User's Manual

V-PM2000 Series

VP-2040 User's Manual

Enhanced IED, Power Measurement, Power Quality and Monitoring Device

VEESTA WORLD

Author: Veesta World Co., Engineering Department

TRADEMARKS

VEESTA and **VEESTA WORLD** are trademarks of Veesta World Co. Iran

V-PM2000 is trademarks of Power Measurement system of VEESTA WORLD Co.

NOTICE

The information in this document is subject to change without notice and should not be construed as a commitment by VEESTA WORLD Co. Veesta World Co assumes no responsibility for any errors that may appear in this document.
In no event shall Veesta World Co be liable for direct, indirect, special, incidental or consequential damages of any nature or kind arising from the use of this document, nor shall Veesta World Co be liable for incidental or consequential damages arising from use of any software or hardware described in this document.

DOCUMENT HISTORY

Version	Date	Comment
1.0	2017/07/18	First issue
1.1	2019/08/18	Add CT information

TABLE OF CONTENT

TABLE OF FIGURES

INDEX OF TABELS

Chapter 1 - Introduction

1.1 General Information

The power quality meter as Enhanced IED VP-2040 is an ideal device to power monitoring in power quality when continuous monitoring to a power system is required.

The VP-2040 provides metering for current, voltage, real and reactive power, power energy, power factor, frequency energy demand. Programmable set-points and optional assignable output relays allow control functions to be added for specific applications. This includes basic alarm on over/under current or voltage, unbalance, demand based load shedding, and capacitor power factor correction control. More complex control is possible using the 8 switch inputs which also can be used for status such as breaker open/closed, or optional pulse counter to flow information or demand synchronized trigger and etc.

The provided measurement to main of AC power and digital inputs and digital outputs, the VP-2040 may be used as a data gathering device for a plant automation system that integrates process, instrument and electrical requirements. All monitored values are available via digital communication ports RS485 running the ModBus® protocol. If analog values are required for direct interface to a PLC, and of the monitored values can be output to one analog output and 2 pulse outputs.

The quality of the power system is important with increasing use of electronic loads such as switching power or variable frequency drives. With the VP-2040 auxiliary input/output, any phase current/voltage can be displayed and the harmonic content calculated. By knowing the harmonic distribution, action can be taken to prevent overheated transformer, motors, capacitors, neutral wires and nuisance breaker trips. Redistribution of system loading can also be determined. Waveform and chart recorder printouts available from the VP-2040 assist in problem diagnosis.

1.2 Features

VP-2040 is a multi-functional power meter, integrating data acquisition and control into a whole. It can take the place of numerous meters, relays, transducers, and other components. Besides, it can be used in electric power systems of various voltage classes.

VP-2040 provides one RS485 communication port, so it can be integrated into any electric power monitoring system. The management software or other configuration software with which it is equipped enables the setting to be carried out easily. Furthermore, it provides an optional PROFIBUS communication port, whose 1.5Mbps communication speed can fully meet the demand for obtaining real-time data on the site.

VP-2040 is really a measuring meter based on true effective values, able to carry out accurate measurement of highly non-linear loads. The complicated sampling technology enables it to measure true effective values up to the 31st harmonic. The user can read remotely some dozens of measured values and minimum/maximum values on a display screen or via software.

VP-2040 provides multiple extension modules and advanced software functions to meet the demands of different sites. Its flexible DI/DO configuration facilitates the design of the user.

VP-2040 adopts connection realized by terminals that can be pulled out and inserted, thus facilitating on-site wiring and maintenance. Especially for the parts to which current is inputted, VP-2040 uses lockable fixation connections to prevent dangers that may be caused by accidental coming off of connections.

1.2.1 Characteristics

- Metering of distribution feeders, transformers, generators, capacitor bands and motors
- Medium and low voltage systems
- Achieving the class-1 measuring accuracy stipulated by IEC 62053, with bidirectional four-quadrant energy values
- High-accuracy measurement of current and voltage (0.1%) (typical situation).
- Commercial, industrial, utility
- Flexible control for demand load shedding, power factor, etc.
- Power quality analysis
- A / W / Var / VA demand
- 8 digital inputs

- 2 controlled relay outputs
- 1 analog output to a transducer function
- 2 pulse outputs based on KWH, KVarH, KVAH or AH
- 50 SOE Event log records
- Minimum / maximum logger
- harmonic analysis through 31rd
- Triggered memory (Fault recording)
- Demand calculation and maximum recording.
- Build-in clock
- Large high-contrast LCD screen, easy for operating and setting with password lock
- RS485 serial port
- ModBus® RTU protocol

1.2.2 Standard features

The VP-2040 of panel mount type with display is easy to local interface. Standard models offer RS485 ModBus® communications for programming and monitoring. To replace expensive additional devices as control output, transducer output and power analysis use with auxiliary I/O monitoring can be required to the VP-2040 option series.

1.2.3 Metering

Each voltage and current is sampled 64 times per cycle for 0.2% accuracy true RMS measured values.

- Ia, Ib, Ic, In
- Va, Vb, Vc, Vab, Vbc, Vca
- W, Var, VA, total & individual
- Hz & phase rotation sequence
- Current & Voltage Unbalance
- True PF & K factor
- WH, VarH
- Demand: A, W, Var, VA

A keyboard and light contrast LCD display module are used for field programming, setup monitoring values and status.

1.2.4 Set-points to Alarms

Any of the assignable output relays may be used to trigger and alarm for specific applications.

Table 1-1: VP-2040 Set-points condition table

Condition	Application
Over current	*Motors / transformers*
Under current	*Pumps / compressors*
Over load	*Motors / transformers*
Over line voltage	*Equipment protection*
Under line voltage	*Motors / load transfer*
Over phase voltage	*Equipment protection*
Under phase voltage	*Motors / load transfer*
Phase lost	*Pumps / equipment*
Over frequency	*Generators*
Under frequency	*Load shedding*
Switch input	*Process control*

1.2.5 Communications

Integrate process, instrumentation and electrical requirements in a plant automation system by connecting VP-2040 meters together to a DCS or SCADA system. A PC running the VP-2040 can change system set-points, monitor values, status and alarms. Continuous monitoring minimizes process downtime by immediately identifying potential problems due to faults or changes from growth.

- RS485 ModBus® 4,800; 9600; 19,200; 48,400 bps
- RTU SCADA system component
- Measure actual values
- Read status
- Issue control commands
- Load all set-points
- Change individual set-points

1.2.6 Upgrade to future expansion

The VP-2040 has ability to expansion module during ordering. Bellow type of expansion module can be order:

- Option A: 4 x Status inputs + 4 x Relay outputs
- Option B: 8 x Status inputs + 2 x Relay outputs
- Option E: 8 x Status inputs + 2 x pulse outputs
- Option P: PROFIBUS communication module

1.3 Power Conventions

Based on bellow diagram the VP-2040 can calculate all of power electric parameters that used in industry.

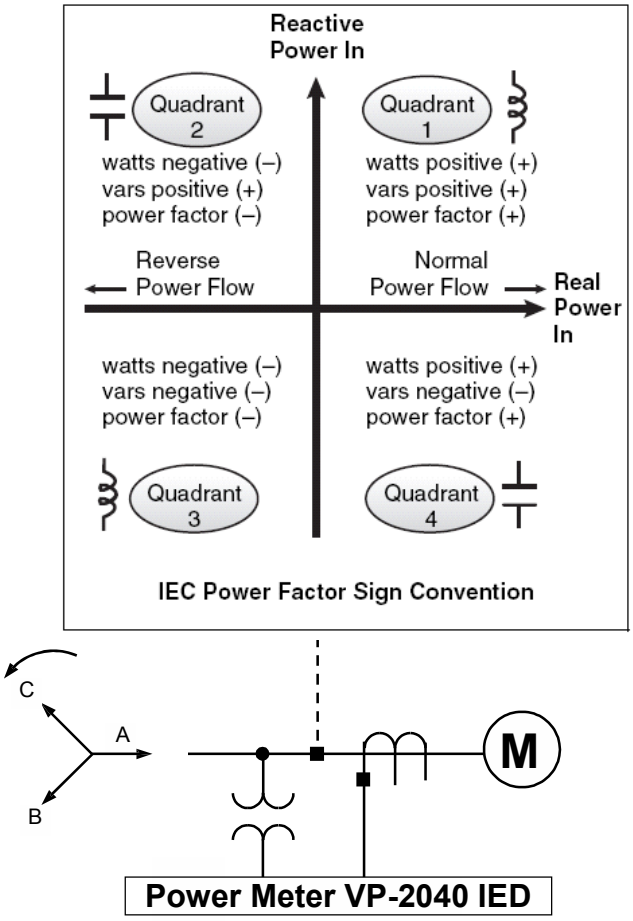


Figure 1-1: VP-2040 E-IED Metering Conventions

1.3.1 Measured parameters

VP1 / VP2 / VP3	3 phase, phase to neutral voltage
VPE	Average of VP1 / VP2 / VP3
VL1 / VL2 / VL3	3 phase, line to line voltage
VLE	Average of VL1 / VL2 / VL3
A1 / A2 / A3 / A0	3 phase and neutral current
AE	Average of A1 / A2 / A3
W	3 phase total active power
W1 / W2 / W3	3 phase individual active power
Q	3 phase total reactive power
Q1 / Q2 / Q3	3 phase individual reactive power
VA	3 phase total apparent power
VA1 / VA2 / VA3	3 phase individual apparent power

WH (±)	3 phase active energy
VarH (±)	3 phase reactive energy
PF	3 Phase total power factor
PF1 / PF2 / PF3	3 phase individual power factor
Frequency	Line frequency
Vubl / Aubl	% unbalance to 3 phase V and A
WD	Watt demand
QD	Var demand
SD	Apparent demand
Status	Switch status input DI1 to DI8

1.4 IED Options

The provided measurement to main of AC power and auxiliary of digital inputs, digital outputs, analog output, the VP-2040 may be used as a data gathering device for a plant automation system that integrates process, instrument and electrical requirements. All monitored values are available via RS485 digital communication ports running the ModBus® protocol.

1.4.1 Option

Bellow options can be order for IED options in hardware and software view of product:

- **Status inputs:** status inputs with internal DC24V powered can be configured to 4 or 8 status inputs (breaker condition).
- **Analog outputs:** one analog output can be used to replace analog transducers. Output signal can be selected from any of the measured parameters.
- **Energy pulse outputs:** 2 energy pulse outputs of WH and VarH can be used to energy management or used to replace energy transducer.
- **Relay outputs:** many alarm set-points with 2 or 4 relay control output or command output for breaker. The relay output can be operating in local mode (alarm set point) or in remote mode to receive commands from remotes.

1.5 Power analysis

1.5.1 Harmonic Analysis

Non linear loads such as variable speed drives, computers and electronic ballasts can cause harmonics which may lead to problems such as nuisance breaker tripping, telephone interference, transformer, capacitor or motor overheating. For fault diagnosis such as detecting undersized neutral wiring, need for a harmonic rated transformer, or effectiveness of harmonic filters, details of the

harmonic spectrum are useful and available with the power analysis option.

1.5.2 Event Logger

Alarms, set-point triggers, input and output events can be stored in a 50 event record and time / date stamped by the internal clock. This is use full for diagnosing problems and system activity. Minimum and maximum values are also continuously up dated.

1.6 VP-2040 IED Software Tools program

The VP-2040 IED Tool is PC program in Windows based program for the VP-2040. It can be used to enter set-points, read metered values, monitor status and evaluate power quality. All data continuously gathered by the VP-2040 can be transferred to a third party software program for display, control or analysis via the communications interface.

Once all set-points have been entered they can be downloaded into any VP-2040 or stored in a file with a tag name for later reference. Screens are available for monitoring all measured values such as current, voltage or power. Status of alarms and control settings can also be displayed.

Harmonic analysis may reveal excessive harmonic content requiring a dreaded transformer or larger neutral wire. Early warning of these problems can prevent equipment damage or nuisance breaker tripping.

Chapter 2 - Model & Ordering

2.1 Overview

The VP-2040 Enhanced-IED has some models that during product ordering shall be defined about desired model. In the figure bellow you can see model and ordering forms.

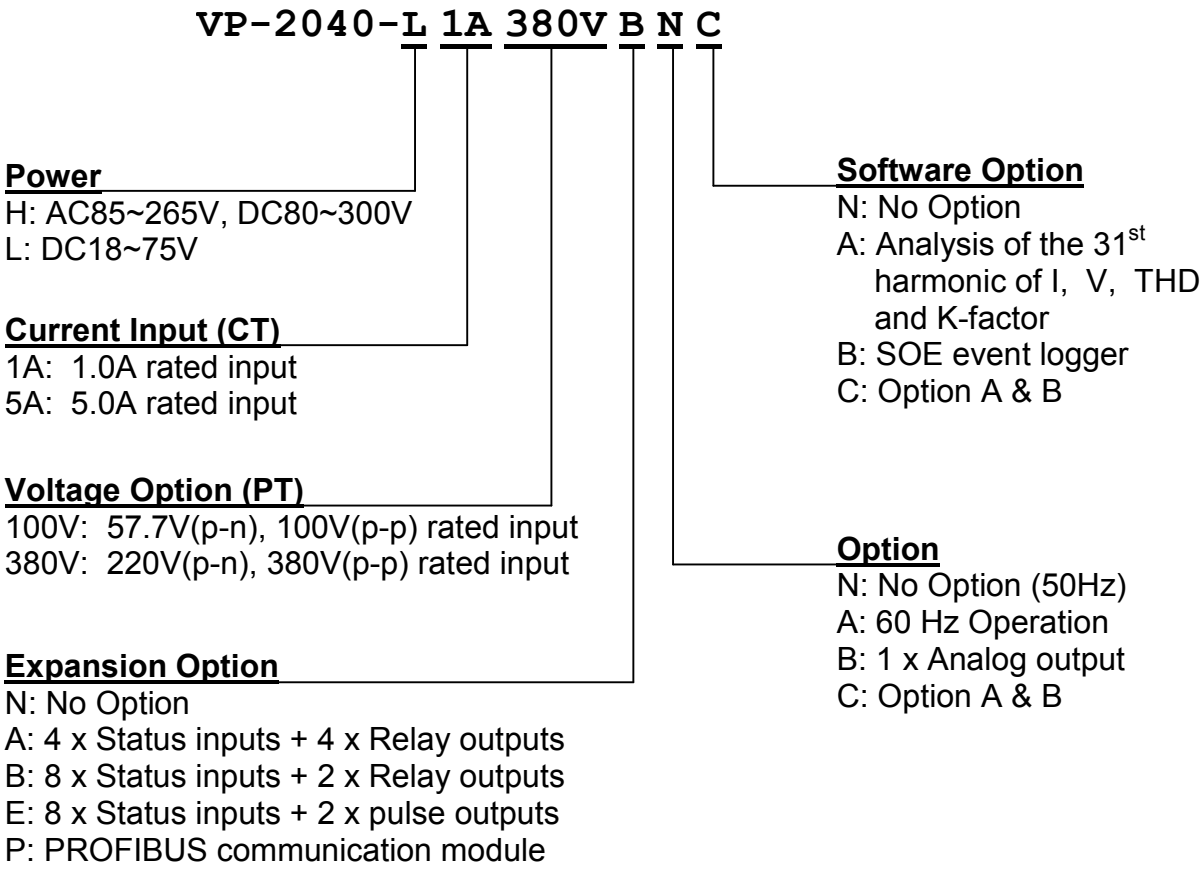


Figure 2-1: VP-2040 Models & Ordering

Chapter 3 - Specifications

3.1 VP-2040 Specifications

3.1.1 Measured Power Parameters

1.	**Display**	:	All measured display scaled to primary readout - Display 4 digits to V / A / W / Var / VA / PF - Display 9 digits to WH / VarH All Status Input/Output and communication All Demand, Harmonic data All Setting and programmable options
2.	**Power Values Display & Measurement**	:	True RMS, 1 sec refresh time VP1 / VP2 / VP3 / VPE, phase to neutral voltage VL1 / VL2 / VL3 / VLE, line to line voltage A1 / A2 / A3 / AE/ A0, phase current VPE / VLE / AE, 3 phase averaged A0, neutral current PF1/PF2/PF3, coincident to conversion element WH / VarH accuracy vs limited input range Up to 31st harmonic analysis, K factor, THD
3.	**Display Screen Type**	:	Large Backlit FSTN LCD display / Blue color

3.1.2 Main AC Power input

1.	**Phase & Wires**	:	3 phase 4 wires wye 3VTs 3 phase 4 wires wye 2VTs 3 phase 3 wires
2.	**Input Voltage Range**	:	Option 100V: 57.7V(p-n), 100V(p-p) rated input Option 380V: 220V(p-n), 380V(p-p) rated input
3.	**Input Current Range**	:	Option 1A: 1.0A rated input Option 5A: 5.0A rated input

4. **Burden** : Voltage < 0.2VA at 600V / phase
   0.02VA at 120V / phase
   Current < 0.1VA at rating

5. **Current Overload capacity** : 120% x rated continuous
   10 x rated 1 seconds
   25 x rated 2 seconds / 50 x rated 1 seconds

6. **Voltage Overload capacity** : 120% rated continuous
   2x rated 1 seconds

3.1.3 Measuring Accuracy

1. **Voltage** : Accuracy: 0.2% Resolution: 0.01 V
   Measuring Range:
   - Directly: 300Vph-N, 520Vph-ph
   - PT primary: 0~499,999V
   - PT secondary: 57.7Vph-N, 100Vph-ph

2. **Current** : Accuracy: 0.2% Resolution: 0.001 A
   Measuring Range:
   - CT primary: 0~49,999A
   - CT secondary: 1 A or 5A

3. **Power** : Accuracy: 0.5% Resolution: 0.1 W/Var
   Measuring Range: Each phase: 0~100 MW/Mvar

4. **Power Factor** : Accuracy: 0.5% Resolution: 0.001
   Measuring Range: -1.000 ~ +1.000

5. **Frequency** : Accuracy: 0.01 Resolution: 0.01 Hz
   Measuring Range: 35~ 65 Hz

6. **Active Energy** : Accuracy: 1.0% Resolution: 0.1 kWh
   Measuring Range: 0~ 99,999,999.9 kWh

7. **Reactive Energy** : Accuracy: 2.0% Resolution: 0.1 kWh
   Measuring Range: 0~ 99,999,999.9 kVarh

8. **THD** : Accuracy: 1.0% Resolution: 0.001
   Measuring Range: 0~100.0%

9. **Individual Harmonic** : Accuracy: 1.0% Resolution: 0.001
   Measuring Range: 0~100.0%

10. **Unbalance** : Accuracy: 1.0% Resolution: 0.001
    Measuring Range: 0~100.0%

3.1.4 Optional Auxiliary Monitoring

1. **Digital Input (DI)** : 4 or 8 status input by option choose
   Internal powered of DC 30V
   Input / dry contact

2. **Control Output (CO)** : 2 or 4 Relay outputs by option choose
   Dry contact form A SPST
   Contact material: gold plate silver alloy
   Normal operation:
   - 220Vac / 30Vdc, 5A resistive

3. **Analog Output (AO)** : 1 Analog output by option choose
   Accuracy, 0.5% fs
   Standard output: 4-20mAdc
   Load resistance 400Ω
   Configurable:
   - Measured parameters
   - Input range, uni-polar / bipolar

4. **Pulse Output (PO)** : 2 pulse outputs photo-isolated by option choose
   Configurable:
   - Parameter: WH / VarH
   - Unit: ±1WH / ±1QH

   Pulse width: 80 ms, 50% duty cycle

3.1.5 Communication Port

1. **Rear panel port** : RS-485 Network 2 wires for networking to master
   Baudrate: 4800, 9600, 19200, 38400bps

2. **Communication Protocol** : ModBus RTU Protocol
   Address: 1~247

3.1.6 Alarms trip set-point

1. **Set points** : 44 set point,
   Over current, under current, over voltage, under voltage, over load, phase lost, over frequency, under frequency, status change
   Circuital set-value
   Time delay

3.1.7 Data Logger Feature

1.	**Event Logger**	:	50 events with time-stamped in NVRAM Status change of switch input Activation of set-points Alarms Operation of controlled relay output
2.	**Control Output**	:	2 assignable relay outputs
3.	**Max / Min Logger**	:	12 parameters without time-stamped A1, A2, A3, W, Var, VA, Voltage V1,V2,V3 THD, Current A1,A2,A3 THD
4.	**Demand / Max Logger**	:	4 parameters with time-stamped AE, W, Var, VA

3.1.8 Standards

1.	**Metering**	:	Class 1 For: Electricity Metering Part 21 Active Energy IEC 62053-21 Electricity Metering Part 21 Reactive Energy IEC 62053-23
2.	**Dielectric Strength**	:	2KV ACrms 1 minute IEC 255-5 Insulation resistance ≥50MΩ
3.	**Impulse & Surge Test (EMC)**	:	Electrostatic discharge immunity test IEC 61000-4-2,Level 4 Radiated immunity test IEC 61000-4-3,Level 3 Electrical fast transient/burst immunity test IEC 61000-4-4,Level 4 Surge immunity test (1, 2/50μs~8/20μs) IEC 61000-4-5,Level 3 Conducted emissions EN 55022,Class B Radiated emissions EN 55022,Class B

3.1.9 Environment

1.	**Operating Condition**	:	Temperature range: -20 to +60°C
2.	**Storage Condition**	:	Temperature range: -30 to +70°C
3.	**Humidity Condition**	:	RH: 5-95% non-condensed

3.1.10 Power Supply

1.	**Power Supply Input**	:	Option H: 85~265 VAC or 80~300V DC Option L: 18~75V DC
2.	**Power consumption**	:	< 2VA

3.1.11 Dimension / Physical

1.	**Dimension**	:	DIN 96 x 96 x 18 mm Case: 96 x 96 x 83 mm (with option 118)
2.	**Mounting**	:	Front Panel mounting Depth without expansion option: 65 mm Depth with expansion option: 100 mm
3.	**Cut out**	:	90^{+1} x 90^{+1} mm
4.	**IP Index**	:	IP54 (front panel) and IP20 (case)
5.	**Weight**	:	Approx. 500gr.

Chapter 4 - Measuring Capability

4.1 Real-time based Electrical Parameters

The VP-2040 provides voltage, current, power, and frequency etc. basic parameters. The following data are effective real values, and the refresh rate is 1 second.

Table 4-1: VP-2040 Electrical Parameters

Real-time Measuring	Measuring Range
Current	
Each Phase	*0 – 50,000 A*
Zero sequence	*0 – 50,000 A*
Degree of unbalance (%)	*0 – 100%*
Voltage	
Line - Line	*0 – 500 kV*
Line - Neutral line	*0 – 500 kV*
Degree of unbalance (%)	*0 – 100%*
Active Power / Reactive Power / Apparent Power	
Single Phase	*0 - ± 100 MW / Var / VA*
Total	*0 - ± 100 MW / Var / VA*
Power Factor	
Single Phase	*-1.000 – +1.000*
Total	*-1.000 – +1.000*
Other Measuring	
Frequency	*35 – 65 Hz*

4.2 Power Factor Symbols

The symbols of measuring power factor conform to the stipulations of IEC, and the figure below describes the relevant definitions.

