OPERATING MANUAL FOR

MULTI FUNCTION METER

(Model: MFM 9015)

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MULTI FUNCTION METER

1. General Features

ICD Multi function meter **MFM 9015** is designed with latest state of art technolgy. It offers high accuracy, reliability and also real value for money. This next generation micro controller based instruments monitors over 30 vital parameters and does not require any external Transducers.This instrument is most suitable for measuring all electrical parameters in 3 phase industrial applications. It replaces several meters like Voltmeters, Ammeters, Wattmeters,Frequency meter, kVA meter, kVAR meter, pf meter and selector switches for the above in an electrical panel.

The measured informations are shown on a 16 digit 0.56" seven segment red LED display, which is splitted into 4 rows. Four keys are provided on the front panel of the meter to access these information easily and quickly. The front panel is provided with antiglare feature for improved readability.

The measurement parameters include 3 phase voltage, 3 phase Instant parameters (current, kVA, kW, kvar, PF & Frequency) and Energy parameter in Import & Export mode. All voltage, Current, Power and energy readings are true R.M.S including harmonics(if applicable). The power and energy measurement is done for the full four quadrants. The meter computes and updates the parameters in every 2 seconds.

The Power Multimeter MFM 9015 is also provided with a optional RS 485 optically isolated communication port supporting MOD BUS RTU protocol. The port is very useful in networking the meters in multidrop communication and to collect datas in a centralised control room using any standard SCADA Software package like cimplicity, intellution, wonderware & citech etc.

Note : For Every change of LT ⟷ HT or 1A ⟷ 5A or 3 Wire ⟷ 4 Wire the instrument should be switched OFF and then made ON.

2. Installation

2.1. Mounting

The meter is housed in a compact ABS plastic enclosure of dimension 96(H) x 96(W) x 45(D)mm. The meter is suitable for panel mounting and has reliable mounting clamps to hold the meter to the panel.

The panel cut out for fixing the meter is a 92 x 92 mm. The depth behind the panel is 45 mm. Always provide extra space for the connectors and wiring. The panel cut out should be punched with proper tool and should be free from burrs. Insert the meter through panel cutout from front and fix the mounting clamps provided with the meter on each side.

2.2. Wiring

2.2.1 Selection of PT & CT

The measurement of voltage and current is done using the PT voltage and CT current inputs. So the accuracy of measurement is determined by the accuracy and phase shift produced by the PT's and CT's so it is recommended to use PT's and CT's of instrument class 0.5 or better.

Also the PT's and CT's should have adequate VA rating to support the burden on the secondary side of them. The primary rating of the CT has to be selected such that the load variation lies between the dynamic range of the CT. (30% to 80% of the primary current).

2.2.2 Voltage signal connections

The MFM 9015 directly accepts voltages upto 415VAC R.M.S line to line (240VAC R.M.S line to neutral) with 10% over load capacity in case of LT selection and 110VAC R.M.S line to line (63.5 VAC R.M.S line to Neutral) with 10% over load capacity in case of HT selection. The primary of the PT is field programmable upto 330 kV.

There are four voltage input terminals marked as R, Y, B & N. The three phase input voltage should be connected to those terminals. MFM 9015 voltage input burden : 0.25VA per phase

2.2.3 Current signal connections

The MFM 9015 current inputs can accept 5A/1A AC R.M.S(selectable) for connecting external CT's. The CT Secondary value is field programmable. The current inputs has over load capability of 120% In both the cases.

