

PM-2133D

Smart Power Meter User's Manual



ICP DAS Co., Ltd.

No. 111, Guangfu N. Rd., Hukou Township, Hsinchu County,
Taiwan 30351, R.O.C.

TEL : 886-3-597-3366 FAX : 886-3-597-3733

[http:// www.icpdas.com](http://www.icpdas.com) E-mail : service@icpdas.com

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Chapter 1 Introduction

1.1. PM-2133D introduction

ICP DAS brings the most powerful, cost-effective, advanced Smart Power Meters PM-2133D series that gives you access to real-time electric usage for three-phase power measurement. With its high accuracy ($<0.5\%$, $PF=1$), the PM-2133D series can be applied to both low voltage primary side and/or medium/high voltage secondary side and enables the users to obtain reliable and accurate energy consumption readings from the monitored equipments in real time under operation. These compact size and cost-effective power meters are equipped with revolutionary wired clip-on CT (various types, support input current up to 400 A). It operates over a wide input voltages range 10 ~ 500 VAC which allows worldwide compatibility. This meter has LED display shows power.

Features :

- True RMS Power Measurements
- Energy Analysis for 3P4W-3CT, 3P3W-2CT, 3P3W-3CT, 1P2W-1CT, 1P3W-2CT
- Current Measurements Up to 400 A with Different CT Ratio
- Voltage Measurements Up to 500 V
- Clip-on CT for Easy Installation
- W Accuracy Better than 0.5% ($PF=1$)
- 8 - Digit LED Display
- Supports RS-485, Ethernet Interface (PoE)
- Supports Modbus RTU, Modbus TCP protocols.
- Bi-directional Energy
- Total Harmonic Distortion (THD)

1.2. Caution



1.2.1. Danger

The meter contains hazardous voltages, and should never be disassembled. Failing to follow this practice will result in serious injury or death. Any work on or near energized meters, meter sockets, or other metering equipment could induce a danger of electrical shock. It is strongly recommended that all work should be performed only by qualified industrial electricians and metering specialist. ICP DAS assumes no responsibility if your electrical installer does not follow the appropriate national and local electrical codes.

1.3. Warning

ICP DAS assumes no liability for any damage resulting from the use of this product. ICP DAS reserves the right to change this manual at any time without notice. The information furnished by ICP DAS is believed to be accurate and reliable. However, no responsibility is assumed by ICP DAS for its use, not for any infringements of patents or other rights of third parties resulting from its use.

1.4. Product Warranty & Customer Support

ICP DAS warrants all products free from defects in material and workmanship for a period of one year from the date of shipping. During the warranty period, we will, at our position, either repair or replace any product that proves to be defective. To report any defect, please contact : **+886-3- 597-3366** or **service@icpdas.com**.

Please have the model, serial number and a detailed problem description available when you call. If the problem concerns a particular reading, please have all meter readings available. When returning any merchandise to ICP DAS, a return SN. is required.

1.4.1. Limitation of Warranty

This warranty does not apply to defects resulting from unauthorized modification, misuse, or use for reason other than electrical power monitoring. The supplied meter is not a user-serviceable product.

Chapter 2 Specifications

2.1 Specifications

Model	PM-2133D		PM-2133D-MTCP
AC Power Measurement			
Wiring	1P2W-1CT, 1P3W-2CT, 3P3W-2CT, 3P3W-3CT and 3P4W-3CT		
Measurement Voltage	10 ~ 500 V (CAT III)		
Measurement Current	CTØ10 mm (0.05 A~60 A); CTØ16 mm (0.1 A~100 A); CTØ24 mm (0.15 A~200 A); CTØ36 mm (0.3 A~300 A); CTØ36 mm (0.3 A~400 A)		
Measurement Frequency	50 Hz (Range 45 ~ 55 Hz)/60 Hz (Range 55 ~ 65 Hz)		
W Accuracy	Better than 0.5% (PF:1)		
Power Parameter Measurement	True RMS voltage (V _{rms}), True RMS current (I _{rms}), Active Power (kW), Active Energy (kWh), Apparent Power (kVA), Apparent Energy (kVAh), Reactive Power (kVAR), Reactive Energy (kVARh), Power Factor (PF), Frequency (45 ~ 65 Hz)		
Data Update Rate	1 Second		
Communication			
RS-485	Protocol	Modbus-RTU	-
	Baud rate	9600,19200 (default), 38400, 115200;	-
	Data format	N,8,1 (default); N,8,2; E,8,1; E,8,2; O,8,1; O,8,2	-
	Isolation	3000 VDC	-
	Bias Resistor	No (Usually supplied by the RS-485 Master. Alternatively, add a tM-SG4 or SG-785)	
Ethernet	Protocol	-	Modbus TCP

Aux Power	
Input Range	+85 ~ +264 VAC (277 VAC available)
Power Consumption	6 W
Dimensions (W x L x H)	110 mm x 50 mm x 115 mm
Environment	
Operating Temperature	-20 ~ +70 °C
Storage Temperature	-25 ~ +80 °C

Chapter 3 Installation

3.1 Inspection

The instrument is no longer safe when,

- a) Shows clear signs of damage
- b) Does not work
- c) Long storage under extreme conditions
- d) Damage during shipment

3.2 Safety

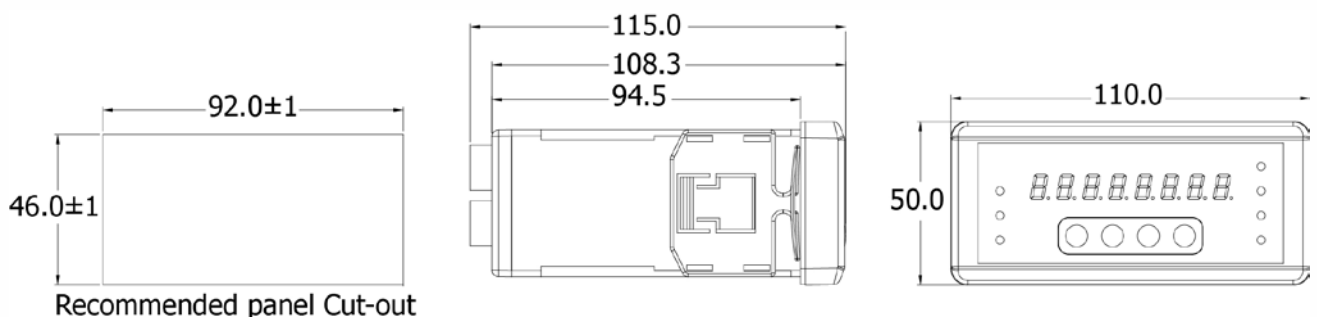


Please use the soft dry clothes to clean the instrument.

Please do not use any chemical or detergent or volatile solvents to clean the instrument, in order to avoid any possibility of the cover damage.

3.2.1 Dimension and Latch

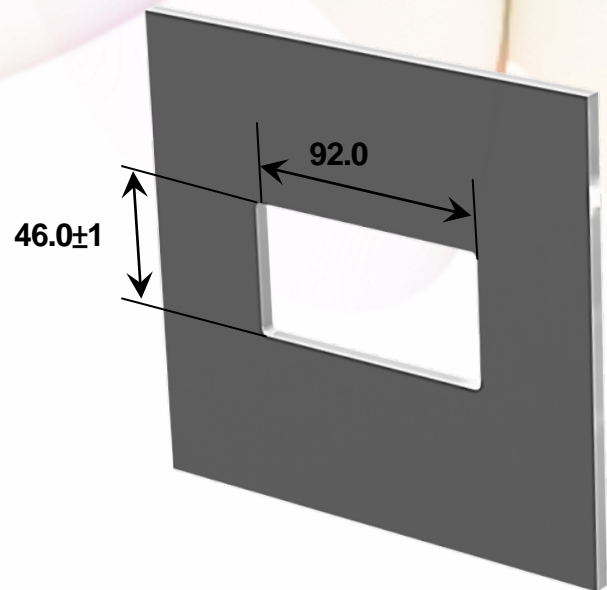
The diagrams below provide the dimensions of the PM-2133D to use in defining your enclosure specifications. Remember to leave room for potential expansion if you are using other components in your system.



- Products come with external split type clip-on CT's. Disconnect the CT's or use other CT's is highly prohibited.
- Please read this operation manual carefully before using.
- Please re-confirm the measure position.
- Meter auxiliary power is +85 ~ +264 VAC (277 VAC available).
- Wire Disconnection:
 1. Open the CT clip to detach the CT, do not remove the CT terminal lines if possible
Note: if you need to remove the terminal lines, always detach the CT before removing the CT terminal lines. **Otherwise the CT may develop open-circuit secondary voltages which may be hazardous to personnel or damaging to the CT or equipment connected in the secondary circuit.**
 2. Disconnect the voltage input wires from terminals and wrap the wire tips with plastic tape.
 3. Disconnect the communication wires from terminal.
 4. Disconnect the auxiliary power from terminal and wrap the wire tip with plastic tape.

