

PM-213x

Compact Power Meter

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User's Manual



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Chapter 1 : Introduction

1.1 Product Introduction

It's always difficult but crucial to the supervisors to figure out how much energy is consuming. ICP DAS brings the most powerful, cost effective, advanced Compact Power Meters, PM213X series, to the markets.

With its high accuracy (1%, PF=1), the PM213x series products can be applied both on low voltage primary side and/or medium/high voltage secondary side and enable the users to obtain in real time the reliable and accurate energy consumption readings from the monitored equipments while in operation. These compact size and cost effective Power Meters are equipped with revolutionary wired clip-on CT (various types support input current up to 200A) and standard Modbus communication RS-485 protocol for easy deployment. It works with input voltages ranging 10V ~ 500V, supporting a wide range of applications.

ICP DAS offers PM-213X family in a full range of Single-phase and Three-phase compact power meters for power monitoring. The products offer a rich feature set combined with easy-to-integrate communications.

Features :

1. True RMS energy and power parameters measurement in compact size.
2. Easy wiring for on-line installation.
3. RS-485 communication supported Modbus RTU protocol , CAN Bus Communication supported Compatible with CAN specification 2.0B.
4. Wh accuracy better than 1% (PF=1).
5. With wired clip-on CT (various types support input current up to 200A) .
6. LED pulse output.

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.

1.2.2 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.

1.2.3 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

Input Voltage	PM-2134 : 10-300V PM-2133 : 10-500V
Input Current	CT Φ 10mm (60A) , CT Φ 16mm (100A) , CT Φ 24mm (200A)
Aux Power	DC +10~+30V
Frequency	60/50Hz
Starting Current	<0.025A
Wiring diagram	PM-2134 : 1-phase 4-channel PM-2133 : Auto or manual setting 1P2W-1CT 、 1P3W-2CT 、 3P3W-2CT 、 3P3W-3CT 、 3P4W
Power Parameters Measures	PM-2134 : V1(rms), V1(rms), V2(rms), V2(rms) I 1(rms), I 2(rms), I 3(rms), I 4(rms) kW1, kW2, kW3, kW4 kVA1, kVA2, kVA3, kVA4 kvar1, kvar2, kvar3, kvar4 PF1, PF2, PF3, PF4 kWh1, kWh2, kWh3, kWh4 kVAh1, kVAh2, kVAh3, kVAh4 kvarh1, kvarh2, kvarh3, kvarh4 PM-2133 : VA(rms), VB(rms), VC(rms), Vave(rms) I A(rms), I B(rms), I C(rms), I ave(rms) kWA, kWB, kWC, kWtot kVAA, kVAB, kVAC, kVAtot kvarA, kvarB, kvarC, kvartot PFA, PFB, PFC, PFtot kWhA , kWhB, kWhC, kWh tot kVAhA , kVAhB, kVAhC, kVAhtot kvarhA , kvarhB, kvarhC, kvarhtot
Communication	Protocol : Modbus-RTU RS485, half duplex isolated Baud Rate : 9600, 19200(default), 38400 Protocol : CAN bus Baud Rate : 125 k(default) , 250 k , 500 k , 1000 k
kWh Accuracy	1% (PF=1)
Dimension	78(L) x 35(W) x 99(H) mm
Operating Temperature	-10 $^{\circ}$ C~70 $^{\circ}$ C
Installation	Rail-mounted
Power consumption	2.4W(When RS485 communication)

Chapter3: 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

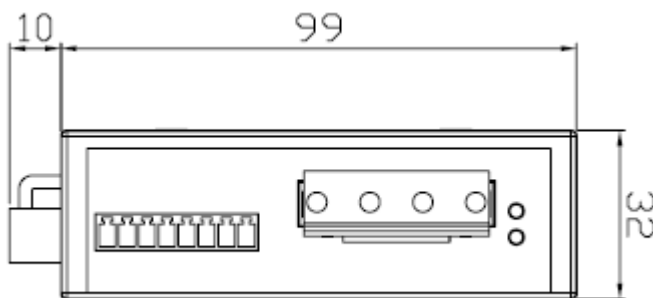
3.2 Safety



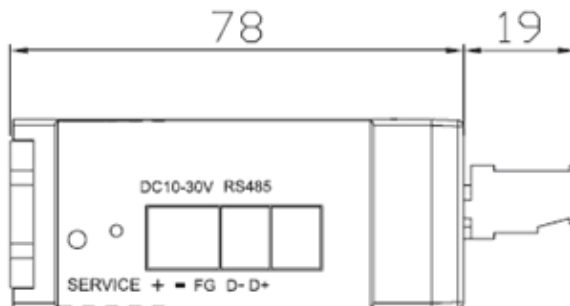
Please use the soft dry clothes to clean the instrument.
Please do not use any chemical or detergent or volatile solvents to clean the instrument, in order to avoid any possibility of the cover damage ◦

3.3 Dimension and Latch

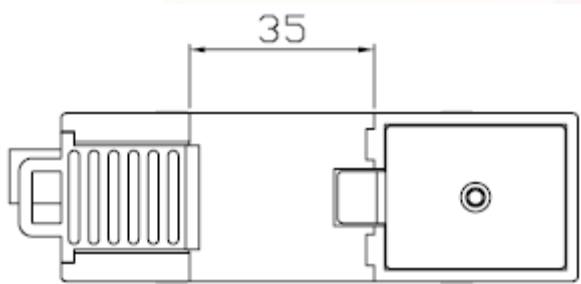
Top View (mm)



Side View (mm)



Position of latch

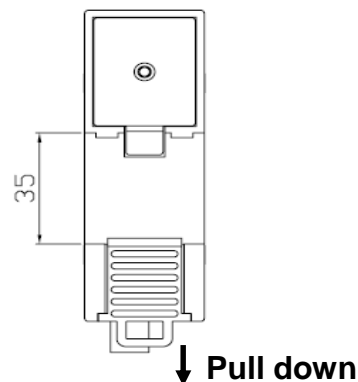


- Dimension: 99mm (length) × 32mm (wide) × 78mm (high)
- Products come with external split type clip-on CT's. Disconnect the CT's or use other CT's is highly prohibited.
- Please read this operation manual carefully before using ◦
- Please re-confirm the measure position ◦
- Reconfirm the RST(ABC) phase sequence of the power sys
- PM-213x series can be installed as rail mounting mode or embedded, no need to drill a hole or screw to fix it (rail mounting width can up to the length of 35 mm) ◦
- Meter auxiliary power for PM-213x series is DC +10V ~+30V ◦

3.4 Mounting and Dismounting

3.4.1 Mounting

Pull down the “latch” of meter, and mount the meter on to the rail and lock it, as shown in below picture.



3.4.2 Dismounting

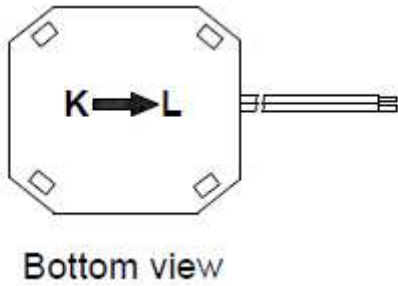
- **Wire Disconnection**

1. the CT's first and remove CT's from the monitoring power cables ◦ Do not disconnect CT's lines from terminals of these smart meters.
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.

- **Dismount**

From the back to pull down the latch, then can release the meter

3.5 CT's installation steps



① At the bottom of the CT, there is a “K→L” mark.

