

# **AC RMS AND AC AVG OPTIONS**

**11032ML-01**

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## **1.0 GENERAL INFORMATION**

This manual outlines the requirements and operating characteristics of the AC RMS Option and the AC AVG Option as offered in the 204B, 2003B, and 2004 digital panel voltmeters. Both options are powered by the host DPM and each requires six insulated jumpers for interconnection with the host DPM.

A full-scale range is available for using either the AC RMS Option or the AC AVG Option with a wide variety of 5A secondary current transformers. In this configuration, a 0.01 ohm, four-lead shunt resistor must be installed on the PCB at R1. For specific details refer to Section 5.1 for the AC RMS Option and Section 5.2 for the AC AVG Option.

### **1.1 AC RMS OPTION**

The AC RMS Option is contained on a 2.8" X 1.75" X 0.062" PCB which is supported by a portion of the D4 barrier strip that is included.

Two inputs to the AC RMS Option are made through a portion of the D4 barrier strip, one is capacitor-coupled and the other is direct-coupled. The AC RMS Option may be configured for one of six voltage ranges or one of four current ranges through the use of shorting jumpers. The modifications to the host DPM are the same for all AC RMS ranges.

### **1.2 AC AVG OPTION**

The AC AVG Option is contained on a 2.75" X 1.75" X 0.062" PCB which is supported by a portion of the D4 barrier strip that is included.

Inputs to the AC AVG Option are made through a portion of the D4 barrier strip and are capacitor-coupled.

The AC AVG Option may be configured for one of six voltage ranges through the use of shorting jumpers. The modifications to the host DPM are the same for all AC AVG ranges.

## 2.0 SAFETY CONSIDERATIONS

This instrument is protected according to Class I (Protective Earth) of the IEC (International Electrotechnical Commission) 348 and the VDE 0411 regulations. To ensure safe operation, follow the guidelines below:

**VISUAL INSPECTION:** Do not attempt to operate the instrument if damage is found.

**POWER VOLTAGE:** This instrument is delivered with the AC power input connected for 240 V ac in Europe (C1 option) or 120 V ac in the USA (unless the instrument is provided with the DC power input option). Verify that the instrument is connected for the correct power voltage rating before using.

**POWER WIRING:** This instrument has no power switch; it will be in operation as soon as the power is connected.

Verify that the power cable has the proper ground (earth) wire and that this wire is properly connected to an adequate ground (earth) point. The meter must be grounded in accordance with the latest local safety regulations.

If AC, the power cable must contain a protective ground conductor which is not disconnected (open) either inside or outside the instrument. No extension cables without grounding wires shall be used.

**SIGNAL WIRING:** Do not make signal wiring connections or changes while power is on.

**RAIN OR MOISTURE:** Do not expose the instrument to condensing moisture.

**FUMES AND GASES:** Do not operate the instrument in the presence of flammable gases or fumes.

**EXERCISE CAUTION:** As with any electronic instrument, high voltages may be exposed when attempting to install, calibrate, or remove parts of the meter.

### 3.0 SPECIFICATIONS

The following specifications pertain to both the AC RMS Option and the AC AVG Option. The specifications for the AC RMS Option are for 1% to 100% of full scale. Near zero performance (1% of full scale) is not specified.

#### 3.1 CALIBRATION CONTROLS

Precision Rectifier Zero Adjust	1 turn, factory adjustment only
Zero Adjust	Host DPM's input offset adjust
Full Scale Adjust	Host DPM's full scale adjust

#### 3.2 POWER REQUIREMENTS

MODEL	E2 = +V	E3 = -V
204B	+7.5 V	-7.5 V
2003B	+12 V	-8 V
2004	+12 V	-8 V

#### 3.3 TB1 PIN ASSIGNMENTS

##### AC RMS Option

PIN	FUNCTION
1	AC Power HI
2	AC Power LO
3	AC Power GND
4	AC SIG IN (Direct-coupled)
5	AC SIG IN (Capacitor-coupled)
6	Common

##### AC AVG Option

PIN	FUNCTION
1	AC Power HI
2	AC Power LO
3	AC Power GND
4	N/C
5	AC SIG IN (Capacitor-coupled)
6	Common

#### 3.4 ENVIRONMENTAL

Operating Temperature	0 to 50°C
Storage Temperature	-40 to 75°C
Humidity	Up to 95% non-condensing at < 40°C

