MAINTENANCE MANUAL

403-430 MHz & 450-512 MHz, DELTA-S NARROWBAND TWO WAY FM RADIO SERVICE SECTION

TABLE OF CONTENTS

DESCRIPTION

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.
- Alignment procedures for the transmitter and receiver.
- Troubleshooting flow charts and waveforms.

INITIAL ADJUSTMENT

After the radio has been installed (as described in the Installation Manual), the following adjustments should be made by a certified electronics technician.

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LBI-31511

TRANSMITTER ADJUSTMENT

The adjustment for the transmitter includes measuring the forward and reflected power and adjusting the antenna length for optimum ratio, then setting the transmitter to rated power output. Next, measure the frequency and modulation and record these measurements for future reference. For the complete transmitter adjustment, refer to the Alignment Procedure (see Table of Contents).

MAINTENANCE

PREVENTIVE MAINTENANCE

To ensure high 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.

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 drips 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. Be sure that all screws are properly torqued.	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. 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 #30 Torx® screwdriver.

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.

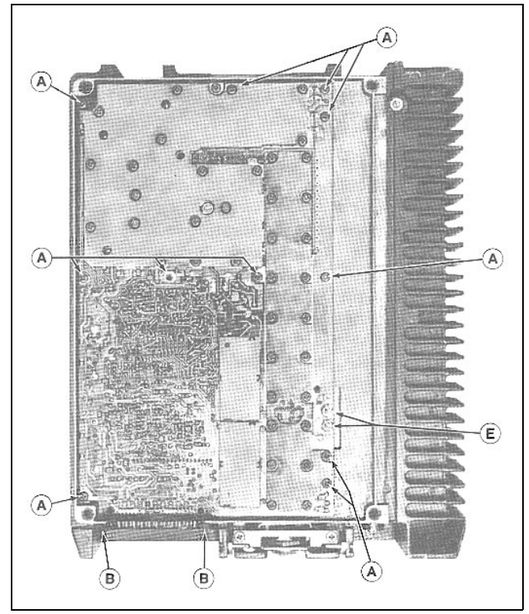

Figure 1 - Disassembly - Bottom View

- To remove the TRS board:

  1. Remove the bottom cover.
  2. Remove the eleven retaining screws at (A) (Figure 1) securing the circuit board to the main frame.
  3. Remove two retaining screws (B) securing systems connector J601 to front casting.
  4. Unsolder the two feed through capacitor terminals (E) on printed wire pattern.
  5. 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 U702 and Q705 to the side of chassis.
  6. To remove the front end shield, remove the 20 retaining screws securing the shield to the front end casting and remove.
  7. To remove the synthesizer shield, remove the seventeen retaining screws securing the shield to the synthesizer top casting.

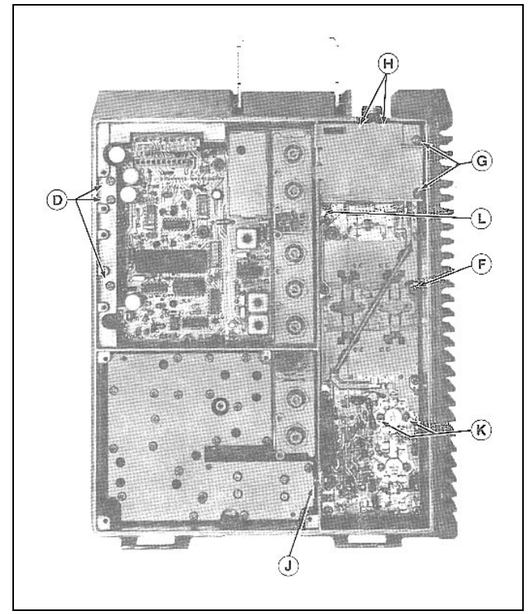

Figure 2 - Disassembly - Top View

LBI-31511

- To replace TRS board:

  1. Perform above procedures in reverse order.

- To remove the PA board:

  1. Remove the three retaining screws (G) securing the PA filter cover to the main frame.
  2. Remove the eight retaining screws (F) from around the edge of the PA board.
  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. Turn the radio over and remove the nut and washer from the stud of PA transistor Q1.

NOTE

Torque #8 nut on Q1 to 6 inch pounds when replacing.

  7. Unsolder the two power feed through capacitors at (L).
  8. Carefully lift the PA board up off the pins extending upward from the TRS board.

NOTE

Note the position of the copper washer spacer under transistor Q1. Be sure that this spacer is in place when replacing the board.

- To replace the PA board:

  1. Perform the above procedures in reverse order, being careful to realign 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 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. Remove retaining screws and lift out the transistor. Remove any old solder from the printed circuit board with a vacuum desoldering 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 r 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 desoldering tool. To remove an IC, heat each lead separately on the solder side and remove the old solder with the desoldering tool.

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.

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

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.
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 possible, "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.

PROGRAMMING AND ALIGNMENT

The following procedure describes how to change the frequencies in the radio EEPROM(S) for new user frequencies. Also included is an alignment procedure guide to assist you in aligning the radio after the frequencies have been changed. The alignment procedure should be performed in the order given and it must be performed prior to putting the radio back in service.

PROGRAMMING

The DELTA-S UHF Narrowband radio may be programmed using the TQ-2310 Suitcase Programmer, the 4EX22A10 Hand Programmer or by a Personal Computer. The procedures for using the programmers are covered in detail in LBI-31263 (TQ-2310) and LBI-31275 (4EX22A10). TQ-3334 provides the software and programming instructions for programming with a PC.

When programming the radio, consideration must be given to the individual band split for the T/R/S board. See the Programming tips on the following page and the individual band splits listed below.

BAND SPLIT	T/R/S BOARD (NEG. GRD. ONLY)	T/R/S BOARD (FLOATING GRD.)
450-470 MHz	19D901620G1 (Tin Cont.)	19D900920G1
470-494 MHz	19D901620G2 (Tin Cont.)	19D900920G2
494-512 MHz	19D901620G3 (Tin Cont.)	19D900920G3
403-430 MHz	19D901620G4 (Tin Cont.)	19D900920G4
450-470 MHz	19D901620G5 (Gold Cont.)	
470-494 MHz	19D901620G6 (Gold Cont.)	
494-512 MHz	19D901620G7 (Gold Cont.)	
403-430 MHz	19D901620G8 (Gold Cont.)	

MICROCOMPUTER SOFTWARE (U705)

The latest software package is a 19A703244P23 or a 19A703868G5; replacing the following packages:

Narrowband	Wideband
19A703244P10	19A703244P21,22
19A703241G3-8	19A703868G2-4

PROGRAMMING TIPS

When programming with the Suitcase Programmer or a Personal Computer, Jumper P707 (if present on Negative Ground System Boards only) must be removed. If programming the S950/S990 Control Unit for download to the radio, P703 on the rear of Control Unit must be disconnected to isolate Advance Change Pulse Line.

When the 4EX22A10 Hand Programmer, Jumper P706 (Negative Ground T/R/S Boards) must be removed (to disconnect D720), or lift one end of D720 on Floating Grd T/R/S Boards.

ALIGNMENT

After the radio has been programmed with new user frequencies, the radio re-alignment procedure is as follows:

UNDER SYNTHESIZER AND TRANSMITTER ALIGNMENT PROCEDURE

1. Check 9 volt regulator.
2. Adjust the synthesizer transmitter VCO.
3. Adjust the synthesizer receiver VCO.
4. Tune the exciter.
5. Adjust transmitter power amplifier.
6. Set the reference oscillator frequency (one setting for both transmit and receive).

UNDER RECEIVE ALIGNMENT SECTION

1. Adjust local oscillator-buffer injection.
2. Adjust front end.
3. Adjust IF selectivity.
4. Adjust FM detector/audio pre-amp.

SERVICE TIPS

CHANNEL GUARD BOARD

When servicing the transmit/receive/synthesizer board it may be helpful to remove and relocate the Channel Guard board. Both the Channel Guard board and Channel Guard extender may be removed and set aside during servicing. While servicing the radio install P608 to connect VOL/SQ/HI.

NOTE

Typical voltage readings are provided on the Schematic Diagram for reference when troubleshooting.

MICROCOMPUTER

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

- To force the microcomputer to continually try to reload the synthesizer. This mode will enable you to check the serial data, clock, channel change pulse and enable signals to the synthesizer. 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 ground 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. When removing either printed circuit board or the shields, note the exact location and position of all mounting hardware including rubber padding and bracket (if included).

When servicing the radio be sure that no solder buildup has occurred 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.

