M850 -MP1 MultiPower
Installation and Operation Manual
(Revision 1.0.0)

March 2011

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Chapter 6: Configuring the M850 -MP1 Using the Front Panel

Appendix A: Modbus Registers

This symbol indicates that the operator must refer to an explanation in the operating instructions. Please see Chapter 3, Electrical Installation, for important safety information regarding installation and hookup of the M850 -MP1 MultiPower meter.

Chapter   1: Meter   Overview   and   Specifications

1.1
Hardware   Overview

MultiPower
AC   Meter

The M850-MP1 MultiPower is a complete 3 phase digital, universal metering system in a standard 96 x 96 mm DIN case. It is a cost-effective replacement for traditional panel meters. This multi-function power meter is suitable for low, medium and high voltagecontrol panels, gensets, load banks, building management systems and power management systems.

The M850-MP1 can be used on single phase or a single phase 3-wire system; 3-phase 3-wire balanced or unbalanced systems, as well as 3-phase 4-wire balanced or unbalanced systems.

Versatile plug-in units for RS485 (Modbus protocol) and pulsed output options can be purchased with the M850-MP1 MultiPower meter. Or, they can be retrofitted at a later time. The RS485 plug-in unit enables remote reading of up to 32 MultiPower units on a single 2-wire bus using Modbus protocol. TheRS485 option is compatible with PC, PLC, RTU, data loggers and SCADA programs.

The   M850   -MP1   MultiPower:

Complete single phase and 3-phase digital universal metering system. Covers a majority of applications without any modifications
Measures a standard range of 16 different parameters. Easy to use and easy to program from the front panel.
CT ratios, PT ratios and calibration data are stored in non-volatile EEPROM memory. In power-loss conditions, the data is retained.
Four, easy-to-access, front control buttons are used for scrolling up or down through the parameters.
Unique blue LED display is designed to be read in a variety of conditions, including bright sunlight, over a very wide viewing angle. There are 8 user-adjustable levels of brightness.
RS485 option and a pulsed output option can be ordered with the M850-MP1 MultiPower unit or they can be retrofitted easily at a later date.
The RS485 (Modbus protocol) unit enables remote reading of up to 32 MultiPower meters on a single, 2-wire bus.
Pulsed output option is via a plug-in relay and can be assigned to W.h. and VAR.h.

The four front control buttons are used for scrolling up or down through the parameters being measured and displayed. These buttons also allow programming of different current and voltage transformer ratios, demand times,baud rates, etc.

The M850-MP1 MultiPower is housed in a 96 mm x 96 mm DIN style case. The case is constructed of black polycarbonate and is compliant with UL 94VO. The front panel of the case has an enclosure code of IP52.

1.1.1
Voltage and Current Inputs

Voltage inputs allow measurement from 28V to 330V line-to-neutral and 48V to 600V line-to-line. This insures proper meter safety when wiring directly to high voltage systems. The M850-MP1 has an input overload rating of 800V,AC continuous. The aux power required is 100 to 440V,AC / 100 to 420V,DC systems.   A separate unit have an auxiliary voltage supply of 19 to 69V,DC is available. The M850-MP1 MultiPower operates at 45-65Hz standard; another unit is available for 400Hz applications.

General Specifications:

Accuracy	Volts/Amps:	0.5% of reading ± 2 digits
	Frequency:	0.1Hz ± 1 digit
	Reactive Power:	1%of reading ± 2 digits
	Apparent Power:	1% of reading ± 2 digits
	Power Factor:	1% of reading ± 2 digits
	Energy:	IEC 1036 Class I
Rated Un	28V to 330V (L-N) and 48V to 600V (L-L)	
Un Overload	800V continuous	
Burden	0.5VA per phase	
Rated In	0.5 to 6A (via CT)	
Input Overload	10 x In for 1 second	
Input Burden	0.5VA per phase	
Frequency	45 – 65 Hz; 400Hz available	
Auxiliary Voltage	100 to 440V,AC / 100 to 420V,DC	
	(19 to 69V,DC optional)	

The auxiliary supply can be connected in parallel with the measuring input voltage, but this restricts the measuring range of the input voltage to ± 15% of nominal. If the auxiliary is separate the measuring range of the voltage input is 10-120%.

Current Transformers:

Internally the M850-MP1 MultiPower fitted to either 5 Amps or 1 Amp. The current circuit is designed for connection to the secondary of external CT.   These transformers should conform to at least accuracy class 1 or preferably ANSI C57.13 or equal.

The secondary of these external transformers must have the same nominal current input as that specified on the data label on the M850-MP1. For example, if the M850-MP1 has a current ratio specified as 500/5A, then the CT could be changed to 800/5A (or any ratio with secondary 5A) and used once the current ratio has been programmed into the M850-MP1.

But if the ratio change was 800/1A, the M850-MP1 would have to be returned to the factory to have the internal circuits changed to 1 Amp.

Warning: The secondary of a current transformer must never be allowed to be in an open circuit condition when the primary is energized. In the open circuit condition voltage may be present. Each current transformer secondary should be short-circuited when not connected to the meter.

Voltage Transformers:

Connection of voltages higher than the rated voltage that is specified on the M850-MP1 data label, is possible using external voltage transformers. These transformers must be at least Class 1 accuracy.

The secondary of these transformers must have the same nominal voltage as that specified on the data label on the side of the M850-MP1. (For example: If the M850-MP1 had a voltage specified as 110V,AC line-to-line, then a transformer with Ratio of 6600/110V,AC volt can be used, once this ratio has been programmed into the M850-MP1. But if the ratio was 6600/400V,AC the unit would have to be returned to the factory or distributor to have internal component changes to accommodate for the 400V,AC input.)

1.1.2
Model Number plus Option Codes

Part Number	Description
M850 -MP1	Standard MultiPower AC meter; Input: 25-300V (L-N) @ 5A,AC; 45-65Hz; Aux: 100-440V,AC/100-420V,DC
M850 -MP1AB	Standard MultiPower AC meter; 1A, AC input
M850 -MP1PE	Standard MultiPower AC meter; Input: 25-300V (L-N) @ 5A,AC; 45-65Hz; Aux: 19-69V,DC
M850 -MP1FC	Standard MultiPower AC meter; Input: 25-300V (L-N) @ 5A,AC; 400Hz
M850 -BAC*	Standard MultiPower AC meter with BACnet protocol
M850 -MKW	Standard MultiPower AC meter measuring AC Current and Watt Hours
M850 -MPA	Measures 3-phase AC current and maximum demand current only
M850 -MPH	Standard MultiPower AC meter with added Hours Run
M850 -MPV	Measures 3-phase AC Volts only
M850 -MVM	Standard MultiPower AC meter with current clamp inputs of 333mV,AC
M850 -THD	Standard MultiPower AC meter with added Total Harmonic Distortion
M850 -RS485	Plug-In Option for RS485 (Modbus)
M850 -PULSED	Plug-In Option for Pulsed Output
M850MP1RTV	NEMA 4 option with RTV internal sealing and panel gasket
M850*RED	Any Standard M850 MultiPower AC meter with red LED display

*M850-BAC unit requires an M850RS485 plug-in module.

1.1.3
Measured Values

Phase Power L-L (V)	Power Factor (P.F.)
Phase to Neutral L-N (V)	Instantaneous Demand Amp
Phase Current (I)	Instantaneous Demand Apparent Power
Frequency (Hz)	Maximum Demand Amps
Active Power (W)	Maximum Demand Active Power
Reactive Power (VA)	Maximum Demand Apparent Power
Active Energy (W.h.)	Maximum Active Power Demand
Reactive Energy (VAR.h)	Maximum Reactive Power Demand

1.2
Specifications

Input

Range:	28V to 330V (L-N); 48V to 600V (L-L)
Burden:	<0.5 VA per phase
In:	0.5A to 6A via current transformer
Frequency:	45 – 65Hz standard; 400Hz unit also available

Secondary of CT's must be connected to earth

Overload

UN:	800V (L-L) continuous
IN:	10 In for 1 second
	10 x In

Accuracy

Voltage (V):	0.5% ± 2 digits
Current (I):	0.5% ± 2 digits
Power (W, VAr, VA):	1.0% ± 2 digits
Power Factor (PF):	1% of range (reading) ± 2 digits
Frequency (Hz):	0.1 Hz ± 1 digit
Energy (kWh/VARh):	IEC 1036 Class 1

Auxiliary Voltage

Range:	100V to 440V,AC (45 to 65Hz) / 100V to 420V,DC
Burden:	<10VA

Display

Digits:	3 lines, 9999, Blue LED
Digit Size:	14.2mm, 7 segment
Update Time:	1 second
Brightness:	User-adjustable for 8 levels

Insulation

Installation Category:	III (480V,AC L-L)
Degree of Pollution:	2
Rated Impulse Withstand Voltage:	IEC 60947-1-V imp: 4kV
Meters Front:	Class II
Electrical Security:	IEC 61010-1

Environment

Working Temperature:	32^oF to +140°F (0^oC to +60°C) (Extended ranges available)
Storage Temperature: -	40°F to +185°F (-40°C to +85°C)
Relative Humidity:	0-95% non-condensing
Shock:	30G in 2 planes
Faceplate Rating:	IP52 Front Panel (IP 55/NEMA4 available)

Enclosure

Standard DIN case:	96 mm x 96 mm x 60 mm
Panel Mounting:	4 retaining clips
Cutout:	92.8 mm x 92.8 mm

Applied   Standards

Immunity to:

- Electrostatic discharges:	IEC 61000-4-2-Level III
- Radiated radio-Hz fields:	IEC 61000-4-3-Level III
- Electrical fast transient / bursts:	IEC 61000-4-4-Level III
- Impulse waves:	IEC 61000-4-5-Level III
- Conducted disturbances:	IEC 61000-4-6-Level III
- Voltage dips & short interruptions:	IEC 61000-4-11

Emissions to:

- Conducted ad radiated	CISPR11-Class A
Safety:	IEC 1010; BSEN 601010
UL:	File No. E337752

Options

Plug-In Modules:	RS485 (Modbus protocol)
	Pulsed output (W.h and VAR.h)

Communication   Format

RS485 (Modbus):	Port: through back plate
	Baud Rate: 38400, 19200, 9600, 4800, 2400
	Parity: Odd, even, no parity
	Address: 1 to 247
	Data Format: 8 bit
	Protocols: Modbus (RTU, Modbus), BACnet MS/TP

Mechanical   Parameters

Dimensions: Across front panel: 96mm high x 96mm wide
                                     Depth: Front screen depth: 19mm
                                              Meter body to edge of terminal block: 61mm
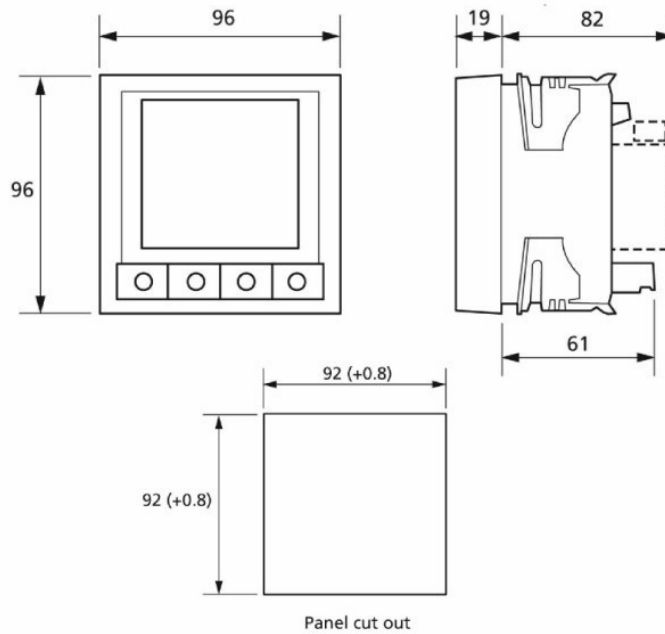   Meter body to edge of plug-in module: 82mm
Weight: 0.66 lbs.

