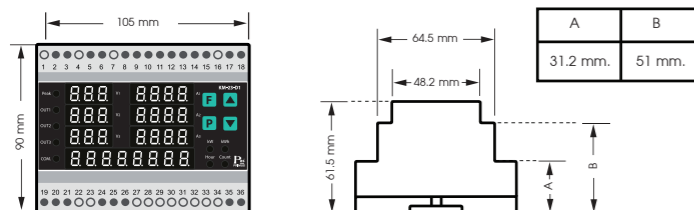


KM-23-DI

**TECHNICAL SPECIFICATION**

|                   |   |   |
|-------------------|---|---|
| Power Supply      | 110-240 VAC 50-60 Hz  |   |
| Power Consumption | 3.5VA   |   |
| Display           | 7-Segment, Size 0.39 Inch, 3 Digit 3 Row, 4 Digit 3 Row 8 Digit 1 Row |   |
| Input             | Volt  | 3 Phase   |
|                   | Volt Range  | 20-500 VAC  |
|                   | Accuracy Volt   | ±0.5% FS.   |
|                   | Current   | Connection 3 CT, Direct                           |
|                   | Current Transformer Ratio   | 1-2000  |
|                   | Primary   | 9999 AMP  |
|                   | Secondary   | 0.01-5A   |
|                   | Accuracy Current  | ±0.5% FS.   |
|                   | kWh   | Class 1   |
|                   | Counter Input   | Dry Contact Max 1k Hz                             |
| Reset Input       | Dry Contact   |   |
| Output            | Relay Output  | SPDT 5A 250VAC / 5A 30VDC                         |
|                   | Protocol  | MODBUS RTU  |
| Communication     | Baud Rate   | 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
|                   | Parity  | None, Even, Odd                                   |
|                   | Stop Bits   | 1, 2  |
|                   | Data Bits   | 8 Bits  |
|                   | Support Device Node   | 255   |
| Ambient Operation | Temperature   | -10 °C to 60 °C                                   |
|                   | Humidity  | 85 % RH Non-Condensing                            |
| Ambient Storage   | Temperature   | -20 °C to 80 °C                                   |
|                   | Humidity  | 85 % RH Non-Condensing                            |
| Protection Degree | IP30  |   |
| Installation      | DIN-RAIL  |   |
| Material          | ABS-V0  |   |
| Size              | 90 x 150 x 61.5 mm.   |   |
| Weighth           | 280 g.  |   |

**DIMENSION**



**DESCRIPTION**

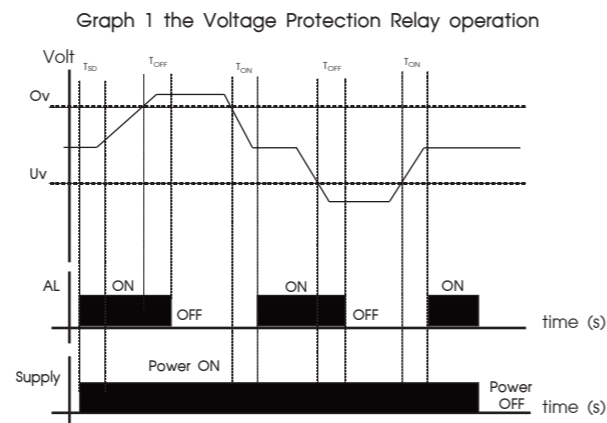
- The voltage range in 3 phase system maximum 500 VAC
- The current range 0.01-5 A, show maximum 9999 A by C.T. Ratio Range 1-2000 (10000/5A)
- kw, kWh, Hour Counter, Counter Display with Relay Output
- Under and Over Voltage, Phase Sequence, Phase Lose, Asymmetry, Protection Relay
- Under and Over Current Protection Relay
- Peak Hold for Maximum of voltage, current and kW
- Fault Display with Memory
- RS-485 Modbus RTU
- LED show the measured value in each Phase, Output and Peak
- Manual / Auto Display the current and voltage value in each phase.

**OPERATION**

KM-23-DI is the device and display voltage and current in 3 phase and show and show kW, kWh, Hour, and Counter. Hour value is measuring the operation of electrical system or machine time to schedule the maintenance. Counter is counting the product from production to compare with the power (kWh) from usage that is measure energy efficiency and it can memory the peak value of voltage(v), current(A), and power(kW) that may happen to analyze the possible of electrical system.

