Mikro®

Power Meter
DPM680

Instruction Manual

BEFORE YOU BEGIN

Please read this instruction manual thoroughly before installation, operation and maintenance of the DPM680 power meter.

This power meter should NOT be installed or used for primary protection. Do not use the device in applications where its failure can cause harm or death. Avoid high fire risk applications.

The symbol on the left is used throughout this instruction manual to alert the user or personnel of the danger or to prompt caution during the installation and maintenance process.

EMC COMPLIANCE

This power meter has been tested and found to comply with the limits of the IEC/EN61000 EMC standards. These standards are designed to provide reasonable protection against interference when using this device. Failure to install or use the device in accordance with the instruction may cause harmful inteference. This does not, however, guarantee that inteference will not occur in any installation. In case of inteference, the user is encouraged to:

- relocate or reorient the victim/emitting equipment
- change the connection point of the victim/emitting equipment
- increase the distance between the victim/emitting equipment and the power meter

Please consult a qualified technician for assistance.

DISCLAIMER

Mikro shall not be liable for errors contained herein including any incidental and/or consequential damages arising from the use of this material. Mikro also reserves the right to vary the product from that described in this material without prior notice.

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TABLE OF CONTENT

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1 INTRODUCTION

Thank you for purchasing the DPM680 Digital Power Meter. This multifunction power meter features a user-friendly colour graphical and touch button interface. It's primary function is for measuring the following parameters:

- True and peak RMS phase voltage (L-N).
- True RMS line voltage (L-L).
- True and peak RMS phase and neutral current.
- Active, reactive and apparent power.
- Active, reactive and apparent energy.
- Total and displacement power factor.
- Frequency.
- Voltage and current total harmonic distortion (THD).
- Positive, negative and zero sequence voltages and currents.
- Demand and maximum demand for current (thermal demand) - phase and neutral.
- Demand and maximum demand for active, reactive and apparent power.

It's large colour graphics LCD also displays:

- Scalable voltage and current waveforms
- Voltage and current harmonic spectrums up to the 32nd order

For SCADA and remote monitoring, this power meter also comes with:

- Modbus RTU connectivity
- Modbus TCP/IP connectivity
- Built-in webserver

1.1 HOW TO USE THIS MANUAL

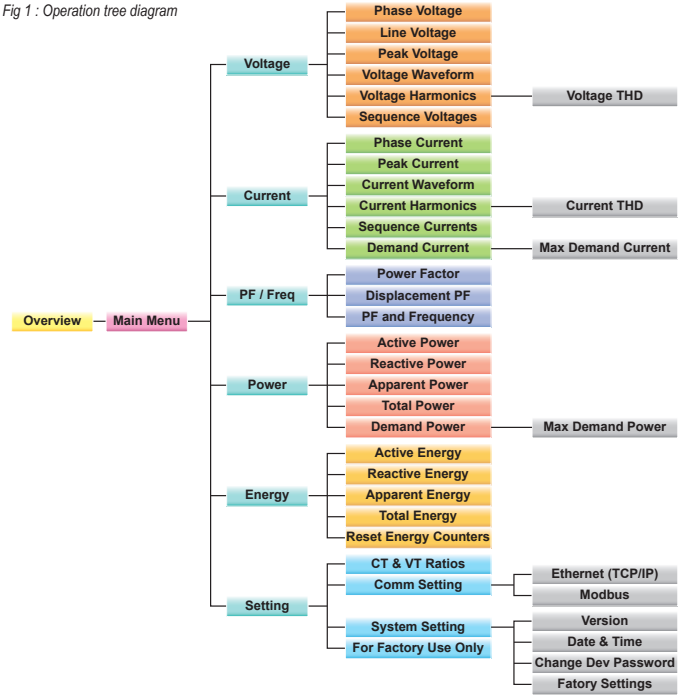
For installation instruction, the Installation chapter (ch2) should be read carefully.

The OVERVIEW page & MAIN MENU and Password Authentication sections of the Operations chapter (ch3) covers the common steps before jumping to any parameter page. The tree diagram shown in Fig 1 shows the menus, sub menus, pages and sub pages to navigate through before reaching the page of interest.

Please refer to the table of content to jump to the operation details in Operations chapter (ch3). The chapters on Webpage Operations (ch4) and Troubleshooting Guide (ch6) can be used stand-alone. The Modbus Operations (ch5) may be used in conjunction with the Modbus Table in Appendix B. Information on calculation methods are given in Appendix C.

Detailed technical specifications and parametric limits are listed in Appendix A.

Fig 1 : Operation tree diagram



1.2
CONTENT OF BOX

Upon opening this box, you should find the following items shown in Table 1:

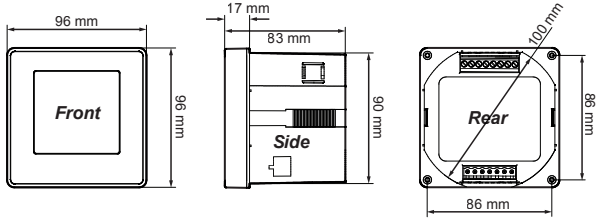
Table 1 : Parts list

No	Description	Quantity
1	DPM680 power meter	1
2	Retainer clip	2
3	Control power plug	1
4	RS-485 plug	1
5	Voltage input plug	1
6	This instruction manual	1

1.3
PARTS OF THE POWER METER

Fig 2 shows the outline dimension of the power meter.

Fig 2 : Dimension of meter



The parts and locations in the meter where connections and fastening is made is shown in Fig 3 and Table 2:

Fig 3 : Parts location

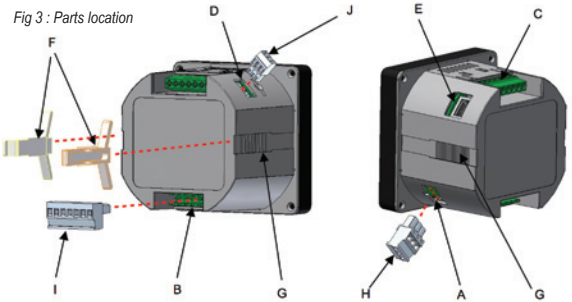


Table 2 : Location and parts labels

Label	Part / Location	Description
A	Control power input	Meter control power supply
B	Voltage input	Metering voltage connection
C	Current input	Metering current connection
D	RS-485 port	RS-485 connection for Modbus RTU
E	RJ45 port	LAN connection for Modbus TCP/IP & webserver
F	Retainer clip	Clip to hold meter in cut out hole
G	Retainer clip slot	Location to slide the retainer clips
H	Control power plug	Meter control power detachable terminal block
I	Voltage input plug	Metering voltage detachable terminal block
J	RS-485 plug	RS-485 detachable terminal block

2 INSTALLATION

2.1 PRECAUTIONS

Please observe the following safety precautions before and during the installation of the power meter:

- Only competent and trained personnel should install this device.
- Use appropriate personal protective gloves, glasses and clothing.
- Never work alone.
- Disconnect ALL (metering, control power and communication) power sources to the meter before performing installation, inspection, test and maintenance.
- Do not perform megger, hi-pot or any high voltage stress test with the meter connected to the system.
- Use a shorting block to short circuit the CTs before disconnecting from the meter.
- Install in a suitable enclosure where meter connections are inaccessible with suffficient clearance from other live parts.
- Do not bypass any fuse.
- Follow safe electrical work practices.
- Use only dry clothes to wipe the meter.

Please note that incorrect installation may impair the operation or even damage the meter.
There is no user servicable part in the meter. Tampering with the meter may damage the meter, resulting in injury or even death and also voiding any warranty.

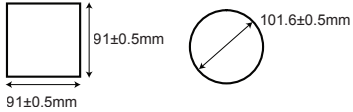
2.2 METER PLACEMENT & CONNECTIONS

Before installing the power meter, please check that the environment meets the following conditions:

- Operating temperature: -20˚C to +70˚C
- Humidity: 5% to 95%, non condensing
- Dust free environment away from electrical noise and radiation

a) provide a cut out hole on the switchgear panel according to DIN43700/ANSI C39.1 as shown in Fig 4 below:

Fig 4 : Cut-out hole

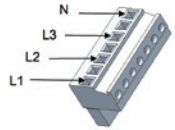


b) insert the meter through the hole and slide in the retainer clip along the slots on both sides of the power meter until the device is tightly secured on the switchgear panel. The direction and orientation of the retainer clips is shown in Fig 3.

The retainer clip can be removed by lifting the tab lightly at the handle end.

c) remove the detachable terminal block from the voltage input connection and connect the metering voltage inputs to the detachable terminal block as shown in Fig 5 according to the wiring schemes shown in Figs 6 to 9 below. The recommended wire size is AWG16~22.

Fig 5 : Metering voltage input detachable terminal block connections



Please make sure the power to the voltage metering input is totally removed.

Fig 6 :
3-phase star plus neutral,
4CTs with direct voltage input connection

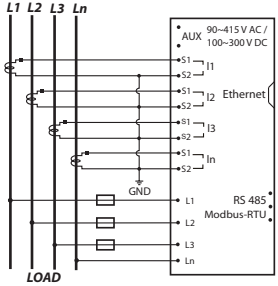


Fig 7 :
3-phase star plus neutral,
3CTs with direct voltage input connection

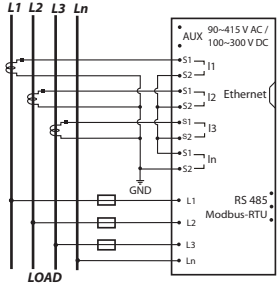


Fig 8 :
3-phase delta without neutral 3CTs with 3VTs connection

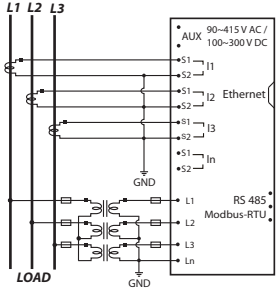
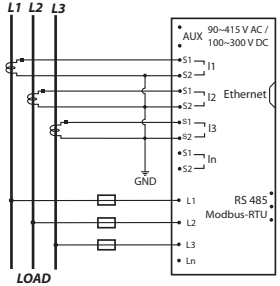


Fig 9 :
3-phase delta without neutral 3CTs with direct voltage input connection



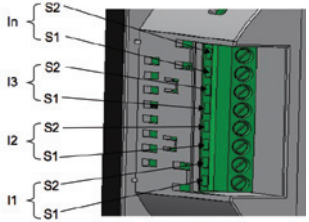
Upon completing this step, please insert the detachable terminal block into the voltage input connector housing.

The terminal block must be inserted securely into the connector housing on the meter to prevent improper operation.

d) connect the metering current input to the current input terminal block as shown in Fig 10. The recommended wire size is AWG12~18.

Please make sure the power to the current metering input is totally shunted. Under no circumstances can the CT connection be left open circuit. Use a CT shorting block if necessary.

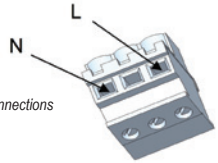
Fig 10 :
3-phase and neutral CT connections



f) remove the detachable terminal block from the meter control power supply connection and connect the control power supply to the terminal block as shown in Fig 11. The recommended wire size is AWG16 ~ 22.

