

USER'S MANUAL

VAR-Z16

Electrical Power Factor Controller

This document contains the latest technical information about VAR-Z16 which is a micro-controller based Electrical Power Factor controller. The unit is tested against latest "MTE" Standard Model PRS400.3 having basic accuracy of 0.02%, traceable up to International Standards derived using appropriate ratio techniques.

The product, VAR-Z16 is sophisticated electronic equipment, and the user is advised to read this User's Manual carefully before attempting to install or operate the equipment.

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Introduction

The digital power meter VAR-Z16 is a micro-controller based unit which not only measures a host of electrical parameters to display them on a 128 X 64 graphical backlit LCD, but also acts as a comprehensive power factor controlling device due to its sixteen numbers of output relay contacts. There are two alarm relays. These two alarm outputs are individually field programmable to generate alarm as well as the values on which to activate alarm. In addition to this flexibility in terms of power factor controlling, the meter also has one serial port: RS485, supports MODBUS RTU protocol for connections to EMS/SCADA.

The unit is meant for use in three phase four wire systems. The installation type, CT ratios are site selectable.

VAR-Z16 is a versatile meter with a robust electrical load measurement system and consists of all the features needed to implement. It can be configured to suit most control and communication needs.

The Main features Available in this Model

- Accuracy Class 1.0 (as per IS14697)
- Displays more than 20 Parameters
- Sixteen Relay contacts for Power Factor Controlling & Two relay for alarm
- RS485 MODBUS-RTU Connectivity
- Large 128 X 64 Backlit LC Display
- CT Ratios field programmable
- External Bank may be either Single Phase or Mono Phase or Three Phase
- External Bank sensing without CT as well as provision to enter bank size manually
- Odd Harmonic Analysis up to 15th for all voltages and currents, including THD.

Technical Specifications

Parameters			
Type	Name	Statistics	
INPUT	Three Phases and Neutral of a 3P4W system		
	Voltage	Direct Voltage Input : Up to 500V L-L, Up to 300V L-N Burden : 0.5VA	
	Current	Secondary Current Input: 5A or 1A (Site Selectable) CT Ratio : Site Selectable Range of Reading : 5 – 5000A Burden : < 1.0VA Overload : 5A CT = 6A RMS Continuous 1A CT = 1.2A RMS Continuous	
	Power Supply	Auxiliary Supply: 90 - 470 VAC, 50-60 Hz drawn from 3 phase connection done for measurement.	
OUTPUT	Relay	16 Relays contact with Common for PF Controlling. 2 Relays contact with Common for ALARM Indication. Switching Voltage : Max. 230 VAC Switching Power : Max. 1000W Expected Mechanical Life : >10X10 ⁶ switching operations Expected Electrical Life : > 4X10 ⁶ switching operations @ (Load = 200VA. Cosφ = 0.5)	
MEASUREMENT	True RMS Basic Parameters	Voltage (Volts L-N & L-L)	VL-N Accuracy : 0.5% of Reading VL-L Accuracy : 1.0% of Reading
		Current (Amps IR, IY, IB)	Accuracy : 0.25% of Reading
		Line Frequency	45 to 55 Hz, Accuracy : 0.3% of Reading
	Power	Active Power (P)	Accuracy (For IPFI>0.5) : 1% of Reading
		Reactive Power (Q)	Accuracy : 1.5% of Reading (Between 0.5 Lag to 0.8 Lead)
		Power Factor	For Individual phases and System. Accuracy : 1.0% of Reading (IPFI≥0.5) Range of Reading : 0.05 to 1.00 Lag/Lead
	Energy	Phase wise Active Energy (KWh)	Range of Reading : 0 to 999999999.9 KWh Accuracy : Class 0.5 as per IS14697
		Phase wise Reactive Energy (KVARh – LAG & LEAD)	Range of Reading : 0 to 999999999.9 KVARh Accuracy : Class 1.0
	Power Quality	3 rd to 15 th Harmonics(Odd) for all Voltages with THD	
		3 rd to 15 th Harmonics(Odd) for all Currents with THD	

MISCELLANEOUS

Parameters		
Type	Name	Statistics
Dimensions	Bezel	144 X 144 mm
	Panel Cutout	138 X 138 mm
	Depth of installation	55 mm
	Display	128 X 64 graphical Backlit LCD
	Operating temp	10°C to 50°C
	Weight	0.60 Kgs (Approx.)
	Operating Current Range	0.4% to 120% of CT primary
	RS485	Modbus-RTU protocol

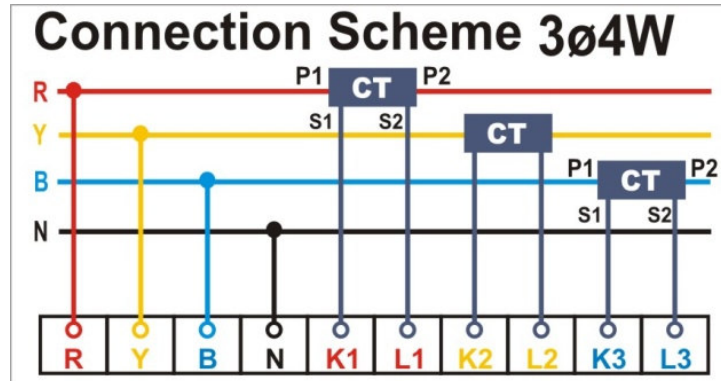
Installation and Commissioning

The VAR-Z16 supports single installation mode – 3P4W only. The installation process of this mode is described below:

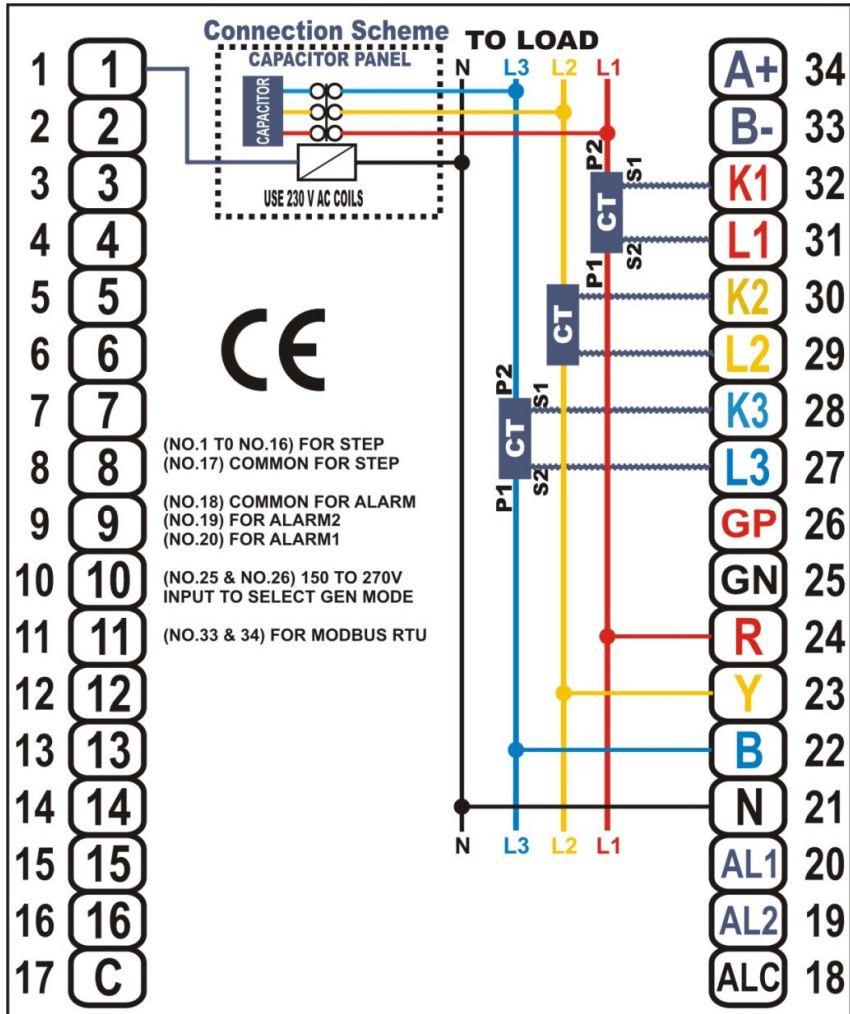
3P4W Mode Installation

Follow these steps to install / commission the unit.