Dimensions   of the M850 -MP1
(shown   in mm)

Panel cut out

1.3 Compliance

Compliance Standard	Applicable to
ANSI C37.90A	Insulation Surge Withstand
BS4753	Insulation Protection, Class II
BS4889	General Construction
BSEN601010	Safety
BSEN60688	General Construction
CISPR11 Class A	Conducted and radiated emissions compatibility
DIN 57411	Insulation Protection, Class II
EN 55020 HF	Insulation Impulse Test
IEC 1010	Safety
IEC 255-4	Insulation Interference
IEC 348	Insulation Protection, Class II
IEC 359	General Construction
IEC 688	General Construction
IEC 801	Insulation Surge Withstand
IEC 1036 Class I	Energy Accuracy
IEC 61000-4-2-Level III	Electrostatic discharge immunity level
IEC 61000-4-3-Level III	Radiated radio-Hz field immunity level
IEC 61000-4-4-Level III	Electrical fast transient / burst immunity
IEC 61000-4-5-Level III	Impulse wave immunity level
IEC 61000-4-6-Level III	Conducted disturbances immunity level
IEC 61000-4-11	Voltage dips and short interruptions immunity level
VDE	Insulation Protection, Class II
UL E337752	UL file number
UL94 VO	Case / Enclosure

2.1

Introduction   / Cut -out Details

The M850-MP1 MultiPower is designed for panel mounting and uses a standard 96mm x 96mm DIN case.   It fits into standard 96mm DIN openings.

**Panel   Cutout   and Dimensions
of the M850 -MP1**
(shown   in mm)
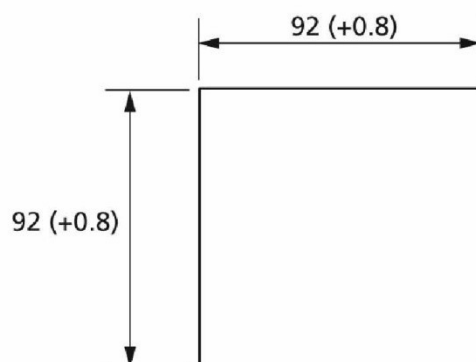
Panel cut out
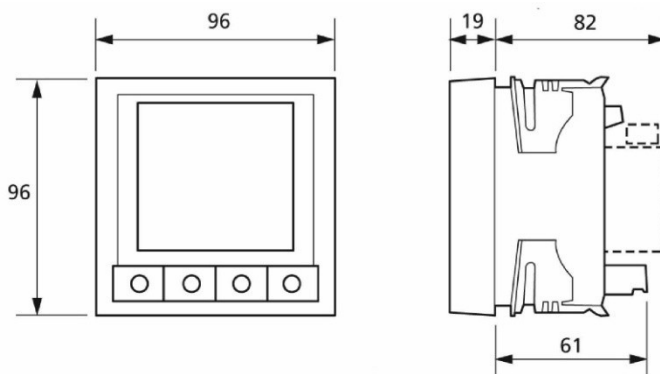
2.2

Panel   Mounting   Procedure

To install   the M850 -MP1 :

1. Remove the 4 retaining clips from the corners of the unit.
2. Insert the M850-MP1 from the front of the panel.
3. Slide the retaining clips back onto each corner of the meter and secure it to the back of panel. Push the clips until tight.

2.3
Terminal   Block   Notes:

Terminal screws are tightened using a flat-head screwdriver. It is recommended that the terminal screws be tightened by hand initially. When re-tightening with pneumatic screwdrivers, use a maximum torque of 0.5-1.0 Newton meters (Nm) or 1.1 in.-lbs.

Force greater than the recommended tightening torque will damage the terminal block and connection.

Connections
of the   M850 -MP1

L1, L2 and L3 current connections

Terminal block for power supply and voltage inputs

RS485 option

Relay option
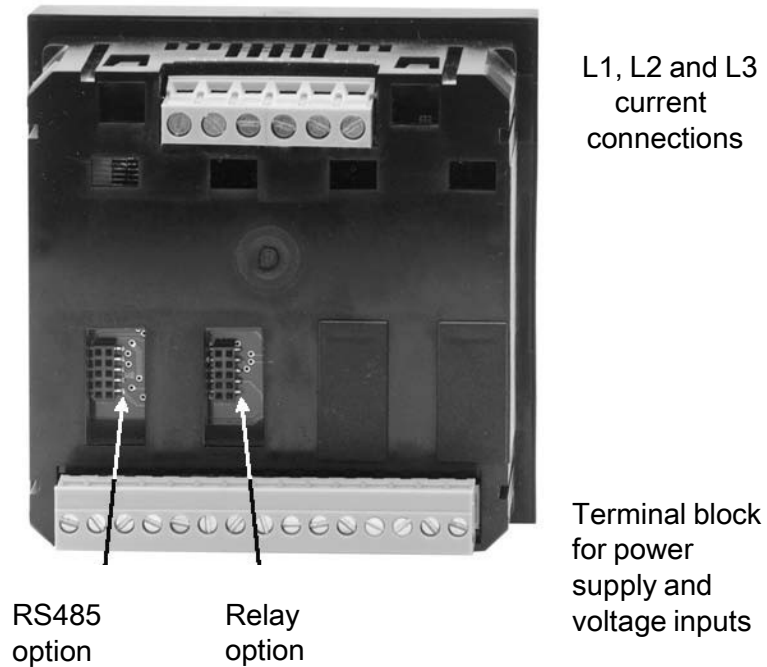
Chapter   3: Electrical   Installation

3.1
Considerations   When   Installing   Meters

It is recommended that wherever possible any/all equipment be installed, serviced, repaired or replaced in de-energized conditions. If this is not possible, then installation of the M850-MP1 must be performed by qualified personnel who follow all required safety precautions and procedures. They must have appropriate training, experience and/or professional certifications (where required) with high voltage devices. Appropriate personal protective safety equipment to meet all relevant standards is required by OSHA.

- During normal operation, dangerous voltages are present on parts of the M850 including: terminals and any connected current transformers (CTs) and potential transformers (PTs), all input and output modules and their circuits. All primary and secondary circuits should be regarded as capable of producing lethal voltages and currents. Avoid contact with any energized parts.

- DO NOT use the M850-MP1 for primary protection or in an energy-limiting capacity. The M850-MP1 is a power meter. DO NOT use the meter for applications where failure of the meter may cause harm or death. DO NOT use the M850-MP1 for any application where there may be a risk of fire.

- All meter terminals must be inaccessible to personnel in normal operation.

- DO NOT apply more than the maximum voltage the meter or any attached device can withstand. Refer to the M850-MP1 meter and/or device labels or see section 1.2 for meter specifications.

- DO NOT Hipot/dielectric test any outputs, inputs or communication terminals.

NOTE:
IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.

- NOTE: THERE IS NO REQUIRED PREVENTATIVE MAINTENANCE OR INSPECTION NECESSARY FOR HOWEVER, ANY REPAIR OR MAINTENANCE SHOULD BE PERFORMED BY THE FACTORY.

3.2
Voltage Current and Power Supply Connections

All inputs are connected to the back of the unit via high contact pressure terminal blocks. The connectors accommodate up to AWG#12 / 2.5mm wire.

L1, L2 and L3 current connections

Inserting the optional plug-in module:

Terminal block for power supply and voltage inputs

RS485 (optional)

Pulsed Output (optional)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
L(+)	Aux	N(-)	N L3	L2	L1									

APPLICABLE ELECTRIAL SYSTEMS

The M850-MP1 can be used on the following measured systems without any changes apart from wiring and programming configurations:

- Single Phase
- Single Phase, 3 Wire

- 3 Phase, 3 Wire balanced
- 3 Phase, 3 Wire unbalanced

- 3 Phase, 4 Wire balanced
- 3 Phase, 4 Wire unbalanced

Auxiliary Supply Note:

On models powered with AC auxiliary supply, the auxiliary supply can be connected in parallel with the measuring AC input voltage, but this restricts the measuring range of the input voltage to ± 15% of nominal. If your application has a very wide range of AC measurement, the auxiliary supply should be from a different source.

Available auxiliary voltages on the M850-MP1 are:
- 100 to 440V,AC / 100 to 420V,DC
- 19 to 69V,DC (optional)

Auxiliary voltage is rated from 45 to 65Hz (AC), with a burden of <10VA (AC or DC).

3.3
Terminations   to Meter

CURRENT   TRANSFORMER   CONNECTIONS:

Internally the M850-MP1s either a 5 Amp or 1 Amp rated. Current transformers must be attached externally. The current circuit is designed for connection to the secondary of external current transformers. These transformers should conform to at least Class 1 accuracy, or preferably ANSI C57.13 or equal.

Warning: The secondary   of a current   transformer   must   never   be allowed   to be in an circuit   condition   when   the primary   is energized.   In the open circuit   condition   high v be present.   Each current   transformer   secondary   must be short -circuited   when   not c the meter.

VOLTAGE   CONNECTIONS:

The secondary of these transformers must have the same nominal voltage as that specified on the data label on the side of the M850-MP1. Only standard voltage inputs of 5A,AC; 1A,AC or 330mV are supplied.

The M850-MP1 standard input is 28-330V,AC (L-N) and 48-570V,AC (L

All connections must be made as shown ensuring all starts and finishes of current and voltage transformers are connected as shown.

3.4
Electrical   Connection   Diagram

Current   Transformer   and Wiring   Connections
Of the   M850 -MP1

I = X2 (black) = Grounded
k = X1 (white)
L = H2
K = H1= faces Source

	Voltage				Current		
	L1	L2	L3	N	L1	L2	L3
1ph	✓	✗	✗	✓	✓	✗	✗
1ph 3W	✓	✓	✗	✓	✓	✓	✗
3ph 3W	✓	✓	✓	✗	✓	✗	✓
3ph 4W	✓	✓	✓	✓	✓	✓	✓
3ph 3W BAL	✓	✓	✓	✗	✓	✗	✗
3ph 4W BAL	✓	✗	✗	✓	✓	✗	✗

Unused voltage terminals are internally connected.
Secondary of CTs must be connected to earth.
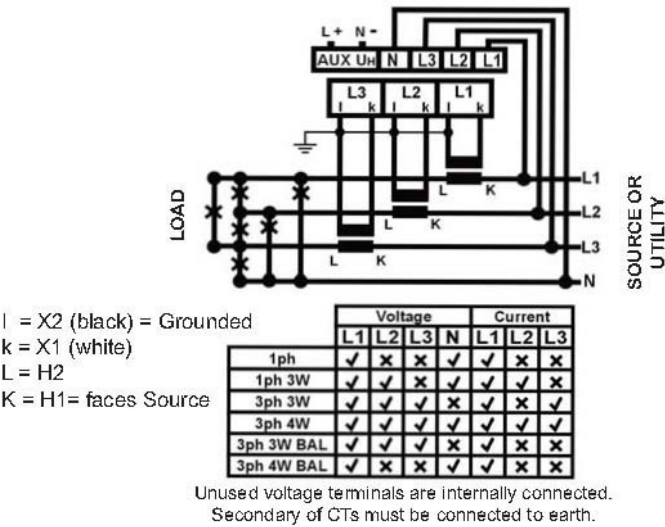
Chapter 4: Optional Plug-In Cards

- RS485 Communication
- Pulsed Output

4.1
Plug-In Card Overview

The M850-MP1 can provide both RS485 (Modus) communications as well as a pulsed output signal as an option. The plug-in units can be purchased with the MultiPower M850-MP1 or they can be retrofitted, when required.

