Made in USA

Y2K
Year 2000
Compliant

269
DIGITAL PYROMETER

10151ML-02

This device is marked with the international hazard 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.

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.

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D	9328	28 MAY 98	ML	

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ILLUSTRATIONS

1.0 GENERAL INFORMATION

1.1 DESCRIPTION

The Newport Model 269 is an accurate, low-cost, reliable, linearizing thermocouple (T/C) meter with a display range of -1999 to 9999. It can be switched to display linearized T/C junction temperature for types K, E, T, R, S, J or DIN J with exceptional cold-junction compensation over a wide ambient range. A proprietary linearization technique enables close conformity to the DIN and IPTS-68-based tables.

When switched to read millivolts, the 269 can read from -19.99 to 80.00 mV. This feature assists accurate temperature calibration. The basic meter is contained on a single PC card mounted in the standard Newport 1/8 DIN plastic case with dual 3-screw barrier strips, one for power and the other for T/C input with self-contained cold-junction compensation detector.

Selection of T/C type, mV, °F/°C or cold-junction temperature output is obtained by means of a simple jumper/pin array behind the lens. This allows the user to select the millivolt range, Celsius or Fahrenheit display of the output of any one of the seven T/C types, or the cold-junction temperature value. The front panel design permits the optional upper board to have a pushbutton/LED/potentiometer combination in either or both corners. A 14-lead soldered jumper strip can be used with the basic meter to supply an optional upper board with isolated AC power, ground, +5V, digital I/O, and input signal type selector lines.

The 269 digital output is a 1200-baud, isolated serial bit stream. The companion pair of input lines are display data input serial stream and the (not) BUFFER FULL. When the serial out is switched or tied to the serial in, the display and serial data is unfiltered; when no input is made the data is filtered; when the input is grounded the display is held and the output data is unfiltered.

Standard power for the 269 is 50/60/400 Hz, 120/240 V ac +10%/-15%. Options are nonisolated 5 V dc (C3A), isolated 9-32 V dc (C3B), and isolated 26-56 V dc (C3D).

1.2 THEORY OF OPERATION

Model 269 utilizes hybrid dual-slope conversion and MICROCURVE (tm) linearization to provide excellent noise rejection and accuracy. A single-chip microcomputer performs the linearization, cold-junction compensation, display, input/output management, and conversion control.

The 269 combines the filtering of dual-slope integration with the precision of digital zero correction. During each measurement cycle, the integrated ground reference is digitally subtracted from the integrated input signal, eliminating the tracking errors and closed-loop stability limitations of analog compensation. The accuracy of the digital ground value is preserved by integrating a new value for each signal measurement.

A simple jumper/pin array, behind the lens, is used to alter the meter operation. The meter configuration can be changed during operation.

For NBS thermocouples, the 269 is calibrated to the International Practical Temperature Scale, IPTS-68, as published in NBS Monograph 125 issued March 1974 or ASTM E230-72 or ASA C96.2-1973, For the DIN J T/C, the 269 is calibrated to DIN 43710, Sept. 1977.

2.0 SPECIFICATIONS

2.1 INPUT

Thermocouple Type	Conformity Error °C ±1/2 LSD	Range °C		Range °F	
J	0.1	-210	+ 760	-346	+1400
K	0.1	-205	+1372	-337	+2502
E	0.2	-205	+1000	-337	+1832
T	0.1	-199.9	+ 400.0	-199.9	+ 752.0
R	0.5	- 50	+1741	- 58	+3166
S	0.5	- 50	+1767	- 58	+3213
DIN J	0.3	-200	+ 775		

Voltage Range: -19.99 to +80.00 mV
Cold-junction Temperature Range: -40 to +125 °C
Conformity error: 0.03 °C
±1/2 LSD

Conversion Technique

Separate, µC-controlled dual-slope conversions of CJ (cold-junction) voltage and T/C voltage. The CJ measurement is taken first and used as the starting point for the T/C measurement. Linearization is done by the µC.

Analog Filtering:

Single-Pole, Low-Pass T = 0.33 S (33K x 10 µfd)

Digital Filtering: AVE(N+1) = (7/8) AVE(N) + (1/8)SIG(N)

NMR at 50/60 Hz: 60 dB
CMR at 250 Ω Imbalance: 120 dB, AC Power to Signal Low

Lead Resistance: 250 Ω max for rated T/C meter accuracy

Range Limits

Thermocouple Type	Range Limits °C		°F	
J	-210	+ 763	-346	+1405
K	-240	+1378	-400	+2513
E	-240	+1001	-400	+1833
T	-199.9	+ 402.4	-199.9	+ 756.3
R	- 50	+1800	- 58	+3272
S	- 50	+1767	- 58	+3213
DIN J	-200	+ 775		

Exceeding range limits will result in underscale or overscale indications.

Voltage Range Limits: -19.99 mV 99.99 mV

For the K and E T/Cs operating between -205°C (-337°F), and -240°C (-400°F), the conformity error is up to twice that specified for warmer temperatures; however, operation of the meter in these areas is useful and repeatable.

Operation of the T/Cs a few degrees above the NBS table limits is possible on all T/Cs except type S. Conformity error is not defined in these areas, but meter operation is repeatable and the values are a reasonable extrapolation of the NBS polynomials.

The low-temperature limit of the T T/C , -199.9°C or °F, is caused by the use of the center segment of the leading digit for a minus sign.

On the Voltage Range, the meter is calibrated at 80.00 mV, but overrange does not occur until the display attempts to exceed 99.99 or until the input causes internal operation of the analog section of the meter to cease, whichever occurs at a lower value.

2.2 SERIAL OUTPUT

1200 BAUD	1 Start Bit
	7 Data Bits (ASCII)
	1 Parity Bit (Odd)
	2 Stop Bits

Each message consists of 9 ASCII characters:

1	+ or -
2 to 6	Numeric data, including floating DP (2EH)
7	Space (20H)
8	C or F for temperature
9	Carriage return (0DH)

Leading zeros are blanked, except those immediately preceding the DP (decimal point).

Overflow	1	+
	2	Space
	3 to 6	4 'E's (45H)
	7 to 8	2 Spaces
	9	Carriage return
Underflow	1	-
	2 to 9	Same as Overflow

2.3 CONTROL OUTPUT

The control output is a single pulse per serial character. The pulse starts 20 μs before the beginning of the start pulse of the character bit sequence and ends at the middle of the start pulse. The trailing edge of the control output pulse can be used to initiate the start of the return character serial bit stream.

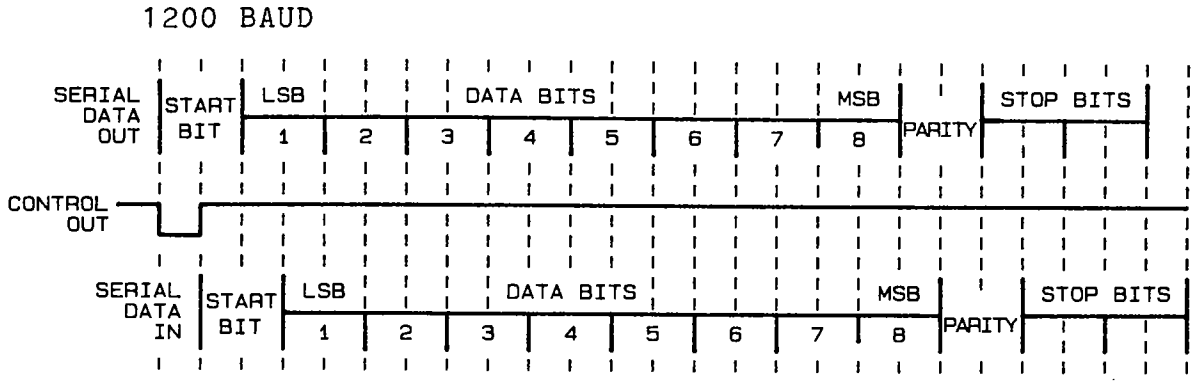


Figure 2-1 Serial I/O Timing Requirement

2.4 SERIAL DATA INPUT

The Serial Data-In bit stream must be synchronous with the Serial Data-Output bit stream as shown in Figure 2-1. Also, the message format must be as specified in Section 2.2, e.g., it must be identical to the 269 Serial Data-Output message format (9 ASCII characters). The Start Bit of the Serial Data-In should (ideally) start in the center of the Serial Data-Out Start Bit. In practice, the Serial Data-In Start Bit can have its leading edge occur within the center 90% of the Serial Data-Out Start Bit. Note that a host computer can return the same data (on a bit for bit basis) as is being transmitted by the 269, but if the 269 data is to be modified by the host for transmission to the 269, the result cannot be returned any sooner than the next 269 message.