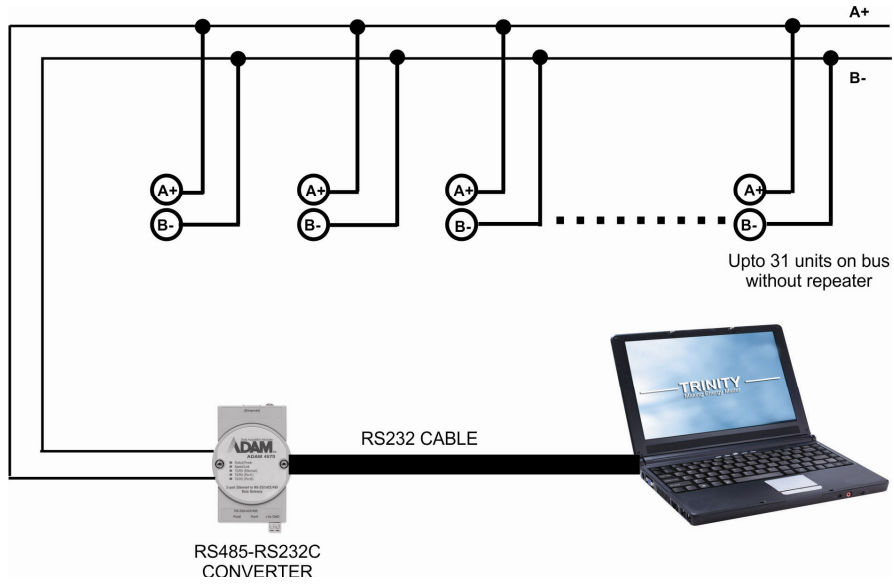
1. Push the unit into the panel and mount using the clamps provided.



2. Connect the three phases with the phase sequence being R-Y-B to the terminals marked U1, U2 and U3 respectively. Make sure that the three phases coming to the unit come through control fuses of 1.0 Amp rating. This will protect the electronics inside from damage due to severe overvoltage or phase faults in the system.
3. Connect the neutral to the terminal marked U4.
4. Connect the two wires from the R-phase CT to terminals marked K1 & L1 such that S1 from CT goes to K1 on the unit. Connect the two wires from the Y-phase CT to terminals marked K2 & L2 such that S1 from CT goes to K2 on the unit. Connect the two wires from the B-phase CT to terminals marked K3 & L3 such that S1 from CT goes to K3 on the unit.
5. Switch on the three phase supply. The unit will come alive and display logo for about three seconds and then, it will display the first page of Run Mode.
6. If there is very little current or no current in the CT circuits, the unit may show PFs as 0.999 or 1.000. This will go away as soon as the current builds up in the CTs, above 0.8 % of rated CT.
7. Now, the unit needs to be programmed for the various parameters which are field programmable. For this refer to next section "OPERATIONAL DETAILS"
8. The unit is ready for operation.



Connection Scheme



RS485 Connection

Operational Details

The PF Controller, VAR-Z16 is a versatile meter, with all the features needed to implement with a robust electrical load measurement system. It can be configured to suit most control and communication needs.

This is achieved by making as many parameters field programmable, as much possible. The unit can be operated with two modes such as:

1. Programming Mode
2. Run Mode

After supplying power (80 VAC - 470 VAC) to the three phases supply the unit displays immediately power receiving information such as logo and then, enters into first page of Run Mode such as shown below.

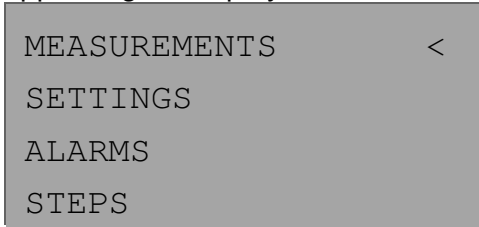
```
L1 V=231 V I=0.00 A
P=0 W
Q=0 VAR
COS=1.000 (E) Q/P=%----
```

Now, the unit can be operated by pressing keys provided with the following:



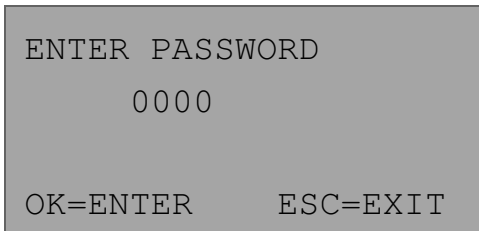
Programming Mode

The unit is designed with a secure default password, "1947". The password is also changeable from 0 to 9 according to user's desire (see in the next section, programmable parameter, "Setting Password"). To enter into Programming Mode, press **ENTR** in Run Mode for about four seconds & following main page will be appearing on display screen.

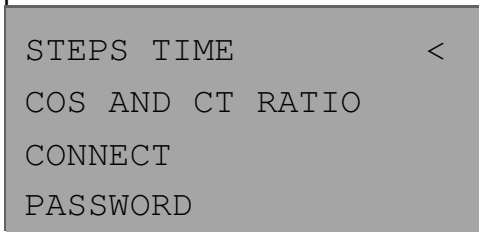


In above page, each parameters has sub parameters. Select appropriate parameter & press **ENTR** key to program sub parameters for selected parameter. On, sub parameters page, there will be EXIT option, through which we can return back on this main page.

Press **▼** key to select SETTINGS & press **ENTR** key, the password display will show with a four digits of zeroes of which first digit, zero will be blinking.



To enter the password, press **▲** key & **▼** key to enter value for selected digit, press **ENTR** key to change digit selection. After entering the default password "1947", press **ENTR** key to enter into Programming Mode. Following page will appear if password verified ok.



Setting STEPS TIME

Press **ENTR** key on selected STEPS TIME & following page will appear.

```
T-ON TIME      <
T-OFF TIME
DISCHARGE TIME
EXIT
```





STEP TIME has 3 sub parameters “T-ON TIME”, “T-OFF TIME” & “DISCHARGE TIME” concerned in Bank On/Off action to maintain system power factor.

T-ON TIME

Press  key on selected T-ON TIME & following page will appear.



```
T-ON TIME
      7 SEC.

OK=ENTER    ESC=EXIT
```

The parameter can now be set by pressing  and  keys between 1 to 60 seconds. Set the desired value and then, press  key to confirm the setting that will be non volatile in internal memory & meter will show STEP TIME page again. If do not want to change value then, press  key, meter will not consider new updated value.





Out of three phases, if condition satisfied for any single phase to switch ON Bank for T-ON TIME duration then meter will look at Bank combination to achieve set PF.

T-OFF TIME

Press  key to select T-OFF TIME on STEP TIME page & press  key.

```
T-OFF TIME
      7 SEC.

OK=ENTER    ESC=EXIT
```

The parameter can now be set by pressing  and  keys between 1 to 60 seconds. Set the desired value and then, press  key to confirm the setting that will be non volatile in internal memory & meter will show STEP TIME page again. If do not want to change value then, press  key, meter will not consider new updated value.




