2004

DIGITAL PANEL METER

Operator's Manual

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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.

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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

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.

1.0 DESCRIPTION

1.1 GENERAL

Newport Model 2004 Digital Panel Voltmeter is a low-cost reliable instruments for digital display of analog bipolar voltages. The display is 39999 counts on any of four ranges from 399.99 mV to 399.99 V.

The Model 2004 DPVM is a line powered meter with 14 mm high, 7-segment LED readout. The housing is a break-resistant black phenylene oxide case. Zero adjustment and full scale adjustment are 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 2004 performs true bipolar signal integration around zero. Many competitive meters rectify the signal before integration which erroneously adds the absolute value of the normal mode noise to the signal reading. The Model 2004 average value circuit provides full normal mode and superior ac line transient noise rejection at signal levels from zero to full scale.

Ratio measurements are possible with the Model 2004 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 parallel BCD, compatible with TTL and DTL. External control signals are also TTL and DTL compatible and increase the flexibility and ease of interfacing the Model 2004 with other instruments.

1.2 SPECIFICATIONS

1.2.1 Input

Model	2004-2	2004-3	2004-4	2004-5	Units
Range	0.4	4	40	400	V
Resolution	0.01	0.1	1	10	mV
Overdrive Protection	100	100	250	500	V
Input Resistance	1000	1000	1.1	1	MΩ
Input Bias Current	2	2	0.2	0.02	nA
Reading Tempco (Typ)	.0015	.001	.002	.002	%R/°C
Zero Noise Digits (Typ)	.4	.3			P-P counts
Full Scale Noise Digits (Typ)	.7	.5			P-P counts
Non-linearity	< 1.5	< 1			counts
External Reference Voltage	+.1 → +.4	+1.00 → +4.00			V
Ratio Accuracy (1) (2)	99.95 ±.05				%R
Ratio Linearity	< ±.05 (.03 Typ)				%R
Ratio Input Resistance (3)	260	2.6K			Ω

(1) The HZ option must be used with the 2004-2 to meet specified accuracy.

(2) R40 may be used as a limited ratio accuracy adjustment in Models 2004-3, -4, and -5 (without HZ option).

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

1.2.2 Accuracy @ 25°C

Total Error	±0.005%R ±10 μV ±1 count
Offset Tempco	(±2 μV ±.1 count)/°C
Warmup Time	1 hour

1.2.3 Conversion

Technique	Dual Slope, average value
Signal Integration Period	33 mSec (60 Hz); 40 mSec (50 Hz)
Read Rate	3.3/Sec (60 Hz) or2.8/Sec (50 Hz). 0-3.3/Sec (60 Hz) or 0-2.8/Sec (50 Hz) with external control.
Polarity	Automatic

1.2.4 Input Characteristics

Type	Single-ended (analog ground common to signal low)
Settling Time	2 readings (asynchronous input step)
NMR	75 dB @ 50 Hz or 60 Hz
CMR	120 dB @ 50 Hz or 60 Hz
Zero	Automatic
Ratio Measurement	3-wire

1.2.5 Calibration Controls

Full Scale Adjust (R41)	20 turn, accessible behind front lens; ±1.25%, 7.2°/count @ full scale
Full Scale Turnover (R40)	1 turn, factory adjustment only, ±.075%, 5°/count @ full scale
Input Offset (R42)	20 turn, accessible behind front lens; ±25 counts (±2.5 mV), 144°/count.
Zero Width (R39)	1 turn, factory adjustment only; -2 +5 counts

1.2.6 Display

Type	14.2mm (.56"), 7-segment LED
Symbols	-3.8.8.8.8
Decimal Points	Four (to the left of the four LSD's)
Overload Indicator	Display flashes
Polarity Sign	Minus
Color	Red filter

1.2.7 Digital Signals

DIGITAL I/O DRIVE REQUIREMENTS

DESCRIPTION	LOGICAL '0'	LOGICAL '1'	ISINK	ISOURCE	INPUT	OUTPUT
Parallel BCD	0 V - .5 V	2.4 V - 5.0 V	4.8 mA	.4 mA		X
+ POLARITY	0 V - .4 V	2.4 V - 5.0 V	14.4 mA	.4 mA		X
$\overline{\text{HOLD}}$	0 V - .6 V	2.0 V - 5.0 V	.3 mA	1.7 mA	X	
$\overline{\text{DATA READY}}$	0 V - .4 V	2.4 V - 5.0 V	4.8 mA	.4 mA		X
Overload	0 V - .5 V	2.4 V - 5.0 V	4.8 mA	.4 mA		X

1.2.8 AC Power

Input Voltage	115 V ac ±10%
Frequency Range	47 to 63 Hz
Input Power	4.5W (5W max)
Optional Input Voltages	C6 - 115 V ac, ±10%, 50 Hz
	C7 - 230 V ac, ±10%, 60 Hz
	C1 - 230 V ac, ±10%, 50 Hz
	C5 - 100 V ac, ±10%, 50 Hz
	C8 - 24 V ac, ±10%, 60 Hz
	C9 - 24 V ac, ±10%, 50 Hz
	C3 - 5 V dc, ±5% (60 Hz rejection)
	C4 - 5 V dc, ±5% (50 Hz rejection)

1.2.9 Temperature

Operating Temp.	0°C to 50°C
Storage Temp.	-40°C to 75°C
Humidity	Up to 95% non-condensing at $\leq$40°C

1.2.10 Mechanical

Weight	480g
Case Material	Black Phenylene Oxide
Case Size - DIN 1A	
Bezel(WxHxT)	96x48x6 mm (3.78x1.89x0.24 in)
Depth Behind Bezel w/Conn.	135.4 mm (5.33 in)
Panel Cutout	92x45 mm (3.62x1.77 in)

Case Size - NEMA (Optional)	
Bezel	104x48x19 mm (4.09x1.88x0.75 in)
Depth Behind Bezel w/Conn.	125 mm (4.91 in)
Panel Cutout	99.6x42.9 mm (3.92x1.69 in)

2.0 RECEIVING AND INSTALLATION

2.1 UNPACKING AND INSPECTION

Your Model 2004 was fully inspected and tested, then carefully packed before shipment. Unpack the meter carefully and inspect it for obvious shipping damage.