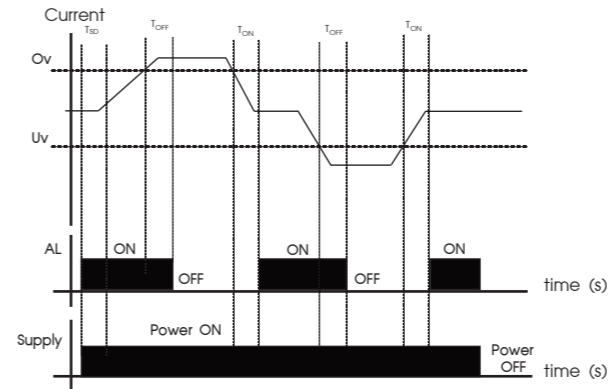
Voltage Protection Relay can set the over - under voltage value between 50 to 500 VAC by set the delay time before start the operation since 1-3600 seconds (ON Delay Time) but the phase sequence are not correct. Relay will not operate and delay. When it start operation it will detect the voltage. If the voltage lower or over the setting value or unbalance phase over than percentage from setting or Phase loss. Relay will OFF in 0-3600 seconds which can set to cut fast or slow as require and show the cause of incident on display. When the voltage back to the setting voltage range. Relay will back to ON again in setting time.

After KM-23-DI cut the circuit or Relay OFF. The user can browse the cause of Relay OFF from Display graph shows the operation of Voltage Protection shows in graph 1.



Current Protection Relay can set the under or over current between 0.1 to 9999 A set the delay time before start working since 1-3600 second (ON Delay Time) when start operation it will detect the current. If the current over than setting value. Relay will OFF in 0-3600 seconds which is able to set as require and show the cause on Display when the current level back to lower level from setting. Relay will back to ON again in 1-3600 seconds.

graph 2 shows the Current Protection Relay operation



Relay Output for kW, Hour and Counter

Alarm Relay for kW, Hour, Counter that choose to response in cut or connect Load in the one of them.

kW Function can set kW 0-100% of Range and the setting when start operate and detect the possible of kW. If kW value more than from setting. Relay will OFF in 0-3600 seconds which can cut fast or slow as require. And shows the cause on display. When kW level back to lower level than the setting. Relay will back to ON again in 1-3600 second or operate in Inverse Function is Relay will ON when kW value more than the setting.

Hour Counter Function can set the operation hour as require when it complete the time. Relay send ON and can Reset to order OFF by press the buttons or use Terminal Reset PIN.

Counter Function can set the required quantity when complete the quantity from setting. Relay will ON and can Reset to OFF by press the buttons or use Terminal Reset PIN.

**Display in Manual and Auto**

Display Volt, Amp, kW, kWh, Hour and Counter from measured. It can do both way of Manual is pressing to see Volt, Amp, kW, kWh, Hour and Counter by pressing key pad on the device or Auto will show circulating by can set to show value since 10-60 second per phase. If the user don't it show on Auto mode. If the user don not want to show it can set to 0

**% Unbalance Voltage Calculation**

This Function will check that the voltage value of each phase compare with the average voltage value all 3 phase. There are the difference over % Unbalance from setting or not. If the value is over than setting. It will delay OFF Delay then Output Relay will stop operate and calculate % Unbalance follow formula 1. When measured value more than Ub value that setting it will made Output Relay will OFF and the screen will show the sign - Ub-

$$\%UBL = 100X \frac{VMD}{V_{avg}} \quad (1) \quad V_{avg} = \left( \frac{V_a + V_b + V_c}{3} \right) \quad (2)$$

VMD is Absolute maximum of the difference of voltage in each phase with the average voltage

