2520

CE

DIGITAL PANEL VOLTMETER

Operator's Manual

MADE IN THE U.S.A.

NEWPORT Electronics, Inc.

http://www.newportUS.com/manuals

Additional products from

NEWPORT Electronics, Inc.

Counters	Rate Meters
Frequency Meters	Timers
PID Controllers	Totalizers
Clock/Timers	Strain Gauge Meters
Printers	Voltmeters
Process Meters	Multimeters
On/Off Controllers	Soldering Iron Testers
Recorders	pH pens
Relative Humidity	pH Controllers
Transmitters	pH Electrodes
Thermocouples	RTDs
Thermistors	Thermowells
Wire	Flow Sensors

For Immediate Assistance
In the U.S.A. and Canada: 1-800-NEWPORT®
In Mexico: (95) 800-NEWPORT℠
Or call your local NEWPORT Office.

NEWPORTnet℠ On-Line Service	**Internet e-mail**
http://www.newportUS.com	info@newportUS.com

It is the policy of NEWPORT to comply with all worldwide safety and EMC/EMI regulations that apply. NEWPORT is constantly pursuing certification of its products to the European New Approach Directives. NEWPORT will add the CE mark to every appropriate device upon certification.

The information contained in this document is believed to be correct but NEWPORT Electronics, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

WARNING: These products are not designed for use in, and should not be used for, patient connected applications.

⚠ This device is marked with the international caution symbol. It is important to read the Setup Guide before installing or commissioning this device as it contains important information relating to safety and EMC.

SAFETY CONSIDERATIONS

This device is marked with the international Caution symbol. It is important to read this manual before installing or commissioning this device as it contains important information relating to Safety and EMC (Electromagnetic Compatibility).

Unpacking & Inspection

Note

Unpack the instrument and inspect for obvious shipping damage. Do not attempt to operate the unit if damage is found.

This instrument is a panel mount device protected in accordance with Class I of EN 61010 (115/230 AC power connections). Installation of this instrument should be done by Qualified personnel. In order to ensure safe operation, the following instructions should be followed.

This instrument has no power-on switch. An external switch or circuit-breaker shall be included in the building installation as a disconnecting device. It shall be marked to indicate this function, and it shall be in close proximity to the equipment within easy reach of the operator. The switch or circuit-breaker shall not interrupt the Protective Conductor (Earth wire), and it shall meet the relevant requirements of IEC 947–1 and IEC 947-3 (International Electrotechnical Commission). The switch shall not be incorporated in the mains supply cord.

Furthermore, to provide protection against excessive energy being drawn from the mains supply in case of a fault in the equipment, an overcurrent protection device shall be installed.

- The **Protective Conductor** must be connected for safety reasons. Check that the power cable has the proper Earth wire, and it is properly connected. It is not safe to operate this unit without the Protective Conductor Terminal connected.

Note

- Do not exceed voltage rating on the label located on the top of the instrument housing.
- Always disconnect power before changing signal and power connections.
- Do not use this instrument on a work bench without its case for safety reasons.
- Do not operate this instrument in flammable or explosive atmospheres.
- Do not expose this instrument to rain or moisture.

EMC Considerations

- Whenever EMC is an issue, always use shielded cables.
- Never run signal and power wires in the same conduit.
- Use signal wire connections with twisted-pair cables.
- Install Ferrite Bead(s) on signal wires close to the instrument if EMC problems persist.

TABLE OF CONTENTS

1.0 DESCRIPTION

1.1 GENERAL

The Newport Model 2520 Digital Panel Voltmeter is a low cost, reliable instrument for digital display of analog bipolar voltages. The display is ±19999 counts on any of three ranges from ±1.9999 V to ±199.99 V.

The Model 2520 DPVM is a 5 V dc powered meter with 14 mm high, 7-segment LED readout. The housing is a break-resistant black phenylene oxide case. No zero adjustment is required and full scale adjustment is easily accessible with the front lens removed.

Accuracy at the low end of each range is not degraded by normal-mode noise because the Model 2520 performs true bipolar signal integration around zero.

Ratio measurements are possible with the Model 2520 without modifications or external logic. The configuration is 3-wire (common ground) and the reference must be within a specified voltage range.

Data output lines are serial BCD at a 100 Hz typical multiplex rate. The BCD outputs are compatible with TTL and DTL inputs. External control signals are also TTL and DTL compatible and increase the flexibility and ease of interfacing the Model 2520 with other instruments.

As an option, parallel BCD outputs may be provided. These are Three-State outputs compatible with TTL, DTL and the Newport Instrument bus.

A preamplifier option is available that provides selectable gains up to 128.

1.2 SPECIFICATIONS

1.2.1 Input

	2520-3	2520-4	2520-5	Units
Range	2	20	200	V
Resolution	0.1	1	10	mV
Overdrive Protection	300			V
Input Resistance	1000	1.1	1	MΩ
Input Bias Current	10	1	.1	pA
Reading Tempco (0°C 50°C Typ)	.005 (1)	.0075 (2)	.0075 (2)	%R/°C
Zero Noise (Typ)	.3			P-P Counts
Full Scale Noise (Typ)	.5			P-P Counts
Full Scale Turnover	2 (1 typ)			Counts
Non-Linearity (Typ)	1			Counts
External Reference Voltage	+.50 → +3.00			V
Ratio Accuracy	99.97 ±.02			%R
Ratio Linearity	2 (1 typ)			Counts
Ext Ref Input Resistance (3)	40			kΩ

(1) .001%R/°C when ordered with LT option

(2) .002%R/°C when ordered with LT option

(3) A higher resistance is available with the HZ option

1.2.2 Accuracy @ 25°C

Total Error	±.01%R ±2 Cts.
Offset Tempco	2 uV/°C
Warmup Time	30 minutes

1.2.3 Conversion

Technique	Dual slope, average value
Signal Integration Period	100 mSec (50/60 Hz)
Read Rate	2.5/Sec
	0-2.5/Sec with external control
Polarity	Automatic

1.2.4 Input Characteristics

Type	True differential
CMV	±1 V (max)
Settling Time	2 seconds
NMR	60 dB at 50 or 60 Hz
CMR	86 dB at 60 Hz
Zero	Automatic
Ratio Measurement	3-wire

1.2.5 Calibration Controls

Full Scale Adjust (R25)	20 turn, accessible behind front lens; ±7.5%, 2.4 %/ct. at full scale
Full Scale Tempco Adjust (R31)	1 turn, factory adjustment only. Adjusts U5 to +2.49 for standard tempco. Further adjusted for reading tempcos < ±0.001%R/°C when LT option is ordered.

1.2.6 Display

Type	14.2 mm (.56") 7-segment LED
Symbols	-1.8.8.8.8
Decimal Points	Four (to the left of the four LSDs)
Overload Indicator	Display flashes
Color	Red filter
Polarity sign	Minus

1.2.7 Digital Signals

OUTPUT	LOGICAL '0'	LOGICAL '1'	I SINK	I SOURCE
DS1-5, BCD1-8	0 - 0.4 V	2.4 - 4.2 V	1.6 mA	1 mA
$\overline{\text{OL}}$	0 - 0.4 V	2.4 - 4.2 V	1.6 mA	0.4 mA
$\overline{\text{STROBE}}$	0 - 0.4 V	2.4 - 4.2 V	1.6 mA	0.4 mA
$\overline{\text{+ POLARITY}}$	0 - 0.4 V	2.4 - 4.2 V	1.6 mA	0.4 mA
$\overline{\text{DATA READY}}$	0 - 0.4 V	2.4 - 4.2 V	1.6 mA	0.4 mA

INPUT	LOGICAL '0'	I SINK	LOGICAL '1'	I SOURCE
$\overline{\text{BLANKING}}$	0.0 - 0.6 V	2.0 mA	OPEN [4]	—
$\overline{\text{HOLD}}$	0.0 - 1.0 V	0.1 mA	2.5 - 5.0 V	10 µA

[4] Not compatible with TTL totem-pole outputs; TTL open-collector devices (or equivalent) must be used to drive the $\overline{\text{BLANKING}}$ input.

1.2.8 DC Power Requirements

Input Voltage	+5 V ±5% (+4.75 to +5.25 V); +5.00 to +5.25 V when used with the PA Option.
Input Current	200 mA ±15% (170 to 230 mA)
Input Power	<1.2 W when display reads -1.8888

1.2.9 General

Operating Temperature	0 to 55°C
Storage Temperature	-40 to 85°C
Humidity	Up to 95% non-condensing at ≤40°C
Weight	145 g (5 oz)
Case Material	94 V-1 UL-Rated Plastic
Case Size	
Bezel (WxHxT)	96 x 26 x 5.1 mm
Depth behind bezel with connector	71 mm
Panel Cutout (WxH)	92.0 x 22.5 mm

2.0 RECEIVING AND INSTALLATION

2.1 UNPACKING AND INSPECTION

Your Model 2520 was fully inspected and tested, then carefully packed before shipment. Unpack the meter carefully and inspect it for obvious damage.

2.2 INITIAL CHECKOUT PROCEDURE

2.2.1 Required Equipment

(1) 5 V dc power source capable of supplying 250 mA.

(2) Calibrated voltage source.

2.2.2 Test Procedure

(1) Connect the input signal as follows:

SIGNAL HI IN Pin 14 and R.