② open the clip-on type CT ◦



③ Make sure the power current direction follow the “K→L” mark on the CT and then clip it on.



④ Installation steps finished.

Chapter 4 : Wiring Diagrams

Voltage Input

- PM-2134 series: Input Voltage up to 300V,
PM-2133 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.
- Confirm the RST (ABC) phase sequence.

Current Input

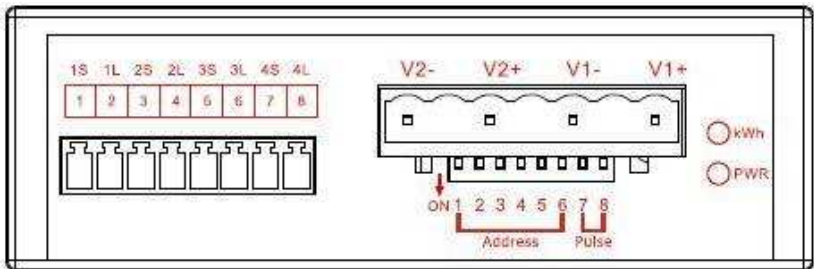
- The external CT's are fragile, please handle with care.
- The current input of PM213x series is in mA range. **Only the ex-factory attached CT's can be used.** The other CT's, for example, from panel will damage the instrument due to its large current (around 5A)
- When more than one smart meters (PM-213x 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 (PM213x series) and its attached split type clip-on CT are calibrated set by set. The mix use may cause wrong measurements.
- 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)
- **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, the fatal damages may happen.**
- Please handle with extra care, especially when the operation space of CT's is limited.
- The current direction must follow K-L marked on CT's.
- Please select the right size CT's for different size of monitoring equipment cables: power cable diameter < Φ 10 use 60A CT · Φ 10~ Φ 16 use 100A CT · Φ 16~ Φ 24 use 200A CT ◦
- The maximum current value can not exceed the CT rating.
- For the consideration of accuracy, 3CT solution is highly recommended for the use in 3P3W compared with 2CT solution.

4.1 Connection diagram

● **PM-2134**

Please firstly check the current input terminal, and then in the white black, white black, white black, white black wired sequences (1S 1L 2S 2L 3S 3L 4S 4L) .After connect the CT's, clip on CT's. Make sure the arrow direction sign on CT's follows current flow direction (K→L) **Note: it must be in the same direction** ◦

Connect the voltage input terminal. For PM-2134, connect V2- V2+ and V1- V1+ ◦

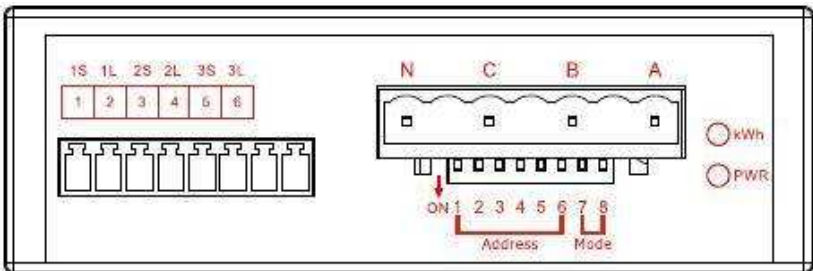


● **PM-2133**

Please firstly check the current input terminal, and then in white black, white black, white black wire sequences (1S 1L 2S 2L 3S 3L. After connect the CT's, clip on CT's. Make sure the arrow direction sign on CT's follows current flow direction (K→L) **Note: it must be in then same direction** ◦

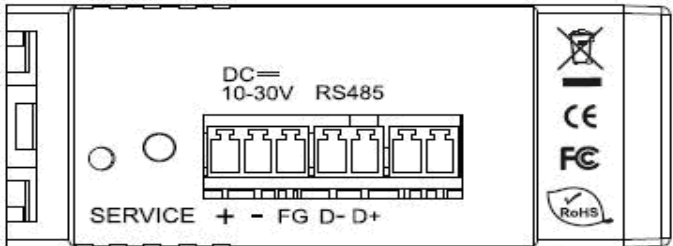
Connect the voltage input terminal N C B A. for PM-2133, in the three phase order as follows on N C B A ◦

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

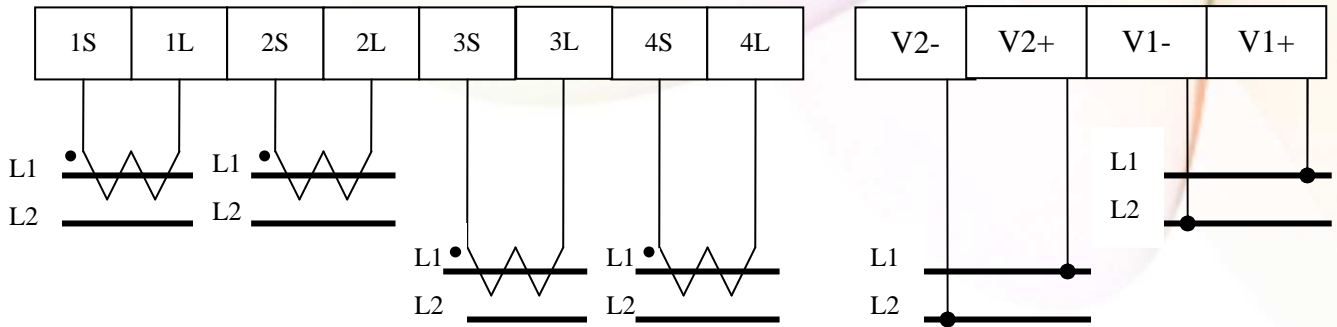


Then, Connect RS485 D+ D- ("–", "+" sequence base on the top cover mark showed) ◦

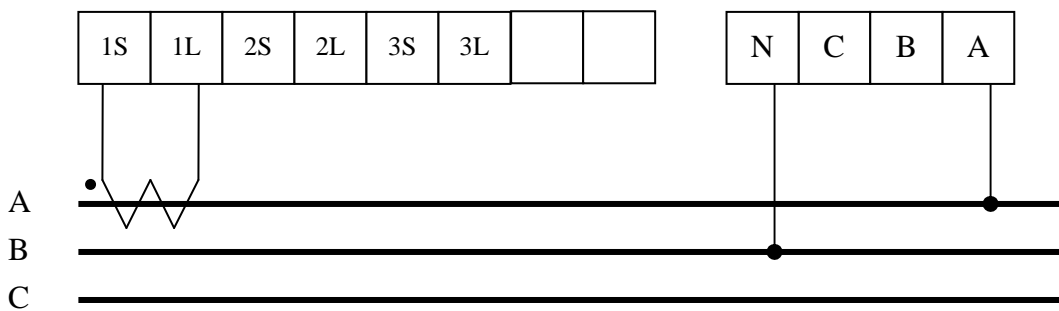
And then, add the auxiliary power ◦ DC+10~+30V (+ - FG)



