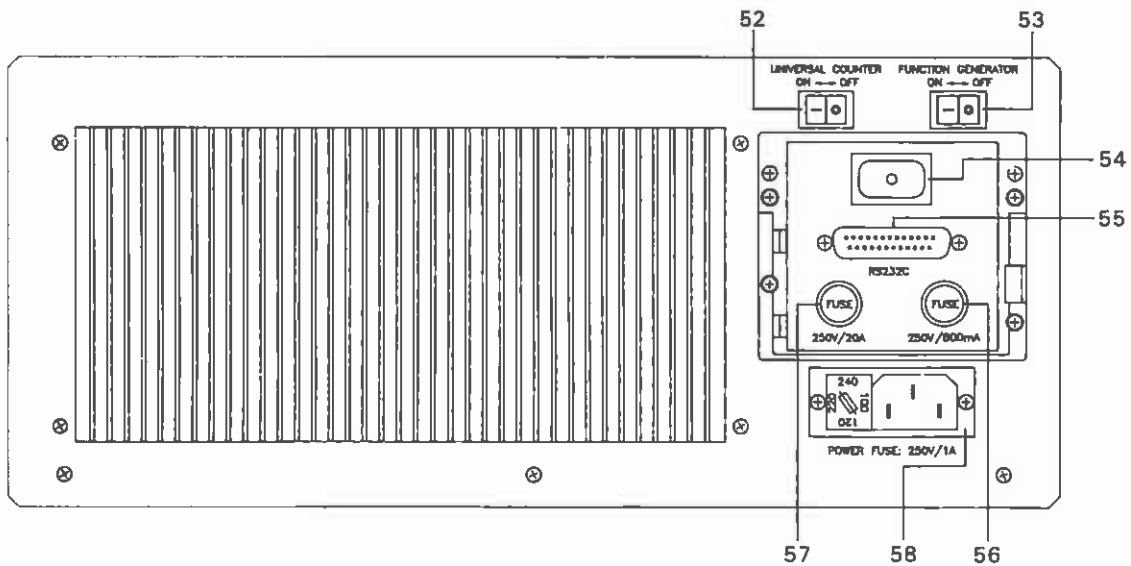
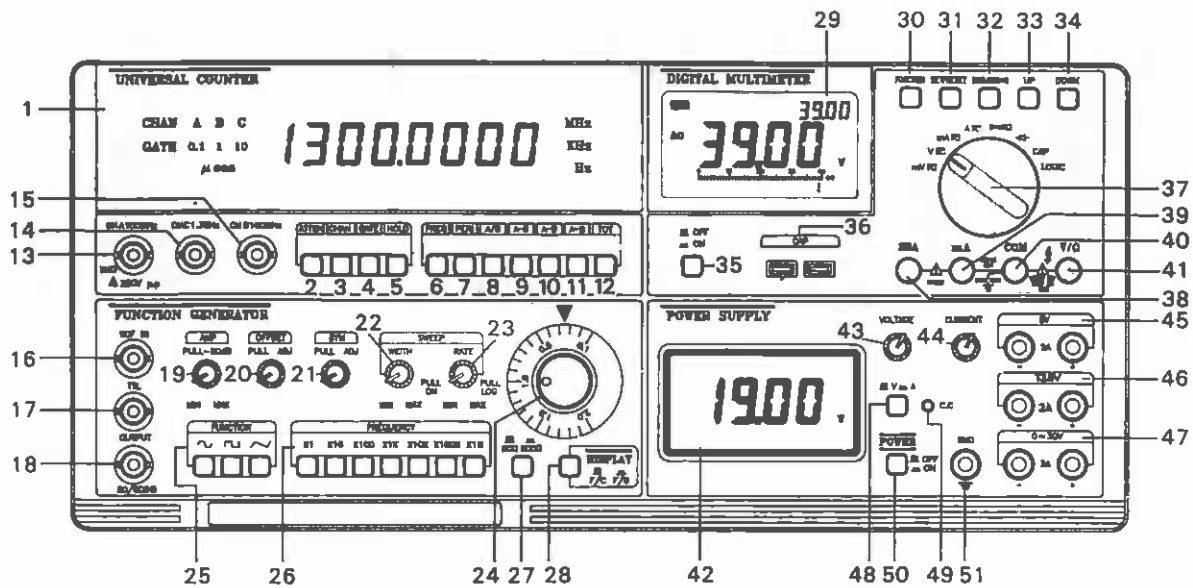