2.2 INITIAL CHECKOUT PROCEDURE

CAUTION

Meters are internally connected for 24, 100, 115 or 230 V ac or 5 V dc power. Check label on meter for proper supply voltage.

2.2.1 Required Equipment

(1) Appropriate power source (5 W) as indicated by the label.

(2) Calibrated voltage source.

Test Procedure

(1) Connect signal as follows:

SIGNAL IN to Pin 17.

ANALOG GND IN to Pin 16.

(2) Connect power as follows:

AC HI to Pin A.

AC LO to Pin 2.

AC GND to Pin C.

(3) Verify that a key is between Pins 3 and 4.

(4) Pins 1, 3 and B must be removed from connector.

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

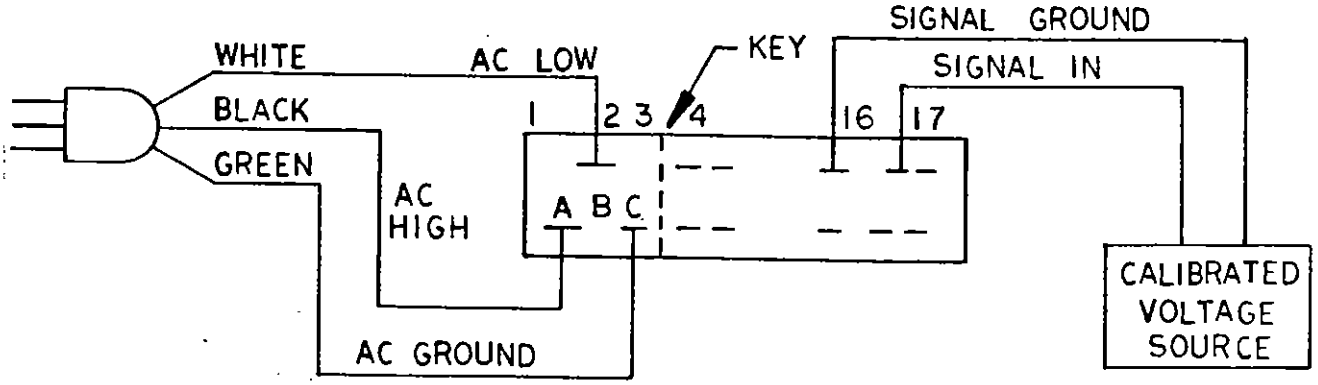


Figure 1

2.3 MECHANICAL INSTRUCTIONS

2.3.1 DIN IA

The drawing number 06896 illustrates the mounting method for your panel voltmeter. The unit is inserted from the front of the panel and held in place by two extrusions. The panel thickness may be between .8 mm (.03") and 6.4 mm (.25").

2.3.2 NEMA (Optional)

The drawing number 05169 illustrates the mounting method for your panel voltmeter. The unit is inserted from the front of the panel and held in place by a "U" bracket. The panel thickness may be between .75 mm (.03") and 6.35 mm (.25").

3.0 OPERATING INSTRUCTIONS

3.1 PIN ASSIGNMENTS

PIN	NAME	PIN	NAME
1	No Connection	A	AC HI
2	AC LO	B	No Connection
3	No Connection	C	AC GND
4	BCD 8	D	BCD 10
5	BCD 4	E	BCD 20
6	BCD 2	F	BCD 40
7	BCD 1	H	BCD 80
8	BCD 800	J	BCD 1 K
9	BCD 400	K	BCD 2 K
10	BCD 200	L	BCD 4 K
11	BCD 100	M	BCD 8 K
12	BCD 10 K	N	+ POLARITY
13	BCD 20 K	P	$\overline{\text{DATA READY}}$
14	DECIMAL POINT B	R	$\overline{\text{HOLD}}$
15	BCD 40 K (Overload)	S	DECIMAL POINT A
16	ANALOG GND IN	T	DIGITAL GND
17	SIGNAL IN	U	Spare
18	Spare	V	REFERENCE HI IN

3.1.1 Connector Type

SAE	#SCC18D/1-2*
ELCO	#00-6007-036-450-012*

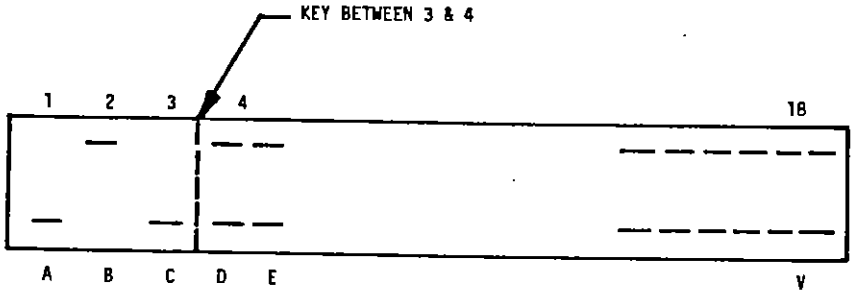


Figure 2
*Pins 1, 3, & B must be removed.

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

3.2 POWER

3.2.1 Input Voltage

The standard meter operates from 115 V ±10%, 60 Hz. It consumes about 4.5 watts. A three-wire connection should be used to connect power to the meter. Two conductors provide power and the third provides a ground for noise rejection. See Section 1.2.8 for optional 50 Hz and 60 Hz input voltages.

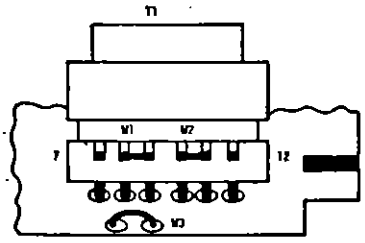
3.2.2 Input Voltage Change

To change the input voltage requirements of the meter from 115 V to 230 V, in the field, the following procedure should be used:

(1) Remove power lines from the meter and remove the meter from the case.

