

JOHN FLUKE MFG. CO., INC.

P.O. Box 7428 Seattle, Washington 98133

~~For Co. Use~~ ~~Serial No.~~

MODEL 893A & 893AR

FOR REFERENCE PURPOSES ONLY

May, 1969

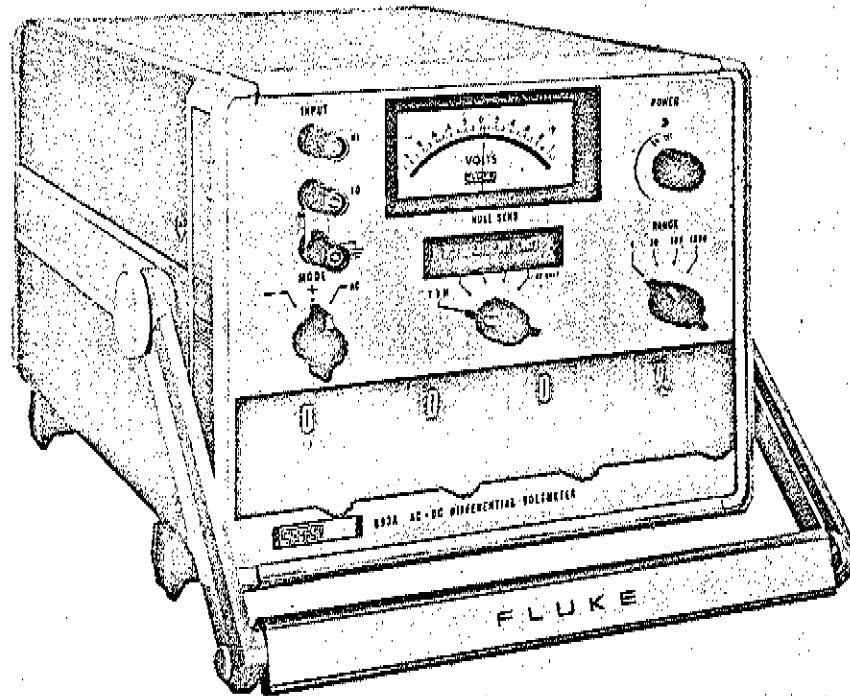
MODEL 893A

AND 893AR

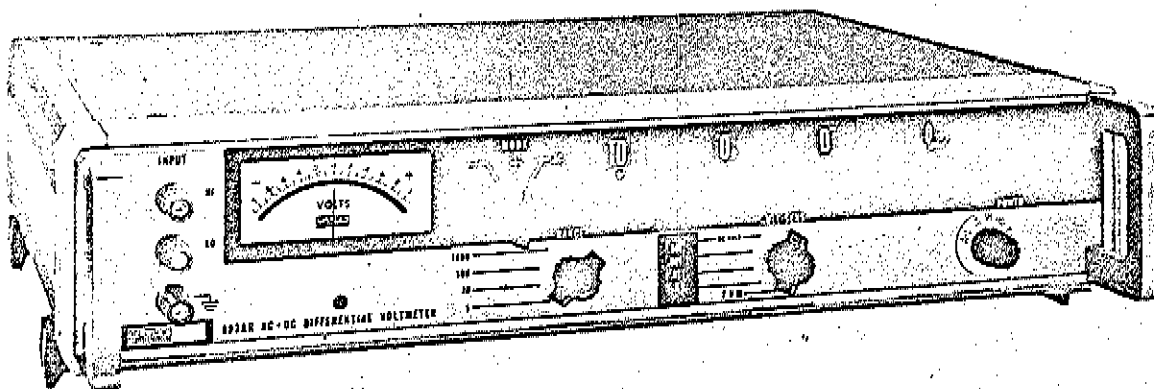
**AC-DC DIFFERENTIAL
VOLTMETERS**

893A & 893AR serial no. _____ and above.

MODEL 893A



MODEL 893AR



MODELS 893A AND 893AR AC-DC DIFFERENTIAL VOLTMETER

SECTION I

INTRODUCTION AND SPECIFICATIONS

1-1. INTRODUCTION

1-2. The Fluke Model 893A and AR AC-DC Differential Voltmeters provide conventional or differential measurements of ac voltages from one millivolt to 1100 volts ac and dc voltages from 10 microvolts to 1100 volts dc. Conventional (TVM) measurements are made with an accuracy of $\pm 3\%$ of the selected range to initially determine the magnitude of the measured voltage. The differential (NULL) mode is then used with an improved accuracy of up to 250% over that of the conventional mode to determine the exact value of the measured voltage. One linear meter-scale greatly simplifies all measurements made with the instrument. Whenever the instrument is operated on the differential mode, an in-line digital readout representing the magnitude of the measured voltage is available from the front panel Readout dials.

1-3. Two versions of the instrument are available and are identified as the Model 893A or Model 893AR. The Model 893A is a portable unit, half-rack in width, with a tilt-down carrying handle. This handle detents into the instrument's feet to serve as a tilt-bale during bench-top use of the instrument. The Model 893AR is also a portable unit, but is of proper width for installation in a standard electronic equipment rack. Carrying of this instrument is provided by two front panel handles. A tilt-down bale located on the bottom of the instrument facilitates bench-top use of the instrument.

1-4. A rechargeable battery and recorder output options are also available for either version of the instrument. These options can be installed at the factory, upon request, or in the field. Option Kit 893A-7001 comprises the rechargeable battery pack and, when installed in the instrument, is identified as the -01 option on the rear panel decal. Option Kit 893A-7002 com-

prises the recorder output and, when installed in the instrument, is identified as the -02 option on the rear panel decal.

1-5. ELECTRICAL SPECIFICATIONS

1-6. DIFFERENTIAL VOLTMETER

DC ACCURACY

$\pm(0.01\%$ of input $+0.001\%$ of range $+10$ uv) from 0 to 1100 volts dc at $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ with up to 80% relative humidity.

$\pm(0.02\%$ of input $+0.001\%$ of range $+10$ uv) from 0 to 1100 volts dc at 10°C to 40°C (50°F to 104°F) with up to 70% relative humidity.

AC ACCURACY

At $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ with less than 70% relative humidity:

50 Hz to 10 kHz

0.001 to 500 volts ac $\pm(0.05\%$ of input $+25$ uv)

500 to 1100 volts ac $\pm 0.1\%$ of input

At 10°C to 40°C with less than 70% relative humidity:

5 Hz to 10 Hz

0.001 to 1100 volts ac $\pm(1\%$ of input $+250$ uv)

10 Hz to 20 Hz

0.001 to 1100 volts ac $\pm(0.5\%$ of input $+100$ uv)

20 Hz to 50 Hz

0.001 to 1100 volts ac $\pm(0.15\%$ of input $+25$ uv)

50 Hz to 20 kHz

0.001 to 110 volts ac $\pm(0.1\%$ of input $+25$ uv)

110 to 1100 volts ac $\pm 0.15\%$ of input

20 kHz to 50 kHz

0.001 to 110 volts $\pm(0.15\%$ of input $+25$ uv)

50 kHz to 100 kHz
0.1 to 110 volts ac $\pm 0.5\%$ of input

INPUT AND NULL VOLTAGE RANGES

INPUT RANGES	DC NULL RANGES
1	0.001, 0.01, 0.1
10	0.001, 0.01, 0.1, 1.0
100	0.01, 0.1, 1.0, 10
1000	0.1, 1.0, 10, 100

INPUT RANGES	AC NULL RANGES
1	0.001, 0.01, 0.1
10	0.01, 0.1, 1.0
100	0.1, 1.0, 10
1000	1.0, 10, 100

DC INPUT RESISTANCE
Infinite at null from 0 to 1100 volts dc.

AC INPUT IMPEDANCE
One megohm shunted by less than 20 pf on all ranges.

OVERRANGE
10% overrange capability on each range.

METER RESOLUTION
10 microvolts maximum resolution.
1 ppm of range for dc ranges above one volt.
10 ppm on the one volt dc range and all ac ranges.

READOUT DIAL RESOLUTION
10 microvolts maximum (10 ppm of range).

1-7. CONVENTIONAL VOLTMETER (TVM)

DC VOLTMETER ACCURACY
 $\pm 3\%$ of range.

AC VOLTMETER ACCURACY
5 Hz to 20 kHz
0.001 to 1100 volts ac $\pm 3\%$ of input

20 kHz to 100 kHz
0.001 to 110 volt ac $\pm 3\%$ of input

DC INPUT RESISTANCE

RANGE	INPUT RESISTANCE - Megohms
1000	100
100	100
10	100
1	100
*0.1-0-0.1	100
*0.01-0-0.01	10
*0.001-0-0.001	10

*These ranges obtained using null ranges with Readout dials set to zero.

AC INPUT IMPEDANCE
One megohm shunted by less than 20 pf on all ranges.

OVERRANGE
10% overrange capability on each range.

1-8. GENERAL SPECIFICATIONS

ELECTRICAL SPECIFICATIONS
Completely solid-state

INPUT RESISTANCE OF NULL DETECTOR
10 megohms on the 0.01 and 0.001 volt ranges and 100 megohms on all other ranges.

REFERENCE ELEMENT
Temperature compensated zener diodes.

REGULATION OF REFERENCE SUPPLY
0.0005% for a 10% line change.

REFERENCE VOLTAGE STABILITY (Peak-to-Peak)
10 ppm per hour
20 ppm per day
40 ppm per month
90 ppm per year

KELVIN-VARLEY DIVIDER ACCURACY
 $\pm 0.005\%$ of readout dial setting above 1/10 of full-scale.

RECORDER OUTPUT
Available as the -02 option, adjustable from 0 to ± 0.2 volts for an end-scale meter deflection. Low side grounded and loading does not effect deflection accuracy.

POLARITY
Reversible with front panel control.

WARM-UP TIME
Less than one minute.

DC COMMON MODE REJECTION
120 db (1 uv/volt of common mode voltage) for maximum of ± 500 volts.

AC COMMON MODE REJECTION
Up to 100 volt peak-to-peak, 50 to 500 Hz signal, produces no measurable instrument error for dc measurements.

INPUT POWER
115/230 volts ac, 50 to 500 Hz, at approximately four watts for line operation and approximately eight watts when recharging batteries on the -01 option equipped instruments. Minimum of eight hours operation on fully charged batteries of the -01 option equipped instruments.

1-9. ENVIRONMENTAL SPECIFICATIONS

OPERATING TEMPERATURE RANGE
Within dc accuracy specifications from 10°C to 40°C (50°F to 104°F), derated at 15 ppm/°C outside these limits to 0°C and 50°C (32°F and 104°F).

Within ac accuracy specifications from 10°C to 40°C (50°F to 104°F), derated at 40 ppm/°C outside these limits to 0°C and 50°C (32°F and 122°F).

HUMIDITY
Within all specifications up to 80% relative humidity below 25°C.

Within all specifications up to 70% relative humidity above 25°C.

STORAGE TEMPERATURE RANGE

Model 893A/AR -40°C to 70°C (-40°F to 158°F)
 Model 893A/AR-01 -40°C to 60°C (-40°F to 140°F)

SHOCK AND VIBRATION

Meets MIL-T-945A.

1-10. MECHANICAL SPECIFICATIONS

SIZE

Model 893A
 9-3/4" wide x 7-5/8" high x 13-3/8" deep.

