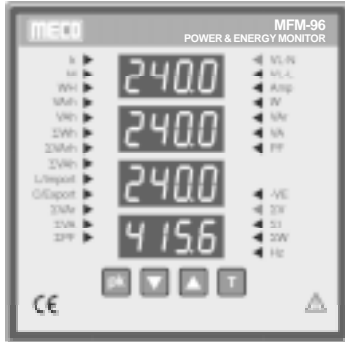




MULTIFUNCTION POWER & ENERGY MONITOR WITH MODBUS RTU PROTOCOL MODEL : MFM-96



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1 Installation and User Manual

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Introduction

MFM-96 3 phase 3 element 4 Wire Multifunction Meter is a microcontroller based electrical analyzer indicating TRMS value of Various electrical parameters. It measures 52 parameters & displays on 18 display pages each page has modbus 4 rows of LED display of 4 digit each.

It features user programmable function such as CT Ratio, PT Ratio & Instrument address. It is equipped with a 4 key keypad for scrolling through display page & to set the programmable function.

Safety Recommendations

To guarantee the level of safety incorporated in the device, follow the instructions below :

- 1) Adhere strictly to the connection diagrams for the installation of the instrument.
- 2) Before gaining access to the terminal, ensure that the conductors to be connected to the instrument are not live.
- 3) Make sure that the electrical panel in which the instrument is to be placed is designed in such a way as to guarantee that the terminals are inaccessible after installation.

Burden : < 0.3 VA / Phase
Accuracy Range : 30% ~ 125%
PT Ratio : Use PT for higher input ranges. PT Ratio Fully Programmable (1.000 ~ 9999)

Current Input :
Nominal : 5A AC (Line) isolated
Measurement : 1A AC (against specific order)
Range : 0 ~ 6A AC Max
Burden : < 0.1VA / Phase
Max. Current : 200% for 1 sec. (10A max.)
Accuracy Range : 0 ~ 120%
CT Ratio : Use CT for higher input ranges. CT Ratio Fully Programmable (1.000 ~ 9999)
Programmable Parameters : CTR, PTR & Instrument address (000 ~ 247)

Accuracy :
Voltage : ± 0.5% of Full Scale
Current : ± 0.5% of Full Scale
Active Power : ± 1% of Full Scale
Reactive Power : ± 1% of Full Scale
Apparent Power : ± 1% of Full Scale
Power Factor : ± 1° Electrical
Energy : Class 1
Frequency : ± 0.2Hz (45 ~ 65Hz)

* **Note** : Watt, VAR, VA Accuracy at Power factor 0.3 Lag-Unity-0.3 Lead

Technical Specifications

Display	: 4 Rows of 4 digit RED LED display For Energy Measurement 8 Digit 00000000 ~ 99999999 x 10 ⁵ LED Display Height 9.2mm / 0.36"
Key Pads	: 4 function keys to scroll through display pages and to set programming parameters.
Measuring Interval	: 0.5 sec
Operating Temp.,	: 0°C to 50°C
Humidity	: <90% RH (Non Condensing)
Dimension (mm)	: Front 96 x 96 mm Depth 60 mm Panel Cutout 92 x 92 mm
Weight	: 490 gms.
Electrical Specifications	
System	: 3 Phase 3 Element 4 Wire
Auxiliary Power Supply :	
Nominal (Range)	: 230V AC (185~264V AC) 110V AC (90~126V AC) optional
Frequency	: 50Hz
Burden	: < 4 VA
Voltage Input	
Nominal	: 230V / 240V AC (Phase - Neutral)
Measurement	: 400V / 440V AC (Phase - Phase)
Max. Range	: 300V AC Max. (Phase - Neutral) 520V AC (Phase - Phase)

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Processing method

a) Phase Values :