3.2.2 Mounting

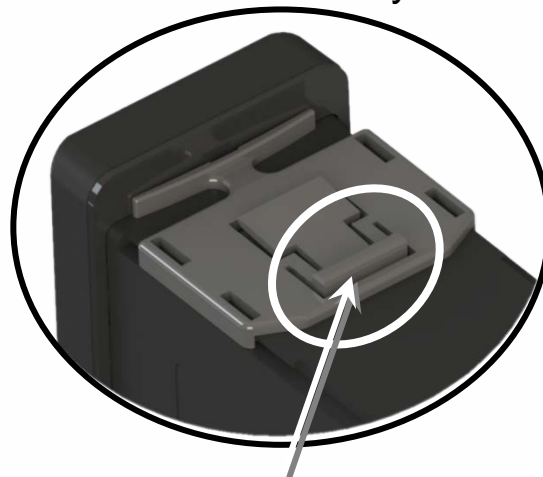
1. Prepare a panel and cut a hole to the specified size (unit: mm).



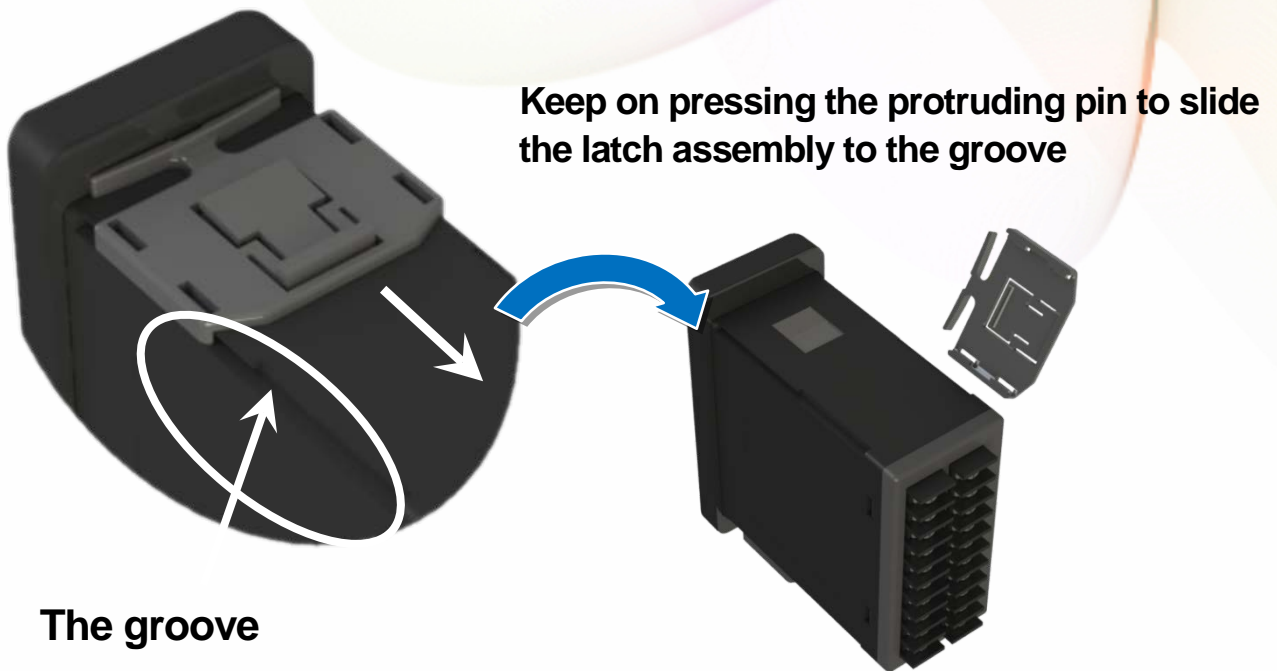
Panel thickness: 1 to 5 mm

2. Remove the latch assembly.

- i. Press the protruding pin of the latch assembly.



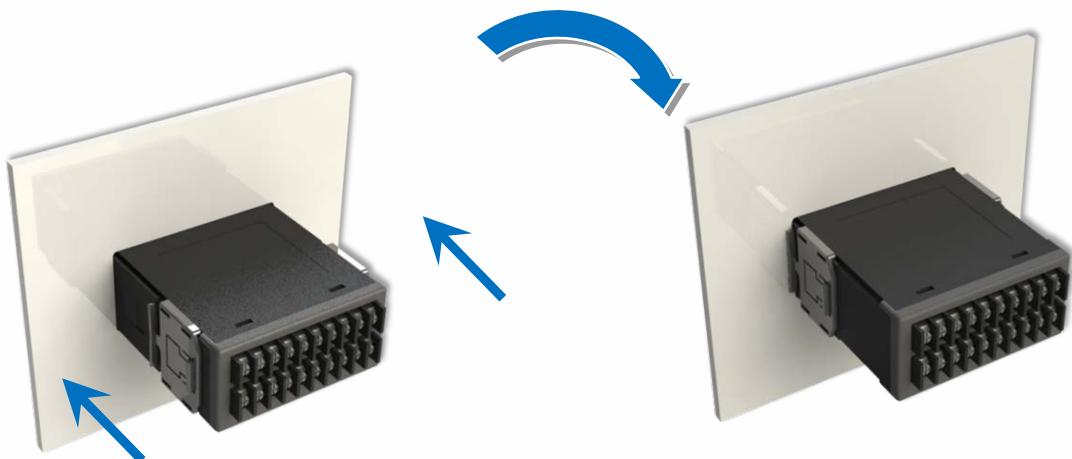
The protruding pin



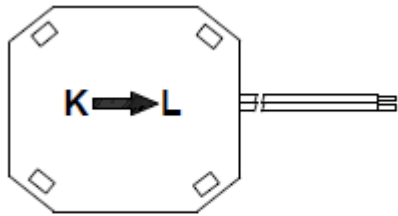
3. Attach the PM-2133D to the cut-out hole.



4. Attach the latch assembly, and then slide the latch assembly toward the panel.



3.2.3 CT's installation steps



Bottom view

- At the bottom of the CT, there is a “K→L” mark.



- Open the CT clip.



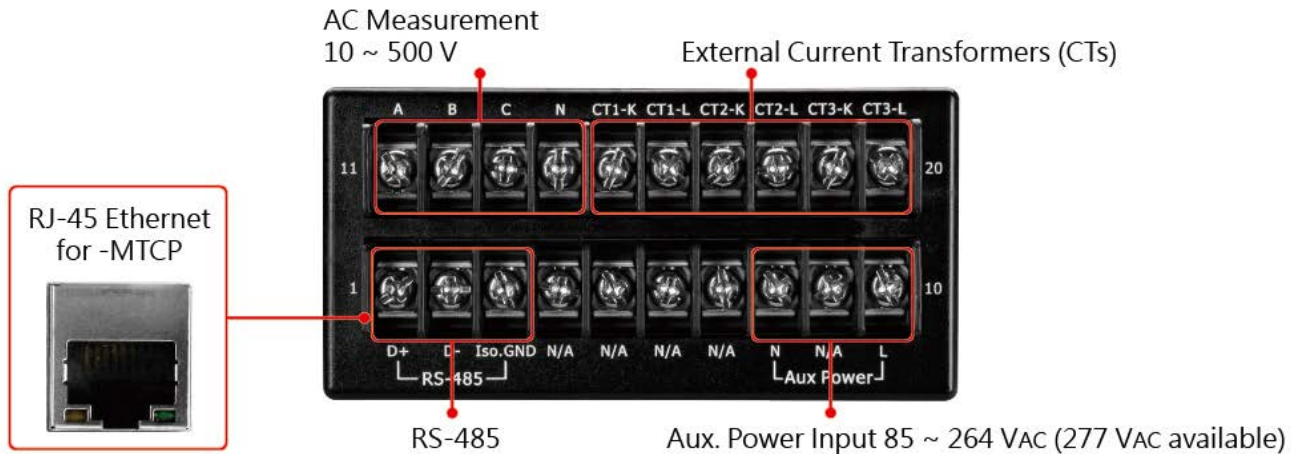
- Make sure the power current direction follow the “K→L” mark on the CT and then close the CT clip.



- Installation steps finished.

Chapter 4 Wiring Diagrams

4.1 Connection



Please firstly check the current input terminal, and then in white black, white black, white black wire sequences (CT1-K, CT1-L, CT2-K, CT2-L, CT3-K, CT3-L). Then connect the CT's, and close the CT clip. Make sure the arrow direction sign on CT's follows current flow direction K (**W**)→L(**B**).

Note: it must be in the same direction.

Connect the voltage input terminal N C B A. for PM-2133D, in the three phase order as follows on N C B A.

Attention please!! For 3P3W-2CT, connect in N C A phase sequence, do not connect phase B (Check the diagram).

Voltage Input

1. PM-2133D series: Input Voltage up to 500V.
For any higher Input Voltage large than 500V, please add the PT (power transformer), and Change PT RATIO setup.
2. Confirm the RST (ABC) phase sequence.