Model 893AR

17" wide x 4-1/8" high x 14-3/16" deep. 19" wide upon installation of mounting brackets.

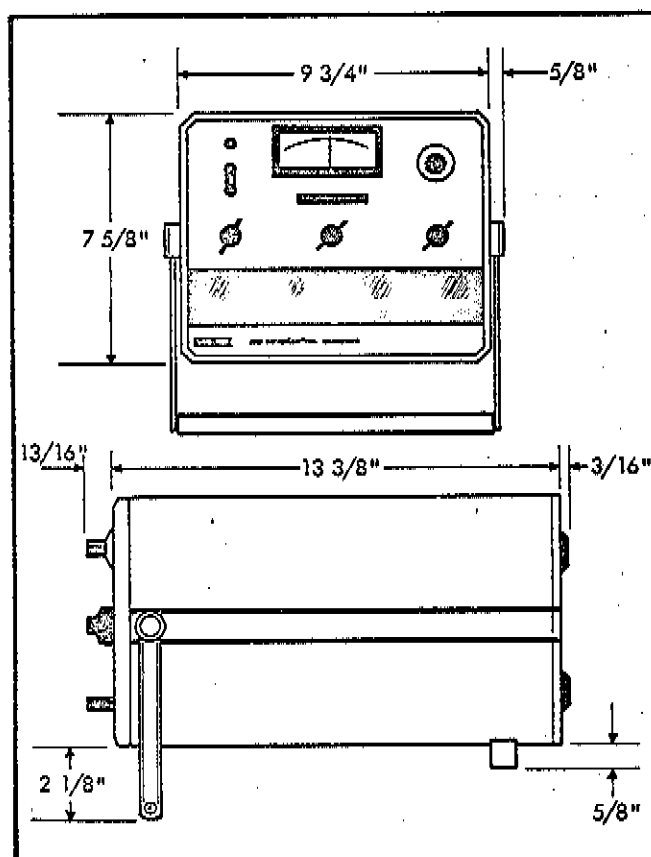


Figure 1-1. MODEL 893A OUTLINE DRAWING

WEIGHT

Model 893A
 Approximately 12 pounds

Model 893AR
 Approximately 12 pounds

Option -01 (Option kit 893A-7001)
 Approximately 2 pounds

Option -02 (Option kit 893-7002)
 Approximately 0.3 pounds

OPTION KIT 893A-7001

Provides rechargeable battery pack for installation in either version instrument.

OPTION KIT 893A-7002

Provides a recorder output for installation in either version instrument.

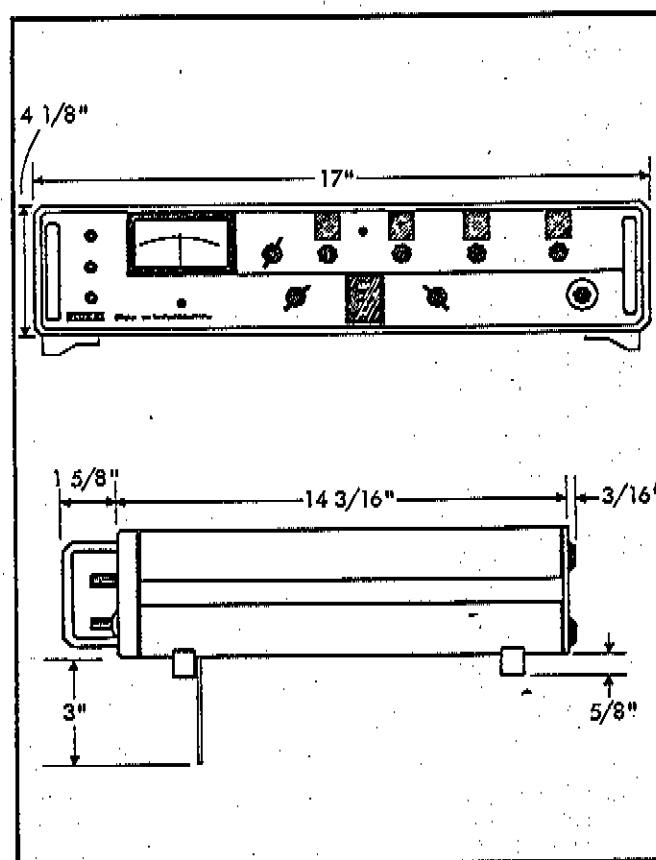


Figure 1-2. MODEL 893AR OUTLINE DRAWING

SECTION II

OPERATING INSTRUCTIONS

2-1. INTRODUCTION

2-2. This section of the manual contains information necessary for you to effectively operate your Model 893 AC/DC Differential Voltmeter. It is recommended that you thoroughly read and understand this section of the manual before attempting to operate your instrument.

2-3. Should any difficulties be encountered during the operation of your instrument, please feel free to contact your nearest John Fluke Sales Representative or write directly to the John Fluke Mfg. Co., Inc., P. O. Box 7428, Seattle, Washington 98133, with a statement of your problem. A complete list of Sales Representatives is contained at the rear of this manual.

2-4. OPERATING FEATURES

2-5. All of the controls, terminals, and indicators for the Model 893A and the Model 893AR are illustrated and described in Figure 2-1 and Figure 2-2.

2-6. OPERATION FROM 115/230 VOLT AC POWER LINES

2-7. The Model 893 may be operated from either a 115 or 230 volt ac power line. The input power transformer primary is composed of two windings which, when connected in parallel, allows the instrument to be operated from a 115 volt ac power line or, when the windings are connected in series, allows the instrument to be operated from a 230 volt ac power line.

2-8. A rear panel 115/230 slide switch (S5) provides the necessary power transformer primary winding connections when placed to the desired 115 or 230 volt position.

2-9. PRELIMINARY OPERATING PROCEDURES

2-10. Connect the Model 893 power cord to available line power. If your instrument does not contain the -01 option, perform only step a. If your instrument contains the -01 option, perform steps a through d.

WARNING!

The instrument case is connected to the round pin of the three-prong connector located on the power cord. Whenever the instrument is operated from ac line power, ensure that this round pin is connected to a high quality earth ground.

a. Place the instrument controls as follows and allow at least one minute of circuit stabilization before attempting any measurements.

POWER	ON/LINE OPR
RANGE	1000
NULLS SENS	TVM
MODE	+
Readout dials	000.00

Note!

The Readout dial labeled 00 in the preceding step, represents the extreme right-hand vernier dial.

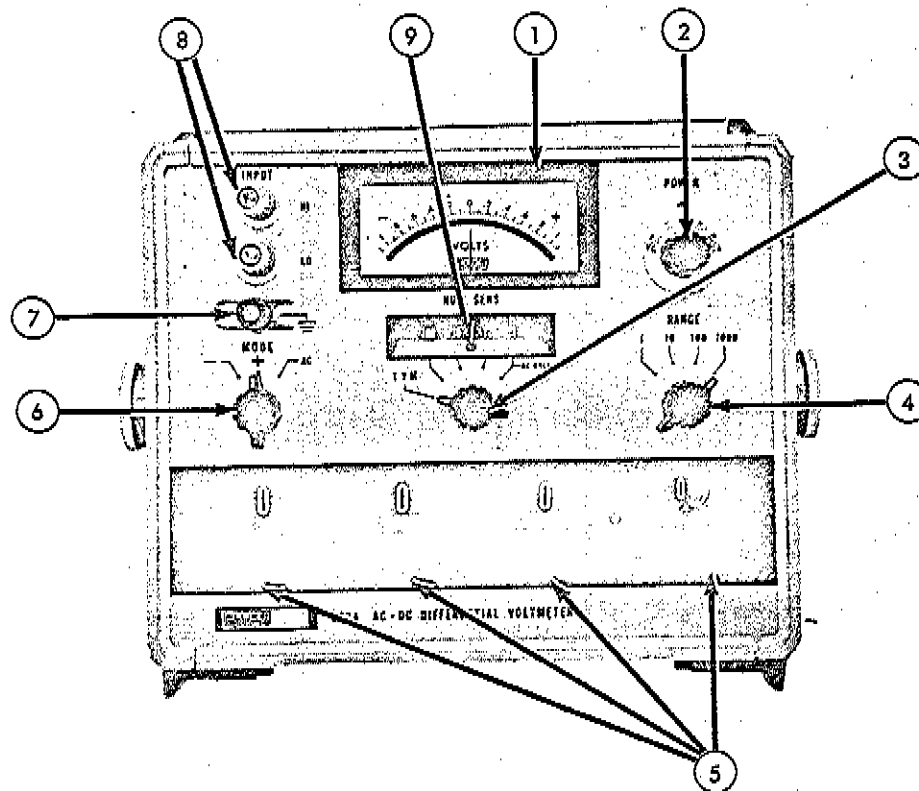
- b. Place the -01 option equipped instrument POWER switch to BAT CHK, observing that the meter needle deflects to the left of the .2 volt increment. If the batteries are adequately charged, the instrument can be operated on battery power by placing the POWER switch to either BAT OPR or BAT OPR/LINE ISOL. To completely isolate your instrument from the line power ground, disconnect the power cord from line power.
- c. If the BAT CHK test results in a deflection of less than .2 volts on the meter, place the POWER switch to BAT CHG and operate the instrument from line power until the batteries are adequately charged. All measurements can be performed during recharging of the batteries. Should the batteries fail the BAT CHK test after 16 hours of recharging, replacement of the batteries may be necessary. Refer to Section IV, paragraph 4-19 and 4-20 for battery replacement instructions.

2-11. OPERATIONAL TEST

2-12. The following information is provided for the operator to initially verify instrument operation. These tests will only check relative instrument operation and are not intended as instrument performance checks. Should you wish to check the accuracy of the instrument against the specifications contained in Section I, refer to the Performance Checks contained in Section IV of this manual.

2-13. To determine relative instrument operation, perform the operations described in the Preliminary Operating Procedures (paragraphs 2-9 and 2-10) and proceed as follows:

- a. Place the RANGE control to 1.