SIGNAL LO IN Pin 13 and P.

(2) Connect the input power as follows:

+5 V dc to Pin J (+5 V dc).

GND to Pin 8 (DIG GND).

(3) Verify that a key is between Pins 8 and 9.

(4) Apply power and check that the meter reads correctly for its specified range.

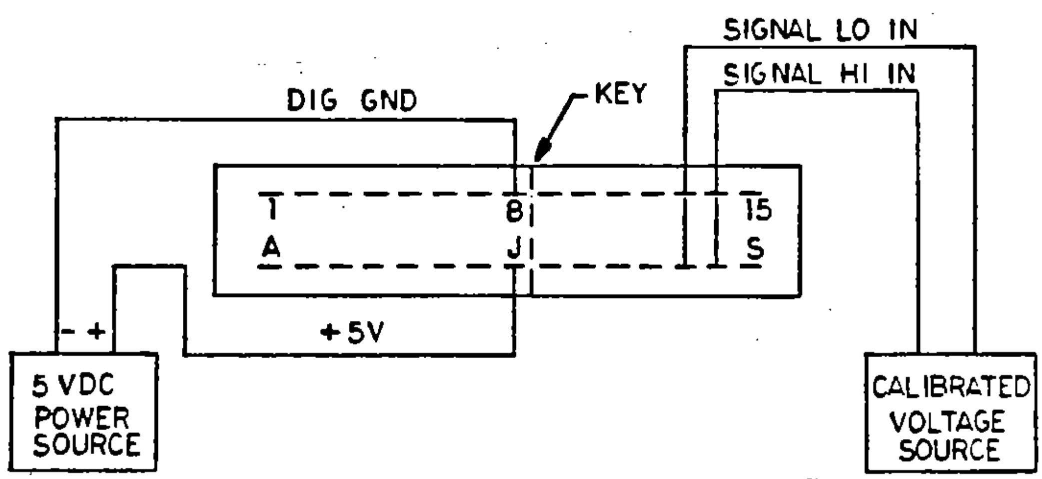


Figure 1

2.3 MECHANICAL INSTRUCTIONS

The drawing number 06296 illustrates the mounting method using the spring clip included with the unit. The unit is inserted from the front of the panel and held in place by the spring clip. The panel thickness may vary from 0.8 mm (.03 inches) to 6.4 mm (.25 inches).

3.0 OPERATING INSTRUCTIONS

3.1 PIN ASSIGNMENTS

PIN	NAME	PIN	NAME
1	BCD1	A	1X.XXX ($\overline{\text{DP2}}$)
2	BCD2	B	1XX.XX ($\overline{\text{DP3}}$)
3	BCD4	C	1XXX.X ($\overline{\text{DP4}}$)
4	BCD8	D	DEC PT RETURN
5	DS5 (10 k)	E	DS3 (100)
6	DS2 (10)	F	DS4 (1 k)
7	$\overline{\text{HOLD}}$ (Run)	H	DS1 (1)
8	DIG GND	J	+5 V (dc Power Input)
9	Spare	K	$\overline{\text{BLANKING}}$
10	OL (over-range)	L	$\overline{\text{DATA RDY}}$ (Busy)
11	Spare	M	+POLARITY
12	Spare	N	$\overline{\text{STROBE}}$
13	ANALOG GND IN	P	SIGNAL LO IN
14	SIGNAL HI IN	R	SIGNAL HI IN
15	1.XXXX ($\overline{\text{DP1}}$)	S	REFERENCE HI IN
	CONNECTOR TYPE		30 Pin SAE SCC15D/1-2 ELCO 00-6007-030-450-012

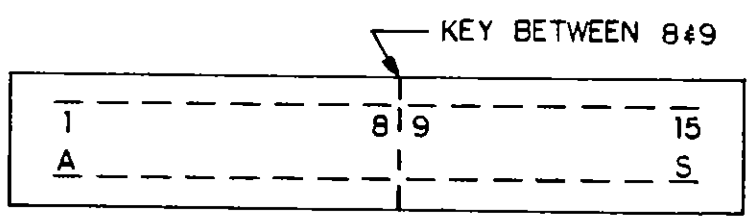


FIGURE 2

Connector pin orientation as viewed from the rear of the meter.

3.2 POWER

3.2.1 Input Voltage

The Model 2520 operates from +5 V dc ±5% (+5.00 V to +5.25 V when used with the PA Option) power. It consumes about 1 watt.

3.3 SIGNAL INPUT

3.3.1 Signal

For best results, shielded, twisted cable should be used for the input signal, with the shield terminated to Analog Ground at the connector.

Analog Ground and Digital Ground are internally connected and should not be connected externally.

If a differential input configuration is used, SIGNAL LO IN is returned to ANALOG GND through an internal parallel RC network, 1 M shunted by 0.1 F. To insure proper operation of the meter in this configuration, the increase in common mode voltage should be limited to ±1 volt.

3.3.2 Range Change

All Model 2520 meters can be converted in the field to ±1.9999 V, ±19.999 V, or ±199.99 V full scale by opening or closing solder switches K, L, and M on the main PCB. See Table I on Assembly Diagram 07873AY-01 for the appropriate solder switch configuration.

3.3.3 Ground Precautions

It is essential that the ground connections to the Model 2520 be proper for accurate readings. The input stage is true differential and analog ground is internally connected to digital ground through a low internal resistance.

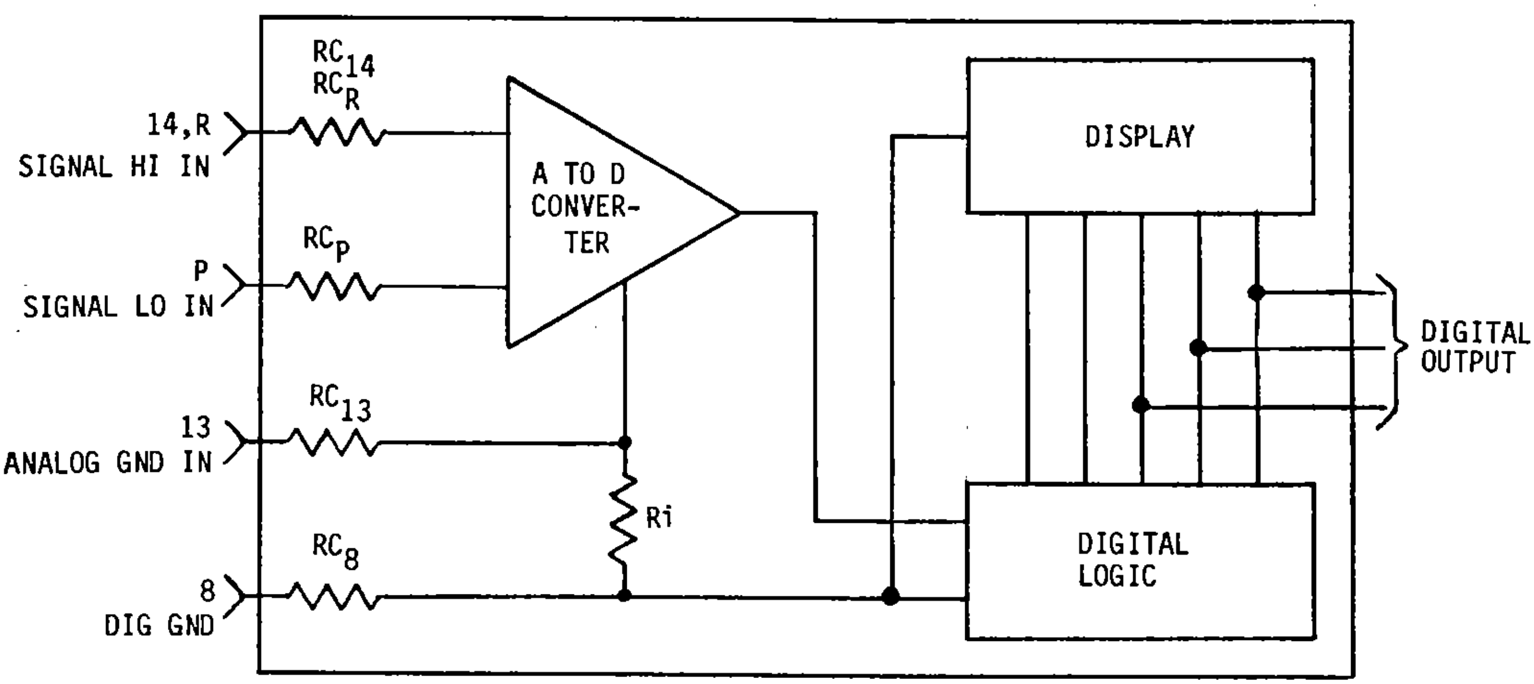


Figure 3

Model 2520 Internal Grounds

The contact resistances resulting from the connection between the connector and the printed circuit board are shown as lumped resistors RC_{14}, RC_R, RC_n, RC_{13}, and RC_8. The internal resistance between the analog and digital grounds is shown as Ri.

CORRECT GROUNDING

The correct grounding method is to connect the low side of the signal to ANALOG GND IN and the common for the digital outputs to DIG GND. This allows the digital current to flow only through RC_8, causing a voltage drop on the digital line only. There will be no voltage drop across RC_{13} or Ri and the meter will read the signal correctly. There will exist a small voltage difference between Pin 13 and Pin 8.

