

**1 YEAR**  
WARRANTY

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# User's Guide

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**DP301AN DC VOLTMETER**  
**DP301AN-AC VOLTMETER**



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## 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.
- Unit mounting should allow for adequate ventilation to ensure instrument does not exceed operating temperature rating.
- Use electrical wires with adequate size to handle mechanical strain and power requirements. Install without exposing bare wire outside the connector to minimize electrical shock hazards.

### 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.

## 1.0 GENERAL INFORMATION

The two versions of voltmeters are different pinout versions of the same 3 1/2 digit panel meter for applications which require a compact, quality dc voltmeter. Standard features include HOLD function, selectable decimal point location and LAMP TEST.

Each model contains the circuitry for all ranges. The range is changed by opening and closing the appropriate switches on the printed circuit board via installation of push-on jumpers.

### 1.1 MODEL DP301AN

Model DP301AN is pin compatible with newer voltmeters DP302, DP3001 and DP3002 series.

Models DP301AN has a resolution of 1 part in  $\pm 1999$  counts, or 0.05% of full scale. By using an external dc voltage reference, any of these ranges can be configured for 3 wire ratio measurement with readout from 0 to 1.999.

### 1.2 MODEL DP301AN-AC

Model DP301AN-AC, for AC power line monitoring, has a screw terminal barrier strip for signal and power. This model uses a half wave average converter calibrated to read RMS. It offers input ranges of 199.9 and 650 V ac, with resolution of 100 mV and 1 V, respectively. Maximum rated input in either range is 650 V RMS or 920 Vp.

## 2.0 SPECIFICATIONS

### 2.1 ANALOG INPUT

#### **Model "AN"**

Signal ranges	$\pm 199.9\text{mV}$	$\pm 1.999\text{V}$	$\pm 19.99\text{V}$	$\pm 199.9\text{V}$
Bias current	50 pA	50 pA	5 pA	1 pA
Maximum input	130 Vp	130 Vp	250 Vp	250 Vp
Resolution	100 $\mu\text{V}$	1 mV	10 mV	100 mV
Input resistance	1 $\text{G}\Omega$	1 $\text{G}\Omega$	1.1 $\text{M}\Omega$	1.0 $\text{M}\Omega$
Configuration	Differential, bipolar			
Zero	Automatic			
Span adjustment	$\pm 5\%$			

#### **Model "AN-AC"**

Signal ranges	199.9 V ac	650 V ac
Bias current	1 pA	1 pA
Overvoltage protection	650 V ac	650 V ac
Resolution	100 mV	1 V ac
Input resistance	1 $\text{M}\Omega$	1 $\text{M}\Omega$
Configuration	Half wave average, RMS calibrated	
Zero	Automatic	
Frequency	47 to 1000 Hz	

## 2.2 ACCURACY AT 25°C

Warmup to rated accuracy 10 minutes

### **Model "AN"**

Maximum error  $\pm 0.05\%$  or reading  $\pm 1$  count

Span to tempco  $\pm 0.01\%$  of reading/ $^{\circ}\text{C}$

Step response 1 second

### **Model "AN-AC"**

**(10% to 100% of full-scale range)**

Maximum error (actual reading)

20.0 to 199.9 V range  $\pm 0.003\% \text{FS (R-110 V) / V} \pm 1$  counts

20.0 to 650. V range  $\pm 0.003\% \text{FS (R-220 V) / V} \pm 1$  counts

Span to tempco  $\pm 0.01\%$  of reading /  $^{\circ}\text{C}$

Step response 1 second

## 2.3 NOISE REJECTION

NMR 56 dB at 50/60 Hz

CMR, SIG LO to SIG GND 80 dB, DC to 60 Hz

CMV, SIG LO to SIG GND  $\pm 1.0 \text{ Vp}$

CMR, AC GND to SIG GND 120 dB, DC to 60 Hz

CMV, AC GND to SIG GND 1500 Vp per HV test; 354 Vp per IEC spacing

## 2.4 ANALOG TO DIGITAL CONVERSION

Technique Dual-slope, average-value

Read rate 2.5/second

Input integration period 100 milliseconds

## 2.5 3 WIRE RATIO REFERENCE

### **Model "AN"**

Analog input range  $\pm 200 \text{ mV}, \pm 2 \text{ V}, \pm 20 \text{ V}, \pm 200 \text{ V}$