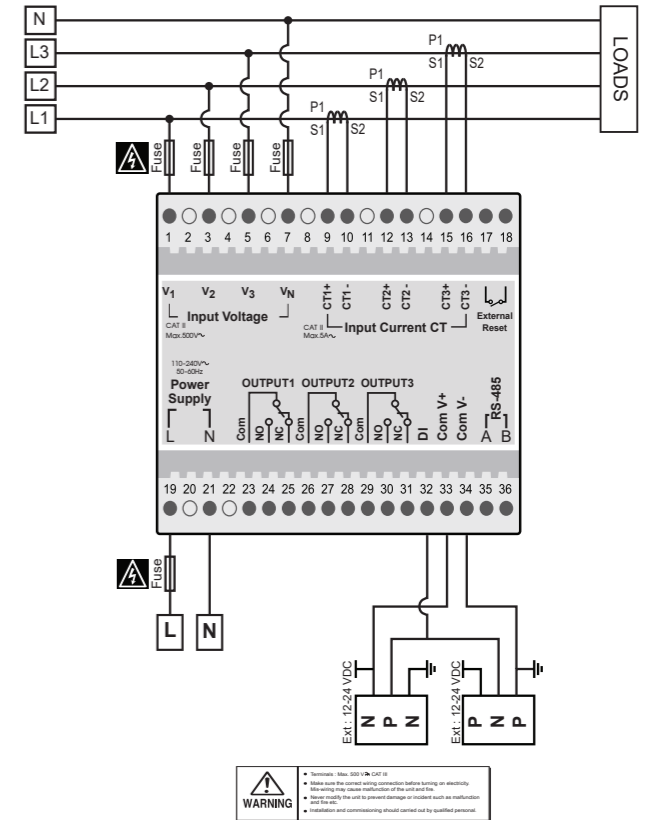
$$VMD = \text{Max} ( |V_a - V_{avg}|, |V_b - V_{avg}|, |V_c - V_{avg}| ) \quad (3)$$

Example if set Ub = 20 % and Vavg = 183 V, Va = 110 V, Vb = 220, Vc = 220

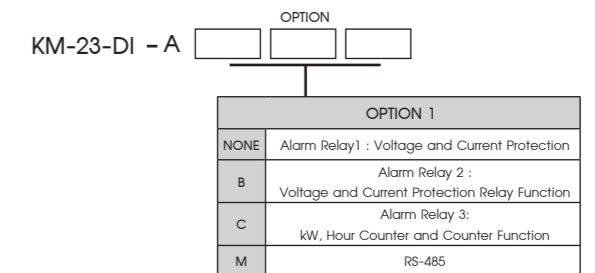
$$|V_a - V_{avg}| = 73 \text{ V} \quad |V_b - V_{avg}| = 37 \text{ V} \quad |V_c - V_{avg}| = 39.8 \text{ V}$$

$$\%UBL = 100 X \frac{73}{183} = 37\%$$

**WIRING DIAGRAM**



**ORDERING CODE**

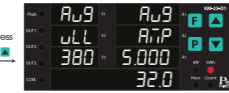
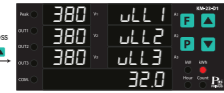


First Page



shows Volt in each Phase, Current in each Phase, kWh

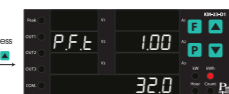
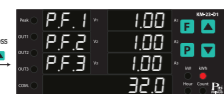
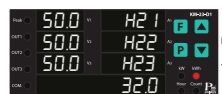
Display Volt in each Phase, Volt(L-L), Current in each Phase, Hz, PF, Total PF



Shows Volt in each Phase, Current in each Phase, kWh

Shows Volt(L-L) , kWh

Shows Volt(L-L)Avg, Current Avg, kWh

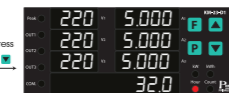
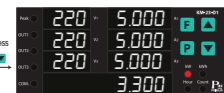


Shows Hz in each Phase, kWh

Shows PF in each Phase, kWh

Shows Total PF, kWh

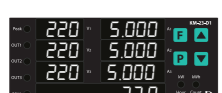
Display kWh, Total kW, Hour Counter, Digital Counter



Shows Volt in each Phase, Current in each Phase, kWh

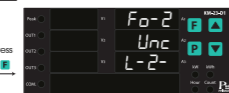
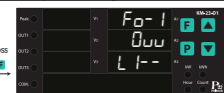
Shows Volt in each Phase, Current in each Phase, kW

