DMM Datalogger Manual

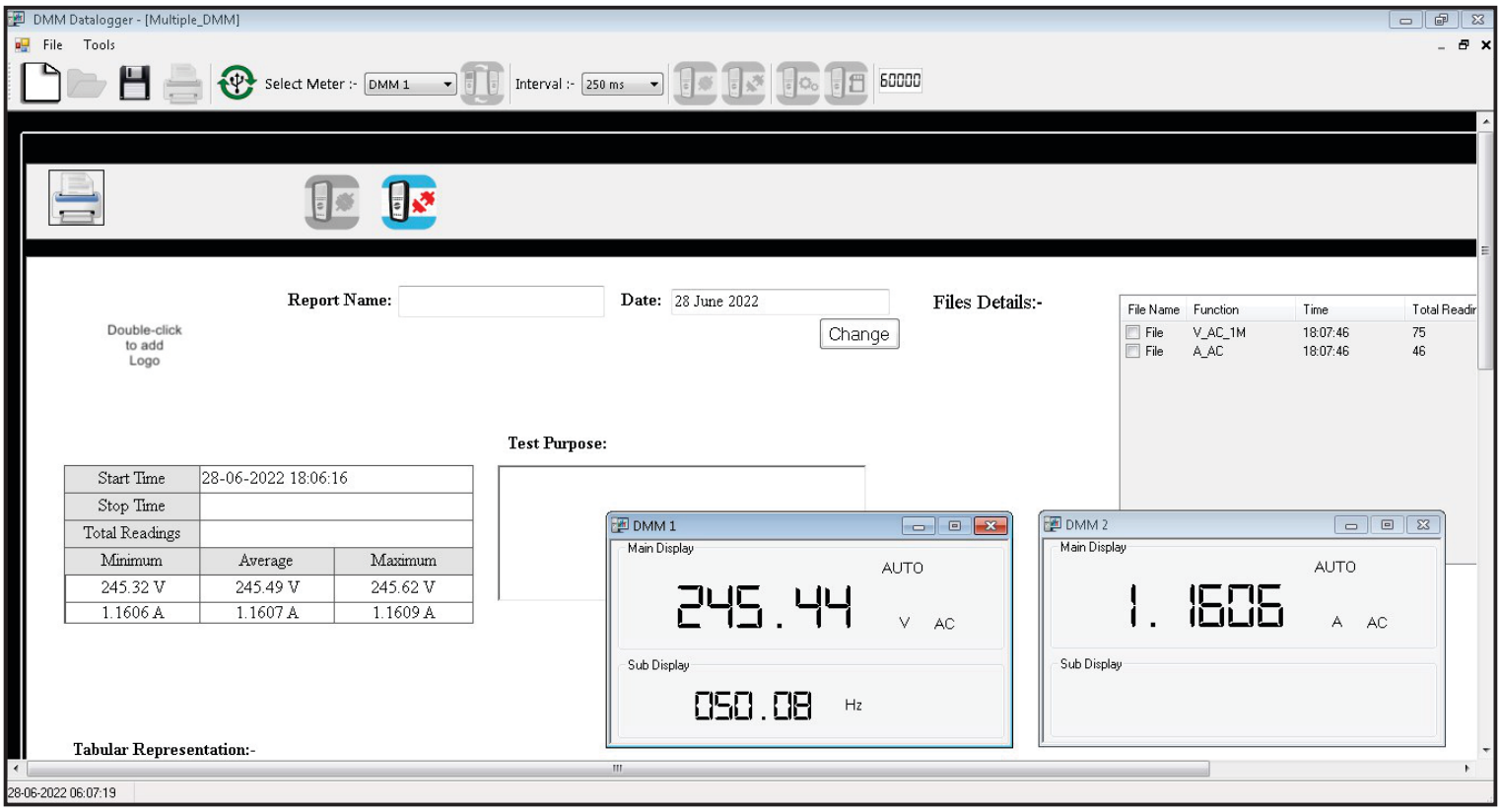


Table of Contents

List of Figures

1. Specification, Installation of Software, Starting Program, Closing Program & Uninstalling the Software

1.1 Specification

DMM Datalogger is a measurement data logging program for recording, visualizing, evaluating and documenting measured values with reference to time for Digital Multimeters. It can also be used to configure the parameters of multimeter.
As a rule, the PC and the measuring instrument communicate via a virtual COM port being assigned to an USB interface.

- Number of instruments supported: up to 4
- Start recording: Automatically or scheduled
- Stop recording: scheduled or Disconnect button Clicked or Communication Error Occurred

1.2 Installation of Software

Refer Software Installation Manual

1.3 Starting Program

In order to start the program:

- Double click the DMM Datalogger.exe icon on the Windows desktop.

or

- Select the program from the Windows start menu:

Start : Programs : DMM Datalogger : DMM Datalogger.exe
The program is started.

1.4 Closing Program

In order to close the program:

- Click on File Menu then on Exit

or

- Simultaneously press the Alt+F4keys.

or

- Click the Close icon at the upper right-hand corner of the title bar.

The program is closed.

1.5 Uninstalling the Software

If desired, the program can be uninstalled by selecting
Window XP: Control Panel : Add or Remove Program : DMM Datalogger : Remove
or
Window 7: Control Panel : Uninstall Program : DMM Datalogger : Uninstall

2. Basic Structure of Software

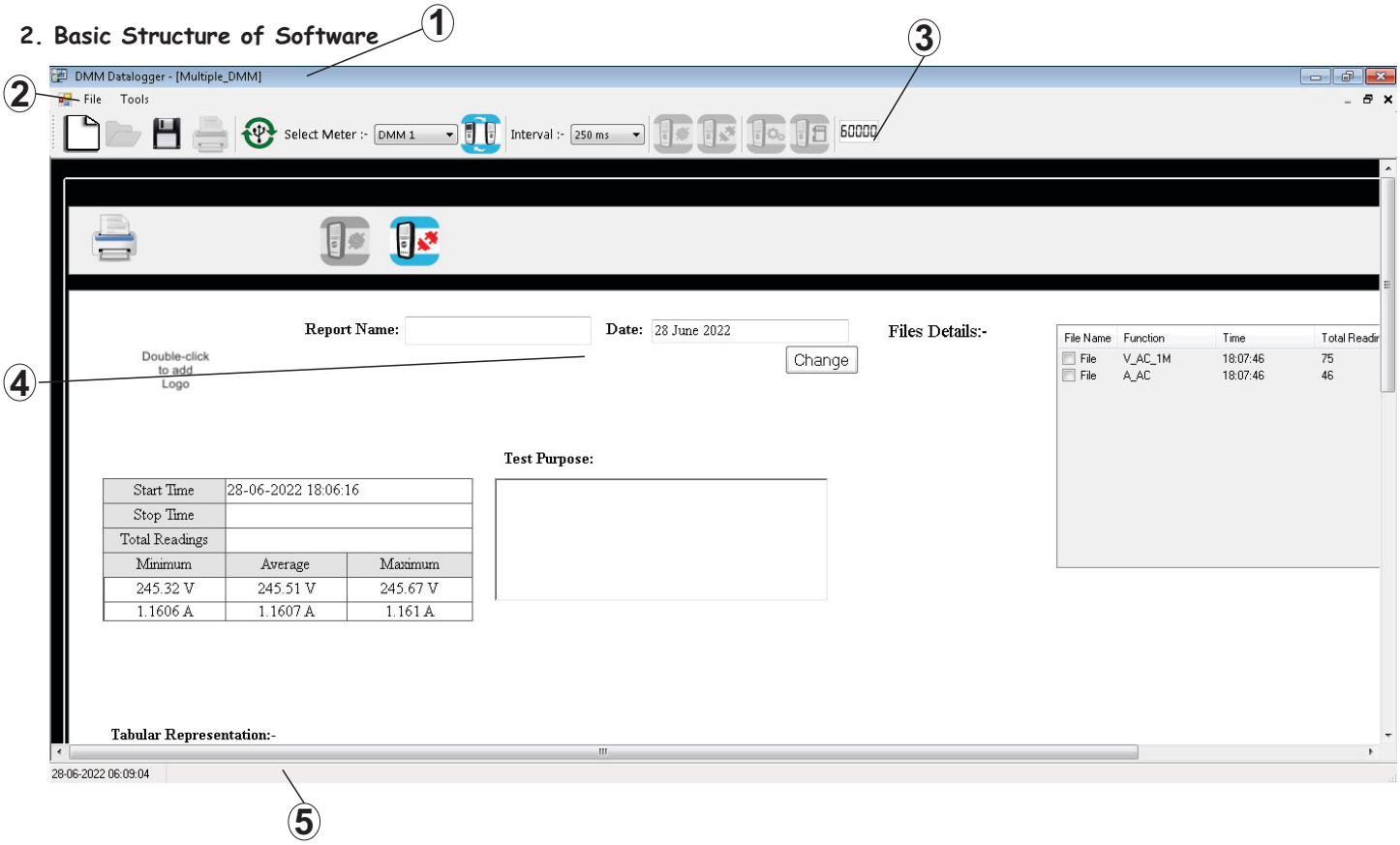


Fig 01. Software Structure

1. Title Bar
The horizontal bar at the top of the program window displays the program name, and the buttons to the right for minimizing, maximizing and closing the program window.

2. Menu Bar
The menu bar includes the names of the main menus from which the various menu functions and submenus can be accessed.

3. Tool Bar
The smart icons in the tool bar allow for quick access to frequently used commands and functions. The function of any given icon can be displayed by moving the mouse pointer to it, and is executed by clicking the icon.

4. Work Area
Measurement data are displayed in various views for analysis and processing in this main field, and various dialog boxes are opened here as well.

5. Info Bar
System Date and Time is shown.

3. Context Menu

A context menu appears after clicking the right mouse button with the mouse pointer in the work area. Just like the tool bar, it allows for quick access to frequently used functions.

3.1 Form Context

Fig 02. Form Right Click Menu

3.1.1 Save to

This option is used to save the form in Excel format.

3.1.1.1 Excel

The file is generated in .xls format. In Excel, graph is not generated.

3.1.2 Print

Print is used to print the current form. Here graph is generated.

