GW-7228

J1939/Modbus RTU Slave Gateway

User's Manual



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1.1	T.H.	2011-04-29	Modify Modbus register define
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1. Introduction

The GW-7228 is a solution that provides a protocol conversion between J1939 and Modbus RTU. For J1939 network, the GW-7228 supports PDU1, PDU2, broadcast and the destination specific type of J1939 messages. From the view of Modbus RTU network, the GW-7228 is a Modbus RTU slave to reply the request from Modbus RTU master. We provide Utility software for users to configure the parameters of J1939 / Modbus RTU of the GW-7228. The application fields can be Diesel power-train applications, In-Vehicle networks for trucks and buses, etc.

The following is the application architecture for the GW-7228 **:**

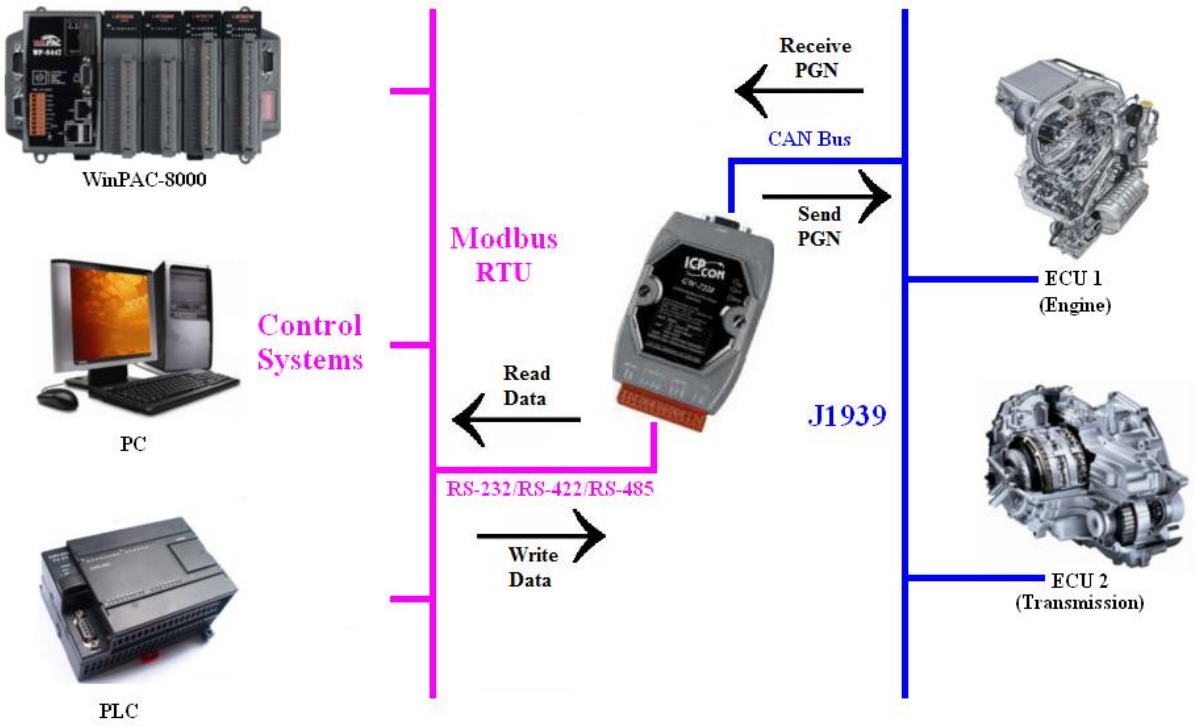


Figure 1-1**:** Application of the GW-7228

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1.1 Mode of operation

The GW-7228 provides centralized data storage, for data that is shared between the Modbus and J1939 networks. Data is placed into the GW-7228 by one network interface, and allowing the data to be read or written through the other network interface.

1.2 Features

- RoHS Design
- Provide PWR / J1939 / MODBUS indication LEDs
- The built-in jumper to select 120 ohm terminal resister of CAN bus
- Watchdog inside
- Transmission and reception of all types of J1939 messages, including PDU1, PDU2, broadcast and destination specific.
- J1939 Transport Protocol for transmission and reception of large messages (9 - 1785 bytes).
- Support BAM of Connection Management Message.
- Network addresses management.
- Support RS-232, RS-485 and RS-422 interfaces
- Support Modbus RTU slave protocol.
- Configurable for Modbus Network ID(1~250).
- Configurable baud rates of 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps.
- Configurable for none, odd, or even parity and 1 or 2 stop bits.
- Support Function Code 03 / 04 / 06 / 16 of Modbus functions for reading and writing J1939 Messages.

1.3 Specifications

[UART specs:]

- Connector : 14-pin screw terminal connector
- COM1 : RS-232(TXD, RXD, GND)
  RS-422(Tx+, Tx-, Rx+, Rx-)
  RS-485(D+, D-)
- Baud Rate (bps) : 2400, 4800, 9600, 19200, 38400, 57600, 115200

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[CAN specs:]

- CAN interface connector **:** 9-pin D-sub male
- CAN Baud Rate **:** 250k
- Isolation Voltage **:** 3000 VDC power protection on CAN side, 2500Vrms photo-couple isolation on CAN bus
- Terminator Resistor: Selectable 120Ω terminator resistor by jumper
- Specification; ISO-11898-2, CAN 2.0A and CAN 2.0B

[Module specs:]

- Dimensions **:** 117mm x 72mm x 35mm (H x W x D)
- Operating temperature **:** -25 to 75°C (-13 to 167°F)
- Storage temperature **:** -40 to 80°C (-40 to 176°F)
- Humidity **:** 5 to 95%, non-condensing
- LEDs **:** PWR LED for power
  J1939 LED for J1939 communication
  MODBUS LED for Modbus communication

[Software Utility Tool:]

- Provide Modbus network configuration interface.
- Provide J1939 network configuration interface – Network Address / Device Name, etc.
- Provide J1939 Input / Output configuration interface.

[Application:]

- Diesel power-train applications
- In-Vehicle networks for trucks and buses
- Truck-Trailer connections
- Fleet management systems
- On Board Diagnostics
- Vehicle Automation

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2. Hardware



Figure 2-1**:** Hardware externals of the GW-7228

2.1 Block Diagram

Figure 2-2 is a block diagram illustrating the functions on the GW-7228 module. It provides the 3000Vrms Isolation in the CAN interface site.

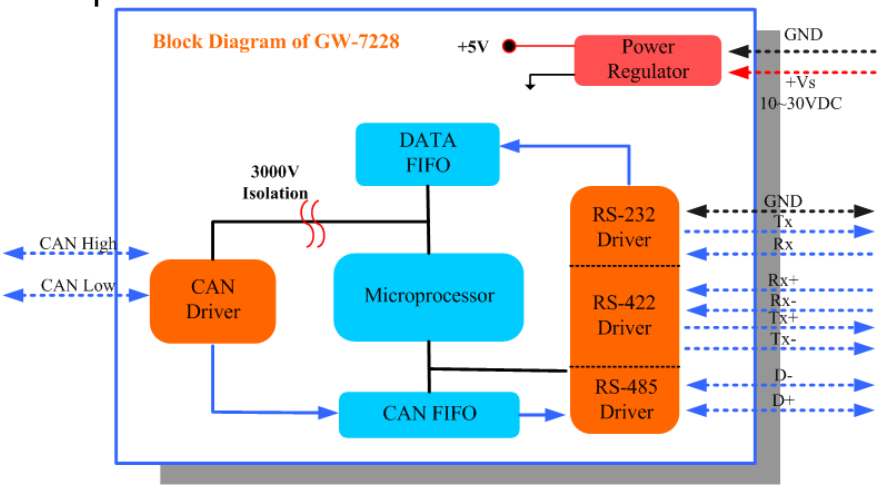


Figure 2-2**:** Block diagram of the GW-7228

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2.2 Pin Assignment

Table 2-1: CAN DB9 Male Connector

Pin	Description
1	Not Connect
2	**CAN Low**
3	CAN Ground
4	Not Connect
5	
6	CAN Ground
7	**CAN High**
8	Not Connect
9	

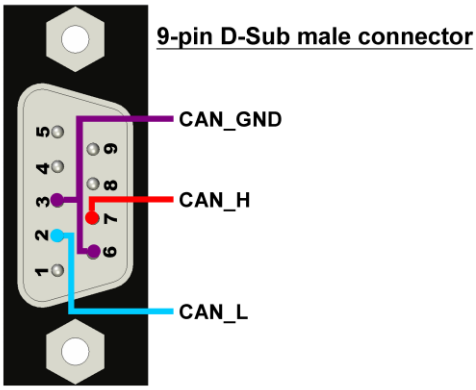


Table 2-2: 14-pin screw terminal connecter

Pin	Description
1	RS-485 DATA+
2	RS-485 DATA-
3	Not Connect
4	RS-422 Tx+
5	RS-422 Tx-
6	RS-422 Rx+
7	RS-422 Rx-
8	Not Connect
9	RS-232 RXD
10	RS-232 TXD
11	RS-232 GND
12	Not Connect
13	+Vs(+10 ~ +30 VDC)
14	GND

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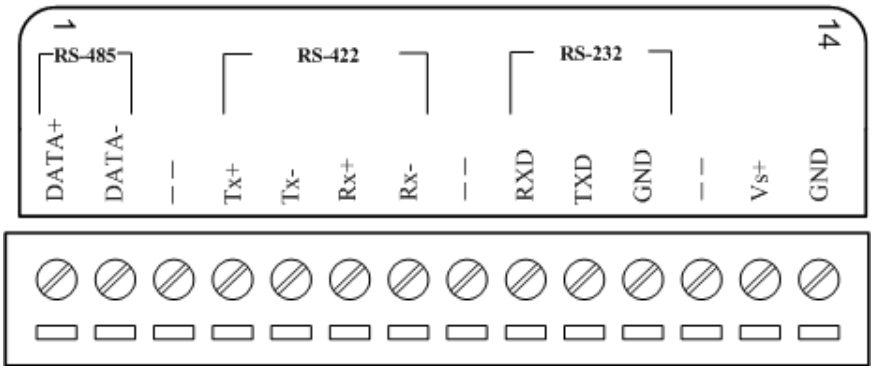


Figure 2-3**:** Pin Assignment on the GW-7228

2.3 Hardware Connection

The GW-7228 module supports J1939 / Serial Port communication, it offers one CAN interface for J1939 network and three serial interfaces for Modbus network.

2.3.1 CAN port connection

The pin assignment of the CAN port on the GW-7228 (DB9 male) is defined in both the CANopen DS102 profile and in appendix C of the DeviceNet specifications. It is the standard pin assignment for CAN. The hardware connection between device and the GW-7228 is as Figure 2-4.