The RS485 plug-in enables remote reading of up to 31 M850 units on a single 2-wire bus using the Modbus protocol. The RS485 Modbus protocol allows the M850-MP1 to be used with PC, PLC, RTU, Data loggers and SCADA program. The plug-in module can be retrofitted to the M850 if RS485 communications are required at a later date.

An M850-BAC unit is available for use on building automation systems running with BACnet MS/TP protocol, as well. The M850-BAC unit requires an RS485 plug-in module for communications.

4.1.1
RS485 Installation:

1. Locate the RS485 port on the back of the M850, shown in figure 1.

2. Remove the temporary cover, shown in figure 2.

3. Install the RS458 card, shown in figure 3.

Note: Install the RS485 card by holding the card square to the opening and only applying downward pressure. The card will snap down into place. Do not insert the card at an angle, it may seem easier, but there is a greater chance of bending the internal pins.
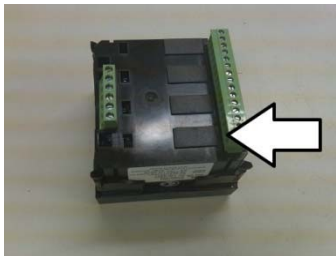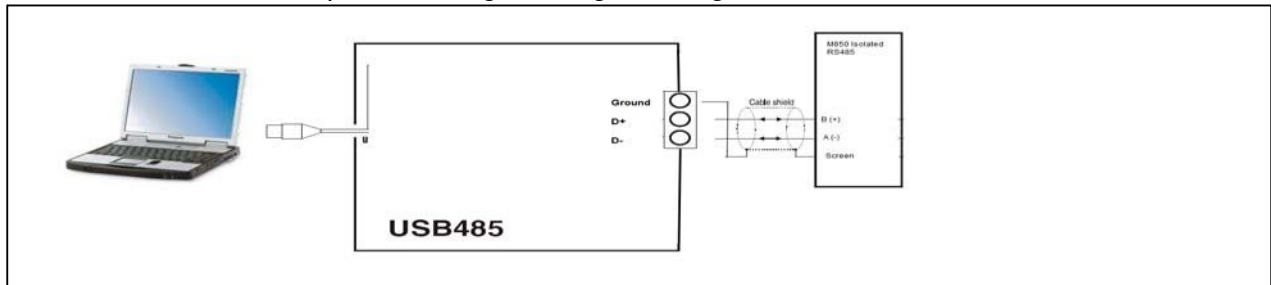

| Figure 1 | Figure 2 | Figure 3 |

4.1.2
Optional USB to RS485 Adapter

Wire in the RS458 to USB adapter following the diagram in figure 4.

4.1.3
Pulsed Output Card

A pulsed output plug-in module is also available. Pulses are supplied via a N/O Form A relay. The pulsed output can be assigned to W.h. or VAr.h. The plug-in module can be retrofitted to the M850 if pulsed output features are required at a later date.

The relay can be set up via a sub-menu. If two relays are installed, the secondary relay is automatically set as the alternative type.

The pulse length of the relay can be set from a list provided in the menu (from 0 to 200 milliseconds). Pulses per hour (PPH) are modified using the decimal point positioning from the main screen.

4.2
Using the Communications Software

Software is available for use with the optional RS485 module In addition, the plug-in module enables the M850 to communicate with other devices using popular Modbus protocol.

4.2.1
Software Installation:

USB -485 Drivers:

1. Insert the M850 Software CD into your computer

2. Connect the USB-485 adaptor to a USB port on your computer

3. When the new hardware wizard starts, point it to search the CD drive, the drivers should install automatically.

Multiview and Multilog software:

1. Browse the CD drive to install the files MultilogV02 and MultiView.

2. When starting the software, set the COM port and communications settings to the virtual COM port that was installed with the USB485 drivers.

3. The MultiView software should start communications with the M850 automatically when connected to the internet. The standard set-up screen for MultiView is shown below:

MultiView software will assist you in logging and downloading the electrical parameters captured with the M850-MP1.

MultiLog software gives you the ability to view your voltage, current and power calculations with graphs and charts.

To access the MultiLog software, double-click the MultiLog icon that appears on your computer's desktop (or select it from your computer's hard drive.) Double clicking with the left mouse button on a graph will enlarge it or, if it's already full screen, will tile it. The right mouse button will enable a short-cut menu (below).
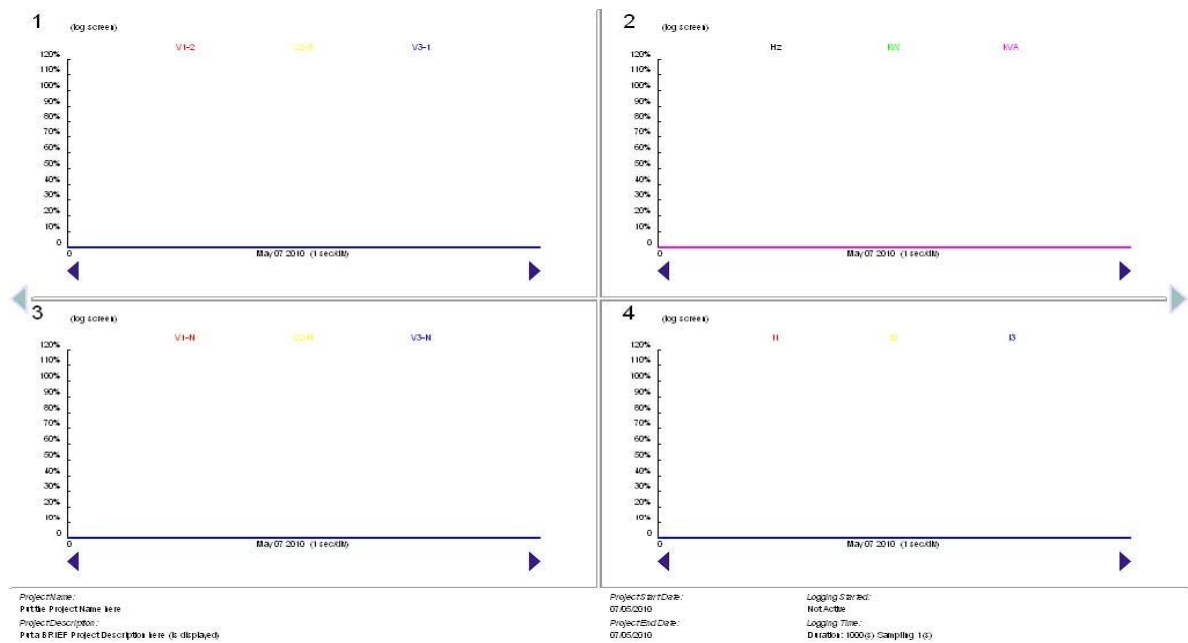
The first tab on the Project set up screen allows all the details of a project to be entered. Some of this can be displayed beneath the graphs.

The second tab is used to enter the logging parameters of a project to be entered.

The Graph Setup screen enables the user to tailor the graph screens. Logging screens can be mixed with Real Time screens provide you with up to 12 graphs, each having 3 traces.

The time base ranges from 5 to 600 seconds in real-time mode or 5 to 600 samples (minimum 1 second) in logging mode. Up to 7200 samples can be stored.

The Y axis can be relative 0-120% to enable displaying mixed signals, for example, 5A and 2000V on the same graph or absolute.

The Port Settings screen sets up the connection to the meter. NOTE: Ensure that the network settings are the same as those of the meter. If the meter's Comms Lock is disabled, successive tries to connect will result in the meter's network settings being changed.

The logged data can be exported as a comma separated variable file (.csv) for Excel to load. Emailing the saved file also possible but the recipient must have a copy of MultiLog to view it.

4.3
Measurement   Logging   with   MultiView

The measurements displayed in the Monitor/Log area of the MultiView program can be captured and saved to files. A choice of 1 to 6 channels can be selected from the drop-down menu 'Measurements'. The order of the registers can be altered to make this set up more effective. See Register Order Function if none of the Trigger Points are enabled, all of the selected measurements are logged at the user-defined time period.

Trigger points can be set up (Over, Under and Window) to provide further flexibility and can be enabled or disabled using the associated 'Enabled' check box. When triggering is enabled, a further choice of whether to save only the triggering measurements (the measurements that fall outside the trigger points) or to record all the measurements regardless of which point caused the triggering.

The files saved will be Tab Separated Variable types suitable for pasting directly into Excel or similar program. There is no limit on the number of the files saved except for available disc space. (NOTE: this is not checked).

A file will have a base name, chosen by the user, and be limited in size to approximately 60,000 bytes. Subsequent files will also be limited to 60,000 and have a '-' and a consecutive number attached before its extension identifier. For example, if the file name selected for the log file is 'SystemVoltage.log', additional files will be System Voltage -2.log, System Voltage -3.log etc.

NOTE: The data will always be APPENDED to the last file of the specified name if the file or sequence of files already exists.

Logging Examples

All 6 values are logged at approx sec intervals.
No trigger points enabled.
Response Time = 300ms, Logging Period = 3, Measurements = 6

May 16 2003 13:23:39	V 1	230.0	V 2	230.0	V 3	230.0	I 1	500.0	I 2	500.0	I 3
		500.0									
May 16 2003 13:23:40	V 1	230.0	V 2	230.0	V 3	230.0	I 1	500.0	I 2	500.0	I 3
		500.0									
May 16 2003 13:23:41	V 1	230.0	V 2	230.0	V 3	230.0	I 1	500.0	I 2	500.0	I 3
		500.0									

The first 4 values are logged at approx. 1 sec intervals.
No trigger points enabled.
Response Time = 300ms, Logging Period = 3, Measurements = 4

May 16 2003 13:30:19	V 1	230.0	V 2	230.0	V 3	230.0	I 1	500.0
May 16 2003 13:30:20	V 1	230.0	V 2	230.0	V 3	230.0	I 1	500.0
May 16 2003 13:30:21	V 1	230.0	V 2	230.0	V 3	230.0	I 1	500.0

V1, V2 and I1 trigger points are enabled and sampled at approx. 1 sec intervals.

Response Time = 300ms, Logging Period = 3, Measurements = 4, No triggering occurred.

V1, V2 and I1 trigger points are enabled and sampled at approx. 1 sec intervals.
Response Time = 300ms, Logging Period = 3, Measurements = 4
Triggering occurred on V1 (over) and all measurements logged.

May 16 2003 13:53:41	V 1	242.0	V 2	242.0	V 3	242.0	I 1	500.0
May 16 2003 13:53:42	V 1	242.0	V 2	242.0	V 3	242.0	I 1	500.0
May 16 2003 13:53:43	V 1	242.0	V 2	242.0	V 3	242.0	I 1	500.0

Triggering occurred on V2 (under) and all measurements logged.

May 16 2003 13:54:13	V 1	210.0	V 2	210.0	V 3	210.0	I 1	500.0
May 16 2003 13:54:14	V 1	210.0	V 2	210.0	V 3	210.0	I 1	500.0
May 16 2003 13:54:15	V 1	210.0	V 2	210.0	V 3	210.0	I 1	500.0

Triggering occurred on I1 (window-over) and all measurements logged.

May 16 2003 13:59:40	V 1	230.0	V 2	230.0	V 3	230.0	I 1	610.0
May 16 2003 13:59:41	V 1	230.0	V 2	230.0	V 3	230.0	I 1	610.0
May 16 2003 13:59:42	V 1	230.0	V 2	230.0	V 3	230.0	I 1	610.0

Triggering occurred on I1 (window-under) and all measurements logged.

May 16 2003 13:59:57	V 1	230.0	V 2	230.0	V 3	230.0	I 1	100.0
May 16 2003 13:59:58	V 1	230.0	V 2	230.0	V 3	230.0	I 1	100.0
May 16 2003 13:59:59	V 1	230.0	V 2	230.0	V 3	230.0	I 1	100.0

V1, V2 and I1 trigger points are enabled and sampled at approx. 1 sec intervals.
Response Time = 300ms, Logging Period = 3, Measurements = 4

Triggering occurred on V1 (over) and only error measurements logged.

