper data transfer to and from all memory locations. The input/output tests include a test which grounds one pin at a time on Port 1 and the data bus, and a test which mirrors the inputs PTT, FB5, CG DISABLE, ADVANCE CHANGE, and FB4 - FB1 onto the data bus. These tests assure proper operation of the ports and data bus, in addition to checking the input/output instructions of the microcomputer. When troubleshooting the radio, the diagnostic routines should be performed first before going on to the test procedures and alignment instructions.

Test Equipment Required

- 13.8 VDC regulated supply, 500 mA (unless being tested in radio)
- DC Voltmeter (Data Tech 30L or equivalent)
- Oscilloscope (Tektronix 464 or equivalent)

Test Procedure

SERVICE NOTE

> If a Binary Converter is used in the radio system (connected in series with Power Control cable) it must be removed to successfully complete the self-diagnostic routines. Connect the Power Control cable directly between the control unit and the radio.

NOTE

> This procedure assumes the transmit/receive/synthesizer board is being tested in the radio. Alternate procedures for bench test are shown in parenthesis ().

1. Connect oscilloscopes to J601-18 (SPKR 1) and ground.
2. Enter the self diagnostic mode as follows:

   o Key microphone while on hook. (Ground J601-11).

- o Apply A+ through a 10K resistor to J604-3.
- o Turn radio on. (Apply 13.8 VDC to J601-19).

NOTE

If any of these tests have failed, the microcomputer function is defective. Before replacing the microcomputer, exhaust all other possibilities. Check associated circuits for shunted or open printed wire runs and components.

ROM and RAM Tests

Once power is supplied to the board, the microcomputer will jump to the self diagnostic test and immediately begin execution of the ROM and RAM tests. Upon completion of the ROM and RAM test (less than a second) the display, data bus, or alert tone will indicate if the tests have been passed, indicated as follows:

	D3	D2	D1	D0	ALERT TONE
ROM TEST FAILED	0	0	0	0	NONE
ROM TEST PASSED RAM TEST FAILED	0	0	0	1	NONE
ROM TEST PASSED RAM TEST PASSED	0	0	1	0	1 kHz

If the data bus is inaccessable then the alert tone can be used to indicate if the tests have passed. If the tests have passed there will be a 1 kHz tone on SPK 1 and it will be heard on the speaker if the board is in a radio. If no alert tone is present, then either the ROM or RAM test has failed.

Input/Output Tests

If the ROM and RAM tests are completed satisfactorily, release the PTT switch and remove A+ from J604-3. Note that the data bus will still indicate 02 (Hex), however, the 1 kHz tone should no longer be displayed on the scope or heard on the speaker.

The I/O test grounds 1 pin at a time on Port 1 and the data bus and is stepped through the test sequence by operating the PTT switch (momentarily grounding J601-11). Port 1 and the data bus can be monitored using a voltmeter. Port 1 consists of pins 27-34 on microcomputer U705. The data bus includes pins 12-19 on U705. Refer to schematic diagram for data bus and port identification for U705. For example: P17 = port 1 bit 7.

1. Momentarily press and release the PTT switch (J601-11) Port 1 and data bus lines will all go high.
2. Momentarily press and release the PTT switch (J601-11). U705-34 and U705-19 will go low. All other outputs should be high.
3. Momentarily press and release the PTT switch (J601-11). U705-33 and U705-18 will go low. All other outputs should be high.
4. Momentarily press and release the PTT switch (J601-11). U705-17 will go low. All other outputs should be high. Note that U705-32 will remain high. This is because this output switches the radio into the transmit mode when grounded. Thus the output is bypassed so that the radio will never go into the transmit mode during self test.
5. Momentarily press and release the PTT switch (J601-11). U705-31 and U705-16 will go low. All other outputs should be high.
6. Momentarily press and release the PTT switch (J601-11). U705-30 and U705-15 will go low. All other outputs should be high.
7. Momentarily press and release the PTT switch (J601-11). U705-29 and U705-14 will go low. All other outputs should be high.
8. Momentarily press and release the PTT switch (J601-11). U705-28 and U705-13 will go low. All other outputs should be high.
9. Momentarily press and release the PTT switch (J601-11). U705-27 and U705-12 will go low. All other outputs should be high.
10. Momentarily press and release the PTT switch (J601-11). Port 1 outputs will all be set high.

NOTE

At this point the program advances to mirror the outputs PTT, FB5, CG DISBL, ADVANCE CHANGE, and FB4-FB1 onto the data bus U705-12 through U705-19 respectively.

11. Momentarily apply ground to the following points while observing status of the associated data bus as indicated below. When ground is applied, the data bus should go low and then go high when ground is removed.

Momentarily Ground	Data Bus	Momentarily Ground	Data Bus
J604-1	U705-18	J601-13	U705-14
J601-10	U705-17	J601-2	U705-13
J604-3	U705-16	J601-1	U705-12
J601-4	U705-15	J601-11	U705-19

12. Exit the diagnostics routines by momentarily removing power to the radio.

ACCESSING CENTER TUNE FREQUENCY

NOTE

When a radio is factory programmed for less than 16 channels, channel 16 is programmed for transmit and receive center tune frequency. Under normal operation, the microcomputer will not access this channel. The following procedure accesses channel 16 to assure its availability for tuning purposes.

1. Apply +12 VDC through a 10K resistor to J604-3, then turn the radio on. This tells the microcomputer to always access channel 16.
2. To select the transmit center tune frequency, press the PTT switch (J601-11). Release the PTT switch to select the receive center frequency.
3. To exit this mode remove power from J604-3 and momentarily remove power from the radio.

TEST FREQUENCIES

If the EE PROM is not custom programmed to the customers specified personality (Option AO), then a standard test program is provided. The EE PROM is programmed on channels 1 through 16 including tone and digital Channel Guard and carrier control timer. The test program is given under Transmitter Alignment.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

PA TROUBLESHOOTING PROCEDURE

When troubleshooting the transmitter check for typical meter readings for the exciter, J101, and the power amplifier, JACK, J1. Typical readings for the various test positions and test points are given in the charts below. The meter readings are typical using General Electric Test Set 4EX3A11 with Test Set Adaptor 19C850590G1.

Power Amplifier Quick Checks

PA JACK READINGS AT J1

TEST POSITION	FUNCTION MEASURED	SCALE	TYPICAL READINGS 60W
A	RF DRIVE	0-15V	5.0V
B	CONTROL VOLTAGE	0-15V	5.0V
C	TX A+	0-15V	13.0V
E	PA CURRENT	0-30A	10A
F	DRIVER CURRENT	0-15A	0.8A

Exciter Quick Checks

TEST POS	FUNCTION	SCALE	TYPICAL READINGS
A	AMPL 1 VOLT	0-1	0.65
B	AMPL 2 VOLT	0-1	0.45
C	EXCITER OUTPUT	0-1	0.65

SYMPTOM	PROCEDURE	ANALYSIS
Little or No RF Output	Key transmitter and check J1-10, Pos A on Test Set, for 5.0 Volts Unkey transmitter and check all supply voltages:	Refer to Schematic Diagram and verify voltage readings.
	• 10 volts at TP351	• Check Q351 and associated circuitry
	• 5.0 ±0.2 volts at J717	• Check U702 -- Be sure P701 is installed
	• 9.0 ±0.1 volts at J602-3	• Check 9.0 volt regulator Check U701 and associated plugs and circuitry
	• A+ (13.8 VDC) at J602-2	• Check Power Control Cable
	• 8.5 VDC at Q218E	• Check filter components C255, R212, etc.
	Run microcomputer diagnostics	If the results are negative the microcomputer function has failed. Check all associated circuitry and printed wire runs before replacing microcomputer.
	Key transmitter and check for +18 dBm of RF at L213 (TX injection)	No RF present - Check DC voltages on TX VCO Q219-Q221. Also check Q202-Q206 and synthesizer U201. RF present - Monitor J101-10 Pos. A (AMPL 1 EM VOLT) with multimeter and key and unkey the transmitter. Voltage should increase when the transmitter is keyed. If not check Q101 and associated circuitry.
	Key transmitter and monitor voltage at J101-9 (Pos B Ampl-2). Voltage should increase.	If voltage does not increase check L101, Q101, L102, and associated components.
	Monitor J101-8 (Pos C Ampl-3 Volt) and key transmitter. Voltage should increase.	If voltage does not increase, check Q102, L104, and associated components.
	Disconnect P101 from PA and measure RF input power from exciter. Should be 0.25 Watts or more.	If exciter output is low, check Q101, Q102 and associated circuitry. If exciter output is correct be sure P101 is soldered securely and that it mates properly with the contact on the power amplifier. Be sure P103 is installed.

TYPICAL PERFORMANCE DATA

SIGNAL	INDICATION	VOLTAGE LEVEL
CAS	High Level Low Level	9.0 VDC 0.15 VDC
RUS	High Level (Rx Un-sq) Low Level (Rx Squelched) Low Level (Rx Mute/PTT pulled low, Rx unsquelched)	9.0 VDC 0.15 VDC 0.6 VDC
Sq Dis, Input	Logic Low (Sq. Dis) Logic High(Sq) Rx Un-Sq	0 VDC 2.4 VDC 0.14 VDC
CCT Sq Dis, Input	Logic Low Logic High	0.35 VDC 5.5 VDC
Tx Enable	Logic Low Logic High	2.0 VDC 9.0 VDC
PTT, Input	Logic Low Logic High	0 VDC 13 VDC
Alert Tone	1000 Hz	15 mV PP
Ref. Osc.	13.2. MHz	0.3V PP

CURRENT REFERENCE CHART (Service Plugs)

PLUG	FUNCTION	TYPICAL CURRENT/mA
P701	5V	175
P702	9V	70
P703	9V	Tx 225, Rx 90
P704	9V	Tx 20, Rx 38

TEST POINT DATA

TEST POINT	VOLTAGE	CONTROL	DESCRIPTION
J602-3	9±0.05 VDC	R703	9 Volt Regulator
J202	2.5-8.5 VDC	C220	VCO Control Voltage (See Synth Align)
J712	5.0	----	5-Volt Regulator
TP701	Less than 1.0	L211	Frequency Lock Detector

TEST PROCEDURES

These Test Procedures are designed to assist you in servicing a transmitter that is operating -- but not properly. Once a defect is pin-pointed, refer to the Transmitter Troubleshooting Procedure. Before starting, be sure that transmitter is tuned and aligned to the proper operating frequency.

CAUTION

> Before bench testing the radio, be sure of the output voltage characteristics of your bench power supply.
>
> To protect the transmitter power output transistors from possible instant destruction, the following input voltages must not be exceeded:
>
> Transmitter unkeyed: 20 Volts
>
> Transmitter keyed (50 ohms resistive load): 18 Volts
>
> Transmitter keyed (no load or non-resistive load): 14 Volts
>
> These voltages are specified at the normal vehicle battery terminals of the radio and take the voltage drop of standardrl cables into account. The voltage limits shown for a non-optimum load is for "worst case" conditions. For antenna mismatches likely to be encountered in practice, the actual limit will approach the 18 Volt figure.
>
> Routine transmitter tests should be performed at EIA Standard Test Voltages (13.6 VDC for loads of 6 to 16 amperes; 13.4 VDC for loads of 16 to 36 amperes. Input voltages must not exceed the limits shown, even for transient peaks of short duration.
>
> Many commonly used bench power supplies cannot meet these requirements for load regulation and transient voltage suppression. Bench supplies which employ "brute force" regulation and filtering (such as Lapp Model 73) may be usable when operated in parallel with a 12 Volt automative storage battery.

TEST PROGRAMMING

In DELTA-S radios, in which the EE PROM is not custom programmed (Option AO), the EE PROM is programmed with the personality shown in Table I below.

There are five channels programmed for each band split, the same radio frequency is used to check tone and digital Channel Guard.

RANGE	CHANNEL	TRANSMIT	RECEIVE	CHANNEL GUARD ENCODE	CHANNEL GUARD DECODE	CARRIER CONTROL TIMER
29.7-36 MHz	1A*,1B 2A,2B 3A	33.020 33.020 33.020	33.080 33.050 33.080	71.9 023 ---	71.9 023 ---	--- --- 30 SEC
36-42 MHz	1A,1B 2A,2B 3A	38.920 38.920 38.920	39.050 39.020 39.050	71.9 71.9 ---	71.9 71.9 ---	--- --- 30 SEC
42-50 MHz	1A,1B 2A,2B 3A	45.040 45.040 45.040	45.080 45.050 45.080	71.9 023 ---	71.9 023 ---	--- --- 30 SEC

* Suffix "A" and "B" indicate the operating mode

TABLE 1 - 29.7-50 MHz PROGRAMMED TEST FREQUENCIES

TRANSMITTER ALIGNMENT

TRANSMITTER FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency should be set with a frequency meter or counter with an absolute accuracy that is 5 to 10 times better than the tolerance to be maintained, and with the entire radio as near as possible to an ambient temperature of 25°C (77°F).

NOTE

> When PA is keyed, rapid rising in ambient temperature must be taken into account.

The oscillator frequency shculd be set at 25°C ambient temperature. In the range of 15°C to 40°C, (59°F to 104°F) if the frequency deviates more than ±1 PPM, it may be reset according to Figure 3, Temperature/Frequency Correction Chart.

Adjust L351 to set the transmit frequency while monitoring RF output jack J2 through a 30 dB decoupler.

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST controls are adjusted to the proper setting before shipment and normally do not required readjustment. This setting permits approximately 75% modulation for the average voice level. The audio peaks which would cause overmodulation are clipped by the modulation limiter. The limiter, in conjunction with the de-emphasis network, instantaneously limits the slope of the audio wave to the modulator, thereby preventing over-modulation while preserving intelligibility.

TEST EQUIPMENT

1. An audio oscillator (GE Model 4EX6A10)
2. Deviation Monitor
3. An output meter or a VTVM
4. GE Test Set Model 4EX3A11 with Test Set Adapter Cable 19C850590G1

PROCEDURE

SYNTHESIZER TRANSMIT DEVIATION

1. Select a center frequency channel. Disable Channel Guard, if present.
2. Preset R358 fully CCW.
3. Apply a 1 kHz tone at 1.0 VRMS to mic input jack J603-07. Connect deviation monitor to RF output jack J2 through a 30 dB decoupler. Set VCO DEVIATION ADJUST R237 for rated deviation (±3.75 kHz with Tone or Digital Channel Guard or ±4.5 kHz without Channel Guard).
4. Apply a 300 Hz tone through a 100 uF capacitor to J603-15. Set output level to obtain a deviation of ±1.0 kHz at transmitter output. Note and maintain this voltage level while switching the output frequency to 10 Hz. Adjust REF OSC Deviation Control R358 for ±1.0 kHz deviation.

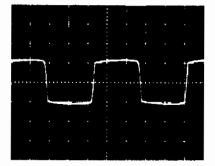
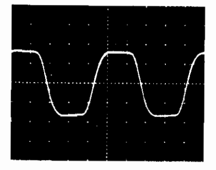
AUDIO CHECKS

TEST EQUIPMENT REQUIRED

- Audio Oscillator
- AC Voltmeter
- Oscilloscope
- Deviation Monitor

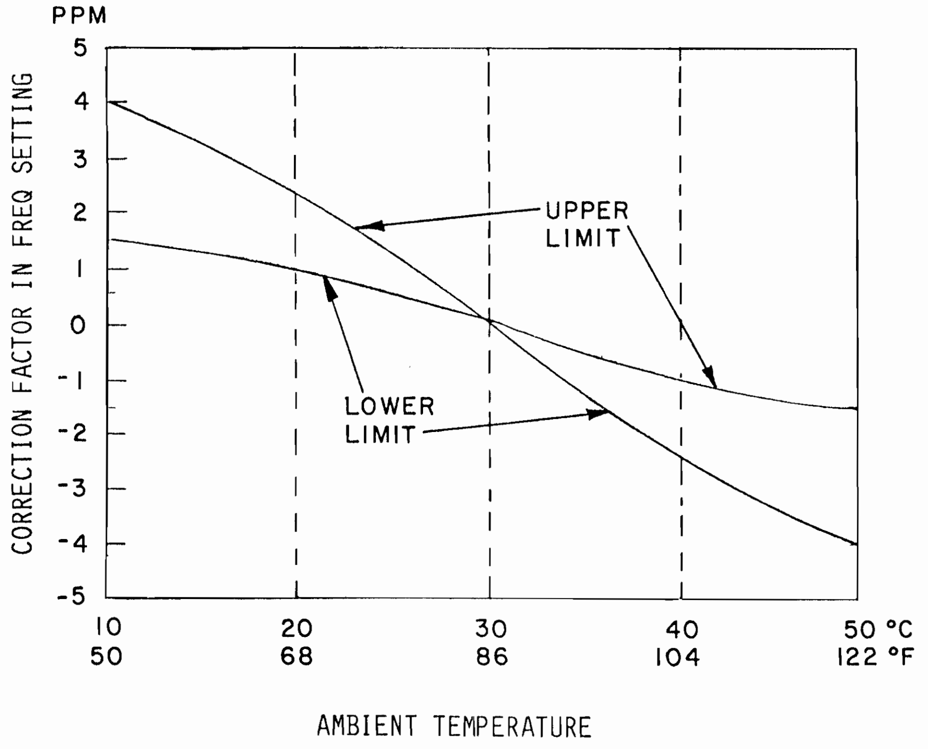
AUDIO AC VOLTAGES

1. Connect audio oscillator output across J603-10 (MIC HI) and J603-16 (MIC LO).

		U301-7	C301-1
SCOPE SETTING	HORIZONTAL	200 U SEC/DIV	200 U SEC/DIV
	VERTICAL	2 VOLTS/DIV	2 VOLTS/DIV
SET AUDIO OSCILLATOR AT 1000 Hz WITH OUTPUT OF 1.0 VRMS. MODULATION ADJUSTED FOR 4.5 kHz DEVIATION. NOTE: AN RMS OR PEAK READING VOLTMETER WILL READ 1/2 TO 1/3 OF PEAK-TO-PEAK READINGS.			

AUDIO SENSITIVITY

1. Connect audio oscillator output across J603-10 (MIC HI) and J603-16 (MIC LO). Adjust output for 1000 Hz at 1.0 VRMS.
2. Reduce generator output until deviation falls to 3.0 kHz for radios without Channel Guard or to 2.25 kHz for radios with Channel Guard. Voltage should be less than 120 millivolts.



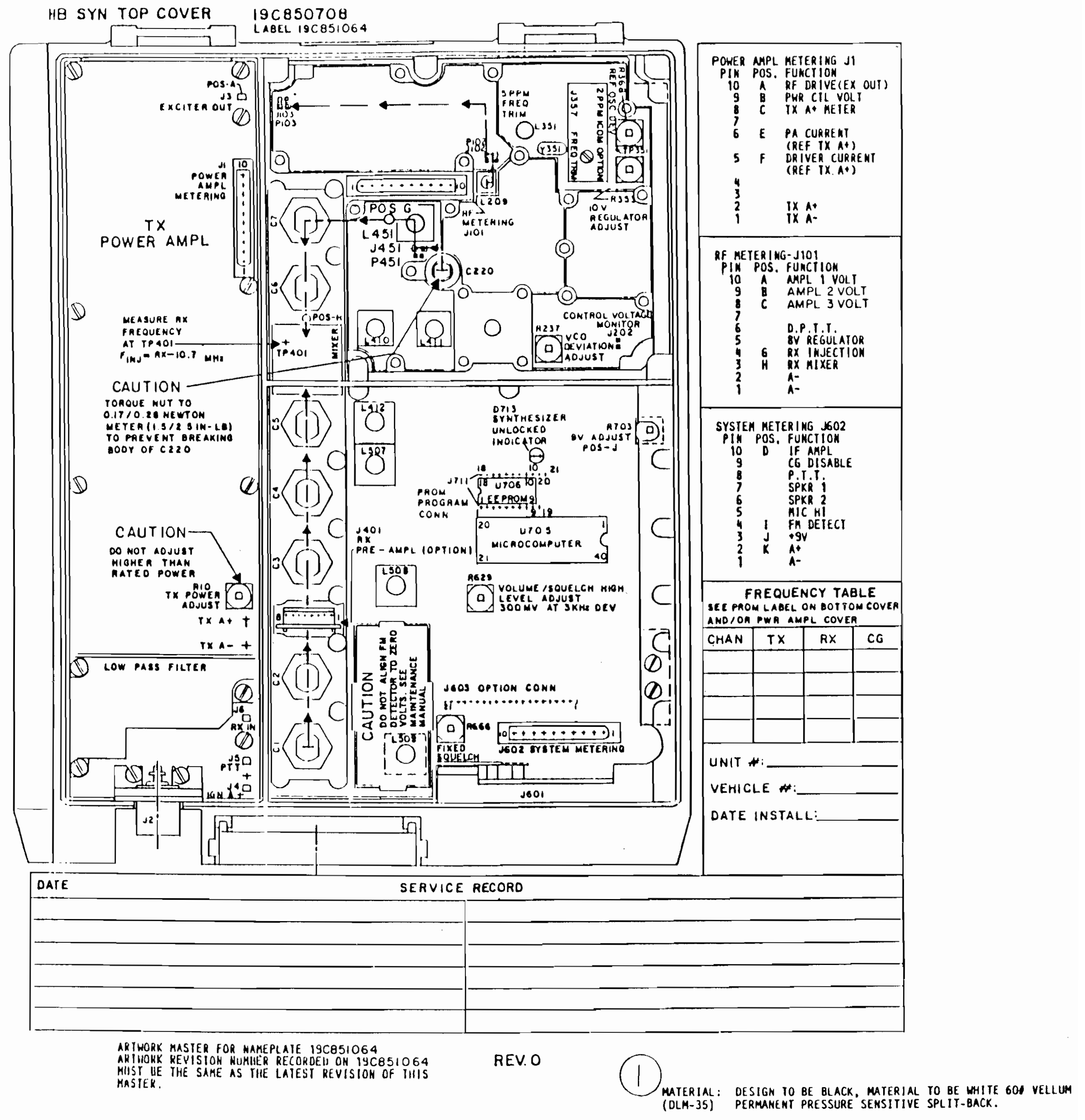


Figure 3 - Transmitter/Receiver Tuning & Adjustment Control

TRANSMITTER ALIGNMENT

TEST EQUIPMENT REQUIRED

1. Wattmeter, 50 ohm (capable of measuring 150 Watts & 1 Watt)
2. DC Voltmeter, 20,000 ohms per volt
3. Digital Voltmeter
4. Power supply, 13.8 VDC regulated
5. GE Test Set, 4EX3A11 with Test Set Adapter Cable 19C850590G1

PRELIMINARY CHECKS AND ADJUSTMENTS

NOTE

Refer to Figure 4 for location of tuning and adjustment controls.

1. Preset the core of L351 (ref osc) to 6.5mm below top of coil form.
2. Apply DC power to radio.
3. Connect black plug of GE Test Set to RF Metering jack J101. Connect red system metering plug to J602, system metering. Set polarity to "+" and voltage range to the 1 volt position (Test 1).

NOTE

Before aligning or making any adjustments to the transmitter, be sure that the output of the 9 Volt regulator is set for 9.0 ±0.05 VDC

4. Apply power to the radio and monitor J602-3 with a digital voltmeter. If necessary, adjust R703 for 9.0 ±0.05 VDC.
5. Verify that reference oscillator frequency is within ±50 PPM of its tuned value (13.2 MHz Standard, 13.8 MHz Alternate).

ALIGNMENT PROCEDURE

STEP	METERING POSITION: GE TEST SET	METERING POSITION: MULTIMETER (- to J101-1)	TUNING CONTROL	METER READING	PROCEDURE
					SYNTHESIZER
					NOTE: Most tuning peaks will be quite broad with small changes in meter readings. Most dips will be sharper. Meter readings given are typical.
1.		TP701	L211	<1.0 VDC	Select highest frequency transmit channel. Tune L211 so that lock detect indicator D713 goes out or the voltage at TP701 is less than 1.0 VDC with no AC pulses present.
2.		J202	L211	7.5 VDC	Monitor J202 with digital voltmeter. Tune L211 for 7.5 VDC ±50 mV.
3.		J202	C220	7.5 VDC	Select receive channel (release PTT switch) and tune C220 for 7.5 VDC ±50 mV at TP201. Verify that lock indicator D713 goes out.
4.		J202		3.0-7.5 VDC	Select lowest frequency channel. Voltage should be between 3.0 - 7.5 VDC transmit and 3.5-7.5 VDC receive for the lowest and highest frequency channels.
5.		J101-10, J101-3		5-20 dBm	Monitor TX injection at J101-10 and Rx injection at J101-3. (NOTE: Terminate TX VCO output with 50 ohms to maintain lock with plug removed). Tx injection +10 to +20 dBm Rx injection +5 to +15 dBm

ALIGNMENT PROCEDURE (Cont'd)

STEP	METERING POSITION: GE TEST SET	METERING POSITION: MULTIMETER	TUNING CONTROL	METER READING	PROCEDURE
					REFERENCE OSCILLATOR FREQUENCY
					NOTE: Be sure the top and bottom covers of the synthesizer casting are in place before making the reference oscillator adjustment.
6		J101-10	L351	Channel Operating Frequency	Monitor Tx injection frequency at J103 or PA output. P103 should be terminated in 50 ohms when used as the monitoring point. If the PA is keyed rapidly rising temperatures must be considered. Refer to Figure 3, Temperature/Frequency Correction Chart. Note: The receiver injection frequency will automatically be correct.
					EXCITER
					NOTE: The exciter can be isolated from the Power Amplifier for servicing, if desired. To isolate the exciter disconnect P103. Connect a (0-1 watt) wattmeter to P103-2,4.
7.				250 mw	Connect a 0-1 Watt wattmeter to P101 (exciter output). Meter should read 250 mw minimum. No tuning is required.
					POWER AMPLIFIER
8.		ANT. JACK J2 Wattmeter	R19/R21	Rated Output Power	Check power output at both ends of the frequency spread. It should be equal to or greater than rated power. Adjust R19 (60-Watt PA) or R21 (110-Watt PA) on power amplifier board for rated output power. Tuning is not required.

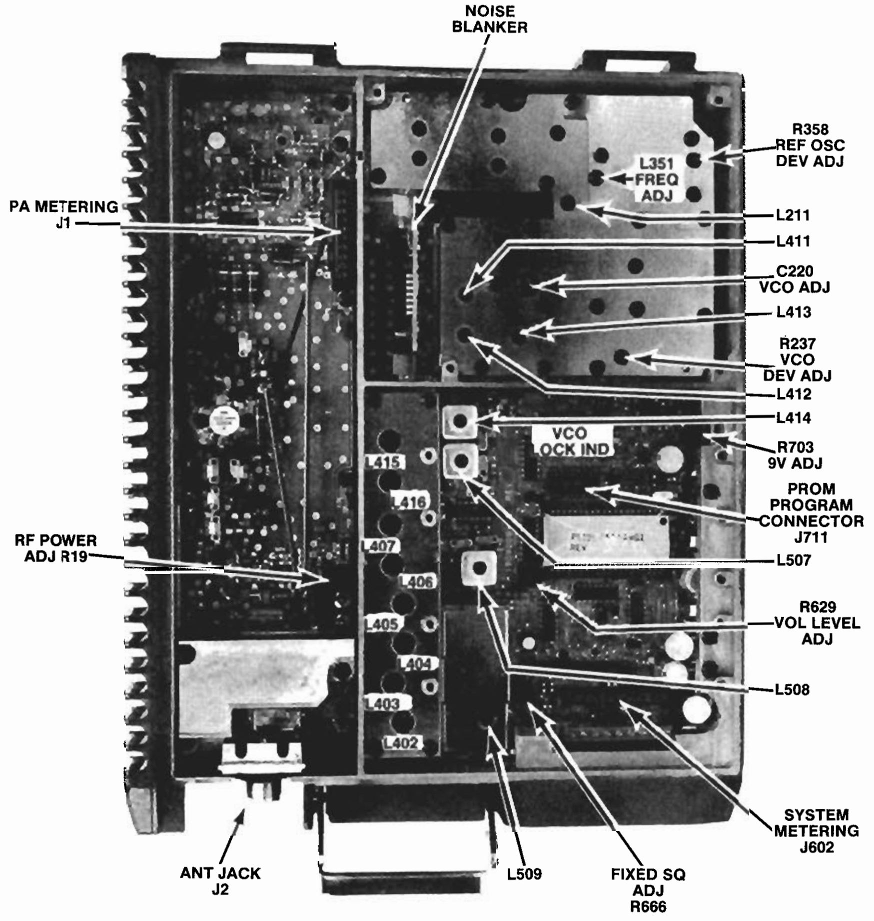
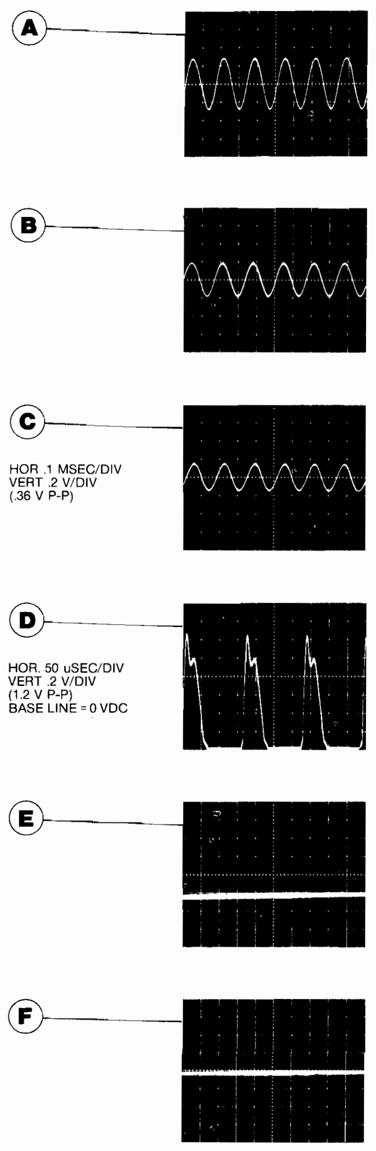


Figure 4 - Location of Tuning & Adjustment Controls

SQUELCH CIRCUIT TEST WITH kHz SIGNAL

PRELIMINARY STEPS

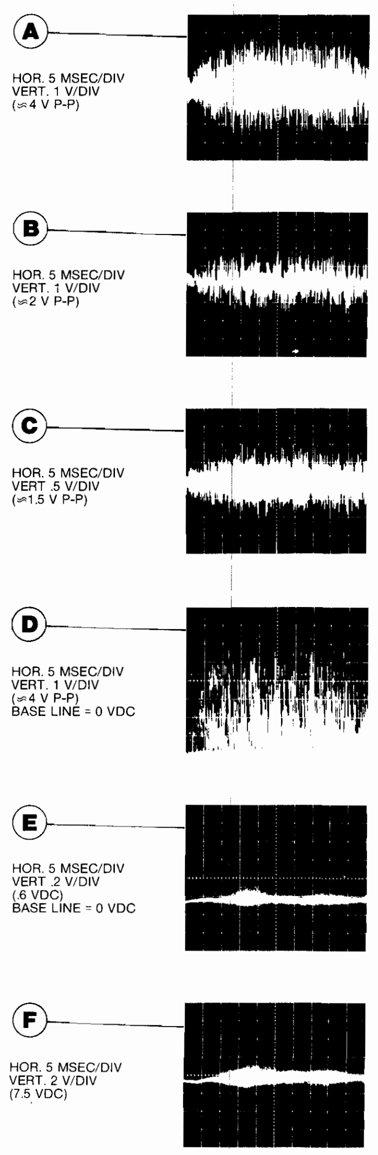
1. Quiet receiver with 1000 uv modulated signal applied to antenna jack J2.
2. Squelch Adjust R666 to 8 dB SINAD.
3. Set modulation to 6 kHz.
4. Set deviation to 3 kHz.
5. Use 10 megohm probe.



SQUELCH CIRCUIT CHECKS WITH NOISE

PRELIMINARY STEPS

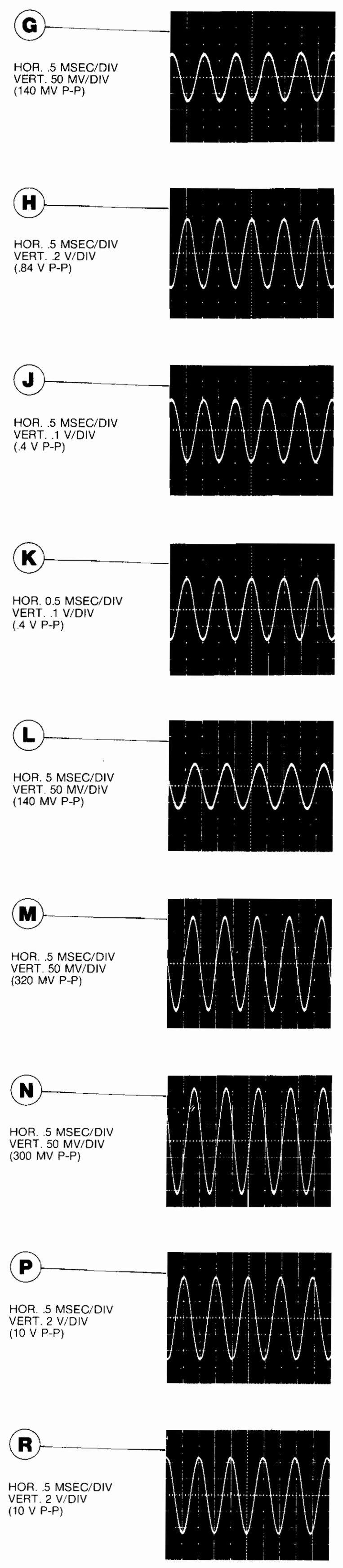
1. No input signal applied.
2. Squelch Adjust R666 set for 8 dB SINAD.
3. Use 10 megohm probe.



