

PM-213x

Compact Power Meter

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User's Manual



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Chapter 1 Introduction

1.1. PM-213x 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 Smart 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 smart power meters for power monitoring. The products offer a rich feature set combined with easy-to-integrate communications.

Features :

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

1.3. 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

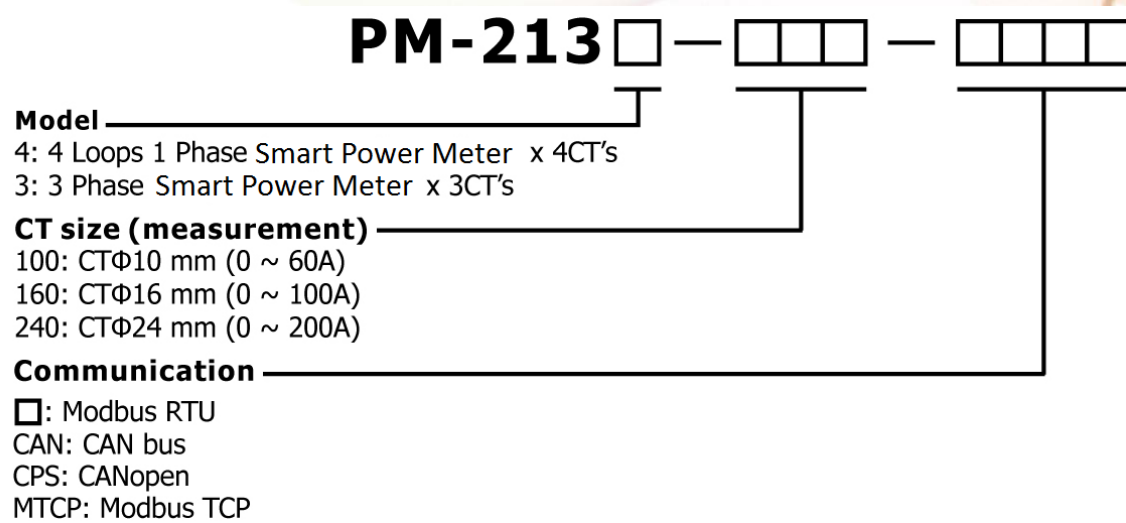
This warranty does not apply to defects resulting from unauthorized modification, misuse, or use for reason other than electrical power monitoring. The supplied meter is not a user-serviceable product.

Chapter 2 Specifications

2.1 Specifications

Model	PM-2134	PM-2133
Input Voltage	10V~300V	10V~500V
Input Current	CT : $\Phi 10$ (60A) 、 $\Phi 16$ (100A) 、 $\Phi 24$ (200A)	
Aux Power	DC +10 ~ +30V	
Starting Current	0.025A	
Frequency	60/50 Hz	
Wiring diagram	1-phase 4-channel	Auto or manual setting 1 Φ 2W-1CT 、 1 Φ 3W-2CT 、 3 Φ 3W-2CT 、 3 Φ 3W-3CT 、 3 Φ 4W
Measurement Parameters	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	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	Modbus-RTU	RS-485, half duplex isolated Baud rate: 9600 、 19200(Default) 、 38400
	Modbus-TCP	Ethernet, 10/100Mbps
	CAN bus	Baud rate: 125K(Default) 、 250K 、 500K
W Accuracy	< 1% (PF=1)	
Dimension	78(L) x 35(W) x 99(H) mm	
Operating Temperature	-10°C ~70 °C	
Power consumption	2.4W	

2.2 Naming Rules



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

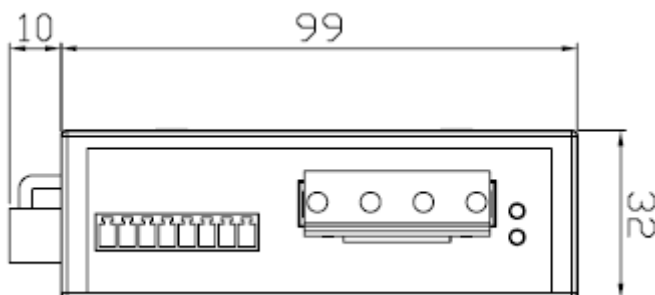


Please use the soft dry clothes to clean the instrument.

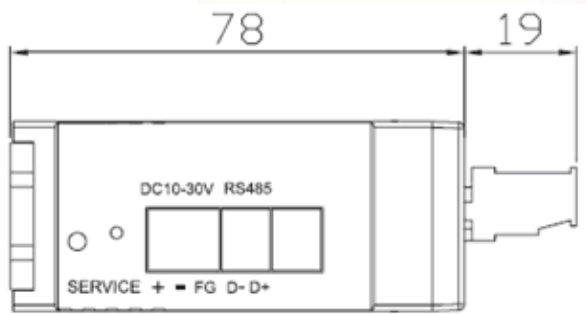
Please do not use any chemical or detergent or volatile solvents to clean the instrument, in order to avoid any possibility of the cover damage.

3.2.1 Dimension and Latch

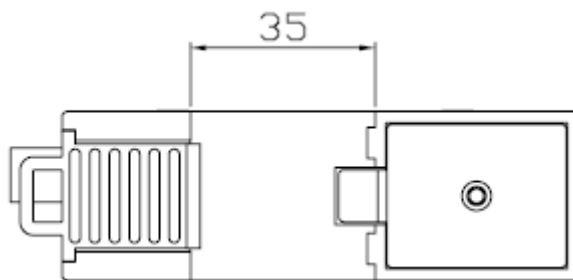
- Top View (mm)



- Side View (mm)



- Position of latch

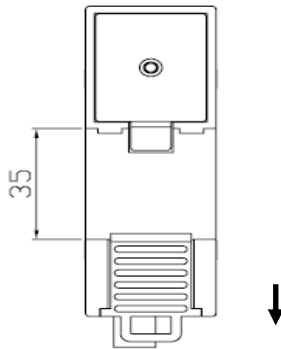


- Dimension: 99mm (length) × 32mm (wide) × 78mm (high)
- Products come with external split type clip-on CT's. Disconnect the CT's or use other CT's is highly prohibited.
- Please read this operation manual carefully before using.
- Please re-confirm the measure position.
- Reconfirm the RST(ABC) phase sequence of the power system.
- 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.

3.2.2 Mounting and Dismounting

- Mounting

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



- Wire Disconnection

1. Open the CT clip to detach the CT, do not remove the CT terminal lines if possible

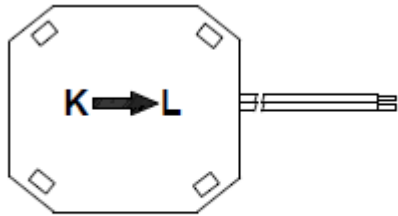
Note: if you need to remove the terminal lines, always detach the CT before removing the CT terminal lines. Otherwise the CT may develop open-circuit secondary voltages which may be hazardous to personnel or damaging to the CT or equipment connected in the secondary circuit.

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.

- Dismount

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

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.



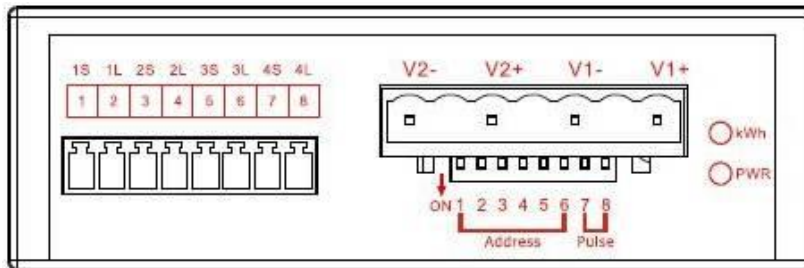
- Installation steps finished.

Chapter 4 Wiring Diagrams

4.1 Connection

- PM-2134

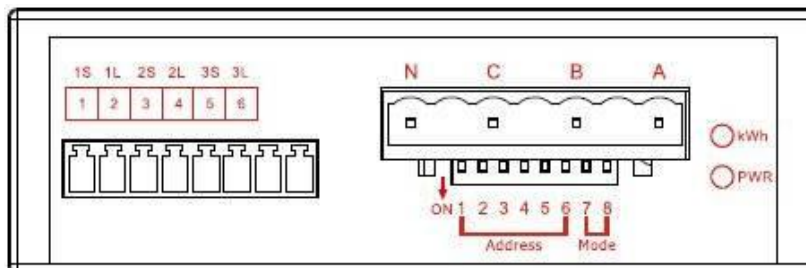
Please firstly check the current input terminal, and then in the white black, white black, white black, white black wired sequences (1S 1L 2S 2L 3S 3L 4S 4L). Then connect the CT's, and close the CT clip. Make sure the arrow direction sign on CT's follows current flow direction (K→L) **Note: it must 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). Then connect the CT's, and close the CT clip. 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 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 N C A phase sequence, do not connect phase B (Check the diagram).



- Voltage Input
 1. 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.
 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 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)
 3. 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.
 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 , $\Phi 10 \sim \Phi 16$ use 100A CT , $\Phi 16 \sim \Phi 24$ use 200A CT .
 9. The maximum current value can not exceed the CT rating.
 10. For the consideration of accuracy, 3CT solution is highly recommended for the use in 3P3W compared with 2CT solution.

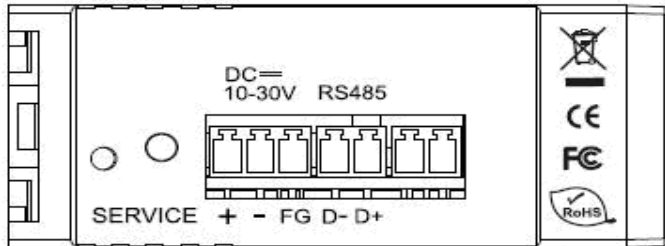
4.2 Communication Interface

- PM-213X (RS-485, Modbus-RTU)

Connect RS-485 D+, D-

("-", "+" sequence base on the top cover mark showed)

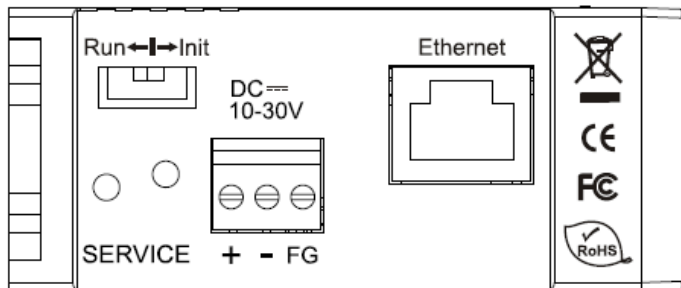
And then, add the auxiliary power ◦ DC+10~+30V (+ - FG)



- PM-213X-MTCP (Ethernet, Modbus-TCP)

Connect Ethernet (RJ-45)

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

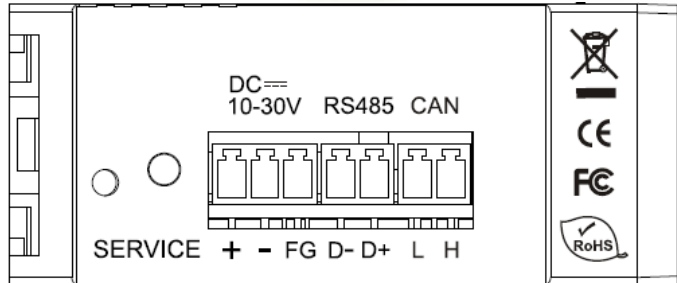


- PM-213X-CAN (CAN bus, CANopen)

Connect CAN_H, CAN_L

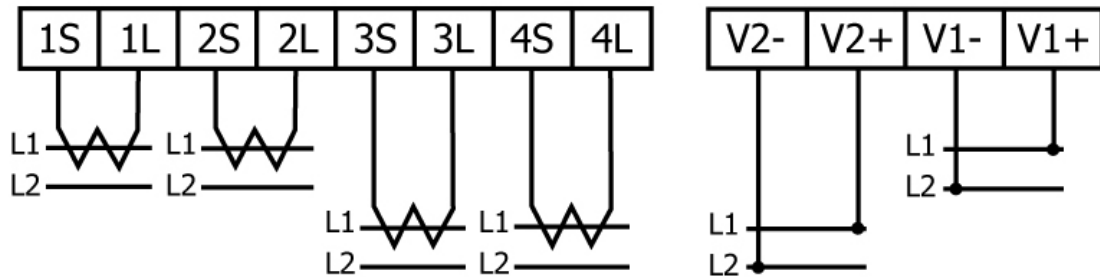
("H", "L" sequence base on the top cover mark showed)

