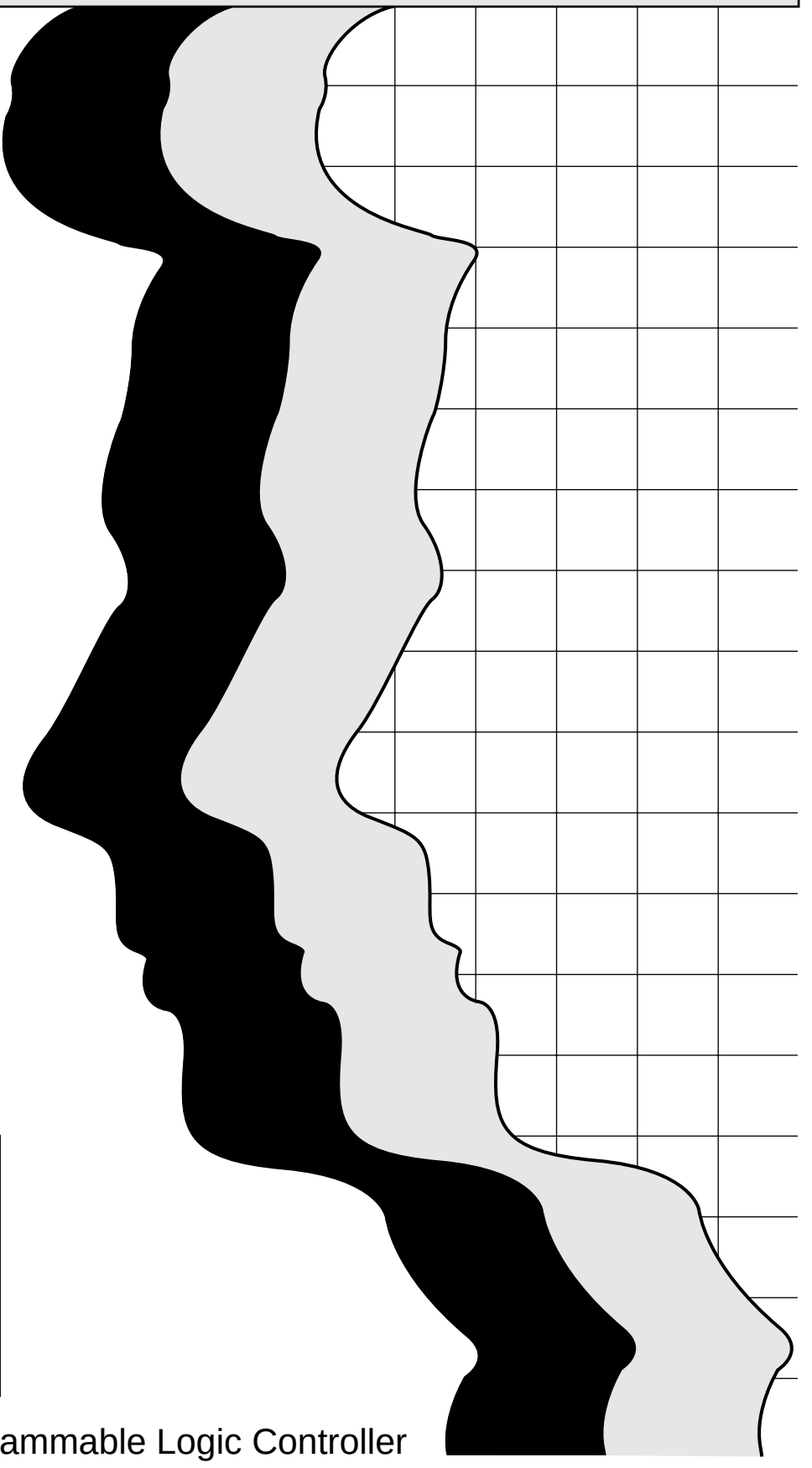
MITSUBISHI

Serial communication compatible with MODBUS
type AJ71UC24-S2/A1SJ71UC24-R2-S2/A1SJ71UC24-R4-S2

User's Manual



MELSEC

Mitsubishi Programmable Logic Controller

● SAFETY PRECAUTIONS ●

(Read these precautions before using.)

When using Mitsubishi equipment, thoroughly read this manual and the associated manuals introduced in this manual. Also pay careful attention to safety and handle the module properly.

These precautions apply only to Mitsubishi equipment. Refer to the CPU module user's manual for a description of the PC system safety precautions.

These ● SAFETY PRECAUTIONS ● classify the safety precautions into two categories: "DANGER" and "CAUTION".

⚠ DANGER	Procedures which may lead to a dangerous condition and cause death or serious injury if not carried out properly.
⚠ CAUTION	Procedures which may lead to a dangerous condition and cause superficial to medium injury, or physical damage only, if not carried out properly.

Depending on circumstances, procedures indicated by ⚠ **CAUTION** may also be linked to serious results.

In any case, it is important to follow the directions for usage.

Store this manual in a safe place so that you can take it out and read it whenever necessary.
Always forward it to the end user.

[System Design Precautions]

⚠ DANGER

- When controlling a PC by connecting a personal computer or other similar control device to a special function module for the purpose of changing the data, changing the program, or changing the operation status (status control), an interlock circuit must be configured in the sequence program so that the entire system will always operate safely.
  If a remote PC is controlled in the manner indicated above by an external device, the system may fail to respond immediately even when trouble occurs at the remote PC due to data communication error.
  In addition to configuring the interlock circuit in a sequence program, determine the response to be taken by the system at the occurrence of a data communication error as the processing between the external device and the PC CPU.

⚠ CAUTION

- Do not bundle control lines or communication wires together with main circuit or power lines, or lay them close to these lines.
  As a guide, separate these lines by a distance of at least 100 mm, otherwise malfunctions may occur due to noise.

[Cautions on Mounting]

⚠ CAUTION
• Use the PC in an environment that conforms to the general specifications in the manual. Using the PC in environments outside the ranges stated in the general specifications will cause electric shock, fire, malfunction, or damage to/deterioration of the product. • Switch off all phases of the power supply outside the PC before starting installing or wiring work. If all phases are not switched off, there will be a danger of electric shock or damage to the product. • Make sure that the module fixing projection on the base of the module is properly engaged in the module fixing hole in the base unit before mounting the module.(AnS series modules must be screwed to the base unit with the specified torque.) Failure to mount the module properly will result in malfunction or failure, or in the module falling. • Tighten screws to the specified torque. If a screw is not tightened to the specified torque, the module may fall out, or a short circuit or malfunction may occur. If a screw is tightened excessively, exceeding the specified torque, the module may fall out, short circuit, or malfunction due to breakage of the screw or the module. • Do not touch conductive parts or electronic components of the module with your bare hands. This could cause malfunction or failure of the module. • When connecting a wire to a connector, use the specified tool to connect it by crimping, pressure welding, or soldering correctly. Plug the connector into the module securely.

[Cautions on Wiring]

⚠ CAUTION

- Communication cables connected to a module must always be run in a duct or held securely using clamps.
  If a cable is not run in a duct or not held securely using clamps, the cable will sag, move, or be pulled by mistake, which will cause damage to the module and the cable and also malfunctioning due to loose connection of the cable.
- Check the correct type of interface for the connection before connecting cables.
  Connecting a cable to the wrong interface or miswiring could cause failure of the module or external device.
- Do not connect an external device that requires power supply from the computer link module to the RS-422 interface of the computer link module.
  This could cause failure of the module or the external device.
- Tighten terminal screws to the specified torque.
  If a terminal screw is not tightened to the specified torque, it the module may fall out, short circuit, or malfunction.
  If a terminal screw is tightened excessively, exceeding the specified torque, the module may fall out, short circuit, or malfunction due to breakage of the screw or the module.
- When removing the communication cable from a module, do not pull it out by the cable.
  For a cable with a connector, hold the connector plugged into the module to disconnect the cable.
  For a cable without a connector, loosen the screws that hold the cable onto the module then remove the cable.
  If the cable is pulled while it is connected to the module, the module and/or the cable will be damaged and may malfunction due to loose connection of the cable.
- Make sure that no foreign matter such as chips or wire offcuts gets inside the module.
  It will cause fire, failure, or malfunction.

