SCHNEIDER Electric Industries

SCHNEIDER MODBUS Master Series

MODBUS-TCP Client (Master) Driver

Supported version TOP Design Studio V1.0 or higher

CONTENTS

We want to thank our customers who use the Touch Operation Panel.

1. System configuration

This driver is the "MODBUS-TCP Client (Master)" among the "MODBUS Protocol" of "MODBUS Organization".

Depending on the external device (MODBUS Slave Protocol supported), you may set the "command code", "protocol frame format" etc., of the driver separately. In this case, set the detailed settings according to the external device side based on the communication method.

The system configuration with an external device supported by this driver is as follows:

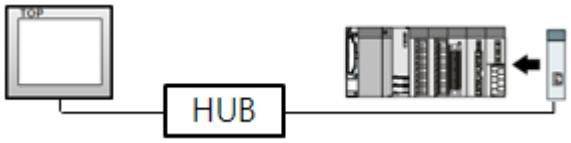
Series	CPU	Link I/F	Communication method	System setting	Cable
MODBUS Slave/Server Device			Ethernet (TCP / UDP)	3. TOP communication setting 4. External device setting	Twisted pair cable*Note 1)

*Note 1) Twisted pair cable

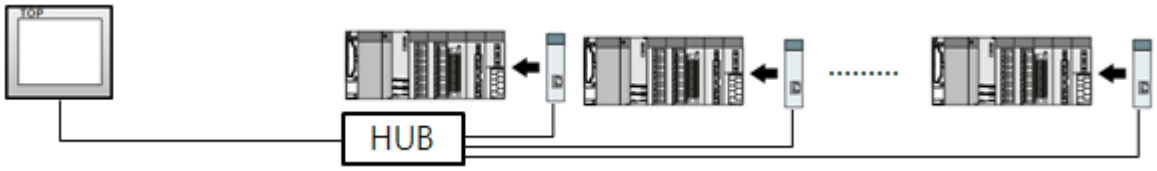
- Refer to STP (Shielded Twisted Pair Cable) or UTP (Unshielded Twisted Pair Cable) Category 3, 4, 5.
- Depending on the network configuration, you can connect to components such as the hub and transceiver, and in this case, use a direct cable.

■ Connectable configuration

• 1:1 connection (one TOP and one external device) connection

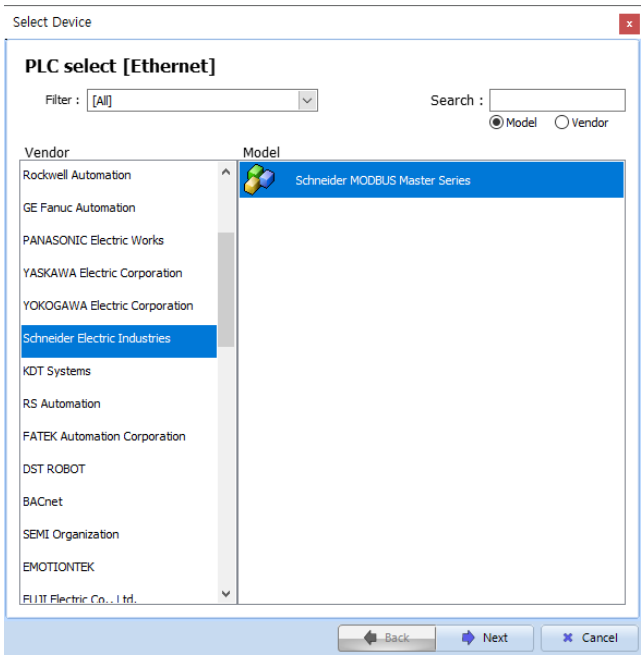


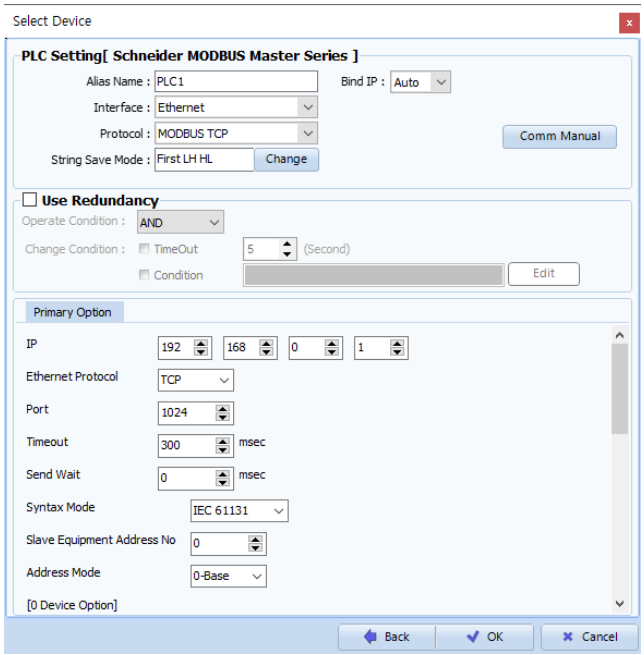
• 1:N connection (one TOP and multiple external devices) connection



2. External device selection

■ Select a TOP model and a port, and then select an external device.