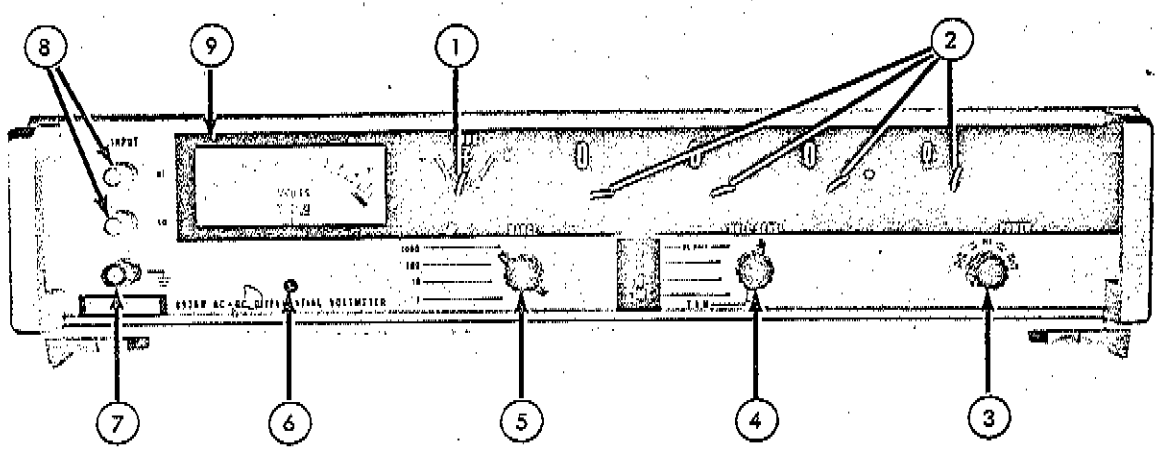


①	METER	Indicates the magnitude and polarity of the measured voltage on the TVM mode. On the differential mode, the meter + or - deflection indicates that the measured voltage is above or below the readout dial indication.
②	POWER SWITCH	Controls application of input power to the instrument. When placed to the LINE OPR position, the instrument is operated from the available line power. On instruments equipped with the 01 Option, additional switch positions of BAT CHK, BAT OPR-LINE ISOL, and LINE OPR-BAT CHG are included. When placed to the BAT CHK position, the front panel meter indicates the charge condition of the battery pack. A meter indication of at least -.2 is required before the instrument is to be operated from the battery power. When placed to the BAT OPR-LINE ISOL position, the instrument is operated from battery power and the power transformer is completely disconnected from line power. However, to completely isolate the instrument circuitry from power line ground, the line power cord must be disconnected. When placed to the LINE OPR-BAT CHG position, the instrument is operated from line power and the battery pack is being charged.
③	NULL SENS SWITCH	Provides selection of the TVM mode of operation and selection of the various full-scale null detector sensitivity ranges when the instrument is operated on the differential mode.
④	RANGE SWITCH	Allows selection of the desired input voltage range of the instrument, while at the same time simultaneously positioning the readout dial decimal point and selecting the available ranges of the NULL SENS switch.
⑤	READOUT DIALS	Provide an in-line digital readout of the measured voltage when the instrument is operated on the differential mode.
⑥	MODE SWITCH	Selects the AC or DC mode of operation. This switch should be placed to the + position on the DC TVM mode. The ± positions provide a means of reversing the internal reference supply voltage on the dc differential mode.

Figure 2-1. THE MODEL 893A CONTROLS, TERMINALS, AND INDICATORS (Sheet 1 of 2)

⑦	GROUND TERMINAL	Provides for connection to earth ground, provided of course that the line cord is connected to available line power.
⑧	INPUT TERMINALS	Provide connection to the measured voltage source.
⑨	MECHANICAL ZERO CONTROL	Allows mechanical zeroing of the meter.

Figure 2-1. THE MODEL 893A CONTROLS, TERMINALS, AND INDICATORS (Sheet 2 of 2)



①	MODE SWITCH	Selects the AC or DC mode of operation. This switch should be placed to the + position on the DC TVM mode. The ± positions provide a means of reversing the internal reference supply voltage on the dc differential mode.
②	READOUT DIALS	Provide an in-line digital readout of the measured voltage when the instrument is operated on the differential mode.
③	POWER SWITCH	Controls application of input power to the instrument. When placed to the LINE OPR position, the instrument is operated from the available line power. On instruments equipped with the 01 Option, additional switch positions of BAT CHK, BAT OPR-LINE ISOL, and LINE OPR-BAT CHG are included. When placed to the BAT CHK position, the front panel meter indicates the charge condition of the battery pack. A meter indication of at least -.2 is required before the instrument is to be operated from the battery power. When placed to the BAT OPR-LINE ISOL position, the instrument is operated from battery power and the power transformer is completely disconnected from line power. However, to completely isolate the instrument circuitry from power line ground, the line power cord must be disconnected. When placed to the LINE OPR-BAT CHG position, the instrument is operated from the line power and the battery pack is being charged.
④	NULL SENS SWITCH	Provides selection of the TVM mode of operation and selection of the various full-scale null detector sensitivity ranges when the instrument is operated on the differential mode.
⑤	RANGE SWITCH	Allows selection of the desired input voltage range of the instrument, while at the same time simultaneously positioning the readout dial decimal point and selecting the available ranges of the NULL SENS switch.
⑥	MECHANICAL ZERO CONTROL	Allows mechanical zeroing of the meter.
⑦	GROUND TERMINAL	Provides for connection to earth ground, provided of course that the line cord is connected to available line power.
⑧	INPUT TERMINALS	Provide connection to the measured voltage source.

Figure 2-2. THE MODEL 893AR CONTROLS, TERMINALS, AND INDICATORS (Sheet 1 of 2)

9	METER	Indicated the magnitude and polarity of the measured voltage on the TVM mode. On the differential mode, the meter+or-deflection indicates that the measured voltage is above or below the readout dial indication.
---	-------	--

Figure 2-2. THE MODEL 893AR CONTROLS, TERMINALS, AND INDICATORS (Sheet 2 of 2)

- b. Touch the HI INPUT terminal and the chassis of the instrument with your hand, observing that the meter pointer deflects to the right or left.
- c. Place the MODE switch to the -DC position and repeat step b. The meter pointer should deflect in the opposite direction by approximately the same amount observed in step b. Place the MODE switch to the +DC position upon completion of this step.
- d. Remove the shorting strap from between the LO and ground INPUT terminals and connect the strap between the HI and LO INPUT terminals.
- e. Perform the Readout dials versus NULL SENS checks of Figure 2-3, observing that the meter pointer indicates -1 for each particular check.

READOUT DIALS	NULL SENS
.000X	.001
.00100	.001
.01000	.01
.10000	.1

Figure 2-3. READOUT DIALS VERSUS NULL SENS CHECKS

- f. Place the Readout dials and NULL SENS switches to their respective .10000 and .1 positions, observing that the meter pointer indicates -1.
- g. Retaining the control positions of step f, place the RANGE switch to each available position, observing that the meter pointer indicates -1 in all positions of the RANGE switch.
- h. Place the Model 893 controls to the following positions:

POWER	ON/LINE OPR
RANGE	1
NULL SENS	.001
MODE	AC
Readout dials	000.00

- i. Touch the HI INPUT terminal of the Model 893, observing that a deflection is obtained on the meter.

2-14. If the results of the Operational Test agree with information given, it can be assumed that the instrument is operating properly and measurements of ac and dc voltages can now be performed.

2-15. OPERATING NOTES

2-16. GROUND LOOP CURRENTS

2-17. A potential difference often exists between different points of power system grounds. Consequently,

current may flow from one power system ground through the voltmeter and the voltage source being measured to another power system ground during the measurement process. These ground loop currents should be avoided as they generate voltages that degrade measurement accuracy. To prevent these ground loop currents, when the system being measured is grounded, remove the shorting strap between the LO INPUT terminal and the ground terminal of the Model 893 or, if your instrument is equipped with the -01 Option, operate the instrument from battery power with the line cord disconnected from line power.

2-18. COMMON MODE VOLTAGES

2-19. Great care has been taken in the design and construction of this instrument to isolate the circuitry from chassis ground to reduce common mode measurement errors caused partly by leakage currents. Accurate dc measurements can be made in the presence of common mode voltages up to 500 volts dc or ac voltages up to 100 volts peak-to-peak at 50 to 500 Hz. If the common mode voltage is greater than 50 volts, the measurement should be made several minutes after the equipment connections for best accuracy due to the time required to charge the stray capacitance through the extremely high leakage resistance to ground.

2-20. USE OF SHORTING LINK

2-21. The INPUT ground terminal is directly connected to the chassis of the instrument to provide a convenient connection to earth ground whenever the line cord is connected to line power. Whenever measurements of voltages having a reference other than ground, but not exceeding 500 volts, are performed, the shorting link between the LO INPUT and ground terminal must be removed or damage to the measurement source, the Model 893, or both may occur.

2-22. DC DIFFERENTIAL OFF-NULL INPUT RESISTANCE

2-23. Input resistance of the Model 893 is infinite at null during dc differential measurements because no current flows between the measured source and the internal reference supply of the instrument. However, a small current does flow between the measured source and the internal reference supply whenever the instrument is not exactly nulled. For example, when the meter deflection is 10% of full-scale on the 0.001 volt NULL SENS range, the input resistance of the instrument is 10^{11} ohms per volt of the measured input voltage or 10^{12} ohms for an input measured voltage of 10 volts dc. A graph of these apparent off-null input resistances is contained in Figure 2-4.

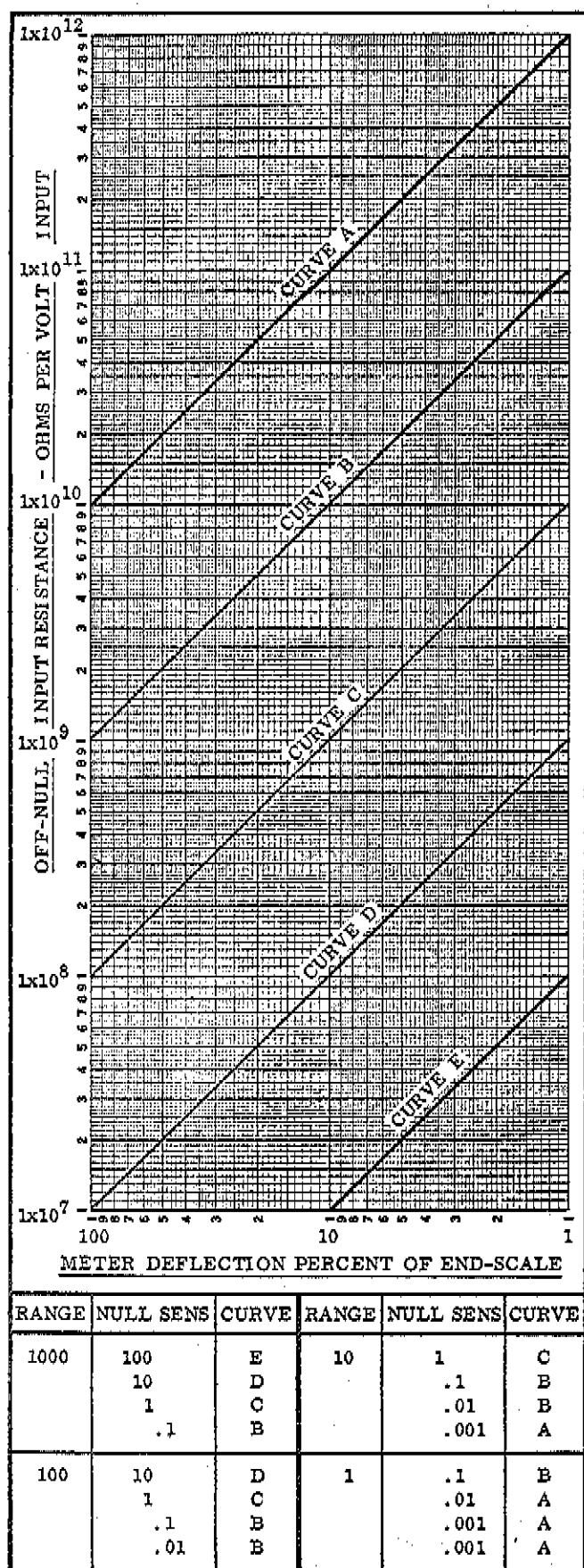


Figure 2-4. OFF-NULL DC INPUT RESISTANCES

2-24. TVM MODE OPERATION

2-25. The Model 893 can be used on the TVM mode to measure ac voltages from one millivolt to 1100 volts ac or dc voltages from 10 microvolts to 1100 volts dc with an accuracy of $\pm 3\%$ of the selected range. To operate the instrument on the TVM mode, perform the operations outlined in the Preliminary Operating Procedures (paragraphs 2-9 and 2-10) and proceed as follows:

- Place the MODE switch to the AC or +DC position that corresponds to the measurement source.
- Connect the circuit to be measured between the HI and LO INPUT terminals. If one side of the voltage source is grounded, connect the grounded side to the LO INPUT terminal.
- Place the RANGE switch to the lowest range possible that maintains an on-scale meter deflection. The meter deflection multiplied by the RANGE switch position is the value of the measured voltage. Left or right meter deflection during dc measurements corresponds to a negative or positive polarity of the measured dc voltage.
- Measurement of ac or dc voltages from 0.02 to 0.1 volts is accomplished on respective NULL SENS switch positions of 0.001 to 0.1. In this application, the RANGE switch is placed to the 1 VOLT range and the Readout dials to .000 00. The resulting meter deflection multiplied by the NULL SENS switch position is the value of the measured voltage.