[Cautions on Startup and Maintenance]

⚠ DANGER

- Do not touch terminals while the power is ON.
  This will cause malfunctions.
- Switch off all phases of the power supply outside the PC before cleaning or re-tightening screws. If all phases are not switched off, the module may fail or malfunction.
  If a screw is not tightened securely, the module may fall out, short circuit, or malfunction.
  If a screw is tightened excessively, the module may fall out, short circuit, or malfunction due to breakage of the screw or the module.

⚠ CAUTION

- Do not disassemble or modify any module.
  This will cause failure, malfunction, injuries, or fire.
- Switch off all phases of the power supply outside the PC before mounting or removing the module.
  If all phases are not switched off, the module may fail or malfunction.

[Cautions on Operation]

DANGER

- Do not write data in the "system area" in the buffer memory of a special function module.
  Among the signals output from the PC CPU to a special function module, do not output the "usage prohibited" signals.
  Writing data in the "system area" or outputting the "usage prohibited" signals will cause malfunctions of the PC system.

CAUTION

- When controlling a PC by connecting a personal computer or other similar control device to a special function module for the purpose of changing the data, changing a program, or changing the operation status (status control), read this manual carefully and start the intended control only after ensuring that it can be performed safely.
  Errors in changing the data, changing the program, or controlling the status will cause system malfunction, and machine damage or accidents.

[Cautions on Disposal]

CAUTION

- Dispose of this product as industrial waste.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Nov., 1995	IB (NA) 66583-A	First edition
Nov., 1999	IB (NA) 66583-B	Correction Chapter 1, Section 4.1, 5.1, 5.2, 8.8.2, 8.11.6, 10.1.1, APPENDIX

INTRODUCTION

Thank you for choosing the Mitsubishi MELSEC-A Series of General Purpose Programmable Controllers. Please read this manual carefully so that the equipment is used to its optimum. A copy of this manual should be forwarded to the end User.

CONTENTS

1. GENERAL DESCRIPTION

This is the external specification for the AJ71UC24-S2, A1SJ71UC24-R2-S2, and A1SJ71UC24-R4-S2 (hereafter collectively "C24-S2") serial communication modules, which are compatible with the MODBUS protocol. *1
The MODBUS protocol is a communication protocol widely used in Europe, particularly for instrumentation applications, which supports communications between computers and various types of controller.
The modules cited above are communication control modules which are connected to the RS-232Cor RS-422/485 ports of computers (mini computers, personal computers, displays, etc.) in order to control and monitor the operating status of a PC CPU, and to communicate data and programs with the PC CPU.

The applicable CPUs for the modules cited above are those indicated below.

Applicable CPUs	
• A0J2HCPU	• A73CPU (P21 / R21)
• A1CPU (P21 / R21)	• A52GCPU
• A1NCPU (P21 / R21)	• A2ACPU (P21 / R21)
• A1SCPU	• A2ACPU (P21 / R21) -S1
• A1SHCPU	• A3ACPU (P21 / R21)
• A1SJCPU	• A2ASCPU
• A1SJCPU-S8	• A2ASCPU-S1
• A1SJHCPU	• A2USHCPU-S1
• A1SCPU-S1	• A2UCPU
• A2CPU (P21 / R21)	• A2UCPU-S1
• A2CPU (P21 / R21) -S1	• A3UCPU
• A2NCPU (P21 / R21)	• A4UCPU
• A2NCPU (P21 / R21) -S1	• Q2ASCPU *2
• A2SCPU	• Q2ASCPU-S1 *2
• A2SHCPU	• Q2ASHCPU *2
• A2SCPU-S1	• Q2ASHCPU-S1 *2
• A2SHCPU-S1	• Q2ACPU *2
• A3CPU (P21 / R21)	• Q2ACPU-S1 *2
• A3NCPU (P21 / R21)	• Q3ACPU *2
• A3HCPU (P21 / R21)	• Q4ACPU *2
• A3MCPU (P21 / R21)	• Q4ARCPU *2

*1 MODBUS is a registered trade mark of MODICON INC.

*2 As for the QnACPU, the range of can the access of the device is as follows.

QnA CPU	Range which can be access
Q2ASCPU, Q2ASHCPU Q2ACPU	Range of A2ACPU
Q2ASCPU-S1, Q2ASHCPU-S1 Q2ACPU-S1	Range of A2ACPU-S1
Q3ACPU, Q4ACPU Q4ARCPU	Range of A3ACPU

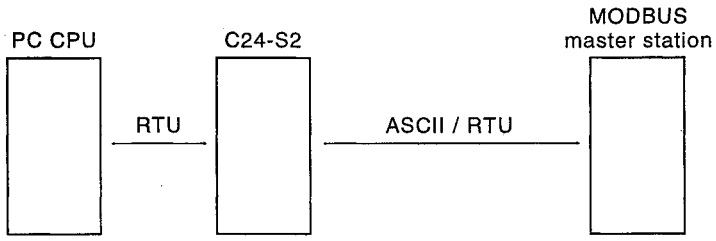
2. CHARACTERISTICS

The characteristics that allow these modules to support data communication in conformance with the MODBUS protocol are listed below.

(1) A single computer serving as the master station and up to 32 slave stations - each allocated an address within the range 1 to 99 - can be arranged in a serial circuit (common circuit), and communication conducted in an enquiry/response format in which processing can only be initiated by the master station, or a broadcast communication/no response format.
However, C24-S2 modules can only operate as slave stations (they cannot be master stations).

(2) The modules support the MODBUS standard functions corresponding to function codes 1 to 21 in the MODBUS protocol, and - as an optional function - the computer link function, which is not supported as a MODBUS standard function.

(3) Two transmission modes can be selected: ASCII or RTU (binary).
ASCII/RTU data codes are used for data communication between the master station and C24-S2 modules, but only RTU codes are used for communication between a C24-S2 and the PC CPU.
Accordingly, PC CPU data processing is performed on RTU code data.



