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**INSTRUCTION MANUAL
DIAL-A-SOURCE**

DAS SERIES

40, 50, 60, 70, AND 80.

GENERAL RESISTANCE, INC.

75 Haven Avenue

Mt. Vernon, New York 10553

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NOTE: From time to time, new applications for DAS Series instruments are discovered. Many of them are of general interest. If you would like to be placed on a special mailing list to receive these Application Notes, please write us on your company letterhead, including department and mail stop if necessary. Just ask for "DAS APPLICATION NOTES".

Naturally, if you have found any new applications, we would be extremely interested in hearing about them.

LIMITED WARRANTY

General Resistance, Inc. warrants each instrument to be free from defects in material and workmanship for a period of one year from date of purchase.

The obligation of General Resistance, Inc. under this Warranty is limited to servicing or adjusting any failed instrument returned, shipped prepaid, to the factory for that purpose.

Units returned under this warranty shall be examined by General Resistance, Inc. to establish that the failure resulted from defective material and/or workmanship and not as a result of misuse, neglect, or improper operation, which latter failure is not within the meaning of this Warranty.

This Warranty does not cover collateral or consequential damages of any nature.

General Resistance, Inc. reserves the right to make changes to design at any time without incurring any obligation to install same in units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of General Resistance, Inc., express or implied, and General Resistance, Inc. neither assumes nor authorizes any person to assume for them any other liability in connection with the sale of General Resistance, Inc. products.

Figure A

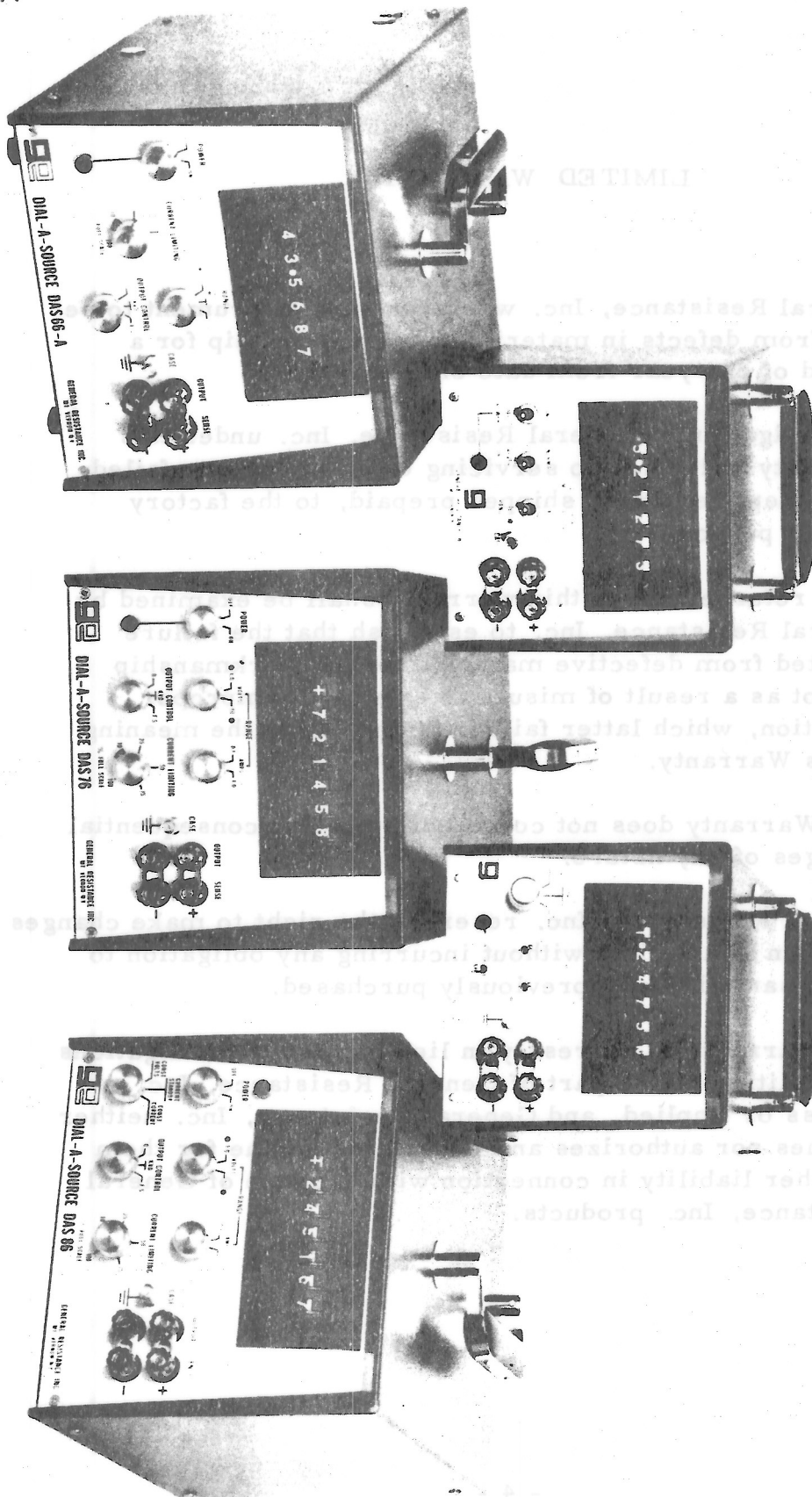
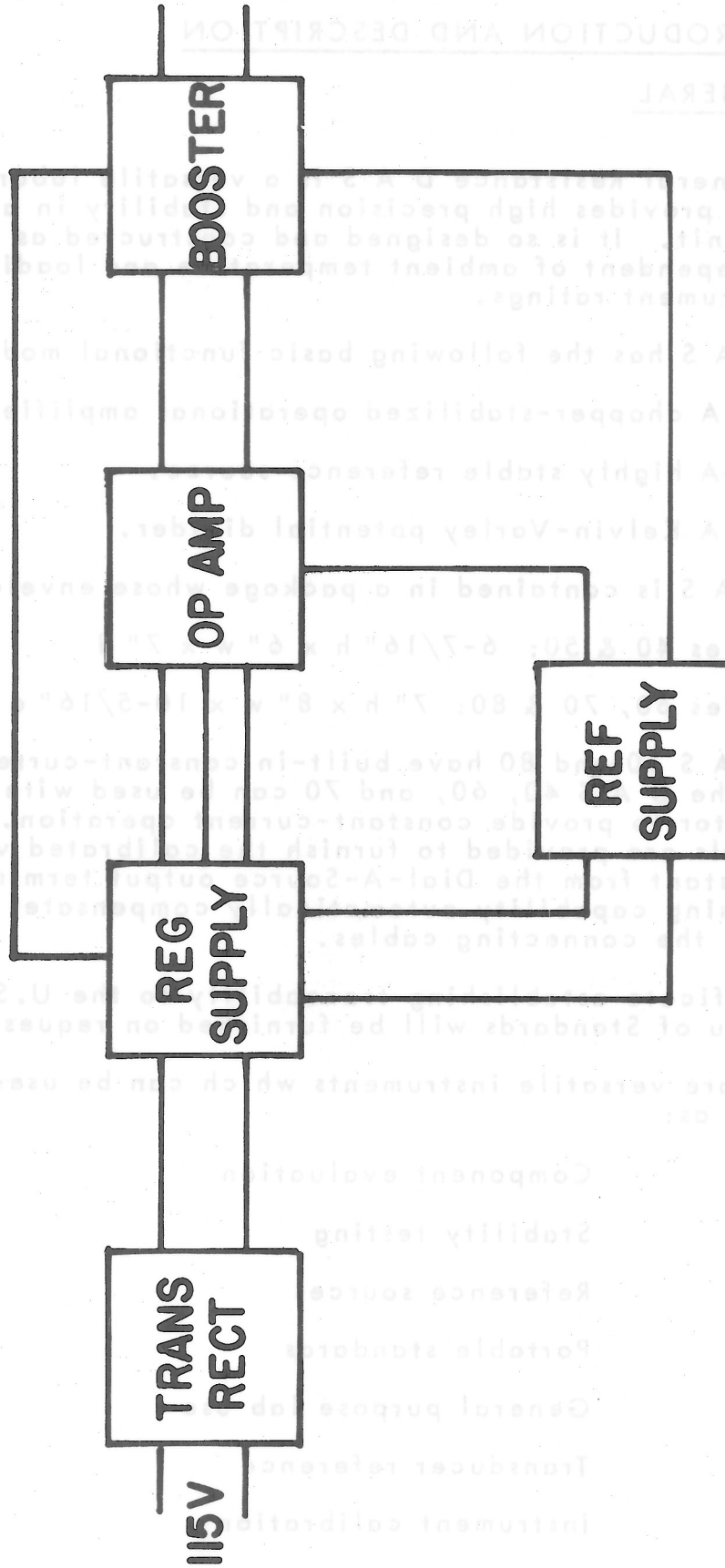


Figure B



SYSTEM BLOCK DIAGRAM

1.0 INTRODUCTION AND DESCRIPTION

1.1 GENERAL

The General Resistance D A S is a versatile laboratory instrument that provides high precision and stability in a compact portable unit. It is so designed and constructed as to be essentially independent of ambient temperature and loading within the instrument ratings.

The D A S has the following basic functional modules:

1. A chopper-stabilized operational amplifier.
2. A highly stable reference source.
3. A Kelvin-Varley potential divider.

The D A S is contained in a package whose envelope is:

Series 40 & 50: 6-7/16" h x 6" w x 7" d

Series 60, 70 & 80: 7" h x 8" w x 10-5/16" d

The D A S 50 and 80 have built-in constant-current operation while the D A S 40, 60, and 70 can be used with an inexpensive adaptor to provide constant-current operation. Remote sensing terminals are provided to furnish the calibrated voltage at locations distant from the Dial-A-Source output terminals. The remote sensing capability automatically compensates for the voltage drop in the connecting cables.

A certificate establishing traceability to the U.S. National Bureau of Standards will be furnished on request.

D A S are versatile instruments which can be used in applications such as:

Component evaluation

Stability testing

Reference sources

Portable standards

General purpose lab use

Transducer reference

Instrument calibration



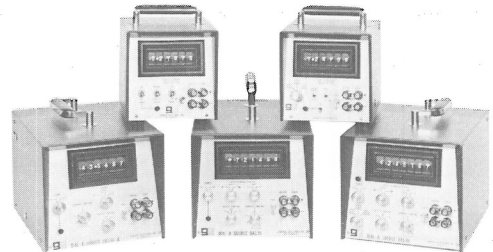
BATTERY & LINE OPERATED DIALABLE REFERENCE/CALIBRATION SOURCES

DIAL-A-SOURCE™

- Battery operated models
- Extremely stable, highly accurate, versatile power sources
- Resolutions to 0.1 μV
- Accuracies to $\pm 0.0015\%$ of setting
- Remote sensing
- "Zero" voltage output Z

APPLICATIONS:

Field standards
(battery operated)
Component evaluation
Stability testing
Reference sources
General purpose lab use
Transducer reference
Instrument calibration



SPECIFICATIONS: (Additional information on other side)

CONSTANT VOLTAGE & CURRENT SOURCES	DAS-56A	DAS-56AX	DAS-56AL	DAS-57AL			DAS-86
CONSTANT VOLTAGE SOURCES*	DAS-46A	DAS-46AX	DAS-46AL	DAS-47AL	DAS-66A	DAS-66AX	DAS-76
Battery/line operated models available	YES; change "A" in model number suffix to "B". (For example: DAS-46A becomes DAS-46B, DAS-57AL becomes DAS-57BL, DAS-66AX becomes DAS-66BX, etc.)						NO
Output EMF, F.S., ranges, dc	$\pm 1\text{V}$ & 10V				$\pm 1\text{V}$, 10V & 100V		$\pm 1\text{V}$ & 10V
Resolution, EMF, per step (LSD): 1V range	$1\mu\text{V}$			$0.1\mu\text{V}$	$1\mu\text{V}$		$1\mu\text{V}$
10V range	$10\mu\text{V}$			$1\mu\text{V}$	$10\mu\text{V}$		$10\mu\text{V}$
100V range	$100\mu\text{V}$						
Accuracy ⁽¹⁾ , EMF, %, \pm	0.005	0.0025	0.0015	0.0015	0.005	0.0025	0.005
Output current, max. load, \pm	30mA						1 Amp.
Resolution, as a constant current source, per step (LSD): 1V range	10nA^*			1nA^*			$1\mu\text{A}^*$
10V range	100nA^*			10nA^*			$10\mu\text{A}^*$
Accuracy ⁽²⁾ , as a constant current source, %, \pm	0.008*	0.0055*	0.0045*	0.0045*			0.008*
T.C., output EMF (20°C-45°C): Typ., ppm/°C, \pm	2	1	0.7	0.7	2	1	2
Max., ppm/°C, \pm	5	2	1.5	1.5	5	2	5
Output stability ⁽³⁾ , EMF: ppm/24 hours, \pm	10	7	5	5	10	7	10
ppm/year, \pm	25	20	15	15	25	20	25
Noise & ripple ⁽⁴⁾ , ppm	10	3	2	2	10	3	10
or μV peak	30	20	15	15	30	20	30
Output Z, voltage mode, typ., dc	$50\mu\Omega$						
Input voltage, line operation/recharge	115 V or 230 V $\pm 10\%$, 50 Hz to 440 Hz, specify voltage						
Line reg. ⁽⁵⁾ , 105-125V, ppm, \pm	1.0	0.5	0.5	0.5	1.0	0.5	1.0
Load reg., no load to full load	1 ppm $\pm 1\mu\text{V}$ peak						
Isolation	Floating output. Either terminal may be grounded. Leakage $10^4 \text{ M}\Omega$ typ. @ 25°C, 50% R.H. Either terminal may be guarded up to 500V with respect to ground.						
Warm-up time ⁽⁶⁾	90 sec. minimum (60 mins. for max. stability)						
Dimensions	See other side						
Weight ⁽⁷⁾	10# (4.5 kg)			15# (6.8 kg)		20# (9 kg)	

*Current resolution and current accuracy specifications apply to the 50 & 80 Series, and to the 40 & 70 Series when used with the appropriate Dial-An-Amp (DAA) Adaptor. (DAA constant current adaptors are also available for use with the 60 Series.) ALSO SEE OTHER SIDE.

