GW-7553-CPM PROFIBUS/CANopen GATEWAY

User's Manual



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1. Introduction

PROFIBUS and CANopen are two kinds of famous protocols and are wildly used in the fields of factory and process automation. The GW-7553-CPM is a PROFIBUS to CANopen gateway. By using this module, users can easily put the CANopen devices into PROFIBUS network.

Figure 1 shows an application example for the GW-7553-CPM module.

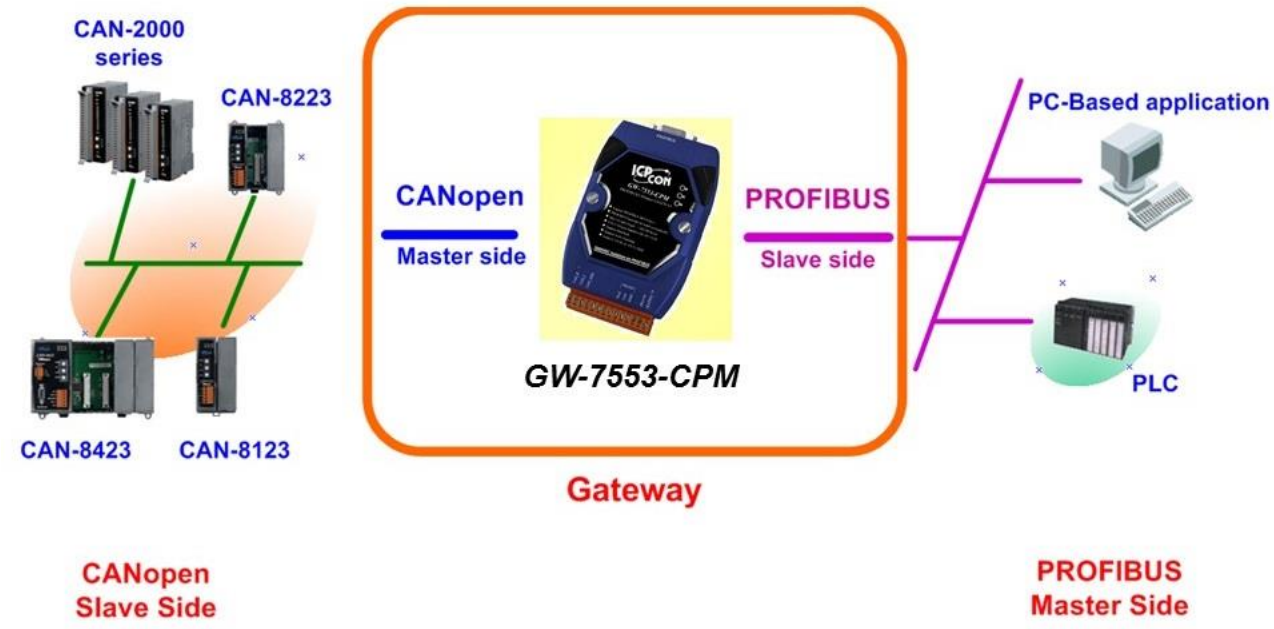


Figure 1 Application architecture of the GW-7553-CPM module

The GW-7553-CPM Gateway is specially designed for the slave device of PROFIBUS DP protocol. It allows the PROFIBUS master to access the CANopen slave devices. We also provide the utility software for users to configure the GW-7553-CPM.

The main features and specification of GW-7553-CPM are described as below:

1.1 Features

- 16-Bit Microprocessor inside with 80MHz
- Siemens VPC3+ PROFIBUS controller
- Supports PROFIBUS DP-V0 slave
- PROFIBUS transmission rate detect automatically

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- Max transmission speed up to 12M bps for PROFIBUS and 115.2K bps for COM Port
- COM Port driver has 1K bytes QUEUE input buffer & 512 bytes QUEUE output buffer
- Max length of output/input data is 240/240 Bytes
- Follow the CiA CANopen Standard DS-301 v4.02
- Support Node Guarding and Heartbeat Consumer protocol
- Support 110 CANopen SDO/PDO commands
- Support 4 data types: Boolean、Byte、Word、4-byte
- 2500Vrms High Speed iCoupler Isolation Protection for PROFIBUS network
- 3000VDC Isolation Protection on the PROFIBUS side
- Provide LED indicators
- Built-in Watchdog
- Mountable on DIN Rail

1.2 Modules Support

Only the following CANopen commands are supported by the gateway.

Table 1: CANopen command support

Communication object	COB-ID(s) hex	Slave node
NMT node control	000	Receive only
Sync	080	Receive only
Emergency	080 + NodeID	Transmit
PDO	180 + NodeID	1.Transmit PDO
	200 + NodeID	1.Receive PDO
	280 + NodeID	2. Transmit PDO
	300 + NodeID	2. Receive PDO
	380 + NodeID	3. Transmit PDO
	400 + NodeID	3. Receive PDO
	480 + NodeID	4. Transmit PDO
	500 + NodeID	4. Receive PDO
SDO	580 + NodeID	Transmit
	600 + NodeID	Receive
NMT node monitoring (guarding/heartbeat)	700 + NodeID	Transmit

1.3 Specification

COM Port specs:

- Serial port - RS-232

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- Serial port interface: 14-pin screw terminal block
- Baud Rate： 115200 bps
- Data Format: 8 data bits, None parity bit, 1 stop bit

PROFIBUS specs:
- PROFIBUS interface connector: D-sub 9-pin female
- Baud Rate: 9.6K/19.2K/45.45K/93.75K/187.5K/500K/1.5M/3M/6M/ 12Mbps
- Address Setting: 0~126 (set by DIP switch or EEPROM)

CANopen specs:
- CAN signal support: CAN_H, CAN_L
- CAN bus interface: ISO 11898-2, screw terminal connector.
- Baud Rate: 10/20/50/125/250/500/800/1000 Kbps

Power requirement:
- Unregulated +10V ~ +30V DC
- Power reverse protection, Over-Voltage brown-out protection
- Power consumption 2.5W

Module specs:
- Dimensions: 119mm X 72mm X 33mm
- Operating temperature: -25 ~ 75 ℃
- Storage temperature: -30 ~ 85 ℃
- Humidity：5 ~ 95%, non-condensing
- LED Status Indicators(*Table 2*)

Table 2: LED status indicator

PWR LED	– Shows the power state
ERR LED	– Show error state – Utility state of connect
RUN LED	– Show communication state of PROFIBUS

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2. Hardware

2.1 Block Diagram of GW-7553-CPM

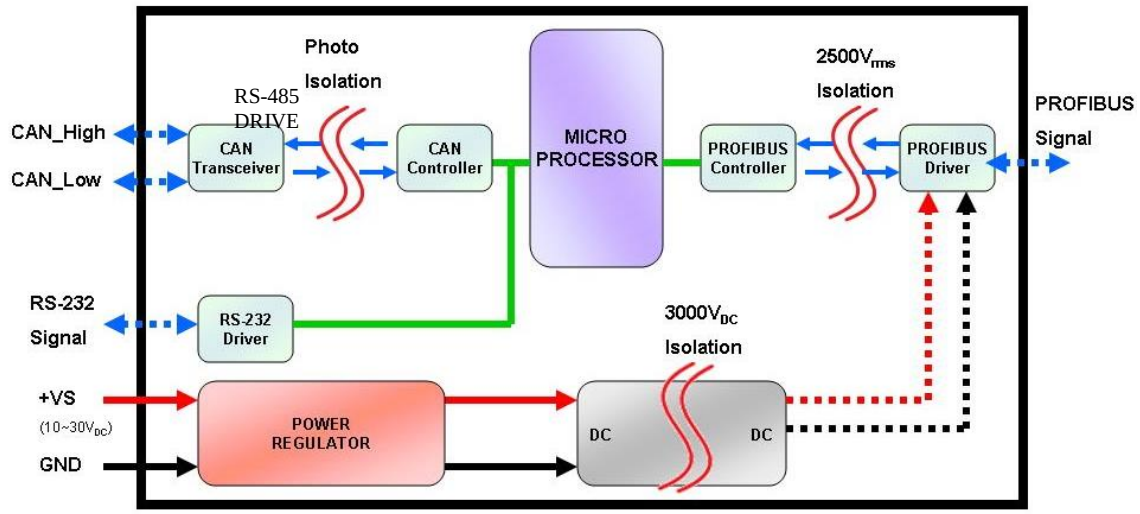


Figure 2 Block diagram of GW-7553-CPM

2.2 Pin Assignment



Figure 3 Pin assignment of GW-7553-CPM

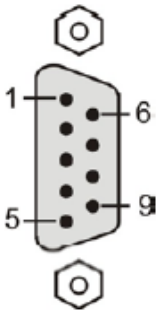
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Table 3 14-pin screw terminal block

Pin	Name	Description
1	CAN_H	Data+ of CANBUS
2	CAN_L	Data- of CANBUS
3	-	N/A
4	-	N/A
5	-	N/A
6	-	N/A
7	-	N/A
8	-	N/A
9	RX	Receive Data of RS-232
10	TX	Transmit Data of RS-232
11	GND	GND of RS-232
12	-	N/A
13	+VS	V+ of Power Supply(+10 to +30VDC)
14	GND	GND of Power Supply

Table 4 PROFIBUS DB9 Female Connector

Pin	Name	Description
1	-	N/A
2	-	N/A
3	B	Non-inverting Bus Line
4	ISODE	Isolated DE output for use in PROFIBUS applications where the state of the isolated drive enable node needs to be monitored.
5	GND	Power supply ground for the first node and the last node
6	VP	+5V Power Supply for the first node and the last node
7	-	N/A
8	A	Inverting Bus Line
9	-	N/A



2.3 Wiring

GW-7553-CPM supports PROFIBUS to CANopen communication. The following section describes the connection interface of GW-7553-CPM

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2.3.1 RS-232 connection

The RS-232 port of the GW-7553-CPM has got three pins. The wiring of the RS-232 device with the RS232 port of the GW-7553-CPM is shown in *figure 4*.