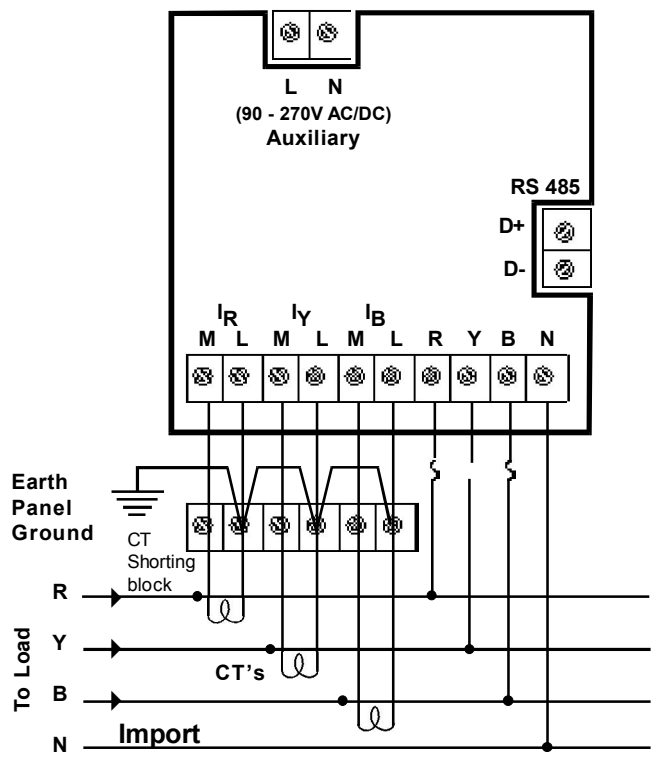
There are three pairs of terminals marked as IR (M,L) IY (M,L) and IB (M,L) for the connection of external CT's. For proper measurements, the polarity of the CT's must be connected properly. The CT wiring must be properly done by deenergising the CT secondary by shorting it through a shorting block. The primary current of CT is field programmable upto 10000A.

MFM 9015 Current input burden : 0.5VA per phase / 0.25VA per phase

3. Wiring Diagram

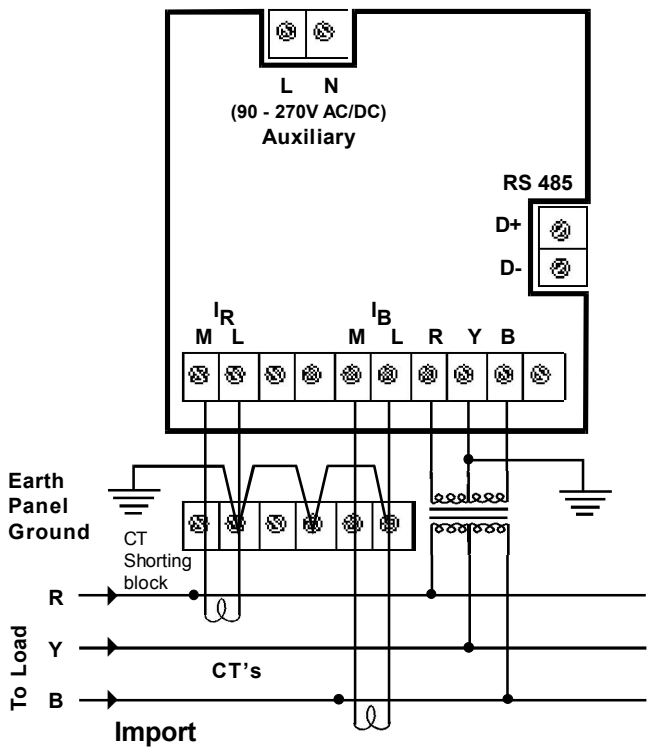
3.1) Three phase four wire LT systems (3 watt measurement)

Voltage Input : Direct 240V AC P-N (-20% to +10%)
Current Input : 5/1A provide through 3 CT's



3.2) Three phase three wire HT systems (2 watt measurement)

Voltage Input : 110V AC (L - L)(Through PT)
Current Input : 5/1A provide through 2 CT's



3.3) Auxiliary power supply connections

The Meter derives power from auxiiiary power supply terminals which is seperatly provided in the meter. SMPS circuit is used to power up the meter so it can work from th range of 90 - 270V AC/DC RMS. The auxiliary supply should be connected to proper specified voltage.

