FEATURES

- Full-scale measurement of AC voltage

- Highly visible 3-1/2 digit LED display with adjustable intensity

- Responsive bar-graph display provides indication of rapidly changing inputs, emulating analog movement meters

- Measurement accuracy within 1% of reading + 4 counts

- Selectable *True RMS* or *Average Reading* modes

- Switch configurable settings simplify adaptation for use in a wide range of applications

- Rugged Polycarbonate housing

- Mechanical drop-in replacement for common analog-movement meters

- Operates from an external 100-264 VAC power supply

- Low power consumption, typically 15 mA at 120 VAC

- Two-year warranty

File: E156931 Vol. D1

For full details go to
www.murata-ps.com/rohs

PRODUCT OVERVIEW

DMR35-ACV series panel meters measure AC voltage, from 5 to 300V, displayed in up to 3-1/2 digits of resolution. The 21-segment bar-graph is tracks rapidly changing inputs.

Rear-accessible DIP switches are provided to set *Measurement Mode*, *Input Range*, and *Display Brightness*.

This meter is capable of displaying *True RMS Mode,* for compatibility with modern digital multimeters as well as *Average Reading Mode,* for compatibility with legacy analog meters.

Basic safety isolation between the measurement and power inputs is provided.

APPLICATIONS

These meters are packaged in a rugged polycarbonate housing and designed for drop-in replacement of most 2-1/2" form-factor analog meters.
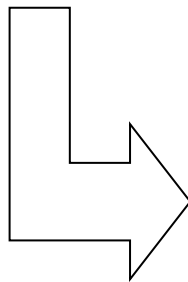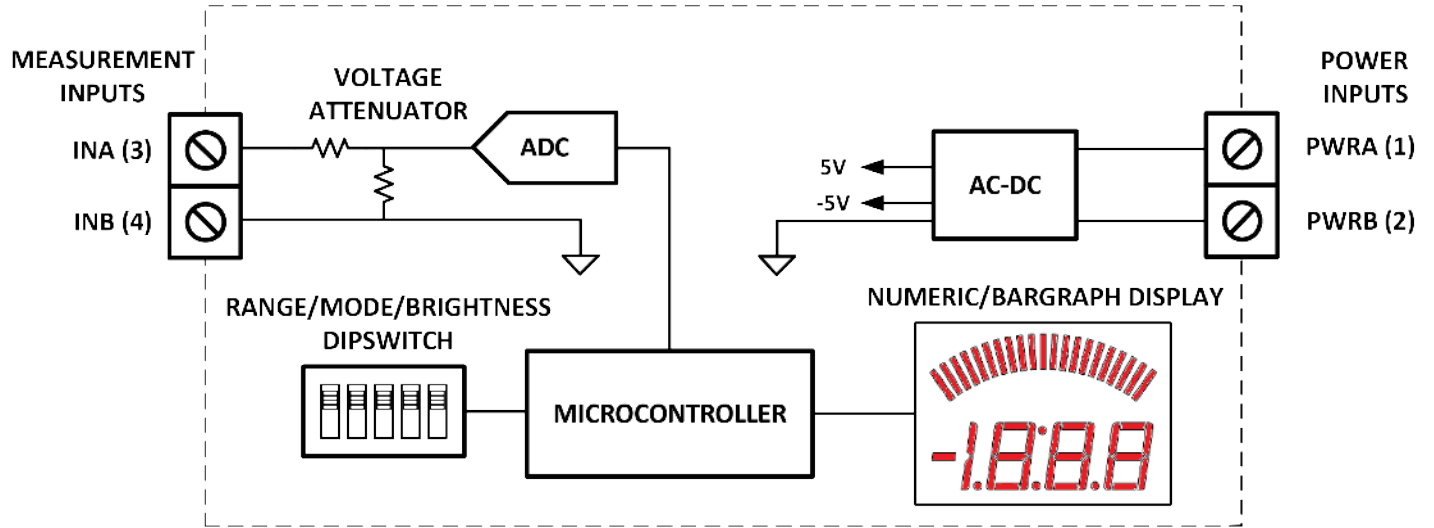
Ideal for use in laboratory instrumentation, factory automation, and other applications requiring precise AC voltage monitoring.

