INSTRUCTION MANUAL

MODEL CSA-3

DC AMPLIFIER

MOSELEY ASSOCIATES, INC.

SANTA BARBARA RESEARCH PARK

GOLETA, CALIFORNIA 93017

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111 Castilian Drive
Goleta, California 93017

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I. INTRODUCTION

The Model CSA-3 DC Amplifier was designed specifically to amplify a low-level DC current to a level suitable to insure compatibility with remote control or telemetering equipment. Examples of typical inputs which may be handled by the CSA-3 are signals in the microampere range, such as from a reflectometer or standing-wave ratio meter or from a frequency meter. An example in the milliampere signal range would be an input from a klystron as employed in a UHF television transmitter. The device has a floating input circuit in order that either or neither input terminal may be grounded. Isolation of 400 volts capability is afforded. The gain of the CSA-3 is such that 15 μamperes flowing through the 2200 Ω input termination resistor will produce an output of 1.5 volts DC. Gain and Zero (bias) controls are provided. The CSA-3 is a general purpose DC amplifier with low input impedance for insertion in series with an existing metering system.

II. SPECIFICATIONS

Input Impedance	2200Ω stock; field convertible to other values up to 4700Ω by shunting or changing the input termination
Input Level	15 μamperes minimum to 500 μamperes maximum through the 2200Ω input termination
Minimum Output Load	5000Ω minimum recommended
Output Level	1.5 volts DC into a 10K load with a 15 μampere input
Bandpass	DC to 10 Hz
Rise Time	50 milliseconds
Adjustments	Gain and Zero adjustments
Temperature Range	0°F to 150°F
Power Requirements	120 VAC, 50 Hz - 480 Hz, 5 watts
Size	5" x 7-1/2" x 1-7/8"
Weight	2 pounds

III. UNPACKING

Although the CSA-3 DC Amplifier is small and hence relatively immune to damage, inspect it immediately upon receipt and report any visible damage to the carrier. Electrical operation should be confirmed as soon as practical.

IV. INSTALLATION

The CSA-3 has been designed to mount in otherwise unused portions of equipment racks. This can be construed to mean the wall or side panel of a transmitter or equipment rack. Other than observing the precaution of keeping it out of the immediate vicinity of very strong magnetic or radio-frequency fields, no particular precautions are needed. It is wise, if RF is present, to use shielded input leads. Note that the input is floating; this enables the use of a shielded 2-conductor cable. A ground terminal has been provided for the shield.

The input circuit of the CSA-3 is basically that of the 2200Ω terminating resistor. The unit has been designed to be inserted in series with the signal to be sampled. This will generally present no particular problem. A drawing at the rear of the text will show typical installation connections. Basically, the CSA-3 is inserted with its input in series with the sample. Most industrial and broadcast equipments are designed for this type of connection.

The output circuit is unbalanced; one side (the negative side) is at ground. The other side is positive and is intended to go to the telemetry input on the associated remote control or data transmission equipment. The output connections are relatively immune to extraneous signals.

The final connection to be made is the primary power connection. This pair of terminals is floating and can connect without regard to polarity to a convenient source of 120 VAC, 50 to 480 Hz. Power consumption is about 5 watts.

V. ADJUSTMENT

The CSA-3 DC Amplifier can be considered as a power amplifier, an isolation amplifier, polarity inverter, or as a combination of any of these.

When used as a power amplifier, it may be connected in series with a sampling reflectometer or VSWR meter to amplify this relatively feeble signal to a level that meets the requirements of the associated equipment.

When used in conjunction with some frequency meters, the CSA-3 is sometimes called upon to translate the input signal from a point above ground to ground potential as well as to amplify the signal.

There may be occasions when the sampled signal has a polarity that is incompatible with the following equipment. The CSA-3 will enable signal polarity reversal or inversion.