INCORRECT GROUNDING

An improper ground connection is to use a single ground pin for both analog and digital ground. When this is done, the return current for the digital outputs flows through either RC_{13} or RC_8. This causes a voltage drop in series with the input signal and the meter reading will be incorrect. An improper system ground connection for the Model 2520 is to tie the two ground connections together at the source. This creates a ground loop and the voltage drop across RC_8 appears across RC_{13} and Ri simultaneously. This presents an erroneous reading as in the previous case with a single tie point at the connector.

3.4 RATIO

The reference input allows an external voltage to be used as the reference source for conversion. In this mode, the meter reads the ratio of the signal voltage to the reference voltage rather than the true value of the input.

$$\text{Reading in Counts} = \frac{\text{Signal voltage}}{\text{Reference voltage}} \times 10000$$

On the 20 V and 200 V ranges, the reference voltage must be scaled by 1/10 or 1/100 respectively. For the 2 V, 20 V, and 200 V ranges the impedance is 40 k ohms. The reference voltage must be between the limits specified, +.50 V to +3.00 V, and must be positive with respect to signal low.

3.5 DIGITAL SIGNALS

DIGITAL I/O DRIVE REQUIREMENTS

OUTPUT	LOGICAL '0'	LOGICAL '1'	ISINK	ISOURCE
D1-D5, BCD1-8	0-0.4 V	2.4 V-4.2 V	1.6 mA	1 mA
OL	0-0.4 V	2.4 V-4.2 V	1.6 mA	0.4 mA
$\overline{\text{STROBE}}$	0-0.4 V	2.4 V-4.2 V	1.6 mA	0.4 mA
+POLARITY	0-0.4 V	2.4 V-4.2 V	1.6 mA	0.4 mA
$\overline{\text{DATA RDY}}$	0-0.4 V	2.4 V-4.2 V	1.6 mA	0.4 mA

INPUT	LOGICAL "0"	I SOURCE	LOGICAL "1"	I SOURCE
$\overline{\text{BLANKING}}$	0.0V - 0.6V	2.0mA	OPEN (5)	———
$\overline{\text{HOLD}}$	0.0V - 1.0V	0.1mA	2.5V - 5.0V	10uA

(5) Not compatible with TTL totem-pole outputs; TTL open collector devices (or equivalent) must be used to drive the $\overline{\text{BLANKING}}$ input.

3.5.1 Digit Drives (D1-D5)

Each digit drive is a positive going signal that lasts for 200 clock pulses. The scan sequence is D5 (MSD), D4, D3, D2, and D1 (LSD). All five digits are scanned and this scan is continuous unless an over-range occurs. Then all digit drives are blanked from the end of the strobe sequence until the beginning of Reference integrate when D5 will start the scan again. This can give a blinking display as a visual indication of over-range.

3.5.2 BCD (BCD1-8)

The Binary coded Decimal bits BCD8, BCD4, BCD2, and BCD1 are positive true logic signals that serially represent the BCD digit corresponding to each digit drive signal.

3.5.3 OL (over-range Pin 10)

This output goes positive when the input signal exceeds the range (20,000 counts) of the meter. The output flip-flop is set when $\overline{\text{DATA RDY}}$ goes true and is reset at the beginning of Reference Integrate in the next measurement cycle.

3.5.4 $\overline{\text{STROBE}}$ (Pin N)

This is a negative-going output pulse that aids in transferring the BCD data to external latches, UARTs or micro-processors. There are 5 negative-going $\overline{\text{STROBE}}$ pulses that occur in the center of each of the digit drive pulses and occur once and only once for each reading starting 101 pulses after the end of the full measurement cycle. Digit 5 (MSD) goes high at the end of the measurement cycle and stays on for 201 counts. In the center of this digit pulse (to avoid a race condition between changing BCD and digit drive outputs) the first $\overline{\text{STROBE}}$ pulse goes negative for 5 s. Similarly, after digit 5, digit 4 goes high (for 200 clock pulses) and 100 pulses later the $\overline{\text{STROBE}}$ goes negative for the second time. This continues through digit 1 (LSD) when the fifth and last $\overline{\text{STROBE}}$ pulse is sent. The digit drive will continue to scan (unless the previous signal was overrange) but no additional $\overline{\text{STROBE}}$ pulses will be sent until a new measurement is available.

3.5.5 + POLARITY (Pin M)

This pin is positive for a positive input signal. It is valid even for a zero reading. In other words, 0000 means the signal is positive but less than the least significant bit. This output becomes valid at the beginning of reference integrate and remains correct until it becomes valid for the next measurement.

3.5.6 $\overline{\text{DATA READY}}$ (Pin L)

This pin goes high (false) at the beginning of signal integrate and stays high until the first clock pulse after zero-crossing (or after end of measurement in the case of an overrange). The internal latches are enabled (i.e., loaded) during the first clock pulse and are latched at the end of this clock pulse.

3.5.7 $\overline{\text{HOLD}}$ (Pin 7)

When high (or open) the A/D will free-run with equally spaced measurement cycles every 40,002 clock pulses. If taken low, the converter will complete the full measurement cycle and then hold this reading as long as $\overline{\text{HOLD}}$ is low. A positive pulse (greater than 300 ns) will now initiate a new measurement cycle, beginning with between 9,001 and 10,001 counts of auto-zero time. If the pulse terminates before the full measurement cycle (40,002 counts) is complete, it will not be recognized and the converter will simply complete the present measurement. An external indication that a full measurement cycle has been completed is that the first strobe pulse will occur 101 counts after the end of this cycle. Thus, if $\overline{\text{HOLD}}$ is low and has been low for at least 101 counts, the converter is holding and ready to start a new measurement when pulsed high.

3.5.8 $\overline{\text{BLANKING}}$ (Pin K)

The digital display may be blanked by grounding the $\overline{\text{BLANKING}}$ input. The $\overline{\text{BLANKING}}$ input must be open for normal display operation. This input may be driven directly by open-collector TTL logic or by using a series diode with TTL or CMOS logic. The polarity sign and decimal points are not blanked by grounding the $\overline{\text{BLANKING}}$ input but they will flash if the displayed reading exceeds ±19999 counts.

NOTE: The $\overline{\text{BLANKING}}$ input is not compatible with TTL totem-pole outputs: TTL open-collector devices (or equivalent) must be used to drive the $\overline{\text{BLANKING}}$ input.

3.5.9 Decimal Points

Any of the four decimal points to the left of the four least significant digits can be lighted.

Decimal Point	Close Solder Switch	Ground P1 Pin
1.XXXX($\overline{DP1}$)	N	15
1X.XXX($\overline{DP2}$)	P	A
1XX.XX($\overline{DP3}$)	R	B
1XXX.X($\overline{DP4}$)	S	C

Decimal points are lighted by closing the appropriate solder switch or grounding the appropriate pin of P1 (see Table). If a pin is grounded, the grounding device must be capable of sinking 20 mA.

4.0 THEORY OF OPERATION

The Model 2520 Panel Voltmeter uses the dual slope method of conversion. Many state-of-the-art panel meters use dual slope conversion, but the Model 2520 includes automatic zeroing before each reading and does so with a minimum of parts for increased reliability.

At the beginning of a conversion, the voltage across C_{int} is zero. The signal is then applied to the integrator and the voltage across C_{int} rises by the formula:

$$E_{Cint} = E_{sig} \frac{(T1)}{R_{int}C_{int}}$$

At the end of a fixed period of 10000 counts (T1), the counters are reset to 00000. The signal input is turned off and a stable reference voltage of the opposite polarity is now applied to the input. Since the reference voltage is constant, the slope, in volts/sec, during this second period (T2) is constant and independent of input signal levels. The time required to discharge the capacitor back to zero volts is then proportional to the signal voltage.

After the clock is stopped by the capacitor voltage reaching zero, a third period (T3) allows the circuit to auto-zero the integrator and comparator for the next reading.

A low level on the $\overline{HOLD}$ input prevents the reset pulse from starting the counters. The relationship between T1 (signal integrate) and T2 (reference integrate) time can be expressed by the formula:

$$E_{ref}\, T2 = E_{sig}\, T1$$

5.0 ADJUSTMENT AND CALIBRATION

The Model 2520 was calibrated at the factory with a precision voltage source. Frequent calibration is not necessary due to the stability and internal accuracy of the meter. If recalibration is necessary, use the following procedure.

5.1 Plug the Model 2520 to be tested into an appropriate test cable.

5.2 Turn on the power and adjust for 5 V dc ±5%.

5.3 Measure the cathode of U5 (LM336Z) and adjust R31 (10 k - 1 turn) for a reading of +2.490 ±2 mV.

NOTE: This measurement should be made between analog ground at J1-13 and the top lead of R29 (95.3 K 1% MF).

NOTE: If the unit has an LT option or R31 has been sealed with Glyptol (or equivalent), Do Not change the adjustment of R31.

5.4 With the voltage source set to 0 V, verify that the DPM readout indicates 0000 bouncing within 0001 and -0001.

5.5 Adjust the voltage source and verify that a reading of ±0000 is obtainable (no zero standoff). The value of R12 (68 ohms) may be increased (or decreased) to increase (or decrease) zero width.

