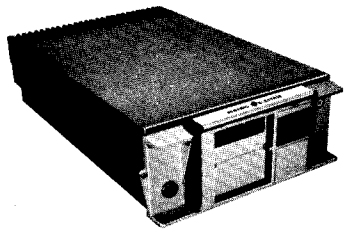
Combs 9031

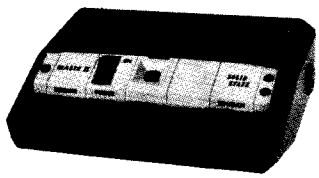
MOBILE RADIO

MASTR II

MAINTENANCE MANUAL

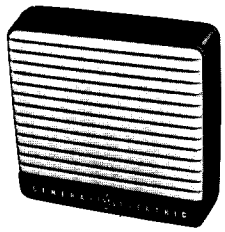


MOBILE RADIO



CONTROL UNIT

"E" SERIES
DUPLEX
TWO-WAY FM MOBILE COMBINATIONS
LBI-4880



SPEAKER

GENERAL ELECTRIC

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ILLUSTRATIONS

WARNING

Although the highest DC voltage in MASTR II Mobile Equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat metal 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!

EQUIPMENT INDEX

EQUIPMENT	MODEL OR PART NUMBER
Transmitter and Receiver	Refer to the applicable Maintenance Manual
Transmitter Multi-Frequency Board	19C320613G1
Receiver Multi-Frequency/Duplex System Board	19D417638G1
Duplex Harness Board and Panel (Includes Interconnection Cable)	19B226255G1
Exciter/PA Cable	5491689P86
Control Unit	Refer to Control Unit Maintenance Manual
Handset	19C320478G1
Handset Hookswitch	19B219846G3
Speaker	Refer to Control Unit Maintenance Manual
Antennas	Refer to Control Unit Maintenance Manual
Power/Control Cable 20-Foot, 38-Conductor	Refer to Control Unit Maintenance Manual
12-Volt Fuse Assembly	Refer to Control Unit Maintenance Manual
Battery Cables	Refer to Control Unit Maintenance Manual
12-Volt Ignition Switch Cable Assembly	Refer to Control Unit Maintenance Manual
Extractor Tool	19B219951P1
Mounting Hardware	19A129474G1
Key (BF-10A)	5491682P8
Alignment Tools	19B219676G1 19B219678P1

OPTIONS

EQUIPMENT	PART OR OPTION NUMBER
Duplexers	
150-162 MHz	19C321056P1
162-174 MHz	19C321056P2
450-470 MHz	19C321056P3
470-494 MHz	19C321056P4
494-512 MHz	19C321056P5
Power/Control Cables	
9-Foot, 38-Conductor	19D416716G10
27 Foot, 38-Conductor	19D416716G12
12-Volt, 3-Wire Ignition Switch Cable Assembly	19B219537G1

SYSTEM SPECIFICATIONS*

GENERAL

FREQUENCY RANGE	150.8-174 MHz (High Band) 450-512 MHz (UHF)
BATTERY DRAIN (less options)	
Receiver Squelched	0.25 amperes at 13.8 VDC
Receiver Unsquelched	2.4 amperes at 13.8 VDC
Transmitter	
22-Watt High Band	9 amperes at 13.6 VDC
20-Watt UHF (450-494 MHz)	10.5 amperes at 13.6 VDC
18-Watt UHF (494-512 MHz)	10.5 amperes at 13.6 VDC
RECEIVER SENSITIVITY	
150.8-174 MHz	1.0 dB degradation (max.)
450-470 MHz	1.0 dB degradation (max.)
470-512 MHz	2.0 dB degradation (max.)
RECEIVER SPURIOUS RESPONSE	
Transmitter Unkeyed	-100 dB
Transmitter Keyed	-85 dB
DIMENSIONS (H X W X D)	5" x 12-1/16" x 18-3/4"
WEIGHT (less mounting plate)	36 pounds
TEMPERATURE RANGE	-40°C to +60°C (-40°F to +140°F)
DUTY CYCLE	Continuous

	DUPLEXER				
	19C321056P1	19C321056P2	19C321056P3	19C321056P4	19C321056P5
Transmitter Frequency Range (MHz)	154.5-162	162.0-174	455-470	473-494	494-512
Receiver Frequency Range (MHz)	150-157.5	157.5-169.5	450-465	470-491	491-509
Frequency Separation, Center to Center (MHz)	4.5-8	4.5-8	5	3	3
Transmitter Bandwidth, (kHz)	± 250	± 250	± 250	± 200	± 200
Receiver Bandwidth (kHz)	± 250	± 250	± 250	± 200	± 200
Maximum Power Input, Continuous Duty (Watts)	35	35	40	40	40
Maximum Insertion Loss, Transmitter to Antenna (dB)	1.5 (9 Watts for 22 watts out)	1.5 (9 Watts for 22 watts out)	1.5 (8 Watts for 20 watts out)	2.0 (10.5 W. for 18 watts out)	2.0 (10.5 watts for 18 watts out)
Maximum Insertion Loss, Receiver to Antenna (dB)	1.0	1.0	1.0	2.0	2.0
Minimum Transmitter Noise Suppression at Receiver Freq. (dB)	70	70	70	80	80
Minimum Receiver Isolation at Transmitter Freq. (dB)	20	20	20	40	40
Maximum VSWR, Transmitter and Receiver, with 50 ohm reference	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1
Frequency Tuning Range (MHz)	12	12	15	25	23

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

COMBINATION NOMENCLATURE

1st Digit	2nd Digit	3rd Digit	4th Digit	5th Digit	6th Digit	7th Digit	8th & 9th Digits	10th Digit
Mechanical Package	System Voltage	Power Output	Channel Spacing	Frequency Capability	Number of Freq.	Options	Frequency Range	Oscillator Stability
E Model	**C** ±12-Volts DC	**5** 16-38 Watts	**5** 25 kHz	**P** 12-Freq.	**A** 1-Freq.	**D** Duplex	**66** 150.8-174 MHz	**A** ±5 PPM (0.0005%)
		6 38-66 Watts	**6** 30 kHz		**C** 2-Freq.Tx&Rx	**L** Duplex & Channel Guard	**88** 450-470 MHz	**B** ±2 PPM (0.0002%)
					E 3-Freq.Tx&Rx		**89** 470-494 MHz	
					F 4-Freq.Tx&Rx		**91** 494-572 MHz	
					G 5-Freq.Tx&Rx			
					H 6-Freq.Tx&Rx			
					J 7-Freq.Tx&Rx			
					K 8-Freq.Tx&Rx			
					L 9-Freq.Tx&Rx			
					M 10-Freq.Tx&Rx			
					N 11-Freq.Tx&Rx			
					P 12-Freq.Tx&Rx			

TRANSMITTER TYPE NUMBERS

TRANSMITTER	FREQ. RANGE (MHz)	NUMBER OF FREQS.	FREQUENCY STABILITY	POWER OUTPUT (Watts)
KT-100-A	150.8-174	1 thru 12	±0.0005%	22
KT-100-C	150.8-174	1 thru 12	±0.0002%	22
KT-101-A	450-470	1 thru 12	±0.0005%	20
KT-101-C	450-470	1 thru 12	±0.0002%	20
KT-102-A	470-512	1 thru 12	±0.0005%	18
KT-102-C	470-512	1 thru 12	±0.0002%	18