Reference voltage  $+0.05$  to  $+0.2 \text{ V}$   $+0.5$  to  $2.0 \text{ V}$

Load on reference 30.6 ohms 65.3 ohms

Accuracy 99.9%R 99.9%R

## 2.6 DISPLAY

Type 7 segment, red LED; 14.2 mm (0.56 in)

Symbols

**Model "AN"** -1.8.8.8

**Model "AN AC"** 1.8.8.8

Decimal points 3 position programmable internally or at connector

Overrange indication 3 least significant digits blank

## **2.7 DIGITAL SIGNALS (Referenced to SIG GND)**

Logical 0	0 to +1.4 V
Logical 1	+3.7 V to +5.0 V
Display HOLD	1 = latched reading
LAMP TEST	1 = display of -1888
Output voltage	+4.7 V dc $\pm 5\%$ at 10 mA max -4.6 V dc $\pm 5\%$ at 10 mA max

## **2.8 POWER**

AC input voltage	115 or 230 V ac $\pm 15\%$
AC frequency range	49 to 440 Hz
DC input voltage	9 to 32 V dc, isolated to 300 Vp 26 to 56 V dc, isolated to 300 Vp
Power consumption	2.4 W (nominal)

## **2.9 ENVIRONMENTAL**

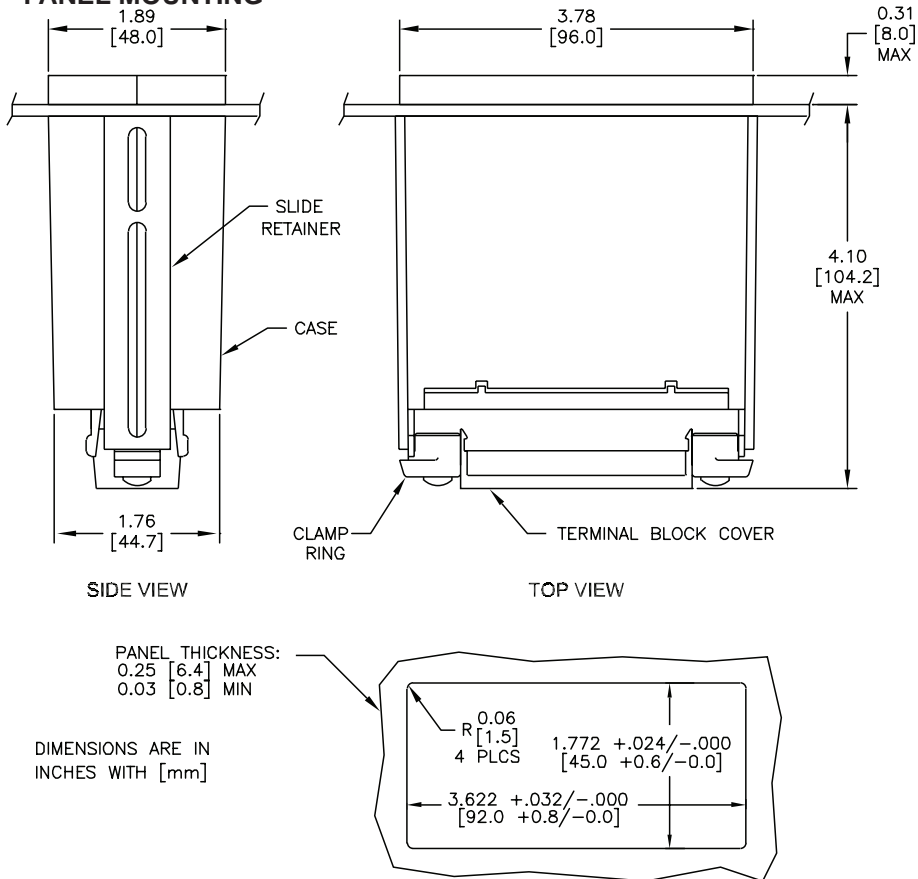
Operating temperature	0 to +60°C
Storage temperature	-40 to +85°C
Relative humidity	95% at +40°C (non-condensing)

## **2.10 MECHANICAL**

Bezel	96 x 48 x 6.1 mm (3.78 x 1.89 x 0.24 in)
Depth behind bezel, with connector	99 mm (3.90 in)
Panel cutout	92 x 45 mm (3.62 x 1.77 in)
Weight	400 g (14 oz)
Case material	94V-O UL rated polycarbonate
D1 connector:	18 pin, double row, 3.96 mm (0.156 in) pin spacing
D4 connector:	Screw terminal barrier strip for signal and power (removes these inputs from D1)