Please make sure the power to the meter control is totally removed.

Fig 11 :
Control power connections



Upon completing this step, please insert the detachable terminal block into the meter control power supply connector housing.

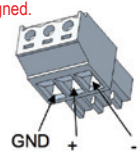
The terminal block must be inserted securely into the connector housing on the meter to prevent improper operation.

An isolation transformer or EMC filter may need to be installed before feeding into the power meter in case of power quality problems in the control power supply.

g) if Modbus RTU is used, remove the detachable terminal block from the RS-485 port and connect the Modbus communication cable to the terminal block as shown in Fig 12. The recommended wire size is AWG22 or thicker, shielded twisted pair.

Please make sure the polarity is correctly aligned.

Fig 12 :
Modbus RTU connections



Up to 32 devices can be connected in a daisy chain fashion and the total cable length should not be more than 1000m.

Avoid running the cable near sources of electrical noise. The network cable shield should be grounded at only ONE end.

Upon completing this step, please insert the detachable terminal block into the RS-485 port connector housing.

The terminal block must be inserted securely into the connector housing on the meter to prevent improper operation.

h) if Modbus TCP/IP or the webserver is used, simply connect the LAN cable's RJ45 connector to the RJ45 port shown in Fig 3.

Please make sure the connector snaps into the port to ensure proper connection is made.

2.3 METER SETUP

Before commencing operation, the meter has to be set up. To do this, the meter must be powered up by the meter control power supply.

Under section 3.8, the following parameters should be reviewed against the default value and modified if necessary:

- CT ratio and VT ratio, see section 3.8.1
- IP address and subnet mask, see section 3.8.2.1
- RS-485 serial data format and baud rate, see section 3.8.2.2
- Modbus RTU device address, see section 3.8.2.2
- Modbus remote read enable, see section 3.8.2.2
- Date and time, see section 3.8.3.2
- Device password, see section 3.8.3.3

To reset the energy register values, please see section 3.7.5

The following parameters should also be reviewed against the default value and modified if necessary:

- demand interval and sub interval block for thermal current demand, see section 3.4.6
- demand interval and sub interval block for power demand, see section 3.6.5

The following registers should be reviewed and reset if necessary:

- peak phase voltage, see section 3.3.3
- peak phase current, see section 3.4.2
- maximum thermal current demand, see section 3.4.7
- maximum power demand, see section 3.6.6

2.4 TCP/IP CONNECTION SETUP

The meter runs on IPv4 and its default IP settings is as follows:

IP address: 192.168.28.28
Subnet mask: 255.255.255.0

These values can be changed at the meter as explained in section 3.8.2.1.

Only devices within the sub-network as defined by the subnet mask can communicate with the meter. In the instance of the above default subnet mask, only devices (e.g. PC or router, etc.) with IP addresses that begin with 192.168.28 can communicate with the meter.

For direct PC connection, the IP address can be changed as follows:

a) go to the **START** menu and click on the **Control Panel** label.

b) under the **Network and Internet** heading, click on the **View network status and tasks** link.

c) under the **Tasks** sidebar, click on the **Manage network connections** link.

d) double click on the LAN port that is connected to the meter. You may be asked by Windows for access permission. Upon confirmation, you will see the **Local Area Connection Properties** window as shown in Fig 13.

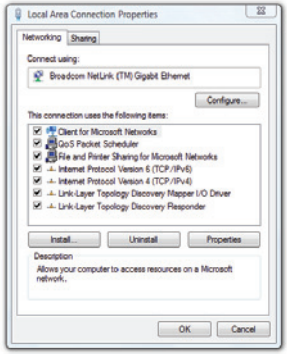


Fig 13 :
***Local Area Connection Properties** window*

e) Single click to highlight the **Internet Protocol Version 4 (TCP/IPv4)** bar and click on the Properties button. The **Internet Protocol Version 4 (TCP/IPv4) Properties** window will appear as shown in Fig 14.

Fig 14 :
***Internet Protocol Version 4 (TCP/IPv4) Properties** window*

f) check on the **Use the following IP address** button and set the IP address to 192.168.28.1 and the subnet mask to 255.255.255.0 as shown above.

NOTE:
The last digit of the IP address may be varied from 1 up to 255. But care must be taken to use only a vacant IP address.

g) click on the **OK** button to exit. Repeat pressing the **OK** button in the **Local Area Connection Properties** window.

3 METER OPERATIONS

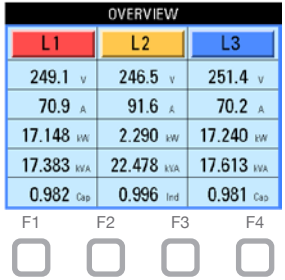
The power meter front panel user interface comes with a large colour LCD display and 4 touch buttons, labelled F1, F2, F3 and F4 as shown in Fig 15.

To touch the button, simply place a finger on the square below the labels corresponding to the menu item at the bottom of the display.

3.1 OVERVIEW PAGE & MAIN MENU

Upon power up, the power meter will display an OVERVIEW page, listing a summary of basic parameters for all phases as shown in Fig 15:

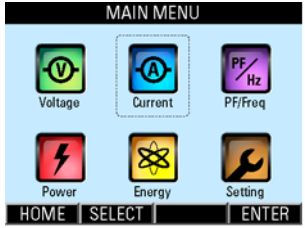
*Fig 15 : **OVERVIEW page***



TOUCH BUTTON FUNCTIONS:

- when any button is touched, the **MAIN MENU** will be displayed as shown in Fig 16 below.
- to go to the sub-menu of interest, touch the **SELECT (F2)** button in multiple times until the corresponding icon is highlighted (within a dashed rectangular box) as shown in Fig 16. To confirm this selection, touch the **ENTER (F4)** button.
- to return to the **OVERVIEW** page, touch the **HOME (F1)** button in the **MAIN MENU**.

*Fig 16 : **MAIN MENU***



When the power meter is left idle for more than 5 minutes, the display will default to the OVERVIEW page.

3.2 PASSWORD AUTHENTICATION

For authentication in the parameter setting operations, the user may be prompted for a valid password. In this mode, the **Enter Password** window as shown in Fig 17 below will appear.

*Fig 17 : **Enter Password** window*

TOUCH BUTTON FUNCTIONS:

- to abort the operation and return to the previous page, touch the **ABORT (F4)** button.
- otherwise, touch the **SET (F1)** button to enter the input password mode.

In the input password mode, the **UP (F2)** and **DOWN (F3)** buttons will become active and the background colour of the active field will be changed to white.

NOTE:
The device password will be used for all authentication purposes except in the **Factory Settings** sub page.

The default device password is 9999. The user is advised to set their own password for security reasons.

On the other hand, the factory setting password is fixed at 6256 and it cannot be changed.

TOUCH BUTTON FUNCTIONS:

- to increase the number, touch the **UP (F2)** button.
- to decrease the number, touch the **DOWN (F3)** button.
- to select the next active field to change, touch the **NEXT (F1)** button and repeat the above 2 steps.

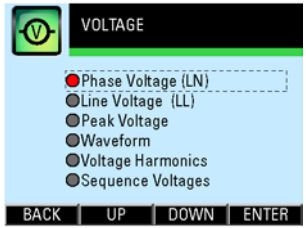
- to abort the operation and return to the previous page, touch the **ABORT (F4)** button.
- to confirm the password, touch the **ENTER (F4)** button. If the password is wrong, an error message will appear and the above process has to be repeated unless aborted by touching the **ABORT (F4)** button.

NOTE:
In a delta system without any neutral as shown in Figs 8 and 9, the phase quantities are measured with respect to a virtual neutral point.

3.3 VOLTAGE SUB-MENU

The **VOLTAGE** sub-menu allows the selection of voltage parameter pages as shown in Fig 18:

*Fig 18 : **VOLTAGE** sub-menu*



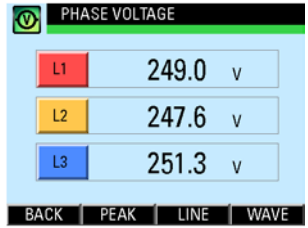
TOUCH BUTTON FUNCTIONS:

- to select the parameter page of interest, touch either the **UP (F2)** or **DOWN (F3)** button until the item of interest is highlighted (within a dashed rectangular box and a RED dot to its left).
- to confirm this selection, touch the **ENTER (F4)** button.
- to return to the **MAIN MENU**, touch the **BACK (F1)** button.

3.3.1 PHASE VOLTAGE

The **Phase Voltage** page shows the true RMS voltage of each phase as shown in Fig 19 below:

*Fig 19 : **Phase Voltage** page*



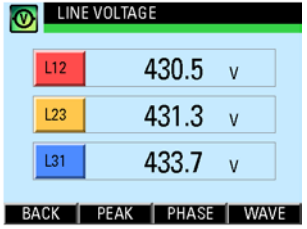
TOUCH BUTTON FUNCTIONS:

- to jump to the **Peak Voltage** page, touch the **PEAK (F2)** button.
- to jump to the **Line Voltage** page, touch the **LINE (F3)** button.
- otherwise, touch the **BACK (F1)** button to return to the **VOLTAGE** sub-menu.

3.3.2 LINE VOLTAGE

The **Line Voltage** page shows the true RMS voltage between any 2 phases as shown in Fig 20:

*Fig 20 : **Line Voltage** page*



TOUCH BUTTON FUNCTIONS:

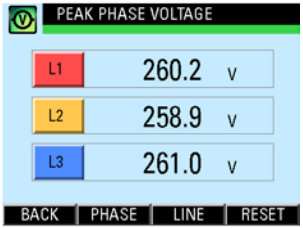
- to jump to the **Peak Voltage** page, touch the **PEAK (F2)** button.
- to jump to the **Phase Voltage** page, touch the **PHASE (F3)** button.
- to jump to the **Voltage Waveform** page, touch the **WAVE (F4)** button.

- otherwise, touch the **BACK (F1)** button to return to the **VOLTAGE** sub-menu.

3.3.3 PEAK VOLTAGE

The **Peak Voltage** page shows the recorded maximum true RMS voltage of each phase since the last reset as shown in Fig 21:

*Fig 21 : **Peak Voltage** page*



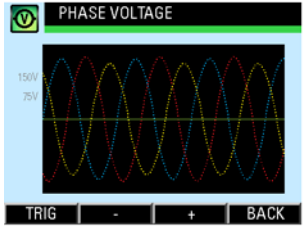
TOUCH BUTTON FUNCTIONS:

- to jump to the **Phase Voltage** page, touch the **PHASE (F2)** button.
- to jump to the **Line Voltage** page, touch the **LINE (F3)** button.
- to reset the recorded maximum voltage values to zero, touch the **RESET (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **VOLTAGE** sub-menu.

3.3.4 VOLTAGE WAVEFORM

The **Voltage Waveform** page shows the phase voltage waveform of all phases as shown in Fig 22:

*Fig 22 : **Voltage Waveform** page*



The RED, YELLOW and BLUE traces show the voltage waveform of phases L1, L2 and L3 respectively.

The three display zoom levels correspond to a maximum range of approximately ±110V, ±220V and ±440V rms at the metering voltage input.