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

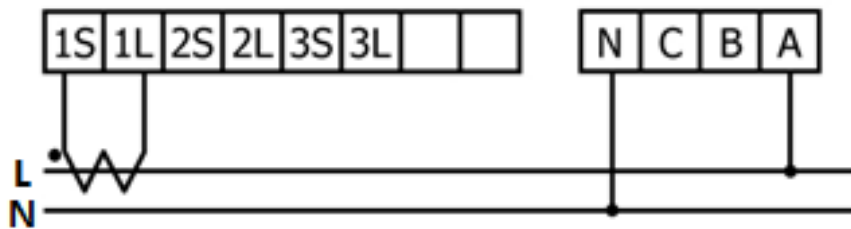


4.3 Wiring

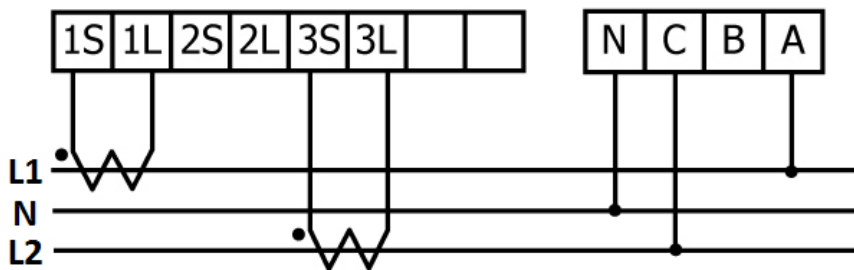
- 1P4W(PM-2134)



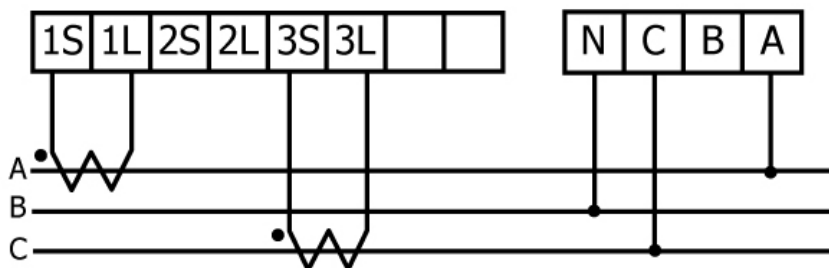
- 1P2W-1CT(PM-2133)



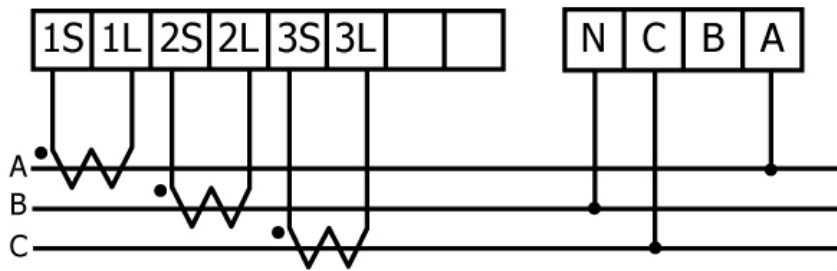
- 1P3W-2CT(PM-2133)



- 3P3W-2CT(PM-2133)



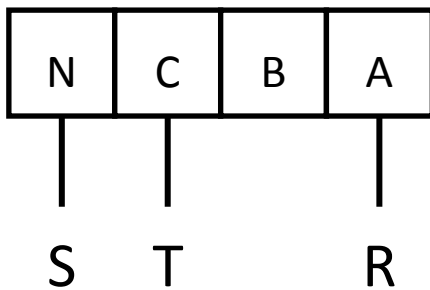
● 3P3W-3CT(PM-2133)



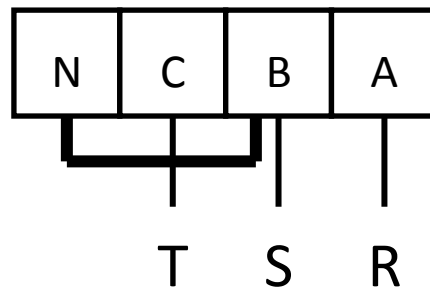
Caution!

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

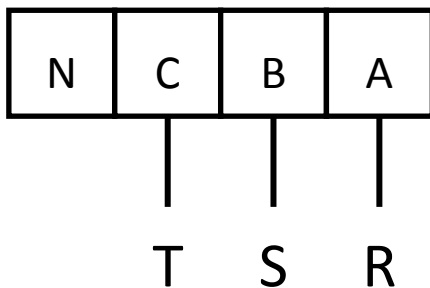
Correct :



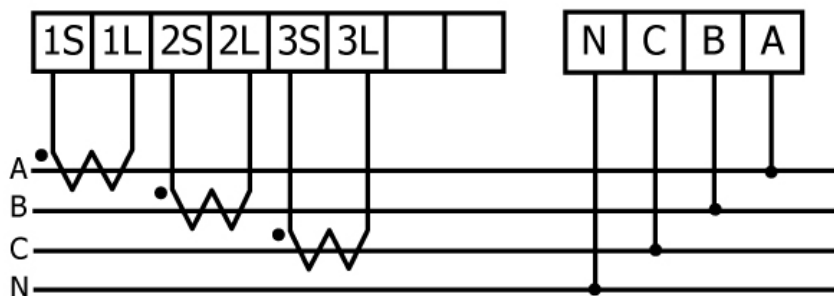
Correct :



Wrong :

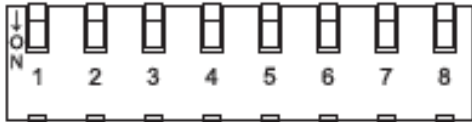


● 3P4W-3CT(PM-2133)



Chapter 5 Modbus-RTU communication

5.1 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

5.1.1 SW1 – SW6 setting

Setting Modbus-RTU address for communication (1-64)

Modbus Address	SW 1	SW 2	SW 3	SW 4	SW 5	SW 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

5.1.2 SW7 – SW8 setting

PM-2134 : Select Wh pulse output

Wh pulse output	SW 7	SW 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)

Wiring	SW 7	SW 8
Auto	OFF	OFF
3P3W and 2CT	ON	OFF
3P3W and 3CT	OFF	ON
3P4W	ON	ON

5.2 Modbus-RTU setting

5.2.1 Specifications

Protocol	Modbus-RTU
Transmission Specifications	Bits per Byte : 1 start bit 8 data bits, least significant bit sent first 1 or 2 stop bits (Default =1 stop bit) 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

Data format

- 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 transmission

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 (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

5.2.2 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	100	0.01	
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	0~99999999.9
kvarh_a	34622- 34623	0x120D-0x120E	DWord	Int32	0~ 99999999	0.1kvarh	0~99999999.9
kVAh_a	34624- 34625	0x120F-0x1210	DWord	Int32	0~ 99999999	0.1kVAh	0~99999999.9
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	0~99999999.9
kvarh_b	34639- 34640	0x121E-0x121F	DWord	Int32	0~ 99999999	0.1kvarh	0~99999999.9
kVAh_b	34641- 34642	0x1220-0x1221	DWord	Int32	0~ 99999999	0.1kVAh	0~99999999.9

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 6 Modbus-TCP Communication

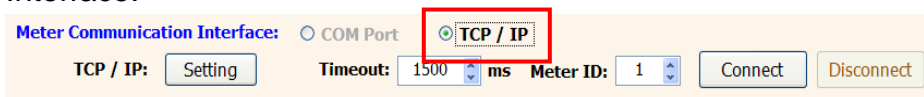
6.1 Default settings

Ethernet default settings :

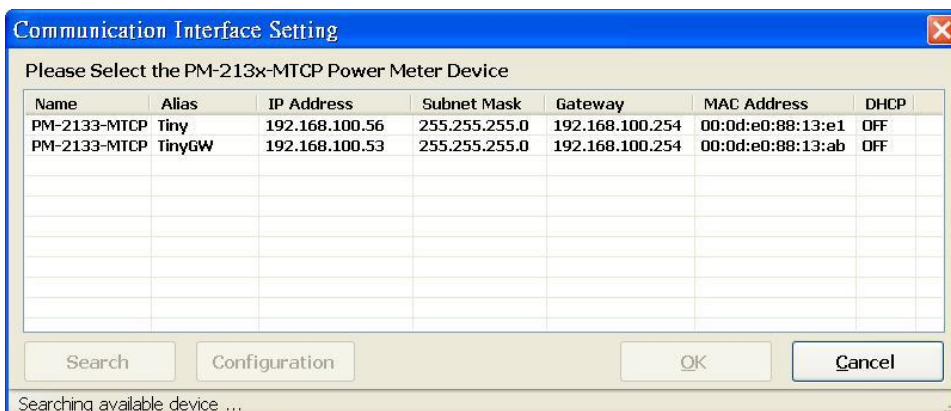
IP Address	192.168.255.1
Subnet mask	255.255.0.0
Gateway	192.168.0.1

6.1.1 Ethernet configurations

In the Power Meter Utility , please select “TCP/IP” in the Meter Communication Interface.



Click “Setting” to enter the “Communication Interface Setting” window, click ”Search” button to search the available power meter.



Select the power meter which you want to modify parameters from the meter list, then click "Configuration" button to setup the meter parameters. After complete all setting, click "OK", and return to the meter list windows.

Communication Interface Setting

Please Select the PM-213x-MTCP Power Meter Device

Name	Alias	IP Address	Subnet Mask	Gateway	MAC Address	DHCP
PM-2133-MTCP	Tiny	192.168.100.56	255.255.255.0	192.168.100.254	00:0d:e0:88:13:e1	OFF
PM-2133-MTCP	TinyGW	192.168.100.53	255.255.255.0	192.168.100.254	00:0d:e0:88:13:ab	OFF

Search Configuration OK Cancel

Configure PM-213x-MTCP Device

Device Name: PM-2133-MTCP

DHCP State: OFF

IP Address: 192.168.100.56

Subnet Mask: 255.255.255.0

Gateway: 192.168.100.254

Alias: Tiny (9 Chars)

MAC Address: 00:0d:e0:88:13:e1

Warning!!
Contact your Network Administrator to get correct configuration before any changing!

OK Cancel

6.2 Specifications

Modbus-TCP structure

Byte 00~05	Byte 06~11
6-byte header	RTU Data

Modbus-TCP(Byte 00~05)

Byte 00	Byte 01	Byte 02	Byte 03	Byte 04	Byte 05
Transaction identifier		Protocol identifier		Data length upper byte	Data length lower byte

Transaction identifier = Assign by Modbus/TCP Master (Client)

Protocol identifier = 0

Data length (upper byte) = 0

Data length (lower byte) = Depend on the number of the RTU Data bytes

RTU Data structure

Byte 06	Byte 07	Byte 08-09	Byte 10-11
Net ID (Station number)	Function Code	Data as needed	
		Address Mapping	data

Net ID (Station number) : Assign the device (Modbus/TCP slave) ◦

6.2.1 Modbus Register

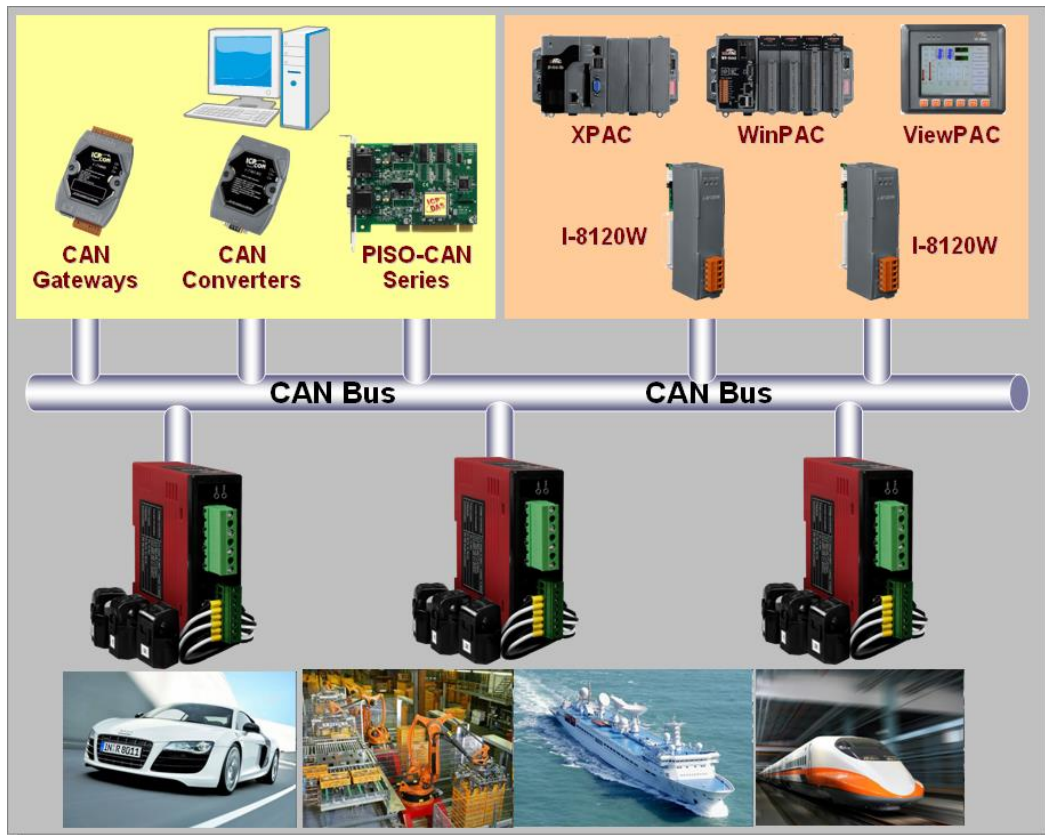
Please refer the 5.2.2 Modbus Register ◦