TENMATM

**UNIVERSAL
TEST CENTER
72-5085**

OPERATION MANUAL



LEGEND

- | | |
|----------------------------------|---|
| 1. Frequency LED Display | 30. Function Select Switch |
| 2. Attenuation Switch | 31. SET/RESET Switch |
| 3. Channel Select Switch | 32. DC Ω /AC $\langle\langle\infty\rangle\rangle$ Switch |
| 4. Gate Time Switch | 33. UP Switch |
| 5. Data Hold Switch | 34. DOWN Switch |
| 6. Reset Switch | 35. Power ON/OFF Switch (DMM) |
| 7. Period Switch | 36. Capacitor Socket |
| 8. Ratio Switch | 37. Range Select Switch |
| 9. Time Interval Switch | 38. 20 Ampere Terminal |
| 10. Difference Switch | 39. Milliampere Terminal |
| 11. Addition Switch | 40. Common Terminal |
| 12. Totalize Switch | 41. Voltage/Ohm Terminal |
| 13. CH A Input Connector | 42. DPS LCD Display(3 1/2digits) |
| 14. CH C Input Connector | 43. Voltage Control Knob |
| 15. CH B Input Connector | 44. Ampere Control Knob |
| 16. VCF Input Connector | 45. 5V/2A Output Terminal |
| 17. TTL Output Connector | 46. 13.8V/3A Output Terminal |
| 18. F/G Output Terminal | 47. 0-30V/1A Output Terminal |
| 19. Amplitude Control Knob | 48. Voltage/Ampere Select Switch |
| 20. Offset Control Knob | 49. Current Limit Indicator |
| 21. Symmetry Control Knob | 50. Power ON/OFF Switch(MAIN) |
| 22. Sweep Width Control Knob | 51. Ground Terminal(Chassis Ground) |
| 23. Sweep Rate Control Knob | 52. Frequency Counter ON/OFF Switch |
| 24. Frequency Control Dial | 53. Function Generator ON/OFF Switch |
| 25. Function Select Switch | 54. 9V Battery Housing(DMM) |
| 26. Frequency Range Select Sw. | 55. RS232C Serial Interface Port |
| 27. Output Impedance Select Sw. | 56. DMM Ampere Fuse(mA Ranges) |
| 28. Display Option Key | 57. DMM Ampere Fuse(20A Range) |
| 29. DMM LCD Display(3 3/4digits) | 58. Supply Power Inlet with Power Fuse |

Prior to operating your new **72-5085** Universal System, please read these safety precautions, installation and operating instructions carefully. These requirements must be observed during operation and repair service.

CONTENTS

1. SECTION 1 : THE 72-5085 UNIVERSAL SYSTEM	5
1-1. Introduction	
1-2. Accessories	
2. SECTION 2 : SAFETY PERCAUSIONS	6
3. SECTION 3 : INSTALLATION	7
3-1. Unpacking and Inspection	
3-2. Preparation for Operation	
4. SECTION 4 : OPERATING THE 72-5085	8
4-1. OPERATING THE UNIVERSAL COUNTER(U/C)	8
4-1-1. Specifications	
4-1-2. Start-Up	
4-1-3. Features	
4-1-4. Measuring the output frequency generated by the F/G	
4-1-5. How to using the arithmetic modes	
4-2. OPERATING THE FUNCTION GENERATOR(F/G)	12
4-2-1. Specifications	
4-2-2. Start-Up	
4-2-3. Wave Forms	
4-2-4. Frequency Ranges	
4-2-5. Features	
4-3 OPERATING THE DC POWER SUPPLY(DPS)	17
4-3-1. Specification	
4-3-2. Start-Up	
4-4 OPERATING THE DIGITAL MULTIMETER(DMM)	18
4-4-1. Precautions	
4-4-2. Specification	
4-4-3. Features	
4-4-4. Measurement	

SECTION 1 : THE 72-5085 UNIVERSAL SYSTEM

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

1 – 1. Introduction

The 72-5085 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.

This instrument is characterized by a wide-range coverage of Function Generator, Universal Counter, DC Power supply, and Digital Multimeter in a single unit.

The 72-5085 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 ranges from 0.2Hz to 2MHz
2. Universal Counter, capable of measuring frequency ranges from 5Hz to 1.3GHz.
3. DC Power Supply, capable of generating voltage at 5V/2A, 13.8V/3A fixed and 0-30V/0.2A 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 40 M Ω , Capacitance up to 400 μ F, 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 RS-232C serial 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 pair |

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. We assume no liability for failure to comply with these requirements.

- ▶ Avoid an extremely hot or cold place for the instrument.
- ▶ 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.
- ▶ Keep the instrument away from live-circuits, a soldering iron, etc.
- ▶ 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 : 1A/220V or 240V
Shape : 6.35 ϕ $\times$ 31.8
Type : Slow-blow
 - * DMM ampere fuses : 400mA AC/DC Ranges : 800mA/250V
20A AC/DC ranges : 20A/250V
Shape : 6.35 ϕ $\times$ 31.8
Type : Fast-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)

- ▶ 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.

