Phase Series
Utilization Manual

Revision E 09/2015

Doc. code: MU215300

altus

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Table of Contents

1. Introduction

The Phase Series is composed by flexible equipment used for electrical energy measurement. The PH3100 Phase Series Multifunction Power Meter turns possible to run real-time measurements, such as: voltage, current, power (active, reactive and apparent), power factor, phase angle and demand of active and reactive power. Furthermore, this device has a RS-485 communication interface which allows the energy consumption monitoring in several applications as, for instance, energy sharing of residential and commercial buildings, industrial panels, motor control centers, shopping centers or any applications that needs the monitoring of several variables in a single device.

The Phase Series provides a group of extension modules that can be connected to PH3100 which are the following: ETHERNET and PROFIBUS communication, mass memory module with harmonics analysis integrated and a digital output module based on relays output.

Through these modules the Phase Series proves to be a great solution for several applications that demand electrical energy measurement.

Figure 1-1. PH3100 Multifunction Power Meter

The picture shows the product with some measurements on display.

PH3100 Multifunction Power Meter module has the following features:

- LCD display
- Line and phase voltage measurement
- Neutral and phase current measurement
- Active/reactive/apparent power and power factor measurement
- Active and reactive energy measurement
- Measurement class in accordance with IEC60687
- RS-485 communication port
- MODBUS RTU (slave) communication protocol
- 2 opto-coupled pulsed energy output (active and reactive energy)
- Calculation of measured values average
- Record of maximum and minimum measured values
- 2GB Mass memory and harmonic analysis (optional)
- ETHERNET communication port (optional)
- PROFIBUS-DP communication port (optional)
- 4 digital output module (optional)

Documents Related to this Manual

To get additional information about Phase Series, other documents (manuals and technical characteristics) may be consulted in addition to this one. The last revision of these documents is available at www.altus.com.br.

Each product has a document named Technical Characteristics (CE), which carries the characteristics of the concerned product. Additionally, the product may be accompanied by Utilization Manuals (the codes of the manuals are mentioned in CE).

The following documents are recommended as source of additional information:

Document code	Description	Language
CE115100 **CT115100** **CS115100**	Phase Series – Technical Features Série Phase – Características Técnica Serie Phase – Especificación Técnica	English Portuguese Spanish
MU215300 **MU215100** **MU215500**	Phase Series User Manual Manual de Utilização Série Phase Manual de Utilización Serie Phase	English Portuguese Spanish

Table 1-1. Documents Related

Visual Inspection

Before the installation, a careful visual inspection of the product is recommended to verify whether there has been any damage during the freight. In case of defects, please inform the company or the nearer ALTUS distributor.

WARNING:
Before taking the modules out of the package, it's important to discharge the static energy stored in the body. For that matter, touch with both hands on any grounded metallic surface before handling the modules. Such procedure secure that the module electricity limits won't be exceeded.

It is important to register the serial number of the equipment received, as well as the revision of software if applicable. This information will be necessary in case there is need to contact Altus Technical Support.

Technical Support

To contact Altus Technical Support in São Leopoldo/RS please call +55 (51) 3589-9500. For information on Altus Technical Support centers in other localities, go to our site (www.altus.com.br) or send an e-mail to altus@altus.com.br. If the software is already installed, please have the following information from our assistance upon request:

- The device model and the installed system configuration.
- Product serial number
- The equipment revision indicated on the product side

Warning Messages Used in this Manual

In this manual, the warning messages will be presented in the following formats and descriptions:

DANGER:
Reports potential hazard that, if not detected, may be harmful to people, materials, environment and production.

WARNING:
Reports configuration, application or installation details that must be taken into consideration to avoid any instance that may cause system failure and consequent impact.

ATTENTION:
Identifies configuration, application and installation details aimed at achieving maximum operational performance of the system.

2. Technical Description

This chapter presents the PH3100 technical features and the expansion modules PH3x20, PH3x31, PH3x50 and PH3x51, as well.

General Features

	PH3100
Module type	Multifunction Power Meter
Current	Phase current, average phase current and neutral current measurements
Phase voltage	Phase voltage and average phase voltage measurements
Line voltage	Line voltage and average line voltage measurements
Active power	Phase active power and load active power measurements
Reactive power	Phase reactive power and load reactive power measurements
Apparent power	Phase apparent power and load apparent total power measurements
Frequency	Frequency measurement
Power factor	Load and phase power factor measurements
Demand	3-phase active (kW) / reactive (kVAr) power demand, apparent (kVAh) power demand
Active energy	Imported, exported and net active energy
Reactive energy	Imported, exported and net reactive energy
Energy pulse output	- 1 active energy pulse output - 1 reactive energy pulse output
Real time display	Year/month/day/hour/minute/second
Serial communication port **Standard** **Communication protocol** **Baud rate**	 1-channel RS-485 MODBUS-RTU 2400/4800/9600/19200/38400 bps
Operation temperature	0 to 60 °C (PH3100 with one expansion module) 0 to 55 ºC (PH3100 with two expansion module) 0 to 50 ºC (PH3100 with three expansion module)
Storage temperature	-20 to 75 °C
Operation humidity	5 to 95% no condensation
IP Level	IP 30
Dimensions (W x H x D)	96 x 96 x 85 mm

Table 2-1. General Features

Limits and Measurement Class

	Measurement limits	Measurement class
Voltage	0 to 9999.9 kV	0.2
Current	0 to 9999.9 kA	0.2
Power factor	-1 to +1	1.0
Frequency	45 to 65 Hz	0.01
Active power	-9999 to 9999 MW	0.5
Reactive power	-9999 to 9999 MVAr	0.5
Apparent power	0 to 9999 MVA	0.5
Active demand	-9999 to 9999 MW	1.0
Reactive demand	-9999 to 9999 MVAr	1.0
Active energy	0 to 99999999.99 MWh	0.5
Reactive energy	0 to 99999999.99 MVArh	1.0
Phase angle	0.0º to 359.9º	2.0
Total harmonic current	0 to 100%	2.0
Total harmonic voltage	0 to 100%	2.0

Table 2-2. Limits and Measurement Class

Note:

The measurement limits are related to the calculation and exhibition, these limits don't correspond to the inputs electrical limits.

Menu Keys

The PH3100 has 5 menu keys: **I, U, P, M**, and ⇦ ("Enter"). The following table presents these keys in the common measurement mode and in the parameter setup mode.

Keys	Common measurement mode	Parameter setup mode
I	Current display page	Add 1 to the current value in the parameter setup mode
U	Voltage display page	Minus 1 to the current value in the parameter setup mode
P	Power display page	Change the current position in the parameter setup mode
M	Displays maximum and minimum value.	Skip to the next parameter setup page without saving the alterations
⇦ **Enter**	Per phase measurement display	Save the current setup and skip to the next parameter set up page
I + U	Enter maximum and minimum page	Clear maximum and minimum values by pressing the 2 keys together in the related page
I + P	Enter or exit setup page.	Enter or exit the parameter setup mode

Table 2-3. Menu Keys Functions

Graphical Display

Through the Multifunction Power Meter graphical display, the user can access several pieces of information. The following picture shows the main marks of the graphical display. The descriptions of the items are show in Table 2-4.

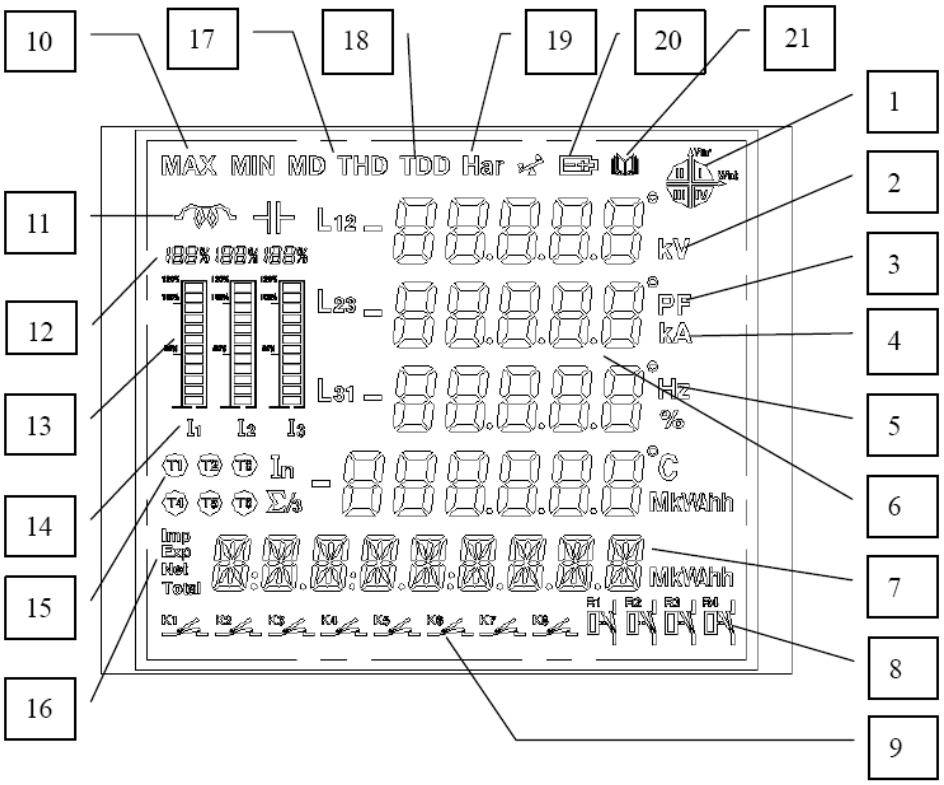

Figure 2-1. Graphical Display Indications

Number	Display	Description
1	4-quadrant power	I, II, III, IV represents 4 quadrants. If “I” or “III” are on, the power is inductive. If “II” or “IV” is on, the power is capacitive.
2	Voltage	Displays voltage unit [V, kV].
3	Power factor	Displays power factor [PF].
4	Current	Displays current unit [A, kA].
5	Frequency	Displays frequency unit [Hz].
6	4 rows of data	Displays main measurement data: voltage, current, power, power factor, frequency, harmonic distortion rate, demand, unbalanced ratio, maximum value, minimum value, parameter setup, etc.
7	Energy or time display rows	Displays measured energy data: active energy, reactive energy, total energy and date/time display.
8	Relay status display (not available)	Displays current status of relay.
9	Remote signal status	Displays current status of remote signal, 1 ~ 8 channels corresponding to K1 ~ K8 status and ON/OFF status can be read in the application.
10	Maximum and minimum display	Displays MAX/MIN symbol. The symbol is shown when the value is maximum or minimum
11	Load characteristic display	Displays inductive or capacitive load. Capacitive symbol displays capacitive load and inductive symbol displays inductive load.
12	Current % display	Displays measured current to full scale %.
13	Current bar chart display	Displays real time current.

14	Current display	Displays 3-phase L1, L2 and L3 current symbol.
15	T1 T2 T3 T4 consumption classification symbol	Consumption profile display mode interface. It displays rate: T1 – Sharp T2 – Peak T3 – Flat T4 – Low
16	Imp. Exp. Net Total symbols	Displays positive phase, negative phase, total net energy and total energy symbols.
17	MD, THD	MD displays demand, THD displays total of all phases THD.
18	TDD – Total Demand Distortion (not available)	As the average sign, representing by "---".
19	Har units	Active power: kW/MW, reactive power: kVAr/MVAr and frequency: Hz.
20	Battery under voltage alarm display (not available)	The light is on when the battery is under voltage.
21	Remote signal event record	Displays 8 channels remote signal SOE Record.
Others	Units and other symbols display	Active energy: kWh/MWh, reactive energy: KVArh/MVArh. Active power: kW/MW, reactive power: kVAr/MVAr. **In** = neutral current, "-" indicates the direction and "°" indicates the angle.

Table 2-4. Graphical Display Indications Description

Electrical Features

Multifunction Power Meter

	PH3100
Input current	0 to 5 A
Measurement range	0.5% to 120% of nominal input current
Power consumption	Lower than 0.2 VA per phase
Continuously maximum current	Two times the nominal input current
Non continuously maximum current	100 A per 1 second
Input voltage	0 to 400 Vac (phase), 0 to 693 Vac (line)
System frequency	45 to 65 Hz
Measurement range	3% to 120% of nominal input voltage
Power consumption	Lower than 0.5 VA per phase
Continuous maximum voltage	Two times the nominal input voltage
Non continuous maximum voltage	2500 Vac per 1 second
Power	85 to 265 Vac or Vdc
Consumption	Lower than 8 VA
Insulation	
Between outputs and logic	1500 Vac per 1 minute
Between power and logic	1500 Vac per 1 minute
Between current inputs and logic	1500 Vac per 1 minute

Table 2-5. PH3100 Electrical Features

Energy Pulse Outputs

	PH3100
Number of common outputs	2 pulse outputs, divided in: EP – 1 output – active energy EQ – 1 output – reactive energy
Maximum current per point	15 mA
Output type	Sink or source opto-coupled
Operation voltage	0 a 30 Vdc
Insulation	1500 Vac per1 minute between outputs and logic circuit
Pin setup	Position 11 – EP output collector (positive) Position 12 – EP output emitter (negative) Position 13 – EQ output collector (positive) Position 14 – EQ output emitter (negative)

Table 2-6. Energy Pulse Outputs Features

Notes:

Maximum current per point: the opto-coupled outputs are not protected against over current. The use of an external fuse is recommended in order to protect the output.

Output type: the output can be of sink or source type, depending on the user's installation.

Pin setup: observe the output polarization (positive collector and negative emitter). In case of reverse polarization, the output can be damaged.

RS-485 Serial Channel

	PH3100
Physical layer	RS-485
Protocol	MODBUS RTU
Internal termination	No
Insulation with logical circuit	No
Baud rate	2400 / 4800 / 9600 / 19200 / 38400 bps
Connector	Position 15 – TX+ Position 16 – TX- Position 17 – Shield

Table 2-7. RS-485 Serial Channel Features

Expansion Modules Electrical Features

Digital Output Expansion Module

	PH3120, PH3220
Output type	Relay contact normally open, individually isolated
Resistive switching capacity (each output)	3 A @ 30 Vdc 3 A @ 250 Vac
Maximum switching capacity	750 VA, 90 W
Maximum module current capacity (4 outputs)	20 A
Minimum load	100 µA @ 100 mV
Isolation	1000 Vac per minute
Expected lifetime	20.000.000 operations at nominal load
Switching time	Open - > closed : 10 ms maximum Closed - > open : 5 ms maximum
Operation temperature	0 to 60 ºC
Storage temperature	-20 to 75 ºC
Dimensions (W x H x D)	20.7 x 59.9 x 65.5 mm

Table 2-8. PH3x20 Expansion Module Electrical Features

Mass Memory and Harmonic Analysis Expansion Module

	PH3131, PH3231
Storage type	SD card
Storage capacity	2 GB
Stored data	Voltage, current, power, energy and harmonics
Harmonic Analysis	2^{nd} to 63^{rd}
Operation temperature	0 to 60ºC
Storage temperature	-20 to 75 ºC
Dimensions (W x H x D)	20.7 x 59.9 x 55.5 mm

Table 2-9. PH3x31 Expansion Module Electrical Features

ETHERNET Expansion Module

	PH3150, PH3250
Interface	Physical layer: RJ45 – 10/100 Base-TX Data link layer: Ethernet DIX2 Network layer: IP Transport layer: TCP
Protocol	MODBUS RTU over TCP/IP (Server connection mode) MODBUS TCP/IP (Server connection mode)
Auto crossover	Yes
Connections	1
Operation temperature	0 to 60ºC
Storage temperature	-20 to 75 ºC
Dimensions (W x H x D)	20.7 x 59.9 x 55 mm

Table 2-10. PH3x50 Expansion Module Electrical Features

Note:

Protocol: MODBUS TCP/IP protocol is available at PH3100's AJ revision and higher and it is the default protocol.

PROFIBUS Expansion Module

	PH3151, PH3251
Channels	1
Baud rate	Baud rate auto detection 9.6 to 12000 kbit/s
Protocol	PROFIBUS DP
Operation temperature	0 to 60ºC
Storage temperature	-20 to 75 ºC
Dimensions (W x H x D)	20.7 x 59.9 x 56.5 mm

Table 2-11. PH3151 Expansion Module Features

ATTENTION:
For further details about the use of more than one expansion module at the same time, please consult Technical Support.
To remove the SD card, you should power off the multifunction power meter to avoid risk of electric shock.

Compatibility with Other Products

The PH31xx expansion modules multifunction are compatible with the following versions:

- PH3100 - Multifunction Power Meter, revision AG or higher.
- PH3101 - PH3100 Configuration Software, version 2.0.7 or higher.

The Multifunction Power Meter Expansion Modules are compatible with the following versions:

- PH3100 – Multifunction Power Meter, revision AE or higher.
- PH3101 – PH3100 Configuration Software, version 1.7.0 or higher.

ATTENTION:
From PH3100's AJ revision, the default protocol used in the Ethernet expansion module is MODBUS TCP/IP. For previous PH3101 revisions, only MODBUS RTU is available. Check the configuration section of Module PH3x50.

PH3101 Multifunction Power Meter Software Features

The Multifunction Power Meter Software runs on Win2000/XP and Vista (32bits) and accounts for PH3100 setup and measurements visualization. Some of the functions performed by PH3101 are:

- Measurement parameters setup
- Measurements visualization
- Communication under MODBUS protocol for PH3100 setup and measurements visualization

Physical Dimensions

Dimensions in mm.

Multimeter Dimensions

Detail dimensions of the Power Meter Module.

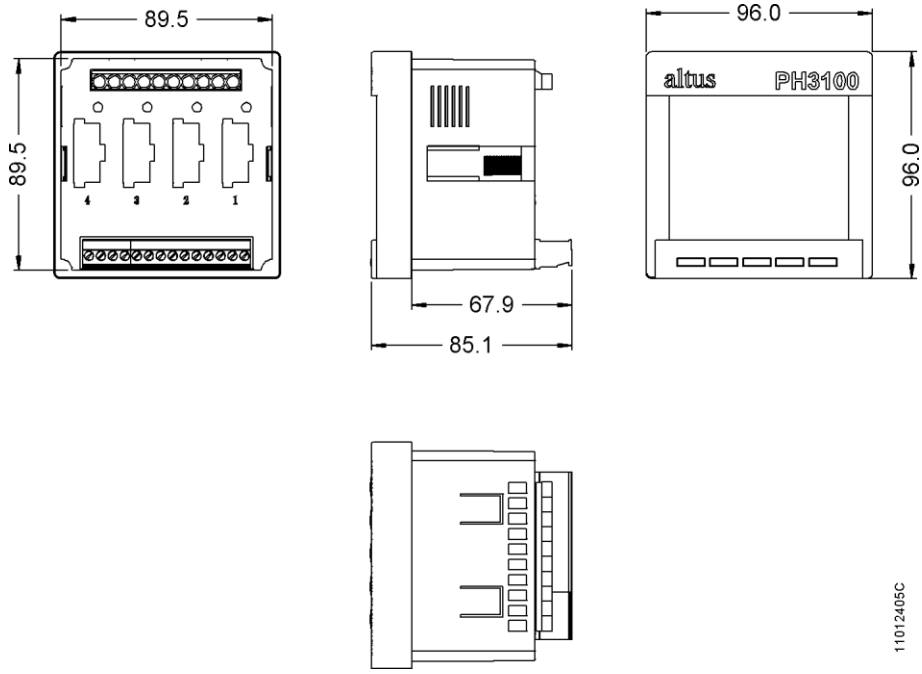

Figure 2-2. PH3100 Multifunction Power Meter Dimension

Multimeter Dimensions with Expansion Modules

Detail dimensions of the Power Meter with 4 Digital Outputs.

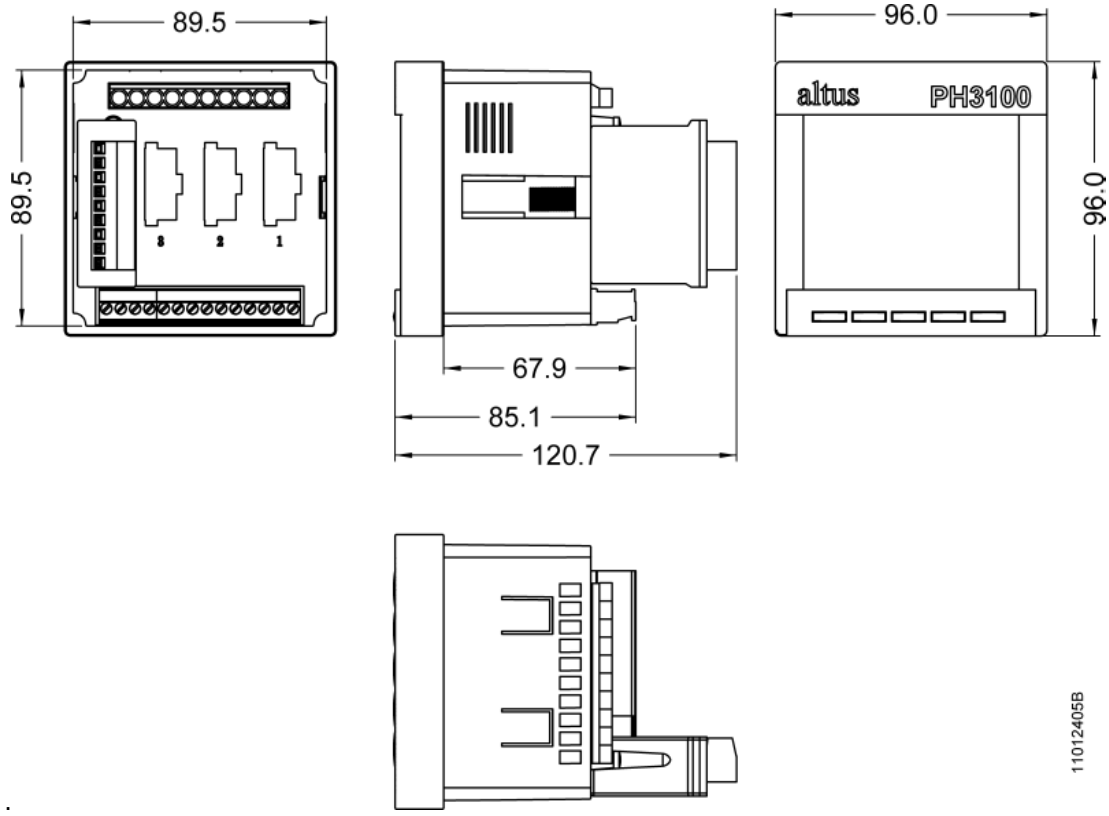

Figure 2-3. PH3x20 Multifunction Power Meter Dimensions

Expansion Modules

Detail dimensions of the expansion modules isolated from the Power Meter.

PH3120

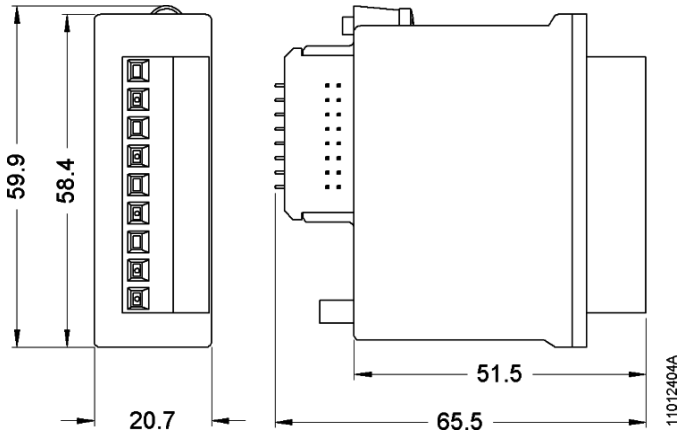

Figure 2-4. PH3120 Expansion Module Dimensions

PH3131

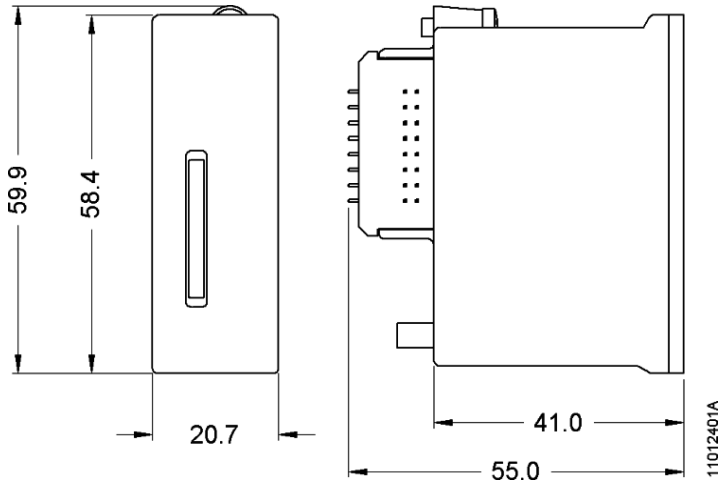

Figure 2-5. PH3131 Expansion Module Dimensions

PH3150

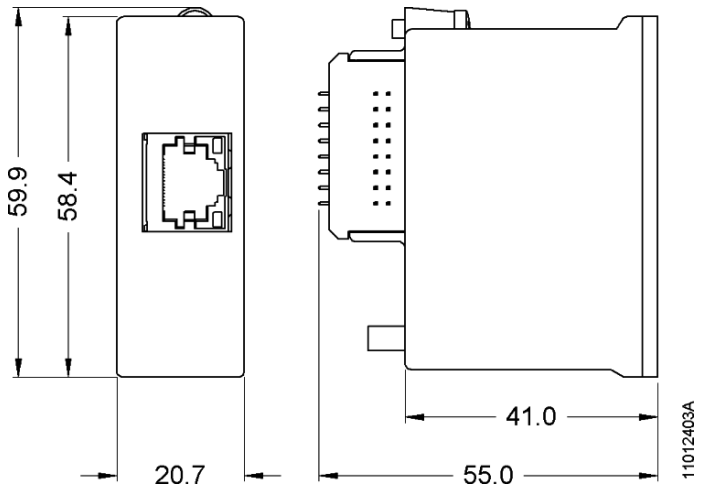

Figure 2-6. PH3150 Expansion Module Dimensions

PH3151

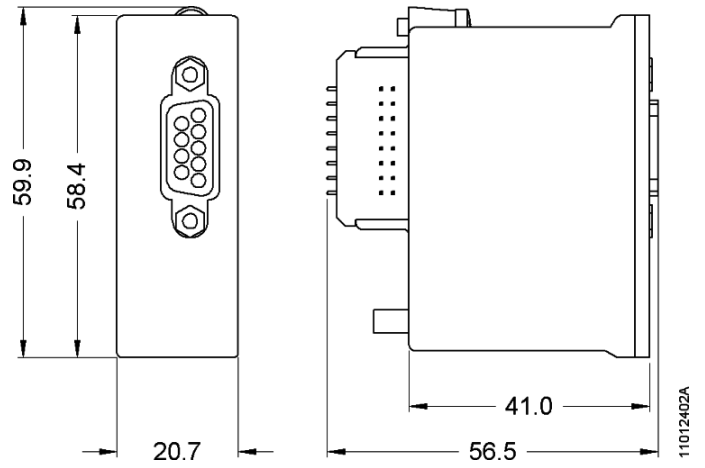

Figure 2-7. PH3151 Expansion Module Dimensions

Ordering Information

Included Items

The product package contains the following items:

- Multifunction Power Meter (PH3100) or expansion modules (PH3120/PH3131/PH3150 or PH3151)
- SD Card 2 GB (included only with the PH3131)
- Connector 9 positions (included only with the PH3120)
- Connector 14 positions (included only with the PH3100)
- 2 clamps for fixing to the panel (included with the PH3100)
- Installation guides

Product Code

The following code should be used to purchase the product:

Code	Denomination
PH3100	Multifunction Power Meter
PH3101	Multifunction Power Meter Configuration Software
PH3120	4 Digital Outputs Module
PH3220	Power Meter with 4 Digital Outputs
PH3131	Mass Memory and Harmonics Analyzer Module
PH3231	Power Meter with Mass Memory and Harmonics Analyzer
PH3150	ETHERNET Module
PH3250	Power Meter with ETHERNET
PH3151	PROFIBUS Module
PH3251	Power Meter with PROFIBUS

Table 2-12. Phase Series Products

Notes:

PH3100: PH3100 Multifunction Power Meter from Phase Series is equipment used for power and energy measurements. This product measures electrical real time data, such as: voltage, current, power (active, reactive and apparent), power factor, phase angle and demand of active and reactive power. Using the communication interface, the Multifunction Power Meter turns possible the energy consumption monitoring in several applications like energy sharing of residential and commercial buildings, shopping centers or any applications that needs the monitoring of several variables in a single device. The PH3100 allows connecting together a communication module (PH3150 or PH3151), a digital output module (PH3120) and a mass memory module (PH3131).

PH3101: PH3100 configuration software allows the multifunction device and its expansion modules configuration. It also has some monitoring functions. The software is available at www.altus.com.br.

PH3120: The 4 digital output module is used for signalization of events that occur during PH3100's electrical values monitoring time, or even for source up to 5-A loads. The events, responsible for the digital outputs control, are completely programmable and have 15 signalization functions. In addition, it's possible to configure delay time for the output activation and the activation signal permanency as well.

PH3131: The mass memory and harmonic analyzer module allows the record of the electrical values measured by the multifunction power meter and the signal harmonic distortion in a unique modules. The period between samples is configurable and the storage capacity is beyond market standard, allowing the record of, about, 10 years with no need for data uploading. The module turns possible the harmonic measurement from 2nd to 63rd. The PH3101 software, available at www.altus.com.br, allows graphic visualization of each harmonic intensity and data conversion from the mass memory to an electronic sheet.

PH3150: Through the ETHERNET communication module the multifunction power meter can be connected to a computer network and use a programmable controller to monitor it or even use a computer with a supervisory application. The available protocol for this application is the MODBUS RTU over TCP/IP.

PH3151: Through the PROFIBUS-DP communication module the Multifunction Power Meter can access measurements using this protocol, allowing the monitoring by a programmable controller or a supervisory system which uses the same protocol.

PH3220, PH3231, PH3250 and PH3251: Each one of these products is a combination of a multimeter and its respective expansion module. The features of each expansion module remain the same. However, from revision XX onwards of the PH3100 multimeter, it is possible to use one or more expansion modules, making the previously available combined sets obsolete.

Related Products

The following products must be purchased separately when necessary:

Code	Denomination
AL-2306	RS-485 network cable (up to 500 meters)
AL-2301	RS-485 network cable (up to 1000 meters)
PO8525	RS-485 network connector and terminator
AL-2600	RS-485 network connector and terminator
FBS-CM25C	Serial interface Module 1 x RS-232 and 1 x RS-485

Table 2-13. Related Products

Notes:

AL-2306: Shielded twisted pair cable without connector intended to be used on RS-485 networks. This cable allows the connection between PH3100 and AL-1413, Al-2600, FBS-CM25C, PO8525 or any other RS-485 compatible product. This cable can reach lengths of up to 500 meters. When longer cables are required AL-2301 must be used.

AL-2301: Two pairs shielded twisted cable with no connectors, used for networks based on RS-485 interface, as an interconnection on a network between two or more AL-2600 or PO8525, with 1000m of maximum length.

PO8525: RS-485 network connector/terminator module. For each connection point there must be a PO8525. On the RJ45 connector from PO8525, the Ponto series (or DUO series) RS-485 communication interface series must be plugged. The PO8525 placed at the network extremities must be configured as terminators, the rest as connection point.

AL-2600: RS-485 network connector/terminator module. It is used to make possible the AL-2306 cable interconnection with the AL-2000 Series and QUARK PLCs and also to provide the RS-485 network termination, preventing signals reflection problems.

FBS-CM25C: FBS-CM25C is a RS-232/RS-485 converter that has an identified connector block for RS-485 and a DB9 connector used for RS-232 communication, allowing the connection of the Multifunction Power Meter to computers with standard serial interface. To connect the PH3100 on this converter, the AL-2301 or the AL-2306 cable must be used.

3. Setup

The PH3100 Multifunction Power Meter is configured through its pages and browsing menus or through the PH3101 Multifunction Power Meter Software. The settings define the Multifunction Power Meter behavior and special features.

Parameters Setup via PH3100 Browsing Menus

To access the Parameters Setup Display Page, press **I** + **P** key simultaneously and enter the access password which is "0000" in the first access. The password is hexadecimal. Press **I** key to add 1 to the current digit, press the **U** key to minus 1 and press the **P** key to move the cursor to the next position. After typing the password, press ⏎ ("Enter") to confirm. Press **I** + **P** key simultaneously to exit the parameter setup mode on any page.

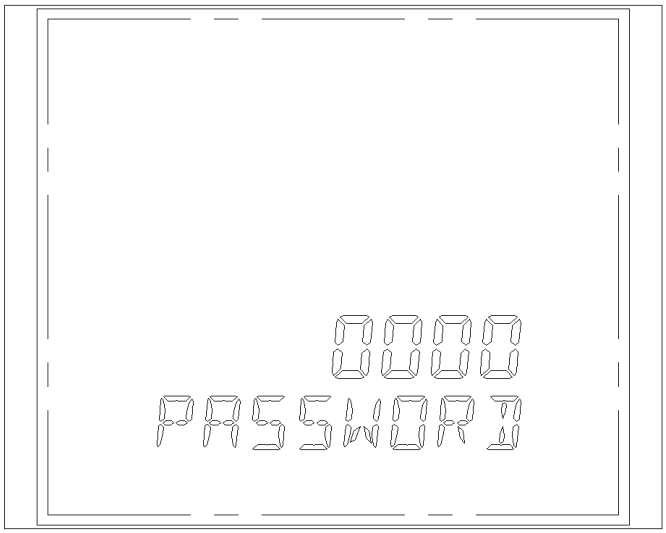

Figure 3-1. Entering Password

The Parameters Setup Display page allows access to the System Setup (SYS SET), Consumption Profile Setup (DUP SET), Ethernet Setup (NET SET) and Clear Data and Time Setup (CLR SET). Press the M key for browsing and the ⏎ key ("Enter") to select them.

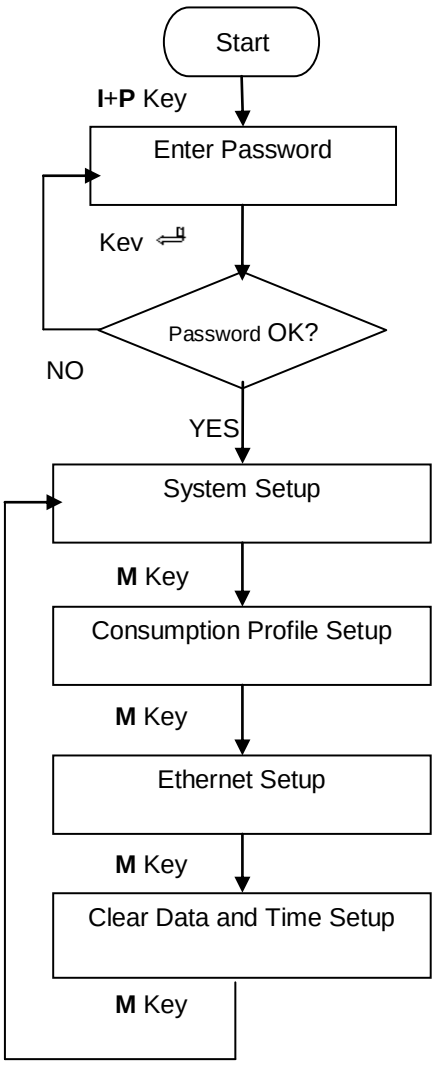

Figure 3-2. Setup Options

System Setup

To select the System Setup Mode, press the ⏎ ("Enter") key on the page shown in the next figure.

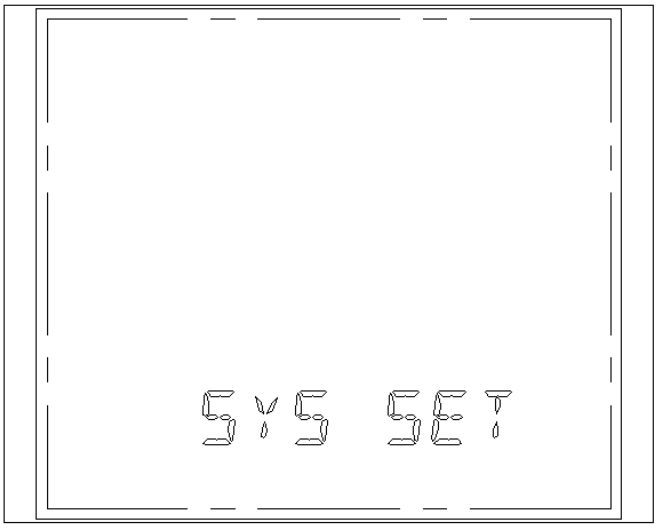

Figure 3-3. System Setup Initial Page

In the System Setup pages, you may set up parameters such as: address PT, CT, baud rate, demand cycle, among others, in accordance with the options shown in the following exhibit. On any page, press the ⏎ ("Enter") key to save changes and move to the next page or press the **M** key to move to the next page without saving them.

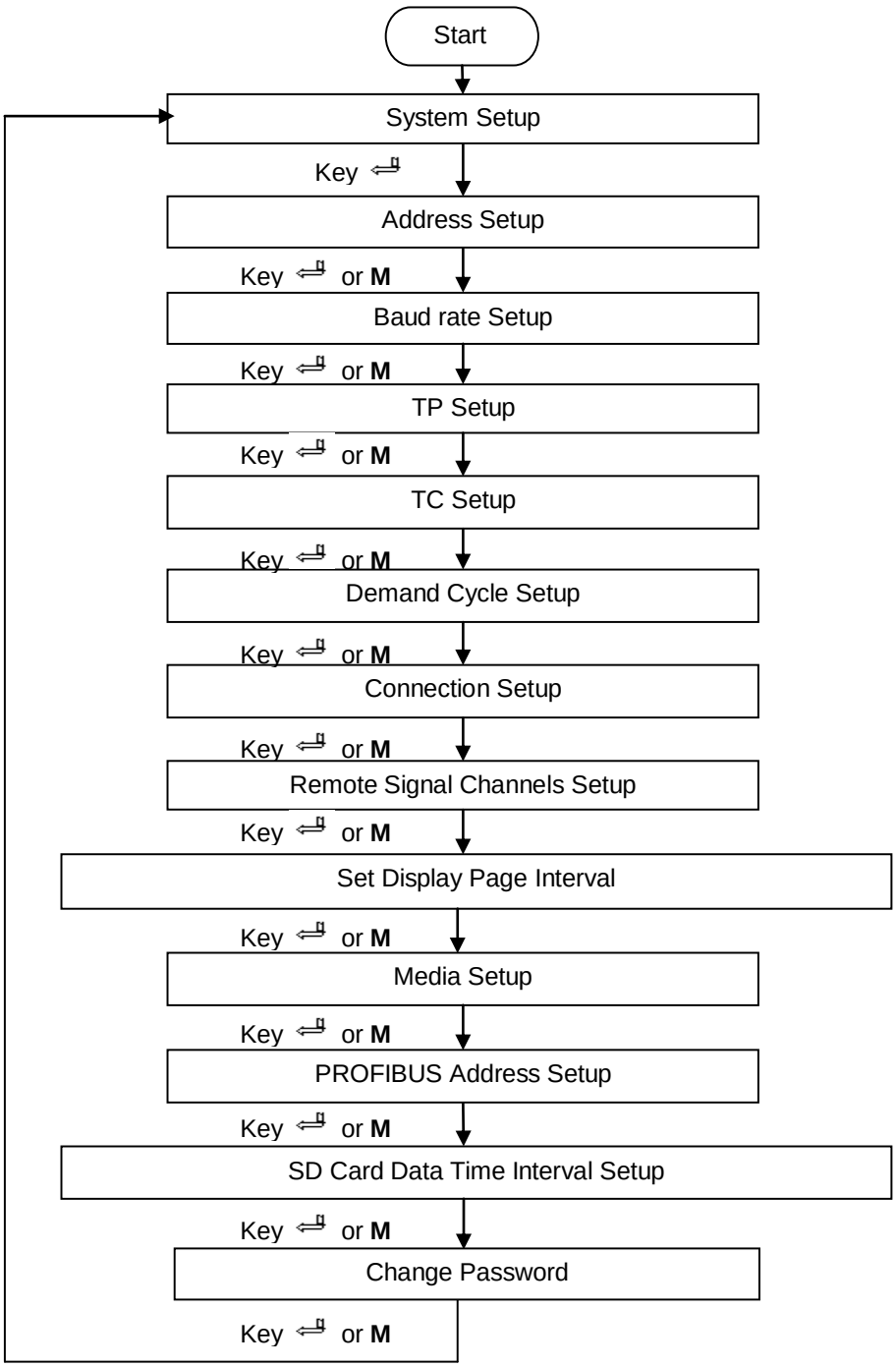

Figure 3-4. System Setup Options

Address Setup

The upper row displays the meter address, which can be set from 001 to 247. As shown in the next exhibit, the meter address is 001. The lower row displays “ADDR SET” which meter address setup page.

