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DUAL DISPLAY DIGITAL

MULTIMETER

MODEL: GDM-8245

User Manual

Good Will Instrument Co., Ltd.

GW Part No. 82DM-82450MD

Printed in Taiwan December 2003

Declaration of Conformity

We

GOOD WILL INSTRUMENT CO., LTD.

No. 95-11, Pao-Chung Rd., Hsin-Tien City, Taipei Hsien, Taiwan

GOOD WILL INSTRUMENT (SUZHOU) CO., LTD.

No.69 Lushan Road, Suzhou New District Jiangsu, China.

declares that the below mentioned product

GDM-8245

is herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Law of Member States relating to Electromagnetic Compatibility (89/336/EEC, 92/31/EEC, 93/68/EEC) and Low Voltage Equipment Directive (73/23/EEC, 93/68/EEC).

For the evaluation regarding the Electromagnetic Compatibility and Low Voltage Equipment Directive, the following standards were applied:

◎ EMC

EN 61326-1: Electrical equipment for measurement, control and laboratory use — EMC requirements **(1997+A1: 1998)**	
Conducted and Radiated Emissions CISPR 22 class B: 1993	Electrostatic Discharge EN 61000-4-2: 1995
Current Harmonic EN 61000-3-2: 1995+A12: 1996	Radiated Immunity EN 61000-4-3: 1996
Voltage Fluctuation EN 61000-3-3: 1995	Electrical Fast Transients EN 61000-4-4: 1995
----------	Surge Immunity EN 61000-4-5: 1995
----------	Conducted Susceptibility EN 61000-4-6: 1996
----------	Voltage Dips/ Interrupts EN 61000-4-11: 1994

◎ **Safety**

Low Voltage Equipment Directive 73/23/EEC & amended by 93/68/EEC
EN 61010-1 : 2001 IEC 61010-1: 2001

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TABLE OF CONTENTS **PAGE**

1. SAFETY SUMMARY…… 1

2. INTRODUCTION…….. 5

3. SPECIFICATION…….. 6

4. OPERATION INSTRUCTION……. 11

5. MEASUREMENT TUTORIAL…..……. 14

6. MEASUREMENT TECHNIQUES.....…… 18

7. MAINTENANCE……... 22

1.SAFETY SUMMARY

Please take a moment to review these safety terms and symbols which may appear in this manual or on Equipment to prevent damage to the instrument.



WARNING. Warning statements identify condition or practices that could result in injury or loss of life.



CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

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DANGER High Voltage

ATTENTION refer to Manual

Protective Conductor Terminal

(ground) Earth Terminal

Frame or Chassis Terminal

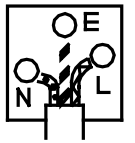
FOR UNITED KINGDOM ONLY

NOTE: This lead/appliance must only be wired by competent persons

WARNING: THIS APPLIANCE MUST BE EARTHED

IMPORTANT: The wires in this lead are coloured in accordance with the following code:

Green/ Yellow: Earth
Blue: Neutral
Brown: Live(Phase)



As the colours of the wires in main leads may not correspond with the colours marking identified in your plug/appliance, proceed as follows:

The wire which is coloured Green & Yellow must be connected to the Earth terminal marked with the letter E or by the earth symbol ⏚ or coloured Green or Green & Yellow.

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The wire which is coloured Blue must be connected to the

terminal which is marked with the letter N or coloured Blue or Black.

The wire which is coloured Brown must be connected to the terminal marked with the letter L or P or coloured Brown or Red.

If in doubt, consult the instructions provided with the equipment or contact the supplier.
This cable/appliance should be protected by a suitably rated and approved HBC mains fuse : refer to the rating information on the equipment and/or user instructions for details. As a guide, cable of 0.75mm² should be protected by a 3A or 5A fuse. Larger conductors would normally require 13A types, depending on the connection method used.

Any moulded mains connector that requires removal /replacement must be destroyed by removal of any fuse & fuse carrier and disposed of immediately, as a plug with bared wires is hazardous if a engaged in live socket. Any re-wiring must be carried out in accordance with the information detailed on this label.

2. INTRODUCTION

This instrument is a portable, bench-type dual display digital multimeter with a good-performance 50000 counts designed for general purpose application. The dual display allows you to display two functions of the input signal being measured.