5.6 Set the voltage source for an output of +1.9000 volts.

5.7 Adjust R25 (100 k, full scale) for a reading of 19000.

5.8 Reverse polarity and note the difference in readings (full scale turnover). Verify that full scale turnover is less than 2 counts.

NOTE: The "apparent turnover" will combine the effects of zero offset and turnover. To determine the DPM's turnover, zero offset must be taken into account.

5.9 Using the voltage source, check linearity at 10, 100, 1000, 9000, 19000, and 19990 counts. Verify that linearity is not worse than 1 count throughout this range in either polarity.

NOTE: This test requires the effects of zero offset and full scale turnover to be taken into account.

5.10 Using the voltage source, observe the DPM readout.

5.10.1 Check all numbers for proper decoding.

5.10.2 Check for Dim/Dead/Bright segments.

5.10.3 Check individual displays for the same relative intensity/illumination.

5.10.4 Check minus polarity sign.

6.0 PREAMPLIFIER OPTION (PA)

6.1 GENERAL

The preamplifier option is contained on a 3.5"x1.8"x.032" upper PCB which is powered and supported by an internal 15-pin interconnect. Inputs to the preamplifier option are made through the main board card-edge connector in a normal fashion. Solder-switches on the main PCB are opened (A-H) and closed (J) to interconnect the preamplifier option.

The configuration array can be divided into four independent sections; coarse-gain, fine-gain, output-offset, and reference. The configuration array jumper positions are silkscreened on the PCB.

The preamplifier may be configured for one of twenty-four coarse-gain ranges; 4-96.4 one of nine fine-gain ranges; 46.3% - 109.4%, one of four offset ranges; -20.9% - +20.9%, and one of two reference modes; internal +2.49 V or external.

The upper/lower limits of the fine-gain ranges and offset ranges are a function of the component tolerances used in the configuration array. The user may have to increase or decrease these ranges one step to accomodate these component tolerances.

6.2 SPECIFICATIONS

6.2.1 Coarse Gain

The preamplifier may be configured for one of twenty-four coarse-gain ranges through the use of shorting jumpers. The jumper positions are silkscreened on the PCB and correspond to coarse gain as follows:

JUMPER	COARSE GAIN (1)
NONE	4
A1-A2	8
B1-B2	12
A1-A2, B1-B2	16
C1-C2	20
A1-A2, C1-C2	24
B1-B2, C1-C2	28
A1-A2, B1-B2, C1-C2	32
D1-D2	36.1
A1-A2, D1-D2	40.1
B1-B2, D1-D2	44.1
A1-A2, B1-B2, D1-D2	48.1
C1-C2, D1-D2	52.1
A1-A2, C1-C2, D1-D2	56.1
B1-B2, C1-C2, D1-D2	60.1
A1-A2, B1-B2, C1-C2, D1-D2	64.1
D2-D3	68.4
A1-A2, D2-D3	72.4
B1-B2, D2-D3	76.4
A1-A2, B1-B2, D2-D3	80.4
C1-C2, D2-D3	84.4
A1-A2, C1-C2, D2-D3	88.4
B1-B2, C1-C2, D2-D3	92.4
A1-A2, B1-B2, C1-C2, D2-D3	96.4

(1) Nominal gain only. Actual gain will depend upon configuration of fine-gain jumpers.

6.2.2 Fine Gain

The preamplifier may be configured for one of nine fine-gain ranges through the use of six shorting jumpers. The fine gain jumper positions are silkscreened on the PCB and correspond to % of coarse gain as follows:

JUMPERS	% COARSE GAIN (2)
A5-A6, A3-B3, A4-B4, B5-C5, C3-C4, D5-D6	94.7% to 109.4%
A4-A5, A6-B6, B3-B4, B5-C5, C3-C4, D5-D6	83.8% to 95.1%
A4-B4, A5-B5, A6-B6, C3-C4, C5-C6, D5-D6	75.2% to 84.1%
A4-A5, A6-B6, B4-B5, C3-C4, C5-D5, C6-D6	68.1% to 75.4%
A4-B4, A6-B6, B5-C5, C3-C4, C6-D6, D4-D5	62.3% to 68.3%
A3-A4, A5-A6, B4-B5, B3-C3, C5-D5, D6-D7	57.3% to 62.4%
A5-A6, A4-B4, B5-B6, B3-C3, C4-C5, D5-D6	53.1% to 57.4%
A3-A4, A5-A6, B3-C3, B4-C4, B5-C5, D5-D6	49.5% to 53.2%
A4-B4, A6-B6, B3-C3, B5-C5, C4-D4, D5-D6	46.3% to 49.6%

(2) Nominal with VRIN = +2.49V. The fine-gain network contains seven 1% MF resistors; upper/lower limits will change with the tolerances of these resistors.

6.2.3 Reference

The preamplifier may be configured for one of two reference modes through the use of a shorting jumper. The jumper position is silkscreened on the PCB.

JUMPER	REFERENCE
B7-C7	Internal +2.49 V
None	External

6.2.4 Output Offset

The output offset voltage is derived from the basic meter's internal +2.49 V reference or the external excitation voltage applied to a pressure cell.

The preamplifier may be configured for one of four offset ranges through the use of four shorting jumpers. The offset jumper positions are silkscreened on the PCB and correspond to % of full scale as follows:

JUMPERS	OFFSET (% OF FULL SCALE) (3)
C9-D9, B8-C8, A7-A8, A9-B9	+8.9% to +20.9%
C9-D9, C8-D8, A8-A9, B8-B9	-1.0% to +10.9%
D8-D9, A8-B8, A9-B9, C8-C9	-10.9% to +1.0%
D8-D9, B8-C8, A8-A9, B9-C9	-20.9% to -8.9%

(3) Nominal. The offset network contains eight 1% MF resistors and one op-amp; upper/lower limits will change with the tolerances of these components.

6.2.5 Temperature Coefficient

Zero	$\pm(0.25\ \text{uVRTI} + \frac{\text{Ecm}-0.5\ \text{V}}{2.0\ \text{V}} \times 10\ \text{uVRTO})/\text{K}$ typical
Full Scale	.003% R/^{o}C typical, .005% R/^{o}C max.
Warmup Time	30 minutes

6.2.6 Input Characteristics

Type	True Differential
Input Bias Current	10 nA typical, 20 nA max.
Input Offset Current	0.1 nA typical, 1 nA max.
Input Offset Voltage	Adjustable from -0.6 mV to +0.6 mV.
CMV, Analog Gnd to Signal Low	-1 to + 2.5 V.
CMR, Analog Gnd to Signals	(coarse gain) x 1000 min.
NMR, 50/60 Hz	60 dB min.
Settling Time	2 seconds (Basic Model 2520 specification predominates).
Ratio Measurement	3-wire.

6.2.7 Output Characteristics

Output Swing	±2.75 V

6.2.8 Calibration Controls

Fine Gain Adjust

20 turn, accessible behind front lens. See 6.2.2 for fine gain ranges.

Output Offset Adjust

20 turn, accessible behind front lens, approximately 11.7% of full scale range or 3^{o}/count. See 6.2.4 for offset ranges.

Tempco Balance Adjust

1 turn, factory adjustment only.

Full Scale Tempco Adjust

1 turn, factory adjustment only.

Input Zero Adjust

20 turn, accessible behind front lens.

6.2.9 Power Requirements

Input Voltage	+5 V ±5% (+4.75 V to +5.25 V) and -5.1 ±5% (-4.85 V to -5.36 V); supplied by 2520.
Input Current	10 mA (Typ)

6.3 PIN ASSIGNMENTS (P2)

PIN	NAME (Function)
1	DIG GND
2	+5 V (customer supplied)
3	ANGND (Analog ground)
4	A (Main board Potentiometer R25-3/CW)
5	B (Main board Potentiometer R25-2/slider)
6	C (Main board Potentiometer R25-1/CCW)
7	-5.1 V
8	ANGOUT (Analog ground out)
9	ANGIN (Analog ground input)
10	SLOUT (Signal low output from preamp)
11	SLIN (Signal low input to preamp)
12	SHOUT (Signal high output from preamp)
13	SHIN (Signal high input to preamp)
14	VROUT (Reference output of fine gain network)
15	VRIN (Nominal +2.490 V reference from main PCB)

6.4 ENVIRONMENTAL

Operating Temperature	0^oC to 55^oC
Storage Temperature	-40^oC to 85^oC
Humidity	up to 95% non-condensing at 40^oC

6.5 FS PROCEDURE

6.5.1 Determine the lowest input voltage, E1, which is specified by the customer.

E1 = ________ mV

6.5.2 Determine the highest input voltage, E2, which is specified by the customer.

E2 = ________ mV

6.5.3 Determine the lowest reading, N1, at input voltage E1, which is specified by the customer.

N1 = ________ counts

6.5.4 Determine the highest reading, N2, at input voltage E2, which is specified by the customer.

N2 = ________ counts

6.5.5 Calculate the value of offset voltage E0 in mV. (The value of E0 is an RTI equivalent only. It has to be multiplied by the coarse-gain to determine the nominal offset voltage in mV at SLOUT, P2 Pin 10)

$$\frac{(N2xE1) - (N1xE2)}{N2-N1}$$

E0 = ____________ mV.