Effective phase voltage

$$V_n (TRMS) = \sqrt{\frac{\sum_{i=1}^N [V_n(i)]^2}{N}}$$

Effective phase current

$$I_n (TRMS) = \sqrt{\frac{\sum_{i=1}^N [I_n(i)]^2}{N}}$$

Active phase power

$$P_n = \frac{\sum_{i=1}^N V_n(i)I_n(i)}{N}$$

Apparent phase power

$$S_n = V_n(TRMS) \times I_n(TRMS)$$

Reactive phase power

$$Q_n = \sqrt{S_n^2 - P_n^2}$$

Phase power Factor

$$PF_n = \frac{P_n}{S_n}$$

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b) Equivalent system Values :

$$\text{Equivalent system voltage} \quad V_T = \frac{V_1 + V_2 + V_3}{\sqrt{3}}$$

$$\text{Equivalent system current} \quad I_T = \frac{I_1 + I_2 + I_3}{\sqrt{3}}$$

$$\text{System active power} \quad P_T = P_1 + P_2 + P_3$$

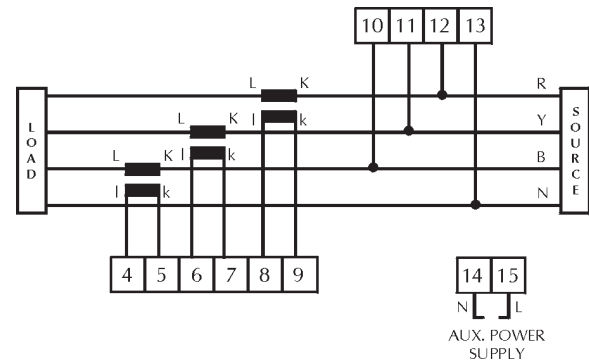
$$\text{System reactive power} \quad Q_T = Q_1 + Q_2 + Q_3$$

$$\text{System apparent power} \quad S_T = S_1 + S_2 + S_3$$

$$\text{Equivalent system power factor} \quad PF_T = \frac{P_T}{S_T}$$

Connection Diagrams

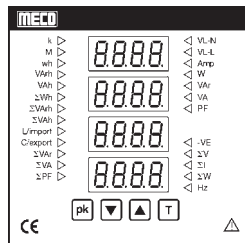
3 Phase 3 Element 4 Wire



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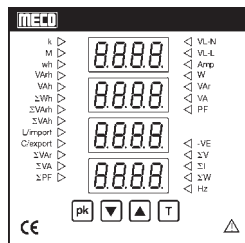
8

Display Indication



1) Numerical Field Zone

This consists of four rows of four digits each. The first row indicates measurement for phase 1, second row indicates measurement for phase 2, third row indicates measurement for phase 3 & fourth row indicates measurement for the whole system except system page.



2) Customised Symbol Zone

This zone backs up the numerical indications and is used to give a "clear" indication of the type of measurement being taken.

◀ VL-N = Line to Neutral Voltage in VAC

◀ VL-L = Line to Line voltage in VAC

- ◀ Amp = Phase current in ampere
- ◀ W = Active Power in Watt
- ◀ Var = Reactive Power in Var
- ◀ VA = Apparent Power in Volt Ampere
- ◀ PF = Power factor of phase angle between Voltage & Current for respective phase
- ◀ -VE = Indication of system export power of the system
- ◀ ΣV = Indicates system Voltage on fourth row of display (see note-1)
- ◀ ΣI = Indicates system Current on fourth row of display (see note-1)
- ◀ ΣW = Indicates system Active power on fourth row of display (see note-1)
- Note-1** = Except system page on which first row = ΣV, Second row = ΣI & Third row = ΣW
- ◀ Hz = Frequency of voltage line to neutral of phase 1

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- K ▶ = Indication of Kilo
- M ▶ = Indication of Mega
- Wh ▶ = Active energy (Phase)
- VAh ▶ = Reactive energy (Phase)
- VAh ▶ = Apparent energy (Phase)
- ΣWh ▶ = System active energy
- ΣVAh ▶ = System reactive energy
- ΣVAh ▶ = System apparent energy
- L/Import ▶ = Indication of energy as import for active energy & inductive for reactive energy
- C/Export ▶ = Indication of energy as export for active energy & capacitive for reactive energy
- ΣVAr ▶ = System reactive power
- ΣVA ▶ = System apparent power
- ΣPF ▶ = System power factor

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Key Pad

The key Pad contains 4 keys with the following functions in normal operation.

