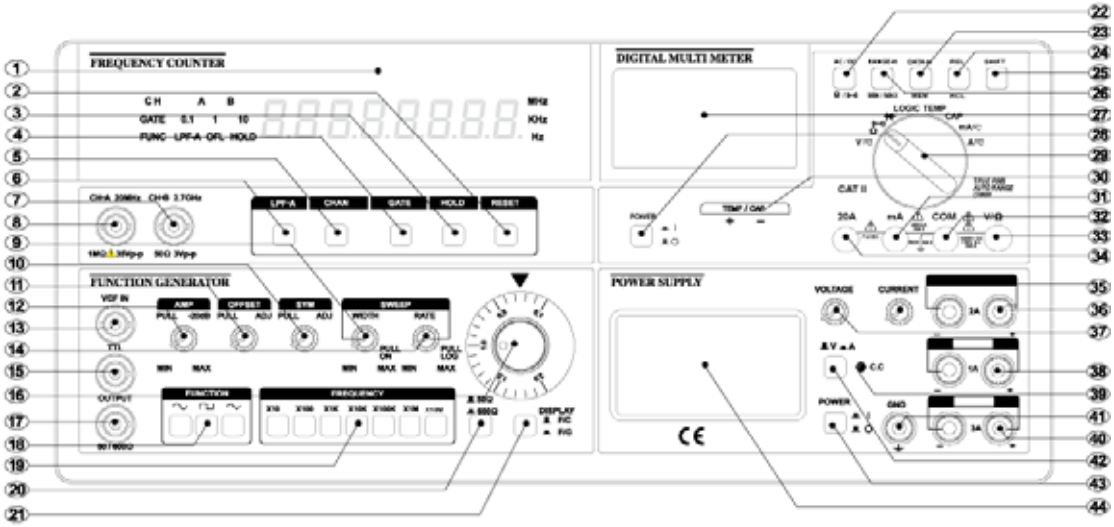
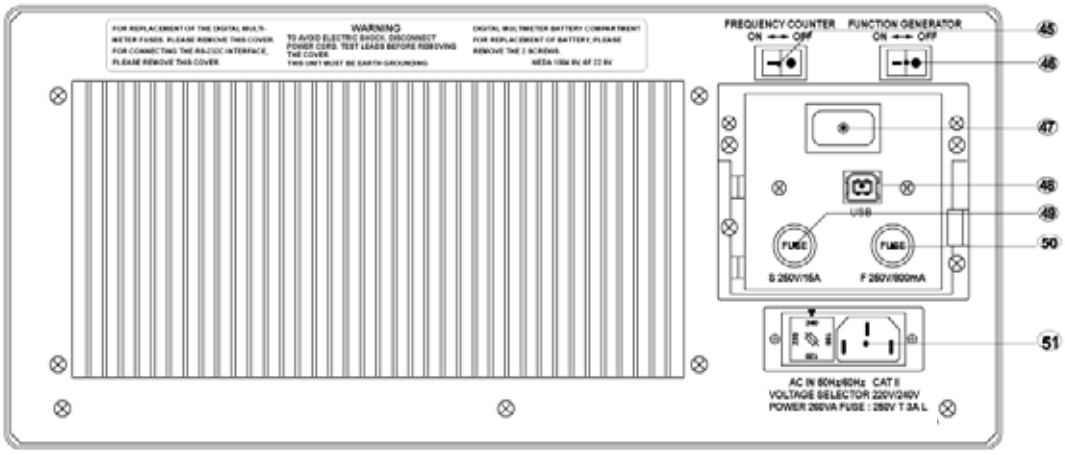
UNIVERSAL SYSTEM

MS-9160

OPERATING MANUAL



MS-9160 FRONT



MS-9160 BACK

LEGEND

1. Frequency Counter LED Display
2. Reset Switch
3. Data Hold Switch
4. Gate Time Switch
5. Channel Select Switch
6. Low Pass Filter Switch
7. Channel B Input Connector
8. Channel A Input Connector
9. Sweep Width Control Knob
10. Symmetry Control Knob
11. Offset Control Knob
12. Amplitude Control Knob
13. VCF Input Connector
14. Sweep Rate Control Knob
15. TTL Output Connector
16. Frequency Control Dial Knob
17. F/G Output Terminal
18. Function Select Switch Area
19. Frequency Range Select Switch Area
20. Output Impedance Select Switch
21. Display Option Key
22. AC/DC(OHM/BEEPER) Select Switch
23. DATA-HOLD(MEM) Switch
24. REL(RCL) Switch
25. SHIFT Switch
26. RANGE-HOLD(MIN/MAX) Switch
27. DMM LCD Display(3 3/4 digits)
28. Power ON/OFF Switch(DMM)
29. Range Select Switch
30.TEMP/ Capacitor Socket
31. Milli ampere Terminal
32. Common Terminal
33. Voltage/Ohm Terminal
34. 20 Ampere Terminal
35 Current Control Knob
36. 5V/2A Output Terminal
37. Voltage Control Knob
38. 15V/1A Output Terminal
39. Current Limit Indicator
40. 0-30V/3A Output Terminal
41. Ground Terminal(Chassis Ground)
42. Voltage/Ampere Select Switch
43. Power ON/OFF Switch
44. DPS LCD Display(3 1/2 digits)
45. Function Generator ON/OFF Switch
46. Frequency Counter ON/OFF Switch
47. 9V Battery Housing(DMM)
48. RS-232C Serial Interface Port
49. DMM Ampere Fuse(20A Range)
50. DMM Ampere Fuse(mA Ranges)
51. Supply Power Inlet with Power Fuse

Prior to operating your MS-9160 Universal System, Please read these safety precautions, installation and operating carefully. These requirements must be observed during operation and repair service.

CONTENTS

SECTION 1 : THE MS-9160 UNIVERSAL SYSTEM

Please read this operating manual very carefully, prior to operating the instrument.

1-1. Introduction

The MS-9160 Universal System is a compact and powerful performance instrument, capable of meeting various needs of laboratories, service-workshop, technical training Institutes, schools, engineering and manufacturing fields, etc.

The Universal System incorporates :

1. Function Generator, capable of generating seven(7) forms of wave, ie, Sine, Square, Triangle, Skewed Sine, Ramp, Pulse and TTL level square in the seven frequency range sourcing 1Hz to 10MHz
2. Frequency Counter, capable of measuring the frequency ranges from 20MHz to 2.7GHz.
3. DC Power Supply, capable of generating the voltage carrying with 5V/2A, 15V/1A fixed and 0-30V/3A variable.
4. Digital Multimeter, capable of measuring DC/AC voltage up to 1000V DC/750C AC, DC/AC current up to 20A, Resistance up to 40MΩ, Capacitance up to 400μF, and Logic test(C-MOS/TTL). This section can be hooked into data acquisition system run on Personal Computers, printers or pen-plotters, etc, through a USB interface connector

1-2. Accessories

This instrument is supplied with the following accessories :

Power cable	1 piece
Operation manual	1 piece
Black & Red test leads	1 piece
Coaxial cable with BNC connector	(optional)
USB interface cable with connector	(optional)
Programmed floppy disc	(optional)

SECTION 2 : SAFETY PRECAUTIONS

The following safety precautions must be observed at all times during operation, service and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture and intended use of the product. Damages resulting from failure to observe these safety precautions are exempt from any legal claims whatever.

