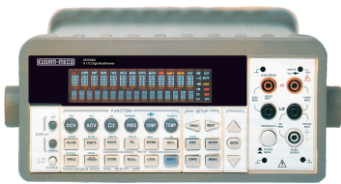


**KUSAM-MECO**<sup>®</sup>

An ISO 9001:2008 Company

# 6½ Digit TRMS DIGITAL MULTIMETER



MODEL - M3500A

**Model - M3500A - 7 FUNCTIONS 23 RANGES****Model - M3510A - FUNCTIONS RANGES****Model - M3511A - FUNCTIONS RANGES****SPECIAL FEATURES:**

- SPEED
- STABILITY
- ACCURACY
- NOISE IMMUNITY



MODEL - M3510A

**FEATURES:**

- Delivers 50 triggered RDGS/sec via remote interface
- Period & Diode measurement.
- Thermocouple Temperature & RTD measurements.
- Full math functions – dB, dBm, MX+B, ratio, %, Max/Min, null & limits.
- Optional multipoint scanner card – For internal scanning, options include M3500–opt01, a 10-channel, general-purpose card. (Model - M3500A)
- Through Microsoft Office Word & Excel for remotely storing and recalling the measured values.
- Calibration Certificate Available.
- Continuity measurement for resistance.
- Through M3500 AP software for simulating the real operation on PC.
- High noise immunity capability. (Model - M3500A)
- Rack-mounted capability.
- Thermocouple / RTD Measurement (Model M3500A / M3510A)
- Dual displays & Dual measurements. (M3510A / M3511A)
- Capacitance Measurements (M3510A / M3511A).
- Wide range current measurement (max. 10A)(M3510A / M3511A)
- RTD Measurement (Model M3511A).
- Self Test & Manual Calibration (Model M3510A / M3511A)



MODEL - M3511A

**GENERAL SPECIFICATIONS :**

- \* **Sensing** : True RMS Sensing.
- \* **High Accuracy** : (Model M3500A) :  
DC Voltage : ± 0.0035% of reading. AC Voltage : ± 0.06% of reading.
- \* **High Accuracy** : (Model M3510A & Model M3511A)  
DC Voltage : <0.012% of reading. AC Voltage : ± 0.12% of reading.
- \* **Resolution** : 6½ digit 2,00,000 Counts
- \* **Display** : 5 x 7 dot matrix VFD, Dual displays with three-color annunciators. (Model M3500A)  
LCD Display for (Model M3510A & Model M3511A).
- \* **High Speed** : Both sampling rate and data rate are at 2000 readings/sec (at 4½ digit setting). Sampling rate 50K (M3510A), 10K (M3511A) readings/Sec
- \* **High Capacity of Internal Data Memory** : It can store up to 2000 readings in data memory
- \* **Full-Featured Operations** : There are 11 measurements and 8 math Functions.
- \* **Temperature Measurements** : The built-in function supports two measurement methods : Thermocouples and RTDs.  
For thermocouples, it supports up to 7 types of sensors E, J, K, N, R, S and T.
- \* **Data Transfer rate** : 2000 readings/Sec. (M3500A)
- \* **Vibration** : MIL-PRF-28800F, 3.84.2. Vibration, Sinusoidal Class 1.2 (Model M3510A & M3511A)
- \* **Shock** : Mil-prf-28800f, 4.5.5.4 Mechanical. (Model M3510A & M3511A)
- \* **± (%of reading + %of range, 23°C ± 5°C) at 6½ digits with 2-hour warm-up.** (Model M3510A & M3511A)
- \* **The specifications are for 2-hour warm-up condition, 10 PLC & they are relative to calibration standards..** (Model M3510A & M3511A)
- \* **Model - M3511A doesn't provide the selection of the range 3A.**
- \* **Null Function Must be used when the 2W is selected .**  
(Model M3510A & M3511A)
- \* **Measurement over 20% at all ranges is allowable except the ranges 750 ACV, 1000DCV & 3A / 10A.**(Model M3510A & M3511A)
- \* **Range 750V is limited to 100KHz.**
- \* **Measurement accuracy excluded the error of test leads.**  
(Model M3510A & M3511A)
- \* **Bandwidth** : 3Hz. Specifications are for sine wave input >5% of range.  
For <50KHz & inputs within 1% to 5% of range, the error 0.3% of range must be added. For inputs within 50KHz to 100KHz, the 0.35% of range must be added. (Model M3510A & M3511A)
- \* **Power Line Frequency** : 50/60Hz ± 10%
- \* **Power Consumption** : 25VA Max. (16W Average)(M3500A)  
25VA Max. (5W Average)(M3510A / M3511A)
- \* **Operating Temperature** : 0°C ~ 50°C; 80% R.H. Upto 31°C.
- \* **Storage Temperature** : -40°C ~ 70°C
- \* **Operating Altitude** : upto 2000M
- \* **Power Supply** : 100V/120V/220V/240V±10%
- \* **Dimension** : 213.6(W) x 88.6(H) x 370.0(D)mm (Model M3500A)  
214.6(W) x 88.6(H) x 280.7(D)mm (Model M3510A / M3511A)
- \* **Weight** : approx. 2.23Kg.(M3500A), 2.650kg. (M3500A / M3511A)