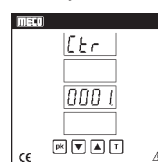
- pk Optional for Max. Demand page
- ▼ Down "▼" is used to move to next page.
- ▲ Up "▲" is used to move previous page.
- T "T" is used to move to first (system) page.

Operating Modes

This instrument has 2 operating modes : 1) Parameter setting mode (Programming mode) 2) Run mode (Normal mode)

1) Parameter setting mode (Programming mode) :

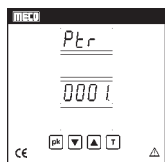
This mode can be invoked by pressing "▲" & "▼" keys simultaneously at power on. In this mode three pages are available for settings, namely CT ratio, PT ratio & Network address of Instrument



Parameter setting mode

A) CT ratio setting page : CT ratio is set by using "▲", "▼" & "T" keys. The digit to be incremented is selected by pressing "▲" key. The selected digit can be incremented using "▼" key.

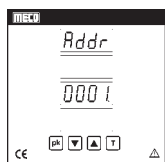
Decimal point position is shifted by pressing " T " key. Shifting of decimal point from first to fourth digit, On pressing " pk " key, CT ratio is stored and PT ratio setting page is displayed.



B) PT ratio setting page :

PT ratio is set by using "▲", "▼" & " T " keys. The digit to be incremented is selected by pressing "▲" key. The selected digit can be incremented by pressing "▼" key. Decimal point position is shifted by pressing " T " key. Shifting of decimal point from first to fourth digit.

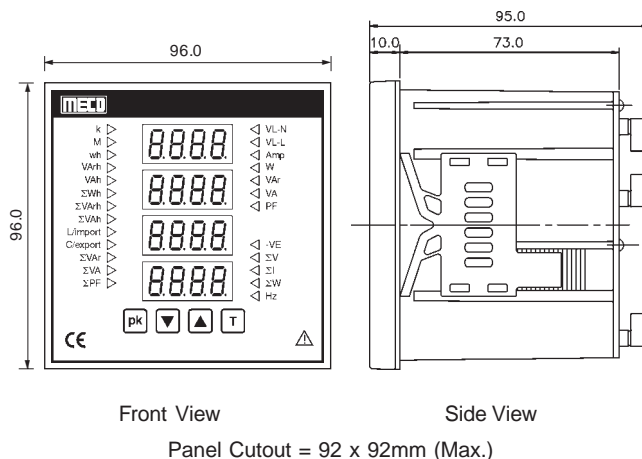
On pressing " pk " key, PT ratio is stored and instrument address setting page is displayed.



C) Network address setting page :

Instrument address is set using up & down keys. The digit that is to be incremented is selected by pressing "▲" key. The selected digit can be incremented by pressing "▼" key. On pressing " pk " key, instrument address is stored & instrument switches to quantity display mode (Normal mode).