## 4.0 RANGE AND RESOLUTION

### 4.1 204B

#### AC RMS Option

204B AC RMS	VR1	VR2	VR3	VR4	VR5	UNITS
Input Range 1*	0.04	0.4	4	40	400	V
Resolution	0.01	0.1	1	10	100	mV
Overdrive Protection, peak	50	100	600	600	600	V
Input Resistance	1.1	1.1	1	1	1	M $\Omega$
Input Bias Current 2*	150	137	14	2	0.2	pA
Reading Tempco (Typ) 3*	.015	.015	.02	.02	.02	%R/°C
Zero Tempco (Typ) 4*	$\pm 0.12$					mV/°C
Non-linearity (Typ)	< 3					Counts
Max Error, 35 Hz to 5 kHz	$\pm 0.1\%R \pm 1$ Count					---
Max Error, 25 Hz to 10 kHz	$\pm 0.2\%R \pm 2$ Counts					---
Max Error, 23 Hz to 15 kHz 5*	$\pm 0.25\%R \pm 3$ Counts					---
Max Error, 20 Hz to 20 kHz 6*	$\pm 0.5\%R \pm 5$ Counts					---
Max Error, 20 Hz to 30 kHz 7*	$\pm 1.0\%R \pm 5$ Counts					---
Maximum Crest Factor 8*	3:1					---
Input Coupling 9* 10*	Direct or AC					---

1\* Also available with ER1 and ER2 options

2\* U1's maximum bias current 150 pA

3\* Includes host DPM reading tempco specification

4\* Includes host DPM zero tempco specification

5\* 204B-VR1,  $\pm 0.5\%R \pm 3$  Counts

6\* 204B-VR1,  $\pm 1.0\%R \pm 5$  Counts

7\* 204B-VR1,  $\pm 2.5\%R \pm 5$  Counts

8\* Crest Factor =  $V_{peak}/V_{rms}$

9\* AC input coupling capacitor = 0.12  $\mu F$

10\* 204B-VR1 AC-Coupled only

To improve frequency response, add trim capacitors at C3 and/or C4.

### AC AVG Option

204B AC AVG	VR1	VR2	VR3	VR4	VR5	UNITS
Input Range <span style="float: right;">1*</span>	0.04	0.4	4	40	400	V
Resolution	0.01	0.1	1	10	100	mV
Overdrive Protection, peak	100	100	600	600	600	V
Input Resistance	1.1	1.1	1	1	1	M $\Omega$
Reading Tempco (Typ) <span style="float: right;">2*</span>	$\pm 0.015$					%R/ $^{\circ}$ C
Zero Tempco (Typ) <span style="float: right;">3*</span>	0.1					Count/ $^{\circ}$ C
Non-linearity (Typ)	< 3					Counts
Max Error, 50 Hz to 60 Hz	$\pm 0.1\%R \pm 1$ Count					---
Max Error, 35 Hz to 2 kHz	$\pm 0.1\%R \pm 2$ Counts					---
Max Error, 20 Hz to 5 kHz	$\pm 0.3\%R \pm 2$ Counts					---
Max Error, 20 Hz to 10 kHz	$\pm 1.0\%R \pm 5$ Counts					---
Maximum Crest Factor <span style="float: right;">4*</span>	2:1					---
Input Coupling <span style="float: right;">5*</span>	AC					---

1\* Also available with ER1 and ER2 options

2\* Includes host DPM reading tempco specification

3\* Includes host DPM zero tempco specification

4\* Crest Factor =  $V_{peak}/V_{rms}$

5\* AC input coupling capacitor = 0.12  $\mu$ Fd

To improve frequency response, add trim capacitors at C3 and/or C4.

**AC RMS Option**

2003B AC RMS	VR2	VR3	VR4	VR5	UNITS	
Input Range	0.2	2	20	200	V	
Resolution	0.01	0.1	1	10	mV	
Overdrive Protection, peak	100	600	600	600	V	
Input Resistance	1.1	1	1	1	M $\Omega$	
Input Bias Current	1*	137	14	2	0.2	pA
Reading Tempco (Typ)	2*	.015	.02	.02	.02	%R/°C
Zero Tempco (Typ)	3*	$\pm 0.12$			mV/°C	
Non-linearity (Typ)		< 30			Counts	
Max Error, 35 Hz to 5 kHz		$\pm 0.1\%R \pm 10$ Counts			---	
Max Error, 25 Hz to 10 kHz		$\pm 0.2\%R \pm 20$ Counts			---	
Max Error, 23 Hz to 15 kHz		$\pm 0.25\%R \pm 30$ Counts			---	
Max Error, 20 Hz to 20 kHz		$\pm 0.5\%R \pm 50$ Counts			---	
Max Error, 20 Hz to 30 kHz		$\pm 1.0\%R \pm 50$ Counts			---	
Maximum Crest Factor	4*	3:1			---	
Input Coupling	5*	Direct or AC			---	