Shows Volt in each Phase, Current in each Phase, Hour Counter



Shows Volt in each Phase, Current in each Phase, Digital Counter

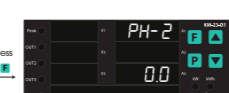
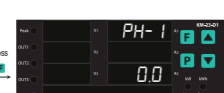
Display Previous Fault of Protection Relay, Volt angle between Current



Shows Volt in each Phase, Current in each Phase, kWh

Shows Previous Fault Output 1

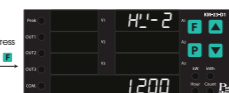
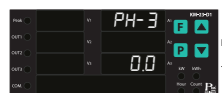
Shows Previous Fault Output 2



Shows Previous Fault Output 3

Shows Volt angle between Current Phase 1

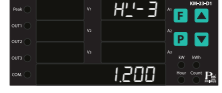
Shows Volt angle between Current Phase 2



Show Volt between Current Phase 3

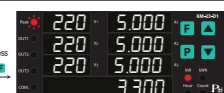
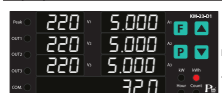
Shows kWATT Phase 1

Shows kWATT Phase 2



Shows kWATT Phase 3

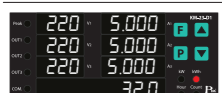
Display Peak Volt in each Phase, Peak Current in each Phase, Demand kW



Shows Volt in each Phase, Current in each Phase, kWh

Shows Peak Volt in each Phase, Peak Current in each Phase, Demand kW

Fault Alarm of Volt and Current Protection Relay



Manual Reset Protection Relay process

Press **[F]** and hold for 5 seconds. Start time will back to start in Start Time use for delay the detection of Volt, Current and kWATT Protection in this time LED Out1, Out2, Out3 will flash until finish Start Time period and check Volt, Current, KWATT in case Output Function in one of them equal to Disable Output that will not operate in Start Time. It make LED Out1, Out2, Out3 will not flash.

### CONFIGURATION

KM-23-DI

**Measurement Display**  
0000 Show Measurement Value  
Press **[F]** hold for 2 seconds

**1. CT Ratio (For KM-21)**  
CT → 1 CTRatio range 1 to 2000  
Press **[F]** 1 Time

**2. Start Delay Time**  
St → 003 1 to 3600 Sec  
Press **[F]** 1 Time

**3. Function Setting for Output1**  
OPF1 → 11 Select Type and Function of Alarm Relay  
Type: 0: Disable, 1: Volt Protection, 2: Current Protection, 3: Inverse Current Protection  
Alarm Function: 0: Disable, 1: Over and Under limit, 2: Over limit, 3: Under limit  
Press **[F]** 1 Time

**4. Over limit setting for Output 1**  
SPH1 → 250 Volt Protection : 50 to 500V, Current Protection : 0.1 to 9999 A  
Press **[F]** 1 Time

**5. Under limit setting for Output 1**  
SPL1 → 190 Volt Protection : 50 to 500V, Current Protection : 0.1 to 9999 A  
Press **[F]** 1 Time

**6. ON Delay Time setting for Output 1**  
Ond1 → 3 1 to 3600 Sec  
Press **[F]** 1 Time

**7. OFF Delay Time setting for Output 1**  
OFd1 → 3 0 to 3600 Sec  
Press **[F]** 1 Time

**8. Function Setting for Output 2**  
OPF2 → 11 Select Type and Function of Alarm Relay  
Type: 0: Disable, 1: Volt Protection, 2: Current Protection, 3: Inverse Current Protection  
Alarm Function: 0: Disable, 1: Over and Under limit, 2: Over limit, 3: Under limit  
Press **[F]** 1 Time

**9. Over limit setting for Output 2**  
SPH2 → 50 Volt Protection : 50 to 500V, Current Protection : 0.1 to 9999 A  
Press **[F]** 1 Time

**10. Under limit setting for Output 2**  
SPL2 → 0.1 Volt Protection : 50 to 500V, Current Protection : 0.1 to 9999 A  
Press **[F]** 1 Time