- (1) Of actual setting, $\pm 5\mu\text{V}$ max. possible offset, @ 25°C, nom. line voltage or battery condition, no load, after warm-up.
- (2) Of actual setting, plus the effect of $\pm 5\mu\text{V}$ max. possible offset across the integral sensing resistor, @ 25°C, nom. line voltage or battery condition, after warm-up.
- (3) After 60 minute warm-up, at constant room temperature.
- (4) Whichever (ppm or μV) is greater. Exclusive of random transients. Dc to 10kHz.
- (5) Not applicable to battery operation.
- (6) For utmost stability, these instruments should be left "on" all the time.
- (7) For battery operated models, add 5# (2.3 kg) to weights shown.

All specifications subject to change without notice.

GENERAL RESISTANCE, INC.
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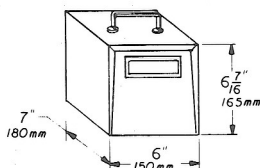
DIAL-A-SOURCE™ BATTERY & LINE OPERATED DIALABLE REFERENCE/CALIBRATION SOURCES

FEATURE HIGHLIGHTS: (✓ = Standard, Opt. = Optional)	40's	50's	60's	70's	80's
Constant voltage source: 0 to ±1 & 10 Vdc F.S.	✓	✓		✓	✓
0 to ±1, 10 & 100 Vdc F.S.			✓		
Constant current source	Opt.	✓	Opt.	Opt.	✓
One ampere output current capability				✓	✓
Battery operated models available	✓	✓	✓		
Current limit control & Voltage output switch: Zero/KVD setting/F.S.			✓	✓	✓
Remote sensing & Output short-circuit protection	✓	✓	✓	✓	✓

DIMENSIONS:

CASE STYLE I:

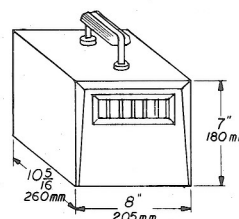
All non-battery
DAS-40's & 50's



Case Style I uses RMA-40 rack adaptor

CASE STYLE II:

All other
models



Case Style II uses RMA-60 rack adaptor

CONSTANT CURRENT OPERATION:

MODEL	ADAPTOR	SCALE FACTOR	SENSING RESISTOR	REMARKS
DAS-80's	BUILT-IN DAA-40	1A/V 10mA/V	1Ω 100Ω	DAS-80's have built-in constant current capability with a range of 1μA to 1 Amp. If low output levels are required (30 mA or less), accuracy can be improved by using an external DAA-40 (with DAS in constant voltage mode). This reduces by a factor of 100 the error contributed by offset (±5μV max.) thus extending the useable range by 2 decades at the low end. For example, if a 500μA output is desired, the accuracy of the output from the built-in adaptor could be ±1%; the use of the DAA-40 would provide an accuracy no worse than ±0.01%
DAS-70's	DAA-70 DAA-40	1A/V 10mA/V	1Ω 100Ω	Provides same performance as DAS-80 Provides same performance as DAS-80 with DAA-40 adaptor (see above)
DAS-60's	DAA-60	1mA/V	1kΩ	Resolution, per step (LSD): 1 nA on 1V range, 10nA on 10V range, 100nA on 100V range Accuracy: DAS-66A, ±0.01% of setting; DAS-66AX, ±0.0075% of setting; each plus the effect of a possible ±5μV offset across the sensing resistor
DAS-50's	BUILT-IN	10mA/V	100Ω	Constant current versions of corresponding DAS-40 models
DAS-40's	DAA-40	10mA/V	100Ω	Provides same performance as corresponding DAS-50 model

LOW NOISE ATTENUATION (Constant voltage operation):

At outputs of 1V or less, the inaccuracy contributed by a possible ±5μV offset may become the determining element of output voltage accuracy. Where output current is not a consideration, the use of the appropriate LNA Low Noise Attenuator will reduce the offset by a factor of 100 or 1000 (see below) to the nanovolt level. The accuracy of LNA's is ±0.005%. LNA's are available for all DAS models.

MODEL	ATTENUATOR	RATIO	OUTPUT Z	REMARKS
DAS-60's	LNA-600	1000/1	100Ω	Attenuates dialed output voltage and offset by a factor of 1000
All others	LNA-100	100/1	10Ω	Attenuates dialed output voltage and offset by a factor of 100

2.0 INITIAL SET-UP

2.1 UNPACKING AND INSPECTION

On receipt of unit

1. Check all switches for proper operation, i.e., thumb wheels should have good detent action and no broken tabs. Rotary switch positions should match the panel markings.
2. Perform "Operational check" of Section 4.2.

2.2 INITIAL TURN-ON

The D A S instrument has been checked and calibrated at the factory. However, an operational check should be performed at initial turn-on.

Operating instructions are given in section 3 while the calibration procedure is given in Section 4.3.

Figure C-1

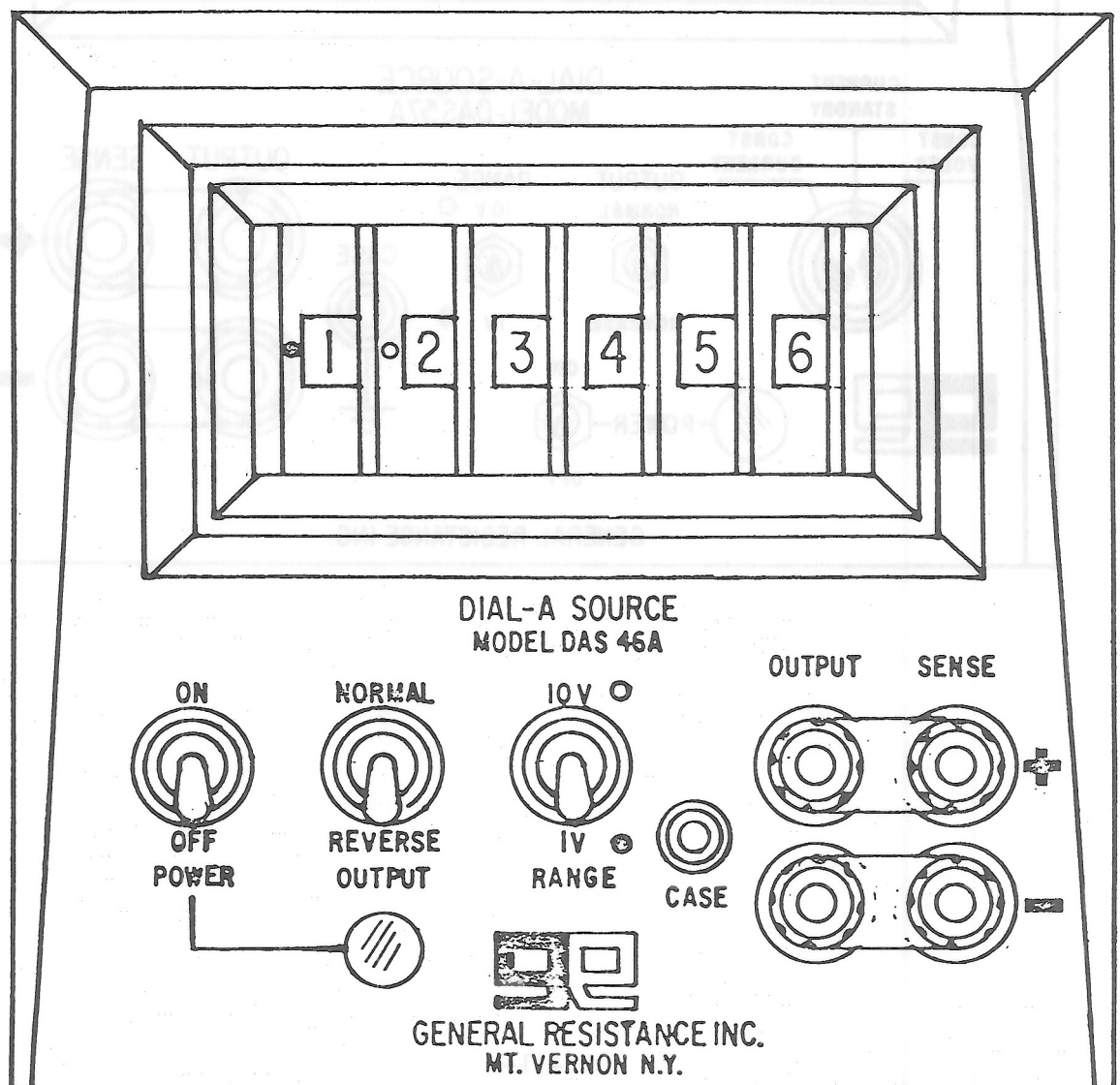
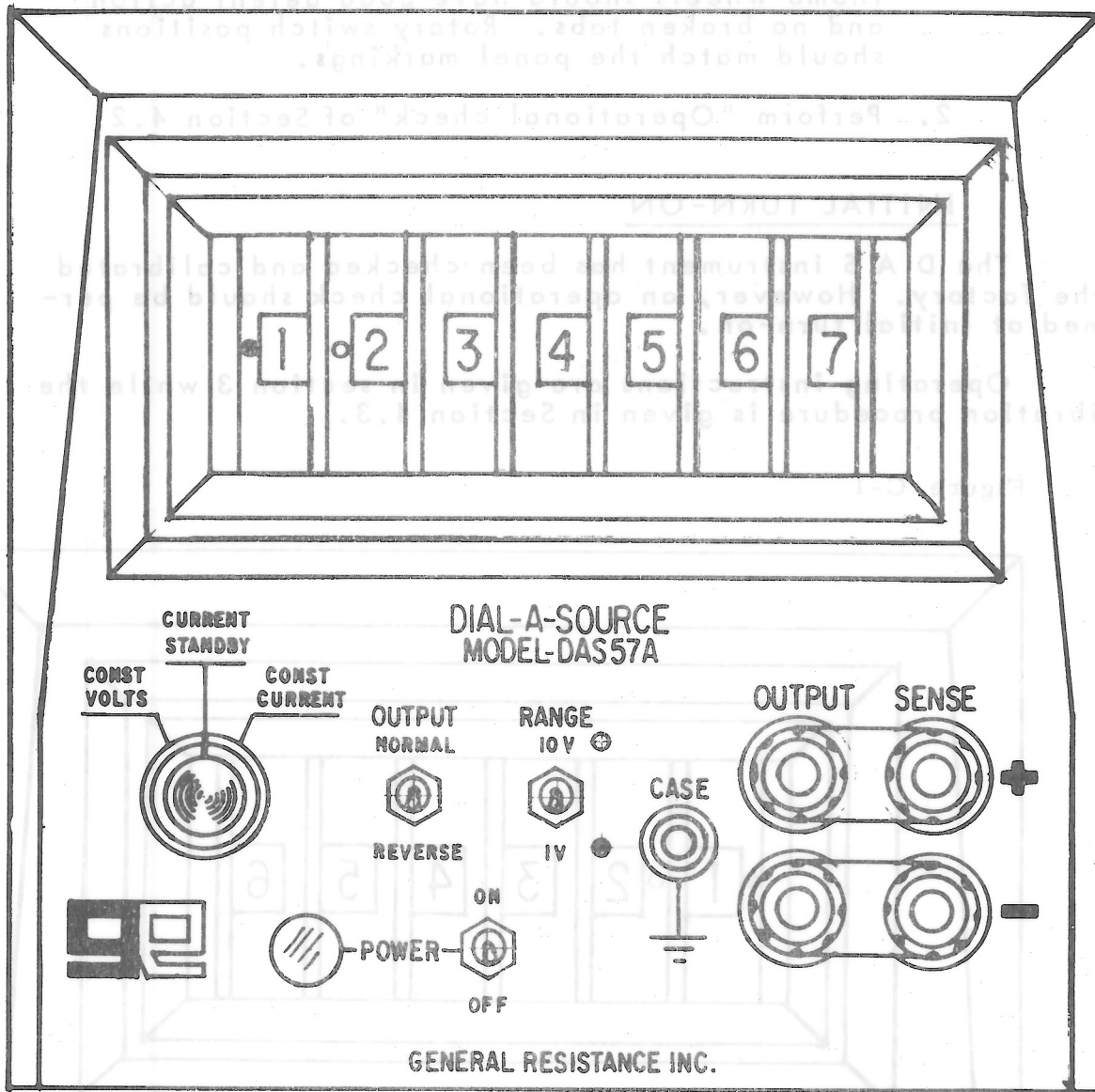


Figure C-2



INITIAL SET-UP
UNPACKING AND INSPECTION

On receipt of unit

1. Check all switches for proper operation, i.e., thumb wheels should have good detent action and no broken tabs. Rotary switch positions should match the panel markings.

