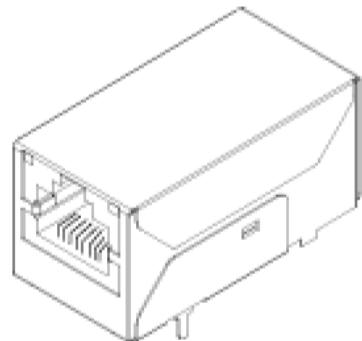


Embedded Modbus TCP Module

EMT-331

User Manual

REV 1.1



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E-mail: support@sibotech.net

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1 About the embedded module

1.1 Function

EMT-331 is an embedded Modbus TCP module. User devices can communicate with it through UART, and then achieve the connection between user devices with Modbus TCP.

1.2 Features

- Upgrade UART interface to Modbus TCP interface expediently;
- Provide two kinds of operating modes:
 - Modbus TCP to Modbus RTU: transparent mode;
 - Modbus TCP to user defined protocol: input and output data buffer mode;
- Ethernet is 10/100M adaptive;
- Modbus TCP supports 16 connects at most;
- The operating mode of Modbus TCP to Modbus TRU can cache 80 request messages at most;
- Web Server for configuration;
- Can finish the module initialization through serial port.

1.3 Specifications

- EMT-331 has an Ethernet interface and UART interface (included in 20-pin socket connectors), can achieve data transformation between Modbus TCP and serial port;
- Ethernet is 10/100M adaptive;
- Act as a Modbus TCP server, support 16 Modbus TCP clients (different IP addresses or different ports) communication at the same time;
- Operating mode of Modbus TCP to Modbus RTU:
 - Can cache 80 request messages at most;

When the buffer of request messages overflows, discard current frame and send exception response with



exception code 06.

- Operating mode of Modbus TCP to user defined protocol:

Support function codes: 04H、03H、06H、10H;

The input and output buffer can be set by users:

The input buffer is 256 bytes at most;

The output buffer is 256 bytes at most;

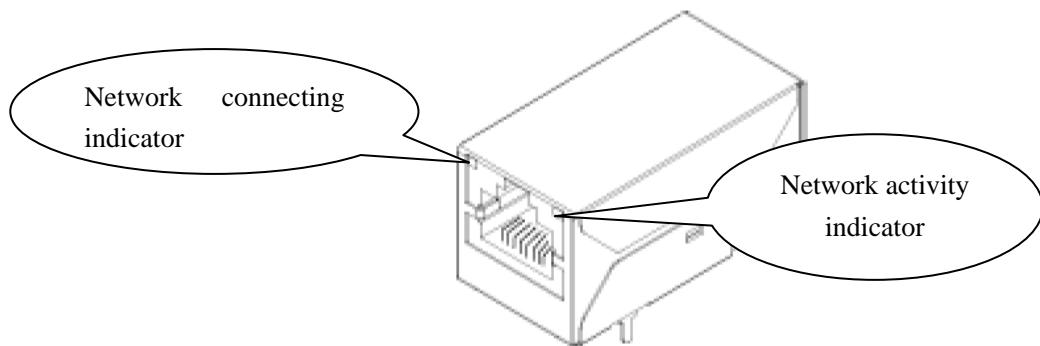
- Serial port is UART, half duplex, baud rate: 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400bps, 8 data bits, None Parity, one stop bit;
- Power: +3.3VDC (3.14 ~ 3.45V), 270mA;

Note: Because the module's Caloric value is large, user board should be kept bigger space for EMT-331 module when designing so as to heat dissipation.

- Environmental temperature: -40 ~ 85°C, humidity: 5% ~ 90%;
- Dimension: 37mm (Length)*20mm (Width)*22mm (Height)

2 Hardware

2.1 External appearance

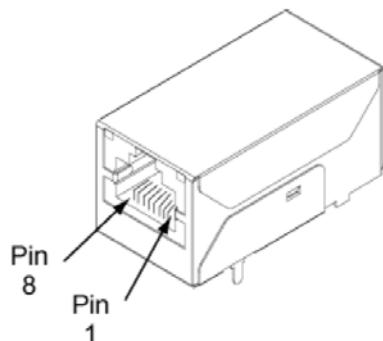


2.2 Indicators

Indicator	Status	Description
Yellow	Off	No network connection
	Always on	Have network connection
Green	Off	No network data transmitting or receiving
	Blinking	Have network data transmitting or receiving

2.3 Interface

2.3.1 Ethernet interface



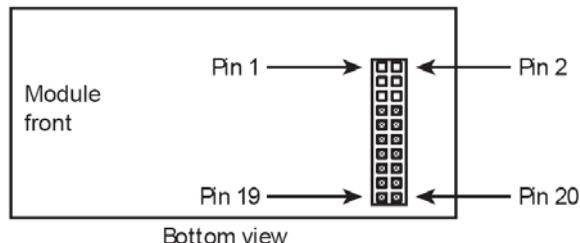
Ethernet interface use 8-line RJ-45 interface, and the pin definition show as follow:

Pins	Signals	Descriptions
Pin 1	TXD+	Transmit Data+
Pin 2	TXD-	Transmit Data-
Pin 3	RXD+	Receive Data+
Pin 4	EPWR+	Power from Switch+
Pin 5	EPWR+	Power from Switch+
Pin 6	RXD-	Receive Data-
Pin 7	EPWR-	Power from Switch-
Pin 8	EPWR-	Power from Switch-

2.3.2 Power and device interface

EMT-331 has 20-pin socket connector (needle-type). It includes power interface, UART interface and GPIO.

Pin position and definition show as follow:



Pins	Signals	Description
1	VETH+	Power Pass-Thru+
2	VETH-	Power Pass-Thru-
3 ~ 6	NC	No Pin

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7	RXD	UART Receive (Input), connect with TXD of user board processor
8	TXD	UART Transmit (Output), connect with RXD of user board processor
9	GPIO	Reserve
10	/RUN	RUN (Output), and need a 10K pull-up resistor on user board. Logic 1: The module is starting; Logic 0: The module finished starting and is in run status (include waiting for initializing, starting TCP protocol stack and being in data exchange and so on). If the pin is polled down to low electrical level through 1K poll-down resistance before starting the module, the module will start with default IP configuration (192.168.0.11) after being started.
11	BAUD2	Set UART baud rate (Input), see next table.
12	BAUD1	
13	BAUD0	
14	/RESET	Reset signal (Input), low-level effectively.
15	+3.3V	Wire DC power +3.3V
16	GND	Wire power ground
17 ~ 19	NC	Reserve
20	/DATAEXCH	Data exchange (Output), and need a 10K pull-up resistor on user board. Logic 1: The module is in non-data exchange (be in starting, be in waiting for initializing, be in starting TCP protocol stack and so on); Logic 0: The module is in data-exchange.

2.4 UART baud rate

UART baud rate setting show as follow:

Index	BAUD2	BAUD1	BAUD0	Baudrate (bps)
0	0	0	0	2400
1	0	0	1	4800
2	0	1	0	9600
3	0	1	1	19200
4	1	0	0	38400



5	1	0	1	57600
6	1	1	0	115200
7	1	1	1	230400

2.5 Reset signal

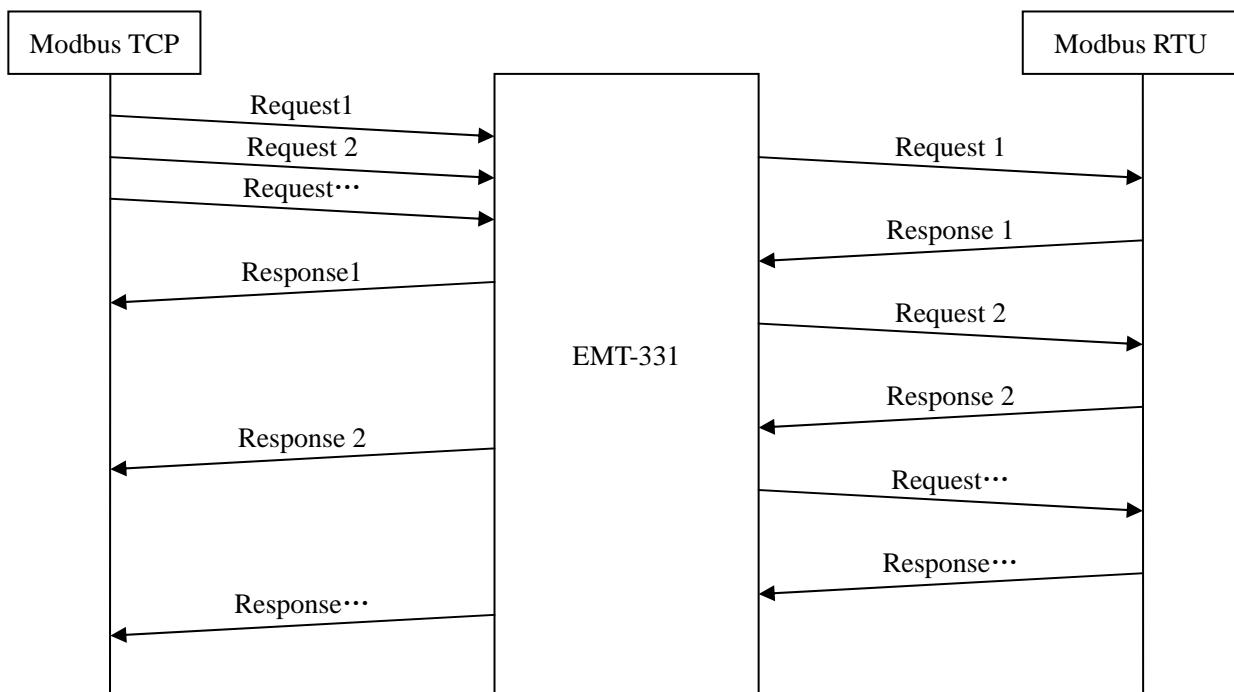
The RESET (Pin 14) of the embedded module support hardware reset signal input. When the RESET pin is polled down to GND or low to 2.88V lasting 1 microsecond, module will be forced to reset, and the delay time of resetting is 250 milliseconds (typical value).

