GOULD

An Electrical/Electronics Company

MANUAL PART NO.
13-804615-10

MEDIUM GAIN D.C. PREAMPLIFIER MODEL 13-4615-10

PRINTED 5-81

Gould Inc., Instruments Division
3631 Perkins Avenue, Cleveland, Ohio 44114

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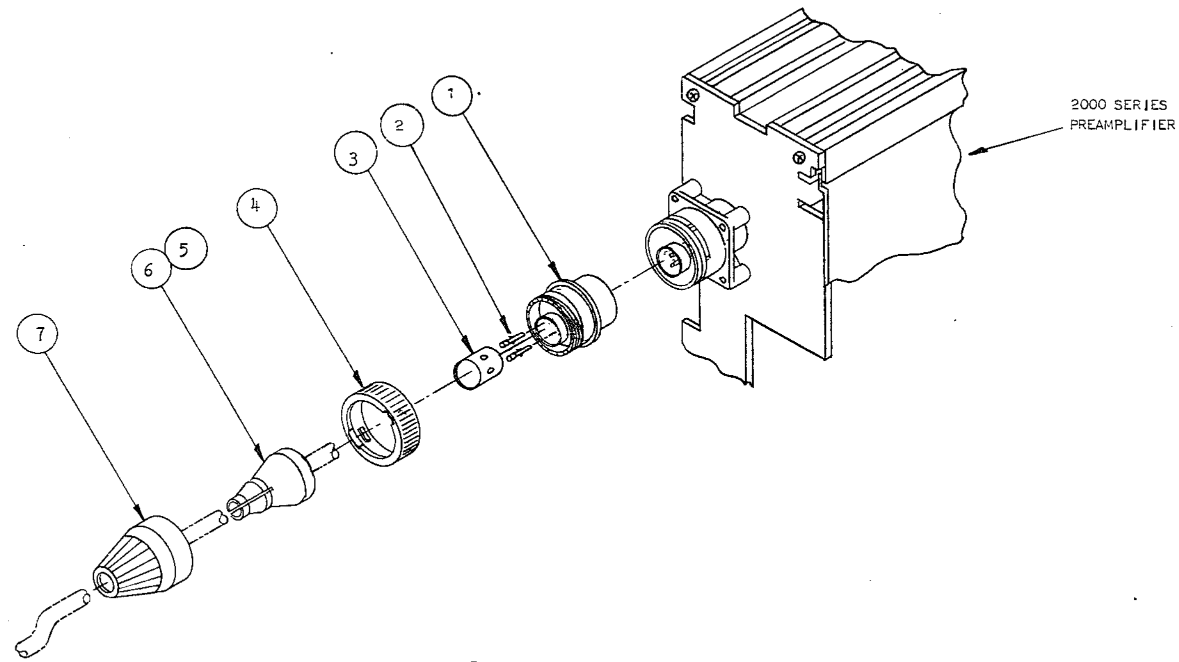

NOTES:
1. NUMBERS IN CIRCLES INDICATE ITEM NUMBERS.
2. MOUNT ITEM-4 TO ITEM-1 BY PRESSING INNER TABS OF ITEM-4 OVER SHOULDER OF ITEM-1.
3. INSTALL ITEM-7 AND ITEM-5 OR ITEM-6 (DEPENDING ON CABLE SIZE) OVER CABLE.
4. WIRE CONNECTIONS:
   A. USING ITEM-3:
      A. INSTALL ITEM-3 OVER CABLE & CRIMP OR SOLDER WIRES TO ITEM-2 & INSERT INTO ITEM-1, (PIN 1+, PIN 2-).
      B. SOLDER SHIELD WIRE TO ITEM-3 AND PRESS ITEM-3 ON TO SHIELD OF ITEM-1.
   B. WITHOUT ITEM-3:
      A. CRIMP OR SOLDER WIRES TO ITEM-2 AND INSERT INTO ITEM-1, (PIN 1+, PIN 2-).
      B. SOLDER SHIELD WIRE TO SHIELD OF ITEM-1.
5. SECURE ITEM-7 ALONG WITH ITEM-5 OR ITEM-6 TO ITEM-1.

THIS DRAWING IS USED BY OTHER GOULD DIVISIONS AND/OR LOCATIONS. A F

NO.	BRUSH PART NO.	DESCRIPTION	QUAN
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7	385548-1	COLLAR, STRAIN RELIEF	1
6	385548-4	WEDGE, STRAIN RELIEF	1
5	385548-3	WEDGE, STRAIN RELIEF	1
4	385548-2	RING, LOCKING	1
3	285402	GUARD	1
2	285301-1	CONTACT, FEMALE	2
1	78557	CONNECTOR, MALE	1

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		ISSUE 6 CODE	PAGE 1 OF 1

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

The Gould Model 13-4615-10 D.C. Preamplifier (Figure 1-1) is a balanced to common medium gain signal conditioner designed for use with Gould 2000 series recorders. It receives its operating power from a companion pendrive amplifier located in the recorder.

This single channel preamplifier module provides a maximum sensitivity of 25mv F.S. on Gould 2000 series recorders. It has been specifically matched both electrically and mechanically for use with any Gould 2000 recorder.

The amplifier response is less than 3db down at 2KHz with filter off; flat to ±.5% from dc to 100Hz with filter off.

This preamplifier is a fully enclosed solid state unit of sturdy construction incorporating the latest components and assembly practices.

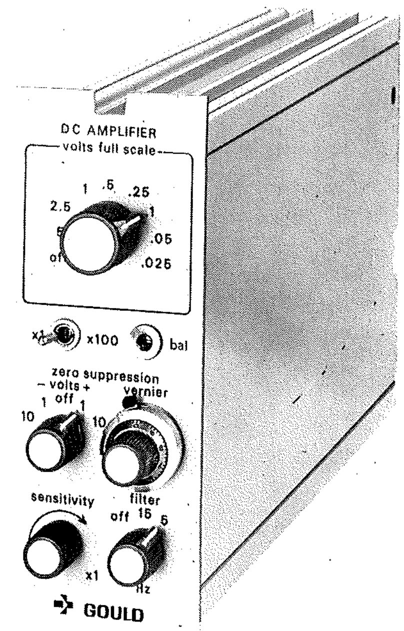


FIGURE 1-1 GOULD MODEL 13-4615-10 MEDIUM GAIN D.C. PREAMPLIFIER

1.2 SPECIFICATIONS

Signal Input

- Circuit . . . . Balanced to Common
- Impedance . . . . 2 megohms differential; 1 megohm each terminal to common.
- Measurement Range . . . . 25 millivolts full scale to 500 volts full scale.
- Sensitivity Steps . . . . .025, .05, .1, .25, .5, 1, 2.5 and 5 volts full scale, and "off"; plus x1 and x100 multiplier.
- Variable Sensitivity . . . . Minimum of 2.5X multiplication of calibrated steps.
- Maximum Safe Voltage . . . . 500 Volts peak-either input terminal to common or chassis. 500 Volts peak-common to chassis.

Signal Output

- Circuit . . . . Single ended to common.
- Voltage:
  - Linear Range . . . . ±5.0 volts into 5Kohms or greater.
  - Minimum Load Resistance . . . . Zero ohms (Short Circuit proof).
- Calibration Inaccuracy . . . . ±0.1% of full range in the least sensitive position at 25° C and nominal line voltage.

Signal Output (continued)

Attenuator Inaccuracy . . . . ±0.5% of calibrated step.

Non-Linearity . . . . ±0.1% of full scale.

Impedance . . . . Less than 5 ohms.

Instability:

Zero with Time . . . . ±3 millivolts/24 hours on the most sensitive range after 15 minutes warmup; decreasing on less sensitive ranges.

Zero with Temp . . . . ±3 millivolts/° C on the most sensitive range after 15 minutes warmup; decreasing on less sensitive ranges.

Zero with Line . . . . ±1 millivolt for 10% line change.

Gain with Time . . . . ±0.01%/24 hours after 15 minutes warmup.

Gain with Temp . . . . ±0.03%/° C.

Gain with Line . . . . ±0.01% for a 10% line change.

Frequency Response . . . . Less than 3db down at 2KHz with filter off; flat to ±.5% from dc to 100Hz with filter off.

Noise . . . . Less than 10mv peak-to-peak from dc to 100Hz on the most sensitive range.

Common Mode Rejection:

Inputs 1 and 2 to Common . . . . DC to 60Hz: Greater than 55dB@ 1 Kohm unbalance on the x1 ranges, decreasing on the x100 ranges.

Common to Chassis . . . . 60Hz: Greater than 100db @ 1Kohm unbalance on the most sensitive range decreasing on higher ranges. D.C. greater than 120db @ 1 Kohm unbalance on the most sensitive range decreasing on higher ranges.

Linear Common Mode Voltage:

Inputs 1 and 2 to Common . . . . 10 volts maximum in x1 position. 500 volts maximum in x100 position.

Common to Chassis . . . . 500 volts maximum, all ranges.

Zero Suppression

Range . . . . -10, -1, "off" +1, +10 volts. Range is multiplied x100 by multiplier switch (maximum ±500 volt).

Inaccuracy . . . . ±.5% of suppression range at nominal line and 25° C.

Zero Suppression (continued)

Non-Linearity . . . . . ±.25% of full suppression range.

Resolution . . . . . ±.1% of full suppression range.

Stability:
With Time . . . . . ±0.02%/week

With Temp . . . . . ±0.02%/° C

With Line . . . . . ±0.02% for ±10% line change.

Noise . . . . . .05% of full range

Filter

Range . . . . . "Off", 15Hz, 5Hz.

Cutoff Frequency . . . . . -3db @ 5Hz (±20%)
-3db @ 15Hz (±20%)

Attenuation . . . . . -12db/Octave

Environment

Temperature:
Storage . . . . . -40° C to +70° C.

Operating . . . . . 0° C to +50° C.

Humidity, Non-Condensing:
Operating . . . . . 95% relative humidity; 0° C to 30° C.
Less than 95% relative humidity; 30° C to 50° C.

Physical Characteristics

Dimensions . . . . . Refer to Figure 2-3 Outline Dimensions.

Weight 3.6lbs (1.5kg)

Mounting . . . . . Retained from Rear

Finish . . . . . Molded Front Panel, Color: Light Parchment.

Controls

Front Panel:
Volts Full Scale . . . . . Sets full scale sensitivity of preamplifier.

x1 – x100 Toggle Switch . . . . . Multiplies setting of volts full scale switch.

Bal . . . . . Sets zero of preamplifier in the most sensitive position, and off position.

Controls (continued)

Zero Suppression (-volts +) . . . . Selects full scale suppression voltage and polarity.

Zero Suppression (vernier) . . . . 10 turn potentiometer allows calibrated setting of suppression from 0% to 100% of range.

Filter . . . . Selects either 5Hz or 15Hz -12db/octave filter.

NOTE: No Pen Position Control.

Internal:

Zero . . . . Single turn potentiometer. Sets zero of output stage.

Cal. 1 . . . . Single turn potentiometer. Sets basic accuracy of preamp.

Cal. 2 . . . . Single turn potentiometer. Sets common mode rejection in the x1 position.

Input Bal . . . . Single turn potentiometer. Sets common mode rejection in the x100 position.

10V ADJ . . . . 10 turn potentiometer. Sets accuracy of 10 volt suppression range.

1V ADJ . . . . Single turn potentiometer. Sets accuracy of 1 volt suppression range.

Rear Panel:

Input . . . . Guarded 2 pin connector (Proprietary). Mating connector 11-5407-02 supplied.

Output . . . . Card edge mates with AMP 582140-5 or equivalent.

Power Input From Recorder

Voltage DC . . . . ±15 volts, ±0.6 volts @/5 ma.
Voltage AC . . . . 13vrms @ 200 ma.

Line and Load Regulation . . . . ±0.5%.

Ripple . . . . 5mv rms max.

System Specifications When used with Series 2000 Recorder

Gain Accuracy . . . . 0.7% of full scale.

Non-Linearity . . . . 0.45% of full scale.

