Modbus/IEC61850 Gateway

iGate-850

User Manual

REV 1. 0

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1 Product Overview

1.1 Product Function

The gateway's main function is to convert Modbus meter data to IEC61850 standard data.

1.2 Product Features

- One way 10/100 BASE-T self-adaptive Ethernet, RJ45 interface;
- Supports IEC61850-8-1 (MMS) and GOOSE (meeting the mechanism of fast message of substation automation system;
- Supports report service,control service, replace service,GOOSE service and time service;
- Maximum data points: 800; supports up to 2 IEC61850 master stations and up to 20 Modbus slave numbers;
- With 2 serial ports, Serial port can be RS-232, RS-485 or RS-422;
- Transmission mode supports Modbus RTU and ASCII;
- The serial baud rate supports 200~38400bps;
- 8 data bits, 1 stop bits, parity : none, odd and even;
- Supports redundant channel transmission;
- Supports communication between two hosts.

1.3 Technical Specification

[1] Each Modbus command can be set polling time, scaling, conversion between big and little Endian;

[2]Two ends of the network support debugging functions;

[3] Provides free configuration software and ICD modeling software;

[4] Supports SNMP network management;

[5] Through IEC61850-10 KEMA certification;

[6] Low power consumption: 3W@24VDC, no fan;

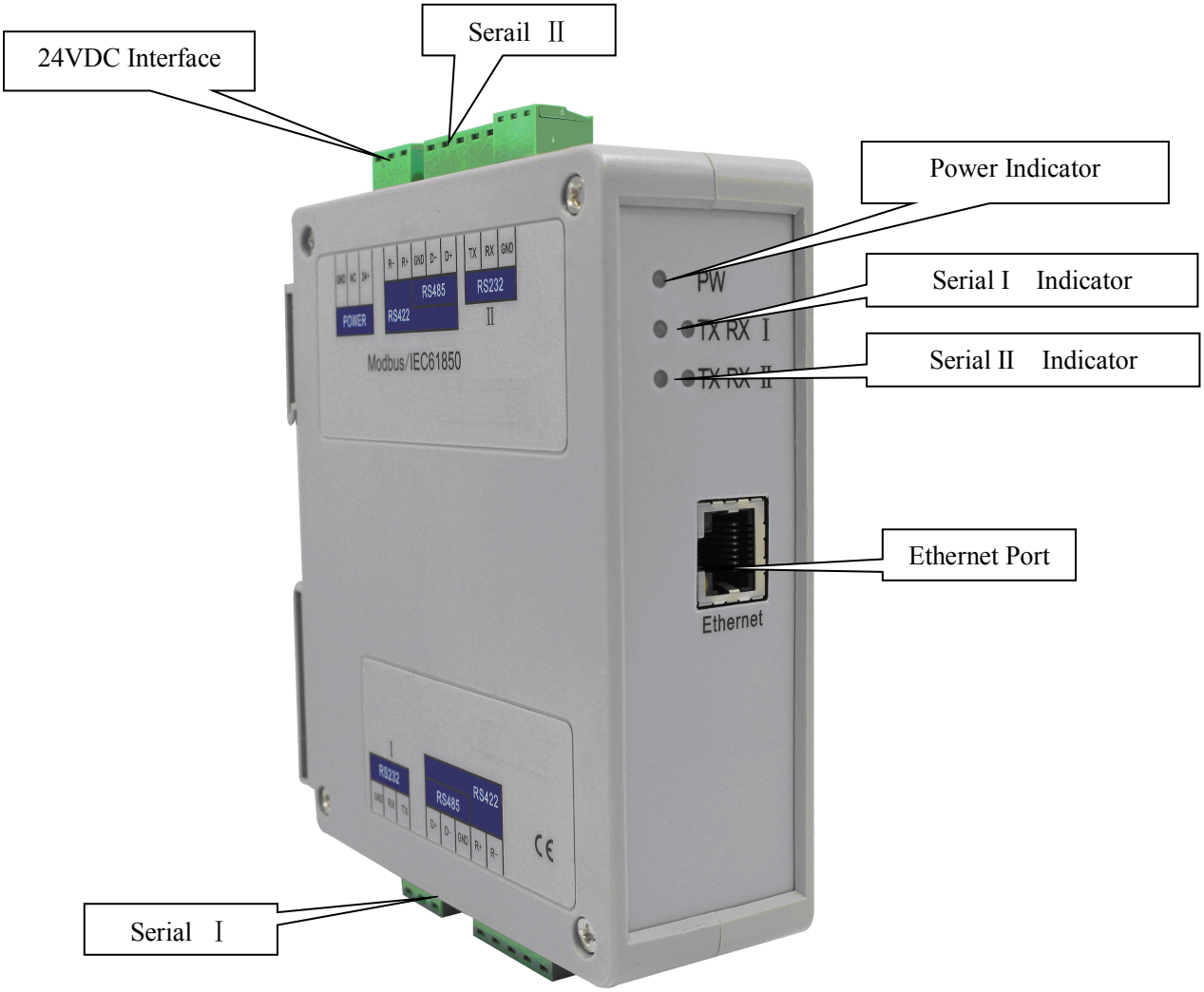
[7] Operation temp: -40℉~158℉(-40℃~70℃), Humidity: 5%~ 95% (non-condensing);

[8] External dimensions (W*H*D): 1.57 in*4.92 in *4.33 in (40mm*125mm*110mm);

[9] Protection level: IP20.

2 Hardware Descriptions

2.1 Product Appearance



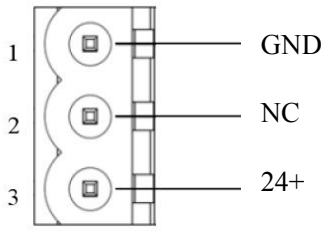
Note: This picture is for reference only. Product appearance should refer to the real object.

2.2 Indicators

Indicators		State	Description
Power		Red on	Module power supply is normal
		Red off	Module is not powered or power supply is abnormal
Serial Port Ⅰ	TX	Red blinking	Serial port data sending
		Red off	Serial connection not established or error
	RX	Green blinking	Serial port data receiving
		Green off	Serial connection not established or error
Serial Port Ⅱ	TX	Red blinking	Serial port data sending
		Red off	Serial connection not established or error
	RX	Green blinking	Serial port data receiving
		Green off	Serial connection not established or error

2.3 Interface

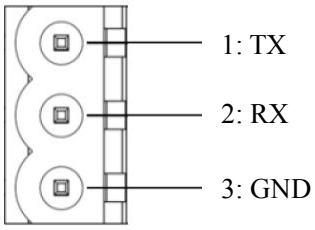
2.3.1 Power Interface



Pin	Function
1	Power GND
2	NC, Not connected
3	24V+, DC Positive 24V, range 9~30V

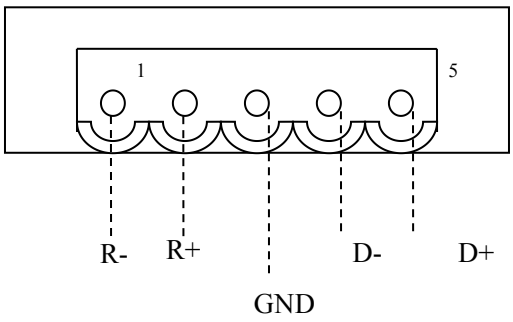
2.3.2 Serial Ⅰ

1) RS-232 interface:



Pin	Function
1	TX, connect RX of RS-232 of user device
2	RX, connect TX of RS-232 of user device
3	GND, connect GND of RS-232 of user device

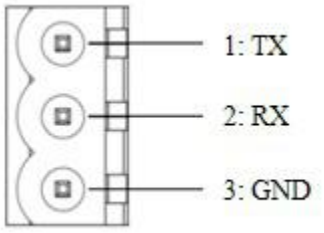
2) RS-422/485 interface:



Pin	Function
1	R-,RS-422 Receive Negative
2	R+,RS-422 Receive Positive
3	GND
4	D-, RS-485 Data Negative/RS-422 Transmit Negative
5	D+, RS-485 Data Positive/RS-422 Transmit Positive

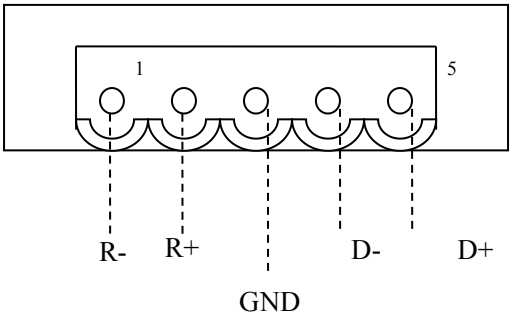
2.3.3 Serial Ⅱ

1) RS-232 interface:



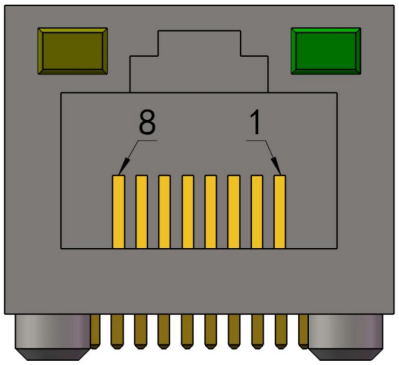
Pin	Function
1	TX, connect RX of RS-232 of user device
2	RX, connect TX of RS-232 of user device
3	GND, connect GND of RS-232 of user device

2) RS-422/485 interface:



Pin	Function
1	R-,RS-422 Receive Negative
2	R+,RS-422 Receive Positive
3	GND
4	D-, RS-485 Data Negative/RS-422 Transmit Negative
5	D+, RS-485 Data Positive/RS-422 Transmit Positive

2.3.4 Ethernet Interface



Ethernet interface uses RJ-45 plug-in; its pin (standard Ethernet signal) is defined as below:

Pin	Signal Description
S1	TXD+, Tranceive Data+, Output
S2	TXD-, Tranceive Data-, Output
S3	RXD+, Receive Data+, Input
S4	Bi-directional Data+
S5	Bi-directional Data-
S6	RXD-, Receive Data-
S7	Bi-directional Data+
S8	Bi-directional Data-

3 Use Method

3.1 Quick Start Guide

Steps of Using iGate-850:

1.Use the network cable to connect the gateway to the network, noted the factory IP address of the gateway is 192.168.0.121. When there appears a problem during network connection, users need to modify the network segment of PC. That is :192.168.0.xx; the subnet mask is 255.255.255.0; the default gateway:192.168.0.1. (xx can be any value except 121).

2.Power on iGate-850, it will take about 1 minute to initialize.

3.Using ICD modeling software for modeling your Modbus devices, using the configuration software EasyConnect to configure the iGate-850. The main point is the Modbus command configuration and the objects mapped to IEC61850. When configuration is complete, download it into the gateway. Restart the iGate-850 or turn off the power then turn it on,makes the configuration take effect.

4. After the configuration has taken effected , the gateway enters the normal operation state.

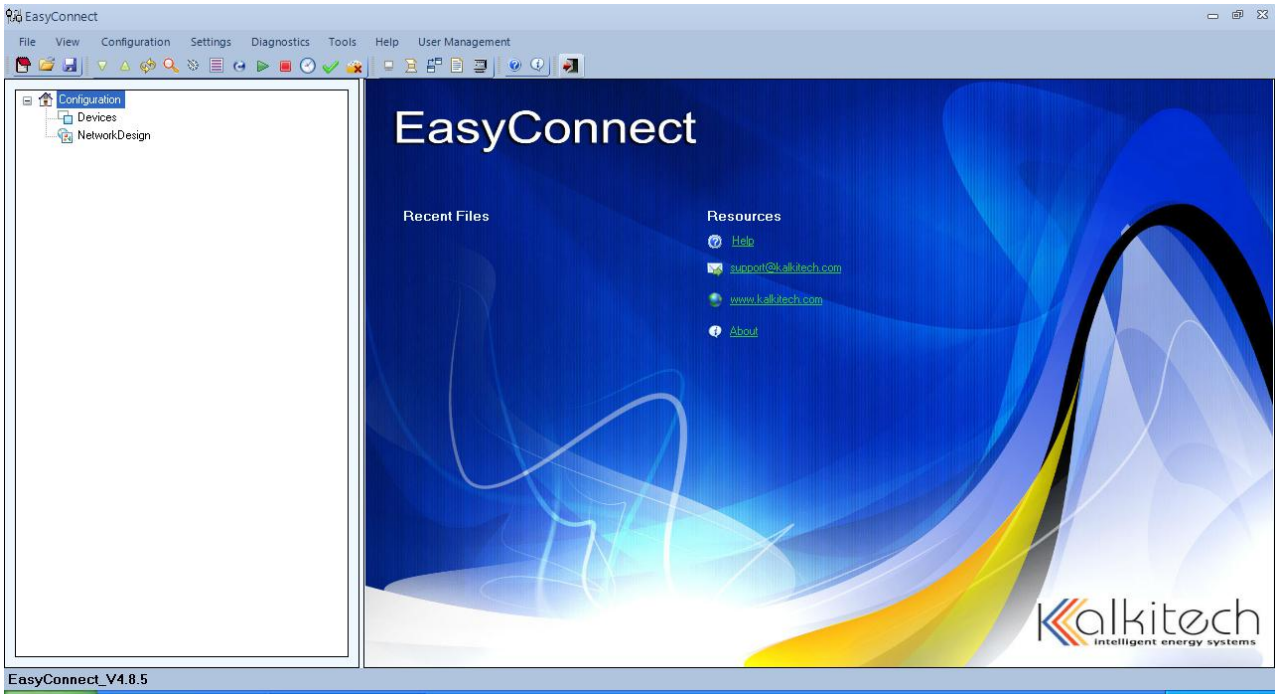
3.2 System Requirements

The configuration module needs to use the EasyConnect software, users need to install EasyConnect.

This software requires the following hardware at a minimum:

- 3.1 GHz Processor
- 512MB installed RAM
- 100MB available disk space
- Operating system requirements: Windows 2000 and above Windows operating system
- Software environment requirements: .Net Framework 3.5 and above

After the installation is complete, the software is shown in the following figure.

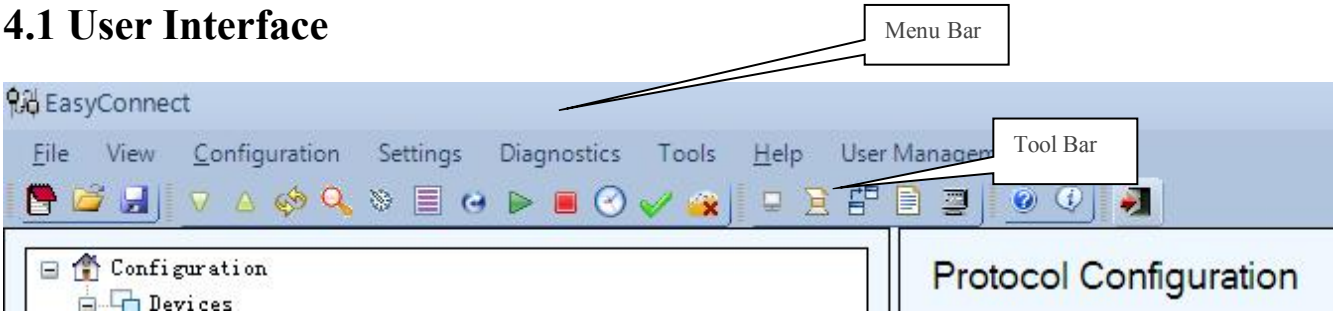


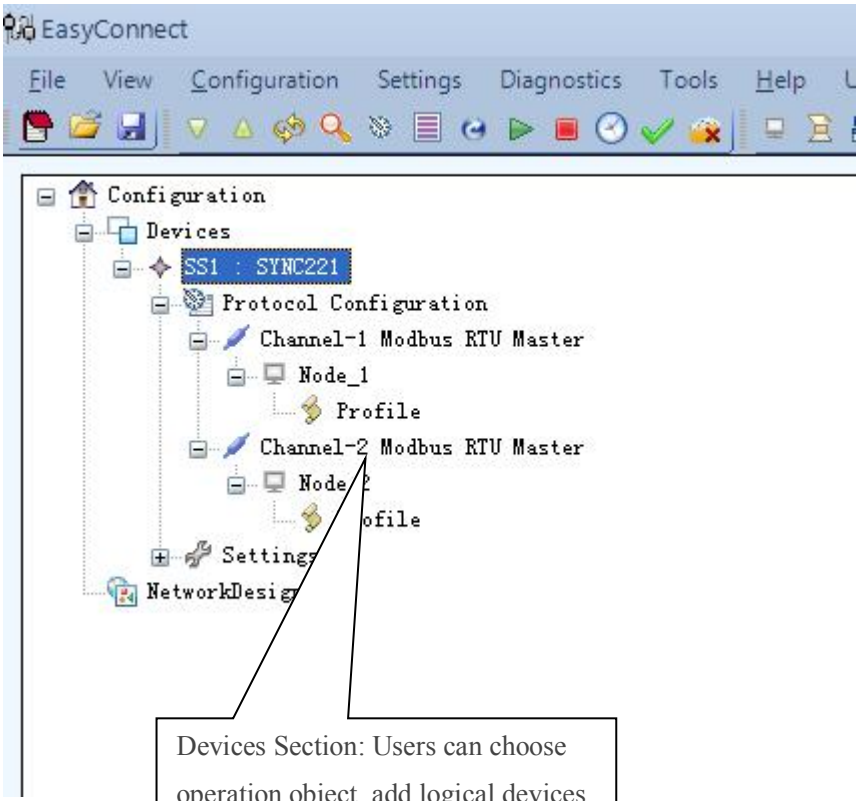
For the detailed use method, please refer to chapter 4.

