6.2 Serial Communication Module

This manual is the technical details about RS232C/422(Computer Network) module among the network modules for CIMON-PLC system.
In this module, the function of the link with diverse communication devices, such as other makers' PLC and PC, with the protocols of different types and the function of modem communication to control a PLC at a long distance are furnished. The features are as follows.

Features :

- As other makers' protocols are written to use RS-232 channel and RS-422(RS-485) channel each, independent operation is available by protocols.
- It is available to use an exclusive protocol to read/write data.
- The function of the exclusive communication suitable for multi-drop configuration of 32 units access as maximum is offered.

- As modem communication function is built in, a PLC at a long distance can be controlled through exclusive communication.
- Baud rate can be set up in the range from 300bps to 38400bps variously.
- It is available to set up RS232C / RS422(RS485) communication port as independent channel or linked channel.
- 1:1 / 1:N / N:M communication (In case RS422 channel is used) are supported.
- Full – Duplex(RS422) and Half-Duplex(RS485) communication method are supported.
- RS485 multi-drop communication system can be configured, using RS485 channel.

See :

- Specifications
- Operation Setup
- Internal I/O
- Shared Memory
- Network Example
- Communication Services
- Installing and Testing
- Trouble Shooting
- Appendix

6.2.1 Specifications

RS 232C/422/485 Specifications :

- SC02A Dimensions
- SC01A Dimensions
- SC01B Dimensions
- General Specifications
- Module Specifications
- Cable Specifications
- Termination Register

6.2.1.1 General Specifications

The general specifications for CIMON PLC communication modules are as follows.

<table>
<tr><th>Item</th><th colspan="5">Specification</th></tr>
<tr><td>Operating Temperature</td><td colspan="5">-10 ~ 65ºC</td></tr>
<tr><td>Storage Temperature</td><td colspan="5">-25 ~ 80ºC</td></tr>
<tr><td>Operating Humidity</td><td colspan="5">5 ~ 95%RH, Not condensed.</td></tr>
<tr><td>Storage Humidity</td><td colspan="5">5 ~ 95%RH, Not condensed.</td></tr>
<tr><td rowspan="6">Vibration</td><td colspan="5">In case of intermittent vibration</td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Amplitude</td><td colspan="2">Sweep</td></tr>
<tr><td>10 ≦ f< 57Hz</td><td>-</td><td>0.075mm</td><td colspan="2" rowspan="2">10 times in each direction (X,Y,Z)</td></tr>
<tr><td>57 ≦ f < 150 Hz</td><td>9.8m/s2 {1G}</td><td>-</td></tr>
<tr><td colspan="5">In case of continuous vibration</td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Amplitude</td><td colspan="2">Sweep</td></tr>
<tr><td>10 ≦ f < 57Hz</td><td>-</td><td>0.035mm</td><td colspan="2" rowspan="2">10 times in each direction (X,Y,Z)</td></tr>
<tr><td>57 ≦ f < 150 Hz</td><td>4.9m/s2 {1G}</td><td>-</td></tr>
<tr><td>Shock</td><td colspan="5">- Max. Shock Acc.: 147 m/s2 {15G}
- Time : 11㎳
- Pulse Wave : Half sine wave pulse</td></tr>
<tr><td rowspan="4">Noise</td><td>Square wave impulse noise</td><td colspan="4">±1500V</td></tr>
<tr><td>Electrostatic discharge</td><td colspan="4">Voltage: 4 kV(Contact discharge)</td></tr>
<tr><td>Radiated electro-magnetic field</td><td colspan="4">27 ~ 500 MHz. 10 V/m</td></tr>
<tr><td>Fast Transient Bust Noise</td><td>Item</td><td>Power Module</td><td>Digital I/O (24V or more)</td><td>Digital I/O(Less than 24V) Analog I/O Comm. interface</td></tr>
<tr><td></td><td>Voltage</td><td>2KV</td><td>1KV</td><td>0.25KV</td></tr>
<tr><td>Environment</td><td colspan="5">No corrosive gas and no dust.</td></tr>
<tr><td>Altitude</td><td colspan="5">2,000m or less</td></tr>
<tr><td>Pollution</td><td colspan="5">Less than 2</td></tr>
<tr><td>Cooling</td><td colspan="5">Natural Air cooling</td></tr>
</table>

6.2.1.2 Module Specifications

<table>
<tr><th colspan="2">Model</th><th>CM-SC02A</th><th>CM1-SC01A</th><th>CM1-SC01B</th></tr>
<tr><td colspan="2">Interface</td><td>RS232C / 422 / 485</td><td>RS232C</td><td>RS422 / 485</td></tr>
<tr><td></td><td>Null Modem</td><td colspan="3">Direct communication between a PC and RS232C/RS422 port</td></tr>
</table>

Communication Method	Leased-Line Modem	Communication using a leased-line modem
	Dial-up Modem	Remote communication using a dial-up modem
Operation Mode	User Protocol	Communication using user protocol
	HMI Protocol	Communication using exclusive protocol
	MODBUS Protocol	Communication using Modicon protocol
	Graphic Loader Mode	Controls a PLC, using link function in the CICON
Data Type	Data Bit	7 or 8 bits
	Stop Bit	1 or 2 bits
	Parity	Even / Odd / None
Synchronous Type		Asynchronous
Baud Rate		300bps / 600 / 1200 / 2400 / 4800 / 9600 / 19200 / 38400bps
Modem Link Function		Long-distance communication linking modem

6.2.1.3 Cable Specifications

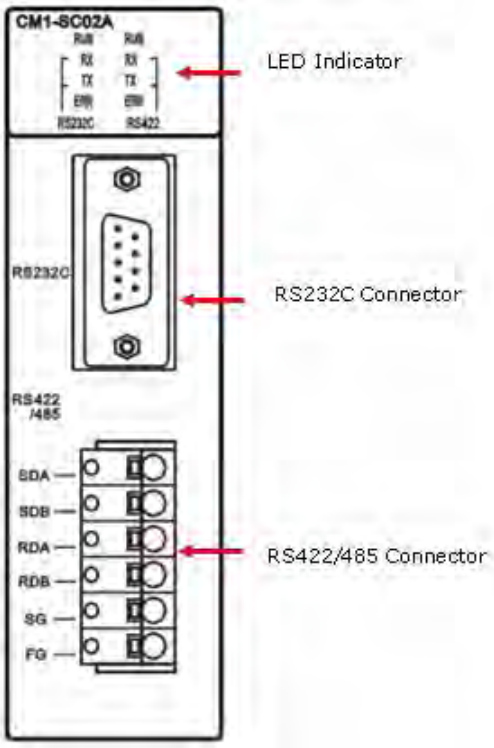
In case of communication, especially, communication distance and baud rate is to be considered among items. In case of the communication using RS-232C port and RS-422/RS-485 port provided from a PLC, to minimize the noise received from outside, a twisted-fair cable for RS-232 is to be used.

6.2.1.4 Termination Register

In case of communication through RS-422 channel, a termination register is to be connected to outside. As termination register protects the signal from the distortion by reflected wave in case of a long-distance communication, the register (1/2W) with the same value as the feature impedance of a cable is to be connected to the termination of a network. In case of recommended cable, connect the termination register of 120? to both ends of the line.

6.2.1.5 SC02A Dimensions

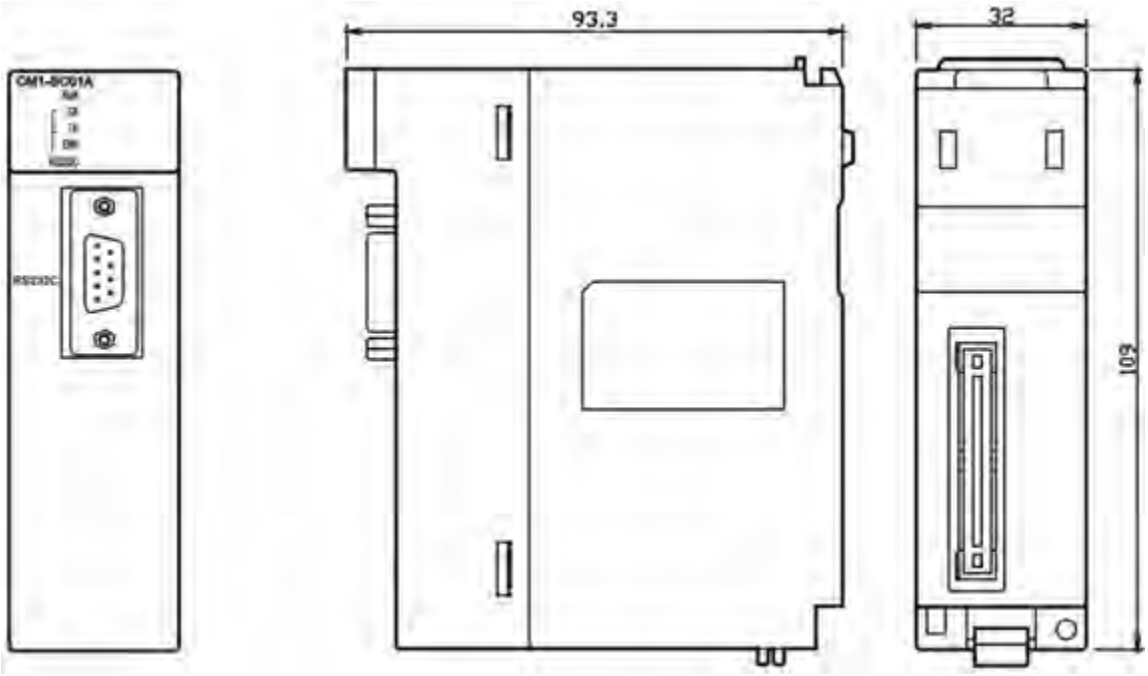
Unit : mm



Name	Description
LED Indicator	Indicates operation status.
RS232C Connector	RS232C connector to connect with an outer device
RS422/485 Connector	RS422/485 connector to connect with an outer device

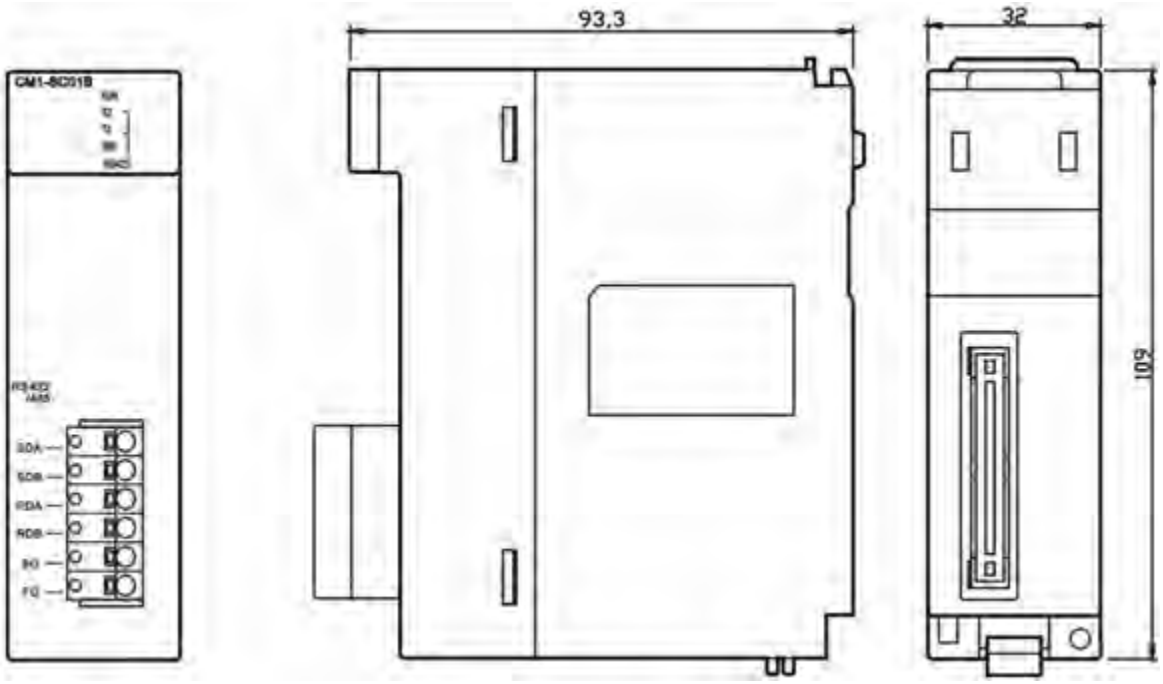
6.2.1.6 SC01A Dimensions

Unit : mm



6.2.1.7 SC01B Dimensions

Unit : mm



6.2.2 Operation Setup

Operation Setup :

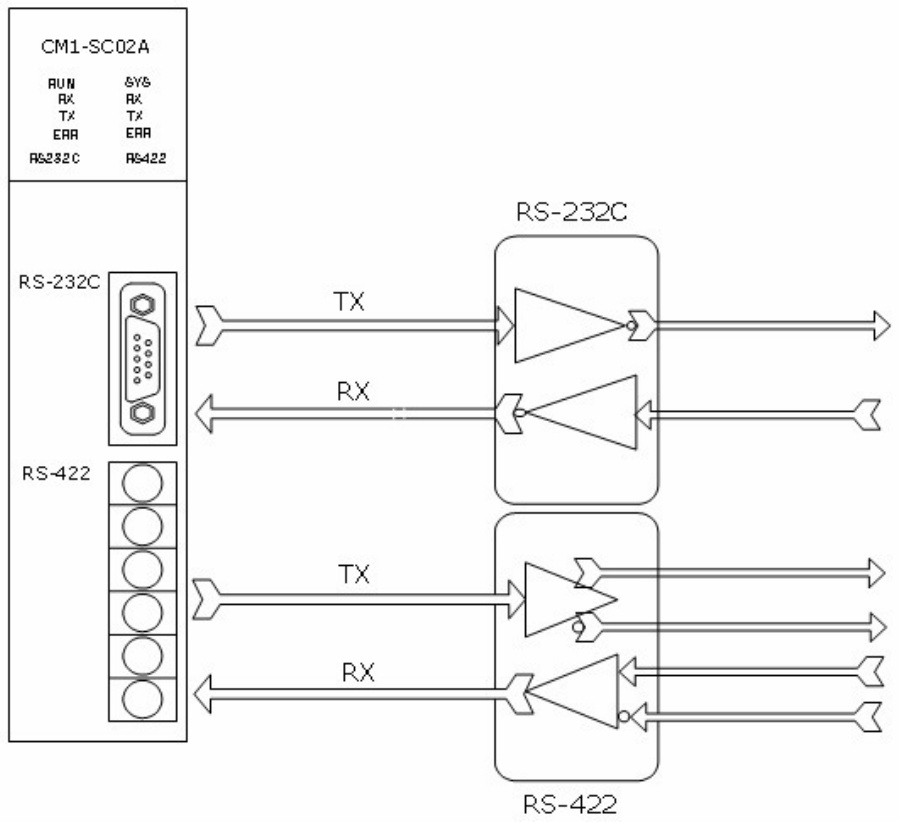
- Operation Mode Setup
- Series Interface Method

6.2.2.1 Operation Mode Setup

Independent mode and linked mode are used as communication operation mode.
Default is independent mode.

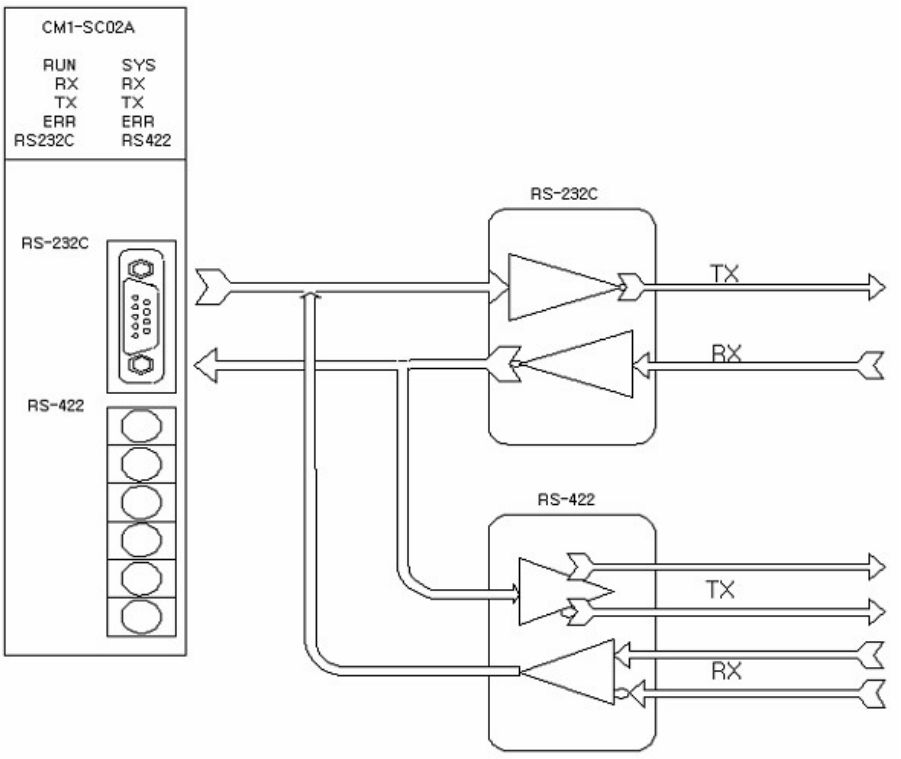
Independent Mode of Channel Operation

As RS-232C channel and RS-422 channel are operated independently each other, sending and receiving are available as individual sending standard at one time. By channels, the sending standard can be set up, and the operation can be started and stopped.



Linked Mode of Channel Operation

The data received through RS-232C channel and RS-422 channel are sent through RS-232C channel.
In the linked mode, RS-232C channel is automatically set up as main channel and the station number is the same as the main channel. The data received through RS-232C channel is both received in RS232C/422 module and sent through RS-422 channel. The data received through RS-422 channel is not received in RS232C/422 module but is automatically sent through RS-232C channel.



6.2.2.2 Series Interface Method

RS-232C channel is communicated with other device with a 9-pin connector.

It is directly communicated with a long-distance device, using a modem, as well as with other device.

Pin	Function	Name	Direction of Signal	Description
1	Carrier Detect	CD	Inside to outside	Signal wire that DCE informs DTE about the detection of carrier
2	Received Data	RXD	Outside to inside	Signal wire receiving data
3	Transmitted Data	TXD	Inside to outside	Signal wire sending data
4	Data Terminal	DTR	Inside to	Signal wire that DTE informs DCE about the state that DTE is

	Ready		outside	able to send and receive
5	Signal Ground	SG	Both directions	Ground wire for signal
6	Data Set Ready	DSR	Outside to inside	Signal wire that DCE informs DTE about the state that DCE is able to send and to receive
7	Request To Send	RTS	Inside to outside	DTE is ready and requests DCE to send data.
8	Clear To Send	CTS	Outside to inside	Signal wire that DCE inform DTE about the state that DCE is able to send
9	Ring	RI	Outside to inside	Signal wire that DCE inform DTE of receiving RING

Connection with a modem

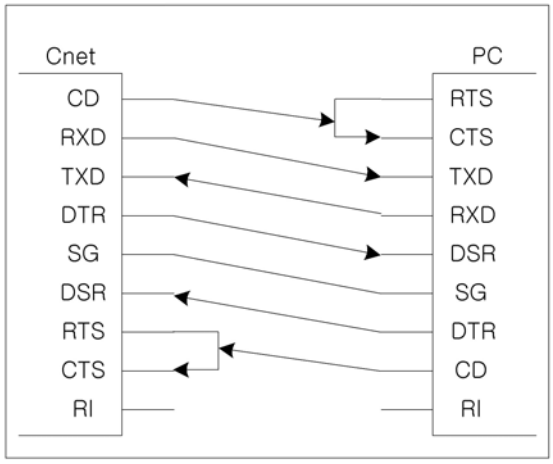
A long-distance communication is available.

modem interface is described.

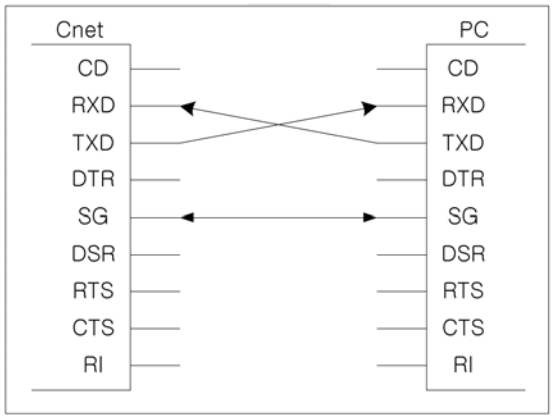
PLC(RS-232C)		Signal Direction	Modem	
Pin	Name		Name	Pin
1	CD	←	CD	8
2	RXD	←	RXD	3
3	TXD	→	TXD	2
4	DTR	→	DTR	20
5	SG	—	SG	7
6	DSR	←	DSR	6
7	RTS	→	RTS	4
8	CTS	←	CTS	5
9	RI	←	RI	22

Connection with a null modem

- PLC and Computer/Communication device: There are 3-wire type and 7-wire type.



- In case that a PC is connected with a RS-232C connector, RXD, TXD and SG is to be connected in 3-wire type.



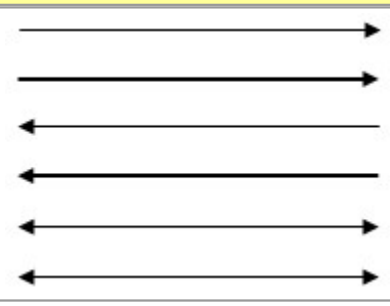
RS-422 Interface

A 6-pin connector is used for RS-422 interface. The functions and names of the pin and the flow of data are described as follows.

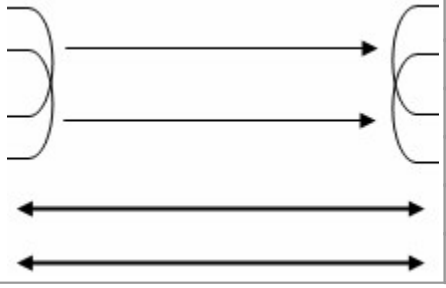
Pin	Name	Direction of Signal PLC Device	Function
1	SDA	→	Sends data. (+)
2	SDB	→	Sends data. (-)
3	RDA	←	Receives data. (+)
4	RDB	←	Receives data. (-)
5	S.G	←	Ground wire of signal

6	F.G		Ground wire of frame

RS-422 channel can be connected with other device for RS-422 and RS-485 (Multi-drop).

Computer Link		Direction of Signal PLC Device	Outside Communication Device
Pin	Name		
1	SDA		RDA
2	SDB		RDB
3	RDA		SDA
4	RDB		SDB
5	S.G		S.G
6	F.G		F.G

The following is an example to connect RS-485 channel with an outside device. At this time, as a sending wire shares with a receiving one (Half Duplex), the channel mode is to be set up as RS-485.

Computer Link		Direction of Signal PLC Device	Outside Device
Pin	Name		
1	SDA		SDA
2	SDB		SDB
3	RDA		RDA
4	RDB		RDB
5	S.G		S.G
6	F.G		F.G

6.2.3 Internal I/O

Device	Description For Signal	Device	Description For Signal
X0000	Error in module	Y0000	Clear error
X0001	Initialized (Card Ready)	Y0001	
X0002		Y0002	
X0003		Y0003	
X0004	Rx Data Existing(Ch1)	Y0004	Clear Rx Buffer (Ch1)

X0005	Tx Buffer Empty(Ch1)	Y0005	Clear Tx Buffer (Ch1)
X0006	Rx Data Existing(Ch2)	Y0006	Clear Rx Buffer (Ch2)
X0007	Tx Buffer Empty(Ch2)	Y0007	Clear Tx Buffer (Ch2)
X0008		Y0008	
X0009		Y0009	
X000A	Modem Initialized	Y000A	Modem Initialization Request
X000B	Dialing	Y000B	Dialing Request(Line Connection)
X000C	Detect DCD Signal	Y000C	Connection Release Request
X000D	Detect DSR Signal	Y000D	
X000E		Y000E	
X000F	Parameter Applied	Y000F	Parameter Setup Request

6.2.4 Shared Memory

Offset	Description	R/W	Remarks
0	Status Code (0=Normal, Others=Error)		
1	Mode		
2	CH1 Port Parameter		
3	CH2 Port Parameter		
4	Number of Retrying Dialing		1 – 5
5	Interval of Retrying Dialing		20 – 300 secs
6	Modem Initialization/Dialing Timeout		1 – 60 secs
7	Number of Retrying Modem Initialization		1 – 5 times
8	Station Number		0 – 31(Ch1=High,Ch2=Low)
9	SND Command Timeout		0 – 3000 sec
10	RCV Command Timeout		0 – 3000 sec
11 ~31	Modem Initialization Command		
…			
37	PLC Link Station Number	R	Not Link Join(0xFF)
38	PLC Link Connection	R	Stn0 ~ Stn15
39	PLC Link Connection	R	Stn16 ~ Stn31
40	Dial Number (H)	R/W	
…			
49	Dial Number (L)		
50	Response Delay Time(CH1)	R/W	Delay Time(0~200ms)
51	Response Delay Time(CH2)	R/W	Delay Time(0~200ms)
…			
62			

63	OS Version	R	
64 - 255	User Message	R/W	216 Word (432 Bytes)

The user data memory device is divided into the contents set up to an optional card and the memory indicating error code. And set contents are stored in buffer memory and finally are stored in Eprom by I/O Point Map.

See :

- Mode
- Parameter

6.2.4.1 Mode

Code	RS232C	RS422/485
0x00--	Independent (User)	-
0x01--	Independent (HMI Protocol)	
0x02--	Independent (MODBUS Protocol)	
0x03--	Independent (PLC LINK Protocol)	
0x04--	Independent (Graphic Loader I/F)	
0x--00	-	Independent (User)
0x--01		Independent (HMI Protocol)
0x--02		Independent (MODBUS Protocol)
0x--03		Independent (PLC LINK Protocol)
0x--04		Independent (Graphic Loader I/F)
0x80FF	Linked (User)	
0x81FF	Linked (HMI Protocol)	
0x82FF	Linked (MODBUS Protocol)	
0x84FF	Linked (Graphic Loader I/F)	

6.2.4.2 Parameter

Bit	내 용
0	Data Bit : 0=7, 1=8
1	Parity : 0=Even, 1=Odd
2	Parity : 0=None, 1=사용 (Bit 설정에 따름)

<table>
<tr><td>3</td><td>Stop Bit : 0=1 Bit, 1=2</td></tr>
<tr><td>4</td><td rowspan="4">통신속도
(0=300, 1=600, 2=1200, 3=2400, 4=4800, 5=9600, 6=19200, 7=38400, 8=76800)</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="3">Network Type
<table><tr><th>Code</th><th>Channel 1</th><th>Channel 2</th></tr><tr><td>0</td><td>NULL Modem</td><td>RS422</td></tr><tr><td>1</td><td>전용선모뎀</td><td>RS485</td></tr><tr><td>2</td><td>Dial-Up Modem</td><td>N/A</td></tr><tr><td>3-7</td><td>N/A</td><td>N/A</td></tr></table></td></tr>
<tr><td>9</td></tr>
<tr><td>10</td></tr>
<tr><td>11~15</td><td>System (Reserved)</td></tr>
</table>

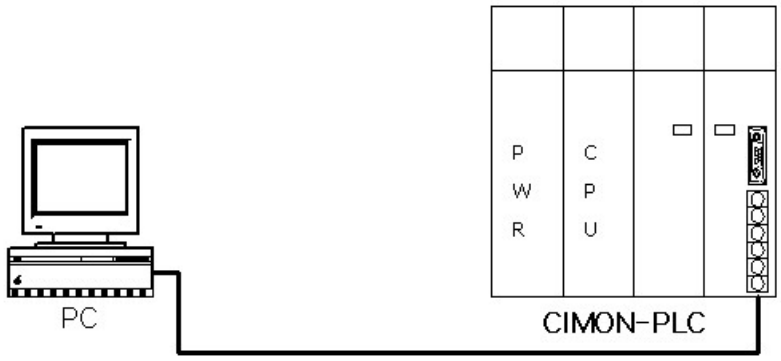
6.2.5 Network Example

System Configuration :

- 1:1 Communication between CIMON PLC and PC
- 1:1 Communication between CIMON PLC and 3rd vendor device
- 1:2 Communication with 3rd vendor device via modem
- 1:2 Communication with 3rd vendor device
- 1:N long distance communication via modem
- 1:N Multi-drop communication
- 1:N Multi-drop communication between various devices via modem
- 1:N Multi-drop communication between various devices
- An example of CIMON PLC network
- An example of CIMON PLC network including 3rd vendor devices

6.2.5.1 1:1 Communication between CIMON PLC and PC

The following is to use RS-232C channel or RS-422 channel, and the exclusive protocol of the CIMON PLC to configure a network.