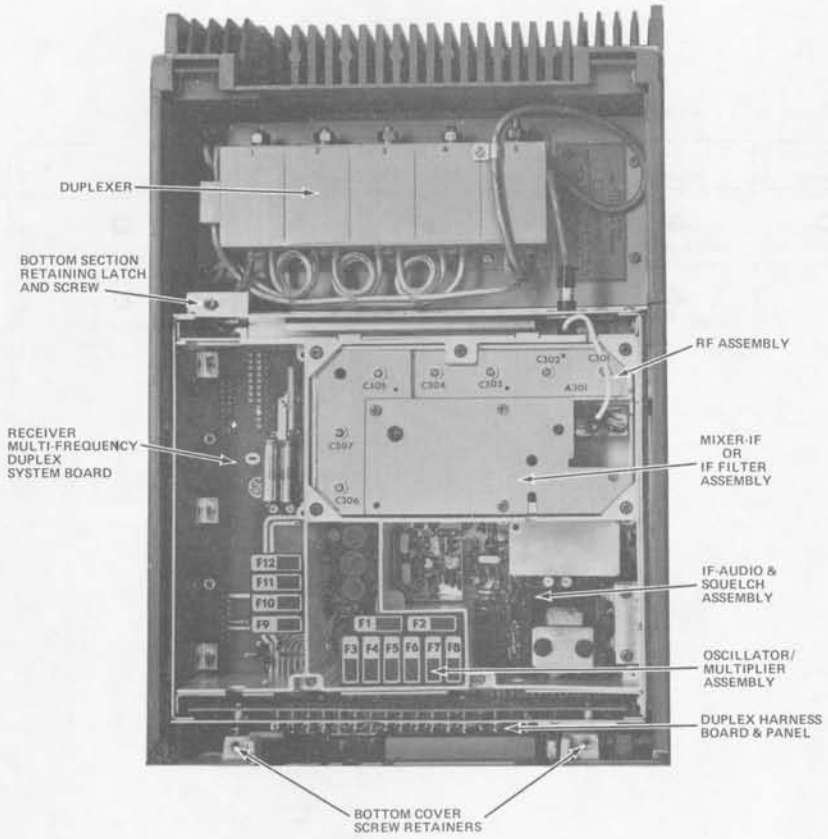

Figure 1 - Typical Bottom Section Module Layout

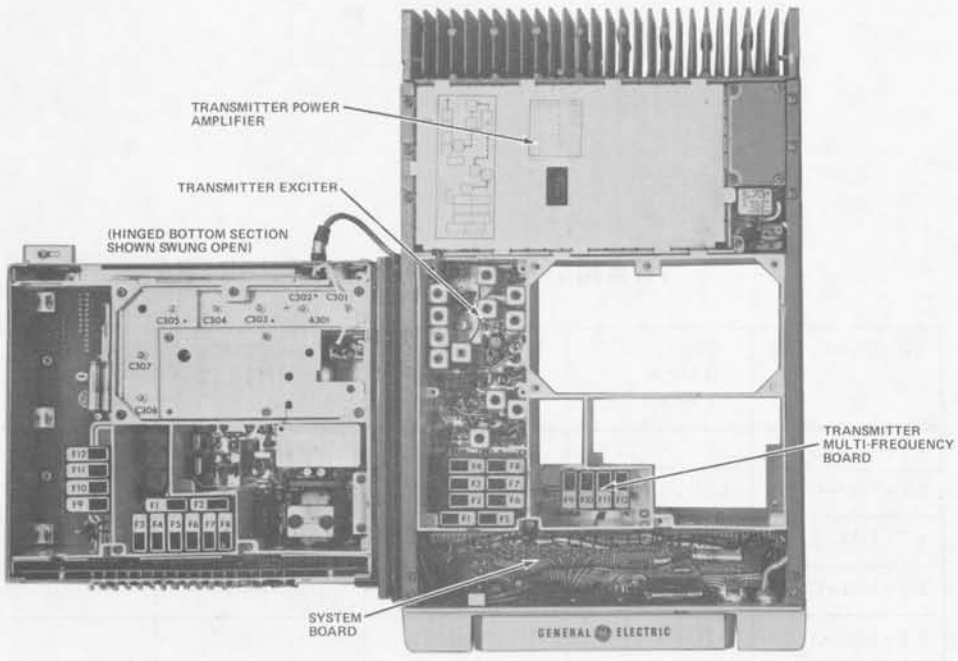

Figure 2 - Typical Top Section Module Layout
(Bottom Section Swung Open)

DESCRIPTION

MASTR II duplex mobile radio combinations are compact, highly reliable and ruggedly-constructed units that are designed to meet the most stringent requirements in the two-way radio field. The duplex radios permit the simultaneous transmission and reception of messages.

The radios are fully transistorized-utilizing both discrete components and Integrated Circuits (IC's) for highest reliability. Since no tubes are used, the radio is ready to use the instant it is turned on. The standard combination may be equipped with the following:

- One through twelve frequencies.
- Plug-in oscillators for ±0.0002% or ±0.0005% oscillator stability
- Channel Guard (tone squelch) Encoder and Decoder

The radio set is housed in a drip-proof case only five inches high. The radio mounts to the vehicle by a bottom mounting plate, and is tamper-proof when locked into the mounting 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 the handle is pulled down 90 degrees, the radio can be locked to hold the handle in the carrying position.

The top section of the radio contains the transmitter modules. The receiver modules are contained in an RF shielded case assembly mounted in a hinged bottom section.

To gain access to the modules in the bottom section, remove the radio from its mounting frame and turn the radio over. Then loosen the two captive screws securing the bottom cover and remove the cover (see Figure 1).

The bottom section swings open so that all major modules and tuning adjustments in the radio are easily accessible for servicing. To swing the bottom section open, first remove the bottom cover. Next, loosen the screw in the retaining latch and slide the latch open. The bottom section will now swing open as shown in Figure 2. Simply remove the top cover of the receiver case assembly to gain access to the receiver modules.

No power supply is required since the highest supply voltage used in the radio is derived from the vehicle battery.

Centralized metering jacks for the transmitter, receiver and system board are provided for simplified alignment and troubleshooting.

The transmitter, receiver and option modules are electrically isolated from the radio chassis to permit operating in positive or negative ground vehicles without the use of a polarity converter. The transmitter exciter, transmitter multi-frequency board and the receiver modules are mounted in Lexan frames for isolation. Simply changing four connections to the control unit and reversing the power leads at the fuse block allows the radio to be used in negative or positive ground vehicles. No changes are required in the radio.

TRANSMITTER

The transmitter consists of an exciter board and a transmitter multi-frequency board located in the top mounting frame, and a power amplifier assembly. The PA assembly consists of a PA board mounted on a PA casting at the rear of the radio. A hermetically sealed antenna switch is also mounted on the PA assembly. Refer to the Table of Contents for details on the Transmitter Multi-frequency Board.

RECEIVER

The receiver consists of an oscillator/multiplier assembly (Osc/Mult), RF assembly, mixer/IF assembly (MIF) or IF assembly in UHF receivers, an IF audio and squelch assembly (IFAS), and a multi-frequency/duplex system board.

NOTE

In duplex applications, the high band receivers are modified, and both high band and UHF receivers are equipped with different frequency ICOMs to provide high-side injection frequencies to the mixer. Refer to the applicable receiver Maintenance Manual for complete details.

The complete receiver is housed in an RF shielded case assembly mounted in the bottom section of the radio. A duplex harness board and panel mounted at the front of the case assembly provide jacks for plugging in the receiver modules. All power and control connections are made to the top section of the radio through a cable harness that is part of the duplex harness board and panel assembly. Refer to the Table of Contents for details on the receiver multi-frequency/duplex system board.

DUPLEXER

MASTR II mobile duplex combinations permit the simultaneous transmission and reception of RF signals. The duplexer mounts at the rear of the radio under the

transmitter PA assembly, and is equipped with cables that connect directly to the transmitter and receiver. The duplexer antenna cable connects to the front of the radio housing.

In duplex applications, the transmitter and receiver operate on different frequencies, with the transmitter operating on a higher frequency than the receiver.

The unit operates as band-reject duplexer, with a transmitter path and a receiver path. Each path includes tuneable cavities that are used in conjunction with the transmitter and receiver to attenuate (reject) a specified undesired signal while passing desired signals with minimum loss. Refer to Table of Contents for the Duplexer Adjustment Procedure.

CONTROL UNIT

The control unit contains the power on-off rocker switch, volume and squelch controls, a channel selector switch, a red transmit indicator light and a power on/frequency indicator light. Space is provided for an optional rocker switch, and two optional indicator lights.

The control unit is enclosed in a two piece molded Lexan® mounting bracket and Safety Release assembly. The Safety Release assembly breaks away under impact for passenger safety. This mounting assembly also permits the control unit to be swiveled as desired for the convenience of the operator.

Three connectors are located on the rear of the control unit. Two of the connectors are for the control cable(s), and one (Vehicle Systems Jack J701) is for power, accessories and external options.

HANDSET AND HOOKSWITCH

MASTR II duplex combinations are equipped with a telephone-type handset and a handset hookswitch. The handset uses a dynamic microphone with a built-in microphone pre-amplifier. The extendable coiled cord plugs into the microphone jack on the bottom of the control unit, and is secured to the jack by a retaining screw. Removing the handset from the hookswitch disables the speaker.

The hookswitch is equipped with a Channel Guard disable switch. In Channel Guard applications, placing the switch in the "up" position (towards the small speaker symbol) disables the receive Channel Guard. With the switch in the "down" position, the Channel Guard is disabled only when the handset is removed from the hookswitch, or when the correct Channel Guard tone is received.

SPEAKER

A five-inch speaker contained in a Lexan® housing provides an audio output of 12 watts. The speaker impedance is eight ohms. The speaker leads are terminated in Vehicle Systems Plug P701 which connects to J701 on the rear of the control unit.

The speaker is supplied with a Lexan® mounting bracket and Safety Release assembly. The Safety Release assembly breaks away under impact for passenger safety, and permits the speaker to be swiveled as desired to direct sound to the operator.

CHANNEL GUARD

In radios equipped with Channel Guard, a separate encoder and decoder board are supplied. The encoder mounts on the main System Board, and the decoder mounts on the Receiver Multi-Frequency/Duplex System Board. For the encoder function, the jumper connected between H71 and H72 on the main System Board must be removed.