3.2 Graph Context

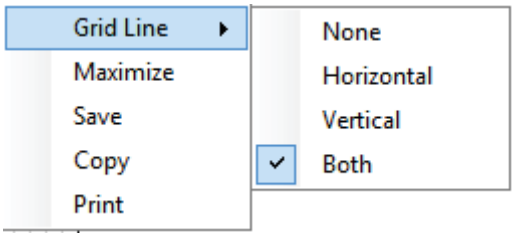


Fig 03. Graph Context Menu

3.2.1Grid Line

A grid consisting of lines or dots can be displayed in graph area.

3.2.1.1 None

In viewing area of graph, there will be no grid line

3.2.1.2 Horizontal

In viewing area of graph, there will be Horizontal grid line

3.2.1.3 Vertical

In viewing area of graph, there will be Vertical grid line

3.2.1.4 Both

In viewing area of graph, there will be both Horizontal and vertical grid line

3.2.2 Maximize

Maximize will open a form where enlarged version of graph can be seen. Maximize graph cannot be seen in XY recorder.

3.2.3 Save

Save option is used to save the graph on following standard image format

- *.jpg
- *.bmp
- *.tif
- *.gif
- *.emf
- *.png

Default Save Format is *.jpg

3.2.4 Copy

Copy option is used to the copy the graph image and can directly paste in paint or any other desired file. It works similar to *Print scrn*. Only *Print scrn* of graph is taken.

3.2.5 Print

Print is used to print the current form.

3.3 File Detail Context

File Detail Context is active in the form only when meter is disconnected or saved or offline data is read.

Fig 04. File Detail Context Menu

3.3.1 Delete Selected

Here, you can delete file from the form which is not necessary.

3.3.2 Delete All

It will delete all the file which are in file detail table.

3.3.3 Save Selected

It will save the selected file into desire location which has been provided.

4. Tool Bar

Fig 05. Tool Bar Item

New Form: This is used to open new form. The following form can be opened using this icon:

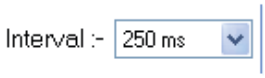
- DMM Analysis
  This Form is used to log data of one or more meter and meter can be added in this form dynamically
- X-Y Recorder
  This Form is used to log data using 2 meter and reading are log in respective axis

Open Menu: This is used to open the save data. While viewing saved file, you can log data by using new form button

Save: This is used to save all the file in file detail table.

Scan: This is used to scan the meter. Drop Down Box shows detected meters.

Test: This is used to test the communication whether it is working or not. This can be used to identify meter also. In this case meter backlit will momentarily on & off.



Interval: This is used to as reference time to store the sample in table and update the graph.

Connect: This is used to start the communication when meter is disconnected or communication error occurs.

Disconnect: This is used to disconnect the communication between PC and Multimeter.

Setting: This is used to set the settable parameter in Multimeter. Parameter from meter can be read and then set again.

Memory: This is used to read the already logged data in memory of multimeter.

Virtual Display: This is used to re-create multimeter display on PC/system.

5. New Form DMM Analysis

5.1 DMM Analysis

This Form can be opened by clicking on New Form Icon and then selecting the DMM Analysis option. This Form is used to log data of one or more meter and meter can be added in this form dynamically. Dynamically means that at any time instant meter can be added into this form by pressing on scan button.

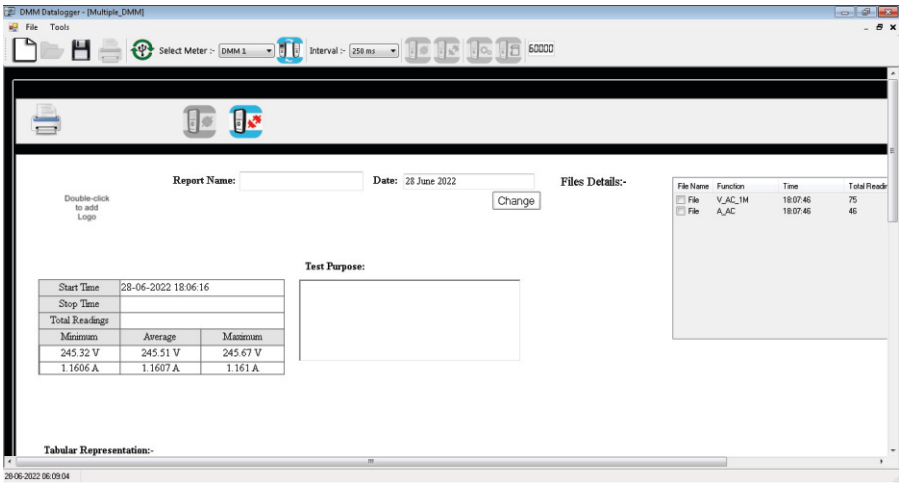


Fig 6.a DMM Analysis Basic Look

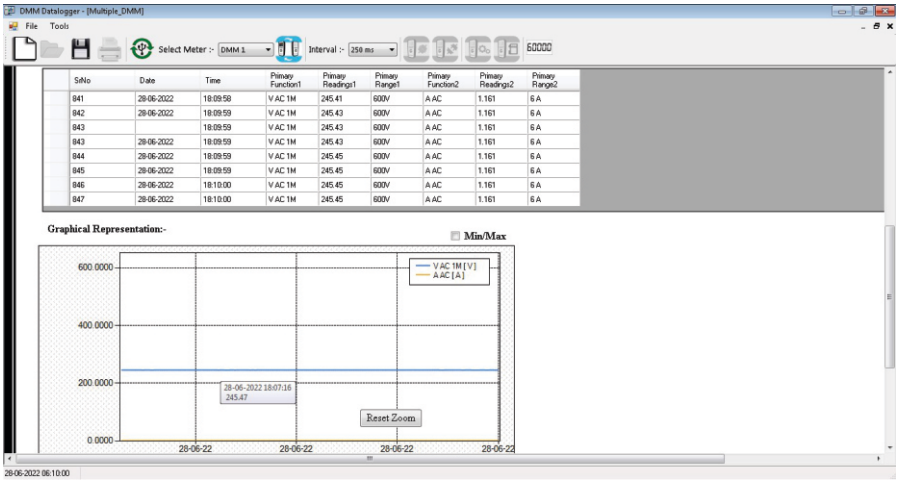


Fig 6.b DMM Analysis with Table and Graph

The Table representation log data is as follows:
SrNo **:** Serial Number of each Entry
Date **:** The Date at which meter send the frame (information)
Time **:** The Time at which meter send the frame (information)
Date and Time are taken from meter
Primary Function **1 :** Function which is selected in Meter no 1 (knob position). The Detail is explained in Section 10.6 Online Communication start query response (Function Code & Function Counter)
Primary Readings **1 :** Main Display Reading of Meter no 1
Primary Range **1 :** Current Range of the Readings for Meter no 1. The Detail is explained in Section 10.6 Online Communication start query response (Range)
Secondary Function **1 :** This function is related to sub display function in Meter no 1 and is updated according to it
Secondary Readings **1 :** Sub Display Reading of Meter no 1
Secondary Range **1 :** Current Range of the Readings for Meter no 1. The Detail is explained in Section 10.6 Online Communication start query response (Range)

Similarly Primary Function, Primary Readings, Primary Range, Secondary Function, Secondary Readings and Secondary Range are shown for Meters 2, 3 and 4.

5.2 X-Y Recorder

The X-Y Recorder is used to analyze two different meter in X-Plane & Y-Plane instead with respect to time. Any desired channel (meter) is assigned to the X abscissa, and other channel to Y abscissa. The X-Y Recorder consider only to channel for its recording.

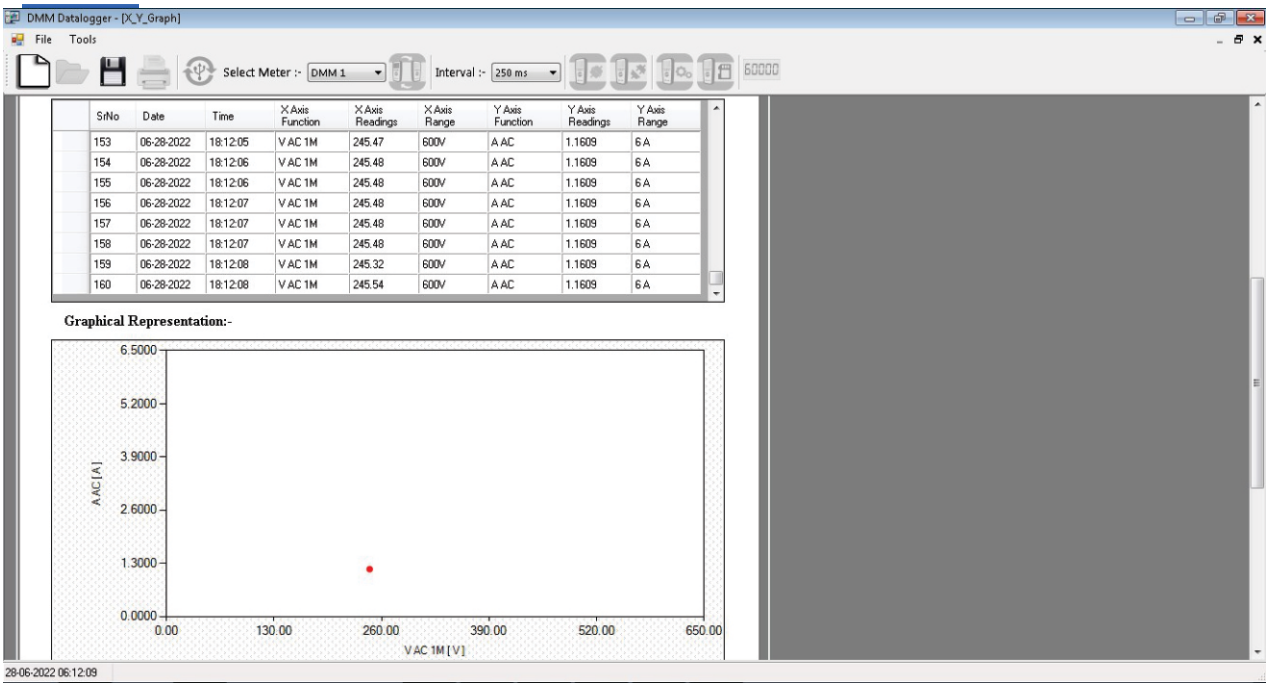


Fig 8. X-Y Recorder

When Software scan the 3 meter or more meter, then software ask for which meter should be considered for X abscissa & Y abscissa.