Settings		Contents
TOP	Model	Check the TOP display and process to select the touch model.
External device	Vendor	Select the vendor of the external device to be connected to TOP. Select "Schneider Electric Industries".
	PLC	Select the external device to be connected to the TOP.

Model	Interface	Protocol
Schneider MODBUS Master Series	Ethernet	MODBUS TCP

Please check the system configuration in Chapter 1 to see if the external device you want to connect is a model whose system can be configured.

3. TOP communication setting

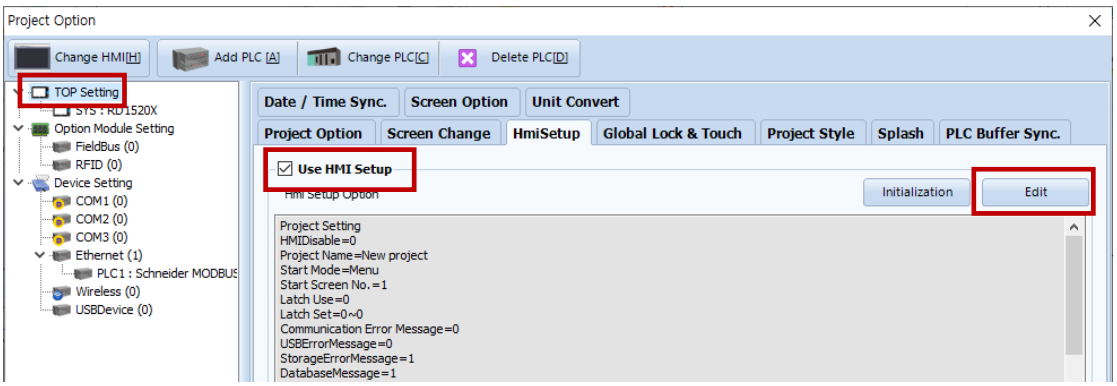
The communication can be set in TOP Design Studio or TOP main menu. The communication should be set in the same way as that of the external device.

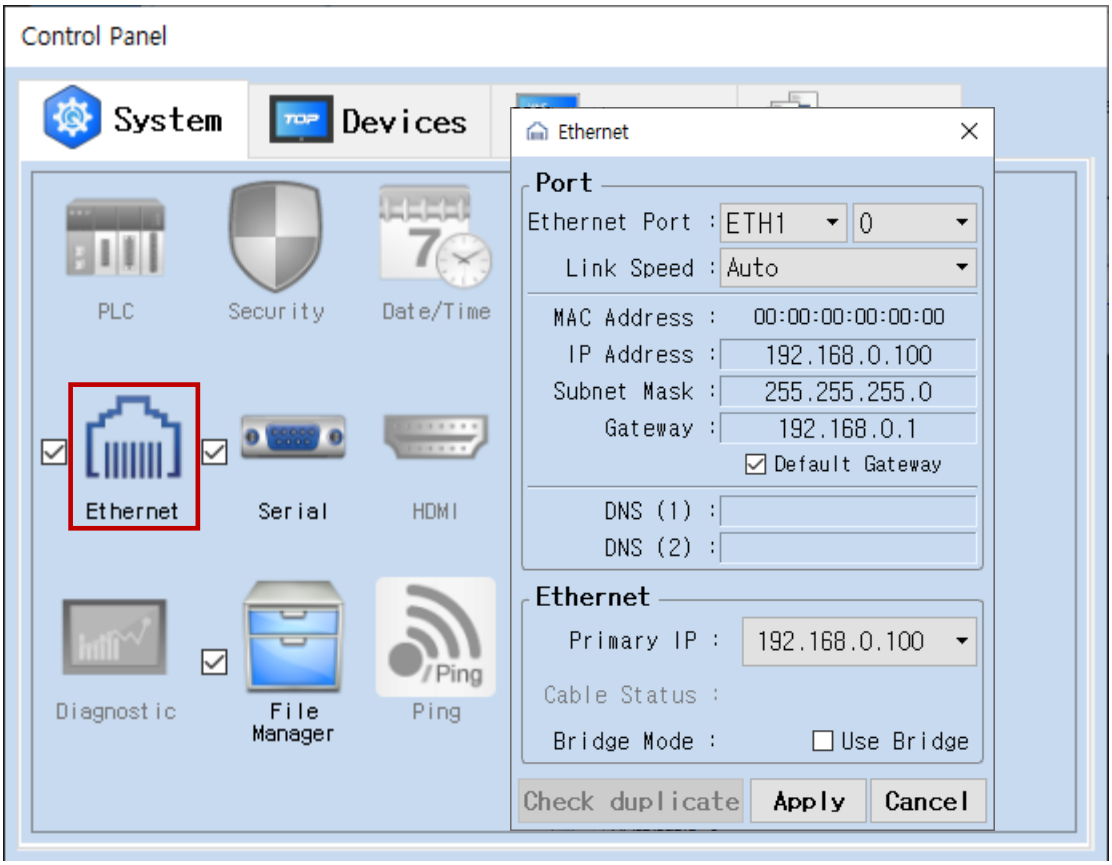
3.1 Communication setting in TOP Design Studio

(1) Communication interface setting

■ [Project > Project Property > TOP Setting] → [Project Option > "Use HMI Setup" Check > Edit > Ethernet]

– Set the TOP communication interface in TOP Design Studio.