If the input signal exceeds 500 μamperes, the input terminals of the CSA-3 should be shunted to avoid overdriving the input circuitry. This will, of course, alter the input impedance and should be taken into account in readjusting the original equipment meter calibration, should that be required.

Adjustment of the CSA-3 will first be covered where the ZERO adjustment is not called upon to perform a major role. A second set of instructions will then cover the adjustment procedure in cases where this zero adjustment control is required to deliver a significant voltage.

> NOTE: There are two controls on the CSA-3. The GAIN adjustment controls the amplification applied to the input signal. The ZERO adjustment controls the no-signal output voltage. This latter control may be thought of as a bias or offset control. The primary purpose of this adjustment is to provide an artificial zero output in order that zero-left meters can be used in zero-center applications.

Prior to adjustment of the CSA-3, it is advisable to be sure of the input signal level that will be applied to it. If in doubt, measure this signal. Should it be in the range of 15 μamperes, no modification need be made to the CSA-3. However, should the signal exceed 500 μamperes the CSA-3 input termination should be changed or shunted. If this is not done, nonlinearity may result. For signals up to 1000 μamperes (1 milliampere) the input termination should be changed to 1000 Ω. To accommodate signals up to 10 milliamperes, the termination should be 100 Ω. To accommodate signals up to 100 milliamperes, terminate the input with 10 Ω.

Should the input signal be less than 15 μamperes, the input terminating resistor on the CSA-3 can be changed upward to a maximum of 4700 Ω. This will allow satisfactory amplification of signals as low as 5 μamperes.

> NOTE: The voltage drop across the input terminals of the CSA-3 should not be less than 0.03 volt DC and not more than 0.5 volt DC if both stability and linearity are to be preserved.

VI. ADJUSTMENT PROCEDURE

A. DC Amplifier Without Offset

The CSA-3 is used in this mode when amplifying the output of a reflectometer or similar low-level signal. Adjustment is straightforward and is as follows:

1. Remove the input signal.

2. Adjust the ZERO control for zero output voltage from the CSA-3 as read on an ordinary voltmeter such as a Simpson Model 260.

3. Apply the maximum signal that is likely to be encountered. In the case of a reflectometer it would be 120% of normal.

4. Adjust the GAIN control for an output voltage of 1.5 volts DC.

5. Go through Steps 1 through 4 again. This is because the GAIN and ZERO controls have some effect on one another.

6. Now connect the following equipment to the CSA-3. This will typically be a remote control or telemetering system.

7. Adjust the control or metering equipment to give normal readings. The CSA-3 controls should not be readjusted unless proven necessary. It is for this reason that they are in a protected environment.

B. DC Amplifier with Offset

The CSA-3 is used in this mode when amplifying the output of a frequency monitor or similar bipolar signal. Adjustment is as follows:

1. Remove the input signal. This can be done physically or preferably the input signal should be adjusted to zero µamperes electrically.

2. Adjust the ZERO control for 1 volt DC output from the CSA-3 as measured on an ordinary voltmeter such as a Simpson Model 260.

3. Apply the maximum signal likely to be encountered. In the case of a broadcast frequency monitor this would probably be 20 Hz or 2 kHz. Be sure this signal is in a positive direction.

4. Adjust the GAIN control for an output voltage of 2.0 volts DC as measured with the voltmeter.

5. Readjust the input signal to zero µamperes. Confirm that the output of the CSA-3 is 1 volt DC. If it is not 1 volt, use the ZERO control to bring it to 1 volt.

6. Apply maximum signal in the positive direction. Confirm that the output is 2.0 volts DC. If it is not, use the GAIN control to bring it to 2.0 volts DC.

7. Apply maximum signal in the negative direction. Confirm that the output drops from 2 volts (maximum positive signal) through 1 volt (no input signal) down to near zero output volts (maximum negative signal).

8. Now connect the following equipment to the CSA-3. This will typically be a remote control or telemetering system.

9. Adjust the control or metering equipment to give normal readings. The CSA-3 controls should not be readjusted unless proven necessary.

