Model SG297
Strain Gage
Signal Conditioner

Amendments to the SG297A instruction manual Regarding the Gain and Frequency Switches

The rotary switches for selectable gains and low-pass frequency filters have been changed to dip switches. For the following sections in the SG297A instruction manual please refer to the newly added pages 32 and 33 – the SW2 gain switch settings and SW3 low-pass filter settings respectively:

Pg. 7, Table 1-1, Low Pass Switch

Pg. 7, Table 1-1, Front Panel Controls

Pg. 16, Sec. 2.7, Paragraph 1

Pg. 16, Sec. 2.8, Paragraph 1

Pg. 19, Sec. 3.1, Paragraph 6

Pg. 22, Front Panel Illustration

Pg. 23, SG297A Component Layout

SG297A PCN

The SG297A is an improvement over the SG297 in that the bridge excitation is selectable between +5 and +10 Vdc. Switch S4 on the SG297A circuit board sets the excitation voltage as follows: open = +10 Vdc excitation; closed = +5 Vdc excitation. The wide-band frequency response of the SG297A has been improved to 20 Khz (-3db).

The SG297A Strain Gage Signal Conditioner is identical to the SG297 described in this instruction manual except as follows:

All Pages - Change reference from SG297 to SG297A

1.2 Description - Page 3 - Add "Bridge excitation is selectable between +5 and +10 Vdc by setting a DIP switch S4 on the circuit board" to second paragraph.

1.3 Technical Characteristics - Page 4 - Bridge Excitation: Change to: "Bridge excitation is selectable between +5 and +10 Vdc by setting a DIP switch S4 on the circuit board. 20 mA maximum fault protected, return to system ground. Using 120 Ohm bridges in the 10 Vdc excitation mode may limit the number of SG297A channels available in a module case".

1.3 Technical Characteristics - Page 4 - Frequency Response - Wideband Mode: Change to: "20 Khz".

1.3 Technical Characteristics - Page 4 - Maximum Common Mode Voltage: Change to: "+7.5 V to -1V".

Add 2.3.8 - Bridge Excitation Selection - Page 7 - Add the following:

"The bridge excitation is selected by switch S4, located on the SG297A circuit board, towards the edge connector. When S4 is Open, the bridge excitation is set to +10 Vdc. When S4 is closed, the bridge excitation is set to +5 Vdc. When using 120 Ohm bridges in the 10 Vdc mode, the number of SG297A channels available in a given module case may be reduced because of the load on the +15 Vdc power supply."

2.7 - Low Pass Filter Selection - Page 10 - Change last sentence of paragraph 2 to read: "This bandwidth is typically 20 Khz."

Circuit Board Layout -Page 17 - Replace existing drawing with attached.

Schematic Diagram - Replace existing drawing with attached.

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1. DESCRIPTION

1.1 INTRODUCTION

This technical manual contains installation and operating instructions for the Model SG297 strain gage signal conditioner. The SG297 is a plug-in module used in several MC170-family multi-channel instrumentation cases manufactured by Validyne Engineering Corporation, Northridge, CA.

1.2 DESCRIPTION

The Model SG 297 (See Figure 1-1, 1-2) is a high-gain signal conditioner which contains power conditioning dc voltage excitation and modern low-drift differential dc amplification for resistive strain gage sensors.

Excitation for the strain gage sensor is +5vdc suitable for 350 ohm bridge loads. An option to permit operation with 120 ohm bridge loads is also available. The excitation is short circuit proof and the design provides compensation for external cable resistance losses when connected in a 7-wire hookup. Excitation power is derived from +6.4 vdc when available (MC170-32, MC374AD, and DAS932 module cases) or from +15vdc when the module case is the MC170, MC170T or MC308 (where +6.4vdc is not available).

The amplifier accepts input from strain gages with bridge sensitivity ranging from 1 to 50 mv/v. A six-position gain switch on the front panel selects the input sensitivity in 1, 2.5, 5 mv/v sequence steps. A gain vernier potentiometer at the front panel varies the gain between 0.3 and 1.3 times the selected gain range.

Bridge completion resistors can be installed on the SG297 to provide compatibility with 1, 2, 3 or 4 active element strain gages. Terminals are provided for mounting the resistors, R47-R50 as shown in Figure 1-2.

Any residual unbalance in the resistive bridge is corrected with a shunt resistor, R_{BAL} (R-9) controlled by a COARSE and FINE BALANCE at the front panel. The authority of these controls can be extended or reduced by changing the value of R9, which is mounted on terminals to facilitate changes.

The 0 to ±10 Vdc output is available at the front panel test point. System signal ground is available on a test point at the front of the power supply in each of the module cases.

1.3 TECHNICAL CHARACTERISTICS

The technical characteristics of the SG297 are listed in Table 1-1. (See next page.)

TABLE 1-1

TECHNICAL CHARACTERISTICS

ELECTRICAL

INPUT SENSITIVITY:	1mV/V - 50mV/V, Switch selected in 1, 2.5, 5 - sequence.
GAIN VERNIER:	0.3 to 1.3 X range, 20 turn gain adjustment potentiometer.
BRIDGE EXCITATION:	5VDC, 20mA maximum fault protected, return to system ground.
DIFFERENTIAL INPUT IMPEDANCE:	Greater than 10 Meg Ohms
BRIDGE BALANCE:	Fine and coarse 20 turn potentiometer, $\pm$2mV/V with 350 Ohm bridge (User changeable range)
OUTPUT:	$\pm$10Vdc, 0 to $\pm$2mA, not affected by cable capacitance.
OUTPUT RESISTANCE:	Less than 10 Ohms.
OUTPUT NOISE:	Less than 20mV rms at 1mV/V sensitivity.
FREQUENCY RESPONSE- WIDE BAND MODE:	3.6kHz typical @ 1mV/V; 15kHz typical @ 5mV/V .
LOW PASS SWITCH:	2 pole Butterworth low pass filter, -3db cutoff @ 1, 10, 100, 1000Hz.
LINEARITY:	0.05% BSL for $\pm$10Vdc output.
COMMON MODE REJECTION RATIO:	-80db at 60Hz, and 1mV/V. -120db at dc, and 1mV/V.
MAXIMUM COMMON MODE VOLTAGE:	$\pm$10V
COMMON MODE INPUT IMPEDANCE:	100 Meg Ohms Min. (with balance resistor open)
ZERO COEFFICIENT:	$\pm$0.2uV/^{O}F RTI @ ImV/V sensitivity
GAIN COEFFICIENT:	$\pm$0.005%/^{O}F typical
POWER REQUIREMENTS:	$\pm$15Vdc @ $\pm$10mA, and +15Vdc or +6.4 Vdc (Provided by module case) @ 14.3mA (350 Ohm bridge)

FRONT PANEL CONTROLS:

(See Figure 1-1 for location)

6-position rotary gain range switch.
20-turn potentiometers--
Coarse Balance, Fine Balance, Gain Vernier.
4-position rotary low-pass filter switch.
+, off, - cal. switch.
Output Test Point

MECHANICAL

Size:	2.76"H X 0.45"W X 7.5"D (7cm H X 1.13 cm W X 19cm D)
Weight:	6 ounces (168 grams)

2.0 INSTALLATION AND OPERATION

2.1 INSTALLATION

The SG297 may be inserted into or removed from any available channel position of the MC170 family module cases* while power is on. No damage will occur and adjacent channels of the module case are not affected. If an extender card is used, take special care to avoid upside-down connections which can cause substantial harm to the SG297.

2.1.1 Input/Output Connections

The strain gage interconnect to the SG297 may be 4- or 7-wire, depending upon which module case is in use.

4 or 7-wire Models: MC170, MC170-32, DAS932, MC374AD

4-wire Only Models: MC170T (Option A), MC308

A 7-wire hookup is preferred for full 4-active element sensors when cable resistance is in excess of 5 percent of the bridge resistance. For lower line resistance, and for fewer than 4-active element sensors a 2, 3, or 4 wire hookup is sufficient.

Full 4-active element, 7-wire hookups are shown in Figures 2-2 and 2-5. Other diagrams for 4-active element sensors, using 4-wire cables are shown in Figures 2-3 and 2-4.

One-quarter active bridge elements are shown in Figures 2-6 and 2-7. A 3-wire hookup for a half-active bridge is shown in Figure 2-8.

Output signal access depends upon the module case being used:

MC170T, MC308 (OPTION A WIRING):

Rear Panel Terminals	Function
5	Output
6	Signal Ground

(No Access for Remote CAL Command Option)

MC170-32, MC374AD, DAS932:

Signal Ground & Output Pins are on J1-(A) Connector:

(See Manual for Module Case)

Optional Remote CAL Command and Ground Pins are on J2-(B) Connector:

(See Manual for Module Case)

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*The MC170 family of module cases includes the following Models:
MC170, MC170T, MC170-32, MC308, MC374AD, DAS932.

2.2 OPERATION

See Figures 1-1 and 1-2 for location of SG297 controls and identification of components that can be selected in the field.

2.2.1 Strain Gage Fundamentals

A strain gage converts a small physical movement into proportional changes in electrical resistance. A strain gage is made by bonding fine wire to a supporting structure. In application, the support structure is stretched or compressed which results in change in dimension.

When a specified excitation voltage is applied, the change in resistance of the strain gage produces from 1 to 3 mV to as much as 50 mV or more per excitation volt applied.