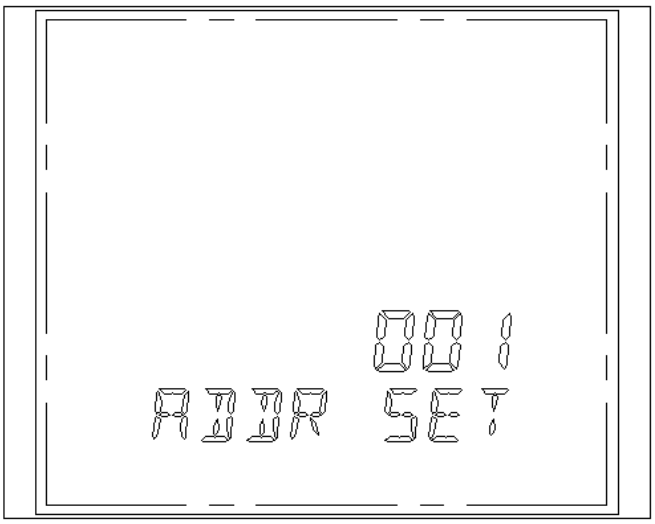

Figure 3-5. Address Setup Page

Baud Rate Setup

The upper row displays the baud rate, which can be 2400, 4800, 9600, 19200 and 38400. As shown in the next exhibit, the baud rate is 9600. The lower row displays “BAUD SET” which the baud rate setup page.

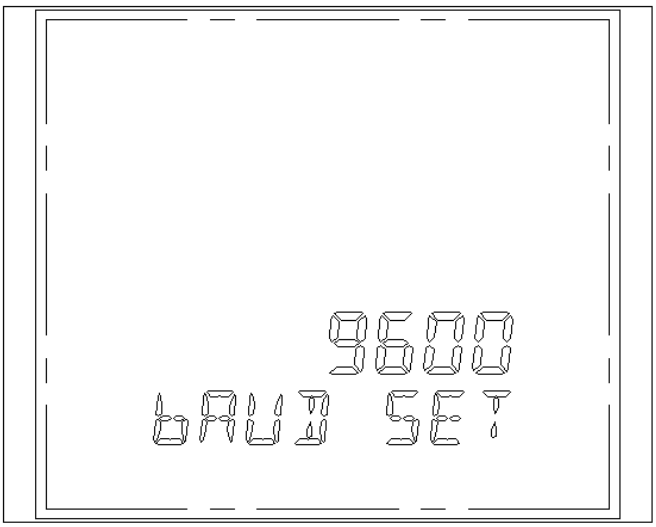

Figure 3-6. Baud Rate Setup Page

PT Setup

The upper row displays the PT value which can be set from 0001.0 to 6499.9.

As shown in the next figure, PT is set as 1.0. The lower row displays “PT SET” which the PT setup page.

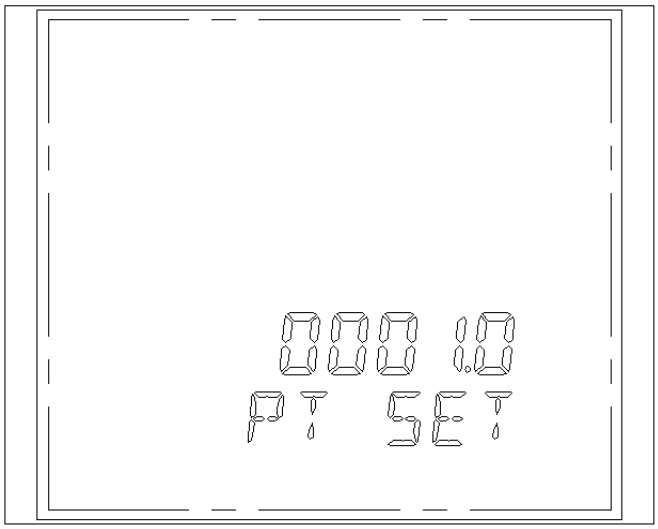

Figure 3-7. PT Setup Page

CT Setup

The upper row displays CT value which can be set from 0001.0 à 6499.9. As shown in the next figure, CT is set as 1.0. The lower row displays “CT SET” which the CT setup page.

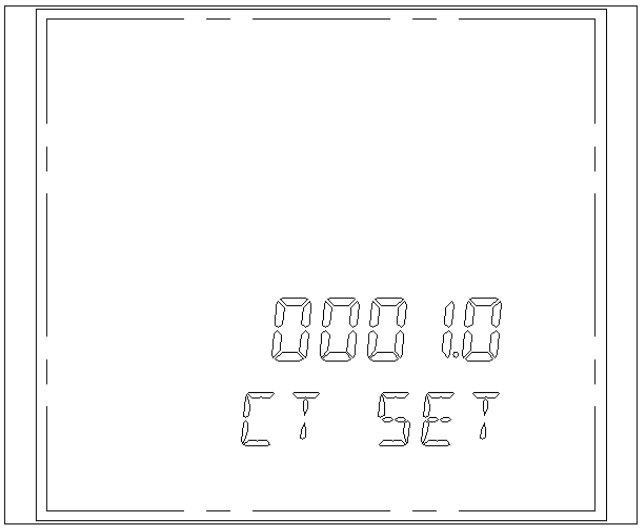

Figure 3-8. CT Setup Page

Demand Cycle Setup

The upper row shows the demand cycle which can be set from 01 to 15 minutes.

As shown in the next figure, the demand cycle is 15 minutes. The lower row shows “DEMD SET” which the demand cycle page.

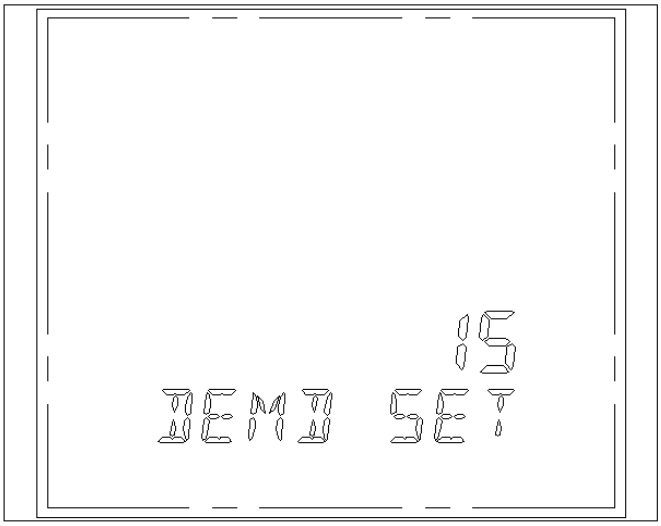

Figure 3-9. Demand Cycle Setup Page

Connection Setup

The upper row shows the connection mode. “1” corresponds to 3P4W (3-phase 4-wire system) and “0” to 3P3W (3-phase 3-wire system).

As shown in the next figure, the current connection is 3P4W. The lower row displays “WIRE SET” which the connection setup page.

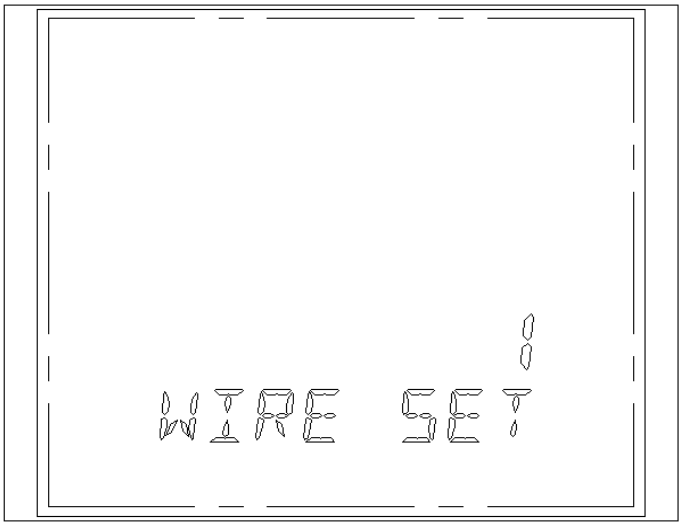

Figure 3-10. Connection Setup Page

Remote Signal Channels Page Setup

The PH3100 has no remote signal channels.

As shown in the following, 8 (eight) represent 8 (eight) remote signal channels. The lower row "CHAN SET" points out to the remote signal channel setup page.

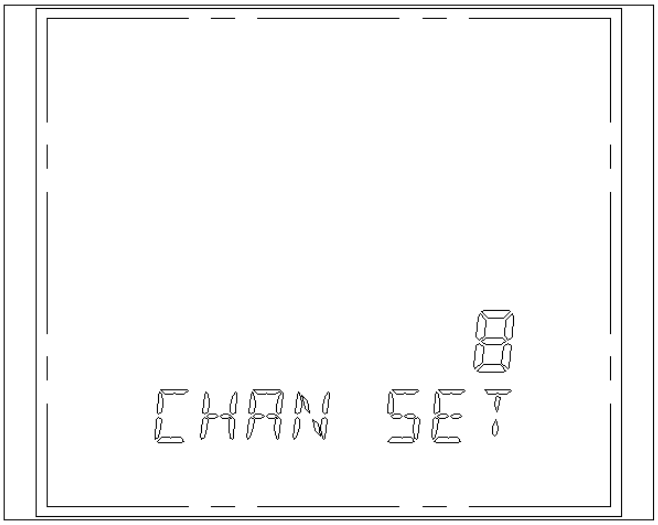

Figure 3-11. Remote Signal Channels Setup Page

Time Interval for Measurement Display Change Setup

The upper row displays the time interval in which the phase measurement display change will take place. This time can be set from 02 to 30 seconds.

As shown in the next exhibit, the interval for the next page is 10 (ten) seconds. The lower row displays "INTV SET", indicating the time interval setup for measurement display change.

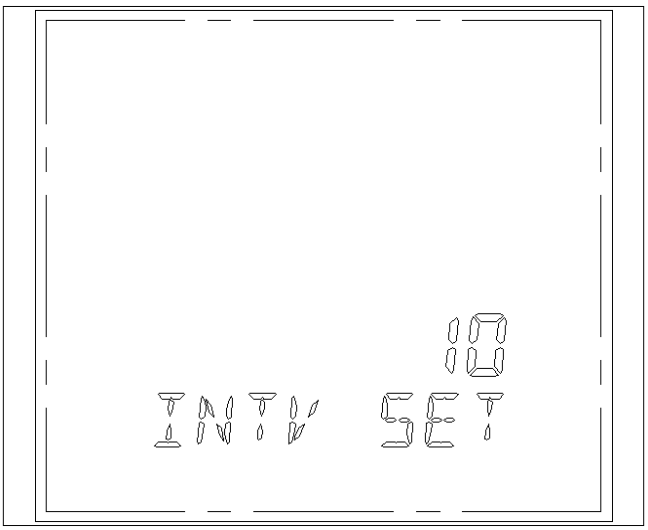

Figure 3-12. Time Interval Setup Page

Communication Media Setup

The upper row shows the selected format (0 as infrared, 1 as RS485). PH3100 has no infrared communication, so this page must always show “1”, as in the following exhibit.

The lower row displays “485 OR IR”, which points out to the communication selection page.

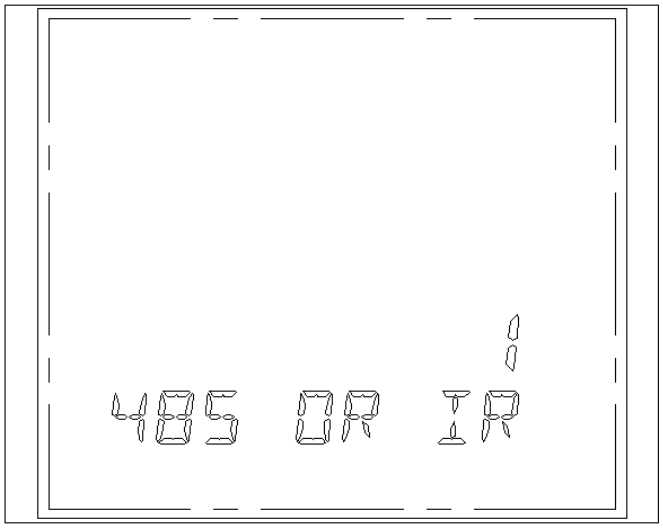

Figure 3-13. Communication Media Setup Page

PROFIBUS Address Setup

When using the expansion module PROFIBUS, PH3x51, use this screen to configure the address on the PROFIBUS network.

The lower row “PROFIBUS” symbol points out to the PROFIBUS address page.

As shown in the next exhibit, the PROFIBUS address is 0 (zero).

The address must be configured following range: 003 to 123.

After choosing the PROFIBUS address, disconnect and reconnect the multimeter to the change to take effect.

For further details about the configuration, see chapter PROFIBUS Communication Module.

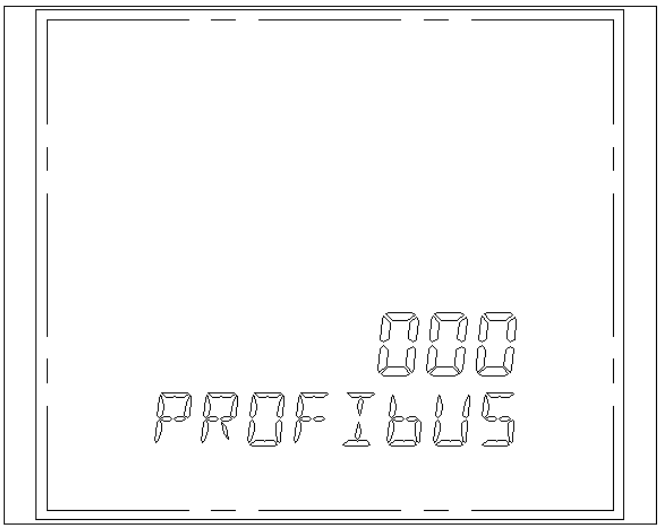

Figure 3-14. PROFIBUS Address Setup Page

SD Card Data Storage Interval Setup

It is necessary to have the PH3x31 expansion module.

The lower row "ELEC KEEP" symbol points out to the SD card storage interval.

As shown in the next figure, the interval for saving the data in SD card is 2601 seconds.

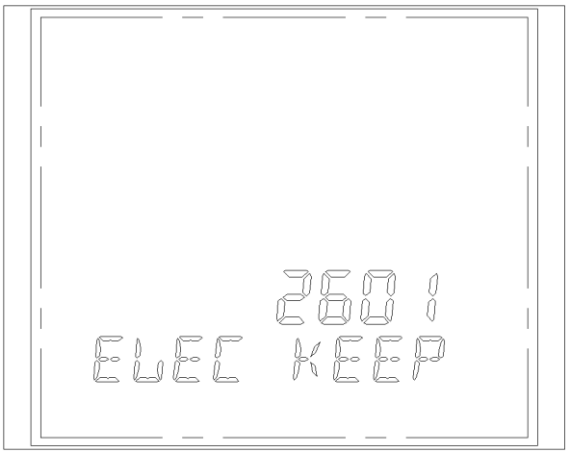

Figure 3-15. Data Storage Interval in SD Card Page

Password Change

WARNING:
In case the user loses the parameter setup password, setting up the PH3100 will not be possible via menu and browsing keys, once the password cannot be retrieved. In this case it is necessary to use the PH3101 software.

Independently of the parameters setup password, the upper row always shows the password as "0000", as in the following exhibit. The password is made up of four hexadecimal digits. Use **I** key to add one digit, the **U key** to subtract one digit and the **P** key to move the cursor to the next position. After inserting the desired password, press the ⏎ ("Enter") key to confirm. Press the **M** key to exit this page without saving the password change.

ATTENTION:
In case the user has a password other than “0000”, and while browsing the PH3100 pages it accesses the change password page and presses the ⏎ key (“Enter”), the password will return to “0000”. Therefore, it is very important that the user always presses the M key to skip to the next page if it does not wish to change the password.

The lower row “CHN PASS” symbol points out to the password change page.

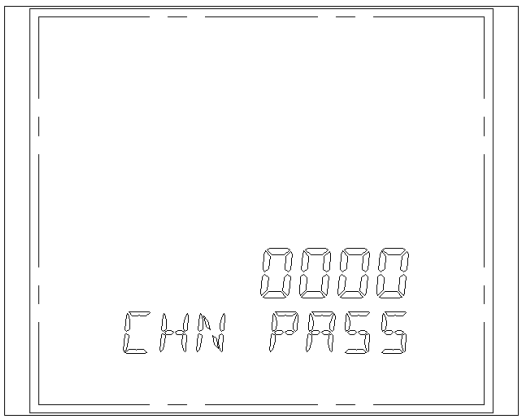

Figure 3-16. Password Change Page

Consumption Profile Setup

To select the Consumption Profile Mode press the ⏎ key (“Enter”) on the page shown in the following picture.

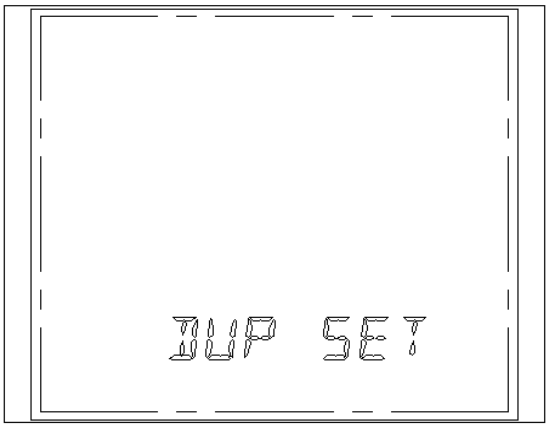

Figure 3-17. Consumption Profile Setup Initial Page

In the Consumption Profile Setup Page, in addition to enabling the Consumption Profile Mode, it is possible to set up the amount of intervals, the characteristics of each interval, as well as the monthly closing date, according to the options shown in the following exhibit. On each page, press the ⏎ key (“Enter”) to save the settings and skip to the next page.

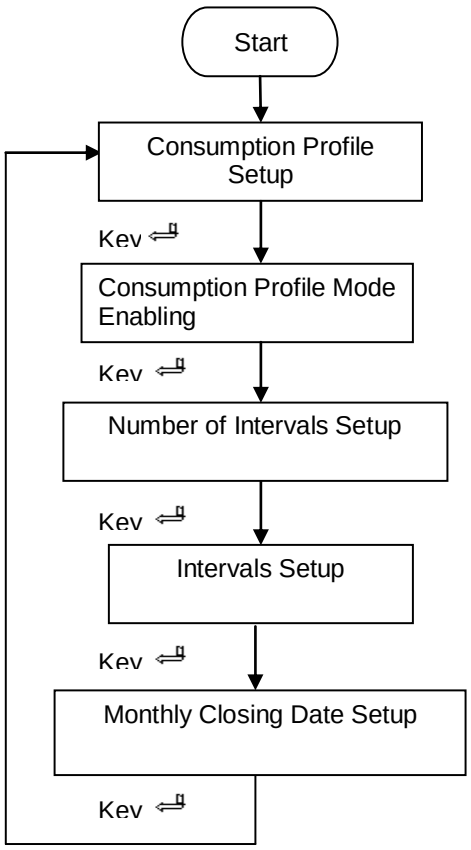

Figure 3-18. Consumption Profile Setup Options Page

Consumption Profile Enabling Page

The upper row shows the Consumption Profile function ON/OFF status (0 = OFF, 1 = ON). As shown in the next exhibit, the Consumption Profile function is OFF.

The lower row displays "ON OFF", which points out to the Consumption Profile ON/OFF page.

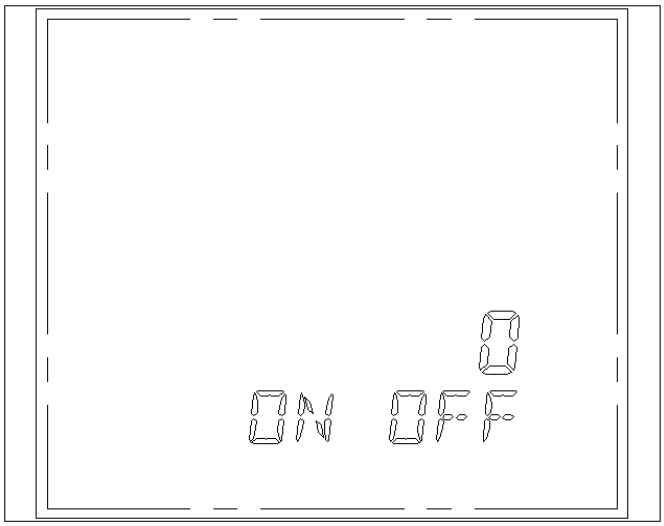

Figure 3-19. Consumption Profile ON/OFF Page

Number of Intervals Setup

The upper row displays the number of intervals, which may be a minimum of 02 and a maximum of 12. The next exhibit shows an example of 2 intervals. The lower row shows "DP NUMB", indicating the interval setup page.

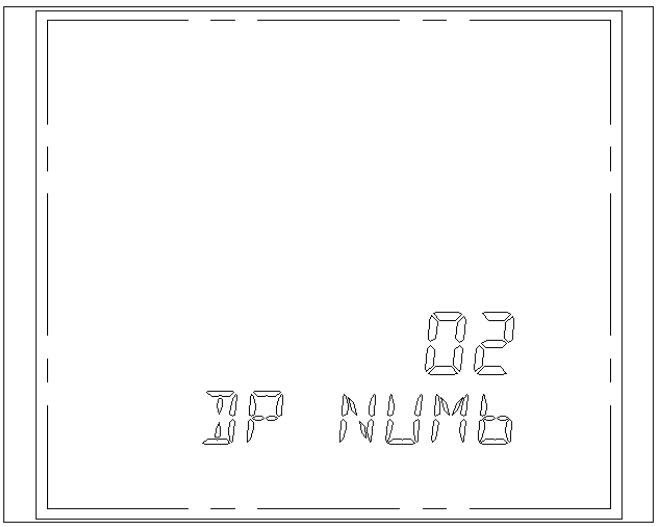

Figure 3-20. Number of Intervals Setup Page

Interval Setup Page

The 1st row displays the current interval, as configured in the Number of Intervals Setup Page. To skip to the next interval setup page press ⏎ ("Enter").

The 3rd row displays the consumption type (0 as Sharp, 1 as Peak, 2 as Flat and 3 as Low).

The 4th row shows the interval initial hour (00:00 to 23:30).

The 5th row “DP TIME” is the indicator.

ATTENTION: The minimum interval is 30 minutes. The starting time of an interval N+1 should be consistent with the ending time of the N interval. Only the ending interval can cross 0:00. If the user tries to set up another interval as 00:00, skipping to the next interval setup page will not be possible, and it will be necessary to turn the module OFF/ON.

Example 1

If the user wants to set up 5 intervals in a period of 1 day, it can separate the intervals in the following way:

Interval	Initial hour	End hour	Consumption type
01	02:00	08:00	3 – Low
02	08:00	12:00	1 – Peak
03	12:00	17:00	0 – Sharp
04	17:00	21:00	2 – Flat
05	21:00	02:00	3 - Low

Table 3-1. Intervals Setup Example

Example 2

As shown in the next picture, the first Consumption Profile interval type is Sharp (0) and the starting time is 21:00.

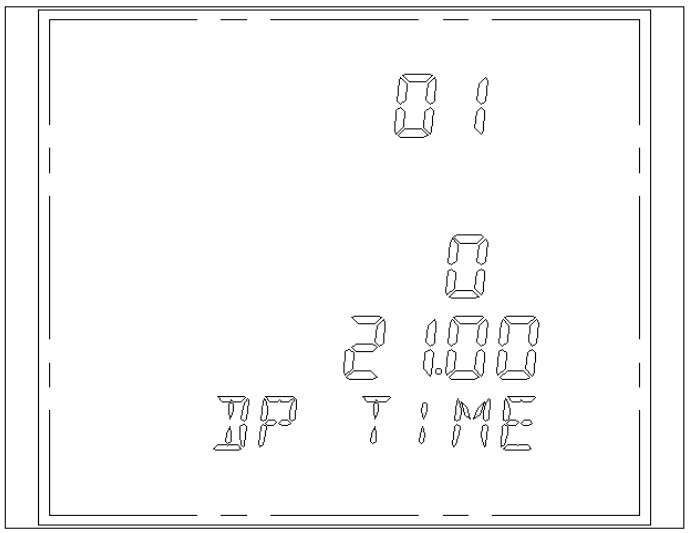

Figure 3-21. Interval Setup Page

Monthly Closing Date Setup

The 1st row displays the monthly measurement closing date (01 to 28).

The 2nd row displays hour (00 to 23).

The 3rd row displays minutes (00 to 59).

The 4th row displays seconds (00 to 59).

The 5th row “FR TIME” indicates the monthly closing date setup page.

As shown in the next exhibit, the closing date every month is 16th, 08:18:30.

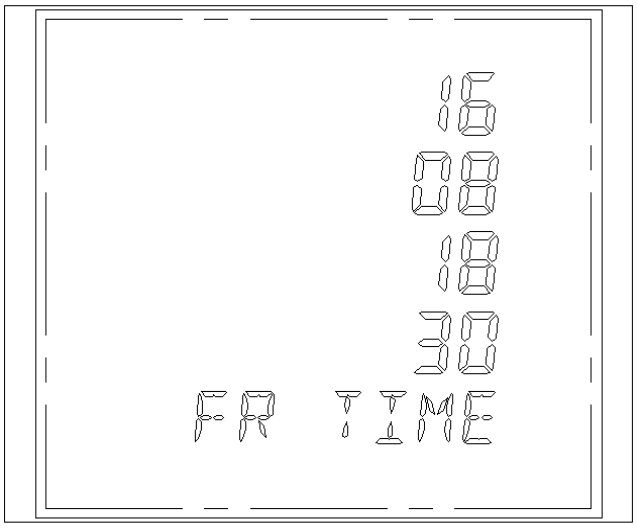

Figure 3-22. Monthly Closing Date Setup Page

Ethernet Setup

The Ethernet configuration is not available by HMI.

Should refer to the Ethernet Communication Module chapter to configure the PH3x50 module.

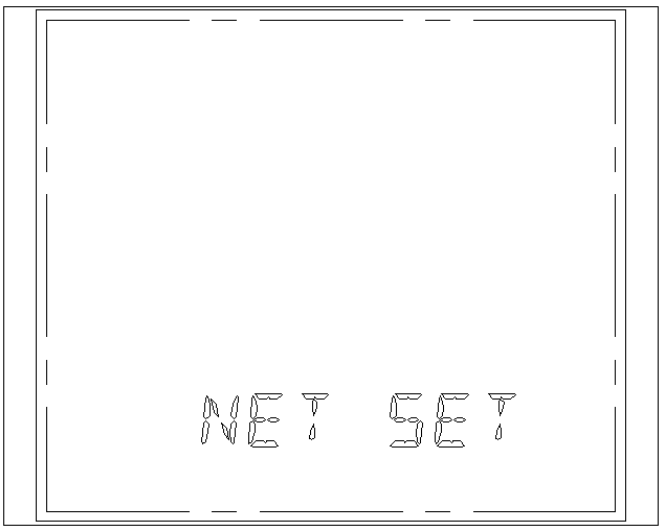

Figure 3-23. Ethernet Setup Page

Clear Date and Time Setup

To select the Clear Date and Time Setup Mode, press ⏎ ("Enter") on the following page.

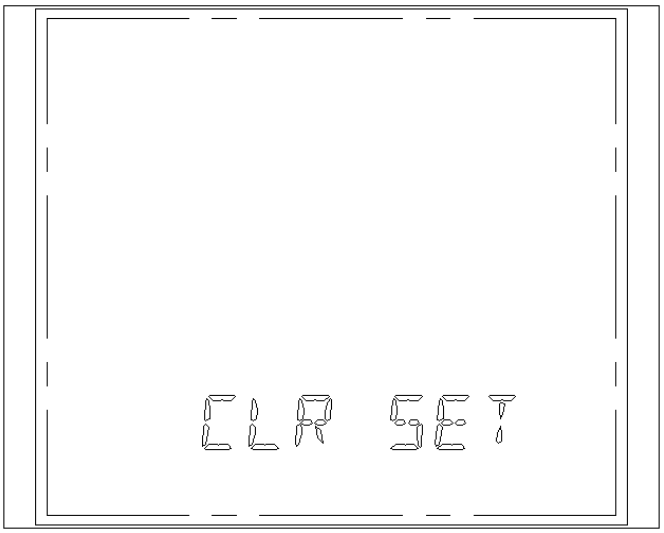

Figure 3-24. Clear Date and Time Setup Mode Page

On the Clear Date and Time Setup Mode Page, the user has permission to set up only date and hour. The "clear data" option is restricted to ALTUS through a special password. Press the **M** key in this mode to go to the next page. If it is necessary to clear maximum or minimum data exit the Parameter Setup and access the desired measurement display page by pressing **I** and **U** keys simultaneously. In the Clear Date and Time Setup Mode press the ⏎ key ("Enter") to save current changes and go to the next page or the **M** key to enter the next page without saving.

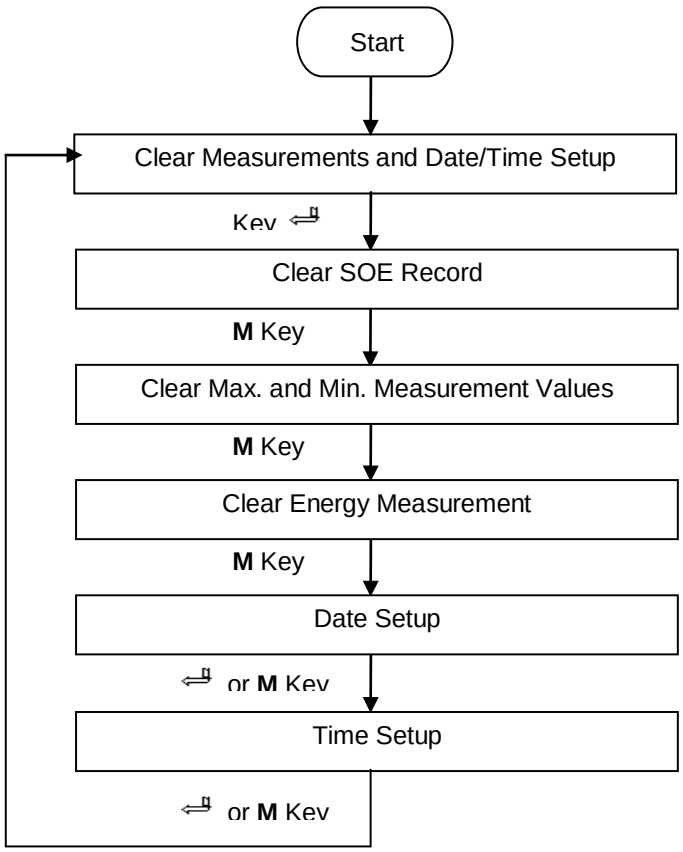

Figure 3-25. Clear Measurements and Date/Time Setup Options

Clear SOE Record

This page has not function to the application.

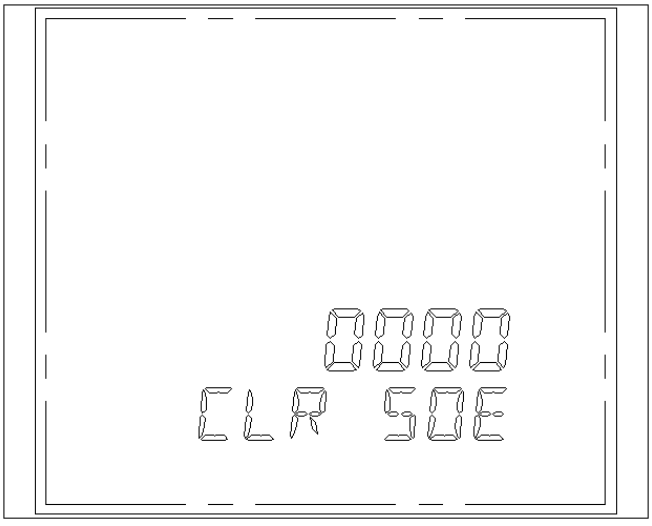

Figure 3-26. Clear SOE Record Page

Clear Maximum and Minimum Measurement Values

This page is for ALTUS use only and it is accessible through a special password. If it is necessary to clear maximum or minimum data exit Parameter Setup and access the desired measurement display page by pressing "**I**" and "**U**" keys simultaneously.

The upper row shows the password.

The lower row “MAXMIN” indicates the Clear Maximum and Minimum Measurement Values Page.

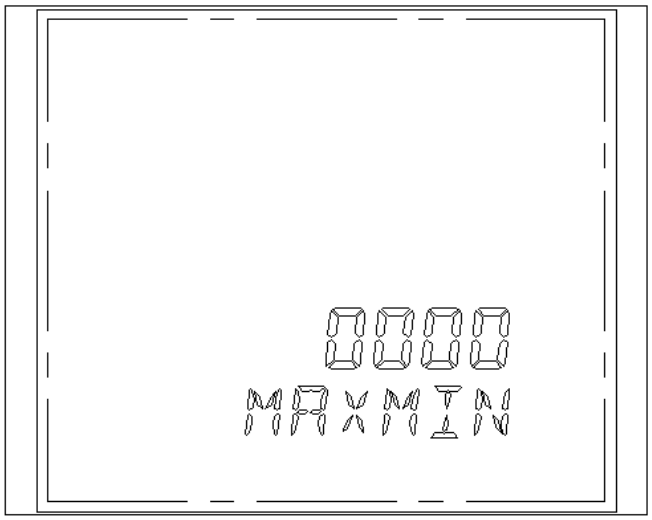

Figure 3-27. Clear Maximum and Minimum Measurement Values Page

Clear Energy Measurement

This page is for ALTUS use only and it is accessible through a special password.

The upper row shows the password.

The lower row “CLR ENER” shows the Clear Energy Measurement page.

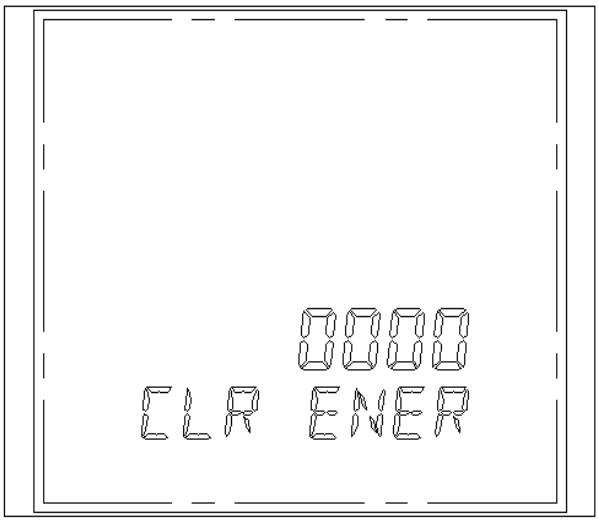

Figure 3-28. Clear Energy Measurement Page

Date Setup

The 2nd row shows the year (2000 to 2099).

The 3rd row shows the month (1 to 12), indicating January to December, respectively.

The 4th row shows the day, which can be setup according to month and year.

The 5th row "DATE SET" indicates the Date setup page.

As shown in the next picture, the date is June 25th, 2008.

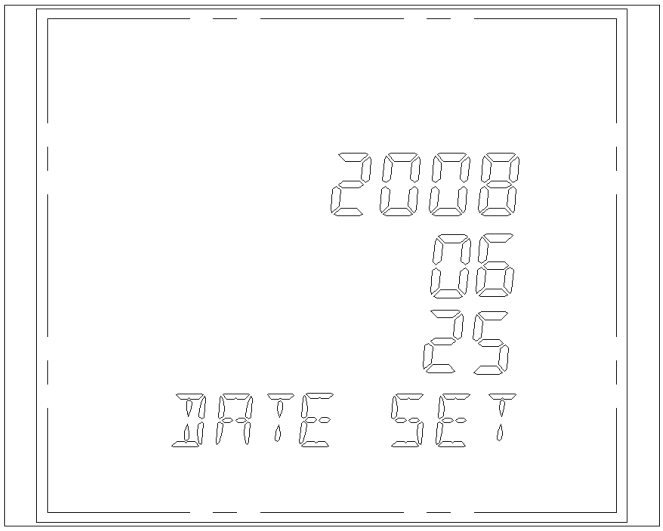

Figure 3-29. Date Setup Page

Time Setup

The 2nd row displays hour(s) (00 to 23).

The 3rd row displays minute(s) (00 to 59).

The 4th row displays second(s) (00 to 59).

The 5th row ("TIME SET") indicates time setup page.

As shown in the next picture, the time is 00:31:40.

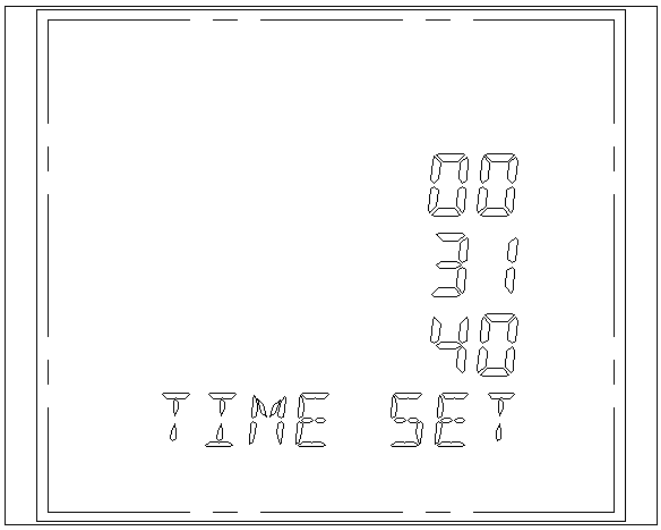

Figure 3-30. Time Setup Page

Parameter Setup Using PH3101 Multifunction Power Meter Software

Besides displaying the PH3100 measurement values, PH3101 allows the System Parameters Setup, Clear Data and Consumption Profile setup in accordance with PH3101 “Measured Value”, “Parameter Setup” and “Multi-rate” available tabs respectively.

System Setup

Parameter System Setup

On the tab “Measured Value”, the user can setup the address parameters, PT and CT relationship, baud rate, demand cycle, date and time (by selecting the “Adjust Time” option), pulse width, etc., by selecting the “Read / Setup” option in “System Parameter”. To send the settings to the Multifunction Power Meter, simply click on “Setup” button.

	System Parameters
Address	1 to 247
PT	1.0 to 6500.0
CT	1.0 to 6500.0
Baud rate	2400, 4800, 9600, 19200, 38400
Demand cycle	1 to 15 minutes
Date	YY / MM / DD
Time	HH : MM: SS
Signal number	0 to 8
Pulse	1 to 9600
Pulse width	60 to 100 ms
Display interval	2 to 30 s
Data storage interval (SD card)	60 to 3600 s

Table 3-2. System Parameter Setup

Note:

Signal number: Although the user can set up the amount of Remote Signal Channels, the PH3100 does not have this option.