Instability:

Zero with Time . . . . ±0.15% of full scale/24 hours in the most sensitive position.

System Specifications When used with Series 2000 Recorder (continued)

Zero with Temp	$\pm$0.085% of full scale/$^{\circ}$C.
Zero with Line	±0.15% of full scale for ±10% line change.
Gain with Time	±0.11%/24 hours.
Gain with Temp	$\pm$0.08%/$^{\circ}$C.
Gain with Line	±0.5% for a ±10% line change.
Frequency Response	Refer to Specifications, 2000 Series Recorder Manual.
Noise	±0.25% of full scale.
Maximum Safe Input	±500 volts peak voltage
Common Mode Rejection	Refer to Specifications, page 1.2 of this manual

Accessories

Supplied with preamplifier

- Input Connector (Male) 11-5407-02

Optional - May be ordered separately

- Extender Card and Cable Assembly 887291
- Input Connector Adapter. Converts input connector to 3 "binding post" terminals 11-5407-09
- Input Connector Adapter. Converts input connector to 6-pin Cannon connector receptical 11-5407-06

SECTION II

INSTALLATION

2.1 GENERAL

This section describes the checks and inspections that should be made upon receiving the Gould D.C. Preamplifier Model 13-4615-10 with a 2000 series unit. It covers; installation procedures, signal input connections, and outline dimensions.

2.2 INITIAL INSPECTION

Prior to attempting any electrical connections or operation visually examine the unit for; broken or loose knobs, dented or nicked panels and broken or chipped rear connectors.

2.3 INSTALLATION

Preamplifier Model 13-4615-10 may be mounted in Gould 2000 Recorder frames, or rack mounted separately in a Gould rack adapter kit.

a. Insertion

To install the preamplifier into its appropriate slot:

1. Slide the preamplifier into the enclosure until the rear output card edge connector is engaged.

2. Tighten the rear retaining screw. This locks the preamplifier into the enclosure.

3. Connect the 2-pin plastic input signal connector and secure it by turning the threaded plastic locking ring clockwise.

b. Removal

1. Disconnect the input connections with a counterclockwsie turn and pull.

2. Loosen the rear retaining screw. The preamplifier will move forward about 1/8 of an inch.

3. Carefully slide the entire preamplifier out of the Gould 2000 enclosure.

2.4 SIGNAL CONNECTIONS

a. General

Gould preamplifier Model 13-4615-10 is a direct coupled, balanced to common dc preamplifier.

Input and output are isolated from chassis, but there is no isolation between input and output. See Figure 2-1, Amplifier Diagram.

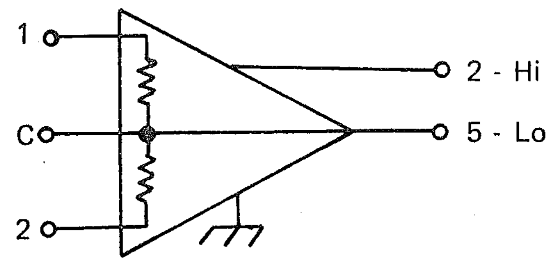


FIGURE 2-1 AMPLIFIER DIAGRAM

The preamplifier can be used with any signal input up to 500 volts peak. The source may be floating, balanced to ground or single ended-grounded.

If either the common input lead or the low side output lead is grounded, the amplifier becomes a balanced to ground amplifier. For details on signal input connections and sources refer to Section VI.

b. Input Connection Hardware

NOTE: For signal input connections, use the special connector provided with the preamp (Gould Model number 11-5407-02).

Connections to the preamplifier are made at the rear. (Figure 2-2). A good two wire shielded cable (Gould P/N 232434) should be used.

c. Output and Power

The amplifier is designed to operate on + and -15 volt, 100 ma regulated supplies, and 13 vrms, 200 ma ac. Output and power connections are provided through an 8 pin card edge on the rear of the preamplifier (Figure 2-2). The mating connector is located in the recorder chassis.

The preamplifier provides a 5 volt full scale signal to the recorder. If the user desires, this output is accessible on the rear of the recorder by means of a phone jack.

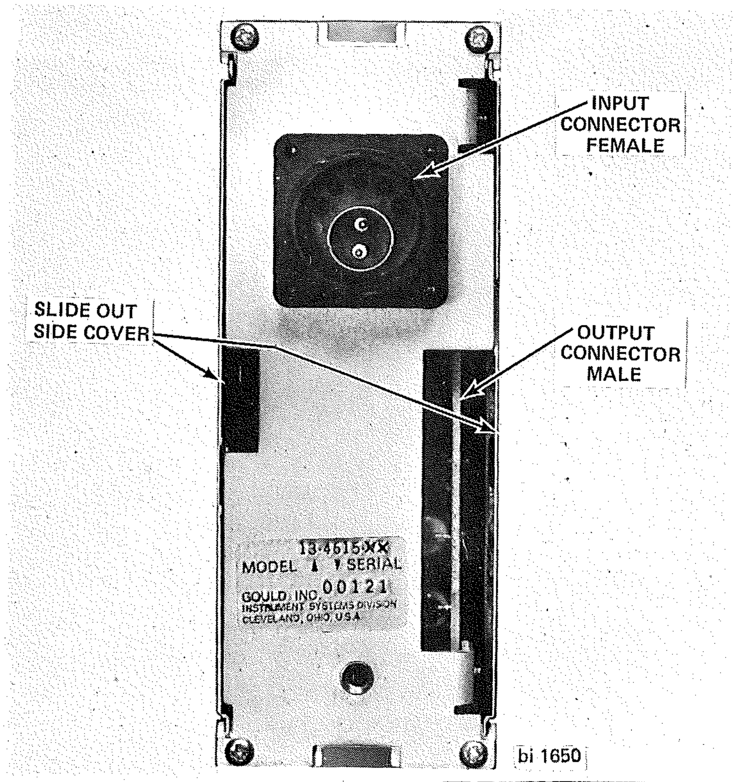


FIGURE 2-2 REAR VIEW

2.5 OUTLINE DIMENSIONS

Refer to Figure 2-3 for outline dimensions.

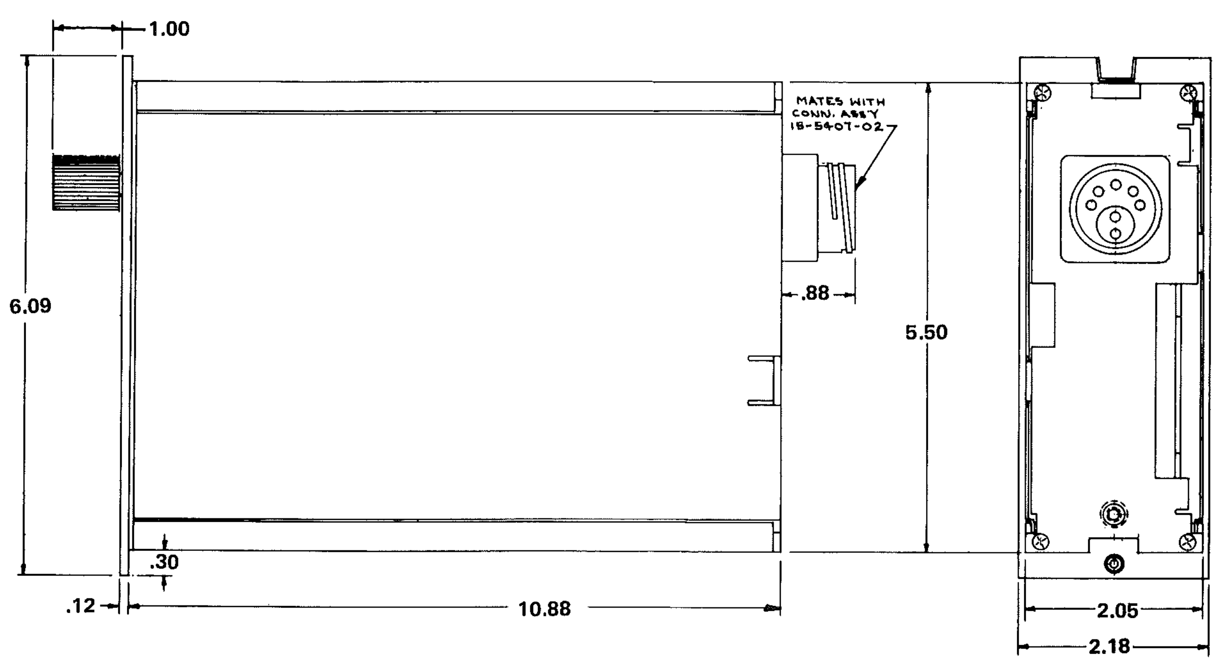


FIGURE 2-3 OUTLINE DIMENSIONS

SECTION III

OPERATION

3.1 GENERAL

This section describes and illustrates the controls of the medium gain preamplifier, Model 13-4615-10 and provides operating instructions.

3.2 CONTROL DESCRIPTION

Item numbers listed below correspond to circled numbers in Figure 3-1.

ITEM	CONTROL	DESCRIPTION
1	Volts Full Scale	A nine position rotary switch allows selection of .025, .05, .1, .25, .5, 1.0, 2.5, 5.0 volts full scale for overall system sensitivity, and an OFF position.
2	x1, x100 (multiplier) switch	Permits selecting sensitivities of 100 times indicated control markings; sensitivities become 2.5, 5, 10, 25, 50, 100, 250, 500 volts full scale.
3	Bal (adjustment)	Sets the zero of the amplifier in the most sensitive position.
4	Zero Suppression (Range) - Volts + ...	Selects full scale suppression voltage and polarity.
5	Zero Suppression Vernier	10 turn potentiometer allows calibrated setting of suppression from 0% to 100% of range.
6	Sensitivity	Minimum of 2.5X multiplication of calibrated steps.
7	Filter	Selects either 5Hz or 15Hz -12db/octave filter.

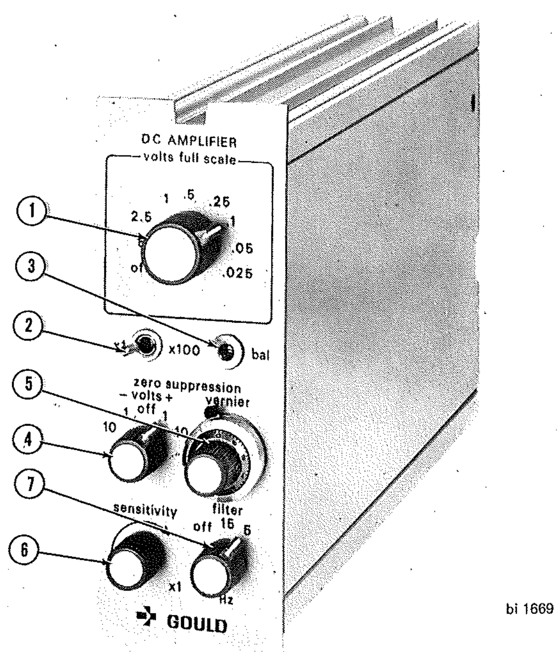


FIGURE 3-1 FRONT PANEL CONTROLS

3.3 PRELIMINARY OPERATION

CAUTION: ALL PROCEDURES OUTLINED IN SECTION II, INSTALLATION SHOULD BE COMPLETE BEFORE ATTEMPTING PRELIMINARY OPERATION.

1. Set VOLTS FULL SCALE to OFF position.
2. PLACE X1/X100 switch in X1 position.
3. Turn SENSITIVITY X1 to FULL clockwise detent position.
4. Connect input cable and short both inputs to common.
5. Apply System power. Allow unit to warm up for 15 minutes.
6. Operate oscillograph at moderate chart speed.
7. Adjust pen POSITION control on oscillograph for approximate chart center.
8. Turn to the most sensitive position and use the BAL control to set zero if necessary.
9. Stop recorder and connect input signal to preamplifier.
10. Preamplifier is now ready for normal operation.

3.4 UNCALIBRATED OPERATION

To obtain more useful records, it may be desirable to operate the amplifier with the sensitivity X1 vernier control in other than the detent position.