6.5.6 Using the value of E0 calculated in step 6.5.5, calculate percent offset.

$$\% = \frac{E0xN2}{(E0-E2)x200}$$

% offset = __________

6.5.7 Using the percent of offset calculated in step 6.5.6, determine the offset range (% of full scale) from the table in step 6.2.4:

% offset range = ________________

6.5.8 Calculate the required preamplifier gain.

$$\text{Gain} = \frac{N2-N1}{(E2-E1)x10}$$

Preamplifier gain = ____________

6.5.9 Using the preamplifier gain calculated in step 6.5.8, determine the required coarse-gain from the following table:

Jumper	Coarse Gain	Gain Range 46.3% to 109.4% of Coarse Gain
None	4	1.85 TO 4.38
A1-A2	8	3.70 TO 8.75
B1-B2	12	5.56 TO 13.1
A1-A2, B1-B2	16	7.41 TO 17.5
C1-C2	20	9.26 TO 21.9
A1-A2, C1,C2	24	11.1 TO 26.3
B1-B2, C1-C2	28	13.0 TO 30.6
A1-A2, B1-B2, C1-C2	32	14.8 TO 35.0
D1-D2	36.1	16.7 TO 39.5
A1-A2, D1-D2	40.1	18.6 TO 43.9
B1-B2, D1-D2	44.1	20.4 TO 48.2
A1-A2, B1-B2, D1-D2	48.1	22.3 TO 52.6
C1-C2, D1-D2	52.1	24.1 TO 57.0
A1-A2, C1-C2, D1-D2	56.1	26.0 TO 61.4
B1-B2, C1-C2, D1-D2	60.1	27.8 TO 65.7
A1-A2, B1-B2, C1-C2, D1-D2	64.1	29.7 TO 70.1
D2-D3	68.4	31.7 TO 74.8
A1-A2,D2-D3	72.4	33.5 TO 79.2
B1-B2, D2-D3	76.4	35.4 TO 83.6
A1-A2, B1-B2, D2-D3	80.4	37.2 TO 88.0
C1-C2, D2-D3	84.4	39.1 TO 92.3
A1-A2, C1-C2, D2-D3	88.4	40.9 TO 96.7
B1-B2, C1-C2, D2-D3	92.4	42.8 TO 101
A1-A2, B1-B2, C1-C2, D2-D3	96.4	44.6 TO 105

Coarse-gain = ____________

The DC input voltage to the 2520 must be in the range of +4.75 to +5.25 for the PA option to meet its rated accuracy (measured at the connector). The output swing at +4.75 V $\geq$ ±2.75 V. E1 x coarse - gain <u>or</u> E2 x coarse - gain $\geq$ ±2.75 V.

6.5.10 Calculate the percent of coarse-gain.

$$\% = \frac{\text{Preamplifier Gain (step 6.5.8)}}{\text{Coarse-gain (step 6.5.9)}} \times 100$$

% = Coarse-gain = ____________________

6.5.11 The preamplifier may be configured for one of two reference modes through the use of a shorting jumper. Use the following table to determine the configuration of the reference.

JUMPER	REFERENCE
B7-C7	Internal +2.49 V
NONE	External

Reference = ______________

6.5.12 To use the preamplifier in the internal reference mode, use the percent of coarse-gain calculated in Step 6.5.10 to determine the required fine-gain range from the table in step 6.2.2.

Fine gain range = ________________

6.5.13 To use the preamplifier in the external reference mode, open solder-switch "J" on the 2520 main PCB and connect the external reference to P1-S.

The external reference voltage is dependent upon the configuration of the fine-gain jumpers. The range of external reference voltage can be determined from the following equations:

Upper Limit of External Reference Voltage =

$$+\frac{1}{\%\ \text{Coarse-Gain (step 6.5.10)} \times 0.00185}\ \text{volts}$$

Lower Limit of External Reference Voltage =

$$+\frac{1}{\%\text{Coarse-Gain (Step 6.5.10)} \times 0.0043}\ \text{volts}$$

The required range of the External reference voltage is

+ ___________ volts to + ___________ volts.

Desired external reference voltage = + ___________.

Find the external reference attenuation factor determined by the following formula:

$$\text{Attn Factor} = \frac{100}{\%\text{Coarse-Gain (Step 6.5.10)} \times \text{External Reference Voltage}}$$

Determine the fine-gain range from the following table, matching the calculated attenuation factor with the range given in the table:

JUMPERS	% COARSE-GAIN	ATTN FACTOR RANGE
A5-A6, A3-B3, A4-B4, B5-C5, C3-C4, D5-D6	94.7% to 109.4%	0.1850-0.2118
A4-A5, A6-B6, B3-B4, B5-C5, C3-C4, D5-D6	83.8% to 95.1%	0.2118-0.2394
A4-B4, A5-B5, A6-B6, C3-C4, C5-C6, D5-D6	75.2% to 84.1%	0.2394-0.2670
A4-A5, A6-B6, B4-B5, C3-C4, C5-D5, C6-D6	68.1% to 75.4%	0.2670-0.2946
A4-B4, A6-B6, B5-C5, C3-C4, C6-D6, D4-D5	62.3% to 68.3%	0.2946-0.3225
A3-A4, A5-A6, B4-B5, B3-C3, C5-D5, D6-D7	57.3% to 62.4%	0.3225-0.3504
A5-A6, A4-B4, B5-B6, B3-C3, C4-C5, D5-D6	53.1% to 57.4%	0.3504-0.3780
A3-A4, A5-A6, B3-C3, B4-C4, B5-C5, D5-D6	49.5% to 53.2%	0.3780-0.4057
A4-B4, A6-B6, B3-C3, B5-C5, C4-D4, D5-D6	46.3% to 49.6%	0.4057-0.4300

Fine-gain range = ___________.

> A BASIC computer program for configuring the 2520 PA Preamplifier Option is available from the factory upon request.

7.0 PARALLEL BCD OPTION (F2M)

7.1 GENERAL

The parallel BCD option is contained on a 3.5" x 1.8" x .062" upper PCB which is powered and supported by a 15-pin interconnect P3.

Serial BCD inputs from the main board's ICL7135CPI A/D converter are made through the 15-pin interconnect P3.

A 30-pin card-edge connector J2 is required for the BCD outputs.

7.2 SPECIFICATIONS

7.2.1 Digital Signals

DESCRIPTION	LOGICAL '0'	LOGICAL '1'	ISINK	ISOURCE	IN	OUT
Parallel BCD (1)	0 V-.4 V	2.4 V-5.0 V	12 mA	2.6 mA		X
+POLARITY (1)	0 V-.4 V	2.4 V-5.0 V	12 mA	2.6 mA		X
OVERLOAD (1)	0 V-.4 V	2.4 V-5.0 V	12 mA	2.6 mA		X
$\overline{\text{DATA RDY}}$ (2)	0 V-.4 V	2.4 V-5.0 V	8 mA	2.6 mA		X
INSTRUMENT SELECT	0 V-.6 V	2.0 V-5.0 V	1.3 mA	.04 mA	X	
MODE (2)	0 V-.4 V	2.4 V-5.0 V	8 mA	2.6 mA		X

(1) I_o (OFF) Off-State (HI-Z state) Output Current = 40 uA max.
(2) I_o (OFF) Off-State (HI-Z state) Output Current = 20 uA max.

Parallel BCD

The data outputs are parallel BCD, TTL, and DTL compatible. The outputs are stable and valid while $\overline{\text{DATA RDY}}$ (Pin U13) is low true. The data outputs are Three-State buffered.

+POLARITY (Pin L1)

The +POLARITY output is a logical '1' when the meter indicates a positive reading. It is stable while $\overline{\text{DATA RDY}}$ is low true, and is Three-State buffered.

OL (BCD 20K - Pin U2)

The OL output will go to a logical '1' if the display is greater than ±19999. It is stable while $\overline{\text{DATA RDY}}$ is low true and is Three-State buffered.

$\overline{\text{DATA RDY}}$ (Pin U13)

The $\overline{\text{DATA RDY}}$ output signal remains high for a period of 8 mS during the transfer of data into the output latches. There is a 5 usec overlap on both leading and trailing edges of $\overline{\text{DATA RDY}}$ before and after new data is updated. Therefore, both edges may be used to transfer data. This output is Three-State buffered.

Instrument Select/Board Enable

A 4-bit address decoder allows the user to enable the instrument's parallel BCD data output with a 4-bit binary address ($\overline{\text{ISB1}}$ through $\overline{\text{ISB8}}$) for Three-State data-bussing applications. The user may program the instrument with any one of sixteen 4-bit address codes by solder switches. In this mode of operation, solder switch 'F' is closed while 'E' is left open.(If solder switch 'F' is closed, new BCD data is not latched when the board is enabled; solder switch 'E' has the opposite effect).

Mode

The MODE outputs B1 and B2 form a 2-bit word that indicates the unit is configured as parallel BCD data (00). This 2-bit word is factory set and not user-selectable.

7.3 PIN ASSIGNMENTS

7.3.1 J2 Pin Assignments

> **CAUTION**
>
> The following pin assignments are pin locations only. UX and LX identify upper and lower rows as viewed from the rear of the instrument. Pin numbering sequences are Manufacturer dependent and must be reconciled with the following pin locations.