2. Perform "Operational check" of Section 4.3.

3. The D.A.S. instrument has been checked and found to be in good working order. The battery should show very low leakage and should be replaced if necessary. The battery should be replaced if the battery level is low. The battery should be replaced if the battery level is low.

DIAL-A-SOURCE
MODEL DAS 48A



GENERAL RESISTANCE INC.
M-11-11-N.Y.

Figure C-3

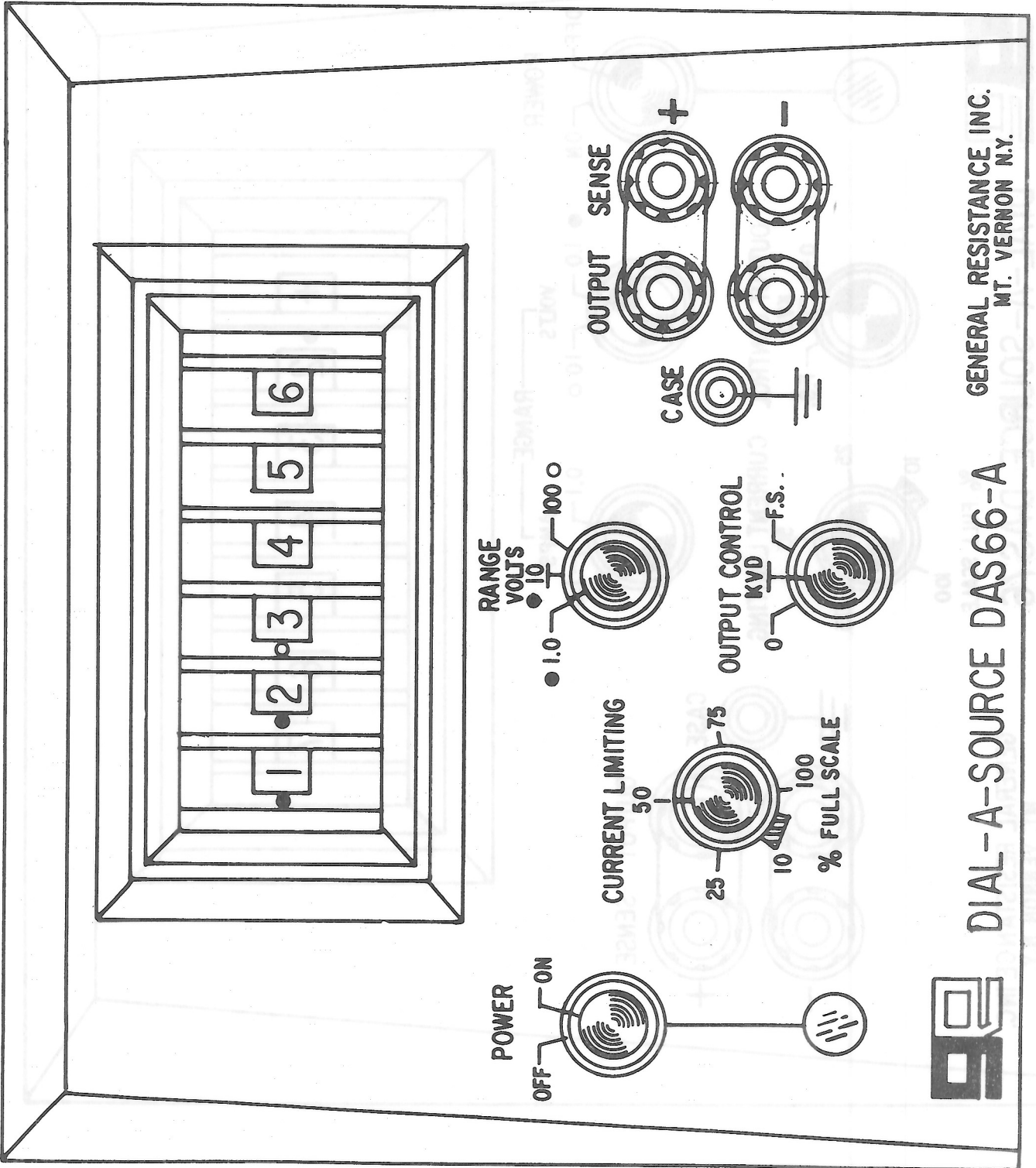


Figure C-4

Figure C-3

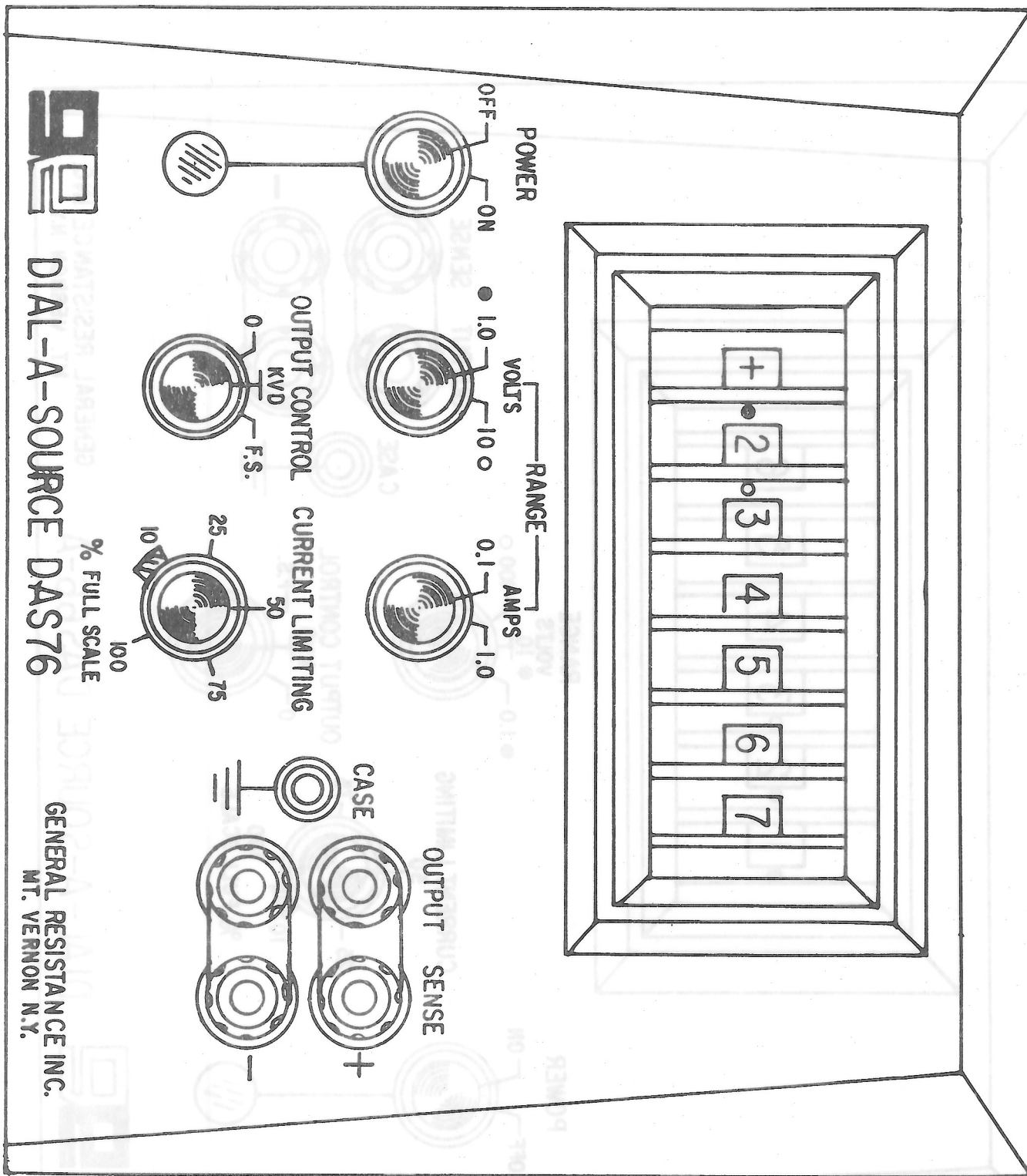


Figure C-5

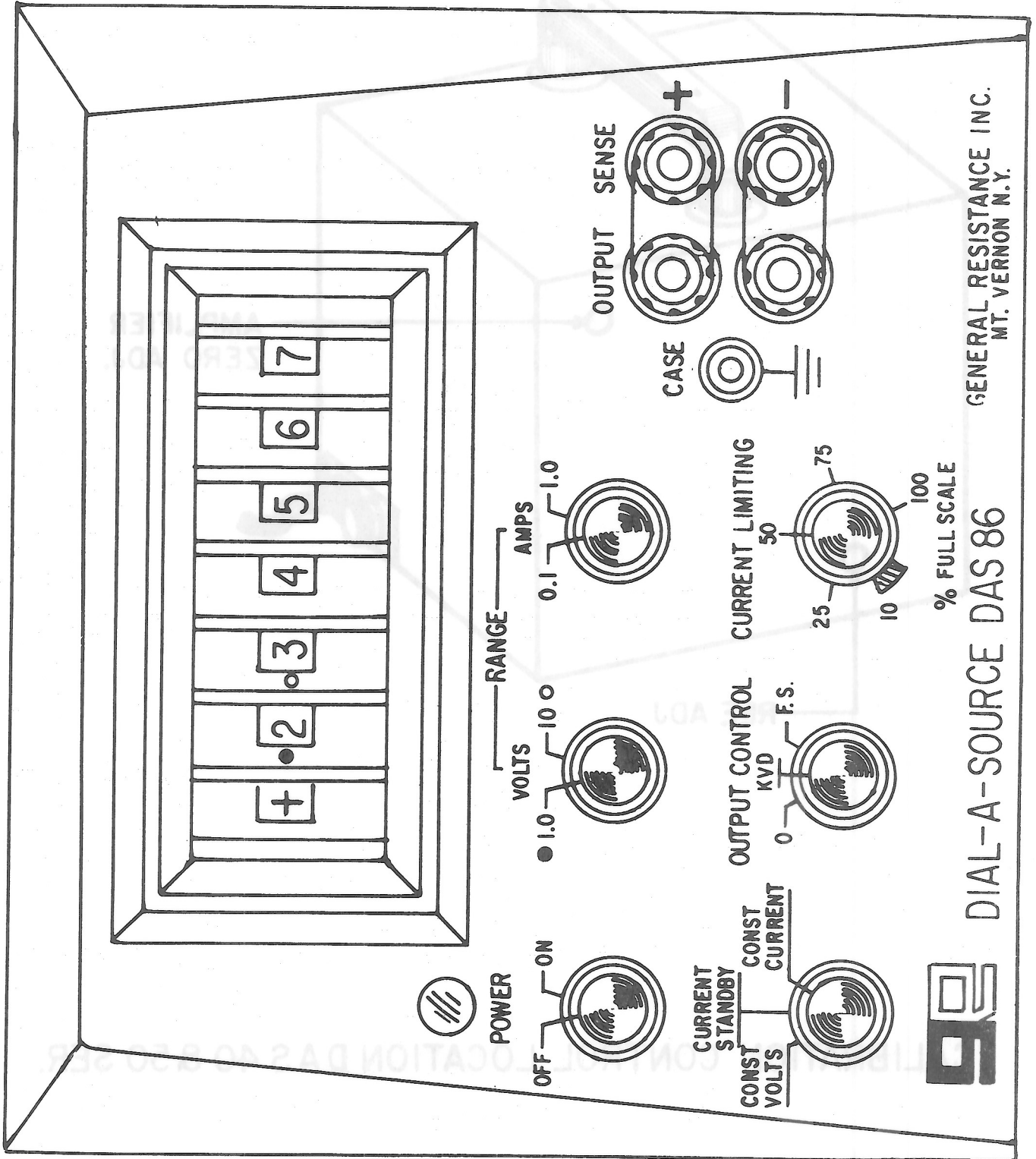
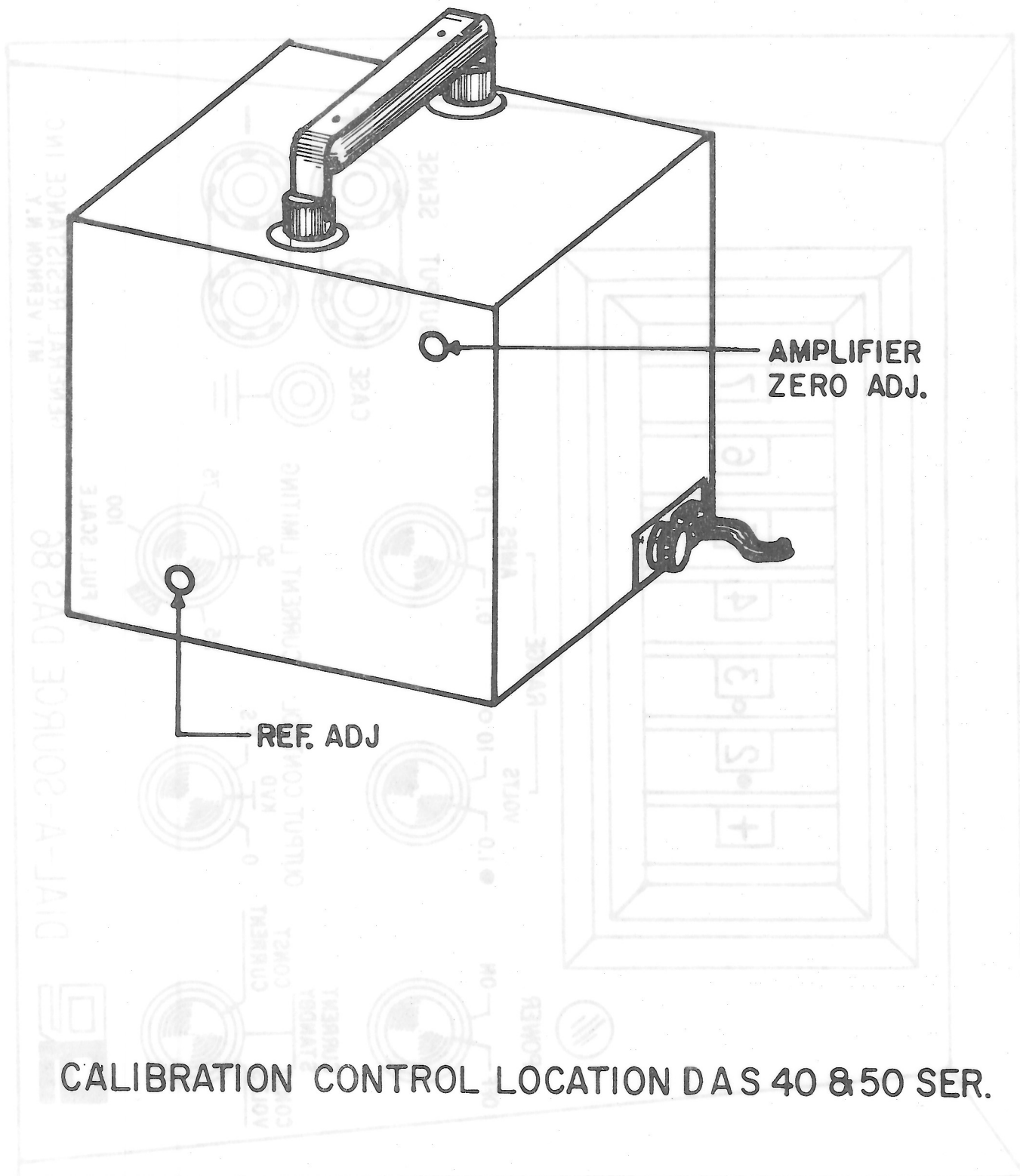


