

OPERATING MANUAL FOR
MULTIFUNCTION METER
(Model: MFM 9013)



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MULTI FUNCTION METER

1. General Features

ICD Multifunction meter **MFM 9013** is designed with latest state of art technology. It offers high accuracy, reliability and also real value for money. This 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 4 rows, 4 digit 0.56" 7 segment customized red block LED display. 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 (Kwh /kvah) in Import mode & Export Mode. All voltage, Current, Power and energy readings are true R.M.S including harmonics, Idle hour, power interrupts, true PF and displacement PF. The power and energy measurement is done for the full four quadrants. The meter computes and updates the parameters in every 2 seconds. Load percentage bar led provided in front the window.

The Power Multimeter MFM 9013 is also provided with a optional RS 485 optically isolated communication port supporting MOD BUS RTU protocol. One more RJ 45 port also provided. The port supporting to TCP protocol. Optional (RJ45, Wifi, profibus). The port is very useful in networking the meters in multidrop communication and to collect data in a centralised control room using any standard SCADA Software package like cimplicity, intellution, wonderware & citech etc.

Note : For Every change of 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 62(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 90 x 90 mm. The depth behind the panel is 62mm. 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 9013 directly accepts voltages 110/115 VAC R.M.S line to line (63.5 VAC R.M.S line to Neutral) with 10% over load capacity in HT selection. The primary of the PT is field programmable upto 440 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 9013 voltage input burden : 0.25VA per phase

2.2.3 Current signal connections

The MFM 9013 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.

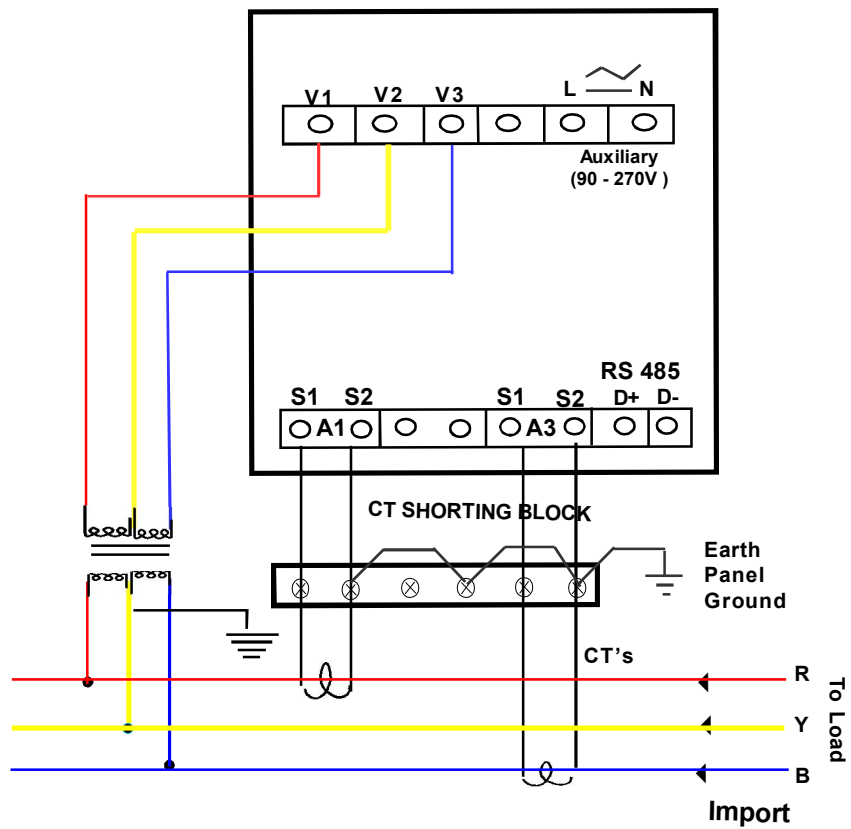
There are three pairs of terminals marked as IR (M,L) IY (M,L) and IB (M,L) for the connection of external CT's. For proper measurements, the polarity of the CT's must be connected properly. The CT wiring must be properly done by deenergising the CT secondary by shorting it through a shorting block.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

MFM 9013 Current input burden : 0.5VA per phase / 0.25VA per phase

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 auxiliary power supply terminals which is separately provided in the meter. SMPS circuit is used to power up the meter so it can work from the range of 90 - 270V AC/DC. 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.