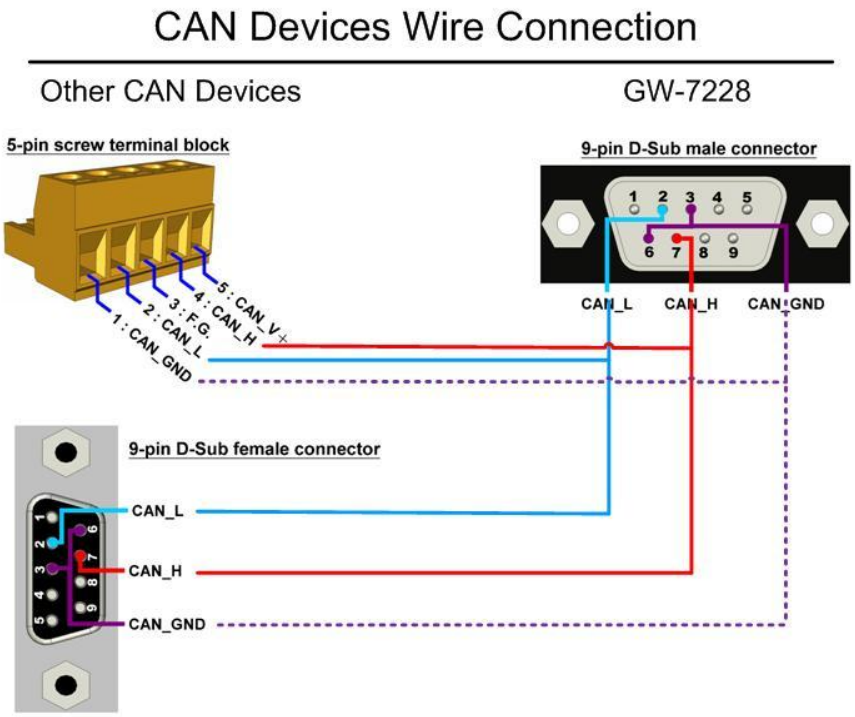


Figure 2-4**:** CAN Hardware Wire Connection

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2.3.2 Serial port connection

Connect the PC running GW-7228 Utility to the GW-7228 module by using a standard serial cable between the PC serial port and the screw terminal connector on the module.

The GW-7228 offers three serial interfaces to the user, and not through any setting. It is recommended to use only one serial port (RS232, RS422 or RS485) of the gateway at the same time. The following figures describe the three COM port types to a serial device via serial network.

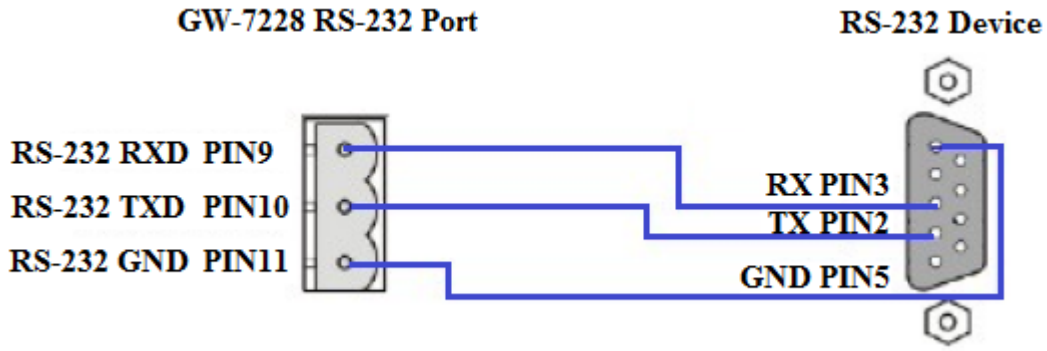


Figure 2-5**:** RS-232 Wire Connection



Figure 2-6**:** RS-422 Wire Connection

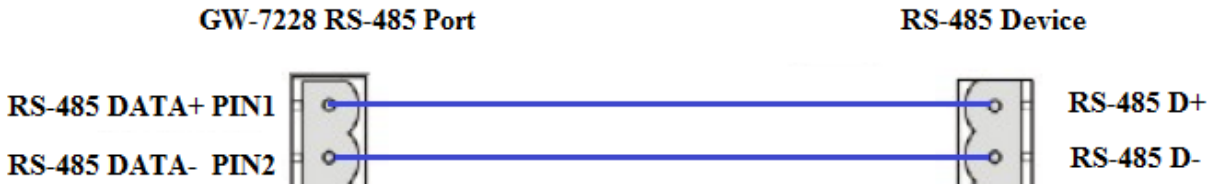


Figure 2-7**:** RS-485 Wire Connection

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2.4 Terminator Resistor Settings

According to the ISO 11898 specifications, the CAN Bus network must be terminated by two terminal resistors (120Ω) for proper operation, as shown in the below figure.

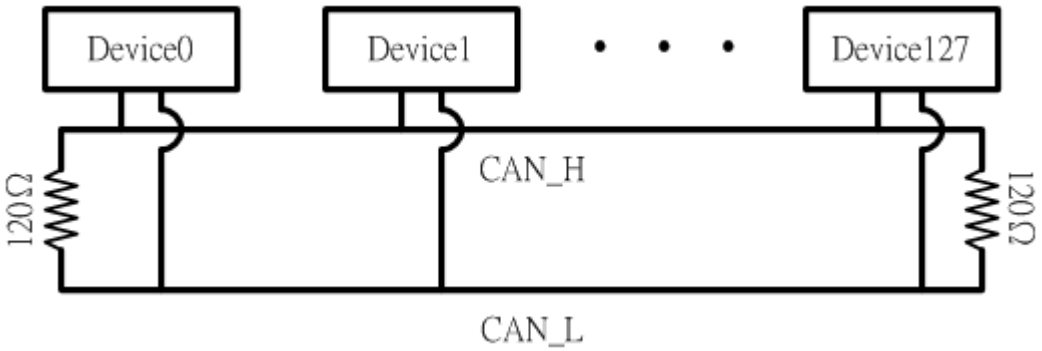


Figure 2-8: Terminal Resistor

Therefore, the GW-7228 module supplies a jumper for users to active the terminal resistor or not. If users want to use this terminal resistor, please open the GW-7228 cover and use the JP3 to activate the 120Ω terminal resistor built in the module, as the Figure 2-9. Note that the default setting is active.

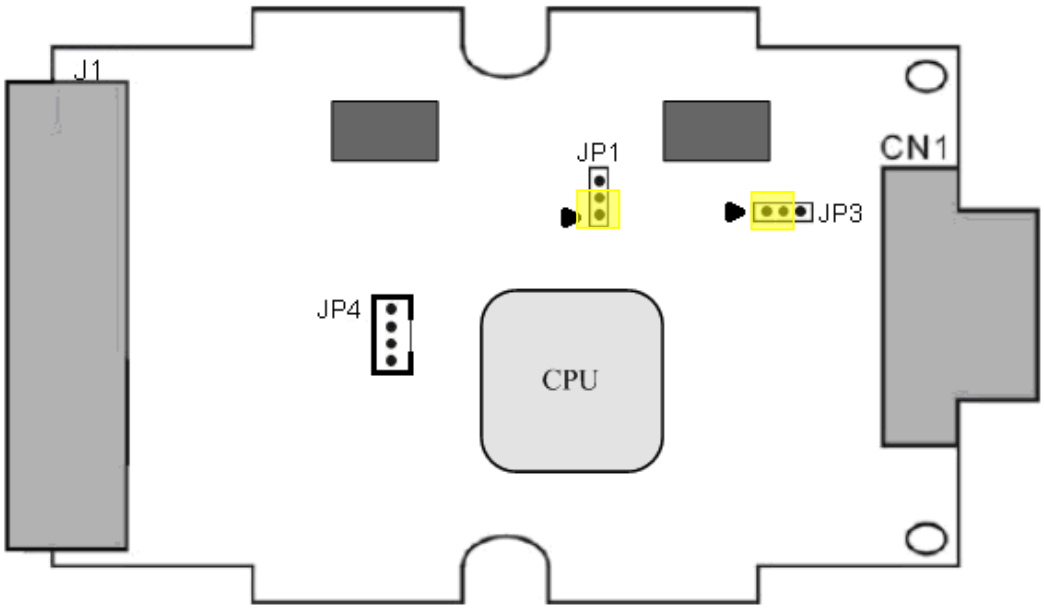


Figure 2-9: Terminal Resistor Jumper

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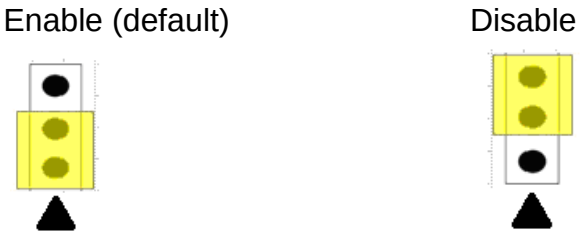


Figure 2-10**:** Terminal resistor JP3 Jumper Position

2.5 Watchdog Timer Settings

A watchdog timer (WDT) is a device that performs a specific operation after a certain period of time if something goes wrong and the system does not recover on its own. A watchdog timer can perform a warm boot(restarting the system) after a certain number of milliseconds.

The GW-7228 module supplies a jumper for users to active the watchdog timer or not. If users want to use this WDT, can open the GW-7228 cover and use the JP1 to activate the WDT built in the module, as the Figure 2-9. Note that the default setting is active.

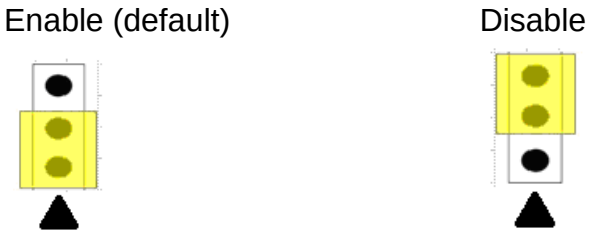


Figure 2-11: Watchdog timer JP1 Jumper Position

2.6 Init / Normal Dip-switch

On the back of the GW-7228 module, there is a dip-switch used for firmware operation or firmware updating of the module. The following steps show how to use this dip-switch.

2.6.1 Firmware Update Mode

Please set the dip-switch to the “Init” (Initial) position as Figure 2-12, and then the GW-7228 will work in the “Firmware Update Mode” after

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reset the power of the module. In this mode, users can update the firmware of the GW-7228 module from computer's RS-232 port via CA-0910 cable shown as Figure 2-14.

