Industrial Ethernet Module
T-BOX
Operating manual

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Catalog

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1. Introduction

1-1. Summarize

As a kind of Industrial Ethernet module, T-BOX supports Modbus-RTU serial port devices, and it is used in the control system of Industrial Ethernet. According to international standards IEEE802.3, Industrial Ethernet is used in industrial unit network.

At present, T-BOX only supports industrial Ethernet LAN unit, wide-area network unit (that is, a remote landing capabilities) are being developed.

1-2. Compatibility

The whole Industrial Ethernet control system includes: T-BOX, networking PC, XC series PLC and upper computer software XCPpro(V3.0g available), TP series Industrial touch screen or OP series Text display, Network connectivity devices (hubs, routers, switches etc.) and transmission cable such as shielded twisted-pair cable or coaxial cable.

1-3. Performance characteristic

♦ Realize flexible distributed automation structure, simplify systems management
♦ Visit the Ethernet via RJ45 standard port, based on standard TCP/IP protocol
♦ The adoption of Industrial Ethernet can realize system remote monitoring and diagnosis, in order to save time and funding
♦ Through the Ethernet data storage and manipulation of information, so as to lay the foundation for simplify the process of data processing and archiving the basis
♦ Ethernet enables automation control equipment and communications with each other so that these devices can be used in complex systems.
♦ High quality, low price, connect Ethernet with all automatic machines and level in a simple form
♦ Easy to maintain and support simple user-friendly diagnostics

1-4. Applied function and field

Technically, Industrial Ethernet is electrical network which is based on the shielded coaxial cable, twisted-pair cable to establish, or is optical network which is based on fiber-optic cable to establish. It is compatible with IEEE802.3 standard, and uses ISO and TCP/IP communication protocol. As the expansion protocol of Modbus/RTU—Modbus/TCP, defines the transmission and application protocol used in TCP/IP network, and has greater flexibility and wide application. So, as an Industrial Ethernet access device, T-BOX has broken the regional restriction, and provides a reliable control and integrated solutions for various control devices to meet the needs of the Business-to-demand network of automatic control.
So, the Industrial Ethernet unit based on T-BOX has below applications:

- PLC program of IP device maintains and diagnoses with remote centralized
- PLC program of IP device monitors with remote centralized
- Traditional Modbus communication mode is one master multi-slave and slower. For multi-site large-scale device system, combined with T-BOX enables to realize data exchange function between master and slave PLC.

For example, in the below system, T-BOX supports Modbus/RTU serial device to access to Ethernet and constitutes an effective industrial control system, that realize the control system of multi-master multi-slave ,which enables control device to be applied in more complex environment and higher demands in industrial control system.
2. Interface and display

2-1. Serial port

T-BOX serial port: RS-232, RS-485 (port A, port B)

1) RS-232 port has nine pin holes, as below shown:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>RXD</td>
</tr>
<tr>
<td>3</td>
<td>TXD</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
</tr>
</tbody>
</table>

DB 9 pinholes

T-BOX and HMI cable connection figure:

XC series PLC and T-BOX cable connection figure:

(2) When use RS-485 port, port A is “+”, port B is “-”, and connect port A, B with PLC port A,B.

Attention: RS-232 port and RS-485 port can’t be used at the same time.

T-BOX serial connection device has some differences according to its working mode. Master mode: it can connect only one Modbus master device and different multi-slave ones Slave mode: it only can connect Modbus multi-slave devices

2-2. Network interface

RJ45 standard interface

Ethernet RJ45 definition:
<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire color</th>
<th>Signal definition</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Orange and white</td>
<td>TXD+</td>
<td>output</td>
</tr>
<tr>
<td>S2</td>
<td>Orange</td>
<td>TXD-</td>
<td>input</td>
</tr>
<tr>
<td>S3</td>
<td>Green and white</td>
<td>RXD+</td>
<td>output</td>
</tr>
<tr>
<td>S4</td>
<td>Blue</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S5</td>
<td>Blue and white</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S6</td>
<td>Green</td>
<td>RXD-</td>
<td>input</td>
</tr>
<tr>
<td>S7</td>
<td>Brown and white</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S8</td>
<td>Brown</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

2-3. Power supply

Output power: DC 24V (port 24V+，GND), it allows DC21.6V~DC26.4V

2-4. External dimension and installation

External dimension is 63mm × 102mm × 73.3mm (width × high × deep)
Use M3 snail to fix the module or install on the DIN46277 (width 35mm) track.

Attention:
1. During installation, avoid metal bits or wire bits dropping into the module
2. Before connecting, please make sure the specs of the module and device are correct
3. Make sure the wire connection is firm. If not, some problem will occur such as data incorrect, short-circuit, ect.
4. When installing or connecting with the module, make sure the power is cut off

2-4. DIP switch

T-BOX has four DIP switches, as the below shown:

ON

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

OFF
The IP settings of T-BOX have three forms: (A) use static IP address, (B) use DHCP distribution, (C) use user setting address, set via DIP switch according to user’s demands.