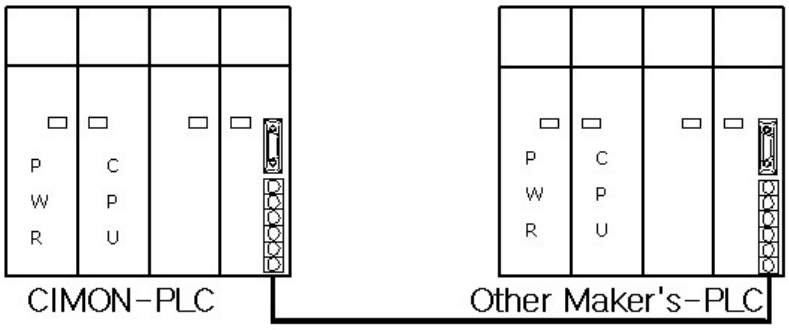


Components and parameters of computer link module,

Component	Name of Module	Parameter	Ex. of Station No.
PC	Built-in RS-232C	-	-
PLC	CM1-SC02A	Exclusive Comm., Independent Mode	0

6.2.5.2 1:1 Communication between CIMON PLC and 3rd vendor device

The following is the network configuration when linking other maker's PLC with a computer module.



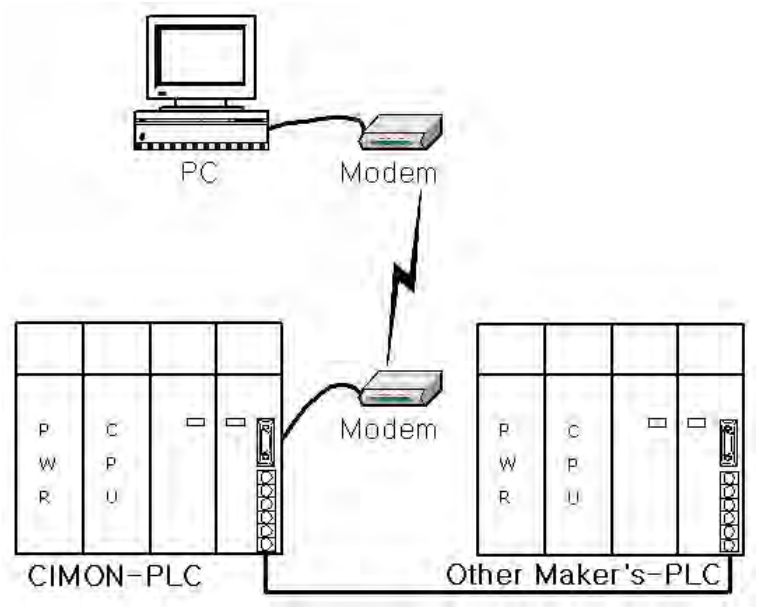
Components and parameters of computer link module,

Component	Name of Module	Parameter	Ex. of Station No.
PLC	CM1-SC02A	User Communication, Independent Mode	1

Other maker's PLC	CM1-SC02A	-	-

6.2.5.3 1:2 Communication with 3rd vendor device via modem

RS-232C and a modem are used for a long-distance communication.

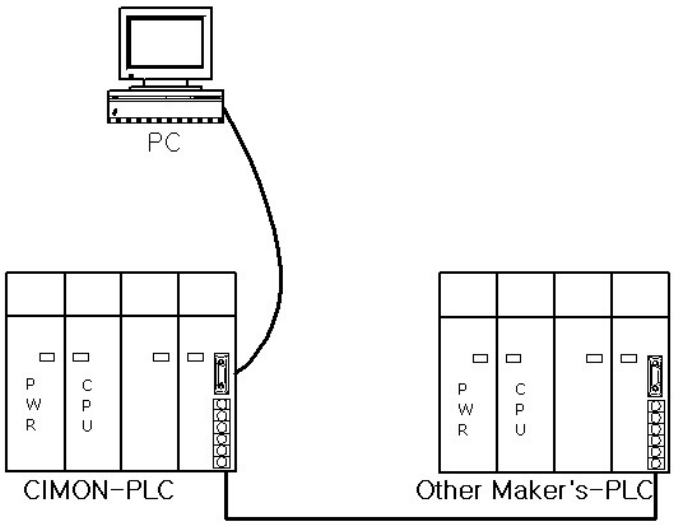


Components and parameters of computer link module,

Component	Name of Module	Parameter		Ex. of Station No.
PC	Built-in RS-232C	-		-
PLC	CM1-SC02A	RS-232C	Exclusive Comm.	0
		RS-485	User Comm.	
		Independent Mode		
Other maker's PLC	-	-		-

6.2.5.4 1:2 Communication with 3rd vendor device

A RS-232C cable is used for interface.

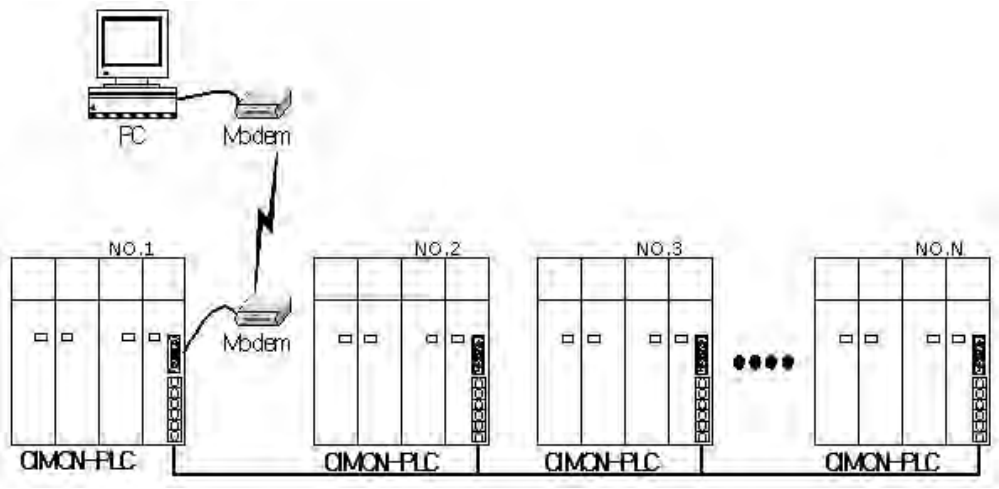


Components and parameters of computer link module,

Component	Name of Module	Parameter		Ex. of Station No.
PC	Built-in RS-232C	-		-
PLC	CM1-SC02A	RS-232C	Exclusive Comm.	0
		RS-422	User Comm.	
		Independent Mode		
Other maker's PLC	-	-		-

6.2.5.5 1:N long distance communication via modem

A modem and RS-232C are used for a long-distance communication.

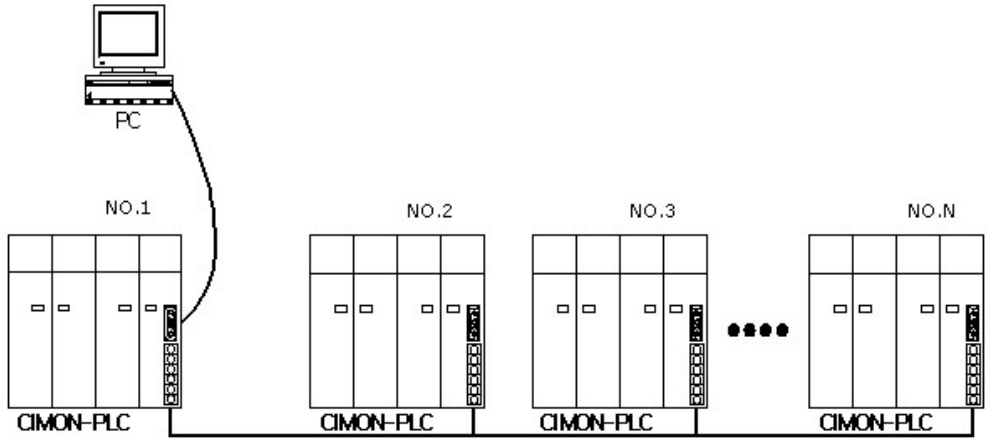


Components and parameters of computer link module,

Component	Name of Module	Parameter		Ex. of Station No.
PC	Built-in RS-232C	-		-
PLC NO.1	CM1-SC02A	RS-232C	Exclusive Comm. (RS-232C Mode)	0
		RS-422	Exclusive Comm.	
		Linked Mode		
PLC NO.2	CM1-SC02A	RS-232C	Exclusive Comm.	1
		RS-422	Exclusive Comm.	
		Independent Mode		
PLC NO.N	CM1-SC02A	RS-232C	Exclusive Comm.	31
		RS-422	Exclusive Comm.	
		Independent Mode		

6.2.5.6 1:N Multi-drop communication

A RS-232C cable is used to connect a PC with a PLC. RS-422 cables are used to connect between PLCs.

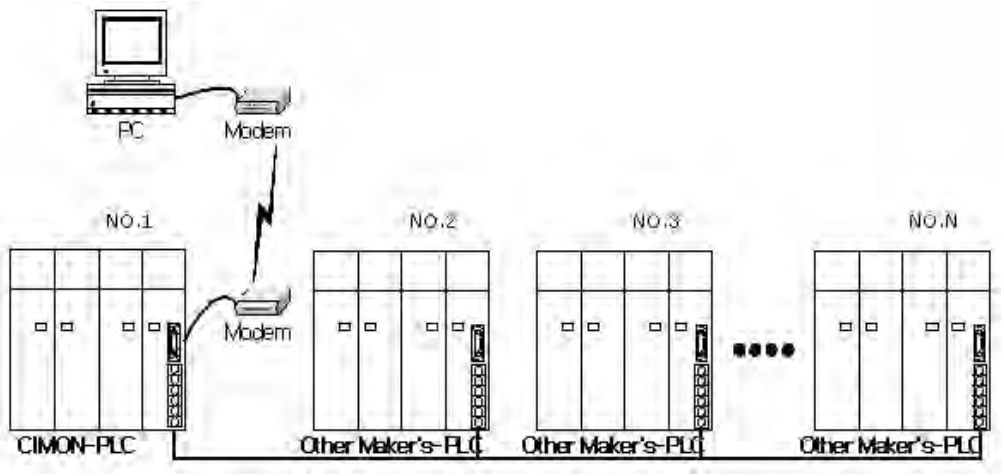


Components and parameters of computer link module,

Component	Name of Module	Parameter		Ex. of Station No.
PC	Built-in RS-232C	-		-
PLC NO.1	CM1-SC02A	RS-232C	Exclusive Comm.	0
		RS-422	Exclusive Comm.	
		Linked Mode		
PLC NO.2	CM1-SC02A	RS-232C	Exclusive Comm.	1
		RS-422	Exclusive Comm.	
		Independent Mode		
PLC NO.3	CM1-SC02A	RS-232C	Exclusive Comm.	2
		RS-422	Exclusive Comm.	
		Independent Mode		
PLC NO.N	CM1-SC02A	RS-232C	Exclusive Comm.	31
		RS-422	Exclusive Comm.	
		Independent Mode		

6.2.5.7 1:N Multi-drop communication between various devices via modem

A RS-232C cable is used to connect a PC with a PLC. RS-422 cables are used to connect between PLCs.

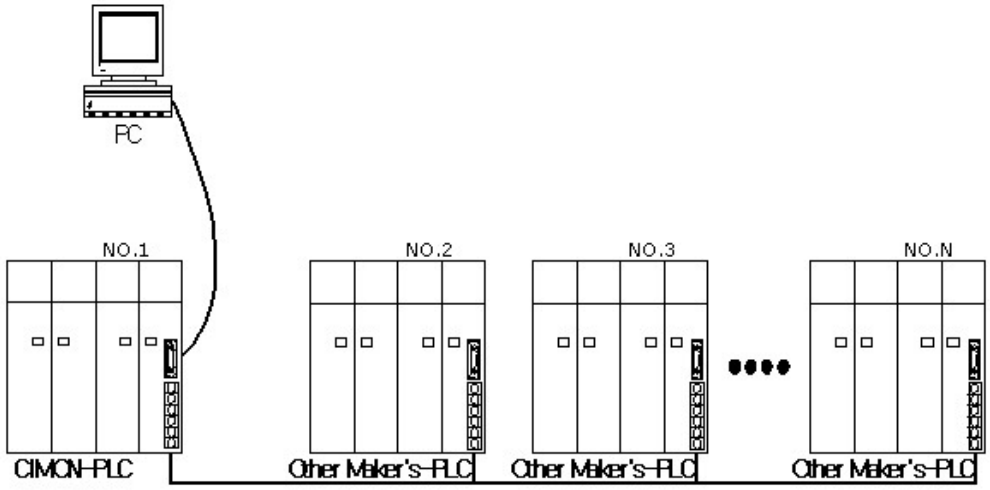


Components and parameters of computer link module,

Component	Name of Module	Parameter		Ex. of Station No.
PC	Built-in RS-232C	-		-
PLC NO.1	CM1-SC02A	RS-232C	Exclusive Comm. (RS-232C Mode)	0
		RS-422	User Comm.	
		Independent Mode		
PLC NO.2	CM1-SC02A	RS-232C	-	-
		RS-422	-	
		-		
PLC NO.3	CM1-SC02A	RS-232C	-	-
		RS-422	-	
		-		
PLC NO.N	CM1-SC02A	RS-232C	-	-
		RS-422	-	
		-		

6.2.5.8 1:N Multi-drop communication between various devices

A RS-232C cable is used to connect a PC with a PLC. RS-422 cables are used to connect between PLCs.

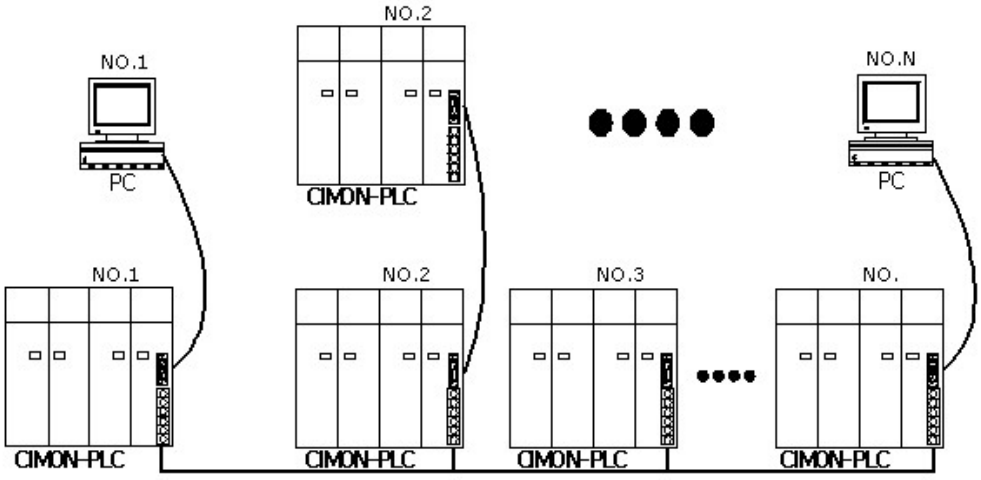


Components and parameters of computer link module,

Component	Name of Module	Parameter		Ex. of Station No.
PC	Built-in RS-232C	-		-
PLC NO.1	CM1-SC02A	RS-232C	HMI Comm. (RS-232C Mode)	0
		RS-422	User Comm.	
		Independent Mode		
PLC NO.2	CM1-SC02A	RS-232C	-	-
		RS-422	-	
		-		
PLC NO.3	CM1-SC02A	RS-232C	-	-
		RS-422	-	
		-		
PLC NO.N	CM1-SC02A	RS-232C	-	-
		RS-422	-	
		-		

6.2.5.9 An example of CIMON PLC network

A RS-232C cable is used to connect a PC with a PLC. A modem can be used in case of long-distance communication. RS-422 cables are used to connect between PLCs.

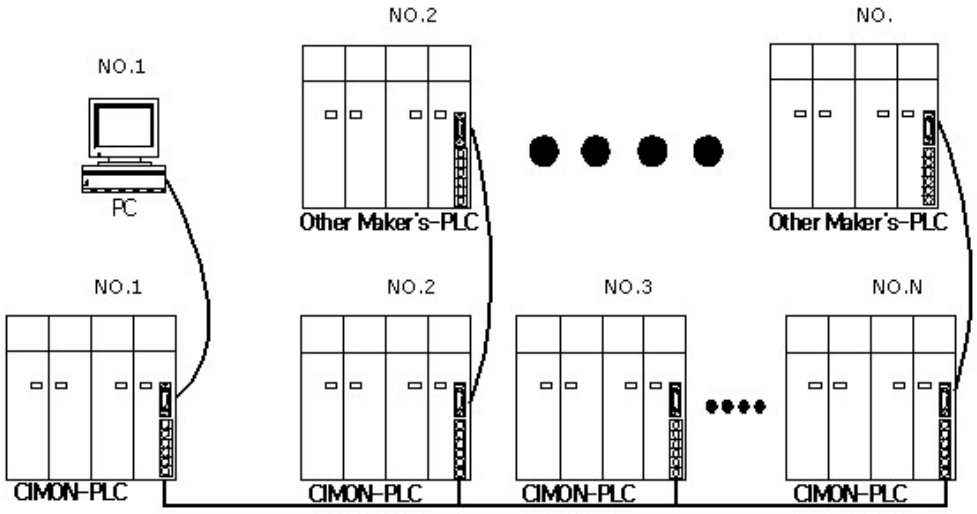


Components and parameters of computer link module,

Component	Name of Module	Parameter		Ex. of Station No.
PC NO.1	Built-in RS-232C	-		-
PC NO.N	Built-in RS-232C	-		-
PLC NO.1	CM1-SC02A	RS-232C	Exclusive Comm.	0
		RS-422	Exclusive Comm.	
		Linked Mode		
PLC NO.2	CM1-SC02A	RS-232C	User Comm.	1
		RS-422	Exclusive Comm.	
		Independent Mode		
PLC NO.2	CM1-SC02A	RS-232C	Exclusive Comm.	2
		RS-422	Exclusive Comm.	
		Independent Mode		
PLC NO.M	CM1-SC02A	RS-232C	Exclusive Comm.	31
		RS-422	Exclusive Comm.	
		Independent Mode		

6.2.5.10 An example of CIMON PLC network including 3rd vendor devices

A RS-232C cable is used to connect a PC with a PLC. A modem can be used in case of long-distance communication. RS-422 cables are used to connect between PLCs



Components and parameters of computer link module,

Component	Name of Module	Parameter		Ex. of Station No.
PC NO.1	Built-in RS-232C	-		-
PLC NO.1	CM1-SC02A	RS-232C	Exclusive Comm.	0
		RS-422	Exclusive Comm.	
		Linked Mode		
PLC NO.2	CM1-SC02A	RS-232C	User Comm.	1
		RS-422	Exclusive Comm.	
		Independent Mode		
PLC NO.N	CM1-SC02A	RS-232C	User Comm.	2
		RS-422	Exclusive Comm.	
		Independent Mode		
Other maker's PLC NO.2	-	-		-
Other maker's PLC NO.M	-	-		-

6.2.6 Communication Services

Communication Services :

1. User Communication (SND, RCV)

6.2.6.1 User Communication (SND, RCV)

Exclusive Commands for Computer Communication,

This is used when the communication frame defined in a user program is used to send and receive data in a program.

SND

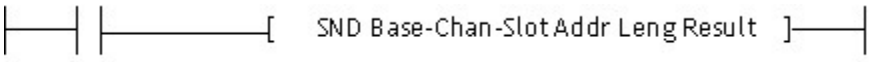
This is used to send data as much as the length of the data requested from a computer link module.

CMD	Usable Device											
	M	X	Y	K	L	F	T	C	S	D	@D	Integer
Base												O
Chan												O
Slot												O
Addr	O	O	O	O	O	O	O	O	O	O	O	
Leng												O
Result	O	O	O	O	O		O	O	O	O	O	

COMMAND	Description
Base-Chan-Slot	**Base:** The number of the base where a computer link module is mounted is indicated. In case of expansion base, the number (1~16) of a corresponding base is

	indicated. In case of local one, the number is '0'. **Channel Mode:** Ch 1(RS232:0) and Ch 2(RS422:1). **Slot No.:** The number of the slot where a computer link module is mounted [Ex.] In case of local base, Slot 2, Channel 1(RS232) -> h0002 : RS-232C [Ex.] In case of expansion base (1), Slot 1, Channel 2(RS422) -> h0111 : RS-422
Addr	Address of the data sent
Leng	Length of the data sent (BYTE), Decimal figure, Max. 500BYTE
Result	The address where the result of sending is noticed is assigned. (X,Y,M,L,K,T,C,D,@D,Z) **Result Format :** • Bit 0 : When sending completed, 1Scan ON. When failed, always ON. • Bit 1 : When sending failed, always ON. • Bit 2-7 : OFF • Bit 8-F : Error Code (0=No Error)

FORMAT



RCV

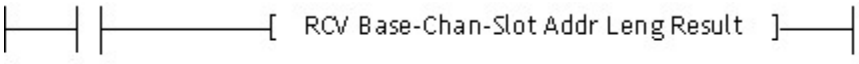
This is used to store data as much as the length of the data requested from a computer link module.

CMD	Usable Device											
	M	X	Y	K	L	F	T	C	S	D	@D	Integer
Base												O
ChNo												O
Slot												O
Addr	O	O	O	O	O	O	O	O	O	O	O	
Leng												O
Result	O	O	O	O	O		O	O	O	O	O	

COMMAND	Description
Base-Chan-Slot	**Base:** The number of the base where a computer link module is mounted is indicated. In case of expansion base, the number (1~16) of a corresponding base is

	indicated. In case of local one, the number is '0'. **Channel Mode:** Ch 1(RS232:0) and Ch 2(RS422:1). **Slot No.:** The number of the slot where a computer link module is mounted [Ex.] In case of local base, Slot 0, Channel 1(RS232)-> h0000 : RS-232C [Ex.] In case of expansion base (1), Slot 4, Channel 2(RS422)-> h0114 : RS-422
Addr	Address where data are received and stored
Leng	Length of the data received (BYTE), Decimal figure, Max. 500BYTE
Result	The address where the result of receiving is noticed is assigned. (X,Y,M,L,K,T,C,D,@D,Z) **Result Format :** • Bit 0 : When receiving completed, 1Scan ON. When failed, always ON • Bit 1 : When receiving failed, always ON • Bit 2-7 : OFF • Bit 8-F : Error Code (0=No Error)

FORMAT



6.2.6.2 User Communication (SEND, RECV)

This is used to define communication frames in the protocol editor, sending or receiving the frames in a program. User communications is the mode that other companies' protocols can be defined in the CIMON PLC to communicate communications modules with other devices. Diverse communications protocols are used according to manufacturers and all the protocols cannot be built in. And if a protocol is defined properly to an application field and a program is written, communications with other devices is available according to a defined protocol. If a protocol editor is used to define protocol frames (In the CICON), it is available to write and edit other manufacturers' protocols. To use as user communication mode for correct data communication, the information about the contents of the protocol used is to be correct and a program using the instructions to control sending/receiving in a PLC as well as editing frames be written. This chapter explains the communication specifications and the directions for use of user protocols.
The modes of communications modules operated as a user protocol are as follows.

Module Name	RS232C	RS422/485	Remarks
CM1-SC01A	User Protocol	X	X

CM1-SC01B	X	User Protocol	X
CM1-SC02A	User Protocol	User Protocol	Linked
	User Protocol	User Protocol	Independent
	User Protocol	HMI User Protocol	Independent
	User Protocol	Modbus RTU User Protocol	Independent
	User Protocol	PLC Link User Protocol	Independent
	User Protocol	CICON User Protocol	Independent
	HMI User Protocol	User Protocol	Independent
	Modbus RTU User Protocol	User Protocol	Independent
	PLC Link User Protocol	User Protocol	Independent
	CICON User Protocol	User Protocol	Independent

But, Make sure the version before using user protocol (SEND, RECV) function.

	CICON	CM1-CPXXX(CPU)	CM1-SCXXX (RS232C/422/485)
Version	1.83.0043	V 1.56	V 1.20

To use user protocols, a version should be higher than the versions described above.
Otherwise, consult with the head office to upgrade.

See :

- Operation Procedure of User Communications
- Registering and Editing a Special Program
- Instructions for User Program
- Error Codes for User Communications
- Example of Programming for User Communications
- Example of Application of MODICON (MODBUS) protocol
- Sending/Receiving communication frames at communication intervals

6.2.6.2.1 Operation Procedure of User Communications

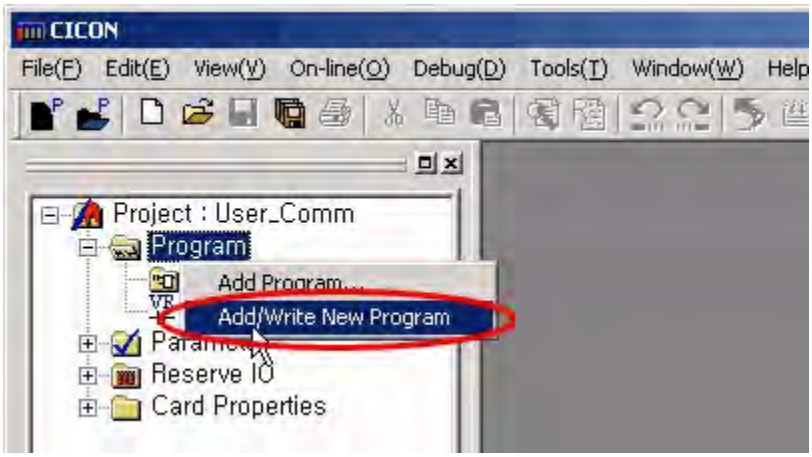
As user communications require to use a frame editor and write a CICON program, it is set up as the following order.

Programming Order for User Communications ,

1. Register a special program to define frames.
2. Edit the protocol in the special program.
3. Write a PLC program for sending/receiving in the CICON.
4. Download the PLC program and the special program.
5. Convert CPU status to RUN mode.
6. Normal communication starts.