Burden on Auxiliary supply terminals : 4VA

3.4) Cross checking the wiring

The three phase voltage wiring and current wiring are to be properly done for correct measurements. Any wrong connections done either during installation or during rewiring can produce wrong measurement of electrical parameters. These incorrect wirings are difficult to detect since they produce wrong readings close to the expected readings.

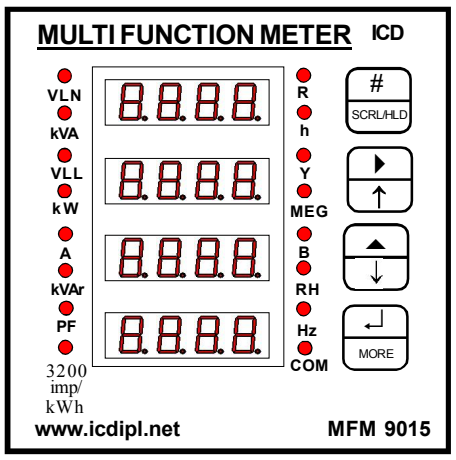
The MFM 9015 has a built in program to identify the reverse sequences in PT as well as CT wiring. A seperate diagnostic display page is provided to view the PT, CT Connections. IT can be selected by pressing the Shift Key repeatedly. If the PT & CT wiring are done correctly. The diagnostic page shows as

C t
n I L
P t -
- - -

Otherwise the phase in which voltage connections or current connections are wrongly connected is displayed. *(PT shows "RYB" when sequence connected is correct (RYB, YBR & BRY) or else shows "RBY', if sequence connected is incorrect (RBY, YRB & BYR). CT shows reversal, when CT not synchronised with PT or wiring are Interchanged/Reversed or Load in Export Mode.*

Note : While checking the wiring through the diagnostic page, make sure the load current is 10% above the full scale current and also the load is in import mode.

4. Front Panel Features



The LED Display is a 4 row 0.56" quard digit 7 segment red display. It is used to display voltage, current, kVA, kW, KVAr, PF, Freq., kWh, kVAh, kVArh, Run Hour, THD(if applicable) & program mode settings.

The "COM" Bicolour LED is provided to Indicate the activity in the communication port. The COM LED flashes, whenever the data is received through communication port and when data is transmitted from the meter.This LED is not provided in the meters without communication port. Calibration pulse output is provided through 3mm RED LED in front panel. Meter constant is 3200 impulse/kWh.

4.1 Changing the configuration Items

In program mode, after selecting the configuration item through Index key, It can be altered by using shift, Increment & Enter key.

The shift (▶) key is used to select the digit one by one. The selected digit is shown by flashing that digit.

The Increment (▲) key is used to increment the selected digit. The increment key Increments the digit from 0 to 9 and then wraps down to zero once again. Shift and Increment keys are also used for selecting the required parameter.

Once the required values are set in the configuration items press the Enter ↵ key to store it in memory. If the change is accepted the display Indicates 'E' otherwise an error message is displayed as 'Error'.

Once the configuration Items are programmed hold in the ▶ & ▲ keys together for 3 seconds to return back to normal operating mode.

4.2 Key Description :

Keys	Program mode	Normal operating mode
# SCRL/HLD	Index key *(To select Menu's)*	SCRL/HLD *(To switch between Scroll/Hold mode)*
▶ ↑	Shift Key *(To move between characters & to select parameters)*	To increment Display pages
▲ ↓	Increment Key *(To increment the selected digit & to select parameters)*	To decrement Display pages
↵ MORE	Enter Key *(To store the modifications & datas)*	More Key *(To view further sub pages)*

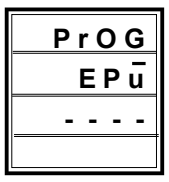
5. Programming Instructions

All meters are to be programmed properly to work in a particular Installation. The various items that are to be programmed are shown in the table below.