Notice that after the CSA-3 is initially adjusted, all subsequent adjustments are made on the following attached equipment. There should be little need to readjust the CSA-3 unless a component failure has definitely occurred. This can be confirmed by going through the initial adjustment procedure as appropriate.

VII. PRINCIPLES OF OPERATION

Referring now to the Schematic 91B 6431, note that the input to the CSA-3 is a 2200Ω terminator resistance. It is recommended that unless there is a definite need to terminate the input with another value of resistance that this resistor be left intact. Should the resistor be changed, do not go over 4700Ω unless linearity checks are made to establish that the CSA-3 is not being overdriven. Lower values of resistors may be used if it is borne in mind that the voltage across the CSA-3 input terminals should be 30 millivolts DC for 1.5 volts DC output.

The DC current flowing through the input terminating resistor causes a voltage drop across that resistor. This drop is filtered to remove any high-frequency transients by R-2 and C-1 and is applied to R-3. This resistor, in conjunction with Q-1, forms a chopper circuit. Q-1 is alternately driven from cutoff to saturation, and chops the input DC voltage into a square wave. This is passed through a blocking capacitor to prevent core saturation in the input transformer T-1. T-1 accepts the chopped DC signal and translates it down to ground potential. Both the primary of this transformer and the chopper excitation winding on T-2 are insulated for 400 volts.

The signal at the secondary of T-1 is amplified between 40 and 60 dB by the integrated circuit amplifier. The fact that this integrated circuit is a very high-gain DC amplifier is not germane to the system performance. What is vitally important is that this is a high-stability amplifier. Depending on the gain setting, between 30 and 50 dB of negative feedback are added to an already very stable amplifier.

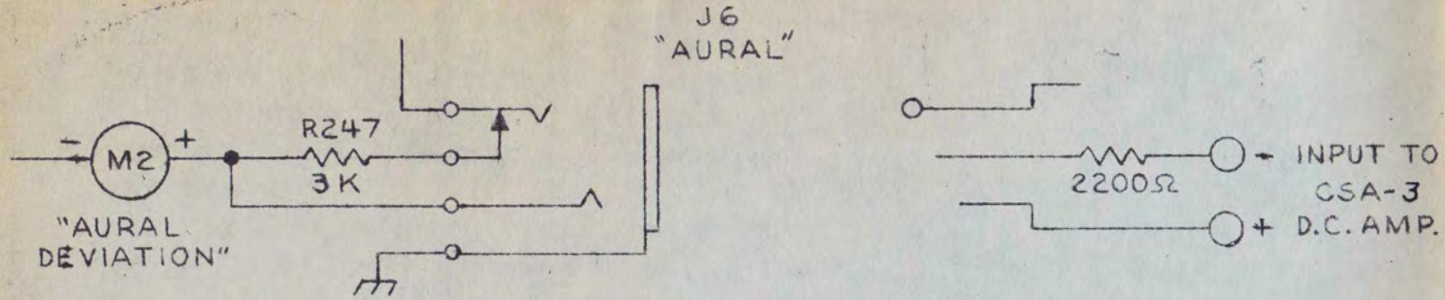
At the output of this amplifier is a square wave similar to the input signal from T-1. Its amplitude, however, has been increased to as much as 5 volts peak-to-peak. The square wave is synchronously demodulated into a signal much like that impressed on the input of the CSA-3.

The switching signals that operate both the input chopping switch and the output demodulator are derived from a free-running multivibrator. This circuit has been designed to include sure starting, to prevent latchup, base-emitter breakdown protection, and output squaring. It is followed by a Class C power amplifier driving the isolation transformer. One winding on this transformer provides excitation to the chopper transistor and another winding drives the diode bridge demodulator.

Added onto the output of the demodulator bridge is an adjustable bias control for offsetting (biasing) the output signal in a positive direction in the absence of input signal. This provides an artificial zero output in order that zero-left meters can be used in zero-center applications.