Chapter 7 CAN bus communication

7.1 Overview

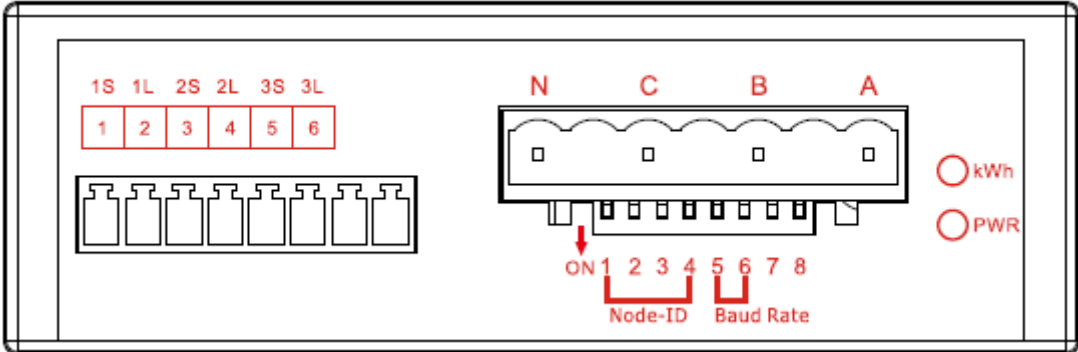
The Controller Area Network (CAN) is a serial communication way, which efficiently supports distributed real-time control with a very high level of security. It provides the error process mechanisms and message priority concepts. These features can improve the network reliability and transmission efficiency. 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 PM-213x-CAN series power meter built-in the CAN bus interface. Therefore, users can easily apply in any CAN applications via the power meter.

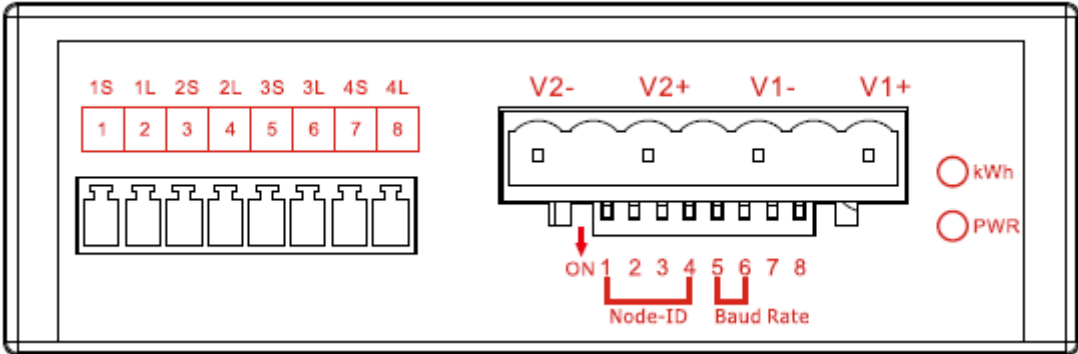


Application Structure

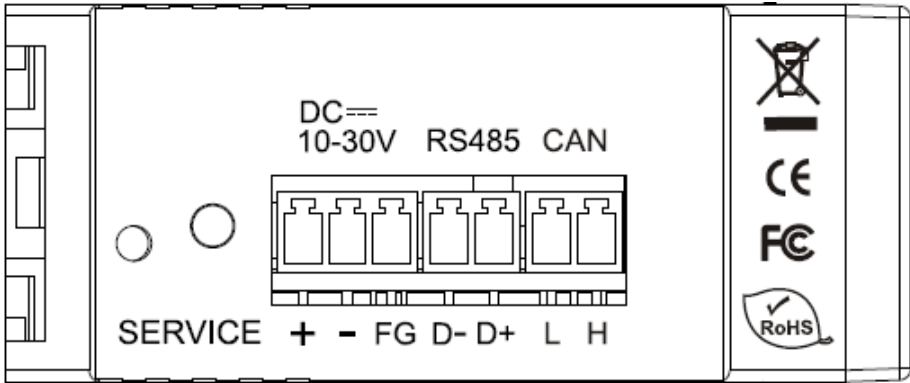
7.2 Hardware structure



PM-2133 Top view



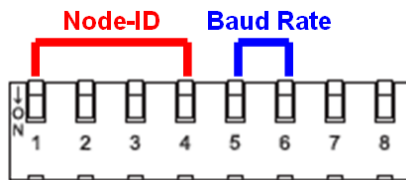
PM-2134 Top view



PM-2133、PM-2134 Side view

7.3 DIP Switch of PM-213x-CAN

7.3.1 The Node-ID of CAN bus



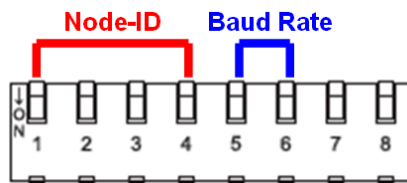
There are hardware Node-ID and software Node-ID in the PM-213x-CAN. The hardware Node-ID can be represented by DIP-Switch binary value with the first 4 pins. The relationship between the Node-ID and the DIP-Switch status is shown below.

Node-ID and DIP-Switch 1 ~ 4

Address	1	2	3	4
0	OFF	OFF	OFF	OFF
1	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
Software Node-ID	ON	ON	ON	ON

When those 4 pins DIP-Switch are all (ON), the actual Node-ID is the software Node-ID which value has been saved in the module. The software Node-ID can be represent from 0 to 255(0xFF) and the default value is 255.

7.3.2 The Baud Rate of CAN bus



The DIP switch from pin 5 to pin 6 represents the CAN bus baud rate of the PM-213x-CAN. The mapping table is shown as below. The default baud rate value is 125K, and the corresponding DIP switch value from pin 5 to pin 6 is (OFF) (OFF).

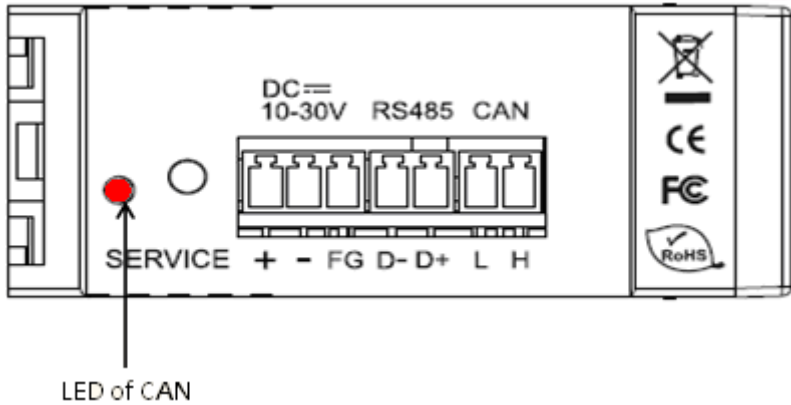
CAN bus baud rate and DIP switch 5 ~ 6

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

The “Initial Mode” is used to change the software Node-ID. At that moment, the meter could accept the command of changing software Node-ID by CAN bus with 500 kbps. The users cannot read other power meter data in the “Initial Mode”. Please change the correct baud rate to make the power meter into the “Normal Mode”.

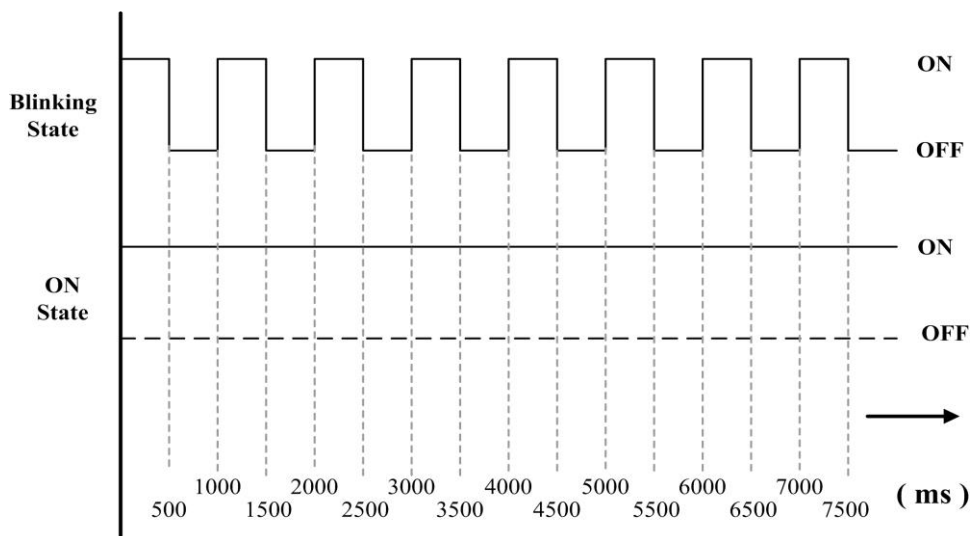
7.3.3 The LED State of CAN bus

“LED of CAN” is an indicator LED of CAN bus in the PM-213x-CAN. It shows whether the CAN communication is normal or incorrect. The following figure shows the LED.



LED state	Description
Blinking state	The PM-213x-CAN communication is normal.
ON state	The PM-213x-CAN communication is error. The LED will be ON when the 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 ~ 255.

Baud Rate : 125K, 250K 500K bps

Support "Polling Mode" and "Auto Response Mode"

Integer (2-bytes)

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

DWORD (4-bytes)

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

CAN-ID Definition (29-bits)

28 ....24	23 .....16	15 0
Function-ID(5-bits)	Address(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
11110 (0x1E)	Set Software Node-ID

Node-ID Field Description

Node-ID (8-bits)	Description
0x00 ~ 0xFF (0 ~ 255)	Node-ID of PM-213x-CAN (0 ~ 255)

Value-ID Field Description**(Please refer to the section 7.4.6)**

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 the section 7.4.6

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
0x18	0x##	0x#####	1	0	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
0x00	0x##	0x#####	0	8/4	##	##	##	##	##	##	##	##

7.4.3 Auto Response Mode

7.4.3.1 Parameters Setting

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
0x10	0x##	0xFFFF	0	8	##	##	##	##	##	##	##	##

The CAN data value format definition

D0	D1	D2	D3	D4	D5	D6	D7
Enable	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 the section 7.4.6. 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
0x10	0x##	0xEEEE	1	0	NA							

7.4.3.2 Parameters Reading

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
0x10	0x##	0xFFFF	1	0	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
0x10	0x##	0xEEEE	0	8/4	##	##	##	##	##	##	##	##

The D0 ~ D7 format is same as the “Parameters Setting” in section 7.4.3.1.

7.4.4 Software Node-ID Setting

The user can use this command to set the software Node-ID of the PM-213x-CAN. The PM-213x-CAN uses the software Node-ID when the DIP-Switch from digital 1. to digital 4. are all ON. Please refer to CH. 2.1.

Before setting new software Node-ID, there are three important steps.

1. Change the DIP-Switch digital 5 and 6 to ON state.
2. Change the user's CAN bus baud rate to 500 kbps.
3. Reset the PM-213x-CAN. The users would see the LED blinking quickly. It is in the "Init Mode" at the moment.

When the PM-213x-CAN is in the "Init Mode", the users can use this command to change the software Node-ID.

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
0x1E	Curr. ID	0xFFFF	0	1	ID	NA						

The "Curr. ID" means the current Node-ID of the PM-213x-CAN.

The "ID" in the "D0" field means the new software Node-ID of the PM-213x-CAN.

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
0x00	New ID	0xEEEE	1	0	NA							

The "New ID" means the new software Node-ID have been changed.

7.4.5 Firmware Version Reading

The user can use this command to acquisition the firmware version of the PM-213x-CAN.