1\* U1's maximum bias current 150 pA

2\* Includes host DPM reading tempco specification

3\* Includes host DPM zero tempco specification

4\* Crest Factor =  $V_{peak}/V_{rms}$

5\* AC input coupling capacitor = 0.12  $\mu$ Fd

To improve frequency response, add trim capacitors at C3 and/or C4.

### AC AVG Option

2003B AC AVG	VR2	VR3	VR4	VR5	UNITS
Input Range	0.2	2	20	200	V
Resolution	0.01	0.1	1	10	mV
Overdrive Protection, peak	100	600	600	600	V
Input Resistance	1.1	1	1	1	M $\Omega$
Reading Tempco (Typ) 1*	$\pm 0.015$				%R/ $^{\circ}$ C
Zero Tempco (Typ) 2*	1.0				Count/ $^{\circ}$ C
Non-linearity (Typ)	< 30				Counts
Max Error, 50 Hz to 60 Hz	$\pm 0.1\%R \pm 10$ Counts				---
Max Error, 35 Hz to 2 kHz	$\pm 0.1\%R \pm 20$ Counts				---
Max Error, 20 Hz to 5 kHz	$\pm 0.3\%R \pm 20$ Counts				---
Max Error, 20 Hz to 10 kHz	$\pm 1.0\%R \pm 50$ Counts				---
Maximum Crest Factor 3*	2:1				---
Input Coupling 4*	AC				---

1\* Includes host DPM reading tempco specification

2\* Includes host DPM zero tempco specification

3\* Crest Factor =  $V_{peak}/V_{rms}$

4\* AC input coupling capacitor = 0.12  $\mu$ Fd

To improve frequency response, add trim capacitors at C3 and/or C4.

## AC RMS Option

2004 AC RMS	VR2	VR3	VR4	VR5	UNITS
Input Range	0.4	4	40	400	V
Resolution	0.01	0.1	1	10	mV
Overdrive Protection, peak	100	600	600	600	V
Input Resistance	1.1	1	1	1	M $\Omega$
Input Bias Current	1*	137	14	2	pA
Reading Tempco (Typ)	2*	.015	.02	.02	%R/°C
Zero Tempco (Typ)	3*	±0.12			mV/°C
Non-linearity (Typ)		< 30			Counts
Max Error, 35 Hz to 5 kHz		±0.1%R ±10 Counts			---
Max Error, 25 Hz to 10 kHz		±0.2%R ±20 Counts			---
Max Error, 23 Hz to 15 kHz		±0.25%R ±30 Counts			---
Max Error, 20 Hz to 20 kHz		±0.5%R ±50 Counts			---
Max Error, 20 Hz to 30 kHz		±1.0%R ±50 Counts			---
Maximum Crest Factor	4*	3:1			---
Input Coupling	5*	Direct or AC			---

1\* U1's maximum bias current 150 pA

2\* Includes host DPM reading tempco specification

3\* Includes host DPM zero tempco specification

4\* Crest Factor =  $V_{peak}/V_{rms}$

5\* AC input coupling capacitor = 0.12  $\mu$ Fd

To improve frequency response, add trim capacitors at C3 and/or C4.

### AC AVG Option

2004 AC AVG	VR2	VR3	VR4	VR5	UNITS
Input Range	0.4	4	40	400	V
Resolution	0.01	0.1	1	10	mV
Overdrive Protection, peak	100	600	600	600	V
Input Resistance	1.1	1	1	1	M $\Omega$
Reading Tempco (Typ) 1*	$\pm 0.01$				%R/ $^{\circ}$ C
Zero Tempco (Typ) 2*	1.0				Count/ $^{\circ}$ C
Non-linearity (Typ)	< 30				Counts
Max Error, 50 Hz to 60 Hz	$\pm 0.1\%R \pm 10$ Counts				---
Max Error, 35 Hz to 2 kHz	$\pm 0.1\%R \pm 20$ Counts				---
Max Error, 20 Hz to 5 kHz	$\pm 0.3\%R \pm 20$ Counts				---
Max Error, 20 Hz to 10 kHz	$\pm 1.0\%R \pm 50$ Counts				---
Maximum Crest Factor 3*	2:1				---
Input Coupling 4*	AC				---