(2) Remove the two jumpers, W1 and W2, located on the transformer.

(3) Add jumper W3 on the printed circuit board. The meter is now wired for 230 V.



To change from 230 V to 115 V input use the reverse of the above procedure.

If other input voltages are required, contact the factory.

3.2.3 Input Frequency Change

The standard Model 2004 is shipped from the factory for 60 Hz operation. If a frequency change is required, the clock frequency must be changed.

The following table summarizes the part changes required to operate from 50 or 60 Hz power.

	50 Hz		60 Hz	
Model	R29	Y1	R29	Y1
2004-2	2.80 k (3)	250 k Hz (5)	2.32 k (6)	300 k Hz (8)
2004-3,4,5	28.0 k (4)	250 k Hz (5)	23.2 k (7)	300 k Hz (8)

(3) ±1%, 1/8W, metal film resistor, NEI P/N 8212801

(4) ±1%, 1/8W, metal film resistor, NEI P/N 8212802

(5) Resonator, NEI P/N 05797

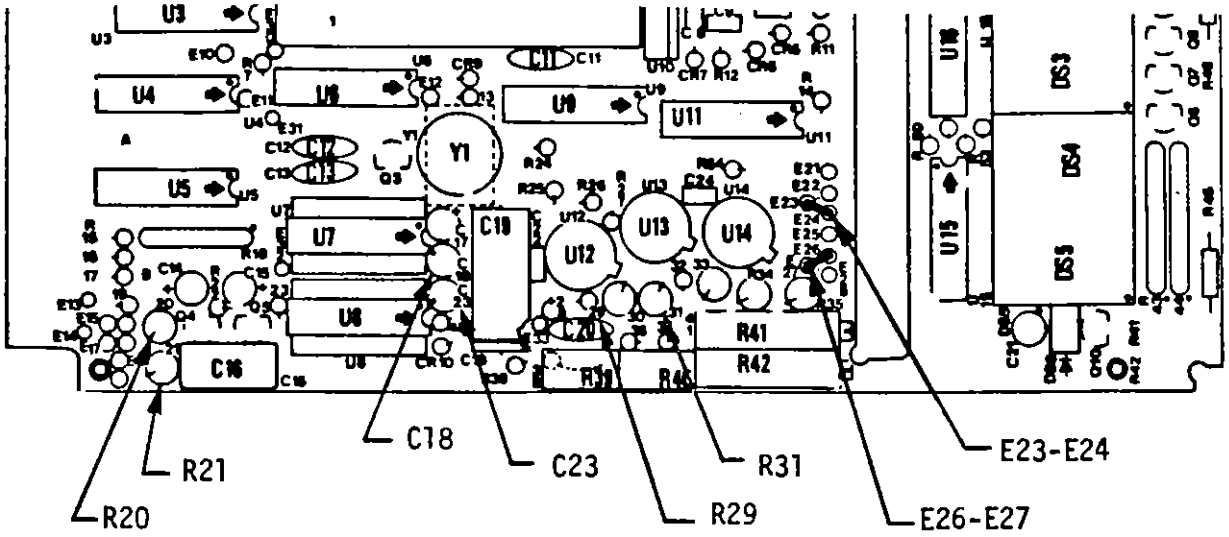
(6) ±1%, 1/8W, metal film resistor, NEI P/N 8212321

(7) ±1%, 1/8W, metal film resistor, NEI P/N 8212322

(8) Resonator, NEI P/N 05798

3.3 SIGNAL INPUT

For best results, shielded, twisted cable should be used for the input signal, with the shield terminated to ANALOG GND IN (Pin 16) at the connector. Analog Ground and Digital Ground are internally connected and should not be connected externally.



3.3.2 Range Change

The standard meter is a 2004-3. To change from ±3.9999 V to ±399.99 mV full scale, use Procedure A; from ±3.9999 to ±39.999 V full scale, use Procedure B; from ±3.9999 V to ±399.99 full scale, use Procedure C.

PROCEDURE A; from ±3.9999 V to ±399.99 mV

1. Remove and replace R29 with a 2.32 k, ±1%, 1/8W, Metal Film resistor (P/N 8212321) for 60 Hz operation or a 2.80 k, ±1%, 1/8W, Metal Film resistor (P/N 8212801) for 50 Hz operation and R28, a 10 k, ±5%, 1/4W, Carbon Film resistor (P/N 8045103).
2. Add C23, a 33 uFd, 6.3 V dip tantalum capacitor (P/N 7111336).
3. Add R31, 292.1 ohm, ±1%, 1/8W, wire wound resistor (P/N 8529218).
4. Add jumper E26-E27 (P/N 9001401, 1XX.XX d.p.).
5. Recalibrate the meter for +399.99 mV full scale.

PROCEDURE B; from ±3.9999 V to ±39.999 V

1. Remove and replace R21 with a 1 megohm, ±1%, 1/8W, wire wound resistor (P/N 8510003).
2. Add R20, 111 k ohm, ±1%, 1/8W, wire wound resistor (P/N 8511102).
3. Remove and discard jumper E22-23.
4. Add jumper E23-24 for 1X.XXX d.p. (Decimal Point B, P1-Pin 14).
5. Recalibrate the meter for +39.999 V full scale.

PROCEDURE C; from ±3.9999 V to ±399.99 V

1. Remove and replace R21 with a 1 megohm, ±1%, 1/8W, wire wound resistor (P/N 8510003).
2. Add R20, 10 k ohm, ±1%, 1/8W, wire wound resistor (P/N 8510001).
3. Add jumper E26-E27 for the 1XX.XX d.p. (Decimal Point A, P1-Pin S).
4. Recalibrate the meter for +399.99 V full scale.