### 3.0 MECHANICAL ASSEMBLY AND INSTALLATION

#### 3.1 PANEL MOUNTING



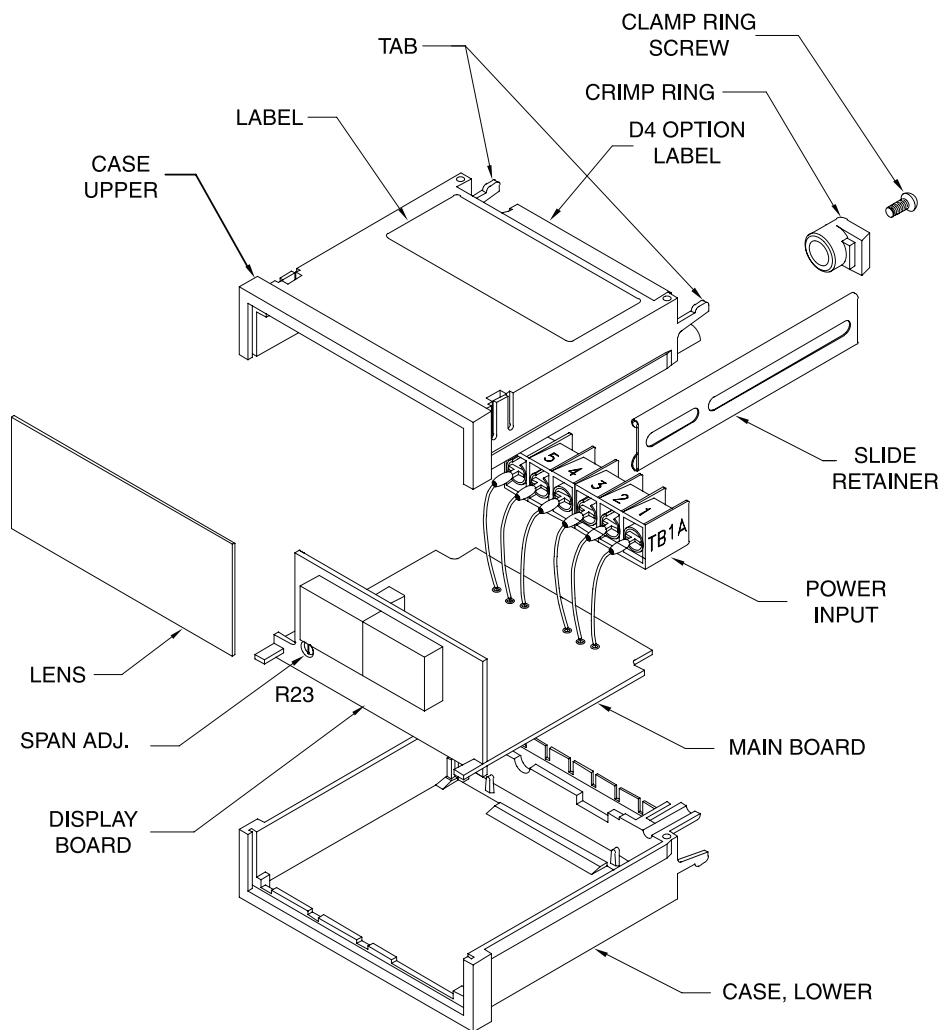
**Figure 3-1 DIN Case Dimensions**

1. Remove the main board edge connector (J1) if installed.
2. Use a #8 Phillips-head screwdriver to loosen the two screws on the rear of the case until you can rotate the two clamp rings. Loosen the screws enough to allow for the panel thickness.
3. Slide the two slide retainers towards the rear of the unit and remove them.
4. Observe the case dimensions previously shown. From the front of the panel, insert the meter into the panel cutout.
5. Slide the slide retainers back onto the case and push up tightly against the rear of the panel.
6. Rotate the clamp rings back into their original position and tighten until the case is held in place. Do not overtighten.
7. Reinstall any connectors that were removed

### 3.1 PANEL MOUNTING (continued)



**WARNING:** High voltage is present when using model "AN-AC" with the 650 V AC option.



**Figure 3-2 Exploded View**

4.0 POWER AND SIGNAL

4.1 CHANGING OPERATING VOLTAGE

Remove power lines from the meter, then remove the meter from the case.