Simple but adequate regulation of the power supply is provided by small zener diode voltage regulators and associated ballast resistors. The primary power supply consists of a pair of full-wave rectifiers for positive and negative voltages, and a pair of storage capacitors.

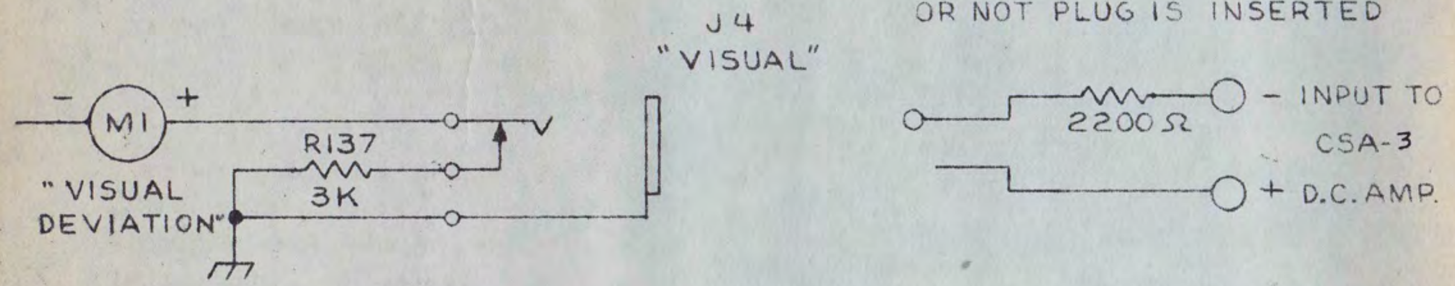
HEWLETT-PACKARD TYPE 335 E AURAL:



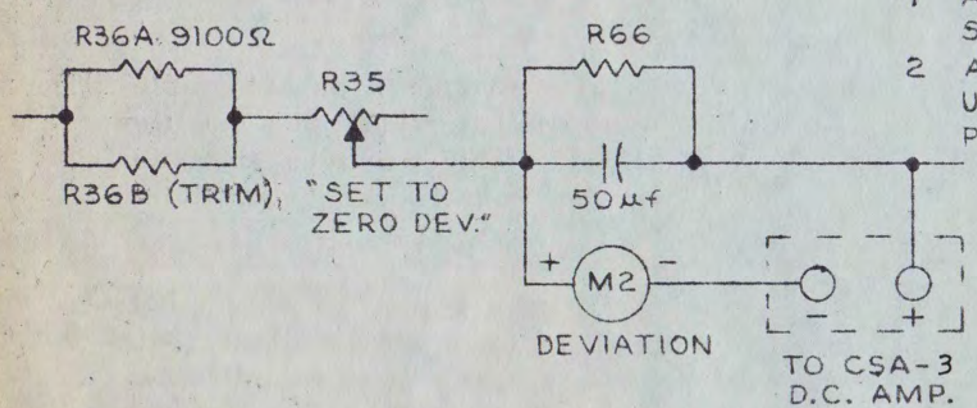
NOTE:

TRIM 2200Ω SO SCALE SENSITIVITY IS SAME WHETHER OR NOT PLUG IS INSERTED

HEWLETT-PACKARD TYPE 335 E VISUAL:



HEWLETT-PACKARD TYPE 335 B FM:

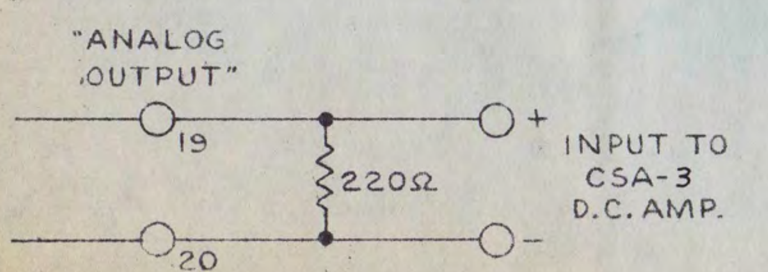


NOTES:

1 ADD BARRIER STRIP AS SHOWN. CONNECT CSA-3
2 ADD SHUNT ACROSS R36 UNTIL R35 FUNCTIONS PROPERLY.

CAUTION: +300 VOLTS ON BARRIER STRIP.