3 Modbus TCP to Modbus RTU

3.1 Description

EMT-331 acts as a Modbus TCP server at the side of Ethernet, and Modbus RTU master at the side of serial port. EMT-331 receives Modbus TCP request messages come from Ethernet, then turn the format of TCP messages to RTU messages, and send to serial port. RUT response messages receiving from serial port are converted to Modbus TCP response messages and are transmitted to corresponding Modbus TCP master.

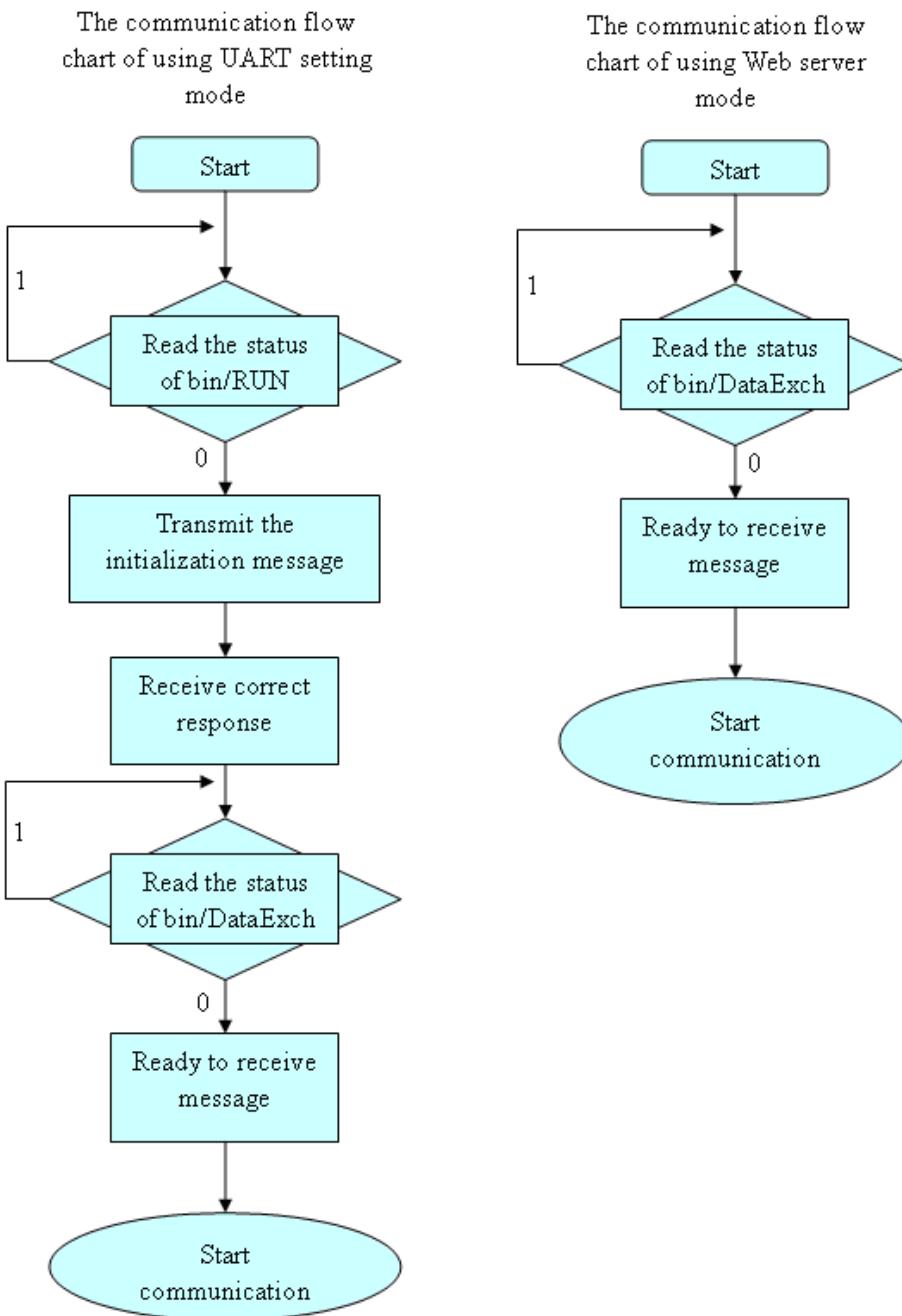
The message transmission procedure of the mode show as follow:



Every Modbus TCP could connect multiple requests at the same time of the mode, all connections share the request buffer which could cache 80 frames.

3.2 The communication flowchart between user program and

EMT-331



3.3 Initialization communication

Communication mode: User board is communication initiator, and EMT-331 response.

Baud rate: EMT-331 obtains the baud rate which will be used by UART through reading bins BAUD0, BAUD1 and BAUD2 when it is started.

1. Initialized message--- request (user board->module)

Byte	Operating mode of Modbus TCP to Modbus RTU
0	Data length 17, high-byte priority
1	
2	Reserve, always 0
3	IP configuration mode, 0: Static configuration; 1: DHCP; 2: BOOTP
4	
5	IP address, high-byte priority
6	
7	
8	
9	Subnet Mask, high-byte priority
10	
11	
12	
13	Gateway address, high-byte priority
14	
15	
16	Reserve, always 0
17	Reserve, always 0
18	Reserve, always 0
19	Check sum, byte 0+byte 1+...+byte 18

Note: The new EMT-331 is compatible with previous versions, use board doesn't been modified and only select "UART setting mode, configurate IP address and so on through receiving initialization message" through web setting.

2. Initialized message--- response (module->user board)

Byte	Correct response	Incorrect response
0	Data length, 2	Data length, 2



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1	0: Correct	Error code (not 0)
2	0	Extra code
3	Check sum, byte 0+byte 1+byte 2	Check sum, byte 0+byte 1+byte 2

3. Error code

Index	Error	Explanation
0	1	Check sum is error.
1	2	Data length is error.
2	3	IP configuration mode that don't exist.

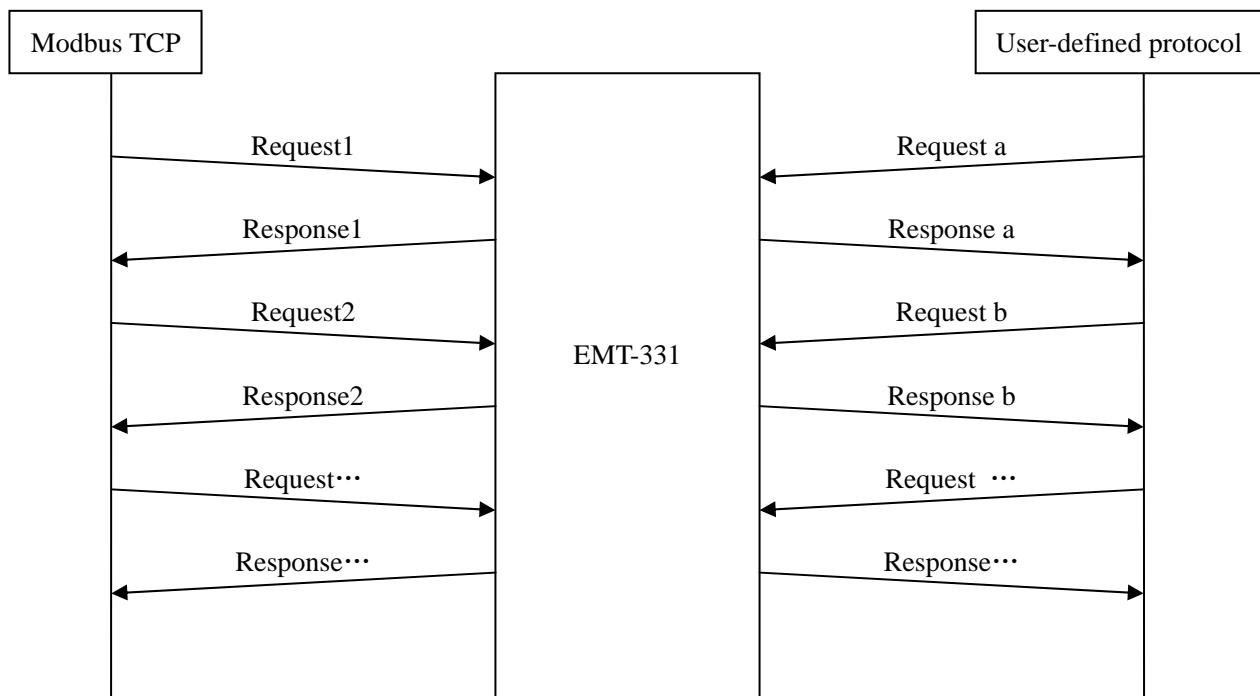
4. Extra code is always 0xFF.

4 Modbus TCP to user-defined protocol

4.1 Description

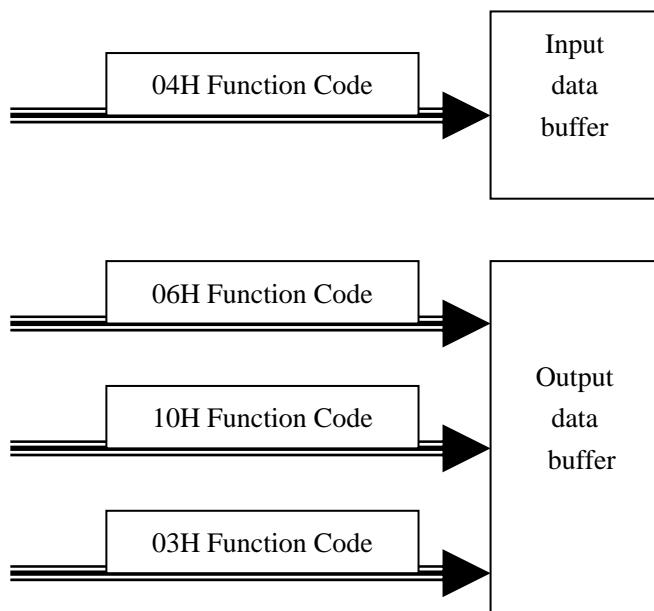
EMT-331 acts as a Modbus TCP server at the side of Ethernet, and the serial protocol is user-defined protocol. Modbus TCP communication and serial communication of EMT-331 are independent, and finish data exchanging through the input and output data buffer inside EMT-331. User board can finish input and output data exchanging according to the simple serial communication protocol of EMT-331.