CIRCUIT ANALYSIS

CONNECTOR BOARD

A 21-pin connector board mounts in the radio in the area next to the transmitter multi-frequency board. The board plugs into J904 on the main System Board, and provides a means of connecting the receiver functions and F9 through F12 frequency select leads to the System Board. The connector board also provides connection points for the optional fixed squelch module.

TRANSMITTER MULTI-FREQUENCY BOARD

The transmitter multi-frequency board may be equipped with ICOMs for frequencies F9 through F12. The RF output from the ICOMs is connected from J2101 of the transmitter multi-frequency board to hole H5 on the transmitter exciter board. Hole H5 is the parallel connection for the RF output of all ICOMs on the exciter board. Refer to applicable Transmitter Maintenance Manual for ICOM adjustment procedures.

Mid-temperature range backup compensation voltage for transmitter ICOMs is provided by voltage divider resistors R2101 and R2102 on the transmitter multi-frequency board as well as the 10-Volt regulator on the main System Board.

Compensation voltage, A- and regulated 10 volts are connected to the multi-frequency board through P2101. Frequency select leads for F9 through F12 are made from Power/Control jack J901 through the

connector board to P2102 on the transmitter multi-frequency board.

NOTE

In duplex applications, printed wire runs on the transmitter multi-frequency board labeled "A", "B", "C" and "D" are cut to isolate frequency select leads F9 through F12 from the F1 thru F4 leads on the main System Board through P2101. Refer to the Schematic and Outline Diagram.

DUPLEX HARNESS BOARD AND PANEL

The Duplex Harness Board and Panel interconnects the receiver modules mounted in the shielded bottom assembly of the radio to the System Board. Connections for the Receiver Multi-frequency Duplex System Board, OSC/MULT and IFAS boards are provided by jacks J951, J952 and J953 respectively. All leads in the cable are filtered by feed through capacitors C1 thru C30 on the front of the shielded receiver housing.

When the Public Address option is present a jumper is connected between H37 and H38 to complete the circuit for the receiver PA input.

All other connections to standard modules are made through the System Board connectors as in standard radios. Refer to the Duplex Interconnection Diagram listed in the Table of Contents for details.

RECEIVER MULTI-FREQUENCY/DUPLEX SYSTEM BOARD

The Receiver Multi-frequency/Duplex System board may be equipped with ICOMs for frequencies F9 through F12, a 10-Volt regulator for the receiver, and interconnections for the Channel Guard Decoder.

The RF output from the ICOMs is connected from J2301 on the receiver multi-frequency/Duplex system board to H3 on the receiver OSC/MULT board. Hole H3 is the parallel connection point for the RF output of all the ICOMs on the OSC/MULT board. Compensation voltage for the receiver ICOMs is provided by the 10 Volt regulator. For ICOMs F1 through F8, compensation voltage is applied through P2301/J951 to J952/P903 on the receiver OSC/MULT board. Refer to applicable Maintenance Manual for ICOM adjustment procedure.

10-Volt Regulator

The 10 Volt regulator provides a closely regulated supply voltage for the receiver OSC/MULT board (F1 through F8 ICOMs), IFAS board, Channel Guard Decoder (when used) and F9 through F12 ICOMs on the receiver multi-frequency/duplex system board and includes pass transistor Q2301. Q2301 uses a heat sink for proper power dissipation.

Turning on the radio applies A+ to pin 1 of the 10 Volt regulator and to the emitter of pass transistor Q2301. The amplifier in the 10 Volt regulator conducts and turns on pass transistor Q2301, causing an output voltage to appear at its collector. The output voltage is fed back to pin 3 and the reference zener diode which controls the conduction of the amplifier and therefore pass transistor Q2301 to maintain a closely regulated 10-Volt output.

Service Note: The 10-Volt regulator is protected against short circuits. When supply voltage is present but there is no 10-Volt output, the trouble is probably not in the 10-Volt regulator. Always check for a short (or high drain) on the 10-Volt line before replacing the regulator (see Troubleshooting Procedure).

Compensation Voltage Divider

The 10-Volt output is applied to a voltage divider network to provide a stable 5-Volt compensation input voltage to the receiver ICOMs. This is a high impedance source and should not be used for any other purposes.

Receiver Oscillator Switch

Since the Transmit Oscillator Switch is not used in duplex systems, it does not turn off the receiver ICOMs when transmitting. Therefore, when the radio is turned on a positive voltage from the Receiver Oscillator Switch is always present and applied to the receiver OSC/MULT board through P2301-5, J951-5 and J952-12 to P903-12.

PRE-INSTALLATION CHECK

MASTR II radios are shipped from the factory completely connected to permit the serviceman to perform system checks on the transmitter and receiver without removing the radio from its shipping container. Simply removing the lid on the internal packing case provides access to the battery cables, ignition switch cables, handset, control unit and radio antenna jack. The radio is shipped connected for 12-Volt, negative ground operation.

CAUTION

Before bench testing the MASTR II Mobile Radio, be sure of the output voltage characteristic 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 ohm resistive load): 18 Volts
Transmitter keyed
(no load or non-resistive load):
14.5 V (150.8-174 MHz)
15.5 V (450-412 MHz)

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 limit 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). 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.

INITIAL ADJUSTMENT

After the MASTR II Radio has been installed (as described in the Installation Manual), the following adjustments should be made by an electronics technician who holds a 1st or 2nd Class FCC Radio-telephone license.

Make sure that a RADIO TRANSMITTER IDENTIFICATION form (FCC Form 452-C or General Electric Form NP270303) has been filled out and attached to the transmitter.

TRANSMITTER ADJUSTMENT

CAUTION

When setting the transmitter power output, check to see that insertion loss (power into duplexer minus power out) does not exceed the limits as listed in the Duplexer specifications (see Table of Contents). Exceeding these limits will damage the transmitter or duplexer. Refer to the Duplexer Tuning Procedure (see Table of Contents).

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 (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 MAINTENANCE MANUAL for the transmitter.

RECEIVER ADJUSTMENT

The initial adjustment for the receiver includes tuning the input circuit to match the antenna. For the Receiver Initial Adjustment Procedure, refer to the FRONT END ALIGNMENT PROCEDURES in the MAINTENANCE MANUAL for the receiver.

OPERATION

Complete operating instructions for the Two-Way Radio are provided in the separate OPERATOR'S MANUAL. The basic procedures for receiving and transmitting messages follows:

TO RECEIVE A MESSAGE

1. Turn the radio on by pressing the POWER-ON rocker switch to the ON position.
2. Turn the SQUELCH control clockwise (to the right) as far as possible.
3. Adjust the VOLUME control until the noise is easily heard, but is not annoyingly loud.
4. Now, slowly turn the SQUELCH control counterclockwise (to the left) until the noise just fades out.

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

TO TRANSMIT A MESSAGE

1. Turn the radio on as directed in the "To Receive a Message" section.
2. Press the push-to-talk button on the microphone and speak into the handset in a normal voice. The red indicator light on the control unit will glow each time the microphone button is pressed, indicating that the transmitter is on the air.

MAINTENANCE

REMOVING IC's

Removing IC's (and all other soldered-in components) can be easily accomplished by using a de-soldering tool such as a SOLDA-PULLT® or equivalent. To remove an IC, heat each lead separately on the solder side and remove the old solder with the de-soldering tool.

An alternate method is to use a special soldering tip that heats all of the pins simultaneously.

PREVENTIVE MAINTENANCE

To insure 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.

TEST AND TROUBLESHOOTING PROCEDURES

The individual Maintenance Manual for the transmitter and receiver describe standard test procedures which the serviceman can use to compare the actual performance of the transmitter or receiver against the specifications of the unit when shipped from the factory. In addition, specific troubleshooting procedures are available to assist the serviceman in troubleshooting the transmitter and receiver.

NOTE

In positive ground operation only, A- is "hot" with respect to vehicle ground. Shorting the receiver front end casting or any printed wiring board ground patterns to the radio case may cause one of the in-line fuses to blow.

MECHANICAL PARTS BREAKDOWN

Mechanical parts breakdown diagrams of the two-way radio are provided in this manual. The diagrams show the placement and GE Part Number of mechanical items on the Two-Way radio set (see Table of Contents).

RE-INSTALLATION

If the radio is ever moved to a different vehicle, always check the battery polarity and voltage of the new system before using the radio.

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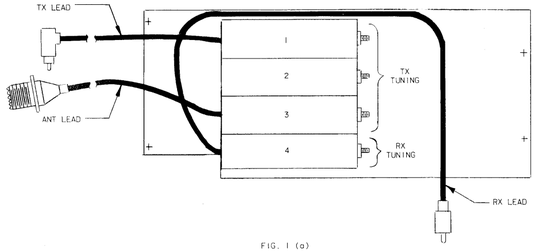
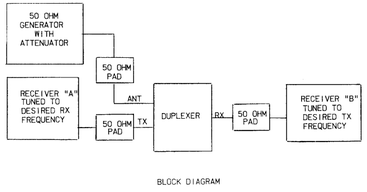


FIG. 1 (a)

(SIMILAR TO PHELPS DODGE COMMUNICATIONS CO.)