The time capture span is fixed at approximately 65 msec.

NOTE:
The displayed waveform is solely for visual inspection and not for measurement purposes.

The waveform is the captured voltage at the metering voltage input, not necessarily the actual phase voltage, especially when voltage transformers are used.

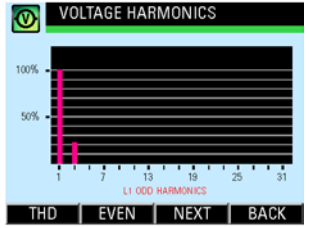
TOUCH BUTTON FUNCTIONS:

- to change the trigger source among the 3 phases, touch the **TRIG (F1)** button.
- to zoom out the voltage display scale, touch the **- (F2)** button.
- to zoom in the voltage display scale, touch the **+ (F3)** button.
- otherwise, touch the **BACK (F4)** button to return to the **VOLTAGE** sub-menu.

3.3.5 VOLTAGE HARMONICS

The **Voltage Harmonics** page shows the voltage harmonics spectrum and the voltage Total Harmonics Distortion (THD) of each phase. Upon entering this parameter page, the voltage harmonics spectrum will be displayed as shown in Fig 23:

*Fig 23 : **Voltage Harmonics** page*



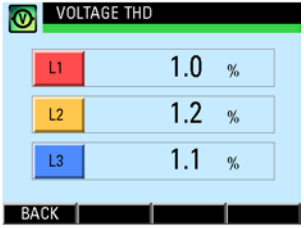
The harmonics content is displayed as a percentage of the fundamental phase voltage. Please see section C.2 in Appendix C for more details.

TOUCH BUTTON FUNCTIONS:

- to alternate between the odd and even harmonics spectrum display, touch the **EVEN (F2)** or **ODD (F2)** button.
- to display the spectrum of the next phase, touch the **NEXT (F3)** button.
- to jump to the **THD** parameter page as shown in Fig 24 below, touch the **THD (F1)** button.
- otherwise, touch the **BACK (F4)** button to return to the **VOLTAGE** sub-menu.

In the Voltage **THD** parameter page, the voltage THD for each phase is displayed as shown in Fig 24.

Fig 24 : Voltage ***THD*** *parameter page*



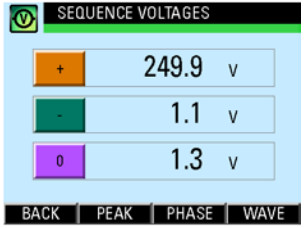
TOUCH BUTTON FUNCTIONS:

- to return to the **Voltage Harmonics** page, touch the **BACK (F4)** button

3.3.6 SEQUENCE VOLTAGES

The **Sequence Voltages** page shows the positive, negative and zero sequence RMS phase voltages as shown in Fig 25. They are useful for identifying abnormalities such as voltage imbalance and phase reversals. Please see section C.3 in Appendix C for details.

Fig 25 : ***Sequence Voltages*** *page*



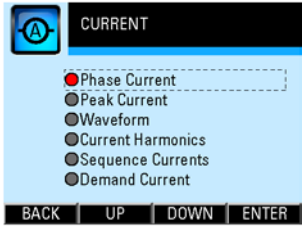
TOUCH BUTTON FUNCTIONS:

- to jump to the **Peak Voltage** page, touch the **PEAK (F2)** button.
- to jump to the **Phase Voltage** page, touch the **PHASE (F3)** button.
- to jump to the **Voltage Waveform** page, touch the **WAVE (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **VOLTAGE** sub-menu.

3.4 CURRENT SUB-MENU

The **CURRENT** sub-menu allows the selection of current parameter pages as shown in Fig 26:

Fig 26 : ***CURRENT*** *sub-menu*



The right-most column of the current value display shows the corresponding percentage loading of the rated metering current input.

TOUCH BUTTON FUNCTIONS:

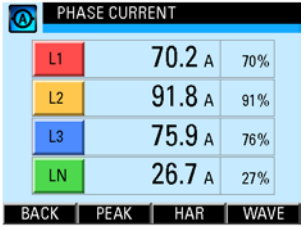
- to select the parameter page of interest, touch either the **UP (F2)** or **DOWN (F3)** button until the parameter item is highlighted (within a dashed rectangular box and a RED dot to its left). To confirm this selection, touch the **ENTER (F4)** button.
- to return to the **MAIN MENU**, touch the **BACK (F1)** button.

NOTE:
In a star system without a neutral CT as shown in Fig 7, the displayed neutral current is derived from the summation of the phase CT currents.

3.4.1
PHASE CURRENT

The **Phase Current** page shows the true RMS current of each phase and where applicable, neutral as shown in Fig 27:

*Fig 27 : **Phase Current** page*



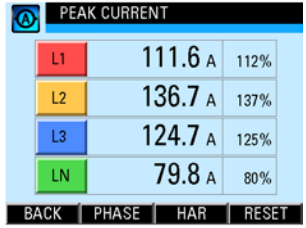
TOUCH BUTTON FUNCTIONS:

- to jump to the **Peak Current** page, touch the **PEAK (F2)** button.
- to jump to the **Current Harmonics** page, touch the **HAR (F3)** button.
- to jump to the **Current Waveform** page, touch the **WAVE (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **CURRENT** sub-menu.

3.4.2
PEAK CURRENT

The **Peak Current** page shows the recorded maximum true RMS current of each phase and where applicable, neutral since the last reset as shown in Fig 28:

*Fig 28 : **Peak Current** page*



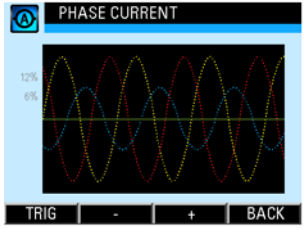
TOUCH BUTTON FUNCTIONS:

- to jump to the **Phase Current** page, touch the **PHASE (F2)** button.
- to jump to the **Current Harmonics** page, touch the **HAR (F3)** button.
- to reset the recorded maximum current values to zero, touch the **RESET (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **CURRENT** sub-menu.

3.4.3
CURRENT WAVEFORM

The **Current Waveform** page shows the current waveform of all phases shown in Fig 29:

*Fig 29 : **Current Waveform** page*



The RED, YELLOW and BLUE traces show the current waveform of phases L1, L2 and L3 respectively.

The three display zoom levels correspond to a maximum range of approximately ±20%, ±40% and ±80% of the rated rms metering current input (5A).

The time capture span is fixed at approximately 65 msec.

NOTE:
The displayed waveform is solely for visual inspection and not for measurement purposes.

The waveform is the captured current at the metering current input, not necessarily the actual phase current.

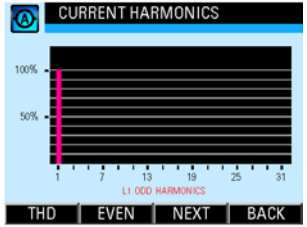
TOUCH BUTTON FUNCTIONS:

- to change the trigger source among the 3 phases, touch the **TRIG (F1)** button.
- to zoom out the current display scale, touch the **- (F2)** button.
- to zoom in the current display scale, touch the **+ (F3)** button.
- otherwise, touch the **BACK (F4)** button to return to the **CURRENT** sub-menu.

3.4.4
CURRENT HARMONICS

The **Current Harmonics** page shows the current harmonics spectrum and the current Total Hormonic Distortion (THD) of each phase. Upon entering this parameter page, the current harmonics spectrum will be displayed as shown in Fig 30. The neutral harmonics content will NOT be displayed.

*Fig 30 : **Current Harmonics** page*



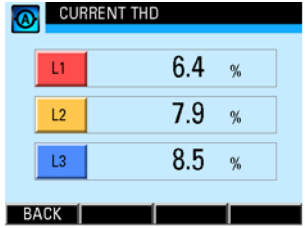
The harmonics content is displayed as a percentage of the fundamental phase current. Please see section C.2 in Appendix C for more details.

TOUCH BUTTON FUNCTIONS:

- to alternate between the odd and even harmonics spectrum display, touch the **EVEN (F2)** or **ODD (F2)** button.
- to display the spectrum of the next phase, touch the **NEXT (F3)** button.
- to jump to the **THD** parameter page as shown in Fig 31, touch the **THD (F1)** button.
- otherwise, touch the **BACK (F4)** button to return to the **CURRENT** sub-menu.

In the Current **THD** parameter page, the current THD for each phase is displayed as shown in Fig 31.

*Fig 31 : Current **THD** parameter page*



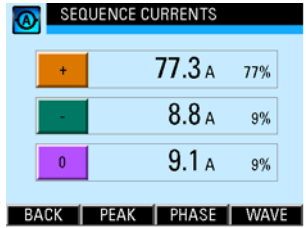
TOUCH BUTTON FUNCTIONS:

- to return to the **Current Harmonics** page, touch the **BACK (F4)** button.

3.4.5
SEQUENCE CURRENTS

The **Sequence Current** page shows the positive, negative and zero sequence currents as shown in Fig 32. They are useful for identifying abnormalities such as current imbalance and phase reversals. Please see section C.3 in Appendix C for details.

*Fig 32 : **Sequence Current** page*



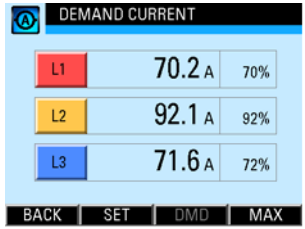
TOUCH BUTTON FUNCTIONS:

- to jump to the **Peak Current** page, touch the **PEAK (F2)** button.
- to jump to the **Phase Current** page, touch the **PHASE (F3)** button.
- to jump to the **Current Waveform** page, touch the **WAVE (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **CURRENT** sub-menu.

3.4.6
DEMAND CURRENT

The **Demand Current** page shows the demand current averaged over a demand interval for each phase as shown in Fig 33. The neutral demand current is not shown. The demand current is calculated using the thermal demand method. Please see section C.1 in Appendix C for details.

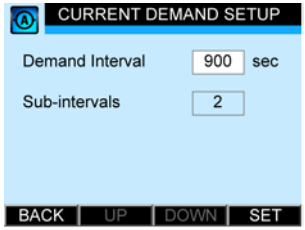
*Fig 33 : **Demand Current** page*



TOUCH BUTTON FUNCTIONS:

- to jump to the **Current Demand Setup** page as shown in Fig 34, touch the **SET (F2)** button.
- to jump to the **Max Demand Current** page, touch the **MAX (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **CURRENT** sub-menu.

Fig 34 : ***Current Demand Setup*** *page*



TOUCH BUTTON FUNCTIONS:

- to input new settings, touch the **SET (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **CURRENT** sub-menu.

In the input mode, the **UP (F2)** and **DOWN (F3)** buttons will become active and the background colour of the active field will be changed to white.

Demand interval can be set from 60 secs to 1800 secs in steps of 60 secs whereas the number of sub interval blocks can be set from 2 to 120.

NOTE:
The demand interval in secs must be whole number multiples of the number of sub intervals and the sub interval period must be longer than 15 secs.

TOUCH BUTTON FUNCTIONS:

- to increase the number, touch the **UP (F2)** button.
- to decrease the number, touch the **DOWN (F3)** button.
- to select the next field to change, touch the **NEXT (F4)** button and repeat the above 2 steps.
- to save the settings and/or return to the **Demand Current** page, touch the **BACK (F1)** button.

