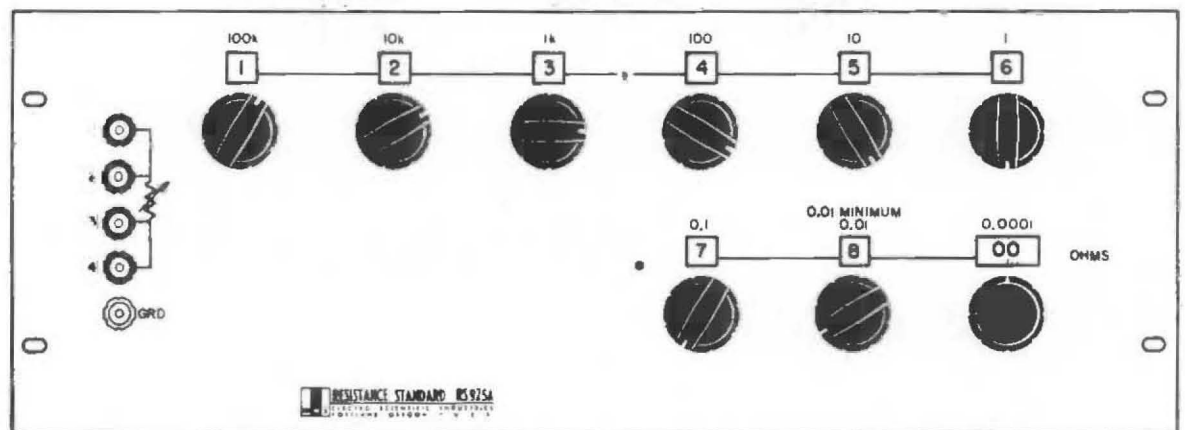


Instruction Manual

JANUARY 1970
REPLACES AUGUST 1964

MODEL RS 925A

RESISTANCE STANDARD



SERIAL NUMBER: _____

PART NUMBER: 8402

esi

Electro Scientific Industries

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ESIAC[®] Algebraic Computer
ESIPOT[®] Potentiometer
DEKABOX[®] Decade Resistors and Capacitors
DEKABRIDGE[®] Bridge Circuit
DEKADIAL[®] Decade Dials
DEKAMATIC[®] Automatic Unit
DEKAPOT[®] Decade Potentiometers
DEKASTAT[®] Decade Rheostat
DEKAPACITOR[®] Decade Capacitor
DEKAVIDER[®] Decade Voltage Divider
KELVIN KLAMPS[®] Four-Terminal Clamps
KELVIN KLIPS[®] Four-Terminal Clips
PORTAMETRIC[®] Portable Measuring Instrument
PVB[®] Potentiometric Voltmeter Bridge

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A.

SECTION I

DESCRIPTION AND SPECIFICATIONS

1.1 DESCRIPTION

The Model RS 925A Decade Resistance Standard is a wide range, four-terminal decade resistor. The use of special ESI resistors and multiple contact, low-resistance switches in the RS 925A assures high accuracy and a short term stability of better than 1 ppm.

1.2 SPECIFICATIONS

Resistance Range: 10 milliohms to 1.2 megohms provided by 8 resistance decades and a rheostat with 20 microhms resolution

Initial Adjustment Accuracy at Any Setting: $\pm(20 \text{ ppm} + 1 \text{ milliohm})$

Short-Term Repeatability of Resistance: Mean value of variation of total switch contact resistance less than 100 microhms

Long-Term Stability of Resistance: Resistance will remain within $\pm(50 \text{ ppm} + 2 \text{ milliohms})$ of nominal value for more than one year.