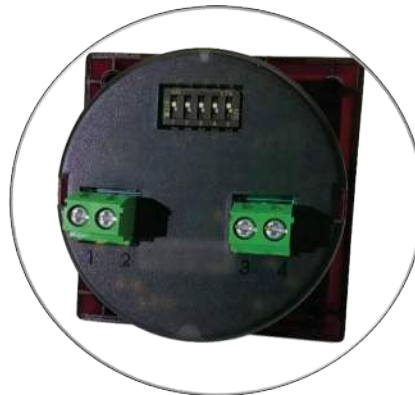This meter requires an external power source of between 100-264 VAC.

ORDERING INFORMATION:

| MODEL NUMBER	DESCRIPTION
DMR35-ACV1-AC1-R	AC Voltmeter, 0-5 to 0-50 VAC ranges, 100-264 VAC powered, red display
DMR35-ACV2-AC1-R	AC Voltmeter, 0-50 to 0-300 VAC ranges, 100-264 VAC powered, red display

SIMPLIFIED BLOCK DIAGRAM

Rear Panel View:

SPECIFICATIONS:

Measurement Performance	Min	Typ.	Max	Units
Measurement Ranges				
DMR35-ACV1	0-5, 0-10, 0-15, 0-25			VAC
DMR35-ACV2	0-50, 0-150, 0-250, 0-300			VAC
Accuracy (25 °C) 60 Hz sinusoidal input	1 % Reading +4 counts			
Measurement Modes	Mean Reading (Average) and True RMS, DIP Switch selectable			
Measurement Frequency Range [1]	20		120	Hz
Measurement Crest Factor			3	
Temperature Stability (full-scale measurement)		0.02		% /°C
Input Impedance				
DMR35-ACV1		100		kΩ
DMR35-ACV2		1		MΩ
Isolation/Hipot (power input terminals to measurement input terminals)[2]		2150		VDC

[1] Frequency range over which measurement is stable to within ±1% with sinusoidal input
[2] 100% Tested in production, applied for 2 seconds

Power Supply Characteristics	Min	Typ.	Max	Units
Power Supply Voltage	100		264	VAC
Power Supply Frequency	47		63	Hz
Power Supply Current				
…at 120 VAC		15		mA
…at 240 VAC		10		mA

Display & User Interface				
Display Type & Size	3-1/2 digit 7-segment, 11.4mm (0.45 in.) high 21 segment curved bar-graph			
Display Color	Red (625nm)			
Decimal Point Selection	Automatic			
Out-of-range Indication	Flashing display			
Measurement Range Selection	Dipswitch selectable (4 ranges)			
Measurement Mode Selection	Dipswitch selectable (Average-reading or RMS)			
Display Intensity Control	Dipswitch selectable (4 ranges)			

Terminal Blocks				
Wire Size	14-24 AWG			
Insulation Strip Length	6mm (0.24 in.)			
Screw Tightening Torque	0.4 N-m (3.5 lb.-in)			
Operating Temperature[4]	0		50	°C
Storage Temperature	-40		70	°C
Humidity (non-condensing)	0		85	%RH
Sealing (front face, when installed with included gasket)	Splash and dust resistant			
Mounting screws (4 included)	#4-20 0.5" thread forming			
Screw Tightening Torque	9 in-lb (1 N-m)			
Panel thickness when used with included mounting screws	0.062 in. (1.6mm)		0.25 in. (6.3mm)	
Weight	2.5 (71)			oz. (g)