It should be noted that, the priority of the three settings is: A> B > C, it means when two settings are effective, follow the above order.

A: use static IP address (DIP switch S3 is off, S4 is random)
When T-BOX’s IP address is unknown or use T-BOX at the first time, it can use the static IP to re-configure the T-BOX.
 IP address: 192.168.0.111
 Subnet mask: 255.255.255.0
 Default gateway: 192.168.0.1
 Preferred DNS: 192.168.0.1

B: use DHCP distribution (DIP switch S3 is on, S4 is off)
When using DHCP distribution, the address is almost the same as the automatic address distribution in the PC.
 Necessary condition: the DHCP server must exist in the network
 Advice: it is not suggested to use when you have conditions

C: use user setting address (DIP switch S3 is on, S4 is off)
IP address, subnet mask, default gateway and preferred DNS(usually the same as default gateway)

### 2-5. LED display

<table>
<thead>
<tr>
<th>LED</th>
<th>Instruction</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERROR</td>
<td>Fault diagnosis</td>
<td>Always on means the received data CRC checking error (it will be off when the data is correct)</td>
</tr>
<tr>
<td>IP</td>
<td>IP address detection</td>
<td>Always on means the IP address conflict</td>
</tr>
<tr>
<td>PWR</td>
<td>Power supply</td>
<td>Always on when power on</td>
</tr>
<tr>
<td>LINK</td>
<td>Ethernet connection</td>
<td>Always on means network connecting is normal</td>
</tr>
<tr>
<td>ACT</td>
<td>Ethernet data receiving</td>
<td>Flickering means the data have been received</td>
</tr>
<tr>
<td>COM</td>
<td>Serial port</td>
<td>Flickering means the connection is ok</td>
</tr>
</tbody>
</table>
For Industry Ethernet control system, before connecting the target device into Industrial Ethernet, you have to configure the T-BOX parameters, please see the following steps:

### 3-1. Hardware setting and connection

A. Set the DIP switch according to user’s demands, (for more details refer to the part of interface and display about DIP switch introduction)

B. Make sure that T-BOX has been connected into the Ethernet, then power on.
   
   **Caution:** when you use it at the first time, make sure DIP switch S3 is off for the network to recognize T-BOX, set it to static IP address 192.168.0.111, then connect it into the Ethernet.

C. Make sure the PC has been connected in the network.

### 3-2. Software setting

A. Open the software XCPpro, double-click “communication”

B. Then it will appear “select communication mode” dialog box, click “+”.

C. It appears “TCP_IP device” dialog box, click “update” to search the T-BOX in the network.
   
   When editing the target T-BOX, it often appears two kinds of situation:
   
   (1) Use the T-BOX at the first time, S3 is off and use static IP address. The parts parameters setting is shown as the following:
(2) If the IP address has been in the T-BOX and S3 is on, the parameters setting is shown as below:

<table>
<thead>
<tr>
<th>Name</th>
<th>IP</th>
<th>Mask</th>
<th>BRZ</th>
<th>Port</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBOX4</td>
<td>192.168.0.125</td>
<td>255.255.255.0</td>
<td></td>
<td></td>
<td>T02</td>
</tr>
</tbody>
</table>

D Double-click the target T-BOX, it shows the “Edit TBOX device” dialog box, the parameters of first time using and not first time using (IP is known) are shown as below:
Each part parameters explanation:

(1) **Configure network**

When DIP switch S3 is off, user can set relevant parameters in IP device according to actual using, including IP address, subnet mask, default gateway, preferred DNS (usually the same as default gateway). After settings are finished, set ON the DIP switch S3 to identify other T-BOX with static IP in the network.

(2) **Remote login in (still developing)**

The aim of setting this part of parameters is to connect the T-BOX and its device into the WAN, user can maintain the remote devices via the remote login in function.

◆ Server 1 and 2: the IP address and port part can be modified according to actually using environment, then click “write in T-BOX”

◆ Login part: MAC and password can be used as the user name and password when T-BOX is remote landing, also can be set according to user’s demand (only one combination is the best to prevent from conflicting in the server list)

Additionally, when DIP switch S2 is off, T-BOX is remote timing landing mode which can save the bandwidth of network and T-BOX.

(3) **Serial parameters**

It includes five parts: baud rate, data bit, stop bit and protocol type. Baud rate can be modified but its numerical value must be consistent with that of connecting device.