Calibration Conditions: 23°C, four-terminal measurement

Temperature Coefficient:

100 ohm steps and higher.	$\pm 5 \text{ ppm}/^{\circ}\text{C}$
10 ohm steps.	$\pm 15 \text{ ppm}/^{\circ}\text{C}$
1 ohm steps and lower.	$\pm 20 \text{ ppm}/^{\circ}\text{C}$
Wiring and Switches.	$\pm 50 \text{ microhms}/^{\circ}\text{C}$

Power Coefficient for Typical Measurement Duty Cycle:

100 ohm steps and higher.	$\pm 0.1 \text{ ppm/mw/step}$
10 ohm steps.	$\pm 0.3 \text{ ppm/mw/step}$
1 ohm steps.	$\pm 0.4 \text{ ppm/mw/step}$
0.1 and 0.01 ohm steps.	$\pm 1 \text{ ppm/mw/step}$
Wiring and Switches.	$\pm 50 \text{ microhms/watt total}$

Power Rating: 1 watt per step, 5 watts total, or 2 amperes maximum current

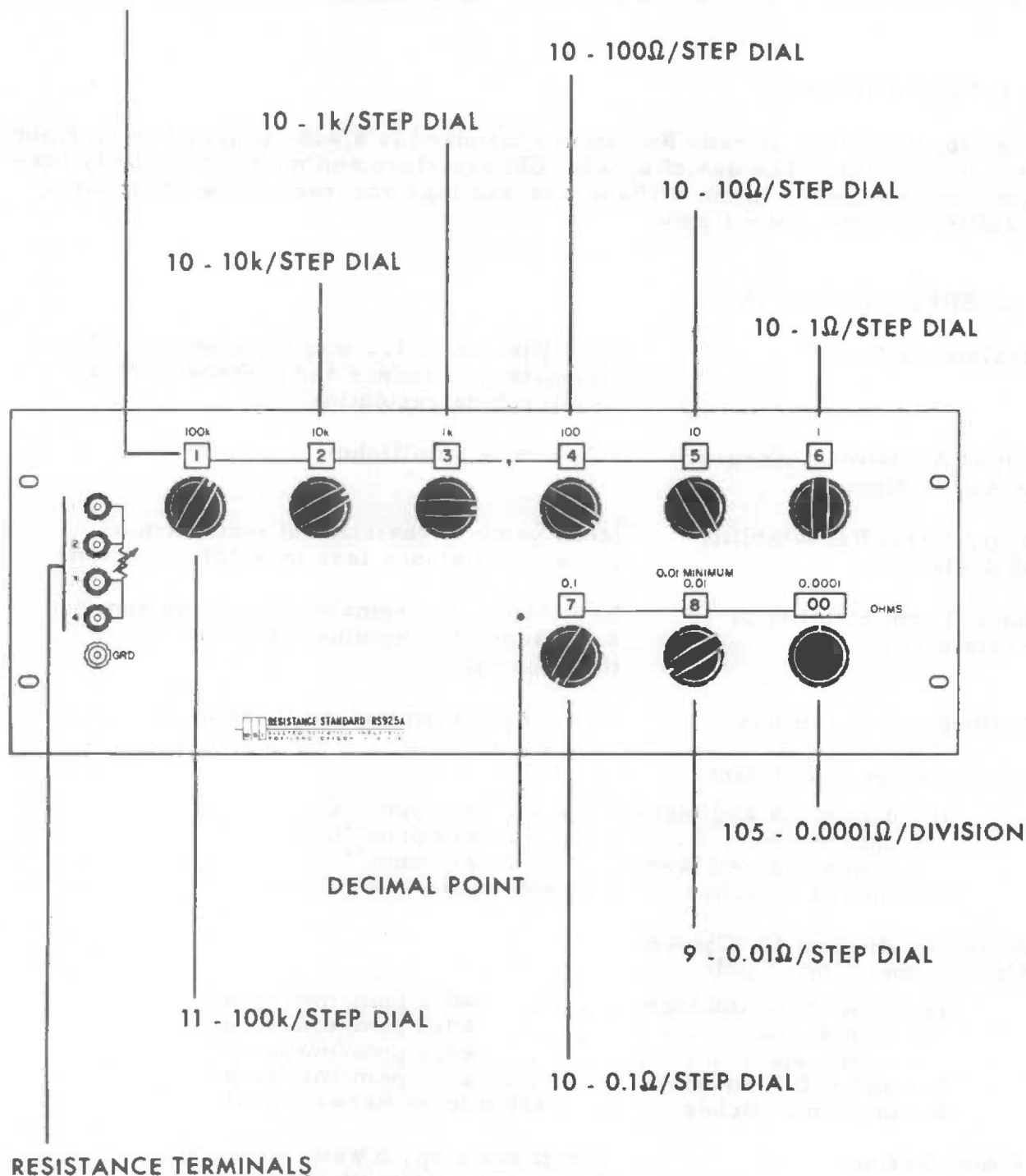
Breakdown Voltage: 1000 volts peak to case