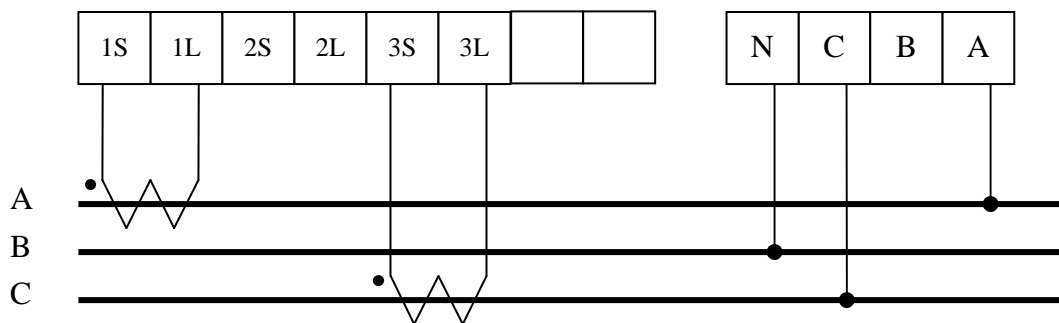
● **1P4W(PM-2134)**



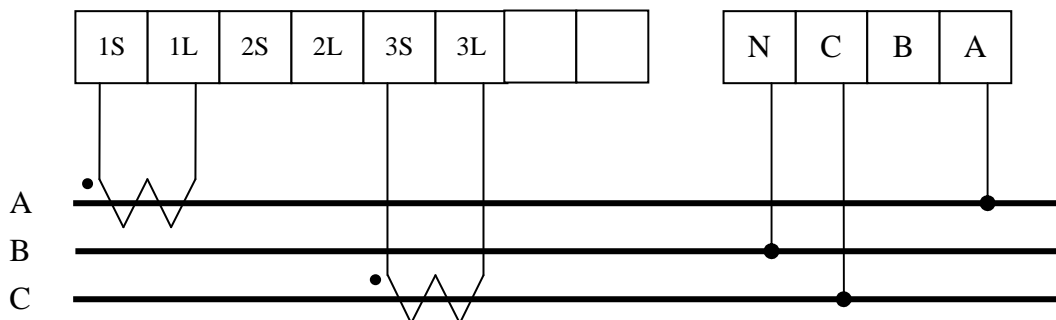
● **1P2W-1CT(PM-2133)**



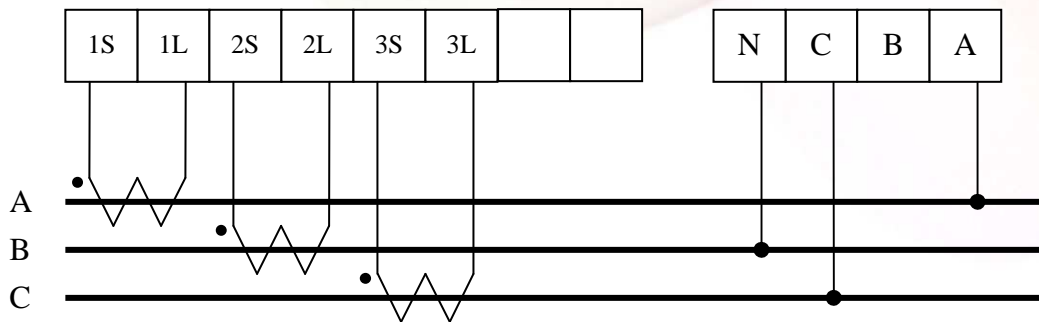
● **1P3W-2CT(PM-2133)**



● **3P3W-2CT(PM-2133)**



● **3P3W-3CT(PM-2133)**

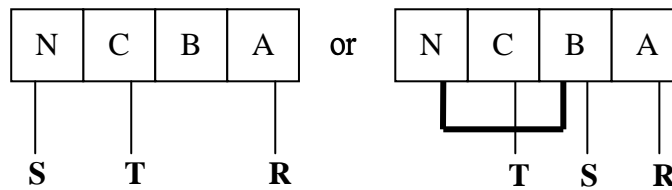


attention !

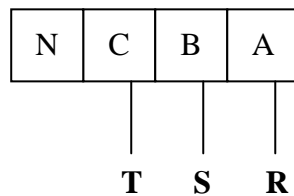
if 3P3W/2CT & 3P3W/3CT, connect only "A N C" for the voltage input terminal , replace B with N .



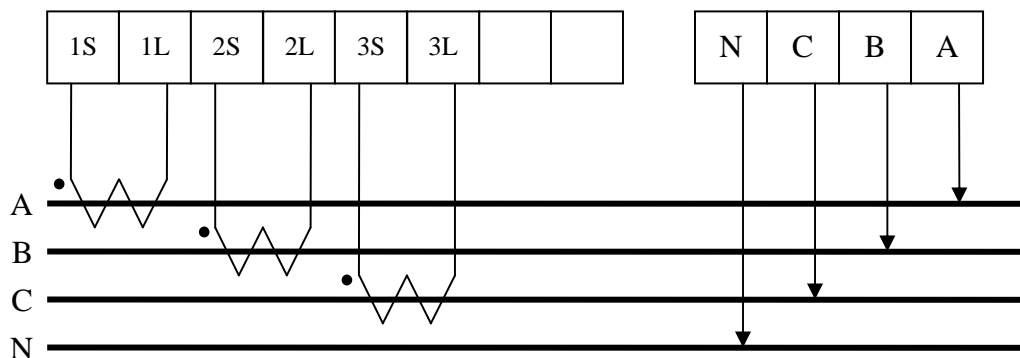
Correct



Wrong

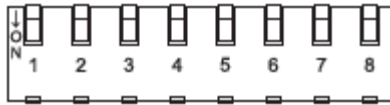


● **3P4W-3CT(PM-2133)**



Chapter 5 : Dip Switch ON /OFF: Modbus Address Setting, Wh pulse output and Wiring Setting.

Dip Switch



Dip switch is used for Modbus address setting, default is 1, i.e. all OFF

For example: Modbus address is 10 · find the table of dip switch 1-6 is **on, off, off, on, off, off ff**

- **SW1 -6 setting the Modbus address of communication, 1-64**

Modbus Address	1	2	3	4	5	6
1	OFF	OFF	OFF	OFF	OFF	OFF
2	ON	OFF	OFF	OFF	OFF	OFF
3	OFF	ON	OFF	OFF	OFF	OFF
4	ON	ON	OFF	OFF	OFF	OFF
5	OFF	OFF	ON	OFF	OFF	OFF
6	ON	OFF	ON	OFF	OFF	OFF
7	OFF	ON	ON	OFF	OFF	OFF
8	ON	ON	ON	OFF	OFF	OFF
9	OFF	OFF	OFF	ON	OFF	OFF
10	ON	OFF	OFF	ON	OFF	OFF
11	OFF	ON	OFF	ON	OFF	OFF
12	ON	ON	OFF	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	OFF
14	ON	OFF	ON	ON	OFF	OFF
15	OFF	ON	ON	ON	OFF	OFF
16	ON	ON	ON	ON	OFF	OFF
17	OFF	OFF	OFF	OFF	ON	OFF
18	ON	OFF	OFF	OFF	ON	OFF
19	OFF	ON	OFF	OFF	ON	OFF
20	ON	ON	OFF	OFF	ON	OFF
21	OFF	OFF	ON	OFF	ON	OFF
22	ON	OFF	ON	OFF	ON	OFF
23	OFF	ON	ON	OFF	ON	OFF
24	ON	ON	ON	OFF	ON	OFF
25	OFF	OFF	OFF	ON	ON	OFF
26	ON	OFF	OFF	ON	ON	OFF
27	OFF	ON	OFF	ON	ON	OFF
28	ON	ON	OFF	ON	ON	OFF
29	OFF	OFF	ON	ON	ON	OFF