OPERATING VOLTAGE	JUMPER INSTALLATION
230 V ac $\pm 15\%$ (Option C1)	Remove W8 and W9 on the transformer Install W4 on the printed circuit board
115 V ac $\pm 15\%$ (Standard)	Install W8 and W9 on the transformer Remove W4 on the printed circuit board

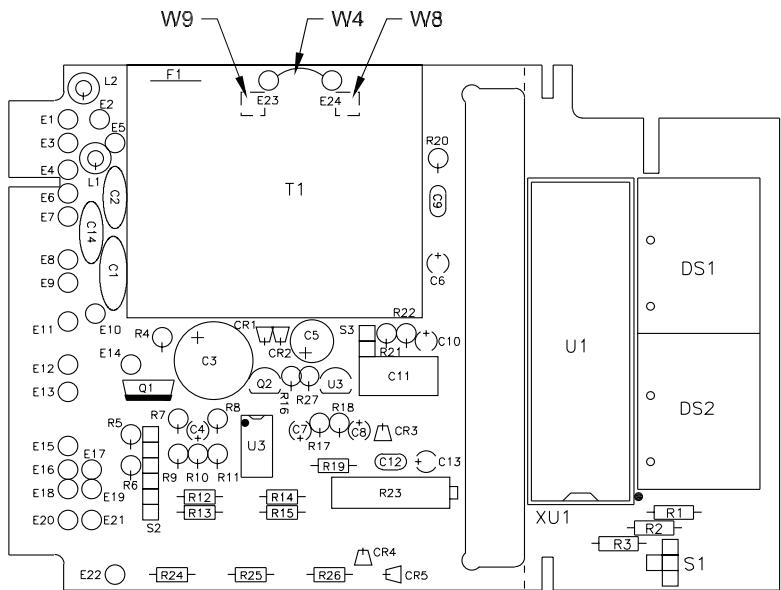


Figure 4-1 Main Board

4.2 POWER AND SIGNAL CONNECTIONS

The voltmeters are factory-set for 115 V ac  $\pm 15\%$  operation. Power and signal can be connected using the D1 or D4 option.

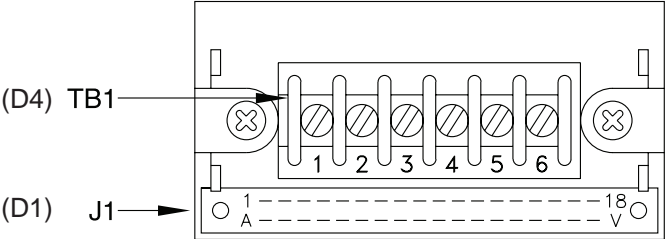


Figure 4-2 Rear Terminal

Refer to Figure 4-2.

### MODEL "AN"

Connector		Power		Signal	
~ AC	D1	A	L (High)	17	High
		2	N (Low)	16	Low
		C	⊕ (Ground)		
	D4	1	L (High)	6	High
		2	N (Low)	5	Low
		3	⊕ (Ground)	4	Signal GRND
≡ DC	D1	2	+ DC	17	High
		C	- DC (return)	16	Low
	D4	1	No connection	6	High
		2	+ DC	5	Low
		3	- DC (return)	4	Signal GRND

### Model "AN-AC"

Connector	Power		Signal	
D4	1	L (High)	6	High
	2	N (Low)	5	Low
	3	⊕ (Ground)	4	No connection

Wire Color for AC Power	USA	Other
L (High)	Black	Brown
N (Low)	White	Blue
⊕ (Ground)	Green	Green

### 4.3 CONNECTOR PIN ASSIGNMENTS

#### Model "AN-AC" J1 Connector (D1 Option)


Spare	A	1	N/C
N/C	B	2	N/C
Spare	C	3	N/C
N/C	D	4	N/C
Spare	E	5	N/C
N/C	F	6	N/C
199.9 DP	H	7	199.9 DP
19.99 DP	J	8	19.99 DP
1.999 DP	K	9	1.999 DP
LAMP TEST	L	10	LAMP TEST
+4.7 V	M	11	+4.7 V
-4.6 V	N	12	-EXC
+REF	P	13	+EXC
HOLD	R	14	HOLD
ANA GND	S	15	Spare
SIG LO	T	16	Spare
N/C	U	17	Spare
Spare	V	18	N/C

