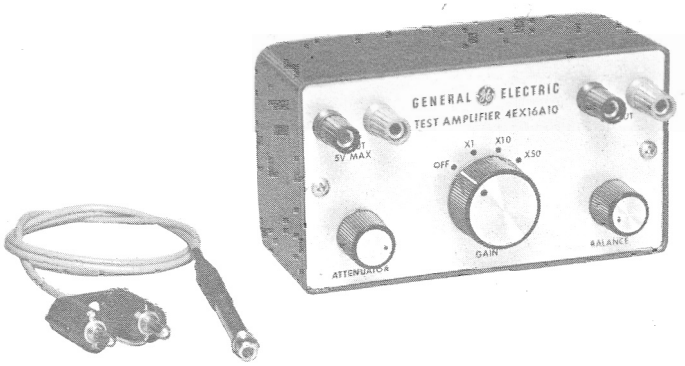
MOBILE RADIO

MAINTENANCE MANUAL

TEST AMPLIFIER MODEL 4EX16A10
& RF PROBE 19C311370G1 (Option 4382)



SPECIFICATIONS *

Input Power	One milliampere at 14 volts (two 7-volt mercury batteries)
Input Voltage	5 volts maximum
Output Voltage	±5 volts maximum
Impedance	
Input	150,000 ohms
Output	25 ohms
Amplifier Gain (±2%)	X1, X10 and X50
Input	
Amplifier	DC to 20 kHz
RF Probe	5 MHz to 500 MHz
Temperature Range	0°C to 45°C (32°F to 113°F)

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

GENERAL ELECTRIC

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DESCRIPTION

General Electric Test Amplifier Model 4EX16A10 uses a single Integrated Circuit module for operation as a high impedance DC amplifier. When used with RF Probe 19C311370G1, the Test Amplifier can be connected to Test Set Models 4EX3A10 & 11 (or a standard multimeter) to function as a high-sensitivity RF voltmeter.

The amplifier and probe are designed for measuring the gain of receiver front end and IF circuits, oscillator injection voltages, and for measuring RF levels in other RF circuits. The amplifier may also be used for amplifying low level audio signals.

OPERATION

All operating controls and the input and output binding posts are conveniently located on the front of the amplifier. The binding posts are spaced for use with a dual-banana plug if desired.

GAIN SELECTOR

Gain selector switch S1001 selects the X1 (unity), X10 and X50 amplifier ranges, and also turns the amplifier on and off.

BALANCE

Balance potentiometer R1002 is used to set the 4EX3A10 (or multimeter) on zero before making measurements. With the Test Set and RF Probe connected to the amplifier and the gain selector on X50, R1002 is adjusted for zero meter reading on the Test Set or multimeter.

ATTENUATOR

Attenuator R1001 controls the input level to the Test Amplifier. To obtain actual gains of X1, X10 or X50, R1001 must be turned fully clockwise to the CALIBRATE position.

References to symbol numbers mentioned in the following text may be found on the applicable Outline Diagram, Schematic Diagram or Parts List (see Table of Contents).

CIRCUIT ANALYSIS

TEST AMPLIFIER

The basic amplifier circuit consists of Integrated Circuit module IC-1 and associated circuitry mounted on printed wiring boards A1001. IC-1 is a high performance, operational amplifier whose gain is controlled by three feedback circuits. The feedback circuits are selected by GAIN switch S1001. Resistors R8 and R9 form the X1 (unity) feedback loop; resistors R6 and R7 form the X10 feedback loop, and R4 and R5 form the X50 feedback loop. Instructions for setting potentiometers R5, R7 and R9 are contained in the Maintenance section of this manual (see Table of Contents).

The input is coupled through ATTENUATOR R1001 and a voltage divider network (R1 and R2) to terminal 5 of the IC. The output is taken from terminal 10 and applied to the feedback loops and the output terminal. Battery voltage (14 volts) is applied to the IC through terminals 11 (+) and 6 (-). Terminal 4 connects to ground through R3.

A small difference in potential called the "offset" voltage is present at terminal 10 regardless of the input voltage applied to IC-1. This voltage can be cancelled out by BALANCE potentiometer R1002 so that the Test Set or multimeter can be set on zero. Instructions for setting the BALANCE control are contained in the OPERATION section of the manual as listed in the Table of Contents.

The amplifier may also be used for amplifying audio signals in the DC to 20-kHz range. The audio frequency response of the amplifier at the different gain levels is shown in Figure 1.

RF PROBE

RF Probe 19C311370G1 is a highly sensitive, uncalibrated probe for detecting RF signals in the 5-MHz to 500-MHz range. Point-contact diodes are used in the probe for better sensitivity. A curve showing the frequency response of the probe is shown in Figure 2.

The probe is terminated in a dual-banana plug that connects to the Test Amplifier. The probe may also be connected directly to a DC oscilloscope for checking RF levels.

As an aid to the serviceman in trouble-shooting RF circuits, a calibration procedure is provided for calibrating the RF Probe (see Table of Contents).

