KM-21-P7

THREE PHASE METER WITH VOLTAGE PROTECTION RELAY

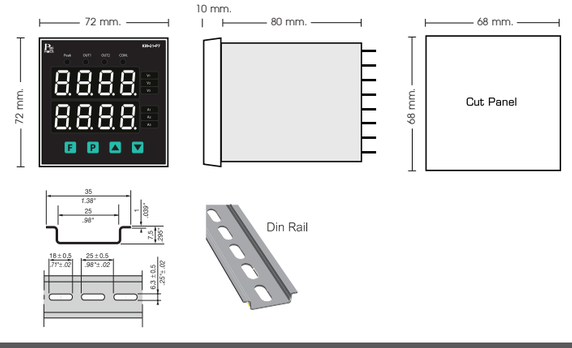
Primus
User Manual

KM-21-P9

TECHNICAL SPECIFICATION

Power Supply		230 ±15% VAC 50-60 Hz
		115 ±15% VAC
Power Consumption		2.5VA
Display		7-Segment, Size 0.56 Inch,
Input	Volt	3 Phase
	Volt Range	20-500 VAC
	Accuracy Volt	±0.5% FS.
	Current	Connection 1 CT, Direct
	Current Transformer Ratio	1-2000
	Primary	9999 AMP
	Secondary	0.01-5A
	Accuracy Current	±0.5% FS.
Output	Relay Output	SPDT 5A 250VAC / 5A 30VDC
Communication	Protocol	MODBUS RTU
	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		Panel Mounting
Material		ABS-V0
Size		72 x 72 x 80 mm.
Weigth		275 g.

DIMENSION (ขนาดและรูปร่าง)



DESCRIPTION

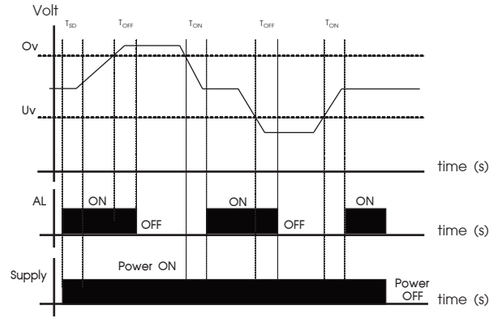
- KM-21 is voltage(V), current(A) meter with protection relay for Over-Under for 3 phases.
- Voltage Range 20-500 VAC.
- Current Range 0.01- 5A. show value maximum 9,999 A by CT Ratio Range 1-2000 (10000/5A).
- Under and Over Voltage, Phase Sequence, Phase Loss , Phase Asymmetry.
- Under and Over Current Protection Relay
- Peak Hold for Maximum of voltage and current.
- Fault Display with Memory.
- RS-485 MODBUS RTU.
- LED show the operation of Output and Peak.
- Manual/Auto Display current and voltage value in each phase.

OPERATION

KM-21 is measure and display device for voltage and current in 3 phase all in one. It come with Voltage Protection Relay and Current Relay to protect over-under voltage, phase loss, Unbalance Phase and Phase sequence. It can remember maximum peak of voltage and current that happens for analyze how is system going.

Voltage Protection Relay can set Over-Under for 20-500VAC in one of each phase or all 3 phase. User set delay time before start operation for 1-3600 seconds (ON Delay Time) but phase sequence is not correct. Relay will not operate and do not delay when it start to operate it will detect voltage. If voltage lower or over setting value or unbalance % over than setting or phase loss. Relay will command OFF in 0-3600 sec. which can set to cut fast or slow as demand and show the cause of incident on display. When voltage level back to setting range. Relay will back to ON again in setting Time (ON Delay Time) after KM-21 cut circuit or Relay OFF then can browse to see cause of Relay OFF incident from display. Graph shows Voltage Protection Relay as graph 1.

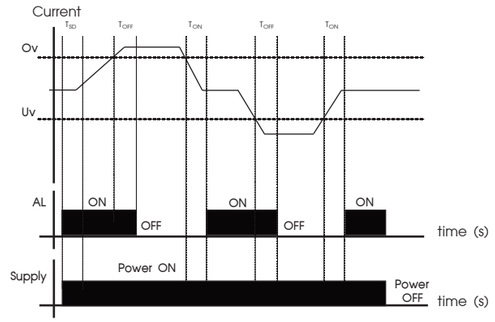
Graph 1 shows Voltage Protection operation



Current Protection Relay can set low current or over between 0.1 to 9999 A. Set delay time before start operation from 1-3600 seconds (ON Delay Time) when it start operation. It will detect current if current is over than value from setting relay will command OFF in 0-3600 seconds which can set to cut slow or fast as demand and show the cause of incident on display. When current level back to lower level from setting then relay will back to on again in 1-3600 second.