#### Model "AN" J1 Connector (D1 Option)

AC HI	A	1	N/C
N/C	B	2	AC LO/+DC PWR
AC GND/-DC PWR	C	3	N/C
N/C	D	4	N/C
Spare	E	5	N/C
N/C	F	6	DIG GND
199.9 DP	H	7	199.9 DP
19.99 DP	J	8	19.99 DP
1.999 DP	K	9	1.999 DP
LAMP TEST	L	10	LAMP TEST
+4.7 V	M	11	+4.7 V
-4.6 V	N	12	-EXC
+REF	P	13	+EXC
HOLD	R	14	HOLD
ANA GND	S	15	Spare
SIG LO	T	16	SIG LO
N/C	U	17	SIG HI
SIG HI	V	18	N/C

## Connector TB1 (D4 Option)

~ AC Power Versions

1	AC HI L
2	AC LO N
3	AC GND 
4	ANA GND*
5	SIG LO
6	SIG HI

≡ DC Power Versions

1	N/C
2	+DC PWR
3	-DC PWR RETURN
4	ANA GND*
5	SIG LO
6	SIG HI

\* No connection with "AN-AC"

## 4.4 DIGITAL TEST SIGNALS

Display HOLD instructs the meter to maintain a display of the last reading. To activate HOLD, connect J1-pin 14/R to J1-pin 11/M.

LAMP TEST instructs the meter to light the minus sign and all digits on the display to verify that the display is operating properly. To test the display, connect J1-pin 10/L to J1-pin 11/M. The decimal point does not light when LAMP TEST is activated.

## 5.0 CONFIGURATION

Select the desired configurations from the following charts.  
Install jumpers and open/close solder switches as indicated.  
Remove all push-on jumpers not used.

### 5.1 DECIMAL POINT SELECTION

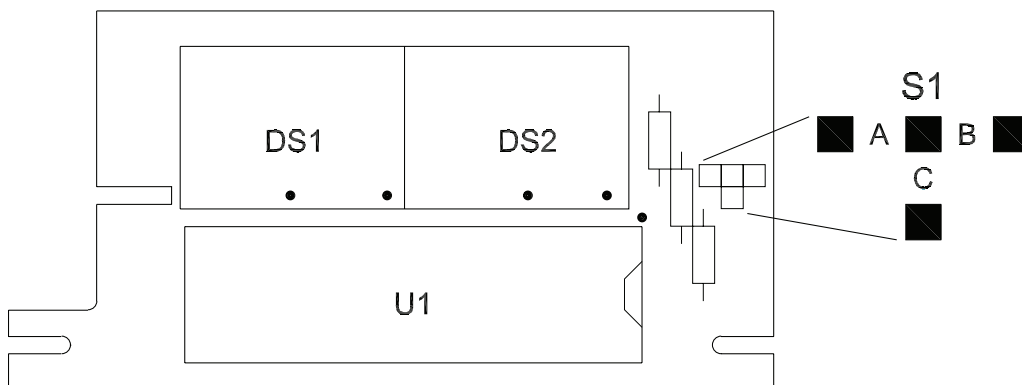
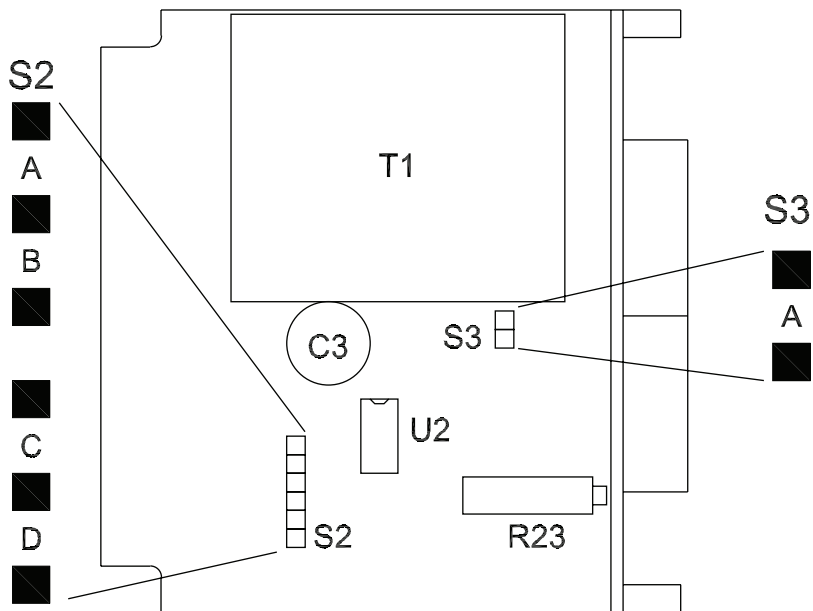