MAINTENANCE

DISASSEMBLY

To disassemble the amplifier for servicing, remove the two Phillips-head screws in the front of the nameplate and carefully

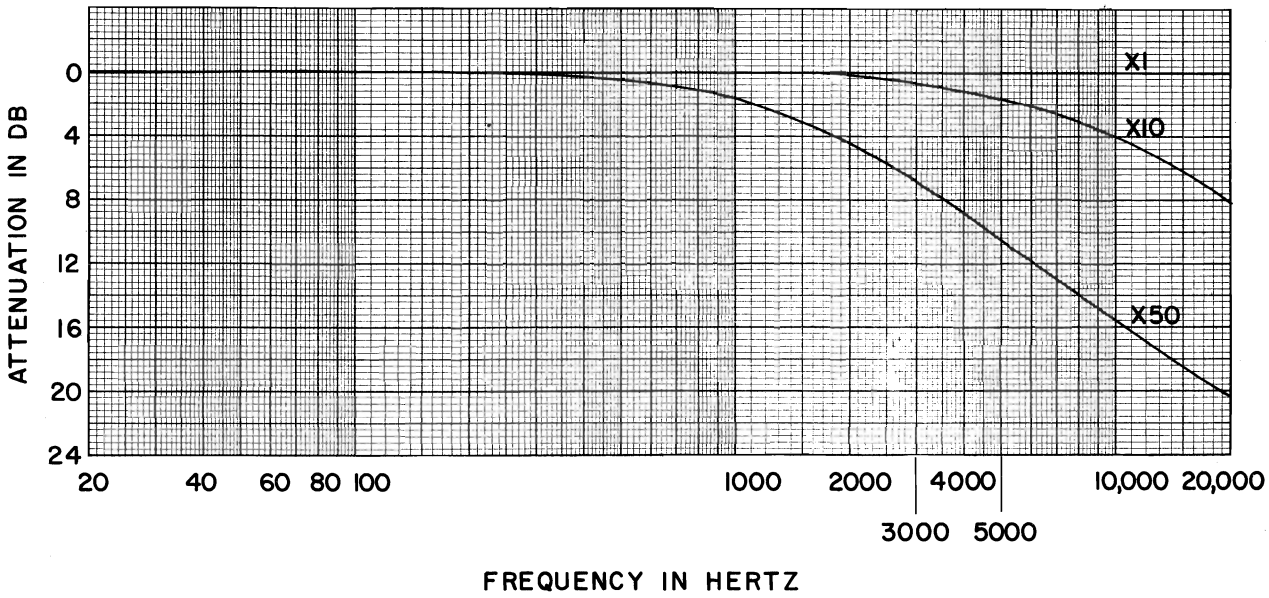


Figure 1 - Test Amplifier Audio Frequency Response

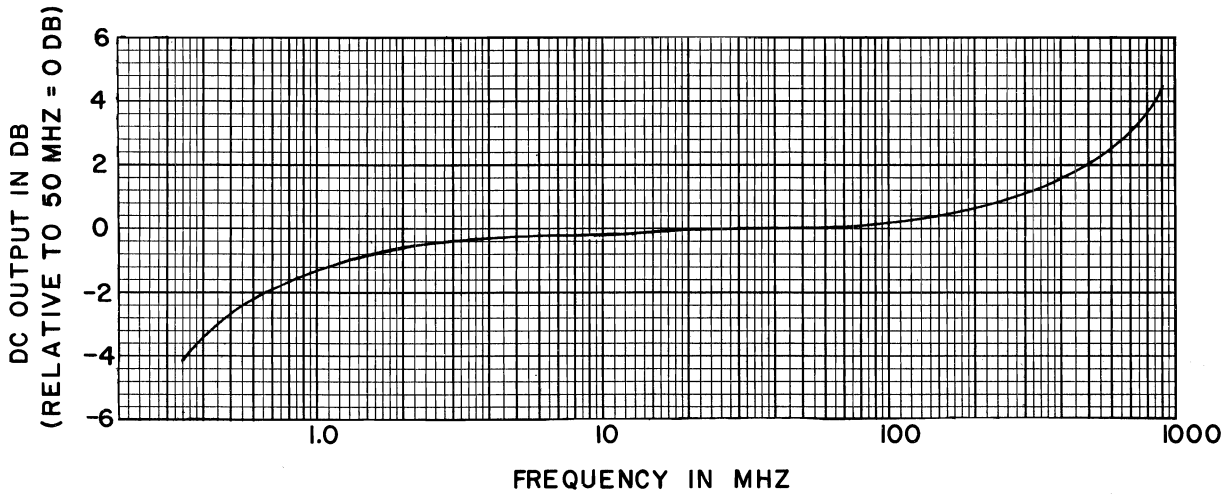


Figure 2 - Frequency Response of RF Probe

slide the amplifier chassis out of the case.

BATTERY REPLACEMENT

To replace the battery, disassemble the amplifier as directed in the procedure above, and remove the old batteries. Install the new batteries (Mallory TR-165 or equivalent) with the flat end (+) toward the + marked on the battery holder.

CAUTION

Do not dispose of mercury batteries by burning as the batteries may explode.

TROUBLESHOOTING PROCEDURE

Whenever the BALANCE control will not set the Test Set of zero, or the gain po-

tentiometers cannot be set for the proper voltage readings, first check the applicable potentiometer. If the potentiometers are operating properly, replace IC-1.

To replace the IC, clip off all of the leads as close to the body of the module as possible. Then unsolder and remove one lead at a time, being careful not to put the printed wiring pattern away from the board.