Current Input

1. The external CT's are fragile, please handle with care.
2. The current input of PM-2133D series is in mA range. Only the ex-factory attached CT's can be used. The other CT's, for example, from panel will damage the instrument due to its large current (around 5A)
3. When more than one smart meter (PM-2133D series) are installed, please do not disconnect the CT with its original meter and mix use with each other. Since each set of smart meter (PM-2133D series) and its attached split type clip-on CT are calibrated set by set. The mix use may cause wrong measurements.
4. To install CT's correctly, please ensure the CT lines sequences is right before clip the CT's onto the power cable of the monitoring equipment. (Detail will be found in next section)

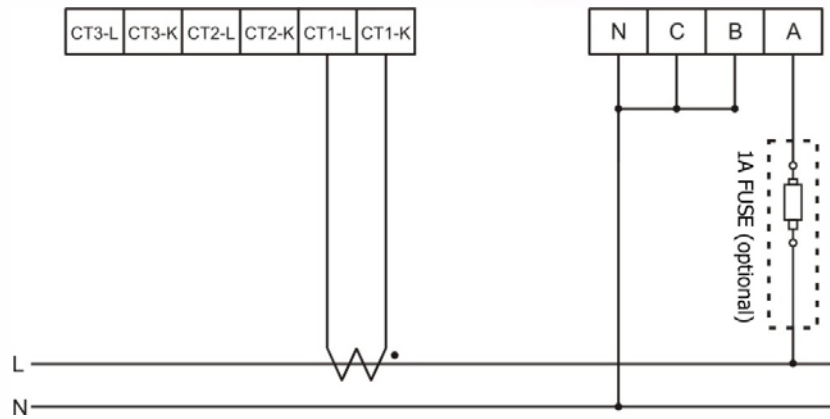


5. When measuring the current, the secondary circuit of a CT should never be opened when a load is passing through its primary. Make sure you always open the CT clip to detach the CT before removing the terminal lines. Otherwise, it will cause severe injury.

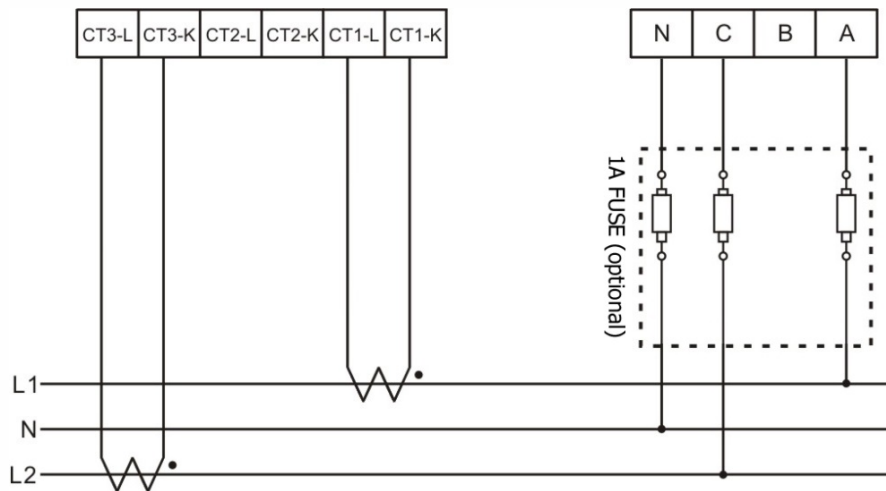
6. Please handle with extra care, especially when the operation space of CT's is limited.
7. The current direction must follow K-L marked on CT's.
8. Please select the right size CT's for different size of monitoring equipment cables:
power cable diameter $\Phi 10$ use 60A CT , $\Phi 10\sim\Phi 16</math> use 100A CT , $\Phi 16\sim\Phi 24</math> use 200A CT,
, $\Phi 36</math> use 300A CT , $\Phi 36</math> use 400A CT$$$$
9. The maximum current value cannot exceed the CT rating

4.2 Wiring

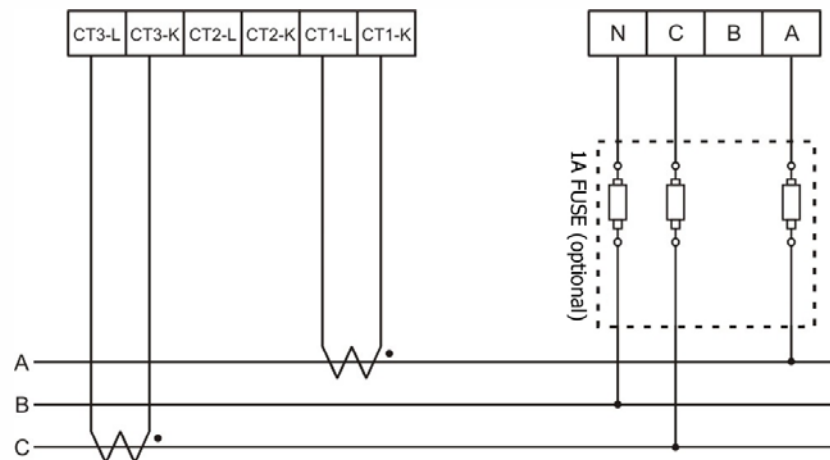
- 1P2W-1CT(PM-2133D)



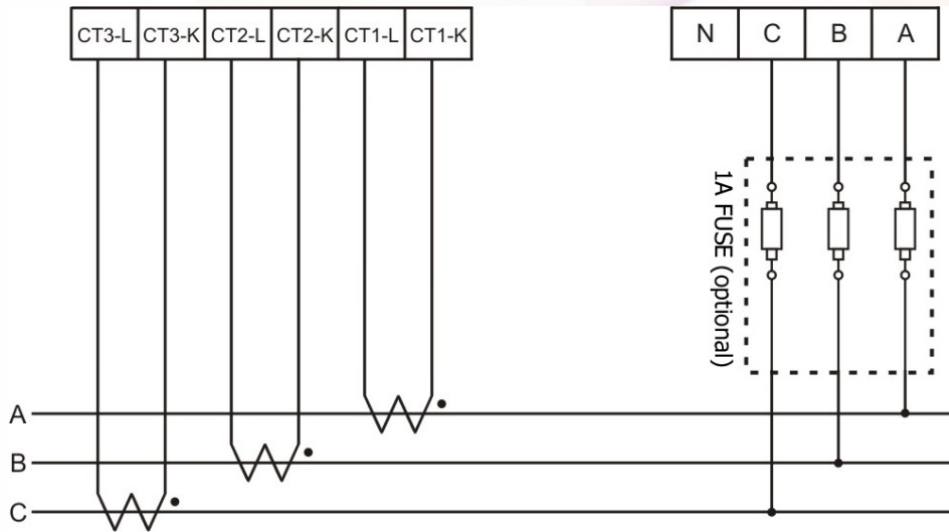
- 1P3W-2CT(PM-2133D)



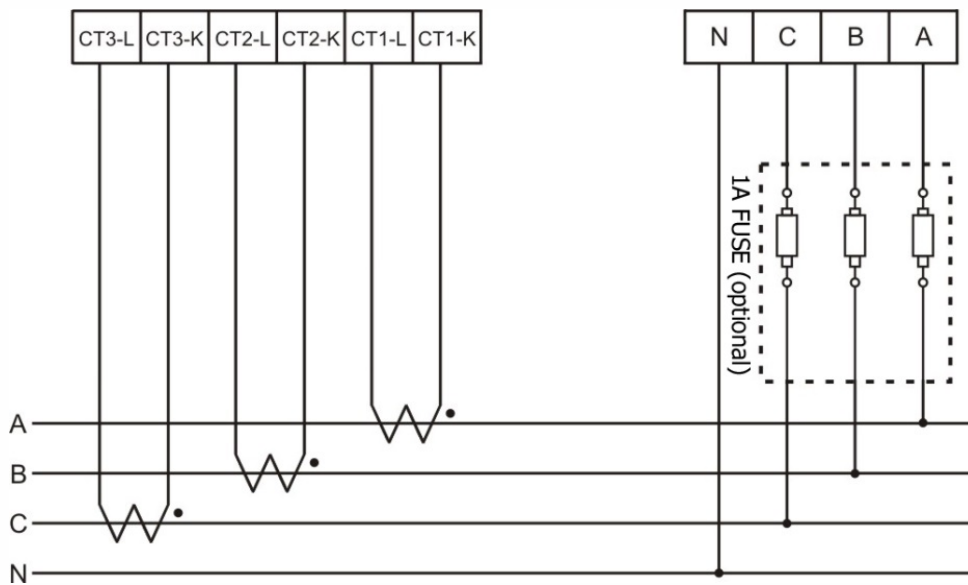
- 3P3W-2CT(PM-2133D)



● 3P3W-3CT(PM-2133D)



