DP280 SERIES DIGITAL PROCESS INDICATORS

THERMOCOUPLE MODELS DP284 & DP285

Operator's Manual

OMEGA ENGINEERING, INC.
An OMEGA Group Company

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 13 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive current, heat, moisture, vibration, or misuse. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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To avoid processing delays, also please be sure to include:

1. Returnee's name, address, and phone number.
2. Model and Serial numbers.
3. Repair instructions.

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PRELIMINARY INFORMATION

Safety Summary

This instrument is designed to prevent accidental shock to operator when properly used. However, no engineering design can ensure the safety of an instrument used negligently. **Therefore, read this manual carefully and completely prior to operating the instrument.** Failure to do so could seriously damage the instrument or injure the operator. Standard safety precautions must be used during installation and operation.

Important Messages

<WARNING> Denotes a hazardous procedure or condition which, if ignored, could injure or be fatal to the operator.

<CAUTION> Denotes a hazardous procedure or condition which, if ignored, could damage or destroy the instrument.

<IMPORTANT> Denotes a procedure or condition which is essential to the correct operation of the instrument.

<NOTE> Specifies supplementary and perhaps essential information which should be recognized in relation to a particular procedure or condition.

Shock Hazard (Industry Standard)

The definition of "Shock Hazard" (as defined in Underwriters Laboratories Radio and Television Receiving Appliances Standards for Safety, 12th ed., dated June 25, 1969) is provided for the safe operation of the unit.

"Shock hazard shall be considered to exist at any part involving a potential of between 42.4 volts peak and 40 kilovolts peak in the following cases:

A. If the current through a load of not less than 500 ohms exceeds 300 milliamperes after 0.0003 second.

B. If the current through a load of not less than 500 ohms exceeds 5 milliamperes after 0.2 second.

C. If the time required for the current through a load of not less than 500 ohms to decrease to .5 milliamperes is between 0.1 and 0.2 second, and the total quantity of electricity passed through the load up to that time exceeds 4 millicoulombs.

D. If the time required for the current through a load of not less than 500 ohms to decrease to 5 milliamperes is between 0.03 and 0.1 second, and the total quantity of electricity passed through the load up to that time exceeds $75T-350T^2$ millicoulombs, where T is the time in seconds.

E. If the potential is more than 5 kilovolts peak and if the total capacitance of the circuit is more than 3000 microfarads.

NOTE: Additional factors might apply when potentials more than 40 kilovolts peak are present."

For Your Information . . .

(1) Specifications, Parts Lists, Component Layouts, and Schematics are subject to change without notice.

(2) The terms "instrument", "unit", and "meter" are used synonymously throughout this manual.

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Section 1 - INTRODUCTION and DESCRIPTION

This manual is organized to provide the following information:

Section 1 - INTRODUCTION and DESCRIPTION
Section 2 - INSTALLATION
Section 3 - OPERATION
Section 4 - SCHEMATICS, ASSEMBLY DRAWINGS, and PARTS LISTS

1.1 Unit Description

Thermocouple Models DP284 and DP285 are part of the DP280 series microprocessor-based, intelligent digital panel meters. These thermocouple meters feature three front panel soft keys that allow you to select °C/°F, setpoint values and hysteresis, and display Min./Max. values.

1.2 Autocalibration

Autocalibration is a standard feature on all meters. A stable voltage reference (8ppm/°C) and internal self-calibrating circuit replace the need for potentiometer adjustments. The meter autocalibrates once every 4 seconds to compensate for drift.

1.3 Options

Option D: Red/Orange Display
Option R: Dual Hi/Lo 5A Relays for Alarms
Option RB: Alarm Relays and BCD Outputs
Option RA: Alarm Relays and 0-10V and 0-50mA Scalable Analog Outputs
Option RS: Alarm Relays and 20mA Serial Digital Output
Option RSA: Alarm Relays, Analog and Serial Outputs

1.4 Common Specifications

- **Display:** 7 segment, 5 digit, vacuum fluorescent, 0.5" (13mm), blue-green.
- **NMR:** 60 dB typical at 50/60 Hz.
- **CMV:** ±2500V peak, input to power line.
- **CMRR:** 80 dB at 50/60 Hz, input to power line; 120dB at DC.
- **Case:** 1/8 DIN cutout; splashproof NEMA 12 front panel; oil-tight with panel seal gasket.
- **Dimensions:** 2" (50.8mm) high x 3.83" (97.3mm) wide x 5.61" (142.5mm) deep.
- **Depth Behind Panel:** 5.25" (133.4mm) min. to 6.25" (158.8mm) max., depending on model.
- **Panel Cutout:** 1.78" (45mm) x 3.63" (92mm).
- **Weight:** 1.22 lb (.553 kg) max.
- **Power:** 115VAC or 230VAC ±10%, 10VA, user-selectable on edge connector.
- **Display Rate:** 2 updates per second nominal.
- **Response Time:** 750 ms typical for input step change.
- **Input:** Floating, protection to 150V peak, 10MΩ minimum input impedance.
- **Environment:** 0 to 50°C operating temperature (0 to 45°C with Option R; 0 to 35°C with multiple option boards); -40°C to +85°C storage temperature. 20 to 80% relative humidity, non-condensing.
- **Terminations:** Screw Terminal Connector.
- **A/D Conversion:** Voltage-to-frequency, microprocessor controlled. Auto-zero, internal reference.
- **Autocalibration:** Autocalibrates once every 4 seconds. Each calibration cycle takes approximately 1 second, varying with user options. Integration time is 300.0 ms max. Temperature coefficient 50ppm/°C maximum. Internal reference temperature coefficient 8ppm/°C; stability 20ppm/1000 hours maximum (nonconcurrent). During autocalibration, input measurement is suspended.

1.5 Model Specifications

Model DP284: 1° resolution
Model DP285: 0.1° resolution

Accuracy: ±1 LSD at 23°C ±(see chart)

TC Type	Range	Model DP284 (±)	Model DP285 (±)
E	-170 to 1000°C	1.0°C	0.8°C
E	-274 to 1832°F	1.7°F	1.5°F
J	-167 to 1120°C	1.0°C	0.8°C
J	-269 to 2048°F	1.7°F	1.5°F
K	-184 to 1372°C	1.0°C	0.8°C
K	-299 to 2502°F	1.7°F	1.5°F
T	-180 to 400°C	1.0°C	0.8°C
T	-292 to 752°F	1.7°F	1.5°F

Ice Point Conformity: DP284 - 0.05°/°C
DP285 - 0.035°/°C

Section 2 - INSTALLATION

The Installation Section is broken down into the following sections:

Section 2.1 - Installation and Assembly
Section 2.2 - Electrical Connections
Section 2.3 - Recalibrate Meter
Section 2.4 - P2 Edge Connector Pin-Outs (Option Board)
Section 2.5 - Option R - Dual Hi/Lo 5A Relays for Alarms
Section 2.6 - Option RB - Alarm Relays and BCD Outputs
Section 2.7 - Option RS - Alarm Relays and 20mA Serial Digital Output
Section 2.8 - Option RA - Alarm Relays and 0-10V and 0-50mA Scalable Analog Outputs

2.1 Installation and Assembly

Refer to Figure 1 for unit installation and assembly.

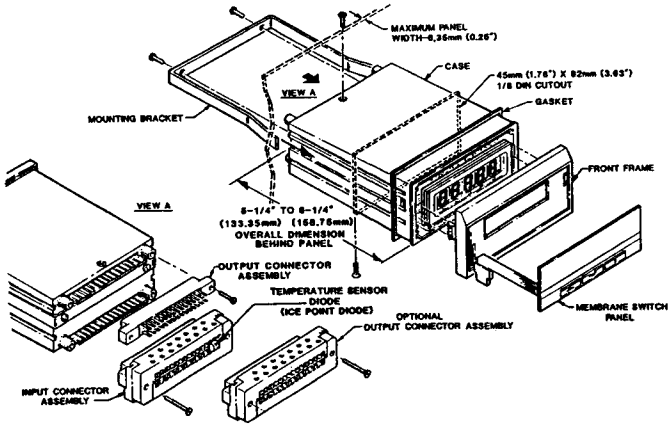

Figure 1. Unit Installation and Assembly

2.2 Electrical Connections (P1 Edge Connector)

WARNING:
When making connections to the P1 Edge Connector, remember that these pins float to the potential applied to P1, Pin R. Refer to the Safety Summary on page 'i' at the beginning of this manual.

2.2.1 P1 Edge Connector Pin-Outs

Pin	Description
1, 3, A, C	AC power input
5	Earth ground. Tie to AC power input grounding wire. Do not allow to float.
2, 4, 6	Reserved (do not use).
B, D, E, F	Reserved (do not use).
7	Data. Used for field recalibration.
8	Reserved (do not use).
9	When connected through a push button switch to Pin K, switch functions as the ◢◣ key.
H	When connected through a push button switch to Pin K, switch functions as the ◥◤ key.
J	When connected through a push button switch to Pin K, switch functions as the <S> key.
K	Strobe common for keyboard and Strobe/Hold.
L	When tied to Pin K, holds the count in the display and stops signal processing (Strobe/Hold).
11	-15V power supply, test point only.
12	+15V power supply, test point only.
N	Internal power supply common return line.
M	Clock In. Used for field recalibration.
10	+5V power supply, test point only.
S	Anode connection for the Ice Point Compensation diode (bead).
15	Cathode connection for the Ice Point Compensation diode (bead).
R	Negative input termination for thermocouple wire.
14	Positive input termination for thermocouple wire.

Figure 2 illustrates the P1 Edge Connector Pin-outs on the Main Logic Board.