Features

- 50000 counts DMM
- Multi-function ACV, DCV, ACA, DCA, R, C , Hz, Continuity Beeper, Diode Test, MAX/MIN, REL, HOLD, dBm
- Dual display Indicate ACV and Hz or DCV (ACV) and dBm
- Manual or Autoranging
- 0.03% DCV accuracy
- 20A high current range
- 1200V high voltage range
- AC True RMS or AC+DC True RMS.

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3.SPECIFICATIONS

The specifications are operated under the essential conditions as follows:

- A 1-year calibration cycle.
- An operating temperature of 18 to 28℃ (64.4 to 82.4℉)
- Relative humidity not exceeding 90%
- Accuracy is expressed as ±(percentage of reading + digits).
- The AC specification is based on the 50% of duty cycle.

1. DC VOLTAGE

RANGE	RESOLUTION	ACCURACY	INPUT IMPEDANCE
500mV	10 μV	0.03%+4	10MΩ
5V	100 μV		11.1 MΩ
50V	1mV		10.1MΩ
500V	10mV		10MΩ
1200V	100mV	0.03%+9	10MΩ

Input Impedance	Approx. 10MΩ in parallel with <100pF, all ranges.
Normal Mode Rejection Ratio	>60dB at 60Hz or 50Hz.
Common Mode Rejection Ratio	>90dB at 60Hz or 50Hz.
Common Mode Voltage (Max.)	500V dc or peak ac.
Maximum Input	450V dc or peak ac continuous on 500mV range. 1200V dc or peak ac continuous on other range.
dBm (ref 600Ω)	63.80 dBm ~-97.7 dBm

When the input exceeds the full scale of the selected range, the display will appear "—OL—" of over-range indication.

2. TRUE RMS AC OR AC+DC VOLTAGE

Accuracy	between 2% of range and full range.

RANGE	20Hz-45Hz	45Hz-1kHz	1kHz-2kHz	2kHz-10kHz	10kHz-20kHz	20kHz-50kHz
500mV	1%+15	0.5%+15		1%+15	2%+30	5%+30
5V	1%+15	0.5%+15		1%+15	2%+30	5%+30
50V	1%+15	0.5%+15		1%+15	2%+30	5%+30
500V	1%+15	0.5%+15	————————			
1000V	1%+15	0.5%+15	————————			

RANGE	RESOLUTION	INPUT IMPEDANCE
500mV	10 μV	10MΩ
5V	100 μV	11.1 MΩ
50V	1mV	10.1MΩ
500V	10mV	10MΩ
1000V	100mV	10MΩ

Input Impedance	Approx. 10MΩ in parallel with < 100pF,all ranges.
Maximum Input	450V dc or peak ac continuous on 500mV range. 1000V rms on other range.
dBm (ref 600Ω)	63.8dBm ~ -97.7dBm
Crest Factor Range	3.0 at full scale.

When the input exceeds the full scale of the selected range, the display will appear "—OL—" of over-range indication.

3. FREQUENCY MEASUREMENT AT ACV RANGE

RANGE	FREQUENCY	INPUT LEVEL (SINE WAVE)	ACCURACY
500mV	10Hz ~ 50kHz	≧ 120mV	0.05%+1
	50k ~ 150kHz	≧ 200mV	0.05%+1
5V	10Hz ~ 200kHz	≧ 1.2V	0.05%+1
50V	20Hz ~ 200kHz	≧ 1.2V	0.05%+1
500V	20Hz ~ 1kHz	≧ 12V	0.05%+1

AC+DC measurement does not support AC+Hz function.

Maximum Input	450V peak ac continuous on 500mV range. 500V peak ac continuous on the other range.

4. DC Current

RANGE	RESOLUTION	ACCURACY	BURDEN VOLTAGE
500 μA	0.01 μA	0.2%+2	0.7Vmax.
5mA	0.1 μA	0.2%+2	0.7Vmax.
50mA	1 μA	0.2%+2	0.7Vmax.
500mA	10 μA	0.2%+2	0.8Vmax.
2A	100 μA	0.3%+2	0.8Vmax.
20A	1mA	0.3%+2	0.9Vmax.

