KUSAM-MECO®

An ISO 9001:2008 Company

3000A AC TRMS AC / DC DIGITAL DUAL DISPLAY CLAMP MULTIMETER

Model 860A

13 FUNCTIONS 10 RANGES

Preliminary Data

SPECIAL FEATURES :

- Dual display 6000 Counts (1 display in front & 1 display at bottom)
- Auto / Manual range selection
- Relative measurement display " " sign.
- The knife like part at the top side of clamp allows user to separate the wires without touching with hand & helps in increasing safety while taking measurement.
- Analog Bar Graph display
- Automatic zero adjustment.
- Low battery indication.
- Data Hold Function.
- LED light for proper connection in dimly light areas, which turns on when the clamp jaws are opened.
- Magnet at the back side of meter allows user to fix the meter on metal surface making the measurement procedure easy.

GENERAL SPECIFICATIONS :

- ✷ **Sensing :** AC True RMS Sensing
- ✷ **Jaw size :** 65mm
- ✷ **Polarity :** Automatic negative polarity indication.
- ✷ **Over range indication :** The "OL" or "-OL" display.
- ✷ **Auto Power Off :** after approx. 15 minutes .
- ✷ **Operating Temperature :** 0°C ~ 40°C (32°F~104°F); Relative Humidity 80% R.H.
- ✷ **Storage Temperature :** -20°C ~ 60°C (-4°F~140°F); Relative Humidity 90% R.H.
- ✷ **Power Supply :** Standard 9V battery.
- ✷ **Dimension :** 275(H) x 120(W) x 32(D) mm
- ✷ **Weight :** Approx. 562gm. (Including Battery).

SAFETY :

- **Safety :** The meter is up to the standards of IEC1010 Double insulation.
- **Pollution Degree :** 2
- **CE EMC/ LVD.**
- **CAT II 1000V.**
- **Overvoltage CAT II.**

ACCESSORIES :

Test leads (pair), User's manual, & Carrying case.

ELECTRICAL SPECIFICATIONS : 860A

Accuracy : ± (% reading digits + Number of digits)at 23 ± 5°C, 75% R.H.

DC VOLTAGE

Range	Resolution	Accuracy
60 mV	0.01 mV	±(0.8%rdg + 10 dgts)
600 mV	0.1 mV	±(0.5%rdg + 15 dgts)
6 V	1 mV	
60 V	10 mV	
600 V	100mV	
1000 V	1 V	±(0.8%rdg + 10 dgts)

Overload Protection : 1000V DC or 750V AC rms
Impedance : 10M

AC VOLTAGE (TRMS)

Range	Resolution	Accuracy					Sensitivity
		50Hz-500Hz	500Hz-1KHz	1K-5KHz	5k-10KHz	10K-20KHz	
60 mV	0.01 mV	±(1.2% rdg + 10 dgts)	±(1.5% rdg + 10 dgts)	±(2% rdg + 10 dgts)	±(3.5% rdg + 10 dgts)	±(4.5% rdg + 10 dgts)	50 mV
600 mV	0.1 mV	±(1.2% rdg + 10 dgts)	±(1.5% rdg + 10 dgts)	±(2% rdg + 10 dgts)	±(3.5% rdg + 10 dgts)	±(4.5% rdg + 10 dgts)	500 mV
6 V	1 mV	50Hz - 1KHz : ±(3.0% rdg + 15 dgts)					1 V
60 V	10 mV	50Hz - 400Hz : ±(1.5% rdg + 10 dgts)					1 V
600 V	100 mV						1 V
750 V	1 V						1 V

Overload Protection : 1000V DC or 750V AC rms
Impedance : 10M

All Specifications are subject to change without prior notice.