**SAFETY :**

- **Safety** : IEC61010-1 / EN61010-1 / UL61010-1 (M3500A), IEC61010-1:2001 / EN61010-1:2001 2nd ed. Measurement CAT II 600V, CAT I 1000V. (M3510A / M3511A)
- **E.M.C.** : EN61326-2006. EN61326-2-1:2006
- **Pollution Degree** : 2

**All Specifications are subject to change without prior notice****KUSAM-MECO**<sup>®</sup>

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**Email:** kusam\_meco@vsnl.net, **Website:** www.kusamelectrical.com,

## ACCESSORIES :

One power line cord, One USB cable, Standard Test Leads, One Software CD & User's manual.

## OPTIONAL ACCESSORIES :

### MODEL : M3500A

Multi-point(10Channel) Scanner Card No. M3500-opt01, Thermocouple adapter (6 Types) : M3500-opt02E, M3500-opt02J, M3500-opt02K, M3500-opt02N, M3500-opt02RS, M3500-opt02T. Adapters (Banana to BNC Adapter) No. M3500-opt03, GPIB Card No. M3500-opt04, RTD Probe Adapter No. M3500-opt05, RS232 cord M3500 - opt06, Kelvin Probe M3500-opt07, 4-Wire Test Leads M3500-opt08, Shorting Plug M3500-opt10, & Calibration Certificate Traceable to NPL.

### MODEL : M3510A / M3511A

GPIB Card No. M3500-opt04, RS232 cord M3500 - opt06, Kelvin Probe M3500-opt07, 4-Wire Test Leads M3500-opt08, Shorting Plug M3500-opt10, K-type Thermocouple cable M3500-opt11 (only for Model-M3510A)

\* **PC Applications :** We provide Matlab® and Lab View® applications that allows user to do a variety of tasks. Also feature the PT-Tool that can acquire data directly from the measurement into MS Word® or Excel®. Even without MS Word® or Excel®, user can choose our PT-Link, which is a stand-alone application. Remote Interface : USB and GPIB (optional).

## ELECTRICAL SPECIFICATIONS : KM 3500A

### DC VOLTAGE

Function	Range	Input Resistance	1 Year Accuracy : ± (% of reading + % of range ) (23°C ± 1°C)
DCV (DC Voltage)	100.0000 mV	> 10G	0.0050 + 0.0035
	1.000000 V	> 10G	0.0040 + 0.0007
	10.000000 V	> 10G	0.0035 + 0.0005
	100.0000 V	10 M	0.0045 + 0.0006
	1000.0000 V	10 M	0.0045 + 0.0010

### DC CURRENT

Function	Range	Shunt Resistance	1 Year Accuracy : ± (% of reading + % of range ) (23°C ± 1°C)
DCA (DC Current)	10.000000 mA	5.1	0.050 + 0.020
	100.0000 mA	5.1	0.050 + 0.005
	1.000000 A	0.1	0.100 + 0.010
	3.000000 A	0.1	0.120 + 0.020