**11. ON Delay Time setting for Output 2**  
Ond2 → 3 1 to 3600 Sec  
Press **[F]** 1 Time

**12. OFF Delay Time setting for Output 2**  
OFd2 → 3 0 to 3600 Sec  
Press **[F]** 1 Time

**13. Function Setting for Output 3**  
OPF3 → 11 Select Type and Function of Alarm Relay  
Type: 0: Non Inverse, 1: Inverse  
Alarm Function: 0: Disable, 1: kWatt, 2: Hour, 3: Counter  
Press **[F]** 1 Time

**14. kWatt setting for Output 3**  
SPK1 → 50 kWatt Protection : 1 to 3,000 kWatt  
Press **[F]** 1 Time

**15. Hour setting for Alarm 3**  
SPHr → 1 Hour Set point : 1 to 100,000  
Press **[F]** 1 Time

**16. Counter setting for Alarm 3**  
SPC1 → 1 Counter Set point : 1 to 99999999  
Press **[F]** 1 Time

**17. ON Delay Time setting for Output 3**  
Ond3 → 3 1 to 3600 Sec  
Press **[F]** 1 Time

**18. OFF Delay Time setting for Output 3**  
OFd3 → 3 0 to 3600 Sec  
Press **[F]** 1 Time

**19. Counter Input Filter**  
CIF → 1 0: Disable, 1: Frequency lower < 10 Hz, 2: Maximum Frequency 1kHz  
Press **[F]** 1 Time

**20. Unbalance Voltage Setting**  
Ub → 1 Setting value of % Unbalance for check Unbalance : 0.0 to 50.0  
Press **[F]** 1 Time

**21. Clear Peak Volt, Current and kWatt**  
CL-P → -CLR --- : Disable, -CLR : Enable  
Press **[F]** 1 Time

**22. Clear Previous Fault**  
CL-F → -CLR --- : Disable, -CLR : Enable  
Press **[F]** 1 Time

**23. Clear kWh, Hour Counter, Counter Input**  
CL-- → CL-- --- : Disable, CL-- : Clear kWh, CL-H : Clear Hour Counter, CL-C : Clear Counter Input, CL-A : Clear kWh, Hour Counter, Counter Input  
Press **[F]** 1 Time

**24. RS-485 Address**  
Addr → 1 Setting Device Address 1 to 255  
Press **[F]** 1 Time

**25. RS-485 Baud Rate**  
bAud → 9600 Baud rate: 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 115200 bps  
Press **[F]** 1 Time

**26. Communication Stop bit/Parity bit**  
Com → n15 n15: none parity, 1 stop bit; n15: even parity, 1 stop bit; n15: odd parity, 1 stop bit; n25: none parity, 2 stop bit; n25: even parity, 2 stop bit; n25: odd parity, 2 stop bit  
Press **[F]** 1 Time

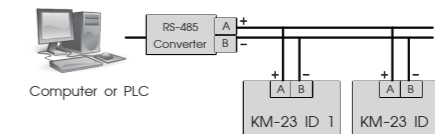
**27. Auto Display**  
Auto → 0 Set time 10 to 60 seconds to change show Volt and Amp for measure by sequence. If set to 0 : Disable  
Press **[F]** 1 Time

**28. Edit kWh**  
Hh → 10 Set kWh as require follow Table 2.  
Press **[F]** 1 Time

### SERIAL COMMUNICATION

The KM-23 are Equipped With a RS-485 Series Communication Interface to Allow Connection to Computer or PLCs. MODBUS PROTOCOL is Provided as Standard Communication. The User Can Connect KM-23 as Network Up to 128 Meters.

Wiring Diagram



MODBUS PROTOCOL

This MODBUS PROTOCOL Has Been Implement In Accordance With MODBUS.ORG MODBUS Application PROTOCOL Specification V1.1 With The Following Conditions Applying. The Following Conditions Apply Baudrate Can Selected Refer 22. Speed Setting The Format Is MODBUS RTU UART Data Can Selected Refer 23. Communication Setting Data Is Considered To Be Half Duplex Using 2 Wire.