The trailing edge of the 269 Control Out can be used as an interrupt to the host computer to synchronize transmission to the 269. Polling can also be used. The bit duration at 1200 baud is 833 µs, so if there is some delay, e.g., 100 µs, in the host response, the leading edge of the Control Out pulse could be used instead.

Note	Current into P1 Pin 11 (Serial-In)	Result at U10 Pin 34	269 Display Output	269 Serial Output
1	2 mA DC	Short to Ground	On Hold	Unfiltered Data
2	0 mA	Floating	Filtered Data	Filtered Data
3	2 mA/0 from Serial Data-Out	Receives Serial Data-Out	Unfiltered Data	Unfiltered Data
4	2 mA/0 from Intelligent Peripheral	Receives data from Intelligent Peripheral	Input Data	Unfiltered Data

Notes:

1. 269 serial output continues, digital filter is disabled, display retains last reading before DC current was applied to diode of Serial Input optocoupler.

2. Assumes Jumper S3A is not installed. (See Section 6.4)

3. Externally - can be implemented with circuit shown in Figure 6-2.
   Internally - Jumper S3A installed.
   2 mA/0 signifies bit stream of 2 mA current pulses.

4. Digital filtering is automatically disabled by the 269 so the intelligent peripheral, e.g., host computer, can have complete control over the display.

Note also, if $\overline{\text{BUFFER FULL}}$ goes true (2 mA to P1 pin 13) while serial data is being output, the measurement being processed will be aborted and restarted.

2.5 DISPLAY

Leading zero blanking: Leading zeros are blanked, except those immediately preceding the DP.

Decimal Point (DP) Position

Voltage Range	1 9.9 9	
Cold-junction (°C/°F)	1 9 9.9	
All Thermocouple Ranges except T	1 9 9 9	(no DP displayed)
Type T	1 9 9.9	

Overscale Indication

Underscale Indication

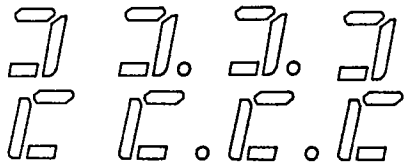


Figure 2-2 Display - Overscale and Underscale

If the signal input is less than approximately -40 mV, the integrator will not ramp up and an underrange is displayed.

2.6 ACCURACY AND CONFORMITY

Temperature Resolution: 1°C / 1°F, except type T, which is: 0.1°C / 0.1°F

Thermocouple Type	Conformity Error °C ±1/2 LSD	Range °C	
J	0.1	-210	+ 760
K	0.1	-205	+1372
E	0.2	-205	+1000
T	0.1	-199.9	+ 400.0
R	0.5	- 50	+1741
S	0.5	- 50	+1767
DIN J	0.3	-200	+ 775

Span Tempco, Standard: 0.006% R/deg from 0 to +55°C
T/C Reference Junction: 0.01 deg/deg from -40 to +125°C

NOTE: This is the T/C reference junction range allowed by the microcomputer. For reference junction operation outside the range 0°C to 55°C (operating temperature range of meter), a remote reference junction must be used.

Warmup for rated accuracy: 10 minutes

2.7 POWER

Input Voltage:	120 V ac +10% -15%	50/60/400 Hz	
	240 V ac +10% -15%	50/60/400 Hz	(Option C1)
	5 V dc ±5%		(Option C3A)
	9-32 V dc	Isolated	(Option C3B)
	26-56 V dc	Isolated	(Option C3D)

Input Power: 3.5 watts maximum

2.8 ENVIRONMENT

Rated Temperature	0 to +55°C
Operating Temperature	-20 to +55°C
Storage Temperature	-40 to +70°C
Humidity	Up to 95% at 40°C

3.0 MECHANICAL ASSEMBLY AND INSTALLATION

3.1 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

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.

- 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.

3.3 INITIAL CHECKOUT PROCEDURE

CAUTION

Meters are internally connected for either 115 or 230 V ac power, 5 V dc power, 9-32 V or 26-56 V isolated DC power. Check label on meter for proper supply voltage.

Required Equipment -

115 V or 230 V, 50 to 60 Hz power source (3 watts), 5 V dc at 150 mA, 9 to 32 V dc, or 26 to 56 V dc (3.5 watts).
Three-wire AC power cord, or two-wire DC power cord.
Flat blade screwdriver (1/4" blade).
Piece of copper bus wire.

Power connections and initial test (See Figures 3-1 and Figure 3-2)

For AC power operation -

1. Connect AC power as follows:

   AC HI (Blk) to TB1A-1.
   AC LO (Wht) to TB1A-2.
   AC GND (Grn) to TB1A-3.

For DC power operation (Option C3A, C3B or C3D) -

1. Connect DC power as follows:

   + DC to TB1A-2.
   DC return to TB1A-3.

2. Connect a piece of copper bus wire between TB1B-5 and TB1B-6.

3. Apply power and examine the display. After a momentary indication of 8 8.8.8, the readout should show 0.00 mV or ambient temperature in °C or °F, as applicable.

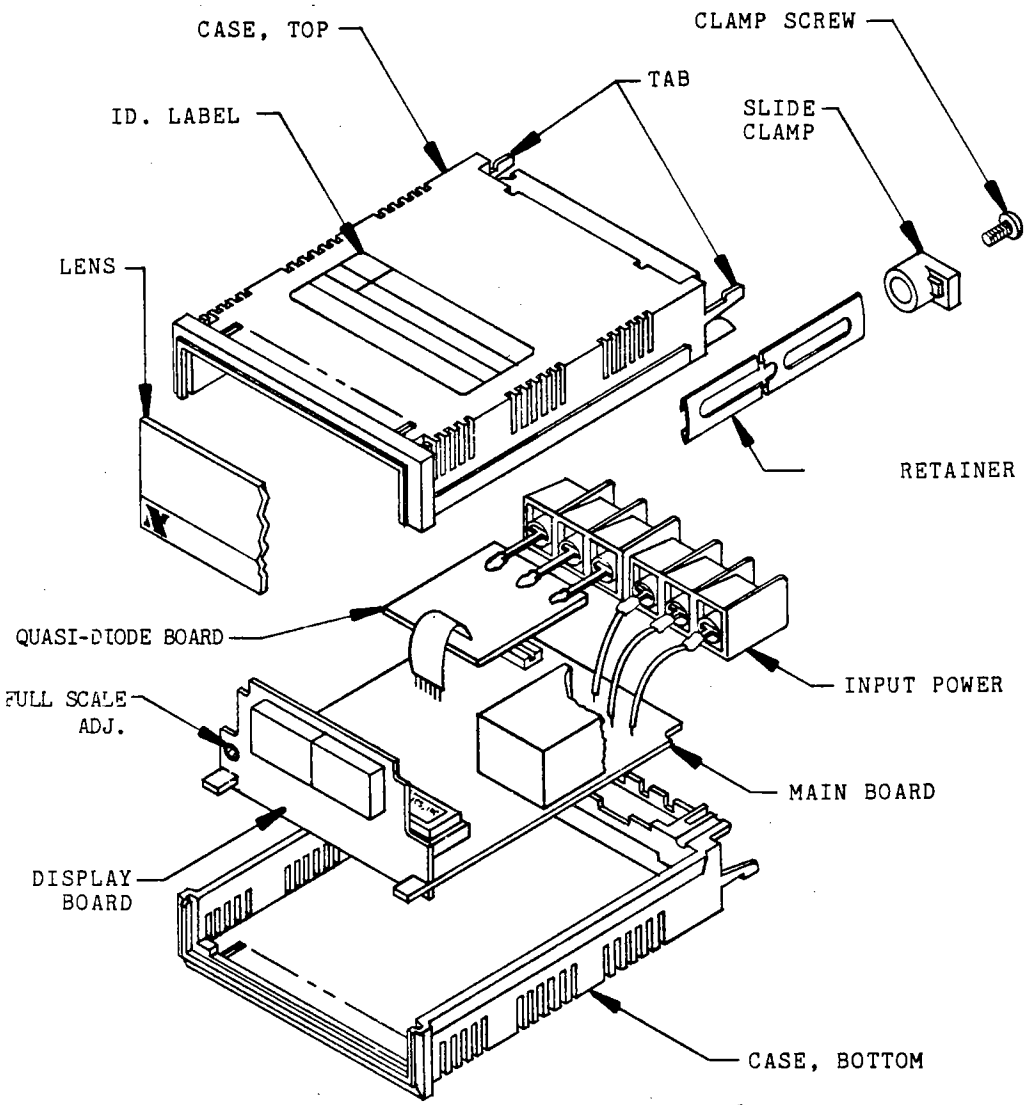


Figure 3-1 Exploded View of Model 269

This illustration includes label placement, read from the rear.