The change in resistance for a single strain gage element is very small. For this reason, many strain gages consist of four elements connected as a Wheatstone Bridge. Half the bridge is compressed while the other half is under tension, for a given amount of change in dimension, this bridge arrangement multiplies the change in resistance by four.

Typical impedance of a strain gage is 350 ohms.

Refer to Figures 2-1 through 2-8. Notice that a potentiometer-like symbol identifies the active strain gage element(s). The direction of the arrow indicates increasing or decreasing resistance, and it establishes a kind of polarity for the transducer.

NOTE

Strain gage "polarity" must be observed when connecting transducers to the SG297.

2.3 SENSOR BRIDGE CIRCUITRY AND RESISTOR SELECTION.

Refer to Figures 2-1 through 2-8.

A strain gage sensor with 1, 2, 3, or 4 active elements can be connected to the SG297. To maintain a proper input polarity, connect increasing resistance (tension) elements between the EXC and -INPUT pins and/or the +INPUT and EXC RTN pins of the SG297. Connect decreasing resistance (compression) elements between the EXC and +INPUT pins and/or the -INPUT and EXC RTN pins of the SG297.

When connecting a sensor with fewer than four active elements, the bridge circuit must be completed with fixed resistors in each of the "missing" arms of the bridge. The best location for the bridge completion resistors is at the sensor end of the cable. If that is not practical, the SG297 design has provisions for mounting the bridge completion resistors on the signal conditioner circuit board. Install resistors equal to the resistance of the active element between the terminal points provided on the circuit board (see Figure 1-2 for bridge completion resistor locations.) One resistor is needed for each "missing" element of the sensor bridge.

2.3.1 1/4 Bridge, 2-Wire Strain Gage

Figure 2-6 shows the configuration for a strain gage and resistors for completing a sensor bridge with only one active element. (See note on next page.)

SG297A PCN

The SG297A is an improvement over the SG297 in that the bridge excitation is selectable between +5 and +10 Vdc. Switch S4 on the SG297A circuit board sets the excitation voltage as follows: open = +10 Vdc excitation; closed = +5 Vdc excitation. The wide-band frequency response of the SG297A has been improved to 20 Khz (-3db).

The SG297A Strain Gage Signal Conditioner is identical to the SG297 described in this instruction manual except as follows:

All Pages - Change reference from SG297 to SG297A

1.2 Description - Page 3 - Add "Bridge excitation is selectable between +5 and +10 Vdc by setting a DIP switch S4 on the circuit board" to second paragraph.

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1.3 Technical Characteristics - Page 4 - Frequency Response - Wideband Mode: Change to: "20 Khz".

1.3 Technical Characteristics - Page 4 - Maximum Common Mode Voltage: Change to: "+7.5 V to -1V".

Add 2.3.8 - Bridge Excitation Selection - Page 7 - Add the following:

"The bridge excitation is selected by switch S4, located on the SG297A circuit board, towards the edge connector. When S4 is Open, the bridge excitation is set to +10 Vdc. When S4 is closed, the bridge excitation is set to +5 Vdc. When using 120 Ohm bridges in the 10 Vdc mode, the number of SG297A channels available in a given module case may be reduced because of the load on the +15 Vdc power supply."

2.7 - Low Pass Filter Selection - Page 10 - Change last sentence of paragraph 2 to read: "This bandwidth is typically 20 Khz."

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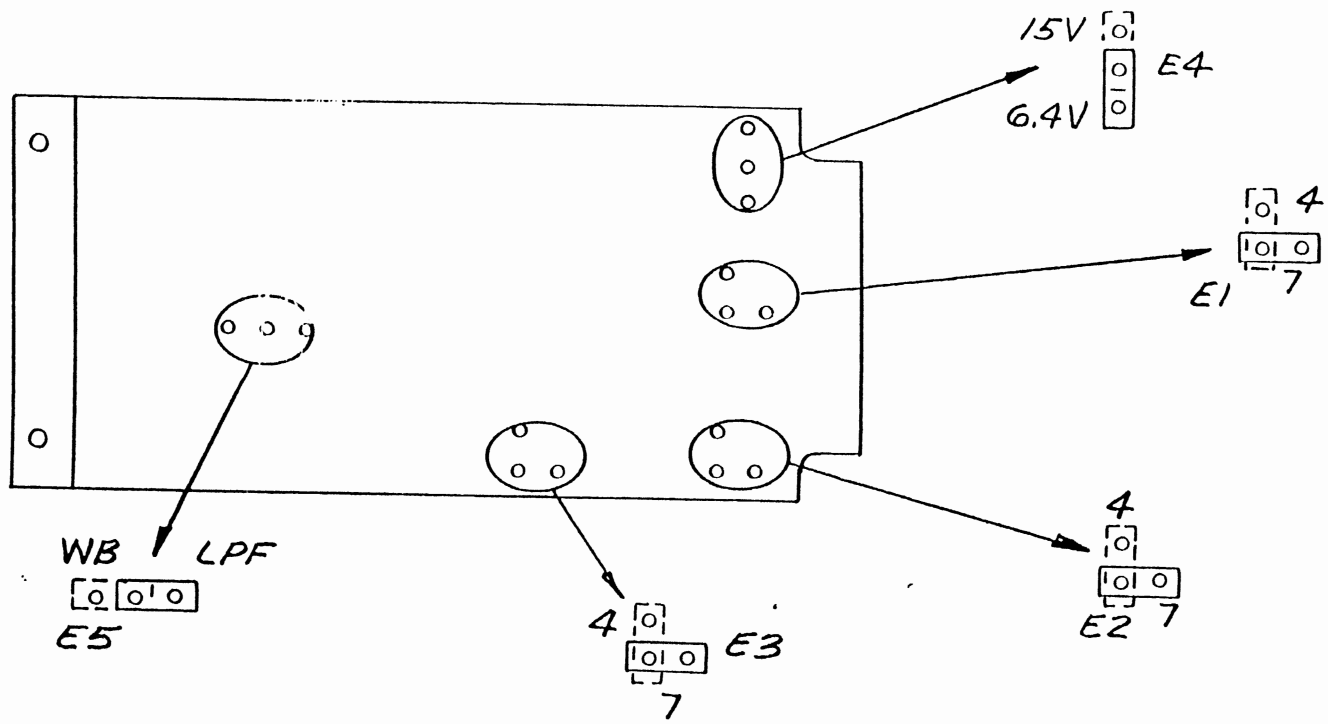
Schematic Diagram - Replace existing drawing with attached.



JUMPER MARKINGS

JUMPER NAME	SHOWN (SOLID) POSITION	ALTERNATE (DOTTED) POSITION
E1	7-WIRE	4-WIRE
E2	7-WIRE	4-WIRE
E3	7-WIRE	4-WIRE
E4	6.4 V POWER-IN	15V POWER-IN
E5	LPF = LOW PASS FILTER	WB = WIDE BAND

FIGURE 3-2

2.2 OPERATION

See Figures 1-1 and 1-2 for location of SG297 controls and identification of components that can be selected in the field.

2.2.1 Strain Gage Fundamentals

A strain gage converts a small physical movement into proportional changes in electrical resistance. A strain gage is made by bonding fine wire to a supporting structure. In application, the support structure is stretched or compressed which results in change in dimension.

When a specified excitation voltage is applied, the change in resistance of the strain gage produces from 1 to 3 mV to as much as 50 mV or more per excitation volt applied.

The change in resistance for a single strain gage element is very small. For this reason, many strain gages consist of four elements connected as a Wheatstone Bridge. Half the bridge is compressed while the other half is under tension, for a given amount of change in dimension, this bridge arrangement multiplies the change in resistance by four.

Typical impedance of a strain gage is 350 ohms.

Refer to Figures 2-1 through 2-8. Notice that a potentiometer-like symbol identifies the active strain gage element(s). The direction of the arrow indicates increasing or decreasing resistance, and it establishes a kind of polarity for the transducer.

NOTE

Strain gage "polarity" must be observed when connecting transducers to the SG297.

2.3 SENSOR BRIDGE CIRCUITRY AND RESISTOR SELECTION.

Refer to Figures 2-1 through 2-8.

A strain gage sensor with 1, 2, 3, or 4 active elements can be connected to the SG297. To maintain a proper input polarity, connect increasing resistance (tension) elements between the EXC and -INPUT pins and/or the +INPUT and EXC RTN pins of the SG297. Connect decreasing resistance (compression) elements between the EXC and +INPUT pins and/or the -INPUT and EXC RTN pins of the SG297.

When connecting a sensor with fewer than four active elements, the bridge circuit must be completed with fixed resistors in each of the "missing" arms of the bridge. The best location for the bridge completion resistors is at the sensor end of the cable. If that is not practical, the SG297 design has provisions for mounting the bridge completion resistors on the signal conditioner circuit board. Install resistors equal to the resistance of the active element between the terminal points provided on the circuit board (see Figure 1-2 for bridge completion resistor locations.) One resistor is needed for each "missing" element of the sensor bridge.

2.3.1 1/4 Bridge, 2-Wire Strain Gage

Figure 2-6 shows the configuration for a strain gage and resistors for completing a sensor bridge with only one active element. (See note on next page.)

NOTE

Any position may be used for the active element. Observe output polarity with respect to the position of increasing and/or decreasing resistance.

2.3.2 1/4 Bridge, 3-Wire Strain Gage

Figure 2-7 shows a sensor-bridge with one active element, connected to the SG297 with three wires for greater accuracy. In this 3-wire configuration the +INPUT lead does not carry excitation current. If the wires in series with pin 28 and pin 18 are equal in resistance (same length of identical gage wire,) they will have no effect on the zero balance of the bridge--regardless of lead length or temperature changes.