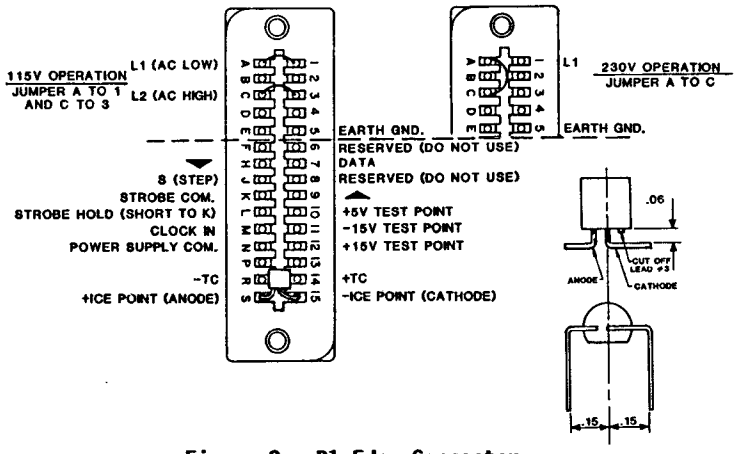

Figure 2. P1 Edge Connector

2.2.2 Ice Point Connections

The +Ice Point (Anode) is connected to Pin S and the -Ice Point (Cathode) is connected to Pin 15.

CAUTION:
Leads on the ice bead are fragile. Avoid bending these leads when making other connections as they can break easily.

2.2.3 Thermocouple Input Connections

1. Connect the red thermocouple lead to Pin R (-TC).
2. Connect the remaining thermocouple lead to Pin 14 (+TC).

Model	TC Type	Material	Color	Polarity
DP284J/DP285J	J	Iron Constanton	White Red	+ -
DP284T/DP285T	T	Copper Constanton	Blue Red	+ -
DP284E/DP285E	E	Chromel Constanton	Purple Red	+ -
DP284K/DP285K	K	Chromel Alumel	Yellow Red	+ -

2.2.4 Strobe/Hold Connection

When strobe/hold is connected, all analog processing stops and the display freezes. To enable strobe/hold, connect pin L to pin K.

2.2.5 Power Connections

115VAC Operation:
1. Make sure the connector is right-side-up.
2. Connect L1 (AC Low) to P1, pin 1 and pin A.
3. Connect L2 (AC High) to P1, pin C and pin 3.
4. Connect earth ground to Pin 5.
5. Check connections.

230VAC Operation:
1. Make sure connector is right-side-up.
2. Connect L2 to P1, pin 3.
3. Connect L1 to P1, pin 1.
4. Connect P1, pin A and pin C together.
5. Connect earth ground to Pin 5.
6. Check connections.

2.3 Recalibrate Meter (refer to Figure 3)

WARNING:
When making connections to the P1 Edge Connector, remember that these pins float to the potential applied to P1, pin R. Refer to the Safety Summary on page 'i' at the beginning of this manual.

All meters can be recalibrated. Since most component settling occurs during the first year of operation, recalibration is recommended after one year of use. However, recalibration is optional.

Procedure:

1. On the P1 Edge Connector, connect one momentary ON pushbutton (S1) between Pins 7 and N (data and common).
2. Connect another momentary ON pushbutton (S2) between Pins M and N (clock and common).
3. Connect the DC voltage calibrator to the input screw terminal and apply 0V.
4. Press the S1 pushbutton for at least 3 seconds then release.
5. Adjust the calibration standard to +80.000mVDC **NOTE:** Unit reading should not change.
6. Wait at least 5 seconds.
7. Momentarily press the S2 pushbutton.
8. With an accurate temperature monitor, measure the temperature of the Ice Point Sensor mounted on the rear Input Screw Terminal. **IMPORTANT:** Allow at least 10 minutes for the monitor and sensor to reach the same temperature.
9. Adjust the calibration standard to equal 200µVDC x the °C value of the measured ice point temperature. Apply this calculated voltage and wait 5 seconds.
10. Press the S2 pushbutton.
11. Remove recalibration connections from the P1 connector.

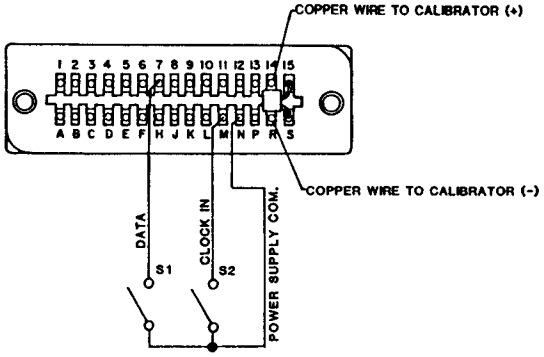

Figure 3. Recalibration Connections (P1 Connector)

2.4 P2 Edge Connector Pin-Outs

Figure 4A depicts the connections made to the P2 edge connector on the R Option Board.

Figure 4B depicts the connections made to the P2 edge connector on the R and B Option Board.

Figure 4C depicts the connections made to the P2 Edge Connector on the "A" (Analog Output) and/or "S" (Serial Output) Option Board. Option R (Relays Output) pin configuration, as shown, is valid only when installed in conjunction with Option A and/or Option S.

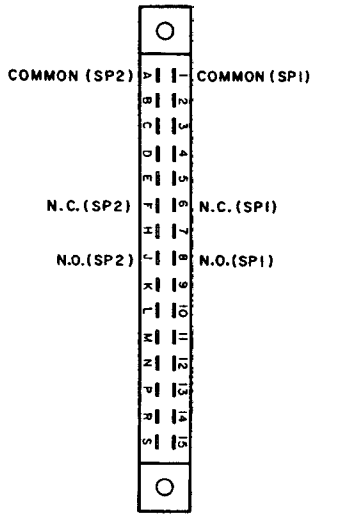

Figure 4A. P2 Edge Connector Option R (Relays Output)

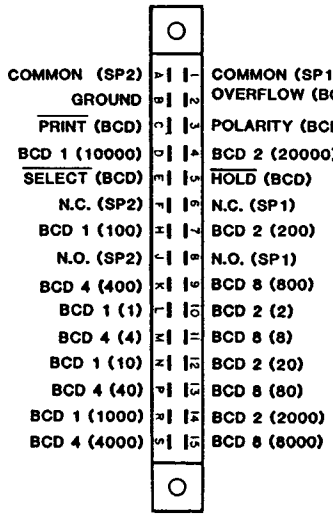

Figure 4B. P2 Edge Connector Option R (Relays Output) and Option B (BCD Output)

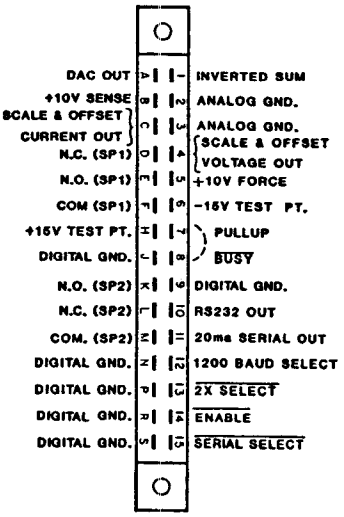

Figure 4C. P2 Edge Connector Option R (Relays Output) and Option A (Analog Output) and Option S (Serial Output)

2.5 Option R - Dual Hi/Lo 5A Relays for Alarms

2.5.1 Option R Description

Option R rating: Resistive: 5A max. at 125VAC max.; 0.6A max. at 110VDC max.; 5A max. at 30VDC max.
Inductive: 0.1A max. at 50VDC max.

Option R has 1500Vpk isolation from the signal input and 500Vpk isolation from Option B, S, or A when Option R is used in conjunction with any of these options (i. e., RB, RS, RA, RSA).

Option R provides two Form C, 5 amp relays with high and low setpoints giving the meter a total of 4 setpoints with deadband (hysteresis). These setpoints are programmed using the front panel keypad.

If either SP1H or SP1L is exceeded, the SP1 relay will be activated. If either SP2H or SP2L is exceeded, the SP2 relay will be activated.

2.5.2 Alarm Condition

When input exceeds a setpoint (SP), the meter goes into an alarm condition. During an alarm condition, the display alternates between an alarm message (Hi or Lo) and the current reading, and the corresponding relay output is activated. An example of the Setpoints with Hysteresis is illustrated in the following graph. The Alarm Messages which may appear during an alarm condition are listed below this graph.

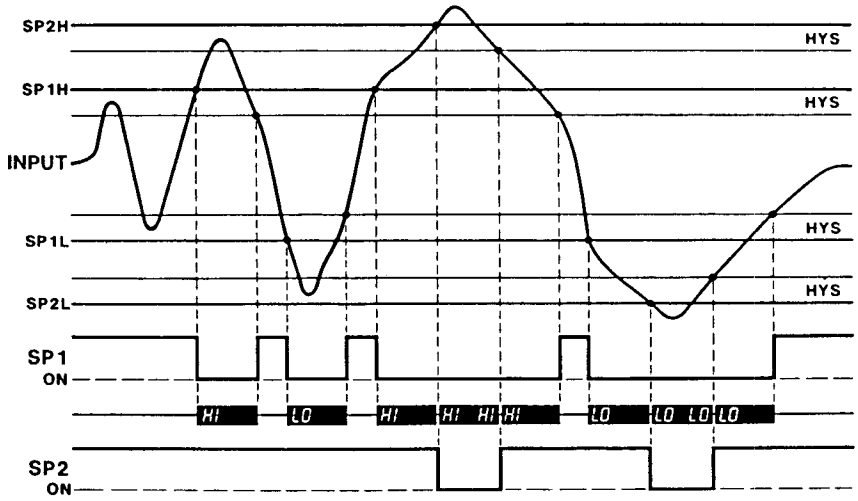

Figure 5. Setpoints with Hysteresis

Alarm Message	Description
[Hi]	SP1H exceeded. Display also flashes current reading.
[Lo]	SP1L exceeded. Display also flashes current reading.
[Hi]	SP2H exceeded. Display also flashes current reading.
[Lo]	SP2L exceeded. Display also flashes current reading.
[Hi Hi]	SP1H and SP2H exceeded. Display also flashes current reading.
[Lo Lo]	SP1L and SP2L exceeded. Display also flashes current reading.
[Hi Lo]	SP1H and SP2L exceeded. Display also flashes current reading.
[Lo Hi]	SP1L and SP2H exceeded. Display also flashes current reading.