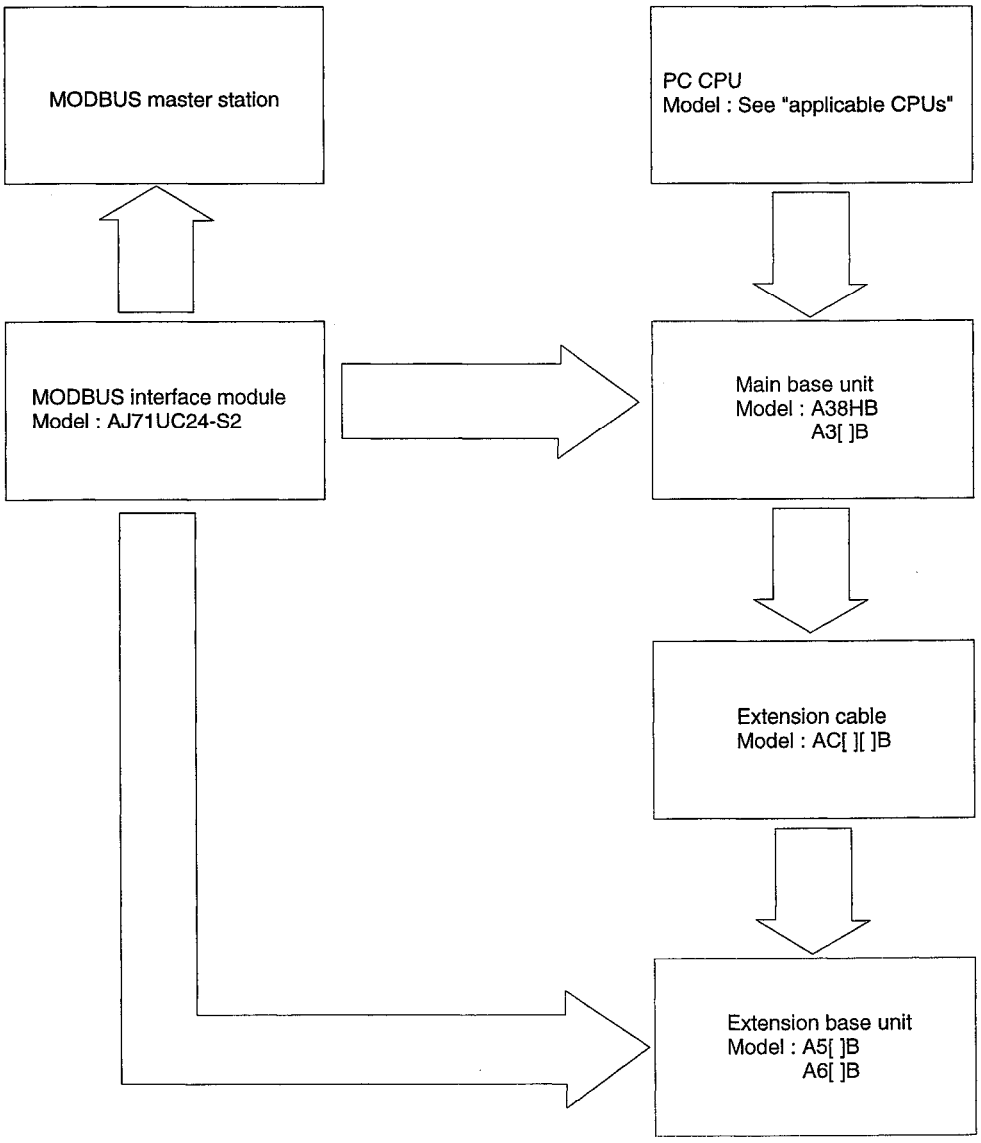
(4) The AJ71UC24-S2 has one channel for a serial transmission port compatible with RS-232C and one for a serial transmission port compatible with RS-422/485: for each of these channels, a 1:1 or 1:n system can be configured between the master station and slave stations. By making a main channel setting, RS-232C and RS-422/485 communications can be used in conjunction.
The A1SJ71UC24-R2-S2 supports only one serial transmission port, compatible with RS-232C, allowing a 1:1 system to be configured between the master station and a slave stastion.
The A1SJ71UC24-R4-S2 supports only one serial transmission port, compatible with RS-422/485, allowing a 1:1 or 1:n system to be configured between the master station and slave station.

(5) In the half-duplex communication transmission mode, a maximum transmission speed of 19.2 Kbps can be set.