When changing any range, the span of the full scale pot may not be sufficient to recalibrate the meter. In this event, R32 (604 k ±1% Metal Film P/N 8216043) must be clipped out or soldered into the circuit board. If the meter reads too high, R32 must be soldered in. If the meter reads too low, R32 must be removed.

3.3.3 Ground Precautions

It is essential that the ground connections to the Model 2004 be proper for accurate readings. The input stage is single-ended and analog ground is internally connected to digital ground through a low internal resistance.

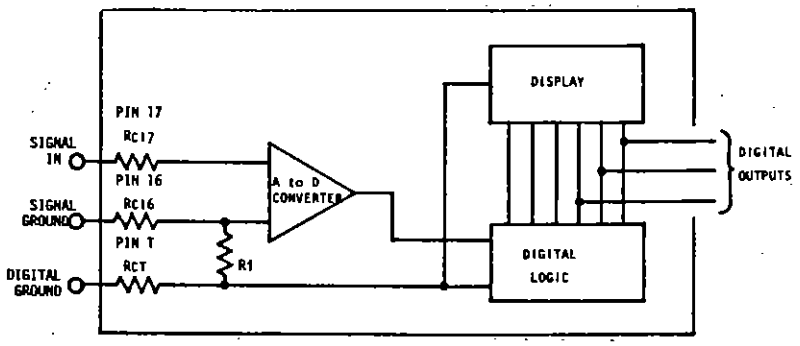


Figure 3

Model 2004 Internal Grounds

The contact resistances resulting from the connection between the connector and the printed circuit board are shown as lumped resistors, RC_{17}, RC_{16}, and RcT. 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 DIGITAL GND. This allows the digital current to flow only through RcT, causing a voltage drop on the digital line only. There will be no voltage drop across RC_{16} or Ri and the meter will read the signal correctly. There will exist a small voltage difference between Pin 16 and Pin T.

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_{16} or RcT. 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 2004 is to tie the two ground connections together at the source. This creates a ground loop and the voltage drop across RcT appears across RC_{16} 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.

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

On the 40 V and 400 V ranges, the reference voltage must be scaled by 1/10 or 1/100 respectively. The reference input impedance for the 400 mV range is about 260 ohms. For the 4 V, 40 V, and 400 V ranges the impedance is 2.6 k ohms. The reference voltage must be between the limits specified and must be positive with respect to signal low.

3.5 DIGITAL SIGNALS

DESCRIPTION	LOGICAL '0'	LOGICAL '1'	ISINK	ISOURCE	IN	OUT
Parallel BCD	0 V - .5 V	2.4 V - 5.0 V	4.8 mA	.4 mA		X
+POLARITY	0 V - .4 V	2.4 V - 5.0 V	14.4 mA	.4 mA		X
$\overline{\text{HOLD}}$	0 V - .6 V	2.0 V - 5.0 V	.3 mA	1.7 mA	X	
$\overline{\text{DATA READY}}$	0 V - .4 V	2.4 V - 5.0 V	4.8 mA	.4 mA		X
Overload	0 V - .5 V	2.4 V - 5.0 V	4.8 mA	.4 mA		X

DIGITAL I/O DRIVE REQUIREMENTS

3.5.1 Parallel BCD Outputs

The data outputs are parallel BCD and are TTL and DTL compatible. The outputs are stable and valid while $\overline{\text{DATA READY}}$ (Pin P) is low.

3.5.2 + POLARITY (Pin N)

The + POLARITY output is a logical '1' when the meter indicates a positive reading.

3.5.3 $\overline{\text{HOLD}}$ (Pin R)

When a logical '0' is applied to the $\overline{\text{HOLD}}$ input, the meter will finish the coversion cycle it is on and will hold that reading. If it is applied before the beginning of a conversion, the meter will not start that conversion. Upon a logical '1' at the $\overline{\text{HOLD}}$ input, a new conversion will begin within 125 ±8.3 msec.

3.5.4 $\overline{\text{DATA READY}}$ (Pin P)

$\overline{\text{DATA READY}}$ will go to a logical '0' at the end of a conversion cycle and to logical '1' at the beginning of a conversion cycle. NOTE: $\overline{\text{DATA READY}}$ actually overlaps both ends of the conversion cycle; a full clock cycle before conversion starts and a half clock cycle after conversion ends, allowing adequate set-up times for either edge of Data Ready to transfer data (one clock cycle: 3.3 us at 60 Hz operation, 4 us at 50 Hz operation).

3.5.5 Overload (Pin 15)

Overload is the parallel BCD 40 k bit. Overload will go to a logical '1' if the display is greater than 39999. It is stable while $\overline{\text{DATA READY}}$ is low.

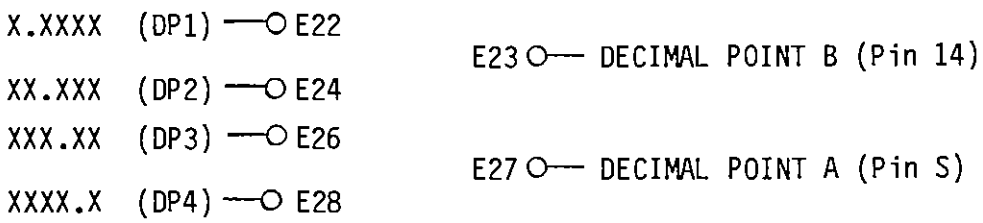
3.6 DECIMAL POINTS

Any of the four decimal points to the left of the four least significant digits can be lighted. The decimal points blank during overload. Two wire jumpers located at the front of the main board select of the two rightmost decimal points and one of the two leftmost decimal points to be controlled by pins on the rear connector. DECIMAL POINT A (Pin S) is one of the two rightmost decimal points, DECIMAL POINT B (Pin 14) is one of the two leftmost decimal points.

JUMPER	DECIMAL POINT	GROUND P1 PIN
E22-E23	X.XXXX (DP1)	14
E23-E24	XX.XXX (DP2)	14
E26-E27	XXX.XX (DP3)	S
E27-E28	XXXX.X (DP4)	S

DECIMAL POINT CONFIGURATION

Decimal points are lit by grounding the appropriate pin (to J1-Pin T). If a pin is grounded, the grounding device must be capable of sinking .5 mA.



