DESCRIPTION AND MAINTENANCE

MASTR® II DC REMOTE/REPEATER STATION CONTROL SHELF

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ILLUSTRATIONS

DESCRIPTION

The General Electric MASTR® II DC Remote/Repeat Station Control Shelf is located in the 7-rack unit radio panel and is accessed by opening the receiver/exciter door.

A mother board is utilized on the shelf to interconnect the plug-in function boards. This mother board includes the function board jacks, the station interconnect jacks and the printed wiring runs between these jacks. External audio and control connections are made to terminal board TB1201 located on the rear of the mother board.

A 19D417385G1 Repeater Control Board is used in repeater control without Channel Guard. A 19D417385G2 Repeater Control Board is used in repeater applications with Channel Guard. A 19A129924G2 Audio Board is used in remote/repeat applications. A 19D417382G4 DC Remote Control Board is required for remote repeater disable.

DC REMOTE/REPEAT CONTROL CURRENT AND FUNCTION

FUNCTION	CONTROL CURRENT IN MILLIAMPS				
	-11	-6	-2.5	0	+6
Repeater Disable		Repeat Disable		Receive	Transmit
Repeater Disable & Channel Guard	Repeat Disable & CG Disable	Repeat Disable	Chan.Gd. Disable	Receive With CG	Transmit

TELEPHONE LINE CHARACTERISTICS

As a result of propagation conditions, ambient noise levels, space limitations or other conditions, the most advantageous location for the dispatcher may not be the best location to originate or receive transmissions. The Remote Control permits the dispatcher to transmit, receive, select transmitter and receive frequencies, etc., over telephone lines. Control currents applied to the telephone lines from the controller are normally translated into the desired operation at the base station by the remote control panel.

The key link in a remote control installation is the telephone pair between the Controller and the base station. To obtain the most satisfactory service over this link, some general knowledge of the capabilities of such lines is required.

A telephone pair is simply a pair of wires, normally ranging from AWG #19 to AWG #26 in size. These wires, furnished by the local telephone company, pass through overhead cables, underground cables, through junction points, and switchboards. To the user, however, they may be considered a simple pair of wires. Equipment that is designed to operate with such a pair should have nominal impedance of 600 ohms. A telephone pair will normally have a maximum length of about 12 miles before amplification is added by the telephone company to make up for line losses. There is an inherent loss in any telephone line installation due to the series inductance and resistance and the shunt capacitance of the wires. This loss is a direct function of the length of the line, and varies with the wire size used. As an example, with AWG #19 wire, a distance of six miles may be covered before one-half the input voltage of a 1,000 Hz tone is lost. With AWG #26 wire, only two and one-quarter miles may be covered before one-half the input voltage is lost. Line losses as high as 30 dB can be tolerated in operating a transmitter from the Remote but such high losses should be avoided whenever possible. Although the telephone pair is fairly well balanced, some noise will be induced into the line, especially if an unshielded run has to be made in a fluorescent-lighted building.

The DC resistance of any telephone pair will affect the control circuits between the Controller and the base station. Current regulators incorporated in the Remote Control minimize these variations after initial adjustment. The Remote operates with a total control line loop resistance as great as 11,000 ohms. There is a possibility, however, that stray currents, due to leakage, noise, faults, earth currents, etc., may cause faulty operation.

Three types of telephone line connections are commonly used. Before choosing one of these types, consider the cost and performance of each, as one type may be available at a much lower rate. Also, some telephone companies offer no choice. The following chart contains information to assist in selecting the control method and type of telephone line to be used in DC control applications.

METHOD	DESCRIPTION	ADVANTAGES OR DISADVANTAGES
1	One metallic pair: for both audio and control voltages with control voltage from line to line.	Economical; dependable where earth currents may be large; slight keying clicks will be heard in paralleled Remote Control Units. In most applications, preferred over Method No. 2.
2	One metallic pair: for both audio and control voltages with control voltages from line to ground.	Economical; earth ground currents may result in interference with control functions; keying clicks minimized. Good earth to ground required at station and all control points.
3	Two telephone pairs; one for audio voltage and one for control voltage (metallic pair).	Provides best performance; keying clicks will not be heard. Requires 2 pair.

<u>Telephone Line Connections (Refer to Figure 1)</u>

METHOD 1 - Single Telephone Pair (control voltage simplexed line to line).

a. Connect telephone pair to TB1201-10 and TB1201-11.
b. Connect jumper between TB1201-13 and TB1201-14.
c. Connect jumper between TB1201-12 and TB1201-15.

METHOD 2 - Single Telephone Pair (control voltage simplexed line to ground).

a. Connect telephone pair to TB1201-10 and TB1201-11.
b. Connect jumper between TB1201-12 and TB1201-13.
c. Connect jumper between TB1201-13 and TB1201-14.
d. Connect TB1201-15 to a good earth ground.

METHOD 3 - Separate Control and Audio Pairs.

a. Connect audio pair to TB1201-10 and TB1201-11.
b. Connect control pair to TB1201-14 and TB1201-15.
c. Connect jumper between TB1201-12 and TB1201-13.