Out of three phases, if condition satisfied for any single phase to switch OFF Bank for T-OFF TIME duration then meter will look at Bank combination to achieve set PF.

DISCHARGE TIME

Press  key to select DISCHARGE TIME on STEP TIME page & press  key.



```
DISCHARGE TIME
      7 SEC.

OK=ENTER    ESC=EXIT
```



The parameter can now be set by pressing  and  keys between 1 to 600 seconds. Set the desired value and then, press  key to confirm the setting.

After applying last Bank Combination in system, DISCHARGE TIME will come in action. After finishing DISCHARGE TIME interval, meter will look at system parameter to either Bank Off or Bank On.

EXIT

Press  key to select EXIT if do not want to change any of above parameters values. Press  to return back on main SETTING page.

Setting COS AND CT RATIO

Press  key to select COS AND CT RATIO in SETTING page & Press  key & following page will appear.





```
COS 1      <
COS 2
CT RATIO
EXIT
```

COS AND CT RATIO has 3 sub parameters “COS 1”, “COS 2” & “CT RATIO”.

COS 1

Press  key on selected COS 1 & following page will appear.

```
COS 1      0.99
0.70...0.99 IND.ZONE
1.01...1.30 CAP.ZONE
OK=ENTER    ESC=EXIT
```




The parameter can now be set by pressing  and  keys between 0.70 to 1.30. For LAG side setting keep value between 0.70 to 0.99 & for LEAD side setting keep value between 1.01 to 1.30. Values between 1.01 & 1.30 indicate 0.99 to 0.70 on LEAD side power factor. Set the desired value and then, press  key to confirm the setting that will be non volatile in internal memory & meter will show COS AND CT RATIO page again. If do not want to change value then, press  key, meter will not consider new updated value.

AC Voltage between GP & GN terminal is less than 150 Volts then, system power factor will be maintained as per power factor set in COS.

COS 2

Press  key to select COS 2 & Press  key.

```
COS 2      0.99
0.70...0.99 IND.ZONE
1.01...1.30 CAP.ZONE
OK=ENTER   ESC=EXIT
```





The parameter can now be set by pressing  and  keys between 0.70 to 1.30. For LAG side setting keep value between 0.70 to 0.99 & for LEAD side setting keep value between 1.01 to 1.30. Values between 1.01 & 1.30 indicate 0.99 to 0.70 on LEAD side power factor. Set the desired value and then, press  key to confirm the setting.

AC Voltage between GP & GN terminal is above than 150 Volts then, system power factor will be maintained as per power factor set in COS 2.



CT RATIO

Press  key to select CT RATIO & Press  key.



```
CT RATIO
      500/5
OK=ENTER   ESC=EXIT
```

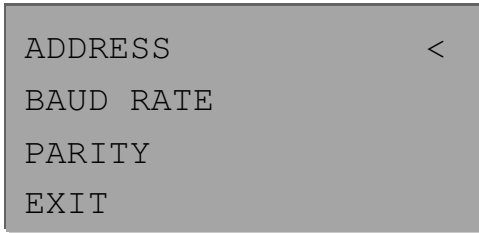
The parameter can now be set by pressing  and  keys, between 5 to 10000. After setting desired value press  key. After pressing  key, internal testing will be going on for sequence testing for Current & Voltage channels.

EXIT

Press  key to select EXIT if do not want to change any of above parameters values. Press  to return back on main SETTING page.

Setting CONNECT

Press  key to select CONNECT in main page & Press  key & following page will appear.



All above parameter can be programmed in same manner as we have seen in “STEPS TIME” & “COS AND CT RATIO” programming.

ADDRESS

This parameter is settable from 1 to 255. On RS485 bus, each connected device must have unique ADDRESS.

BAUD RATE

Baud rate can be either 9600 or 19200 or 38400 or 57600. Selected baud rate should match with external device while doing communication over RS485.



PARITY

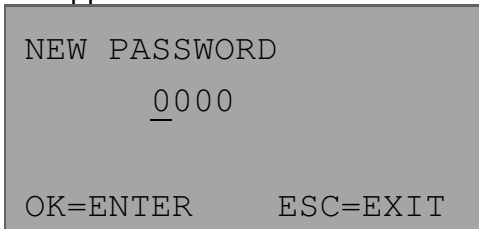
Parity can be either EVEN or ODD or NONE.





EXIT

To return back on main SETTING page, press  on EXIT.



Setting PASSWORD

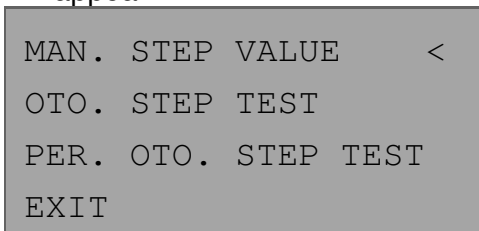
Press  key to select PASSWORD in main page & Press  key & following page will appear.



To enter the password, press  key &  key to enter value for selected digit & press  key to change digit selection. After entering 4th digit in password press  key, entered new password will be saved in internal memory & main SETTING page will appear.

Setting STEPS MODE

Press  key to select STEPS MOD in main page & Press  key & following page will appear.




These parameters are concerned to Bank Size. MAN. STEP VALUE & OTO. STEP TEST has 16 sub parameters.




MAN. STEP VALUE


Press  key on selected MAN. STEP VALUE & following page will appear.


```
1. STEP TEST      <
2. STEP TEST
3. STEP TEST
4. STEP TEST
```

This page provides option to manually feel bank value of 16 stages. To, enter 1st Bank value, Press  key on 1. STEP TEST & following page will appear.



```
1. STEP (TWO PHASE)
L1      L2      L3
1.59    0.00    1.55
UP=CAP      DOWN=IND
```

The value can be set by pressing  and  keys between -99.99 to 99.99. Press  key to enter value as well phase selection will change. Negative value shows INDUCTIVE type bank. Means, when we switched on such type of negative KVAR specified bank, then system power factor goes down. If, there is nonzero value entered for L1, and for L2 & L3 zero value entered then, this bank will be considered as MONO PHASE in power factor controlling action. Suppose, if nonzero value specified for L1 & L2, and for L3, zero value entered then this bank will be considered as TWO PHASE. And, if nonzero value entered for all three phases then this bank will be considered as THREE PHASE bank. If zero value entered for all three phases then it means BANK is not connected on 1st stage.

On, 3rd phase, press  key to return bank on MAN. STEP VALUE page. Same way we can program all remaining banks.



Press  key on last option EXIT to return back on STEPS MODE page.

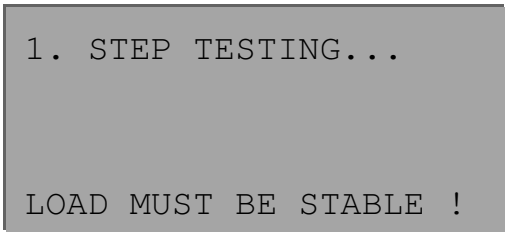
OTO. STEP TEST

Press  key to select OTO. STEP TEST & Press  key.

```
ALL STEPS TEST      <
1. STEP TEST
2. STEP TEST
3. STEP TEST
```

Here, meter provides option to do AUTO SENSE for all 16 stage or any single stage.