3.4 PANEL MOUNTING

The unit is inserted from the front of the panel and held in place by two slide retainers. The panel thickness may be between 0.75mm (0.030") and 6.35mm (0.25"). For further reference, Figure 8-4 in the drawings section illustrates DIN 1A case dimensions.

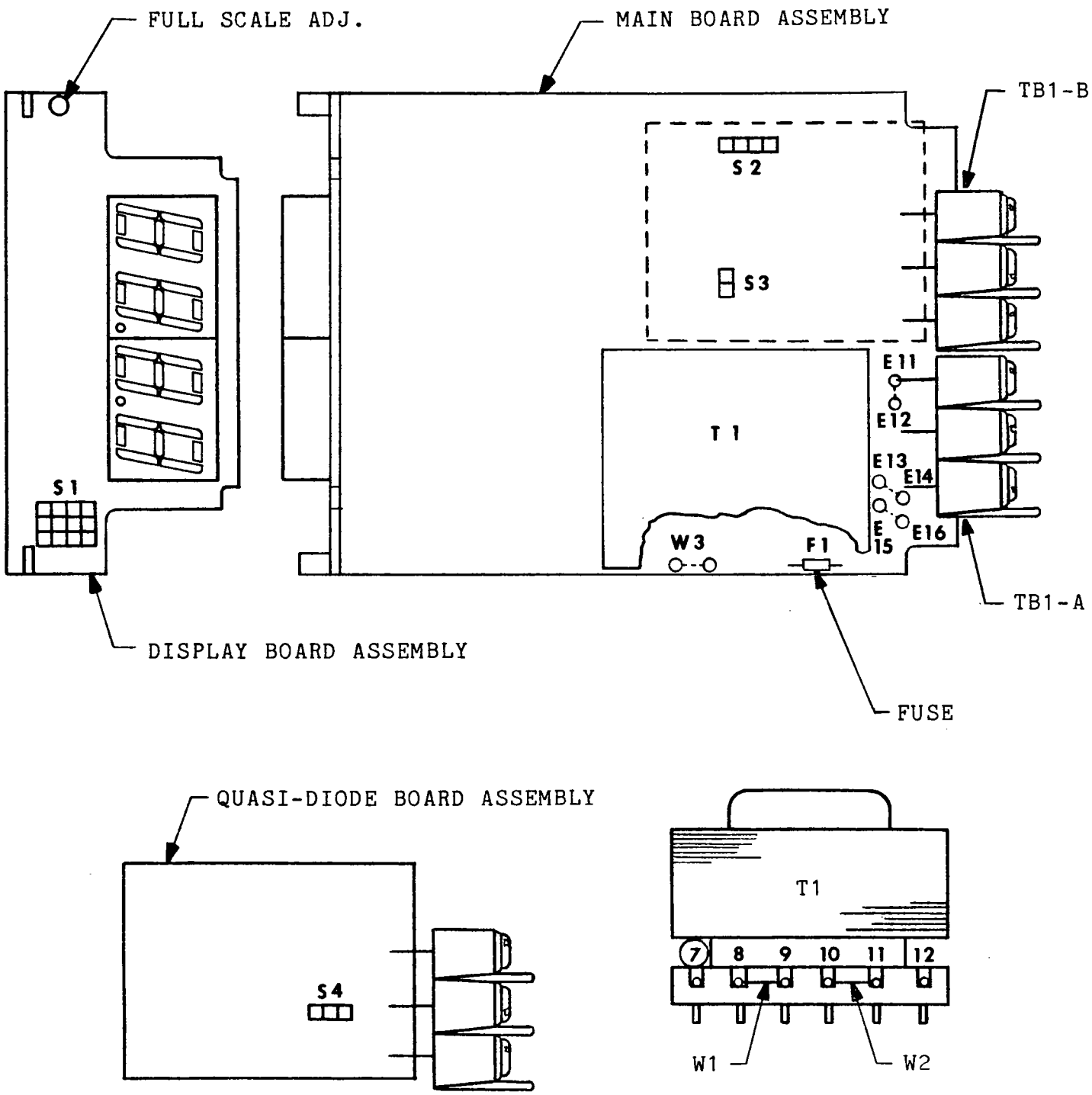


Figure 4-1 Quasi-Diode and Main Board Assemblies

CAUTION: Incorrect power can cause damage to your meter.

4.1 INSTALLING OPTION C1 (240 V ac)

If this option is to be used, it must be installed prior to any power and signal connections. Option C1 is 240 V ac +10% -15%, 50 to 60 Hz operation. To change the meter in the field from 120 V ac to 240 V ac, follow this procedure:

1. Refer to Section 4.4. Remove power lines from the meter, then remove the meter from the case.
2. Remove jumpers W1 and W2 on the transformer.
3. Add jumper W3 on the printed circuit board. The meter is now wired for 240 V ac operation.

NOTE: To change the meter from 240 V ac to 120 V ac operation, reverse the above procedure.

4.2 POWER INPUT

The standard meter draws 3.5 watts from 120 V +10% -15%, 50 to 60 Hz. A three-wire connection should be used to connect power to the meter; two conductors provide power to the meter and the third provides a ground for noise rejection protection.

The power input to the Model 269 is protected by a carbon composition resistor fuse (F1, Figure 4.1). If the meter does not light and it is suspected that the fuse has been blown, check the continuity of the primary circuit. The resistance from power Hi to power Lo will be approximately 118 Ω for a 120 V meter and 470 Ω for the 240 V meter. If the fuse is blown, it is imperative that it is replaced by an identical part; failure to do so will void the warranty. The fuse is an Allen-Bradley 1/8W, 10 Ω, ±10% carbon composition resistor, Newport part number 8181109.

4.3 SIGNAL INPUT

For best results a shielded T/C should be used for the input signal, with the shield terminated to Signal Guard (TB1B-4). Signal Guard and Analog Ground are internally connected. Analog Ground and the digital In/Out signals are optically isolated.

4.3.1 Ground Precautions

Proper ground connections must be made to the meter for accurate readings. A shielded T/C must not have the shield connected at both the T/C end and the meter end.

4.4 POWER CONNECTIONS

AC Power Connections via Terminal TB1 for C3A, C3B and C3D Options.

J1 Connector

Terminal TB1	AC Power Operation	Wire Color (USA)
1	AC HI	Black
2	AC LO	White
3	AC GND	Green

Terminal TB1	T/C or mV Operation
4	Shield (SIG GND)
5	- Input
6	+ Input

NOTE: TB1-3 AC GND should be returned to earth ground to obtain best noise immunity.

DC Power Connections via Terminal TB1 for C3A, C3B and C3D Options.