NOTE:
When the Demand Interval is changed, the sub intervals defaults to 2. This can however, be changed separately when the **NEXT (F4)** button is touched.

The user will be prompted to confirm the saving of settings.

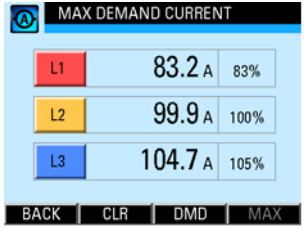
TOUCH BUTTON FUNCTIONS:

- to abort saving the settings and return to the **Demand Current** page, touch the **NO (F3)** button.
- otherwise, touch the **YES (F2)** button to save the settings and the user will be prompted for password authentication as per section 3.2

3.4.7
MAX DEMAND CURRENT

In the **Max Demand Current** page, the recorded maximum demand current for each phase is displayed as shown in Fig 35. The neutral maximum demand current will NOT be displayed.

Fig 35 : ***Max Demand Current*** *page*



TOUCH BUTTON FUNCTIONS:

- touch the **BACK (F1)** button to return to the **CURRENT** sub-menu.
- to jump to the **Demand Current** page, touch the **DMD (F3)** button.
- to reset the recorded maximum demand current values to zero, touch the **CLR (F2)** button.

In clearing the recorded maximum values, the user will be prompted with a **Clear demand log**? confirmation.

TOUCH BUTTON FUNCTIONS:

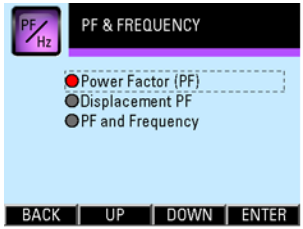
- to confirm clearing the recorded values, touch the **YES (F3)** button.
- otherwise, touch the **NO (F2)** button.

In any case, the meter will return to the **Demand Current** page.

3.5 PF & FREQUENCY SUB-MENU

The **PF & FREQUENCY** sub-menu allows the selection of parameter pages as shown in Fig 36:

*Fig 36 : **PF & FREQUENCY** sub-menu*



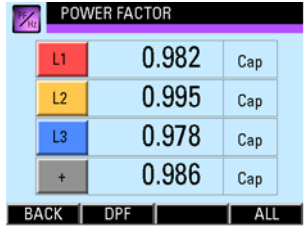
TOUCH BUTTON FUNCTIONS:

- to select the parameter page of interest, touch either the **UP (F2)** or **DOWN (F3)** button until the parameter item is highlighted (within a dashed rectangular box and a RED dot to its left). To confirm this selection, touch the **ENTER (F4)** button.
- to return to the **MAIN MENU**, touch the **BACK (F1)** button.

3.5.1 POWER FACTOR (PF)

The **Power Factor** page shows the total power factor for each phase as well as the overall total power factor as shown in Fig 37. The total power factor is derived from the phase RMS voltage, RMS current and active power. Please see section C.4 in Appendix C for more details.

*Fig 37 : **Power Factor** page*



The right-most column of the display indicates the capacitive or inductive nature of the power factor.

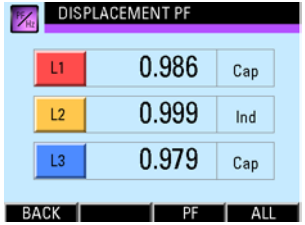
TOUCH BUTTON FUNCTIONS:

- to jump to the **Displacement PF** page, touch the **DPF (F2)** button.
- to jump to the **PF & FREQUENCY** page, touch the **ALL (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **PF & FREQUENCY** sub-menu.

3.5.2 DISPLACEMENT PF

The **Displacement PF** page shows the displacement power factor for each phase as shown in Fig 38. The displacement power factor is derived from the fundamental component of the phase voltage, current and fundamental active power. Please see section C.4 in Appendix C for more details.

*Fig 38 : **Displacement PF** page*



The right-most column of the display indicates the capacitive or inductive nature of the power factor.

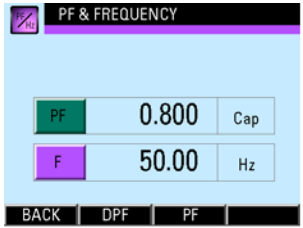
TOUCH BUTTON FUNCTIONS:

- to jump to the **Power Factor** page, touch the **PF (F3)** button.
- to jump to the **PF & FREQUENCY** page, touch the **ALL (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **PF & FREQUENCY** sub-menu.

3.5.3 PF & FREQUENCY

The **PF & Frequency** page shows the summary of the overall total power factor as well as the power frequency as shown in Fig 39:

*Fig 39 : **PF & FREQUENCY** page*



The right-most column of the total power factor display indicates the capacitive or inductive nature of the power factor.

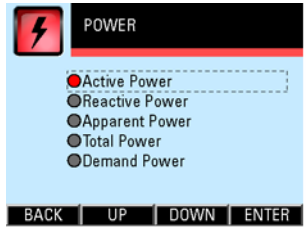
TOUCH BUTTON FUNCTIONS:

- to jump to the **Displacement PF** page, touch the **DPF (F2)** button.
- to jump to the **Power Factor** page, touch the **PF (F3)** button.
- otherwise, touch the **BACK (F1)** button to return to the **PF & FREQUENCY** sub-menu.

3.6 POWER SUB-MENU

The **POWER** sub-menu allows the selection of power parameter pages as shown in Fig 40:

*Fig 40 : **POWER** sub-menu*



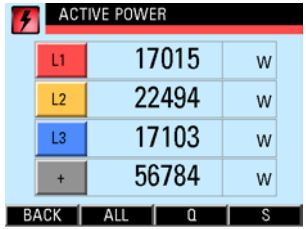
TOUCH BUTTON FUNCTIONS:

- to select the parameter page of interest, touch either the **UP (F2)** or **DOWN (F3)** button until the parameter item is highlighted (within a dashed rectangular box and a RED dot to its left). To confirm this selection, touch the **ENTER (F4)** button.
- to return to the **MAIN MENU**, touch the **BACK (F1)** button.

3.6.1 ACTIVE POWER

The **Active Power** page shows the nett active power for each phase as well as the total nett active power as shown in Fig 41:

*Fig 41 : **Active Power** page*



TOUCH BUTTON FUNCTIONS:

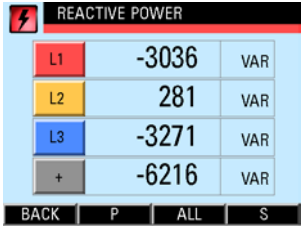
- to jump to the **Total Power** page, touch the **ALL (F2)** button.
- to jump to the **Reactive Power** page, touch the **Q (F3)** button.
- to jump to the **Apparent Power** page, touch the **S (F4)** button.

- otherwise, touch the **BACK (F1)** button to return to the **POWER** sub-menu.

3.6.2 REACTIVE POWER

The **Reactive Power** page shows the nett reactive power for each phase as well as the total nett reactive power as shown in Fig 42:

*Fig 42 : **Reactive Power** page*



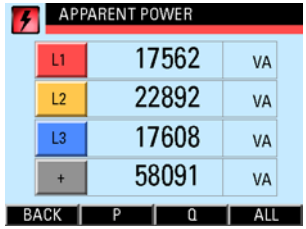
TOUCH BUTTON FUNCTIONS:

- to jump to the **Active Power** page, touch the **P (F2)** button.
- to jump to the **Total Power** page, touch the **ALL (F3)** button.
- to jump to the **Apparent Power** page, touch the **S (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **POWER** sub-menu.

3.6.3 APPARENT POWER

The **Apparent Power** page shows the nett apparent power for each phase as well as the total nett apparent power as shown in Fig 43:

*Fig 43 : **Apparent Power** page*



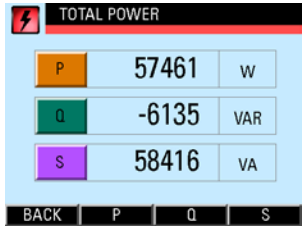
TOUCH BUTTON FUNCTIONS:

- to jump to the **Active Power** page, touch the **P (F2)** button.
- to jump to the **Reactive Power** page, touch the **Q (F3)** button.
- to jump to the **Total Power** page, touch the **ALL (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **POWER** sub-menu.

3.6.4 TOTAL POWER

The **Total Power** page shows the total nett power flow for active, reactive and apparent power as shown in Fig 44:

*Fig 44 : **Total Power** page*



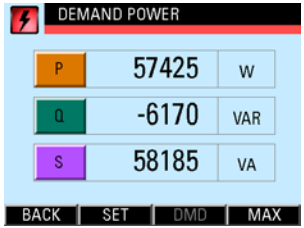
TOUCH BUTTON FUNCTIONS:

- to jump to the **Active Power** page, touch the **P (F2)** button.
- to jump to the **Reactive Power** page, touch the **Q (F3)** button.
- to jump to the **Apparent Power page**, touch the **S (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **POWER** sub-menu.

3.6.5
DEMAND POWER

The **Demand Power** page shows the demand power averaged over a demand interval for active, reactive and apparent power as shown in Fig 45. Please see section C.1 in Appendix C for details.

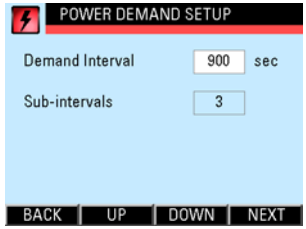
*Fig 45 : **Demand Power** page*



TOUCH BUTTON FUNCTIONS:

- to jump to the **Power Demand Setup** page as shown in Fig 46, touch the **SET (F2)** button.
- to jump to the **Max Demand** page, touch the **MAX (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **POWER** sub-menu.

*Fig 46 : **Power Demand Setup** page*



TOUCH BUTTON FUNCTIONS:

- to input new settings, touch the **SET (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **POWER** sub-menu.

In the input mode, the **UP (F2)** and **DOWN (F3)** buttons will become active and the background colour of the active field will be changed to white.

Demand interval can be set from 60 secs to 1800 secs in steps of 60 secs whereas the number of sub interval blocks can be set from 2 to 120.

NOTE:

The demand interval in secs must be whole number multiples of the number of sub intervals and the sub interval period must be longer than 15 sec.

TOUCH BUTTON FUNCTIONS:

- to increase the number, touch the **UP (F2)** button.
- to decrease the number, touch the **DOWN (F3)** button.
- to select the next field to change, touch the **NEXT (F4)** button and repeat the above 2 steps.
- to save the settings and/or return to the **Demand Power** button page, touch the **BACK (F1)** buttons.

NOTE:

When the **Demand Interval** is changed, the sub intervals defaults to 2. This can however, be changed separately when the **NEXT (F4)** button is touched.

The user will be prompted to confirm the saving of settings.

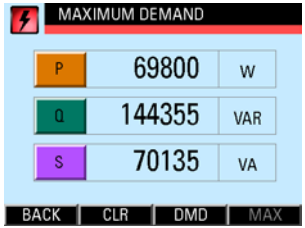
TOUCH BUTTON FUNCTIONS:

- to abort saving the settings and return to the **Demand Power** page, touch the **NO (F3)** button.
- otherwise, touch the **YES (F2)** button to save the settings and the user will be prompted for password authentication as per section 3.2.