2.5.3 Option R Connections

Refer to Figures 4A, 4B, 4C (P2 Edge Connector) and Figures 10, 12 (P. C. Option Board Schematic).

NOTE: To obtain maximum contact life, or when Option R is used in conjunction with Option B (RB), S (RS), or A (RA) the relay contacts should have arc suppression on the P2 connector across the contacts energizing the load. No internal suppression is provided. Use 0.047µF/500V ceramic disc in series with a 10 ohm, 1/2 W resistor.

When Option R is installed alone or with Option B (RB), SP1H and SP1L control Pins 1, 6, and 8 on the P2 Edge Connector. SP2H and SP2L control Pins A, F, and J on the P2 Edge Connector.

When Option R is installed with Option A (RA) and/or Option S (RS), SP1H and SP1L control Pins D, E, and F on the P2 Edge Connector. SP2H and SP2L control Pins K, L, and M on the P2 Edge Connector.

2.6 Option B - Parallel BCD Output (from Option RB)

Option B is a tri-state parallel BCD output with 1500Vpk isolation to the signal input.

Option B Specifications

- **Output** — Logic Low "0" = 0.45V (max.) at 1.6mA Sink. Logic High "1" = 2.4V (min.) at 50µA Source.
- **20 BCD Lines** — Parallel BCD data output, one TTL load compatible, valid while $\overline{\text{SELECT}}$ (Pin E) is Low.
- **$\overline{\text{PRINT}}$ (Pin C)** — Low output for valid BCD data. Goes high for 100µs while new data is being written to BCD data lines. Falling edge can be used as print command for a receiving device. **NOTE:** This pin can also be referred to as BUSY.
- **POLARITY (Pin 3)** — Logic Low indicates a positive reading.
- **$\overline{\text{HOLD}}$ (Pin 5)** — When Pin 5 receives a Logic Low, the meter maintains present BCD output until a Logic High is applied. Processing continues while the meter is in the "hold" state.
- **$\overline{\text{SELECT}}$ (Pin E)** — When Pin E receives a Logic Low, the state of the 20 BCD Lines is checked. If all lines are tri-state, the unit writes to the BCD Lines and $\overline{\text{PRINT}}$ (Pin C) goes Low. If any of the BCD Lines are active, the unit does not write data and $\overline{\text{PRINT}}$ stays High.
- **OVERFLOW/$\overline{\text{DATA VALID}}$ (Pin 2)** — When a reading is greater than full scale, Pin 2 goes Logic High.

2.6.1 Option B Connections

Option B connections are made to the P2 connector (see Figure 4B) on the Parallel BCD option board.

2.7 Option S - Serial Output (ASCII) (from Option RS)

Option S provides 20mA and TTL-compatible serial output capability. The optically isolated 20mA current source interface can be operated 4-wire half-duplex while providing up to 1500V peak isolation from the signal input.

Option S Specifications

- **Output** — Half duplex, isolated ASCII 20mA current loop or RS-232.
- **Baud Rate** — 300 or 1200 bits/sec., external jumper selectable. For 1200 baud, short Pin 12 and Pin N on P2 connector. For 300 baud, leave both pins open.
- **Format** — 1 start bit; 7 data bits, no parity check; 2 stop bits.
- **Transmission Sequence** — ASCII characters comprised of polarity, 5 digits (with dP location), and CR LF.
- **$\overline{\text{SERIAL SELECT}}$ (Pin 15)** — Logic 0 = -0.5V (min.) to .8V (max.) at 1mA sink, selected. Logic 1 = 2.0V (min.) to 5.0V (max.) internal 5.6K pull up not selected.

  When $\overline{\text{SERIAL SELECT}}$ is pulled to Logic Low, a new line of data is transmitted over RS-232 and 20mA lines. For continuous printing, short Pin 15 to Pin S.
- **$\overline{\text{BUSY}}$ (Pin 8)** — Logic 0 = 0.5V (max.) to -50V (min.), hold transmissions. Logic 1 = 1.5V (min.) to 50V (max.) at 20mA source, resume transmission.

  The $\overline{\text{BUSY}}$ line functions as a handshake to control the flow of data. If $\overline{\text{BUSY}}$ is taken Low, the meter will terminate the transmission of data after the character currently in transmission is transmitted. Transmission will resume where it left off when $\overline{\text{BUSY}}$ is returned High. If $\overline{\text{BUSY}}$ is not used, it must be jumped to Pin 7 to pull it high.
- **Distance** — 20mA current loop = 4000 ft. at 300 or 1200 baud; RS-232-C = 75 ft. max.

2.7.1 Option S Connections

Figure 6 details serial output connections for Option S.

Data Transmission

The $\overline{\text{BUSY}}$ line functions as a handshake to control the flow of data. If $\overline{\text{BUSY}}$ is taken Low, data transmission will terminate after the last character being transmitted completes transmission. Data transmission will resume where it left off when $\overline{\text{BUSY}}$ is returned High. If $\overline{\text{BUSY}}$ is not used, jumper Pin 8 to Pin 7.

Single Line Transmission

To transmit one line of data output only, the $\overline{\text{SERIAL SELECT}}$ line must be pulsed Low for 10ms to 50ms and then returned High. If $\overline{\text{SERIAL SELECT}}$ is held Low longer than 50ms, multiple outputs will occur.

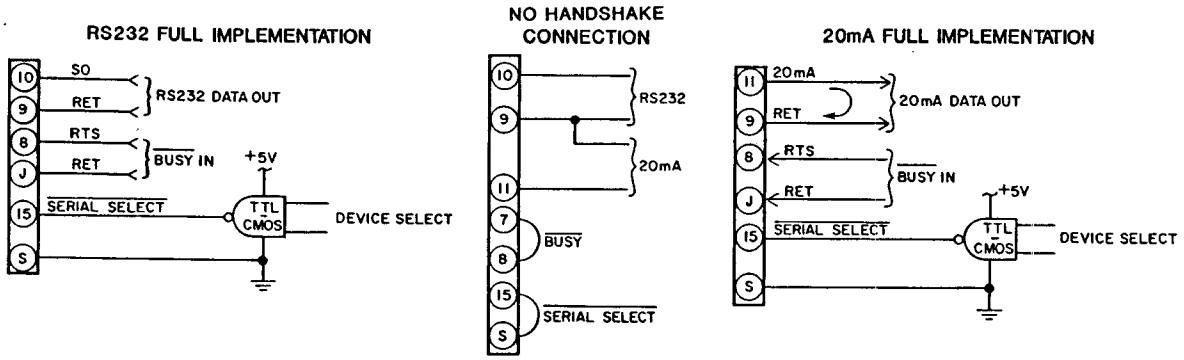

Figure 6. Various Option S Connections

2.8 Option A - Analog Output (from Option RA)

2.8.1 Description

Option A contains a 12 bit, D/A converter and current transmitter that enable the meter to interface with analog devices. Analog output is derived from the display.

Option A Specifications

- **Operating Temperature:** 0-35°C.
- **Stability:** ±2% of maximum full scale after two hour warm-up period. Includes all errors resulting from temperature coefficient tolerances.
- **Linearity:** Adjustable gain (±0.25% setability). ±0.025% maximum full scale non-linearity.
- **Offset Error:** Adjustable offset (±0.25% setability).
- **Output:** Voltage - 10VDC (max.) at 10mA (max.).
  Current - 20mA (max.) 13-18V compliance.
- **DAC Resolution:** 12 bit (1 part in 4096 counts).
- **Output Resolution:** Shown on chart below. Listed output values increase as gain increases at P2, Pin 4.

Model	Display	Typical DAC Output	Typical DAC Output X2 Mode
DP284	-500 to +3500	2.5mV/ct	2.857mV/ct
*DP285	-500.0 to +3500.0	2.5mV/ct	2.857mV/ct

*Same as DP284 except decimal digit is ignored by Option A.

Note: A minimum change of 200 display counts (175 counts in X2 Mode) is necessary to obtain a 4-20mA change out of the current transmitter at maximum gain.

2.8.2 P2 Edge Connector Pin-Outs for Option A

Pin	Function
A	Raw DAC output. 0 to +10 volts full scale. Not zero or gain trimmed. Can source 5mA max. If a load is applied, it must be >2,000Ω.
1	Inverted sum of the DAC output plus the offset value determined by R12 trimpot. Can source up to 2mA and is used as a setup testpoint only.
B	Sense input for 10V compliance (excitation) source.
5	+10V compliance (excitation) source. Must be tied to pin B at transducer or at P2 connector for proper operation. Output can source up to 90mA.
2	Analog ground for pins A, B, 1, 5.
3	Analog ground for pins C, 4.
H	+15V test point only.
6	-15V test point only.
4	Scaled and offset voltage output controlled by the DAC plus trimpots R12 and R17. Output can supply up to 10mA and is the input to the analog current transmitter, U6.
C	Scaled and offset analog current transmitter output.

2.8.3 Bipolar, Unipolar Connections (refer to Figure 4C)

NOTE: Current and voltage outputs are adjusted by the same potentiometers. At minimum current output, voltage output is at the minimum (and vice versa) and at maximum current output, voltage output is at the maximum (and vice versa). However, the relationship is not exact.

BIPOLAR OPERATION (X1 Mode)

Current Output: On the P2 connector, connect (+) R Load to Pin C and connect (-) R Load to Pin 3.

When the display is at negative full scale, current output is at the minimum (typically 4mA). When the display is at positive full scale, current output is at the maximum (typically 20mA).

Voltage Output: On the P2 connector, connect (+) R Load to pin 4 and connect (-) R Load to pin 3.