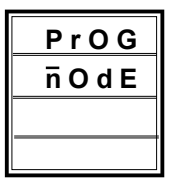
Configuration Item	**Multi Function Meter**
New pass word	*All meters*
Primary & secondary Voltage	*All meters*
Primary & Secondary Current	*All meters*
Device Id	*Meters with Communication Interface only*
Energy & Run Hour reset	*All meters*

The meters are provided with password facility to prevent alteration of configuration items by unauthorised persons. The configuration Items of the meter may be changed by following the sequence given below.

With power applied to the meter hold in the ▶ & ▲ keys (shift and Incr) together for 3 seconds.



The display Indicates Program enter password. The password set in the menu, “new password” has to be entered by using Shift, Incr and enter keys (Refer changing the configuration items for using Shift, Increment and Enter keys).

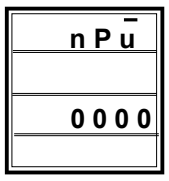


After valid password is entered the meter enters into program mode by showing it in display.

Special Note :

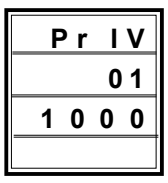
If the user enters the ‘Enter pass word’ for the first time, or if the user fails to remember the password entered in ‘New pass word’, the default password ***0386*** *can be entered.*

The configuration Items can be selected by pressing the Index (#) key. Top row in displays are used to differentiate the various configuration items. The displays for various configuration item are given below,



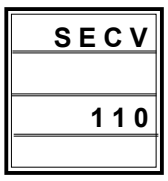
Press # Key

Password to prevent unauthorised persons entry *(Range : 0000 - 9999)*



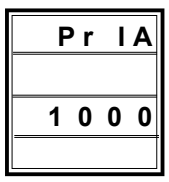
Press # Key

Primary Voltage setting *(Range : 0 - 330000V AC)*



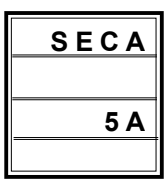
Press # Key

Secondary Voltage setting *(415V for LT & 110V for HT meters)*



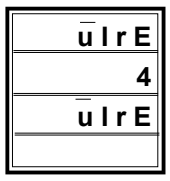
Press # Key

Primary Current setting *(Range : 0 - 9999 AC)*



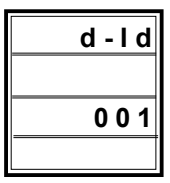
Secondary Current setting *(Range : 1 / 5 A AC)*

Press # Key



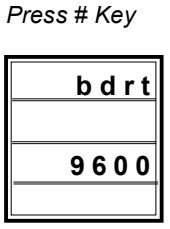
Wiring System
(4 Wire / 3 Wire)

Press # Key



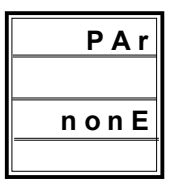
Device address *(Range : 001 - 255)*

Press # Key



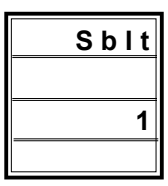
Baude Rate setting for Communication speed
(Range : 9600 & 19200)

Press # Key



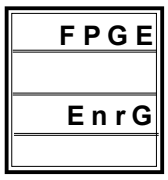
Parity Set Either we can select
(None, Odd & Even)

Press # Key



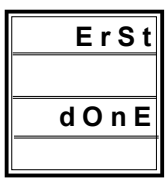
Stop bit, Either we can select
(1 / 2)

Press # Key



Favourite page selection, Either we can select any one as a first page *(VAF / Power / Energy)*

Press # Key



kWh Energy Reset. *(pressing Enter key resets energy & Run Hour and displays* "kWh rst dOnE" *in Bottom Row)*

