**Installation and User Manual**

**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.

**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)

**Processing Method**

**a) Phase Values**

**Effective phase voltage**

\[ V_i \text{ (TRMS)} = \sqrt{\frac{1}{N} \sum_{i=1}^{N} [V_i (\theta)]^2} \]

**Effective phase current**

\[ I_i \text{ (TRMS)} = \sqrt{\frac{1}{N} \sum_{i=1}^{N} [I_i (\theta)]^2} \]

**Active phase power**

\[ P_i = \frac{1}{N} \sum_{i=1}^{N} V_i I_i (\theta) \]

**Apparent phase power**

\[ S_i = V_i \text{ (TRMS)} \times I_i \text{ (TRMS)} \]

**Reactive power**

\[ Q_i = \sqrt{S_i^2 - P_i^2} \]

**Phase power factor**

\[ PF_i = \frac{P_i}{S_i} \]

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### b) Equivalent system Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent system voltage</td>
<td>( V_t = \frac{V_1 + V_2 + V_3}{\sqrt{3}} )</td>
</tr>
<tr>
<td>Equivalent system current</td>
<td>( I_t = \frac{i_1 + i_2 + i_3}{\sqrt{3}} )</td>
</tr>
<tr>
<td>System active power</td>
<td>( P_t = P_1 + P_2 + P_3 )</td>
</tr>
<tr>
<td>System reactive power</td>
<td>( Q_t = Q_1 + Q_2 + Q_3 )</td>
</tr>
<tr>
<td>System apparent power</td>
<td>( S_t = S_1 + S_2 + S_3 )</td>
</tr>
<tr>
<td>Equivalent system power factor</td>
<td>( PF_t = \frac{P_t}{S_t} )</td>
</tr>
</tbody>
</table>

### 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, and fourth row indicates measurement for the whole system except system page.
   - **VL-N** = Line to Neutral Voltage in VAC
   - **VL-L** = Line to Line voltage in VAC

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.
   - **\( \sqrt{3} \)** = System apparent energy
   - **\( \Sigma \)** = System reactive energy
   - **\( \Sigma V \)** = System active energy
   - **\( \Sigma V A \)** = System apparent energy

### Key Pad

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

- \( \uparrow \) = Down " \( \uparrow \) " is used to move to next page.
- \( \downarrow \) = Up " \( \downarrow \) " 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 " \( \uparrow \) " & " \( \downarrow \) " 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 " \( \uparrow \) " & " \( \downarrow \) " keys. The digit to be incremented is selected by pressing " \( T \) " key. The selected digit can be incremented using " \( \downarrow \) " 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. Decimal point position is shifted by pressing "T" key. Shifting of decimal point from first to fourth digit.
On pressing "pk" key, instrument address is stored & instrument switches to quantity display mode (Normal mode).

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.
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.

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

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

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.

13) Reactive Energy page:
(Energy inductive - KVarh1, KVarh2 - phase angle 90°)
This page displays reactive energy inductive 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.

15) Reactive Energy page:
(Energy capacitive - KVarh1, KVarh2 - phase angle 270°)
This page displays reactive energy capacitive of 1st & 2nd phase.

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.
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.

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, along with 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.

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

Printers (If Used)
- Printers compatible with Windows 95

Distribution
- CD ROM

RS 485 / RS 232 Interface Connection
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".

RS 485 / RS232 Interface

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.
Plot No. EL-1, MIDC Electronic Zone, TTC Industrial Area,
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 : _________________________________