AUDIO CIRCUIT

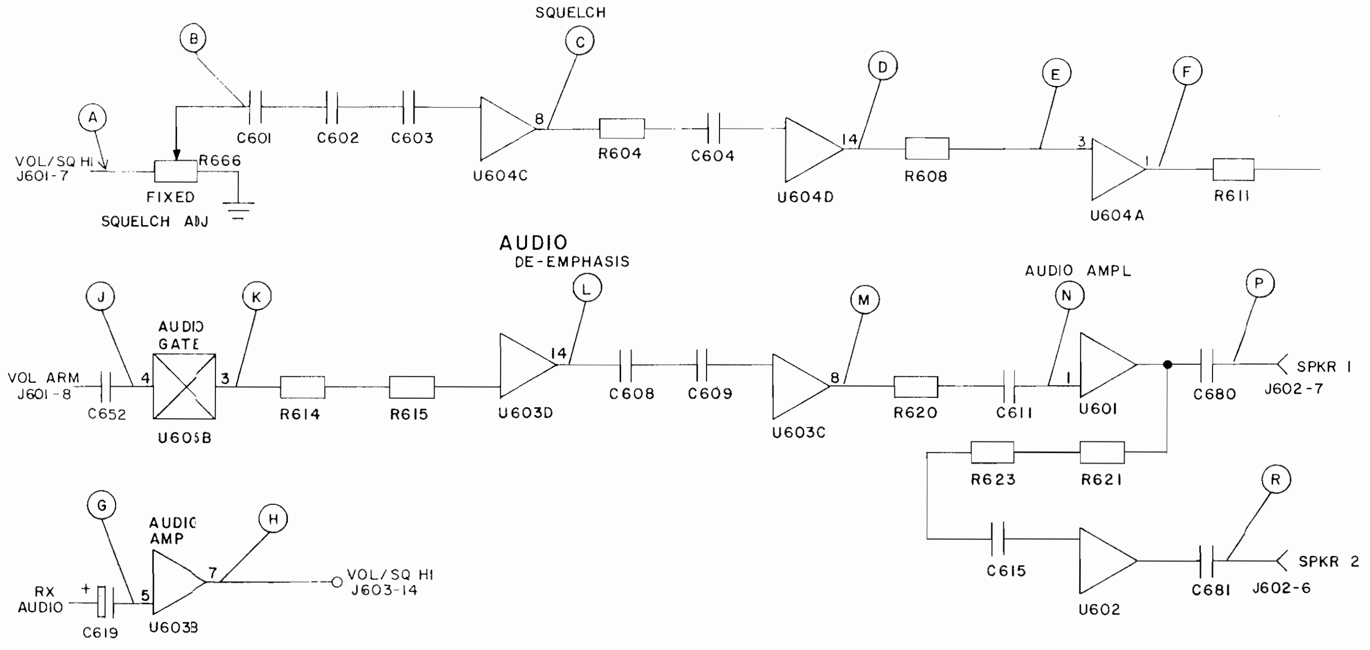
PRELIMINARY STEPS

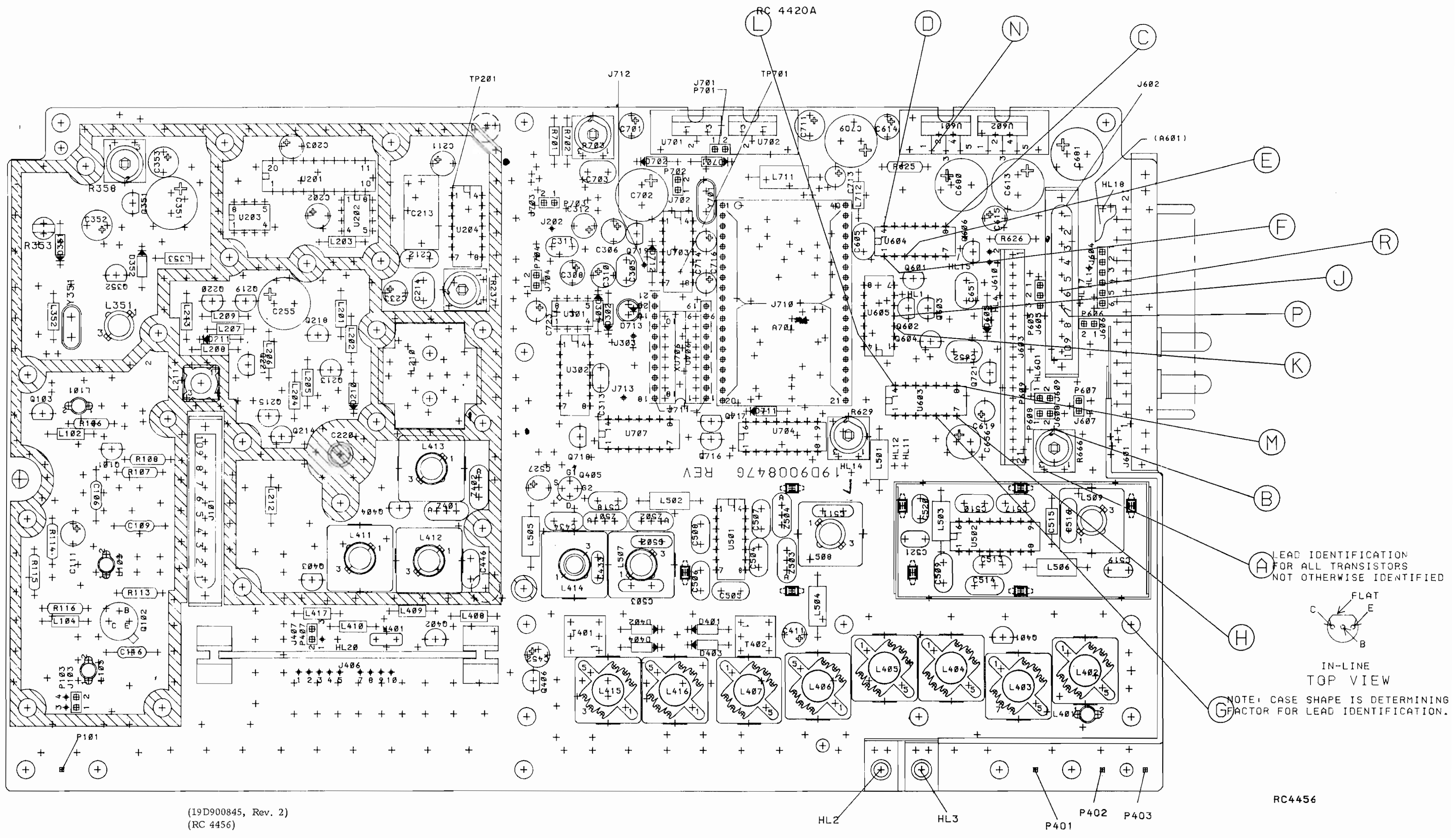
1. Apply 1000 uV on frequency signal with 1000 Hz modulation and 3 kHz deviation to antenna jack J2.
2. Output set to 12 Watts (6.93 VRMS) into 4-ohm load.
3. Use 1 megohm probe.



RECEIVER AUDIO AND SQUELCH WAVEFORM CHECKS

AUDIO AND SQUELCH WAVEFROMS





(19D900845, Rev. 2)
(RC 4456)

RECEIVER FREQUENCY ADJUSTMENT

(Refer to Transmit Frequency Adjustment, no receive frequency adjustment is required)

ALTERNATE IF SWEEP ALIGNMENT

1. Attach an oscilloscope probe to IF AMP. MTR. (J602-10). (Refer to Figure 5).
2. Using an HP8640B signal generator, set with an on-channel frequency, feed a 20 Hz modulating frequency with 12 kHz of deviation into the radio at antenna jack J2.
3. Connect a coaxial cable between the AM output of the HP8640B and the external 10 trigger signal on the scope. Use NORMAL triggering.
4. DC couple the scope probe and adjust the controls for 0.1V per div. and 2 msec per div.
5. Adjust the AM output level to make sure the scope is triggering. Adjust the RF input signal level to keep the IF passband sweep pattern just below saturation (typ. 9 uV). After using the vertical and horizontal positioning controls to center the waveform, check for a scope pattern similar to the one below:

SERVICE NOTE: L410, L411, L412, L507, and L508 should be tuned to peak the IF passband, and minimum ripple should be present in the passband.

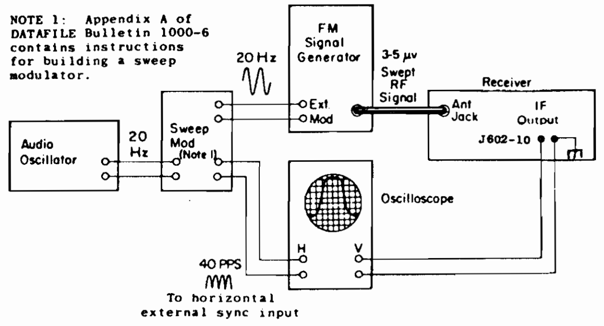


Figure 5 - Test Setup for 20 Hz Double-Trace Sweep Alignment

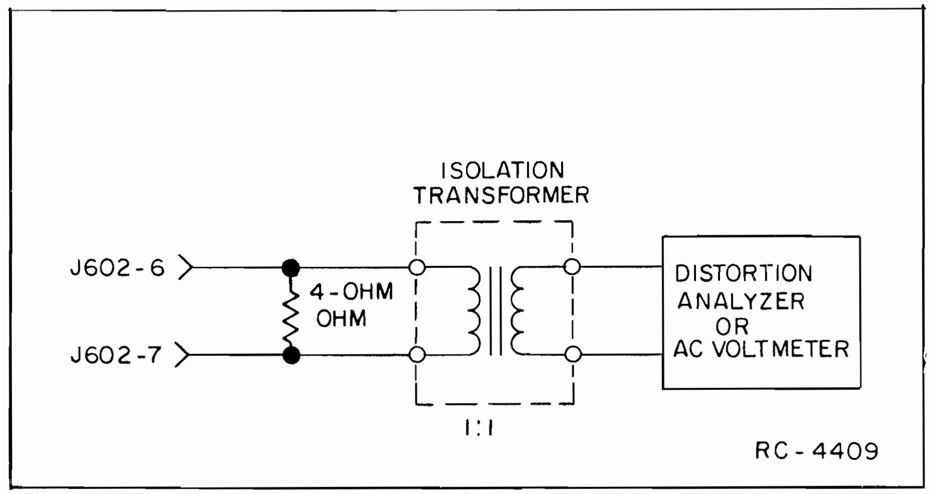


Figure 6 - Test Set-up, Audio Output Measurement

RECEIVER ALIGNMENT

TEST EQUIPMENT REQUIRED (Or Equivalent)

1. GE Test Set 4EX3A11, 4EX8K12, or 20,000 ohms-per-volt millimeter with 1 volt scale
2. AC Voltmeter
3. FM Deviation Monitor (29.7-50 MHz)
4. DC Voltmeter (10 M ohms/volt)
5. DC (2,000 ohms per volt)
6. RF Signal Generator (19.7-50 MHz)
7. Frequency Counter (29.7-50 MHz).
8. Oscilloscope
9. Audio Isolation Transformer (1:1) 19A116736P1 or equivalent.
10. 4 ohm 15 watt resistor.

PRELIMINARY CHECKS AND ADJUSTMENTS

NOTE

Refer to Figure 4 for location of tuning and adjustment controls.

1. Connect the black plug from the Test Set to the RF metering jack J101. Connect red system metering plug to J602, system metering. Set Test Set to 1 volt scale. A 20,000 ohms-per-volt multimeter may be used when the GE Test Set is not available.
2. Preset L402-L407, L415, and L416 flush with top of coil form.
3. Preset L411-L414, L507 and L508 to top of coil form and then turn clockwise 9 full turns.
4. Apply power to radio and monitor the regulated 9 volt supply at J602-3. Adjust R703 if necessary to obtain 9±0.01 VDC. Use a digital multimeter.

NOTE

Before aligning the receiver or making any adjustments to the radio be sure thavt the output of the 9 volt regulator is set for 9.0±0.1 VDC.

5. If the radio is equipped with the noise blanker option be sure P407 is installed on J407-2,3.

NOTE

If installing the Noise Blanker Option board, cut jumper W401 and plug option board into J406 (be sure plug is installed on J407-2,3). Set RF generator as specified in Step 6 and peak L411 and L412 with Test Set in Pos. D.

ALIGNMENT PROCEDURE

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE TEST SET	MULTIMETER			
					LOCAL OSCILLATOR-BUFFER INJECTION
1.	H (RX INJ)	J101-3	L415	Minimum	Select desired channel or test frequency. Set Test Set to 1 volt scale and tune L415 for minimum reading on Test Set.
2.	H (RX INJ)	J101-3	L415,L416	Peak/Dip	Peak L416 then dip L415 again. This dip may be small. Do NOT retune L416.
					FRONT END ALIGNMENT
3.	D (IF AMP)	J602-10	L402	MAX	Connect RF signal generator to antenna jack J2. Set frequency to desired receive channel or center tune frequency. Set modulation frequency to 1 kHz and deviation to 3 kHz. Set input level to 0 dBm (225 mV). Tune L402 for maximum indication on meter while reducing the input level of the signal generator as required to keep the IF AMP reading from saturating. (0.6 V typical).
4.	D (IF AMP)	J602-10	L402-L407	Peak	NOTE: At some frequencies a definite peak at L407 may not be noticable. If this occurs, tune L407 to the point where maximum is just reached. Peak L402-L407 in sequence while reducing output level of signal generator to prevent saturation.
					IF SELECTIVITY
					NOTE: If the IF amplifiers have been aligned using the alternate sweep alignment method, proceed to Step 9.

ALIGNMENT PROCEDURE (Cont'd)

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE TEST SET	MULTIMETER			
5.	D (IF AMP)	J602-10	L508, L507, L411, L412, L413, L414	Maximum (See Procedure)	Select a center frequency channel. Apply an on-frequency signal with 1 kHz modulation to antenna jack J2. Set deviation to 3 kHz. Reduce signal level to approximately 75% of saturated level shown on Test Set meter. While making the following adjustments keep the signal level below saturation. Tune L508, L507, L414, L413 and L412, in that order, for a peak reading. Peak L411. Repeak coils in sequence until no further improvement is noted.
					FM DETECTOR/AUDIO PREAMPLIFIER
6.			L509	0.35 - 0.5 VRMS	NOTE: The audio output is a balanced bridge circuit and requires all test equipment connected across the speaker leads to be both AC and DC isolated from ground. See Figure 6. Set R629 fully clockwise. Monitor the speaker outputs (J602-6,7) with an AC voltmeter. Tune quadrature coil L509 for a peak reading.
7.		J603-14	R629		Adjust R629, audio preamplifier level for a nominal 300 mV RMS at VOL/SQ HI.
					FIXED SQUELCH ADJUSTMENT (8 dB SINAD)
8.			R666		Adjust fixed squelch control R666 fully clockwise (open squelch). Adjust input level of RF Signal Generator to produce a SINAD sensitivity reading of 8 dB. Turn R666 fully counterclockwise (maximum squelch position) to close squelch. Slowly readjust R666 to the position where the squelch just opens. Check that squelch opens at 8 dB (±1 dB).
					MULTI-FREQUENCY CHANNEL SPACING (OMIT FOR SINGLE CHANNEL)
9.	D (If AMP)	J602-10	L403		Select a center frequency channel. Apply an on-frequency signal with 1 kHz modulation to antenna jack J2. Set deviation to 3 kHz. Reduce signal level to approximately 75% of saturated level shown on Test Set meter. Detune L403 at least three turns clockwise for center tune frequencies above the midpoint of a particular frequency split or counterclockwise for frequencies below the midpoint of a particular frequency split. Increase or decrease signal generator level as required to maintain 75% of the saturated signal level.
10.	D (IF AMP)	J602-10	L402		Peak L402. Adjust level of signal generator as necessary to maintain 75% of saturated level.
11.	D (IF AMP)	J602-10	L403-L407		Detune L404 as directed for L403 in Step 10 above. Peak L403. Detune L405, peak L404. Detune L406, peak L405. Detune L407, peak L406. Peak L407.

TEST PROCEDURE

These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

- Distortion Analyzer
- Signal Generator
- 6 dB attenuation pad
- Audio Isolation Transformer
- 4 ohm resistor (15 watt minimum)

PRELIMINARY ADJUSTMENTS

NOTE

These procedures are written around the Heathkit Distortion Analyzer. If a Distortion Analyzer other than the Heath IM-12 is used, measure the sensitivity and modulation acceptance bandwidth in accordance with manufacturer's instructions.

1. Unsquelch the receiver.

STEP 1

AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power Output as follows:

A. Apply a 1000 microvolt, on-frequency test signal modulated by 1,000 Hz with ±3.0 kHz deviation to antenna jack J2.

B. With 12 Watt Speaker

Disconnect speaker lead pins from J1A-36 and 37 on rear of control unit. Connect a 4.0 ohm, 15 Watt load resistor across system metering jack J602-6 and 7 on the TRS board.

Connect the isolation transformer input across the resistor. Connect the isolation transformer output to the Distortion Analyzer (See Figure 5).

C. Adjust the VOLUME control for 12 Watts output 6.93 VRMS using the Distortion Analyzer as a voltmeter.

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 3%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 3%, or maximum audio output is less than 12 Watts, make the following checks:

E. Battery and regulator voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

F. Audio Gain (Refer to Receiver Troubleshooting Procedure).

G. FM Detector Alignment (Refer to Receiver Alignment).

STEP 2

USABLE SENSITIVITY (12 DB SINAD)

If STEP 1 checks out properly, measure the receiver sensitivity as follows:

A. Apply a 1000 microvolt, on-frequency signal modulated by 1000 Hz with 3.0 kHz deviation to J601.

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000 Hz distortion range position (1000 Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. Set signal generator output to 0.3 uV. Switch the RANGE control from SET LEVEL to the distortion range. Readjust Distortion Analyzer SET LEVEL as required until a 12 dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12 dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specifications with an audio output of at least 6 Watts (49 Volts RMS across the 4.0 ohm receiver load using the Distortion Analyzer as a Voltmeter).

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the RF stages as directed in the Alignment Procedure.

STEP 3

MODULATION ACCEPTANCE BANDWITH (IF BANDWITH)

If STEPS 1 and 2 check out properly, measure the bandwidth as follows:

A. Reduce audio output level to 10% of rated output.

B. Set the Signal Generator output for twice the microvolt reading obtained in the 12 dB SINAD measurement.

C. Set the Range control on the Distortion Analyzer in the SET LEVEL position (1000 Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

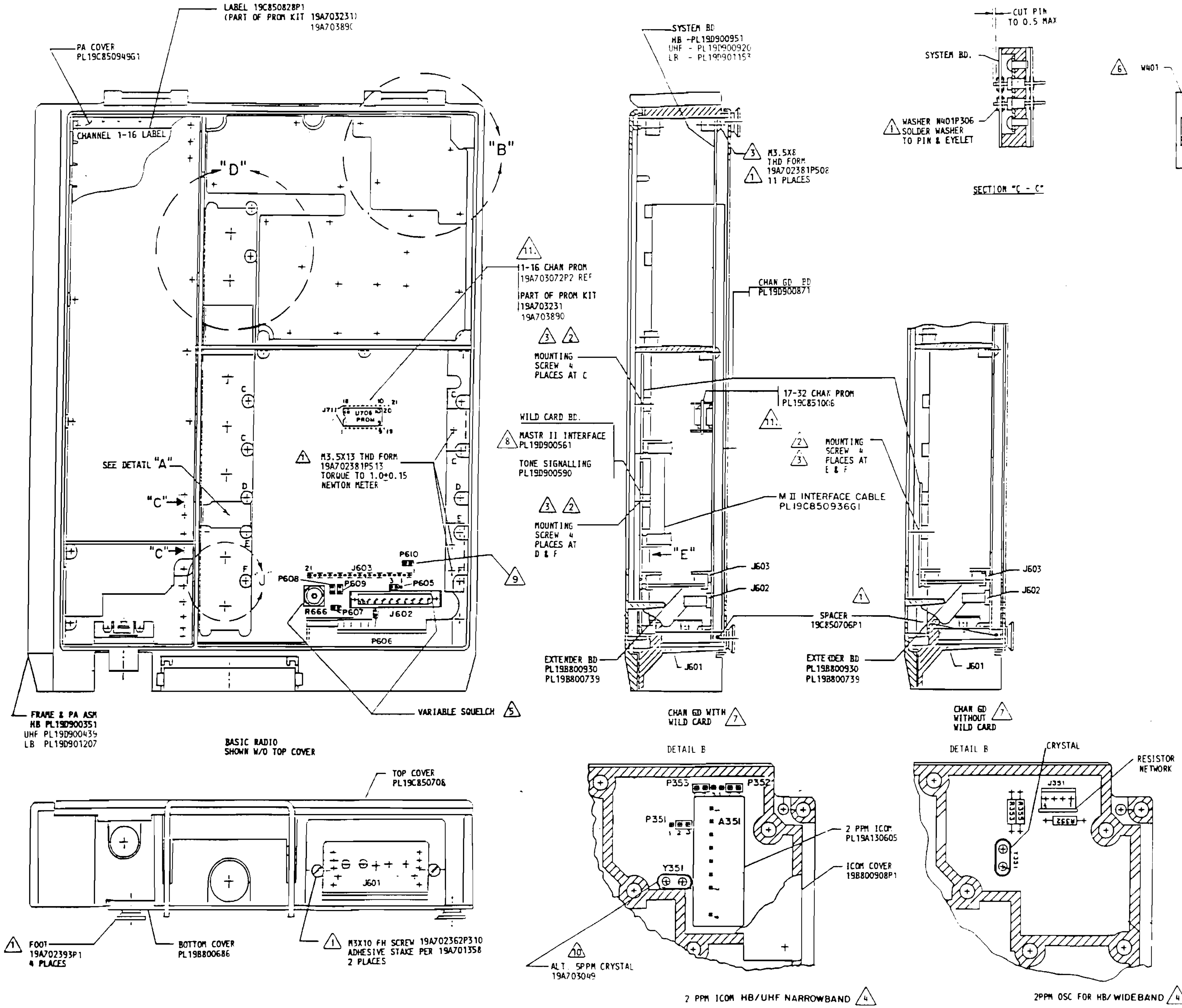
D. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12 dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

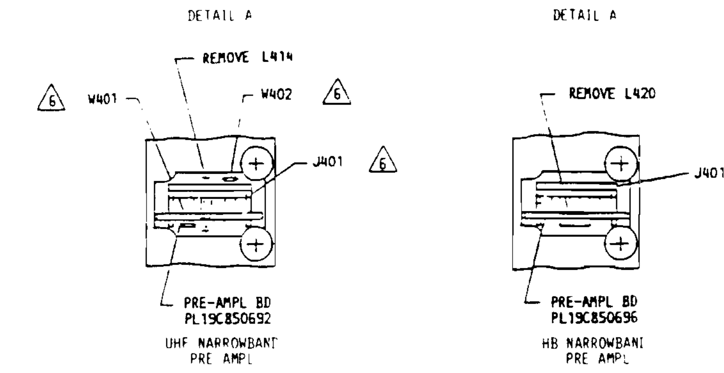
E. The deviation control reading for the 12 dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±7.0 kHz.

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, check the synthesizer frequency and then refer to the Alternate IF Sweep Alignment Section of the Receiver Alignment Procedure.

RECEIVER TEST PROCEDURE





NOTES:

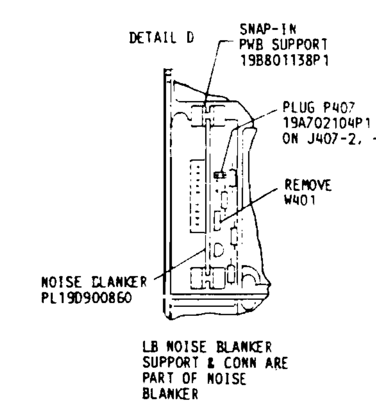
1. PART OF HARDWARE KIT PL19A702024.
2. MOUNTING SCREWS FOR CHANNEL GUARD/WILD CARD ARE CAPTIVE TO EACH BOARD.
3. TORQUE M3.5 SCREWS TO 1.75±0.15 NEWTON METER.
4. REMOVE EXISTING COVER 19B800908P2 AND REMOVE 5 PPM CRYSTAL Y351. MOVE P351, P352, P353 TO POSITION SHOWN IN DETAIL "F". PLUG-IN 2 PPM ICOM. INSTALL ICOM COVER USING EXISTING SCREWS: TORQUE SCREWS PER NOTE 3.
5. FOR VARIABLE SQUELCH, REMOVE R666 AND MOVE P605 TO J605-2 & 3.
6. PART OF UHF PER-AMPL 19C850692.
7. P607 THRU P609 PLUGS ON SYSTEM BD. SHALL BE REMOVED WHERE "X" IS SHOWN BELOW. W3, W4 AND W8 ARE JUMPERS ON THE TONE SIGNALING OPTION BOARD.

DESCRIPTION	P607	P608	P609	W3	W4	W8
CHANNEL GUARD		X				
TONE SIGNALING OPTION	X	X	X	X		
CG, TONE SIGNALING OPTION	X	X	X	X		X

8. WHEN USING THE MASTR II INTERFACE BD. REMOVE P608 ON THE SYSTEM BD. THE MASTR II INTERFACE BOARD IS ASSEMBLED WITH ALL JUMPERS PRESENT. "X" INDICATES THAT THE JUMPER OR PART IS REMOVED. P3 IS LOCATED ON THE CHANNEL GUARD BOARD. P609 IS LOCATED ON THE SYSTEM BD.

APPLICATION	W1	W2	W3	W4	W5	W6	R5	P3	P609
STANDARD (NO OPTION PRESENT)		X	X			X			
DELTA CG	X		X			X	X		X
MASTR II CG ENCODER		X				X			
DELTA CG DECODER MASTR II CG ENCODER	X					X		X	X
VOICE OVER-RIDE	X		X	X	X				X

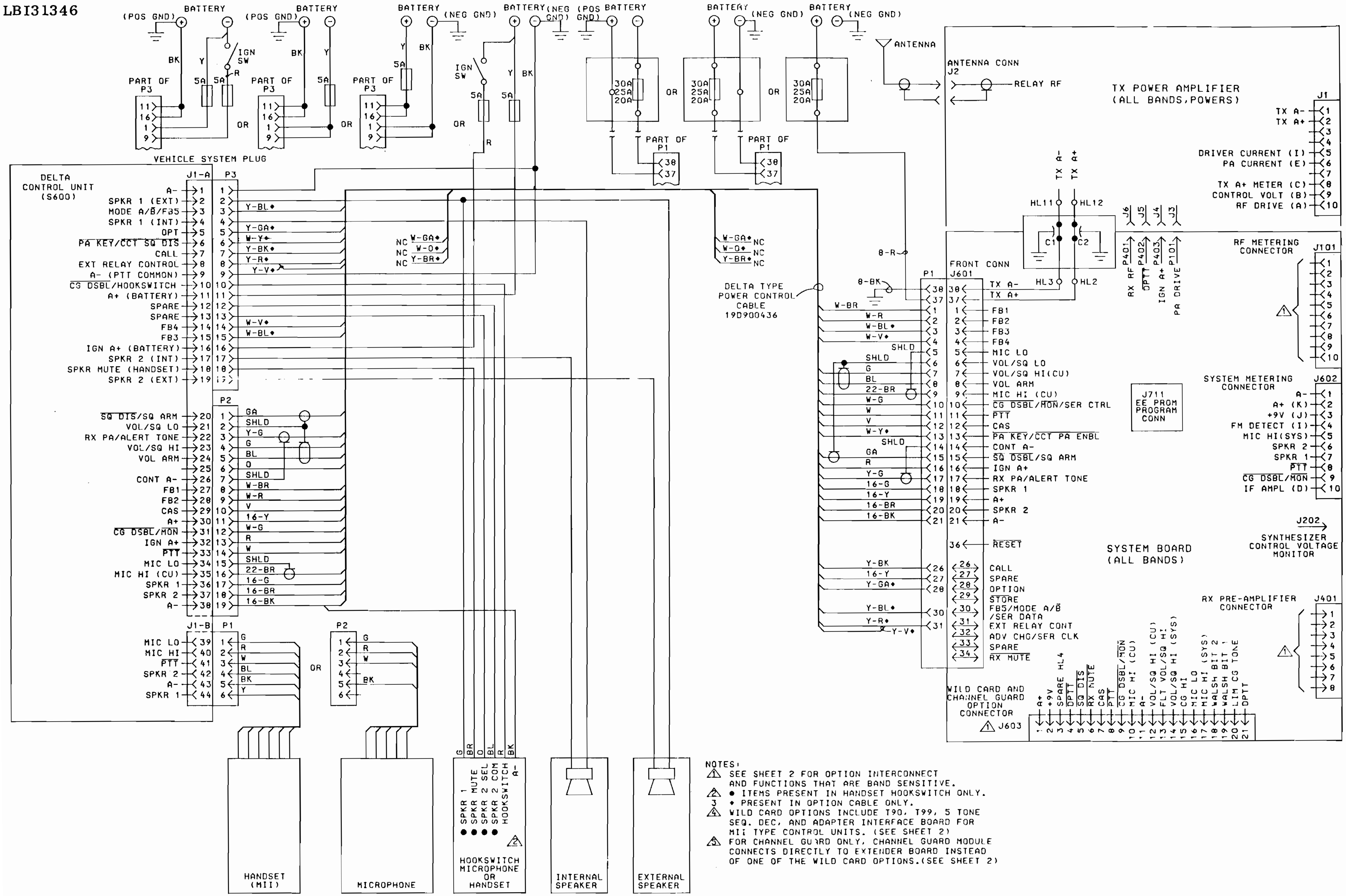
9. ADD P610 WHEN PUBLIC ADDRESS OPTION IS PRESENT IN CONTROL UNIT. P610 IS PART OF HARDWARE KIT PL19A702024.
10. REMOVE ICOM COVER. REMOVE EXISTING Y351 AND INSTALL ALTERNATE CRYSTAL. INSTALL ICOM COVER USING EXISTING SCREWS: TORQUE SCREWS PER NOTE 3.
11. THE FOLLOWING ARE ELECTROSTATIC SENSITIVE DEVICES REQUIRING SPECIAL CARE. U706 (1-16 CHANNEL PROM) AND U1 (17-32 CHANNEL PROM).
12. REMOVE EXISTING COVER 19B800908P2. REMOVE 5PPM CRYSTAL Y351. REMOVE R352, R353, R355. PLUG-IN RESISTOR NETWORK AND CRYSTAL SUPPLIED IN KIT 19C851230. REPLACE COVER USING EXISTING SCREWS. TORQUE SCREWS PER NOTE 3.



RC 4448A

MECHANICAL LAYOUT DIAGRAM

(19D900977, Sh. 1, Rev. 3)

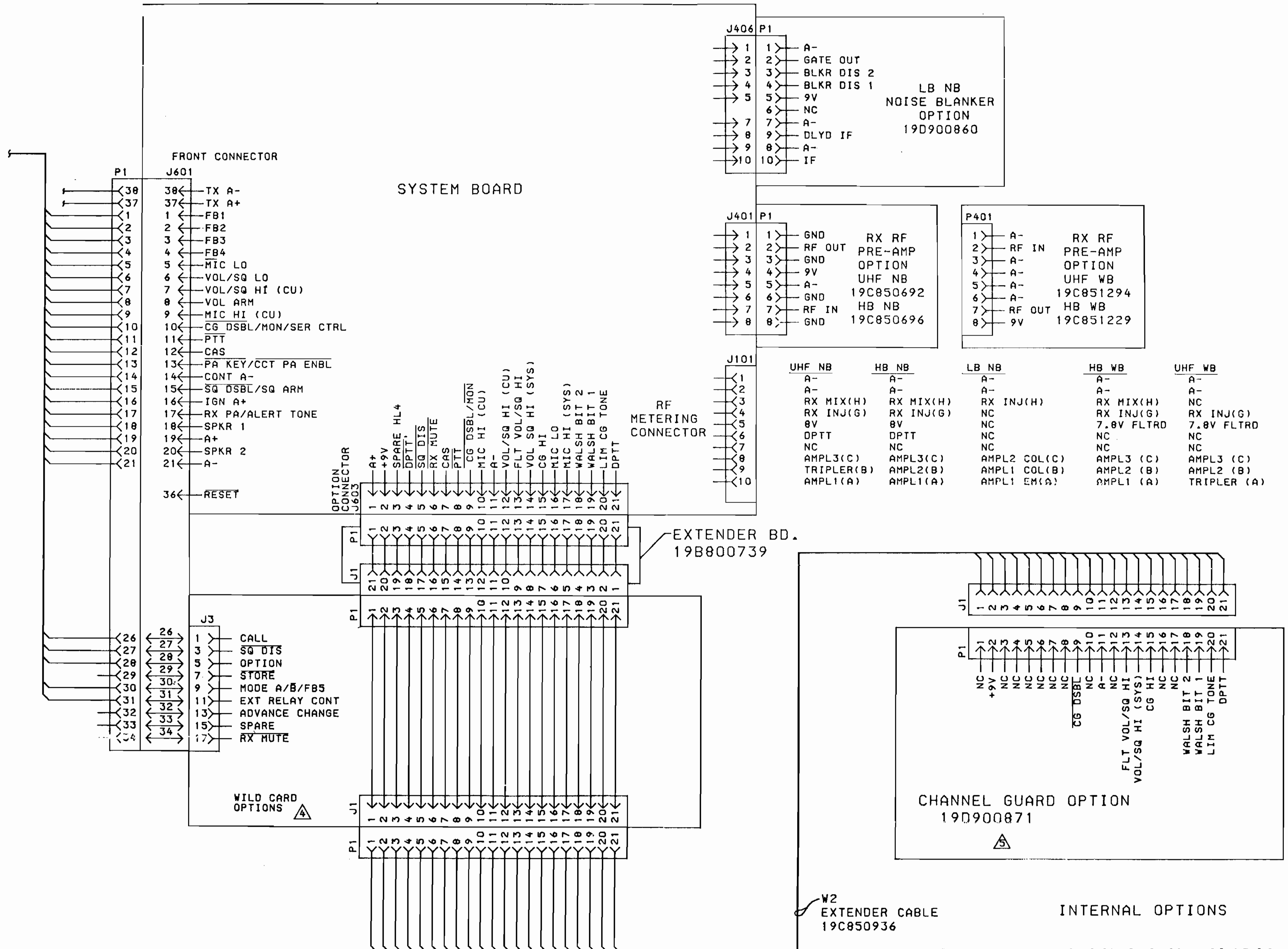


NOTES:

1. SEE SHEET 2 FOR OPTION INTERCONNECT AND FUNCTIONS THAT ARE BAND SENSITIVE.
2. ● ITEMS PRESENT IN HANDSET HOOKSWITCH ONLY.
3. ♦ PRESENT IN OPTION CABLE ONLY.
4. WILD CARD OPTIONS INCLUDE T90, T99, 5 TONE SEQ. DEC, AND ADAPTER INTERFACE BOARD FOR MII TYPE CONTROL UNITS. (SEE SHEET 2)
5. FOR CHANNEL GUARD ONLY, CHANNEL GUARD MODULE CONNECTS DIRECTLY TO EXTENDER BOARD INSTEAD OF ONE OF THE WILD CARD OPTIONS. (SEE SHEET 2)