3.6.6
MAX DEMAND

In the **Max Demand** page, the recorded maximum demand power for active, reactive and apparent power is displayed as shown in Fig 47:

*Fig 47 : **Max Demand** page*



TOUCH BUTTON FUNCTIONS:

- touch the **BACK (F1)** button to return to the **POWER** sub-menu.
- to jump to the **Demand Power** page, touch the **DMD (F3)** button.
- to reset the recorded maximum demand power values to zero, touch the **CLR (F2)** button.

In clearing the recorded maximum values, the user will be prompted with a **Clear demand log**? confirmation.

TOUCH BUTTON FUNCTIONS:

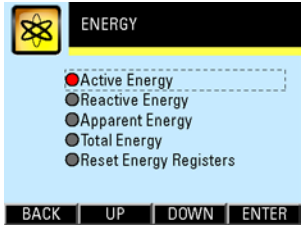
- to confirm clearing the recorded values, touch the **YES (F3)** button.
- otherwise, touch the **NO (F2)** button.

In any case, the meter will return to the **Demand Power** page.

3.7 ENERGY SUB-MENU

The **ENERGY** sub-menu allows the selection of energy parameter pages as shown in Fig 48:

*Fig 48 : **ENERGY** sub-menu*



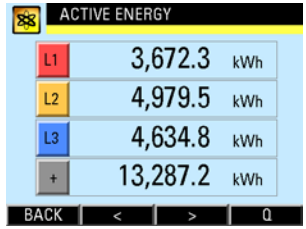
TOUCH BUTTON FUNCTIONS:

- to select the parameter page of interest, touch either the **UP (F2)** or **DOWN (F3)** button until the parameter item is highlighted (within a dashed rectangular box and a RED dot to its left). To confirm this selection, touch the **ENTER (F4)** button.
- to return to the **MAIN MENU**, touch the **BACK (F1)** button

3.7.1 ACTIVE ENERGY

The Active Energy page shows the nett active energy for each phase as well as the total nett active energy as shown in Fig 49:

*Fig 49 : **Active Energy** page*



The displayed values may be incomplete due to the limited display width. Use the **<** and **>** buttons to view the complete values.

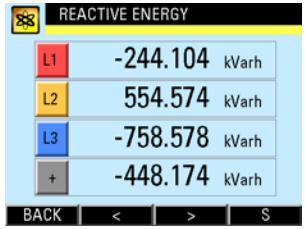
TOUCH BUTTON FUNCTIONS:

- to view the digits on the right of the displayed numbers, touch the **< (F1)** button.
- to view the digits on the left of the displayed numbers, touch the **> (F2)** button.
- to jump to the **Reactive Energy** page, touch the **Q (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **ENERGY** sub-menu.

3.7.2 REACTIVE ENERGY

The **Reactive Energy** page shows the nett reactive energy for each phase as well as the total nett reactive energy as shown in Fig 50:

*Fig 50 : **Reactive Energy** page*



The displayed values may be incomplete due to the limited display width. Use the **<** and **>** buttons to view the complete values.

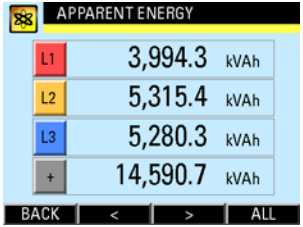
TOUCH BUTTON FUNCTIONS:

- to view the digits on the right of the displayed numbers, touch the **< (F1)** button.
- to view the digits on the left of the displayed numbers, touch the **> (F2)** button.
- to jump to the **Apparent Energy** page, touch the **S (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **ENERGY** sub-menu.

3.7.3 APPARENT ENERGY

The **Apparent Energy** page shows the nett apparent energy for each phase as well as the total nett apparent energy as shown in Fig 51:

*Fig 51 : **Apparent Energy** page*



The displayed values may be incomplete due to the limited display width. Use the **<** and **>** buttons to view the complete values.

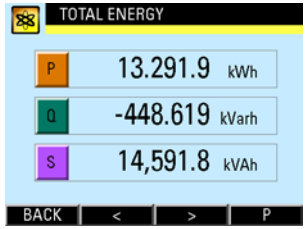
TOUCH BUTTON FUNCTIONS:

- to view the digits on the right of the displayed numbers, touch the **< (F1)** button.
- to view the digits on the left of the displayed numbers, touch the **> (F2)** button.
- to jump to the **Total Energy** page, touch the **ALL (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **ENERGY** sub-menu.

3.7.4 TOTAL ENERGY

The **Total Energy** page shows the total nett energy flow for active, reactive and apparent energy as shown in Fig 52:

*Fig 52 : **Total Energy** page*



The displayed values may be incomplete due to the limited display width. Use the **<** and **>** buttons to view the complete values.

TOUCH BUTTON FUNCTIONS:

- to view the digits on the right of the displayed numbers, touch the **< (F1)** button.
- to view the digits on the left of the displayed numbers, touch the **> (F2)** button.
- to jump to the **Active Energy** page, touch the **P (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **ENERGY** sub-menu

3.7.5 RESET ENERGY COUNTERS

When the **Reset Energy Counter** page is selected, the user will be prompted with a **Clear All Registers?** confirmation.

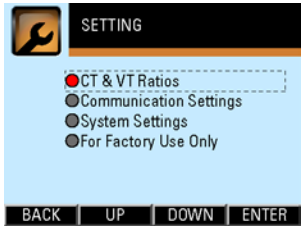
TOUCH BUTTON FUNCTIONS:

- to abort clearing the energy register values, touch the **NO (F2)** button.
- otherwise, touch the **YES (F2)** button to clear the energy registers and the user will be prompted for password authentication as in section 3.2.

3.8 SETTING SUB-MENU

The **SETTING** sub-menu allows the selection of parameter pages as shown in Fig 53:

*Fig 53 : **SETTING** sub-menu*



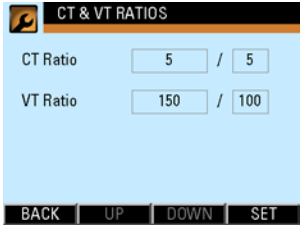
TOUCH BUTTON FUNCTIONS:

- to select the parameter page of interest, touch either the **UP (F2)** or **DOWN (F3)** button until the parameter item is highlighted (within a dashed rectangular box and a RED dot to its left). To confirm this selection, touch the **ENTER (F4)** button.
- to return to the **MAIN MENU**, touch the **BACK (F1)** button.

3.8.1 CT & VT RATIOS

The **CT & VT Ratios** page as shown in Fig 54 displays and allows the setting of the current transformer (CT) and voltage transformer (VT) ratios used to scale the metering inputs.

*Fig 54 : **CT & VT Ratios** page*



The CT primary current input can be set from 5 A to 50,000 A but the CT secondary current output is fixed at 5A full scale.

The VT primary voltage input can be set from 60 V to 50,000 V and the VT secondary voltage output can be set from 60 V to 300V full scale.

NOTE:
The VT secondary voltage must be lower than the VT primary voltage.

TOUCH BUTTON FUNCTIONS:

- to input new settings, touch the **SET (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **SETTING** sub-menu

In the input mode, the **UP (F2)** and **DOWN (F3)** buttons will become active and the background colour of the active field will be changed to white.

TOUCH BUTTON FUNCTIONS:

- to increase the number, touch the **UP (F2)** button.
- to decrease the number, touch the **DOWN (F3)** button.
- to select the next field to change, touch the **NEXT (F4)** button and repeat the above 2 steps.
- to save the settings and/or return to the **CT & VT Ratios** sub-page, touch the **BACK (F1)** button.

The user will be prompted to confirm the saving of settings.

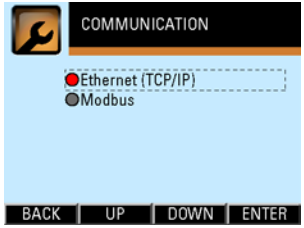
TOUCH BUTTON FUNCTIONS:

- to abort saving the settings, touch the **NO (F3)** button to return to the **SETTING** sub-menu.
- otherwise, touch the **YES (F2)** button to save the settings and the user will be prompted for password authentication as in section 3.2.

3.8.2 COMMUNICATION SETTINGS

The **Communication Settings** page displays and allows the setting of the communication parameters as shown in Fig 55.

*Fig 55 : **Communication Settings** page*



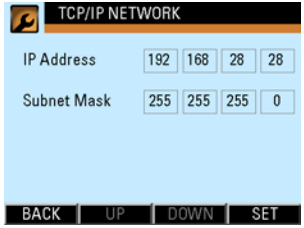
TOUCH BUTTON FUNCTIONS:

- to select the parameter sub-page of interest, touch either the **UP (F2)** or **DOWN (F3)** button until the parameter item is highlighted (within a dashed rectangular box and a RED dot to its left). To confirm this selection, touch the **ENTER (F4)** button.
- to return to the **SETTING** sub-menu, touch the **BACK (F1)** button.

3.8.2.1 ETHERNET (TCP/IP)

The **Ethernet (TCP/IP)** sub-page as shown in Fig 56 displays and allows the setting of TCP/IP network parameters for the purpose of accessing the webpage and the Modbus TCP/IP server.

*Fig 56 : **Ethernet (TCP/IP)** sub-page*



The default TCP/IP setting is as follows:

IP address: 192.168.28.28
Subnet mask: 255.255.255.0

NOTE:
The server is not DHCP enabled, so the IP address has to be assigned manually.

TOUCH BUTTON FUNCTIONS:

- to input new settings, touch the **SET (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **Communication Setting** page.

In the input mode, the **UP (F2)** and **DOWN (F3)** buttons will become active and the background colour of the active field will be changed to white. Each field in the IP address and subnet mask must be numerical from 0 to 255.

TOUCH BUTTON FUNCTIONS:

- to increase the number, touch the **UP (F2)** button.
- to decrease the number, touch the **DOWN (F3)** button.
- to select the next field to change, touch the **NEXT (F4)** button and repeat the above 2 steps.
- to save the settings and/or return to the **Ethernet (TCP/IP)** sub-page, touch the **BACK (F1)** button.

The user will be prompted to confirm the saving of settings.

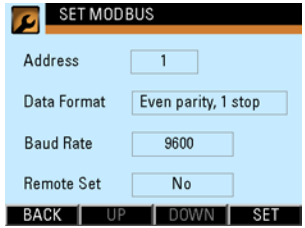
TOUCH BUTTON FUNCTIONS:

- to abort saving the settings, touch the **NO (F3)** button to return to the **Ethernet (TCP/IP)** sub-page.
- otherwise, touch the **YES (F2)** button to save the settings and the user will be prompted for password authentication as in section 3.2.

3.8.2.2 MODBUS

The **Modbus** sub-page displays and allows the setting of Modbus communication parameters as shown in Fig 57.

*Fig 57 : **Modbus** sub-page*



TOUCH BUTTON FUNCTIONS:

- to input new settings, touch the **SET (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **Communication Setting** page.

In the input mode, the **UP (F2)** and **DOWN (F3)** buttons will become active and the background colour of the active field will be changed to white.