3.5 CALIBRATED ZERO SUPPRESSION

a. General

Zero suppression permits the dc component of a complex wave form to be suppressed, thus allowing a small dynamic portion to be further amplified. Calibrated zero suppression indicates the magnitude of the dc voltage which has been suppressed. The zero suppression is independent of attenuator setting and amplifier sensitivity. This feature permits the attenuator settings to be changed without resetting the zero suppression.

b. Application of Zero Suppression (Signal less than 10V)

To examine the dynamic component (or components) or signal with a static (dc) level below 10 volts, proceed as follows:

1. Turn the VOLTS FULL SCALE control to the OFF position.
2. Place the X1/X100 switch in the X1 position.
3. Turn ZERO SUPPRESSION RANGE control (-volts+) to the OFF position and the VERNIER control fully counterclockwise.
4. Turn X1 SENSITIVITY control fully clockwise to the detent position.
5. Operate the recorder at a nominal speed and set the pen to chart center.
6. Advance the VOLTS FULL SCALE control clockwise until the pen approaches the edge of the chart.
7. Note whether the signal is greater or less than 1 volt and note the polarity also.
8. Set the ZERO SUPPRESSION RANGE control (-volts+) to the appropriate range and use the VERNIER dial to bring the pen to the center of the chart.
9. Advance the VOLTS FULL SCALE Control clockwise until the desired sensitivity of the dynamic signal is obtained. Bring the signal to chart center with the ZERO SUPPRESSION VERNIER.
10. Read the peak-to-peak value of the dynamic signal from the recorder chart.

    NOTE: On high sensitivity settings, and the RANGE control set to + or -10V, the resolution fo the VERNIER control may limit the ability to set the pen trace to center zero.

11. The average value of the static portion of the signal is read from the VERNIER dial.

    A signal greater than 10 volts may be examined in a like manner by placing the X1/X100 switch in the X100 position. (The zero suppression range is increased by a factor of 100).

NOTE: The maximum allowable signal is + or -500 volts.

3.6 FILTER OPERATION

To eliminate 60 Hz or other unwanted frequencies a two position filter is provided. The user has the option of either 15Hz or 5Hz band width (-3dB). The filter is a two pole -12dB/Octave type.

3.7 ZERO ADJUSTMENT

During extended operation of the amplifier or under extreme temperature variation, it is advisable to check the amplifier zero. The following is recommended:

1. Remove the input signal and short the amplifier inputs to common (pins 1, 2 and shield of J101).
2. Set VOLTS FULL SCALE control to OFF.
3. Run recorder at moderate speed and use pen position pot to set pen to center zero.
4. Set VOLTS FULL SCALE control to most sensitive position.
5. Adjust front panel BAL pot to rezero output if necessary.
6. Return VOLTS FULL SCALE control to the OFF position. Amplifier is now ready to use.

NOTE: If the amplifier does not return to zero in the OFF position, an internal potentiometer will have to be adjusted. See the Calibration Section.

3.8 FUNCTIONAL TEST PROCEDURE

This procedure should be performed to verify operation and calibration of the unit. If the output is within the tolerance given, no calibration is required. If not, refer to Section V of this manual.

1. With the Volts Full Scale to .025V position, Filter OFF, Sensitivity fully clockwise to X1 and Zero Suppression OFF, short together J101 pins 1 and 2 and connect to common. Output should be 0V ±5mv.
2. Remove jumpers shoriting inputs together and to common. Set Volts Full Scale to 5 position and apply +5vdc to input. Output should be +5vdc ±5mv.
3. Change input to +10vdc. Set Zero Suppression switch to +10 and vernier dial to 10.00. Output should be 0V ±20mv.
4. Remove signal, power and test equipment. Unit is ready for use.

SECTION IV

THEORY OF OPERATION

4.1 GENERAL

The Gould D.C. Preamplifier, Model 13-4615-10 consists of an input divider, input amplifier with variable gain and zero suppression, buffer amplifier and an output amplifier with active filtering. Power for the amplifier is supplied by the recorder. See Figure 4-1 Block Diagram.

4.2 DETAILED DESCRIPTION (Schematic 286367)

a. Input Divider and Amplifier

A simplified schematic (Figure 4-2) illustrates the operation of the input section.

Amplifiers U201 and U202 are connected as non-inverting amplifiers to provide a high input resistance. Feedback resistors R206 through R212, R215 and R235 provide a differential gain of;

$$1 + \frac{R215 + R235}{R206 \text{ thru } R212}$$

A common mode signal is amplified **by 1.**

The resulting signals are then applied to the differential amplifier U203 along with resistors R219, R220, R221, R222, R223 and R224. The gain is adjusted to equal 1 for either input. Thus, the common mode signal is rejected and the normal mode (differential) signal is amplified by a gain of 1 and converted into a single ended output.

The input attentuator R201, R202, R203, R204 and R205 extends the useful range of the amplifier to 500 volts when placed in the X100 position.

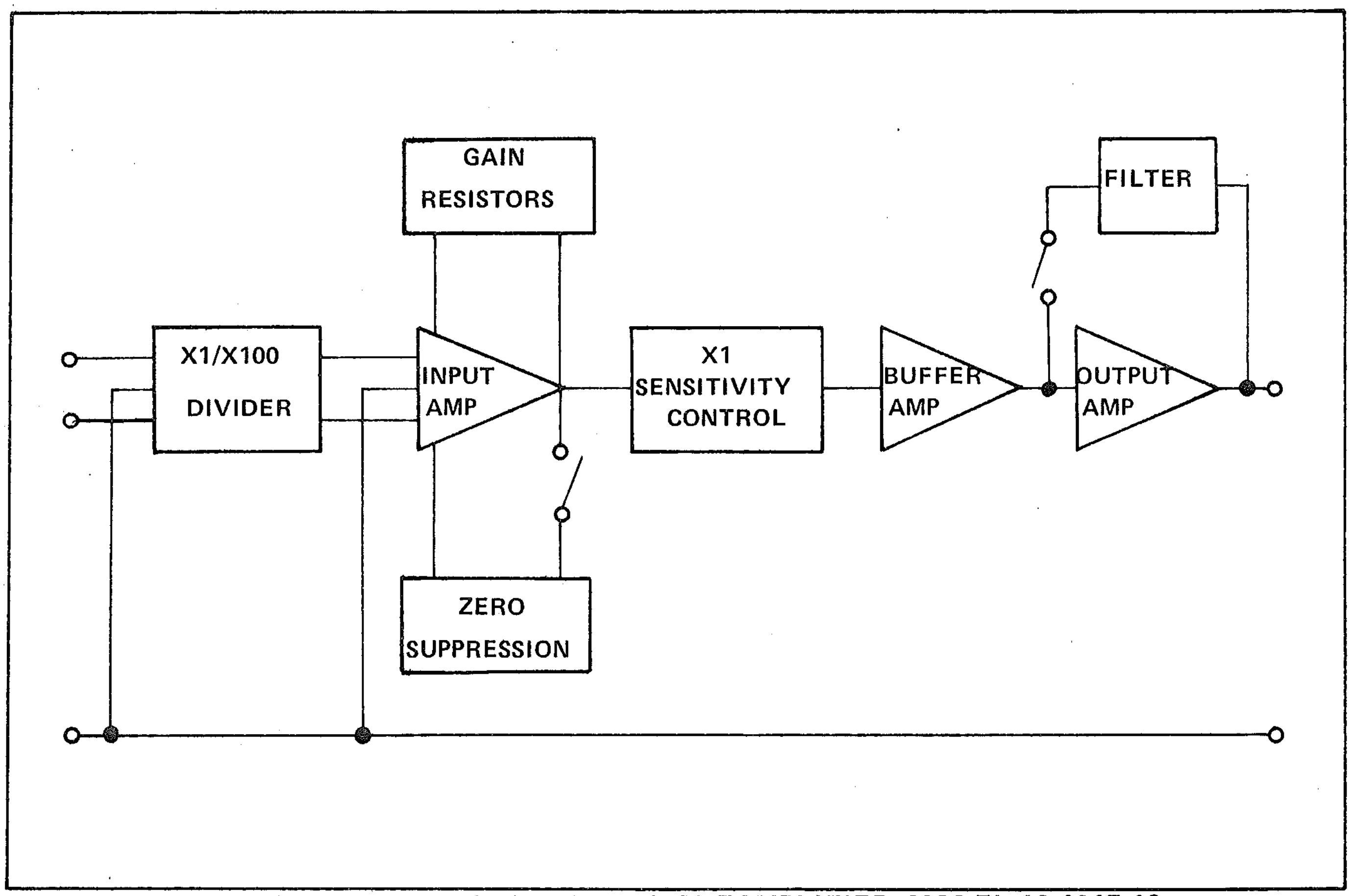


FIGURE 4-1 BLOCK DIAGRAM - D.C. PREAMPLIFIER, MODEL 13-4615-10

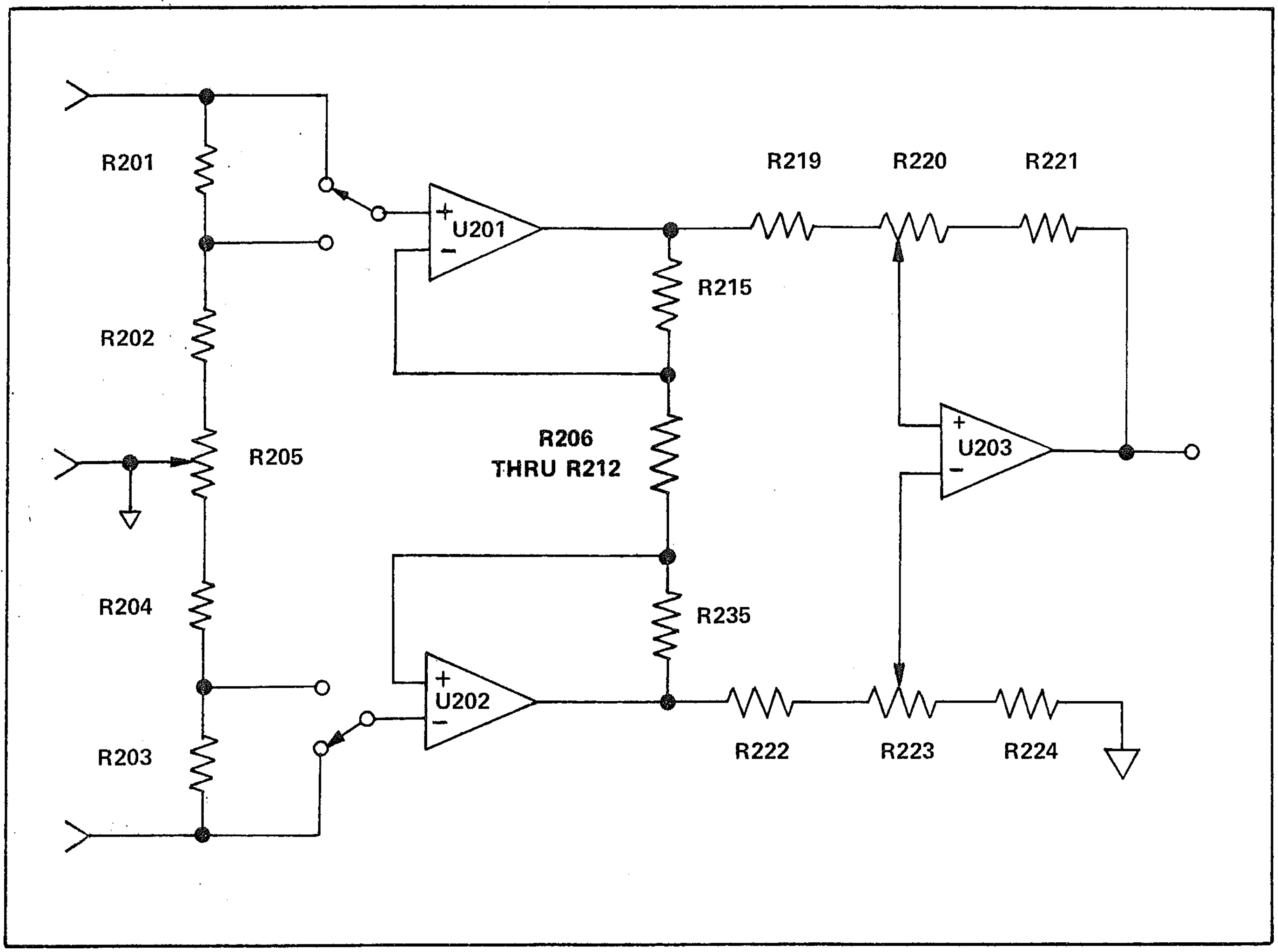


FIGURE 4-2 INPUT SECTION SCHEMATIC

b. Buffer and Active Filter

Amplifier U204 is connected as an approximately unity gain non-inverting buffer. R233 is used for output zero adjustment.