Suppose, we want to do AUTO SENSE for only 1st connected bank then press  key to select 1. STEP TEST & Press  key.



```
1. STEP TESTING...

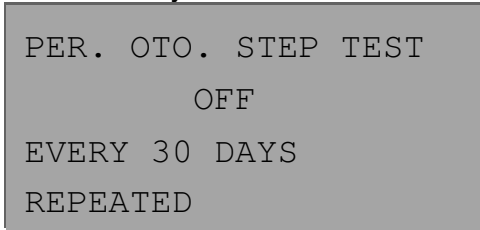
LOAD MUST BE STABLE !
```

Here, there is no provision for bank current sensing, so meter will note down bank's KVAR based on changes occur in phase wise KVAR after making bank on. So, there must not come variation in load while doing auto sensing bank KVAR.




Press  key on last option EXIT to return back on STEPS MODE page.


PER. OTO. STEP TEST

Press  key to select PER. OTO. STEP TEST & Press  key.



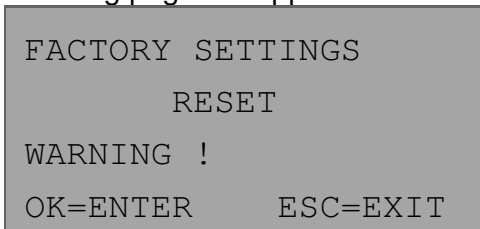
```
PER. OTO. STEP TEST
      OFF
EVERY 30 DAYS
REPEATED
```

ON or OFF option can be set by pressing  and  keys. If ON option is selected, then meter will periodic auto sense after ever 30 powered on days. Press  key, to return back on STEPS MODE page.


Press  key on last option EXIT to return back on main SETTING page.


Restoring to FACTORY SETTINGS

Press  key to select FACTORY SETTINGS in main page & Press  key & following page will appear.





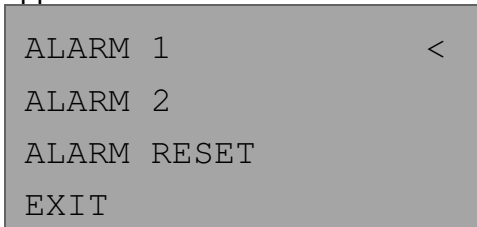
```
FACTORY SETTINGS
      RESET
WARNING !
OK=ENTER   ESC=EXIT
```

By doing FACTORY SETTING RESET, all parameter will set to default value as per programmed at factory. It will also, reset Energy, reset Min-Max, reset day counter for periodic auto sense, as well as all bank KVAR will be zero. After doing all reset on pressing  key, it will return to main page of SETTING.

Press  key on last option EXIT to return back from SETTING page to main programming page.

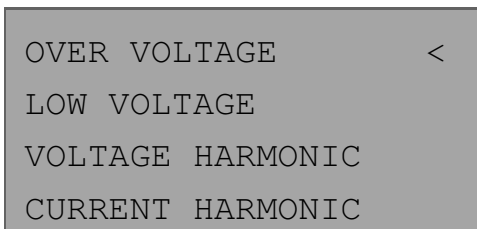
Setting ALARMS

Press  key to select ALARMS in main page & Press  key & following page will appear.



Meter has 2 alarm relays. Both alarm relays parameter can be programmed through this page.

To, program 1st alarm parameter, press  key on ALARM 1 & following page will appear.



To, occur alarm any of “OVER VOLTAGE”, “LOW VOLTAGE”, “VOLTAGE HARMONIC”, “CURRENT HARMONIC”, “OVER COMPENSATION” and “UNDER COMEPSTION” is responsible.

OVER VOLTAGE

Over Voltage is settable from 230 to 300 Volts. If all phase to neutral voltage go above specified limit of OVER VOLTAGE for around 10 seconds then OVER VOLTAGE alarm will occur. To, resolve OVER VOLTAGE alarm condition, all phase to neutral voltage has to go down 5 % hysteresis. Means, all voltage has to go down from $(\text{OVER VOLTAGE} + (\text{OVER VOLTAGE} * 0.05))$.

LOW VOLTAGE

Low Voltage is settable from 150 to 210 Volts. If all phase to neutral voltage go down below specified limit of LOW VOLTAGE for around 10 seconds then LOW VOLTAGE alarm will occur. To, resolve LOW VOLTAGE alarm condition, all phase to neutral voltage has to go above 5 % hysteresis. Means, all voltage has to go above from $(\text{LOW VOLTAGE} + (\text{LOW VOLTAGE} * 0.05))$.

VOLTAGE HARMONIC

Voltage harmonic is settable from 10.0 to 100.0. If all phase voltage THD go above specified limit of VOLTAGE HARMONIC for around 10 seconds then VOLTAGE HARMONIC alarm will occur. To, resolve alarm condition, each phase voltage THD

has to go down from (VOLTAGE HARMONIC – 4.0).

CURRENT HARMONIC

Current harmonic is settable from 10.0 to 100.0. If all phase current THD go above specified limit of CURRENT HARMONIC for around 10 seconds then CURRENT HARMONIC alarm will occur. To, resolve alarm condition, each phase current THD has to go down from (CURRENT HARMONIC – 4.0).



OVER COMPENSATION

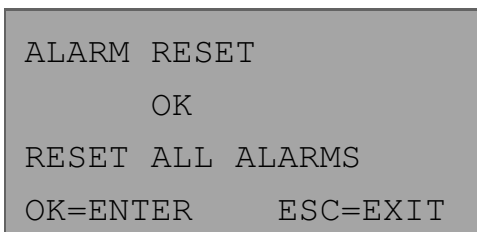
Over compensation is settable from 0.05 to 0.99. When all banks are off & any phase PF is more then set target PF in LAG side or less then set target PF in LEAD side and difference created between target PF and phase wise PF is more than OVER COMPENSATION value for 3 times of DISCHARGING TIME duration then OVER COMPENSATION alarm will occur. Alarm will automatically resolve if any of above condition become false for at least single time.


UNDER COMPENSATION


Under compensation is settable from 0.05 to 0.99. When any one bank is ON at any phase & that phase PF is less then set target PF in LAG side or more then set target PF in LEAD side and difference created between target PF and phase PF is more than UNDER COMPENSATION value for 3 times of DISCHARGING TIME duration then UNDER COMPENSATION alarm will occur. Alarm will automatically resolve if any of above condition become false for at least single time.

Press  key on last option EXIT to return back to ALARMS page.

Press  key to select ALARM RESET in ALARMS page & Press  key & following page will appear.



Press  key to reset ALARM condition. Alarm relay will be activated on any alarm condition occur & Alarm relay will be deactivated if all alarm condition not satisfied. But, message from ALARM STATUS page will not removed automatically for last occurrence of alarm. By, doing ALARM RESET, ALARM relay will be off & ALARM STATUS page will show NO ALARM.

Press  key on last option EXIT to return back to main programming parameter selection page.

Run Mode

In the run mode, the various parameters measured/calculated by the meter are displayed on different pages on a 128X64 graphical Backlit LC Display.

Run Mode display in 3P4W

```
L1 V=231 V I=0.00 A
P=0 W
Q=0 VAR
COS=1.000 (E) Q/P=%---
```

The first page shows L1 Phase (R-Phase) Voltage, Current, Active Power, Reactive Power, Power Factor with LAG (E) or LEAD (K) sign and Ratio of Reactive Power to Active Power (Q/P) in form of percentage. If Active Power is zero then it shows as "---" in Q/P ratio.

The second page shows L2 Phase (Y-Phase) data.