May 16 2003 14:03:55	V 1	242.0
May 16 2003 14:03:56	V 1	242.0
May 16 2003 14:03:57	V 1	242.0

Triggering occurred on V2 (under) and only error measurements logged.

May 16 2003 14:04:11	V 2	210.0
May 16 2003 14:04:12	V 2	210.0
May 16 2003 14:04:13	V 2	210.0

Triggering occurred on I1 (window-over) and only error measurements logged.

May 16 2003 14:04:30	I 1	610.0
May 16 2003 14:04:31	I 1	610.0
May 16 2003 14:04:32	I 1	610.0

Triggering occurred on I1 (window-under) and only error measurements logged.

May 16 2003 14:04:41	I 1	100.0
May 16 2003 14:04:42	I 1	100.0
May 16 2003 14:04:43	I 1	100.0

4.4
Network Description

NODE: a network device, typically a PLC, PC, instrument or transducer.
MASTER: a NODE which controls the protocol of a MASTER-SLAVE network.
SLAVE: a node which responds to specific requests from a MASTER node.
ADDRESS: a node's unique network identifier in the range of 1-247.
PACKET: a string of bytes transmitted sequentially across a network.
FIELD: a byte or sequence of bytes within a packet of data.
CYCLIC REDUNDANCY CHECK (CRC): a packet's error check value.
PROTOCOL: a set of rules or a procedure.

A node's unique address allows the master to selectively request data from a specific node. The master node, under the control of a program, requests measurements from one of its slave nodes using an established protocol.

For more information on the Modbus protocol and to download relevant literature, go to http://www.modbus.org and click on "Modbus Standard Library".

Format

- Up to five baud rates are supported (not all units) 76800, 57600, 38400, 19200, 9600, and 4800.
- Bit transfer rates for 1 bit of data are 26us, 52us, 104us, 208us and 417us respectively.
- The format, as specified by Modbus, is a constant 11 bits per byte transmitted and received, consisting of 1 start bit, 8 data bits, 1 parity bit and 1 stop bit.
- If NO parity bit is used there should be an extra stop bit inserted in its place (i.e. 1 start bit, 8 data bits and 2 stop bits).

Note: In more recent units a format of 10 bits is supported, i.e. 1 start bit, 8 data bits, NO parity stop bit.

4.5
Measurement Registers (3X and duplicated 3X)

Sample Coding
Slave Address = 1
Reading 6, 3X Registers - code 4
V1 = 239.9V , V2 = 239.7V, V3 = 239.7V
I1 = 499.8A, I2 = 499.3A , I3 = 499.3A
Start Address = 6, number of WORD registers required = 12 (0C) hex
Number of values returned = 6, 32 bit floating point (24 bytes)

Message Packet To SLAVE
01 04 00 06 00 0C 10 0E

Response Packet From SLAVE
01 04 18 43 6F E2 28 43 6F A9 C8 43 6F A9 C8 43 F9 E0 A6 93 43 F9 43 F9 A6 31 EC 6D

See Appendix A.1 for 3X Registers. Appendix A.2 shows the 4X Registers. These list the parameters with the Modbus equivalent address and its address within the M850-MP1. Any data requested that isn't applicable to the Type & System column, will return the value -ve infinity (FFFFFFFFh). The order can be altered using the MultiView Program supplied or by a suitable SCADA program.

Retrieving Measurements

The measurement registers in Multitek's instruments are stored as 32 bit (4 byte) IEEE754 floating point numbers. Each is arranged as 2, 16 bit words; hence the evenly numbered real Start Addresses in the tables in this document.

The Modbus protocol dictates the retrieval of data as 2 bytes (one word) at a time. To accommodate Modbus register addressing when the registers are 4 bytes wide, the data has to be retrieved in double words. Modbus registers in this case are merely pointers to real addresses within an instrument whether the data at that address is 2, 4 or 8 bytes wide. This makes programming a controller simpler in so far that a pointer can be a word, double or float type and essentially the code to retrieve data from a node remains the same.

The SLAVES require data start ADDRESSES on even numbered register locations and will reject odd numbers and return an exception code.

The SLAVES require the number of DATA words requested in multiples of 2 and will reject odd numbers and return an exception code.

Example 1

Volts L2 -L1 - Modbus Address 30001 (Reg. Start Address 0000h)
The implied address of this measurement is 30001. The actual register addresses in the SLAVE *0000h*, containing the most significant bits of the floating point measurement and *0001h*, containing the least significant bits of the floating point measurement. Both of these registers are 16 bits wide.

Example 2

Volts L3 -L2 - Modbus Address 30002 (Reg. Start Address 0002h)
The implied address of this measurement is 30002. The actual register addresses in the SLAVE are *0002h*, containing the most significant bits of the floating point measurement and *0003h*, containing the least significant bits of the floating point measurement. Both of these registers are 16 bits wide.

To calculate the correct register offset within the SLAVE and the correct number of registers to retrieve, use the following formula:

((Modbus implied 3x start address - 30001)*2) for the register start address.
(Number of measurements required x 2) for registers required.

Packet Structure

A packet of data transmitted by a MASTER node will look something like the following example:
[Address (1 byte)][Function Code (1 byte)][Register Start Address (2 bytes)][Number of Registers Required (2 bytes)][CRC error check (2 bytes)]

Request the measured voltages of a meter (Modbus addresses 30004 to 30006) from SLAVE 2.
Modbus address 30004 = Meter address (30004 - 30001) * 2 = 6 = 06h

The packet to send will be,
[02][04][0006][0006][CRC][CRC]
The packet returned will be,
[02][04][0C][12 bytes of data (three ~~floating point~~ measurements)] [CRC][CRC]

Sample Coding:

READ
Slave Address = 1
Reading 6, 3X Registers - code 4
V1 = 239.9V, V2 = 239.7V, V3 = 239.7V
I1 = 499.8A, I2 = 499.3A, I3 = 499.3A
Start Address = 6, number of WORD registers required = 12 (0C hex)
Number of values returned = 6, 32 bit floating point (24 bytes)
Message Packet To SLAVE
01 04 00 06 00 0C 10 0E

Response Packet From SLAVE
01 04 18 43 6F E2 28 43 6F A9 C8 43 6F A9 C8 43 F9 E0 E9 43 F9 A6 31 43 F9 A6 31

WRITE
Slave Address = 1
Writing To 4X Registers - code 16 (10 hex)
Changing system Voltage to 220V

Message   Packet   To SLAVE
01 10 00 00 00 02 04 43 5C 00 00 26 39
NOTE: 43 5C 00 00 = 220

Response   Packet   From SLAVE
01 10 00 0000 02 41 C8

4.5.1
3X Registers

Internally,   the M850 3X Registers   are duplicated   in the 4X Register   area from address   41001, (internal
offset   2001 (07D1h)).   This allows   PLCs that can't read floating   point data in the 3X area to retrieve
measurements   from   the 4X area. See Appendix for a list of the 3X Registers.

- The registers are listed with their Modbus addresses
- The data held at these addresses are Read-Only
- 3X registers are read using function 04h
- 4X registers are read using function 03h

A sample   read packet   using code 4 to access   the 3X registers   will look like this:
[Node][04][start address][No. of Double Registers Requested][CRC(2 bytes)]

e.g. To read line to neutral voltages on node 23h:
[23h][04h][0006h][0006h(3, 4 byte regs)] [CRC(2 bytes)]

The node's   return   packet   will look like:
[23h][04h][0Ch][12 bytes of data = 3 floating point numbers][CRC(2 bytes)]

A sample   read packet   using code 3 to access   the 4X registers   will look like this:
[Node][03][start address][No. of Double Registers Requested][CRC(2 bytes)]

e.g. To read line to line voltages on node 23h using the duplicated measurements in the 4X area:
[23h][03h][07D0h][0006h(3, 4 byte regs)] [CRC(2 bytes)]

Thenode's return packet will look like:
[23h][03h][0Ch][12 bytes of data = 3 floating point numbers] [CRC(2 bytes)]

See Appendix A for a default order of the 3X registers in the M850. The order can be altered using the System
Monitor program, supplied on request, or by using a suitable SCADA program.

3X Register Re-Ordering

The M850 has the facility to re-order its ~~Modbus 3X~~ registers to suit an existing Modbus network.
The integrated register re-ordering function ('Registers' button) in ~~the System Monitor~~ program provides an easy method of achieving this.

If System Monitor isn't going to be used, Modbus function code 42h (66) can be used to request this data and Modbus function code 41h (65) can be used to send a string of data to set the order of the registers. The order will automatically be saved in FLASH.

UNLIKE THE 3X AND 4X REGISTERS, THESE DATA ARE WORD WIDE INTEGER.

It is important to remember that each register in the packet's data field contains two references to the registers to be re-ordered.

A sample read packet will look like this:
[Node][42][start address(**always 0000h**)][No. of Double Registers Required][CRC(2 bytes)]

e.g. To read the 41 Modbus registers in node 23h a request to send 21 (15h) registers is made :
[23h][42h][0000h][0015h][CRC(2 bytes)]

A sample write packet will look like this:
[Node][41][start address(**always 0000h**)][No. of Double Registers][Data length in bytes] [REGISTERS][CR bytes)]

e.g. To set the 41 Modbus registers to their default order in node 23h:
[23h][41h][0000h][0015h][29h][0102h][0304h][0506h][0708h][090Ah][0B0Ch][0D0Eh]
[0F10h][1112h][1314h][1516h][1718h][191Ah][1B1Ch][1D1Eh][1F20h][2122h]
[2324h][2526h][2728h][29xx][CRC(2 bytes)]

Note: xx = don't care

Sample Coding:

WRITE
1) Set the default order

Slave Address = 1
Writing - code 65 (41 hex)

Message Packet To SLAVE
01 41 00 0000 15 29 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C
1D 1E 1F 20 21 22 23 24 25 26 27 28 29 6E 58

Response Packet From SLAVE
01 41 00 00 00 15 FC 0A

2) Move registers W Sum (position 10), VAr Sum (position 12) and VA Sum (position 11) into the first three positions in the table so that the measurements can be retrieved from the slave by reading just the first three registers (30001-30003 or 42001-42003).

Slave Address = 1
Writing - code 65 (41 hex)

Message   Packet   To SLAVE
01 41 00 00 00 15 29 0A 0C 0B 01 02 03 04 05 06 07 08 09 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C
1D 1E 1F 20 21 22 23 24 25 26 27 28 29 74 1E

Response   Packet   From   SLAVE
01 41 00 00 00 15 FC OA

READ
Note: Asking for more registers than the M850 supports will not result in an error. A read command will always return the maximum number of registers.

M850 Energy Relays   - Modbus   Function   103/104

Send relay channel's parameters   (function   103)
Send 8, 16 byte structures.

Note: Only the first two structures are used by the M850

Format:
[node number][67h][register start(2 bytes)][number of registers(2 bytes)][number of bytes]
[<-8, 16 byte structures + 1 relay actions + 1 padding byte ((82h) bytes of data)->][crc(2 bytes)]

One of the 8, 16 byte structures to send to the M850 is defined below.

Byte #	Name	Usage Type
0	N/A (send NULL)	unsigned char
1	N/A (send NULL)	unsigned char
2	Energy Relay (send 254)	char
3	N/A (send NULL)	char
4	N/A (send NULL)	char
5	N/A (send NULL)	char
6	N/A (send NULL)	unsigned int
8	N/A (send NULL)	unsigned int
10	N/A (send NULL)	char
11	ID value (15 = W.h, 16 = VAr.h)	char
12	N/A (send NULL)	char
13	Relay Number (1 or 2)	char
14	Relay Divisor (0 = /1, 1 = /10, 2 = /100, 3 = /1000)	char
15	Relay Pulse Width (0 = OFF, 2 to 10 = 20ms to 200ms)	char

In addition to sending the 8 structures, two bytes must be appended to the packet.