After KM-21 cut circuit or Relay OFF can browse to see the cause of Relay OFF incident from display or operate in Reverse Function.
Graph shows Current Protection Relay operation as graph 2.

Graph2 Current Protection Relay operation



Phaseloss

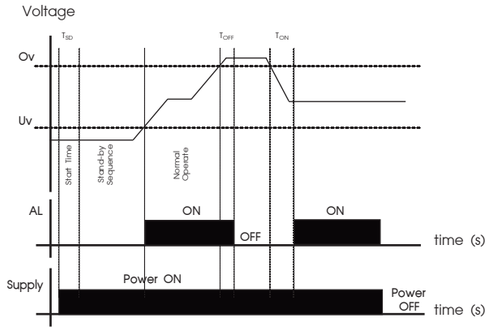
This function will check voltage value of each phase in case that KM-21 read voltage value one in each phase has value equal to 0 Volt. It will delay OFF Delay time then Output will operate.

* Remark: Phaseloss can check in case that motor load has not operated yet.

Stand-by Sequence

This function will check voltage value of each phase in case that voltage or current of each phase after finish Start time phase. Output Relay will not operate until value will be in Output Relay can operate as graph 3.

Graph 3 show Stand-by Sequence of voltage operation.



% Unbalance Voltage calculation

This function will check voltage of each phase compare with average voltage of all 3 phase has the difference more than % Unbalance from setting or not. If it has value more than setting it will delay OFF Delay time then Output Relay will stop operation. Calculate % Unbalance (%UBL) follow as formula 1 when value from measuring more than Ub value from setting will made Output Relay stop operation(OFF) and the screen will show signal -Ub- .

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

MD is maximum absolute value of difference value of voltage of each phase with average voltage.

$$V_{MD} = Max\left(\left|V_a - V_{avg}\right|, \left|V_b - V_{avg}\right|, \left|V_c - V_{avg}\right| \right) \quad (3)$$

ตัวอย่าง หากตั้งค่า Ub = 20 % และค่า V_{avg} = 183 V, V_a=110 V, V_b = 220, V_c = 220

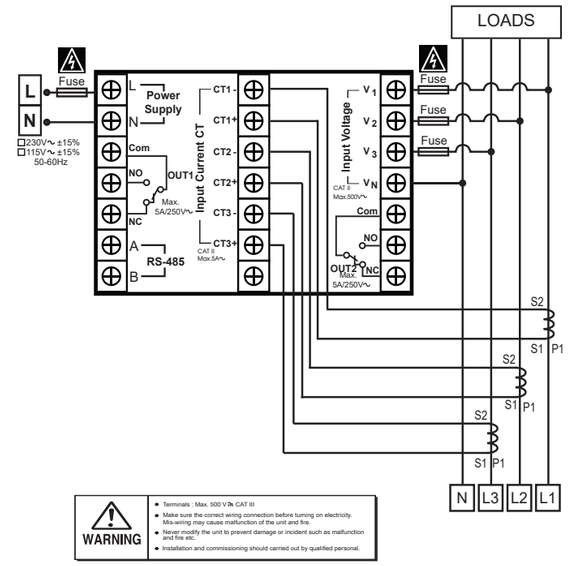
$\left|V_a - V_{avg}\right|$ = 73 V $\quad \left|V_b - V_{avg}\right|$ = 37 V $\quad \left|V_c - V_{avg}\right|$ = 39.8 V

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

Display in Manual and Auto

Display Volt, Amp from measure.It can do in Manual mode is press to see value Volt, Amp by pressing Key pad on device or Auto is show Volt, Amp of each phase circulating all the time by user can set to show from 10 seconds to 60 seconds per phase. If user do need to show value in auto mode it can can do by setting time to be 0.