2.3.3 1/2 Bridge, 3-Wire Strain Gage

Figure 2-8 shows a sensor bridge with two active elements. For two elements, 1/2 bridge operation, complete the bridge "missing" resistors as shown in Figure 2-8.

2.3.4 Full Bridge, 4-Wire Strain Gage

Figures 2-1, 2-3, and 2-4 show the 4-wire connections. No resistors need be installed for bridge completion on the SG292.

2.3.5 Full Bridge, 7-Wire Strain Gage

Figures 2-2 and 2-5 show the 7-wire connections. Note that the appropriate jumper connections for E1-E4 of the SG297 are shown in these figures.

2.3.6 Shunt Calibration

With a full bridge sensor, the resistance of opposing elements is theoretically equal, and the voltage across each half of the bridge is equal. This means that shunt calibration (with either plus (+) or minus (-) voltage) across any element will provide the same output.

2.3.6.1 Plus (+) Shunt Calibration

In the 3-wire, 1/4 bridge, one cable lead is put in series with the active element. The other cable resistance is in series with a dummy element of the bridge.

This means that the relationship between R in the active gage and positive (+) shunt calibration across the dummy element is independent of cable resistance or cable length.

2.3.6.2 Minus (-) Shunt Calibration

NOT RECOMMENDED. Minus (-) shunt calibration with a 1/4 bridge, 3-wire sensor places the calibration resistor across both the active gage and both of its cable resistances. Regardless of cable length, this technique will always produce shunt calibration errors.

2.3.7 Resistor Specifications

Use only high quality resistors (0.1% or better) with a low temperature coefficient for completing the input bridge circuit.

2.4 CALIBRATION SWITCH AND RESISTOR SELECTION

The front panel CAL switch is a 3-position toggle switch, with "center-off" position. When positioned up, the switch connects R12 to provide a plus deviation signal. Similarly the CAL switch positioned DOWN will provide a negative deviation signal. Terminals are provided for the user to install a suitable resistance value for R12 (R_{cal}). See Figure 1-2 for the R12 location.

2.4.1 Resistor Selection

Use this formula to calculate the approximate values for calibration resistor R12.

$$RC = \frac{RB}{2} \quad \frac{10^3}{2\ ECAL} \quad - 1$$

where RC = calibration resistance R12 (in Ohms)

RB = bridge sensor resistance, four equal-arm bridge (in Ohms)

ECAL = desired calibration voltage sensitivity (in mV/V)

For example: 350 Ohm bridge; sensitivity = 1 mV/V

$$RC = \frac{350}{2} \quad \frac{1000}{2(1)} \quad - 1$$

$$= 175(499)$$

$$= 87{,}325 \text{ Ohm}$$

2.4.2 Resistor Specifications

Use only high quality resistors (0.1% or better) with a low temperature coefficient for shunt calibration.

2.5 BRIDGE BALANCE AND RESISTOR SELECTION

Two front panel potentiometers provide adjustment for bridge balance. These controls are R3 and R4, COARSE and FINE balance, and are marked as C and F BAL on the front panel. To balance the bridge, connect a DC voltmeter between the front panel OUT test point and system ground (on the module case power supply at the front panel). Adjust the COARSE BAL control, then the FINE BAL control to obtain a minimum reading (less than 0.01 vdc) on the voltmeter.

The bridge balance authority is determined by R_{BAL}, (R9), which is mounted on terminals as shown in Figure 1-2. A typical value for R9 is 42.2K Ohms, which provides about ± 2mV/V of balance authority for a 350 Ohm bridge.

NOTE

Check the condition of the sensor bridge and the values of the resistors used to complete the input bridge before altering the value of R9 to make large changes in the balance signal. Also verify the correct placement of jumpers E1-E3, and the presence of +5Vdc across the sensor bridge. The CAL switch and optional remote CAL command should be OFF (or open).

2.5.1 Resistor Selection

A new value for the bridge balance resistor can be calculated with the same formula used to select calibration resistors. Just substitute "balance voltage" for "calibration voltage":

$$Rb = \frac{RB}{2} \frac{10^3}{2EBAL} - 1$$

where Rb = value of bridge balance resistor (in Ohms)

RB = bridge sensor resistance, four equal-arm bridge (in Ohms)

EBAL = desired balance voltage (in mV/V)

For example: 350 Ohm bridge: balance voltage = 4 mV/V

$$Rb = \frac{350}{2} \frac{1000}{2(4)} - 1$$

= 175 (124)

= 21.7K Ohm

2.5.2 Resistor Specifications

Use only high quality resistors (0.1% is acceptable) with a low temperature coefficient when field selecting the bridge balance voltage.

2.6 REMOTE CALIBRATION OPTION AND RESISTOR SELECTION

A remote calibration option can provide for external control of the CAL mode. This option provides a relay such that an external switch closure to system ground will energize the K1 relay coil via pin 25 of the SG297 card edge connector. When energized the relay will connect $R_{REM\ CAL}$, (R52) into the bridge circuit. The position in which R52 is installed on the circuit board determines the polarity of the REMOTE CAL signal deviations.

As shown in Figure 1-2, R52 should be installed in one position only, A or B. If R52 is installed in position A, the REMOTE CAL command will provide a positive deviation signal to be imposed on the bridge signal. If instead, R52 is installed in Position B, the REMOTE CAL will be a negative deviation.

NOTE

Exercise care in installing R52, since "through-hole" printed circuit board soldering is required. Excessive heat can cause trace pads to separate, and solder flux should be removed from the board surfaces after installing R52.

2.6.1 Resistor Selection

The R52 REMOTE CAL resistor value can be calculated with the same formula as used for other calibration or balance resistors. Use the technique as explained in paragraph 2.5.1, substituting "Remote Calibration Voltage" for "balance voltage."

2.6.2 Resistor Specifications

Use only high quality resistors (0.1% is acceptable) with a low temperature coefficient when selecting the Remote CAL resistor R52.

NOTE

Be careful not to bend the resistor leads too close to the resistor body when forming the R52 leads for installation into the circuit board holes. Make sure the installed resistor profile is not greater than 3/8-inch above the circuit board surface (so as to avoid conflict with the adjacent plug-in).

2.7 LOW PASS FILTER SELECTION

A wide range of low-pass filter choices is available. If jumper E5 is placed in the LPF position, (see Figure 1-2 for location) the front-panel switch SW3 labeled LPF, determines the SG297 bandwidth. Choices for the -3db cutoff frequency are 1, 10, 100, or 1K Hertz, selected by the LPF switch SW3.

Alternatively, if jumper E5 is placed in the WB position, the front panel switch, SW3, labeled LPF, is not operational and the maximum output bandwidth is provided. This bandwidth is a function of the gain range, and is typically 3.6KHz at 1mV/V range, or 15KHz at 5mV/V range.

Verification of actual bandwidth is best obtained by capacitive coupling a signal generator via a suitable series resistor, typically in the order of 100K ohms, to the input of the SG297. The output test point is observed on an oscilloscope, to avoid clipping or such high amplitudes of signal that could result in slew rate limiting. It is usually a simple matter to sweep the input frequency in the range of interest to verify the flatness of frequency response, and to locate the -3db upper frequency cut-off point.

2.8 GAIN SWITCH AND VERNIER GAIN CONTROL

The SG297 is designed to provide 10 Vdc output when the input signal level (in mV/V) is in the proper range of the Gain Range Switch, SW2, and the Gain Vernier Control, R29. The gain vernier provides a 0.3 to 1.3 X adjustability so that overall sensitivity has overlapping gain adjustment when changing gain ranges on SW2. The table below shows the gain vernier range of adjustment for each of the SW2 gain range settings.

NOTE

Choose the highest numerical (mV/V) sensitivity range for SW2 that can produce the desired full scale output in combination with the gain vernier R29 adjustment. As an example: For a 3.1 mV/V full scale input signal, choose the 2.5 mV/V range for SW2 rather than the 1 mV/V range. This results in a better overall stability (insensitivity to R29 movements) and more bandwidth for the Wide Band choice of E5 jumper positions when applicable (see section 2.7).