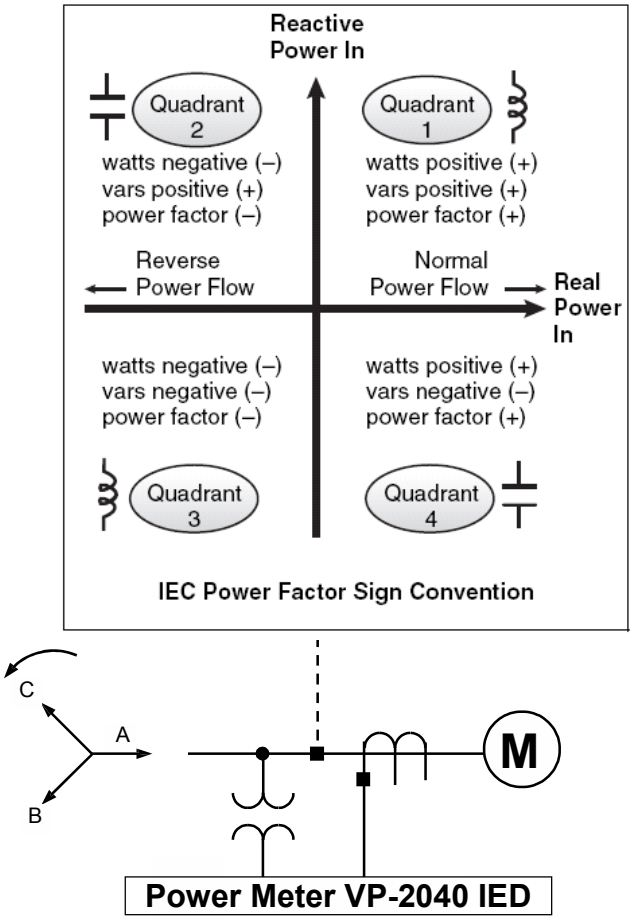


Figure 4-1: VP-2040 Power Factor Symbols

4.3 Demand Parameters

Demand refers to the value obtained in the following way: the accumulated electrical parameters within a period of time divided by the time length. To facilitate the operation of the user, VP-2040 adopts the fixed-block calculation method in the fixed period of time, and the period of time is fixed, being 15 minutes.

VP-2040 provides the following demand data and measuring ranges:

Table 4-2: VP-2040 Demand Parameters

Demand Reading	Measuring Range
Demand Current	
Three-phase average value	*0 – 50,000 A*
Maximum peak	*0 – 50,000 A*
Active Power / Reactive Power / Apparent Power	
Three-phase average value	*0 - ± 100 MW / Var / VA*
Maximum peak	*0 - ± 100 MW / Var / VA*

The figure below describes demand calculation:

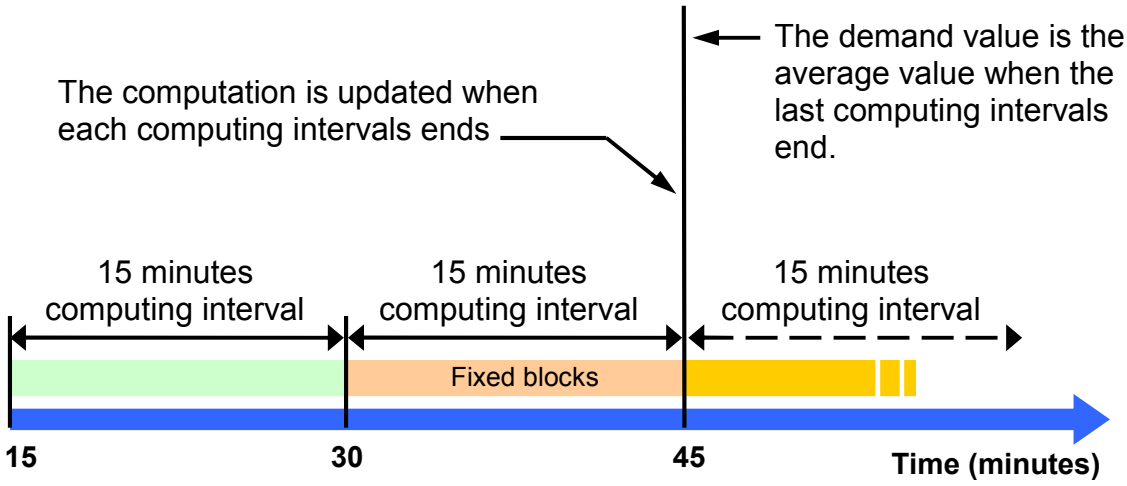


Figure 4-2: VP-2040 Power Factor Symbols

4.4 Energy Parameters

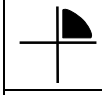
The VP-2040 can measure bidirectional four-quadrant active and reactive energy, and the maximum accumulated value is up to 99,999,999.9

The decimal place will not show. When the accumulated value reaches to maximum, it will overturn automatically.

The polarity of energy is identical to that of power, both conforming to the stipulations of IEC standards. For the relevant definitions, please refer to the descriptions of 4.2 Power Factor Symbols.

The table below describes the interrelationships of various types of energy and the symbolic relationships between energy and power:

Table 4-3: VP-2040 Energy Parameters

Direction	IEC Quadrant		Power Sign
Active Energy Input		First-quadrant active energy	Positive Inductive Active Power
		Fourth-quadrant active energy	Positive Capacitive Active Power
Active Energy Output		Second-quadrant active energy	Negative Capacitive Active Power
		Third-quadrant active energy	Negative Inductive Active Power
Reactive Energy Input		First-quadrant reactive energy	Positive Inductive Reactive Power
		Second-quadrant reactive energy	Positive Capacitive Reactive Power
Reactive Energy output		Third-quadrant reactive energy	Negative Inductive Reactive Power
		Fourth-quadrant reactive energy	Negative Capacitive Reactive Power

4.5 Harmonic Parameters

The VP-2040 provides optional measurement of complete 31st harmonic for voltage and current as well as their total harmonic content (THD) and K factor of current.

The data of harmonics are given according to the percentage of fundamental harmonics and have one digit after the decimal point. That is to say, when the value of the fundamental harmonic is fixed at 1000, it is 100.0% of the effective value of the fundamental harmonic; others are by analogy.

THD refers to the total of higher harmonics except fundamental harmonics, and it is calculated according to the following formula:

$$THD = \sqrt{\sum_{i=2}^{i=n} X_i^2}$$

The formula for calculating K factor is as follows:

$$K = \sqrt{\sum_{i=1}^{i=n} (i \times X_i)^2} \Big/ \sqrt{\sum_{i=1}^{i=n} X_i^{\,2}}$$

In above formulas:

- i : Harmonic order.
- X_i : Percentage of the effective value of each harmonic to that of the fundamental harmonic.
- n : Highest harmonic order, which should be 31 here.

Notes:

- Each harmonic and THD can be checked through display or communication.
- K factor can be checked only through communication.

Chapter 5 - IED Capability

5.1 Status Input

The VP-2040 provides 4 or 8 status input channels based on model chooses, which are used to detect state information such as breaker position signals and isolator position signals.

The Internal wet DC voltage will be used to send to the dry node contacts and return nodes in close or open circuits. When external nodes are closed, the corresponding status input channels will be closed.

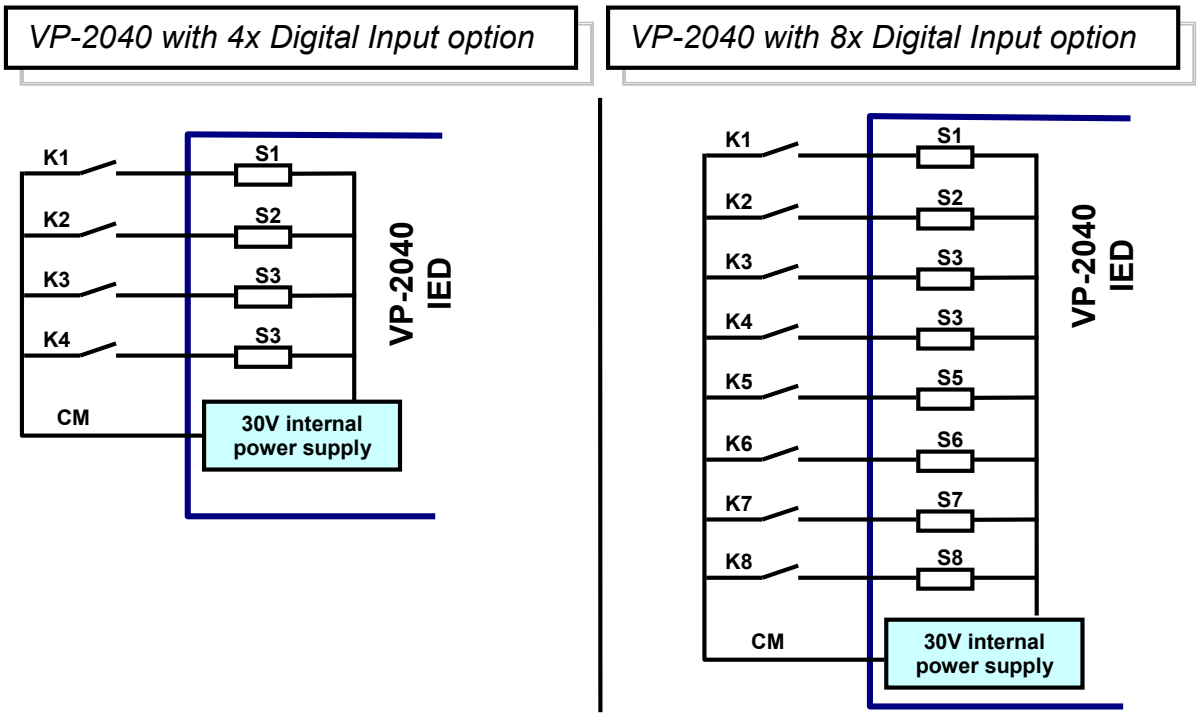


Figure 5-1: VP-2040 Status Input Capability

Since there is a power supply available for detection and providing the wet voltage for field inside the meter, any external nodes cannot be further connected to any another voltage system. Otherwise, the status input channels will be burnt down.

5.2 Relay Output

The VP-2040 provides 2 or 4 relay output channels based on model choose. The contact of each relay output is in mode of SPST-NO (Single Pole, Single Throw, and Normally Open).

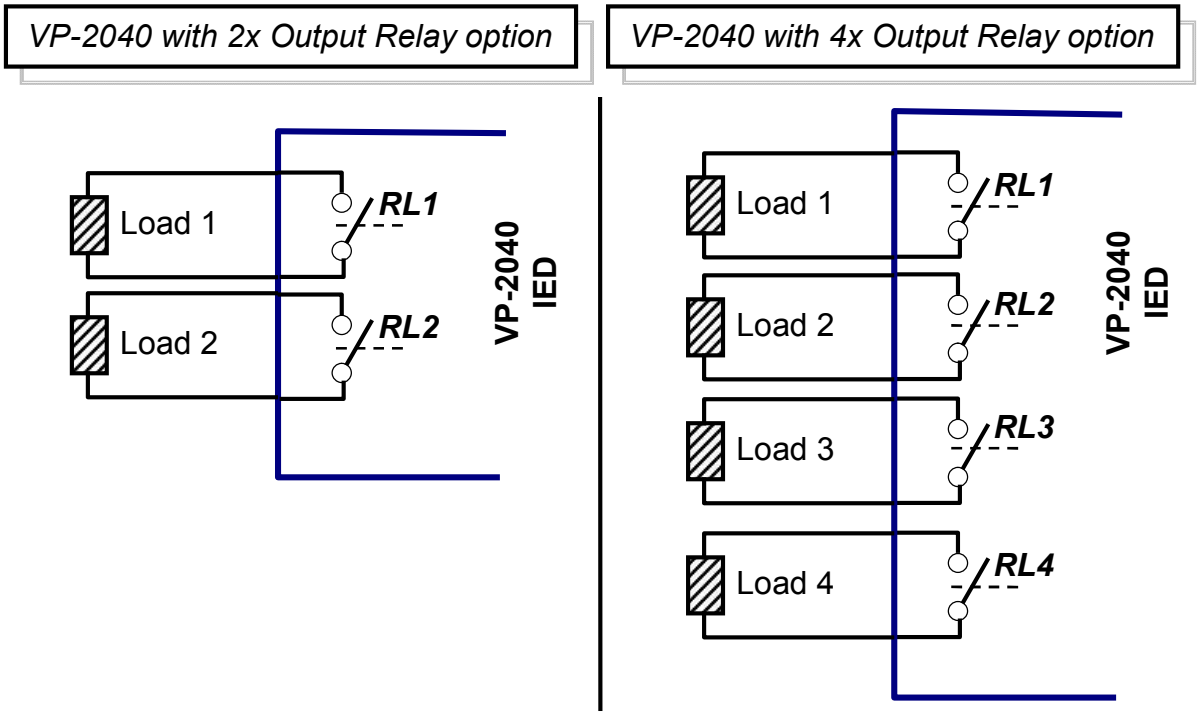


Figure 5-2: VP-2040 Relay Output Capability

The VP-2040 provides two relay control modes. They are Remote control and Local control modes. The action of relay is different in these two modes. So, users should distinguish the relay is in Remote control mode or in Local control mode at first.

The default control mode of the product is Remote control. Users can change the mode through communication or via front panel.

- **Remote Control mode (external)** - The relay is controlled by a PC or PLC by using commands through Modbus RTU communication protocol.
- **Local Control mode (internal)** - The relay is controlled by one of the electrical parameters inside the meter, which serves as the response to the control alarm conditions of a set point.

Once the relay has been in the remote control mode, even though the local control conditions have been set, the relay will not operate. Therefore for any set point and alarm that trigger action need that the relay mode must be set at local control mode.

Also there are the two relay operations modes are as follows:

- **Normal Operation:** that in two difference mode provides:
  - *Remote Control mode*: By receiving a command from a PC or PLC, the relay closes. The relay's status will be kept until the PC or PLC gives a release command or the meter is de-energized.
  - *Local Control mode:* When an alarm signal activating the relay is generated, the relay operates. The relay will not be released until all the alarm conditions activating the relay disappear or the meter is de-energized. If the power supply for the meter is resumed and the alarm conditions still exist, the relay will operate again.

- **Time Delay Reset:** that in two difference mode provides:
  - *Remote Control mode*: By receiving a command from a PC or PLC, the relay operates. The relay's operating status will be kept until a special timer overflows or the meter is de-energized. If, before the timer overflows, there is a new command that makes the relay operates, the timer will restart.
  - *Local Control mode*: When an alarm signal activating the relay is generated, the relay operates. The relay's operating status will be kept within the period of time for timing. When the timer overflows, the relay will be released and kept released.

5.3 Pulse Output

The VP-2040 provides optional two pulse output outlets, one for active energy pulse output and the other for reactive energy pulse output. The user can self-define the type of energy, and the default types are active energy input and reactive energy input. The user can also forbid pulse outputs.

A typical wiring mode of external acquisition equipment is shown as follows:

VP-2040 with 2x Pulse Output option

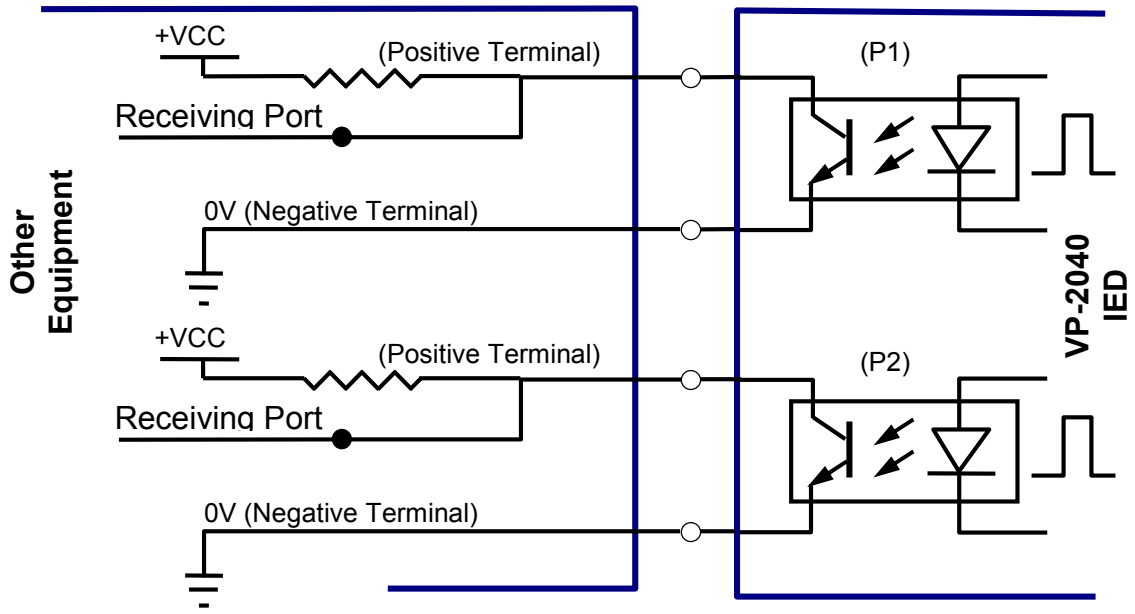


Figure 5-3: VP-2040 Pulse Output Capability

Attention

- Different pulse acquisition devices have different operating modes. The pulse output port circuit provided by VP-2040 is adopting the collecting electrode open-circuit mode, isolated by optically coupled.
- For the collecting electrodes, open-circuit characteristics should be in range 48V ≤ Vcc ≤ 50V for voltage and I ≤ 50mA for current

The pulse outputs of VP-2040 correspond to the signal energy values inputted into the meter, and they can also be called secondary side energy values. When the user calculates the actual energy, the pulse outputs should be multiplied by the CT and PT factors.

Each pulse does not represent one kilowatt-hour or kilovar-hour, so the user needs to set a reasonable pulse constant. The maximum setting range is between 1000 and 40000.

The maximum pulse speed does not exceed 200 ms, which means that, when the accumulated energy of the meter is 1 kwh, the number of pulse outputs is N.

Please note that the energy values here are all secondary side data. Therefore, when there are PTs and CTs, the primary side energy corresponding to N pulses should be 1 kwh×PT×CT .

The maximum settable scope of 220V/5A range is 1000 to 5000, those of 220V/1A and 100V/5A ranges are both 1000 to 20000, and that of 100V/1A range is 1000 to 40000.

The pulse lengths are all 100ms.

5.4 Analog Output

The VP-2040 can provide one optional 4-20mA analog output, supporting the access of the DCS system. The user can, through the communication interface, set the parameter value corresponding to the analog output. The maximum load resistance of the interface should not exceed 500 Ohms.

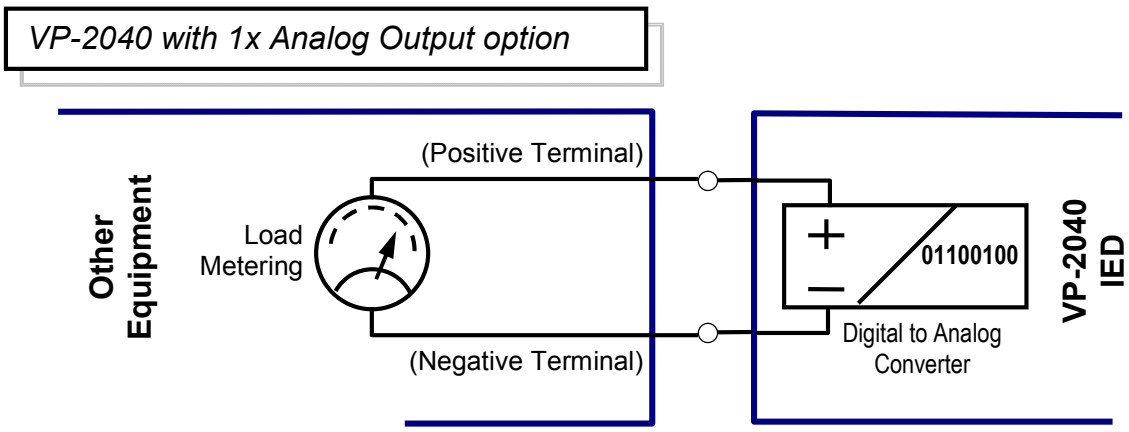


Figure 5-4: VP-2040 Analog Output Capability

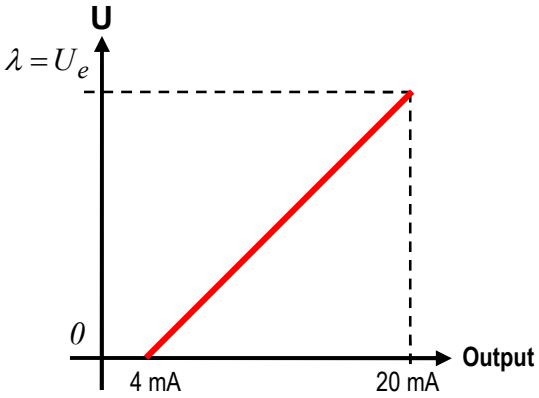
On some sites, due to different transmission cables or loading conditions, the analog output at the high end appears to be non-linear. VP-2040 provides a settable magnification factor. By modifying the magnification factor, the user can adjust the proportion factor of the output curve.

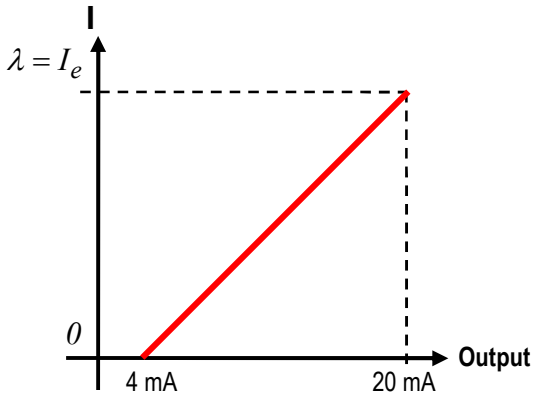
The analog output can be set as any of the items in the table below:

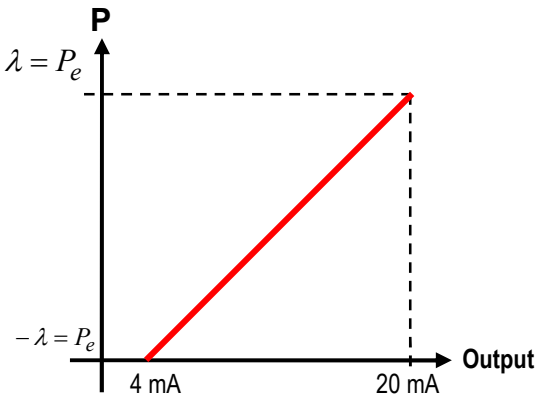
Table 5-1: VP-2040 Analog Output Parameters

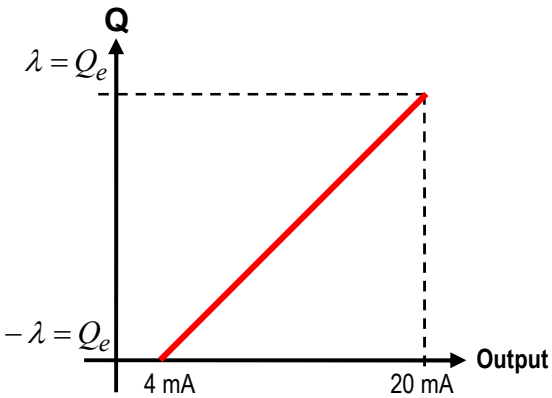
Parameter	Value Type
Phase Voltage	*1- Phase A Voltage, 2- Phase B Voltage, 3- Phase C Voltage*
Voltage	*1- Line A-B Voltage, 2- Line B-C Voltage, 3- Line C-A Voltage*
Current	*1- Phase A Current, 2- Phase B Current, 3- Phase C Current*
Active Power	*Total Active Power*
Reactive Power	*Total Reactive Power*
Power Factor	*Total Power Factor*
Frequency	*System Frequency*

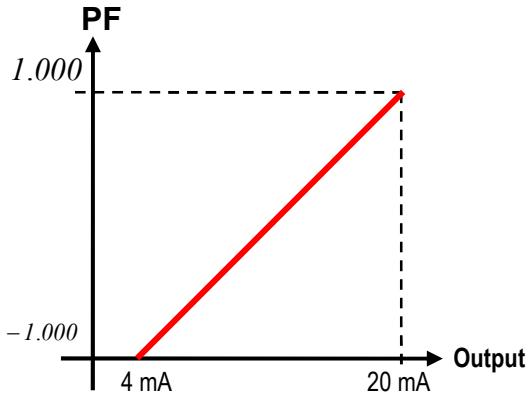
In the figure below shows the analog output characteristic curve, and the magnification factor is λ.