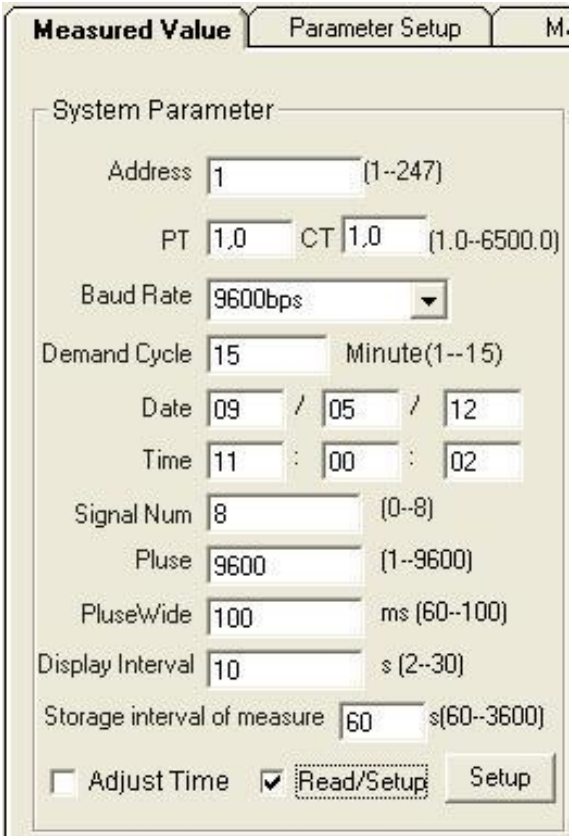

Figure 3-31. System Parameter Setup

Pulse Output Setup

To setup the pulse outputs the user should regard the following equations, considering that "Energy_Consumption" can be active or reactive.

$$Pulse\_per\_Hour = \frac{Energy\_Consumption * Pulse\_Constant}{PT * CT}$$

$$Pulse\_Duration = \frac{3600s}{Pulse\_per\_Hour}$$

$$Pulse\_Energy\_Consumption = \frac{PT * CT}{Pulse\_Constant}$$

Example

Consider that the user uses a setup system with the following indicated characteristics.

	PH3100
Connection system	4-wire 3-phase
Voltage	220 V
Current	5 A
Pulse constant	1600
PT	10
CT	10
Active energy consumption	330 kWh

Table 3-3. Setup Example for Pulse Calculation

First of all, we calculate the pulse amount per hour:

$$Pulse\_per\_Hour = \frac{330 * 1600}{10 * 10} = 5280$$

The pulse duration is defined by:

$$Pulse\_Duration = \frac{3600s}{5280} = 0.6818s$$

Finally, we calculate the energy consumption which will be represented by each output pulse if the parameters previously described in table are used.

$$Pulse\_Energy\_Consumption = \frac{10 * 10}{1600} = 0.0625kWh$$

It means that we have an output pulse every 0.0625 kWh.

System Information Setup

Select the option “Read/Setup”, tab “Measured Value” on “System Information” to set up voltage/current scale, the Ethernet module communication configuration (RTU or TCP) and connection type (3P4W refers to 3-phase 4-wire system and 3P3W refers to 3-phase 3-wire system). To send the settings to the Multifunction Power Meter, simply click on "Setup" button.

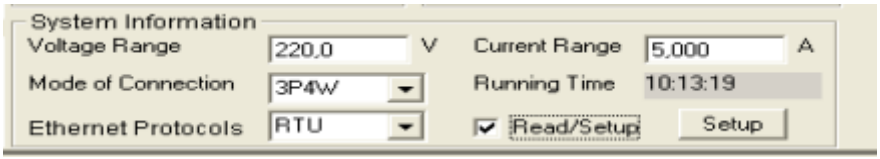

Figure 3-32. System Information Setup

Clear Measurements

Click on “Parameter Setup” to check some Multifunction Power Meter parameters, however, this module allows only for the clearing of maximum/minimum and demand values through the buttons “Clear Max._ Min.Demand” in “Clear Command” option. The PH3100 does not have SOE record, so the “Clear SOE” option is not used. The option “Clear Energy” is for ALTUS use only, through a special password.

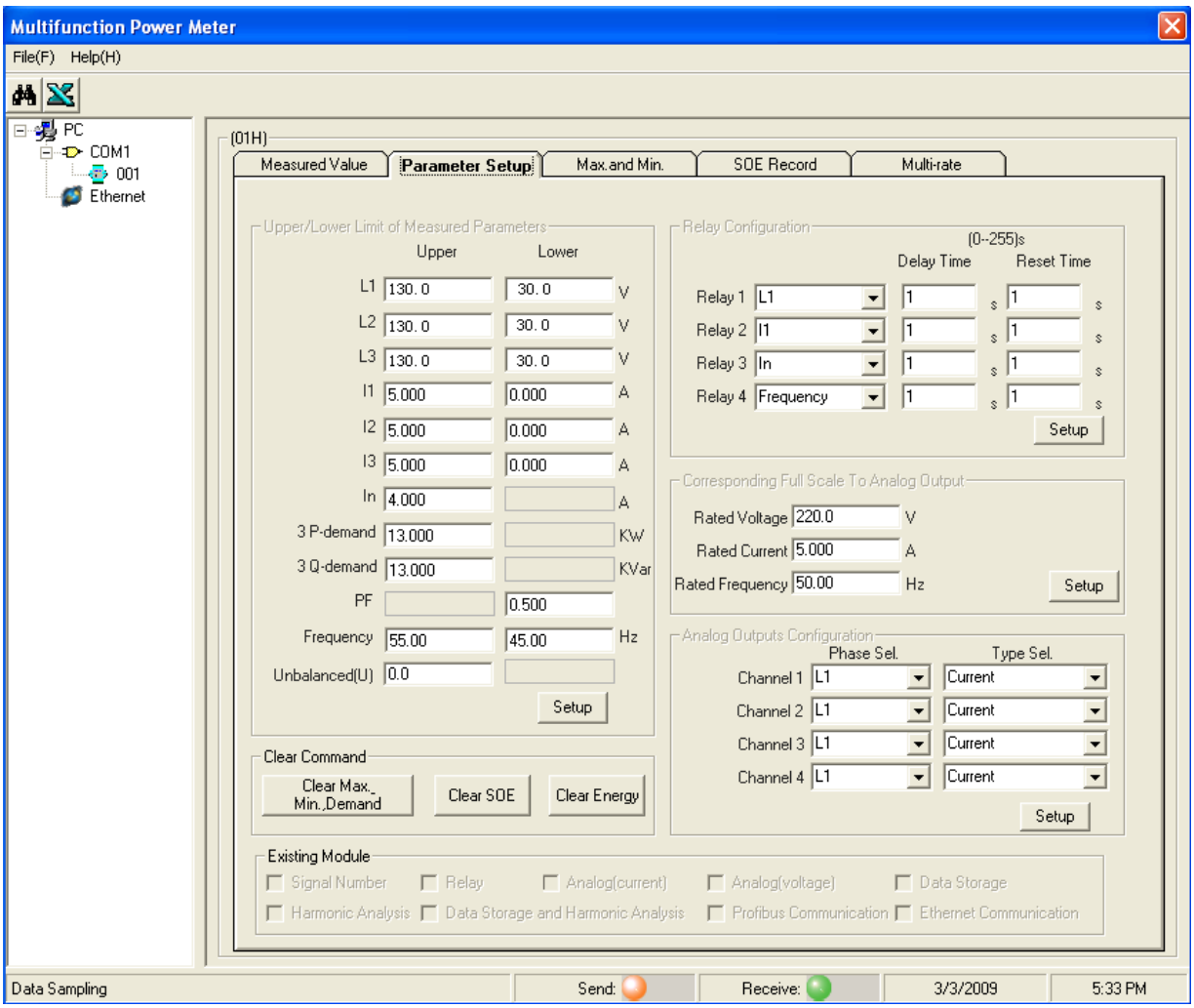

Figure 3-33. Parameters Visualization Page

Consumption Profile Setup

Select the “Multi-rate” tab to activate the Consumption Profile Mode (this option is not default) by checking the “Using Multi-rate” option and listing period(s) as shown in the following picture.

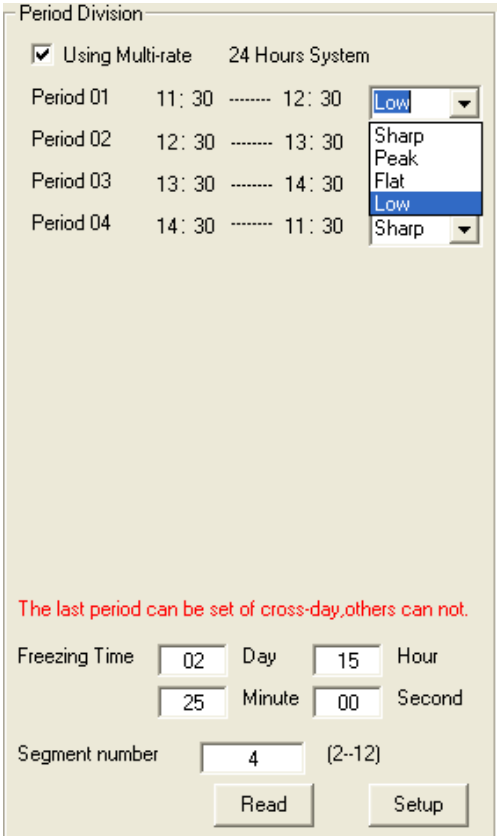

Figure 3-34. Consumption Profile Setup

In "Segment number" it is possible to set up the number of intervals (minimum = 2 and maximum = 12). After that, the periods, their start/end times and the consumption type will be presented.

In order to edit the start and end time of a period click on the desired time to change it. The consumption type may be classified as Sharp, Peak, Flat or Low. The "Freezing Time" option allows for the setup of the closing measurement monthly date and time.

ATTENTION: The minimum interval is 30 minutes. The starting time of an interval N+1 should be consistent with the ending time of the previous N interval. Only the last interval can include 00:00.

Example

If the user wants to set up 5 intervals in a period of 1 day, the intervals can be separated in the following way:

Interval	Start time	End time	Consumption type
01	02:00	08:00	Low
02	08:00	12:00	Peak
03	12:00	17:00	Sharp
04	17:00	21:00	Flat
05	21:00	02:00	Low

Table 3-4. Interval Setup Example

4. Installation

Electrical Installation

DANGER:
When performing any electrical panel installation, make sure that its main power supply is de-energized.

PH3100 shall function properly under the following working conditions:

- Auxiliary power supply: 85 ~ 265 Vac/Vdc. PH3100 might be damaged or function improperly if the power supply is out of range. The following picture shows PH3100 power connection diagram.
- For the secondary measurement, line voltage range shall be 0 ~ 693 V, phase voltage range shall be 0 ~ 400 V and current range 0 ~ 5 A. The PH3100 might be damaged or function improperly if the measurement is out of above range. For operation above of the specified range is obligatory the use of a potential or current transformer (PT/CT).
- The meter connections must be done strictly following the wiring connection instructions.
- Operation temperature: 0 ~ 60oC. The PH3100 might be damaged or function improperly if the temperature is out of range.

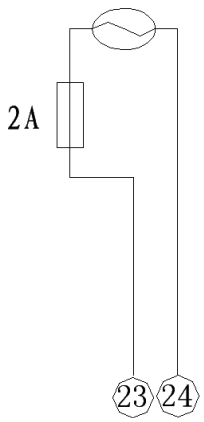

Figure 4-1. PH3100 Power Supply Connection Diagram

Terminal Chart

8	L1	INPUT VOLTAGE		PULSE OUTPUT	Ep+	11
9	L2				Ep−	12
10	L3				EQ+	13
7	N				EQ−	14
1	I1*	INPUT CURRENT		RS-485	A+	15
2	I1				B−	16
3	I2*				Earth	17
4	I2					
5	I3*					
6	I3					
22	Earth	POWER				
23	L					
24	N					

Figure 4-2. Terminal Chart

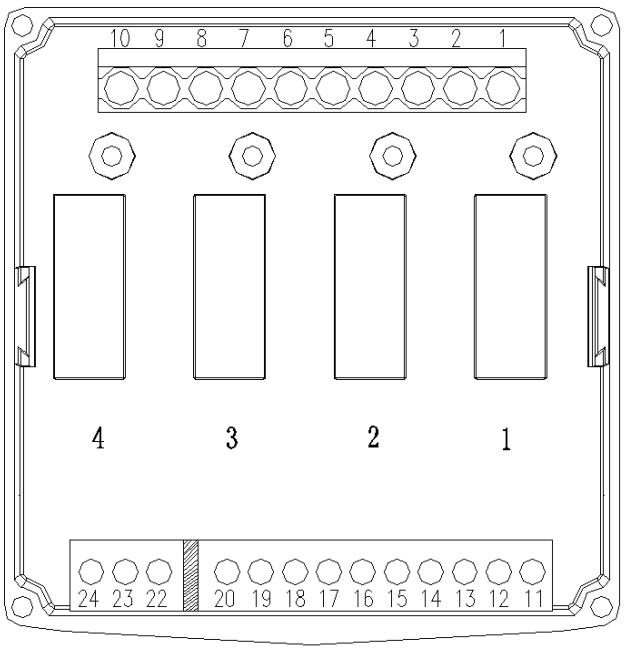

Figure 4-3. Back-Side View

4-wire 3-phase Voltage and Current Measurement Diagram with PT

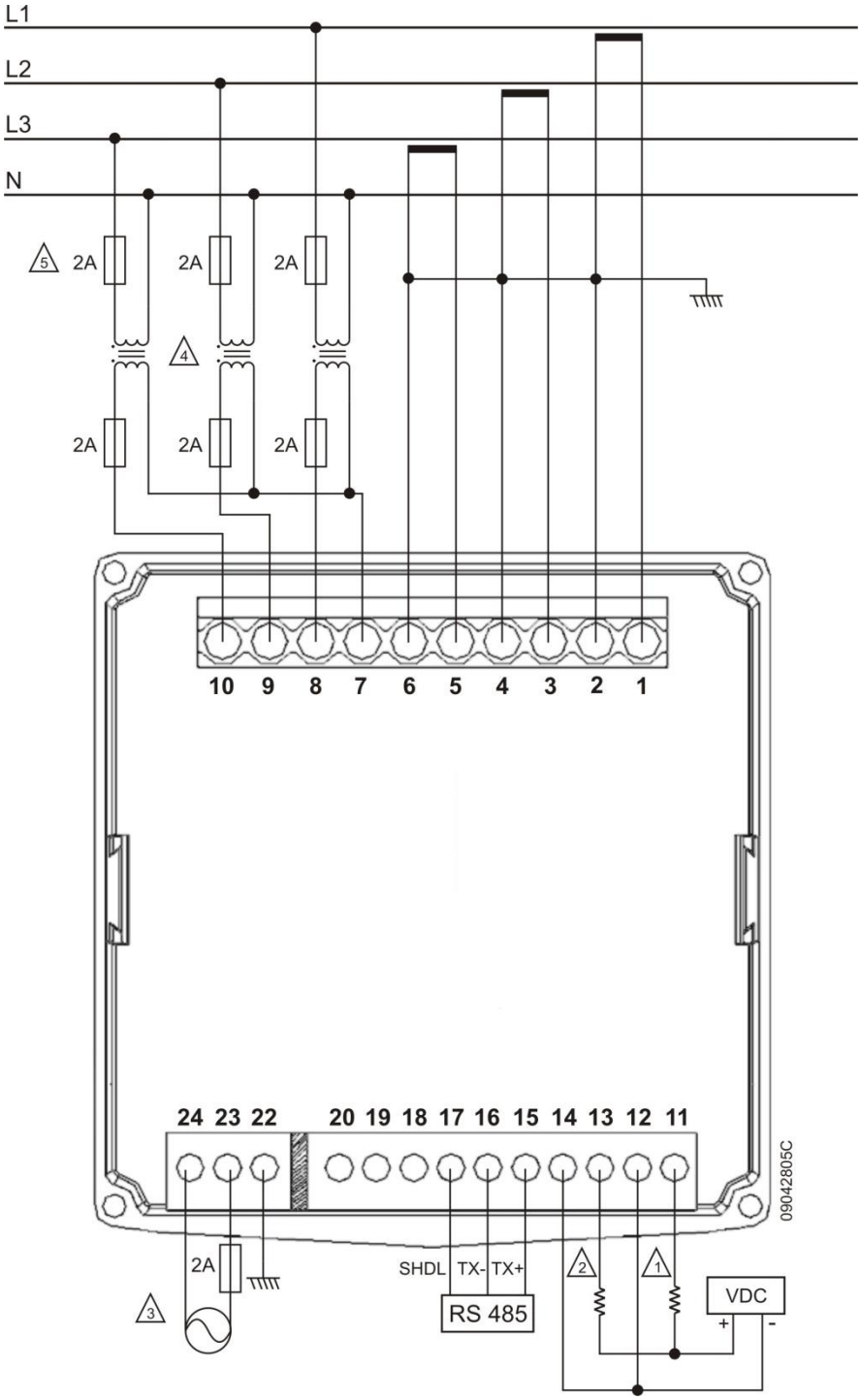

Figure 4-4. 4-Wire 3-Phase Voltage and Current Measurement Diagram with PT

Notes

1 – Example of pulse output "sink" type installation relative to active energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages where The positive pole of the power supply must be on pin 11 and the negative on pin 12.

2 – Example of pulse output "sink" type installation relative to reactive energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages. The positive pole of the power supply must be on pin 13 and the negative on pin 14.

3 – 85 to 265 Vdc/Vac power supply, on the following pins: 24 (neutral - negative), 23 (phase - positive) and 22 (ground). The use of 2 A protection fuses is recommended to avoid damages to the Multifunction Power Meter.

4 – Installation example with potential transformer for voltages over 400 Vac (phase-neutral) and 690 Vac (phase-phase).

5 – The use of 2 A protection fuses in voltage inputs is recommended to avoid damages to the Multifunction Power Meter.

3-Wire 3-Phase Voltage and Current Measurement Diagram with PT

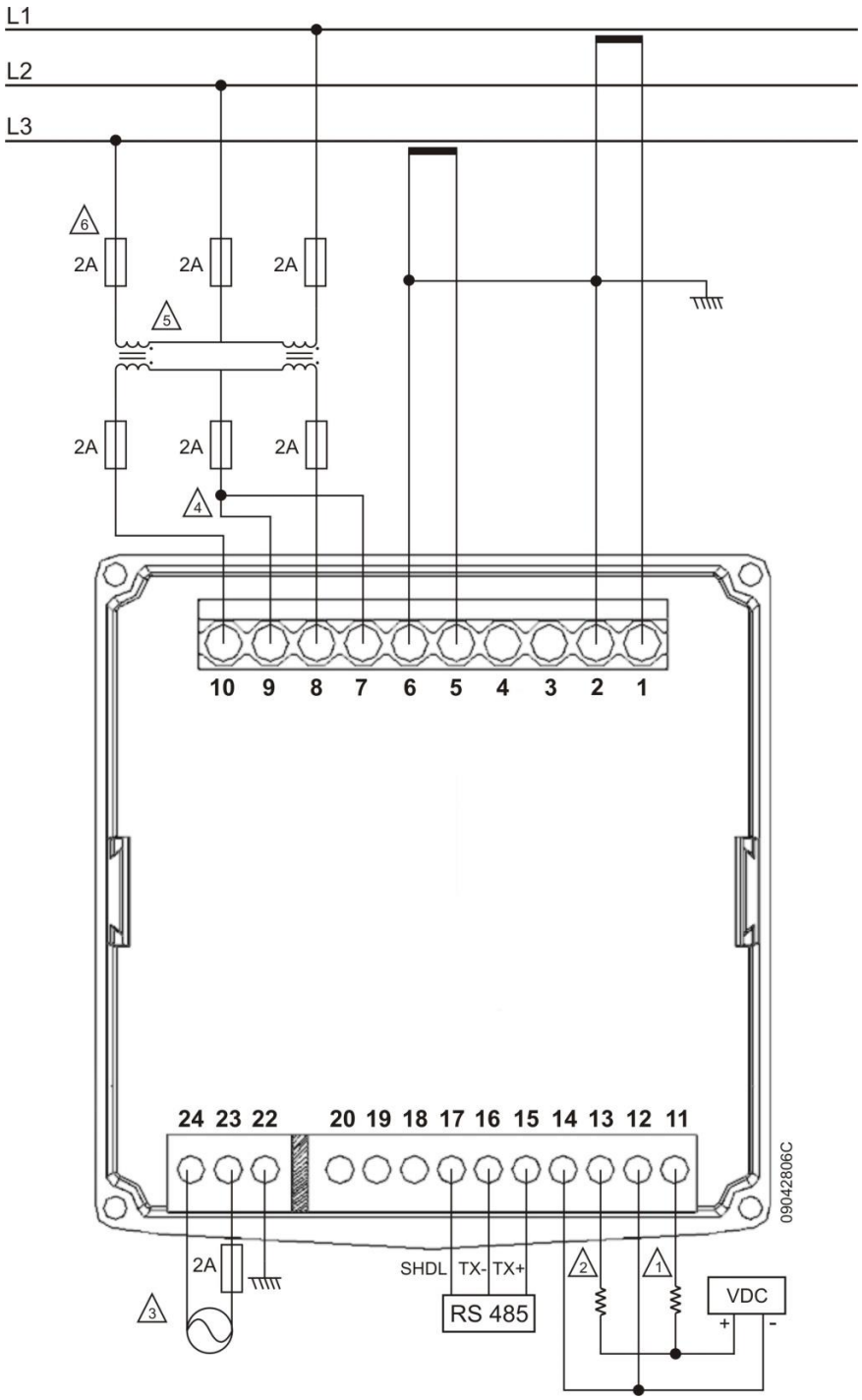

Figure 4-5. 3-Wire 3-Phase Voltage and Current Measurement Diagram with PT

Notes:

1 – Example of pulse output "sink" type installation relative to active energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages where the positive pole of the power supply must be on pin 11 and the negative on pin 12.

2 – Example of pulse output "sink" type installation relative to reactive energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages. The positive pole of the power supply must be on pin 13 and the negative on pin 14.

3 – 85 to 265 Vdc/Vac power supply, on the following pins: 24 (neutral - negative), 23 (phase - positive) and 22 (ground). The use of 2 A protection fuses is recommended to avoid damages to the Multifunction Power Meter.

4 – For the 3-phase 3-wire system, L2 voltage input (pin 9) must be connected to N voltage input (pin 7).

5 – Installation example with TP for voltages over 400 Vac (phase-neutral) and 690 Vac (phase-phase).

6 – The use of 2 A protection fuses in voltage inputs is recommended to avoid damages to the Multifunction Power Meter.

7 – This installation is recommended for systems with balanced load.

NOTE: When measuring 3-wire, only the total power must be considered.

4-Wire 3-Phase Voltage and Current Measurement Diagram without PT

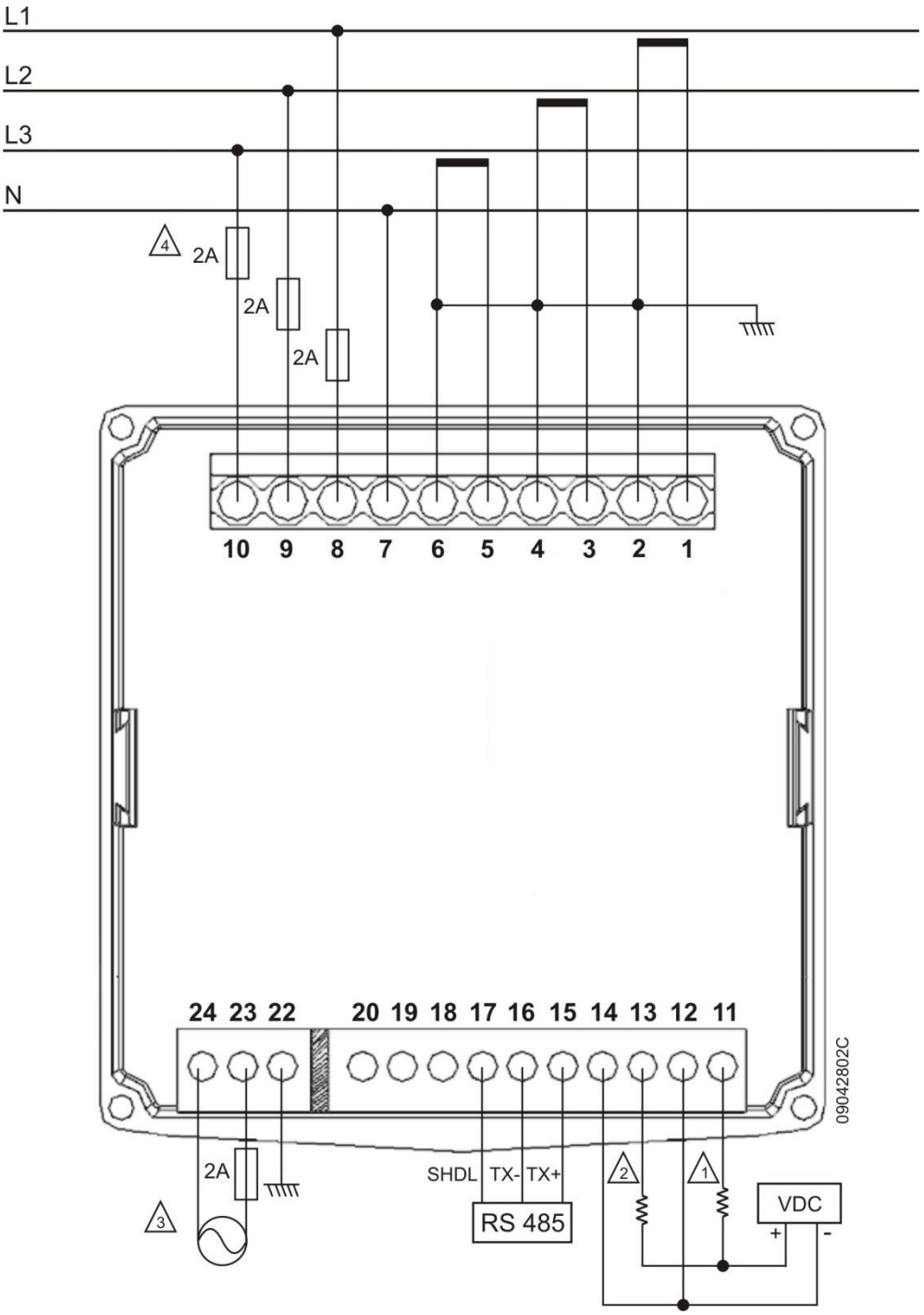

Figure 4-6. 4-Wire Voltage and 3-Phase Current Measurement Diagram Without PT

Notes:

1 – Example of pulse output "sink" type installation relative to active energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages where The positive pole of the power supply must be on pin 11 and the negative on pin 12.

2 – Example of pulse output "sink" type installation relative to reactive energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages. The positive pole of the power supply must be on pin 13 and the negative on pin 14.

3 – 85 to 265 Vdc/Vac power supply, on the following pins: 24 (neutral - negative), 23 (phase - positive) and 22 (ground). The use of 2 A protection fuses is recommended to avoid damages to the Multifunction Power Meter.

4 – The use of 2 A protection fuses in voltage inputs is recommended to avoid damages to the multifunction power meter.

3-Wire 3-Phase Voltage and Current Measurement Diagram without PT

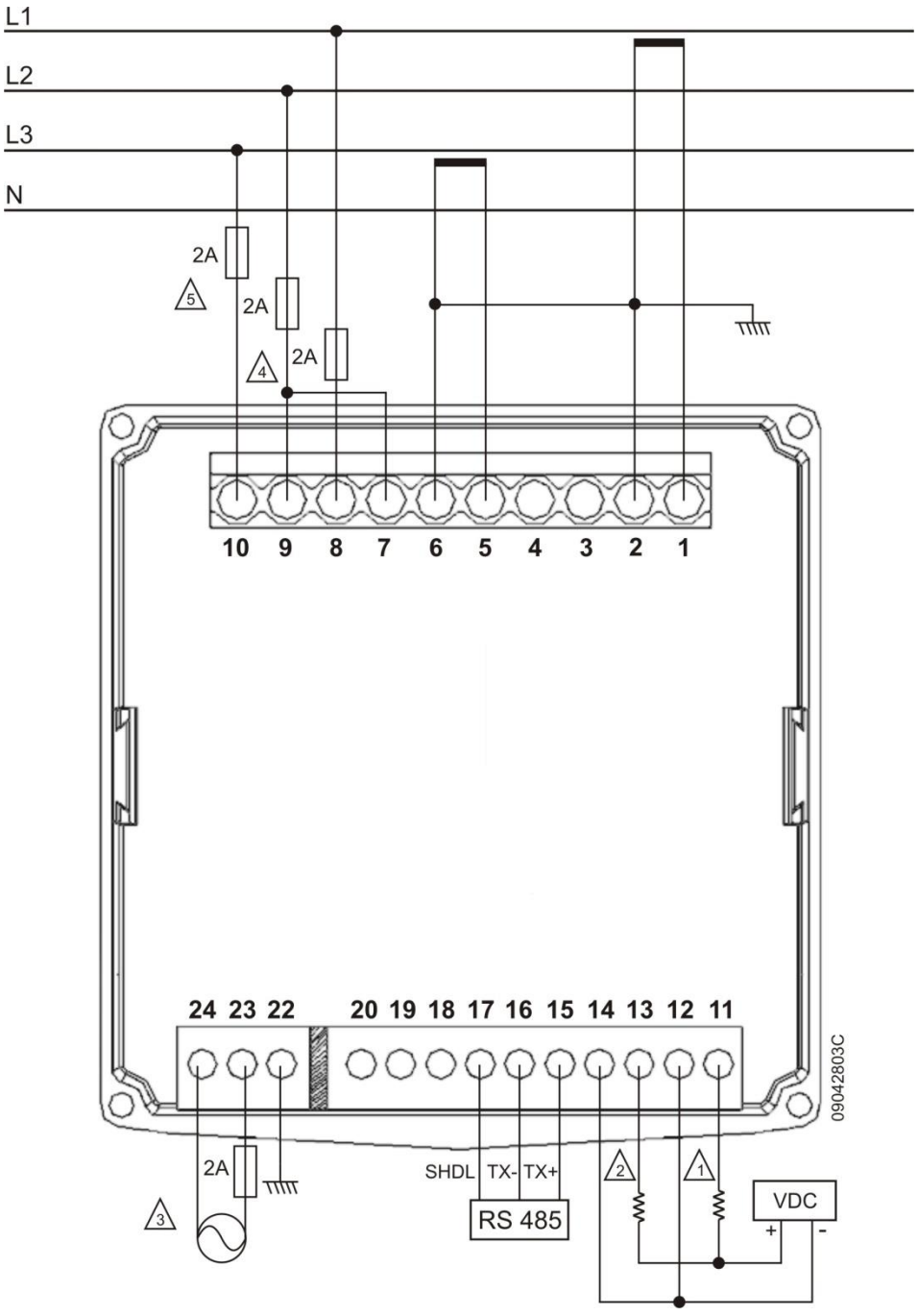

Figure 4-7. 3-Wire 3-Phase Voltage and Current Measurement Diagram Without PT

Notes:

1 – Example of pulse output “sink” type installation relative to active energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages where The positive pole of the power supply must be on pin 11 and the negative on pin 12.

2 – Example of pulse output “sink” type installation relative to reactive energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages. The positive pole of the power supply must be on pin 13 and the negative on pin 14.

3 – 85 to 265 Vdc/Vac power supply, on the following pins: 24 (neutral - negative), 23 (phase - positive) and 22 (ground). The use of 2 A protection fuses is recommended to avoid damages to the Multifunction Power Meter.

4 – For the 3-phase 3-wire system, L2 voltage input (pin 9) must be connected to N voltage input (pin 7).

5 – The use of 2 A protection fuses in voltage inputs is recommended to avoid damages to the Multifunction Power Meter.

6 – This installation is recommended for systems with balanced load.

NOTE: When measuring 3-wire, only the total power must be considered.

Single-phase Voltage and Current Measurement Diagram

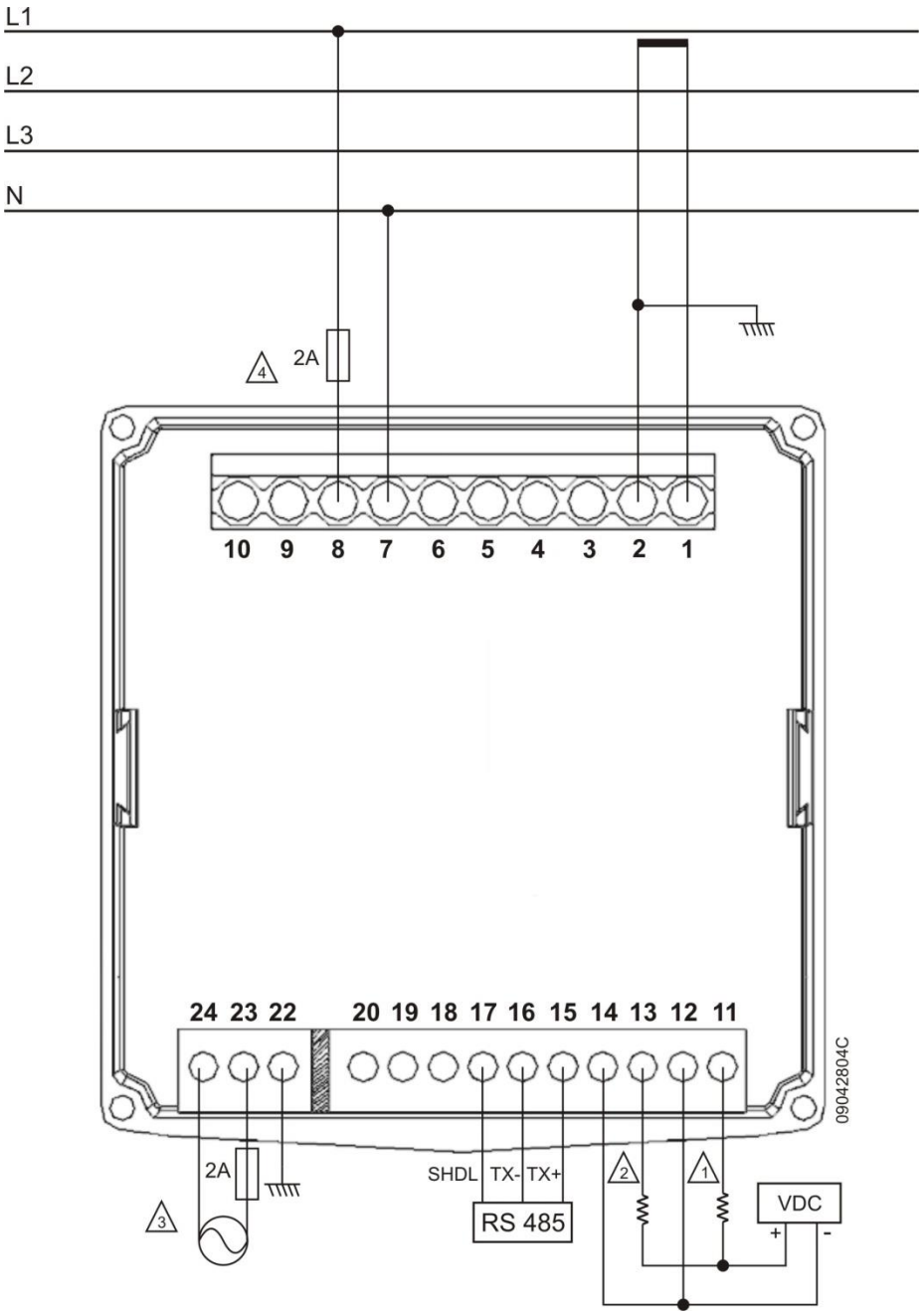

Figure 4-8. Single-Phase Voltage and Current Measurement Diagram

Notes:

1 – Example of pulse output "sink" type installation relative to active energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages where The positive pole of the power supply must be on pin 11 and the negative on pin 12.

2 – Example of pulse output "sink" type installation relative to reactive energy. The supply voltage must range from 5 to 24 Vdc with a 10 kΩ resistor. The polarization must be respected to avoid damages. The positive pole of the power supply must be on pin 13 and the negative on pin 14.

3 – 85 to 265 Vdc/Vac power supply, on the following pins: 24 (neutral - negative), 23 (phase - positive) and 22 (ground). The use of 2 A protection fuses is recommended to avoid damages to the Multifunction Power Meter.

4 – The use of 2 A protection fuses in voltage inputs is recommended to avoid damages to the Multifunction Power Meter.

Pulse Output Diagram: Source Type

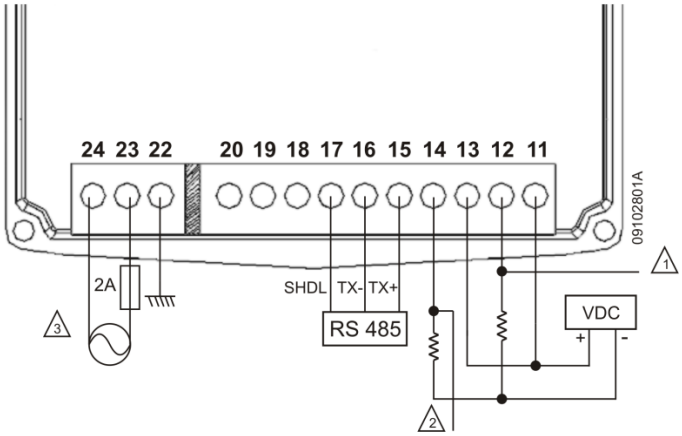

Figure 4-9. Pulse Output Diagram: Source Type

Notes:

1 – Example of pulse output source type installation for active energy. The Vdc source voltage must be from 5 up to 24 Vdc with a 10 kΩ resistor. The source polarization must be respected to avoid output damages. Consider that positive must be on pin 11 and the negative on pin 12.

2 – Example of pulse output source type installation for reactive energy. The Vdc source voltage must be from 5 up to 24 Vdc with a 10 kΩ resistor. The source polarization must be respected to avoid output damages. Consider that positive must be on pin 13 and the negative on pin 14.

3 – 85 to 265 Vdc/Vac power supply, on the following pins: 24 (neutral - negative), 23 (phase - positive) and 22 (ground). The use of 2 A protection fuses is recommended to avoid damages to the Multifunction Power Meter.

PH3x20 Interconnection Diagram

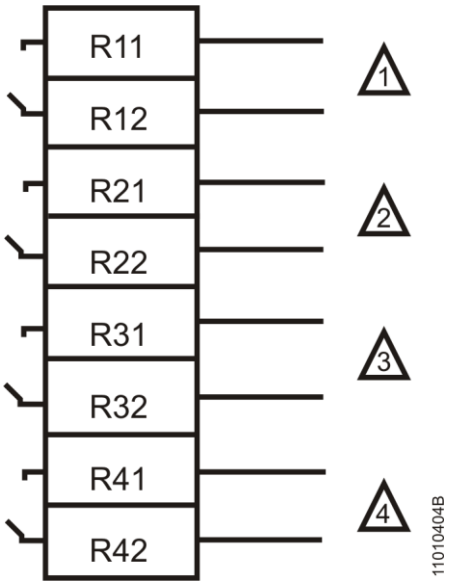

Figure 4-10. PH3x20 Expansion Module Installation Diagram

Note:

1 to 4 – Relay output with normally open contact. Consult module electrical features table for load limits.

Connections

The correct connection of the PH3100 cables and expansion modules ensure the equipment safety, and its proper operation. For that purpose, the following must be checked:

- The cables diameter and isolation voltage must be consistent with the application
- The cables on mounting panel terminals must be safely and firmly connected
- The system power supply pins and grounding parts must be strong and well connected, ensuring good current flow
- The connection between equipment and mounting panel ground must be strong and with the correct cable diameter to ensure proper grounding and noise insulation. It is recommended to use 1.5 mm^2 wires
- It is recommended to identify all cables with plastic rings or similar, to make easy the assembly and maintenance operations

Grounding

The pin ⏚ (22) must be directly connected to the panel grounding bar through a 1.5 mm^2 cable.

Mechanical Assembly

During the installation, please insert the meter into the hollow in the cabinet, then push and lock the meter with the installation accessories. It is strongly recommended to leave a 20 mm space around the meter for ventilation purpose.

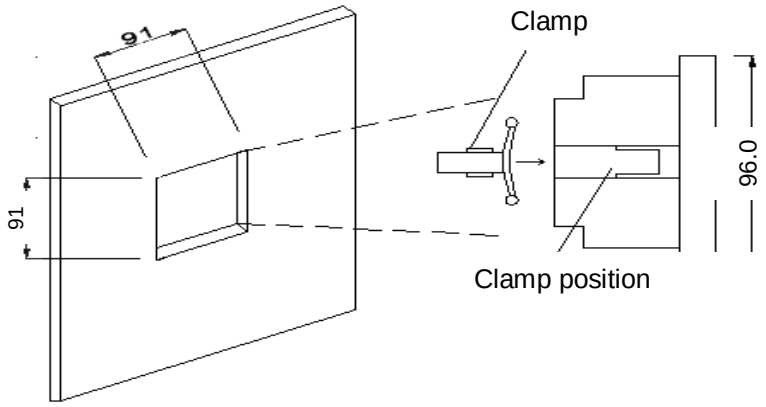

Figure 4-11. Mechanical Assembly

PH3101 Multifunction Power Meter Software Installation

To install the PH3101 Multifunction Power Meter Software, make sure that the software environment is Win2000/XP and Vista, which are the only PH3101 compatible. Then, download the install file from Altus site (www.altus.com.br). After the download, close all current programs on your desktop and then double-click the installation file. The following installation page will be displayed.