Dimensions: 7" high, 19" long, 8" deep

Weight: 14 lbs net

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RESISTANCE READING WINDOWS



MODEL RS 925A PANEL CONTROLS

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SECTION II

OPERATING INSTRUCTIONS

2.1 RESISTANCE SELECTION KNOBS

The first knob on the left in the top row is used to change the four-terminal resistance in steps of 100 kilohms. The successive seven knobs are used to adjust the resistance in units down to 10 milliohms. The last knob in the bottom row varies a 10.5 milliohm potentiometer which is connected as a four-terminal variable resistor. The dial reading in the window above each knob is an in-line resistance reading.

Engraved above each window is the resistance per step of that decade. A decimal point is engraved on the panel to the left of the 0.1 ohm per step decade.

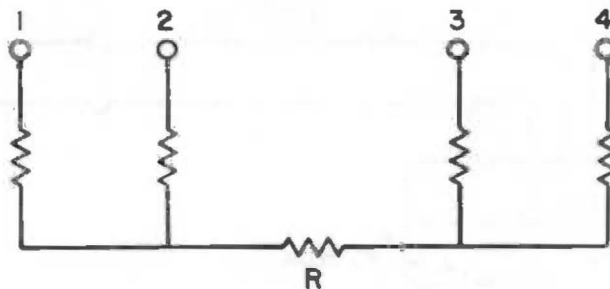
The minimum reading on the 0.01 ohm per step decade is 0.01 ohm since this is the minimum internal resistance of the RS925A. An effective zero reading may be obtained on the 0.01 ohm per step dial by reducing the setting of the 0.1 ohm per step dial one position and setting the 0.01 ohm per step dial at (TEN).

2.2 RESISTANCE TERMINALS

The terminals provided permit four-terminal connection to an external circuit. The ground terminal is provided for convenience.

2.3 FOUR-TERMINAL APPLICATIONS

The ESI Model RS925A is constructed with four terminals as shown below.



opposite end of the resistor R , and the voltage is measured between the remaining two terminals, the four-terminal resistance of R is the ratio of the measured voltage to the current. Four terminal resistors are normally used for meter shunt applications and as resistance standards for Kelvin bridge measurements.

a) Meter Shunt Applications

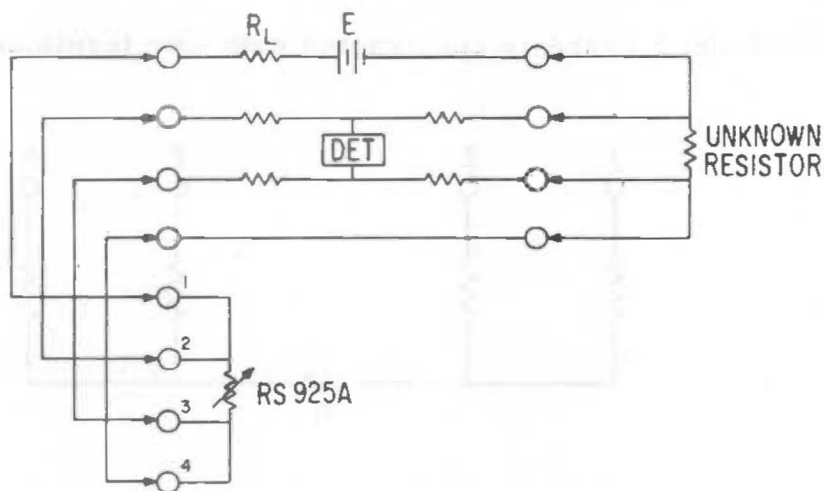
To measure the current in a four-terminal resistance, the voltage drop is measured between the two-terminals of the resistor not connected to the source. The current is then determined by the ratio of the measured voltage to the known resistance. Use of the four-terminal technique avoids measuring errors caused by voltage drops in the current carrying leads and contacts. Errors caused by lead and contact resistance in the voltage measuring circuit are negligible if the current in this circuit is small.