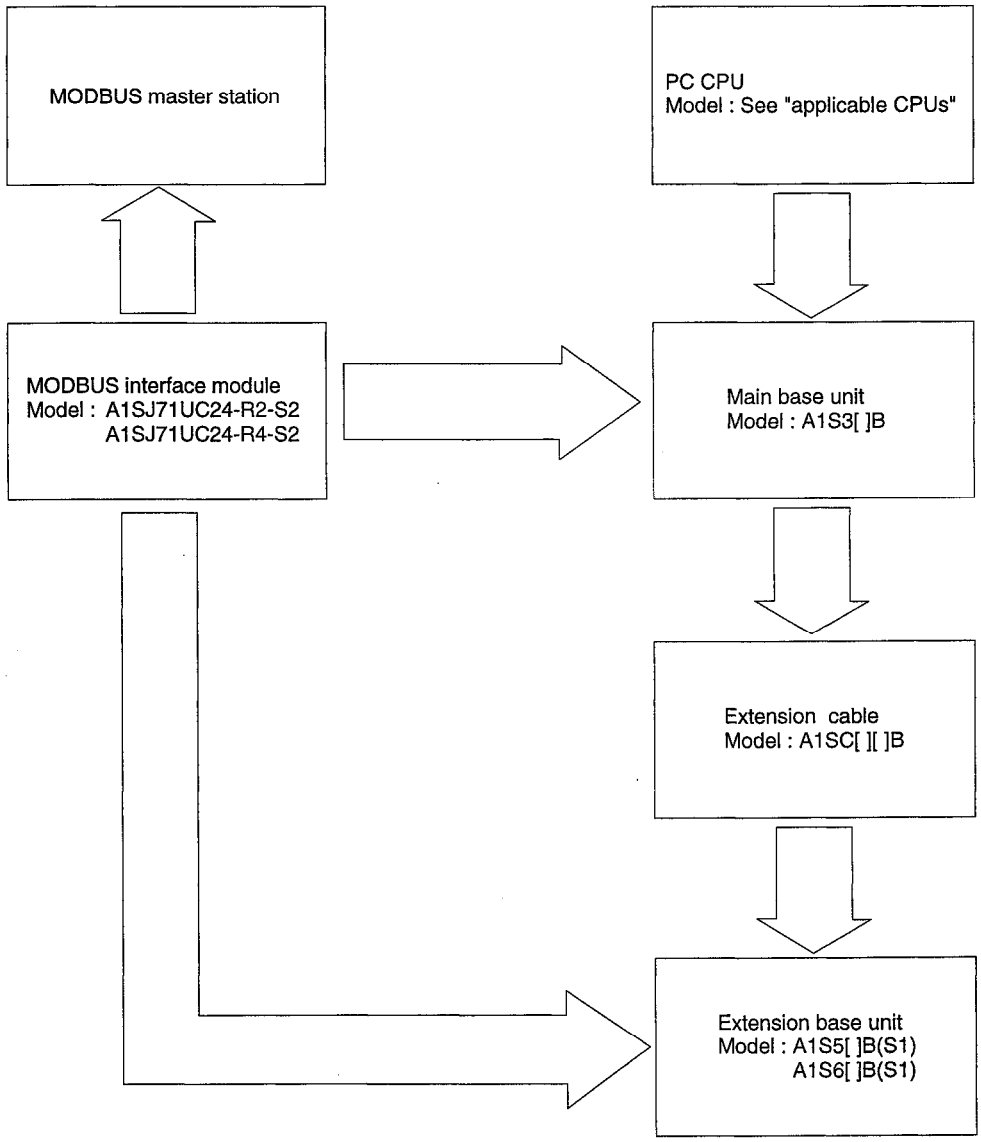
3. SYSTEM CONFIGURATION

3.1 Overall Configuration

(1) AJ71UC24-S2

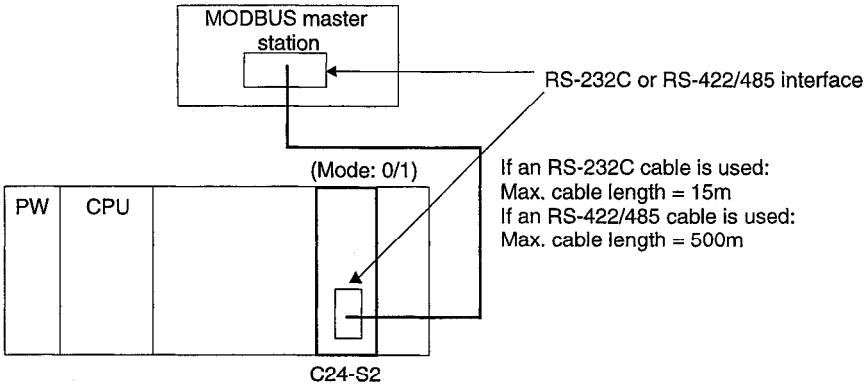


(2) A1SJ71UC24-R2-S2
A1SJ71UC24-R4-S2

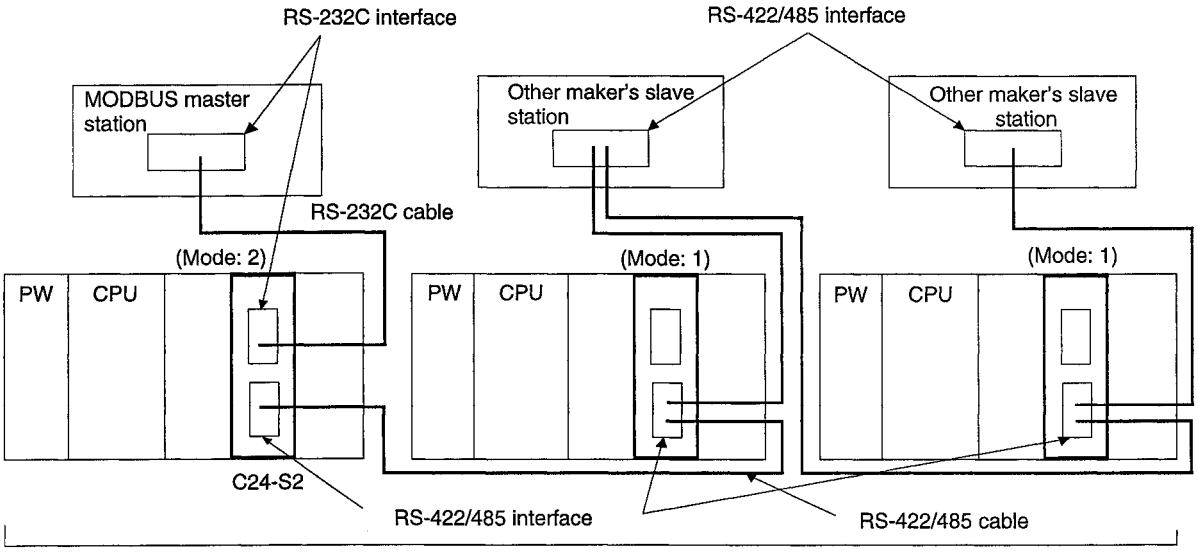


3.2 Computer Link System Configuration

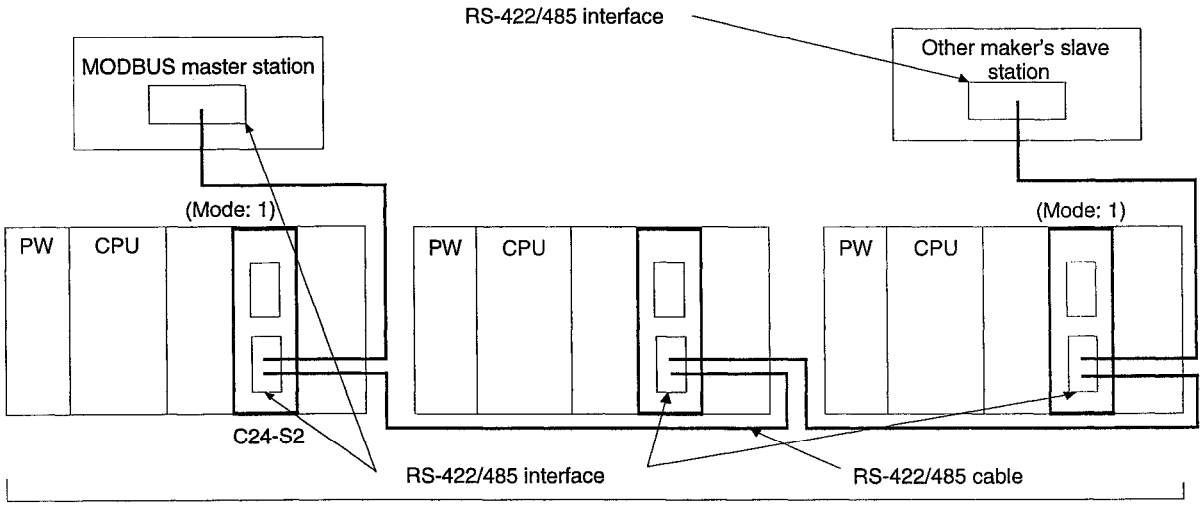
(1) Master station and slave station in 1:1 ratio



(2) Master station and slave station in 1:n ratio



Maximum of 32 stations connected to RS-422/485



Maximum of 32 stations connected to RS-422/485

4. SPECIFICATIONS

4.1 General Specifications

<table>
<tr><th>Item</th><th colspan="5">Specifications</th></tr>
<tr><td>Operating ambient temperature</td><td colspan="5">0 to 55 °C</td></tr>
<tr><td>Storage ambient temperature</td><td colspan="5">-20 to 75 °C</td></tr>
<tr><td>Operating ambient humidity</td><td colspan="5">10 to 90 % RH, no dewing</td></tr>
<tr><td>Storage ambient humidity</td><td colspan="5">10 to 90 % RH, no dewing</td></tr>
<tr><td rowspan="3">Vibration resistance</td><td rowspan="3">Conforms to JIS C 0911</td><td>Frequency</td><td>Acceleration</td><td>Amplitude</td><td>Sweep Count</td></tr>
<tr><td>10 to 57 Hz</td><td>———</td><td>0.075 mm</td><td rowspan="2">10 times
*(1 octave/minute)</td></tr>
<tr><td>57 to 150 Hz</td><td>9.8 m/s^2</td><td>———</td></tr>
<tr><td>Shock resistance</td><td colspan="5">Conforms to JIS C 0911 (147 m/s^2 × 3 times in 3 directions)</td></tr>
<tr><td>Noise resistance</td><td colspan="5">By noise simulator, 1500 V.P.P. noise voltage, 1 μ sec noise width, and 25 to 60 Hz noise frequency</td></tr>
<tr><td>Withstanding voltage</td><td colspan="5">500 VAC for one minute between all DC terminals together and the ground</td></tr>
<tr><td>Insulation resistance</td><td colspan="5">5MΩ or greater measured with 500 VDC insulation resistance tester between all DC terminals together and ground</td></tr>
<tr><td>Operating environment</td><td colspan="5">No corrosive gases or dust</td></tr>
<tr><td>Cooling method</td><td colspan="5">Self-cooling</td></tr>
</table>

REMARKS

(1) One octave (marked * above) indicates a change from the initial frequency to double or half that frequency. For example, all of the following are one octave changes: 10 Hz to 20 Hz, 20 Hz to 40 Hz, 40 Hz to 20 Hz, and 20 Hz to 10 Hz.

(2) The noise resistance and withstanding voltage values were obtained with the RS-232C and RS-422 interfaces not connected.

(3) JIS: Japanese Industrial Standards.

4.2 Transmission Specifications

Item		Specification		
Interface		RS-232C		
		RS-422/485		
Transmission mode		Half-duplex		
Synchronous mode		Start-stop synchronization		
Transmission speed		300, 600, 1200, 2400, 4800, 9600, 19200 BPS (selectable by switch)		
Transmission mode		ASCII mode	RTU mode	
Motor type	Start bit	1		
	Data bits	7	8	
	Parity bit	1 or none *3		Depends on the selection
	Stop bit	1 or 2		
Error detection		Parity check (odd/even) / No parity check		
		LRC	CRC	
Access cycle		At sequence program END processing, processing for one request is performed. In other words, the access cycle is one scan time.		
DTR/DSR (ER/DR) control		None		
DC1/DC3, DC2/DC4 control		None		
Circuit configuration (external device: PC CPU)		1 : 1, 1 : n *1		
Transmission distance		RS-232C: 15 m maximum		
		RS-422/485: Total extension of 500 m maximum		
Current consumption (5 VDC)		AJ71UC24-S2: 1.4 A A1SJ71UC24-R2-S2: 0.1 A A1SJ71UC24-R4-S2: 0.1 A		
Number of occupied I/O points		32 *2		
Weight kg (lb)		AJ71UC24-S2: 0.63 (1.39) A1SJ71UC24-R2-S2: 0.22 (0.49) A1SJ71UC24-R4-S2: 0.25 (0.55)		

*1 The maximum value for n is 32.