Items	TOP	External device	Remarks
IP Address*Note 1) Note 2)	192.168.0.100	192.168.0.51	
Subnet Mask	255.255.255.0	255.255.255.0	
Gateway	192.168.0.1	192.168.0.1	

*Note 1) The network addresses of the TOP and the external device (the first three digits of the IP, 192 . 168 . 0 . 0) should match.

*Note 2) Do not use duplicate IP addresses over the same network.

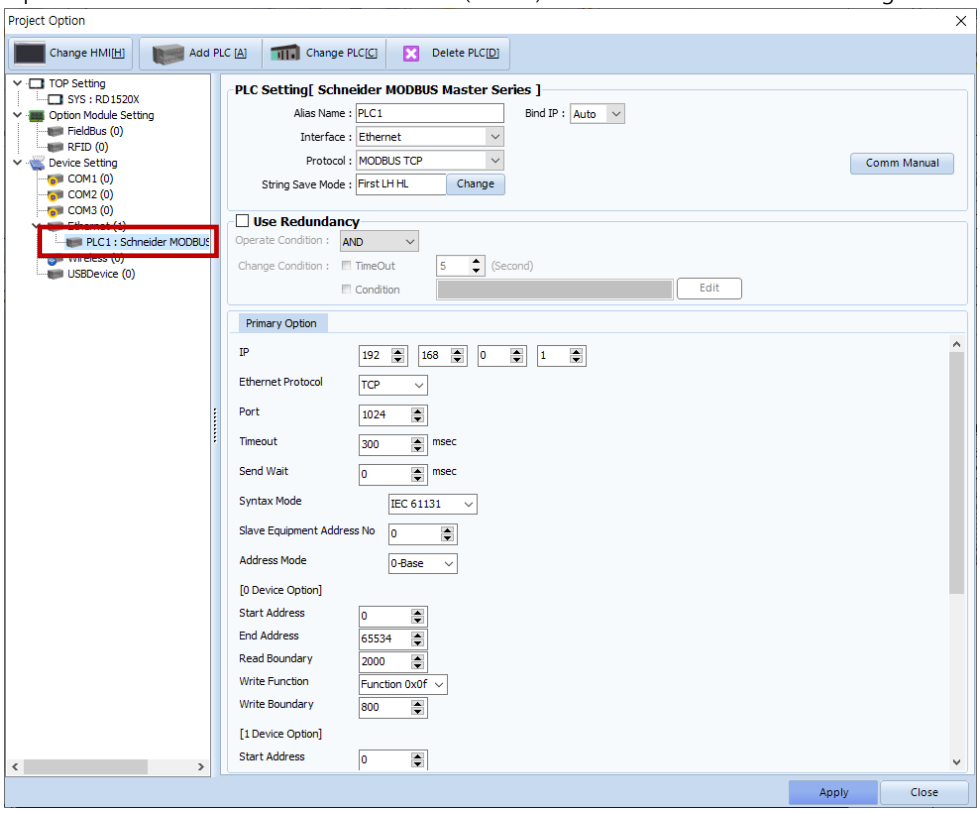
* The above settings are examples recommended by the company.

Items	Description
IP Address	Set an IP address to be used by the TOP to use over the network.
Subnet Mask	Enter the subnet mask of the network.
Gateway	Enter the gateway of the network.

(2) Communication option setting

■ [Project > Project Property > Device Setting > ETHERNET > "PLC1 : Schneider MODBUS Master Series"]

– Set the options of the Schneider MODBUS-TCP Client (Master) communication driver in TOP Design Studio.

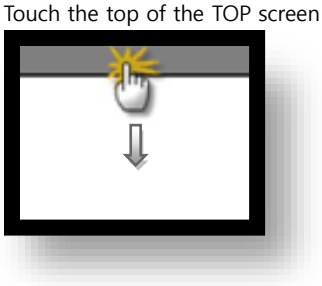


Items	Settings	Remarks
Interface	Select "Ethernet".	Refer to "2. External device selection".
Protocol	Select "MODBUS TCP".	
IP	Enter the IP address of the external device.	
Ethernet Protocol	Select the Ethernet protocol between the TOP and an external device.	
Port	Enter the Ethernet communication port number of the external device.	
TimeOut (ms)	Set the time for the TOP to wait for a response from an external device.	
SendWait (ms)	Set the waiting time between TOP's receiving a response from an external device and sending the next command request.	
Syntax Mode	Set the device notation.	
Slave Equipment Address No	Enter the prefix number of an external device (Slave).	
Address Mode	Select the Address Mode. (1-base: "address-1" operation/0-base: no operation)	
[0 Device Option]		
Start Address	Enter the Start Address of the Coil.	
End Address	Enter the End Address of the Coil.	
Read Boundary	Set the maximum number of consecutive reads for the Coil.	
Write Function	Set the write command for the Coil. Force Single Coil : 05(Hex) / Force Multiple Coils : 0F(Hex)	
Write Boundary	Set the number of consecutive writes for the Coil.	
[1 Device Option]		
Start Address	Enter the Start Address of the Discrete Input.	
End Address	Enter the End Address of the Discrete Input.	
Read Boundary	Set the number of consecutive reads for the Discrete Input.	
[3 Device Option]		
Start Address	Enter the Start Address of the Input Register.	
End Address	Enter the End Address of the Input Register.	
Read Boundary	Set the number of consecutive reads for the Input Register.	
[4 Device Option]		
Start Address	Enter the Start Address of the Holding Register.	
End Address	Enter the End Address of the Holding Register.	
Read Boundary	Set the number of consecutive reads for the Holding Register.	
Write Function	Set the write command for the Holding Register. Preset Single Register : 06(Hex) / Preset Multiple Registers : 10(Hex)	
Write Boundary	Set the number of consecutive writes for the Holding Register.	