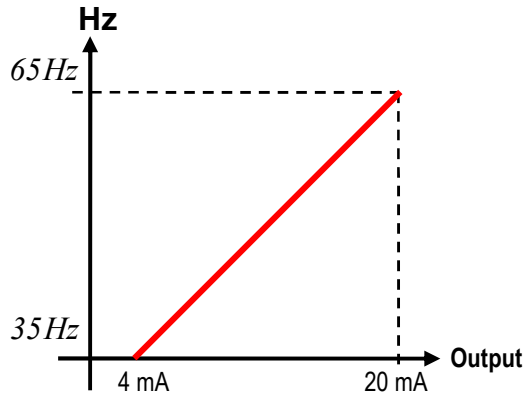












$$P = \frac{(P_\lambda - 12)}{8} \times P_e \times \lambda \times CT \times PT$$

P_λ : Measured value of the analog quantity, unit: mA;

P_e : Corresponding rated power value, unit: W/Var;

λ : Magnification factor of the corresponding channel. Its range is between 1 and 10.

$$P_e = \sqrt{3} \times U_e \times I_e$$

U_e : Rated line voltage of the meter

I_e : Rated current of the meter

5.5 Alarm System

The VP-2040 provides optional multiple relay alarm outputs, any of which can work independently and support the user's programming.

Any of the relay output that has been set at Local Control mode (refer to section 5.2 of this manual for more information) corresponds to alarm about voltage or current and etc. Each alarm needs 2 parameters for setting and triggering into memory and creates the alarm record event and also 3 parameters for trigger an output relay to act as alarm output status or act as tripping function.

Bellow table shows a list of alarm detection and its individual setting:

Table 5-2: VP-2040 Alarm System Capability

It.	Alarm Detection	Setting Parameter	Alarm
1	**Over Voltage Phase A**	Setting the upper limit in primary reading of Voltage and threshold action time in seconds.	☒Record ☒Output
2	**Over Voltage Phase B**	Setting the upper limit in primary reading of Voltage and threshold action time in seconds.	☒Record ☒Output
3	**Over Voltage Phase C**	Setting the upper limit in primary reading of Voltage and threshold action time in seconds.	☒Record ☒Output
4	**Under Voltage Phase A**	Setting the lower limit in primary reading of Voltage and threshold action time in seconds.	☒Record ☒Output
5	**Under Voltage Phase B**	Setting the lower limit in primary reading of Voltage and threshold action time in seconds.	☒Record ☒Output
6	**Under Voltage Phase C**	Setting the lower limit in primary reading of Voltage and threshold action time in seconds.	☒Record ☒Output
7	**Over Current Phase A**	Setting the upper limit in primary reading of Current and threshold action time in seconds.	☒Record ☒Output
8	**Over Current Phase B**	Setting the upper limit in primary reading of Current and threshold action time in seconds.	☒Record ☒Output
9	**Over Current Phase C**	Setting the upper limit in primary reading of Current and threshold action time in seconds.	☒Record ☒Output
10	**Under Current Phase A**	Setting the lower limit in primary reading of Current and threshold action time in seconds.	☒Record ☒Output
11	**Under Current Phase B**	Setting the lower limit in primary reading of Current and threshold action time in seconds.	☒Record ☒Output
12	**Under Current Phase C**	Setting the lower limit in primary reading of Current and threshold action time in seconds.	☒Record ☒Output
13	**Over Frequency**	Setting the upper limit in primary reading of Frequency and threshold action time in seconds.	☒Record ☒Output

It.	Alarm Detection	Setting Parameter	Alarm
14	**Under Frequency**	Setting the lower limit in primary reading of Frequency and threshold action time in seconds.	☒Record ☒Output
15	**Over Load**	Setting the upper limit in primary reading of Power and threshold action time in seconds.	☒Record ☒Output
16	**Phase Loss**	Setting the enabling the phase lost alarm detection	☒Record ☒Output
17	**Status Input Change**	Setting which input status channel and also set the change detection in from On to Off or from Off to On action	☒Record ☒Output
18	**Over Phase Voltage**	Setting the upper limit in primary reading of phase voltage for 3 phase system alarm detection and threshold action time in seconds	☒Record ☒Output
19	**Under Phase Voltage**	Setting the lower limit in primary reading of phase voltage for 3 phase system alarm detection and threshold action time in seconds	☒Record ☒Output
20	**Over Line Voltage**	Setting the upper limit in primary reading of line voltage for 3 phase system alarm detection and threshold action time in seconds	☒Record ☒Output
21	**Under Line Voltage**	Setting the lower limit in primary reading of line voltage for 3 phase system alarm detection and threshold action time in seconds	☒Record ☒Output
22	**Under Line Voltage**	Setting the lower limit in primary reading of line voltage for 3 phase system alarm detection and threshold action time in seconds	☒Record ☒Output
23	**Over Current**	Setting the upper limit in primary reading of line current for any of 3 phase system alarm detection and threshold action time in seconds	☒Record ☒Output
24	**Under Current**	Setting the lower limit in primary reading of line current for any of 3 phase system alarm detection and threshold action time in seconds	☒Record ☒Output

For more information about setting and parameters please refer to Chapter 9 - Register Map Profile .

5.6 Sequence of Event (SOE) Log

The VP-2040 provides optional function of recording up to 50 records of Sequence of Events (SOE), and the records can be kept for more than 10 years.

The SOE recording function can record the displacements of switch contacts. When an event occurs, the meter will automatically record the type of the event such as closing of status 1. At the same time, the year, month, day, hour, minute, second, millisecond when the event occurs will be recorded precisely, and the resolution is 2 ms.

Users can read all the SOE records through communication and Modbus RTU protocol. For details, refer to Chapter 9 - Register Map Profile .

A standard structure of SOE event data is as follows:

Table 5-3: VP-2040 SOE Capability

Byte	Definition	Description
0	**Type of Event**	1: S1 Channel 2: S2 Channel 3: S3 Channel 4: S4 Channel 5: S5 Channel 6: S6 Channel 7: S7 Channel 8: S8 Channel 9: Over Voltage Phase A 10: Over Voltage Phase B 11: Over Voltage Phase C 12: Under Voltage Phase A 13: Under Voltage Phase B 14: Under Voltage Phase C 15: Over Current Phase A 16: Over Current Phase B 17: Over Current Phase C 18: Under Current Phase A 19: Under Current Phase B 20: Under Current Phase C 21: Over Frequency 22: Under Frequency 23: Over Load 24: Phase Loss 25: 3x Phase Over Phase Voltage 26: 3x Phase Under Phase Voltage 27: 3x Phase Over Line Voltage 28: 3x Phase Under Line Voltage 29: 3x Phase Over Current 30: 3x Phase Under Current
1	**Status of Operation**	0: Open Status 1: Close Status Valid only for Type 1~8
2 - 3	**Milliseconds**	Milliseconds Time of event occurrence in one WORD format.
4 - 7	**Unix Clock**	Number of seconds that have elapsed since 00:00:00 in January 1, 1970 in Greenwich Mean Time. This format also called as Unix Time or POSIX Time or EPOCH Time

For more information about setting and parameters please refer to Chapter 9 - Register Map Profile .

Chapter 6 - Unit Installation

6.1 Unit Observation

The VP-2040 is DIN 96x96 device that install on the front panel of metering cubicles, control cubicles and normally in the medium voltage compartments of any power distribution system components. The bellow figure shows you observation on VP-2040:

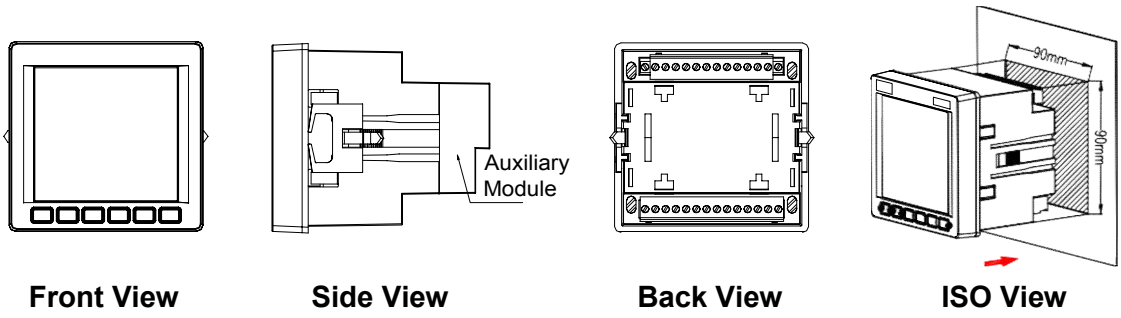


Figure 6-1: VP-2040 Unit Observation

6.2 Terminal Definitions

Based on each selected model, the VP-2040 has the special terminal definitions. By terminal number each terminal has a specific function, generally the VP-2040 without expansion module has 18 terminals and with expansion module has 42 terminals. You can find in bellow table for base system and expansion type the terminal definitions:

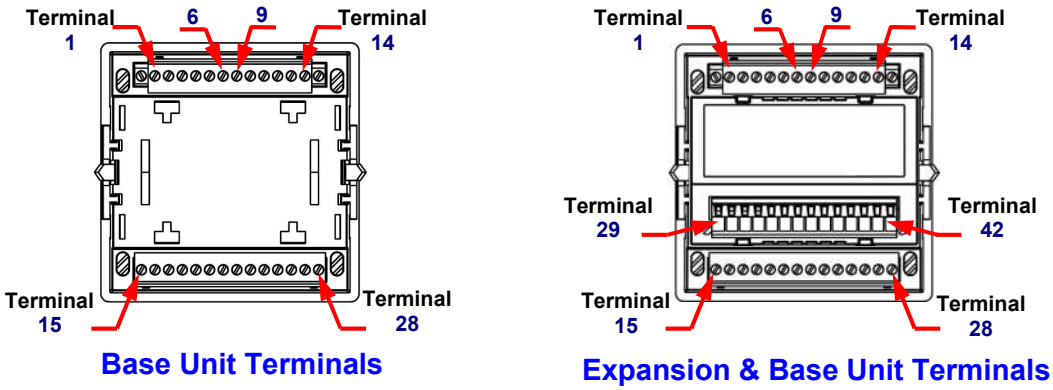


Figure 6-2: VP-2040 Terminal Definitions

6.2.1 Base Terminal Definitions

In regarding the only base unit used, there are 2 rows terminal and the terminal numbered from 1 up to 28. Please pay attention that terminal with code (--) tagged as NC (Not Connect), so you should leave this terminal float and disconnect to any wiring.

Table 6-1: VP-2040 Base Terminal Definitions

No.	Code	Definition
1	L/+	Positive of power supply
2	--	--
3	N/-	Negative of power supply
4	--	--
5	FG	Earth protection Field Ground System
6	--	--
~~7~~	~~(Not Exist)~~	
~~8~~	~~(Not Exist)~~	
9	I32	Phase C current outgoing line
10	I31	Phase C current incoming line
11	I22	Phase B current outgoing line
12	I21	Phase B current incoming line
13	I12	Phase A current outgoing line
14	I11	Phase A current incoming line
15	A+	Positive pole of RS485 (A)
16	B-	Negative pole of RS485 (B)
17	Sg	Communication shielded earth of RS485
18	--	--
19	--	--
20	A1(option)	Positive pole analog output (If AO option selected)
21	Ag(option)	Negative pole of Analog Output (If AO option selected)
22	VN	Voltage neutral line
23	--	--
24	V3	Phase C voltage
25	--	--
26	V2	Phase B voltage
27	--	--
28	V1	Phase A voltage

6.2.2 Expansion Option A: 4x Status + 4x Relay

The option with 4 Status Input and 4 Relay output has bellow terminal definition. The definition table terminal No started from 29.

Table 6-2: VP-2040 4x Status + 4x Relay Expansion Terminal Definitions

No.	Code	Definition
29	R42	Relay 4 output Common
30	R41	Relay 4 output Normally Open Contact
31	R32	Relay 3 output Common
32	R31	Relay 3 output Normally Open Contact
33	R22	Relay 2 output Common
34	R21	Relay 2 output Normally Open Contact
35	R12	Relay 1 output Common
36	R11	Relay 1 output Normally Open Contact
37	Cm	Positive Common power supply for Status Inputs
38	S4	Status 4 input
39	S3	Status 3 input
40	S2	Status 2 input
41	S1	Status 1 input
42	--	--

6.2.3 Expansion Option B: 8x Status + 2x Relay

The option with 8 Status Input and 2 Relay output has bellow terminal definition. The definition table terminal No started from 29.

Table 6-3: VP-2040 8x Status + 2x Relay Expansion Terminal Definitions

No.	Code	Definition
29	R22	Relay 2 output Common
30	R21	Relay 2 output Normally Open Contact
31	R12	Relay 1 output Common
32	R11	Relay 1 output Normally Open Contact
33	Cm	Positive Common power supply for Status Inputs
34	S8	Status 8 input
35	S7	Status 7 input
36	S6	Status 6 input
37	S5	Status 5 input
38	S4	Status 4 input
39	S3	Status 3 input
40	S2	Status 2 input
41	S1	Status 1 input
42	--	--

6.2.4 Expansion Option E: 8x Status + 2x Pulse

The option with 8 Status Input and 2 Pulse output has bellow terminal definition. The definition table terminal No started from 29.

Table 6-4: VP-2040 8x Status + 2x Pulse Expansion Terminal Definitions

No.	Code	Definition
29	P2-	Negative pole of Reactive Energy Pulse Output
30	P2+	Positive pole of Reactive Energy Pulse Output
31	P1-	Negative pole of Active Energy Pulse Output
32	P1+	Positive pole of Active Energy Pulse Output
33	Cm	Positive Common power supply for Status Inputs
34	S8	Status 8 input
35	S7	Status 7 input
36	S6	Status 6 input
37	S5	Status 5 input
38	S4	Status 4 input
39	S3	Status 3 input
40	S2	Status 2 input
41	S1	Status 1 input
42	--	--

6.2.5 Expansion Option P: PROFIBUS Communication

The option with PROFIBUS communication module has bellow terminal definition. The definition table terminal No started from 29.

Table 6-5: VP-2040 PROFIBUS Communication Expansion Terminal Definitions

No.	Code	Definition
29	R22	Terminal Resistor B
30	R21	Negative Pole of PROFIBUS bus
31	R12	Positive Pole of PROFIBUS bus
32	R11	Terminal Resistor A
33	Sg	Communication Shielded Earth
34	--	--
35	--	--
36	--	--
37	--	--
38	--	--
39	--	--
40	--	--
41	--	--
42	--	--

Note:

There should be a resistance (150 Ohms) connected between terminal 29 and 30.

There should be a resistance (150 Ohms) connected between terminal 31 and 32.

6.3 Power Supply Connection

A power supply to the VP-2040 can be in two options which should be selected one of them during ordering the component.

If Option H ordered, therefore the power supply input of VP-2040 is a universal AC / DC voltage with range 85~265VAC, 40~70Hz, and 80~300VDC.

If other power option L ordered it is just in DC system and can be in range of 18~75VDC supply.

The power supplied option is available on the meter data and can be verified from identification label on the back of the VP-2040 that may be in mode of H or L input application.

Extensive filtering with transient protection is built into the VP-2040 to ensure reliable operation. Transient energy must be suppressed and conducted back to the source through filter ground terminal FG. The terminal FG filter ground allow performing dielectric strength testing of switchgear with an Enhance IED VP-2040 wired up “connection to the filter ground terminal must be removed during dielectric test”.

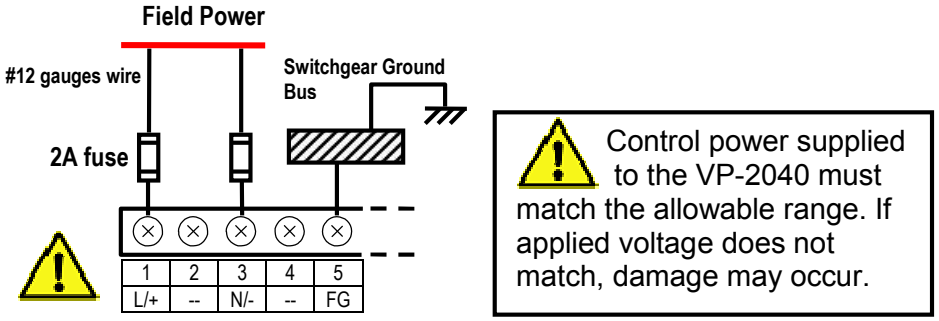


Figure 6-3: VP-2040 Power Supply Control

6.4 Voltage to PT inputs

The VP-2040 allows input voltage range from 0~400Vac between voltage inputs (V1, V2, V3) and voltage neutral (VN). These inputs can be direct connected or supplied via from external PTs. If the measured voltage is greater than 400VAC, external PTs are required. The voltage reference input (VN) is the common of measured voltage input as VR = VN input for 3 phase 4 wire WYE to phase voltage measurement and as VR = V2 input for 3 phase 3 wire to line voltage measurement.

"All connection to the VP-2040 voltage inputs should be in serious connection with buses with a 2 Amp rating to ensure adequate interrupting capacity"

6.5 Current to CT inputs

The VP-2040 allows input current in 1.0A rated and 5.0A rated based on ordered model. Please refer to Chapter 2 - Model & Ordering for detail information.

If you connect wrong Current Transformer (CT) to the VP-2040 your device may damage (for example you ordered 1.0A input rating and connect to 5.0A CT or connect to the protection CT) or may loss the accuracy (for example you ordered 5.0A input rating and connect to 1.0A CT). So it is important before order device choose the right product model.

Also it is important to select the correct CT type for VP-2040 device. Please see bellow table for some detail specifications for choosing the right CT for connect to VP-2040 IED device.

Table 6-6: VP-2040 Recommendation for choosing CTs

Item	Code	Definition
1	General	The CTs shall be suitable for metering purpose
2	Type	Ring or Window Type
3	Polarity	Shall have mark for primary and second leads
4	Class of Accuracy	Better than 0.5
5	Rated Burden	Better than 5.0 VA
6	Withstand Voltage	> 3Kv
7	Frequency	50 Hz
8	Ratio	1.0A or 5.0A (Depend on VP-2040 order code)
9	Rated Error	5% of Rated of primary < 1.5% 20% of Rated of primary < 0.75% 100% of Rated of primary < 0.5% 120% of Rated of primary < 0.5%

6.6 Shielding Ground

The input and output wiring to the VP-2040 for AO, PO, RS485 comport are required to use shielding cable “the shielding ground (SHLD) should be with one end ground at VP-2040 end only or at SCADA / PLC / Computer only” to minimize noise effects.

6.7 RS485 Communication Wiring

A serial port provides communication capabilities between the Enhance-IED VP-2040 and remote computer, PLC or distributed control system (DCS). Up to thirty-two, VP-2040 can be daisy chained together with 24 AWG stranded, shielded, twisted pair wire on a single communication channel.

Suitable wire should have a characteristic impedance of 120 ohms such as Belden #9841. These wires should be routed away from high power AC lines and other sources of electrical noise. The total length of communications wiring should not exceed 1200 meters for reliable operation.

Correct polarity is essential for the communications port to operate. Terminal (485+ or D+) of every VP-2040 in a serial communication link must be connected together. Similarly, terminal (485- or D-) of every VP-2040 must also be connected together. These polarities are specified for a “0” logic and should match the polarity of master device.

The last VP-2040 in the chain and the master computer need a terminating resistor and terminating capacitor to prevent communication errors by ensuring proper electric matching of the loads. Using terminating resistors on all the VP-2040 would load down the communication network while omitting them at the ends could cause reflections resulting in communication errors. Install the 120Ω terminating resistor and 1nF capacitor externally.