LOCATION	NAME	LOCATION	NAME
L1	+POLARITY	U1	BCD 10 K
L2	BCD 40 K	U2	OL (BCD 20 K)
L3	BCD 2 K	U3	BCD 1 K
L4	BCD 8 K	U4	BCD 4 K
L5	BCD 200	U5	BCD 100
L6	BCD 800	U6	BCD 400
L7	BCD 20	U7	BCD 10
L8	BCD 80	U8	BCD 40
L9	BCD 2	U9	BCD 1
L10	BCD 8	U10	BCD 4
L11	E1 DIG GND	U11	DIG GND
L12	BCD 80 K	U12	MODE B1
L13	MODE B2	U13	$\overline{\text{DATA RDY}}$
L14	$\overline{\text{ISB2}}$ ($\overline{2}$ Bit Address Input)	U14	$\overline{\text{ISB1}}$ ($\overline{1}$ Bit Address Input)
L15	$\overline{\text{ISB8}}$ ($\overline{8}$ Bit Address Input)	U15	$\overline{\text{ISB4}}$ ($\overline{4}$ Bit Address Input)

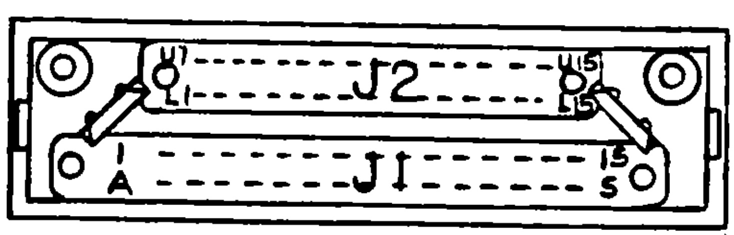


FIGURE 4. Connector Pin Orientation as Viewed From The Rear of The Instrument.

7.3.2 Connector J2

The following chart should serve as a guide when wiring J2. Since pin numbering sequences are Manufacturer dependent and must be reconciled with NEI pin locations, the following chart may be used to make this conversion.

P2 LOCATION	J2 PIN	NAME
U1		BCD 10 K
U2		OL (BCD 20 K)
U3		BCD 1 K
U4		BCD 4 K
U5		BCD 100
U6		BCD 400
U7		BCD 10
U8		BCD 40
U9		BCD 1
U10		BCD 4
U11		DIG GND
U12		MODE B1
U13		$\overline{\text{DATA RDY}}$
U14		$\overline{\text{ISB1}}$ ($\overline{1}$ Bit Address Input)
U15		$\overline{\text{ISB4}}$ ($\overline{4}$ Bit Address Input)
L1		+ POLARITY
L2		BCD 40 K
L3		BCD 2 K
L4		BCD 8 K
L5		BCD 200
L6		BCD 800
L7		BCD 20
L8		BCD 80
L9		BCD 2
L10		BCD 8
L11		E1 DIG GND
L12		BCD 80 K
L13		MODE B2
L14		$\overline{\text{ISB2}}$ ($\overline{2}$ Bit Address Input)
L15		$\overline{\text{ISB8}}$ ($\overline{8}$ Bit Address Input)

7.3.3 P3 (Internal) Pin Assignments

PIN	NAME
1	B1
2	B2
3	B4
4	B8
5	D5
6	D4
7	D3
8	D2
9	D1
10	OVER-RANGE
11	$\overline{\text{STROBE}}$
12	+POLARITY
13	E1 (Spare)
14	+5 V
15	DIG GND

7.4 POWER REQUIREMENTS

Input Voltage	5 V dc ±5%
Input Current	120 mA
Input Power	.6 Watts

7.5 ENVIRONMENTAL

Operating Temperature	0°C to 55°C
Storage Temperature	-40°C to 85°C
Humidity	Up to 95% noncondensing at $\leq$40°C

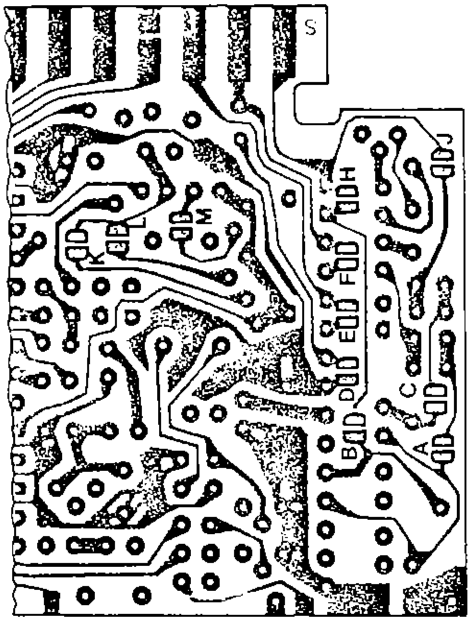


TABLE I - RANGE CHANGE

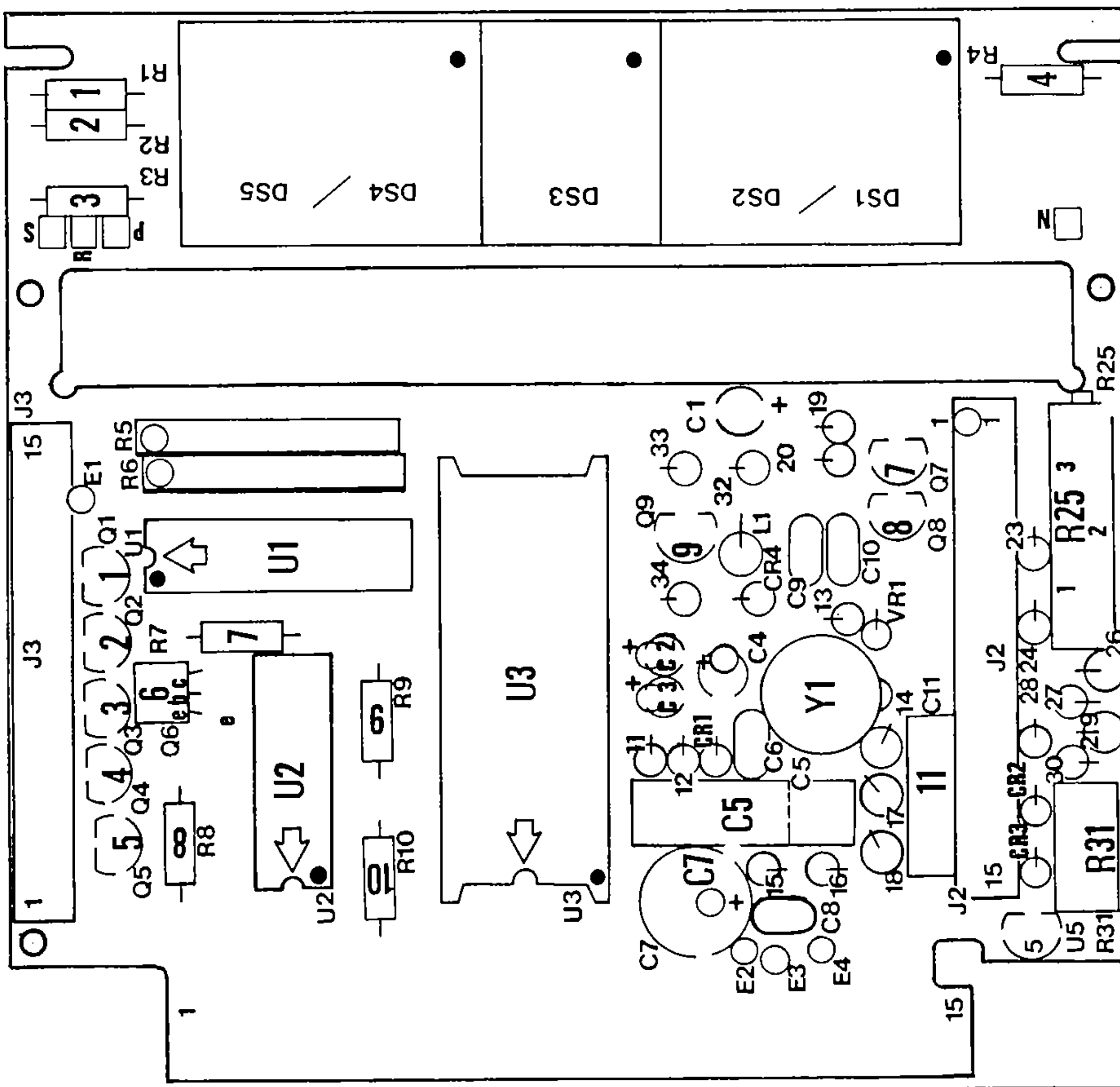
MODEL	RANGE	K	L	M
2520-3	2V	OPEN	OPEN	CLOSED
2520-4	20V	OPEN	CLOSED	OPEN
2520-5	200V	CLOSED	OPEN	OPEN

TABLE II - FIXED DECIMAL OPTION

	N	P	R	S
I.XXXX (DP1)	CLOSED	OPEN	OPEN	OPEN
IY.XXX (DP2)	OPEN	CLOSED	OPEN	OPEN
IXX.XX (DP3)	OPEN	OPEN	CLOSED	OPEN
IXXX.X (DP4)	OPEN	OPEN	OPEN	CLOSED