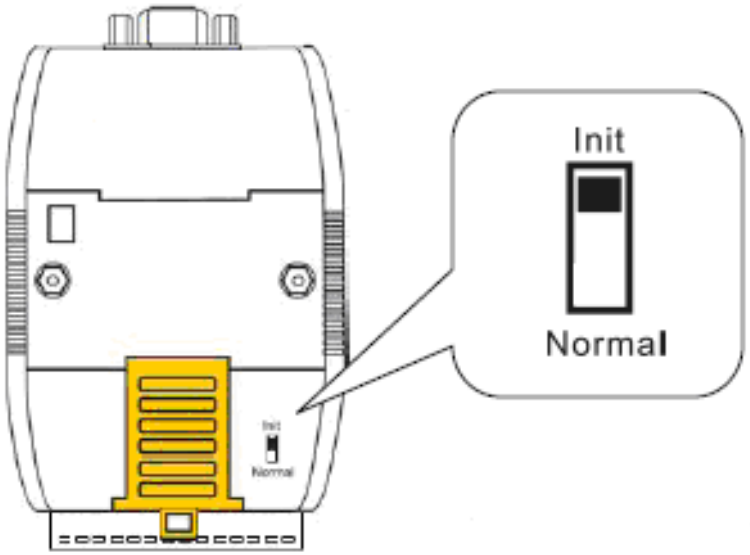


Figure 2-12**:** Init Position of Dip-Switch



Figure 2-13**:** CA-0910 Cable

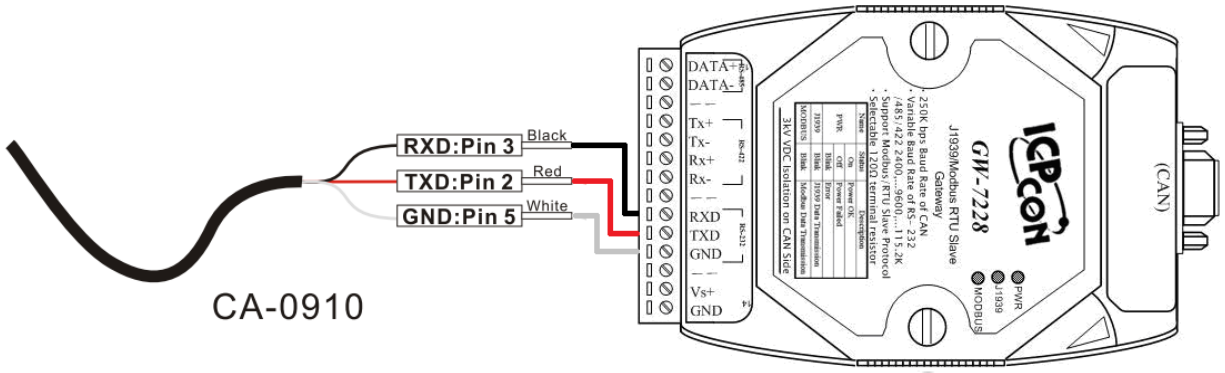


Figure 2-14**:** Firmware downloads connection

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Users just need to execute “Firmware_Update_Tool.exe” and follow the below steps to complete the firmware updating process.
[1] Choose “**COM**” interface and “**COM Port**”.
[2] Click “**Browser**” button to choose firmware file. (e.g. **GW7228.fw**)
[3] Click “**Firmware Update**” button to start firmware updating process.

The result will show in “Firmware Update” field.

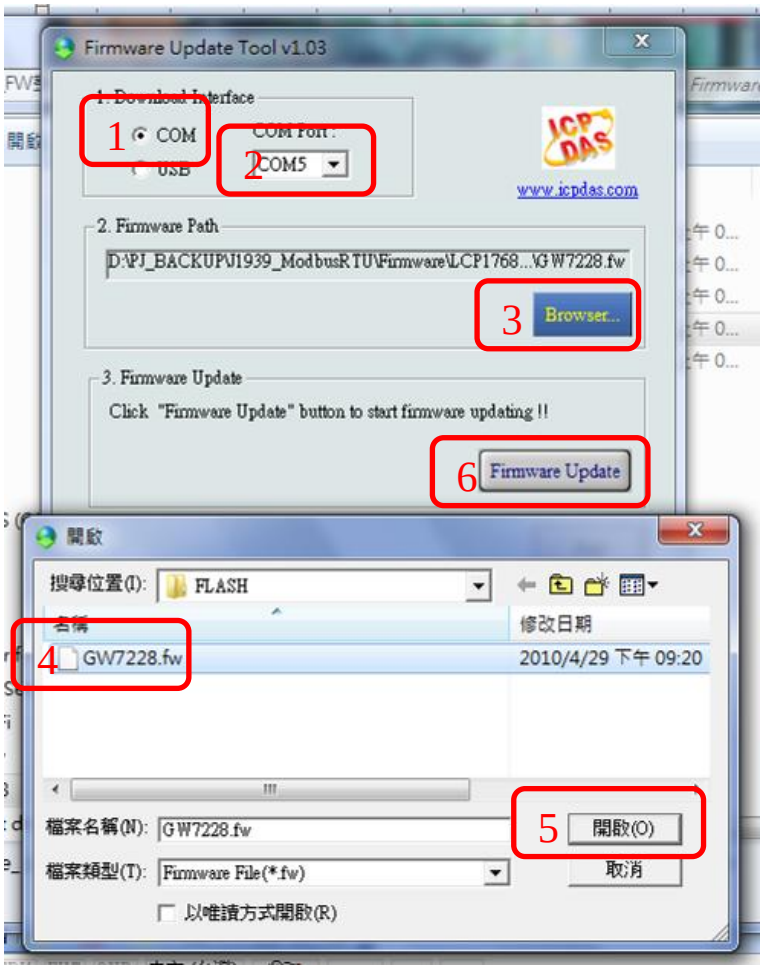


Figure 2-15**:** GW-7228 firmware update process

The GW-7228 firmware can be downloaded from http://ftp.icpdas.com/pub/cd/fieldbus_cd/J1939/gateway/gw-7228/firmware.

The Firmware_Update_Tool program can be downloaded from http://ftp.icpdas.com/pub/cd/fieldbus_cd/J1939/gateway/gw-7228/software/tool.

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2.6.2 Firmware Operation Mode

In the operation mode, users need to set the dip-switch to the “Normal” position as Figure 2-16 and reset the power. The GW-7228 can run in the operation mode. In this mode, users can use the Modbus Master command to set / get J1939 messages via COM port.

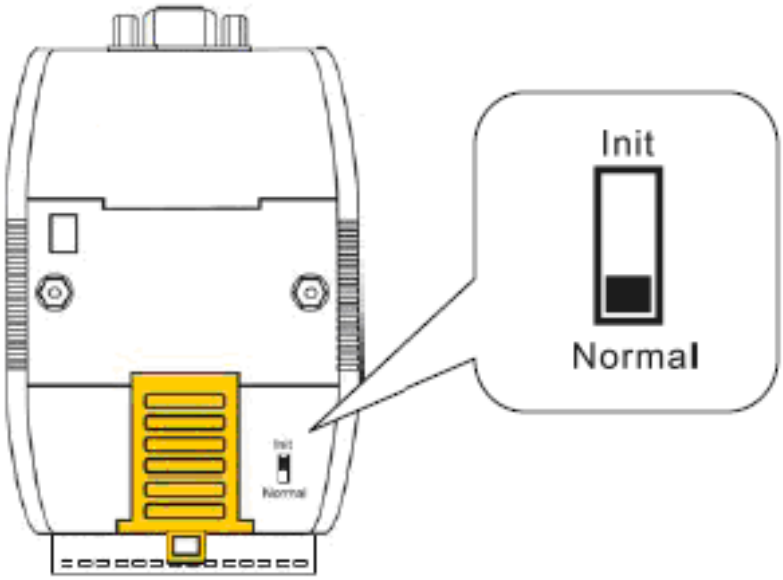


Figure 2-16**:** Normal Position of Dip-Switch

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2.7 LED Indication

There are three LEDs to indicate what state the GW-7228 is in. The following is the illustration of these three LEDs and the position of these three LEDs shown as Figure 2-17.

(1) PWR LED :

It is used to help users to check whether the GW-7228 is standby. If the module is working in “firmware operation” mode, the PWR LED is always turned on.

It is also used for demonstrating an error that has occurred. The PWR LED is normally turned on when the module works in a good condition. When the Bus-Off error is happened, the PWR LED will blink per 500 ms until the Bus-Off condition disappears. If the CAN message can’t be sent out successfully, then the PWR LED will blink per 100 ms.

(2) J1939 LED :

It is used to show whether the GW-7228 is transmitting/receiving CAN messages. The J1939 LED will blink whenever a CAN message is sending or receiving.

(3) MODBUS LED :

It is used to show whether the GW-7228 is transmitting/receiving Modbus messages. The MODBUS LED will blink whenever a Modbus message is sending or receiving.

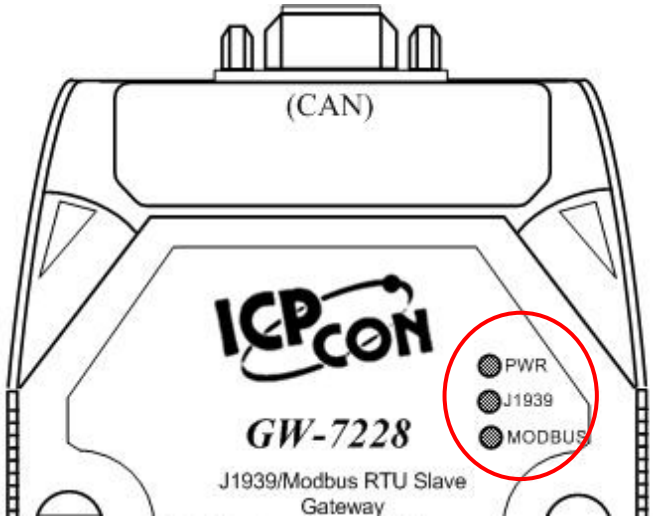


Figure 2-17**:** LED position of the GW-7228

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Table 2-3**:** LED indication of the GW-7228

LED Name	GW-7228 Status	LED Status
ALL LEDs	Firmware Updating Mode	All LED always turned on
	Hardware WDT Fail	All LED blink per 1 second
	Contact to ICP DAS	All LED blink per 100 ms
PWR LED	No Error	Always turned on
	CAN Bus Transmission Fail	Blink per 100 ms
	CAN Bus-Off	Blink per 500 ms
	Can't Claim Address in J1939 Network	Blink per 1000 ms
	Power Failure	Off
J1939 LED	Transmission	Blink
	Bus Idle	Off
MODBUS LED	Transmission	Blink
	Bus Idle	Off

2.8 Cable Selection

The CAN bus is a balanced (differential) 2-wire interface running over either a Shielded Twisted Pair (STP), Un-shielded Twisted Pair (UTP), or Ribbon cable. The CAN-L and CAN-H Wire start on one end of the total CAN network that a terminator of 120 Ohm is connected between CAN-L and CAN-H. The cable is connected from CAN node to CAN node, normally without or with short T connections. On the other end of the cable again a 120Ω(Ohm) terminator resistor is connected between the CAN lines. How to decide a cable type, cable length, and terminator depends on the baud rate in the CAN bus network, please refer to the following table 2-4.



Figure 2-18**:** Un-shielded Twisted Pair (UTP)

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Table 2-4**:** Cable selection

Bus speed	Cable type	Cable Resistance/m	Terminator	Bus Length
50k bit/s at 1000m	0.75~0.8mm2 18AWG	70 mOhm	150~300 Ohm	600~1000m
100k bit/s at 500m	0.5~0.6 mm2 20AWG	< 60 mOhm	150~300 Ohm	300~600m
500k bit/s at 100m	0.34~0.6mm2 22AWG, 20AWG	< 40 mOhm	127 Ohm	40~300m
1000k bit/s at 40m	0.25~0.34mm2 23AWG, 22AWG	< 40 mOhm	124 Ohm	0~40m

Note: The AWG means a standard method used to measure wire. The numbering system works backwards from what people would think, the thicker (heavier) the wire, the lower the number. For example: a 24AWG wire is thicker/heavier than a 26AWG wire.

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3. Software

This chapter describes how the GW-7228 J1939/Modbus RTU Interface is configured using the configuration tool (GW-7228 Utility).