The message transmission procedure of the mode show as follow:



In this mode, every Modbus TCP connection only sends a request frame for better, the next request frame is sent until receiving response or overtime.

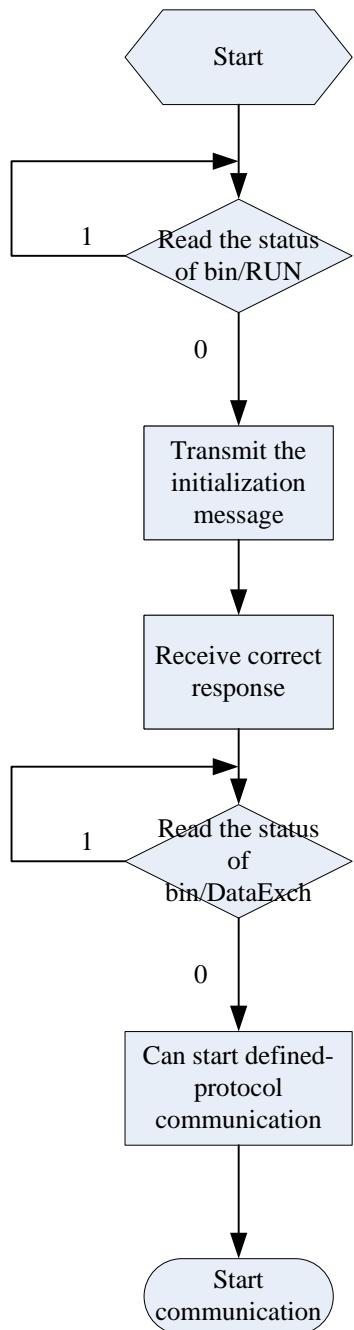
Modbus TCP supports 03H、04H、06H、10H function codes, data buffer and function codes corresponding relation is shown as follow:



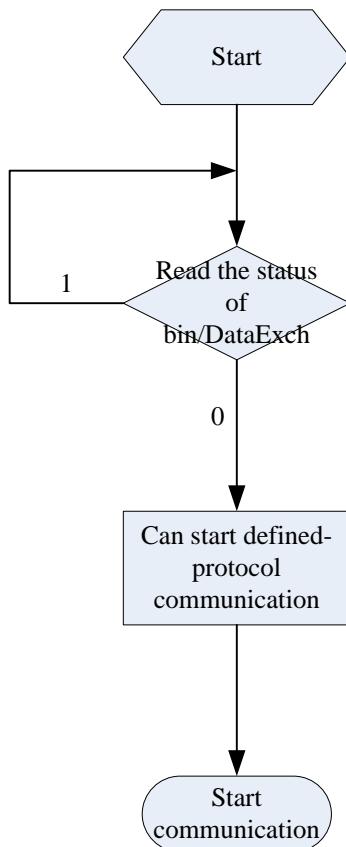
04H function code is used to read input-data; 06H and 10H function codes are used to write output-data; 03H function code is used to read back output-data, so multiple Modbus TCP masters can exchange data through the function code.

4.2 The communication flowchart between user program and EMT-331

The communication flow chart of using UART setting mode:



The communication flow chart of using web server mode:



4.3 Initialization communication

Communication mode: User board is communication initiator, and EMT-331 response.

Baud rate: EIP-341 obtains the baudrate which will be used by UART through reading bins BAUD0, BAUD1 and BAUD2 when it is started.

1. Initialized message---request (user board->module)

Byte	EtherNet/IP turn user-defined protocol
0	Data length 17, high-byte priority
1	
2	Reserve, always 0
3	IP configuration mode, 0: Static configuration; 1: DHCP; 2: BOOTP
4	
5	IP address, high-byte priority
6	
7	
8	
9	Subnet Mask, high-byte priority
10	
11	
12	
13	Default gateway address, high-byte priority
14	
15	
16	Reserve, always 0
17	Reserve, always 0
18	Reserve, always 0
19	Check sum, byte 0+byte 1+...+byte 18

Note: The new EMT-331 is compatible with previous versions, use board doesn't been modified and only select "UART setting mode, configurate IP address and so on through receiving initialization message" through web www.sibotech.net/en

setting.

2. Initialize message---response (module->user board)

byte	Correct response	Incorrect response
0	Data length, 2	Data length, 2
1	0: Correct	Error code (not 0)
2	0	Extra code
3	Check sum, byte 0+byte 1+byte 2	Check sum, byte 0+byte 1+byte 2

3. Error code

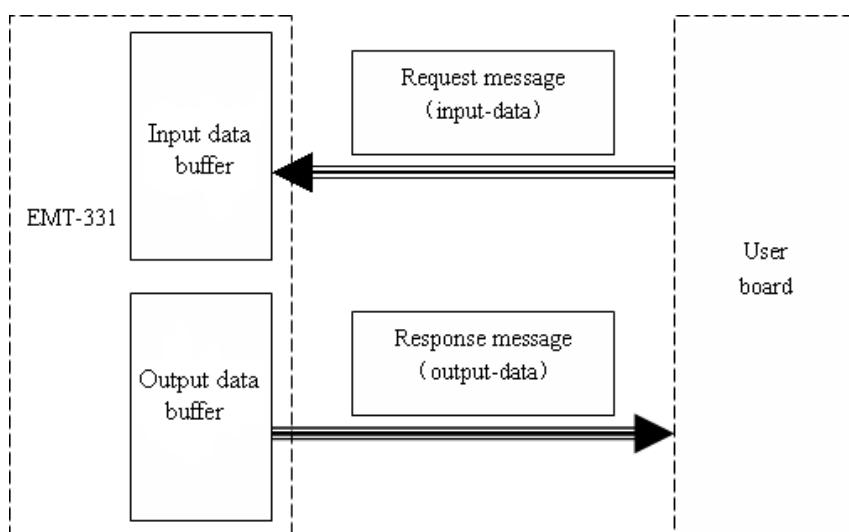
Index	Error	Explanation
0	1	Check sum is error.
1	2	Data length is error.
2	3	IP configuration mode that don't exist.

4. Extra code is always 0xFF

4.4 User-defined protocol communication

Communication mode: User board is communication initiator, and EMT-331 response.

The request messages contain input-data in the protocol, and the response message contain output-data. The communication process show as follow:



1. Request message of user-defined protocol (user board -> module)

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Byte	Description
0	
1	Input-data length, which is input-data buffer bytes number setting in initial message, high-byte priority
2	
...	Input data, high-byte priority
n	
n+1	Check sum, byte 0+byte 1+...+byte n

2. Response message of user-defined protocol (module -> user board)

Byte	Correct response	Byte	Incorrect response
0	Output-data length, which is output-data buffer bytes	0	0x80
1	number setting in initial message, high-byte priority	1	Data length, 2
2		2	Error code
...		3	Extra code
n	Output data, high-byte priority	4	Check sum, byte 0+byte 1+byte 2+byte3
n+1	Check sum, byte 0+byte 1+...+byte n		

3. Error code

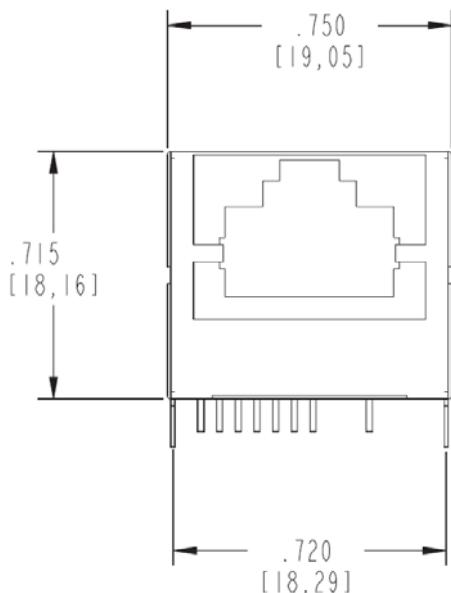
Index	Error code	Description
0	1	Check sum error
1	2	Data length error

4. Extra code is always 0xFF.

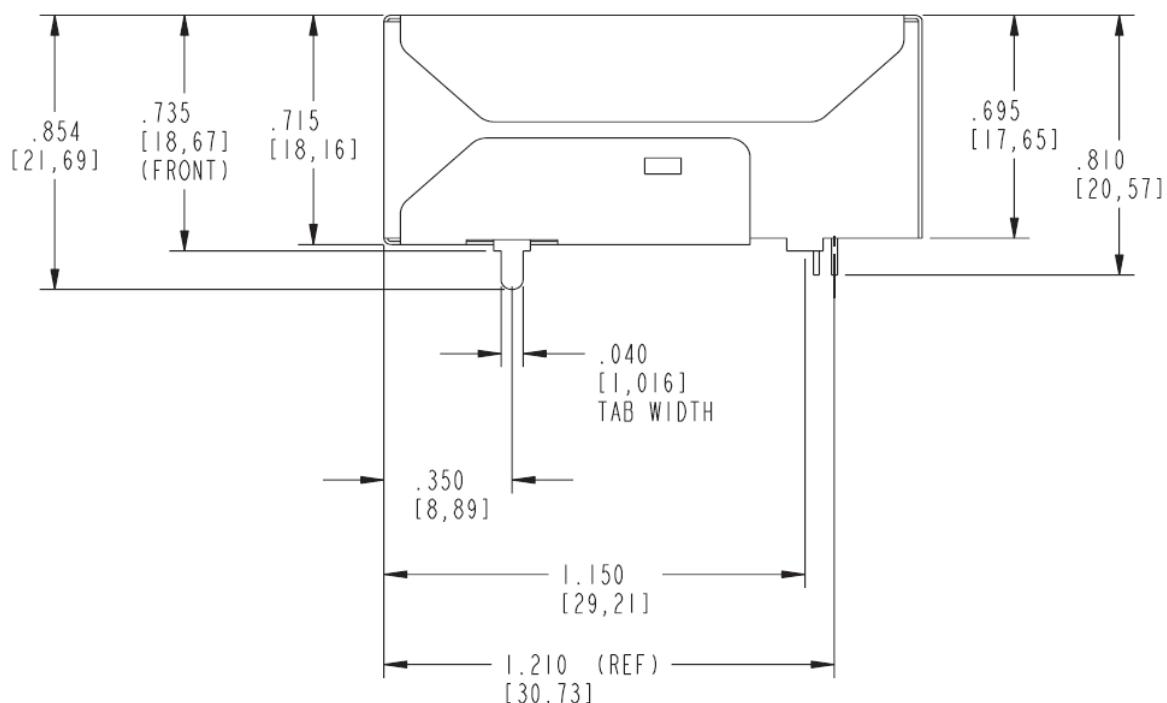
5 Dimension

Unit: in [mm]