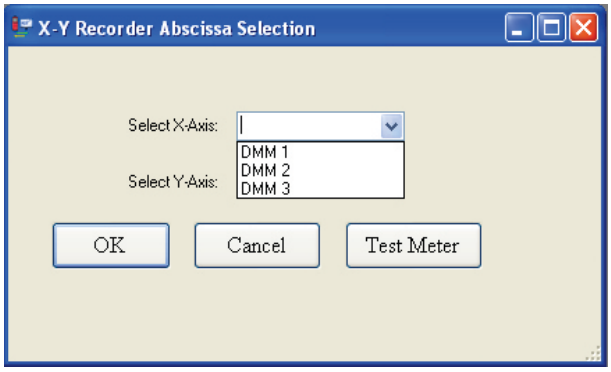


Fig 9.a Meter Selection

Fig 9.b Selected Meter for X-Y Recorder

Note: During X-Y Recorder, Prefer to use only "Two" Meter.

6. Virtual Display, Save & Open

6.1 Virtual Display

This is used to re-create multimeter display on PC/system.

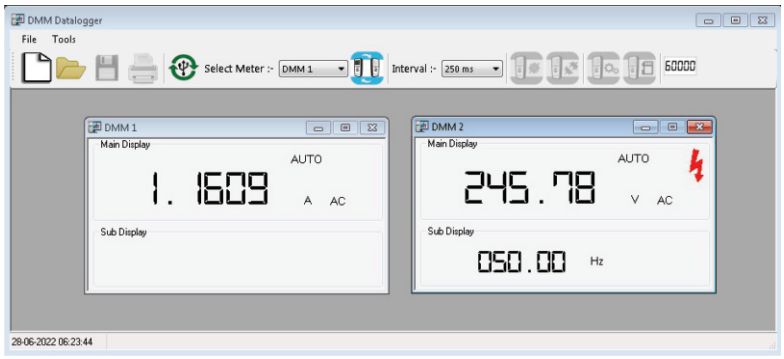


Fig 10. Virtual Display

6.2 Save

This is used to save all the file in File detail Table of DMM Analysis, X-Y Recorder and Offline Memory read.
The file saved using this button or ***Section 3.3.3*** option are not in excel or pdf format but in ***'.xml'*** format. Currently in Xml Format only data from the tabular representation are saved.

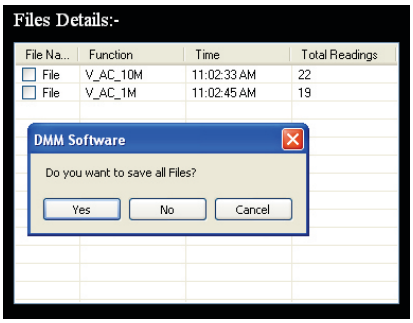


Fig 11.a File Save

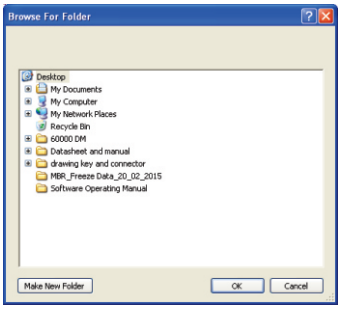


Fig 11.b Save Location

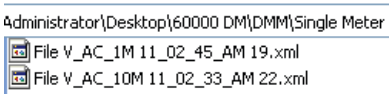


Fig 11.c File at Desire Location

Note: ***Prefer Section 3.1*** *to save in pdf or excel*

Suppose that Selected Folder is D:\XYZ\, in that folder software will create a ***"DMM"*** and then for respective Analysis sub folder created. Single DMM Analysis: ***D:\XYZ\DMM\Single Meter*** Multiple DMM Analysis: ***D:\XYZ\DMM\Multiple Meter***
X-Y Recorder: ***D:\XYZ\DMM\X_Y_Recorder*** Memory Data: ***D:\XYZ\DMM\Memory Data***

6.3 Open

This is used to open the save data. This Open menu is to open saved ****.xml*** file. The Step is as follows:

- Click on Open
- Goto file which is required to be reviewed

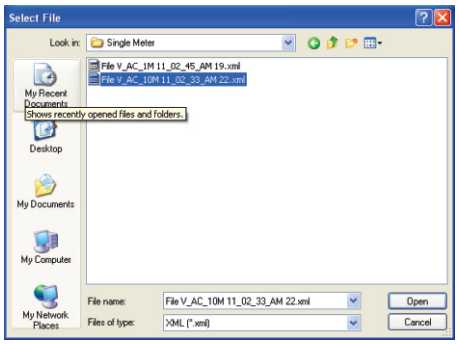


Fig 12. Open Saved File

- Click on open.

7. Tool Menu

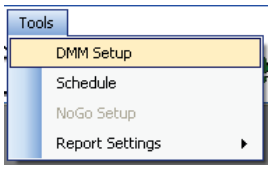


Fig 13. Tool Menu

7.1 DMM Setup

This is used to set the settable parameter in Multimeter. Parameter from meter can be read and them set again.

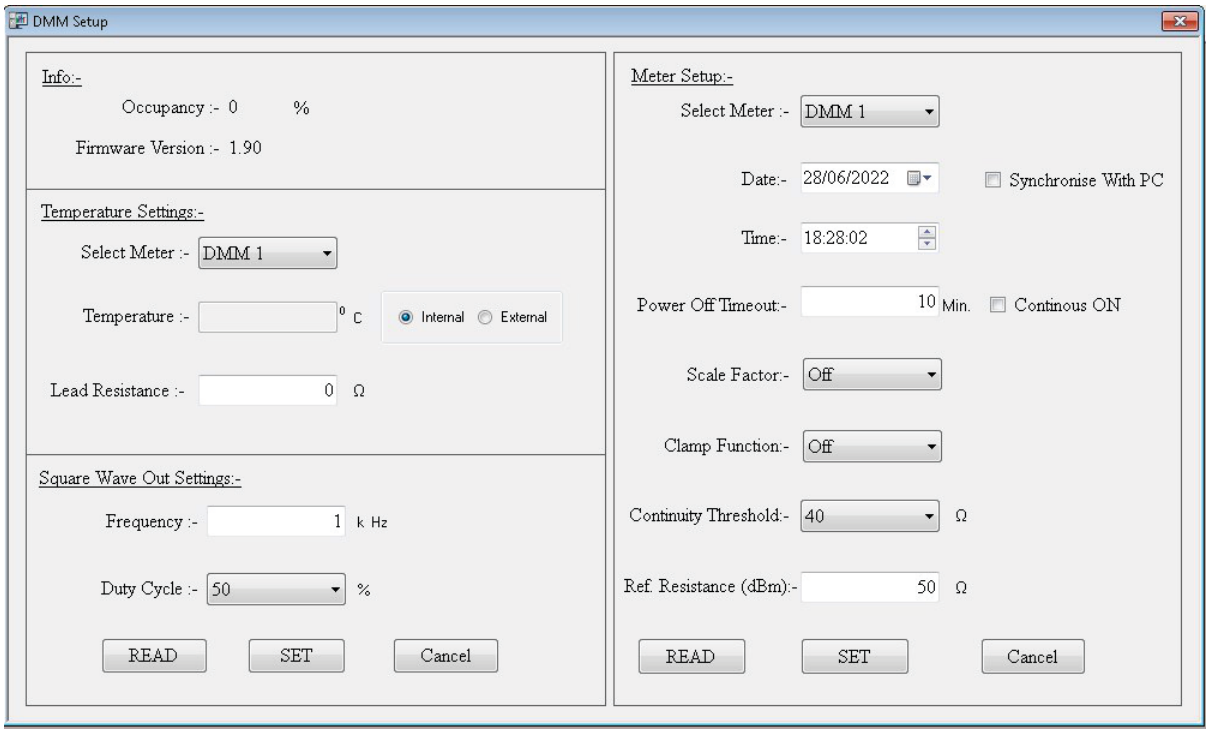


Fig 14. Setup Parameter

READ Button: Used to read the settable parameter from the meter.
SET Button: Used to the set the unmodified, modified parameter
Cancel Button: Used to close the form

Note: Two Read / Set Button are used to read / set parameter part-wise.

7.2 Report Setting

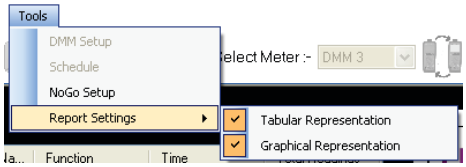


Fig 15. Report Setting

Report Setting is used to decide how the form look-like, how pdf and print will result in.

7.2.1 Tabular Representation

Removing the Tick will result in, no table will be shown in form, pdf and print.

7.2.2 Graphical Representation

Removing the Tick will result in, no graph will be shown in form, pdf and print.

7.3 Schedule

Schedule can be used to start the data-log at specific time or stop at specific time or start and stop at specific interval of time.