= OPEN
= CLOSED

DWG. NO. 07873AY-01 C



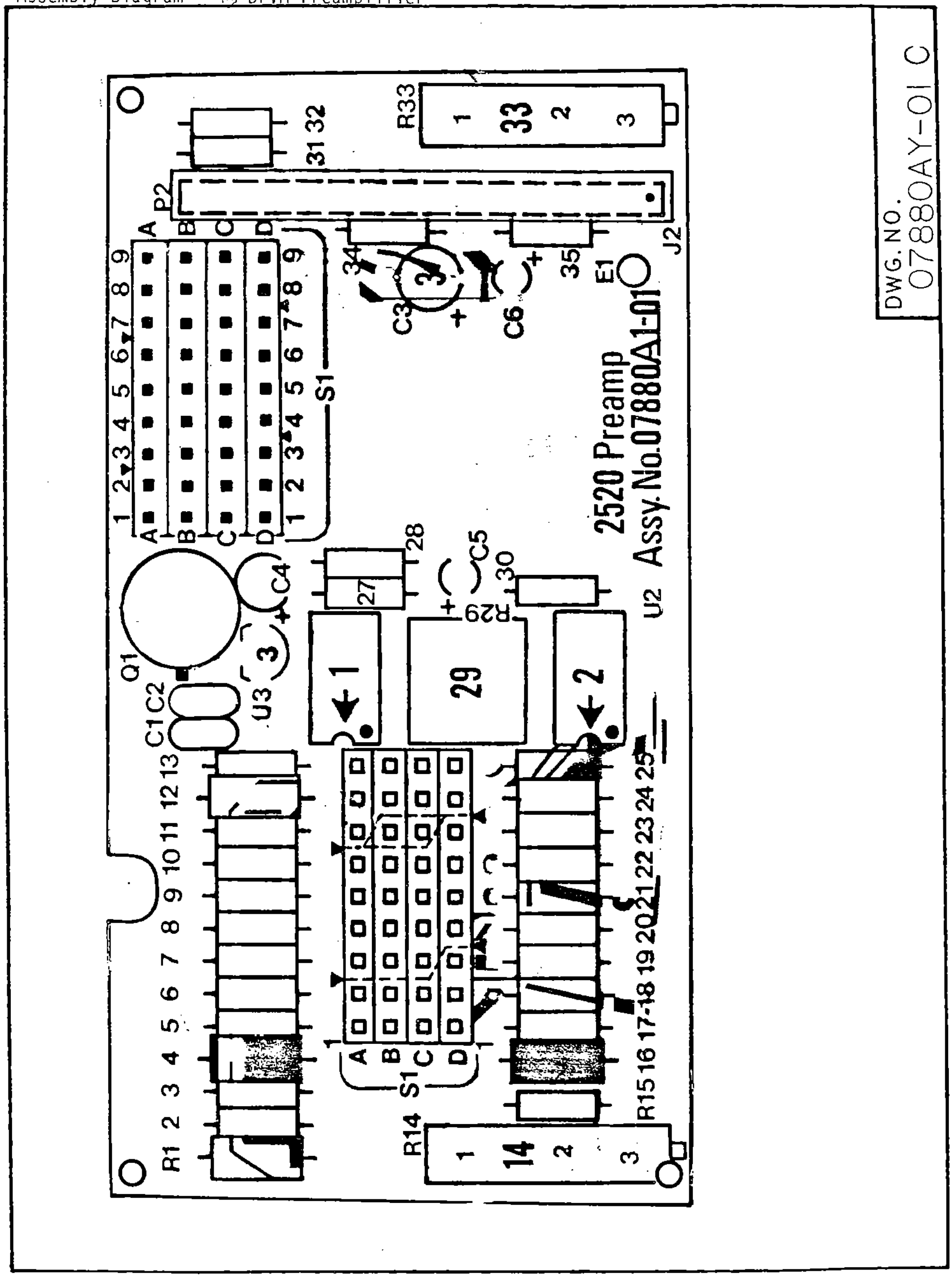
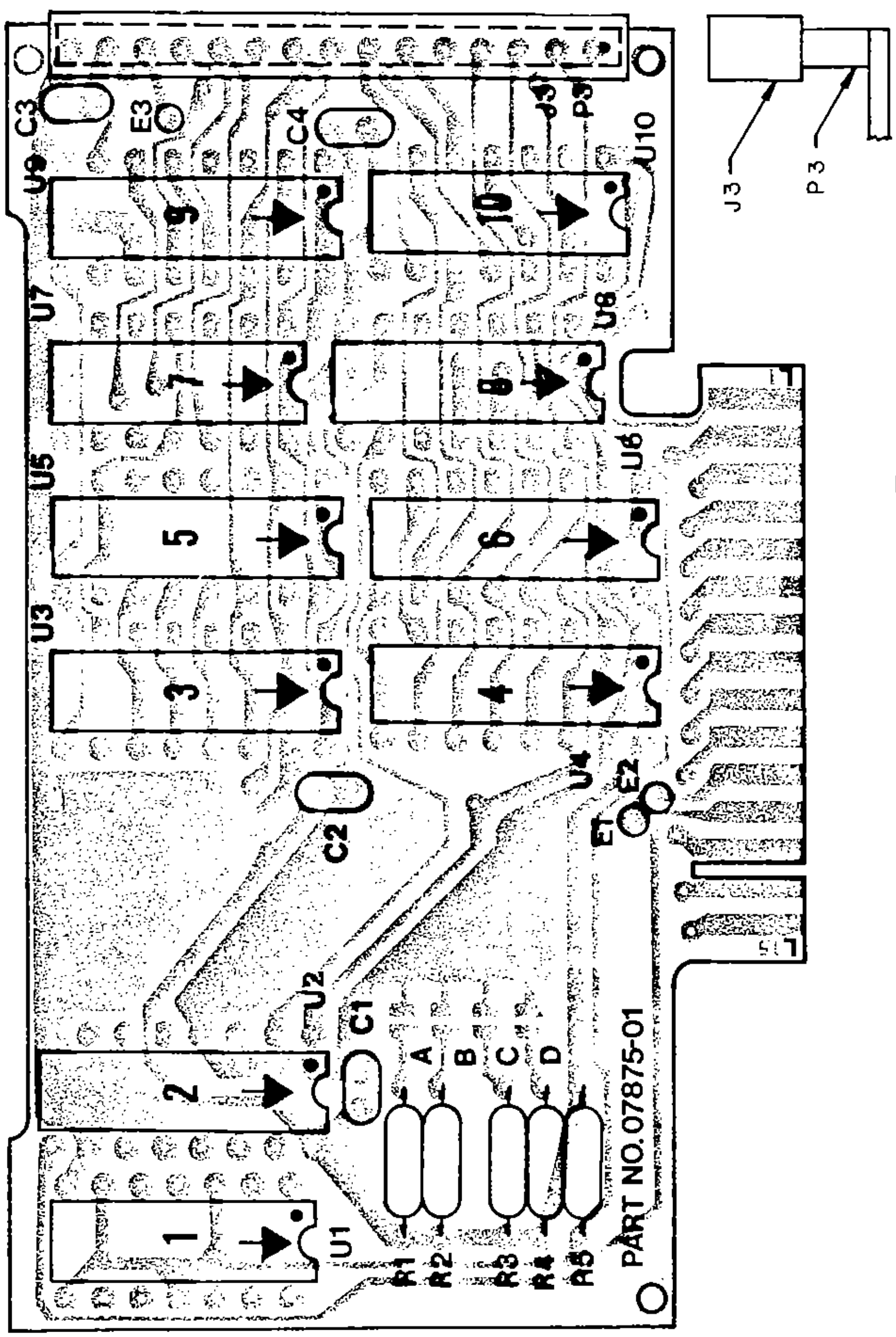

2520 Preamp
Assy.No.07880A1-01
DWG. NO.
07880AY-01 C

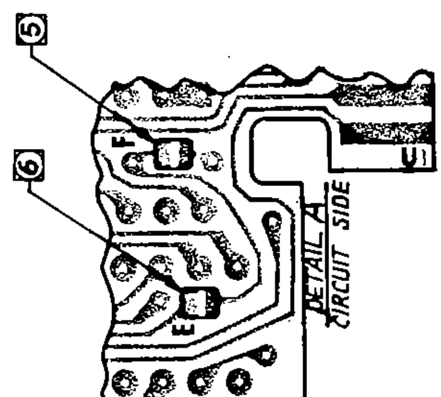
TABLE I [7]

ADDRESS	SOLDER SWITCH A	SOLDER SWITCH B	SOLDER SWITCH C	SOLDER SWITCH D
15	OPEN	OPEN	OPEN	OPEN
14	CLOSED	OPEN	OPEN	OPEN
13	OPEN	CLOSED	OPEN	OPEN
12	CLOSED	CLOSED	OPEN	OPEN
11	OPEN	OPEN	CLOSED	OPEN
10	CLOSED	OPEN	CLOSED	OPEN
9	OPEN	CLOSED	CLOSED	OPEN
8	CLOSED	CLOSED	CLOSED	OPEN
7	OPEN	OPEN	OPEN	CLOSED
6	CLOSED	OPEN	OPEN	CLOSED
5	OPEN	CLOSED	OPEN	CLOSED
4	CLOSED	CLOSED	OPEN	CLOSED
3	OPEN	OPEN	CLOSED	CLOSED
2	CLOSED	OPEN	CLOSED	CLOSED
1	OPEN	CLOSED	CLOSED	CLOSED
0	CLOSED	CLOSED	CLOSED	CLOSED