[4] Maximum operating temperature applies to both front face and rear of housing. Unit must not be installed so that the rear of housing is exposed to more than the maximum operating temperature when powered.
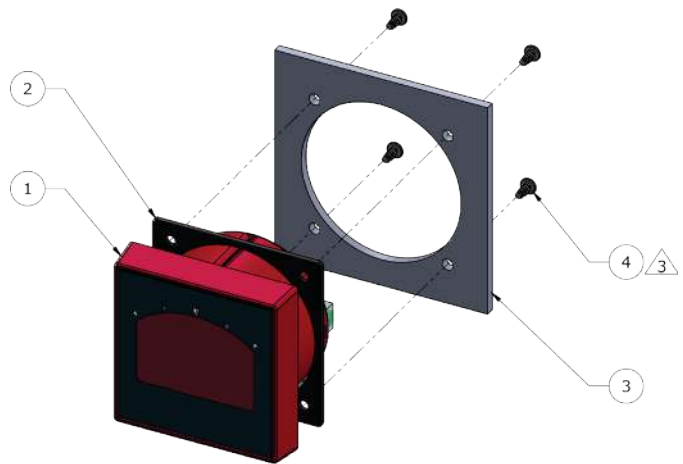
NOMINAL OUTLINE DIMENSIONS

ISOMETRIC VIEW

TOP VIEW

FRONT VIEW

SIDE VIEW

REAR VIEW
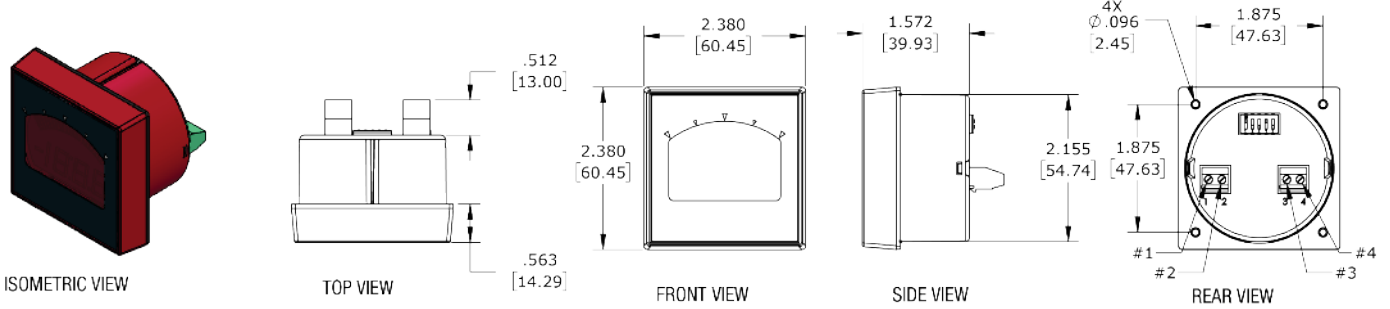
Panel Drill Template
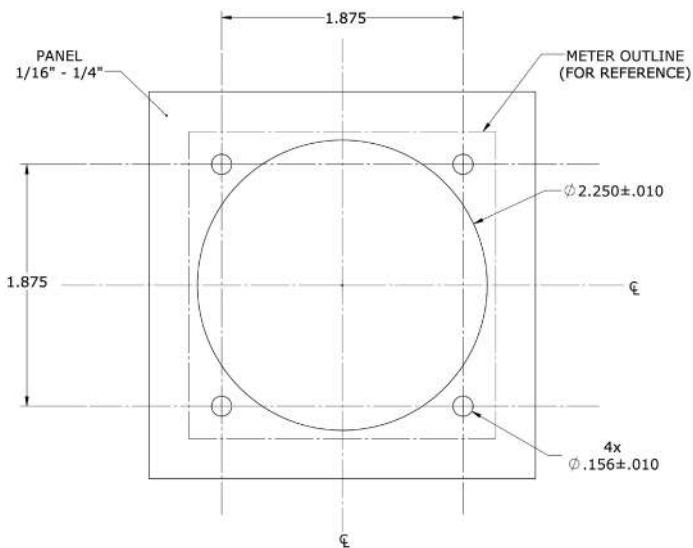
Panel Mounting Details

ITEM NO.	DESCRIPTION	QTY.	NOTES
1	DMR35 panel meter	1	Shown for reference
2	Gasket	1	Included with DMR35 panel meter
3	Provided screws are compatible with panel Thickness: 1/16" – ¼"	REF	Shown for reference
4	4-20 x ½" thread forming screw	4	Torque: 9 IN-LB (1 N-m) Included with DMR35 panel meter

OPERATION, MEASUREMENT TYPE, CAPABILITIES

The DMR35 series meters employ precision, low power electronics to provide high performance full-scale measure of AC voltage. The following illustrations describe the features and operation to simplify deployment in a wide variety of systems.