30	ON	OFF	ON	ON	ON	OFF
31	OFF	ON	ON	ON	ON	OFF
32	ON	ON	ON	ON	ON	OFF
33	OFF	OFF	OFF	OFF	OFF	ON
34	ON	OFF	OFF	OFF	OFF	ON
35	OFF	ON	OFF	OFF	OFF	ON
36	ON	ON	OFF	OFF	OFF	ON
37	OFF	OFF	ON	OFF	OFF	ON
38	ON	OFF	ON	OFF	OFF	ON
39	OFF	ON	ON	OFF	OFF	ON
40	ON	ON	ON	OFF	OFF	ON
41	OFF	OFF	OFF	ON	OFF	ON
42	ON	OFF	OFF	ON	OFF	ON
43	OFF	ON	OFF	ON	OFF	ON
44	ON	ON	OFF	ON	OFF	ON
45	OFF	OFF	ON	ON	OFF	ON
46	ON	OFF	ON	ON	OFF	ON
47	OFF	ON	ON	ON	OFF	ON
48	ON	ON	ON	ON	OFF	ON
49	OFF	OFF	OFF	OFF	ON	ON
50	ON	OFF	OFF	OFF	ON	ON
51	OFF	ON	OFF	OFF	ON	ON
52	ON	ON	OFF	OFF	ON	ON
53	OFF	OFF	ON	OFF	ON	ON
54	ON	OFF	ON	OFF	ON	ON
55	OFF	ON	ON	OFF	ON	ON
56	ON	ON	ON	OFF	ON	ON
57	OFF	OFF	OFF	ON	ON	ON
58	ON	OFF	OFF	ON	ON	ON
59	OFF	ON	OFF	ON	ON	ON
60	ON	ON	OFF	ON	ON	ON
61	OFF	OFF	ON	ON	ON	ON
62	ON	OFF	ON	ON	ON	ON
63	OFF	ON	ON	ON	ON	ON
64	ON	ON	ON	ON	ON	ON

- **SW7-8** : For Single-phase Meter(PM-2134 series): are used to select Wh pulse output.
For Three-Phase Meter(PM-2133 series):are used to select the way of wiring.

PM-2134 : Select Wh pulse output

Wh pulse output	7	8
Wh1	OFF	OFF
Wh2	ON	OFF
Wh3	OFF	ON
Wh4	ON	ON

PM-2133 : Select the different wiring mode

(please select the AUTO, if 1P2W or 1P3W are used)

接線方式	7	8
Automatic	OFF	OFF
3P3W and 2CT	ON	OFF
3P3W and 3CT	OFF	ON
3P 4W	ON	ON

Chapter 6 communication Formats

6.1 Specifications

- **Communication protocol** :Modbus
 - **Transport specification**
 - Bits per Byte : 1 start bit
 - 8 data bits, least significant bit sent first
 - 1 or 2 stop bits (default = 1, stop)
 - Error Check : Cyclical Redundancy Check (CRC)
 - **Baud Rate** : 9600, 19200 (default) , 38400
 - **Modbus slave address** : 1-64(default : 1)
- Modbus Function Code** : 03h, 04h, 10h

Code	MODBUS_name	Description
03h	Read Holding Registers	Read the contents of read/write location
04h	Read Input Registers	Read the contents of read only location
10h	Pre-set Multiple Registers	Set the contents of read/write location

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

● **Format of data**

Integer : 16 bits with sign

Unsigned Integer : 16 bits without sign

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

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

Where:

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.

● **transport sequence(Float)**

1	2	3	4
Data Lo Word , Hi Byte	Data Lo Word , Lo Byte	Data Hi Word , Hi Byte	Data Hi Word , Lo Byte

● **transport sequence(Integer)**

1	2	3	4
Data Hi Word , Hi Byte	Data Hi Word , Lo Byte	Data Lo Word , Hi Byte	Data Lo Word , Lo Byte

6.2 Modbus Register

Modbus Module #1 Holding Register : Setup Parameter

Parameter name	Modbus Register		Len	Data Type	Range	Default value	Units	Comment
	Modicom Format	Hex						
Comm_485_BaudRate	44097	0x1000	Word	UInt	0: 9600 1: 19200 2: 38400	1	bps	
Comm_485_StopBit	44098	0x1001	Word	UInt	0:1 Stop bit, 1:2 Stop bit	0		
Meter_Ratio	44099	0x1002	Word	UInt	1-65535	500		
PT_Ratio	44100	0x1003	Word	UInt	1-65535	10	0.1	
CT_Ratio	44101	0x1004	Word	UInt	1-65535	1		

Modbus Module #2 Input Register : Voltage, Current, Power, Energy(Float) for PM-2133 · PM-2134

Parameter name	Modbus Register		Len	Data Type	Range	Units	Comment
	Modicom Format	Hex					
V_a	34353-34354	0x1100-0x1101	DWord	Float		Volt	Primary
I_a	34355-34356	0x1102-0x1103	DWord	Float		Amp	Primary
kW_a	34357-34358	0x1104-0x1105	DWord	Float		kW	Primary
kvar_a	34359-34360	0x1106-0x1107	DWord	Float		kvar	Primary
kVA_a	34361-34362	0x1108-0x1109	DWord	Float		kVA	Primary
PF_a	34363-34364	0x110A-0x110B	DWord	Float			Primary
kWh_a	34365-34366	0x110C-0x110D	DWord	Float			Primary
kvarh_a	34367-34368	0x110E-0x110F	DWord	Float			Primary
kVAh_a	34369-34370	0x1110-0x1111	DWord	Float			Primary
V_b	34371-34372	0x1112-0x1113	DWord	Float		Volt	Primary
I_b	34373-34374	0x1114-0x1115	DWord	Float		Amp	Primary
kW_b	34375-34376	0x1116-0x1117	DWord	Float		kW	Primary
kvar_b	34377-34378	0x1118-0x1119	DWord	Float		kvar	

kVA_b	34379-34380	0x111A-0x111B	DWord	Float		kVA	Primary
PF_b	34381-34382	0x111C-0x111D	DWord	Float			Primary
kWh_b	34383-34384	0x111E-0x111F	DWord	Float			Primary
kvarh_b	34385-34386	0x1120-0x1121	DWord	Float			Primary
kVAh_b	34387-34388	0x1122-0x1123	DWord	Float			Primary
V_c	34389-34390	0x1124-0x1125	Dword	Float		Volt	Primary
I_c	34391-34392	0x1126-0x1127	Dword	Float		Amp	Primary
kW_c	34393-34394	0x1128-0x1129	Dword	Float		kW	Primary
kvar_c	34395-34396	0x112A-0x112B	Dword	Float		kvar	Primary
kVA_c	34397-34398	0x112C-0x112D	Dword	Float		kVA	Primary
PF_c	34399-34400	0x112E-0x112F	Dword	Float			Primary
kWh_c	34401-34402	0x1130-0x1131	Dword	Float			Primary
kvarh_c	34403-34404	0x1132-0x1133	Dword	Float			
kVAh_c	34405-34406	0x1134-0x1135					
V_avg(V_d)	34407-34408	0x1136-0x1137	Dword	Float		Volt	Primary
I_avg(I_d)	34409-34410	0x1138-0x1139	Dword	Float		Amp	Primary
kW_tot(kW_d)	34411-34412	0x113A-0x113B	Dword	Float		kW	Primary
kvar_tot(kvar_d)	34413-34414	0x113C-0x113D	Dword	Float		kvar	Primary
kVA_tot(kVA_d)	34415-34416	0x113E-0x113F	Dword	Float		kVA	Primary
PF_avg(PF_d)	34417-34418	0x1140-0x1141	Dword	Float			Primary
kWh_tot(kWh_d)	34419-34420	0x1142-0x1143	Dword	Float			Primary
kvarh_tot(kvarh_d)	34421-34422	0x1144-0x1145	Dword	Float			
kVAh_tot(kVAh_d)	34423-34424	0x1146-0x1147	Dword	Float			