J1 Connector

Terminal TB1	DC Power Operation
1	N/C
2	+ DC PWR
3	DC PWR RET

Terminal TB1	T/C or mV Operation
4	Shield (SIG GND)
5	- Input
6	+ Input

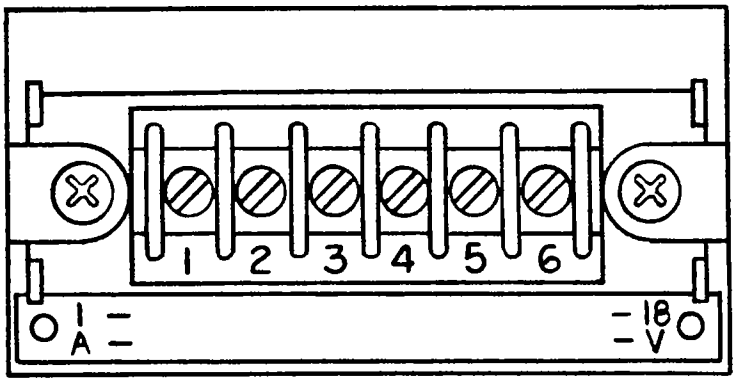


Figure 4-2 Rear View of Case with Connectors

	Upper Row		Lower Row		
	Pin	Signal	Signal	Pin	
	1	N/C	AC HI	A	
	2	AC LO	N/C	B	
	3	N/C	AC GND	C	
	4	N/C	N/C	D	
	5	N/C	N/C	E	
	6	N/C	N/C	F	
	7	N/C	N/C	H	
	8	N/C	N/C	J	
	9	N/C	N/C	K	
+	10	Control output return	Control output	L	+
+	11	Serial input	Serial input return	M	+
+	12	Serial output return	Serial output	N	+
+	13	Buffer full	Buffer full return	P	+
	14	N/C	N/C	R	
*	15	+ 5 V OUT	N/C	S	
*	16	T/C - (ANALOG GND)	DIGITAL GND	T	*
*	17	T/C + (SIGNAL)	QD GND	U	*
*	18	- 2.49 Vref OUT	QD Emitter	V	*

\+ Optically isolated

* For these signals to be present on J1, a header, wired as shown in Figure 5-1, must be inserted into socket labeled XU7. A 33K-1/4 W resistor is required from pin 3 to pin 14 on header to provide input filtering and protection.

This header should be removed if connector isolation from the T/C common-mode voltage is required.

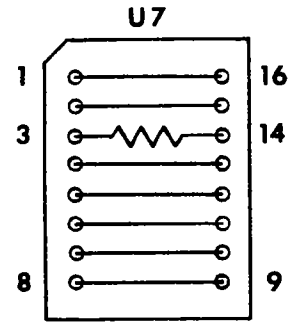


Figure 5-1 U7 Header

Connector Type

ELCO	00-6007-036-450-012
TRW/CINCH	251-18-90-160
SAE	SCC18D/1-2

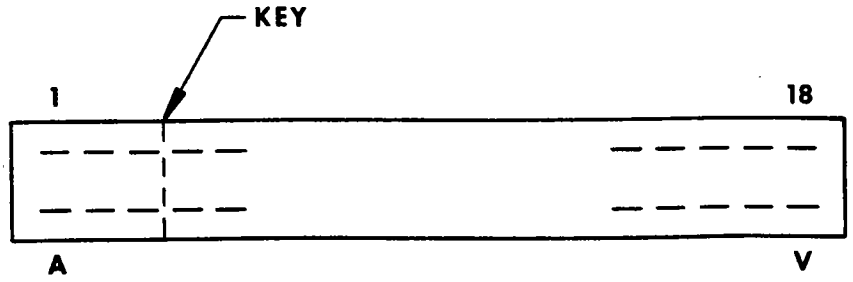


Figure 5-2 Rear View of Connector Pin Orientation

6.0 CONFIGURATION

6.1 EDGE CONNECTOR POWER JUMPERS

Power connections to the card edge connector, wire jumpers E11-E12, E13-E14, and E15-E16, are used during production checkout of the Model 269. Prior to shipment, these three jumpers are removed and replaced by connections between TB1A and solder eyelets E11, E13, E15.

JUMPERS E11-E12, E13-E14, E15-E16 SHOULD NEVER BE USED IF TB1A IS INSTALLED; TO DO SO WOULD PLACE HAZARDOUS VOLTAGES ON THE EXPOSED CONDUCTORS OF P1

Input Configuration by Thermocouple and Degree	Jumper Placement S1
T (°F)	A, C, E, H
T (°C)	A, C, E, G
J (°F)	A, C, F, H
J (°C)	A, C, F, G
K (°F)	A, D, E, H
K (°C)	A, D, E, G
E (°F)	A, D, F, H
E (°C)	A, D, F, G
R (°F)	B, C, E, H
R (°C)	B, C, E, G
S (°F)	B, C, F, H
S (°C)	B, C, F, G
CJ (°F)	B, D, E, H
CJ (°C)	B, D, E, G
Millivolts DIN J (°C)	B, D, F, H
	B, D, F, G

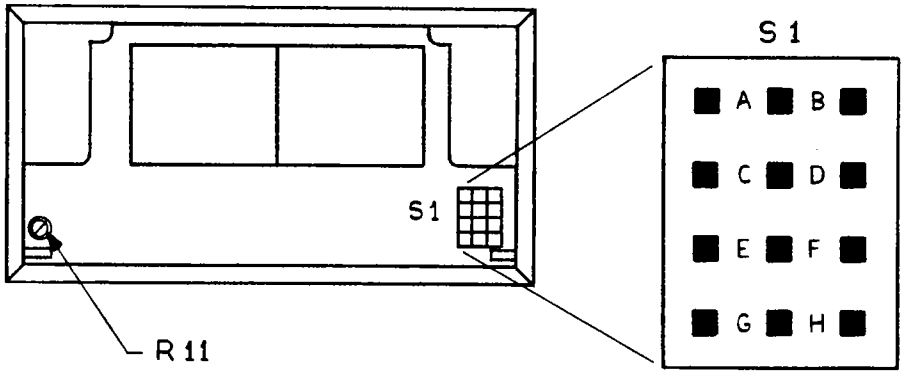


Figure 6-1 Jumper Placement for Input Range Selection

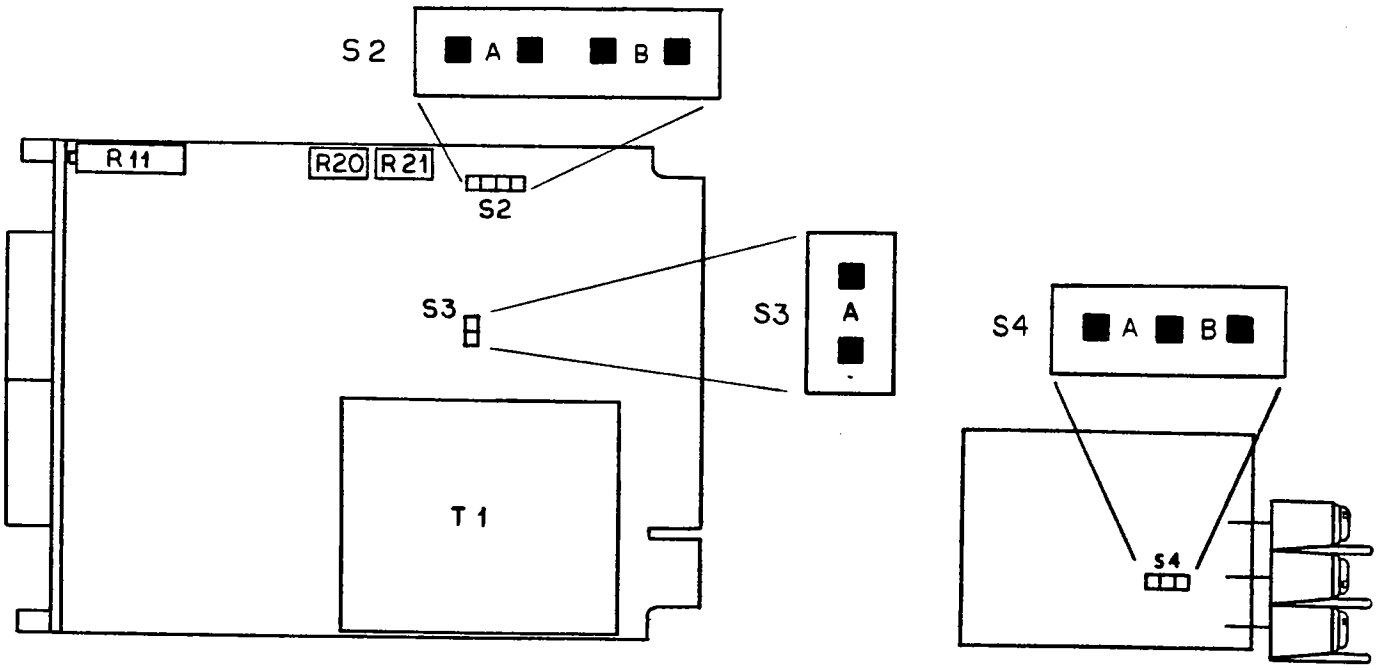


Figure 6-2 Location of S2, S3, and S4 Jumper Groups

For Sections 6.2 through 6.4, refer to the above illustration.