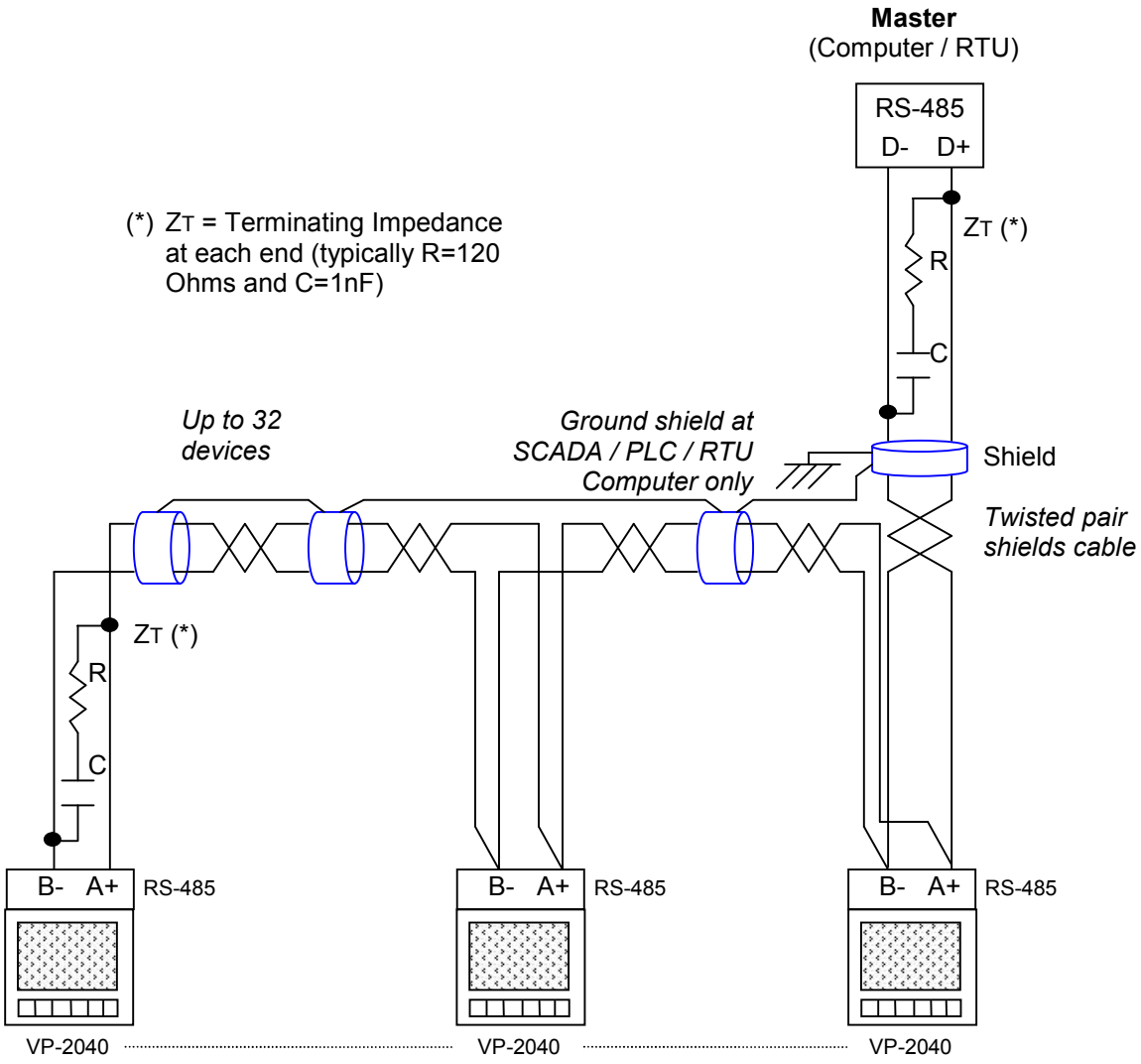


Figure 6-4: VP-2040 RS-485 Communication Wiring

6.8 Wiring Diagrams

6.8.1 High Voltage, 3 Phase, 4 Wires, Star, 3PT/3CT

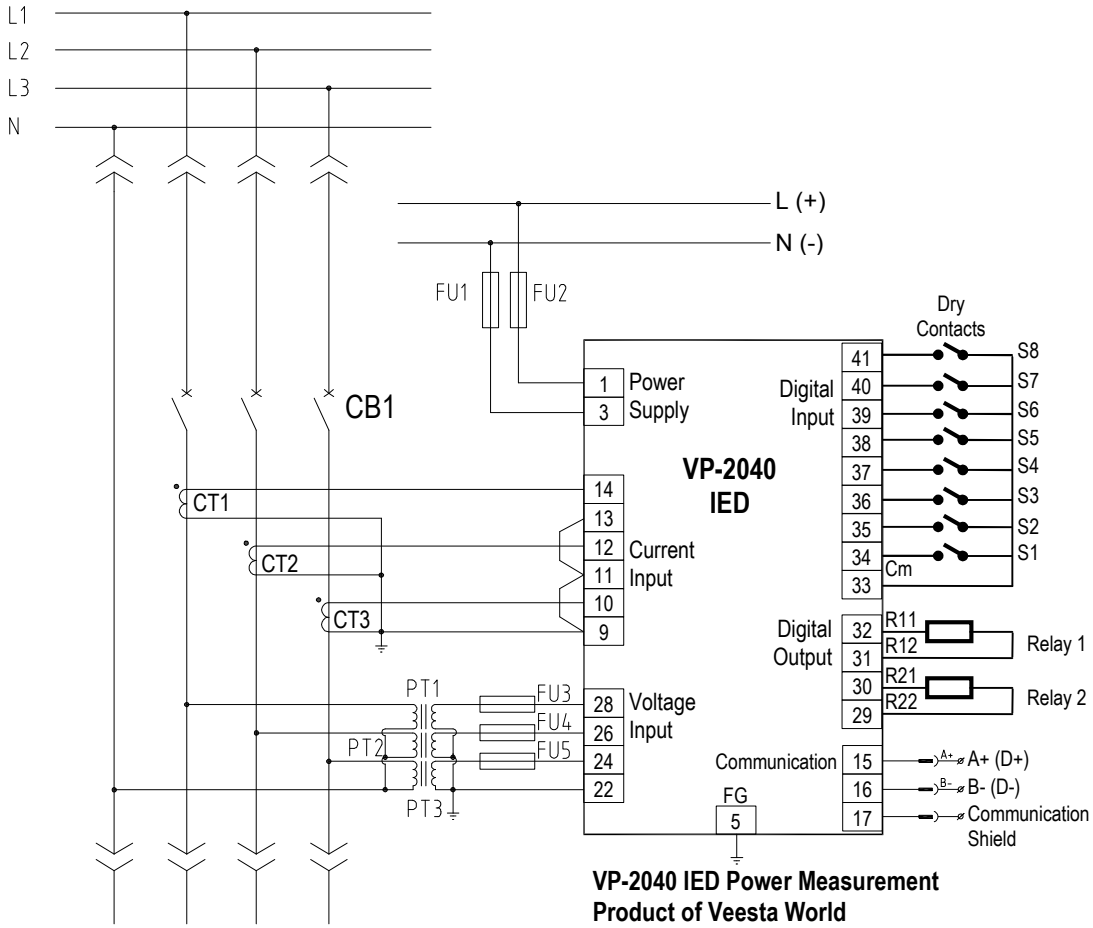


Figure 6-5: VP-2040 H.V. Wiring, 3 phase 4 wires Start, 3PT/3CT

- This diagram is a typical 4 wire WYE Start connection which covers any voltage range.
- System setting and programming into IED should be as "***4Y***" measurement mode.

6.8.2 High Voltage, 3 Phase, 3 Wires, Delta, 2PT/3CT

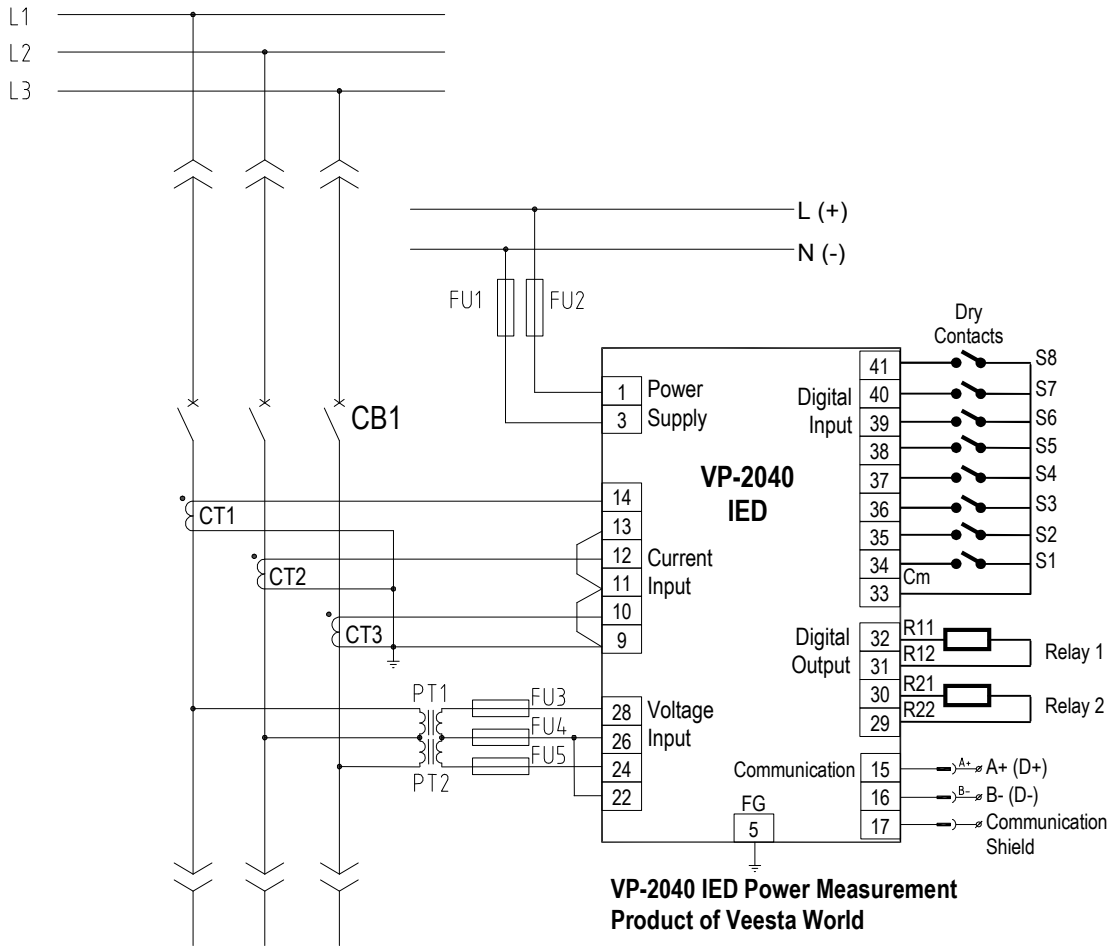


Figure 6-6: VP-2040 H.V. Wiring, 3 phase 3 wires Delta, 2PT/3CT

- Accurate only with balanced phase voltage
- System setting and programming into IED should be as "***3d***" measurement mode.

6.8.3 High Voltage, 3 Phase, 3 Wires, Delta, 2PT/2CT

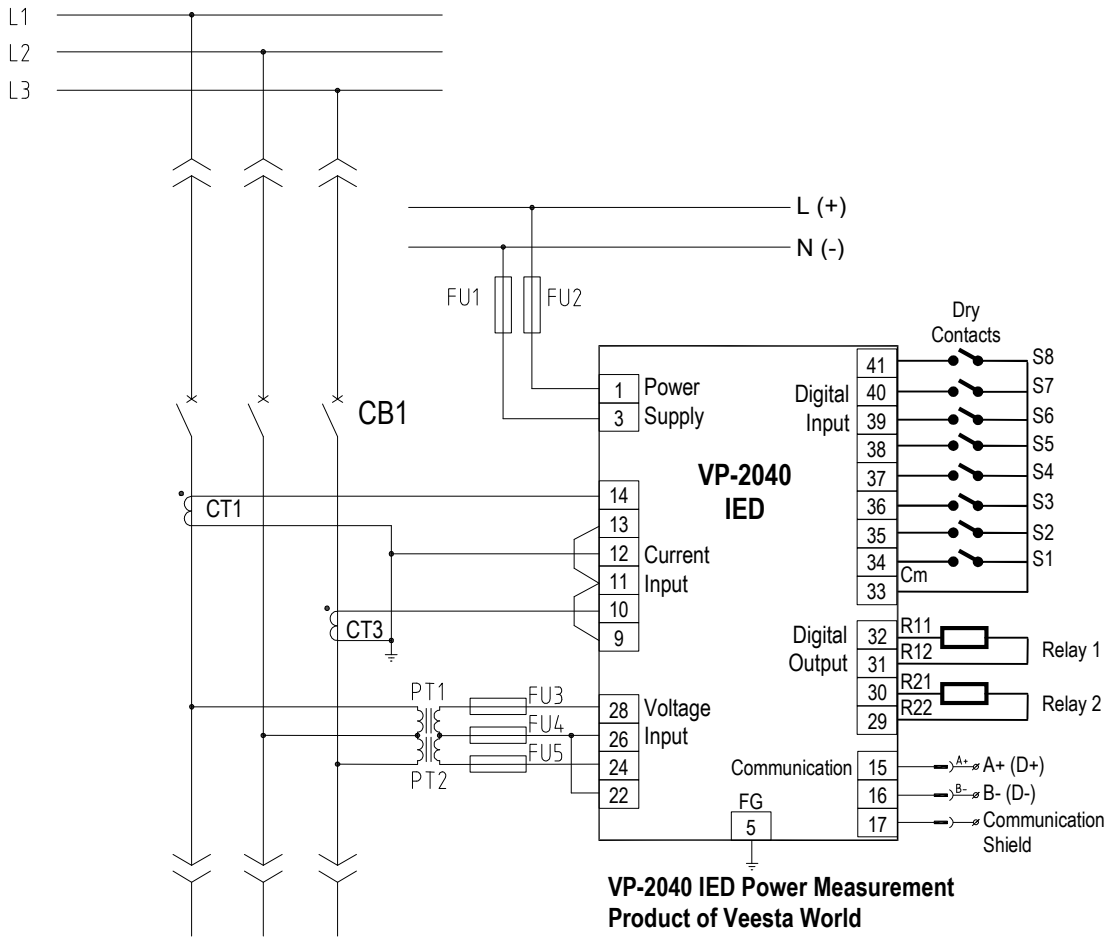


Figure 6-7: VP-2040 H.V. Wiring, 3 phase 3 wires Delta, 2PT/2CT

- Accurate only with balanced phase voltage
- System setting and programming into IED should be as "***3d***" measurement mode.

6.8.4 Low Voltage, 3 Phase, 4 Wires, Star, 3CT

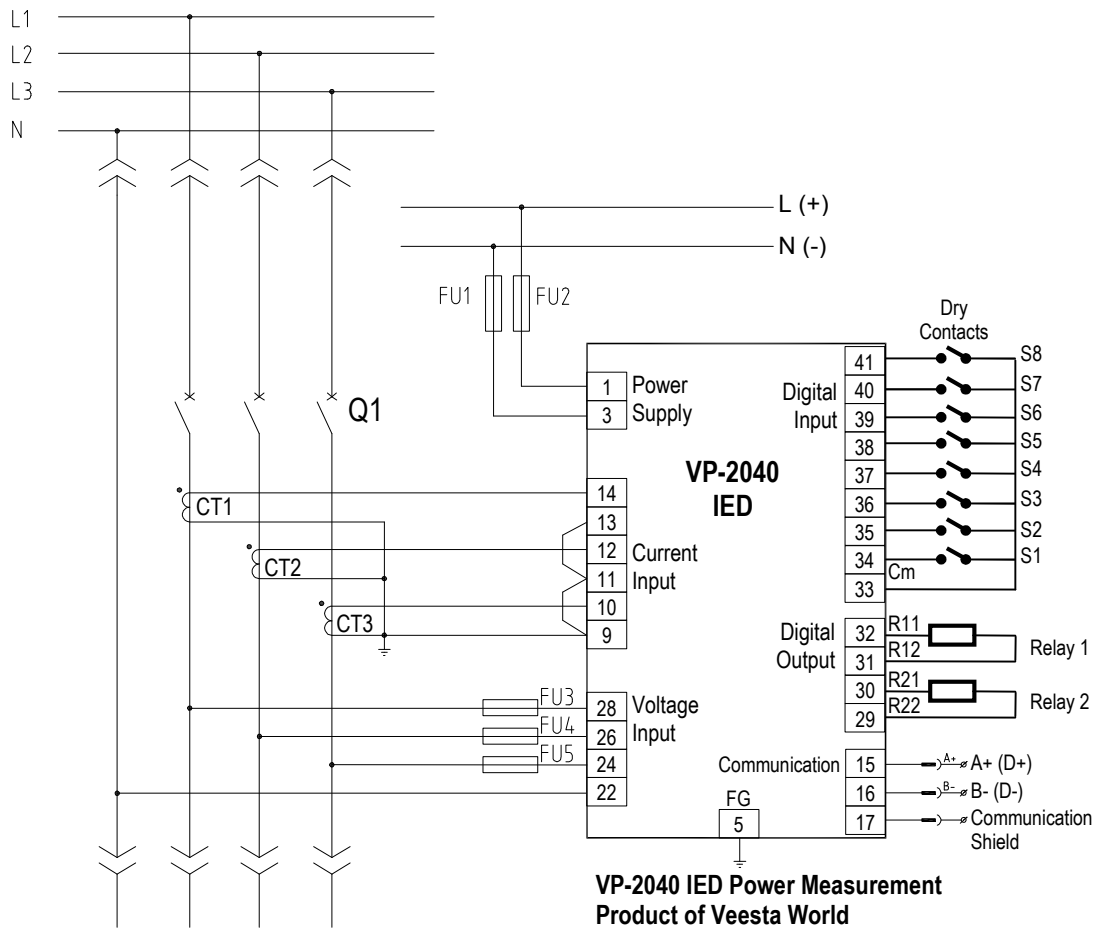


Figure 6-8: VP-2040 L.V. Wiring, 3 phase 4 wires Start, 3CT

- This diagram is a typical 4 wire WYE Start connection which covers any voltage range.
- System setting and programming into IED should be as "***4Y***" measurement mode.

6.8.5 Low Voltage, 3 Phase, 3 Wires, Delta, 3CT

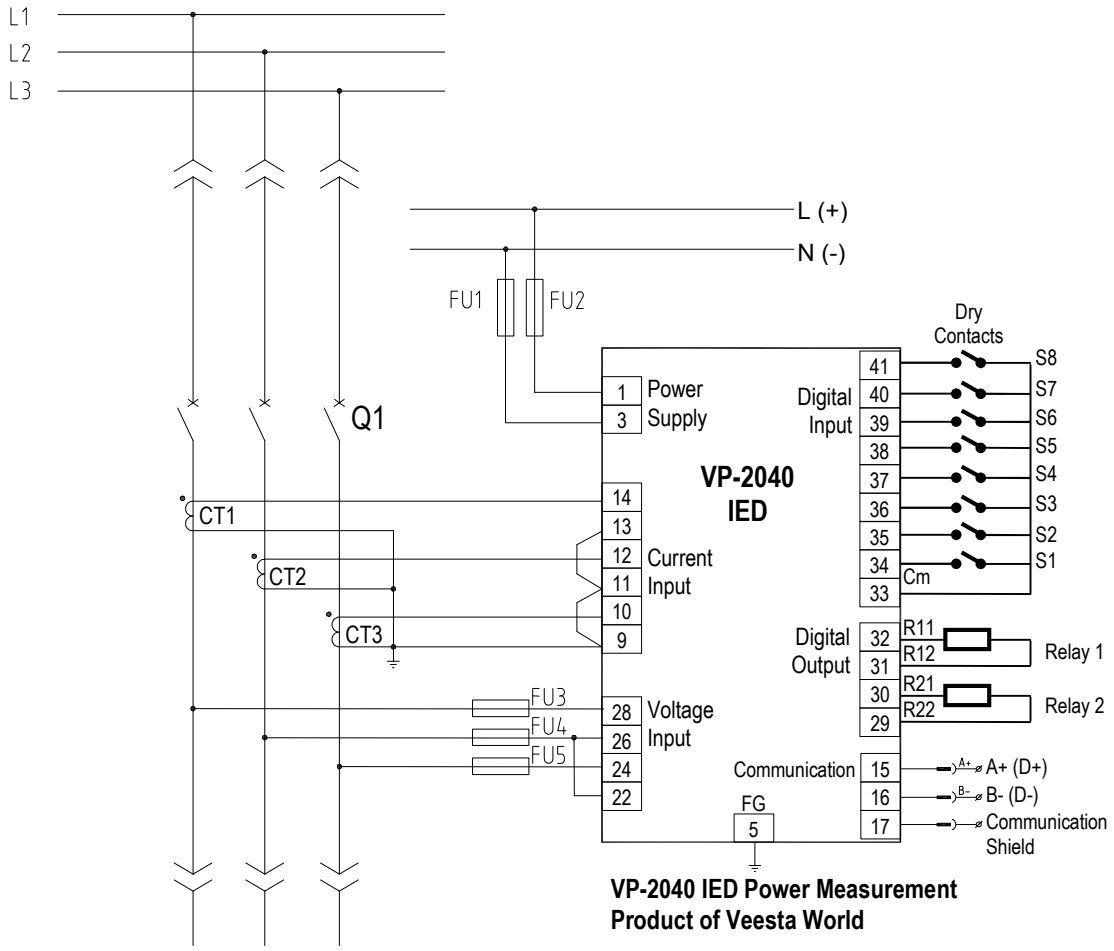


Figure 6-9: VP-2040 L.V. Wiring, 3 phase 3 wires Delta, 3CT

- Accurate only with balanced phase voltage
- System setting and programming into IED should be as "***3d***" measurement mode.

6.8.6 Low Voltage, 3 Phase, 3 Wires, Delta, 2CTs

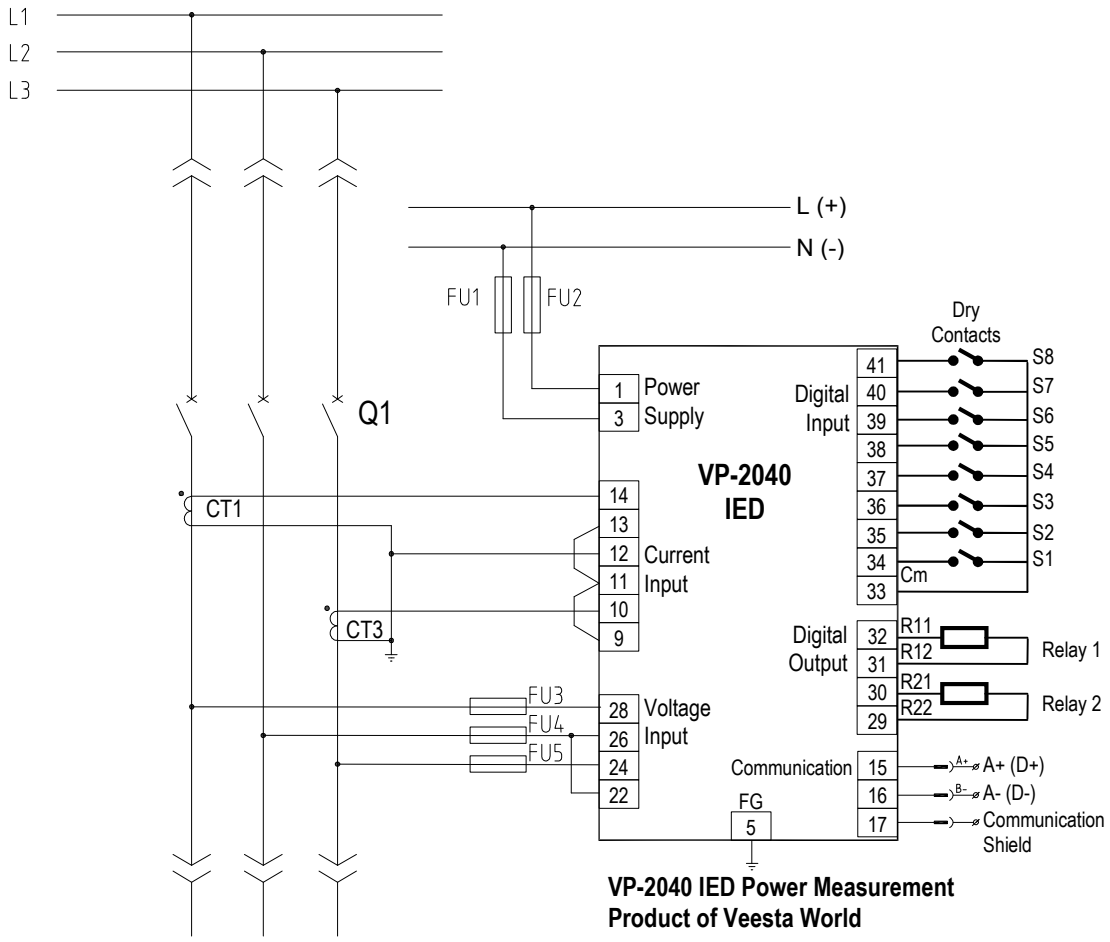


Figure 6-10: VP-2040 L.V. Wiring, 3 phase 3 wires Delta, 2CT

- Accurate only with balanced phase voltage
- System setting and programming into IED should be as "***3d***" measurement mode.