1\* Includes host DPM reading tempco specification

2\* Includes host DPM zero tempco specification

3\* Crest Factor =  $V_{peak}/V_{rms}$

4\* AC input coupling capacitor = 0.12  $\mu$ Fd

To improve frequency response, add trim capacitors at C3 and/or C4.

## 5.0 FACTORY SET-UP PROCEDURE

### 5.1 AC RMS Option

The 50 mV range (FS - option CR7) supports a wide variety of 5 A secondary current transformers. After the AC RMS Option has been configured for the FS range, the value of R16 has to be selected to provide the correct number of full-scale counts. The following table lists the value of R16 ( $\pm 1\%$ , 1/8 W, Metal Film resistor, RN55E or equivalent) for some of the available current transformer primary ranges.

PRIMARY RANGE	FULL-SCALE COUNTS	R16
0-25 A	2500	26.1 k
0-50 A	5000	191 k
0-75 A	750	4.53 k
0-100 A	1000	6.65 k
0-150 A	1500	11.8 k
0-200 A	2000	18.2 k
0-250 A	2500	26.1 k
0-300 A	3000	37.4 k
0-400 A	4000	75.0 k
0-500 A	5000	191 k
0-600 A	6000	OPEN
0-750 A	750	4.53 k
0-800 A	800	4.87 k
0-1000 A	1000	6.65 k
0-1500 A	1500	11.8 k
0-2000 A	2000	18.2 k

In the event that the resolution is different from that of the table or a range is not covered by the table, the value of R16 may be determined as follows:

Solve for RT in ohms:  $RT = (6.7 \times \text{desired counts at full scale}) - 1000$

Solve for R16 in ohms:  $R16 = \frac{(3.92 \times 10^4) \times (RT)}{(3.92 \times 10^4) - RT}$

OR

Solve for R16:  $\frac{1}{R16} = \frac{1}{(6.7 \times \text{desired counts at full scale}) - 1000} - \frac{1}{3.92 \times 10^4}$

## 5.2 AC AVG Option

The 50 mV range (FS - option CR7) supports a wide variety of 5 A secondary current transformers. After the AC AVG Option has been configured for the FS range, the value of R8 has to be selected to provide the correct number of full-scale counts. The following table lists the value of R8 ( $\pm 1\%$ , 1/8 W, Metal Film resistor, RN55E or equivalent) for some of the available current transformer primary ranges.

PRIMARY RANGE	FULL-SCALE COUNTS	R8
0-25 A	2500	40.2 k
0-50 A	5000	287 k
0-75 A	750	7.32 k
0-100 A	1000	10.7 k
0-150 A	1500	18.2 k
0-200 A	2000	28.0 k
0-250 A	2500	40.2 k
0-300 A	3000	57.6 k
0-400 A	4000	115 k
0-500 A	5000	287 k
0-600 A	6000	OPEN
0-750 A	750	7.32 k
0-800 A	800	7.87 k
0-1000 A	1000	10.7 k
0-1500 A	1500	18.2 k
0-2000 A	2000	28.0 k

In the event that the resolution is different from that of the table or a range is not covered by the table, the value of R8 may be determined as follows:

Solve for RT in ohms:  $RT = (10 \times \text{desired counts at full scale}) - 1000$

Solve for R8 in ohms:  $R8 = \frac{(5.9 \times 10^4) \times (RT)}{(5.9 \times 10^4) - RT}$

OR

Solve for R8:  $\frac{1}{R8} = \frac{1}{(10 \times \text{desired counts at full scale}) - 1000} - \frac{1}{5.9 \times 10^4}$