BLOCK DIAGRAM

(19C321056, Sh. 3, Rev. 2)

TUNING PROCEDURE FOR DUPLEXER NO. 19C321056P1-P2-P3 (FIG. 1(a))

TUNING INSTRUCTIONS

THE DUPLEXER IS FACTORY TUNED TO THE EXACT OPERATING FREQUENCIES. NO FURTHER TUNING OR ADJUSTMENT IS REQUIRED. TUNING INSTRUCTIONS ARE FURNISHED ONLY FOR THE PURPOSE OF READJUSTMENT IN THE EVENT OF FREQUENCY CHANGES IN THE ASSOCIATED EQUIPMENT.

EQUIPMENT REQUIRED FOR THE TUNING PROCEDURE IS:

1. A 50 OHM OUTPUT IMPEDANCE SIGNAL GENERATOR CAPABLE OF COVERING THE DESIRED TRANSMIT AND RECEIVE FREQUENCIES AND HAVING AN OUTPUT ATTENUATOR.
2. A 50 OHM INPUT RECEIVER TUNED TO THE DESIRED TRANSMITTING FREQUENCY.
3. A 50 OHM INPUT RECEIVER TUNED TO THE DESIRED RECEIVING FREQUENCY. (THE SAME RECEIVER MAY BE RETUNED AND USED IN BOTH POSITIONS AS LONG AS A 50 OHM LOAD IS MAINTAINED AT ALL THREE POINTS.)
4. THREE 50 OHM PADS.

TUNING PROCEDURE:

1. THE BLOCK DIAGRAM SHOWS THE CONNECTIONS TO BE MADE TO THE DUPLEXER FOR NULLING ADJUSTMENTS. NOTE THAT THE RECEIVER TUNED TO THE TRANSMITTER FREQUENCY IS CONNECTED TO THE DUPLEXER RECEIVER CABLE, AND THE RECEIVER TUNED TO THE RECEIVER FREQUENCY IS CONNECTED TO THE DUPLEXER TRANSMITTER CABLE.
2. THE RECEIVERS ARE USED AS NULL (MINIMUM SIGNAL) INDICATORS. A 20 dB QUIETING MEASUREMENT SET-UP CAN BE USED FOR INDICATION. WITH SOME RECEIVERS THE LIMITER CURRENT CAN BE USED FOR INDICATION AS LONG AS LIMITER SATURATION IS AVOIDED.
3. UNLOCK THE TUNING SCREW SHAFT NUTS.
4. TUNE THE SIGNAL GENERATOR TO THE RECEIVER FREQUENCY. ADJUST THE THREE TUNING SCREWS OF THE TRANSMITTER CHANNEL, #3, #2, #1 FOR MINIMUM SIGNAL IN RECEIVER "A". LOCK THE TUNING SCREW SHAFT NUTS.
5. TUNE THE SIGNAL GENERATOR TO THE TRANSMITTER FREQUENCY. ADJUST THE ONE TUNING SCREW OF THE RECEIVER CHANNEL, #4, FOR MINIMUM SIGNAL IN RECEIVER "B". LOCK THE TUNING SCREW SHAFT NUT.
6. THE DUPLEXER IS NOW READY FOR OPERATION.

A HOLLOW SHAFT NUT DRIVER THRU WHICH A LONG SCREWDRIVER CAN BE INSERTED WILL MAKE ADJUSTMENTS AND LOCKING OF THE TUNING SCREWS EASIER.

WARNING- DO NOT TUNE THE DUPLEXER WITH THE TRANSMITTER KEYED INTO THE DUPLEXER.

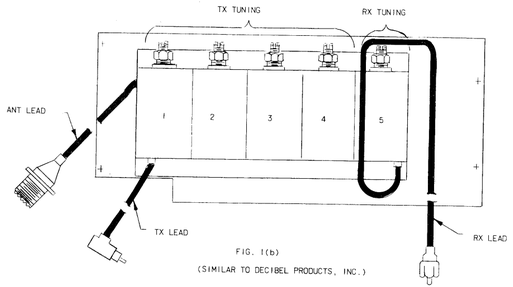
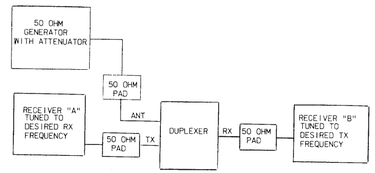


FIG. 1(b)

(SIMILAR TO DECIBEL PRODUCTS, INC.)



BLOCK DIAGRAM

(19C321056, Sh. 2, Rev. 3)

TUNING PROCEDURE FOR DUPLEXER NO. 19C321056P1-P2 (FIG. 1(b))

TUNING INSTRUCTIONS

THE DUPLEXER IS FACTORY TUNED TO THE EXACT OPERATING FREQUENCIES. NO FURTHER TUNING OR ADJUSTMENT IS REQUIRED. TUNING INSTRUCTIONS ARE FURNISHED ONLY FOR THE PURPOSE OF READJUSTMENT IN THE EVENT OF FREQUENCY CHANGES IN THE ASSOCIATED EQUIPMENT.

EQUIPMENT REQUIRED FOR THE TUNING PROCEDURE IS:

1. A 50 OHM OUTPUT IMPEDANCE SIGNAL GENERATOR CAPABLE OF COVERING THE DESIRED TRANSMIT AND RECEIVE FREQUENCIES AND HAVING AN OUTPUT ATTENUATOR.
2. A 50 OHM INPUT RECEIVER TUNED TO THE DESIRED TRANSMITTING FREQUENCY.
3. A 50 OHM INPUT RECEIVER TUNED TO THE DESIRED RECEIVING FREQUENCY. (THE SAME RECEIVER MAY BE RETUNED AND USED IN BOTH POSITIONS AS LONG AS A 50 OHM LOAD IS MAINTAINED AT ALL THREE POINTS.)
4. THREE 50 OHM PADS.

TUNING PROCEDURE

1. THE BLOCK DIAGRAM SHOWS THE CONNECTIONS TO BE MADE TO THE DUPLEXER FOR NULLING ADJUSTMENTS. NOTE THAT THE RECEIVER TUNED TO THE TRANSMITTER FREQUENCY IS CONNECTED TO THE DUPLEXER RECEIVER CABLE, AND THE RECEIVER TUNED TO THE RECEIVER FREQUENCY IS CONNECTED TO THE DUPLEXER TRANSMITTER CABLE.
2. THE RECEIVERS ARE USED AS NULL (MINIMUM SIGNAL) INDICATORS. A 20 dB QUIETING MEASUREMENT SET-UP CAN BE USED FOR INDICATION. WITH SOME RECEIVERS THE LIMITER CURRENT CAN BE USED FOR INDICATION AS LONG AS LIMITER SATURATION IS AVOIDED.
3. UNLOCK THE TUNING SCREW SHAFT NUTS.
4. TUNE THE SIGNAL GENERATOR TO THE TRANSMITTER FREQUENCY. ADJUST THE ONE TUNING SCREW, #5, FOR MINIMUM SIGNAL IN RECEIVER "B". LOCK THE TUNING SCREW SHAFT NUT.
5. ADJUST THE FOUR TUNING SCREWS, #1, #2, #3, #4, UNTIL THEY ARE FLUSH WITH THE LOCK SHAFT.
6. TUNE THE SIGNAL GENERATOR TO THE RECEIVER FREQUENCY. ADJUST THE FOUR TUNING SCREWS, #1, #2, #3, #4, FOR MINIMUM SIGNAL INTO RECEIVER "A". LOCK THE TUNING SCREWS SHAFT NUTS.
7. THE DUPLEXER IS NOW READY FOR OPERATION.

WARNING - DO NOT TUNE THE DUPLEXER WITH THE TRANSMITTER KEYED INTO THE DUPLEXER

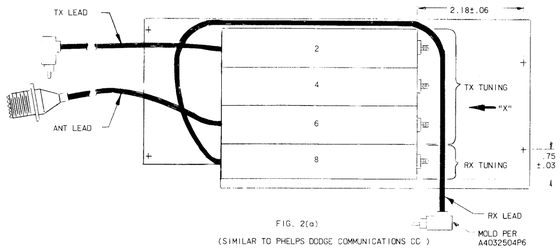
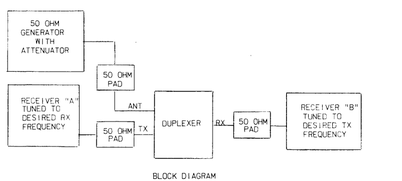
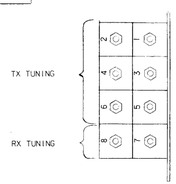


FIG. 2(a)

(SIMILAR TO PHELPS DODGE COMMUNICATIONS CO.)