6.9 Dimensions

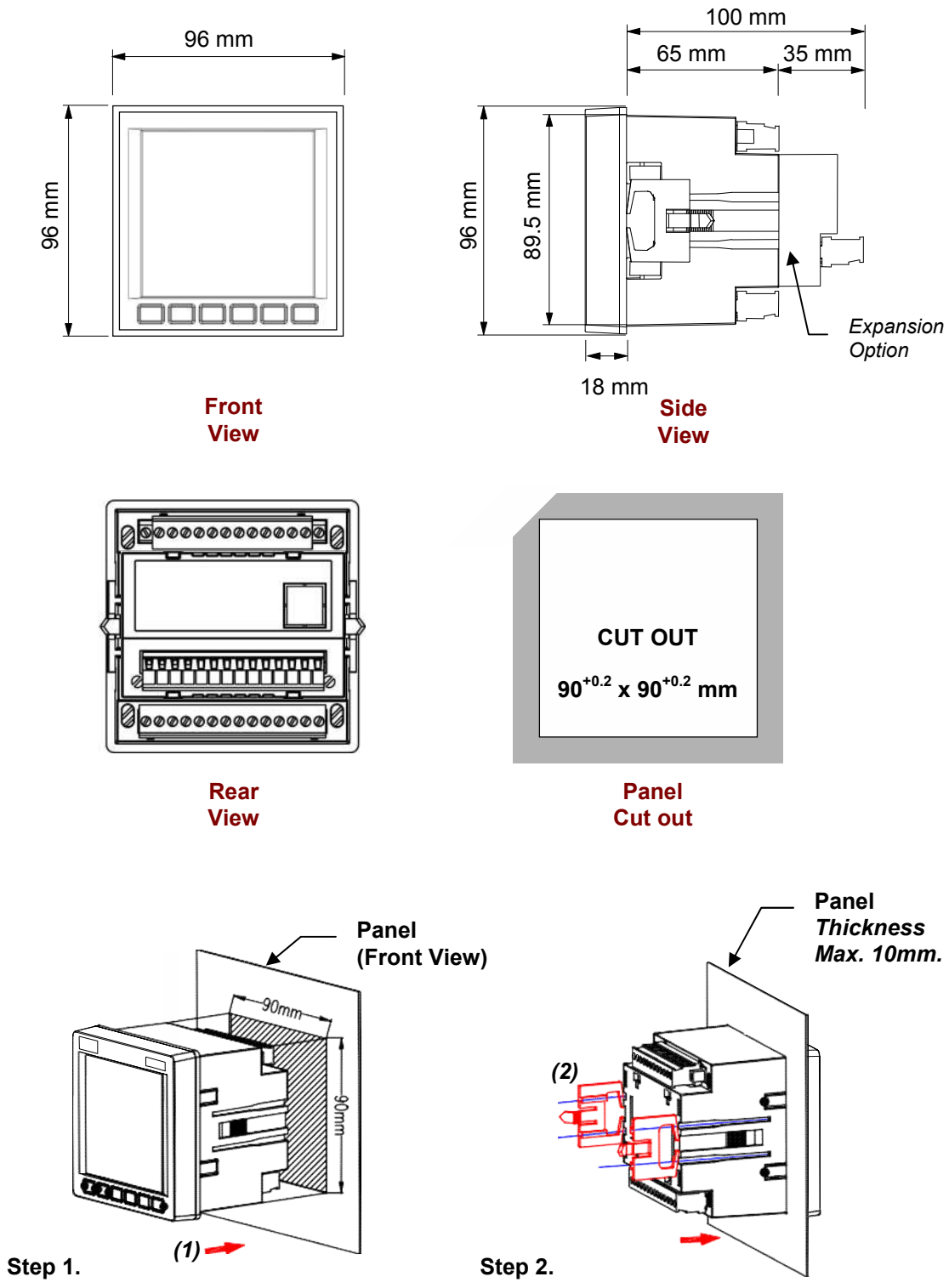


Figure 6-11: VP-2040 Dimension & Panel cut out

6.10 Application Configuration Sample

In this section we describe a sample configuration about VP-2040 Unit used normally in DCS configurations of substations. The VP-2040 rear network can help utility operator to connect many VP-2040 networked units for Power Quality Monitoring and SCADA application rapidly.

The VP-2040 PC program tools provided along with VP-2040 device, which allows easy access to all device setups and information and actual values via a personal computer running Microsoft Windows and one of PC's or Laptop's communication ports (COM1,COM2).

And with enhanced protocol implementation of MODBUS RTU protocol the SCADA master can monitor device in multi drop insert Modbus protocol. It is enhanced communication configurations that save a lot of auxiliary devices normally used in such substation automation.

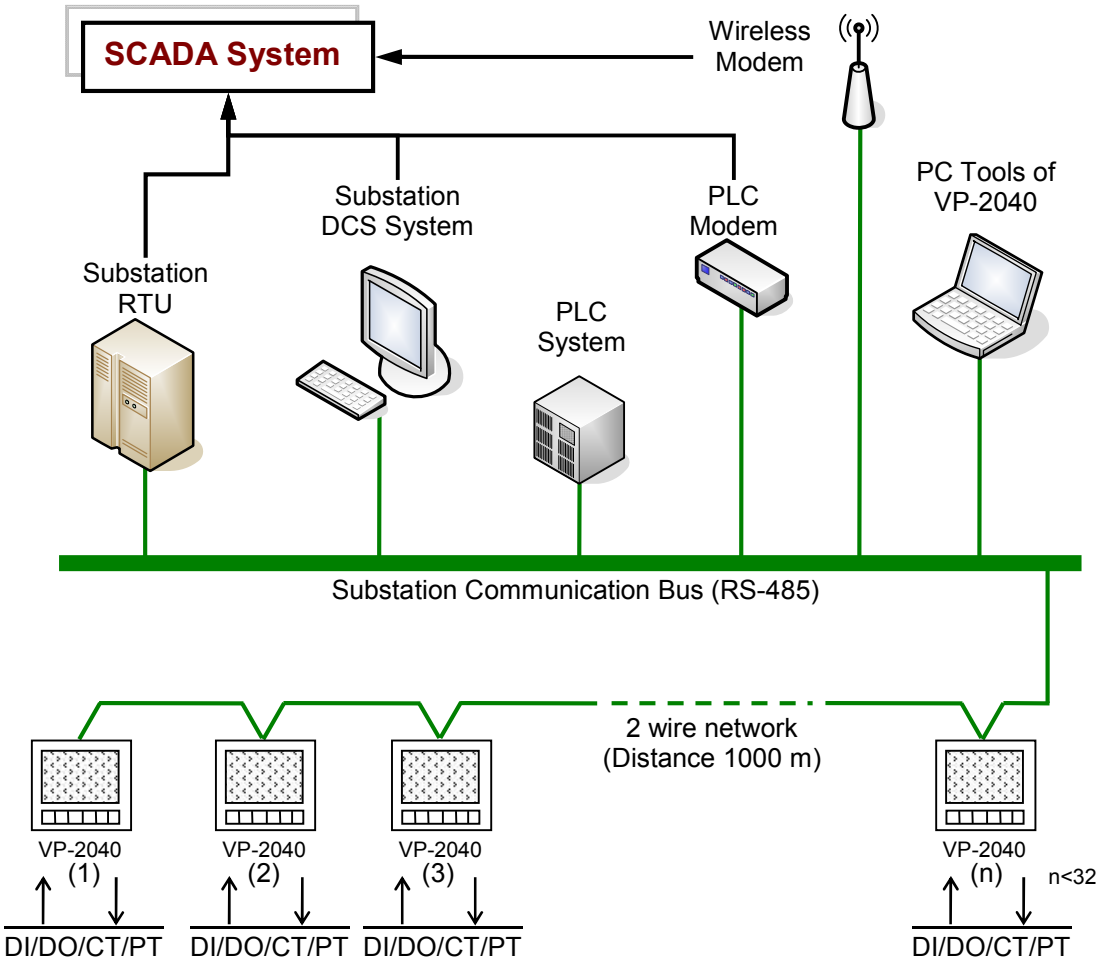


Figure 6-12: VP-2040 Sample Application Diagram

Chapter 7 - Unit Front Panel Operation

7.1 Unit Observation

The VP-2040 has a front display module with small control key pads. From this panel you can do diagnostic and monitoring with able to do some parameterizing of device. In this Chapter we describe you how you view and do setting on device from front display and key pad screen.

7.1.1 Display and Keys

In the bellow figure you can see all details of display and its instructions:

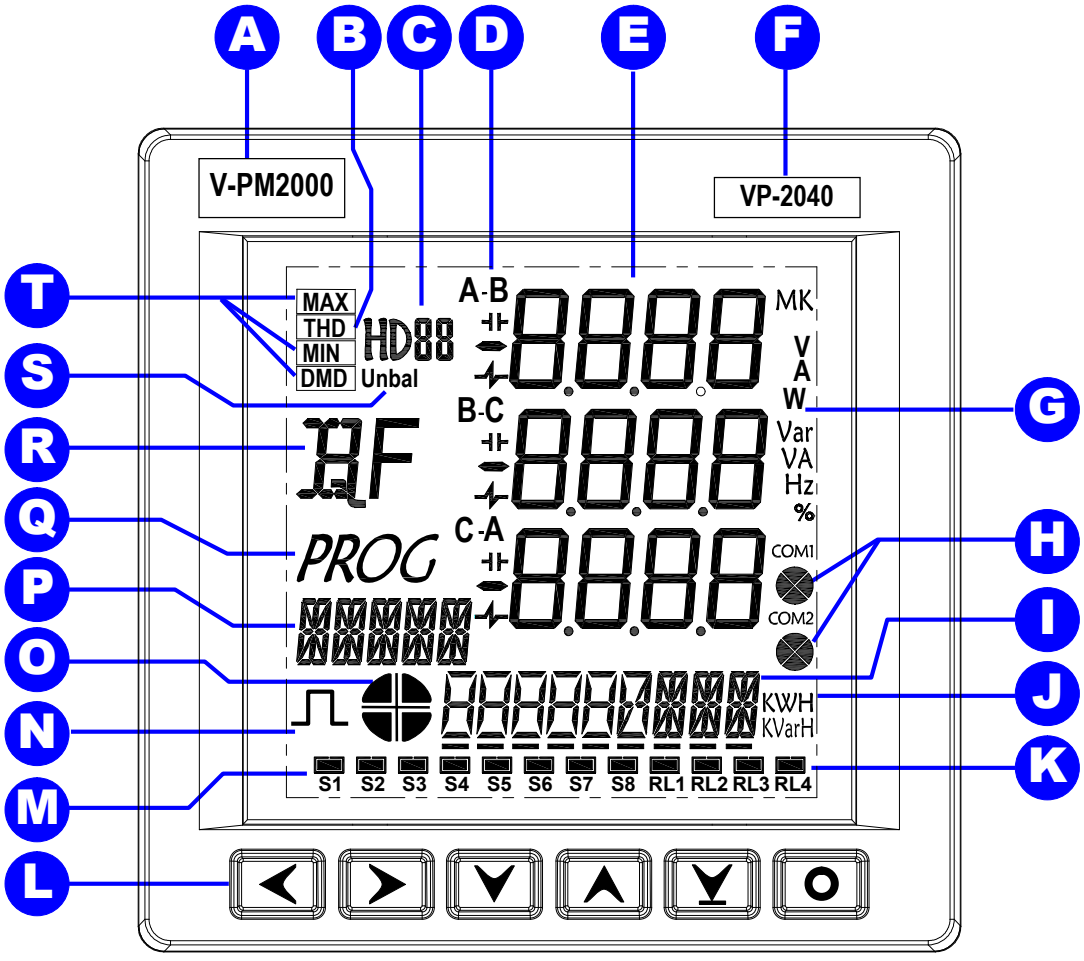


Figure 7-1: VP-2040 Front Panel Descritions

A The Veesta-Power Measurement 2000 Product Series Trade Mark

B THD Prompt

C Higher Harmonic Prompt

D Phase Sequence & Quadrant Prompt

E Real-Time Data Display Area

F Product Model of Veesta Power Measurement 2000 Series

G Real-Time Data Unit Display Area

H Communication Prompt and progress

I Energy Display or Programming Area

J Energy Unit display area

K Relay Status Positions as RL1 ~ RL4 based on model

L Key pads

M State Status Indications as S1 ~ S8 based on model

N Energy pulse output function prompt

O Energy Quadrant Prompt

P Programming Setting display area

Q Programming Mode of Display

R Real-Time Data Types

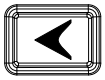
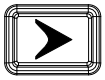
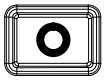
S Unbalance rate Prompt

T Minimum/Maximum/Demand Prompt

7.1.2 Key pad function

The front keys operate in various conditions; the two main categories are in View mode and Programming mode. In the Programming mode you also have two mode of setting view and modify setting. Therefore based on you enter in which mode each key has its special function. Please see bellow table to see key pad functions:

Table 7-1: VP-2040 Key Pad Functions

Key Symbol	Key Name	View Mode	Programming Mode	
			View Setting	Modify Setting
	Left	Sub-menu page-up	---	Move the cursor left
	Right	Sub-menu page-down	---	Move the cursor right
	Down	Main-menu page-down	Menu turning-down	Decrease the numeric value at the cursor
	Up	Main-menu page-up	Menu turning-up	Increase the numeric value at the cursor
	Enter	Energy view page turning	Press the key to enter to Modification	Press the key to confirm and save Modification
	Exit	Enter Programming Mode	Exit from Programming Mode	Exit from Programming Mode

Chapter 8 - Protocol and Communication

8.1 PLC Modbus® Compatible

The Modbus® communications protocol allows information and data to be efficiently transferred between the Enhanced-IED VP-2040 series and Modicon programmable logic controller (PLC) or other third party Modbus® compatible monitoring and control system. The VP-2040 also can establish a monitoring system simply to adopt an IPC-based centralized master running software.

8.2 Comprehensive System Integration

The Enhanced-IED VP-2040 provides the Modbus® compatible as a standard feature for comprehensive system integration. The PLC compatible RS485 Modbus® communication protocol allows information and data to be transferred efficiently between the IED VP-2040 and PLC, existing RTU Power SCADA system, DCS system, IPC running software.

8.3 Transmission Mode

The mode of transmission is the structure of the individual units of information within a message, and the numbering system used to transmit the data. The mode is defined in the following which is compatible with Modbus® protocol - RTU Mode.

Table 8-1: VP-2040 Modbus conventions table

Item	Convention
Coding System	*8-bits binary*
Start bits	*1*
Data bits	*8*
Parity	*No parity*
Stop bit	*1*
Error Checking	*CRC (Cyclical Redundancy Check)*
Start of Frame	*silence on line for time ≥ 4 characters*

Item	Convention
Slave Address	*1 Character*
Function Code	*1 Character*
Data field	*N Characters*
Error Check	*16 bit CRC*
End of Frame	*silence on line for time ≧ 4 characters*

8.3.1 Slave Address

This is the first byte of every transmission. This byte response the user assigned address of the slave device that is to receive the message sent by the master. Each slave is started with its address. In a master request transmission the slave address represents the address of the slave that is sending the response.

In the VP-2040 the salve address can be from 1 to 247.

8.3.2 Function Code

This is a second byte of every transmission. Modbus® defines function codes of 1 to 127. The VP-2040 implements some of these functions. In a master request transmission the function code tells the slave what action to perform. In a slave response transmission, if the function code sent from the slave is 1 (i.e. if the function code > 127), then the slave did not perform the function as requested and is sending an error or exception response.

8.3.3 Data

This will be a variable number of bytes depending on the function code. This may be actual values, setpoints, or addresses ... sent from the master to the slave or from the slave to the master.

8.3.4 CRC

This is a two-byte error checking code.

8.3.5 Protocol

When the master message sent to the assigned slave, it wire enter to the addressed device through a similar "port". The addressed device removes the envelope, reads the message, if no errors occurred and performs the requested task and then replaces the message into the slaved envelope and "returns to sender".

The information in the response message is the slave address, the action performed, data acquired as a result of the action, and a

means of checking for errors. No response is transmitted if any error has occurred.

8.4 Modbus Framing

Modbus Message Format is as bellow:

Address	Function	Data	Check
8-Bits	8-Bits	N * 8-Bits	16-Bits

8.4.1 Address Field

The address is the beginning of the frame and consists of 8-bits (1-247). These bits indicate the user assigned address of the slave device that is to receive the message sent by the attached master. Each slave must be assigned a unique address and only the addressed slave will respond to query that contains its address. When the slave sends a response, the slave address informs the master which slave is communicating.

8.4.2 Function Field

The function code field tells the addressed slaves what function to perform. Table lists the function code, all measuring and action that initiated.

Table 8-2: VP-2040 Modbus Function Codes

Code	Meaning	Action
3 (03H)	Read data	Obtain current binary value in one or more registers
5 (05H)	Execute operation	Perform specific command operation
16 (10H)	Preset multiple - register	Place specific binary value into a series of consecutive multiple - registers

8.4.3 Data field

The data field contains information needed by the save to perform the specific function or contains data collected by the slave response to query. This information may be values, address references, or limits. For example, the function code tells the slave to read a register, and the data field is needed to indicated which register to

start at and how many to read. The imbedded address and data information varied with the type and capacity of slave associated with the slave.

In the VP-2040 maximum of N = 95 bytes. You should observe this limitation when you are calling to read out data or setting data by different function codes.

8.4.4 Error Check filed

The field allows the master and slave devices to check a message for errors in transmission. Sometimes, because of electrical noise or other interference, a message may be changed slightly while it is on its way from one unit to another. The error checking assures that the slave or master does not react to messages that have changed during transmission. This increases the safety and the efficiency of the system. The error check uses a CRC – 16 check methods.

Note: The sending sequence is always the same - address, function code, data, and error check - relative to the direction

8.4.5 Error Detection

The RTU version of Modbus® includes a two byte CRC-16 (16 bit cyclic redundancy check) with every transmission. The CRC-16 algorithm essentially treats the entire data stream (data bits only; start, stop and parity ignored) as one continuous binary number.

This number is first shifted left 16 bits and then divided by a characteristic polynomial (11000000000000101B). The 16-bit remainder of the division is appended to the end of the transmission, MSB byte first. The resulting message including CRC, when divided by the same polynomial at the receiver will give a zero remainder if no transmission errors have occurred.

If a VP-2040 Modbus® slave device receives a transmission in which an error is indicated by the CRC-16 calculation, the slave device will not respond to the transmission.

A CRC-16 error indicates than one or more bytes of the transmission were received incorrectly and thus the entire transmission should be ignored in order to avoid the VP-2040 performing any incorrect operation.

The CRC-16 calculation is an industry standard methodized used for error detection. An algorithm is included here to assist programmers in situations where no standard CRC-16 calculation routines are available.

8.4.6 CRC-16 Algorithm

Once the following algorithm is complete, the working register "A" will contain the CRC value to be transmitted.

Note that this algorithm requires the characteristic polynomial to be reverse bit ordered. The MSbit of the characteristic polynomial is dropped since it does not affect the value of the remainder. The following symbols are used in the algorithm:

→	Data transfer
A	16 bit working register
AL	Low order byte of A
AH	High order byte of A
CRC	16 bit CRC-16 value
i, j	Loop counters
(+)	Logical exclusive or operator
Di	i-th data byte (i = 0 to N - 1)
G	16 bit characteristic polynomial equal 1010000000000001 with MSbit dropped and bit order reversed
shr(X)	Shift right (the LSbit of the low order byte of x shifts into a carry flag, a "0" is shifted into the MSbit of the high order byte of x, all other bits shift right one location.)

Algorithm:

1.	FFFF hex → A	
2.	0 → i	
3.	0 → j	
4.	Di (+) AL → AL	
5.	j + 1 → j	
6.	shr (A)	
7.	is there a carry ?	No : go to 8. Yes : G (+) A → A
8.	is j = 8 ?	No : go to 5. Yes : go to 9.
9.	i + 1 → i	
10.	is i = N ?	No : go to 3. Yes : go to 11.
11.	A → CRC	

8.5 Supported Function Codes

8.5.1 Function Code 3 (03H) - Read Holding registers

The VP-2040 implementation of Modbus®, these commands can be used to read any set-point (" holding registers ") or actual value (" input registers ").

Holding and input registers are 16 bits (two byte) values transmitted for high order byte first. Thus all VP-2040 set-points and actual values are sent as two bytes.

The maximum number of registers that can be read in one transmission is 45. Function code 03 is configured to read set-points or actual values interchangeably because some PLCs do not support it.

The slave response to these function codes is the slave address, function code, a count of number of data bytes to follow the data itself and the CRC.

Each data item is sent as a two-byte number with the high order byte sent first.

8.5.1.1 Message format and example

Request slave 01 to respond with 3 registers starting at ModBus address of 41001 (address 03E8 hex). For this example the register data in these addresses is:

Register Number	HEX Address	Data (HEX)
41001	03E8	0032
41002	03E9	0005
41003	03EA	0001

Master Transmission	Bytes	Example (hex)	Meaning
Slave Address	1	01	Message for slave 01
Function Code	1	03	Read registers
Data starting Address	2	03	Data starting at 41001 (03E8)
		E8	
Number of Setpoints	2	00	3 registers (6 bytes total)
		03	
CRC	2	85	CRC calculated by the master
		BB	

Slave Response	Bytes	Example (hex)	Meaning
Slave Address	1	01	Message from slave 01
Function Code	1	03	Read registers
Byte Count	1	06	3 registers = 6 bytes
Data 1	2	00	Value in address 41001 = 50
		32	
Data 2	2	00	Value in address 41002 = 5
		05	
Data 3	2	00	Value in address 41003 = 1
		01	
CRC	2	C9	CRC calculated by the slave
		70	

8.5.2 Function Code 5 (05H) - Execute Operation

This function code allows the master to request the VP-2040 to perform specific command operations. The command numbers listed in the commands area of the memory map correspond to operation code for function code 05. The operation commands can also be initiated by writing to the commands area of the memory map using function code 16. Refer to function 16 - performing commands section for complete details.

8.5.2.1 Message format and example

Write and Send command to operate Relay-1 of VP-2040:

Master Transmission	Bytes	Example (hex)	Meaning
Slave Address	1	01	Message for slave 1
Function Code	1	05	Execution Operation
Operation Code	2	00	Relay 1 Command
		00	
Code Value	2	FF	ON Command
		00	
CRC	2	8C	CRC calculated by the master
		3A	

Slave Response	Bytes	Example (hex)	Meaning
Slave Address	1	01	Message for slave 1
Function Code	1	05	Execution Operation
Operation Code	2	00	Relay 1 Command
		00	
Code Value	2	FF	ON Command
		00	
CRC	2	8C	CRC calculated by the master
		3A	

8.5.3 Function Code 16 (10H) - Write multiple registers

This function code allows single and multiple setpoints to be stored into the memory of VP-2040 device. Modbus® "registers" are 16 bit (two byte) value transmitted high order first.

This all VP-2040 setpoints are sent as two bytes. The maximum number of setpoints that can be stored in one transmission is dependent on the slave device. Modbus® allows up to a maximum of 60 holding registers to be stored. The VP-2040 allows 60 registers to be stored in one transmission.

The VP-2040 response to this function code is to echo the slave address, function code, starting address, the number of setpoints stored, and the CRC.