FRONT PANEL & FRONT PANEL LAYOUT AND FUNCTION
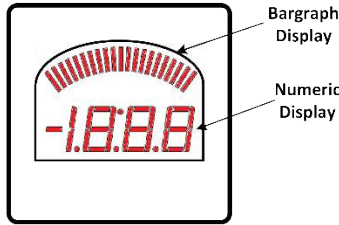
Bar-graph Display: The 21-segment bar-graph display responds quickly and smoothly like an analog meter movement to aid in reading rapidly changing measurements.

Numeric Display: The 3-1/2 digit display provides precise measurements for steady-state and slowly changing measurement values.

REAR PANEL LAYOUT AND SCREW TERMINAL CONNECTIONS
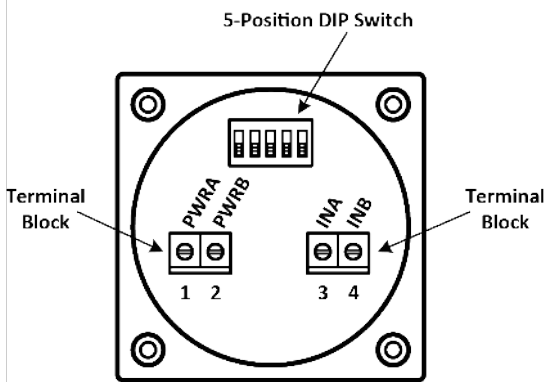
| Terminal Position No.	Name	Function
1	PWRA	Power supply input terminals (100-264 VAC, 50/60Hz)
2	PWRB	
3	INA	Voltage measurement input terminals
4	INB	

DIP Switch: comprised of five individual switches to configure display intensity (SW1-SW2), measurement mode (SW3), and measurement range (SW4-SW5)

Notes:

1) Ensure all screw-terminals are tightened in accordance with the torque specifications for reliable operation.

2) Stranded wire is recommended for high-vibration applications.

3) Basic safety isolation is provided between the meter's measurement and input power electronics, no connection from the measurement-point and AC input power is required

4) External fusing for input power and or measurement source may be required. It is incumbent upon the end-user to ensure all local electrical safety regulations and external fusing requirements are followed where-ever this meter is deployed

CONNECTION EXAMPLES

In this application, the meter is configured for simple voltage measurement where the meter shares a common load and power connection point.
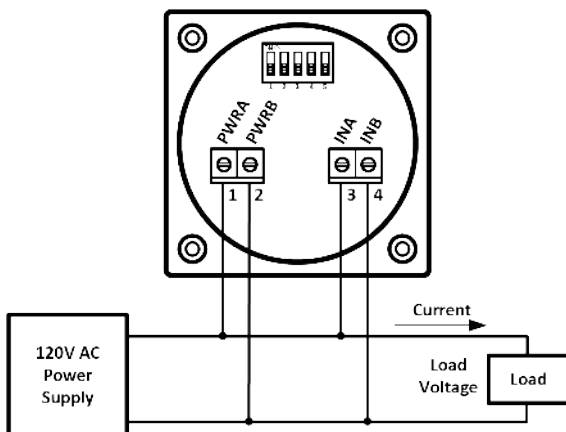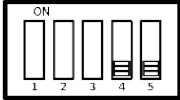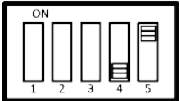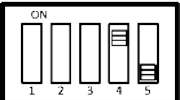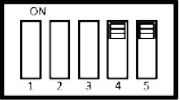
In this application, the meter is monitoring a voltage independent of the meter's power supply circuit. In such applications, the user must ensure the voltage between the power and measurement terminals does not exceed the meter's isolation voltage rating.
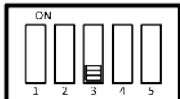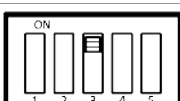
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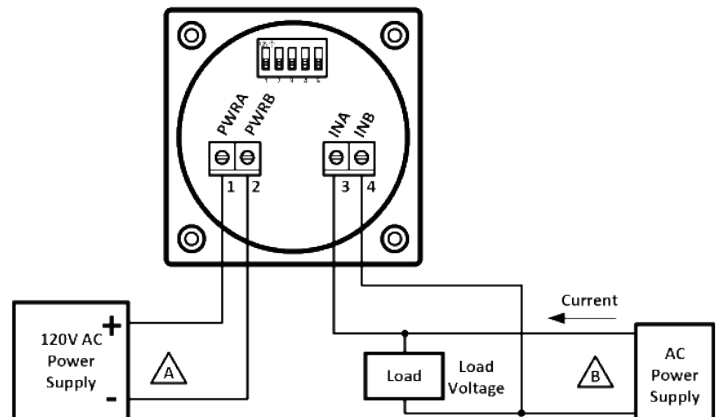
METER CONFIGURATION