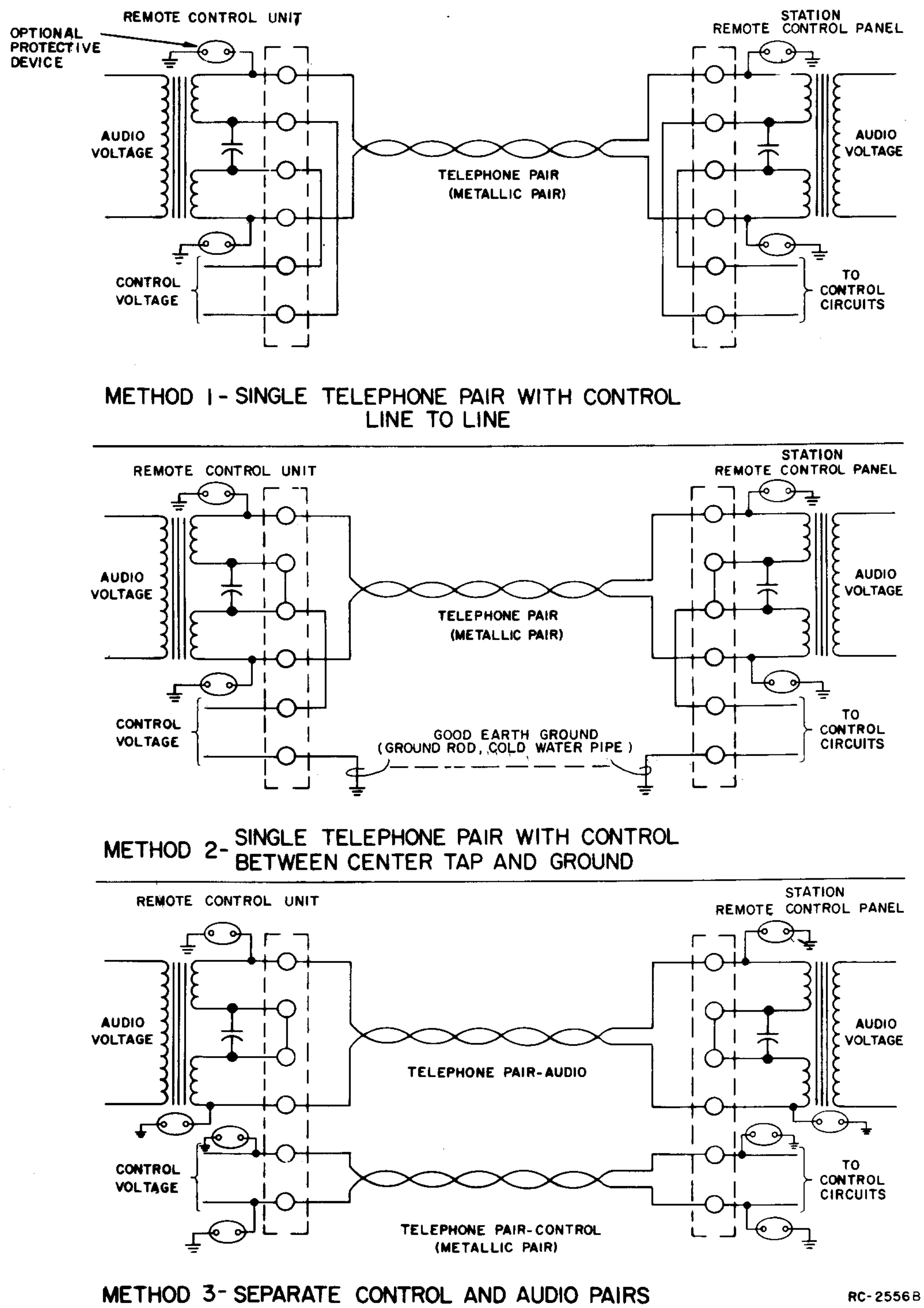


Figure 1 - Telephone Line Connections

Proper Grounding Practices (Method 2)

The telephone company specifies that their customer's equipment signal ground should be made using the proper connection to a ground electrode such as a metallic cold water pipe. The ground connection should be made with a single No. 14 AWG or larger copper conductor. The conductor should be short, straight and a continuous piece of wire. Attention should be given to providing the lowest possible resistance at the connection at each end of the ground wire.

When option line surge protection devices are provided in the customer equipment, it is imperative that the good earth ground be used. If the telephone company also provides protective devices, the customer provided device earth ground connecttions should be located close to the telephone company earth ground connections but should not use the same ground clamp that the telephone company uses.

If a good earth ground as described above cannot be obtained, Method 2 should not be used. Also, the addition of surge protective devices are of little value without the proper earth ground.

E & M Signaling

E & M lead signaling systems derive their name from certain historical designations of the signaling leads on circuit drawings. An "M" lead is associated with the transMit function while the "E" lead is associated with the recEive function. In two-way radio systems with remote control, E & M Signaling may be the only type of supervision offered by the available carrier circuits.

General both 4-Wire Audio and E & M Signaling options are used to interface between the radio and carrier systems. However, 2-Wire Audio may be used in the two-way radio portion of the control system if hybrids are installed to provide transition between the 2-wire and 4-wire connections. Usually the E & M Signaling is separated from the audio (separate line) in both 2-wire and 4-wire installations.

Figure 2 illustrates a typical interface between a two-way radio system and a multiplex/microwave system. The Remote Control Console and Base Station are equipped with the E & M Signaling Option and 4-Wire Audio Option. The console provides a regulated -48 VDC output (or -24 VDC with minor modifications) to the "M" lead when the TRANSMIT switch is pressed. This -48 volts activates a tone encoder (usually 3825 Hertz) in the multiplex rack. The tone encoder modulates the carrier frequency which is transmitted over the microwave link.

At the station end of the microwave link, the signal is demodulated and the 3825 Hertz tone operates a tone decoder in the mutiplex rack. The output of the decoder results in a contact closure to provide transmitter keying in the Remote Control Base Station.

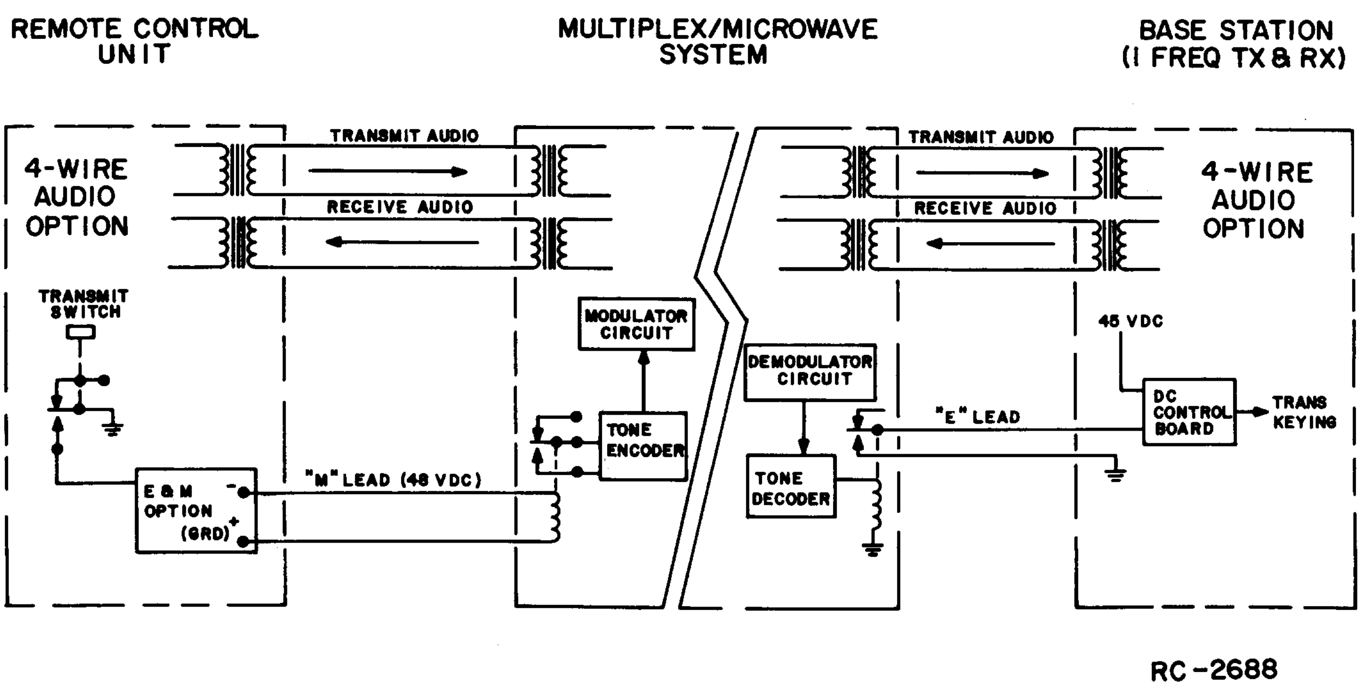


Figure 2 - Typical Application of E & M Signaling

ADJUSTMENT PROCEDURE

Before making adjustments on the Base Station Control Shelf, make sure that all power line, phone line and ground connections have been completed at the remote control console and at the Base Station. Also, the remote control console and Base Station should have been properly aligned.