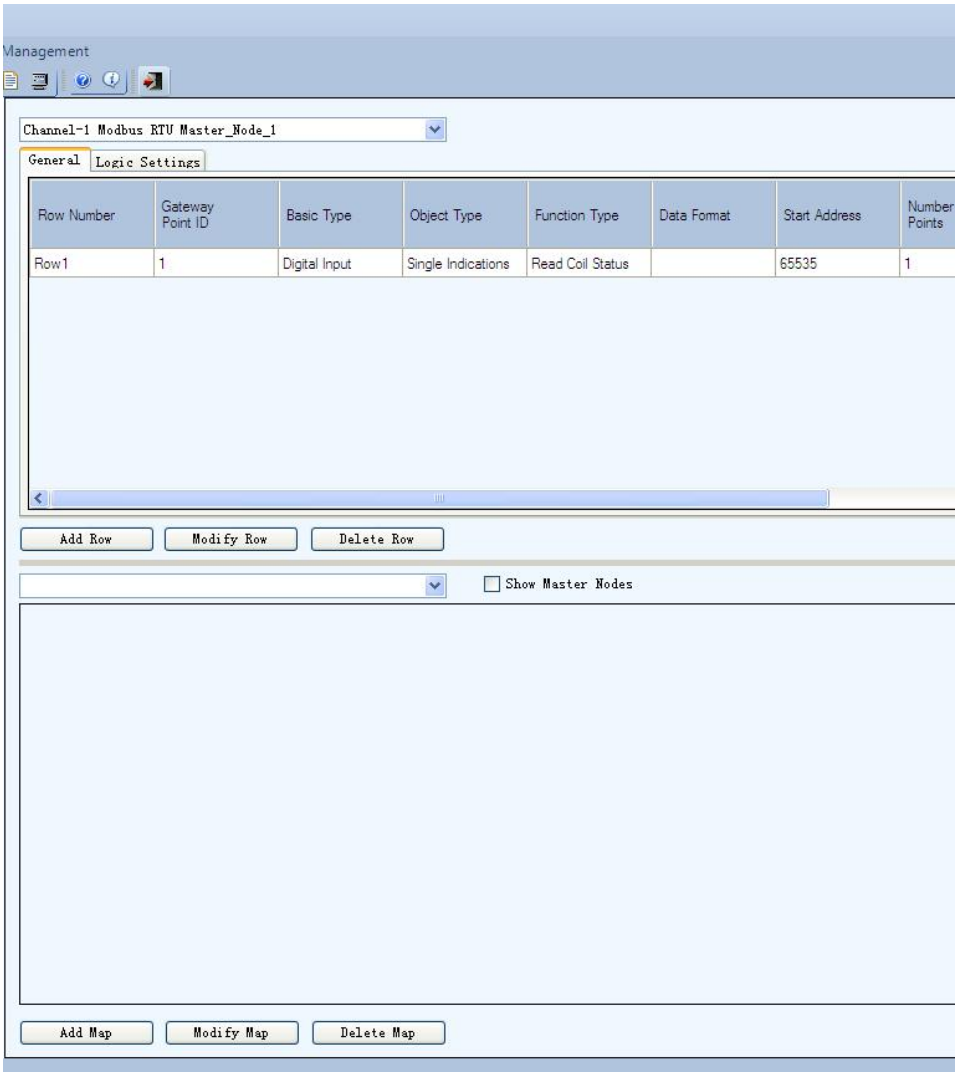
4 Software Instructions

The interface of EasyConnect includes: title bar, menu bar, toolbar, device section and configuration section.

4.1 User Interface






Management
Channel-1 Modbus RTU Master_Node_1
General
Logic Settings
Row Number
Gateway Point ID
Basic Type
Object Type
Function Type
Data Format
Start Address
Number Points
Row1
1
Digital Input
Single Indications
Read Coil Status
65535
1
Add Row
Modify Row
Delete Row
Show Master Nodes
Add Map
Modify Map
Delete Map

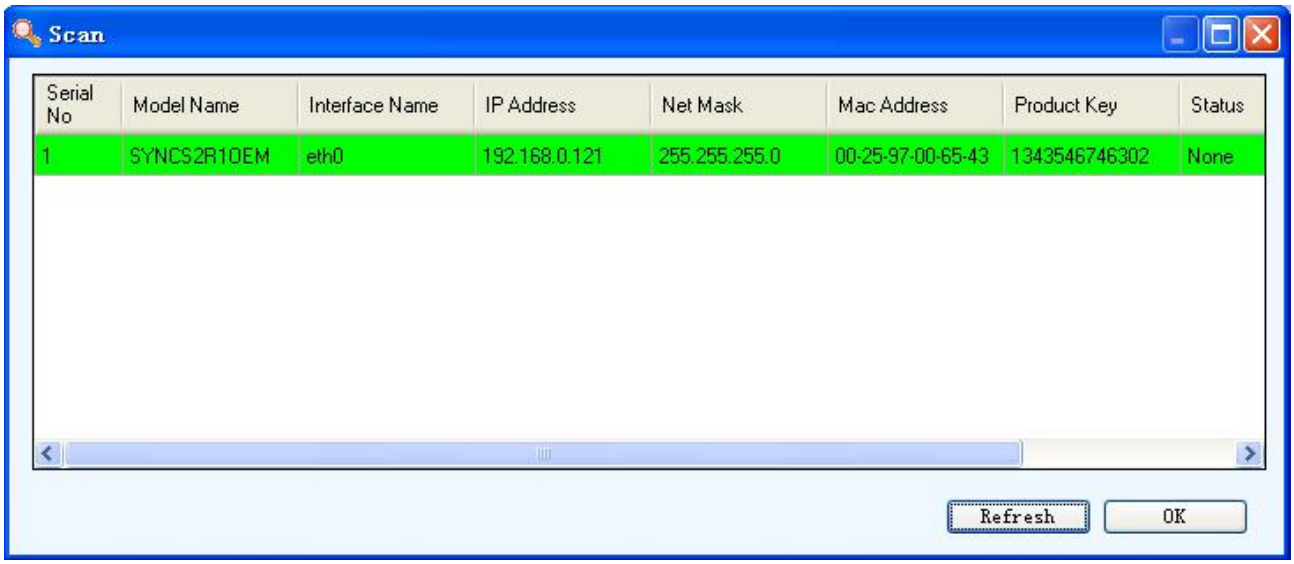
4.2 Toolbar

4.2.1 Restart

It's used to make configuration take effect after downloading the configuration.

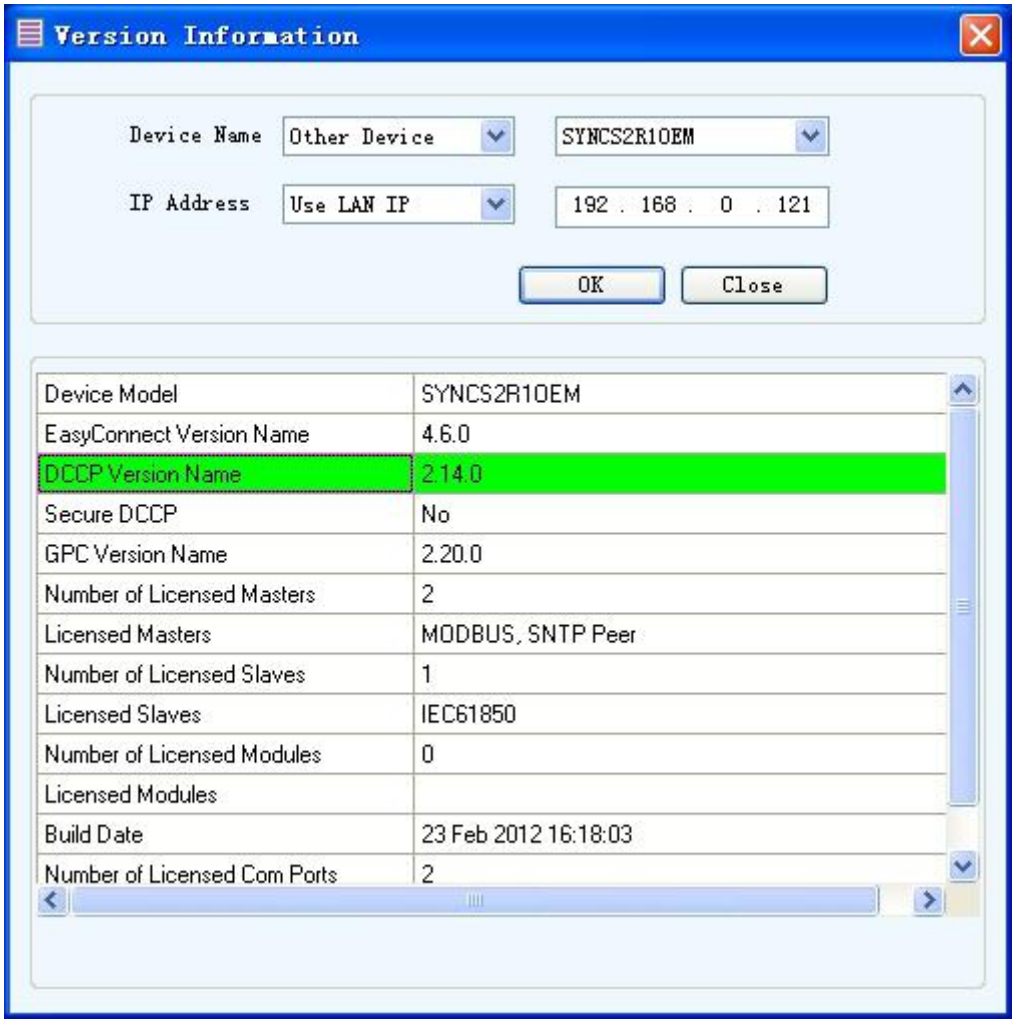
When it appears the following hint, click OK button and the gateway starts to restart.

4.2.2 Device Scan



4.2.3 Version Information

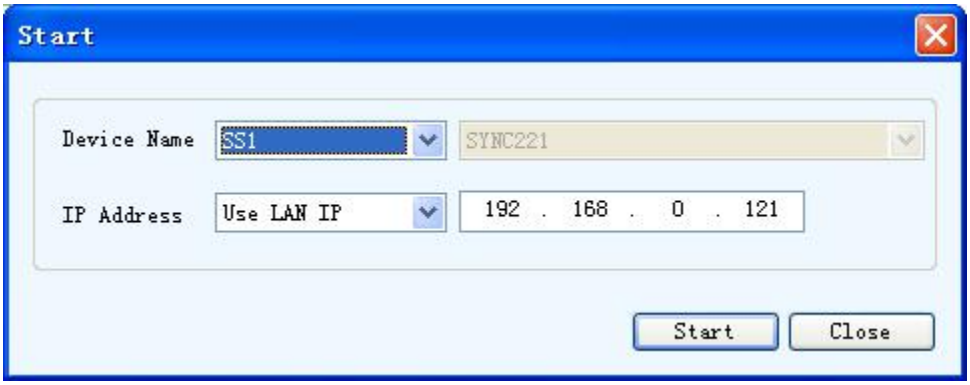
After opening, make sure the device model and IP address is correct, click OK, as shown in the following figure, confirm and click "Close" to exit.


Version Information
Device Name
Other Device
SYNCS2R10EM
IP Address
Use LAN IP
192 . 168 . 0 . 121
OK
Close
Device Model
SYNCS2R10EM
EasyConnect Version Name
4.6.0
DCCP Version Name
2.14.0
Secure DCCP
No
GPC Version Name
2.20.0
Number of Licensed Masters
2
Licensed Masters
MODBUS, SNTP Peer
Number of Licensed Slaves
1
Licensed Slaves
IEC61850
Number of Licensed Modules
0
Licensed Modules
Build Date
23 Feb 2012 16:18:03
Number of Licensed Com Ports
2

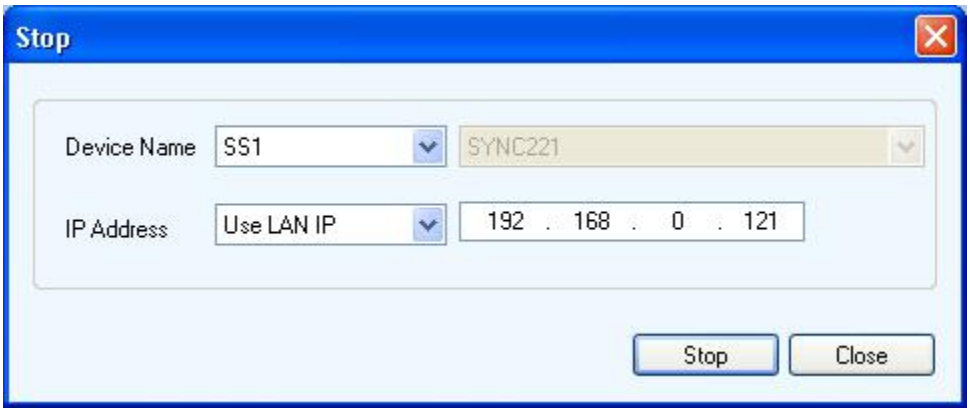
4.2.4 Update

Note: please do not update the program. If there is a problem with the product, be sure to carry out the function update process in the company's guidance.