Front:



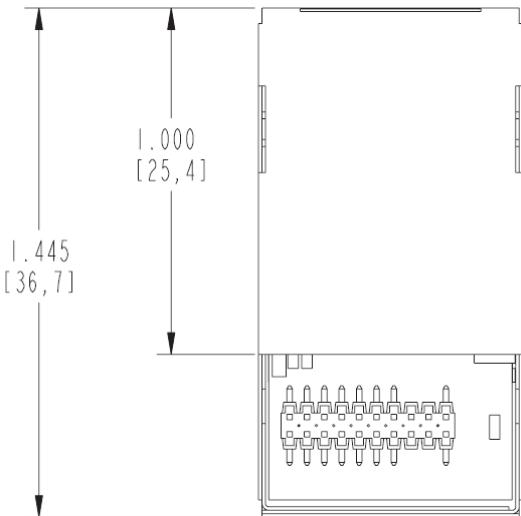
Side:



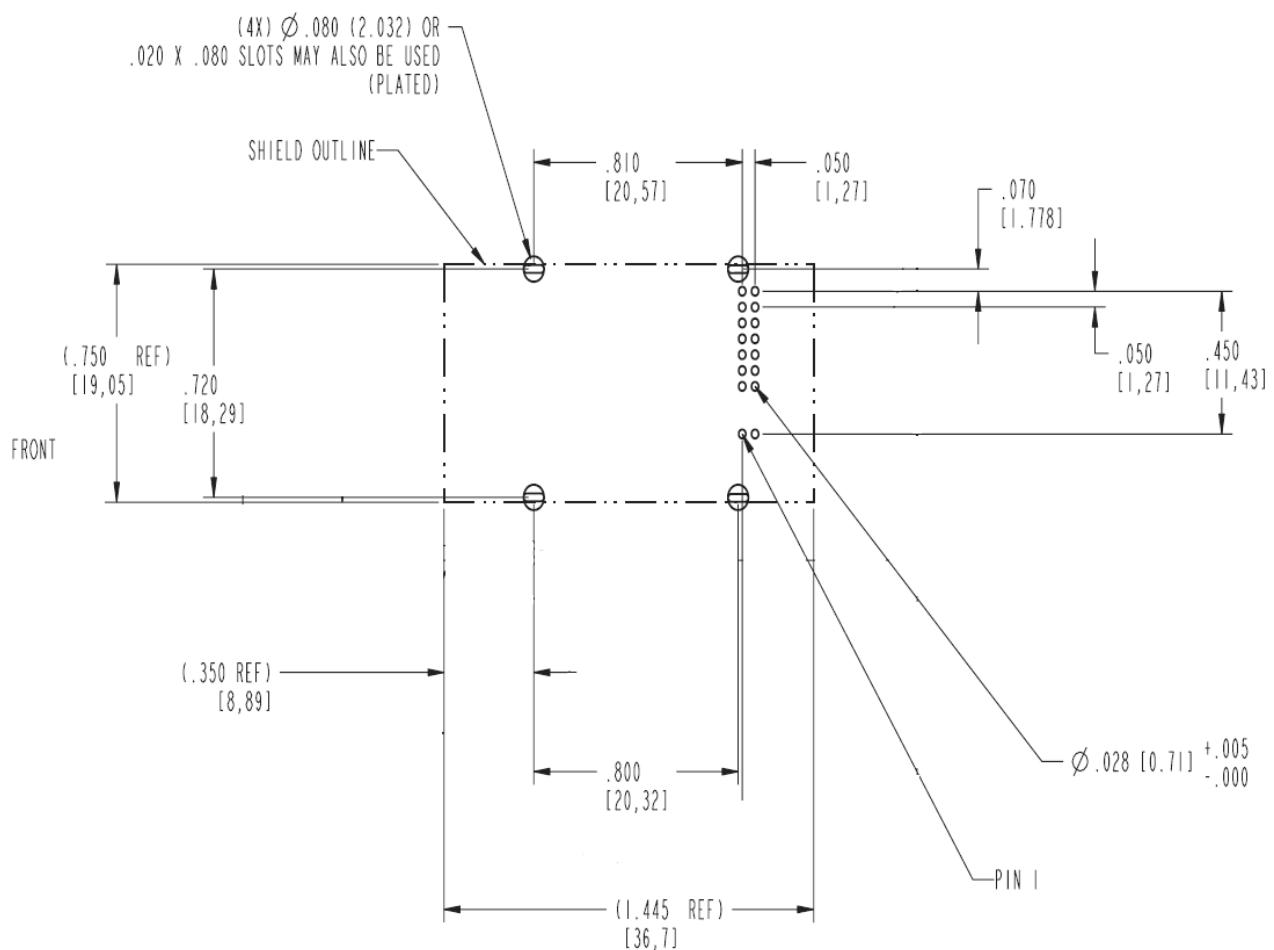
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Undersurface:

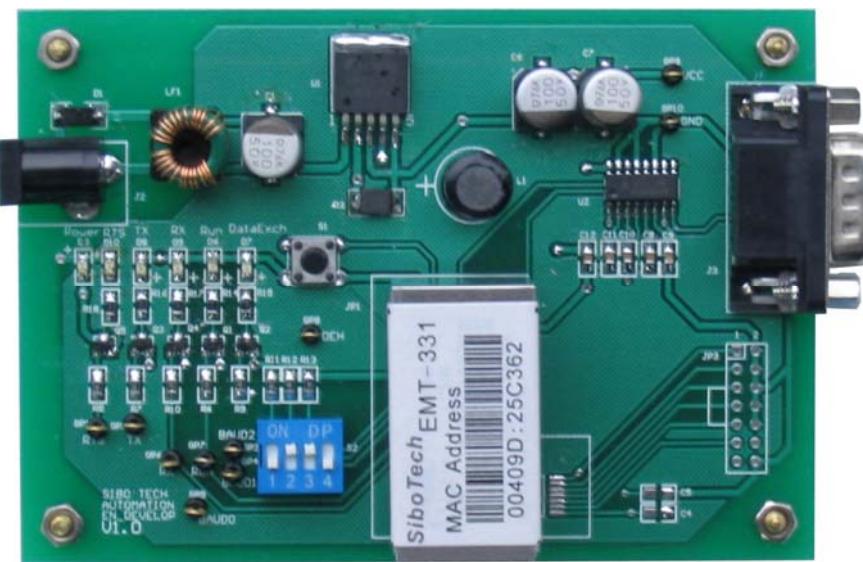


PCB dimension:



6 Development board

6.1 Appearance



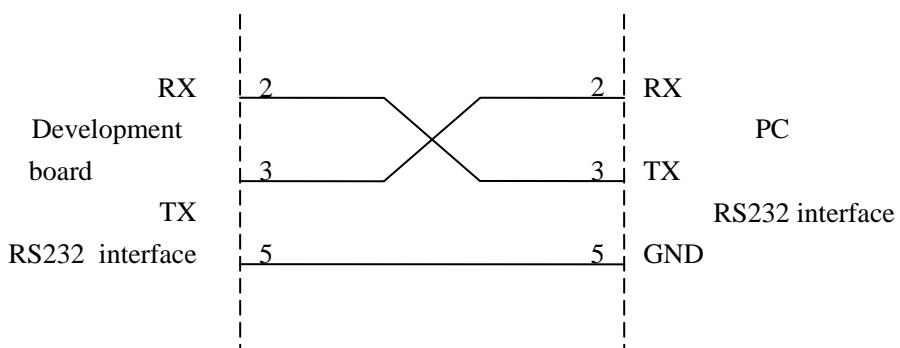
6.2 Function

6.2.1 RS232 interface

RS232 interface is DB9 pin-connector, the description show as follow:

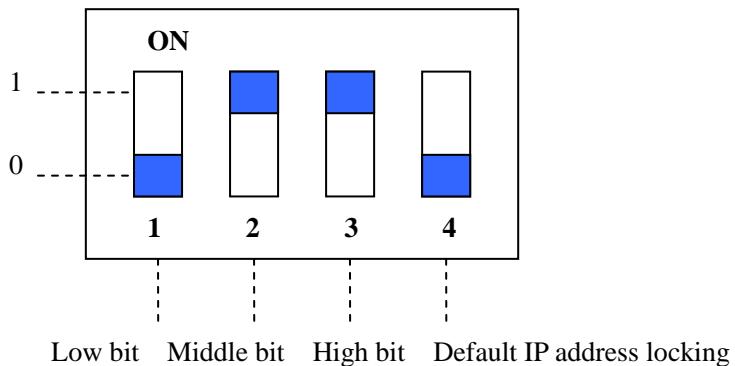
Pin	Signal	Description
2	RX	Connect with pin TX of RS232 of PC
3	TX	Connect with pin RX of RS232 of PC
5	GND	Connect with pin GND of RS232 of PC

DB9 hole-connector crossover cable must be used when connect the board with RS232 interface of PC:



6.2.2 Baudrate setting switch

The 4-bit DIP switch on the development board is used setting serial baud rate and default IP address locking:



Corresponding relation of baud rate show as follow:

Index	High bit	Middle bit	Low bit	Corresponding baud rate (bps)
0	0	0	0	2400
1	0	0	1	4800
2	0	1	0	9600
3	0	1	1	19200
4	1	0	0	38400
5	1	0	1	57600
6	1	1	0	115200
7	1	1	1	230400

The baud rate showing in the picture is 115200bps.