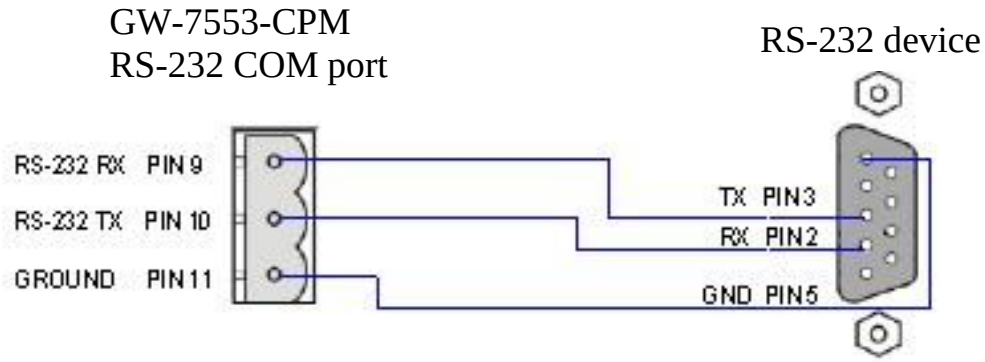


Figure 4 RS-232 wiring diagram

2.3.2 PROFIBUS Connection

The PROFIBUS interface of the GW-7553-CPM is a DB9 female connector. The connector uses the standard PROFIBUS 9 pin assignment. It is recommended to use a standard PROFIBUS cable and connector (DB9 male). As with every serial bus the rate of safe data transmission in a PROFIBUS network decreases with increasing distance between master and slave. *Table 7* shows the transmission rate and range for a cable with the following properties:

1. Impedance :135~165Ω
2. Capacity : lower than 30 pF/m
3. Loop resistance : lower than 110Ω/Km
4. Wire diameter : greater than 0.65mm
5. Core cross-section : greater than 0.34mm^2

Table 5 Transmission rate decreasing with increasing transmission distance

Transmission Rate(Kbps)	Transmission Distance per Segment (meter)
9.6; 19.2; 45.45;93.75	1200
187.5	1000
500	400
1500	200
3000; 6000; 12000	100

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In order to minimize the reflection effect of signal transmission, both ends (first node and last node) of a PROFIBUS segment needs to be equipped with an active terminal resistor as shown in *figure6*. A standard PROFIBUS connector is usually already equipped with a terminal resistor. The user therefore only has to switch on the resistor of the devices stationed at the ends of a segment as shown in *figure5*.

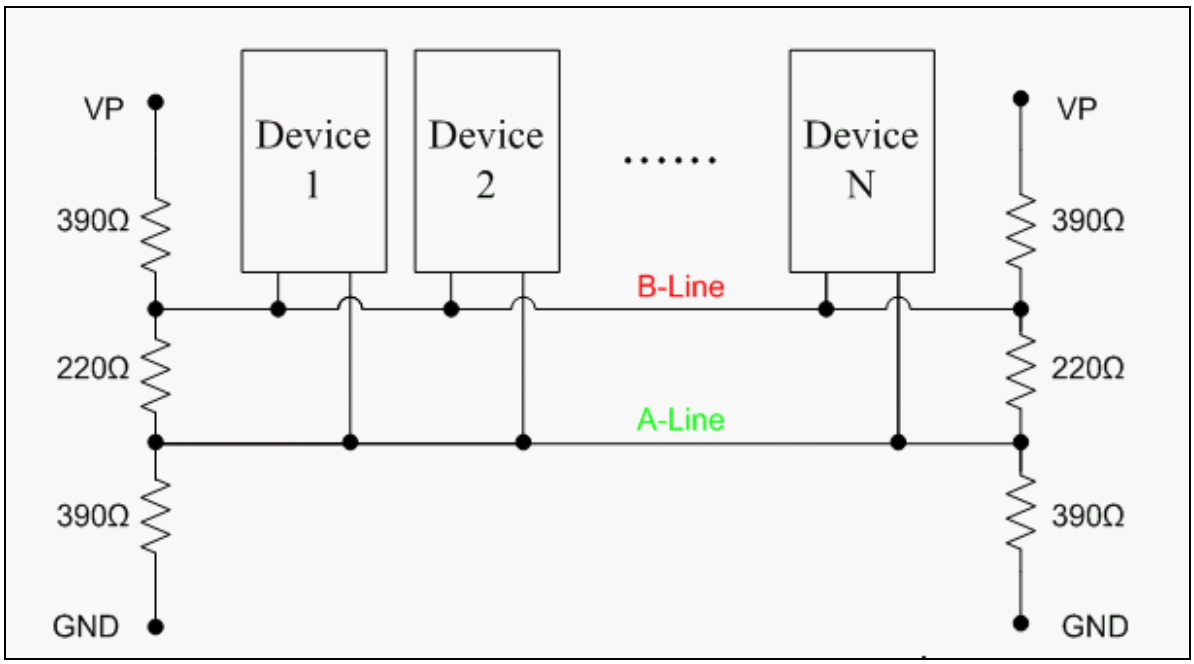


Figure 5 PROFIBUS connection

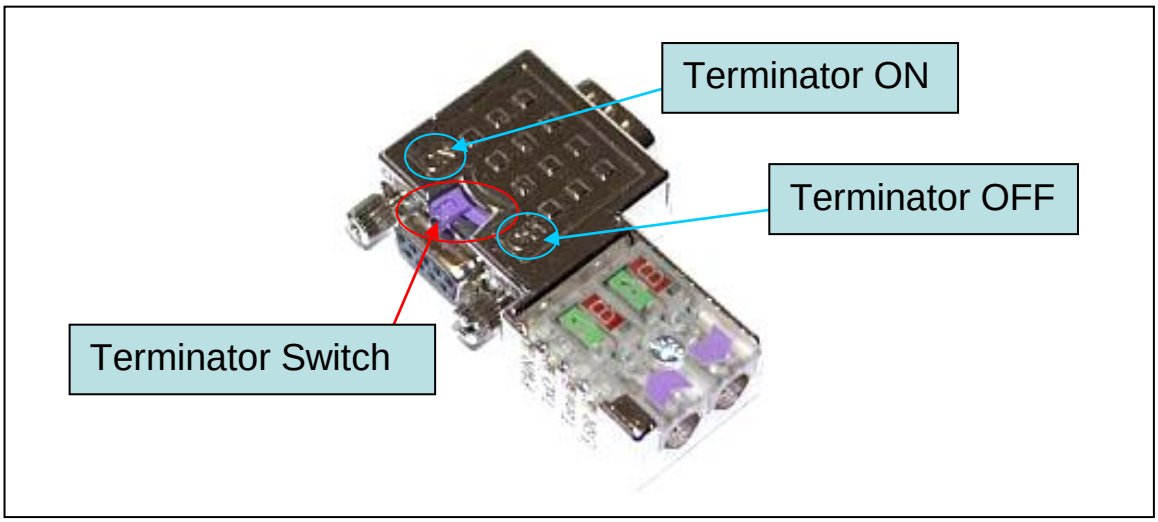


Figure 6 PROFIBUS connector

The number of stations in a PROFIBUS network is restricted to 126. According

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to the PROFIBUS specification up to 32 stations are allowed per segment. A repeater has to be used to link the bus segments.

2.3.3 CANopen terminator resistor settings

In order to minimize reflection effects on the CAN bus line, the CAN bus lines have to be terminated at both ends by two terminal resistances. Based on the ISO 11898-2 spec, each terminal resistance is 120Ω (or between 108Ω~132Ω). The length related resistance should have 70 mΩ/m. Users should check the resistances of their CAN bus, before they install a new CAN network as figure 7, 8.

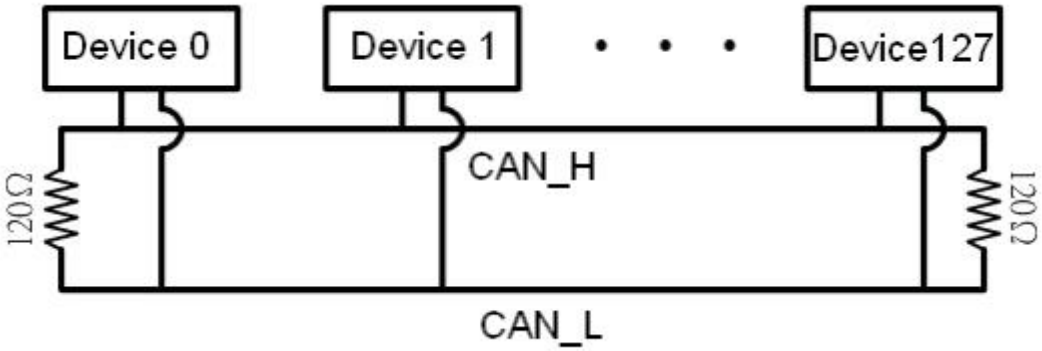


Figure 7 CANopen terminator resistor

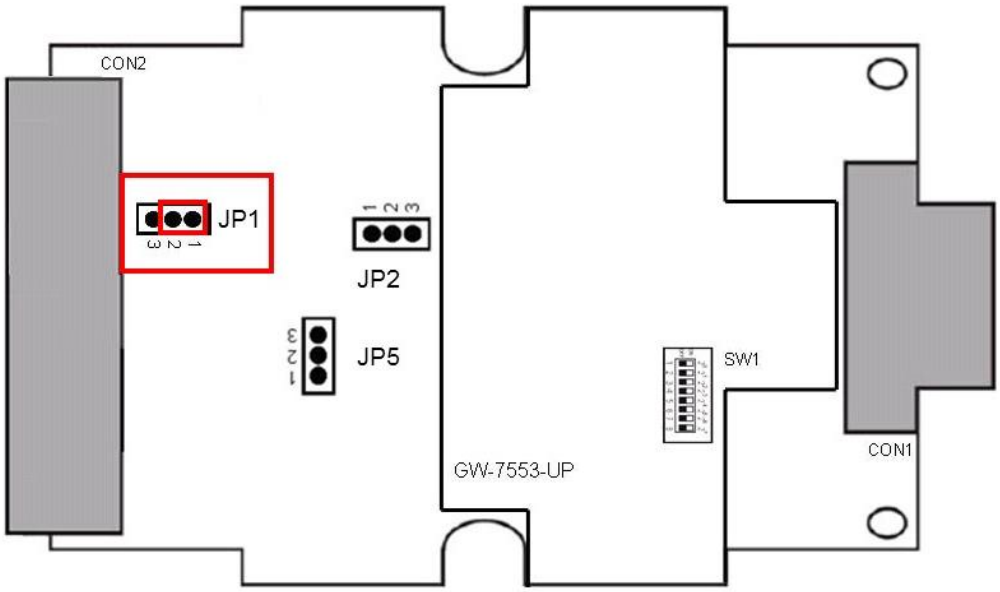


Figure 8 CANopen terminator resistor

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2.4 Setting the PROFIBUS Address

The station address of GW-7553-CPM can be set by using either the dip switch or by writing it directly to the EEPROM. The dip switch covers a range from 0 to 255. The valid address range of a PROFIBUS station spans from 0 to 126. *Table 6* shows three examples of setting the station address by using the dip switch. The dip switches are accessed by opening the modules housing (*Figure 9)*. *Table 7* explains which address will be used by the module after power on, if the dip switch address setting differs from the address stored in the EEPROM.

Table 6: Dip switch setting example

Station address	**DIP SWITCH(SW1)**							
	1	2	3	4	5	6	7	8
1	1	0	0	0	0	0	0	0
10	0	1	0	1	0	0	0	0
126	0	1	1	1	1	1	1	0

Table 7: The Address setting of the GW-7553-CPM

Dip Switch Setting	Description
0~125	1. The address setting of the EEPROM is ignored. 2. The address can not be set by the PROFIBUS configuration tool.
126-254	1. The address setting of the dip switch is ignored. 2. If the address in the EEPROM is 126, the PROFIBUS configuration tool can set a new address and save it to the EEPROM.
255	1. Slave address in the EEPROM is set to 126.