WIRING DIAGRAM



ORDERING CODE

KM-21-P7 - A [ ] [ ] - [ ]

OPTION	
	None
B	Alarm Relay 2
M	RS-485

SUPPLY	
None	230 VAC
115	115 VAC

หน้าแรก

แสดงค่า Volt(L-L) Avg, Current Avg

<u>แสดงค่า Volt แต่ละ Phase , Current แต่ละ Phase</u>

แสดงค่า Volt(L-L) Avg, Current Avg | แสดงค่า Volt Phase1, Current Phase1 | แสดงค่า Volt Phase2, Current Phase2

แสดงค่า Volt Phase3, Current Phase3 | แสดงค่า Volt Phase1-Phase2 | แสดงค่า Volt Phase2-Phase3

แสดงค่า Volt Phase1-Phase3

<u>แสดงค่าPrevious Fault ของ Protection Relay, มุม Volt ระหว่าง Current, Hz</u>

แสดงค่า Volt(L-L) Avg, Current Avg | แสดงค่า Previous Fault Output 1 | แสดงค่า Previous Fault Output 2

แสดงค่ามุม Volt ระหว่าง Current Phase 1 | แสดงค่ามุม Volt ระหว่าง Current Phase 2 | แสดงค่ามุม Volt ระหว่าง Current Phase 3

แสดงค่า Hz

<u>แสดงค่า Peak Volt แต่ละ Phase, Peak Current แต่ละ Phase</u>

แสดงค่า Volt(L-L) Avg, Current Avg | แสดงค่า Peak Volt Phase 1, Peak Current Phase 1 | แสดงค่า Peak Volt Phase 2, Peak Current Phase 2

แสดงค่าPeak Volt Phase 3, Peak Current Phase 3

<u>การแจ้งเตือนFault ของ Volt และ Current Protection Relay</u>

วิธี Manual Reset Protection Relay

กดปุ่ม P ค้างไว้ 5 วินาที Start Time จะกลับมาเริ่มต้นใหม่ช่วงเวลา Start Time ใช้สำหรับหน่วงเวลาการตรวจจับการทำงานของ Volt , Current ในช่วงเวลานี้ LED Out1, Out2 จะกระพริบ จนหมดช่วงเวลา Start Time และทำการตรวจสอบ Volt , Current ในกรณีที่ Output Function ตัวใดตัวหนึ่ง เท่ากับ Disable Output ตัวนั้นจะไม่ทำงานในช่วงเวลา Start Time ทำให้ LED Out1, Out2 จะไม่กระพริบ

CONFIGURATION

KM-21-P7

Measurement Display
0000 — Show Measurement Value
กดปุ่ม F ค้าง 2 วินาที

1. CT Ratio (For KM-21)
CT 1 — CTratio range 1 to 2000
กดปุ่ม F 1 ครั้ง

2. Start Delay Time
St 003 — 1 to 3600 Sec
กดปุ่ม F 1 ครั้ง

3. Function Setting for Output1
OPF1 11 — Select Type and Function of Alarm Relay

1 1	Type	Alarm Function
	1 : Volt Protection 2 : Current Protection 3 : Inverse Current Protection	0 : Disable 1 : Over and Under limit 2 : Over limit 3 : Under limit

กดปุ่ม F 1 ครั้ง

4.Stand-by Sequence
Stb1 oFF — OFF : Disable, ON : Enable
กดปุ่ม F 1 ครั้ง

5. Over limit setting for Output 1
SPH1 250 — Volt Protection : 50.0 to 500.0V, Current Protection : 0.1 to 999.0 A
กดปุ่ม F 1 ครั้ง

6. Under limit setting for Output 1
SPL1 190 — Volt Protection : 50.0 to 500.0V, Current Protection : 0.1 to 999.0 A
กดปุ่ม F 1 ครั้ง

7. ON Delay Time setting for Output 1
Ond1 3 — 1 to 3600 Sec
กดปุ่ม F 1 ครั้ง

8. OFF Delay Time setting for Output 1
OFd1 3 — 0 to 3600 Sec
กดปุ่ม F 1 ครั้ง

9. Function Setting for Output 2
OPF2 11 — Select Type and Function of Alarm Relay

1 1	Type	Alarm Function
	1 : Volt Protection : 2 : Current Protection 3 : Inverse Current Protection	0 : Disable 1 : Over and Under limit 2 : Over limit 3 : Under limit

กดปุ่ม F 1 ครั้ง

10. Over limit setting for Output 2
Stb2 oFF — OFF : Disable, ON : Enable
กดปุ่ม F 1 ครั้ง

11. Over limit setting for Output 2
SPH2 5.0 — Volt Protection : 50 to 500V, Current Protection : 0.1 to 9999 A
กดปุ่ม F 1 ครั้ง

12. Under limit setting for Output 2
SPL2 0.1 — Volt Protection : 50.0 to 500.0V, Current Protection : 0.1 to 999.0A
กดปุ่ม F 1 ครั้ง

13. ON Delay Time setting for Output 2
Ond2 3 — 1 to 3600 Sec
กดปุ่ม F 1 ครั้ง

14. OFF Delay Time setting for Output 2
OFd2 3 — 0 to 3600 Sec
กดปุ่ม F 1 ครั้ง

15. Unbalance Voltage Setting
Ub 1 — ค่า Setting ของ % Unbalance สำหรับตรวจสอบแรงดันไฟฟ้าของระบบไฟ Unbalance : 0.0 to 50.0
กดปุ่ม F 1 ครั้ง