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
0x1D	0x##	0xFFFF	1	0	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
0x1D	0x##	0xEEEE	0	6	##	##	##	##	##	##	NA	NA

The CAN data value format definition

D0	D1	D2	D3	D4	D5	D6	D7
Part No.	Part No.	Part No.	Part No.	Version MMSB	Version LMSB	NA	NA

For example:

D0	D1	D2	D3	D4	D5	D6	D7
20	00	C0	00	00	02	NA	NA

The D0 to D3 is the part number. D4 and D5 is the firmware version.

D0	D1	D2	D3	D4	D5	D6	D7
20	00	C0	00	00	02		

Part No.

Firmware Version
 00,02 → Ver 2.0

7.4.6 Value-ID vs. Power Meter Data Table

The Value-ID and power meter data table is shown as below.

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	

7.5 How-To and Examples

7.5.1 Polling Example

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 Len.	8-byte Data (byte)							
Func. ID	Add-ID	ValueID			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

Master → Slave (PM-213x)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Add-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 Auto Response Parameters Setting Example

The 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 Len.	8-byte Data (byte)							
Func. ID	Add-ID	ValueID			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

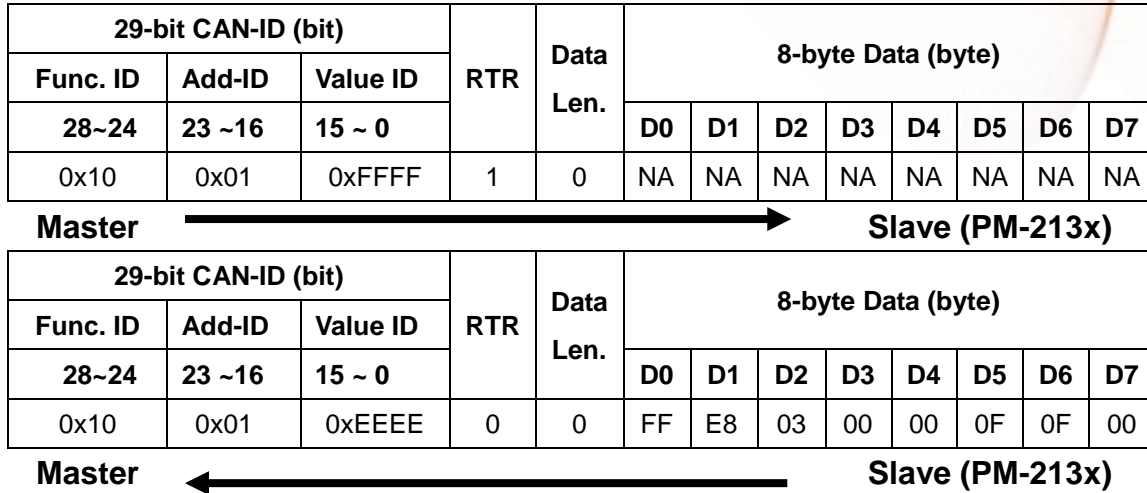
Master → Slave (PM-213x)

29-bit CAN-ID (bit)			RTR	Data Len.	8-byte Data (byte)							
Func. ID	Add-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 Auto Response Parameters Reading Example

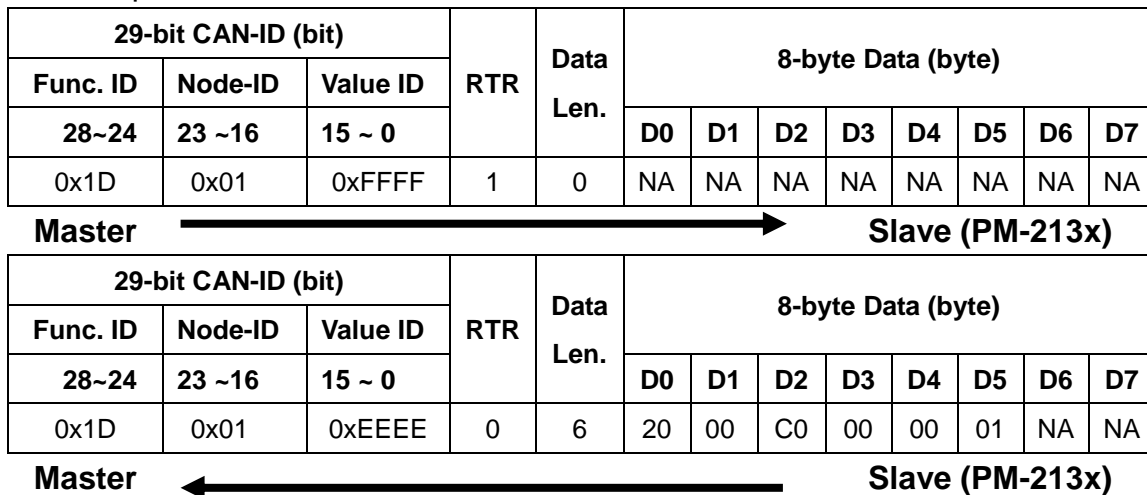
The user can use the command as below to read the current setting of auto response. For example, if the Node-ID of PM-213x is 0x01, the command is as below:



7.5.4 Version Reading Example

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:

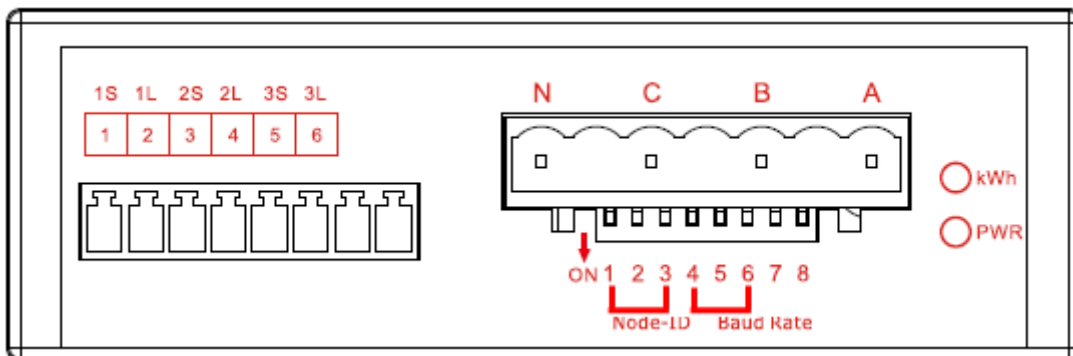


Chapter 8 CANopen communication

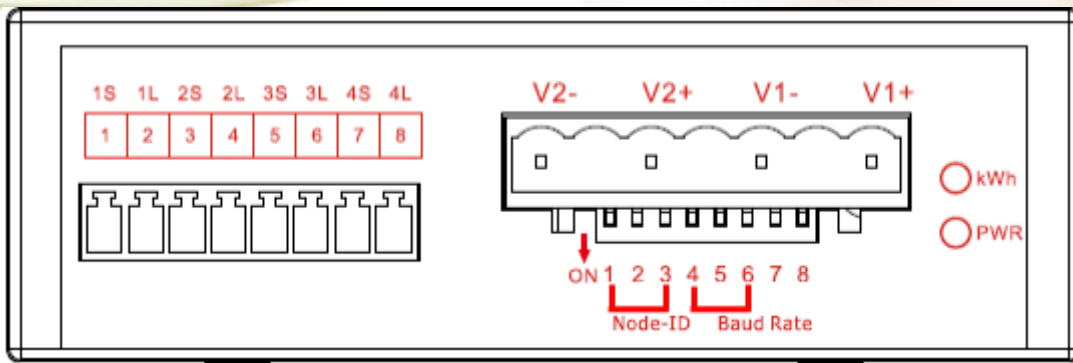
8.1 Overview

CANopen, a kind of communication protocols, is an intelligent field bus (CAN bus). It has been developed as a standard embedded network with a high flexible configuration. It provides a standard communication protocol transmitting real-time data in PDO (**P**rocess **D**ata **O**bjects), configuration data in SDO (**S**ervice **D**ata **O**bjects), and network management data (NMT message, and Error Control), even supports the special functions (Time Stamp, Sync message, and Emergency message). These features can improve the network reliability and transmission efficiency. Nowadays, CANopen is used on many applications and in specific fields, such as medical equipment, off-road vehicles, maritime electronics, public transportation, automation and so on. The PM-213x-CPS power meter is built-in the CANopen interface. Therefore, users can easily apply in any CANopen applications via the power meter.

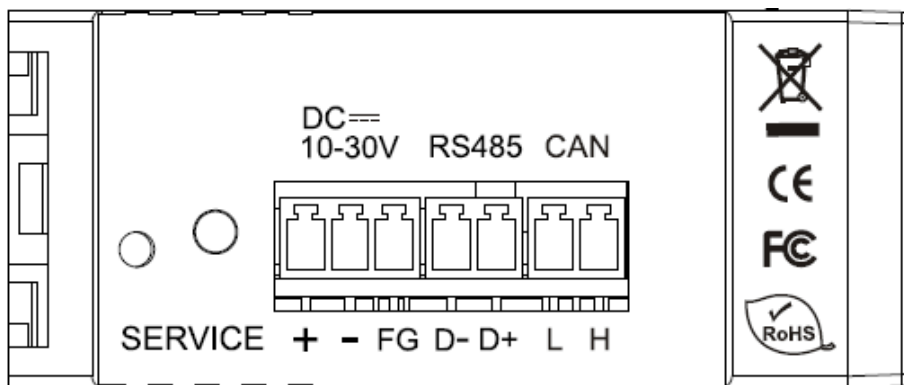
8.2 Hardware Structure



PM-2133 Top view



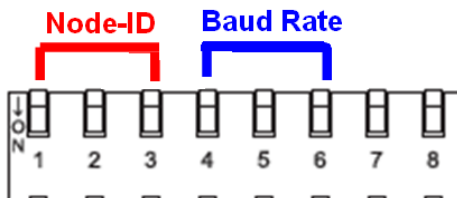
PM-2134 Top view



PM-2133、PM-2134 Side view

8.3 DIP Switch of PM-213x-CPS

8.3.1 The Node-ID of CANopen

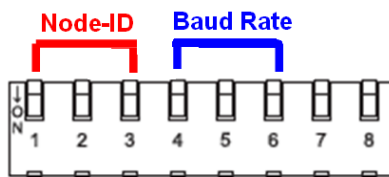


There are hardware Node-ID and software Node-ID in the PM-213x-CPS. The hardware Node-ID can be represented by DIP-Switch binary value with the first 3 pins. The relationship between the Node-ID and the DIP-Switch status is shown below.

Node-ID and Dip-Switch 1 ~ 3 digital.

Node ID	Pin 1	Pin2	Pin 3
Software Node ID	OFF	OFF	OFF
1	ON	OFF	OFF
2	OFF	ON	OFF
3	ON	ON	OFF
4	OFF	OFF	ON
5	ON	OFF	ON
6	OFF	ON	ON
7	ON	ON	ON

When those 3 pins DIP-Switch are all (OFF), the actual Node-ID is the software Node-ID which value has been saved in the module. The software Node-ID can be represent from 8 to 127(0x7F) and the default value is 8. The users can refer to 8.4.4.2 for changing the software Node-ID.

8.3.2 The baud rate of CANopen

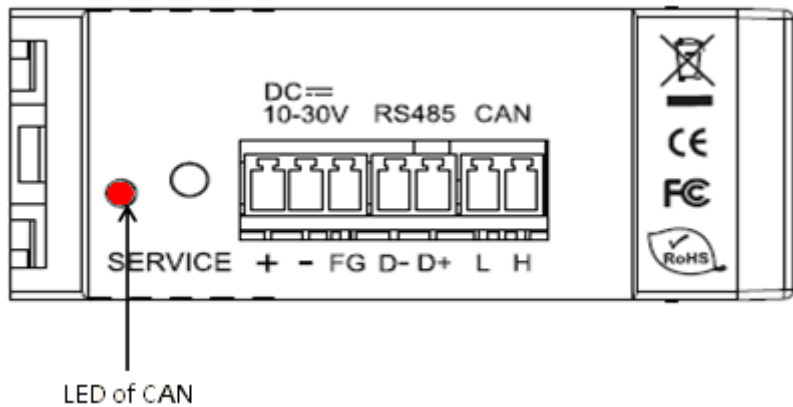
The DIP-Switch from pin 4 to pin 6 represents the CAN bus baud rate of the PM-213x-CPS. The mapping table is shown as Table 2-2. The default baud rate value is 125K, and the corresponding DIP-Switch value from pin 4 to pin 6 is (ON) (ON) (OFF).

CAN baud rate and Dip-Switch 4~ 6.