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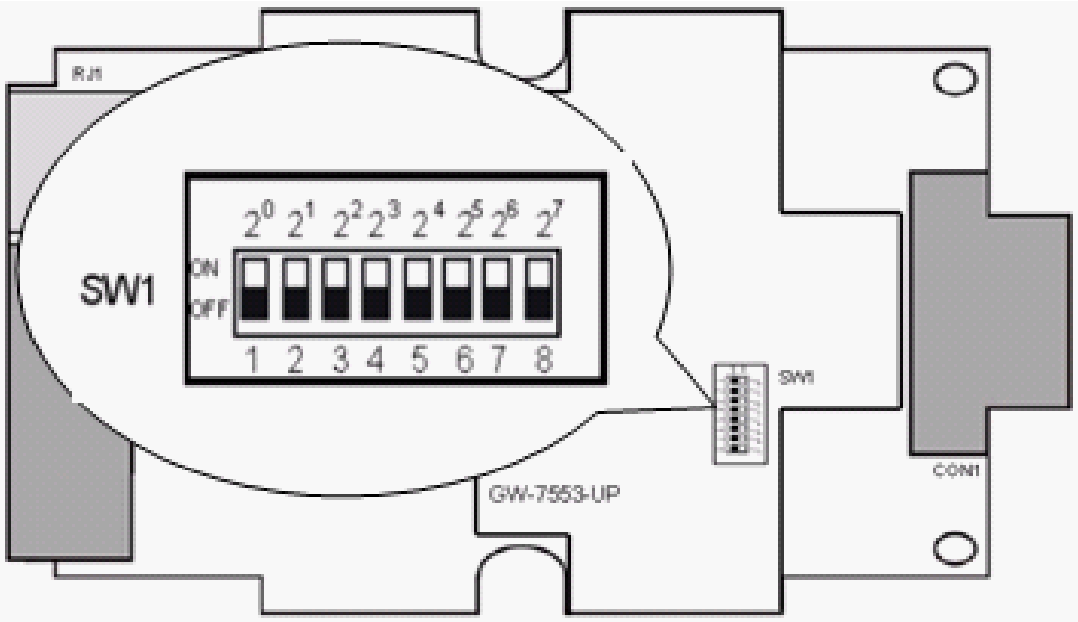


Figure 9: DIP switch

Each slave must have a unique valid address (1 to 125) in order to be able to communicate with the master. To change the address by using the configuration tool it is necessary to first set the address stored in the EEPROM to 126. This is done by setting the dip switch to 255 in the power off state. Switching the module on is forcing the module to change its address in the EEROM to 126. In the next step switch the module off and change the dip switch setting to any value from 126 to 254. This step is necessary in order to prevent the module to change its address in the EEPROM to 126 every time it is powered on. The configuration tool can now assign the slave a new address.

2.5 LED status indicator

The GW-7553-CPM provides three LEDs to indicate the statuses of the GW-7553-CPM module. The position of LEDs and descriptions are shown in *table 8* and *figure 10.*

Table 8: LED status description

LED Name	Status	Description
PWR	on	Power supply is ok. The firmware has loaded.
	off	Power supply has failed.
ERR	flash	When the GW-7553-CPM connects with the utility tool, it will flash fast (flash once about 55ms). When the GW-7553-CPM has diagnostic message, it

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LED Name	Status	Description
		will flash slowly (flash once about 220ms).
	on	Connection error between PROFIBUS master and slave or PROFIBUS system has not been configured correctly.
	off	Normal operation PROFIBUS system has been configured correctly
RUN	on	Data exchange mode Normal operation.
	off	GW-7553-CPM module is not in a data exchange mode.



Figure 10 LED position

2.6 Normal/Setting Dip Switch

There is a dip switch on the back of the GW-7553-CPM module, as shown in *Figure 11*. The dip switch is used to set the GW-7553-CPM module works in operation mode or setting mode. In the normal situation, it needs to set the dip switch to the "Normal" position. In this case, the GW-7553-CPM module can communicate with CANopen devices, module can communicate with the utility tool and read the information of CANopen from the module. When the user sets the dip switch to the "Setting" position, the GW-7553-CPM module can communicate with the utility tool and save the information of CANopen to module.

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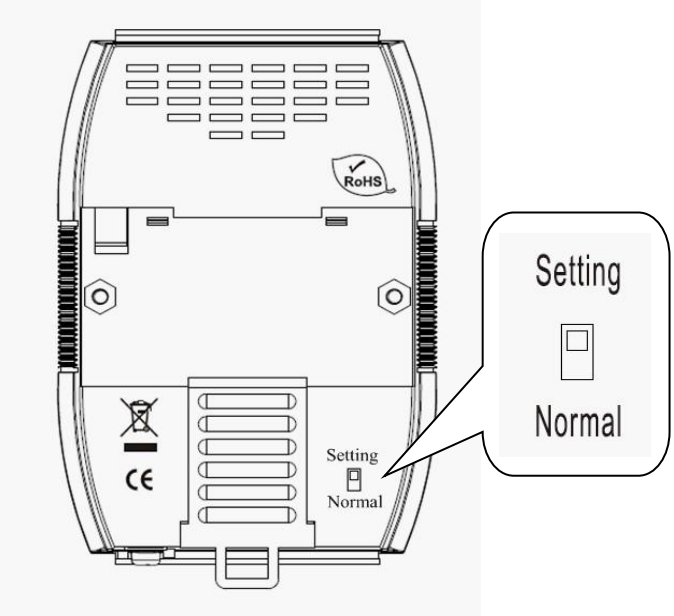


Figure 11 Dip switch of the GW-7553-CPM

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3. Communication protocol transfer theorem

3.1 PROFIBUS data exchange

The GW-7553-CPM is a PROFIBUS DP slave device. The GW-7553-CPM is first parameterized then configured and finally it goes into the data exchange mode (*Figure 12*).

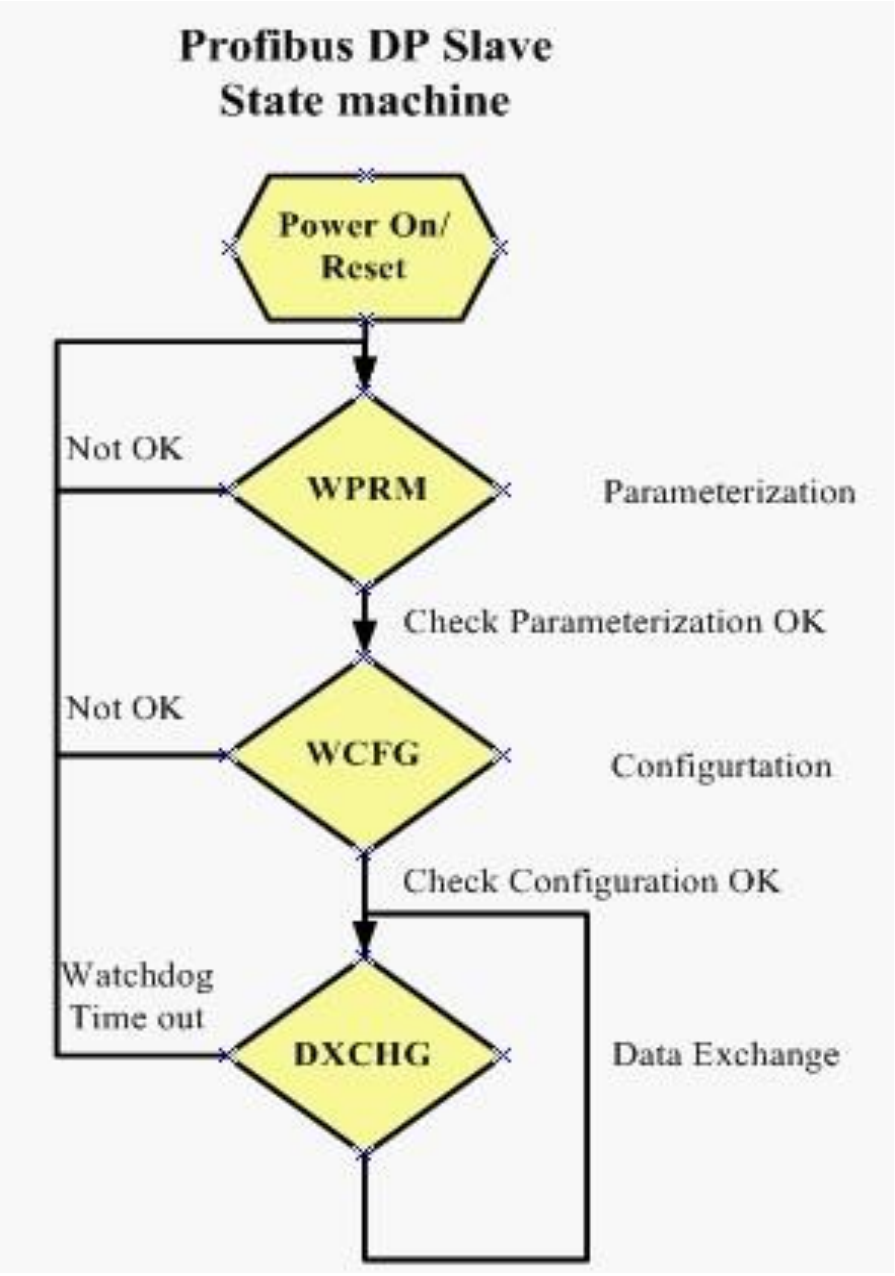


Figure 12 State machine of PROFIBUS DP slave device

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The GW-7553-CPM exchanges data cyclically between internal TxPDO、RxPDO、TxSDO、RxSDO data and PROFIBUS master device in data exchange mode, as shown in *figure 13*.

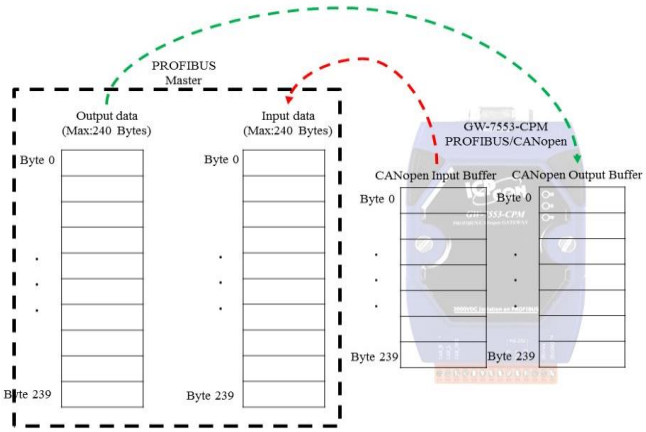


Figure 13　Data exchange between PROFIBUS master device and GW-7553-CPM

The GW-7553-CPM downloads the parameter and configuration from PROFIBUS master device to be the module parameters. The GW-7553-CPM and PROFIBUS master device have different data type and data address, the GW-7553-CPM can transfer different data format to PROFIBUS master device through module parameters.