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Protection	500 μ A,5mA,50mA,500mA,2A 5 ranges fuse protection. 20A range no fuse,15 seconds max.
When the input exceeds the full scale of the selected range, the display will appear "—OL—" of over-range indication.	

5. TRUE RMS AC OR AC+DC CURRENT

Accuracy	Between 2% of range and full range.

RANGE	20Hz-45Hz	45Hz-2kHz	2kHz-10kHz	10kHz-20kHz
500 μ A	1%+15	0.5%+15	1%+15	2%+15
5mA	1%+15	0.5%+15	1%+15	2%+15
50mA	1%+15	0.5%+15	1%+15	2%+15
500mA	1%+15	0.5%+15	————————	
2A	1%+15	0.5%+15	————————	
20A	1%+15	0.5%+15	————————	

Protection	500 μ A,5mA,50mA,500mA,2A 5 ranges fuse protection. 20A range no fuse,15 seconds max.
Crest Factor Range	3.0 at full scale.
The burden voltage is the same as the DC current.	
When the input exceeds the full scale of the selected range, the display will appear "—OL—" of over-range indication.	

6. FREQUENCY MEASUREMENT AT ACA RANGE

RANGE	FREQUENCY	INPUT LEVEL (SINE WAVE)	ACCURACY
500 μ A	10Hz ~ 20kHz	≧ 90 μ A	0.05%+1
5mA	10Hz ~ 20kHz	≧ 0.9mA	0.05%+1
50mA	10Hz ~ 20kHz	≧ 9mA	0.05%+1
500mA	10Hz ~ 20kHz	≧ 90mA	0.05%+1
2A	10Hz ~ 2kHz	≧ 1A	0.05%+1
20A	10Hz ~ 2kHz	≧ 9A	0.05%+1
AC+DC measurement does not support AC+Hz function.			

7.RESISTANCE

RANGE	RESOLUTION	ACCURACY
500Ω	0.01Ω	0.1%+4
5kΩ	0.1Ω	0.1%+2
50kΩ	1Ω	0.1%+2
500kΩ	10Ω	0.1%+2
5MΩ	100Ω	0.2%+2
20MΩ	1kΩ	0.3%+2
Open-circuit Voltage	3.2 volts maximum on 500Ω, 1.3 volts maximum on all other ranges.	
Protection	450V dc or peak ac continuous.	

8. CAPACITANCE

RANGE:	RESOLUTION	ACCURACY
5n *	0.001n	≧1nF: 2%+10 <1nF & ≧0.5nF: 2%+20
50n	0.01n	≧10nF: 2%+10 <10nF & ≧5nF: 2%+30
500n	0.1n	2%+4
5 μ	1n	2%+4
50 μ	10n	2%+4
*5n range tends to be interfered by the test lead's impedance and position. For the accuracy, please measure the range on the input terminal directly.		
Protection	450V dc or peak ac continuous.	

9. DIODE CHECK

Description	Display read forward voltage of diode.
Open Voltage	3.1V approx.
Maximum Forward Voltage	1.5V
Protection	450V dc or peak ac continuous.

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10. CONTINUITY BEEPER	
Description	Built in buzzer sounds if conductance is less than 5 ohm.
Open Voltage	3 volts maximum.
Protection	450V dc or peak ac continuous.
11. ENVIRONMENTAL	
Operation Environment	Indoor use, altitude up to 2000m. Ambient Temperature 0℃ to 50℃. Relative Humidity 80% (Maximum). Installation category II Pollution Degree 2
Storage temperature	-40℃ to 70℃.
Relative Humidity	Up to 90%, 0℃ to 35℃, Up to 50%, 35℃ to 50℃, except the ranges of 2MΩ and 20MΩ which are up to 80% , 0℃ to 35℃.
12. GENERAL	
Maximum Common Mode Voltage	500V dc or peak ac (low terminal potential with respect to power line ground).
Warm Up	0.5 hours to achieve rated accuracy.
Power source	AC 100V/120V/230V±15%, 50/60Hz, 8.0VA, 6.0W.
Accessories	Test Lead × 1 Instruction manual × 1
Dimension	251(W)×91(H)×291(D) m/m
Weigh	Approx. 2.6 kg

WARNING：To avoid electrical shock, the power cord protective grounding conductor must be connected to ground.