The third page shows L3 Phase (B-Phase) data.

```
L1, L2, L3 (COS-Q/P)
L1 1.000 (E) %---
L2 1.000 (E) %---
L3 1.000 (E) %---
```

The fourth page shows phase wise Power Factor with lag & lead sign by E & K respectively. Also shows each phase wise ratio of Reactive Power to Active Power (Q/P) in form of percentage. If Active Power is zero then it shows as "---" in Q/P ratio.

```
ALARM 1


NO ALARM
```

The fifth page shows ALARM STATUS for Alarm 1 relay. After ALARM RESET, if no alarm occurs then it shows as NO ALARM. But, any alarm condition was occurred to activate ALARM-1 relay then it shows either “OVER VOLTAGE” or “LOW VOLTAGE” or “VOLTAGE HARMONIC” or “CURRENT HARMONIC” or “OVER COMPENSATION” or “UNDER COMPENSATION”.

The sixth page shows ALARM STATUS for Alarm 2 relay.

To, see other run mode parameters, Press  key for 4 seconds & following page will be displayed.

```
MEASUREMENTS    <
SETTINGS
ALARMS
STEPS
```

Press  key on MEASUREMENTS to see remaining run mode parameters. Here, parameters are sub divided in groups of “REAL TIME”, “MIN.-MAX.” & “ENERGY METER” as shown in below page.

```
REAL TIME        <
MIN.-MAX.
ENERGY METER
EXIT
```

REAL TIME Display parameters

```
VOLTAGE (V)
L1      231 V
L2      0 V
L3      0 V
```

The first page in REAL TIME shows each phase voltage.

```
CURRENT (A)
L1      0.00 A
L2      0.00 A
L3      0.00 A
```

The second page in REAL TIME shows each phase current.

```
COS
L1 1.000 (E)
L2 1.000 (E)
L3 1.000 (E)
```

The third page shows each phase power factor with LAG (E) or LEAD (K) sign.

```
ACTIVE POWER (W)
L1 0 W
L2 0 W
L3 0 W
```


The fourth page shows each phase Active Power in either W or KW.

```
REACTIVE POWER (VAR)
L1 0 VAR (E)
L2 0 VAR (E)
L3 0 VAR (E)
```

The fifth page shows each phase Reactive Power in either VAR or KVAR with sign.

```
TOTAL HARMONIC V, I (%)
L1 %3.40 %0.00
L2 %0.00 %0.00
L3 %0.00 %0.00
```

The sixth last page in REAL TIME shows each phase Total Harmonic Distortion for Voltage & Current.

Press  to return back to MEASUREMENTS page.

MIN.-MAX. Display parameters

```
VOLTAGE (V)  MIN. -MAX.
L1  231 V    232 V
L2  0 V      0 V
L3  0 V      0 V
```

The first page in MIN.-MAX. shows each phase Minimum Voltage on left side & Maximum Voltage on right side.

```
CURRENT (A)  MIN. -MAX.
L1  0.00 A    0.00 A
L2  0.00 A    0.00 A
L3  0.00 A    0.00 A
```

The second page shows each phase Minimum Current on left side & Maximum Current on right side.

```
COS (E)  MIN. -MAX.
L1  1.000    1.000
L2  1.000    1.000
L3  1.000    1.000
```

The third page shows each phase LAG side Power Factor Minimum & Maximum values.

```
COS (K)  MIN. -MAX.
L1  1.000    1.000
L2  1.000    1.000
L3  1.000    1.000
```

The fourth page shows each phase LEAD side Power Factor Minimum & Maximum values.

```
ACTIVE P. (W) MIN. -MAX.
L1  0 W      0 W
L2  0 W      0 W
L3  0 W      0 W
```

The fifth page shows each phase Minimum & Maximum Active Power.

```
R.P. (E) (VAR) MIN. -MAX.
L1  0 VAR    0 VAR
L2  0 VAR    0 VAR
L3  0 VAR    0 VAR
```

The sixth page shows each phase Lag side Minimum & Maximum Reactive Power.

```
R.P. (K) (VAR) MIN. -MAX.
L1  0 VAR    0 VAR
L2  0 VAR    0 VAR
L3  0 VAR    0 VAR
```


The seventh page shows each phase Lead side Minimum & Maximum Reactive Power.

```
THDV (%) MIN. -MAX.
L1  %3.10    %3.70
L2  %0.00    %0.00
L3  %0.00    %0.00
```

The eighth page shows each phase Minimum & Maximum Total Harmonic Distortion of Voltage.

```
THDI (%) MIN.-MAX.
L1  %3.10      %3.70
L2  %0.00      %0.00
L3  %0.00      %0.00
```

The ninth page shows each phase Minimum & Maximum Total Harmonic Distortion of Current.

Press  to return back to MEASUREMENTS page.

ENERGY METER Display parameters

```
ACTIVE ENERGY (KWH)
L1  0.000 KWH
L2  0.000 KWH
L3  0.000 KWH
```


The first page in ENERGY METER shows each phase Active Energy.

```
R. ENERGY (E) (KVARH)
L1  0.000 KVARH
L2  0.000 KVARH
L3  0.000 KVARH
```



The second page shows each phase LAG side Reactive Energy.

```
R. ENERGY (K) (KVARH)
L1  0.000 KVARH
L2  0.000 KVARH
L3  0.000 KVARH
```

The third page shows each phase LEAD side Reactive Energy.



Press  to return back to MEASUREMENTS page.

Bank STEPS

Press  key to select STEPS in main programming page & Press  key & following page will appear.

```
1. STEP    (0H, 0M)
L1 1.00 KVAR
L2 0.00 KVAR
L3 0.00 KVAR
```

There are such 16 pages in STEPS which shows each stage BANK KVAR. If connected bank has non zero value in any phase then it will also show BANK ON TIME in Hour & Minute. If any bank has zero value in all phases or difference between any two non zero phase KVAR is more than 20% then it will show as CANCELED & this bank will not be considered while doing Power Factor Controlling action.

Press  key on last 16. SETP page or  key on 1. STEP page to come back on main programming page.

Communication

Standard RS-485 communication port is available in **VAR-Z16**. This option make it possible for a user to select VAR-Z16 to provide power and energy information into a variety of existing or new control systems. Communication option supports data transfer with external devices or applications. Metering measurement & configuration accessed via communication.

Modbus RTU on RS485 Port

For connection to a SCADA software, VAR-Z16 supports an RS485 port with MODBUS-RTU protocol. The station id for every meter is site selectable. The data which can be read using MODBUS query # 3 (Read Holding Registers) is provided in an address map, with the applicable multiplication factors, vide **Appendix A**. The programmable data which can be program using MODBUS query #6 (Preset Single Register) is provided in an address map, vide **Appendix B**.

Communication line parameters: 9600 or 19200 or 38400 or 57600/8/O-E-N/1.

The register map is described in Appendix A. All addresses are in decimal whose parameters are float (32-bits). If illegal address is sent in query or the host, tries to read more than 254 bytes of data in one query exception message is generated.

Reserved values are for future use, which are transmitted as zeroes.

VAR-Z16 as a Power Factor Controller

The special feature provided in this advance technology based meter is Capacitor Sensing without CT. As well as provision done to connect either Mono, Two or Three phase banks to compensate phase wise power factor as much as possible. Each relay can be programmed separately to generate alarm on a specific parameter with its specific value. The value at which it should open is also programmable. Thus, user could have the first relay programmed to close when the avg. Voltage exceeds certain value, second when the Avg. Amps exceeds some level, third for KW, or KVAR or PF or Demand and so on.

This allows the user to deploy *VAR-Z16 as a true LOAD manager*, to generate alarm / trip signals for four different conditions!

Appendix-A

Address Map of Various Parameters for 3P4W installation. All parameters are 32-bit FLOAT supported by Query-03 Read Holding Register.