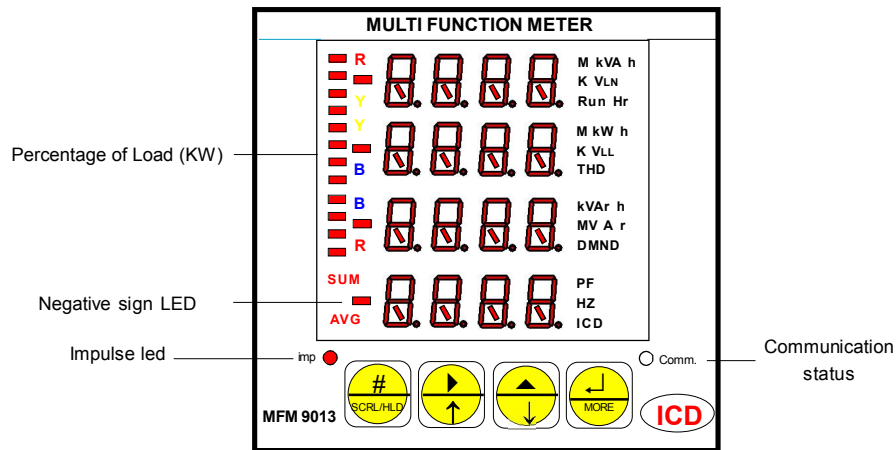
The MFM 9013 has a built in program to identify the reverse sequences in PT as well as CT wiring. A separate diagnostic display page is provided to view the PT, CT Connections. It can be selected by pressing the Shift Key repeatedly. If the PT & CT wiring are done correctly. The diagnostic page shows as

C t
n 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" quad digit 7 segment red display. It is used to display voltage, current, kVA, kW, kVA r, PF, Freq., kWh, 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.

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 :

<u>Keys</u>	<u>Program mode</u>	<u>Normal operating mode</u>
	Index key <i>(To select Menu's)</i>	SCRL/HLD <i>(To switch between Scroll/Hold mode)</i>
	Shift Key <i>(To move between characters & to select parameters)</i>	To increment Display pages
	Increment Key <i>(To increment the selected digit & to select parameters)</i>	To decrement Display pages
	Enter Key <i>(To store the modifications & datas)</i>	More Key <i>(To view further sub pages)</i>

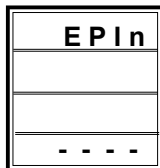
5. Programming Instructions

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.

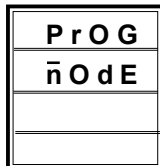
Configuration Item	Multi Function Meter
<i>New pass word</i>	<i>All meters</i>
<i>Primary & secondary Voltage</i>	<i>All meters</i>
<i>Primary & Secondary Current</i>	<i>All meters</i>
<i>Device Id</i>	<i>Meters with Communication Interface only</i>
<i>Energy & Run Hour reset</i>	<i>All meters</i>

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 enter pin 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, Incr 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 pin pass word' for the first time, or if the user fails to remember the password entered in 'New pin 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,

n P I n
0 0 0 0

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

Press # Key

P r I
V L t
0 0
0 4 1 5

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

Press # Key

S E C
V L t
4 1 5 V

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

Press # Key

P R I
C r n t
1 0 0 0

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

Press # Key

S E C
C r n t
5 A

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

Press # Key

WIrE
4
WIRE

Wiring System
(4 Wire / 3 Wire)

Press # Key

IdLE
Hr
0100

Idle current set point (0000 -9999)

Press # Key

d -Id
001

Device address (Range: 001 - 255)

Press # Key

b d r t
9600

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

Press # Key

P Ar
nonE

Parity set either we can select
(None / Odd / Even)

Press # Key

S b I t
1

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

Press # Key

F P G E
E n r G

Favourite page selection, Either we can select any one
as a first page VAF,Power & Energy

Press # Key

E n r G
K W h

User can select the Energy Integration either kWh or
Kvah

Press # Key

E r S t
d O n E

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

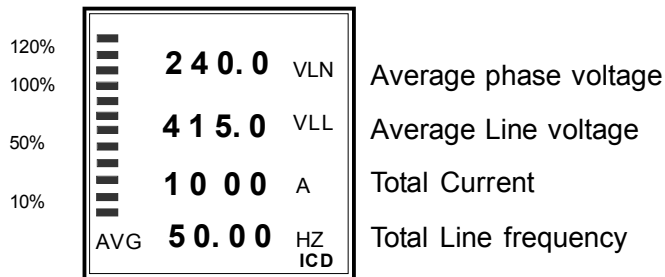
Again pressing Index (#) key repeats the same process in cyclic
manner. Press ▶ & ▲ keys (Shift & Increment) together for few sec-
onds to quit program mode & return to RUN mode.