The fourth bit of DIP is “Default IP address locking” bit, when the bit is “ON”, the module start with default



IP configuration:

IP address: 192.168.0.11

Subnet mask: 255.255.255.0

Default gateway: 192.168.0.1

6.2.3 Reset

The press-button on the development board is reset button, which is used hand-resetting EMT-331.

6.2.4 LED

There are six indicators on the development board, and the description show as follow:

Index	Name	Description
0	Power	Power indicator, Always light: Power on; Close: Power off
1	RTS	The version doesn't support the function.
2	TX	EMT-331serial port transmit indicator, Blinking: Serial port is transmitting data; Close: Serial port isn't transmitting data.
3	RX	EMT-331serial port receive indicator, Blinking: Serial port is receiving data; Close: Serial port isn't receiving data.
4	Run	EMT-331status indicator, Always light: In run status; Close: In starting status.
5	DataExch	EMT-331data-exchange indicator, Always light: In data-exchange status; Close: Not in data-exchange status.

7 Web server

EMT-331 default IP configuration is:

IP address: 192.168.0.11

Subnet mask: 255.255.255.0

Default gateway: 192.168.0.1

7.1 Embedded parts

Input IP address/eif-en.htm in IE address bar, then you can see login interface:



User name: admin; Password: The default is empty.

Input user name “admin”, then you can see:

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Configuration

Monitor

User

Embedded Interface

Parameter setting

Configuration options:

- Web server mode, configurate IP address and so on through PC IE browser.
- UART setting mode, configurate IP address and so on through receiving initialization message.
[Note: After choosing the function, the ethernet interface will be started only when transmitting correct initialization message to serial port !]

Work Mode:

Modbus RTU

User-defined protocol

Response Timeout:

300 ms

Input Data Bytes:

64 (Uart->EtherNet)

Delay Between Polls:

50 ms

Output Data Bytes:

64 (EtherNet->Uart)

The left side is provided to end-user, which will be explained next section.

Parameter setting: Configuration options, Work Mode

Configuration options:

Configuration options:

- Web server mode, configurate IP address and so on through PC IE browser.
- UART setting mode, configurate IP address and so on through receiving initialization message.
[Note: After choosing the function, the ethernet interface will be started only when transmitting correct initialization message to serial port !]

If choose “Web server mode”, then you can configure IP address and so on through PC IE browser.

If choose “UART setting mode”, then you can configure IP address and so on through receiving initialization message.

Note: After choosing the “UART setting mode”, the EtherNet interface will be started only when transmitting correct initialization message to serial port!

Work Mode:

Work Mode:

Modbus RTU User-defined protocol

Response Timeout:

300 ms

Input Data Bytes:

64 (Uart->EtherNet)

Delay Between Polls:

50 ms

Output Data Bytes:

64 (EtherNet->Uart)

Unit ID:

1 Ignore

Submit

There are two kinds of work modes: Modbus RTU and user-defined protocol.

If you select Modbus RTU mode, you need set the “Response Timeout” and “Delay between Polls”.

Response Timeout----The maximum permission time from the beginning of sending requests by serial port to receiving response completely, the range is 100ms~60000ms.

Delay between Polls----The minimum time from receiving response by serial port to sending the next frame, the range is 0 ~ 60000ms.

If you select user-defined protocol mode, you need set “Input Data Bytes”, “Output Data Bytes” and “Unit ID”.

Input Data Bytes, Output Data Bytes----There are input and output buffers respectively, user can set the two data buffers size here, every data buffer's range is 0~256 bytes.

Unit ID----As device address of Modbus TCP slave, it could be ignored.

7.2 End-user parts

Input IP address in address bar of IE browser, then you can see the login interface.



Input user name “admin”, then you can see: (User name: admin; Password: The default is empty)

SibоТех**SibоТех Automation Co. Ltd.****EMT-331****Please select the language****中文 English**

SibоТех Automation Co. Ltd. Copyright(c) 2004-2010 All Rights Reserved
Website: <http://www.sibotech.net/>

You can enter different configuration interface through choosing “Chinese” or “English”. After choosing “English”, you can see the configuration interface showing as follow:

SibоТех

EMT-331 Configuration

Configuration

Monitor

User

Configuration

Network parameters

- Use static IP configuration

IP Address

Subnet Mask

Default Gateway

- Using DHCP to obtain IP address

- Use BOOTP to obtain IP address

Apply

The configuration interface includes three parts which can be configured: “Configuration”, “Monitor”, and

“User”.

Choosing “Configuration”, then you can see:

Network parameters

- Use static IP configuration

IP Address

Subnet Mask

Default Gateway

- Using DHCP to obtain IP address

- Use BOOTP to obtain IP address

Apply

You can configure Network parameters in the interface. You can choose three kinds of mode to set IP: “Use static IP configuration”, “Using DHCP to obtain IP address”, and “Use BOOTP to obtain IP address”

Choosing “Monitor”, then you can see:

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The screenshot shows the "Monitor" section of the EMT-331 User Manual. On the left, there is a vertical navigation bar with three buttons: "Configuration", "Monitor", and "User". The "Monitor" button is highlighted. The main content area is titled "Monitor" and contains three sections: "Ethernet", "Modbus TCP Connection", and "Data".

- Ethernet:** Displays "Speed: 100M" and "Duplex: Full". Below these fields is a "Refresh" button.
- Modbus TCP Connection:** Displays "Active Connections: 0". Below this field is a "Refresh" button.
- Data:** A text input field labeled "Input data(HEX):" with a file icon to its right.

The “Monitor” interface include three parts: “Ethernet”, “Modbus TCP Connection”, and “Data”. In the “Ethernet” part, you can monitor the speed and duplex of Ethernet through clicking “Refresh”; In the “Modbus TCP Connection” part, you can monitor the connection status through clicking “Refresh”; In the “Data” part, you can monitor input and output data (HEX) of Ethernet through clicking “Refresh”.

Note: It Don't use data buffer mode when EMT-331 work mode is Modbus RTU, but use the mode which is similar with transparent, so the data monitor area of the monitor page doesn't display any data. Data monitor function could be used only working in user-defined protocol mode.

Choosing “User”, then you can see:

SibоТех

EMT-331 User

Configuration

Monitor

User

User

admin

User has permission of reading and modifying the configuration.

New Password

Confirm Password

Submit

The “User” interface provides the function of change the password of admin.

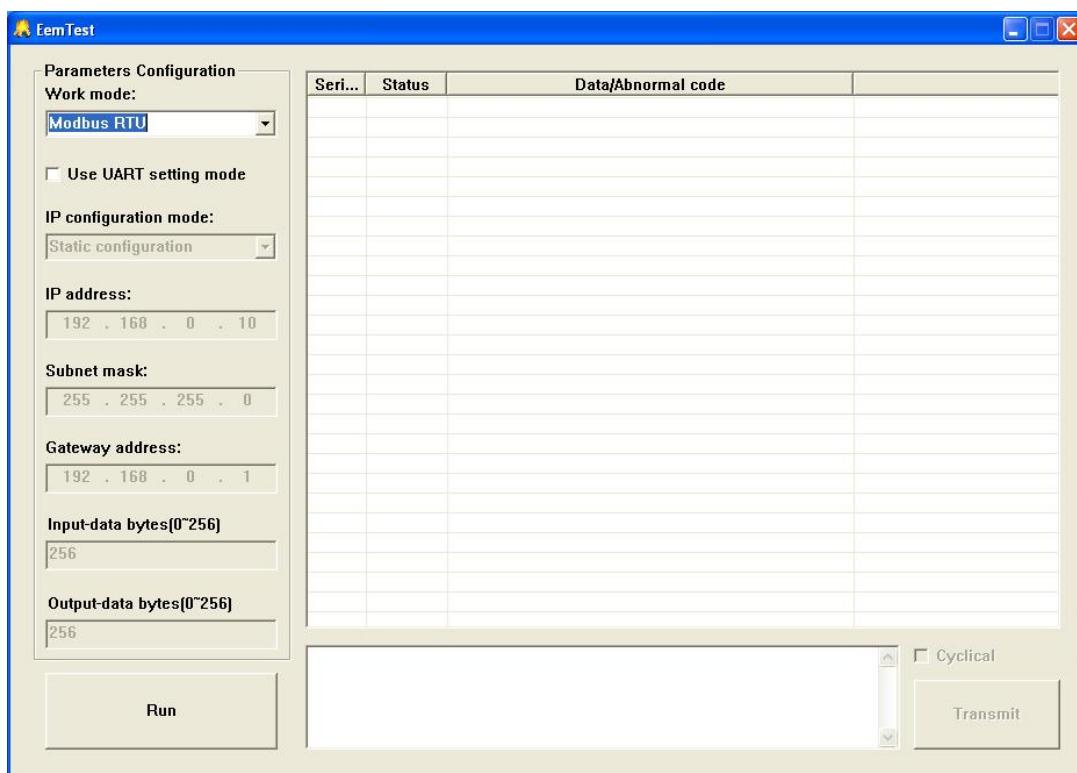
8 Test software

8.1 Attention before the configuration

EemTest basing on Windows platforms is a software being used for testing embedded Ethernet module EIP-341 and EMT-331. The software function is testing the data transceiver of EIP-341 and EMT-331. The manual introduce the method of testing EMT-331. You can obtain the method of testing EIP-341 in EIP-341 user manual.

You need use the software with EMT-331 development board. We are very sorry that the test software may exist bug!