3.2　CANopen data exchange

CANopen protocol belongs to Master-Slave communication and it uses query and response message to arrive at data exchange and device control, as shown in *figure 14*.

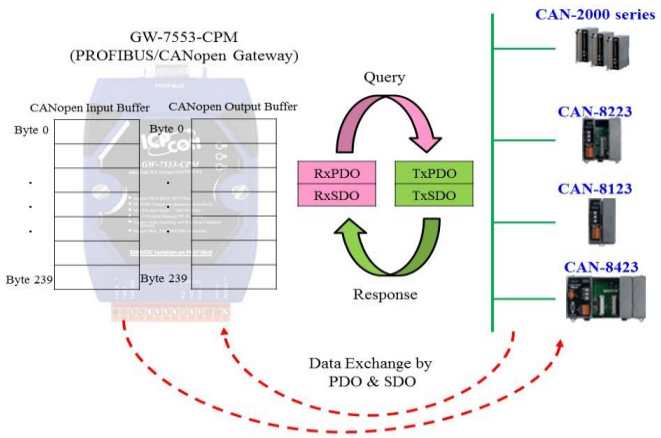


Figure 14　Data exchange between the CANopen devices and the GW-7553-CPM

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3.3 Communication protocol transfer

In section 3.1 and 3.2, we can understand that data exchange is through CANopen Output Buffer、CANopen Input Buffer of the GW-7553-CPM between PROFIBUS master、CANopen Slave and the GW-7553-CPM. The data exchange runs continuously between PROFIBUS master、CANopen slave and the GW-7553-CPM, as shown in *figure 15*、*16.*

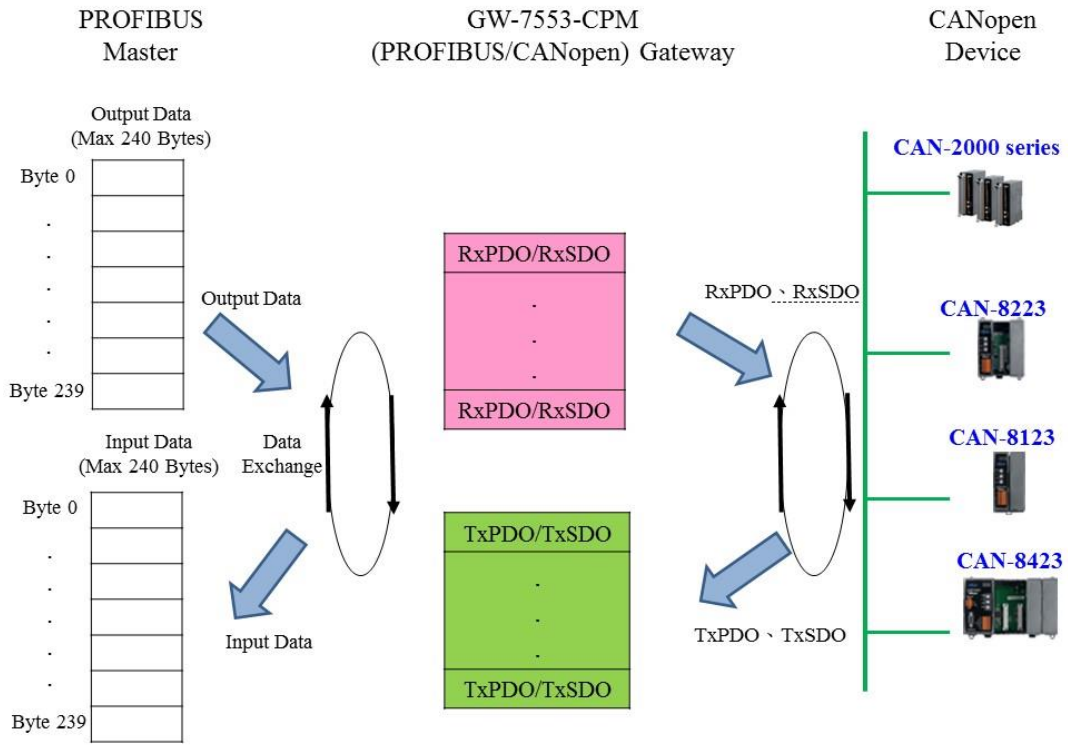


Figure 15 GW-7553-CPM communication protocol transfers

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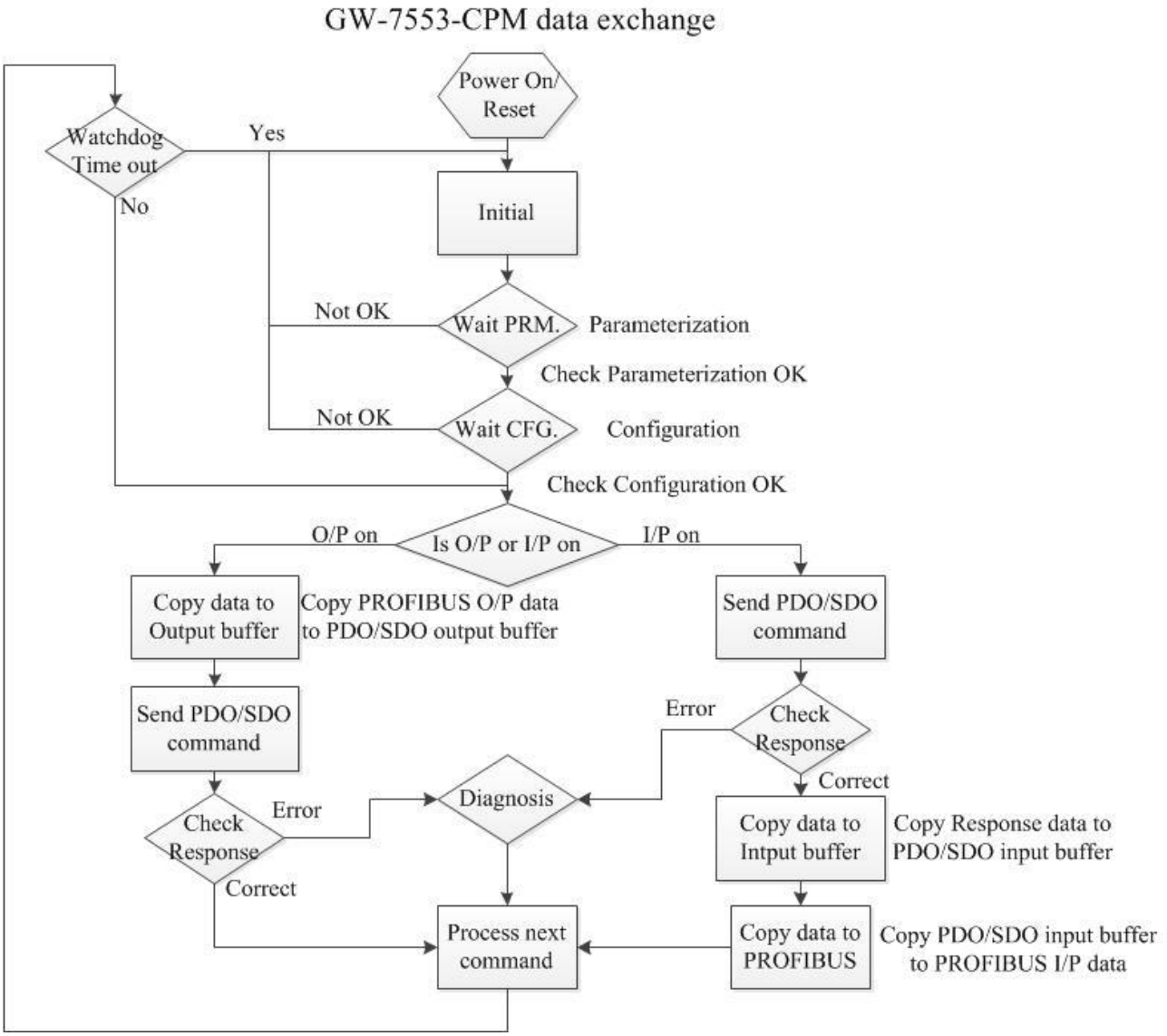


Figure 16 GW-7553-CPM flowchart

4. Communication

4.1 Field of application

A master station can be a PLC, PC or any other smart device. The system can be a mono-master system (*Figure 17*) or a multi-master system (*Figure 18*). The GW-7553-CPM enables the integration of the CANopen devices into a PROFIBUS DP network.

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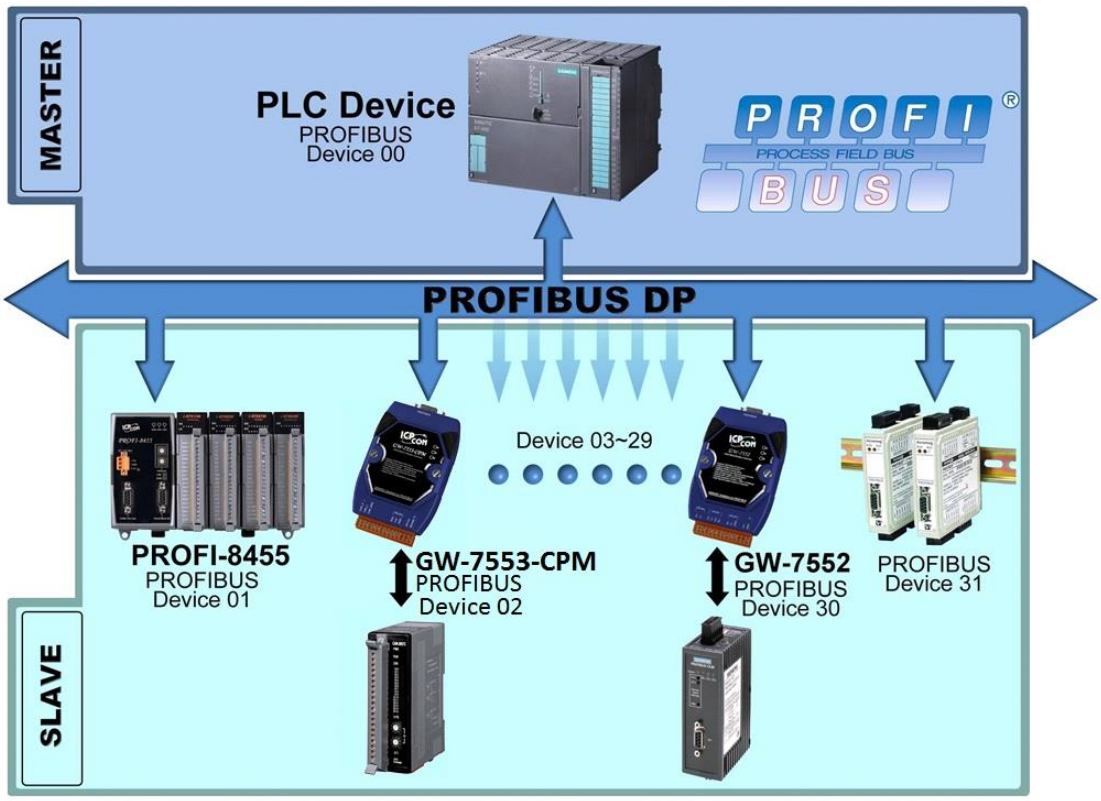