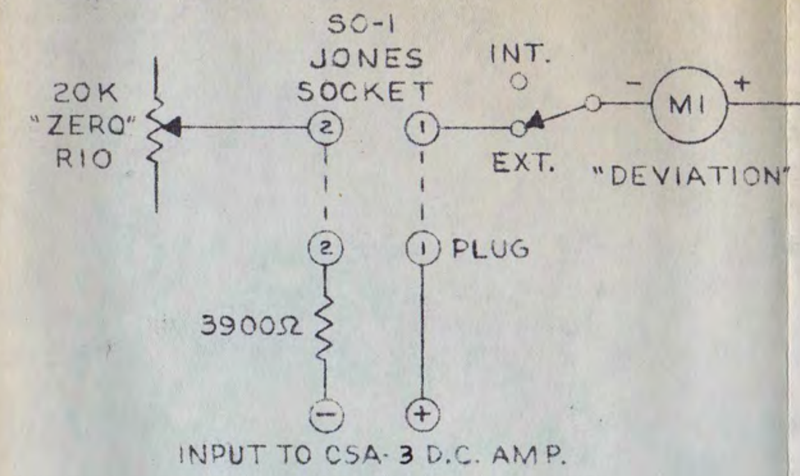
COLLINS TYPE 54 MONITOR:



NOTES:

1 D.C. AMP. NEEDED ONLY FOR LEVEL TRANSLATION TO GROUND FOR PBR-( ) SERIES EQUIPMENT.
2 OUTPUT SATURATED IF OFF-FREQUENCY IN EITHER DIRECTION.

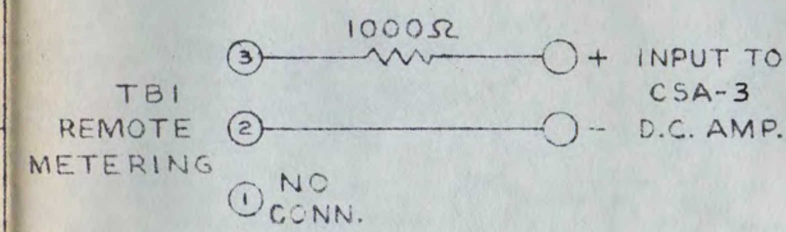
GENERAL RADIO TYPE 1181 B AM:



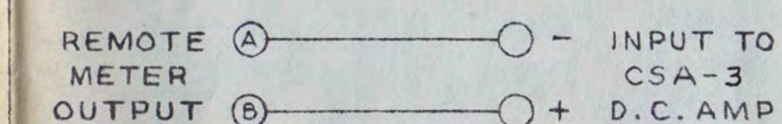
NOTES:

1 USE JONES PLUG AS SHOWN.
2 TRIM 3900Ω SO EXT. & INT. POSITIONS HAVE SAME SCALE SENSITIVITY.

GATES TYPE M4990 MONITOR:



McMARTIN TYPE TBM-3000 FM MONITOR



NOTES:

1 REMOVE JUMPER BETWEEN "A" AND "B"; CONNECT "A" & "B" TO CSA-3 AS SHOWN.
2 R-23 (SCALE LENGTH) MAY HAVE TO BE READJUSTED TO RESTORE SCALE LENGTH (METER SENSITIVITY) ON TBM-3000. THEN ADJUST CSA-3 PER MANUAL.