TEST FREQUENCIES

If the EEPROM is not custom programmed to the customers specified personality, then a standard test program is provided. The EEPROM is programmed on channels 1 through 16 including tone and digital Channel Guard and carrier control timer. Table 1 identifies the programmed test frequencies.

TYPICAL PERFORMANCE INFORMATION

SIGNAL LEVELS

SIGNAL	INDICATION	VOLTAGE LEVEL
CAS	High Level	9.0 Vdc
	Low Level	0.15 Vdc
RUS	High Level (RX Un-sq)	9.0 Vdc
	Low Level (RX Squelched)	0.15 Vdc
	Low Level (RX Mute/PTT)	
	Pulled low (RX unsquelched)	0.6 Vdc
Sq Dis, Input	Logic Low (Sq. Dis)	0 Vdc
	Logic High (Sq)	2.4 Vdc
	RX Un-Sq	0.14 Vdc
CCT Sq Dis, Input	Logic Low	0.35 Vdc
	Logic High	5.5 Vdc
TX Enable	Logic Low	2.0 Vdc
	Logic High	9.0 Vdc
PTT, Input	Logic Low	1.0 Vdc
	Logic High	13 Vdc

CURRENT REFERENCE CHART

SERVICE PLUG	FUNCTION	TYPICAL CURRENT/mA
P701	5V	75
P702	9V	70
P703	9V	TX 90, RX 80
P704	9V	TX 45, RX 75
P705	9V	TX 40, RX 55

TEST POINT DATA (Typical)

TEST POINT	VOLTAGE	CONTROL	DESCRIPTION
J602-3	9.0 ±0.05 Vdc	R703	9 Volt Regulator
J602-2	13.2 Vdc (A+)		
J202	3.0-7.5 Vdc	C220 (RX) L209 (TX)	VCO Control Voltage (See Synth Align)
J353	0.7 VPP		Reference Osc. Output (high impedance)
J352	5.5 Vdc (Nominal)		Reference Oscillator compensation line voltage
J712	5.0 Vdc		VCC to Microcomputer

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TYPICAL PERFORMANCE INFORMATION

RADIO CONNECTOR IDENTIFICATION

Front Connector	J601
Systems Metering	J602
Option Connector	J603
PROM Program Plug	J711
RF Metering	J101
RX Input	P401
IF Input	P404
RX Inj.	P451
Exciter Input	P102
Exciter Output	P101, P103
Hand Programmer Enable	P706
Program Disable	P707
TX PA Metering	J1
VG Interface	P612
Fixed Squelch	P605
Channel Guard	P608
Aux Audio	P610
DPTT	P402
IGN A+	P403

RECEIVER READINGS SYSTEM JACK, J602

TEST POS	FUNCTION	SCALE	TYPICAL READING
D	IF AMP	1V	0.75
H	RX INJ	1V	0.55

TRANSMITTER QUICK CHECKS

- Connect red system metering plug to J602, system metering.
- Connect black plug of GE Test Set to RF Metering jack J101. Set polarity to "+" and voltage range to the 1 volt position (Test 1).

EXCITER

RANGE POSITION	RF METERING J101 EXCITER READINGS					PROBABLE CAUSE METERING READINGS	
	TEST POS.	METERING JACK J101	FUNCTION	METER SCALE	TYPICAL READING	HIGH	LOW
TEST 1	A	J101-10	AMPL-1	0-1	0.2V	Q101 Shorted R101, R103 Open	Q101 Open; R103, R105, Open; L103 Open; Oscillator/ Buffer Defective
TEST 1	B	J101-9	TRIPLER	0-3	0.2V	Q102 Defective; R107 Open	Q102 Shorted; R110 Open; L104, L105, and associated circuits, defective or improperly tuned.
TEST 1	C	J101-8	AMPL-3 REL PWR OUT	0-1	0.5V	Helical Coil L114 Shorted Or Mis-tuned	Q103 OR Q104 defective. Check resistors, capacitors around Q103 and Q104. Helical coils L107, L108 mis-tuned or defective. D101 and associated metering circuits defective.

PA QUICK CHECKS

- Connect red system metering plug to J602, system metering.
- Connect black plug of GE Test Set of RF Metering jack J1 of PA. Set polarity to "+" and voltage range to the 1 volt position (Test 1).

NOTE

Regulated +5 Vdc and +9 Vdc can be opened by P701 thru P705 to facilitate troubleshooting.

POWER AMPL METERING J1 PA JACK READINGS							METER READING	PROBABLE CAUSE
				80, 90 100W	35, 40 50W	65, 75W		
TEST POS.	METERING POINT	FUNCTION MEASURED	SCALE	TYPICAL READING	TYPICAL READING	TYPICAL READING	HIGH	LOW
A	J1-10	RF DRIVE	0-1 V	0.5 V	0.5 V	0.5V		Low exciter output. Realign or repair exciter.
B	J1-9	CONTROL VOLTAGE	0-15V	4 V	4.5 V	7.5V	Low exciter output	High exciter output.
C	J1-8	TX A+	0-15V	12.5V	12.5V	12.5V		Excessive voltage drop in power cable.
E	J1-6	PA CURRENT	0-30A	15 A	---	11A	RF output excessively high. Be sure antenna is properly matched to 50 ohms.	RF output low.
F	J1-5	DRIVER CURRENT	0-15A	5 A	8 A	4A	100 WATT PA Check A1Q5 and A1Q6. Be sure antenna is properly matched to 50 ohms. 40 WATT PA RF output power is excessive. Be sure antenna is properly matched to 50 ohms.	100 WATT PA A1Q5 and A1Q6 have excessive gain. RF gain. RF output set too low. 40 WATT PA Low RF output.

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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.

SYMPTOM	PROCEDURE	ANALYSIS
Little or No RF Output	Key transmitter and check J1-10 (Pos A) for +0.5 V (exciter output).	Refer to Schematic Diagram and verify voltage readings.
	Unkey transmitter and check Q105-C for +9.0 Vdc.	Verify +9.0 volt supply. Check R124 and L117.
	Check DC voltages on Q101-Q105.	If voltages are incorrect, check L103, L106, L110, L112, L117 and all resistors for each stage. Check R106, R110, R114, R118, R119 and R124. Check Q101-Q105. Replace components if defective.
	Disconnect P102 on Exciter and measure RF output of synthesizer.	No RF present: see Synthesizer Troubleshooting Procedure.
	Key transmitter and monitor voltage at J101-9 (Pos B Tripler). Voltage should increase.	RF present: reconnect P102 and proceed to next step.
	Monitor J101-8 (Pos C) and key transmitter. Voltage should increase.	If voltage does not increase check Q116-Q118, L106 and associated components.
	Disconnect P103 on exciter and measure RF output power from exciter. Should be 0.5 watts or more.	If voltage does not increase, check Q103, Q104 and associated components. Check D101 and associated metering circuitry. Finally, check both helical filters. If exciter output is low, check Q105 and associated circuitry. Also check 2nd helical filter including L114 and L115. Retune exciter if needed. If output power is correct be sure P101 is soldered securely and that it mates properly with the contact on the power amplifier.

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 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 µV. 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 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 the rated 12 dB SINAD, check the alignment of the RF stages as directed in the Alignment Procedure.

STEP 3
MODULATION ACCEPTANCE BANDWIDTH (IF BANDWIDTH)

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

A. Set audio 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 Alignment Procedure.

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 the transmitter is tuned and aligned to the proper operating frequency.

CAUTION

Before bench testing the radio, be sure or 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 standard 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 of (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 automotive storage battery.

(Cont.)

TEST PROGRAMMING

In DELTA-S radios, in which the EEPROM is not custom programmed, the EEPROM may be programmed with the personality similar to the ones shown in Table 1 below. See data on production tag with radio for exact data.