When the display is at negative full scale, voltage output is at the minimum (typically 2V). When the display is at positive full scale, voltage output is at the maximum (typically 12V).

UNIPOLAR OPERATION (X2 Mode)

During unipolar operation, the output span corresponds to only positive display values.

Unipolar operation requires the "2X Select" hook-up to make any negative input equal to zero. To select "2X", short Pin 13 to Pin P on the P2 connector.

Current Output: On the P2 connector, first make the "2X" connection, then connect (+) R Load to Pin C and then (-) R Load to Pin 3.

When the display is at zero (0), current output is at the minimum (typically 4mA). When the display is at positive full scale, current output is at the maximum (typically 20mA).

Voltage Output: On the P2 connector, first make the "2X" connection, then connect (+) R Load to Pin 4 and (-) R Load to Pin 3.

When the display is at zero, voltage output is at the minimum (typically 2V). When the display is at positive full scale, voltage output is at the maximum (typically 12V).

2.8.4 10V Compliance (Excitation) Adjustment (refer to Figure 7)

Pin B on the P2 Edge Connector is the sense input for the 10V excitation source. Pin 5 is the +10V excitation source. For proper operation, pin 5 must be tied to pin B at either the transducer or the P2 connector. This output can source up to 90mA. R19 (trimpot, see Figure 7) is the +10V excitation adjustment and has a range of +9Vdc to +11Vdc. Turn R19 clockwise to increase the voltage. This adjustment is not important to the operation of the DAC.

IMPORTANT: When this +10V exciter is used, the isolation between the signal input and analog output is compromised. If Option S is being used concurrently (i. e., Option RSA), it too will have compromised isolation. Option R is not affected.

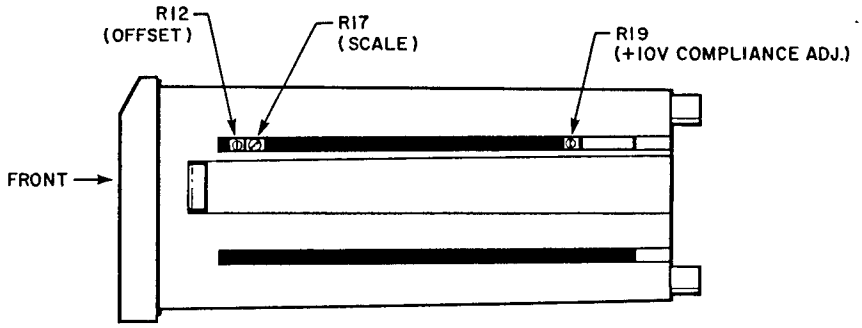

Figure 7. Analog Output Trimpot Positions

2.8.5 Analog Output Adjustment (refer to Figure 7)

The loop load resistance range for 4-20mA operation of this meter is 0 to 600 ohms. The loop is returned to Pin 3 on the P2 edge connector.

Adjust the 4-20mA current transmitter as follows:

1. Connect a volt meter between Pins 1 and 2 on the P2 edge connector.

2. Connect a current monitor to the transmitter loop at P2 Pin C and measure the loop current, or calculate the loop current by measuring the voltage across the load resistance and dividing that reading by the measured value of the load resistance.

3. To the meter input, apply a potential that causes the lowest planned display reading and adjust R12 (OFFSET) until the voltage at P2 Pin 1 goes to zero or slightly negative (to get any output from the current transmitter, this point must be at some negative potential).

4. With the display remaining at its lowest count, slowly rock the offset trimpot R12 back and forth until the current transmitter shows a small positive output current near zero (approximately 10-100μA).

5. To the meter input, apply a potential that causes the highest planned display reading and adjust R17 (SCALE) for 16mA in the loop. Turn R17 clockwise to decrease current in the loop.

6. With the display remaining at its highest count, adjust R12 (OFFSET) until the loop current reaches 20mA. Turn R12 clockwise to increase the pedestal (OFFSET) current in the loop.

7. To the meter input, apply a potential that causes the lowest planned display reading and check the pedestal (OFFSET) current to verify that it is 4mA. If it is not 4mA, repeat steps 4, 5, and 6 until it is.

This concludes the Installation Section of this manual.

Section 3 - OPERATION

Section 3 describes how to operate the meter using the front panel keypad. The following functions will be discussed:

Section 3.1 Normal Operation
Section 3.2 Alarm Conditions
Section 3.3 Setup Mode
Section 3.4 Open Thermocouple

3.1 Normal Operation

When the meter is in the Run (normal) Mode, it displays the current reading. If any setpoint is exceeded, the meter goes into an alarm condition.

3.1.1 Nonvolatile Memory

All meters feature a nonvolatile memory, in addition to a temporary memory. The nonvolatile memory is maintained even when power to the meter is off. The temporary memory is used during the Setup Mode to store selected values until they are transferred to nonvolatile memory after exiting the Setup Mode. This feature makes it unnecessary to reprogram the meter each time it is turned on.

3.1.2 Min./Max. Feature

The Min./Max. feature keeps track of the highest and lowest readings since the values were last cleared. Press ▲ to display the highest reading or ▼ to display the lowest reading. These keys do not function if a thermocouple is open.

IMPORTANT: Min./Max. must be reset whenever the meter is turned on.

To reset Min., press and hold ▼, then press <S>. Release <S> and then ▼. The positive full scale value will flash on the display, followed by the current reading.

To reset Max., press and hold ▲, then press <S>. Release <S> and then ▲. The negative full scale value will flash on the display, followed by the current reading.

3.2 Alarm Conditions

When input exceeds a setpoint (SP), the meter goes into an alarm condition. During an alarm condition, the display alternates between an alarm message (Hi or Lo) and the current reading, and, if your meter has Option R, the corresponding relay is activated. The Alarm Messages which may appear during an alarm condition are listed below.

Alarm Message	Description
[Hi]	SP1H exceeded. Display also flashes current reading.
[Lo]	SP1L exceeded. Display also flashes current reading.
[Hi]	SP2H exceeded. Display also flashes current reading.
[Lo]	SP2L exceeded. Display also flashes current reading.
[Hi Hi]	SP1H and SP2H exceeded. Display also flashes current reading.
[Lo Lo]	SP1L and SP2L exceeded. Display also flashes current reading.
[Hi Lo]	SP1H and SP2L exceeded. Display also flashes current reading.
[Lo Hi]	SP1L and SP2H exceeded. Display also flashes current reading.

3.3 Setup Mode

Use the setup mode to select setpoint values, temperature scale (°C or °F), and hysteresis.

During Setup, setpoints and values are entered into the meter's temporary memory until the normal Run Mode is entered at the end of the Setup cycle. At that time, temporary memory is transferred to nonvolatile memory.

IMPORTANT

(1) Two-Minute Entry Time:

During Setup, the meter allows ONLY 2 MINUTES between keystrokes to enter or change a parameter. If 2 minutes lapse without a keystroke, the meter automatically returns to the Run Mode and erases any temporary memory without changing nonvolatile memory.

(2) Change setting in nonvolatile memory:

After entering the Setup mode, press <S> until you come to the function you want to change. After changing a setup entry, press <S> again until the "run" prompt is displayed. The new value is entered into nonvolatile memory when the display goes blank.

3.3.1 Key Functions

The keys on the front panel are used to step through the Setup Program. The Setup Program is used to program setpoints and select values such as temperature scale and hysteresis. These keys do not function if a thermocouple is open.

There are 3 keys on the front panel:

S — Used to enter Setup Mode, to scroll through setup prompts, or to enter a selection or value into temporary memory.

▲ — Used to increase a displayed value. Press and hold this key to rapidly increase the displayed value.

▼ — Used to decrease a displayed value. Press and hold this key to rapidly decrease the displayed value.

3.3.2 Setup Prompts

The following Setup Prompts will appear in the display during the Setup Mode:

SETUP - This prompt tells you to enter the lockout code (28) to enter the Setup Mode.

°C-°F - This prompt, which is followed by the current selection, tells you to select the temperature scale.

SP 1H - This prompt, which is followed by the current setting, tells you to select the High Limit value of setpoint 1 (SP1H).

SP 1L - This prompt, which is followed by the current setting, tells you to select the Low Limit value of setpoint 1 (SP1L).

SP 2H - This prompt, which is followed by the current setting, tells you to select the High Limit value of setpoint 2 (SP2H).

SP 2L - This prompt, which is followed by the current setting, tells you to enter the Low Limit value of setpoint 2 (SP2L).

HYS - This prompt, which is followed by the current setting, tells you to select the Hysteresis (deadband) value. This is a number to be added to a low limit value or subtracted from a high limit value before an alarm condition is cancelled, and is common to all setpoints.

run - This prompt tells you that the Setup Mode is complete. Any values selected in the Setup Mode are transferred to nonvolatile memory when the meter returns to the Run Mode.

3.3.3 Sample Setup Program

The following example shows the Setup Program.

Remember: Three Front Panel Keys: <S> to start Setup, to scroll through Setup entries, and to save a selection in temporary memory; ▲ to increase a displayed value; and ▼ to decrease a displayed value.

Setup Sequence:

1. Press <S>. The display says **SETUP** followed by **0.**
2. Enter the Lock Out Code (28) using ▲ to raise the displayed value to 30, then press ▼ twice to get to 28.
3. Press <S>. The display says **°C-°F** followed by the current setting. Press ▲ or ▼ to alternate the display choices (°C or °F). Press <S> to enter the displayed selection into temporary memory.
4. When **SP 1H** is displayed, followed by the current setting, enter the high limit of Setpoint 1 (SP1H) by raising or lowering the displayed value and pressing <S>.
5. When **SP 1L** is displayed, followed by its current value, enter the low limit of Setpoint 1 (SP1L) by raising or lowering the displayed value and pressing <S>. Repeat these steps to set the two remaining setpoint values. NEVER set SP1L higher than SP1H or SP2L higher than SP2H.
6. When **HYS** is displayed, followed by its current value, enter the Hysteresis (deadband) by raising or lowering the displayed value and pressing <S>. If you want to stay in the Setup Mode, continue to press <S> when **run** is displayed.
7. The display will say **run** and, if you are not still holding <S>, the display will go blank (at which time the values and setpoints are entered into nonvolatile memory).