### RESISTANCE

Function	Range	Test Current	1 Year Accuracy : ± (% of reading + % of range ) (23°C ± 1°C)
Resistance (Specifications are for 4W or 2W when a NULL operation is used).	100.0000	1 mA	0.010 + 0.004
	1.000000 K	1 mA	0.010 + 0.001
	10.000000 K	100 A	0.010 + 0.001
	100.0000 K	10 A	0.010 + 0.001
	1.000000 M	5 A	0.010 + 0.001
	10.000000 M	500 nA	0.040 + 0.001
	100.0000 M	500 nA/ 10 M	0.800 + 0.010
Diode Test	1.000000 V	1 mA	0.010 + 0.020
Continuity	1000.00	1 mA	0.010 + 0.030

### FREQUENCY AND PERIOD

Function	Range	Frequency (Hz)	1 Year Accuracy : ± (% of reading) (23°C ± 1°C)
Frequency & Period	100 mV to 750 V	3 - 5	0.10
		5 - 10	0.05
		10 - 40	0.03
		40 - 300K	0.01

### AC CHARACTERISTICS

Function	Range	Frequency (Hz)	1 Year Accuracy : ± (% of reading + % of range ) (23°C ± 1°C)
ACV (AC TRMS Voltage)	100.0000 mV	3 - 5	1.00 + 0.04
		5 - 10	0.35 + 0.04
		10 - 20 K	0.06 + 0.04
		20K - 50 K	0.12 + 0.05
		50K - 100K	0.60 + 0.08
		100K - 300K	4.00 + 0.50
	1.000000 V to 750.000V	3 - 5	1.00 + 0.03
		5 - 10	0.35 + 0.03
		10 - 20 K	0.06 + 0.03
		20K - 50 K	0.12 + 0.05
ACA (AC TRMS Current)	1.000000 A	3 - 5	1.00 + 0.04
		5 - 10	0.30 + 0.04
		10 - 5 K	0.10 + 0.04
		3 - 5	1.10 + 0.06
	3.000000 A	5 - 10	0.35 + 0.06
		10 - 5 K	0.15 + 0.06

Note 1 : Specifications are for 1-hour warm-up at 6.5 digits, slow ac filter with Bandwidth 3Hz, sine wave input.

Note 2 : 750 Vac range limited to 100kHz

### TEMPERATURE

Sensor Type	Temperature Range (Degree C)	Temperature (Degree F)
E	-270 ~ 1000	-518 ~ 1832
J	-210 ~ 1200	-140 ~ 2192
K	-270 ~ 1372	-518 ~ 2502
N	-270 ~ 1300	-518 ~ 2372
R	-50 ~ 1768	-122 ~ 3236
S	-50 ~ 1768	-122 ~ 3236
T	-270 ~ 400	-518 ~ 752
RTD (PT-100)	-200 ~ 850	-392 ~ 1562

All specifications are subject to change without prior notice.

## ELECTRICAL SPECIFICATIONS : KM 3510A/3511A

### DC CHARACTERISTICS

Function	Range	Resolution	1 Year Accuracy :
DCV	100.0000 mV	0.1 $\mu$ V	0.0080+0.0045
	1.000000 V	1.0 $\mu$ V	0.0090+0.0010
	10.000000 V	10 $\mu$ V	0.0120+0.0020
	100.00000 V	100 $\mu$ V	0.0120+0.0020
	1000.0000 V	1 mV	0.0130+0.0030
DCI	10.000000 mA	10 nA	0.050+0.020
	100.00000 mA	100 nA	0.050+0.010
	1.0000000 A	1 $\mu$ A	0.150+0.020
	3.000000 A	10 $\mu$ A	0.200+0.030
	10.000000 A	10 $\mu$ A	0.250+0.050
W W	100.00000	100 $\mu$	0.020+0.005
	1.0000000 K	m	0.020+0.002
	10.000000 K	10 m	0.020+0.002
	100.00000 K	100 M	0.020+0.002
	1.0000000 M	1	0.020+0.004
	10.000000 M	10	0.100+0.004
	100.00000 M	100	1.500+0.005
DIODE	1.000000 V	10 $\mu$ V	0.020+0.020
CONTINUTY (for 2 W )	10000.00	10 m	0.020+0.030