2-26. DIFFERENTIAL MODE OPERATION

2-27. An improved accuracy of up to 250 times over that of the TVM mode is obtained when the instrument is operated as a differential voltmeter. To operate the instrument as an ac or dc differential voltmeter, proceed as follows:

- Determine the approximate value of the measured voltage by performing the TVM mode measurements described in paragraph 2-9 and 2-10.
- Place the MODE switch to the respective dc polarity observed on the TVM mode measurement and set the Readout dials to the TVM measurement value. If an ac measurement is being made, leave the MODE switch in its AC position.
- Place the NULL SENS switch to successively high null sensitivity positions and adjust the Readout dials to obtain a center-zero meter deflection.

CAUTION!

Whenever the NULL SENS switch is placed to a position other than TVM on the dc measurement mode, a voltage corresponding to the Readout dial indications is present between the HI and LO INPUT terminals. A personnel hazard does not exist as the source resistance is 90 megohms on the

100 and 1000 volt ranges, however, this potential can damage high input impedance semiconductor devices such as field effect transistors.

- d. The Readout dial digit indications correspond to the magnitude of the measured voltage. If dc measurements have been performed, the MODE switch position indicates the polarity of the measured dc voltage.

2-28. OPTIONAL RECORDER OUTPUT OPERATION

2-29. Instruments equipped with the -02 option provide an isolated recorder output voltage which is available at the rear panel terminals. The recorder output dc voltage is adjustable from zero to ± 0.2 volts dc for a full-scale meter deflection and is used to drive a center-zero recorder. To utilize the recorder output voltage, proceed as follows:

- a. Connect the recorder to the rear panel RECORDER OUTPUT terminals.

Note!

The LO RECORDER OUTPUT terminal is connected to chassis ground of the Model 893. If a ground reference is undesirable, operate the Model 893 on battery power with its line cord disconnected from line power.

- b. Turn the recorder on and place the Model 893 controls to the following positions:

POWER	ON/LINE-OPR
RANGE	10
NULL SENS	1
MODE	+DC
Readout dials	1. 00 00

- c. Connect the shorting link between the HI and LO INPUT terminals and adjust the RECORDER OUTPUT LEVEL control for the desired left full-scale indication on the recorder. The left full-scale meter is now plotted and from this information the right full-scale point can be determined.

- d. Remove the shorting link from between the HI and LO INPUT terminals and proceed with the desired measurement. The external recorder will now record all meter excursions of the Model 893.

2-30. APPLICATIONS

2-31. INTRODUCTION

2-32. The Model 893 AC DC Differential Voltmeter, because of its calibrated meter end-scale and high dc mode input impedance, can be used in many special applications. These applications, to mention a few, are: measurement of ac or dc voltage excursions about a nominal value, measurement of extremely high resistances, operation as a dc null detector, and measurement of DBM.

2-33. MEASUREMENT OF VOLTAGE EXCURSIONS ABOUT A NOMINAL VALUE

2-34. Whenever the instrument is operated on the differential mode, the meter end-scale is calibrated to be a known voltage by the position of the NULL SENS switch, thus allowing rapid determination of any voltage excursions about a nominal value. For example, by selecting a null sensitivity of .1 with the RANGE switch on any voltage range, the full left or right scale meter deflection represents ± 0.1 volts deviation from the Readout dial settings. To measure voltage excursions about a nominal value, proceed as follows:

- Perform the Preliminary Operating Procedures of paragraph 2-9 and 2-10.
- Determine the nominal value of the ac or dc voltage being measured, using the TVM mode on the Model 893. Refer to paragraphs 2-24 and 2-25 for the TVM mode operating procedures.
- Place the Readout dials to the nominal value of the voltage measured in step b and select the desired full-scale meter sensitivity with the NULL SENS switch. The voltage excursions about the Readout dial settings can now be determined by the left or right meter deflections.

2-35. MEASUREMENT OF EXTREMELY HIGH RESISTANCES

2-36. The Model 893 can be used as a megohmmeter for measurements of high resistances from 10 to 10^6 megohms with a typical accuracy of $\pm 5\%$. To operate the instrument as a megohmmeter, perform the Preliminary Operating Procedures described in paragraphs 2-9 and 2-10 and proceed as follows:

- a. Place the Model 893 controls to the following positions:

POWER	ON/LINE OPR
RANGE	10
NULL SENS	.01 (.001 if the R is greater than 10^{10})
MODE	+DC
Readout dials	0. 00 00

Note!

The 10 volt range has been used only as an example in step a. Other voltage ranges may be used to provide high resistance measurements at different voltage levels.

- Connect the unknown resistance between the HI and LO INPUT terminals. Use short isolated leads to prevent measuring the leakage resistance between the leads.
- Rotate the Readout dials to obtain a meter deflection of -1 and use the following calculations to determine the value of the unknown resistance.

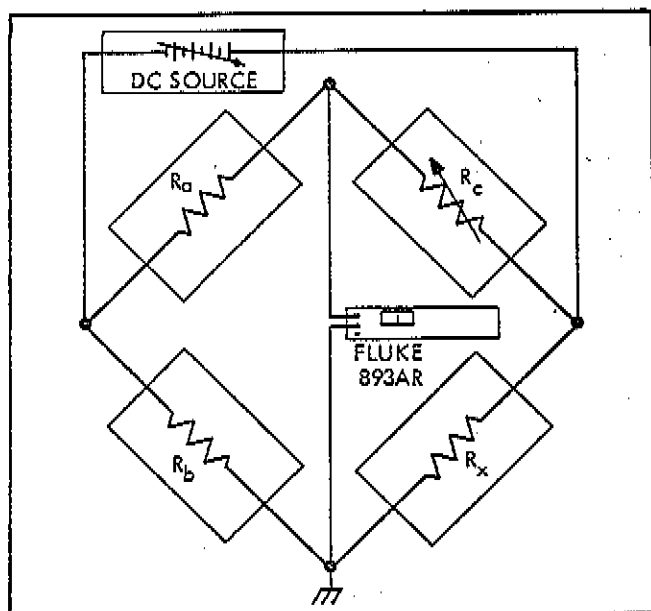


Figure 2-5. BRIDGE DETECTOR - FLOATING SUPPLY

$$R_x = \left(\frac{E_{ro}}{E_m} - 1 \right) R_{nd}$$

R_x = Unknown resistance

R_{nd} = Null detector input resistance of 10 megohms for NULL SENS settings of .01. Null detector input resistance is 100 megohms on all other settings.

E_{ro} = Readout dial voltage

E_m = Meter deflection in volts (Proportional to selected NULL SENS).

2-37. OPERATION AS A NULL DETECTOR

2-38. The Model 893, because of its high input impedance on the dc differential mode, can be used to monitor small voltage differences in bridge circuits, potentiometers, and other measuring devices. In most of these applications, the circuits are adjusted for a zero deflection or null on the Model 893. Equipment connections for two types of null detector configurations are illustrated in Figure 2-5 and 2-6. To operate the instrument as a null detector, perform the Preliminary Operating Procedures described in paragraphs 2-9 and 2-10, and proceed as follows:

- Select the desired equipment applications illustrated in Figure 2-5 and 2-6 and make the appropriate connections.
- Place the Model 893 MODE and NULL SENS switches to the +DC and desired null detector sensitivity

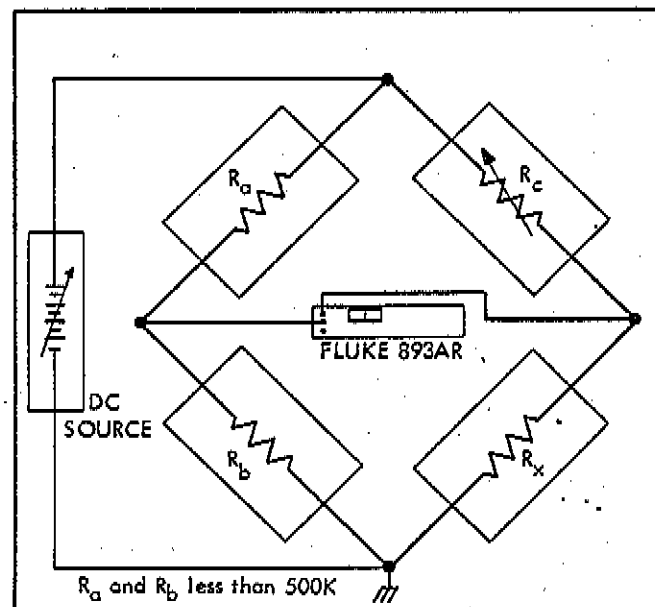


Figure 2-6. BRIDGE DETECTOR - FLOATING NULL DETECTOR

positions, respectively. Adjust the circuit being measured for a zero or null deflection on the Model 893.