In practice, E23 and E27 can be configured to light any two of the four decimal points in any of the possible combinations.

4.0 THEORY OF OPERATION

The Model 2004 Panel Voltmeter uses the dual slope method of conversion. Many state-of-the-art panel meters use dual slope conversion, but the Model 2004 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;

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

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 zero the integrator and comparator for the next reading.

The readings are synchronized to the ac power since the read-rate generator is clocked by the ac line frequency. A '0' on the $\overline{\text{HOLD}}$ 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;

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

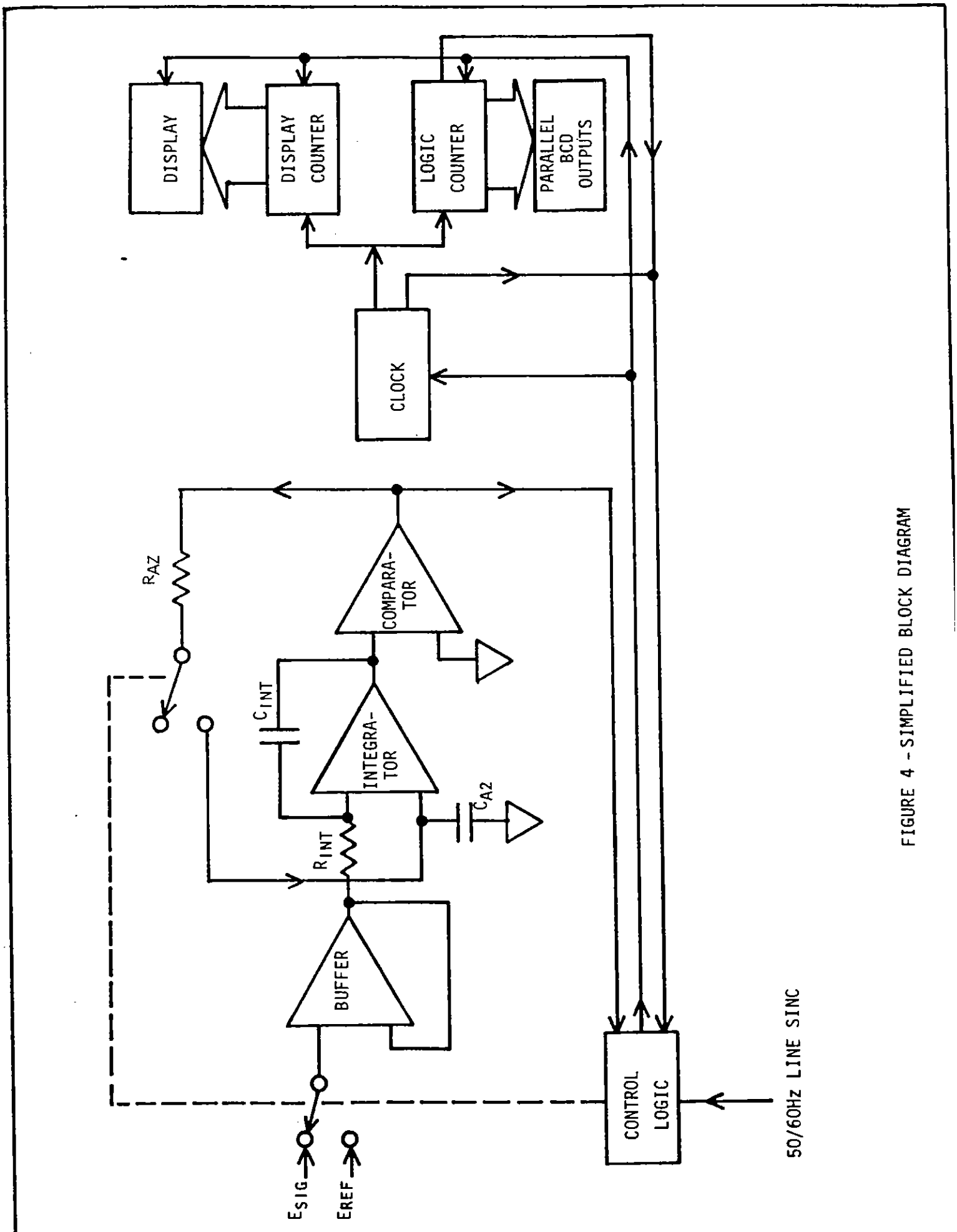


FIGURE 4 - SIMPLIFIED BLOCK DIAGRAM

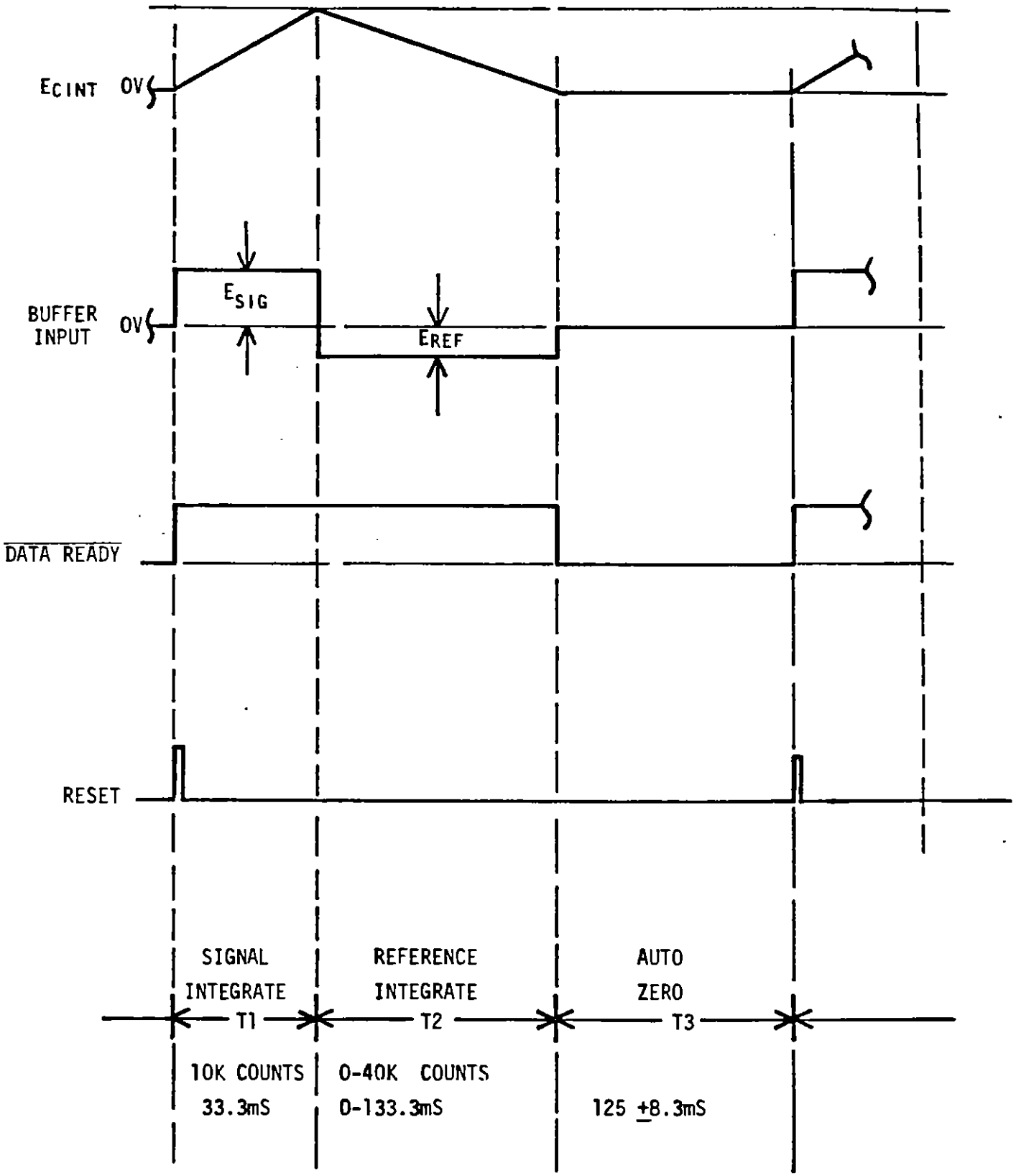


FIGURE 5 - CONVERSION CYCLE WAVE FORMS

5.0 ADJUSTMENT AND CALIBRATION

The Model 2004 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 2004 to be tested into an appropriate test cable.

5.2 Turn on the power and adjust for 115 V ac.