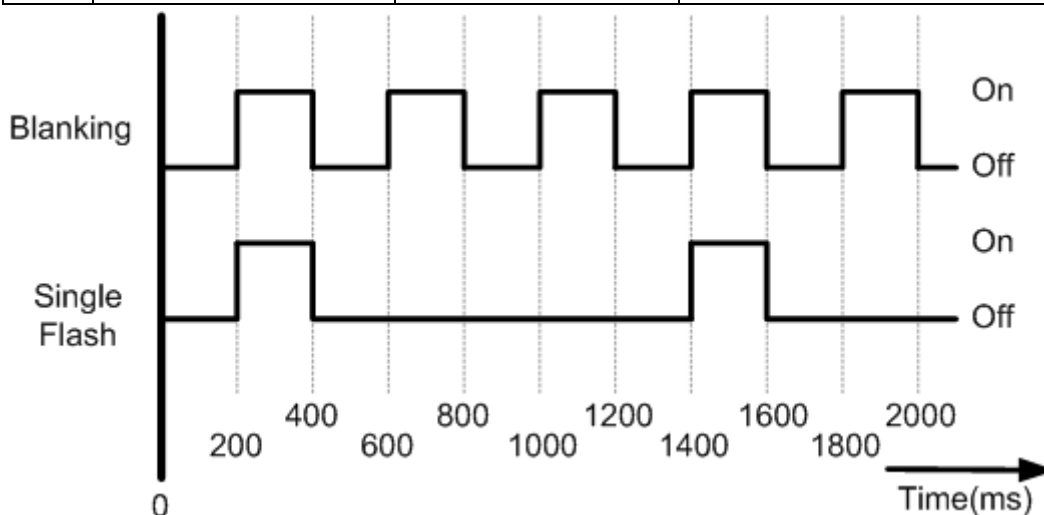
CAN baud-rate	Pin 4	Pin5	Pin 6
10kbps	OFF	OFF	OFF
20kbps	ON	OFF	OFF
50kbps	OFF	ON	OFF
125kbps	ON	ON	OFF
250kbps	OFF	OFF	ON
500kbps	ON	OFF	ON
800kbps	OFF	ON	ON
1000kbps	ON	ON	ON

8.3.3 The LED State

LED of CANopen™ is an indicator LED of CAN bus in the PM-213x-CPS. It shows whether the CAN communication is normal or incorrect. The following figure shows the LED.



No.	Signal	State	Description
1	No Light	Non-operation	Malfunction or Power Supply/Connection not ready
2	Single Flash	Stopped	The device is in Stopped state
3	Blinking	Pre-operation	The device is in the pre-operation state
4	Continuing Light	Operation	The device is in the operational state



8.4 CANopen Protocol

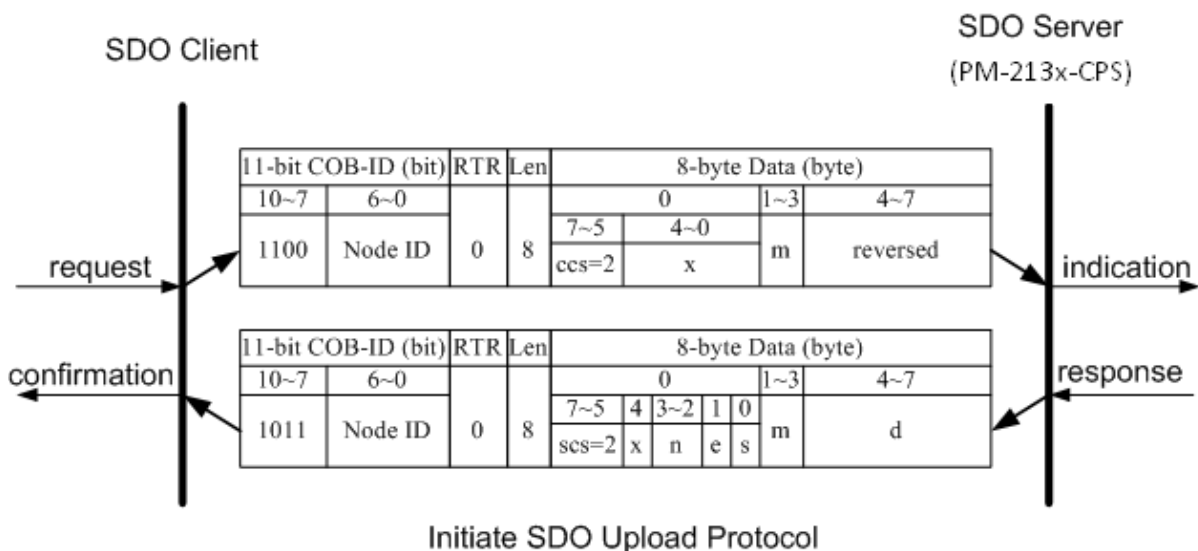
The CANopen is a kind of network protocols evolving from the CAN bus, used on car control system in early days, and has been greatly used in various applications, such as vehicles, industrial machines, building automation, medical devices, maritime applications, restaurant appliances, laboratory equipment & research.

8.4.1 SDO Introduction

8.4.1.1 Upload SDO Protocol

Initiate SDO Upload Protocol

Before transferring the SDO segments, the client and server need to communicate with each other by using the initiate SDO upload protocol. Via the initiate SDO upload protocol, the SDO client will inform the SDO server what object the SDO client wants to request. As well, the initiate SDO upload protocol is permitted to transmit up to four bytes of data. Therefore, if the data length of the object, which the SDO client can read, is equal to or less than the permitted data amount, the SDO communication will be finished only by using the initial SDO upload protocol, i.e. if the data upload is less enough to be transmitted in the initiate SDO upload protocol, then the upload SDO segment protocol will not be used. The communication process of this protocol is shown as follows.



ccs: client command specified

2: initiate upload request

scs: server command specified

2: initiate upload response

n : Only valid if **e** = 1 and **s** = 1, otherwise 0.

If valid, it indicates the number of bytes in **d** that do not contain data. Bytes [8-**n**, 7] do not contain segment data.

e: transfer type

0: normal transfer

1: expedited transfer

If the **e**=1, it means that the data of the object are equal or less than 4 bytes, and only initiate SDO upload protocol is needed. If **e**=0, the upload SDO segment protocol is necessary.

s: size indicator

0: Data set size is not indicated.

1: Data set size is indicated.

m: multiplexer

It represents the index/sub-index of the data to be transfer by the SDO. The first two bytes are the index value and the last byte is the sub-index value.

d: data

e=0, **s**=0: **d** is reserved for further use.

e=0, **s**=1: **d** contains the number of bytes to be uploaded, and byte 4 contains the least significant bit, and byte 7 contains the most significant bit.

e=1, **s**=1: **d** contains the data of length 4-**n** to be uploaded, the encoding depends on the type of the data referenced by index and sub-index.

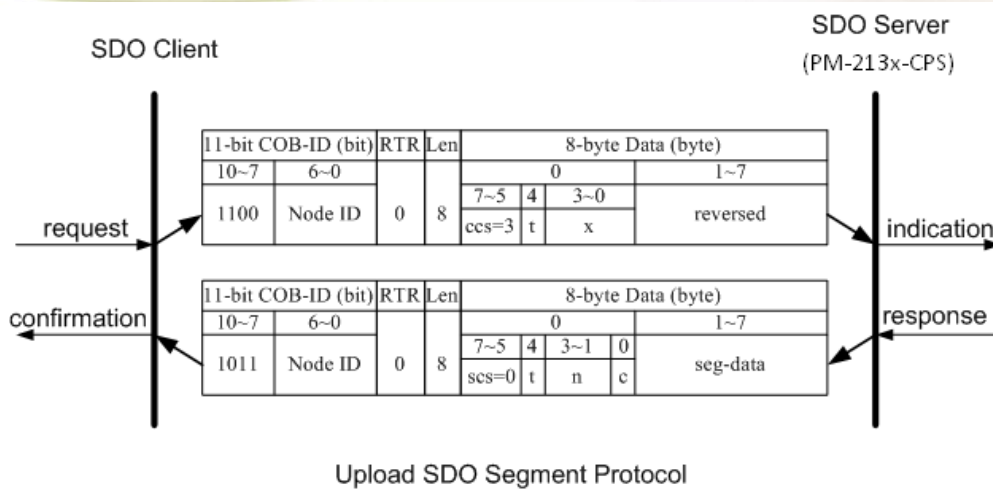
e=1, **s**=0: **d** contains unspecified number of bytes to be uploaded.

x: not used, always 0

reserved: reserved for further use , always 0

Upload SDO Segment Protocol

When the upload data length is over 4 bytes, the upload SDO segment protocol will be needed. After finishing the transmission of the initiate SDO upload protocol, the SDO client will start to upload the data. The upload SDO segment protocol will comply with the process shown below.



Upload SDO Segment Protocol

ccs: client command specified

3: upload segment request

scs: server command specified

0: upload segment response

t: toggle bit.

This bit must alternate for each subsequence segment that is uploaded. The first segment will have the toggle bit set to 0. The toggle bit will be equal for the request and response message.

c : indicates whether there are still more segments to be uploaded

0: more segments to be uploaded .

1: no more segment to be uploaded.

seg-data: It is at most 7 bytes of segment data to be uploaded.

The encoding depends on the type of the data referenced by index and sub-index.

n: It indicates the number of bytes in **seg-data** that do not contain segment data.

Bytes [8-n, 7] do not contain segment data. **n** = 0 if no segment size is indicated.

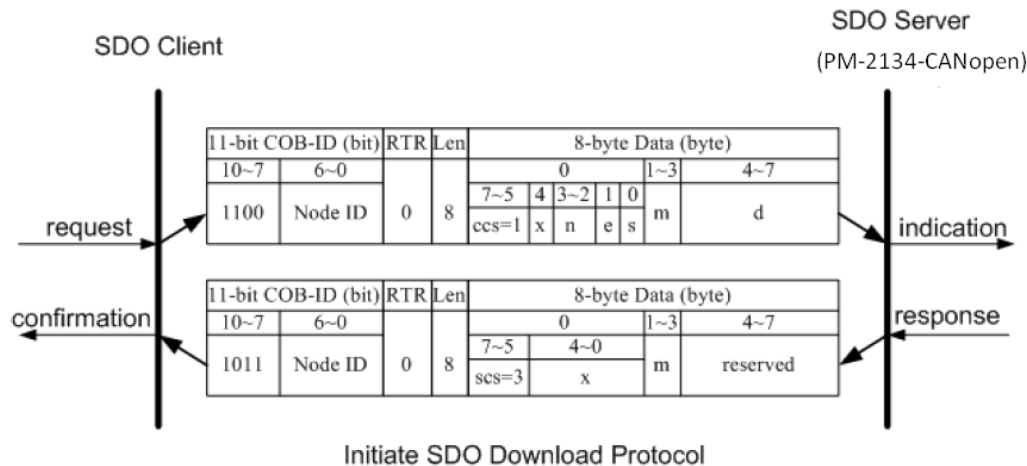
x: not used, always 0

reserved: reserved for further use , always 0

8.4.1.2 Download SDO Protocol

Initiate SDO Download Protocol

The download modes are similar to the upload modes, but different in some parameters of the SDO messages. They are also separated into two steps. If the download data length is less than 4 bytes, the download action will finish in the download initialization protocol. Otherwise, the download segment protocol will be needed. These two protocols are shown below.



ccs: client command specified

1: initiate download request

scs: server command specified

3: initiate download response

n: Only valid if e = 1 and s = 1, otherwise 0.

If valid, it indicates the number of bytes in d that do not contain data. Bytes [8-n, 7] do not contain segment data.

e: transfer type

0: normal transfer

1: expedited transfer

If the e=1, it means that the data of the object are equal or less than 4 bytes, and only initiate SDO download protocol is needed. If e=0, the download SDO segment protocol is necessary.

s: size indicator

0: Data set size is not indicated.

1: Data set size is indicated.

m: multiplexer

It represents the index/sub-index of the data to be transfer by the SDO. The first two bytes are the index value and the last byte is the sub-index value.

d: data

e=0, s=0: d is reserved for further use.