# 6.0 DRAWINGS

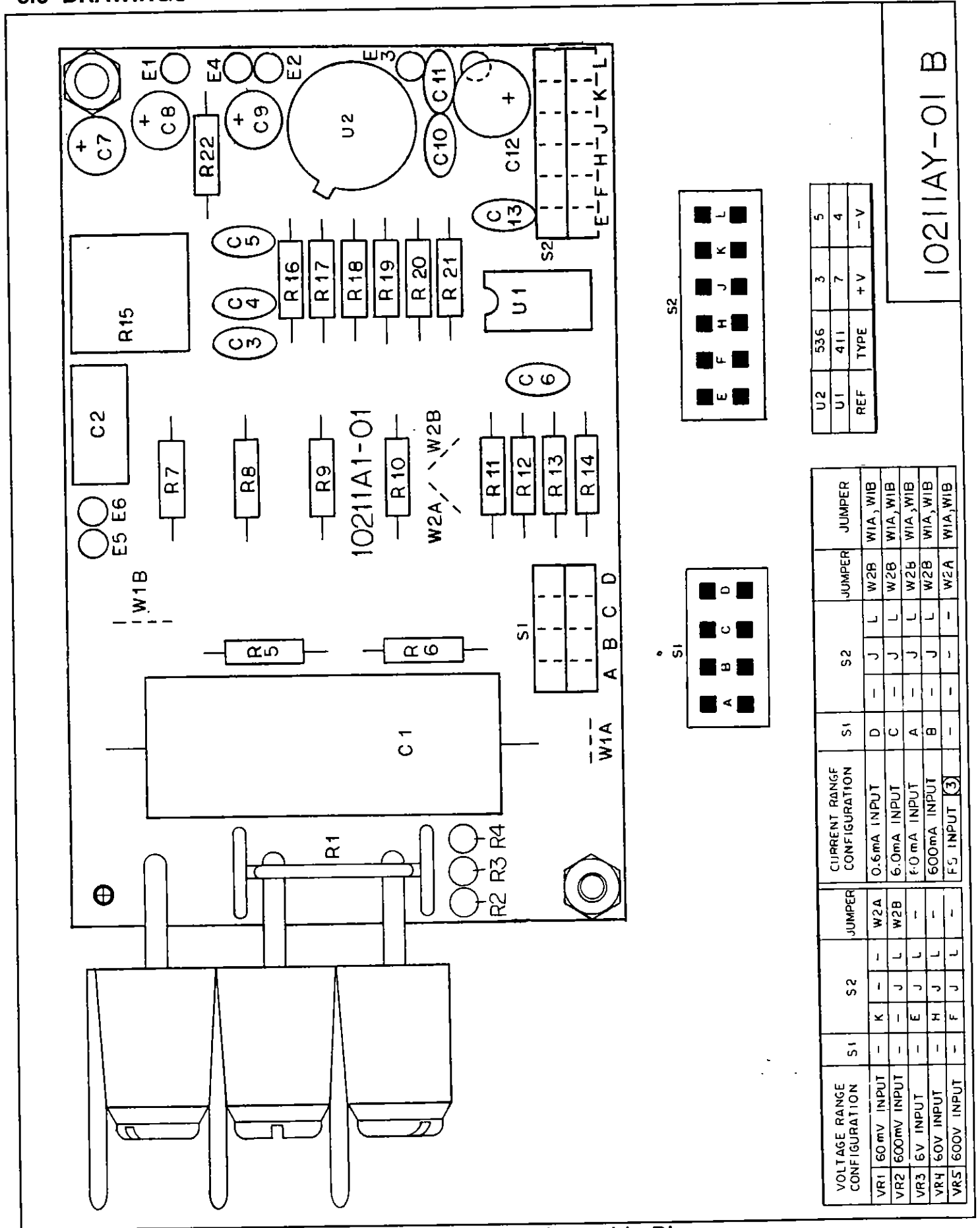
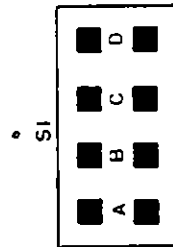
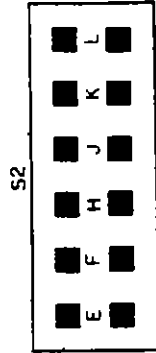


Figure 6-1 AC RMS Option Assembly Diagram

U2	536	3	5
U1	411	7	4
REF	TYPE	+V	-V

VOLTAGE RANGE CONFIGURATION	S1	S2	JUMPER	CURRENT RANGE CONFIGURATION	S1	S2	JUMPER	JUMPER		
VR1 60 mV INPUT	-	-	K	0.6mA INPUT	D	-	J	L	W2B	W1A, W1B
VR2 600mV INPUT	-	-	-	6.0mA INPUT	C	-	J	L	W2B	W1A, W1B
VR3 6V INPUT	-	-	E	6.0mA INPUT	A	-	J	L	W2B	W1A, W1B
VR4 60V INPUT	-	-	H	600mA INPUT	B	-	J	L	W2B	W1A, W1B
VR5 600V INPUT	-	-	F	FS INPUT (3)	-	-	-	-	W2A	W1A, W1B