### AC CHARACTERISTICS

Function	Range	Resolution	Frequency (Hz)	1 Year Accuracy
ACV (TRMS)	100.00000 mV	0.1 $\mu$ V	10K - 20K	0.12 + 0.05
			20K - 50K	0.25 + 0.05
			50K - 100K	0.65 + 0.08
			100K -300K	4.50 +0.50
	1.0000000 V to 750.00000 V	1.0 $\mu$ V to 1mV	10K - 20K	0.12 + 0.04
			20K - 50K	0.25 + 0.05
			50K - 100K	0.65 + 0.08
			100K -300K	4.50 +0.50
ACI (TRMS)	1.000000 A 3.000000 A 10.000000 A	1 $\mu$ A 10 $\mu$ A 10 $\mu$ A	10K - 5K	0.20 +0.04
			10K - 5K	0.30 +0.06
			10K - 5K	0.50 + 0.12

### CAPACITANCE

Function	Range	Test current	1 Year Accuracy
CAPACITANCE	1 nF	10 $\mu$ A	2.0 + 0.80
	10 nF	10 $\mu$ A	1.0 + 0.50
	100 nF	100 $\mu$ A	1.0 + 0.50
	1 $\mu$ F	100 $\mu$ A	1.0 + 0.50
	10 $\mu$ F	100 $\mu$ A	1.0 + 0.50
	100 $\mu$ F	1 mA	1.0 + 0.05
	1000 $\mu$ F	1 mA	1.0 + 0.50
	10000 $\mu$ F	1 mA	2.0 + 0.50

### TEMPERATURE CHARACTERISTICS

Function	Type	Range	1 Year Accuracy
THERMO-COUPLE	B	600°C ~ 1820 °C	1.5°C
	C	0°C ~ 2316 °C	1.5°C
	E	-250°C ~ 1000°C	1.5°C
	J	-210°C ~ 1200°C	1.0°C
	K	-200°C ~ 1372° C	1.0°C
	N	-200°C ~ 1300°C	1.0°C
	R	0°C ~ 1767°C	1.5°C
	S	0°C ~ 1767°C	1.5°C
T	-250°C ~ 400°C	1.5°C	

### FREQUENCY % PERIOD

Function	Range	Frequency	1 Year Accuracy
Ferquency & Period	100mV~750V	10 - 40	0.03
		40 - 300k	0.02

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## MODEL - M3500A / M3510A / M3511A COMPARISON SHEET

MODEL	M3500A	M3510A	M3511A
<b>FUNCTION</b>			
Digits 6 ½	6 ½	6 ½	6 ½
Display	VFD	LCD	LCD
True RMS	YES	YES	YES
Basic Functions (DCV/DCI, ACV/ACI, 2W/4W, CONT/DIODE, RTD, LIMITS, MX+B,% dBm, dB, Min/max & null)	YES	YES	YES
DCV Accuracy (1Year )	0.0035%	<0.012%	<0.012%
Sensitivity	DCV :0.1µV 2W / 4W      µ	DCV :0.1µV 2W / 4W      µ	DCV :0.1µV 2W / 4W      µ
AC Measurement Range	3Hz to 300 KHz	10Hz to 300 KHz	10Hz to 300 KHz
Dual Measurement	NO	YES	YES
Sampling Rate	2000 Rdgs / s	50K Rdgs / s	10K Rdgs / s
Thermocouple Measurement	YES (Indirect)	YES (Direct)	NO
Capacitance Measurement	NO	YES	YES
Maximum Current Measurement Capability	3A	10A	10A
Support Scanner Card Measurement	YES	NO	NO
Rear Terminal	YES	YES	YES
Compliant SCPI	YES	YES	YES
CE Approved	YES	YES	YES
USBTMC	YES	YES	YES
Free Software	YES	YES	YES
GPIB / RS - 232	Support	Support	Support

All specifications are subject to change without prior notice.



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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 reading 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 an 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.