6.2 OPEN-THERMOCOUPLE DETECTION

Model 269 is shipped with jumpers placed at S4A, S2A and S2B.

When T/C is open, a jumper at:

S4A - Meter indicates overscale S4B - Meter indicates underscale

NOTE: Removal of S4 jumper will increase meter accuracy if maximum resistance of the T/C exceeds 250 ohms; however, there will not be open T/C detection with this modification.

The 269 is shipped with the jumpers set for normal operation.

6.3 COLD-JUNCTION CONFIGURATION

S2A ON For normal operation Energizes internal cold-junction circuitry.

S2A OFF If external cold-junction is used.

6.4 ANALOG AND DIGITAL FILTERING

S2B ON For normal operation Connects analog input filter (33 kOhm X 10 µfd) providing a normal mode rejection of 60 dB at 50/60 Hz.

S2B OFF Only for special tests.

S3A ON Disables the digital filtering by connecting the digital serial output to serial input. (This jumper is internal to the meter, see Figure 6-2.)

S3B OFF For normal operation Digital filtering enabled.

For test purposes, an SPST switch connected to the S3A pins will switch the filter function on and off. External connection of a 2.2k resistor to +5 V, as shown in Figure 6-3, would have the same effect. Digital filtering may be switched on or off while meter is in operation.

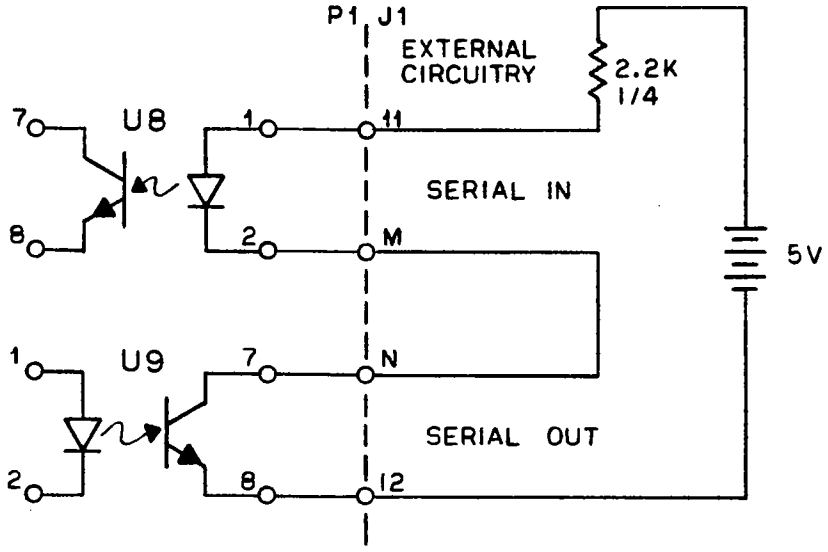


Figure 6-3 Serial In and Serial Out

6.5 DIGITAL SIGNALS

Normal use of the Model 269 is with the optically-isolated serial Output/Input provided at 1200 baud, giving the 269 the ability to be interfaced with computers and systems equipment. The 269 can also accept a synchronous, serial ASCII display-value input in place of the internally-generated value. A BUFFER FULL input (active low) allows the receiving device to halt the flow of data as needed. A CONTROL output is provided for convenience in certain applications.

SERIAL OUTPUT - open collector of opto-isolator (2 mA max)

CONTROL OUTPUT - open collector of opto-isolator (2 mA max)

SERIAL INPUT - LED input of opto-isolator (2 mA source required)

BUFFER FULL INPUT - LED input of opto-isolator (2 mA source required)

If BUFFER FULL or CONTROL OUT are not used, the connections for these signals can be left open.

SERIAL IN AND SERIAL OUT can be left open for meter stand-alone operation. With no jumper at S3A, the normal condition, the 269 microcomputer will sense that there is no serial-out-to-serial-in data transfer and will send the meter-generated data to the meter display automatically. If there is a serial-out-to-serial-in data transfer (see Section 2.3 for timing relationships), it will also be sensed by the microcomputer and the digital filtering will be disabled. The host computer can then process the data as required. The return data to the 269 can be any character string that satisfies the 269 format. Refer to Section 2.2.

The timing of the return sequence to the 269 is optimized if the return bits are delayed by 1/2 bit period (417 μs). An exact overlap, as is achieved by using jumper S3A, will work, but the 1/2 bit delay provides the best margin of operation for pulse distortion and timing variations.

The CONTROL OUTPUT pulse trailing edge can be used to initiate the start of the return character serial bit stream (see Section 2.3).

7.0 CALIBRATION

7.1 CALIBRATION OF Vref, Cold-junction Compensation and FULL SCALE

Model 269 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. When verification of calibration is necessary, the following procedure can be used.

The linearization algorithms use the millivolt and cold-junction values plus the S1 jumper configuration to determine the appropriate temperature display. Thus the millivolt and cold-junction displays are sufficient to determine the calibration of the meter. To expedite the calibration check, a 4PST switch can be connected to the S1 A, C, E, and G positions of the pin-forest located behind the front lens. The meter will be unharmed if the operational modes are changed while it is operating. Results will be obtained more quickly if the digital filtering is disabled. (See Section 6.4)

The Vref (meter internal voltage reference), is initially factory-set to a value which results in a minimum temperature coefficient, i.e., Vref versus ambient temperature. This value is not the same for all meters. If the voltage reference must be replaced, return the meter to the factory. The Vref potentiometer (R20) is sealed after adjustment at the factory. If this seal is broken, the accuracy of Vref is questionable.

Potentiometer R21, the cold-junction reference adjustment, is also factory-set and sealed. Proper operation can be checked, however, by simply configuring the meter for CJ temperature display and comparing the CJ temperature with the actual temperature of the terminal block. Note that the temperature of the block must be known with an accuracy commensurate with the Model 269 specifications.

Full-Scale adjustment is controlled by potentiometer R11, located behind the lens, and is front-panel accessible. Adjustment can be made by configuring the Model 269 as a millivoltmeter. Verify that the unit indicates +/- 0.00 mV with shorted inputs. Then apply +80.005 mV to Signal In, (TB1B- 6), referenced to Analog Ground, (TB1B-5), and adjust R11 for a reading of +80.00/80.01 mV. The 1/2 count is obtained when the display alternates between +80.00 and +80.01 mV.

If S4A is in place (Normal Position), approximately 50 nA will be flowing into the signal input terminal; therefore the input resistance of the calibration source can offset the reading.

Calibrating the meter for plus full scale should automatically insure calibration for minus full scale; however, minus full scale can be checked to verify proper operation of the meter. In this case, although -19.99 mV is the most negative display value, it is more convenient to check the meter at -19.90 mV, which will avoid a possible underscale condition. If Digital Filtering is OFF, recovery from underscale will appear to be instantaneous, i.e., as soon as the input voltage is in range, the display will indicate in-range operation. If Digital Filtering is ON, recovery will take longer because the digital filtering is not automatically disengaged while the meter is in the overrange condition.

Note that for positive inputs, overrange does not occur in the mV mode until the display attempts to exceed 99.99 or until the overrange condition causes internal operation of the analog section of the meter to cease, whichever occurs at a lower value. The meter cannot display mV values more negative than -19.99, because the g-segment (center segment) of the leading display digit is used to indicate minus.