The X1 sensitivity control R101 forms a divider along with R225 and allows the gain to be varied by a factor of 2.5 to 1.

Amplifier U205 is a non-inverting unity gain amplifier when switch S102 is in the OFF position. The amplifier becomes a two pole active filter in the 15 and 5 position. The attenuation is approximately -12dB/Oct.

c. Zero Suppression

An isolated supply is obtained by means of transformer T201. A constant current is fed to zener CR201 to provide a stable voltage. It is divided down to either 10 volts or 1 volt and placed in the feedback loop of amplifier U202.

The suppression is done within the feedback loop, rather than at the input, in order to keep the impedance level low. Practically no extra noise is introduced by the suppression circuit regardless of the source resistance.

Switch S103 is used to select the polarity and magnitude of the suppression voltage.

SECTION V

CALIBRATION

5.1 GENERAL

In addition to detailed calibration procedures, this section contains paragraphs on troubleshooting and maintenance.

5.2 CALIBRATION

a. General

The Gould D.C. Preamplifier, Model 13-4615-10, has been accurately calibrated before shipment from the factory and should give long trouble free service. Should recalibration be required, it should be performed by qualified technical personnel only.

NOTE: This procedure is broken down into sub paragraphs by individual adjustments. Under normal conditions, complete calibration should be performed every six months. After repair of the unit or some other change in the electronics it is necessary only to recalibrate those circuits affected by the change.

b. Test Equipment Required

The following is a list of test equipment necessary for calibration.

1. Extender card and cable assembly, Gould P/N 887291.
2. AC/DC Digital Multimeter: 4½ digit, 0.05% accuracy. (DVM)
3. AC source: Wavetek Model 110 or equivalent.
4. Power Supplies: ±15vdc @ 150ma, ±5%; 13vrms, 60Hz @ 200ma.
5. DC Source: Electronic Development Corp. Model VS330H or equal.
6. Oscilloscope: Gould Model OS3300B or equivalent.
7. 2000 series recorder.

c. Preliminary Procedure

1. Remove right side cover from preamp (Figure 5-1).
2. Attach signal input cable and output connector.
3. Apply Power: ±15vdc supplies and 13 vrms or power from a series 2000 recorder. Allow 15 minutes for warmup.

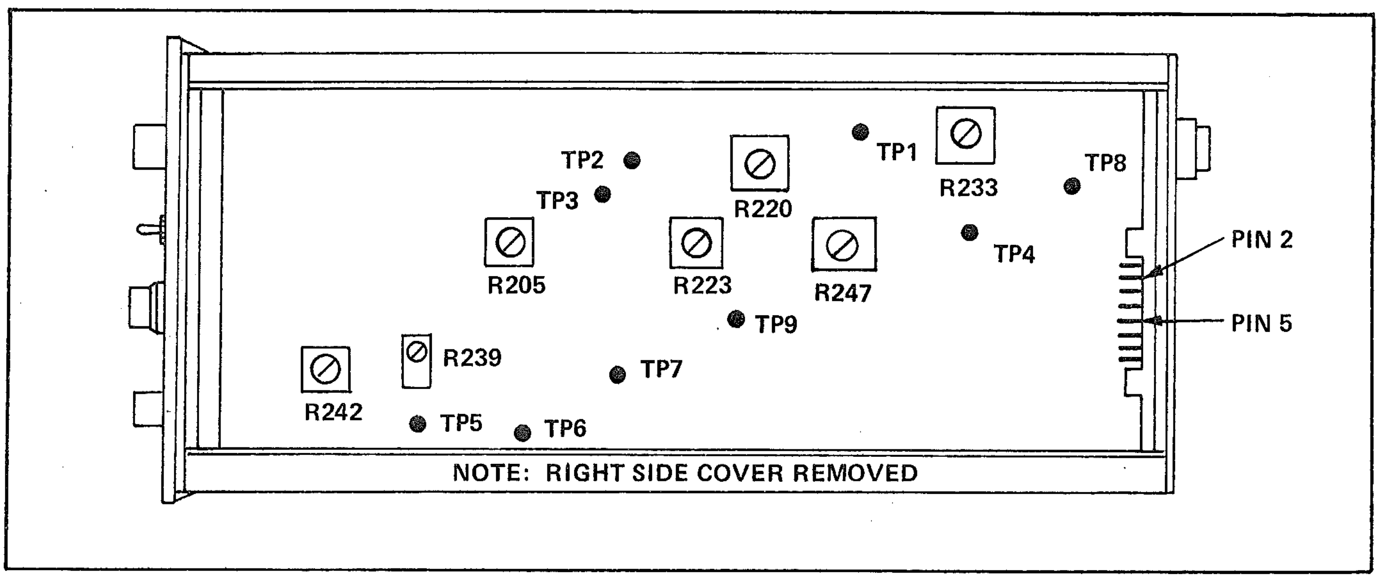


FIGURE 5-1 CALIBRATION COMPONENT LOCATION

4. Set preamp front panel controls as listed below:

CONTROL	POSITION
Volts full scale	Off
X1, X100 switch	X1
Zero Suppression, Vernier	0.0
Zero Suppression, Range (-Volts +)	Off
X1 Sensitivity	Fully C.W. (Detent Pos.)
Filter	Off
Bal	Mid-Range

5. Apply power and allow unit to warm up for 15 minutes.

5.3 CALIBRATION PROCEDURE

a. Zero Adjustment

1. Short both inputs (J-101) to common and set the VOLTS FULL SCALE switch to .025.

2. Connect the DVM to TP-2 (High) and TP-3 (Low). Adjust the front panel BAL adjustment (R-102) for 0 volts ±2mv.

3. Connect the DVM to TP-1 (High) and TP-9 (Common). Adjust R-247 for 0 volts ±2mv (Figure 5-1).

4. Set the VOLTS FULL SCALE switch to 5. Connect the DVM to TP-8 (High) and TP-9 (Common). Adjust R-233 for 0 volts ±2mv (Figure 5-1).

5. Set VOLTS FULL SCALE switch back to .025. and check for 0 volts ±2mv. If necessary readjust front panel BAL adjustment (R-102) for 0 volts ±2mv.

6. Rotate the VOLTS FULL SCALE switch thru all ranges with the input shorted. Make sure that there is less than ±5mv shift from 0 volts on all ranges. Repeat steps 2 thru 5 if necessary.

7. Remove jumpers from step 1.

b. Gain Adjustment

1. Set the VOLTS FULL SCALE switch to the 5V position and the multiplier switch to the X1 position.

2. Connect the plus (+) input to common and apply a -5V dc signal to the minus (-) input. Monitor the output with a DVM and adjust the output to read +5.0 volts ±5mv with the CAL 1 pot, R220 (Figure 5-1).

3. Disconnect the source and connect both inputs to common and note the zero reading with the VOLTS FULL SCALE switch set to 5V. Remove jumpers to common.

4. Apply a +5V dc signal low to common and high to plus input. Short plus and minus inputs together (common mode). Adjust the output to read the same as in step 3, with the CAL 2 pot, R223 (Figure 5-1).

5. Set the multiplier switch to X100 and the VOLTS FULL SCALE switch to 5V. Note the zero reading.

6. Apply a 100vdc signal as in step 4 and use the input BAL pot, R205 (Figure 5-1), to adjust the output to read the same as with zero applied voltage. Remove the input voltage and check zero. Repeat the various steps if necessary. Remove jumpers.

7. Apply full scale normal mode voltages to all ranges. The output should read 5V ±25 mv on all ranges.

c. Zero Suppression Adjustment

1. Short both inputs (J-101) to common (ring).

2. Connect DVM to TP-8 (High) and TP-9 (Common). (Figure 5-1).

3. Rotate the front panel VERNIER dial to 10.0 and lock it in position.

4. Set VOLTS FULL SCALE switch to 5 and the "-VOLTS+" switch to +10.

5. Adjust R-239 (Figure 5-1) for an output voltage of -10 volts ±2mv.

6. Reset the "-VOLTS+" switch to +1. Adjust R-242 for an output of -1.0 volt ±.2mv. (Figure 5-1).

7. Reset the "-VOLTS+" switch to -1. The output should be +1.0 volt ±.2mv. (R-242), Figure 5-1).

8. Reset the "-VOLTS+" switch to -10. The output should read +10 volts ±2mv. (R-239, (Figure 5-1).

9. Remove jumpers from step 1.

5.4 TROUBLESHOOTING

a. General

Troubleshooting may be performed in conjunction with the schematic (in the parts section) and the necessary bench equipment listed in paragraph 5.2. When the preamplifier is used with the Gould Series 2000 recorders refer to the troubleshooting table in Section V of the recorder manual.

5.5 MAINTENANCE

a. General

Maintenance on the preamplifier is limited to cleaning only.

b. General Cleaning

CAUTION:

1) Before attempting to clean the preamp, turn power off and remove from enclosure.

2) Avoid use of chemical cleaning agents which might damage plastic or printed surfaces. Do not use chemicals which contain toluene, cellusolve, acetone or similar solvents.

EXTERIOR: Remove loose dust with a soft cloth or small paint brush. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. **DO NOT USE ABRASIVE CLEANERS.**

INTERIOR: Dust in the interior should be removed occasionally due to its electrical conductivity under high humidity conditions. Blow off accumulated dust with dry low pressure air. Remove any dirt which remains with a soft paint brush or a soft cloth dampened in a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces and/or printed circuit boards.

SECTION VI

SIGNAL SOURCES

6.1 GENERAL

An understanding of signal sources, amplifier input configurations and signal connections in electrical measurement is vital to prevent noise or ambient conditions from overshadowing desired physical or electrical variables. Final data may be useless unless a signal source is properly selected or identified and used with an appropriate signal conditioning amplifier.

The following explanation of signal sources has been extracted from Gould Brush Applications booklet No. 101, SIGNAL CONDITIONING.

Signal Sources

Transducer or signal source selection is the first step in most measurement or recording applications. Low impedance devices are preferred, to reduce system noise and to minimize the shunting effect (loading) which the measuring instrument imposes on the source.

The signal source must be properly identified so that it can be matched with an appropriate amplifier. Signal sources fall into six classes, according to the configuration of the ouptut circuit. These are summarized as follows:

A SINGLE ENDED-GROUNDED signal source has two output terminals, one of which is connected to source ground as shown in Figure 1-A. The a-c line powered signal generator with a two terminal grounded output is typical.

A SINGLE ENDED-FLOATING signal source has two output terminals which are isolated from ground as shown in Figure 1-B. A FLOATING output can be grounded or reversed without disturbing the circuit. The dry cell battery, the output from a magnetic head, or a two terminal battery powered signal generator are typical examples.

A SINGLE ENDED-DRIVEN OFF GROUND signal source has two output terminals which are driven off ground by a second voltage, as shown in Figure 1-C. A DRIVEN OFF GROUND signal source can NEVER be grounded. A resistive shunt installed in the hot side of a power line or d-c bus for measuring current is a classic example.

A BALANCED-GROUNDED signal source has two active output terminals which have equal impedance to a common ground, as shown in Figure 1-D. The output terminals can be reversed without disturbing the circuit. A four arm wheatstone bridge output that is excited from a grounded power supply is a good example.