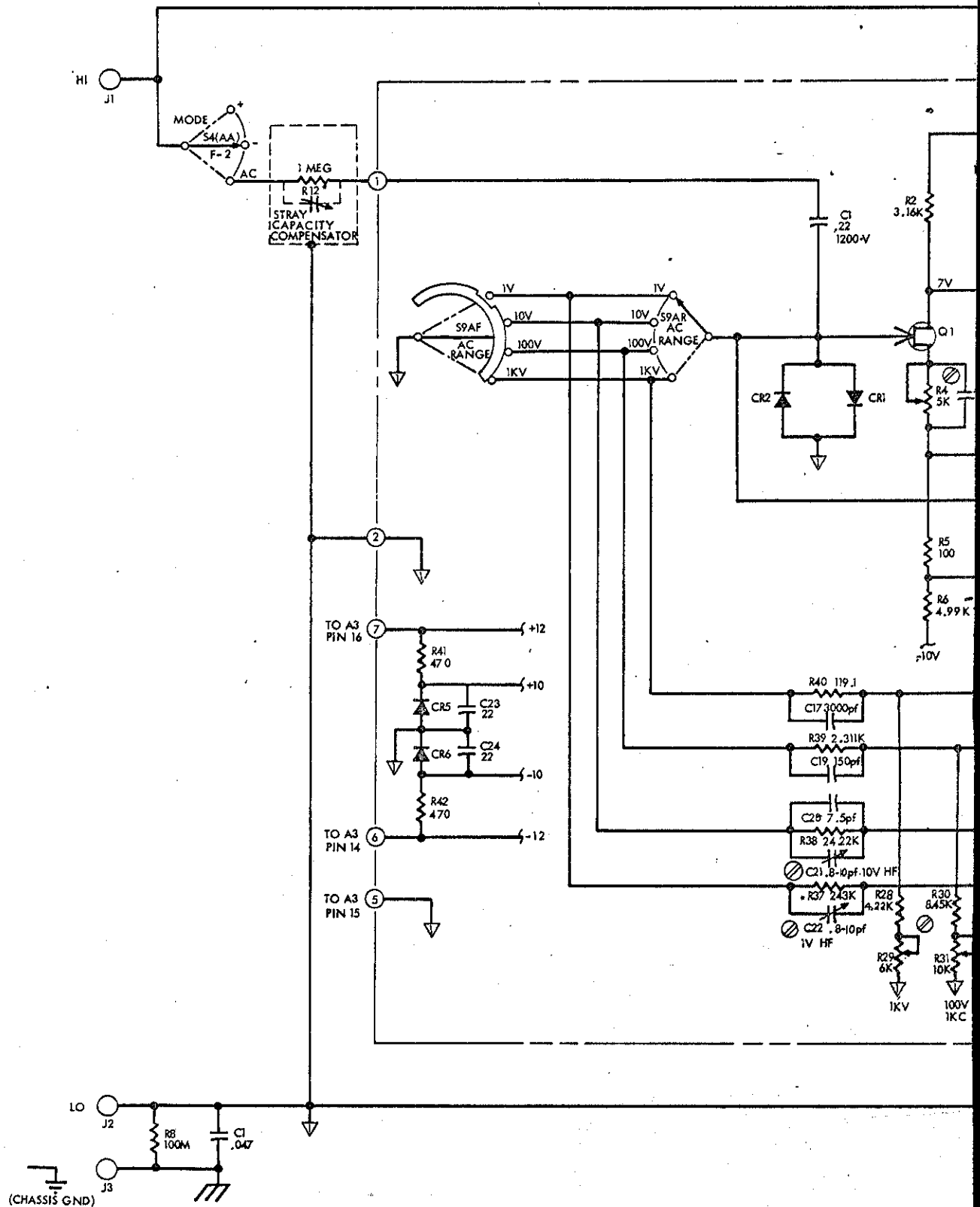
2-39. MEASUREMENT OF DBM

2-40. The Model 893, when operated on either the TVM or Differential AC mode, can be used as an output meter. For this application, the output to be measured must be terminated into a 600 ohm load and the Model 893 INPUT connected across the 600 ohm load. The Model 893 is then operated on the TVM or Differential AC mode and the resulting deflection or Readout dial indication converted to DBM using the information contained in Figure 2-7. For DBM measurements above one volt ac, multiply the voltages listed in Figure 2-7 by ten for each range and then add 20 DBM for each range.

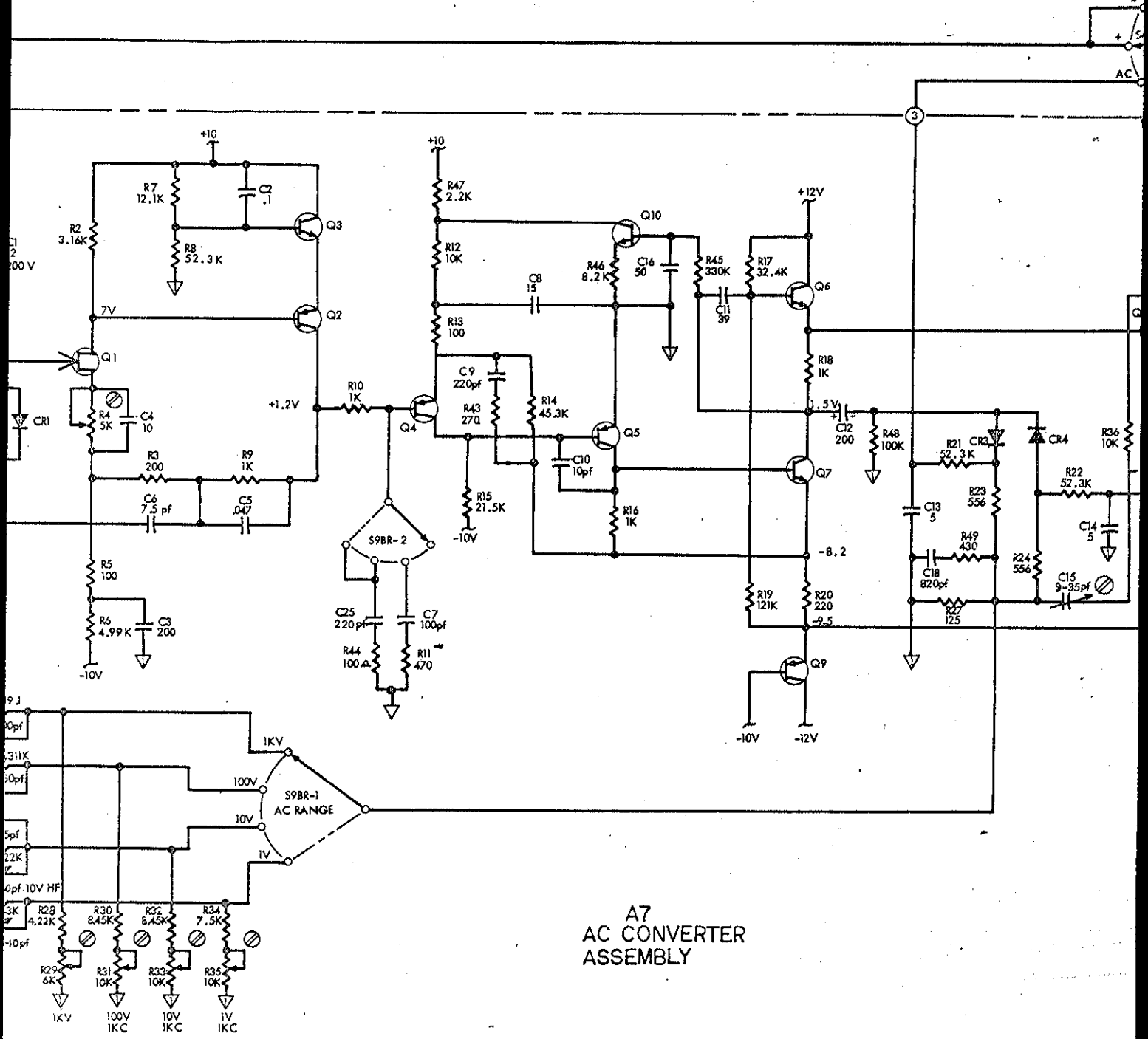
INDICATED VOLTAGE	DBM LEVEL FOR 1 VOLT RANGE (1 mw into 600Ω)
.0975	-18
.1227	-16
.1545	-14
.1946	-12
.2450	-10
.3088	-8
.3897	-6
.4887	-4
.6150	-2
.7746	0
.9752	+2