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 moulded to a fully-shrouded 3-pin socket, 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 72-5085 is operative within the line voltage ranges 110/120V $\pm$ 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 or 6F22). The "  " 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 72-5085

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 ; Universal Counter(U/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 UNIVERSAL COUNTER

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

4-1-1. Specification

Input Frequency Measurement

▶ Measuring range	
Channel A and B	5Hz to 100MHz LSD display depending on Gate Time and Input Signal. At least 7 Digits displayed per second of Gate Time.
Channel C	100MHz to 1.3GHz
▶ Input VOLTAGE	
Channel A and B	70mV RMS Sinewave or 100mVp
Channel C	35mV RMS Sinewave or 70mVp
▶ Maximum Input Voltage	
Channel A, B and C	3V
▶ Input Impedance	
Channel A, B	1Mohm
Channel C	50 ohm
▶ Attenuator	
Channel A only	1 or 1/10(-20dB)
▶ Time Base	
Channel A, B and C	Switch selectable
▶ Resolution	
Channel A, B and C	
100MHz or more	10Hz/0.1S, 1Hz/1S, 0.1Hz/10S
10MHz or less	6 digit/0.1S 7 digit/1S 8 digit/10S

▶ Period Measurements	
Channel A and B	
Range	0.1 Sec to 10 Sec
LSD Display	1uSec to 0.1Psec
	Depending on Gate Time and Input Signal at least 7 digits displayed per second of Gate Time.
Channel C	
Range	0.1 sec to 10 sec
LSD Display	Least display limited by Display method 0.1Psec.
▶ Totalize	
Totalze A or B	
Manual Range	0 to 9, 99, 999
	Manual Reset possible
▶ Ratio A/B measurements	
Range	5Hz to 100MHz both channels
LSD display	$\frac{2.5 \times \text{period}}{\text{Gate Time}} \times \text{Ratio}$
▶ Difference A-B	
Range	5Hz to 100MHz both channels
LSD display	100Hz to 100uHz depending on Gate Time, Input signal and Display method.
▶ Addition A+B	
Range	5Hz to 100MHz both channels
LSD display	100Hz to 10nHz depending on Gate Time and Input Signal
▶ Time Interval A⇒B	
Range	100nSec to 10Sec
LSD display	100nSec
Average	1, 10, 100 Intervals Averaged
▶ Overflow Indication	The OVER LED indicator flashes, when an input exceeds, only under the LOW range set at 10S gate time.
▶ Operating Temperature	10°C to 40°C
▶ Storage Temperature	-10°C to 50°C
▶ Line Voltage Range	220V or 240C at 50-60Hz, selectable
▶ Power Comsumption	2W max.
▶ Coaxial Cable	RG-58 C/U, Impedance 50ohm, with
(with BNC connector)	one (1) meter in length.

4-1-2. Start-Up

- ▶ Check conductors of the A, B, and C channels 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 of DPS.
- ▶ Turn on the Power switch of U/C located on the rear panel.
In this case, all segments, *PASS-ALL* and *UC-1300* shall be displayed as a self test.
- ▶ Set the Display Option key(28) at U/C position.
- ▶ Set the Gate Time Switch (4) at 1S position.
- ▶ Set the Channel Select Switch (3) at Channel A position.
- ▶ Set the Data-Hold Switch and the Attenuation Switch at the pushed-out position.
Now, "GATE" "0.000000" "MHz" is lit up at frequency LED display.

4-1-3. Features

- ▶ Channel Select Switch(3)
The Channels A and B will cover your measurement of the frequency from 5Hz up to 100MHz with auto range.
The Channel C will cover your measurement of the frequency from 100MHz up to 1.3GHz.
- ▶ Gate Time Switch(4)
For a better resolution in your measurement, your selection for a proper gate time is advisable.
The following table will help you refer to the optional frequency resolution.

Frequency Resolution Table

GATE TIME	100 mS	1 S	10 S
LOW RANGE	10 Hz	1 Hz	0.1 Hz
HIGH RANGE	100 Hz	10 Hz	1 Hz

- ▶ Data-Hold Switch(5)
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.
- ▶ Attenuation Switch(2)
If input signal is greater than 700mV, set the Attenuation Switch at the pushed-in position with connecting the input signal to channel A only.

The triggering sensitivity of the input signal will be decrease by 1/10(-20dB) and reduce errors.
- ▶ Reset Swtich(6)
If you want to return to the normal frequency mode from the arithmetic modes, set FREQ switch at the pushed-in position.

4-1-4. Measuring the output frequency generated by F/G

If you want to measure the output frequency being measured by the Function Generator, set the Display Option key(28) at F/G position.

Because the maximum output frequency of F/G is 2MHz, the Range Select Channel should be set at CH-A which can read the frequency ranging from 5Hz to 100MHz.

Under activation of this mode, the Universal Counter will not measure any input frequency injected from the Frequency Input Connector.

4-1-5. How to using the arithmetic modes.

► PERIOD MEASUREMENT PROCEDURE

Perform Period measurement as follows :

- 1) Press the Power to ON position.
- 2) Set the channel selector to the desired channel prior to pressing the PERIOD switch to select the period mode of operation.
- 3) Connect the input signal to the front-panel BNC connector.
- 4) Read the period time on display.