GAIN ADJUSTMENT PROCEDURE

If potentiometers R5, R7, R9 or IC-1 are ever replaced, it will be necessary to readjust R5, R7 and R9. Adjust the potentiometers according to the following procedure:

Equipment Required

1. An audio oscillator with a 100-Hz output.
2. An AC-VTVM.

Procedure

1. Connect the audio oscillator and the VTVM to J1001 and J1002 on the Test Amplifier.
2. Turn R1001 on the Test Amplifier fully clockwise to the CALIBRATE position, and place the GAIN control in the X1 position.
3. Apply a 100-Hz, .04-volt RMS signal to the amplifier.
4. Now connect the VTVM to output jacks J1003 and J1004 on the Test Amplifier, and adjust R9 for a meter reading of .04 volt RMS.
5. Place GAIN control S1001 to the X10 position and adjust R7 for a meter reading of 0.4 volt RMS.
6. Place GAIN control S1001 in the X50 position and adjust R5 for a meter reading of 2.0 volts RMS.

CALIBRATION PROCEDURE

If desired, the output of the RF Probe can be calibrated in millivolts. Calibrate the probe as follows:

Equipment Required

1. Signal Generator (M-560 or equivalent) with a Type N male to BNC female adaptor and a Type BNC Tee connector, and a 50-ohm load.
2. Test Amplifier and RF Probe.