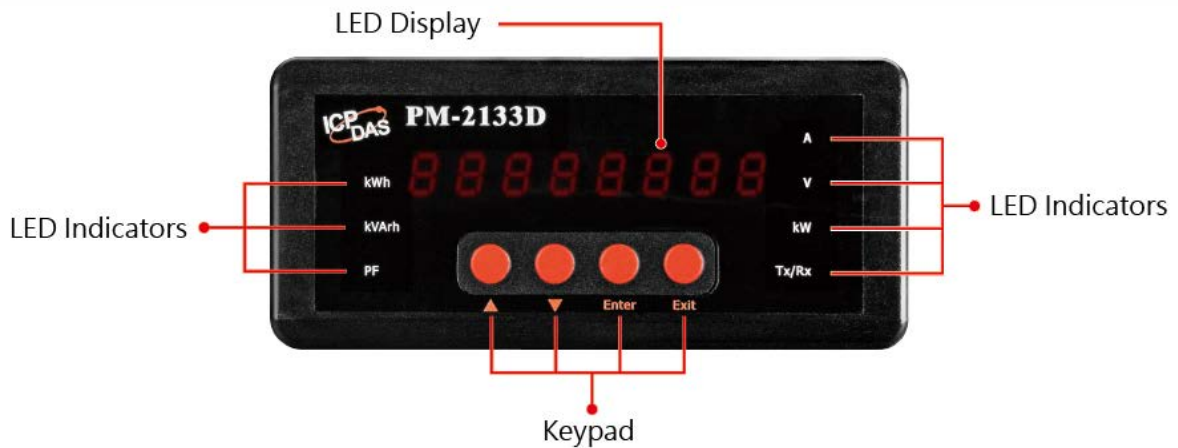
● 3P4W-3CT(PM-2133D)



Chapter 5 Keypad, LED Indicator & Display

5.1 Function of LED Display, Indicator and Keypad

PM-2133D has a built-in 8-Digit LED Display to display the power data measured by the meters. The 7 LED Indicators are used to indicate the type of the power data which are currently shown on the 8-Digit LED Display, and the status of RS-485 communication(Tx/Rx).



PM-21333D also has a built-in four buttons of keypad which is used to adjust the power data which is currently shown on the LED Display or the parameters setting of PM-2133D.

Keypad	Function
▲	Move to next item be shown or decrease the settings of parameters
▼	Move to previous item be shown or increase the settings of parameters
Enter	Change LED Display to "Setup Mode" or enable the modification of parameters
Exit	Change LED Display to "Normal Mode" or disable the modification of parameters

5.2 Operation of LED Display, Indicator and Keypad

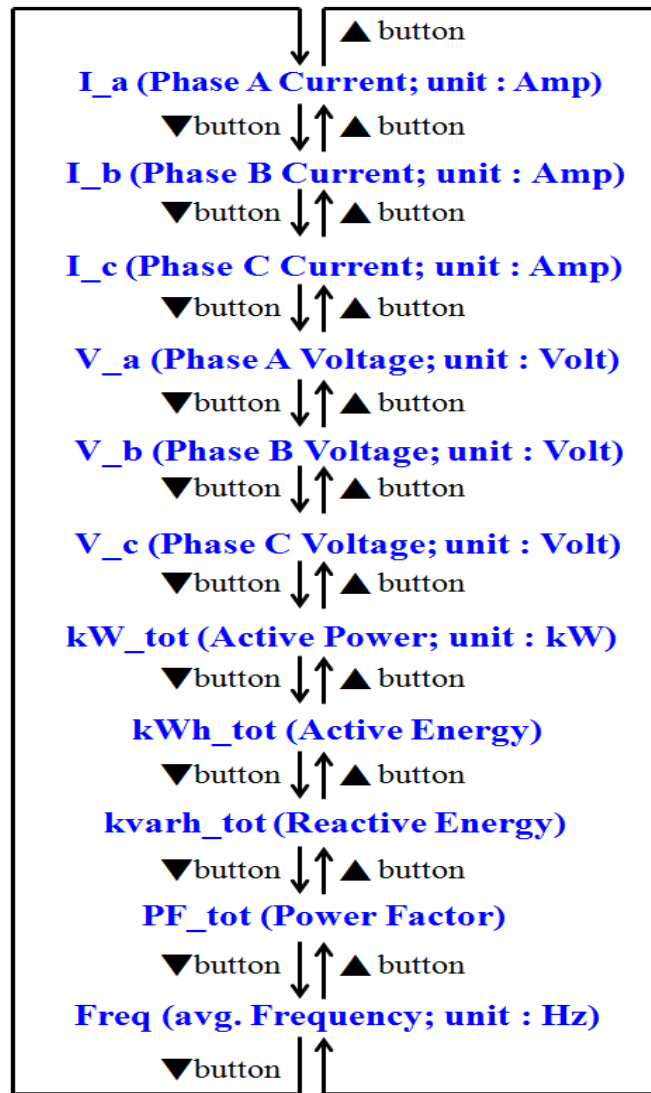
With the built-in LED Display, Indicator and Keypad, PM-2133D can display the real-time power data it measures. User can also change the setting of the power meter. The following sections describe the features provided.

5.2.1 Normal Mode

After power up PM-2133D, the default power data shown is power data of I_a (Phase A Current). User can press the "▲" button and "▼" button of the Keypad to select the desired power data to be displayed on PM-2133D. The corresponding LED Indicator of the power data selected will also be in "ON" status - lights up in red.



The power data provided by PM-2133D will be displayed circularly in the sequence as below:



5.2.2 Setup Mode

User can press the buttons of Keypad to enter the Setup Mode to adjust the parameters setting of PM-2133D. The steps are as below:



- i. Press the "Enter" button to enter the Setup mode, all the LED Indicators of PMD-2133D will be in "ON" status, and the LED Display panel will display **8.8.8.8.8.8.8.**

ii. Press the "▲" button and "▼" button of the Keypad to select the parameter of PM-2133D to be modified. The settings of parameters provided by PM-2133D will be shown in sequence as below:.

- **8.8.8.8.8.8.8.8** : LED Segment check (read only, cannot be modified)
- **uEr 0209** : Firmware version (read only, cannot be modified).
- **Ad 01** : Modbus Address setting.
 - Press the "Enter" button, the current address setting will blink.
 - Press the "▲" button and "▼" button to adjust the setting of address. The range is from 1 to 64.
- **br 9600** : Modbus Baudrate setting.
 - Press the "Enter" button, the current Baudrate setting will blink.
 - Press the "▲" button and "▼" button to adjust the Baudrate setting. There are 4 options : 9600(**9600**), 19200(**19200**), 38400(**38400**) and 115200(**115200**) for selection.
- **df 801**: Modbus Data Format setting.
 - Press the "Enter" button, the current Data Format setting will blink.
 - Press the "▲" button and "▼" button to adjust the Data Format setting. There are 6 options: 8N1(**8n1**; 8 data bits, None Parity, 1 stop bits), 8O1(**8o1**; 8 data bits, Odd Parity, 1 stop bits;), 8E1(**8E1**; 8 data bits, Even Parity, 1 stop bits), 8N2(**8n2**; 8 data bits, None Parity, 2 stop bits), 8O2(**8o2**; 8 data bits, Odd Parity, 2 stop bits;) and 8E2(**8E2**; 8 data bits, Even Parity, 2 stop bits) for selection.
- **Pt 012.33** : PT ratio setting. The range is from 0.01 to 655.35.
 - Press the "Enter" button, the hundreds digit of the PT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of hundreds digit.
 - After completing the setting of hundreds digit, press the "Enter" button, the tens digit of the PT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of tens digit.
 - After completing the setting of tens digit, press the "Enter" button, the units digit of the PT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of units digit.

- After completing the setting of units digit, press the "Enter" button, the tenths digit of the PT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of tenths digit.
- After completing the setting of tenths digit, press the "Enter" button, the hundredths digit of the PT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of hundredths digit.
- **CT 00025** : CT ratio setting. The range is from 1 to 65535.
 - Press the "Enter" button, the ten thousands digit of the CT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of ten thousands digit.
 - After completing the setting of ten thousands digit, press the "Enter" button, the thousands digit of the CT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of thousands digit.
 - After completing the setting of thousands digit, press the "Enter" button, the hundreds digit of the CT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of hundreds digit.
 - After completing the setting of hundreds digit, press the "Enter" button, the tens digit of the CT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of tens digit.
 - After completing the setting of tens digit, press the "Enter" button, the units digit of the CT ratio will blink. Press the "▲" button and "▼" button to adjust the setting of units digit.
- **V 1P24** : Wiring mode setting.
 - Press the "Enter" button, the current Wiring mode setting will blink.
 - Press the "▲" button and "▼" button to adjust the Wiring mode setting. There are 5 options: 1P2W(**1P24**), 1P3W(**1P34**), 3P3W2CT (**3P342C**), 3P3W3CT(**3P343C**) and 3P4W3CT(**3P443C**) for selection.
- **V AUTO** : Display Voltage setting.
 - Press the "Enter" button, the current Display Voltage setting will blink.
 - Press the "▲" button and "▼" button to adjust the Display Voltage setting. There are 3 options: Automatic(**AUTO**), "Show as VIn" (**EO ULN**) and "Show as VII" (**EO ULL**) for selection. **Please refer to the Q12 of "Appendix 1: Questions & Answers" section before change the setting of Display Voltage.**

iii. After completing the setting, press the "Enter" button to save the new setting.

- iv. Repeat Step ii~iii to complete all parameter settings.
- v. After all parameter settings are completed, press the "Exit" button to return the Normal Mode.