8.5.3.1 Message format and example

In this example we want to change the PT Primary Side value to the 132000 Volts. The register numbers that hold the PT Primary side is in 41003 as low word of PT Primary value and 41004 as high word of the value of set-point and 132000 is 000203A0 in Hex format.

After the transmission in this example is complete, the VP-2040 slave 01 will have the following setpoints information stored:

Register Number	HEX Address	Data (HEX)
41003	03EA	03A0 (low word)
41004	03EB	0002 (high word)

Master Transmission	Bytes	Example (hex)	Meaning
Slave Address	1	01	Message for slave 01
Function Code	1	10	Store Multiple Setpoint (function 16)
Data Starting Address	2	03	Setpoint address 41003
		EA	
Number of Setpoints	2	00	2 Setpoints (4 bytes total)
		02	
Byte Count	1	04	4 bytes of data
Data 1	2	03	Data for Address 41003 (low word) must set to 03A0H
		A0	
Data 2	2	00	Data for Address 41004 (high word) must set to 0002H
		02	
CRC	2	E8	CRC calculated by the master
		CF	

Slave Response	Bytes	Example (hex)	Meaning
Slave Address	1	01	Message from slave 01
Function Code	1	10	Store Multiple Setpoint (function 16)
Data Starting Address	2	03	Setpoint address 41003
		EA	
Number of Setpoints	2	00	2 setpoints has been updated
		02	
CRC	2	60	CRC calculated by the slave
		78	

8.6 Error responses

When VP-2040 detects an error other than a CRC error, a response will be sent to the master. The MSBit of the function code byte will be set to 1 (i.e. the function code sent from the slave will be equal to the function code sent from the master plus 128).

The following byte will be an exception code indicating the type of error that occurred.

Transmissions received from the master with CRC errors will be ignored by the VP-2040.

The slave response to an error (other than CRC error) will be:

Slave Address	Function Code	Exception Code	CRC Check
8-Bits	8-Bits (With MSBit set to 1)	8-Bits	16-Bits

The VP-2040 implements the following exception response codes:

Table 8-3: VP-2040 Modbus Exception Codes

Exception Code	Meaning	Action
01	Illegal Function	The function code transmitted is not one of the functions supported by the VP-2040.
02	Illegal Data Address	The address referenced in the data field transmitted by the master is not an allowable address for the VP-2040 or over-long data received.

Chapter 9 - Register Map Profile

9.1 Introduction

This chapter describes about Modbus Register Map table and profile. To have better view on all of parameters of VP-2040 you must consider bellow items to communicating and translating data of registers.

- In this section all of references to the hexadecimal register number, byte number, word number and bit numbers all start from “Zero”.

9.2 Summary of Data Conversion

The raw value of each memory register based on the unit value and data format and scale factor can be analyzed by master. For example, the calculation factor of the power factor register is 0.001. When the value read by the user via raw value of corresponding register as example like 892, the real current power factor will be: 892 × 0.001 = 0.892.

It is called also Engineering Value conversion. In this section we listed summary for most common use of power parameters in VP-2040. For the bellow table also review the bellow terms:

- **Rx**: Rx shows the raw value read from VP-2040 via corresponding register value.
- **PTR**: It is PT ratio of Primary per Secondary setting. For example for system with 20kV in primary and 100V transformer in secondary so the PTR will be PTR = 20000/100 = 200
- **CTR**: It is CT ratio of Primary per Secondary setting. For example for system with 300A in primary and 5A in secondary so the CTR will be CTR = 300 / 5 = 60

Table 9-1: VP-2040 Data Conversion Formula

No	Item	Engineering Value	Unit	Type	Note
1	Voltage	U = Rx * PTR * 0.01 0 ≤ Rx ≤ 65535	V	Unsigned	Ua, Ub, Uc, UP_av, Uab, Ubc, Uca, UL_av
2	Current	I = Rx * CTR * 0.001 0 ≤ Rx ≤ 65535	A	Unsigned	Ia, Ib, Ic, Iav, Ineu Idmd, Imax, Imin
3	Frequency	F = Rx * 0.01 0 ≤ Rx ≤ 65535	Hz	Unsigned	F
4	Active Power	P = Rx * PTR * CTR * 0.1 -32768 ≤ Rx ≤ 32767	W	Signed	Pa, Pb, Pc
5	Reactive Power	P = Rx * PTR * CTR * 0.1 -32768 ≤ Rx ≤ 32767	Var	Signed	Qa, Qb, Qc
6	Apparent Power	VA = Rx * PTR * CTR * 0.1 0 ≤ Rx ≤ 65535	VA	Unsigned	Sa, Sb, Sc
7	3xP Active Power	P = Rx * PTR * CTR * 0.1 -100M ≤ Rx ≤ +100M	W	Long Signed	Ptotal, Pdmd, Pmax, Pmin
8	3xP Reactive Power	P = Rx * PTR * CTR * 0.1 -100M ≤ Rx ≤ +100M	Var	Long Signed	Qtotak, Qdmd, Qmax, Qmin
9	3xP Apparent Power	VA = Rx * PTR * CTR * 0.1 0 ≤ Rx ≤ +100M	VA	Long Unsigned	Stotal, Sdmd, Smax, Smin
10	Energy	Eh = Rx * 0.1 0 ≤ Rx ≤ 99999999	WH VarH	Long Unsigned	+WH, -WH (reverse) +VarH, -VarH
11	Unbalance rate	Unbalance = Rx * 0.001 0 ≤ Rx ≤ 1000	%	Unsigned	UPun, ULunb Iun
12	Harmonic	THD = Rx * 0.001 0 ≤ Rx ≤ 1000	THD	Unsigned	Ua/Uab, Ub/Ubc, Uc/Uca, Ia, Ib, Ic
13	Power factor	PF = Rx * 0.001 -1000 ≤ Rx ≤ 1000	%	Signed	PFa, PFb, PFc, PF + : lagging load - : leading load

9.3 Memory Map Data Format

Data format of each memory register value of VP-2040 based on its meaning is difference with other one. In the last column memory register map table in bellow of this section there is a column named as “FORMAT”.

Each format type is described in memory map data format table as bellow.

Table 9-2: VP-2040 Data Format types

FORMAT	DESCRIPTION	CODING (HEX)
F1	**UNSIGNED INTEGER – NUMERICAL DATA (16 Bit)**	---
	Range From: 0	0000
	To: 65535	FFFF
F2	**SIGNED INTEGER – NUMERICAL DATA (16 Bit)**	---
	Range From: -32768	8000
	To: 32767	7FFF
F3	**UNSIGNED LONG INTEGER – NUMERICAL DATA (32 Bit)**	---
	Range From: 0	00000000
	To: 4,294,967,295	FFFFFFFF
F4	**SIGNED LONG INTEGER – NUMERICAL DATA (32 Bit)**	---
	Range From: -2,147,483,648	80000000
	To: 2,147,483,647	FFFFFFFF
F5	**DIGITAL INPUT STATUS BITS: (0 = OPEN, 1 = CLOSED)**	FFFF
	BIT 0: Digital Input 1 (S1)	0001
	BIT 1: Digital Input 2 (S2)	0002
	BIT 2: Digital Input 3 (S3)	0004
	BIT 3: Digital Input 4 (S4)	0008
	BIT 4: Digital Input 5 (S5)	0010
	BIT 5: Digital Input 6 (S6)	0020
	BIT 6: Digital Input 7 (S7)	0040
	BIT 7: Digital Input 8 (S8)	0080
F6	**OUTPUT RELAY STATUS: (0=DE-ENERGIZED, 1=ENERGIZED)**	FFFF
	BIT 0: Relay 1 Status (RL1)	0001
	BIT 1: Relay 2 Status (RL2)	0002
	BIT 2: Relay 3 Status (RL3)	0004
	BIT 3: Relay 4 Status (RL4)	0008

FORMAT	DESCRIPTION	CODING (HEX)
F7	**WORD STRUCTRE - YEAR / MONTH**	FFFF
	High Byte = Year: 1 =2001, 2=2002, ……., 99=2099	FFXX
	Low Byte = Month: 1=January, 2=February, ..., 12=December	XXFF
F8	**WORD STRUCTRE - DAY / HOUR**	FFFF
	High Byte = Day: 1-31 in step of 1	FFXX
	Low Byte = Hour: 0 = 12 am, 1 = 1 am, ..., 23 = 11 pm	XXFF
F9	**WORD STRUCTRE - MINUTE / SECOND**	FFFF
	High Byte = Minutes: 0-59 in steps of 1	FFXX
	Low Byte = Seconds: 0-59 in steps of 1	XXFF
F10	**YEAR**	FFFF
	Year: 0 = 2000, 1 =2001, 2=2002, ……., 99=2099	---
F11	**MONTH**	FFFF
	Month: 1=January, 2=February, ..., 12=December	---
F12	**DAY**	FFFF
	Day: 1-31 in step of 1	---
F13	**HOURS**	FFFF
	Hours: 0 = 12 am, 1 = 1 am, ..., 23 = 11 pm	---
F14	**MINUTES**	FFFF
	Minutes: 0-59 in steps of 1	---
F15	**SECONDS**	FFFF
	Seconds: 0-59 in steps of 1	---
F16	**MILLISECONDS**	FFFF
	Milliseconds: 0-999 in steps of 1	---
F17	**UNIX CLOCK**	FFFFFFFF
	Number of seconds that have elapsed since 00:00:00 in January 1, 1970 in Greenwich Mean Time. This also called as POSIX Time.	---
F18	**SOE EVENT COUNTER**	FFFF
	Counter: 0 - 59999 in steps of 1	---
F19	**UNSIGNED INTEGER - MEASURING MODE**	---
	0 = 3 phase 4 wire, Star Connection mode (3VT)	0000
	1 = 3 phase 3 wire, Delta Connection mode (2VT)	0001
F20	**UNSIGNED INTEGER – PULSE OUTPUT TYPE**	---
	0 = OFF No Pulse Output	0000
	1 = Input Energy Type (+WH, +QH)	0001
	2 = Output Energy Type (-WH, -QH)	0002

FORMAT	DESCRIPTION	CODING (HEX)
F21	**UNSIGNED INTEGER – PULSE OUTPUT PARAMETER**	---
	1000- 5000 = For Meter Type of 220V/5A in step of 100	03E8-1388
	1000-20000 = For Meter Type of 100V/5A or 200V/1A in step of 100	03E8-4E20
	1000-40000 = For Meter Type of 100V/1A in step of 100	03E8-9C40
F22	**UNSIGNED INTEGER - MODBUS BAUD RATE**	---
	0 = 4800 bps	0000
	1 = 9600 bps	0001
	2 = 19200 bps	0002
	3 = 38400 bps	0003
F23	**UNSIGNED INTEGER – ANALOG OUTPUT PARAMETER**	---
	0 = Disable Analog Output Feature	0000
	1 = Voltage Phase A	0001
	2 = Voltage Phase B	0002
	3 = Voltage Phase C	0003
	4 = Voltage Line A-B	0004
	5 = Voltage Line B-C	0005
	6 = Voltage Line C-A	0006
	7 = Current Phase A	0007
	8 = Current Phase B	0008
	9 = Current Phase C	0009
	10 = Total Active Power	000A
	11 = Total Reactive Power	000B
	12 = Total Power Factor	000C
	13 = Frequency	000D
F24	**UNSIGNED INTEGER - RELAY ACTIVATION TIME**	
	0 = Output Relay Latched ON up to receive Off command	0000
	1 - 1200 = Output Relay Trigger up to specific 1-1200 seconds	0000-04B0
F25	**UNSIGNED INTEGER – RELAY CONTROL MODE**	FFFF
	0 = Local Mode (Relay action based on Alarm Set-points)	---
	1 = Remote Mode (Relay action only from remote connection)	---
F26	**UNSIGNED INTEGER – OPERATION OBJECT OF RELAY**	---
	0 = All of Set-point	0000
	1 = Set-point 1 (Over Voltage Phase A)	0001
	2 = Set-point 2 (Over Voltage Phase B)	0002

FORMAT	DESCRIPTION	CODING (HEX)
(F26)	3 = Set-point 3 (Over Voltage Phase C)	0003
	4 = Set-point 4 (Under Voltage Phase A)	0004
	5 = Set-point 5 (Under Voltage Phase B)	0005
	6 = Set-point 6 (Under Voltage Phase C)	0006
	7 = Set-point 7 (Over Current Phase A)	0007
	8 = Set-point 8 (Over Current Phase B)	0008
	9 = Set-point 9 (Over Current Phase C)	0009
	10 = Set-point 10 (Under Current Phase A)	000A
	11 = Set-point 11 (Under Current Phase B)	000B
	12 = Set-point 12 (Under Current Phase C)	000C
	13 = Set-point 13 (Over Frequency)	000D
	14 = Set-point 14 (Under Frequency)	000E
	15 = Set-point 15 (Over Load)	000F
	16 = Set-point 16 (Phase Loss)	0010
	17 = Set-point 17 (Status Change)	0011
	18 = Set-point 18 (Over Phase Voltage)	0012
	19 = Set-point 19 (Under Phase Voltage)	0013
	20 = Set-point 20 (Over Line Voltage)	0014
	21 = Set-point 21 (Under Line Voltage)	0015
	22 = Set-point 22 (Over Current)	0016
	23 = Set-point 23 (Under Current)	0017
F27	**ALARM STATUS PER PHASE: (0 = NO ALARM, 1 = ALARM)**	FFFF
	BIT 0: Over Voltage Phase A Alarm (Set-point 1)	0001
	BIT 1: Over Voltage Phase B Alarm (Set-point 2)	0002
	BIT 2: Over Voltage Phase C Alarm (Set-point 3)	0004
	BIT 3: Under Voltage Phase A Alarm (Set-point 4)	0008
	BIT 4: Under Voltage Phase B Alarm (Set-point 5)	0010
	BIT 5: Under Voltage Phase C Alarm (Set-point 6)	0020
	BIT 6: Over Current Phase A Alarm (Set-point 7)	0040
	BIT 7: Over Current Phase B Alarm (Set-point 8)	0080
	BIT 8: Over Current Phase C Alarm (Set-point 9)	0100
	BIT 9: Under Current Phase A Alarm (Set-point 10)	0200
	BIT 10: Under Current Phase B Alarm (Set-point 11)	0400
	BIT 11: Under Current Phase C Alarm (Set-point 12)	0800

FORMAT	DESCRIPTION		CODING (HEX)
(F27)	BIT 12: Not Used		1000
	BIT 13: Not Used		2000
	BIT 14: Not Used		4000
	BIT 15: Not Used		8000
F28	**ALARM STATUS: (0 = NO ALARM, 1 = ALARM)**		FFFF
	BIT 0: Over Frequency Alarm	(Set-point 13)	0001
	BIT 1: Under Frequency Alarm	(Set-point 14)	0002
	BIT 2: Over Load Alarm	(Set-point 15)	0004
	BIT 3: Phase Loss Alarm	(Set-point 16)	0008
	BIT 4: Digital Input X, ON or OFF Alarm	(Set-point 17)	0010
	BIT 5: Over Phase Voltage Alarm	(Set-point 18)	0020
	BIT 6: Under Phase Voltage Alarm	(Set-point 19)	0040
	BIT 7: Over Line Voltage Alarm	(Set-point 20)	0080
	BIT 8: Under Line Voltage Alarm	(Set-point 21)	0100
	BIT 9: Over Current Alarm	(Set-point 22)	0200
	BIT 10: Under Current Alarm	(Set-point 23)	0400
	BIT 11: Not Used		0800
	BIT 12: Not Used		1000
	BIT 13: Not Used		2000
	BIT 14: Not Used		4000
	BIT 15: Not Used		8000
F29	**WORD STRUCTURE - CAUSE OF EVENT**		FFFF
	High Byte: EVENT TYPE		FFXX
	1 = Input Channel S1 Changed	(Set-point 17)	01XX
	2 = Input Channel S2 Changed	(Set-point 17)	02XX
	3 = Input Channel S3 Changed	(Set-point 17)	03XX
	4 = Input Channel S4 Changed	(Set-point 17)	04XX
	5 = Input Channel S5 Changed	(Set-point 17)	05XX
	6 = Input Channel S6 Changed	(Set-point 17)	06XX
	7 = Input Channel S7 Changed	(Set-point 17)	07XX
	8 = Input Channel S8 Changed	(Set-point 17)	08XX
	9 = Over Voltage Phase A	(Set-point 1)	09XX
	10 = Over Voltage Phase B	(Set-point 2)	0AXX
	11 = Over Voltage Phase C	(Set-point 3)	0BXX

FORMAT	DESCRIPTION		CODING (HEX)
(F29)	12 = Under Voltage Phase A	(Set-point 4)	0CXX
	13 = Under Voltage Phase B	(Set-point 5)	0DXX
	14 = Under Voltage Phase C	(Set-point 6)	0EXX
	15 = Over Current Phase A	(Set-point 7)	0FXX
	16 = Over Current Phase B	(Set-point 8)	10XX
	17 = Over Current Phase C	(Set-point 9)	11XX
	18 = Under Current Phase A	(Set-point 10)	12XX
	19 = Under Current Phase B	(Set-point 11)	13XX
	20 = Under Current Phase C	(Set-point 12)	14XX
	21 = Over Frequency	(Set-point 13)	15XX
	22 = Under Frequency	(Set-point 14)	16XX
	23 = Over Load	(Set-point 15)	17XX
	24 = Phase Loss	(Set-point 16)	18XX
	25 = 3xPhase Over Phase Voltage	(Set-point 18)	19XX
	26 = 3xPhase Under Phase Voltage	(Set-point 19)	1AXX
	27 = 3xPhase Over Line Voltage	(Set-point 20)	1BXX
	28 = 3xPhase Under Line Voltage	(Set-point 21)	1CXX
	29 = 3xPhase Over Current	(Set-point 22)	1DXX
	30 = 3xPhase Under Current	(Set-point 23)	1EXX
	Low BYTE: STATUS OF OPERATION		XXFF
	0 = Open Status (Valid Only for Event Type 1~8)		XX00
	1 = Close Status (Valid Only for Event Type 1~8)		XX01
F30	**UNSIGNED LONG INTEGER – VOLTAGE SET-POINT VALUE**		FFFFFFFF
	0 = Disable Set-Point and Alarm Triggering Function		00000000
	Range From: 100 V	(Raw value expand 10 times)	000003E8
	To: 650,000 V	(Raw value expand 10 times)	00632EA0
F31	**UNSIGNED LONG INTEGER – CURRENT SET-POINT VALUE**		FFFFFFFF
	0 = Disable Set-Point and Alarm Triggering Function		00000000
	Range From: 1.0 A	(Raw value expand 10 times)	0000000A
	To: 50,000.0 V	(Raw value expand 10 times)	0007A120
F32	**UNSIGNED INTEGER – FREQUENCY SET-POINT VALUE**		FFFF
	0 = Disable Set-Point and Alarm Triggering Function		0000
	Range From: 45 Hz		002D
	To: 65 Hz		0041

FORMAT	DESCRIPTION	CODING (HEX)
F33	**UNSIGNED LONG INTEGER – OVER LOAD SET-POINT VALUE**	FFFFFFFF
	0 = Disable Set-Point and Alarm Triggering Function	00000000
	Range From: 0.1 kW (Raw value expand 10 times)	00000001
	To: 99999999.9kW (Raw value expand 10 times)	3B9AC9FF
F34	**UNSIGNED INTEGER – PHASE LOSS SET-POINT**	FFFF
	0 = Disable Set-Point and Alarm Triggering Function	0000
	1 = Enable Set-Point and Alarm Triggering Function	0001
	Trigger only when one or two phase is less than 110V, if three phases are less than 110V at the same time, this situation will not considered as phase loss.	---
F35	**UNSIGNED INTEGER – INPUT CHANNEL "X" SET-POINT**	FFFF
	0 = Disable Set-Point and Alarm Triggering Function	0000
	1 = Enable Alarm when Digital Input Status S1 is ON	0001
	2 = Enable Alarm when Digital Input Status S2 is ON	0002
	3 = Enable Alarm when Digital Input Status S3 is ON	0003
	4 = Enable Alarm when Digital Input Status S4 is ON	0004
	5 = Enable Alarm when Digital Input Status S5 is ON	0005
	6 = Enable Alarm when Digital Input Status S6 is ON	0006
	7 = Enable Alarm when Digital Input Status S7 is ON	0007
	8 = Enable Alarm when Digital Input Status S8 is ON	0008
	9 = Enable Alarm when Digital Input Status S1 is OFF	0009
	10 = Enable Alarm when Digital Input Status S2 is OFF	000A
	11 = Enable Alarm when Digital Input Status S3 is OFF	000B
	12 = Enable Alarm when Digital Input Status S4 is OFF	000C
	13 = Enable Alarm when Digital Input Status S5 is OFF	000D
	14 = Enable Alarm when Digital Input Status S6 is OFF	000E
	15 = Enable Alarm when Digital Input Status S7 is OFF	000F
	16 = Enable Alarm when Digital Input Status S8 is OFF	0010
F36	**UNSIGNED INTEGER – ALARM ACTION TIME SETTING**	FFFF
	Alarm Action Time. 0 = Immediate Action	0000
	1~120 = Delay Thresholds in Second	0078
F37	**SIGNED INTEGER – PERCENTAGE VALUE**	FFFF
	Range From: -100.0 % (Raw value expand 1000 times)	FC18
	To: 0.0% (Raw value expand 1000 times)	0000
	To: +100.0% (Raw value expand 1000 times)	03E8

FORMAT	DESCRIPTION	CODING (HEX)
F38	**UNSIGNED INTEGER – COMMAND - FUNCTION CODE 5 (05H)**	FFFF
	ON / CLOSE / ACTIVE / SET	FF00
	OFF / OPEN / RELESE / RESET	0000

9.4 Memory Map Register Table

In Memory Register map table in bellow of this chapter there are some columns which describe about register profile as bellow:

- **GROUP:** This column shows the meaning of group of register. You may have some register together to show a data like time or other structured data.
- **REG ADDR (HEX):** This column shows Register Address in format of hexadecimal number. Each Address in table represent address pointer to one register (word value) of Modbus. For values in 32 bits format two register addresses are allocated.
- **DESCRIPTION:** This column consists of full description of each register address and map. In some case in table you may find the one merged row that describe about following register functions such as READ or READ/WRITE or describe about kind of register as holding or set-point and etc.
- **REGISTER VALUE RANGE:** This column shows about the valid range of register. This is useful data for reading and analyzing read register value or to be used to check valid range for set-points. The format and range of value is described for each register separately.
- **UNIT VALUE:** This column shows about each count of RAW value read or set from or to register address means about which unit value. This column must be in purpose of other columns of SCALE FACTOR and FORMAT.
- **SCALE FACTOR:** This column shows scaling factor for each count of RAW value read or set from or to register address. Each count of RAW value of register must be multiply by SCALE FACTOR. The meaning of SCALE FACTOR of each register is described separately and if this column shows none or dashed means that there is no scaling factor.
- **FORMAT:** This column shows format type of RAW value of each register value. There are a lot of format types that has been coded in other table. Each register value based on its format type must be analyzed for reading or writing. For example the format type of “F1” represent that the register raw value must be typed cast to the “16 bit unsigned integer numerical value” and format type of “F2” represent that the register raw value must be typed cast to the “16 bit signed integer numerical value”.