Table 1 - Programmed Test Frequencies

FREQUENCY SPLIT	CHANNEL NO.	TRANSMIT FREQUENCY	RECEIVE FREQUENCY	CHANNEL GUARD ENC/DEC	CCT
450-470 MHz	1	461.025	461.050	71.9	---
	2	467.025	462.050	023	---
	3	461.025	461.050	---	30 SEC
	4	455.025	460.050	---	---
	5	450.000	460.025	---	---
	6	470.000	469.750	71.9	---
	7	461.000	460.750	---	---
470-494 MHz	1	483.8875	483.050	71.9	---
	2	489.8875	484.050	023	---
	3	483.8875	483.050	---	30 SEC
	4	477.8875	482.050	---	---
	5	470.000	470.050	---	---
	6	494.000	493.750	71.9	---
	7	485.000	484.750	---	---
494-512 MHz	1	503.000	502.975	71.9	---
	2	509.000	503.975	023	---
	3	503.000	502.975	---	30 SEC
	4	497.000	501.975	---	---
	5	494.000	501.975	---	---
	6	512.000	511.750	71.9	---
	7	503.000	502.750	---	---
403-430 MHz	1	413.025	413.050	71.9	---
	2	419.025	414.050	023	---
	3	413.025	413.050	---	30 SEC
	4	407.025	412.050	---	---
	5	403.000	403.050	---	---
	6	430.000	429.750	71.0	---
	7	414.000	413.750	---	---

(Cont.)

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).

The oscillator frequency should be set at 25°C ambient temperature. In the range of 15°C to 40°C, if the frequency deviates more than ±1 PPM, it may be reset to ±1 PPM, respectively.

NOTE

Refer to Figures 3 and 4 Frequency Correction Factor.

Adjust L352 to set the transmit frequency while monitoring RF output jack J2 through a 30 dB decoupler. If adjusting L352 does not result in setting transmitter on frequency, remove synthesizer top cover, set L352 two turns from top of coil form, then adjust course frequency control L354 on frequency. Replace cover. This procedure would be necessary if repair/replacing parts in oscillator circuit.

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST controls are adjusted to the proper setting before shipment and normally do not require 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 overmodulation 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 Test Cable 19C850590G1

PROCEDURE

1. Select a center frequency channel. Disable Channel Guard if present.
2. Preset R366 fully counterclockwise and R22 on Channel Guard board (if present) to the center of its range.
3. Apply a 1 kHz tone at 1.0 VRMS to mic input jack J603-17. Connect deviation monitor to RF output jack J2 through a 30 dB decoupler. Set DEVIATION ADJUST R237 for rated deviation. ±3.75 kHz with Channel Guard or ±4.5 kHz without Channel Guard.
4. Apply a 400 Hz tone through a 100 µF capacitor to J603-15. Set output level to obtain a deviation of ±2.0 kHz. Note and maintain this voltage level while switching the output frequency to 10 Hz. Adjust REF OSC Deviation Control R366 starting from the fully clockwise position for ±2.0 kHz deviation. Remove the modulation.
5. Select a channel with Channel Guard nearest the center frequency and adjust R22 on the Channel Guard option board to ±0.65 kHz (tone or digital Channel Guard).

ACCESSING CENTER TUNE FREQUENCY

When a radio is factory programmed for less than 16 channels, channel 16 is programmed for transmit and receive center tune frequency.

To access center tune frequency use available control unit and select channel 16.

NOTE

Under normal operation, in radios built prior to January 1989, the microcomputer will not access this channel. The following tests 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 receiver center frequency.
3. To exit this mode remove power from J604-3 and momentarily remove power from the radio.

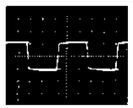
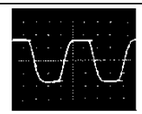
AUDIO CHECK

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 µ SEC/DIV**	**200 µ 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.

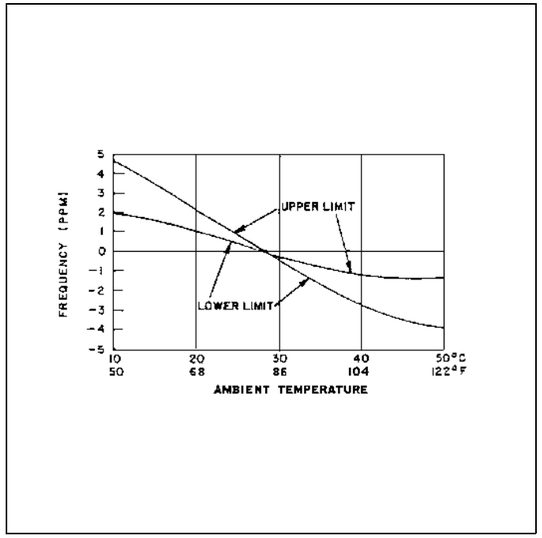


Figure 3 - Correction Factor in Freq. Setting

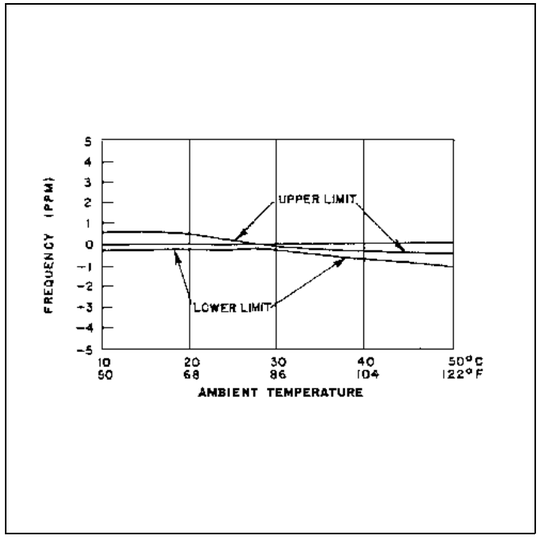
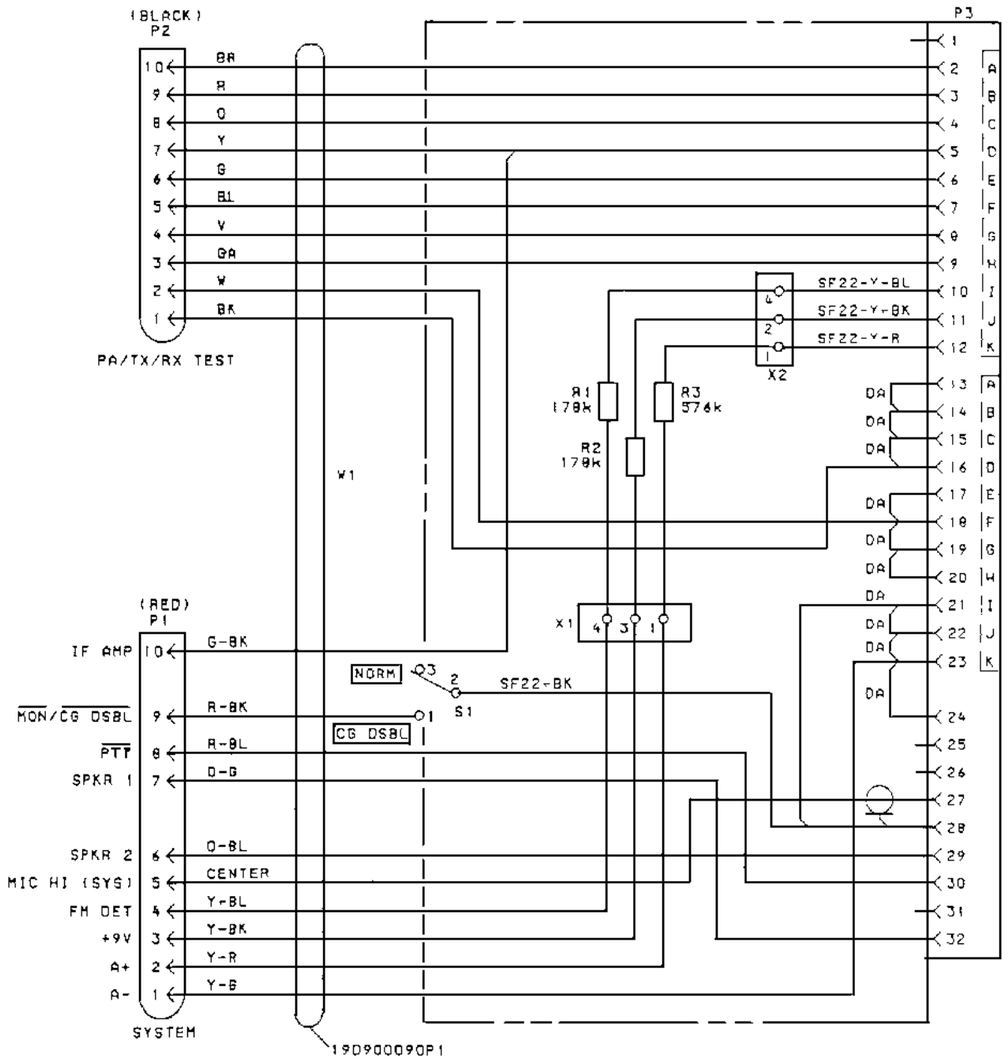


Figure 4 - Correction Factor in Freq. Setting



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.