3.4 Open Thermocouple

Whenever the thermocouple circuit opens, the display will say **OPEn.**

This completes the Operation Section of this manual.

Section 4 - SCHEMATICS, ASSEMBLY DRAWINGS and PARTS LISTS

IMPORTANT: Replacement of certain parts may require field or factory recalibration of the meter.

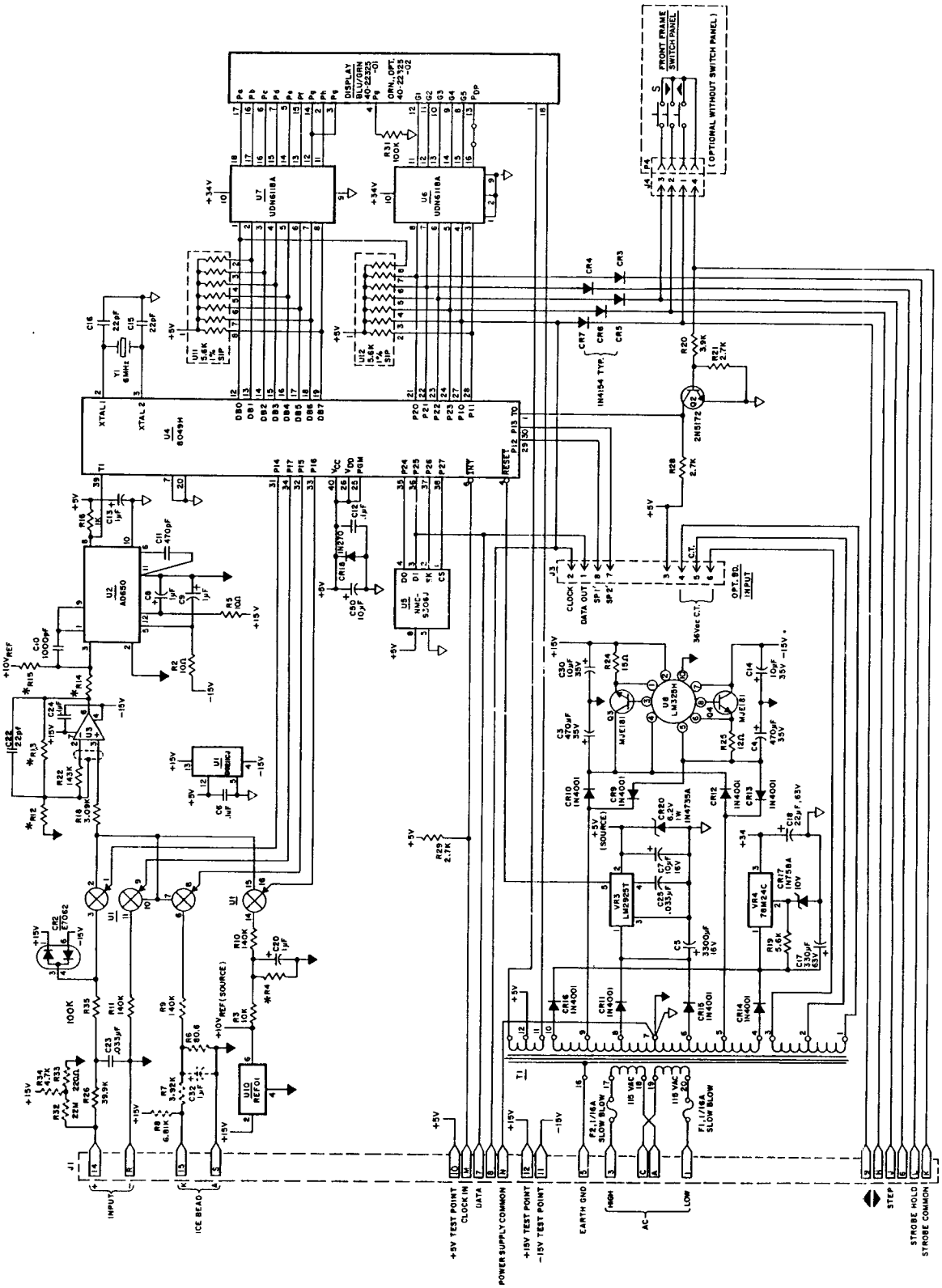

Figure 8. Main P. C. Board Schematic

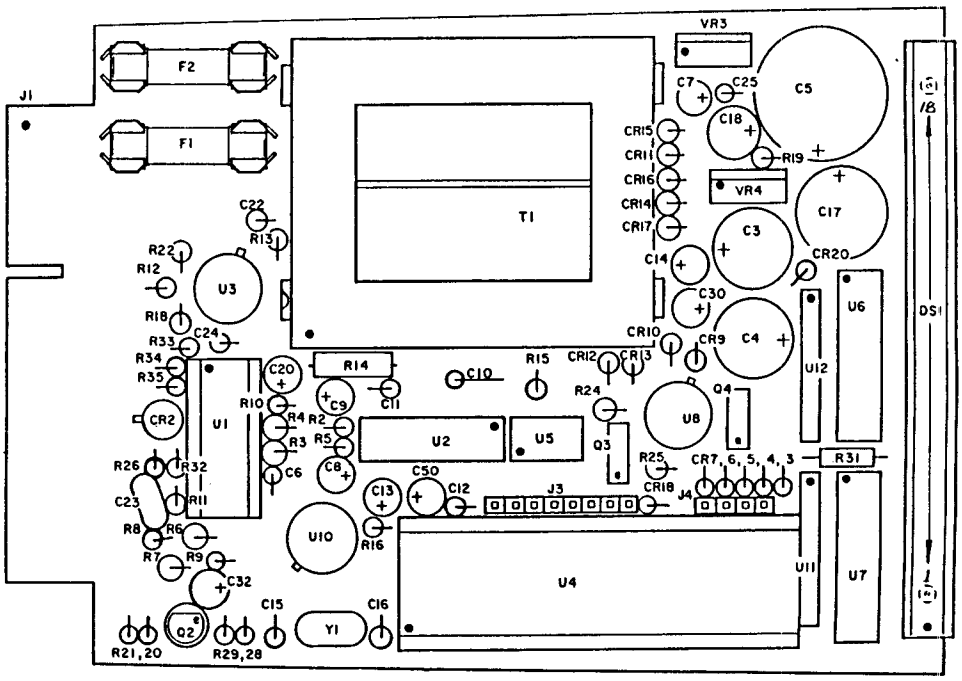

Figure 9. Main P.C. Board Assembly

Main P. C. Board Parts List

*Reference Number	Description	Vendor
C3	Capacitor, Electro., 470µF, 35V	Nichicon, UVX
C4	Capacitor, Electro., 470µF, 35V	Nichicon, UVX
C5	Capacitor, Electro., 3300µF, 16V	Nichicon, UVX
C6	Capacitor, Ceramic, 0.1µF, 50V, 20%	Corning, Z5U
C7	Capacitor, Electro., 10µF, 16V	Panasonic, Z
C8	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C9	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C10	Capacitor, Cog, 1000pF, 100V, 5%	Corning, CAC02/03/04/05
C11	Capacitor, Cog, 470pF, 50V,2%	Corning, CAC02/03/04/05
C12	Capacitor, Ceramic, 0.1µF, 50V, 20%	Corning, Z5U
C13	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C14	Capacitor, Electro., 10µF, 35V	Panasonic, Z
C15	Capacitor, Cog, 22pF, 50V, 5%	Corning, CAC02/03/04/05
C16	Capacitor, Cog, 22pF, 50V, 5%	Corning, CAC02/03/04/05
C17	Capacitor, Electro., 330µF, 63V	Nichicon, UVX
C18	Capacitor, Electro., 22µF, 63V	Nichicon, UVX
C20	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C22	Capacitor, Cog, 22pF, 50V, 5%	Corning, CAC02/03/04/05
C23	Capacitor, Ceramic, 0.033µF, 200V, 20%	Murata Erie, RPE
C24	Capacitor, Ceramic, 0.1µF, 50V, 20%	Corning, Z5U
C25	Capacitor, Ceramic, 0.033µF, 50V, 20%	Corning, Z5U
C30	Capacitor, Electro., 10µF, 35V	Panasonic, Z
C32	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C50	Capacitor, Electro., 10µF, 16V	Panasonic, Z
CR2	Diode, Dual Low Leakage, E7062	Siliconix
CR3	Diode, Signal, 1N4154	Motorola
CR4	Diode, Signal, 1N4154	Motorola
CR5	Diode, Signal, 1N4154	Motorola
CR6	Diode, Signal, 1N4154	Motorola
CR7	Diode, Signal, 1N4154	Motorola
CR9	Diode, Power, 1N4001	ITT
CR10	Diode, Power, 1N4001	ITT

* Reference Number is found on the corresponding assembly drawing.

Main P. C. Board Parts List (cont.)