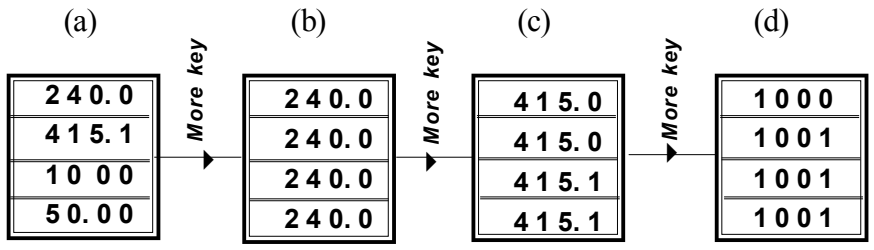
Again pressing Index (#) key repeats the same process in cyclic manner. Press ▶ & ▲ keys (Shift & Increment) together for few seconds to quit program mode & return to RUN mode.

6. RUN Mode display pages

When power is applied to the Multi function meter the starting message consisting of make, year & model no, and the run mode is selected automatically. In Run mode the power parameters are shown in different pages. These pages are accessed using the “Page UP & DOWN” keys provided on the front panel. The display pages, can also be made to scroll automatically 5 seconds once by selecting scroll mode by pressing scroll/hold key. The selected mode is initially shown in the first tow rows of the display.

The Scroll or Scroll/Hold key toggles between Scroll & Hold mode. The available display pages are given below. Each displayed parameter is assigned with LED, on displaying the parameters, LED assigned to it glows to enable the user to understand easily.

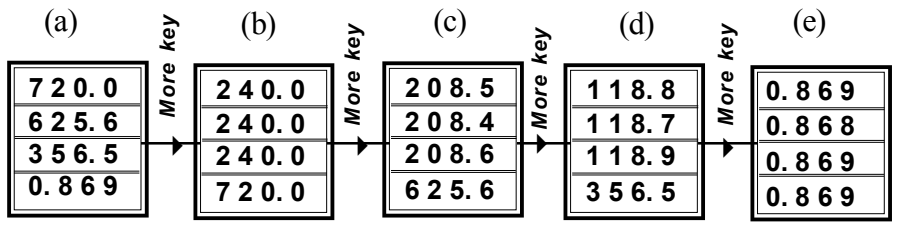
Page - 1



press key

a) Line to neutral voltage,Line to Line voltage, Current and Line frquency
b) Individual line to neutral voltage (R,Y & B) and Average VLN
c) Individual Line to Line voltage (RY,YB & BR) and Average VLL
d) Individual current (R,Y & B) and Average current.

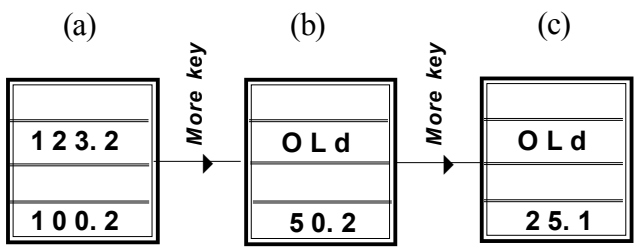
Page - 2



press key

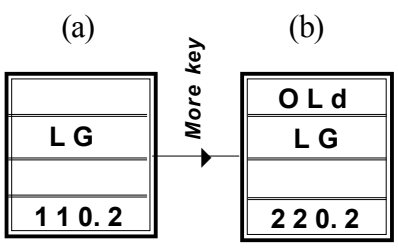
a) Total KVA, Total KW, Total KVAr, Average PF.
b) Individual KVA, (R, Y & B). & Total KVA.
c) Individual KW (R, Y & B) & total kW .
d) Individual KVAr(R, Y & B) & Total KVAr.
e) Individual PF (R, Y & B) & Avearage PF.