Modbus Function code

| Function code | Operation                 | Broadcast |
|---------------|---------------------------|-----------|
| 0x03          | Read Holding Registers    | No        |
| 0x04          | Read Multiple Registers   | No        |
| 0x06          | Preset Single Registers   | Yes       |
| 0x10          | Preset Multiple Registers | Yes       |

Modbus Exception code

| Code | Name                 | Meaning   |
|------|----------------------|---|
| 01   | ILLEGAL FUNCTION     | The function code received in the query is not an allowable action for the server (or slave). |
| 02   | ILLEGAL DATA ADDRESS | The data address received in the data field is not an allowable value for server (or slave).  |
| 03   | ILLEGAL DATA VALUE   | A value contained in the query data field is not an allowable value for server (or slave).    |

Example of a client request and server exception response

| Request                      | Response          |
|------------------------------|-------------------|
| Field Name (Hex)             | Field Name (Hex)  |
| Slave Address 01             | Slave Address 01  |
| Function 04                  | Function 84       |
| Starting Address Hi 00       | Exception Code 02 |
| Starting Address Lo 00       | CRC Hi C2         |
| Quantity of Input Reg. Hi 00 | CRC Lo C1         |
| Quantity of Input Reg. Lo 1E |                   |
| CRC Hi 70                    |                   |
| CRC Lo 02                    |                   |

MODBUS table of KM-23 as follow

Modbus Table 1

Table with columns: Reg. Address (Decimal, Hex), Contents, Format, Word, Access, Comment. Rows include Volt (L-L) Avg, Volt L1-L2, Volt L2-L3, Volt L3-L1, Volt Phase 1, Volt Phase 2, Volt Phase 3, Current Avg, Current Phase 1, Current Phase 2, Current Phase 3, Current Exponential, PF Total, PF Phase 1, PF Phase 2, PF Phase 3, Hz Phase 1, Hz Phase 2, Hz Phase 3, Peak Volt Phase 1, Peak Volt Phase 2, Peak Volt Phase 3, Peak Current Phase 1, Peak Current Phase 2, Peak Current Phase 3, Peak Current Exponential, Previous Fault Alarm 1, Previous Fault Alarm 2, Previous Fault Alarm 3, Status Digital Counter.

Modbus Table 2

Table with columns: Reg. Address (Decimal, Hex), Contents, Format, Word, Access, Comment. Rows include Watt MSB, Watt LSB, VA MSB, VA LSB, kWh MSB, kWh LSB, kWh Exponential MSB, kWh Exponential LSB, Peak Watt MSB, Peak Watt LSB, Hour MSB, Hour LSB, Counter MSB, Counter LSB.

Modbus Table 3

Table with columns: Reg. Address (Decimal, Hex), Contents, Format, Word, Access, Comment. Rows include CT Ratio, Start Time, On Delay 1 Time, Off Delay 1 Time, Function Alarm 1, On Delay 2 Time, Off Delay 2 Time, Function Alarm 2, On Delay 3 Time, Off Delay 3 Time, Function Alarm 3, Unbalance, Counter Filter, Over Limit Alarm 1 MSB, Over Limit Alarm 1 LSB, Under Limit Alarm 1 MSB, Under Limit Alarm 1 LSB.

Table with columns: Address, Hex, Contents, Access, Word, R/W, Comment. Rows include Over Limit Alarm 2 MSB, Over Limit Alarm 2 LSB, Under Limit Alarm 2 MSB, Under Limit Alarm 2 LSB, kWatt Set point MSB, kWatt Set point LSB, Hour Set point MSB, Hour Set point LSB, Counter Set point MSB, Counter Set point LSB.

Table 1

Table with columns: Symbol, Display, Comment. Rows show symbols like ----, -PH-, L055, L 1--, L055, L-2-, L--3, L 12-, L-23, L055, L-23, L 1-3, L 123, -U6-, 0uu, L 1--, 0uu, L-2-, 0uu, L--3, 0uu, L 12-, 0uu, L 123, 0uu, L 1-3, 0uu, L 123, 0uu, L 123, 0uu, L 1--, 0uu, L-2-, 0uu, L--3, 0uu, L 123, 0uu, L 123, 0uu, L 1-3, 0uu, L 123, 0uu, L 123.