16 Clear Peak Volt,Current and kWatt
CL-P -CLr — ---- : Disable, -CLr : Enable
กดปุ่ม F 1 ครั้ง

17. Clear Previous Fault
CL-F -CLr — ---- : Disable, -CLr : Enable
กดปุ่ม F 1 ครั้ง

18. RS-485 Address
Addr 1 — Setting Device Address 1 to 255
กดปุ่ม F 1 ครั้ง

19. RS-485 Baud Rate
bAUd 9600 — Baud rate
2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps
กดปุ่ม F 1 ครั้ง

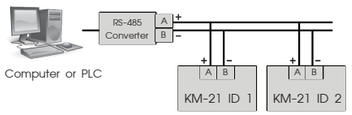
20. Communication Stop bit/Parity bit
Comm n 1S — n 1S : none parity, 1 stop bit; E 1S : even parity, 1 stop bit; o 1S : odd parity, 1 stop bit; n2S : none parity, 2 stop bit; E2S : even parity, 2 stop bit; o2S : odd parity, 2 stop bit
กดปุ่ม F 1 ครั้ง

21. Auto Display
AUtO 0 — ตั้งค่าเวลา 10 ถึง 60 วินาทีสำหรับเปลี่ยนการแสดงค่า Volt และ Amp ที่วัดได้ไปตามลำดับ หากตั้งเป็น 0 : Disable

SERIAL COMMUNICATION (การสื่อสาร)

The KM-21 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-22 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 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	Brodcast
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		

วิธีการ Reset ค่า Peak volt, Current

1. ตั้งค่า Parameter CL-P ให้เป็น -CLr
2. ต้องอยู่ Page แสดงผล Peak หน้าใดหน้าหนึ่ง แล้วกดปุ่ม ▲ + ▼ ค้างไว้ 5 วินาที
3. เมื่อ Reset แล้วค่า Parameter CL-P จะเป็น ----

วิธีการ Reset ค่า Fault Alarm

1. ตั้งค่า Parameter CL-F ให้เป็น -CLr
2. ต้องอยู่ Page แสดงผล Fault Alarm หน้าใดหน้าหนึ่ง แล้วกดปุ่ม ▲ + ▼ ค้างไว้ 5 วินาที
3. เมื่อ Reset แล้วค่า Parameter CL-P จะเป็น ----

วิธีการคำนวนค่า

$$\text{Volt} = \frac{\text{Volt}_{\text{Reg}}}{10}$$

$$\text{Current} = \frac{\text{Current}_{\text{reg}}}{10^{\text{Current Exponential}}}$$

$$\text{Hz} = \frac{\text{Hz}_{\text{Reg}}}{10}$$

ตาราง MODBUS ของ KM-21 ดังตารางต่อไปนี้

Modbus Table 1

Reg. Address		Contents	Format	Word	Access	Comment
Decimal	Hex					
0	0x0	Volt (L-L) Avg	Unsignde int	1	Read Only	
1	0x1	Volt L1-L2	Unsignde int	1	Read Only	
2	0x2	Volt L2-L3	Unsignde int	1	Read Only	
3	0x3	Volt L1-L3	Unsignde int	1	Read Only	
4	0x4	Volt Phase 1	Unsignde int	1	Read Only	
5	0x5	Volt Phase 2	Unsignde int	1	Read Only	
6	0x6	Volt Phase 3	Unsignde int	1	Read Only	
7	0x7	Current Avg	Unsignde int	1	Read Only	
8	0x8	Current Phase 1	Unsignde int	1	Read Only	
9	0x9	Current Phase 2	Unsignde int	1	Read Only	
10	0xA	Current Phase 3	Unsignde int	1	Read Only	
11	0xB	Current Exponential	Unsignde int	1	Read Only	
12	0xC	Hz	Unsignde int	1	Read Only	
13	0xD	Peak Volt Phase 1	Unsignde int	1	Read Only	
14	0xE	Peak Volt Phase 2	Unsignde int	1	Read Only	
15	0xF	Peak Volt Phase 3	Unsignde int	1	Read Only	
16	0x10	Peak Current Phase 1	Unsignde int	1	Read Only	
17	0x11	Peak Current Phase 2	Unsignde int	1	Read Only	
18	0x12	Peak Current Phase 3	Unsignde int	1	Read Only	
19	0x13	Peak Current Exponential	Unsignde int	1	Read Only	
20	0x14	Previous Fault Alarm 1	Unsignde int	1	Read Only	
21	0x15	Previous Fault Alarm 2	Unsignde int	1	Read Only	