Figure 17 Mono-master system

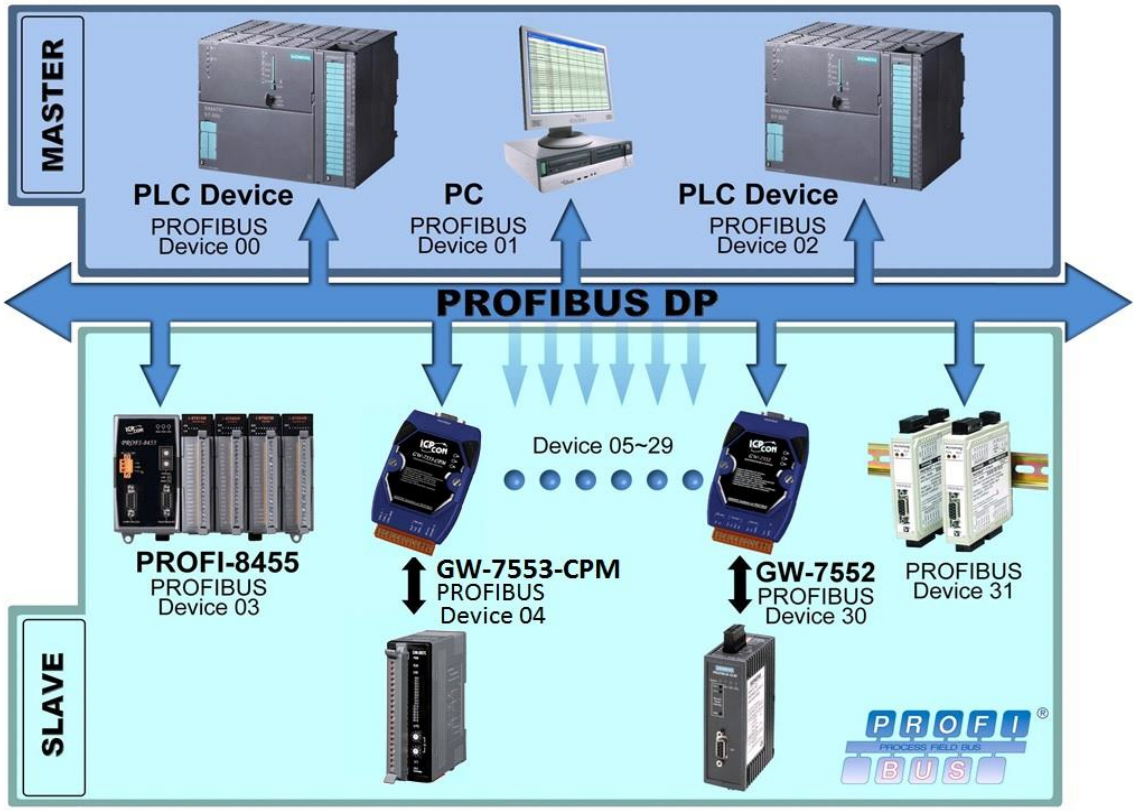


Figure 18 Multi-master system

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4.2 GSD file

The characteristic (ex: baud rate, message length, number of input / output data.....) of each PROFIBUS DP device is described in the GSD file. The GSD file of the GW-7553-CPM is in the ICP DAS companion CD-ROM (PATH--> CD: \PROFIBUS\GATEWAY\GW-7553-CPM\GSD\). The user can copy GSD file (i7553CPM.gsd) and the Bitmap file (icp_7553.bmp、i_7553.bmp) to the PROFIBUS configuration tool.

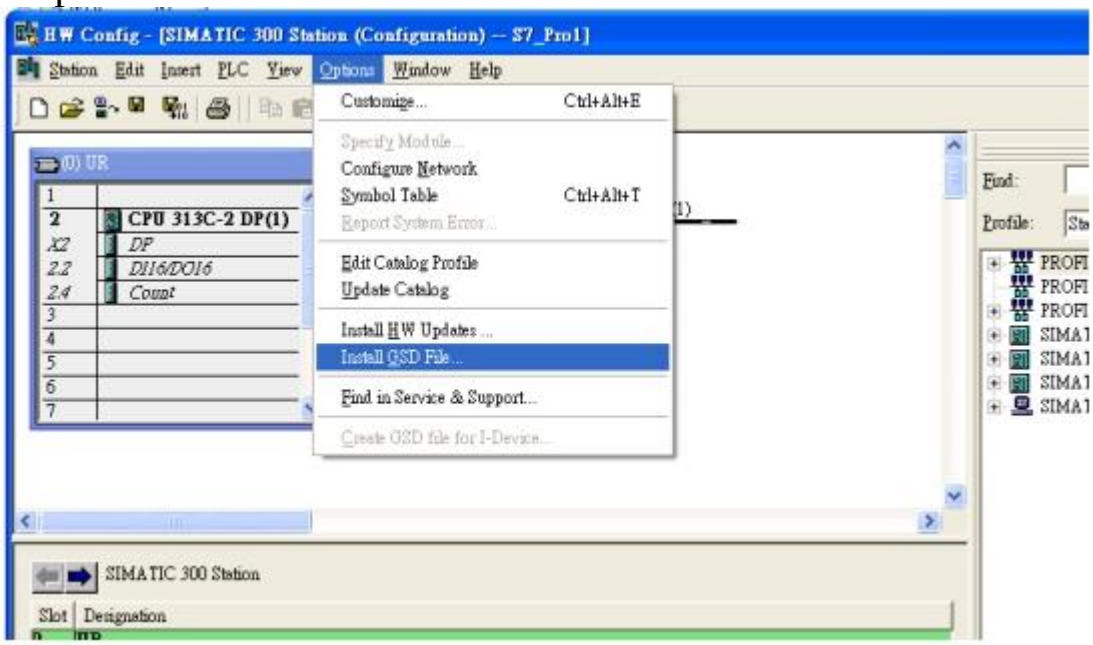
4.2.1 The example of how to load GSD file

In the following examples the Siemens S7-300 PLC is used. The configuration and communication is done by the program "SIMATIC Manager" provided by Siemens.

Step 1: Open "SIMATIC Manager" tool and select "New Project Wizard" to open a new project.

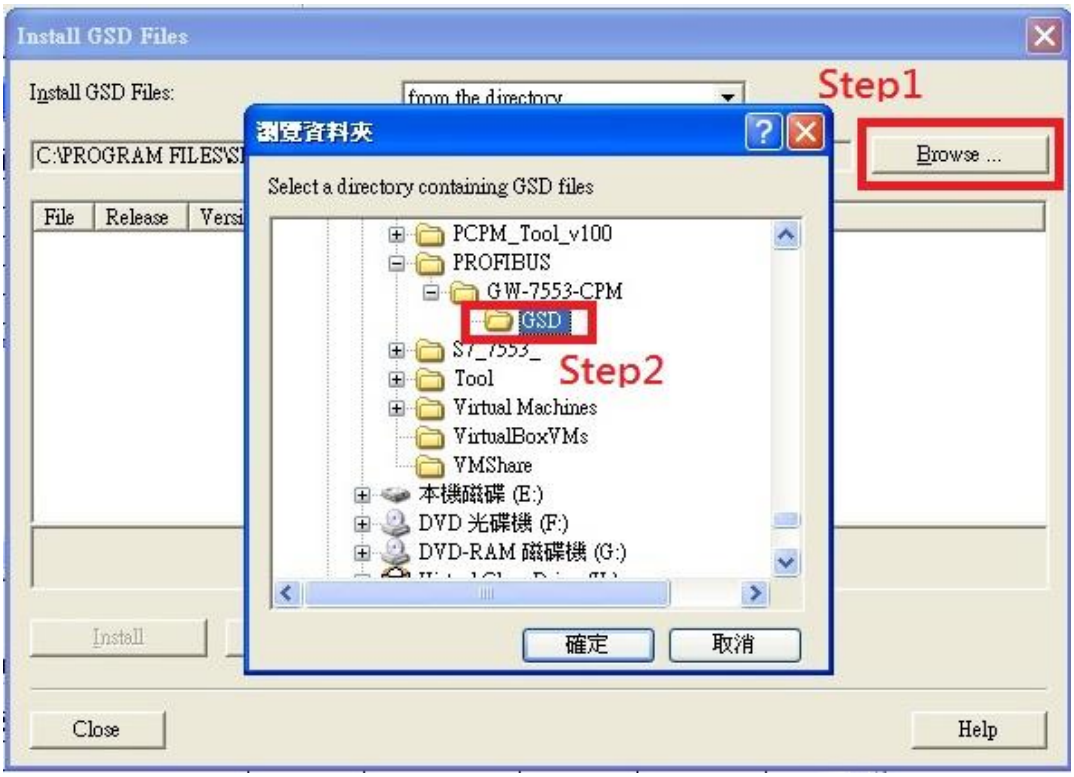
Step 2: Double Click "Hardware" to open "HW Config"

Step 3: Click "Install GSD File"