7.2 CALIBRATION VERIFICATION USING THERMOCOUPLES

The following procedure can be used to verify the calibration of the Model 269 using T/Cs.

1. Connect test cables as shown in Figure 7-1.
2. Apply power and allow meter to warm up for ten minutes.
3. Apply zero volts from the Calibrated Voltage Source and verify readout of ±0°C or 32°F.
4. Verify that the Model 269 is operating within specification per the International Practical Temperature Scale, IPTS-68, as published in the NBS Monograph 125 issued March 1974 (or DIN 43710), by applying the appropriate voltage to the input.

Note that this method only requires that the NBS (or DIN J) voltage be determined for the simulated measure junction temperature. The ice bath will zero the copper - T/C junctions for the copper wires which are connected to the Calibrated Voltage Source; however, the cold-junction compensation detector of the Model 269 must be previously calibrated so the meter will properly compensate for the T/C junctions at the meter barrier block. For accurate results, T/C wires which have a known accuracy should be used.

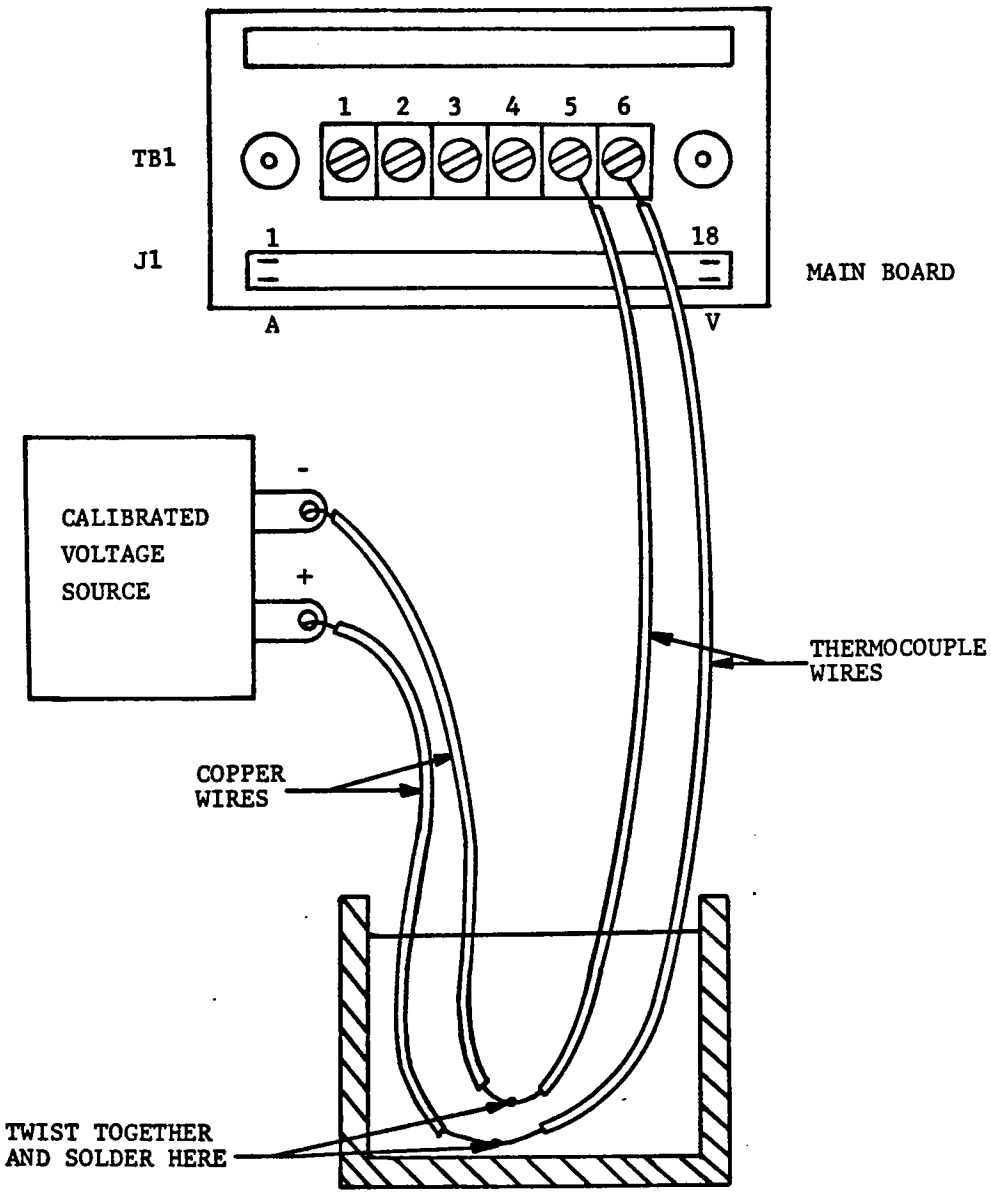


Figure 7-1 Ice Bath Calibration Setup

7.3 CONFORMITY VERIFICATION

Even if the meter is not properly calibrated, the conformity can be verified for the indicated CJ (cold-junction) and mV values. First note the values of CJ temperature and millivolts displayed by the meter, then determine the temperature from the appropriate NBS (or DIN) table. The example below is for the J T/C, °C, configuration with the meter indicating CJ = 23.6°C and 41.09 mV (mV display). Note that in this procedure, only a stable millivolt source is required; neither T/C wires nor a separate millivoltmeter is required. This conformity verification demonstrates that, for given net MJ (measure-junction) CJ voltage and CJ temperature meter display values, the correct MJ temperature result will be obtained when the meter is switched to the appropriate T/C configuration (using S1).

Millivolts displayed by meter : 41.09

Cold-junction temperature displayed, °C : 23.6

NBS value for 23.6°C : 1.2098 mV

NBS value for 750.2°C : 42.2960

Net NBS value for CJ = 23.6, MJ = 750.2 : 41.0862 mV

(use linear interpolations of NBS values)

The expected meter display value is 750°C when switched to the J T/C mode.

Note that the meter display has a resolution of one degree in this case (J T/C). Noise in the millivolt source or a change in the cold junction value will cause variations.

The following is another example of how to check the conformity. This time the T T/C configuration, which has a display resolution of 0.1°, will be used. The object is to determine if the meter will display 390.3°C for values obtained from the NBS table.

STEP	MODE	DISPLAY	NBS VALUE
1.	CJ	23.6°C	934.9 uV
2.	MV	19.33/19.34 mV	19335.9 uV
3.	T T/C	390.3°C	20270.8 uV

In this example, the Model 269 was first configured to read CJ temperature in °C. A value of 23.6°C was displayed. Linear interpolation between the values for 23 and 24°C in the NBS table for the T T/C yields 934.9 uV. Likewise, 390.3°C yields 20270.8 uV which gives a net value of 19335.9 uV. The meter configuration was then changed to mV and a stable millivolt source was adjusted to obtain a display of 19.33/19.34 mV (alternating between 19.33 and 19.34 mV). This would be the voltage expected for "perfect" T T/Cs. Changing the mode to T T/C should then yield a display of 390.3°C.

After step 3, it is advisable to recheck the CJ value since, in a realistic situation, a change of 0.1°C (or more) ambient temperature could occur during the time interval required for the procedure. The procedure can be made more efficient by providing a 4PST switch connected to the pin-forest, plus a SPST switch connected to S3A. (See 6.3 for an alternative which avoids removing the meter case.) When the SPST switch is on, it simulates an external serial data source, thereby disabling the 269 digital filtering.