BLOCK DIAGRAM



VIEW AT "X"

(19C321056, Sh. 4, Rev. 3)

TUNING PROCEDURE FOR DUPLEXER NO. 19C321056P4-P5 (FIG. 2(a))

TUNING INSTRUCTIONS

THE DUPLEXER IS FACTORY TUNED TO THE EXACT OPERATING FREQUENCIES. NO FURTHER TUNING OR ADJUSTMENT IS REQUIRED. TUNING INSTRUCTIONS ARE FURNISHED ONLY FOR THE PURPOSE OF READJUSTMENT IN THE EVENT OF FREQUENCY CHANGES IN THE ASSOCIATED EQUIPMENT.

EQUIPMENT REQUIRED FOR THE TUNING PROCEDURE IS:

1. A 50 OHM OUTPUT IMPEDANCE SIGNAL GENERATOR CAPABLE OF COVERING THE DESIRED TRANSMIT AND RECEIVE FREQUENCIES AND HAVING AN OUTPUT ATTENUATOR.
2. A 50 OHM INPUT RECEIVER TUNED TO THE DESIRED TRANSMITTING FREQUENCY.
3. A 50 OHM INPUT RECEIVER TUNED TO THE DESIRED RECEIVING FREQUENCY. (THE SAME RECEIVER MAY BE RETUNED AND USED IN BOTH POSITIONS AS LONG AS A 50 OHM LOAD IS MAINTAINED AT ALL THREE POINTS.)
4. THREE 50 OHM PADS.

TUNING PROCEDURE:

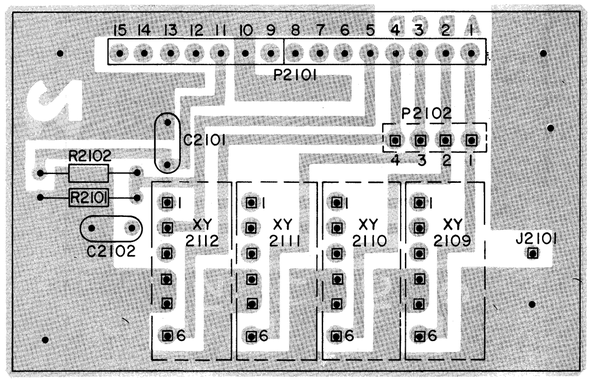
1. THE BLOCK DIAGRAM SHOWS THE CONNECTIONS TO BE MADE TO THE DUPLEXER FOR NULLING ADJUSTMENTS. NOTE THAT THE RECEIVER TUNED TO THE TRANSMITTER FREQUENCY IS CONNECTED TO THE DUPLEXER RECEIVER CABLE, AND THE RECEIVER TUNED TO THE RECEIVER FREQUENCY IS CONNECTED TO THE DUPLEXER TRANSMITTER CABLE.
2. THE RECEIVERS ARE USED AS NULL (MINIMUM SIGNAL) INDICATORS. A 20 dB QUIETING MEASUREMENT SET-UP CAN BE USED FOR INDICATION. WITH SOME RECEIVERS THE LIMITER CURRENT CAN BE USED FOR INDICATION AS LONG AS LIMITER SATURATION IS AVOIDED.
3. UNLOCK THE TUNING SCREW SHAFT NUTS.
4. TUNE THE SIGNAL GENERATOR TO THE RECEIVER FREQUENCY. ADJUST THE SIX TUNING SCREWS OF THE TRANSMITTER CHANNEL, #6, #5, #4, #3, #2, #1 FOR MINIMUM SIGNAL IN RECEIVER "A". LOCK THE TUNING SCREW SHAFT NUTS.
5. TUNE THE SIGNAL GENERATOR TO THE TRANSMITTER FREQUENCY. ADJUST THE TWO TUNING SCREWS OF THE RECEIVER CHANNEL, #7, #8 FOR MINIMUM SIGNAL IN RECEIVER "B". LOCK THE TUNING SCREW SHAFT NUT.
6. THE DUPLEXER IS NOW READY FOR OPERATION.

A HOLLOW SHAFT NUT DRIVER THRU WHICH A LONG SCREWDRIVER CAN BE INSERTED WILL MAKE ADJUSTMENTS AND LOCKING OF THE TUNING SCREWS EASIER.

WARNING- DO NOT TUNE THE DUPLEXER WITH THE TRANSMITTER KEYED INTO THE DUPLEXER.

DUPLEXER TUNING PROCEDURES

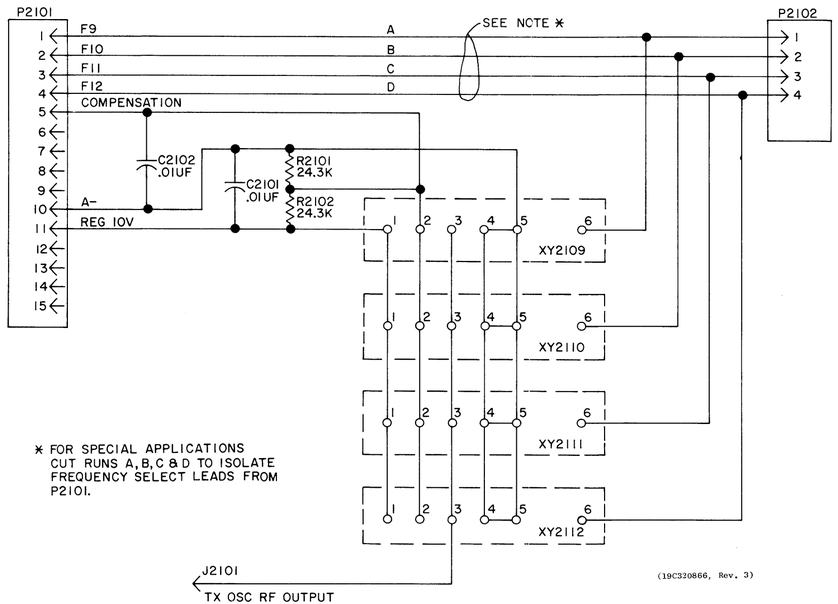
OUTLINE DIAGRAM



(19C321547, Rev. 0)
(19C320612, Sh. 2, Rev. 2)
(19C320612, Sh. 3, Rev. 2)

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

SCHEMATIC DIAGRAM



* FOR SPECIAL APPLICATIONS CUT RUNS A, B, C & D TO ISOLATE FREQUENCY SELECT LEADS FROM P2101.

(19C320866, Rev. 3)

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO. REV LETTER

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN IN THE PARTS LIST FOR THAT PART.

PARTS LIST

LBI-4838

TRANSMITTER MULTI-FREQUENCY BOARD
19C320613G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C2101 and C2102	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - -
J2101	19A116779P1	Contact, electrical: sim to Molex 08-54-0404.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P2101		Includes:
	19B219594P1	Contact, electrical: 7 pins.
	19B219594P2	Contact, electrical: 8 pins.
P2102	19A116779P1	Contact, electrical: sim to Molex 08-54-0404.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2101 and R2102	19C314256P22432	Metal film: 24,300 ohms ±1%, 1/4 w.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY2109 thru XY2112	19A116779P1	Contact, electrical: sim to Molex 08-54-0404.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SCHEMATIC & OUTLINE DIAGRAM

TRANSMITTER MULTI-FREQUENCY BOARD

PARTS LIST

LBI-4907

RECEIVER MULTI-FREQ/DUPLEX SYSTEM BOARD
19D417638G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C2301 and C2302	19A115680P10	Electrolytic: 200 µf +150% -10%, 18 VDCW; sim to Mallory Type TT.
C2303	5496267P28	Tantalum: 0.47 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C2304 and C2305	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C2306	5496267P5	Tantalum: 4.7 µf ±20%, 10 VDCW; sim to Sprague Type 150D.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR2301	19A115250P1	Silicon.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J2301	19A116779P1	Contact, electrical: sim to Molex 08-54-0404.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P2301	19B219594P1	Contact, electrical: 7 pins.
P2302 thru P2304	19A116779P1	Contact, electrical: sim to Molex 08-54-0404.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q2301	19A116375P1	Silicon, PNP.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2301	3B152P222K	Composition: 2200 ohms ±10%, 1/4 w.
R2302	3B152P133J	Composition: 13,000 ohms ±5%, 1/4 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - -
U2301	19D416564G2	Regulator, 10 volts.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY2309 thru XY2312	19A116779P1	Contact, electrical: sim to Molex 08-50-0404.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
		NOTE: When reordering specify ICOM Frequency.
		(150.8-174 MHz) Fx= Fo ÷ 11.2 / 9
Y2309 thru Y2312	19A130283G1	Compensated: 2 PPM.
	19A130283G3	Externally Compensated: ±5 PPM.
	19A130283G5	Compensated: 5 PPM.
		(450-512 MHz) Fx= Fo ÷ 11.2 / 27
Y2309 thru Y2312	19A130283G2	Compensated: 2 PPM.
	19A130283G4	Externally Compensated: ±5 PPM.
	19A130283G6	Compensated: 5 PPM.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19A129851P1	Support. (Used with Q2301).
	19A116023P1	Insulator, plate. (Used with Q2301).
	19A116022P1	Insulator, bushing. (Used with Q2301).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