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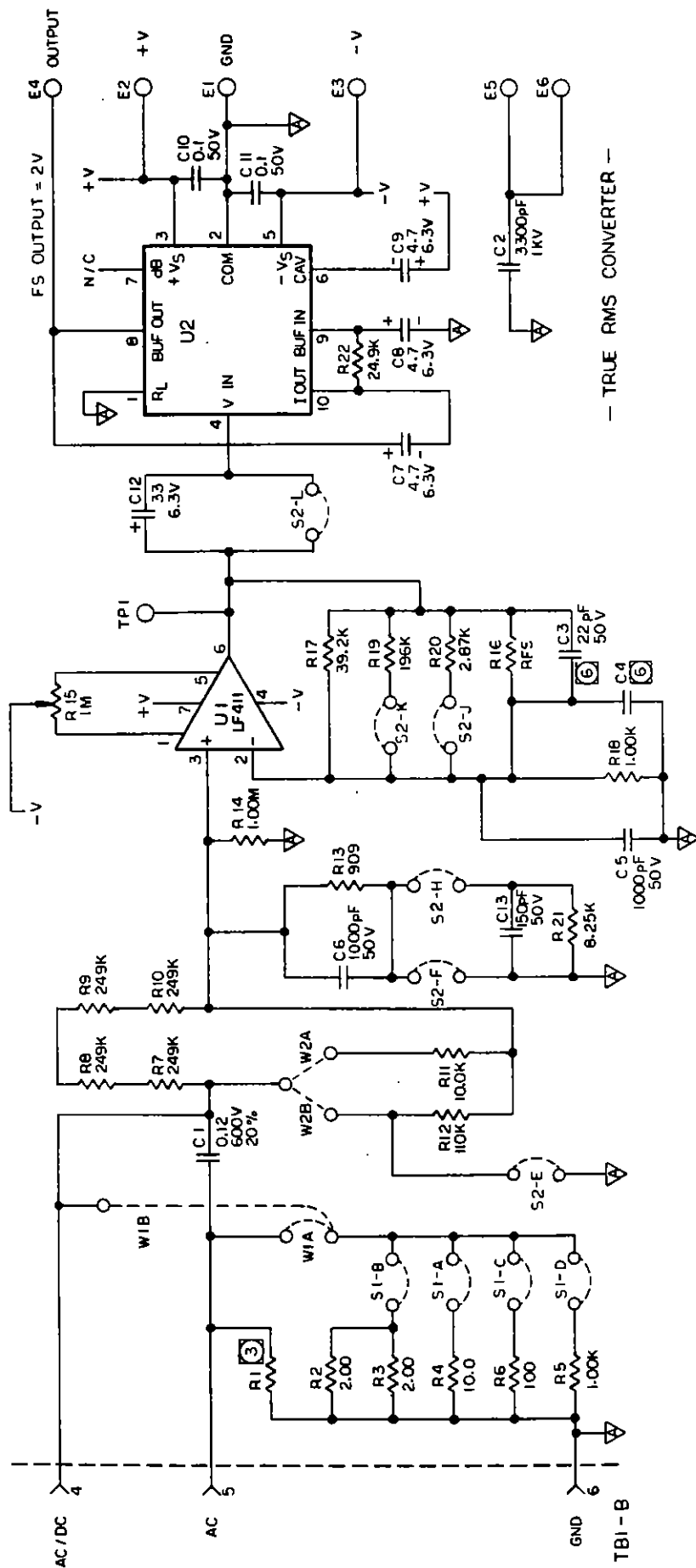