19C850590G1

(19C850593, Rev. 4)

SYNTHESIZER AND TRANSMITTER ALIGNMENT

TEST EQUIPMENT REQUIRED

1. Watt meter, 50 ohm (capable of measuring 150 watts & 1 watt)
2. Digital Voltmeter
3. RF Frequency Counter
4. RF Voltmeter
5. Power Supply, 13.8 Vdc regulated
6. GE Test Set, 4EX3A11 with Test Set Adapter 19C850590G1
7. Tuning Tool 19B800716P2

PRELIMINARY CHECKS AND ADJUSTMENTS

NOTE

Refer to Figure 5 for location of tuning adjustment controls.

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. Monitor J602-3 with a digital voltmeter and adjust R703.

ALIGNMENT PROCEDURE

Synthesizer TX and RX Vco

The TX and TX VCO voltage adjustments are described by the following steps 1-5. After the lock detect light D713 goes out (step 1 and 3) each VCO is adjusted after selecting the appropriate channel for the maximum reading indicated.

If the light is not out, all readings are meaningless.

As long as the highest operating frequency (VCO voltage) does not exceed the maximum meter reading and the lowest operating frequency (VCO voltage) is not less than the minimum meter reading, the adjustment is proper.

When the two frequency spread is minimal it is acceptable to center tune the VCO voltage between the maximum and minimum meter readings.

If the highest operating frequency is at the low end of the frequency split (example 451.025 MHz on the 450-470 MHz split), the VCO reading may never reach the maximum. Therefore adjust the lowest operating frequency to a VCO voltage above the minimum reading.

SYNTHESIZER & TRANSMITTER ALIGNMENT

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE TEST SET	MULTIMETER (- TO A-)			
1.		LED D713	L209	Light out	Select the highest frequency transmit channel. Key the transmitter and tune L209 so that the lock detect indicator D713 goes out.
2.		J202	L209	Below 7.5 Vdc	Monitor J202 with a digital voltmeter. Tune L209 for 7.5 Vdc max.
3.		LED D713	C220	Light out	Unkey the transmitter. Select the highest frequency receive channel and tune C220 so that the lock detect indicator D713 goes out.
4.		J202	C220	Below 7.5 Vdc	Monitor J202 with a digital voltmeter. Tune C220 for 7.5 Vdc max.
5.		J202		Above 3.0 Vdc	Select the lowest frequency transmit and receive channel. Key the transmitter and check the TX VCO voltage. Unkey the transmitter and check the RX VCO voltage. Both readings should be above 3.0 Vdc.
Test aid for TX and RX Injection					Monitor TX injection at J102 and RX injection at J451. (Note: Terminate TX VCO output with 50 ohms to maintain lock with plug removed). TX injection +5 to +15 dBm RX injection +5 to +15 dBm

EXCITER TRANSMITTER POWER AMPLIFIER

Preset all four tuning screws in the exciter (C8-C11) so that the tops of the tuning screws are approximately 7 mm above the top of the casting.

Preset L103 so that the core is flush with the top of the coil form.

NOTE

The exciter can be isolated from the rest of the radio for tuning purposes, if desired. To isolate and set up, remove P102 and P103. Connect a (0-1 watt) wattmeter to J103-2, 4. Apply a +7 dBm at 1/3 carrier frequency signal to J102-2, 4.

If less than 6.0 MHz (5.0 MHz on 403-430 MHz split) channel spacing is required, select the highest transmit RF frequency. If 6.0 to 12.0 MHz bandwidth (5.0 to 10.0 MHz on 403-430 MHz split) is required, select center frequency. (Refer to "Accessing Center Tune Frequency" and complete steps.

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE TEST SET	MULTIMETER (- TO A-)			
6.	A (AMPL-1)	J101-10		0.25 V	Key the transmitter. No tuning required in this step.
7.	B (TRIPLER)	J101-9	L103	-0.45 V	Tune L103 for maximum negative meter reading (switch voltmeter for negative reading.)
8.	B (TRIPLER)	J101-9	C8	-0.5 V	Tune C8 for maximum meter reading.
9.	C (AMPL-3)	J101-8	C9	2.0 V	Tune C9 for maximum meter reading. Stop when maximum is reached.

EXCITER/TRANSMITTER POWER AMPLIFIER (Cont.)

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE TEST SET	MULTIMETER (- TO A-)			
10.	C (AMPL-3)	J101-8	C10	0.01	Tune C10 for a dip, 0.01 volts typical. Note, after C11 is tuned, this voltage typically will be 0.5 volts.
11.			C11	500 mw	Tune C11 for maximum exciter power output as indicated on the wattmeter, connected to J103-2, 4. Exciter output is typically 600 mw.
12.	A (PA INPUT)	J1-10	C11	Rated Output Power	Check exciter power output at both ends of the frequency spread. It should be equal to or greater than 500 mw. If wattmeter to measure exciter power is unavailable and the exciter is already connected to the PA, connect the meter to PA board J1. Connect a 150 watt wattmeter to antenna connector J2. Set the RF Power Adjust control for maximum power (fully clockwise). Tune C11 for maximum meter reading on J1, position A. Check the meter reading at both ends of the frequency spread. They should be approximately equal. If not adjust C11 accordingly. Set RF power Adjust for rated output power.
13.	A (PA INPUT)	J1-10	C11		**NOTE** If more than 6.0 MHz (5.0 MHz on 403-430 MHz split) channel spacing is required. Perform steps 13 and 14. Select the highest frequency channel. Key transmitter and adjust C11 so that output power is slightly above rated power.
14.			C10		Select lowest frequency channel. Key transmitter and adjust C10 so that output power is slightly above rated power. Switch to highest frequency channel and verify rated output power. If necessary repeat this step.

* Fo is the transmit output frequency at the antenna. The injection frequency is Fo/3 at J102.

REFERENCE OSCILLATOR FREQUENCY

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE TEST SET	MULTIMETER (- TO A-)			
15.		J2	L352	Channel Operating Frequency	**NOTE** This step assumes the frequency is measured when the transmitter is first keyed. If delayed the rapidly rising ambient temperature must be taken into consideration. Figures 4 and 5 below show the temperature versus frequency correction curve for the 5 PPM and optional 2 PPM reference osc. Key the transmitter while monitoring the frequency at the antenna connector J2. Adjust L352 for the assigned channel freq. ±225 Hz for a 5 PPM radio (standard) or ±90 Hz for a 2 PPM radio (optional). Note: The receiver injection frequency will automatically be correct.