Figure 2-7. 1 VOLT RANGE DBM CONVERSION TABLE

Schem. 1
 Slt 1 of 5

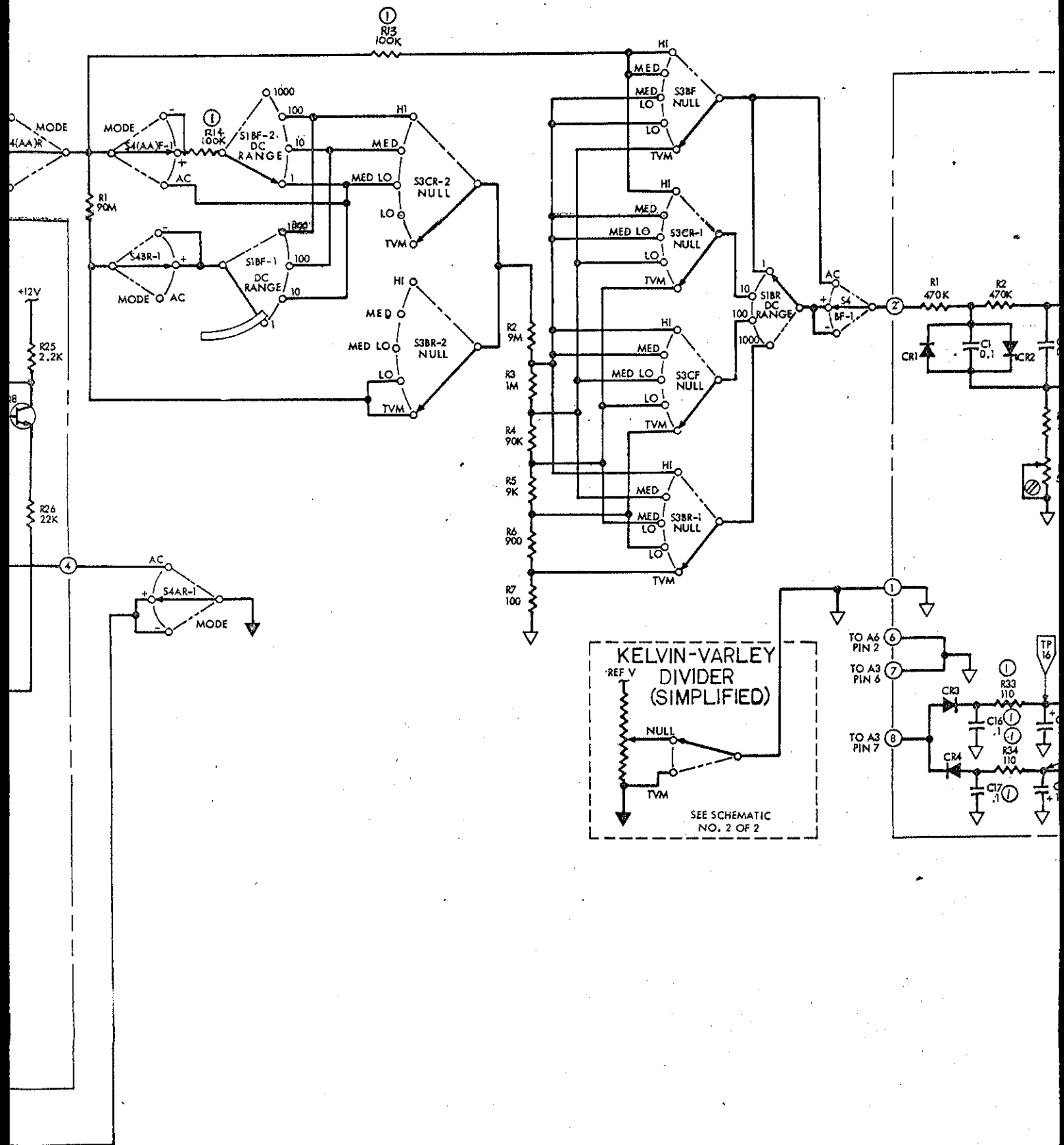


Schem 1
 Sht 2 of 5

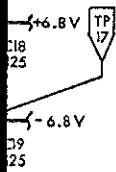
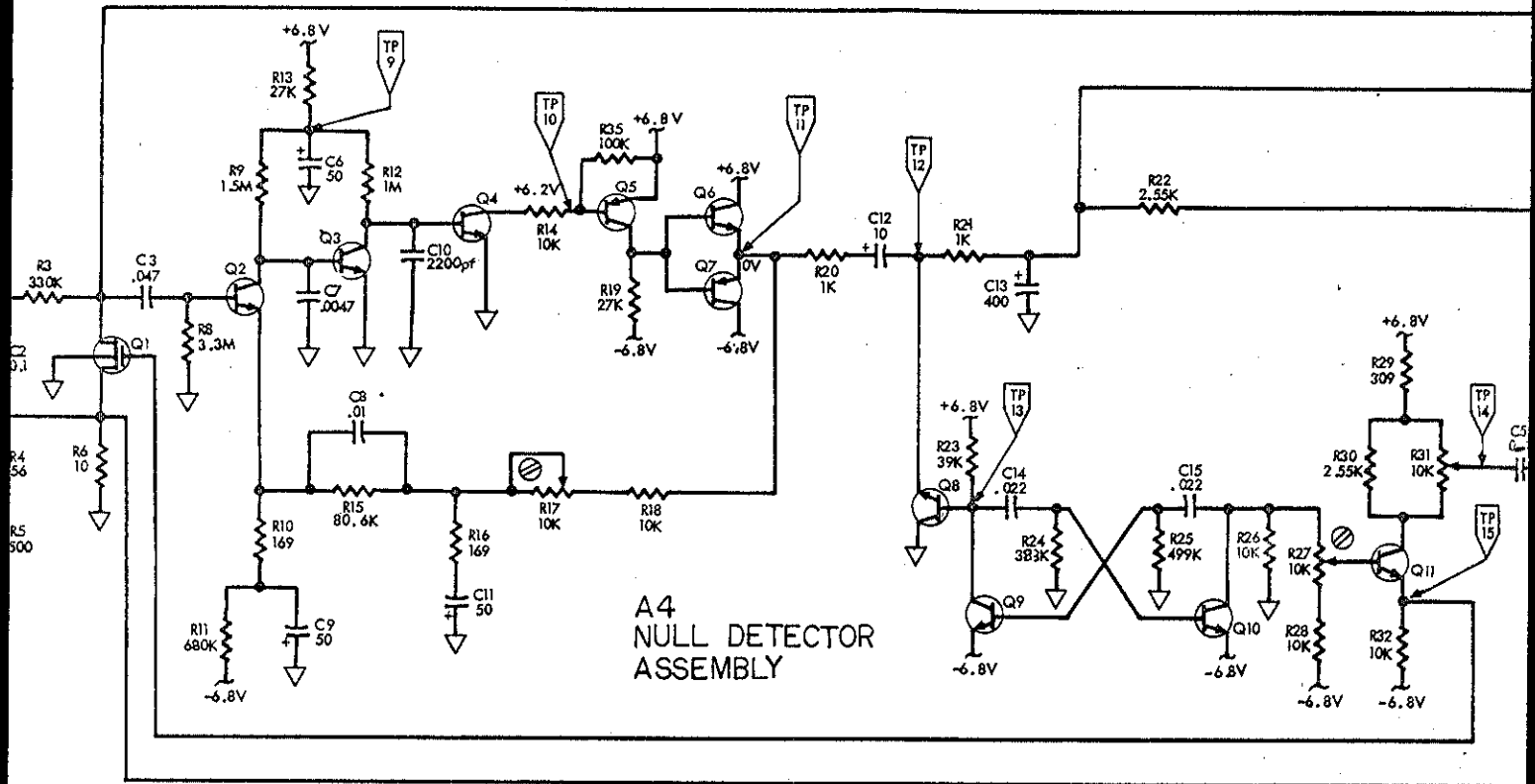


A7
 AC CONVERTER
 ASSEMBLY

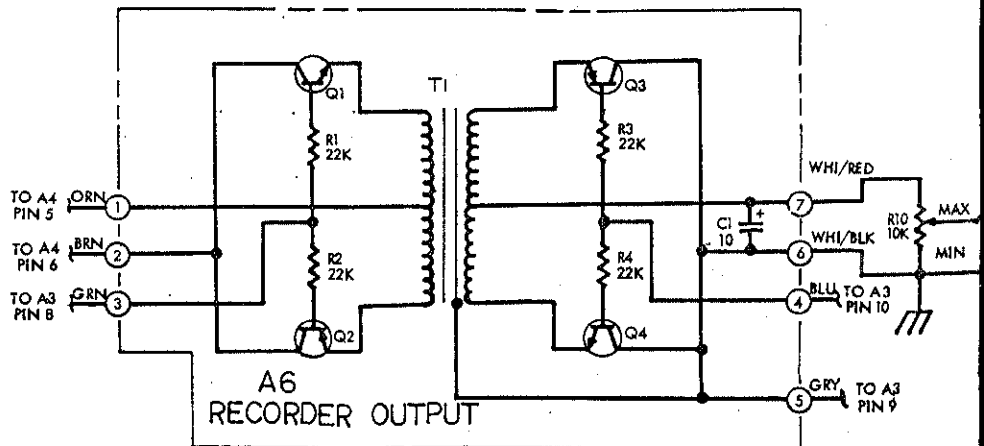
Schem. 1
 Sht 3 of 5



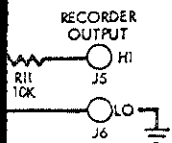
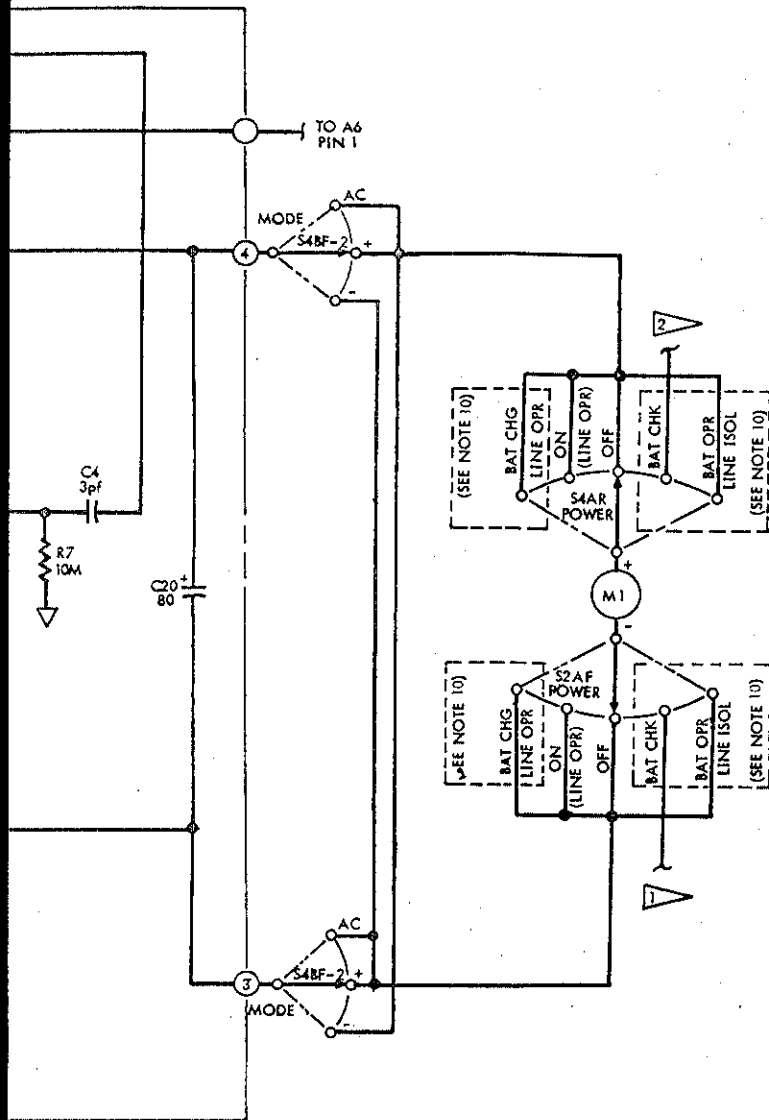
Schem. 1
Skt 4 of 5



RECORDER OUTPUT OPTION -02



Schem 1
Sht 5 of 5



CHANGES:

- ① SERIAL NO. 171 & ON
R13, R14 ADDED.
A2R37 ADDED
A4C16, U17, R33, R34
DELETED.

12. BELOW IS A BRIEF EXPLANATION OF THE COMPLETE REFERENCE DESIGNATIONS OF SWITCHES S1 THRU S4. NULL SWITCH S3BR-2 IS USED AS AN EXAMPLE.

- (S3) THE BASIC REFERENCE DESIGNATION.
(B) THE SWITCH DECK LOCATION AS VIEWED FROM THE FRONT-PANEL. "B" IS THE SECOND DECK FROM THE FRONT-PANEL OF SWITCH S3.
(R) "R" INDICATES THE REAR SECTION OF THE ABOVE DECK. AN "F" INDICATES THE FRONT SECTION.
(-2) INDICATES WHICH FUNCTION OF THE ABOVE DECK SECTION IS ILLUSTRATED. NO NUMBER IN THIS POSITION INDICATES THAT ONLY ONE FUNCTION IS ACCOMPLISHED BY THE DECK SECTION.

11. ALL VOLTAGE MEASUREMENTS SHOWN ARE TAKEN UNDER THE FOLLOWING CONDITIONS:

- (A) POWER SWITCH IN LINE OPERATE
(B) LINE VOLTAGE AT 115/230 VOLTS, 50-440 HERTZ.
(C) ALL VOLTAGES MEASURED WITH A 3% 10 MEG OHM VOLTMETER FROM SPECIFIED TERMINAL TO REFERENCE SUPPLY-NULL DETECTOR COMMON. THE COMMON POST IS REFERENCE SUPPLY-NULL DETECTOR COMMON WHEN IN THE TVM MODE OR WHEN IN A NULL MODE WITH ALL VOLTAGE DIALS SET TO 0 AND MODE SWITCH SET TO +.
(D) SOME VOLTAGES MAY VARY AS MUCH AS 15 TO 20%.
(E) BIAS VOLTAGES (DIFFERENCE BETWEEN EMITTER AND BASE VOLTAGES) SHOULD REMAIN APPROXIMATELY THE SAME.
(F) ALL VOLTAGES ARE DC UNLESS OTHERWISE INDICATED.

10. POWER SWITCH (S2) POSITIONS WITHIN DASHED LINES ARE USED ONLY IN UNITS CONTAINING THE OPTIONAL RECHARGEABLE BATTERY SUPPLY.