Modbus Module #3 Input Register : Voltage, Current, Power, Energy(Integer) for PM-2133、PM-2134

Parameter name	Modbus Register		Len	Data Type	Range	Units	Comment
	Modicom Format	Hex					
V_a	34609-34610	0x1200-0x1201	DWord	UInt32		0.1 Volt	Primary
I_a	34611-34612	0x1202-0x1203	DWord	UInt32		0.1A	Primary
kW_a	34613-34614	0x1204-0x1205	DWord	Int32		0.1kW	Primary

kvar_a	34615-34616	0x1206-0x1207	DWord	Int32		0.1kvar	Primary
kVA_a	34617-34618	0x1208-0x1209	DWord	Int32		0.1kVA	Primary
PF_a	34619	0x120A	Word	Int	-1000~+1000	0.001PF	-1.000~1.000
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	Primary
I_b	34628-34629	0x1213-0x1214	DWord	UInt32		0.1A	Primary
kW_b	34630-34631	0x1215-0x1216	DWord	Int32		0.1kW	Primary
kvar_b	34632-34633	0x1217-0x1218	DWord	Int32		0.1kvar	Primary
kVA_b	34634-34635	0x1219-0x121A	DWord	Int32		0.1kVA	Primary
PF_b	34636	0x121B	Word	Int	-1000~+1000	0.001PF	-1.000~1.000
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	Primary
I_c	34645-34646	0x1224-0x1225	DWord	UInt32		0.1A	Primary
kW_c	34647-34648	0x1226-0x1227	DWord	Int32		0.1kW	Primary
kvar_c	34649-34650	0x1228-0x1229	DWord	Int32		0.1kvar	Primary
kVA_c	34651-34652	0x122A-0x122B	DWord	Int32		0.1kVA	Primary
PF_c	34653	0x122C	Word	Int	-1000~+1000	0.001PF	-1.000~1.000
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(V_d)	34660-34661	0x1233-0x1234	DWord	UInt32		0.1 Volt	Primary
I_avg(I_d)	34662-34663	0x1235-0x1236	DWord	UInt32		0.1A	Primary
kW_tot(kW_d)	34664-34665	0x1237-0x1238	DWord	Int32		0.1kW	Primary
kvar_tot(kvar_d)	34666-34667	0x1239-0x123A	DWord	Int32		0.1kvar	Primary
kVA_tot(kVA_d)	34668-34669	0x123B-0x123C	DWord	Int32		0.1kVA	Primary
PF_avg(PF_d)	34670	0x123D	Word	Int	-1000~+1000	0.001PF	-1.000~1.000
kWh_tot(kWh_d)	34671-34672	0x123E-0x123F	DWord	Int32	0~99999999	0.1kWh	0~9999999.9
kvarh_tot(kvarh_d)	34673-34674	0x1240-0x1241	DWord	Int32	0~99999999	0.1kvarh	0~9999999.9
kVAh_tot(kVAh_d)	34675-34676	0x1242-0x1243	DWord	Int32	0~99999999	0.1kVAh	0~9999999.9

Chapter 7: CAN Bus

6.1 Overview

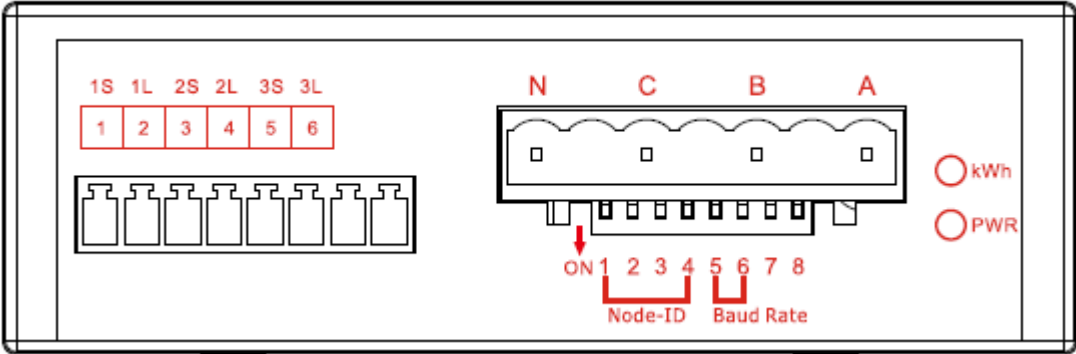
The Controller Area Network (CAN) is a serial communication way, which efficiently supports distributed real-time control with a very high level of security. It provides the error process mechanisms and message priority concepts. These features can improve the network reliability and transmission efficiency. Furthermore, CAN supplies the multi-master capabilities, and is especially suited for networking “intelligent” devices as well as sensors and actuators within a system or sub-system ◦

The PM2000-CAN provides the CAN bus interface for the PM-213x series power meter. Therefore, users can easily apply in any CAN applications via the PM2000-CAN ◦