► RATIO A/B MEASUREMENT PROCEDURE

This measurement shows the value of the channel A signal divided by the Channel B

- 1) Press the Power switch to ON position.
- 2) Press A/B switch
- 3) Connect the input signal to the front-panel BNC connector CH-A and CH-B
- 4) Read the value on display.

► TIME INTERVAL A⇒B MEASUREMENT PROCEDURE

This measurement counts the scaled reference frequency for a period whose start is determined by the CH-A input signal and whose stop is determined by the CH-B signal.

- 1) Press the Power to ON position.
- 2) Press A⇒B switch.
- 3) Connect the input signal to the front-panel BNC connector CH-A, and CH-B.
- 4) Read the value on the display.

► DIFFERENCE A-B MEASUREMENT PROCEDURE

This measurement counts the subtraction of the scaled input pulses occurred between CH A signal and CH B signal.

Perform A-B measurement as follow :

- 1) Press the Power switch to ON position.
- 2) Press A-B switch.

- 3) Connect the input signal to the front-panel BNC connector CH A and CH B.
- 4) Read the value on the display.

► **ADDITION A+B MEASUREMENT PROCEDURE**

This measurement counts the addition of the scaled input pulse occurred between CH A signal and CH B signal.

Perform A+B measurements as follows ;

- 1) Press the Power switch to ON position.
- 2) Press A+B switch.
- 3) Connect the input signal to the front-panel BNC connector CH A and CH B.
- 4) Read the value on the display.

► **TOTALIZE MEASUREMENT PROCEDURE**

Perform Totalize measurement as follows ;

- 1) Press the Power switch to ON position.
- 2) Press TOTAL switch to select the totalize mode of operation and to initialize the Counter.
- 3) Connect the input signal to the front-panel BNC connector CHA or CHB.
- 4) If input signal is greater than 700 mV, set the Attenuation Switch at the pushed-in position with connecting the input signal to Channel A only.

The triggering sensitivity of the input signal will be decreased by 1/10(-20dB) and reduce errors.

- 5) Read the accumulated value on the display after depressing the HOLD switch.

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. Ramp, Pulse, TTL Level Square
► Frequency	0.2Hz to 2MHz in 7 ranges
► VCF Voltage Level	0 to 10VDC(Max. Input Voltage : $\pm 15V$)
► Output Impedance	$50\Omega \pm 10\%$, $600\Omega \pm 10\%$ selectable
► Output Amplitude	2Vpp to 20Vpp at open load 1Vpp to 10Vpp at 50 ohm load
► Attenuator	-20dB
► Frequency Variable Range	20 : 1 or more
► Symmetry Variable Range	3 : 1 or more
► Offset Variable Range	Max. $\pm 10V$ DC

- ▶ Sine wave
 - Distortion Less than 1%(at 1KHz)
 - Flatness $\pm 0.3\text{dB}$
- ▶ Square wave
 - Symmetry Less than $\pm 3\%$ (at 1KHz)
 - Rise & Fall Time Less than 150 ns(at 1KHz)
- ▶ Triangle wave
 - Linearity Less than 1%(up to 100KHz)
Less than 5%(100KHz to 2MHz)
- ▶ TTL output
 - Rise & Fall Time Less than 30ns(at 1KHz)
 - Output Level More than 3V
- ▶ Frequency Sweep
 - Sweep Time 20ms to 2s
 - Internal Sweep Mode Linear
Logarithmic
 - Sweep width More than 100 : 1
 - External Sweep by means of VCF input

4-2-2. Start-Up

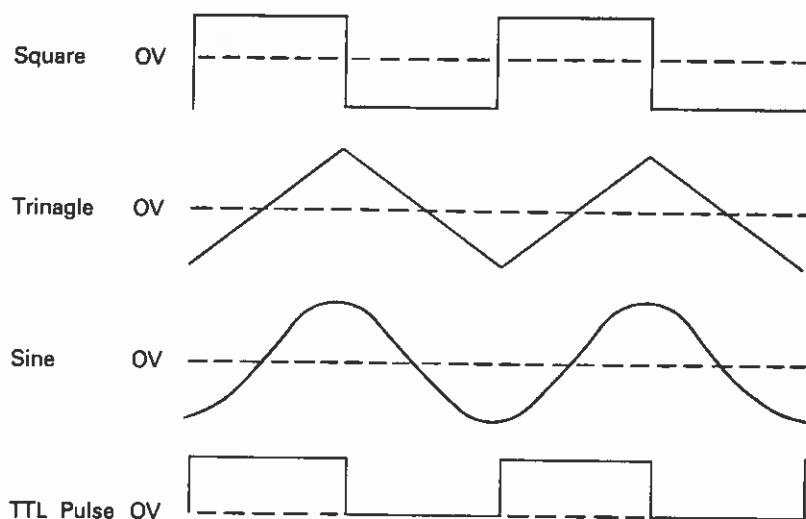
- ▶ Check conductors of the terminals in good condition without shorted.
- ▶ Connect the AC power cable to the recess power receptacle located on the rear panel, and plug it into the three-contact electrical outlet.
- ▶ Turn on the power switch(50) of the DPS.
- ▶ Turn on the power switch of the F/G located on the rear panel.
- ▶ Set all the variable controls, as follows ; -