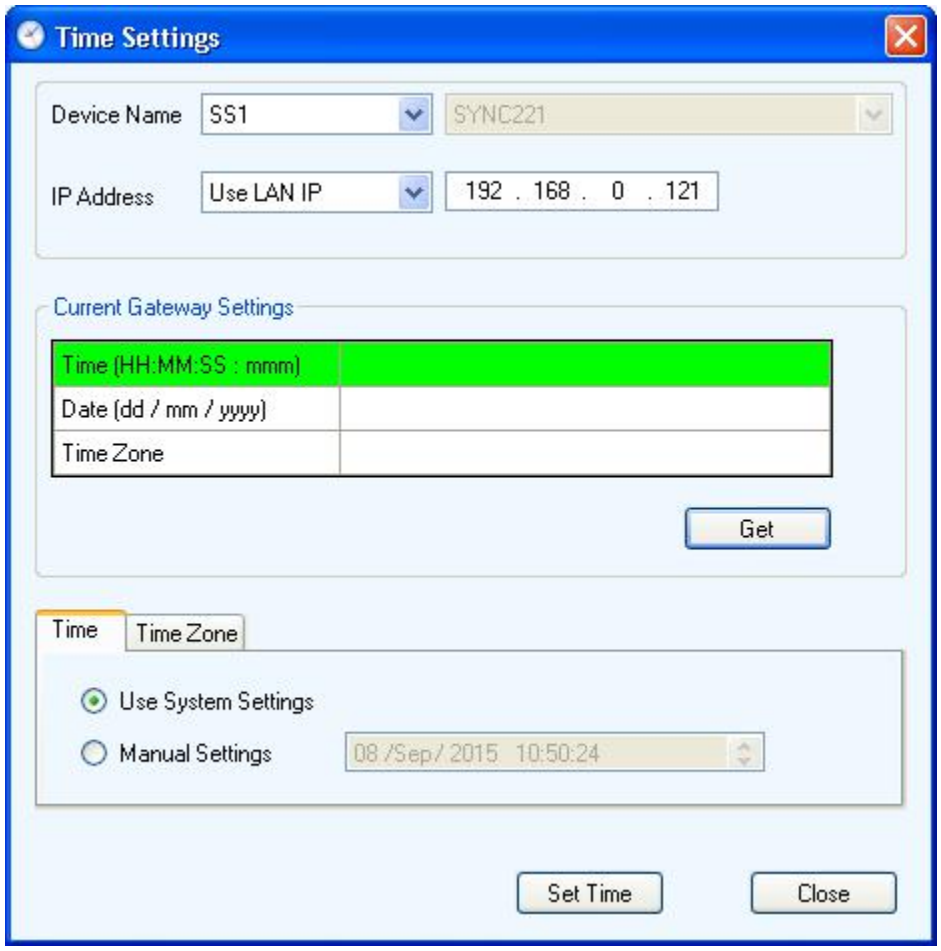
4.2.5 Start



4.2.6 Stop

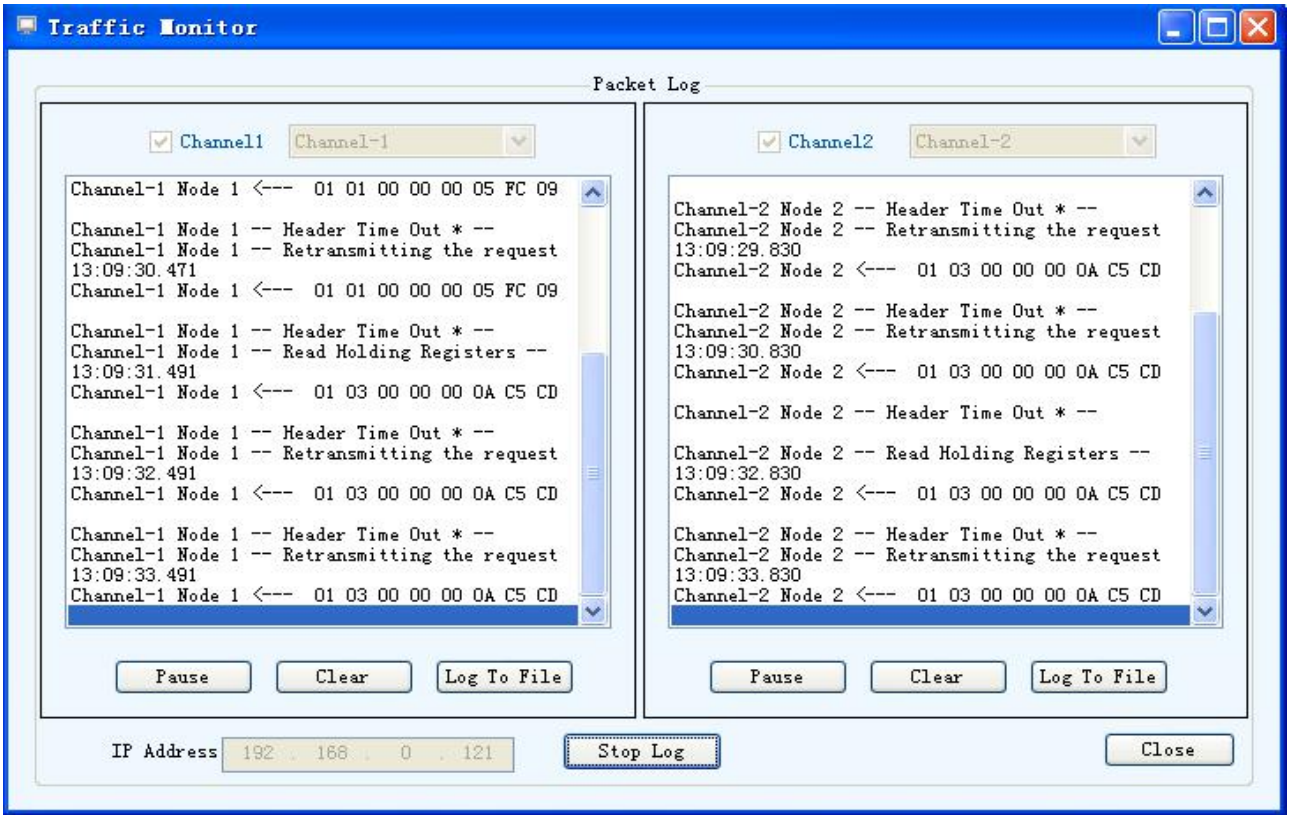

Stop
Device Name
SS1
SYNC221
IP Address
Use LAN IP
192 . 168 . 0 . 121
Stop
Close

4.2.7 Time Settings



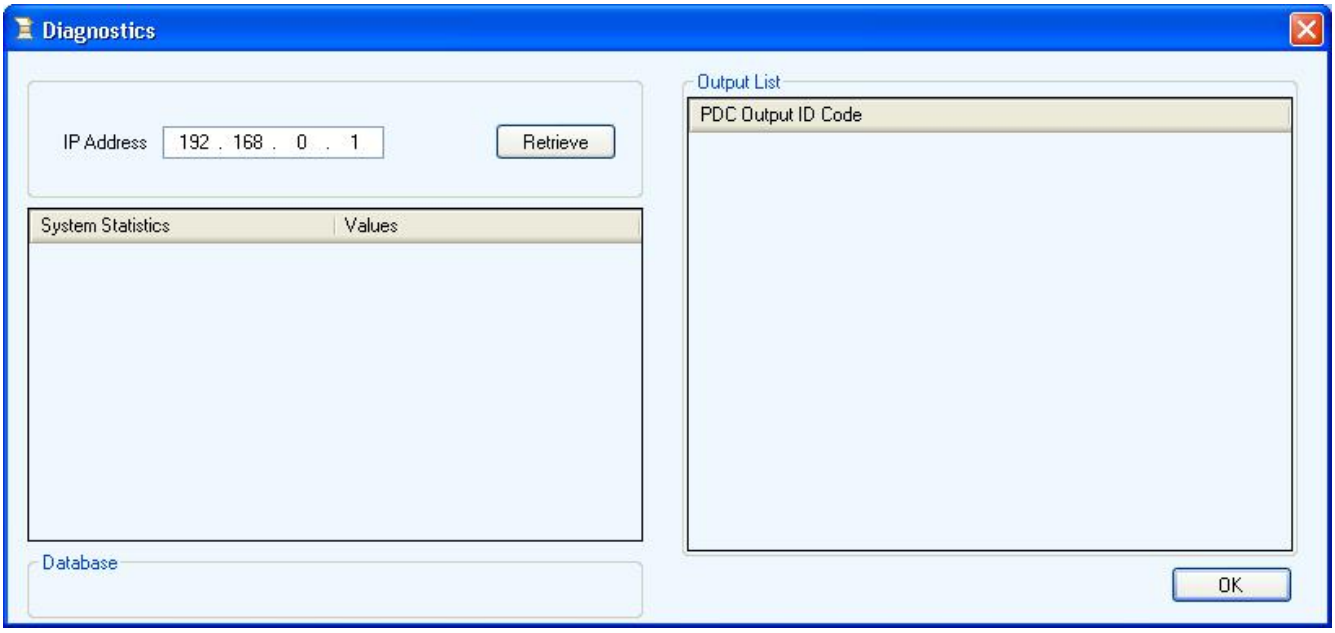
It is used to set the system time and time zone.

4.2.8 Traffic Monitor



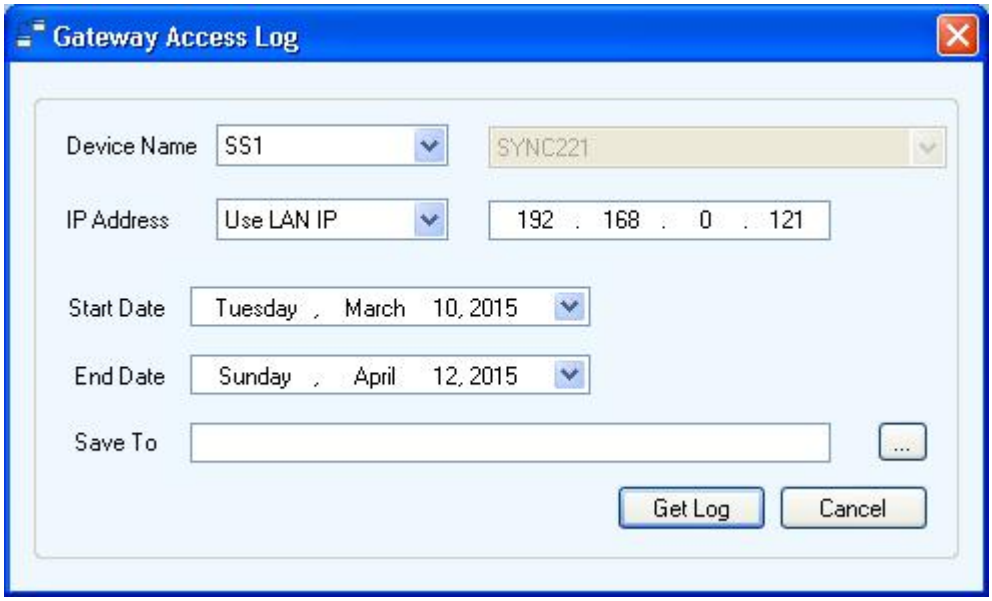
Used to monitor communication status of each channel.

4.2.9 Diagnostics



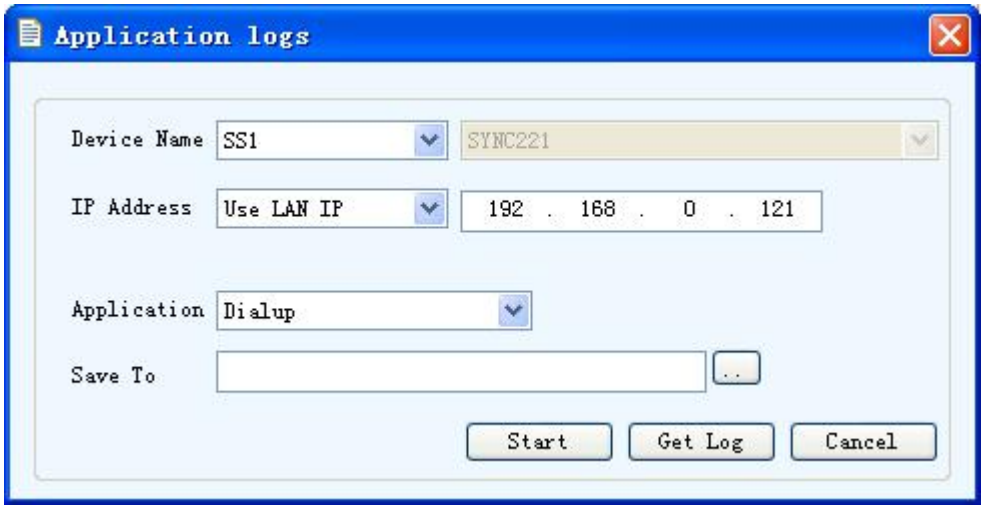
Note: This function is disabled.

4.2.10 Gateway Log



Note: This function is disabled.

4.2.11 Application Logs



4.3 EasyConnect Guide

Before using EasyConnect, you need to set up ICD model for your Modbus devices.

4.3.1 Device Selection

Open EasyConnect, click the Device option in the left column, as shown in figure 4.3.1.1, in the "SYNC"page, choose SYNC 200 IED Upgrade Card in SYNC SERIES; choose SYNC221 in MODEL option, click "OK" button, as shown in figure 4.3.1.2; The configuration file is mainly composed of three parts: "Channel", "Node" and "Profile" (as device path, node, and profile). First, you need to configure the channel (Channel), then is new node (Node), the last is configuring attributes (Profile). Currently iGate-850 supports 3 channels, one channel for the Ethernet interface (IEC61850), the remaining two channels for the serial port 1 and 2.

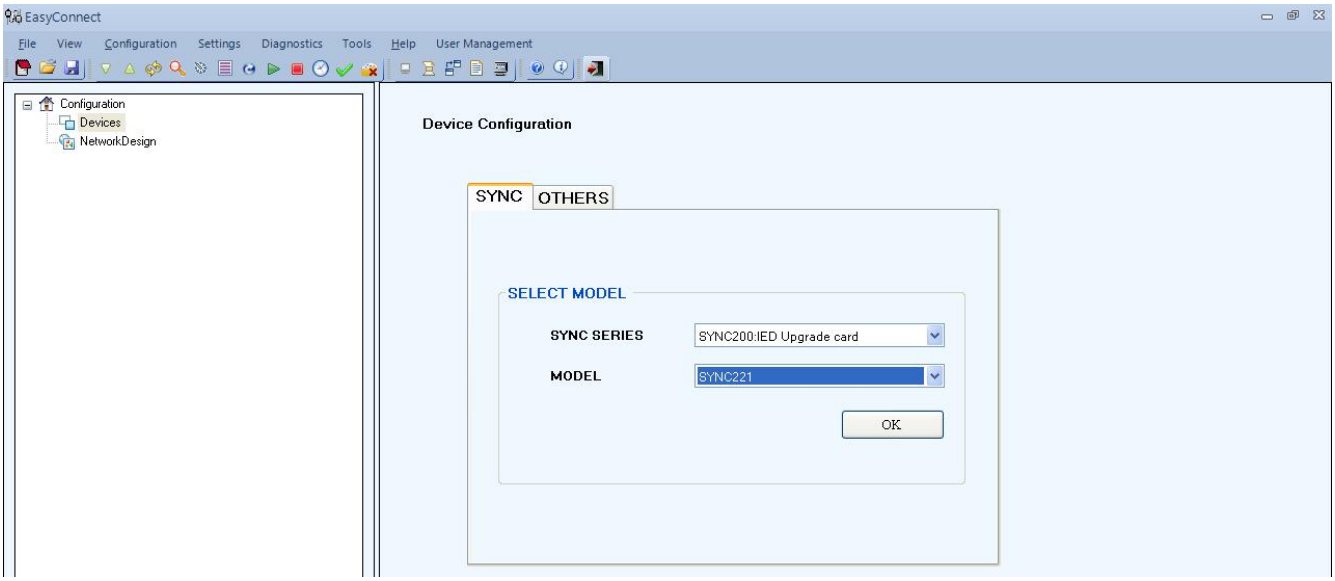

EasyConnect
File View Configuration Settings Diagnostics Tools Help User Management
Configuration
Devices
NetworkDesign
Device Configuration
SYNC
OTHERS
SELECT MODEL
SYNC SERIES
SYNC200:IED Upgrade card
MODEL
SYNC221
OK

Figure 4.3.1.1

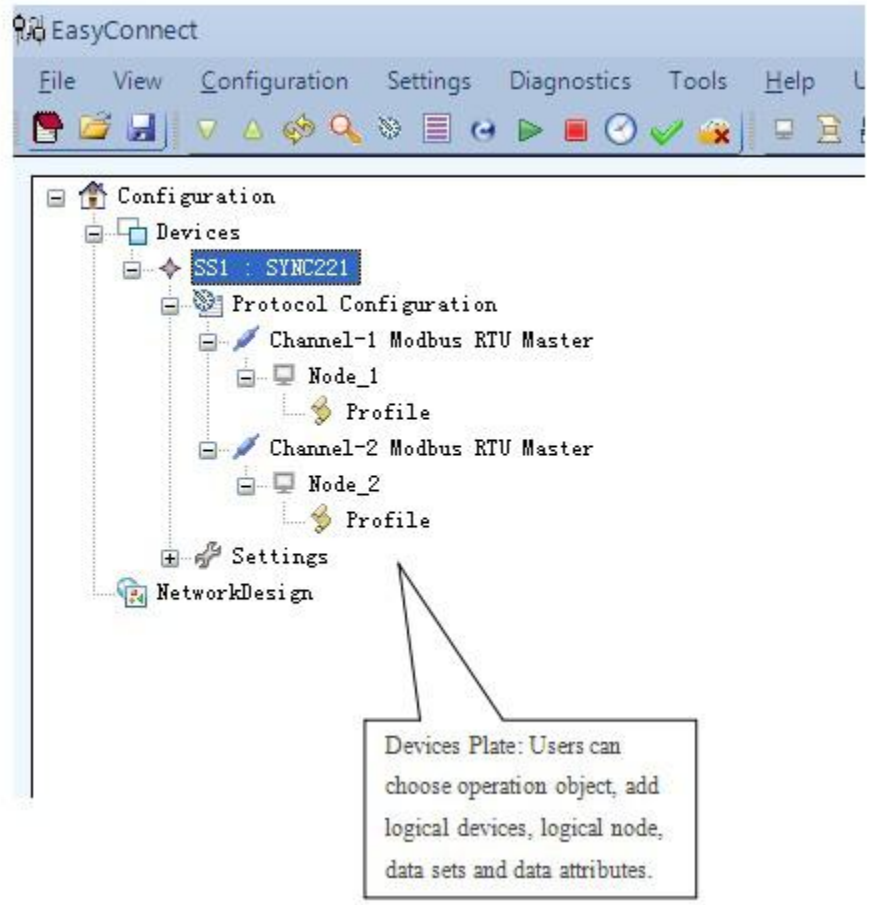

EasyConnect
File View Configuration Settings Diagnostics Tools Help
Configuration
Devices
SS1 : SYNC221
Protocol Configuration
Channel-1 Modbus RTU Master
Node_1
Profile
Channel-2 Modbus RTU Master
Node_2
Profile
Settings
NetworkDesign
Devices Plate: Users can choose operation object, add logical devices, logical node, data sets and data attributes.