Indoor use only
Avoid an extremely hot or cold place for the instrument
Prior to connection of the equipment to the mains outlet, check that the available mains voltage corresponds to the voltage setting of the equipment.
Ground the chassis and cabinet by only using a three-contact AC power cable which must be plugged into an approved three-contact electrical outlet
Do not operate the instrument in wet, damp or explosive areas.
Do not subject the equipment to direct sunlight or extreme temperatures.
Do not subject the equipment to extreme humidity or dampness
Keep the instrument away from live-circuits, a soldering iron, ect.
Do not change parts or apply an unauthorized modification to the instrument
Make sure that any use of modified fuses or the short circuiting of the fuse-holders shall be prohibited
Use only the specified fuses for the instrument, as follows : -

* Power line fuse : 3A for 220V/240V or
  5A for 100V/120V
  Shape : 5 × 20mm
  Type : Slow-blow
* DMM ampere fuse : 400mA AC/DC Ranges : 800mA/250V
  Shape : 6 × 32mm, Type : Fast-blow
  20A AC/DC ranges : 15A/250V
  Shape : 6 × 32mm , Type : Slow-blow

Pay your attention to warning-signs printed on the instrument :


The user should refer to the operation manual to protect the instrument against damage.


Dangerous voltage exists

Ground(Earth Terminal)


Indicates protection class II, double insulation.

CATII Overvoltage Category II.

Do not exceed the maximum permissible input ratings
Conduct measuring works only in dry clothing and in rubber shoes i.e. on isolating mats.
Check test leads and probes for faulty insulation or bare wires before connection to the equipment.
Disconnect test leads or probe from the measuring circuit before switching modes or functions.

- For proper ventilation, do not cover the cooling plates and avoid touch it.
- Do not insert metal objects into the equipment by way of the ventilation slots.
- Do not place water-felled containers on the equipment (danger of short-circuit In case of knockover of the container).
- Do not operate the equipment near strong magnetic fields (motors, transformers etc.)
- Do not subject the equipment to shocks or strong vibrations.
- Allow the equipment to stabilize at room temperature before taking up measurement (important for exact measurements)
- Do not modify the equipment in any way.
- Do not place the equipment face-down on any table or work bench to prevent damaging the controls at the front.

- Do not try repair service or adjustment. Unless the first aid is available around you.
- To avoid injuries, always disconnect power and discharge circuits by grounding before touching them.
- Safety : EN 61010-031 : 2002
- Altitude : max. 2000m
- Temperature : 5 to 40°C, < 80% R.H.
- Operating Temperature 10 to 40°C
- Storage Temperature -10 to 50°C
- Pollution degree II

SECTION 3 : INSTALLATION

3-1. Unpacking and Inspection

Every care is taken in the choice of packing materials to ensure that your equipment will reach you in perfect condition.
Unpack the equipment and check for external damage to the case, sockets, keys etc. If damage is found, notify the carrier and your sales representative immediately.
The standard accessories supplied with the instrument are as described in the Section 1.

3-2. Preparation for Operation

- Under no circumstances should users touch any of the front terminals, unless they are first assured that no dangerous voltage is present.
- Power input
  The recess power input plug, power fuse and line voltage indicator are contained in an integral module on the rear panel.
- Power cable
  The detachable supply cable, comprising of 3-core PVC cable permanently molded to a fully-shrouded 3-pin socket, this fits in the power input plug recess and should be fitted fully.
  The supply lead should be connected to a grounded AC power receptacle ensuring that the ground lead is connected, to avoid electrical shock.
- Line voltage
  The MS-9160 are operative within the line voltage ranges 220V/240V ± 10%, 50 or 60Hz, for F/G, F/C and DPS.
  Adjust the line voltage selector, suitable for your line supply power.
- The DMM section of the instrument is powered by a single 9 volt battery(Type : NEDA 1604 vor 6F22). The LowBAT annunciator appears on the LCD display, when the battery voltage drops to certain limits.
  Continued operation with a flat battery will lead abnormal readings.
- Bench Mounting
  This instrument is fitted with four rubber feet. It is intended to stand flat on a bench, located at least 30cm of free space at the rear In addition, 2 plastic tilt-stand are provided next to the front rubber feet, to facilitate the viewing angle of the instrument from the bench level.

SECTION 4 : OPERATING THE MS-9160

Prior to operating this instrument, it is important that it has been correctly installed as detailed in the Section 3.
The operating instructions are divided into four major groups : Frequency counter (F/C), Function Generator (F/G), DC Power supply (DPS), and Digital Multimeter (DMM).

Throughout these sections, warnings identify potentially dangerous procedures. Instructions contained therein must be observed.

4-1. OPERATING THE FREQUENCY COUNTER

Check the line voltage and fuse ratings before connecting to the power outlet. Be sure to turn on F/C power switch located on the rear panel. For stabilizing the counter, warm-up time of 20minutes is required, before commencing measurements.

4-1-1. Specification

Input Frequency Measurement	
Measuring Range	1Hz to 20MHz LED display depending on Gate Time and
Channel A	Input signal. At least 7digits are displayed per each second of gate time.
Channel B	20MHz to 2.7GHz
Input Sensitivity	
Channel A	40mV RMS Sinewave or 100mVp-p
Channel B	40mV RMS Sinewave for 20MHz to 1.3GHz 40mV RMS Sinewave for 1.3GHz to 2.7GHz
Maximum Input Voltage	
Channel A	35V-p-p
Channel B	3Vp-p
Input Impedance	
Channel A	1Mohm
Channel B	50ohm
Time Base	
Channel A,B	Switch selectable
Resolution	
CH A	0.1Hz (Gate 10s) 1Hz (Gate 1s) 10Hz (Gate 0.1s) (Gate 0.1s 1KHz~20MHz only)
CH B	10Hz (Gate 10s) 100Hz (Gate 1s) 1KHz (Gate 0.1s)
Operating Temperature	10 to 40°C
Storage Temperature	-10 to 50°C
Line Voltage Range	AC 220~240V~+/-10%, 50/60Hz or AC 100~120V~+/-10%, 50/60Hz
Power Consumption	35W max.
Coaxial Cable	RG-58C/U, Impedance 50ohm, with 1 meter in (w/BNC connector) length.

4-1-2. Start-Up

Check the test leads connected to Channel A and B are in good condition.

Connect the AC power cable to the recess power receptacle and plug it into three-contact electrical outlet.

Turn on the power switch. 0 will be displayed.

Gate time at 1 sec. position.

Channel at Channel A position.

The Date-Hold and the LPF-A at off position.
Now GATE 1, CHAN A, 0 and Hz indicators are lit up at frequency LED display.