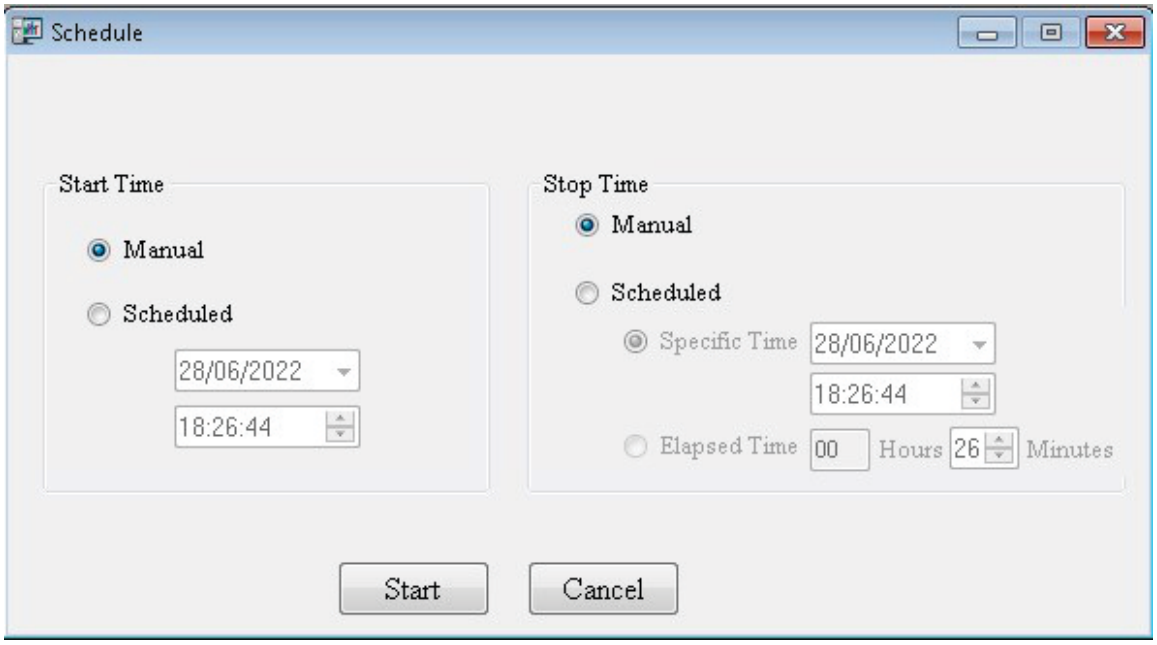


Fig 16. Schedule

By clicking on start button, schedule will be enabled.
By clicking on cancel button, schedule form will be closed.
In ideal case when schedule is not enabled, then software is in manual start time and manual stop time.

7.4 NoGo Setup

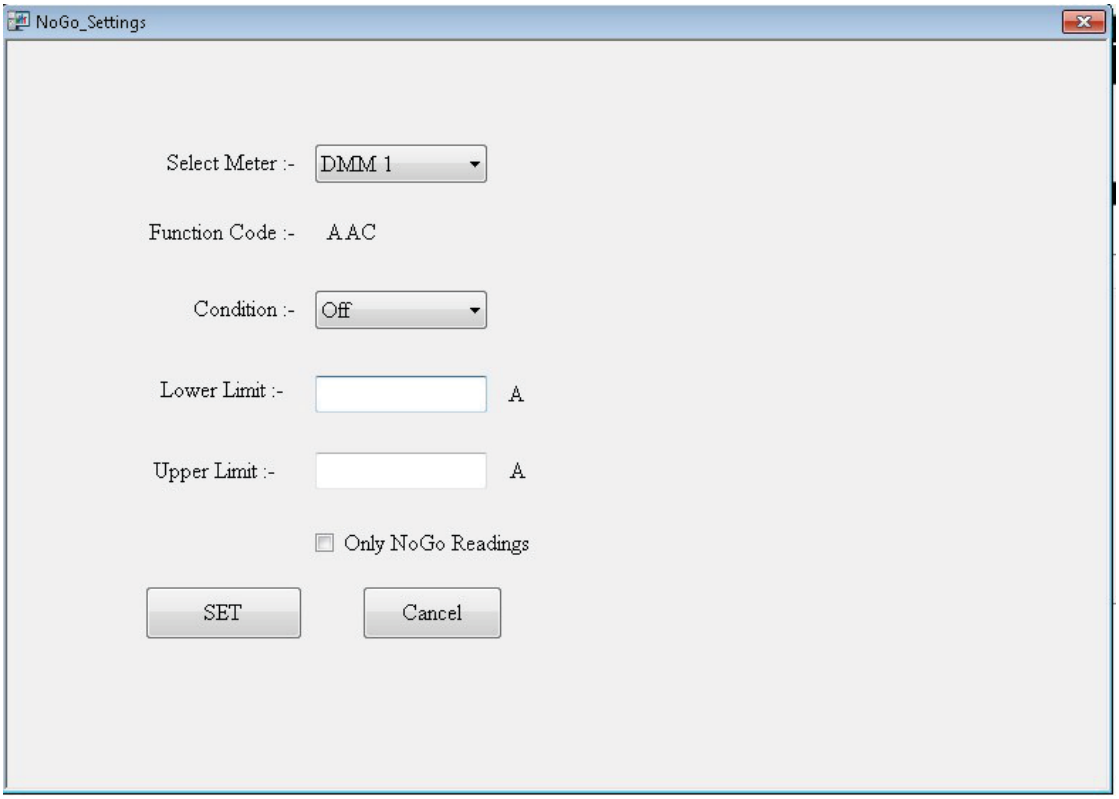


Fig 17. NoGo Setup Form

GO NO-GO feature for all measuring functions. This is very useful feature which gives changes in background color, if the measured value is outside the NO-GO band or inside the NO-GO band or Below the limit or Above the limit. All conditions are settable. Limits or band for GO NO-GO are also settable. Its very useful feature to give pass or fail signal in case of measurement is not in the desired band.

Note: NoGo of Software and of meter are independent.
NoGo Setup is Enbled only when Datalogging is ON

7.4.1 NoGo Conditions

7.4.1.1 Off

If this condition is selected and then clicked in *SET*, then NoGo Function is turned off.

7.4.1.2 Both

When primary reading of form is lower than the *Lower Limit* or higher than the *Upper Limit* then the color of reading is changed that mean either of the event has occured.

7.4.1.3 OverFlow

When primary reading of form is higher than *Upper Limit* then the color of the reading changed. It means Overflow occurs.

7.4.1.4 UnderFlow

When primary reading of form is lower than *Lower Limit* then the color of the reading changed. It means Underflow occurs.

7.4.1.5 In-between

When primary reading of form is higher than the *Lower Limit* and also lower than the *Upper Limit* then the color of reading is changed. It means In-between event occurs.

7.4.2 Only NoGo Readings

When this is checked, it means reading should be logged in table and in graph only NoGo condition satisfied. Unchecking means log all the reading that are sent from the multimeter.

Note: NoGo Limit: Upper Limit > Lower Limit.

7.4.3 SET

It will be set the specified NoGo condition when all the basic information is provided.

7.4.4 Cancel

It will close the form.

8. Form Logo Change & Graph

8.1 Form Logo Change

To set new logo or to change current logo to desired logo, following procedure to be followed

* Double click on the logo or default logo location

Fig 18. Default logo location

* Select desired logo

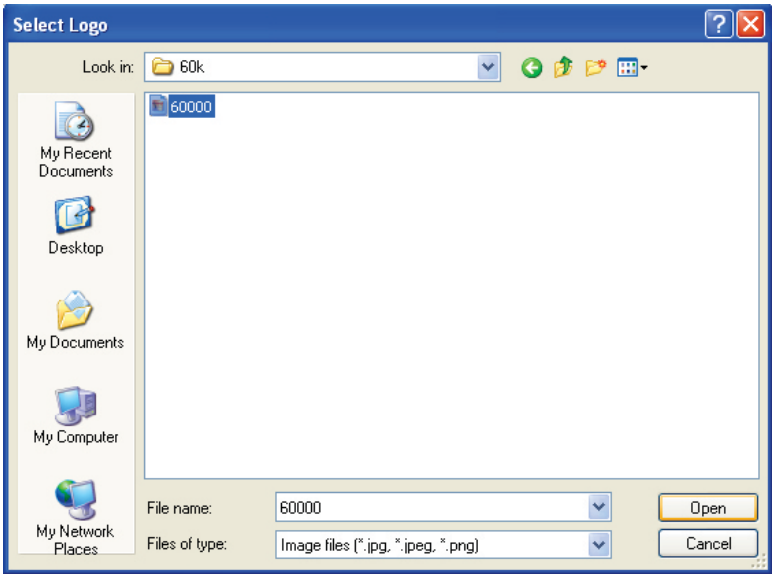


Fig 19. Select Desire logo Location

* Click on open to select new logo.
* New logo has been set as default logo.

8.2 Graph (Graphical Representation)

While data is logging in the form, to reduce system usage, graphical representation of the data will be showing only latest 2000 reading for DMM Analysis and 5000 reading for X-Y recorder.
When already logged data viewing is going on then all the reading which has been logged will be represented in graph.

Note: Maximize Graph Option: When Graph is maximized, new logged reading will not be updated but in normal size graph reading update will go on.

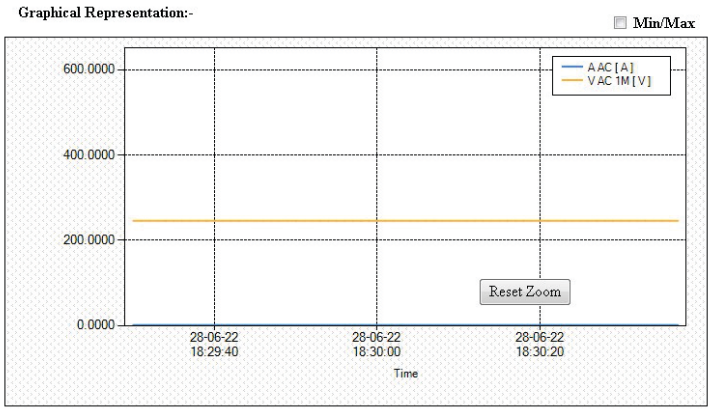


Fig 20. Graph Outlook

8.2.1 Select Color

This is used to change the graph reading representation color. Default Color is Blue
Note: Select color option not available in DMM Analysis

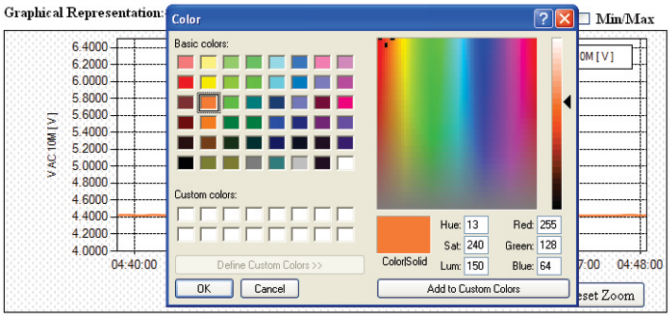


Fig 21. Color Palette

8.2.2 Zoom

With the help off the zoom function, the horizontal and vertical axis can be expanded in the graphic view, in order to recognize details or to gain an overview of particular area.