Variable controls	Setting Position
Function Select S/W(25)	Sinewave
Freq. Range Select S/W(26)	$\times 1\text{K}$
Freq. Control Dial(24)	1.0
Amplitude Control Knob(19)	Switch Off (push-in position)
Offset Control Knob(20)	
Symmetry Control Knob(21)	
Sweep-Width Control Knob(22)	
Sweep-Rate Control Knob(23)	

- ▶ Match the output impedance between the F/G output and the unit under test by switching the impedance output select switch(27).
- ▶ 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 quadruple TR IC.
- The output wave forms and phase relationship are as follows.



Note: Under activation of the 600 ohm impedance mode(27), the output wave forms can be normal up to 100KHz range.

4-2-4. Frequency Ranges

- The **72-5085** 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
× 1	0.1Hz – 2 Hz	2 Hz
× 10	1Hz – 20 Hz	20 Hz
× 100	10Hz – 200 Hz	200 Hz
× 1 K	100Hz – 2KHz	2 Kz
× 10 K	1KHz – 20KHz	20KHz
× 100 K	10KHz – 200KHz	200KHz
× 1 M	100KHz – 2MHz	2MHz

Note:

The output frequency can be read by multiplying figures optioned by the frequency control dial(24), and the frequency Range Select Switch(26).

Ex. 1KHz=1.0(at the dial 24)×1K(at the S/W 26)

4-2-5. Features

► Voltage Controlled Frequency

Output frequency can be varied with an external voltage input from the VCF Input Terminal(16).

For 0~10VDC VCF input voltage, the frequency is changed by 1 : 2, depending upon activation of the Frequency Range Select Switch(26).

To operate the VCF function, turn the Frequency Control Knob(24), 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 the open load, but it is reduced by half(50%) under the 50 Ω load or 600 Ω load.

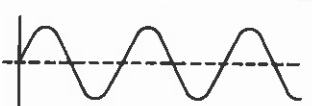
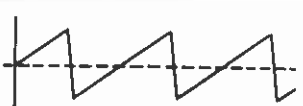
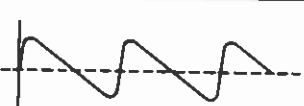
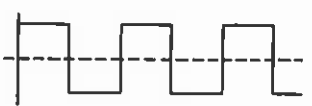
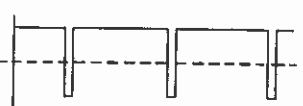
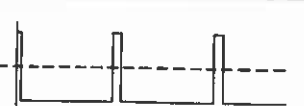
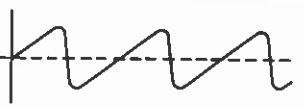
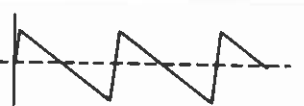
The Amplitude of output voltage can be varied continuously with operating the Amplitude Control Knob(19), in the range of -20dB. If the Amplitude Control Knob is pulled out, the output signal is set to the -20dB fixed.

► OFF-SET Control

The DC level of output signal can be varied continuously with operating the OFF-SET Control Knob(20) in the range of $\pm 10V$. 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(21) in the range of 1 : 3 or 3 : 1. To adjust the symmetry of the waveforms, pull out the Symmetry Control Knob, then turn it slowly to the CCW direction. The following table shows such variations under this mode.

BASIC WAVEFORMS	CLOCK WISE	COUNTER CLOCKWISE
		
SINE	SKEWED SINE	SKEWED SINE
		
SQUARE	PULSE	PULSE
		
TRIANGLE	SAWTOOTH	SAWTOOTH

Note: After setting the Symmetry Control Knob(21), 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 (22).

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(24) fully to the CCW direction, and turn the sweep Width Control Knob fully to 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 operative with by pulling the Sweep Rate Control Knob(23).

► TTL Output

The TTL level signal output is available at the TTL Output Terminal(17).

The TTL output can drive 30 unit loads in the HIGH state and 20 unit loads in the LOW state.

One unit load in the HIGH state is defined as 40 μ A and 1.6mA in the LOW state.

► Output Impedance

Output impedance of the Function Generator can be changed with the 50 Ω or the 600 Ω by pressing or releasing the Output Impedance Select Switch(27).

Under activation of the 600 ohm mode, the output frequency in normal waveform is available in the range of 0.2Hz to 100KHz.

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 2.5 Ω to the Terminal(46) and below 15 Ω to the Terminal (47).