6.2.6.2.2 Registering and Editing a Special Program

1. Select the add/write new program in the CICON.

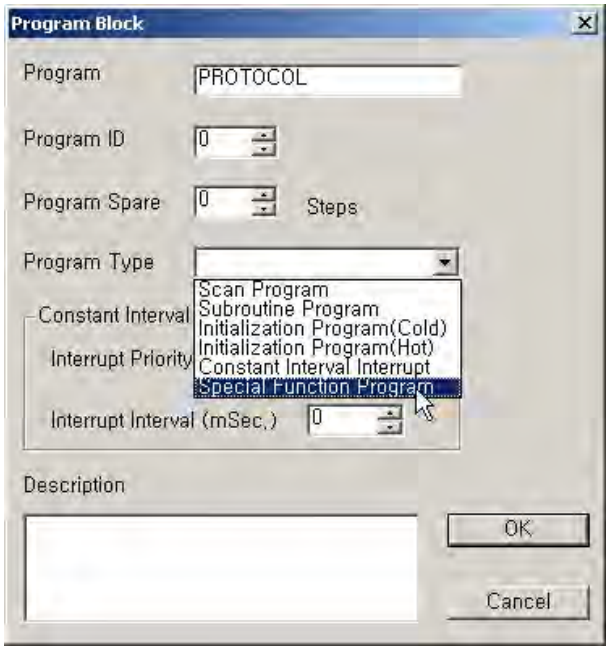


2. If you select the add/write new program, the program block dialog box will appear as follows.

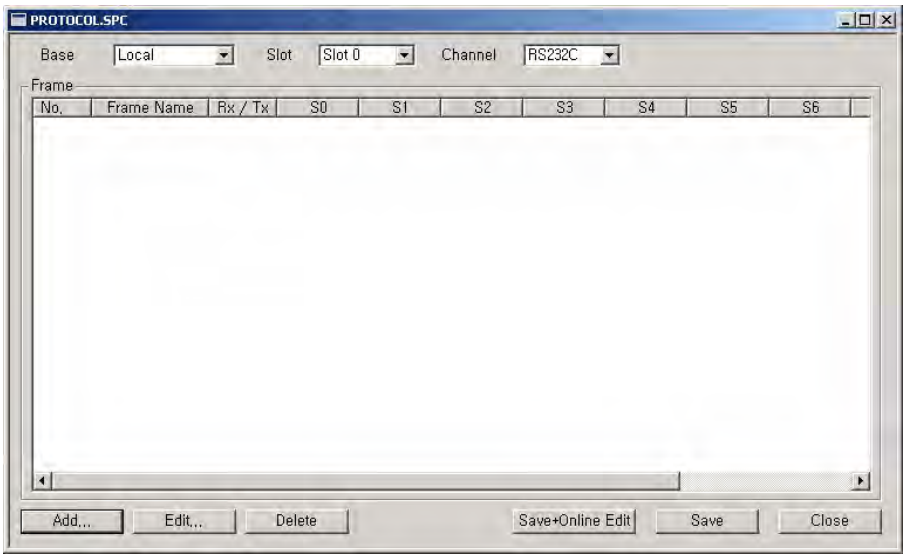
- **Program:** This is used to define the name of special program. Up to 12 letters can be entered.

- **Program ID:** This is used to define ID for each program.
- **Program Spare:** This is to indicate the max. size for editing the protocols in a special program while CPU status is run.
- **Program Type:** This is used to select the type of the program registered at this time. Here, select the special program.

If you finish registering the parameters, press the **[OK]** button.



3. If you press the [OK] button, the dialog box for registering protocols will appear.

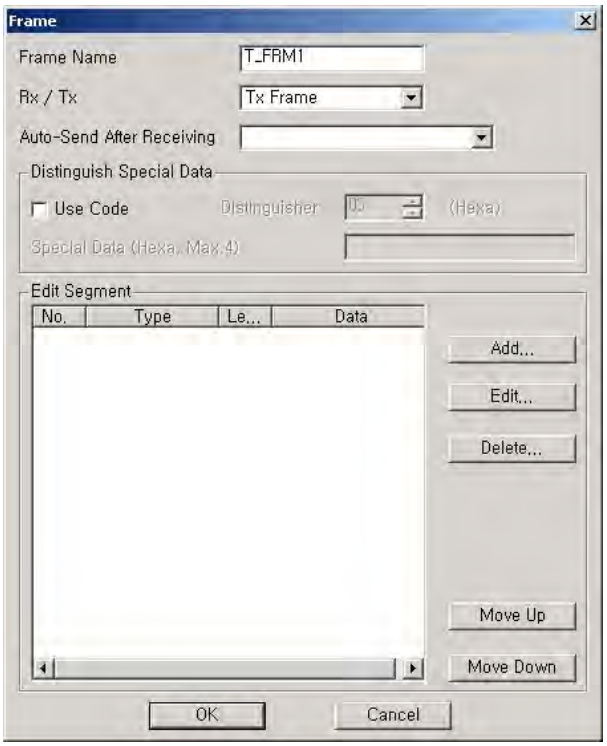


In a created PROTOCOL.SPC file, protocols can be registered.

- **Base:** This is used to select the base where a communication card (CM1- SCXXX) is mounted.
- **Slot:** This is used to select the slot where a communication card (CM1-SCXXX) is mounted. Slot number is counted from the slot next to a CPU module.
- **Channel:** This is used to select the communication port between a master and a slave.
- **Result:** This is used to send data without SEND command as sending interval is set up and, if a receiving frame is defined, to indicate whether a defined receiving frame is normally received. (Memory device: M0000)
  a. Received: The bit corresponding to the frame number in M0000 is on for 1 scan.
  b. Not Received: The bit corresponding to the frame number in M0020 is on for 1 scan.

4. If you select the add button, the dialog box for adding a frame will appear.

- **Frame Name:** This is used to register a frame name. (Max. 20 letters)
- **Comm. Direction:** This is used to select whether the frame registered is the one sent or the one received.



- **Comm. Interval:** Frames are automatically sent at intervals without SEND command in a PLC program. If Comm. interval is '0', frames will be sent only by SEND command. A PLC program is not needed in case of sending/receiving frames by using comm. interval.

  [Receiving frame for sending] This corresponds to the case comm. frames are sending ones.
  If a corresponding frame is sent and the receiving frame for the sending frame is registered, the registered frame will be received without RECV command in the PLC program.

- **Auto-send after Receiving:** This is operated in case that comm. direction is the frame received. If a corresponding frame is received, the frame registered for sending will be automatically sent without the command to send in a PLC program.

- **Use Code:** This is used to distinguish a special data from the data in the frames sent/received. In case that there is the same letter as the corresponding distinguishes among the data in the frames sent/received, registered data are attached next to the distinguishes to be sent or received.

  For example, the case hexadecimal FEh is registered to a distinguishes and FFh to special data.

Header	Length	Cmd	MSG	Checksum
FEh	03h	3Ch	3Fh	FEh

Header	Length	Cmd	MSG	Checksum	Special Data
FEh	03h	3Ch	3Fh	FEh	FFh

Up to 4 special data can be registered. If 4 special data are registered, they will be sent/received continuously next to a distinguisher.

- **Add:** This is used to add segments to write a frame. Up to 10 segments can be registered.
- **Edit:** This is used to edit the segments in a made frame.
- **Delete:** This is used to delete the segments in a made frame.
- **Move Up:** This is used to switch the location of the segments in a made frame. A selected one is moved up one step by one step.
- **Move Down:** This is used to switch the location of the segments in a made frame. A selected one is moved down one step by one step.

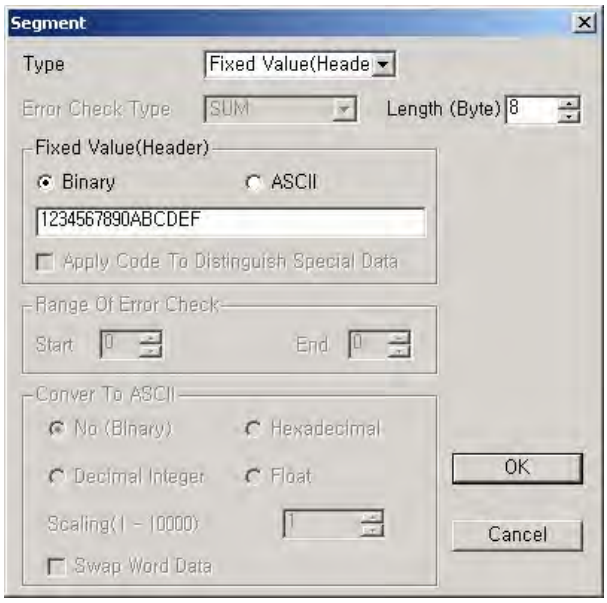
5. To make a frame, segments should be added.

SEGMENT0	SEGMENT1	.....	SEGMENT8	SEGMENT9

1. Type

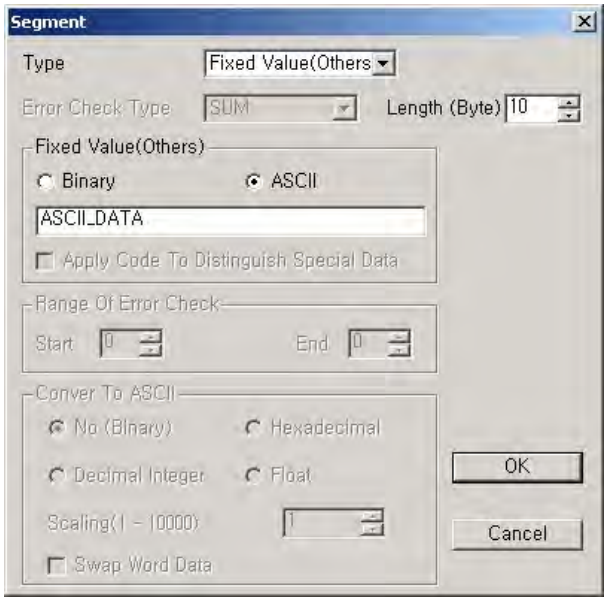
[Fixed Value (Header)]

This means the first data in the frame made. The value is to be assigned in the type of ASCII or Binary. In case that data is in Binary type, assign in hexadecimal number and a byte data in 2-place hexadecimal number. In case of ASCII type, a letter is processed as byte data.



[Fixed Value (Others)]

This is the segment assigning general data in the frame made.



Assign constant value in the type of ASCII or Binary.
In case that data is in Binary type, assign in hexadecimal number and a byte data in 2-place hexadecimal number. In case of ASCII type, a letter is processed as byte data.

- Fixed Value (Header, Tail, Others) Data Sent

PLC	12345678	12345678

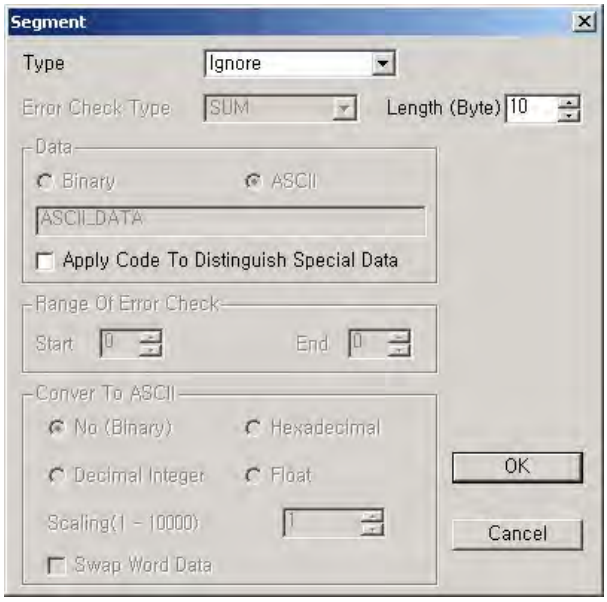
Data Conversion	Binary	ASCII
Other Device	12345678	3132333435363738

- Fixed Value (Header, Tail, Others) Data Received

Other Device	12345678	3132333435363738
Data Conversion	Binary	ASCII
PLC	12345678	3132333435363738

[Ignore]

This segment is used to ignore assigned-length data after receiving, irrelevantly to the value of received data. This can be set up in case of only the frame received. If the use code is applied, it is distinguished that the letters like the distinguisher of special data are continuously received and the data next to the distinguisher are disregarded. It is available to apply the use code.



[Memory Link]

This segment is used to send the data stored in the memory of CPU as much as an assigned length or store received data in the memory device of CPU as much as assigned length. The maximum data size is 250Byte. If the use code is applied, it is distinguished that the letters like the distinguisher of the special data are continuously received and the data next to the distinguisher are disregarded. It is available to apply the use code.

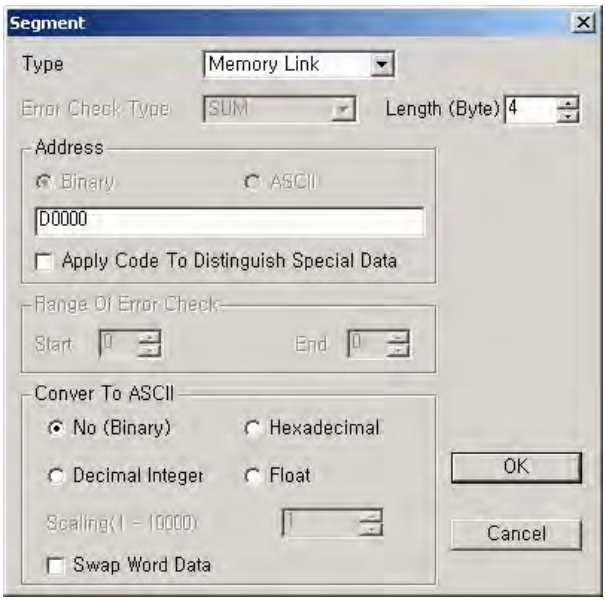
- **Convert to ASCII**

No(Binary) This is used to send/receive the data in the memory device of CPU as they are.

Hexadecimal Integer This is used to convert the data in the memory device of CPU to hexadecimal ASCII data, sending the result. And to convert received hexadecimal ASCII data to binary data, storing the result in the memory of CPU.

Decimal Interger This is used to convert the data in the memory device of CPU to decimal ASCII data, sending the result. And to convert the received decimal ASCII data to binary data, storing the result in the memory of CPU.

Real Number(Float) This is used to scale the data in the memory of CPU(Ratio.1-10000), sending the result. And to scale the received data(Ratio.1-10000), storing the result in the memory of CPU.



If you select the swap word data, upper 1 byte data and lower 1 byte data of the data sent/received are swapped. For example, if the data stored in the memory of CPU is h1234(ASC:1234), the actual data sent will be h3412(ASC:3421). If a received data is h1234(ASC:1234), the actually received data h3412(ASC:3412) will be stored in the memory of CPU.

- Memory Link Data Sent

PLC	1234h	1234h	1234h	1234h
Data Conversion	No(Binary)	Hexadecimal Integer	Decimal Integer	Real Number (Scaling:10)
Other Device	1234h	31323334	34363630	01D2h

- Memory Link Data Received

Other Device	1234h	31323334	34363630	1234h
Data Conversion	No(Binary)	Hexadecimal Integer	Decimal Integer	Real Number

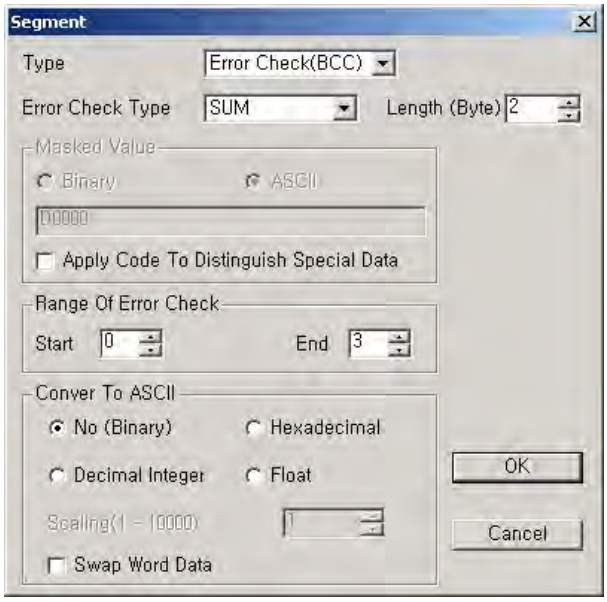
				(Scaling:10)
PLC	1234h	1234h	1234h	B608h

2. Error Check Type

This is used to check whether the data of a frame are correctly sent/received. It is available to distinguish special data.

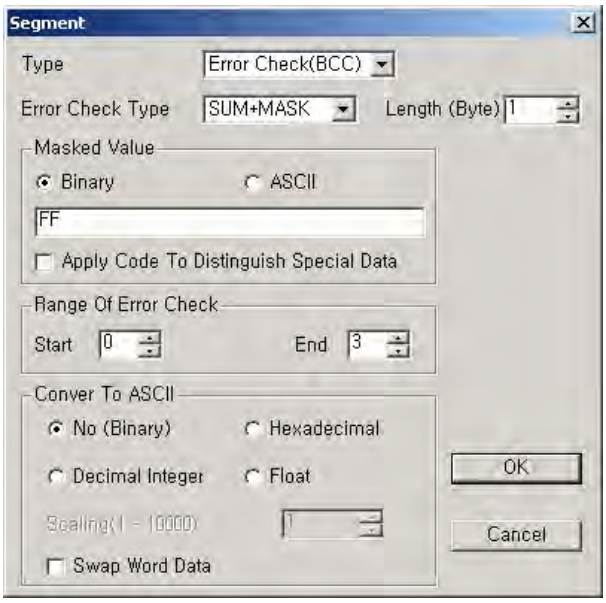
[SUM]

This is used to binary-sum an edited frame from the first of a selected range to the last of it and to send/receive data as much as a set length (Byte). Enter a range in the error check range (Range of segments). Refer to the memory link for ASCII data conversion.



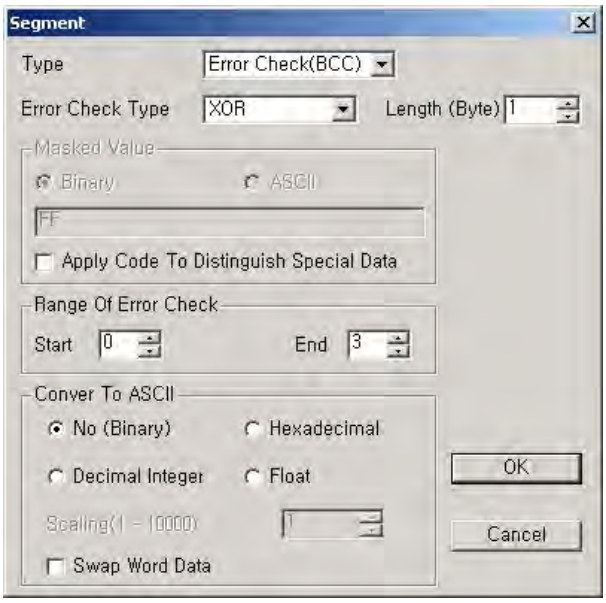
[SUM+MASK]

This is used to binary-sum an edited frame from the first of a selected range to the last of it, masking the binary-summed data with masking value (FFh) and to send/receive data as much as a set length (Byte). Refer to the memory link for ASCII data conversion.



[XOR]

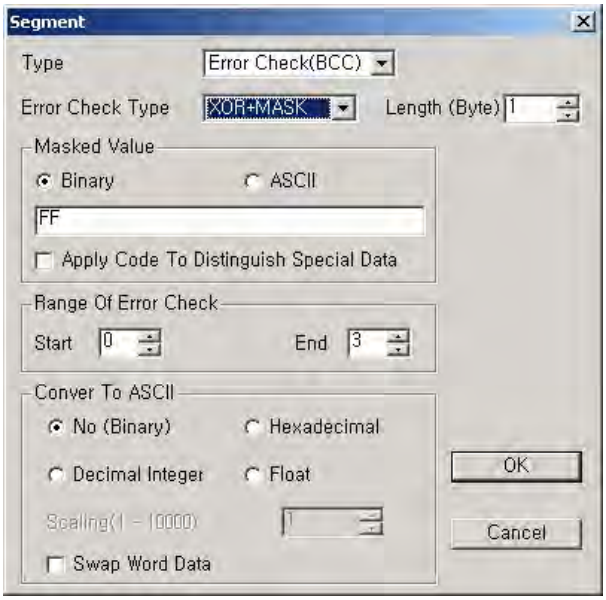
This is used to binary-or an edited frame from the first of a selected range to the last of it and to send/receive the data as much as a set length (Byte). Refer to the memory link for ASCII data conversion.



[XOR+MASK]

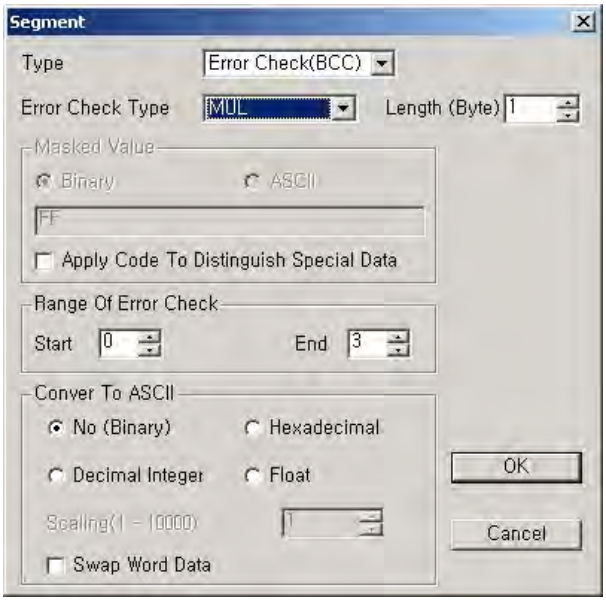
This is used to binary-or an edited frame from the first of a selected range to the last of it, masking the binary-summed data with masking value (FFh) and to send/receive the data as much as a set length

(Byte). Refer to the memory link for ASCII data conversion.



[MUL]

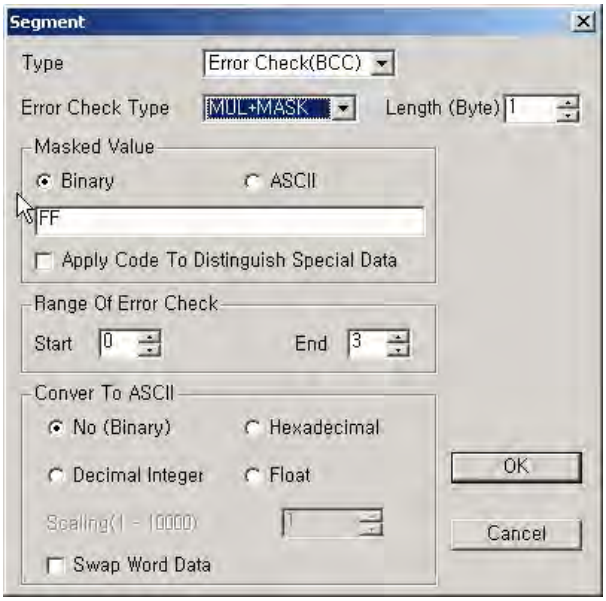
This is used to binary-mul an edited frame from the first of a selected range to the last of it and to send/receive the data as much as a set length (Byte).



[MUL+MASK]

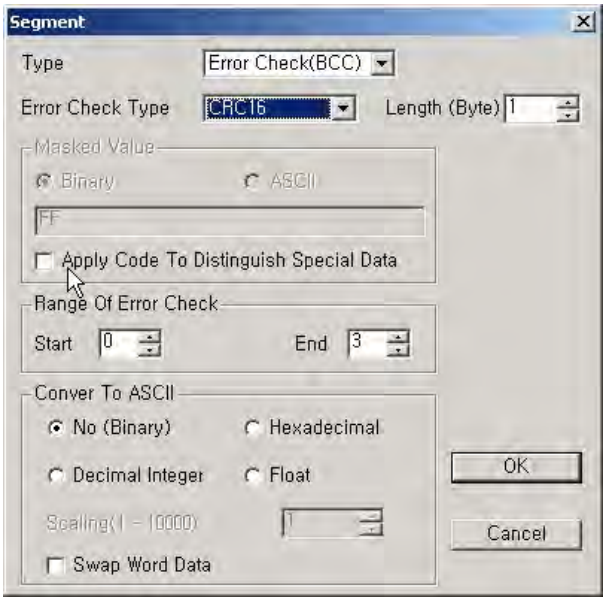
This is used to binary-mul an edited frame from the first of a selected range to the last of it, masking the

binary-summed data with masking value (FFh) and to send/receive the data as much as a set length (Byte).



[CRC16]

This is used to CRC16 an edited frame from the first of a selected range to the last of it.



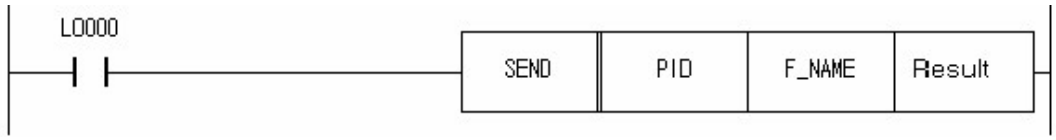
6.2.6.2.3 Instructions for User Program

SEND(P)

Function

This is the instruction used to send frame data of user type from a master station to slave stations. To use this instruction, a user protocol is to be selected as action mode protocol and to be downloaded in the RS232C/422/485 card setup. SEND instruction is to be executed by pulse.

FORAMT



- **PID:** This is used to assign the name or the ID of special program.

- **F_NAME**

1. This is used to enter a frame name or to assign a frame number. The number is to be assigned according to the following form.

2. Format in case of assigning a frame number
   a. Upper byte(Bit 8-F): Assigning communication form(0: RS232C, 1: RS422/485)
   b. Lower byte(Bit 0-7): Frame number in special program

Assigning communication form (Upper byte)	Frame number (Lower byte)

[Ex.] In case communication form is RS232C and the frame of which number is 3 is sent,

SEND (PID) h0003 (Result)

Result

- The word device informed of the result of sending is assigned.

- Result Format
  a. First Bit(Bit 0): In case of having been sent, 1 Scan On.

b. Second Bit(Bit 1): In case of having not been sent, always On.

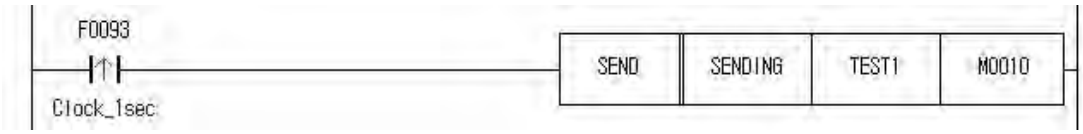
c. Third Bit – Eighth Bit(Bit 2-7): Always Off.

d. Ninth Bit – Sixteenth Bit(Bit 8-F): Error Code.(0=No Error)

Error Code	Not Use	In case of an error in sending, On	In case of having been sent, 1Scan On
Bit 8 ~ F	Bit 2 ~ 7	Bit 1	Bit 0

Example of Application

The following is an example of PLC program that a frame is sent to a slave station, in case that the special program file name of a master station is SENDING and the frame name registered to a protocol editor is TEST1.