CAUTION：To avoid damaging the instrument, do not use it in a place where ambient temperature exceeds 50℃.

4. OPERATION INSTRUCTIONS

4-1 Front panel and rear panel

The front panel, shown in Figure4-1, contains three main elements: the input terminals, the primary and secondary displays, and the push buttons.

The rear panel, shown in Figure 4-2, contains the AC power-line connector, and fuse & line voltage selector, and input fuse holder.

4-2 The [SHIFT] key and function keys

[SHIFT] button is used to enable the secondary function of certain function keys that with blue symbols printed above. The SHIFT LED will be on after pressed the [SHIFT] button. At this time, only the buttons with blue symbols are workable. To release SHIFT function, press [SHIFT] again. For example, to select DCmV function, press [SHIFT], then press [DCV] ([DCmV]).

4-3 Warm up

The instrument requires half-an-hour warm up to achieve rated accuracy.

4-4 Over-range indication

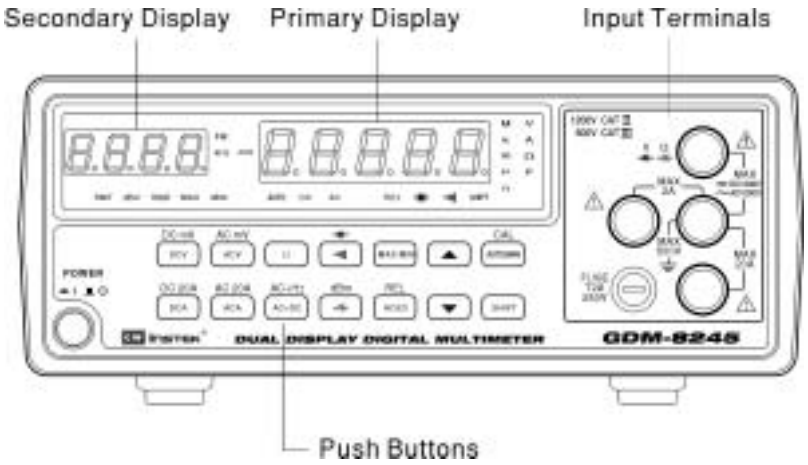
An input is over-range if it exceeds the full scale of the selected range. GDM-8245 indicates an input is over-range by lighting the "—OL—" pattern on display.

4-5 No specification indication

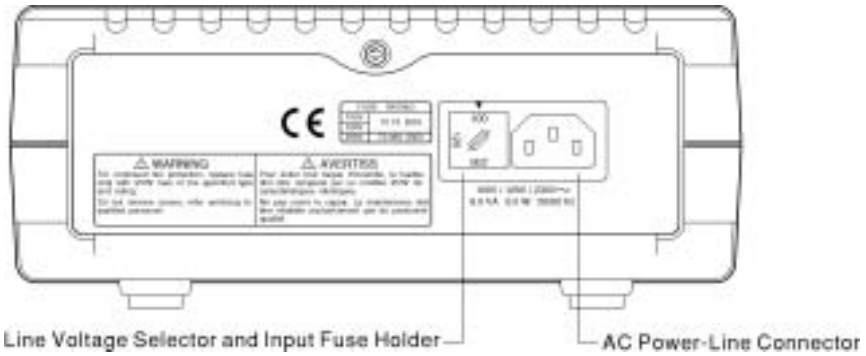
On AC+Hz measured mode, when an input is less sensitivity, the secondary display show "————". When the frequency of an input exceeds 51kHz, the primary display will show "————".

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- **Figure 4-1 Front Panel**



- **Figure 4-2 Rear Panel**



4-6 Input overload protection

The maximum allowable input is shown as table 4-1. Please proceed the measurement accordingly.