b) Kelvin Bridge Applications

A four-terminal resistance standard is used for all Kelvin bridge measurements. Errors caused by lead and contact resistances are usually negligible because they appear as part of the generator or yoke resistance, or in series with high resistance bridge arms.

For optimum performance with a Kelvin bridge connect the RS 925A terminals as follows:

1. Generator
2. Bridge (generator side)
3. Bridge (yoke side)
4. Yoke



2.4 POWER LIMITATIONS

For maximum protection and accuracy it is recommended that the available power to the RS 925A Resistance Standard be limited to ONE WATT. This is accomplished by placing a resistor in series with the bridge generator or battery.

The value of this resistance can be calculated from the following formula:

$$R_L = \frac{E^2}{4}$$

where

R_L is the value of the power limiting resistor.

E is the open circuit voltage of the generator.

The protective resistor should have a power rating of 4 watts or more. Input power should be limited to 1/10 watt or less for most accurate measurements.

SECTION III

PREVENTIVE MAINTENANCE

The following procedures should be performed periodically (approximately once a year) to insure maximum accuracy and reliability from the ESI MODEL RS925A RESISTANCE STANDARD.

If the need for major repairs is apparent, it is recommended that the unit be sent to the factory for service. The service department will be glad to furnish the necessary information for repairs as well as any replacement parts. However, unauthorized repairs will invalidate the instrument warranty. If the instrument is more than one year old when returned to the factory, a reasonable charge may be expected for replacement of parts or complete reconditioning.

3.1 VISUAL INSPECTION

Inspect the bridge for dial orientation and damage to binding posts and binding post caps. Also check for dirt around the binding post insulators. Then remove the dust cover as described in Section 3.2 and inspect the unit for possible internal defects. These defects include such things as loose or broken connections, damaged or dirty switch contacts, worn or dirty potentiometers and sliders, and heat damaged resistors.

3.2 REMOVING THE DUST COVER

Prepare a soft, clean place to set the instrument. Be sure that no projections or pointed objects will be underneath the panel. See that there are no metal filings in the area.

Remove the instrument from the rack and place it face down on the prepared surface. Loosen the screws on the back of the instrument and carefully slide the dust cover off.

3.3 CLEANING AND LUBRICATION

Clean the front panel with a soft, dry, lint-free cloth, being particularly careful to remove all dirt from around the binding post insulators. The only internal component which requires cleaning and lubrication is the potentiometer, and occasionally the switch decks. Clean and lubricate the potentiometer as follows:

CAUTION: Do not use solvents on the potentiometer. Solvents will leave a residue which may affect their performance.

- a) Polish the contact surface lightly with an abrasive cloth (Crocus cloth or equivalent).

- b) Remove loose particles by wiping with a nylon cloth.
- c) Apply a moderate amount of pure petroleum jelly to the contact surface.

The switch decks are carefully lubricated at the time of manufacture and are protected from contamination by the dust cover. They should rarely, if ever, require maintenance. It is recommended that they be cleaned or lubricated only if it is determined that they are not making good electrical contact. If the switch decks are in need of cleaning or lubrication, proceed as follows:

- a) Apply solvent (Freon printed circuit solvent or equivalent) to the contact surfaces with a small brush or pipe cleaner.
- b) Wipe surfaces with clean, dry brush or dry with low pressure air.
- c) Apply a thin coating of lubricant (Oak #2008 or equivalent) to the contact surfaces with a hypodermic needle.
- d) Apply two drops of the same oil to each of the switch bearings and detent mechanisms.
- e) Remove excess oil with a clean, dry cloth and remove all traces of lint with a soft brush.