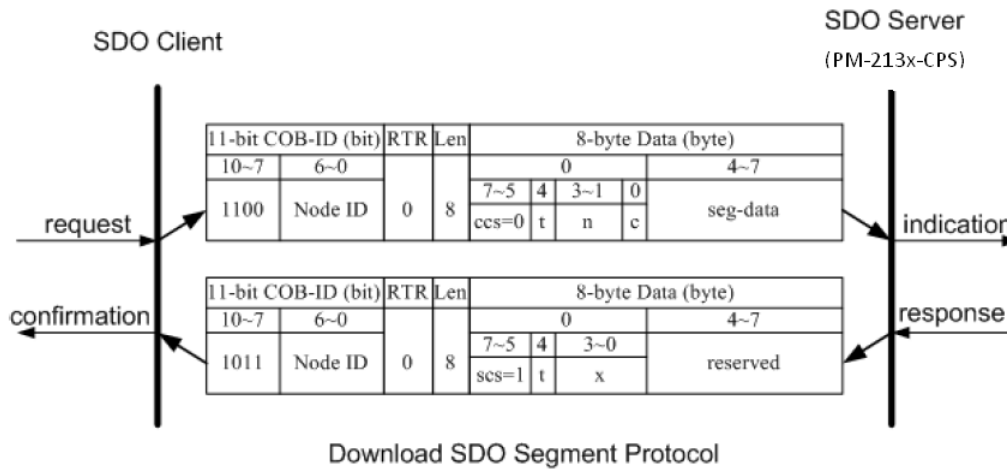
e=0, s=1: d contains the number of bytes to be downloaded, and byte 4 contains the least significant bit, and byte 7 contains the most significant bit.

e=1, s=1: d contains the data of length 4-n to be downloaded, the encoding depends on the type of the data referenced by index and sub-index.

e=1, s=0: d contains unspecified number of bytes to be downloaded.

x: not used, always 0
reserved: reserved for further use , always 0

Download Segment Protocol



ccs: client command specified

0: download segment request

scs: server command specified

1: download segment response

seg-data: It is at most 7 bytes of segment data to be downloaded.

The encoding depends on the type of the data referenced by index and sub-index.

n: It indicates the number of bytes in seg-data that do not contain segment data.

Bytes [8-n, 7] do not contain segment data. n = 0 if no segment size is indicated.

c: It indicates whether there are still more segments to be downloaded.

0:more segments to be downloaded.

1:no more segments to be downloaded.

t: toggle bit

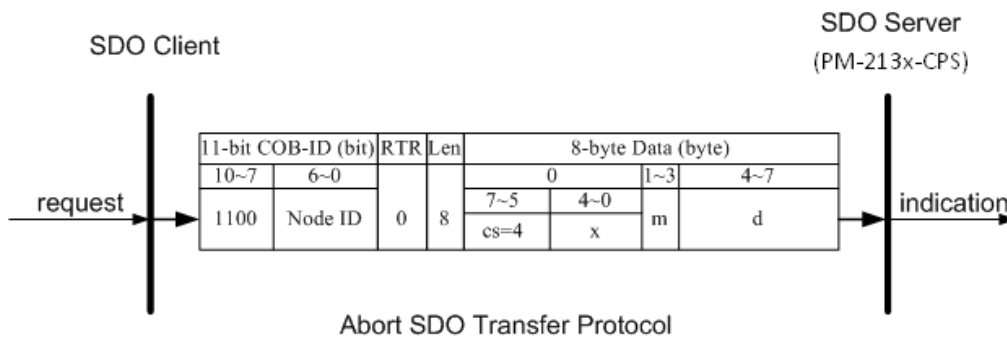
This bit must alternate for each subsequent segment that is downloaded. The first segment will have the toggle-bit set to 0.The toggle bit will be equal for the request and the response message.

x: not used, always 0

reserved: reserved for further use , always 0

8.4.1.3 Abort SDO Transfer Protocol

In some conditions, the SDO client or SDO server will terminate the SDO transmission. For example, the value of entries that users want to modify does not exist or is read-only, even users wouldn't continue the uncompleted SDO protocol under some special situations. When these conditions occur, both the client and the server can be activated to send the Abort SDO Transfer message. The Abort SDO Transfer protocol is shown below.



- cs:** command specified
4: abort transfer request
- x:** not used, always 0
- m:** multiplexer
It represents index and sub-index of the SDO
- d:** contains a 4-byte "Abort Code" about the reason for the abort.

Abort Code	Description
0503 0000h	Toggle bit not alternated.
0504 0000h	SDO protocol timed out.
0504 0001h	Client/server command specified not valid or unknown.

0504 0002h	Invalid block size (block mode only).
0504 0003h	Invalid sequence number (block mode only).
0504 0004h	CRC error (block mode only).
0504 0005h	Out of memory.
0601 0000h	Unsupported access to an object.
0601 0001h	Attempt to read a write only object.
0601 0002h	Attempt to write a read only object.
0602 0000h	Object does not exist in the object dictionary.
0604 0041h	Object cannot be mapped to the PDO.
0604 0042h	The number and length of the objects to be mapped would exceed PDO length.
0604 0043h	General parameter incompatibility reason.
0604 0047h	General internal incompatibility in the device.
0606 0000h	Access failed due to an hardware error.
0607 0010h	Data type does not match, length of service parameter does not match
0607 0012h	Data type does not match, length of service parameter too high
0607 0013h	Data type does not match, length of service parameter too low
0609 0011h	Sub-index does not exist.
0609 0030h	Value range of parameter exceeded (only for write access).
0609 0031h	Value of parameter written too high.
0609 0032h	Value of parameter written too low.
0609 0036h	Maximum value is less than minimum value.
0800 0000h	General error.
0800 0020h	Data cannot be transferred or stored to the application.
0800 0021h	Data cannot be transferred or stored to the application because of local control.
0800 0022h	Data cannot be transferred or stored to the application because of the present device state.
0800 0023h	Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of an file error).

8.4.2 PDO Introduction

8.4.2.1 PDO COB-ID Parameters

Before the real-time data are transmitted by the PDO, it is necessary to check the COB-ID parameter of this PDO in the PDO communication objects. This parameter setting controls the COB-ID of the PDO communication, which is in 32 bits, and each bit with its meaning is given in the table follow.

Bit Number	Value	Meaning
31(MSB)	0	PDO exists (PDO is valid)
	1	PDO does not exist (PDO is not valid)
30	0	RTR allowed on this PDO
	1	No RTR allowed on this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28-11	0	If bit 29=0
	X	If bit 29=1: 28-11 bits of 29-bit COB-ID
10-0(LSB)	X	10-0 bits of COB-ID

Note: PM-213x-CPS supports CAN 2.0A only.

In the following table, it's regarding the default PDO COB-ID parameters.

Number of PDO	Default COB-ID	
	Bit10~Bit7 (Function Code)	Bit6~Bit0
TxPDO1	0011	Node-ID
TxPDO2	0101	Node-ID
TxPDO3	0111	Node-ID
TxPDO4	1001	Node-ID
RxPDO1	0100	Node-ID
RxPDO2	0110	Node-ID
RxPDO3	1000	Node-ID
RxPDO4	1010	Node-ID

Note:

1. Users can also define the PDO COB-ID by themselves. Actually, all COB-ID can be defined by users except the reserved COB-ID described in the table of the section 3.1. It is important to avoid the conflict with the defined COB-ID used in the same node.
2. The PDO COB-ID parameters cannot be changed if the PDO is valid (bit 31 =0).

8.4.2.2 Transmission Type

The transmission type is one of the several parameters defined in PDO communication objects with sub-index 02. Each PDO has its own transmission type. The transmission type can indicate the transmission or reception character for its corresponding PDO. The following table describes the relationship between the value of the transmission type and the PDO character. For example, if users used transmission type 0 for the first TxPDO, the CANopen device will follow the rule of the acyclic and synchronous PDO transmission.

Transmission Type	PDO Transmission Method				
	cyclic	acyclic	synchronous	Asynchronous	RTR only
0		○	○		
1-240	○		○		
241-251	-----Reserved-----				
252			○		○
253				○	○
254				○	
255				○	

Note:

- The transmission type 1-240 indicates how many SYNC objects the TxPDO will be triggered. The RxPDO is always triggered by the following SYNC upon reception of data independent of the transmission types 0-240.
- The transmission type 252 and 253 are only used for TxPDO. The transmission type 252 means that the data is updated (but not sent) immediately after reception of the SYNC object. For these two transmission types, the PDO is only transmitted on remote transmission requests.
- For the transmission types 254 and 255, the event timer will be used in the TxPDO.

The PDO, including the DI value, will be sent when the DI value is changed. And both transmission types will directly trigger an update of the mapped data when receiving the RxPDO.

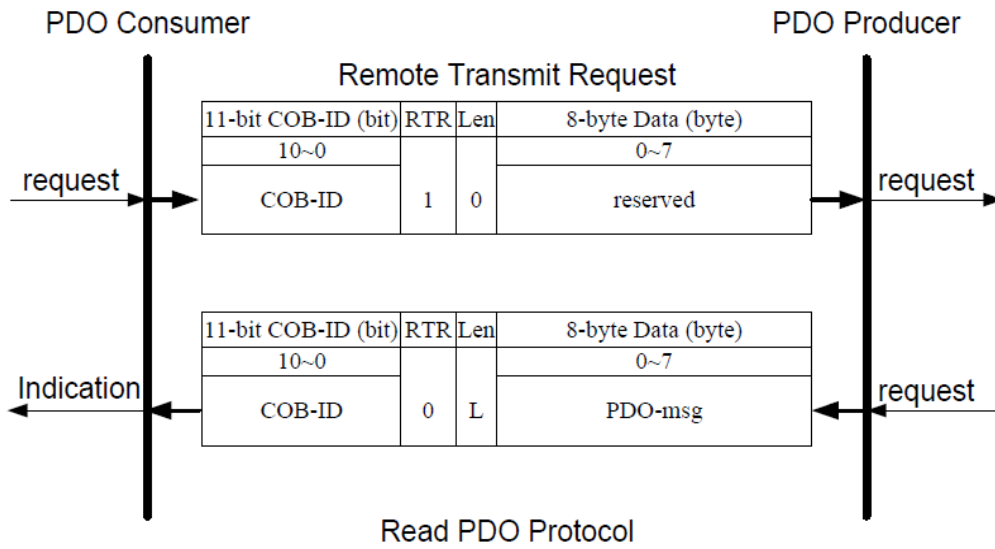
- The PM-213x-CPS doesn't support RxPDO.

8.4.2.3 PDO Communication Rule

The PDO related objects are indicated from index 0x1400 to 0x1BFF. For the PM-213x-CPS, RxPDO communication objects are not used. The ranges of the TxPDO communication objects and the mapping objects are from index 0x1800 to index 0x1813 and from index 0x1A00 to index 0x1A13 respectively. Moreover, each PDO communication object has its own PDO mapping object.

For example, the first TxPDO communication object is stored in the entry with index 0x1800, and the corresponding mapping object is stored in an entry with index 0x1A00. The object with index 0x1801 and the object with index 0x1A01 are a group, and so on. Therefore, before users access the practical data via PDO communication, each parameter for the PDO communications and mapping objects must be controlled.

Besides, only PDO communications can be used in the NMT operational state. Users can use the NMT module control protocol to change the NMT state of the PM-213x-CPS. It is described in the section 3.4. Besides, during communication via the PDO messages, the data length of the PDO message must match with the PDO mapping object. If the data length 'L' of the PDO message exceeds the total bytes 'n' of the PDO mapping object entries, only the first 'n' bytes of the PDO message are used by the PDO consumer. If 'L' is less than 'n', the PDO message will not be disposed by the PDO consumer, and an Emergency message with error code 8210h will be transmitted to the PDO producer. The PDO communication set is shown as follows.



COB-ID: the default PDO COB-ID, or the PDO COB-ID defined by users

L: the data length about how many bytes the PDO message has

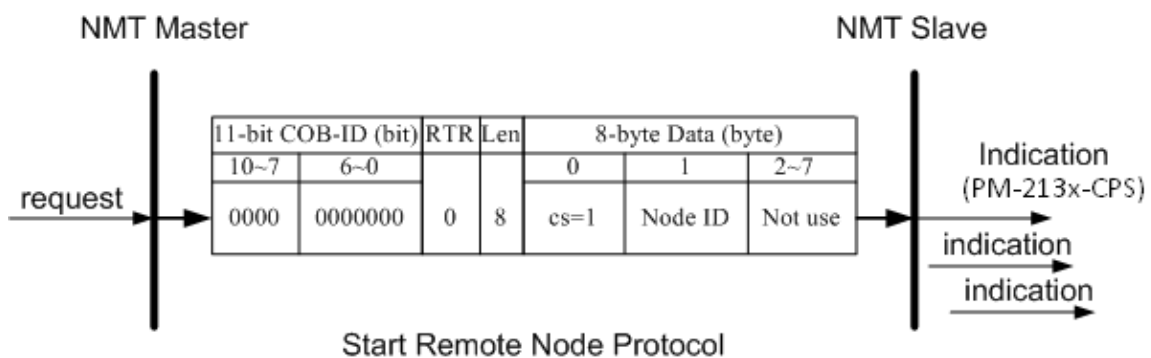
PDO-msg: the real-time data or the data which can be mapped into the PDO mapping objects

8.4.3 NMT Introduction

8.4.3.1 Module Control Protocol

The NMT communication set can be applied for changing the NMT slave status. The following figure shows how to change the different NMT statuses for the PM-213x-CPS.