Figure 4.3.1.2

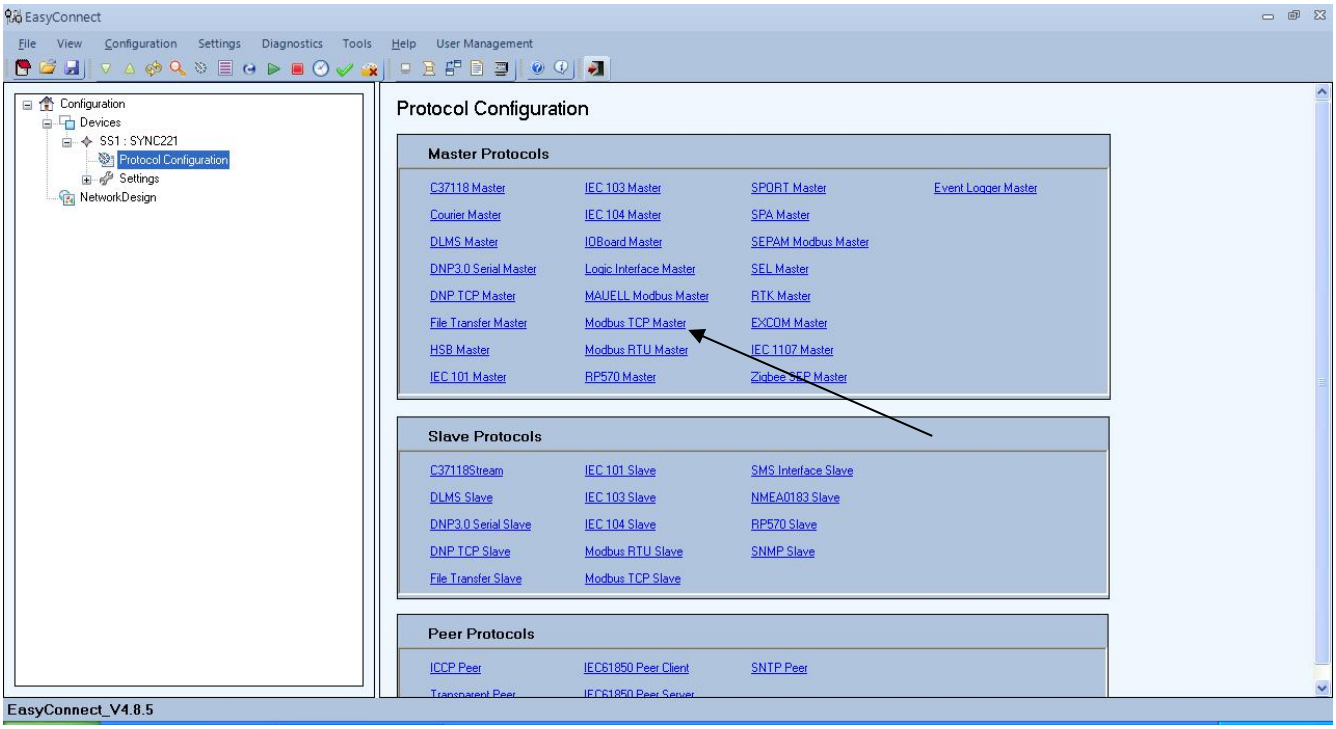


Figure 4.3.1.3

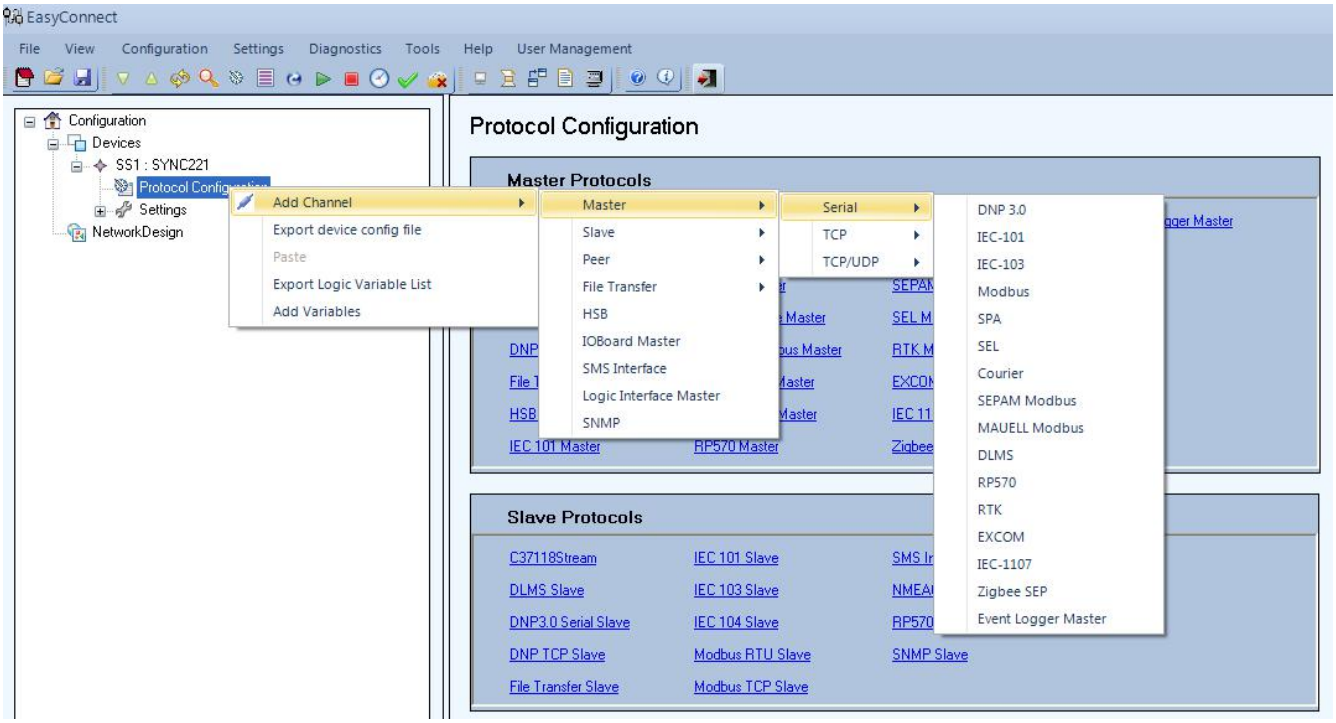


Figure 4.3.1.4

4.3.2 Configure Modbus Device channel

Click "Modbus RTU Master" of the "Master Protocols" in the area of "Protocol Configuration" in figure 4.3.2.1, and click once to add a Modbus RTU Master Channel. This device can add up to two channels, namely two Modbus RTU master, we can also directly right click "Add Channel" in the Protocol Configuration, then choose "Master"->"Serial"->"Modbus", click Channel in the left column, where the interface can display the serial property in the right column. As shown in figure 4.3.2.1, we can choose Modbus RTU or Modbus ASCII in the right column. You can choose COM port and select the transmission form of RS-232 or RS-485 or RS-422.

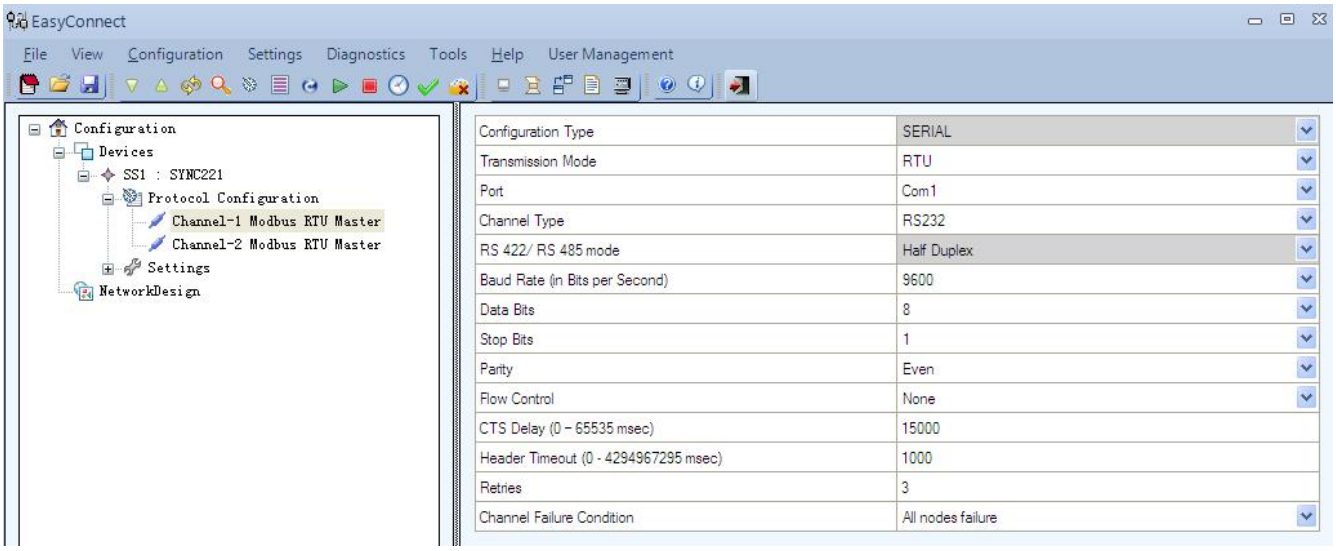


Figure 4.3.2.1

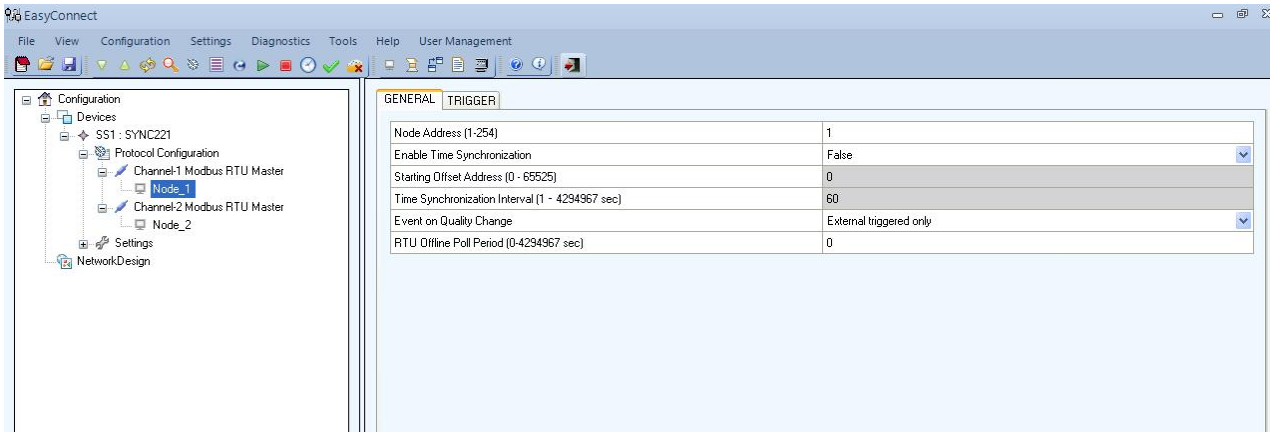
Parameter name	Range / optional values	Default value	Description
Transmission Mode	RTU/ASCII	RTU	Specifies how information will be packed into the message fields and decoded. In ASCII mode, each 8–bit byte in a message is sent as two ASCII characters and in RTU mode, each 8–bit byte in a message contains two 4–bit hexadecimal characters.
Port	Com1 - Com2	Depends on serial	This product only supports Com1 and Com2

		channels configured	
Channel Type	RS-232/ RS-422/ RS-485	RS-232	Type of serial communication for the particular channel. **Note:** RS 485/RS-422 configuration depends on specific SYNC model. Refer SYNC User Manual.
RS-422/RS-485 mode	Half Duplex, Full Duplex	Half Duplex	Type of serial communication for the particular channel. **Note:** RS 485/RS-422 configuration depends on specific SYNC model. Refer SYNC User Manual.
Baud Rate (bits/sec)	200 - 38400 bits/sec	9600 bps	Baud rate for serial communication in Bits per second.
Data Bits	7,8	8	Number of data bits for serial communication. Data Bits 7 is for Transmission Mode ASCII.
Stop Bits	1,2	1	Number of stop bits for serial communication. Stop Bits 2 is for Transmission Mode ASCII.
Parity	None, Even, Odd	Even	Parity for serial communication.
Flow Control	Hardware,Software, None	None	Currently not supported
CTS Delay (0 – 65535 msec)	0 – 65535 milliseconds	15000 msec	Currently not supported
Header Timeout (0 – 4294967295 msec)	0 - 4294967295 milliseconds	1000 msec	Indicates the maximum waiting time in milliseconds within which the first byte of a response from the station should be received after the transmission of a request message.

Retries	0 - 255	3	Indicates the maximum number of retries when there is no reply from the Slave device.
Channel failure condition	All node failure, Single node failure, Ignore the failure	All node failure	This channel is considered as active or inactive depending on this configuration. If HSB is configured in the gateway, it will use this channel status for making the switch over decision All node failure: channel is made inactive if all the nodes in the channel fails. Single node failure:channel is made inactive if any of the the nodes in the channel fails. Ignore:channel is made inactive if all the nodes in the channel fails. But HSB will not use this channel status for making the switch over decision.

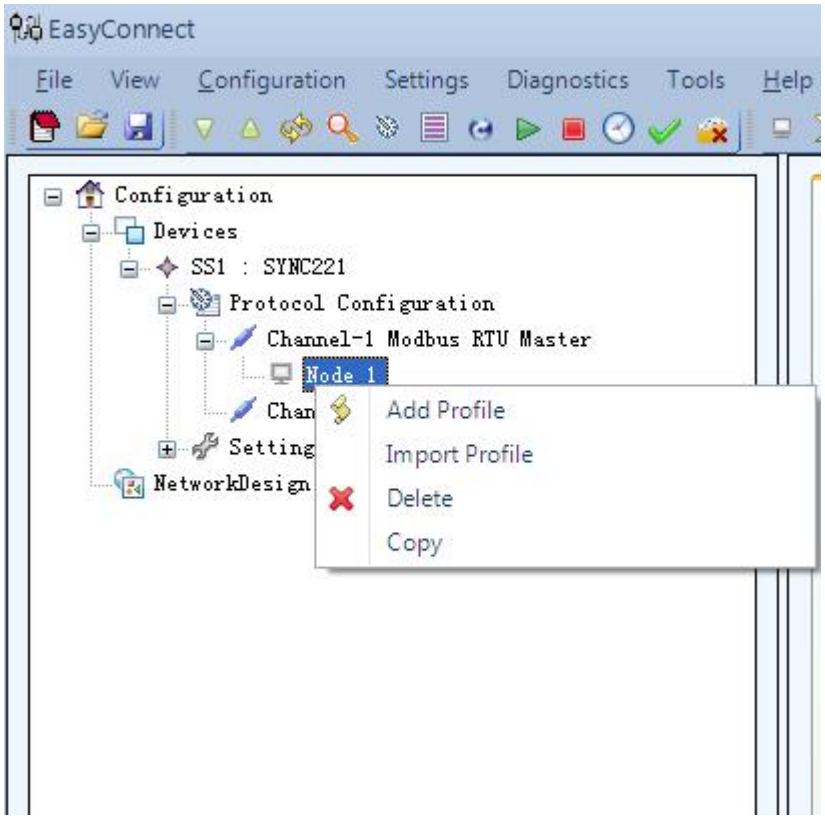
4.3.3 Configure Modbus Node

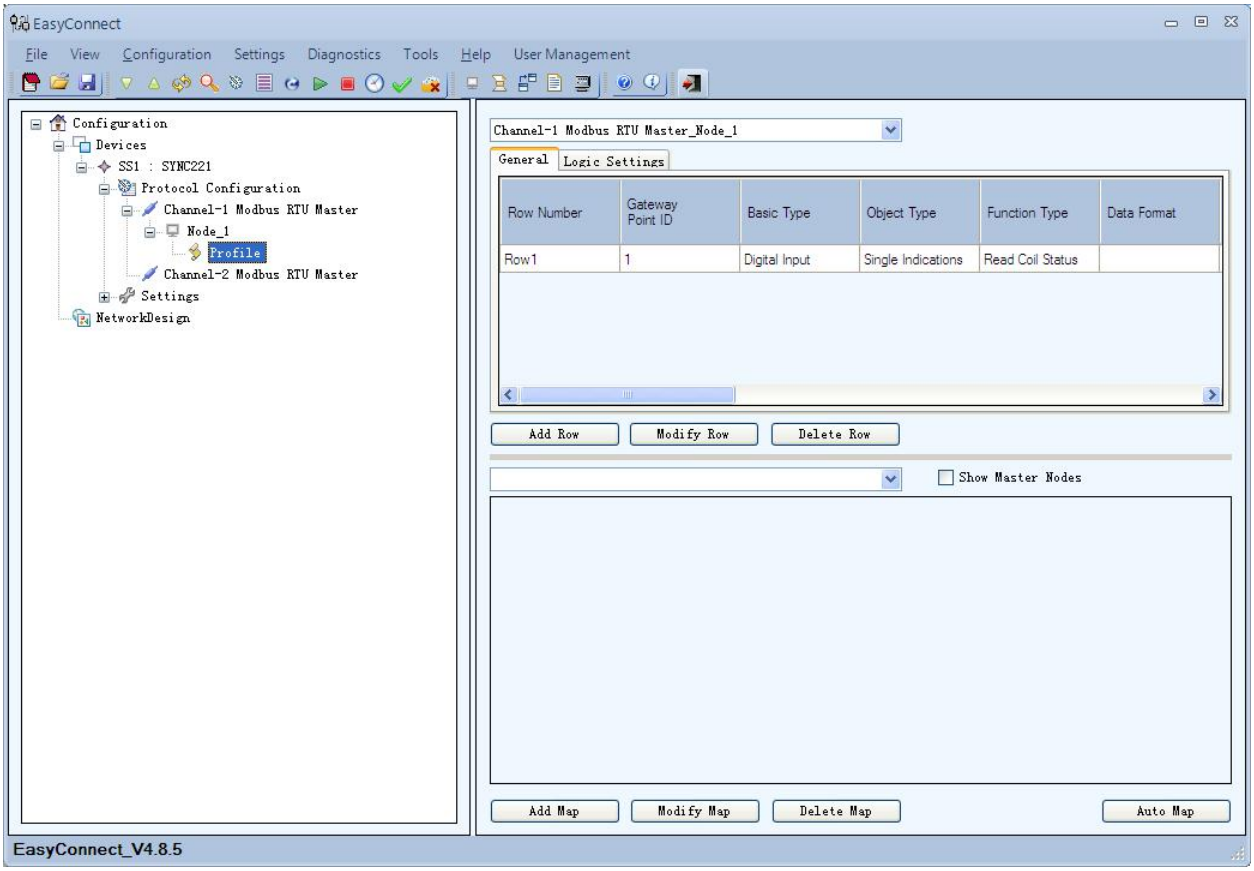
After adding nodes, we can configure the node's properties in the right column, such as node address, enable time synchronization and so on.