A. TEST EQUIPMENT REQUIRED

1. Audio Oscillator. Hewlett Packard Model 401C or equivalent.
2. VOM. Simpson Model 260 or equivalent.
3. AC VTVM. Heathkit Model IM-38 or equivalent.

B. LINE INPUT

1. Feed a 1000 Hz tone at the required level into the microphone jack on the remote control console having the largest line loss. Adjust the remote control console line output control for 2.7 Volts RMS as measured across the audio pair at the remote control console.
2. Key the Base Station Transmitter from the remote control console.* Adjust LINE INPUT control R39 on the Remote Audio Board for threshold of compression as indicated by a drop of 1 dB on an AC VTVM connected between the emitter of Q19 and ground.

D. LINE OUTPUT

1. Connect a signal generator to the Base Station Receiver, adjusted to the receiver frequency and modulated at 3 kHz deviation by a 1000 Hz signal. Disable Channel Guard if present.
2. Adjust the LINE OUT control R14 on the Remote Audio Board for a reading of 2.7 Volts RMS as measured at the Base Station Audio pair.

E. REPEATER TIMER ADJUSTMENTS

In stations equipped with Channel Guard, the CG Decoder Board should be removed to make the following adjustments. In Remote/Repeat combinations, operating the CG DISABLE switch <u>does not</u> disable the repeater function <u>but only</u> allows monitoring the receiver on noise squelch operation.

DROP OUT DELAY TIMER ADJUST

1. Using the station SQUELCH control, unsquelch and squelch the receiver. Note the time required for the transmitter to unkey.
2. If an adjustment is necessary, turn the DROP OUT DELAY TIMER control R14 clockwise to increase the delay time or counterclockwise to decrease the delay time.

3-MINUTE LIMIT TIMER ADJUST

1. Unsquelch the receiver with the station SQUELCH control and note the time for the transmitter to unkey.
2. If an adjustment is necessary, turn the LIMIT TIMER control R8 clockwise to increase the timing cycle or counterclockwise to decrease the timing cycle.

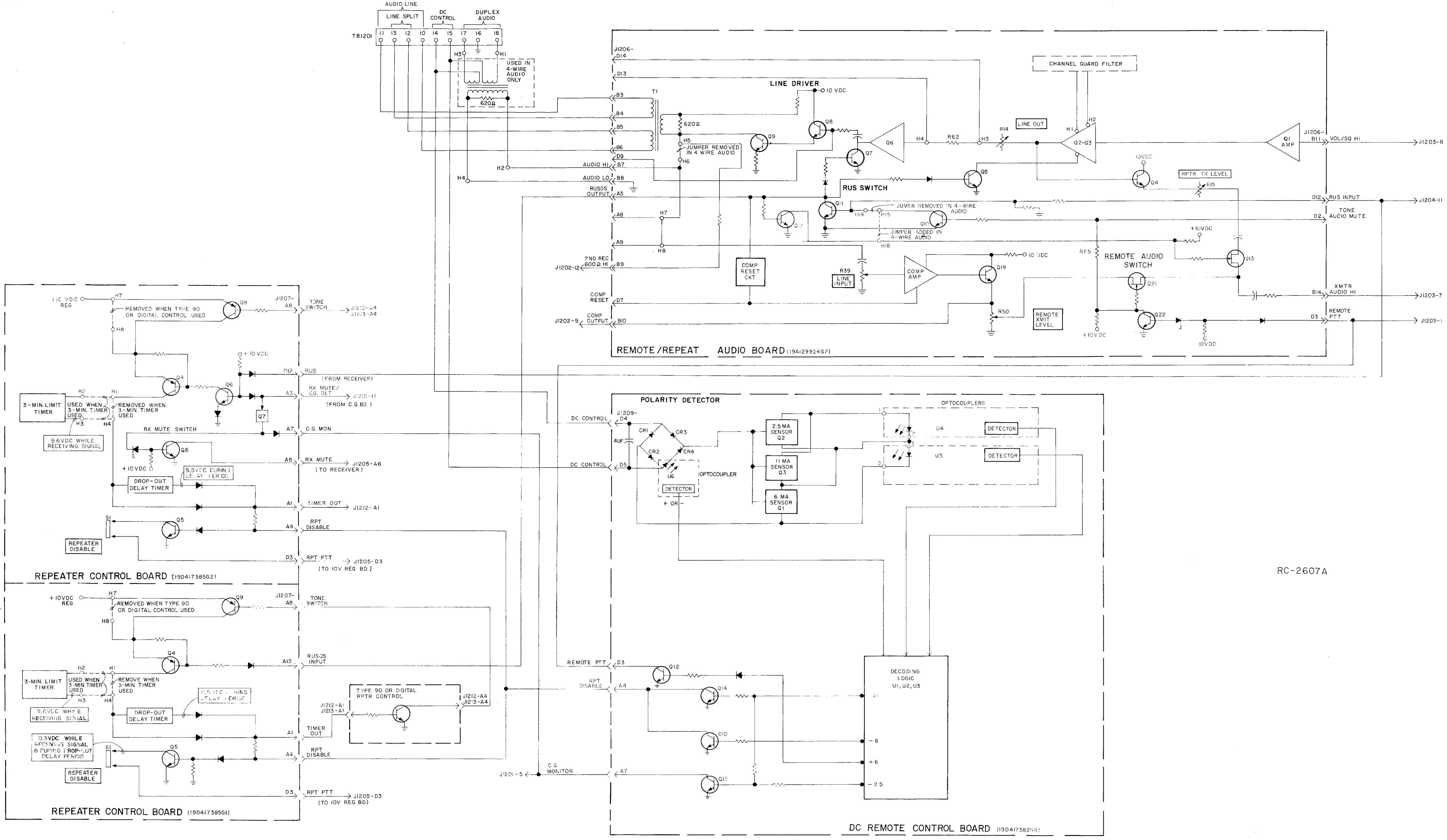
MAINTENANCE

The DC Remote/Repeater Control Shelf is designed for ease of servicing and minimum maintenance. All circuit modules can be easily removed for routine inspection. An Extender Board (19D417458G1, Option 9544) is recommended for servicing any of the modules out of the shelf while maintaining circuit connections. Refer to the Troubleshooting Procedure (see Table of Contents) when maintenance becomes necessary.

* The station adjustments may also be made by connecting the audio generator across the audio pair at the station and keying the transmitter by holding the REMOTE PTT switch on the 10-Volt Regulator/Control Module in the REMOTE PTT position.