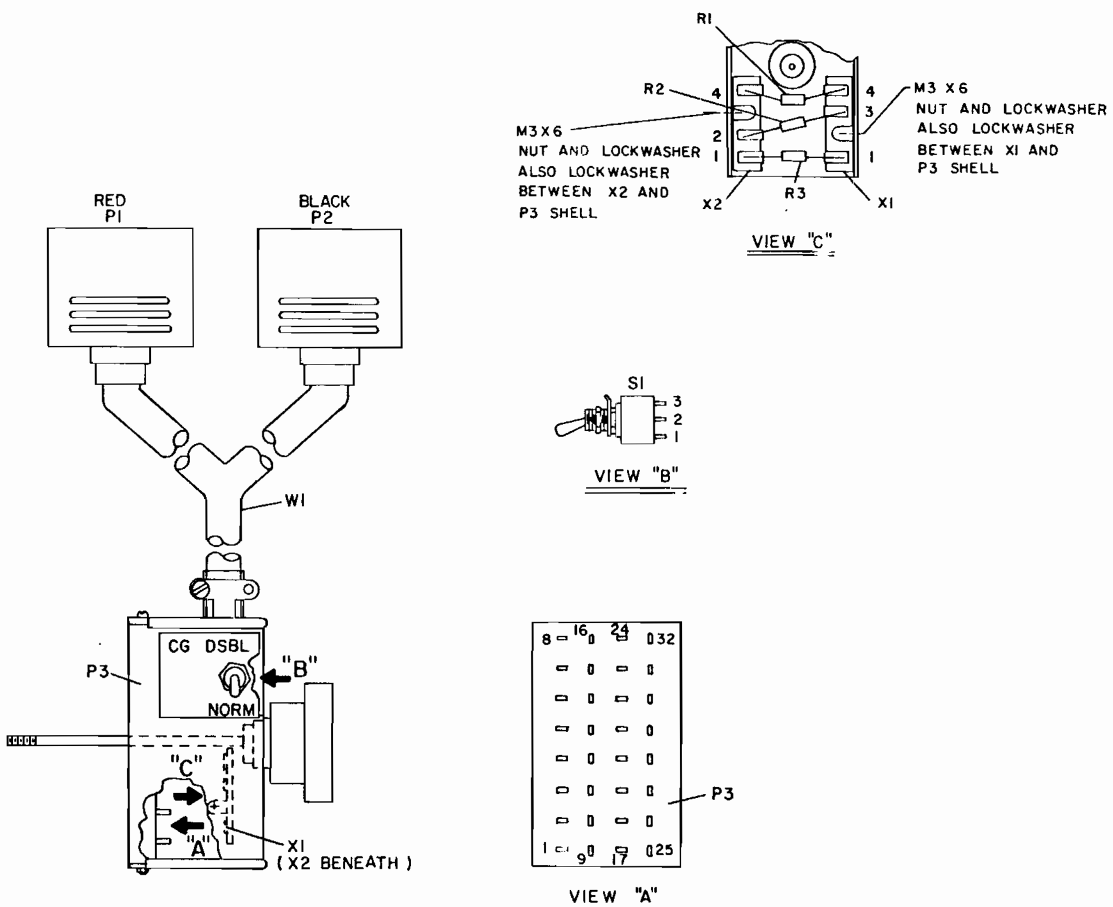
RADIO INTERCONNECTION DIAGRAM

(19D900980, Sh. 1, Rev. 2)

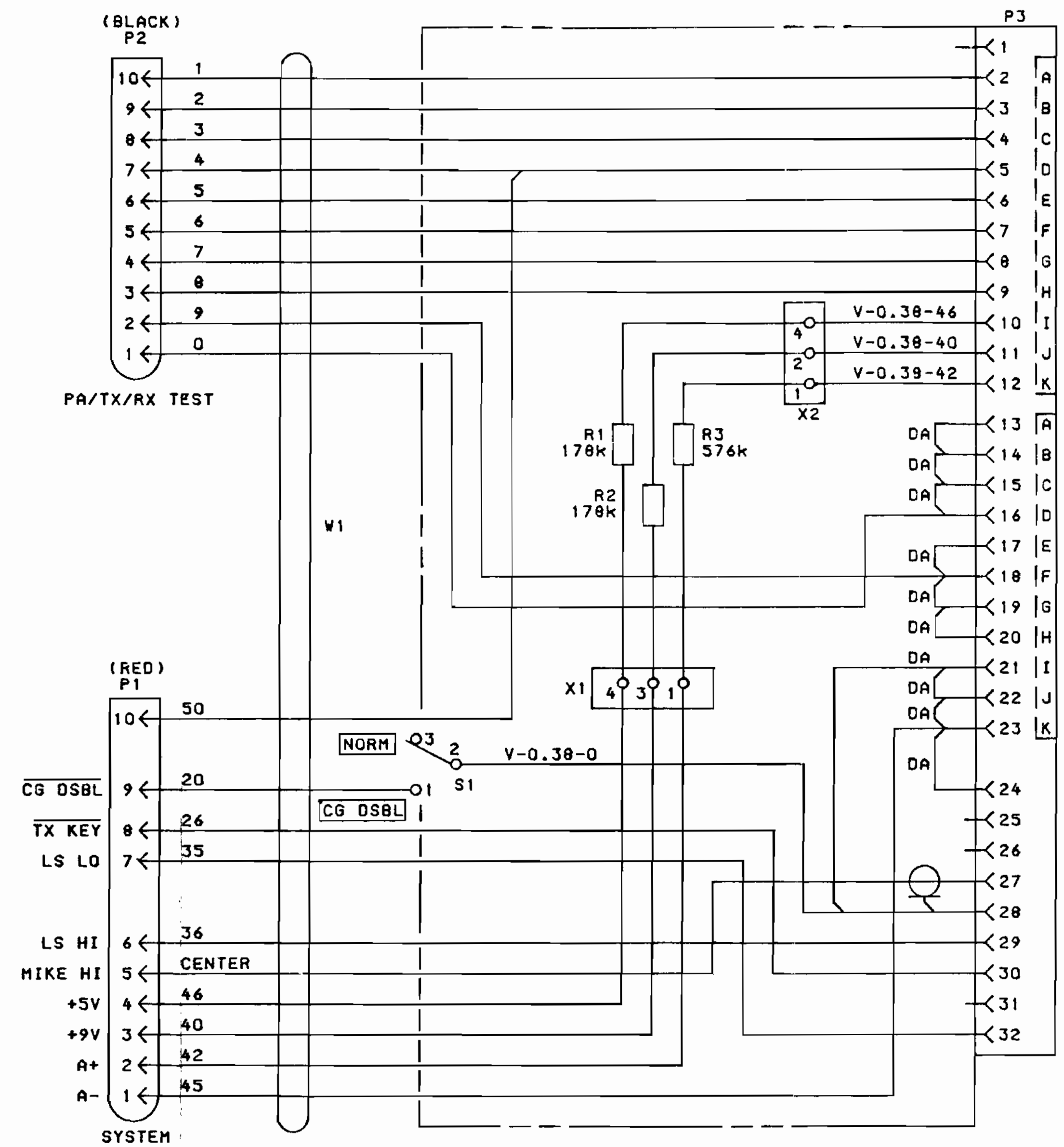


OPTION INTERCONNECTION DIAGRAM

(19D900980, Sh. 2, Rev. 1)



(19C850843, Rev. 0)



ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER μ, n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR μ.

(19C850593, Rev. 3)

SERVICE SHEET

Test Set Adapter Cable
Delta-S

MAINTENANCE MANUAL

29.7-50 MHz TRANSMITTER/RECEIVER/SYNTHESIZER ASSEMBLY 19D901153G1-3

TABLE OF CONTENTS

DESCRIPTION

The transmitter/receiver/system board (TRS) for DELTA-S provides all functions necessary for two-way communications in the 29.7-50 MHz range. The TRS board is provided in three groups. TRS board 19D901153G1 is used in radios operating in the 29.7-36 MHz range, 19D901153G2 operates in the 36-42 MHz range, and 19D901153G3 operates in the 42-50 MHz range. Maximum channel separation for each frequency split is shown in Table 1.

The TRS board contains the transmitter (less PA) and receiver circuitry, microcomputer and EE PROM, frequency synthesizer, audio processor, and voltage regulators. The microcomputer controls all system functions, supplies frequency data to the frequency synthesizer, and tone/code data to the Channel Guard option board. All RF frequencies are generated by the frequency synthesizer.

The transmitter PA is mounted on a separate board located along the side of the radio near the heat sink assembly.

The TRS board is controlled by the control unit. The control unit interconnects with the radio by a power/control cable connected to front connector J601.

In addition to the normal radio functions, the microcomputer contains self diagnostic routines to aid in troubleshooting the radio. Included are internal tests of the microcomputer and input/output tests to assure proper operation of the data port and data bus. Diagnostic and Troubleshooting Procedures are included in the Service Section of this manual.

Centralized metering jacks are accessible from the top of the radio, and provide access for system, RF and PA metering.

CIRCUIT ANALYSIS

SYSTEM CONTROL & INTERFACE

The system control and interface circuits consist of the microcomputer, electrically eraseable PROM (EE PROM), interface circuits for voltage shifting

FREQUENCY SPLIT (MHz)	NO CENTER TUNING	W/CENTER TUNING	W/CENTER TUNING 1 dB DEGRADATION
29.7-36	0.5 MHz	1.0 MHz	1.5 MHz
36-42	0.625 MHz	1.25 MHz	1.75 MHz
42-50	0.75 MHz	1.5 MHz	2.0 MHz

TABLE 1 - Maximum Channel Separation

and protection and a watchdog timer. The EE PROM gives the user the capability to program or reprogram the radio's personality as desired. The EE PROM contains the receive and transmit frequency data, Channel Guard tone frequencies/digital codes and the CCT delay on a per channel basis.

NOTE

The EE PROM may be programmed serially through the front connector using the General Electric Universal Radio Programmer Model TQ2310.

The TRS board also provides access for parallel loading (through program connector J111) on a per channel basis using the General Electric MIN•E^2 Programmer, the 4EX22A10.

The microcomputer interfaces with the control unit through J601, responding to all user commands and control functions originating from the control unit. It provides the transmit and receive data to the frequency synthesizer, switching information for tone and digital Channel Guard, and the carrier control timer (CCT) function when the radio is in the transmit mode. A block diagram of the system control functions and frequency synthesizer are shown in Figure 1.

When the microphone is keyed the PTT line from the control unit goes low. This low is applied to the microcomputer through buffer Q701 and inverter Q711. Q701 is controlled by ignition switch A+. The ignition switch must be on and A+ applied to the base of Q701. Q701 must be turned on to permit keying of the transmitter. When Channel Guard is present the release of the PTT signal is delayed by the microcomputer for approximately 160 milliseconds to eliminate any squelch tails.

The microcomputer immediately closes the antenna relay switch by applying a low level to DPTT at A701-28. The microcomputer then delays 15 milliseconds before the transmit 9V is switched on by applying a low level on TX ENBL at A701-32. This is done to guarantee that the antenna relay contacts are closed before the transmitter is energized. Once DPTT is at a low level the receive audio is muted. Buffers Q716 and Q717 provide DPTT to the audio control circuits, antenna relay, and the option board.

The $\overline{\text{TX ENBL}}$ line is controlled by microcomputer port 1, (bit 5 A701-32) through inverter Q718 and bilateral switch U302C & D. A low level on A701-32 turns Q718 off, allowing the bilateral switches to be turned on and A- applied on the $\overline{\text{TX ENBL}}$ line. Inverter Q720 is also turned on during this time to inhibit the alert tone PTT.

CHANNEL SELECTION

The microcomputer and EE PROM provide the radio with up to 32 independent transmit and receive frequencies. Each time the PTT switch is operated the microcomputer transfers channel data from the EE PROM and converts it to frequency data assigned to the selected channel. The frequency data is then loaded serially into the frequency synthesizer.

The microcomputer continually monitors the status of tri-state buffers Q704A-D. These buffers are periodically turned off by a positive 5 volt, 1 millisecond pulse from A701-36. At the same time PROM power switch Q715 is turned on and applies +5 VDC to the EE PROM. When the buffers are turned on channel select data is loaded into input/output ports of the microcomputer through ports P20-P23. Power is then applied to the EE PROM and the tri-state buffers are turned off. The microcomputer converts the channel select data into address information, accesses the EE PROM, and receives the frequency data stored in the addressed location. This data then passes through the I/O ports of the EE PROM and P20-P23 of the microcomputer. The conversion process is repeated eight times in rapid succession (eight locations are required for each channel) and the data loaded serially into the frequency synthesizer using the clock and data lines. This data also includes Channel Guard information, if present, and carrier control timer information on a per channel basis. A 4-millisecond channel change pulse from port P16 of the microcomputer is also sent to the frequency synthesizer to speed up channel acquisition.

Also considered at this time is the status of frequency bit 5 (FB5) and the PTT line A701-38. The status of the PTT line is used to determine if the radio is in the transmit or receive mode to assure the right frequency data is accessed. The status of FB5 also determines which EE PROM contains the requested data.

A second EE PROM is required if more than 16 channels are provided. The second EE PROM is plugged directly into pins extending above the top of the first EE PROM. Programming Jack J711 may be used to program both PROMS (using PROM Programmer 4EX22A10). Diodes D718A and B and D719A and B provide spike protection for the microcomputer. D717A and B provide spike protection for the EE PROMS.

CIRCUIT ANALYSIS

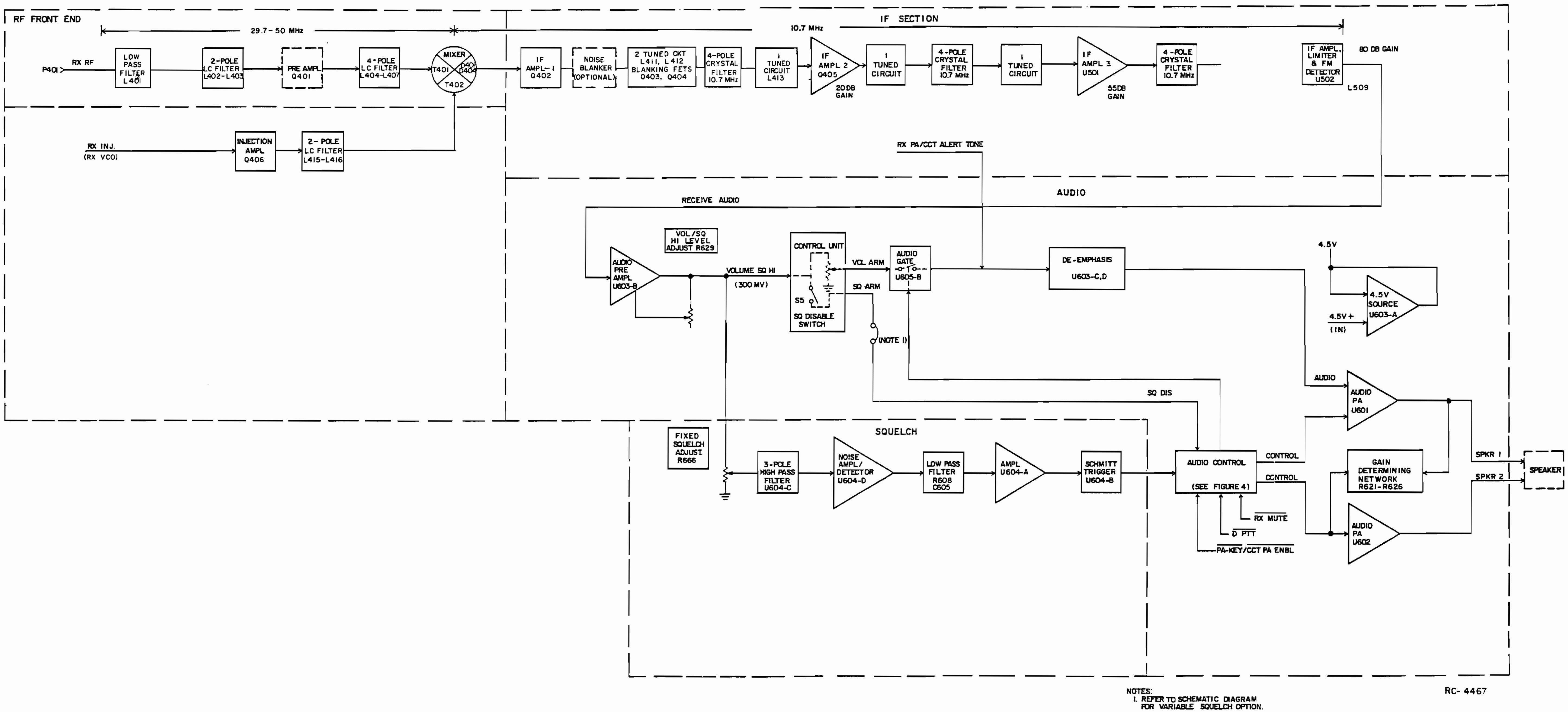


Figure 1 - Block Diagram System Control and Synthesizer

WATCHDOG TIMER

The watchdog timer, consisting of a digital counter U703-A and Q714, monitors the operation of the microcomputer and U703A generates a reset pulse in the unlikely condition that the microcomputer gets lost and does not execute the software properly. A 6 MHz crystal, Y701, steps the microcomputer through the software. As programmed in software a random pulse appears at A701-35 and is applied to the base of inverter Q714, momentarily turning it on and inhibiting any reset pulse from timer U703-A. If the timer does not receive any inputs for a specified period of time, Q714 turns off and U703-A times out and applies a reset pulse to pin 4 of the microcomputer. The watchdog reset will normally restore the microcomputer to normal operation so that only one pulse will occur. In the event the microcomputer is not restored to normal operation a 6 Hz square wave will appear on the reset line and the indicator D713 (now unlocked) will turn on. Refer to the Service Section of this manual and run the self diagnostics routine to determine the problem.

ADVANCE CHANGE PULSE

The advance change pulse is received from the option board through connector J601 and applied to the microcomputer interrupt port A701-6 through inverter Q713. The advance change pulse is required in radios equipped with PSLM. When a call is received on a priority channel the advance change pulse interrupts the microcomputer forcing it to service immediately the I/O circuits. The tri-state buffers are turned on and new channel select information read in.

CARRIER CONTROL TIMER

The carrier control timer function is executed by the microcomputer under software control on a per channel basis. When the programmed time has lapsed an alert tone is generated from P13 (A701-30) on the microcomputer, applied to the audio PA and heard on the speaker. The CCT may be programmed for 1, 2, or 3 minutes or disabled (not programmed).

VOLTAGE TRANSLATION

Inverter buffers U707D-F, and Q721 translate the 5 VDC levels required by the microcomputer to the +9 VDC level used by the frequency synthesizer. Inverter Q719 restores clock polarity.

Channel Guard

The Channel Guard encode and decode functions are implemented in the microcomputer under software control. The microcomputer provides digital and/or tone Channel Guard with STE.

If the radio is in the receive mode, the Channel Guard tone/code is hard limited and inputted into the microcomputer through A701-29 (LIM CG Tone Decode). If the correct tone code is present, the receiver is opened by the RX MUTE line. If the radio is in the transmit mode, the microcomputer generates the Channel Guard tone using WALSH BIT 1 and WALSH BIT 2. Those outputs are summed together and filtered on the optional Channel Guard board to generate a smooth sinewave for tone Channel Guard or a digital waveform for digital Channel Guard.

FREQUENCY SYNTHESIZER

The frequency synthesizer receives clock, data, and control information from the microcomputer and from this generates the Tx/Rx RF frequencies and provides frequency lock status to the microcomputer. It consists of synthesizer chip U201, low and high current buffers, loop filter, Tx & Rx voltage controlled oscillators (VCO's), feedback amplifiers, dual modulus prescaler, and reference oscillator. The VCO's are locked to the refer ence oscillator by a single direct divide synthesis loop consisting of the feedback buffer, prescaler, and synthesizer. The VCO's operate over a frequency range of 29.7 MHz to 50 MHz.

Reference Oscillator

The reference oscillator consists of a 5 PPM oscillator, an audio amplifier and temperature compensation network. The standard reference oscillator frequency is 13.2 MHz.

The 5 PPM oscillator is a standard Colpitts circuit using a FET transistor Q352 and fundamental crystal Y351. Oscillator output is typically 0.7 VPP. Audio deviation is set by R358 for ±1 kHz.

The temperature compensation network consists of R351-R354 and D351. R353 is a thermistor having a negative temperature coefficient. Its resistance increases with a decrease in temperature. The output voltage of the temperature compensator varies the voltage applied to varicap D353 to maintain the oscillator frequency within ±5 PPM.

The output of the reference oscillator is applied to the synthesizer input, XI along with Q203 and Q205.

SYNTHESIZER

Synthesizer U201 contains a programmable reference oscillator divider (÷ R), phase detector, and programmable VCO dividers (÷N, A). The reference frequency, 13.2 MHz from the reference oscillator is divided by a fixed integer number to obtain a 5 kHz channel reference for the synthesizer. The internal phase detector compares the output of the reference divider with the output of the internal ÷ N, A counter. The ÷ N, A counter receives as its input the VCO frequency divided by the dual modulus prescaler and programmed by the microcomputer. This comparison results in a ± error voltage when the phases differ and a constant output voltage when the phase detector inputs compare in frequency and phase.

If a phase error is detected an error voltage is developed and applied to the high current buffers and loop filter to reset the VCO frequency. The count of the N, A counters is controlled by the frequency data received on the clock and data lines from the microcomputer. Thus, when a different channel is selected or when changing to the transmit or receive mode an error voltage is generated and appears at the phase detector output, ANO, causing the phase locked loop to acquire the new frequency.

The enable pulse from the microcomputer enables the synthesizer and allows frequency data to be internally stored.

DC Offset and High Current Buffers

DC offset buffers Q203, Q205 and Q206 receive the error voltage from the synthesizer and increases this level by 1.8 VDC to extending the operating range of the high current buffers. When the PLL is off frequency due to a channel change or frequency drift the error voltage from the synthesizer (ANO) rises or falls turning Q206 on or off. Q206 controls the DC offset buffers Q203 and Q205 and high current buffers Q202 and Q204. Q202 and Q204 complete a high current rapid charge path for C212-C214. Q205 and Q206 provide the rapid discharge path.

As the error voltage decreases Q206, Q023 and Q205 turn on completing a discharge path for C212-C214 through bilateral switches U204A-D. When the error voltage goes positive Q203, Q205 and Q206 are turned off, allowing C212-C214 to charge through Q202 and R223-R225. U204 is turned on for 4 milliseconds each time a channel is changed in receive or when changing from transmit to receive. The time is 20 milliseconds when in transmit.

Loop Filter

The loop filter consists of R223-R225, and C212-C214. This filter controls the bandwidth and stability of the synthesizer loop. Bilateral switch U204 is controlled by the 4 millisecond, 9 volt channel change pulse. When the channel change pulse is present the bilateral switch shorts out the low pass filter greatly increasing the loop bandwidth to achieve the 4 millisecond channel acquisition time required for PSLM. The low pass filter removes noise and other extraneous signals internal to the synthesizer chip.

The output of the filter is applied to the varicaps in the transmit and receive VCO's to adjust or correct the VCO frequency.

Receiver Voltage Controlled Oscillator

The Receiver VCO consists of a low noise JFET oscillator, Q213, followed by high gain buffers Q214 and Q215. These buffers prevent external loading and improves power gain. The VCO is a Colpitts oscillator with the various varactors, capacitors and inductors forming the tank circuit. Capacitor C220 allows manual adjustment of the VCO across the frequency split. The varicaps provide voltage controlled frequency adjustment of about 3 MHz. The VCO is switched on and off under control of the DPTT line. When the DPTT line is low the Receiver VCO is turned on (Q218 is on). Oscillator output is typically +10 dBm. Rx VCO lock time is 4 milliseconds maximum.

Transmitter VCO

The transmit VCO is basically the same as the Receiver VCO except that coil L211 is tuned to provide an operating range of approximately 8 MHz, depending on which frequency split the radio is operating on. The varactors provide a voltage controlled adjustment range of approximately 3 MHz. The high gain series buffers Q219 and Q220 provide a typical output of +10 dBm. Transmit audio is applied to deviation adjustment control R237. Deviation is set for 4.5 kHz. Tx VCO lock time is 20 milliseconds maximum.

Tx VCO control switch Q216 and Q218 turn the Transmit VCO on when DPTT is high. Q216 is off, Q218 is on.

The use of two VCO's allows rapid independent selection of transmit and receive frequencies across the frequency split.

VCO Characteristics

The synthesizer has two VCO's or voltage controlled oscillators. The VCO frequency is directly related to a control voltage generated by the synthesizer circuitry and must remain within specified limits for the synthesizer to function properaly. The RX VCO typically will increase in frequency about 4 MHz when the control voltage moves from its lower limit to its upper limit. The TX VCO moves about 6 MHz for the same situation. By tuning the coil for the TX VCO or the capacitor in the RX VCO, the same control voltage frequency spread can be moved up or down through the full range of frequencies that the radio operates on.

In order to maintain the excellent selectivity and hum and noise performance of the radio, the frequency range that the VCO's can be voltage tuned must be kept to a minimum. This requires that all the available voltage range be fully utilized. The alignment procedure, therefore, instructs the user to accurately set the control voltage to the upper limit of the voltage range at the highest frequency channel.

NOTE

Going too high with the voltage setting at the highest frequency channel may cause problems over temperature extremes as the VCO's will drift slightly. Set the voltage too low and you may not remain within the required lower voltage limit as you cover the radio's maximum two frequency spread.

If the required frequency spread is less than the maximum two frequency spread, then there are no restrictions on setting the lowest and highest frequencies within the required voltage limits.

The minimum tuning requirement of the VCO's is to cover the proper frequency range. For instance, to cover 29.7 to 50 MHz the VCO must be tunable such that at 29.7 MHz the control voltage is at least greater than or equal to the lower voltage limit, and at 50 MHz the voltage must be less than the upper limit. If the control voltage can be tuned higher than the lower limit at 29.7 MHz, this simply means that you can program channels below 29.7 until you finally run into the lower voltage limit. When tuning the VCO's to a channel close to 50 MHz, the control voltage may not reach the upper control voltage limit. This is normal for some radios and is due to the tolerances on the many capacitors in the VCO. Even though it takes very little change in capacitance to shift the VCO frequency range a few megahertz, this variation has been carefully compensated for by increased tuning range for the VCO. Therefore, if you tune to 50 MHz, you may not achieve the maximum control voltage for all radios, but you will always be greater than the lower voltage limit.

Note that the RX & TX VCO's have totally different tuning adjustment devices. The TX VCO will tune as any coil will by reaching a peak voltage setting at the 50 MHz frequency, assuming that the peak falls within the control voltage limits of the VCO. The RX VCO uses a multi-turn trimmer capacitor which lowers the VCO frequency linearly with clockwise turns of the screw-type slotted piston. Unlike the coil used in the TX VCO, the trimmer C does not peak but simply reaches a maximum setting (lowest frequency is maximum setting) and stops turning. The 50 MHz receive channel should have a control voltage greater than the lower limit. The trimmer cap is a very high quality device which allows the RX VCO to always have consistent state-of-the-art noise performance necessary for a high quality synthesized radio.

Feedback Buffers

The Rx injection and Tx injection voltage output from the Rx VCO and Tx VCO are supplied to the receiver mixer and the exciter respectively and to the feedback buffers. Buffering is provided by Q222 and Q223 and the output applied to dual modulus prescaler U202.

Dual Modulus Prescaler

The dual modulus prescaler completes the PLL feedback path from the synthesizer to loop filter, to the VCO's and feedback buffers and then back to the synthesizer through the prescaler. The prescaler divides the VCO frequency by 64 or 65 under control of MOD C from the synthesizer. The output of the prescaler is applied to the synthesizer where it is divided down to 5 kHz by an internal ÷ N. A counter and compared in frequency and phase with the divided down frequency from the reference oscillator. The result of this comparison is the error voltage used to maintain frequency lock. The ÷ N, A counter is controlled by data received from the microcomputer. Depending on the operating frequency, the DC voltage at TP201 should be within the range 3.5 to 7.5 VDC when the PLL is locked.

Lock Detect

The lock detect circuit consists of comparator IC U203, diodes D201 and D203, and reference oscillator mute switch Q207 and Q208. It is used to quickly synchronize the phase relation of the divided down VCO frequency and the reference oscillator if the loop loses lock. It also provides a fast lock detect signal to the microcomputer to turn on the out-of-lock indicator. If a large change in frequency is required the ramp capacitor output (RC) of the synthesizer may increase to near 7.5 VDC and cause the comparator output to decrease. This decrease in voltage turns Q207 off and allows Q208 to be turned on by the positive LD line from the synthesizer. Thus Q208 disables the reference oscillator and allows the PLL loop to be brought back to synchronization rapidly.

If a large frequency error exists the LD positive lead from the synthesizer out-of-lock indicator. If a large change in frequency is required the ramp capacitor output (RC) of the synthesizer may increase to near 7.5 VDC and cause the comparator output to decrease. This decrease in voltage turns Q207 off and allows Q208 to be turned on by the positive LD line from the synthesizer. Thus Q208 disables the reference oscillator and allows the PLL loop to be brought back to synchronization rapidly.

If a large frequency error exists the LD positive lead from the synthesizer will carry negative spikes to the microcomputer through D203B to activate the lock indicator circuit. Pulse shaper U703 is a one-shot multivibrator which increases the pulse width to span 1 computer cycle. Q207 is turned on, keeping Q208 off thereby preventing Q208 from muting the reference oscillator.

TRANSMITTER

The transmitter section of the TRS board includes the audio processor and exciter. The power amplifier is contained on a separate board adjacent to the TRS board and next to the heat sink assembly. Information related to the PA is included in a separate insert. Figure 2 is a block diagram showing the exciter and PA. The audio processor is shown in Figure 1.

AUDIO PROCESSOR U301

The audio processor provides audio pre-emphasis with amplitude limiting and post limiter filtering and a total gain of approximately 24 dB. Approximately 20 dB gain is provided by U301B and 4 dB by U301A.

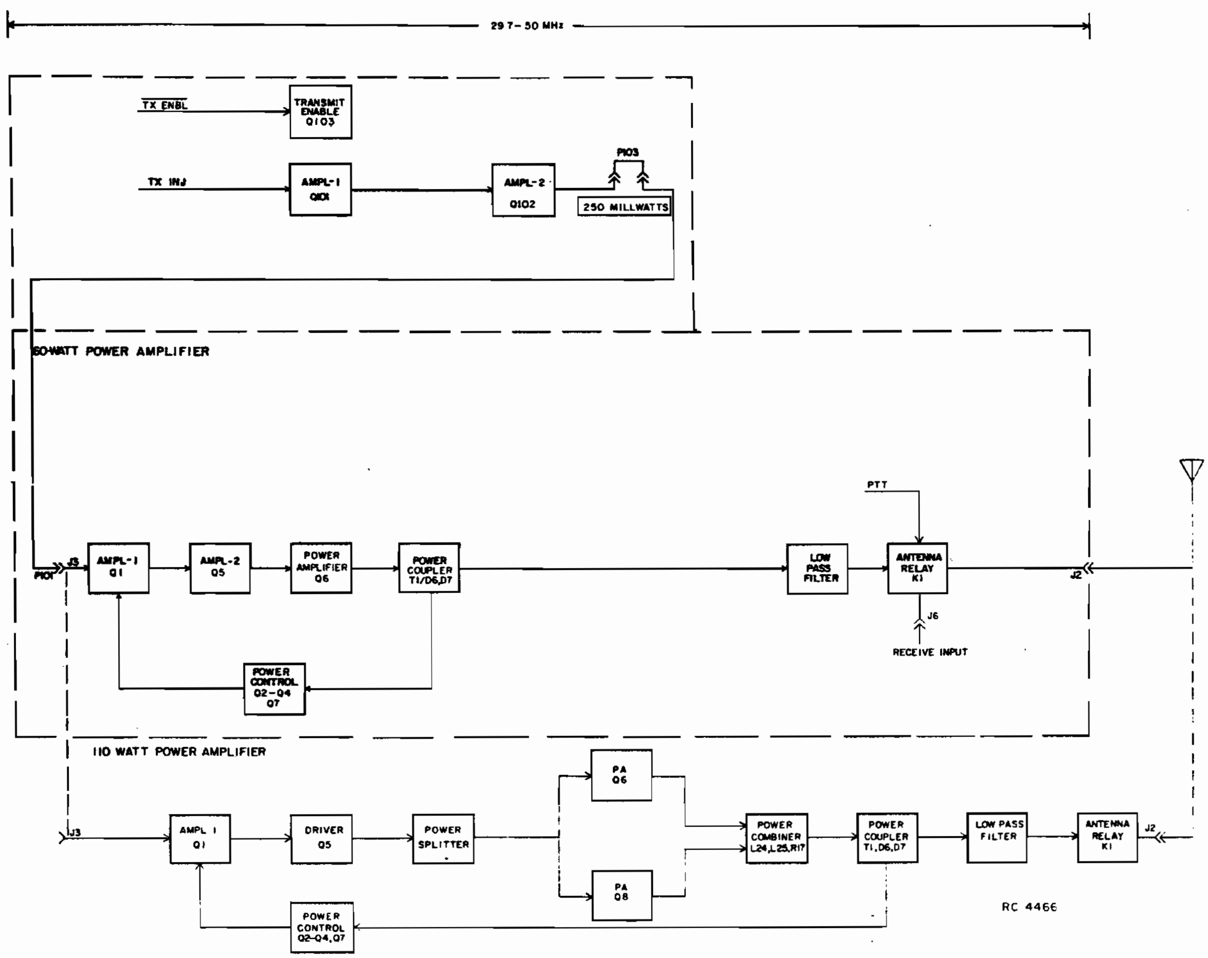


Figure 2 - Transmitter Block Diagram

The 9 Volt regulator powers the audio processor and applies regulated 9 volts to a voltage divider consisting of R303, R313, R308 and R312. The +4.5 V output from the voltage divider establishes the operating reference point for operational amplifiers U301B and U301A. C302 provides an AC ground at the summing input of both operational amplifiers.

The voltage divider and diodes D301 and D302 provide limiting for U301B. Diodes D301 and D302 are reversed biased at +1.7 VDC. Voltage divider network R303, R308, R312 and R313 provides +6.2 VDC at the cathode of D301 and +2.8 VDC at the anode of D302. The voltage junction of D301 and D302 is 4.5 V. C308 and C312 permit a DC level change between U301B-7 and the voltage divider network for diode biasing.

When the input signal to U301B-6 is of a magnitude such that the amplifier output at U301B-7 does not exceed 4 volts PP, the amplifier provides a nominal 20 dB gain. When the audio signal level at U301B-7 exceeds 4 volts PP, diodes D301 and D302 conduct on the positive and negative half cycles providing 100% negative feedback to reduce the amplifier gain to 1. This limits the audio amplitude at U301B-7 to 5 volts PP.

Resistors R309, R310 and R311 and C311 comprise the audio pre-emphasis network that enhances the signal-to-noise ratio. R311 and C311 control the preemphasis curve below limiting. R306 and C311 control the cut-off point for high frequency pre-emphasis. As high frequencies are attenuated, the gain of U301 is increased.

Audio from the microphone is coupled to the audio processor through C307 and R307.

The amplified output of U301B is coupled through R305, C306, R314, R315 and bilateral switch U302-A to a second operational amplifier U301A. The bilateral switch is controlled by the DPTT line so that Tx audio is transmitted only when the PTT switch is pressed.

The Channel Guard tone input is applied to U301A-2 through J603-15, R301 and bilateral switch U302A. The CG tone is then combined with the microphone audio at U301A. U301-A provides a signal gain of approximately 4 dB.

A post limiter filter consisting of U301A, R314-R316, C309 and C313 provides 12 dB per octave roll-off. R305 and C305 provide an additional 6 dB per octave roll-off for a total of 18 dB. The output of the post limiter filter is coupled through R236 to the transmitter VCO.

SERVICE NOTE

Some resistors have a tolerance of 1%. This tolerance must be maintained to assure proper operation of the post limiter filter. Use exact replacments.

Tx enable switch U302-B shorts out operational amplifier U301-A when the radio is in the receive mode. The TX ENABLE signal is generated by the microcomputer when the PTT switch is released and is less than 2.7 VDC in the receive mode.

Provisions for data input are provided by J303.