Modbus Table 2

Reg. Address		Contents	Format	Word	Access	Comment
Decimal	Hex					
256	0x100	CT Ratio	Unsignde int	1	R/W	ตั้งค่า 1-2000
257	0x101	Start Time	Unsignde int	1	R/W	ตั้งค่า 1-3600
258	0x202	On Delay 1 Time	Unsignde int	1	R/W	ตั้งค่า 1-3600
259	0x203	Off Delay 1 Time	Unsignde int	1	R/W	ตั้งค่า 0-3600
260	0x204	Function Alarm 1	Unsignde int	1	R/W	
261	0x205	On Delay 2 Time	Unsignde int	1	R/W	ตั้งค่า 1-3600
262	0x206	Off Delay 2 Time	Unsignde int	1	R/W	ตั้งค่า 0-3600
263	0x207	Function Alarm 2	Unsignde int	1	R/W	
264	0x208	Unbalance	Unsignde int	1	R/W	ตั้งค่า 0-500
265	0x209	Over Limit Alarm 1	Unsignde int	1	R/W	Volt : 50-500 Current : 1-9990
266	0x20A	Under Limit Alarm 1	Unsignde int	1	R/W	Volt : 50-500 Current : 1-9990
267	0x20B	Over Limit Alarm 2	Unsignde int	1	R/W	Volt : 50-500 Current : 1-9990
268	0x20C	Under Limit Alarm 2	Unsignde int	1	R/W	Volt : 50-500 Current : 1-9990

Table 1

Symbol	Display	Comment
0	----	None
1	-PH-	Phase Sequence
2	L 1--	Phase 1 Loss
3	L-2-	Phase 2 Loss
4	L--3	Phase 3 Loss
5	L 12-	Phase 1,2 Loss
6	L-23	Phase 2,3 Loss
7	L 1-3	Phase 3,1 Loss
8	L 123	Phase 1,2,3 Loss
9	-Ub-	Unbalance
10	Ouu ● V1 ○ V2 ○ V3	Over Volt Phase 1
11	Ouu ○ V1 ● V2 ○ V3	Over Volt Phase 2
12	Ouu ○ V1 ○ V2 ● V3	Over Volt Phase 3
13	Ouu ● V1 ● V2 ○ V3	Over Volt Phase 1, 2
14	Ouu ○ V1 ● V2 ● V3	Over Volt Phase 2, 3
15	Ouu ● V1 ○ V2 ● V3	Over Volt Phase 1, 3
16	Ouu ● V1 ● V2 ● V3	Over Volt Phase 1, 2, 3
17	Unu ● V1 ○ V2 ○ V3	Under Volt Phase 1
18	Unu ○ V1 ● V2 ○ V3	Under Volt Phase 2
19	Unu ○ V1 ○ V2 ● V3	Under Volt Phase 3
20	Unu ● V1 ● V2 ○ V3	Under Volt Phase 1, 2
21	Unu ○ V1 ● V2 ● V3	Under Volt Phase 2, 3
22	Unu ● V1 ○ V2 ● V3	Under Volt Phase 1, 3
23	Unu ● V1 ● V2 ● V3	Under Volt Phase 1, 2, 3
24	OuC ● C1 ○ C2 ○ C3	Over Current Phase 1
25	OuC ○ C1 ● C2 ○ C3	Over Current Phase 2
26	OuC ○ C1 ○ C2 ● C3	Over Current Phase 3
27	OuC ● C1 ● C2 ○ C3	Over Current Phase 1, 2
28	OuC ○ C1 ● C2 ● C3	Over Current Phase 2, 3
29	OuC ● C1 ○ C2 ● C3	Over Current Phase 1, 3
30	Ouc ● C1 ● C2 ● C3	Over Current Phase 1, 2, 3
31	UnC ● C1 ○ C2 ○ C3	Under Current Phase 1
32	UnC ○ C1 ● C2 ○ C3	Under Current Phase 2
33	UnC ○ C1 ○ C2 ● C3	Under Current Phase 3
34	UnC ● C1 ● C2 ○ C3	Under Current Phase 1, 2
35	UnC ○ C1 ● C2 ● C3	Under Current Phase 2, 3
36	UnC ● C1 ○ C2 ● C3	Under Current Phase 1, 3
37	UnC ● C1 ● C2 ● C3	Under Current Phase 1, 2, 3

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