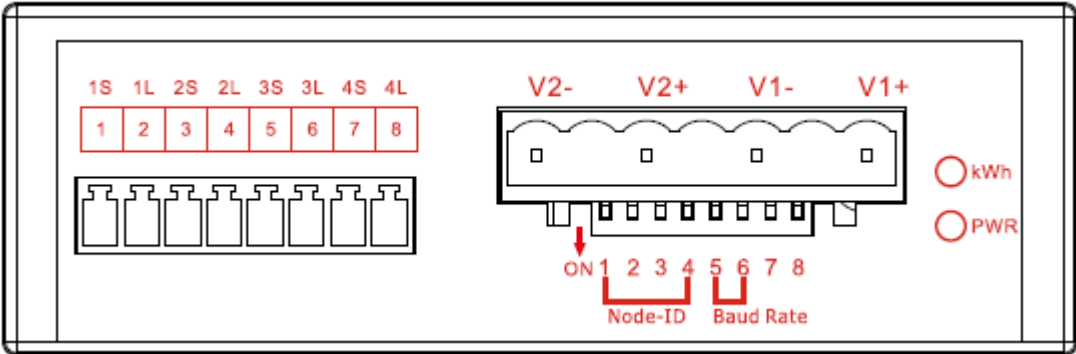


Application Structure

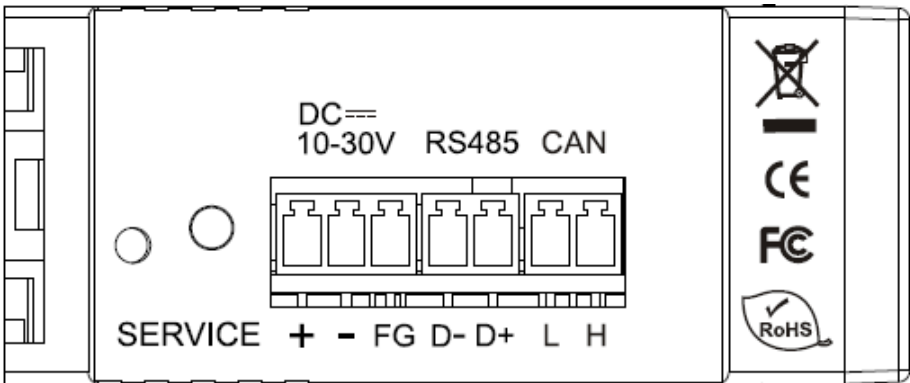
6.2 Contact mark



PM-2133 Top View



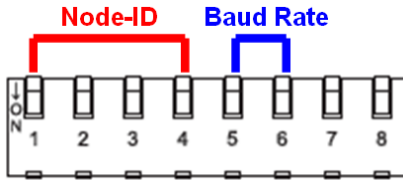
PM-2134 Top View



PM-2133、PM-2134 Side View

6.3 DIP Switch

6.3.1 The Node-ID of CAN bus



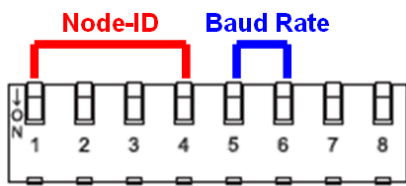
The Dip-Switch from 1 to 4 represents the Node-ID of the PM2000-CAN in a CAN network. Mapping as shown in the following table. **The default Node-ID value is 1, and the Dip-Switch value from 1 to 4 is (ON) (OFF) (OFF) (OFF).**

For example, if user wants to set the Node-ID to 10, the Dip-Switch value from 1 to 4 is (OFF) (ON) (OFF) (ON).

Node-ID and Dip-Switch 1 ~ 4.

Node-ID	1	2	3	4
0	OFF	OFF	OFF	OFF
1 (Default)	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
4	OFF	OFF	ON	OFF
5	ON	OFF	ON	OFF
6	OFF	ON	ON	OFF
7	ON	ON	ON	OFF
8	OFF	OFF	OFF	ON
9	ON	OFF	OFF	ON
10	OFF	ON	OFF	ON
11	ON	ON	OFF	ON
12	OFF	OFF	ON	ON
13	ON	OFF	ON	ON
14	OFF	ON	ON	ON
15	ON	ON	ON	ON

6.3.2 The baud rate of CAN bus



The Dip-Switch from 5 to 6 represents the baud rate of the PM2000-CAN in a CAN network. Mapping as shown in the following table. **The default baud rate value is 125K, and the Dip-Switch value from 5 to 6 is (OFF) (OFF).**

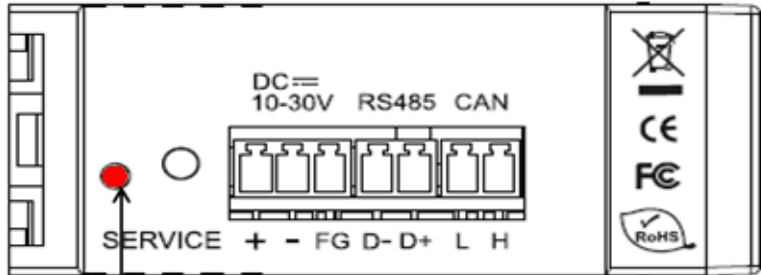
For example, if user wants to set the CAN baud rate to 1000 kbps, the Dip-Switch value from 5 to 6 is (ON) (ON).

CAN baud rate and Dip-Switch 5~ 6.

CAN baud-rate	5	6
125 k (Default)	OFF	OFF
250 k	ON	OFF
500 k	OFF	ON
1000 k	ON	ON

7.3.3 The LED state

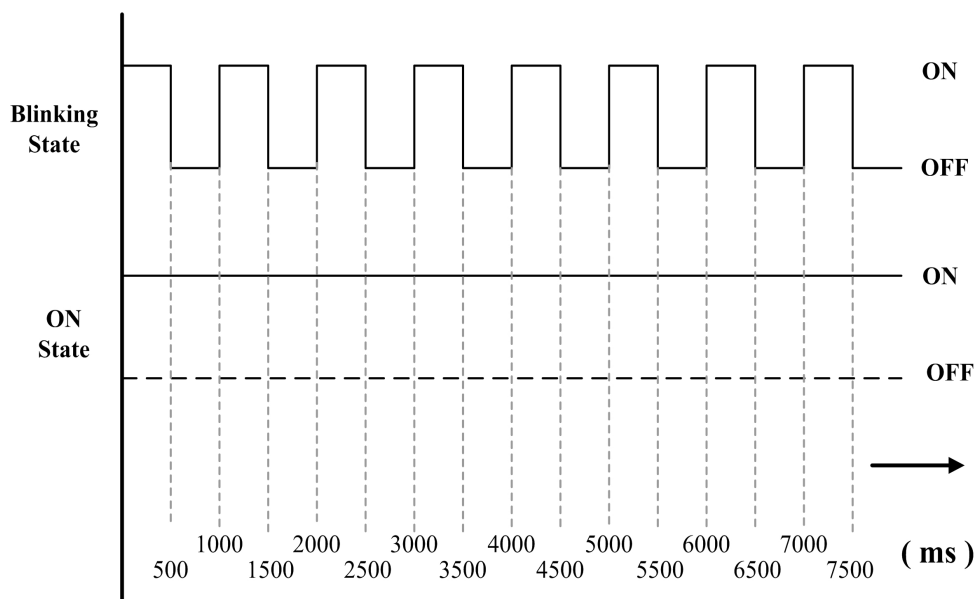
‘LED of CAN’ is an indicator LED of CAN bus in the PM-2000. It shows whether the CAN communication is normal or incorrect. The following figure shows the LED.



LED of CAN

LED State	Description
Blinking State	The PM-2000 communication is normal.
ON State	The PM-2000 communication is error. The LED will be ON when CAN bus occurs the following state. <ol style="list-style-type: none"> 1. The CAN controller transfer into Bus-off state. 2. The baud rate is incorrect. 3. The Rx or Tx error counter within CAN controller is not zero.

CAN LED State



7.4 CAN Protocol

7.4.1 Specification

- Node-ID : 0 ~ 15.
- Baud Rate: 125k, 250k, 500k, 1000k.
- Support modes: a). Polling Mode
b). Auto Response Mode

DWORD (4-bytes)

Data Low Word	Data Low Word	Data Hi Word	Data Hi Word
Hi byte	Low byte	Hi byte	Low byte

Integer (2-bytes)

Data Low Word	Data Hi Word
---------------	--------------

CAN-ID Definition (29-bits)

2824	2316	15 0
Function-ID(5-bits)	Node-ID(8-bits)	Value-ID(16-bit)

Function-ID Field Description

Function ID (5-bits)	Description
11000(0x18)	Read Data Request
00000(0x00)	Data Response
10000(0x10)	Get / Set Auto Response Parameters
11101(0x1D)	Read Firmware Version

Node-ID Field Description

This field represents the Node-ID of the PM-213x. Please refer to the ch 7.3.1.

Node-ID (8-bits)	Description
00000000 ~ 00001111 (0x00 ~ 0x0F)	Node-ID value (0 ~ 15)

Value-ID Field Description

This field represents the data within the PM-213x. Please refer to the ch 7.4.5.

Value-ID (16-bits)	Description
0x1100 ~ 0x1146	For corresponding data
0xFFFF	For parameter request command
0xEEEE	For parameter response data

7.4.2 Polling Mode

The user can use this command to acquisition information of PM-213x which are described in the Value-ID of ch 7.4.5.