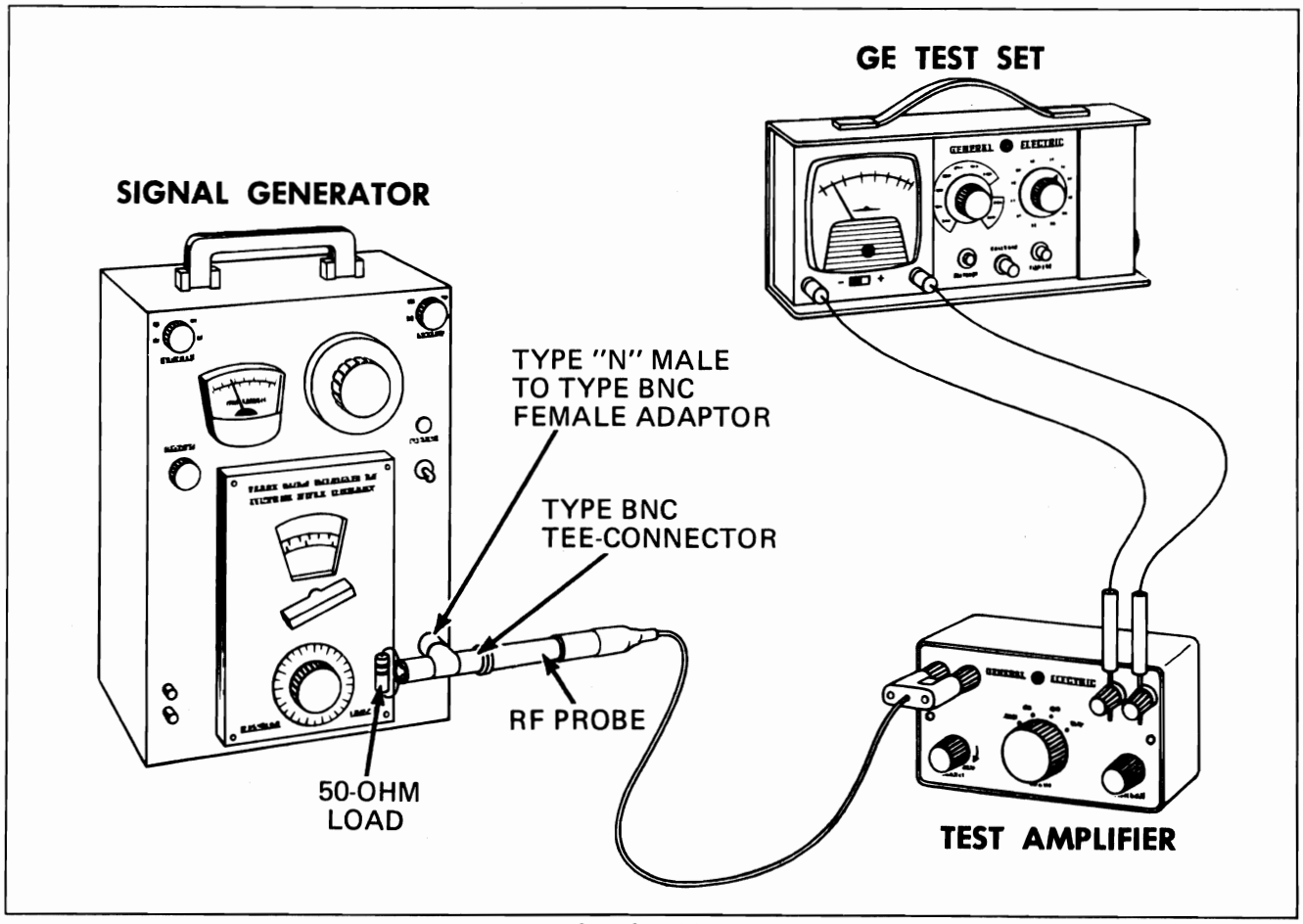


Figure 3 - Calibration Test Set-Up

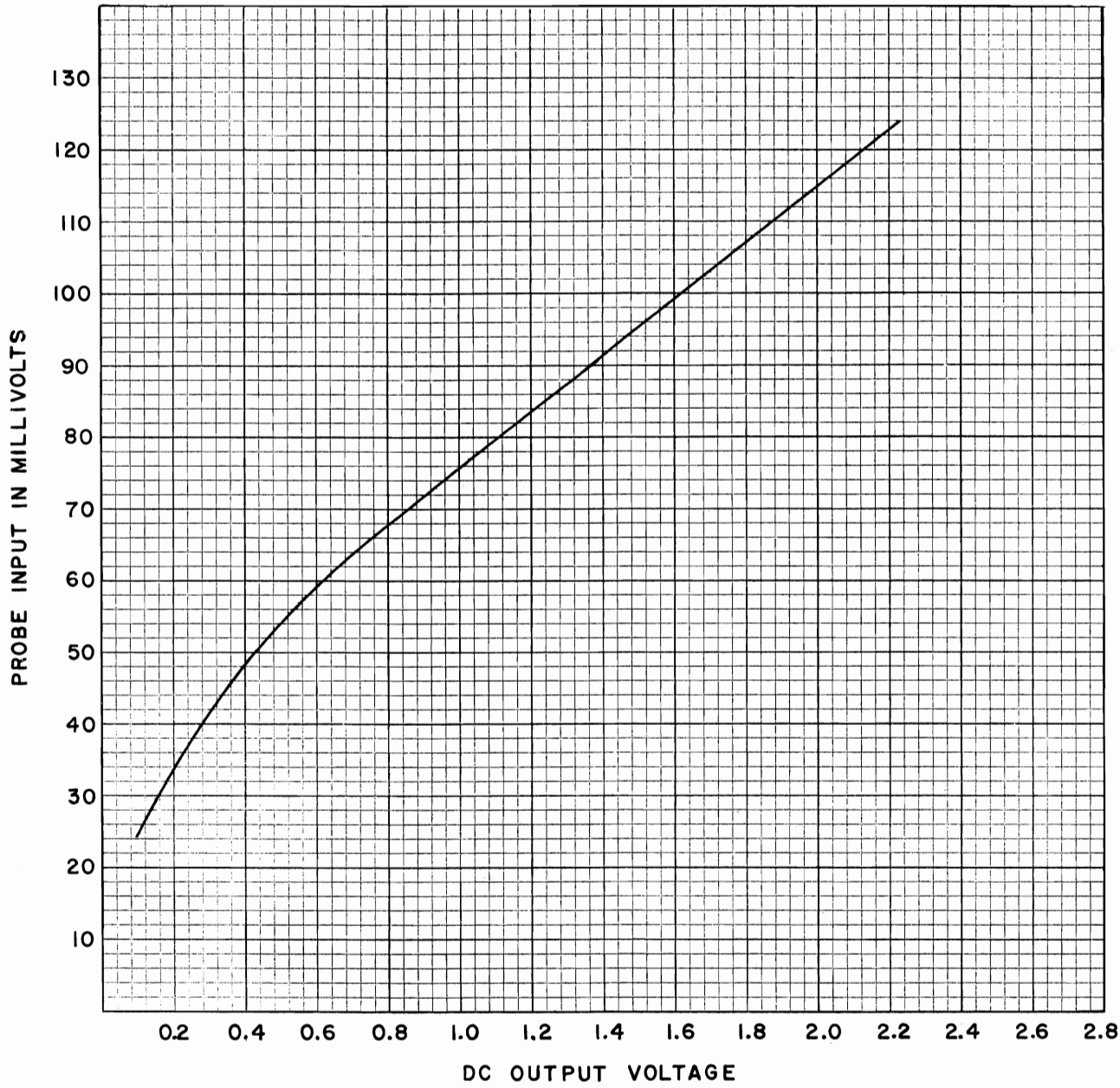


Figure 4 - Typical Calibration Curve for RF Probe

3. GE Test Set Model 4EX3A10 or equivalent multimeter.

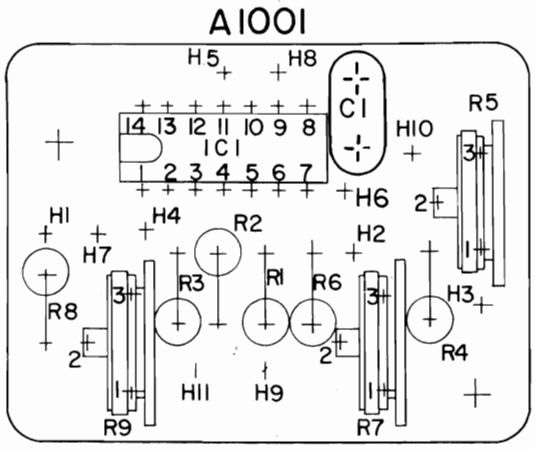
Procedure

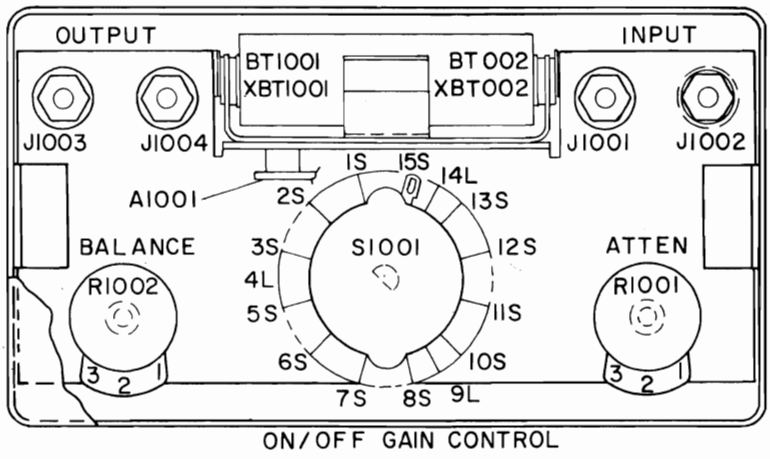
1. Terminate one end of the "T" connector directly into a 50-ohm load (no cable), and connect the RF Probe directly into the unterminated end as shown in Figure 3.
2. Place the Test Set on the 1-volt scale and set the amplifier GAIN control in the X50 position.
3. Adjust the BALANCE control for zero meter reading, and turn the ATTENUATOR control fully clockwise to the CALIBRATE position.
4. Adjust the signal generator output for a meter reading of 0.1 volt on the Test Set. Then record the millivolt reading directly off of the signal generator.
5. Increase the signal generator output in 1/10-volt steps and record the millivolt readings. The readings can be plotted on graph paper as shown in Figure 4.

NOTE

Whenever three or four of the readings fall in a straight line indicating that the output is increasing in a linear fashion with the input (normally between 1 volt and 1.6 volts). The straight line may be continued to complete the curve without further measurements.