Five configuration switches are provided to *configure measurement range*, *measurement mode*, and *display intensity.*
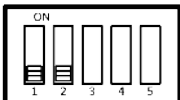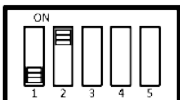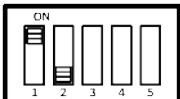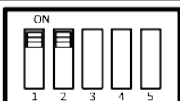
Measurement Range: Switches 4 and 5:

Switch Settings			DMR35 Model	
4	5	Dipswitch	-ACV1	-ACV2
OFF	OFF		0-5 VAC	0-50 VAC
OFF	ON		0-10 VAC	0-150 VAC
ON	OFF		0-15 VAC	0-250 VAC
ON	ON		0-25 VAC	0-300 VAC

Measurement Mode: Switch 3:

Switch Settings		Measurement Mode
3	Dipswitch	
OFF		'Average' Reading (RMS Adjusted)
ON		RMS Reading

Display Intensity: Switches 1 and 2:

Switch Settings			Display Intensity
SW1	SW2	Dipswitch	
OFF	OFF		Low
OFF	ON		Medium
ON	OFF		High
ON	ON		High 2 (Subtle increase in intensity compared with 'High' setting)

## RMS MEASUREMENT MODE VS. AVERAGE MEASUREMENT MODE.

These meters are capable of both RMS and Average Reading (RMS adjusted) measurement modes:

RMS (Root-Mean-Square) Mode – RMS voltage can be thought of as the equivalent DC voltage required to dissipate a given amount of energy in a resistive load. Benefit of RMS measurements:

- Provides an indication of delivered power, independent of the exact waveform being measured
- Comparable with most high-quality handheld multimeters that tend to adapt RMS measurement

RMS Measurement Signal Flow.
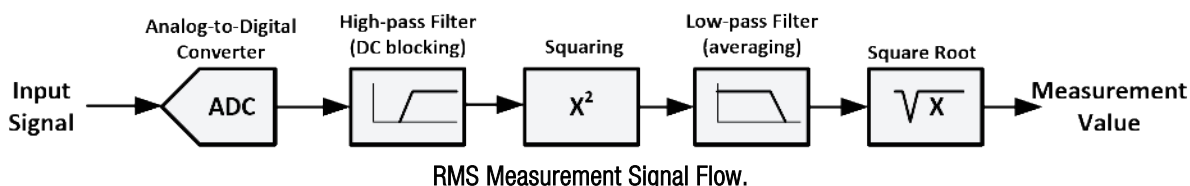
Average-Reading mode – In this mode, the meter measures the average rectified value of the voltage waveform. Since the resulting measurement is different from the RMS measurement, it is typically 'adjusted' to match the RMS measurement value for the case of a sinusoidal waveform. The benefit of this measurement mode it that it enables DMR35 meters to provide measurements comparable to those provided by many electro-mechanical analog meters. The block diagram below shows the signal-processing performed in making RMS-adjusted average mode measurements.