Modbus Address	Parameters	Format	MF
40200	VIn-R	Float	1
40202	VIn-Y	Float	1
40204	VIn-B	Float	1
40206	I _r	Float	1
40208	I _y	Float	1
40210	I _b	Float	1
40212	KW _r	Float	1
40214	KW _y	Float	1
40216	KW _b	Float	1
40218	PFR	Float	1
40220	PFR _y	Float	1
40222	PFR _b	Float	1
40224	Kvar-r	Float	1
40226	Kvar-y	Float	1
40228	Kvar-b	Float	1
40230	THD HV _r	Float	1
40232	THD HV _y	Float	1
40234	THD HV _b	Float	1
40236	THD HI _r	Float	1
40238	THD HI _y	Float	1
40240	THD HI _b	Float	1
40242	KWH _r	Float	1
40244	KWH _y	Float	1
40246	KWH _b	Float	1
40248	KVARH _r (E)	Float	1
40250	KVARH _y (E)	Float	1
40252	KVARH _b (E)	Float	1
40254	KVARH _r (K)	Float	1
40256	KVARH _y (K)	Float	1
40258	KVARH _b (K)	Float	1
40260	Min- VIn-R	Float	1
40262	Min- VIn-Y	Float	1
40264	Min- VIn-B	Float	1
40266	Max- VIn-R	Float	1
40268	Max- VIn-Y	Float	1
40270	Max- VIn-B	Float	1
40272	Min- I _r	Float	1
40274	Min- I _y	Float	1
40276	Min- I _b	Float	1
40278	Max- I _r	Float	1
40280	Max- I _y	Float	1
40282	Max- I _b	Float	1
40284	Min- PFR(E)	Float	1

40286	Min- PFy(E)	Float	1
40288	Min- PFb(E)	Float	1
40290	Max- PFr(E)	Float	1
40292	Max- PFy(E)	Float	1
40294	Max- PFb(E)	Float	1
40296	Min- PFr(K)	Float	1
40298	Min- PFy(K)	Float	1
40300	Min- PFb(K)	Float	1
40302	Max- PFr(K)	Float	1
40304	Max- PFy(K)	Float	1
40306	Max- PFb(K)	Float	1
40308	Min- KW _r	Float	1
40310	Min- KW _y	Float	1
40312	Min- KW _b	Float	1
40314	Max- KW _r	Float	1
40316	Max- KW _y	Float	1
40318	Max- KW _b	Float	1
40320	Min- VAR _r (E)	Float	1
40322	Min- VAR _y (E)	Float	1
40324	Min- VAR _b (E)	Float	1
40326	Max- VAR _r (E)	Float	1
40328	Max- VAR _y (E)	Float	1
40330	Max- VAR _b (E)	Float	1
40332	Min- VAR _r (K)	Float	1
40334	Min- VAR _y (K)	Float	1
40336	Min- VAR _b (K)	Float	1
40338	Max- VAR _r (K)	Float	1
40340	Max- VAR _y (K)	Float	1
40342	Max- VAR _b (K)	Float	1
40344	Min- THD HV _r	Float	1
40346	Min- THD HV _y	Float	1
40348	Min- THD HV _b	Float	1
40350	Max- THD HV _r	Float	1
40352	Max- THD HV _y	Float	1
40354	Max- THD HV _b	Float	1
40356	Min- THD H _{lr}	Float	1
40358	Min- THD H _{ly}	Float	1
40360	Min- THD H _{lb}	Float	1
40362	Max- THD H _{lr}	Float	1
40364	Max- THD H _{ly}	Float	1
40366	Max- THD H _{lb}	Float	1
40368	Bank-1 ON Time	Float	1
40370	Bank-2 ON Time	Float	1
40372	Bank-3 ON Time	Float	1
40374	Bank-4 ON Time	Float	1
40376	Bank-5 ON Time	Float	1
40378	Bank-6 ON Time	Float	1
40380	Bank-7 ON Time	Float	1
40382	Bank-8 ON Time	Float	1
40384	Bank-9 ON Time	Float	1
40386	Bank-10 ON Time	Float	1
40388	Bank-11 ON Time	Float	1
40390	Bank-12 ON Time	Float	1

40392	Bank-13 ON Time	Float	1
40394	Bank-14 ON Time	Float	1
40396	Bank-15 ON Time	Float	1
40398	Bank-16 ON Time	Float	1
40400	Alarm-1 Status	Float	1
40402	Alarm-2 Status	Float	1
40404	Banks Relay Status	Float	1
40406	Generator Status	Float	1
40408	Days -(PER. AUTO)	Float	1
40410	Hour	Float	1
40412	Minute	Float	1
40414	Second	Float	1

NOTES

Here all parameters are in 32-bit float format, so no multiplying factor applied.

If an attempt is made to read from some address other than the valid addresses, the exception response is sent.

EXCEPTION CODE

In the event that the query from the HOST has no communication error, but there is some error in specifying the address of register to be read, the meter return in exception message. The format of the exception message will be under:

Unit address 0x83 Exception code CRC CRC

Exception code can have only one value: 0x02 (in Hex)

If the address is not a valid start address or host has requested more than 254 bytes of the data, this code is return.

Appendix-B

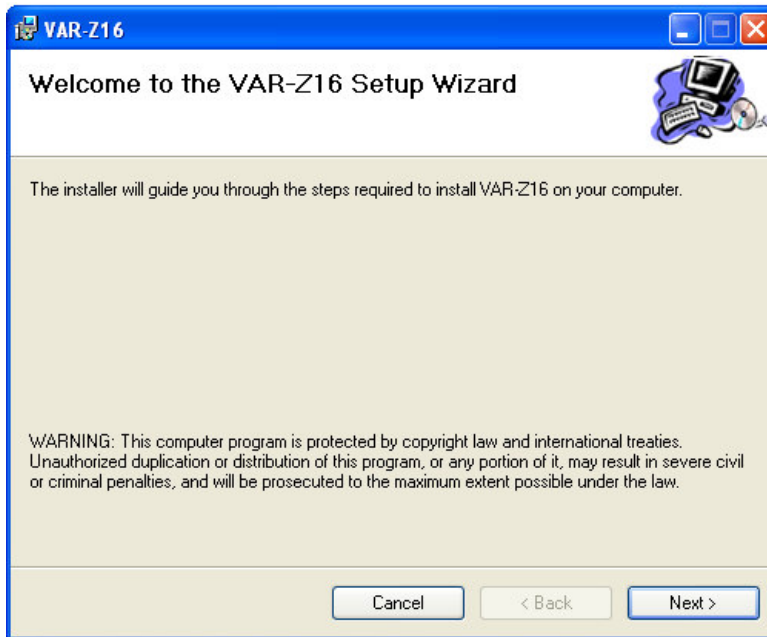
All parameters are 16-bit INTEGER supported by Query-06 Preset Single Register.