*2 When making the parameter I/O allocations, the module is set as "special function module, 32 points". (F32)

*3 Horizontal parity

4.2.1 Message frame configuration

The MODBUS protocol has two transmission modes - the ASCII mode and the RTU mode - but in general, with regard to the interpretation of fields within messages, there is no difference between the ASCII mode and the RTU mode. The main differences between these two modes are the method for the error check performed on messages, and the fact that the ASCII mode allows the use of about twice the number of characters that can be used in the RTU mode.

4.2.1.1 Frame configuration in the ASCII mode

In the frame configuration for the ASCII transmission mode, a single colon is used to indicate the start of a frame, and carriage return (CR) and line feed (LF) characters are used to indicate the end of a frame. The line feed character also serves as the synchronization character, indicating the transmitting station (source station) is ready to receive a response immediately.

BEG OF FRAME	ADDRESS	FUNCTION	DATA	ERROR CHECK	EOF	READY TO REC RESP
:	2-CHAR 16-BITS	2-CHAR 16-BITS	N×2-CHAR N×16-BITS	2-CHAR 16-BITS	CR	LF

4.2.1.2 Frame configuration in the RTU (Remote Terminal Unit) mode

In the RTU transmission mode, frame synchronization can be maintained by simulating simultaneous messages. The receiving equipment monitors the time lapse between character receptions and if the time taken to receive 3.5 characters elapses without a new character being received or the frame completed, the frame is flushed and the next byte to be received is taken as an address. See the diagram below.

T1 T2 T3	ADDRESS	FUNCTION	DATA	ERROR CHECK	T1 T2 T3
	8-BITS	8-BITS	N×8-BITS	16-BITS	

The time interval between characters is less than 3.5 times the time taken to receive a character.

The time interval between frames is greater than 3.5 times the time taken to receive a character.

4.2.1.3 Address field

The address field starts immediately after the start of the frame and comprises 8 bits in the RTU mode or 16 bits in the ASCII mode. These bits indicate the slave device addresses allocated by the user in order to receive messages sent from the master station connected to the slave.
Each slave station must be allocated a unique address. Then, only the slave whose address is specified will respond to an enquiry that includes its address. When the slave sends a response, the slave address notifies the master station which slave is communicating with it.
Address "0" is used for broadcast messages. All the slaves interpret this address as an instruction to read the message. However, they do not interpret it as an instruction to send a response.

4.2.1.4 Function field

The function code field informs the slave whose address is specified which function it is to execute. MODBUS function codes are specifically designed for communication with PCs in MODBUS industrial communication systems. The most significant bit in this field is set by the slave to indicate that a response other than a normal response (i.e. "NAK") is being transmitted to the master station. The function codes and their meanings are indicated below.

Code	Meaning	Remarks
0 to 21	MODBUS function codes supported by 184/384, 484, & 584 controllers. For details, see chapter 6.	
22 to 64	Reserved for expansion functions.	
65 to 72	Reserved for user functions'	Reserved for customized functions; may not be usable with some future MODICON products
73 to 119	Abnormal function codes	
120 to 127	Reserved	Reserved for internal use
128 to 255	Reserved	Reserved for NAK use

4.2.1.5 Data field

The data field contains either information required by a slave to execute a specific function, or data accumulated by a slave as a response to an enquiry. This information can include values, address references, or ranges. For example, assuming the function code informs the slave of a latched register reading, the data field could indicate which register the reading starts from and how many registers are read. The address settings and data information will differ according to the type and capacity of the PC associated with the slave.

4.2.1.6 Error check field

This field enables the master station and slave stations to detect errors in the transmission of messages. Sometimes, due to electrical noise or other forms of interference, there is a possibility that data may be changed slightly while being transmitted from one device to another. Error detection guarantees that the slave or master will not react to a message that has changed during transmission.
This field increases the safety and efficiency of MODBUS systems.
The error check field uses a longitudinal redundancy check (LRC) in the ASCII mode, and the CRC-16 check in the RTU mode.

(1) CRC (Cyclic Redundancy Check) error check procedure

The CRC-16 error check procedure is executed in the manner described below.

The message (the data bits only: the start/stop bits and optional parity bit are excluded) is interpreted as a single continuous binary value with the most significant bit (MSB) transmitted first. The message is shifted 16 bits to the left by X^{16} processing, and then divided by the binary value $X^{16} + X^{15} + X^2 + 1$ (expressed as 11000000000000101). The integral quotient value is ignored, and the 16-bit remainder (in order to except cases in which a value comprising only zeros is received as the message, all zeros are initialized to "1" at the start of the check) is added to the message as two CRC check bytes (the MSB is first).
The resulting message including the CRC check bytes is divided by the same polynomial ($X^{16} + X^{15} + X^2 + 1$) at the receiving device, and if there is no error the remainder is "0". (The CRC value is calculated again at the receiving device and the transferred CRC value compared with this recalculated value).
All calculations are performed as non-equivalence operations (with no carrying over).
The device used for serial conversion of the data for transmission sends the data with the stipulated LSBs, i.e., the rightmost bits of each character, first. The first bit transmitted during generation of the CRC is defined as the MSB of the multiplicand. For the sake of convenience, and since no carry-over is performed in the operation, the MSB is assumed to be at the right during calculation of the CRC. Since the MSB of the polynomial only influences the quotient and has no effect on the remainder, it is excluded. This gives 1010 0000 0000 0001 (A001H in hexadecimal).
Note that reversal of the order of bits has no effect whatever on the interpretation or the order of character bits outside the computer used to calculate the CRC value.

<<Procedure for generating the CRC-16 check bytes>>

1) Load a 16-bit register whose bits are all "1".
2) In order to receive a result in the 16-bit register, execute an exclusive logical sum operation on the higher byte of the 16-bit register and the first byte of the data.
3) Shift the 16-bit register one bit to the right.
4a) If the bit (flag) shifted to the right is "1", the polynomial 1010 0000 0000 0001 is generated in a 16-bit register and an exclusive logical sum operation performed.
4b) If the bit shifted to the right is "0", the operation returns to step 3.
5) Eight shifts are performed, with steps 3 and 4 executed after each.
6) An exclusive logical sum operation is executed on the next 8 bits in the 16-bit register.
7) Steps 3 to 6 are repeated until all the bytes of the message have been subjected to an exclusive logical sum operation and shifted to the right eight times.
8) The contents of the 16-bit register are the 2-byte CRC error check, and the message of the MSB is appended at the beginning.