4-1-3. Features

LPF-A Switch
This switch is used for noise removal in case of measurement of frequency lower than 300KHz with high frequency noise in CH-A.

Channel Select Switch
The channel A covers measurements of frequencies from 1Hz to 20MHz with auto range.
The channel B covers your measurements of frequencies from 20MHz to 2700MHz.

Gate Time Switch
For a better resolution in your measurements, your selection of a proper gate time is recommended. The following table will help you refer to the optional frequency resolution.
In case the input signal is lower than 1KHz, we recommend you select gate time 1 s or 10s.
If you select 0.1s, the counted data has to be multiplied by 10times for an actual measuring value. But their errors maybe 10% or more.

Frequency Resolution Table

GATE TIME	0.1s	1s	10s
CH A	10Hz	1Hz	0.1Hz
CH B	1KHz	100Hz	10Hz

Date-Hold Switch
Upon activation of this mode, a read-out on the LED display will be captured and remained even after disconnecting the test connector from a measuring point.

Reset Switch
If you want to clear the displayed data, press RESET button.

OFL indicator LED
When the counted data is over 8th digit, the OFL LED flickers.

4-2. Operating the Function Generator(F/G)

Check the line voltage and fuse ratings before connecting to the power outlet. Be sure to turn on F/G power switch located on the rear panel. For stabilizing the System, warm-up time of 30 minutes is required before commencing operation.

4-2-1. Specification

□ Wave Forms	Sine, Square, Triangle, Skewed Sine,
□ Frequency	Ramp, Pulse, TTL Level Square
	1Hz to 10MHz 7 ranges
	0 to 10VDC(Max. Input Voltage : ± 15V)
□ VCF Voltage Level	50Ω ± 10%, 600Ω ± 10% selectable
□ Output Impedance	2Vpp to 20Vpp at open load
□ Output Amplitude	1Vpp to 10Vpp at 50ohm load
	-20dB
□ Attenuator	20:1 or more
□ Frequency Variable Range	3:1 or more
□ Symmetry Variable Range	Max. ± 10V DC
□ Offset Variable Range	
□ Sine Wave	Less than 1%(at 1KHz)
- Distortion	± 0.3dB
- Flatness	
□ Square wave	Less than 3%(1KHz)
- Symmetry	Less than 150ns(at 1KHz)
- Rise & Fall Time	
□ Triangle wave	Less than 1%(up to 100KHz)
- Linearity	Less than 5%(100KHz to 2MHz)
□ TTL output	Less than 30ns(at 1KHz)
- Rise & Fall Time	More than 3V
- Output Level	
□ Frequency Sweep	20ms to 2s
- Sweep Time	Linear
- Internal Sweep Mode	Logarithmic
	More than 100:1
- Sweep width	input
- External Sweep by means of VCF	

4-2-2. Start-Up

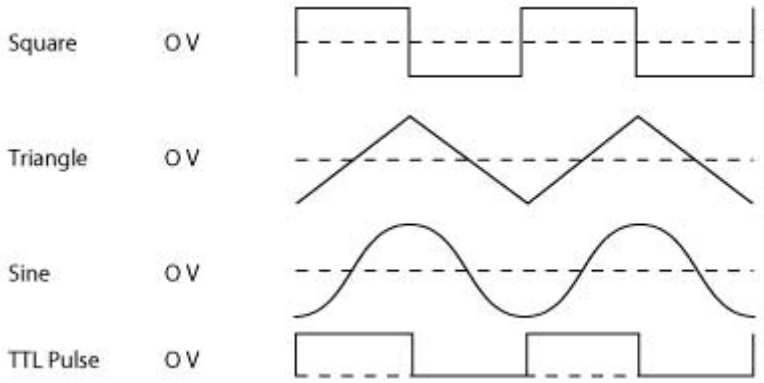
- Check conductors of the terminals in good condition without shorted.
- Connect the AC power cable to the recess power receptacle located on the rear panel and plug it into the three-contact electrical outlet.
- Turn on the power switch (43) of the DPS.
- Turn on the power switch of the F/G located on the rear panel.
- Set all the variable controls, as follows :

Variable Controls	Setting Position
Function Select Switch(17)	Sinewave
Freq. Range Select Switch(19)	X1K
Freq. Control Dial(16)	1.0
Amplitude Control Knob(13)	
Offset Control Knob(11)	Switch Off
Symmetry Control Knob(10)	(push-in position)
Sweep-Width Control Knob(9)	
Sweep-Rate Control Knob(14)	

- Match the output impedance between the F/G output and the unit under test by switching the impedance output select switch(20).
- In case that you want to measure the frequency under process, please refer to the section 4-1-4 for further information.

4-2-3. Wave Forms

- The basic ramp signal has been generated by the OP Amp. Based on this basic signal, the squarewave has been formed by the line receiver IC. And, the sinewave has been formed by the quardruple TR IC.
- The output wave forms and phase relationship are as follows.



Note ; *Under activation of the 600 ohm impedance mode(20) the output wave forms can be normal up to 100KHz range.*

4-2-4. Frequency Ranges

- The MS-9160 can supply the frequency in the 7 ranges as shown on the following table.

Frequency Range assigned to each select switch

Select Switch	Assigned Range	Maximum Output
x 10	1Hz ~ 20Hz	10Hz
x 100	10Hz ~ 200Hz	100Hz
x 1K	100Hz ~ 2KHz	1Kz
x 10K	1KHz ~ 20KHz	10KHz
x 100K	10KHz ~ 200KHz	100KHz

x 1M	100KHz ~ 2MHz	1MHz
x 10M	1MHz ~ 10MHz	10MHz

Note ;
The output frequency can be read by multiplying figures optioned by the frequency control dial(16), and the frequency Range Select Switch(19). Ex. 1KHz=1.0 (at the dial 16) X 1K (at the switch 19)

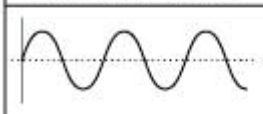
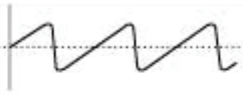
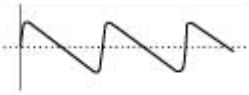
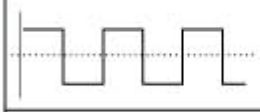
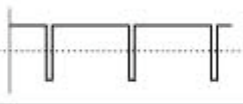
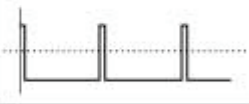
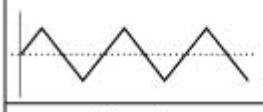
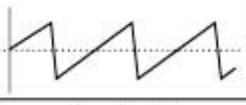
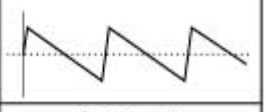
4-2-5. Features

 Voltage Controlled Frequency
Output frequency can be varied with an external voltage input from the VCF input Terminal(12). For 0~10VDC VCF input voltage, the frequency is changed by 1:2, depending upon activation of the Frequency Range Select Switch(19).
To operate the VCF function, turn the Frequency Control Knob(16), fully CCW and connect the external voltage to the VCF input Terminal.