(open symbol) = OPEN (closed symbol) = CLOSED

DWG. NO. 07875-00 C

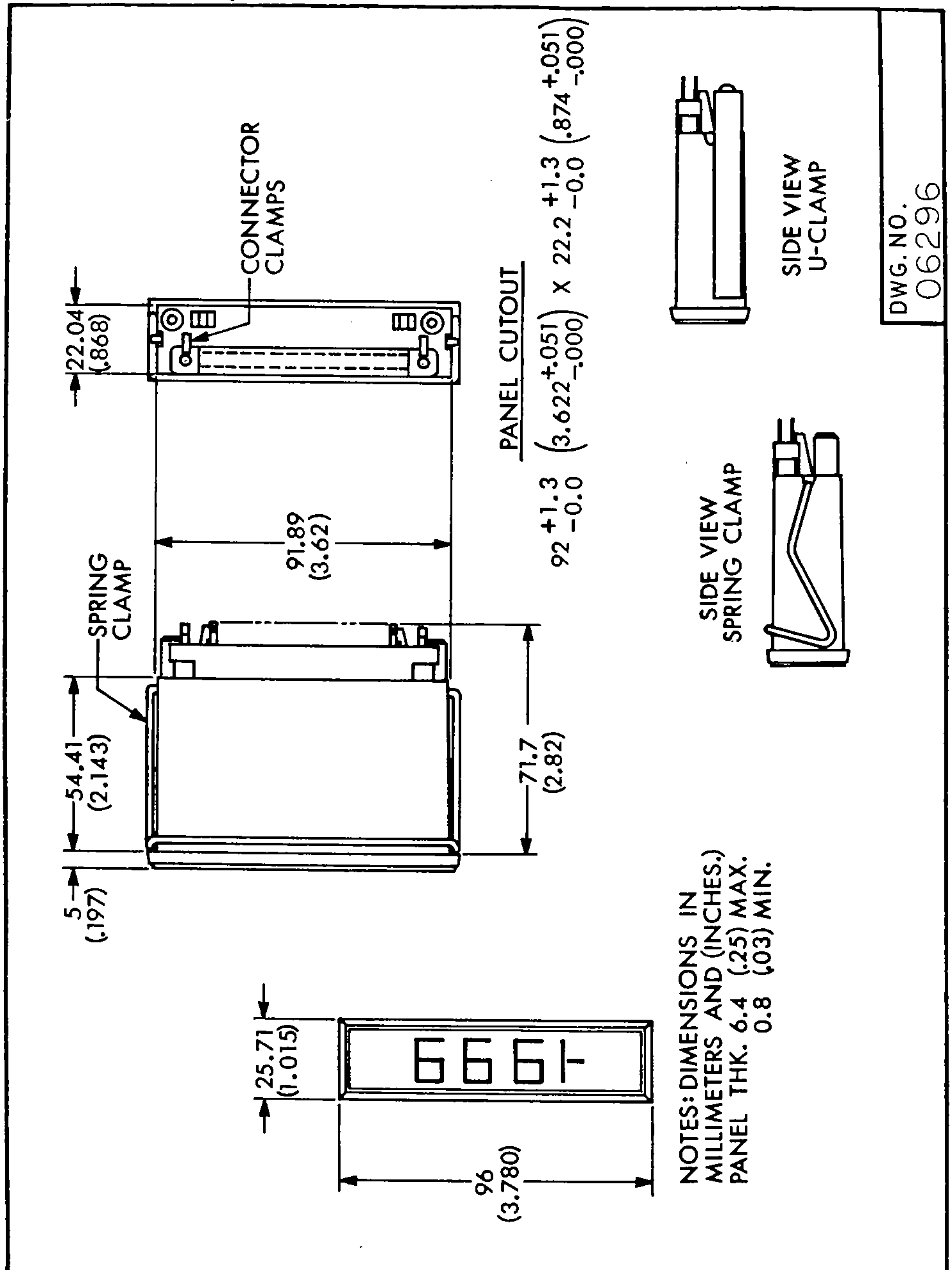




[7] CUSTOMER PROGRAMMED ADDRESS OPTION-SEE TABLE I.

[6] SOLDER SWITCH 'E' WILL ALLOW CONTINUED UPDATING IF BOARD IS ENABLED.

[5] SOLDER SWITCH 'F' WILL PREVENT NEW BCD DATA FROM GETTING LATCHED IF BOARD IS ENABLED


CONNECTOR CLAMPS
22.04 (.868)
SPRING CLAMP
91.89 (3.62)
54.41 (2.143)
71.7 (2.82)
5 (.197)
PANEL CUTOUT
92 +1.3 -0.0 (3.622 +.051 -.000) X 22.2 +1.3 -0.0 (.874 +.051 -.000)
SIDE VIEW U-CLAMP
SIDE VIEW SPRING CLAMP
DWG. NO. 06296
25.71 (1.015)
96 (3.780)
NOTES: DIMENSIONS IN MILLIMETERS AND (INCHES.)
PANEL THK. 6.4 (.25) MAX.
0.8 (.03) MIN.

Warranty/Disclaimer

NEWPORT ELECTRONICS, INC. warrants this unit to be free of defects in materials and workmanship for a period of one (1) year from date of purchase. In addition to NEWPORT's standard warranty period, NEWPORT ELECTRONICS will extend the warranty period for one (1) additional year if the warranty card enclosed with each instrument is returned to NEWPORT.

If the unit should malfunction, it must be returned to the factory for evaluation. NEWPORT's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by NEWPORT, if the unit is found to be defective it will be repaired or replaced at no charge. NEWPORT's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. 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 corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of NEWPORT's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

NEWPORT is pleased to offer suggestions on the use of its various products. However, NEWPORT neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by NEWPORT, either verbal or written. NEWPORT warrants only that the parts manufactured by it will be as specified and free of defects. NEWPORT MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and the total liability of NEWPORT with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall NEWPORT be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by NEWPORT is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, NEWPORT assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and additionally, purchaser will indemnify NEWPORT and hold NEWPORT harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

Return Requests/Inquiries

Direct all warranty and repair requests/inquiries to the NEWPORT Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO NEWPORT, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM NEWPORT'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting NEWPORT:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult NEWPORT for current repair charges. Have the following information available BEFORE contacting NEWPORT:

1. P.O. number to cover the COST of the repair,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

NEWPORT's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

NEWPORT is a registered trademark of NEWPORT ELECTRONICS, INC.

© Copyright 2005 NEWPORT ELECTRONICS, INC. All rights reserved. This document may not be copied, photocopied, reproduced, translated, or reduced to any electronic medium or machine-readable form, in whole or in part, without prior written consent of NEWPORT ELECTRONICS, INC.

For immediate technical or application assistance please call:

1-800-6397678®
1-800-NEWPORT

Newport Electronics, Inc.
2229 South Yale Street • Santa Ana, CA • 92704 • U.S.A.
TEL: (714) 540-4914 • FAX: (203) 968-7311
Toll Free: 1-800-639-7678 • www.newportUS.com • e-mail:info@newportUS.com
ISO 9001 Certified

Newport Technologies, Inc.
976 Bergar • Laval (Quebec) • H7L 5A1 • Canada
TEL: (514) 335-3183 • FAX: (514) 856-6886
Toll Free: 1-800-639-7678 • www.newport.ca • e-mail:info@newport.ca

Newport Electronics, Ltd.
One Omega Drive • River Bend Technology Centre
Northbank, Irlam • Manchester M44 5BD • United Kingdom
Tel: +44 161 777 6611 • FAX: +44 161 777 6622
Toll Free: 0800 488 488 • www.newportuk.co.uk • e-mail:sales@newportuk.co.uk

Newport Electronics B.V.
Postbus 8034 • 1180 LA Amstelveen • The Netherlands
TEL: +31 20 3472121 • FAX: +31 20 6434643
Toll Free: 0800 0993344 • www.newport.nl • e-mail: info@newport.nl

Newport Electronics spol s.r.o.
Frystatska 184, 733 01 Karviná • Czech Republic
TEL: +420 59 6311899 • FAX: +420 59 6311114
Toll Free: 0800-1-66342 • www.newport.cz • e-mail: info@newport.cz

Newport Electronics GmbH
Daimlerstrasse 26 • D-75392 Deckenpfronn • Germany
TEL: 49 7056 9398-0 • FAX: 49 7056 9398-29
Toll Free: 0800 / 6397678 • www.newport.de • e-mail: sales@newport.de

Newport Electronique S.A.R.L.
11, rue Jacques Cartier • 78280 Guyancourt • France
TEL: +33 1 61 37 29 00 • FAX: +33 1 30 57 54 27
Toll Free: 0800 466 342 • www.newport.fr • e-mail: sales@newport.fr

Mexico and Latin America
FAX: 001 (203) 359-7807
En Español: 001 (203) 359-7803

NEWPORTnet℠ On-Line Service	Internet e-mail
www.newportUS.com	info@newportUS.com

NEWPORT Electronics, Inc.

0805 07894ML-02 N