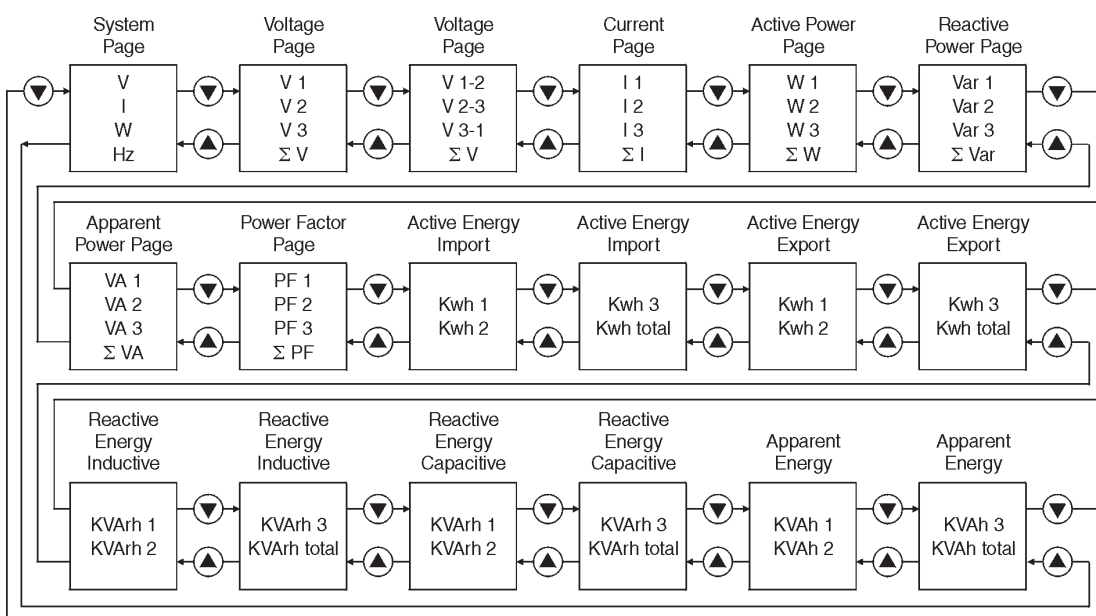
Mechanical Dimensions (mm) Model : MFM-96



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Page Sequence Diagram



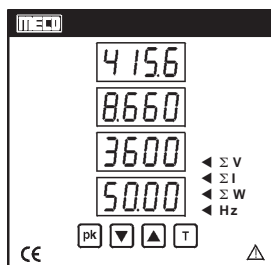
Note : T
When you are operating any other page by pressing this key system page will appear

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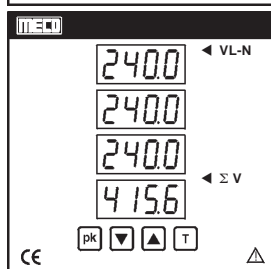
Sequences of Display Pages

System 3P3E4W 240V, 5A & Phase angle 0°



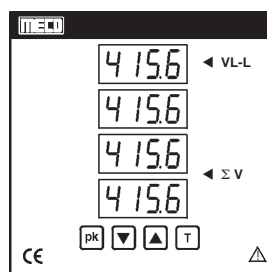
1) System page :

This page appears on the display after the power is switched on & first page in the sequences showing system parameters, system voltage, system current, i.e. system active power & system frequency.



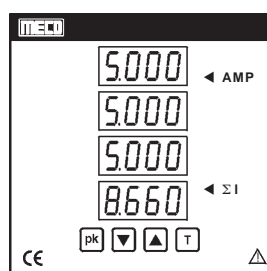
2) Effective Phase Voltage page :

This page displays the phase to neutral voltage (TRMS) for all the three phases & system voltage.



3) Effective Line Voltage page :

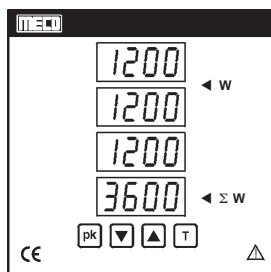
This page displays the line to line voltages (TRMS) for each of the three phases & system voltage.



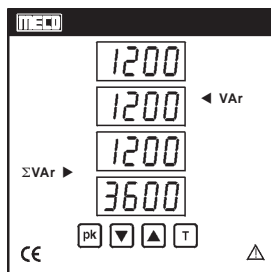
4) Effective Phase Current page :

This page displays the Phase Current (TRMS) value for the three pages & system current.