 Amplitude Control
The maximum amplitude of output voltage is more than 20V under open load but It is reduced by half(50%) under the 50Ω load or 600Ω load. The Amplitude of the output voltage can be varied continuously with operating the Amplitude Control Knob(13), in the range of -20dB. If the Amplitude Control Knob is pulled out, the output signal is set to the -20dB fixed.

 OFF-SET control
The DC level of output signal can be varied continuously with perating the OFF-SET Control Knob(11) in the range of ±10V. To adjust the DC level, pull out the OFF-SET Control Knob then, turn slowly CW(positive volt) or CCW(negative volt).
If the OFF-SET Control Knob is pushed in, there is no DC level, but only AC voltage exists in the output signal.

 Symmetry Control
The duty cycle of output signal can be varied continuously with the Symmetry Control Knob(10) in the rage of 1:3 or 3:1. To adjust the symmetry of the waveforms, pull out the symmetry control knob, then turn it slowly in the CCW direction. The following table shows such variations under this mode.

Basic Wave Forms	Clock Wise	Conter Clock Wise
		
Sine	Skewed Sine	Skewed Sine
		
Suare	Pulse	Pulse
		
Triangle	Sawtooth	Sawtooth

Note ; *After setting the symmetry Control Knob(10), the output frequency will decrease and the operator should re-adjust the frequency.*

 Sweep Control
To enable the internal frequency to sweep, pull out the Sweep-Width Control Knob(9).
The width of the frequency sweep can be varied continuously in the range of 100:1.
To maximize the sweep width, set the Frequency Control Dial(16) fully to the CCW direction, and turn the sweep Width Control Knob fully CW.
To adjust the rate of frequency sweep. turn the Sweep Rate Control Knob slowly CW or CCW for linear frequency sweep. Logarithmic frequency sweep mode is operated

with by pulling out the Sweep Rate Control Knob(14).

 TTL Output
The TTL level signal output is available at the TTL Output Terminal(15).
The TTL output can drive 30 unit loads in the HIGH state and 20unit loads in the LOW state.
One unit load in the HIGH state is defined as 40mA and 1.6mA in the LOW state.
 Output Impedance
Output impedance of the Function Generator can be changed with the 50Ω or the 600Ω by pressing or releasing the output impedance select switch(20).
Under activation of the 600ohm mode, the output frequency in normal waveform is available in the range of 0.2Hz to 100KHz(MS-9150), 1Hz to 100KHz(MS-9160)

4-3. OPERATING THE DC POWER SUPPLY

Check the line voltage and fuse ratings before connecting input power. Do not short + and - output terminals. Avoid a heavy shock to this instrument. For continued protection against damage, do not connect loads below 2.5Ω to the Terminal(38) and below 15Ω to the Terminal(41).

4-3-1. Specification

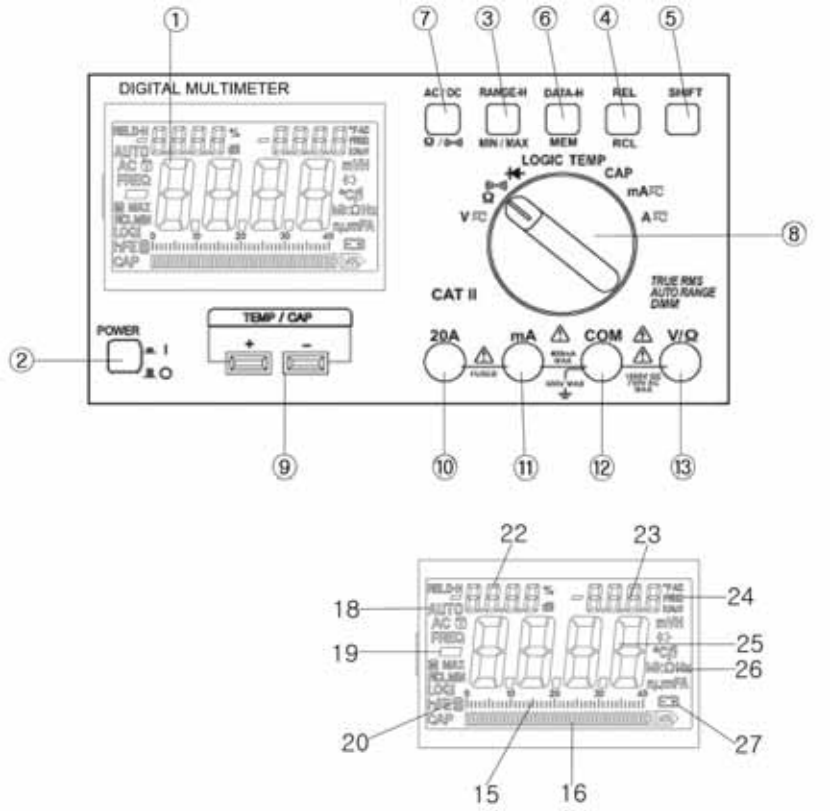
FUNCTION	Terminal(41)	Terminal(36)	Terminal(38)
Output Voltage	0-30V	5V fixed	15V fixed
Output Current	0-3A	2A	1A
Ripple	1mV Max	2mV Max	2mV Max
Load Regulation	0.1%±40mV	0.1%±70mV	0.1%±50mV
Line Regulation	0.1%±20mV	0.1%±30mV	0.1%±30mV
Output Current (Maximum)	3A (current limit)	2.2A (fold back)	1.2A (fold back)
Display with	LED 3½digit V/A selectable	Turn-on LED	Turn-on LED

4-3-2. Start-Up

 Be sure to disconnect any load from the output terminals, before energizing the instrument.
 Turn the Ampere Control Knob(35) fully CW to ensure that the output current reaches a maximum output.
 Connect the AC Power cable to the recess power receptacle, located on the rear panel, and plug it into the three-contact electrical outlet.
 Press the Power ON/OFF Switch(50) to turn on
 The LED indicators 5V 2A and 15V 1A will light.
 In order to use the variable voltage or current, you can choose the Voltage/Ampere Select Switch(40). While observing the displayed figures on the LCD(44), set your voltage in need, by turning the Voltage Control Knob(37).
 In need of limiting the current for protection your device under test, set your limit current by the Current Control Knob (35) During operation of the DPS, an excessive current over your setting current will bead the voltage to drop and the Current Limit Indicator(39) will light.