3.1 Configuration Tool – GW-7228 Utility

The GW-7228 configuration tool allows you to configure the parameters associated with the Modbus and J1939 network interfaces as well as to layout of the I/O table and set up the contents.

GW-7228 Utility is a Microsoft Windows application that communicates with a GW-7228 over a standard RS-232/ RS-422/ RS-485 serial link by using the PC serial port. It is compatible with Microsoft Windows 95, 98, NT, 2000, Vista and 7.

The GW-7228 Utility can be downloaded from http://ftp.icpdas.com/pub/cd/fieldbus_cd/J1939/gateway/gw-7228/software/utility.

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3.2 GW-7228 Utility

The following is the main screens provided by GW-7228 Utility.

3.2.1 Connection Screen

When users execute the GW-7228 Utility, it will show connection function screen first for connecting to the GW-7228 as Figure 3-1. The following is the illustration for connection parameters.

[1] **COM** : The serial com port number.
(COM1~ COM32)

[2] **Baud Rate** : Serial com port baud rate setting.
(2400~115200 bps, default:115200)

[3] **Parity** : Serial com port parity setting.
(NONE / ODD / EVEN, default:NONE)

[4] **Net ID** : Modbus network Net ID setting.
(1~250, default:1)

[5] **Data Bits** : Serial com port data bits setting.
(Fixed at 8)

[6] **Stop Bits** : Serial com port stop bits setting.
(1 / 2, default:1)

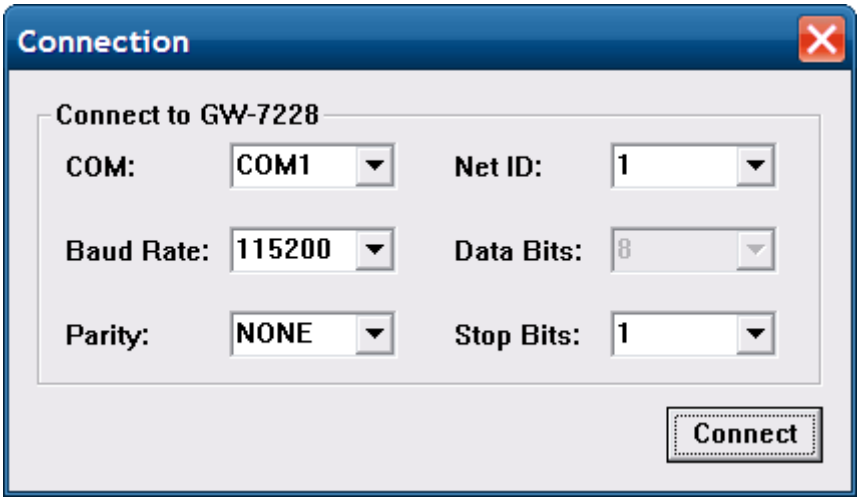


Figure 3-1**:** Connection Screen of GW-7228 Utility

After finish the connection setting, please click "**Connect**" button to connect to the GW-7228 module.

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If the connection settings, external wiring and the GW-7228 module are normal, it shows connection successful screen as Figure 3-4.

The GW-7228 status such as Interface/Data Created/Error/Firmware Version would be shown, otherwise, it shows abnormal connection screen as Figure 3-2 and Figure 3-3.



Figure 3-2: Open COM Error Screen



Figure 3-3: COM Receive Time Out Error Screen

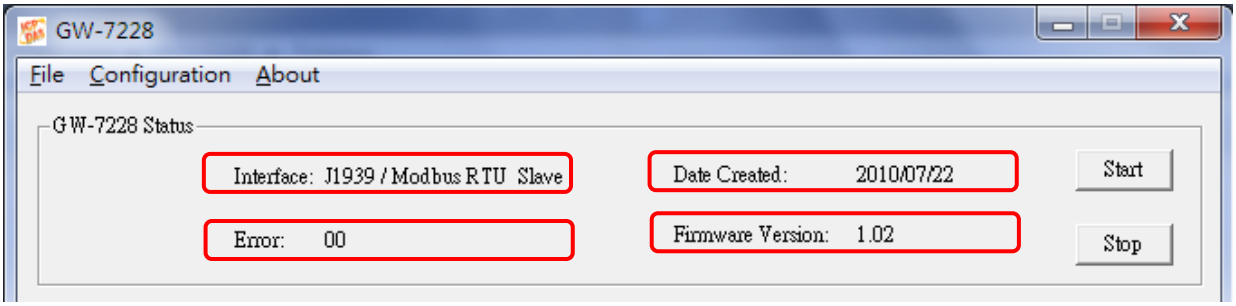


Figure 3-4: COM Connection Successful Screen

Table 3-1 GW-7228 error status

Error Code	Status
00	No Error
01	Can't Claim Address in J1939 Network
02	CAN Bus-Off
04	CAN Bus Transmission Fail

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3.2.2 Main Screen

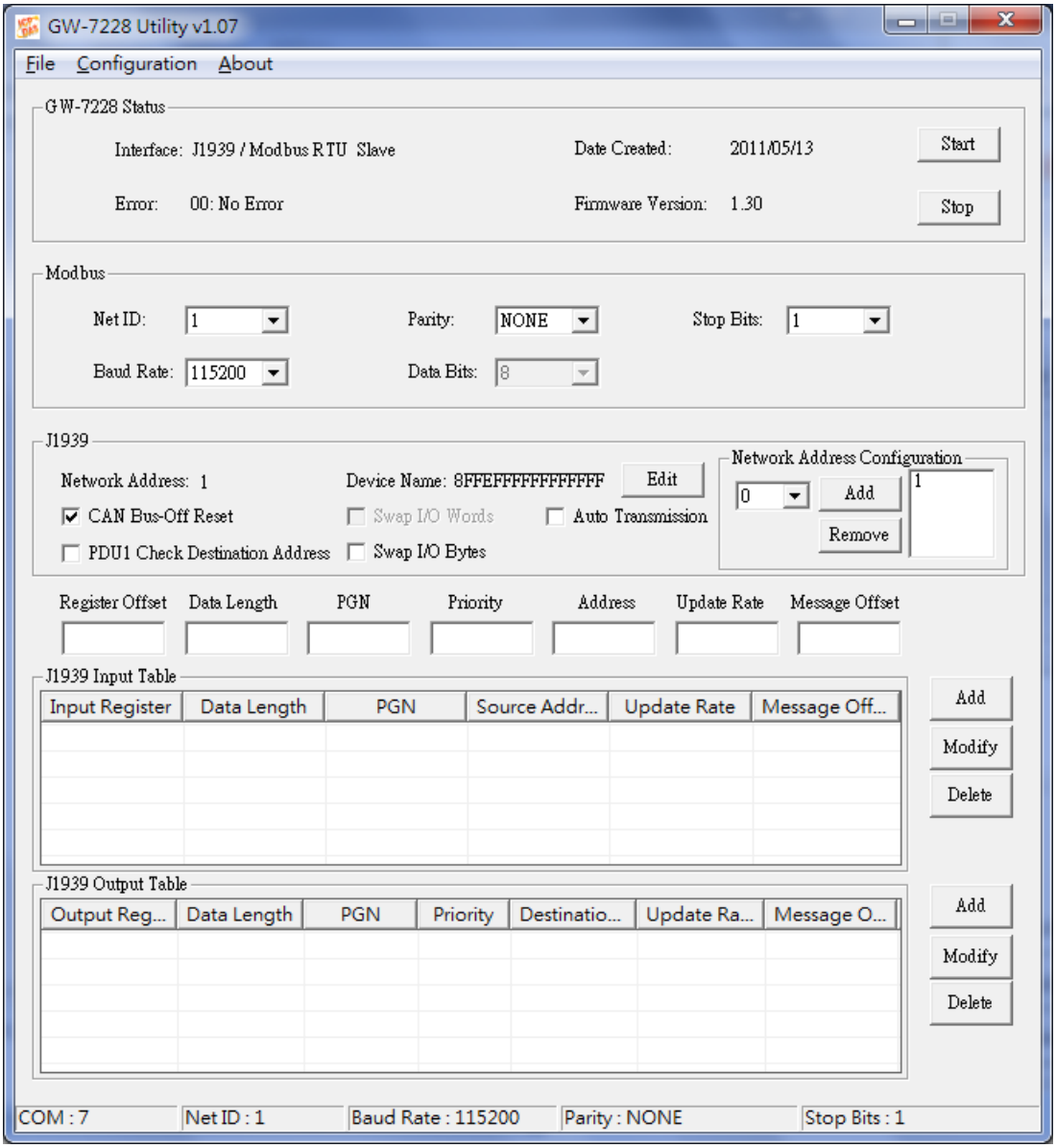


Figure 3-5**:** GW-7228 Utility Main Screen

Display Areas:

[1] **GW-7228 Status** **:** Display the module type and status information about the GW-7228 module that was detected.

[2] **Modbus** **:** Configuration of Modbus network parameters.

[3] **J1939** **:** Configuration of J1939 network parameters.

[4] **J1939 I/O table** **:** Configuration of the contents and layout of the I/O tables.

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Menus and Tool Bar:

[1] **Load Configuration :** Load a previously saved the GW-7228 configuration file.
[2] **Save Configuration :** Save the current GW-7228 configuration to a file.
[3] **Download Parameter:** Download the configuration from the GW-7228 module and shown on the Utility's interface.
[4] **Upload Parameter :** Upload the configuration shown on the Utility's interface to the GW-7228 module.
[5] **Connect to GW-7228 :** Establish a connection with the GW-7228.
[6] **Device Name :** The J1939 NAME to be used by the module in address claim messages.
[7] **About :** Display the GW-7228 utility version.

Modbus Configuration

The Modbus configuration contains the parameters used to control the behavior of the Modbus serial interface. The parameters are described as Table 3-2.

All modules on the network must use the same baud/parity/data/stop bits configuration.

Table 3-2 Modbus Configuration Parameters

Item	Description	Range
Net ID	The ID of the module on the Modbus network. All modules on the network must have a unique address.	1~250
Baud Rate	The network baud rate.	2400~115200
Parity	The serial communication parity.	NONE / ODD / EVEN
Data Bits	The number of data bits used in the serial communication.	Fixed at 8
Stop Bits	The number of stop bits used in the serial communication.	1 / 2

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J1939 Configuration

The J1939 network configuration parameters are described in Table 3-3 below.