*Reference Number	Description	Vendor
CR11	Diode, Power, 1N4001	ITT
CR12	Diode, Power, 1N4001	ITT
CR13	Diode, Power, 1N4001	ITT
CR14	Diode, Power, 1N4001	ITT
CR15	Diode, Power, 1N4001	ITT
CR16	Diode, Power, 1N4001	ITT
CR17	Diode, Zener, 10V, 1N758A	Fairchild
CR18	Diode, Signal, 1N270	ITT
CR20	Diode, Zener, 6.2V, 1W, 1N4735A	Motorola
DS1	Display, Blue/Green	Omega
F1	Fuse, Type FTR, Slo-Blo, 1/16 Amp	Schurter
F2	Fuse, Type FTR, Slo-Blo, 1/16 Amp	Schurter
Q2	Transistor, NPN, Signal, 2N5172	GE
Q3	Transistor, NPN, Power, MJE181	Motorola
Q4	Transistor, NPN, Power, MJE181	Motorola
R2	Resistor, C. C., 10 Ohm, 1/4W, 5%	IRC, GBT 1/4
R3	Resistor, M. F., 10K Ohm, 1/8W, .5%	TRW, MAR 6
R4	Resistor, M. F., 80.6 Ohm, 1/8W, .5%	TRW, MAR 6
R5	Resistor, C. C., 10 Ohm, 1/4W, 5%	IRC, GBT 1/4
R6	Resistor, M. F., 80.6 Ohm, 1/8W, .5%	TRW, MAR 6
R7	Resistor, M. F., 3.92K Ohm, 1/8W, .5%	TRW, MAR 6
R8	Resistor, F. F., 6.81K Ohm, 1/8W, .5%	Dale, MFF
R9	Resistor, F. F., 140K Ohm, 1/8W, 1%	Dale, MFF
R10	Resistor, F. F., 140K Ohm, 1/8W, 1%	Dale, MFF
R11	Resistor, F. F., 140K Ohm, 1/8W, 1%	Dale, MFF
R12	Resistor, M. F., 80.6 Ohm, 1/8W, .5%	TRW, MAR 6
R13	Resistor, M. F., 9.76K Ohm, 1/8W, .5%	TRW, MAR 6
R14	Resistor, M. F., 28.7K Ohm, 1/10W, .5%	TRW, MAR 6
R15	Resistor, M. F., 162K Ohm, 1/8W, .5%	TRW, MAR 6
R16	Resistor, C. C., 1K Ohm, 1/4W, 5%	IRC, GBT 1/4
R18	Resistor, F. F., 3.09K Ohm, 1/8W, 1%	Dale, MFF
R19	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R20	Resistor, C. C., 3.9K Ohm, 1/4W, 5%	IRC, GBT 1/4
R21	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R22	Resistor, F. F., 143K Ohm, 1/8W, 1%	Dale, MFF
R24	Resistor, C. C., 15 Ohm, 1/4W, 5%	IRC, GBT 1/4
R25	Resistor, C. C., 12 Ohm, 1/4W, 5%	IRC, GBT 1/4
R26	Resistor, F. F., 39.9K Ohm, 1/8W, 1%	Dale, MFF
R28	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R29	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R31	Resistor, C. C., 100K Ohm, 1/4W, 5%	IRC, GBT 1/4
R32	Resistor, C. C., 22M Ohm, 1/4W, 5%	IRC, GBT 1/4
R33	Resistor, C. C., 200 Ohm, 1/4W, 5%	IRC, GBT 1/4
R34	Resistor, C. C., 4.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R35	Resistor, F. F., 100K Ohm, 1/8W, 1%	Dale, MFF
T1	Transformer	Omega
U1	IC, Analog Switch, DG211CJ	Siliconix
U2	IC, Voltage/Frequency Converter, AD650JN	Analog Devices
U3	IC, Op-Amp, OPA111AM	Burr-Brown
U4	PROM, Programmed (DP284E and DP285E)	Omega
U4	PROM, Programmed (DP284J and DP285J)	Omega
U4	PROM, Programmed (DP284K and DP285K)	Omega
U4	PROM, Programmed (DP284T and DP285T)	Omega
U5	IC, Programmable, Memory	Not User Replaceable
U6	IC, Display Driver, UDN6118A	Sprague
U7	IC, Display Driver, UDN6118A	Sprague
U8	IC, DPTR, ±15V, LM325H	National Semiconductor
U10	IC, Voltage Reference, REF01EJ	Precision Monolithics
U11	Resistor Module, 8 Pin SIP, 5.6K Ohm	Bourns
U12	Resistor Module, 8 Pin SIP, 5.6K Ohm	Bourns
VR3	Regulator, +5V w/Reset, LM2925T	National Semiconductor
VR4	Regulator, +24V, 78M24C	Motorola
Y1	Crystal, 6 MHz	M-Tron

* Reference Number is found on the corresponding assembly drawing.

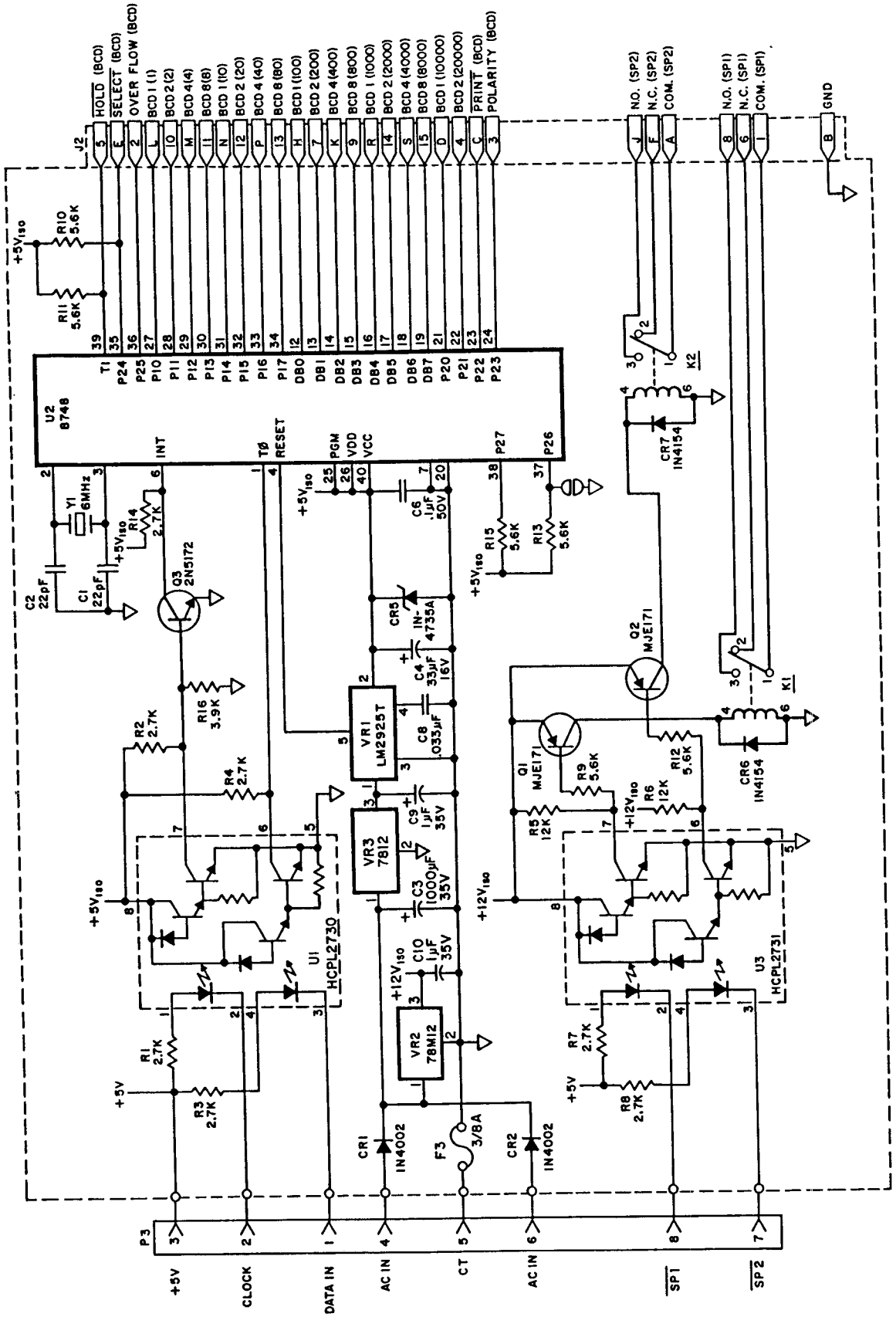

Figure 10. RB Option Board Schematic

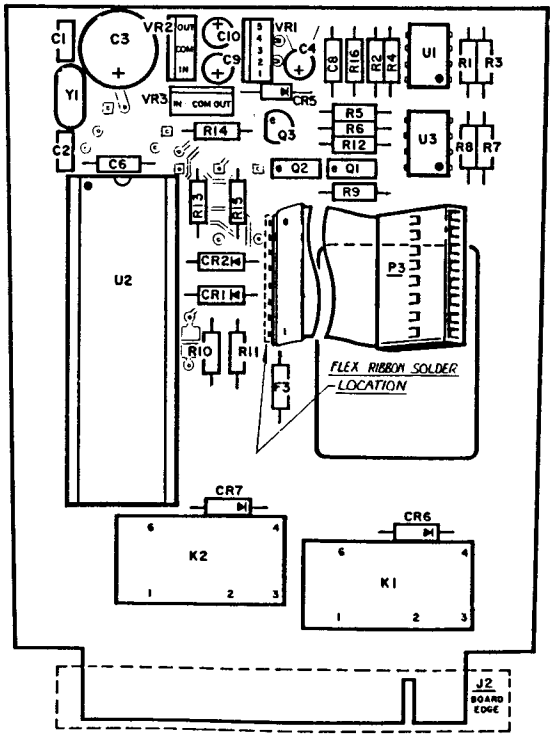

Figure 11. RB Option Board Assembly

RB Option Board Parts List

*Reference Number	Description	Vendor
	Complete Board Assy. For Option R	Omega
	Complete Board Assy. For Option RB	Omega
C1	Capacitor, Cog, 22pF, 50V	Corning, CAC02/03/04/05
C2	Capacitor, Cog, 22pF, 50V	Corning, CAC02/03/04/05
C3	Capacitor, Electro., 1000µF, 35V	Nichicon, UVX
C4	Capacitor, Electro., 33µF, 16V	Nichicon, UVX
C6	Capacitor, Ceramic, 1µF, 50V	Corning, Z5U
C8	Capacitor, Ceramic, 0.033µF, 50V	Corning, Z5U
C9	Capacitor, Tant., 1µF, 35V	Sprague, 196D
C10	Capacitor, Tant., 1µF, 35V	Sprague, 196D
CR1	Diode, Power, 1N4001	ITT
CR2	Diode, Power, 1N4001	ITT
CR5	Diode, Zener, 6.2V, 1W, 1N4735A	Motorola
CR6	Diode, Signal, 1N4154	Motorola
CR7	Diode, Signal, 1N4154	Motorola
F3	Fuse, 375mA, Picofuse	Little Fuse, 275.062
K1	Relay, Power, NB1DC12V	Aromat
K2	Relay, Power, NB1DC12V	Aromat
P3	Cable, Flex	T and B, Flexpac
Q1	Transistor, PNP, Power, MJE171	Motorola
Q2	Transistor, PNP, Power, MJE171	Motorola
Q3	Transistor, NPN, Signal, 2N5172	GE
R1	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R2	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R3	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R4	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R5	Resistor, C. C., 12K Ohm, 1/4W, 5%	IRC, GTB 1/4
R6	Resistor, C. C., 12K Ohm, 1/4W, 5%	IRC, GTB 1/4
R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4

* Reference Number is found on the corresponding assembly drawing.