Note ; *This DC Power Supply has the Output Terminals isolated from the Grounding Terminal (Chassis Ground). However the 0-30V/0-3A Output Terminal has been connected by the short-bar between the Ground Terminal(42) and the(-) output connector of the Terminal at the factory.*

4-4. Operating the Digital Multimeter



1. LCD (3 3/4 digit max. 3999 counts)
2. POWER Button
3. RANGE Button
4. REL Button
5. SHIFT Button
6. HOLD Button
7. DC /AC, Ω/ ⊣◀ Button
8. Rotary Function Selector
9. Cap. & Temp.(“K”type) Socket
10. 20A Terminal
11. mA Terminal
12. COM Terminal
13. V/Ω Terminal
15. Bar graph Scale
16. Analog Bar graph
17. Range Table Indication Area Indication Area
18. Auto Range Indicator
19. Negative Polarity
20. SHIFT Indicator
21. Advanced Function
22. Secondary Sub 1 Display
23. Secondary Sub 2 Display
24. Secondary Annunciators
25. Main Display
26. Main Annunciators
27. Low Battery Indicator

5. INTRODUCTION

With this Digital Multi meter, you have acquired a high-quality, Powerful performance, heavy-duty rugged accurate multi meter That will give you confidence and peace of mind in your every Measuring job.
Please read this operating instruction very carefully before Commencing your measurements.

6. SAFETY INFORMATION

6-1. Safety Requirements

This meter has been manufactured and tested in accordance with IEC-1010-1/EN61010-1.
Part1 : Safety Requirements for Electrical Equipment for
Measurement, control and laboratory use, Safety ClassII, Over voltage Category II.
This manual contains information and warnings which must be observed
to assure safe operation and maintain the meter in safe condition.

6-2. Environmental Conditions

This part applies to your Multi meter designed to be safe at least
under the following conditions.
Indoor use only:

- · Altitude up to 2000m
- · Temperature 0 to 40°C
- · Maximum relative humidity 75% for temperature up to 31%
  decreasing linearity to 50%, Relative humidity at 40%
- · Accuracy specified in temperature of ±23°C + 5k
- · Pollution degree 2

6-3. Safety Symbols

The following symbols have been placed on the meter to remind you of measurement limitations and safety

20A 	The maximum current that you can measure at this terminal is 20A DC/AC. This terminal is fuse protected by S250V/15A slow blow fuse. When using this range with high current, keep the duty cycle to 30 seconds on load and 15 minutes off load.
mA 	The maximum current that you can measure at this terminal is 400mA DC/AC. This terminal is fuse protected by FF 800mA Fast blow fuse.
500V MAX 	To avoid electric shock or instrument damage, do not connect the common 500V input terminal COM to any source of more than 500volts with respect to earth/ground.
1000V DC **750V AC** **MAX**	The maximum voltage that you can measure at this terminal can Measure is 1000V DC or 750V AC.
	Be exceptionally careful when measuring high voltages. DO NOT TOUCH THE TERMINALS OR PROBE ENDS.
	Refer to the complete operating instructions.
	Indicates protection class II, Double insulation.
CAT II	Over voltage category II.

NOT FOR HIGH ENERGY INDUSTRIAL USE.

6-4. Safety Warnings

- To prevent electric shock hazard and damage to the meter, do not attempt to measure voltage exceeding 1000V DC or 750V AC.
- To avoid damage to the instrument and body injury, observe the input limits as stated in Table 1.
- To avoid damage to the meter, disconnect the test leads from test points before changing the function or range.
- To avoid electric shock, be careful when working above 35V DC/25V AC. Such voltage poses a shock hazard.
- The 20A range is fuse protected. To avoid damage or injury, use the Meter only in circuits limited by fuse or circuit breaker to 20A or 4000VA.
- Do not apply voltage to 20A or mA terminal and COM terminal at the same time.
- Do not get the meter and test leads wet.
- Ensure the test leads are in good condition.

Table1. Input Limits

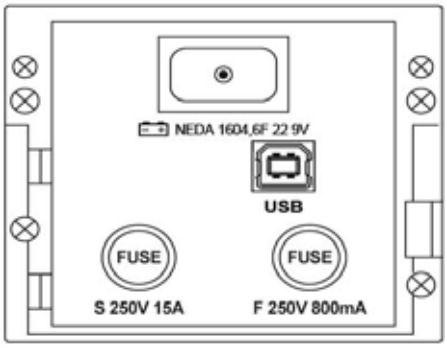
FUNCTION	TERMINAL	INPUT LIMIT
V DC	V/Ω+COM	1000V DC
V AC	V/Ω+COM	750V AC
Ω	V/Ω+COM	250V DC/AC
mA	mA+COM	400mA/250V
20A	20A+COM	20A/250V
Capacitance	Cap. Socket	Less than 25V RMS or 30V DC
Diode	V/Ω+COM	250V DC/AC
Logic	V/Ω+COM	250V DC/AC
Temperature	Temp. Socket	Less than 25V RMS or 30V DC

7.Preparation for Operation

7-1 Installing the Battery

Your meter required s 9V battery for power. The symbol "  " appears when the battery voltage drops to certain limits. For proper operation, replace the battery as soon as possible. Continued use with a low battery will lead to an abnormal reading. Follow these steps to install the battery.

Warning : TO AVOID ELECTRIC SHOCK, DISCONNECT BOTH TEST LEDS FROM THE METER BEFORE YOU REMOVE INSTALL THE BATTERY WITH BATTERY INSULATION CAPSULE!
Follow these steps to install the battery.
1. Turn off the power and disconnect the two test leads from the meter.
2. Remove the screw to open the battery compartment.
3. Place the battery into the insulation capsule and snap it onto the contacts.
4. Replace the battery compartment cover and secure it with screw.



7-2. Using the Test Leads

Use only the type of test leads supplied with Your meter . These test leads are rated for 1200volts.

CAUTION :

· Although the supplied test leads are rated for 1200 volts, the maximum Input voltage to your meter can measure is 1000V DC or 750V AC. If you try to measure DC voltage above 1000V or AC voltage above 750V, you might damage your meter and expose yourself to a serious shock hazard. Use extreme care when you measure such high voltages.

· Never connect the probe you plug into the COM terminal to a source of voltage greater than 500 volts with respect to earth/ground. This creates a serious shock hazard.

8. PRE-OPERATION CHECK

To ensure correct operation and familiarize yourself with the meter,
follow these steps before using the meter.

1. Push the POWER button.
2. To select a function, turn the rotary switch to the appropriate switch position at your desire. The meter is ready for normal operation.
3. To select an additional operation, press the appropriate push buttons above the rotary switch.

9. How to use the Instrument

This section describes your meter and how to use it.

9-1. Push Buttons

This section describes how to use the push buttons. These buttons are used in conjunction with the rotary switch to select operating modes.
When a push button is pushed, the beeper sounds. An annunciator is Displayed to indicate that a mode or function has been selected.
A quick wayto reset all the push buttons to their default state is to turn the rotary switch to an adjacent function and then back to the function you are using.

POWER :
- Press to turn the meter on/off.

DATA-H :
- Press to operate Data Hold function.
- Press with SHIFT to operate Memory function.
- Press to set an automatic power off time.

REL :
- Press to operate Relative Offset function.
- Press with SHIFT to operate Recall function.

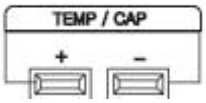
RANGE-H :
- Press to operate Range Hold function.
- Press with SHIFT to operate Minimum/Maximum Hold function.