3.2. Communication setting in TOP

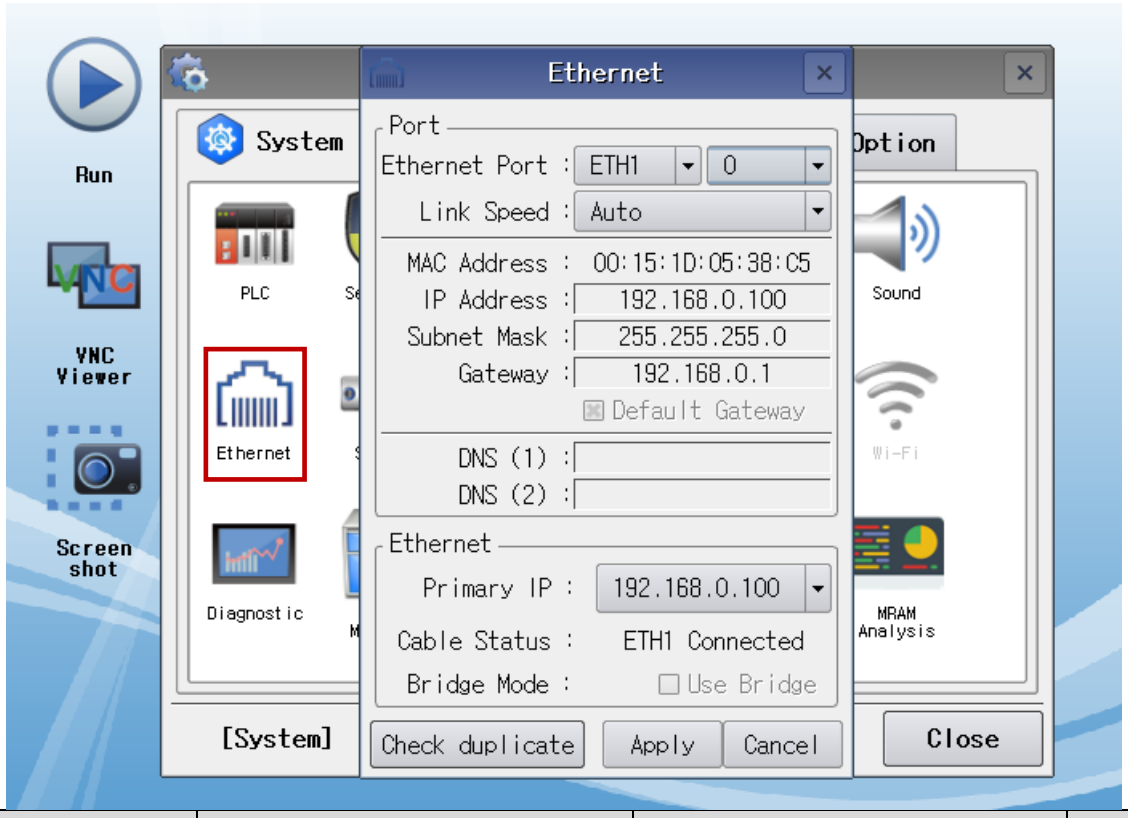
*** This is a setting method when "Use HMI Setup" in the setting items in "3.1 TOP Design Studio" is not checked.**

■ Touch the top of the TOP screen and drag it down. Touch "EXIT" in the pop-up window to go to the main screen.



(1) Communication interface setting

■ [Main Screen > Control Panel > Ethernet]



Items	TOP	External device	Remarks
IP Address*Note 1) Note 2)	192.168.0.100	192.168.0.51	
Subnet Mask	255.255.255.0	255.255.255.0	
Gateway	192.168.0.1	192.168.0.1	

*Note 1) The network addresses of the TOP and the external device (the first three digits of the IP, 192 . 168 . 0 . 0) should match.