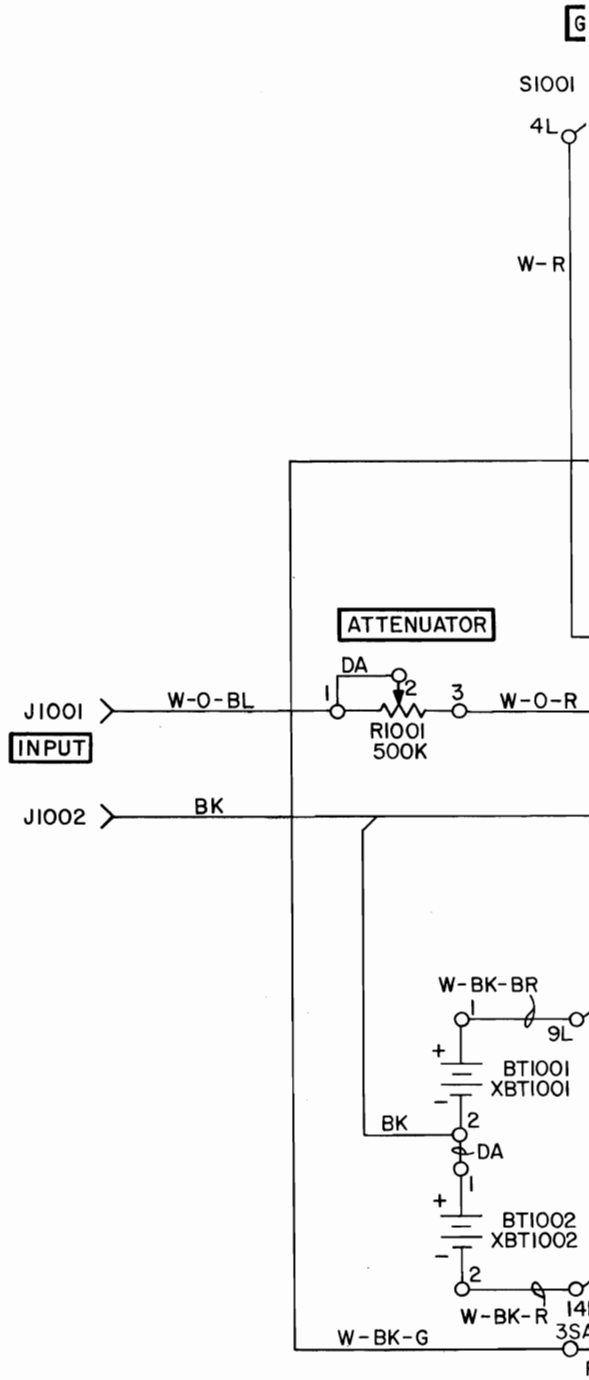
OUTLINE DIAGRAM



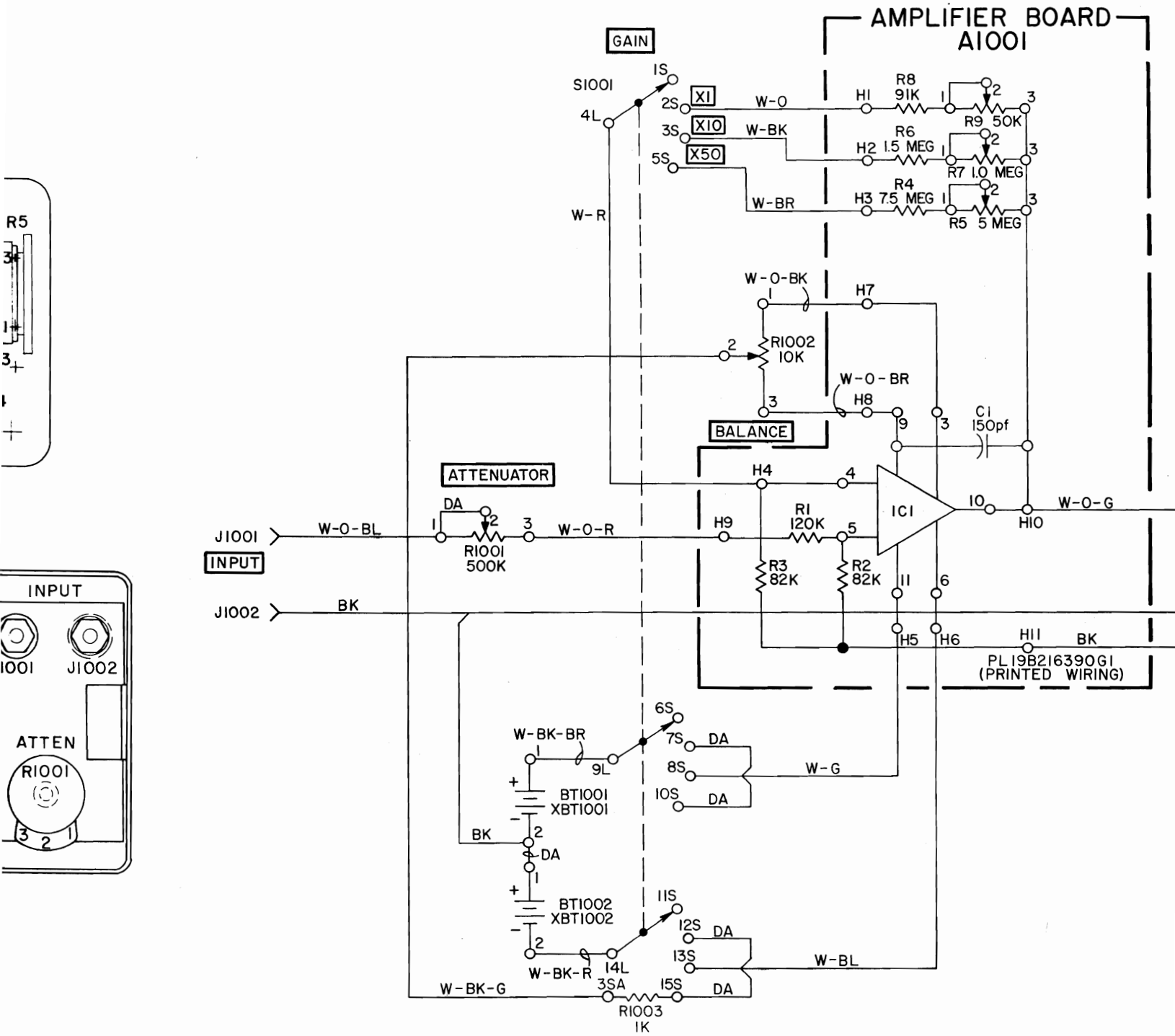


ON/OFF GAIN CONTROL

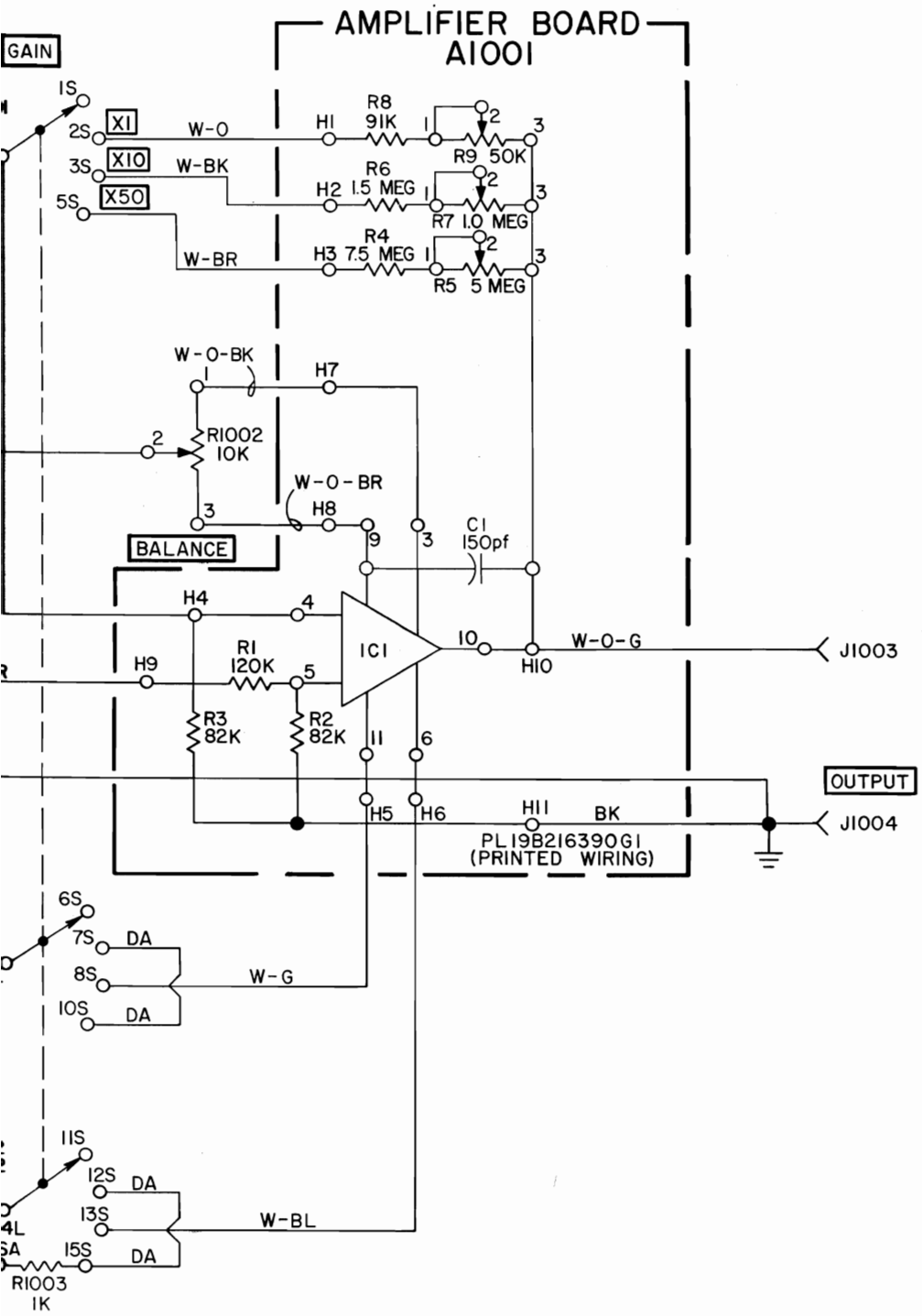
(19B219054, Rev. 1)



SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



NOTES:

1. ALL WIRES ARE SF24 EXCEPT AS NOTED.
2. DA = #22 AWG WIRE SIZE.
3. ALL S1001 CONNECTIONS ARE TO B SECTION UNLESS OTHERWISE SPECIFIED.

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
4EX16A10	A

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.

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.

(19C317238, Rev. 2)

PARTS LIST

LBI-4126C

TEST AMPLIFIER MODEL 4EX16A10
AND
RF PROBE 19C311370G1

SYMBOL	GE PART NO.	DESCRIPTION
A1001		COMPONENT BOARD 19B216390G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1*	7489162P31	Silver mica: 150 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15. Added by REV A.
		- - - - - - - INTEGRATED CIRCUITS - - - - - -
IC1	19A116297P1	Operational Amplifier: Monolithic; sim to Fairchild μA741C.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R77P124J	Composition: 0.12 megohm ±5%, 1/2 w.
R2 and R3	3R77P823J	Composition: 82,000 ohms ±5%, 1/2 w.
R4	3R77P755J	Composition: 7.5 megohms ±5%, 1/2 w.
R5	19B209358P115	Variable, carbon film: approx 5000 to 5 megohms ±20%, 0.25 w; sim to CTS Type X-201.
R6	3R77P155J	Composition: 1.5 megohms ±5%, 1/2 w.
R7	19B209358P112	Variable, carbon film: approx 2000 to 1 megohm ±20%, 0.25 w; sim to CTS Type X-201.
R8	3R77P913J	Composition: 91,000 ohms ±5%, 1/2 w.
R9	19B209358P108	Variable, carbon film: approx 100 to 50,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
		- - - - - - - - - - BATTERIES - - - - - - - - -
BT1001 and BT1002	5492174P1	Mercury: 7 v; sim to Mallory Type TR-165.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J1001	19B209238P1	Binding post: Red, 15 amp; sim to HH Smith 1517.
J1002	19B209238P2	Binding post: Black, 15 amp; sim to HH Smith 1517.
J1003	19B209238P1	Binding post: Red, 15 amp; sim to HH Smith 1517.
J1004	19B209238P2	Binding post: Black, 15 amp; sim to HH Smith 1517.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1001	19A116306P2	Variable, carbon film: 500,000 ohms ±20%, 1/5 w; to CTS Series 200.
R1002	19A116306P1	Variable, carbon film: 10,000 ohms ±20%, 1/4 w; sim to CTS Series 200.
R1003*	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w. Added by REV A.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1001	19C307060P4	Rotary: 2 section, 4 position, 6 poles; sim to CTS 222-17254-2.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XBT1001 and XBT1002	19B216684G1	Battery holder.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19C311370G1	RF Probe. Includes 19A127381P1 spring.
	19A122719P1	Knob. (Used with S1001).
	19A116296P1	Knob. (Used with R1001 and R1002).
	19B205453G1	Housing.
		- - - - - - CALIBRATION CONNECTORS - - - - - -
		(Not part of Test Amplifier)
	4037803P2	Adapter, coaxial: sim to Type "N" to "BNC" Female UG-201A/U.
	7776570P11	Adapter, coaxial: sim to Type "BNC" TEE UG-274A/U.

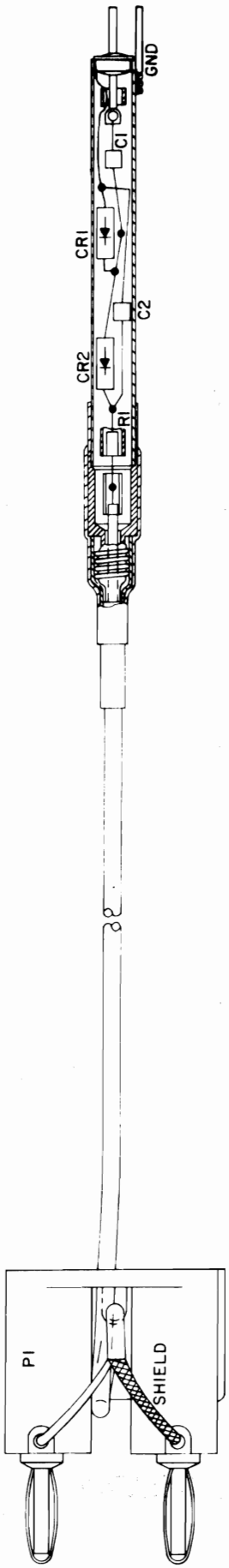
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRODUCTION CHANGES