TOUCH BUTTON FUNCTIONS:

- to increase the number or select the next option, touch the **UP (F2)** button.
- to decrease the number or select the prior option, touch the **DOWN (F3)** button.
- to select the next field to change, touch the **NEXT (F4)** button and repeat the above 2 steps.
- to save the settings and/or return to the **Modbus** sub-page, touch the **BACK (F1)** button.

The unit **Address** can be set from 1 to 247.

The serial **Data Format** options are shown in Table 3.

Table 3 : RS-485 data format

Parity	Stop
Even	1
Odd	1
No	2
No	1

Baud Rate can be set as either 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400.

Enabling the **Remote Set** allows the remote terminal to **read and write** the meter settings via Modbus RTU or Modbus TCP/IP, otherwise the setting data can only be read.

Before the saving of settings, the user will be prompted for confirmation.

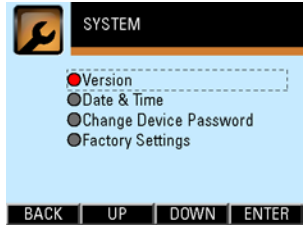
TOUCH BUTTON FUNCTIONS:

- to abort saving the settings, touch the **NO (F3)** button to return to the **Modbus** sub-page.
- otherwise, touch the **YES (F2)** button to save the settings and the user will be prompted for password authentication as in section 3.2.

3.8.3 SYSTEM SETTINGS

The System Settings page displays the system parameters and allows the adjustment of time, date and password as shown in Fig 58:

*Fig 58 : **System Settings** page*



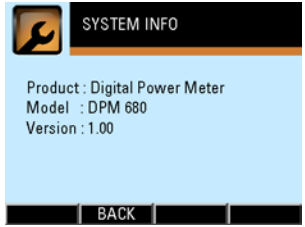
TOUCH BUTTON FUNCTIONS:

- to select the parameter sub-page of interest, touch either the **UP (F2)** or **DOWN (F3)** button until the parameter item is highlighted (within a dashed rectangular box and a RED dot to its left). To confirm this selection, touch the **ENTER (F4)** button.
- to return to the **SETTING** sub-menu, touch the **BACK (F1)** button.

3.8.3.1 VERSION

The Version sub-page displays the basic identity information of the power meter as shown in Fig 59:

*Fig 59 : **Version** sub-page*



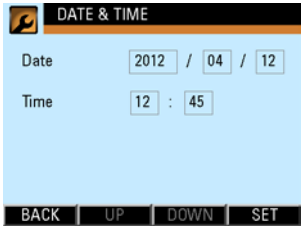
TOUCH BUTTON FUNCTIONS:

- to return to the **System Settings** page, touch the **BACK (F2)** button.

3.8.3.2 DATE & TIME

The **Date & Time** sub-page displays and allows the setting of date and time as shown in Fig 60:

*Fig 60 : **Date & Time** sub-page*



TOUCH BUTTON FUNCTIONS:

- to input new settings, touch the **SET (F4)** button.
- otherwise, touch the **BACK (F1)** button to return to the **System Settings** page.

In the input mode, the **UP (F2)** and **DOWN (F3)** buttons will become active and the background colour of the active field will be changed to white.

TOUCH BUTTON FUNCTIONS:

- to increase the number, touch the **UP (F2)** button.
- to decrease the number, touch the **DOWN (F3)** button.
- to select the next field to change, touch the **NEXT (F4)** button and repeat the above 2 steps.
- to save the settings and/or return to the **Date & Time** sub-page, touch the **BACK (F1)** button.

The date format is **year** / **month** / **day**.

The time is **hour : minute** in 24-hour format.

The year is settable from 2000 to 2050 and the settable day of the month depends on the selected month and the applicable leap year.

Before the saving of settings, the user will be prompted for comfirmation.

TOUCH BUTTON FUNCTIONS:

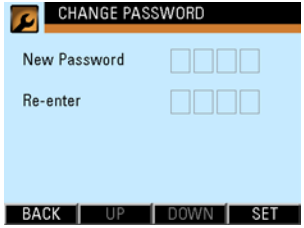
- to abort saving the settings, touch the **NO (F3)** button to return to the **Date & Time** sub-page.
- otherwise, touch the **YES (F2)** button to save the settings and the user will be prompted for password authentication as in section 3.2.

3.8.3.3 CHANGE DEVICE PASSWORD

To enter the **Change Device Password** sub-page, the user will be prompted for password authentication as in section 3.2.

When the correct password is authenticated, the **Change Device Password** sub-page will appear as shown in Fig 61:

*Fig 61 : **Change Device Password** sub-page*



TOUCH BUTTON FUNCTIONS:

- to abort the saving operation and return to the **System Settings** page, touch the **BACK (F1)** button.
- otherwise, touch the **SET (F4)** button to input the password.

In the input mode, the **UP (F2)** and **DOWN (F3)** buttons will become active and the background colour of the active field will be changed to white.

TOUCH BUTTON FUNCTIONS:

- to increase the number, touch the **UP (F2)** button.
- to decrease the number, touch the **DOWN (F3)** button.
- to select the next field to change, touch the **NEXT (F1)** button and repeat the above 2 steps.
- when all the fields are filled, touch the **ENTER (F4)** button and the **SAVE (F1)** button will appear.
- touch the **SAVE (F1)** button and if the **New Password** does not match with the **Re-entered** password, an error message will appear and the above process has to be repeated unless aborted by touching the **BACK (F1)** button. If the password is correct, it will be saved and the display will return to the **System Settings** page.

3.8.3.4 FACTORY SETTINGS

The **Factory Settings** sub-page displays a warning message that all settings (and device password) will be reset to the factory default values except for the energy register values. (The energy registers can be cleared through the **Reset Energy Counter** page).

TOUCH BUTTON FUNCTIONS:

- to abort resetting the meter to default values, touch the **NO (F3)** button to return to the **System Settings** page.
- otherwise, touch the **YES (F2)** button and the user will be prompted for password authentication as in section 3.2.

The password for this purpose is the factory setting password. Please see section 3.2 for more details.

3.8.4 FOR FACTORY USE ONLY

The access to the **For Factory Use Only** page is restricted to factory personnel only.

4 WEBPAGE OPERATIONS

The webpages stored in the meter's built-in server can be accessed by a browser. However, it is recommended to use IE7 or higher versions.

NOTE:
Please ensure the LAN is properly connected to the meter and the TCP/IP setting is properly configured both at the meter and the client and/or router.

4.1 VOLTAGE AND CURRENT PAGE

The **Voltage and Current** webpage can be accessed either by typing the IP address in the URL input of the web browser or by clicking on the **Voltage & Current** link in any page. In systems where NetBIOS is implemented, the webpage may also be accessed through **http://dpm680**, provided the client or PC is in the same subnet. The main webpage as shown in Fig 62 should appear.

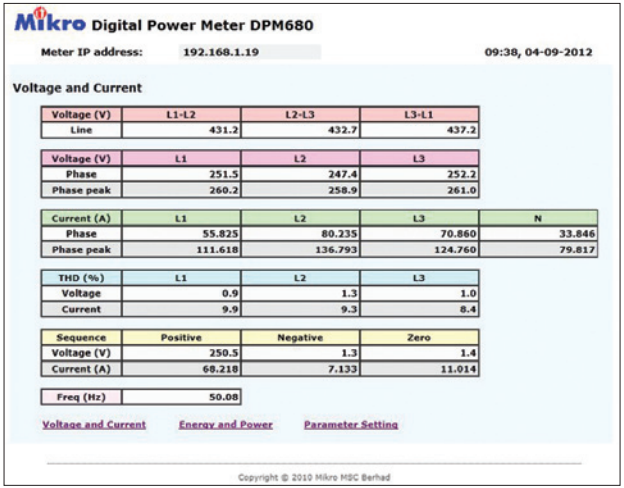
This main webpage displays the following parameters:

- line voltage: between any 2 phases.
- phase voltage: all phases.
- maximum/peak phase voltage: all phases.
- current: all phases and neutral.
- maximum/peak current: all phases & neutral.
- current THD: all phases.
- voltage THD: all phases.
- voltage sequence component: positive, negative & zero.
- current sequence component: positive, negative & zero.
- line frequency.
- time & date

By clicking on the links at the bottom of the webpage, the browser will download the corresponding webpage.

Clicking on the **Voltage and Current** link will reload this webpage.

Fig 62 : Voltage and Current webpage display



Mikro Digital Power Meter DPM680

Meter IP address: 192.168.1.19 09:38, 04-09-2012

Voltage and Current

Voltage (V)	L1-L2	L2-L3	L3-L1
Line	431.2	432.7	437.2

Voltage (V)	L1	L2	L3
Phase	251.5	247.4	252.2
Phase peak	260.2	258.9	261.0

Current (A)	L1	L2	L3	N
Phase	55.825	80.235	70.860	33.846
Phase peak	111.618	136.793	124.760	79.817

THD (%)	L1	L2	L3
Voltage	0.9	1.3	1.0
Current	9.9	9.3	8.4

Sequence	Positive	Negative	Zero
Voltage (V)	250.5	1.3	1.4
Current (A)	68.218	7.133	11.014

Freq (Hz)	50.08

Voltage and Current Energy and Power Parameter Setting

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4.2 ENERGY AND POWER PAGE

The **Energy and Power** webpage can be downloaded by clicking on the **Energy and Power** link in any page. The webpage as shown in Fig 63 should appear.

This webpage displays the following parameters:

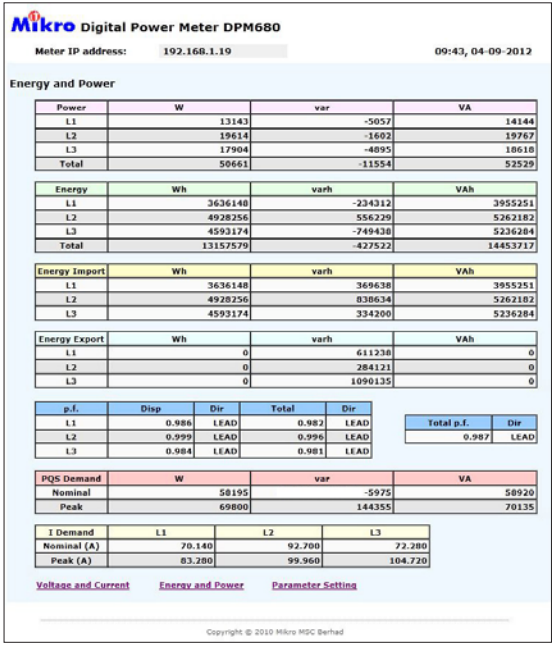
- nett active, reactive and apparent power: all phases & total.
- nett active, reactive and apparent energy: all phases & total.
- imported active, reactive and apparent energy: all phases.
- exported active, reactive and apparent energy: all phases.
- displacement and total power factor: all phases.
- overall total power factor.
- nominal active, reactive & apparent power demand.
- maximum/peak active, reactive and apparent power demand.
- nominal thermal current demand: all phases.
- maximum/peak power demand: all phases.
- time & date.