Chapter 6 Modbus-RTU communication

6.1 RS-485 setting

About the Modbus Baudrate setting, Modbus Data Format setting and Modbus Address setting, Please refer to "5.3.2 Setup Mode" section for detail.

- The default setting for RS-485: **19200, n, 8, 1**
- The default setting for Modbus Address: **1**

6.2 Modbus-RTU setting

6.2.1 Specifications

Protocol	Modbus-RTU
Transmission Specifications	Bits per Byte : 1 start bit 8 data bits, least significant bit sent first None Parity, Odd Parity or Even Parity, 1 stop bits or 2 stop bits Error Check : Cyclical Redundancy Check (CRC)
Baud Rate	9600, 19200 (Default), 38400, 115200
Modbus slave address	1-64 (Default = 1)

- Modbus Function Code : 01h, 03h, 04h, 05h, 06h, 0Fh, 10h

Code	MODBUS_name	Description
01h	Read Coils	Read boolean values of read/write location
05h	Write Single Coil	Set one boolean value of read/write location
0Fh	Write Multiple Coil	Set boolean values of read/write location
03h	Read Holding Registers	Read the contents of read/write location
06h	Write Single Register	Set the content of one read/write location
10h	Write Multiple Registers	Set the contents of read/write location
04h	Read Input Registers	Read the contents of read only location

Note: the max. data reading of Function 03 and Function04 is 125 registers

● **Data format**

Integer : 16 bits with sign, each with 1 register

Unsigned Integer : 16 bits without sign, each with 1 register

Float : IEEE 754 Format , each with 2 registers,

Low Word is first priority while transmit

IEEE 754 Format

Definition of the floating format of the Bits

Data Hi Word , Hi Byte	Data Hi Word , Lo Byte	Data Lo Word , Hi Byte	Data Lo Word , Lo Byte
SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM

$$\text{Value} = (-1)^S \times (1.M) \times 2^{E-127} \quad 0 < E < 255$$

S represents the sign bit where 1 is negative and 0 is positive

E is the two's complement exponent with an offset of 127.

i.e. an exponent of zero is represented by 127, an exponent of 1 by 128 etc.

M is the 23-bit normal mantissa. The highest bit is always 1 and, therefore, is not stored.

Transfer sequence (Float)

1	2	3	4
Data Low Word , High Byte	Data Low Word , Low Byte	Data High Word , High Byte	Data High Word , Low Byte

Transfer sequence (Inverse Integer)

1	2	3	4
Data High Word , High Byte	Data High Word , Low Byte	Data Low Word , High Byte	Data Low Word , Low Byte

Transfer sequence (Integer)

1	2	3	4
Data Low Word , High Byte	Data Low Word , Low Byte	Data High Word , High Byte	Data High Word , Low Byte

6.2.2 Modbus Register

- Modbus Module #1 – N/A
- Modbus Module #2 – Holding Register : System Parameter Setting

Parameter name	Modbus Register		Len	Data Type	Range	Default value	Units	Comment
	Modicom Format	Hex						
PT_Ratio	44100	0x1003	Word	UInt	1-65535	100	0.01	
CT_Ratio	44101	0x1004	Word	UInt	1-65535	1		
Wiring Mode	44107	0x100A	Word	UInt	1: 1P2W 2: 1P3W 3: 3P3W2CT 4: 3P3W3CT 5: 3P4W3CT	5		
Set Energy to Zero	44108	0x100B	Word	UInt		0x0055		Only Write
Reset to Factory Settings	44109	0x100C	Word	UInt		0x0055		Only Write
Default Frequency	44110	0x100D	Word	UInt	0x0055: Auto 0x0064: 50Hz 0x0078: 60Hz	0x0055		Re-power the module after setting
Energy Absolute Accumulated Mode	44113	0x1010	Word	UInt	0: Enable 1: Disable	0		
Harmonic Phase Select	44114	0x1011	Word	UInt	0: Disable 1: Phase A 2: Phase B 3: Phase C	0		
Display Voltage	44115	0x1012	Word	UInt	0: Automatic 1: Show as VIn 2: Show as VII	0		Refer to Q12
Baud rate	44127	0x101E	Word	UInt	0: 9600 1: 19200 2: 38400 3: 115200	19200		
Modbus ID	44128	0x101F	Word	UInt	1-64	1		

● Modbus Module #3 – Input Register : System Information

Parameter name	Modbus Register		Len	Data Type	Range	Default value	Units	Comment
	Modicom Format	Hex						
Wiring Type	30513	0x0200	Word	UInt	9: 1P2W 10: 1P3W 11: 3P3W2CT 12: 3P3W3CT 13: 3P4W	13		
Phase Sequence	30514	0x0201	Word	UInt	0: Negative (ACB) 1: Positive (ABC)			Only work when 3P4W
Model Name	30515	0x0202	Word	UInt	21330: PM-2133D	21330		
Model Type	30516	0x0203	Word	UInt	0x0001: 50Hz 0x0002: 60Hz	0x0002		
Firmware Version	30517	0x0204	Word	BCD		0x0100		Ver. 1.0

● Modbus Module #4 – Input Register :Power value (Float)

Parameter name	Modbus Register		Len	Data Type	Range	Units	Comment
	Modicom Format	Hex					
V_a	34353-34354	0x1100-0x1101	DWord	Float		Volt	
I_a	34355-34356	0x1102-0x1103	DWord	Float		Amp	
kW_a	34357-34358	0x1104-0x1105	DWord	Float		kW	
kvar_a	34359-34360	0x1106-0x1107	DWord	Float		kvar	
kVA_a	34361-34362	0x1108-0x1109	DWord	Float		kVA	
PF_a	34363-34364	0x110A-0x110B	DWord	Float			
kWh_a	34365-34366	0x110C-0x110D	DWord	Float			
kvarh_a	34367-34368	0x110E-0x110F	DWord	Float			
kVAh_a	34369-34370	0x1110-0x1111	DWord	Float			
V_b	34371-34372	0x1112-0x1113	DWord	Float		Volt	
I_b	34373-34374	0x1114-0x1115	DWord	Float		Amp	
kW_b	34375-34376	0x1116-0x1117	DWord	Float		kW	
kvar_b	34377-34378	0x1118-0x1119	DWord	Float		kvar	
kVA_b	34379-34380	0x111A-0x111B	DWord	Float		kVA	
PF_b	34381-34382	0x111C-0x111D	DWord	Float			
kWh_b	34383-34384	0x111E-0x111F	DWord	Float			
kvarh_b	34385-34386	0x1120-0x1121	DWord	Float			
kVAh_b	34387-34388	0x1122-0x1123	DWord	Float			
V_c	34389-34390	0x1124-0x1125	DWord	Float		Volt	
I_c	34391-34392	0x1126-0x1127	DWord	Float		Amp	
kW_c	34393-34394	0x1128-0x1129	DWord	Float		kW	
kvar_c	34395-34396	0x112A-0x112B	DWord	Float		kvar	
kVA_c	34397-34398	0x112C-0x112D	DWord	Float		kVA	
PF_c	34399-34400	0x112E-0x112F	DWord	Float			
kWh_c	34401-34402	0x1130-0x1131	DWord	Float			
kvarh_c	34403-34404	0x1132-0x1133	DWord	Float			
kVAh_c	34405-34406	0x1134-0x1135	DWord	Float			
V_avg	34407-34408	0x1136-0x1137	DWord	Float		Volt	
I_avg	34409-34410	0x1138-0x1139	DWord	Float		Amp	
kW_tot	34411-34412	0x113A-0x113B	DWord	Float		kW	
kvar_tot	34413-34414	0x113C-0x113D	DWord	Float		kvar	
kVA_tot	34415-34416	0x113E-0x113F	DWord	Float		kVA	

PF_tot	34417-34418	0x1140-0x1141	DWord	Float			
kWh_tot	34419-34420	0x1142-0x1143	DWord	Float			
kvarh_tot	34421-34422	0x1144-0x1145	DWord	Float			
kVAh_tot	34423-34424	0x1146-0x1147	DWord	Float			
Freq_a	34425-34426	0x1148-0x1149	DWord	Float	45~65	Hz	
Freq_b	34427-34428	0x114A-0x114B	DWord	Float	45~65	Hz	
Freq_c	34429-34430	0x114C-0x114D	DWord	Float	45~65	Hz	
Freq_max	34431-34432	0x114E-0x114F	DWord	Float	45~65	Hz	
VTHD	34459-34460	0x116A-0x116B	DWord	Float			Phase set by Harmonic Phase Select Register
ITHD	34461-34462	0x116C-0x116D	DWord	Float			

● Modbus Module #5 – Input Register :Power value (Inverse Integer)