A BALANCED-FLOATING signal source is one that has two active output terminals which have equal impedance to common point that is floating, is shown in Figure 1-E. A four arm wheatstone bridge output that is excited from a FLOATING power supply or a center-tapped transformer secondary are typical examples. The output terminals can be reversed or the common terminal can be grounded without disturbing the circuit.

A BALANCED-DRIVEN OFF GROUND signal source has two active output terminals which have equal impedance to a common point which is driven off ground by a second voltage, is shown in Figure 1-F. The active output terminals can be reversed to invert signal polarity, but it can NEVER be grounded without disturbing or destroying the signal source. An example is a differential output amplifier which produces an output of ±30 volts, but operates at about +60 volts d-c off ground.

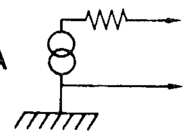
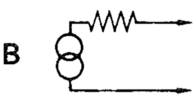
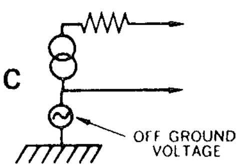
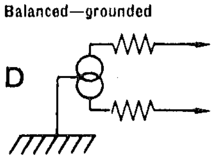
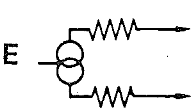
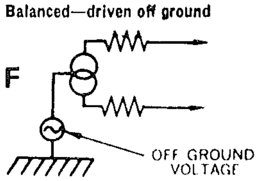
Source	Description	Examples
Single ended—grounded A 	Two output terminals one of which is connected to ground.	AC line powered signal generator.
Single ended—floating B 	Unbalanced output, isolated from ground. Can be grounded without disturbing circuit.	Dry cell battery. Magnetic tape head. Battery-powered signal generator.
Single ended—driven off ground C 	Unbalanced output, driven off ground by second voltage source. Cannot be grounded.	Resistive shunt in hot side of line or bus—for measuring current.
Balanced—grounded D 	Terminals have equal impedance to common ground.	Four arm Wheatstone bridge, excited from grounded DC supply.
Balanced—floating E 	Terminals have equal impedance to floating common point. Common point can be grounded without disturbing circuit.	Four arm Wheatstone bridge excited from floating DC supply. Center-tapped transformer.
Balanced—driven off ground F 	Terminals have equal impedance to common point, driven off ground by a second voltage source. Cannot be grounded.	Differential output recorder amplifier (e.g., device with ±30 v output, operates in 0—60 v range).

Figure 1. Classification of Signal Sources

Identification of Signal Sources

If an electrical schematic is not available, a signal source may be identified by using one channel of a Brush recorder plus an ohmmeter. To identify a two-terminal source, the ground or low recorder input terminal is connected to a good solid ground at the signal source. With the source turned ON, the high side of the recorder input is connected to one output terminal of the signal source and then the other. The amplitude and character of these two measurements provide the required information about the source.

A zero signal from one signal source terminal and a usable signal from the other indicate a **single ended-grounded** source. Equal 60 Hz noise signals from both terminals indicate a floating source, and if there are only two terminals a floating source is probably **single ended-floating.** A resistance of several hundred megohms from each terminal to ground confirms that the source is floating. Usable but unequal signals from the two terminals indicate a driven off ground output. The average of the two signals is the off ground or common mode voltage, the difference is the signal amplitude. If the two-terminal source is turned OFF and the ohmmeter shows unequal resistance from the terminals to ground, the source is probably **single ended-driven off ground.** For all three source types, an ohmmeter across the two terminals with the source turned OFF indicates the source resistance.

To identify a three terminal signal source, the **ground** or **low** recorder input terminal is again grounded at the signal source. The **high** recorder terminal is connected to each of the three source output terminals in sequence.

A zero signal from one terminal and equal or similar signals from the other two indicates a **balanced-grounded** source. With the signal source turned OFF, resistance readings from ground to each terminal identify the ground terminal and the source resistance of each active output terminal to ground. Equal 60 Hz noise signals from the three terminals, and a resistance of several hundred megohms between all three terminals to ground, indicates a **balanced-floating** source. With the source turned OFF, ohmmeter readings across the three output terminals reveal the common terminal, the source resistance of each leg to common, and the total source resistance.

A usable signal from one terminal to ground and nearly equal signals from the other two, indicates a **driven off ground** source. The terminal with the minimum signal or a signal different from the other two is probably the common terminal, and the signal from it to ground is the off-ground or common mode voltage. With the source turned OFF, equal resistance readings to ground from any pair of terminals and a smaller resistance to ground from a third terminal confirms that the source is **balanced-driven off ground.** Resistance readings taken across the three output terminals reveal the common terminal, the output resistance of each leg to common and the total source resistance.

The Elusive Ground Loop

The GROUND LOOP is the largest source of electrical noise between electronic modules. More than one ground on a signal circuit or signal cable shield produces a common impedance coupling or ground loop between these two points. This generates large 60 Hz electrical noise currents which are in series and combined with the useful signal. The magnitude of ground loop current is directly proportional to the difference in absolute potential between the two grounds. In most cases a ground loop through either a cable shield or signal circuit will produce so much 60 Hz noise that it will obscure millivolt level signals.

Two separate grounds are seldom, if ever, at the same absolute voltage. This potential difference creates unwanted current in series with one of the signal leads. In Figure 2-A the potential difference between "Earth Ground No. 1" and "Earth Ground No. 2" produces ground loop current in the lower signal lead from the signal source to the input of the amplifier, causing ground loop noise to be combined with the useful signal. There is a second ground loop in Figure 2-A through the signal cable shield from the signal source to the amplifier. The ground loop current in the shield is coupled to the signal pair through the distributed capacity in the signal cable. This current is returned through the output impedance of the signal source and back to Earth Ground No. 1, adding a second source of noise to the useful signal. Either one of these ground loops is capable of generating a noise signal that is at least one hundred times larger than a typical millivolt level signal.

The amplifier shown in Figure 2-B is capable of being FLOATED a few volts off ground. The ground loop through the signal lead can be broken by simply lifting the amplifier grounding strap. The amplifier enclosure is still solidly grounded to "Earth Ground No. 2", but this will not create a ground loop, since the amplifier enclosure is insulated from the signal circuit. The ground loop through the signal cable shield is eliminated by removing the jumper from the cable shield to "Earth Ground No. 2". Now the signal source and the signal cable shield are grounded ONLY at the signal source, which is the proper configuration for minimum noise pickup.

In off-ground measurements, the signal cable shield should NOT be grounded. Effective shielding is secured by stabilizing the signal cable shield with respect to the useful signal. The signal cable should be connected to either the center tap or the low side of the signal source. Since the signal cable shield is being driven by an off-ground common mode voltage, it is necessary that the cable have appropriate insulation between the shield and the outside of the cable. THIS IS VERY IMPORTANT.

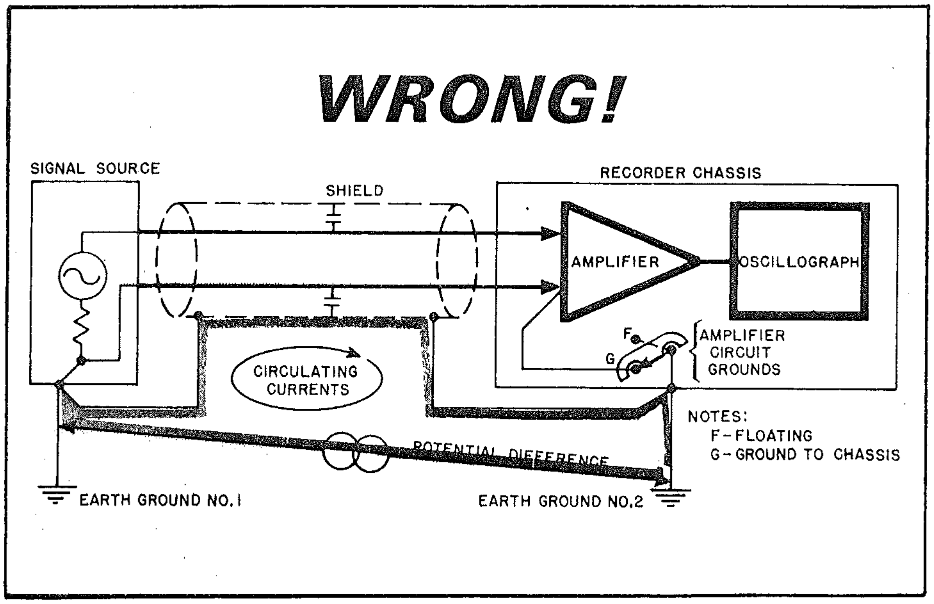


Figure 2A.

Typical ground loop is created by more than one ground on a signal circuit.

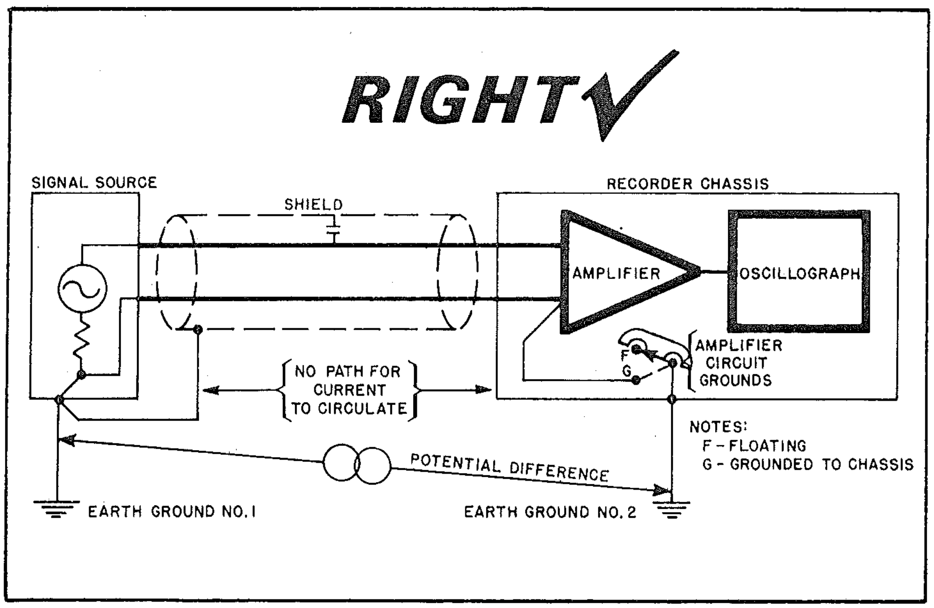


Figure 2B.

Ground loops are eliminated by turning amplifier input switch to FLOATING position and removing jumper from earth ground No. 2 to signal cable shield.

Recording system should have stable system ground
Signal circuit should never be grounded at more than one point
Signal cable shield should not be attached to more than one ground, and this ground should be at the signal source
More than one intentional or accidental ground on the signal circuit or signal cable shield will produce excessive electrical noise in any low level circuit
In off-ground recording, the signal cable shield should *not* be grounded; it should be connected to the center tap or the low side of the signal source

Figure 3.
Guide lines on Grounding

Amplifier Input Configurations

The SINGLE ENDED-GROUNDED AMPLIFIER has two input terminals, one of which is common with the output. This direct connection from the input to output is normally grounded through the third conductor in the a-c power cord. The amplifier enclosure is usually internally connected to this common point.

This type of amplifier works well with BALANCED-FLOATING signal sources or SINGLE ENDED-FLOATING signal sources, but it will NOT operate properly with any type of grounded signal source unless it is connected to the same ground as the amplifier, or unless one of the grounds is disconnected. Any difference in potential between the signal source ground and the amplifier ground WILL ADD TO OR SUBTRACT FROM the true value of the signal being measured. This erroneous noise signal is generally referred to as a "Ground Loop" and must be avoided.