Request: (# represents the optional value. “NA” means “Not Available”)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
11000	0x##	0x#####	1	NA	NA	NA	NA	NA	NA	NA	NA	NA

Response: (# represents the optional value)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
00000	0x##	0x#####	0	8/4	##	##	##	##	##	##	##	##

7.4.3 Auto Response Mode

7.4.3.1 Set Auto Response Parameters

The user can use this command to set parameter into PM-213x, and then it will return information according the ID-Flag and Cyclic-Time automatically.

Request: (# represents the optional value)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
10000	0x##	0xFFFF	0	8	##	##	##	##	##	##	##	##

The CAN data value format definition

D0	D1	D2	D3	D4	D5	D6	D7
Enable Flag	Cyclic-Time LLSB	Cyclic-Time LSB	Cyclic-Time MSB	Cyclic-Time MMSB	ID-Flag	ID-Flag	ID-Flag

- (1) The D0 means that the user could turn on/off the auto response function.
D0 → 0xFF = Enable , 0x00 = Disable ◦
- (2) The D1 to D4 means how much time of the corresponding data would be sent out automatically.
D1 ~ D4 → Cyclic Time(100ms ~ 0xFFFFFFFF ms) ◦
- (3) The D5 to D7 represents the selected/unselected flags of all No of Value-ID in ch 7.4.5. The users could set the corresponding bit to ONE (1) or ZERO (0) to select or unselect the Value-ID. The corresponding bit sets to ONE (1) means that the Value-ID is selected in this command. The corresponding bit sets to ZERO (0) means that the Value-ID is unselected in this command. Here shows the corresponding bits and No. of the Value-ID.

D5 ~ D7 (ID-Flag)

	D5	D6	D7
8-bit	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0
ID-Flag	01,02,03,04,05,06,07,08	09,10,11,12,13,14,15,16	17,18,19,20,--,--,--,--

Response: (# represents the optional value. “NA” means “Not Available”)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
10000	0x##	0xEEEE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA

7.4.3.2 Get Auto Response Parameters

The user can use this command to read the parameters of the auto response in the PM-213x.

Request: (# represents the optional value. “NA” means “Not Available”)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
10000	0x##	0xFFFF	1	NA	NA	NA	NA	NA	NA	NA	NA	NA

Response: (# represents the optional value)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
10000	0x##	0xEEEE	0	8/4	##	##	##	##	##	##	##	##

The D0 ~ D7 format is same as the “Set Auto Response Parameters” in ch 7.4.3.1.

7.4.3.3 Set Meter Parameter mode

Request ID (RTR = 0 , Length = 6)

Function ID	Address	Value-ID	D0 ~ D5
0x11100	8-bits	0xFFFF	Data Value

The Data Value Format Definition:

D0	D1	D2	D3	D4	D5
Meter-Ratio LSB	Meter-Ratio MSB	PT-Ratio LSB	PT-Ratio MSB	CT-Ratio LSB	CT-Ratio MSB

D0,D1→ Meter-Ratio ◦

D2,D3→ PT-Ratio ◦

D4,D5→ CT-Ratio ◦

Response ID (RTR = 1)

Function ID	Address	Value-ID
0x11100	8-bits	0xEEEE

7.4.3.4 Read Meter Parameter mode

Request ID (RTR = 1)

Function ID	Address	Value-ID
0x11100	8-bits	0xFFFF

Response ID (RTR = 0)

Function ID	Address	Value-ID	D0	~	D5
0x11100	8-bits	0xEEEE	Data Value		

The data value formats. It is same as the Set Meter Parameter Mode.

7.4.4 Read Firmware Version

The user can use this command to acquisition the firmware version information of the PM-213x, and then it will return information according Name and Version

Request: (# represents the optional value. “NA” means “Not Available”)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
11101	0x##	0xFFFF	1	0	NA	NA	NA	NA	NA	NA	NA	NA

response: (# represents the optional value)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
11101	0x##	0xEEEE	0	6	##	##	##	##	##	##	NA	NA

The CAN data value format definition

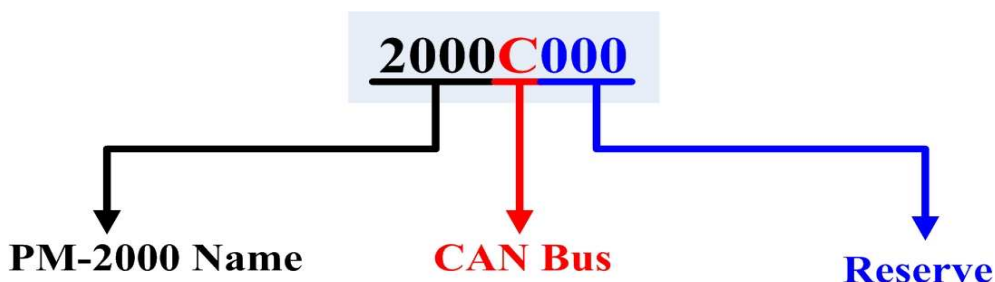
D0	D1	D2	D3	D4	D5	D6	D7
Name MMSB	Name MLSB	Name LMSB	Name LLSB	Version MMSB	Version LMSB	NA	NA

For example:

D0	D1	D2	D3	D4	D5	D6	D7
20	00	C0	00	00	01	NA	NA

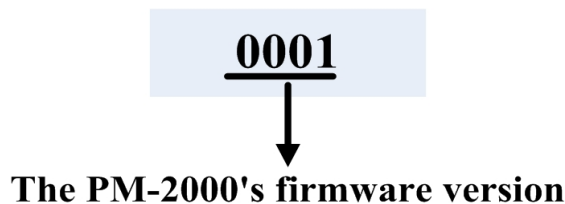
(1) The D0 to D3 means that the user can read the PM2000-CAN name.

D0 ~ D3 → The name of PM-2000 is 0x2000C000



(2) The D4 to D5 means what version of the PM2000-CAN will be read

D4~ D5 → The PM-2000's firmware version is 0x0001 ◦



7.4.5 The Value-ID and Power Meter Data Table

The Value-ID and power meter data table is shown in Mapping as shown in the following table. The D0 to D7 represents the CAN message from Data 0 to Data 7.

No.(ID-Flag)	Value-ID	Data-Length	D0 ~ D3	D4 ~ D7
1	0x1100	8	Volt(V_a)	Amp(I_a)
2	0x1104	8	kW(Kw_a)	kvar(kvar_a)
3	0x1108	8	kVA(Kva_a)	PF_a
4	0x110C	8	kWh_a	kVAh_a
5	0x1110	4	kvarh_a	
6	0x1112	8	Volt(V_b)	Amp(I_b)
7	0x1116	8	kW(Kw_b)	kvar(kvar_b)
8	0x111A	8	kVA(Kva_b)	PF_b
9	0x111E	8	kWh_b	kVAh_b
10	0x1122	4	kvarh_b	
11	0x1124	8	Volt(V_c)	Amp(I_c)
12	0x1128	8	kW(Kw_c)	kvar(kvar_c)
13	0x112C	8	kVA(Kva_c)	PF_c
14	0x1130	8	kWh_c	kVAh_c
15	0x1134	4	kvarh_c	
16	0x1136	8	Volt(V_d)	Amp(I_d)
17	0x113A	8	kW(Kw_d)	kvar(kvar_d)
18	0x113E	8	kVA(Kva_d)	PF_d
19	0x1142	8	kWh_d	kVAh_d
20	0x1146	4	kvarh_d	

Holding Register : Setup Parameter

Parameter Name	Index	Length	Data Type	Range	Default Type	Units	Comment
Meter_Ratio	0x1002	Word	UInt	1-65535	500		
PT_Ratio	0x1003	Word	UInt	1-65535	10	0.1	
CT_Ratio	0x1004	Word	UInt	1-65535	1		

7.5 CAN Protocol Examples

7.5.1 Polling Example

Polling mode

If users want to read V_a and I_a information from PM-213x, they can set the CAN-ID = 0x18011100 to read the data.