Parameter name	Modbus Register		Len	Data Type	Range	Units	Comment
	Modicom Format	Hex					
V_a	34609- 34610	0x1200-0x1201	DWord	UInt32		0.1 Volt	
I_a	34611- 34612	0x1202-0x1203	DWord	UInt32		0.1A	
kW_a	34613- 34614	0x1204-0x1205	DWord	Int32		0.1kW	
kvar_a	34615- 34616	0x1206-0x1207	DWord	Int32		0.1kvar	
kVA_a	34617- 34618	0x1208-0x1209	DWord	Int32		0.1kVA	
PF_a	34619	0x120A	Word	Int	0~1000	0.001PF	0~1.000
kWh_a	34620- 34621	0x120B-0x120C	DWord	Int32	±0~99999999	0.1kWh	±0~9999999.9
kvarh_a	34622- 34623	0x120D-0x120E	DWord	Int32	0~99999999	0.1kvarh	0~9999999.9
kVAh_a	34624- 34625	0x120F-0x1210	DWord	Int32	±0~99999999	0.1kVAh	±0~9999999.9
V_b	34626- 34627	0x1211-0x1212	DWord	UInt32		0.1 Volt	
I_b	34628- 34629	0x1213-0x1214	DWord	UInt32		0.1A	
kW_b	34630- 34631	0x1215-0x1216	DWord	Int32		0.1kW	
kvar_b	34632- 34633	0x1217-0x1218	DWord	Int32		0.1kvar	
kVA_b	34634- 34635	0x1219-0x121A	DWord	Int32		0.1kVA	
PF_b	34636	0x121B	Word	Int	0~1000	0.001PF	0~1.000
kWh_b	34637- 34638	0x121C-0x121D	DWord	Int32	±0~99999999	0.1kWh	±0~9999999.9
kvarh_b	34639- 34640	0x121E-0x121F	DWord	Int32	0~99999999	0.1kvarh	0~9999999.9
kVAh_b	34641- 34642	0x1220-0x1221	DWord	Int32	±0~99999999	0.1kVAh	±0~9999999.9
V_c	34643- 34644	0x1222-0x1223	DWord	UInt32		0.1 Volt	
I_c	34645- 34646	0x1224-0x1225	DWord	UInt32		0.1A	
kW_c	34647- 34648	0x1226-0x1227	DWord	Int32		0.1kW	

kvar_c	34649- 34650	0x1228-0x1229	DWord	Int32		0.1kvar	
kVA_c	34651- 34652	0x122A-0x122B	DWord	Int32		0.1kVA	
PF_c	34653	0x122C	Word	Int	0~1000	0.001PF	0~1.000
kWh_c	34654- 34655	0x122D-0x122E	DWord	Int32	±0~99999999	0.1kWh	±0~9999999.9
kvarh_c	34656-34657	0x122F-0x1230	DWord	Int32	0~99999999	0.1kvarh	0~9999999.9
kVAh_c	34658-34659	0x1231-0x1232	DWord	Int32	±0~99999999	0.1kVAh	±0~9999999.9
V_avg	34660-34661	0x1233-x1234	DWord	UInt32		0.1 Volt	
I_avg	34662-34663	0x1235-0x1236	DWord	UInt32		0.1A	
kW_tot	34664-34665	0x1237-0x1238	DWord	Int32		0.1kW	
kvar_tot	34666-34667	0x1239-0x123A	DWord	Int32		0.1kvar	
kVA_tot	34668-34669	0x123B-0x123C	DWord	Int32		0.1kVA	
PF_tot	34670	0x123D	Word	Int	0~1000	0.001PF	0~1.000
kWh_tot	34671-34672	0x123E-0x123F	DWord	Int32	±0~99999999	0.1kWh	±0~9999999.9
kvarh_tot	34673-34674	0x1240-0x1241	DWord	Int32	0~99999999	0.1kvarh	0~9999999.9
kVAh_tot	34675-34676	0x1242-0x1243	DWord	Int32	±0~99999999	0.1kVAh	±0~9999999.9
Freq_a	34677	0x1244	Word	Int	45~65	1Hz	45~65
Freq_b	34678	0x1245	Word	Int	45~65	1Hz	45~65
Freq_c	34679	0x1246	Word	Int	45~65	1Hz	45~65
Freq_max	34680	0x1247	Word	Int	45~65	1Hz	45~65

● Modbus Module #6 – Input Register :Power value (Integer)

Parameter name	Modbus Register		Len	Data Type	Range	Units	Comment
	Modicom Format	Hex					
V_a	34865-34866	0x1300-0x1301	DWord	UInt32		0.1 Volt	
I_a	34867-34868	0x1302-0x1303	DWord	UInt32		0.1A	
kW_a	34869-34870	0x1304-0x1305	DWord	Int32		0.1kW	
kvar_a	34871-34872	0x1306-0x1307	DWord	Int32		0.1kvar	
kVA_a	34873-34874	0x1308-0x1309	DWord	Int32		0.1kVA	
PF_a	34875	0x130A	Word	Int	0~1000	0.001PF	0~1.000
kWh_a	34876-34877	0x130B-0x130C	DWord	Int32	±0~99999999	0.1kWh	±0~9999999.9
kvarh_a	34878-34879	0x130D-0x130E	DWord	Int32	0~99999999	0.1kvarh	0~9999999.9
kVAh_a	34880-34881	0x130F-0x1310	DWord	Int32	±0~99999999	0.1kVAh	±0~9999999.9
V_b	34882-34883	0x1311-0x1312	DWord	UInt32		0.1 Volt	
I_b	34884-34885	0x1313-0x1314	DWord	UInt32		0.1A	
kW_b	34886-34887	0x1315-0x1316	DWord	Int32		0.1kW	

kvar_b	34888-34889	0x1317-0x1318	DWord	Int32		0.1kvar	
kVA_b	34890-34891	0x1319-0x131A	DWord	Int32		0.1kVA	
PF_b	34892	0x131B	Word	Int	0~1000	0.001PF	0~1.000
kWh_b	34893-34894	0x131C-0x131D	DWord	Int32	±0~99999999	0.1kWh	±0~9999999.9
kvarh_b	34895-34896	0x131E-0x131F	DWord	Int32	0~99999999	0.1kvarh	0~9999999.9
kVAh_b	34897-34898	0x1320-0x1321	DWord	Int32	±0~99999999	0.1kVAh	±0~9999999.9
V_c	34899-34900	0x1322-0x1323	DWord	UInt32		0.1 Volt	
I_c	34901-34902	0x1324-0x1325	DWord	UInt32		0.1A	
kW_c	34903-34904	0x1326-0x1327	DWord	Int32		0.1kW	
kvar_c	34905-34906	0x1328-0x1329	DWord	Int32		0.1kvar	
kVA_c	34907-34908	0x132A-0x132B	DWord	Int32		0.1kVA	
PF_c	34909	0x132C	Word	Int	0~1000	0.001PF	0~1.000
kWh_c	34910-34911	0x132D-0x132E	DWord	Int32	±0~99999999	0.1kWh	±0~9999999.9
kvarh_c	34912-34913	0x132F-0x1330	DWord	Int32	0~99999999	0.1kvarh	0~9999999.9
kVAh_c	34914-34915	0x1331-0x1332	DWord	Int32	±0~99999999	0.1kVAh	±0~9999999.9
V_avg	34916-34917	0x1333-0x1334	DWord	UInt32		0.1 Volt	
I_avg	34918-34919	0x1335-0x1336	DWord	UInt32		0.1A	
kW_tot	34920-34921	0x1337-0x1338	DWord	Int32		0.1kW	
kvar_tot	34922-34923	0x1339-0x133A	DWord	Int32		0.1kvar	
kVA_tot	34924-34925	0x133B-0x133C	DWord	Int32		0.1kVA	
PF_tot	34926	0x133D	Word	Int	0~1000	0.001PF	0~1.000
kWh_tot	34927-34928	0x133E-0x133F	DWord	Int32	±0~99999999	0.1kWh	±0~9999999.9
kvarh_tot	34929-34930	0x1340-0x1341	DWord	Int32	0~99999999	0.1kvarh	0~9999999.9
kVAh_tot	34931-34932	0x1342-0x1343	DWord	Int32	±0~99999999	0.1kVAh	±0~9999999.9
Freq_a	34933	0x1344	Word	Int	45~65	1Hz	45~65
Freq_b	34934	0x1345	Word	Int	45~65	1Hz	45~65
Freq_c	34935	0x1346	Word	Int	45~65	1Hz	45~65
Freq_max	34936	0x1347	Word	Int	45~65	1Hz	45~65

Appendix 1: Questions & Answers

Q1. Can we use the other 5A CT's (like 300/5) to directly connect to the input current terminals of PM-2133D series?

No, because the input current is only mA size on PM-2133D series, definitely not to directly use other 5A CT's to connect and apply (like 100/5...). It could cause the fatal damages. Users can use the PM-2133D series attached split type clip-on CT to connect the other CT's secondary test 5A current.

Q2. If I want to replace the failed split type clip-on CT, can I just detach it? Anything I should pay more attention to?

In any circumstance, please make sure the CT had been disconnected with the power cable of monitoring equipments before the CT lines detach from the terminals of the smart meter. Otherwise, it will cause the severe injury.

Q3. If the turn point of the split type clip-on CT has broken, or inner Ferrite-core has broken, how to settle this condition?

The measure data will be not accuracy as before, please do not use any more. You need the new CT.

Q4. If multiple set of meters being installed, Can I detach the CT's and mix use with each other?