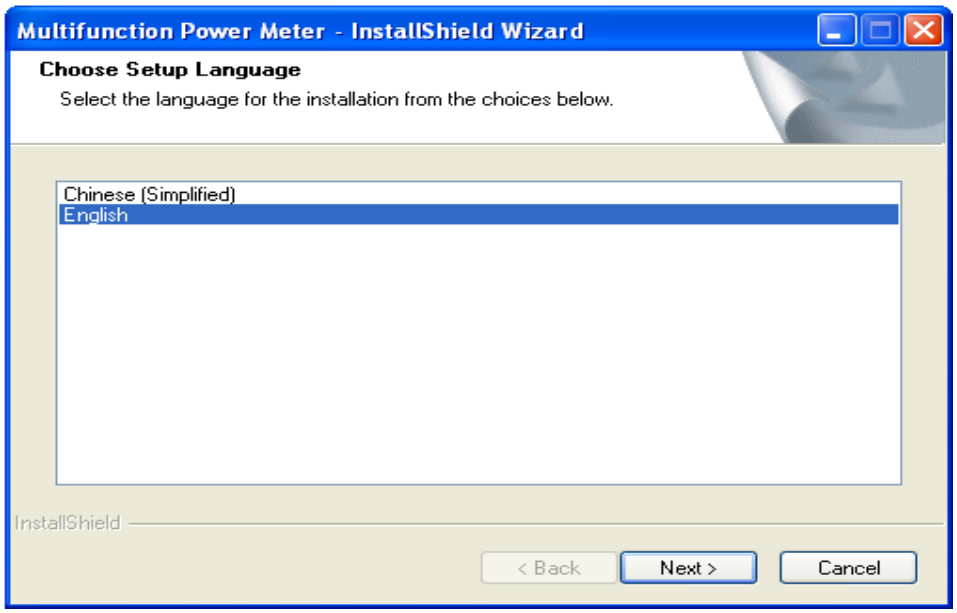

Figure 4-12. Language Selection Page

Choose the installation language for the Multifunction Power Meter software. Select the desired option and click “Next”.

The next page will be shown indicating the installation start.

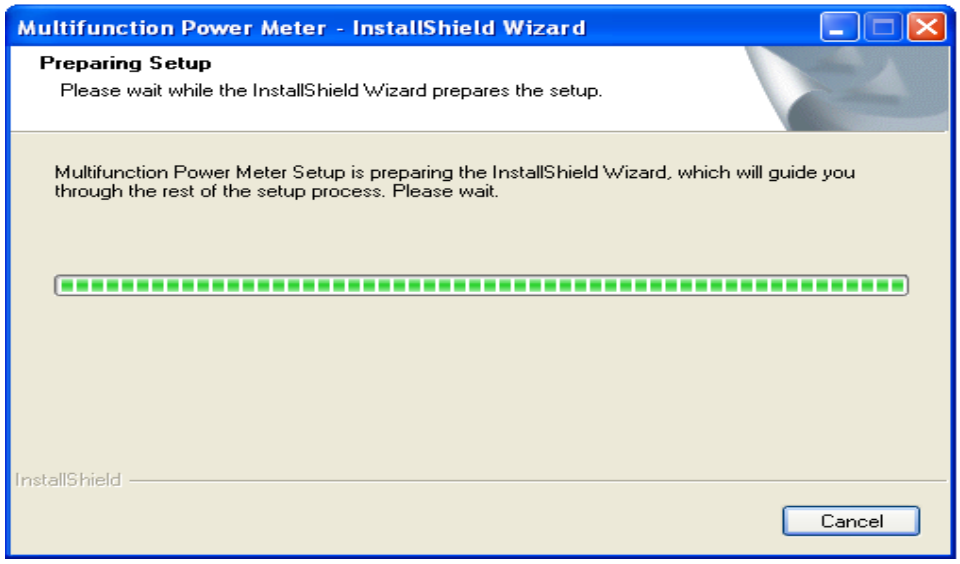

Figure 4-13. Preparing Setup Page

When the following page is shown, click “Next”.

Figure 4-14. InstallShield Wizard Page

If the user wants to change the destination file, click “Change” to change it. Click “Next” to continue and “Install” to software installation.

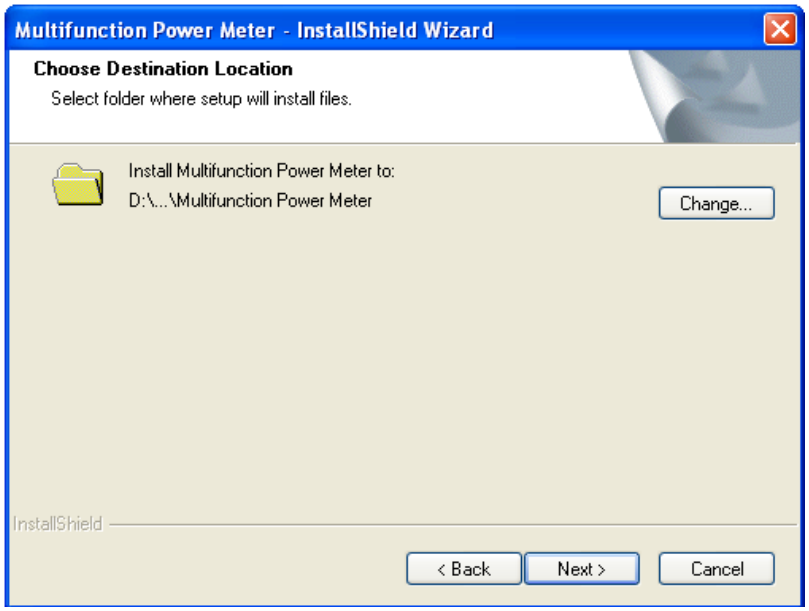

Figure 4-15. Choose Destination Location Page

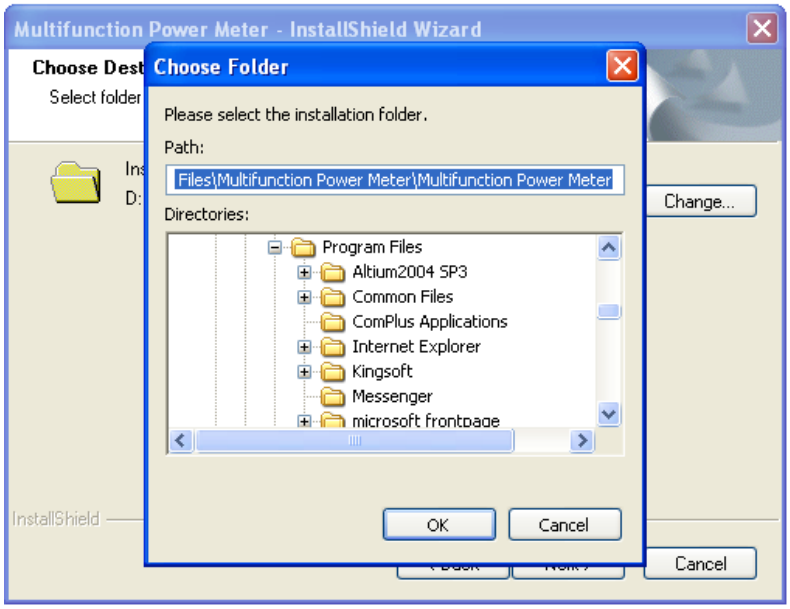

Figure 4-16. Installation Folder Selection Page

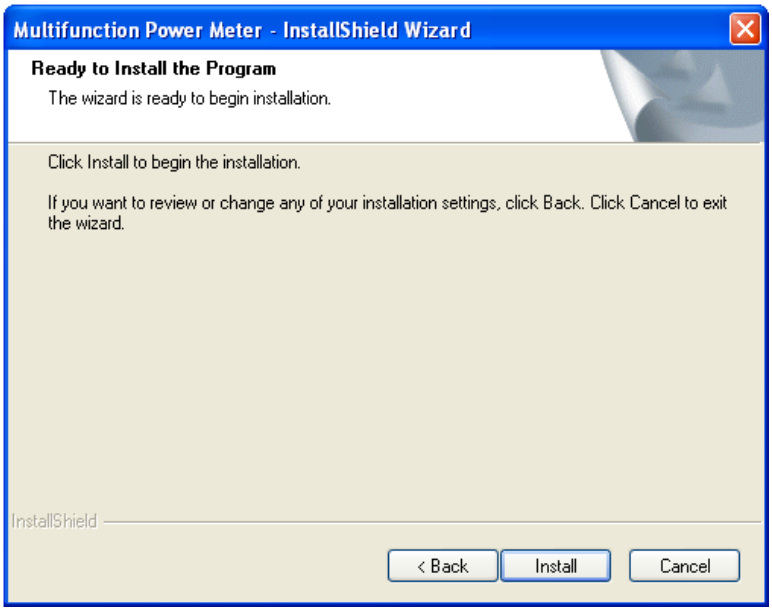

Figure 4-17. Ready to Install the Program Page

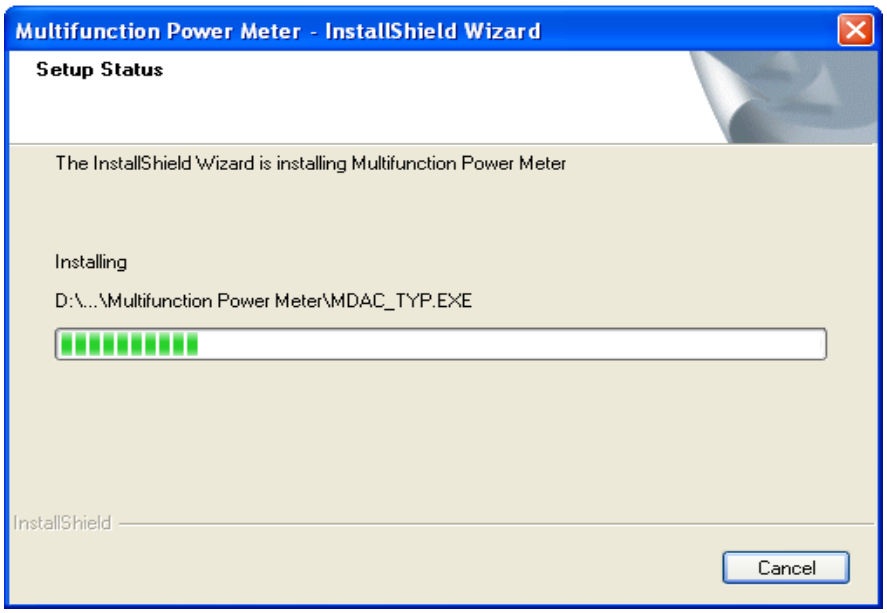

Figure 4-18. Setup Status Page

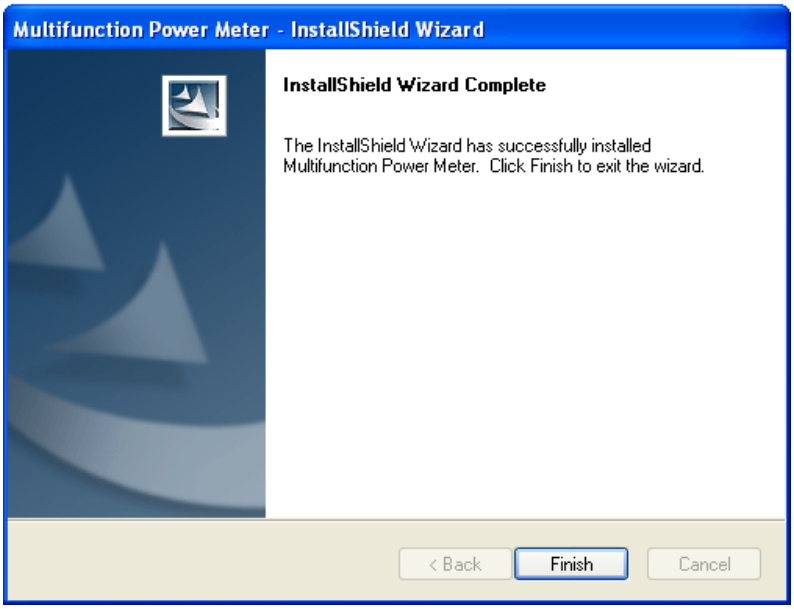

Figure 4-19. Install Shield Wizard Complete

Click “Finish” and the PH3100 icon shall appear on the desktop.

Figure 4-20. PH3100 Icon on the Desktop

5. Communication

RS-485 Serial Channel

The RS-485 serial channel bears the signals TX + and TX- only. The communication with a microcomputer may be performed as follows:

ATTENTION: Regardless of the cable to be connected to PH3100, you should use only the terminal TX +, TX- and shield, disregarding the other terminals of the cable.

- Using FBS-CM25C converter: FBS -CM25C is a RS-232/RS-485 converter that has one identified pin for RS-485 network cable connection and a DB9 connector for RS-232 network cable connection. The use of AL-2301 or AL-2306 cables is recommended to connect PH3100 with this converter
- Using AL-1413 converter: AL-1413 is a RS-232/RS-485 converter that has one identified pin for RS-485 network cable connection and a DB9 connector for RS-232 network cable connection. The use of AL-2301 or AL-2306 cables is recommended to connect PH3100 with this converter

The RS-485 network installation can be done in one of the following ways:

- Using PO8525 connector: the PO8525 has two identified pins for RS-485 network cable connection and a RJ45 connector for network cables, with the possibility of enabling the termination. The use of AL-2301, AL-2306 or AL-1717 cables is recommended to connect PH3100 with this connection.
- Using AL-2600 connector: the AL-2600 has three identified pins for network cables connection with the possibility of enabling the termination. The use of AL-2301 or AL-2306 cables is recommended to connect PH3100 with this connector.

ATTENTION: For further information on these products, see the respective technical characteristics documents.

The PH3100 serial channel has no option for RS-485 network termination and it requires the use of an external terminator.

ATTENTION: On RS-485 network the termination should be enabled only for devices mounted at the ends of the network.

MODBUS RTU Slave

The protocol used on RS-485 interface is the MODBUS RTU. The data format is **1 start bit** + 8 **bit**s + 1 **stop bit.**

RTU Commands

Read Single and Consecutive Registers (Function 03H)

Send

Byte	Description	Example
1	Meter address	01H
2	Function number	03H
3	Address (High Byte)	01H
4	Address (Low Byte)	02H
5	Number of bytes (N) (High Byte)	00H
6	Number of bytes (N) (Low Byte)	02H
7	CRC (High Byte)	CRC (H)
8	CRC (Low Byte)	CRC (L)

Table 5-1. Example of Read Registers Command

Note:

Read 2 consecutive words from the starting address 0102H of PH3100 meter with address 01H.

Response

Byte	Description	Example
1	Meter address	01H
2	Function number	03H
3	Number of bytes (2N)	04H
4	Data 1 (high)	00H
5	Data 1 (low)	01H
6	Data 2 (high)	00H
7	Data 2 (low)	01H
8	CRC (High Byte)	CRC (H)
9	CRC (Low Byte)	CRC (L)

Table 5-2. Example of Read Registers Command Response

Note:

Read 2 consecutive words from the starting address 0102H of PH3100 meter with address 01H.

Write Single Register (Function 06H)

Send

Byte	Description	Example
1	Meter Address	01H
2	Function Number	06H
3	Address (High Byte)	01H
4	Address (Low Byte)	02H
5	Data (High Byte)	00H
6	Data (Low Byte)	01H
7	CRC (High Byte)	CRC (H)
8	CRC (Low Byte)	CRC (L)

Table 5-3. Example of Write Single Register

Note:

Write 1 data word (2 bytes) in the starting address 0102H register of PH3100 meter with address 01H.

Response

Byte	Description	Example
1	Meter Address	01H
2	Function Number	06H
3	Address (High Byte)	01H
4	Address (Low Byte)	02H
5	Data (High Byte)	00H
6	Data (Low Byte)	01H
7	CRC (High Byte)	CRC (H)
8	CRC (Low Byte)	CRC (L)

Table 5-4. Example of Write Single Register Command Response

Note:

Send and response have the same content.

Writing of Multiple Registers (Function 10H)

Send

Byte	Description	Example
1	Meter Address	01H
2	Function Number	10H
3	Address (High Byte)	01H
4	Address (Low Byte)	02H
5	Number of bytes (N) (High Byte)	00H
6	Number of bytes (N) (Low Byte)	02H
7	Number of bytes (2N)	04H
8	Data 1 (High byte)	00H
9	Data 1 (Low byte)	01H
10	Data 2 (High byte)	00 H
11	Data 2 (Low byte)	01H
12	CRC (High byte)	CRC (H)
13	CRC (Low Byte)	CRC (L)

Table 5-5. Example of Write Multiple Registers Command

Note:

Write 2 data words in 2 registers with starting address 0102H of the address 01H - PH3100

Response

Byte	Description	Example
1	Meter Address	01H
2	Function N°.	10H
3	Address (High Byte)	01H
4	Address (Low Byte)	01H
5	Data (High byte)	00H
6	Data (Low byte)	02H
7	CRC (High byte)	CRC (H)
8	CRC (Low Byte)	CRC (L)

Table 5-6. Example of Write Multiple Registers Response

Data Format

According to MODBUS protocol, the data in the register is 1WORD, 16 bit data.

Date and time can be represented (Year/month/day/hour/minute as BCD code)

Energy can be represented in 4 (four) registers:

- Integral: quotient = actual value / 1000000
- Decimal: residual = actual value % 100000
- Integral (high 16 bit = quotient / 1000 low 16 bit = quotient % 1000)
- Residual (high 16 bit = residual / 1000, low 16 bit = residual % 1000)

Demand cycle is 1to 15 minutes; the shortest interval is 1 minute.

Unbalanced Voltage ratio= ((V H – V L) /V H) * 1000

Unbalanced Current rate= ((IH – IL) /IH) * 1000

Energy calculation: ([register value] converted to decimal system) to the current value. Then calculate the energy using the above formula.

ATTENTION:
The addressing the following register may need to be added to one, because there are MODBUS masters that does not allow the MODBUS address 0, starting in 1, in these cases is necessary that sum.
Example: Address 0000 - version of hardware - it must be accessed at 0001 and so on, considering that initiates a MODBUS master addressing in 1.
The access to addresses not described in this manual, or invalid values written, can be occurs bad work in the product, so suggests to use only the know addresses.

Calibration Registers (Current 0 to 12 A, Voltage 20 to 690 V)

Register Value (Hex)	Type	Description	Remark
0000	RO	Hardware version	---
0001	RW	Connection method	0 – 3-phase 3-wire others – 3-phase 4-wire
0002	RO	Operation time H	---
0003	RO	Operation time L	---
0004	RW	U Scope Register value = U scope*10, U Scope = register value / 10	U Scope = 0 to 690, 1 decimal is kept
0005	RW	I scope Register Value = I scope*1000. I scope=register value/1000.	I scope = 0 to 5, 3 decimals are kept.

Table 5-7. Calibration Registers

System Registers

Register Value (Hex)	Type	Description	Remark
0100	RW	Address	1 to 247
0101	RW	PT	9999
0102	RW	CT	9999
0103	RW	Baud rate	2 – 38400 3 – 19200 4 – 9600 5 – 4800 6 - 2400
0104	RW	Demand cycle	1 to 15 s
0105	RW	Time (year/month)	Hi – year Low – month
0106	RW	Time (day/ hour)	Hi – day Low – hour
0107	RW	Time (minute/second)	Hi – minutes Low – seconds
0108	RW	L1 phase voltage upper limit	Phase voltage
0109	RW	L1 phase voltage lower limit	
010A	RW	L2 phase voltage upper limit	
010B	RW	L2 phase voltage lower limit	
010C	RW	L3 phase voltage upper limit	
010D	RW	L3 phase voltage lower limit	
010E	RW	L1 phase current upper limit	Phase current
010F	RW	L1 phase current lower limit	

0110	RW	L2 phase current upper limit	
0111	RW	L2 phase current lower limit	
0112	RW	L3 phase current upper limit	
0113	RW	L3 phase current lower limit	
0114	RW	Neutral current upper limit	---
0115	RW	3 phase active demand upper limit	---
0116	RW	3 phase reactive demand upper limit	---
0117	RW	Power factor lower limit	---
0118	RW	System frequency lower limit	---
0119	RW	Neutral current upper limit	---
011A	RW	Unbalanced voltage (lower limit)	---
011B	RW	Delay and output 1 reset	High: delay Low: reset time Values: 1 to 255 Time unit: seconds
011C	RW	Delay and output 2 reset	
011D	RW	Delay and output 3 reset	
011E	RW	Delay and output 4 reset	
011F	RW	Output 1 setup	Describe the options or point to a table where the options are listed
0120	RW	Output 2 setup	Same as above
0121	RW	Output 3 setup	Same as above
0122	RW	Output 4 setup	Same as above
0123	RW	Relay output control	D0 – Output 1 D1 – Output 2 D2 – Output 3 D3 – Output 4 0 = Off 1 = On
012D	RW	Meter constant	1 to 9600
012E	RW	Pulse width	80 ± 20 ms
012F	RW	Display interval	2 to 30 s (default 10 s)
0130	RO	Software edition	---
0131	RW	Infrared/485 (stand by)	0 = infrared 1 = RS-485
0132	RW	Data storage interval	1 to 3600 s
0134	RW	PROFIBUS address	3 to 123
0135	RO	No. of times energy out of scope	0 to 65535

Table 5-8. Control Registers

Profile Consumption Registers

Register Value (Hex)	Type	Description	Remark
0200	RW	Start consumption profile (enable)	0 = off 1 = on
0201	RW	Default consumption Profile (stand by)	(change default consumption)
0202	RW	No of intervals	2 to 12
0203	RW	Interval 01	00: 00 (0000 ~ 2400)
0204	RW	Interval 02	00: 00
0205	RW	Interval 03	00: 00
0206	RW	Interval 04	00: 00
0207	RW	Interval 05	00: 00
0208	RW	Interval 06	00: 00
0209	RW	Interval 07	00: 00
020A	RW	Interval 08	00: 00

020B	RW	Interval 09	00: 00
020C	RW	Interval 10	00: 00
020D	RW	Interval 11	00: 00
020E	RW	Interval 12	00: 00
020F	RW	Interval 01 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0210	RW	Interval 02 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0211	RW	Interval 03 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0212	RW	Interval 04 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0213	RW	Interval 05 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0214	RW	Interval 06 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0215	RW	Interval 07 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0216	RW	Interval 08 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0217	RW	Interval 09 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0218	RW	Interval 10 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
0219	RW	Interval 11 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
021 A	RW	Interval 12 – consumption type	0 – Sharp 1 – Peak 2 – Flat 3 – Low
021 B	RW	Frozen time every month (day/hour)	High – day Low – hour
021 C	RW	Frozen time every month (minute/second)	High - minute Low - second

Table 5-9. Consumption Profile Registers

Automatic Record Registers

Register Value (Hex)	Type	Description	Remark
0331	RO	The last calibration clock time (year/month) (stand by)	High = year, Low = month
0232	RO	The last calibration clock time (day/Hour) (stand by)	High = day, Low = hour
0233	RO	The last calibration clock time (minute/ second) (stand by)	High = minute, Low = second
0234	RO	N°. of calibration (stand by)	---
0235	RO	The last programming time (year/month) (stand by)	High = year, Low = month
0236	RO	The last programming time (day/hour) (stand by)	High = day, Low = hour
0237	RO	The last programming time (minute/second) (stand by)	High = minute, Low = second
0238	RO	N°. of programming (stand by)	---
0239	RO	The latest energy reverse running start time (year/month)	High = year, Low = month
023A	RO	The latest energy reverse running start time (day/hour)	High = day, Low = hour
023B	RO	The latest energy reverse running start time (minute/second)	High = minute, Low = second
023C	RO	Total reverse running time (High)	999999. 999 hours
023D	RO	Total reverse running time (Low)	---
023E	RO	Consumption profile (month) – records of the numbers and indicators	High = records of the numbers, Low = indicators

Table 5-10. Automatic Record Registers

Demand Registers

Register Value (Hex)	Type	Description	Remark
0268	RO	L1 - active demand	---
0269	RO	L2 - active demand	---
026A	RO	L3 - active demand	---
026B	RO	3-phase active demand	---
026C	RO	L1- reactive demand	---
026D	RO	L2 - reactive demand	---
026E	RO	L3 - reactive demand	---
026F	RO	3-phase reactive demand	---
0270	RO	L1- max. active demand	---
0271	RO	L2 - max. active demand	---
0272	RO	L3 - max. active demand	---
0273	RO	3-phase max. active demand	---
0274	RO	L1 - max. reactive demand	---
0275	RO	L2 - max. reactive demand	---
0276	RO	L3 - max. reactive demand	---
0277	RO	3-phase max. reactive demand	---
0278	RO	L1 - min. active demand	---
0279	RO	L2 - min. active demand	---
027A	RO	L3 - min. active demand	---
027B	RO	3-phase min. active demand	---
027C	RO	L1 - min. reactive demand	---
027D	RO	L2 - min. reactive demand	---

027E	RO	L3 - min. reactive demand	---
027F	RO	3-phase min. reactive demand	---

Table 5-11. Demand Registers

Instant Value Register

Register Value (Hex)	Type	Description	Remark
0300	RO	L1 - phase voltage	---
0301	RO	L2 - phase voltage	---
0302	RO	L3 - phase voltage	---
0303	RO	Average phase voltage	---
0304	RO	L12 - line voltage	---
0305	RO	L23 - line voltage	---
0306	RO	L31 - line voltage	---
0307	RO	Average - line voltage	---
0308	RO	I1 - phase current	---
0309	RO	I2 - phase current	---
030A	RO	I3 - phase current	---
030B	RO	Average phase current	---
030C	RO	L1 - apparent power	---
030D	RO	L2 - apparent power	---
030E	RO	L3 - apparent power	---
030F	RO	3-phase apparent power	---
0310	RO	L1- phase active power	---
0311	RO	L2 - phase active power	---
0312	RO	L3- phase active power	---
0313	RO	3-phase active power	---
0314	RO	L1- phase reactive power	---
0315	RO	L2 - phase reactive power	---
0316	RO	L3 - phase reactive power	---
0317	RO	3-phase reactive power	---
0318	RO	L1 - power factor	---
0319	RO	L2 - power factor	---
031A	RO	L3 - power factor	---
031B	RO	3-phase power factor	---
031C	RO	System frequency	---
031D	RO	Neutral current	---
031E	RO	Voltage unbalanced ratio	In 3P4W system = phase voltage In 3P3W = line tension
031F	RO	Current unbalanced ratio	---
0320	RO	Energy direction	---
0321	RO	Output alarm status	**Output 1** B0 = Alarm B8 = Alarm type **Output 2** B1 = Alarm B9 = Alarm type **Output 3** B2 = Alarm B10 = Alarm type

			Output 4 B3 = Alarm B11 = Alarm type **B0 to B3** 0 = No alarms 1 = Alarm active B8 to B11 0 = Under limit 1 = Over limit

Table 5-12. Instant Value Registers

Instant Maximum / Minimum Value Registers

Register Value (Hex)	Type	Description	Remark
0400	RO	L1 - max. phase voltage	---
0401	RO	L2 - max. phase voltage	---
0402	RO	L3 - max. phase voltage	---
0403	RO	Average max. phase voltage	---
0404	RO	L12 - max. line voltage	---
0405	RO	L23 - max. line voltage	---
0406	RO	L31 - max. line voltage	---
0407	RO	Average max. line Voltage	---
0408	RO	I1 - max. phase current	---
0409	RO	I2 - max. phase current	---
040A	RO	I3 - max. phase current	---
040B	RO	Average max. phase current	---
040C	RO	L1 - max. apparent power	---
040D	RO	L2 - max. apparent power	---
040E	RO	L3 - max. apparent power	---
040F	RO	3-phase max. apparent power	---
0410	RO	L1 - max. active power	---
0411	RO	L2 - max. active power	---
0412	RO	L3 - max. active power	---
0413	RO	3 phase max. active power	---
0414	RO	L1 - max. reactive power	---
0415	RO	L2 - max. reactive power	---
0416	RO	L3 - max. reactive power	---
0417	RO	3-phase max. reactive power	---
0418	RO	L1 - max. power factor	---
0419	RO	L2 - max. power factor	---
041A	RO	L3 – max. power factor	---
041B	RO	3-phase max. power factor	---
041C	RO	Max. system frequency	---
041D	RO	Max. neutral current	---
041E	RO	Max. unbalanced voltage ratio	---
041F	RO	Max. unbalanced current ratio	---
0420	RO	L1 - min. phase voltage	---
0421	RO	L2 - min. phase voltage	---
0422	RO	L3 - min. phase voltage	---
0423	RO	Average min. phase voltage	---
0424	RO	L12 - min. line voltage	---

0425	RO	L23 - min. line voltage	---
0426	RO	L31 - min. line voltage	---
0427	RO	Average min. line voltage	---
0428	RO	I1 - min. phase current	---
0429	RO	I2 - min. phase current	---
042A	RO	I3 - min. phase current	---
042B	RO	Average min. phase current	---
042C	RO	L1 - min. apparent power	---
042D	RO	L2 - min. apparent power	---
042E	RO	L3 - min. apparent Power	---
042F	RO	3-phase min. apparent power	---
0430	RO	L1- min. active power	---
0431	RO	L2 - min. active power	---
0432	RO	L3 - min. active power	---
0433	RO	3-phase min. active power	---
0434	RO	L1 - min. reactive power	---
0435	RO	L2 - min. reactive power	---
0436	RO	L3 - min. reactive power	---
0437	RO	3-phase min. reactive power	---
0438	RO	L1 - min. power factor	---
0439	RO	L2 - min. power factor	---
043A	RO	L3 - min. power factor	---
043B	RO	3 phase min. power factor	---
043C	RO	Min. system frequency	---
043D	RO	Min. neutral current	---
043E	RO	Min. unbalanced voltage ratio	---
043F	RO	Min. unbalanced current ratio	---

Table 5-13. Maximum/Minimum Instant Value Registers

Energy Registers

Register Value (Hex)	Type	Description	Remark
1A00	RO	Active total energy Hi	999999999 MWh / MVArh
1A01	RO	Active total energy Lo	
1A02	RO	Importing active power Hi	
1A03	RO	Importing active power Lo	
1A04	RO	Exporting active power Hi	
1A05	RO	Exporting active power Lo	
1A06	RO	Reactive total energy Hi	
1A07	RO	Reactive total energy Lo	
1A08	RO	Inductive reactive energy Hi	
1A09	RO	Inductive reactive energy Lo	
1A0A	RO	Capacitive reactive energy Hi	
1A0B	RO	Capacitive reactive energy Lo	
1A0C	RO	Active energy decimal Hi	< 1MWh or 1MVArh 0,00000001*100000000
1A0D	RO	Active energy decimal Lo	
1A0E	RO	Importing active energy decimal Hi	
1A0F	RO	Importing active energy decimal Lo	
1A10	RO	Exporting active energy decimal Hi	
1A11	RO	Exporting active energy decimal Lo	
1A12	RO	Reactive energy decimal Hi	
1A13	RO	Reactive energy decimal Lo	

1A14	RO	Inductive reactive energy decimal Hi	
1A15	RO	Inductive reactive energy decimal Lo	
1A16	RO	Capacitive reactive energy decimal Hi	
1A17	RO	Capacitive reactive energy decimal Lo	
0518	RO	Current month sum energy Hi	19999999,99 W
0519	RO	Current month sum energy Lo	
051A	RO	Current month sharp energy Hi	
051B	RO	Current month sharp energy Lo	
051C	RO	Current month peak energy Hi	
051D	RO	Current month peak energy Lo	
051E	RO	Current month flat energy Hi	
051F	RO	Current month flat energy Lo	
0520	RO	Current month low energy Hi	
0521	RO	Current month low energy Lo	
0522	RO	Current month total energy in 01 interval Hi	
0523	RO	Current month total energy in 01 interval Lo	
0524	RO	Current month importing energy in 01 interval Hi	
0525	RO	Current month importing energy in 01 interval Lo	
0526	RO	Current month exporting energy in 01 interval Hi	
0527	RO	Current month exporting energy in 01 interval Lo	
...			
0564	RO	Current month total energy in 12 interval Hi	
0565	RO	Current month total energy in 12 interval Lo	
0566	RO	Current month importing energy in 12 interval Hi	
0567	RO	Current month importing energy in 12 interval Lo	
0568	RO	Current month exporting energy in 12 interval Hi	
0569	R O	Current month exporting energy in 12 interval Lo	
056A	R O	Last month sum energy Hi	
056B	RO	Last month sum energy Lo	
056C	RO	Last month sharp energy Hi	
056D	RO	Last month sharp energy Lo	
056E	RO	Last month peak energy Hi	
056F	RO	Last month peak energy Lo	
0570	RO	Last month flat energy Hi	
0571	RO	Last month flat energy Lo	
0572	RO	Last month low energy Hi	
0573	RO	Last month low energy Lo	
0574	RO	Last month total energy in 01 interval Hi	
0575	RO	Last month total energy in 01 interval Lo	
0576	RO	Last month importing energy in 01 interval Hi	
0577	RO	Last month importing energy in 01 interval Lo	
0578	RO	Last month exporting energy in 01 interval Hi	
0579	RO	Last month exporting energy in 01 interval Lo	
...		2 to 11	
05B6	RO	Last month total energy in 12 interval Hi	
05B7	RO	Last month total energy in 12 interval Lo	
05B8	RO	Last month importing energy in 12 interval Hi	
05B9	RO	Last month importing energy in 12 interval Lo	

05BA	RO	Last month exporting energy in 12 interval Hi
05BB	RO	Last month exporting energy in 12 interval Lo
05BC	RO	1 month before last total energy Hi
05BD	RO	1 month before last total energy Lo
05BE	RO	1 month before last sharp energy Hi
05BF	RO	1 month before last sharp energy Lo
05C0	RO	1 month before last peak energy Hi
05C1	RO	1 month before last peak energy Lo
05C2	RO	1 month before last flat energy Hi
05C3	RO	1 month before last flat energy Lo
05C4	RO	1 month before last low energy Hi
05C5	RO	1 month before last low energy Lo
05C6	RO	1 month before last 01 interval total energy Hi
05C7	RO	1 month before last 01 interval total energy Lo
05C8	RO	1 month before last 01 interval imp energy Hi
05C9	RO	1 month before last 01 interval imp energy Lo
05C8	RO	1 month before last 01 interval exp energy Hi
05C9	RO	1 month before last 01 interval exp energy Lo
...		
0606	RO	1 month before last 12 interval total energy Hi
0607	RO	1 month before last 12 interval total energy Lo
0608	RO	1 month before last 12 interval imp energy Hi
0609	RO	1 month before last 12 interval imp energy Lo
060A	RO	1 month before last 12 interval exp energy Hi
60B	RO	1 month before last 12 interval exp energy Lo
060E	RO	2 month before last total energy Hi
060F	RO	2 month before last total energy Lo
0610	RO	2 month before last sharp energy Hi
0611	RO	2 month before last sharp energy Lo
0612	RO	2 month before last peak energy Hi
0613	RO	2 month before last peak energy Lo
0614	RO	2 month before last flat energy Hi
0615	RO	2 month before last flat energy Lo
0616	RO	2 month before last low energy Hi
0617	RO	2 month before last low energy Lo
0618	RO	2 month before last 01 interval total energy Hi
0619	RO	2 month before last 01 interval total energy Lo
061A	RO	2 month before last 01 interval imp energy Hi
061B	RO	2 month before last 01 interval imp energy Lo
061C	RO	2 month before last 01 interval exp energy Hi
061D	RO	2 month before last 01 interval total energy Lo
...		2 to 11
065A	RO	2 month before last 12 interval total energy Hi
065B	RO	2 month before last 12 interval total energy Lo
065C	RO	2 month before last 12 interval imp energy Hi
065D	RO	2 month before last 12 interval imp energy Lo
065E	RO	2 month before last 12 interval exp energy Hi
065F	RO	2 month before last 12 interval exp energy Lo

Table 5-14. Energy Registers

Harmonic Registers

Register Value (Hex)	Type	Description	Remark
0660	RO	L1 – Total harmonic voltage	0 to 65535 (0.01 %)
0661	RO	L2 – Total harmonic voltage	0 to 65535 (0.01 %)
0662	RO	L3 – Total harmonic voltage	0 to 65535 (0.01 %)
0663	RO	L1 – Voltage (THD – R)	0 to 65535 (0.01 %)
0664	RO	L2 – Voltage (THD – R)	
0665	RO	L3 – Voltage (THD – R)	
0666	RO	L1 – Voltage (THD – F)	0 to 65535 (0.01 %)
0667	RO	L2 – Voltage (THD – F)	
0668	RO	L3 – Voltage (THD – F)	
0669	RO	L1 – Voltage (CF)	0 to 65535 (0.1 %)
066A	RO	L2 – Voltage (CF)	
066B	RO	L3 – Voltage (CF)	
066C	RO	I1 – Total harmonic current	0 to 65535 (0.01 %)
066D	RO	I2 – Total harmonic current	
066E	RO	I3 – Total harmonic current	
066F	RO	Neutral total harmonic current	
0670	RO	I1 – Current (THD – R)	0 to 65535 (0.01 %)
0671	RO	I2 – Current (THD – R)	
0672	RO	I3 – Current (THD – R)	
0673	RO	Neutral current (THD – R)	
0674	RO	I1 – Current (THD – F)	0 to 65535 (0.01 %)
0675	RO	I2 – Current (THD – F)	
0676	RO	I3 – Current (THD – F)	
0677	RO	Neutral current (THD – F)	
0678	RO	I1 (K – factor)	0 to 65535 (0.1%)
0679	RO	I2 (K – factor)	
067A	RO	I3 (K – factor)	
067B	RO	Neutral current (K – factor)	
067C	RO	Total harmonic voltage (odd)	0 to 65535 (1%)
067D	RO	Total harmonic voltage (odd)	0 to 65535 (1%)
067E	RO	Total harmonic voltage (odd)	0 to 65535 (1%)
067F	RO	Total harmonic current (even)	0 to 65535 (1%)
0680	RO	L1 – Odd voltage (THD – R)	0 to 65535 (0.01 %)
0681	RO	L2 – Odd voltage (THD – R)	
0682	RO	L3 – Odd voltage (THD – R)	
0683	RO	L1 – Even voltage (THD – R)	
0684	RO	L2 – Even voltage (THD – R)	
0685	RO	L3 – Even voltage (THD – R)	
0686	RO	I1 – Odd current (THD – R)	
0687	RO	I2 – Odd current (THD – R)	
0688	RO	I3 – Odd current (THD – R)	
0689	RO	Odd neutral current (THD – R)	
068A	RO	I1 – Even current (THD – R)	
068B	RO	I2 – Even current (THD – R)	
068C	RO	I3 – Even current (THD – R)	
068D	RO	Even neutral current (THD – R)	
068E	RO	L1 – Voltage	0 to 65535 (0.1V)
068F	RO	L2 – Voltage	
0690	RO	L3 – Voltage	
0691	RO	Phase angle of L1 voltage	0 to 359.9 (0.1º)