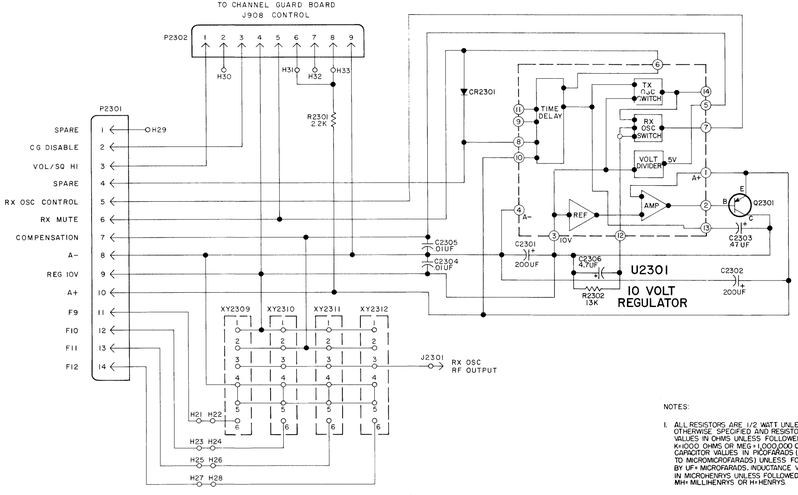
PRODUCTION CHANGES

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 - Incorporated into initial shipment.

SCHEMATIC DIAGRAM

RX MULTIFREQ/DX SYSTEM BOARD



(190417580, Rev. 3)

NOTES:

1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H= HENRYS.

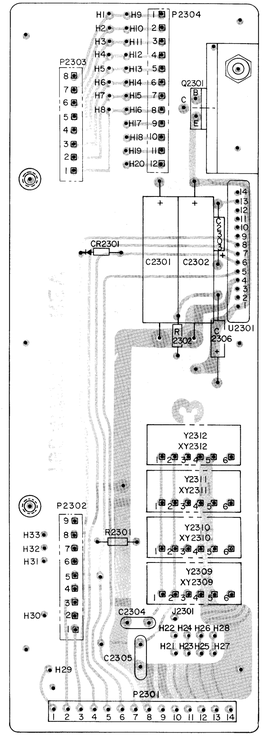
SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PLI9041763861	A

IN ORDER TO MAINTAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

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

OUTLINE DIAGRAM

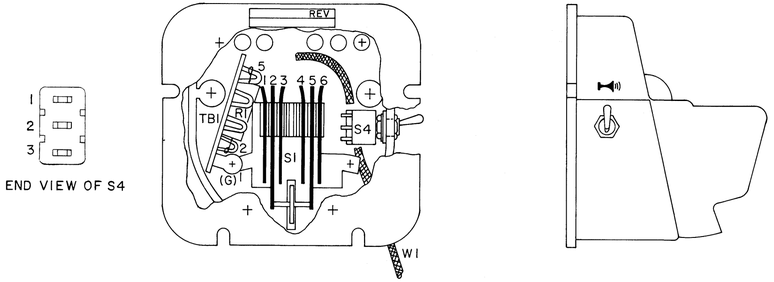


(190433204, Rev. 1)
(190417602, Sh. 2, Rev. 3)
(190417602, Sh. 3, Rev. 3)

SCHEMATIC & OUTLINE DIAGRAM

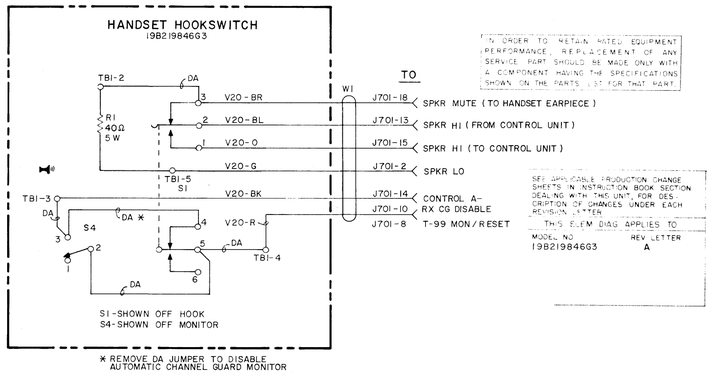
RECEIVER MULTI-FREQUENCY/
DUPLEX SYSTEM BOARD

OUTLINE DIAGRAM



(19B226585, Rev. 0)

SCHEMATIC DIAGRAM



IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
19B219846G3	A

(19B226471, Rev. 1)

SCHEMATIC & OUTLINE DIAGRAM

DUPLEX HANDSET AND HOOKSWITCH

PARTS LIST

LBI-4685

DUPLEX HANDSET HOOKSWITCH
19B219846G3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	5493035P11	Wirewound: 40 ohms ±5%, 5 w; sim to Hamilton Hall Type HR.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19B209203P1	Holder and switch: Thermoplastic case, contact rating 1 amp at 125 v; sim to Telephone Components Inc.
S4	19A116877P1	Toggle: SPDT, 1 ma at 6 VDC; sim to C and K Components 7101G. (CHANNEL GUARD DISABLE).
		- - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB1	7775500P203	Phen: 4 insulated, 1 grounded terminal.
		- - - - - - - - - - CABLES - - - - - - - - - -
W1	19B219841G1	6 conductor, 5 feet long.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	N190AP1312C	Tap screw, phillips posidriv: No. 6 x 3/4. (Secures housing to base plate).
	N101P1510P	Tap screw, phillips: No. 8 x 5/8. (Used for mounting base plate).
	19B219852P1	Base plate.
	19A129586P1	Bumper, rubber. (2)
	NP276142B	Decal (MONITOR-Located over S4).

*COMPONENTS ADDED, DELETED OR CHANGED 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 - Incorporated into initial shipment.