6. RUN Mode display pages

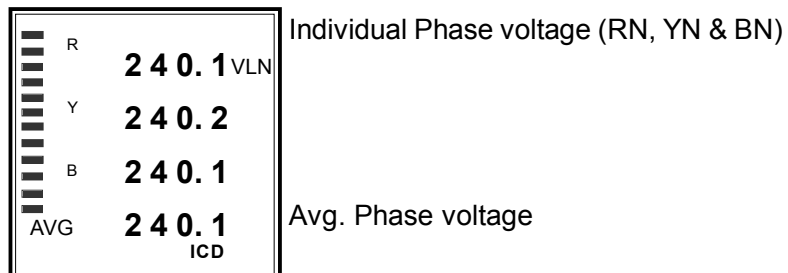
When power is applied to the Multi function meter the starting message consisting of Make, Year, model No & Version No and the run mode is selected automatically. In Run mode the power parameters are shown in different pages. These pages are accessed using the “Page UP & DOWN” keys provided on the front 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 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.

6.1 Voltage / Current page



Press More Key



Press More Key

█	R	415.1	
█	Y	415.1	
█	B	416.1	VLN
█	B	415.1	
█	R	415.1	
█	AVG	415.5	ICD

Individual Line voltage (RY, YB & BR)

Avg. Line voltage

Press More Key

█	R	1000	
█	Y	1000	
█	B	1000	A
█	AVG	1000	ICD

Individual Line current (R, Y & B) and Avg. Line current

Total Current

6.2 Power page

█	720.1	kVA	
█	460.1	kW	
█	640.2	kVAr	
█	0.501	PF	
SUM			ICD

Total kVA

Total kW

Total kVAr

Total PF

Press More Key

R	240.1	KVA
Y	240.2	
B	240.1	
SUM	720.3	ICD

Individual kVA (R, Y & B)

Total kVA

Press More Key

R	103.1	KW
Y	103.2	
B	103.1	
SUM	306.3	ICD

Individual kW (R, Y & B)

Total kW

Press More Key

R	213.1	KVAr
Y	213.2	
B	213.1	
SUM	640.2	ICD

Individual kVar (R, Y & B)

Total kVAr

Press More Key

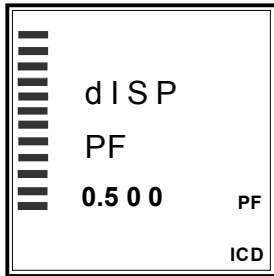
truE
PF
ICD

Auto Scroll

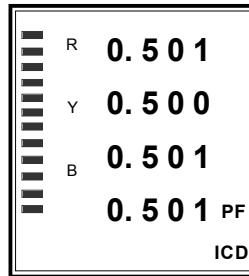
R	0.501	PF
Y	0.500	
B	0.501	
	0.501	ICD

Individual PF (R, Y & B)

Press Shift Key



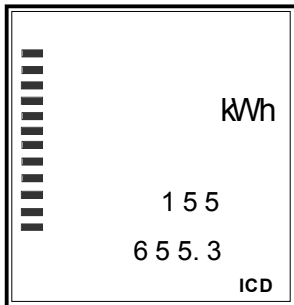
Press More Key



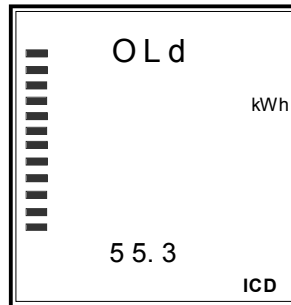
Individual PF (R, Y & B)

Displacement PF (with Harmonics)