CRC-16 error check example .... Status request to slave No.2 (address 2, function7)

CRC Error Check Procedure	16-Bit Register			(MSB)	Flag
(Remainder initialized at start of check)	1111	1111	1111	1111	
02H (address)			0000	0000	
Exclusive logical sum	1111	1111	1111	1101	
Shift 1	0111	1111	1111	1110	1
Polynomial	1010	0000	0000	0001	
Exclusive logical sum	1101	1111	1111	1111	
Shift 2	0110	1111	1111	1111	1
Polynomial	1010	0000	0000	0001	
Exclusive logical sum	1100	1111	1111	1110	
Shift 3	0110	0111	1111	1111	0
Shift 4	0011	0011	1111	1111	1
Polynomial	1010	0000	0000	0001	
Exclusive logical sum	1001	0011	1111	1110	
Shift 5	0100	1001	1111	1111	0
Shift 6	0010	0100	1111	1111	1
Polynomial	1010	0000	0000	0001	
Exclusive logical sum	1000	0100	1111	1110	
Shift 7	0100	0010	0111	1111	0
Shift 8	0010	0001	0011	1111	1
Polynomial	1010	0000	0000	0001	
Exclusive logical sum	1000	0001	0011	1110	
07H (function)			0000	0111	
Exclusive logical sum	1000	0001	0011	1001	
Shift 1	0100	0000	1001	1100	1
Polynomial	1010	0000	0000	0001	
Exclusive logical sum	1110	0000	1001	1101	
Shift 2	0111	0000	0100	1110	1
Polynomial	1010	0000	0000	0001	
Exclusive logical sum	1101	0000	0100	1111	
Shift 3	0110	1000	0010	0111	1
Polynomial	1010	0000	0000	0001	
Exclusive logical sum	1100	1000	0010	0110	
Shift 4	0110	0100	0001	0011	0
Shift 5	0011	0010	0000	1001	1
Polynomial	1010	0000	0000	0001	
Exclusive logical sum	1001	0010	0000	1000	
Shift 6	0100	1001	0000	0100	0
Shift 7	0010	0100	1000	0010	0
Shift 8	0001	0010	0100	0001	0
CRC check byte	12H		41H		

<<Message format>>

Address (02H)	Function code (07H)	CRC error check field	
		(41H)	(12H)

(2) LRC (Longitudinal Redundancy Check) error check procedure

The error check procedure used in the ASCII mode is LRC.
This error check uses an 8-bit binary value which is sent expressed as two ASCII hexadecimal characters.
In the error check, the hexadecimal values are converted to binary, the binary characters are added with no carry over, and the complement of 2 is generated as the result.
At the receiving side, the LRC value is calculated again and compared with the sent LRC value.

Colons, CR and LF codes, and all embedded non-ASCII characters are ignored in the calculation of the LRC value.

LRC error check example....Reading a coil (address 2, function 1) to slave station 2

LRC Error Check Procedure on Transmission			
Address	0 2	0 0 0 0	0 0 1 0
Function	0 1	0 0 0 0	0 0 0 1
Start address (H)	0 0	0 0 0 0	0 0 0 0
Start address (L)	0 0	0 0 0 0	0 0 0 0
Number of points read (H)	0 0	0 0 0 0	0 0 0 0
Number of points read (L)	0 8	+0 0 0 0	1 0 0 0
Result of addition	0 B	0 0 0 0	1 0 1 1
Complement of 1	F 4	1 1 1 1	0 1 0 0
+ 1			1
Complement of 2	F 5	1 1 1 1	0 1 0 1
Error Check	F 5	F	5

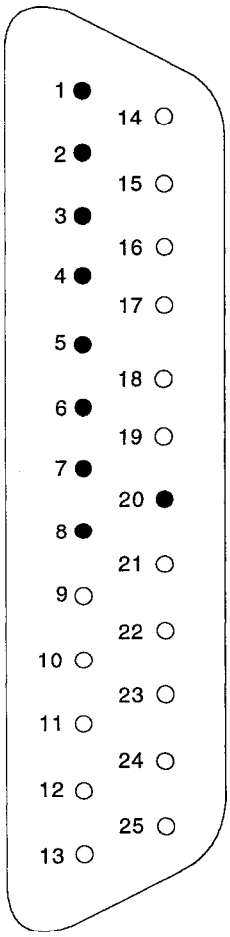
LRC Error Check Procedure on Reception			
Address	0 2	0 0 0 0	0 0 1 0
Function	0 1	0 0 0 0	0 0 0 1
Start address (H)	0 0	0 0 0 0	0 0 0 0
Start address (L)	0 0	0 0 0 0	0 0 0 0
Number of points read (H)	0 0	0 0 0 0	0 0 0 0
Number of points read (L)	0 8	0 0 0 0	1 0 0 0
Error Check	F 5	+1 1 1 1	0 1 0 1
Total	0 0	0 0 0 0	0 0 0 0

<<Message format>>

Colon	Address		Function Code		Start Address				Number of Points Read				Error Check		Carriage Return	Line Feed
" : "	(02H)		(01H)		(00H)		(00H)		(00H)		(08H)		(F5H)		"CR"	"LF"
3AH	30H	32H	30H	31H	30H	30H	30H	30H	30H	30H	30H	38H	46H	35H	0DH	0AH

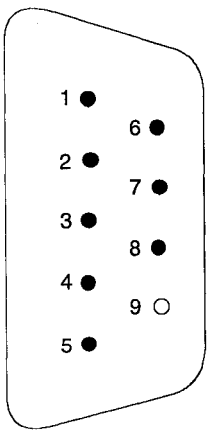
4.3 Connector and Terminal Block Specifications

(1-1) RS-232C connector specifications (25-pin)



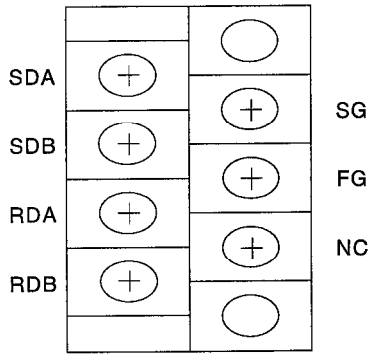
Pin No.	Signal Code	Signal Name	Signal Direction
1	FG	Frame ground	——→
2	SD (TXD)	Send data	——→
3	RD (RXD)	Receive data	←——
4	RS (RTS)	Request to send	——→
5	CS (CTS)	Clear to send	←——
6	DSR (DR)	Data set ready	←——
7	SG	Signal ground	———
8	CD	Carrier detected	←——
9	NC	———	
10	NC	———	
11	NC	———	
12	NC	———	
13	NC	———	
14	NC	———	
15	NC	———	
16	NC	———	
17	NC	———	
18	NC	———	
19	NC	———	
20	DTR (ER)	Data terminal ready	——→
21	NC	———	
22	NC	———	
23	NC	———	
24	NC	———	
25	NC	———	

(1-2) RS-232C connector specifications (9-pin)



Pin No.	Signal Code	Signal Name	Signal Direction
1	CD	Carrier detected	←——
2	RD (RXD)	Receive data	←——
3	SD (TXD)	Send data	——→
4	DTR (ER)	Data terminal ready	——→
5	SG	Signal ground	———
6	DSR (DR)	Data set ready	←——
7	RS (RTS)	Request to send	——→
8	CS (CTS)	Clear to send	←——
9	NC	———	

(2) RS-422/485 terminal box specifications



Signal Code	Signal Name	Signal Direction
SDA	Send data (+)	——→
SDB	Send data (-)	——→
RDA	Receive data (+)	←——
RDB	Receive data (-)	←——
SG	Signal ground	——→
FG	Frame ground	——→
NC	————	

4.4 External Wiring

(1) Master station and slave station connected in 1:1 ratio

(1-1) Connection of MODBUS master station and C24-S2 via RS-232C

• Connection to a device that can switch the CD signal ON

C24-S2 Side	Cable Connections and Signal Directions	MODBUS Master Station Side
Signal Name		Signal Name
FG		FG
SD (TXD)		SD (TXD)
RD (RXD)		RD (RXD)
RS		RS
CS (CTS)		CS (CTS)
DSR (DR)		DSR (DR)
SG		SG
CD		CD
DTR (ER)		DTR (ER)