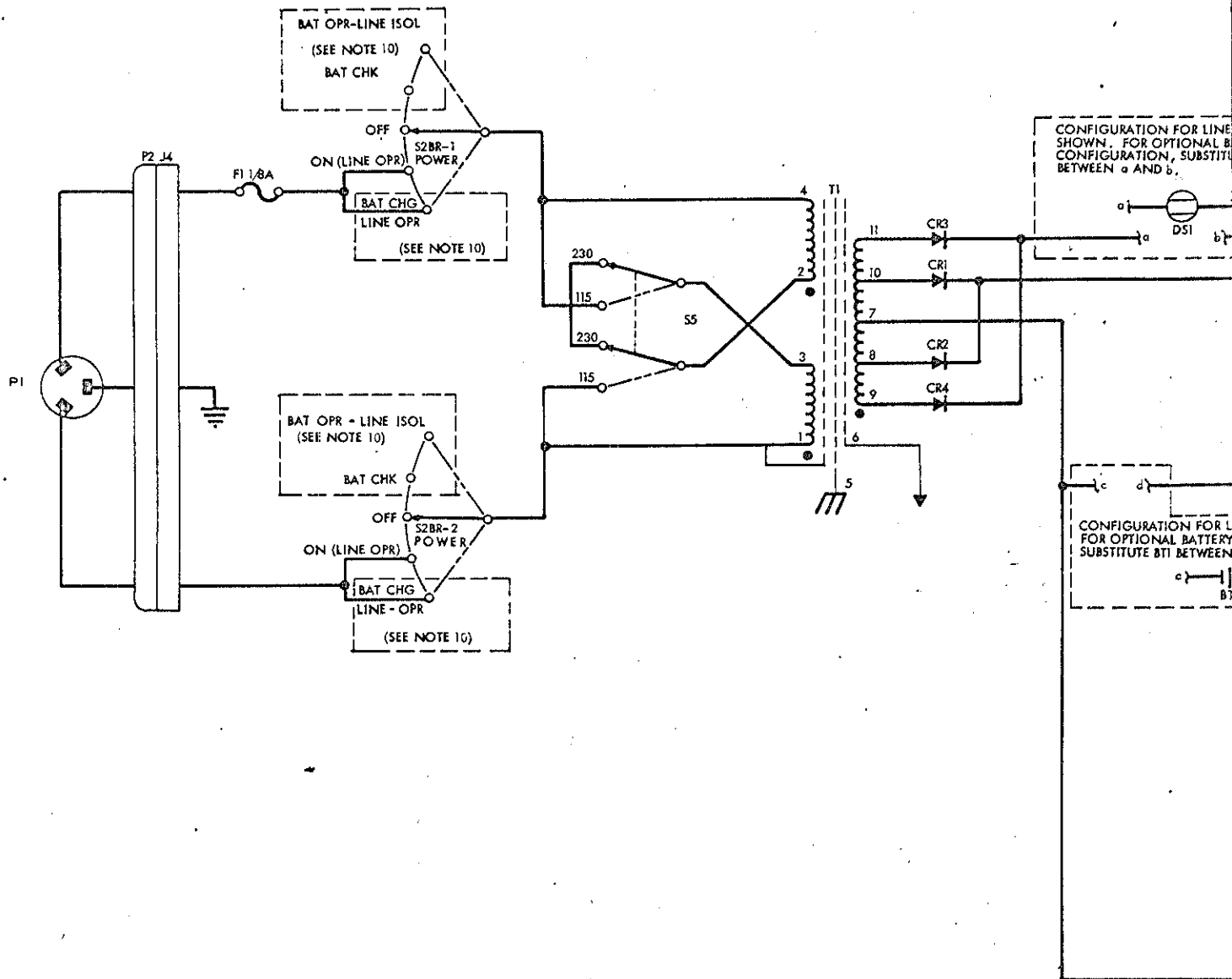
9. ALL RESISTANCE VALUES ARE IN OHMS AND ALL CAPACITANCE VALUES ARE IN MICROFARADS UNLESS OTHERWISE INDICATED.

8. ▽ FLAGS WITH THE SAME NUMBERS ARE CONNECTED.
7. ▽ TEST POINT
6. ⊗ INTERNAL ADJUSTMENT
5. * FACTORY SELECTED COMPONENT
4. ▽ REFERENCE SUPPLY COMMON
3. ▽ NULL DETECTOR COMMON
2. ▽ DC REFERENCE COMMON
1. ▽ LO INPUT COMMON

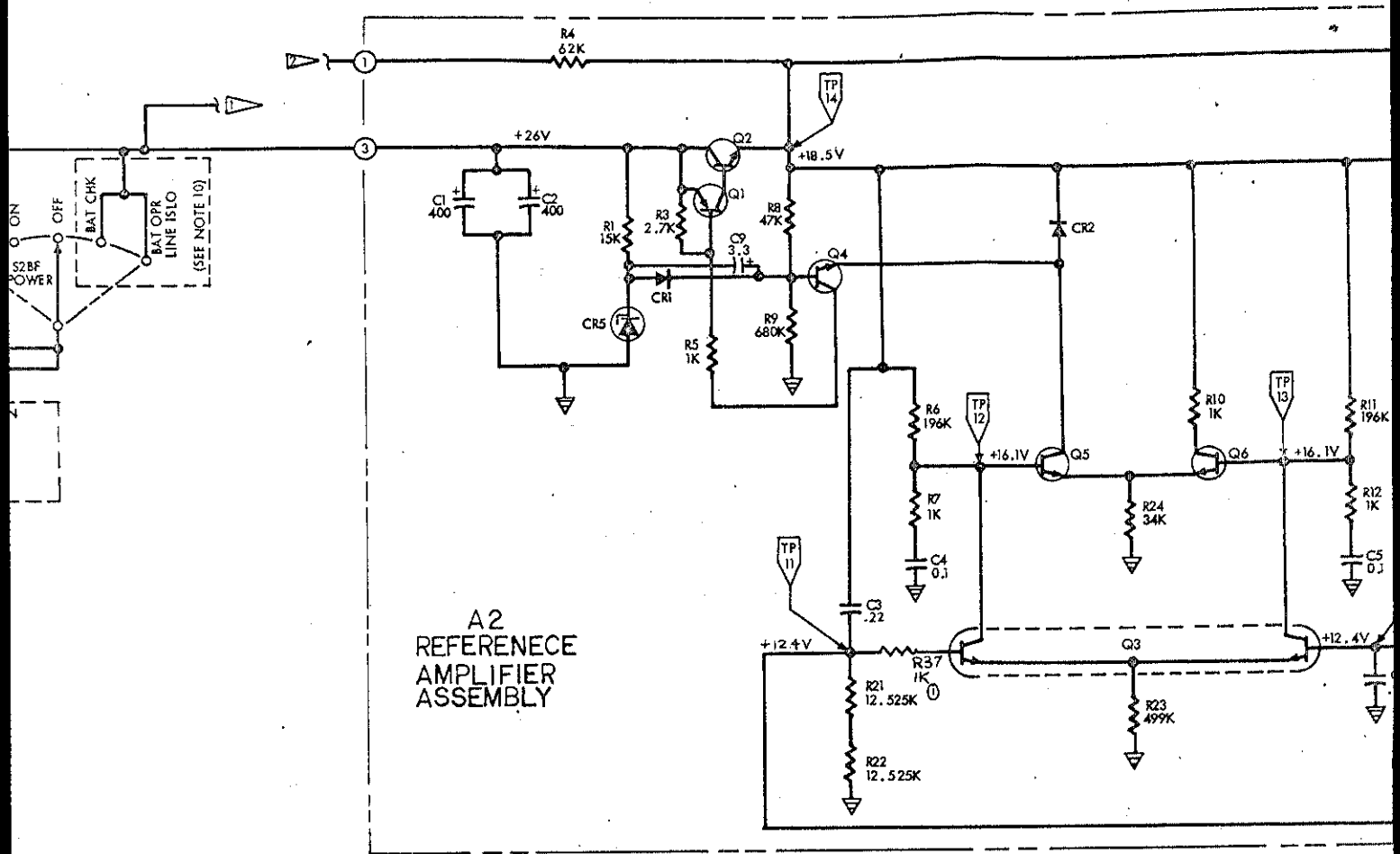
FUNCTIONAL SCHEMATIC DIAGRAM	
MODEL 893A & AR	
AC - DC DIFFERENTIAL VOLTMETER	
SCHEMATIC NO. 1 OF 2	
SER. NO. 123 & ON	REV. C
JOHN FLUKE MFG. CO., INC. P.O. Box 7428 Seattle, Washington 98133	