Table 2-1 Sensitivity Ranges

Gain Range Switch SW2	Gain Vernier R29 Range Limits
1 mV/V	0.77 - 3.3 mV/V
2.5	1.9 - 8.3
5	3.8 - 16
10	7.7 - 33
25	19 - 83
50	38 -160

2.9 SYSTEM CALIBRATION

The SG297 can be calibrated as a system when the strain gage sensor can be controlled to provide zero and full-scale conditions. The following procedure indicates the usual sequence.

a) Select the appropriate jumper E1-E3 positions for 4, or 7-wire cables, as outlined in section 2.3 above.

b) Select the appropriate jumper E4 position as per the following table:

TABLE 2-2 E4 LOCATION FOR MODULE CASE MODELS

+5V EXCITATION POWER SOURCE

E4 = 15V	E4 = +6.4V
MC170	MC170-32
MC170T	MC374AD
MC308	DAS932

c) Select the appropriate E5 filter jumper, as described in Section 2.7.

d) Install or verify suitability of previously installed values for R_{BAL}(R9), R_{CAL}(R12), $R_{REM\ CAL}$ (R52), and any bridge completion resistors R_A - R_D (R47-R50). See Sections 2.3 through 2.6 for directions.

e) Plug the SG297 into the desired slot position of the module case, and connect the strain gage transducer and its cable to the slot which contains the SG297. Figures 2-1 through 2-8 give examples. Consult the module case Instruction Manual for addition information.

f) Turn "ON" the module case power supply. The SG297 may be inserted or removed from the module case with power "ON" with no harm or effect on other modules in the case.

g) Select the appropriate mV/V range on SW2 (see section 2.8 above).

h) For this and subsequent steps, make sure the CAL Switch (SW1), and REM CAL signal are "OFF."

i) Apply the "ZERO" condition to the strain gage transducer and monitor the OUTPUT test point with a DC voltometer (with respect to the system GROUND test point on the module case power supply or front panel). Adjust the C and F BAL controls to obtain 0.0 ± 0.01 Vdc. See Section 2.5.

j) Apply the desired 100% full scale conditions to the strain gage transducer. Adjust the GAIN vernier control R29 to obtain the desired (typically +10V dc) output. Section 2.8 explains the gain range and vernier settings.

k) Recheck and repeat (i) and (j) above until no further adjustments are needed.

l) The front panel CAL switch may be positioned to the + or - position to verify the correct amplitude of deviation signal. See Section 2.4 for descriptions. Note that the Gain Range

Switch position and Gain Vernier Control affect the observed deviation during a CAL mode, and thus the CAL mode can verify that those controls have not been changed once the correct deviation has been established.

NOTE

Make sure the CAL switch is in the "O", (or "OFF") position for normal operation of the SG297. Similarly, the REMOTE CAL external switch (if used) should be OPEN (or "OFF") for normal operation.

3.0 THEORY OF OPERATION

3.1 THEORY OF OPERATION

A functional block diagram for the SG297 is shown in Figure 3-1. The complete schematic is shown in Figure 4-1, and physical component locations may be found in Figure 1-2.

The external strain gage (1, 2, 3 or 4 active elements) is excited with 5Vdc from the excitation regulator, V1B, U2, and Q1. Excitation power is derived from +6.4V module case power when available, or from +15V as selected by jumper E4. Remote sensing is used in the 7-wire configuration so that cable resistance effects are canceled.

Sensor bridges with fewer than 4 active elements are accommodated by completing the missing elements on the SG297. R_A through R_D are equipped with terminals to simplify installing of bridge completion resistors (see section 2.3).

The sensor bridge output is applied to a high-gain differential amplifier, U3 - U5. Balance is obtained by summing a portion of the excitation voltage through U1A and R9 to correct the sensor bridge residual unbalance.

Both a Coarse and a Fine adjustment control are provided. Each is a 20-turn potentiometer and the Fine balance has one-tenth the authority of the Coarse balance to permit a precision balance.

SW2 provides six gain ranges to be selected in the feedback of the input amplifier stage, U3 and U4. The second amplifier stage, U5, provides the differential to single-ended conversion and contains the common mode adjustment, R51.

The Gain Vernier adjustment potentiometer follows U5 and drives the last voltage gain stage U6. This U6 amplifier contains the output zero control R41, which corrects for any offset voltage in U6 and U7.

U7 is a dual amplifier stage, providing a selectable low pass filter (U7A) and a voltage-follower output buffer (U7B). A selectable jumper, E5, selects the wide-band signal from U6 output, or the low-pass-filtered output from U7A to be applied to the output of the SG297.

Shunt calibration is provided by a front panel toggle switch (SW1) and user changeable CAL resistor, R12. Either + or - shunt calibration polarity, and "OFF" positions and provided by SW1.

Remote CAL option can be provided by adding relay K1 and REM CAL resistor R52. A choice of + or - remote CAL polarity must be made when installing R52. Operation of the relay by closing the circuit to system ground (through card edge connector pin 25) causes the REM CAL resistor to be connected across one arm of the sensor bridge.

4.0 MAINTENANCE AND REPAIR

4.1 INTRODUCTION

The SG297 is designed to permit convenient front-panel access to calibration adjustments. The two potentiometers, R41 and R51, which are not accessible through the front panel, are factory-set controls for output zero and common-mode adjustment. These typically do not need to be periodically reset. Instructions for their adjustment are included below in the event of repair or accidental misadjustment of either control.

Avoid contaminating the electrical contact surfaces--the card edge connector and the contact-posts engaged by jumpers E1-E5. The jumper contacts should be securely inserted. Take care to not lose any of the push-on jumpers. Use only a 0.080-inch diameter probe in the front-panel OUT test point to avoid spreading the contact.

4.1.1 Output Zero Adjustment, R41

Place E5 into LPF position. Disconnect input sensor bridge and connect card edge connector pins 20, 22, and 18 together (+IN, -IN and GROUND). Adjust output zero, R41, to obtain 0 $\pm$0.002Vdc at OUT test point.

4.1.2 Common Mode Adjustment, R51.

Perform 4.1.1 and note OUT test point reading. Reconnect card edge connector pins 20 and 22 to pins 16 and 19, which will provide +IN and -IN with +5Vdc common mode voltage.

Adjust CM ADJ (R51) to obtain OUT test point voltage within $\pm$0.001Vdc of value noted above.

Confirm correct adjustment by reconnecting card edge connector pins 20 and 22 to pin 18, (+IN, -IN tied to ground). The OUT test point reading should remain unchanged $\pm$0.001 Vdc.

4.2 FACTORY REPAIR SERVICE

If abnormal performance cannot be corrected using the calibration and adjustment procedures outlined in this manual, return the unit to the factory for evaluation and repair. All repairs must be sent transportation PREPAID.

For the speediest reply, send a brief explanation of the malfunction. Also include purchase order number and date.

At your request, we will submit an estimate of costs before starting to repair the unit.

Mark all repair shipments and correspondence **"ATTN: CUSTOMER RETURNS GROUP"** and send to:

Validyne Engineering Corporation

8626 Wilbur Avenue

Northridge, CA 91324

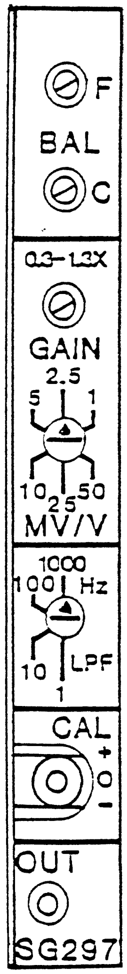
4.3 FIELD SERVICING HINTS

Validyne plug-in modules are designed to simplify field servicing and component selection.

Special heavy-duty "bifurcated" terminals are provided for mounting calibration and bridge completion resistors.

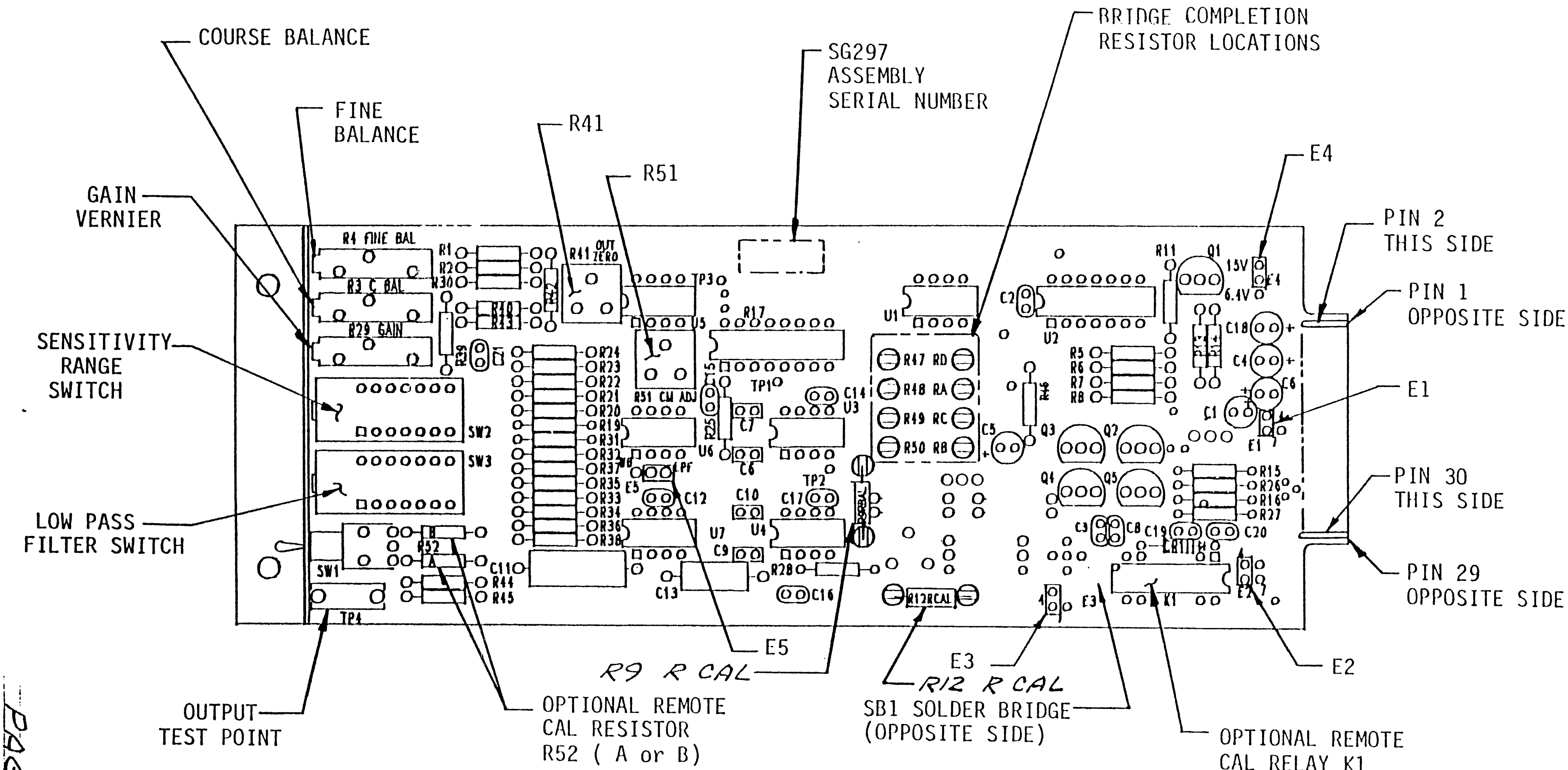
These bifurcated terminals require no crimping or lead bending. Simply drop the component in place and solder. This speeds both installation and removal.