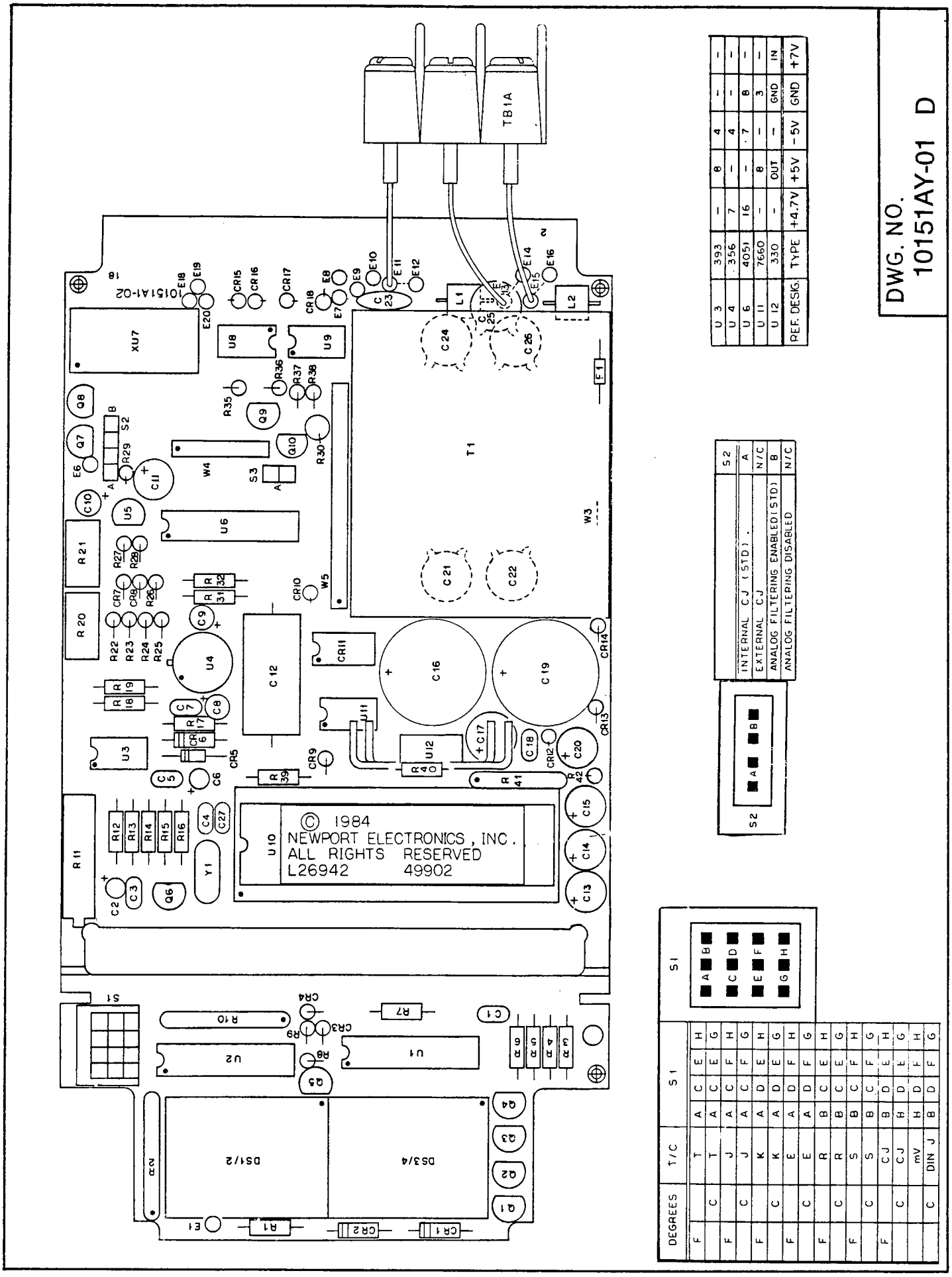


Figure 8-1 PCBAD, 269 Main Board Assembly

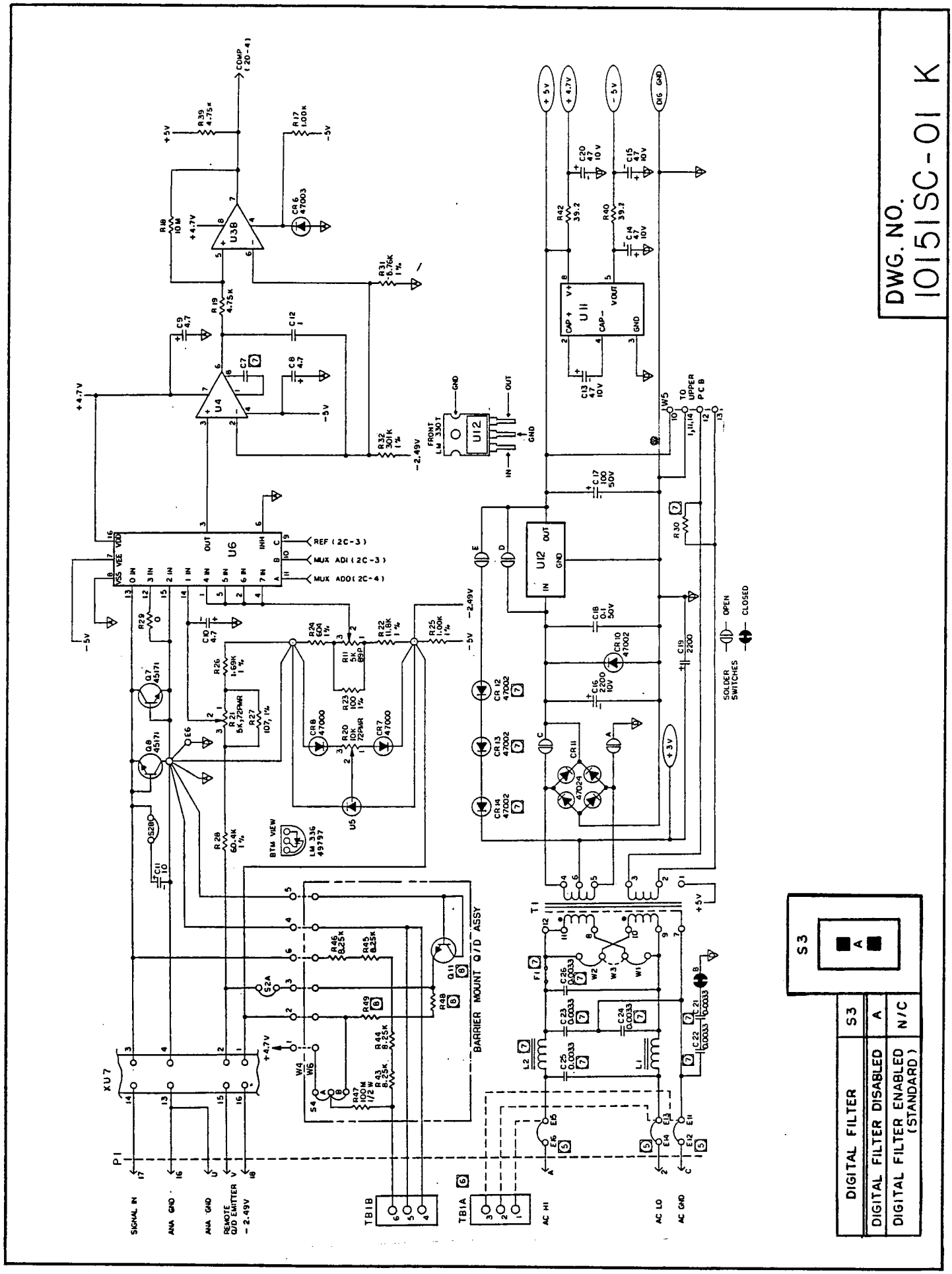


Figure 8-2 Main Board Schematic (1 of 2)