4-3-1. Specification

	Terminal(47)	Terminal(45)	Terminal(46)
►			
► Output Voltage	0-30V	5V fixed	13.8V fixed
► Output Current	0-2A	2A	3A
► Ripple	1mV Max	2mV Max	2mV Max
► Load Regulation	0.1%+5mV	0.1%+70mV	0.1%+35mV
► Line Regulation	0.1%+5mV	0.1%+30mV	0.1%+30mV
► Output Current (Maximum)	2A (current limit)	2.2A (fold back)	3A (fold back)
► Display with Back-Lit	LCD 3½ digit V/A 'slectable	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(44) 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 " 13.8V/3A" will light.
- ▶ In order to use the variable voltage or current, you can choose the Voltage/Ampere Select Switch(48). While observing the displayed figures on the LCD(42), set your voltage in need, by turning the Voltage Control Knob(43).
- ▶ In need of limiting the current for protection your device under test, set your limit current by the Current Control Knob(44) During operation of the DPS, an excessive current over your setting current will lead the voltage to drop down and the Current Limit Indicator(49) will light.

Note:

This DC Power Supply has the Output Terminals isolated from the Grounding Terminal (Chassis Ground). However, the 0-30V/0-2A Output Terminal has been connected by the short-bar between the Ground Terminal(51) and the (—) output connector of the Terminal at the factory.

4-4. Operating the Digital Multimeter

The Digital Multimeter is powered by a single 9 volt battery, and fully isolated from the U/C, F/G, DPS and the chassis.

4-4-1. Precautions

- ▶ To prevent electric shock hazard and/or damage to the meter, do not measure voltages exceeding 1000V DC or 750V AC.
- ▶ To avoid damage to the meter, disconnect test leads from test points before changing the function/range.
- ▶ To avoid electric shock, be careful when working above 60V DC or 25V AC. Such voltages pose a shock hazard.
- ▶ Do not apply voltage to between the 20A or mA and COM terminals. This warning is to assure protection against injury and/or damage to the meter and the user.
- ▶ To avoid damage to the meter and/or injury observe the input limits as stated hereunder.

INPUT LIMITS

FUNCTION	TERMINALS	INPUT LIMITS
V DC	V/ Ω +COM	1000V DC
V AC	V/ Ω +COM	750V AC
Ω	V/ Ω +COM	250V DC/AC
mA DC/AC	mA+COM	400mA DC/AC
20A DC/AC	20A+COM	20A DC/AC
Logic	V/ Ω +COM	250V DC/AC

- ▶ The common input of the multimeter must never be connected to circuitry which is more than 500V above ground potential. Failure to observe this precaution may result in injury to the user, damage to the meter and connected computer equipment.
- ▶ To avoid electric shock hazard, do not touch test leads, tips or the circuit under measurement while power is turned on.
- ▶ Ensure the test leads are in good condition.

4-4-2. Specification

LCD Display :	3 $\frac{3}{4}$ digits w/Dual-Display, Analog Bargraph & Back Lit.
Function/Range Selection :	Push-button and rotary switch
Relative OFFSET :	3999counts
Input Impedance :	10 Mohm
AC/DC Max. Input Current :	20A (15 minutes max.)
Reading Time :	10 reading per second.
Operating Temperature :	0°C to 40°C
Storage Temperature :	-10°C to 50°C
Temp for guaranteed Accuracy :	23°C $\pm$ 5°C
Battery Type :	NEDA 1604 9V or 6F22 9V

FUNCTION	RANGE	ACCURACY	RESOLUTION
DC VOLTAGE	400 mV 4 V 40 V 400 V	$\pm 0.3\%$ of rdg +1 dgt	100 μ V 1 mV 10 mV 100 mV
	1000 V	$\pm 0.5\%$ of rdg +1 dgt	1 V
AC VOLTAGE	400 mV 4 V 40 V 400 V	$\pm 0.8\%$ of rdg +3dgt	100 μ V 1 mV 10 mV 100 mV
	750 V	$\pm 1.0\%$ of rdg +3 dgt	1 V
DC CURRENT	40 mA 400 mA	$\pm 0.8\%$ of rdg +1 dgt	10 μ A 100 μ A
	20 A	$\pm 1.5\%$ of rdg +5 dgt	10 mA
AC CURRENT	40 mA 400 mA	$\pm 1.5\%$ of rdg +3 dgt	10 μ A 100 μ A
	20 A	$\pm 2.0\%$ of rdg +5 dgt	10 mA
RESISTANCE	400 Ω 4 K Ω 40 K Ω 400 K Ω 4 M Ω	$\pm 0.5\%$ of rdg +1 dgt	1.0 Ω 1 Ω 10 Ω 100 Ω 1 K Ω
	40 M Ω	$\pm 1.0\%$ of rdg+2 dgt	10 K Ω
CAPACITANCE	4 nF 40 nF 400 nF	$\pm 2.0\%$ of rdg +3 dgt	1 pF 10 pF 100 pF
	4 μ F 40 μ F 400 μ F	$\pm 3.0\%$ of rdg +5 dgt	1 μ F 10 μ F 100 μ F

4—4—3. Features

- Computer Interface & Software-let you interface the meter with your PC-compatible computer so you can log measurements.
- Analog Bargraph Display-indicates the magnitude of the input compared to the full-scale value of the measurement range.
- Dual-Display-allows the meter to show two primary+secondary readings simultaneously on the LCD.