5.3 With the voltage source set to 0 V, adjust R42 (input-offset; 200 k) until the polarity sign is bouncing between plus and minus polarity.

5.4 Apply an input signal equal to +10.5 counts and adjust R39 (zero width; 100 ohm) until the display is bouncing bewtween +00010 and +00011.

5.5 Apply an input signal equal to -10.5 counts and verify that the display indicated -00010 or -00011 or bouncing between -00010 and -00011 (the error between + and - polarities should only be a few tenths of a digit).

5.6 Apply an input signal equal to -39000.5 and slowly adjust R41 (full scale; 500 ohm) until the display is bouncing between -39000 and -39001.

5.7 Apply an input signal equal to +39000.5 and adjust R40 (turnover; 50 ohm) until the display is bouncing between +39000 and +39001.

5.8 Using the voltage source, check linearity at 10, 100, 1000, 5000, 10000, 20000, 30000, and 39990 counts. Verify that linearity is not worse than 1 count throughout this range in both polarities.

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

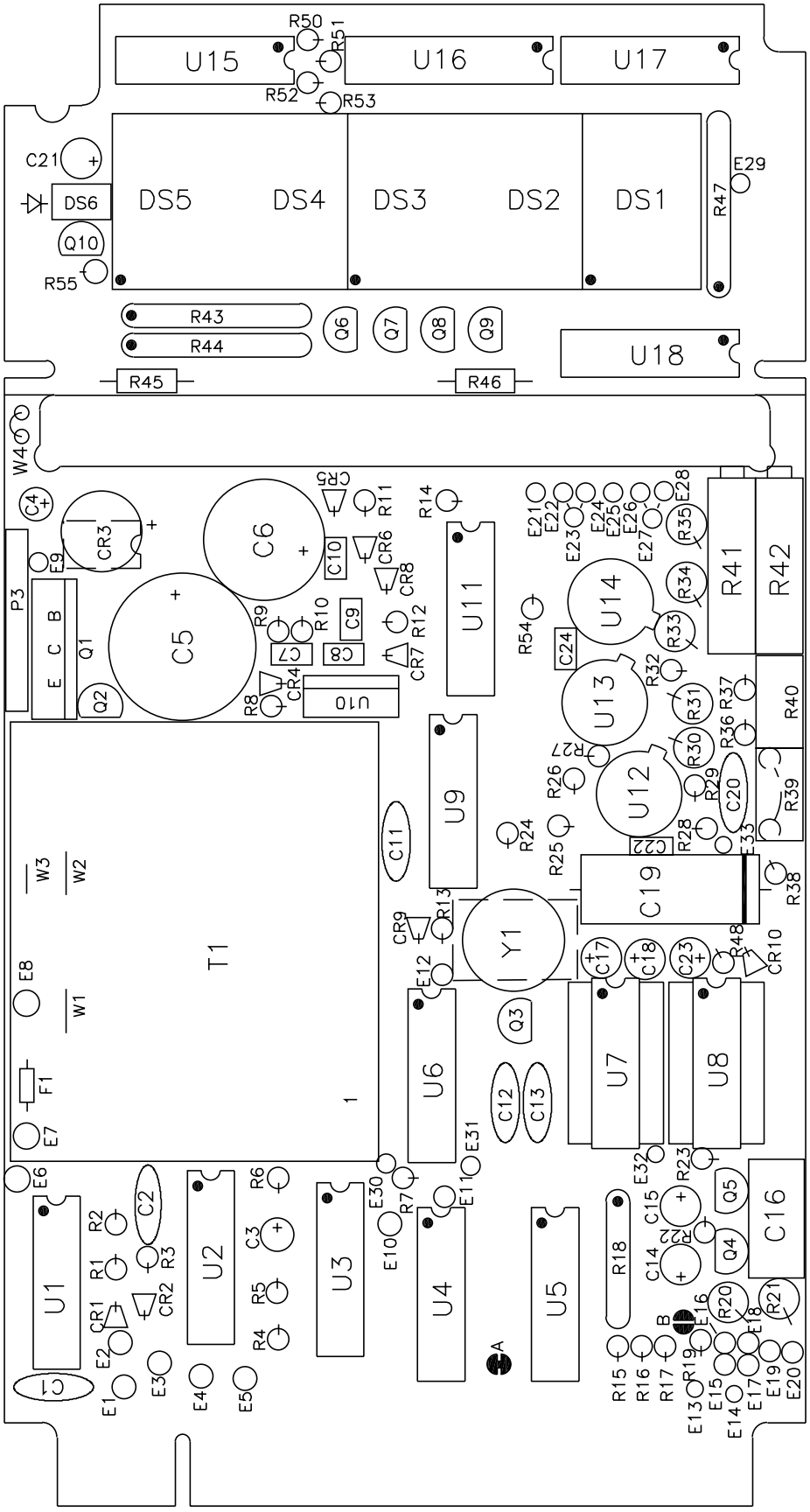
5.9 Using the voltage source, observe the DPM readout.