The imported energy is the energy flow from the supply end to the load while the exported energy is the energy flow from the load to the supply end. These parameters are NOT available for display at the meter.

By clicking on the links at the bottom of the webpage, the browser will download the corresponding webpage.

Clicking on the **Energy and Power** link will reload this webpage.

Fig 63 : Energy and Power webpage display



Mikro Digital Power Meter DPM680

Meter IP address: 192.168.1.19 09:43, 04-09-2012

Energy and Power

Power	W	var	VA
L1	13143	-5057	14144
L2	19614	-1602	19767
L3	17904	-4895	18618
Total	50661	-11554	52529

Energy	Wh	varh	VAh
L1	3636148	-234312	3955251
L2	4928256	556229	5262182
L3	4593174	-749438	5236284
Total	13157579	-427522	14453717

Energy Import	Wh	varh	VAh
L1	3636148	369638	3955251
L2	4928256	838634	5262182
L3	4593174	334200	5236284

Energy Export	Wh	varh	VAh
L1	0	611238	0
L2	0	284121	0
L3	0	1090135	0

p.f.	Disp	Dir	Total	Dir
L1	0.986	LEAD	0.982	LEAD
L2	0.999	LEAD	0.996	LEAD
L3	0.984	LEAD	0.981	LEAD

Total p.f.	Dir
0.987	LEAD

PQS Demand	W	var	VA
Nominal	58195	-5975	58920
Peak	69800	144355	70135

I Demand	L1	L2	L3
Nominal (A)	70.140	92.700	72.280
Peak (A)	83.280	99.960	104.720

Voltage and Current Energy and Power Parameter Setting

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4.3 PARAMETER SETTING PAGE

The **Parameter Setting** webpage can be downloaded by clicking on the **Parameter Setting** link in any page. The following main webpage as shown in Fig 64 should appear.

In this webpage, the user is allowed to modify the following displayed parameters:

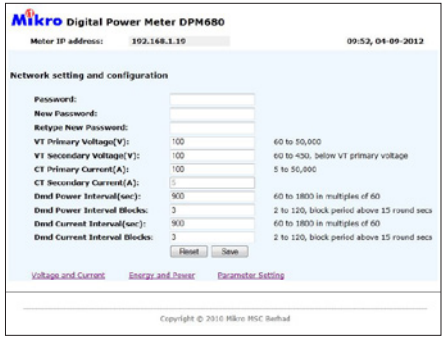
- VT primary voltage
- VT secondary voltage
- CT primary current
- power demand interval
- power demand sub interval blocks
- thermal current demand interval
- thermal current demand sub interval blocks

NOTE:
The CT secondary current is fixed at 5A.

By clicking on the links at the bottom, the brower will download the corresponding webpage.

Clicking on the **Parameter Setting** link will reload this webpage.

Fig 64 : Energy and Power webpage display



Mikro Digital Power Meter DPM680

Meter IP address: 192.168.1.19 09:52, 04-09-2012

Network setting and configuration

Password:		
New Password:		
Retype New Password:		
VT Primary Voltage(V):	100	60 to 50,000
VT Secondary Voltage(V):	100	60 to 430, below VT primary voltage
CT Primary Current(A):	100	5 to 50,000
CT Secondary Current(A):	5	
Dmd Power Interval(sec):	900	60 to 1800 in multiples of 60
Dmd Power Interval Blocks:	3	2 to 120, block period above 15 round secs
Dmd Current Interval(sec):	900	60 to 1800 in multiples of 60
Dmd Current Interval Blocks:	3	2 to 120, block period above 15 round secs

Reset Save

Voltage and Current Energy and Power Parameter Setting

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The input parameter is checked according to the following restrictions:

- the VT primary voltage is between 60V and 50,000V.
- the VT secondary voltage is between 60V and 300V AND it is lower than the VT primary voltage.
- the CT primary current is between 5A and 50,000A.
- the interval for both thermal current demand and power demand is between 60 and 1,800 in multiples of 60.
- the demand interval for both power and thermal current demands in secs must be whole number multiples of their respective sub interval blocks and,
- the sub interval period must be longer than 15 secs.

If any of the above restrictions is violated, the user will be prompted to review the violated restriction, highlighted in red.

4.3.1 WEBPAGE PASSWORD

To authenticate the changing of parameters, a valid webpage password must be entered. The factory default webpage password is dpm680.

The user is advised to set their own webpage password for security reasons. This be done by entering the new webpage password in both the **New Password** and **Retype New Password** fields while entering current webpage password in the **Password** field.

NOTE:
The maximum length of the webpage password is 15 characters.

If an invalid webpage password is entered, the parameter changes will not take place and the **Invalid Password or Setting** error message window will appear, urging the user to retry.

5 MODBUS OPERATIONS

The meter is accessible through either Modbus-RTU or Modbus TCPIP.

NOTE:
It is NOT advisable to access the meter through both RTU and TCP/IP at the same time.

The table of variables and their respective addresses are similar for both protocols and they are listed in Table B.1 in Appendix B.

The Modbus registers are divided into 4 broad categories:

- Device Information Data
- Communication Information Data
- Setting Data
- Operations Data

The registers in ALL categories can be accessed either through the function code 03 or 04. Only Setting Data registers can be written over through function code 06. Function code 06 can only be enabled through the meter touch buttons – please see section 3.8.2.2.

The physical interface for Modbus-RTU is isolated RS-485. Therefore, the limitations and restrictions according to the RS-485 standard must be observed. In particular, the total length should not be more than 1,000 m per network and each network should be daisy- chained with not more than total 32 devices.

In the Modbus TCPIP interface, the physical interface is 10M/100M Base T Ethernet, based on IPv4. The meter may auto-negotiate with the PC or router whenever possible to run at 100M Base T speed if available.

NOTE:
The device ID is fixed at 1 for Modbus TCP/IP.

The Modbus server is limited to opening no more than 2 TCP/IP sockets, i.e. it can serve no more than 2 clients.

The Modbus TCP/IP server shares the same TCP/IP stack with the webserver, therefore sharing the same IP address and subnet mask. As such, DHCP also not enabled for the Modbus TCP/IP server.

6
TROUBLESHOOTING GUIDE

The meter contains no user serviceable parts. Please contact your dealer or local sales representative should the meter require maintenance service.

Table 4 shows some basic checking that can be done at the user level to identify some possible causes of problems and possible solutions.

Please do NOT open the meter. Doing so will void the warranty and may endanger the user.

Table 4 Troubleshooting guide

Problem	Possible Causes	Possible Solution
LCD display not illuminating	No power from the meter control power supply to the meter.	Verify meter control power connection to the meter, including fuses.
Meter displaying unexpected value, phase order and polarity	Incorrect setting	Verify the meter settings as per section section 2.3
	Improper connection	Verify connections as per section 2.2, esp the polarity and phase order
Meter unable to communicate with remote terminal	Improper termination	Verify connections as per section 2.2, esp the polarity
	Improper termination	Verify the network terminator is installed properly
	Incorrect setting	Verify the meter settings as per section 3.8.2
	Incorrect setting	Verify the network settings as per section 2.4

APPENDIX A
SPECIFICATIONS

Table A.1 below shows the list of measurement parameters and their associated limits and resolution. It also shows the display, communication, environmental and mechanical attributes of the meter, including standards compliance.

Table A.1 Specification list

No	Parameter		Max value	Min value	Resolution	Accuracy
1. Voltage						
1.1	Direct line voltage	L1-2, L2-3 & L3-1	480 V	10 V	0.1 V	-
1.2	Direct phase voltage	L1-N, L2-N & L3-N	300 V	10 V	0.1 V	0.2% of full scale
1.3	Indirect phase voltage through VT	L1-N, L2-N & L3-N	50 kV	-	-	-
1.4	Peak phase voltage	L1-N, L2-N & L3-N	50 kV	-	-	-
2. Current						
2.1	Direct phase current through CT	L1, L2 & L3	10 A	5 mA	1 mA	0.2% of full scale
2.2	Indirect phase current through CT	L1, L2 & L3	50 kA	-	-	-
2.3	Peak phase current	L1, L2 & L3	50 kA	-	-	-
2.4	Pulse withstand	1 sec	100A	-	-	-

Table A.1 Specification list

No	Parameter		Max value	Min value	Resolution	Accuracy
3. VT and CT						
3.1	CT primary current	L1, L2 & L3	5 A	50 kA	1 A	-
3.2	Current input burden	L1, L2, L3 & N	0.05 VA	-	-	-
3.3	VT primary voltage	L1-N, L2-N & L3-N	60 V	50 kV	1 V	-
3.4	VT secondary voltage	L1-N, L2-N & L3-N	60 V	300V	1 V	-
4. Power						
4.1	Active power	L1, L2, L3 & Total	$\pm 2 \times 10^9$ W	-	-	0.5%
4.2	Reactive power	L1, L2, L3 & Total	$\pm 2 \times 10^9$ VAR	-	-	0.5%
4.3	Apparent power	L1, L2, L3 & Total	$\pm 2 \times 10^9$ VA	-	-	0.5%
5. Energy						
5.1	Active energy	L1, L2, L3 & Total	$\pm 9 \times 10^{18}$ Wh	-	1 Wh	IEC 62053-22 Class 0.5
5.2	Reactive energy	L1, L2, L3 & Total	$\pm 9 \times 10^{18}$ Varh	-	1 Varh	IEC 62053-23 Class 2
5.3	Apparent energy	L1, L2, L3 & Total	$\pm 9 \times 10^{18}$ VAh	-	1 VAh	-
6. Power factor						
6.1	Total power factor	L1, L2, L3 & Nett	1.000	0.5	0.001	0.5%, 1A to 5A
6.2	Displacement power factor	L1, L2 & L3	1.000	0.5	0.001	0.5%, 1A to 5A

Table A.1 Specification list

No	Parameter		Max value	Min value	Resolution	Accuracy
7. Power quality						
7.1	Voltage THD	L1, L2 & L3	100.0%	-	0.1%	-
7.2	Current THD	L1, L2 & L3	100.0%	-	0.1%	-
7.3	Harmonics order display	L1, L2, L3 & Total	32nd	Fundamental		-
7.4	Frequency	-	65.00 Hz	45.00 Hz	0.01 Hz	0.2%
8. Sequence components						
8.1	Sequence voltage	Positive, negative & zero	50 kV	-	-	-
8.2	Sequence current	Positive, negative & zero	50 kA	-	-	-
9. Demand						
9.1	Thermal demand current: nominal & max	L1, L2 & L3	50 kA	-	-	-
9.2	Max thermal current demand	L1, L2 & L3	50 kA	-	-	-
9.3	Power demand	P, Q & S	$\pm 2 \times 10^9$ W	-	-	-
9.4	Max power demand	P, Q & S	$\pm 2 \times 10^9$ W	-	-	-
9.5	Demand interval	Thermal current & power	1800 sec	60 sec	60 sec	-
9.6	Demand sub interval blocks	Thermal current & power	180	2	-	-
10. Waveform display						
10.1	Voltage full scale	L1, L2 & L3	110 V, 220 V & 440 V rms			-
10.2	Current full scale	L1, L2 & L3	20%, 40% & 80% of rated rms current			-

Table A.1 Specification list

No	Parameter		Max value	Min value	Resolution	Accuracy
11. Communication						
11.1	Baud rate	Isolated RS-485	300, 600, 1200, 2400, 4800, 9600, 19200 & 38400 bps			-
11.2	Data format	Isolated RS-485	Odd parity: 1 stop, even parity: 1 stop, no parity: 1 stop or 2 stop			-
11.3	Base T speed	Auto negotiate	100M	10M	-	-
12. Meter control power supply						
12.1	Supply voltage	AC	415 V	90 V	-	-
12.2	Supply voltage	DC	300 V	100 V		
12.3	Frequency		60 Hz	50 Hz	-	-
12.4	Power consumption		typ 3W		-	-
12.5	AC Sustained overload		500 V	-	-	-
13. Environmental						
13.1	Overvoltage category		IV			
13.2	Pollution degree		2			
13.3	Operating temperature		+55˚C	-10˚C	-	-
13.4	Storage temperature		+70˚C	-20˚C	-	-
13.5	Humidity	Non condensing	95%	5%		
14. Mechanical						
14.1	Mounting		DIN 43700 or ANSI C39.1			-
14.2	Dimension		96 x 96 x 83 mm			
14.3	Weight		400 g	-	-	-
14.4	Protection (as per IEC 60529)	Panel	IP 63			-
14.5		Body	IP 30			-
15. Standard compliance						
15.1	Electromagnetic Compatibility		IEC 61326-1			-
15.2	Safety		IEC 61010-1			-
15.3	Environment		IEC 60068-2			-

APPENDIX B
MODBUS TABLE

Table A.2 below shows the variables accessible through Modbus for both read and write functions.