Input range selection	Main display	Secondary display
AC Voltage	AC VOLT	dB(m)
LOGIC	HI / LO	DC VOLT

- Overload and Transient Protection-helps protect the meter from accidental overload on most ranges. "OL" is displayed with flashing the bar-graph, when an input is too excess to display.
- Back-Lit Display-affords you of a more flexibility in your working area when turn the power to on. Back-Lit is powered by a voltage supplied from Power Supply(DPS).
- Auto-Hold-freezes a reading automatically recorded 3 seconds ago, when last reading is completed. For the measurement of DC Volt, Current, Diode, Capacitance "A" is displayed at the front of secondary display. When this feature is turned on, the secondary display shows the reading taken 4-5 seconds earlier.
- Min/Max/Data-Hold-let you keep a readings of minimum, maximum and captured value on the sub-display, while showing the present readings on the main-display.
- Range-Hold-sets the meter from auto-range to manual-range mode except capacitance position. In the manual-range mode, each you press UP DOWN keys, the range and the input range annunciator increment and/or decrements, and a new value is displayed.
- Relative Offset-displays the difference between the stored value and subsequent readings.
To set the reference value, follow these steps :
 - 1) Set the function mode at REL mode.
 - 2) Store the polarity, values and range of the reference value you desire by pressing the UP DOWN keys and SET/RESET ket by turns.
 - 3) Press SET/RESET key for final setting. Then your meter will be set in the manual-range automatically. In this mode, the total range of relative offset is 3999 counts.
- Memory & Memory Recall-stores the reference measurements up to 5 values you can download to a computer and get the memorized reading back on the LCD by using UP DOWN and SET/RESET key.
- Comparison-enables to do the HIGH LOW test of subsequent readings by comparing a reading with both the stored highest reference value and the stored lowest reference value. To set the reference values of Min and Max, see the steps of REL 2, 3. On the sub-display. LO sign for reading less than the lowest reference value, HI sign for reading more than the highest reference value and PASS for middle reading.
- Logic Test Function-checks logic levels without extra logic probes.

- EXT-your meter can measure and readout two different types of measurement at the same time. To set EXT feature, repeatedly press FUNCTION until EXT appears at the top of the display.

Input range selection	Main display	Secondary display
AC Voltage	AC Voltage	Frequency
AC Current	AC Current	Frequency

4-4-4. MAKING MEASUREMENTS

UNDERSTANDING PHANTOM READINGS

In some DC and AC voltage ranges, when the probes are not connected to any circuit, the display might show a "phantom" reading. This is normal. The meter's high input sensitivity produces a wandering effect. When you connect the probes to a circuit, accurate readings appear.

MEASURING HIGH-VOLTAGE CIRCUITS

When you use the meter to check a high voltage circuit, do not try to position both probes at once. Instead, clamp one probe to the neutral or ground lead of the circuit(usually a bare, green, or white of the in AC wiring circuits) using Insulated Slip-On Alligator Clips. Then probe for voltages with the other probe. This helps prevent you from accidentally touching a hot wire because you need to concentrate on only one test probe.

Warning: Never clamp onto a hot wire. (usually red, black, or blue in AC wiring circuits.) If you clamp onto a hot wire and touch the other probe, you could receive a shock.

1. AC/DC VOLTAGE MEASUREMENT

WARNING: DO NOT TRY TO MEASURE A VOLTAGE GREATER THAN 1000 VOLTS DC OR 750 VOLTS AC. YOU MIGHT DAMAGE YOUR METER AND EXPOSE YOURSELF TO A SEVERE SHOCK HAZARD.

Note: All the figures on the display blink when more than the maximum voltage(DC 1000/AC 750 VOLTS) is supplied. If this happens, DISCONNECT THE PROBES IMMEDIATELY.

Follow these steps to measure AC/DC Voltage:

1. Rotate the range selector to the desired V $\overline{\sim}$ position.
2. Press the DC Ω /AC ($\overline{\sim}$) button to toggle between DC and AC voltage.
3. Plug the black probe into the meter's COM terminal and the red probe into the meter's V/ Ω terminal.
4. Connect the meter in parallel with the load or circuit.

Notes:

- If polarity is negative, — appears on the left of display.
- For the most accurate measurement, select the lowest voltage range possible without getting an overload reading.
- Each of the AC/DC voltage ranges presents an input impedance of approximately 10M Ω in parallel with less than 100pF. AC voltage is ac-coupled to the 10M Ω input.

Caution: Never try to measure an AC voltage that is riging on a DC voltage level where the peak AC voltage exceeds 1000V with respect to earth ground.