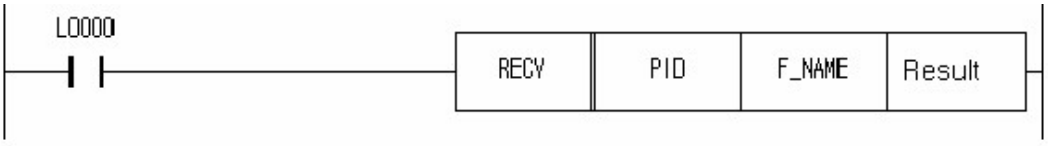


RECV(P)

Function

This is the instruction used in slave stations to receive frame data from a master station. In case that a data accords with the frame of user form and is normal frame, the flag indicating received(Bit 0) is turned on. To use this instruction, a user protocol is to be selected as action mode protocol and to be downloaded in the RS232C/422/485 card setup. RECV instruction is to be executed by pulse.

FORAMT



- **PID:** This is used to assign the name or the ID of special program.

- **F_NAME**

1. This is used to enter a frame name or to assign a frame number. The number is to be assigned according to the following form.

2. Format in case of assigning a frame number

a. Upper byte(Bit 8-F): Assigning communication form(0: RS232C, 1: RS422/485)

b. Lower byte(Bit 0-7): Frame number in special program

Assigning communication form (Upper byte)	Frame number (Lower byte)

[Ex.] In case communication form is RS422/485 and the frame of which number is 5 is sent,

RECV (PID) h0105 (Result)

Result

- The word device informed of the result of sending is assigned.

- Result Format

  e. First Bit(Bit 0): In case of having been sent, 1 Scan On.

  f. Second Bit(Bit 1): In case of having not been sent, always On.

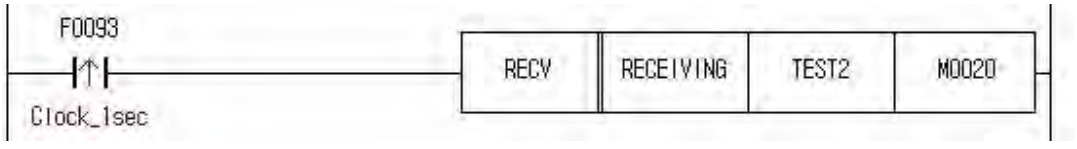
  g. Third Bit – Eighth Bit(Bit 2-7): Always Off.

  h. Ninth Bit – Sixteenth Bit(Bit 8-F): Error Code.(0=No Error)

Error Code	Not Use	In case of an error in receiving, On	In case of having been received, 1Scan On
Bit 8 ~ F	Bit 2 ~ 7	Bit 1	Bit 0

Example of Application

Using RS232C/422/485 card, slave stations receive data from a master station. After receiving the data, the slave stations compare them with assigned frame data. The following is an example of PLC program that the frame is sent to a slave station, in case that a special program file name is RECEVING and the frame name registered in a protocol editor is TEST2.



6.2.6.2.4 Error Codes for User Communications

Error Code	Description
18 (12h)	The range to check errors is wrongly set up.
19 (13h)	There is no registered frame.
20 (14h)	Segments are not registered to the frame.
21 (15h)	The communication direction of the frame is wrongly set up.
22 (16h)	Sending/receiving frames are disabled.
23 (17h)	Access to buffer memory is failed.
24 (18h)	The size of each segment data is over.
25 (19h)	When swapping word data, the size of the data is wrong.
26 (20h)	The entire length of sending/receiving frame is over 600Byte.
27 (21h)	The size of data is wrongly assigned.

6.2.6.2.5 Example of Programming for User Communications

The following shows an example of configuration of communication system and frame between a CIMON-PLC and other manufacturer's PLC to explain the programming method for user communication. It is the case that the 18-byte data in Memory D0000 of the CIMON-PLC are written to other manufacturer's PLC and the 24-byte data of other manufacturer's PLC are read and stored in Memory D0020 of the CIMON-PLC.

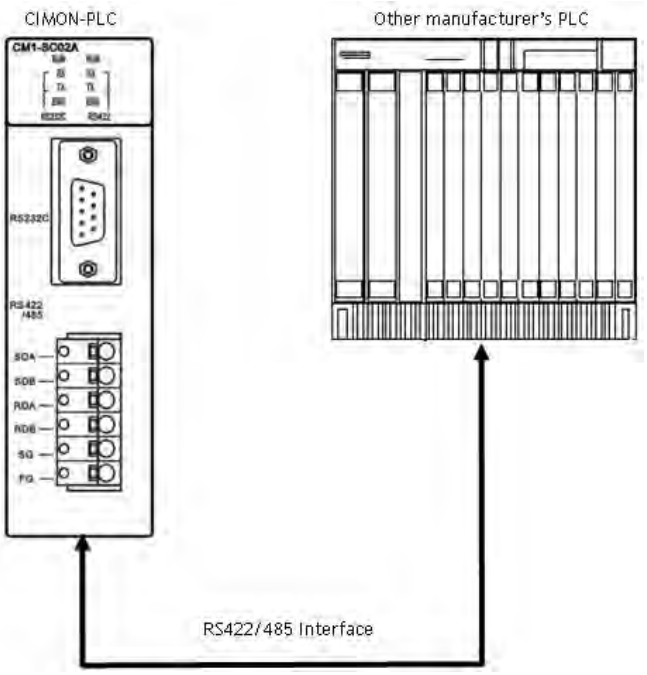
PLC protocol of other manufacturer,

Frame requesting to write (CIMON-PLC -> Other manufacturer's PLC)

Header	Station (H)	Station (L)	Command	Size (H)	Size (L)	Data	Tail	Error Check(H)	Error Check(L)
ENQ	0	1	W	1	2	18Byte	EOT	?	?

Frame responding to request to read (Other manufacturer's PLC -> CIMON-PLC)

Header	Station (H)	Station (L)	Command	Size (H)	Size (L)	Data	Tail	Error Check (H)	Error Check (L)
STX	0	1	R	1	8	24Byte	ETX	?	?



Description for Protocols,

1) Frame Requesting to Write

ENQ and EOT, which are the control letters of ASCII code, are used at the header and the tail.
Command 'W' is used.
The length of data indicates 18 bytes(12h).

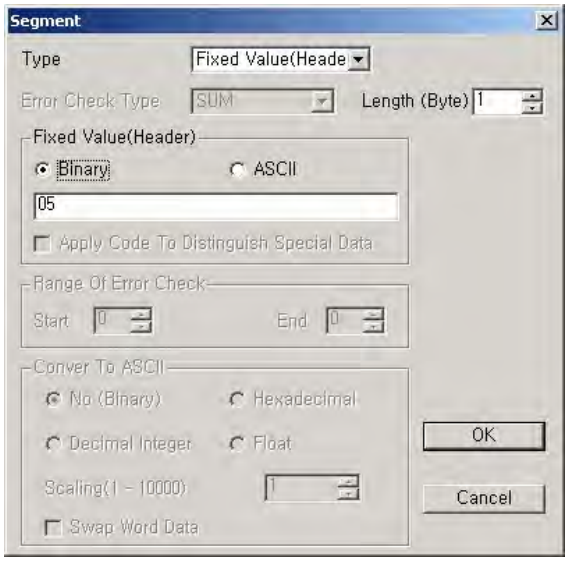
Order of Sending	Start ----------> End									
Type of Frame	Header	Fixed Value (Others)					Data	Tail	Error Check	
Frame sent	ENQ	0	1	W	1	2	Variable Data	EOT	H	L
Binary	05h	30h	31h	57h	31h	32h	D0000	04h		
ASCII		'0'	'1'	'W'	'1'	'2'	D0000			

12-byte data in the memory for sending data of CPU (CIMON-PLC D0000) are sent.
The error check is to binary-sum ASCII code values from the header to the tail. Calculated data is varied according to frame.

To make the above frame sent in a protocol editor, binary or ASCII can be selected as fixed value. In case of binary like the above table, enter a hexadecimal value. In case of ASCII, enter letters. But, hexadecimal 2-digit number occupies 1 byte and a letter occupies 1 byte.

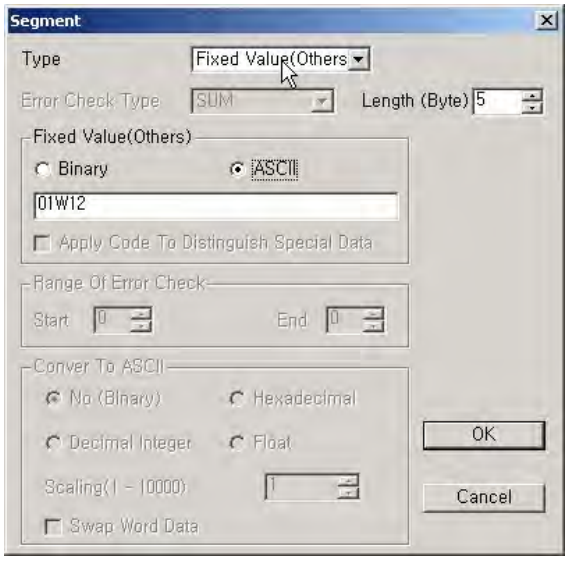
Using the protocol editor, make the frame sent of other manufacturer's protocol as the following procedure.

1. **Fixed Value (Header):** This is the first data of a frame.



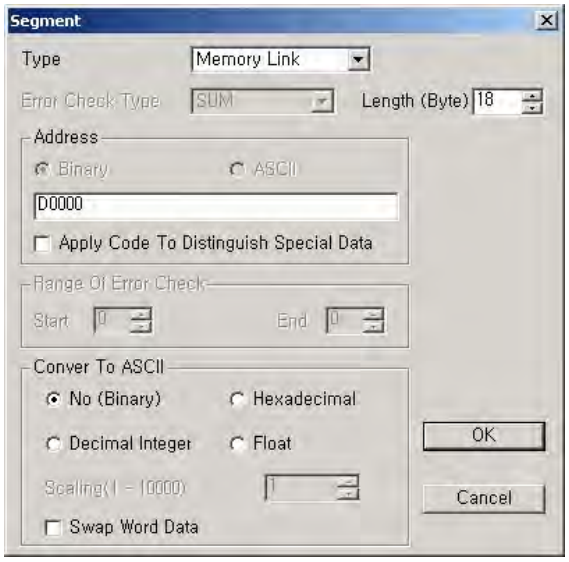
Binary 05h is ENQ. Hexadecimal 2-digit number occupies **1 byte**.

2. **Fixed Value (Others):** As a data is displayed in ASCII, a letter occupies 1 byte.



Binary data (30 31 57 31 32) can be displayed.

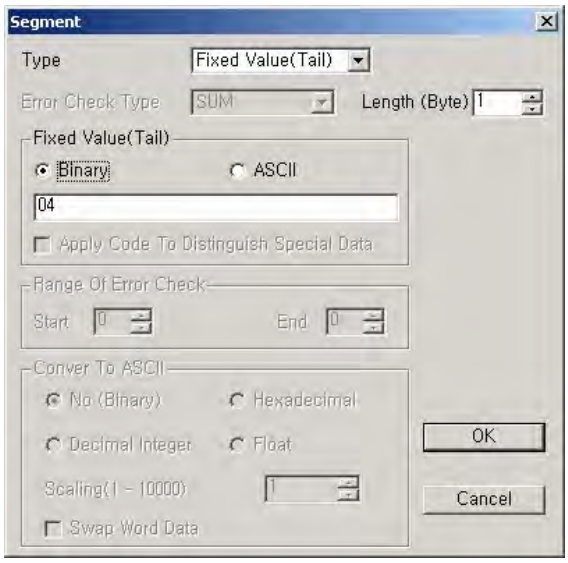
3. **Memory Link:** If an address is selected as D0000 with the length of 18 bytes, the 18-byte data stored in D0000 will be sent without ASCII conversion.



Convert to ASCII Data :

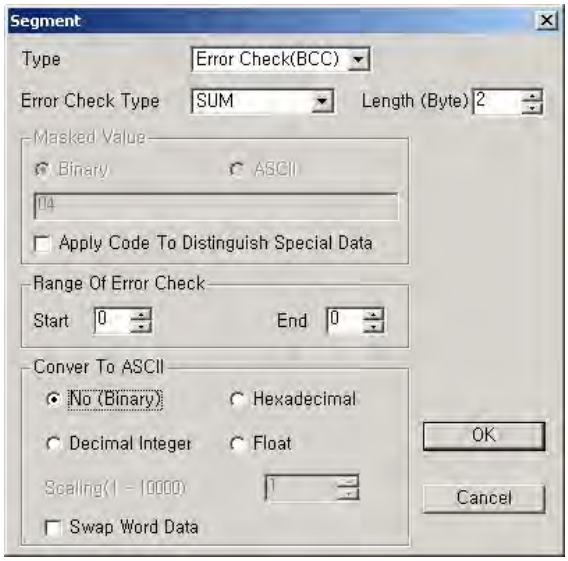
- No(Binary): The data stored in the memory of CPU is sent without conversion. For example, if the length of a data is 2 bytes and the value is 0x1234(2Byte), Data 1234 will be sent.
- Hexadecimal Integer: A data is converted to ASCII data and the result is sent. As actually sent data are '1','2','3','4', in case that a data value is 0x1234, 4 bytes is to be set up as the length of the data.
- Decimal Integer: 0x1234 is equivalent to decimal 4660. As actually sent data are '4','6','6','0', 4 bytes is to be set up as the length of the data.
- Real Number: In case that scaling is 10, Data Value 0x1234 is divided by 10 and the result is sent in binary data. The actual sent data is 0x01D2.

4. **Fixed Value (Tail):** This is the last data of a frame.

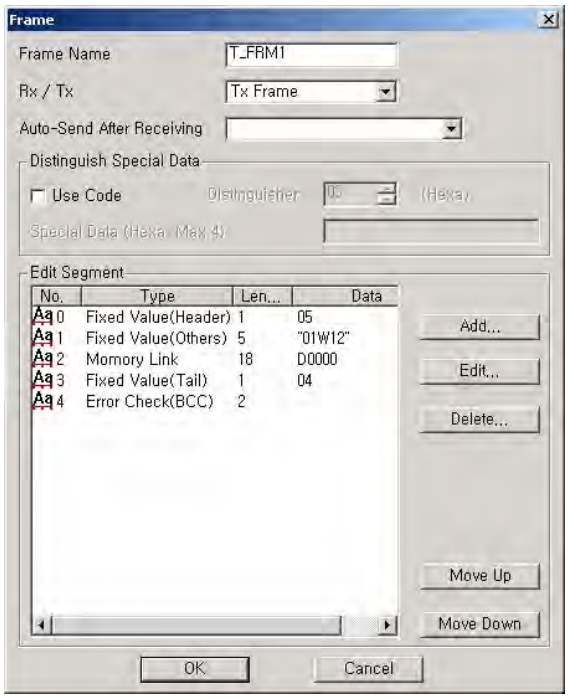


Binary 04h is EOT. Hexadecimal 2-digit number occupies **1 byte.**

5. **Error Check:** The data of the frame sent are binary-summed as much as a set value in the range of error check. Refer to the memory link for ASCII data conversion.



6. The frame sent has been edited.



2) Frame Responding to Request to Read

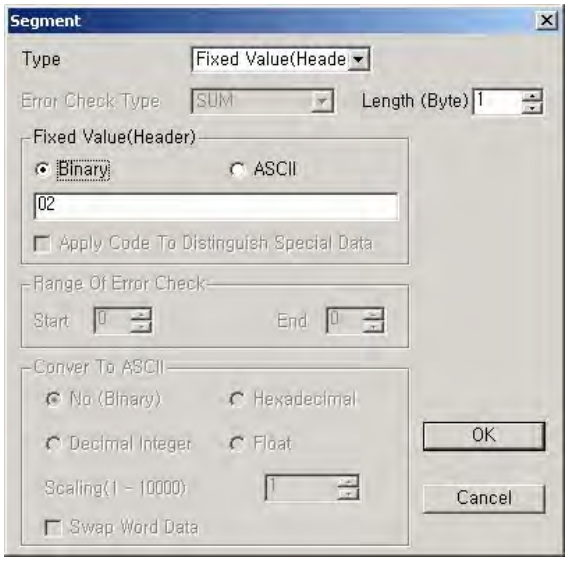
Order of Sending	Start ----------> End									
Type of Frame	Header	Fixed Value (Others)					Data	Tail	BCC	
Frame sent	STX	0	1	R	1	8	Variable Data	ETX	H	L
Binary	02h	30h	31h	57h	31h	38h	D0000	03h		
ASCII		'0'	'1'	'R'	'1'	'8'	D0000			

STX and ETX, which are the control letters of ASCII code, are used at the header and the tail.
Command 'R' is used.
The length of a data displays 24 bytes(18).
24-byte data in the memory for sending data of CPU are sent.
Error check is to binary-sum ASCII code values from the header to the tail. A calculated data is varied according to frame.

To make the above frame received in a protocol editor, binary or ASCII can be selected as fixed value. In case of binary like the above table, enter a hexadecimal value. In case of ASCII, enter letters. But, hexadecimal 2-digit number occupies 1 byte and a letter occupies 1 byte.

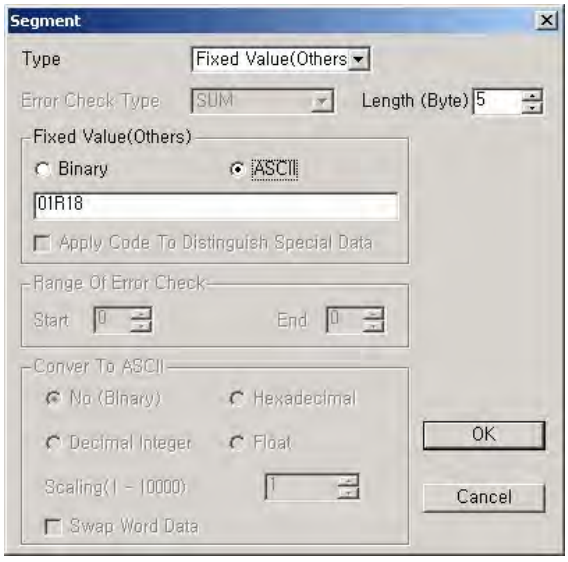
Using a protocol editor, make the frame sent of other manufacturer's protocol as the following procedure.

1. **Fixed Value (Header):** This is the first data of a frame.



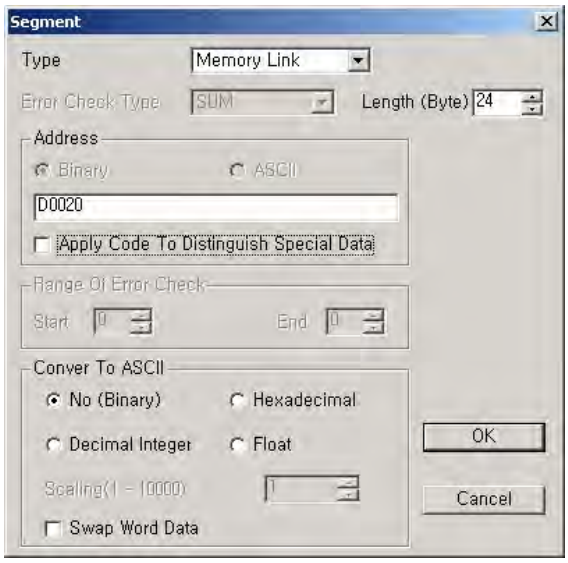
Binary 02h is STX. Hexadecimal 2-digit number occupies **1 byte**.

2. **Fixed Value (Others):** As a data is displayed in ASCII, a letter occupies 1 byte.



Binary data (30 31 52 31 38) can be displayed.

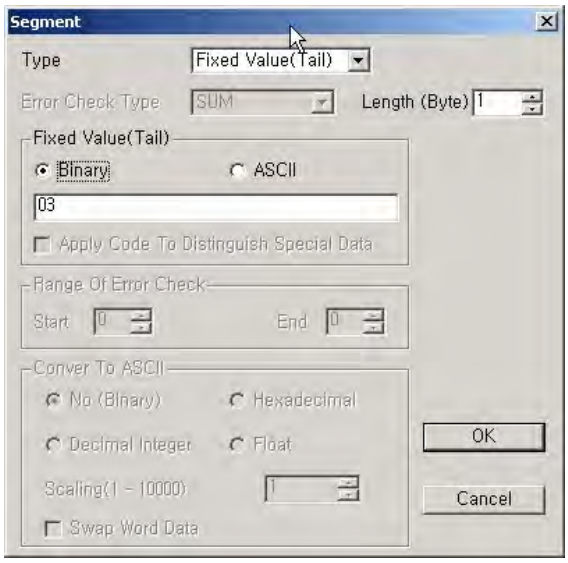
3. **Memory Link:** As D0020 is selected as address, 24-byte data is sent without ASCII conversion.



Convert to ASCII Data

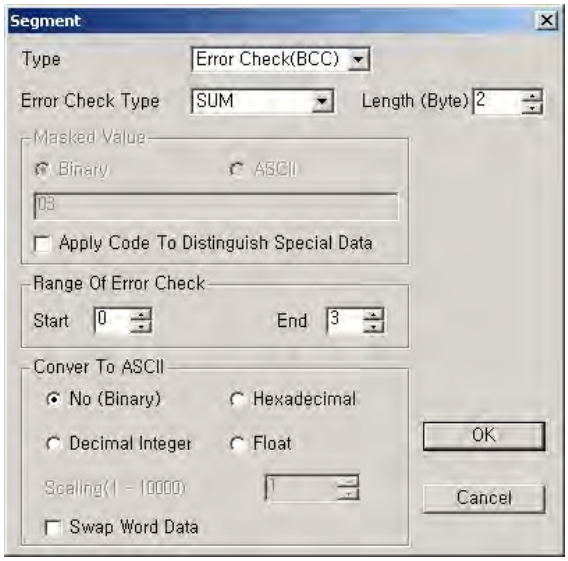
- No(Binary): A received data is stored in the memory of CPU without conversion. For example, if the length of a data is 2 bytes and the value is 0x1234(2Byte), Data h1234 will be stored in the memory of CPU.
- Hexadecimal Integer: A received data is converted to hexadecimal integer and the result is stored. And Data '1','2','3','4' are received. In this case, the actually stored data is 0x1234. But, 4 bytes are set up as the length of the data.
- Decimal Integer: A received data is converted to decimal integer and the result is stored. And Data '4','6','6','0' are received. In this case, the actually stored data is 0x1234. But, 4 bytes are set up as the length of the data.
- Real Number: In case that scaling is 10, Data Value 0x1234 is multiplied by 10 and the result is received in binary data. The actual sent data is 0xB608.

4. **Fixed Value (Tail):** This is the last data of a frame.



Binary 04h is ETX. Hexadecimal 2-digit number occupies **1 byte.**

5. **Error Check:** The data of the frame sent are binary-summed as much as a set value in the range of error check. Refer to the memory link for ASCII data conversion.

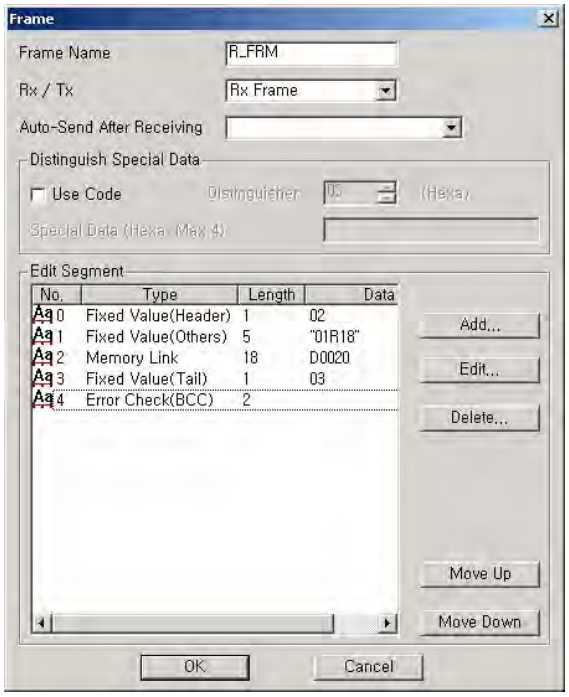


Range of Error Check (Segment) : Start: 0 / End: 3

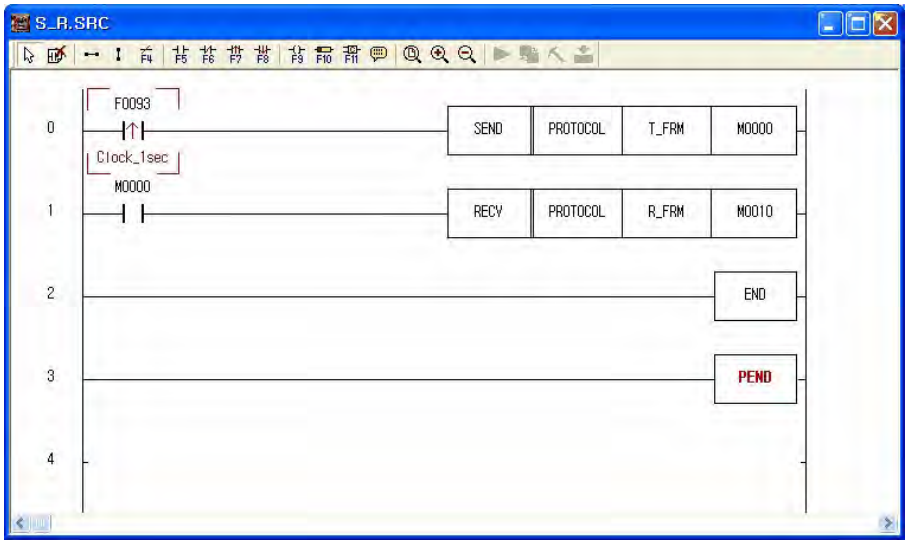
Segment 0	Segment 1	Segment 2	Segment 3

Error Check = Segment 0 + Segment 1 + Segment 2 + Segment 3

6. The frame received has been edited.



PLC Program: Use a protocol editor to send a registered frame every second. If the frame is sent, M0000 is turned on for one scan to execute Receive command. Send/Receive command is to be turned on for one scan.



6.2.6.2.6 Example of Application of MODICON (MODBUS) protocol

It is available to configure a communication system and frames between a CIMON-PLC and other manufacturer's PLC using Modbus Protocol.
The following is an example for request to read 16-bit data from other manufacturer's PLC using Modbus Protocol to a CIMON-PLC. If a requesting frame is received from other manufacturer's PLC, the received frame will be evaluated. If correct, it will be sent automatically.

Structure of Modbus Protocol Request (Other manufacturer's PLC)

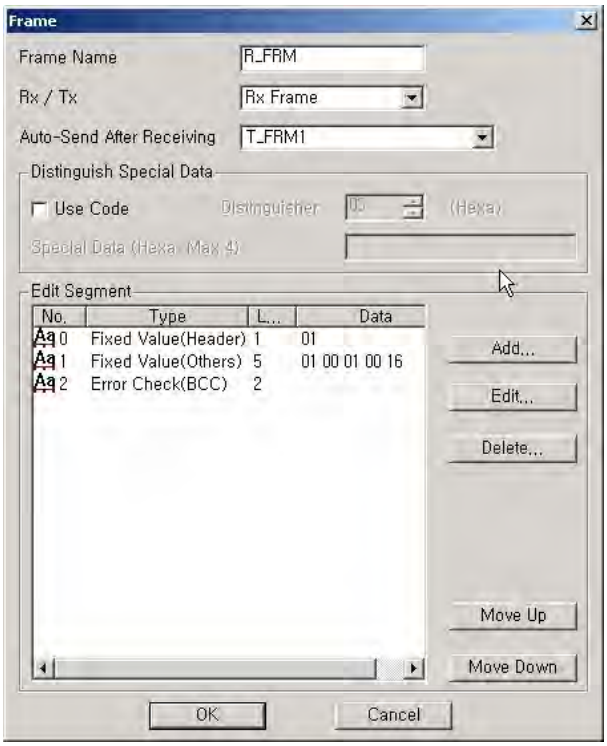
Slave Address	Function	Starting Address(H)	Start Address(L)	No. Point(H)	No. Point(H)	BCC(H)	BCC(L)
01	01	00	01	0	16	?	?