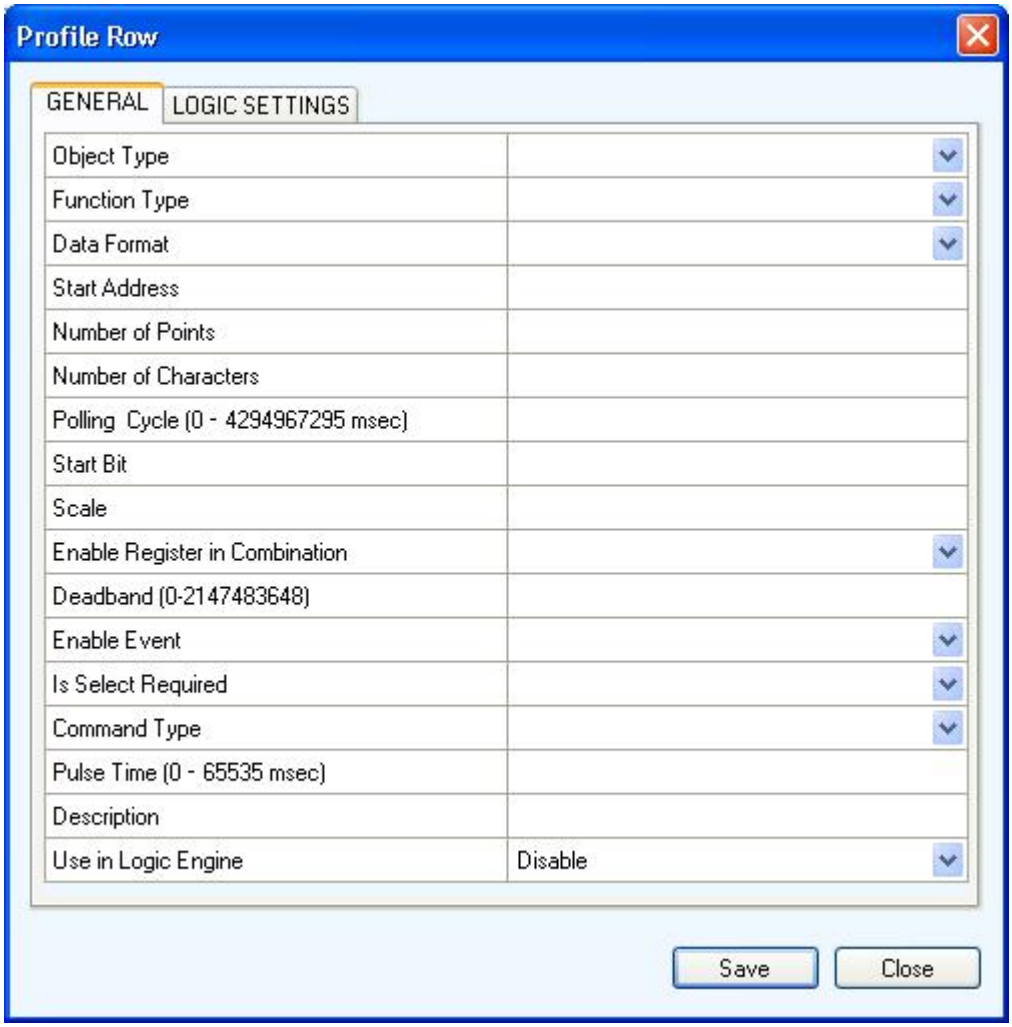
Parameter name	Range / optional values	Default value	Description
Node Address	1-254	NA	Indicates the Address of Remote slave Device
Enable Time Synchronization	True, False	False	Modbus master can send time synchronization messages if it is True
Starting Offset Address (0 - 65525)	0 – 65525	0	Indicates the starting address of continuous registers to which master has to write the date and time information.
Time Synchronization Interval (1-4294967 sec)	1 – 4294967 seconds	60 sec	This is the time interval between successive time synchronization command.
Event on Quality Change	External triggered only Generate Internal Event	External triggered only	Current not supported

Right click the node, users can add profile, shown as below:


EasyConnect
File
View
Configuration
Settings
Diagnostics
Tools
Help
Configuration
Devices
SS1 : SYNC221
Protocol Configuration
Channel-1 Modbus RTU Master
Node 1
Chan
Setting
NetworkDesign
Add Profile
Import Profile
Delete
Copy



Click the "Add Row" will pop up dialog box as follows:



Modbus master profile parameter details:

Parameter name	Range / optional values	Default value	Description
Object Type	Single Indications Double Indications Analog Inputs Pulse Counters Single Commands Double Commands Analog Outputs String	NA	Each profile entry is classified according to its type

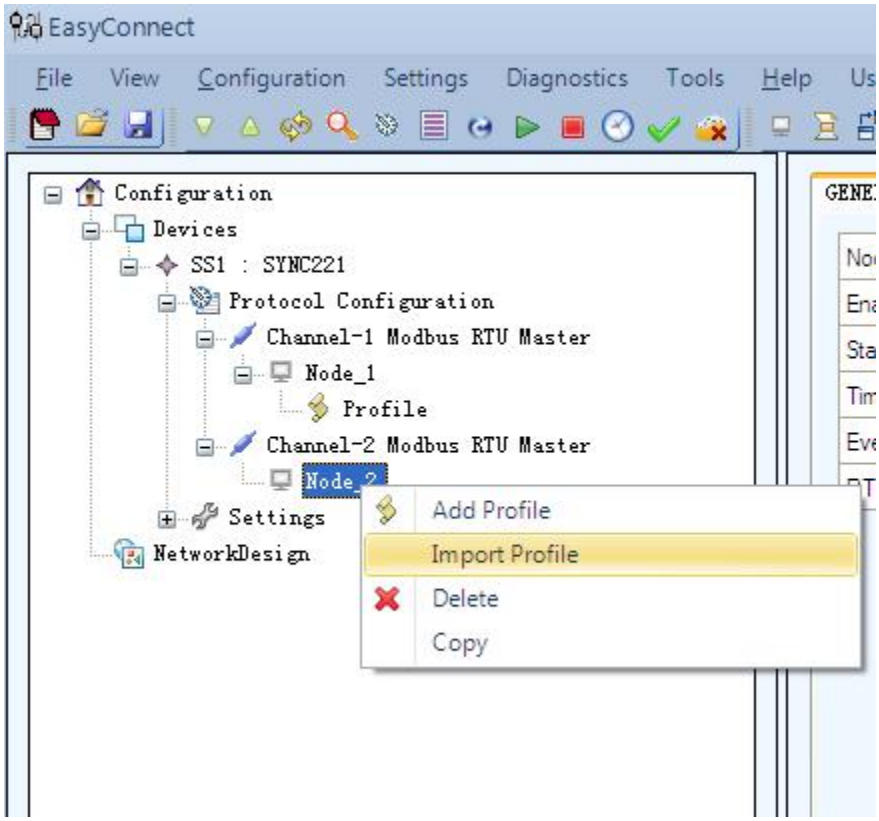
Function Type	Read Coil Status Read Discrete Inputs Read Holding Register Read Input Register Force Single Coil Force Single Register Force Multiple Coils Force Multiple Register	NA	This indicates the possible function types for the points
Data Format	Double Float Float (lsw-msw) Signed 32 bit(msw-lsw) Signed 32 bit(lsw-msw) Signed Single Register Unsigned 32 bit(msw-lsw) Unsigned 32 bit(lsw-msw) Unsigned Single Register Single Register to be mapped to SI Register mapped to 16 Single Commands	NA	Indicates the supported Data types .
Start Address	0 – 65535	NA	It is the starting address of a sequence of points in the Modbus TCP/RTU Slave. And the number of contiguous points can be configure using *Number of Points*.
Number of Points	1– 65535	NA	The number of contiguous points to be added from the *Start Address* point.
Number of	1-200	NA	The number of characters in the string. This field is applicable only for Object

Characters			Type String.
Polling Cycle (0 – 4294967295 msec)	0 – 4294967295 milliseconds	1000 msec	The particular profile is polled at every configured polling cycle milliseconds.
Start Bit	1-16	1	User may select the particular *start bit* in entire 16 bit register and gateway must only consider bits from *Start bit*
Scale	100, 1, 0.1, 0.01, 0.001, 0.0001	1	This is the factor by which the Modbus data gets multiplied before sending to the external master.
Enable Register in Combination	True / False	False	Used to interpret data differently. If this parameter is *False,* the master will consider all the Master registers are with 16 bit register size. If *True* master will assume that the Master register has as much size as data type.
Deadband (0 - 2147483648)	0 - 2147483648	0	If the change in data value from the previous updated value is higher than '*Deadband*', the analog data points will get updated in the SYNC database. If event reporting is supported by the slave row mapped to this master row , data will be reported as event. *Deadband*, set to '0' will work as if the '*Deadband*' is disabled. Note: This parameter is valid / active only if *Object Type* is set as Analog Inputs, Binary Counter or Frozen Counter.

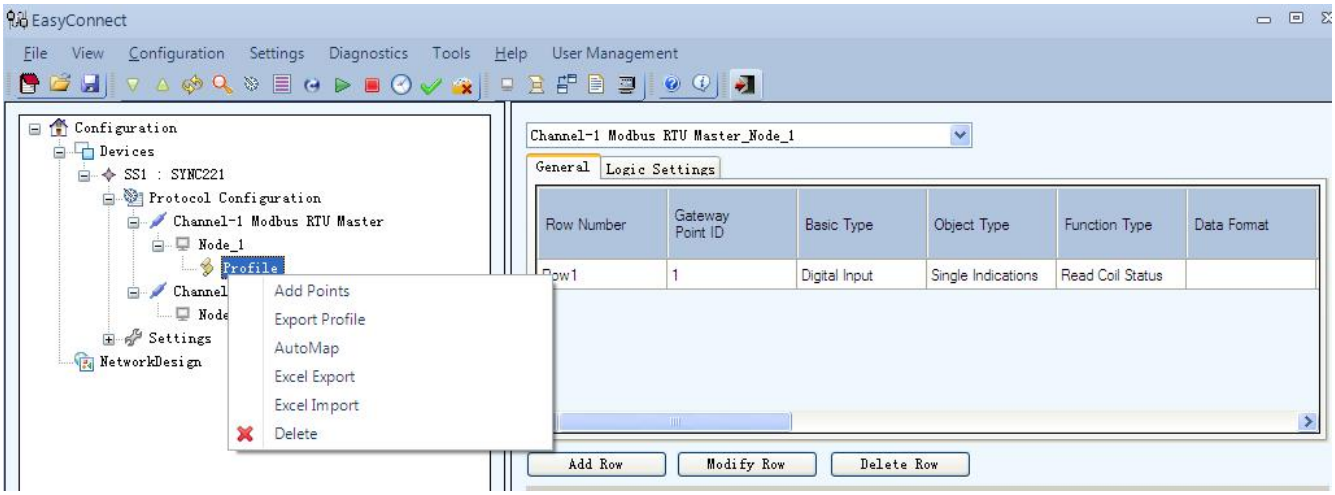
Enable Event	True / False	True	Indicates whether the configured parameter should be reported when there is change in the value or on the request from the other master protocol. Note: Mapping protocol also must support this.
Is Select Required	True / False	False	If this parameter is 'True', it will cause a command to execute only if a valid select is obtained on the slave protocol point mapped to this Modbus point. Note: This parameter is valid/ active only if *Object Type* is set as *Single Commands*, *Double Commands* or *Analog Outputs*
Command Type	Latch Pulse Copy From Slave	Latch	Indicates the modes to configure 'Force single command' The options are described below. Latch: If configured in this option, the value of command from the slave side will be used in the force single coil command. Pulse:– If configured in this option, the value which is forced using Force Single Coil Command will be forced back to the previous value after *Pulse Time* Copy From Slave – This mode of configuration, executes a command operation on Modbus side, depending on the command got on the slave side protocol.

			Note : Valid only when the object type is *Single Commands*
Pulse Time (0 – 65535 msec)	0 – 65535 milliseconds	1000 msec	Specifies the time interval after which the forced value will be back to its previous value for command on Modbus side, if '*Command Type*' is configured for the value of 'Pulse'.
Description			Description of the Row

In the software, users also can import profile besides adding profiles manually, as follows:



Right click Profile, users can add data attributes, export the data set (in XML format), automap, export data profile in Excel format, as shown in the following figure.



4.3.4 Configure IEC61850 Channel

Click "IEC61850 Peer Server" of "Peer Protocols" in the "Protocol Configuration" area, this device can add up to one IEC61850 Channel, namely one IEC61850 slave, we can also directly click "Add Channel"in the Protocol Configuration, then choose "Peer" -> "IEC61850 Server", click Channel in the left column, where it can display the IEC61850 channel property in the right column. As shown in figure 4.3.4.2.

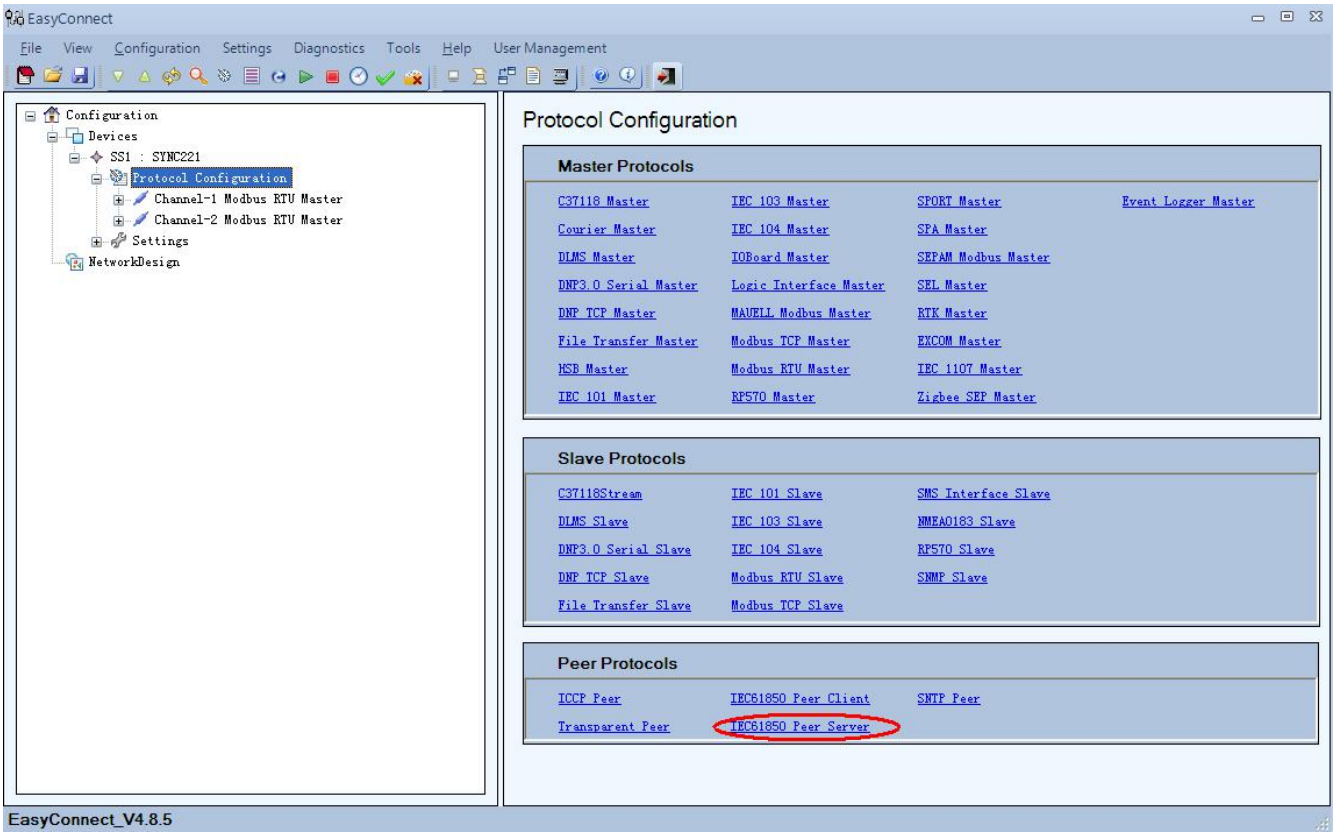

EasyConnect
File View Configuration Settings Diagnostics Tools Help User Management
Configuration
Devices
SS1 : SYNC221
Protocol Configuration
Channel-1 Modbus RTU Master
Channel-2 Modbus RTU Master
Settings
NetworkDesign
Protocol Configuration
Master Protocols
C37118 Master
IEC 103 Master
SPORT Master
Event Logger Master
Courier Master
IEC 104 Master
SPA Master
DLMS Master
IOBoard Master
SEPAM Modbus Master
DNP3.0 Serial Master
Logic Interface Master
SEL Master
DNP TCP Master
MAUELL Modbus Master
RTK Master
File Transfer Master
Modbus TCP Master
EXCOM Master
HSB Master
Modbus RTU Master
IEC 1107 Master
IEC 101 Master
RP570 Master
Zigbee SEP Master
Slave Protocols
C37118Stream
IEC 101 Slave
SMS Interface Slave
DLMS Slave
IEC 103 Slave
NMEA0183 Slave
DNP3.0 Serial Slave
IEC 104 Slave
RP570 Slave
DNP TCP Slave
Modbus RTU Slave
SNMP Slave
File Transfer Slave
Modbus TCP Slave
Peer Protocols
ICCP Peer
IEC61850 Peer Client
SNTP Peer
Transparent Peer
IEC61850 Peer Server
EasyConnect_V4.8.5