2. MEASURING AC/DC CURRENT

WARNING: YOU MAY DAMAGE THE METER OR BE INJURED IF THE FUSE BLOWS WHILE CURRENT IS BEING MEASURED IN A CIRCUIT WHICH EXHIBITS AN OPEN CIRCUIT VOLTAGE GREATER THAN 250V. THE 20A TERMINAL IS FUSED. A SEVERE FIRE HAZARD AND SHORT CIRCUIT DANGER EXISTS IF YOU APPLY A VOLTAGE WITH HIGH CURRENT CAPABILITY TO THIS TERMINAL. THE METER CAN BE DESTROYED UNDER SUCH CONDITIONS.

Follow these steps to measure Current:

1. Rotate the range selector to the desired Ampere position.
2. Press DC Ω /AC (⎓) button to toggle between DC and AC Ampere.
3. Plug the black probe into your meter's COM terminal and the red probe into your meter's mA or 20A terminal.
4. Remove power from the circuit under test and then break the circuit at the appropriate point.
5. Connect the meter in series with the load or circuit under test.

Notes:

- If you do not know approximately what the current is, connect the circuit to 20A input terminal first to see if you have a safe level for the mA input terminal. Use the mA input terminal for current up to 400mA.
- When measuring current, the meter's internal shunt resistors develop a voltage across the meter's terminals called "burden voltage". This voltage drop is very low in your meter, but, it may affect precision circuits or measurement.
- If you set the meter for DC current, — appears or disappears to indicate the polarity of the measured current.

3. 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 be charged with considerable electricity.

Caution: If you attempt to measure the capacitance of a charged capacitor, you might damage your meter.

2. Rotate the range selector to the desired CAP range.
3. Insert the discharged capacitor into the CAP+ and — clips connectors. Your meter displays the capacitance value.

Note: For polarized capacitors, be sure to insert the negative lead in the — clip.

4. MEASURING RESISTANCE

Warning:

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

Follow these steps to measure Resistance:

1. Rotate the function selector to the Ω range.
2. Press the DC Ω /AC Ω button to toggle between Resistance and Continuity.
3. Connect the probes to the device you want to measure.

Notes:

- If the measured resistance value exceeds the maximum value of the range selected, "OL" displays to indicate overload and the bar graph flashes.
- The resistance in the test leads can diminish accuracy on the lowest range. The error is usually 1 to 0.2ohms for a standards pair of test leads. To determine the error, short the test leads together and read the resistance of the leads.
- For resistance of approximately 1 Megohm and above, the display might take a few seconds to stabilize. This is normal for high resistance readings.

5. CHECKING DIODES

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

Follow these steps to check Diode

1. Rotate function selector to the diode position.
2. Plug the black probe into your meter's COM terminal and the red probe into your meter's V/ Ω terminal.
3. Connect the probes to the diode you want to check and note the meter reading.

Notes:

- If the display shows a value, for example 0.2 for germanium diode or 0.5 for a silicon diode, reverse the diode. If the meter indicates an overrange, the diode is good. The displayed number is the diode's actual forward voltage(up to 2.0 volts).
- 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 probe or socket is connected to the diode's anode, and the black probe 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.

6. CHECKING CONTINUITY

Continuity testing verifies that circuit connections are intact. To perform audible continuity tests, set the rotary switch to Ω press the DC Ω /AC Ω button to toggle between Resistance and Continuity, and connect the meter to your circuit.

Warning: Never perform a continuity measurement on a circuit that has power connected.

Note: The buzzer sounds if the measured resistance is below 30 ohms.

7. Logic Test

The logic function lets you easily check the digital circuits to determine the logic state of different parts of the circuit. Rather than display an absolute voltage, this function displays Hi, LO, or ---- indicated logic high, low, or undetermined respectively.

Follow these steps to perform Logic test:

1. Rotate the function selector to the LOGIC range.
2. Plug the black probe into your meter's COM terminal and the red probe into your meter's V/ Ω terminal.
3. Connect the black probe to the ground point(GND) of the test circuit and the red probe to the supplying voltage point(V+). While keeping the test probes firmly connected to each point, press SET/RESET key.
4. While keeping a connection between the black probe and the circuit's GND point, move the red probe to the other desired points. The meter immediately displays one of the 3 modes, as follows:
 - If value exceeds 70% of the stored (V+) value, Hi(HIGH) appears.
 - If value falls below 30% of the stored (V+) value, Lo(LOW) appears.
 - If value is between 30% and 70%, the segment --- appears.

Notes:

- In this mode, the Date-Hold and Max/Min-Hold functions do not work.
- The supplying voltage above 3V for setting the reference value and from 0V up to 39.99V is limited for testing a logic.
- AFTER PERFORMING LOGIC TEST, YOU MUST PRESS SET/RESET BUTTON BEFORE ROTATING THE RANGE SELECTOR TO ANOTHER RANGE.

TENMA™
TEST EQUIPMENT

405 Pioneer Blvd.
Springboro, Ohio 45066