EXCITER

The exciter consists of two broadband fix tuned amplifier stages operating over a frequency range of 29.7-50 MHz. An attentuator pad (R101- R103) at the input of the exciter provides a constant load for the VCO and attenuates the signal from the VCO to approximately 18 dBm. The exciter amplifies the 18 dBm signal from the VCO to provide 250 milliwatts drive to the power amplifier.

The injection frequency input from the Tx VCO is applied to the base of amplifier Q101 through an attenuator pad and impedance matching components C101, C102 and L101. The impedance matching network matches the VCO output to the base of Q101. R106 and R107 set the bias voltage for the Q101. Collector voltage is applied direct from the +9V synth/EXCTR line through Tx enable sw. Q103 and collector feed network L102 and R109. C103 provides noise decoupling.

The output of Q101 is coupled to the base of transmitter driver Q102 through C106 and impedance network C109, L103 and R113. The 250 milliwatt output of Q102 is coupled to the power amplifier board through 50 ohm impedance matching network C116, L105 C117, and service plug P103 and output plug P101.

Collector voltage for Q101 is supplied by +9V synth/EXCTR through 9V Tx switch Q103. Q103 is controlled by TX ENBL from the microcomputer. When TX ENBL is low Q103 is turned on providing voltage to amplifiers Q101. When TX ENBL goes high (receive mode) Q101 is turned off, preventing any interference by the Tx VCO frequencies.

Collector voltage for driver Q102 is supplied from the +9V synth/EXCTR source through R114 and R115 and collector feed network L102 and R109.

P101 consists of a pin soldered to the end of the microstrip. The outer shield consists of a hole in the casting through which the pin connects to the PA.

Three exciter metering points are accessible at RF metering jack J101. The first metering point at J101-10 monitors the emitter voltage of Q101 through metering network C104, R117 and R110. Typical reading is 0.65 V on the GE test set.

The second metering point at J101-9 monitors the collector voltage of amplifier Q102, through R111, R118 and C110. This point typically is 0.45 V on the GE test set.

The third metering point at J101-8 monitors the Collector voltage of driver Q102. The metering network consists of R112, R119, and C108. The relative exciter power output can be read at the test jack on the power amplifier assembly.

SERVICE NOTE

J103 can be used for trouble-shooting purposes and measuring the RF output level of the exciter.

The exciter is energized by pressing the PTT switch. A regulated 9 volts is present on Q102 when the radio is turned on. It is normal to read collector voltage at J101-9 when the transmitter is not keyed.

Capacitors C112, C114 and C115 isolate the exciter board from vehicle ground for operation in vehicles with positive or negative ground.

RECEIVER

The FM receiver used in DELTA-S radios is a single conversion receiver using 10.7 MHz as the IF frequency. Adjacent channel selectivity is provided by three 4-pole crystal filters.

The nine volt regulator supplies power to all receiver circuits except the audio PA IC's which receive power directly from the A+ supply through the power on switch. A block diagram of the receiver is shown in Figure 3.

All receiver circuitry is mounted on the TRS board and consists of:

- Receiver Front End
- LO Injection Amplifier
- Diode Mixer
- 10.7 MHz IF Circuitry
- Limiter/FM Detector
- Audio PA
- Squelch

RECEIVER FRONT END

The RF signal is coupled through a 2-pole LC filter (L402 and L403) to a common gate JFET pre-amplifier, Q401. After amplification by Q401, the RF signal is coupled through a 4-pole LC filter and T401 to the double-balanced diode mixer D401-D404.

RX INJECTION

The injection frequency from the synthesizer (5-15 dBm) is applied to the base of injection buffer/amplifier Q406 through 50 ohm microstrip Z403. The output of Q406 is filtered by a 2-pole LC filter (L415, L416) to remove spurious signals and coupled to the diode mixer through T402.

Injection metering (INJ METER) is taken from the emitter of injection amplifier Q406 and metered at J101-3 (position H on the Test Set). The reading is typically 0.4 volts with injection and 0.1 volts without injection. The synthesizer frequency may be monitored at C435.

MIXER

The diode mixer, D401-D404, provides low input impedance, spurious protection, and an output relatively free of harmonics (low in intermod products).

Receiver RF from the pre-amplifier and LC filters is applied across D402 and D404 of the diode mixer. Injection voltage from the frequency synthesizer is amplified by injection amplifier Q406, filtered by 2-pole LC filter, L415 and L416, and applied to the diode mixer across D401 and D403. The 10.7 MHz output is coupled from the center tap of T401 through C420 and R405 to the source input of IF AMPL Q402. Q402 is a JFET amplifier/buffer stage. The output of the JFET buffer is coupled through C421 to the optional noise blanker (W401 removed) or through impedance matching networks L411, L412, and associated circuitry (bypassing IF blanking FETS Q403 and Q404) to a 4-pole XTAL bandpass filter (W401 connected).

The highly-selective crystal filter consisting of Z401 and Z402 provides the first portion of receiver IF selectivity. The output of the filter is coupled through a second impedance matching network (C431, R414 and L413) to G1 of IF amplifier Q405.

Voltage to the drain of Q405 is supplied from the +9V Rx supply through L501, L502, R410, R418 and L414.

IF & DETECTOR STAGES

IF amplifier Q405 is a dual-gate low-noise MOS FET amplifier. The filter

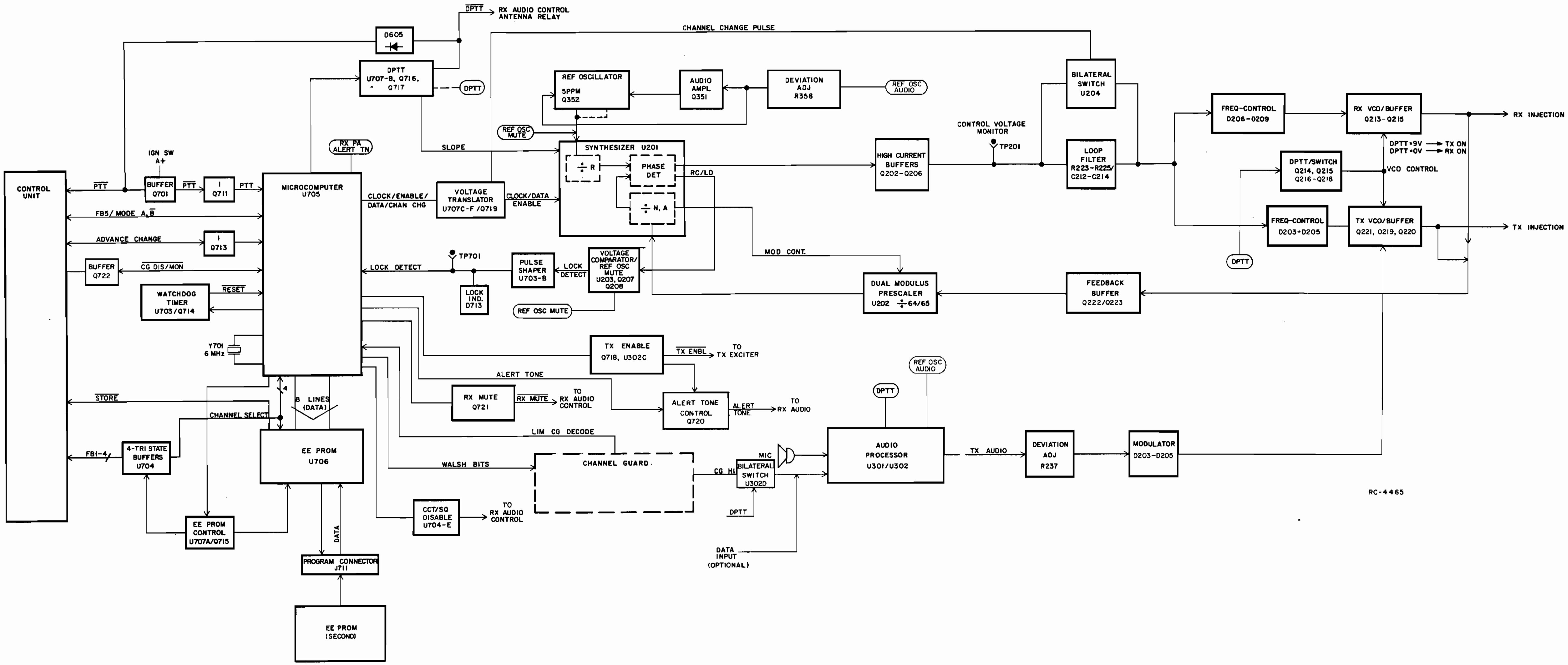


Figure 3-

System Control and Frequency Synthesizer Block Diagram output is applied to gate 1 of the amplifier, and the output is taken from the drain. The biasing on gate 2 and the drain load determines the gain of the stage. The amplifier provides approximately 20 dB of IF gain. The output of Q405 is matched into a second 4-pole crystal filter by tuned circuit L414, C433 and R419. The output of the crystal filter is applied to IF amplifier IC U501 through impedance matching network L507, C502, C503, and R501.

U501 provides approximately 55 dB of gain. Following U501 is a third 4-pole crystal band-pass filter (Z503 and Z504) which provides the final stage of IF selectivity.

IF signal from the 4-pole crystal filter is applied to the IF amplifier/limiter/FM detector IC (U502) through impedance matching network L508, C511, C512, and R503. The amplifier provides approximately 80 dB of gain to insure that the signal is well into limiting.

U502 also contains the quadrature FM detector. The single-tuned LRC network, consisting of L509, C515, C516, and R504, provides the 90° phase shift necessary to produce the recovered audio. The low level detected audio is applied to audio preamplifier U603-B.

The metering for the FM detector and IF amplifier is provided by the red systems metering jack J602-4 and 10 respectively. The metered outputs are taken from U502.

AUDIO AND SQUELCH CIRCUITS

Audio

Received audio from the FM detector is applied to the input of audio preamplifier U603-B. The audio output level of the audio preamplifier is adjusted by Volume/Squelch HI level control R629 for 300 millivolts RMS. The audio is then applied to the volume and squelch (optional) controls in the control unit through front connector J601-7.

Audio is returned on VOL ARM through J601-8 and applied to audio gate (bilateral switch) U605-B. The audio gate is controlled by DPTT delayed Push-To-Talk) and PA KEY/CCT PA ENBL through Q603 and is turned on when the control input (pin 5) exceeds 7 VDC. The gate is turned off when the control input is less than 2 volts. Receipt of an on frequency signal (if present) with sufficient signal to noise level and the correct Channel Guard frequncy will cause the audio control circuit to apply +9 volts to U605-B turning the audio gate on.

Audio from the audio gate is applied to the de-emphasis network consisting of a 2-pole low-pass filter (U603D), a 2-pole high pass filter (U603C) and associated circuitry. The low pass filter consisting of R614, R615, C606, C607 and U603-D provides a 6 dB per octave roll-off between 300 and 3000 Hz. C608, C609, R617, R616, R618, R619 and U603-C form a 2-pole high pass filter that attenuates frequencies below 300 Hz. The audio output from the de-emphasis network is applied to the non-inverting input of the audio power amplifier. The audio power amplifier is comprised of U601, U602, and associated circuitry, and forms a bridge amplifier to provide 12 watts (6.93 VRMS across a 4 ohm load) of audio output power at radio output metering terminals J602-6 and 7. The output of U601 is applied to one side of the speaker and through a voltage divider (R621 and R622) to the inverting input of U602. The output of U602 is equal in amplitude but 180° out of phase with U601 and is applied to the other side of the speaker. U601 and U602 provide a balanced pushpull output to the speaker. The gain of U602 U601 and U602 provide a balanced pushpull output to the speaker. The gain of U602 is determined by the value of R623 and R624.

Squelch Circuits

The squelch circuit monitors noise on the VOL/SQ HI input line and allows the receiver to be unmuted when an on frequency signal reduces the noise level below the squelch threshold setting.

The 300 millivolt output of the audio preamplifier is applied to the squelch circuit through the variable squelch control (optional) in the control unit or the fixed squelch control. The squelch control sets the noise threshold level required to operate the squelch circuit. When the noise falls below the threshold level, the receiver is unmuted.

The squelch circuit consists of a 3-pole high pass filter, an averaging detector, DC amplifier, and a Schmitt trigger. The high pass filter, consisting of R601-R603, C601-C603, and U604-C, removes all voice signals from the VOL/SQ HI input and couples noise to U604-D.

Noise in the 6-8 kHz range is applied to the averaging detector consisting of U604-D and associated circuitry. The noise is rectified and filtered by U604-D, R608, and C605 to provide an average DC output level proportional to the noise input.

The average DC level is amplified by U604A to a level ranging from 0 to

6.0 VDC, and applied to the non-inverting input of the Schmitt trigger, U604B. The inverting input of U604B is referenced to 4.5 VDC. U603A provides the stable 4.5 VDC reference voltage.

When the DC level exceeds 4.5 VDC, Schmitt trigger U604B switches and provides a positive voltage to the CAS (Carrier Activity Sensor) and RUS (Receiver Unsquelched Sensor) control transistors in the audio control circuits. The Schmitt trigger will remain on until the threshold level falls below approximately 4.3 VDC. This difference in voltage between the firing point and turn-off point provides sufficient hysteresis to eliminate "bubbling" -- i.e., noise popping in the speaker. The "bubbling" would normally be caused by transitional changes in the DC level around the reference point which allows the receiver to be unmuted. The hysteresis is provided by R611 and R612.

When an on frequency signal is received, there will be little or no noise present at the squelch input. This results in an absence of voltage at the output of the squelch circuit Schmitt trigger, allowing the receiver to be unmuted.

Audio Control

The audio control circuits shown by Figure 4 control the operation of the audio gate (U605-B) and the final audio PA and consists of Q601-Q606, inverter U605-C and associated circuitry. The audio control circuit inputs consist of DPTT (Delayed Push-To-Talk), RX MUTE (Receiver Mute), PA KEY/CCT PA ENBL (Public Address Key/Carrier Control Timer Squelch Disable), and the output of the squelch circuit.

When an on frequency signal with the correct Channel Guard Tone is received, CAS control transistor Q601 and RUS control transistor Q602 are turned off by the absence of a positive voltage at their bases. The CAS line from the collector of Q601 rises to +9 VDC and is supplied to J601-12 and option connector J603-7.

The collector of RUS Transistor Q602 also rises to +9 VDC and turns on inverter U605-C. A- is then applied to the base of inverter Q603, turning it off and allowing its collector to go high. The positive voltage on the collector is applied to audio gate U605-B, turning it on. Q604 is biased on but has no affect

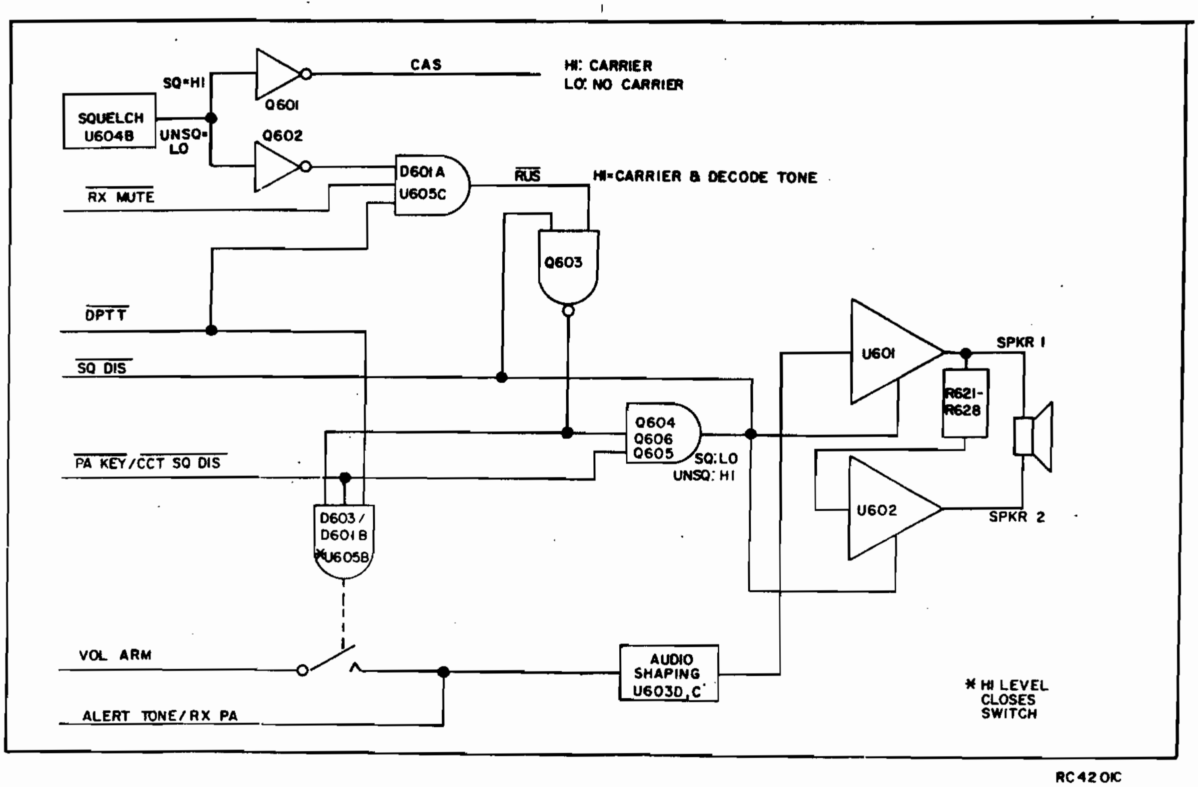


Figure 4 - Audio Control

on audio switches Q605 and Q606. The base of the transistors are parallel connected to the output of audio control switch (U605C-9) which is at A-. Therefore Q605 and Q606 are both turned off, allowing the audio PA's to turn on and complete the audio path to the speaker.

When the microphone is keyed, the PTT/DPTT input is low. This low is applied to audio gate U605-B through D603-B, turning U605-B off. It is also applied to audio control switch U605-C (through D601B) turning it off. Q603 is also off and Q604-Q606 are on. Q605 and Q606 turn off audio PA's U601 and U602.

POWER DISTRIBUTION

Battery supply A+ enters the radio through the front connector at J601-37. A- enters through J601-21. Figure 5 is a block diagram of the power distribution system. Two heavy connections are provided for transmit A+ and transmit A- and connect to two busses. The busses are connected to the PA through a special feed through arrangement. A second set of wires is routed through the control unit and supplies power to the audio amplifier and 9 volt regulator.

9 Volt Regulator

Regulated 9 volts is provided by U701. The input is supplied by the A+ line through J601-19. The output is set to 9.0 VDC by 9V ADJ R703. Regulated 9 volts is distributed throughout the radio and to the MIC HI lead through R651, R652, and J601-9.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or de-soldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery-operated soldering iron may be used in place of the regular soldering iron.

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WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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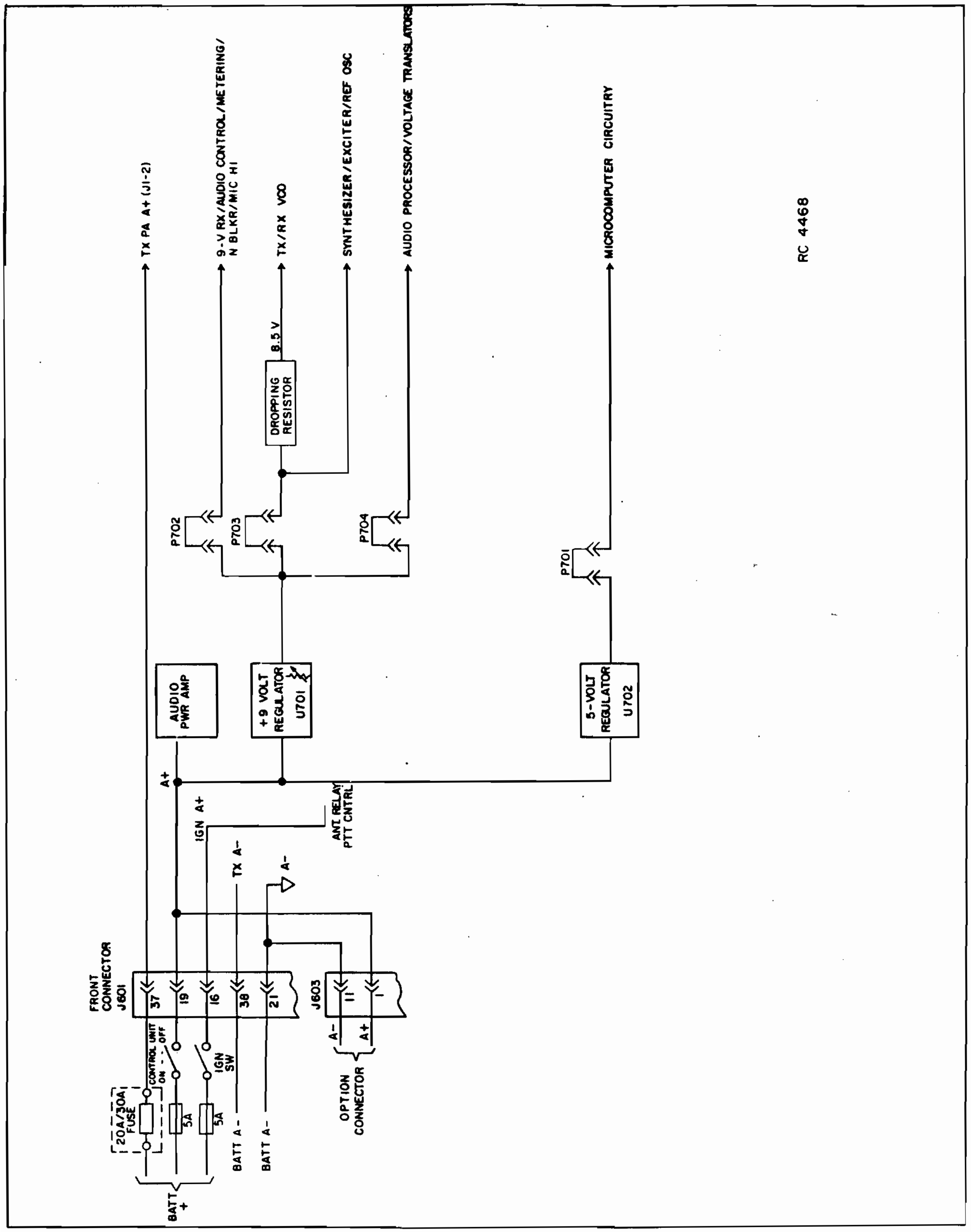
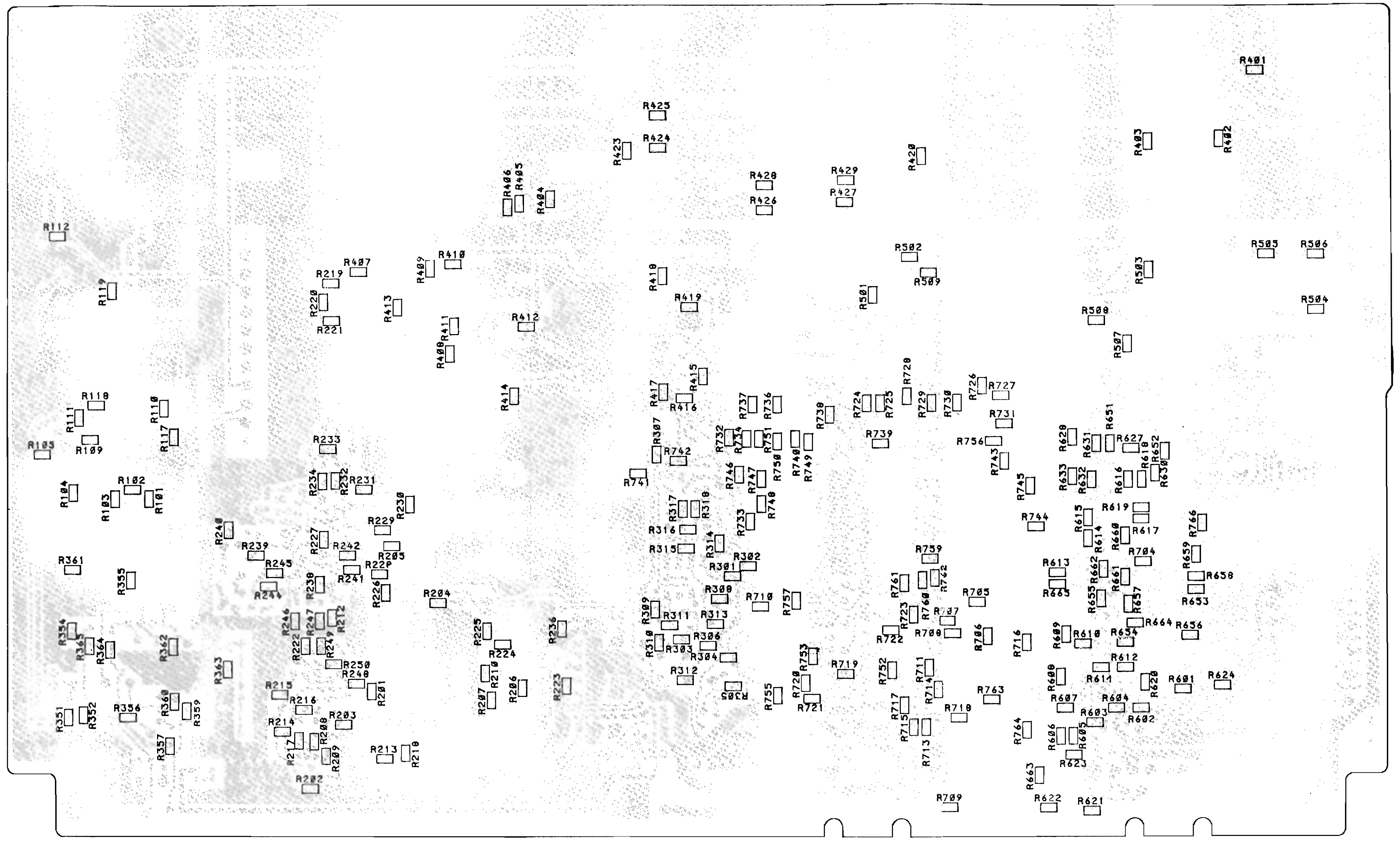


TX PA A+ (J1-2)
9-V RX/AUDIO CONTROL/METERING/ N BLKR/MIC HI
TX/RX VCO
SYNTHESIZER/EXCITER/REF OSC
AUDIO PROCESSOR/VOLTAGE TRANSLATORS
MICROCOMPUTER CIRCUITRY
RC 4468
8.5 V
DROPPING RESISTOR
P702
P703
P704
P701
AUDIO PWR AMP
+9 VOLT REGULATOR U701
5-VOLT REGULATOR U702
A+
IGN A+
ANT RELAY PTT CNTRL
TX A-
A-
FRONT CONNECTOR J601
37
19
16
38
21
J603
11
1
A-
A+
OPTION CONNECTOR
20A/30A FUSE
CONTROL UNIT ON - OFF
IGN SW
5A
5A
BATT A -
BATT A -
BATT +

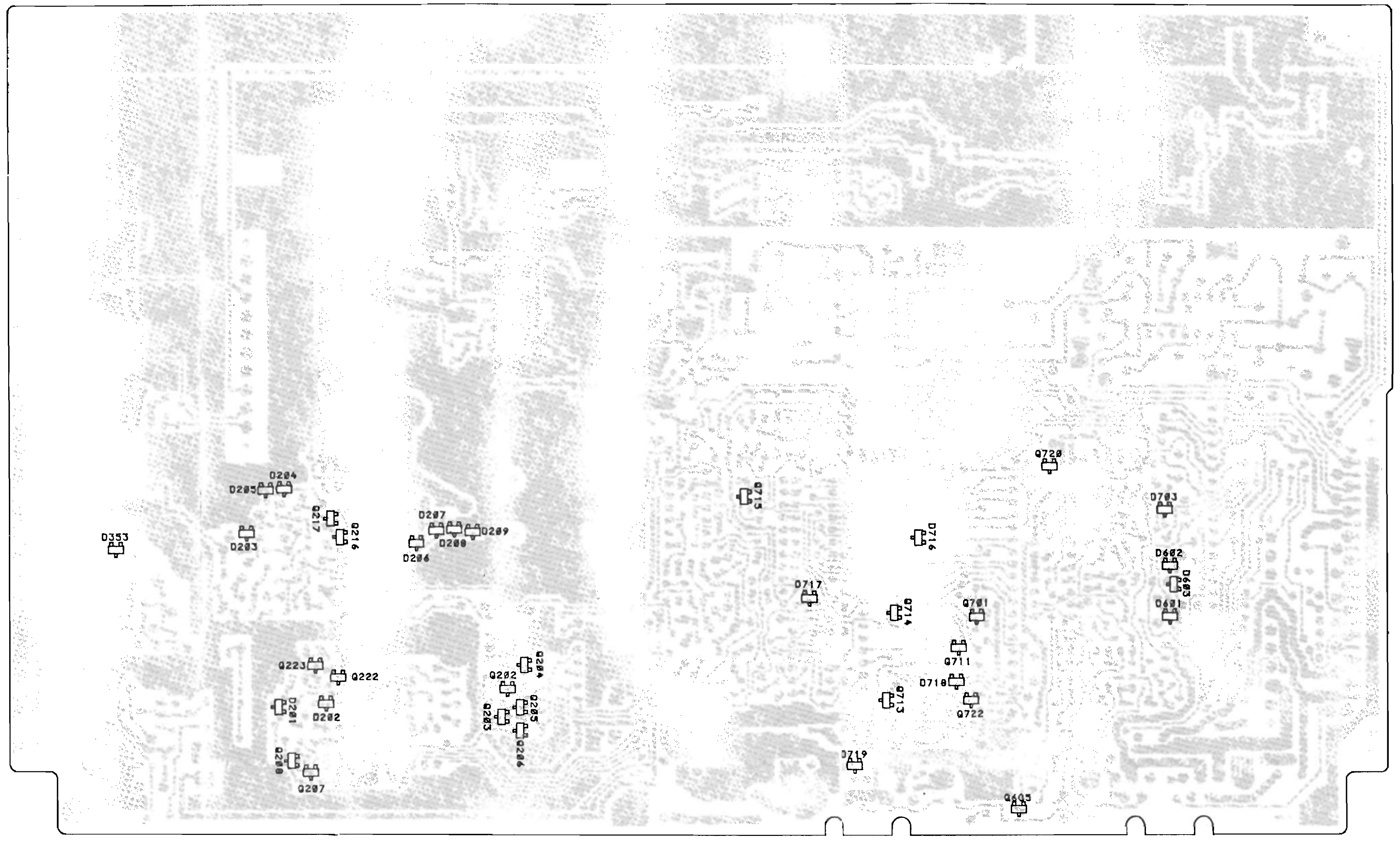
CHIP RESISTOR LOCATION



BACK VIEW OF COMPONENT BOARD

(19D900847, Sh. 2, Rev. 1)
(19A702995, Sh. 2, Rev. 1)

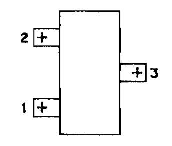
CHIP DIODE & TRANSISTOR LOCATION



BACK VIEW OF COMPONENT BOARD

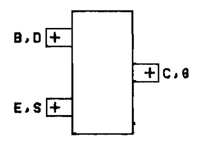
LEAD IDENTIFICATION FOR (SOT) DIODES

(TOP VIEW)



LEAD IDENTIFICATION FOR (SOT) TRANSISTORS

(TOP VIEW)



(19D900847, Sh. 3, Rev. 1)
(19A702995, Sh. 2, Rev. 1)