A one-byte bit pattern, where each bit is mapped to one physical relay,
(bit 0 = Relay 1, bit 1 = Relay 2 etc.)
If a bit is reset (0), the corresponding relay's function is to operate at pulse time.
If set (1) it will release.

2nd Byte:

This is a NULL byte for padding and is ignored.

Retrieve relay channel's parameters (code 104)

Requests 8, 16 byte structures representing the parameters for the energy relay(s).
Only the first two structures are valid.

Format:

[node address][68h][register start(2 bytes)][number of registers(2 bytes)][crc(2 bytes)]

One of the 8, 16 byte structures read from the M850 is defined below.

Byte #	Name	Usage Type
0	N/A	unsigned char
1	N/A	unsigned char
2	Energy Relay (254)	char
3	N/A	char
4	N/A	char
5	N/A	char
6	N/A	unsigned int
8	N/A	unsigned int
10	N/A	char
11	ID value(15 = W.h, 16 = VAr.h)	char
12	N/A	char
13	Physical Relay Number of attached relay	char
14	Relay Divisor (0 = /1, 1 = /10, 2 = /100, 3 = /1000)	char
15	Relay Pulse Width (0 = OFF, 2 to 10 = 20ms to 200ms)	char

In addition to receiving the 8 structures, two bytes will be appended to the packet.

1st Byte:

This is a one-byte bit pattern where each bit is mapped to one physical relay.
If a bit is reset (0), the corresponding relay's function is to operate on exceptions. If set (1) it will release.

READ/WRITE

The M850 relay's action (energize or de-energize) at pulse time can be written/read using the table below.

The format is a one-byte bit pattern, where each bit is mapped to one physical relay
(bit 0 = Relay 1, bit 1 = Relay 2)

At pulse time,if a bit is reset (0), the corresponding relay's function is to energize, if set (1) it will de-energize.

Example:

An M850 has two relays installed and these are numbered RLY1 and RLY2.
By default, they correspond to bit positions 0 and 1 respectively. The rest of the bits (2 - 7) in the actions byte are ignored.

Relays	2	1
Bit No.	1	0
Action Byte	0	1
Action at pulse time	De-energize	Energize

If a bit is reset (0), the corresponding relay's function is to operate on exceptions. If set (1) it will release.

2nd Byte:

A NULL byte for padding.

Function   104   Coding   Example

Request   relay(s)   channel's   parameters   from   node   1.

All eight structures are requested but only the first two are valid.

Format:

[node address][68h][register start(2 bytes)][number of registers(2 bytes)][crc(2 bytes)] [01][68][0000][0041][A033]

Returned   relay(s)   channel's   parameters

Format:

[node number][68h][register start(2 bytes)][number of registers(2 bytes)][number of bytes][<-8 structures + 1 relay actions + 1 padding byte (130 (82h) bytes of data)->][crc(2 bytes)]
[01][68][0000][0041][82]

[64 05 FE 00 01 01 00 00 00 00 01 0E FE 01 00 0A]
[64 05 FE 00 01 01 00 00 00 00 01 10 FE 02 00 0A]
[64 05 00 00 01 03 00 00 00 00 01 00 00 00 00 0A]
[64 05 00 00 01 03 00 00 00 00 01 00 00 00 00 0A]
[64 05 00 00 01 03 00 00 00 00 01 00 00 00 00 0A]
[64 05 00 00 01 03 00 00 00 00 01 00 00 00 00 0A]
[64 05 00 00 01 03 00 00 00 00 01 00 00 00 00 0A]
[64 05 00 00 01 03 00 00 00 00 01 00 00 00 00 0A]
[00][FF][5B62]

* In 3 wire mode system V1, V2, V3 will have the same value as volts L2-L1, L3-L2, L1-L3.
**M850-MP1 only measures import W.h and VAr.h

4.5.2
4X Registers

The registers are listed with their Modbus addresses. See Appendix A.2 for a complete list of 4X Registers. The data held at these addresses are Read-Only, Write-Only or Read+Write, as indicated below.

4X registers are read using function 03h and written using function 10h.
A sample write packet will look like this:
[Node][10][start address][No. of Double Registers][Data length in bytes][CRC(2 bytes)]

e.g. To set Node 23h Primary Voltage and Secondary Voltage together:
[23h][10h][001Ch][0004h(4, 2 byte regs)][08h(2, 4 byte regs)][CRC(2 bytes)]

READ
Packet from master format :
[Node addr][03][Register start addr.(2 bytes)][No of reg(2 bytes)][CRC(2 bytes)]
Response from Slave format :
[Node addr][03][Byte count][Data(byte count bytes)][CRC(2 bytes)]
Function 16 (10 hex) - Preset Multiple registers (4X)

These registers contain the system settings and controls. Register addresses in the M850-MP1 at 0, but in keeping with Modicon Modbus codes, are designated addresses starting 40001.

See Appendix A for a default order of the 4X Registers in the M850. The order can be altered using the System Monitor program, supplied on request, or by using a suitable SCADA program.

M850 Supported Modbus Codes

Read Holding (4X) Registers (code 3)
Returns a specified number of consecutive system registers.

Read Input (3X) Registers (code 4)
Returns a specified number of consecutive measurement registers.
NOTE: the measurement registers are duplicated (mapped) into the 4X area.

Pre -set Multiple Holding (4X) Registers (code 16)
Writes data to a specified number of consecutive system registers.

Report Slave ID (code 17)
This function returns the status of an instrument, the returned packet consists of 14, four byte floating point numbers. (IEEE754)

Register Order (codes 65 and 66)
The register order can be written or read using the above codes.

Send relay channel's parameters (code 103)
Send 8, 16 byte structures representing the parameters for the 8 conditions that can be attached to each relay installed. NOTE: only the first two channels are applicable but all 16 have to be sent.

Read relay channel's parameters (code 104)

Requests 8, 16 byte structures representing the parameters for the 8 conditions that can be attached to each relay installed. NOTE: only the first two channels are applicable but all 16 will be read.

Exception Codes

A normal response from a slave is the echoing of the function code and the supplying of the data that is requested.

Exceptions are reported in the response from a slave node by setting the msb of the function code and inserting the applicable error code in the data field. Only the last example below will result in an exception being reported to the master node.

- If the slave does not receive the query due to a communication error, no response is returned. The master node will eventually process a time-out condition for the query.
- If the slave receives the query, but detects a communication error (parity or CRC), no response is returned. The master program will eventually process a time-out condition for the query.
- If the slave receives the query without a communication error but cannot handle it (e.g. a request to read a non-existent register), the slave will return an exception response informing the master of the nature of the error.

The error codes that could be returned in the data field are:
    01 - Illegal or Unknown Function
    02 - Illegal Data Address
    03 - Illegal Data value

4.6
M850-MP1 Communication and Programming Overview

Communication Format

Baud rate: 4800, 9600, 19200, 38400, 57600 and 76800
Low level character format:
    With Odd or Even parity = 1 start bit, 8 data bits, 1 parity bit, 1 stop bit
    With NO parity = 1 start bit, 8 data bits, 2 stops bits.

Modbus Format

Data format: RTU
32 bit, floating point format to IEEE-754 standard, exponent bias 127, most significant byte transmitted first. There is no word reversal.
Address range: 1-247
Error Check:
Cyclic Redundancy Check (CRC), Polynomial exclusive OR value A001h Low byte sent first.

Modbus Protocol

Only the RTU (Remote Terminal Unit) form of the Modbus protocol will be supported and all references in this sheet refer to RTU format.

Typically, the master or controller requests data from its slaves by polling them one at a time and waiting for a pre-defined amount of time for a response. If a node doesn't respond within this time period the master will retry accessing it a further two times before indicating to the SCADA system that the node has gone off-line or there is a fault with it. If all is well the node will respond with the data requested.

A typical communication 'packet' will be in the form:
[Node Address] [Function] [Byte count, Data etc.] [Error check]

Because Modbus is a word (2 byte) orientated protocol, floating point (4 byte) register numbers are counted in multiples of two.

> viz register 1 = start address 0
> register 2 = start address 2
> register 3 = start address 4
> register 4 = start address 6
> Formula = (register required -1) x2

This also applies to the number of registers requested. If 2 registers are requested the number of WORDS in the packet's [Number of registers] slot should equal 4.

4.7
Factory Initial Default Settings

All units are fully programmed by the factory but there are many features that can be programmed by the User to suit individual applications and needs.

Programmed values and parameters are stored in non volatile memory and are therefore retained in power down situations.

To enterthe programming mode, simultaneously press the two front buttons "I" and "E". Keep them pressed and held for 5 seconds.

The M850-MP1 now enters the screen setup mode and the display shows SCREEN. This mode allows the User to customize the display to specific parameter requirements, rather than using the standard parameters. (If you do not wish to alter Screen page set up mode, then Press again and the M850-MP1 display moves to the next programming mode: SUPPLY set up).

For example

> Standard page   Line 1 = L1 N Volts
>   Line 2 = L2 N Volts
>   Line 3 = L3 N Volts
> Custom page   Line 1 = L1 Amps
>   Line 2 = Watts
>   Line 3 = Power Factor

NOTE
When in programming mode if the control buttons are not used for more than 6 minutes the M850 returns to the measuring mode and displays the first screen.

Chapter 5: Using the M850 -MP1 Meter

5.1
Introduction

All units are fully programmed by the factory but there are many features that can be programmed by the User to suit individual applications and needs. Programmed values and parameters are stored in non volatile memory and are therefore retained in power down situations.

To enter the programming mode, simultaneously press the two front buttons 'I' and 'E'. Keep them pressed and held for 5 seconds.

The M850-MP1 now enters the screen setup mode and the display shows SCREEN. This mode allows the User to customize the display to specific parameter requirements, rather than using the standard parameters as shown in section 3. (If you do not wish to alter Screen page set up mode, then press again and the M850-MP1 display moves to the next programming mode: SUPPLY set up).

For example:

Standard page	Line 1 = L1 N Volts
	Line 2 = L2 N Volts
	Line 3 = L3 N Volts
Custom page	Line 1 = L1 Amps
	Line 2 = Watts
	Line 3 = Power Factor

NOTE
When in programming mode, if the control buttons are not used for more than 6 minutes M850-MP1 returns to the measuring mode and displays the first screen.

5.1.1
Meter Face Elements

The face of the M850-MP1 contains a blue LED display designed to be read in a variety of conditions, including bright sunlight over a very wide viewing angle. An optional red LED display is also available. Four, easy-to-access, front control buttons are used for scrolling up and down through the parameters.

The user can measure a standard range of 16 different electrical parameters by scrolling through the buttons on the front of the panel. LED annunciators will provide indication of measured values.