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

GENERAL ELECTRIC



DC REMOTE CONTROL VOLTAGE READINGS

19D417382G4

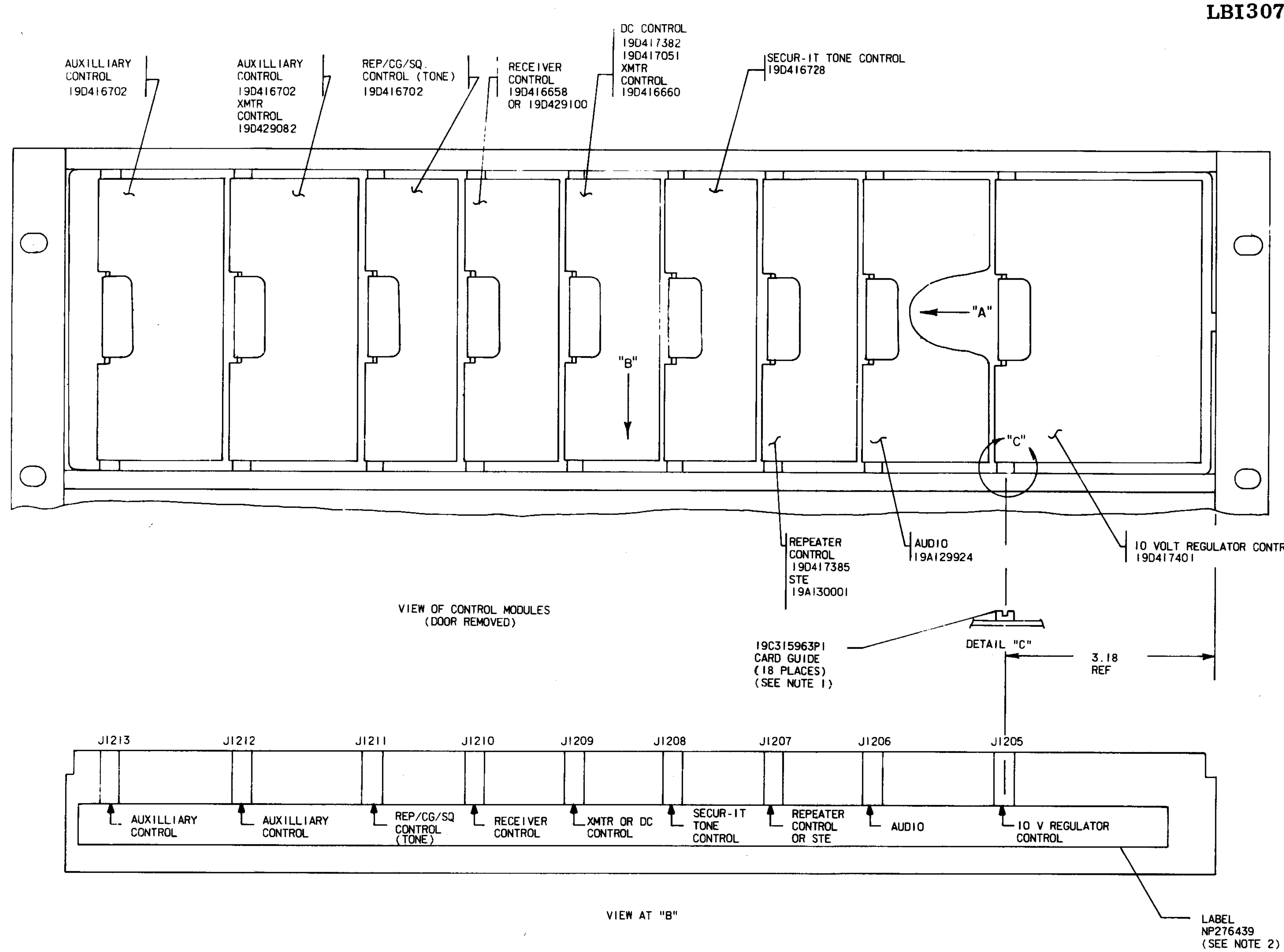
FUNCTION	-11 MA	-6 MA	-2.5 MA	0 MA	+6 MA	+11 MA
1T-1R CG MON			CG MON	R1	T1	
LOCAL REMOTE CG MON			CG MON	R1	T1	
REMOTE REPEATER REPEATER DISABLE		REPEATER DISABLE		R1	T1	
REMOTE REPEATER REPEATER DISABLE CG MON	REP DISABLE CG MON	REP DISABLE	CG MON	R1	T1	
TEST POINT TPA	0	1	1	0	1	
TPB	1	1	0	0	1	
TPC	0	0	0	0	1	
TP7 (-6 MA)	0	1	0	0	1	
TP6 (+6 MA)	0	0	0	0	1.9V	
TP3 (-11 MA)	1	0	0	0	0	
TP5 (-2.5 MA)	1	0	1	0	0	
PIN NUMBER A4 (REP DISABLE)	0	0	9V	9V	9V	
A7 (CG MON)	0	9V	0	9V	9V	
D3 (REMOTE PTT)	9V	9V	9V	9V	0	

0 = 0.4 V or less
1 = 2.5 V or more

V = acutal voltage reading

All readings should be taken with a high-impedance measuring instrument, such as DC-VTVM, EVM or 'scope.

Figure 3 - DC Remote/Repeat System and Troubleshooting



NOTES:
1. PART OF MOTHER BD. HDW. KIT PL19A130031G3
2. ALIGN ARROW WITH CENTER OF FIRST GUIDE WITHIN .06.