Figure 5-1 Display Board Jumper Locations

Decimal Point	S1	Alternate Decimal Point Configuration Using Main Board Connector J1
1.999	A	Connect K/9 to 6
19.99	C	Connect J/8 to 6
199.9	B	Connect H/7 to 6

## 5.2 VOLTAGE RANGE SELECTION



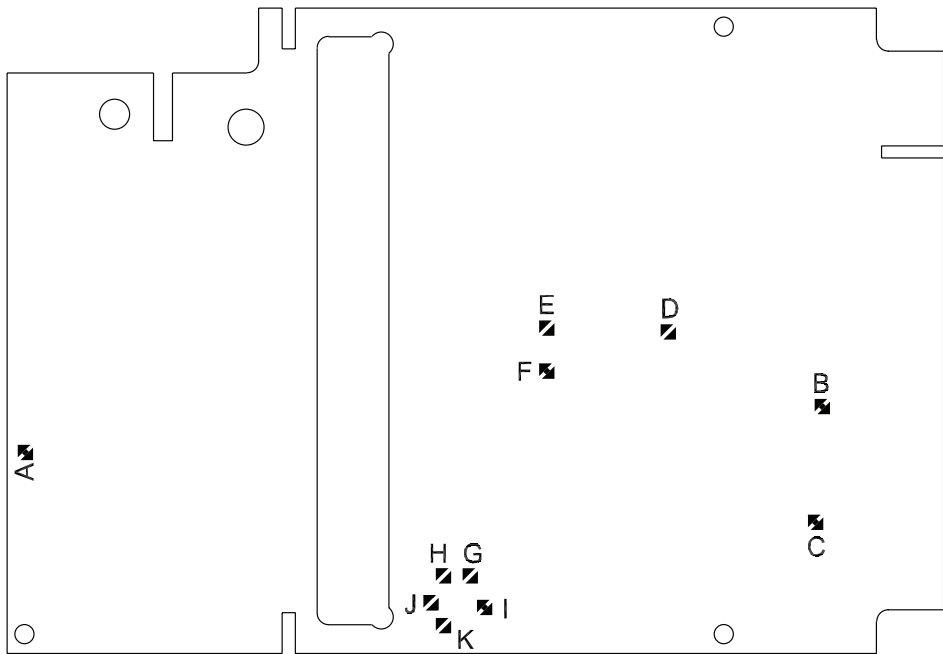
**Figure 5-2 Main Board Jumper Locations**

Input Configuration	Solder Switches*		Push-on Jumpers		Remove Jumper
	Open	Close	S2	S3	Wire
200 mV dc	-	-	A	A	
2 V dc	-	-	B	-	
20 V dc	-	-	B, C	-	
200 V dc	-	-	B, D	-	
200 V ac	I	G, K, J	B	-	E-17 to TB1B-4
650 V ac	I	H, K, J	B	-	E-17 to TB1B-4
True-differential	C	--	-	-	

\* Refer to **Figure 5-3** on the following page for solder switch locations.

### 5.3 BLANKING THE LEAST-SIGNIFICANT DIGIT

To blank the least-significant digit, open solder switch 'A' on the circuit side of the display board.