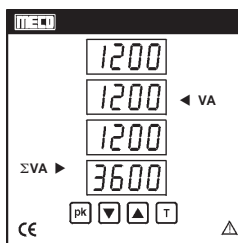
18



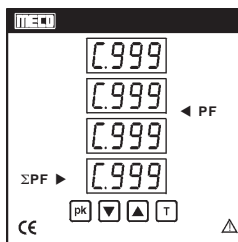
5) Phase Active Power page :
This page displays the phase active power value for each of the three phases & system active power.



6) Phase Reactive Power page :
This page displays the phase reactive power values for each of the three phases & system reactive power.



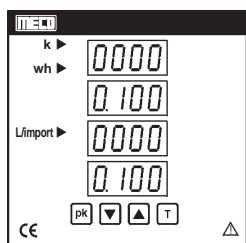
7) Phase Apparent Power page :
This page displays the phase apparent power value for each of the three phases & system apparent power.



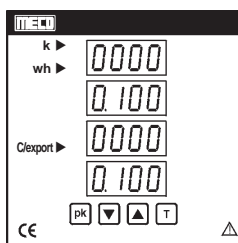
8) Phase Power Factor page :
This page displays the phase power factor value for each of the three phases & system power factor.

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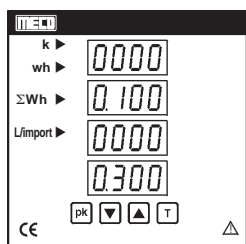
20



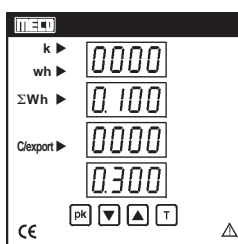
9) Active Energy page :
(Energy import - Kwh1, Kwh2 at phase angle 0°)
This page displays active energy value of 1st & 2nd phase.



11) Active Energy page :
(Energy export -Kwh1, Kwh2 - phase angle 180°)
This page displays active energy value export for 1st & 2nd phase.



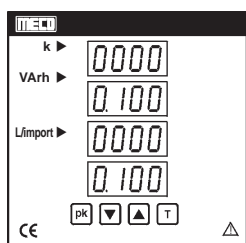
10) Active Energy page :
(Energy import - Kwh3, Kwh total at phase angle 0°)
This page displays active energy value of 3rd Phase & total active energy import.



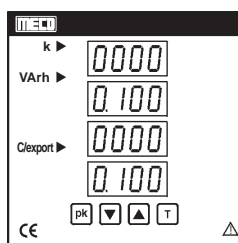
12) Active Energy page :
(Energy export -Kwh3, Kwh total - phase angle 180°)
This page displays active energy value of 3rd Phase & total active energy export.

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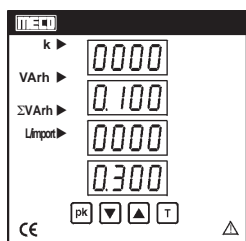
22



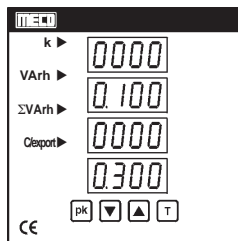
13) Reactive Energy page :
(Energy inductive - KVARh1, KVARh2 - phase angle 90°)
This page displays reactive energy inductive of 1st & 2nd phase.



15) Reactive Energy page :
(Energy capacitive - KVARh1, KVARh2 - phase angle 270°)
This page displays reactive energy capacitive of 1st & 2nd phase.



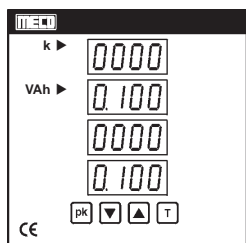
14) Reactive Energy page :
(Energy inductive - KVARh3, KVARh total - phase angle 90°)
This page displays reactive energy inductive of 3rd Phase & total reactive energy inductive.