Figure 4.3.4.1

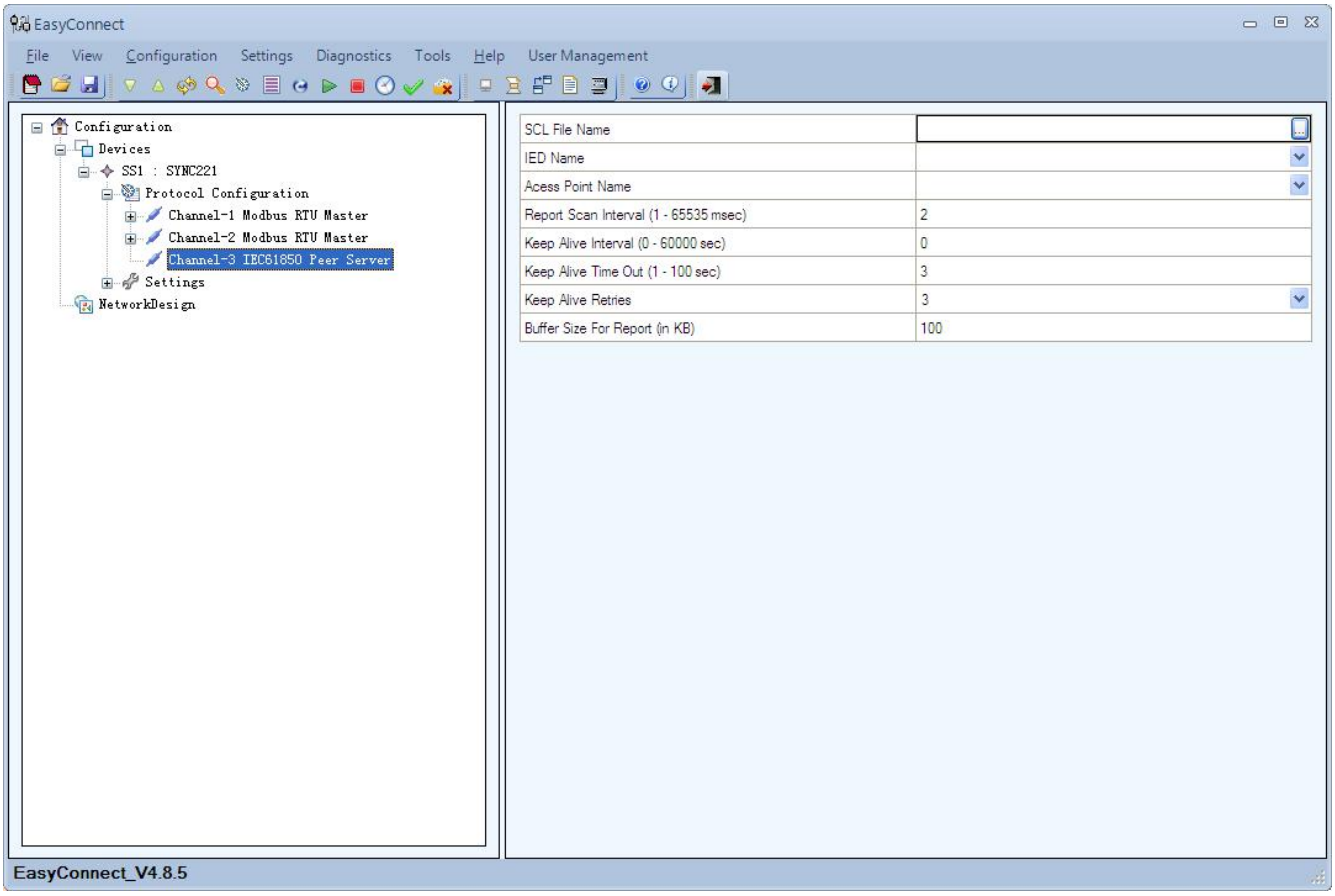


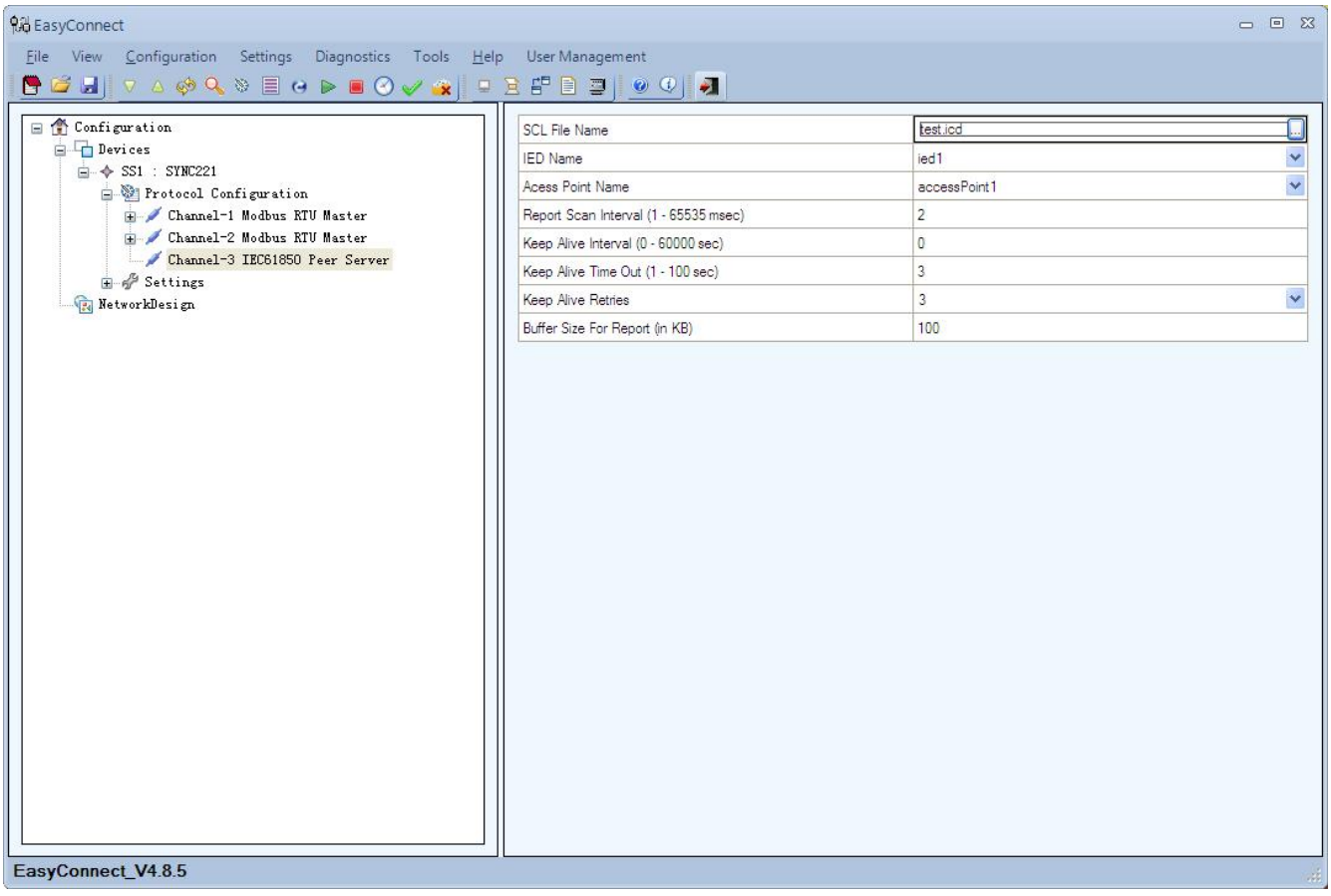
Figure 4.3.4.2

IEC61850 Server Channel Parameter Details:

Parameter name	Range / optional values	Default value	Description
SCL Filename	Browse any files with extension .ICD	None	The selected/ browsed file will get copied to the IEC61850 folder available in the installed path of EasyConnect. If there is a file with similar name it will prompt user to over right the same. Note: The ICD file can be created using the software "SCL Manager".The procedures for creating ICD files are explained in its user manual .The ICD files used for SYNC should be saved

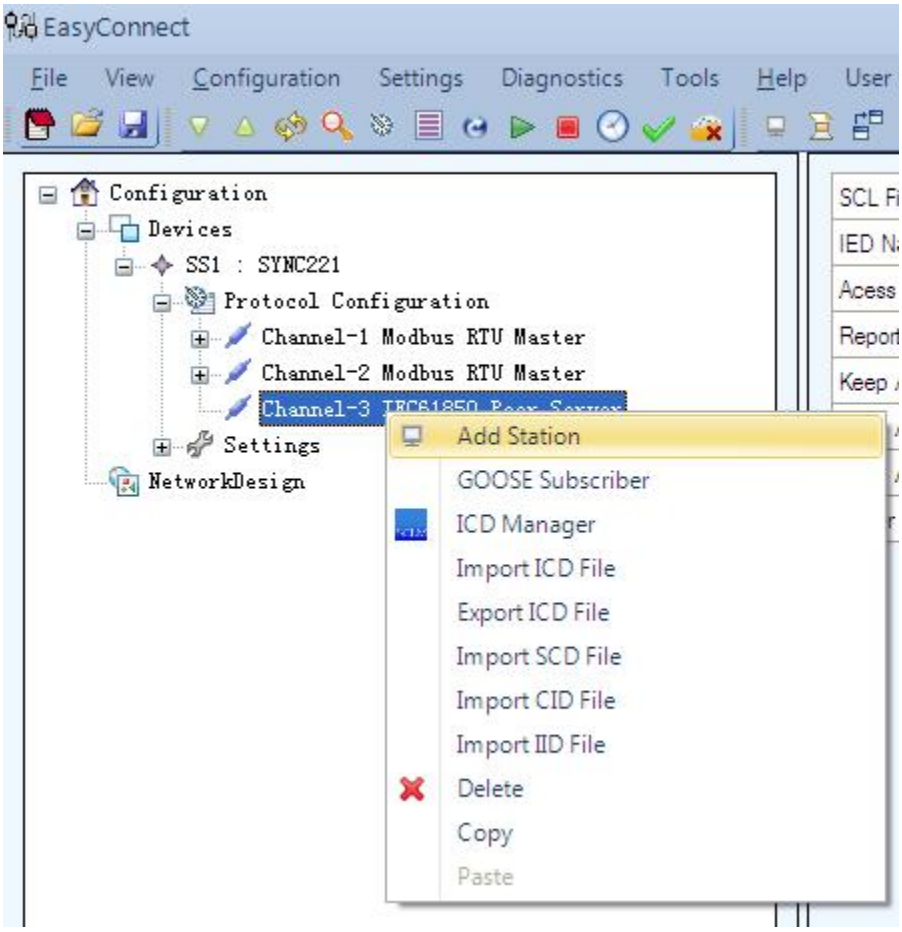
			in UTF-8 format.
IED Name	List all the IED names inside the chosen SCL File.	First entry available in the SCL file.	The IED name will have specific significance if user map from IEC 61850 client to the server where user have multiple IEDs.
Access point name	List all the access point names inside the chosen SCL File.	First entry available in the file with the specified IED	It indicates a communication access point of the logical device(s) of an IED. Access point includes complete server address details for client-server connection and details of GSE address.
Report Scan interval (1 – 65535 msec)	1 – 65535 msec	2 milliseconds	It indicates the interval at which the server checks/ scans for the RCB data. After scanning at specified interval, reports will be generated immediately if available.
Keep Alive Interval (0 – 6000 sec)	0 – 6000 sec	0 second	It is the interval at which the server initiate the keep alive message. The message will be initiated if there is no messages from the client during this interval. If there is no reply from client even after the retries, the server will close its connection. '0' indicates the keep alive is not required.
Keep Alive Timeout (1 – 100 sec)	1 – 100 sec	3 seconds	It is the time for which the server will wait for reply from client (for keep alive message). The server will either retry for keep alive or close the connection as per the configuration of Keep alive

			retries.
Keep Alive Retries	1 – 10 times	3	It indicates number of retries to be performed to keep alive messages.
Buffer Size For Report (in KB)	10 – 1000 KB	100	It indicates the Buffer Size for Buffered Reports.



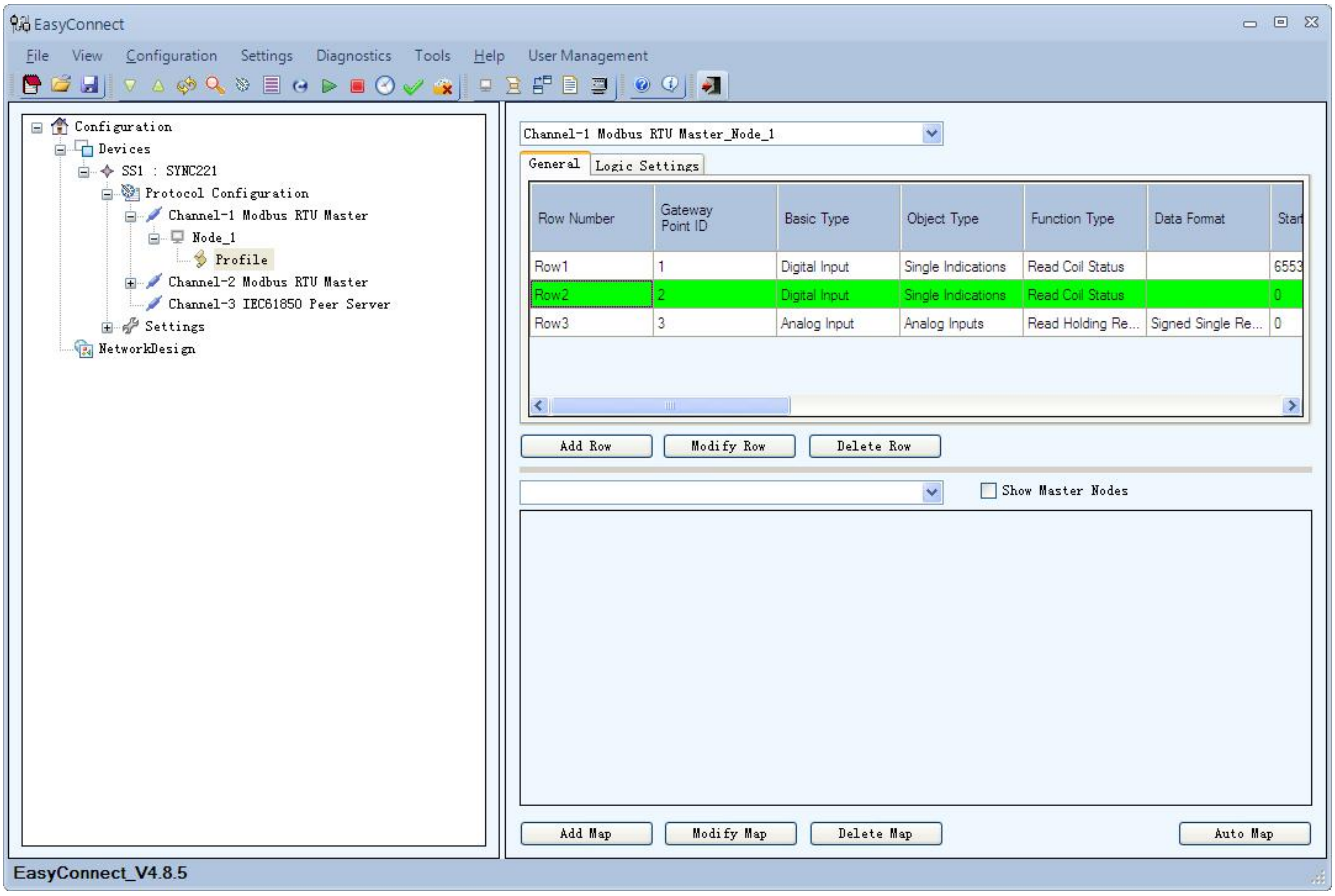
4.3.5 Configure IEC61850 Node

Select IEC61850 Peer Server Channel, right click on "Add Station", as shown follows:

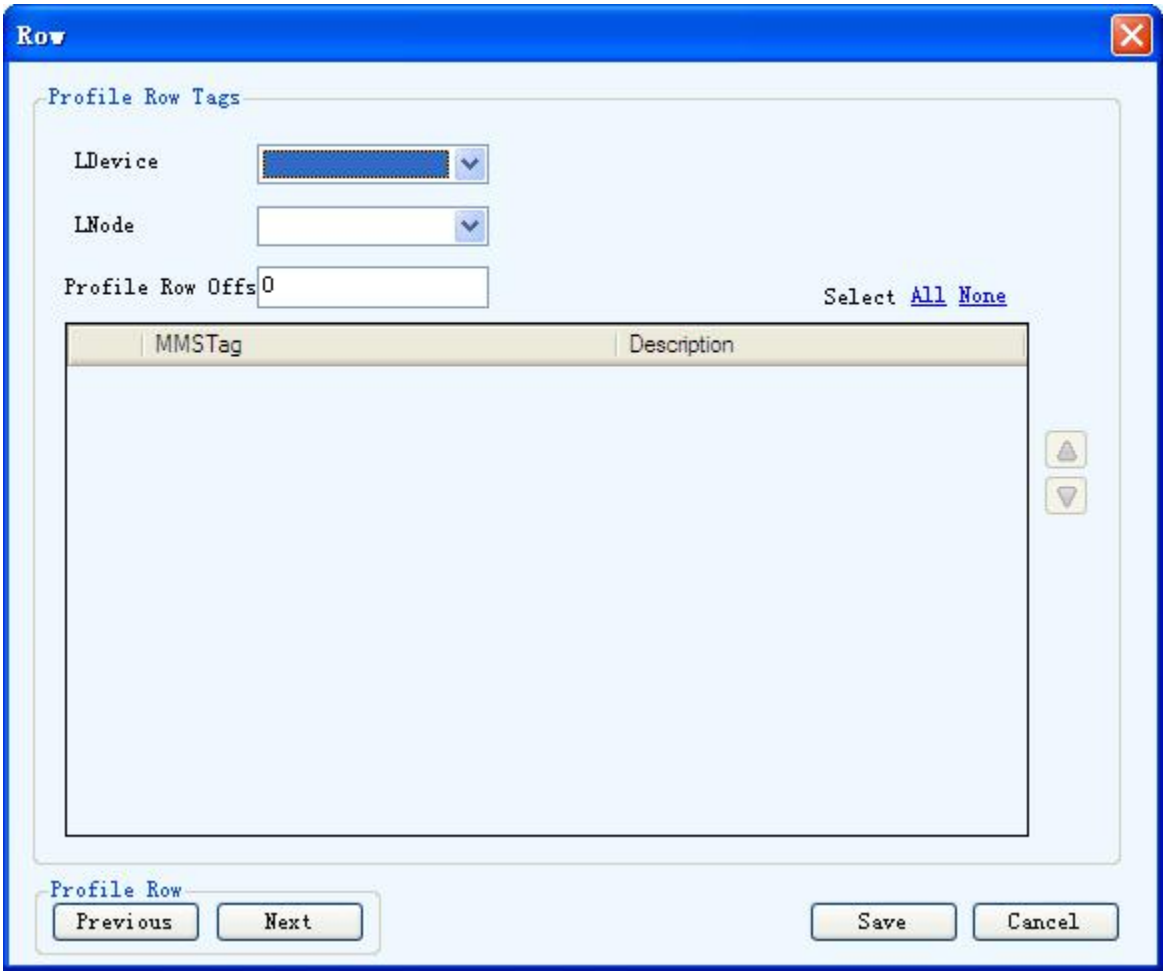


4.3.6 Data Map

Select the Profile under the Modbus RTU Master channel, and select the Modbus command you want to map to the IEC61850 object, as shown follows:



Click "Add Map" for the selected the Modbus command, click the "Add Map" button and it will pop up the following figure:

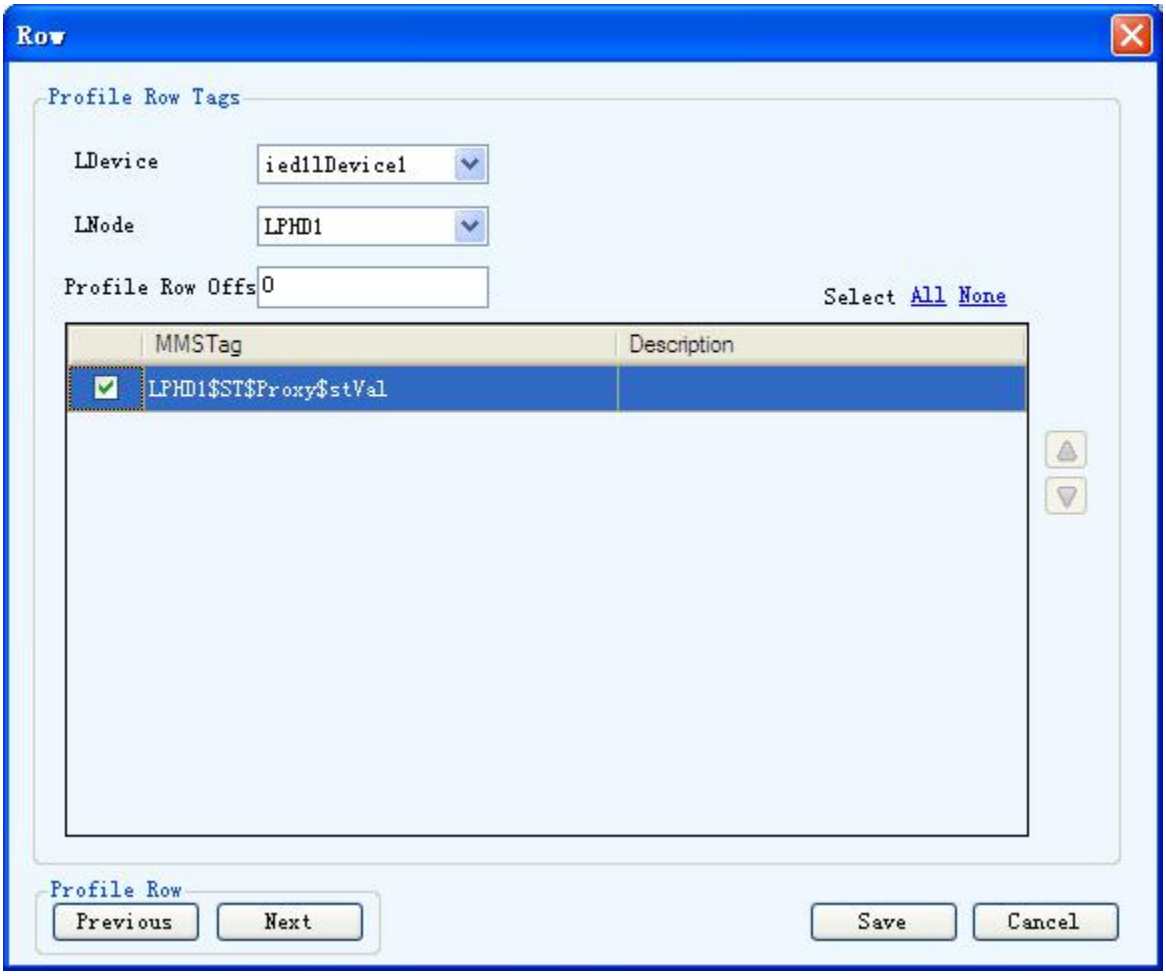


IEC61850 mapping details:

Parameter name	Range / optional values	Default value	Description
LDevice (Logical Deivce)	List out all the available logical devices under the selected SCL file (SCL file is selected as part of the channel configuration)	None	User need to select the desired logical device to get tags for mapping.
LNode (Logical	List out all the	None	User need to select the desired

Node)	available logical nodes under the selected Ldevice under the SCL.		logical node to get tags for mapping.
Profile Row Offset	0-(Number of Points in source row -1)	Least offset of the master unmapped points	Profile row offset allow the user to map selected points in a master row having more than 1 number of points. If 0 is configured and number point is N, N number of points are mapped from the 1 st point of the master row in an order basis. If 1 is selected the 1 st point will be omitted and the N points from the 2nd point of Master row is mapped in order.
MMS tags	All the tags under the chosen Ldevice and Lnode	None	Depending upon the master row selected to map, the possible MMS tags, under the chosen Ldevice and Lnode, will be listed
Description	None	None	It is an optional field where user can enter the description of each tag involved in the mapping

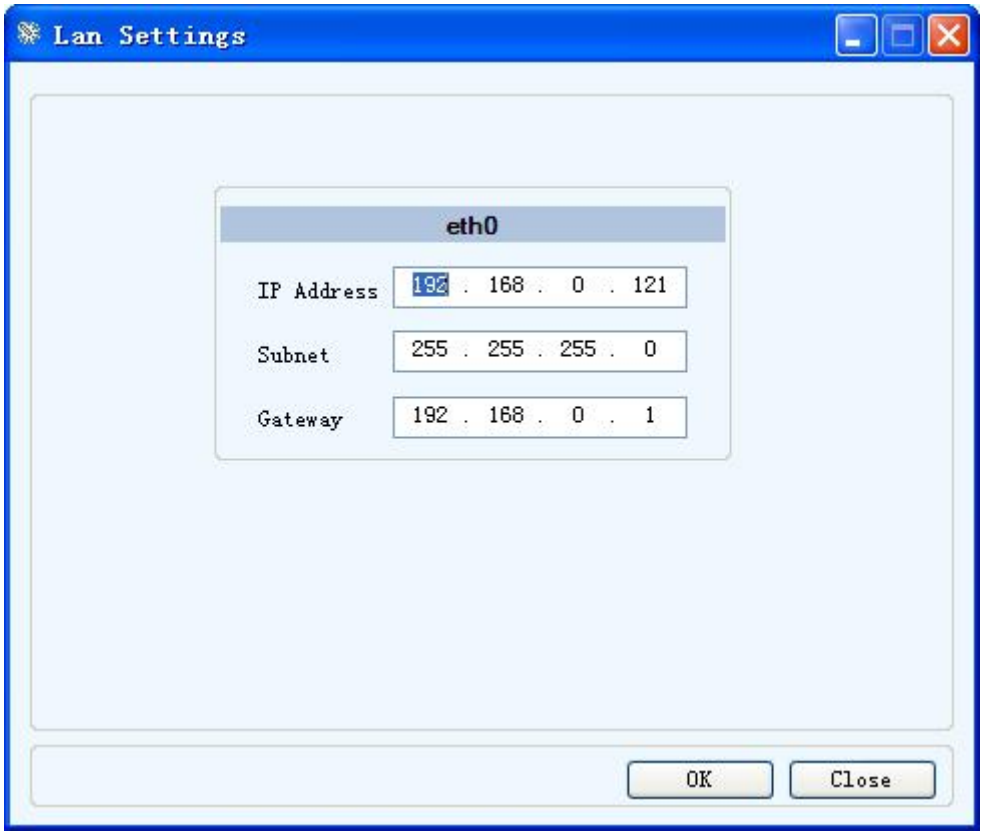
Select the mapping object, as shown in the following figure, click the "Save" button to save the mapping relationship;



Click "Previous", then select the next Modbus command; click the "Next" button, then select the last Modbus command; click the "Cancel" button to exit the data map.

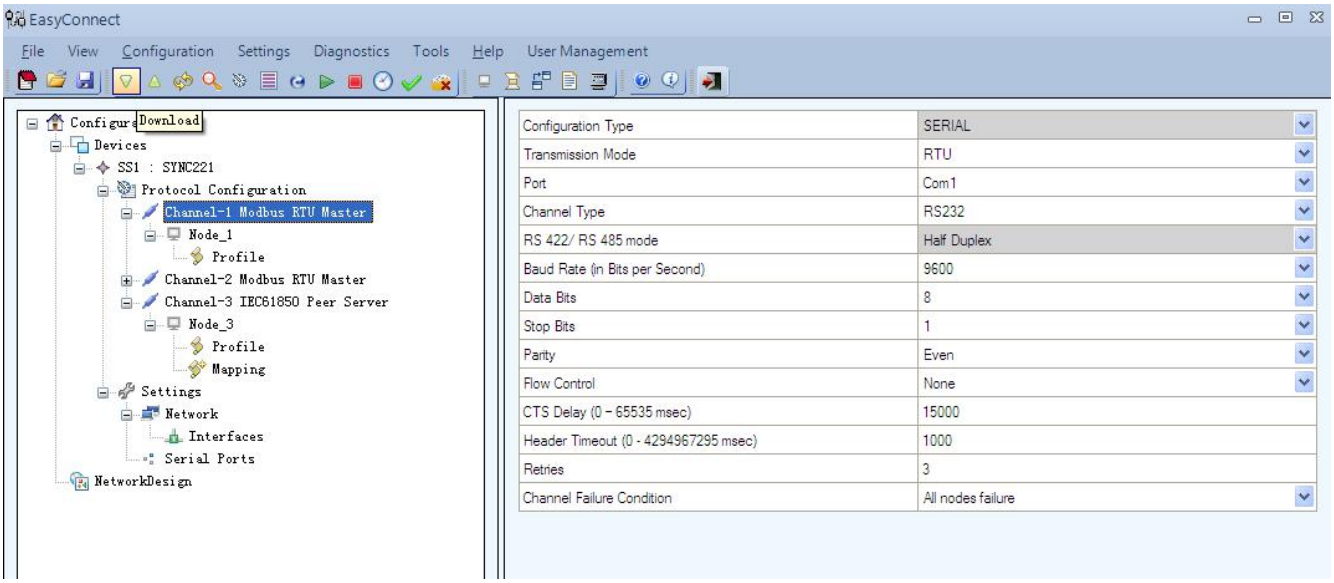
4.4 Change Gateway IP Address

As shown in the following figure, click "Edit Lan Settings"in the "Settings" , set the IP address, subnet and gateway of the local area network.

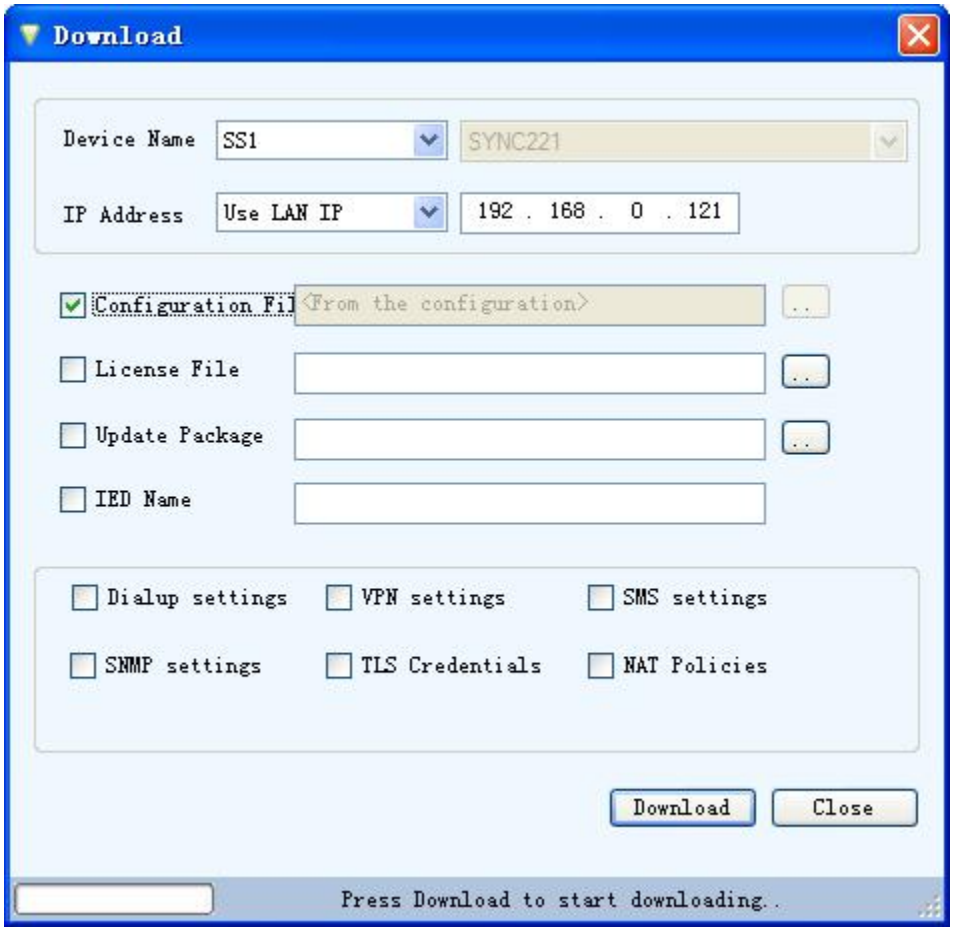


4.5 Download

Users can download the file to the module when configuration is finished, as shown below:



After clicking the download button, it will pop up a dialog box, we need to set the device name, as well as the IP address as shown below.

