KUSAM-MECO®
An ISO 9001:2008 Company

DIGITAL TRMS MULTIMETER
Model 405MK-1

17 Functions 33 Ranges

FEATURES :

- Auto Polarity Display.
- Overrange Indication.
- Low Battery Indication.
- Data Hold Function.
- Auto power off
- Shock Resistant & Fire Retardant Casing.
- Input warning beeper
- Logic test, Diode Test & Continuity Test
- Duty Cycle Function.
- CE approved

NEW IMPROVED

GENERAL SPECIFICATIONS :

- ✶ **Sensing :** True RMS Sensing.
- ✶ **Basic Accuracy :** ±(0.05%rdg + 3 dgts)
- ✶ **Display :** 4½ digits, 19999 counts large LCD display with function and unit sign annunciators.
- ✶ **Display Size :** 17 mm
- ✶ **Over range indication :** "1" most significant digit blinks.
- ✶ **Low battery indication :** The " ⊟+ " is displayed when the battery voltage drops below the operating level.
- ✶ **Polarity :** Automatic, (-) negative polarity indication.
- ✶ **Auto power off** : Meter automatically shuts down after approx.45 minutes of inactivity.
- ✶ **Altitude :** 6561.7 (2000M)
- ✶ **Measurement rate :** 2.5 times per second, nominal.
- ✶ **Operating Temperature :** 0°C to 50°C at < 70% R.H.
- ✶ **Storage Temperature :** -20°C to 60°C, 0 to 80 % R.H with battery removed from meter.
- ✶ **Temperature Coefficient :** 0.1 x (specified accuracy) / °C (0°C ~ 18° or 28°C ~ 50°C)
- ✶ **Power :** Single 9V Alkaline battery.
- ✶ **Battery life :** 500 hours typical with alkaline.
- ✶ **Dimension :** 198(H) x 90(W) x 44(D)mm.
- ✶ **Weight:** Approx. 400g including battery.
- ✶ **Accessories :** Test leads pair, User's Manual, Battery installed, Carrying Case.

CE

Preliminary Data

ELECTRICAL SPECIFICATIONS : 405MK-1

Accuracy is given as ±(% of reading + no. of digits) at 18°C to 28°C upto 75% R.H.

DC VOLTAGE

Range	Resolution	Accuracy
200 mV	10 µV	±(0.05%rdg + 3dgts)
2 V	100 µV	
20 V	1 mV	
200 V	10 mV	
1000 V	100 mV	

Input Impedance : 10MΩ
Overload Protection : 500V DC / 350V rms on 200mV range, 1000V DC/750V AC rms on all other ranges

FREQUENCY

Range	Resolution	Accuracy
2 kHz	0.1 Hz	±(0.5%rdg + 3dgts)
20 kHz	1 Hz	
200 kHz	10 Hz	

Min Input Range : >10Hz for 2kHz, <60 dgts for 20kHz & 200kHz.
Sensitivity : 50mV RMS min. (Sine Wave), 400mV RMS min. at > 30% and < 70% duty cycle
Input Frequency : More than 10 Hz at pulse width > 2µ sec.
Overload Protection : 500V DC or AC RMS

DIODE TEST

Range	Resolution	Accuracy
2 V	0.1mV	±(0.5%rdg + 1dgt)

Test Current : 1.0mA
Open Circuit Voltage : 3.3V DC typical
Overload Protection : 500V DC or AC RMS

CONTINUITY TEST

Range	Audible Indication	Response time
2 V	Less than 100Ω	Approx. 500ms

Open Circuit Voltage : 3.3V DC typical
Overload Protection : 500V DC or AC RMS

AC VOLTAGE (TRUE RMS)

Range	Resolution	Accuracy(50Hz~500Hz)
200 mV	10 µV	±(1.0%rdg +10dgts)
2 V	100 µV	
20 V	1 mV	
200 V	10 mV	
750 V	100 mV	±(2.0%rdg + 20dgts)

Input Impedance : 10MΩ **Crest Factor :** ≤ 3
Overload Protection : 500V DC / 350V rms on 200mV range, 1000V DC / 750V AC rms on all other ranges
Accuracy (500Hz TO 2kHz) : ±(2.0%rdg +20dgts) for ranges 200mV, 2V, 20V, 200V.
Unspecified for range 750V.

RESISTANCE

Range	Resolution	Accuracy
200 Ω	10 mΩ	±(0.25%rdg + 10dgts)
2 KΩ	100 mΩ	±(0.15%rdg + 3dgts)
20 KΩ	1 Ω	
200 KΩ	10 Ω	
2 MΩ	100 Ω	±(0.25%rdg + 10dgts)
20 MΩ	1 KΩ	+(1.0%rdg + 10dgts)

Overload Protection : 500V DC or AC RMS
Open Circuit Voltage : 3.3V DC

LOGIC TEST

Threshold	
Logic1(Hi)	Logic 0 (Lo)
2.8V ± 0.8V	0.8V ± 0.5V

Pulse Rise (max) :10µ Sec. **Pulse Rep (max.) :** 1Mpps
Pluse Width (min) : 25 nS. **Test Voltage :** 5V DC
Duty Cycle : >20% & <80% **Frequency Response:**20MHz
Indication : 40msec beep at logic 1 (Hi)
Overload protection : 500V DC or AC RMS

DC CURRENT

Range	Resolution	Accuracy
200 µA	10 nA	±(0.5%rdg + 5dgts)
2 mA	100 nA	
20 mA	1 µA	
200mA	10 µA	
20 A*	1 mA	±(2.0%rdg + 10dgts)

Burden Voltage : 300mV for 200µA, 2mA, 20mA, 600mV for 200mA & 800mV for 20A.
Overload Protection : 500mA / 500V fuse on mA inputs (fast blow ceramic fuse). 20A / 600V fuse on 20A inputs (fast blow ceramic fuse).* 20A for 30 seconds maximum.

AC CURRENT (TRUE RMS)

Range	Resolution	Accuracy(50Hz~ 1kHz)
200 µA	10 nA	±(1.2%rdg + 10dgts)
2 mA	100 nA	
20 mA	1 µA	
200mA	10 µA	
20 A*	1 mA	±(2.5%rdg + 10dgts)

Burden Voltage : 300mV for 200µA, 2mA, 20mA, 600mV for 200mA & 800mV for 20A.
Overload Protection : 500mA / 500V fuse on mA inputs (fast blow ceramic fuse). 20A / 600V fuse on 20A inputs (fast blow ceramic fuse).* 20A for 30 seconds maximum.

DUTY CYCLE

Range	Resolution	Pulse Width
0 - 90.0%	0.1%	> 10µ sec.

Accuracy (5V logic) : ±(2.0%rdg + 10dgts)
Overload Protection : 500V DC or AC RMS
Frequency Range : 40Hz to 20KHz

Note: All Specification 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 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.