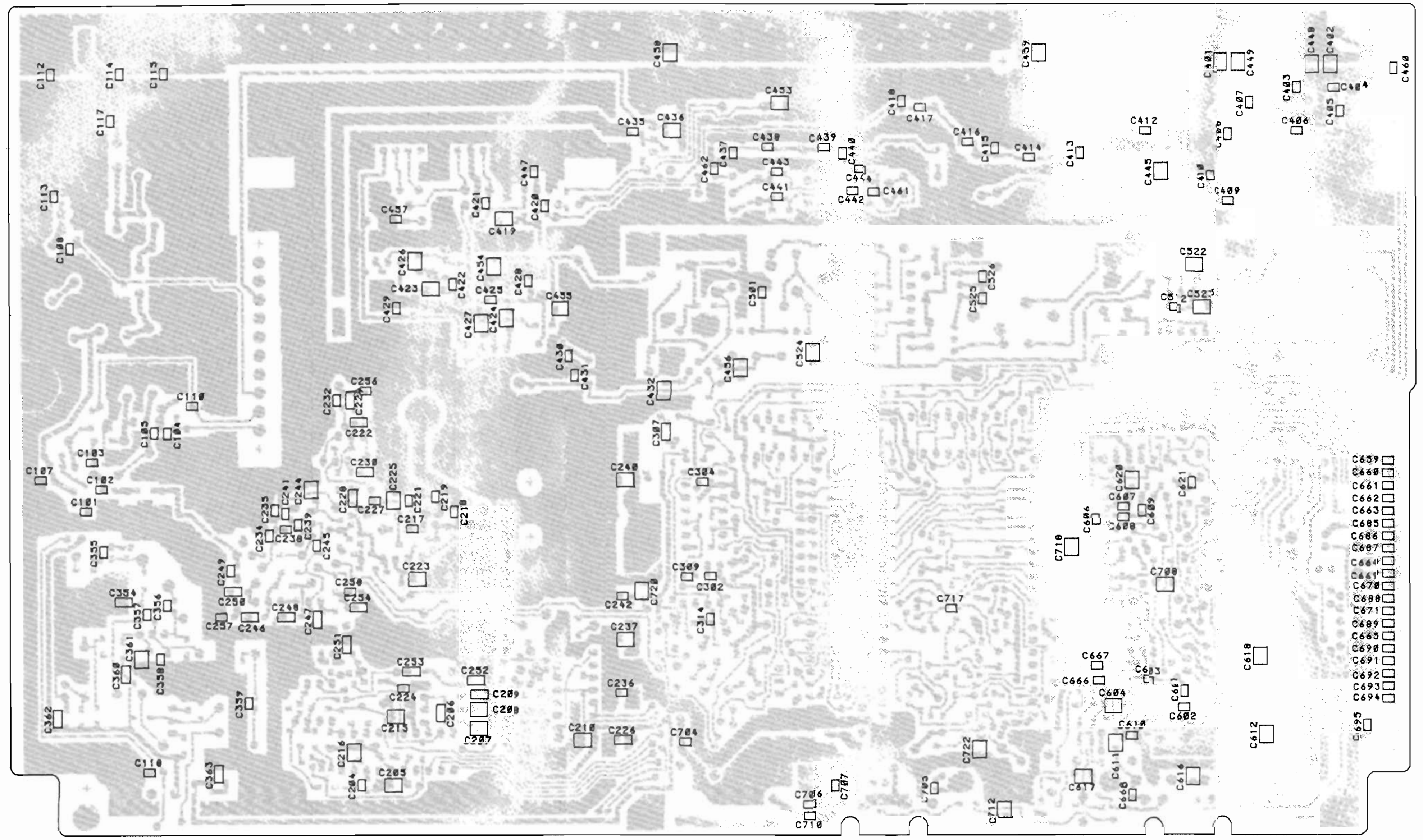
OUTLINE DIAGRAM

29.7-50 MHz TRANSMIT/RECEIVER
SYSTEM BOARD

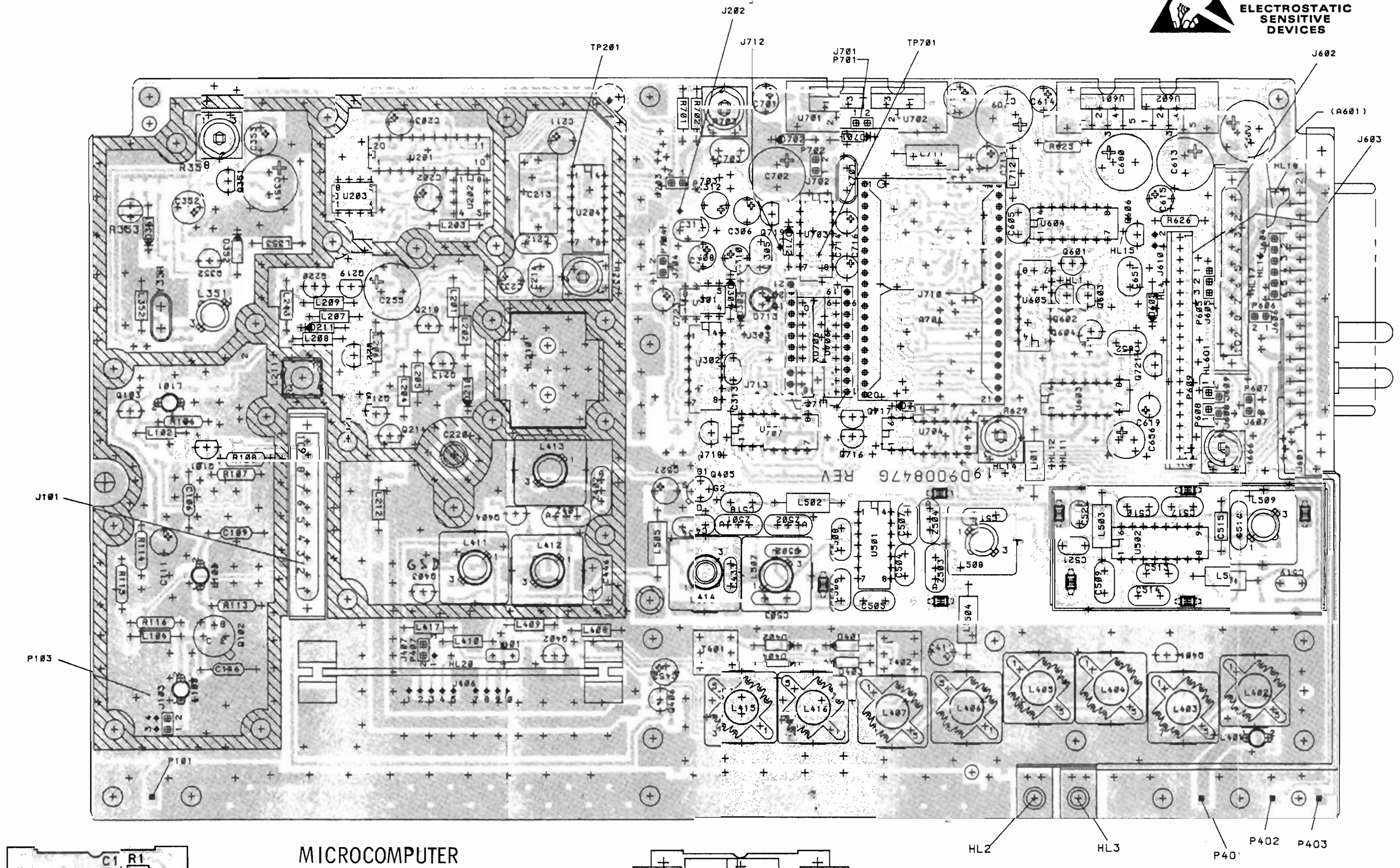
Issue 1

CAUTION
OBSERVE PRECAUTIONS FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES

CHIP CAPACITOR LOCATION



BACK VIEW OF COMPONENT BOARD

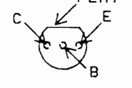


MICROCOMPUTER

(19D900845, Rev. 4)
(19A702995, Sh. 1, Rev. 1)
(19A702995, Sh. 2, Rev. 1)

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

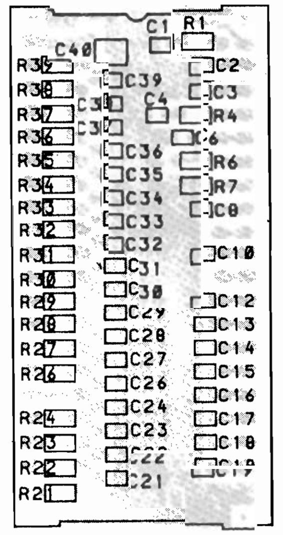
LEAD IDENTIFICATION
FOR ALL TRANSISTORS
NOT OTHERWISE IDENTIFIED



IN-LINE
TOP VIEW

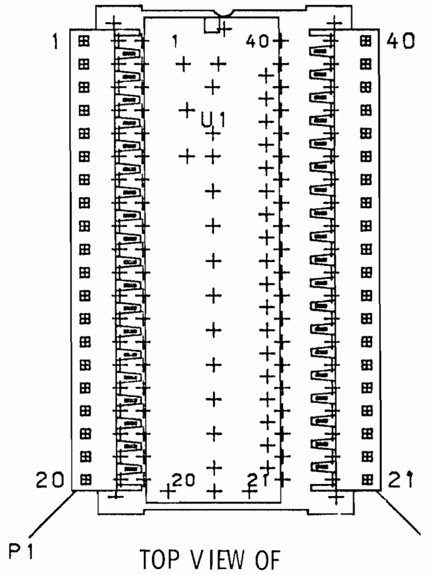
NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

(19D900847, Sh. 4, Rev. 3)
(19A702995, Sh. 2, Rev. 1)



BACK VIEW OF
COMPONENT BOARD

(19C851149, Rev. 3)
(19A703549, Sh. 2, Rev. 0)



TOP VIEW OF
COMPONENT BOARD

(19B801102, Rev. 1)

OUTLINE DIAGRAM

29.7-50 MHz TRANSMIT/RECEIVER
SYSTEM BOARD

TABLE OF CONTENTS

△ COMPONENT IDENTIFICATION CHART

PART	GP1 29.7-36 MHz	GP2 36-42 MHz	GP3 42-50 MHz
C106	39p	33p	27p
C109	120p	100p	68p
C116	47p	39p	39p
C217	150p	100p	82p
C235	47p	47p	33p
C239	150p	100p	100p
C241	47p	47p	56p
C256	22p	18p	15p
C257	27p	22p	18p
C404	270p	220p	220p
C405	68p	47p	39p
C406	3.9p	2.7p	2.2p
C407	56p	39p	33p
C410	56p	39p	33p
C412	3.3p	2.2p	1.8p
C413	56p	39p	33p
C414	2.7p	1.8p	1.5p
C415	56p	39p	33p
C416	4.7p	3.3p	2.7p
C417	100p	56p	56p
C418	120p	82p	82p
C437	33p	27p	27p
C438	1p	1.8p	1.2p
C439	39p	39p	33p
C440	220p	100p	100p
C461	1.5p		
C462		27p	
L102	680n	560n	560n
L103	150n	115n	115n
L212	560n	470n	390n
L213	820n	680n	560n
R113	18	18	22
R116	270	330	390
R426	820	220	220
R427	820	220	220
R428	820	220	220
R429	820	220	220

NOTES:

1. PART OF PWB.

2. PART OF HIGHER ASSEMBLY LEVEL.

3. # IDENTIFIES "CHIP" COMPONENTS (EXAMPLE: R456#) WHICH ARE LOCATED ON SOLDER SIDE OF PWB.

4. TO ADD NOISE BLANKER OPTION, REMOVE W401, AND PLUG IN NOISE BLANKER BOARD INTO J406. TO DISABLE NOISE BLANKER, MOVE P407 FROM J407-2&3 TO J407-1&2.

5. ⏚ INDICATES VEHICULAR GROUND

⏚ INDICATES A-

6. MARKING SHOWN IN BLOCK ▭ IS PART OF LABEL 19A703653.

7. FOR IMPROVED RX INTERMOD PERFORMANCE (WITHOUT NOISE BLANKER) REMOVE Q403 AND Q404.

8. VOLTAGE READINGS:

ALL VOLTAGES ARE TYPICAL. VOLTAGES ARE MEASURED WITH A 20,000 OHM PER VOLT METER, REFERENCE TO A- AND NOT CHASSIS GROUND, UNLESS OTHERWISE INDICATED.

SHEET 2:
S - SQUELCHED RECEIVER
U - UNSQUELCHED RECEIVER
R - RECEIVER MODE (PTT HIGH)
T - TRANSMIT MODE (PTT LO)

SHEET 5,6:
VOLTAGE READINGS ARE TAKEN WITH THE TRANSMITTER UNKEYED/KEYED. EX: .45 (UNKEYED)/.65 (KEYED). A 22 uH CHOKE MUST BE USED IN THE HOT METER LEAD TO AVOID DETUNING RF CIRCUITS.

SHEET 3,4,7:
VOLTAGE READINGS ARE TAKEN WITH THE TRANSMITTER UNKEYED. INTEGRATED CIRCUIT VOLTAGES ARE MEASURED WITH A HIGH INPUT IMPEDANCE DIGITAL VOLTMETER.

9. JUMPER PLUG CONNECTIONS FOR OPTIONS.

THE BOARD IS ASSEMBLED WITH ALL JUMPER PLUGS PRESENT (EXCEPT P610). "X" INDICATES THAT JUMPER PLUG IS REMOVED IN CHART BELOW. FOR VARIABLE SQUELCH OPTION, MOVE P605 TO J605-2 & 3 & REMOVE R666. FOR MII INTERFACE OPTION, REMOVE P608.

	P607	P608	P609
CHANNEL GUARD OPTION		X	
TONE SIGNALING OPTION	X	X	X
CG/TONE SIGINALING OPTION	X	X	X

10. REGULATED +5V AND +9V CAN BE OPENED BY P701 THRU P704 FOR TROUBLE SHOOTING.

11. FOR SERIAL LOAD OF EE PROM FROM RADIO FRONT CONNECTOR J601
J601-10 SERIAL CONTROL
J601-29 STORE
J601-30 SERIAL DATA
J601-32 SERIAL CLOCK
J601-36 RESET

12. FUNCTION INTERFACE POINTS PROVIDED FOR DATA INTERFACE.

13. STANDARD REFERENCE OSCILLATOR FREQUENCY = 13.2 MHZ.

14. PROVIDED FOR TEST/TROUBLE SHOOTING.

ALL CHIP RESISTORS ARE 1/8 WATT
ALL OTHER RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k, OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER u, n OR, p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m, n OR u.

SPARE GATES			
DEVICE	INPUT	OUTPUT	CONTROL
U605D	11	10	12
U605A	1	2	13
U704F	14	13	

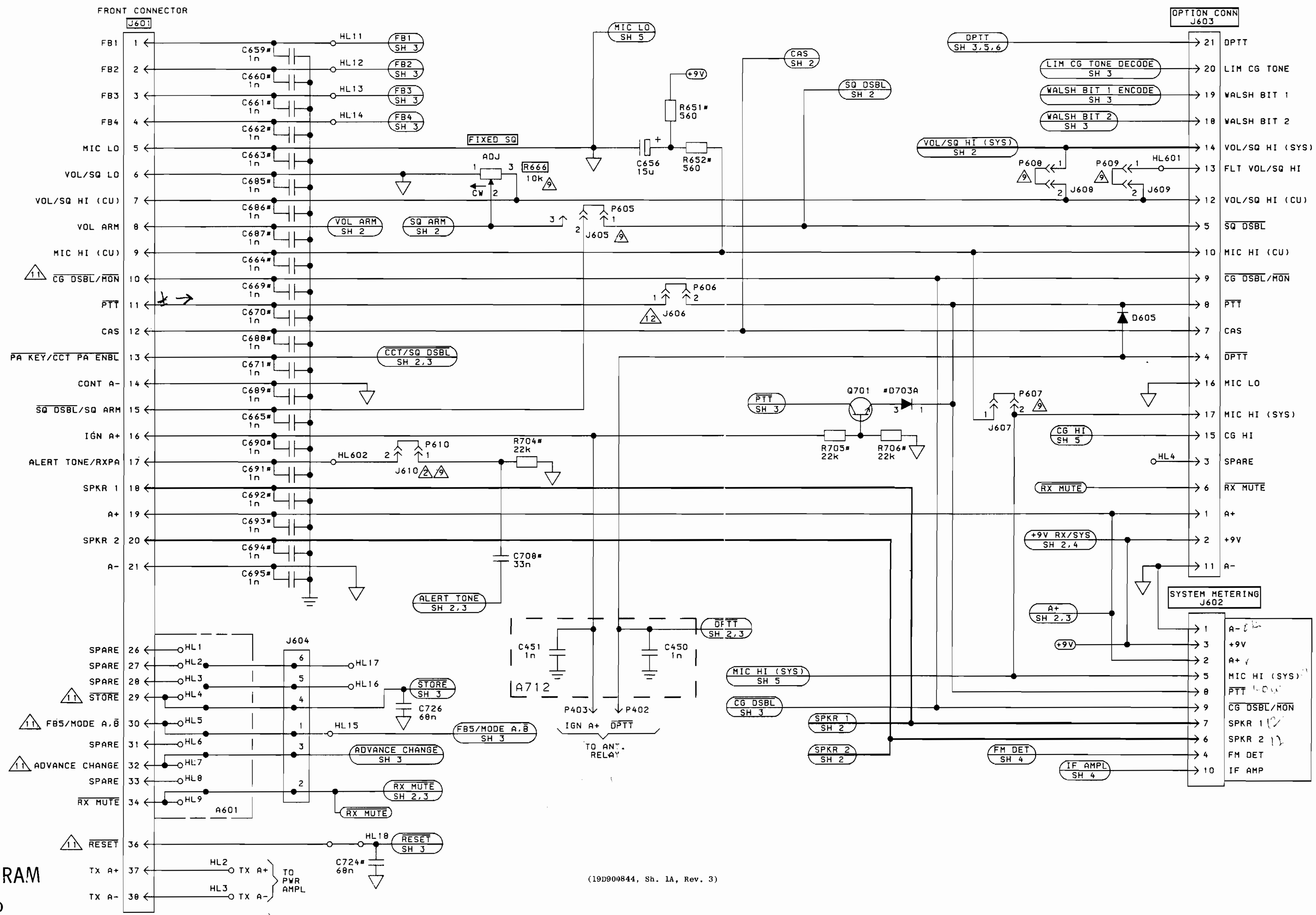
POWER & GROUND CONNECTIONS			
DEVICE	+9V PIN NO.	A- PIN NO.	+5V PIN NO.
U203	8	1,4	
U204	14	7	
U301	8	4	
U302	14	7	
U603	4	11	
U604	4	11	
U605	14	1,7,11,12,13	
U703		7	14
U704		8,14	16
U707		7	14

MODEL NO.	REV. LETTER	FREQ
PL19D901153G1		29.7-36 MHz
PL19D900847G1	E	
PL19D901153G2		36-42 MHz
PL19D900847G2	E	
PL19D901153G3		42-50 MHz
PL19D900847G3	E	

(19D900844, Sh. 1, Rev. 7)

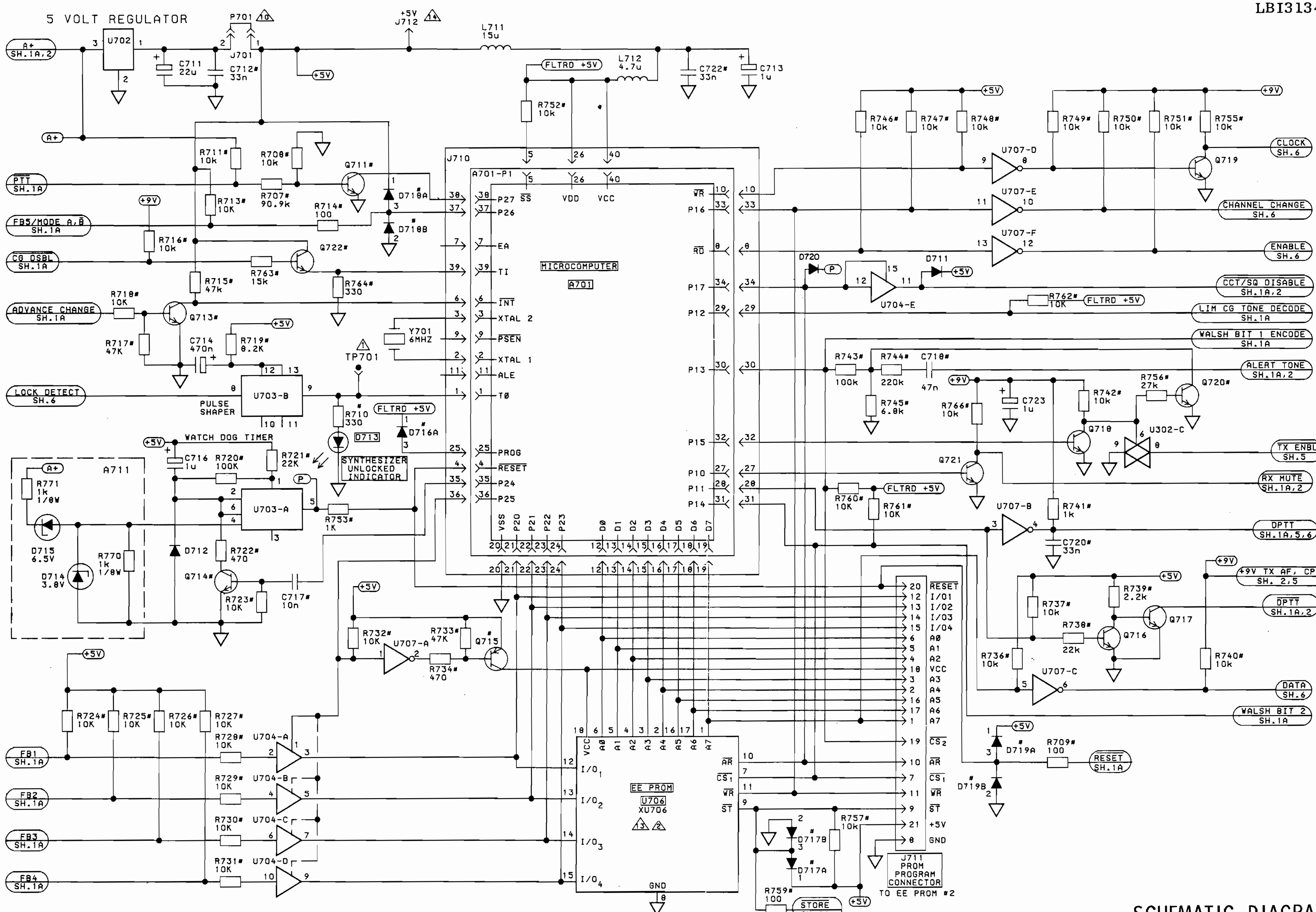
SCHEMATIC DIAGRAM LEGEND

29.7-50 MHz



SCHEMATIC DIAGRAM

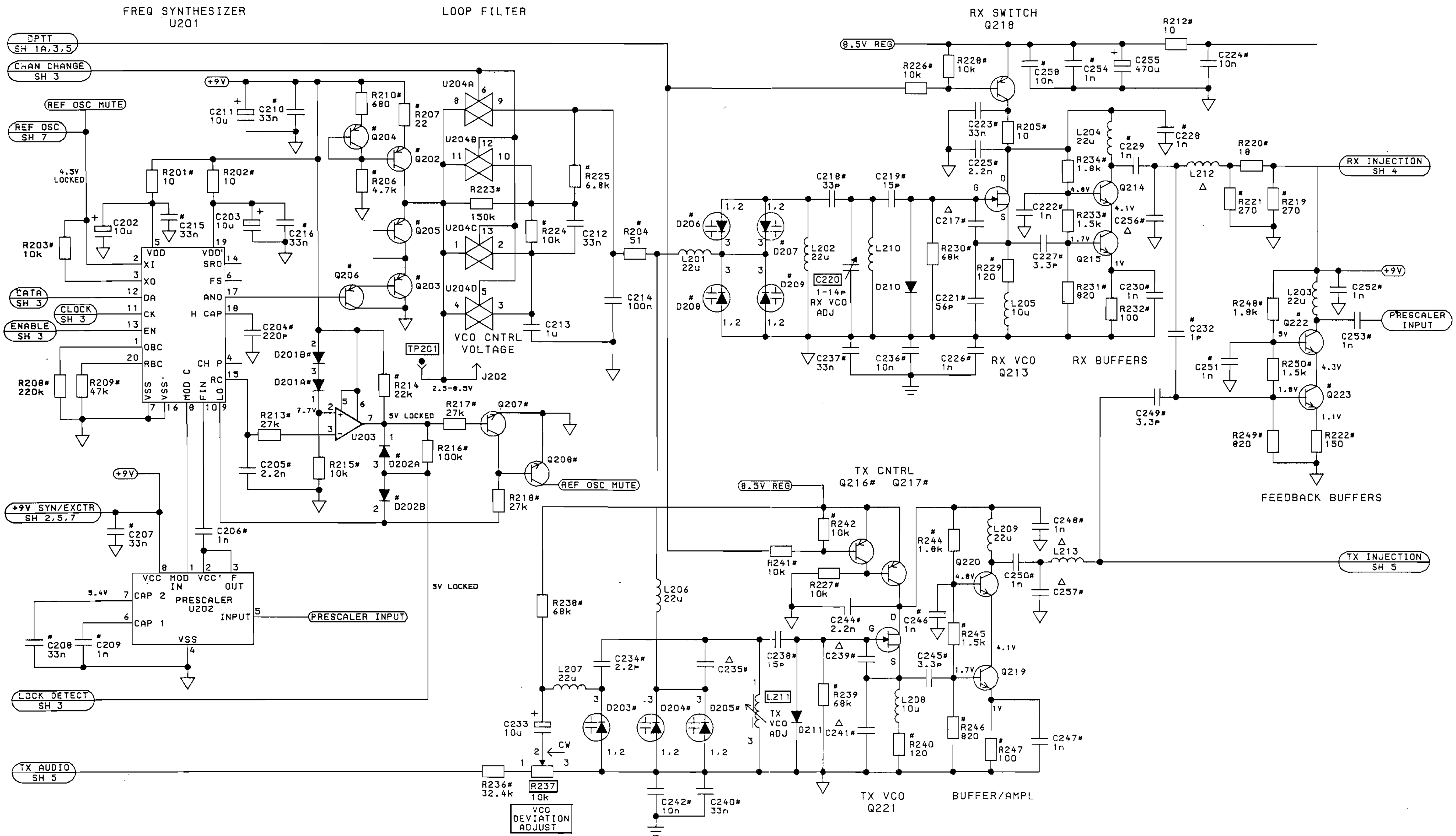
29.7-50 MHz RADIO
INTERCONNECTION DIAGRAM



SCHEMATIC DIAGRAM

SYSTEM CONTROL FUNCTIONS

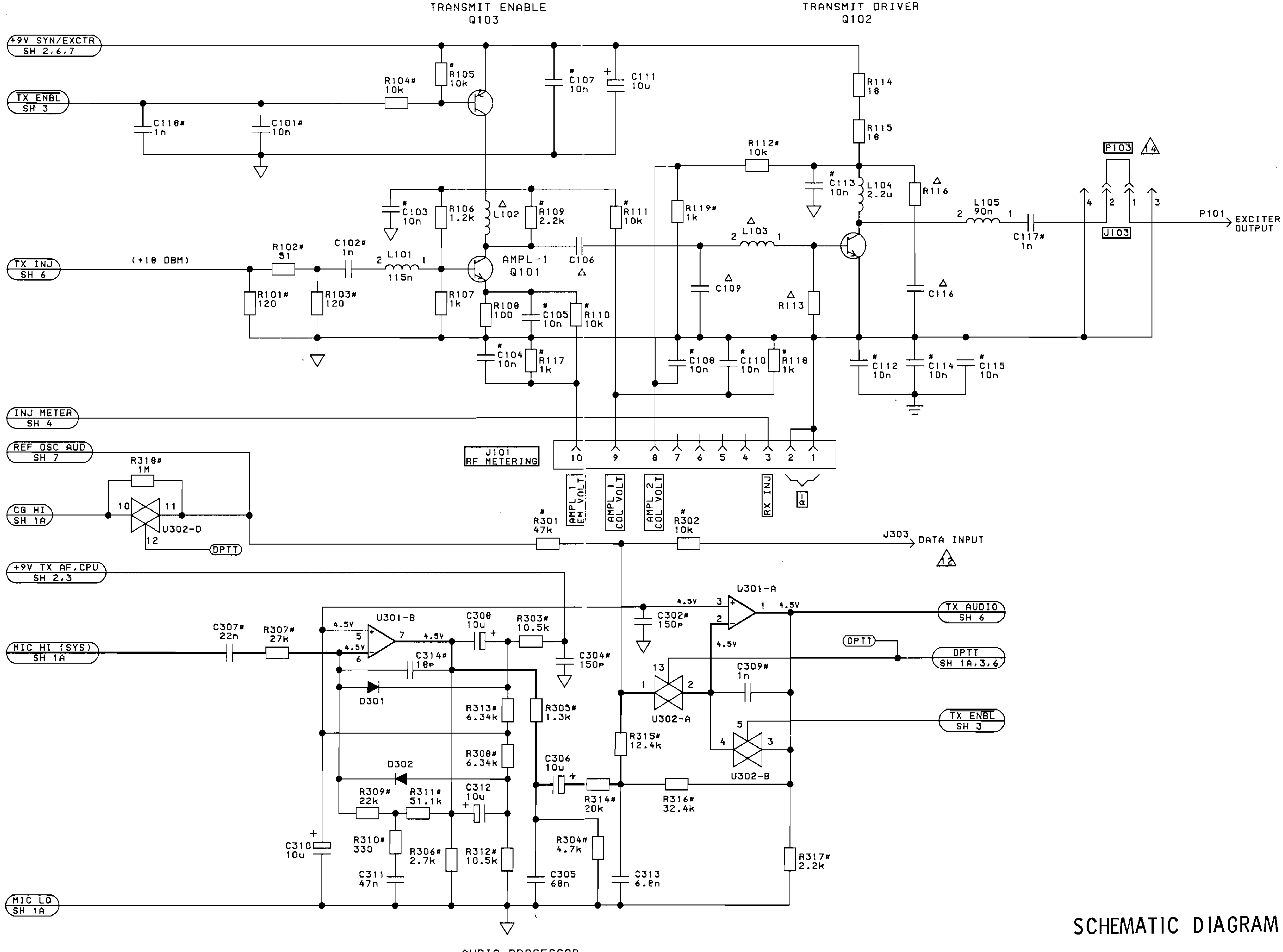
(19D900844, Sh. 3, Rev. 4)



SCHEMATIC DIAGRAM

(19D900844, Sh. 6, Rev. 3)

29.7-50 MHz SYNTHERSIZED/VCO

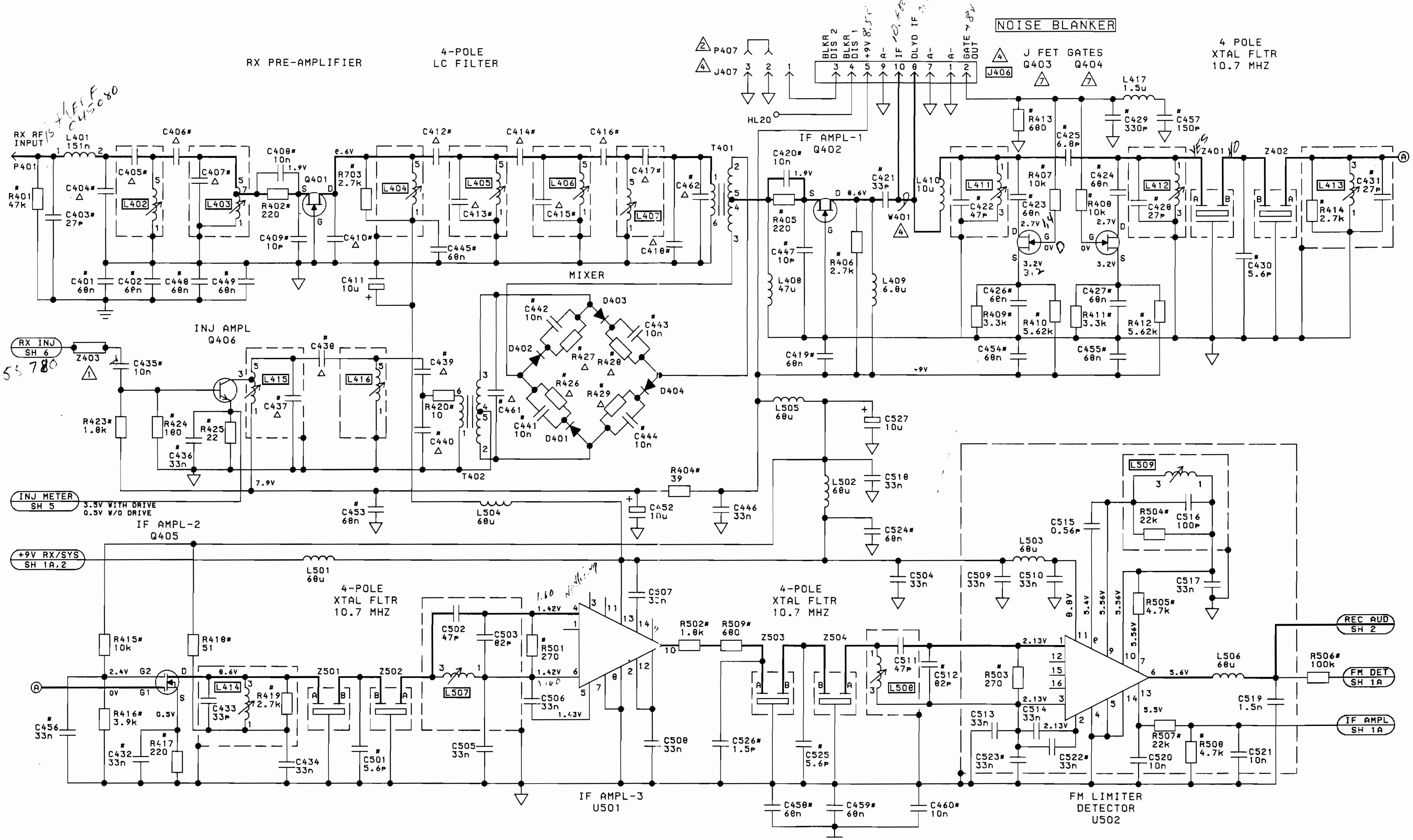


(19D900844, Sh. 5, Rev. 1)

SCHEMATIC DIAGRAM

29.7-50 MHz TRANSMITTER

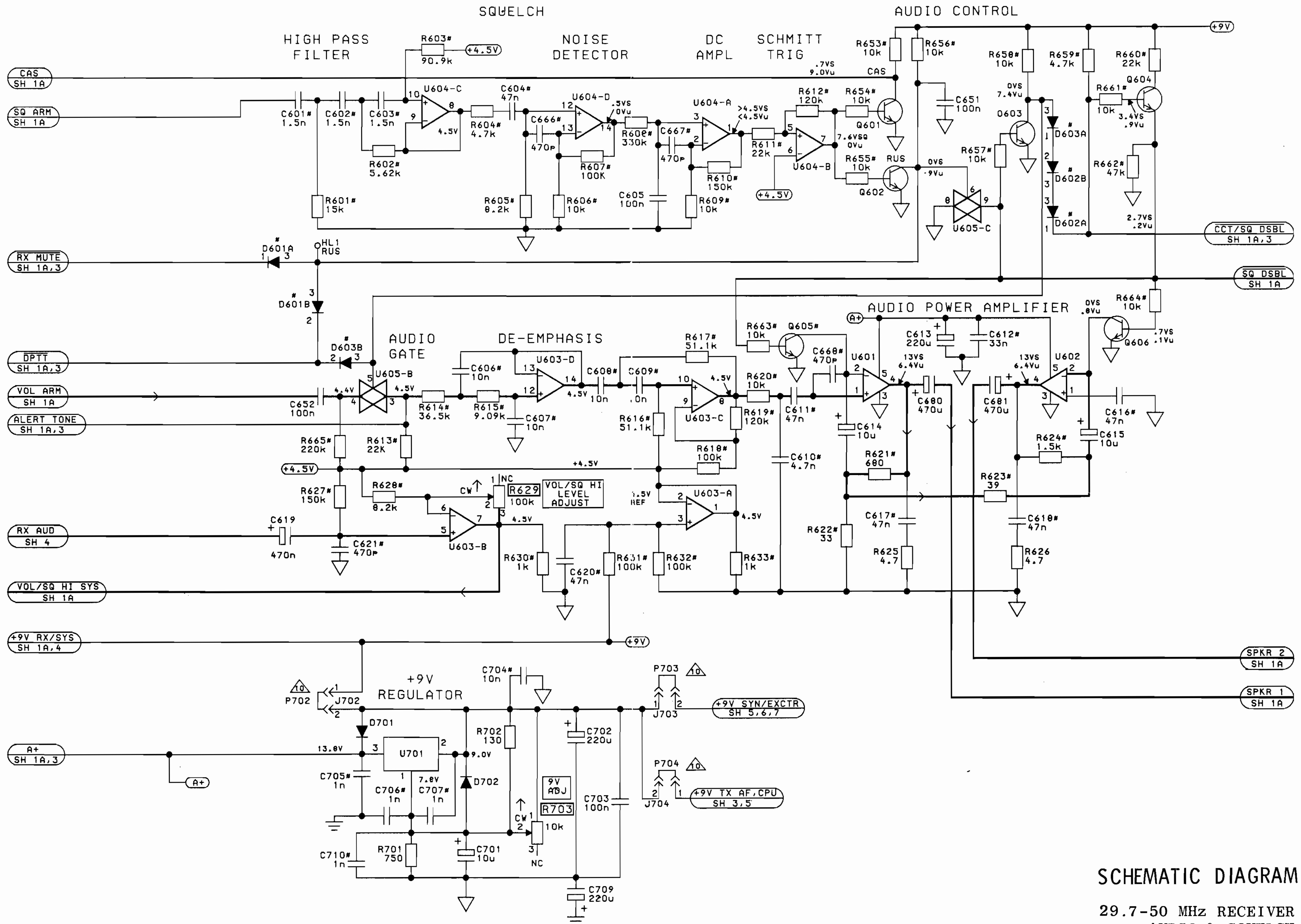
Issue 1



(19D900844, Sh. 4, Rev. 2)