Figure 4-1 is a schematic diagram of the SG297 Strain Gage Amplifier.



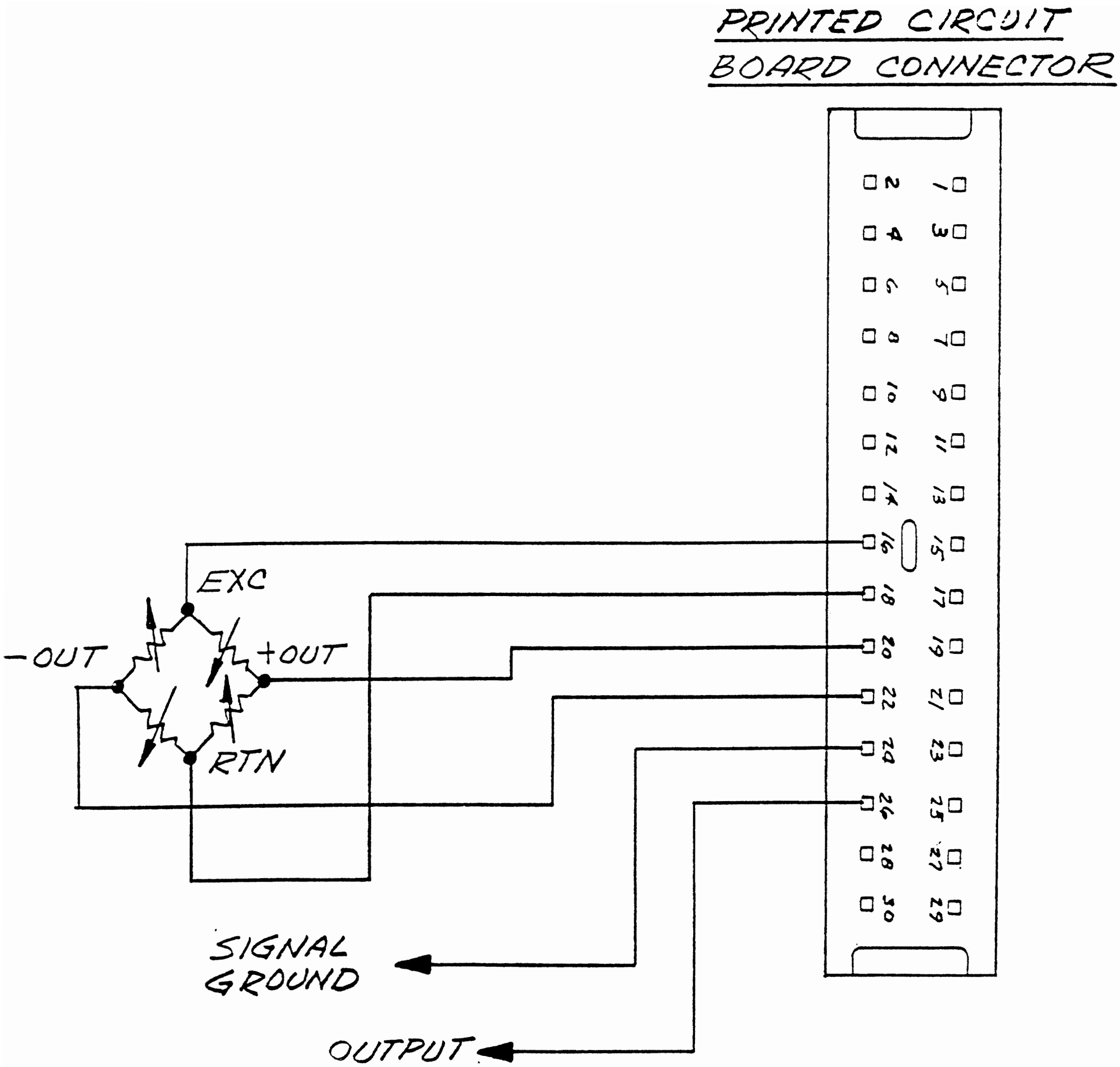
SG297 FRONT PANEL

FIGURE 1-1



SG297 COMPONENT LAYOUT

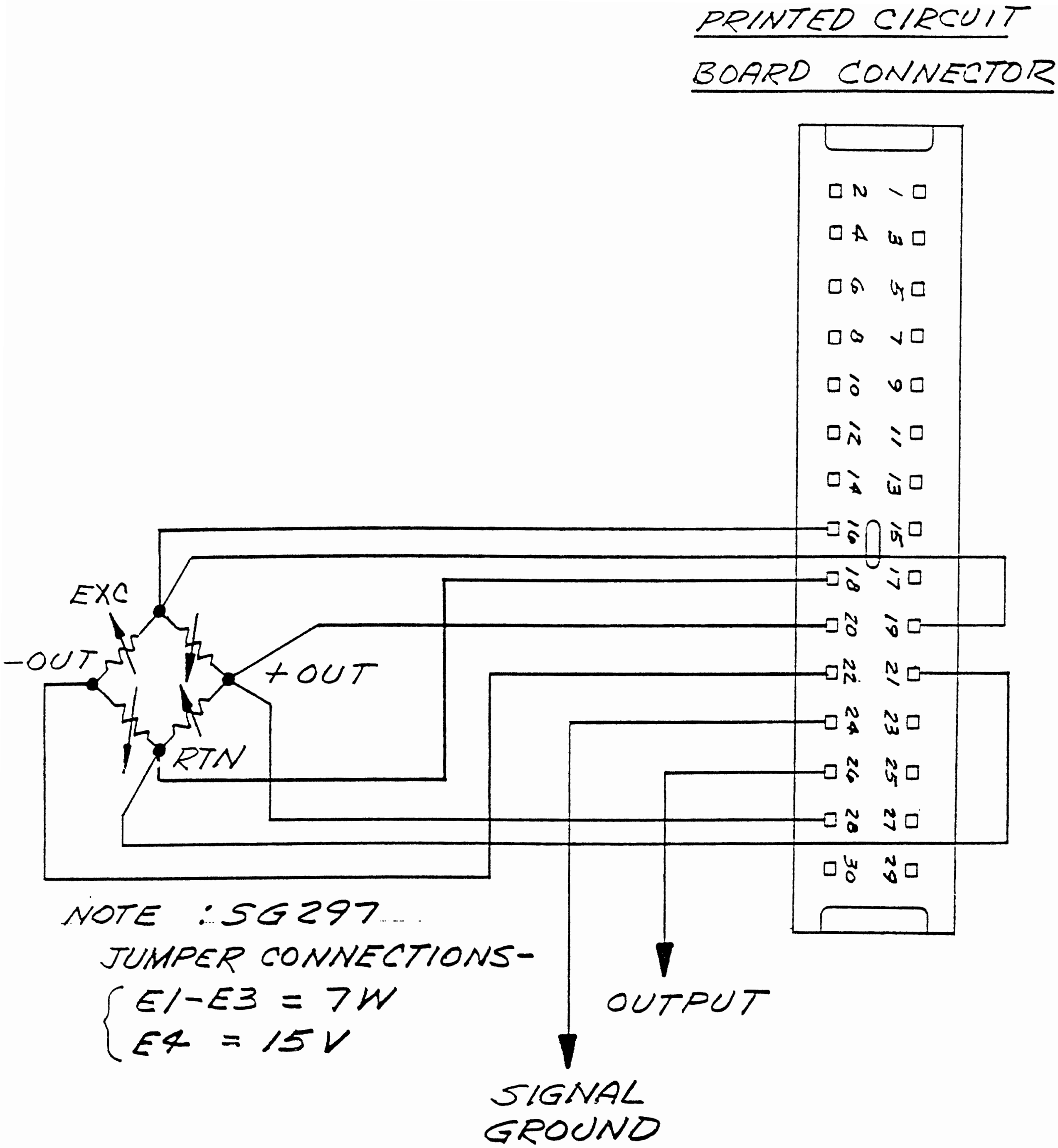
FIGURE 1-2



NOTE: SG297
JUMPER CONNECTIONS -
E1 - E3 = 4W
E4 = 15 V

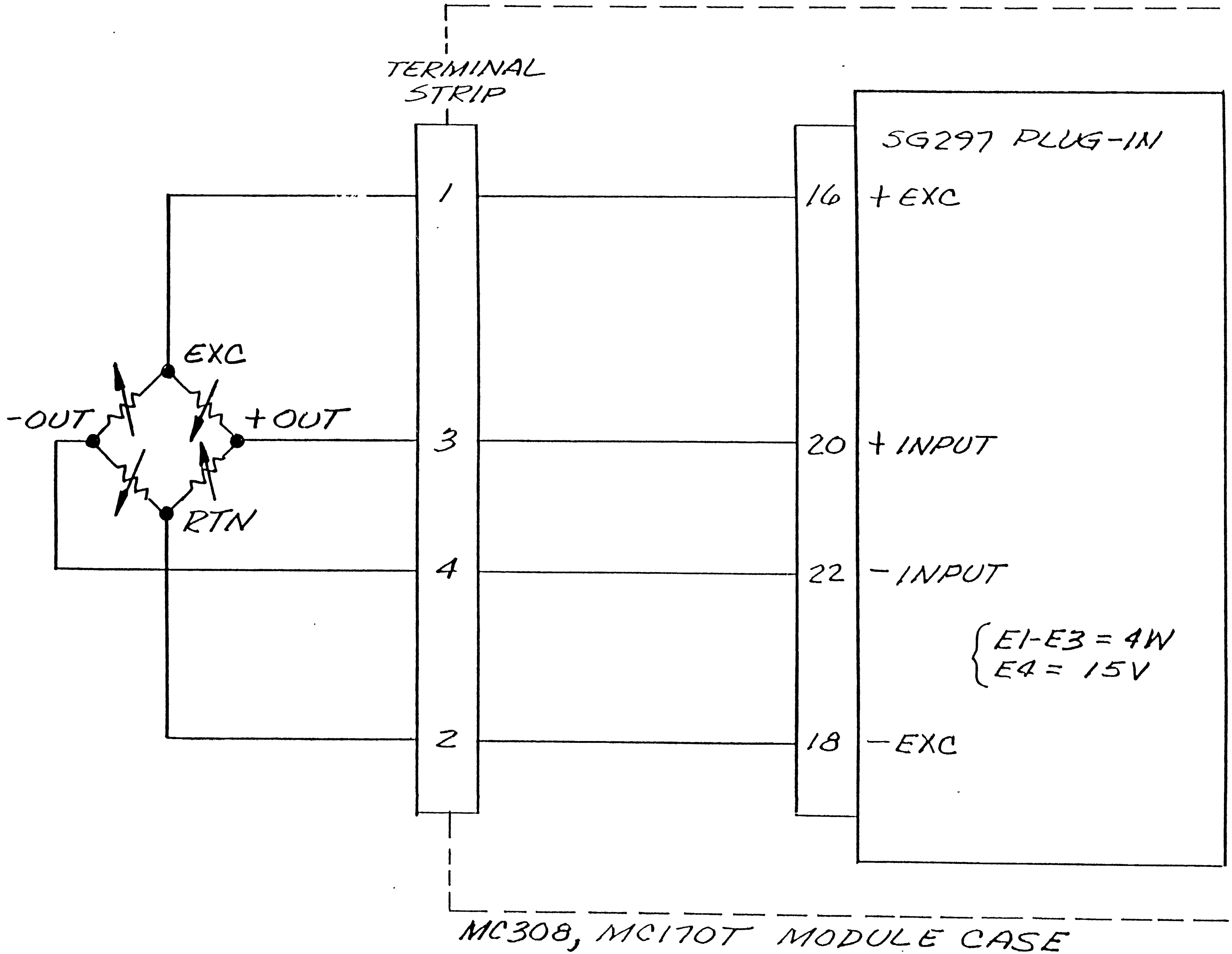
MC170 WIRING 4 WIRE HOOKUP

FIGURE 2-1



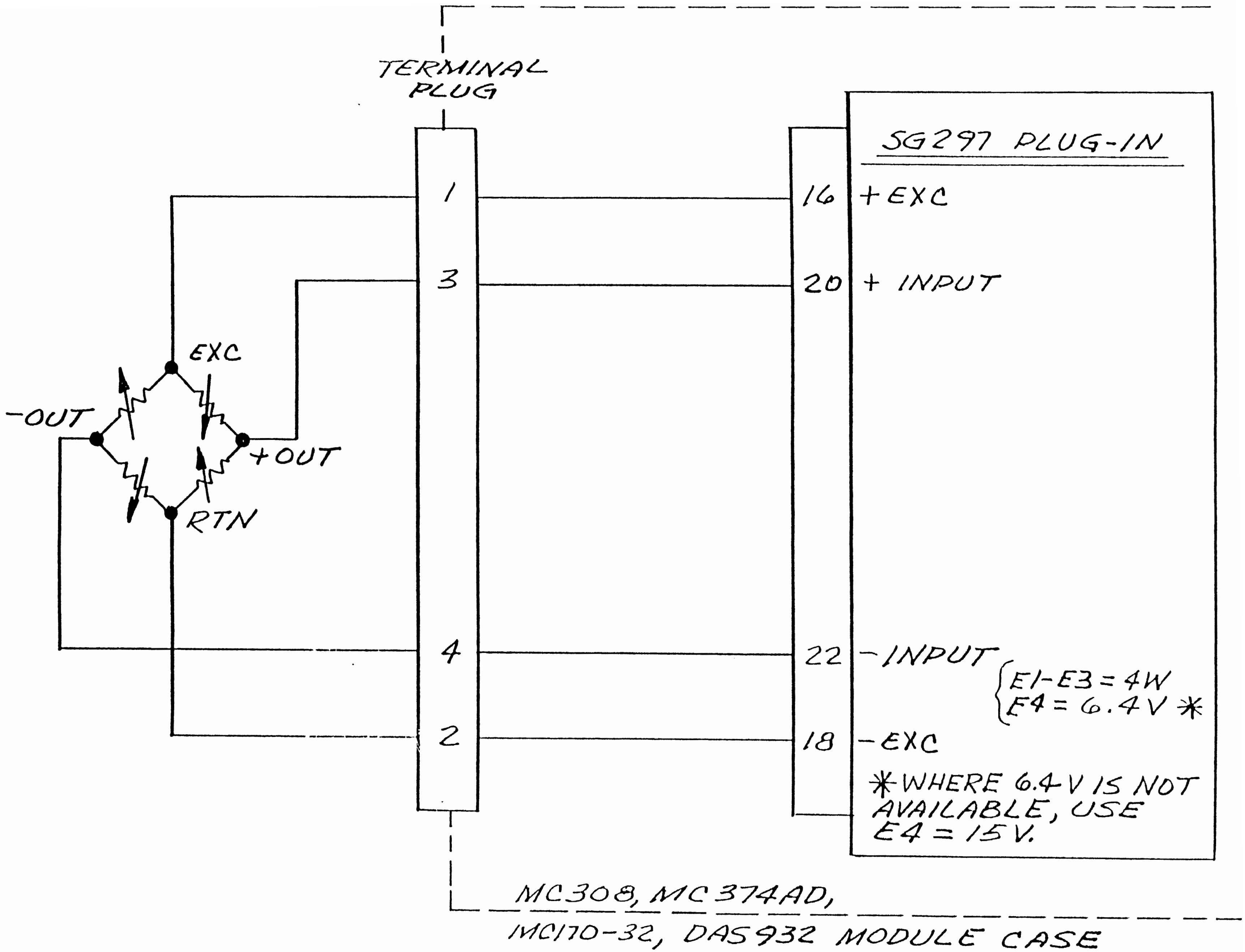
MC170 WIRING - 7 WIRE HOOKUP