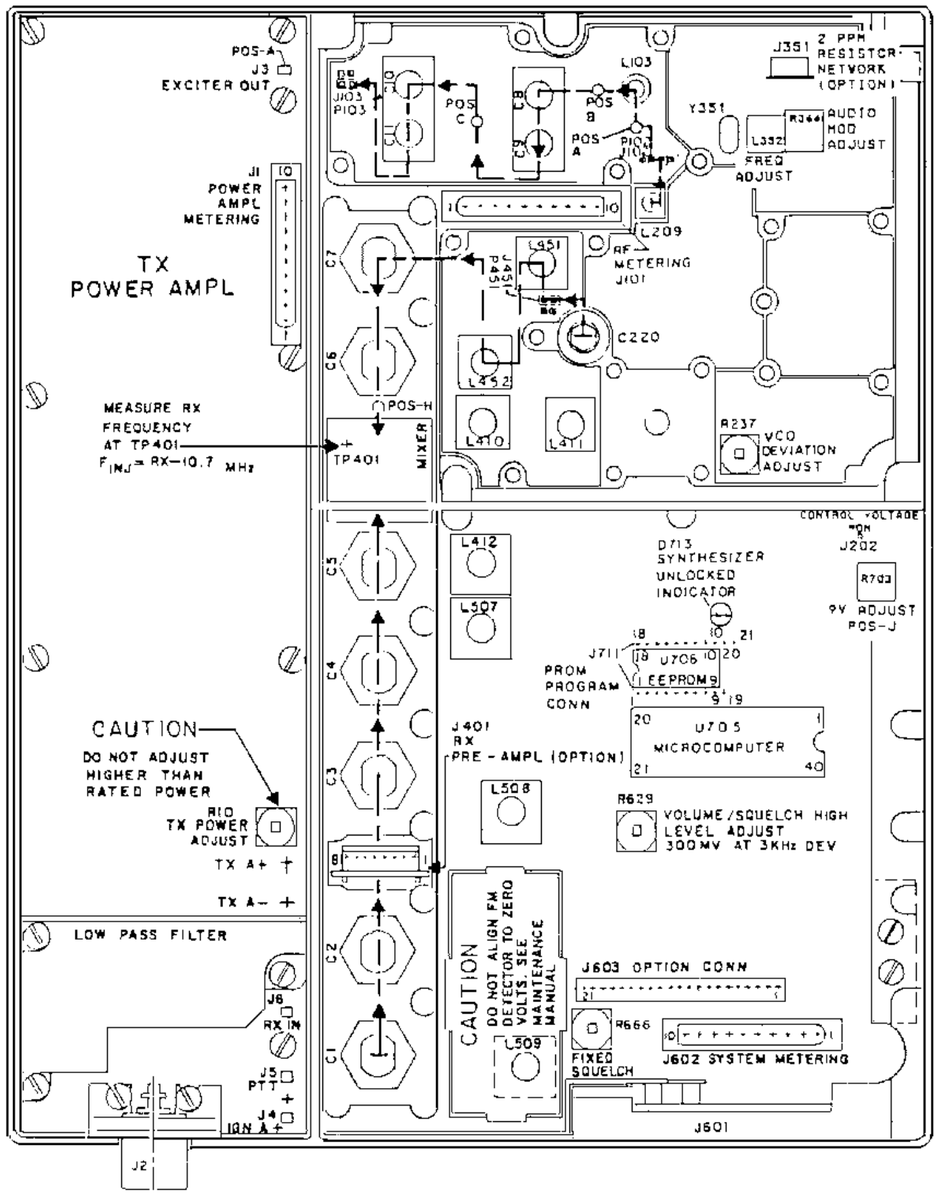


Figure 5 - Transmitter/Receiver Tuning & Adjustment Controls

RECEIVER FREQUENCY ADJUSTMENT

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

ALTERNATE IF SWEEP ALIGNMENT

1. Attach an oscilloscope probe to IF AMP. MTR. (J602-10). (Refer to Figure 6).

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 µV). 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 any ripple should be minimized in the passband.

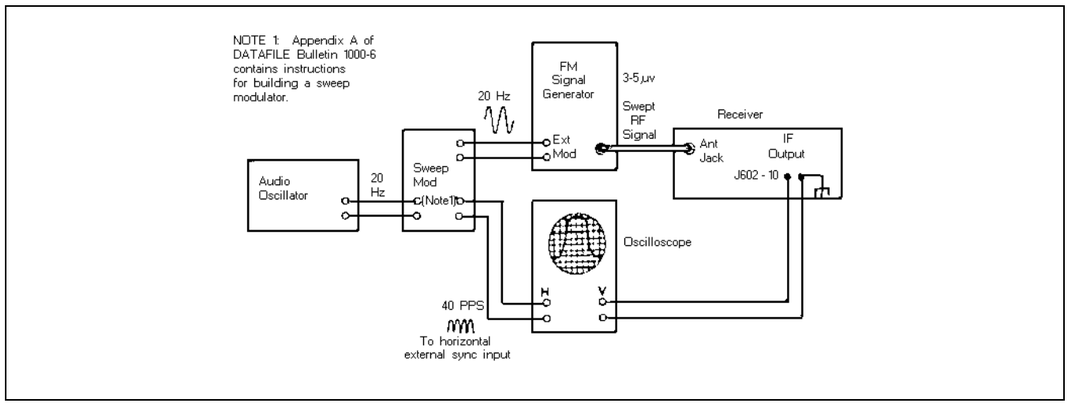


Figure 6 - Test Set-Up For 20 Hz Double-Trace Sweep Alignment

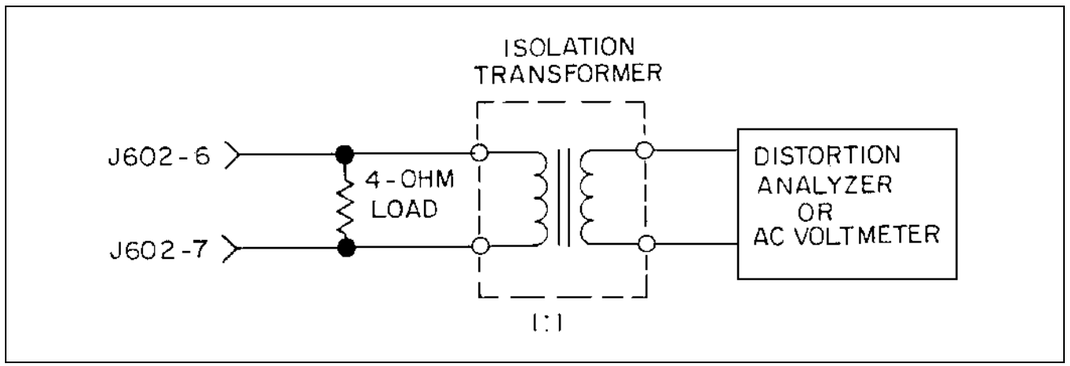


Figure 7 - Test Set-Up, Audio Output Measurement

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
4. Digital Voltmeter
5. VOM
6. RF Signal Generator (403-512 MHz)
7. Frequency counter (Hewlett-Packard 5300B)
8. Oscilloscope
9. Audio Isolation Transformer (1:1) 19A116736P1 or equivalent
10. 4 ohm 15 watt resistor
11. Tuning tool 19B800716P2

PRELIMINARY CHECKS AND ADJUSTMENTS

NOTE

Refer to Figure 5 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 C1-C7 to maximum height above top of tuning nut (10 mm above casting).
3. Preset L509 to top of coil form and then turn clockwise 11 full turns.
4. Preset L451 to top of coil form, then turn 15 turns clockwise.
5. Preset L410, L411, L412, L507 and L508 to top of coil form and then turn clockwise 9 full turns.
6. 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 that the output of the 9 volt regulator is set for 9.0 ±0.1 Vdc.

ALIGNMENT PROCEDURE

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE TEST SET	MULTIMETER (- TO A-)			
LOCAL OSCILLATOR-BUFFER INJECTION					
1.	G (RX INJ)	J101-4	L452	Peak	Select desired channel or center tune frequency. Set Test Set to 1 volt scale and tune L452 for maximum reading on Test Set.

(Cont.)

ALIGNMENT PROCEDURE (Cont.)

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE TEST SET	MULTIMETER (- TO A-)			
3.	G (RX INJ)	J101-4	C7	Dip	Tune C7 for a dip in Test Set reading.
4.	H (RX MIX)	J101-3	C6, C7 L452	Peak	Tune C6 for maximum. Sequentially retune L452, C6 and C7 until there is no further increase in meter reading.
FRONT END ALIGNMENT					
5.	D (IF AMP)	J602-10	C3	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 -10 dBm (70 mV). Tune C3 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).
6.	D (IF AMP)	J602-10	C1, C5 C2, C4	Peak	Peak C1, C5, C2, C4 in sequence while reducing output level of signal generator to prevent saturation.
RF SELECTIVITY					
7.	D (IF AMP)	J602-10	L508, L507 L410, L411 and L412	Maximum (See Procedure)	**NOTE** If the IF amplifiers have been aligned using the alternate sweep alignment method, proceed to Step 9. 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, L412, L411 and L410, in that order, for a peak reading. Repeak coils until no further improvement in meter reading is noted.
8.	D (IF AMP)	J602-10	C1-C5	Maximum	Repeak C1-C5.
FM DETECTOR/AUDIO PREAMPLIFIER					
9.			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 the both AC and DC isolated from ground. Connect test equipment as shown in Figure 5. Set signal generator output for 1000 µV. Set R629 and volume control to the center position. Monitor the speaker outputs (J602-6, 7) with an AC voltmeter. Tune quadrature coil L509 for a peak reading.
10.			R629		Adjust R629, audio preamplifier level for nominal 300 mV RMS at VOL/SQ HI (J603-14).

(Cont.)

ALIGNMENT PROCEDURE (Cont.)