Please do not mix use, because each set of smart meter (PM-2133D series) and its attached split type clip-on CT are calibrated set by set. The mix use may cause the wrong measurements.

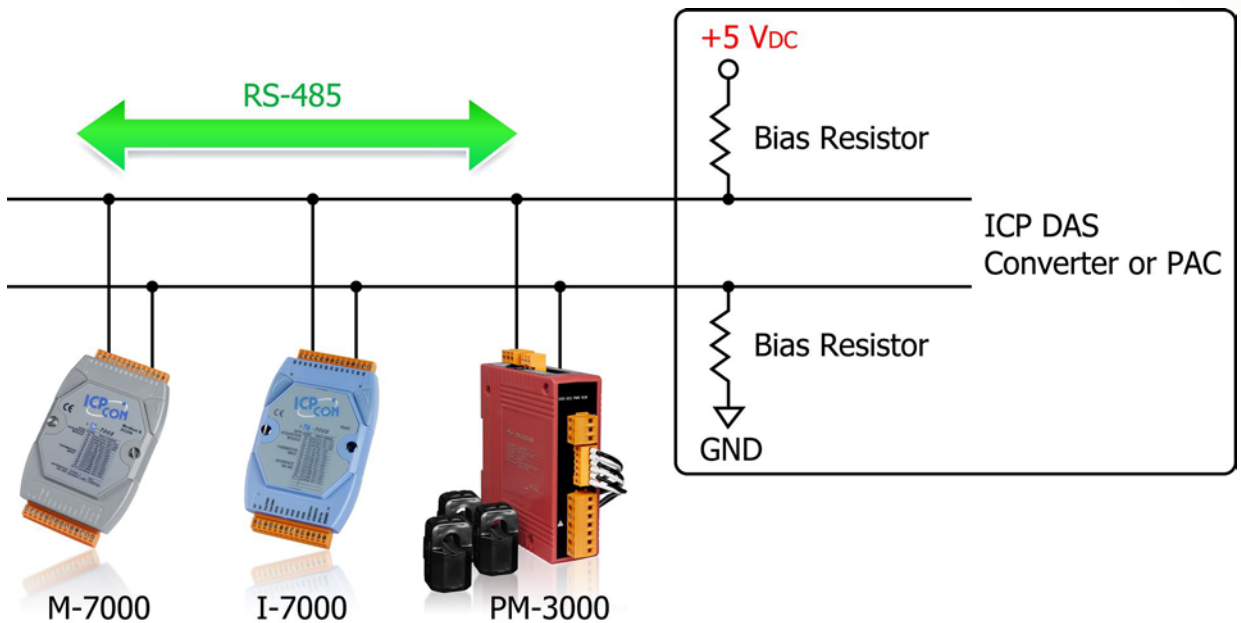
Q5. What problem is while the measured readings of the power consumption (kw) is negative?

- (1) First check the current input end – line terminal, (check the connection should be **CT1-K, CT1-L, CT2-K, CT2-L, CT3-K, CT3-L**) , base on white black, white black, white black follow the sequence order
- (2) Check the field current direction (K→L) is same as the inner arrow direction of the split type clip-on CT.

Q6. PC and meter cannot make the connection with RS-485 ?

- (1) Confirm the Modbus Address, default is 1.
- (2) Confirm the Band Rate, default is 19200.
- (3) Confirm the stop bit, default is 1.
- (4) Confirm the RS-485 connection, make sure the D+/D- is right.
- (5) Confirm the RS-485 master have to provide the bias for PM-2133D series.

Otherwise, the tM-SG4 or SG-785 should be added to provide the bias. All ICP DAS controllers and converters provide the bias.

**Q7. What the power cable diameter (mm) of the monitoring equipments should be for the various CT's?**

Power cable diameter $\Phi 10$ use 60A CT , $\Phi 10 \sim \Phi 16</math> use 100A CT , $\Phi 16 \sim \Phi 24</math> use 200A CT , $\Phi 36</math> use 300A CT , $\Phi 36</math> use 400A CT$$$$

Q8. Regarding to the split type clip-on CT's, if the wire is not long enough?

$\Phi 10, \Phi 16, \Phi 24</math> split type CT , the standard length is 1.8M.$

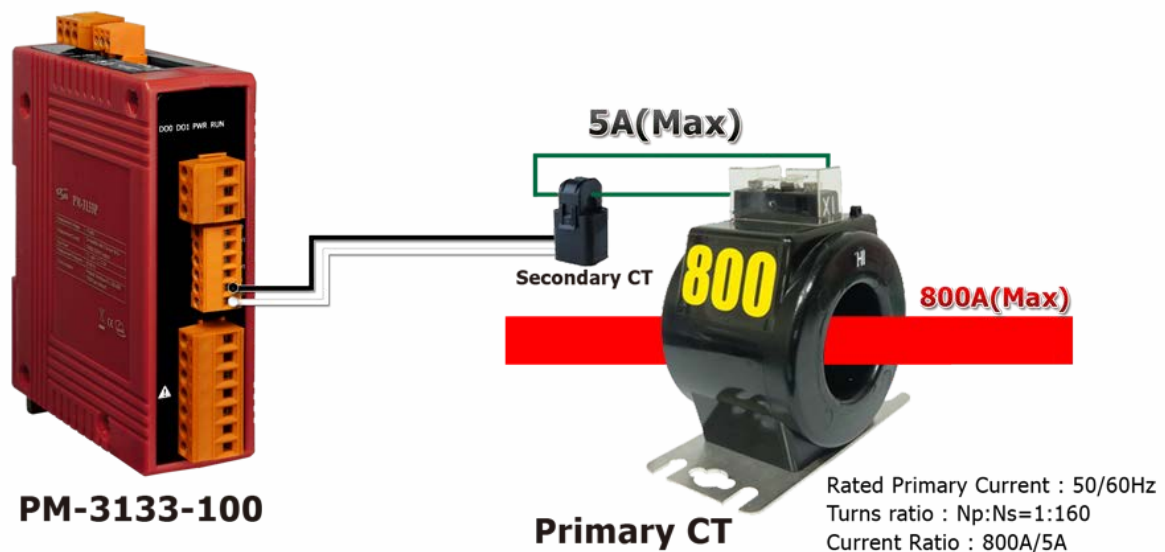
$\Phi 36</math> split type CT , the standard length is 4M.$

For special length, please contact ICP DAS.

Q9. How to measure the current large than 400A?

The CT of PM-2133D maximum range is 400A. If the target is more than 400A, we suggest the solution as follow.

For example the target is to measure maximum 800A current. We can measure big CT output and set a CT Ratio.

**Note:**

- Primary CT accuracy will influence the measurement.
- Even primary CT output current max is 5A, please don't wire to PM-2133D and PM-2133DP directly.

You need to choose primary current Transformers, please refer to

http://www.omega.com/pptst/MFO_RCT.html

Q10. Can I use CT's that I currently own with PM-2133D Power Meter?

You can use CT's that you currently own with PM-2133DP (without CTs) Power Meter. The CT inputs of the PM-2133DP can handle a maximum of 333mV of AC current. PM-2133DP's current ratio is always full scale to 5A. CT ratio can be set internally to work with up to 1200 amp CTs.

Adding current transformer (333mV Output CTs) has the effect of reducing the measured current by the CT ratio (let's say 40:1 for 200A CT as example). So a current of 200A becomes 5A. Since the meter sees 5A, many of the measurements it reports will be low by a factor of 40 unless they are scaled up by 40.