Page - 3



a) Intergration of Kva & Kw
b) Previous Kvah
c) Previous Kwh

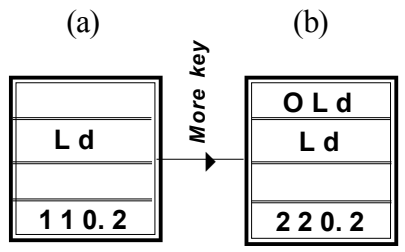
Page - 4



press key

a) Intergration of Kvar in Lag
b) Previous Lag Kvarh

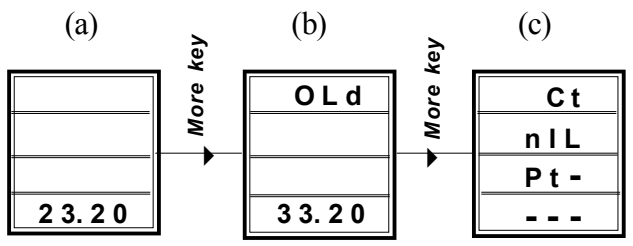
Page - 5



press ▶ / ▲ key

a) Intergration of Kvar in Lead
b) Previous Lead Kvarh

Page - 6



press ▶ / ▲ key

a) Run Hour (RH)
b) Previous Run Hour (RH)
c) CT reverse status & PT sequence.

The above pages are given for 3 phase 4 wire LT meters. For HT meters, the resolution and units will change as given in technical specifications. The display pages sequence and parameters can be altered based on user requirement (to be mention while ordering).

7. Communication Port Details

The MFM 9015 is provided with a optically Isolated RS 485 communication Port. The communication protocol used is MODBUS - RTU or MODBUS-ASCII (to be specified while ordering).Using the communication Port, the meters can be connected in multi drop network and data can be collected in a centralised control room using any standard SCADA Software.

The communication between the PC and the instrument would be in Master slave mode. P.C acts as a master and sends a command message (query) containing the slave Id, function code and address of the information required. The command is received by all the slaves. The slave whose address is matching with that of the command address would respond with the requested data.

The communication settings are,

Protocol	:	MODBUS RTU
Baud rate	:	9600
Data bit	:	8
Starting Address	:	40001
Data Type	:	UINT
Communicating mode	:	Half Duplex

The above configuration are to be done in any standard scada package for collecting the data.

The instrument is provided with screwable 2 pin phoenix connector for connecting the communication cable at the rear side. Terminal details are (From top to Bottom)

Sl.No	Parameter	Address	Resolution	
			LT	HT
1	R - Voltage	40001	0.1	0.01
2	Y - Voltage	40002	0.1	0.01
3	B - Voltage	40003	0.1	0.01
4	RY Voltage	40004	0.1	0.01
5	YB Voltage	40005	0.1	0.01
6	BR Voltage	40006	0.1	0.01
7	R Current	40007	0.1	0.1
8	Y Current	40008	0.1	0.1
9	B Current	40009	0.1	0.1
10	Total kVA	40010	0.1	1
11	Total kW	40011	0.1	1
12	Total kVAr	40012	0.1	1
13	Total PF	40013	0.001	0.001
14	Frequency	40014	0.01	0.01
15	kWH MSB	40015	0.1	1
16	kWH LSB	40016	0.1	1
17	Meter Type / Runhour MSB	40017		
18	Runhour LSB	40018		
19	Import / Export	40019		
20	kVAh MSB	40020	0.1	1
21	kVAh LSB	40021	0.1	1
22	Lag kVArh MSB	40022	0.1	1
23	Lag kVArh LSB	40023	0.1	1
24	Lead kVArh MSB	40024	0.1	1
25	Lead kVArh LSB	40025	0.1	1