8.2.3 Reset Zoom

This is used to reset the zoom scale. The scale of the axis is returned to its previous (default) setting.

8.2.4 Min/Max

When Min/Max is checked then in graph information you will also able to view minimum, maximum, and average value of the log data.

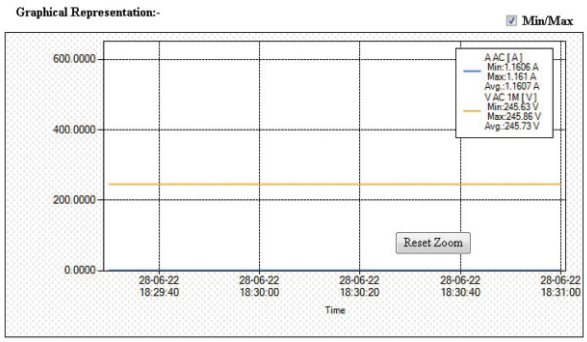


Fig 22. Min/Max/Avg Readings in Graph

9. Memory Offline Data

This is used to read the already logged data in memory of multimeter. The procedure to read data is as follows:

* Click on memory button.
* After clicking, it will read file detail.
* It takes approx. 17 sec to read complete file detail and show the screen.

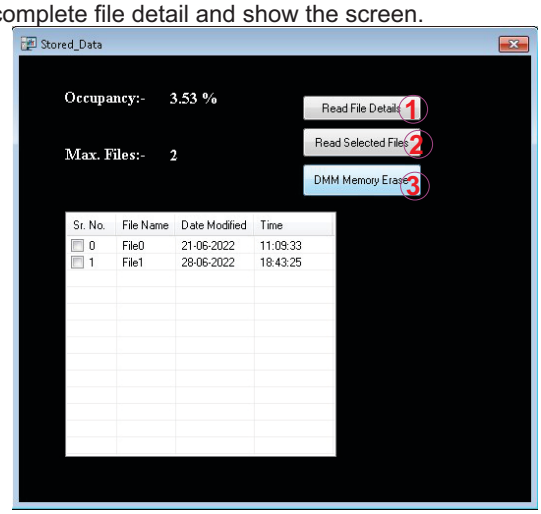


Fig 23. Memory File Detail Screen

- 1.Read File Detail : Will again read the file details from the meter.
- 2.Read Selected Files : Will read the file data which has been selected in the list. In above picture, File 1 selected.
- 3.DMM Memory Erase : Will the erase memory from the meter.

* After clicking on Read Selected File, following screen will be shown after reading data from the meter completes.

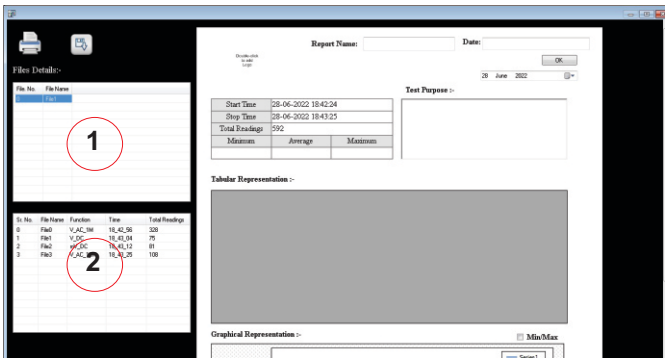


Fig 24. Memory Display Screen

* After Clicking on File 1 at①, it will generate sub file at position②, and then single click on any sub-File, will show the data contain in it.

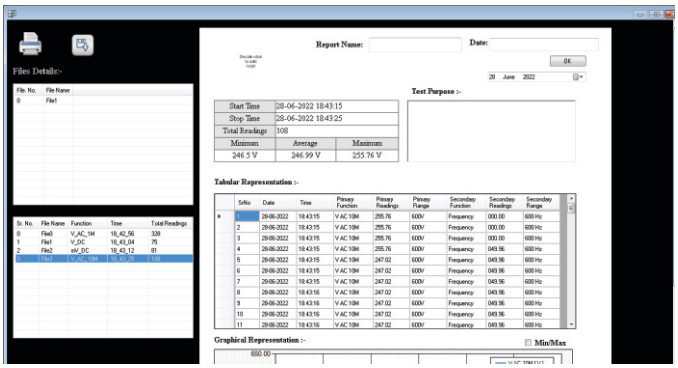


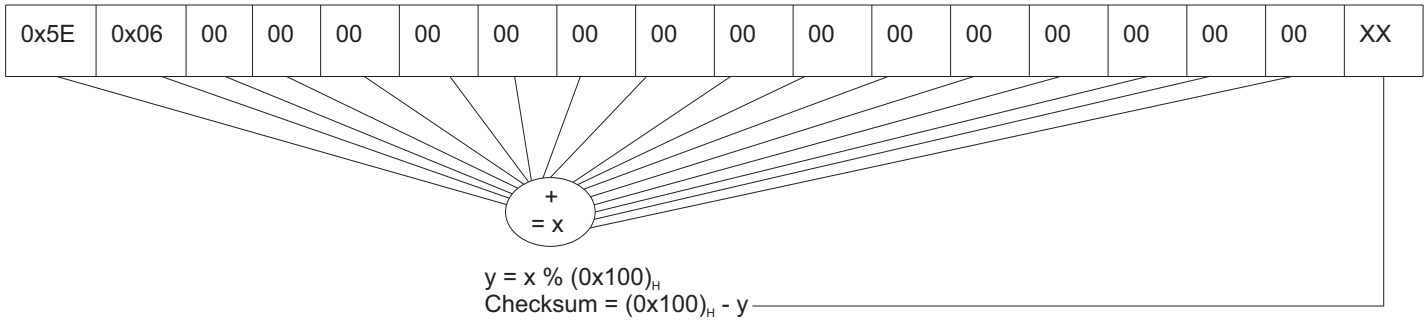
Fig. 25 Memory Data Display Screen

10. Tool for Automation, Protocol

10.1 Introduction

Note: All the value are in Hexadecimal Format ( )$_H$

In Protocol, the frame length is of not same length, for offline Memory Communication Response is of 16 bytes and others 18 bytes.
1st Byte: is always Start of frame
Query From system contains : $(0x5E)_H$
Response from meter : $(0x24)_H$ or $(0x40)_H$
18th Byte: is always Checksum. Formula for Checksum:



In case of checksum greater than $(0xFF)_H$, then checksum value = $(0x00)_H$
In case of total 16 Byte frame i.e. offline memory response, checksum is not included.

10.2 Query for Scan

Since Software start the communication then meter send information, it is necessary to find the total number meter connected to the USB.
To identify meter model number,
Meter Identification Query :

0x5E	0x06	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start of Frame	Meter Model Information	Don't Care or Dummy Byte														CC

-18 byte frame Length
- CC stands for checksum
- XX not a fixed value

Response from meter (When data is correctly received at meter)

0x40	0x23	0x0D	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start of frame	Special Character	Model Number	Dummy Byte														CC

-18 byte frame Length
- Model Number Varies
$(0x0C)_H$ - Model 6012
$(0x0D)_H$ - Model 6013
$(0x0F)_H$ - Model 6015
$(0x10)_H$ - Model 6016
- CC stands for checksum
- XX not a fixed value

Response from meter (When query is not correctly received at meter) (Stated: ***Checksum Error Frame***)

0x24	0x23	0x0D	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start of Frame	Special '#'	Model Number	Dummy Byte														CC

-18 byte frame Length
- CC stands for checksum
- XX not a fixed value

10.3 Setup Parameter Read Frame Format

The parameter like memory space(occupancy), Firmware Version, Temperature, Square Wave Output, Meter Date, Meter Time, Standard clamp ratio, Percentage scale function, beep level, dB reference resistor and others are read using '3' different Frames.
Setup parameter Query:

0x5E	0x03	XY	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	XX
Start Frame	Setup Parameter	Query	Dummy Byte														Checksum

-18 byte frame Length
- XX not a fixed value
- XY Data is as follows:
1. $(0x01)_H$ - First set of Parameter query
2. $(0x02)_H$ - Second set of Parameter query
3. $(0x03)_H$ - Third set of Parameter query

After query of $(0x01)_H$ is send then wait for response, it takes maximum of 0.5sec to provide response. After receiving response send frame containing $(0x02)_H$ and so on.