RB Option Board Parts List (cont.)

*Reference Number	Description	Vendor
R8	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R9	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GTB 1/4
R10	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GTB 1/4
R11	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GTB 1/4
R12	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GTB 1/4
R14	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GTB 1/4
R16	Resistor, C. C., 3.9K Ohm, 1/4W, 5%	IRC, GTB 1/4
U1	IC, Opto-Isolator, HCPL2730	Hewlett-Packard
U2	Microcomputer, Programmed	Omega
U3	IC, Opto-Isolator, HCPL2731	Hewlett-Packard
VR1	Regulator, +5V w/Reset, LM2925T	National
VR2	Regulator, +12V, 78M12	Motorola
VR3	Regulator, +12V, MC7812CT	Motorola
Y1	Crystal, 6 MHz	M-Tron

* Reference Number is found on the corresponding assembly drawing.

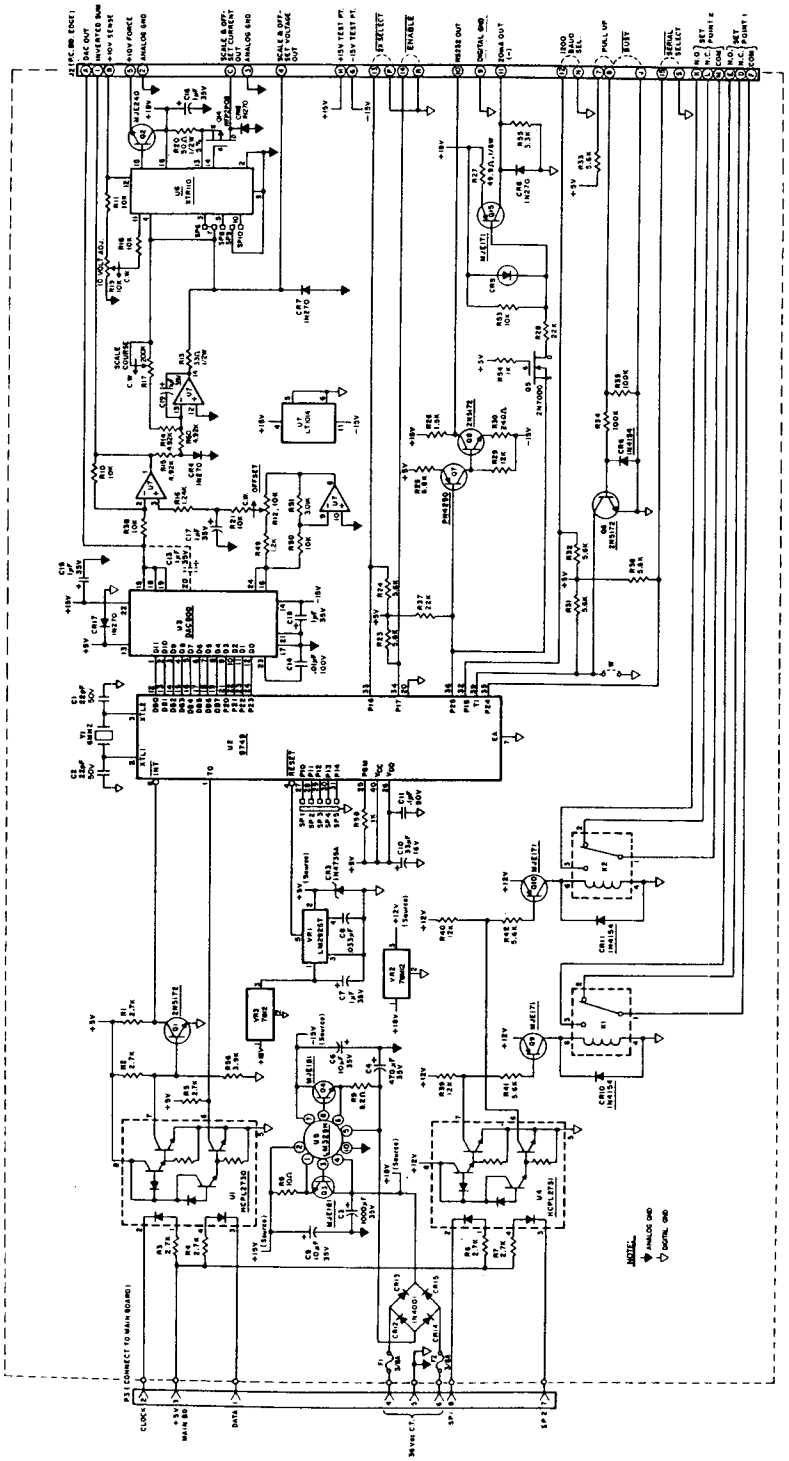

Figure 12. RA, RS, RSA Option Board Schematic

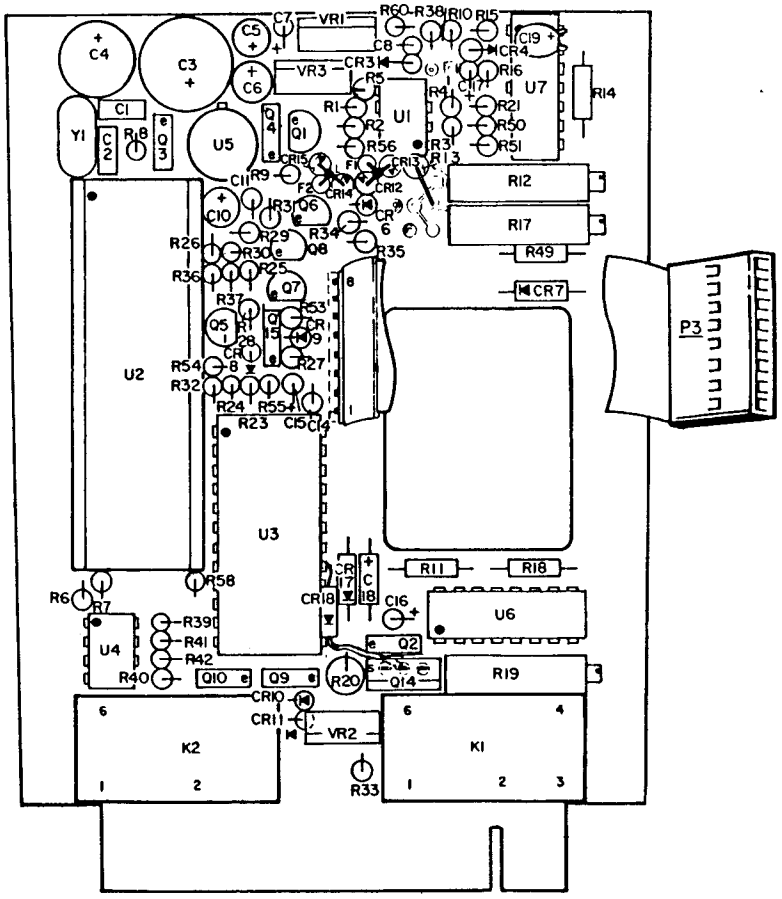

Figure 13. RS, RA, RSA Option Board Assembly

RS, RA, RSA Option Board Parts List

*Reference Number	Description	Vendor
	Complete Board Assy. For Option RA	Omega
	Complete Board Assy. For Option RS	Omega
	Complete Board Assy. For Option RSA	Omega
C1	Capacitor, Cog, 22pF, 50V	Corning, CAC02/03/04/05
C2	Capacitor, Cog, 22pF, 50V	Corning, CAC02/03/04/05
C3	Capacitor, Electro., 1000µF, 35V	Nichicon, UVX
C4	Capacitor, Electro., 470µF, 35V	Nichicon, UVX
C5	Capacitor, Electro., 10µF, 35V	Nichicon, UVX
C6	Capacitor, Electro., 10µF, 35V	Nichicon, UVX
C7	Capacitor, Tant., 1µF, 35V	Kemet, T322
C8	Capacitor, Ceramic, 0.033µF, 50V, 20%	Corning, Z5U
C10	Capacitor, Electro., 33µF, 16V	Nichicon, UVX
C11	Capacitor, Ceramic, 0.1µF, 50V, 20%	Corning, Z5U
C14	Capacitor, Ceramic, 0.1µF, 100V, 20%	Corning, Z5U
C15	Capacitor, Tant., 1µF, 35V	Kemet, T322
C16	Capacitor, Tant., 1µF, 35V	Kemet, T322
C17	Capacitor, Tant., 1µF, 35V	Kemet, T322
C18	Capacitor, Tant., 1µF, 35V	Kemet, T322
C19	Capacitor, Tant., 1µF, 35V	Sprague, 196D
CR3	Diode, Zener, 6.2V, 1W, 1N4735A	Motorola
CR6	Diode, Signal, 1N4154	Motorola
CR7	Diode, Signal, 1N270	ITT
CR8	Diode, Signal, 1N270	ITT
CR9	Diode, LED, HLMP1520	Hewlett-Packard
CR10	Diode, Signal, 1N270	Motorola
CR11	Diode, Signal, 1N270	Motorola

* Reference Number is found on the corresponding assembly drawing.