• Connection to a device that cannot switch the CD signal ON

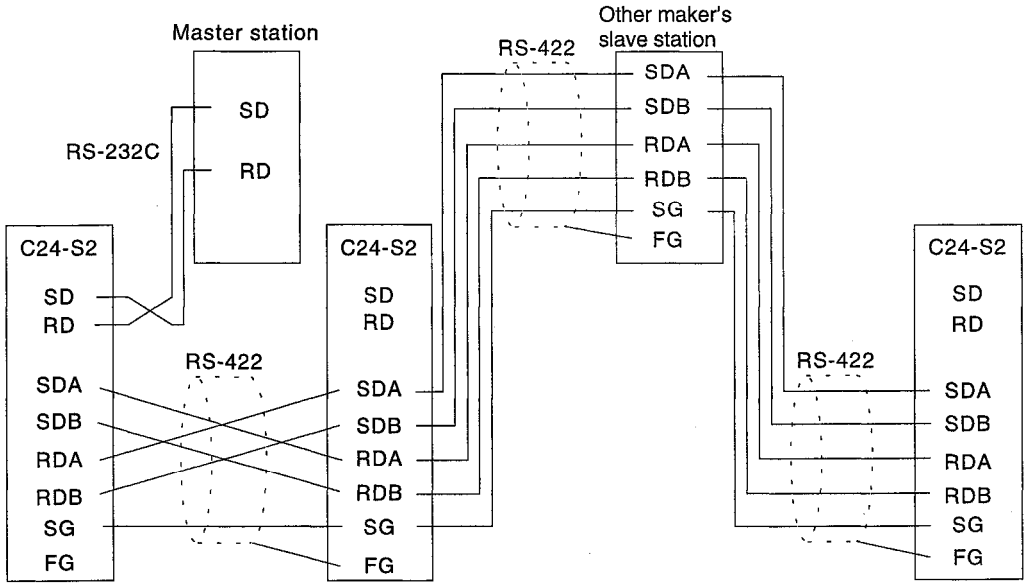
C24-S2 Side	Cable Connections and Signal Directions	MODBUS Master Station Side
Signal Name		Signal Name
FG		FG
SD (TXD)		SD (TXD)
RD (RXD)		RD (RXD)
RS		RS
CS (CTS)		CS (CTS)
DSR (DR)		DSR (DR)
SG		SG
CD		CD
DTR (ER)		DTR (ER)

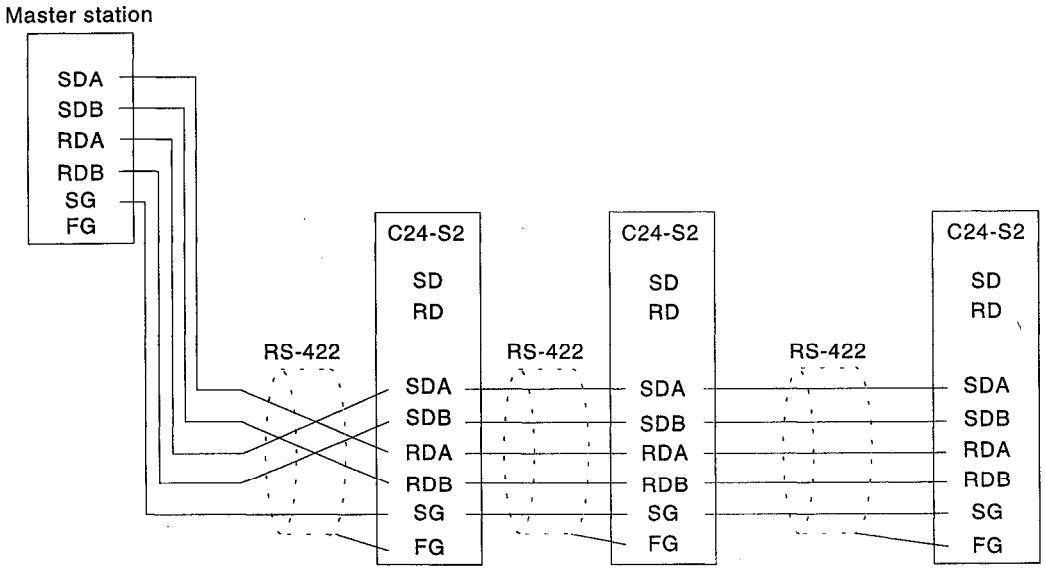
(1-2) Connection of MODBUS master station and C24-S2 via RS-422/485

C24-S2 Side	Cable Connections and Signal Directions	MODBUS Master Station Side	Signal Function
Signal Name		Signal Name	
SDA		RDA	Receive data
SDB		RDB	Receive data
RDA		SDA	Send data
RDB		SDB	Send data
		RSA	Request to send
		RSB	Request to send
		CSA	Clear to send
		CSB	Clear to send
SG		SG	Signal ground
FG		FG	Frame ground

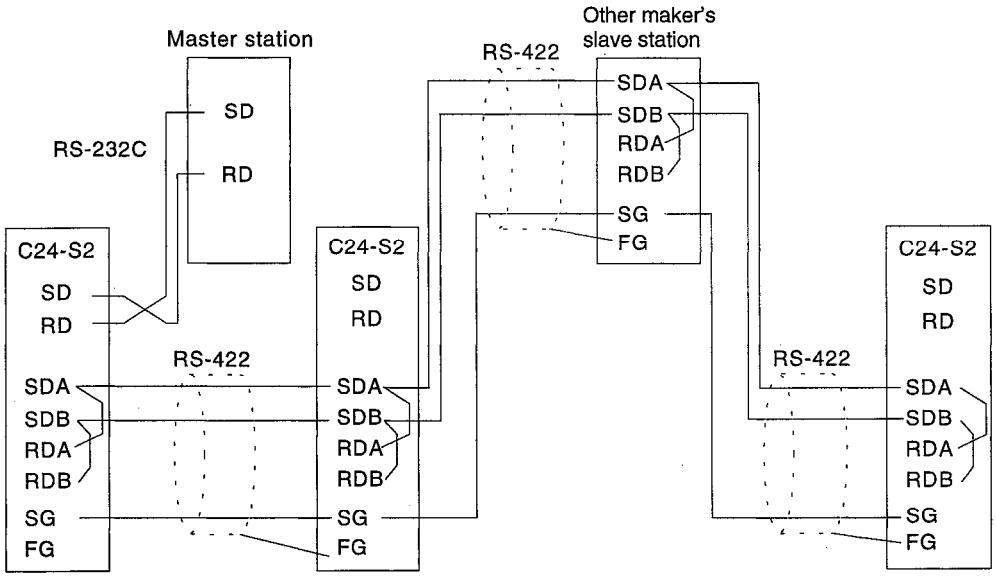
(2) Master station and slave stations connected in 1:n ratio