STEP	METERING POSITION		TUNING CONTROL	METER READING	PROCEDURE
	GE TEST SET	MULTIMETER (- TO A-)			
FIXED SQUELCH ADJUSTMENT (8 dB SINAD) (EARLIER MODELS)					
11.			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. Verify that squelch opens at 8 ±1 dBm.
MULTI-FREQUENCY SPREAD (Multi-Frequency Radios) (Single Frequency Radio Proceed to Step 16.)					
12.	D (IF AMP)	J602-10	C1-C3		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 C2 three turns clockwise or counterclockwise. Detune in direction that will not exceed maximum or minimum tuning screw height. Tune C1 for a peak. Increase or decrease signal generator level as required to maintain 75% of the saturated signal level. Detune C3 and then tune C2 for a peak. Detune C4 and then tune C3 for a peak.
13.	D (IF AMP)	J602-10	C4, C5		Detune C5 clockwise to minimum tuning screw height. Tune C4 for a peak. Then tune C5 to maximum tuning screw height. Tune C5 for a peak reading.
14.		J101-3	C6		Select highest channel frequency and note meter reading. Select lowest channel frequency and note reading. Tune C6 slightly to equalize these two readings. If they cannot be equalized tune C6 to improve the channel with lowest reading.
15.	H (RX MIX)	J2	C5		Adjust the frequency of the signal generator to the highest frequency channel. Apply a modulated signal at the 0.35 µV level. Measure the SINAD level in accordance with Step 2 of Receiver Test Procedures. If the SINAD reading is 12 dB SINAD or less, tune C5 counterclockwise until the SINAD reading is greater than 12 dB. Switch to the lowest frequency channel and set the signal generator to the lowest frequency channel. Measure the SINAD level on the distortion analyzer. If the SINAD reading is less than 12 dB, tune C5 clockwise until the SINAD reading is 12 dB. Recheck the sensitivity at the high frequency channel. Readjust C5, if necessary, to keep the sensitivity at the band edges greater than or equal to 12 dB SINAD.
16.	D (IF AMP)		C1-C5		Set signal generator for 12 dB SINAD level. Adjust C1-C5 for best sensitivity.

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 6 dB SINAD.
3. Set modulation to 6 kHz.
4. Set deviation to 3 kHz.
5. Use 10 megohm probe.

A

B

C

HOR .1 MSEC/DIV
VERT .2 V/DIV
(.36 V P P)

D

HOR .50 uSEC/DIV
VERT .2 V/DIV
(1.2 V P-P)
BASE LINE = 0 VDC

E

F

SQUELCH CIRCUIT CHECKS WITH NOISE

PRELIMINARY STEPS

1. No input signal applied.
2. Squelch Adjust R666 set for 6 dB SINAD.
3. Use 10 megohm probe.

A

HOR .5 MSEC/DIV
VERT .1 V/DIV
(= 4 V P-P)

B

HOR .5 MSEC/DIV
VERT .1 V/DIV
(= 2 V P-P)

C

HOR .5 MSEC/DIV
VERT .5 V/DIV
(=1.5 V P-P)

D

HOR .5 MSEC/DIV
VERT .1 V/DIV
(=4 V P P)
BASE LINE = 0 VDC

E

HOR .5 MSEC/DIV
VERT .2 V/DIV
(6 VDC)
BASE LINE = 0 VDC

F

HOR .5 MSEC/DIV
VERT .2 V/DIV
(7.5 VDC)

G

HOR .5 MSEC/DIV
VERT .50 MV/DIV
(140 MV P-P)

AUDIO CIRCUIT

PRELIMINARY STEPS

1. Apply 1000 mV 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.

H

HOR .5 MSEC/DIV
VERT .2 V/DIV
(.64 V P-P)

J

HOR .5 MSEC/DIV
VERT .1 V/DIV
(.4 V P P)

K

HOR .0.5 MSEC/DIV
VERT .1 V/DIV
(.4 V P-P)

L

HOR .5 MSEC/DIV
VERT .50 MV/DIV
(140 MV P-P)

M

HOR .5 MSEC/DIV
VERT .50 MV/DIV
(320 MV P-P)

N

HOR .5 MSEC/DIV
VERT .50 MV/DIV
(300 MV P-P)

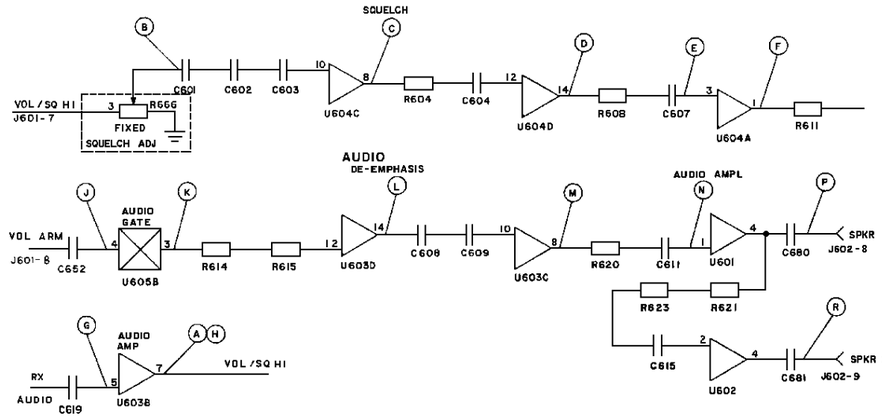
P

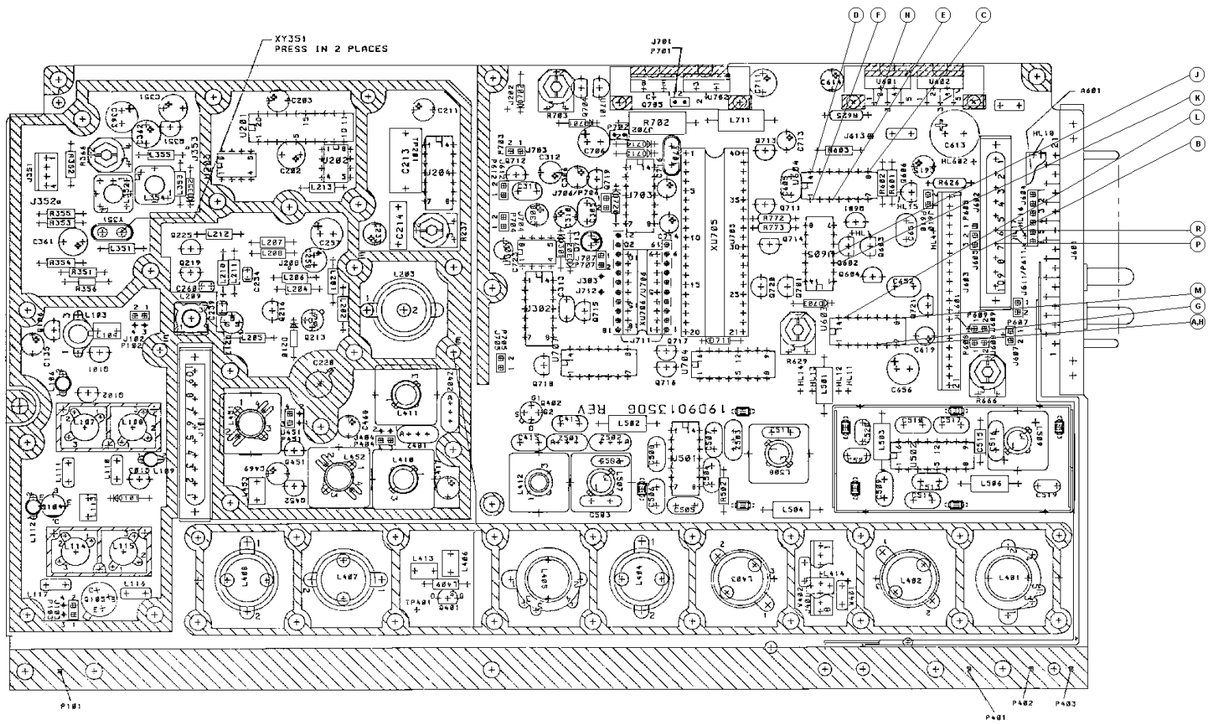
HOR .5 MSEC/DIV
VERT .2 V/DIV
(10 V P P)

R

HOR .5 MSEC/DIV
VERT .2 V/DIV
(10 V P P)