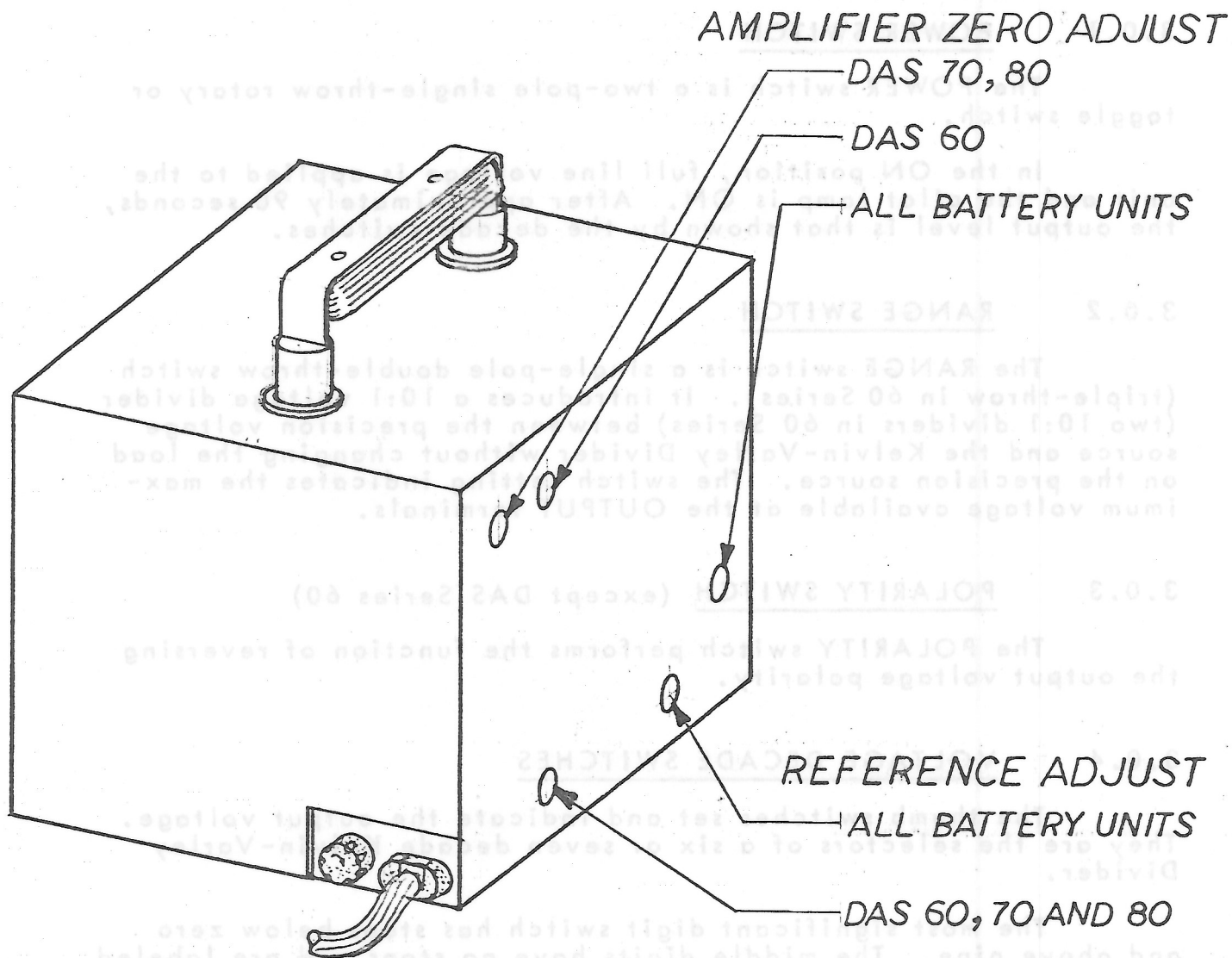
Figure D-1

Figure C-2



CALIBRATION CONTROL LOCATION DAS 40 & 50 SER.

Figure D-2



CALIBRATION CONTROL LOCATION
DAS 60, 70, 80 AND ALL BATTERY UNITS

3.0 DESCRIPTION OF OPERATING CONTROLS

The D A S's front panel controls are shown in Figure C.

3.0.1 POWER SWITCH

The POWER switch is a two-pole single-throw rotary or toggle switch.

In the ON position, full line voltage is applied to the unit and the pilot lamp is ON. After approximately 90 seconds, the output level is that shown by the decade switches.

3.0.2 RANGE SWITCH

The RANGE switch is a single-pole double-throw switch (triple-throw in 60 Series). It introduces a 10:1 voltage divider (two 10:1 dividers in 60 Series) between the precision voltage source and the Kelvin-Varley Divider without changing the load on the precision source. The switch setting indicates the maximum voltage available at the OUTPUT terminals.

3.0.3 POLARITY SWITCH (except DAS Series 60)

The POLARITY switch performs the function of reversing the output voltage polarity.

3.0.4 VOLTAGE DECADE SWITCHES

The thumb switches set and indicate the output voltage. They are the selectors of a six or seven decade Kelvin-Varley Divider.

The most significant digit switch has stops below zero and above nine. The middle digits have no stops and are labeled from zero through nine, while the least significant digit switch is labeled zero through ten.

3.0.5 OUTPUT FUNCTION SWITCH

On D A S Series 60, 70, and 80 a three-position OUTPUT FUNCTION switch permits the output to be zero (0), the KVD setting, or full scale depending on the switch setting.

3.0.6 CURRENT LIMIT CONTROL

On D A S Series 60, 70, and 80 a current limit control allows output current to be limited as a function of percent (%) of full scale.

3.0.7 CONSTANT-CURRENT SELECTION

D A S Series 40, 60, and 70 can be equipped with an optional DAA adaptor which will allow these units to function exactly as D A S Series 50 and 80 in which constant-current capability is built-in.

3.1 CALIBRATION CONTROLS

Calibration adjustments are made through holes in the case normally covered by snap-in plugs. See Figure D.

3.1.1 REFERENCE CALIBRATION

The calibration adjustment is a detented switch accessible through a hole in the right side of the cover.

3.1.2 AMPLIFIER ZERO ADJUST

The amplifier zero adjust control (see Figure D), is a potentiometer. The control is used to set the amplifier output voltage to zero for zero input.

3.2 OPERATING INSTRUCTIONS

3.2.1 POWER

Connect the power plug to a source of 115 VAC (or 230 VAC if unit is so equipped) at 50/60 Hz, and turn the POWER switch on. Power is indicated by the red light on the front panel.

3.2.2 WARMUP

The Dial-A-Source is ready for use almost immediately after the power is turned ON. Allow a period of 30 to 40 seconds for the amplifier to come out of saturation. The instrument will be within its accuracy specifications 2 to 5 minutes after turn-on in a 25°C environment, although 30 minutes may be required for maximum stability.

3.2.3 RANGE

With the D A S RANGE switch in the 100V position (60 Series only) output voltages from 0-100 volts may be dialed in 100 microvolt steps. With the D A S RANGE switch in the 10V position, output voltages from 0 to 10 volts may be dialed in 10 microvolt steps. For voltages from 0 to 1.0 volt, greater accuracy and resolution (1 μ V per step) will be obtained with the RANGE switch in the 1V position. These resolution figures are 0.1 μ V per step and 1 μ V per step in the 1 and 10 volt ranges using a seven decade D A S.

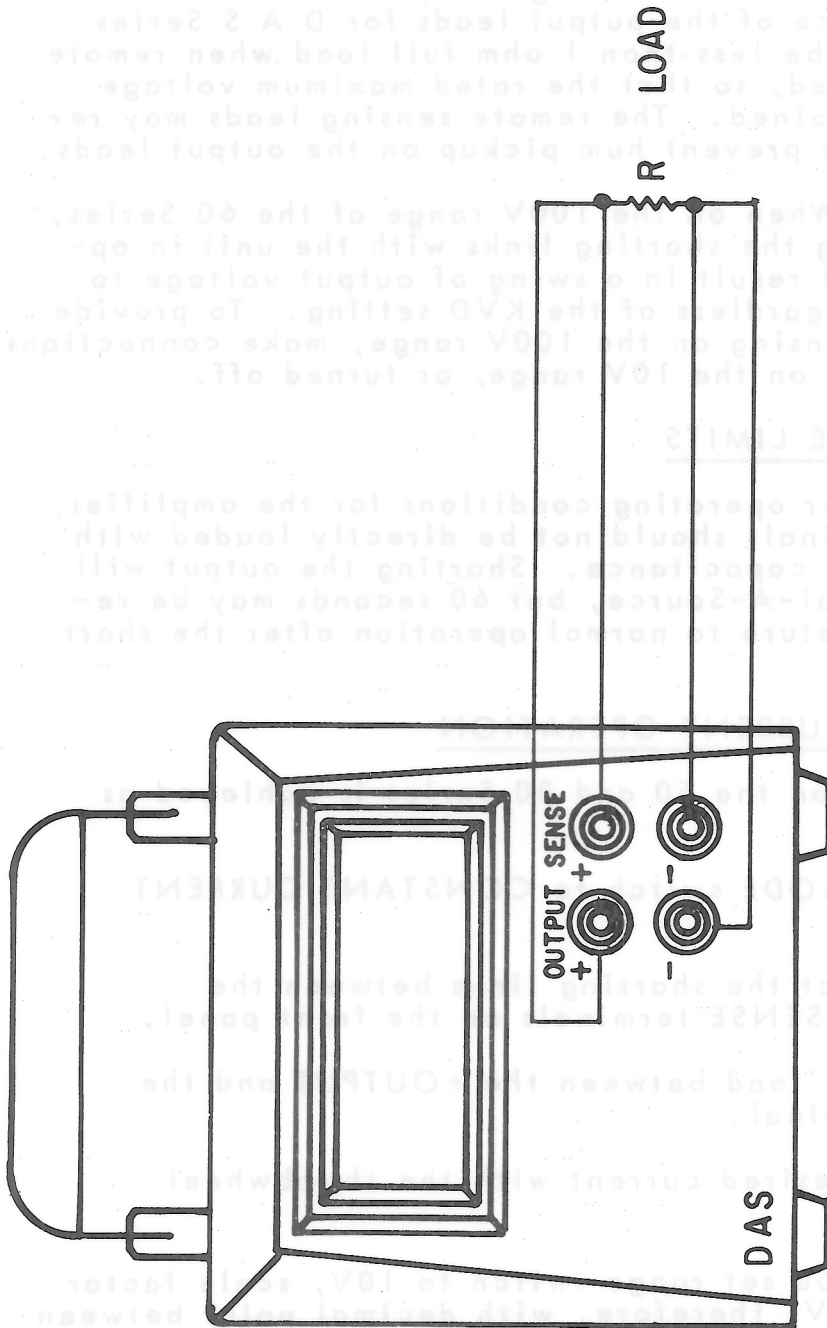
3.2.4 POLARITY

On D A S Series 40, 50, 70, and 80, position the OUTPUT switch to NORMAL (+) if the desired polarity is that indicated by the OUTPUT terminals. For the opposite polarity, throw the OUTPUT switch to REVERSE (-). On D A S 60, if the opposite polarity is desired, reverse output leads.