Start Remote Node Protocol

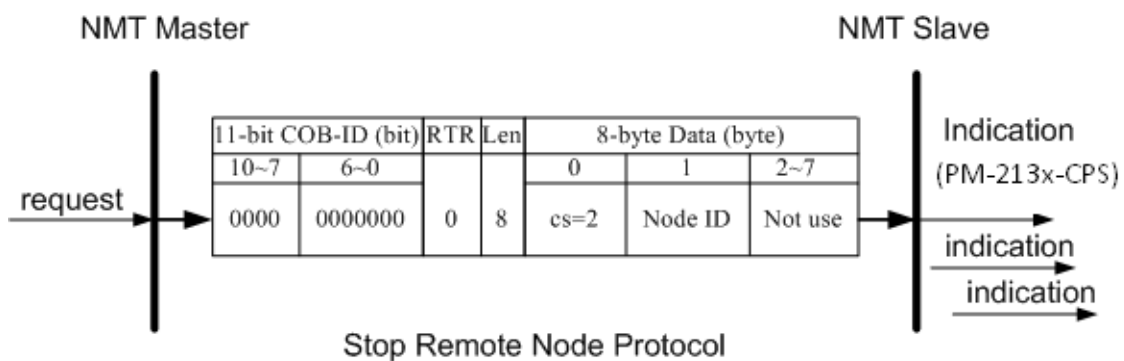


cs: NMT command specified

1: start

Node ID: the node ID of the NMT slave device

Stop Remote Node Protocol

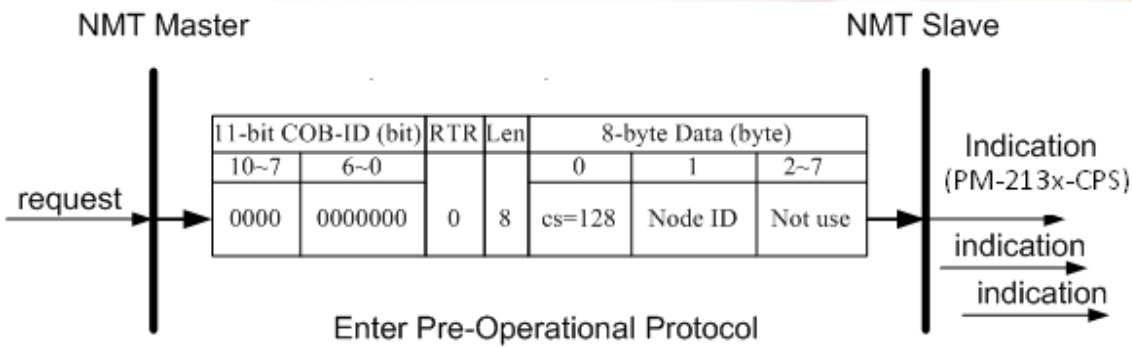


cs: NMT command specified

2: stop

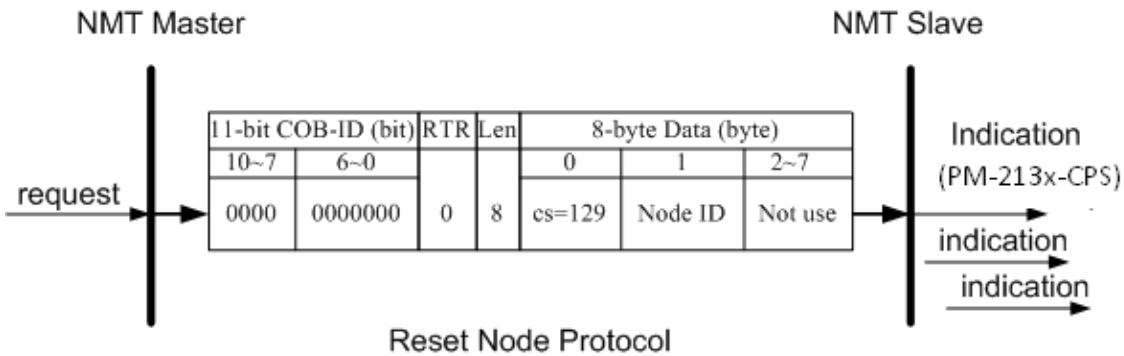
Node ID: the node ID of the NMT slave device

Enter Pre-Operational Protocol



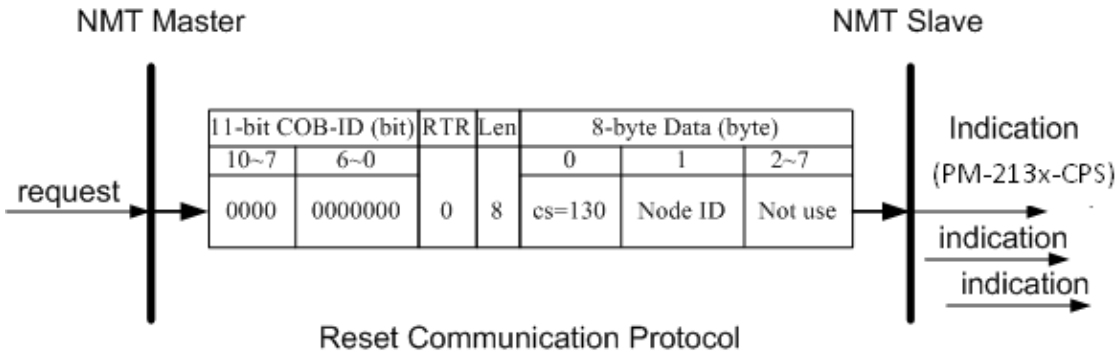
cs: NMT command specified
 128: enter PRE-OPERATIONAL
Node ID: the node ID of the NMT slave device

Reset Node Protocol



cs : NMT command specified
 129: Reset_Node
Node ID : the node ID of the NMT slave device

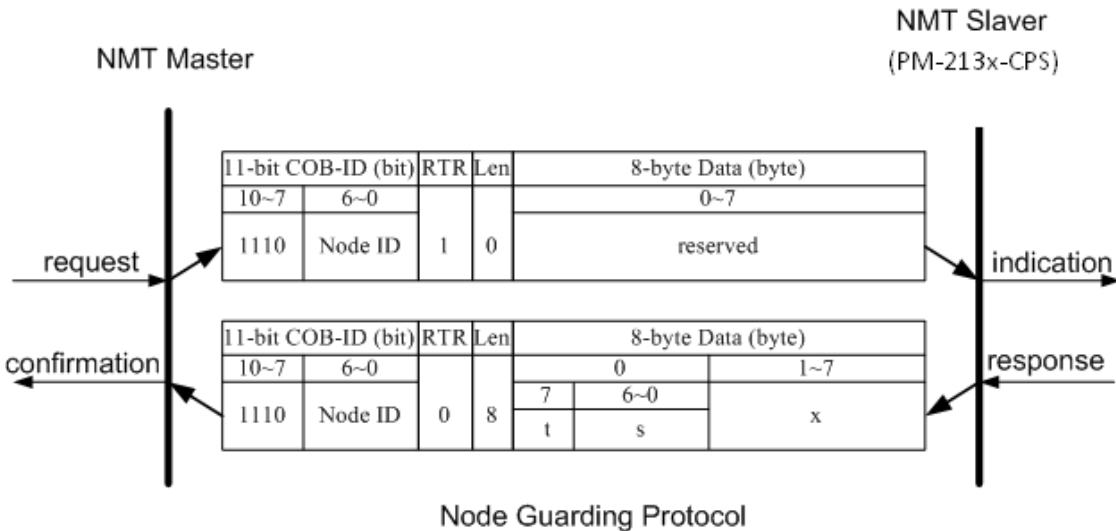
Reset Communication Protocol



cs: NMT command specified
 130: Reset_Communication
Node ID: the node ID of the NMT slave device

8.4.3.2 Error Control Protocol

Error Control Protocol is a kind of the solution to check whether the CANopen device is still alive or not. And its related objects include 0x100C and 0x100D. The 0x100C is the guard time, and the 0x100D is the life time factor. The node life time is the guard time multiplied by the life time factor. The Node Guarding timer of the PM-213x-CPS will start to count after receiving the first RTR message for the guarding identifier. The communication set of the Error Control protocol is displayed below.



t: toggle bit
 The value of this bit will be alternatively changed between two consecutive responses from the NMT slave. After the Node Guarding protocol becomes active, the value of the toggle-bit of the first response will be 0.

s: the state of the NMT Slave

4: STOPPED

5: OPERATIONAL

127: PRE_OPERATIONAL

8.4.4 Special Functions for PM-213x-CPS

8.4.4.1 Power Meter Data Table

The PM-213x-CPS Manufacturer in the Specific Profile Area defines some entries, which are used for the power meter data. The objects with index 0x3200~0x3208 will map to the PDOs as below table. The D0 to D7 represent the CANopen message from Data0 to Data7.

No.(PDO)	COB-ID	Data Length	D0~D3	D4~D7
1	0x180+Node-ID	8	kW(Kw_a)	kWh_a
2	0x280+Node-ID	8	kW(Kw_b)	kWh_b
3	0x380+Node-ID	8	kW(Kw_c)	kWh_c
4	0x480+Node-ID	8	kW(Kw_d)	kWh_d
5	---	8	Volt(V_a)	Amp(I_a)
6	---	8	Volt(V_b)	Amp(I_b)
7	---	8	Volt(V_c)	Amp(I_c)
8	---	8	Volt(V_d)	Amp(I_d)
9	---	8	kvar(kvar_a)	kVA(Kva_a)
10	---	8	kvar(kvar_b)	kVA(Kva_b)
11	---	8	kvar(kvar_c)	kVA(Kva_c)
12	---	8	kvar(kvar_d)	kVA(Kva_d)
13	---	8	PF_a	kVAh_a
14	---	8	PF_b	kVAh_d
15	---	8	PF_c	kVAh_c
16	---	8	PF_d	kVAh_d
17	---	4	kvarh_a	---
18	---	4	kvarh_b	---
19	---	4	kvarh_c	---
20	---	4	kvarh_d	---

8.4.4.2 Set Software Node-ID

The user can use this command to set the software Node-ID of the PM-213x-CPS. The PM-213x-CPS uses the software Node-ID when the DIP-Switch from digital 1. to digital 3. are all OFF. Please refer to Section. 8.2.1.

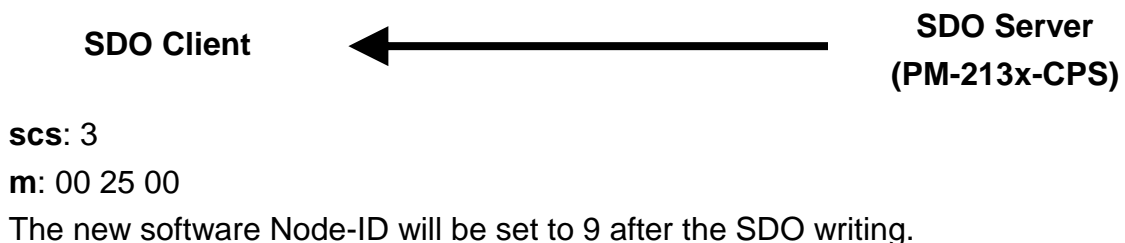
The default software Node-ID is 8. User can use SDO to set a new software Node-ID as following.

11-bit COB-ID (bit)											RTR	Data Length	8-byte Data (byte)							
Func Code				Node ID									0	1	2	3	4	5	6	7
10	9	8	7	6	5	4	3	2	1	0										
1	1	0	0	0	0	0	0	0	0	1	0	8	2F	00	25	00	09	00	00	



The PM-213x-CPS will reply with the below message.

11-bit COB-ID (bit)											RTR	Data Length	8-byte Data (byte)							
Func Code				Node ID									0	1	2	3	4	5	6	7
10	9	8	7	6	5	4	3	2	1	0										
1	0	1	1	0	0	0	0	0	0	1	0	8	60	00	25	00	00	00	00	



8.5 Object Dictionary of PM-213x-CPS

8.5.1 Communication Profile Area

The following tables are regarding each entry of the communication profile area is defined in PM-213x-CPS. For the convenient purpose, all communication entries are divided into several tables. They are “General Communication Entries”, “TxPDO Communication Entries”, and “TxPDO Mapping Communication Entries”.

Please note that in the table header with “Idx”, “Sidx” and “Attr” represent “index”, “sub-index”, and “attribute” respectively. The sign “---” in the default field means that the default is not defined or can be defined conditionally by the firmware built in PM-213x-CPS. In the table, the number accompanying letter “h” indicates that this value is in the hex format.