Note:

a) Σ PF Calculation : If P.F < 1000 PF is in Lag (P.F = PF)
If P.F > 1000 PF is in Lead P.F = (PF-1000)

b) Σ kWh Calculation : Σ kWh = (kWh MSB * 65536) + kWH LSB

c) Meter Type / Runhour MSB : 256

d) Q = Meter Type : 03 = LT 3W, 04 = LT 2W, 05 = HT 3W,
06 = HT 2W

e) Imp. & Exp. status : 0 = Import, 1 = Export

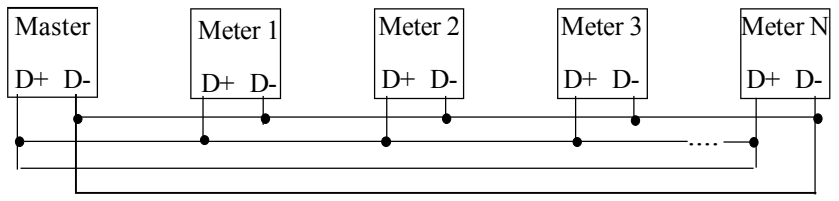
f) R : Runhour MSB

g) Total Runhour : (Runhour MSB * 65536) + Runhour LSB

7.1 Communication connection diagram

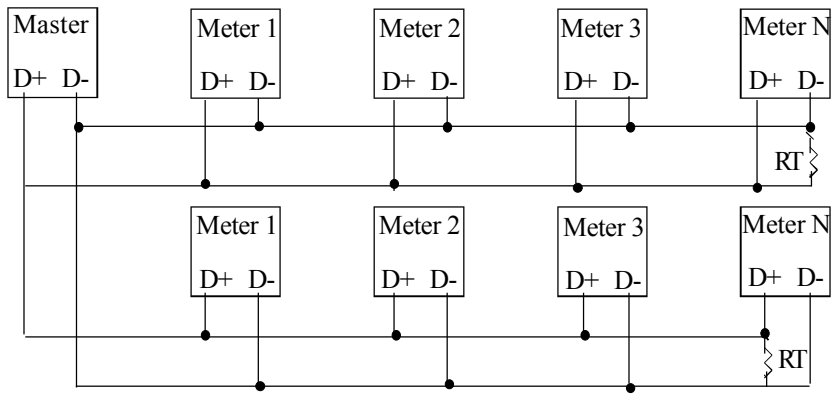
When connecting the meters in multidrop communication network, the following methods are to be adopted for trouble free communication.

1. **Loop Topology**



In this method, the communication continous to work even if there is a breakage in any one of the Loop. Termination resistors are not required.

2. **Straight line Topology**



In this method termination resistor RT (60 -100 W) of value equal to characteristic Impedance of the cable used may be required to avoid reflection loses.

It is recommended to use proper & suitable communication cable for trouble free communication.

8. Technical specification (class 0.5 / 1)

Type	: ICD make **MULTI FUNCTION METER**
Model	: **MFM 9015**
Application	: LT / HT Application (Field Programmable)
Voltage Input	: **LT :** 415 AC RMS (-20% to +10%)
(Line to Line)	**HT :** 110V AC RMS (-20% to +10%)
Current Input	: 5A /1A AC R.M.S. (Field Programmable)
Over Load Capacity	: 10A Max continuous, 50A max for 3 seconds
Working Load Range	: 0.5% to120% of load current
Frequency	: 45.00 to 55.00Hz
Measurement Method	: 3 Watt Meter or
	2 Watt Meter (Field programmable).
Accuracy	: **Class 0.5** as per **IS 14697** (or)
	Class 1 as per **IS 13779 (ordering Option)**
Display	: 4 row 0.56" Quard digit 7 segment red display
Programmable	: PT primary & secondary Voltage,CT Primary &
Parameters	secondary current, Device ID, Energy & Runhour
	Reset facility with password protection
Parameters storage	: In non-volatile EERAM (including
	Energy & Runhour)
Phase Reverse Indication:	Provided in the display page
Display page selection	: By set of keys provided in front panel.
Calibration pulse O/P	: Provided through Red LED in front panel
Meter Constant	: 3200imp/kWh
THD Accuracy	: ± 2%OFS for % values (for loads > 20%)

Burden on Voltage I/P : 0.25VA per phase

Burden on Current I/P : 0.25 V A per phase

PC Interface (Optional) : An optically isolated RS 485 O/P is available with MODBUS-RTU protocol.