6.3 Energy page



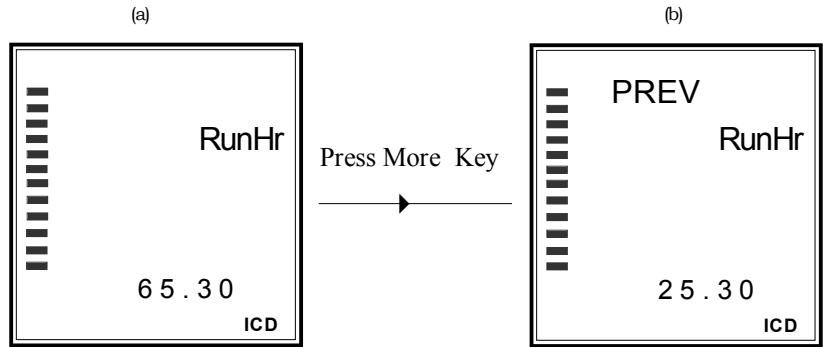
Press More Key



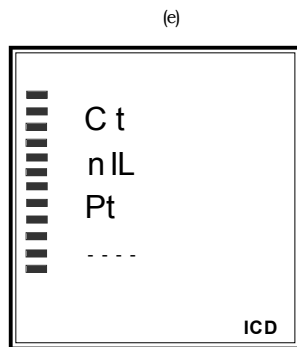
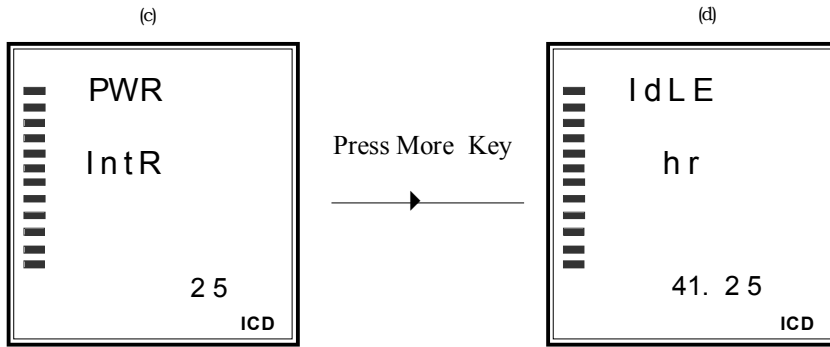
Total accumulated kWh / kVAh Energy

Old kWh /kVAh Energy (user can be select either KVAh / kWh)

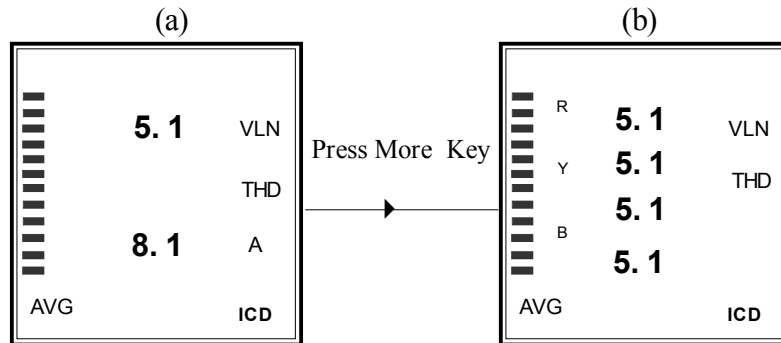
Press Shift Key



Press More Key

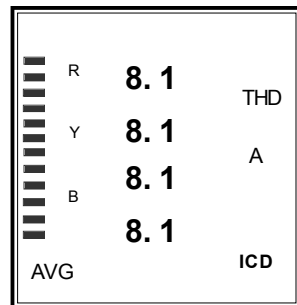


- a) Run Hour (RH)
- b) Previous Run Hour (RH)
- c) Power interrupt
- d) Idle hour
- e) CT reverse status & PT sequence.

6.4 THD Page

Press More Key

(c)



a) Total Harmonic Distortion for Voltage & Current

b) Individual Voltage THD

c) Individual Current THD

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).

Idle Hour :

Whenever average instant current is less than the set current of idel hour, the durations starts cummmulates continuously with 30 secs of initial time delay.