Double-click the icon to enter the main interface:



8.2 User interface

The main interface include: Parameters configuration section, Data receiving section, Data transmitting

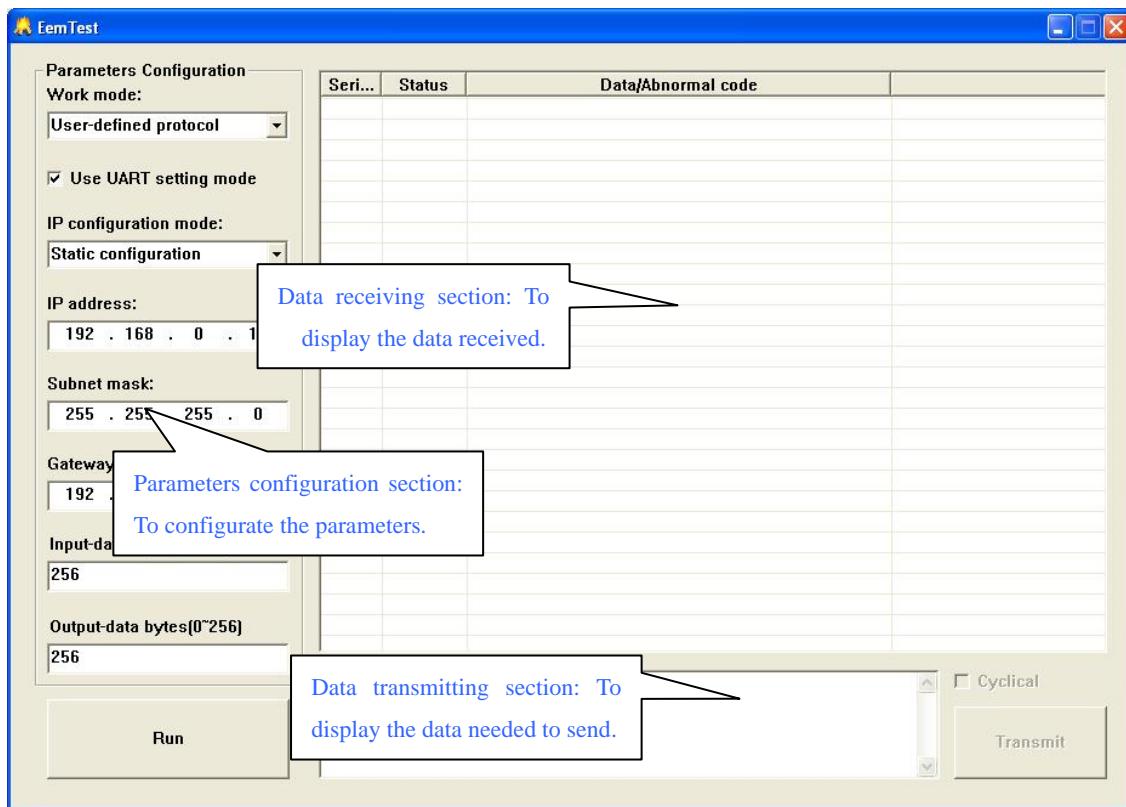
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section and some functional button.

Note: In the software, all the gray part can not be changed.



Work mode: The function of the first part of the parameters configuration is setting work mode.

Use UART setting mode: when you choose it, “IP configuration mode”, “IP address”, “Subnet mask”, “Gateway address” can be changed. When you choose “UART setting mode” in embedded configuration interface, you must choose the mode here.

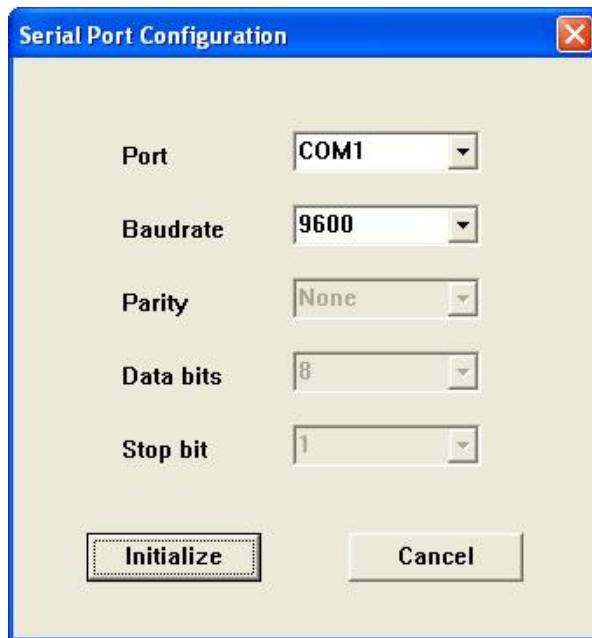
IP configuration mode: Static configuration mode, DHCP, and BOOTP can be selected.

When you don't choose it, “IP configuration mode”, “IP address”, “Subnet mask”, “Gateway address” can not be changed, and you can configurate IP address and so on through PC IE browser.

Input-data bytes, Output-data bytes: The value must be the same with the input and output bytes of Modbus TCP setting in embedded configuration interface.

8.3 Establish connection and disconnect

The data in the parameters configuration section is default after you open the software, you can input the value you need and click the “Run” button. You need configure serial port:



“Port” is the serial port being used; “Baudrate” is current serial port baudrate being set through DIP switches.

After finish configuring parameters, click “Initialize” button to establish the connection and initialize hardware configuration.

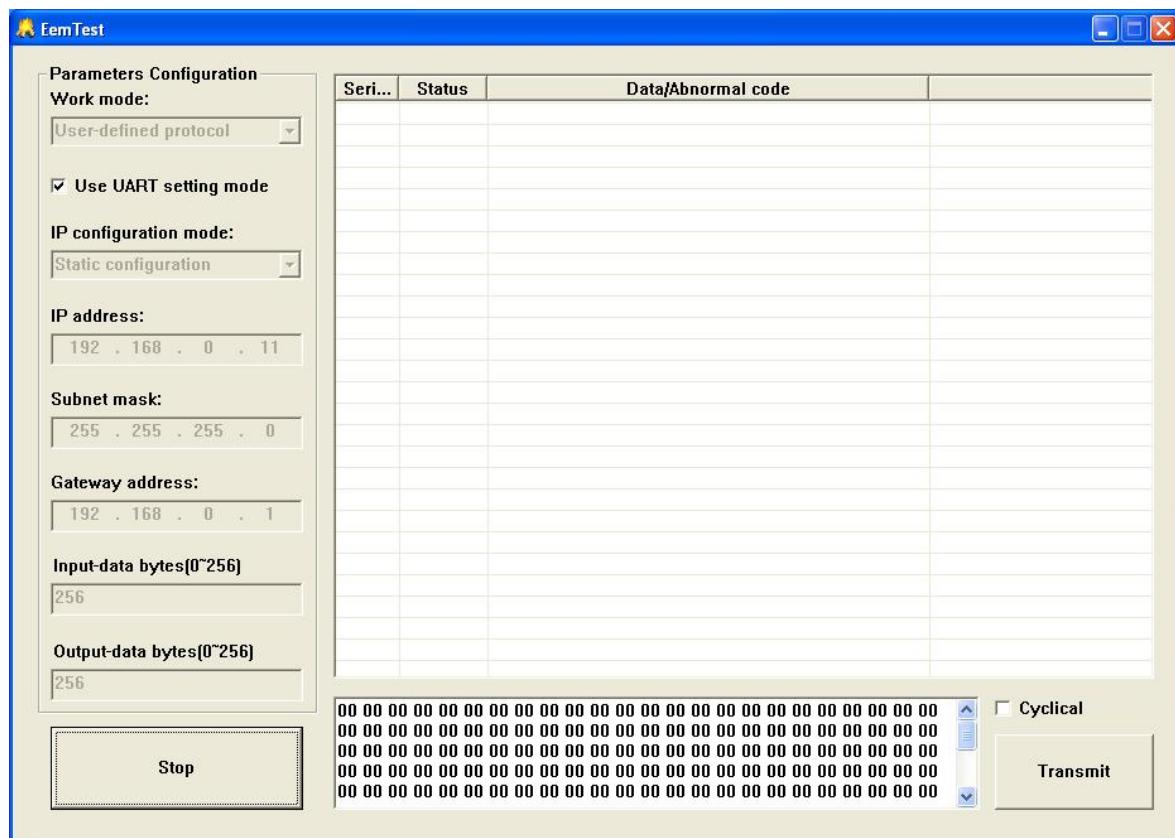
When choosing “Use UART setting mode”, click “Initialize” button to send initial message and enter run status.

When not choosing “Use UART setting mode”, click “Initialize” button and enter run status directly.

After establishing the connection, all the options in parameters configuration section will be gray, “Run” button will change to “Stop” and “Transmit” button will change to be usable.

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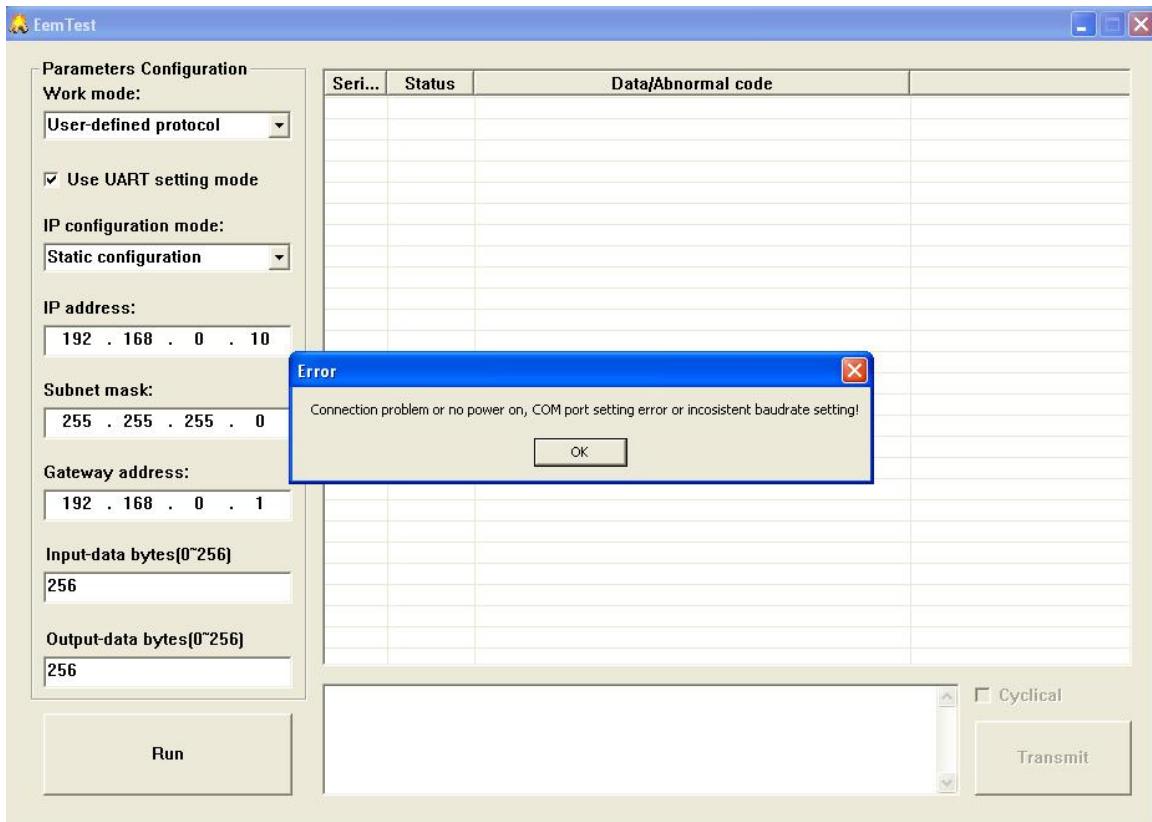
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If be fail in establishing the connection, there will pop-up failure dialog, and the options in parameters configuration section will not be gray.