Response for XY = $(0x01)_H$ Query:

0x40	0x01	L1	T1	T2	T3	T4	F1	F2	F3	D1	XX	XX	XX	XX	XX	XX	XX
Start Frame	First Query	Lead Resistance	Thermocouple Temperature Detail				Square Wave Out Frequency			SquareWave Out Duty Cycle	Dummy Byte						Checksum

-18 byte frame Length
- XX not a fixed value
-Lead Resistance
Eg: L1 = $(0x0A)_H$ = $(10)_D$
Lead Resistance = 10Ω (for: Lead Resistance - RTD Probe Resistance and Square Wave Out Duty Cycle, convert Hexadecimal Value to Decimal Value for End Result (Data))
- Thermocouple Temperature Detail
T1 - Internal or External Reference Temperature
Data $(0x00)_H$ - External Reference Temperature
Date $(0x01)_H$ - Internal Reference Temperature
T2 - Positive or Negative Temperature Value
Data $(0x00)_H$ - Positive Sign '+'
Date $(0x01)_H$ - Negative Sign '-'
T3 & T4 - Temperature Data
Temperature Data = T3.T4
Eg: T1 = $(0x01)_H$, T2 = $(0x01)_H$, T3 = $(0x17)_H$, T4 = $(0x00)_H$
Temperature = Internal - $(0x17)_H$.$(0x00)_H$
Decimal Equivalent = Internal -$(23)_D$.$(0)_D$ =>-23.0 Degree Centigrade
- Square Wave out Frequency
Frequency = $((F3 * (2710)_H) + (F2 * (0x64)_H) + F1) /(0x64)_H$
Eg: F1 = $(0x00)_H$, F2 = $(0x5B)_H$, F3 = $(0x00)_H$
F4 = $((0x00)_H * (2710)_H) + ((0x5B)_H * (0x64)_H) + (0x00)_H$ => $(0x238C)_H$ => $(9100)_D$
Frequency = F4 / $(0x64)_H$ => $(91.00)_D$ KHz

Response for XY = $(0x02)_H$ Query:

0x40	0x02	hh	MM	ss	dd	mm	yy	S1	C1	R1	R2	R3	A1	A2	XX	XX	XX
Start Frame	2nd Query	Hour	Minute	Second	Date	Month	Year	%age Scale	Continuity Threshold	Reference Resistor (dbm)			Auto Power OFF		Clamp Ratio	Dummy Byte	Checksum

-18 byte frame Length
- XX not a fixed value
- %age Scale (S1)
S1 $(0x00)_H$ - No Percentage Scale is selected
S1 $(0x01)_H$ - 0-20mA Percentage Scale Selected
S1 $(0x02)_H$ - 4-20mA Percentage Scale Selected
- Reference Resistor (dbm)
Reference Resistor = $(R3 * (2710)_H) + (R2 * (0x64)_H) + R1$
Eg: R1 = $(0x63)_H$, R2 = $(0x09)_H$, R3 = $(0x00)_H$
Reference Resistor = $((0x00)_H * (2710)_H) + ((0x09)_H * (0x64)_H) + (0x63)_H$ => $(0x3E7)_H$ => $(999)_D$
-Auto Power OFF
A1 - Continuous On or Auto Power Off
Data $(0x00)_H$ - Continuous On
Data $(0x01)_H$ - Auto Power off Enable
A2 - Power off Timer Value
-Hour, Minute, Second, Date, Month & Year
Hour value is in 24-Hour Format
Eg: hh = $(0x17)_H$, MM = $(0x30)_H$, ss = $(0x48)_H$, dd = $(0x28)_H$, mm = $(0x06)_H$, yy = $(0x15)_H$
Time => 17:30:48
Date => 28/06/15
-Continuity Threshold = $(C1)_H$ => $(XX)_D$
Eg: C1 = $(0x28)_H$ => $(40)_D$ = > Continuity Threshold = $(40)_D$

-Clamp Ratio (CR)
CR $(0x00)_H$ - Normal Function
CR $(0x10)_H$ - 1:1 Clamp Ratio is Selected
CR $(0x20)_H$ - 1:10 Clamp Ratio is Selected
CR $(0x30)_H$ - 1:100 Clamp Ratio is Selected
CR $(0x40)_H$ - 1:1000 Clamp Ratio is Selected

Response for XY = $(0x03)_H$ Query

0x40	0x03	XX	XX	M1	M2	V1	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
Start Frame	3rd Query	Don't Care		Memory Space in %		Ver	Dummy Byte										Checksum

-18 byte frame Length
- XX not a fixed value
- Memory Space in %age (Occupancy)
Occupancy = $((M1 * (0x64)_H)+M2)/(0x64)_H$
-Ver (Firmware Version)
Ver =$((V1)_H * (0x0A)_H)/(0x64)_H$ = > $(XX)_D$
Eg: V1 = $(0x25)_H$, Ver =$((0x25)_H * (0x0A)_H)/(0x64)_H$ = > $(3.70)_D$

10.4 Meter Test Query

Test query is used to test whether Communication between PC and meter is broken or not. For this query, Meter Backlit will on-off momentarily (appx. 1Sec)

Query: (18 Byte Frame Length)

0x5E	0x05	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start Frame	Test	Dummy Byte															Checksum

Response: (18 Byte Frame Length)
Wait for maximum 1.5sec for response

0x40	0x23	0x0D	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Special Character	Model Number	Dummy Byte														Check sum

- Model Number Information

10.5 Set Setup Parameter

The parameter like Reference Temperature, Square Wave Output, Meter Date, Meter Time, Standard clamp ratio, Percentage scale function, beep level, dB reference resistor and others are setted using '2' different frames.

Frame 1:

0x5E	0x04	0x01	L1	T1	T2	T3	T4	F1	F2	F3	D1	FF	FF	FF	FF	FF	XX
Start frame	Parameter Write	Para meter	Lead Res.	Reference Temperature				Square Wave Out Frequency			SWO Duty	Dummy Byte					Checksum

-18 byte frame Length
- XX not a fixed value
-Lead Res. & SWO Duty: Convert the Decimal to Hexadecimal and Send the Hexadecimal Value
Eg: Lead Res. = $(50)_D$ => $(0x32)_H$, L1 = $(0x32)_H$, Similar Calculation for D1.
Note: SWO Duty : Duty cycle should be set in step of 10 like $(10)_D$, $(20)_D$, $(30)_D$, $(40)_D$, $(50)_D$, $(60)_D$, $(70)_D$, $(80)_D$, $(90)_D$.
Lead Res. (Lead Resistance) value can be set from $(00)_D$ to $(99)_D$

- Reference Temperature
T1 - Internal or External Reference Temperature
T1 $(0x00)_H$ - External Reference Temperature
T1 $(0x01)_H$ - Internal Reference Temperature
During internal reference, the contains of T2,T3 & T4 is Don't Care
T2 - Positive or Negative Temperature Value
T2 $(0x00)_H$ - Positive Sign '+'
T2 $(0x01)_H$ - Negative Sign '-'
T3 & T4 - Temperature Data
Temperature Data = AB.C Degree Centigrade
T3 = AB, T4 = C
Eg. External -$(0x17)_H$.$(0x01)_H$ => $(-23.1)_D$
T1 = $(0x00)_H$ T2 = $(0x01)_H$ T3 = $(0x17)_H$ T4 = $(0x01)_H$
Note: Reference Temperature Value can be set from $(-99.9)_D$ to $(99.9)_D$

-Square Wave Out Frequency
Frequency = ABC.DE
x= Frequency *$(0x64)_H$ =>ABCDE
F1 = x % $(0x64)_H$
F2 = (x / $(0x64)_H$) %$(0x64)_H$
F3 = (x / $(0x2710)_H$)
Eg: Frequency = $(100.30)_D$
*x = Frequency *$(0x64)_H$ => $(10030)_D$ => $(0x272E)_H$*
F1 = $(0x272E)_H$ %$(0x64)_H$ => $(0x1E)_H$
F2 = ($(0x272E)_H$ / $(0x64)_H$) %$(0x64)_H$=> $(0x00)_H$
F3 = ($(0x272E)_H$ / $(0x2710)_H$) => $(0x01)_H$
*In meter, ($(0x01)_H$ * $(0x2710)_H$) + ($(0x00)_H$ * $(0x64)_H$) + $(0x1E)_H$=> $(0x272E)_H$ / $(0x64)_H$ =>$(100.30)_D$*

Note: Square Wave Out Frequency can be set from $(0.03)_D$ to $(500.00)_D$

Frame 2:

0x5E	0x04	0x02	hh	mm	ss	dd	MM	yy	XX	C1	R1	R2	R3	A1	A2	FF	XX
Start frame	Parameter Write	Para meter	Hou r	Minut e	Sec ond	Date	Month	Year	SC	Beep Level	Reference Resistor (dbm)			APO		Don't Care	Checksum

- 18 byte Frame Length
- XX value is not fixed
- SC stands for %age scale Function and standard clamp ratio
Lower Nibble of Data is %age scale Function
Upper Nibble of Data is standard clamp ration
%age Scale Function (SF)
SF $(0x00)_H$ - No Percentage Scale is selected
SF $(0x01)_H$ - 0-20mA Percentage Scale Selected
SF $(0x02)_H$ - 4-20mA Percentage Scale Selected
Standard Clamp Ratio(CR)
CR $(0x00)_H$ - Normal Function
CR $(0x10)_H$ - 1:1 Clamp Ratio is Selected
CR $(0x20)_H$ - 1:10 Clamp Ratio is Selected
CR $(0x30)_H$ - 1:100 Clamp Ratio is Selected
CR $(0x40)_H$ - 1:1000 Clamp Ratio is Selected
Eg: SF = $(0x02)_H$ & CR = $(0x40)_H$
SC = $(0x42)_H$
-Beep Level stands for continuity threshold value
Eg: Beep Level = $(70)_D$, C1 = $(70)_D$ => $(0x46)_H$ C1 = $(0x46)_H$
Note: Continuity Threshold (Beep Level) value can be set in step 10 like $(10)_D$, $(20)_D$, $(30)_D$, $(40)_D$, $(50)_D$, $(60)_D$, $(70)_D$, $(80)_D$, $(90)_D$.

-Reference Resistor (dbm)
Reference Resistor = ABCD
R1 = Reference Resistor % $(0x64)_H$
R2 = (Reference Resistor / $(0x64)_H$) %$(0x64)_H$
R3 = (Reference Resistor / $(0x2710)_H$)
Eg: Reference Resistor = $(9999)_D$ => $(0x270F)_H$
R1 = $(0x270F)_H$ %$(0x64)_H$ => $(0x63)_H$
R2 = ($(0x270F)_H$ / $(0x64)_H$) %$(0x64)_H$=> $(0x63)_H$
R3 = ($(0x270F)_H$ / $(0x2710)_H$) => $(0x00)_H$
*In meter, ($(0x00)_H$ * $(0x2710)_H$) + ($(0x63)_H$ * $(0x64)_H$) + $(0x63)_H$=> $(0x270F)_H$ =>$(9999)_D$*
Note: Reference Resistor (dbm) value can be set from $(0001)_D$ to $(9999)_D$

-APO stands for auto power off function
A1 - $(0x00)_H$ - Continuous On
A2 data should be $(0x3C)_H$ => $(60)_D$
A1 - $(0x01)_H$ - Auto power off
A2 data should be in range $(0x05)_H$ to $(0x3B)_H$
-Date and Time : Time should be in 24 Hour Format
Eg: Date: 30/06/15 & Time: 09:42:10
hh = $(0x09)_H$, mm = $(0x42)_H$, ss = $(0x10)_H$, dd = $(0x30)_H$, MM = $(0x06)_H$, yy = $(0x15)_H$
Note: It is expected that valid date and time should be setted through the frame.