0692	RO	Phase angle of L2 voltage	
0693	RO	Phase angle of L3 voltage	
0694	RO	I1 – Current	0 to 65535 (0.001A)
0695	RO	I2 – Current	
0696	RO	I3 – Current	
0697	RO	Neutral current phase	
0698	RO	Phase angle of L1 current	0 to 359.9 (0,1º)
0699	RO	Phase angle of L2 current	
069A	RO	Phase angle of L3 current	
069B	RO	Neutral current phase angle	
069C	RO	L1 – Active power	-32767 to 32767 (0.001 kW)
069D	RO	L2 – Active power	
069E	RO	L3 – Active power	
069F	RO	L1 – Reactive power	-32767 to 32767 (0.001 kVar)
06A0	RO	L2 – Active power	
06A1	RO	L3 – Active power	
06A2	RO	L1 – Apparent power	0 to 65535 (0.001kVA)
06A3	RO	L2 – Apparent power	
06A4	RO	L3 – Apparent power	
1001	RO	Voltage L1 – 1st harmonic %	0.01% (L1)
1002	RO	Voltage L1 – 2nd harmonic %	
1003	RO	Voltage L1 – 3rd harmonic %	
...			
103F	RO	Voltage L1 – 63rd harmonic %	
1041	RO	Voltage L2 – 1st harmonic %	0.01 % (L2)
1042	RO	Voltage L2 – 2nd harmonic %	
...			
107F	RO	Voltage L2 – 63rd harmonic %	
1081	RO	Voltage L3 – 1st harmonic %	0.01 % (L3)
1082	RO	Voltage L3 – 2nd harmonic %	
10BF	RO	Voltage L3 – 63rd harmonic %	
10C1	RO	I1 Current – 1st harmonic %	0.01 % (I1)
10C2	RO	I1 Current – 2nd harmonic %	
...			
10FF	RO	I1 Current – 63rd harmonic %	
1101	RO	I2 Current – 1st harmonic %	0.01 % (I2)
1102	RO	I2 Current – 2nd harmonic %	
...			
113F	RO	I2 Current – 63rd harmonic %	
1141	RO	I3 Current – 1st harmonic %	0.01 % (I3)
1142	RO	I3 Current – 2nd harmonic %	
...			
117F	RO	I3 Current – 63rd harmonic %	
1181	RO	Neutral current – 1st harmonic %	0.01 % (Iz)
1182	RO	Neutral current – 2nd harmonic %	
...			
11BF	RO	Neutral current – 63rd harmonic %	

Table 5-15. Harmonic Registers

Harmonic – Phase Angle Registers

Register Value (Hex)	Type	Description	Remark
1201	RO	L1 Voltage – 1st phase angle	359.9º (L1)
1202	RO	L1 Voltage – 2nd phase angle	
1203	RO	L1 Voltage – 3rd phase angle	
...			
123F	RO	L1 Voltage – 63rd phase angle	
1241	RO	L2 Voltage – 1st phase angle	359.9º (L2)
1242	RO	L2 Voltage – 2nd phase angle	
...			
127F	RO	L2 Voltage – 63rd phase angle	
1282	RO	L3 Voltage – 1st phase angle	359.9º (L3)
1083	RO	L3 Voltage – 2nd phase angle	
12BF	RO	L3 Voltage – 63rd phase angle	
12C1	RO	Current I1 – 1st phase angle	359.9º (I1)
12C2	RO	Current I1 – 2nd phase angle	
...			
12FF	RO	Current I1 – 63rd phase angle	
1301	RO	Current I2 – 1st phase angle	359.9º (I2)
1302	RO	Current I2 – 2nd phase angle	
...			
133F	RO	Current I2 – 63rd phase angle	
1341	RO	Current I3 – 1st phase angle	359.9º (I3)
1342	RO	Current I3 – 2nd phase angle	
...			
137F	RO	Current I3– 63rd phase angle	
1381	RO	Neutral current – 1st phase angle	359.9º (Iz)
1382	RO	Neutral current – 2nd phase angle	
...			
13BF	RO	Neutral current – 63rd phase angle	

Table 5-16. Harmonic – Phase Angle Registers

Demand Statistics Registers

Register Value (Hex)	Type	Description	Remark
1800	RO	L1 Active demand Hi	x 1000
1801	RO	L1 Active demand Mi	
1802	RO	L1 Active demand Lo	
1803	R0	L2 Active demand Hi	
1804	RO	L2 Active demand Mi	
1805	RO	L2 Active demand Lo	
1806	RO	L3 Active demand Hi	
1807	RO	L3 Active demand Mi	
1808	R0	L3 Active demand Lo	
1809	RO	Active demand total Hi	
180A	RO	Active demand total Mi	
180B	RO	Active demand total Lo	
180C	R0	L1 Reactive demand Hi	
180D	RO	L1 Reactive demand Mi	
180E	RO	L1 Reactive demand Lo	

180F	RO	L2 Reactive demand Hi	
1810	RO	L2 Reactive demand Mi	
1811	R0	L2 Reactive demand Lo	
1812	RO	L3 Reactive demand Hi	
1813	RO	L3 Reactive demand Mi	
1814	RO	L3 Reactive demand Lo	
1815	R0	Reactive demand total Hi	
1816	RO	Reactive demand total Mi	
1817	RO	Reactive demand total Lo	
1818	RO	L1 maximum. active demand Hi	
1819	RO	L1 maximum. active demand Mi	
181A	R0	L1 maximum. active demand o	
181B	RO	L2 maximum. active demand Hi	
181C	RO	L2 maximum. active demand Mi	
181D	RO	L2 maximum. active demand Lo	
181E	R0	L3 maximum. active demand Hi	
181F	RO	L3 maximum. active demand Mi	
1820	RO	L3 maximum. active demand Lo	
1821	RO	Maximum. active demand total Hi	
1822	RO	Maximum. active demand total Mi	
1823	R0	Maximum. active demand total Lo	
1824	RO	L1 maximum reactive demand Hi	
1825	RO	L1 maximum reactive demand Mi	
1826	RO	L1 maximum reactive demand Lo	
1827	R0	L2 maximum reactive demand Hi	
1828	RO	L2 maximum reactive demand Mi	
1829	RO	L2 maximum reactive demand Lo	
182A	RO	L3 maximum reactive demand Hi	
182B	RO	L3 maximum reactive demand Mi	
182C	R0	L3 maximum reactive demand Lo	
182D	RO	maximum reactive demand total Hi	
182E	RO	maximum reactive demand total Mi	
182F	RO	maximum reactive demand total Lo	
1830	R0	L1 minimum active demand Hi	
1831	RO	L1 minimum active demand Mi	
1832	RO	L1 minimum active demand Lo	
1833	RO	L2 minimum active demand Hi	
1834	RO	L2 minimum active demand Mi	
1835	R0	L2 minimum active demand Lo	
1836	R0	L3 minimum active demand Hi	
1837	RO	L3 minimum active demand Mi	
1838	RO	L3 minimum active demand Lo	
1839	RO	Minimum active demand total Hi	
183A	RO	Minimum active demand total Mi	
183B	R0	Minimum active demand total Lo	
183C	R0	L1 minimum reactive demand Hi	
183D	RO	L1 minimum reactive demand Mi	
183E	RO	L1 minimum reactive demand Lo	
183F	RO	L2 minimum reactive demand Hi	
1840	RO	L2 minimum reactive demand Mi	
1841	R0	L2 minimum reactive demand Lo	
1842	R0	L3 minimum reactive demand Hi	
1843	RO	L3 minimum reactive demand Mi	
1844	RO	L3 minimum reactive demand Lo	

1845	RO	Minimum reactive demand total Hi	
1846	RO	Minimum reactive demand total Mi	
1847	R0	Minimum reactive demand total Lo	

Table 5-17. Demand Statistics Registers

Instant Values Demand Registers

Register Value (Hex)	Type	Description	Remark
1848	RO	L1 Voltage phase Hi	x 10
1849	RO	L1 Voltage phase Lo	
184A	RO	L2 Voltage phase Hi	
184B	RO	L2 Voltage phase Lo	
184C	RO	L3 Voltage phase Hi	
184D	RO	L3 Voltage phase Lo	
184E	RO	Average voltage phase Hi	
184F	RO	Average voltage phase Lo	
1850	RO	L12 Line voltage Hi	
1851	RO	L12 Line voltage Lo	
1852	RO	L31 Line voltage Hi	
1853	RO	L31 Line voltage Lo	
1854	RO	L23 Line voltage Hi	
1855	RO	L23 Line voltage Lo	
1856	RO	Average line voltage Hi	
1857	RO	Average line voltage Lo	
1858	RO	I1 phase current Hi	x1000
1859	RO	I1 phase current Lo	
155A	RO	I2 phase current Hi	
185B	RO	I2 phase current Lo	
185C	RO	I3 phase current Hi	
185D	RO	I3 phase current Lo	
185E	RO	Average phase current Hi	
185F	RO	Average phase current Lo	
1860	RO	L1 Apparent power Hi	x1000
1861	RO	L1 Apparent power Mi	
1862	RO	L1 Apparent power Lo	
1863	RO	L2 Apparent power Hi	
1864	RO	L2 Apparent power Mi	
1865	RO	L2 Apparent power Lo	
1866	RO	L3 Apparent power Hi	
1867	RO	L3 Apparent power Mi	
1868	RO	L3 Apparent power Lo	
1869	RO	Total three-phase apparent power Hi	
186A	RO	Total three-phase apparent power Mi	
186B	RO	Total three-phase apparent power Lo	
186C	RO	L1 Phase active power Hi	
186D	RO	L1 Phase active power Mi	
186E	RO	L1 Phase active power Lo	
186F	RO	L2 Phase active power Hi	
1870	RO	L2 Phase active power Mi	
1871	RO	L2 Phase active power Lo	
1872	RO	L3 Phase active power Hi	
1873	RO	L3 Phase active power Mi	

1874	RO	L3 Phase active power Lo	
1875	RO	Total three-phase active power Hi	
1876	RO	Total three-phase active power Mi	
1877	RO	Total three-phase active power Lo	
1878	RO	L1 Phase reactive power Hi	
1879	RO	L1 Phase reactive power Mi	
187A	RO	L1 Phase reactive power Lo	
187B	RO	L2 Phase reactive power Hi	
187C	RO	L2 Phase reactive power Mi	
187D	RO	L2 Phase reactive power Lo	
187E	RO	L3 Phase reactive power Hi	
187F	RO	L3 Phase reactive power Mi	
1880	RO	L3 Phase reactive power Lo	
1881	RO	Total three-phase reactive power Hi	
1882	RO	Total three-phase reactive power Mi	
1883	RO	Total three-phase reactive power Lo	
1884	RO	L1 Power factor	x1000
1885	RO	L2 Power factor	x1000
1886	RO	L3 Power factor	x1000
1887	RO	Three-phase power factor	x1000
1888	RO	Frequency	x100
1889	RO	Zero sequence current Hi	x1000
188[a]	RO	Zero sequence current Lo	
188B	RO	Unbalance voltage ratio	x1000
188C	RO	Unbalance current ratio	x1000

Table 5-18. Instant Values Demand Registers

Example of MODBUS RS-485 Network Architecture

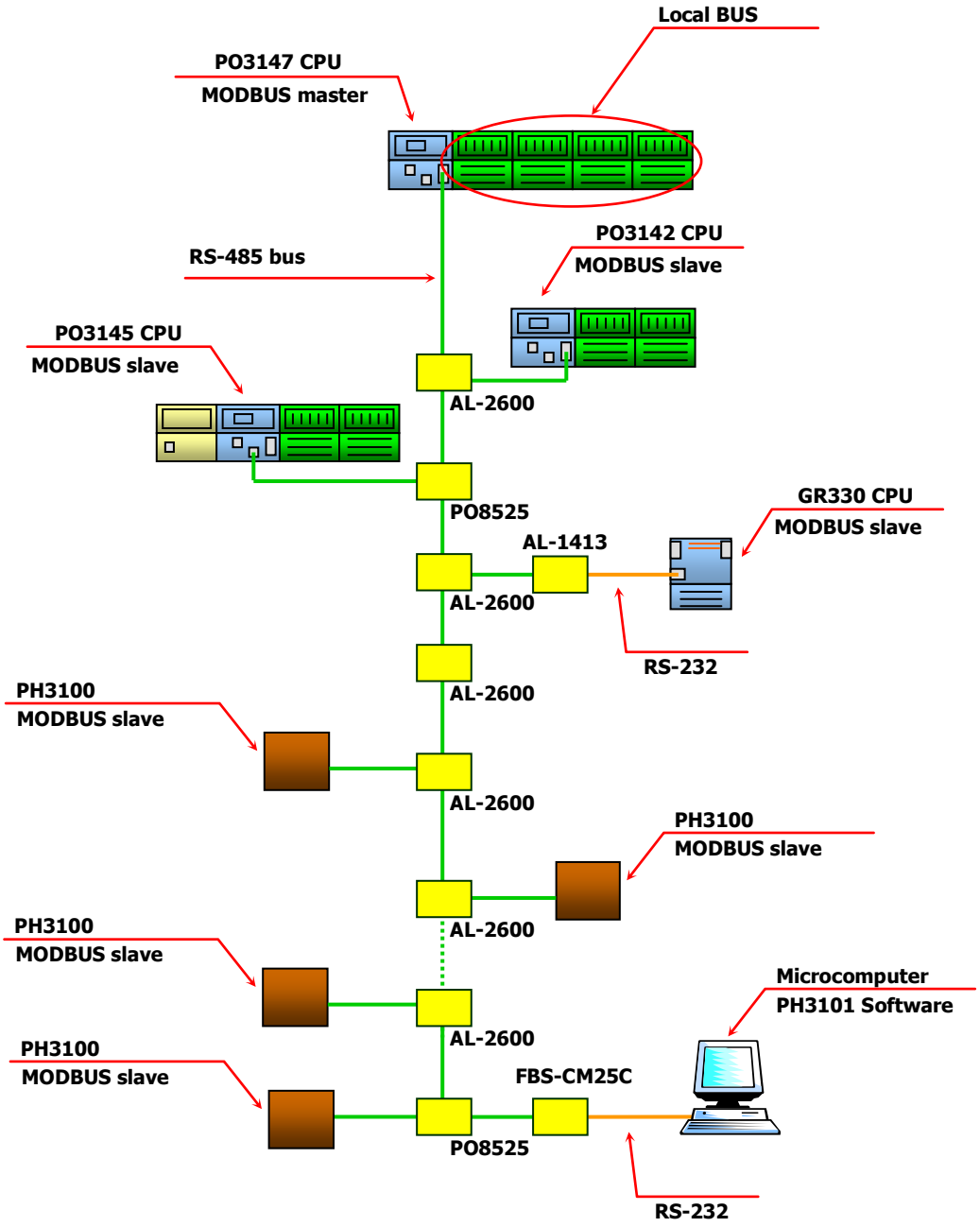

Figure 5-1. Example of MODBUS RS-485 Network Architecture

6. Operation

Using PH3100 Browsing Menus

Parameters Measurement Pages

When starting PH3100, press the ⏎ key (“Enter”) on any page (voltage, current or power measuring) and the Phase L1 Measurement page will appear. This is part of the Parameter Measurement set which can be selected by pressing the ⏎ key (“Enter”). Besides the Per-Phase Measurement Display, the Date and Time Parameters Setup, Consumption Profile (Multi-rate) and Quality Power Factor Measurement Displays are shown.

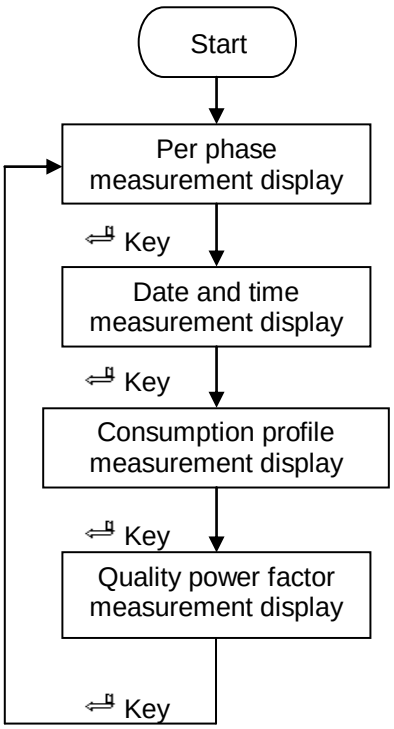

Figure 6-1. Parameter Measurement Options

Per Phase Measurement

At first, the initial Per-Phase Measurement is Phase L1 Measurement page. To visualize other phase pages, press the **M** key or wait for the changing page time (see chapter 3).

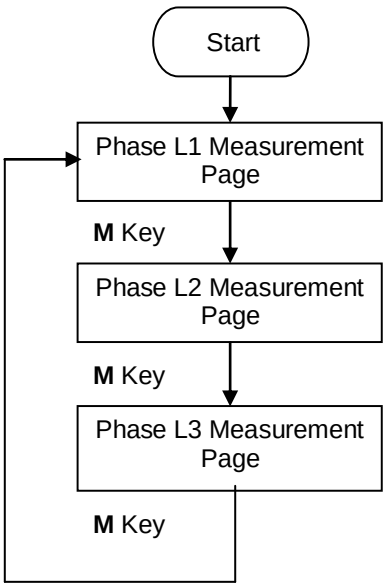

Figure 6-2. Per Phase Measurement Options

Phase L1 Measurement Page

This page shows phase L1 main measurements.

The power quadrant is displayed in the right upper corner. The inductive or capacitive character is displayed in the upper right corner.

The 1st row displays L1 voltage phase.

The 2nd row displays L1 current phase.

The 3rd row displays system frequency.

The 4th row displays L1 power phase.

The 5th row displays total active energy of the three phases.

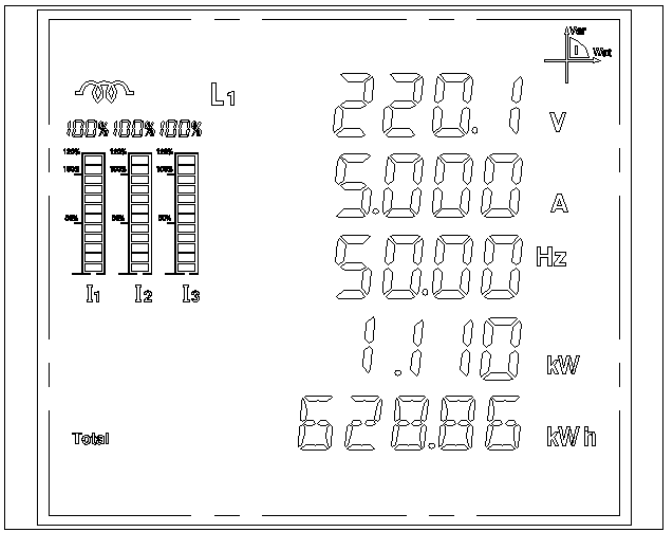

Figure 6-3. Phase L1 Measurement Page

Phase L2 Measurement Page

The power quadrant is displayed in the right upper corner. The inductive or capacitive are displayed in the upper left corner.

The 1st row displays phase L2 voltage.

The 2nd row displays L2 current phase.

The 3rd row displays system frequency.

The 4th row displays phase L2 power.

The 5th row displays total reactive energy of the three phases.

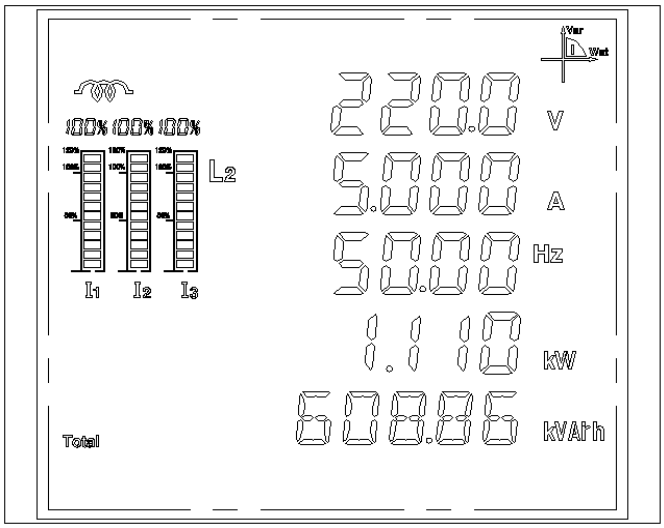

Figure 6-4. Phase L2 Measurement Page

Phase L3 Measurement Page

The power quadrant is displayed in the right upper corner. The inductive or capacitive is displayed in the upper left corner.

The 1st row displays phase L3 voltage.

The 2nd row displays L3 current phase.

The 3rd row displays system frequency.

The 4th row displays phase L3 power.

The 5th row displays time (hour, minute, second).

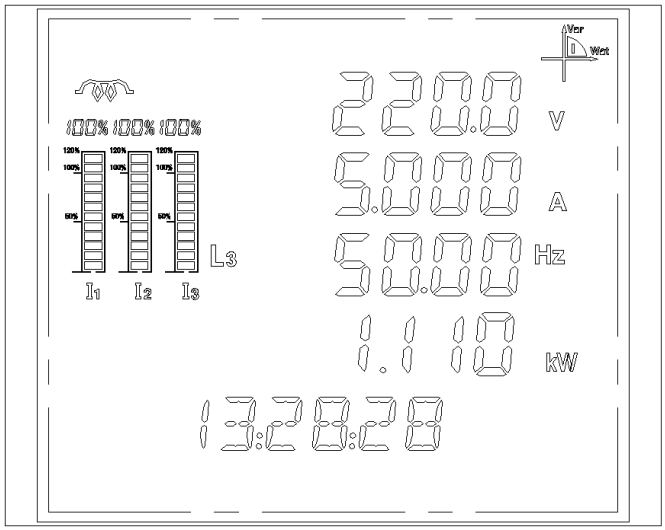

Figure 6-5. Phase L3 Measurement Page

Time Page

The 3rd row displays year.

The 4th row displays month and date.

The 5th row displays hour, minute and second.

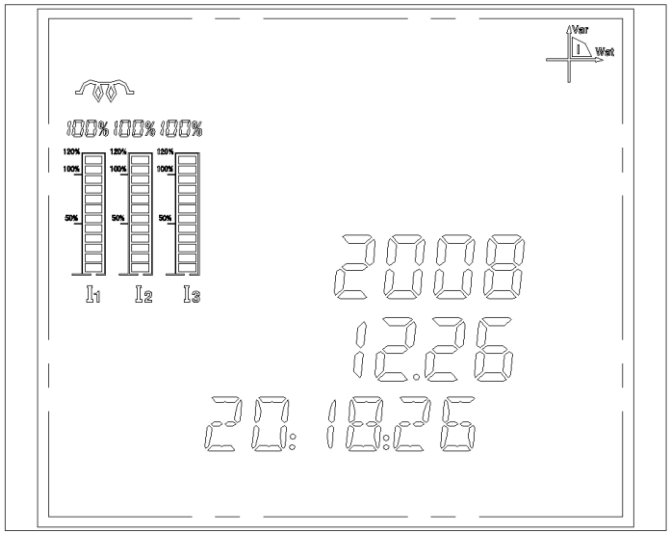

Figure 6-6. Time Page

Consumption Profile Measurement Page

In the consumption profile page, press the U key repeatedly to display the last 4 months' consumption profile. 00, 01, 02, 03 shows the consumption profile of the current month (00), last month (01), the month before the last (02), and 2 months before the last (03) in sequence.

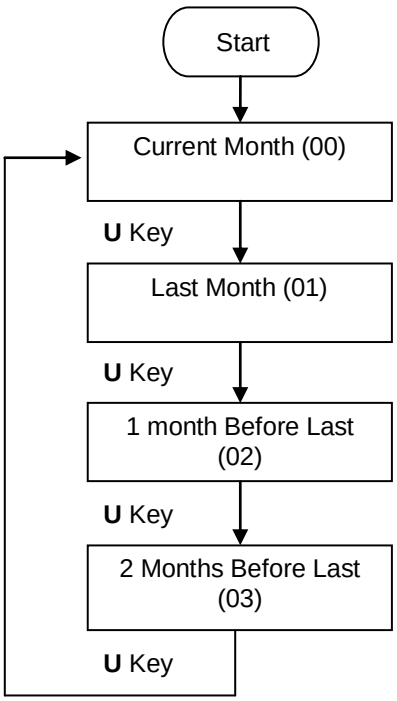

Figure 6-7. Consumption Profile: Month Selection

In each month, you can view the total imported energy. You can also view the total value for each of the periods classified as Sharp (T1), Peak (T2), Flat (T3) or Low (T4), by pressing "**I**" key repeatedly to view the classes in sequence.

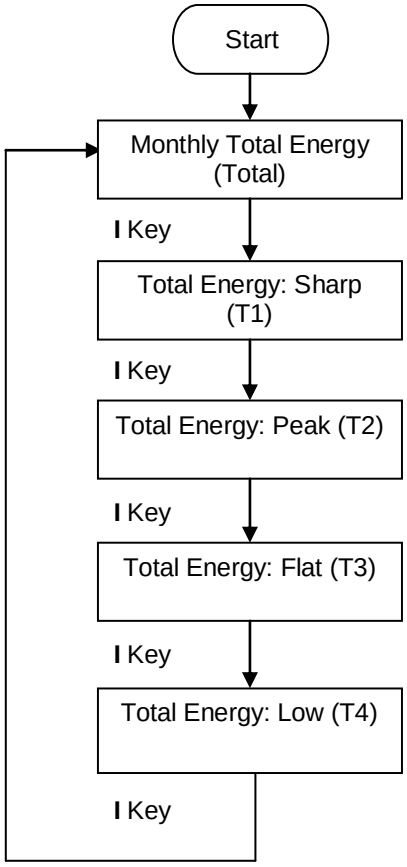

Figure 6-8. Imported Energy Measurement Options

The 3rd row displays the selected month: 00 (current month), 01 (last month), 02 (month before last) and 03 (month before the last 2).

The symbol of Total in the center of the right segment of the display shows the total energy consumed in a month. The symbols T1 to T4 represent the (5th row) class: T1 (Sharp), T2 (Peak), T3 (Flat), T4 (Low).

The 5th row displays the total energy. The symbol T1 to T4 represents energy class.

As shown in the next exhibit, current months' total imported energy during the Sharp period is 3068206.36 kWh.

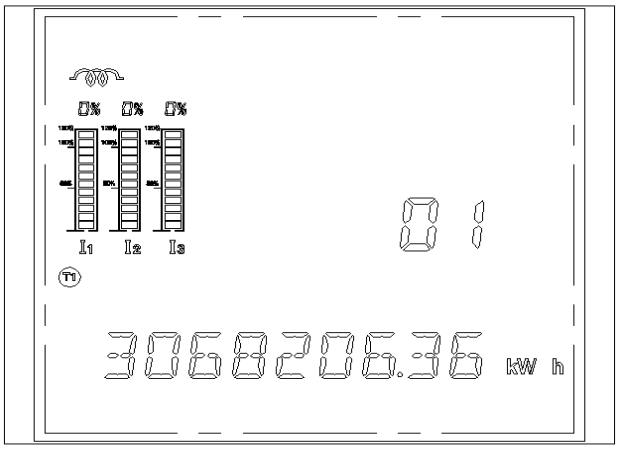

Figure 6-9. Consumption Profile Measurement Page

Power Quality Factor Page

The PH3100 will only acquire these measurements when connected with the harmonic analysis module, or PH3x31.

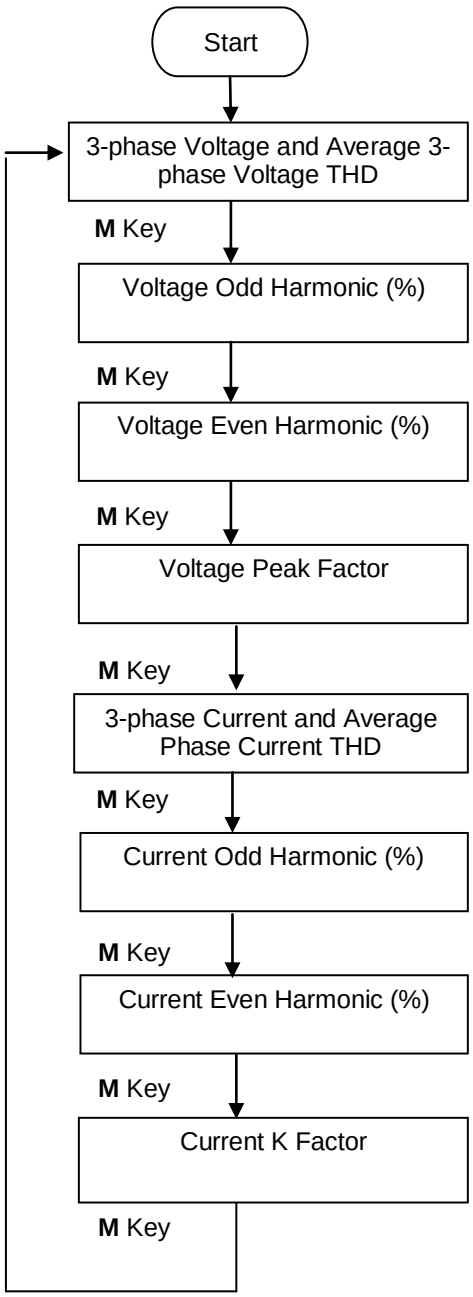

Figure 6-10. Power Quality Factor Options

Current Measurement Page

Pressing "**I**" key on any page (per-phase, voltage or power measurement) the Phase Current and Average Current will appear. This is part of the Current Measurement set that can be selected by pressing "**I**" key again. In addition to the Phase and Average Current, the Voltage Unbalanced Ratio Page and Neutral Current Measurement Page are shown. In each of these pages, it is possible to check the maximum and minimum measurements by repeatedly pressing the **M** key. The maximum (MAX) or minimum (MIN) value are shown at the upper left corner in the graphic display.

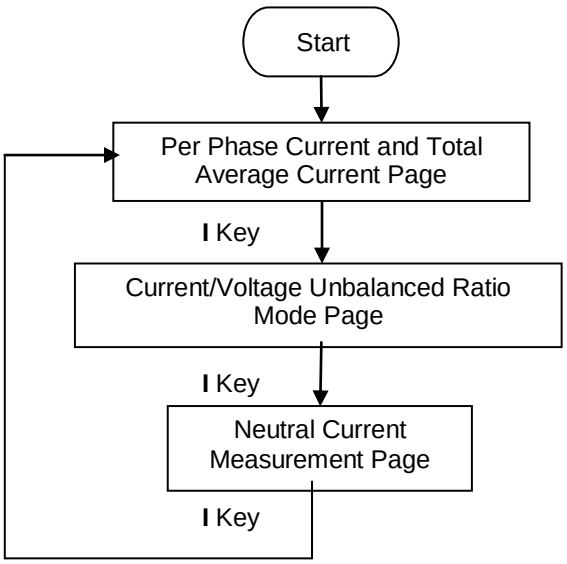

Figure 6-11. Current Measurement Options

Current and Average Current Measurement

The 1st row displays L1 Current phase.

The 2nd row displays L2 Current phase.

The 3rd row displays L3 Current phase.

The 4th row displays average 3-phase Current.

In the maximum and minimum value page, the upper left corner displays symbol "MAX" or "MIN".

As shown in the following picture phases L1, L2, L3 are 5.002 A, 5.001 A, 5.002 A, respectively, while the average current is 5.001.

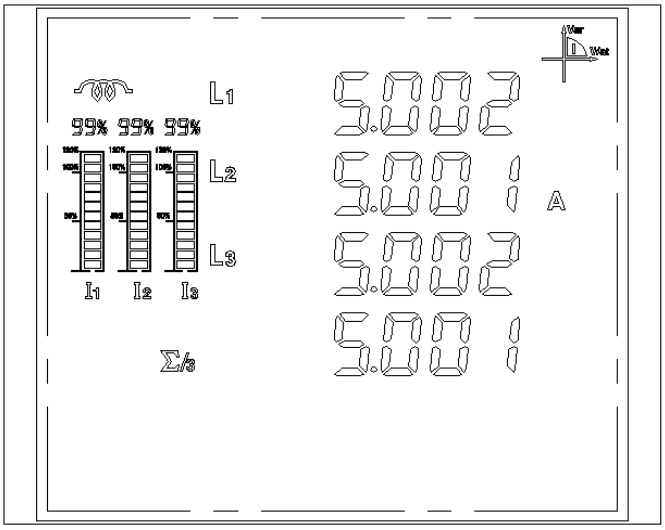

Figure 6-12. Current per Phase and Total Average Current Page

Current/Voltage Unbalanced Ratio Mode Page

The 1st row displays Voltage unbalanced ratio.

The 2nd row displays Current unbalanced ratio.

The 5th row displays "U AND I", representing Voltage and Current.

As shown in the following picture, the unbalanced ratio of Voltage and Current are 99.6% and 98.8% respectively.

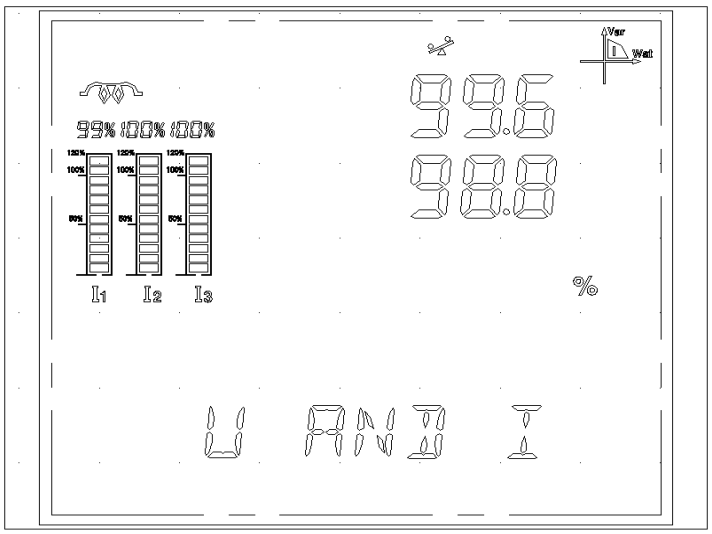

Figure 6-13. Current/Voltage Unbalanced Ratio Page

Neutral Current Measurement Page

The neutral current is applicable for electrical installation on the 3P4W system. The 4th row displays, the neutral current.

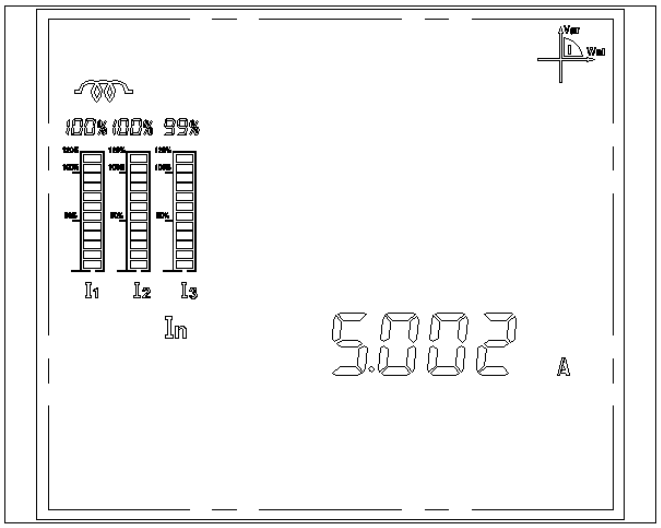

Figure 6-14. Neutral Current Measurement Page

Voltage Measurement Page

By pressing the **U** key on any page (per-phase, current or power measurement) the Phase Voltage and Average Voltage will appear. This is part of the Voltage Measurement set, which can be selected by pressing the **U** key again. Besides the phase and Average Voltage, the Line Voltage, Average Line Voltage and the Frequency Pages are shown. In each of these pages, you can view the maximum and minimum measurements, by repeatedly pressing the **M** key. The maximum (MAX) or minimum (MIN) value is shown at the upper left corner in the graphic display.

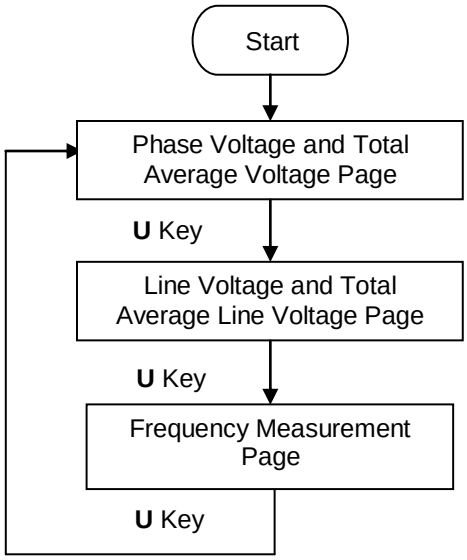

Figure 6-15. Voltage Measurement Options

Phase Voltage and Average Voltage Page

The 1st row displays L1 phase voltage.

The 2nd row displays L2 phase voltage.

The 3rd row displays L3 phase voltage.

The 4th row displays 3-phase average phase voltage.

When maximum and minimum page are displayed, the upper left corner shows “MAX” and “MIN” symbol.

As shown in the following picture, phases L1, L2, L3 voltage are 220.2 V, 220.0 V, 220.0 V, respectively, while the average voltage displays 220.0 V.

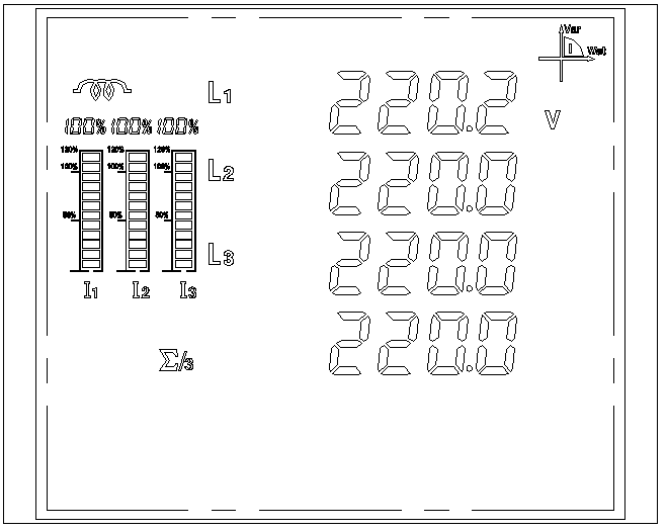

Figure 6-16. Phase Voltage and Average Voltage Display Page

Line Voltage and Average Line Voltage Display Page

Line Voltage measurement is applied in electrical installation on 3P4W system.

The 1st row displays phase L1 line voltage.

The 2nd row displays phase L2 line voltage.

The 3rd row displays phase L3 line voltage.

The 4th row displays average line voltage.

As shown in the following picture, Line 12, Line 23, Line 31 are 230.0 V, 210.8 V, 238 .6 V, respectively, while the average line voltage is 230.6 V.

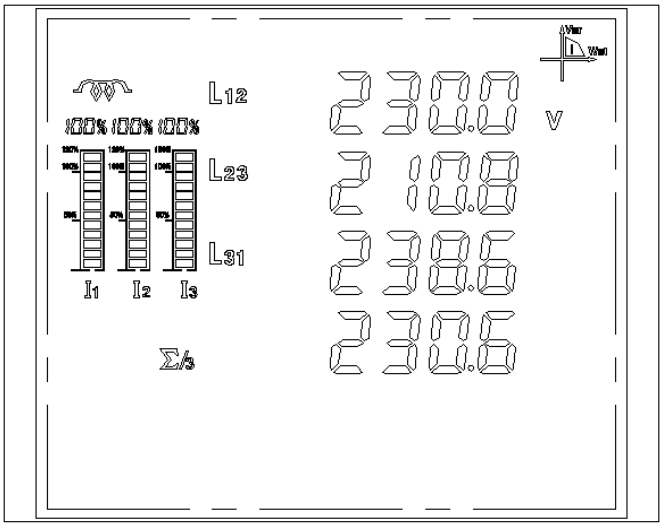

Figure 6-17. Line Voltage and Average Line Voltage Page

Frequency Display Page

The 3rd row displays the system Frequency.

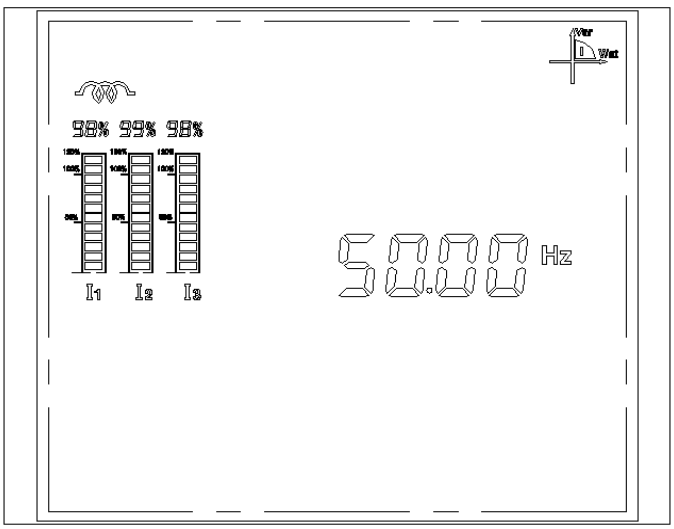

Figure 6-18. Frequency Page

Power Measurement Page

By pressing the **P** key on any page (per phase, current or tension measurement), the Apparent Power Measurement display page will appear. This is part of the Power Measurements set, which can be selected by pressing the **P** key again. In each one of these display pages, you can view the respective maximum and minimum measurements, by pressing the **M** key. The maximum (MAX) or minimum (MIN) value is shown at the upper left corner in the graphic display.