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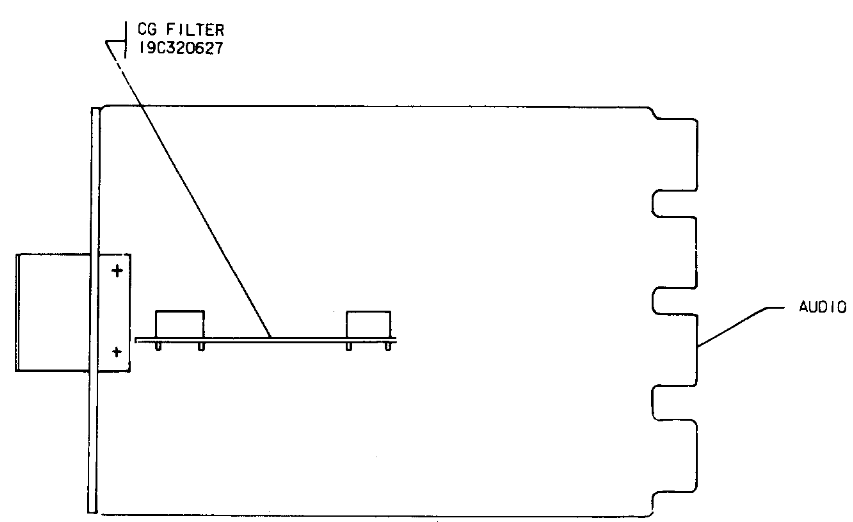
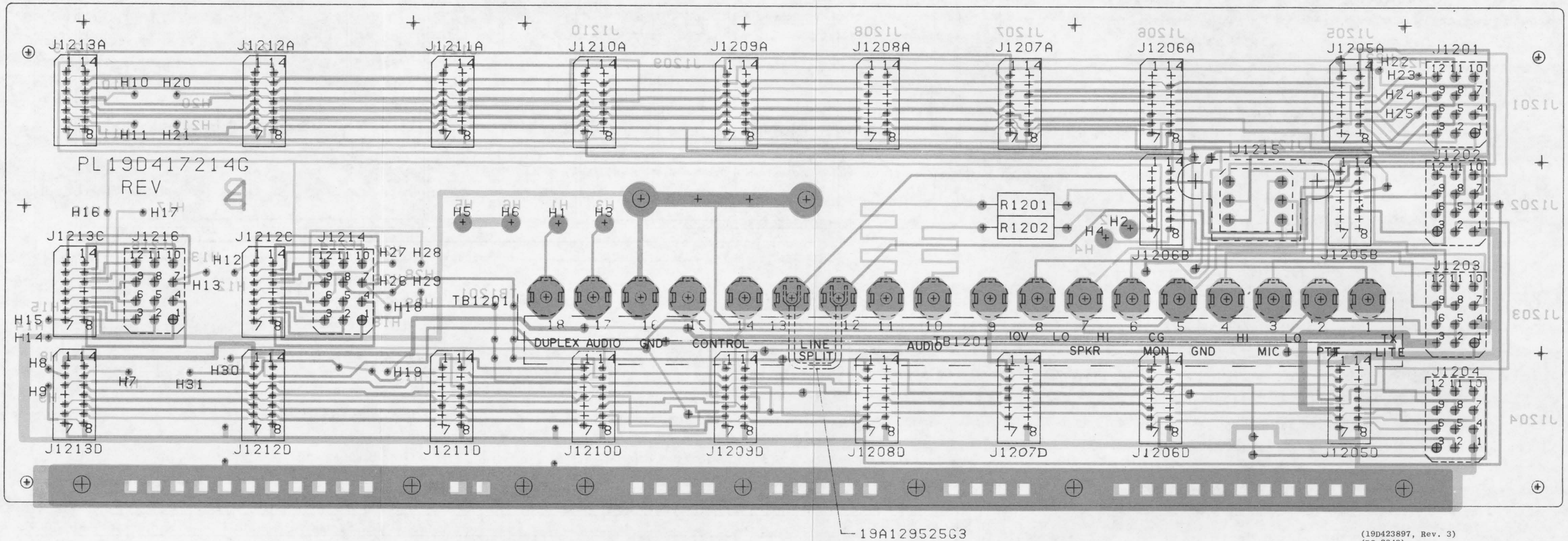


VIEW AT "A"

OUTLINE DIAGRAM

CONTROL SHELF



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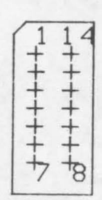
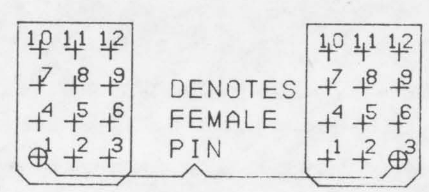
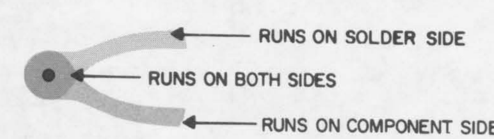


TYP. MOUNTING
FOR J1205-J1213



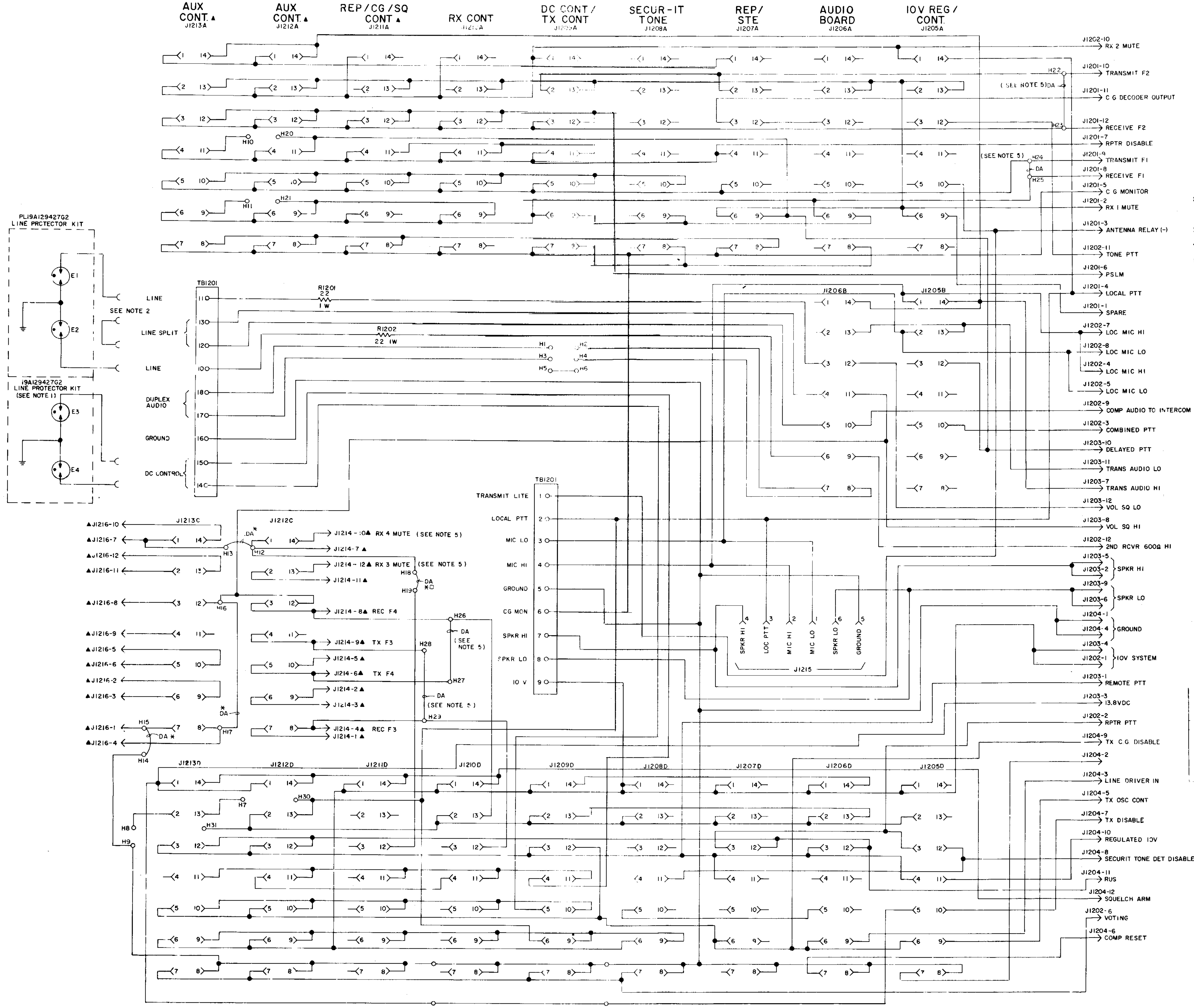
TYP. MOUNTING
FOR J1201, J1203,
J1214, J1216
FARSIDE VIEW