Blue 4-digit LED display with a range 0000 to 9999. Each of the 4 LED numerals measures 0.56" and has an update time of 1 second. Decimal selection is defined by the user through the front panel as XXX. Polarity is always assumed positive on the display.
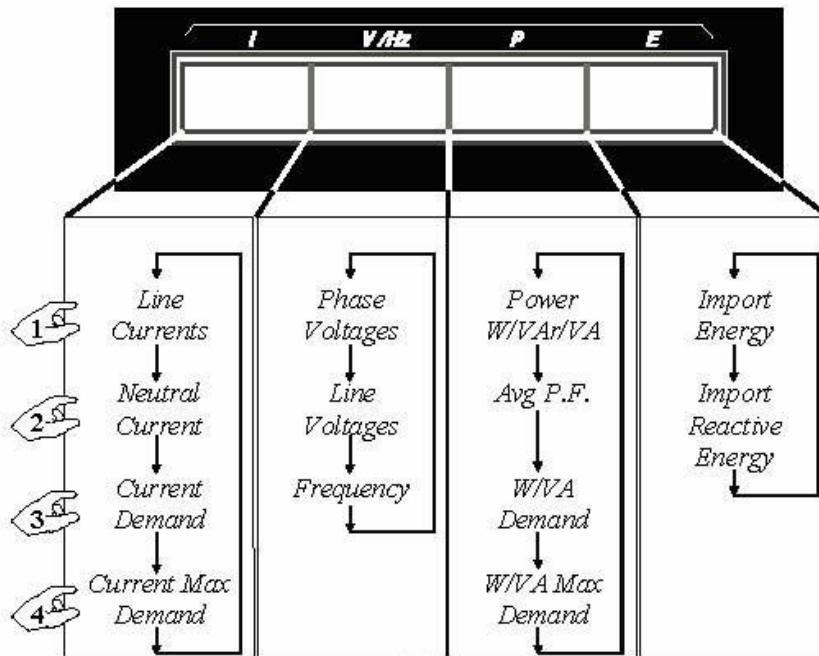
5.1.2
Display   Screens

Each screen is displayed by pressing one of the four front panel buttons:

'I' for Current
'V/Hz' for Voltage and Frequency
'P' for Power and
'E' for Energy

Display   Screens   of the M850 -MP1

Press the 'I' button to access measurements on Current. One press of the button displays line currents; two presses of the button displays neutral current; three presses displays current demand; four presses of the 'I' button displays current maximum demand; five presses of the button brings the user back to the top of the category listing (in this instance.)

Each press of the button steps the user to the next measurement.

LED Brightness adjustment:

It is possible to adjust the M850-MP1 display to 8 levels of brightness to be read even in direct sunlight.
To adjust the brightness of the LED:

1. Hold down the two center buttons ('V/Hz' and 'P') simultaneously on the front panel.
2. The brightness level will adjust as the buttons are held down.
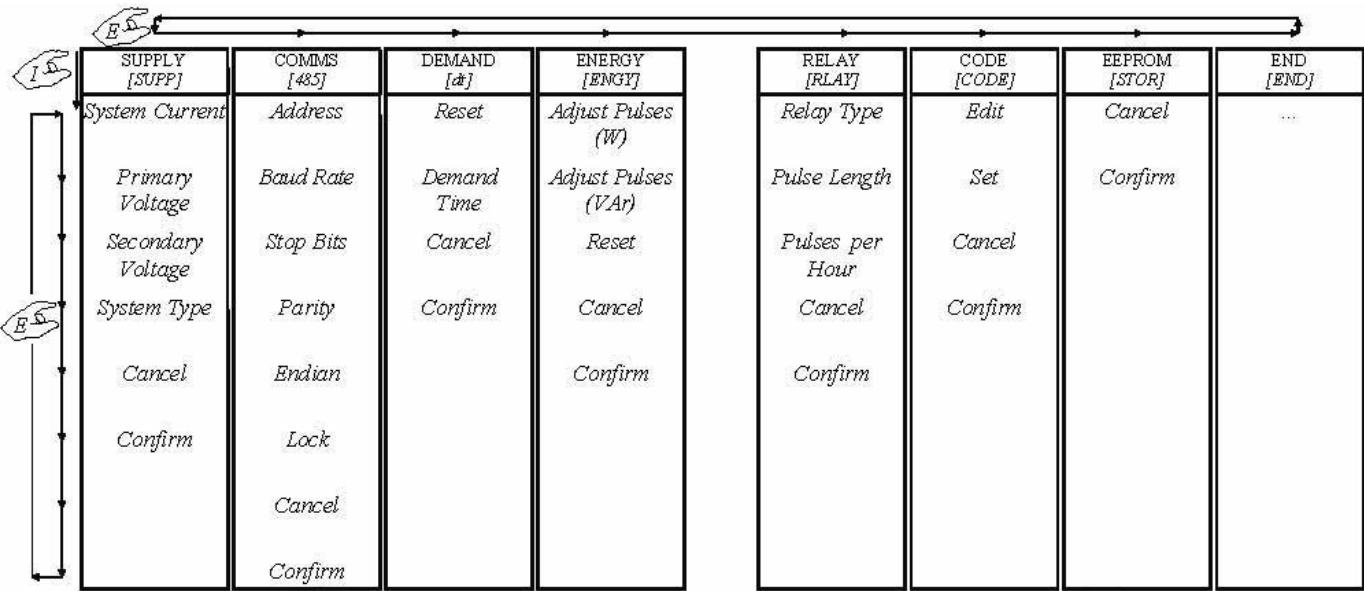3. Each individual press of the buttons steps to the next level of brightness.

5.2
Settings Menu

The main Settings menu is accessed on the M850-MP1 by holding down the 'I' and the 'E' buttons simultaneously.
The main menu, and all sub-menus, are scrolled through using the 'E' button. Any selection is made using the 'I'
button. If no buttons are pressed for 6 minutes, the M850-MP1 will exit the Settings menu.

There are 8 sub-menus: Supply; Communications (485); Demand; Energy; Relay; Code; EEPROM; and, End. The u
will cycle through each sub-menu screen as the User pushes the 'E' or 'I' button.

The Settings Menu structure is shown below:

SUPPLY [SUPP]	COMMS [485]	DEMAND [dt]	ENERGY [ENGY]		RELAY [RLAY]	CODE [CODE]	EEPROM [STOR]	END [END]
System Current	Address	Reset	Adjust Pulses (W)		Relay Type	Edit	Cancel	...
Primary Voltage	Baud Rate	Demand Time	Adjust Pulses (VAr)		Pulse Length	Set	Confirm	
Secondary Voltage	Stop Bits	Cancel	Reset		Pulses per Hour	Cancel		
System Type	Parity	Confirm	Cancel		Cancel	Confirm		
Cancel	Endian		Confirm		Confirm			
Confirm	Lock							
	Cancel							
	Confirm							

The following abbreviations are displayed on the sub-menu screens when the M850 is in Setting Menu mode:

Display	Indicates
ADDR	Address for communications
ADJ (VAr)	Adjust Pulses (VAr)
ADJ (W)	Adjust Pulses (Power)
BAUD	Baud Rate
CNCL	Cancel any changes
CODE	Password Code
COMMS	RS485 network setting
CONF	Confirm any changes
DT	Demand
DTST	Demand Time Set Value
EDIT	Edit Pass Code
END	End main menu
ENDI	Endian
ENGY	Energy
LOC	Lock
PAR	Parity
PPH	Pulses per Hour
PULS LNTH	Pulse Length
RLAY	Relay
RST	Reset
SET	Set Pass Code
STOP	Stop Bits
STOR	EEPROM sub -menu
STOR	Store to EEPROM
SUPP	Supply
SYSA	System Current
TYPE	System Type
UPRI	Primary Voltage
USEC	Secondary Voltage

At the end of most sub-menus is the option to CANCEL any changes made in that sub-menu. In addition, confirmation is required before any changes are implemented. The CONFIRM button within the sub-menu screens should be selected to confirm the changes. The changes are effective as soon as they are confirmed.

CANCEL or CONFIRM must be pressed to return to the sub-menu title (i.e. SUPP, 485, etc.)

5.2.1
Supply (SUPP) Sub -Menu
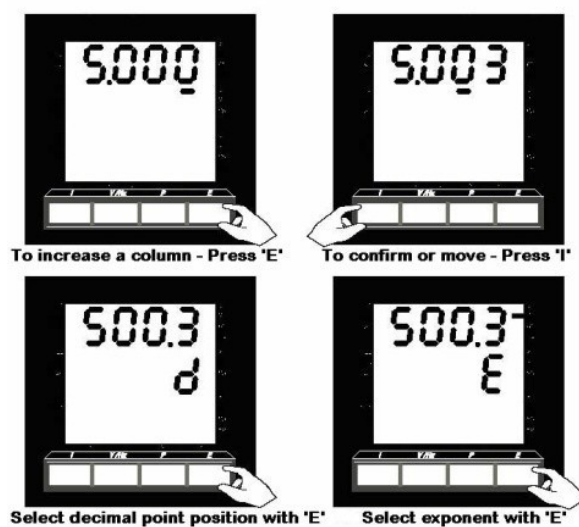
This sub-menu contains screens for monitoring: System Current; Primary Voltage; Secondary Voltage; System Type Canceling and Confirming actions made within this section.

The VT ratio and the system current are entered using this sub-menu. The secondary voltage (meter input) is optimized at 280V (L-N). Decimal point positioning and exponent selection are used in this section.

The system's type is selected from the following list:

Unbalanced	
1P2	1 phase 2 wire
3P3	3 phase 3 wire
3P4	3 phase 4 wire
1P3	1 phase 3 wire
Balanced	
3P3B	3 phase 3 wire
3P4B	3 phase 4 wire

When entering data, numbers can be entered into the unit in the following way:

To increase a column - Press 'E'   To confirm or move - Press 'I'

Select decimal point position with 'E'   Select exponent with 'E'

5.2.2
Communications   (485)   Sub -Menu

This sub-menu contains screens for monitoring: Communications Address; Baud Rate; Stop Bits; Parity; Endian; Lock; Canceling and Confirming actions within this section.
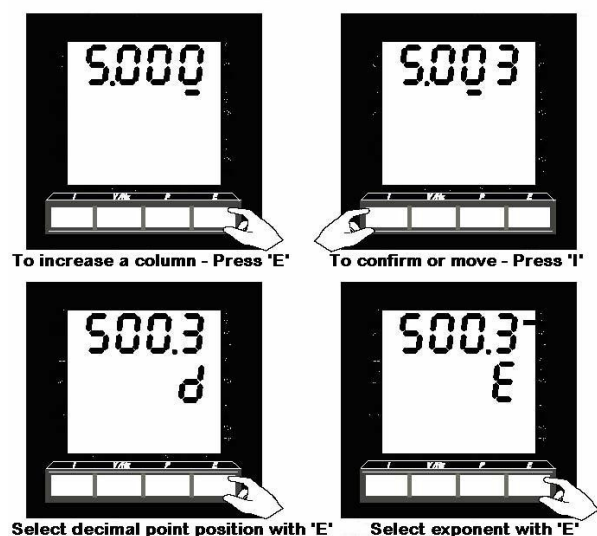
When using the plug-in RS485 (Modbus protocol) option, the network settings can be detected and the unit configured automatically. If manual configuration is preferred, the meter can be set up as follows:

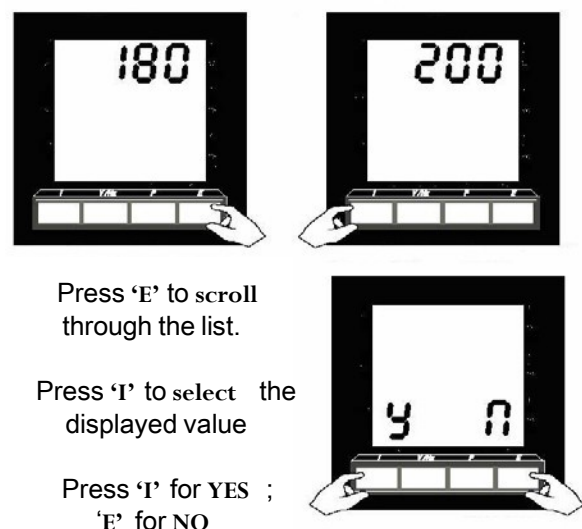| Baud rate	
4.8	4800 baud
9.6	9600 baud
19.2	19,200 baud
38.4	38,200 baud
57.6	57,600 baud
76.8	76,800 baud
Stop Bits	
0	No stop bits
1	1 stop bit
2	2 stop bits
Parity	
N	No parity bit
O	Odd parity bit
E	Even parity bit

The unit's baud rate, number of stop bits and parity can be selected from the list above. Floating point numbers can be transmitted in either Big Endian (default) or Little Endian BYTE order. They can be selected using the Endian item.