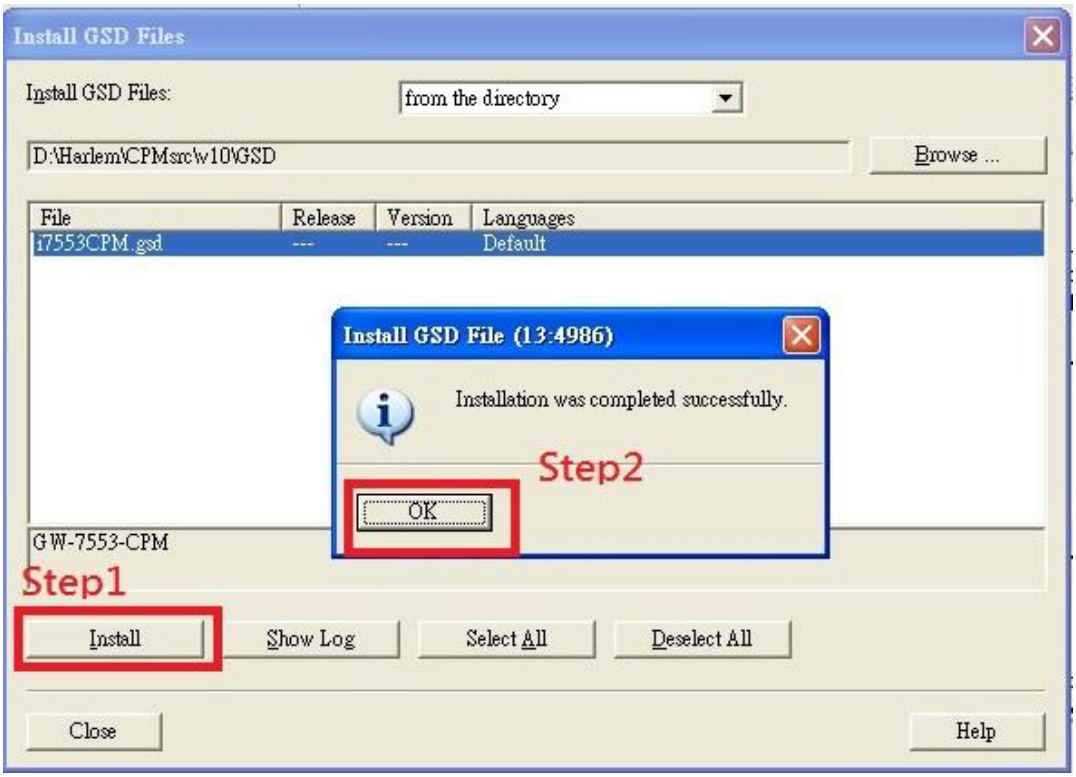


Step 4: Select the directory of GW-7553-CPM's GSD file(i7553CPM.gsd)

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Step 5: Click “Install” button



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4.3 The Configuration of the modules

The user can set the number and size of the I/O modules in the PROFIBUS configuration tool. The settings of the modules are described below.

- Max. I/O modules：111 modules
- System setting module：10 byte in, 10 byte out
- Output module：RxPDO => 1~8 Bytes
  RxSDO => 1、2、4Bytes
- Input module：TxPDO => 1~8 Bytes
  TxSDO => 1、2、4Bytes
- Max. length of I/O data：480 Bytes
- Output length：0~240 Bytes
- Input length：0~240 Bytes

Note:
The user must add "System setting module" at the first module before the other modules, else the GW-7553-CPM will send the diagnostic messages to PROFIBUS Master and the system will be abnormal.

The modules have module parameters about the communication settings. The module parameters are shown in the below：

A. TxPDO module parameters：
- TxPDO COBID : 0x180~0x4FF

B. RxPDO module parameters：
- RxPDO COBID : 0x200~0x57F

C. TxSDO module parameters：
- TxSDO COBID : 0x580~0x5FF

D. RxSDO module parameters：
- RxSDO COBID : 0x600~0x67F

4.4 Diagnostic messages

The GW-7553-CPM can show maximally 10 diagnostic messages at the same time. If the number of the diagnostic messages is bigger than 10, the GW-7553-CPM will not process other diagnostic message. The diagnostic messages have four types. They are "CANopen Device Error", "I/O Module Error", "System Setting Module Error" and "Communication Error". The diagnostic messages are

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shown in *table 9*.

Table 9 diagnostic messages

Messages	Description
CANopen Device 1~10 Error	CANopen Slave Disconnect!
	CANopen Set Guard Error!
	CAN Guard Failed!
	CAN Heartbeat Failed!
System setting module Error	Not find System setting module.
	Position is not correct!
Communication Error	I/O Module 1~110 Error!
I/O Module Error	Module Mismatch!
	COBID Error!

4.5 I/O data exchange

4.5.1 Input data area

The maximum length of input data is 240 bytes. Before arrange "Input module "or "CANopen Command module", the user must arrange and configure the "system setting module". The user can get data form CANopen slave devices by "read Input module" or "CANopen Command module".

Table 10 Input data area

Module	Byte	Data	Description
System setting module	0 ~9	Data	Diagnosis data
Input module	10~239	Data	Input data

4.5.2 Output data area and communication command

The maximum length of output data is 240 bytes. Before arrange the output module, the user must arrange and configure the system setting module. As shown in *table 11*.

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Table 11 Output data area

Module	Byte	Bit Position								Description
		7	6	5	4	3	2	1	0	
System setting module	0									Data output command
	1	-	-	-	-	-	-	-	DC	Control bit
	2									Output module select
	3~9									reserved
Output module	10~239									Output data

- Data output command(byte 0)
  When this byte is changed, PROFIBUS master device will send data of output module to RxPDO(non-cyclic) data of GW-7553-CPM.

  PS: When the user use this byte to trigger "data output command", the user must increase this byte in order (ex: 0->1, 1->2,…, 255->0) or else the GW-7553-CPM will send a diagnostic message to the PROFIBUS master.

- Control bit(byte 1)
  DC(bit 0)：When this bit is set (DC=1), diagnostic messages send by the GW-7553-CPM module will all be cleared.

  Bit 1~7：The remaining bits have to be set to zero.
- Output module select(byte 2)
  When this byte isn't '0' and the user change data output command(byte 0), it will trigger single data output command of the output module and this byte represent module address of the output module (ex: "byte 2"=3, it represent that the user want to trigger data output command of the third module)

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5. Application of Utility

5.1 Install Utility

Download the PROFIBUS/CANopen gateway utility setup file from the CD-ROM disk following the path of "CD:PROFIBUS\gateway\gw-7553-CPM\utilities \" or the web site "ftp://ftp.icpdas.com.tw/pub/cd/fieldbus_cd/PROFIBUS/gateway/gw-7553-cpm/utilities/"

5.2 Utility introduction

It introduces main window of the utility first, as shown in *Figure 19*.

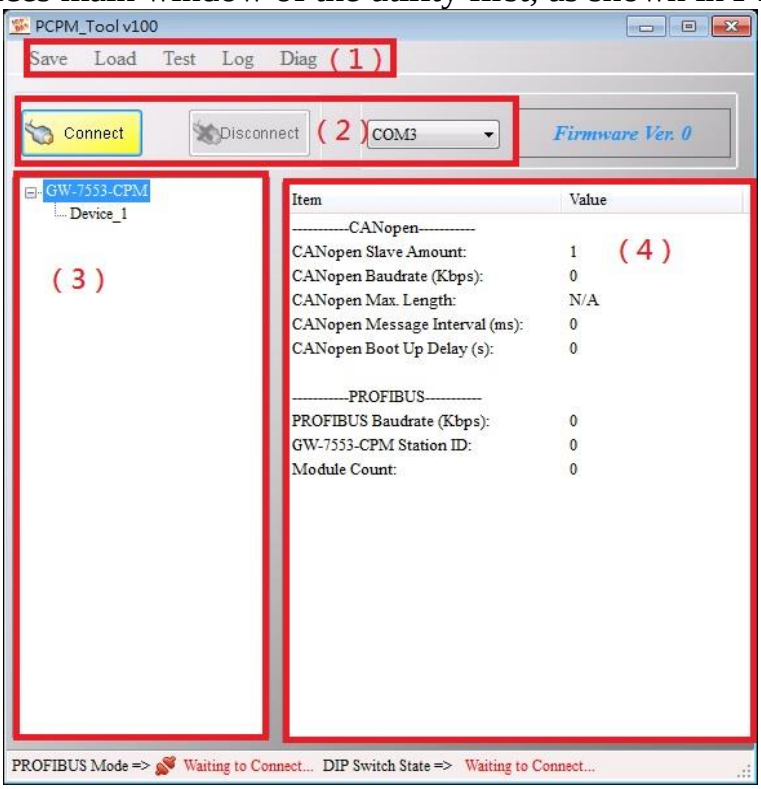


Figure 19 Main window of the utility

Main window of the utility has 4 parts, they are (1)Menu、(2)Connection control、(3)Device state、(4)Device information.

5.2.1 Menu：

1. Save:

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a. Save to Device：Save the CANopen setting to GW-7553-CPM.
b. Save Project File：Save the CANopen setting to project file of PC.

2. Load:
a. Load From Device：Load the CANopen setting from GW-7553-CPM.
b. Load Project File：Load the CANopen setting from project file of PC.

3. Test:
a. When user clicks this button, the PC will test all the CANopen commands of user setting.

4. Log:
a. When user clicks this button, the PC will log the CANopen messages between GW-7553-CPM and CANopen slave.

5. Diag:
a. When user clicks this button, the PC will read the diagnosis messages from GW-7553-CPM, and display on PC.

5.2.2 Connection control：

1. Connect button:
When the user clicks this button, the PC will open the com port and try to connect the GW-7553-CPM module.

2. Disconnect button:
When the user clicks this button, the PC will break the connection of theGW-7553-CPM and close the com port.

3. Com port select:
The PC will finds usable com port.

5.2.3 Device state

It can display the number of modules in the GW-7553-CPM and display module parameters in the window of the module.

1. Edit GW-7553-CPM Parameter
Right click on the GW-7553-CPM, as shown in *figure 18, 19.*
(a) CANopen Device Count:
The number of CANopen Slave in GW-7553-CPM, The max amount is 10.

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(b) CANopen baudrate(Kbps):
CAN bus baud rate setting. (10K ~ 1000K bps)

(c) CAN Message Interval:
User can slow the polling speed of the GW-7553-CPM through the parameter to avoid the CANopen network too busy.

(d) CAN Boot Up Delay:
This parameter let user decide when the GW-7553-CPM will really boot-up after power-on.