RA, RS, RSA Option Board Parts List (cont.)

*Reference Number	Description	Vendor
CR12	Diode, Power, 1N4001	ITT
CR13	Diode, Power, 1N4001	ITT
CR14	Diode, Power, 1N4001	ITT
CR15	Diode, Power, 1N4001	ITT
CR17	Diode, Signal, 1N270	ITT
CR18	Diode, Signal, 1N270	ITT
F1	Fuse, 375mA, Picofuse	Little Fuse, 275.062
F2	Fuse, 375mA, Picofuse	Little Fuse, 275.062
K1	Relay, Power, NB1DC12V	Aromat
K2	Relay, Power, NB1DC12V	Aromat
P3	Cable, Flex	T and B, Flexpac
Q1	Transistor, NPN, Signal, 2N5172	GE
Q2	Transistor, PNP, Power, MJE240	Motorola
Q3	Transistor, NPN, Power, MJE181	Motorola
Q4	Transistor, NPN, Power, MJE181	Motorola
Q5	Transistor, FET, P-Chan., 2N7000	Siliconix
Q6	Transistor, NPN, Signal, 2N5172	GE
Q7	Transistor, PNP, Signal, PN4250	Fairchild
Q8	Transistor, NPN, Signal, 2N5172	GE
Q9	Transistor, PNP, Power, MJE171	Motorola
Q10	Transistor, PNP, Power, MJE171	Motorola
Q14	Transistor, Power, MOSFET, RFP2P08	RCA
Q15	Transistor, PNP, Power, MJE171	Motorola
R1	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R2	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R3	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R4	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R5	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R6	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R7	Resistor, C. C., 2.7K Ohm, 1/4W, 5%	IRC, GBT 1/4
R8	Resistor, C. C., 10 Ohm, 1/4W, 5%	IRC, GBT 1/4
R9	Resistor, C. C., 8.2 Ohm, 1/4W, 5%	IRC, GBT 1/4
R10	Resistor, F. F., 10K Ohm, 1/8W, .5%	TRW, MAR 6
R11	Resistor, F. F., 10K Ohm, 1/8W, .5%	TRW, MAR 6
R12	Potentiometer, 10K, 30-Turn	Bourns
R13	Resistor, C. C., 33 Ohm, 1/2W, 5%	IRC, GBT 1/2
R14	Resistor, M. F., 4.92K Ohm, 1/8W, .5%	TRW, MAR 6
R15	Resistor, M. F., 4.92K Ohm, 1/8W, .5%	TRW, MAR 6
R16	Resistor, F. F., 1.24K Ohm, 1/8W, 1%	Dale, MFF
R17	Potentiometer, 200K, 30-Turn	Bourns
R18	Resistor, F. F., 10K Ohm, 1/8W, .5%	TRW, MAR 6
R19	Potentiometer, 10K, 30-Turn	Bourns
R20	Resistor, Wire Wound, 50 Ohm, 1/2W, .5%	RCL, T-1/2
R21	Resistor, F. F., 10K Ohm, 1/8W, 1%	Dale, MFF
R23	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R24	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R25	Resistor, C. C., 6.8K Ohm, 1/4W, 5%	IRC, GBT 1/4
R26	Resistor, C. C., 1.5K Ohm, 1/4W, 5%	IRC, GBT 1/4
R27	Resistor, F. F., 49.9 Ohm, 1/8W, 1%	Dale, MFF
R28	Resistor, C. C., 22K Ohm, 1/4W, 5%	IRC, GBT 1/4
R29	Resistor, C. C., 12K Ohm, 1/4W, 5%	IRC, GBT 1/4
R30	Resistor, C. C., 240 Ohm, 1/4W, 5%	IRC, GBT 1/4
R31	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R32	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R33	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R34	Resistor, C. C., 100K Ohm, 1/4W, 5%	IRC, GBT 1/4
R35	Resistor, C. C., 100K Ohm, 1/4W, 5%	IRC, GBT 1/4
R36	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R37	Resistor, C. C., 22K Ohm, 1/4W, 5%	IRC, GBT 1/4
R38	Resistor, F. F., 10K Ohm, 1/8W, .5%	TRW, MAR 6
R39	Resistor, C. C., 12K Ohm, 1/4W, 5%	IRC, GBT 1/4
R40	Resistor, C. C., 12K Ohm, 1/4W, 5%	IRC, GBT 1/4
R41	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R42	Resistor, C. C., 5.6K Ohm, 1/4W, 5%	IRC, GBT 1/4
R49	Resistor, F. F., 1.2K Ohm, 1/8W, .5%	TRW, MAR 6
R50	Resistor, F. F., 10K Ohm, 1/8W, .5%	TRW, MAR 6

* Reference Number is found on the corresponding assembly drawing.

RA, RS, RSA Option Board Parts List (cont.)

*Reference Number	Description	Vendor
R51	Resistor, F. F., 3.01K Ohm, 1/8W, .5%	TRW, MAR 6
R53	Resistor, C. C., 10K Ohm, 1/4W, 5%	IRC, GBT 1/4
R54	Resistor, C. C., 1K Ohm, 1/4W, 5%	IRC, GBT 1/4
R55	Resistor, C. C., 3.3K Ohm, 1/4W, 5%	IRC, GBT 1/4
R56	Resistor, C. C., 3.9K Ohm, 1/4W, 5%	IRC, GBT 1/4
R58	Resistor, C. C., 1K Ohm, 1/4W, 5%	IRC, GBT 1/4
R60	Resistor, F. F., 4.92K Ohm, 1/8W, .5%	TRW, MAR 6
U1	IC, Opto-Isolator, HCPL2730	Hewlett-Packard
U2	EPROM, Programmed	Omega
U3	IC, D/A Converter DAC800P-CB1-V	Burr-Brown
U4	IC, Opto-Isolator, HCPL2731	Hewlett-Packard
U5	IC, DPTR, ±15V, LM325H	National Semiconductor
U6	IC, Current Transmitter, XTR110	Burr-Brown
U7	IC, Quad OP Amp, LT1014DN	Linear
VR1	Regulator, +5V w/Reset, LM2925T	National
VR2	Regulator, +12V, MC78M12	Motorola
VR3	Regulator, +12V, MC7812CT	Motorola
Y1	Crystal, 6 MHz	M-Tron

* Reference Number is found on the corresponding assembly drawing.

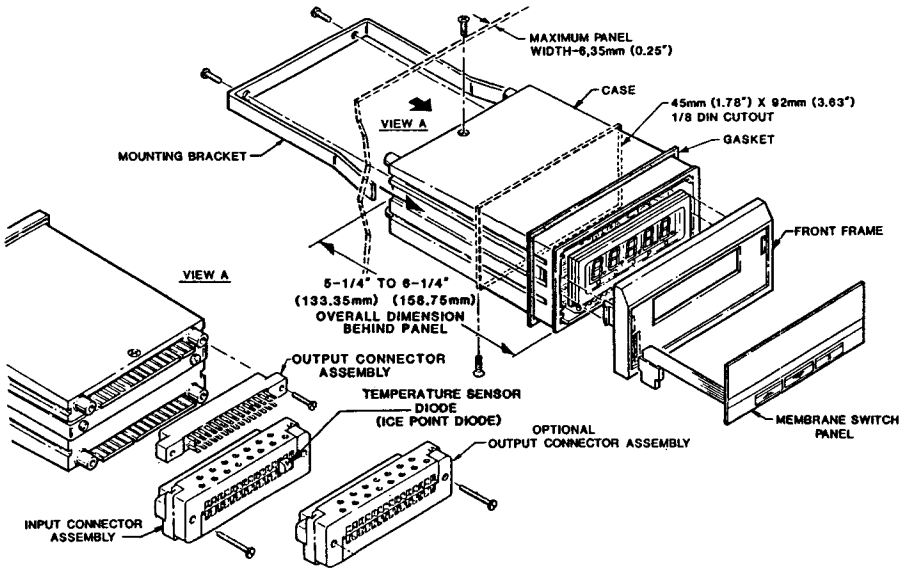

Figure 14. Miscellaneous Parts

Miscellaneous Parts List

Part Number	Description	Vendor
30-22941-00	Case	Omega
30-22941-01	Case (Used With Option RA)	Omega
16-22385	Gasket	Omega
25-22984	Front Frame	Omega
31-23002-00	Membrane Switch Panel	Omega
31-23002-01	Membrane Switch Panel (Used With Option D)	Omega
34-23017	Mounting Bracket	Omega
04-23208-22	Input Connector Assy (Includes Ice Point Diode)	Omega
40-22282	Temperature Sensor Diode (Ice Point Diode)	Omega
04-23188-23	Output Connector Assy	Omega
04-23192-23	Optional Output Connector (Screw Terminals)	Omega

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- ☐ Transducers
- ☐ Strain Gauges
- ☐ Load Cells
- ☐ Pressure Gauges
- ☐ Instrumentation

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- ☐ Rotameters
- ☐ Flowmeter Systems
- ☐ Air Velocity Indicators
- ☐ Turbine/Paddlewheel Systems
- ☐ Vortex Meters and Flow Computers

pH

- ☐ Electrodes
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- ☐ Controllers
- ☐ Calibrators/Simulators
- ☐ Transmitters

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