(4) **Master mode and client mode**

Under the “edit IP device” dialog box, it will show device type. When T-BOX is master mode, it shows “device type: T-BOX_Master”, the parameters setting of “Master” part is effective, “Slave” part is ineffective. When T-BOX is slave mode, it shows “device type: T-BOX Slave”, the parameters setting of “Slave” part is effective and that of “Master” part is ineffective.

◆ **Device type: T-BOX Master**

It includes three sections: protocol, station number- IP table and shield table.

➢ **Protocol**: more efficient and faster

TCP: better stability to send and receive data, but occupy more resources
Station number-IP table: station number: in Industrial Ethernet, the station number of Slave station

IP address: slave station IP address

Shield table: for application, when T-BOX is Master mode, it can connect with several Modbus devices with different station numbers by RS485 communication, but only one can be Modbus Master device and others are Modbus Slave devices. Then, list the station numbers of Modbus Slave devices in shield table in order to limit their access authority for T-BOX.

- **Device type: T-BOX Slave**
  
  It includes three sections: send delay (ms), static station number table and shield table.

- Send delay: as soon as T-BOX receives the reply from Slave device, it will send next order at once. Adding delay time between reply and sending order to reduce the possibility of lose command packets of the slave device.

- Static station number table: the station number of Slave device in Industrial Ethernet, supporting direct access

- Shield table: in Industrial Ethernet, when Master device access to Slave device by broadcasting mode, in order to limit the access authority of this slave station, write the IP of this slave station into the shield table.

For example, in the following Industrial Ethernet control system, T-BOX1 is Master mode, T-BOX2 and T-BOX3 are all Slave mode, the settings of T-BOX1 and T-BOX3 are as follows:

The setting of T-BOX1:
1) Station NO.-IP table: station NO.5, NO.6 and NO.8, it means T-BOX sends data to target stations. NO.7 is not in the table, but when it is asked by broadcasting mode, as long as station NO.7 is not in the T-BOX Slave shield table, it can answer.

2) Shield table: the Modbus Slave device station numbers which T-BOX1 has connected with must be written into shield table.

(5) Annotate part
   It includes two parts: device name and content. It can be modified according to user’s demands, then click “OK”.

E Click “Write into T-BOX”, the click “OK”. The devices will be listed in the TCP-IP device window. Close this window.

F It shows “select communication mode” window, please select “UDP” for communication mode, network type can be “outer network” or “inner network”. If there are many T-boxes, only the target station works. Now, you can monitor and upload, download program of PLC via Ethernet.

G Click “OK” to finish the T-BOX parameters setting.
4. Application examples

In the practical application, it can make the complicated system by connecting the devices into the industrial Ethernet.

In this system, it uses six T-boxes, T-BOX1 and T-BOX2 are master mode, others are Slave T-BOX. For many control devices, touch screen 1 and touch screen 2 are Master device, PLC1, PLC2, PLC3 and PLC4 are all Slave devices.

The aim of this control system is to realize the control of Mater multi-device to Slave multi-device, so that Industrial Ethernet provides a wider application in the region.

Then, the detailed work flow is shown as following:
1) Through the XC Series XCPpro software to confirm the Station numbers of 4 PLCs, set the station number to 1,2,3,4.
2) Connect the T-boxes which are in Master mode and Slave mode with corresponding control devices. If it is the first time to use T-BOX, it can’t be identified. Please turn the DIP switch S3 off, use the static IP address and connect the T-boxes into the Industrial Ethernet in turn. After setting T-BOX in the XCPpro software, turn the DIP switch S3 on so as to set next T-BOX. If T-BOX has IP address, multi-T-BOX can be connected into the network at the same time and configured in the software.
3) In this example, set the IP address of each T-BOX, the IP address of T-BOX1 – T-BOX6 are 192.168.0.1, 192.168.0.2, 192.168.0.3, 192.168.0.4, 192.168.0.5, 192.168.0.6.
For the "editing IP device", please see the following detailed configuration:
T-BOX1 parameters setting:

T-BOX2 parameters setting:

T-BOX3 parameters setting:
T-BOX4 parameters setting:

T-BOX5 parameters setting:

T-BOX6 parameters setting:
After setting, click “write into T-BOX”. The following steps refer to the part of “Operating step”. Now, the parameters settings of T-BOX have been finished.

(4) Make sure the HMI has the control program. Connect the HMI with T-BOX via RS232 or RS485.
So, the two Master-stations could control four Slave-stations and improve the efficient.
Of course, in actual application, if several PLCs are near to each other, we can use a T-BOX to connect with several PLCs via RS485:

The settings of T-BOX3 are shown as the following:

![Diagram of connections between T-BOXes, PLCs, and HMI]

The settings of T-BOX1 and T-BOX2 in the Master mode are shown as following:
The rest steps are consistent with the above example. According to actual conditions, user can select appropriate combination and communication method, so as to achieve optimal distribution of resources, improve the productivity.