02
2
4

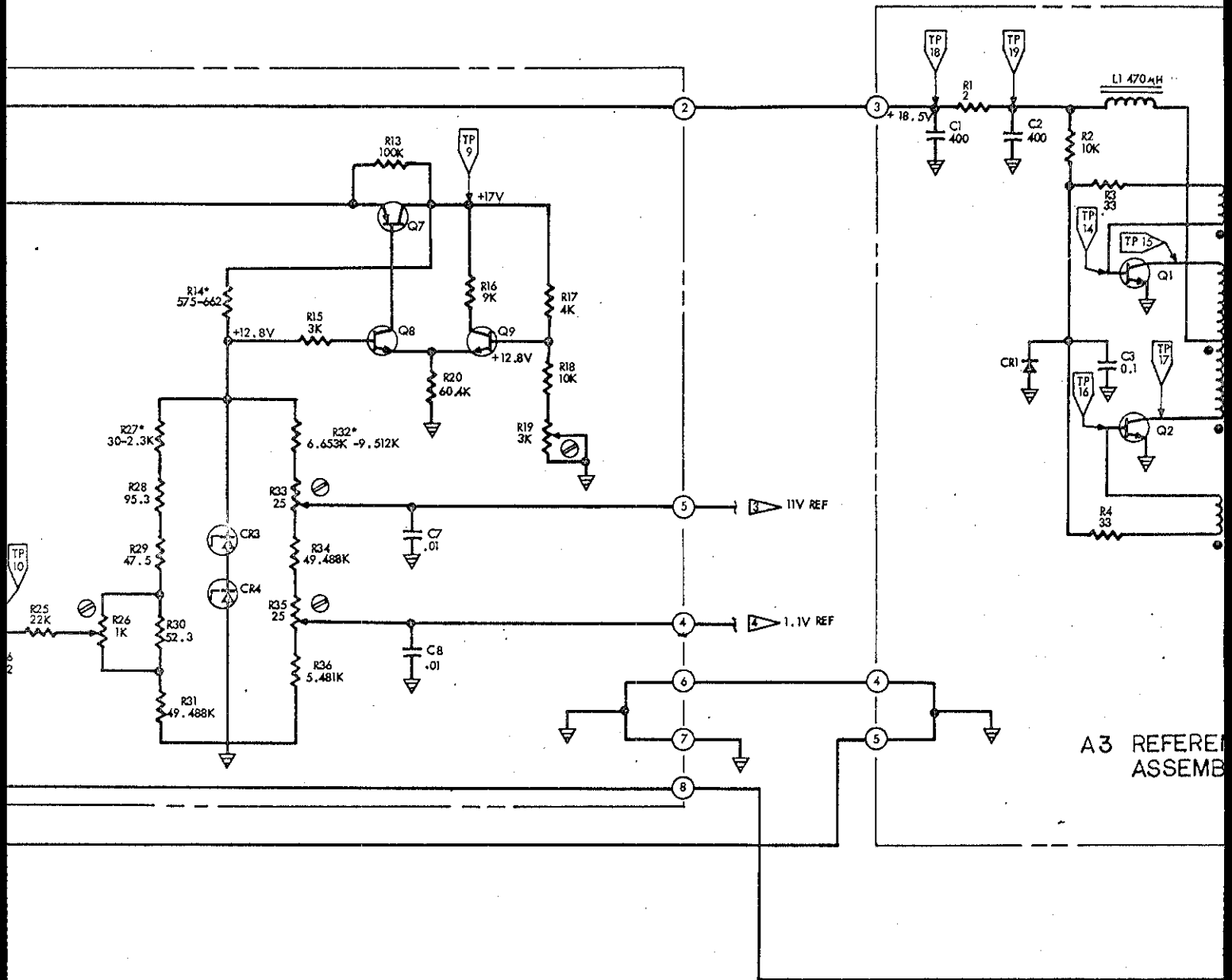
Schem. 2
Sht 1 of 5



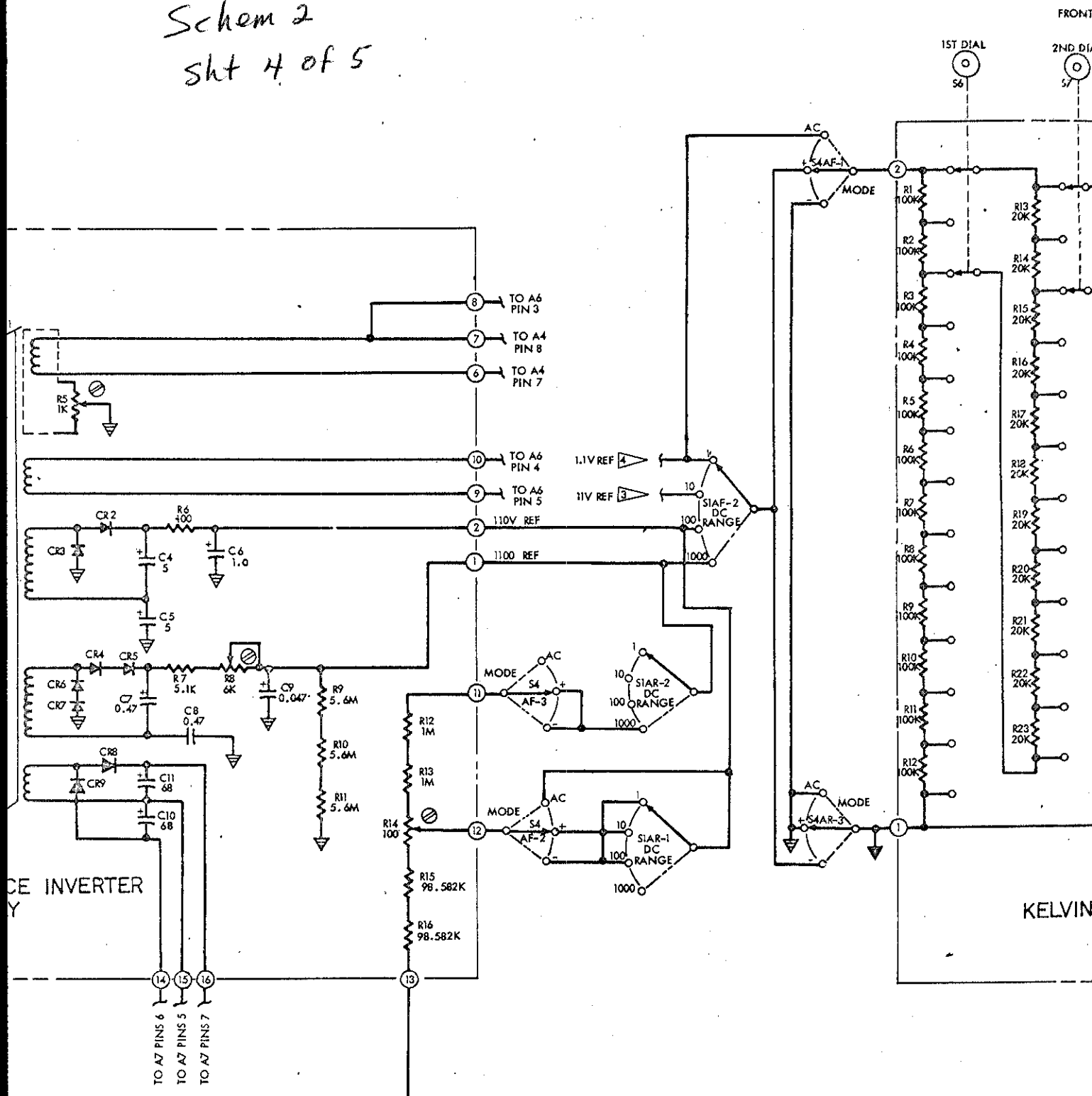
Schem 2
 Sht 2 of 5



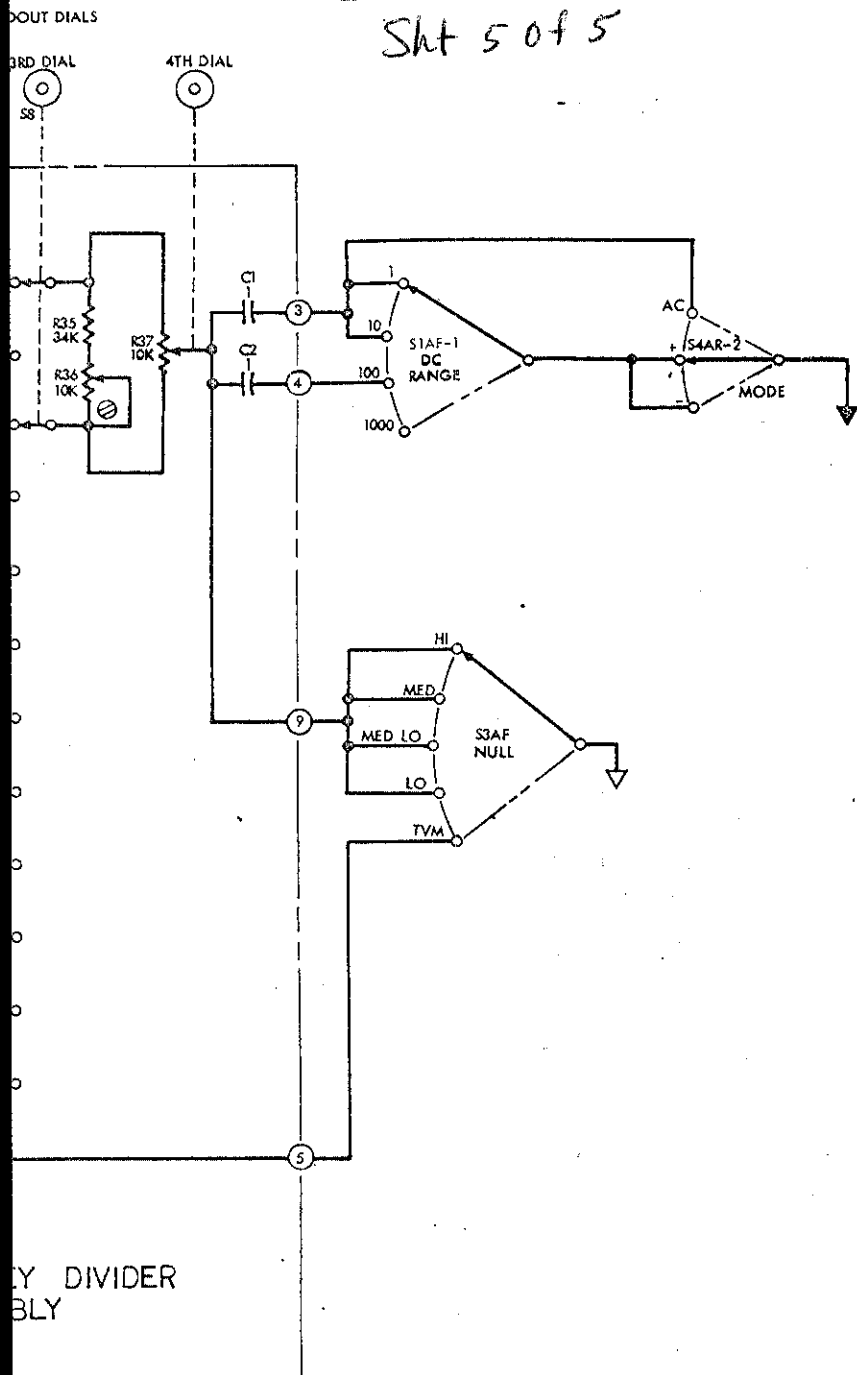
Schem 2
 skt 3 of 5



Schem 2
 sht 4 of 5



Schem. 2
Sht 5 of 5



CHANGES:

- ① SERIAL NO. 171 & ON:
R13, R14, ADDED
A2R37 ADDED
A4C16, C17, R33, R34
DELETED.

12. BELOW IS A BRIEF EXPLANATION OF THE COMPLETE REFERENCE DESIGNATIONS OF SWITCHES S1 THRU S4. NULL SWITCH S3BR-2 IS USED AS AN EXAMPLE.

- (S3) THE BASIC REFERENCE DESIGNATION.
(B) THE SWITCH DECK LOCATION AS VIEWED FROM THE FRONT-PANEL. "B" IS THE SECOND DECK FROM THE FRONT-PANEL OF SWITCH S3.
(R) "R" INDICATES THE REAR SECTION OF THE ABOVE DECK. AN "F" INDICATES THE FRONT SECTION.
(-2) INDICATES WHICH FUNCTION OF THE ABOVE DECK SECTION IS ILLUSTRATED. NO NUMBER IN THIS POSITION INDICATES THAT ONLY ONE FUNCTION IS ACCOMPLISHED BY THE DECK SECTION.

11. ALL VOLTAGE MEASUREMENTS SHOWN ARE TAKEN UNDER THE FOLLOWING CONDITIONS:

- (A) POWER SWITCH IN LINE OPERATE
(B) LINE VOLTAGE AT 115/230 VOLTS, 50-440 HERTZ.
(C) ALL VOLTAGES MEASURED WITH A 3 Ω 10 MEG OHM VOLTMETER FROM SPECIFIED TERMINAL TO REFERENCE SUPPLY -NULL DETECTOR COMMON. THE COMMON POST IS REFERENCE SUPPLY -NULL DETECTOR COMMON WHEN IN THE TVM MODE OR WHEN IN A NULL MODE WITH ALL VOLTAGE DIALS SET TO 0 AND MODE SWITCH SET TO +.
(D) SOME VOLTAGES MAY VARY AS MUCH AS 15 TO 20%.
(E) BIAS VOLTAGES (DIFFERENCE BETWEEN EMITTER AND BASE VOLTAGES) SHOULD REMAIN APPROXIMATELY THE SAME.
(F) ALL VOLTAGES ARE DC UNLESS OTHERWISE INDICATED.

10. POWER SWITCH (S2) POSITIONS WITHIN DASHED LINES ARE USED ONLY IN UNITS CONTAINING THE OPTIONAL RECHARGEABLE BATTERY SUPPLY.

9. ALL RESISTANCE VALUES ARE IN OHMS AND ALL CAPACITANCE VALUES ARE IN MICROFARADS UNLESS OTHERWISE INDICATED.

8. FLAGS WITH THE SAME NUMBERS ARE CONNECTED.
7. TEST POINT
6. INTERNAL ADJUSTMENT
5. FACTORY SELECTED COMPONENT
4. REFERENCE SUPPLY COMMON
3. NULL DETECTOR COMMON
2. DC REFERENCE COMMON
1. LO INPUT COMMON

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 893A & AR
AC - DC
DIFFERENTIAL VOLTMETER

SCHEMATIC NO. 2 OF 2

SER. NO. 123 & ON

REV.

C

JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133