RMS-adjusted Average Measurement Signal Flow
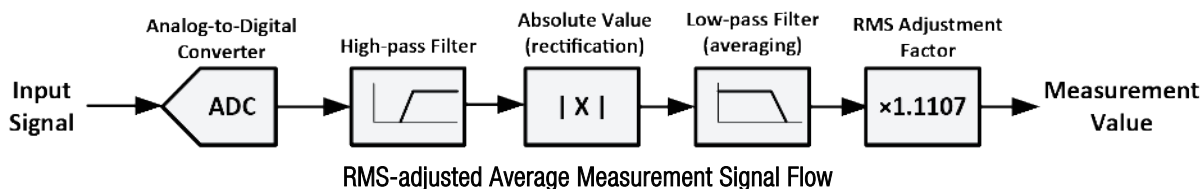
Note that both measurement modes adapt a digital high-pass filter, placed after the ADC, to remove any DC bias from the input signal and generate a signal that is symmetric about zero. As a result, these meters only measure the AC component of the input signal, and not the DC component – a DC signal presented to the meter will read as zero. Significant amounts of DC input signal, however, may force the meter's ADC into over-range and reduce measurement accuracy. For this reason, the DMR35-ACVx series of meters should not be used to measure currents having a significant DC component.
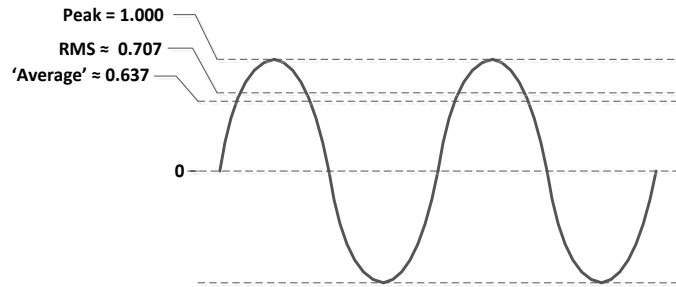
Crest Factor

When making AC measurements, the shape of the waveform to be measured can influence the measurement results. One of the most basic metrics used to quantify waveform shape is *crest factor*, which is defined as the ratio between the waveform's peak value and its RMS value.
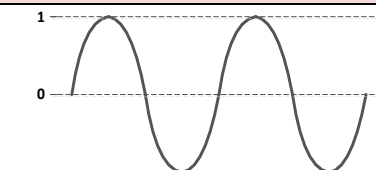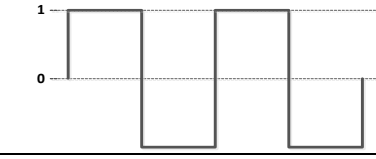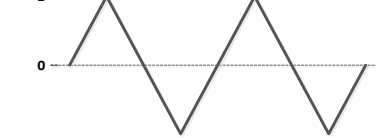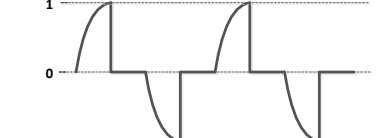
$$Crest\ factor = \frac{Peak\ Value}{RMS\ Value}$$

(CONTINUED):
RMS MEASUREMENT MODE VS. AVERAGE MEASUREMENT MODE.

In the case of a sinusoidal waveform, the figure below shows the relevant quantities.

Peak = 1.000
RMS ≈ 0.707
'Average' ≈ 0.637
0

The table below lists the crest factor, RMS and average values for various familiar waveforms. It illustrates the extent RMS-adjusted average measurement can vary significantly in relation to the RMS measurement for signals with non-sinusoidal waveforms.

| Waveform		Crest Factor	RMS Value	'Average' Value	Average Value with RMS adjustment	% Deviation from RMS
Sinusoid		1.414	0.707	0.637	0.707	0%
Square wave		1.000	1.000	1.000	1.111	+11%
Triangle		1.732	0.577	0.500	0.555	-4%
Phase-controlled Sinusoid – leading 50%		2.000	0.500	0.318	0.354	-29%