3.2.5 OUTPUT VOLTAGE

Set the dial switches to read the desired output voltage. On the 100V range (60 Series only) the decimal point is read between the second and third digits. On the 10V range, the decimal point is read between the first and second digits. On the 1V range, it is read before the first digit. These decimal point positions are conveniently color coded. All dials except the first may be continuously rotated in either direction. This permits quicker switching between high and low digits. The first dial has stops at the 0 and 9 positions.

Figure E



1. FOR REMOTE SENSE OPERATION, CONNECT "OUTPUT" AND "SENSE" LINES TOGETHER AT LOAD.
2. FOR VERY LONG DISTANCES, "SENSE" LINES SHOULD BE SHIELDED OR TWISTED FOR LOW NOISE OPERATION.

3.2.6 REMOTE SENSING

If the load is to be connected through an appreciable resistance such as a long cable, disconnect the shorting links between the OUTPUT and SENSE terminals and connect each of the four terminals to the load by separate wires as in Figure E. The dialed voltage will then appear across the load. The loop resistance of the output leads should be limited to 20 ohms when remote sensing is employed, so that the rated maximum voltage output can be attained. The loop resistance of the output leads for D A S Series 70 and 80 should be less than 1 ohm full load when remote sensing is employed, so that the rated maximum voltage output can be attained. The remote sensing leads may require shielding to prevent hum pickup on the output leads.

CAUTION: When on the 100V range of the 60 Series, disconnecting the shorting links with the unit in operation could result in a swing of output voltage to Full Scale regardless of the KVD setting. To provide for remote sensing on the 100V range, make connections with the unit on the 10V range, or turned off.

3.2.7 LOAD IMPEDANCE LIMITS

To maintain proper operating conditions for the amplifier, the OUTPUT terminals should not be directly loaded with more than 1 μ F of capacitance. Shorting the output will not injure the Dial-A-Source, but 60 seconds may be required for it to return to normal operation after the short is removed.

3.2.8 A) CONSTANT CURRENT OPERATION

Constant current on the 50 and 80 Series is achieved as follows:

- 1) Set the MODE switch to CONSTANT CURRENT STANDBY.
- 2) Disconnect the shorting links between the OUTPUT and SENSE terminals on the front panel.
- 3) Insert the load between the +OUTPUT and the + SENSE terminal.
- 4) Set the desired current with the thumbwheel switches.
 - a) DAS 50 set range switch to 10V, scale factor is 10mA/V, therefore, with decimal point between the second and third dial, the thumbwheel switches are direct reading in milliamperes.

PLEASE NOTE

IMPORTANT NOTE, PLEASE READ

On DAS 50's (serial number 200 and up) and on DAS 80's (serial number 120 and up) the following changes are to be made to this instruction manual:

PAGE 21

3.2.8 Constant Current Operation

- A)
 - 2) Delete in its entirety
 - 3) Change + Sense to - Output

PAGE 22

3.2.8 Constant Current Operation

- A) Continued

Note: First sentence; change + Sense to - Output

Second sentence; change + Sense to - Output

PLEASE NOTE

IMPORTANT NOTE, PLEASE READ

If your unit happens to fail, in order to expedite repair, please supply the following information with the unit:

ALL DAS 40, 50, 70 and 80 models

Actual readings (4) with KVD set to all zeros with both plus (normal) and minus (reverse) polarity settings on both one and ten volt ranges and the same data (4 more readings) as above except with the KVD set at all nines, except the LSD should be set at ten.

FOR DAS 60 models

Same as above only since unit has no polarity switch there will only be six readings (all zeros 1V, 10V and 100V and all nines, ten LSD 1V, 10V and 100V).

Please also supply any other complaints with the unit.

3.2.8 A) CONSTANT CURRENT OPERATION (continued)

NOTE: With the polarity switch set to NORMAL current flows from the +OUTPUT terminal to the +SENSE terminal. With the POLARITY switch set to REVERSE current flows from the +SENSE terminal to the +OUTPUT terminal.

b) DAS 80 set range switch to 1V, scale factor is 1A/100mV, therefore, with decimal point between first and second dial, the thumbwheel switches are direct reading in amperes. Note from 4a applies.

5) Set MODE switch to CONSTANT CURRENT.

3.2.8 B) Constant current operation on the 40, 60, and 70 Series is achieved as follows:

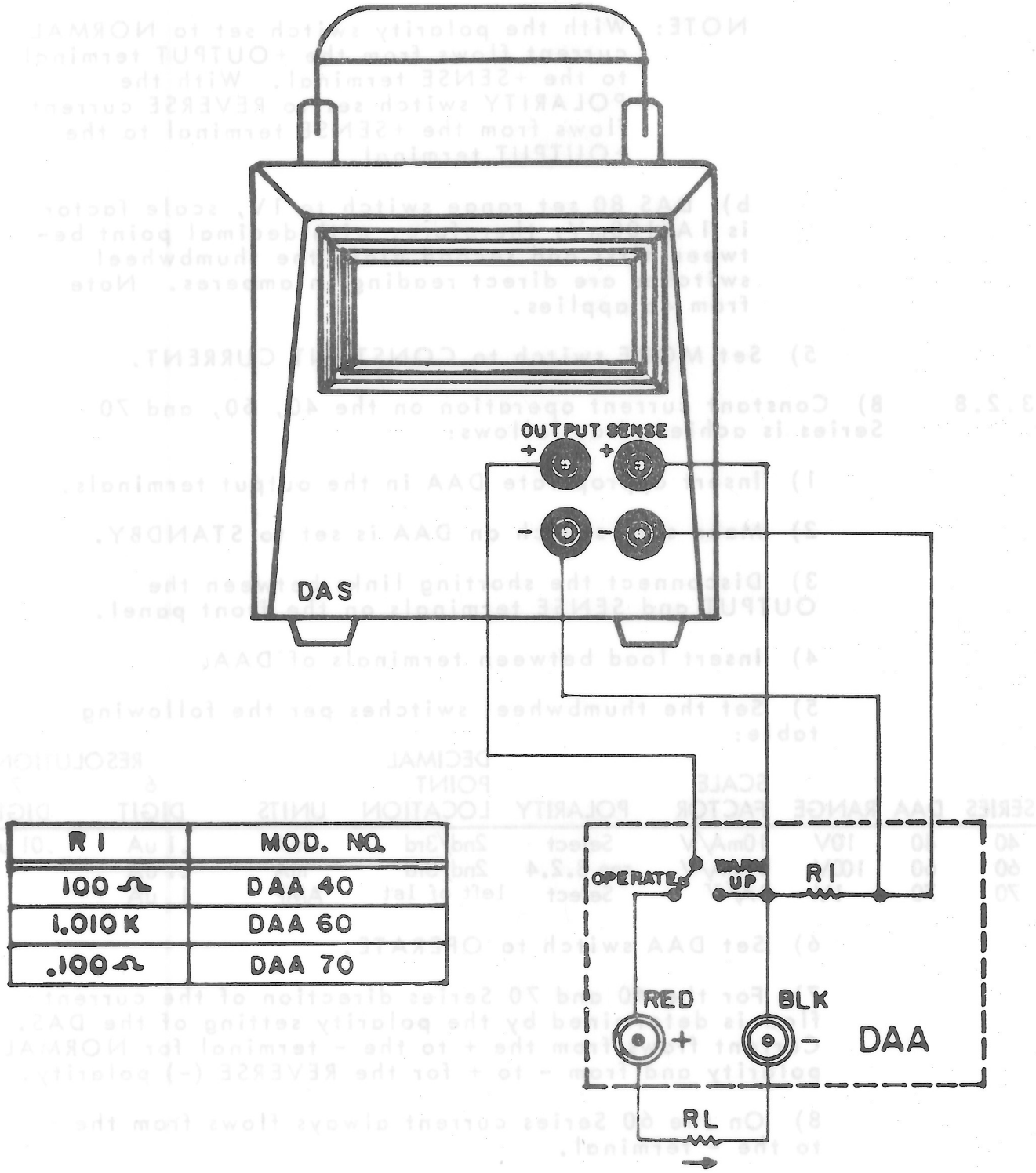
- 1) Insert appropriate DAA in the output terminals.
- 2) Make sure switch on DAA is set to STANDBY.
- 3) Disconnect the shorting links between the OUTPUT and SENSE terminals on the front panel.
- 4) Insert load between terminals of DAA.
- 5) Set the thumbwheel switches per the following table:

SERIES	DAA	RANGE	SCALE FACTOR	POLARITY	DECIMAL POINT LOCATION	UNITS	RESOLUTION	
							6 DIGIT	7 DIGIT
40	40	10V	10mA/V	Select	2nd/3rd	mA	.1 μ A	.01 μ A
60	60	100V	1 mA/V	see 3.2.4	2nd/3rd	mA	.1 μ A	
70	70	1V	1A/V	Select	left of 1st	AMP	1 μ A	

- 6) Set DAA switch to OPERATE.
- 7) For the 40 and 70 Series direction of the current flow is determined by the polarity setting of the DAS. Current flows from the + to the - terminal for NORMAL (+) polarity and from - to + for the REVERSE (-) polarity.
- 8) On the 60 Series current always flows from the + to the - terminal.

NOTE: The 60, 70, and 80 Series also have a current limiting control which is always operational. Therefore when working in the constant current mode the current limiting control should be set at some value slightly above the value of current programmed with the thumbwheel switches.

Figure F



CONSTANT CURRENT SOURCE

3.2.9 CURRENT LIMIT CONTROL

On DAS Series 60, 70, and 80 there is a variable current limit calibrated from zero (0) to one hundred (100) % of full scale, to increase the resolution of this control on DAS Series 70 and 80 there is both a 100 mA and 1 ampere range. (SEE NOTE 8B8). This control is useable for both constant voltage and constant current operation and should be set for a current slightly higher than that required.

3.2.10 OPTIONAL LOW NOISE ATTENUATOR (LNA-100)

The LNA-100 is used with the 40, 50, 60, 70, and 80 Series to attenuate the output voltage set on the thumb-wheel switches by a factor of 100. This attenuation is applied to the set voltage and to any offset and drift. This reduces the offset and drift to the nanovolt level (10^{-9} V). The LNA has an output impedance of 10Ω . Care must be taken when using the LNA not to generate any thermal voltages which could exceed the drift, offset, and signal, and destroy the accuracy of the generated voltage at the output terminals of the LNA.

The LNA-100 plugs directly into the output terminals of the DAS 40, 50, 60, 70, and 80 Series. It is not necessary to remove the shorting links on the front panel. The LNA-100 output terminals are switch controlled by a toggle switch on its top. In SHORT position, the output terminals are shorted to establish a reference level for any thermal or extraneous noise. In the OPERATE position, the output at the terminals is the voltage set by thumb-wheel switches, RANGE switch, and POLARITY switch, divided by a factor of 100. Its accuracy is $\pm 0.005\%$.

The LNA-100 is used to provide noise attenuation with great accuracy when the DAS is being used at extremely low output voltage levels where output current is not a consideration.

NOTE: When used on the 60 Series, the instrument must not be used on the 100V range.

4.0

MAINTENANCE AND CALIBRATION

4.1

MAINTENANCE AND REPAIR

The maintenance procedures for DAS are limited to replacement of items that are damaged, broken, or burnt out, such as knobs, pilot lamp or the line fuse.

For failures such as standard transistors, capacitors or carbon resistors, regular trouble-shooting and replacement techniques are used. There are no unusual or tricky circuits requiring special analysis or measurement. While ordinary service instruments such as a VOM or a digital DC meter are adequate for general trouble-shooting and repair, the DAS is a very precise instrument that requires precise measurements for its calibration.

The precise output values are dependent upon resistors matched and accurate to better than 0.001%. Should any of these resistors be damaged or over dissipated, the instrument must be returned to the factory.