Table 3-3 J1939 Configuration Parameters

Item	Description	Range
Network Address	It shows the current location of J1939 network.	0~254
Device NAME	To be used by the module in address claim messages, each J1939 module should have a unique NAME.	Please see the J1939-81 specification
Auto CAN Bus-Off Reset	When Can Bus-off, the module will auto reset the CAN controller.	Enable Disable
PDU1 Check Destination Address	Enable/Disable to check the destination address in PDU1 mode.	Enable Disable
Swap IO Byte	If this option is enabled, data in the I/O table would be byte swapped on 16-bit boundaries; this function is easy reading the J1939 data on Modbus network.	Enable Disable
Auto Transmission	Enable or Disable auto transmission J1939 output message without to control the Modbus register 42009 (Dec).	Enable Disable
Network Address Configuration	This is the list of possible addresses, the module only claims a single address at a time. Up to 20 addresses may be in this list.	0~253

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J1939 Device Name

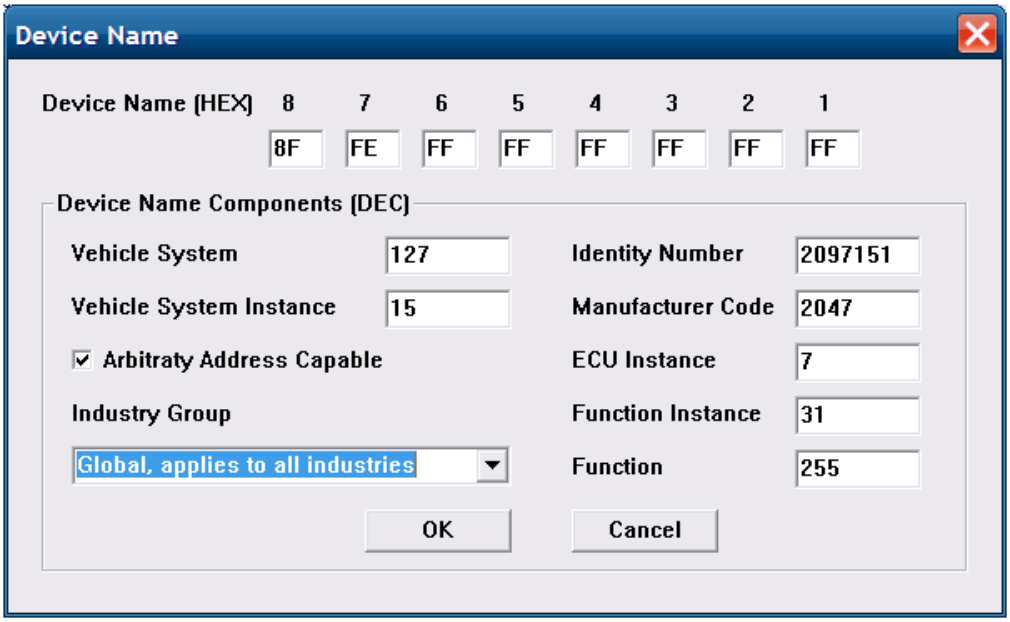


Figure 3-6**:** J1939 Device Name Screen

The J1939 NAME is a 64-bit value that must be unique for every module on J1939 network. NAME are composed of fields as shown in Table 3-4

Table 3-4 J1939 NAME Fields

Arbitrary Address Capable	Industry Group	Vehicle System Instance	Vehicle System	Reserved	Function	Function Instance	ECU Instance	Manufacturer Code			Identity Number
1 bit	3 bit	4 bit	7 bit	1 bit	8 bit	5 bit	3 bit	11 bit			21 bit
Byte 8			Byte 7		Byte 6	Byte 5		Byte 4	Byte 3	Byte 2	Byte 1

J1939 Input/Output Table

The J1939 Input/Output table is used define the content and format of the J1939 messages. The Data from J1939 messages that are to be transmitted are mapped to the locations in the input or output table

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respectively.

Input Table

The Input table holds data that is collected from the J1939 network and can be read by the Modbus master. Input data points are associated with data from messages that are received on the J1939 network.

Output Table

The Output table holds data that is written by the Modbus master and will be transmitted on the J1939 network. Output data points are associated with data of messages that will be transmitted on the J1939 network.

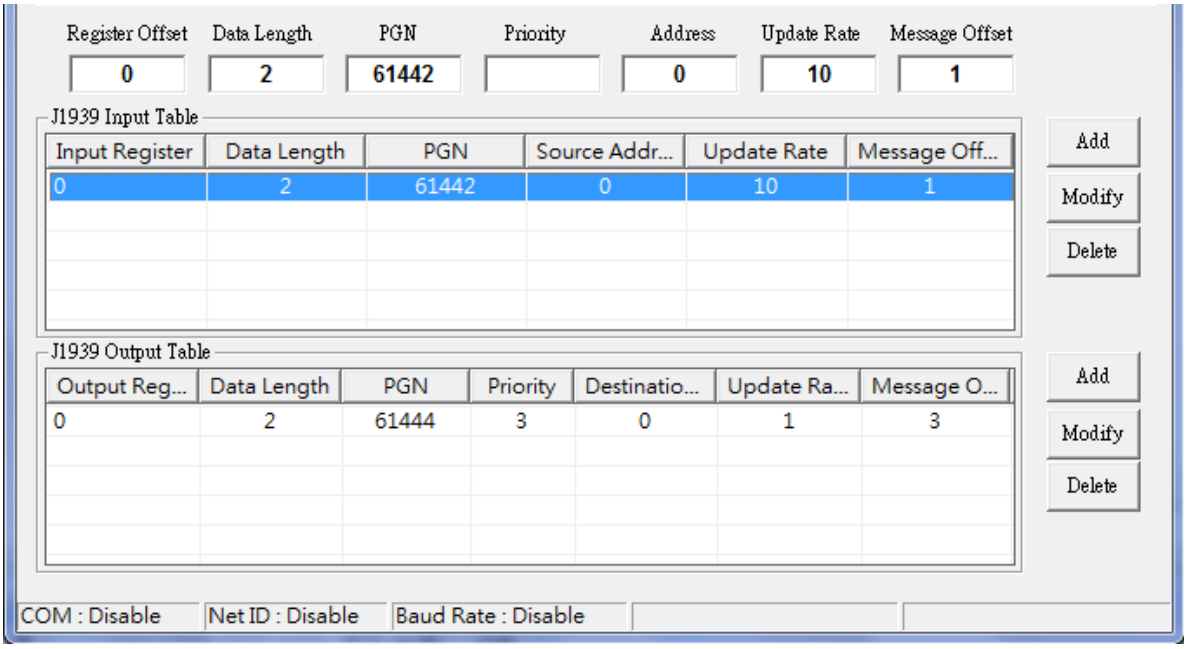


Figure 3-7**:** J1939 Input/Output Configuration Table

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Table 3-5 J1939 Input/Output Configuration Parameter

<table>
<tr><th>Item</th><th>Description</th><th>Range</th></tr>
<tr><td>Register Offset</td><td>The offset setting into the Modbus I/O Register data, the offset is in bytes.
In the Input Table, the offset is into the Modbus AI Input table.
<table>
<tr><th>Input Register Offset (Byte)</th><th>Modbus Input Register (Word)</th></tr>
<tr><td>0,1</td><td>30001(LSB/MSB)</td></tr>
<tr><td>2,3
…
3070, 3071</td><td>30002(LSB/MSB)
…
31536(LSB/MSB)</td></tr>
</table>
In the Output Table, the offset is into the Modbus AI Output table.
<table>
<tr><th>Output Register Offset (Byte)</th><th>Modbus Output Register (Word)</th></tr>
<tr><td>0,1</td><td>40001(LSB/MSB)</td></tr>
<tr><td>2,3
…
3070, 3071</td><td>40002(LSB/MSB)
…
41536(LSB/MSB)</td></tr>
</table></td><td>0~1535 (byte)</td></tr>
<tr><td>Data Length</td><td>The amount of the data to be transferred between the Modbus I/O table and the J1939 message data, the length is in bytes.</td><td>0~1785 (byte)</td></tr>
<tr><td>PGN</td><td>The J1939 PGN is associated with this data field.
In Input Table, the data from messages received with this PGN will be transferred into the Input table.
In Output Table, a message with this PGN will be built and transmitted using data from the Output table.</td><td>Any kinds of J1939 Parameter Group Number</td></tr>
<tr><td>Priority</td><td>The data is used to optimize message latency</td><td>0~7</td></tr>
</table>

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	for transmission onto the bus only; the priority of any message can be set from highest, 0, to lowest, 7.	
Address	In the output table, which refers to the Destination Address, this data defines the specific address to which the message is being sent. If the Destination Address is set to 255, the message will be broadcast. In the input table, which refers to the Source Address, It shall only be one device on the network with a given source address, messages received must match both the PGN and source address to be used for this data field. If the Source Address is 255, any message with a matching PGN will be accepted.	0~253 255
Update Rate	In the input table, the data will be updated within the configured Update Rate. If no update is received within the configured time, the module will request the data point's PGN by transmitting a Request PGN to the Source Address. If the Update Rate is set to zero, the PGN will never be requested. In the output table, the associated message will be transmitted on the network with this rate. If the Update Rate is set to zero, the message will only be transmitted when received a request PGN for the configured PGN.	0~65535
Message Offset	This is the J1939 message buffer location where data will be transferred input and output of the message buffer.	0~1784 (bytes)

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4. Communication Network

4.1 Modbus Network

The GW-7228, J1939 to Modbus Interface, supports the Modbus RTU serial protocol. It plays a Modbus slave on the network.

4.1.1 **Supported Modbus Functions**

The Modbus function codes supported by the Modbus interface are shown as the table below.

Table 4-1 Supported Modbus Function Codes

Function Code	Function Name	Description
3 (03 Hex)	Reading Holding Register	Read multiple registers (4xxxx) for AO
4 (04 Hex)	Reading Input Register	Read multiple input registers (3xxxx) for AI
6 (06 Hex)	Preset Single Register	Write single register (4xxxx) for AO
16 (10 Hex)	Preset Multiple Registers	Write multiple registers (4xxxx) for AO

4.1.2 **Modbus Address**

Only the areas of the Modbus I/O tables that are configured with J1939 I/O data are addressable, Modbus functions that use Word addressing address the I/O tables by using 16-bit words.

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Table 4-2**:** Input Register Function Table

Input Register Offset (Byte)	Modbus Input Register (Word)
0,1	30001(LSB/MSB)
2,3 … 3070, 3071	30002(LSB/MSB) … 31536(LSB/MSB)

Table 4-3**:** Output Register Function Table

Output Register Offset (Byte)	Modbus Output Register (Word)
0,1	40001(LSB/MSB)
2,3 … 3070, 3071	40002(LSB/MSB) … 41536(LSB/MSB)

The following register address is defined to start or stop the transmission of output J1939 messages in the GW-7228. It can use the Modbus functions code 6 (06 Hex) and 16 (10 Hex) to change the register.

Table 4-4**:** Start/Stop the transmission register of J1939 output message

Register	Description
42009(Dec) 7D8(Hex)	If Value=0, Start the transmission of output J1939 message. If Value=1, Stop the transmission of output J1939 message.

The following register address is defined the error status in the GW-7228. It can use the Modbus functions code 4 (04 Hex) to read the register.

Table 4-5**:** Registry Error Code of the GW-7228

Register	Description	
31807(Dec) 70E(Hex)	00 01 02 04	No Error Can't Claim Address in J1939 Network CAN Bus-Off CAN Bus Transmission Fail

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4.2 J1939 Network

J1939 is a higher-layer protocol based on Controller Area Network (CAN). It provides serial data communications between microprocessor systems (also called Electronic Control Units - ECU) in any kind of heavy duty vehicles. The messages exchanged between these units can be data such as vehicle road speed, torque control message from the transmission to the engine, oil temperature, and many more.

4.2.1 **Communication Methods**

The GW-7228 provides two communication methods of SAE J1939, each serving a specific purpose.