AUDIO AND SQUELCH WAVEFORMS





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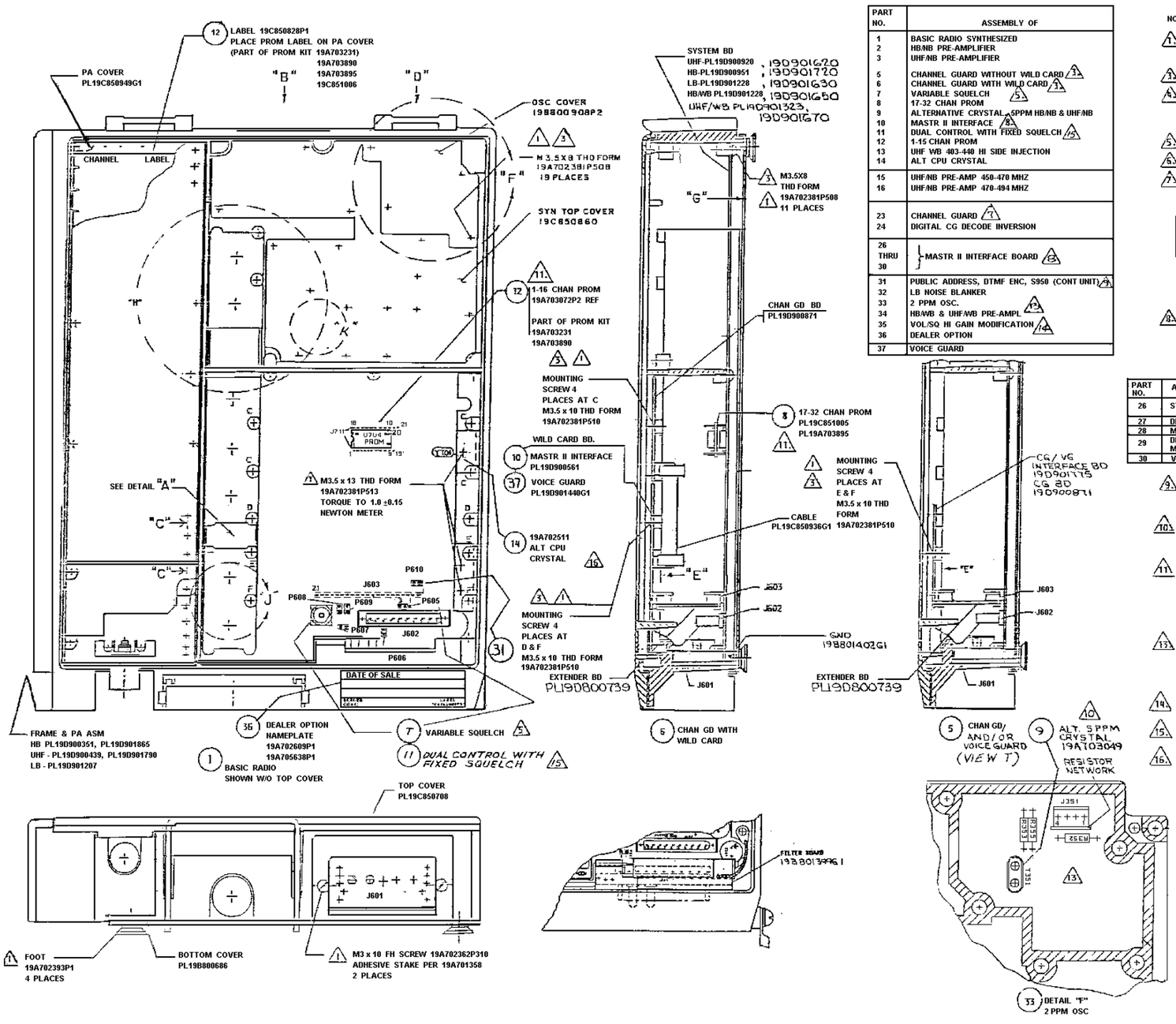


PART NO.	ASSEMBLY OF
1	BASIC RADIO SYNTHESIZED
2	HB/NB PRE-AMPLIFIER
3	UHF/NB PRE-AMPLIFIER
6	CHANNEL GUARD WITHOUT WILD CARD 7
7	CHANNEL GUARD WITH WILD CARD 4 7
8	VARIABLE SQUELCH 5
9	17-32 CHAN PROM
10	ALTERNATIVE CRYSTAL 5PPM HB/NB & UHF/NB
11	MASTR II INTERFACE 8
12	DUAL CONTROL WITH FIXED SQUELCH 15
13	1-15 CHAN PROM
14	UHF WB 403-440 HI SIDE INJECTION
	ALT CPU CRYSTAL
15	UHF/NB PRE-AMP 450-470 MHZ
16	UHF/NB PRE-AMP 470-494 MHZ
23	CHANNEL GUARD 7
24	DIGITAL CG DECODE INVERSION
26 THRU 30	MASTR II INTERFACE BOARD 13
31	PUBLIC ADDRESS, DTMF ENC, S950 (CONT UNIT) 9
32	LB NOISE BLANKER
33	2 PPM OSC.
34	HB/WB & UHF/WB PRE-AMPL 16
35	VOL/SQ HI GAIN MODIFICATION 14
36	DEALER OPTION
37	VOICE GUARD

NOTES:

1. PART OF HARDWARE KIT PL19A702024.
3. TORQUE M3.5 SCREWS TO 1.75 ± 0.15 NEWTON METER
4. REMOVE EXISTING COVER 19B800908P2 AND RETURN TO STOCK. REMOVE 5 PPM CRYSTAL Y351 AND RETURN TO STOCK. 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 POT R666 AND MOVE P605 TO J605-2 & 3.
6. PART OF UHF PRE-AMPL 19C850692.
7. P607 THRU P609 PLUGS ON SYSTEM BD. SHALL BE REMOVED WHERE "X" IS SHOWN BELOW.

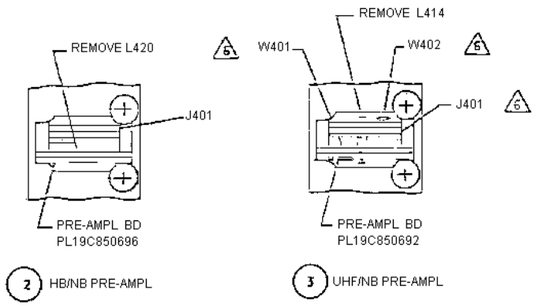
PART NO.	DESCRIPTION	P607	P608	P609
23	CHANNEL GUARD		X	

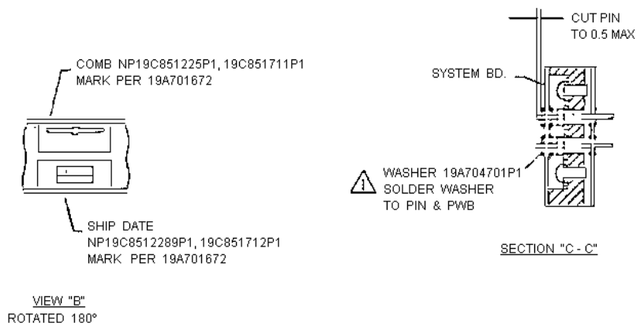
8. WHEN USING THE MASTR II INTERFACE BD, REMOVE P608 ON THE SYSTEM BD. THE MASTR II INTERFACE BOARD IS ASSEMBLED WITH ALL JUMPERS PRESENT. "X" INDICATES THAT THE JUMPER OR PART IS REMOVED. P3 IS LOCATED ON THE CHANNEL GUARD BOARD. P609 IS LOCATED ON THE SYSTEM BD.

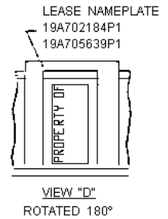
PART NO.	APPLICATION	W1	W2	W3	W4	W5	W6		P3	P609
26	STANDARD (NO OPTION PRESENT)		X	X			X			
27	DELTA CG	X		X			X			X
28	MASTR II CG ENCODER		X				X			
29	DELTA CG DECODER MASTR II CG ENCODER	X					X		X	X
30	VOICE OVER-RIDE	X		X	X	X				X

9. ADD P610 WHEN PUBLIC ADDRESS OR DTMF ENC OPTIONS ARE PRESENT IN CONTROL UNIT OR WITH S950 CONTROL UNIT. P610 IS PART OF HARDWARE KIT PL19A702024
10. REMOVE ICOM COVER, REMOVE EXISTING Y351 AND RETURN TO STOCK. 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 PER 19A701294: U706 (1-16 CHANNEL PROM) AND U1 (17-32 CHANNEL PROM).
13. REMOVE 5 PPM CRYSTAL Y351 AND RETURN TO STOCK. REMOVE R352, R353, R355. PLUG-IN RESISTOR. NETWORK AND CRYSTAL SUPPLIED IN KIT 19C851230.
14. FOR APPLICATIONS THAT REQUIRE VOL/SQ HI GAIN REMOVE W7 ON M11 INTERFACE BOARD. SEE SHEET 2.
15. FOR APPLICATIONS OF DUAL CONTROL WITH FIXED SQUELCH (NOT P7 VARIABLE SQUELCH) REMOVE P605.
16. FOR APPLICATIONS THAT REQUIRE AN ALTERNATE CPU CRYSTAL, REMOVE 19A702511G3 CRYSTAL, RETURN TO STOCK, AND REPLACE WITH NEW GP CRYSTAL CALLED FOR ON STOCK SELECTION SHEET.