Table 9-3: VP-2040 Input Registers, Read Only Data

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						***READ ONLY***	
VOLTAGE	40001	0000	Phase A Voltage	0 - 65535	V	PTR × 0.01	F1
	40002	0001	Phase B Voltage	0 - 65535	V	PTR × 0.01	F1
	40003	0002	Phase C Voltage	0 - 65535	V	PTR × 0.01	F1
	40004	0003	Line A-B Voltage	0 - 65535	V	PTR × 0.01	F1
	40005	0004	Line B-C Voltage	0 - 65535	V	PTR × 0.01	F1
	40006	0005	Line C-A Voltage	0 - 65535	V	PTR × 0.01	F1
CURRENT	40007	0006	Phase A Current	0 - 65535	A	CTR × 0.001	F1
	40008	0007	Phase B Current	0 - 65535	A	CTR × 0.001	F1
	40009	0008	Phase C Current	0 - 65535	A	CTR × 0.001	F1
	40010	0009	Neutral Current	0 - 65535	A	CTR × 0.001	F1
POWER	40011	000A	3 Phase Active Power (low word)	-2,147,483,648 ~ 2,147,483,647	W	PTR × CTR × 0.1	F4
	40012	000B	3 Phase Active Power (high word)	---	---	---	F4
	40013	000C	3 Phase Reactive Power (low word)	-2,147,483,648 ~ 2,147,483,647	VAR	PTR × CTR × 0.1	F4
	40014	000D	3 Phase Reactive Power (high word)	---	---	---	F4
	40015	000E	3 Phase Apparent Power (low word)	0 ~ 4,294,967,295	VA	PTR × CTR × 0.1	F3
	40016	000F	3 Phase Apparent Power (high word)	---	---	---	F3
PFC	40017	0010	3 Phase Power Factor	-1000 ~ +1000	%	0.001	F37
FREQUENCY	40018	0011	Frequency	0 - 65535	Hz	0.01	F1
ENERGY	40019	0012	3 Phase Input Active Energy (low word)	32 Bit	kWH	0.1	F3
	40020	0013	3 Phase Input Active Energy (high word)	---	---	---	F3
	40021	0014	3 Phase Input Reactive Energy (low word)	32 Bit	kVarH	0.1	F3
	40022	0015	3 Phase Input Reactive Energy (high word)	---	---	---	F3
	40023	0016	3 Phase Output Active Energy (low word)	32 Bit	kWH	0.1	F3
	40024	0017	3 Phase Output Active Energy (high word)	---	---	---	F3
	40025	0018	3 Phase Output Reactive Energy (low word)	32 Bit	kVarH	0.1	F3
	40026	0019	3 Phase Output Reactive Energy (high word)	---	---	---	F3
DI STAUS	40027	001A	Digital Input Status	---	---	---	F5

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
DO STATUS	40028	001B	Digital Relay Output Status	---	---	---	F6
HARRMONIC	40029	001C	Va/Vab - Harmonic THD	0 ~ 1000	THD	0.001	F37
VOLTAGE	40030	001D	Vb/Vbc - Harmonic THD	0 ~ 1000	THD	0.001	F37
	40031	001E	Vc/Vbc - Harmonic THD	0 ~ 1000	THD	0.001	F37
CURRENT	40032	001F	Ia - Harmonic THD	0 ~ 1000	THD	0.001	F37
	40033	0020	Ib - Harmonic THD	0 ~ 1000	THD	0.001	F37
	40034	0021	Ic - Harmonic THD	0 ~ 1000	THD	0.001	F37
K FACTOR	40035	0022	Ia - K Factor	0 ~ 1000	K	0.1	F37
	40036	0023	Ib - K Factor	0 ~ 1000	K	0.1	F37
	40037	0024	Ic - K Factor	0 ~ 1000	K	0.1	F37
DEMAND	40038	0025	Average Phase Current Demand	0 - 65535	A	CTR × 0.001	F1
	40039	0026	3 Phase Active Power Demand (low word)	-2,147,483,648 ~ 2,147,483,647	W	PTR × CTR × 0.1	F4
	40040	0027	3 Phase Active Power Demand (high word)	---	---	---	F4
	40041	0028	3 Phase Reactive Power Demand (low word)	-2,147,483,648 ~ 2,147,483,647	VAR	PTR × CTR × 0.1	F4
	40042	0029	3 Phase Reactive Power Demand (high word)	---	---	---	F4
	40043	002A	3 Phase Apparent Power Demand (low word)	0 ~ 4,294,967,295	VA	PTR × CTR × 0.1	F3
	40044	002B	3 Phase Apparent Power Demand (high word)	---	---	---	F3
SOE	40045	002C	SOE Buffer Event Counter	0 ~ 59,999	Qty	---	F18

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
VOLTAGE PHASE	40101	0064	Phase A Voltage	0 - 65535	V	PTR × 0.01	F1
	40102	0065	Phase B Voltage	0 - 65535	V	PTR × 0.01	F1
	40103	0066	Phase C Voltage	0 - 65535	V	PTR × 0.01	F1
	40104	0067	Phase Voltage Unbalance Rate	0 ~ 1000	%	0.001	F37
	40105	0068	Average Phase Voltage	0 - 65535	V	PTR × 0.01	F1
VOLTAGE LINE	40106	0069	Line A-B Voltage	0 - 65535	V	PTR × 0.01	F1
	40107	006A	Line B-C Voltage	0 - 65535	V	PTR × 0.01	F1
	40108	006B	Line C-A Voltage	0 - 65535	V	PTR × 0.01	F1
	40109	006C	Line Voltage Unbalance Rate	0 ~ 1000	%	0.001	F37
	40110	006D	Average Line Voltage	0 - 65535	V	PTR × 0.01	F1
	40111	006E	Neutral Voltage	0 - 65535	V	PTR × 0.01	F1
CURRENT	40112	006F	Phase A Current	0 - 65535	A	CTR × 0.001	F1
	40113	0070	Phase B Current	0 - 65535	A	CTR × 0.001	F1
	40114	0071	Phase C Current	0 - 65535	A	CTR × 0.001	F1
	40115	0072	Current Unbalance Rate	0 ~ 1000	%	0.001	F37
	40116	0073	Average Phase Current	0 - 65535	A	CTR × 0.001	F1
	40117	0074	Neutral Current	0 - 65535	A	CTR × 0.001	F1
ACTIVE POWER	40118	0075	Phase A Active Power	-32768 ~ 32768	W	PTR × CTR × 0.1	F2
	40119	0076	Phase B Active Power	-32768 ~ 32768	W	PTR × CTR × 0.1	F2
	40120	0077	Phase C Active Power	-32768 ~ 32768	W	PTR × CTR × 0.1	F2
	40121	0078	Total Active Power (low word)	-2,147,483,648 ~ 2,147,483,647	W	PTR × CTR × 0.1	F4
	40122	0079	Total Active Power (high word)	---	---	---	F4
REACTIVE POWER	40123	007A	Phase A Reactive Power	-32768 ~ 32768	VAR	PTR × CTR × 0.1	F2
	40124	007B	Phase B Reactive Power	-32768 ~ 32768	VAR	PTR × CTR × 0.1	F2
	40125	007C	Phase C Reactive Power	-32768 ~ 32768	VAR	PTR × CTR × 0.1	F2
	40126	007D	Total Reactive Power (low word)	-2,147,483,648 ~ 2,147,483,647	VAR	PTR × CTR × 0.1	F4
	40127	007E	Total Reactive Power (high word)	---	---	---	F4

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
APPARENT POWER	40128	007F	Phase A Apparent Power	0 ~ 65535	W	PTR × CTR × 0.1	F2
	40129	0080	Phase B Apparent Power	0 ~ 65535	VA	PTR × CTR × 0.1	F2
	40130	0081	Phase C Apparent Power	0 ~ 65535	VA	PTR × CTR × 0.1	F2
	40131	0082	Total Apparent Power (low word)	0 ~ 4,294,967,295	VA	PTR × CTR × 0.1	F3
	40132	0083	Total Apparent Power (high word)	---	---	---	F4
POWER FACTOR	40133	0084	Phase A Power Factor	-1000 ~ +1000	%	0.001	F37
	40134	0085	Phase B Power Factor	-1000 ~ +1000	%	0.001	F37
	40135	0086	Phase C Power Factor	-1000 ~ +1000	%	0.001	F37
	40136	0087	Total Power Factor	-1000 ~ +1000	%	0.001	F37
SYSTEM	40137	0088	Frequency	0 – 65535	Hz	0.01	F1
	40138	0089	Digital Input Status	---	---	---	F5
	40139	008A	Digital Relay Output Status	---	---	---	F6
ALARM STATUS	40140	008B	Alarm Statuses	---	---	---	F28
	40141	008C	Alarm Statuses Per Phase	---	---	---	F27
	40142	008D	Alarm Statuses – Latched	---	---	---	F28
	40143	008E	Alarm Statuses Per Phase – Latched	---	---	---	F27

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
ENERGY	40201	00C8	Input Active Energy (low word)	32 Bit	kWH	0.1	F3
	40202	00C9	Input Active Energy (high word)	---	---	---	F3
	40203	00CA	Input Reactive Energy (low word)	32 Bit	kVarH	0.1	F3
	40204	00CB	Input Reactive Energy (high word)	---	---	---	F3
	40205	00CC	Output Active Energy (low word)	32 Bit	kWH	0.1	F3
	40206	00CD	Output Active Energy (high word)	---	---	---	F3
	40207	00CE	Output Reactive Energy (low word)	32 Bit	kVarH	0.1	F3
	40208	00CF	Output Reactive Energy (high word)	---	---	---	F3
ACTIVE ENERGY	40209	00D0	First-Quadrant Active Energy (low word)	32 Bit	kWH	0.1	F3
	40210	00D1	First-Quadrant Active Energy (high word)	---	---	---	F3
	40211	00D2	Second-Quadrant Active Energy (low word)	32 Bit	kWH	0.1	F3
	40212	00D3	Second-Quadrant Active Energy (high word)	---	---	---	F3
	40213	00D4	Third-Quadrant Active Energy (low word)	32 Bit	kWH	0.1	F3
	40214	00D5	Third-Quadrant Active Energy (high word)	---	---	---	F3
	40215	00D6	Fourth-Quadrant Active Energy (low word)	32 Bit	kWH	0.1	F3
	40216	00D7	Fourth-Quadrant Active Energy (high word)	---	---	---	F3
REACTIVE ENERGY	40217	00D8	First-Quadrant Reactive Energy (low word)	32 Bit	kVarH	0.1	F3
	40218	00D9	First-Quadrant Reactive Energy (high word)	---	---	---	F3
	40219	00DA	Second-Quadrant Reactive Energy (low word)	32 Bit	kVarH	0.1	F3
	40220	00DB	Second-Quadrant Reactive Energy (high word)	---	---	---	F3
	40221	00DC	Third-Quadrant Reactive Energy (low word)	32 Bit	kVarH	0.1	F3
	40222	00DD	Third-Quadrant Reactive Energy (high word)	---	---	---	F3
	40223	00DE	Fourth-Quadrant Reactive Energy (low word)	32 Bit	kVarH	0.1	F3
	40224	00DF	Fourth-Quadrant Reactive Energy (high word)	---	---	---	F3

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
DEMANDS	40301	012C	Average Current Demand	0 - 65535	A	CTR × 0.001	F1
	40302	012D	Total Active Power Demand (low word)	-2,147,483,648 ~ 2,147,483,647	W	PTR × CTR × 0.1	F4
	40303	012E	Total Active Power Demand (high word)	---	---	---	F4
	40304	012F	Total Reactive Power Demand (low word)	-2,147,483,648 ~ 2,147,483,647	VAR	PTR × CTR × 0.1	F4
	40305	0130	Total Reactive Power Demand (high word)	---	---	---	F4
	40306	0131	Total Apparent Power Demand (low word)	0 ~ 4,294,967,295	VA	PTR × CTR × 0.1	F3
	40307	0132	Total Apparent Power Demand (high word)	---	---	---	F3
MAXIMUM DEMAND CURRENT	40308	0133	Maximum of Average Current Demand	0 - 65535	A	CTR × 0.001	F1
	40309	0134	Date of Maximum Current Demand (Year / Month)	---	---	---	F7
	40310	0135	Time of Maximum Current Demand (Day / Hour)	---	---	---	F8
	40311	0136	Time of Maximum Current Demand (Minute / Second)	---	---	---	F9
MAXIMUM DEMAND ACTIVE POWER	40312	0137	Maximum of Total Active Power Demand (low word)	-2,147,483,648 ~ 2,147,483,647	W	PTR × CTR × 0.1	F4
	40313	0138	Maximum of Total Active Power Demand (high word)	---	---	---	F4
	40314	0139	Date of Maximum Total Active Power Demand (Year / Month)	---	---	---	F7
	40315	013A	Time of Maximum Total Active Power Demand (Day / Hour)	---	---	---	F8
	40316	013B	Time of Maximum Total Active Power Demand (Minute / Second)	---	---	---	F9
MAXIMUM DEMAND REACTIVE POWER	40317	013C	Maximum of Total Reactive Power Demand (low word)	-2,147,483,648 ~ 2,147,483,647	VAR	PTR × CTR × 0.1	F4
	40318	013D	Maximum of Total Reactive Power Demand (high word)	---	---	---	F4
	40319	013E	Date of Maximum Total Reactive Power Demand (Year / Month)	---	---	---	F7
	40320	013F	Time of Maximum Total Reactive Power Demand (Day / Hour)	---	---	---	F8
	40321	0140	Time of Maximum Total Reactive Power Demand (Minute / Second)	---	---	---	F9
MAXIMUM DEMAND APPARENT POWER	40322	0141	Maximum of Total Apparent Power Demand (low word)	0 ~ 4,294,967,295	VA	PTR × CTR × 0.1	F3
	40323	0142	Maximum of Total Apparent Power Demand (high word)	---	---	---	F3
	40324	0143	Date of Maximum Total Apparent Power Demand (Year / Month)	---	---	---	F7
	40325	0144	Time of Maximum Total Apparent Power Demand (Day / Hour)	---	---	---	F8
	40326	0145	Time of Maximum Total Apparent Power Demand (Minute / Second)	---	---	---	F9

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
HARMONIC	40401	0190	Va/Vab - Harmonic THD	0 ~ 1000	THD	0.001	F37
	40402	0191	Vb/Vbc - Harmonic THD	0 ~ 1000	THD	0.001	F37
	40403	0192	Vc/Vbc - Harmonic THD	0 ~ 1000	THD	0.001	F37
	40404	0193	Ia - Harmonic THD	0 ~ 1000	THD	0.001	F37
	40405	0194	Ib - Harmonic THD	0 ~ 1000	THD	0.001	F37
	40406	0195	Ic - Harmonic THD	0 ~ 1000	THD	0.001	F37
	40407	0196	Ia - K Factor	0 ~ 1000	K	0.1	F37
	40408	0197	Ib - K Factor	0 ~ 1000	K	0.1	F37
	40409	0198	Ic - K Factor	0 ~ 1000	K	0.1	F37
HARMONIC THD 2^{nd}	40410	0199	Va/Vab - 2^{nd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40411	019A	Vb/Vbc - 2^{nd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40412	019B	Vc/Vca - 2^{nd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40413	019C	Ia - 2^{nd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40414	019D	Ib - 2^{nd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40415	019E	Ic - 2^{nd} Harmonic Component	0 ~ 1000	THD	0.001	F37
HARMONIC THD 3^{rd}	40416	019F	Va/Vab - 3^{rd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40417	01A0	Vb/Vbc - 3^{rd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40418	01A1	Vc/Vca - 3^{rd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40419	01A2	Ia - 3^{rd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40420	01A3	Ib - 3^{rd} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40421	01A4	Ic - 3^{rd} Harmonic Component	0 ~ 1000	THD	0.001	F37
HARMONIC THD 4^{th}	40422	01A5	Va/Vab - 4^{th} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40423	01A6	Vb/Vbc - 4^{th} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40424	01A7	Vc/Vca - 4^{th} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40425	01A8	Ia - 4^{th} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40426	01A9	Ib - 4^{th} Harmonic Component	0 ~ 1000	THD	0.001	F37
	40427	01AA	Ic - 4^{th} Harmonic Component	0 ~ 1000	THD	0.001	F37

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
HARMONIC THD 5th	40528	020F	Va/Vab - 5th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40529	0210	Vb/Vbc - 5th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40530	0211	Vc/Vca - 5th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40531	0212	Ia - 5th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40532	0213	Ib - 5th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40533	0214	Ic - 5th Harmonic Component	0 ~ 1000	THD	0.001	F37
HARMONIC THD 6th	40534	0215	Va/Vab - 6th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40535	0216	Vb/Vbc - 6th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40536	0217	Vc/Vca - 6th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40537	0218	Ia - 6th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40538	0219	Ib - 6th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40539	021A	Ic - 6th Harmonic Component	0 ~ 1000	THD	0.001	F37
HARMONIC	40540	021B	Va/Vab - 7th Harmonic Component	0 ~ 1000	THD	0.001	F37
↓	↓	↓	↓ ↓	↓	↓	↓	↓
↓	↓	↓	↓ ↓	↓	↓	↓	↓
HARMONIC THD 30th	40578	0241	Va/Vab - 30th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40579	0242	Vb/Vbc - 30th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40580	0243	Vc/Vca - 30th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40581	0244	Ia - 30th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40582	0245	Ib - 30th Harmonic Component	0 ~ 1000	THD	0.001	F37
	40583	0246	Ic - 30th Harmonic Component	0 ~ 1000	THD	0.001	F37
HARMONIC THD 31st	40584	0247	Va/Vab - 31st Harmonic Component	0 ~ 1000	THD	0.001	F37
	40585	0248	Vb/Vbc - 31st Harmonic Component	0 ~ 1000	THD	0.001	F37
	40586	0249	Vc/Vca - 31st Harmonic Component	0 ~ 1000	THD	0.001	F37
	40587	024A	Ia - 31st Harmonic Component	0 ~ 1000	THD	0.001	F37
	40588	024B	Ib - 31st Harmonic Component	0 ~ 1000	THD	0.001	F37
	40589	024C	Ic - 31st Harmonic Component	0 ~ 1000	THD	0.001	F37

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
MAXIMUM MEASURING VALUES	40601	0258	Maximum Phase A Current	0 - 65535	A	CTR × 0.001	F1
	40602	0259	Maximum Phase B Current	0 - 65535	A	CTR × 0.001	F1
	40603	025A	Maximum Phase C Current	0 - 65535	A	CTR × 0.001	F1
	40604	025B	Maximum Total Active Power (low word)	-2,147,483,648 ~ 2,147,483,647	W	PTR × CTR × 0.1	F4
	40605	025C	Maximum Total Active Power (high word)	---	---	---	F4
	40606	025D	Maximum Total Reactive Power (low word)	-2,147,483,648 ~ 2,147,483,647	VAR	PTR × CTR × 0.1	F4
	40607	025E	Maximum Total Reactive Power (high word)	---	---	---	F4
	40608	025F	Maximum Total Apparent Power (low word)	0 ~ 4,294,967,295	VA	PTR × CTR × 0.1	F3
	40609	0260	Maximum Total Apparent Power (high word)	---	---	---	F3
MAXIMUM HARMONIC VALUES	40610	0261	Maximum Ia - THD	0 ~ 1000	THD	0.001	F37
	40611	0262	Maximum Ib - THD	0 ~ 1000	THD	0.001	F37
	40612	0263	Maximum Ic - THD	0 ~ 1000	THD	0.001	F37
	40613	0264	Maximum Va - THD	0 ~ 1000	THD	0.001	F37
	40614	0265	Maximum Vb - THD	0 ~ 1000	THD	0.001	F37
	40615	0266	Maximum Vc - THD	0 ~ 1000	THD	0.001	F37

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
MINIMUM MEASURING VALUES	40616	0267	Minimum Phase A Current	0 - 65535	A	CTR × 0.001	F1
	40617	0268	Minimum Phase B Current	0 - 65535	A	CTR × 0.001	F1
	40618	0269	Minimum Phase C Current	0 - 65535	A	CTR × 0.001	F1
	40619	026A	Minimum Total Active Power (low word)	-2,147,483,648 ~ 2,147,483,647	W	PTR × CTR × 0.1	F4
	40620	026B	Minimum Total Active Power (high word)	---	---	---	F4
	40621	026C	Minimum Total Reactive Power (low word)	-2,147,483,648 ~ 2,147,483,647	VAR	PTR × CTR × 0.1	F4
	40622	026D	Minimum Total Reactive Power (high word)	---	---	---	F4
	40623	026E	Minimum Total Apparent Power (low word)	0 ~ 4,294,967,295	VA	PTR × CTR × 0.1	F3
	40624	026F	Minimum Total Apparent Power (high word)	---	---	---	F3
MINIMUM HARMONIC VALUES	40625	0270	Minimum Ia - THD	0 ~ 1000	THD	0.001	F37
	40626	0271	Minimum Ib - THD	0 ~ 1000	THD	0.001	F37
	40627	0272	Minimum Ic - THD	0 ~ 1000	THD	0.001	F37
	40628	0273	Minimum Va - THD	0 ~ 1000	THD	0.001	F37
	40629	0274	Minimum Vb - THD	0 ~ 1000	THD	0.001	F37
	40630	0275	Minimum Vc - THD	0 ~ 1000	THD	0.001	F37

GROUP	REG ADDR (INDEX)	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT
Actual Values (Input Registers)						*READ ONLY*	
EVENT NO	40710	02C5	SOE Event Records Number	0 ~ 59,999	Qty	---	F18
EVENT RECORD 1	40711	02C6	SOE Record 1 Cause of Event	---	---	---	F29
	40712	02C7	SOE Record 1 Milliseconds	---	---	---	F16
	40713	02C8	SOE Record 1 UNIX Time (low word)	32 BITS	---	---	F17
	40714	02C9	SOE Record 1 UNIX Time (high word)	---	---	---	F17
EVENT RECORD 2	40715	02CA	SOE Record 2 Cause of Event	---	---	---	F29
	40716	02CB	SOE Record 2 Milliseconds	---	---	---	F16
	40717	02CC	SOE Record 2 UNIX Time (low word)	32 BITS	---	---	F17
	40718	02CD	SOE Record 2 UNIX Time (high word)	---	---	---	F17
EVENT RECORD 3	40719	02CE	SOE Record 3 Cause of Event	---	---	---	F29
	40720	02CF	SOE Record 3 Milliseconds	---	---	---	F16
	40721	02D0	SOE Record 3 UNIX Time (low word)	32 BITS	---	---	F17
	40722	02D1	SOE Record 3 UNIX Time (high word)	---	---	---	F17
EVENT RECORDS	40723	02D2	SOE Record 4 Cause of Event	---	---	---	F29
	40724	02D3	SOE Record 4 Milliseconds	---	---	---	F16
↓	↓	↓	↓ ↓	↓	↓	↓	↓
↓	↓	↓	↓ ↓	↓	↓	↓	↓
	40901	0384	SOE Record 48 UNIX Time (low word)	32 BITS	---	---	F17
	40902	0385	SOE Record 48 UNIX Time (high word)	---	---	---	F17
EVENT RECORD 49	40903	0386	SOE Record 49 Cause of Event	---	---	---	F29
	40904	0387	SOE Record 49 Milliseconds	---	---	---	F16
	40905	0388	SOE Record 49 UNIX Time (low word)	32 BITS	---	---	F17
	40906	0389	SOE Record 49 UNIX Time (high word)	---	---	---	F17
EVENT RECORD 50	40907	038A	SOE Record 50 Cause of Event	---	---	---	F29
	40908	038B	SOE Record 50 Milliseconds	---	---	---	F16
	40909	038C	SOE Record 50 UNIX Time (low word)	32 BITS	---	---	F17
	40910	038D	SOE Record 50 UNIX Time (high word)	---	---	---	F17