Response After Frame 1 or Frame 2 Query:
Wait for maximum 1sec to get response

0x40	0x23	0x0D	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Special Character	Model Number	Dummy Byte														Check sum

- 18 byte Frame Length
- Model Number Information

10.6 Online Communication

Online Communication means to get the data which are currently appearing on the meter screen. Multimeter Send data at the rate 250ms.

Online Communication Start Query:

0x5E	0x01	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Online Com	Dummy Byte															Checksum

- 18 byte Frame Length

To start communication send start query only once, response will be given until stop query is send.

Response:

0x24	XX	M1	M2	M3	S1	S2	S3	XX	R1	hh	mm	ss	dd	MM	XX	yy	XX
Start frame	Function Detail	Main Display Readings			Sub Display Readings			Standards key & data	Range	Hour	Min ute	Sec onds	Date	Mon th	Fla gs	Year	Checksum

- 18 byte Frame Length
- XX value is not fixed
- Function Details

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
BATT	Function Code				Function Counter		

BATT- DATA $(0b1)_2$ means data which is send is of battery voltage

Note: Ignore other bits of this frame. In case of Battery, sub display readings are of no use.

Function Code -

Function Code $(0x01)_H$ means VAC 10MΩ

Function Code $(0x02)_H$ means VAC 1MΩ

For Data $(0x01)_H$ & $(0x02)_H$ Function Counter:

Function Counter $(0x00)_H$ means Hz Function

Function Counter $(0x01)_H$ means Low Pass Filter Enabled

Function Counter $(0x02)_H$ means dB

Function Counter $(0x03)_H$ means dBm

Function Counter $(0x04)_H$ means dBµ

Function Code $(0x03)_H$ means VDC

Function Counter:

Function Counter $(0x00)_H$ means VDC

Function Counter $(0x01)_H$ means VACDC

Function Code $(0x05)_H$ means Resistance

Function Counter data is Don't Care

Function Code $(0x06)_H$ means Diode

Function Counter:

Function Counter $(0x00)_H$ means Diode

Function Counter $(0x01)_H$ means Continuity

Function Code $(0x07)_H$ means Temperature

Function Counter:

Function Counter $(0x00)_H$ means Thermocouple K Degree Centigrade

Function Counter $(0x01)_H$ means Thermocouple J Degree Centigrade

Function Counter $(0x02)_H$ means PT100 Degree Centigrade

Function Counter $(0x03)_H$ means PT100 Degree Centigrade

Function Code $(0x08)_H$ means Capacitance

Function Counter:

Function Counter $(0x00)_H$ means Capacitance

Function Code $(0x09)_H$ means milli - Ampere

Function Counter:

Function Counter $(0x00)_H$ means mA DC

Function Counter $(0x01)_H$ means mA AC

Function Counter $(0x02)_H$ means mA ACDC

Function Code $(0x0A)_H$ means Ampere

Function Counter:

Function Counter $(0x00)_H$ means A DC

Function Counter $(0x01)_H$ means A AC

Function Counter $(0x02)_H$ means A ACDC

Function Code $(0x0B)_H$ means mVDC

Function Counter:

Function Counter $(0x00)_H$ means mVDC

Function Counter $(0x01)_H$ means mVACDC

Function Counter $(0x02)_H$ means Hz

Function Counter $(0x03)_H$ means Duty Cycle

Function Code $(0x0F)_H$ means No Function

Function Counter Don't Care. Display Shows -----

-Main Display Readings

M1=>

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Sign	Data						

Sign: Sign $(0b0)_2$ means Positive Value

Sign $(0b1)_2$ means Negative Value

It is necessary to make sign data $(0b0)_2$ for getting proper Data value of digits

Main Readings = $(M1 * (0x10000)_H) + (M2 * (0x100)_H) + M3$

Eg: Data Send for meter = (60000)D => $(0xEA60)_H$

M1 = $(0x00)_H$, M2 = $(0xEA)_H$, M3 = $(0x60)_H$

Main Readings = $((0x00)_H * (0x10000)_H) + ((0xEA)_H * (0x100)_H) + (0x60)_H => (0xEA60)_H$

- Sub Display Readings

Calculation is Similar to Main Display Readings instead of M1, M2 & M3 it is S1, S2, S3

- Standards keys & Data

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Standard Clamp Ratio			Flag Sub display	HOLD key	Relative key	Min/Max/Avg key	

Standard Clamp ratio (SCR)

SCR $(0b000)_2$ - Normal Function

SCR $(0b001)_2$ - 1:1 Clamp Ratio is Selected

SCR $(0b010)_2$ - 1:10 Clamp Ratio is Selected

SCR $(0b011)_2$ - 1:100 Clamp Ratio is Selected

SCR $(0b100)_2$ - 1:1000 Clamp Ratio is Selected

Flag Sub Display (FSD)

FSD $(0b0)_2$ - Sub Display Readings Don't Care

FSD $(0b1)_2$ - Sub Display Readings is valid and can be used/shown

HOLD key

Hold key $(0b1)_2$ is pressed (Sub display Reading is Hold Value)

Relative key

Relative key $(0b1)_2$ is pressed (Sub display Reading is Relative Value)

Min/Max/Avg key (MMA)

MMA $(0b00)_2$ - Normal Function

MMA $(0b01)_2$ - Min key Pressed (Sub display Reading is Minimum Value)

MMA $(0b10)_2$ - Max key Pressed (Sub display Reading is Maximum Value)

MMA $(0b11)_2$ - Average key pressed (Sub display Reading is Average Value)

-Range

Range contain Main Display Range and Sub Display Range.

Main Display Range = $(R1)_H$ /$(0x0A)_H$

Sub Display Range = $(R1)_H$ %$(0x0A)_H$

Milli-Volt (mV)	
60.000	$(0x00)_H$
600.00	$(0x01)_H$

Voltage (V)	
6.0000	$(0x00)_H$
60.000	$(0x01)_H$
600.00	$(0x02)_H$
1000.0	$(0x03)_H$

Milli-Ampere(mA)	
600.00	$(0x00)_H$
6.0000	$(0x01)_H$
60.000	$(0x02)_H$
600.00	$(0x03)_H$

Ampere (A)	
6.0000	$(0x00)_H$
10.000/ 16.000	$(0x01)_H$

Resistance (Ω)	
600.00 Ω	$(0x00)_H$
6.0000 kΩ	$(0x01)_H$
60.000 KΩ	$(0x02)_H$
600.00 KΩ	$(0x03)_H$
6.0000 MΩ	$(0x04)_H$
40.00 MΩ	$(0x05)_H$

Frequency (Hz)	
600.00 Hz	$(0x00)_H$
6.0000 kHz	$(0x01)_H$
60.000 KHz	$(0x02)_H$
600.00 KHz	$(0x03)_H$
1.0000 MHz	$(0x04)_H$

dB, dBm, dBμ	
40.000	$(0x00)_H$

Capacitance (F)	
10.00 nF	$(0x00)_H$
100.0 nF	$(0x01)_H$
1.000 μF	$(0x02)_H$
10.00 μF	$(0x03)_H$
100.0 μF	$(0x04)_H$
1000 μF	$(0x05)_H$

Temperature	
1372.0	$(0x00)_H$

Conductance / Time (S)	
1.0000 S	$(0x00)_H$
100.00 mS	$(0x01)_H$
100.00 μS	$(0x02)_H$
1.0000 μS	$(0x03)_H$

Temperature	
Deg. C	$(0x00)_H$
Deg. F	$(0x01)_H$
Kelvin	$(0x02)_H$

Note: Main Display Range & Sub Display Range is used to determine Decimal point for Main Display Reading and sub Display Reading

For Min/Max/Avg/Hold/Rel Data Decimal point position for Main Display Readings and Sub Display Reading is same

Eg: VAC R1= $(0x0B)_H$

Main Display Range = $(0x0B)_H$ /$(0x0A)_H$ = $(0x01)_H$ => VAC 60.000V Main Display Range

Sub Display Range = $(0x0B)_H$ %$(0x0A)_H$ = $(0x01)_H$ => 6.0000KHz Sub Display Range

The Function like Duty Cycle, Diode & Continuity Main Display Range & Sub Display Range $(0x00)_H$
-Hour, Minute, Second, Date, Month & Year
Hour value is in 24-Hour Format
Eg: hh = $(0x17)_H$, MM = $(0x30)_H$, ss = $(0x48)_H$, dd = $(0x28)_H$, mm = $(0x06)_H$, yy = $(0x15)_H$
Time => 17:30:48
Date => 28/06/15
-Flags

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
'OL' Sub Display	REL 'OL'	AUTO MAN	%age Scale Function		FUSE BLOW	Danger Voltage	Low Battery

'OL' sub Display
OL $(0b0)_2$ - Sub Display Readings is not overloaded
OL $(0b1)_2$ - Sub Display Readings is Overloaded
Rel 'OL'
Rel 'OL'$(0b0)_2$ - Main Display Data For Relative Function is not Overloaded
Rel 'OL' $(0b1)_2$ - Main Display Data For Relative Function is loaded
For DC Functions, Main Display Value can goes to '99999' counts
AUTO MAN (AM)
AM $(0b0)_2$ - Meter is in Manual Mode
AM $(0b1)_2$ - Meter is in Auto Mode
%age Scale Function (PSF)
PSF $(0b00)_2$ - Normal Function
PSF $(0b01)_2$ - 0-20 mA %age scale is setted
PSF $(0b10)_2$ - 4-20 mA %age scale is setted
FUSE BLOW(FB)
FB $(0b0)_2$ - Fuse is proper
FB $(0b1)_2$ - Fuse is damaged
Danger Voltage(DV)
DV $(0b0)_2$ - No Danger/ Hazardous Voltage
DV $(0b1)_2$ - Danger Voltage Detected
Low Battery (LB)
LB $(0b0)_2$ - Battery voltage is ok
LB $(0b1)_2$ - Battery voltage has fallen below 2.4V (low battery detected)

Note: For Memory Offline Data Read :
In Function Detail, BATT data is always $(0b0)_2$ since BATT, Square Wave Output Function value are not logged in meter.
Year and Checksum, Byte are not sent.
Decoding Method of offline frame is same as of online communication frame.