While an ideal measuring instrument would be able to handle any input waveform, realizable meters have restrictions on the maximum allowable crest factor for accurate measurements. DMR35 AC meters are designed to handle signals with crest factors up to 3 with minimal additional measurement errors.
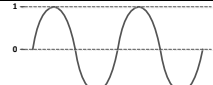
(CONTINUED):
RMS MEASUREMENT MODE VS. AVERAGE MEASUREMENT MODE.
Frequency Response, Crest Factor, and Accuracy

DMR35 AC meters are designed to accurately measure signals typically seen in 50/60 Hz AC systems. For sinusoidal input waveforms, the measurement error typically varies less than ±1 % over the range of 20 Hz to 120 Hz, as shown in the graph below.

Typical Measurement Error vs. Frequency, Sinusoidal Input
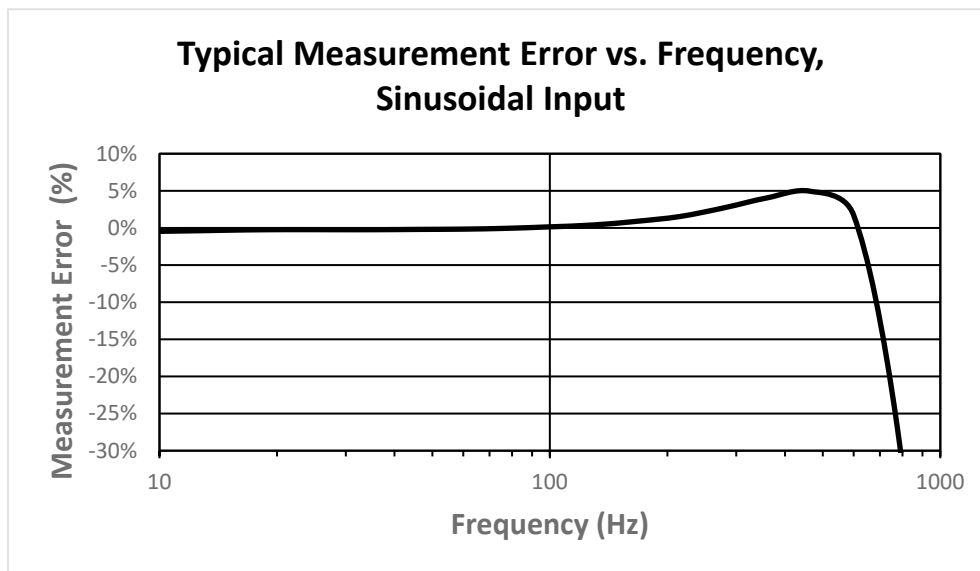
Since more complex waveforms contain higher frequency components and varying crest factors, the expected accuracy can vary considerably as a function of both frequency and waveform. The table below shows some typical accuracies for RMS measurements of the following waveforms at specified frequencies.

Waveform		Crest Factor	Typical % Error at Given Frequency [1]				
			30 Hz	60Hz	120 Hz	240 Hz	400 Hz
Sinusoid		1.414	0.0%	0.1%	0.4%	2.2%	4.9%
Square wave		1.000	-0.4%	-1.0%	-2.0%	-3.9%	-4.9%
Triangle		1.732	0.1%	0.1%	0.3%	1.8%	4.1%
Phase-controlled Sinusoid – leading 50%		2.000	-0.7%	-1.5%	-2.6%	-6.0%	-12.4%

[1] DMR35-ACV1 response, measured against calibrated Fluke 8845A RMS digital multimeter

TECHNICAL NOTES

1. **Calibration**

   DMR35 digital panel meters is calibrated at the factory at the time of manufacture. There are no user or field-adjustable calibration features.

2. **Wiring:**

   Power supply and input wiring must be rated for the electrical and environmental conditions under which the meter will be operated. They must also comply with any regulatory or application-mandated requirements pertaining to the user's installation. The terminal blocks can accommodate wire gauges ranging from #14 to #24 AWG. Wiring insulation should be stripped to the proper length as described in the Terminal Block specifications table and wires must be inserted into the terminal block openings such that the screw terminal does not pinch any insulation. It is important to tighten all screw terminals to their torque specification, which also may be found in the Terminal Block specifications table. Proper tightening will help ensure reliable operation. Applications subject to vibration should use stranded wire. After final assembly, inspect all terminal block connections for shorts between adjacent conductors; this step is especially important when using stranded wire.