FIGURE 2-2



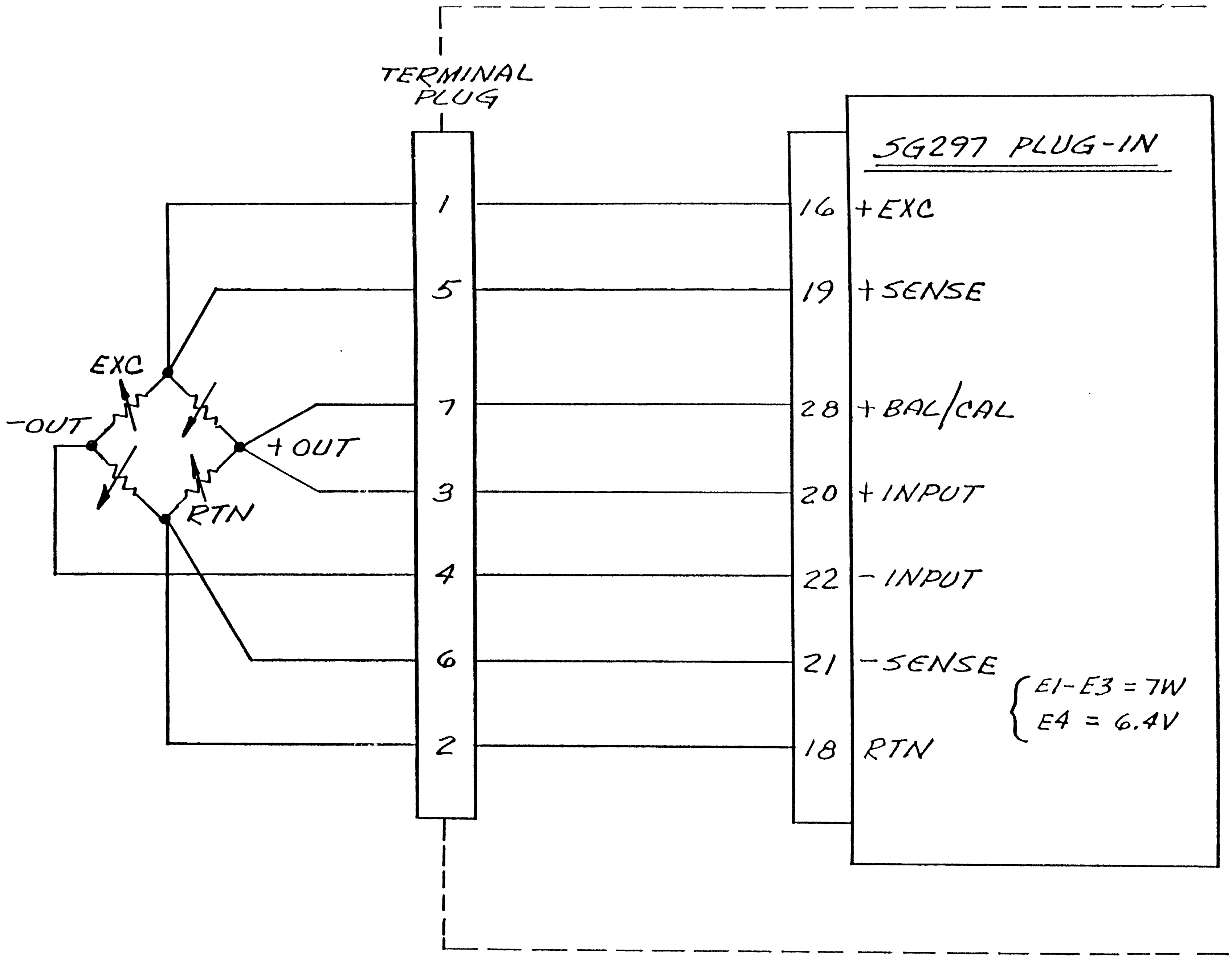
MC170T WIRING

FIGURE 2-3



MC308, MC374AD, MC170-32, DAS932 WIRING, 4 WIRE HOOKUP

FIGURE 2-4



MC374AD, MC170-32, DAS932 MODULE CASE

MC374AD, MC170-32, DAS932 WIRING, 7 WIRE HOOKUP

FIGURE 2-5

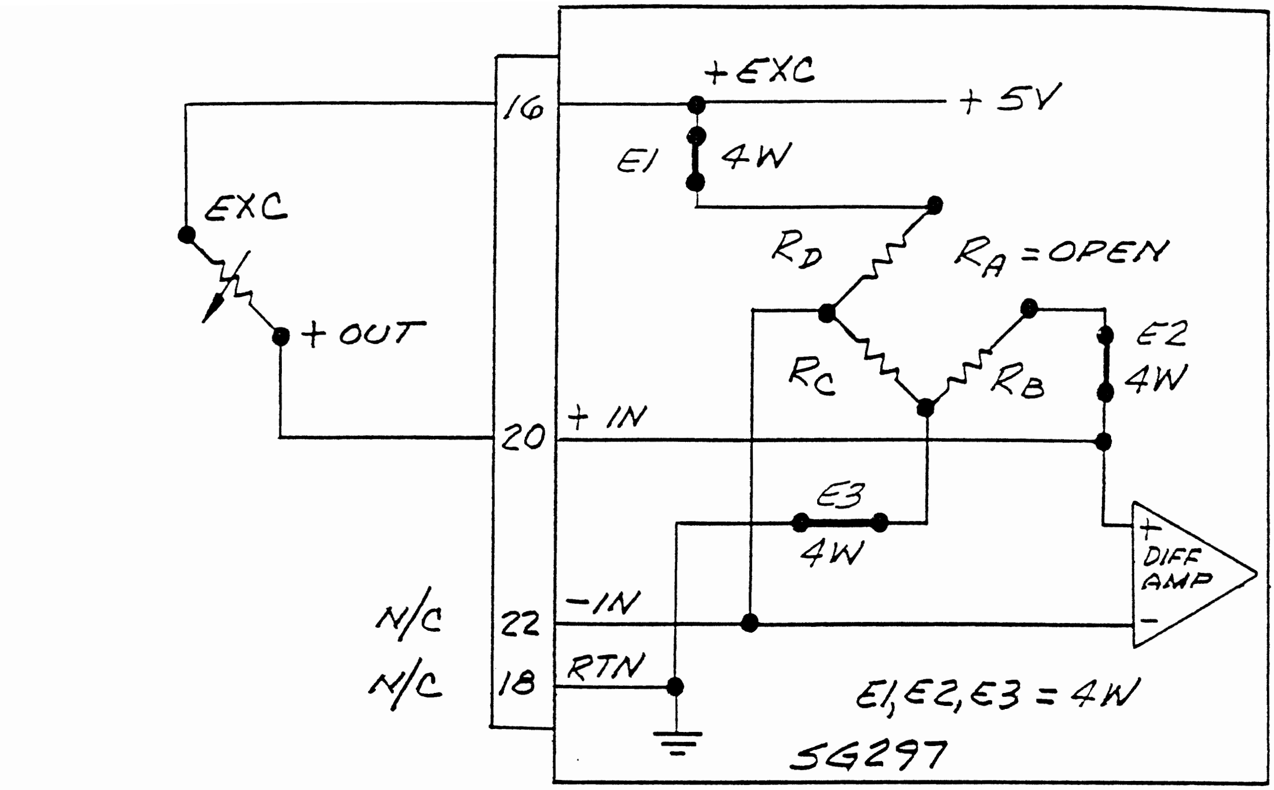


FIGURE 2-6 1/4 BRIDGE, 2 WIRES

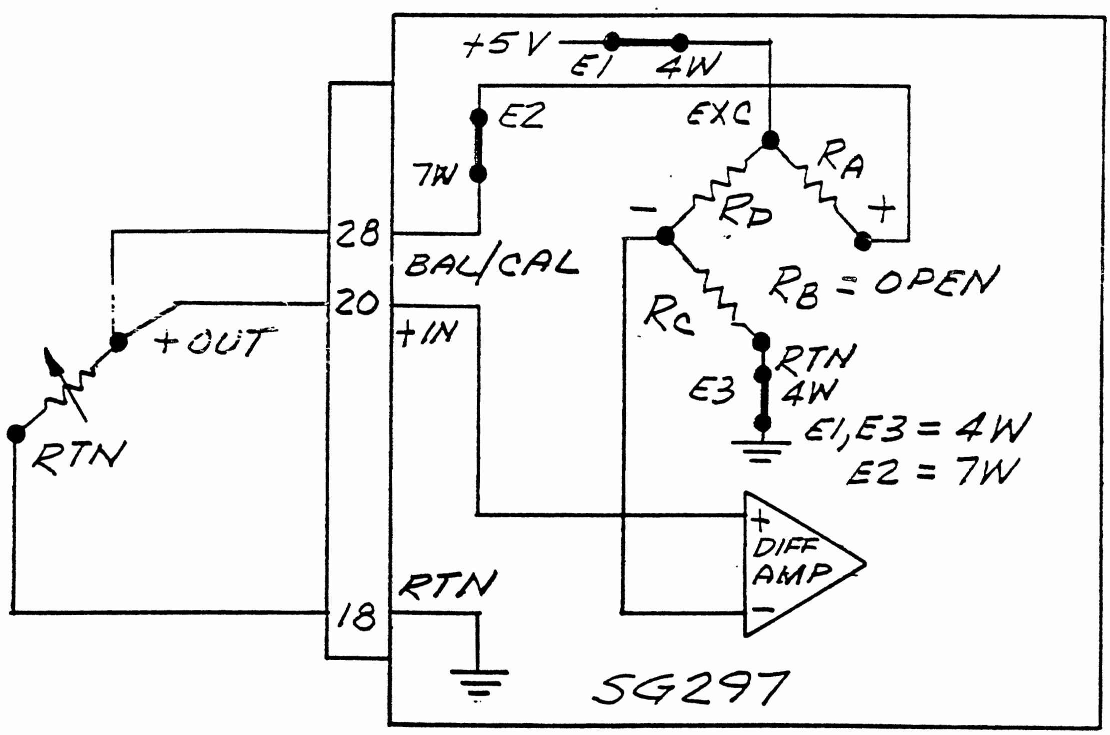
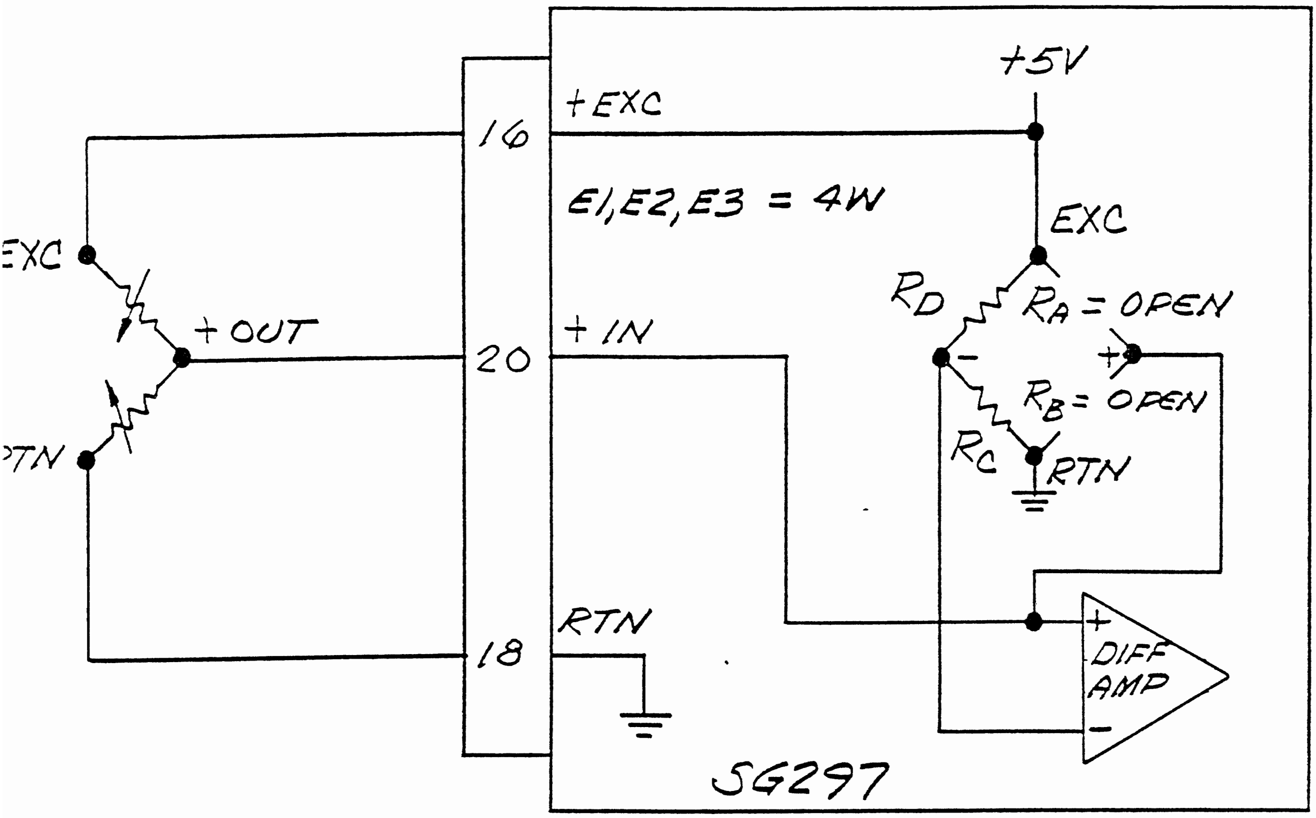