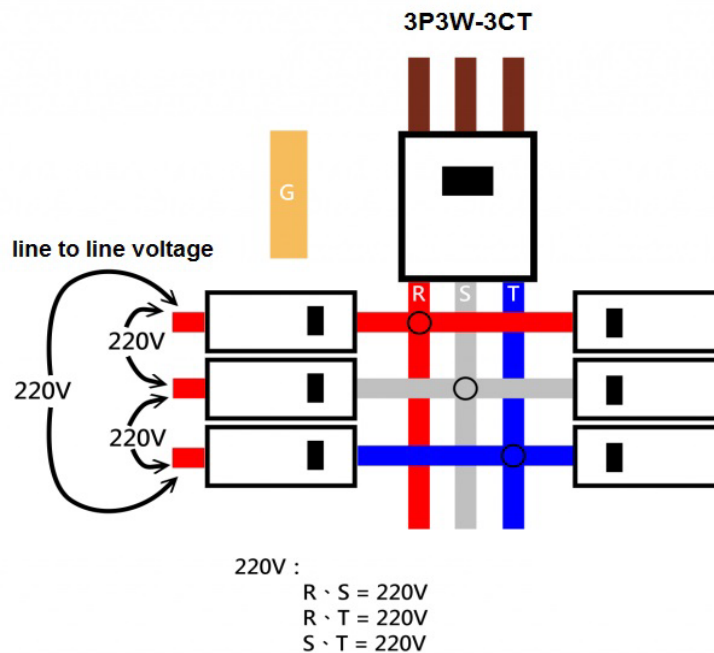
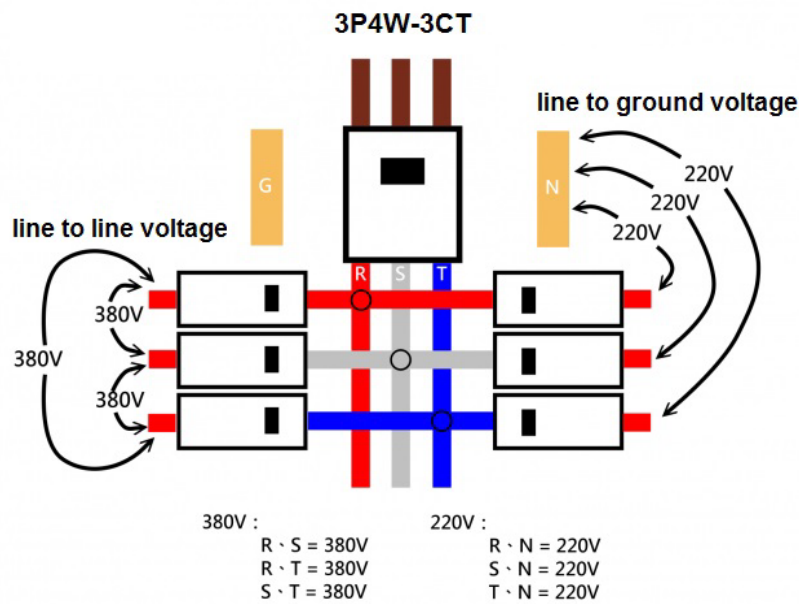
Current transformer	CT Ratio (PM-2133DP)	Current transformer	CT Ratio (PM-2133DP)
50A CT	10:1	400A CT	80:1
60A CT	12:1	800A CT	160:1
100A CT	20:1	1000A CT	200:1
200A CT	40:1	1200A CT	240:1

Note:

- A. Please use low phase angle error CTs: essential for accurate power and energy measurements. (Example: phase error $<2^\circ$)
- B. Primary CT accuracy will influence the measurement.
- C. PM-2133DP only for external 333mV Output CTs.
Safe: burden resistor built-in, 333 mVac voltage output at rated full scale current, no shorting blocks needed.
- D. This meter requires external CT(s) to operate:
1P2W-1CT requires 1 CT per meter.
3P3W-2CT/1P3W-2CT requires 2 CTs per meter.
3P4W-3CT/3P3W-3CT requires 3 CTs per meter.

Q11. What is the difference between line to line voltages to line to ground voltage?

On a three phase wye connected system line to line voltages will be the voltages between the terminals A - B, B - C, A - C. On a three phase wye connected system line to ground voltages will be the voltages between the terminals A - N, B - N, C - N. To calculate the line to ground voltages divide the line voltage by the square root of three which equals 1.73. An example, on a 380 volt wye system, line to line voltage is 380 volts and line to ground voltage is $380/1.73 = 220$ volts



Q12. How to set up [Display Voltage] register value to correctly display line to ground voltage or line to line voltage?

The voltage [V_x] register in Modbus register table can be used to show line-to-ground voltage or line-to-line voltage value by setting [Display Voltage] register value. According to different wiring types, it is required to set different [Display Voltage] value. If the voltage is not displayed as expected value, please refer to the table below and check if the setting value is set accurately.

	Line to Ground Voltage	Line to Line Voltage
3P3W-2CT	[Display Voltage] = 1 (Show as Vln)	[Display Voltage] = 0 (Automatic)
3P3W-3CT	[Display Voltage] = 0 (Automatic)	[Display Voltage] = 2 (Show as Vll)
3P4W-3CT	[Display Voltage] = 0 (Automatic)	[Display Voltage] = 2 (Show as Vll)

Q13. How about the harmonic (THD) analysis capability?

The number of harmonics N that can be analyzed within the 2.8 kHz pass band is the whole number of $2800/f$. The absolute maximum number of harmonics accepted by the Energy Metering IC is 63.

$$N = [2800/f], N \leq 63$$

Q14. How to measure the Voltage large than 500V?

For service voltage above 600 Vac, voltage transformers (PTs) are used to step down the voltage to a lower range that will work with a PM-2133D meter.

Selecting a Transformer:

Selecting the right voltage transformer is simple. Review the following considerations to determine the best fit for your application.

**Input Voltage:**

Select a transformer that will operate on the supply voltage available at your facility (Example: PRI. Voltage 720V; SEC. Voltage 120V). Check the connection diagram (three-phase Y and delta; phase sequence) to ensure compatibility.

Adding potential transformers has the effect of reducing the measured line voltage by the PT ratio (let's say 6:1 for this example). So a voltage of 720 Vac becomes 120 Vac. Since the meter sees 120 Vac, many of the measurements it reports will be low by a factor of 6 unless they are scaled up by 6.

Frequency:

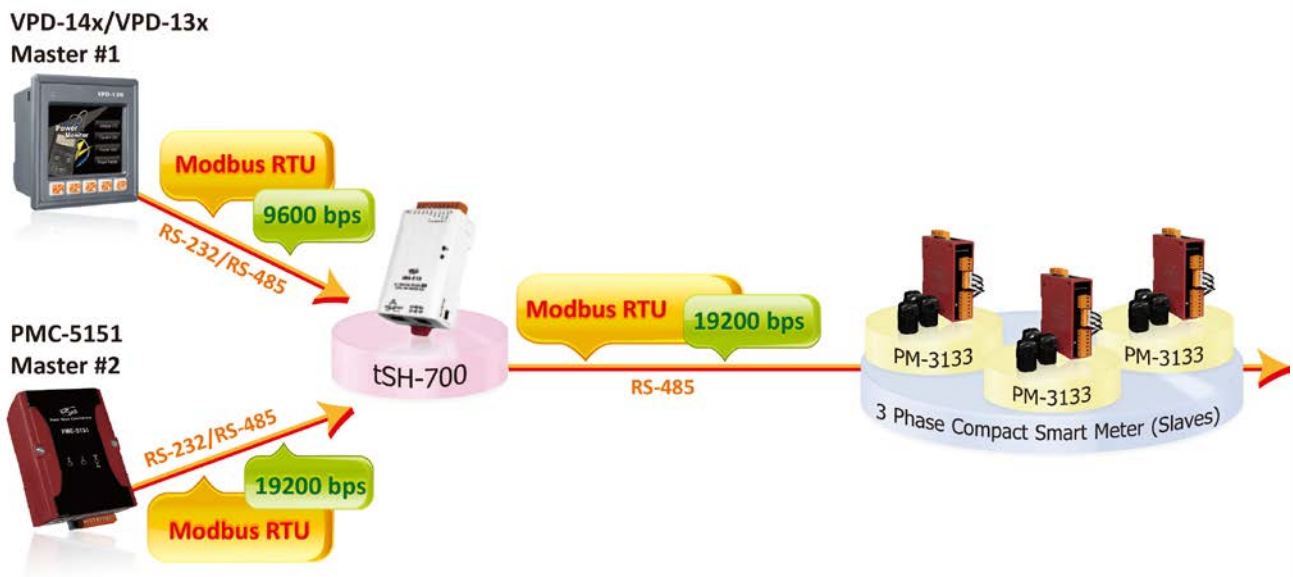
If you are operating in the United States, you will most likely be operating on 60 Hz. However should you need a 50 Hz rated transformer.

Accuracy: Transformer (PT) accuracy (Example: 1% or 3%) will influence the measurement.

Rated Output (VA): Example: 150 VA (50VA per phase).

Q15. Two Masters Share One Slave (via tSH-735):

This function allows two master devices connected to different serial ports to share slave devices. Modbus mode can be used to convert the Modbus RTU/ASCII protocols, while raw data mode can be used for DCON or other query-response protocols. Different baud rates and data formats can also be used on the different serial ports. The built-in cache function reduces the loading of serial communication on the slave port by removing duplicated queries when the two master devices are requesting the same information.



Appendix 2: PVC wire and model

Item	copper wire		Wire external diameter (mm)	Reference current (A)	CT size and product model	CT spec. (internal diameter/Max . current)		
	AWG SIZE (mm ²)	Quantity /Diameter (mm)						
Flat cable		1.6	3.2	15	Ø10 (PM-2133D-100 P)	10mm/60A		
		2.0	3.6	20				
Twisted pair	2.0	7/0.6	3.4	17				
	3.5	7/0.8	4.0	20				
	5.5	7/1.0	5.0	30				
	8.0	7/1.2	6.0	40				
	14	7/1.6	7.6	55				
	22	7/2.0	9.2	70				
	30	7/2.3	10.5	90			Ø16 (PM-2133D-160 P)	16mm/100A
	38	7/2.6	11.5	100				
		50	19/1.8	13.0	120	Ø24 (PM-2133D-240 P)	24mm/200A	
		60	19/2.0	14.0	140			
		80	19/2.3	15.5	165			
		100	19/2.6	17.0	190			
		125	19/2.9	19.0	220			
		150	37/2.3	21.0	250			
	200	37/2.6	23.0	300				

*Wire and current will have discrepancy because of the temperature, material and brand