Destination Specific Communications

Destination specific communications use PDU1, but also the global destination address 255. There are cases where this method will require the utilization of destination specific Parameter Group Numbers, for instance, in the case of more than one engine. A torque message, for example, must be sent only to the desired engine and not to both.

Broadcast Communications

Broadcast communications use PDU2 and, as the name implies, they can include: Sending a message from a single or multiple sources to a single destination; sending a message from a single or multiple sources to multiple destinations.

4.2.2 **Parameter Groups**

Parameters groups are, for instance, engine temperature which includes coolant temperature, fuel temperature, oil temperature, etc. The Parameter Groups (PG) architecture and Parameter Group Numbers (PGN) are described in SAE J1939/21 and defined in SAE J1939/71.

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Parameter Groups contain information on parameter assignments within the 8 byte CAN data field of each message as well as repetition rate and priority.

The following is an example of a parameter group definition as listed in SAE J1939/71:

PGN 65262 Engine Temperature 1 - ET1

Transmission Repetition Rate:	1 s		
Data Length:	8		
Extended Data Page:	0		
Data Page:	0		
PDU Format:	254		
PDU Specific:	238	PGN Supporting Information:	
Default Priority:	6		
Parameter Group Number:	65262	(0xFEEE)	

Start Position	Length	Parameter Name	SPN
1	1 byte	Engine Coolant Temperature	110
2	1 byte	Engine Fuel Temperature 1	174
3-4	2 bytes	Engine Oil Temperature 1	175
5-6	2 bytes	Engine Turbocharger Oil Temperature	176
7	1 byte	Engine Intercooler Temperature	52
8	1 byte	Engine Intercooler Thermostat Opening	1134

Figure 4-1**:** Example of a parameter group definition of SAE J1939/71

4.2.3 **Suspect Parameter Number (SPN)**

A Suspect Parameter Number (SPN) is a number assigned by the SAE to a specific parameter within a parameter group.

SPN that shares common characteristics are grouped into Parameter Groups (PG) and they will be transmitted throughout the network using the Parameter Group Number (PGN).

To follow up on the previous example (PGN 65262), the parameter Engine Coolant Temperature is described by SPN 110 as following Figure:

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SPN 110 Engine Coolant Temperature

Temperature of liquid found in engine cooling system.

Data Length:	1 byte		
Resolution:	1 deg C/bit, -40 deg C offset		
Data Range:	-40 to 210 deg C	Operational Range:	same as data range
Type:	Measured		

Supporting information:

PGN reference: 65262

Figure 4-2**:** Example of a Suspect Parameter Number definition of SAE J1939/71

The following figure demonstrates the use of Suspect Parameter Numbers, Parameter Groups and Parameter Group Numbers.

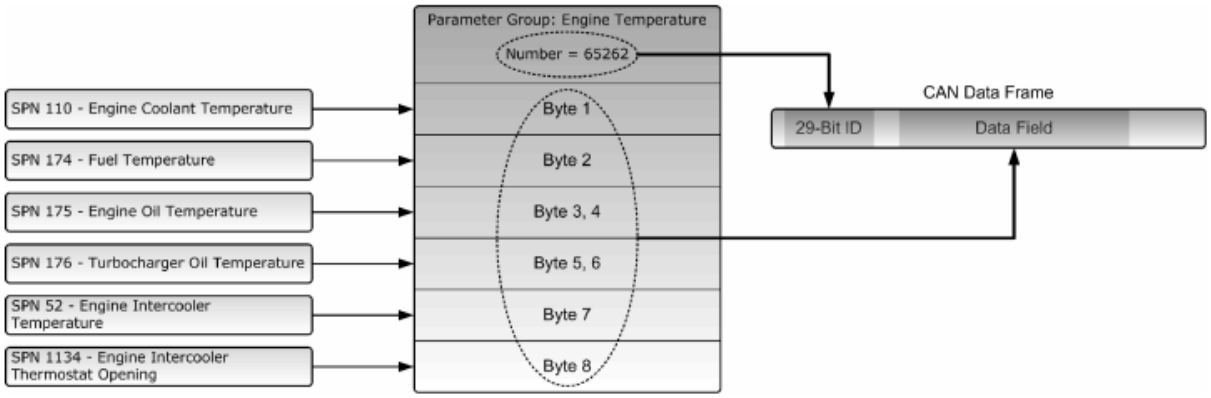


Figure 4-3**:** SPN, PG and PGN structure

4.2.4 **J1939 Message Transmission**

In the GW-7228, messages are transmitted on the J1939 network according to the J1939 output configuration table. Messages are assembled from data in the output table and transmitted on a cyclic time basis. Messages are transmitted automatically based on the Update Time parameter in the output data associated with the message.

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4.2.5 **J1939 Receiving Messages**

Input data points are combined according to PGN and Target Address. If the Target Address is configured as 255, all messages with a matching PGN will be parsed using the data point, regardless of source address. If the Target Address is not 255, received messages must match both the PGN and source address in order to be handled by the input data point.

4.2.6 **Transport Protocol for Large Messages**

Transmission and Reception of Large Messages

Messages with buffer sizes of 8 bytes or less can be directly sent and received on J1939. However, messages with buffer sizes greater than 8 bytes must be fragmented, transmitted, and reassembled using the J1939 transport protocol.

Users should reference the J1939-21 specification. It provides the description of when and how the transport protocol is used by the GW-7228.

GW-7228 now provides a BAM (Broadcast Announce Message) mechanism, when messages larger than 8 bytes in length and the destination address is 255, the message will be sent or receive using transport protocol BAM.

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5. Application

Control systems such as PAC, PLC and PC on Modbus network require some data that is collected by an ECU such as engine on J1939 network. There is also a part of data that is determined by the system controller and transmitted through the Modbus network for the ECU to the J1939 network.

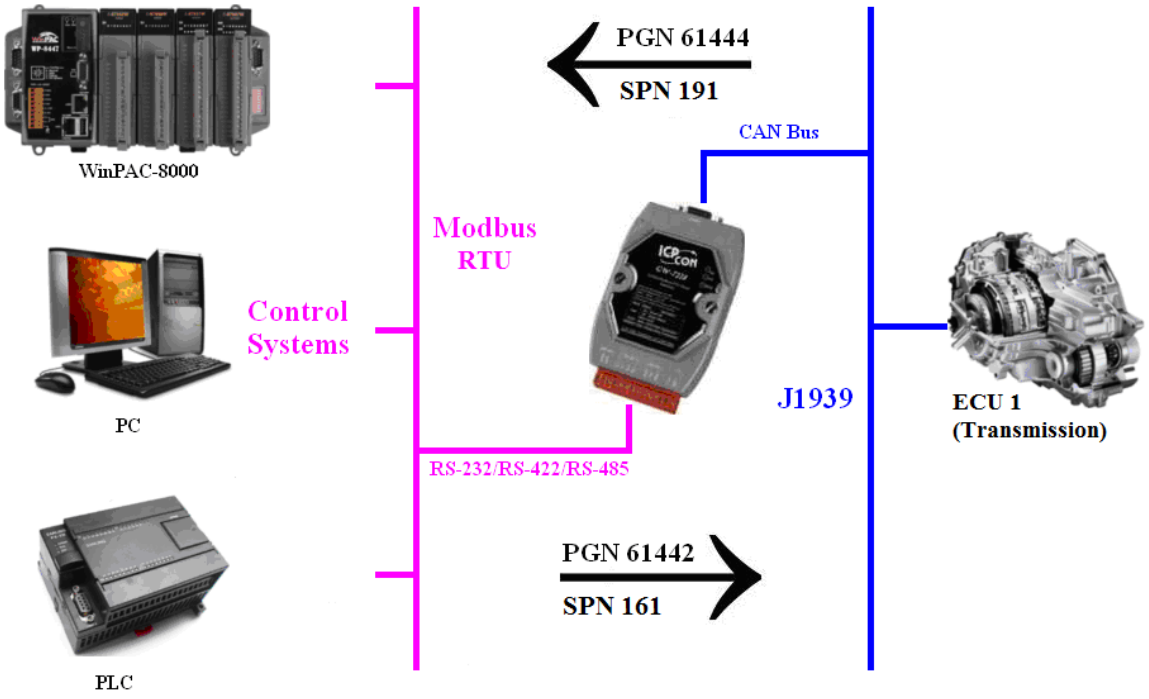


Figure 5-1**:** Application network structure

5.1 Hardware Installation

Users may need to make some hardware settings before the application. The detailed illustration is as below:

Step1: Check GW-7228 Firmware Mode

In operation mode, users can use the Modbus Master command to send and receive J1939 messages via the GW-7228

Users need to set the dip-switch to the “Normal” position as Figure 5-2 and reset the power, and that the GW-7228 can run in the operation mode.

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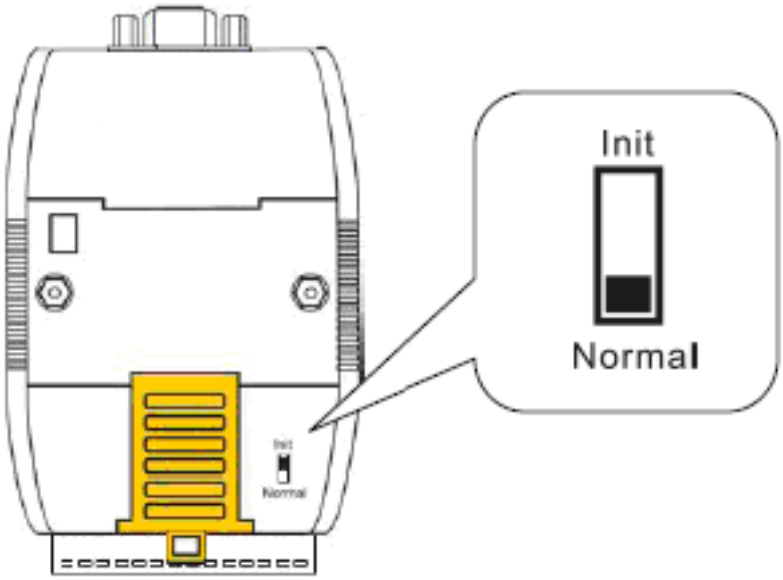


Figure 5-2**:** Operation mode Position of Dip-Switch

Step2: Enable the 120Ω terminator resistor

Please open the GW-7228 cover and use the JP3 to activate the 120Ω terminal resistor built in the module, as the Figure 5-3.