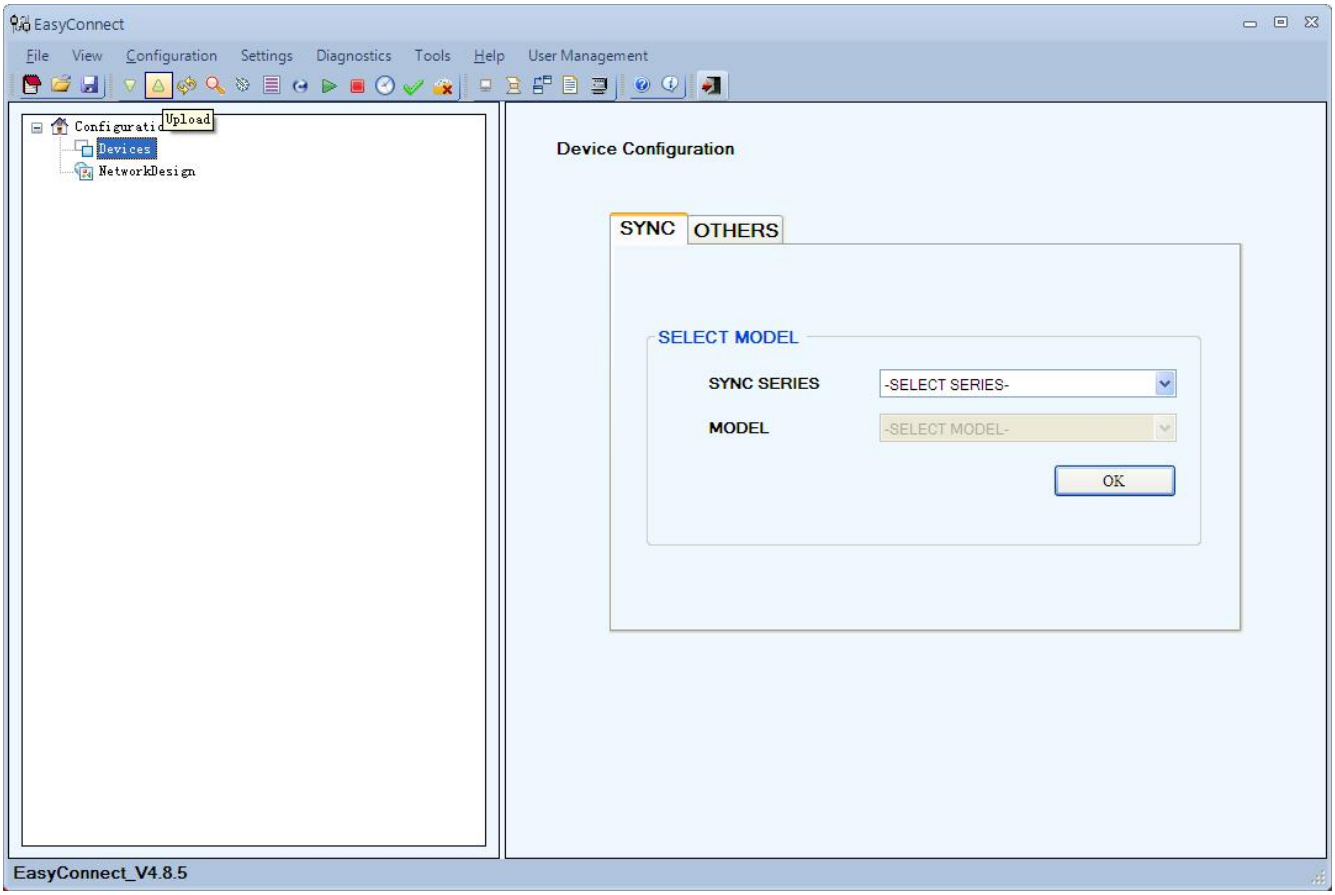


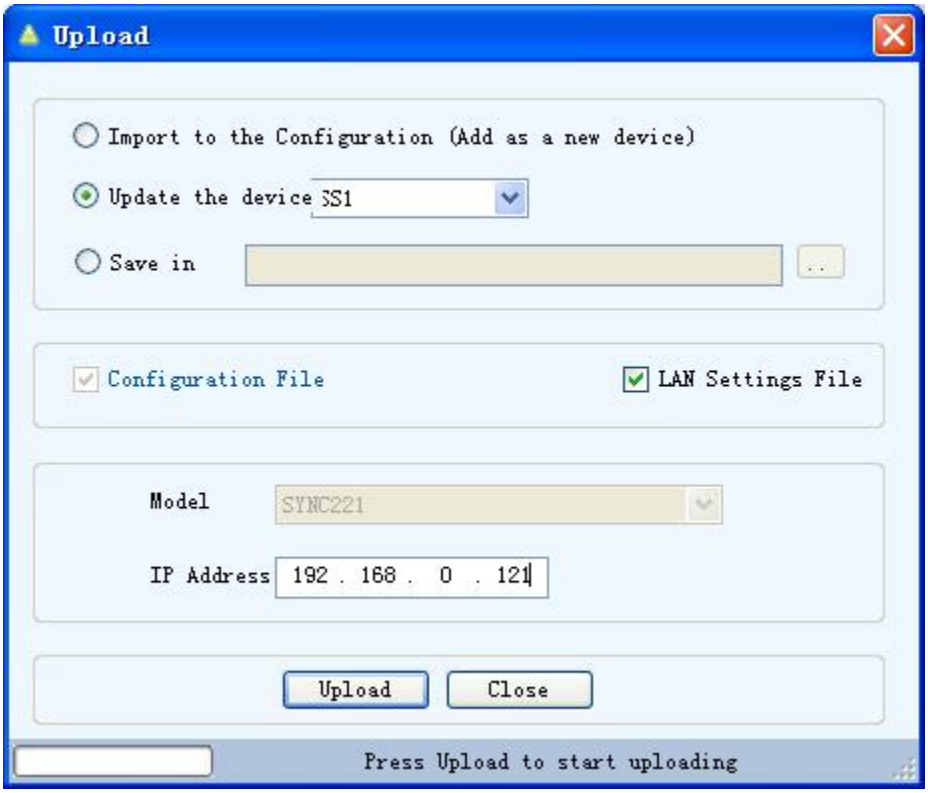
Users need to select the " Configuration File ", click the "Download" button, after download is succeed, it will pop up a dialog box below:

We can upload the configuration file to see if the configuration file is downloaded successfully. Upload configuration file method see below. After downloading ,you need to restart the device, see the chapter 4.2.1.

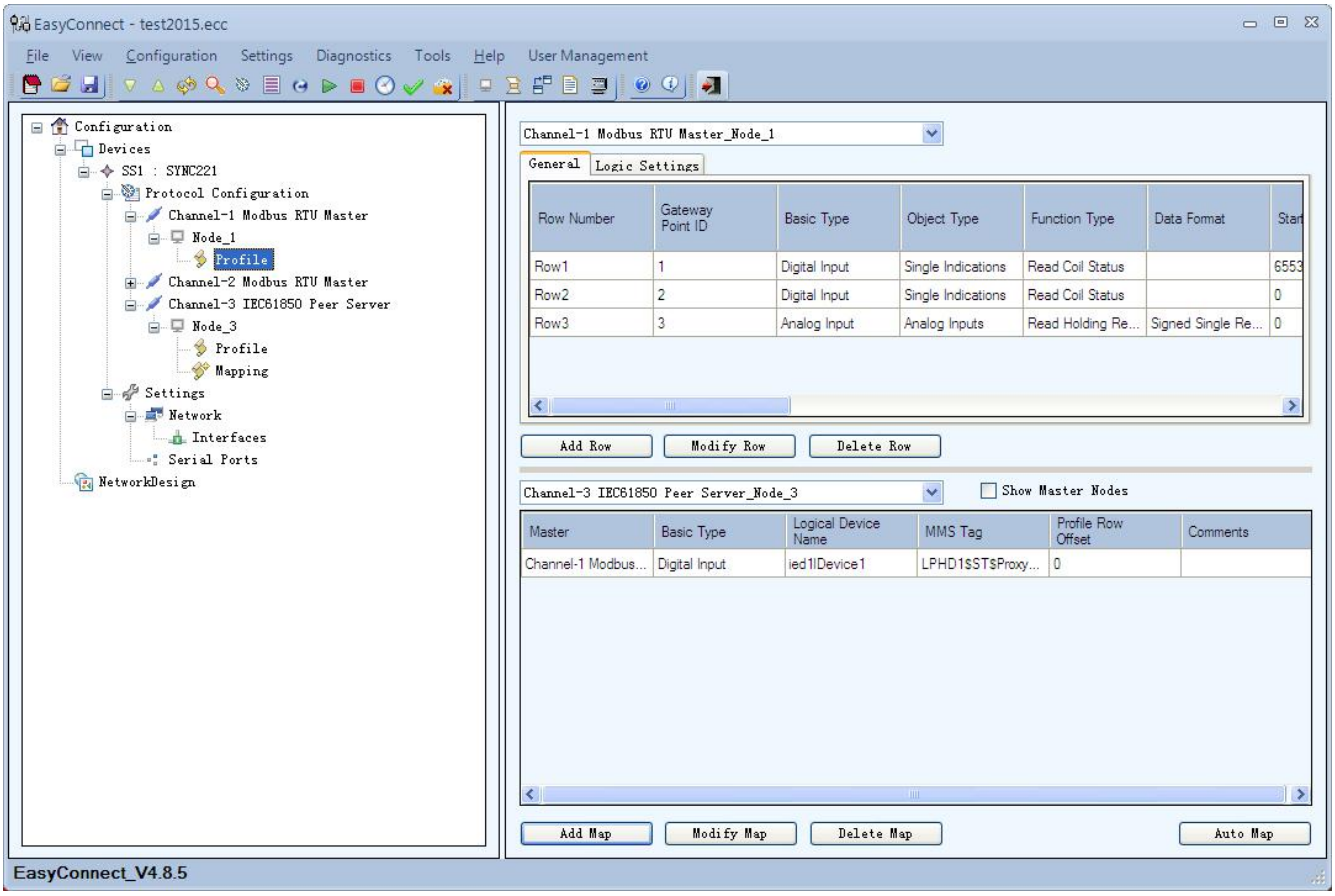
4.6 Upload

Upload the configuration file:





As shown in the above dialog, click the Upload button, as shown in the figure below.

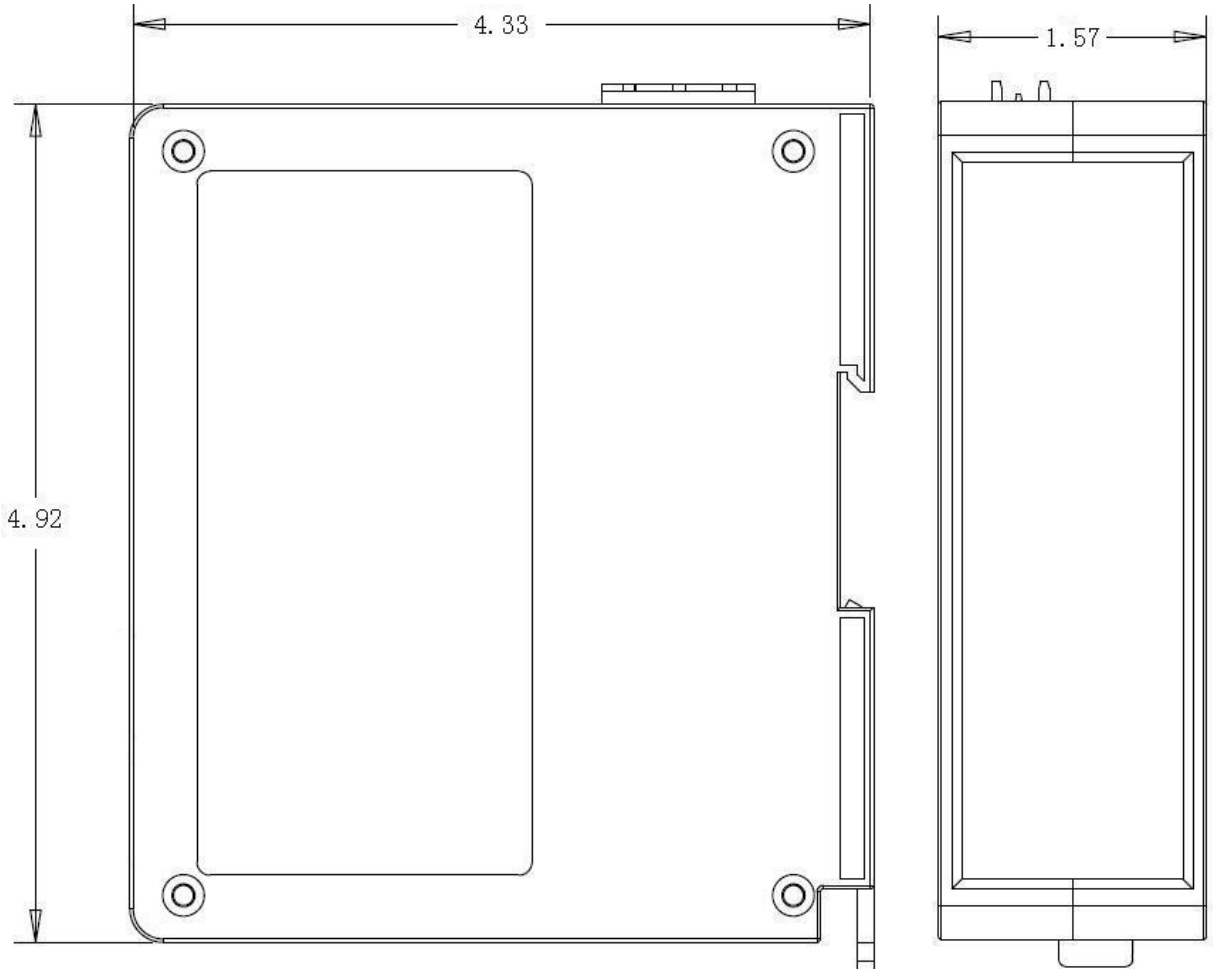


So far uploaded configuration file successfully.

5 Installation

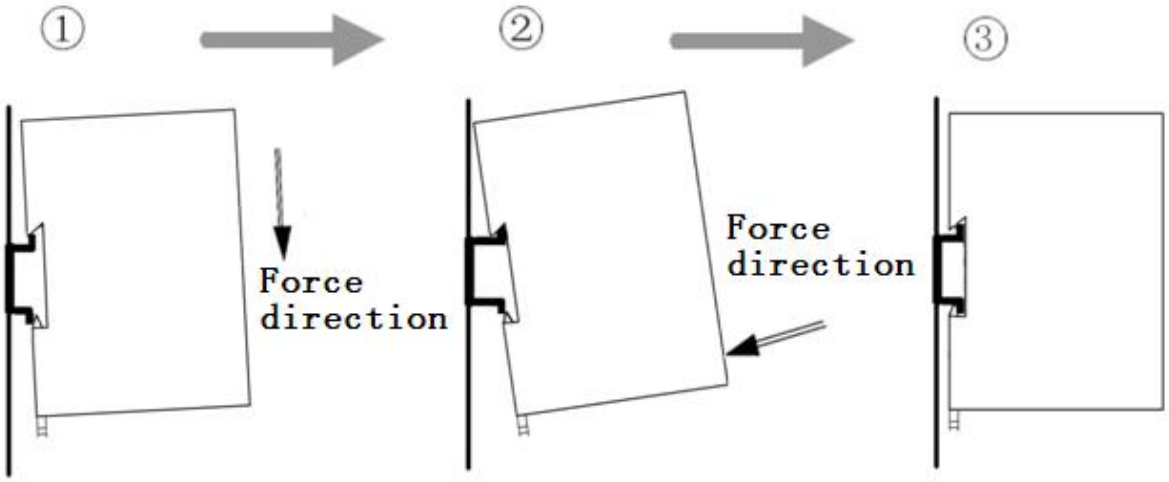
5.1 Machine Dimension

Size: 1.57 in (width)*4.92 in (height)*4.33 in (depth)



5.2 Installation Method

Using 35mmDIN rail


①
②
③
Force direction
Force direction