General Communication Entries

Idx	Sidx	Description	Type	Attr	Default
1000h	0h	device type	UNSIGNED 32	RO	---
1001h	0h	error register	UNSIGNED 8	RO	---
1003h	0h	largest sub-index supported for “predefine error field”	UNSIGNED 8	RO	0h
	1h	actual error (the newest one)	UNSIGNED 32	RO	---
	---
	5h	actual error (the oldest one)	UNSIGNED 32	RO	---
1005h	0h	COB-ID of Sync message	UNSIGNED 32	RW	80h
1008h	0h	manufacturer device name	VISIBLE_STRING	RO	
1009h	0h	manufacturer hardware version	VISIBLE_STRING	RO	---
100Ah	0h	manufacturer software version	VISIBLE_STRING	RO	---
100Ch	0h	guard time	UNSIGNED 16	RW	0
100Dh	0h	life time factor	UNSIGNED 8	RW	0
1014h	0h	COB-ID of EMCY	UNSIGNED 32	RW	80h+Node-ID
1015h	0h	Inhibit time of EMCY	UNSIGNED 16	RW	0
1018h	0h	largest sub-index supported for “identity object”	UNSIGNED 8	RO	1
	1h	vender ID	UNSIGNED 32	RO	---

SDO Communication Entries

Idx	Sidx	Description	Type	Attr	Default
1200h	0h	largest sub-index supported for "server SDO parameter"	UNSIGNED 8	RO	2
	1h	COB-ID form client to server (RxSDO)	UNSIGNED 32	RO	600h+Node-ID
	2h	COB-ID form server to client (TxSDO)	UNSIGNED 32	RO	580h+Node-ID

TxPDO Communication Entries

Idx	Sidx	Description	Type	Attr	Default
1800h	0	largest sub-index supported for "receive PDO parameter"	UNSIGNED 8	RO	5
	1	COB-ID used by PDO (Tx)	UNSIGNED 32	RW	180h+Node-ID
	2	transmission type	UNSIGNED 8	RW	FFh
	3	inhibit time	UNSIGNED 16	RW	0
	4	Reversed	...	...	...
	5	event timer	UNSIGNED 16	RW	0
1801h	0	largest sub-index supported for "receive PDO parameter"	UNSIGNED 8	RO	5
	1	COB-ID used by PDO (Tx)	UNSIGNED 32	RW	280h+Node-ID
	2	transmission type	UNSIGNED 8	RW	FFh
	3	inhibit time	UNSIGNED 16	RW	0
	4	Reversed	...	...	...
	5	event timer	UNSIGNED 16	RW	0
1802h	0	largest sub-index supported for "receive PDO parameter"	UNSIGNED 8	RO	5
	1	COB-ID used by PDO (Tx)	UNSIGNED 32	RW	380h+Node-ID
	2	transmission type	UNSIGNED 8	RW	FFh
	3	inhibit time	UNSIGNED 16	RW	0
	4	Reversed	...	...	...
	5	event timer	UNSIGNED 16	RW	0
1803h	0	largest sub-index supported for "receive PDO parameter"	UNSIGNED 8	RO	5
	1	COB-ID used by PDO (Tx)	UNSIGNED 32	RW	480h+Node-ID
	2	transmission type	UNSIGNED 8	RW	FFh

	3	inhibit time	UNSIGNED 16	RW	0
	4	Reversed	...	...	...
	5	event timer	UNSIGNED 16	RW	0
1804h	0	largest sub-index supported for "receive PDO parameter"	UNSIGNED 8	RO	5
	1	COB-ID used by PDO (Tx)	UNSIGNED 32	RW	80000000h
	2	transmission type	UNSIGNED 8	RW	FFh
	3	inhibit time	UNSIGNED 16	RW	0
	4	Reversed	...	...	...
	5	event timer	UNSIGNED 16	RW	0
...
1813h	0	largest sub-index supported for "receive PDO parameter"	UNSIGNED 8	RO	5
	1	COB-ID used by PDO (Tx)	UNSIGNED 32	RW	80000000h
	2	transmission type	UNSIGNED 8	RW	FFh
	3	inhibit time	UNSIGNED 16	RW	0
	4	Reversed	...	...	...
	5	event timer	UNSIGNED 16	RW	0

TxPDO Mapping Communication Entries

Idx	Sidx	Description	Type	Attr	Default
1A00h	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	2
	1	read kW(Kw_a) data	INTEGER 32	RO	3200 0120h
	2	read kWh_a data	INTEGER 32	RO	3201 0120h
1A01h	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	2
	1	read kW(Kw_b) data	INTEGER 32	RO	3200 0220h
	2	read kWh_b data	INTEGER 32	RO	3201 0220h
1A02h	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	2

		mapping”			
	1	read kW(Kw_c) data	INTEGER 32	RO	3200 0320h
	2	read kWh_c data	INTEGER 32	RO	3201 0320h
1A03h	0	largest sub-index supported for “transmit PDO mapping”	UNSIGNED 8	RO	2
	1	read kW(Kw_d) data	INTEGER 32	RO	3200 0420h
	2	read kWh_d data	INTEGER 32	RO	3201 0420h
1A04h	0	largest sub-index supported for “transmit PDO mapping”	UNSIGNED 8	RO	2
	1	read Volt(V_a) data	INTEGER 32	RO	3202 0120h
	2	read Amp(I_a) data	INTEGER 32	RO	3203 0120h
1A05h	0	largest sub-index supported for “transmit PDO mapping”	UNSIGNED 8	RO	2
	1	read Volt(V_b) data	INTEGER 32	RO	3202 0220h
	2	read Amp(I_b) data	INTEGER 32	RO	3203 0220h
1A06h	0	largest sub-index supported for “transmit PDO mapping”	UNSIGNED 8	RO	2
	1	read Volt(V_c) data	INTEGER 32	RO	3202 0320h
	2	read Amp(I_c) data	INTEGER 32	RO	3203 0320h
1A07h	0	largest sub-index supported for “transmit PDO	UNSIGNED 8	RO	2

		mapping”			
	1	read Volt(V_d) data	INTEGER 32	RO	3202 0420h
	2	read Amp(I_d) data	INTEGER 32	RO	3203 0420h
1A08h	0	largest sub-index supported for “transmit PDO mapping”	UNSIGNED 8	RO	2
	1	read kvar(kvar_a) data	INTEGER 32	RO	3204 0120h
	2	read kVA(Kva_a) data	INTEGER 32	RO	3205 0120h
1A09h	0	largest sub-index supported for “transmit PDO mapping”	UNSIGNED 8	RO	2
	1	read kvar(kvar_b) data	INTEGER 32	RO	3204 0220h
	2	read kVA(Kva_b) data	INTEGER 32	RO	3205 0220h
1A0Ah	0	largest sub-index supported for “transmit PDO mapping”	UNSIGNED 8	RO	2
	1	read kvar(kvar_c) data	INTEGER 32	RO	3204 0320h
	2	read kVA(Kva_c) data	INTEGER 32	RO	3205 0320h
1A0Bh	0	largest sub-index supported for “transmit PDO mapping”	UNSIGNED 8	RO	2
	1	read kvar(kvar_d) data	INTEGER 32	RO	3204 0420h
	2	read kVA(Kva_d)	INTEGER 32	RO	3205 0420h

		data			
1A0Ch	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	2
	1	read PF_a data	INTEGER 32	RO	3206 0120h
	2	read kVAh_a data	INTEGER 32	RO	3207 0120h
1A0Dh	0	inhibit time	UNSIGNED 8	RO	2
	1	read PF_b data	INTEGER 32	RO	3206 0220h
	2	read kVAh_b data	INTEGER 32	RO	3207 0220h
1A0Eh	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	2
	1	read PF_c data	INTEGER 32	RO	3206 0320h
	2	read kVAh_c data	INTEGER 32	RO	3207 0320h
1A0Fh	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	2
	1	read PF_d data	INTEGER 32	RO	3206 0420h
	2	read kVAh_d data	INTEGER 32	RO	3207 0420h
1A10h	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	1
	1	read kvarh_a data	INTEGER 32	RO	3208 0120h
1A11h	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	1
	1	read kvarh_b data	INTEGER 32	RO	3208 0220h
1A12h	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	1

	1	read kvarh_c data	INTEGER 32	RO	3208 0320h
1A13h	0	largest sub-index supported for "transmit PDO mapping"	UNSIGNED 8	RO	1
	1	read kvarh_d data	INTEGER 32	RO	32080h

8.5.2 Manufacturer Specific Profile Area

In the following table, there is information about some special functions for the PM-213x-CPS. The index from 0x3200 to 0x3208 records the power meter measurement parameters. The number of these entries will be automatically updated when the PM-213x-CPS boot up. 0x2500 and 0x3209 are meter parameters information. 0x2500 records the software CANopen Node-ID. 0x3209 stores three meter parameters including Meter Ratio, PT Ratio and RT Ratio. PT Ratio means potential transformer ratio, the default value is 100 and the unit is 0.1. RT Ratio means current transformer ratio, the default value is 1 and the unit is 1.

Idx	Sidx	Description	Type	Attr	Default
2500h	0	Software CANopen Node-ID	UNSIGNED 8	RW	8

Idx	Sidx	Description	Type	Attr	Default
3200h	0	largest sub-index supported for "kW"	UNSIGNED 8	RO	4
	1	kW(Kw_a)	INTEGER32	RO	0
	2	kW(Kw_b)	INTEGER32	RO	0
	3	kW(Kw_c)	INTEGER32	RO	0
	4	kW(Kw_d)	INTEGER32	RO	0
3201h	0	largest sub-index supported for "kWh"	UNSIGNED 8	RO	4
	1	kWh_a	INTEGER32	RO	0
	2	kWh_b	INTEGER32	RO	0
	3	kWh_c	INTEGER32	RO	0
	4	kWh_d	INTEGER32	RO	0

3202h	0	largest sub-index supported for "Volt"	UNSIGNED 8	RO	4
	1	Volt(V_a)	INTEGER32	RO	0
	2	Volt(V_b)	INTEGER32	RO	0
	3	Volt(V_c)	INTEGER32	RO	0
	4	Volt(V_b)	INTEGER32	RO	0
3203h	0	largest sub-index supported for "Amp"	UNSIGNED 8	RO	4
	1	Amp(I_a)	INTEGER32	RO	0
	2	Amp(I_b)	INTEGER32	RO	0
	3	Amp(I_c)	INTEGER32	RO	0
	4	Amp(I_d)	INTEGER32	RO	0
3204h	0	largest sub-index supported for "kvar"	UNSIGNED 8	RO	4
	1	kvar(kvar_a)	INTEGER32	RO	0
	2	kvar(kvar_b)	INTEGER32	RO	0
	3	kvar(kvar_c)	INTEGER32	RO	0
	4	kvar(kvar_d)	INTEGER32	RO	0
3205h	0	largest sub-index supported for "kVA"	UNSIGNED 8	RO	4
	1	kVA(Kva_a)	INTEGER32	RO	0
	2	kVA(Kva_b)	INTEGER32	RO	0
	3	kVA(Kva_c)	INTEGER32	RO	0
	4	kVA(Kva_d)	INTEGER32	RO	0
3206h	0	largest sub-index supported for "PF"	UNSIGNED 8	RO	4
	1	PF_a	INTEGER32	RO	0
	2	PF_b	INTEGER32	RO	0
	3	PF_c	INTEGER32	RO	0
	4	PF_d	INTEGER32	RO	0
3207h	0	largest sub-index supported for "kVAh"	UNSIGNED 8	RO	4
	1	kVAh_a	INTEGER32	RO	0
	2	kVAh_b	INTEGER32	RO	0
	3	kVAh_c	INTEGER32	RO	0
	4	kVAh_d	INTEGER32	RO	0

3208h	0	largest sub-index supported for "kvarh"	UNSIGNED 8	RO	4
	1	kvarh_a	INTEGER32	RO	0
	2	kvarh_b	INTEGER32	RO	0
	3	kvarh_c	INTEGER32	RO	0
	4	kvarh_d	INTEGER32	RO	0
3209h	0	largest sub-index supported for system configuration variables	UNSIGNED 8	RO	3
	1	Meter Ratio	UNSIGNED 16	RW	500
	2	PT Ratio	UNSIGNED 16	RW	100
	3	RT Ratio	UNSIGNED 16	RW	1

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-213x series ?

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 (like 100/5...) , It could causes the fatal 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?

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(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?

(2) 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

(3) 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?

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 cannot make the connection ?

- (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.

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

Power cable diameter < Φ 10 use 60A CT , Φ 10~ Φ 16 use 100A CT , Φ 16~ Φ 24 use 200A CT.

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

- (1) Φ 10split type CT , the standard length is 1.8M. For special length, please contact ICP DAS.
- (2) Φ 16and Φ 24split type CT , the standard length is 2M. For special length, please contact ICP DAS.

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-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			Ø16 (PM-2133-160)	16mm/100A
	38	7/2.6	11.5	100				
	50	19/1.8	13.0	120	Ø24 (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