5.9.1 Check all numbers for proper decoding.

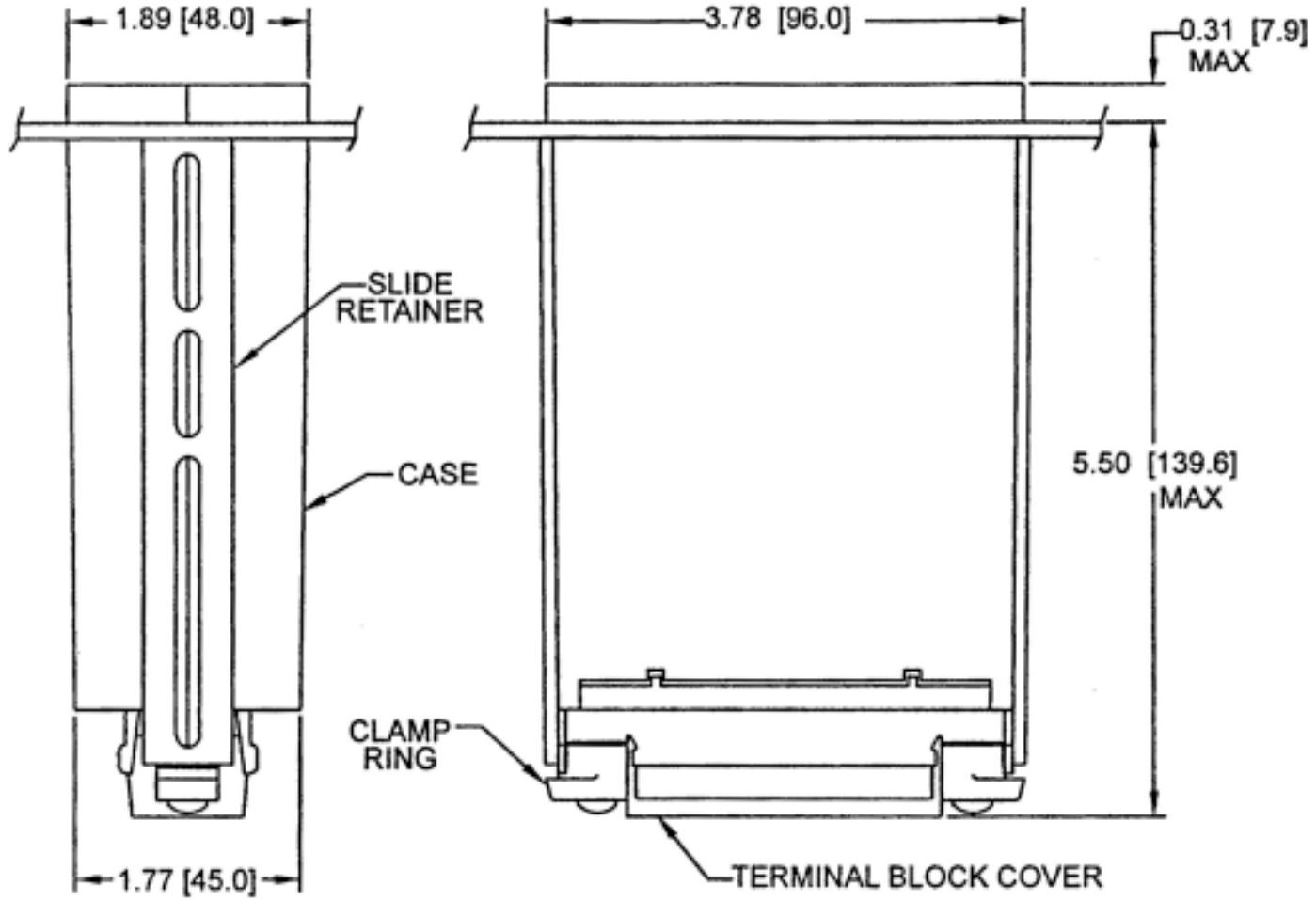
5.9.2 Check for Dim/Dead/Bright segments.