Isolation : 2 kV Isolation for 1 minute between communication and other circuits.

Parameter displayed : (Class 0.5)

Parameter	Range	Resolution	Accuracy
R, Y, B Voltage	180 - 270 V AC	0.1 V (LT)	±0.5%±2Least digit
	Primary Voltage set	0.01kV (HT)	±0.5%±2Least digit
RY, YB, BR Voltage	310 - 470 V AC	0.1 V (LT)	±0.5%±2Least digit
	Primary Voltage set	0.01kV (HT)	±0.5%±2Least digit
Current	0000 - 0100 A AC	0.1 A (LT & HT)	±0.5%±2Least digit
	>0100 A - primary current (CT) set	1 A (LT & HT)	
kVA, kVAr (LT) 3 Phase & total	0 -1000 kVA / kVAr	0.1kV A / kVAr	±0.5%±2Least digit
	>1000 kVA / kVAr	1 kVA / kVAr	
kVA, kVAr (HT) 3 Phase & total	0 -10000 kVA / kVAr	1kV A / kVAr	±0.5%±2Least digit
	>10000 kVA / kVAr	0.01 MVA/MVAr	
kW (LT) 3 Phase & total	0 -1000 kW	0.1kW	±0.5%±2Least digit
	>1000 kW	1 kW	
kW (HT) 3 Phase & total	0 -10000 kW	1kW	±0.5%±2Least digit
	>10000 kW	0.01 MW	
Power factor 3 Phase & total	0.1Lg - Unity - 0.1Ld	0.001 (LT & HT)	±0.5%±2Least digit
Frequency	45.00 - 55.00 Hz	0.01Hz(LT & HT)	±0.2%
kWh, kVAh & kVArh	9999999.9	0.1 (LT)	Class 0.5 as per IS 14697 (±0.5%)
	9999999.9	0.1 (HT)	
Run Hour	9999.59 Hours Max.	1 Minute	± 1 sec/day

Parameter displayed : (Class 1)

Parameter	Range	Resolution	Accuracy
R, Y, B Voltage	50 - 280 V AC	0.1 V (LT)	±1%+2Least digit
	25 - 80 V AC	0.01kV (HT)	±1%+2Least digit
RY, YB, BR	90 - 485 V AC	0.1 V (LT)	±1%+2Least digit
Voltage	40 - 140 V AC	0.01kV (HT)	±1%+2Least digit
Current	0 - 100 A AC	0.1 A (LT & HT)	±1%+2Least digit
	> 100 A - primary current (CT) set	1 A (LT & HT)	
kVA/KW/kVAr (LT)	0 -1000 KVA/KW/KVAr	0.1kV A/KW / kVAr	±1%+2Least digit
3 Phase & total	>1000 kVA/KW / kVAr	1 kVA /KW / kVAr	±1%+2Least digit
kVA/KW/kVAr(HT)	0-10000kVA/KW/ kVAr	1kV A/KW / kVAr	±1%+2Least digit
3 Phase & total	>10000 kVA/KW/ kVAr	0.01 MVA/MW/MVAr	±1%+2Least digit
3Phase Power factor&Avg	0.0Lg - Unity - 0.0Ld	0.001 (LT & HT)	±1%+2Least digit
Frequency	40.00 - 60.00 Hz	0.01Hz(LT & HT)	±0.2%+2Least digi
kWh, KVAh & kVArh	9999999.9	0.1 (LT/HT)	Class 1 as per IS 13779 (±1%)
Run Hour	9999.59 Hours Max.	1 Minute	± 3 sec/day

Auxiliary Supply	: 90 - 270V AC/DC
Burden on Auxiliary I/P	: 4 V A
Operating Temperature	: 10ºC to 55ºC
Box Dimension	: 96(W) x 96(H) x 45(D) mm
Cutout	: 92 x 92 mm
Mounting	: Panel
Enclosure	: ABS Plastic case
Weight	: 400 g (Approximately)