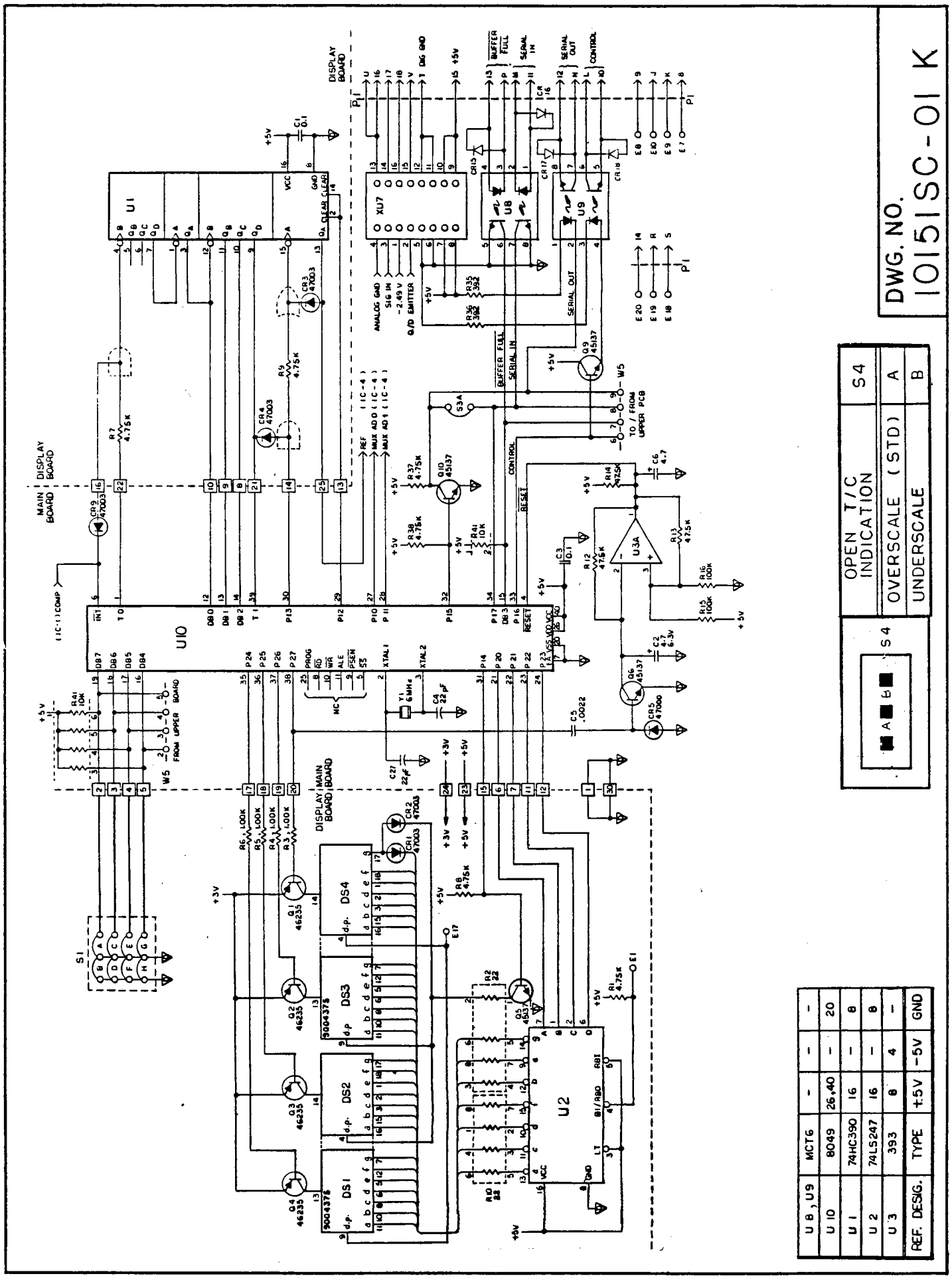
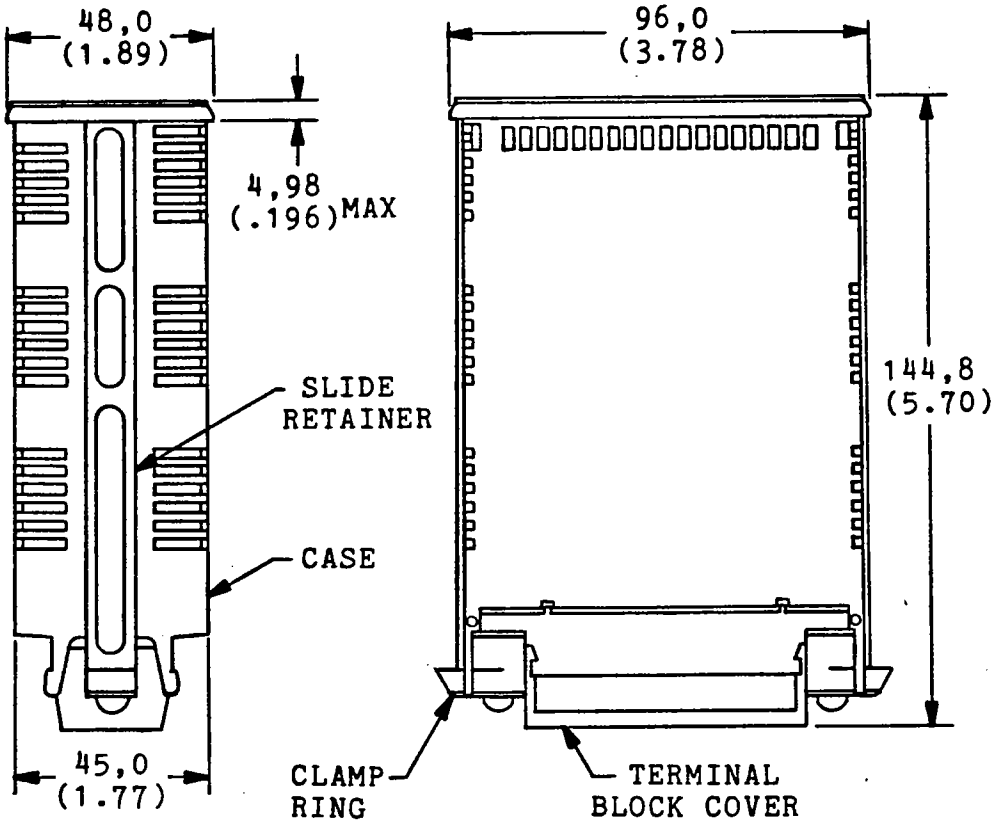


Figure 8-3 Main Board Schematic (2 of 2)

PHYSICAL:

Weight	480 g (17 oz)
Case Material	94V-0 UL-rated polycarbonate
DIN Case Size	
Bezel (WxHxT)	96 x 48 x 6 mm (3.78 x 1.89 x 0.24 in)
Depth behind bezel with connector	135.4 mm (5.33 in)
Panel Cutout	92 x 45 mm (3.62 x 1.77 in)



NOTE: DIMENSIONS ARE IN MILLIMETERS ±0.25 MM
AND INCHES ARE IN ( ) ±0.01 IN

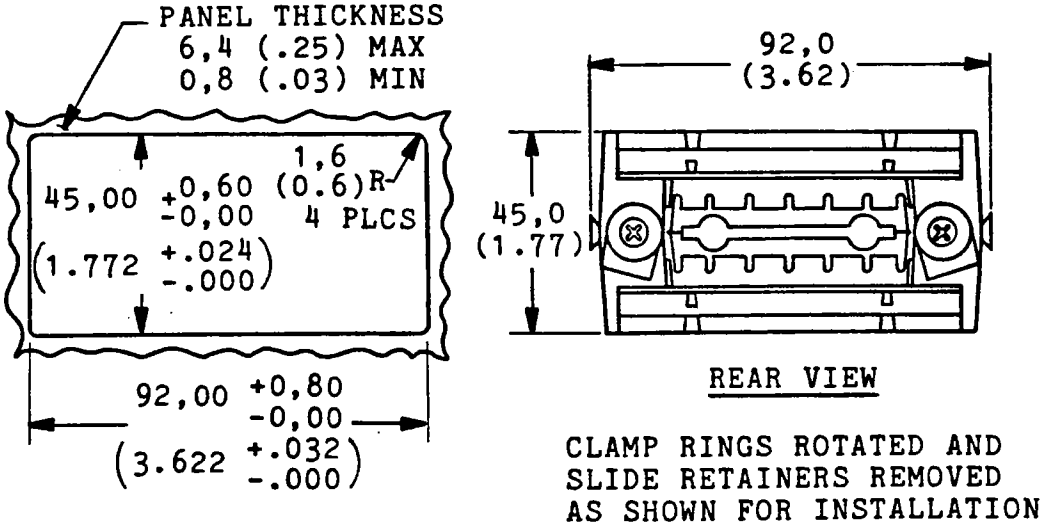


Figure 8-4 DIN Case Dimensions