The BALANCED TO GROUND AMPLIFIER has two active input terminals which have equal resistance to a common ground terminal. This common input terminal is firmly grounded through the third wire in the a-c power cord. Both the enclosure and the low side of the output are normally grounded to this same point inside the amplifier case. It can be operated as a "Balanced to Common" amplifier by removing the ground connection in the a-c power cord. In this case the amplifier would normally be connected to ONE ground at the signal source. It can also be operated as a "Single Ended-Grounded" amplifier by simply installing a ground strap from one active input terminal to ground.

The major limitation of a "Balanced to Ground" amplifier is its restricted off ground voltage capability which decreases as the input attenuator is advanced to a more sensitive position. This type of amplifier will work well with a SINGLE ENDED-FLOATING signal source, a BALANCED-FLOATING signal source and in most cases with a BALANCED-GROUNDED signal source.

The SINGLE ENDED-FLOATING AMPLIFIER has two input terminals that are electrically isolated from the output terminals. It is normally provided with an internal floating shield which is internally connected to the low side of the input. Both input terminals are free to float up or down in compliance with any common mode voltage that may appear at the signal source but the capacity to ground of the low input terminal is greater than the capacity to ground of its "hot" input terminal. It is therefore important to connect this amplifier so that any common mode voltage at the signal source is used to drive the low side of the input. The amplifier enclosure and the low side of the output are normally grounded through the third wire in the a-c power cord.

This type of amplifier works well with SINGLE ENDED-GROUNDED signal sources SINGLE ENDED-FLOATING sources or SINGLE ENDED-DRIVEN OFF GROUND sources and can be used down to millivolt levels with BALANCED- FLOATING signal sources.

The BALANCED, FLOATING AND GUARDED AMPLIFIER is the most sophisticated for all d-c amplifier types and can be used with all types of self-generating signal sources. Both input terminals are isolated from amplifier chassis and isolated from the output. The input terminals also have equal impedance to a third terminal called the Guard Shield or simply "GUARD", which is a full floating internal shield. The guard is used to minimize internal capacity from signal input terminals to chassis ground and to improve the a-c common mode rejection of the amplifier.

Both amplifier input terminals are free to float up or down in compliance with any common mode voltage that may appear at the signal source. Since both input terminals are floating and have very low capacity to chassis ground, the incoming signals may be GROUNDED, FLOATING or DRIVEN OFF-GROUND without affecting accuracy or system noise. When the guard shield is properly connected,

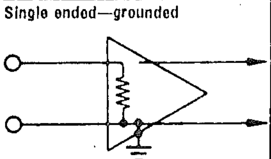
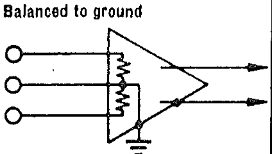
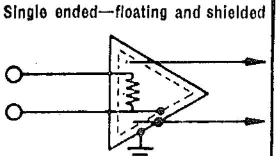
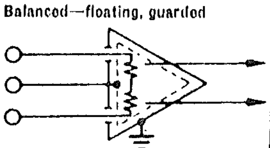
Input configuration	Input terminals	Grounding
Single ended—grounded 	2 active terminals, one common with an output terminal.	Common terminal and enclosure grounded through AC power cord.
Balanced to ground 	2 active terminals, each with equal resistance to a third, common ground terminal.	Common input terminal, enclosure, and low output terminal grounded through AC power cord.
Single ended—floating and shielded 	2 active terminals, isolated from output. Internal shield connected to low input terminal.	Enclosure and low output terminal grounded through AC power cord.
Balanced—floating, guarded 	2 active terminals, each with equal impedance to a common terminal. This third terminal is a floating internal shield, or guard shield.	Only the amplifier enclosure is grounded through AC power cord.

Figure 4. Classification of Amplifiers

the a-c noise rejection characteristics are quite good, so this amplifier can be used over a wide range of signal amplitudes, down to and including the microvolt level. The guard shield is NOT internally connected, but it is brought out to separate terminals in the amplifier input connector so that it may be properly connected for all types of signal sources.

Single Ended-Grounded Amplifier

When a "Single Ended-Grounded" amplifier is used with a SINGLE ENDED-FLOATING signal source, the low side of the source and the signal cable shield are connected to the grounded amplifier input terminal as shown in Figure 5. The other side of the source is connected to the "active" amplifier input terminal.

When a "Single Ended-Grounded" amplifier is used with a BALANCED-FLOATING signal source, the grounded amplifier input terminal may be connected to either side of the signal source. The other side of the source is connected to the "active" amplifier input terminal. The signal cable shield is connected to the grounded amplifier terminal as shown in Figure 6.

A "Single Ended-Grounded" amplifier can be operated at millivolt levels with a SINGLE ENDED-GROUNDED signal source provided one of the grounds is disconnected. Where possible, remove the ground at the source and connect the cable shield to the amplifier ground as shown in Figure 5. If this is not practical, the amplifier ground must be disconnected so the amplifier can float a few volts away from power line ground. It is done by using a ground isolation adapter on the a-c power plug. In this configuration, the grounded side of the signal source is connected to the amplifier ground terminal and the signal source is connected to the amplifier as shown in Figure 7. The amplifier enclosure is still grounded but to the signal source ground instead of the power line ground. When the source ground is used, all channels in a multichannel system must be connected to a common signal source ground.

The "Signal Ended-Grounded" amplifier is NOT appropriate for low-level applications because it has no common mode rejection and would therefore be quite noisy. It should NOT be used with a BALANCED-GROUNDED signal source because the amplifier ground would disturb or unbalance the source. It should NEVER be used with a DRIVEN OFF GROUND source because the "Single Ended-Grounded" amplifier input would destroy the source, or burn off the amplifier grounding connection or both.

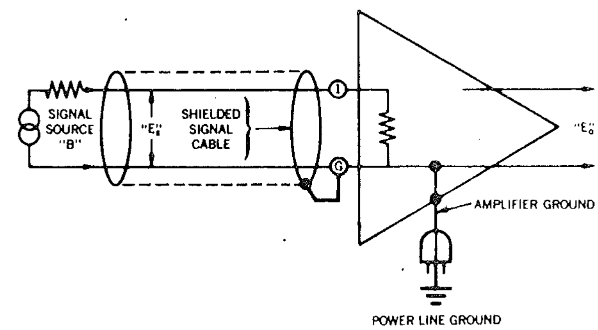


Figure 5. Single Ended-Grounded Amplifier. Operating grounded with floating signal source.

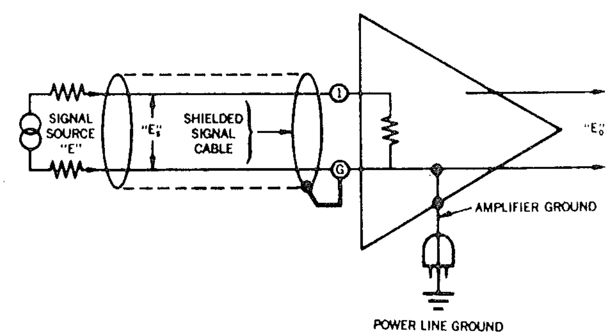


Figure 6. Single Ended-Grounded Amplifier. Operating grounded with floating signal source.

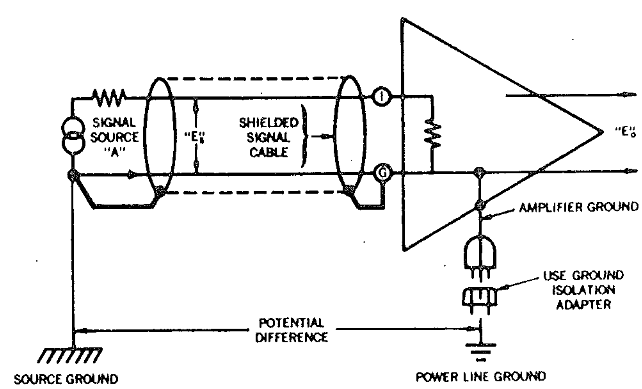


Figure 7. Single Ended-Grounded Amplifier. Operating floating from grounded signal source.

Balanced to Ground Amplifier

When a Balanced to Ground Amplifier is used with SINGLE ENDED-FLOATING or BALANCED-FLOATING signal sources, the two active amplifier input terminals are connected to both sides of the signal source. The connections can be reversed if a change in polarity is desired. The signal cable shield is connected to the grounded input terminal on the amplifier as shown in Figures 8 and 9. The optional ground strap shown in Figure 8 may be installed or omitted depending on which condition provides minimum electrical noise.

The BALANCED-GROUNDED signal source can be used with a "Balanced to Ground" amplifier and operated at full sensitivity if the potential difference between the signal source ground and the amplifier ground is quite small. In this case the difference in absolute potential between the signal source ground and the amplifier ground would show up as a common mode voltage as shown in Figure 10. For example, if the two grounds differed in absolute potential by 2.8 volts peak-to-peak and the amplifier has a common mode rejection of 1000:1 (60 dB) at 60 Hz, then 2.8 millivolts would show up as an error or noise signal at the amplifier input.

For this balanced to ground application the active amplifier input terminals are connected to both sides of the signal source. These connections can be reversed if a change in signal polarity is desired. The signal cable shield is connected to the grounded input terminal on the amplifier and to the grounded center tap on the signal source as shown in Figure 10. The common mode problem could be eliminated if it is possible to lift the ground at the signal source creating a balanced-floating input as shown in Figure 9, or by lifting the ground at the amplifier and operating as a "Balanced to Common" amplifier as shown in Figure 11. When the signal source ground is used, all channels in a multichannel system must be connected to a common source ground.

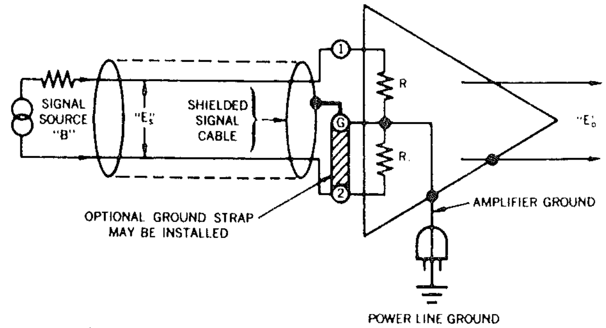


Figure 8. **Balanced to Ground Amplifier. Operating grounded with single ended-floating source.**

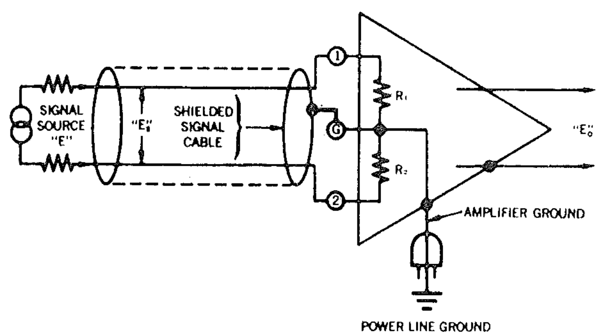


Figure 9. **Balanced to Ground Amplifier. Operating grounded with balanced-floating source.**

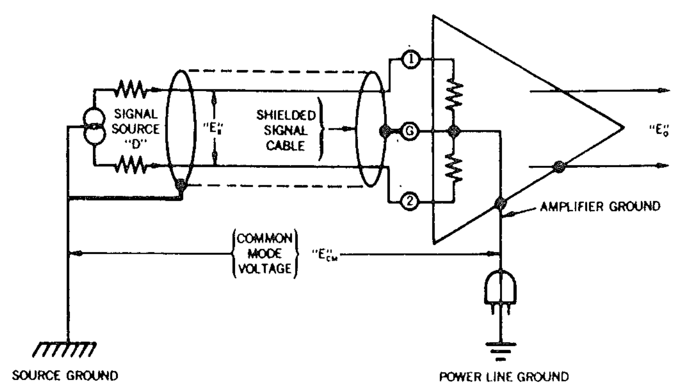


Figure 10. **Balanced to Ground Amplifier. Operating grounded with balanced-grounded signal source.**

The "Balanced to Ground" amplifier can NOT be used with a SINGLE ENDED-GROUNDED signal source. The best solution would be to remove the ground at the signal source and operate the amplifier "Single Ended-Grounded" as shown in Figure 8. If this is impractical, then the amplifier would have to be operated "Single Ended-Floating". This can be done by installing the ground strap from input terminal (2) to the ground terminal and then lifting the ground in the a-c power cord as shown in Figure 12. When the signal source ground is used, all channels in a multichannel system must be connected to a common source ground.