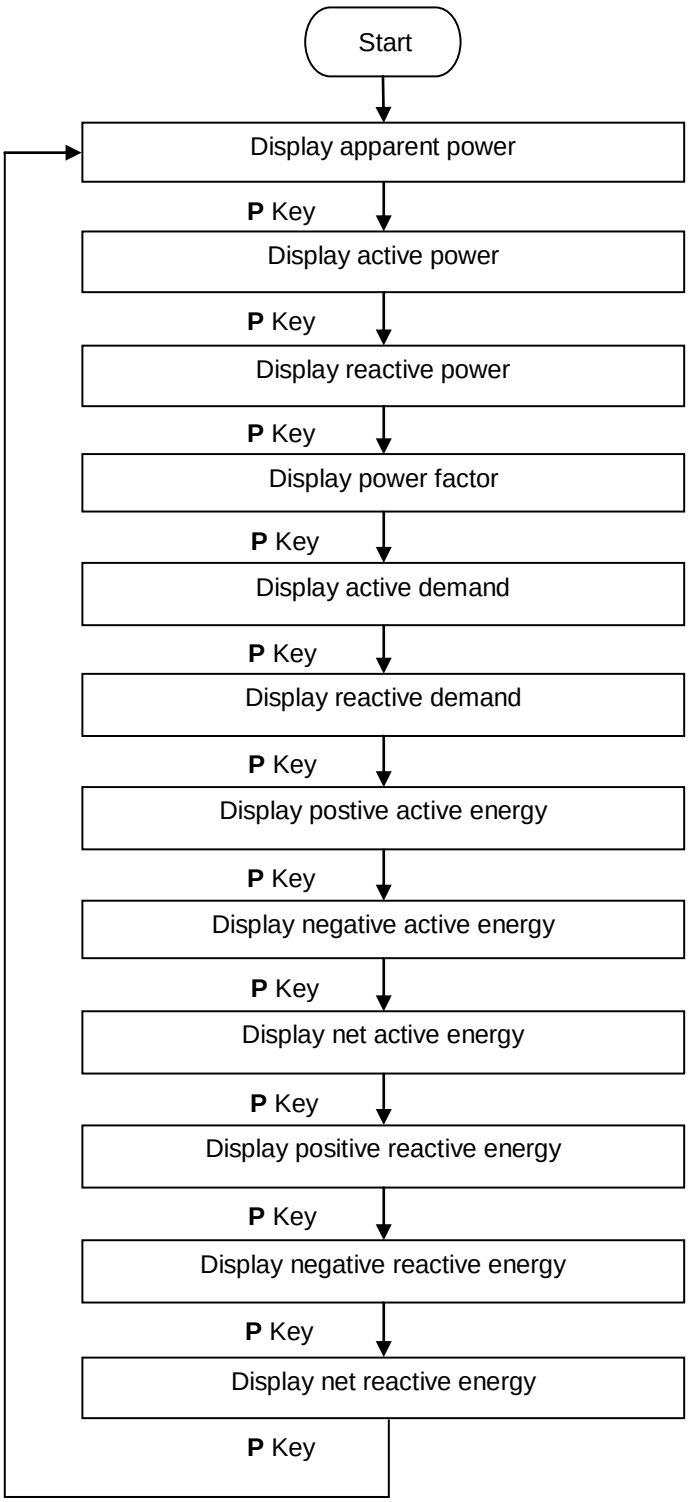

Figure 6-19. Power Measurement Options

Apparent Power Page

The 1st row displays L1 apparent power.

The 2nd row displays L2 apparent power.

The 3rd row displays L3 apparent power.

The 4th row displays the sum of apparent power.

As shown in the next figure, phase L1, phase L2, phase L3 and 3 phase total Apparent Power are 1.101 kVA, 1.103 kVA, 1.102 kVA and 3.306 kVA resp.

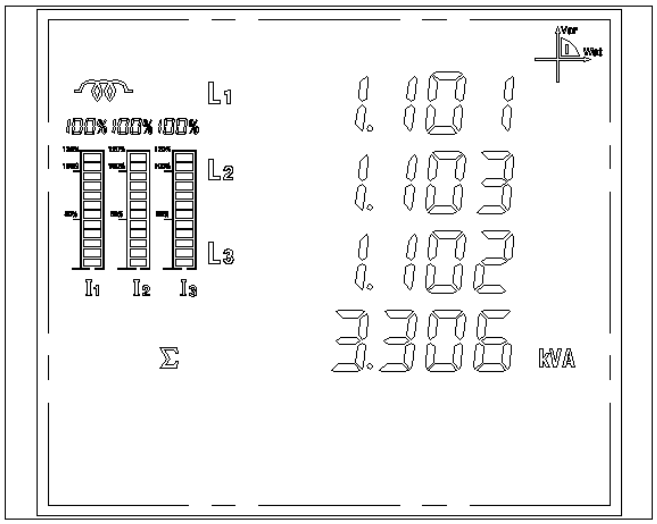

Figure 6-20. Apparent Power Page

Active Power Measurement Page

The 1st row displays L1 active power.

The 2nd row displays L2 active power.

The 3rd row displays L3 active power.

The 4th row displays 3 phase total active power.

As shown in the next figure, phase L1, L2 and L3 and 3-phase total Active Power are 1.100 kW, 1.100 kW, 1.101 kW, 3.301 kW resp.

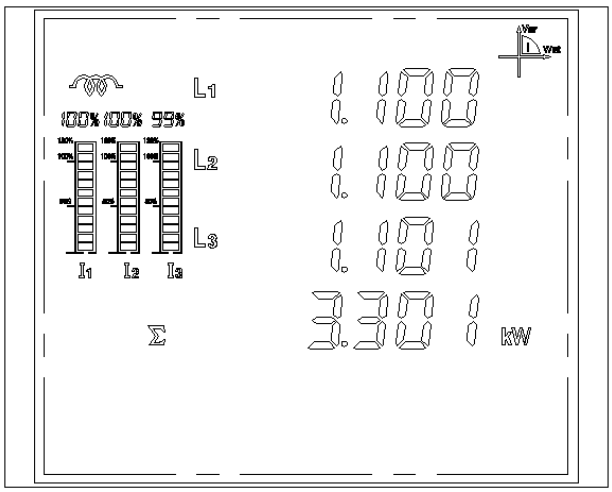

Figure 6-21. Active Power Page

Reactive Power Page

The 1st row displays L1 reactive power.

The 2nd row displays L2 reactive power.

The 3rd row displays L3 reactive power.

The 4th row displays the sum of Reactive Power.

As shown in the next figure, phase L1, L2 and L3 and 3-phase total Reactive Power are 1.101 kVAr, 1.101 kVAr, 1.101 kVAr, 3.303 kVAr resp.

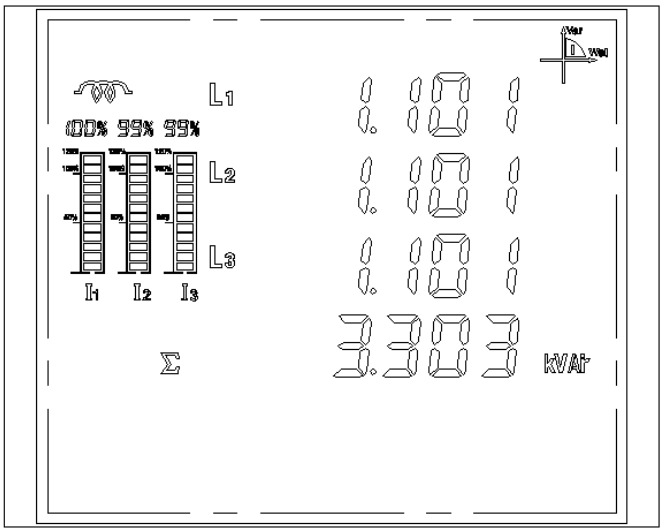

Figure 6-22. Reactive Power Page

Power Factor Page

The 1st row displays L1 power factor.

The 2nd row displays L2 power factor.

The 3rd row displays L3 power factor.

The 4th row displays 3-phase power factor.

As shown in the next figure, phase L1/L2/L3 and 3-phase Power Factor are 1.000, 1.000, 1.000 and 1.000 respectively.

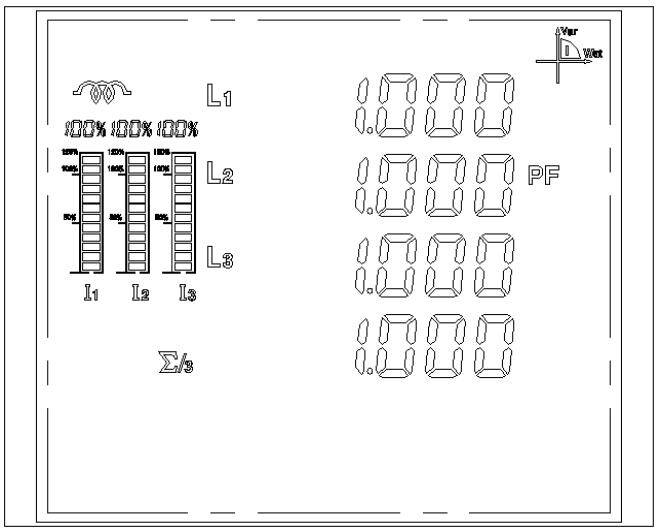

Figure 6-23. Power Factor Page

Active Demand Page

The 1st row displays L1 active demand.

The 2nd row displays L2 active demand.

The 3rd row dispays L3 active demand.

The 4th row displays the sum of active demand (3-phase).

The symbol “MD” displayed in the upper row indicates the demand page.

As shown in the next figure, phase L1/L2/L3 and 3-phase total Active Demand are 1.000 kW, 1.000 kW, 1.000 kW and 3.000 kW resp.

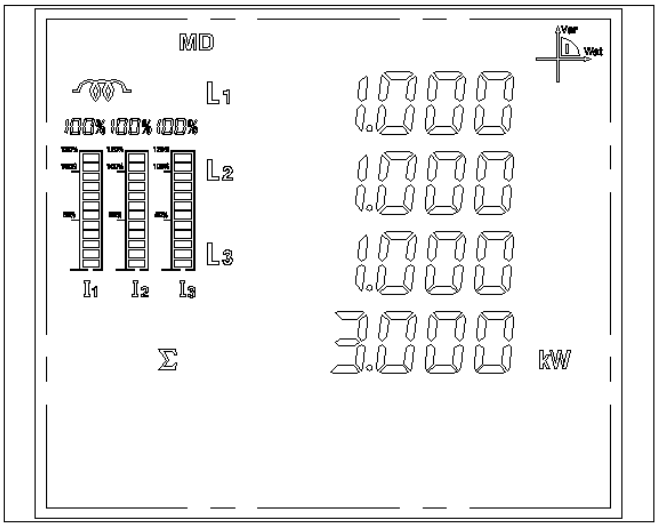

Figure 6-24. Active Demand Page

Reactive Demand Page

The 1st row displays L1 reactive demand.

The 2nd row displays L2 reactive demand.

The 3rd row displays L3 reactive demand.

The 4th row displays the sum of the reactive demand (3-phase).

The symbol “MD” displayed in the upper row indicates the demand display.

As shown in the next figure, phase L1/L2/L3 and 3-phase total Reactive Demand are 1.000 kVAr, 1.000 kVAr, 1.000 kVAr and 3.000 kVAr resp.

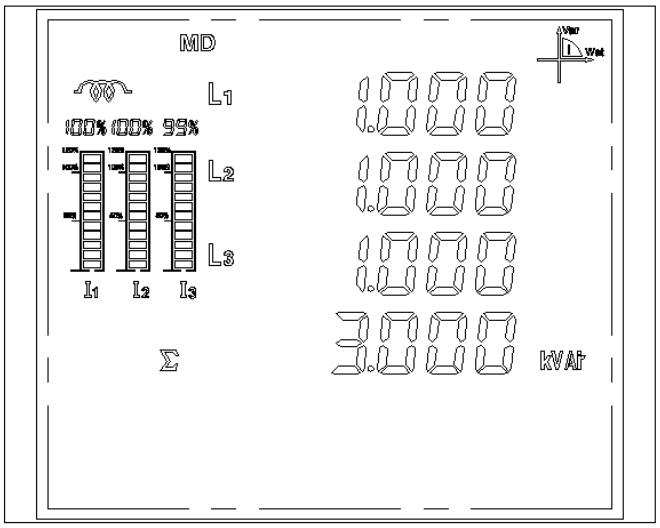

Figure 6-25. Reactive Demand Page

Importing Active Energy Page

The symbol “Imp” indicates importing Active Energy display.

As shown in the next figure, the importing Active Energy is 623.28 kWh.

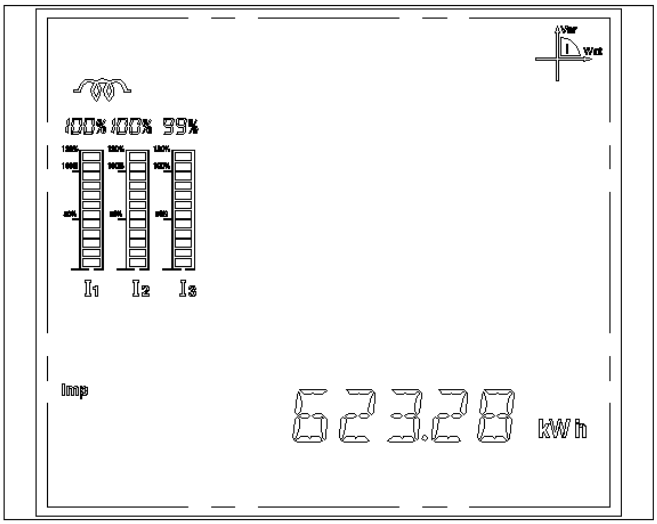

Figure 6-26. Importing Active Energy Page

Exporting Active Energy Page

The symbol “Exp” indicates exporting Active Energy display.

As shown in the next figure, the exporting Active Energy is 621.27 kWh.

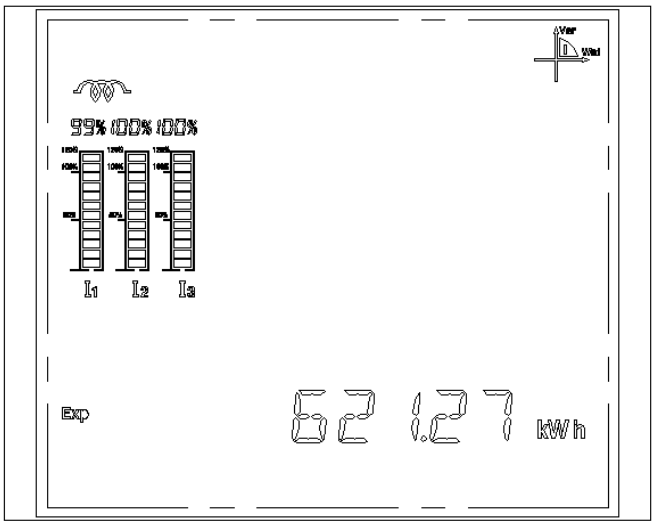

Figure 6-27. Exporting Active Energy Page

Net Active Energy Page

The symbol “Net” indicates net Energy display page.

As shown in the next figure, the net Active Energy is 623.28 kWh.

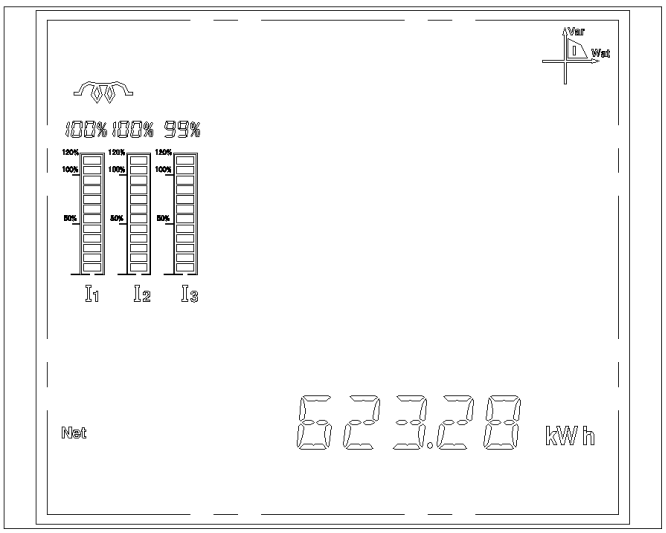

Figure 6-28. Net Active Energy Page

Importing Reactive Energy Page

The symbol “Imp” indicates importing Reactive Energy.

As shown in the next figure, the importing Reactive Energy is 126.36 kVArh.

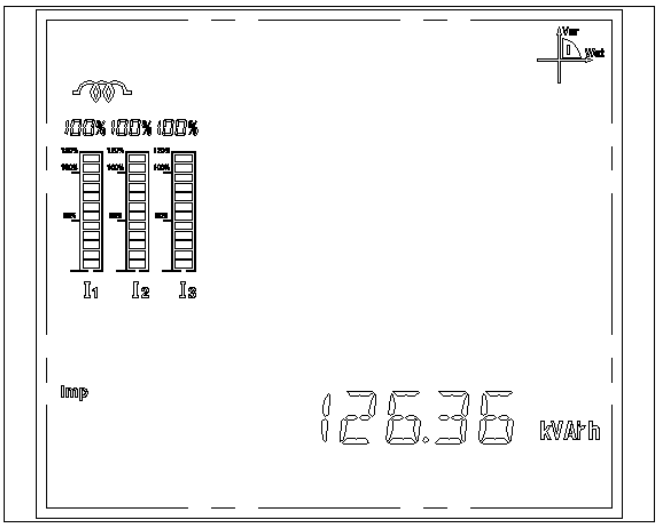

Figure 6-29. Importing Reactive Energy Page

Exporting Reactive Energy Page

The symbol “Exp” indicates exported Energy.

As shown in the next figure, the exporting Reactive Energy is 125.76 kVArh.

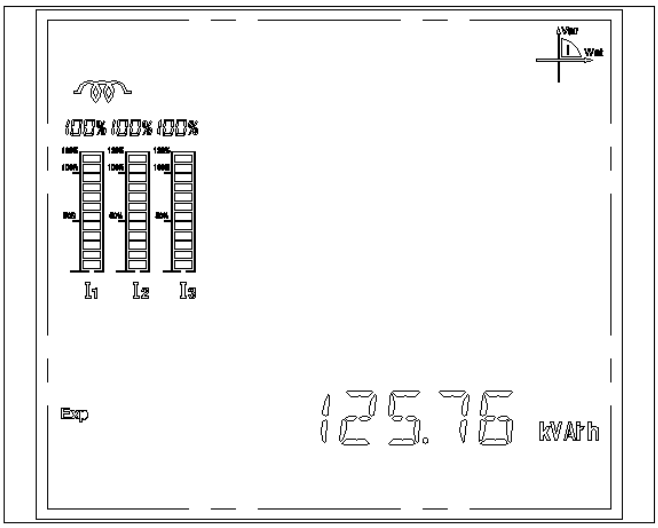

Figure 6-30. Exporting Reactive Energy Page

Net Reactive Energy Page

The symbol “Net” indicates net Reactive Energy.

As shown in the next figure, the net Reactive Energy is 125.76 kVArh

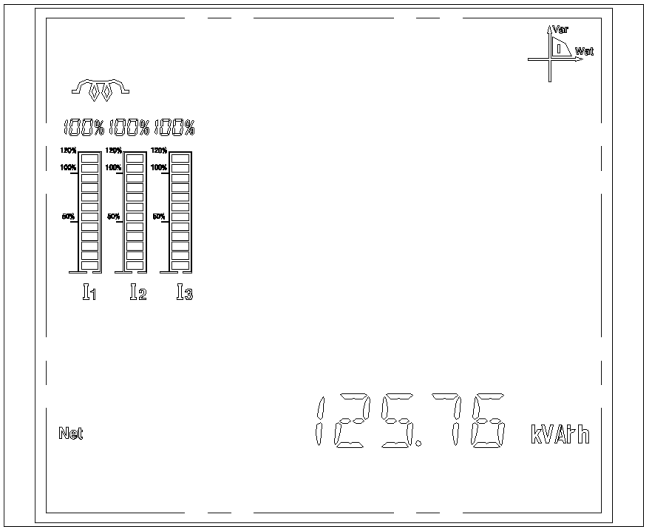

Figure 6-31. Net Reactive Energy Page

Using the PH3101 Multifunction Power Meter Software

Initializing the PH3101

When the software installation is complete, a double click on the icon allows for entering following page.

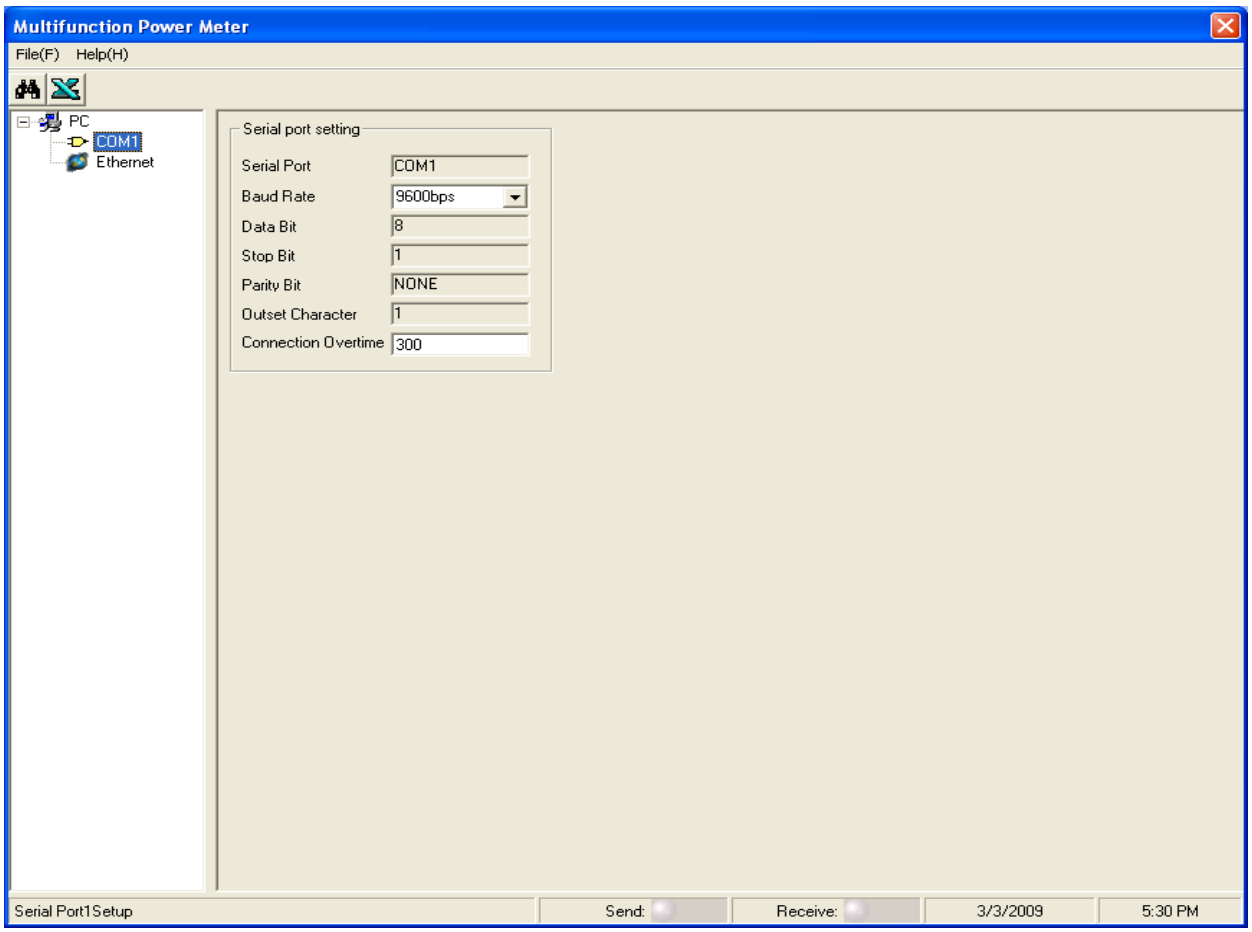

Figure 6-32. PH3101 Initial Screen

Choose the corresponding com. port and set up the “Baud rate” according the configuration of the Baud rate screen shows in Figure 3-6 of this manual.

Click on the search button  (Search Meter Address).

On the next screen, the user can type the corresponding address as the meter setup (the default setting is 1).

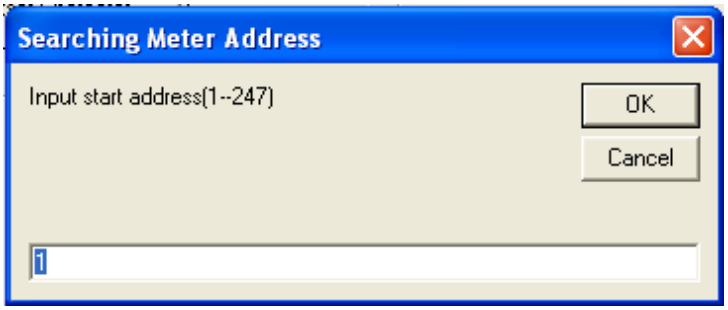

Figure 6-33. Address Selection Screen

Click “ok” for a software address scan.

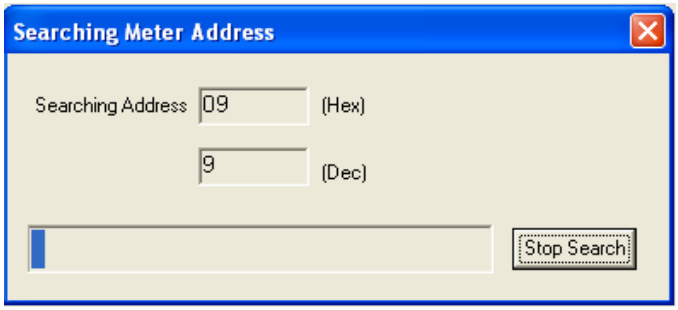

Figure 6-34. Search Online Screen

After the meter identification, the user can click on the button “Stop Search” or wait for the end of a complete search.

Figure 6-35. Online Search Stop Screen

Next, click on the previously identified meter icon (on the selected COM interface) to get to the interface page.

Parameters Measurement Display

The following interface screens, 3-phase 4- and 3-wire systems measurement data have been used as illustration.

On the “Measured Value” tab you find the measured values of phase voltage, line voltage, current, active power, apparent power, reactive power, frequency, demand, active power, reactive power, etc.

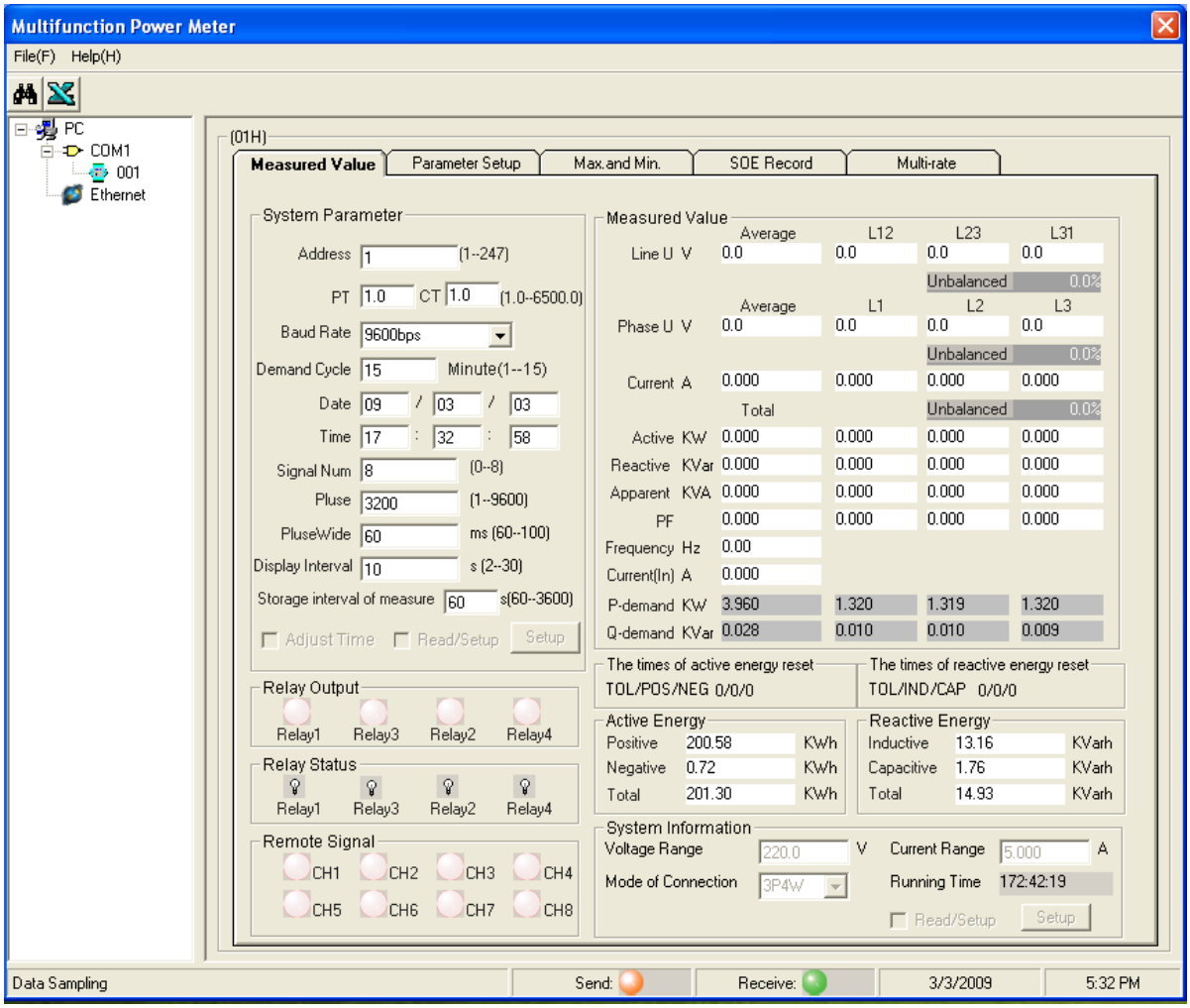

Figure 6-36. Measurement Page in 3P4W Screen

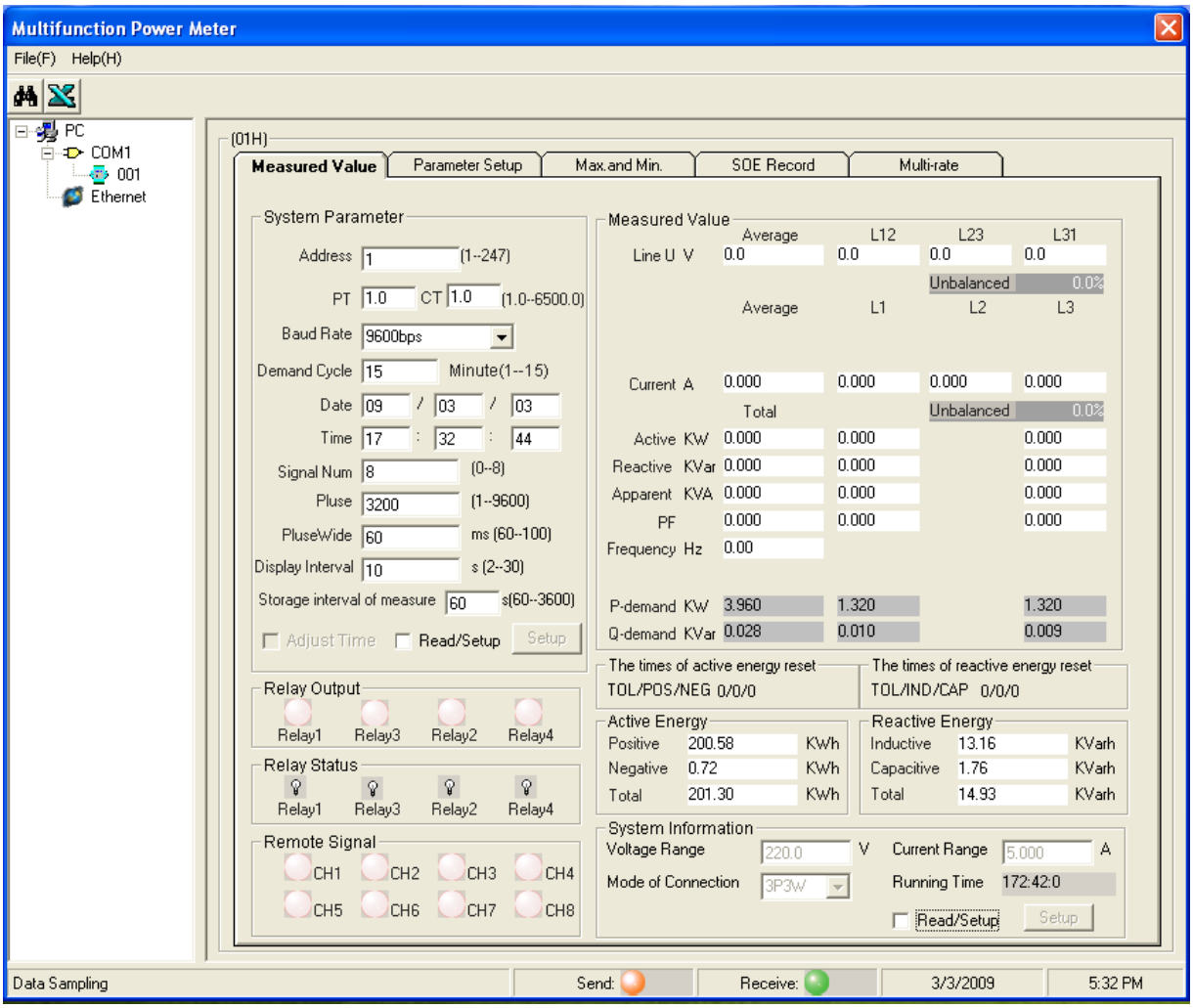

Figure 6-37. Measurement 3P3W System Screen

Maximum and Minimum Measurement Display

On the “Max and Min” tab it is possible to verify the maximum measured values by clicking on the “Read Maximum”, and the minimum measured values by clicking the “Read Minimum”. You can also check demand by clicking on “Read Demand”.

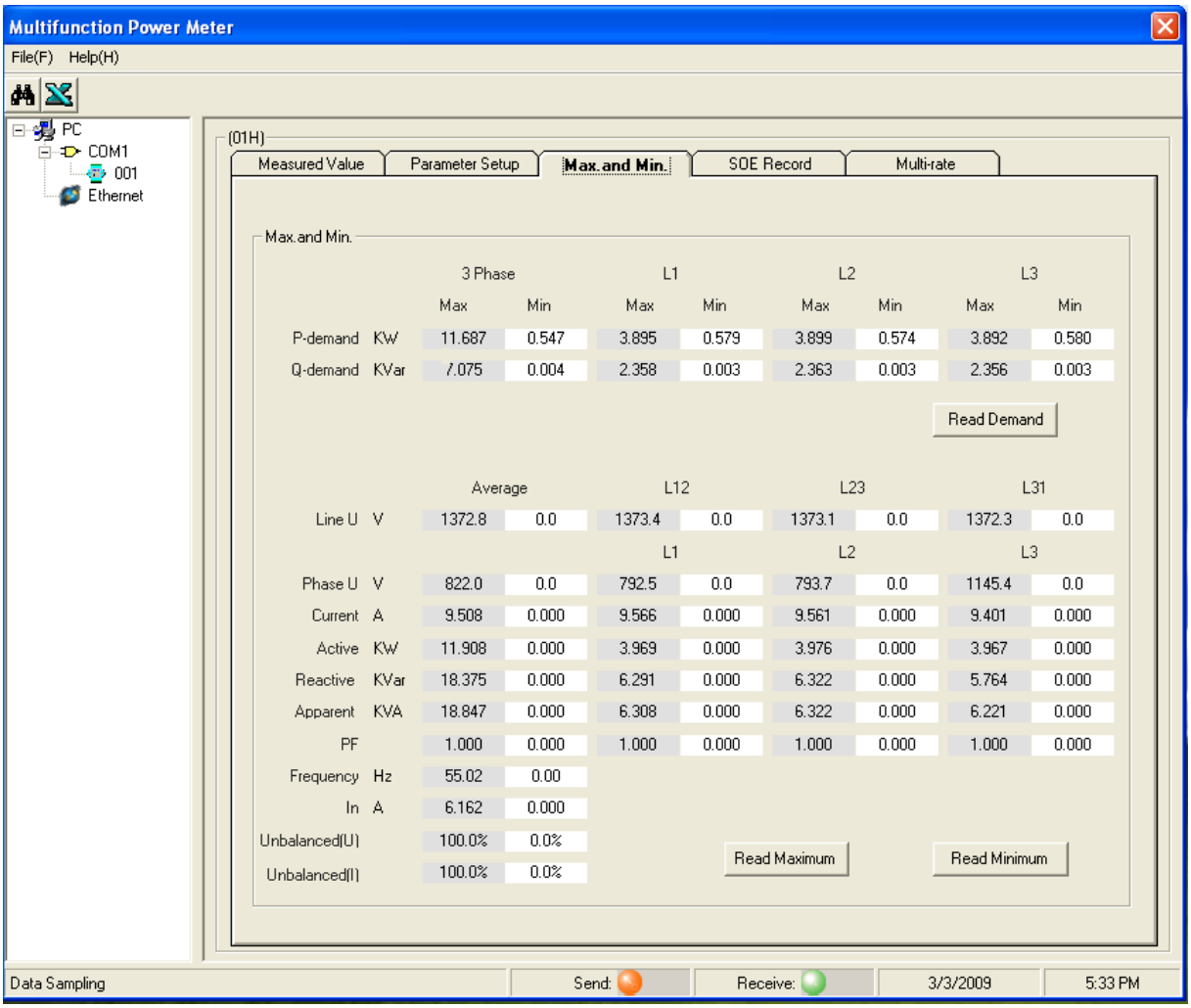

Figure 6-38. Max/Min Value 3P4W Screen

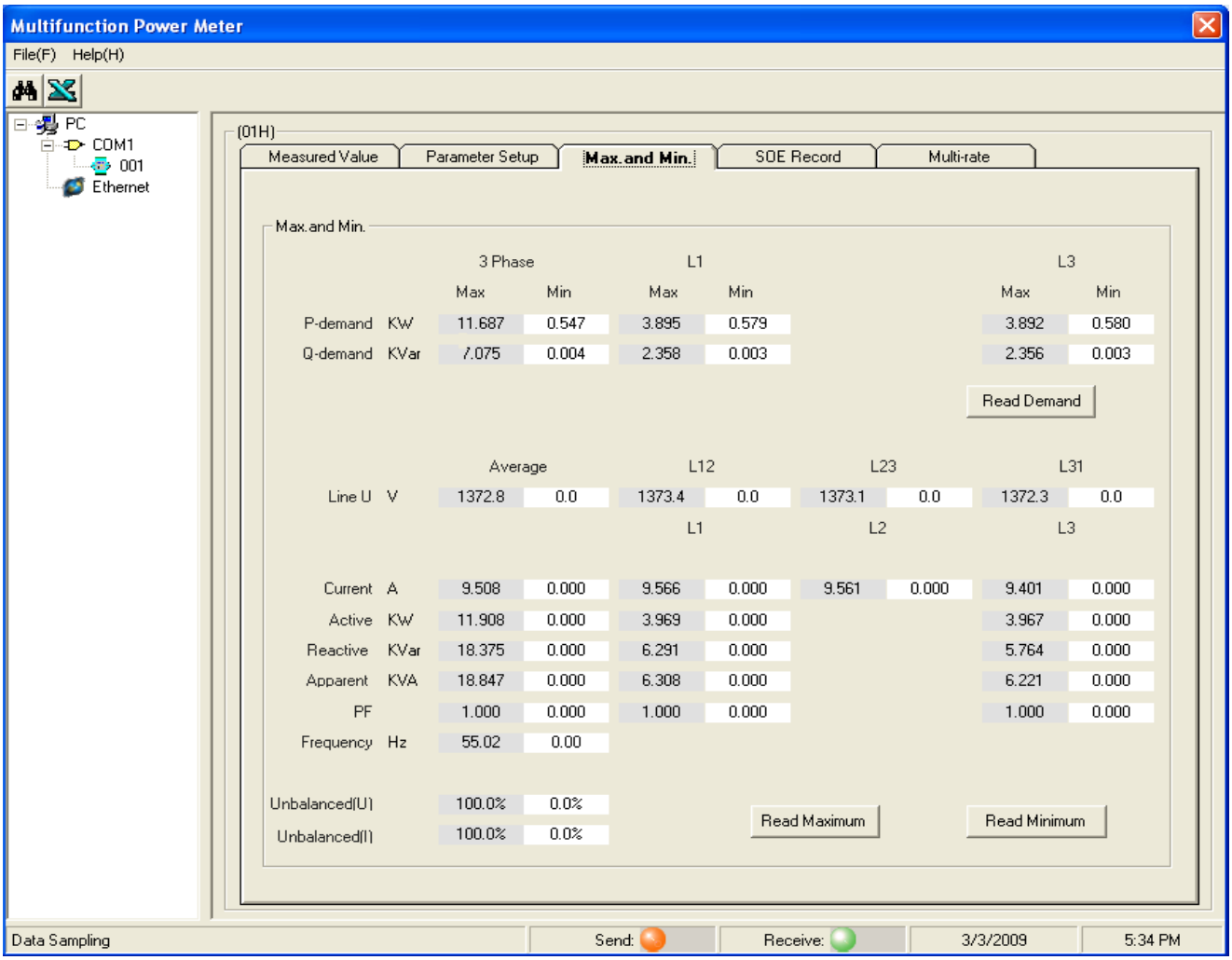

Figure 6-39. Max/Min Value 3P3W Screen

Consumption Profile Measurement Page

By selecting the “Multi-rate” tab it is possible to verify, in “Active Energy”, the active energy values in each period by clicking on “Read”. In addition to the measurements of the current month, you may also view the measurements of the last 3 months by selecting the desired month in “Select Month”.