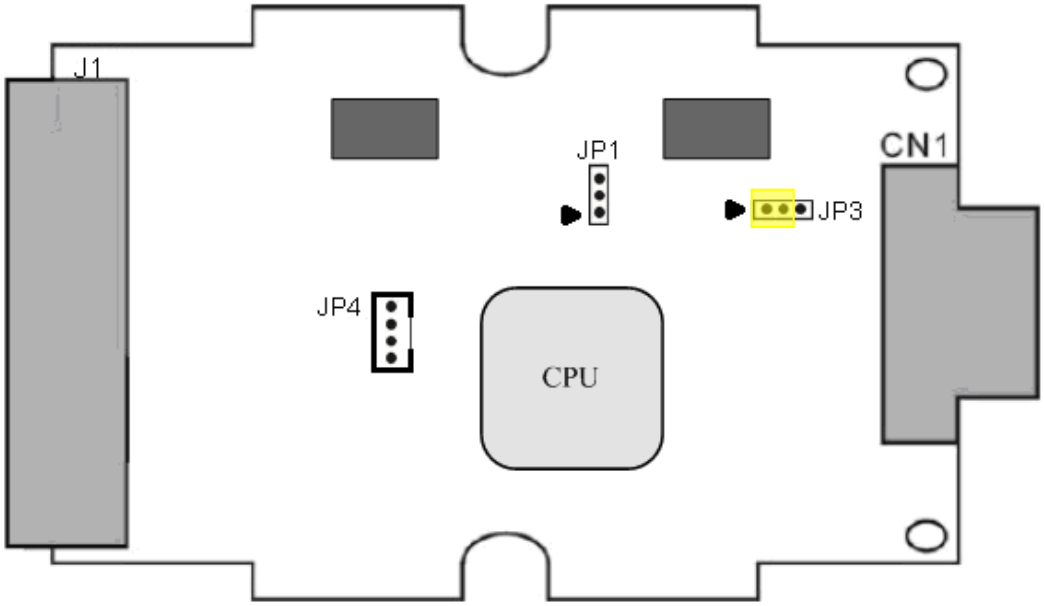


Figure 5-3**:** JP3 Jumper Position

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Step3: J1939 network - CAN bus connection

Connect the CAN ports with the GW-7228 modules and ECU (e.g. engine) in J1939 network using the following structure as Figure 5-4.

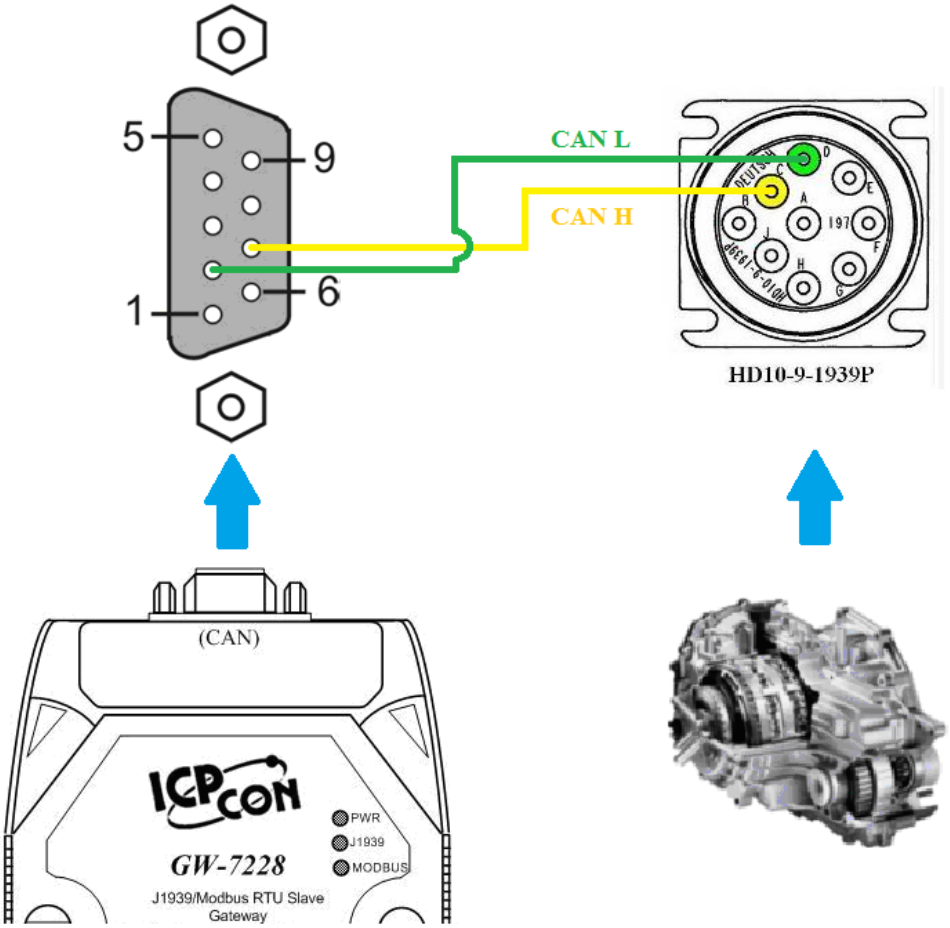


Figure 5-4**:** CAN bus Wire Connection

Step4: Modbus network - Serial port connection

It is recommended to use only one serial port (RS232, RS422 or RS485) of the gateway at the same time. The following figures describe the three COM port types to a serial device via serial network.

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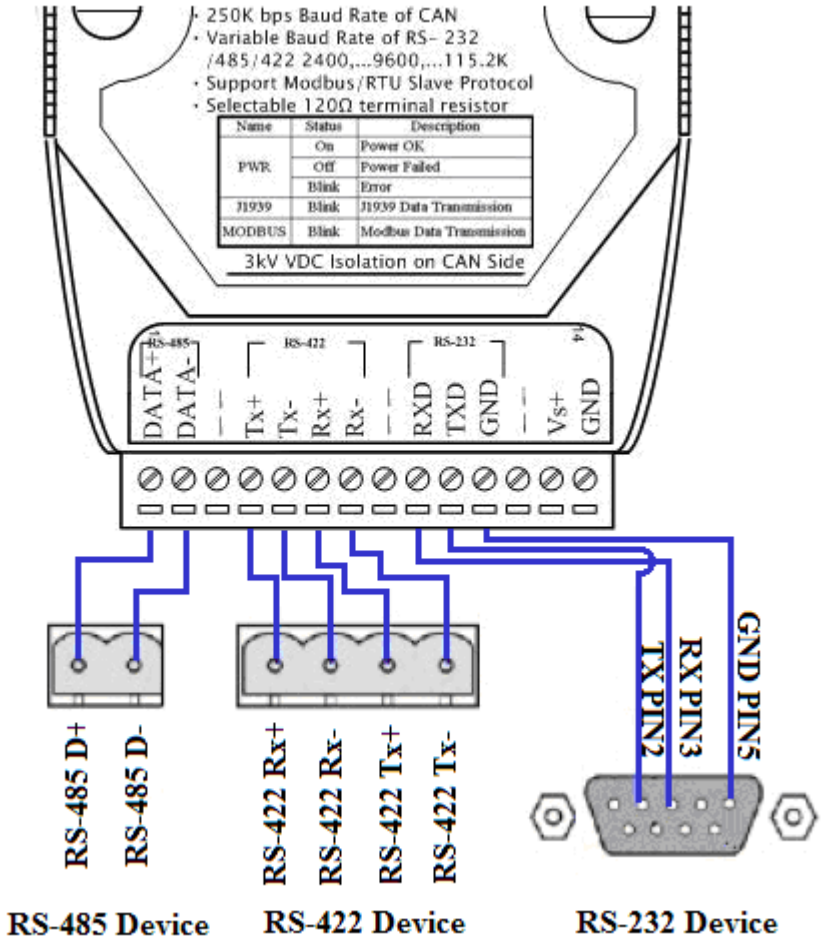


Figure 5-5**:** Serial Port Wire Connection

Step5: Power wire connection

Connect the power supply to the GW-7228 module's power terminal connecter, please see the following connection as Figure 5-6.

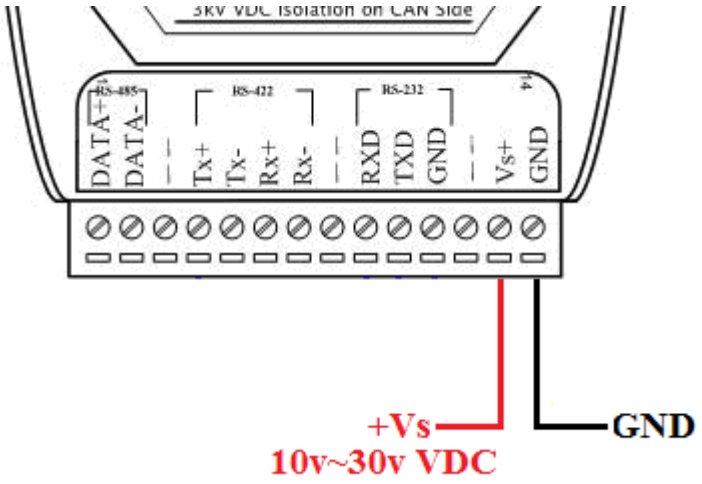


Figure 5-6**:** Power Wire Connection

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Step6: Connect to GW-7228

When in the first connection, the controller must run the network at 115200 baud with none parity, 1 stop bit and 1 Net ID, shown as below figure. After the first connection, it should follow the GW-7228 Modbus connection settings to change.

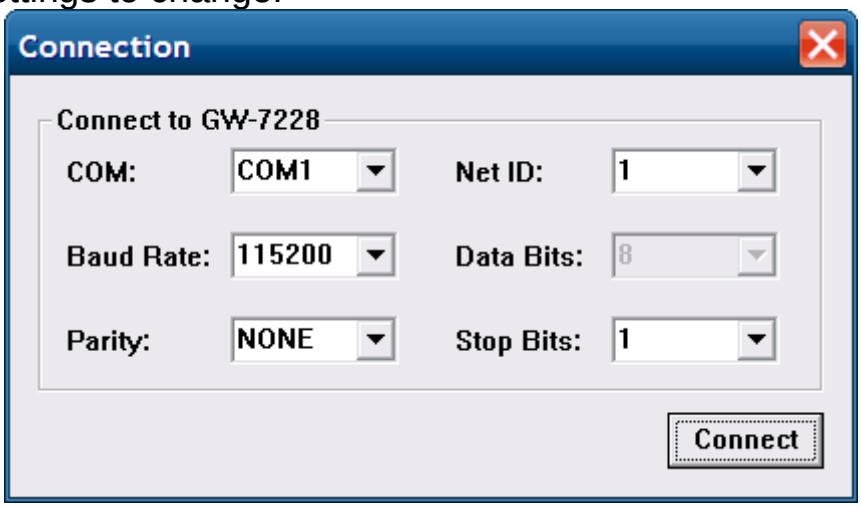


Figure 5-7**:** Connection Setting of GW-7228 Utility

5.2 GW-7228 Utility Configuration

5.2.1 **Modbus Network Configuration**

The GW-7228 and the controller must be set the same serial communication parameters of the Modbus network configuration.

The Modbus network configuration screen from the GW-7228 is shown as Figure 5-8.



Figure 5-8**:** Modbus configuration screen

5.2.2 **J1939 Network Configuration**

The device NAME should be set according to the application and the vendor where the module is being used based on the J1939 network specification.

The J1939 network configuration screen from the GW-7228 is shown as Figure 5-9.