The "Balanced to Ground" amplifier can be used in some LOW GAIN applications where the signal source is driven off ground by a common mode voltage as shown in Figure 13. The magnitude of the off ground voltage is limited by the maximum common mode voltage that is permitted on the amplifier at various sensitivity settings and by the amount of common voltage error that can be tolerated. For example a typical amplifier has a common mode rejection of 60 dB (1000:1) at 60 Hz which means that a 20 volt peak-to-peak common mode voltage would produce a 60 Hz error voltage of 20 millivolts. If the recorder sensitivity was 1.0 volt full scale (20 mv per chart div.) this would represent a common error of 2% of full scale which would probably be all right for most applications.

If the amplifier common mode rejection is 40 dB 100:1, the error would be 20% which can NOT be tolerated for any application. This problem could be resolved by operating the amplifier "Balanced to Common" as shown in Figure 11, providing the user is willing to assume the responsibility of operating the amplifier enclosure and output circuit 20 volts off ground. Otherwise an isolation amplifier would be required.

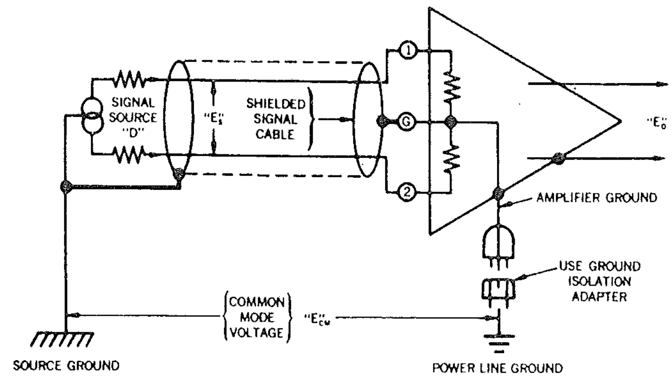


Figure 11. **Balanced to Ground Amplifier. Operating floating with balanced grounded signal source.**

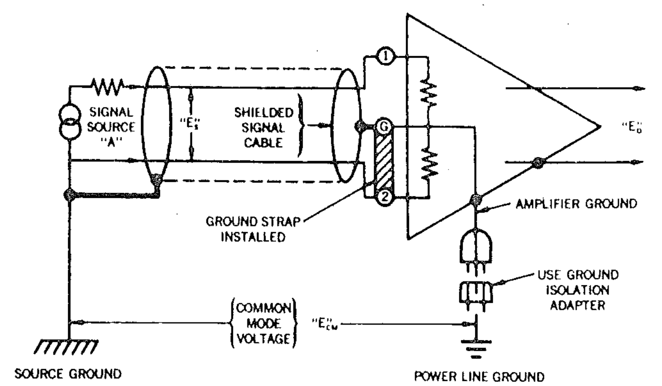


Figure 12. **Balanced to Ground Amplifier. Operating floating with single ended-grounded source.**

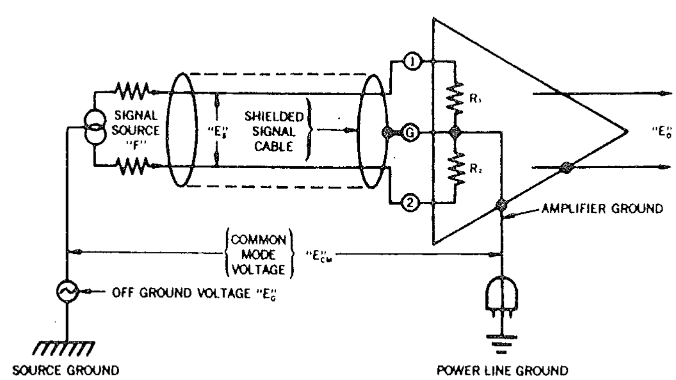


Figure 13. **Balanced to Ground Amplifier. Operating grounded with balanced-driven off ground source.**

SECTION VII

PARTS IDENTIFICATION

7.1 GENERAL

This instrument has been accurately calibrated and adjusted before shipment from the factory and should give long, trouble-free service. For servicing beyond the scope of the instructions contained in this manual or the technical equipment available, contact your nearest Gould Service Engineer listed on the warranty card shipped with the instrument.

The following parts lists and schematic diagrams are designed to assist in servicing and repairing the instrument.

NOTE: Check to be sure the schematic number and revision letter stamped on the rear of the instrument agree with the number and revision letter on the schematic contained in this section.

To assure prompt and satisfactory delivery of replacement parts, include the following with the purchase order:

1. Name, model number, and serial number of the instrument.

   For Example: DC Preamplifier Model 13-4615-10 Serial Number ________________

2. Description of the part as listed in the manual.
3. Gould part number.

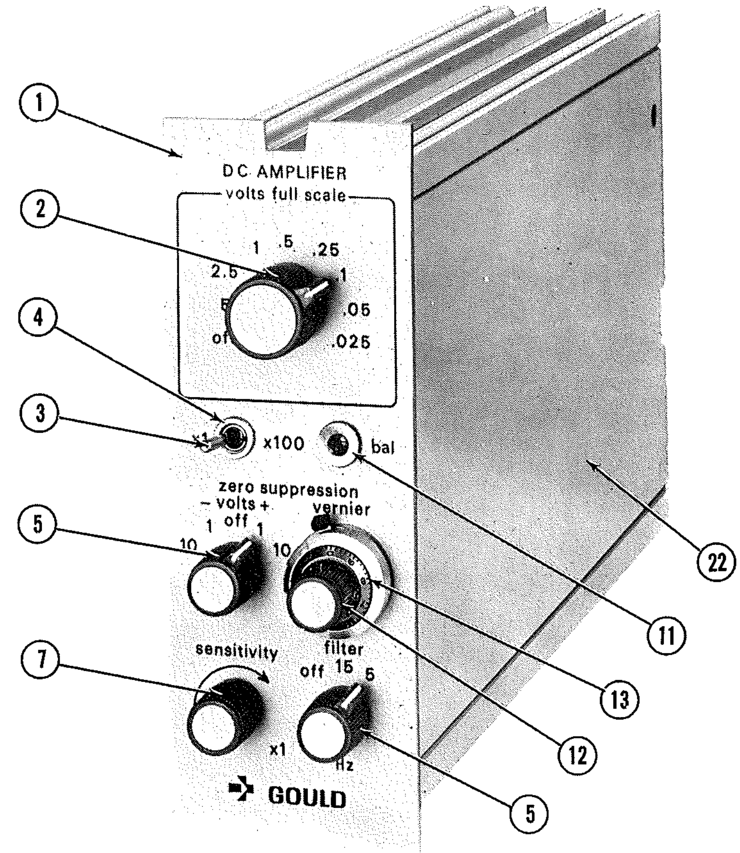
NOTE: Do not use the SYMBOL NUMBER from the parts list for identifying desired parts on the order.

GOULD MEDIUM GAIN D.C. PREAMPLIFIER MODEL 13-4615-10 FIGURE 7-1

ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
1	786073	Front Panel Assembly	
2	285652-2	Knob	
3	686765	Switch, Toggle	S101
4	663800-1	Nut, Knurled	
5	285652-1	Knob	
6	685120	Rotary Switch Assembly	S103
7	285651-3	Knob	
8	246393-103	Resistor, Variable	R101
9	286467	Nut, Adapter	
10	685113	Resistor Assembly, Variable	R102
11	286318	Bushing, Adapter	
12	285650	Knob	
13	284990	Knob, Turns Counting	
14	685121	Resistor Assembly, Variable	R103
15	286151-1	Switch, Rotary	S102
16	9-281501-9	Connector	P201,P202
17	281502-1	Contact (Not shown, Part of item 16)	
18	685944-1	Frame, Top or Bottom	
19	886331	Amplifier Board Assembly (See Fig. 7-2)	
20	686335	Input Connector Assembly	J101

GOULD MDEIUM GAIN D.C. PREAMPLIFIER
MODEL 13-4615-10 (continued)
FIGURE 7-1

ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
21	686421	Cover Assembly, Left Side	
22	285943	Cover, Right Side	
23	785946	Panel Assembly, Rear	
24	386317	Sub Panel, Front	



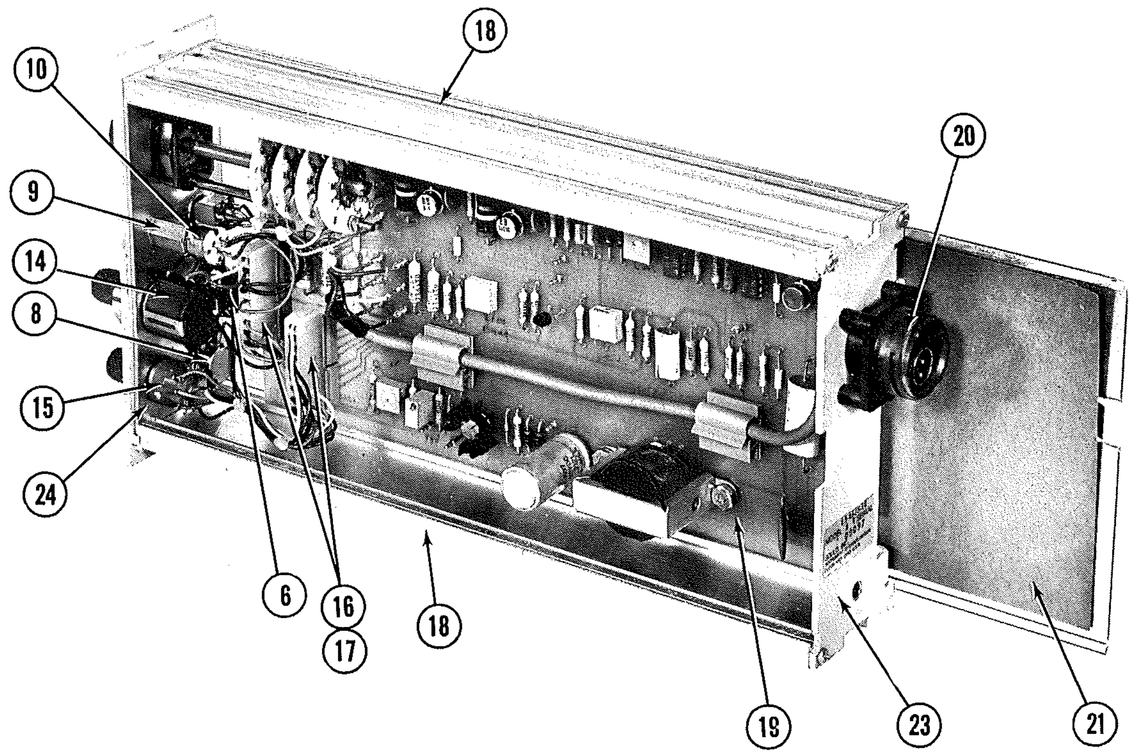


FIGURE 7-1 MEDIUM GAIN D.C. PREAMPLIFIER

GOULD MEDIUM GAIN D.C. PREAMPLIFIER, MODEL 13-4615-10
ELECTRICAL PARTS LIST
AMPLIFIER BOARD ASSEMBLY (886331)
FIGURE 7-2

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
C201, C202	281344-103	Capacitor
C203	240352-102	Capacitor
C204, C205	262585-106	Capacitor
C206	5-241145-224	Capacitor
C207	5-241145-684	Capacitor
C208	240352-103	Capacitor
C209, C210	231707-336	Capacitor
C211	240352-102	Capacitor
C212	281509-507	Capacitor
CR201	247151-2	Semiconductor, 1N942
CR202	249747	Semiconductor, 1N752A
CR203, CR204	231887	Semiconductor
J201, J202	281711-4 & 5	Connector
Q202	266484	Transistor, 2N4036
S	262176	Heat Sink
R201	R1-286685-10003	Resistor
R202	R1-284694-10001	Resistor
R203	R1-286685-10003	Resistor
R204	R1-284694-10001	Resistor
R205	284878-201	Resistor, Variable
R206	25-265969-15001	Resistor
R207	25-265969-27780	Resistor
R208	25-265969-11690	Resistor
R209	25-265969-645R0	Resistor
R210	25-265969-206R0	Resistor
R211	25-265969-102R0	Resistor
R212	25-265969-100R0	Resistor
R213	5-115559-104	Resistor
R214	1-265969-10002	Resistor
R215	25-265969-10001	Resistor
R216	5-241111-101	Resistor
R217	5-115559-104	Resistor
R218	5-241111-101	Resistor
R219	25-265969-10001	Resistor
R220	284878-201	Resistor, Variable
R221-R222	25-265969-10001	Resistor
R223	284878-201	Resistor, Variable
R224	25-265969-10001	Resistor
R225, R226	1-265969-50000	Resistor