(19D900977, Sh. 1, Rev. 20)

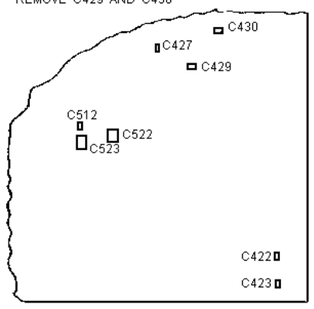






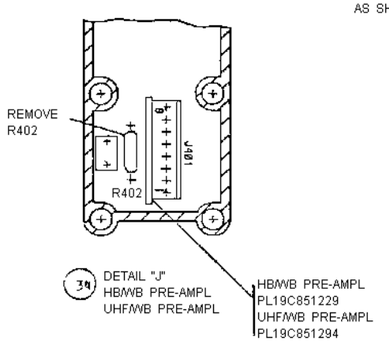
DETAIL "A"

15 450 - 470 MHZ ONLY
ON 19D901620G1, G5 (19D901350G1, G13)
REMOVE C429 AND C430

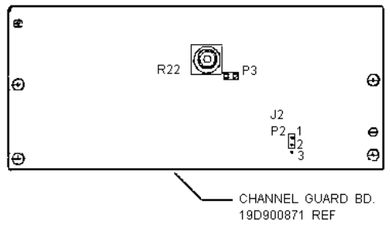


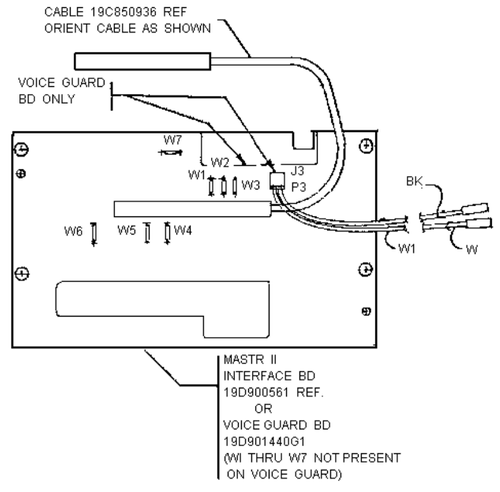
SOLDER SIDE SHOWN

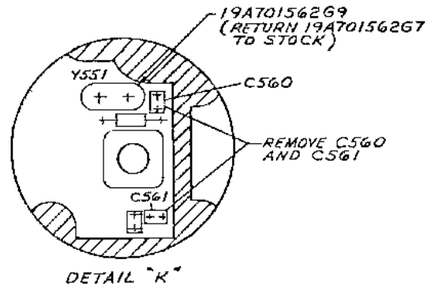
16 470 - 494 MHZ ONLY
ON 19C901620 G2, G6 (19D901350G3, G15)
ADD C429 AND C430
AS SHOWN ABOVE. 6



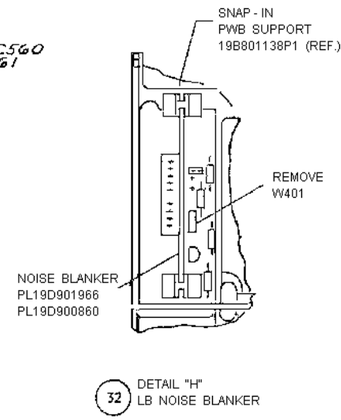
24 DIGITAL CG DECODE INVERSION
MOVE P2 FROM J2-1 & 2 TO J2-2 & 3 ON CG BOARD.





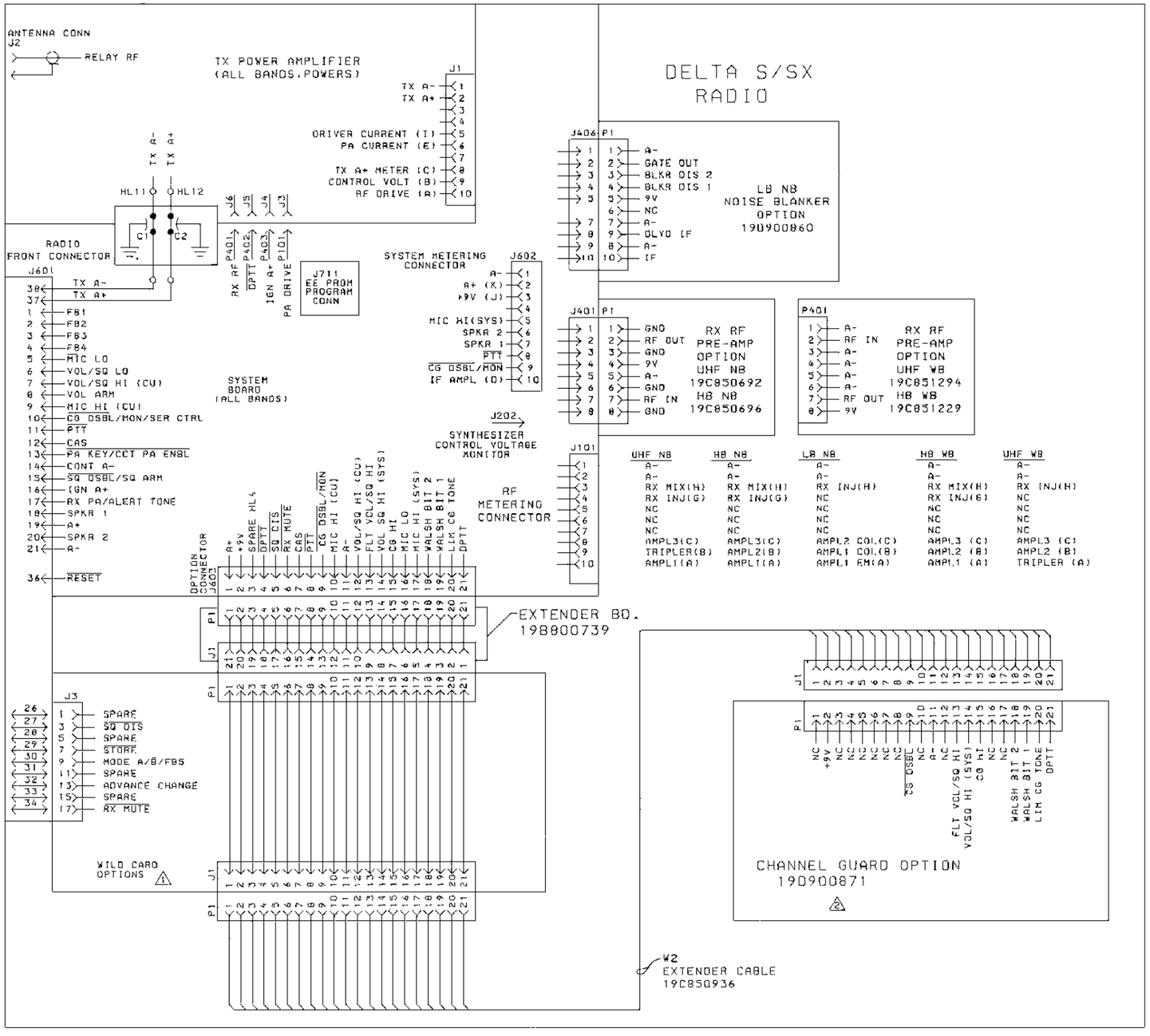


13 UHF WB 403-440 HI SIDE INJECTION



32 DETAIL "H"
LB NOISE BLANKER

(19D900977, Sh. 2, Rev. 14)



NOTES:

1. WILD CARD OPTIONS INCLUDE CHANNEL GUARD/VOICE GUARD INTERFACE OPTION BOARD 19D901775, VOICE GUARD INTERFACE OPTION BOARD 19D901440, OR ADAPTER INTERFACE BOARD 19D900561 FOR MII TYPE CONTROL UNITS.
2. FOR CHANNEL GUARD ONLY, CHANNEL GUARD MODULE CONNECTS DIRECTLY TO EXTENDER BOARD INSTEAD OF ONE OF THE WILD CARD OPTIONS.

(19D900980, Sh. 1, Rev. 4)