**Figure 5-3 Solder Switch Locations**

## **6.0 CALIBRATION**

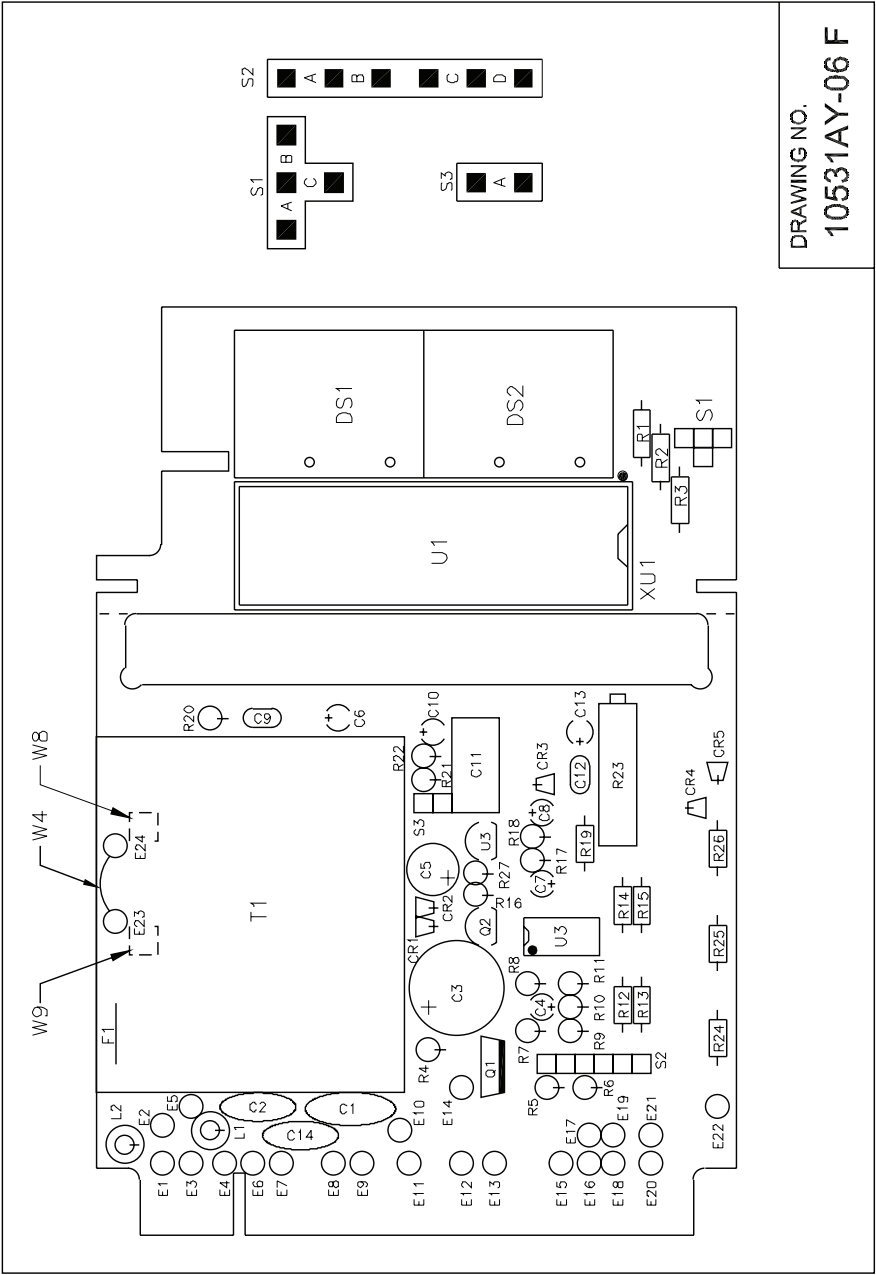
### **6.1 DC VOLTAGE RANGES**

1. Remove the front lens. Insert a blade screwdriver under the notch at the bottom of the lens and gently pry it off.
2. Short the input signal connections and verify that the display reads zero.
3. Apply an input voltage equal to 95% of the high end of the range selected.
4. Locate the Span potentiometer (R23) in **Figure 3-2**. Adjust until the display reads  $1900 \pm 1$  count.

### **6.2 AC VOLTAGE RANGES**

1. Follow steps 1 and 2 from above.
2. Apply an input voltage equal to 110.0 V ac at 50 or 60 Hz on 200 V ac range or 220 V ac at 50 or 60 Hz on 650 V ac range.
3. Locate the Span potentiometer (R23) in **Figure 3-2**. Adjust until the display reads:  
110.0 on 200 V ac range  
220 on 650 V ac range

7.0 DRAWINGS



DRAWING NO.  
10531AY-06 F

## NOTES

[illegible]

## WARRANTY/DISCLAIMER

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

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1. P.O. number under which the product was **PURCHASED**,
2. Model and serial number of the product under warranty, and
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