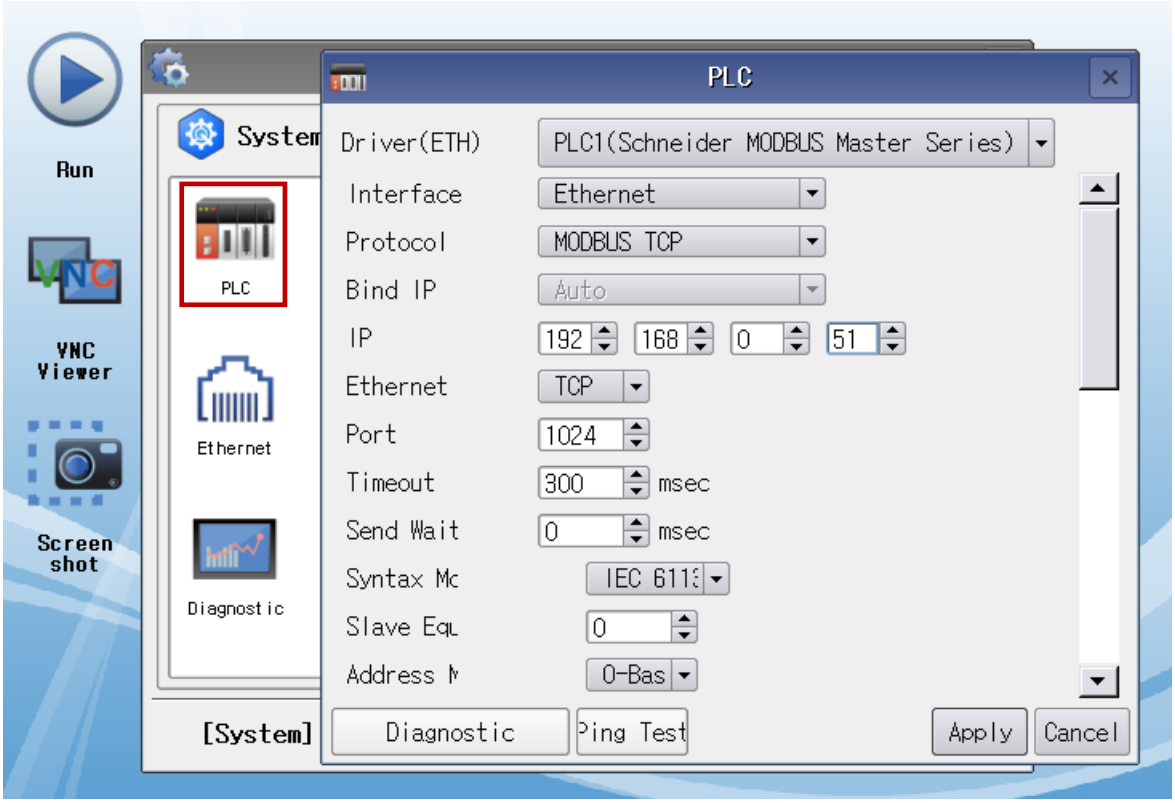
*Note 2) Do not use duplicate IP addresses over the same network.

* The above settings are examples recommended by the company.

Items	Description
IP Address	Set an IP address to be used by the TOP to use over the network.
Subnet Mask	Enter the subnet mask of the network.
Gateway	Enter the gateway of the network.

(2) Communication option setting

■ [Main Screen > Control Panel > PLC]



Items	Settings	Remarks
Interface	Select "Ethernet".	Refer to "2. External device selection".
Protocol	Select "MODBUS TCP".	
IP	Enter the IP address of the external device.	
Ethernet Protocol	Select the Ethernet protocol between the TOP and an external device.	
Port	Enter the Ethernet communication port number of the external device.	
TimeOut (ms)	Set the time for the TOP to wait for a response from an external device.	
SendWait (ms)	Set the waiting time between TOP's receiving a response from an external device and sending the next command request.	
Syntax Mode	Set the device notation.	
Slave Equipment Address No	Enter the prefix number of an external device (Slave).	
Address Mode	Select the Address Mode. (1-base: "address-1" operation/0-base: no operation)	
[0 Device Option]		
Start Address	Enter the Start Address of the Coil.	
End Address	Enter the End Address of the Coil.	
Read Boundary	Set the maximum number of consecutive reads for the Coil.	
Write Function	Set the write command for the Coil. Force Single Coil : 05(Hex) / Force Multiple Coils : 0F(Hex)	
Write Boundary	Set the number of consecutive writes for the Coil.	
[1 Device Option]		
Start Address	Enter the Start Address of the Discrete Input.	
End Address	Enter the End Address of the Discrete Input.	
Read Boundary	Set the number of consecutive reads for the Discrete Input.	
[3 Device Option]		
Start Address	Enter the Start Address of the Input Register.	
End Address	Enter the End Address of the Input Register.	
Read Boundary	Set the number of consecutive reads for the Input Register.	
[4 Device Option]		
Start Address	Enter the Start Address of the Holding Register.	
End Address	Enter the End Address of the Holding Register.	
Read Boundary	Set the number of consecutive reads for the Holding Register.	
Write Function	Set the write command for the Holding Register. Preset Single Register : 06(Hex) / Preset Multiple Registers : 10(Hex)	
Write Boundary	Set the number of consecutive writes for the Holding Register.	

3.3 Communication diagnostics

■ Check the interface setting status between the TOP and an external device.