ELECTRICAL SPECIFICATIONS : KM 860A

AC CURRENT (TRMS)

Range		Resolution	Accuracy	
			50-500Hz	500-1KHz
400A		0.1 A	±(3.5% rdg + 25 dgts)	±(3.5% rdg + 35 dgts)
3000A	0-1000	1 A	±(3.5% rdg + 30 dgts)	±(3.5% rdg + 40 dgts)
	1000-2000	1 A	±(5.5% rdg + 30 dgts)	±(4.0% rdg + 40 dgts)
	2000-3000	1 A	±(6.5% rdg + 50 dgts)	±(5.5% rdg + 60 dgts)

Overload Protection : 3000A DC or AC rms

DC CURRENT

Range		Resolution	Accuracy
400A		0.1 A	±(3.0%rdg + 10 dgts)
3000A	0-1000	1 A	±(3.5%rdg + 20 dgts)
	1000-2000	1 A	±(5.5%rdg + 20 dgts)
	2000-3000	1 A	±(6.5%rdg + 40 dgts)

Overload Protection : 3000A DC or AC rms

RESISTANCE

Range	Resolution	Accuracy
600	0.1	±(1.2%rdg + 10 dgts)
6 k	1	
60 k	10	
600 k	100	
6 M	1 k	
60 M	10 k	±(2.5%rdg + 15 dgts)

Overload Protection : 250V DC or AC rms

CAPACITANCE

Range	Resolution	Accuracy
40 nF	10 pF	±(5.0%rdg + 10 dgts)
400 nF	100 pF	±(2.5%rdg + 5 dgts)
4 F	1 nF	
40 F	10 nF	±(5.0%rdg + 10 dgts)
400 F	100 nF	±(20.0%rdg + 20 dgts)
4000 F	1 F	

Overload Protection : 250V DC or AC rms

DIODE & AUDIBLE CONTINUITY TEST

Range	Description	Test Condition
	Display read approx. Forward voltage of diode.	Forward DC current approx. 0.4mA Reverse DC Voltage approx. 2.8V
	Built-in buzzer sounds if resistance is less than 100	Open circuit voltage approx. 0.5V

Overload Protection : 250V DC or AC rms

FREQUENCY

Range	Resolution	Accuracy
10 Hz	0.01 Hz	±(0.5%rdg + 5dgts)
100 Hz	0.1 Hz	
1000 Hz	1 Hz	
10 kHz	10 Hz	
100 kHz	100 Hz	
1000 kHz	1 KHz	
10 MHz	10 KHz	

Sensitivity : Range of input Voltage : 1.5V ~ 10V, if input voltage over range, need adjust

Overload Protection : 250V DC or AC rms

TEMPERATURE

Range	Resolution	Accuracy	
°C / °F	1°C / 1°F	-20~150°C -4 ~ 302°F	±(3°C + 2)
		150 ~ 300°C 302 ~ 572°F	±(3% rdg + 2 dgts)
		300 ~ 1000°C 572 ~ 1800°F	±(3.5%rdg + 10dgts)

NiCr-NiSi sensor. Sensor accuracy not included in above specified accuracy.

Overload Protection : 36V DC or AC rms

DUTY CYCLE

Range	Accuracy	Frequency
0.1% ~ 99.9%	±(2.0% rdg + 2 dgts)	<10kHz

Sensitivity : sine wave 0.6Vrms

Overload Protection : 250V DC or AC rms

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WHAT IS DC + AC TRUE RMS

DC AC TRUE RMS

DC AC True RMS is a term which identifies a DMM that responds accurately to the total effective RMS value regardless of the waveform, and is given by the expression :

$$\sqrt{DC^2 + (AC\ rms)^2}$$

DC + AC True RMS voltage is the total effective voltage having the same heating value corresponding a DC voltage. With DC + AC True RMS voltage measurement, you can accurately measure the voltage values regardless of the waveforms such as: square, sawtooth, triangle, pulse trains, spikes, as well as distorted waveforms with the presence of harmonics and DC components / Harmonics and DC components may cause:

1) Overheated transformers, generators and motors to burn out faster than their rated life
2) Circuit breakers to trip prematurely
3) Fuses to blow
4) Neutrals to overheat due to triplen harmonics present on the neutral (180Hz)
5) Bus bars and electrical panels to vibrate

Only AC or True RMS and Average responding meters can introduce significant errors in many applications.