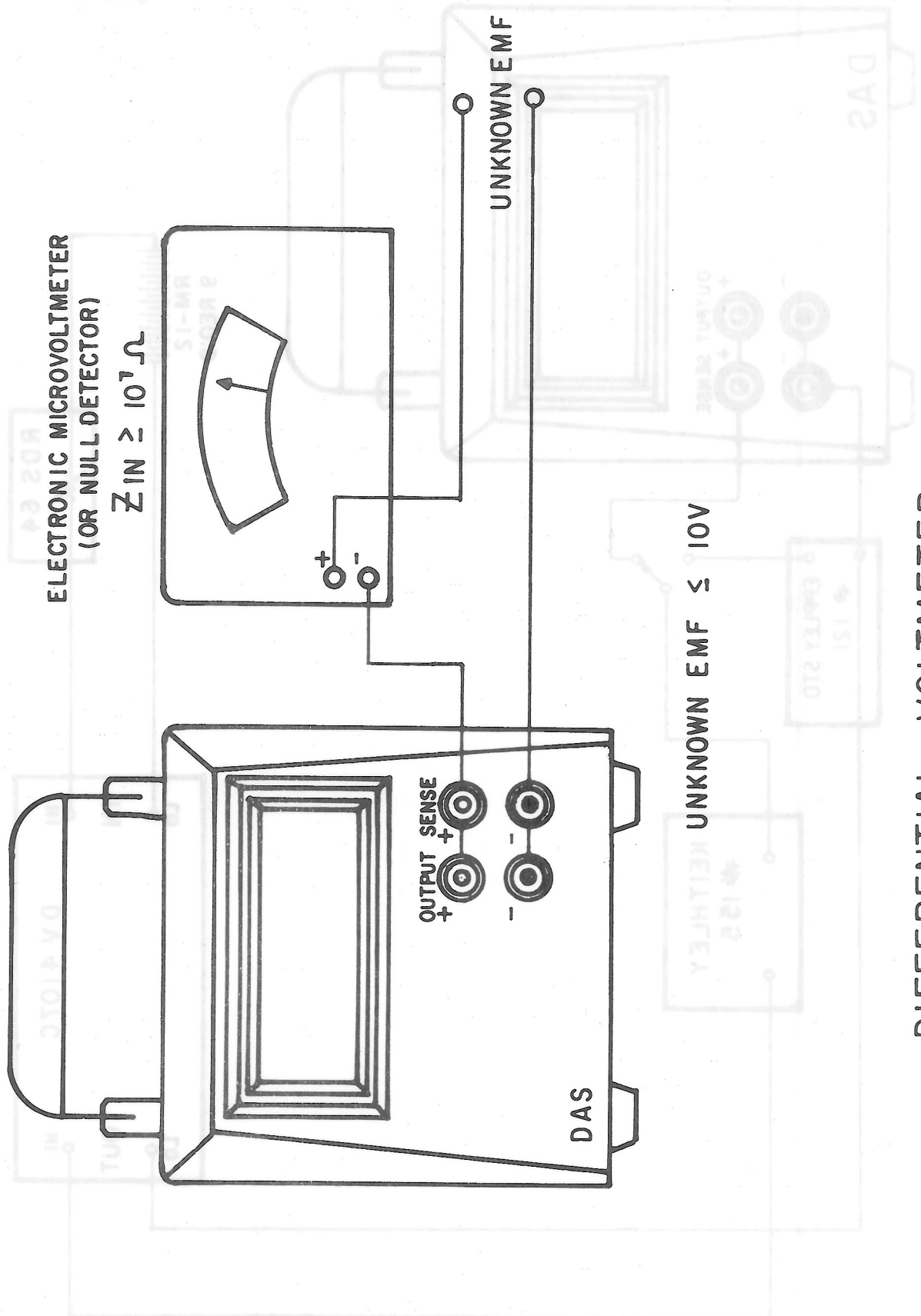
4.2

OPERATIONAL CHECK

Perform the following operational check before each CALIBRATION.

1. Set all thumb-switches to zero, the RANGE switch to 1 volt. POWER switch OFF.
2. Connect the rated name plate power.
3. Operate the POWER switch and check that the pilot lamp lights.
4. With VOM set to VOLTS, measure zero volts between the output leads.
5. Change POLARITY switch, output remains zero.
6. Set most significant decade switch to 9. Then read 0.9 volts on VOM.
7. Reverse POLARITY switch and meter polarity at same time. Read 0.9 volts on VOM. (Except 60 Series)
8. Set VOM to 10V scale or higher. Set RANGE switch to 10V. Read 9.0 volts on VOM.
9. Reverse POLARITY switch and meter polarity at same time. Read 9.0 volts on VOM.
10. Set all switches to 9 (LSD to 10). Read 10 volts on VOM.

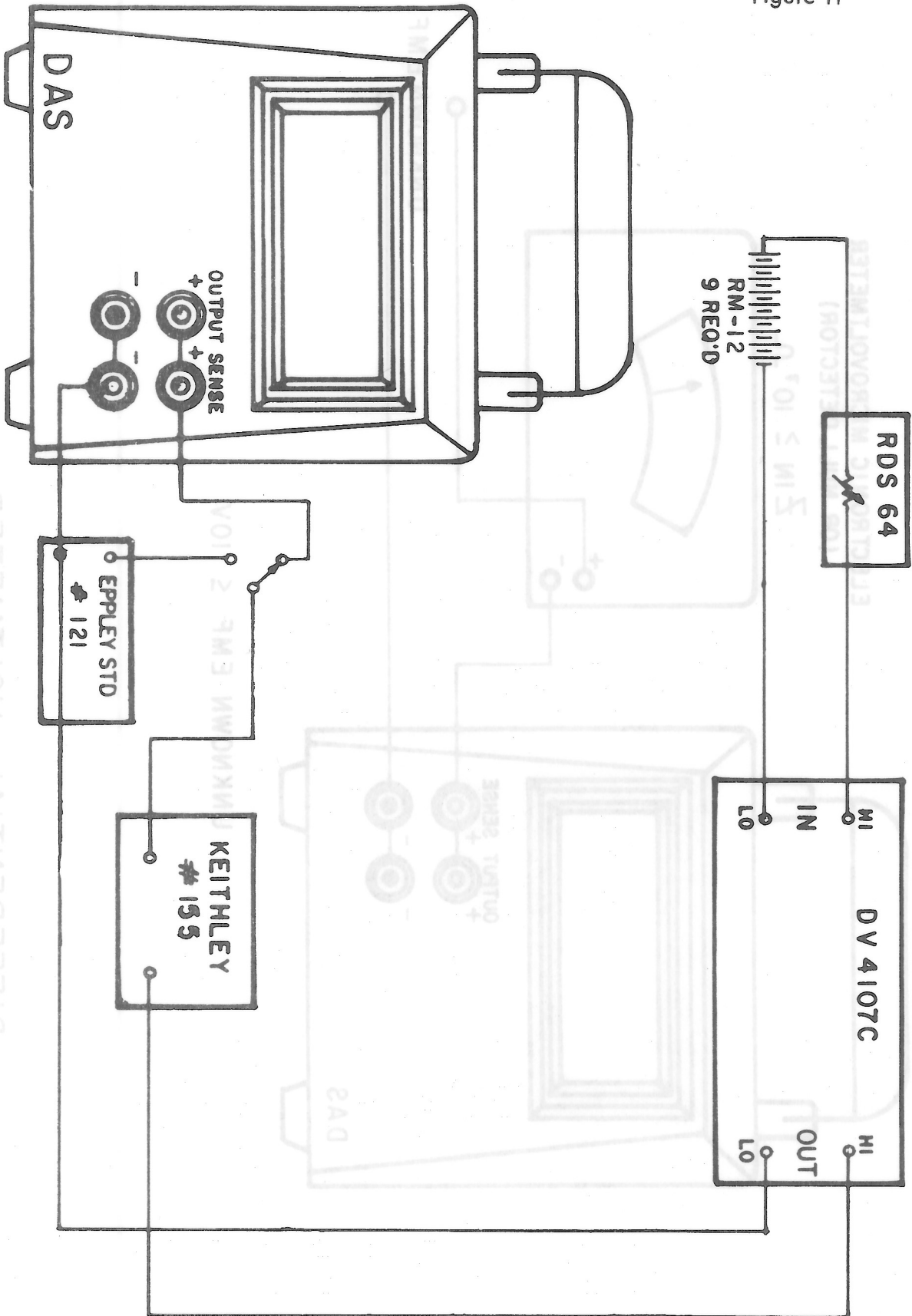
Figure G



DIFFERENTIAL VOLTMETER

KEITHLEY - VARLEY CALIBRATION

Figure H



KELVIN-VARLEY CALIBRATION

4.2 OPERATIONAL CHECK (continued)

THE FOLLOWING STEPS APPLY TO THE 60 SERIES ONLY:

11. Set VOM to 100V scale or higher. Set RANGE switch to 100V. Read 90 volts on VOM.
12. Set all switches to 9 (LSD to 10). Read 100 volts on VOM.

4.3 CALIBRATION

The usual routine maintenance will be the periodic zero setting to the operational amplifier and recalibration of the value of the precision source. General Resistance offers complete calibration at a nominal charge.

4.3.1 AMPLIFIER - ZERO SET

The amplifier zero set should be checked periodically. Annual calibration is adequate for most applications. See Figure D.

PROCEDURE:

1. Set the dials to zero, RANGE switch to 1V, POLARITY switch to "+", allow a 30 minute warm-up time. Measure the output voltage with a micro volt-meter such as the Keithley model 155, or equivalent, set to the 10-0-10 microvolt range. If the reading exceeds ± 5 microvolt, the amplifier must be zero set. The microvolt meter is connected across the + and - SENSE terminals.

2. If resetting is indicated, the zero set adjustment is accessible through a hole in the case on the top right side near the back. The hole is normally covered by a snap-in cap. The adjustment is made with a screwdriver until the output is within the range of ± 5 microvolts. Replace the cap.

4.3.2 REFERENCE VOLTAGE CALIBRATION

The reference voltage calibration should be checked at least annually. See Figure D.

PROCEDURE:

1. Zero set the amplifier as described in section 4.3.1.
2. Set the dials to zero, the POLARITY to "+", and the RANGE switch to 10V.

PROCEDURE: (continued)

3. Set the dials to the standard cell value. Connect the DAS, microvolt meter and standard cell in a differential voltmeter configuration as shown in Figure G.
4. The meter should read within ± 25 microvolts of zero. If it does not, adjust the 10-step position switch through the hole covered by a snap-in cap near the bottom on the right side. Replace the cap.

4.3.3 CHECK OF KELVIN-VARLEY DIVIDER

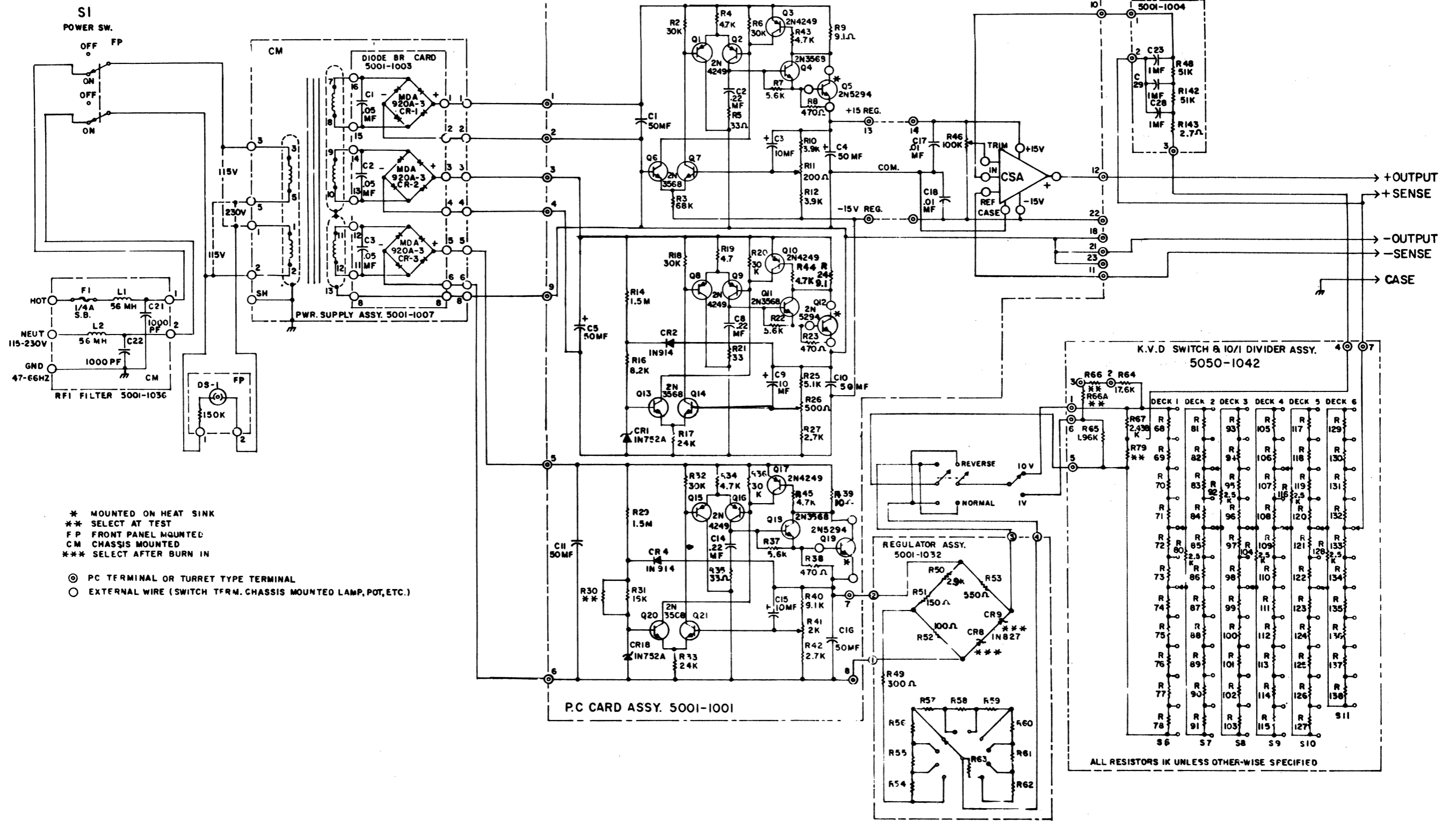
The Kelvin-Varley Divider cannot be adjusted but it may be desirable to check one or more decades for accuracy of reading. The procedure is to use a separate 1ppm KVD as a transfer source.