- Touch the top of the TOP screen and drag it down. Touch "EXIT" in the pop-up window to go to the main screen.
- Check if the ETH port settings you want to use in [Control Panel > Ethernet] are the same as those of the external device.

■ Diagnosis of whether the port communication is normal or not

- Touch "Communication diagnostics" in [Control Panel > PLC].
- The Diagnostics dialog box pops up on the screen and determines the diagnostic status.

OK	**Communication setting normal**
Time Out Error	**Communication setting abnormal** - Check the cable, TOP, and external device setting status. **(Reference: Communication diagnostics sheet)**

■ Communication diagnostics sheet

- If there is a problem with the communication connection with an external terminal, please check the settings in the sheet below.

Items	Contents		Check		Remarks
System configuration	How to connect the system		OK	NG	1. System configuration
	Connection cable name		OK	NG	
TOP	Version information		OK	NG	2. External device selection 3. Communication setting
	Port in use		OK	NG	
	Driver name		OK	NG	
	Other detailed settings		OK	NG	
	Relative prefix	Project setting	OK	NG	
		Communication diagnostics	OK	NG	
	Ethernet port setting	IP Address	OK	NG	
		Subnet Mask	OK	NG	
		Gateway	OK	NG	
External device	CPU name		OK	NG	4. External device setting
	Communication port name (module name)		OK	NG	
	Protocol (mode)		OK	NG	
	Setup Prefix		OK	NG	
	Other detailed settings		OK	NG	
	Ethernet port setting	IP Address	OK	NG	
		Subnet Mask	OK	NG	
		Gateway	OK	NG	
	Check address range		OK	NG	5. Supported addresses (For details, please refer to the PLC vendor's manual.)

4. External device setting

Refer to the user manual of the external device to set "MODBUS-TCP Slave (Server) Driver" in the external device I/F.

- Do not use duplicate IP addresses over the same network.
- Check the contents of the address map on the external device side and use the communication address according to its contents.

5. Supported addresses

The devices available in TOP are as follows:

The device range (address) may differ depending on the CPU module series/type. The TOP series supports the maximum address range used by the external device series. Please refer to each CPU module user manual and be take caution to not deviate from the address range supported by the device you want to use.

■ **Syntax Mode : IEC 61131**

	Bit Address	Word Address	32 bits	Remarks
Coil	%Q00001 – %Q65536	%Q00001 – %Q65521	L/H	
Discrete Input	%I00001 – %I65536	%I00001 – %I65521		*Note 1)
Input Register	%IW00001.00 – %IW65536.15	%IW00001 – %IW65536		*Note 1)
Holding Register	%MW00001.00 – %MW65536.15	%MW00001 – %MW65536		

***Note 1)** Cannot be written (Read-only)

■ **Syntax Mode : MODBUS**

	Bit Address	Word Address	32 bits	Remarks
Coil	000001 – 065536	000001 – 065521	L/H	
Discrete Input	100001 – 165536	100001 – 165521		*Note 1)
Input Register	300001.00 – 365536.15	300001 – 365536		*Note 1)
Holding Register	400001.00 – 465536.15	400001 – 465536		

***Note 1)** Cannot be written (Read-only)

Appendix A. MODBUS TCP/IP ADU Frame(Data Frame)

Describes MODBUS protocol commands and devices supported by "MODBUS TCP Client (Master) Driver" of this device.

WHAT IS MODBUS?

The MODBUS protocol was developed in 1979 by Modicon, Incorporated, for industrial automation systems and Modicon programmable controllers. It has since become an industry standard method for the transfer of discrete/analog I/O information and register data between industrial control and monitoring devices. MODBUS is now a widely-accepted, open, public-domain protocol that requires a license, but does not require royalty payment to its owner.

MODBUS devices communicate using a master-slave (client-server) technique in which only one device (the Client(Master)) can initiate

transactions (called queries). The other devices (slaves/servers) respond by supplying the requested data to the master, or by taking the action requested in the query. A slave is any peripheral device (I/O transducer, valve, network drive, or other measuring device) which processes information and sends its output to the master using MODBUS. The Acromag I/O Modules form slave/server devices, while a typical master device is a host computer running appropriate application software. Other devices may function as both clients (masters) and servers (slaves).

Masters can address individual slaves, or can initiate a broadcast message to all slaves. Slaves return a response to all queries addressed to them individually, but do not respond to broadcast queries. Slaves do not initiate messages on their own, they only respond to queries from the master.

A master's query will consist of a slave address (or broadcast address), a function code defining the requested action, any required data, and an error checking field. A slave's response consists of fields confirming the action taken, any data to be returned, and an error checking field. Note that the query and response both include a device address, a function code, plus applicable data, and an error checking field. If no error occurs, the slave's response contains the data as requested. If an error occurs in the query received, or if the slave is unable to perform the action requested, the slave will return an exception message as its response (see MODBUS Exceptions). The error check field of the slave's message frame allows the master to confirm that the contents of the message are valid. Traditional MODBUS messages are transmitted serially and parity checking is also applied to each transmitted character in its data frame.

At this point, It's important to make the distinction that MODBUS itself is an application protocol, as it defines rules for organizing and interpreting data, but remains simply a messaging structure, independent of the underlying physical layer. As it happens to be easy to understand, freely available, and accessible to anyone, it is thus widely supported by many manufacturers.