Structure of Modbus Protocol Response (CIMON-PLC)

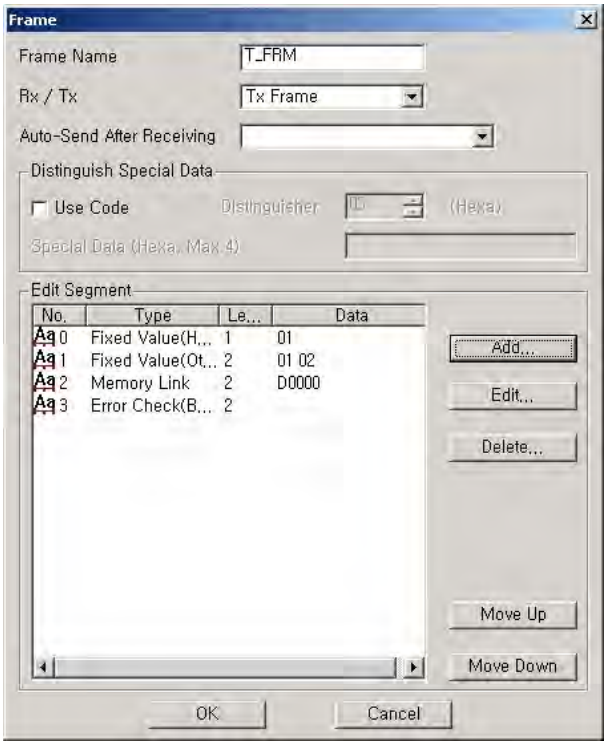
Slave Address	Function	Byte Count	Data	Data	BCC(H)	BCC(L)
01	01	02	CD	6B	?	?

Setting up the requesting frame received from other manufacturer's PLC

Select the auto-send after receiving. But, the frame sent automatically is to be registered.

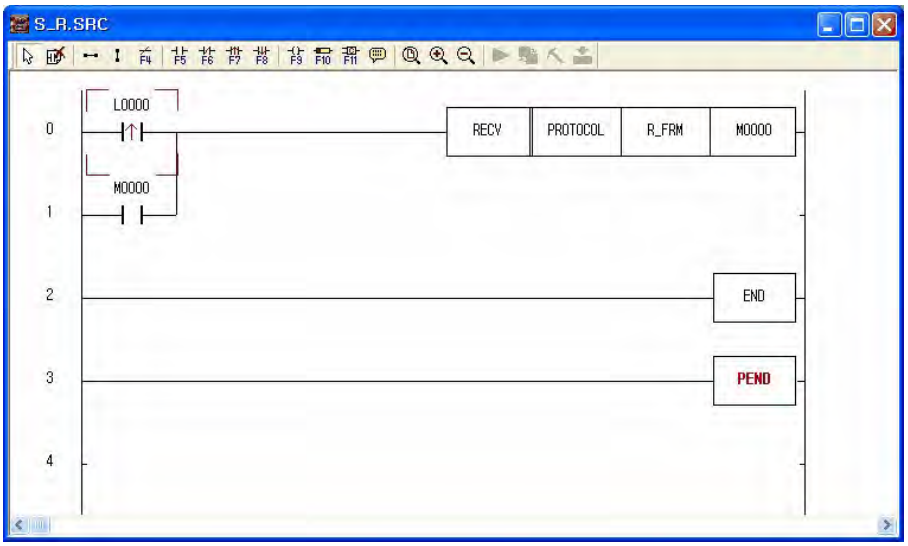


Setting up a responding frame



PLC Program:

If Data Value L0000 is '1', the received data is evaluated. The frame registered to the auto-send after receiving is sent without SEND command. Also, M0000 is or-operated and the above will be continuously processed if a frame is received.



6.2.6.2.7 Sending/Receiving communication frames at communication intervals

The following is the example of a communication system and frame composition between a master CIMON-PLC and a slave CIMON-PLC by using CIMON-PLC exclusive protocol.

A master PLC requests 5-word data of Memory Device 'D0000' at every 100ms.
Enter parameters as follows.

- Master PLC : User Protocol
- Slave PLC : HMI Protocol

Request Frame Format of CIMON-PLC Exclusive Protocol

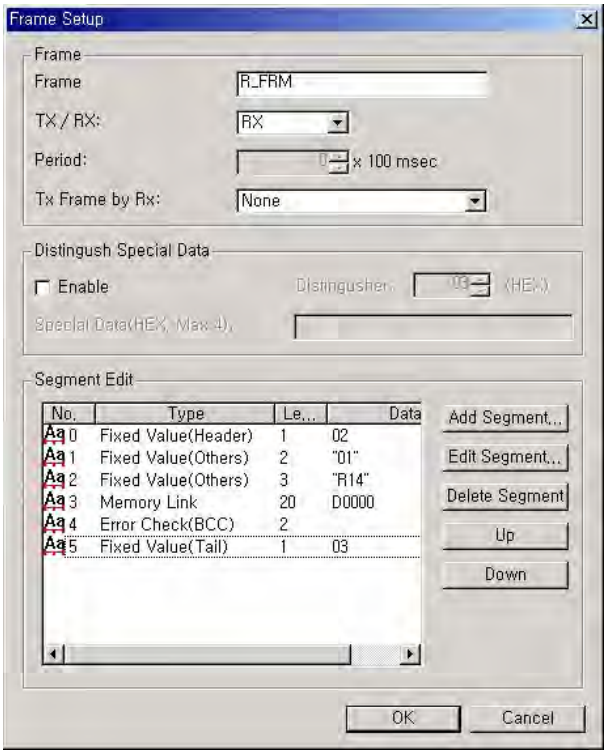
ENQ	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	0	1	R	0	A	D0000000 05	?	?	EOT

Response Frame Format of CIMON-PLC Exclusive Protocol

STX	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX
STX	0	1	R	1	4	0000 0000 0000 0000 0000	?	?	ETX

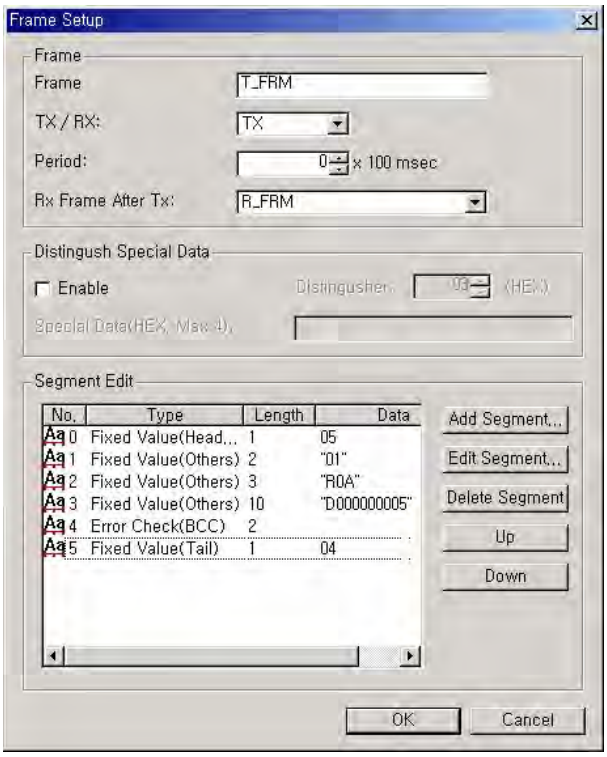
Response frame of master side

This is used to define the response frame received from a slave CIMON-PLC.
Sending frames are sent from a master PLC and expected receiving frames are registered.



Request frame of master side

This is used to define the request frames sent to a slave CIMON-PLC.
Sending frame is sent from a master PLC at every 100ms and the above-defined receiving frame is registered to the receiving frame for sending.
If a sending frame is sent and a registered frame is received, the bit corresponding to the frame number of communication result memory device(If frame number is 1, communication result bit is M0001) will be on for one scan.



6.2.6.3 CIMON PLC - HMI Protocol

This service is used to have a PC and other devices read and write the information and data in a PLC, and to have them control a PLC (RUN, STOP, PAUSE). In the system composing of a Master and a Slave, if station numbers are assigned, multi-drop communication is available.

See :

- Structure of Frame
- Details of Command

6.2.6.3.1 Structure of Frame

Request Frame (Master) :

The frame that an outside communication device requests to a computer link module

ENQ	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT

Response Frame (Slave) :

The frame that a computer link module responds to an outside communication device

STX	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX

1) The structure of a sending frame and the one of a receiving frame are same.

2) The same as the command codes received from a request frame (Master) are used for response frame. But, if there is an error in communication or process, Code E is responded.

3) Description for Codes

Code	Hex Value	Description
ENQ	05H	Master Frame Header
EOT	04H	Master Frame Tail
STX	02H	Slave Header
ETX	03H	Slave Tail
Stn	00H~1FH, FFH	PLC Station Number
Cmd		Command
Leng		Length of Data Device (Length Bytes), Hexadecimal
Data		Data Device according to Command (Length Bytes)
BCC		Remainder value when dividing the binary-sum from Cmd to the end of data by 256

4) Commands

The commands used for exclusive communication service are as follows.

Command	Code	ASCII	Function
Read Word Data	52H	R	Reads Word Memory Device.
Write Word Data	57H	W	Writes to Word Memory Device.
Read Bit Data	72H	r	Reads Bit Memory Device.
Write Bit Data	77H	w	Writes to Bit Memory Device.
Change PLC Mode	4DH	M	Changes PLC Mode.
Register Monitoring Device	58H	X	Registers Monitoring Device.
Read Monitoring Device	59H	Y	Reads Registered Monitoring Device
Respond Error	45H	E	Responds Error in PLC.

6.2.6.3.2 Details of Command

List :

Read Word Data

Function

- This is used to read the data in the word device of a PLC. (Max. 63 words)
- Device Symbol: X, Y, M, L, K, F, Z, TC, TS, CC, CS, D, S

Request Frame (Master)

- COMMAND: 'R'

- Data Device Format

Address 8 Char	Size (Word) Hexadecimal, 2 Char	.....	Address 8 Char	Size (Word) Hexadecimal, 2 Char

[Master(Request Format)]

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	02		R	0A		D0000001 01	B9		EOT
05H	30H	32H	52H	30H	41H	4430303030303031 3031H	42H	39H	04H

Leng is the length of a data and its value means the length of a data (D0000001 01).

Data means the address really read (D0000001) and the length of the word data read (01).
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame (Slave)

- COMMAND (In completed case: 'R' / In failed case: 'E')
- Format of Data Device

[Completed Case]

PLC Data

Word Data 4 Char	Word Data 4 Char	.....	Word Data 4 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX
STX	02		R	04		F4AC	B4		ETX
02H	30H	32H	52H	30H	34H	46344143H	42H	34H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing binary-sum from Cmd to the end of data by 256.
As the response frame is processed, Cmd is 'R'. (* Leng means the length of a data (F4AC).

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		02	09		ETX
02H	30H	32H	45H	30H	32H	3032H	30H	39H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is not processed, Cmd is 'E'. (*Leng means the length of error code(02).)

* Error code displays the type of an error. Please refer to the 'ERROR RESPONSE'.

[Ex.] Read data from Address D00040 of Station 02H.

Master (Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	02		R	0A		D0000040 01	BC		EOT
05H	30H	32H	52H	30H	41H	4430303030303430 3031H	42H	43H	04H

Completed Case> reads 1-word data 'F4AC'

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX
STX	02		R	04		F4AC	B4		ETX
02H	30H	32H	52H	30H	34H	46344143H	42H	34H	03H

Failed Case> Error in BCC

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		02	09		ETX
02H	30H	32H	45H	30H	32H	3032H	30H	39H	03H

Write Word Data

Function

- This is used to write a data to the word device of a PLC.
- **Device Symbol:** X, Y, M, L, K, F, Z, TC, TS, CC, CS, D, S

Request Frame

- COMMAND: 'W'

- Format of Data Device

Address 8 Char	Size (Word) Hexadecimal, 2 Char	Word Data Hexadecimal, Size*4 Char	.....	Address 8 Char	Size (Word) Hexadecimal, 2 Char	Word Data Hexadecimal, Size*4 Char

[Master (Request Format)]

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT

ENQ	02		W	0E		D0000010 01 FA34	B0		EOT
05H	30H	32H	57H	30H	45H	4430303030303130 3031 46413334H	42H	30H	04H

Leng is the length of a data and its value means the length of the Data (D0000010 01 FA34).
The address really written (D0000010), the length of the data (01) and the data written (FA34) are input in the Data (D1000 02 FA34).
BCC is the remainder value (F3) when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame

- COMMAND (In completed case: ‘W’ / In failed case: ‘E’)
- Format of Data Device

[Completed Case]

No Data

Slave (Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	02		W	00		B7		ETX
02H	30H	32H	57H	30H	30H	42H	37H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is processed, Cmd is ‘W’.
Leng means the length of a data.

[Failed Case]

Error Code

Error Code 2 Char

Slave (Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		01	08		ETX
02H	30H	32H	45H	30H	32H	3031H	30H	38H	03H

The request frame received from a master is used as the response frame of a PLC.

BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is not processed, Cmd is ‘E’.
Leng(02) means the length of Error Code(01).
Error code displays the type of an error. Please refer to the ‘ERROR RESPONSE’.

[[Ex.] Write FA34H to Address D0010 and 8D41H to Address D0020.]

Master (Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	02		W	12		D0000010 02 FA34 8D41	AF		EOT
05H	30H	32H	57H	31H	32H	4430303030303130 3032 46413334 38443431H	41H	46H	04H

Completed Case>

Slave (Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	02		W	0		B7		ETX
02H	30H	32H	57H	30H	30H	42H	37H	03H

Failed Case>Receiving unknown command code (01H).

Slave (Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		01	08		ETX
02H	30H	32H	45H	30H	32H	3031H	30H	38H	03H

Read Bit Data

Function

- This is used to read the data in the bit device of a PLC.
- Device Symbol: X, Y, M, L, K, F, Z, T, C

Request Frame

- COMMAND: ‘r’

- Format of Data Device

Address 8 Char	Size (Bit) Hexadecimal, 2 Char	.....	Address 8 Char	Size (Bit) Hexadecimal, 2 Char

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	03		r	0A		M000010F 02	F9		EOT
05H	30H	33H	72H	30H	41H	4D303030313030 46 3032H	46H	39H	04H

Leng is the length of a data and its value means the length of Data (M000010F 02H).
The address really read(M000010F) and the length of the data(02) are input in the Data.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame

- COMMAND (In completed case: ‘r’ / In failed case: ‘E’)
- Format of Data Device

[Completed Case]

PLC Data

Bit Data 1 Char	Bit Data 1 Char	.....	Bit Data 1 Char

Slave (Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX
STX	01		r	02		0 1	35		ETX
02H	30H	31H	72H	30H	32H	30 31H	33H	35H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is processed, Cmd is ‘r’.
Leng(02) means the length of the Data(0 1).

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	03		E	02		01	08		ETX
02H	30H	33H	45H	30H	32H	3031H	30H	38H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is not processed, Cmd is 'E'.
Leng(02) means the length of Error Code(01).
Error code indicates the type of an error. Please refer to the 'ERROR RESPONSE'.

[Ex.] Read the bit data in Address M0104 and Address M0105 of Station 03 PLC.

Master (Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	03		r	0A		M0000104 02	E7		EOT
05H	30H	33H	72H	30H	41H	4D3030303031 3034 3032H	45H	37H	04H

Completed Case > Reads Data '0 1'.

Slave (Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX
STX	03		r	02		0 1	35		ETX
02H	30H	33H	72H	30H	32H	30 31H	33H	35H	03H

Failed Case > Error in BCC

Slave (Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	03		E	02		02	09		ETX
02H	30H	33H	45H	30H	32H	3032H	30H	39H	03H

Write Bit Data

Function

- This is used to write data to the bit device of a PLC.
- Device Symbol : X, Y, M, L, K, F, Z, T, C

Request Frame

- COMMAND : ‘w’

- Format of Data Device

Address 8 Char	Size (Bit) Hexadecimal, 2 Char	Bit Data Size*1 Char	.....	Address 8 Char	Size (Bit) Hexadecimal, 2 Char	Bit Data Size*1 Char

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	03		w	0D		M0000101 03 110	82		EOT
05H	30H	33H	77H	30H	42H	4D303030303130 31 3033 313130H	38H	32H	04H

Leng(0B) is the length of data and its value means the length of Data (M0000101 03 110).
The address really written(M0000101), the length of the data(03) and the data written(110) are input in the Data.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame

- COMMAND (In completed case: ‘w’ / In failed case: ‘E’)

- Format of Data Device

[Completed Case]

No Data

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	03		w	00		D7		ETX
02H	30H	33H	77H	30H	30H	44H	37H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is processed, Cmd is ‘w’.
Leng(00) means the length of the data.

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		04	0B		ETX
02H	30H	32H	45H	30H	32H	3034H	30H	42H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is not processed, Cmd is 'E'.
Leng(02) means the length of Error Code (04).
Error code indicates the type of an error. Please refer to the 'ERROR RESPONSE'.

[Ex.] Write bit data to Bit Address M0104.

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		w	0D		M0000104 03 110	82		EOT
05H	30H	31H	77H	30H	44H	4D303030303130 34 3033 313130H	38H	32H	04H

Completed Case

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	01		w	00		D7		ETX
02H	30H	31H	77H	30H	30H	44H	37H	03H

Failed Case> Data Size Overflow

Slave (Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		04	0B		ETX
02H	30H	31H	45H	30H	32H	3034H	30H	42H	03H

Change PLC Mode

Function

- This is used to change the operation mode of a PLC.

Request Frame

- COMMAND : ‘M’

- Format of Data Device

Mode Code

Mode	Code
Run	0
Program	1
Pause/Remote	2

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		M	01		0	DE		EOT
05H	30H	31H	4DH	30H	31H	30H	44H	45H	04H

Leng(01) is the length of data.
Mode code value(0) is input in the Data(0).
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
Only the case CPU is under REMOTE status is available.

Response Frame

- COMMAND (In completed case: ‘M’ / In failed case: ‘E’)

- Format of Data Device

[Completed Case]

No Data

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	01		M	00		AD		ETX

02H	30H	31H	4DH	30H	30H	41H	44H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is processed, Cmd is 'M'.
Leng(00) means the length of the data.

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		03	0A		ETX
02H	30H	32H	45H	30H	32H	3033H	30H	41H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is not processed, Cmd is 'E'.
Leng(02) means the length of Error Code (03).
Error code indicates the type of an error. Please refer to the 'ERROR RESPONSE'.

[Ex.] Change the operation mode of a PLC to PAUSE/REMOTE mode.

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		M	01		2	E0		EOT
05H	30H	31H	4DH	30H	31H	32H	45H	30H	04H

Completed Case

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	01		M	00		AD		ETX
02H	30H	31H	4DH	30H	30H	41H	44H	03H

Failed Case > Invalid mode

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		03	0A		ETX
02H	30H	31H	45H	30H	32H	3033H	30H	41H	03H

Register Monitoring Device

Function

- This is used to register a monitoring device.
- 16 devices can be registered as maximum. (Distinguishing by Frame No., 0h – Fh)
- Individual device should be continuous and is limited to 63 words as maximum.

Request Frame

- COMMAND : ‘X’

- Format of Data Device

Frame No. 1 Char	Word Address 8 Char	Word Size Hexadecimal, 2 Char

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data			BCC H	BCC L	EOT
ENQ	01		X	0B		0	D0000001	02	C0		EOT
05H	30H	31H	58H	30H	42H	30H	4430303030 303031H	3032H	43H	30H	04H

Leng(0B) is the length of a data.
The Mode code(0), the Address(D0000001) and the Size(02) are input in the Data (0 D00001 02).
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame

- COMMAND (In completed case: ‘X’ / In failed case: ‘E’)

- Format of Data Device

[Completed Case]

No Data

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	01		X	00		B8		ETX
02H	30H	31H	58H	30H	30H	42H	38H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is processed, Cmd is ‘X’.
Leng(00) means the length of the data.

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		07	0E		ETX
02H	30H	31H	45H	30H	32H	3037H	30H	45H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is not processed, Cmd is ‘E’.
Leng(02) means the number of Error Codes (07).
Error code indicates the type of an error. Please refer to the ‘ERROR RESPONSE’.

[Ex.] Register Frame 1 and Addresses from D0011 to D0014 to Station 1.

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		X	0B		1 D0000011 04	C5		EOT
05H	30H	31H	58H	30H	42H	31 443030303030 3131 3034H	43H	35H	04H

Completed Case

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	01		X	00		B8		ETX
02H	30H	31H	58H	30H	30H	42H	38H	03H

Failed Case > Invalid Monitor Frame No.(0h~Fh)

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		07	0E		ETX
02H	30H	31H	45H	30H	32H	3037H	30H	45H	03H

Read Monitoring Device

Function

- This is used to read the registered monitoring device.

Request Frame

- COMMAND : 'Y'

- Format of Data Device

Frame No. 1 Char

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		Y	01		0	EA		EOT
05H	30H	31H	59H	30H	31H	30H	45H	41H	04H

Leng(01) is the length of a data.

Frame No. is input in the Data(0).

BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame

- COMMAND (In completed case: 'Y' / In failed case: 'E')

- Format of Data Device

[Completed Case]

Frame No.	Word Data 4 Char	.....	Word Data 4 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		Y	05		0 87F3	D6		EOT
05H	30H	31H	59H	30H	35H	30 38374633H	44H	36H	04H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is processed, Cmd is ‘Y’.
Leng(05) means the length of the Data(0 87F3).

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		08	0F		ETX
02H	30H	31H	45H	30H	32H	3038H	30H	46H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is not processed, Cmd is ‘E’.
Leng(02) means the length of Error Code(08H).
Error code indicates the type of an error. Please refer to the ‘ERROR RESPONSE’.

[Ex.] If Frame 2h, Address D1005 and Address D1006 are registered as a monitoring device, read the registered device.

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT

ENQ	01		Y	01		2	EC		EOT
05H	30H	31H	59H	30H	31H	32H	45H	43H	04H

Completed Case

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		Y	09		2 87F3 32E7	BD		EOT
05H	30H	31H	59H	30H	39H	32 38374633 33324537H	42H	44H	04H

Failed Case > Number of the unregistered(Not initialized) frame

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		08	0F		ETX
02H	30H	32H	45H	30H	32H	3038H	30H	46H	03H

Error Response

Function

- This is the function to inform a master of error occurring in the process of a communication frame or a request frame and is used in a response frame only.

Request Frame

- All request frames

Response Frame

- COMMAND : ‘E’
- Format of Data Device

Error Code

Error Code 2 Char

Error Code	Description
01	Receives unknown command code.
02	An error occurs in BCC.
03	CPU does not respond.
04	Receives unknown device code.
05	Exceeds the device read.
06	Invalid address.
07	Internal error
08	Receives the number of invalid data
09	Invalid data
10	Unregistered (Not initialized) frame number
11	Invalid Monitor Frame No. (0h – Fh) Invalid frame number
12	CPU is not in REMOTE status.
13	Invalid CPU status is assigned.
14	An error occurs in the size of the data written.
15	It is disabled to write.
16	It is disabled to change mode.

6.2.6.4 Dial-Up Modem Communication

Outline

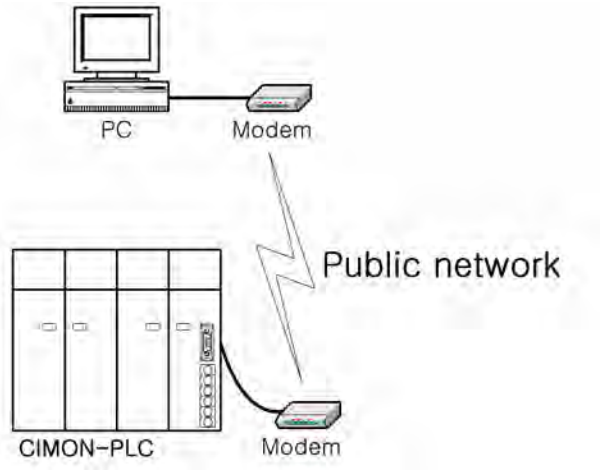
This function is to use the public network for a long-distance network.

Modem Specifications

In case of modem communications, it is required to use the modem complying with the recommendable specifications for reliability.
According to the performance of a modem and the state of a public network, the case that a line is not linked or the case that a link is cut off while exchanging data may occur.

- **Baud Rate** Over 14400 bps
- **DTE Interface** CTS / RTS Flow Control
- **Command** Hayes Exchange AT Command

- **Error Correction** Error Correction Function while Sending data
- **Controlling carrier** Controls to send carrier



Modem Link

Order of Modem Installation

1. Use RS-232C interface cable to connect a computer link module and an external type RS-232C modem.
2. Connect a RS-232C interface cable to the RS-232C port of the computer link module and DTE link terminal.
3. Connect the telephone line of a public network to the line terminal of the modem.
4. If there is a telephone set, connect the phone terminal of the modem with the telephone set.
5. Turning on the power for the PLC and the modem, make sure the modem is initialized.

Parameters Setup for Modem Communications

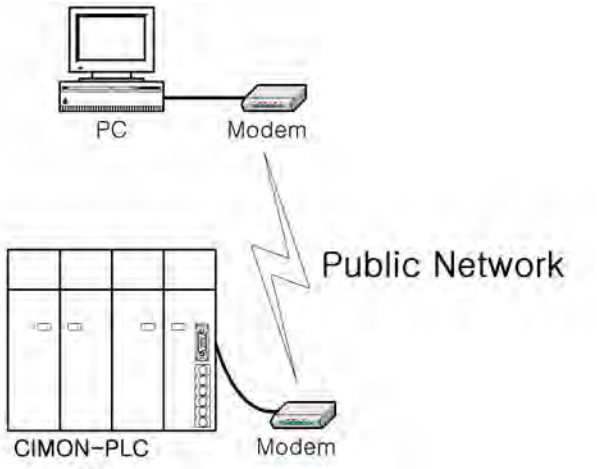
As all modems provide the functions discriminated by manufacturers, the parameters for modems are to be set up.
The modem operation mode is set up with the initialization command of a modem. The same operation mode is to be set up for the two modems used.

1. Select the menu to run the graphic loader(CICON).
2. Select menu to set up communication parameters such as communication channel, modem, baud rate, parity bit, stop bit, station number and communication type.
3. If a modem is set up, it will be available to set up the initialization command. Enter the modem initialization command set up.

4. Enter the default value for basic parameters such as station number, communication method, parity bit, stop bit and initialization command. Baud rate is to be set up according to the maximum rate of a modem.

CICON Link Service through Modem

- **This function is used to write programs, to download user programs, to debug programs and to monitor in the network system that a PLC is linked through a computer link module by remote control without moving the physical link of the CICON.**



When a master(CICON) is far away from a slave(PLC), using the function of the modem link, a PLC can be linked with the CICON.
As it is available to link with the PLC located at the place difficult to access as well as to link with a PLC at a long distance without moving the contents of the PLC, using the communication service of the CICON, programming is easy after installation. This function reduces the time and efforts taken when installing and modifying.