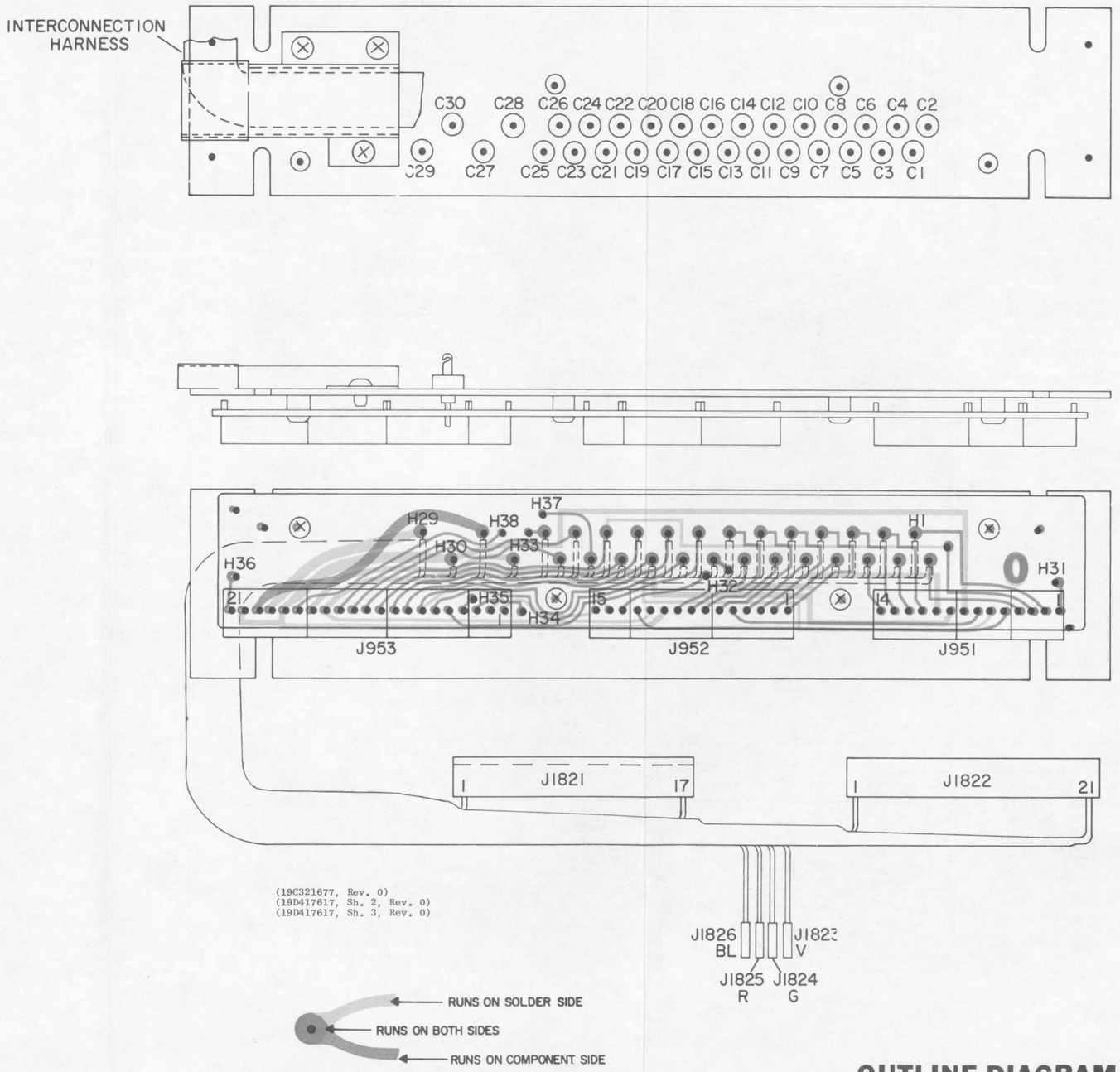
PARTS LIST

LBI-4908

DUPLEX HARNESS BOARD AND PANEL
19B226255G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J951		Includes:
	19A116659P6	Connector: 6 contact: sim to Molex 09-52-3061.
	19A116659P7	Connector: 4 contact: sim to Molex 09-52-3041.
J952 and J953		Includes:
	19A116659P5	Connector: 3 contact: sim to Molex 09-52-3031.
	19A116659P6	Connector: 6 contact: sim to Molex 09-52-3061.
		PLATE ASSEMBLY 19B226031G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 thru C30	5493392P7	Ceramic, feed-thru: 1000 pf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.
		HARNESS ASSEMBLY 19B226113G1
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J1821		Includes:
	19A1299854P1	Shell.
	19A116781P5	Contact, electrical: wire range No. 16-20 AWG; sim to Molex 08-50-0106. (J1821 terminal 1).
	19A116781P6	Contact, electrical: wire range No. 22-26 AWG; sim to Molex 08-50-0108. (J1821 terminals 8-11, 14-17).
J1822		Includes:
	19A116659P25	Shell.
	19A116781P5	Contact, electrical: wire range No. 16-20 AWG; sim to Molex 08-50-0103. (J1822 terminals 15, 17-19).
	19A116781P6	Contact, electrical: wire range No. 22-26 AWG; sim to Molex 08-50-0108. (J1822 terminals 1-13, 16, 21).
J1823 thru J1826	19A127042P1	Terminal, solderless: sim to Malco 12093-12.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A130177P1	Cable clip.
	19B201074P304	Tap screw, Phillips POZIDRIV®: No. 6-32 x 1/4.

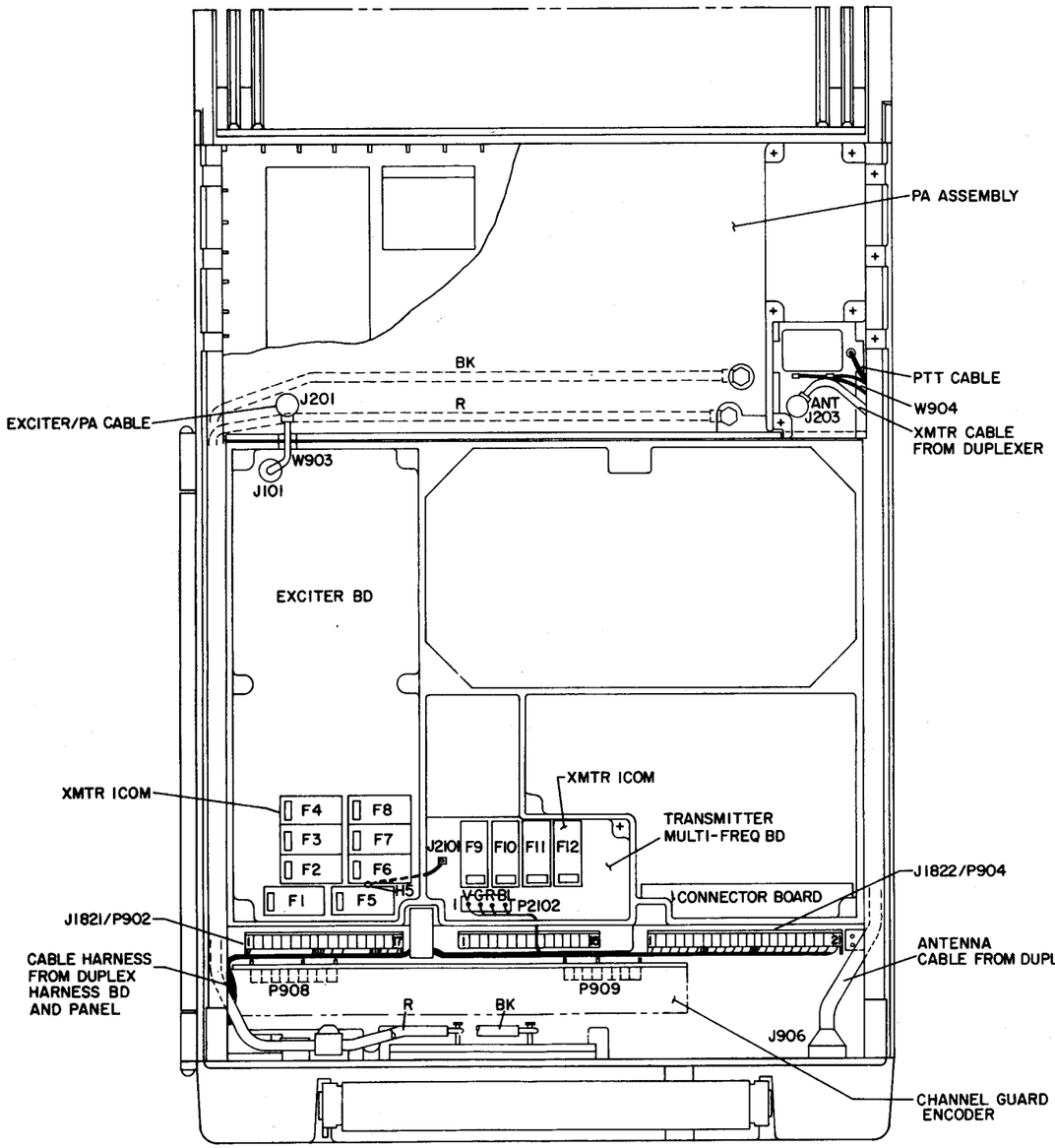
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



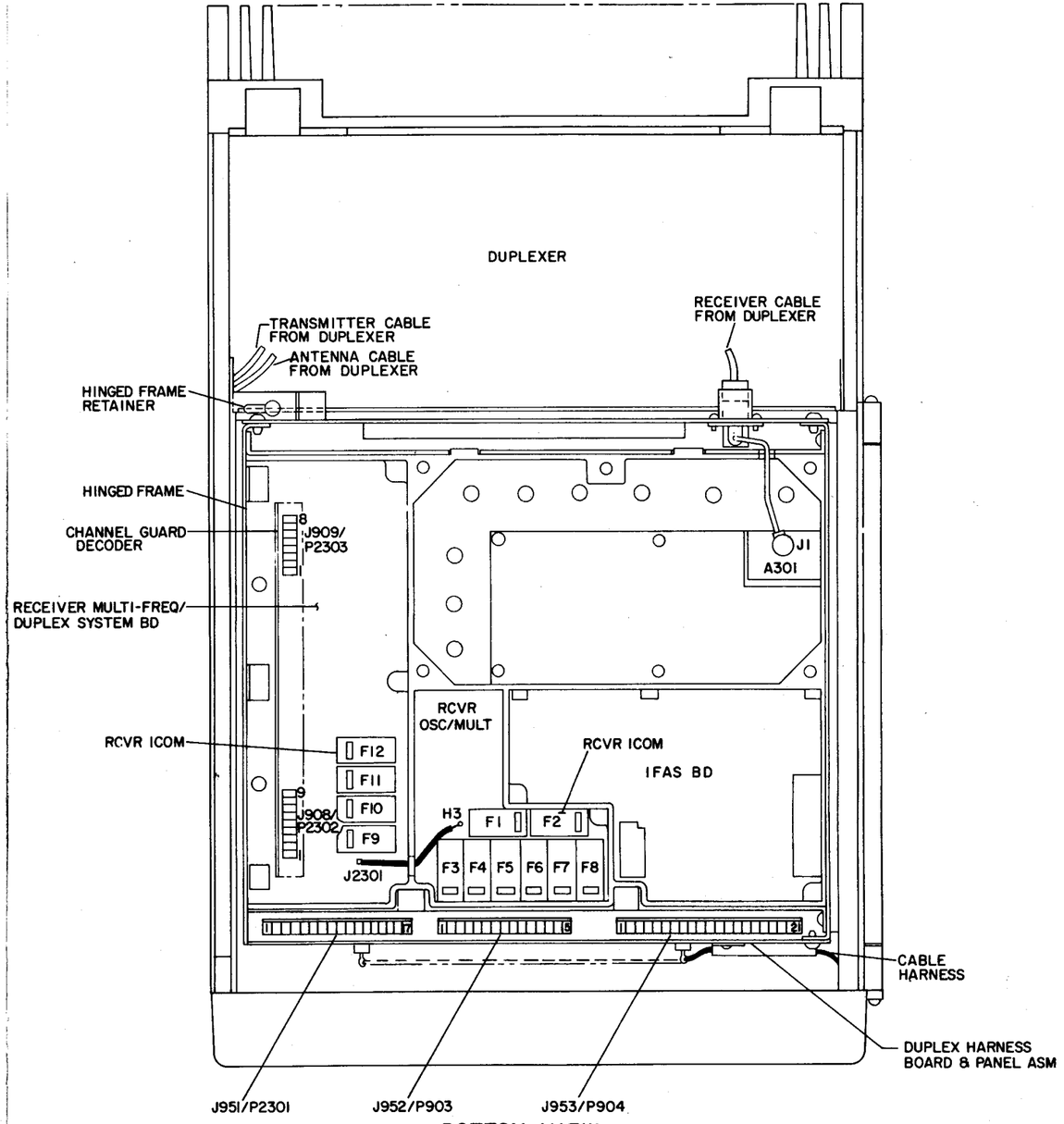
OUTLINE DIAGRAM

DUPLEX HARNESS BOARD AND PANEL ASSEMBLY

Issue 1



TOP VIEW
(TOP SECTION)