TYP. MOUNTING
FOR J1202&1204
FARSIDE VIEW



OUTLINE DIAGRAM

CONTROL SHELF MOTHER BOARD
19D417214



▲PRESENT IN GROUP 1 ONLY

NOTES:

1. THE TELEPHONE LINE PROTECTORS CONNECTED TO TB1201-15 AND 14 ARE NEEDED ONLY WHEN SEPARATE AUDIO AND CONTROL PAIRS ARE USED.
2. JUMPER PRESENT IN ALL TONE REMOTE SYSTEMS AND IN DC CONTROL SYSTEMS USING SEPARATE AUDIO AND CONTROL PAIRS.
3. ◻ JUMPERS PRESENT FOR LOCAL EACOM.
4. ✕ JUMPERS PRESENT FOR REGIONAL EACOM
5. JUMPERS PRESENT FOR 4 FREQ. TONE REMOTE, 4 FREQ. TONE REMOTE/REPEAT, 4 FREQ. TX WITH 4 RECEIVERS RX 3 & 4 MUTE USED WITH 4 TX WITH 4 RECEIVERS.

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
19D417214G1	C
19D417214G2	C

SCHEMATIC DIAGRAM

CONTROL SHELF MOTHER BOARD
19D417214G1 & G2

(19E501157, Rev. 11)

PARTS LIST

LBI-4811A

CONTROL SHELF MOTHER BOARD
19D417214G1, G2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1201	19A116647P4	Connector, printed wiring: 12 terminals, sim to Molex 09-18-5121.
J1202	19A116647P6	Connector, printed wiring: 12 terminals, sim to Molex 09-18-5927.
J1203	19A116647P4	Connector, printed wiring: 12 terminals, sim to Molex 09-18-5121.
J1204	19A116647P6	Connector, printed wiring: 12 terminals, sim to Molex 09-18-5927.
J1205A	19A116446P5	Connector, printed wiring: 14 contacts.
J1205B	19A116446P5	Connector, printed wiring: 14 contacts.
J1205D	19A116446P5	Connector, printed wiring: 14 contacts.
J1206A	19A116446P5	Connector, printed wiring: 14 contacts.
J1206B	19A116446P5	Connector, printed wiring: 14 contacts.
J1206D	19A116446P5	Connector, printed wiring: 14 contacts.
J1207A	19A116446P5	Connector, printed wiring: 14 contacts.
J1207D	19A116446P5	Connector, printed wiring: 14 contacts.
J1208A	19A116446P5	Connector, printed wiring: 14 contacts.
J1208D	19A116446P5	Connector, printed wiring: 14 contacts.
J1209A	19A116446P5	Connector, printed wiring: 14 contacts.
J1209D	19A116446P5	Connector, printed wiring: 14 contacts.
J1210A	19A116446P5	Connector, printed wiring: 14 contacts.
J1210D	19A116446P5	Connector, printed wiring: 14 contacts.
J1211A	19A116446P5	Connector, printed wiring: 14 contacts.
J1211D	19A116446P5	Connector, printed wiring: 14 contacts.
J1212A	19A116446P5	Connector, printed wiring: 14 contacts.
J1212C	19A116446P5	Connector, printed wiring: 14 contacts.
J1212D	19A116446P5	Connector, printed wiring: 14 contacts.
J1213A	19A116446P5	Connector, printed wiring: 14 contacts.
J1213C	19A116446P5	Connector, printed wiring: 14 contacts.
J1213D	19A116446P5	Connector, printed wiring: 14 contacts.
J1214	19A116647P4	Connector, printed wiring: 12 terminals, sim to Molex 09-18-5121.
J1215	19B219627G1	Connector: 6 contacts.
J1216	19A116647P4	Connector, printed wiring: 12 terminals, sim to Molex 09-18-5121.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1201* and R1202*	3R78P220J	Composition: 22 ohms ±5%, 1 w. Added by REV A.
		- - - - - - - TERMINAL BOARDS - - - - - - - -
TB1201	19A116667P3	Plate nut. (Quantity 18).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19A129525G3	Cable: approx 3 inches long.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

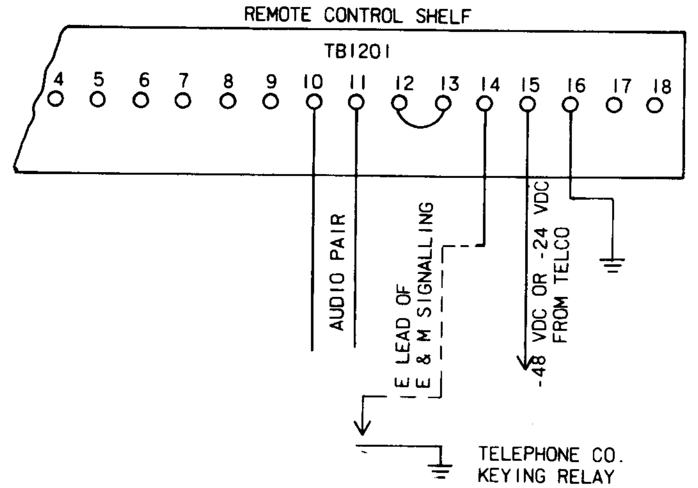
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To provide line surge protection and change polarity of DC control leads. Added R1201 and R1202. Reversed connections to J1209-4 and J1209-5.

REV. B - Changed printed board to provide outputs for EACOM Systems.

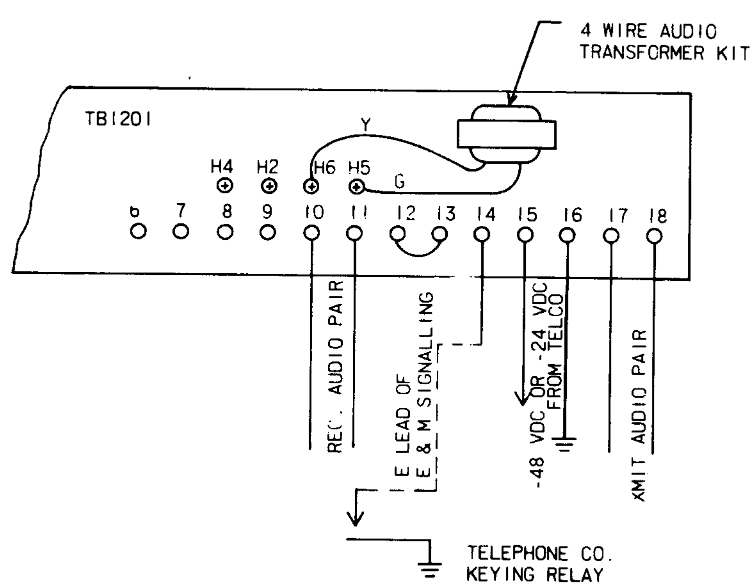
REV. C - Changed board for use in 4-frequency remote systems.