Table 4-1:

FUNCTION	RANGE	MAXIMUN INPUT
DCV	5V~1200V	1200Vdc or peak ac
ACV (AC+DC)	5V~1000V	1000V rms continuous & 10^7 V•Hz maximum
DCA,ACA(AC+DC)	500 μ A~2A	fuse protected: 2A 250V
DC,AC20A(AC+DC)	20A	no fuse protected
DC,ACmV (AC+DC)	500mV	450V dc or ac peak
OHM	all ranges	450V dc or ac peak
CAPACITANCE	all ranges	450V dc or ac peak

WARNING: To avoid shock hazard and/or instrument damage, do not apply input potentials that exceed the input overload limits shown in table 4-1.

4-7 Input connections to common

WARNING: To avoid shock hazard and/or instrument damage, do not connect the common input terminal to any source of more than 500 volts DC or peak AC above earth ground.

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5. MEASUREMENT TUTORIAL

5-1. Voltage measurements (DCV, ACV, DCmV, ACmV)

1).Press the button to select desired function.

2).Press [▲]or[▼]to the desired range (if you have no idea about the value of input, we suggest you always start at the highest range). Press [AUTO/MAN] button for manual or auto-ranging selection.

3).Connect the test lead to the V and COM input terminals of the instrument.

4).Connect the test lead to the measuring points and read the displayed value.

NOTE: After measuring high voltage to 1000V dc, errors may occur when the 100μV is measured. Allow up to one minute prior to making low-level measurements

5-2. Current measurements (DCA, DC 20A, ACA, AC 20A)

1).Press the button to select function.

2).Press [▲]or[▼]to the desired range.(if you have no idea about the value of input. we suggest you always start at the highest range).Press [AUTO/MAN] button to change manual or auto-ranging.

3).Connect the test lead to the 2A or 20A and COM input terminals of the instrument.

4).Connect the test lead to the measuring points and read the displayed value.

5-3. Resistance, capacitance, continuity beeper measurements

1).Press the button to select function.

2).Press [▲]or[▼]to the desired range. Press [AUTO/MAN] button to change manual or auto-ranging.

3).Connect the test lead to the Ω, ⊣← and COM input terminals of the instrument.

4).Connect the test lead to the measuring points and read the displayed value.

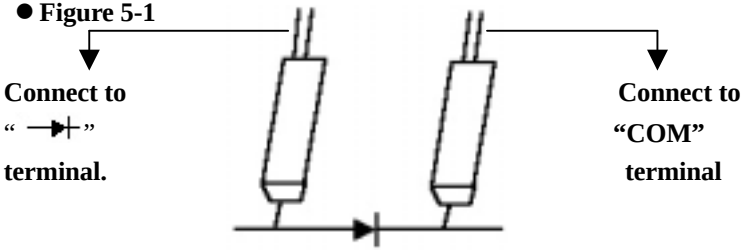
5-4. Diode test measurements

1).Press the button to select function.

2).Connect the test lead to the →⊣ and COM input terminals of the instrument.

3).Connect the test lead to the semiconductor junction (diode or transistor) as shown in Figure 5-1,and read the displayed value.

● **Figure 5-1**



5-5. dBm measurements

This function converts a voltage measurement into dBm. The function can be selected only when a voltage function (volts ac, volts dc, or volts ac+dc) is selected. Press [dBm] button, the secondary display shows the dBm value that reposed on the voltage value showed in the primary display.

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For example, if [dBm] is pressed when measuring voltage in the max mode, the maximum value is converted to dBm. To release the dBm function, press [dBm] again. The dBm mode and AC+Hz mode are not selected concurrently.

The standard reference impedance of the instrument is 600Ω.

5-6. AC+Hz measurements

The function can be selected only when ac range is selected. Press [SHIFT], then press [AC+Hz], the secondary display shows the frequency of the input signal that is higher than the sensitivity. The frequency measurement does not depend on the max/min, rel, or hold mode. In this mode, the reading rate of the DMM may be slower than the normal state.

To release the AC+Hz function, press [AC+Hz] again. The dBm mode and AC+Hz mode are not selected concurrently.

5-7 AC+DC measurements

The function can be selected only when voltage or current function is selected. Press [AC+DC] button, the primary display shows the true rms value of the input signal including the ac component and dc component. In this mode, the reading rate of the DMM is slower than the normal state.

To release the AC+DC function, press other function (voltage ac or dc, current ac or dc, R,C, Continuity Beeper, Diode Test) key.