Table 9-4: VP-2040 Holding Registers, Read/Write Data

GROUP	REG ADDR INDEX	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT	FACTORY DEFAULT VALUE
Programming Values (Holding Registers)								***READ OR WRITE***
MEASURING SYSTEM SETTINGS	41001	03E8	CT Primary Side Setting	1 ~ 49,999	A	1	F1	1 A
	41002	03E9	CT Secondary Site Setting	1 or 5	A	1	F1	**READ ONLY**
	41003	03EA	PT Primary Side Setting (low word)	1 ~ 500,000	V	1	F3	1 V
	41004	03EB	PT Primary Side Setting (high word)	---	---	---	---	---
	41005	03EC	PT Secondary Site Setting	1 ~ 200	V	1	F1	1 V
	41006	03ED	Measuring Mode	0 ~ 1	---	---	F19	0 = 3VT
Communication	41007	03EE	Communication Address	1 ~ 247	Address	---	F1	1
	41008	03EF	Communication Baud Rate	0 ~ 3	---	---	F22	1
	41009	03F0	Reserved	---	---	---	---	---
CLEAR DATA COMMANDS	41010	03F1	CLEAR Max/Min Real Data	255	---	---	F1	**WRITE ONLY**
	41011	03F2	CLEAR Energy Data	255	---	---	F1	**WRITE ONLY**
	41012	03F3	CLEAR Demand Data	255	---	---	F1	**WRITE ONLY**
	41013	03F4	CLEAR Event Records Data	255	---	---	F1	**WRITE ONLY**
	41014	03F5	Reserved	---	---	---	---	---
	41015	03F6	Reserved	---	---	---	---	---
RELAY PULSE TIME SETTING	41016	03F7	Action Time of Relay 1	0 ~ 1200	Second	1	F24	0 = Latch
	41017	03F8	Action Time of Relay 2	0 ~ 1200	Second	1	F24	0 = Latch
	41018	03F9	Action Time of Relay 3	0 ~ 1200	Second	1	F24	0 = Latch
	41019	03FA	Action Time of Relay 4	0 ~ 1200	Second	1	F24	0 = Latch
	41020	03FB	Reserved	---	---	---	---	---
	41021	03FC	Reserved	---	---	---	---	---
PULSE OUT SETTING	41022	03FD	Active Energy Pulse Output	0 ~ 2	---	---	F20	0 = OFF
	41023	03FE	Reactive Energy Pulse Output	0 ~ 2	---	---	F20	0 = OFF
	41024	03FF	Pulse Output Constant Parameter	1000 ~ 40000	---	---	F21	1000
AO SETTING	41025	0400	Analog Output Parameter	0 ~ 13	---	---	F23	0 = OFF
	41026	0401	Analog Output Factor	10 ~ 100	---	1	F1	10

GROUP	REG ADDR INDEX	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT	FACTORY DEFAULT VALUE
Programming Values (Holding Registers)								*READ OR WRITE*
	41027	0402	Reserved	---	---	---	---	---
	41028	0403	Reserved	---	---	---	---	---
	41029	0404	Reserved	---	---	---	---	---
	41030	0405	Reserved	---	---	---	---	---
RELAY 1	41031	0406	Control Mode of Relay 1	0 ~ 1	Mode	---	F25	1 = Remote
SETTING	41032	0407	Operation Object of Relay 1	0 ~ 23	---	---	F26	0 = All Active
	41033	0408	Reserved	---	---	---	---	---
	41034	0409	Reserved	---	---	---	---	---
	41035	040A	Reserved	---	---	---	---	---
RELAY 2	41036	040B	Control Mode of Relay 2	0 ~ 1	Mode	---	F25	1 = Remote
SETTING	41037	040C	Operation Object of Relay 2	0 ~ 23	---	---	F26	0 = All Active
	41038	040D	Reserved	---	---	---	---	---
	41039	040E	Reserved	---	---	---	---	---
	41040	040F	Reserved	---	---	---	---	---
RELAY 3	41041	0410	Control Mode of Relay 3	0 ~ 1	Mode	---	F25	1 = Remote
SETTING	41042	0411	Operation Object of Relay 3	0 ~ 23	---	---	F26	0 = All Active
	41043	0412	Reserved	---	---	---	---	---
	41044	0413	Reserved	---	---	---	---	---
	41045	0414	Reserved	---	---	---	---	---
RELAY 4	41046	0415	Control Mode of Relay 4	0 ~ 1	Mode	---	F25	1 = Remote
SETTING	41047	0416	Operation Object of Relay 4	0 ~ 23	---	---	F26	0 = All Active
	41048	0417	Reserved	---	---	---	---	---
	41049	0418	Reserved	---	---	---	---	---
	41050	0419	Reserved	---	---	---	---	---

GROUP	REG ADDR INDEX	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT	FACTORY DEFAULT VALUE
Programming Values (Holding Registers)								***READ OR WRITE***
DATE & TIME SETTING AND READING	40701	02BC	Real Time Clock: Year	0 ~ 99	Year	---	F10	---
	40702	02BD	Real Time Clock: Month	1 ~ 12	Month	---	F11	---
	40703	02BE	Real Time Clock: Day	1 ~ 31	Day	---	F12	---
	40704	02BF	Real Time Clock: Hour	0 ~ 23	Hour	---	F13	---
	40705	02C0	Real Time Clock: Minute	0 ~ 59	Minute	---	F14	---
	40706	02C1	Real Time Clock: Second	0 ~ 59	Second	---	F15	---
	40707	02C2	Unix Clock (low word)	32 BITS	Second	---	F17	---
	40708	02C3	Unix Clock (high word)	---	---	---	F17	---
	40709	02C4	Unix Clock Milliseconds	0 ~ 999	m-sec	---	F16	---
ACTIVE ENERGY SETTING	41101	044C	First-Quadrant Active Energy (low word)	0 ~ 999,999,999	kWH	0.1	F3	**WRIE ONLY**
	41102	044D	First-Quadrant Active Energy (high word)	---	---	---	F3	**WRIE ONLY**
	41103	044E	Second-Quadrant Active Energy (low word)	0 ~ 999,999,999	kWH	0.1	F3	**WRIE ONLY**
	41104	044F	Second-Quadrant Active Energy (high word)	---	---	---	F3	**WRIE ONLY**
	41105	0450	Third-Quadrant Active Energy (low word)	0 ~ 999,999,999	kWH	0.1	F3	**WRIE ONLY**
	41106	0451	Third-Quadrant Active Energy (high word)	---	---	---	F3	**WRIE ONLY**
	41107	0452	Fourth-Quadrant Active Energy (low word)	0 ~ 999,999,999	kWH	0.1	F3	**WRIE ONLY**
	41108	0453	Fourth-Quadrant Active Energy (high word)	---	---	---	F3	**WRIE ONLY**
REACTIVE ENERGY SETTING	41109	0454	First-Quadrant Reactive Energy (low word)	0 ~ 999,999,999	kVarH	0.1	F3	**WRIE ONLY**
	41110	0455	First-Quadrant Reactive Energy (high word)	---	---	---	F3	**WRIE ONLY**
	41111	0456	Second-Quad. Reactive Energy (low word)	0 ~ 999,999,999	kVarH	0.1	F3	**WRIE ONLY**
	41112	0457	Second-Quad. Reactive Energy (high word)	---	---	---	F3	**WRIE ONLY**
	41113	0458	Third-Quadrant Reactive Energy (low word)	0 ~ 999,999,999	kVarH	0.1	F3	**WRIE ONLY**
	41114	0459	Third-Quadrant Reactive Energy (high word)	---	---	---	F3	**WRIE ONLY**
	41115	045A	Fourth-Quadrant Reactive Energy (low word)	0 ~ 999,999,999	kVarH	0.1	F3	**WRIE ONLY**
	41116	045B	Fourth-Quadrant Reactive Energy (high word)	---	---	---	F3	**WRIE ONLY**

GROUP	REG ADDR INDEX	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT	FACTORY DEFAULT VALUE
Programming Values (Holding Registers)								*READ OR WRITE*
SET-POINT 1	42001	07D0	Over Voltage Phase A High Limit (low word)	32 BITS	---	0.1	F30	0 = Disable
	42002	07D1	Over Voltage Phase A High Limit (high word)	---	---	---	F30	---
	42003	07D2	Over Voltage Phase A Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 2	42004	07D3	Over Voltage Phase B High Limit (low word)	32 BITS	---	0.1	F30	0 = Disable
	42005	07D4	Over Voltage Phase B High Limit (high word)	---	---	---	F30	---
	42006	07D5	Over Voltage Phase B Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 3	42007	07D6	Over Voltage Phase C High Limit (low word)	32 BITS	---	0.1	F30	0 = Disable
	42008	07D7	Over Voltage Phase C High Limit (high word)	---	---	---	F30	---
	42009	07D8	Over Voltage Phase C Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 4	42010	07D9	Under Voltage Phase A Low Limit (low word)	32 BITS	---	0.1	F30	0 = Disable
	42011	07DA	Under Voltage Phase A Low Limit (high word)	---	---	---	F30	---
	42012	07DB	Under Voltage Phase A Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 5	42013	07DC	Under Voltage Phase B Low Limit (low word)	32 BITS	---	0.1	F30	0 = Disable
	42014	07DD	Under Voltage Phase B Low Limit (high word)	---	---	---	F30	---
	42015	07DE	Under Voltage Phase B Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 6	42016	07DF	Under Voltage Phase C Low Limit (low word)	32 BITS	---	0.1	F30	0 = Disable
	42017	07E0	Under Voltage Phase C Low Limit (high word)	---	---	---	F30	---
	42018	07E1	Under Voltage Phase C Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 7	42019	07E2	Over Current Phase A High Limit (low word)	32 BITS	---	0.1	F31	0 = Disable
	42020	07E3	Over Current Phase A High Limit (high word)	---	---	---	F31	---
	42021	07E4	Over Current Phase A Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 8	42022	07E5	Over Current Phase B High Limit (low word)	32 BITS	---	0.1	F31	0 = Disable
	42023	07E6	Over Current Phase B High Limit (high word)	---	---	---	F31	---
	42024	07E7	Over Current Phase B Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 9	42025	07E8	Over Current Phase C High Limit (low word)	32 BITS	---	0.1	F31	0 = Disable
	42026	07E9	Over Current Phase C High Limit (high word)	---	---	---	F31	---
	42027	07EA	Over Current Phase C Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate

GROUP	REG ADDR INDEX	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT	FACTORY DEFAULT VALUE
Programming Values (Holding Registers)								***READ OR WRITE***
SET-POINT 10	42028	07EB	Under Current Phase A Low Limit (low word)	32 BITS	---	0.1	F31	0 = Disable
	42029	07EC	Under Current Phase A Low Limit (high word)	---	---	---	F31	---
	42030	07ED	Under Current Phase A Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 11	42031	07EE	Under Current Phase B Low Limit (low word)	32 BITS	---	0.1	F31	0 = Disable
	42032	07EF	Under Current Phase B Low Limit (high word)	---	---	---	F31	---
	42033	07F0	Under Current Phase B Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 12	42034	07F1	Under Current Phase C Low Limit (low word)	32 BITS	---	0.1	F31	0 = Disable
	42035	07F2	Under Current Phase C Low Limit (high word)	---	---	---	F31	---
	42036	07F3	Under Current Phase C Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 13	42037	07F4	Over Frequency High Limit	45 ~ 65	---	1	F32	0 = Disable
	42038	07F5	Over Frequency Action Time	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 14	42039	07F6	Under Frequency Low Limit	45 ~ 65	---	1	F32	0 = Disable
	42040	07F7	Under Frequency Action Time	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 15	42041	07F8	Over Load Power High Limit (low word)	32 BITS	---	0.1	F33	0 = Disable
	42042	07F9	Over Load Power High Limit (high word)	---	---	---	F33	---
	42043	07FA	Over Load Power Action Time	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 16	42044	07FB	Phase Loss set-point setting	0 ~ 1	---	---	F34	0 = Disable
SET-POINT 17	42045	07FC	Input Channel “X” On or Off	0 ~ 16	---	---	F35	0 = Disable
SET-POINT 18	42046	07FD	3x Phase Over Phase Voltage (low word)	32 BITS	---	0.1	F31	0 = Disable
	42047	07FE	3x Phase Over Phase Voltage (high word)	---	---	---	F31	---
	42048	07FF	3x Phase Over Phase Voltage Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 19	42049	0800	3x Phase Under Phase Voltage (low word)	32 BITS	---	0.1	F31	0 = Disable
	42050	0801	3x Phase Under Phase Voltage (high word)	---	---	---	F31	---
	42051	0802	3x Phase Under Phase Voltage Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 20	42052	0803	3x Phase Over Line Voltage (low word)	32 BITS	---	0.1	F31	0 = Disable
	42053	0804	3x Phase Over Line Voltage (high word)	---	---	---	F31	---
	42054	0805	3x Phase Over Line Voltage Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate

GROUP	REG ADDR INDEX	REG ADDR (HEX)	DESCRIPTION	REGISTER VALUE RANGE	UNIT VALUE	SCALE FACTOR	FORMAT	FACTORY DEFAULT VALUE
Programming Values (Holding Registers)								***READ OR WRITE***
SET-POINT 21	42055	0806	3x Phase Under Line Voltage (low word)	32 BITS	---	0.1	F31	0 = Disable
	42056	0807	3x Phase Under Line Voltage (high word)	---	---	---	F31	---
	42057	0808	3x Phase Under Line Voltage Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 22	42058	0809	3x Phase Over Current (low word)	32 BITS	---	0.1	F31	0 = Disable
	42059	080A	3x Phase Over Current (high word)	---	---	---	F31	---
	42060	080B	3x Phase Over Current Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate
SET-POINT 23	42061	080C	3x Phase Under Current (low word)	32 BITS	---	0.1	F31	0 = Disable
	42062	080D	3x Phase Under Current (high word)	---	---	---	F31	---
	42063	080E	3x Phase Under Current Action Time Setting	0 ~ 120	Second	1	F36	0 = Immediate

Table 9-5: VP-2040 Coil Registers, Write Data, Execution Command

GROUP	REG ADDR INDEX	REG ADDR (HEX)	DESCRIPTION	ON DATA	OFF DATA	FORMAT
Programming Values (Coil Register)						***WRITE ONLY***
RELAY OPERATION	0	0000	Relay #1 ON/OFF Operation	65280 (FF00)	0 (0000)	F38
	1	0001	Relay #2 ON/OFF Operation	65280 (FF00)	0 (0000)	F38
	2	0002	Relay #3 ON/OFF Operation	65280 (FF00)	0 (0000)	F38
	3	0003	Relay #4 ON/OFF Operation	65280 (FF00)	0 (0000)	F38
ALL ALARM RESET	100	0064	Reset All Alarm Flags (Registers 40142-3)	---	0 (0000)	F38
INDIVIDUAL ALARM RESET	101	0065	Reset Latched Alarm of SET-POINT 1 (Over Voltage Phase-A Alarm)	---	0 (0000)	F38
	102	0066	Reset Latched Alarm of SET-POINT 2 (Over Voltage Phase-B Alarm)	---	0 (0000)	F38
	103	0067	Reset Latched Alarm of SET-POINT 3 (Over Voltage Phase-C Alarm)	---	0 (0000)	F38
	104	0068	Reset Latched Alarm of SET-POINT 4 (Under Voltage Phase-A Alarm)	---	0 (0000)	F38
	105	0069	Reset Latched Alarm of SET-POINT 5 (Under Voltage Phase-B Alarm)	---	0 (0000)	F38
	106	006A	Reset Latched Alarm of SET-POINT 6 (Under Voltage Phase-C Alarm)	---	0 (0000)	F38
	107	006B	Reset Latched Alarm of SET-POINT 7 (Over Current Phase-A Alarm)	---	0 (0000)	F38
	108	006C	Reset Latched Alarm of SET-POINT 8 (Over Current Phase-B Alarm)	---	0 (0000)	F38
	109	006D	Reset Latched Alarm of SET-POINT 9 (Over Current Phase-C Alarm)	---	0 (0000)	F38
	110	006E	Reset Latched Alarm of SET-POINT 10 (Under Current Phase-A Alarm)	---	0 (0000)	F38
	111	006F	Reset Latched Alarm of SET-POINT 11 (Under Current Phase-B Alarm)	---	0 (0000)	F38
	112	006F	Reset Latched Alarm of SET-POINT 12 (Under Current Phase-C Alarm)	---	0 (0000)	F38
	113	0070	Reset Latched Alarm of SET-POINT 13 (Over Frequency Alarm)	---	0 (0000)	F38
	114	0071	Reset Latched Alarm of SET-POINT 14 (Under Frequency Alarm)	---	0 (0000)	F38
	115	0072	Reset Latched Alarm of SET-POINT 15 (Over Load Alarm)	---	0 (0000)	F38
	116	0073	Reset Latched Alarm of SET-POINT 16 (Phase Loss Alarm)	---	0 (0000)	F38
	117	0074	Reset Latched Alarm of SET-POINT 17 (Input Channel Alarm)	---	0 (0000)	F38
	118	0075	Reset Latched Alarm of SET-POINT 18 (3x Phase Over Phase-Voltage Alarm)	---	0 (0000)	F38
	119	0076	Reset Latched Alarm of SET-POINT 19 (3x Phase Under Phase-Voltage Alarm)	---	0 (0000)	F38
	120	0077	Reset Latched Alarm of SET-POINT 20 (3x Phase Over Line-Voltage Alarm)	---	0 (0000)	F38
	121	0078	Reset Latched Alarm of SET-POINT 21 (3x Phase Under Line-Voltage Alarm)	---	0 (0000)	F38

GROUP	REG ADDR INDEX	REG ADDR (HEX)	DESCRIPTION	ON DATA	OFF DATA	FORMAT
Programming Values (Coil Register)					***WRITE ONLY***	
INDIVIDUAL ALARM RESET	122	0079	Reset Latched Alarm of SET-POINT 22 (3x Phase Over Current Alarm)	---	0 (0000)	F38
	123	0078	Reset Latched Alarm of SET-POINT 23 (3x Phase Under Current Alarm)	---	0 (0000)	F38

Chapter 10 - Troubleshooting

10.1 Introduction

Normally maintenance and installation of VP-2040 end without problem if engineer consider terms and conditions in this manual. But sometimes you may encounter to some trouble that normally caused device not operate or has malfunction.

In this case before contact to Veesta World Company support center, review this chapter. You may found common problems that may encounter to them.

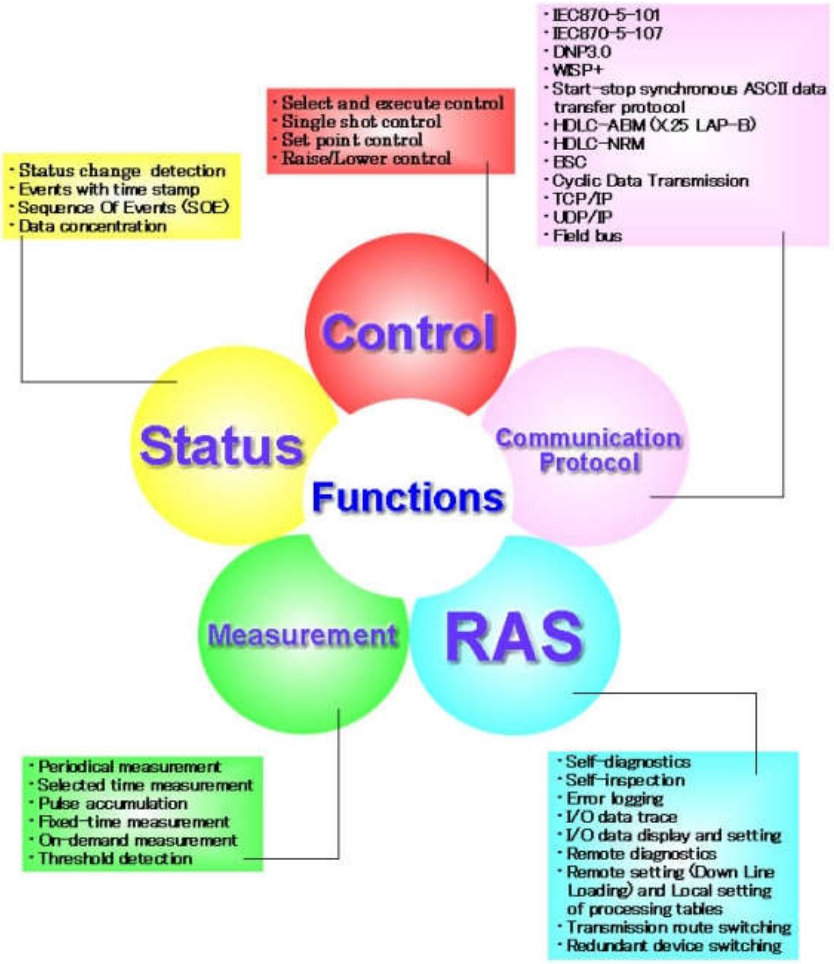
These common problems normally are from your missed a condition mentioned in this manual. So this chapter not only helps you to find the problem, but also let you have a check list to installation of Enhanced IED VP-2040.

Please pay attention that if you not follow terms and conditions in this manual any damage to product will not be in guarantee terms.

Table 10-1: VP-2040 Troubleshooting

Possible Problem	Possible Cause	Possible Solution
The meter has no indication after the control power supply is imposed.	The power supply fails to be imposed on the meter.	Check if the correct working voltage has been imposed on the L/+ and N/- terminals of the meter.
The measured value is not correct or does not conform to the expectation.	The voltage measurement is not correct.	Check if the fuse for the control power supply has been burnt down.
	The current measurement is not correct.	Check if the neutral point has been connected reliably.
	The power measurement is not correct.	Check if the measured voltage matches the rated parameter of the meter.

Possible Problem	Possible Cause	Possible Solution
There is no change in the on-off status.	The on-off operating voltage is not correct.	Check if the transformation ratio of the PT has been set correctly.
The relay doest not operate.	The relay does not receive the control command.	Check if the measured current matches the rated parameter of the meter.
	The working mode of the relay is not correct.	Check if the transformation ratio of the CT has been set correctly.
	The operating time has not been set correctly.	Check if the measurement mode has been set correctly.
No analog output.	The analog is set as “disable” or wrong object.	Check if the phase sequence corresponding to the voltage and the current is correct.
No pulse output or incorrect pulse output	The setting of the pulse object or constant is wrong.	Check if the current terminals of the same name are wrong.
There is no communication between the upper end device and the meter.	The communication address of the meter is not correct.	Check if the types of external nodes match the rated parameters of the meter.
	The communication speed of the meter is not correct.	Check if the external connection is correct.
	The communication link has not been connected to the terminal resistor.	Check if the communication link is correct.
	The communication link suffers interference.	Check if the current relay is under the correct mode.
	The communication line is interrupted.	Check the setting of the operating time of the relay. For the specific information, refer to the content regarding relays of the operation manual.



VEESTA WORLD

Veesta World Co
World Wide Web: http://www.veesta-world.com/
E-Mail: info@veesta-world.com