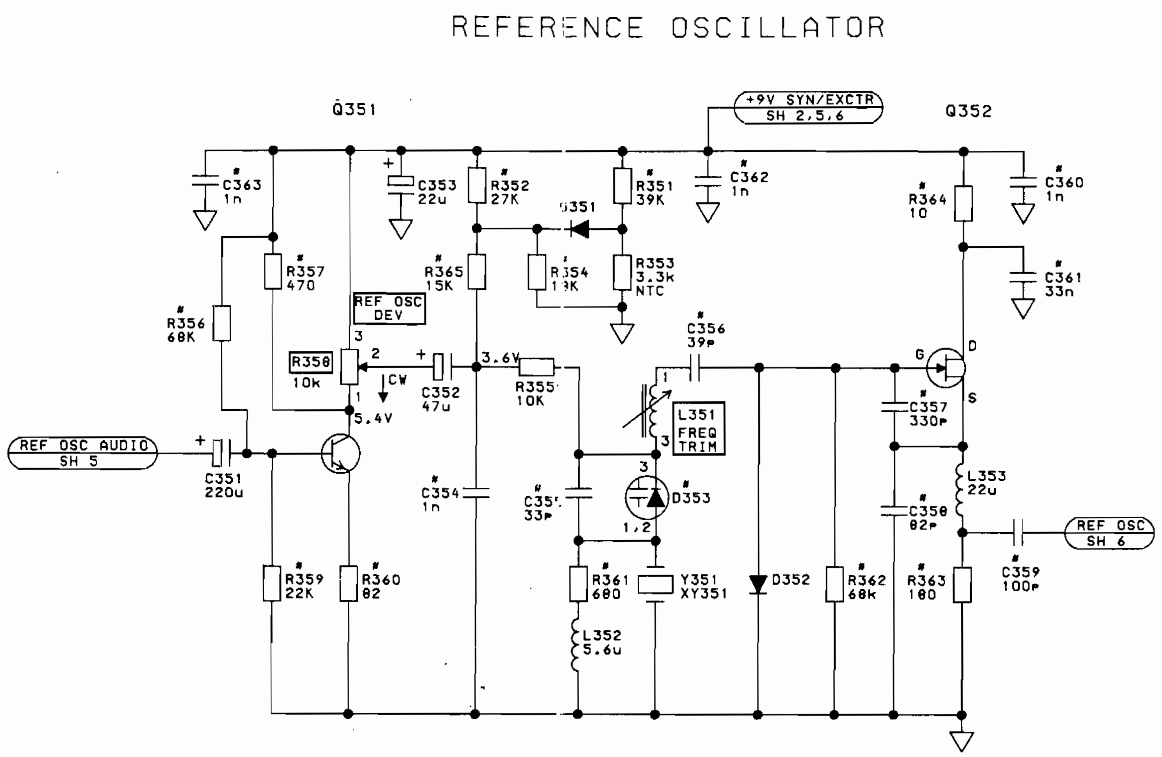
SCHEMATIC DIAGRAM

29.7-50 MHz RECEIVER



SCHEMATIC DIAGRAM

29.7-50 MHz RECEIVER
AUDIO & SQUELCH

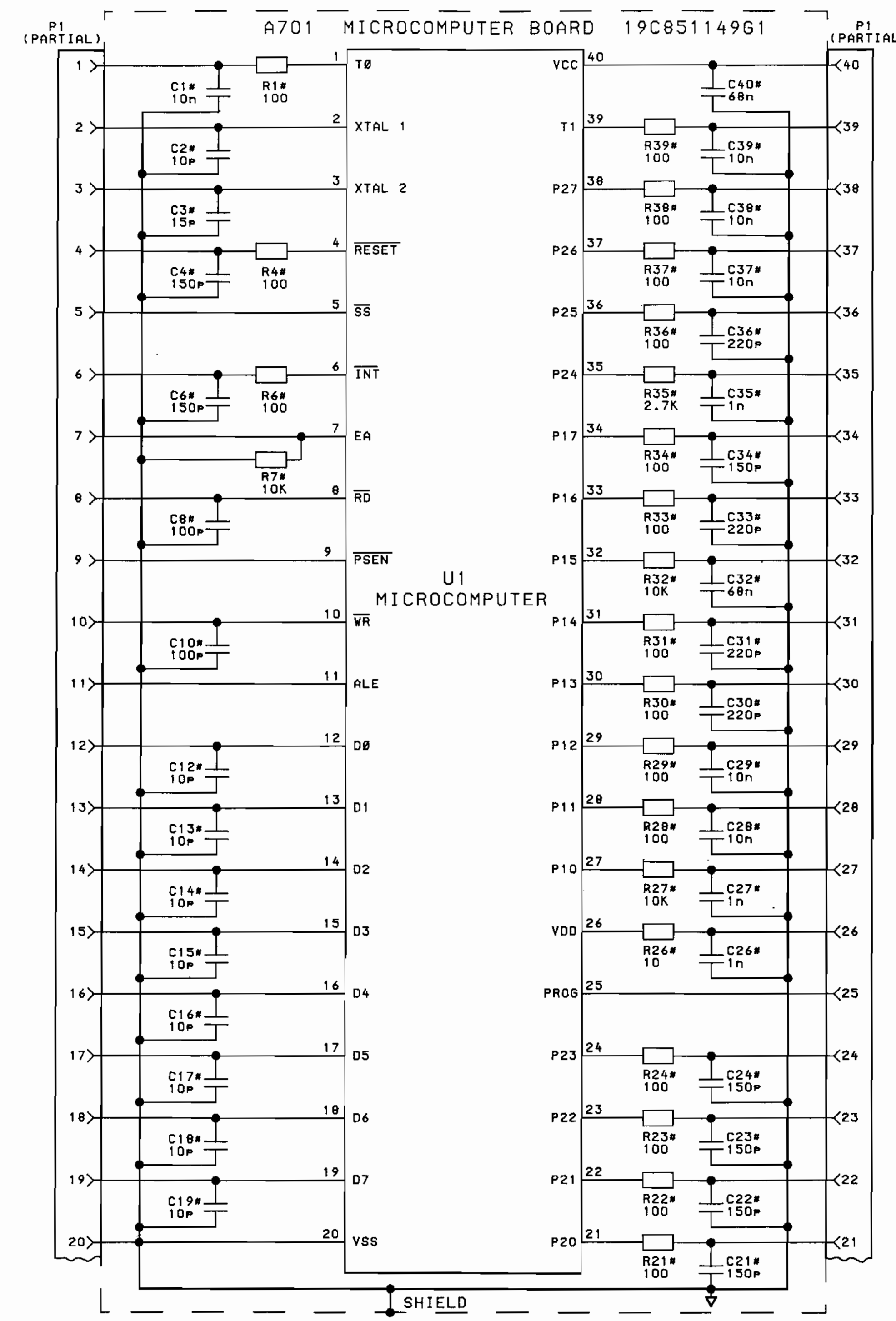


NOTES:
1. # DENOTES "CHIPS" COMPONENTS (EXAMPLE R1#) WHICH ARE LOCATED ON SOLDER SIDE OF BOARD.
2. ⏚ INDICATES A-.

(19D900844, Sh. 7, Rev. 1)

ALL CHIP RESISTORS ARE 1/8 WATT.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER μ, n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR μ.

MODEL NO.	REV. LETTER
19C851149G1	



(19D901133, Rev. 3)

SCHEMATIC DIAGRAM

29.7-50 MHz REFERENCE OSCILLATOR/
MICROCOMPUTER BOARD

PARTS LIST

29.7 - 50 MHz TRANSMIT/RECEIVE/SYSTEM BOARD
19D901153G1 29.7-36 MHz
19D901153G2 36-42 MHz
19D901153G3 42-50 MHz
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
A1		SYSTEM BOARD 19D900847G1 29.7-36 MHz - REV D 19D900847G2 36-42 MHz - REV D 19D900847G3 42-50 MHz - REV D
		EXCITER
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C102	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C103 thru C105	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C106	19B800590P27	Ceramic: 39 pF ±5%, 50 VDCW; OPPM temp coef. (Used in G1).
C106	19B800590P25	Ceramic: 33 pF ±5%, 50 VDCW; OPPM temp coef. (Used in G2).
C106	19B800590P23	Ceramic: 27 pF ±5%, 50 VDCW; OPPM temp coef. (Used in G3).
C107 and C108	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C109	19B800590P639	Ceramic: 128 pF ±5%, 50 VDCW, temp coef -220 +700 PPM. (Used in G1).
C109	19B800590P637	Ceramic: 100 pF ±5%, 50 VDCW, temp coef -220+700 PPM. (Used in G2).
C109	19B800590P633	Ceramic: 68 pF ±5%, 50 VDCW; +350 -1000 PPM temp coef. (Used in G3).
C110	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C111	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C112 thru C115	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C116	19B800590P629	Ceramic: 47 pF ±5%, 50 VDCW, temp coef -150 PPM. (Used in G1).
C116	19B800590P27	Ceramic: 39 pF ±5%, 50 VDCW; OPPM temp coef. (Used in G2 & G3).
C117 and C118	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
		- - - - - - - - - - JACKS - - - - - - - - - -
J101	19B800555G3	Connector: metering, block. Includes: (10) 19A700237P1 contacts.
J103	19A703248P1	Contact, electrical.
		- - - - - - - - - - COILS - - - - - - - - - -
L101	19B800937P10	Coil, RF: sim to Paul Smith SK887-1.
L102	19A700024P11	Coil, RF: 680 nH ±10%. (Used in G1).
L102	19A700024P10	Coil, RF: 560 nH ±10%. (Used in G2 & G3).
L103	19B801084P12	Coil RF: sim to Paul Smith SK917-1. (Used in G1).
L103	19B800937P10	Coil, RF: sim to Paul Smith SK887-1. (Used in G2 & G3).
L104	19A700024P17	Coil, RF: 2.2 uH ±10%.
L105	19B800937P8	Coil, RF: sim to Paul Smith SK887-1.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P101	19A701785P3	Contact, electrical.
P103	19A702104P1	Receptacle: 2 position, shorting, rated at 3 amps; sim to Berg 65474-002.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101	19A702084P2	Silicon, NPN; sim to MPS 2369.
Q102	19J706357P1	Silicon, NPN; sim to Type 2N4427.
Q103	19A700022P2	Silicon, PNP: sim to 2N3906.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	19B800607P121	Metal film: 120 ohms ±5%, 200 VDCW, 1/8 w.
R102	19B800607P510	Metal film: 51 ohms ±5%, 200 VDCW, 1/8 w.
R103	19B800607P121	Metal film: 120 ohms ±5%, 200 VDCW, 1/8 w.
R104 and R105	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R106	19A700019P38	Deposited carbon: 1.2K ohms ±5%, 1/4 w.
R107	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R108	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R109	19B800607P222	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 w.
R110 thru R112	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R113	19A700019P16	Deposited carbon: 18 ohms ±5%, 1/4 w. (Used in G1 & G2).
R113	19A700019P17	Deposited carbon: 22 ohms ±5%, 1/4 w. (USed in G3).
R114 and R115	19A700019P16	Deposited carbon: 18 ohms ±5%, 1/4 w.
R116	19A700019P30	Deposited carbon: 270 ohms ±5%, 1/4 w. (Used in G1).
R116	19A700019P31	Deposited carbon: 330 ohms ±5%, 1/4 w. (Used in G2).
R116	19A700019P32	Deposited carbon: 390 ohms ±5%, 1/4 w. (Used in G3).
R117 thru R119	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
		SYNTHESIZER
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C202 and C203	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C204	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C205	19A702061P93	Ceramic: 2200 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C206	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C207 and C208	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C209	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C210	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C211	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C212	19A700234P10	Polyester: 0.033 uF ±10%, 50 VDCW.
C213	19A703232P2	Metallized: 1 uF ±10%, 100 VDCW.
C214	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C215 and C216	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C217	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C217	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2).
C217	19A702061P57	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C218	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C219	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C221	19A702061P49	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C222	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C223	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C224	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C225	19A702061P93	Ceramic: 2200 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C226	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C227	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM.
C228 thru C230	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C232	19A702061P1	Ceramic: 1 pF ±0.5 pF, 50 VDCW.
C233	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C234	19A702061P5	Ceramic: 2.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM.
C235	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1 & G2).
C235	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C236	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C237	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C238	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C239	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C239	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2 & G3).
C240	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C241	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1 & G2).
C241	19A702061P49	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C242	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C244	19A702061P93	Ceramic: 2200 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C245	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM.
C246 thru C248	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C249	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM.
C250 thru C254	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C255	19A701225P8	Electrolytic: 470 uF -10+75%, 16 VDCW; sim to Sprague 5002D477-G016DGIC.
C256	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C256	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2).
C256	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C257	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C257	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2).
C257	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C258	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
		- - - - - - - - - - DIODES - - - - - - - - - -
D201	19A700053P2	Silicon, fast recovery (2 diodes in series).
D202	19A703561P2	Silicon, fast recovery (2 diodes in series).
D203 thru D209	19A700085P3	Silicon, capacitive.
D210	19A700047P2	Silicon.
D211	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
		- - - - - - - - - - JACKS - - - - - - - - - -
J202	19A703248P1	Contact, electrical.
		- - - - - - - - - - COILS - - - - - - - - - -
L201 thru L204	19A700024P29	Coil, RF: 22 uH ±10%.
L205	19A700024P25	Coil, RF: 10.0 uH ±10%, 3.70 ohms DC res max.
L206 and L207	19A700024P29	Coil, RF: 22 uH ±10%.
L208	19A700024P25	Coil, RF: 10.0 uH ±10%, 3.70 ohms DC res max.
L209	19A700024P29	Coil, RF: 22 uH ±10%.
L210	19B801055P6	Coil RF: sim to Standex SK916-1. (Used in G1).
L210	19B801055P5	Coil RF: sim to Standex SK916-1. (Used in G2).
L210	19B801055P4	Coil RF: sim to Standex SK916-1. (Used in G3).
L211	19B801036P15	Coil RF: sim to Paul Smith SK918-1. (Used in G1).
L211	19B801036P11	Coil RF: sim to Paul Smith SK918-1. (Used in G2).
L211	19B801036P9	Coil RF: sim to Paul Smith SK918-1. (Used in G3).
L212	19A700024P10	Coil, RF: 560 nH ±10%. (Used in G1).
L212	19A700024P9	Coil, RF: 470 nH ±10%. (Used in G2).
L212	19A700024P8	Coil, RF: 390 nH ±10%. (Used in G3).
L213	19A700024P12	Coil, RF: 820 nH ±10%. (Used in G1).
L213	19A700024P11	Coil, RF: 680 nH ±10%. (Used in G2).
L213	19A700024P10	Coil, RF: 560 nH ±10%. (Used in G3).
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q202 thru Q206	19A700059P2	Silicon, PNP.
Q207 and Q208	19A700076P2	Silicon, NPN.
Q213	19A700060P3	N Type, field effect.
Q214 and Q215	19A700023P2	Silicon, NPN: sim to 2N3904.
Q216 and Q217	19A700059P2	Silicon, PNP.
Q218	19A700022P2	Silicon, PNP: sim to 2N3906.
Q219 and Q220	19A700023P2	Silicon, NPN: sim to 2N3904.
Q221	19A700060P3	N Type, field effect.
Q222 and Q223	19A700076P2	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R201 and R202	19B800607P100	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w.
R203	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R204	19B800607P510	Metal film: 51 ohms ±5%, 200 VDCW, 1/8 w.
R205	19B800607P100	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w.
R206	19B800607P472	Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w.
R207	19B800607P220	Metal film: 22 ohms ±5%, 200 VDCW, 1/8 w.
R208	19B800607P224	Metal film: 220K ohms ±5%, 200 VDCW, 1/8 w.
R209	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R210	19B800607P681	Metal film: 680 ohms ±5%, 200 VDCW, 1/8 w.
R212	19B800607P100	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w.
R213	19B800607P273	Metal film: 27K ohms ±5%, 200 VDCW, 1/8 w.
R214	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R215	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R216	19B800607P104	Metal film: 100K ohms ±5%, 200 VDCW, 1/8 w.
R217 and R218	19B800607P273	Metal film: 27K ohms ±5%, 200 VDCW, 1/8 w.
R219	19B800607P271	Metal film: 270 ohms ±5%, 200 VDCW, 1/8 w.
R220	19B800607P180	Metal film: 18 ohms ±5%, 200 VDCW, 1/8 w.
R221	19B800607P271	Metal film: 270 ohms ±5%, 200 VDCW, 1/8 w.
R222	19B800607P151	Metal film: 150 ohms ±5%, 200 VDCW, 1/8 w.
R223	19B800607P154	Metal film: 150K ohms ±5%, 200 VDCW, 1/8 w.
R224	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R225	19B800607P682	Metal film: 6.8K ohms ±5%, 200 VDCW, 1/8 w.
R226 thru R228	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R229	19B800607P121	Metal film: 120 ohms ±5%, 200 VDCW, 1/8 w.
R230	19B800607P683	Metal film: 68K ohms ±5%, 200 VDCW, 1/8 w.
R231	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R232	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R233	19B800607P152	Metal film: 1.5K ohms ±5%, 200 VDCW, 1/8 w.
R234	19B800607P182	Metal film: 1.8K ohms ±5%, 200 VDCW, 1/8 w.
R236	19A702931P350	Metal film: 32.4K ohms ±1%, 200 VDCW, 1/8 w.
R237	19A700185P4	Variable: 10K ohms ±20%, 1/3 w.
R238 and R239	19B800607P683	Metal film: 68K ohms ±5%, 200 VDCW, 1/8 w.
R240	19B800607P121	Metal film: 120 ohms ±5%, 200 VDCW, 1/8 w.
R241 and R242	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R244	19B800607P182	Metal film: 1.8K ohms ±5%, 200 VDCW, 1/8 w.
R245	19B800607P152	Metal film: 1.5K ohms ±5%, 200 VDCW, 1/8 w.
R246	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R247	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R248	19B800607P182	Metal film: 1.8K ohms ±5%, 200 VDCW, 1/8 w.
R249	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R250	19B800607P152	Metal film: 1.5K ohms ±5%, 200 VDCW, 1/8 w.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP201		Part of printed board 19D900846P1
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U201	19B800902P1	SYNTHESIZER: CMOS SERIAL INPUT; sim to MC145159P.
U202	19A703091P1	DIVIDER; sim to MC12017P.
U203	19J706579P2	Comparator. Sim to LM311.
U204	19A700029P44	Digital: BILATERAL SWITCH; sim to 4066B.
		AUDIO PROCESSOR
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C302 and C304	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C305	19A702250P212	Polyester: 0.68 uF ±5%, 50 VDCW.
C306	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C307	19A702052P28	Ceramic: 0.022 uF ±10%, 50 VDCW.
C308	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
C309	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C310	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C311	19A702250P211	Polyester: 0.47 uF ±5%, 50 VDCW.
C312	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C313	19A702059P6	Polyester: 6800 pF ±5%, 50 VDCW.
C314	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		- - - - - - - - - - - DIODES - - - - - - - - - - -
D301 and D302	19A702015P1	Silicon; sim to 1N458A.
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J303	19A703248P1	Contact, electrical.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R301	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R302	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R303	19A702931P303	Metal film: 10.5K ohms ±1%, 200 VDCW, 1/8 w.
R304	19B800607P472	Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w.
R305	19A702931P212	Metal film: 1300 ohms ±1%, 200 VDCW, 1/8 w.
R306	19B800607P272	Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w.
R307	19B800607P273	Metal film: 27K ohms ±5%, 200 VDCW, 1/8 w.
R308	19A702931P278	Metal film: 6340 ohms ±1%, 200 VDCW, 1/8 w.
R309	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R310	19B800607P331	Metal film: 330 ohms ±5%, 200 VDCW, 1/8 w.
R311	19A702931P369	Metal film: 51.1K ohms ±1%, 200 VDCW, 1/8 w.
R312	19A702931P303	Metal film: 10.5K ohms ±1%, 200 VDCW, 1/8 w.
R313	19A702931P278	Metal film: 6340 ohms ±1%, 200 VDCW, 1/8 w.
R314	19A702931P330	Metal film: 20K ohms ±1%, 200 VDCW, 1/8 w.
R315	19A702931P310	Metal film: 12.4K ohms ±1%, 200 VDCW, 1/8 w.
R316	19A702931P350	Metal film: 32.4K ohms ±1%, 200 VDCW, 1/8 w.
R317	19B800607P222	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 w.
R318	19B800607P105	Metal film: 1M ohms ±5%, 200 VDCW, 1/8 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U301	19A700086P4	Operation Amplifier, Dual OP AMP; sim to 4558 Type.
U302	19A700029P44	Digital: BILATERAL SWITCH.
		OSCILLATOR
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C351	19A701225P3	Electrolytic: 220 uF, -10+50%, 25 VDCW.
C352	19A701534P9	Tantalum: 47 uF ±20%, 6.3 VDCW.
C353	19A701534P8	Tantalum: 0.47 uF ±20%, 35 VDCW.
C354	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C355	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C356	19A702061P41	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C357	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C358	19A702061P57	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C359	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C360	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C361	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
C362 and C363	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		- - - - - - - - - - - DIODES - - - - - - - - - - -
D351 and D352	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D353	19A700085P3	Silicon, capacitive.
		- - - - - - - - - - - COILS - - - - - - - - - - -
L351	19C850701P501	Coil RF: sim to Paul Smith SK923-1.
L352	19A700024P22	Coil, RF: 5.6 uH ±10%.
L353	19A700024P29	Coil, RF: 22 uH ±10%.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q351	19A700023P2	Silicon, NPN: sim to 2N3904.
Q353	19A700060P3	N Type, field effect.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R351	19B800607P393	Metal film: 39K ohms ±5%, 200 VDCW, 1/8 w.
R352	19B800607P273	Metal film: 27K ohms ±5%, 200 VDCW, 1/8 w.
R353	19A701828P5	Thermistor: 3.3K ohms ±5%; sim to Midwest ID2299.
R354	19B800607P183	Metal film: 18K ohms ±5%, 200 VDCW, 1/8 w.
R355	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R356	19B800607P683	Metal film: 68K ohms ±5%, 200 VDCW, 1/8 w.
R357	19B800607P471	Metal film: 470 ohms ±5%, 200 VDCW, 1/8 w.
R358	19A700185P4	Variable: 10K ohms ±20%, 1/3 w.
R359	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R360	19B800607P820	Metal film: 82 ohms ±5%, 200 VDCW, 1/8 w.
R361	19B800607P681	Metal film: 680 ohms ±5%, 200 VDCW, 1/8 w.
R362	19B800607P683	Metal film: 68K ohms ±5%, 200 VDCW, 1/8 w.
R363	19B800607P181	Metal film: 180 ohms ±5%, 200 VDCW, 1/8 w.
R364	19B800607P100	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w.
R365	19A702931P318	Metal film: 15K ohms ±1%, 200 VDCW, 1/8 w.
		- - - - - - - - - - - SOCKETS - - - - - - - - - - -
XY351	19A702742P1	Crystal socket.
		- - - - - - - - - - - CRYSTALS - - - - - - - - - - -
Y351	19A703049G1	Quartz: 13.200 MHz.
		FRONT END/MIXER
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C401 and C402	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C403	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C404	19A702061P71	Ceramic: 270 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C404	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2 & G3).
C405	19A702061P53	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C405	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2).
C405	19A702061P41	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C406	19A702061P8	Ceramic: 3.9 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM. (Used in G1).
C406	19A702061P6	Ceramic: 2.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM. (Used in G2).

SYMBOL	GE PART NO.	DESCRIPTION
C406	19A702061P5	Ceramic: 2.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM. (Used in G3).
C407	19A702236P44	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C407	19A702236P40	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2).
C407	19A702236P38	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C408	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C409	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C410	19A702236P44	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C410	19A702236P40	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2).
C410	19A702236P38	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C411	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C412	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM. (Used in G1).
C412	19A702061P5	Ceramic: 2.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM. (Used in G2).
C412	19A702061P4	Ceramic: 1.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±250 PPM. (Used in G3).
C413	19A702236P44	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C413	19A702236P40	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2).
C413	19A702236P38	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C414	19A702061P6	Ceramic: 2.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM. (Used in G1).
C414	19A702061P4	Ceramic: 1.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±250 PPM. (Used in G2).
C414	19A702061P3	Ceramic: 1.5 pF ±0.5 pF, 50 VDCW, temp coef 0 ±250 PPM. (Used in G3).
C415	19A702236P44	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C415	19A702236P40	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2).
C415	19A702236P38	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C416	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM. (Used in G1).
C416	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM. (Used in G2).
C416	19A702061P6	Ceramic: 2.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM. (Used in G3).
C417	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C417	19A702061P49	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2 & G3).
C418	19A702061P63	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C418	19A702061P57	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2 & G3).
C419	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C420	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C421	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C422	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C423 and C424	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C425	19A702061P11	Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C426 and C427	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C428	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.

SYMBOL	GE PART NO.	DESCRIPTION
C429	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C430	19A702061P10	Ceramic: 5.6 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C431	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C432	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C433	19A700235P19	Ceramic: 33 pF ±5%, temp coef -150 PPM.
C434	19A700234P10	Polyester: 0.033 uF ±10%, 50 VDCW.
C435	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C436	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C437	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C437	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2 & G3).
C438	19A702061P1	Ceramic: 1 pF ±0.5 pF, 50 VDCW. (Used in G1).
C438	19A702061P4	Ceramic: 1.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±250 PPM. (Used in G2).
C438	19A702061P2	Ceramic: 1.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±250 PPM. (Used in G3).
C439	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C439	19A702061P41	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1 & G2).
C440	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C440	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G2 & G3).
C441 thru C444	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C445	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C446	19A700234P10	Polyester: 0.033 uF ±10%, 50 VDCW.
C447	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C448 and C449	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C452	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C453 thru C455	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C456	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C457	19A702061P85	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C458 and C459	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C460	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C461	19A702061P3	Ceramic: 1.5 pF ±0.5 pF, 50 VDCW, temp coef 0 ±250 PPM.
C462	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		- - - - - - - - - - - DIODES - - - - - - - - - - -
D401 thru D404	19A700047P2	Silicon.
		- - - - - - - - - - - JACKS - - - - - - - - - - -
J406 and J407	19A703248P1	Contact, electrical.
		- - - - - - - - - - - COILS - - - - - - - - - - -
L401	19B801084P10	Coil, RF: sim to Paul Smith SK917-1.
L402	19C851187P800	Coil RF: sim to Paul Smith SK923-1. (Used in G1 & G2).
L402	19C851187P700	Coil RF: sim to Paul Smith SK923-1. (Used in G3).

SYMBOL	GE PART NO.	DESCRIPTION
L403	19C851187P810	Coil RF: sim to Paul Smith SK923-1. (Used in G1 & G2).
L403	19C851187P711	Coil RF: sim to Paul Smith SK923-1. (Used in G3).
L404	19C851187P800	Coil RF: sim to Paul Smith SK923-1. (Used in G1 & G2).
L404	19C851187P700	Coil RF: sim to Paul Smith SK923-1. (Used in G3).
L405	19C851187P800	Coil RF: sim to Paul Smith SK923-1. (Used in G1 & G2).
L405	19C851187P700	Coil RF: sim to Paul Smith SK923-1. (Used in G3).
L406	19C851187P800	Coil RF: sim to Paul Smith SK923-1. (Used in G1 & G2).
L406	19C851187P700	Coil RF: sim to Paul Smith SK923-1. (Used in G3).
L407	19C851187P800	Coil RF: sim to Paul Smith SK923-1. (Used in G1 & G2).
L407	19C851187P700	Coil RF: sim to Paul Smith SK923-1. (Used in G3).
L408	19A700024P33	Coil, RF: 47 uH ±10%.
L409	19A700024P23	Coil, RF: 6.8 uH ±10%.
L410	19A700024P25	Coil, RF: 10.0 uH ±10%, 3.70 ohms DC res max.
L411 thru L414	19C850701P101	Coil, RF: variable, wire size No. 34 AWG.
L415	19C851187P811	Coil RF: sim to Paul Smith SK923-1. (Used in G1).
L415	19C851187P710	Coil RF: sim to Paul Smith SK923-1. (Used in G2).
L415	19C851187P610	Coil RF: sim to Paul Smith SK923-1. (Used in G3).
L416	19C851187P800	Coil RF: sim to Paul Smith SK923-1. (Used in G1).
L416	19C851187P700	Coil RF: sim to Paul Smith SK923-1. (Used in G2).
L416	19C851187P600	Coil RF: sim to Paul Smith SK923-1. (Used in G3).
L417	19A700024P15	Coil, RF: 1.5 uH ±10%.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P401 thru P403	19A701785P3	Contact, electrical.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q401 and Q402	19A700060P3	N Type, field effect.
Q403 and Q404	19A134137P6	N Type, field effect.
Q405	19A700075P1	N-CHANNEL, field effect. (MOS DUAL GATE).
Q406	19A701808P2	Silicon, NPN; sim to MPS 6595.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R401	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R402	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R403	19B800607P272	Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w.
R404	19B800607P390	Metal film: 39 ohms ±5%, 200 VDCW, 1/8 w.
R405	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R406	19B800607P272	Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w.
R407 and R408	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R409	19B800607P332	Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 w.
R410	19A702931P273	Metal film: 5620 ohms ±1%, 200 VDCW, 1/8 w.
R411	19B800607P332	Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 w.
R412	19A702931P273	Metal film: 5620 ohms ±1%, 200 VDCW, 1/8 w.
R413	19B800607P681	Metal film: 680 ohms ±5%, 200 VDCW, 1/8 w.

SYMBOL	GE PART NO.	DESCRIPTION
R414	19B800607P272	Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w.
R415	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R416	19B800607P392	Metal film: 3.9K ohms ±5%, 200 VDCW, 1/8 w.
R417	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R418	19B800607P510	Metal film: 51 ohms ±5%, 200 VDCW, 1/8 w.
R419	19B800607P272	Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w.
R420	19B800607P100	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w.
R423	19B800607P182	Metal film: 1.8K ohms ±5%, 200 VDCW, 1/8 w.
R424	19B800607P181	Metal film: 180 ohms ±5%, 200 VDCW, 1/8 w.
R425	19B800607P220	Metal film: 22 ohms ±5%, 200 VDCW, 1/8 w.
R426	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R426	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R427	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R427	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R428	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R428	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R429	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R429	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T401 and T402	19B801143P1	Transformer, Balun.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W401	19B800890P1	Coil, RF: 9.5 nH ±5%; sim to Paul Smith SK-896-1.
		- - - - - - - - - - - NETWORKS - - - - - - - - - -
Z401	19A702068G3	Crystal filter.
Z402		Part of Z401.
Z403		Part of printed board 19D900846P1.
		IF
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C501	19A702061P10	Ceramic: 5.6 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C502	19A700235P21	Ceramic: 47 pF ±5%, 50 VDCW.
C503	19A700235P24	Ceramic: 82 pF ±5%, 50 VDCW.
C504 thru C510	19A700234P10	Polyester: 0.033 uF ±10%, 50 VDCW.
C511	19A700235P21	Ceramic: 47 pF ±5%, 50 VDCW.
C512	19A702061P57	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C513 and C514	19A700234P10	Polyester: 0.033 uF ±10%, 50 VDCW.
C515	19A700013P10	Phenolic: 0.56 pF ±5%, 500 VDCW.
C516	19A701624P132	Ceramic: 47 pF ±5%, 500 VDCW, -700 ±120 PPM temp coef.
C517 and C518	19A700234P10	Polyester: 0.033 uF ±10%, 50 VDCW.
C519	19A700234P2	Polyester: 1500 pF ±10%, 50 VDCW.
C520 and C521	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C522 and C523	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C524	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C525	19A702061P10	Ceramic: 5.6 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.

SYMBOL	GE PART NO.	DESCRIPTION
C526	19A702061P3	Ceramic: 1.5 pF ±0.5 pF, 50 VDCW, temp coef 0 ±250 PPM.
C527	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
		- - - - - - - - - - - - COILS - - - - - - - - - - - -
L501 thru L506	19A701761P45	Coil, RF: 68 uh ±10%, 3.30 ohms DC res max.
L507 and L508	19C850701P101	Coil, RF: variable, wire size No. 34 AWG.
L509	19C850701P102	Coil, RF: variable, wire size No. 34 AWG.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R501	19B800607P271	Metal film: 270 ohms ±5%, 200 VDCW, 1/8 w.
R502	19B800607P182	Metal film: 1.8K ohms ±5%, 200 VDCW, 1/8 w.
R503	19B800607P271	Metal film: 270 ohms ±5%, 200 VDCW, 1/8 w.
R504	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R505	19B800607P472	Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w.
R506	19B800607P104	Metal film: 100K ohms ±5%, 200 VDCW, 1/8 w.
R507	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R508	19B800607P472	Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w.
R509	19B800607P681	Metal film: 680 ohms ±5%, 200 VDCW, 1/8 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U501	19A700044P1	Linear, IF Amplifier & Detector; sim to ULN2111A.
U502	19A700091P1	Linear, IF Amplifier & Detector; sim to CA3089E.
		- - - - - - - - - - - NETWORKS - - - - - - - - - -
Z501	19A702068G3	Crystal filter.
Z502		Part of Z501
Z503	19A702068G3	Crystal filter.
Z504		Part of Z503.
		SYSTEM/AUDIO/SQUELCH
A601	19C851003P1	Printed Board.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601 thru C603	19A702052P6	Ceramic: 1500 pF ±10%, 50 VDCW.
C604	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C605	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C606 thru C609	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C610	19A702052P10	Ceramic: 4700 pF ±10%, 50 VDCW.
C611	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C612	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C613	19A701225P3	Electrolytic: 220 uF, -10+50%, 25 VDCW.
C614 and C615	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C616 thru C618	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW
C619	19A701534P3	Tantalum: 0.47 uF ±20%, 35 VDCW.
C620	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C621	19A702052P3	Ceramic: 470 pF ±10%, 50 VDCW.
C651 and C652	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C656	19A701225P1	Electrolytic: 15 uF -10 +75%, 25 VDCW; sim to Sprague 501D156-G025BB1C.

SYMBOL	GE PART NO.	DESCRIPTION
C659 thru C665	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C666 thru C668	19A702052P3	Ceramic: 470 pF ±10%, 50 VDCW.
C669 thru C671	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C680 and C681	19A702055P1	Electrolytic: 470 uF +100-10%, 18 VDCW.
C685 thru C695	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
		- - - - - - - - - - - - DIODES - - - - - - - - - - -
D601	19A703561P2	Silicon, fast recovery (2 diodes in series).
D602	19A700053P2	Silicon, fast recovery (2 diodes in series).
D603	19A703561P2	Silicon, fast recovery (2 diodes in series).
D605	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J601	19C850591G4	Connector. Includes: 19A701246G2 shell; 19A701254P1 Connector; 19A701254P2 Connector.
J602	19B800555G4	Connector: metering, red. Includes (10) 19A700237P1 contacts.
J603	19A700072P47	Printed wire: 21 contacts rated @ 2 1/2 amps per contact; sim to Molex 22-27-2211.
J604	19A701898P3	Printed wire: 3 contacts rated @ 2-1/2 amps.
J605 thru J610	19A703248P1	Contact, electrical.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P605 thru P609	19A702104P1	Receptacle: 2 position, shorting, rated at 3 amps; sim to Berg 65474-002.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q601 thru Q604	19A700023P2	Silicon, NPN: sim to 2N3904.
Q605	19A700076P2	Silicon, NPN.
Q606	19A700023P2	Silicon, NPN: sim to 2N3904.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R601	19A702931P318	Metal film: 15K ohms ±1%, 200 VDCW, 1/8 w.
R602	19A702931P273	Metal film: 5620 ohms ±1%, 200 VDCW, 1/8 w.
R603	19A702931P393	Metal film: 90.9K ohms ±1%, 200 VDCW, 1/8 w.
R604	19B800607P472	Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w.
R605	19B800607P822	Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 w.
R606	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R607	19B800607P104	Metal film: 100K ohms ±5%, 200 VDCW, 1/8 w.
R608	19B800607P334	Metal film: 330K ohms ±5%, 200 VDCW, 1/8 w.
R609	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R610	19B800607P154	Metal film: 150K ohms ±5%, 200 VDCW, 1/8 w.
R611	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R612	19B800607P124	Metal film: 120K ohms ±5%, 200 VDCW, 1/8 w.
R613	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R614	19A702931P355	Metal film: 36.5K ohms ±1%, 200 VDCW, 1/8 w.
R615	19A702931P293	Metal film: 9090 ohms ±1%, 200 VDCW, 1/8 w.
R616 and R617	19A702931P369	Metal film: 51.1K ohms ±1%, 200 VDCW, 1/8 w.
R618	19B800607P104	Metal film: 100K ohms ±5%, 200 VDCW, 1/8 w.
R619	19B800607P124	Metal film: 120K ohms ±5%, 200 VDCW, 1/8 w.
R620	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.