PROCEDURE:

1. Set up the equipment shown in Figure H.
2. Set the external KVD to the value of the standard cell.
3. Adjust the decade box so that the microvolt meter reading is zero. Do not change the decade box setting for the remainder of the tests.
4. Replace the standard cell by the DAS output cables. With the external KVD and that of the DAS under test set to the same reading, the output voltage difference should not exceed the specified accuracy of the DAS ± 10 μ V uncertainty of the external 1ppm KVD.

4.3.4 RECOMMENDED TEST EQUIPMENT (or equal)

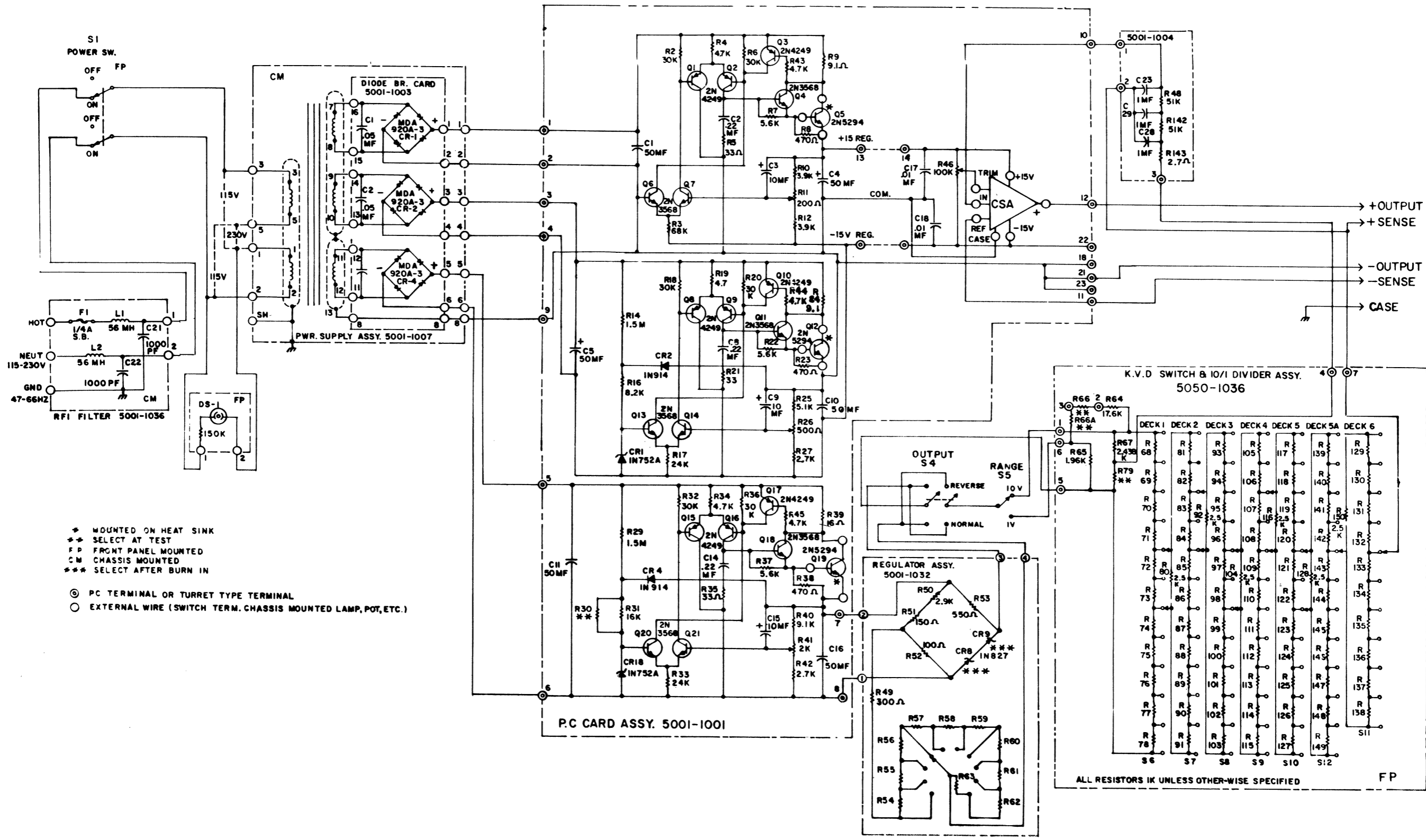
1. Simpson 260 VOM.
2. Keithley Model 155 microvolt meter.
3. General Resistance Kelvin-Varley Divider, model DV 4107C.
4. Eppley Standard cell # 121.
5. General Resistance Decade Box.
6. 9 each Mallory RM-12 Mercury batteries.



* MOUNTED ON HEAT SINK
 ** SELECT AT TEST
 FP FRONT PANEL MOUNTED
 CM CHASSIS MOUNTED
 *** SELECT AFTER BURN IN

⊙ PC TERMINAL OR TURRET TYPE TERMINAL
 ○ EXTERNAL WIRE (SWITCH TRFM. CHASSIS MOUNTED LAMP, POT, ETC.)

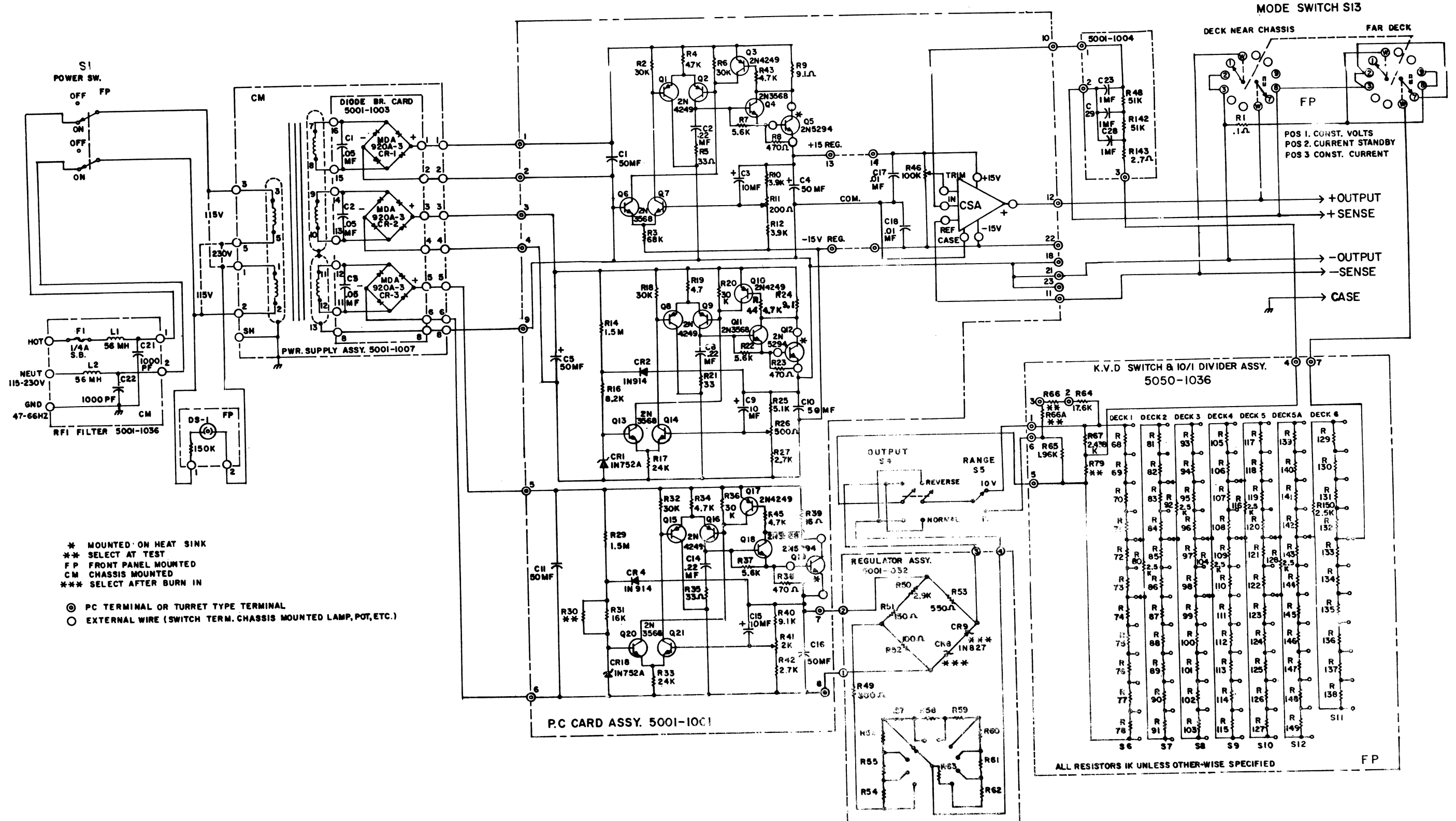
REVISIONS					FINISH		TRUE CENTERS WITHIN 50% OF CENTER LINE TOLERANCE IS 0.01 INCH UNLESS OTHERWISE SPECIFIED	
LETTER NO.	FCN NO.	DATE	BY	APP.	GENERAL RESISTANCE INC.			
					TITLE DAS 46A, AX,AL SCHEMATIC			
					DRAWN BY: DATE: 7-4-73 EID NO:			
					CHECKED BY: DATE: EID NO:			
					DRAWING NO. 5001-1000			



- * MOUNTED ON HEAT SINK
- ** SELECT AT TEST
- FP FRGNT PANEL MOUNTED
- CM CHASSIS MOUNTED
- *** SELECT AFTER BURN IN
- ⊙ PC TERMINAL OR TURRET TYPE TERMINAL
- EXTERNAL WIRE (SWITCH TERM. CHASSIS MOUNTED LAMP, POT, ETC.)

ALL RESISTORS 1K UNLESS OTHERWISE SPECIFIED

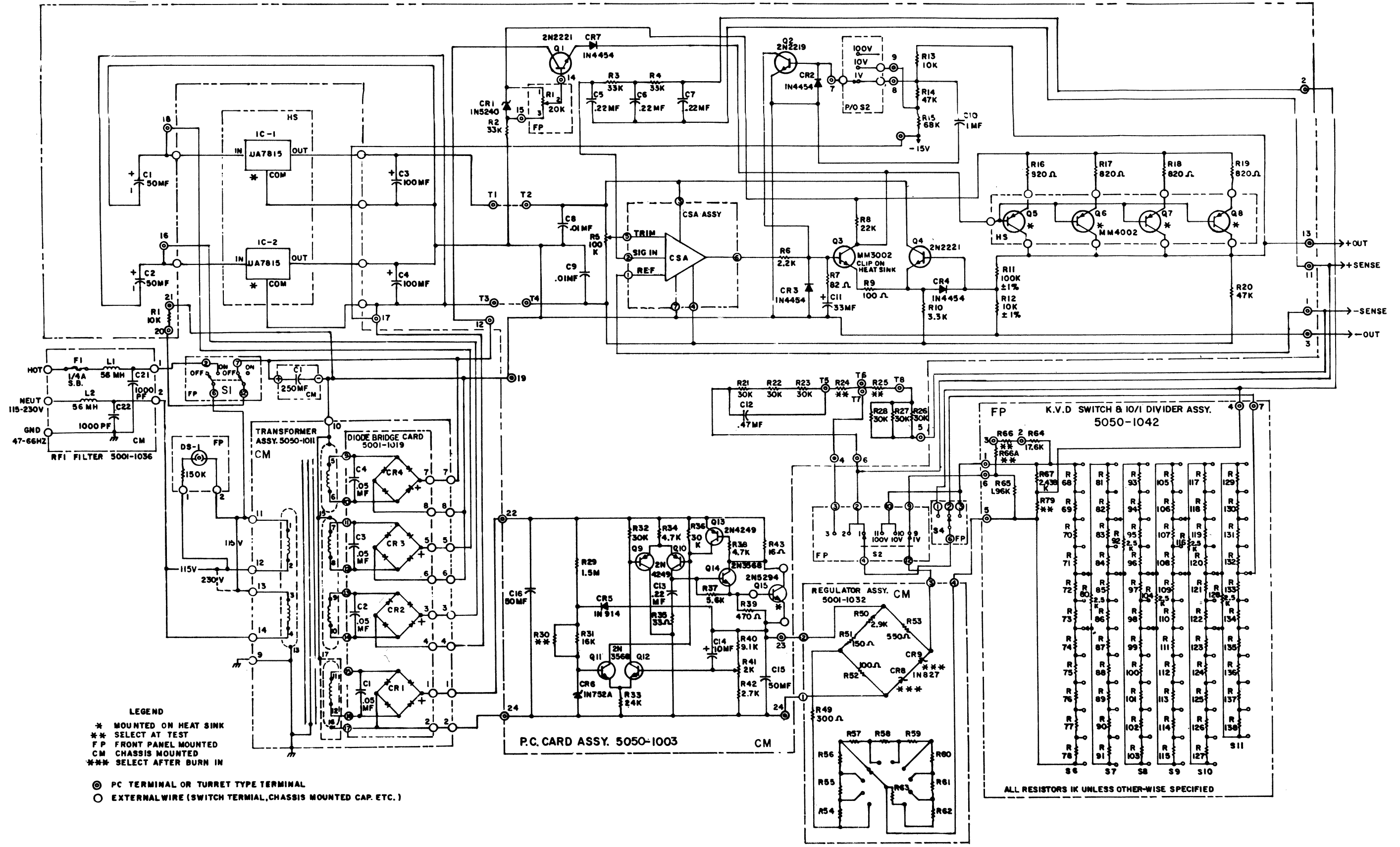
MATERIAL					FINISH					TRUE CENTERS WITHIN .003 OF CENTER LINE TOLERANCES: DECIMALS ± .005 FRACTIONS ± 1/64" UNLESS OTHERWISE SPECIFIED									
REVISIONS										GENERAL RESISTANCE INC.									
LETTER NO	E.C.N. NO	DATE	BY	APP	TITLE					DESIGN BY					E.I.D. NO.				
					DAS 47AL SCHEMATIC														
					CHECKED BY					SCALE					DRAWING NO.				
															5011-1000				