- **CICON-Modem Link Method**

This service is to link a computer link module with the CICON through a modem. After the CICON is connected with a telephone, the order of remote link is as follows.

1. Select the menu to set up a dial-up modem and the CICON protocol as the parameters of a computer link module. And select the menu to set up baud rate.
2. After connecting a modem with a computer link module and a telephone wire to the modem, turn the power on.
3. Select the menu to initialize the modem.

4. After the CICON is run, select the environment setup in the tools.
5. Select the dial-up and set the values for other parameters.
6. If the CICON dials, the message that the dial-up link is completed will appear.
7. It is available to control the PLC at a remote place.

6.2.6.5 Leased Line Modem Communication

Outline

A computer link module is used for the long-distance communication using a leased line through a leased line modem of external type and the control of the modem for communication.

Leased Line Modem Specifications

The performance of the leased line modem communication using a computer link module is decided according to the state of a leased line. For reliable communication, the modem complying with a recommended standard is to be used.

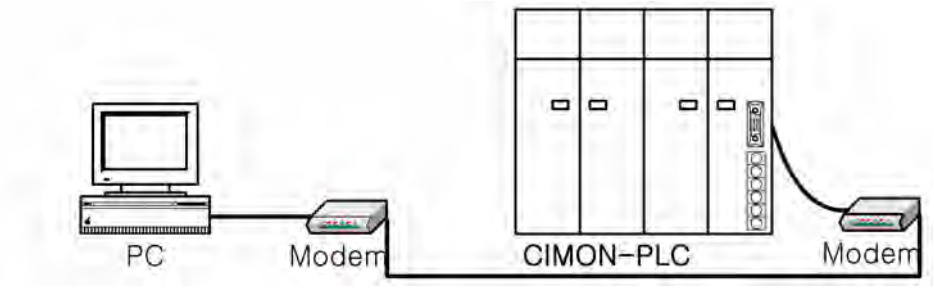
- **Baud Rate** Over 1200 bps
- **DTE Interface** CTS / RTS Flow Control
- **Error Correction** Corrects error when sending data
- **Carrier Control** Controls to send carrier
- **Line Control** Full duplex/Half duplex(2-wire, 4-wire)
- **RTS/CTS Delay Time** Within 500ms

Modem Link Method

Order to Link a Computer Link Module with a Modem

1) Connect a RS-232C cable to an external type modem and a computer link module.

2) Select the menu to set up the leased modem method as the communication method in the CICON.



3) Make sure the modem is initialized after inputting the power to it.

4) If the modem is not initialized normally, make sure the communication method is set up as the leased line modem communication and the wiring of the RS-232C cable.

5) The wiring of the RS232C cable is 1:1 connection.

6.2.6.6 RS485 PLC Link Service

Outline

CM1-SC01A/SC01B/SC02A card are used for this service, which is the protocol using a RS485 Network to exchange data between the CIMON PLCs. The specifications are as follows.

- Maximum connected PLCs : 32 units
- Up to 32 sending blocks per PLC can be assigned.
- The interval of communication for each sending block can be set up in the range from 50ms to 3s.
- The data of up to 64 words per one sending block can be sent.
- The number of the communication blocks assigned to each PLC, summing receiving blocks and sending blocks, is up to 64.
- The necessary blocks selected among the sending blocks of other PLCs in a network are assigned to receiving blocks.

Link Points

Max. Comm. Points	Max. Sending Points	Max. Block No.	Max. Points per Block
4,096	2,048	64Points (0~63)	64

Processing the Sent Data and the Received Data under PLC Link

An Example is taken to explain how data are processed when they are sent or received under PLC Link.

- **Sending Party :** This is used to set up the data read, the number of the block where data is sent, data size and sending interval to a sending party in broadcasting method.
- **Receiving Party :** This is used to set up the station number and block number for the sent data to a receiving party in broadcasting method to receive a desired data.

[Ex.] Station 0 sends the data of Device D0000 and Station 1 stores received data in Device Y0000.

Sending Party (Station: 0)

Type	Block Number	Sending Interval	Address	Size
Sending Block	0	100ms	D0000	10 Words

Receiving Party (Station: 1)

Type	Station Number	Block Number	Address	Size
Receiving Block	0	0	Y0000	4 Words

The block number of a sending party and the one of a receiving party are the same as 0, and the station number of the sending party is set up as 0 like the one of the receiving party. In this condition, the receiving party can receive every 100ms and the data sent from the sending party every 100ms. Though the sending party sends the data of 10-word size, the receiving party selects and receives the necessary data of 4-word size. But, if the size of received data is greater than the size of sent data, the PLC will receive the data as much as the size of the sent data.

Setting up PLC Link Parameter

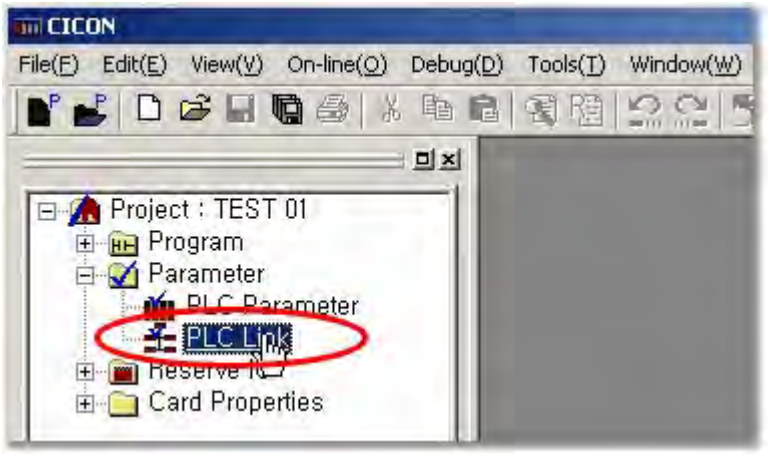
To run PLC Link and to exchange data between communication modules, the parameter is to be set up in

the CICON.

1) Creating a Project in the CICON

Select the menu to run the CICON and to open a corresponding project.

[Picture 6-1]



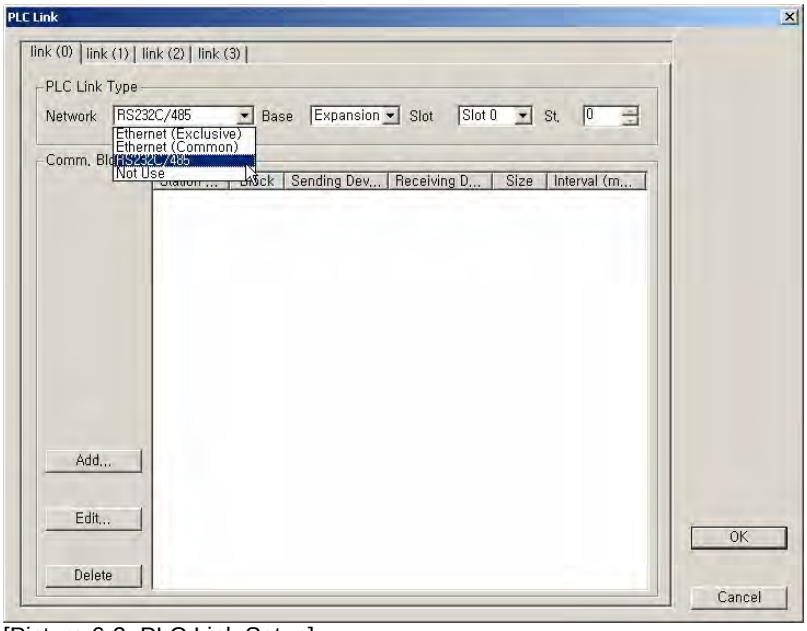
2) Setting up PLC Link Parameter

1. Selecting PLC Link Parameter:

If you select the PLC Link on the window like [Picture 6-1], a PLC link dialog box will appear. In the dialog box, up to 4 communication modules can be set up for one CPU. To set up the PLC Link to a mounted communication module, select Link(0), Link(1), Link(2) and Link(3) on the top of the dialog box and enter the values for each communication module

a. Setting up PLC Link Type:

PLC Link Type is used to set up basic items such as network type, base, slot number, station number and so on.



[Picture 6-2. PLC Link Setup]

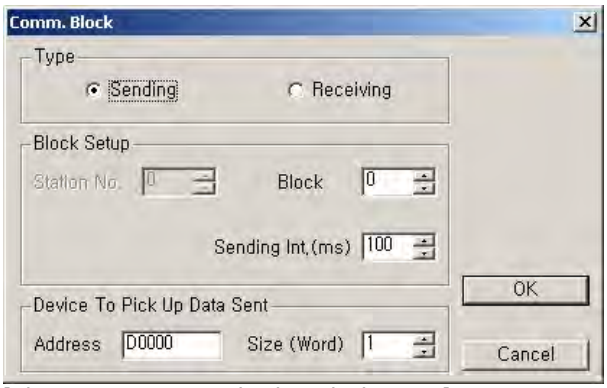
Network This is used to set up the type of the communication module for PLC Link. If you do not use PLC Link, select the Not Use.
Here, select the RS232C/485.

Base This is used to select the base where the communication module for PLC Link is mounted. For example, if there is no expansion base (The base where a expansion card is mounted), select the Local. If there is expansion base (The base where a expansion card is mounted), select the Expansion Base where the communication module is mounted.

Slot This is used to select the slot number of the base where a communication module is mounted.

b. Setting up the communication block for PLC Link:

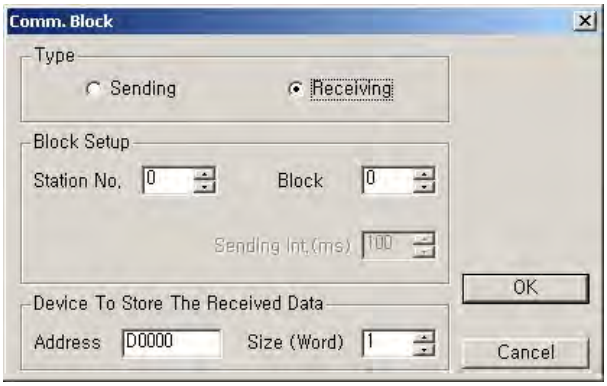
Communication Block is used to register the information about sending/receiving real data. If you select RS232C/422 as Network and the Add button in [Picure 6-2. PLC Link Setup], a Communication Block dialog box will appear like [Picture 6-3. Communication Block Setup].



[Picture 6-3. Communication Block Setup]

Sending When communication modules communicate each other, this is used to send a selected block.

Receiving When communication modules communicate each other, this is used to receive a selected block.



Station No. When communication modules communicate each other, in case of sending data, it is not necessary to set up station number. But, in case of receiving data, the station number of a receiving communication module is to be selected. The station number can be set up in the range from 0 to 63.

Block No. The communication modules for a sending party communicate with each peculiar block number. In the same way, the communication modules for a receiving party have each peculiar block number to receive data. The receiving block number is used to detect the data that a receiving party wants together with the station number when the party communicates with a sending party. But, the block number can be set up in the range from 0 to 31. To receive the data of a sending party, the same number is to be set up as the block number for the sending party and the block number for a receiving party.

Sending Interval The sending interval, the parameter for deciding the interval at which data are sent, can be set up in the range from 50ms to 3sec according to users' need. For example, if 50 ms is set up as sending interval, the data will be sent every 50ms.

Device to Pick up Data Sent & Device to Store The Received Data (Address):

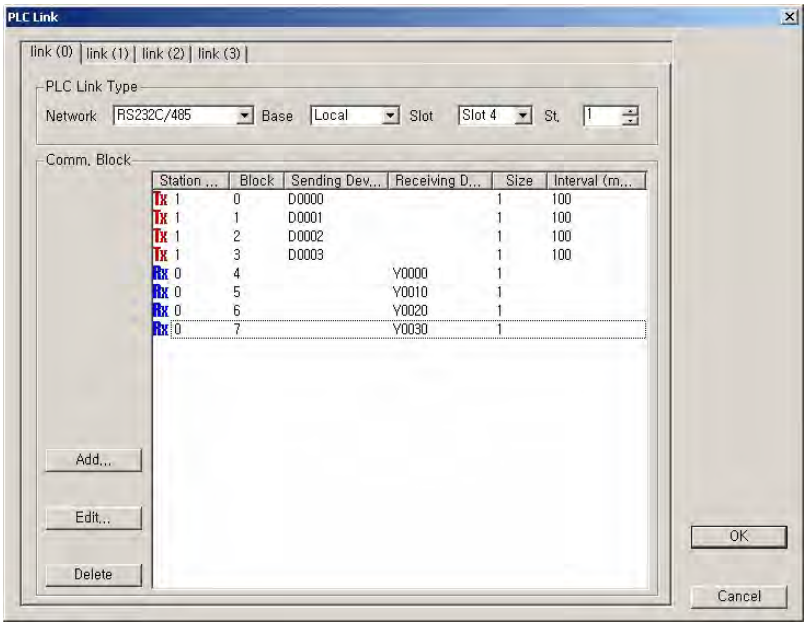
- When sending: This is used to set up the device where the data sent are read.
- When receiving: This is used to set up the device where received data are stored.

Device to Pick up Data Sent & Device to Store The Received Data (Size):

This, the size of the data sent or received, can be set up by the word. But, the size is from one word to 64 words. If the data size of a sending device is greater than the size of the data set up to a receiving device, the necessary data as much as the size of the one set up to the receiving device can be received selectively and used.

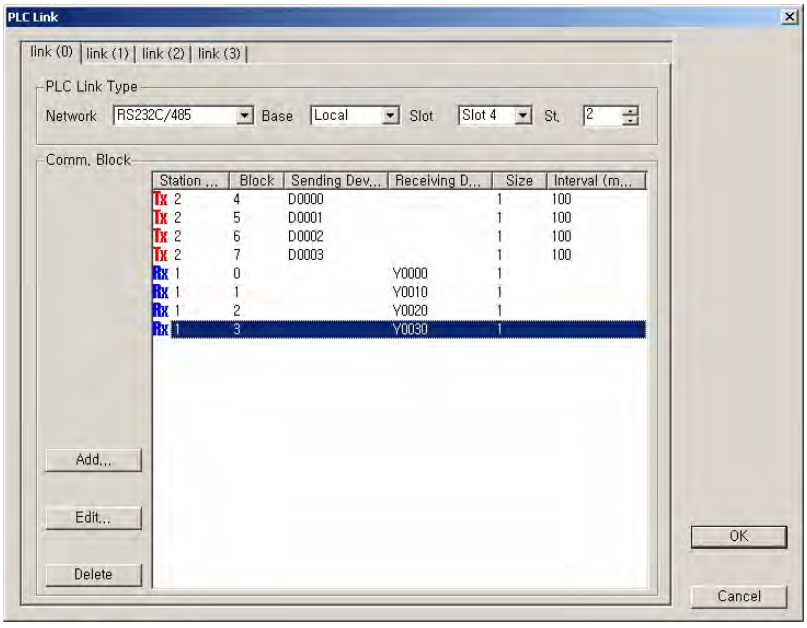
[Ex.] The communication module of Station 1 sends Block 0, 1, 2 and 3, and receives Block 4, 5, 6 and 7. And the communication module of Station 2 sends Block 4, 5, 6, and 7, receives 0, 1, 2 and 3. An RS232C/422 card is mounted on Slot 4. Each data size is one word and the interval is 50 ms each.
Such case is taken as an example and the PLC link parameter for it is configured as follows.

[Station 1]



Station 1 sends the data of the sending devices from D0000 to D0003 by the word at each interval. The received data will be written to the corresponding addresses in the receiving devices from Y0000 to Y0030, if the corresponding station and blocks are in accord.

[Station 2]



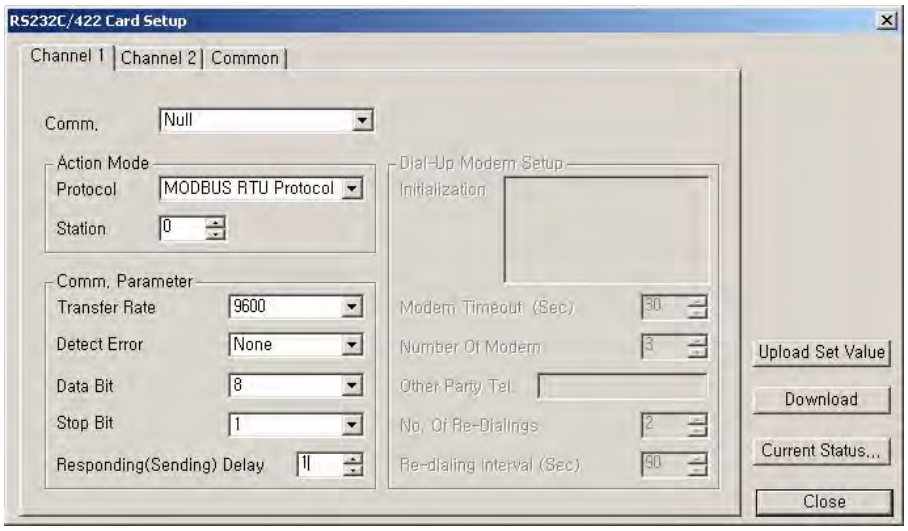
Enter 2 as the sending station number and 4, 5, 6, 7 as the block number to send at each interval. If so, the RS232C/422 module of Station 1 receives, comparing the receiving station and the blocks. In the same way, Station 2 compares the numbers of the blocks in the received frames with Block 0, 1, 2, and 3 of Station 1. And if they are the same, Station 2 receives them and writes the data to the devices from Y0000 to Y0030.

6.2.6.7 MODBUS Protocol Service

Outline

This is to access CPU data, using MODBUS protocol in a PC.

Parameter Setup



Select the MODBUS RTU Protocol as the protocol in the Action Mode and enter the station number of the communication card as the station number. If the parameters are set up, press the download button. If they are downloaded and you press the upload button, the downloaded value will be uploaded.

Modbus Command

Command	Description	Remarks
1 (Read Coil)	Accesses the bit device where data can be read and written.	Read Bit
2 (Read Input)	Accesses the bit device where data can be read.	Read Bit
3 (Read Holding)	Accesses the word device where data can be read and written.	Read Word
4 (Read Input)	Accesses the word device where data can be read.	Read Word
5 (Force Single Coil)	Accesses the bit device where data can be written.	Write Bit
6 (Preset Single Register)	Accesses the word device where data can be written.	Write Word
15 (Force Multiple Coils)	Accesses the bit device where data can be written.	Write Bit
16 (Preset Multiple Regs)	Accesses the word device where data can be written.	Write Word

Address Map

Device Memories of all kinds can be corresponded.

Bit / Word	Modicon Address	CIMON-PLC Address	Size CIMON-PLC
Bit Read Input	100001 ~ 104096	X 0000 ~	4096 Bits
	104097 ~ 106144	F 0000 ~	2048 Bits
	106145 ~ 107168	T 0000 ~	1024 Bits

	107169 ~ 108192	C 0000 ~	1024 Bits
Bit Read Coil	000001 ~ 004096	Y 0000 ~	4096 Bits
	004097 ~ 012288	M 0000 ~	8192 Bits
	012289 ~ 014336	K 0000 ~	2048 Bits
	014337 ~ 016384	L 0000 ~	2048 Bits
Word Input Register	400001 ~ 400256	X 0000 ~	256 Words
	400257 ~ 400384	F 0000 ~	128 Words
	400385 ~ 401408	TC 0000 ~	1024 Words
	401409 ~ 402432	CC 0000 ~	1024 Words
	402433 ~ 402482	S 0000 ~	50 Words
Word Holding Register	300001 ~ 300256	Y 0000 ~	256 Words
	300257 ~ 300384	K 0000 ~	128 Words
	300385 ~ 301408	TS 0000 ~	1024 Words
	301409 ~ 302432	CS 0000 ~	1024 Words
	302433 ~ 302560	L 0000 ~	128 Words
	302561 ~ 303072	M 0000 ~	512 Words
	303073 ~ 313072	D 0000 ~	10000 Words

Bit(Read Inputl, Read Coil) occupies Modicon Address bit by bit.

[Ex.] Read Input -> 100001: X0000, 100002: X0001,....., 100017: X0010,.....

[Ex.] Read Coil -> 000001: Y0000, 000002: Y0001,..... , 000017: Y0010,.....

Word(Input Register, Holding Register) occupies Modicon Address word by word.

[Ex.] Input Register -> 400001: X0000, 400002->X0010, 400003->X0020,.....

[Ex.] Holding Register -> 302561: M0000, 302562: M0010, 302563: M0020,.....

[Note] Some MODBUS Master devices can read and write the devices from 1 to 9999 in the range of the address of each data type. In this case, as the part corresponding to the device greater than Modicon Address 9999 in the data of a PLC cannot be accessed, the access memory of the user program may be controlled.

6.2.6.8 MODBUS Master Special module program Service

Outline

1.1 General information

CM1-SC01A/SC01B/SC02A cards are used for this service, which is the protocol using RS232/485 MODBUS Master to exchange data between the Slaves. The specifications are as follows.

- Maximum connectable Slaves: 128 units.
- Easy to recognize to communicate successful or not with result bits of communication.
- Sequnce program is not necessary when periodic communication.
- It is Flexible for Slaves supported variable commands
- To communication in special events is possible with command, "SEND"?

CAUTION, identify a version of program for MODBUS Master special program. If it cannot support program as lower version, please make sure whether it is the recommend version

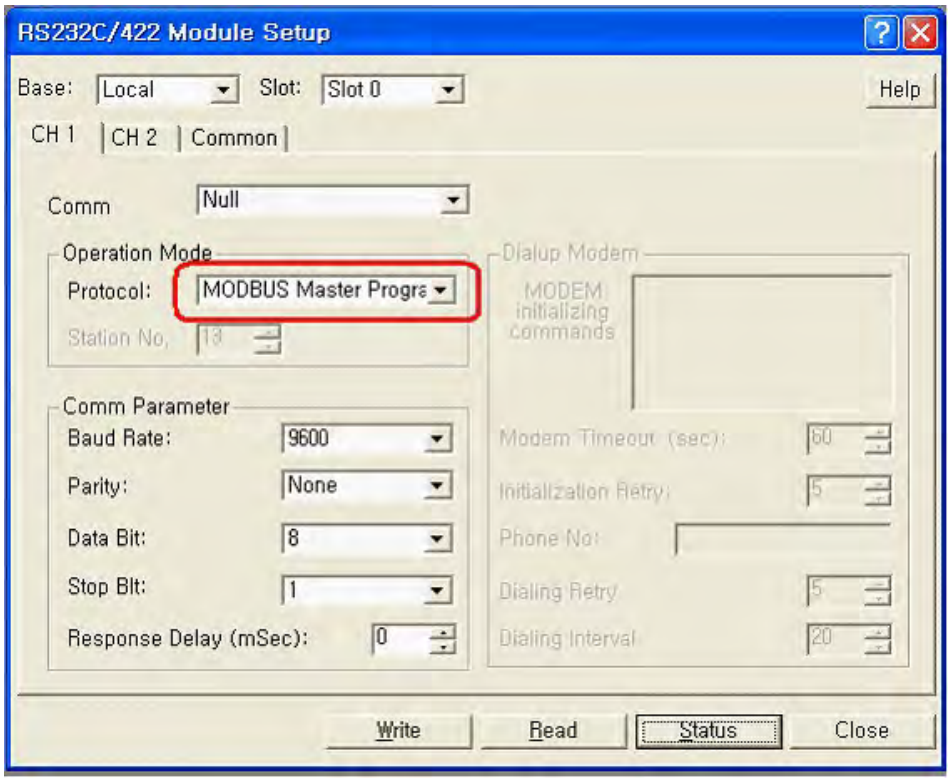
	CICON	CM1-CPxx(CPU)	CM1-SC0xx
Version	V1.89	V1.56	V1.40

1.2 Supported MODBUS RTU commands

Command	Substance	Remark	Domain
1 (Read Coil)	Read the bit device coil	Read Bit	0X
2 (Read Input)	Read the bit device input	Read Bit	1X
3 (Read Holding)	Read the word device holding register	Read Word	4X
4 (Read Input)	Read the word device input	Read Word	3X
5 (Force Single Coil)	Write the bit device coil	Write Bit	0X
6 (Preset Single Register)	Write Accesses the word device register	Write Word	4X
16 (Preset Multiple Regs.)	Write the word device register	Write Word	4X

SETTING UP COMMUNICATION CARD

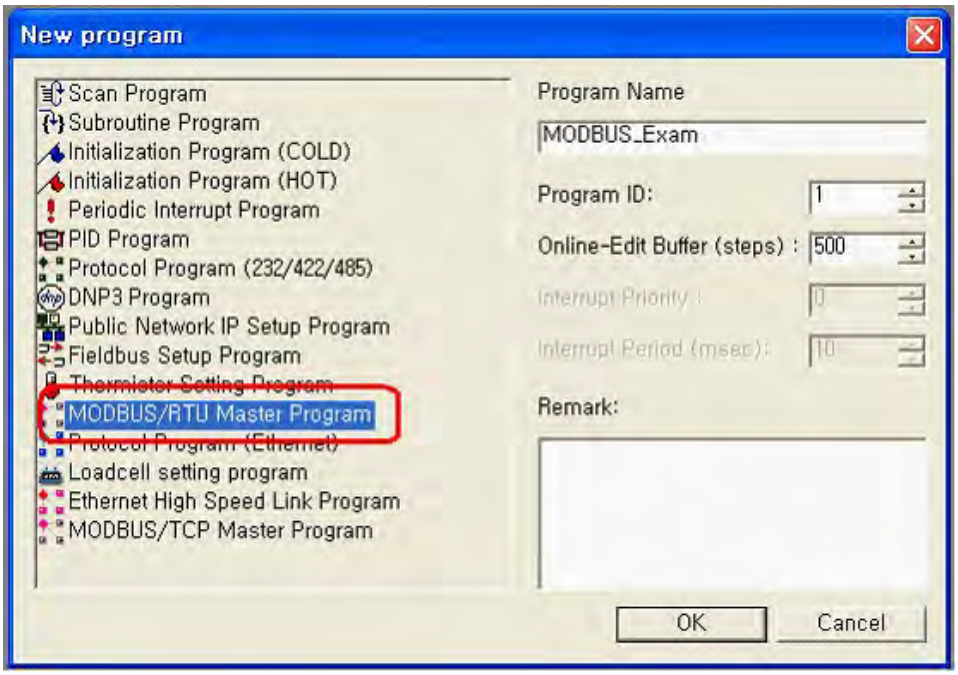
To run MODBUS Master function, the parameter have to be set up in the special module setup. After running the CICON, select the menu **[tool - Special Module Setup – RS232C/422 module...]**
Please select "MODBUS Master Program".