Modbus Address	Parameters	Value Range	Format	MF
40500	T-ON TIME	1 to 60	INT	1
40501	T-OFF TIME	1 to 60	INT	1
40502	DISCHARGE TIME	1 to 600	INT	1
40503	COS 1	0.70 to 1.30	INT	100
40504	COS 2	0.70 to 1.30	INT	100
40505	CT PRIMARY	5 to 10000	INT	1
40506	PASSWORD	0 to 9999	INT	1
40507	STEP-1 KVAR (R)	-99.99 to 99.99	INT	100
40508	STEP-1 KVAR (Y)	-99.99 to 99.99	INT	100
40509	STEP-1 KVAR (B)	-99.99 to 99.99	INT	100
40510	STEP-2 KVAR (R)	-99.99 to 99.99	INT	100
40511	STEP-2 KVAR (Y)	-99.99 to 99.99	INT	100
40512	STEP-2 KVAR (B)	-99.99 to 99.99	INT	100
40513	STEP-3 KVAR (R)	-99.99 to 99.99	INT	100
40514	STEP-3 KVAR (Y)	-99.99 to 99.99	INT	100
40515	STEP-3 KVAR (B)	-99.99 to 99.99	INT	100
40516	STEP-4 KVAR (R)	-99.99 to 99.99	INT	100
40517	STEP-4 KVAR (Y)	-99.99 to 99.99	INT	100
40518	STEP-4 KVAR (B)	-99.99 to 99.99	INT	100
40519	STEP-5 KVAR (R)	-99.99 to 99.99	INT	100
40520	STEP-5 KVAR (Y)	-99.99 to 99.99	INT	100
40521	STEP-5 KVAR (B)	-99.99 to 99.99	INT	100
40522	STEP-6 KVAR (R)	-99.99 to 99.99	INT	100
40523	STEP-6 KVAR (Y)	-99.99 to 99.99	INT	100
40524	STEP-6 KVAR (B)	-99.99 to 99.99	INT	100
40525	STEP-7 KVAR (R)	-99.99 to 99.99	INT	100
40526	STEP-7 KVAR (Y)	-99.99 to 99.99	INT	100
40527	STEP-7 KVAR (B)	-99.99 to 99.99	INT	100
40528	STEP-8 KVAR (R)	-99.99 to 99.99	INT	100
40529	STEP-8 KVAR (Y)	-99.99 to 99.99	INT	100
40530	STEP-8 KVAR (B)	-99.99 to 99.99	INT	100
40531	STEP-9 KVAR (R)	-99.99 to 99.99	INT	100
40532	STEP-9 KVAR (Y)	-99.99 to 99.99	INT	100
40533	STEP-9 KVAR (B)	-99.99 to 99.99	INT	100
40534	STEP-10 KVAR (R)	-99.99 to 99.99	INT	100
40535	STEP-10 KVAR (Y)	-99.99 to 99.99	INT	100
40536	STEP-10 KVAR (B)	-99.99 to 99.99	INT	100
40537	STEP-11 KVAR (R)	-99.99 to 99.99	INT	100
40538	STEP-11 KVAR (Y)	-99.99 to 99.99	INT	100
40539	STEP-11 KVAR (B)	-99.99 to 99.99	INT	100
40540	STEP-12 KVAR (R)	-99.99 to 99.99	INT	100
40541	STEP-12 KVAR (Y)	-99.99 to 99.99	INT	100
40542	STEP-12 KVAR (B)	-99.99 to 99.99	INT	100

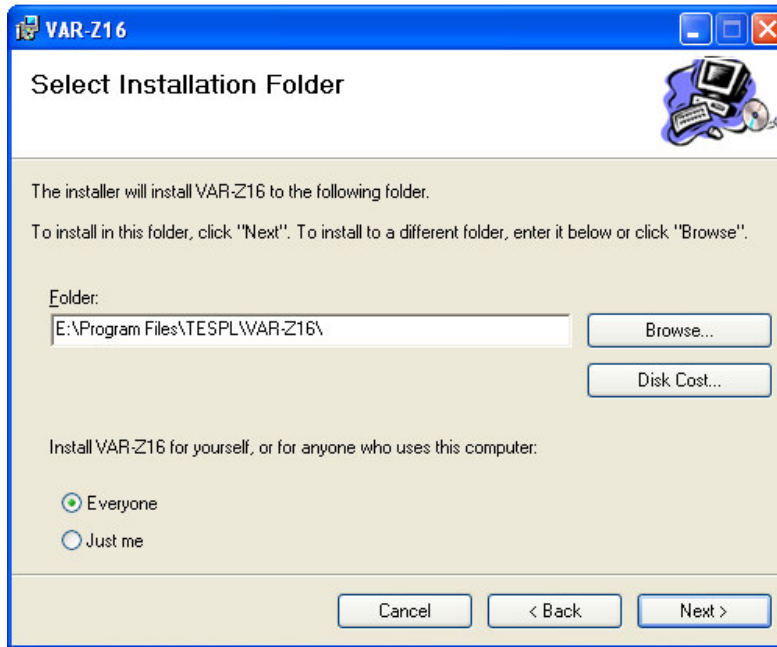
40543	STEP-13 KVAR (R)	-99.99 to 99.99	INT	100
40544	STEP-13 KVAR (Y)	-99.99 to 99.99	INT	100
40545	STEP-13 KVAR (B)	-99.99 to 99.99	INT	100
40546	STEP-14 KVAR (R)	-99.99 to 99.99	INT	100
40547	STEP-14 KVAR (Y)	-99.99 to 99.99	INT	100
40548	STEP-14 KVAR (B)	-99.99 to 99.99	INT	100
40549	STEP-15 KVAR (R)	-99.99 to 99.99	INT	100
40550	STEP-15 KVAR (Y)	-99.99 to 99.99	INT	100
40551	STEP-15 KVAR (B)	-99.99 to 99.99	INT	100
40552	STEP-16 KVAR (R)	-99.99 to 99.99	INT	100
40553	STEP-16 KVAR (Y)	-99.99 to 99.99	INT	100
40554	STEP-16 KVAR (B)	-99.99 to 99.99	INT	100
40555	PER. OTO. STEP TEST	1 or 0	INT	1
40556	ALARM-1 OV	230 to 300	INT	1
40557	ALARM-1 LV	150 to 210	INT	1
40558	ALARM-1 VH	10.0 to 100.0	INT	10
40559	ALARM-1 CH	10.0 to 100.0	INT	10
40560	ALARM-1 OC	0.05 to 0.99	INT	100
40561	ALARM-1 UC	0.05 to 0.99	INT	100
40562	ALARM-2 OV	230 to 300	INT	1
40563	ALARM-2 LV	150 to 210	INT	1
40564	ALARM-2 VH	10.0 to 100.0	INT	10
40565	ALARM-2 CH	10.0 to 100.0	INT	10
40566	ALARM-2 OC	0.05 to 0.99	INT	100
40567	ALARM-2 UC	0.05 to 0.99	INT	100

To program above parameter, please install utility from provided CD.

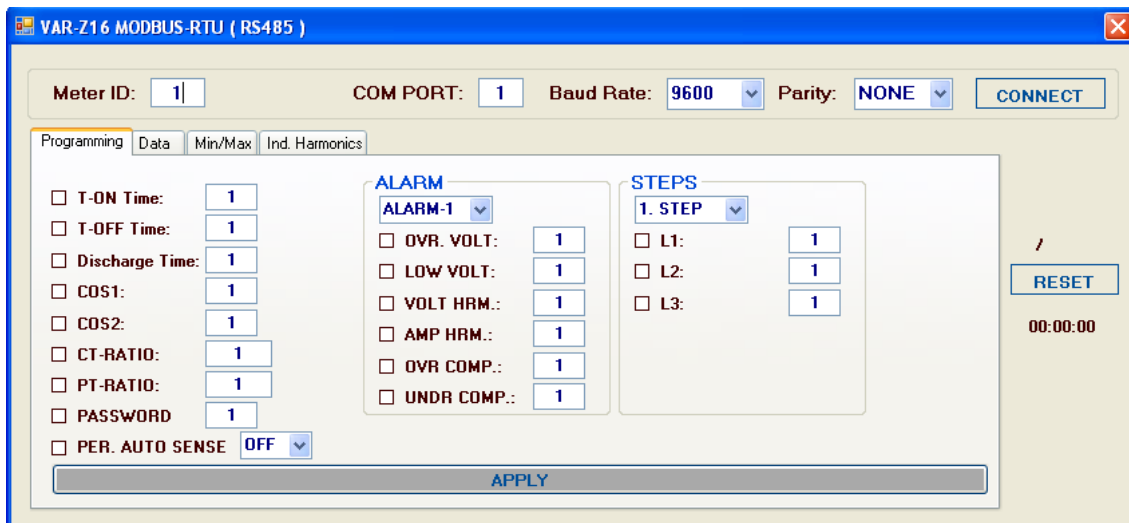
Once you run VAR-Z16.msi file from CD, following window will appear on your screen.