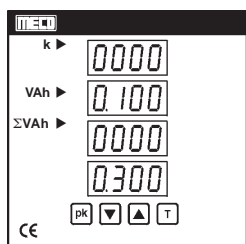
16) Reactive Energy page :
(Energy inductive - KVARh3, KVARh total - phase angle 270°)
This page displays reactive energy capacitive of 3rd Phase & total reactive energy capacitive.

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17) Apparent Energy page :
(KVAh1, KVAh2)
This page displays apparent energy for phase 1 & phase 2.



18) Apparent Energy page :
(KVAh3, KVAh total)
This page displays apparent energy for 3rd Phase & total apparent energy.

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Software

- Windows 95, 98, 98SE, 2000, ME, XP

Printers (If Used)

- Printers compatible with Windows 95

Distribution

- CD ROM

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RS 485 / RS232 Interface

Connect the Instrument to the PC through RS485 to RS232 Converter.

Power the RS485/RS232 interface module by means of its own power supply (230V/50Hz). Follow the connection diagram as shown in fig. 'A'.

Check that the setting of dip-switch on the interface is effectively positioned as shown in the connection diagram.

Installation and Start-Up

To install the Power Master Software, proceed as follows.

- 1) Place CD in the drive. It will automatically run the setup.
- 2) A window to confirm the installation of Power Master 2.04 will be displayed. click " Next " to continue installation and " Exit " to abort installation.
- 3) Next window displays information about the licence agreement. Click " Next ".
- 4) Now next window will ask for the directory in which the Power Master, MODBUS-RTU Ver. 2.04 Software is to be installed.
- 5) Now click " Start " to start the installation.
- 6) When installation is successfully completed a window will confirm the success of the installation operation press " Next ".
- 7) Now click " Exit ".

Serial Output

The instrument has a RS-485 serial output & can be connected through RS485 to RS232 converter to a personal computer. MFM-96 is identified by its own address, which can be configured from the instrument keyboard (See parameter setting mode page). The software communication protocol is dedicated to a network of Meter and has following characteristics :

- RS - 485 line, two wire multidrop.
- Twisted screened duplex cable for connection up to 1200m.
- Speed : 9600 baud rate.
- Data bits - 8, Parity - N, Stop bits - 1

Power Master Software MODBUS-RTU (Version 02 .04)

When the power master software is installed it is possible to monitor all the quantities measured, alongwith their graphical view. In this way it is possible to obtain data files and time trend of the quantity measured.

Minimum Hardware Requirements :

- Pentium II (350MHz)
- 32 MB Ram
- 10 MB Hard Disk (Free space)
- 1 COM serial port dedicated to RS-232 / 485 connection.

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RS 485 / RS 232 Interface Connection

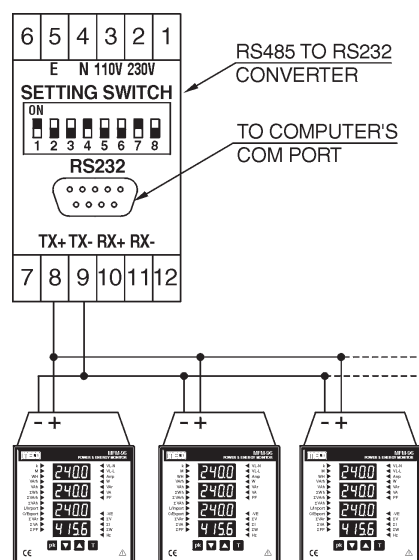


fig. 'A'

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CERTIFICATE OF CALIBRATION

We hereby certify that this product has been calibrated and found to be in accordance with the applicable SPECIFICATIONS and MECO STANDARDS.

Accuracies of the standard equipment used in this calibration are traceable to the National Standards.

MECO INSTRUMENTS PVT. LTD.

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Mahape, Navi Mumbai - 400710, INDIA

Tel. : 0091-22-27673311-16, 27673300 (Board)

Fax : 0091-22-27673310, 3330

E-mail : sales@mecoinst.com

SR. NO : _____
CHECKED BY : _____
DATE : _____
MODEL NO : _____

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