"E" LEAD KEYING – 2- WIRE AUDIO SYSTEM



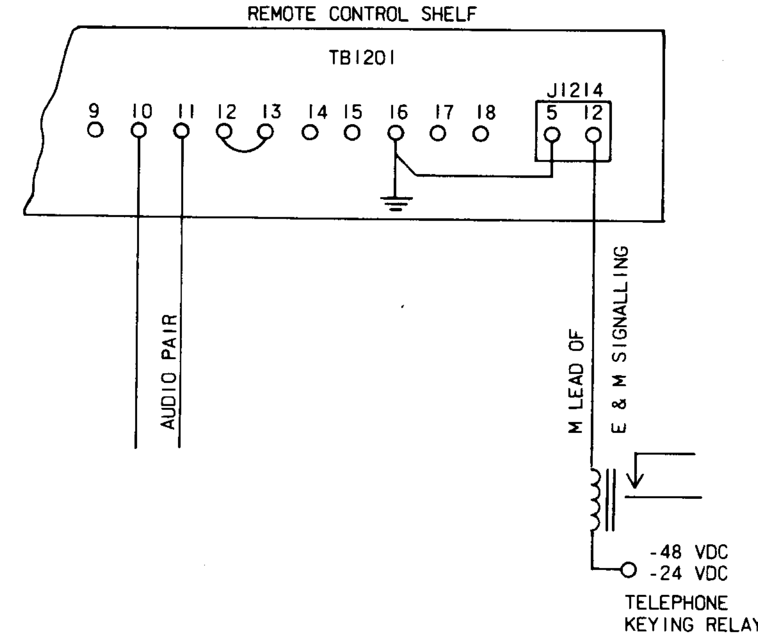
NOTES:
1. FOR -48 VDC SIGNALLING, REMOVE D.A. WIRE FROM H5-H6 AND H7-H8 ON D.C. REMOTE CONTROL BOARD 19D417051G2.
2. MAX. LOOP RESISTANCE ON E LEAD IS 2000 OHMS FOR -24 VOLTS AND 4000 OHMS FOR -48 VOLTS OPERATION.

"E" LEAD KEYING – 4- WIRE AUDIO SYSTEM

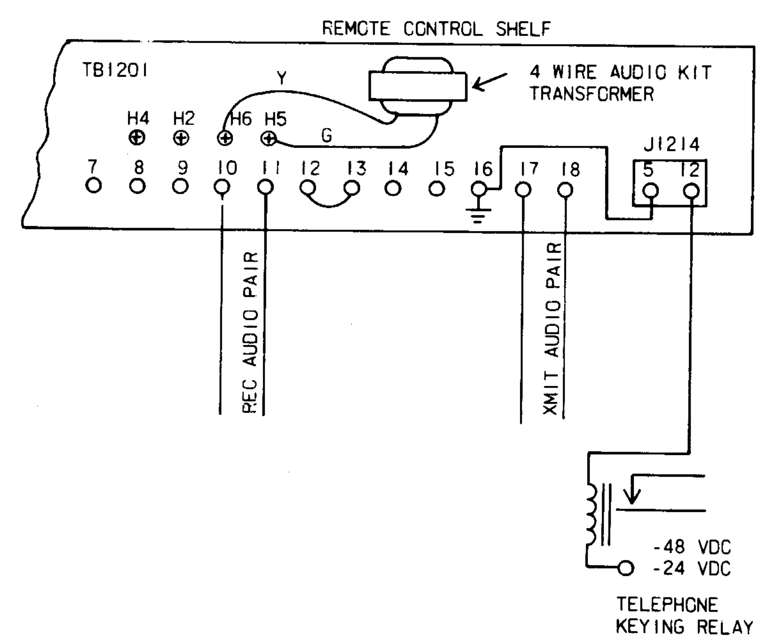


NOTES:
1. FOR DC CONTROL 4-WIRE AUDIO WITH E&M SIGNALLING, REMOVE TRANSFORMER GREEN LEAD FROM TB1201-15 AND YELLOW LEAD FROM TB1201-16. CLIP TERMINALS FROM LEADS. SOLDER GREEN LEAD IN HOLE 5 AND YELLOW LEAD IN HOLE 6.
2. ON D.C. REMOTE CONTROL BOARD 19D417051G2 REMOVE D.A. WIRE FROM H1-H2 AND H3-H4.
3. FOR -48 VDC SIGNALLING, REMOVE D.A. WIRE FROM H5-H6 AND H7-H8 ON D.C. REMOTE CONTROL BOARD 19D417051G2.
4. MAX. LOOP RESISTANCE ON E LEAD IS 2000 OHMS FOR -24 VOLTS AND 4000 OHMS FOR -48 VOLTS OPERATION.

"M" LEAD KEYING – 2- WIRE AUDIO SYSTEM



"M" LEAD KEYING – 4 – WIRE AUDIO SYSTEM



NOTES:
1. FOR D.C. CONTROL 4-WIRE AUDIO WITH E&M SIGNALLING, REMOVE TRANSFORMER GREEN LEAD FROM TB1201-15 AND YELLOW LEAD FROM TB1201-16. CLIP TERMINALS FROM LEADS. SOLDER GREEN LEAD IN HOLE 5 AND YELLOW LEAD IN HOLE 6.

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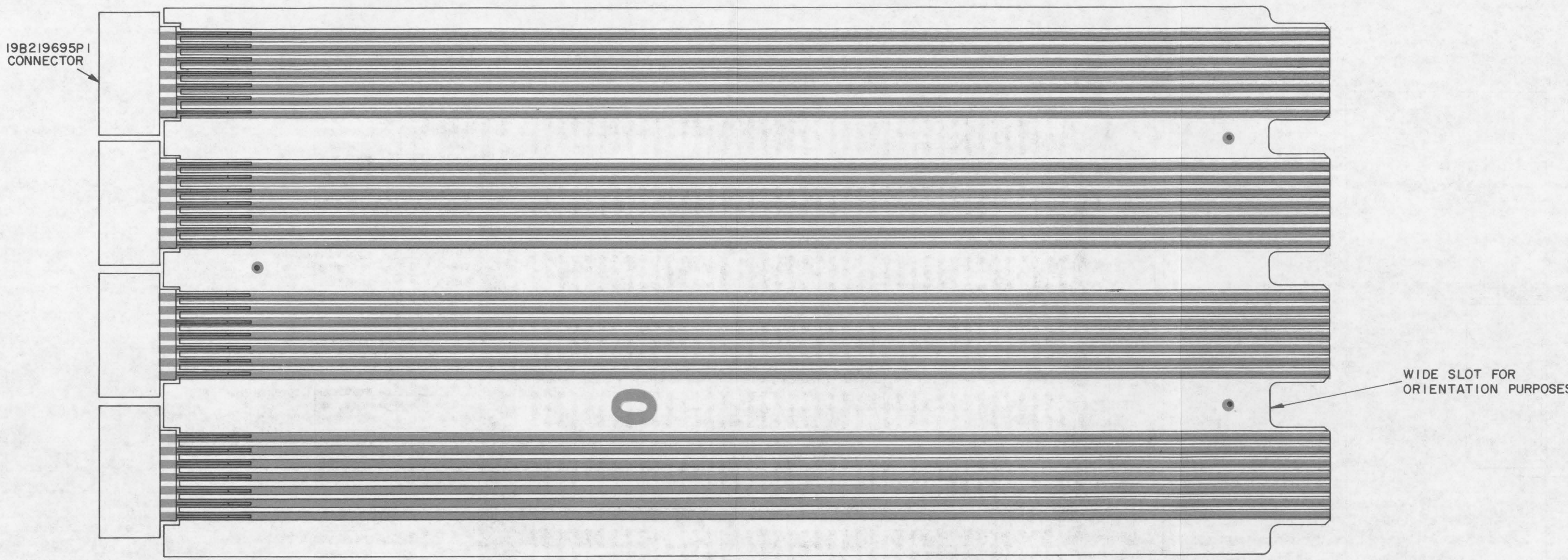