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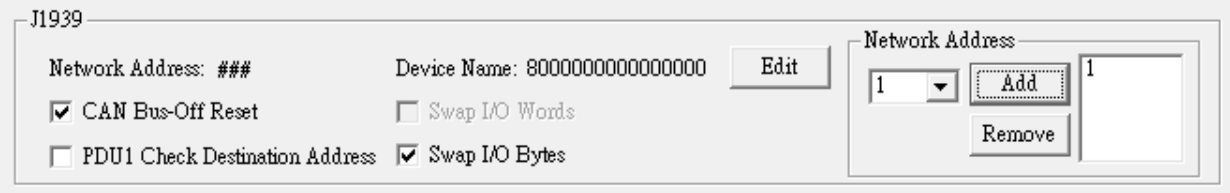


Figure 5-9**:** Modbus configuration screen

Enable the CAN Bus-off Reset option, when the CAN bus off status occurs the module will auto reset the CAN controller.

The Swap I/O Bytes option has been enabled, the data will be in the right byte orientation when accessing it via Modbus.

The Network Address list is set to 1.

5.2.3 **J1939 I/O Configuration**

The following figure is a PGN definition about Electronic Transmission Controller when users want to receive the Transmission Output Shaft Speed from the transmission and send the Transmission Input Shaft Speed to the transmission via the GW-7228.

PGN 61442 Electronic Transmission Controller 1 - ETC1

Transmission Repetition	10 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	240	
PDU Specific:	2	PGN Supporting Information:
Default Priority:	3	
Parameter Group Number:	61442	(0xF002)

Start Position	Length	Parameter Name	SPN
1.1	2 bits	Transmission Driveline Engaged	560
1.3	2 bits	Torque Converter Lockup Engaged	573
1.5	2 bits	Transmission Shift In Process	574
2-3	2 bytes	Transmission Output Shaft Speed	191
4	1 byte	Percent Clutch Slip	522
5.1	2 bits	Engine Momentary Overspeed Enable	606
5.3	2 bits	Progressive Shift Disable	607
6-7	2 bytes	Transmission Input Shaft Speed	161
8	1 byte	Source Address of Controlling Device for Transmission Control	1482

Figure 5-10**:** Example of a parameter group definition of SAE J1939/71

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Related configuration data, the following table shows the current planning.

Table 5-1: Configuration data of J1939 and Modbus

Parameters	PGN	Data Length (bytes)	Byte Order In J1939 Data Field	Byte Order in MODBUS	MODBUS Address
Send					
Input Shaft Speed	61442(Dec) F002(Hex)	2	5	0	40001
Receive					
Output Shaft Speed	61442(Dec) F002(Hex)	2	1	0	30001

Note:

PGN/Data Length(Bytes)/Byte Oder in J1939 Data Field
=> Transmission manufacturers provide the information required

Byte Order in MODBUS
=> User-defined Modbus address

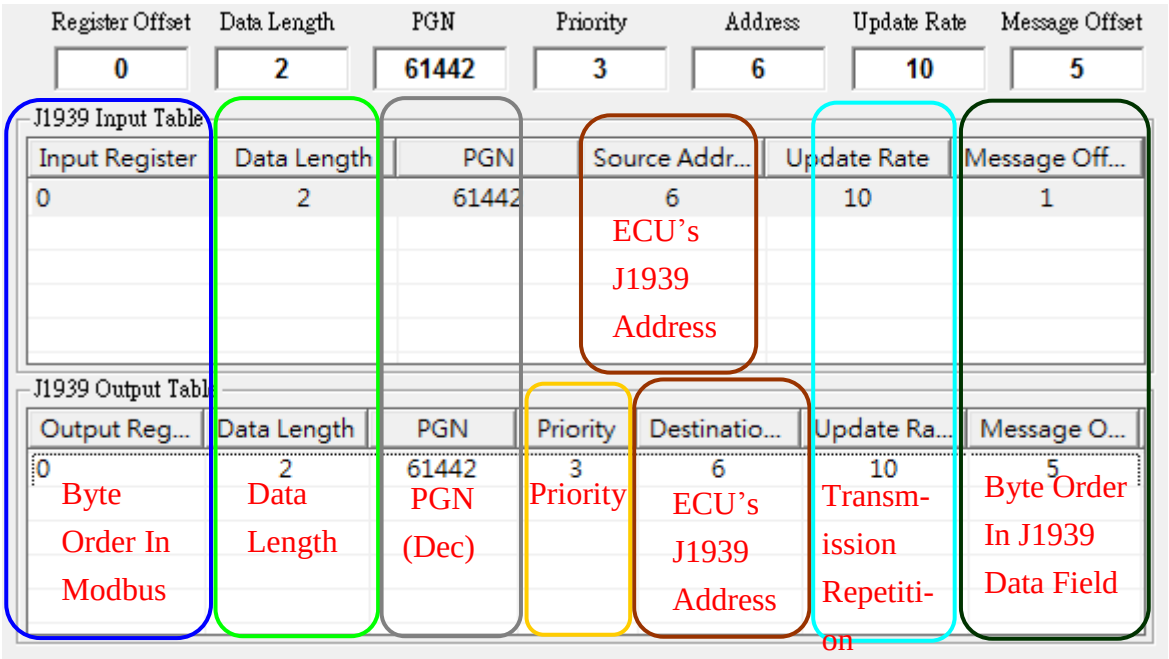


Figure 5-11: J1939 configuration screen

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5.2.4 **Upload Parameter to the GW-7228**

After the previous parameter settings, users need to upload the parameters to the GW-7228. Please refer to the following figure to finish the operation.



Figure 5-12**:** Parameter upload screen

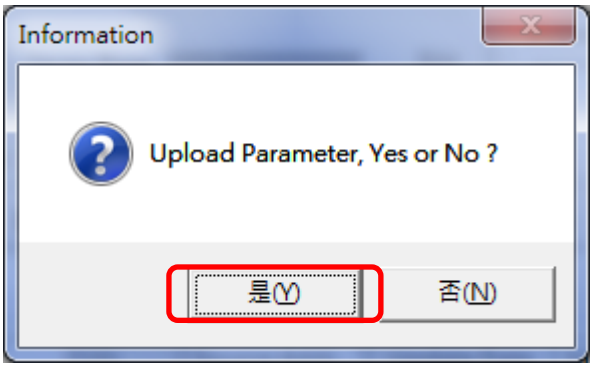


Figure 5-13**:** Confirm Parameter upload screen



Figure 5-14**:** Parameter upload successful screen

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5.3 Modbus Communication

Set J1939 output data

Using the Modbus command as below:
FC16 Write multiple registers (4xxxx) for AO

[Request] (Request by Modbus master device)

Byte 0:	Net ID (Station number)
Byte 1:	FC=10 (Hex)
Byte 2-3:	Reference number
Byte 4-5:	Word count
Byte 6:	Byte count (B=2 x word count)
Byte 7-(B+6):	Register values
Byte (B+7)-(B+8):	Value for the CRC calculation

[Response] (Response from the GW-7228)

Byte 0:	Net ID (Station number)
Byte 1:	FC=10 (Hex)
Byte 2-3:	Reference number
Byte 4-5:	Word count
Byte 6-7:	Value for the CRC calculation

Example:

In the address 40001, write the value in 0x1234.
[Request Command] (Byte0, Byte1... Byten) (Hex)
01 10 00 00 00 01 02 12 34 AB 27

GW-7228's response is OK.
[Response] (Byte0, Byte1... Byten) (Hex)
01 10 00 00 00 01 01 C9

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Get J1939 input data

Using the Modbus command as below:
FC4 Read multiple input registers (3xxxx) for AI

[Request] (Request by Modbus master device)

Byte 0:	Net ID (Station number)
Byte 1:	FC=04
Byte 2-3:	Reference number
Byte 4-5:	Word count
Byte 6-7:	Value for the CRC calculation

[Response] (Response from the GW-7228)

Byte 0:	Net ID (Station number)
Byte 1:	FC=04
Byte 2:	Byte count of response (B=2 x word count)
Byte 3-(B+2):	Register values
Byte (B+3)-(B+4):	Value for the CRC calculation

Example:

Read a value of one word in the address 30001.
[Request] (Byte0, Byte1... Byten) (Hex)
01 04 00 00 00 01 31 CA

GW-7228 responds a value of one word in the address 30001.
[Response](Byte0, Byte1... Byten) (Hex)
01 04 02 12 34 B4 47

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Start or Stop sending J1939 output message

Using the Modbus command as below:
FC6 Write single register (4xxxx) for AO

[Request] (Request by Modbus master device)

Byte 0:	Net ID (Station number)
Byte 1:	FC=06 (Hex)
Byte 2-3:	Reference number
Byte 4-5:	Register value
Byte 6-7	Value for the CRC calculation

[Response] (Response from the GW-7228)

Byte 0:	Net ID (Station number)
Byte 1:	FC=06 (Hex)
Byte 2-3:	Reference number
Byte 4-5:	Register value
Byte 6-7	Value for the CRC calculation

Example: Start sending J1939 output message

In the address 42009, write the value in 0x00.
[Request Command] (Byte0, Byte1... Byten) (Hex)
01 06 07 D8 00 00 08 85

GW-7228 responds the register value.
[Response] (Byte0, Byte1... Byten) (Hex)
01 06 07 D8 00 00 08 85

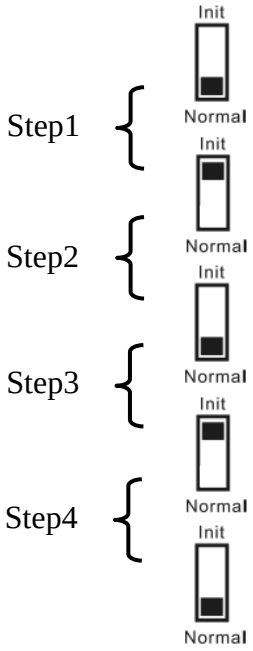
Example: Stop sending J1939 output message

In the address 42009, write the value in 0x01.
[Request Command] (Byte0, Byte1... Byten) (Hex)
01 06 07 D8 00 01 C9 45

GW-7228 responds the register value.
[Response] (Byte0, Byte1... Byten) (Hex)
01 06 07 D8 00 01 C9 45

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6. Troubleshooting

Item	Trouble state	Solution
1	CAN Bus Transmission Fail (Power LED Blink per 100 ms)	Make sure the CAN bus wiring is connected, and connected to the correct pin.
2	CAN Bus-Off (Power LED Blink per 500 ms)	Make sure the CAN bus wiring does not short-circuit
3	Can't Claim Address in J1939 Network (Power LED Blink per 1000 ms)	Please configure another J1939 network address in GW-7228 Utility.
4	Can not transmit the output J1939 message	1. Make sure the Start/Stop sending J1939 output message register (42009) is 0x00. 2. Make sure the Update Rate of J1939 output message table is not zero.
5	How to restore factory default  	1. Power on the GW-7228 2. Change the Dip-Switch position of the GW-7228 and to complete the following steps in 5 seconds. Step1. From "Normal" to "Init" position. Step2. From "Init" to "Normal" position. Step3. From "Normal" to "Init" position. Step4. From "Init" to "Normal" position. 3. When the correct implementation of the above steps, the J1939/Modbus LEDs of the GW-7228 should be turn on, and that should be turn off after 500 ms later.

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		4. Reset the power of the GW-7228, and the GW-7228 would back to factory defaults. 6. Reconnect the GW-7228 by using the network setting as 115200 baud with none parity, 1 stop bit and 1 Net ID.

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