SYMBOL	GE PART NO.	DESCRIPTION
R621	19B800607P681	Metal film: 680 ohms ±5%, 200 VDCW, 1/8 w.
R622	19B800607P330	Metal film: 33 ohms ±5%, 200 VDCW, 1/8 w.
R623	19B800607P390	Metal film: 39 ohms ±5%, 200 VDCW, 1/8 w.
R624	19B800607P152	Metal film: 1.5K ohms ±5%, 200 VDCW, 1/8 w.
R625 and R626	19A700019P9	Deposited carbon: 4.7 ohms ±5%, 1/4 w.
R627	19B800607P154	Metal film: 150K ohms ±5%, 200 VDCW, 1/8 w.
R628	19B800607P822	Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 w.
R629	19A700185P7	Variable, conductive: 100K ohms ±20%, 0.33 w max.
R630	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R631 and R632	19B800607P104	Metal film: 100K ohms ±5%, 200 VDCW, 1/8 w.
R633	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R651 and R652	19B800607P561	Metal film: 560 ohms ±5%, 200 VDCW, 1/8 w.
R653 thru R658	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R659	19B800607P472	Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w.
R660	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R661	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R662	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R663 and R664	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R665	19B800607P224	Metal film: 220K ohms ±5%, 200 VDCW, 1/8 w.
R666	19A700185P4	Variable: 10K ohms ±20%, 1/3 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U601 and U602	19A701830P1	Linear, Audio AMPLIFIER; sim to TDA 2003.
U603 and U604	19A701789P1	Linear, Low Power OP AMP; sim to LM324N.
U605	19A700029P44	Digital: BILATERAL SWITCH.
		REGULATOR/MICROCOMPUTER
A701		MICROCOMPUTER BOARD 19D851149G3
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C2	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C3	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C4	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C6	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C8	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C10	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C12 thru C19	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C21 thru C24	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C26 and C27	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C28 and C29	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
C30 and C31	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C32	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C33	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C34	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C35	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C36	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C37 thru C39	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C40	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P1	19A700041P19	Printed wire: 20 pins rated @ 2 1/2 amps; sim to Molex 22-14-2204. (Quantity 2).
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R1	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R4	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R6	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R7	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R21 thru R24	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R26	19B800607P100	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w.
R27	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R28 thru R31	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R32	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R33 and R34	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R35	19B800607P272	Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w.
R36 thru R39	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A703241G7	Microcomputer. (HMOS, 8-BIT).
A711		DIODE/RESISTOR NETWORK 19A704116G1
		- - - - - - - - - - - DIODES - - - - - - - - - -
D714	4036887P3	Silicon, zener diode; sim to 1N5228B.
D715	4036887P6	Zener: 500 mW, 6.5 v. nominal.
		- - - - - - - - - - RESISTORS - - - - - - - - - - -
R770 and R771	3R151P102J	Composition: 1K ohms ±5%, 1/8 w.
A712		CAPACITOR NETWORK 19A704116G3
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	19A700005P1	Polyester: 1000 pF ±10%, 50 VDCW.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C701	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C702	19A701225P3	Electrolytic: 220 uF, -10+50%, 25 VDCW.
C703	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
C704	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C705 thru C707	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C708	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C709	19A701225P3	Electrolytic: 220 uF, -10+50%, 25 VDCW.
C710	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C711	19A701534P8	Tantalum: 0.47 uF ±20%, 35 VDCW.
C712	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C713	19A701534P4	Tantalum: 1 uF ±20%, 35 VDCW.
C714	19A701534P3	Tantalum: 0.47 uF ±20%, 35 VDCW.
C716	19A701534P4	Tantalum: 1 uF ±20%, 35 VDCW.
C717	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C718	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C720	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C722	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C723	19A701534P4	Tantalum: 1 uF ±20%, 35 VDCW.
C724	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C726	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - - -
D701 and D702	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D703	19A700053P2	Silicon, fast recovery (2 diodes in series).
D711	19A700047P2	Silicon.
D712	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D713	19A134354P1	Diode, optoelectronic: red; sim to Hew. Packard 5082-4655.
D716 thru D719	19A700053P2	Silicon, fast recovery (2 diodes in series).
D720	19A700047P2	Silicon, 100 mW, continuous dissipation; sim to DO-15.
		- - - - - - - - - - - JACKS - - - - - - - - - - -
J701 thru J704	19A703248P1	Contact, electrical.
J710	19A703248P2	Contact, electrical.
J711	19A703248P4	Contact, electrical.
J712	19A703248P1	Contact, electrical.
		- - - - - - - - - - - COILS - - - - - - - - - - -
L711	19A700000P25	Coil, RF: 15 uH ±10%; sim to Jeffers 4421-9K.
L712	19A700024P21	Coil, RF: 4.7 uH ±10%.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P701 thru P704	19A702104P1	Receptacle: 2 position, shorting, rated at 3 amps; sim to Berg 65474-002.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - - -
Q701	19A700076P2	Silicon, NPN.
Q711	19A700076P2	Silicon, NPN.
Q713 and Q714	19A700076P2	Silicon, NPN.
Q715	19A700059P2	Silicon, PNP.
Q716 thru Q719	19A700023P2	Silicon, NPN: sim to 2N3904.
Q720	19A700076P2	Silicon, NPN.
Q721	19A700023P2	Silicon, NPN: sim to 2N3904.
Q722	19A700076P2	Silicon, NPN.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R701	19A701250P185	Metal film: 750 ohms ±1%, 1/4 w.
R702	19A701250P112	Metal film: 130 ohms ±1%, 1/4 w.
R703	19A700185P4	Variable: 10K ohms ±20%, 1/3 w.
R704 thru R706	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R707	19A702931P393	Metal film: 90.9K ohms ±1%, 200 VDCW, 1/8 w.
R708	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R709	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R710	19B800607P331	Metal film: 330 ohms ±5%, 200 VDCW, 1/8 w.
R711	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R713	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R714	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R715	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R716	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R717	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R718	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R719	19B800607P822	Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 w.
R720	19B800607P104	Metal film: 100K ohms ±5%, 200 VDCW, 1/8 w.
R721	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R722	19B800607P471	Metal film: 470 ohms ±5%, 200 VDCW, 1/8 w.
R723 thru R732	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R733	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R734	19B800607P471	Metal film: 470 ohms ±5%, 200 VDCW, 1/8 w.
R736 and R737	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R738	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R739	19B800607P222	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 w.
R740	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R741	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R742	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R743	19B800607P104	Metal film: 100K ohms ±5%, 200 VDCW, 1/8 w.
R744	19B800607P224	Metal film: 220K ohms ±5%, 200 VDCW, 1/8 w.
R745	19B800607P682	Metal film: 6.8K ohms ±5%, 200 VDCW, 1/8 w.
R746 thru R752	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R753	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R755	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R756	19B800607P273	Metal film: 27K ohms ±5%, 200 VDCW, 1/8 w.
R757	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R759	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R760 thru R762	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R763	19A702931P318	Metal film: 15K ohms ±1%, 200 VDCW, 1/8 w.
R764	19B800607P331	Metal film: 330 ohms ±5%, 200 VDCW, 1/8 w.
R766	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
		- - - - - - - - - - - TEST POINTS - - - - - - - - - - -
TP701		Part of printed board 19D900846P1.
		- - - - - - - - - - - INTEGRATED CIRCUITS - - - - - - - - - - -
U701	19A701999P1	Linear, Positive Voltage Regulator; sim to LM317T.

SYMBOL	GE PART NO.	DESCRIPTION
U702	19J706032P1	Linear: POSITIVE VOLTAGE REGULATOR; sim to MC7805CT.
U703	19A116968P3	Linear, timer: DUAL IN-LINE 14 Pin Dip Package; sim to Signetics SA556N.
U704	19A700029P229	Digital: HEX 3-STATE BUFFER.
U706	19A703072P2	Digital: sim to XICOR X2212DI.
U707	19A116180P33	Digital: HEX INVERTER BUFFER/DRIVER (OPEN COLLECTOR).
		- - - - - - - - - - - SOCKETS - - - - - - - - - - -
XU706	19A700156P11	Integrated circuit.
		- - - - - - - - - - - CRYSTALS - - - - - - - - - - -
Y701	19A702511G3	Quartz: 6.000000 MHz.
		- - - - - - - - - - - CAPACITORS - - - - - - - - - - -
C220	19A134227P4	Variable: 1.5 to 14 pF, 100 VDCW.
		- - - - - - - - - - - MISCELLANEOUS - - - - - - - - - - -
	19C850719P1	IF Cover.
	19D901143P1	Front End Casting.
	19D900777P1	Bottom cover, casting.
	19B800647G1	IF Shield.
	19B800655P1	Gasket. (J601).
	19D901144P1	Front End Spacer.
	19A702381P508	Screw, thd. form: No. 3.5-0.6 x 8. (Secures covers).
	7141225P2	Hex nut: No. 4-40. (Secures C220).
	N404P11C6	Lockwasher, internal: No. 4. (Secures C220).
	19B801103P2	Spring, trimmer. (Used with C220).
	19A703087P1	Nut, variable cap. (C220).
	19A701332P4	Insulator, washer: nylon. (Located between Q102 and board).
	19A700116P55	Eyelet, metal. (Located at HL2 & HL3 holes).
	19A701289P1	Retaining ring: 3/16 inches; sim to National Lockwasher WA 510. (Located on two pins on J601).
	19C850674G1	Can. (Encloses U502, L509, etc.).
	19A701887P1	Heat sink. (Q102).
	19A701900P2	Compression clip. (Used with Q102).
	19A701516P1	Insulator, plate. (Used with Y701).
	19A700068P1	Insulator, bushing. (Used with U601, U602, U701 & U702).
	19A700115P3	Insulator, plate. (Used with U601, U602, U701 & U703).
	19A702362P210	Machine screw, TORX Drive N2.5-0.45 x 10. (Secures U601, U602, U701 & U702).
	19A701538P2	Gasket. (Used with L509).
	19A703576P1	Insulator. (Located under A701).
		ASSOCIATED ASSEMBLIES
	19A703231G1	EE PROM KIT. (PROGRAMMED) Includes integrated circuit 19A703072P2 and EE PROM label. NOTE: When reordering a preprogrammed electrically erasable PROM, include complete combination number, RF frequencies assigned to each channel and Channel Guard tones/digital codes assigned to each channel. Also carrier control timer information for each channel.
	19A703072P2	Digital. (STATIC RAM - Not Programmed); sim to XICOR X2212D. (Integrated Circuit only).

SYMBOL	GE PART NO.	DESCRIPTION
		ELECTRICALLY ERASABLE PROM
	19C851006G2	(2nd Preprogrammed EE PROM, used in 32 channel radios). NOTE: When reordering a preprogrammed electrically erasable PROM, include complete combination number, RF frequencies assigned to each channel and Channel Guard tones/digital codes assigned to each channel. Also carrier control timer information for each channel.
	19C851006G1	(2nd EE PROM, used in 32 channel radios - not programmed).

PARTS LIST

LBI31199A
29.7 - 50 MHz DELTA-S
ASSOCIATED PARTS

SYMBOL	GE PART NO.	DISCRIPTION
		ARDWARE KIT 9A702024G1
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P610	19A702104P1	Receptacle: 2 postion, shorting, rated at 3 amps; sim to Berg65474-002. (For Public Address).
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W601	19A702028P1	Jumper. (For Variible Squelch).
		- - - - - - - - - - - ISCELLANEOUS - - - - - - - - - - -
	1R11P6	Fuse, quick blowin: 25 amps, 250 v; sim to Bussmann NON25.
	1R11P7	Fuse, quick blowin: 30 amps, 250 v; sim to Bussmann NON30.
	19B216021G4	Fuseholder.
	19C850706P1	Spacer. (Located t front right leg).
	N401P3C6	Flatwasher, No. 2. (Soldered to feed thru capacitors on fram).
	19A702362P310	Machine screw, TOR Drive M3-0.5 x 10. (Secures J601-Quantity 2).
	19A702381P508	Screw, thd. form: No. 3.5-0.6 x 8. (Secures Transmit/Receive/Sstem Board to frame - Quantity 11).
	19A702381P513	Screw, thread formng: TORX DRIVE No. M3.5 - 0.6 x 13. (Secures trnsistor heat sinks to frame - Quantity 3).
	19A702393P1	Screw, special hea, TORX Drive M6-1 x 11. (Secures legs - Quntity 4).
	19C850708G3	Radio top cover.
	19C850949P1	P.A. Cover.
	19B800686G1	Radio bottom cover
	19B800716P2	Tuning tool.
	19B800004P3	Key.
	19A703653P1	Metering label.
	19B800587P1	Gasket. (Part of bttom cover).
	19B800500P5	Gasket. (Part of op cover).
	19A702029P1	Spring clip; sim tc Tinnermann C57306-036M. (Located in top cover).
		ASSOCIATED PARTS
	19B801124P1	Front End Cover.
	19C850860P3	Synthesizer Top Cover.
	19B800908P2	Oscillator Cover.

*COMPONENTS ADDED, DELETED OR CHANGEI BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - 29.7-50 MHZ TRANSMIT/RECEIVE/SYSTEM BOARD 19D900847G1-3
To add low voltage reset circuit to microprocessor to improve operation under low voltage conditions. Added A711 and C724. A711 consists of R770, R771, D714, and D715.

REV. B - To incorporate improved components. Deleted C450, C451, and C243. Added A712. Old part numbers were:

C450 - 19A702052P24 - Ceramic: 0.068 uF ±10%, 50 VDCW.
C451 - 19A702052P24 - Ceramic: 0.068 uF ±10%, 50 VDCW.

C243 - 19A702061P99 - Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM

REV. C - To make compatible for use with the S950 Control Unit. Added C726 on solder side of board between J604-4 and J604-15.

REV. D - To make compatible with the S950 Control Unit. Added D720, A Schottky diode, between U703-5 (cathode) and U706-10 (anode) on the solder side of the board. Sleeve the leads.

D720 - 19A700047P2, Silicon

REV. E - To improve operation of the noise blanker. Changed Q403 and Q404. Old part number was:

19A134137P4 - N Type, field effect: sim to Type 2N3458.

29.7-50 MHz NOISE BLANKER

19D900860G1

TABLE OF CONTENTS

DESCRIPTION

The noise blanker option for the DELTA-S synthesized radio consists of a single plug-in printed wire board which plugs into J406 on the transmit/receive/synthesizer board (TRS). The noise blanker is designed to improve receiver performance by blanking out impulse noise emanating from the alternator, ignition system, etc. This is accomplished by delaying the IF signal for 200 n seconds while generating a blanking gate (pulse) having the same characteristics as the noise pulses. These blanking pulses then are used to turn off the delayed IF signal precisely where the noise occurs, resulting in noise free audio reception.

The noise blanker may be disabled, if desired, by relocating a ground plug (P401) and connecting HL20 to ground on the TRS board. An alternate method (if the noise blanker is to be permanently disabled) is to remove the noise blanker board from the radio, reconnect W401 (between J406-8-10) and remove Q403 and Q404 on the TRS board. The alternate method results in improved intermod performance.

INSTALLATION

The noise blanker plugs into J406 on the TRS board. If the board is installed after the receiver has been aligned (or installed in the field), cut jumper wire W401 on the TRS board. Be sure that P407 is plugged onto J407-2,3. Refer to Receiver Alignment Procedures in the Service Section of the Maintenance Manual (Step 5 of Preliminary Checks and Adjustments) and tune accordingly.

NOTE

If the noise blanker is installed prior to receiver alignment, simply plug the noise blanker onto J406 and perform standard receiver Alignment Procedures. Be sure P407 is plugged onto J407-1,2.

CIRCUIT ANALYSIS

The noise blanker consists of a 200 n sec fixed delay line, three pulse amplifiers, a pulse amplifier/limiter, gate driver and blanker disable switch as shown in Figure 1. Input signals from the TRS board include the 10.7 MHz IF signal and two BLKR DISABLE inputs. A blanker gate output signal is returned to the TRS board.

The 10.7 MHz IF signal is acquired from JFET buffer Q402 on the TRS board and applied to gate 1 of pulse amplifier Q1 and to delay line Z1. Z1 delays the IF signal by 200 n seconds and returns it to the two JFET gating switches on the TRS board. The undelayed IF signal is amplified by pulse amplifier Q1. Q1 provides approximately 20 dB of amplification. Bias for Q1 is established by R3, R4. The IF output of Q1 is further amplified and limited by pulse amplifier/limiter U1. U1 provides approximately 50 dB of amplification.

The output of the limiter is applied to pulse detector Q2. DC bias for Q2 is set at the threshold of conduction so that all noise pulses regardless of magnitude or duration will be detected.

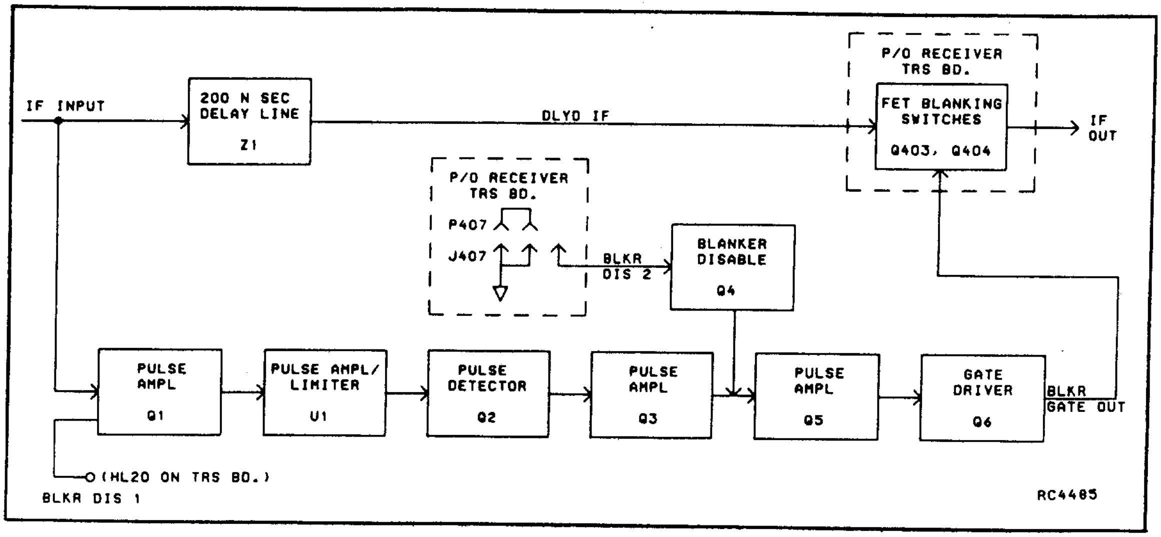


Figure 1 -

Threshold bias is established by R10-R12, R25 and D1. R10 is a negative temperature compensating resistor whose temperature characteristics complement U1 to adjust the threshold level of Q2 with changes in temperature.

The detected pulse is taken from the collector of Q2 and further amplified by pulse amplifiers Q3 and Q5. C16 in the emitter circuit of Q3 provides a low frequency bypass to ground and also maintains a full charge to allow Q3 to be switched on and off more rapidly. The output of pulse amplifier Q5 is applied to gate driver Q6. Q6 provides drive to operate the two JFET switches (Q403, Q404) located just ahead of the crystal filters on the TRS board. Output is through P1-2. The delayed IF signal from delay line Z1 arrives at Q403 and Q404 at the same time as the gating pulses from the blanker switch. The gating pulse switches Q403 and Q404 off coincident with the noise pulses on the IF signal, shunting all noise pulses to ground.

BLANKER DISABLE

Two blanker disable inputs are provided to assure complete turn off of the noise blanker function while allowing the delayed IF signal to be processed through the receiver. Both blanker disable inputs apply A- to the blanker board. BLKR DIS 1 is applied to pulse amplifier Q1 gate 2. This will nearly turn off Q1. BLKR DIS 2 is applied to the base of Q4, turning it on. Q4 shorts the emitter and collector of pulse amplifier Q3, preventing any remaining noise pulses from passing.

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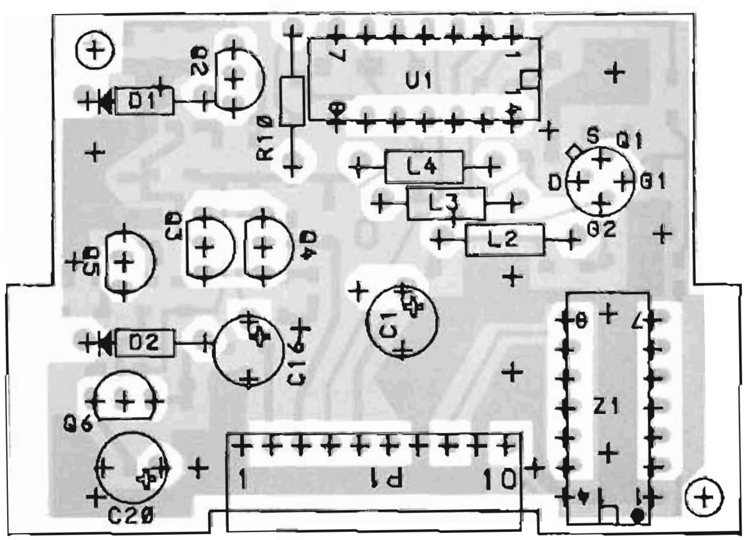
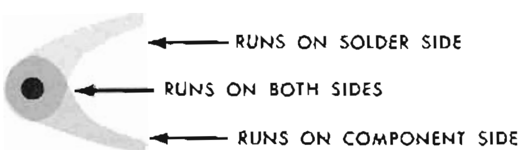
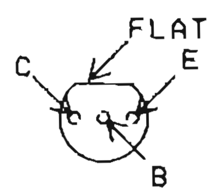


(19D901130, Rev. 0)
(19A702990, Sh. 1, Rev. 0)
(19A702990, Sh. 2, Rev. 0)



LEAD IDENTIFICATION
FOR Q2-Q6

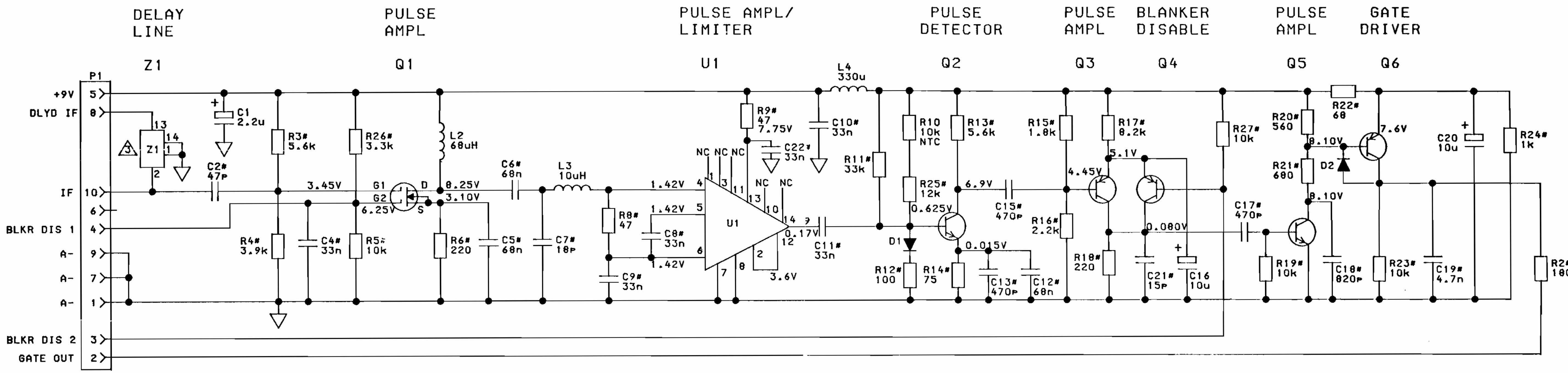


IN-LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

OUTLINE DIAGRAM

29.7-50 MHz NOISE BLANKER



(19D901132, Rev. 1)

ALL CHIP RESISTORS ARE 1/8 WATT.
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k, OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER u, n OR, p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR u.

NOTES:
1. # DENOTES "CHIP" COMPONENTS (EXAMPLE R1#) WHICH ARE LOCATED ON SOLDER SIDE OF PWB.
2. ▽ INDICATES A-.
3. PINS 3-12 NOT CONNECTED.
4. VOLTAGES SHOWN ARE DC VOLTAGES WITH NO RX SIGNAL INPUT.

MODEL NO.	REV. LETTER
PL19D900860G1	

SCHEMATIC DIAGRAM

29.7-50 MHz NOISE BLANKER

Issue 1

PARTS LIST

29.7 - 50 MHz NOISE BLANKER
19D900860G1

ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A701534P5	Tantalum: 2.2 uF, ±20%, 35 VDCW.
C2	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C4	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C5 and C6	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C7	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C8 thru C11	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
C12	19A702052P24	Ceramic: 0.068 uF ±10%, 50 VDCW.
C13	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C15	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C16	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C17	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C18	19A702061P83	Ceramic: 820 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C19	19A702052P10	Ceramic: 4700 pF ±10%, 50 VDCW.
C20	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C21	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C22	19A702052P20	Ceramic: 0.033 uF ±10%, 50 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - -
D1 and D2	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
		- - - - - - - - - - - COILS - - - - - - - - - - -
L2 and L3	19A700024P35	Coil, RF: 68 uH ±10%.
L4	19A700024P43	Coil, RF: 330 uH ±10%.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19A700041P84	Printed wire: 10 contacts rated 2.5 amps; sim to Molex 22-15-2106.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A700075P1	N-CHANNEL, field effect. (MOS DUAL GATE).
Q2	19A700023P2	Silicon, NPN: sim to 2N3904.
Q3 and Q4	19A700022P2	Silicon, PNP: sim to 2N3906.
Q5	19A700023P2	Silicon, NPN: sim to 2N3904.
Q6	19A700022P2	Silicon, PNP: sim to 2N3906.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2	19B800607P181	Metal film: 180 ohms ±5%, 200 VDCW, 1/8 w.
R3	19B800607P562	Metal film: 5.6K ohms ±5%, 200 VDCW, 1/8 w.
R4	19B800607P392	Metal film: 3.9K ohms ±5%, 200 VDCW, 1/8 w.
R5	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R6	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R8 and R9	19B800607P470	Metal film: 47 ohms ±5%, 200 VDCW, 1/8 w.
R10	19A701864P4	Thermal 10K ohms ±10%, sim to Midwest Components 2H-103.
R11	19B800607P333	Metal film: 33K ohms ±5%, 200 VDCW, 1/8 w.
R12	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R13	19B800607P562	Metal film: 5.6K ohms ±5%, 200 VDCW, 1/8 w.
R14	19B800607P750	Metal film: 75 ohms ±5%, 200 VDCW, 1/8 w.
R15	19B800607P182	Metal film: 1.8K ohms ±5%, 200 VDCW, 1/8 w.
R16	19B800607P222	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 w.
R17	19B800607P822	Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 w.
R18	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R19	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R20	19B800607P561	Metal film: 560 ohms ±5%, 200 VDCW, 1/8 w.
R21	19B800607P681	Metal film: 680 ohms ±5%, 200 VDCW, 1/8 w.
R22	19B800607P680	Metal film: 68 ohms ±5%, 200 VDCW, 1/8 w.
R23	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R24	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R25	19B800607P123	Metal film: 12K ohms ±5%, 200 VDCW, 1/8 w.
R26	19B800607P332	Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 w.
R27	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A700044P1	Linear, IF Amplifier & Detector; sim to ULN2111A.
		- - - - - - - - - - - NETWORKS - - - - - - - - -
Z1	19B801117P1	Delay line, 200 nano seconds ±5% delay; sim to Sprague 60Z14A-200H.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A702104P1	Receptacle: 2 position, shorting, rated at 3 amps; sim to Berg 65474-002.
	19B801138P1	Board guide. (Quantity 2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

29.7-50 MHz, 110 WATT POWER AMPLIFIER 19D900207G4-6

TABLE OF CONTENTS

DESCRIPTION

The PA assembly uses a driver and three RF power transistors to provide 110 watts of output power. The output power is adjustable over a range of 55 to 110 watts. Four transistors are used in the power control circuit.

Supply voltage for the PA is connected from power leads on the Transmit-Receive-System (TRS) board through feedthrough capacitors A2-C1 and C2 to hole 12 (A+) and 11 (A-) on the PA board. C54, C70 and L29 and L30 prevent RF from getting on the power leads. Diode D8 will cause the main fuse in the fuse assembly to blow if the polarity of the power leads is reversed.

The PA assembly is isolated from vehicle ground by C1, C2, C5, C16, C17, C19, C20, C38, C46, C47, C60-C63, C79, and C80 to permit operation in positive or negative ground vehicles.

NOTE

In positive ground vehicles, A- is "hot" with respect to vehicle ground. Shorting the transmitter PA printed wiring board ground pattern to the radio case may cause one of the in-line fuses to blow.

PA metering Jack J1 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12 with a cable adaptor. The Test Set meters the RF drive (exciter output), control voltage, driver current, PA current and PA voltage.

CIRCUIT ANALYSIS

RF AMPLIFIERS

The exciter output is coupled through P101 on the TRS board to the PA input jack J3. The RF is coupled through DC blocking capacitor C3 to the gate of pre-driver Q1 through matching elements L1, L2 and C6. R1 provides a DC path for the gate of Q1.

A portion of the RF input is coupled by C4 to D1. Diode D1 rectifies the RF input and applies DC to Q4, switching on the power control circuit.

Drain voltage on pre-driver Q1 is controlled by the Power Control Circuit and is applied through a decoupling network which consists of L4, C8, L3, R7 and C7. The drain voltage is metered through R11 at J1 pin 9. (CONTROL VOLT).

DRIVER Q5

CAUTION

CMOS devices (Q1 and Q5) can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering an CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery-operated soldering iron may be used in place of the regular soldering iron.

Following Q1 is matching network C9, C10, L9 and L5. C10 provides DC blocking to isolate driver Q5 from the drain voltage of Q1. R10 provides base loading for Q5. R3 provides stabilizing resistance to Q5.

Collector voltage to driver Q5 is supplied through a decoupling network consisting of L7, C11, R13, L6, C12 and C13.

Current for both Q1 and Q5 is monitored across resistor R24 at J1 pin 5 (DRIVER CURRENT). The reading is taken on the 1-Volt scale with the polarity switch in the minus (-) position and High Sensitivity button pressed. The meter is read at 15 Amps full scale.

The RF output from Q5 passes through matching network L8, C15, and DC blocking capacitor C14. (NOTE: This is a 50 ohm point and may be used for checking power levels). From C14, RF passes through stabilizing resistors R27, R29 and R30 to input of 4:1 transformer T3. The output of T3 is applied to a Wilkinson power splitter.

WARNING

The RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic, or other encapsulation is opened, crushed, broken or abraded, the dust if inhaled may be hazardous. Use care in replacing transistors of this type.

POWER SPLITTER

The Wilkinson power splitter consists of L10, L11, C21, C22, C76, C77 and balancing resistor R14. The power splitter feeds dual power amplifiers Q6 and Q8 through identical impedance matching elements. The impedance matching elements of power amplifier Q6 consists of L12, L14, and C23-C27. The impedance matching elements of Q8 consists of C34, C35, L13, L15, C32, C33, and C36. R15 and R16 provide base loading for power amplifiers Q6 and Q8. L16 and L17 are base coils that provide a DC path to ground for Q6 and Q8.

POWER AMPLIFIER

The power amplifiers, consisting of Q6 and Q8, are driven in parallel from the power splitter. Each PA transmitter provides a minimum of 55 watts RF output power to the antenna.

Operating voltage for the power amplifier is supplied from the DC input through R23 and a stabilizing and decoupling network consisting of C29-C31, C42, C43, L18, L19, Z2 and Z3. 12.4 VDC is supplied to the collectors of Q6 and Q8. PA current is monitored across R23 through W1 at J1-6 (PA current). The reading is taken on the 1-volt scale with the polarity switch in the (-) position and the HIGH SENSITIVITY button pressed. The meter is read as 30 amps full scale. PA voltage is monitored at J1 pin 8 (metered) or J1 pin 2 (if using a VOM). J1 pins 1 is PA A-. Voltage is read in position C on the 15V scale.

POWER COMBINER

The output of the power amplifiers passes through two identical impedance matching networks to a Wilkinson power combiner consisting of C50, R17, L24, and L25. The impedance matching networks are comprised of L20-L23, C39-C41, C44, C45, and C48. The combiner RF output passes through DC blocking capacitors C49 and C75 to 1:4 transformer T2. From T2, RF goes through blocking capacitor C81. (NOTE: This is a 50 ohm point and may be used for checking power levels.) The RF power passes through 50- microstrip Z4 and Z5 and power coupler T1 to the low-pass filter. The filter output is applied to the antenna connection J2 through transmit/receive relay K1.

The relay is switched through J4 and J5 by switching voltage supplied from the TRS board.

POWER CONTROL CIRCUIT

The power control circuit provides closed-loop RF power leveling and power turndown when it senses high VSWR load conditions.

When the transmitter is keyed, RF is rectified by D1. The resulting DC turns on RF switch Q4. Turning on Q4 supplies current to zener diode D2, which provides a constant control reference voltage. This reference voltage is metered through R9 at J1 pin 10.

Q2, Q3 and Q7 serve as DC amplifiers to supply voltage to the drain of Q1. The setting of R21 determines the current supplied to the base of Q2. As the detected RF power increases, the current to the base of Q2 increases causing Q2 to pull current away from the base of Q3. This turns off Q3 and in turn Q7 which reduces voltage to the drain of Q1, decreasing RF output power. This controlled drain voltage is metered through R11 at J1 pin 9.

RF power is sensed by power coupler T1 and its associated elements. Forward power is sensed by D7 and reflected power by D6. Forward power is determined by the setting of R21. R20 and R22 set the level of reflected RF power at which the control circuit reduces the RF output.

CAUTION

Do not operate the transmitter at levels higher than rated output. Operating at higher than rated output will shorten the life of the RF power transistors.