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When users want to disconnect after establishing connection, they can click “Stop” button. The gray options will be usable again after disconnecting, “Stop” button will change to “Run”, and “Transmit” button will change to be unusable.

8.4 Set work mode

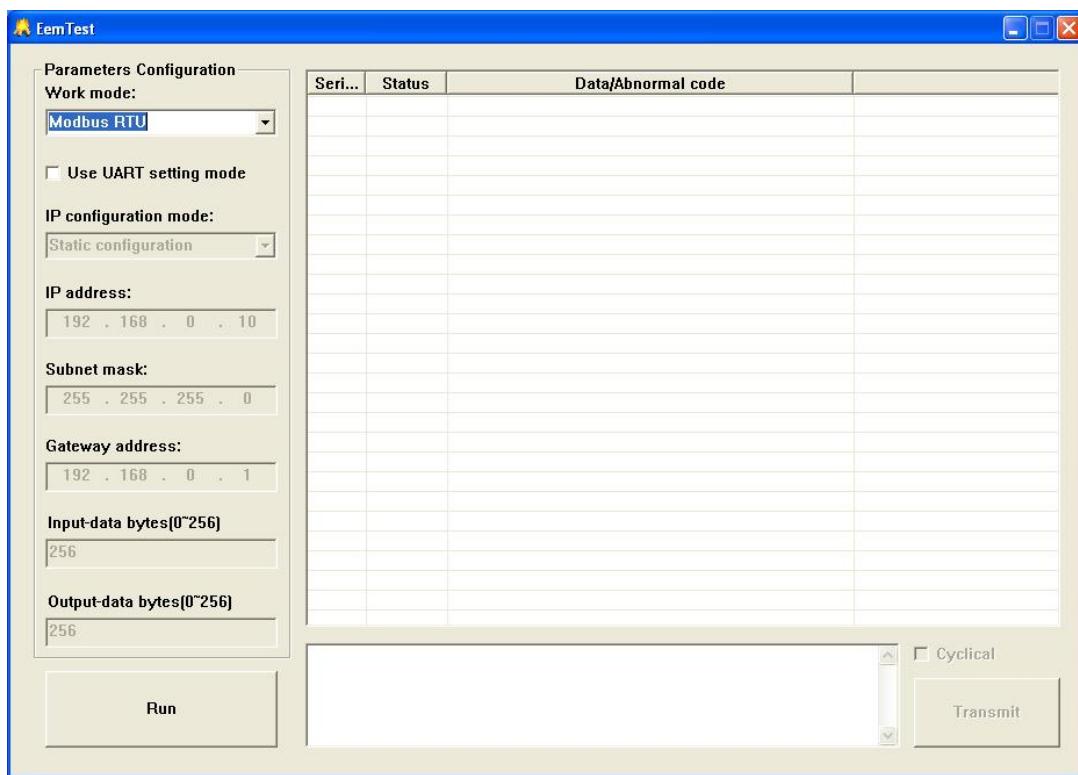
The function of the first part of the parameters configuration is setting work mode, currently it supports two kinds of work modes, one is Modbus TCP work mode and the other is user-defined protocol work mode, the interface and use method are different if you select different work mode..

Modbus RTU work mode: Test software is Modbus RTU slave, and response. The interface as follow:

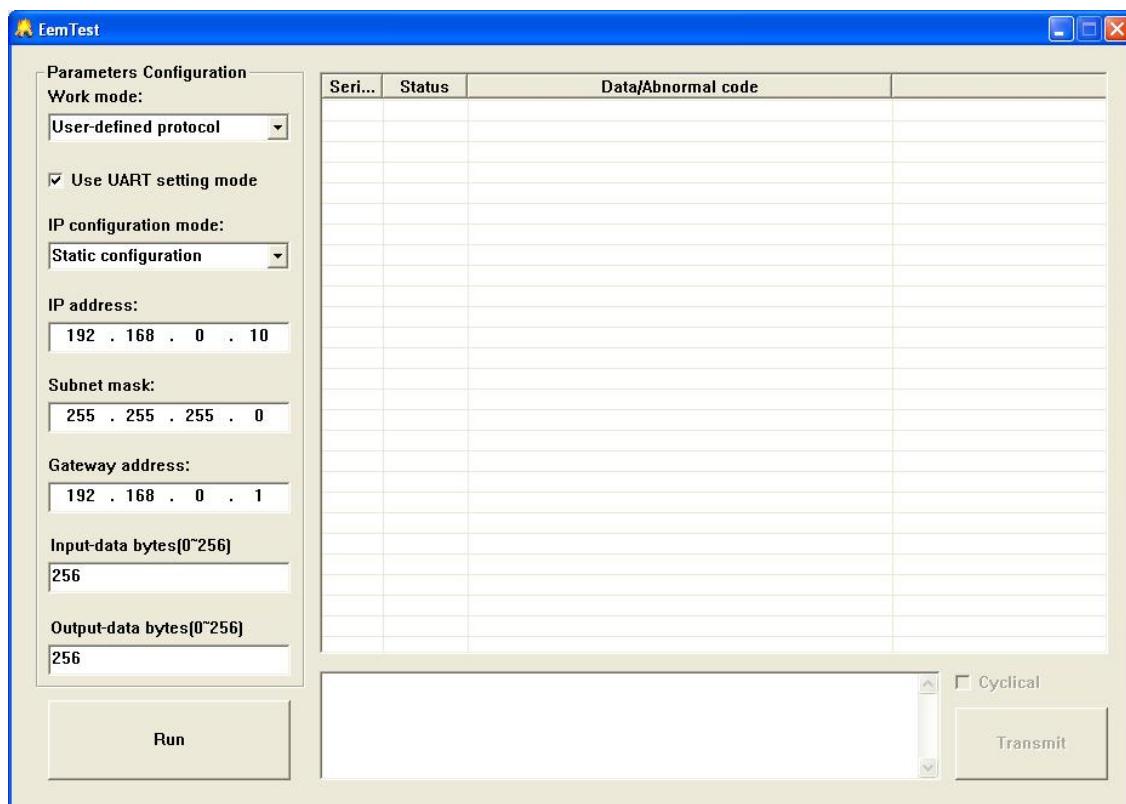
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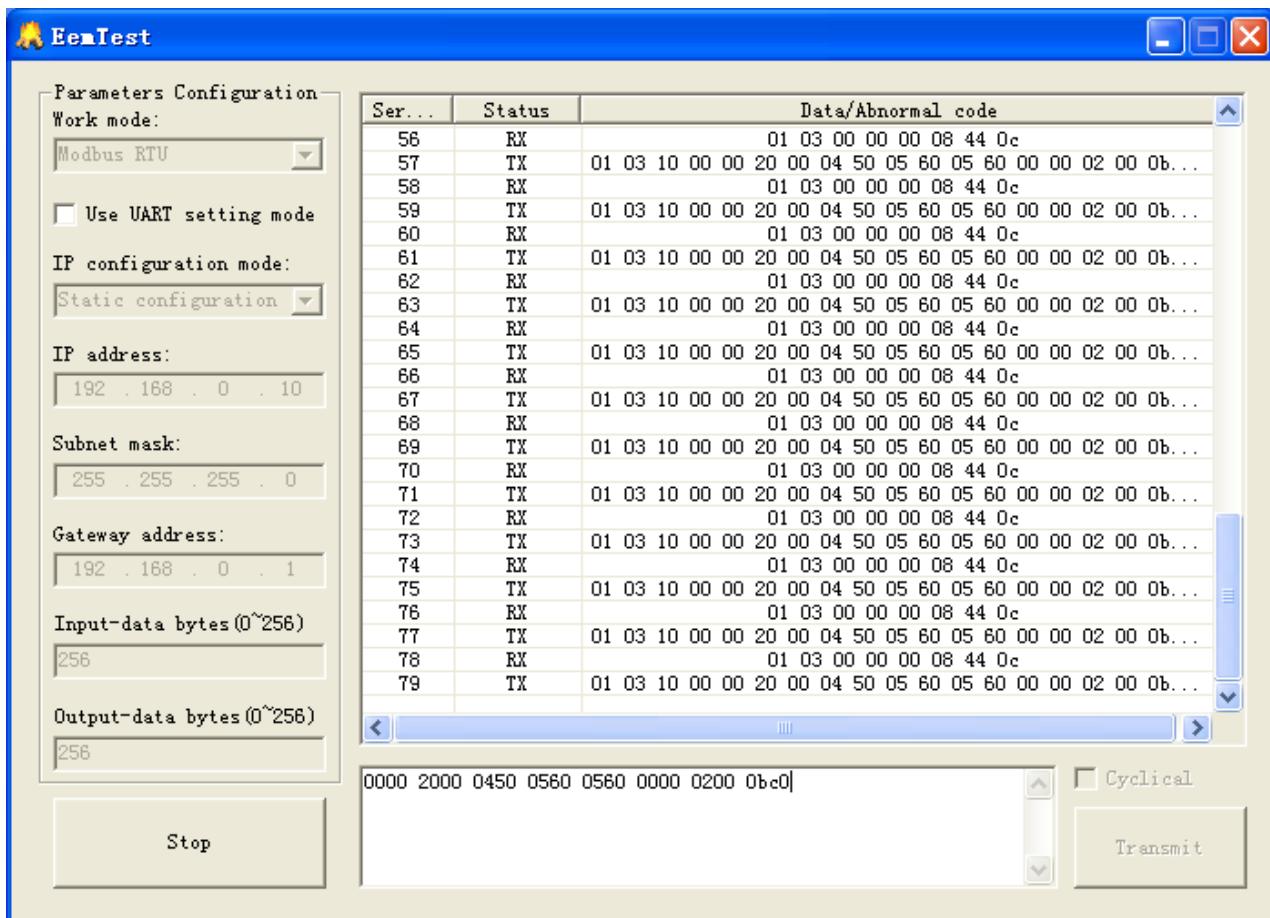
At the user-defined protocol work mode, test software is communication initiator, and module response. The interface as follow:



8.5 Receive and transmit data

Modbus RTU work mode:

Receive data: After establishing the connection, data receiving section will display the receiving data without other operations.