5-8 MAX/MIN measurements

The MAX/MIN mode causes the DMM to hold the lowest and highest readings. Press [MAX/MIN] button to the MAX mode. The highest will be displayed in continuous input. In the MAX mode, press [MAX/MIN] button to the MIN mode. The lowest will be displayed in continuous input. In the MIN mode, press [MAX/MIN] button to release the MAX/MIN mode.

5-9. REL measurements

When the [REL] button is pressed, the meter stores the present reading and displays subsequent measurements as the difference between the measured value and the stored reading.

In the MAX/MIN mode, set [REL] button to the REL mode. The maximum or minimum reading will become the relative base.

5-10. HOLD measurements

The HOLD mode that allows you to keep your eyes fixing on the probes when taking measurements in difficult or hazardous circumstances, then read the display when it is convenient and safe. Press the [HOLD] button the last reading is held on the display in all function. To release the HOLD function, press [HOLD] again.

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6.MEASUREMENT TECHNIQUES

6-1 dBm measurement technique

dBm is defined as above or below a 1mW reference. A voltage measurement is converted to dBm using the following formula:

dBm=10*log $_{10}$(1000*voltage value^2/reference impedance.)

The standard reference impedance of the instrument is 600Ω.

For example, 0.7746V will be convert to 0 dBm.

6-2 True rms measurement

The true rms (root-mean-square) value of a waveform is equivalent to dc value that causes the same amount of heat to be dissipated in a resistor.

Since average-responding meters have been in use for so long, you may have accumulated test or reference data based on them. Figure 6-1 illustrates the relationship between ac and dc components for common waveforms, and compares readings for true rms meters and average-responding meters. Figure 6-1 will help you convert between the two measurement methods.

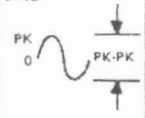
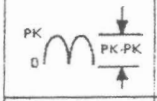
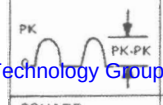
- **Figure 6-1: Voltage Conversion**

AC-COUPLED INPUT WAVEFORM	PEAK VOLTAGES		METERED VOLTAGE			DC AND AC TOTAL RMS
			AC COMPONENT ONLY		DC COMPONENT ONLY	
	PK-PK	0-PK	*RMS CAL	AC TRUE RMS		**TRUE RMS= $\sqrt{ac^2+dc^2}$
SINE	2.828	1.414	1.000	1.000	0.000	1.000
RECTIFIED SINE (FULL WAVE)	1.414	1.414	0.421	0.435	0.900	1.000
RECTIFIED SINE (HALF WAVE)	2.000	2.000	0.764	0.771	0.636	1.000
SQUARE	2.000	1.000	1.110	1.000	0.000	1.000
RECTIFIED SQUARE	1.414	1.414	0.785	0.707	0.707	1.000
RECTANGULAR PULSE	2.000	2.000	2.22K	2K	2D	$2\sqrt{D}$
TRIANGLE SAWTOOTH	3.464	1.732	0.960	1.000	0.000	1.000

*RMS CAL IS THE DISPLAYED VALUE FOR AVERAGE RESPONDING METERS THAT ARE CALIBRATED TO DISPLAY RMS FOR SINE WAVES.
** Your Digital Multimeter.

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• Figure 6-1: Voltage Conversion

AC-COUPLED INPUT WAVEFORM	PEAK VOLTAGES		METERED VOLTAGE			DC AND AC TOTAL RMS
			AC COMPONENT ONLY		DC COMPONENT ONLY	
	PK-PK	0-PK	*RMS CAL	AC TRUE RMS		**TRUE RMS= $\sqrt{ac^2 + dc^2}$
SINE 	2.828	1.414	1.000	1.000	0.000	1.000
RECTIFIED SINE (FULL WAVE) 	1.414	1.414	0.421	0.435	0.900	1.000
RECTIFIED SINE (HALF WAVE) 	2.000	2.000	0.764	0.771	0.636	

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6-3 AC+DC measurement

A signal includes an ac component and a dc level. The relationship between the total rms value of the signal and the ac component and the dc component is:

$$\text{rms total} = \sqrt{(\text{ac component rms})^2 + (\text{dc component})^2}$$