Continued on next page.

WHAT IS MODBUS TCP/IP?

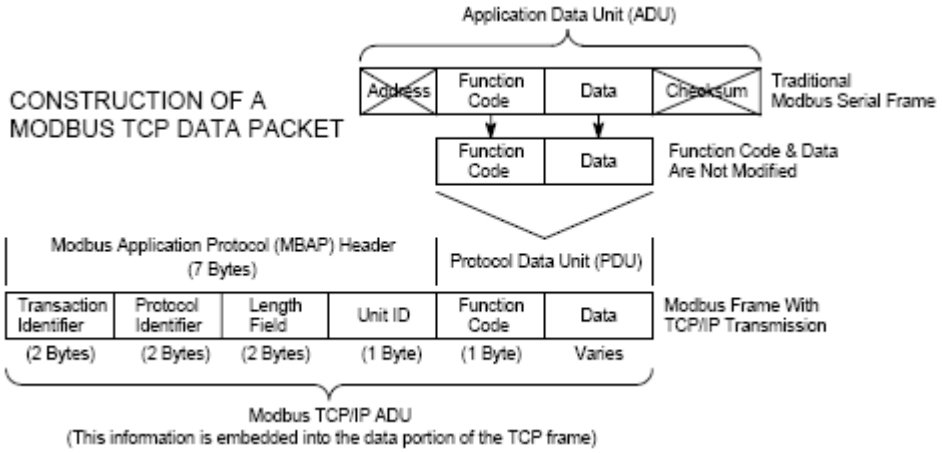
MODBUS TCP/IP (also MODBUS-TCP) is simply the MODBUS RTU protocol with a TCP interface that runs on Ethernet. The MODBUS messaging structure is the application protocol that defines the rules for organizing and interpreting the data independent of the data transmission medium.

TCP/IP refers to the Transmission Control Protocol and Internet Protocol, which provides the transmission medium for MODBUS TCP/IP messaging.

Simply stated, TCP/IP allows blocks of binary data to be exchanged between computers. It is also a world-wide standard that serves as the foundation for the World Wide Web. The primary function of TCP is to ensure that all packets of data are received correctly, while IP makes sure that messages are correctly addressed and routed. Note that the TCP/IP combination is merely a transport protocol, and does not define what the data means or how the data is to be interpreted (this is the job of the application protocol, MODBUS in this case).

So in summary, MODBUS TCP/IP uses TCP/IP and Ethernet to carry the data of the MODBUS message structure between compatible devices. That is, MODBUS TCP/IP combines a physical network (Ethernet), with a networking standard (TCP/IP), and a standard method of representing data (MODBUS as the application protocol). Essentially, the MODBUS TCP/IP message is simply a MODBUS communication encapsulated in an Ethernet TCP/IP wrapper.

In practice, MODBUS TCP embeds a standard MODBUS data frame into a TCP frame, without the MODBUS checksum, as shown in the following diagram.



The MODBUS commands and user data are themselves encapsulated into the data container of a TCP/IP telegram without being modified in any way. However, the MODBUS error checking field (checksum) is not used, as the standard Ethernet TCP/IP link layer checksum methods are instead used to guaranty data integrity. Further, the MODBUS frame address field is supplanted by the unit identifier in MODBUS TCP/IP, and becomes part of the MODBUS Application Protocol (MBAP) header (more on this later).

From the figure, we see that the function code and data fields are absorbed in their original form. Thus, a Modbus TCP/IP Application Data Unit (ADU) takes the form of a 7 byte header (transaction identifier + protocol identifier + length field + unit identifier), and the protocol data unit (function code + data). The MBAP header is 7 bytes long and includes the following fields:

- **Transaction/invocation Identifier (2 Bytes):** This identification field is used for transaction pairing when multiple messages are sent along the same TCP connection by a client without waiting for a prior response.
- **Protocol Identifier (2 bytes):** This field is always 0 for MODBUS services and other values are reserved for future extensions.
- **Length (2 bytes):** This field is a byte count of the remaining fields and includes the unit identifier byte, function code byte, and the data fields.
- **Unit Identifier (1 byte):** This field is used to identify a remote server located on a non TCP/IP network (for serial bridging). In a typical MODBUS TCP/IP server application, the unit ID is set to 00 or FF, ignored by the server, and simply echoed back in the response.

The complete MODBUS TCP/IP Application Data Unit is embedded into the data field of a standard TCP frame and sent via TCP to well-known system port 502, which is specifically reserved for MODBUS applications. MODBUS TCP/IP clients and servers listen and receive MODBUS data via port 502.

We can see that the operation of MODBUS over Ethernet is nearly transparent to the MODBUS register/command structure. Thus, if you are already familiar with the operation of traditional MODBUS, then you are already very with the operation of MODBUS TCP/IP.

A.1 "0" Device (Coil)

(1) Read Single Coil : 01

Describes "01" command frame through the example where "**0**00020–**0**00056 Coil" data of the Slave device side (prefix: 17) is read from the MASTER device.