For example, if the Node-ID of the PM-213x is 0x01, the command is as below:

29-bit CAN-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7	
28~24	23 ~16	15 ~ 0											
0x18	0x01	0x1100	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA

Master → **Slave (PM-213x)**

29-bit CAN-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7	
28~24	23 ~16	15 ~ 0											
0x00	0x01	0x1100	0	8	E8	BA	42	DB	0C	1D	3F	10	

Master ← **Slave (PM-213x)**

7.5.2 Set Auto Response Parameter Example

Set Auto Response Parameter

For Example, users need some PM-213x information to response every 1 second automatically. The PM-213x information are the Value-ID (0x1110, 0x1112, 0x1116, 0x111A, 0x112C, 0x1130, 0x1134, 0x1136).

For example, if the Node-ID of the PM-213x is 0x01, the command is as below:

29-bit CAN-ID (bit)			RTR	Data Length	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
28~24	23 ~16	15 ~ 0										
0x10	0x01	0xFFFF	0	8	FF	E8	03	00	00	0F	0F	00

Master



Slave (PM-213x)

29-bit CAN-ID (bit)			RTR	Data Length	8-byte Data (byte)							
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7
28~24	23 ~16	15 ~ 0										
0x10	0x01	0xEEEE	1	0	00	00	00	00	00	00	00	00

Master



Slave (PM-213x)

7.5.3 Get Auto Response Parameter Example

Get Auto Response Parameters

The user can use the command as below to read the current setting of auto response.

For example, if the Node-ID of PM-213x is 0x01, the command is as below:

29-bit CAN-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7	
28~24	23 ~16	15 ~ 0											
0x10	0x01	0xFFFF	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA

Master → **Slave (PM-213x)**

29-bit CAN-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7	
28~24	23 ~16	15 ~ 0											
0x10	0x01	0xEEEE	0	0	FF	E8	03	00	00	0F	0F	00	00

Master ← **Slave (PM-213x)**

Set Meter Parameter Mode(0x1C30FFFF)

User can use the COBID 0x1C30FFFF to set the meter parameter of PM-213x ◦

For example, if the node id of PM-213x is 0x30, the commands are as below:

29-bit COB-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func Code	Add-ID	Value ID			0	1	2	3	4	5	6	7	
28~24	23 ~16	15 ~ 0											
0x1C	0x30	0xFFFF	0	6	F4	01	64	00	01	00	00	00	00

Master → **Slave (PM-213x)**

29-bit COB-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func Code	Add-ID	Value ID			0	1	2	3	4	5	6	7	
28~24	23 ~16	15 ~ 0											
0x1C	0x30	0xEEEE	1	0	00	00	00	00	00	00	00	00	00

Master ← **Slave (PM-213x)**

User can write the meter parameter into the PM-213x as above command, and the PM-213x will response 0x1030EEEE to present fiendishly to master ◦

Read Meter Parameter Mode(0x1C30FFFF)(Remote mode)

User can use the COBID 0x1C30FFFF remote mode to read the meter parameter from PM-213x ◦

For example, if the node id of PM-213x is 0x30, the commands are as below:

29-bit COB-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func Code	Add-ID	Value ID			0	1	2	3	4	5	6	7	
28~24	23 ~16	15 ~ 0	1	0	00	00	00	00	00	00	00	00	00
0x1C	0x30	0xFFFF											

Master → **Slave (PM-213x)**

29-bit COB-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func Code	Add-ID	Value ID			0	1	2	3	4	5	6	7	
28~24	23 ~16	15 ~ 0	0	6	F4	01	64	00	01	00	00	00	00
0x1C	0x30	0xEEEE											

Master ← **Slave (PM-213x)**

User can read the meter parameter for the PM-213x as above command, and the PM-213x will response the meter parameter information value to master ◦

Meter-Ratio → 0xF4 0x01 = 500.

PT-Ratio → 0x64 0x00 = 100.

CT-Ratio → 0x01 0x00 = 1.

7.5.4 Read Firmware Example

Read Firmware

The user can use the command as below to read the module name and firmware version .

For example, if the Node-ID of PM-213x is 0x01, the command is as below:

29-bit CAN-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7	
28~24	23 ~16	15 ~ 0											
0x1D	0x01	0xFFFF	1	0	NA	NA	NA	NA	NA	NA	NA	NA	NA

Master → **Slave (PM-213x)**

29-bit CAN-ID (bit)			RTR	Data Length	8-byte Data (byte)								
Func. ID	Node-ID	Value ID			D0	D1	D2	D3	D4	D5	D6	D7	
28~24	23 ~16	15 ~ 0											
0x1D	0x01	0xEEEE	0	0	20	00	C0	00	00	01	NA	NA	

Master ← **Slave (PM-213x)**

Appendix 1 : Question and Answer

Q1. Can we use the other 5A CT's(like 300/5..) to directly connect to the input current terminals of PM-213x series ?

A : No, because the input current is only mA size on PM-213x series , **definitely not to directly use** other 5A CT's to connect and apply (like100/5...) , It could causes the fetal damages. Users can use the PM-213x 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?

A : 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, the fetal damages maybe happened.

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?

A : 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?

A : Please do not mix use , because each set of smart meter(PM213x 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?

A : (1) first check the current input end – line terminal, (check the connection should be **1S** 、 **1L** 、 **2S** 、 **2L** 、 **3S** 、 **3L** 、 **4S** 、 **4L**) , 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. If power factor (P.F) reading below 0.8 or even negative?

A : Confirm the split type clip-on CT measure current phase order (R 、 S 、 T) is same as voltage order (A 、 B 、 C 、 N) , please refer to User Guide -Chapter I V.

Q7. PC and meter can not make the communication ?

A : (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 RS485 connect line terminal + 、 - , does it connect correct ?

Q8. What the power cable diameter(mm) of the monitoring equipments should be for the various CT's?

A : Power cable diameter < $\Phi 10$ use 60A CT , $\Phi 10 \sim \Phi 16$ use 100A CT , $\Phi 16 \sim \Phi 24$ use 200A CT .

Q9. Regarding to the split type clip-on CT's, if the wire is not long enough?

A : (1) $\Phi 10$ split type CT , the standard length is 1.8M. For special length, please contact ICP DAS.
(2) $\Phi 16$ and $\Phi 24$ split type CT , the standard length is 2M. For special length, please contact ICP DAS.

Q10. How to measure the equipments with current large than 200A?

A : For larger current measurement requirement, please choose ICP DAS's other series power meter: PM-3310 with bigger CT (400A , 1000A ...)

Appendix 2 : PVC wire and Product 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	$\Phi 10$ (PM-2133-100) or (PM-2134-100)	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			$\Phi 16$ (PM-2133-160)	16mm/100A
	38	7/2.6	11.5	100				
	50	19/1.8	13.0	120	$\Phi 24$ (PM-2133-240)	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 >