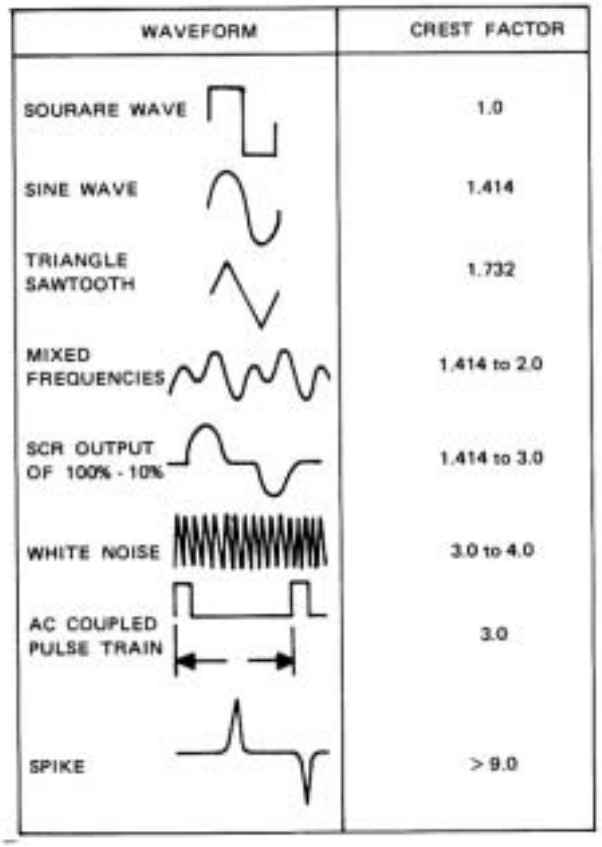
6-4 Crest factor

Crest factor is often overlooked in determining the accuracy of an ac measurement. Crest factor is defined as the ratio of the peak signal amplitude to the rms value of the signal.

If an input signal has a crest factor of 3.0 or less, voltage measurements will not be in error due to dynamic range limitations at full-scale.

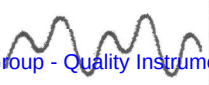
The waveforms in Figure 6-2 show signals with increasing value of crest factor. As you can see from the series of waveforms, a signal with a crest factor above 3.0 is unusual.

- **Figure 6-2: Crest Factor**



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- **Figure 6-2: Crest Factor**

WAVEFORM	CREST FACTOR
SOURARE WAVE 	1.0
SINE WAVE 	1.414
TRIANGLE SAWTOOTH 	1.732
MIXED FREQUENCIES 	1.414 to 2.0

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7.MAINTENANCE

The following instructions are executed by qualified personnel only. To avoid electrical shock, do not perform any servicing other than the operating instructions unless you are qualified to do so.

7-1 Line fuse replacement

If the fuse blows, the DMM would not work. Try to determine and correct the cause of the blown fuse, then replace the fuse with correct rating and type shown as below:

FUSE RATING AND TYPE	
100/120V	T0.1A 250V
230V	T0.08A 250V
F101 on PCB	T0.5A 250V

7-2 Current fuse replacement

The current fuse protects the 500 μ A~ 2A range from an input current greater 2A.To replace the current fuse, perform the following steps:

1).Turn off the power, disconnect the power line and remove the test leads.

2).Place the end of a flat blade screwdriver into the slot of the fuse holder on the front panel. Push and carefully rotate the fuse carrier turn counterclockwise till remove the fuse and the fuse carrier off the front panel.

3).Remove the defective fuse and replace the correct fuse (F2A 250V).

7-3 Line voltage conversion

The primary winding of the power transformer is tapped to permit operation from 100/120V, or 230V AC 50/60Hz line voltage. Conversion from one line voltage to another is done by changing the line voltage selector switch as shown in Figure 4-2. The rear panel identifies the line voltage to which the unit was factory set. To convert to a different line voltage, perform the following procedure:

1). Make sure the power cord is unplugged.

2). Adjust the line voltage selector switch to the desired line voltage position.

3). A change in line voltage may also require a corresponding change of fuse value. Install the correct fuse value as listed on rear panel.

7-4 Cleaning

To keep the instrument clean, wipe the case with a damp cloth and detergent. Do not use abrasives or solvents.

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