Table B.1 Modbus table

	Read Only (Function 0x03 or 0x04)			
	Register	Description	Min unit	Range
Device Info Data	0000	Device type – main	$00;$03;$02	-
	0001			
	0002			
	0003	Device type – sub	$00	-
	0004	Version number- main	$00;$01	-
	0005			
	0006	Version number- sub	$00;$00	-
	0007			
Communication Info Data	1000	Device ID address	1	-
	1001	Parity selection	0=none, 1 stop 1=none, 2 stop 2=odd, 1 stop 3=even, 1stop	0 – 3
	1002	Baudrate selection	1=300 2=600 3=1200 4 = 2400 5=4800 6 =9600 7=19200 8 = 38400	0 – 8
	1003	IP Address byte1.byte2|byte3.byte4	0|0.0|0	0 - $FF | 0 - $FF : 0 - $FF | 0 - $FF
	1004			
	1005	Subnet mask byte1.byte2|byte3.byte4	0|0.0|0	0 - $FF | 0 - $FF : 0 - $FF | 0 - $FF
	1006			
Operations Data	4000	Real energy	1Wh	-$7FFFFFFFFFFFFFFF to +$7FFFFFFFFFFFFFFF
	4001			
	4002			
	4003			
	4004	Apparent energy	1VAh	-$7FFFFFFFFFFFFFFF to +$7FFFFFFFFFFFFFFF
	4005			
	4006			
	4007			
	4008	Reactive energy	1VArh	-$7FFFFFFFFFFFFFFF to +$7FFFFFFFFFFFFFFF
	4009			
	4010			
	4011			
	4012	Total real power	1W	-$7FFFFFFF to + $7FFFFFFF
	4013			
	4014	Total apparent power	1VA	-$7FFFFFFF to + $7FFFFFFF
	4015			
	4016	Total reactive power	1VAr	-$7FFFFFFF to + $7FFFFFFF
	4017			
	4018	Total power factor**	0.001	0 – 1000
	4019	Frequency	0.01Hz	4500 – 6500
	4020	Instantaneous current A	0.001A	0 - $FFFFFFFF
	4021			

Table B.1 Modbus table

	Read Only (Function 0x03 or 0x04)			
	Register	Description	Min unit	Range
Operations Data	4022	Instantaneous current B	0.001A	0 - $FFFFFFFF
	4023			
	4024	Instantaneous current C	0.001A	0 - $FFFFFFFF
	4025			
	4026	instantaneous current N	0.001A	0 - $FFFFFFFF
	4027			
	4028	Voltage line AB	0.1V	0 - $FFFFFFFF
	4029			
	4030	Voltage line BC	0.1V	0 - $FFFFFFFF
	4031			
	4032	Voltage line AC	0.1V	0 - $FFFFFFFF
	4033			
	4034	Voltage phase AN	0.1V	0 - $FFFFFFFF
	4035			
	4036	Voltage phase BN	0.1V	0 - $FFFFFFFF
	4037			
	4038	Voltage phase CN	0.1V	0 - $FFFFFFFF
	4039			
	4040	Real power A	1W	-$7FFFFFFF to + $7FFFFFFF
	4041			
	4042	Real power B	1W	-$7FFFFFFF to + $7FFFFFFF
	4043			
	4044	Real power C	1W	-$7FFFFFFF to + $7FFFFFFF
	4045			
	4046	Apparent power A	1VA	-$7FFFFFFF to + $7FFFFFFF
	4047			
	4048	Apparent power B	1VA	-$7FFFFFFF to + $7FFFFFFF
	4049			
	4050	Apparent power C	1VA	-$7FFFFFFF to + $7FFFFFFF
	4051			
	4052	Reactive power A	1VAr	-$7FFFFFFF to + $7FFFFFFF
	4053			
	4054	Reactive power B	1VAr	-$7FFFFFFF to + $7FFFFFFF
	4055			
	4056	Reactive power C	1VAr	-$7FFFFFFF to + $7FFFFFFF
	4057			
	4058	Current demand A	0.001Arms	0 - $FFFFFFFF
	4059			
	4060	Current demand B	0.001Arms	0 - $FFFFFFFF
	4061			
	4062	Current demand C	0.001Arms	0 - $FFFFFFFF
	4063			
	4064	Real power demand	1W	-$7FFFFFFF to + $7FFFFFFF
	4065			
	4066	Reactive power demand	1VAr	-$7FFFFFFF to + $7FFFFFFF
	4067			
	4068	Apparent power demand	1VA	-$7FFFFFFF to + $7FFFFFFF
	4069			

Table B.1 Modbus table

	Read Only (Function 0x03 or 0x04)			
	Register	Description	Min unit	Range
Operations Data	4070	Positive sequence current	0.001A	0 - $FFFFFFFF
	4071			
	4072	Negative sequence current	0.001A	0 - $FFFFFFFF
	4073			
	4074	Zero sequence current	0.001A	0 - $FFFFFFFF
	4075			
	4076	Positive sequence phase voltage	0.1V	0 - $FFFFFFFF
	4077			
	4078	Negative sequence phase voltage	0.1V	0 - $FFFFFFFF
	4079			
	4080	Zero sequence phase voltage	0.1V	0 - $FFFFFFFF
	4081			
	4082	Current THD A**	0.1%	0 - 1000
	4083	Current THD B**	0.1%	0 - 1000
	4084	Current THD C**	0.1%	0 - 1000
	4085	Voltage THD A**	0.1%	0 - 1000
	4086	Voltage THD B**	0.1%	0 - 1000
	4087	Voltage THD C**	0.1%	0 - 1000
	Read or write (Function 0x03, 0x04 or 0x06)			
Setting Data	100	PT primary voltage	1V	60 - 50000
	101	PT secondary voltage	1V	60 - 300
	102	CT primary current	1A	5 - 50000
	103	CT secondary current	5A	-
	104	Power demand interval	1sec	60 - 1800
	105	Power demand sub interval	-	2 - 120
	106	Current demand interval	1sec	60 - 1800
	107	Current demand sub interval	-	2 - 120
	108	Reserved as $0000 for each register		
	109			
	110			
	111	Minutes*	1m	0 - 59 (decimal)
	112	Hours*	1hr	0 - 23 (decimal)
	113	Days*	1day	1 - 31 (decimal)

* The Minutes, Hours and Day data is returned in BCD format.

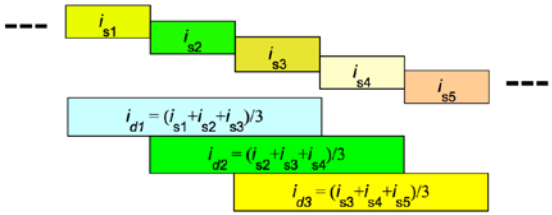
** For PF and THD quantities, $FFFF will be returned for invalid data.

APPENDIX C
NUMERICAL METHODS

C.1 DEMAND CALCULATION

Demand parameters are used to show average values over a demand interval.
This power meter calculates the demand quantity by using the sliding block method. In this method, the demand interval is divided into n sub intervals. For each sub interval s, the quantity average, qs is taken. Finally, the demand quantity is the average of the n consecutive sub interval quantity average over the demand interval, i.e. Σ(qs)/n . The demand quantity is therefore updated at the expiry of each sub interval.

In the example shown in the Fig below for 3 sub intervals per demand interval, sub interval average current, is1 to is5 are taken over sub intervals 1 to 5. At the end of sub interval 3, the demand current id1 is calculated from the average of the last 3 sub interval average current, i.e. id1 = (is1 + is2 + is3) / 3. This process will repeat again at the end of sub interval 4 where id2 = (is2 + is3 + is4) / 3.



C.2 TOTAL HARMONIC DISTORTION CALCULATION

Total Harmonic Distortion (THD) is a power quality indicator used to show the extent of voltage and current waveform distortion by the load. The THD is calculated by the following equation:

$$THD=\{h_2 + h_3 + h_4 + ...+h_{32}\}/ h_1 \times 100\%$$

where h_n represents the n^{th} harmonic component of the quantity, resolved using Fourier's Transform.

C.3 SEQUENCE COMPONENTS CALCULATION

Sequence components are abstract quantities resolved from the phase voltages and currents. They describe the degree and nature of imbalance and phase reversal. Any 3-phase system can be resolved into 3 balanced 3-phase components: positive, negative and zero sequences using the following equations:

$$I_{zero} = \tfrac{1}{3}\{I_1 + I_2 + I_3\}$$
$$I_{pos} = \tfrac{1}{3}\{I_1 + aI_2 + a^2I_3\}$$
$$I_{neg} = \tfrac{1}{3}\{I_1 + a^2I_2 + aI_3\}$$
$$V_{zero} = \tfrac{1}{3}\{V_1 + V_2 + V_3\}$$
$$V_{pos} = \tfrac{1}{3}\{V_1 + aV_2 + a^2V_3\}$$
$$V_{neg} = \tfrac{1}{3}\{V_1 + a^2V_2 + aV_3\}$$

where a = 120° unit vector phase shifter

These values are useful for identifying sources of imbalance and for troubleshooting protective relay settings and wiring faults such as phase reversals.

C.4 POWER FACTOR CALCULATION

The total power factor is a measure of effectiveness of actual power transfer and it is calculated by the following equation:

Total power factor = Active power / {RMS voltage x RMS current}
= Active power / Apparent power

The overall total power factor is calculated based on arithmetic apparent power and total active power.

On the other hand, the displacement power factor is calculated using only the fundamental components of the voltage, current and active power, i.e.

Displacement power factor = Fundamental active power /
{Fundamental RMS voltage
x Fundamental RMS current}

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