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

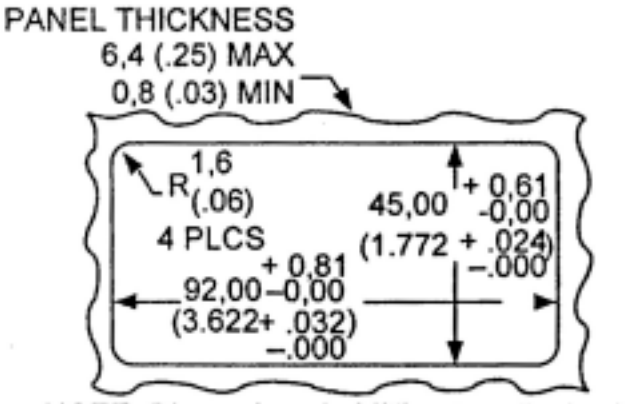
5.9.4 Check minus polarity sign.



PCBA DWG, 2004

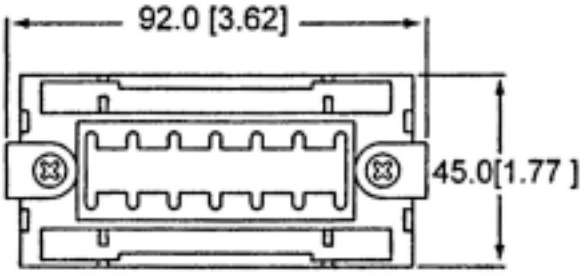


Notes: Dimensions are in inches ±0.01"
with millimeters in [ ] ±0.25 mm.



NOTE: Dimensions in Millimeters (Inches)

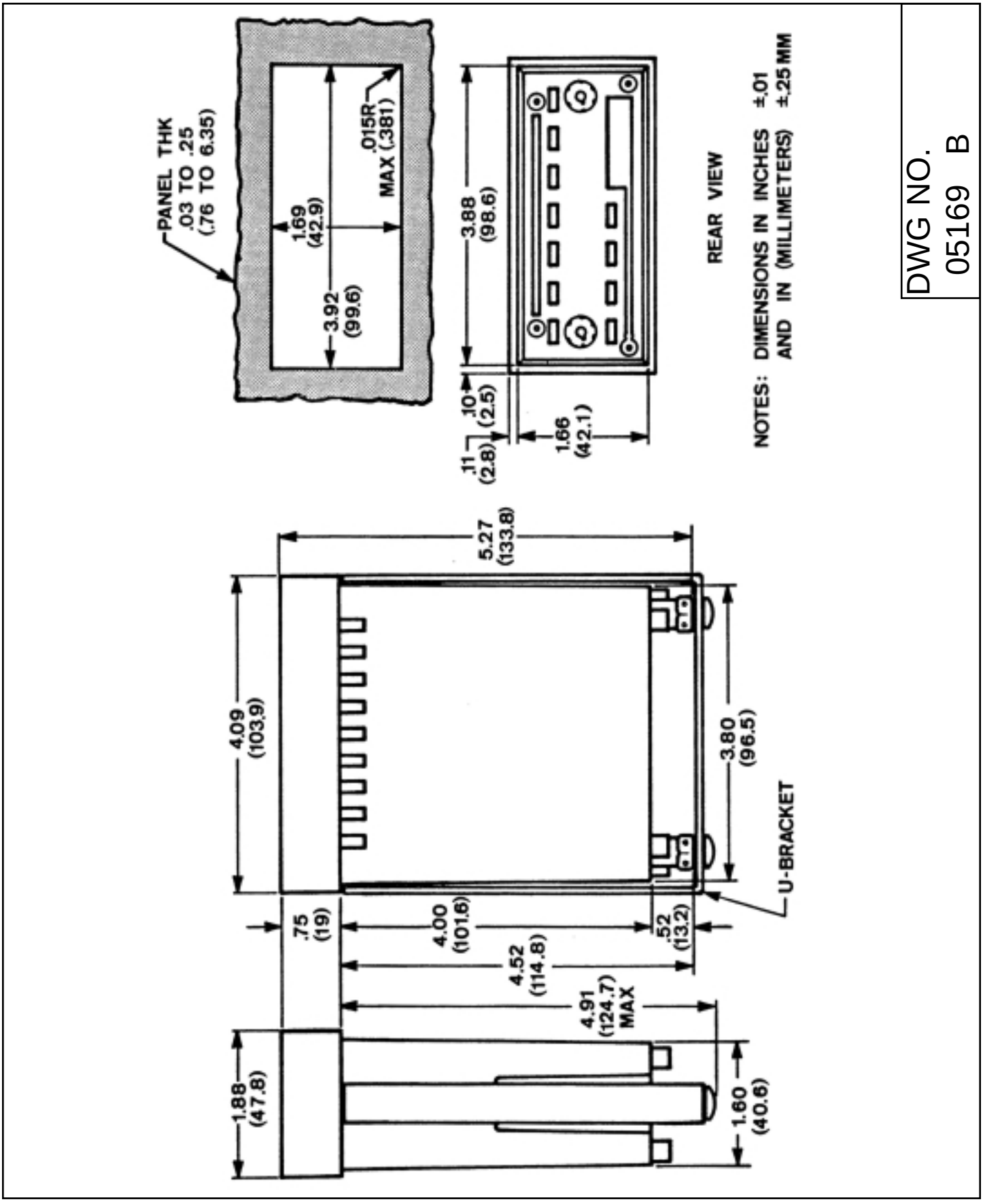
PANEL CUTOUT



REAR VIEW

(TERMINAL BLOCK COVER AND
BEZEL NOT SHOWN FOR CLARITY)
SLIDE CLAMPS ROTATED AND SLIDE RETAINERS
REMOVED AS SHOWN FOR INSTALLATION.

OUTLINE AND MOUNTING FOR DIN 1A CASE



OUTLINE AND MOUNTING FOR OPTIONAL NEMA CASE

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.

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For immediate technical or application assistance please call:

1-800-6397678®
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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

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