- * MOUNTED ON HEAT SINK
- ** SELECT AT TEST
- FP FRONT PANEL MOUNTED
- CM CHASSIS MOUNTED
- *** SELECT AFTER BURN IN
- ⊙ PC TERMINAL OR TURRET TYPE TERMINAL
- EXTERNAL WIRE (SWITCH TERM. CHASSIS MOUNTED LAMP, POT, ETC.)

ALL RESISTORS 1K UNLESS OTHERWISE SPECIFIED

REVISIONS					FINISH		TRUE CENTERS WITHIN .003" OF CENTER LINE TOLERANCES: DECIMALS ±.005" FRACTIONS ±1/64"	
LETTER NO.	E.C.N. NO.	DATE	BY	APP.	GENERAL RESISTANCE INC.			
					TITLE DAS 57AL SCHEMATIC			
					DESIGNED BY	DATE	E.I.D. NO.	
					CHECKED BY	DATE	SCALE	DRAWING NO.
					APPROVED BY	DATE		5039-1000



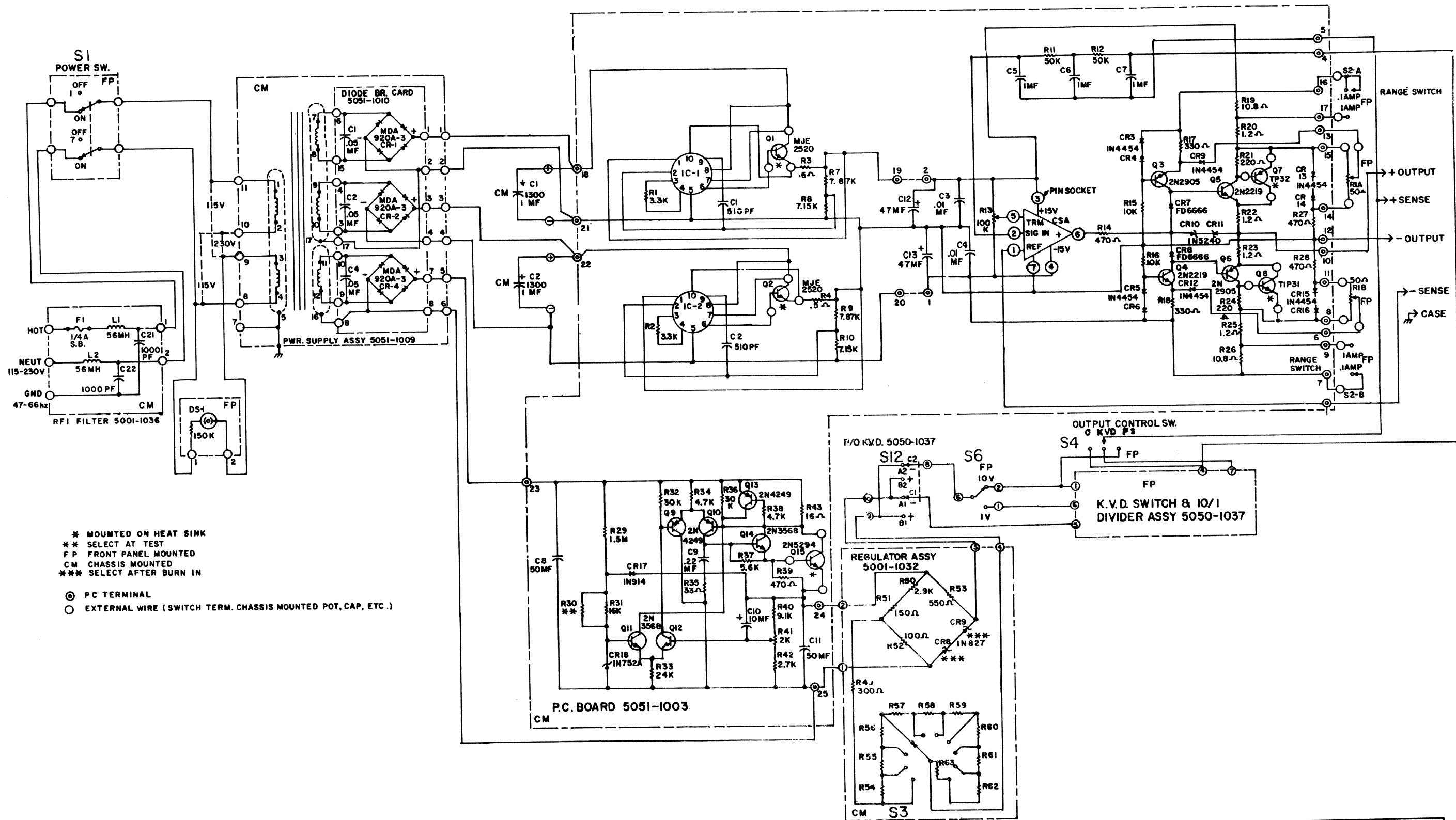
LEGEND

- * MOUNTED ON HEAT SINK
- ** SELECT AT TEST
- FP FRONT PANEL MOUNTED
- CM CHASSIS MOUNTED
- *** SELECT AFTER BURN IN

⊙ PC TERMINAL OR TURRET TYPE TERMINAL
 ○ EXTERNAL WIRE (SWITCH TERMINAL, CHASSIS MOUNTED CAP. ETC.)

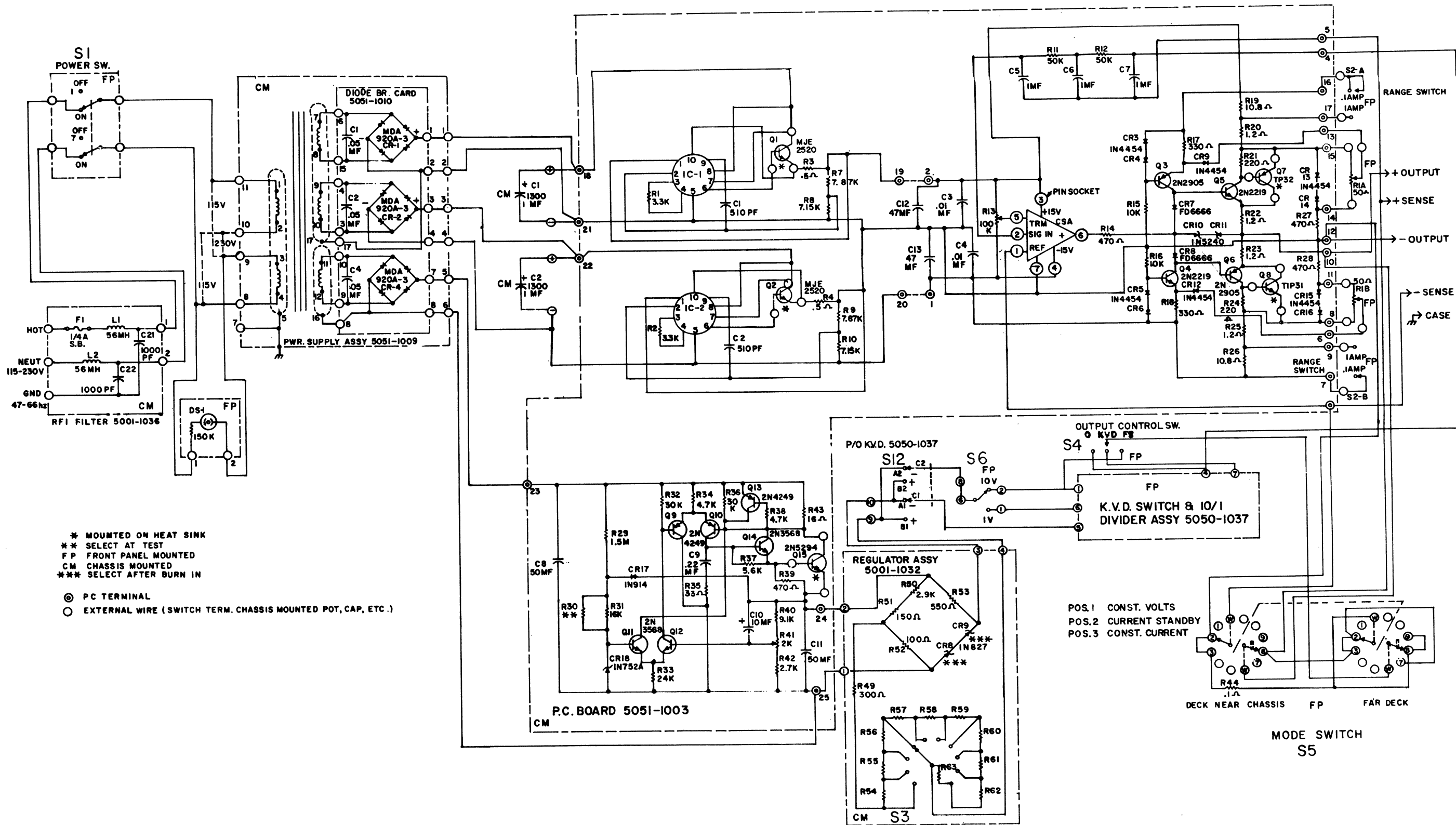
ALL RESISTORS 1K UNLESS OTHERWISE SPECIFIED

REVISIONS					MATERIAL		FINISH		TRUE CENTERS WITHIN .005" OF CENTER LINE TOLERANCES: DECIMALS ±.005" FRACTIONS ±1/64" UNLESS OTHERWISE SPECIFIED	
LETTER NO.	E.C.N. NO.	DATE	BY	APP.	GENERAL RESISTANCE INC.					
A	155	12-5-73	GL	[Signature]	TITLE SCHEMATIC DAS 66A, AX					
					DESIGNED BY	SCALE	DRAWING NO.		5050-1001	
					CHECKED BY					
					APPROVED BY					



- * MOUNTED ON HEAT SINK
- ** SELECT AT TEST
- FP FRONT PANEL MOUNTED
- CM CHASSIS MOUNTED
- *** SELECT AFTER BURN IN
- ⊙ PC TERMINAL
- EXTERNAL WIRE (SWITCH TERM. CHASSIS MOUNTED POT, CAP, ETC.)

REVISIONS					MATERIAL		FINISH		TRUE CENTERS WITHIN .003" OF CENTER LINE TOLERANCES DECIMALS ±.005 FRACTIONS ±1/64" UNLESS OTHERWISE SPECIFIED	
LETTER NO	E.C.N. NO	DATE	BY	APP.	GENERAL RESISTANCE INC		TITLE		SCHEMATIC DAS 76	
A	154	12-9-72	GL				DRAWN BY		E.I.D. NO	
							CHECKED BY		SCALE	
							APPROVED BY		DATE	
										DRAWING NO.
										5051-1001



REVISIONS					MATERIAL		FINISH		TRUE CENTERS WITHIN .005" OF CENTER LINE TOLERANCES: DECIMALS ± .005 FRACTIONS ± 1/64" UNLESS OTHERWISE SPECIFIED	
LETTER NO.	E.C.N. NO.	DATE	BY	APP.	GENERAL RESISTANCE INC.		TITLE		DAS 86 SCHEMATIC	
A	154	12-5-73	EL		DESIGNED BY	DATE	9-1-73	E.I.D. NO.		
					DRAWN BY			SCALE		
					CHECKED BY					5055-1000