3.4 REPLACING THE DUST COVER

Be sure that the interior of the dust cover is completely clear of all foreign material.

Slip the dust cover over the bridge being careful not to touch any resistors with the cover. Replace the screws.

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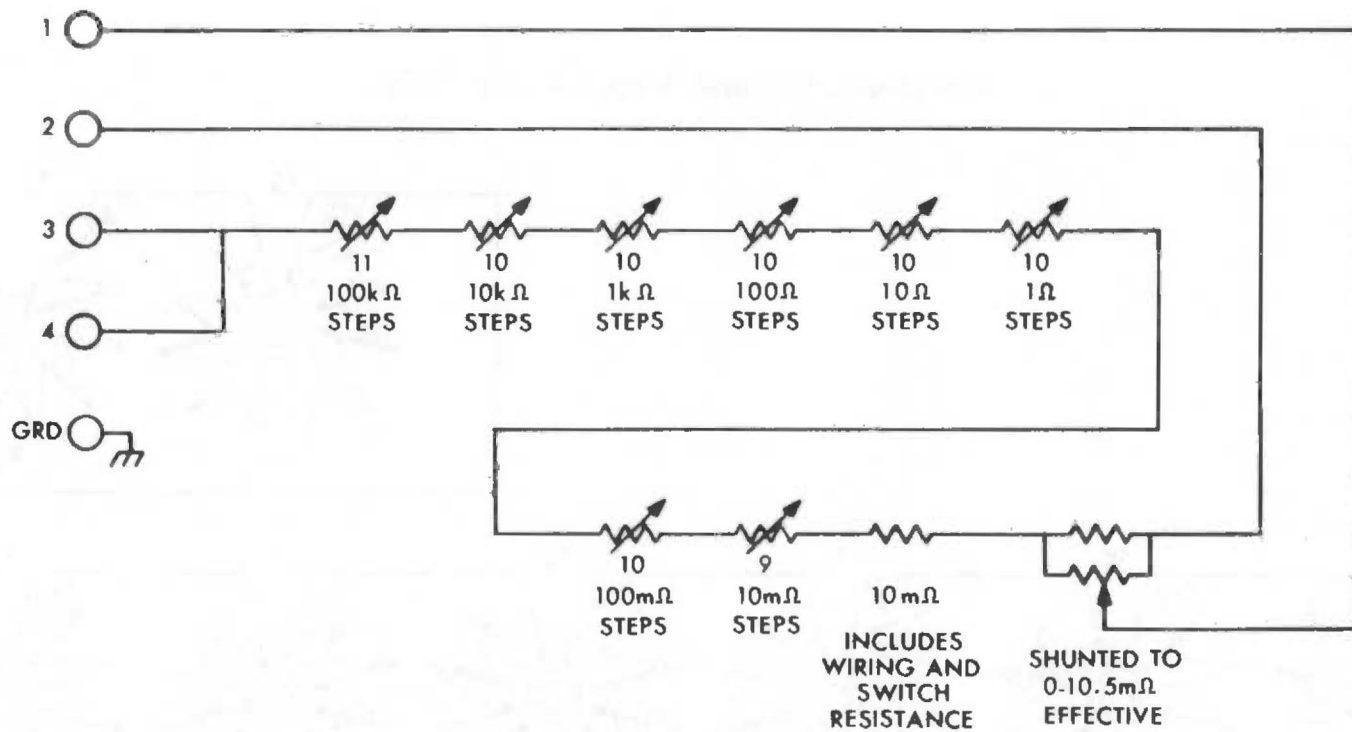