■ RTU Mode

(Master → Slave: request frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Device score	
	H	L	H	L	H	L			H	L	H	L
Hex	00	01	00	00	00	06	11	01	00	13	00	25

(Slave → Master: response frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Number of data (bytes)	Data				
										Coils 2720	Coils 3528	Coils 4336	Coils 5144	Coils 5652
	H	L	H	L	H	L				L	–	–	–	H
Hex	00	01	00	00	00	08	11	01	05	CD	6B	B2	0E	1B

■ Coils data status

Coils	27	26	25	24	23	22	21	20
on/off	1	1	0	0	1	1	0	1
Coils	35	34	33	32	31	30	29	28
on/off	0	1	1	0	1	0	1	1
Coils	43	42	41	40	39	38	37	36
on/off	1	0	1	1	0	0	1	0
Coils	51	50	49	48	47	46	45	44
on/off	0	0	0	0	1	1	1	0
Coils	59	58	57	56	55	54	53	52
on/off	–	–	–	1	1	0	1	1

0: OFF /

(2) Force Single Coil : 05

Describes "05" command frame through an example where FORCE "ON" is done on Coil 000173 of the Slave device side in the MASTER device.

■ RTU Mode

(Master → Slave: request frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Force data	
	H	L	H	L	H	L			H	L	H	L
Hex	00	02	00	00	00	06	11	05	00	AC	FF	00

■ Force Data

	High	Low
Force ON	FF_H	00_H
Force OFF	00_H	00_H

(Slave → Master: response frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Force data	
	H	L	H	L	H	L			H	L	H	L
Hex	00	02	00	00	00	06	11	05	00	AC	FF	00

A.2 "1" Device (Discrete Input)

(1) Read Input Status : 02

Describes "02" command frame through an example where "**1**00197–**1**00218 Input" data of the Slave device side (prefix: 17) is read from the MASTER device.

(Master → Slave: request frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Device score	
	H	L	H	L	H	L			H	L	H	L
Hex	00	03	00	00	00	06	11	02	00	C4	00	16

(Slave → Master: response frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Number of data	Data (Inputs)		
	H	L	H	L	H	L				10204~0197	10212~0205	10218~0213
Hex	00	03	00	00	00	06	11	02	03	AC	DB	35

■ Coils data status

Coils	204	203	202	201	200	199	198	197
on/off	1	0	1	0	1	1	0	0
Coils	212	211	210	209	208	207	206	205
on/off	1	1	0	1	1	0	1	1
Coils	220	219	218	217	216	215	214	213
on/off	–	–	1	1	0	1	0	1

0: OFF / 1:ON

A.3 "3" Device (Input Register)

(1) Read Input Registers : 04

Describes "03" command frame through an example where "**3**00009 Register" data of the Slave device side (prefix: 17) is read from the MASTER device.

(Master → Slave: request frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Device score (Word Count)	
	H	L	H	L	H	L			H	L	H	L
Hex	00	04	00	00	00	06	11	04	00	08	00	01

(Slave → Master: response frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Number of data	Data 30009 Register	
	H	L	H	L	H	L				H	L
Hex	00	04	00	00	00	05	11	04	02	00	0A

A.4 "4" Device (Holding Register)

(1) Read Holding Registers : 03

Describes "03" command frame through an example where "**4**00108 – **4**00110 Register" data of the Slave device side (prefix: 17) is read from the MASTER device.

(Master → Slave: request frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Device score	
	H	L	H	L	H	L			H	L	H	L
Hex	00	05	00	00	00	06	11	03	00	6B	00	03

(Slave → Master: response frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Number of data (bytes)	Data					
										Register 40108		Register 40109		Register 40110	
	H	L	H	L	H	L				H	L	H	L	H	L
Hex	00	05	00	00	00	09	11	03	06	02	2B	00	00	00	64

(2) Preset Single Register : 06

Describes "06" command frame through an example where 00 03 (hex) data is entered in **4**00002 Register of the Slave device side .

(Master → Slave: request frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Preset data	
	H	L	H	L	H	L			H	L	H	L
Hex	00	06	00	00	00	06	11	06	00	01	00	03

(Slave → Master: response frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Preset data	
	H	L	H	L	H	L			H	L	H	L
Hex	00	06	00	00	00	06	11	06	00	01	00	03

(3) Preset Multiple Register : 10

Describes "10" command frame through an example where two consecutive data, "00 0A (hex)", "01 02 (hex)" are entered in **4**00002 Register of the Slave device side. (Error Code : 90_H)

(Master → Slave: request frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Quantity of Register (Word Count)		Number of data (bytes)	Data			
														Register 40002		Register 40003	
	H	L	H	L	H	L			H	L	H	L		H	L	H	L
Hex	00	07	00	00	00	0B	11	10	00	01	00	02	04	00	0A	01	02

(Slave → Master: response frame)

Comment	Transaction Identifier		Protocol Identifier		Length Field		Unit ID (Slave prefix)	Command	Leading device		Quantity of Register (Word Count)	
	H	L	H	L	H	L			H	L	H	L
Hex	00	07	00	00	00	06	11	10	00	01	00	02