Power Interrupt:

It counts the No of PT interrupts occurred over that period. Whenever the PT voltage starts from zero, it gets counted. Both idle hour and power interrupt gets cleared during energy reset done through keypad in program mode.

7. Communication Port Details

The MFM 9013 is provided with a optically Isolated RS 485 communication Port, which is an optional Feature and has to be specified at the time of ordering. 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 & TCP/IP
Baud rate	:	9600
Data bit	:	8
Parity	:	None
Stop bit	:	1
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 top side for RJ45. Terminal details are (From Bottom to Top)



RJ45 Ethernet port

RJ45 Ethernet Port**Pin Details**

Pin No	Wire Colour (T568B)	10/100 Signal
1	White/Orange	Transmit +
2	Orange	Transmit -
3	White/Green	Receive +
4	Blue	Not used
5	White/Blue	Not used
6	Green	Receive -
7	White/Brown	Not used
8	Brown	Not used

The address of the parameters are as follows.

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	R Voltage THD	40039	0.1	0.1
21	Y Voltage THD	40040	0.1	0.1
22	B Voltage THD	40041	0.1	0.1
23	R Current THD	40042	0.1	0.1
24	Y Current THD	40043	0.1	0.1
25	B Current THD	40044	0.1	0.1
26	Idle Hour	40045&46		
27	No.Of Power Interrupts	40047	1	1
28	Total displacement PF	40048	0.001	0.001

INDIVIDUAL POWER PARAMETERS

No	Parameter	Address	Resolution	
			LT	HT
29	R - KVA	40061	0.1	1
30	Y - KVA	40062	0.1	1
31	B - KVA	40063	0.1	1
32	R - KW	40064	0.1	1
33	Y - KW	40065	0.1	1
34	B - KW	40066	0.1	1
35	R - KVAr	40067	0.1	1
36	Y - KVAr	40068	0.1	1
37	B - KVAr	40069	0.1	1
38	R - PF	40070	0.001	0.001
39	Y - PF	40071	0.001	0.001
40	B - PF	40072	0.001	0.001
41	R - displacement PF	40073	0.001	0.001
42	Y - displacement PF	40074	0.001	0.001
43	B - displacement PF	40075	0.001	0.001

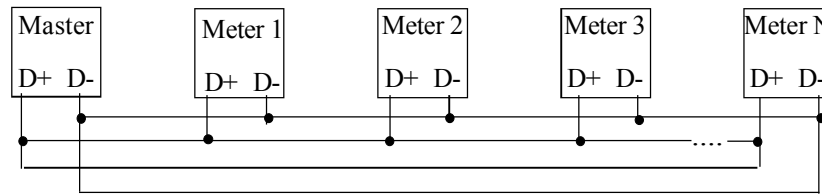
Note:

- 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 : 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

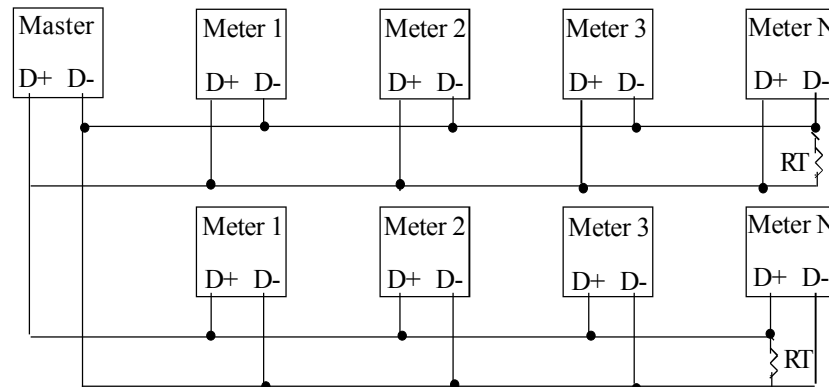
When connecting the meters in multidrop communication network, the following methods are to be adopted for trouble free communication.

1. Loop Topology



In this method, the communication continues 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 R_T (60 -100 Ω) of value equal to characteristic Impedance of the cable used may be required to avoid reflection losses.

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 9013 (Block led type)
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% to 120% 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" block led 7 segment red display
Programmable Parameters	: PT primary & secondary Voltage, CT Primary & secondary current, Device ID, Energy & Runhour power interrupts, Idle hour, displacement PF & 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.
Load percentage bar led indication	: Provided
Calibration pulse O/P	: Provided through IR LED in front panel
Meter Constant	: 3200imp/kWh

Phase Reverse led Indication: Provided showing minus sign in display.