See TABLE 2 for typical example.

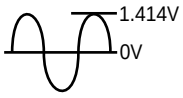
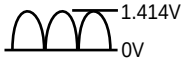
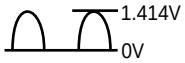
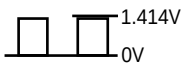
INPUT WAVEFORM	DC + AC TRMS	AC RMS	AVERAGE RESPONSE
Sine 	1.000V ERROR= 0% CF=1.414	1.000V ERROR= 0% CF=1.414	1.000V ERROR= 0%
Full wave rectified Sine 	1.000V ERROR= 0% CF=1.414	0.436V ERROR= 56.4% CF=3.247	0.421V ERROR= 57.9%
Half wave rectified Sine 	0.707V ERROR= 0% CF=2.000	0.546V ERROR= 22.7% CF=2.591	0.550V ERROR= 22.2%
50% duty pulse train 	1.000V ERROR= 0% CF=1.414	0.707V ERROR= 29.3% CF=2.000	0.785V ERROR= 21.5%

TABLE 2. WAVEFORMS AND CREST FACTORS

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USE TRUE RMS WHEN MEASURING AC WAVEFORMS

The waveforms on today's AC power lines are anything but clean. Electronic equipment such as office computers, with their switching power supplies, produce harmonics that distort power-line waveforms. These distortions make measuring AC voltage inaccurate when you use an averaging DMM.

Average voltage measurements work fine when the signal you're measuring is a pure sine wave, but errors mount as the waveform distorts. By using true RMS measurements, however, you can measure the equivalent heating effect that a voltage produces, including the heating effects of harmonics. Table 1 shows the difference between measurements taken on averaging DMMs & those taken on true RMS DMMs. In each case, the measured signal's peak-to-peak value is 2V. Therefore, the peak value is 1V.

For a 1-V peak sine wave, the average & RMS values are both 0.707V. But when the input signal is no longer a sine wave, differences between the RMS values & the average readig values occur. Those errors are most prominent when you are measuring square waves & pulse waveforms, which are rich in harmonics.

Table 1. Average versus true RMS comparison of typical waveforms.

Waveform	Actual Pk-Pk	True RMS Reading	Average Reading	Reading Error
Sine Wave	2.000	0.707	0.707	0%
Triangle Wave	2.000	0.577	0.555	-3.8%
Square Wave	2.000	1.000	1.111	+11.1%
Pulse (25% duty Cycle)	2.000	0.433	0.416	-3.8%
Pulse (12.5% duty Cycle)	2.000	0.331	0.243	-26.5%
Pulse (6.25% duty Cycle)	2.000	0.242	0.130	-46.2%

One limitation to making true RMS measurements is crest factor, and you should consider crest factor when making AC measurements. Crest factor is the ratio of a waveform's peak ("crest") voltage to its RMS voltage. Table 2 shows the crest factors for ideal waveforms.

Table 2. Crest factors of typical waveforms.

Waveform	Crest Factor
DC	1.000
Square Wave	1.000
Sine Wave	1.414
Triangle Wave	1.732
Pulse (25% duty Cycle)	1.732
Pulse (12.5% duty Cycle)	2.646
Pulse (6.25% duty Cycle)	3.873

A DMM's specifications should tell you the maximum crest factor that the meter can handle while maintaining its measurement accuracy. True RMS meters can handle higher crest factors when a waveform's RMS voltage is in the middle of the meter's range setting. Typically, a DMM may tolerate a crest factor of 3 near the top of its scale but it might handle a crest factor of 5 that's in the middle of the range. Therefore, if you're measuring waveforms with high crest factors (greater than 3), you should adjust the DMM so the measured voltage is closest to the center of the measurement range.

Another limitation of true RMS is speed. If you're measuring relatively clean sine waves, then you can save time & money by using as averaging DMM. True RMS meters cost more than averaging meters and can take longer to produce measurements, especially when measuring millivolt-level AC signals. At those low levels, true RMS meters can take several seconds to stabilize a reading. Averaging meters won't leave you waiting.