REGISTER SPECIAL PROGRAM

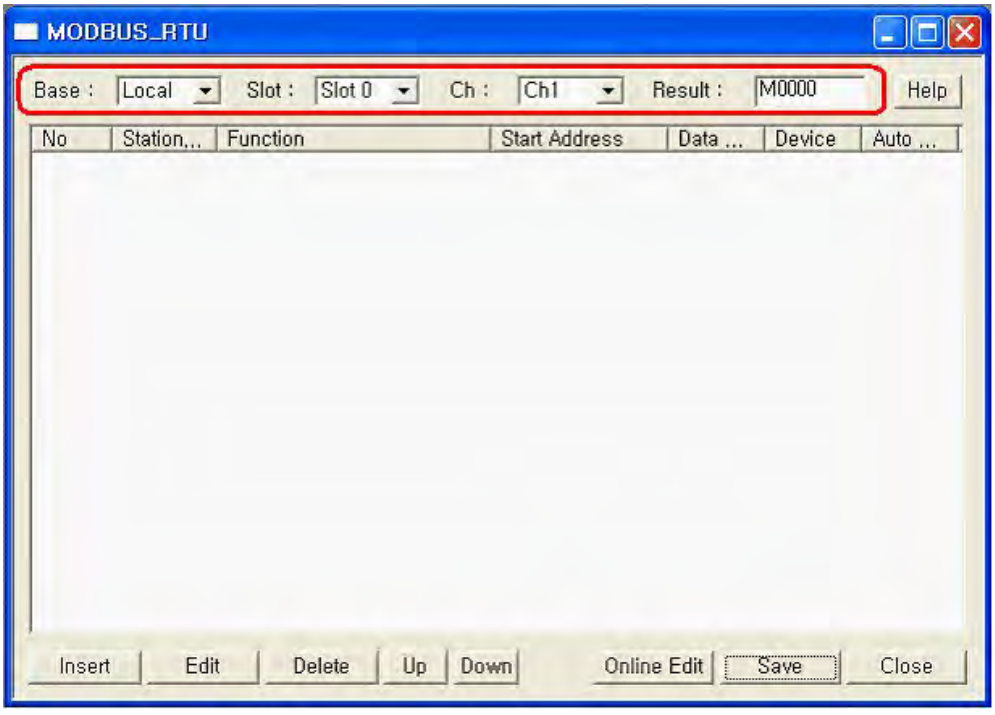
3.1 Start scan program

- Select [NEW program – MODBUS/RTU Master Program], and register program name.



Select the [OK] button.

3.2 MODBUS_RTU dialog box will appear, set up a device.



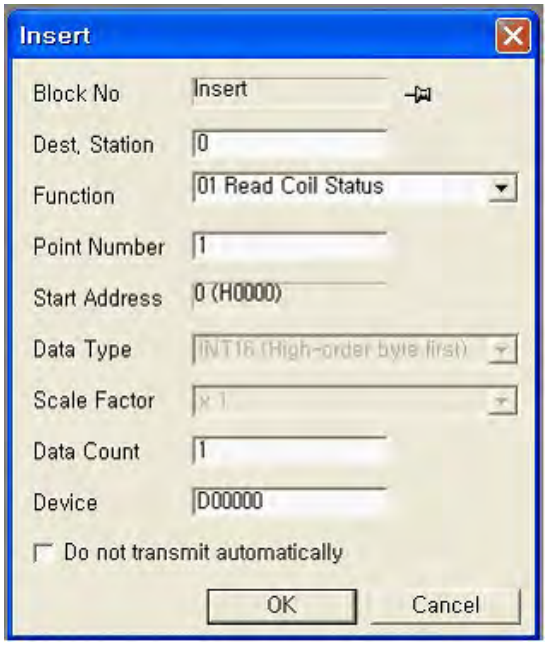
- Base: This is used select the base of MODBUS/RTU Master module configured.

- Slot: This is used select the slot of MODBUS/RTU Master module configured.
- Ch : This is used select the channel of MODBUS/RTU Master module configured.
- Result: This is used to appear the send/receive data's result of communication frame.

result	Frame No.	The comm. Result Flag		The comm. Result Flag Running	
		Succeed	Fail	Succeed	Fail
M0000	0	M0000	M0080	1 Scan On	On at all times Off at communication flag success
	11	M000B	M000B		
	127	M007F	M007F		

Example of configuration " result " M0000

3.4 REGISTER COMM. BLOCK



- Dest. Station. : This is used to select a station number of RTU MODBUS Slave configured, In case of connecting between several slaves used through RS422/485 communication, the station number have to be different between slaves each other.
- Function : This is used to select a suitable function when a data read/write between slaves. Please refer to the manual of "Command"
- Point Number : Resister read/write domains referred to a address table of slaves. Please refer to " Address table in SLAVE "
- Start Address: It is used to register the address of a read/write domain which is referred to address tables of slave. Please refer to the manual of " Address table of slave "

- Data Type : This is used to select a type of send/receive data between slaves. Only selected analog data (Function 3, 4, 6, 16),
  they are valid

Data Type	Valid Data(Byte)	Result Data(Byte)
INT16(High-Order byte first)	12 34	12 34
INT16(Low-Order byte first)	12 34	34 12
INT32(High-Order byte first)	12 34 56 78	56 78 12 34
INT32(Low-Order byte first)	12 34 56 78	34 12 78 56
Float(High-Order byte first)	12 34 56 78	56 78 12 34
Float(Low-Order byte first)	12 34 56 78	34 12 78 56

- Scale Vector: Not Necessary
- Data Count: This is used to set up a count of read/write slaves data.

Command(Function)	Data Size
1 - Read Coil Status 2 - Read Input Status	Bit Size
3 – Read Holding Registers 4 – Read Input Registers	Word Size
5 – Force Single Coil	Not Necessary.(1Bit Write)
6 – Preset Single Registers	Not Necessary.(2Byte Write)
16 - Preset Multiple Registers	Word Size

- device: This is used to select a device address of send/receive data stored.

Function	device	Substance
Read Function	D0000	Address stored receive data between slaves
Write Function	D0010	Address stored send data between slaves

- Do not transmit Automatically : This is used to communicate the block configured MODBUS

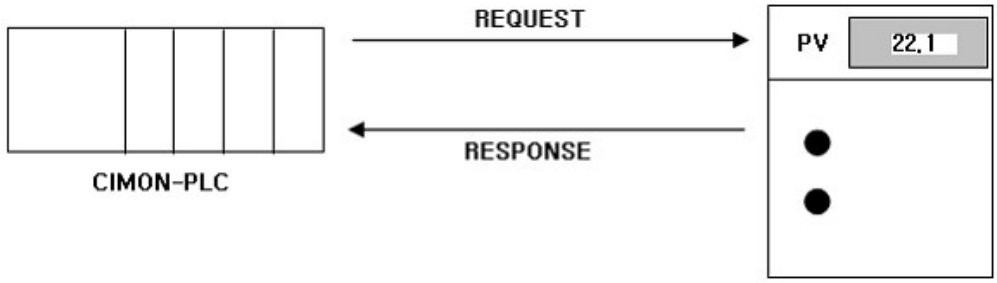
RTU Master

program sequencely(0~15). When you don't use this function, check the blank. It is possible to receive data if only

SEND command when check the blank,

Example of MODBUS RTU Master Special Programming Communication

Following picture shows slaves, communication system and frame structure which supported CIMON-PLC and MODBUS RTU Protocol.



[Information of slave]

Parameter of slave	Substance
Comm. Protocol	MODBUS RTU protocol(Slave)
Comm. Type	RS232C
Station	1
Baud Rate	9600bps
Parity	None
Data bit	8
Stop bit	1

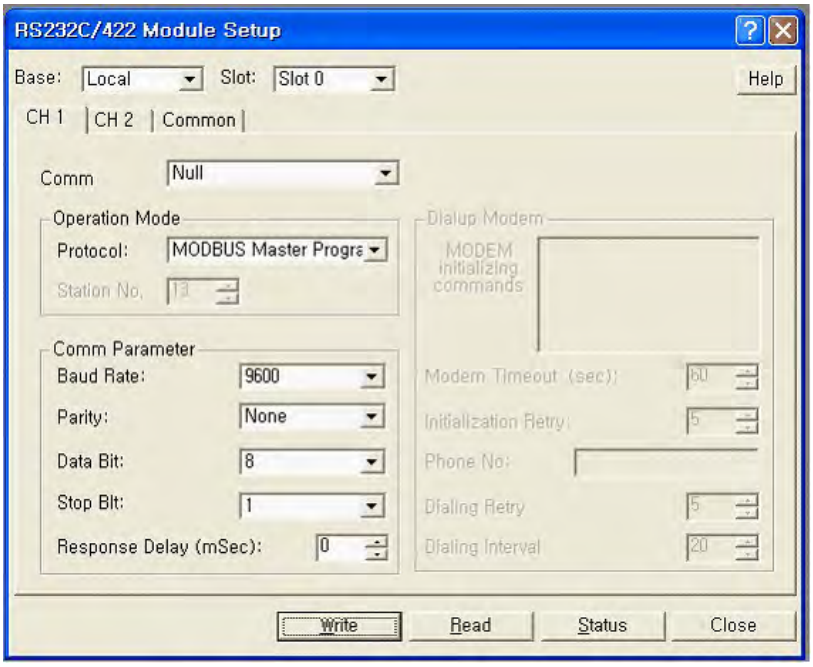
[Address table of slave]

Address	Substance	PLC device address
00001	PV(present)	D00000

00002	SV(set value)	D00010
…	…	…

4-1. EXAMPLE OF REGISTE

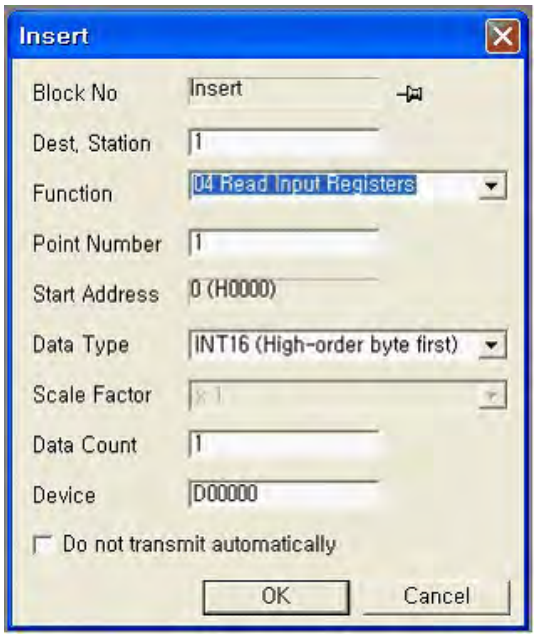
1. Register " special module setup ". Please refer to " Communication Setup "



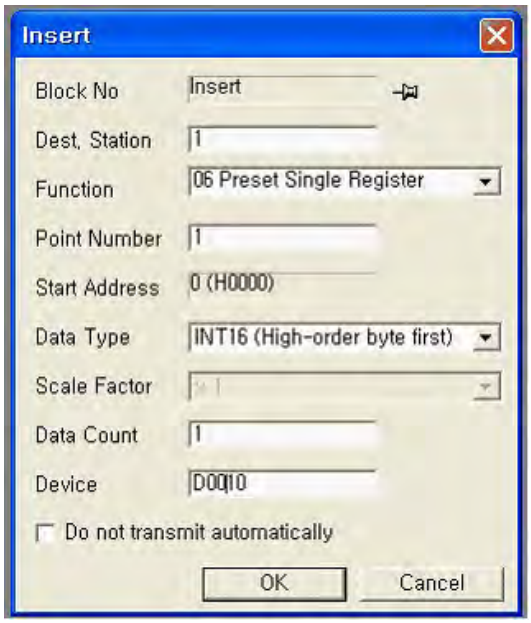
2. Register " a communication parameter of slave" . Please compare to " special module setup " whether it's the same or not.

3. Register " MODBUS RTU MASTER special program "

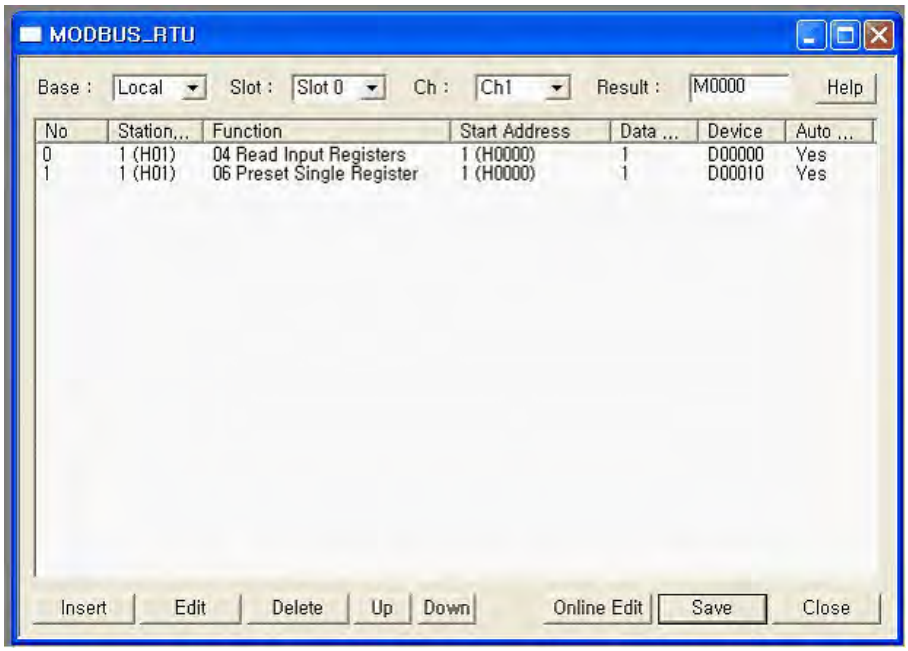
   a. Register a communication block for receiving PV value



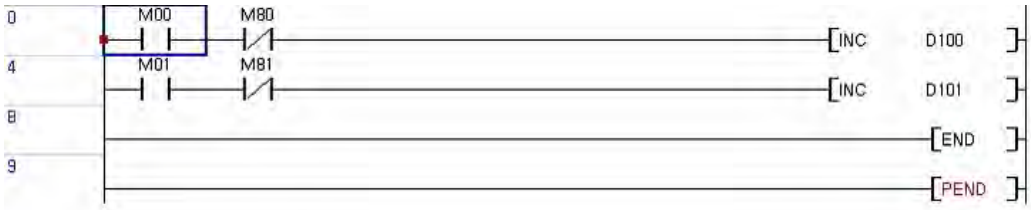
b. Register a communication block for sending SV value



c. Complete to register two communication blocks ,‘a’ and ‘b’



4. Download PLC program. After downloading, please change the mode to " RUN "
5. Program PLC scan program for debugging.
    a. In case of succeed in receiving PV value, Increase a data in D00100..
    b. In case of succeed in sending SV value, Increase a data in D00101.



6.2.7 Installing and Testing

Installing and Testing :

- Order of Installation
- Safety Precautions

- Testing

6.2.7.1 Order of Installation

1. Prepare the components for system configuration.

2. Mount a communication module in the state that the power for a PLC is not supplied.

3. Make sure there are dust and remains in the connecter of the base where the communication module will be mounted and whether the connecter pins of the communication module are broken.

4. The maximum number of modules mounted on one base is 8.
   When you mount this module, insert the connecting part on the bottom of the module to the slot of a base exactly in the state that the communication cable is not connected and press the power sufficient to lock the module to the base completely. Otherwise, an error in the interface with CPU may occur.

5. Tighten the screws at both ends of the RS232C cable to secure connection.

6. Input the power after connecting the communication cable. Make sure whether the module is operated normally, observing the operation of the LED. In case of normal operation, select the menu to set up various parameters for the communication module and to download the program to run.

6.2.7.2 Safety Precautions

1. Select communication method correctly.

2. Select the action mode of a computer link module correctly and click it to set up. If the action mode is set up wrongly, the communication may be disabled.

3. If the station number is duplicated in the state that the action mode is set up as the exclusive communication mode, there will be an error in communication.

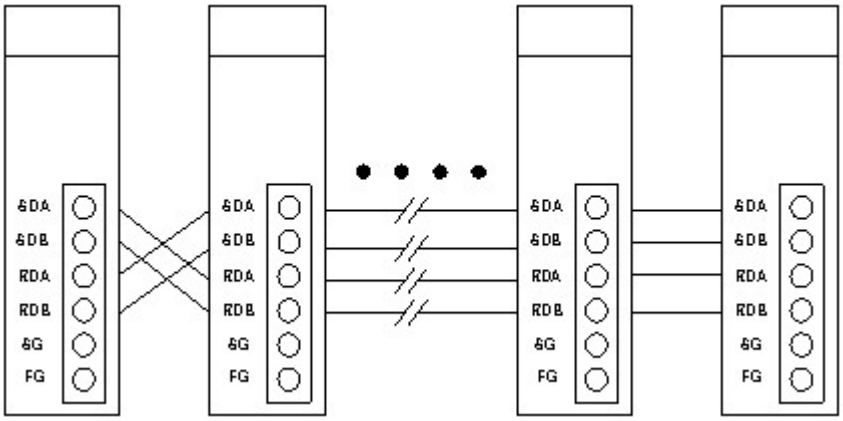
4. Use the cable of the assigned standard as the communication cable.

5. Check where the communication cable is broken.

6. Tighten the screws to fix the communication cable connecter.

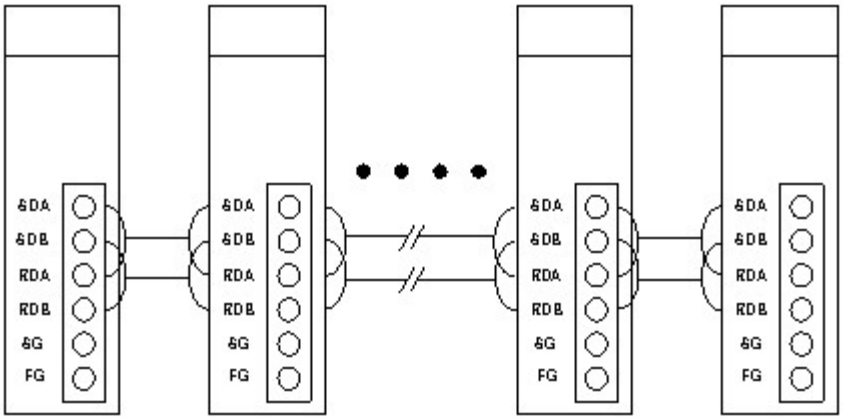
7. Connect the cable of Channel 2(RS422/RS485) correctly.

- **Installation of RS422 Cable :**
  Connect TX with RX between the first two stations. Connect TX with TX and RX with RX, between other stations.



- **Installation of RS485 Cable :**

  Connect SDA with SDB and RDA with RDB each other in 2-wire type connection.

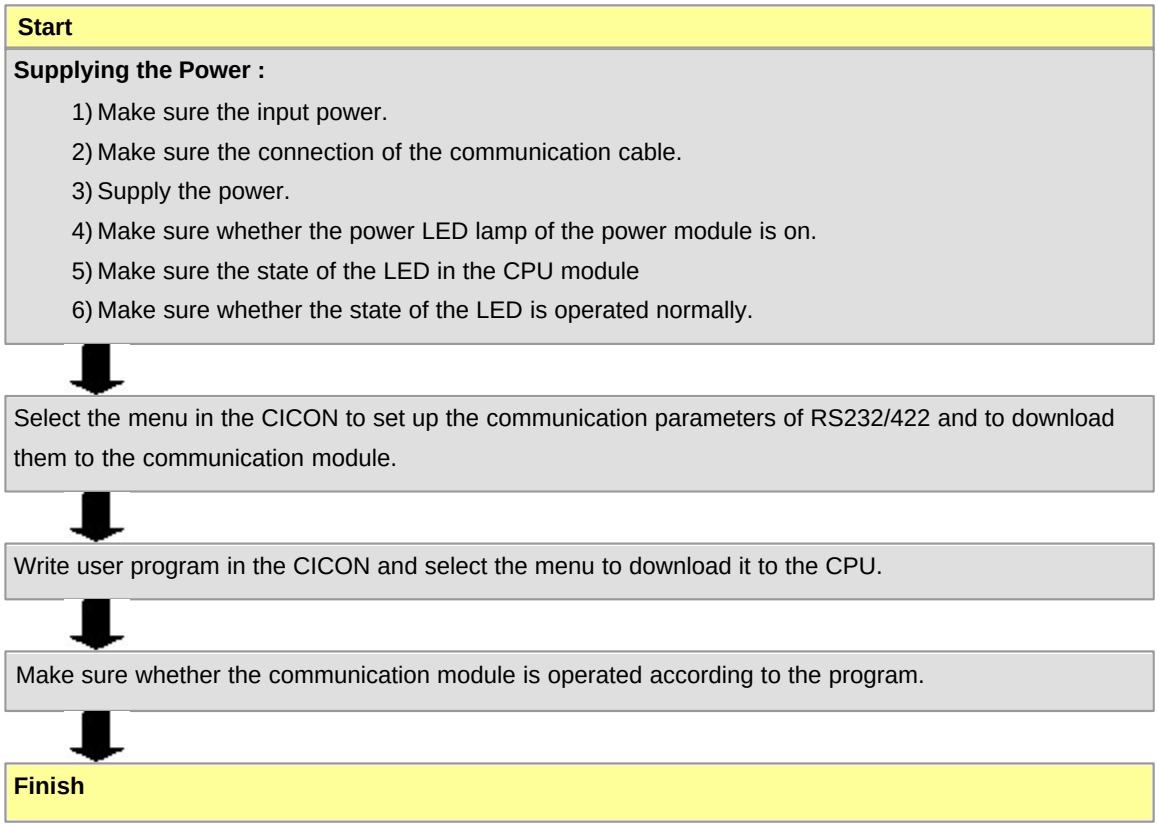


6.2.7.3 Testing

Check Points before Testing ,

Check Point	Description
Mount of This Module	Is it all right the mounted state of this communication module on the base?
Mount of Standard Modules	Does the power used for the power module comply with its specifications? Is it all right the mounted state of the standard modules? Does a battery connect with the CPU module?
Connection of Comm. Cable	Is it all right the connected state of the communication cable?

Testing ,



6.2.8 Trouble Shooting

Trouble Shooting :

- Error Codes
- Error in Hardware
- Error in Exclusive Communications
- Error in Modem Link when Linking CICON

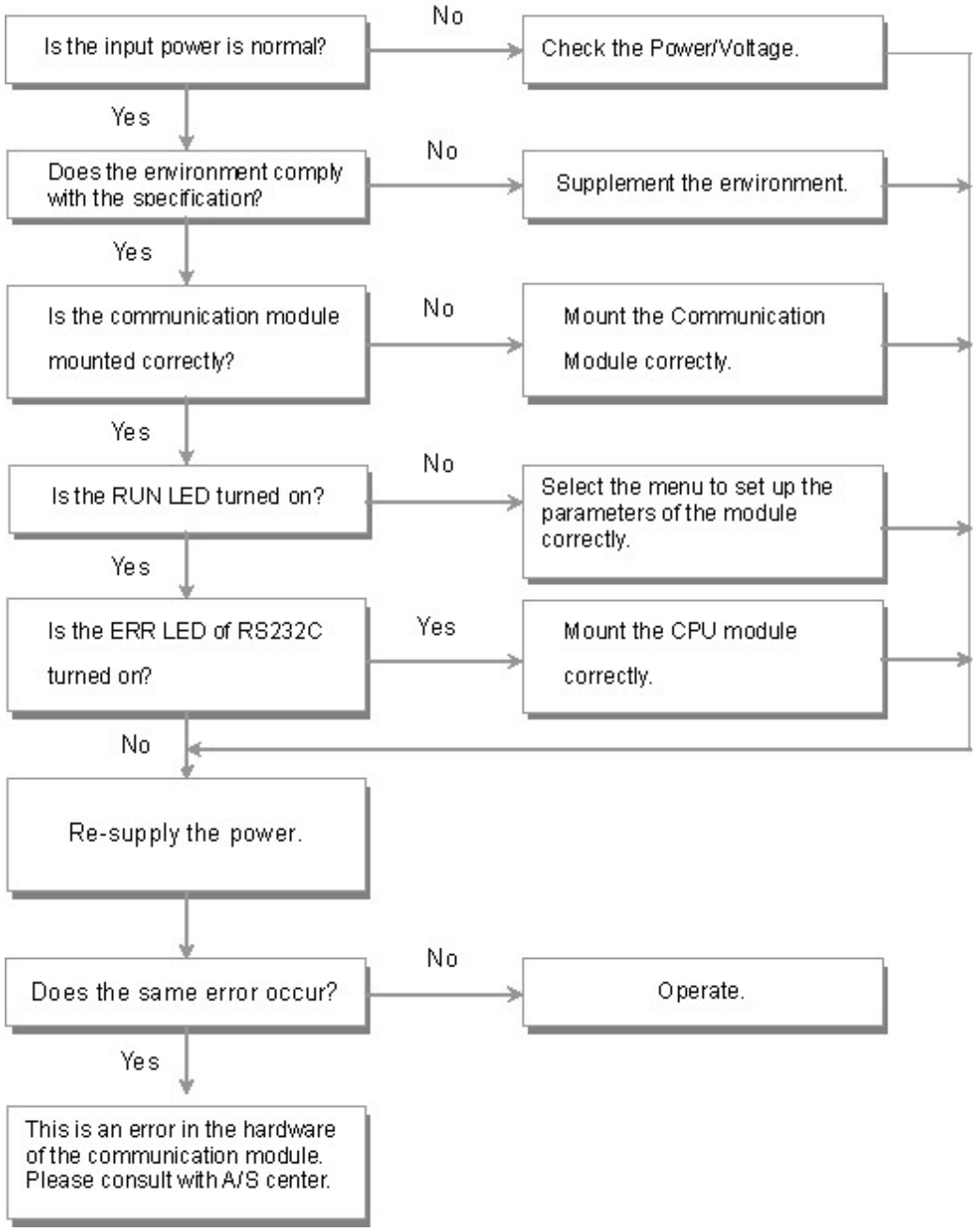
6.2.8.1 Error Codes

Error Code Hexa(Deci)	Description	Remarks

0x0000 (0)	No error	
0x0001 (1)	A module is not initialized.	
0x0005 (5)	A CPU module does not respond.	
0x0006 (6)	Not able to access buffer memory.	
0x0007 (7)	A CPU module is dismounted from a base plate.	
0x0009 (9)	CTS signal does not come from modem.	
0x000A (10)	A modem is not initialized.	
0x000D (13)	Station number for PLC Link is duplicated.	
0x0010 (16)	Link between modems is failed.	
0x0012 (18)	SND command is duplicated.	
0x0013 (19)	RCV command is duplicated.	
0x0014 (20)	Invalid serial port is used.	
0x0016 (22)	Unregistered frame for sending/receiving	
0x0017	A segment is not registered to a frame.	
0x0018	The registration of Sending/receiving frame is wrong.	
0x001D	Sending/receiving size is over the maximum.	