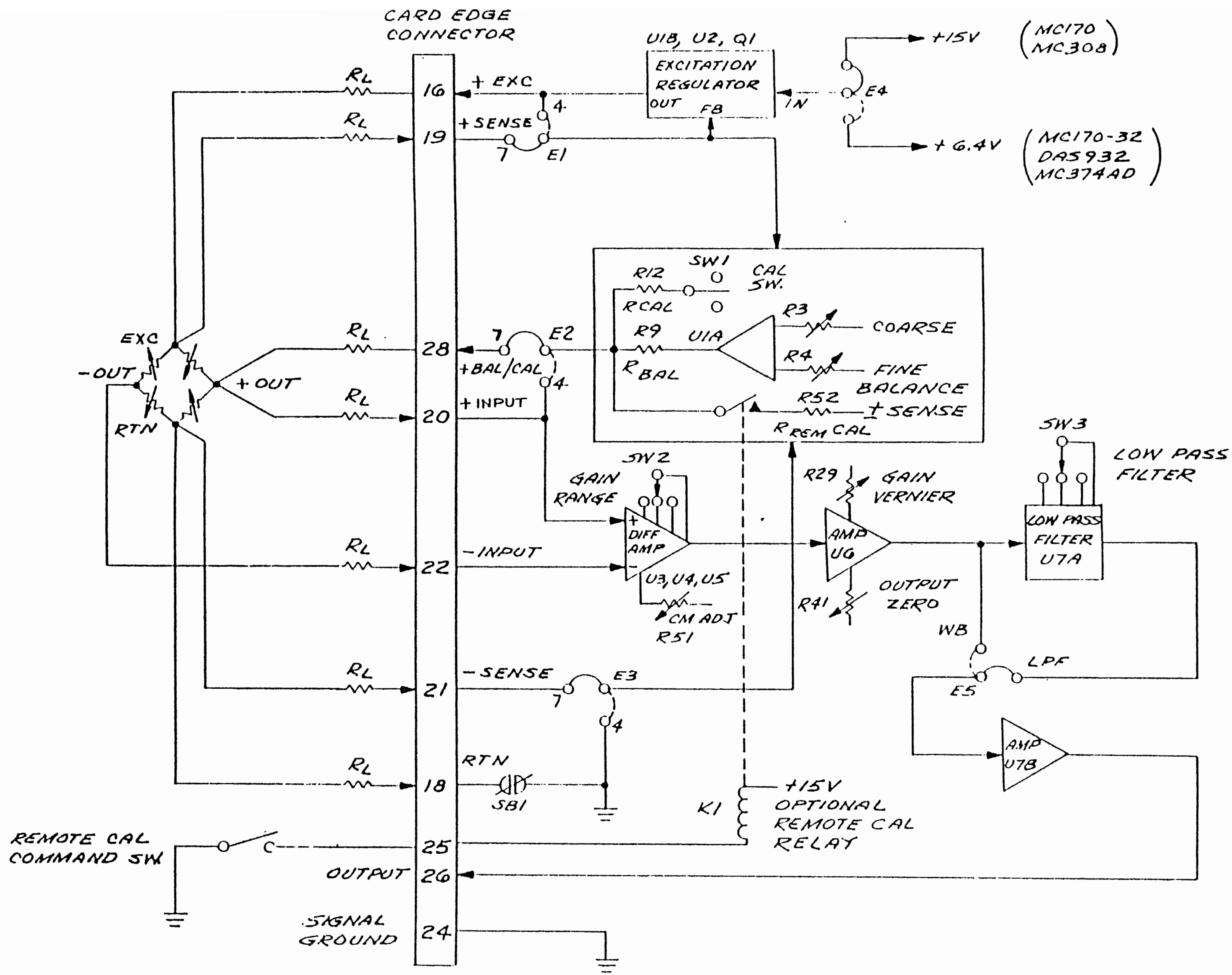


FIGURE 2-7 1/4 BRIDGE, 3 WIRES



1/2 BRIDGE, 3 WIRES

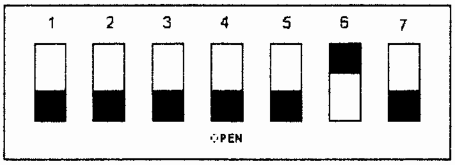
FIGURE 2-8



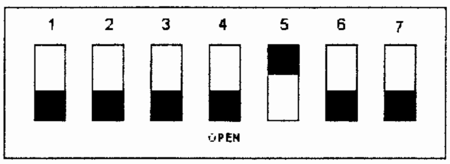
SG297 FUNCTIONAL WIRING BLOCK DIAGRAM

FIGURE 3-1

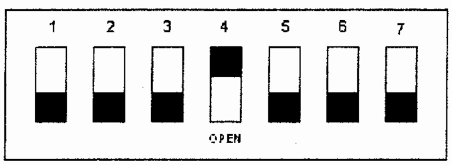
SG297A
SW2 Switch Settings for Various Gains



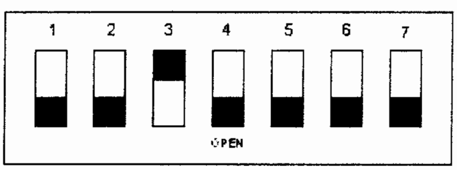
Gain of 1 mV/V full scale



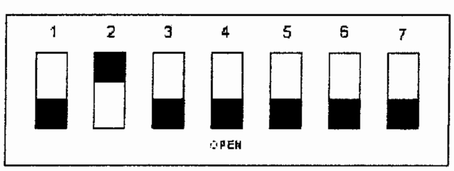