REVISIONS		
B	REMOVE CSA-2	2/2/74
A	ADD McMARTIN	6/69
		DATE

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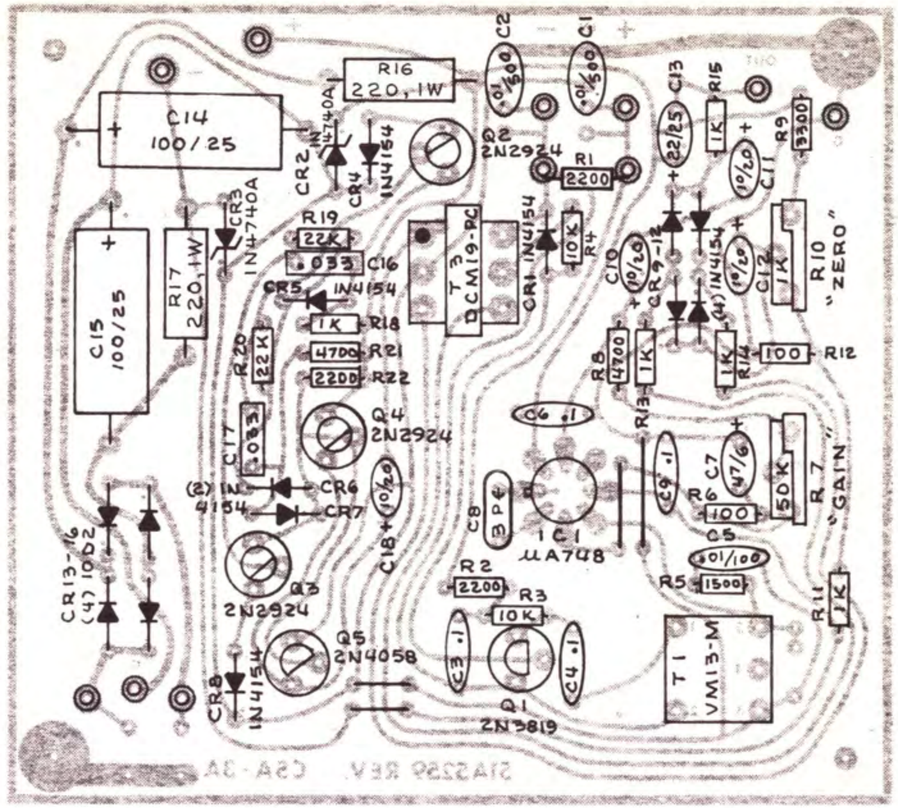
FREQUENCY MONITOR INTERFACE
MODEL CSA-3

TOL. FRACT ± 1/32, .XX ± .030, .XXX ± .010			
DWN	F X Y	11/68	SCALE: NONE
CHK			
ENG	JLT	11-68	91 B 6289 B



NOTES :

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS 1/4 W, 10%
   CAPACITOR " " " MICROFARADS
2. P. C. BOARD 51A5259
3. SCHEMATIC 91B6431