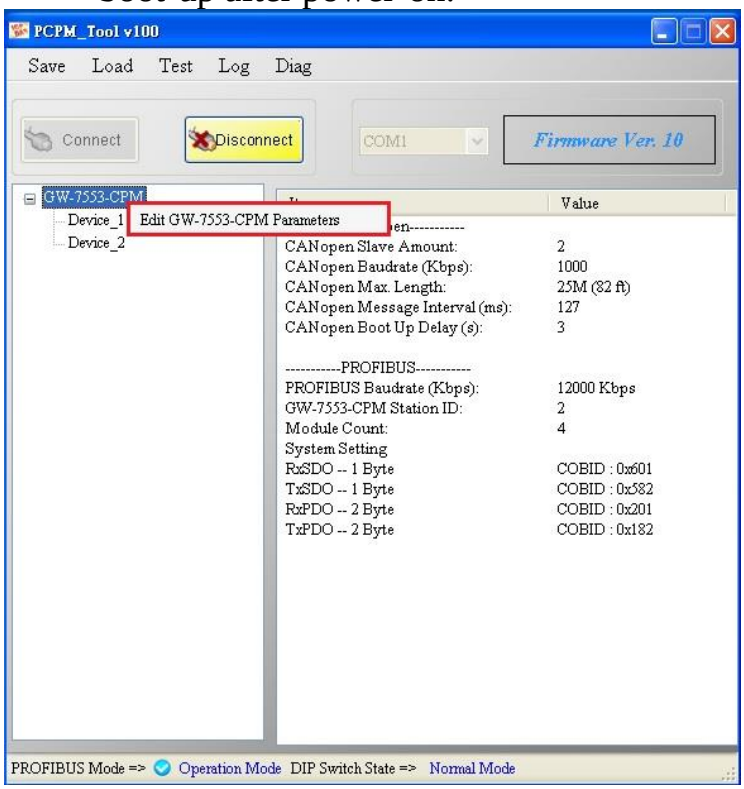


Figure 20 Select "Edit GW-7553-CPM Parameter" of the utility

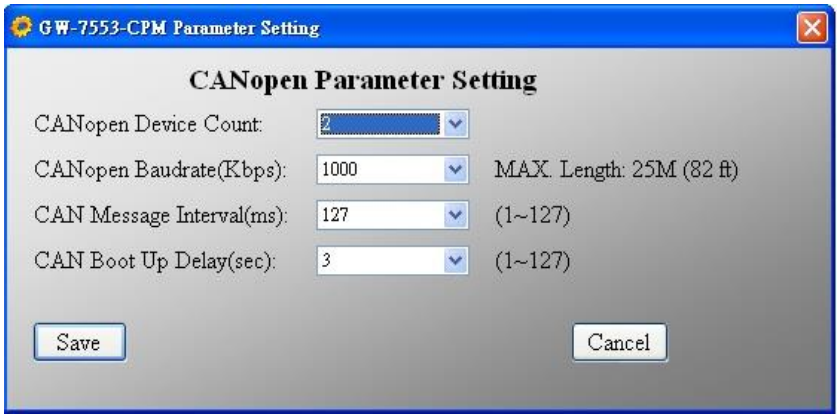


Figure 21 Edit GW-7553-CPM Parameter of the utility

2. Device Configurations
Double click a "Device_1" item, then the "Device Configurations" setting dialog is shown on the screen. Users can set CANopen slave ID,

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CANopen protect function, TxPDO, RxPDO, TxSDO, RxSDO, and so on, as shown in *figure 22*, *23*.

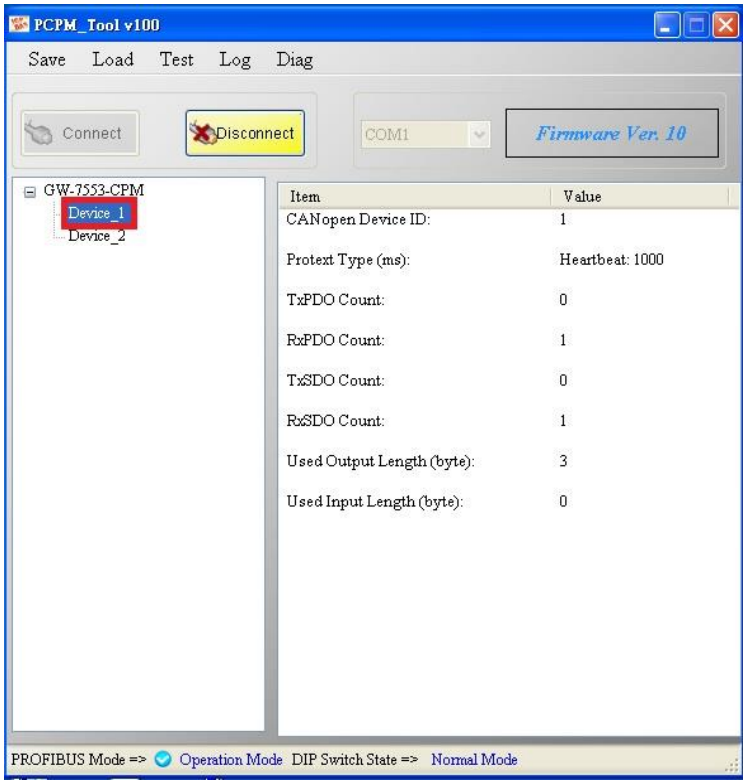


Figure 22 Select "Device_1" of the utility

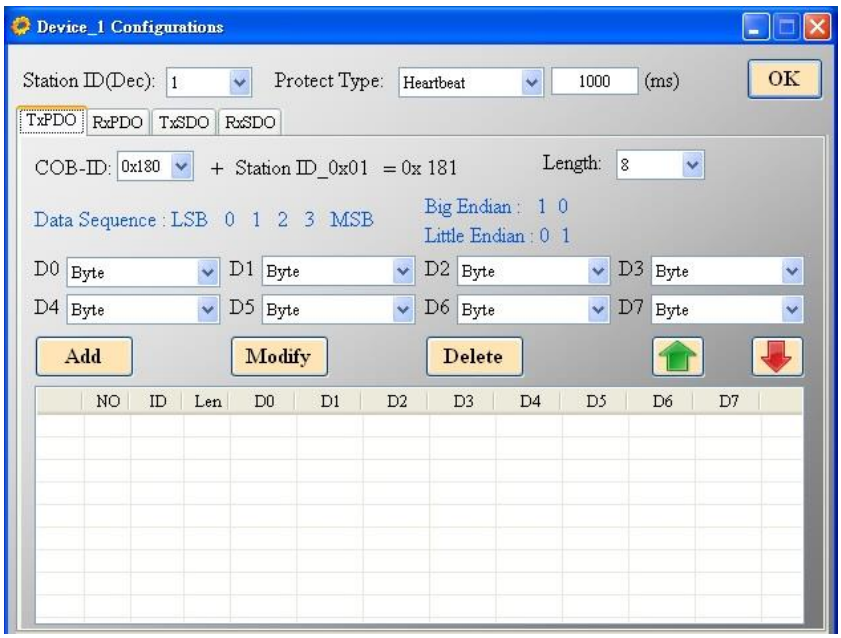


Figure 23 Device Configurations of the utility

(a) Station ID:

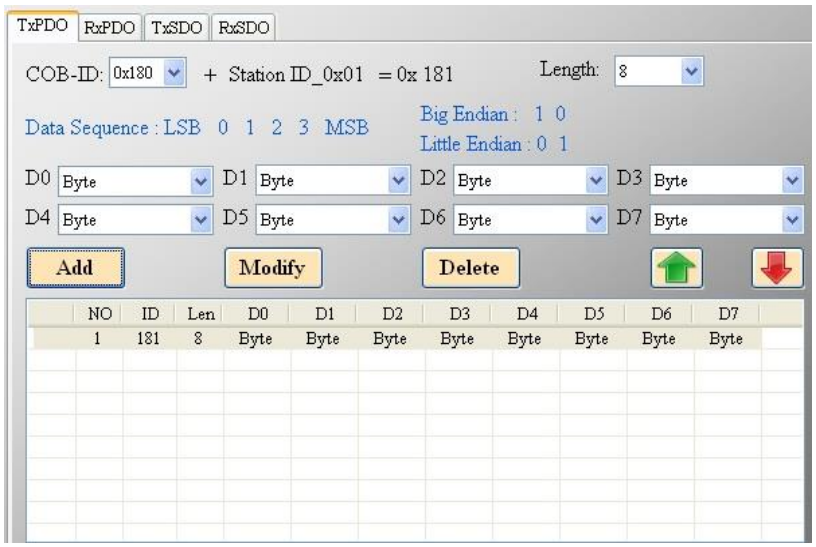
User can change it refer to his real CANopen slave ID. The range of ID is 1 ~ 127.

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(b) Protect Type:

The GW-7553-CPM provides two protect type, Node Guarding and Heartbeat protocol. If the CANopen slave supports one of these protocols, users can input the value for the life time of the CANopen slave. While the GW-7553-CPM boots up, it will start to detect the connection status of the specific CANopen slave.

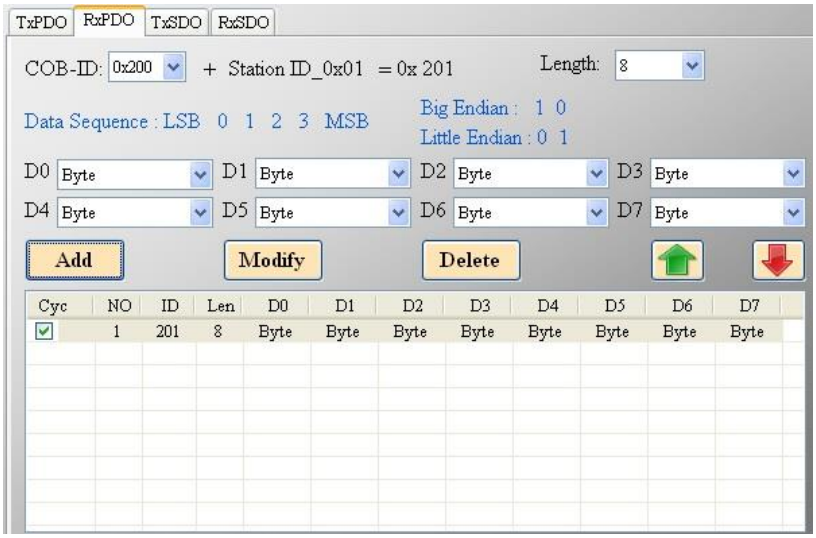
(c) TxPDO:



First, click the TxPDO Cob-ID finction code on combo box. The Cob-ID can is used to transmit the slave data which users want to read. Second, click “Len” combo box to set the proper PDO’s data length. Users must refer to the user manual of the CANopen slave device to set the data length. Then select the data type of each byte in the TxPDO and click “Add” to store the PDO configuration into the list. Users can also select the TxPDO information in the list and click the “Modify” and “Delete” button to modify the content of the list.

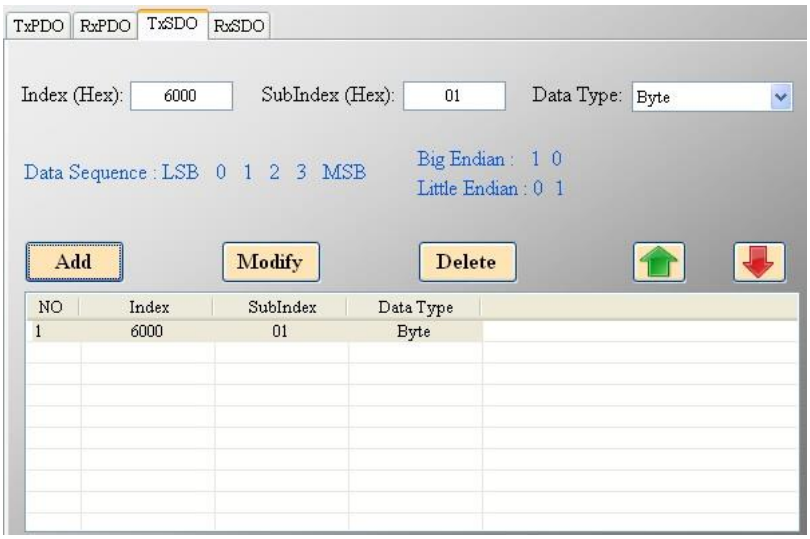
(d) RxPDO:

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The configuration of the RxPDO is almost the same as TxPDO except “Cyc” check box. The “Cyc” check box can decide the RxPDO to be run in the cyclic mode or the trigger mode. Check it to enable the cyclic mode, the RxPDO will be sent cyclically by the GW-7553-CPM whether the GW-7553-CPM has received the PROFIBUS triggers event to output the RxPDO message or not. If the “Cyc” not be checked, the RxPDO will be sent only while the GW-7553-CPM has received a PROFIBUS triggers event to output it.