SHIFT :
- Press to operate Memory, Recall and Minimum/Maximum Hold Function with HOLD, REL and RANGE button.
- Press to set/reset the logic state in Logic range.
- Press to scroll the output frequency step in Signal Out range.
- Press to select an automatic power off time.

DC Ω / AC (•) :
- Press “DCΩ / AC (•) “ button to toggle between DC and AC when the Rotary switch is set to Voltage or Current, or between Resistance and Continuity when the rotary switch is set to Ω (•) position.

9-2. Input Sockets

Capacitor & Temperature Socket

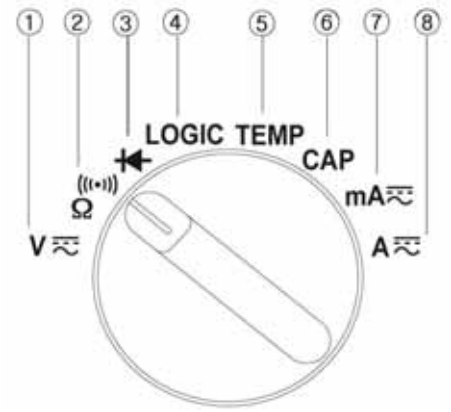


In case of the capacitance range, insert a discharged capacitor Into the outermost connections observing the correct polarity required
In case of the temperature range, insert a K-type thermocouple Into the innermost connections.

9-3. Function Selector Rotary Switch

This section describes function that are selected by setting the rotary switch.

1 Volts DC/AC
2 Ohm/Continuity
3 Diode Test
4 Logic Test
5 Temperature
6 Capacitance
7 Milliampere DC/AC
8 20 Ampere DC/AC



9-4. Input Terminals

This section describe the input terminals. (See Table 1 (page 9) for input limits.)

20A Amperes Input Terminal

20A

For current measurements (DC or AC) up to 20A the function rotary switch is set to 20A position. When measuring with high current over 12amps, keep the duty cycle to 30 seconds on load.

mA Milliamperes Input Terminal

mA For current measurements (DC or AC) up to 400mA the function rotary switch is set to mA position.

COM Common Terminal

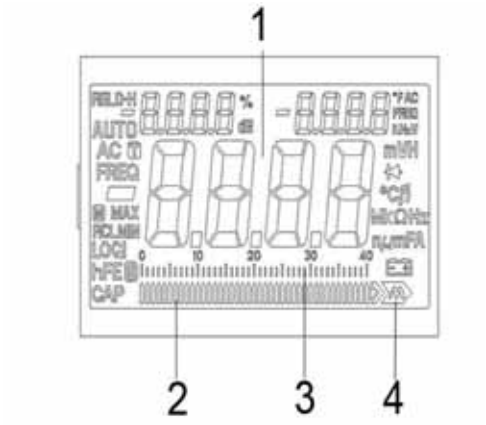
COM Return terminal for all measurements except temperature, S/O, capacitance and transistor test.

V/Ω Voltage/ohm input Terminal

V/Ω For measurements of volts, resistance, continuity & diode.

9-5. Digital and Bar graph Displays

This section describes the digital and bar graph display.



1:Digital Display

Digital readings are displayed on 4000 counts display with automatic polarity indication and decimal point placement.

2:Analog bar graph

The bar graph consists of 20 segments that illuminate from left to right as the input increases. It functions much the same as the needle on an analog meter without the mechanical overshoot inherent in needle movement. If input equals or exceeds 4000 counts on the range selected, OL is displayed with flashing the bar graph and beeping.

3:Bar graph scale

Scale for absolute readings.

4:Overload Indication

OL is displayed with flashing bar graph and beeping when input is too excessive to display. If the initial value of the range is OL, it does not beep.

9-6. Automatic power off

Automatic power off extends the life of the battery by turning the meter off if neither the rotary switch nor a push button is operated for selecting time. Press “SHIFT” button and turn on the meter for the automatic power off time selection. Repeatedly press “SHIFT” button and select an automatic power off time (15, 30, 60 minutes or no automatic power off). And press “HOLD” button to set the automatic power off time.

9-7. Using the Advanced Function

This section describes the advanced function.

DATA-H : Data Hold

The Data Hold function lets you hold a reading on the secondary display.
To turn on the Data Hold function, press “HOLD” button. Then “D-H” segment is turned on and the hold data is displayed on the sub 1 display.
To return to the normal display, press again “ HOLD” button or other buttons (“RANGE”, “SHIFT”, “REL”).

RANGE-H : Range Hold

The Range Hold feature lets you set the meter from auto range to manual range mode.
To turn on the Range Hold function, press “RANGE” button. Then “AUTO” Segment is turned off and the Range Hold data is displayed on the main display. Range can be changed by repeatedly pressing “RANGE” button.
To return to the normal display, press “RANGE” button for 2 seconds or other buttons (“RANGE”, “SHIFT”, “REL”).

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SHIFT+RANGE-H:Min./Max. Hold

The Minimum/Maximum Hold function lets you measure the minimum/maximum
value of a changing reading.
To turn on the Minimum/Maximum Hold function, first press “SHIFT” button.
Then “SHIFT” segment is turned on. And repeatedly press “RANGE” button.
Then function is entered to MIN/MAX/Normal Status. Because of aujtomatical ranging hold, “AUTO” segment is turned off and “MIN”/”MAX” segment is turned on.
To return to the normal display, press other buttons (“HOLD”, “SHIFT”, ‘REL”).

REL : Relative Offset

The Relative Offset function lets you measure relative values to a reference Value that you set.
To turn on the Relative Offset function, press “REL” button. Then the main value is the reference value of relative offset and the relative offset value is displayed on sub 1 display (Relative Offset = Main Value – Reference Value).
To return to the normal display, press again “REL” button or other buttons (“RANGE”, “HOLD”, “SHIFT”).

SHIFT + HOLD : Memory Function

The Memory function lets you save the measured data.
To operate the Memory function, first press “SHIFT” button and “HOLD” Button when displayed the saved data. There are 10 memory addresses.
And it can be changed by repeatedly pressing “HOLD” button.
To return to the normal display, press “RANGE”, “SHIFT” OR “REL” button.

SHIFT+REL : Recall Function

The Recall function lets you load the saved data.
To operate the Recall function, first press “SHIFT” button and “REL” button.
And the saved data is loaded by pressing repeatedly “REL” botton.
To return to the normal display, press “RANGE”, “SHIFT” OR “REL” button.

9-8. Annunciators

This section describes annunciators that indicate the mode or state in
Which the meter is operating

AUTO(Auto Range)
The measurement range is automatically changed by input value.

AC(Altermating Voltage or Current)
Enables you to measure the AC voltage or current.

CAP(Capacitance)
Lets you to measure capacitance from 4/40/400nF to 4/40/200uF.

LOGIC(Logic Test)
Enables you to test the logic state.

TEMP (Temperature)
Lets you to measure Celsius( ) and Fahrenheit(□) at the same time.

 (Negative Polarity)
Automatically indicates negative input.

 **SHIFT**
Enables you to operate MEM, RCL and MIN/MAX Hold function.

- (Continuity Check)

Make it easy to check wiring, continuity of cables, fuses and connection, etc.