REVISIONS		DATE
B	R16 & R17 WERE 100 Ω. CR2 & 3 WERE 1Z516A ECO 479	10/26/71
A	C13 WAS 10/25. ADD R1. ECO 431.	4/2/71

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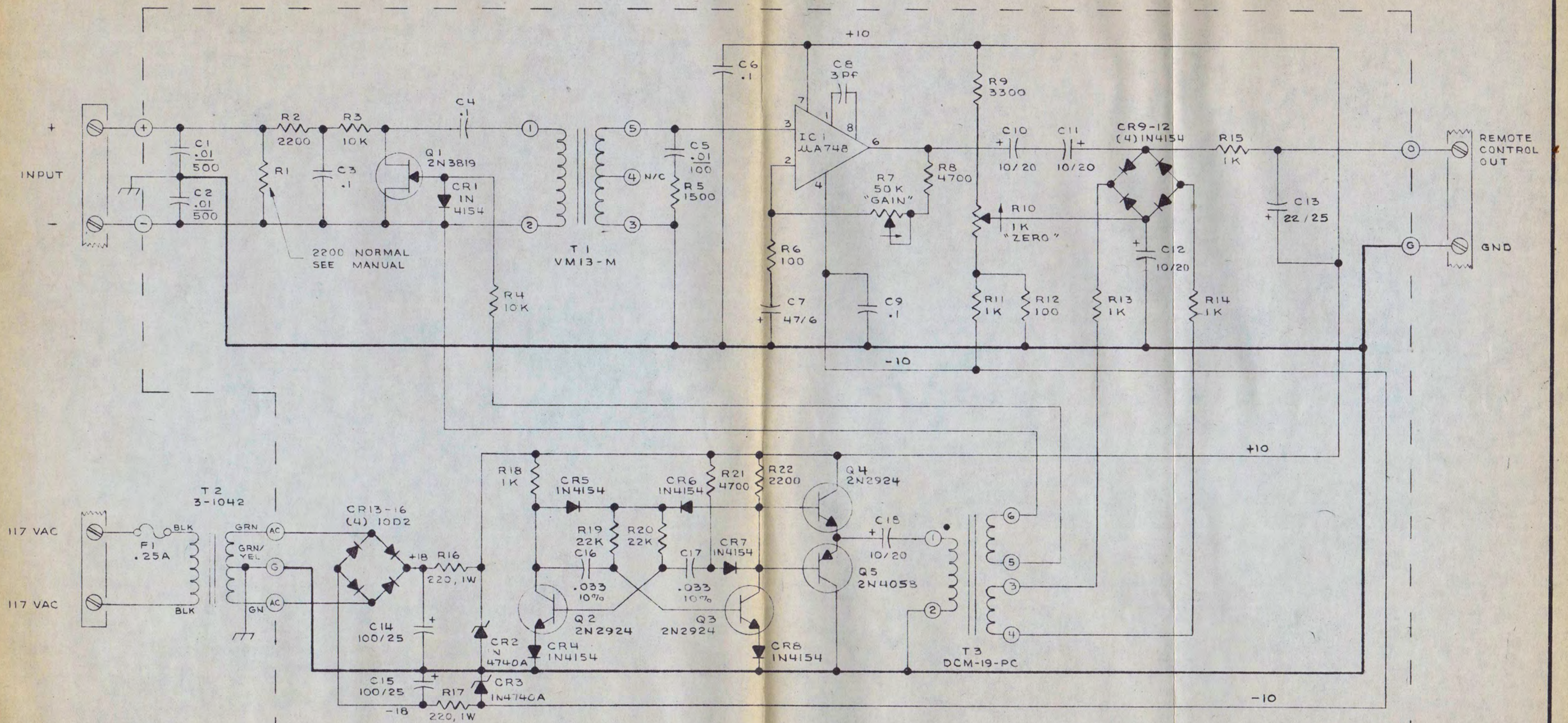
COMPONENT LAYOUT
DC AMPLIFIER CSA-3A

TOL. FRACT ± 1/32, .XX ± .030, .XXX ± .010			
DWN	JAG	1-27-71	SCALE: FULL
CHK	FXY	2/9/71	20A2257 B
ENG	JLT	9 FEB 71	



NOTES:

1 UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%
CAPACITOR " " " MICROFARADS.
2 P.C. BOARD 51A5259
3 COMPONENT LAYOUT 20A2257

REVISIONS		DATE
B	R16 & 17 WERE 100Ω, CR2 & 3 WERE 15V, ECO 479	10/26/71
A	C13 WAS 10/25, +15 & -15 WERE +10 & -10, ECO 431	4/2/71

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SCHEMATIC
CSA-3A DC AMPLIFIER

TOL. FRACT ± 1/32, .XX ± .030, .XXX ± .010			
DWN	JAG	1-26-71	SCALE: FULL
CHK	FXY	2/5/71	91B6431 B
ENG	JCP	9 FEB 71	