Fig. 3.1 RS925A CIRCUIT DIAGRAM

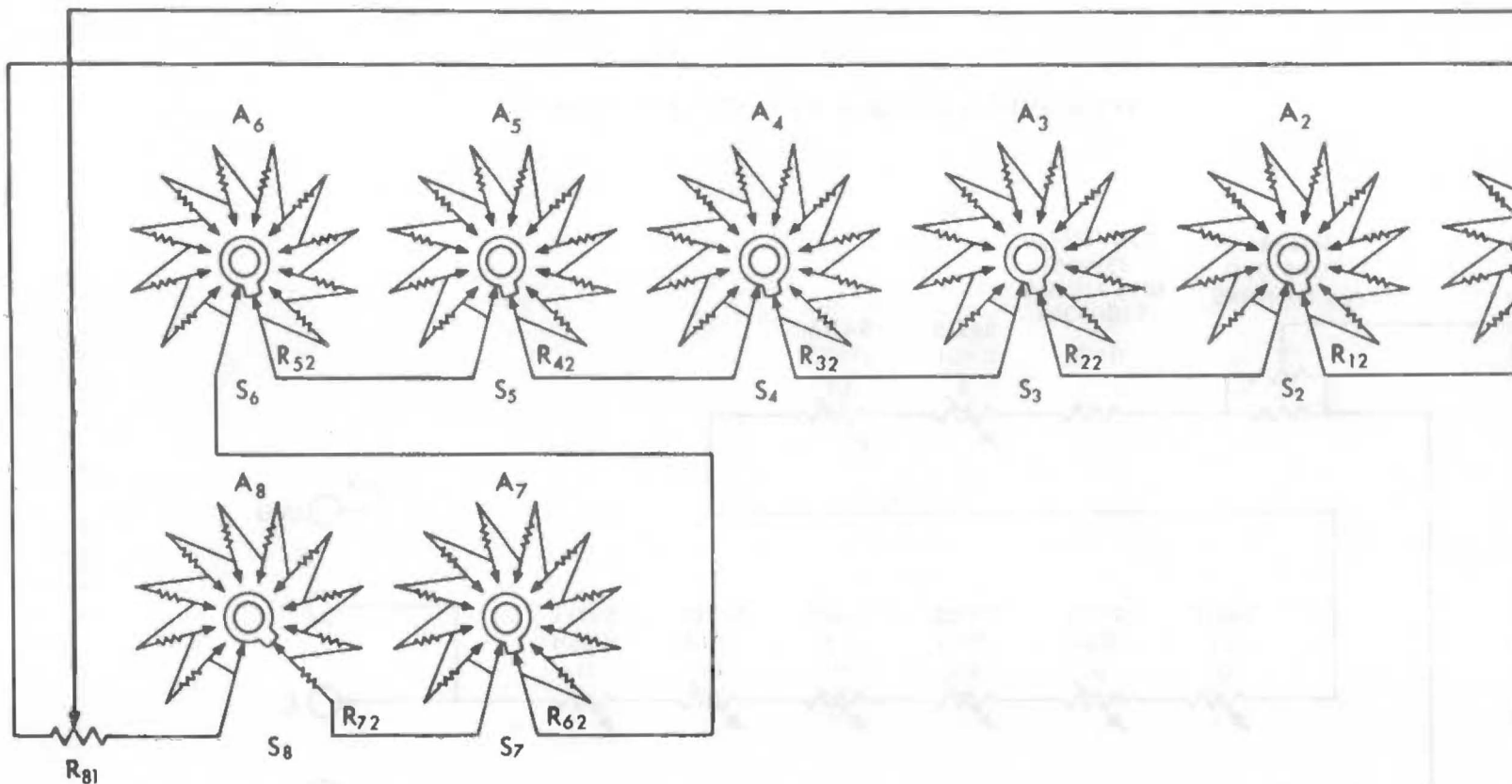


Fig. 3.2 RS925A WIRING DIAGRAM

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SECTION IV

PARTS LIST

The following parts list is in alpha numerical order of the circuit reference designator. Miscellaneous parts are included at the end of the list. Manufacturer of the part is given in a code number according to the Federal Supply Code for Manufacturers; see list of manufacturers below. Parts recommended as spares to sustain operation in isolated locations are indicated in the recommended spare parts column.