Click on Next button then following window will appear, which shows Utility installation location.

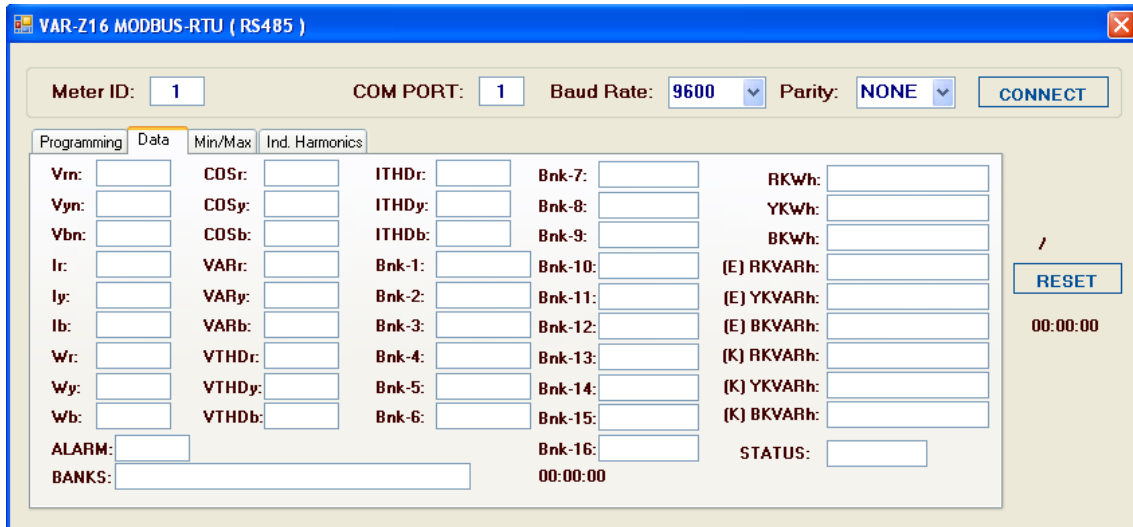


Click on Next button to proceed further to complete setup procedure. After completion of setup, sort cut icon will appear on your desktop by name "VAR-Z16 MODBUS-RTU". And, new folder will be added in your START menu which is "VAR-Z16". To, launch application click on "VAR-Z16 MODBUS-RTU" and following window will appear on screen.

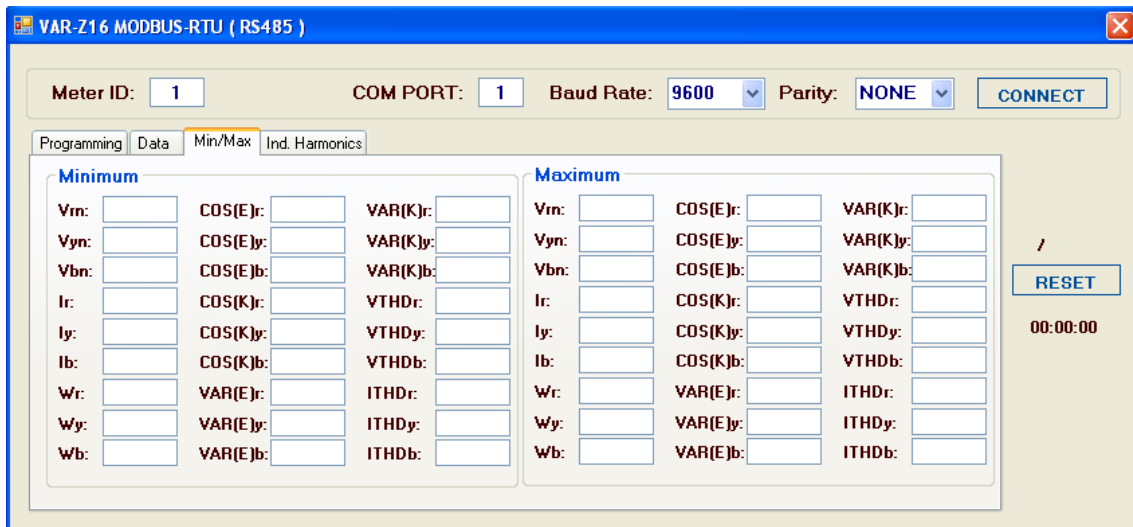


In, above screen, we have to provide communication parameter same as set in meter & then click on "CONNECT" button. "Programming" tabs shows all programmable parameters. Select parameters by Click on Checkbox, if you want to

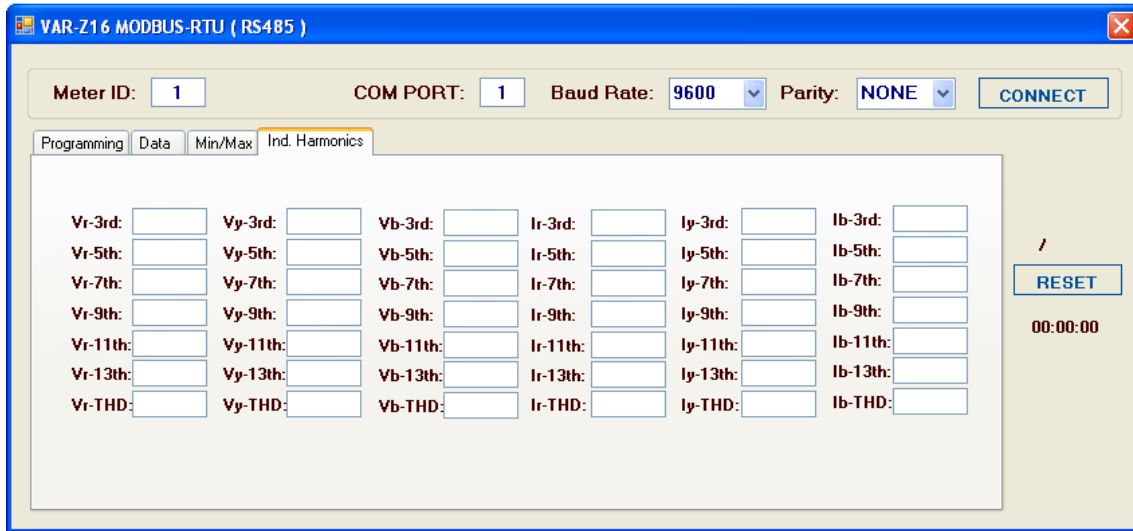
program those parameters. Then click on “APPLY” to program selected parameters via checkboxes.



Above screen shows, data collected by Query-03 (Read Holding Register). This utility not only providing facility of parameter programming over RS485, but it also send query-03 to read supported parameter over RS485.



Above screen shows Minimum & Maximum data for supported parameters.



Above screen shows Harmonic Data.

P.O No. :

Customer :

Sr. No. :

Routine and function tests conducted to relevant standards and our Specifications/Literature/O & M Manual.

Traceability: tested against "MTE" Standard Model PRS400.3 having basic accuracy of 0.02% traceable upto International Standards derived using appropriate ratio techniques.

Result of Test :

Remarks :

Test engineer :

Date :