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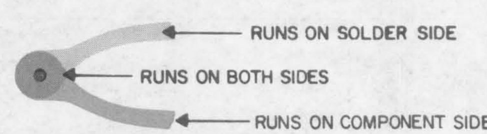
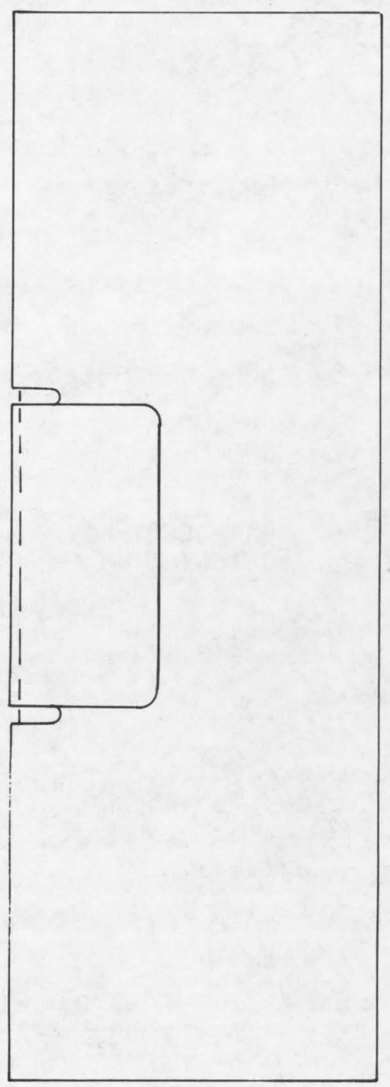


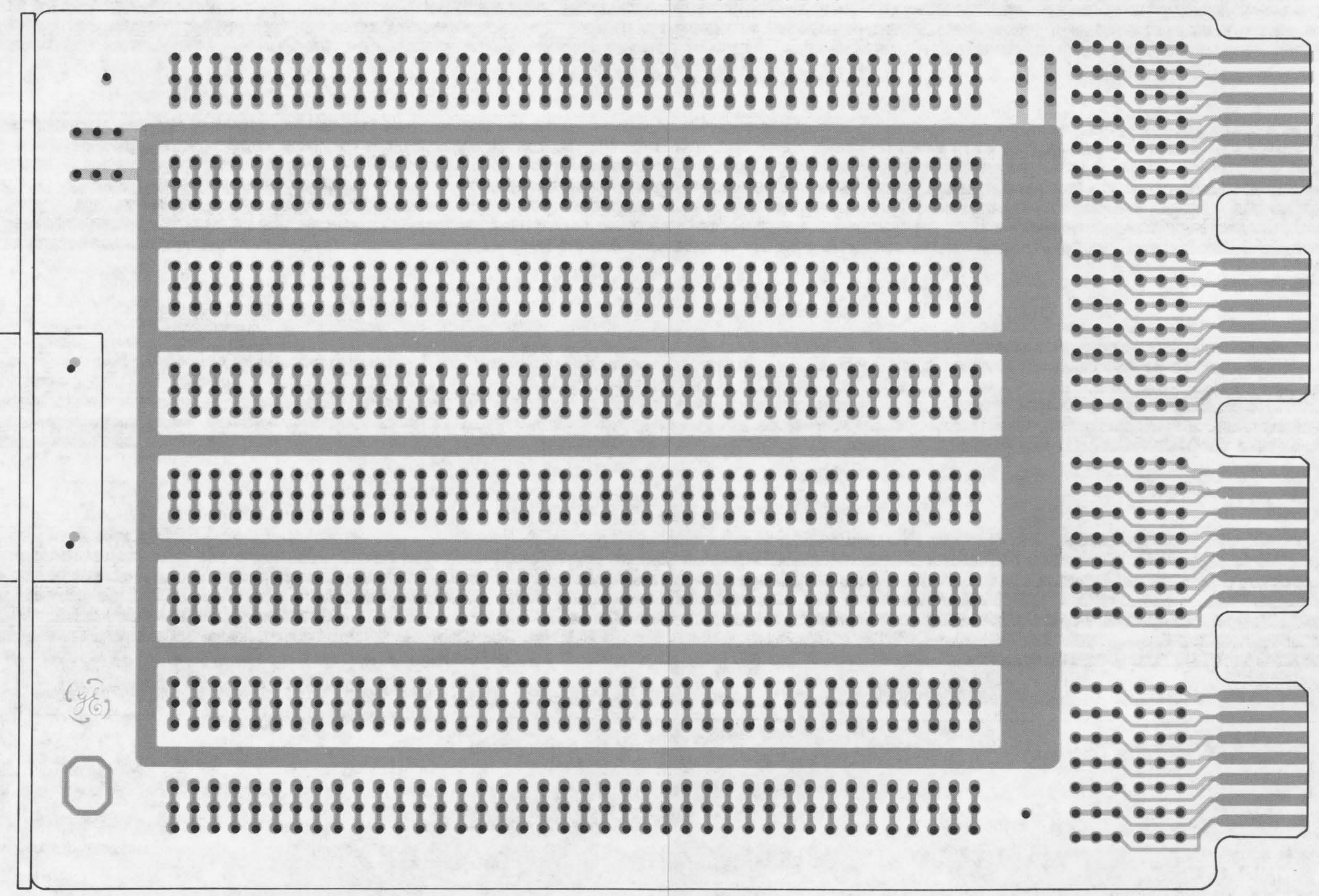
OUTLINE DIAGRAM

EXTENDER BOARD
19D417458G1

COMPONENT BOARD 19C320912P1



FRONT PANEL: 19D417384P5
HANDLE: 19B219690G1



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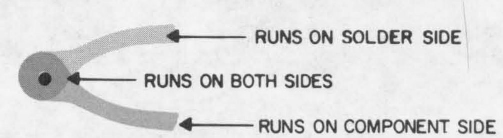

OUTLINE DIAGRAM

FIELD APPLICATION MODULE
19D417941