Locking prevents the unit hunting for a valid network if communication errors are occurring and can be set using the LOCK item.

When entering data, numbers can be entered into the unit in the following way:

When only fixed data can be entered, you can select the values from the list:

To increase a column – Press 'E'   To confirm or move – Press 'I'

Select decimal point position with 'E'   Select exponent with 'E'

Press 'E' to scroll through the list.

Press 'I' to select the displayed value

Press 'I' for YES ;
'E' for NO

5.2.3
### Demand (DT) Sub-Menu

This sub-menu contains screens for: Reset; Demand Time; Canceling and Confirming actions within this section.

The unit integrates all measurement of Amps, Power and VA within a variable time length sliding window. The Reset option will reset all demand and maximum demand measurements.

The Demand Time window can be set to a value of between 3 and 60 minutes (inclusive).

When entering data, numbers can be entered into the unit in the following way:
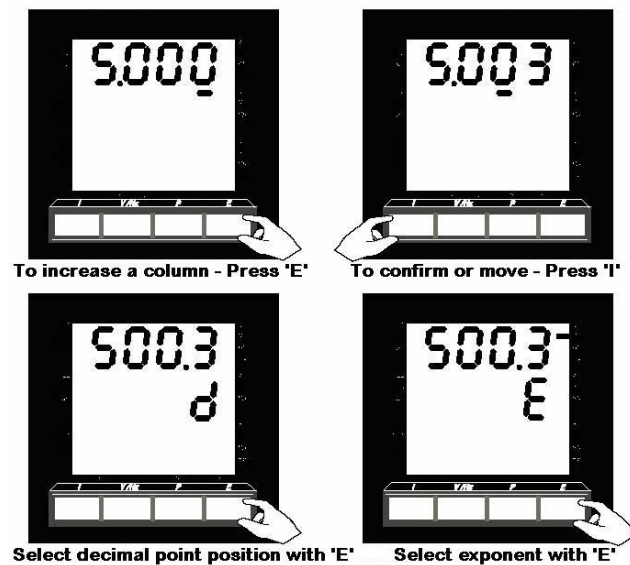
5.2.4
Energy (ENGY) Sub-Menu

This sub-menu contains screens for: Adjust Pulses (W); Adjust Pulses (VAr); Reset; Canceling and Confirming action within this section.
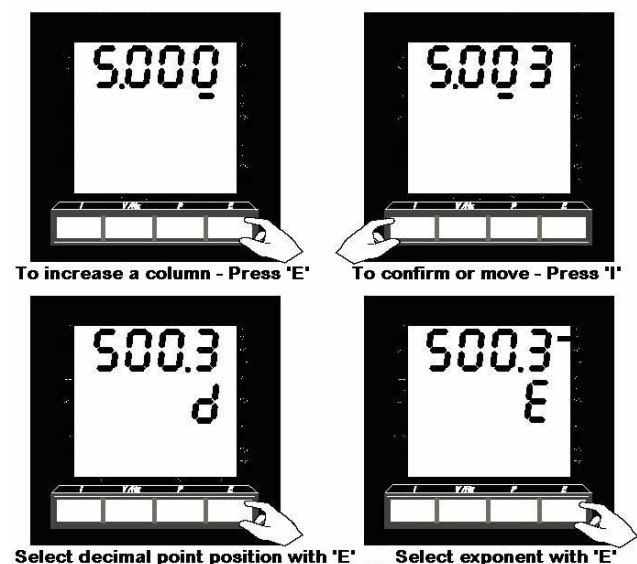
There are two energy accumulators in the unit: Import Power and Import VAr. Modifications to the pulses per hour rate can be done through this sub-menu.

Adjust pulses (W or VAr) allows the selection of a DIVISOR from the list below. *(CAUTION: Changing the divisor and confirming the selections will reset ALL energy readings.)*
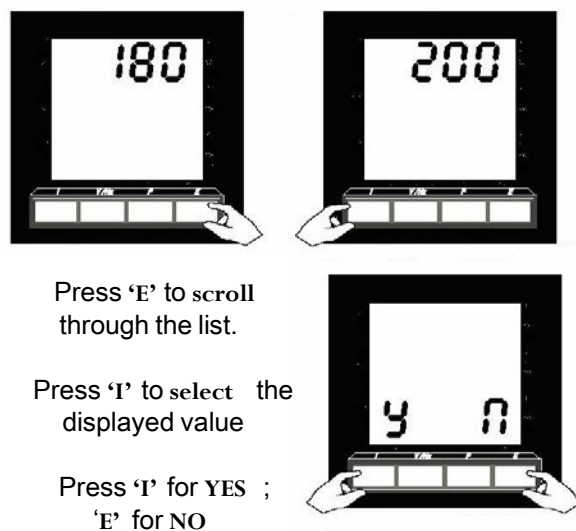
Divisor
1000
100
10
1
0.1
0.01
0.001

The reset option resets ALL energy readings.

When entering data, numbers can be entered into the unit in the following way:

To increase a column – Press 'E'

To confirm or move – Press 'I'

Select decimal point position with 'E'

Select exponent with 'E'

When only fixed data can be entered, you can select the values from the list:

Press 'E' to scroll through the list.

Press 'I' to select the displayed value

Press 'I' for YES ; 'E' for NO

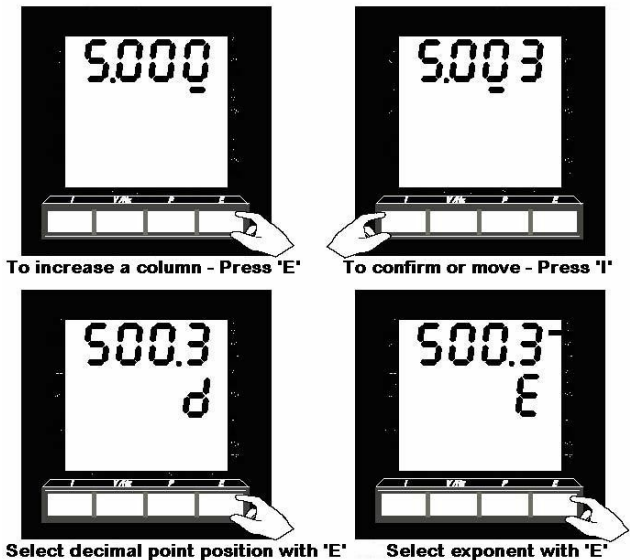## 5.2.5
Relay (RLAY) Sub -Menu

This sub-menu contains screens for: Relay Type; Pulse Length; Pulses per Hour; Canceling and Confirming actions within this section.

The Pulsed Output module option of the M850-MP1 can operate as W.h. or VAR.h. types. The principal relay can be set up in this sub-menu. If two relays are installed, the secondary relay is automatically set as the alternative type.
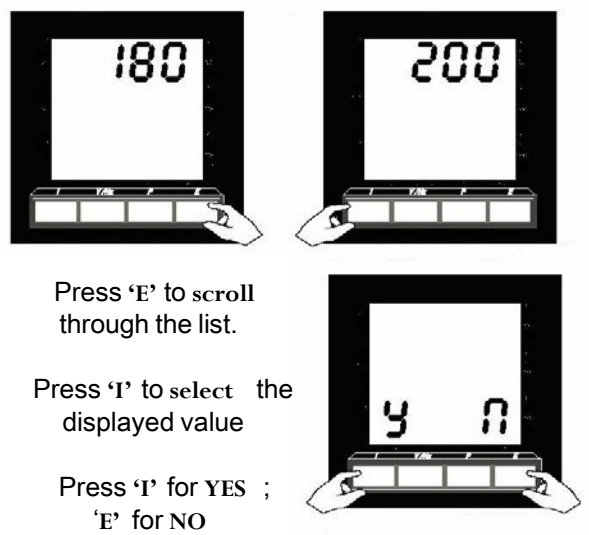
The pulse length of the relay(s) can be set from the list below (0-200 ms). Pulses per Hour (PPH) are modified using the decimal point positioning method.

Pulse Length
(in milliseconds)
OFF
40
60
80
100
120
140
160
180
200

When entering data, numbers can be entered into the unit in the following way:

To increase a column – Press 'E'

To confirm or move – Press 'I'

Select decimal point position with 'E'

Select exponent with 'E'

When only fixed data can be entered, you can select the values from the list:

Press 'E' to scroll through the list.

Press 'I' to select the displayed value

Press 'I' for YES ;
'E' for NO

5.2.6
Code (CODE) Sub -Menu

This sub-menu contains screens for: Edit; Set; Canceling and Confirming actions within this section.

Within this sub-menu, password protection can be set to prevent accidental and unauthorized tampering of the M850-MP1's settings. The Pass Code can be changed using the EDIT facility in the sub-menu. It is activated using the SET option.

5.2.7
EEPROM (STOR) Sub -Menu

This sub-menu contains screens for: Canceling and Confirming any actions to be saved to the unit's non-volatile memory.

It is recommended that whenever settings have been updated that this option be used. However, the unit will save all settings on a power down or brown-out condition.

5.2.8
END (END) Sub -Menu

This selection exits the main menu and resumes displaying measurements on the M850-MP1.

6.1
System   Type Programming

1. Press "I" & "E" simultaneously and hold for 5 seconds. The unit is now in setup mode. The screen will change to "SUPP".   (Most times, the display goes through "SUPP" directly to "SYSA". This is due to a timing problem with releasing the buttons.)

2. Press "I" button once. The screen displays "SYSA".

3. Press "E" button until "TYPE" is displayed.

4. Press "I" to select the desired phase/wire configuration.

5. Press "E" to change to the desired phase/wire configuration.

6. Press "E" to choose: 1P3, 1P2, 3P3, 3P4, 3P3b, or 3P4b. Press "I". The screen returns to "Type".

7. Press "E" until "CONF" is displayed. Then, press "I". Now the display shows "SUPP".

8. Press "E" until "END" is displayed. Then, press "I". Now you are out of programming mode.

9. Check the resulting display on the meter for voltage and current to see that the desired numeral is

   displayed and the decimal is in the proper location.

10. If not, repeat procedure starting with step 1 and check that the proper numbers are programmed into

   the meter.

Step 1	Step 2	Step 3	Step 6
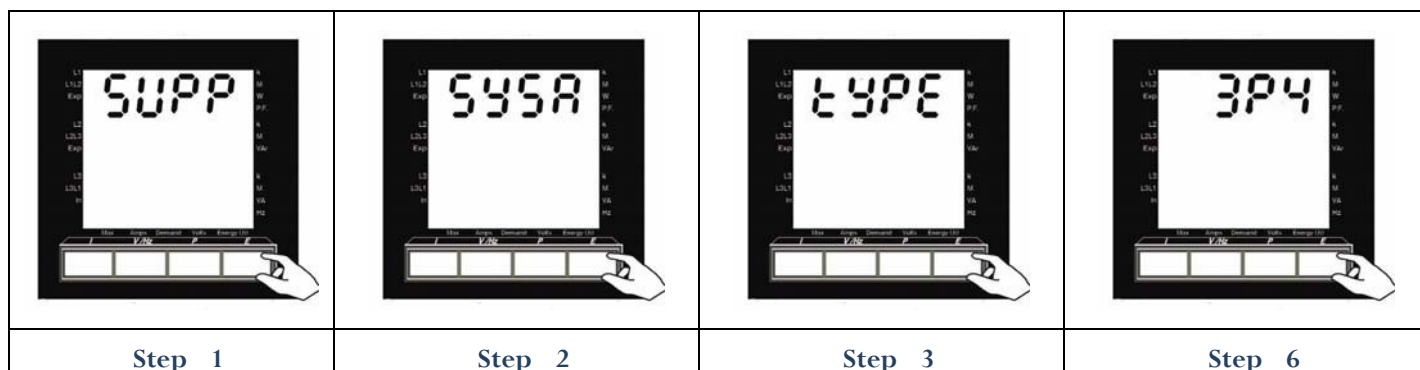
6.2
Configure   CT Setting

Internally the M850-MP1 MultiPower is fitted to either 5 Amp or 1 Amp. The current circuit is designed for connection to the secondary of external CT.   These transformers should conform to at least Class 1 as per BS7626 (IEC 185) or equivalent. The secondary of these external transformers must have the same nominal current input as that specified on the data label on the M850-MP1. For example, if the M850-MP1 has a current ratio specified as 500/5A, then the CT could be changed to 800/5A (or any ratio with secondary 5A) and used once the current ratio has been programmed into the M850-MP1.