Burden on Voltage I/P : 0.25VA per phase

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

PC Interface : 1)An optically isolated RS 485 O/P is available
with MODBUS-RTU protocol.

Auxiliary Supply : 90 - 270V AC/DC

Burden on Auxiliary I/P : 4 V A

Operating Temperature : 10°C to 55°C

Box Dimension : 96(W) x 96(H) x 62(D) mm

Cutout : 90 x 90 mm

Mounting : Panel

Enclosure : ABS Plastic case

II) RJ 45 output (Odering option)

Communication Output : Ethernet connectivity (RJ45).

Output data : Through RJ45 -USR IOT K6 output

Max distance of : 1.2 kms

Comm. for RTU

Baud Rate : 10 / 100 MBPS

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

Default Factory set IP address : 192.168.0.7

Type of Protocol : TCP/IP

Reset button : Provided in back side of the meter

III) Support Profibus (Odering option)

Transmission Rate(Kbps) : 1.2,2.4,4.8,9.6,19.2,38.4,57.6,115.2
 Transmission Rate Setting : Detected Automatically
 Maximum Input Data Length : 128 Bytes
 Maximum Output Data Length : 128 Bytes
 Address Setting : 1 - 126 set by keypad
 Network Isolation Protection : High Speed Coupler

IV) Wi-Fi Module(Odering option)

Network Protocol : Modbus - TCP
 Network Encryption : WEP64/WEP128/TKIP/AES
 Configuration : Through web serverwith any wi-fi device
 (laptop/mobile/Tab)can be added with
 Wi-fi network available
 Frequency range : 2.412 GHZ to 2.484 GHZ
 Wireless Standard : 802.11 b/g/n
 Transmit Power : 802.11b : +20 dbm (max)
 802.11g : +18 dbm (max)
 802.11n : +15 dbm (max)
 Receive Sensitivity : 802.11b : - 89 dbm (max)
 802.11g : - 81 dbm (max)
 802.11n : -71 dbm (max)

Parameter displayed : (Class 0.5)

Parameter	Range	Resolution	Accuracy
R, Y, B Voltage	50 - 280 V AC	0.1 V (LT)	±0.5%±2Least digit
	25 - 80 V AC	0.01kV (HT)	±0.5%±2Least digit
RY, YB, BR Voltage	90 - 485 V AC	0.1 V (LT)	±0.5%±2Least digit
	40 - 140 V AC	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, kVA _r (LT) 3 Phase & total	0 -1000 kVA / kVA _r	0.1kVA/kVA _r	±0.5%±2Least digit
	>1000 kVA / kVA _r	1 kVA / kVA _r	
kVA, kVA _r (HT) 3 Phase & total	0 -10000 kVA / kVA _r	1kVA/kVA _r	±0.5%±2Least digit
	>10000 kVA / kVA _r	0.01 MVA/MVA _r	
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 ·	9999999.9 kWh/kVAh	0.1 (LT)	Class 0.5 as per IS 14697 (±0.5%)
	9999999.9 kWh/kVAh	0.1 (HT)	
Run Hour	9999.59 Hours Max.	1 Minute	± 1 sec/day

Parameter displayed : (Class 1.0)

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
	0 - 100 A AC	0.1 A (LT & HT)	±1%+2Least digit
Current	> 100 A - primary current (CT) set	1 A (LT & HT)	
kVA/kW/kVAr(LT)	0-1000 kVA/kW/kVAr	0.1kVA/kW / kVAr	±1.0%+2Least digit
3 Phase & total	>1000 kVA/kW/kVAr	1 kVA/kW / kVAr	±1%+2Least digit
kVA/kW/kVAr(HT)	0-10000kVA/kW/kVAr	1kVA/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	45.00 - 55.00 Hz	0.01Hz(LT & HT)	±0.2%+2Least digit
kWh / kVAh	9999999.9 kWh (or) kVAh	0.1 (LT/HT)	Class 1.0 as per IS 13779 (±1.0%)
Run Hour idle hour	9999.59 Hours Max.	1 Minute	± 3 sec/day