GOULD MEDIUM GAIN D.C. PREAMPLIFIER, MODEL 13-4615-10
ELECTRICAL PARTS LIST
AMPLIFIER BOARD ASSEMBLY (886331) — Continued
FIGURE 7-2

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
R227	1-265969-85000	Resistor
R228	1-265969-16901	Resistor
R229	1-265969-39201	Resistor
R230	25-265969-12502	Resistor
R231	25-265969-10001	Resistor
R232	50-128182-4954	Resistor
R233	284878-103	Resistor, Variable
R234	1-265969-10002	Resistor
R235	25-265969-10001	Resistor
R236, R237	1-265969-15001	Resistor
R238	25-265969-900R0	Resistor
R239	269085-201	Resistor, Variable
R240	1-265969-50R00	Resistor
R241	1-265969-250R0	Resistor
R242	284878-100	Resistor, Variable
R243	25-265969-98R00	Resistor
R244	5-241111-472	Resistor
S201	286085	Switch, Rotary
T201	286132	Transformer
U201, U202	286020	Integrated Circuit, 3501
U203, U204	280863-3	Integrated Circuit, 741
U205	289385	Integrated Circuit, 13741
———	270903-11	Clamp
———	267235	Jumper
R245, R246	5-115557-105	Resistor
R247	284878-103	Resistor, Variable

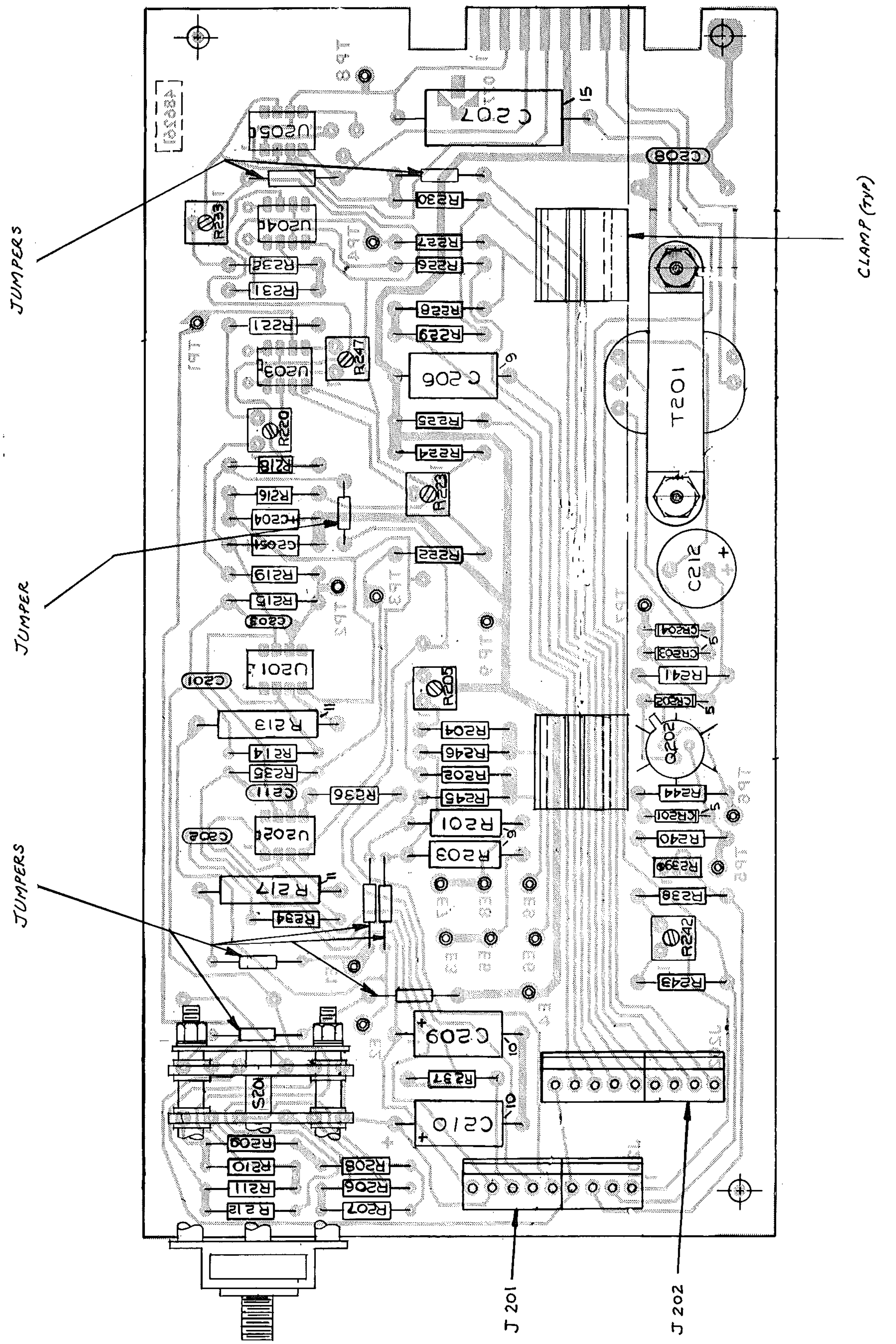
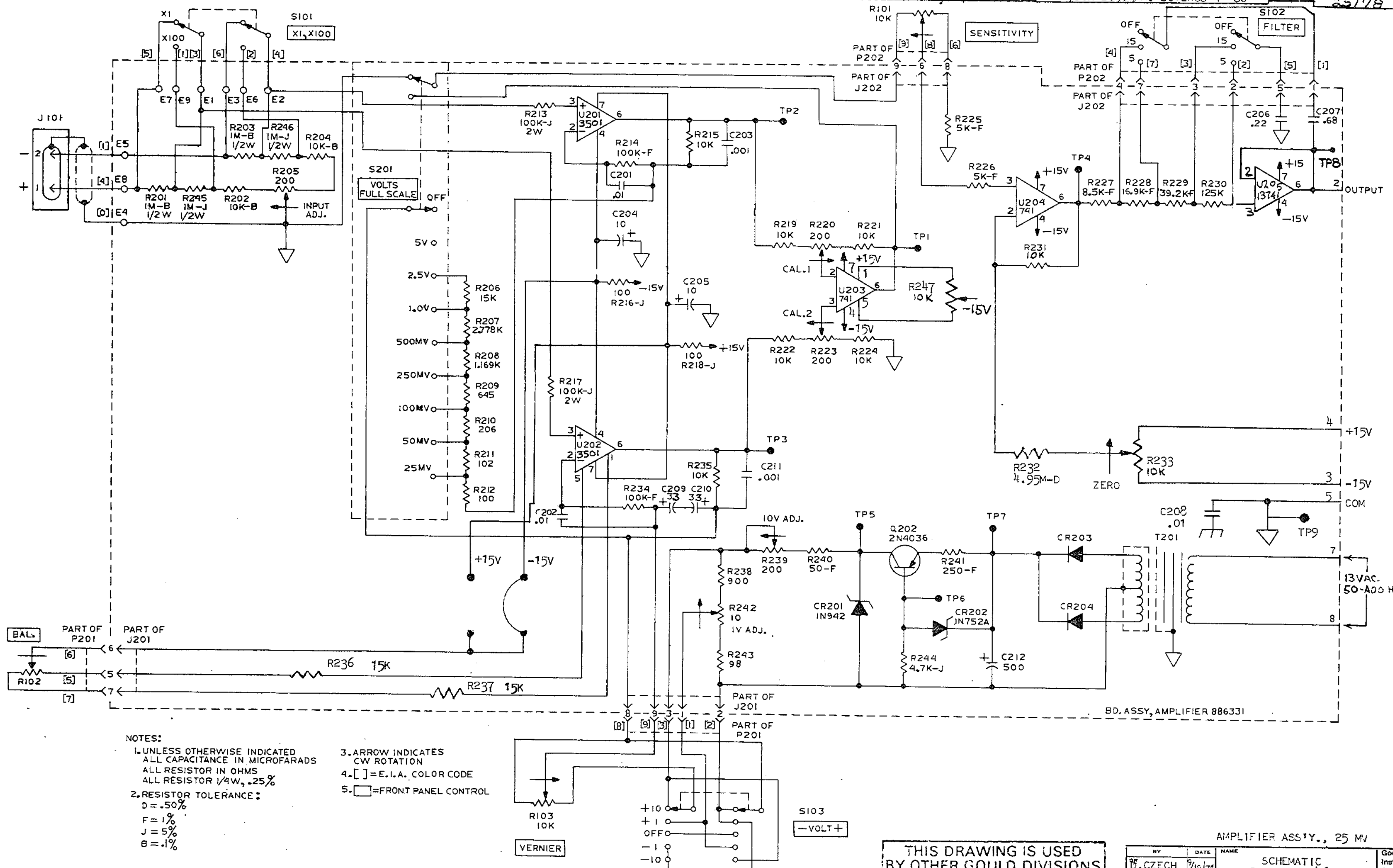


FIGURE 7-2 AMPLIFIER BOARD ASSEMBLY 886331

	REVISIONS	
H-1	VALUE OF R231 WAS 6.8K-F DCN 27996/JONES	4-22-81
F-1	REVISED PER DCN 27006/K.HAMILTON	9-24-80
G-1	CAPACITORS; C209 & C 210 WERE 35MF DCN 27639 /S.JONES	2-12-81
G-2	RESHOT FOR CLARITY/NO CHANGES	2-16-81

SYM.	DESCRIPTION	DATE
D-1	REVISED SCHEMATIC PER DCN 25690/A. SOTEROS	10-23-79
E-1	REVISED SCHEMATIC PER DCN 26563/A. SOTEROS	5-23-80

SYM.	DESCRIPTION	DATE
A-1	REVISED PER DCNS 20052 AND 20056	7-8-
B-1	REVISED PER DCN 20540	9-11-
C-1	REVISED PER DCN 25178	4-3-



NOTES:

1. UNLESS OTHERWISE INDICATED ALL CAPACITANCE IN MICROFARADS ALL RESISTOR IN OHMS ALL RESISTOR 1/4W, .25%
2. RESISTOR TOLERANCE:
   - D = .50%
   - F = 1%
   - J = 5%
   - B = .1%
3. ARROW INDICATES CW ROTATION
4. [ ] = E.I.A. COLOR CODE
5. ▭ = FRONT PANEL CONTROL

THIS DRAWING IS USED BY OTHER GOULD DIVISIONS AND/OR LOCATIONS. A F

AMPLIFIER ASS'Y., 25 MV

BY	DATE	NAME
B. CZECH	9/10/74	SCHEMATIC MODEL NO. 13-4615-10
CH LENARC	9/13/74	CODE IDENT. 96795
J. NAYLOR	9/13/74	ISSUE G

Gould Inc. Instrument Systems Division Cleveland, Ohio 44114 U.S.A.

DWG. NO. 286367

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