(Diode Test)
The value displayed is the forward voltage of semiconductor function at Approximately 1.5mA test current.
Single 0 -2.0V range.

 (Low Battery)
Your meter is operated by a single 9V battery. When this symbol is displayed,
Replace the battery to avoid errors in reading.

Secondary Display
Allows secondary display readings being displayed independently of the main display.

Unit Annunciators

mV : Millivolts (1×10^{-3} volts)

V : Volts

kHz : Kilohertz (1×10^{3} cycles)

MHz : Megahertz (1×10^{6} cycles)

uF : Microfarad (1×10^{-6} farad)

nF : Nanofarad (1×10^{-9} farad)

A : Ampere (amps.)

mA : Milliampere (1×10^{-3} amps.)

uA : Microampere (1×10^{-6} amps.)

Ω : Ohm

kΩ : Kiloohm (1×10^{3} Ω)

MΩ : Megaohm (1×10^{6} Ω)

°C : Celsius

dB : Fahrenheit

10. HOW TO MAKE MEASUREMENTS

This section discusses some common applications for your meter and alerts you to some considerations to keep in mind when making measurements.

10-1. Measuring DC/AC Voltage

Warning : DO NOT TRY TO MEASURE A VOLTAGE GREATER THAN 1000VOLTS DC OR 750 VOLTS AC. DOING SO, YOU MIGHT DAMAGE YOUR METER AND EXOES YOURSELF TO A SEVERE SHOCK HAZARD.

Follow these steps to measure DC/AC voltage.

1. Rotate the function selector to the desired volt position.
2. Press “DC Ω/AC (•)) “ button to toggle between DC and AC. AC appears for AC measurement.
3. Plug the black probe into the COM terminal and the red probe into The V/Ω terminal.
4. Connect the probes to the DC or AC voltage source you want to measure.

Note :

· If polarity is negative, appears on the left of the display.

· Each of the DC or AC voltage range presents an input impedance of approximately 10 in parallel with less than 100pF. AC voltage is AC coupled to the 100 input.

· The meter’s high input sensitivity produces wandering effect when the test leads are not connected to any circuit being measured. This is normal and accurate reading will be appeared when you connect the test leads to a circuit.

10-2. Measuring Resistance

Warning : NEVER CONNECT THE TEST LEADS TO A SOURCE OF VOLTAGE WHEN YOU HAVE SELECTED THE OHMS FUNCTION AND PLUGGED THE LEADS INTO THE V/Ω TERMINAL.
BE SURE THAT THE CIRCUIT UNDER TEST HAS ALL POWER REMOVED AND THAT ANY ASSOSICATED CAPACITORS ARE FULLY DISCHARGED BEFORE MAKING A RESISTANCE MEASUREMENT.

Follow these steps to measure resistance.
1. Rotate the function selector to Ω (•)) position.
2. Press “DC Ω / AC (•)) “ button to toggle between resistance and continuity.
3. Connect the test leads to the device you want to measure.

Note :

· The resistance in the test leads can diminish the accuracy on the lowest range (400Ω). The error is usually 1 to 0.2 ohm for a standard pair of test leads. To determine the error, short the test leads together and read the resistance of the leads.

· When measuring resistance, be sure that the contact between the test leads and the circuit is good, dirt, oil, solder flux or other foreign matter seriously affects the resistance.

· If the measured resistance value exceeds the maximum value, OL displays to indicate overload and the bargraph flashes. For resistance of approximately 4 and above, the display might take a few seconds to stabilize. This is normal for high resistance readings.

10-3. Testing Continuity

Testing continuity verifies that circuit connections are intact.

Follow these steps to perform audible continuity test.
1. Rotate the function selector to Ω (•)) position.
2. Press “DC Ω /AC (•)) “ button to toggle between resistance and continuity.
3. Remove power from the circuit.
4. Connect the probes to the circuit.

Warning : NEVER PERFORM A CONTINUITY MEASUREMENT ON A CIRCUIT THAT HAS POWER CONNECTED.

Note :

· THE BUZZER SOUNDS IF THE MEASURED RESISTANCE IS BELOW 80Ω.

10-4. Checking Diode

This function lets you check diodes and other semiconductors for opens and shorts. It also lets you determine the forward voltage fordiodes. You can use this function when you need to match diodes.

Follow these steps to check diode.

1. Rotate the function selector to ⊣◀ position.
2. Plug the test leads into the COM and V/Ω terminals.
3. Connect the test leads to the diode you want to check and note the meter's reading.

Note :

· If the display shows value, for example, 0.2 for a germanium diode or 0.5 for a silicon diode, reverse the diode. If the meter indicates an overvoltage, the diode is good. The displayed number is the diode's a actual forward voltage.

· If the display indicates an overrange condition, reverse the polarity of the connection. If the display shows a value, the device is good. The displayed value is the component's actual forward voltage (up to 2.0 volts). If the display still indicates an overrange condition, the device is open.

· If the display shows a value both before and after you reverse the polarity, the device is shorted. When you connect the diode to the meter and the meter displays the device's forward voltage, the red test lead or socket is connected to the diode's anode, the black test lead or socket is connected to the diode's cathode. This meter supplies enough forward voltage to light most LEDs. However, if the LED's forward voltage is greater than 2.0 volts, the meter incorrectly indicates that the device is open.

10-5 Logic

Follow these steps to measure current.

1. Rotate the rotary switch to the desired ampere position.
2. Press button to toggle between DC and AC ampere.
3. Connect the meter in series with the load or circuit under test.
4. While keeping a connection between the black test lead and the circuit GND point, move the red test lead to other desired points.

The meter's main display will immediately indicate one of the three modes.
If the measured value exceeds 70% of the stored value (V+), Hi (high) appears.
If the measured value falls 30% of the stored value (V+), Lo (low) appears.
If the measured value is between 30% and 70% of the stored value (V+), appears.The logic test lets you easily check digital circuits to determine the logic state of different parts of the circuits.

10-6. Measuring Temperature

Follow these steps to measure temperature.

1. Rotate the function selector **Temp** position.
2. Insert a K-type thermocouple into the innermost temperature socket.

10-7. Measuring Capacitance

Follow these steps to measure normal capacitance.

1. Discharge each capacitor before testing by shorting its leads together. Use caution when handling some capacitors as they can hold the considerable electricity.
2. Rotate the function selector to **Cap** position.
3. Insert the discharged capacitor into the CAP + and – clips. Your meter displays the capacitance value. For polarized capacitors, be sure to insert the negative lead in the – clip.

CAUTION :

If you try to measure the capacitance of a charged capacitor, you might damage your meter and expose yourself to a severe shock hazard.