Online Communication Stop Query:

0x5E	0x00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Stop Com	Dummy Byte															Checksum

-18 byte Frame length

Response:
wait for nearly 250ms to get response

0x40	0x23	0x0D	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Special Character	Model Number	Dummy Byte														Check sum

-18 byte Frame Length
- Model Number Information

10.7 Memory Data

Memory Data Initialization Query:

0x5E	0x02	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Offline Init	Dummy Byte															Checksum

-18 Byte Frame Length

Response (16 Byte Frame Length)

P1	P2	F1	F2	00	00	00	00	00	00	00	00	00	00	00	00
Max. Page Number		Max. File Number		Dummy Byte											

-Max. Page Number (Max Page Number Can be $(7FF)_H$)

Pg.No. = $(P1 * (0x100)_H)+P2$

Eg: P1 = $(0x01)_H$ P2 = $(0x23)_H$ Pg.No = $((0x01)_H * (0x100)_H)+(0x23)_H => (0x123)_H => (291)_D$

Memory Used Space in % = $(((Pg.No)_D - (39)_D) / (2009)_D) *(100)_D$

Pg. No. = $(291)_D$ Memory Used Space in % = $(((291)_D - (39)_D) / (2009)_D)*(100)_D$ => 12.54 %

$P1 = P2 = (0xFF)_H$ then there is no data in the memory, memory is empty.

-Max. File Number

File = $(F1 * (0x100)_H)+F2$

Eg: Suppose Max File Number = (0x02)H means there is total 3 file => File0 , File 1, & File 2

Memory Erase Query:

0x5E	0x02	0x04	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Offline Init	Eras e	Dummy Byte														Checksum

-18 Byte Frame Length

Response:

wait for maximum 10s to get response

0x40	0x23	0x0D	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Special Character	Model Number	Dummy Byte															Check sum

-18 byte Frame Length

- Model Number Information

Note: Continuous ON symbol glows after Memory Erase query

Memory File Details Query:

0x5E	0x02	0x02	00	00	00	00	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Offline Init	File Detail	Dummy Byte														Checksum

-18 byte Frame length

Response:

The Response is of total byte $(2800)_H => (10240)_D$

Out of $(10240)_D$ First 256 byte of data is of no use because its information is already sent in Memory Initialization Query

After 256 byte of data, data is in following format:

P1	P2	XX	XX	XX	XX	XX	XX
File End Page Address		Hour	Minute	Second	Date	Month	Year

-8 Byte Frame Length

-File End Page Address (Max Page Address Can be $(7FF)_H$)

File End Page Address = $(P1 * (0x100)_H)+P2$

Eg: P1 = $(0x01)_H$ P2 = $(0x23)_H$

File End Page Address = $((0x01)_H * (0x100)_H)+(0x23)_H => (0x123)_H => (291)_D$

$P1 = P2 = (0xFF)_H$ then memory is empty.

-If there is continuously $(0xFF)_H$ for minimum of 8 Byte then Data is of no need (Don't Care)

-Above frame is repeated for maximum file number present in memory

Memory Page Data Read Query:

0x5E	0x02	0x03	S1	S2	E1	E2	00	00	00	00	00	00	00	00	00	00	XX
Start frame	Offline Init	Data Read	Start Page		End Page		Dummy Byte										Checksum

-18 Byte Frame Length
- Start Page
S2 = Start Page % $(0x64)_H$
S1 = (Start Page / $(0x64)_H$) %$(0x64)_H$
-End Page
E2 = End Page % $(0x64)_H$
E1 = (End Page / $(0x64)_H$) %$(0x64)_H$
Eg: If you want to read certain file, Check which of the file detail should be read, in that file detail there is File End Page Number which should be used as End Page in case of data read.
If you are reading File 0 data then start page will always be $(0x28)_H$
If you are reading other than File 0 data the Start will be Previous File End page Number + 1.

Eg: There are total 3 File Details
File 0, File 1, File 2
File 0, P1 = File End Page Address
File 1, P2 = File End Page Address
File 2, P3 = File End Page Address
Now Suppose we want to read File 0
Then, Start Page = $(0x28)_H$, End Page = P1
Now suppose we want to read File 1
Then, Start Page = P1 + $(0x01)_H$, End Page = P2

Response:

The response from meter of ((End Page Number)$_D$ - (Start Page Number)$_D$ *$(256)_D$) Byte.
The response time may varies according the number of byte being sent from meter.
The Start of frame is always $(0x24)_H$
From start of frame total byte length of data is 16 byte.
If Continuous $(0xFF)_H$ arrives for 16 byte means that data is not valid data move until next 16 byte of data, start frame contains $(0x24)_H$

0x24	XX	M1	M2	M3	S1	S2	S3	XX	R1	hh	mm	ss	dd	MM	XX
Start frame	Function Detail	Main Display Readings			Sub Display Readings			Standards key & data	Range	Hour	Minute	Seconds	Date	Month	Flags

****Refer to Section 10.6 Online Communication Start Query Response Frame, Only difference is that in memory data year and checksum is not sent from the meter.*

-16 Byte Frame Length
-XX means value is not fixed
-At Each frame
-Above frame is repeated for maximum number data byte read.

10.8 Memory Distribution:

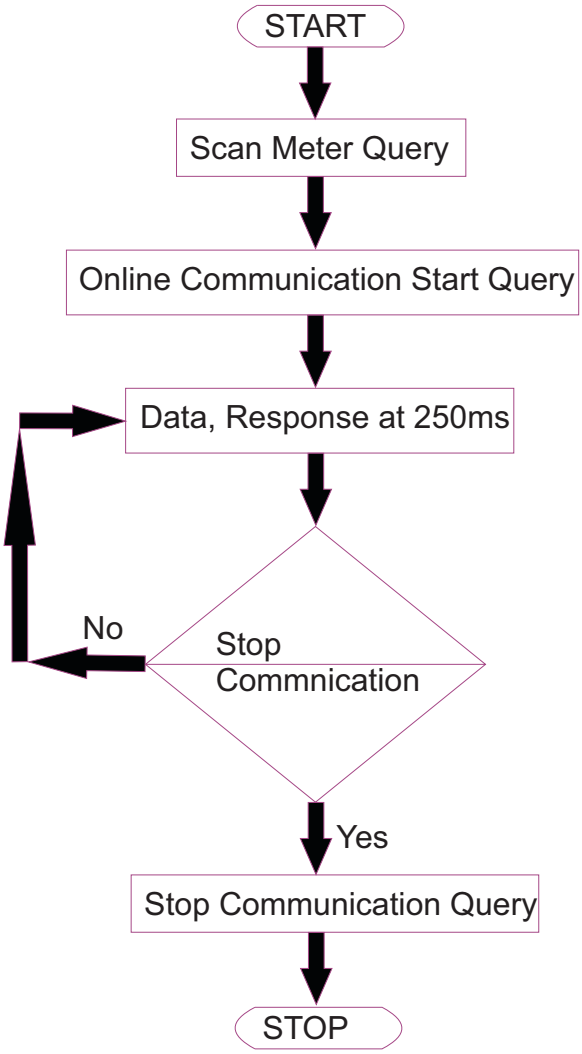
Page Number	Information	(Byte Length)$_D$
0	Basic Data	256
1 - 39	File Details	9984
40 - 2047	Data	513792

A Single Page consist of 256byte of information.

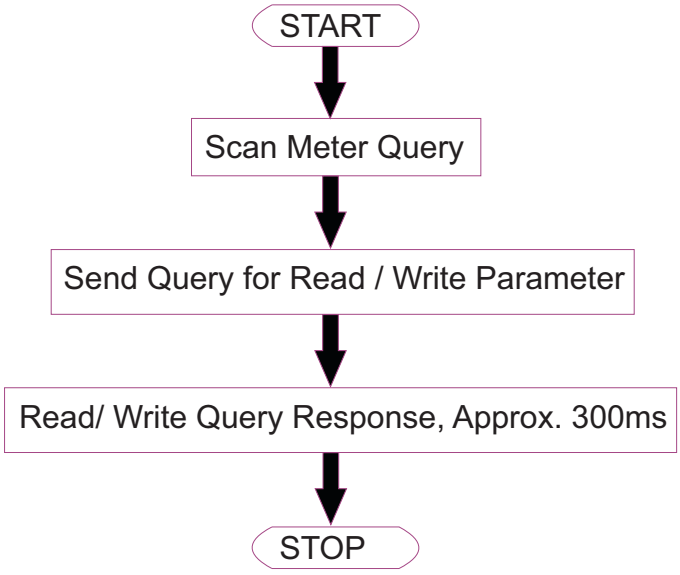
10.9 Communication Detail

Baud Rate: 9600
Parity: None
Data bits: 8
Stop bits: 1
Flow Control: None

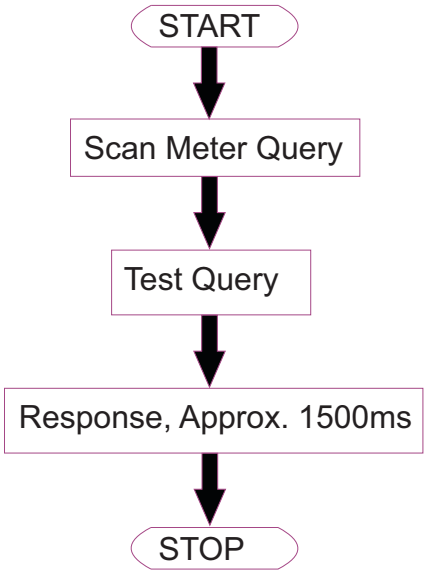
10.10 Online Communication Flow Chart



10.11 Setup Read/Write Parameter FlowChart



10.12 Test Query FlowChart



10.13 Memory Read FlowChart