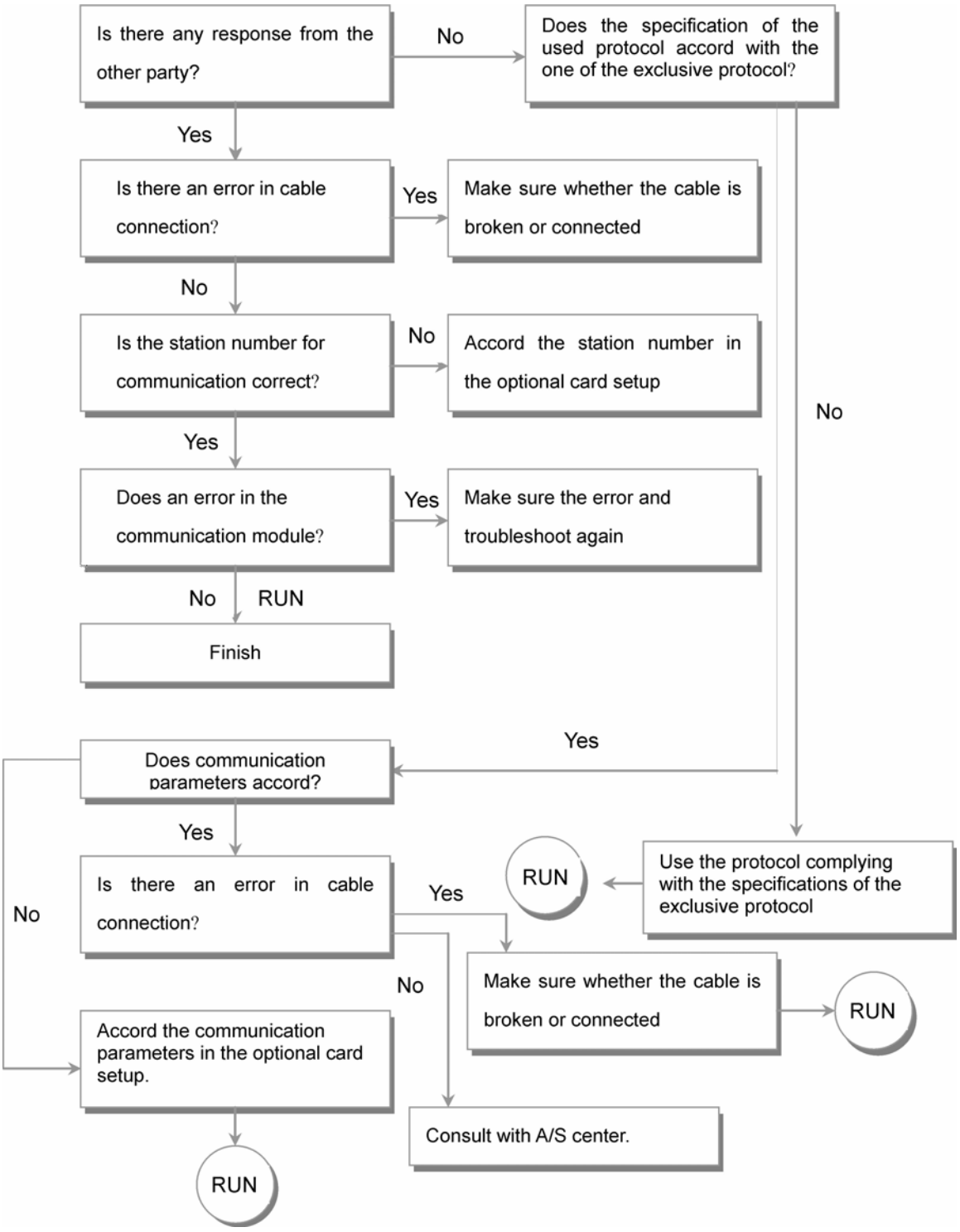
6.2.8.2 Error in Hardware

This corresponds to Error Code 1, 2, 3, 6 and 7.



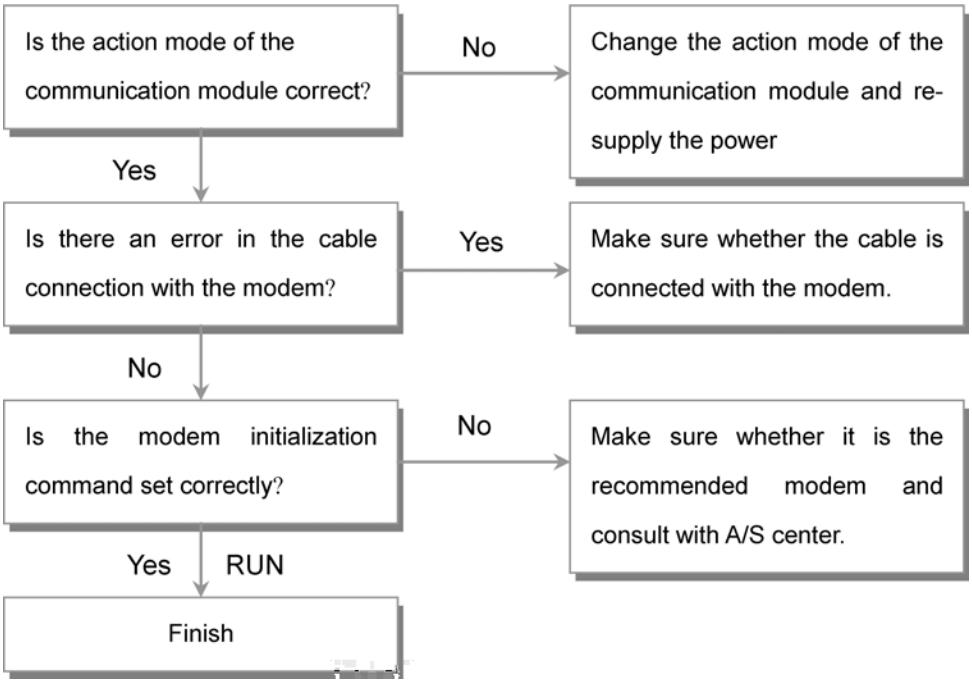
6.2.8.3 Error in Exclusive Communications

This corresponds Error Code 5.



6.2.8.4 Error in Modem Link when Linking CICON

This corresponds Error Code 4, 9 and10.



6.2.9 Appendix

Appendix :

- Definitions
- ASCII Code Table

6.2.9.1 Definitions

Communication Method

Simplex This communication method is that the flow of information is always constant in one direction. Information cannot be transferred in reverse direction.

Half Duplex As one-wire cable is used, this communication method is that information can be transferred in both directions not at the same time, but at regular intervals.

Full Duplex As two-wire cable is used, this communication method is that data can be sent and received at the same time.

Sending Method

According to rate, safety and economical efficiency when data are sent, sending method is classified into series sending and parallel sending. Advantage, disadvantage and features for each method are described as follows.

Series sending This method is to send data bit by bit through one cable. Though baud rate is slow, installation cost is cheap and software is simple.

Parallel sending This method is used for a video card or a hard disc in a computer and is to transfer data by one byte (8 bits). Though baud rate is fast and data is transferred exactly, there is disadvantage that the longer sending distance is, the higher installation cost is.

Protocol This is the communication rule prescribed in advance between a sending party and a receiving party to send and receive efficient and confident information without error among more than two (2) computers and terminal units.

Asynchronous method This method is to send word by word in synchronism in case of series sending. Start bit is sent in front of one character and the character code is sent. Finally, Stop bit is sent.

Node This is the location where the data in the tree structure of a network is. Each node is composed of the device storing data and the pointer device for sub-node.

BPS and CPS

- BPS : Bits Per Second
- CPS : Characters Per Second

BPS means the number of sending bits in a second. CPS, the abbreviation for characters per second, is the unit of printer speed and means the number of the characters printed by a printer in a second.

Packet This is a bundle of the data used when sending data. The data communicated between two stations is divided into suitable-size Packets and the packets are sent one by one. Packet includes the information about control such as receiving party, address or control code as well as a certain-size data.

Port This is the part of the computer used to communicate with other devices. In case of computer link communication, this means RS-232C port or RS-422(485) port.

RS232C This, one of the communication interface codes established by Electronics Industry Association (EIA), is mainly used to link with diverse devices such as computer, terminal unit, printer, floater and modem. And this is a synchronous series communication interface or an asynchronous series communication interface. There is the disadvantage that sending distance is short and only one to one communication is available, but cost is cheap.

RS422 / RS485 This, one of series communication interfaces such as RS-232C, is used in longer sending distance than the one of RS-232C and one to N access is available. RS-422(1:N) is used for Full Duplex communication with 4 signal lines and RS-485(N:M) is used for Half Duplex communication with 2 signal lines.

BCC Block Check Character
As series sending may send distorted signal due to the influence of noise to sending line, this is the data that is for a receiving party to decide whether signal is normal or distorted. A receiving party calculates the data received up to the front of BCC and compares the result with received BCC to decide whether signal is normal or not.

FRAME This, the constant-size data sent in data communication, includes additional information such as destination code, control character for synchronism, parity or CRC to detect an error as well as data.

6.2.9.2 CIMON-PLC/HMI Protocal

CIMON-PLC / HMI Protocal Manual.

See :

Structure of Frame / Exclusive Communication / Error Response

6.2.9.2.1 Structure of Frame

Request Frame (Master) : The frame that an outside communication device requests to a computer link module

ENQ	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT

Response Frame (Slave) : The frame that a computer link module responds to an outside communication device

STX	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX

1) The structure of a sending frame and the one of a receiving frame are same.

2) The same as the command codes received from a request frame (Master) are used for response frame.
But, if there is an error in communication or process, Code E is responded.

Description for Codes

Code	Hex Value	Description
ENQ	05H	Master Frame Header
EOT	04H	Master Frame Tail
STX	02H	Slave Header
ETX	03H	Slave Tail
Stn	00H~1FH, FFH	PLC Station Number
Cmd		Command
Leng		Length of Data Device (Length Bytes), Hexadecimal
Data		Data Device according to Command (Length Bytes)
BCC		Remainder value when dividing the binary-sum from Cmd to the end of data by 256

Commands : The commands used for exclusive communication service are as follows

Command	Code	ASCII	Function
Read Word Data	52H	R	Reads Word Memory Device.
Write Word Data	57H	W	Writes to Word Memory Device.
Read Bit Data	72H	r	Reads Bit Memory Device.
Write Bit Data	77H	w	Writes to Bit Memory Device.
Mode Change	4DH	M	Changes PLC Mode.
Register Monitoring Device	58H	X	Registers Monitoring Device.
Monitor Read	59H	Y	Reads Registered Monitoring Device
Error Response	45H	E	Responds Error in PLC.

6.2.9.2.2 Exclusive Communications

IN THIS TOPIC :

READ WORD DATA

Function

- This is used to read the data in the word device of a PLC. (Max. 63 words)
- Device Symbol : X, Y, M, L, K, F, Z, TC, TS, CC, CS, D, S

Request Frame (Master)

- COMMAND : 'R'
- Data Device Format

Address 8 Char	Size (Word) Hexadecimal, 2 Char	.....	Address 8 Char	Size (Word) Hexadecimal, 2 Char

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	02		R	0A		D0000001 01	B9		EOT
05H	30H	32H	52H	30H	41H	4430303030303031 3031H	42H	39H	04H

Leng is the length of a data and its value means the length of a data (D0000001 01).
Data means the address really read (D0000001) and the length of the word data read (01).
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256

Response Frame (Slave)

- COMMAND (In completed case: 'R' / In failed case: 'E')
- Format of Data Device

[Completed Case]

PLC DATA

Word Data 4 Char	Word Data 4 Char	.....	Word Data 4 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX
STX	02		R	04		F4AC	B4		ETX
02H	30H	32H	52H	30H	34H	46344143H	42H	34H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing binary-sum from Cmd to the end of data by 256.
As the response frame is processed, Cmd is 'R'..
Leng means the length of a data (F4AC).

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		02	09		ETX
02H	30H	32H	45H	30H	32H	3032H	30H	39H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is not processed, Cmd is 'E'.
Leng means the length of error code(02).

Error code displays the type of an error. Please refer to the 'ERROR RESPONSE'.

Ex.) Read data from Address D00040 of Station 02H.
Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	02		R	0A		D0000040 01	BC		EOT
05H	30H	32H	52H	30H	41H	4430303030303430 3031H	42H	43H	04H

Completed Case> reads 1-word data 'F4AC'
Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX

STX	02		R	04		F4AC	B4		ETX
02H	30H	32H	52H	30H	34H	46344143H	42H	34H	03H

Failed Case> Error in BCC
Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		02	09		ETX
02H	30H	32H	45H	30H	32H	3032H	30H	39H	03H

Write WORD DATA ?

Function

- This is used to write a data to the word device of a PLC.
- Device Symbol : X, Y, M, L, K, F, Z, TC, TS, CC, CS, D, S

Request Frame

- COMMAND : 'W'
- Format of Data Device

Address 8 Char	Size (Word) Hexadecimal, 2 Char	Word Data Hexadecimal, Size*4 Char	.....	Address 8 Char	Size (Word) Hexadecimal, 2 Char	Word Data Hexadecimal, Size*4 Char

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	02		W	0E		D0000010 01 FA34	B0		EOT
05H	30H	32H	57H	30H	45H	4430303030303130 3031 46413334H	42H	30H	04H

Leng is the length of a data and its value means the length of the Data (D0000010 01 FA34).
The address really written (D0000010), the length of the data (01) and the data written (FA34) are input in the Data (D1000 02 FA34).
BCC is the remainder value (F3) when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame

- COMMAND (In completed case: 'W' / In failed case : 'E')
- Format of Data Device

[Completed Case]

No Data?

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	02		W	00		B7		ETX
02H	30H	32H	57H	30H	30H	42H	37H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is processed, Cmd is 'W'.
Leng means the length of a data.

[Failed Case]

ERROR CODE

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		01	08		ETX
02H	30H	32H	45H	30H	32H	3031H	30H	38H	03H

The request frame received from a master is used as the response frame of a PLC.

BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

As the response frame is not processed, Cmd is 'E'.

Leng(02) means the length of Error Code(01).

Error code displays the type of an error. Please refer to the 'ERROR RESPONSE'.

Ex.) Write FA34H to Address D0010 and 8D41H to Address D0020.
Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	02		W	12		D0000010 02 FA34 8D41	80		EOT
05H	30H	32H	57H	31H	32H	4430303030303130 3032 46413334 38443431H	38H	30H	04H

Completed Case > No Data?

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	02		W	0		B7		ETX

02H	30H	32H	57H	30H	30H	42H	37H	03H

Failed Case>Receiving unknown command code (01H).
Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		01	08		ETX
02H	30H	32H	45H	30H	32H	3031H	30H	38H	03H

Read BIT DATA

Function

- This is used to read the data in the bit device of a PLC.
- Device Symbol : X, Y, M, L, K, F, Z, T, C

Request Frame

- COMMAND : 'r'
- Format of Data Device

Address 8 Char	Size (Bit) Hexadecimal, 2 Char	.....	Address 8 Char	Size (Bit) Hexadecimal, 2 Char

Master(Requset Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	03		r	0A		M000010F 02	F9		EOT
05H	30H	33H	72H	30H	41H	4D303030313030 46 3032H	46H	39H	04H

• Leng is the length of a data and its value means the length of Data (M000010F 02H).
• The address really read(M000010F) and the length of the data(02) are input in the Data.
• BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame

- COMMAND (In completed case: 'r' / In failed case: 'E')
- Format of Data Device

[Completed Case]

PLC Data

Bit Data	Bit Data	.....	Bit Data

1 Char	1 Char		1 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX
STX	01		r	02		0 1	35		ETX
02H	30H	31H	72H	30H	32H	30 31H	33H	35H	03H

Ÿ The request frame received from a master is used as the response frame of a PLC.
Ÿ BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
Ÿ As the response frame is processed, Cmd is 'r'.
Ÿ Leng(02) means the length of the Data(0 1).

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	03		E	02		01	08		ETX
02H	30H	33H	45H	30H	32H	3031H	30H	38H	03H

ŸThe request frame received from a master is used as the response frame of a PLC.

ŸBCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

ŸAs the response frame is not processed, Cmd is 'E'.

ŸLeng(02) means the length of Error Code(01).

ŸError code indicates the type of an error. Please refer to the 'ERROR RESPONSE'.

Ex.) Read the bit data in Address M0104 and Address M0105 of Station 03 PLC.
Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	03		r	0A		M0000104 02	E7		EOT
05H	30H	33H	72H	30H	41H	4D3030303031 3034 3032H	45H	37H	04H

Completed Case > Reads Data '0 1'.
Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX
STX	03		r	02		0 1	35		ETX
02H	30H	33H	72H	30H	32H	30 31H	33H	35H	03H

Failed Case > Error in BCC
Slave (Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	03		E	02		02	09		ETX
02H	30H	33H	45H	30H	32H	3032H	30H	39H	03H

Write BIT DATA

Function

- This is used to write data to the bit device of a PLC
- Device Symbol : X, Y, M, L, K, F, Z, T, C

Request Frame

- COMMAND : 'w'
- Format of Data Device
-

Address 8 Char	Size (Bit) Hexadecimal, 2 Char	Bit Data Size*1 Char	…	Address 8 Char	Size (Bit) Hexadecimal, 2 Char	Bit Data Size*1 Char

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	03		w	0D		M0000101 03 110	7F		EOT
05H	30H	33H	77H	30H	44H	4D303030303130 31 3033 313130H	37H	46H	04H

• Leng(0B) is the length of data and its value means the length of Data (M0000101 03 110).
• The address really written(M0000101), the length of the data(03) and the data written(110) are input in the Data.
• BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame

- COMMAND (In completed case: 'w' / In failed case: 'E')
- Format of Data Device

[Completed Case]

No Data

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	03		w	00		D7		ETX
02H	30H	33H	77H	30H	30H	44H	37H	03H

ŸThe request frame received from a master is used as the response frame of a PLC.
ŸBCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
ŸAs the response frame is processed, Cmd is 'w'.
ŸLeng(00) means the length of the data.

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		04	0B		ETX
02H	30H	32H	45H	30H	32H	3034H	30H	42H	03H

- The request frame received from a master is used as the response frame of a PLC.
- BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
- As the response frame is not processed, Cmd is 'E'.
- Leng(02) means the length of Error Code (04).
- Error code indicates the type of an error. Please refer to the 'ERROR RESPONSE'.

Ex.) Write bit data to Bit Address M0104.

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		w	0D		M0000104 03 110	82		EOT
05H	30H	31H	77H	30H	44H	4D303030303130 34 3033 313130H	38H	32H	04H

< Completed Case >

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	01		w	00		D7		ETX

02H	30H	31H	77H	30H	30H	44H	37H	03H

Failed Case > Data Size Overflow

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		04	0B		ETX
02H	30H	31H	45H	30H	32H	3034H	30H	42H	03H

Change PLC Mode

Function

- This is used to change the operation mode of a PLC. .

Request Frame

- COMMAND : 'M'
- Format of Data Device

Mode Code

Mode	Code
Run	0
Program	1
Pause / Remote	2

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		M	01		0	DE		EOT
05H	30H	31H	4DH	30H	31H	30H	44H	45H	04H

• Leng(01) is the length of data.

• Mode code value(0) is input in the Data(0).

? • BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

• Only the case CPU is under REMOTE status is available.

Response Frame

- COMMAND (In completed case: 'M' / In failed case: 'E')
- Format of Data DEvice

[Completed Case] No Date?

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	01		M	00		AD		ETX
02H	30H	31H	4DH	30H	30H	41H	44H	03H

- The request frame received from a master is used as the response frame of a PLC.
- BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
- As the response frame is processed, Cmd is 'M'.
- Leng(00) means the length of the data.

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	02		E	02		03	0A		ETX
02H	30H	32H	45H	30H	32H	3033H	30H	41H	03H

ŸThe request frame received from a master is used as the response frame of a PLC.
ŸBCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
ŸAs the response frame is not processed, Cmd is 'E'.
ŸLeng(02) means the length of Error Code (03).
ŸError code indicates the type of an error. Please refer to the 'ERROR RESPONSE'.

Ex.) Change the operation mode of a PLC to PAUSE/REMOTE mode.

Master(Requset Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		M	01		2	E0		EOT
05H	30H	31H	4DH	30H	31H	32H	45H	30H	04H

Completed Case

Slave(Response Format)

HEADER	Stn	Stn	Cmd	Leng	Leng	BCC	BCC	ETX

	H	L		H	L	H	L	
STX	01		M	00		AD		ETX
02H	30H	31H	4DH	30H	30H	41H	44H	03H

< Failed CAse > Invalid mode

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		03	0A		ETX
02H	30H	31H	45H	30H	32H	3033H	30H	41H	03H

Register Monitoring Device

Function

- This is used to register a monitoring device.
- 16 devices can be registered as maximum. (Distinguishing by Frame No., 0h – Fh)
- Individual device should be continuous and is limited to 63 words as maximum.

Request Frame

- COMMAND : 'X'
- Format of Data Device
-

Frame No. 1 Char	Word Address 8 Char	Word Size 16진 2 Char

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data			BCC H	BCC L	EOT
ENQ	01		X	0B		0	D0000001	02	C0		EOT
05H	30H	31H	58H	30H	42H	30H	4430303030303031H	3032H	43H	30H	04H

• Leng(0B) is the length of a data.

• The Mode code(0), the Address(D0000001) and the Size(02) are input in the Data (0 D00001 02).

• BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

Response Frame

- COMMAND (In completed case: 'X' / In failed case: 'E')

- Format of Data Device

[Completed Case]

No Data

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	01		X	00		B8		ETX
02H	30H	31H	58H	30H	30H	42H	38H	03H

• The request frame received from a master is used as the response frame of a PLC.

• BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

• As the response frame is processed, Cmd is 'X'.

• Leng(00) means the length of the data.

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		07	0E		ETX
02H	30H	31H	45H	30H	32H	3037H	30H	45H	03H

The request frame received from a master is used as the response frame of a PLC.
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
As the response frame is not processed, Cmd is 'E'.
Leng(02) means the number of Error Codes (07).
Error code indicates the type of an error. Please refer to the 'ERROR RESPONSE'.

Ex.) Register Frame 1 and Addresses from D0011 to D0014 to Station 1.

Master(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		X	0B		1 D0000011 04	C5		EOT
05H	30H	31H	58H	30H	42H	31 443030303030 3131 3034H	43H	35H	04H

< Completed Case >

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	BCC H	BCC L	ETX
STX	01		X	00		B8		ETX
02H	30H	31H	58H	30H	30H	42H	38H	03H

Failed CAse > Invalid Monitor Frame No.(0h~Fh)

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		07	0E		ETX
02H	30H	31H	45H	30H	32H	3037H	30H	45H	03H

Read Monitoring Device

Function

- This is used to read the registered monitoring device..

Request Frame

- COMMAND : 'Y'
- Format of Data Device

Frame No. 1 Char

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		Y	01		0	EA		EOT
05H	30H	31H	59H	30H	31H	30H	45H	41H	04H

Leng(01) is the length of a data.
Frame No. is input in the Data(0).
BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

Request Frame

- COMMAND (In completed case: 'Y' / In failed case: 'E')
- Format of Data Device

[Completed Case]

Frame No.	Word Data 4 Char	.....	Word Data 4 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		Y	05		0 87F3	D6		EOT
05H	30H	31H	59H	30H	35H	30 38374633H	44H	36H	04H

- The request frame received from a master is used as the response frame of a PLC.
- BCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.
- As the response frame is processed, Cmd is 'Y'.
- Leng(05) means the length of the Data(0 87F3).

[Failed Case]

Error Code

Error Code 2 Char

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		08	0F		ETX
02H	30H	31H	45H	30H	32H	3038H	30H	46H	03H

ŸThe request frame received from a master is used as the response frame of a PLC.

ŸBCC is the remainder value when dividing the binary-sum from Cmd to the end of data by 256.

ŸAs the response frame is not processed, Cmd is 'E'.

ŸLeng(02) means the length of Error Code(08H).

ŸError code indicates the type of an error. Please refer to the 'ERROR RESPONSE'.

Ex.) If Frame 2h, Address D1005 and Address D1006 are registered as a monitoring device, read the registered device.

Master(Request Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	EOT
ENQ	01		Y	01		2	EC		EOT
05H	30H	31H	59H	30H	31H	32H	45H	43H	04H

< Completed Case >

Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Data	BCC H	BCC L	ETX
STX	01		Y	09		2 87F3 32E7	BD		ETX
02H	30H	31H	59H	30H	39H	32 38374633 33324537H	42H	44H	03H

< Failed Case > Number of the unregistered(Not initialized) frame
Slave(Response Format)

HEADER	Stn H	Stn L	Cmd	Leng H	Leng L	Error Code	BCC H	BCC L	ETX
STX	01		E	02		08	0F		ETX
02H	30H	32H	45H	30H	32H	3038H	30H	46H	03H

6.2.9.2.3 Error Response

Function

- This is the function to inform a master of error occurring in the process of a communication frame or a request frame and is used in a response frame only.

Request Frame

- All request frames

Response Frame

- COMMAND : 'E'
- Format of Data Device
- Error Code

Error Code
2 Char

Error Code	Description
00	No error.
01	Receives unknown command code.
02	An error occurs in BCC.
03	CPU does not respond.
04	Receives unknown device code.
05	Exceeds the device read.
06	Invalid address.
07	Internal error
08	Receives the number of invalid data
09	Invalid data
10	Unregistered (Not initialized) frame number

11	Invalid Monitor Frame No. (0h – Fh) Invalid frame number
12	CPU is not in REMOTE status.
13	Invalid CPU status is assigned.
14	An error occurs in the size of the data written.
15	It is disabled to write.
16	It is disabled to change mode.

6.2.9.3 ASCII Code Table

BIN	Hex	Symbol	BIN	Hex	Symbol	BIN	Hex	Symbol	BIN	Hex	Symbol
0	0	NUL	**32**	20	(space)	**64**	40	@	**96**	60	`
1	1	SOH	**33**	21	!	**65**	41	A	**97**	61	a
2	2	STX	**34**	22	"	**66**	42	B	**98**	62	b
3	3	ETX	**35**	23	#	**67**	43	C	**99**	63	c
4	4	EOT	**36**	24	$	**68**	44	D	**100**	64	d
5	5	ENQ	**37**	25	%	**69**	45	E	**101**	65	e
6	6	ACK	**38**	26	&	**70**	46	F	**102**	66	f
7	7	BEL	**39**	27	'	**71**	47	G	**103**	67	g
8	8	BS	**40**	28	(	**72**	48	H	**104**	68	h
9	9	TAB	**41**	29	)	**73**	49	I	**105**	69	i
10	A	LF	**42**	2A	*	**74**	4A	J	**106**	6A	j
11	B	VT	**43**	2B	+	**75**	4B	K	**107**	6B	k
12	C	FF	**44**	2C	,	**76**	4C	L	**108**	6C	l
13	D	CR	**45**	2D	-	**77**	4D	M	**109**	6D	m
14	E	SO	**46**	2E	.	**78**	4E	N	**110**	6E	n
15	F	SI	**47**	2F	/	**79**	4F	O	**111**	6F	o
16	10	DLE	**48**	30	0	**80**	50	P	**112**	70	p
17	11	DC1	**49**	31	1	**81**	51	Q	**113**	71	q
18	12	DC2	**50**	32	2	**82**	52	R	**114**	72	r
19	13	DC3	**51**	33	3	**83**	53	S	**115**	73	s
20	14	DC4	**52**	34	4	**84**	54	T	**116**	74	t
21	15	NAK	**53**	35	5	**85**	55	U	**117**	75	u
22	16	SYN	**54**	36	6	**86**	56	V	**118**	76	v
23	17	ETB	**55**	37	7	**87**	57	W	**119**	77	w
24	18	CAN	**56**	38	8	**88**	58	X	**120**	78	x
25	19	EM	**57**	39	9	**89**	59	Y	**121**	79	y
26	1A	SUB	**58**	3A	:	**90**	5A	Z	**122**	7A	z
27	1B	ESC	**59**	3B	;	**91**	5B	[	**123**	7B	{
28	1C	FS	**60**	3C	<	**92**	5C	\	**124**	7C	|
29	1D	GS	**61**	3D	=	**93**	5D	]	**125**	7D	}

30	1E	RS	**62**	3E	>	**94**	5E	^	**126**	7E	~
31	1F	US	**63**	3F	?	**95**	5F	_	**127**	7F	□