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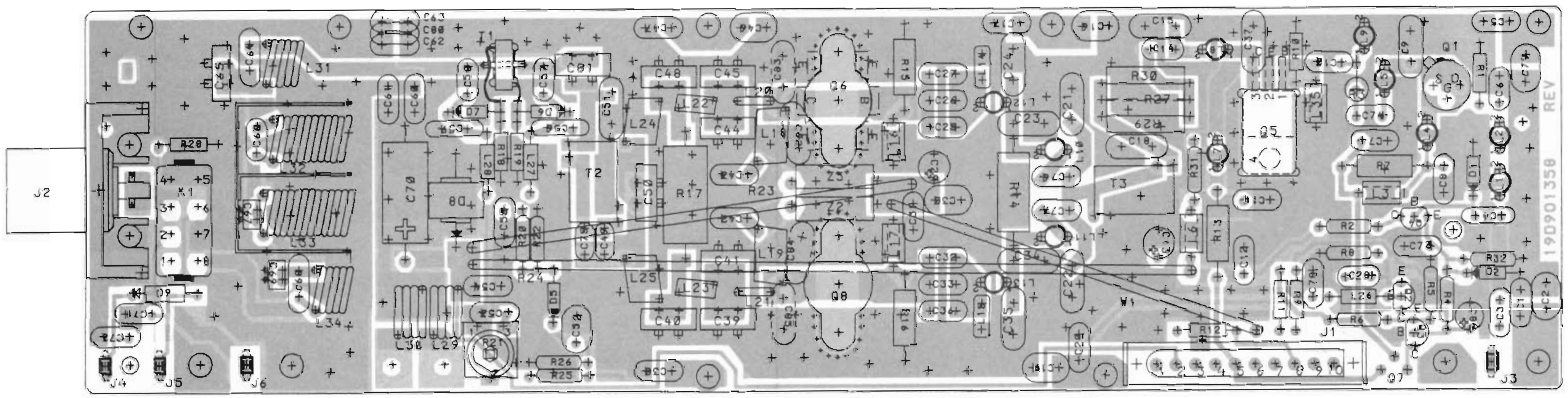
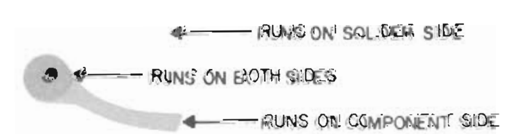


(19D901361, Rev. 0)
(19A704106, Sh. 1, Rev. 0)
(19A704106, Sh. 2, Rev. 0)



OUTLINE DIAGRAM

29.7-50 MHz 110 WATT
POWER AMPLIFIER

COMPONENT IDENTIFICATION CHART			
PART	GROUP 1 42-50 MHz	GROUP 3 36-42 MHz	GROUP 5 29.7-36 MHz
C4	47P	56P	56P
C6	---	---	12P
C7	1N	1N	10N
C9	180P	270P	330P
C10	680P	1N	1N
C11	1N	470P	470P
C15	150P	180P	220P
C21	150P	180P	180P
C22	150P	180P	120P
C23	220P	220P	390P
C24	180P	470P	470P
C25	470P	1000P	1500P
C26	1000P	1000P	1500P
C27	220P	470P	1000P
C28	1N	2.2N	2.2N
C32	1000P	470P	1500P
C33	220P	1000P	1000P
C34	220P	220P	390P
C35	180P	470P	470P
C36	470P	1000P	1500P
C37	62P	62P	68P
C39	820P	820P	1000P
C40	330P	470P	750P
C41	750P	820P	1000P
C42	1N	1N	2.2N
C43	1N	1N	2.2N
C44	750P	820P	1000P
C45	820P	820P	1000P
C48	330P	470P	750P
C50	270P	220P	390P
C64	51P	56P	68P
C65	56P	68P	91P
C66	10P	12P	13P
C67	82P	91P	110P
C68	51P	56P	68P
C69	75P	82P	91P
C82	---	---	180P
C83	---	---	270P
C84	---	---	180P
C85	---	---	270P
R10	18	27	10
R13	5.6 1/2W	6.8 1/2W	6.8 1/2W
R15	10 1/2W	22 1/2W	22 1/2W
R16	10 1/2W	22 1/2W	22 1/2W
R27	15 1W	47 1W	39 1W
R29	15 1W	47 1W	39 1W
R30	15 1W	47 1W	39 1W
R31	------	560	-----

NOTES:

1. PA A-

   CHASSIS GROUND

2. VOLTAGE READINGS ARE TYPICAL READINGS MADE WITH THE TRANSMITTER KEYED, AND MEASURED WITH A 20K-OHM/VOLT METER REFERENCED TO PA A-. USE A 22uH CHOKE IN HOT METER LEAD TO AVOID DETUNING RF CIRCUITS.

3. MARKING SHOWN IN BLOCK ▭ IS PART OF LABEL 19A703653.

4 PART OF PWB

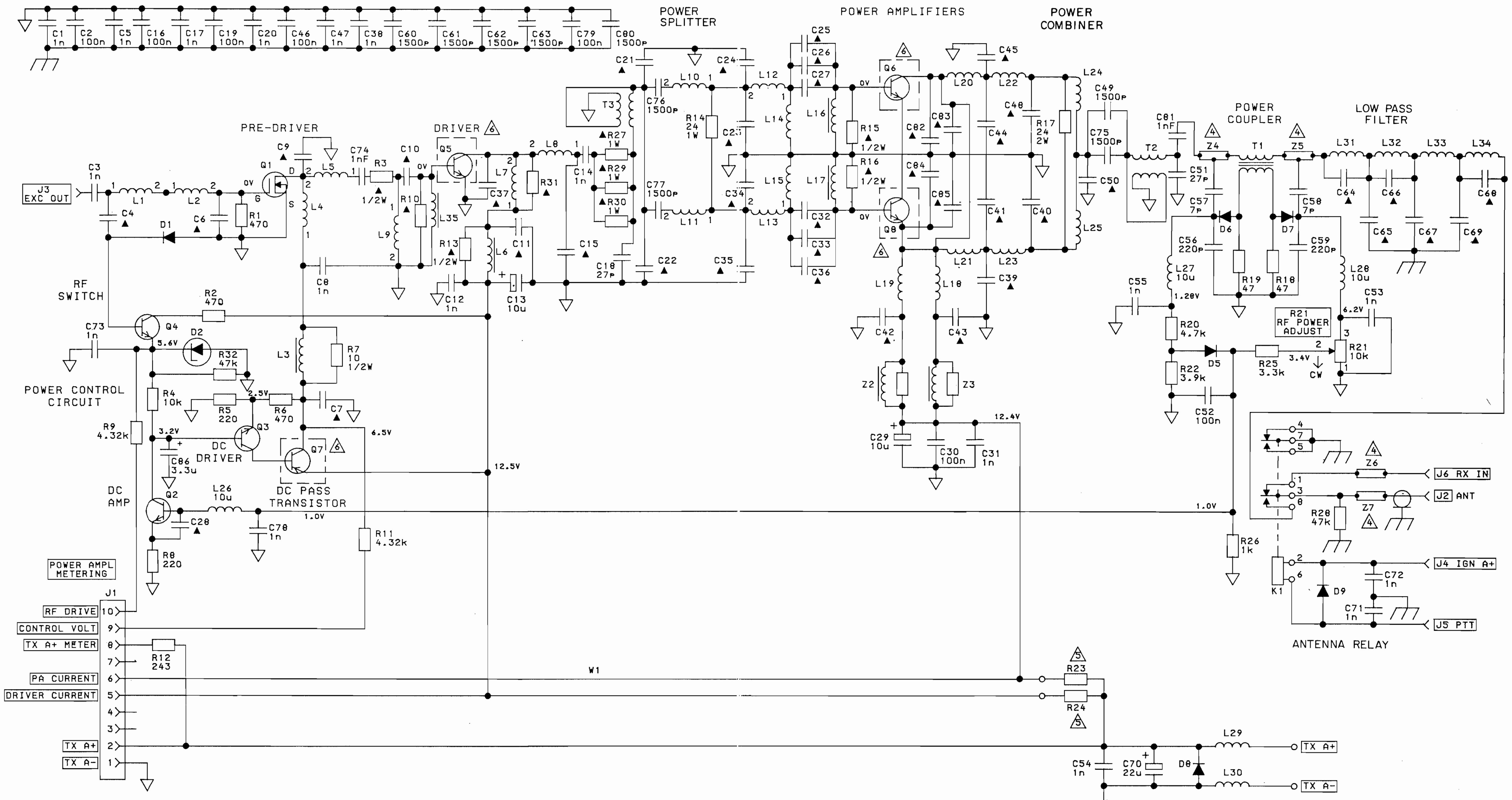
5 R23 & R24 ARE METER SHUNTS.

6 CALLED FOR AT HIGHER LEVEL ASM.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER U, N OR P.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER M OR U.

MODEL NO	110W FREQ. SPLIT	REV LETTER
PL19D901358G1	42-50 MHz	
PL19D901207G4		
PL19D901358G3	36-42 MHz	
PL19D901207G5		
PL19D901358G5	29.7-36 MHz	
PL19D901207G6		

(19D901360, Sh. 2, Rev. 0)



VOLTAGES MEASURED WITH TX KEYED.
12.5V AT PA TERMINALS, 50 OHM LOAD,
110 WATTS OUT AND 250 mW EXCITER
DRIVE TO PA.

(19D901360, Sh. 1, Rev. 2)

SCHEMATIC DIAGRAM

29.7-50 MHz 110 WATT POWER AMPLIFIER

PARTS LIST

29.7 - 50 MHz 110 WATT
POWER AMPLIFIER
19D901207G4 42-50 MHz
19D901207G5 36-42 MHz
19D901207G6 29.7-36 MHz
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
A1		PA BOARD 19D901358G1 42-50 MHz 19D901358G3 36-42 MHz 19D901358G5 29.7-36 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C2	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C3	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C4	19A700235P21	Ceramic: 47 pF ±5%, 50 VDCW. (Used in G1).
C4	19A700235P22	Ceramic: 56 pF ±5%, 50 VDCW. (Used in G3 & G5).
C5	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C6	19A701624P10	Ceramic, disc: 12 pF ±5%, 500 VDCW, temp coef 0 PPM ±30.
C7	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G1 & G3).
C7	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW. (Used in G5).
C8	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C9	19A700105P41	Mica: 180 pF ±5%, 500 VDCW. (Used in G1).
C9	19A700105P46	Mica: 270 pF ±5%, 500 VDCW. (Used in G3).
C9	19A700105P48	Mica: 330 pF ±5%, 500 VDCW. (Used in G5).
C10	19A701602P18	Ceramic, stabilized disc: 680 pF ±10%, 1000 VDCW. (Used in G1).
C10	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G3 & G5).
C11	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G1).
C11	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW. (Used in G3 & G5).
C12	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C13	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C14	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C15	19A700105P38	Mica: 150 pF ±5%, 500 VDCW. (Used in G1).
C15	19A700105P41	Mica: 180 pF ±5%, 500 VDCW. (Used in G3).
C15	19A700105P44	Mica: 220 pF ±5%, 500 VDCW. (Used in G5).
C16	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C17	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C18	19A700105P19	Mica: 27 pF ±5%, 500 VDCW.
C19	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C20	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C21	19A700105P38	Mica: 150 pF ±5%, 500 VDCW. (Used in G1).
C21	19A700105P41	Mica: 180 pF ±5%, 500 VDCW. (Used in G3 & G5).
C22	19A700105P38	Mica: 150 pF ±5%, 500 VDCW. (Used in G1).
C22	19A700105P41	Mica: 180 pF ±5%, 500 VDCW. (Used in G3).
C22	19A700105P36	Mica: 120 pF ±5%, 500 VDCW. (Used in G5).
C23	19A700105P44	Mica: 220 pF ±5%, 500 VDCW. (Used in G1 & G3).
C23	19A700105P50	Mica: 390 pF ±5%, 500 VDCW. (Used in G5).
C24	19A700105P41	Mica: 180 pF ±5%, 500 VDCW. (Used in G1).
C24	19A700105P52	Mica: 470 pF ±5%, 300 VDCW. (Used in G3 & G5).
C25	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW. (Used in G1).
C25	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G3).
C25	19A703309P8	Ceramic, stabilized disc: 1500 pF ±10%, 50 VDCW. (Used in G5).
C26	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G1 & G3).
C26	19A703309P8	Ceramic, stabilized disc: 1500 pF ±10%, 50 VDCW. (Used in G5).
C27	19A701602P10	Ceramic: 220 pF ±10%, 1000 VDCW. (Used in G1).
C27	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW. (Used in G3).
C27	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G5).
C28	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G1).
C28	19A703309P9	Ceramic: 22 pF ±20%, 50 VDCW. (Used in G3 & G5).
C29	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C30	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C31	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C32	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G1).
C32	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW. (Used in G3).
C32	19A703309P8	Ceramic, stabilized disc: 1500 pF ±10%, 50 VDCW. (Used in G5).
C33	19A701602P10	Ceramic: 220 pF ±10%, 1000 VDCW. (Used in G1).
C33	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G3 & G5).
C34	19A700105P44	Mica: 220 pF ±5%, 500 VDCW. (Used in G1 & G3).
C34	19A700105P50	Mica: 390 pF ±5%, 500 VDCW. (Used in G5).
C35	19A700105P41	Mica: 180 pF ±5%, 500 VDCW. (Used in G1).
C35	19A700105P52	Mica: 470 pF ±5%, 300 VDCW. (Used in G3 & G5).
C36	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW. (Used in G1).
C36	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G3).
C36	19A703309P8	Ceramic, stabilized disc: 1500 pF ±10%, 50 VDCW. (Used in G5).
C37	19A700105P29	Mica: 62 pF ±5%, 500 VDCW. (Used in G1 & G3).
C37	19A700105P30	Mica: 68 pF ±5%, 500 VDCW. (Used in G5).
C38	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C39	19A700015P51	Mica: 820 pF ±5%, 250 VDCW. (Used in G1 & G3).
C39	19A700015P53	Mica: 1000 pF ±5%, 250 VDCW. (Used in G5).
C40	19A700015P41	Teflon/Mica: 330 pF ±5%, 250 VDCW. (Used in G1).
C40	19A700015P45	Silver mica: 470 pF ±5%, 250 VDCW. (Used in G3).
C40	19A700015P50	Mica: 750 pF ±5%, 250 VDCW. (Used in G5).
C41	19A700015P50	Mica: 750 pF ±5%, 250 VDCW. (Used in G1).
C41	19A700015P51	Mica: 820 pF ±5%, 250 VDCW. (Used in G3).
C41	19A700015P53	Mica: 1000 pF ±5%, 250 VDCW. (Used in G5).
C42	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G1 & G3).
C42	19A703309P9	Ceramic: 22 pF ±20%, 50 VDCW. (Used in G5).
C43	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW. (Used in G1 & G3).
C43	19A703309P9	Ceramic: 22 pF ±20%, 50 VDCW. (Used in G5).
C44	19A700015P50	Mica 750 pF ±5%, 250 VDCW. (Used in G1).
C44	19A700015P51	Mica: 820 pF ±5%, 250 VDCW. (Used in G3).
C44	19A700015P53	Mica: 1000 pF ±5%, 250 VDCW. (Used in G5).
C45	19A700015P51	Mica: 820 pF ±5%, 250 VDCW. (Used in G1 & G3).
C45	19A700015P53	Mica: 1000 pF ±5%, 250 VDCW. (Used in G5).
C46	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C47	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C48	19A700015P41	Teflon/Mica: 330 pF ±5%, 250 VDCW. (Used in G1).
C48	19A700015P45	Silver mica: 470 pF ±5%, 250 VDCW. (Used in G3).
C48	19A700015P50	Mica: 750 pF ±5%, 250 VDCW. (Used in G5).
C49	19A703309P8	Ceramic, stabilized disc: 1500 pF ±10%, 50 VDCW.
C50	19A700015P39	Silver mica: 270 pF ±5%, 250 VDCW. (Used in G1).
C50	19A700015P37	Teflon/Mica: 220 pF ±5%, 250 VDCW. (Used in G3).
C50	19A700015P43	Mica: 390 pF ±5%, 250 VDCW. (Used in G5).
C51	19A700105P19	Mica: 27 pF ±5%, 500 VDCW.
C52	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C53 thru C55	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C56	19A700235P29	Ceramic: 220 pF ±5%, 50 VDCW.
C57 and C58	19A700235P11	Ceramic: 6.8 pF ±0.25 pF, 50 VDCW, temp coef N150 PPM.
C59	19A700235P29	Ceramic: 220 pF ±5%, 50 VDCW.
C60 thru C63	19A703309P8	Ceramic, stabilized disc: 1500 pF ±10%, 50 VDCW.
C64	19A701624P225	Ceramic, disc: 51 pF ±5%, 500 VDCW, temp coef N150 ±30. (Used in G1).
C64	19A701624P326	Ceramic, disc: 56 pF ±5%, 500 VDCW, temp coef N220 PPM ±30. (Used in G3).
C64	19A701624P528	Ceramic, disc: 68 pF ±5%, 500 VDCW, temp coef N470 PPM ±60. (Used in G5).
C65	19A700015P23	Teflon/Mica: 56 pF ±5%, 250 VDCW. (Used in G1).
C65	19A700015P25	Silver mica: 68 pF ±5%, 250 VDCW. (Used in G3).
C65	19A700015P28	Teflon/Mica: 91 pF ±5%, 250 VDCW. (Used in G5).
C66	19A701624P208	Ceramic, disc: 10 pF ±0.5 pF, 500 VDCW, temp coef N150 PPM ±30. (Used in G1).
C66	19A701624P210	Ceramic, disc: 12 pF ±5%, 500 VDCW, temp coef N150 ±30. (Used in G3).
C66	19A701624P211	Ceramic, disc: 13 pF ±5%, 500 VDCW, temp coef N150 ±30. (Used in G5).
C67	19A701413P32	Mica: 82 pF ±5%, 100 VDCW. (Used in G1).
C67	19A701413P33	Mica: 91 pF ±5%, 100 VDCW. (Used in G3).
C67	19A701413P35	Mica: 110 pF ±5%, 100 VDCW. (Used in G5).
C68	19A701624P225	Ceramic, disc: 51 pF ±5%, 500 VDCW, temp coef N150 ±30. (Used in G1).
C68	19A701624P326	Ceramic, disc: 56 pF ±5%, 500 VDCW, temp coef N220 PPM ±30. (Used in G3).
C68	19A701624P528	Ceramic, disc: 68 pF ±5%, 500 VDCW, temp coef N470 PPM ±60. (Used in G5).
C69	19A701413P31	Mica: 75 pF ±5%, 100 VDCW. (Used in G1).
C69	19A701413P32	Mica: 82 pF ±5%, 100 VDCW. (Used in G3).
C69	19A701413P33	Mica: 91 pF ±5%, 100 VDCW. (Used in G5).
C70	19A700064P2	Electrolytic: 22 uF ±10%, 25 VDCW.
C71 thru C74	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C75 thru C77	19A703309P8	Ceramic, stabilized disc: 1500 pF ±10%, 50 VDCW.
C78	19A703309P6	Ceramic, stabilized disc: 1000 pF ±10%, 50 VDCW.
C79	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C80	19A703309P8	Ceramic, stabilized disc: 1500 pF ±10%, 50 VDCW.
C81	19A700015P53	Mica: 1000 pF ±5%, 250 VDCW.
C86	19A703314P8	Electrolytic: 3.3 uF -10+50%, 50 VDCW; sim to Panasonic LS Series.
		- - - - - - - - - - - DIODES - - - - - - - - - -
D1	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D2	19A700025P7	Silicon, zener: 400 mW max; sim to BZX55-C5V6.
D5	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D6 and D7	19A700047P3	Silicon: 100 mW; sim to 1N6263.
D8	19A700082P1	Rectifier, silicon; sim to MR751.
D9	19J706100P1	Rectifier, silicon; sim to 1N4001.
		- - - - - - - - - - - JACKS - - - - - - - - - - -
J1	19B800555G3	Connector: metering, block. Includes: (10) 19A700237P1 contacts.
J2	19A701854G1	Coax; sim to Amphenol 83-87601002.
J3 thru J6	19A701883P4	Contact, electrical; sim to AMP 86444-1.
		- - - - - - - - - - - RELAYS - - - - - - - - -
K1	19A700061P1	Hermetic sealed: 180 to 341 ohms coil res, 8-16.3 VDC; sim to GE 3SAV1760A2, CP Clare HFW-1201558, or Potter-Brumfield HCM6160.
		- - - - - - - - - - - COILS - - - - - - - - - - -
L1	19B801084P16	Coil, RF: sim to Paul Smith SK917-1. (Used in G1).
L1	19B801084P19	Coil, RF: sim to Paul Smith SK917-1. (Used in G3).
L1	19B801084P21	Coil, RF: sim to Paul Smith SK917-1. (Used in G5).
L2	19B801084P16	Coil, RF: sim to Paul Smith SK917-1. (Used in G1).
L2	19B801084P19	Coil, RF: sim to Paul Smith SK917-1. (Used in G3).
L2	19B801084P21	Coil, RF: sim to Paul Smith SK917-1. (Used in G5).
L3	19A701091G1	Coil.
L4	19B800937P10	Coil, RF: sim to Paul Smith SK887-1.
L5	19B800937P5	Coil, RF: sim to Paul Smith SK-887-1. (Used in G1).
L5	19B800937P6	Coil, RF: sim to Paul Smith SK-887-1. (Used in G3).
L5	19B800937P7	Coil, RF: sim to Paul Smith SK-887-1. (Used in G5).
L6	19A701091G1	Coil.
L7	19B801084P16	Coil, RF: sim to Paul Smith SK917-1.
L7	19B801084P11	Coil, RF: sim to Paul Smith SK-954-1.
L8	19B800937P6	Coil, RF: sim to Paul Smith SK-887-1.
L8	19B800937P10	Coil, RF: sim to Paul Smith SK887-1.
L9	19B800891P2	Coil, RF Choke: sim to Paul Smith SK-890-1.
L9	19B800937P3	Coil, RF: sim to Paul Smith SK-887-1.
L9	19B800891P3	Coil, RF Choke; sim to Paul Smith SK890-1.
L10	19B800937P3	Coil, RF: sim to Paul Smith SK-887-1.
L10	19B800937P7	Coil, RF: sim to Paul Smith SK-887-1.
L11	19B800937P3	Coil, RF: sim to Paul Smith SK-887-1.
L11	19B800937P7	Coil, RF: sim to Paul Smith SK-887-1.
L12	19B800891P1	Coil, RF Choke: sim to Paul Smith SK-890-1.
L12	19B800937P2	Coil, RF: sim to Paul Smith SK-887-1.
L13	19B800891P1	Coil, RF Choke: sim to Paul Smith SK-890-1. (Used in G1).
L13	19B800937P2	Coil, RF: sim to Paul Smith SK-887-1. (Used in G3 & G5).
L14	19B800890P2	RF: sim to Paul Smith SK-891-1. (Used in G1 & G5).
L14	19B800890P3	Coil, RF: 11.7 uH ±5%, sim to Paul Smith SK-896-1. (Used in G3).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
L15	19B800890P2	RF: sim to Paul Smith SK-891-1. (Used in G1 & G5).
L15	19B800890P3	Coil, RF: 11.7 uH ±5%, sim to Paul Smith SK-896-1. (Used in G3).
L16 and L17	19A701091G1	Coil.
L18	19A703774P1	Coil.
L19	19A703847P1	Transformer.
L20	19A703775P8	Coil. (Used in G1).
L20	19A703775P5	Coil. (Used in G3 & G5).
L21	19A703775P8	Coil. (Used in G1).
L21	19A703775P5	Coil. (Used in G3 & G5).
L22	19A703847P2	Transformer. (Used in G1).
L22	19A703847P4	Transformer. (Used in G3).
L22	19A703847P8	Transformer. (Used in G5).
L23	19A703847P2	Transformer. (Used in G1).
L23	19A703847P4	Transformer. (Used in G3).
L23	19A703847P8	Transformer. (Used in G5).
L24	19A703847P3	Transformer. (Used in G1).
L24	19A703847P5	Transformer. (Used in G3).
L24	19A703847P7	Transformer. (Used in G5).
L25	19A703774P9	Coil. (Used in G1).
L25	19A703774P10	Coil. (Used in G3).
L25	19A703774P11	Coil. (Used in G5).
L26 thru L28	19A700024P25	Coil, RF: 10.0 uH ±10%, 3.70 ohms DC res max.
L29 and L30	19A703774P3	Coil.
L31	19A129360P1	Coil. (Used in G1).
L31	19A129360P4	Coil. (Used in G3).
L31	19A129360P6	Coil. (Used in G5).
L32	19A129360P2	Coil. (Used in G1).
L32	19A129360P3	Coil. (Used in G3).
L32	19A129360P7	Coil. (Used in G5).
L33	19A129360P3	Coil. (Used in G1).
L33	19A129360P5	Coil. (Used in G3).
L33	19A129360P8	Coil. (Used in G5).
L34	19A129360P1	Coil. (Used in G1).
L34	19A129360P4	Coil. (Used in G3).
L34	19A129360P6	Coil. (Used in G5).
L35	19A701091G1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A703443P1	N-Channel, field effect, 12 1/2 volt, 1.2 watt; sim to RF2060.
Q2 thru Q4	19A700023P2	Silicon, NPN: sim to 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19A700106P55	Composition: 470 ohms ±5%, 1/4 w.
R2	19A700019P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R3	19A700113P3	Composition: 3.3 ohms ±5%, 1/2 w.
R4	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R5	19A700019P29	Deposited carbon: 220 ohms ±5%, 1/4 w.
R6	19A700019P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R7	19A700113P15	Composition: 10 ohms ±5%, 1/2 w.

SYMBOL	GE PART NO.	DESCRIPTION
R8	19A700019P29	Deposited carbon: 220 ohms ±5%, 1/4 w.
R9	19A701250P262	Metal film: 4.3K ohms ±1%, 1/4 w.
R10	19A700106P21	Composition: 18 ohms ±5%, 1/4 w. (Used in G1).
R10	19A700106P25	Composition: 27 ohms ±5%, 1/4 w. (Used in G3).
R10	19A700106P15	Composition: 10 ohms ±5%, 1/4 w. (Used in G5).
R11	19A701250P262	Metal film: 4.3K ohms ±1%, 1/4 w.
R12	19A701250P138	Metal film: 243 ohhms ±1%, 250 VDCW, 1/4 watt.
R13	19A700113P9	Composition: 5.6 ohms ±5%, 1/2 w.
R13	19A700113P11	Composition: 6.8 ohms ±5%, 1/2 w. (Used in G1).
R14	3R78P240J	Composition: 24 ohms ±5%, 500 VDCW, 1 w. (Used in G3 & G5).
R15	19A700113P15	Composition: 10 ohms ±5%, 1/2 w. (Used in G1).
R15	19A700113P23	Composition: 22 ohms ±5%, 1/2 w. (Used in G3 & G5).
R16	19A700113P15	Composition: 10 ohms ±5%, 1/2 w. (Used in G1).
R16	19A700113P23	Composition: 22 ohms ±5%, 1/2 w. (Used in G3 & G5).
R17	19A700111P24	Composition: 24 ohms ±5%, 750 VDCW.
R18 and R19	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
R20	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R21	19A700185P4	Variable: 10K ohms ±20%, 500 VDCW, 1/3 w.
R22	19A700019P44	Deposited carbon: 3.9K ohms ±5%, 1/4 w.
R23	19A703720G1	Shunt.
R24	19A703720G2	Shunt.
R25	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 1/4 w.
R26	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R27	19A700112P19	Composition: 15 ohms ±5%, 1 w.
R27	19A700112P31	Composition: 47 ohms ±5%, 1 w.
R27	19A700112P29	Composition: 39 ohms ±5%, 1 w.
R28	19A700106P103	Composition: 47K ohms ±5%, 1/4 w.
R29	19A700112P19	Composition: 15 ohms ±5%, 1 w.
R29	19A700112P31	Composition: 47 ohms ±5%, 1 w.
R29	19A700112P29	Composition: 39 ohms ±5%, 1 w.
R30	19A700112P19	Composition: 15 ohms ±5%, 1 w.
R30	19A700112P31	Composition: 47 ohms ±5%, 1 w.
R30	19A700112P29	Composition: 39 ohms ±5%, 1 w.
R31	19A700106P57	Composition: 560 ohms ±5%, 1/4 w.
R32	19A700106P103	Composition: 47K ohms ±5%, 1/4 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T1	19A703768G1	Coil.
T2 and T3	19A703846G1	Transformer.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W1	19A703720G3	Shunt.
		- - - - - - - - - - - FILTERS - - - - - - - - - -
Z2 and Z3	19A701092G4	Filter Assembly.
A2		CAPACITOR FEED THRU ASSEMBLY 19A703218G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	19A701895P1	Ceramic, feed thru: 100 pF -0+100%, 500 VDCW.

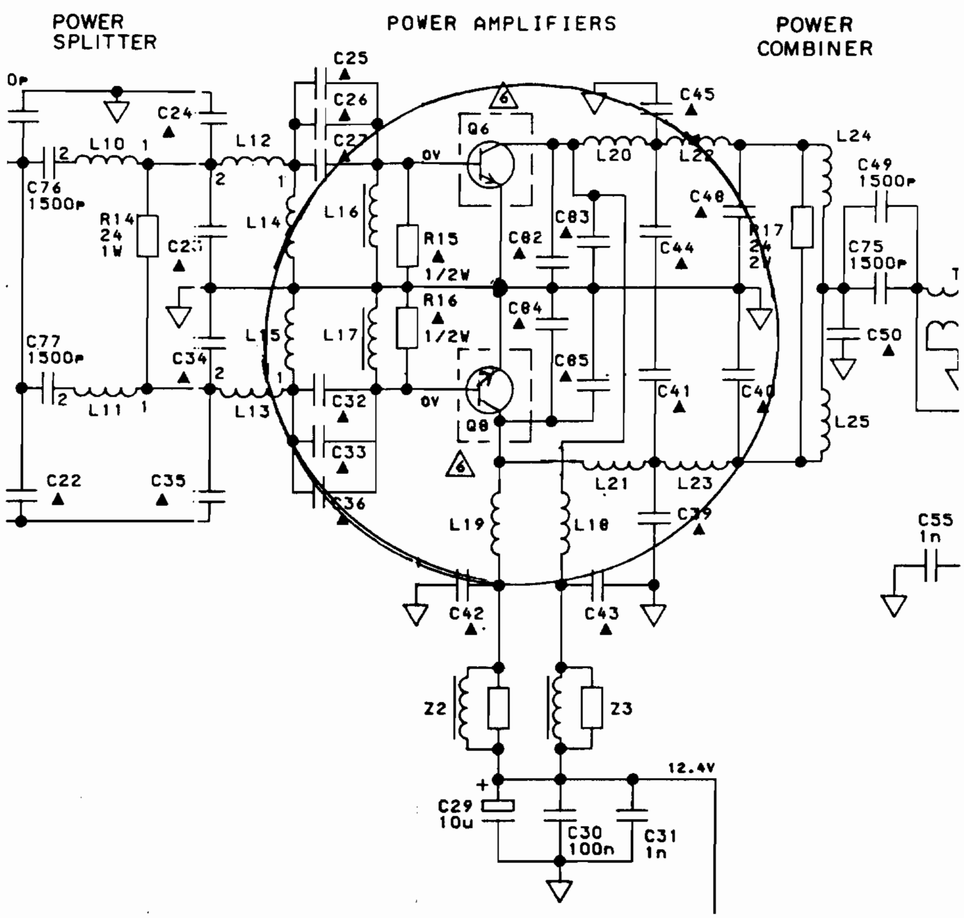
SYMBOL	GE PART NO.	DESCRIPTION
C82	19A700105P41	Mica: 180 pF ±5%, 500 VDCW.
C83	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C84	19A700105P41	Mica: 180 pF ±5%, 500 VDCW.
C85	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q5	19A703438P1	N-Channel, field effect, 12 1/2 volt, 7 watt; sim to RF2061.
Q5	19A701891P3	Silicon, NPN: sim to MRF-262.
Q6	19A703422P1	Silicon, NPN, 12.5 v, 70 w; sim to RF2570.
Q7	19A116375P1	Silicon, PNP.
Q8	19A703422P1	Silicon, NPN, 12.5 v, 70 w; sim to RF2570.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19C850627P1	Locking handle.
	19A700132P818	Dowel pin. (Hinge pins for locking handle - Quantity 2).
	19A701347P1	Lock pin. (Locks handle in place).
	19A700140P2	Compression spring. (Part of lock assembly).
	19C850941P1	Lock slide.
	19C850699P1	Lock support.
	19A702362P408	Machine screw: M3.5-0.6 x 8. (Secures lock suport).
	19B800004P5	Key lock.
	19A702381P525	Screw, thd. form: No. M3.5-0.6 x 25. (Secures filter casting).
	19D900262P1	Filter casting.
	19D900349G4	Handle and Lock frame assembly.
	19B801238P1	Insulator. (Located on side of PA assembly).
	19A700068P1	Insulator, bushing. (Used with Q7).
	19A700115P3	Insulator, plate. (Used with Q5 & Q7).
	19A701706P1	Heat sink. (Used with Q5).
	19A701983P1	Shield washer. (Secures Q5).
	19A702364P208	Machine screw, TORX®Drive, M2.5 - 0.45 x 8. (Secures Q5-Q8).
	19A701368P1	Gasket. (Used with J2).
	19A702381P510	Screw, thread forming: TORX®Drive No. M3.5 - 0.6 x 10. (Secures J2).
	19A702381P508	Screw, thd. form: No. 3.5-0.6 x 8. (Secures A1 & A2).
	N330P905F22	Metallic eyelet. (Soldered to C1 & C2 on A2).
	19A701502P1	Plastic bumper. (Located on bottom of frame assembly).
	19A700034P3	Hex nut, metric: M2.5 x 0.45. (Secures Q7).
	19A700033P3	Lockwasher, external tooth: M2.5. (Secures Q7).
	19A701312P3	Flatwasher, metric: M2.5. (Secures Q7).
	19B800940G1	Shield assembly. (Located around L32 & L33).
	19A701309P1	RF terminal. (Located on J2).

This addendum updates the Schematic Diagram and Parts List to agree with the first production units. Changed C8 and L8. New part numbers are:

<u>29.7-36 MHZ 110 POWER AMPLIFIER BOARD 19D901358G5</u>

C8- 19A700233P9,Ceramic disc: 2.2nF +20%, 50vdcw.
L8- 19B800937P10, Coil, RF/ sim to Paul Smith SK88T1

SCHEMATIC DIAGRAM



ADDENDUM NO. 2 TO LBI31381

PCN3

This addendum describes Revision Letter changes that are not yet included in the publication.

REV.A- 29.7-36 MHZ 110 WATT POWER AMPLIFIER BOARD 19D901358G5

To improve power at low end of the split. Changed L9,L14 and L15. New part numbers are:

L9- 19B800937P4: Coil, RF; Sim to Paul Smith SK-887-1.

L14,L15- 19B800890P3: Coil,RF; 11.9uH ±5%, Sim to Paul Smith SK-896-1.

END OF DOCUMENT