3. **Protection and Fusing:**

   DMR35 meters' power supply leads (PWRA, PWRB) are protected against momentary overvoltage and reverse polarity conditions. Input terminals INA and INB are protected against noise and brief transients. Protection, however, is not provided against sustained conditions exceeding the limits listed in in the Performance & Functional Specifications Table. External fusing must be supplied by the user in accordance with applicable safety and regulatory requirements for the system in which the meter is installed.

4. **Noisy Power Supplies**

   Some power supplies contain high-frequency switching devices that may conduct and/or radiate significant noise onto the low-level signal developed across the measurement inputs. Even though the meter incorporates built-in input filtering, some portion of this noise may be amplified and subsequently measured by its sensitive input circuitry. Limiting runs of wire to less than 3 meters (10 feet) is strongly recommended. In certain situations, the use of twisted pair or shield wiring may be required.

5. **Self-Diagnostics**

   Upon power-on the meter performs a self-test and checks the integrity of calibration data stored in internal non-volatile memory. If the factory calibration data has been corrupted, the meter will display 'CAL' on power-on and approximately once a minute thereafter to indicate that the meter is relying on default calibration factors and that displayed measurements may have more than the datasheet-specified amount of error. If the meter detects other internal fault conditions, it will attempt to reset itself. Repeated restarts, which appear in the form of a highly intermittent display, are indicative of a hardware fault that cannot be cleared through a reset operation, in which case the meter should no longer be used.

STANDARD PACKAGING, NOMINAL DIMENSIONS

INDIVIDUAL PACKAGING
(SHOWN FOR REFERENCE ONLY)
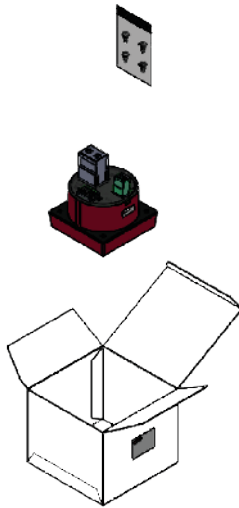
MOQ PACKAGING (12 UP)
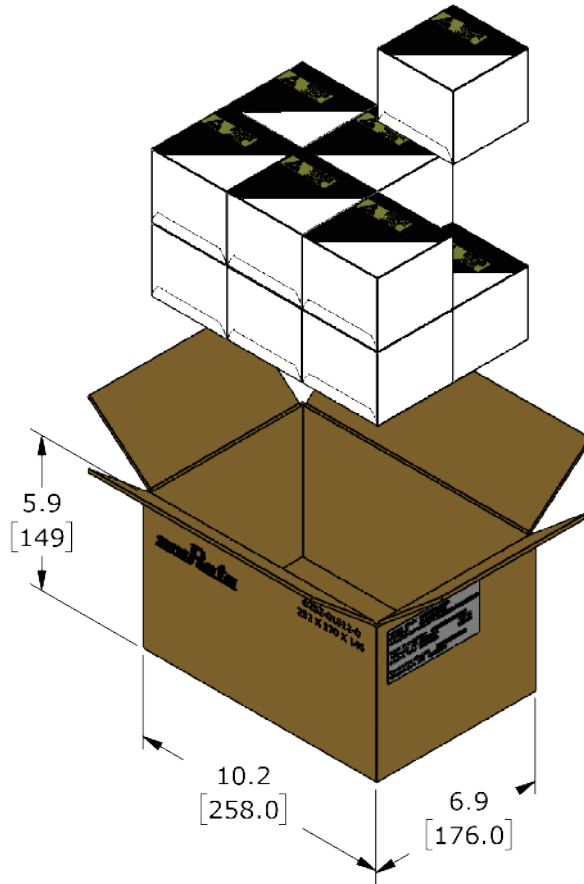
5.9
[149]

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6.9
[176.0]

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