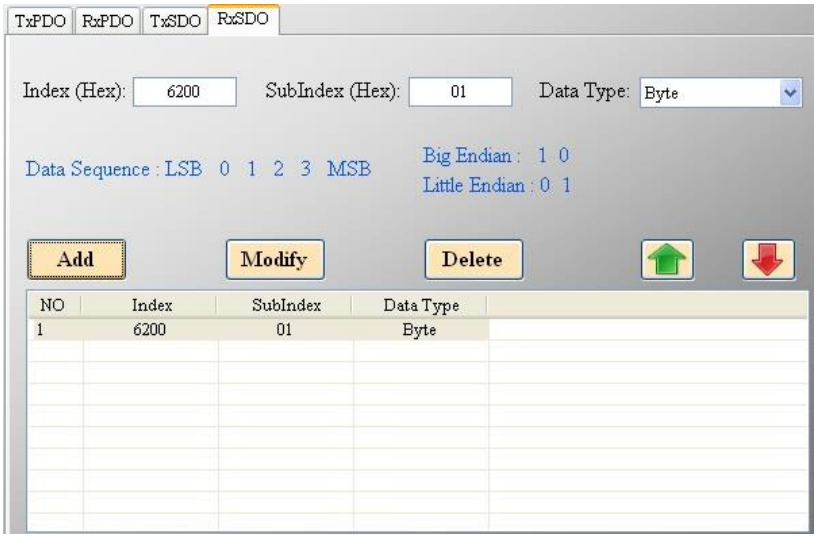
(e) TxSDO:



Input the “Index” and “SubIndex” of the object dictionary of the CANopen slave in these fields if users want to get the data via SDO. The GW-7553-CPM will polling these TxSDO messages.

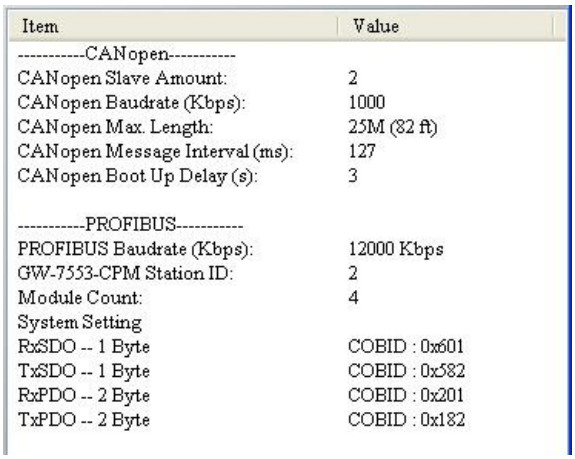
(f) RxSDO:

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Sometimes, users need to use the RxSDO to set some objects of a CANopen slave. Fill the "Index" and "SubIndex" of the object dictionary of the CANopen slave here.

5.2.4 Device information：



Item	Value
----------CANopen----------	
CANopen Slave Amount:	2
CANopen Baudrate (Kbps):	1000
CANopen Max. Length:	25M (82 ft)
CANopen Message Interval (ms):	127
CANopen Boot Up Delay (s):	3
----------PROFIBUS----------	
PROFIBUS Baudrate (Kbps):	12000 Kbps
GW-7553-CPM Station ID:	2
Module Count:	4
System Setting	
RxSDO -- 1 Byte	COBID : 0x601
TxSDO -- 1 Byte	COBID : 0x582
RxPDO -- 2 Byte	COBID : 0x201
TxPDO -- 2 Byte	COBID : 0x182

Figure 24 Device Information of the utility

Display module parameters of the GW-7553-CPM

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6. Troubleshooting

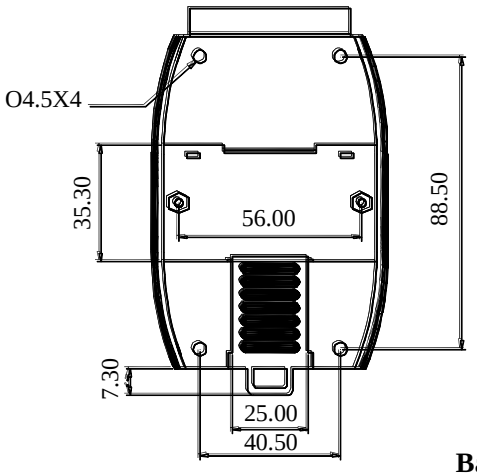
The troubleshooting list can help users to resolve the problems when using the GW-7553-CPM. If the problem still can't be solved, please contact with technical staff of ICP DAS.

Table 12 Errors and solutions

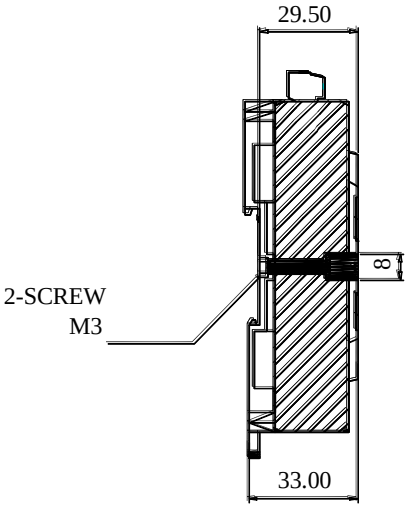
Item	Trouble state	Solution
1	'PWR' LED indication of the GW-7553-CPM is always turned off	The power supply of GW-7553-CPM has some problems. Please check the wire connection of the power and the voltage is between 10~30VDC.
2	'ERR' LED indication of the GW-7553-CPM is always turned on	That means the GW-7553-CPM isn't connecting to the PROFIBUS master station. Please check the wire connection and the PROFIBUS master station. The configuration and address of GW-7553-CPM in the PROFIBUS master station are not correct.
3	'ERR' LED indication of the GW-7553-CPM is flashing fast	It means the GW-7553-CPM is connects with Utility. Please close Utility.
4	'ERR' LED indication of the GW-7553-CPM is flashing slow	It means the GW-7553-CPM has diagnostic messages. Please check diagnostic messages in the PROFIBUS master station.
5	PROFIBUS master station can not communicate with the CANopen device, when “RUN LED” of the GW-7553-CPM is light and “ERR LED” of the GW-7553-CPM is dark.	a. Please confirm the GW-7553-CPM is working in normal mode and avoid clearing diagnostic message by communication command (please refer section 2.6 Normal/Setting Dip Switch and section 4.5.2 Output data area and communication command). b. Please confirm the connection between the GW-7553-CPM and CANopen device. c. Please connect with Utility, and use “Load From Device” item, check the CANopen information of GW-7553-CPM.

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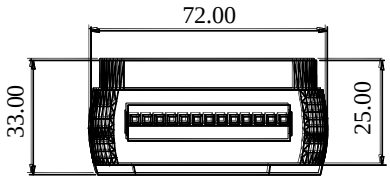
7. Dimensions



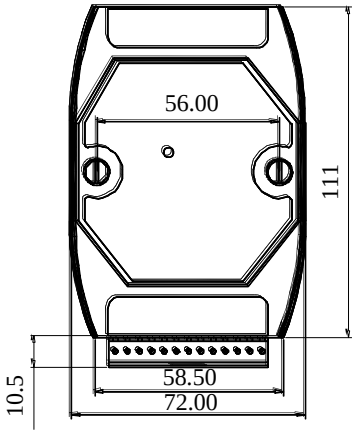
Back View



Side View



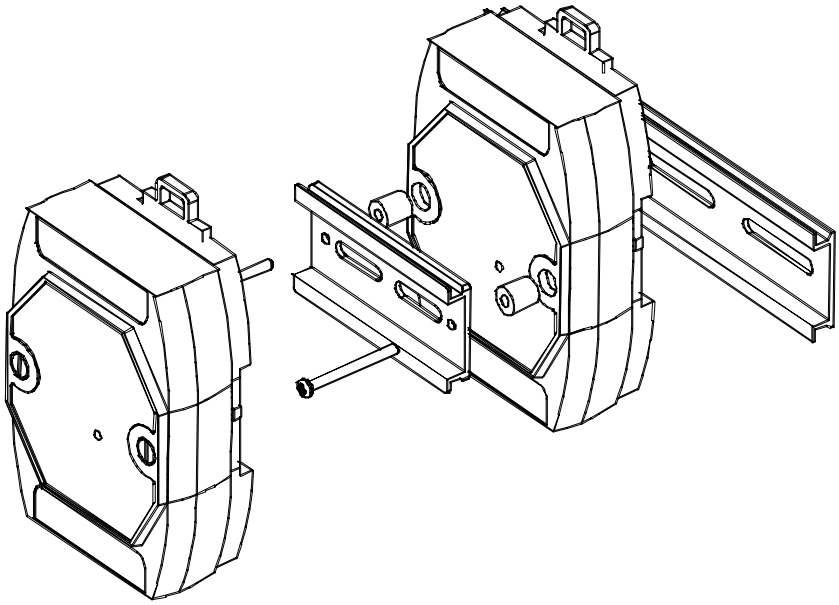
Top View

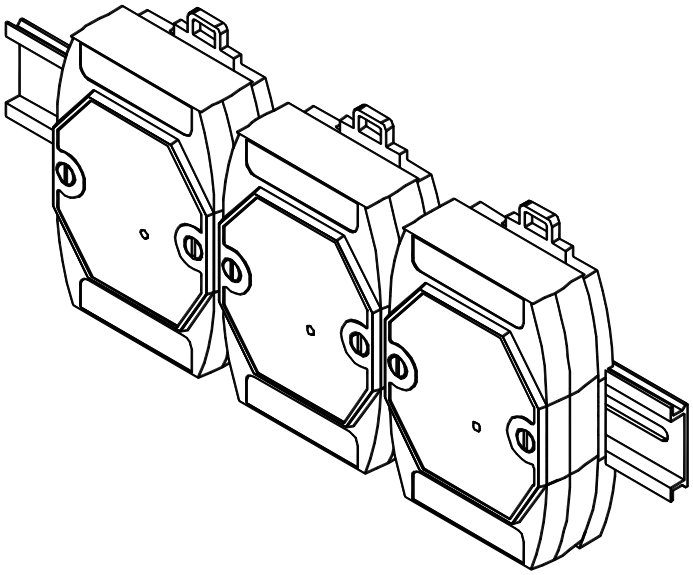


From View

Unit : mm

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