10-8. Measuring DC/AC Current

Warning : YOU MIGHT DAMAGE THE METER OR BE INJURED IF THE FUSE BOLWS WHILE CURRENT IS BEING MEASURED IN A CIRCUIT VOLTAGE GREATER THAN 250V. THE 20A TERMINAL IS FUSE PROTECTED. A SEVERE FIRE HAZARD AND SHORT CIRCUIT DANGER EXISTS IF YOU APPLY A VOLTAGE WITH HIGH-VOLTAGE WITH HIGH-CUUENT CAPABILITY TO THIS TERMINAL. THE METER CAN BE DESTROYED UNDER SUCH CONDITIONS.

Note :

· If you do not know approximately what the current being measured is, connect the circuit to 20A input terminal first to see if you have a safe level for mA input terminal.
Use the mA terminal input terminal for ampere up to 400mA.

· When measuring ampere, the meter's internal shunt resistors develop a voltage across the meter's terminal called "burden voltage".
This voltage drop is very low in your meter, but is may affect precision circuits or measurements.

· If you set the meter for DC ampere, **--** appears or disappears to indicate the polarity of the measured current.

11. USING THE METER WITH COMPUTER

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Installing and Using the Application Program

Follow these steps to install the application program.

1. Insert the installation disk to the floppy disk.
2. Double-click [My Computer].
3. Double-click [3.5 Floppy (A:)].
4. Double-click setup.exe file.
5. Click [Next].
6. Click [Finish] and the installation is complete.

Follow these steps to use the application program.

1. Connect the USB cable between the meter's and the computer's USB port. 2. Turn on the meter.
3. Click [Start], point to [Program] and [USB DMM].
4. Click [USB DMM] to run the application program.
5. In [Tool] popup menu, Click [Config] to set configuration.
6. In [Tool] popup meny, Click [Start] / [Stop] to run/stop the application program.

Note :

· To assist you for understanding the application program feature, read the ReadMe file before using the application program.

· Don't disconnect the USB cable when operating the application Program. Disconnect the USB cable after clicking [Stop] icon.

· Don't excessively use the computer when operation the application program for the moderate operation of the application program

12. CARE AND MAINTENANCE

12-1. Replacing the Fuse

Warning : TO AVOID ELECTRIC SHOCK, DISCONNECT THE TEST LEADS BEFORE REMOVING THE BATTERY OR THE FUSE. REPLACE ONLY WITH THE SAME TYPE OF FUSE SPECIFIED. DO NOT REMOVE THE TOP COVER. THE SERVICE SHOULD BE PERFORMED ONLY BY QUALIFIED PERSONNEL.

CAUTION :

FOR CONTINUED PROTECTION AGAINST FIRE OR OTHER HAZARD, REPLACE ONLY WITH FUSE OF THE SPECIFIED VOLTAGE AND CURRENT RATINGS.

Follow these steps to replace the fuse.

1. Press the POWER push button to turn the power off and disconnect the test leads.
2. Remove the back cover by unscrewing the screws and pulling off the meter's cover.
3. Remove the blown fuse.
4. Install the new fuse in the fuse compartment.
5. Replace the cover and secure it with the screws.

Warning : DO NOT OPERATE YOUR METER UNTIL THE BACK COVER IS IN PLACE AND FULLY CLOSED.

12-2. General Maintenance

Any adjustment, maintenance or repair of the instrument except the battery and fuse replacement should be done only by qualified personnel.

1. Keep your meter dry. If it does get wet, wipe it dry immediately. Liquids might contain minerals that can corrode the electrocin circuits.

2. Use and store your meter only in normal temperature environments. Extreme temperature can shorten the life of electronic devices, damage battery and distort or melt plastic parts.

3. Handle your meter gently and carefully. Dropping if can damage circuit boards and cases the meter to work improperly.

4. Use only a brand-new battery of the same size and type. Always remove an old or weak battery. It can leak chemicals that destroy electronic circuits. Modifying or tampering with your meter's internal components can cause a malfunction and might invalidate its warranty.

13. SPECIFICATIONS

13-1. General Specifications

·MaximumDisplay ····· 4000 counts(3 3/4 digit) with automatic polarity indication

·Max Input Current ····· DC & AC 20Amps

·Reading Time····· 3~4 readings per second

·Operating Temperature····· 0 to 40°C (32 to 104°F)

·Storage Temperature····· 10 to 50°C (14 to 122°F)

·Temperature for····· 23°C ±5°C (Guaranteed Accuracy)

·Battery Type····· NEDA 1604 or 6F22(one 9V battery)

13-2. Special Specifications

			ACCURACY		RESOLUTION
DC Voltage	400mV		± 0.5% ± 2dgts		100 uV
	4 V		± 0.8% ± 2dgts		1mV
	40 V				10mV
	400 V				100mV
	1000 V				1 V
AC Voltage True RMS	4 V		± 2.5% ± 5dgts(40Hz~5KHz)		1mV
	40 V				10mV
	400 V		± 2.5% ± 5dgts(40Hz~1KHz)		100mV
	750 V				1V
DC Current	400mA	40mA	± 1.5% ± 2dgts		20uA
		400mA			200uA
	20A	20A	± 2.0% ± 3dgts		2mA
AC Current	400mA	40mA	± 2.5% ± 5dgts(40Hz~1KHz)		20uA
		400mA			200uA
	20A	20A	± 3.0% ± 5dgts(40Hz~1KHz)		2mA
RESISTANCE	400Ω		± 0.8% ± 4dgts		0.1Ω
	4kΩ		± 0.8% ± 2dgts		1Ω
	40kΩ				10Ω
	400kΩ				100Ω
	4MΩ		± 2.0% ± 4dgts		1kΩ
	40MΩ		± 3.0% ± 5dgts		10kΩ
CAPACITANCE	4nF		± 2.0% ± 5dgts		1pF
	40nF				10pF
	400nF				100pF
	4uF		± 3.0% ± 5dgts		1nF
	40uF				10nF
	200uF		± 5.0% ± 10dgts		100nF
TEMPERATURE			-40°C~200°C	200°C~1200°C	1°C
			± 3.0% ± 5dgts	± 3.0% ± 2dgts	
DIODE TEST			Test current max 1.5mA (forward voltage max.2V)		
CONTINUITY			Buzzer sounds of resistance less than 80 Ω		
LOGIC			Three Logic Level(Lo,----,Hi)		

Due to our policy to refine the products continuously, this manual
May contain minor differences in specification, components, parts
And circuit design of the instrument actually delivered.

WARRANTY

We warrant to the original purchaser that the instrument is free from defects in material and workmanship for a period of one year from the delivery date. Any instrument found defective within the warranty period and returned to us with transportation charges prepaid, adjusted, or replaced at no charge to the original purchaser.
This warranty shall not cover expendable items such as batteries or fuses. If the defect has been caused by a misuse or abnormal operating conditions, accidental damages, unauthorized modifications of miscalibration, this warranty shall not apply, and the repair will be billed at a nominal cost.

Note : 1. Do not ship to us the returned goods by courier, as the post office will refused it.
2. Attach proper documentation to indicate the unit is being returned for repair.
3. Please, pack carefully to avoid breakage in transit

Due to our policy to refine the products continuously, this manual may contain minor differences in specification, components, parts and circuit design to the Instrument actually delivered.