Gain of 2.5 mV/V full scale



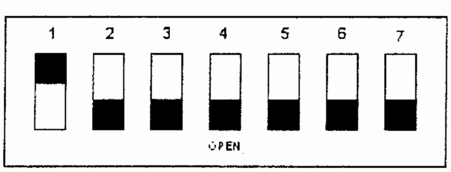
Gain of 5 mV/V full scale



Gain of 10 mV/V full scale

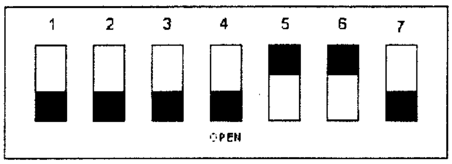


Gain of 25 mV/V full scale

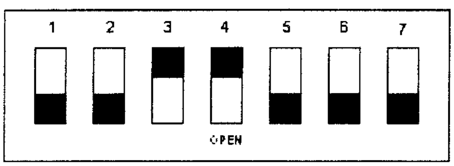


Gain of 50 mV/V full scale

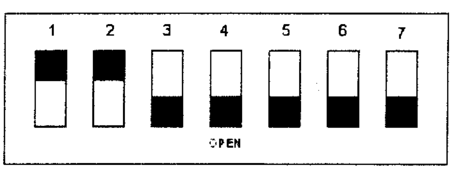
SG297A
SW3 Switch Settings for Filter Frequencies



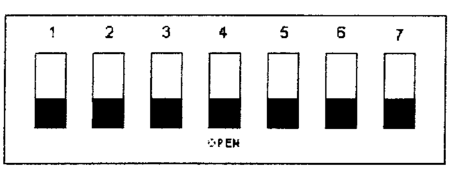
1 KHz



100 Hz



10 Hz



1 Hz