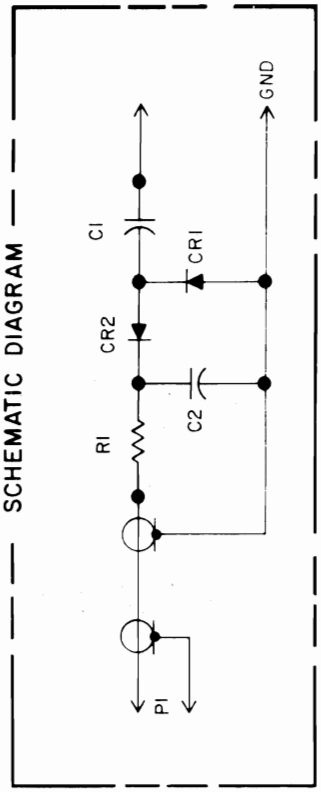
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To improve amplifier stability.
Added C1 and R1003.

OUTLINE DIAGRAM



SCHEMATIC DIAGRAM



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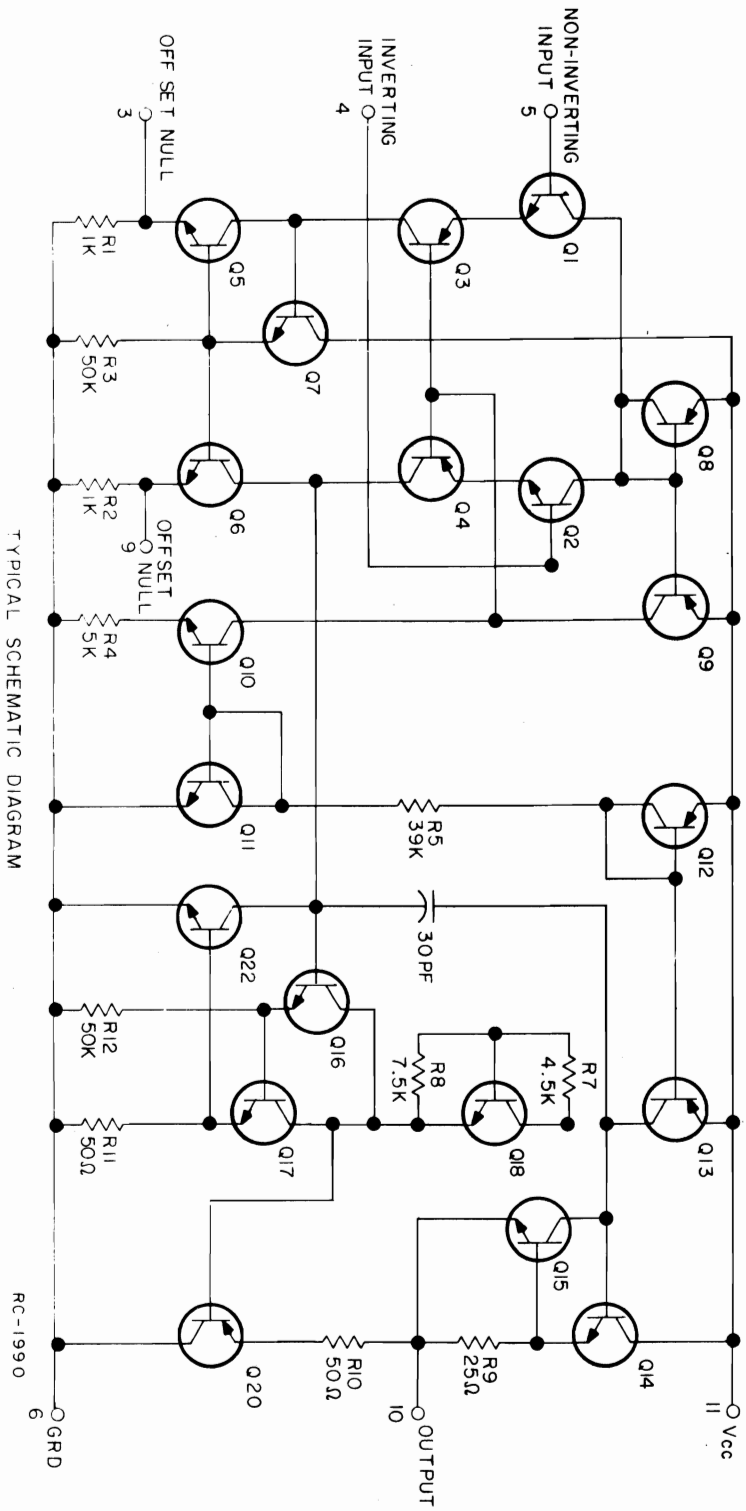
SCHEMATIC DIAGRAM

RF PROBE 19C311370G1
OPTION 4382



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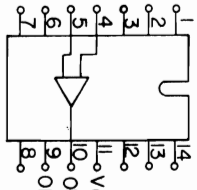
OPERATIONAL AMPLIFIER
19A116297P1



LOGIC DIAGRAM

TYPICAL LOGIC & SCHEMATIC DIAGRAMS

OPERATIONAL AMPLIFIER 19A116297P1

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 its description and GE Part No.

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-4097

DF-10008

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

GENERAL ELECTRIC

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