Table with columns: Address, Display, Comment. Rows include Over Current Phase 1, Over Current Phase 2, Over Current Phase 3, Over Current Phase 1, 2, Over Current Phase 2, 3, Over Current Phase 1, 3, Over Current Phase 1, 2, 3, Under Current Phase 1, Under Current Phase 2, Under Current Phase 3, Under Current Phase 1, 2, Under Current Phase 2, 3, Under Current Phase 1, 3, Under Current Phase 1, 2, 3, Over kWATT, Hour Counter, Digital Counter.

#### How to Reset Peak volt, Current, Total kWatt value

- 1. Set Parameter [L-P] to be [-Lr
2. Must stay in Page shows Peak in the one page then press [ ] + [ ] hold 5 seconds
3. When Reset then Parameter [L-P] will be ----

#### How to Reset Fault Alarm value

- 1. Set Parameter [L-F] to [-Lr
2. Must stay in Page shows Fault Alarm in the one page then press [ ] + [ ] for 5 seconds
3. When Reset then Parameter from [L-P] to ----

#### How to Reset kWh, Hour Counter, Counter Input value

##### Reset kWh

- 1. Set Parameter from [L--] to [L-''
2. Must stay in Page shows kWh then press [ ] + [ ] for 5 seconds
3. When Reset then Parameter from [L--] to ----

##### Reset Hour Counter

- 1. Set Parameter from [L--] to [L-H
2. Must stay in Page shows Hour Counter then press [ ] + [ ] hold for 5 seconds
3. When Reset then Parameter from [L--] to ----

##### Reset Counter Input

- 1. Set Parameter from [L--] to [L-C
2. Must stay in Page shows Counter Input press [ ] + [ ] for 5 seconds
3. When Reset then Parameter from [L--] to ----

##### Reset kWh, Hour Counter, Counter Input

- 1. Set Parameter from [L--] to [L-R
2. Must Stay Page shows kWh, Hour Counter, Counter Input in one of page then press [ ] + [ ] for 5 seconds
3. When Reset then Parameter [L--] to [L-R

#### How to Reset kWh, Hour Counter, Counter Input value by External Input

##### Reset kWh

- 1. Set Parameter from [L--] to [L-''
2. Stay in Page shows anything wiring Input follow Fig 5, hold for 3 seconds
3. when Reset then Parameter from [L--] to ----

##### Reset Hour Counter

- 1. Set Parameter from [L--] to [L-H
2. Stay in Page shows anything then wiring Input follow Fig 5, hold for 3 seconds
3. When Reset then Parameter from [L--] to ----

##### Reset Counter Input

- 1. Set Parameter from [L--] to [L-C
2. Stay in Page shows anything then wiring Input follows Fig 5, hold for 3 seconds
3. When Reset then Parameter from [L--] to ----

##### Reset kWh ,Hour Counter ,Counter Input

- 1. Set Parameter from [L--] to [L-R
2. When stay Page shows anything wiring Input follow Fig 5, hold for 3 seconds
3. When Reset then Parameter from [L--] to [L-R

Fig 5. External Input Reset Connection

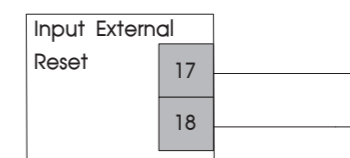
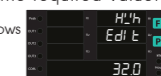


Table 2.

#### How to Edit kWh

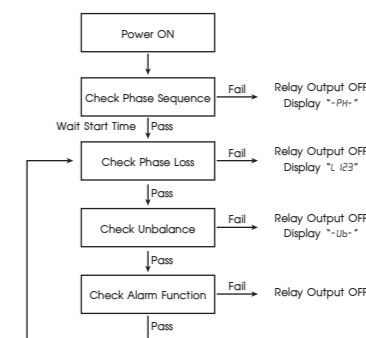
- 1. Stay in page Menu Parameter H''h
2. Press [ ] + [ ] hold for 5 seconds until show PASS fill password 5041 press P to move digit Press F for accept press [ ] or [ ] to move the required value.
3. When fill password finished press [ ] until shows H''h Ed: t then press [ ] or [ ] to move the required value. when finished press [ ]



#### Value Calculation

Volt = Volt Reg / 10; Current = Current reg / Current Exponential; Hz = Hz Reg / 10; Power Factor = Power Factor Reg / 1000

#### Output Volt Process



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