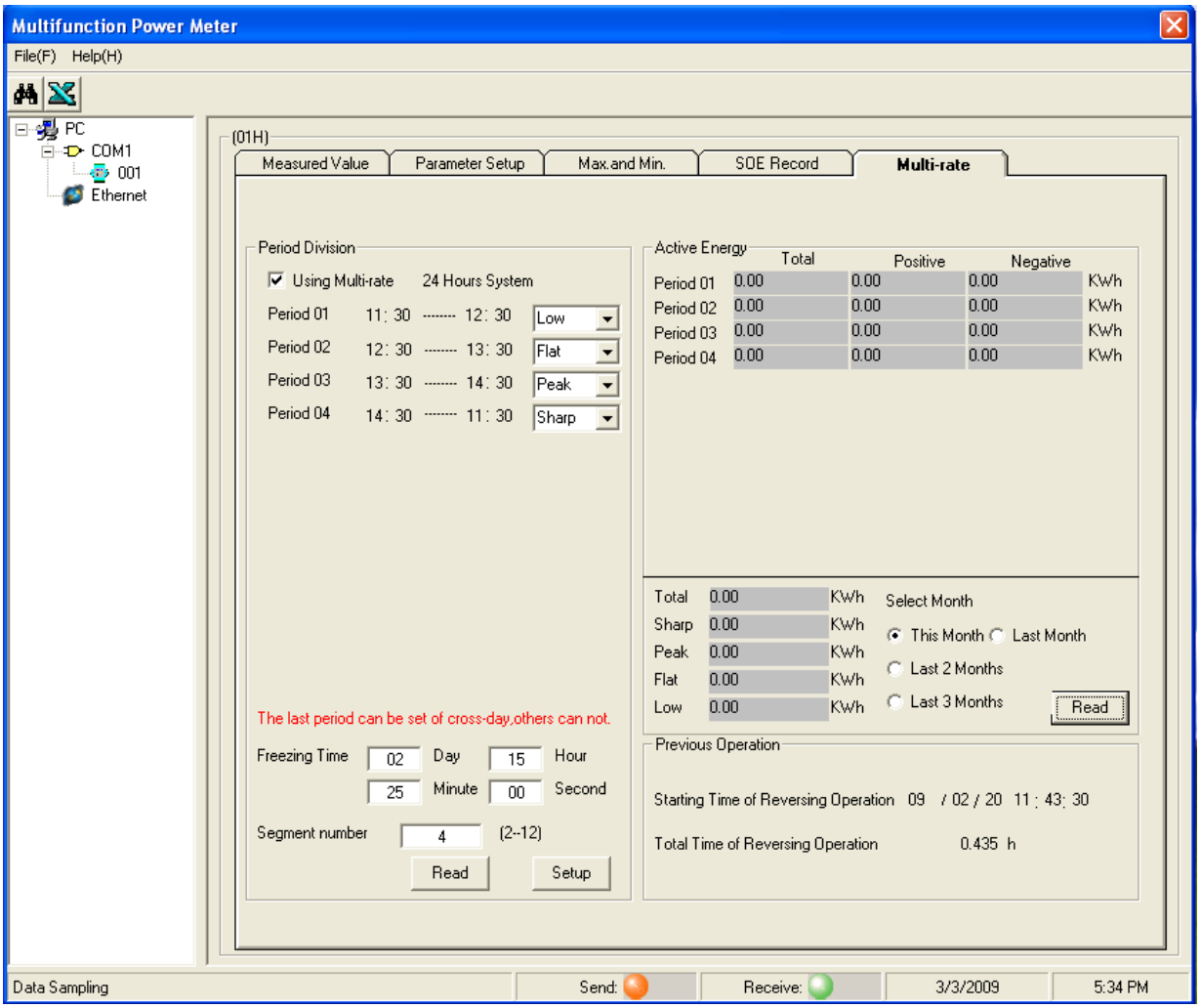

Figure 6-40. Consumption Profile Measurement Screen

Using the PH3100 Expansion Modules

4 Digital Inputs Module

PH3x20 Module Configuration

The PH3x20 has four configurable and independent relay digital outputs. It is possible to configure outputs to act as an out of range measurement signalization or in manual mode when the output can be controlled through its respective bit in the control module's operand. When configured to measurement signalization status, the output can have its set and reset delayed time defined by user configuration. The reset will occur after the measurement has returned to its normal operation condition and the delay time configured by the user has passed. For instance, it's possible to configure one output to be set when the measured L1 voltage exceeds200 Vac or when remain under 150 V, as shown in Figure 6-41. On this case, the output signal will be set after the defined delay time and when the measurement return to within range, the output will be reset, again after the reset time has passed.

The PH3x20 has configuration parameters for each output, configurable through the PH3101 software as illustrated in Figure 6-41. However it's suggested that the configuration is made through MODBUS communication. On this case the operand addresses are available on Table 6-1. The 0x011F to 0x0122 parameters configurable functions are available on Table 6-2. The 0x0108 to 0x011A parameters configurable limits of measure.

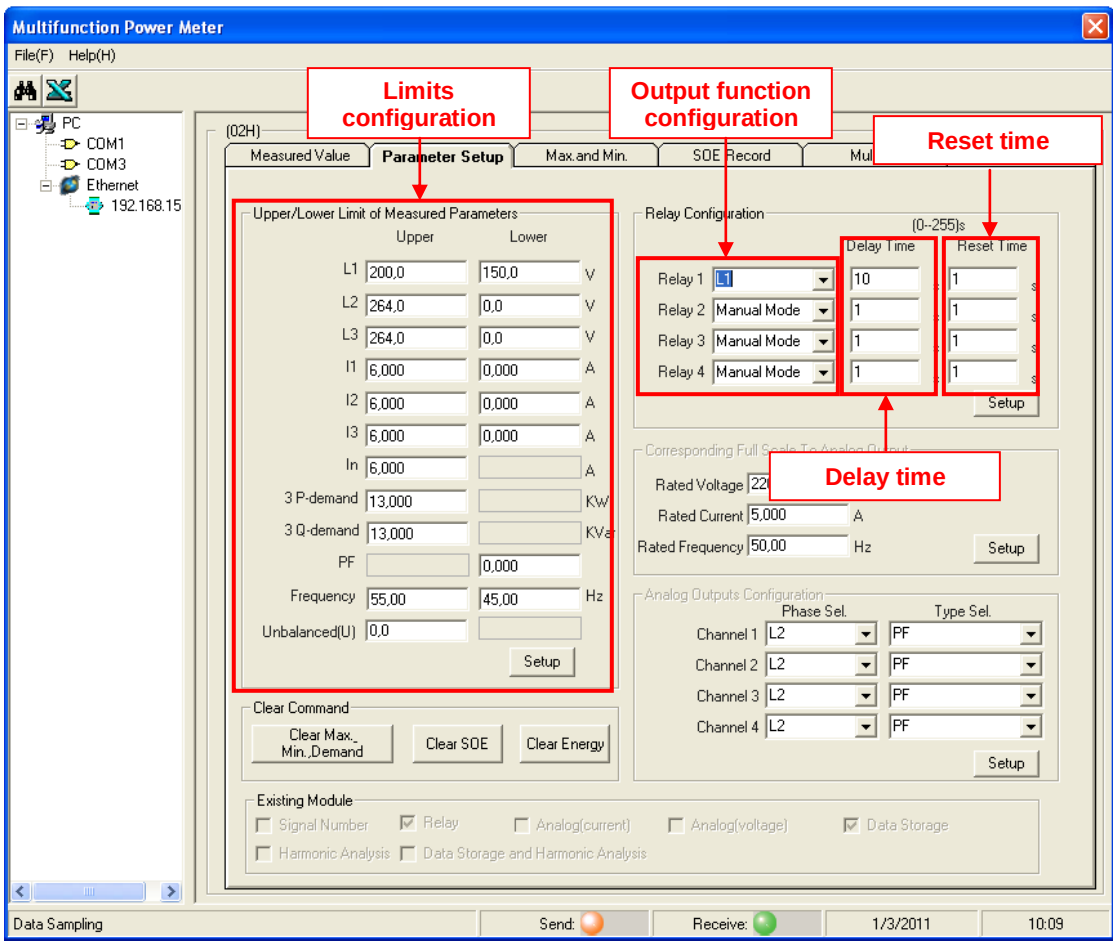

Figure 6-41. PH3x20 Module Configuration Parameters

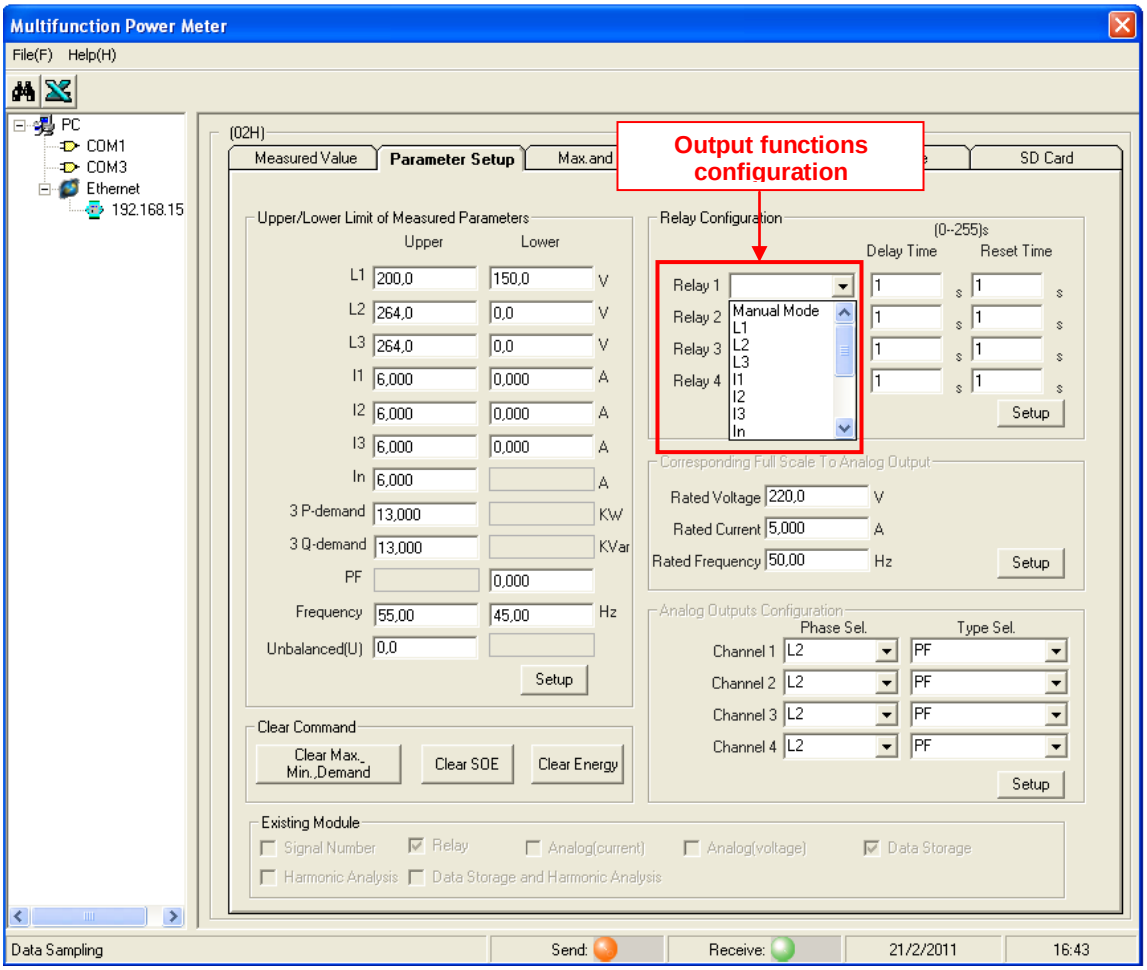

Figure 6-42. Outputs Functions Configuration

Register Value (Hex)	Type	Description	Remark
011B	RW	Time delay and output reset 1	High: time delay Low: reset time Values: 1 to 255 Time unit: seconds
011C	RW	Time delay and output reset 2	
011D	RW	Time delay and output reset 3	
011E	RW	Time delay and output reset 4	
011F	RW	Output 1 configuration	See Table 6-2
0120	RW	Output 2 configuration	Same as above
0121	RW	Output 3 configuration	Same as above
0122	RW	Output 4 configuration	Same as above
0123	RW	Relay output control	Bit 0 – Output 1 Bit 1 – Output 2 Bit 2 – Output 3 Bit 3 – Output 4 0 = Off 1 = On

Table 6-1. PH3x20 Module Configuration Parameters

Register Value (Hex)	Type	Description
0	Manual mode	“Manual Mode”
1	L1 Phase voltage	“L1 Phase Voltage”
2	L2 Phase voltage	“L2 Phase Voltage”
3	L3 Phase Voltage	“L3 Phase Voltage”
4	I1 Phase Current	“I1 Phase Current”
5	I2 Phase Current	“I2 Phase Current”
6	I3 Phase Current	“I3 Phase Current”
7	Phase sequence	“Sequence Current”
8	3 Phase Active Demand	“3 Phase Active Demand”
9	3 Phase Reactive Demand	“3 Phase Reactive Demand”
A	Power Factor	“Power Factor”
B	Reserved	
C	Frequency	“Frequency”
D	Active Power	“Active Power”
E	Unbalanced Voltage	“Unbalanced Voltage”

Table 6-2. PH3x20 Module Output Configurable Functions

Register Value (Hex)	Type	Description	Remark
0108	RW	L1 phase voltage upper limit	Phase voltage
0109	RW	L1 phase voltage lower limit	
010A	RW	L2 phase voltage upper limit	
010B	RW	L2 phase voltage lower limit	
010C	RW	L3 phase voltage upper limit	
010D	RW	L3 phase voltage lower limit	
010E	RW	L1 phase current upper limit	Phase current
010F	RW	L1 phase current lower limit	
0110	RW	L2 phase current upper limit	
0111	RW	L2 phase current lower limit	
0112	RW	L3 phase current upper limit	
0113	RW	L3 phase current lower limit	
0114	RW	Neutral current upper limit	---
0115	RW	3 phase active demand upper limit	---
0116	RW	3 phase reactive demand upper limit	---
0117	RW	Power factor lower limit	---
0118	RW	System frequency lower limit	---
0119	RW	Neutral current upper limit	---
011A	RW	Unbalanced voltage (lower limit)	---

Table 6-3. Max/Min Configuration Limits of Measure

PH3x20 Module Utilization in Manual Mode

The outputs signals can be manually manipulated through 0x0123 operand – Relay output control, see Table 6–1, allowing the independent control of each output.

To configure the manual mode functioning, the configuration function has to be changed to Manual Mode, as shown on Figure 6-43. To configure and send the parameters to the Multifunction Power Meter, it’s only required click on Setup.

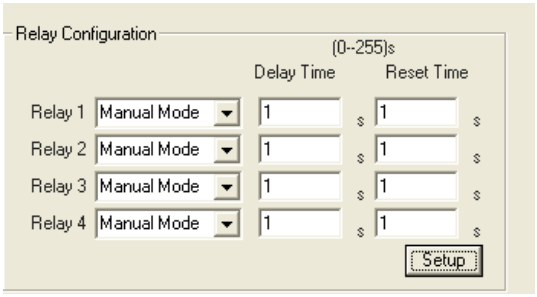

Figure 6-43. Manual Mode Configuration

To set the outputs through the power meter configuration software, PH3101, as shown on Figure 6-44, the correspondent output has to be double-clicked. The result can be seen right below the output symbol. In the auto mode the output set status can be set trough MODBUS command, but the output will have not any change because the configured mode (auto) is respected.

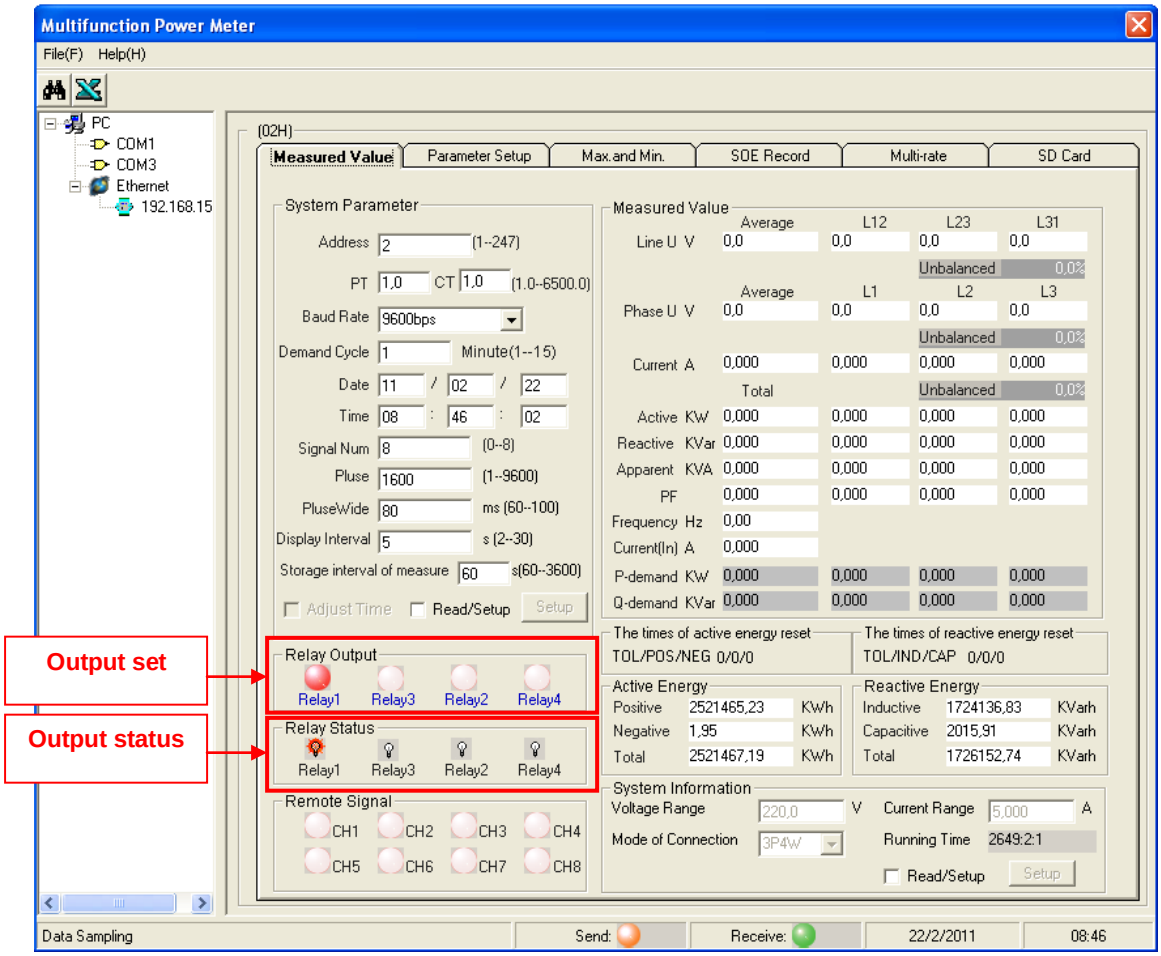

Figure 6-44. Manual Mode Outputs Set

Mass Memory and Harmonic Analysis Module

PH3x31 Module Configuration

The PH3x31, Mass Memory and Harmonic Analysis Module, allows the storage of the power meter measurements in a SD memory card, turning possible the easy data acquisition and further analysis. This module also store information regarding the system harmonics, where the power meter is installed and making measurements.

To use the PH3x31 module needs just the adjust of the parameter Time Between Storage before to be used. This configuration is available on the ELEC KEEP parameters configuration screen, see Figure 3-15, on the power meter configuration menu, or through the power meter configuration software as illustrated in Figure 6-45. For the module correct functioning, it is necessary the insertion of a memory card on it.

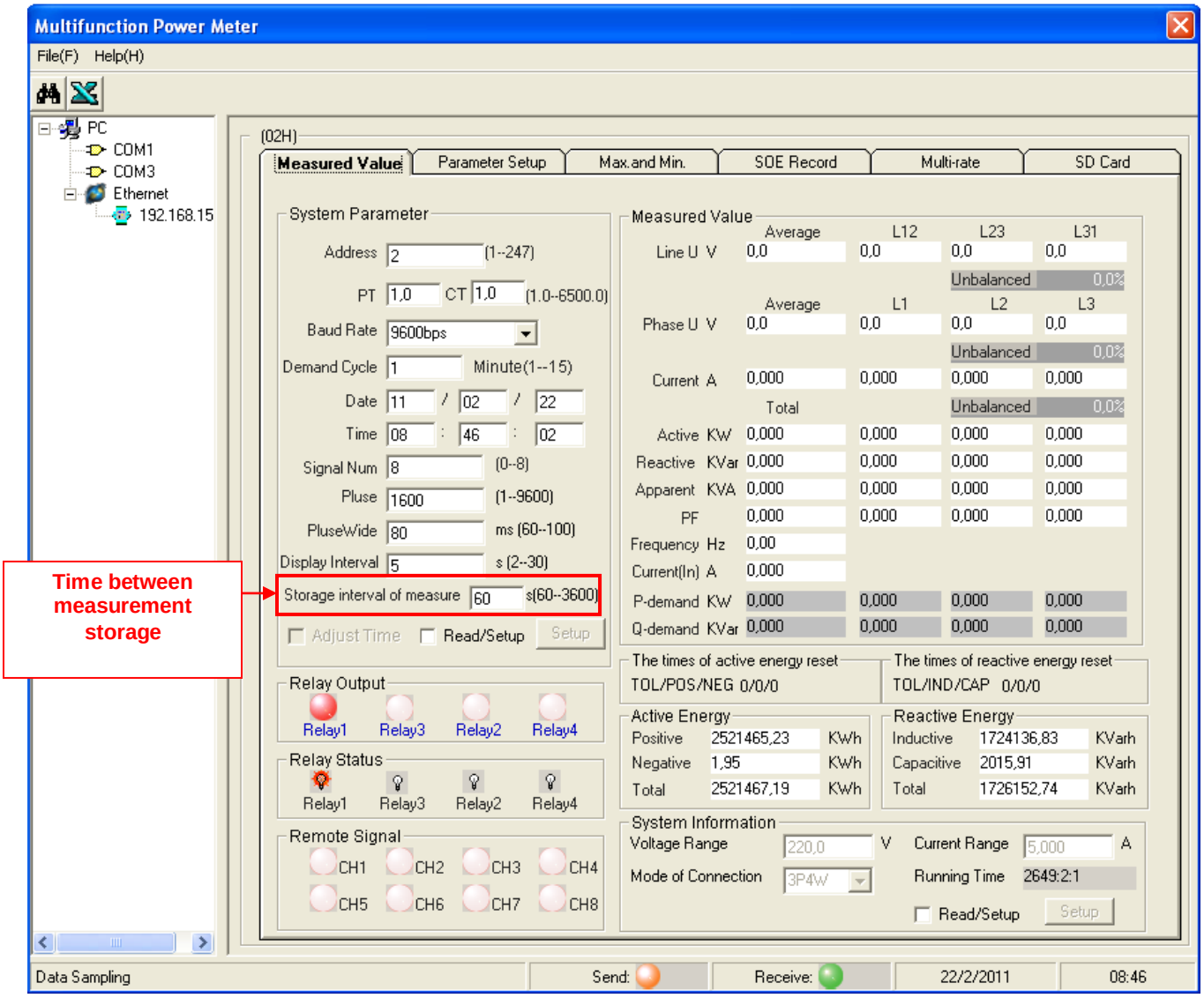

Figure 6-45. Memory Card Storage Time Configuration for the Power Meter Measurements

In case when the SD memory card has been removed from the module, the power meter will display the Figure 6-46 message on the moment it is switched on. To continue the power meter utilization, it's necessary, on this case, press any key. However the storage function won't be executed due to the lack of a memory card.

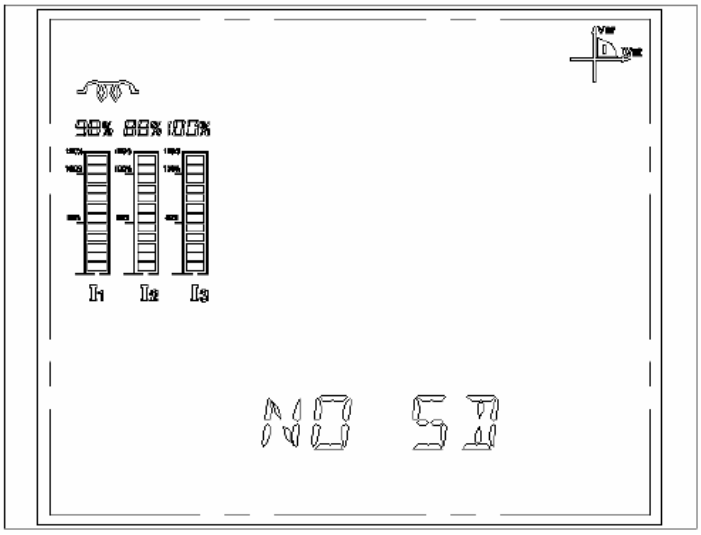

Figure 6-46. PH3x31 Module Screen Indicating the Lack of a Memory Card

ATTENTION: The SD memory card has 2 GB of storage capacity and when it's configured for the minimum value between data recording, 1 minute, the whole memory could take several years to be filled with data, therefore it's important that a memory cleaning and a security copy are run so avoid data loss. It is strongly suggested the running of such procedure each year. Furthermore, the use of SD cards with storage capacity different from 2 GB must be avoided.

Memory Card Information Reading

To do the reading of the memory card stored data it is suggested the power meter configuration software utilization, this way the data reading and conversion to MS-Excel data sheet format is possible. The data reading procedure is explained in the following instructions:

- Take the memory card off the expansion module and insert it in a compatible PC memory card reader
- On Figure 6-47, on the tab "SD Card" (this tab is only available if the PH3x31 module is inserted in the Multifunction Power Meter) click on "Read SD File".
- Define a date in the field "Select Date" on the new window that has just opened
- Search for the folder with all measured data folders within, clicking on "…". It is important to remember that only the highest level folder must be set in "Select Path". For instance, if the memory card is addressed in unit i:\, inside of this unit there are several data folders.
- Only the highest level folder ("i:\") must be informed as on Figure 6-47.
- Choose one of the following 4 options:
    - Measured Value
    - Event Record
    - Harmonic Record
    - Demand/Energy Record

The chosen one will be converted to MS-Excel.

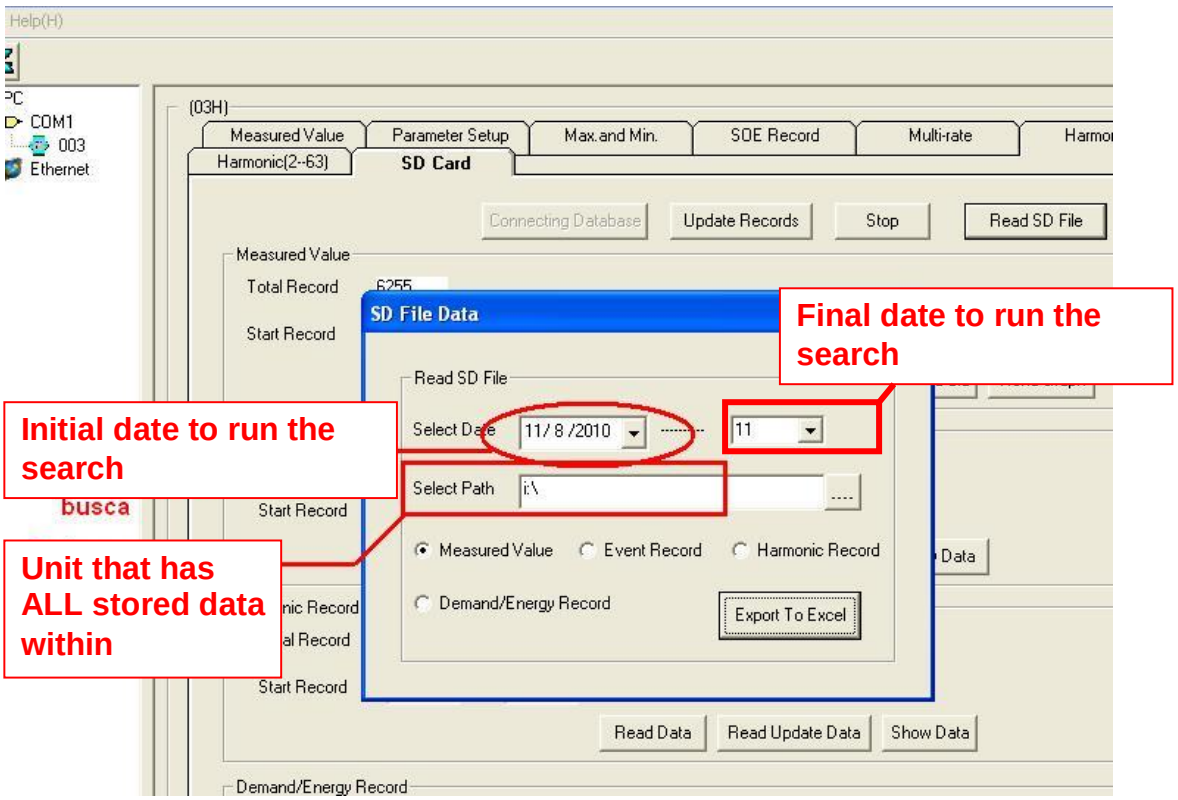

Figure 6-47. SD Card Data Reading Window

It's also possible to read the memory card data without the connection with PH3x31 module. On the configuration software main screen it is possible to access the data reading window the same way as before, as shown on Figure 6-47.

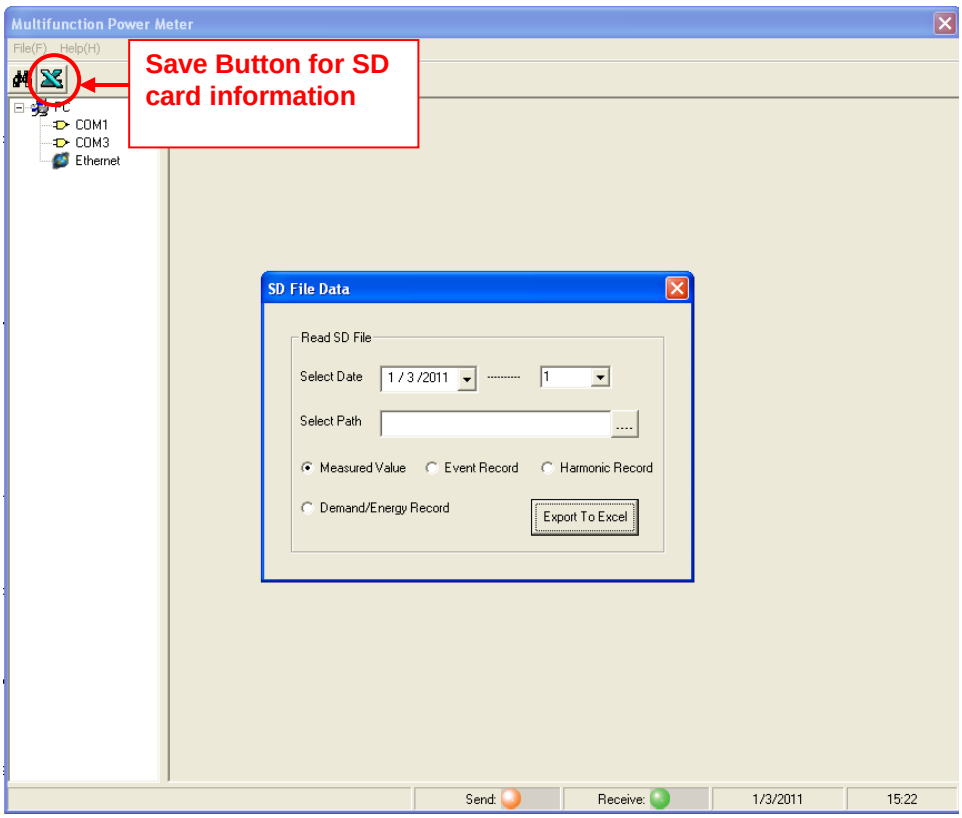

Figure 6-48. Main Window Access to Save Memory Card Information

Folders and Files Struct in the SD Card

Although it is necessary to use the PH3101configurator to convert the data generated by the module PH3x31, it is important to understand how the organization of folders and files stored in the memory card. The following figure shows the structure formed.

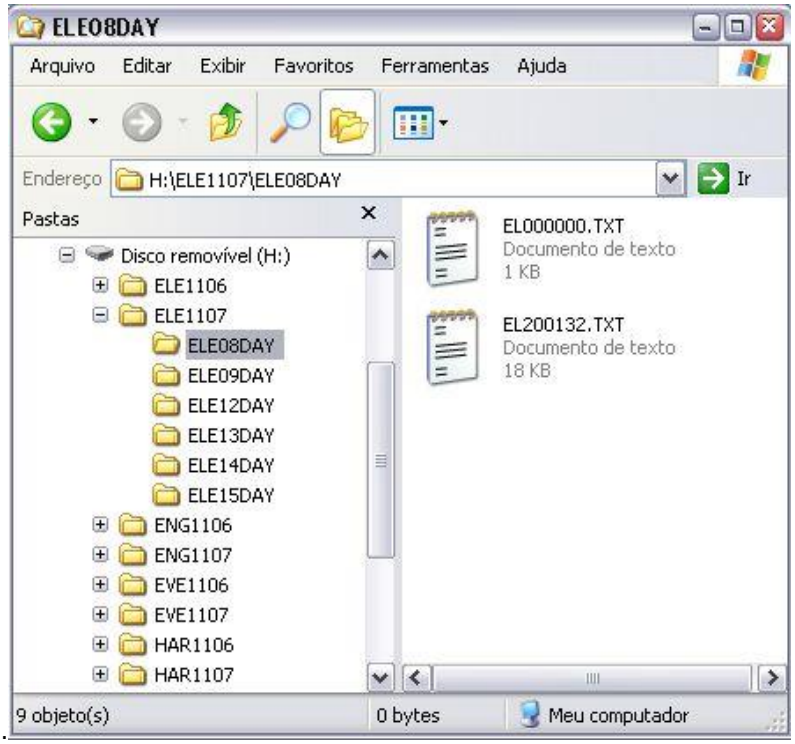

Figure 6-49. Folders and Files Struct in the SD Card

The folders created in the card is divided into four groups of stored measurement type: general measurements (ELEXXXX), measurement of demand (ENGXXXX), events generated (EVEXXXX) and harmonic measures (HARXXXX). The value represented by XXXX represents the year and month of recording, each occupying two positions, YYMM. Within each folder the folders are generated daily for each type of measurement (TTT), the day and the suffix DAY, in the above case ELE08DAY folder contains files with those obtained on July 8, 2011.

ATTENTION: The measures are recorded on the card in sequence, not being organized by time, so when it is necessary to delay an hour in the summer time (daylight saving time) the data will be recorded in sequence and not organized by time.

Harmonic Analysis

The harmonic monitoring function is intended to allow the consumed energy quality analysis, becoming possible the verification of harmonic amplitude and phase ratio in order to allow actions to decrease its presence in the system being monitored.

Figure 6-49 shows the voltage, current and power general measurements screen of the fundamental frequency besides the harmonic measured values.

Through Figure 6-50 is possible to visualize each harmonic ratio, from 2^{nd} to 63^{rd}, composing the measured signal, besides the phase angle of each one of them.

The tabs presented on Figure 6-49 and Figure 6-50 will only be available in the configuration software when the PH3x31 module is connected to the power meter.

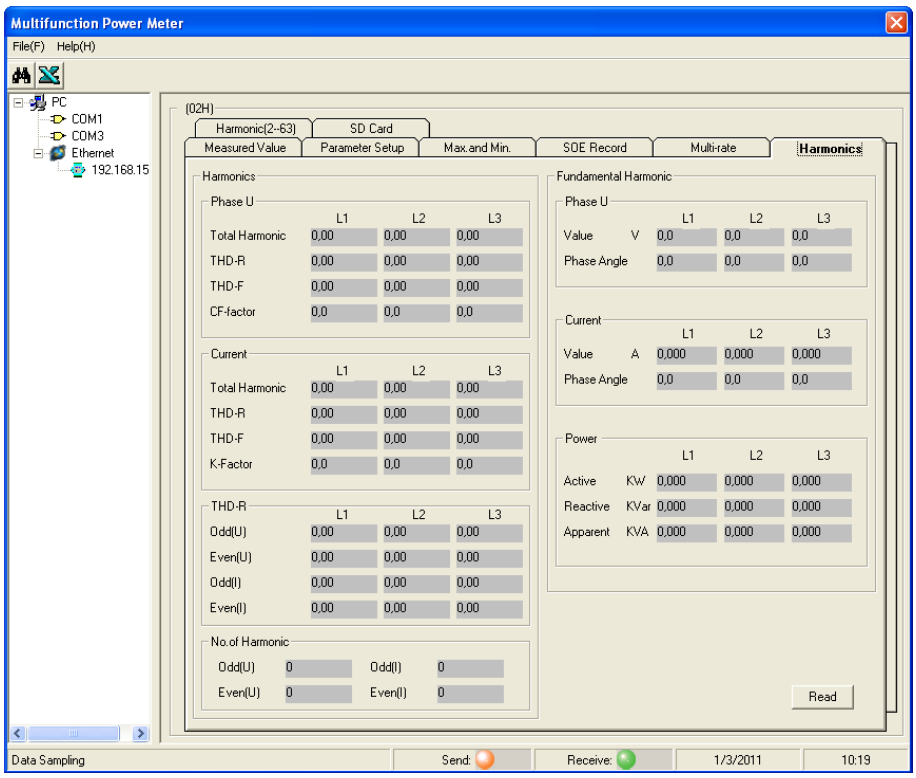

Figure 6-50. Harmonic Measurements Screen

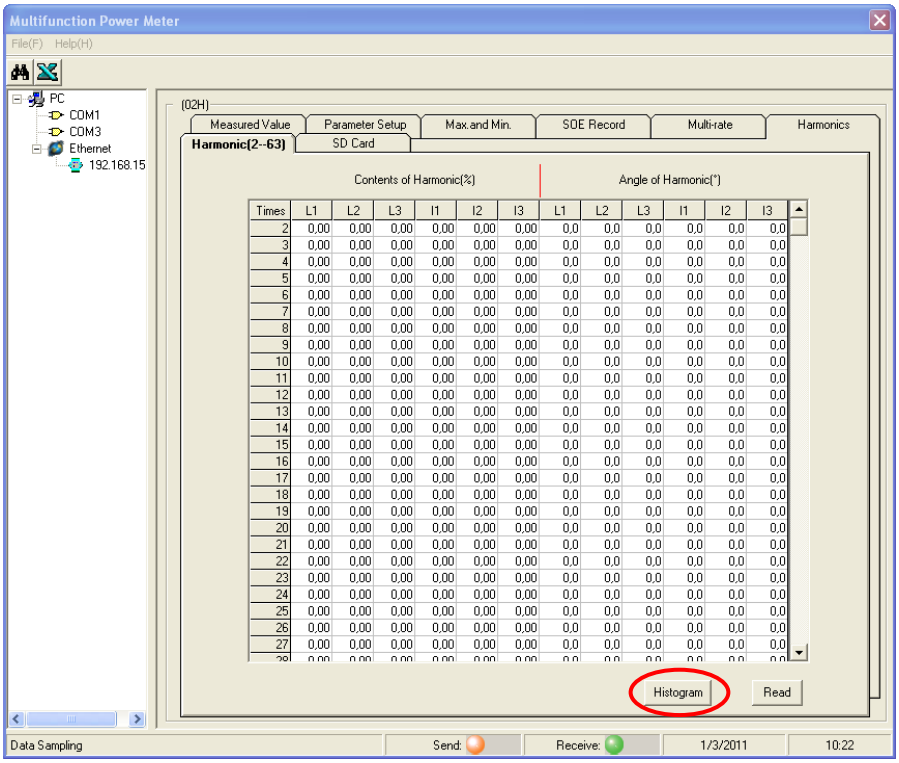

Figure 6-51. Ratio and Phase Angle of Harmonics from 2nd to 63rd

Through “Histogram” button available on the screen presented on Figure 6-50, it’s possible to visualize the histogram graphic presented on Figure 6-51.