But if the ratio change was 800/1A, the M850-MP1 would have to be returned to the factory to have the internal circuits changed to 1 Amp.


Warning: The secondary of a current   transformer   must never be allowed   to be in an open circuit   condition   when the primary   is energized.   In the open circuit   condition voltage   may be present. Each current   transformer   secondary   should be short -circuited when   not connected   to the meter.

6.2.1
CT Ratio Programming

1. Press "I" & "E" simultaneously and hold for 5 seconds. The unit is now in setup mode. The screen will change to "SUPP"

2. Press "I" button once. The screen displays "SYSA".

3. Press "I" button once. The screen displays the Primary Ampere setting.

4. Press "I" to select the desired numeral to be changed. i.e.: for a CT primary of 2000Amps, the display will show 2.000KA.

5. Press "E" to change to the desired digit. i.e.: for a CT primary of 2000Amps, the display will show 2.000KA. Press "I" to set.

6. When the screen displays "d" you can select a decimal location by pressing "E". Press "I" to set.

7. The screen then will display "E" for descriptor selection. Press button "E" to select K (kilo)/ M (mega) or no descriptor.

8. Press "I" once. The display will read "SYSA".

9. Press "E" until "CONF" is displayed. Then press "I". Now the display shows "SUPP".

10. Press "E" until "END" is displayed. Then press "I". Now you are out of programming mode.

11. Check the resulting display on the meter for voltage and current to see that the desired numeral is displayed and the decimal is in the proper location.

12. If not, repeat procedure starting with step 1 and check that the proper numbers are programmed into the meter.

Step 1	Step 2	Step 4	Step 10
SUPP	SYSA	1.500 E	End
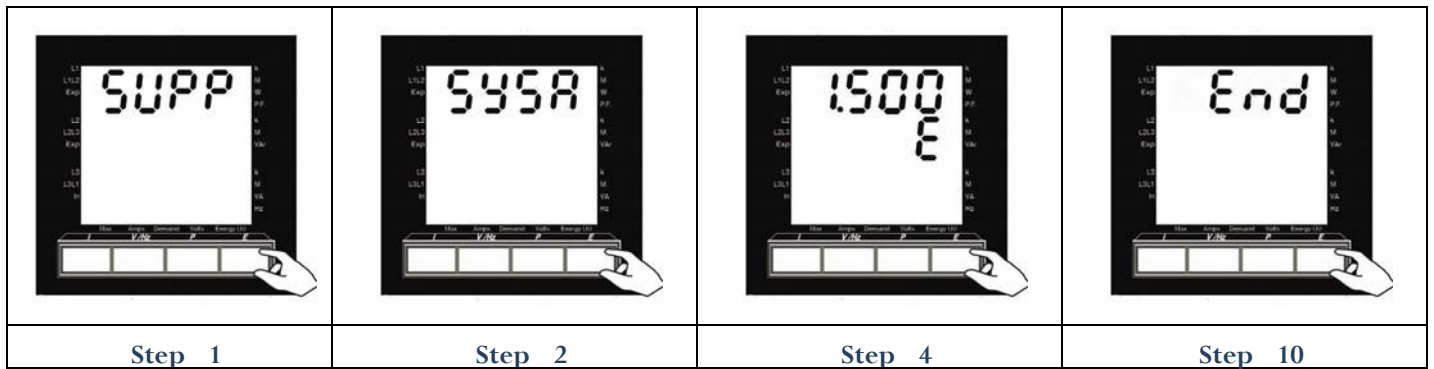
6.3
Configure   VT Ratio   Setting

Connection of voltages higher than the rated voltage that is specified on the M850-MP1 data label, is possible using external voltage transformers. These transformers must be at least Class 1 accuracy.

6.3.1
VT Ratio   Programming

1. Press "I" & "E" simultaneously and hold for 5 seconds. The unit is now in setup mode. The screen will change to "SUPP"

2. Press "I" button once. The screen displays "SYSA".

3. Press "E" button once. The screen displays "UPr1".

4. Press "I" once. The screen displays the VT Primary Voltage setting.

5. Press "I" to select the desired digit. i.e.: for a VT Primary of 280Volts, the display will show 280.0.

6. Press "E" to change to the desired digit. i.e.: for a VT Primary of 400Volts, the display will show 400.0.

    Press "I" to set.

7. When the screen displays "d", you can select a decimal location by pressing "E". Press "I" to set.

8. The screen will then display "E" for descriptor selection. Press "E" to select K (kilo) / M (Mega) or no

    descriptor.

9. Press "I" once. The display will read "UPr1".

10. Press "E" once to display "USEC". Then press "I". Now the display shows the Secondary Voltage setting.

11. Press "I" to select the desired numeral to be changed. i.e.: for a VT secondary of 280Volts, the display

    will show 280.0.

12. Press "E" to change to the desired digit. i.e.: for a VT secondary of 400Volts, the display will show 400.0.

    Press "I" to set.

13. When the screen displays "d", you can select a decimal location by pressing "E". Press "I" to set.

14. The screen will display "E" for descriptor selection. Press "E" to select K(kilo) / M(mega) or no

    descriptor.

15. Press "I" once. The display will read "USEC".

16. Press "E" until "CONF" is displayed. Then, press "I". Now the display shows "SUPP".

17. Press "E" until "END" is displayed. Then, press "I". Now you are out of programming mode.

18. Check the resulting display on the meter for voltage and current to see that the desired numbers are displayed and the decimal is in the proper location.

19. If not, repeat procedure starting with step 1 and check that the proper numbers are programmed into the meter.

SUPP	SYSA	UPr 1	USEC
Step 1	Step 2	Step 3	Step 10
SUPP	End		
Step 16	Step 17		

6.4
Configure   Max Demand   Time   Setting

The M850-MP1 integrates all measurements of Amps, Power and VA within a variable time length, sliding window. The reset option will reset all demand and maximum demand measurements. The time demand window can be set to a value of between 3 and 60 minutes (inclusive).

6.4.1
Max Demand   Time   Setting

In this example, the maximum Demand Time setting will be made to 30 minutes. Here are the programming instructions to set the M850 to that setting:

1. Press "I" & "E" simultaneously and hold for 5 seconds. The unit is now in setup mode. The screen will change to "SUPP"

2. Press "E" button twice. The screen displays "dt".

3. Press "I" button once. The screen will move into Reset "rSEt" mode.

4. Press "I" to reset any value that may have already been logged. (Press "Y" to reset the value, press, "N" to keep the value as shown.)

5. Press "E" to show "dtSt" for Demand Time setting.

6. Press "I". This will show what is currently set in minutes. Keep pressing "E" until you get to "0".

7. Press "I" to move to the next digit.

8. Press "E" three times to change the 0 to 3. Now the display should show "30".

9. Press "I" to return to "dtSt".

10. If this is incorrect, press "E" to "CNCL", then "I" and repeat the setting.

11. Press "E" to go the Confirm screen.

12. Press "I" to confirm the setting.

13. Press "E" five times to get to "END."

14. Press "I" to exit the Settings mode of the M850-MP1

Please note: The M850-MP1 has the capacity to be set up to 60 minutes in 1 minute increments.

If no buttons are pressed for 6 minutes, the M850-MP1 will exit the Settings menu.

Appendix A: Modbus Registers

A.1
3X Registers

3X Address	Register	Register Name	Order No	?
30001	(0x0000)	V L1-2	1	
30002	(0x0002)	V L2-3	2	
30003	(0x0004)	V L3-1	3	
30004	(0x0006)	V 1	4	
30005	(0x0008)	V 2	5	
30006	(0x000A)	V 3	6	
30007	(0x000C)	I 1	7	
30008	(0x000E)	I 2	8	
30009	(0x0010)	I 3	9	
30010	(0x0012)	kW Sum	10	
30011	(0x0014)	kVA Sum	11	
30012	(0x0016)	kVAR Sum	12	
30013	(0x0018)	PF Avg	13	
30014	(0x001A)	kWHr (Import)	14	
30015	(0x001C)	kVArHr (Import)	15	
30016	(0x001E)	Hz	16	
30017	(0x0020)	N/A	17	
30018	(0x0022)	N/A	18	
30019	(0x0024)	N/A	19	
30020	(0x0026)	N/A	20	
30021	(0x0028)	N/A	21	
30022	(0x002A)	N/A	22	
30023	(0x002C)	kWd (Import)	23	
30024	(0x002E)	kVAd	24	
30025	(0x0030)	Ad	25	
30026	(0x0032)	Neutral Current	26	
30027	(0x0034)	N/A	27	
30028	(0x0036)	N/A	28	
30029	(0x0038)	N/A	29	
30030	(0x003A)	N/A	30	
30031	(0x003C)	N/A	31	
30032	(0x003E)	N/A	32	
30033	(0x0040)	N/A	33	
30034	(0x0042)	N/A	34	
30035	(0x0044)	N/A	35	
30036	(0x0046)	N/A	36	
30037	(0x0048)	N/A	37	
30038	(0x004A)	Max kWd (Import)	38	
30039	(0x004C)	N/A	39	
30040	(0x004E)	Max kVAd	40	
30041	(0x0050)	Max Ad	41	

A.2
4X Registers

4X Address	Register	Register Name	Order No
41001	(0x07D0)	V L1-2	1
41002	(0x07D2)	V L2-3	2
41003	(0x07D4)	V L3-1	3
41004	(0x07D6)	V 1	4
41005	(0x07D8)	V 2	5
41006	(0x07DA)	V 3	6
41007	(0x07DC)	I 1	7
41008	(0x07DE)	I 2	8
41009	(0x07E0)	I 3	9
41010	(0x07E2)	kW Sum	10
41011	(0x07E4)	kVA Sum	11
41012	(0x07E6)	kVAR Sum	12
41013	(0x07E8)	PF Avg	13
41014	(0x07EA)	kWHr (Import)	14
41015	(0x07EC)	kVArHr (Import)	15
41016	(0x07EE)	Hz	16
41017	(0x07F0)	N/A	17
41018	(0x07F2)	N/A	18
41019	(0x07F4)	N/A	19
41020	(0x07F6)	N/A	20
41021	(0x07F8)	N/A	21
41022	(0x07FA)	N/A	22
41023	(0x07FC)	kWd (Import)	23
41024	(0x07FE)	kVAd	24
41025	(0x0800)	Ad	25
41026	(0x0802)	Neutral Current	26
41027	(0x0804)	N/A	27
41028	(0x0806)	N/A	28
41029	(0x0808)	N/A	29
41030	(0x080A)	N/A	30
41031	(0x080C)	N/A	31
41032	(0x080E)	N/A	32
41033	(0x0810)	N/A	33
41034	(0x0812)	N/A	34
41035	(0x0814)	N/A	35
41036	(0x0816)	N/A	36
41037	(0x0818)	N/A	37
41038	(0x081A)	Max kWd (Import)	38
41039	(0x081C)	N/A	39
41040	(0x081E)	Max kVAd	40
41041	(0x0820)	Max Ad	41