Figure 6-2 AC RMS Option Schematic Diagram

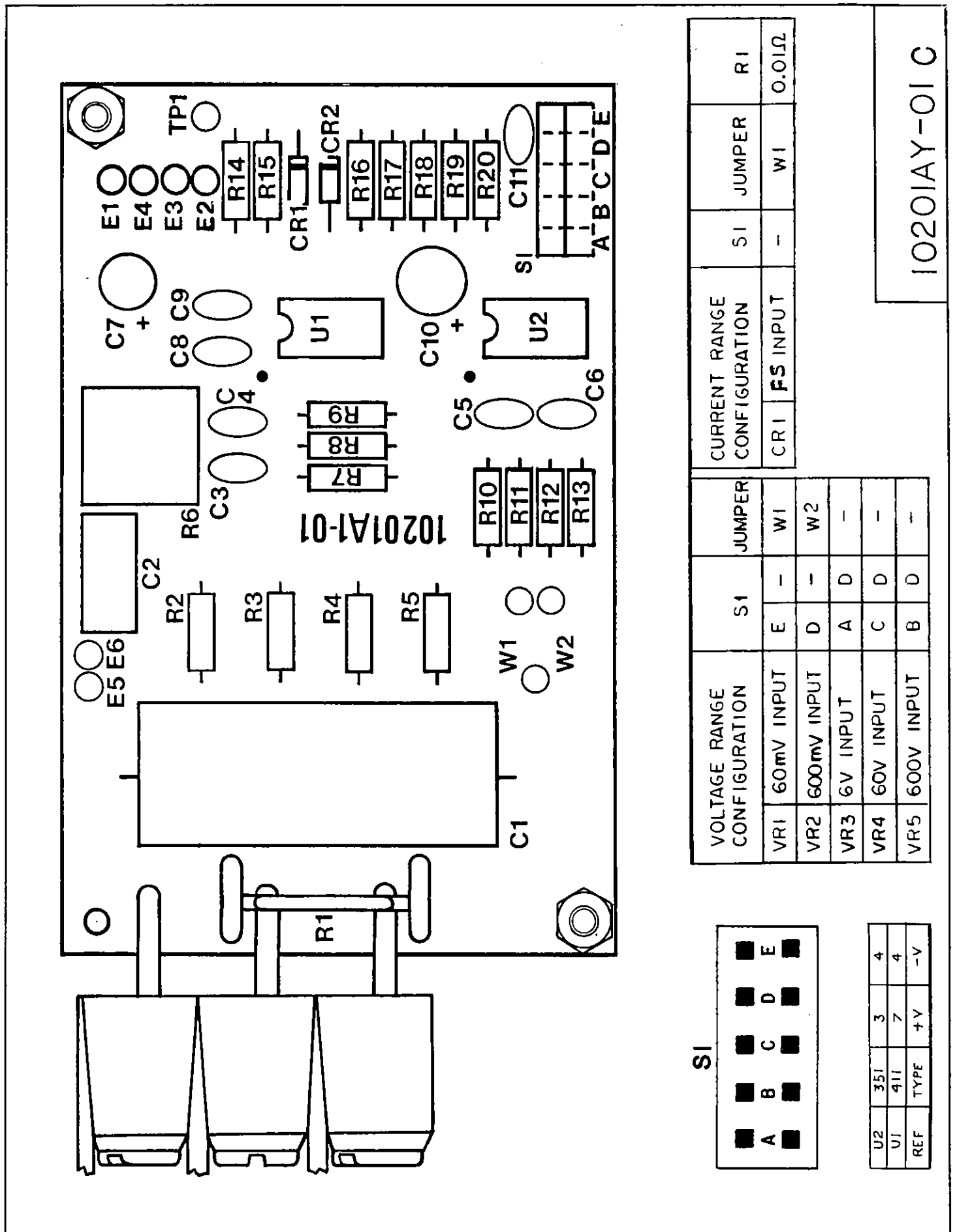
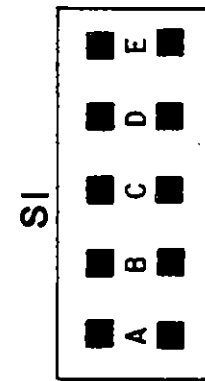


Figure 6-3 AC AVG Option Assembly Diagram



U2	351	3	4
U1	411	7	4
REF	TYPE	+V	-V

VOLTAGE RANGE CONFIGURATION	S1	JUMPER	
		E	W1
VR1 60mV INPUT	-	-	W1
VR2 600mV INPUT	-	D	W2
VR3 6V INPUT	A D	-	-
VR4 60V INPUT	C D	-	-
VR5 600V INPUT	B D	-	-

CURRENT RANGE CONFIGURATION		S1	JUMPER	R1
CR1	F5 INPUT			
-	-	-	W1	0.01Ω

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**NOTES:**