Parts manufactured by Electro Scientific Industries must be ordered from the factory. When ordering parts from the factory include the following information:

Model and serial number of the instrument
Electro Scientific Industries part number
Circuit reference designator
Description of part

CODE LIST OF MANUFACTURERS

11837

ELECTRO SCIENTIFIC INDUSTRIES
Portland, Oregon

Ckt Ref	Description	Mfr.	ESI Part No.	Qty Used	Recm SP
A ₁	Assy, Sw, Res, 100K Per Step	11837	8421	1	
A ₂	Ass'y, Sw, Res, 10K Per Step	11837	8422	1	
A ₃	Ass'y, Sw, Res, 1K Per Step	11837	8423	1	
A ₄	Ass'y, Sw, Res, 100Ω Per Step	11837	8424	1	
A ₅	Ass'y, Sw, Res, 10Ω Per Step	11837	8425	1	
A ₆	Ass'y, Sw, Res, 1Ω Per Step	11837	8426	1	
A ₇	Ass'y, Sw, Res, 0.1Ω Per Step	11837	8427	1	
A ₈	Ass'y, Sw, Res, 0.01Ω Per Step	11837	8428	1	

Parts List
ESI MODEL RS-925

Ckt Ref.	Description	Mfr	ESI Part No.	Qty Used	Recm SP
R ₁ -R ₁₁	Res, Fxd, Precision, 100K, Part of Ass'y A ₁	11837	*	11	
R ₁₂ -R ₂₁	Res, Fxd, Precision, 10K, Part of Ass'y A ₂	11837	*	10	
R ₂₂ -R ₃₁	Res, Fxd, Precision, 1K, Part of Ass'y A ₃	11837	*	10	
R ₃₂ -R ₄₁	Res, Fxd, Precision, 100Ω, Part of Ass'y A ₄	11837	*	10	
R ₄₂ -R ₅₁	Res, Fxd, Precision, 10Ω, Part of Ass'y A ₅	11837	*	10	
R ₅₂ -R ₆₁	Res, Fxd, Precision, 1Ω, Part of Ass'y A ₆	11837	*	10	
R ₆₂ -R ₇₁	Res, Fxd, Precision, 0.1Ω, Part of Ass'y A ₇	11837	*	10	
R ₇₂	Res, Fxd, Factory adj to 0.01Ω including wiring and sw res	11837	*	1	
R ₇₃ -R ₈₀	Res, Fxd, Precision, 0.01Ω, Part of Ass'y A ₈	11837	*	8	
R ₈₁	Res, Variable	11837	8446	1	
S ₁	Sw, Rot., Part of Ass'y A ₁	11837	*	1	
S ₂	Sw, Rot., Part of Ass'y A ₂	11837	*	1	
S ₃	Sw, Rot., Part of Ass'y A ₃	11837	*	1	

* Replace entire ass'y

Parts List
ESI MODEL RS-925

Ckt Ref	Description	Mfr	ESI Part No.	Qty Used	Recm SP
S ₄	Sw, Rot., Part of Ass'y A ₄	11837	*	1	
S ₅	Sw, Rot., Part of Ass'y A ₅	11837	*	1	
S ₆	Sw, Rot., Part of Ass'y A ₆	11837	*	1	
S ₇	Sw, Rot., Part of Ass'y A ₇	11837	*	1	
S ₈	Sw, Rot., Part of Ass'y A ₈	11837	*	1	
	<u>MISCELLANEOUS</u>				
	Dial, Decade, 2nd thru 8th	11837	7807	7	
	Dial, Decade, 1st	11837	7809	1	
	Knob, Bar	11837	1266	8	
	Knob, Round	11837	1271	1	
	Cap, Binding Post, Ins	11837	1170	4	2
	Cap, Binding Post, Metal	11837	1172	1	1
	Window, Decade	11837	7242	8	
	Window, Rheostat	11837	7789	1	
	Slider, Rheostat	11837	4196	1	1
	Reversing Drive Ass'y	11837	8817	1	
	Washer, Spring	11837	4264	1	1
	Insulator, Sw stacking bolt	11837	2326	16	

* Replace entire ass'y

Parts List
ESI MODEL RS-925

Ckt Ref	Description	Mfr	ESI Part No.	Qty Used	Recm SP
	Washer, Shoulder, Ins	11837	1390	12	