BOTTOM VIEW
(HINGED ASSEMBLY)

RC-2746

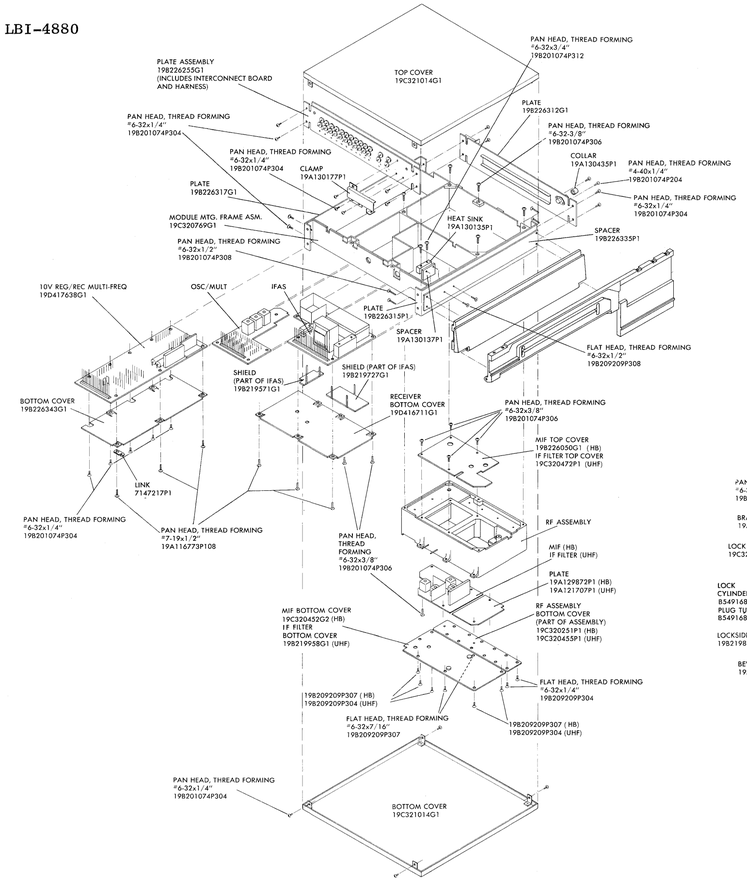
DUPLEXER CABLE HARNESS ROUTING

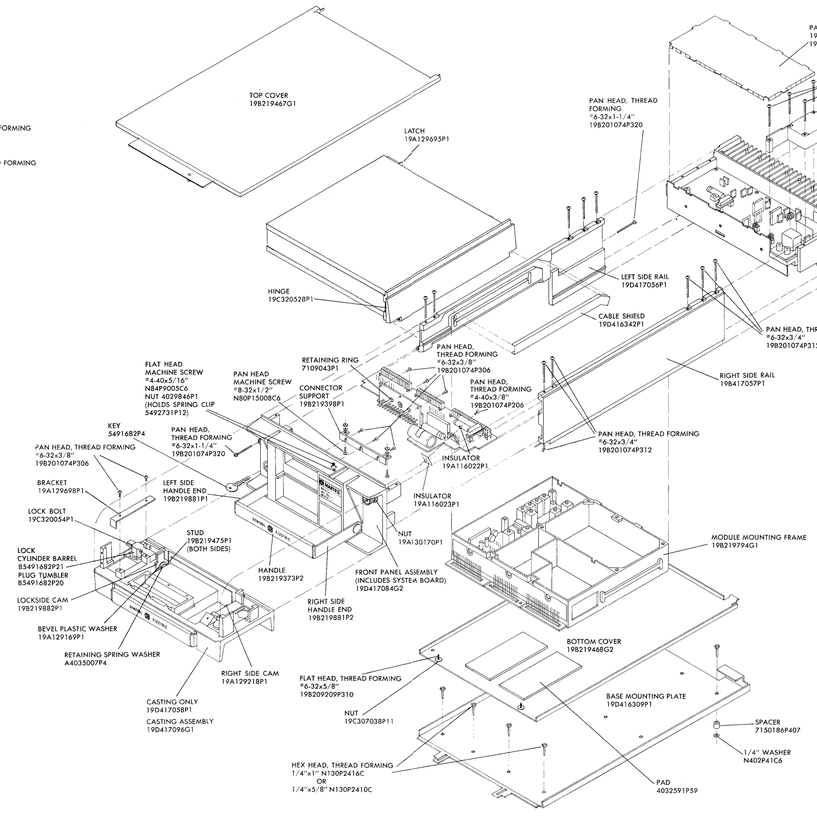
NOTES:
1. ALL UNMARKED WIRES SF24.
2. CONNECT H37 TO H38 & H100 TO H101 WITH DA JUMPERS FOR PUBLIC ADDRESS OPTION.
▲ REMOVE FOR ENCODE CHANNEL GUARD.
DA = #22 AWG WIRE SIZE.

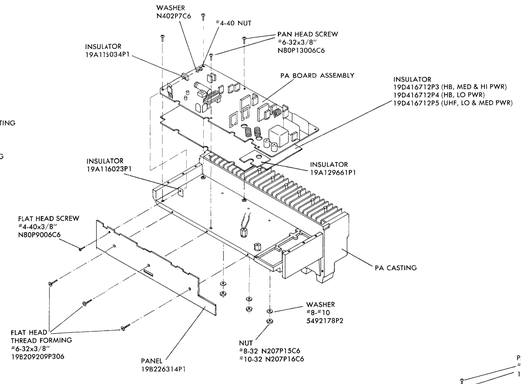
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

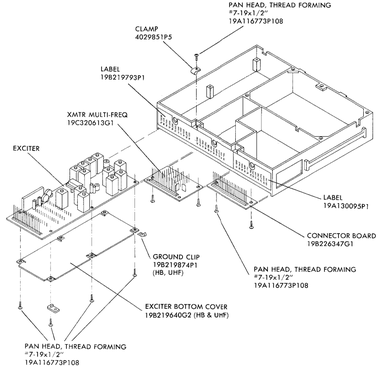
	REV LETTER
"E" MODEL DUPLEX FRONT PANEL 19D417084G2	
SYSTEM BOARD 19D416602G1	D
DUPLEX HARNESS BOARD & PANEL 19B226255G1	

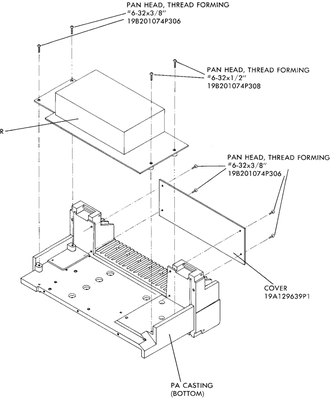
DUPLEXER INTERCONNECTION DIAGRAM











DUPLEX MECHANICAL PARTS BREAKDOWN

ORDERING SERVICE PARTS

Each component appearing on the schematic diagram is identified by a symbol number, to simplify locating it in the parts list. Each component is listed by symbol number followed by description and GE Part Number.

Service parts may be obtained from Authorized GE Communication Equipment Service Stations or through any GE Radio Communication Equipment Sales Office. When ordering a part, be sure to give:

1. GE Part Number for component
2. Description of part
3. Model Number of equipment
4. Revision letter stamped on unit

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired, or should particular problems arise which are not covered sufficiently for the purchaser's purposes, contact the nearest Radio Communication Equipment Sales Office of the General Electric Company.

MAINTENANCE MANUAL

LBI-4880

DF-9031

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY ● LYNCHBURG, VIRGINIA 24502

GENERAL ELECTRIC

PRINTED IN U.S.A.

ECP-736