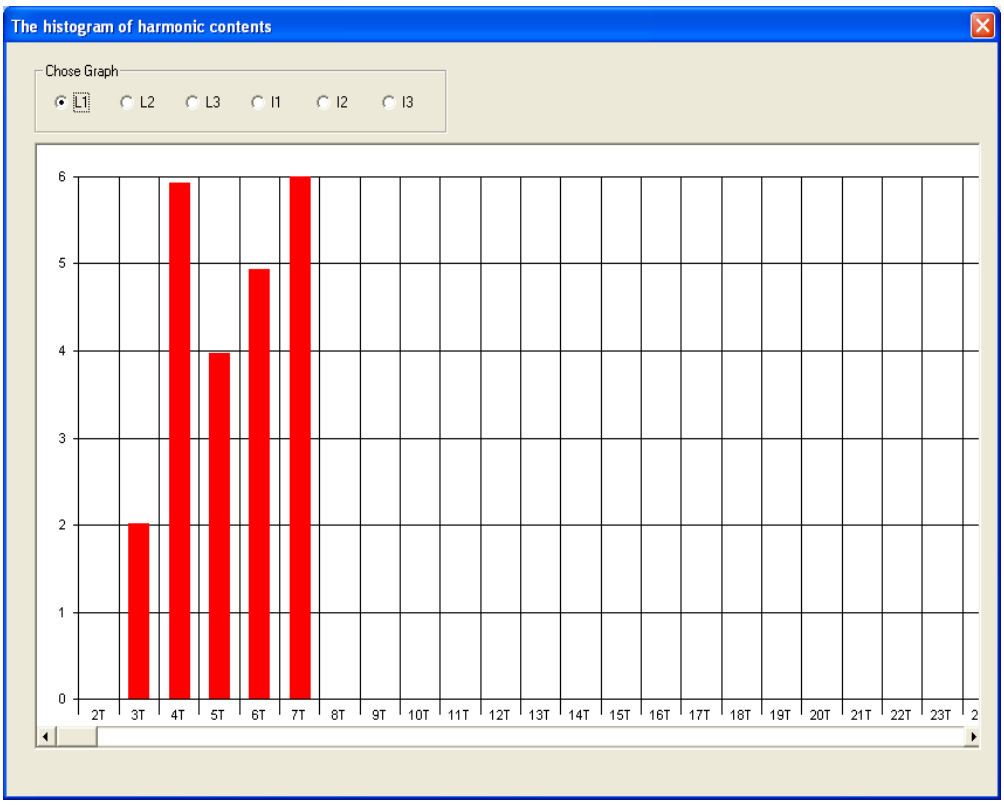

Figure 6-52. Harmonics Histogram Graphic

ETHERNET Communication Module

PH3x50 Module Configuration

The PH3x51 expansion module can be configured through PH3101 software or HMI. This module configuration steps are presented below, using the PH3100 configuration software.

The first configuration of the Multifunction Power Meter equipped with the ETHERNET module must be run using a point-to-point connection as the module has a standard fixed IP and is manufactured with the 192.168.0.178 address. It is important to do the module configuration using a PC on the 0 subnet and in case this network has been changed, a new subnet must be used. To run the module configuration it is necessary to follow the steps below:

The first step, when the configuration software PH3101 is already running, is to select the protocol (MODBUS TCP/IP or MODBUS RTU). After, to click on Ethernet item from selection tree on the left side. The screen on Figure 6-53 will be presented, where the “LAN” item must be selected in Select Network.

NOTE: From PH3100's AJ revision, the default protocol used in the Ethernet expansion module is MODBUS TCP/IP. For previous PH3101 revisions, only MODBUS RTU is avalilable.

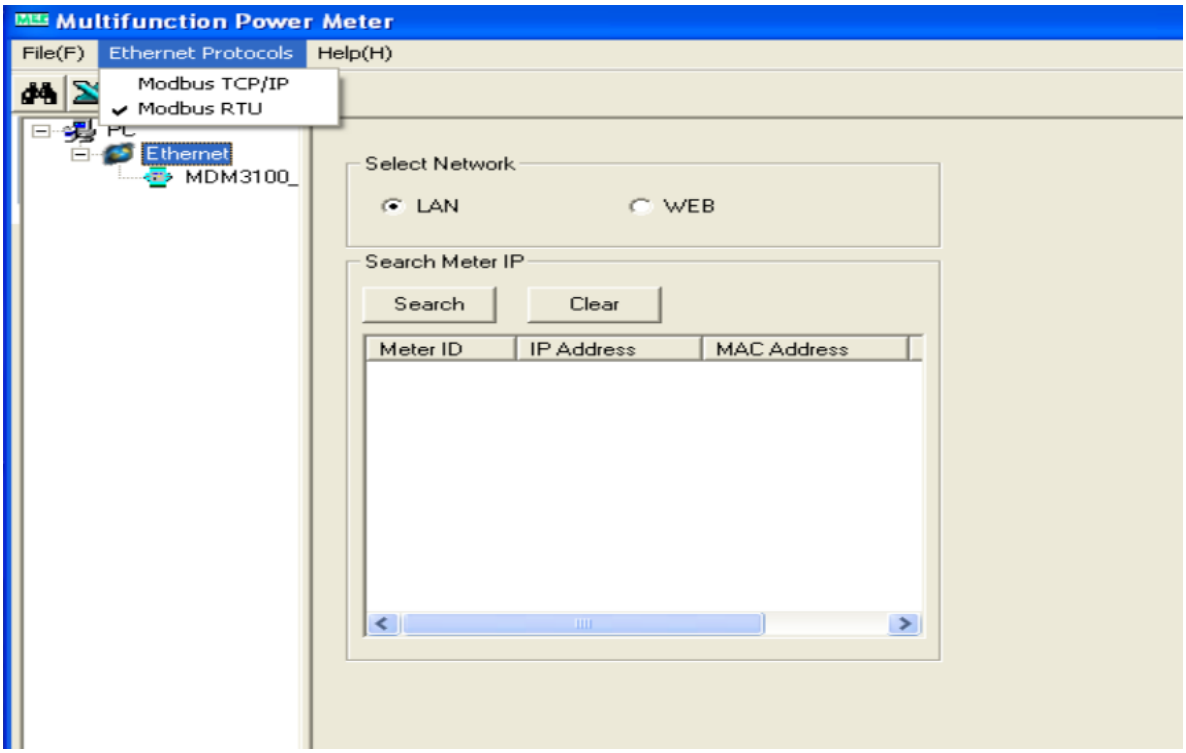

Figure 6-53. Network Selection for the PH3x50 Module Scanning

After the first step conclusion the button “Search” must be clicked, in Search Meter IP, when the power meter found will be displayed right under, informing the following data:

“Meter ID”, “IP Address” and “MAC Address”. On clicking on the found power meter data the ETHERNET module configuration parameters will be displayed (“Ethernet Module Setting”), as shown on Figure 6-54.

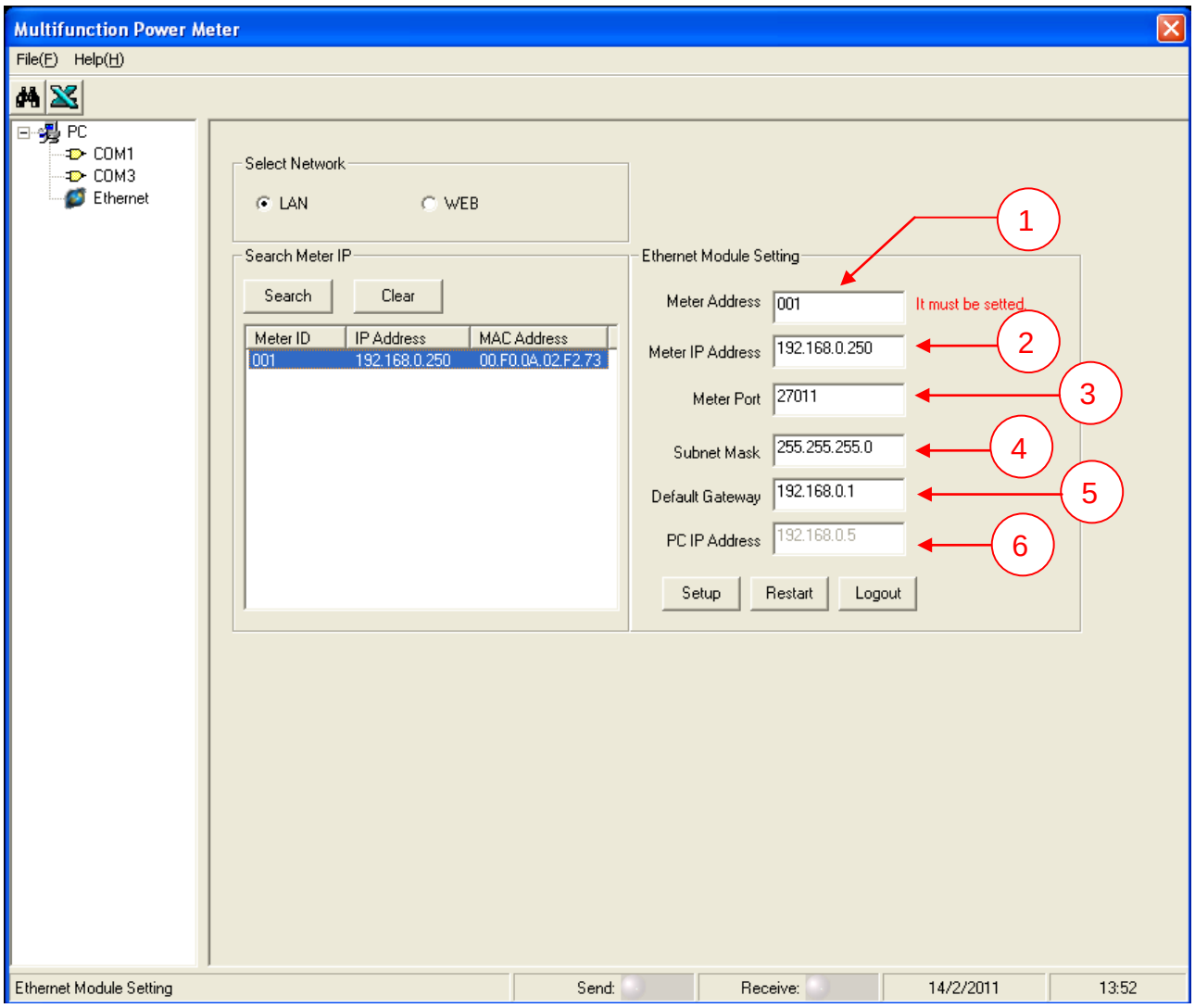

Figure 6-54. ETHERNET Module Configuration Parameters

The ETHERNET expansion module configurable parameters identified above are:

1 Meter Address: MODBUS address configured through power meter HMI. The informed value on this screen must be the same as the HMI configuration, if not the communication won't work.
2 Meter IP Address: IP address. A fixed IP value must be chosen for communication. The module doesn't have dynamic IP resources.
3 Meter Port: Establish the communication port. In case of other supervisory software utilization this value must be used in the supervisory configuration.
4 Subnet Mask: Subnet mask
5 Default Gateway: Network standard Gateway address
6 PC IP Address: Address of the PC which is been configured to communicate with the power meter at the present moment.

ATTENTION: It is necessary that the ETHERNET module use Subnet Mask = 255.255.255.255 configuration must be avoided, if not, the ETHERNET module won't be found in the network.

At the parameters configuration conclusion, the information must be sent to the module through a click on the "Setup" button.

With the concluded configuration it's possible start the communication with the power meter. To start the power meter must be searched in the network, clicking on the button indicated on the Figure

6-55. When the power meter is found, with a valid configuration, the IP address will be presented right under the “Ethernet” tree.

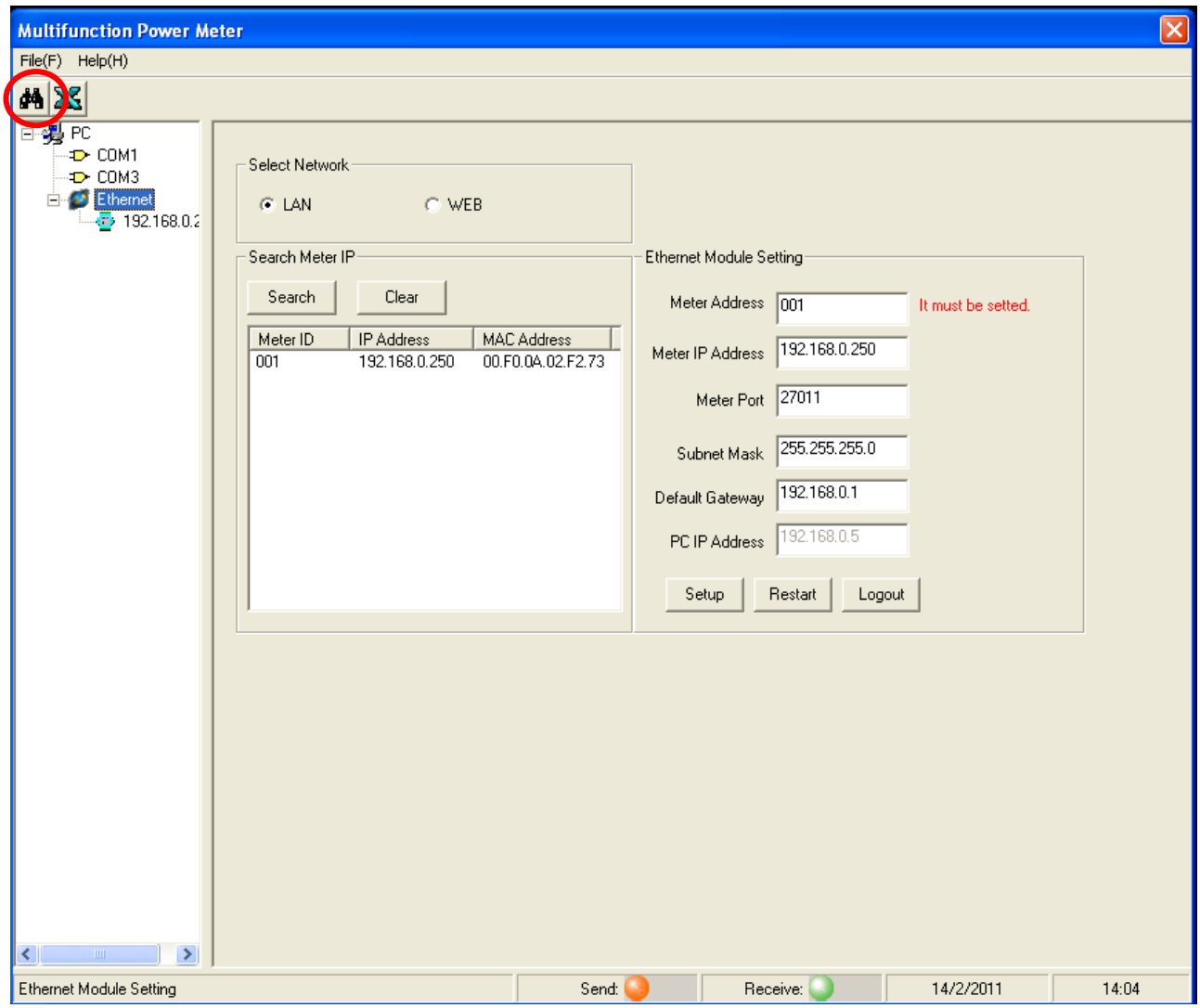

Figure 6-55. Search for the Configured IP Address

To get in the power meter information visualization, the IP address must be double-clicked, when the power meter monitoring and configuration tabs will be presented.

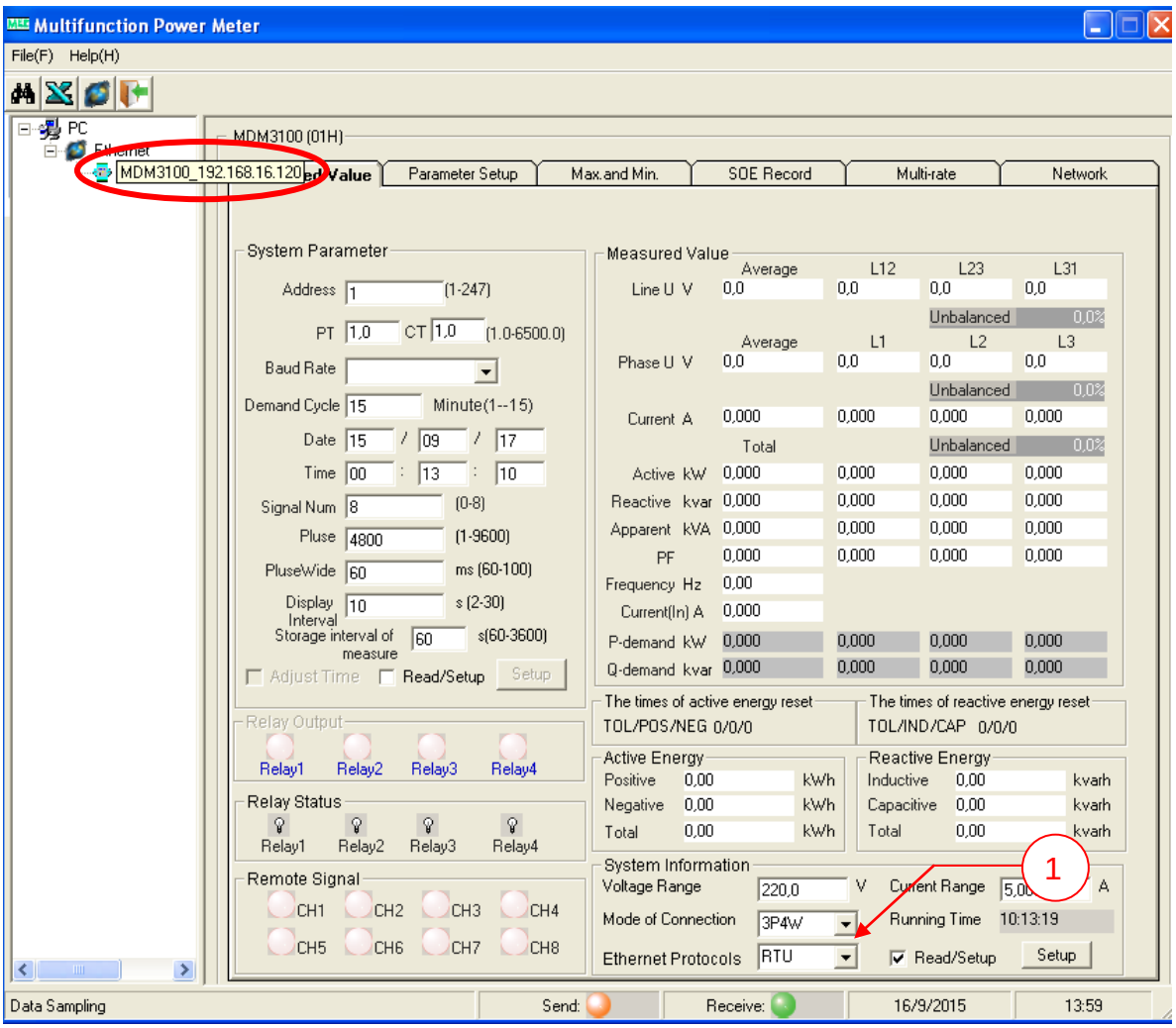

Figure 6-56. PH3100 Measurements and Configuration Monitoring

Note:

1: Selection of MODBUS ETHERNET RTU or TCP/IP communication protocol.

From this point forward the configuration and monitoring will follow the same instructions as the PH3101 software utilization in item “Parameters Measurement Display”.

PH3x50 Module Diagnosis

The following legend must be used to identify the LEDs status:

Status	Symbol
On	●
Blinking	X
Off	O
Any other state	-

Table 6-4. LEDs Status Identification Table

Note:

Blinking – X: the LED starts to blink and keep blinking while the interface remains on a state determined by any specific event.

RJ45 Connector LEDs

Both RJ45 connector LEDs help the user to detect problems in the installed network. They show the LINK network speed and if there is data exchange with the interface. The LEDs meaning is presented on Table 6-5.

Orange	Green	Meaning
○	○	Lack of network LINK (broken cable or disconnected).
●	–	Network LINK detected.
●	X	Ethernet network transmission or reception occurrence, through or to this IP address. Blinks on each transmission or reception.

Table 6-5. NET LEDs Meaning

PROFIBUS Communication Module

PH3x51 Module Configuration

The power meter will receive the PROFIBUS address configured in the PROFIBUS parameter in the PH3100 browsing menu as shown on Figure 3.14.

Then the device PROFIBUS network configuration must be done. Considering the utilization of an Altus PROFIBUS master, the software indicated for the task is the ProfiTool. For a start the device configuration file, in this case the ARTL0BB5.GSD, must be put in the folder C:\Program Files\Altus\ProfiTool\Fieldbus\PROFIBUS\GSD. Next the software must be open and a new projected created (or an existing project updated) and a slave added.

Next, on the slave insert window, in the vendor field, the option ARTEL must be selected and M60 selected, as a slave available, and added.

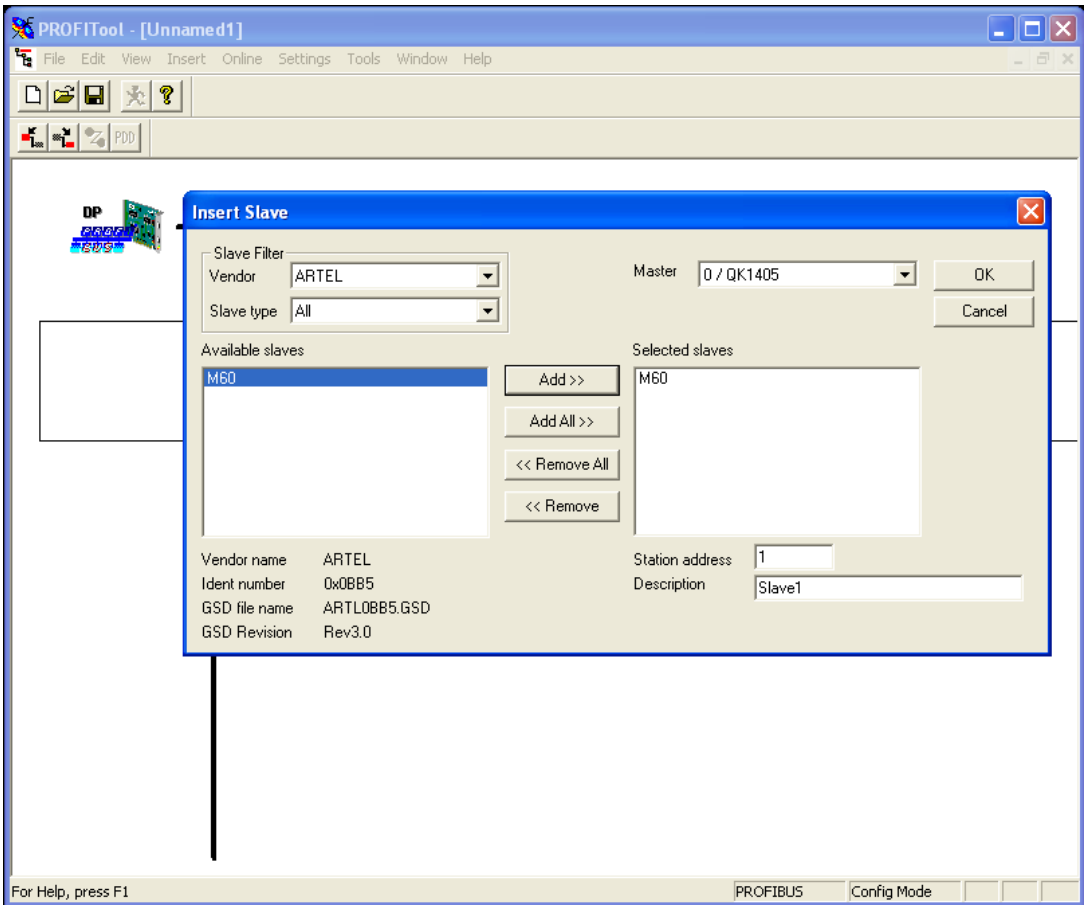

Figure 6-57. PROFIBUS Slave Insertion Using the ProfiTool Software

After the slave has been added, its properties must be selected clicking on “DP settings”.

The slave configuration window will open, where one of the three configuration profiles must be chosen: “Beisp1”, “Beisp2” or “Beisp3”. The slave PROFIBUS address has to be inserted and its value has to be the same as the value configured in the browsing screen menu, as presented on Figure 3.14.

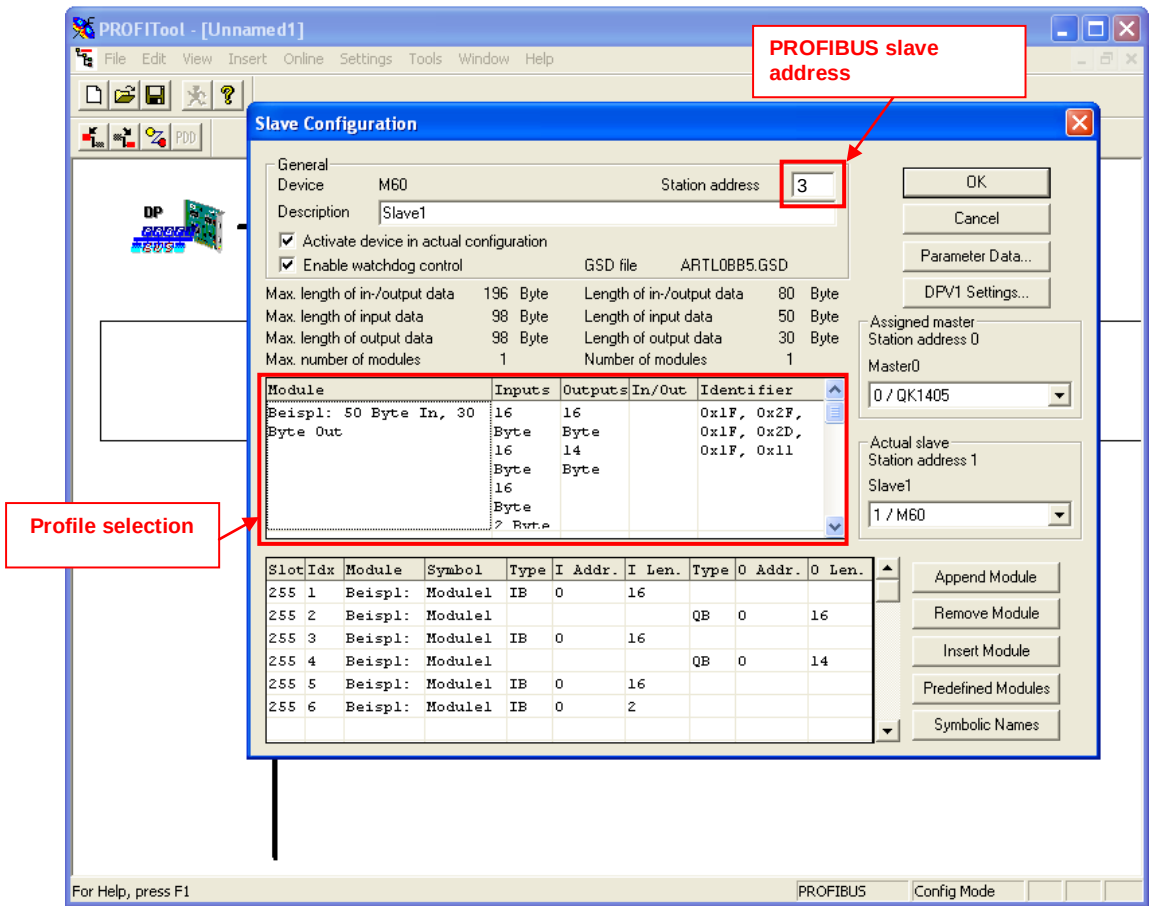

Figure 6-58. PROFIBUS Module Profile Selection Window

The basic difference between the configuration profiles is the available input and output byte number which are:

- “Beisp1” are 50 input bytes and 30 output bytes;
- “Beisp2” are 30 input bytes and 30 output bytes;
- “Beisp3” are 49 input bytes and 49 output bytes.

After the profile has been added and the OK button pressed, the project must be saved and sent to the Altus PROFIBUS master.

In the following steps the configuration software used is the MasterTool XE. In this software a PROFIBUS configuration module must be added, where the file “.pb” (saved by ProfiTool) has to be imported. The start of the memory operand addresses that will be used for PROFIBUS command writing, in case of output bytes, and reading, in case of input bytes.

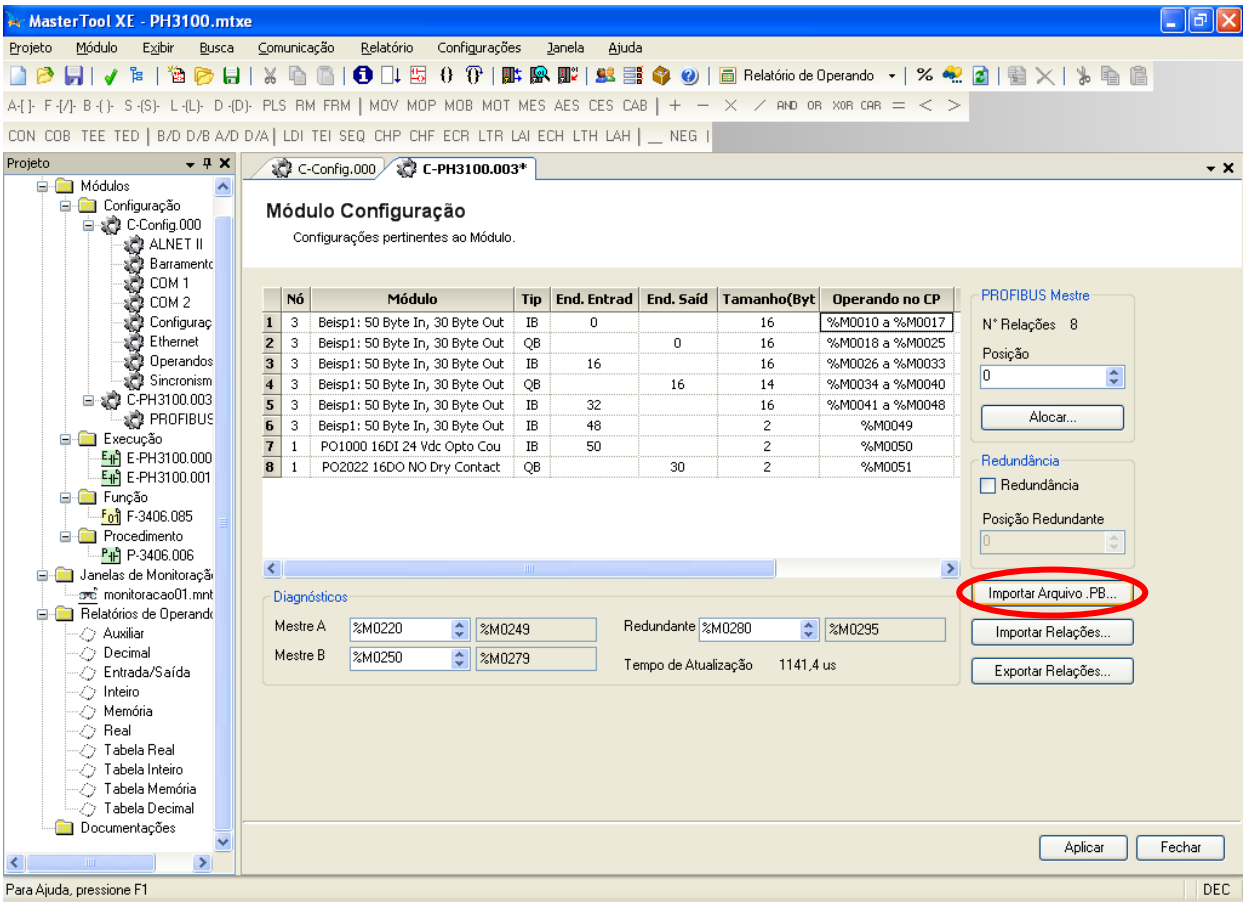

Figure 6-59. Import Screen for ProfiTool Generated File

After the configuration is concluded and the project sent to the master, to make reading request to PH3100 through PROFIBUS, at least two memory operands must be used related to QB type in the PROFIBUS configuration module. In the first %M0010, the initial address higher byte from the register to be read must be written (note 1) and the function number (0x03 for reading or 0x10 for writing, in this case 0x03). The second operand %M0011 must have the number of parameters to be read and the initial address lower byte, as shown on Figure 6-59.

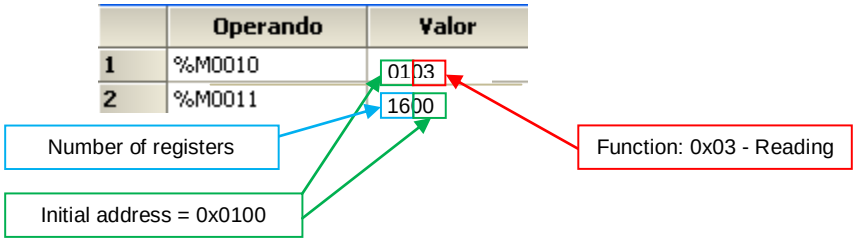

Figure 6-60. Initial Operand Setup for Communication Configuration

Note:

The PROFIBUS data address is the same as presented on the MODBUS table registers.

To use equipment from other manufacturers must be observed the necessity of reversing the bytes of the operands.

In the reply to be read, the first two %M input operand will be a repetition of the command sent and the following will be the requested data.

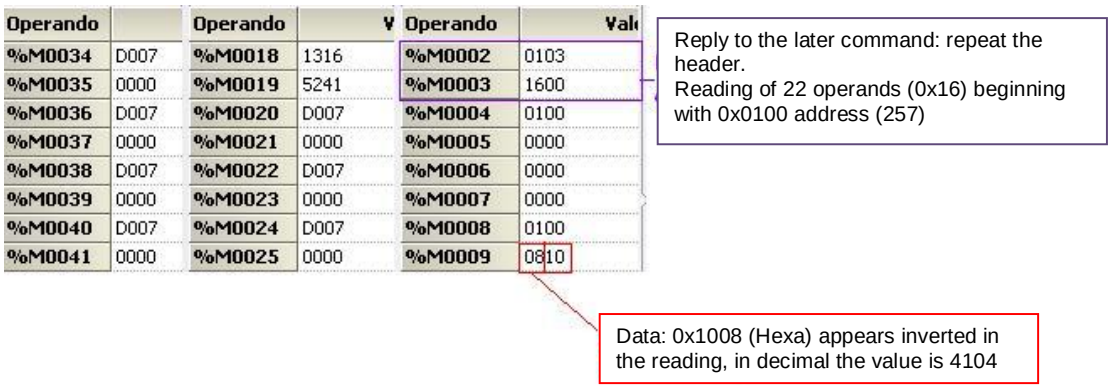

Figure 6-61. Data Reading Command Reply

It is important to observe that the operands has its bytes swapped. For example: %M0009, as the data read has the higher byte and the lower byte inverted, as it can be seen on Figure 6-59. The value shown is 0x0810 but the real value, with no inversion, is 0x1008.

To invert the bytes it's suggested the utilization of MOP instruction, in ladder language.

To request a writing (0x10 function), the steps can be repeated, as they are almost the same. However, before start the writing function, the data to be written must be already in the %M output operands, otherwise the value zero will be written. Therefore a device unexpected behavior could take place.

7. Maintenance

Preventive Maintenance

7 Every year you should check the interconnection cables of the protection devices, mainly, to ensure that their connections are firm, and without dust

8 In environments subject to excessive contamination, you should periodically clean out the device by removing residues, dust, etc.

CAUTION:
Before any maintenance, it is important to discharge any static potential accumulated in the body. To do this, touch (with bare hands) a grounded metal surface before handling the modules. This procedure ensures that the levels of static electricity supported by the module will not be exceeded.

8. Glossary

3P3W	3-phase, 3-wire
3P4W	3-phase, 4 wire
Baud rate	Rate in which information bits are transmitted through a serial interface or communication network (measured in Bits/second, bps)
Bit	Basic information unit, it may be at 1 or 0 logic level.
Bus	Set of electrical signals that are part of a logic group with the function of transferring data and control between different elements of a subsystem
Byte	Information unit composed by eight bits.
Commercial Code	Product code formed by the letters PO and followed by four digits.
Communication Network	Set of devices (nodes) interconnected by communication channels.
CT	Current transformer.
Diagnostic	Procedures to detect and isolate failures. It also relates to the data set used for such tasks, and serves for analysis and correction or problems.
EIA RS-485	Industrial standard for physical layer on data communication.
ESD	Electrostatic Discharge.
Hardware	Physical equipment used to process data where normally programs (software) are executed
I/O	See Input/Output.
Input/Output	Also known as I/O. Data input or output devices in a system. In PLCs these are typically the digital or analog modules that monitor or actuate the devices controlled by the system.
Interface	Normally used to refer to a device that adapts electrically or logically the transferring of signals between two equipments.
LED	Light Emitting Diode. Type of semiconductor diode that emits light when energized. It's used for visual feedback.
Master	Device connected to a communication network originating all the command requests to other network units.
Master-slave communication network	Communication network where the data transfer are initiated only by one node (the network master). The remaining network nodes (slaves) only reply when requested.
Menu	Set of available options for a program, they may be selected by the user in order to activate or execute a specific task
Module (hardware)	Basic element of a system with very specific functionality. It's normally connected to the system by connectors and may be easily replaced.
Multimaster communication network	Communication network where the data transferred are initiated by any node connected to the data bus.
Nibble	Information unit composed of four bits.
Node	Any station in a network with the capacity to communicate using a determined protocol.
PLC	See Programmable Controller
Programmable Controller	Also known as PLC. Equipment controlling a system under the command of an application program. It is composed of a CPU, a power supply and I/O modules.
Protocol	Procedures and formats rules that allow data transmission and error recovery among devices with the use of control signals
PT	Potential transformer.
Ripple	Oscillation present in continuous voltages.
Scan Cycle	A complete execution of the PLC application program.
Serial Channel	Unit interface that transfers data serially.
Slave	Device connected to a communication network that only transmits upon the master requests.
SOE	Sequence Of Events.
Software	Computer programs, procedures and rules related to the operation of a data processing system
Sub network	Segment of a communication network that connects a group of devices (nodes) with the goal of isolating the local data traffic or using different protocols or physical media.
Supervisory Station	Equipment connected to a PLC network with the goal of monitoring and controlling the process variables
TDD	Total Demand Distortion.
THD	Total Harmonic Distortion.
Time-out	Maximum preset time to a communication to take place. When connection time exceeded then retry procedures are started or diagnostics are activated.
TX	Acronym used to indicate serial transmission.

Upload Reading a program or configuration from the PLC.

Word Information unit composed by 16 bits.