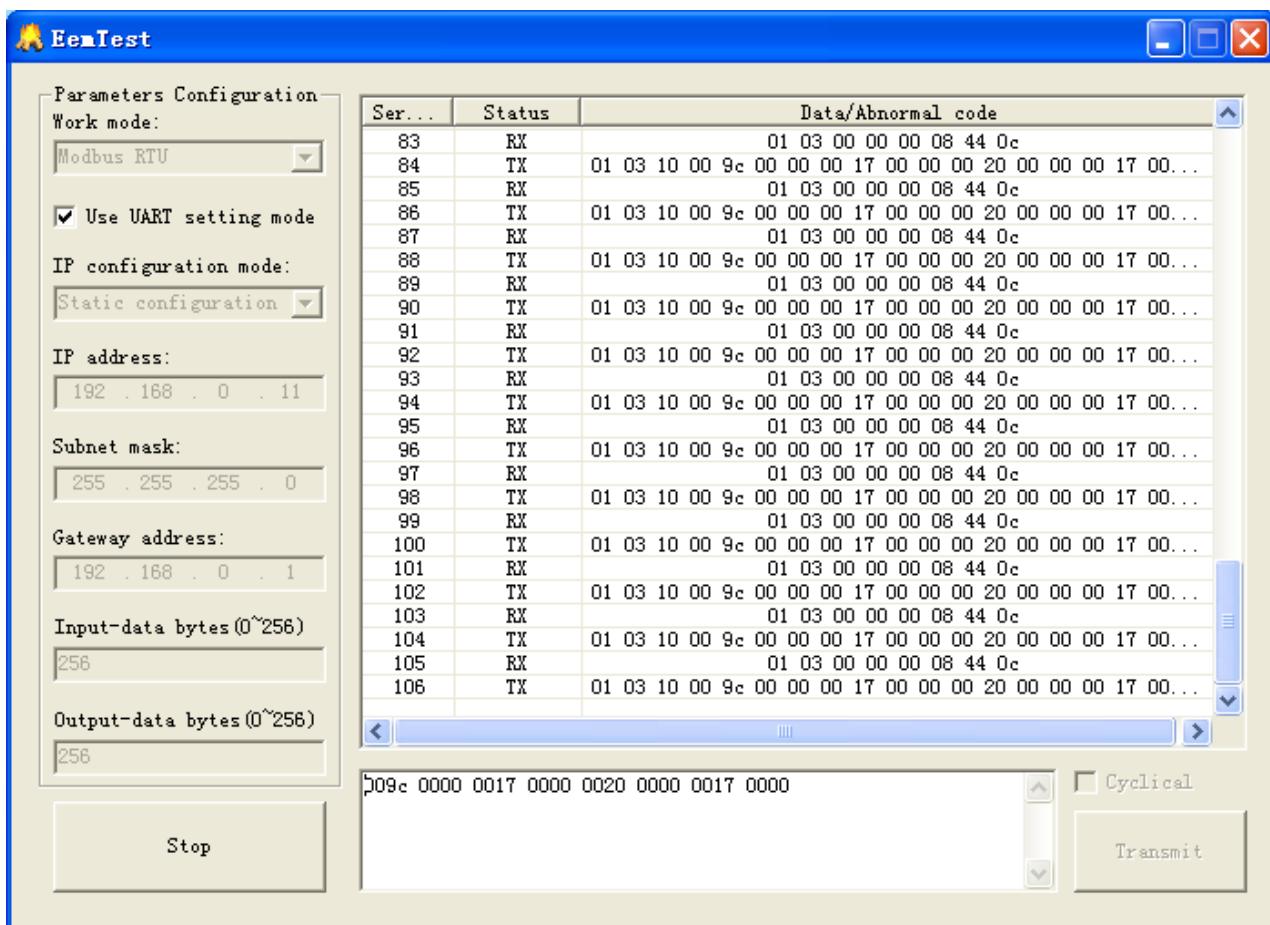


Transmit data: After establishing the connection, software receives data, transmits data according Modbus protocol and displays them. Test software current version only supports 03H and 10H function codes (EMT-331 supports all of Modbus function codes, and support the maximum data length being allowed by protocol.), and 8 registers, the start address of register is 0(40001), users only need to modify the relevant data of the data transmitting section.

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Note: RX is receiving data, TX is transmitting data.

User-defined protocol work mode:

Data transmitting: After establishing the connection, user can transmit data in data transmitting section through clicking “Transmit” button. The format of data must be correct. There is a space every two bytes (HEX), and the data length must be the same with “Input-data bytes”.

Data receiving: After establishing the connection, user transmit data successfully then can receive data transmitting form the module, and display the data in data receiving section.

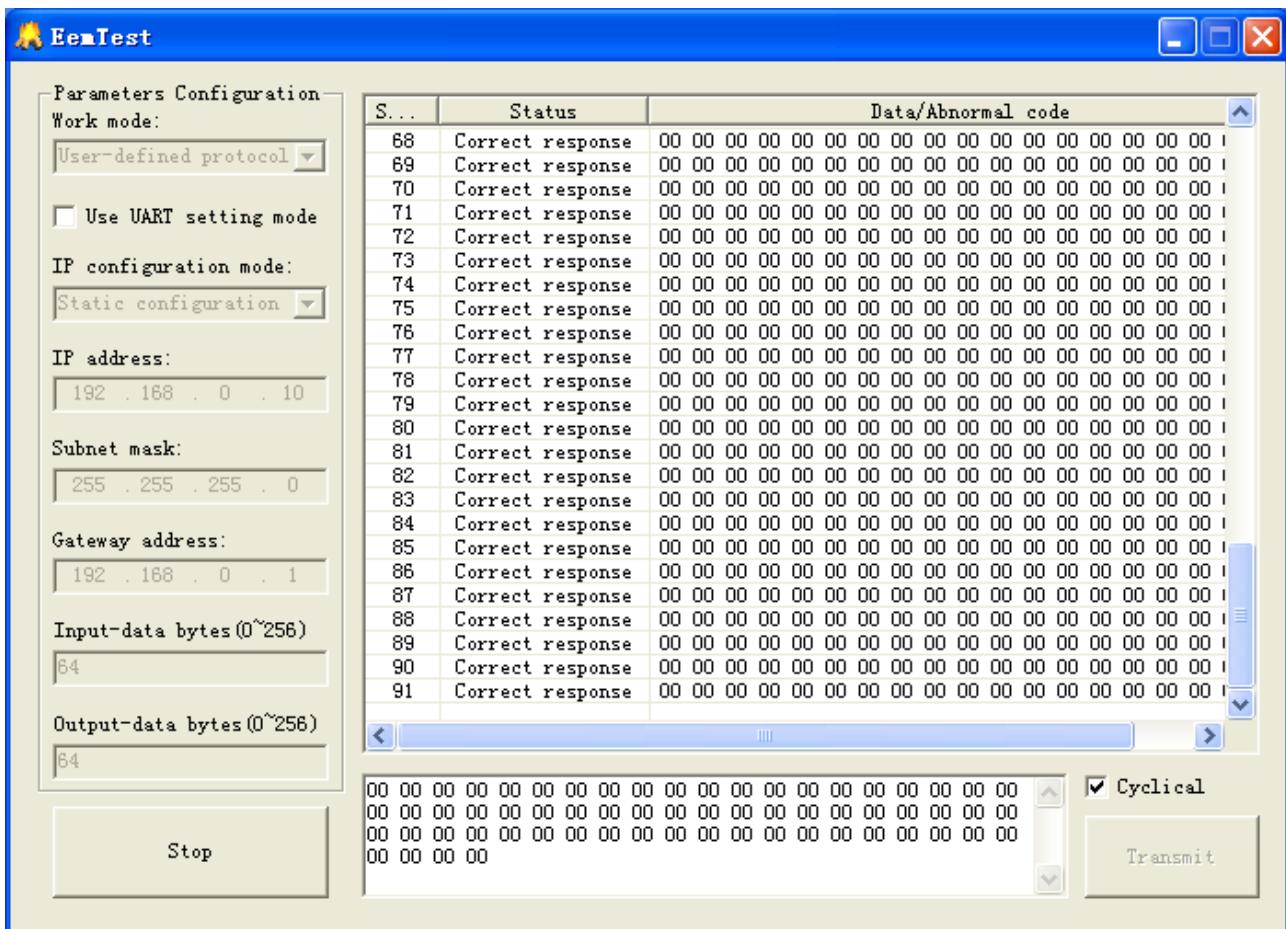
Cyclical: When user want to transmit data cyclically, you need choose “Cyclical”, and click “Transmit” button; When user want to stop transmitting data cyclically, you need only not choose “Cyclical”.

Note: The format of transmitting data must be correct, or you can not transmit them.

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9 Operation Maintenance and Cautions

- Prevent great pressure or will damage the panel;
- Prevent collision or may damage the inside elements;
- Power must be controlled in the range of that the manual have told you to prevent the module burned;
- Prevent water or will affect the normal work;
- Please check on the wiring before powering on.

Note: Because of much heat productivity of the module in running status, user must give EMT-331 enough space in designing the user board to emit heat!



10 Copyright information

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The product has many applications. The users must make sure that all operations and results are in accordance with the safety of relevant field, and the safety includes laws, rules, codes and standards.



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