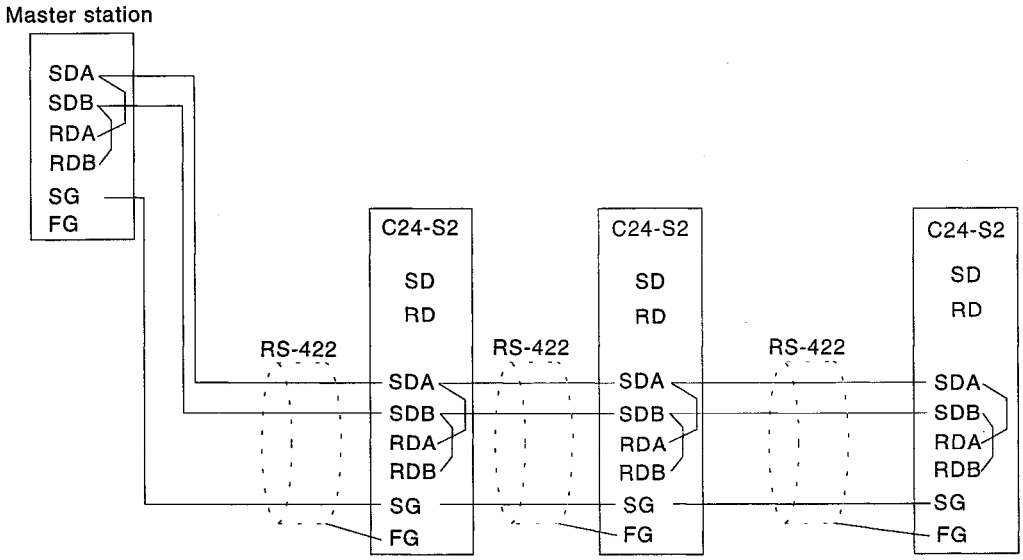
(2-1) Communication through 4 cables





(2-2) Communication through 2 cables

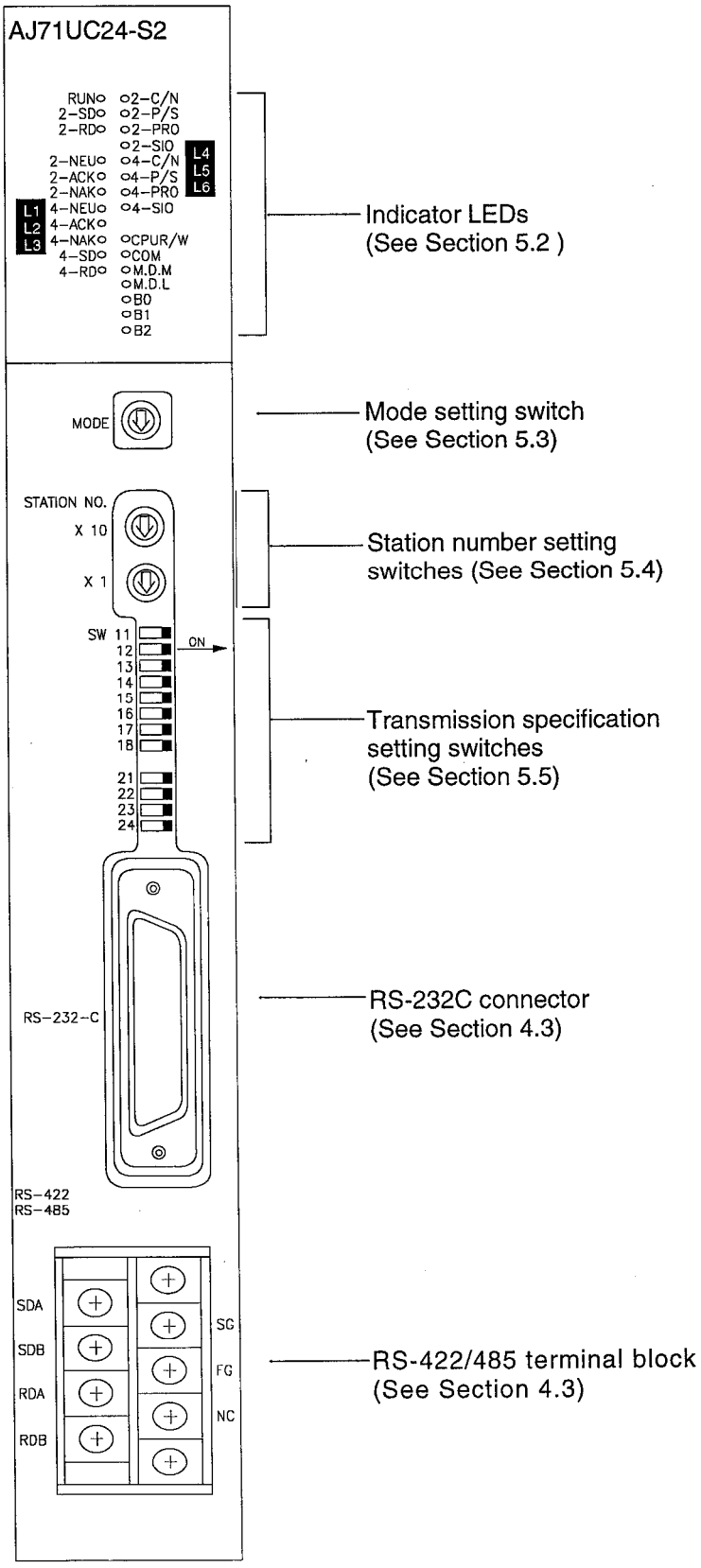




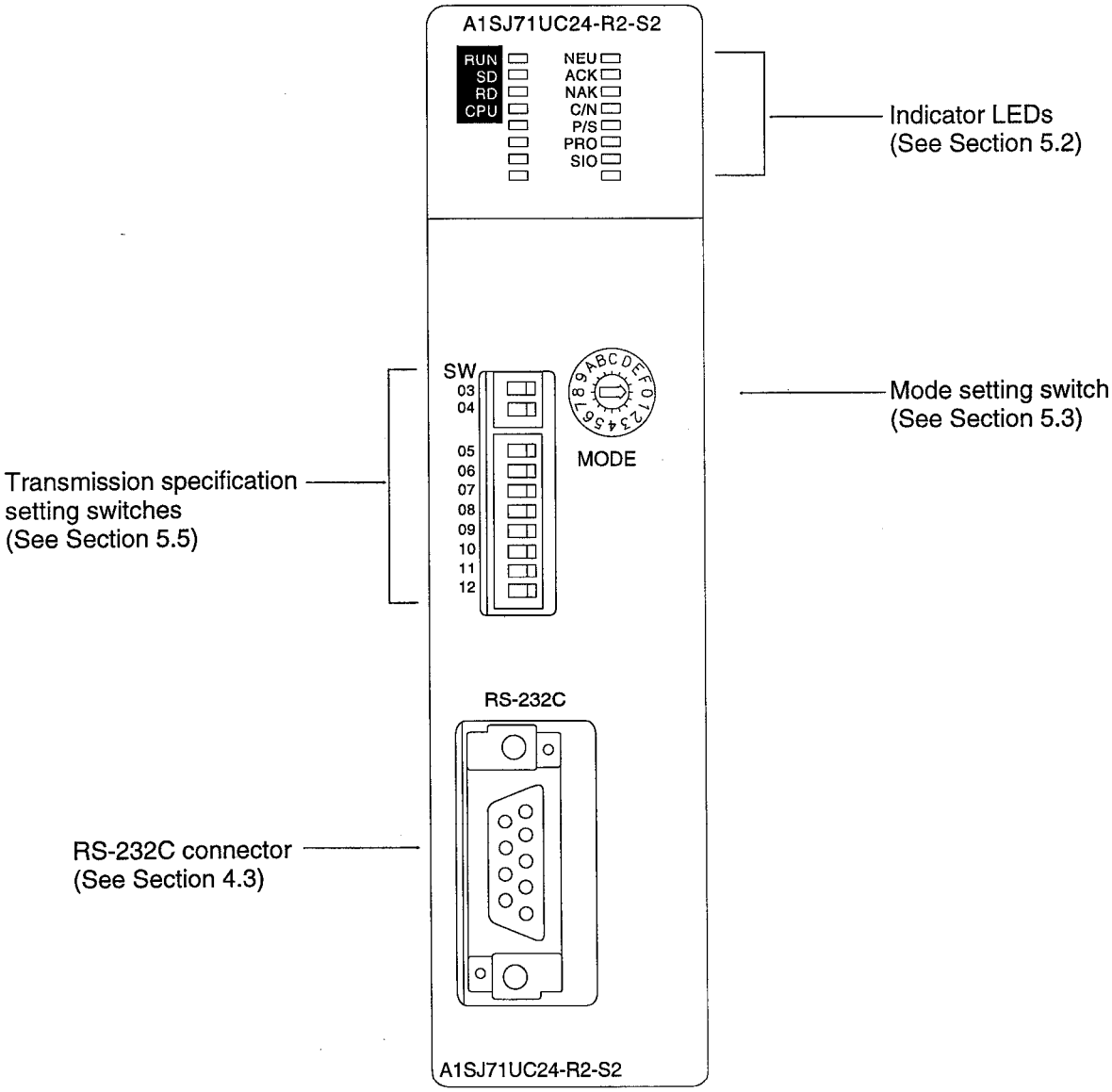
5. HANDLING

5.1 External Views

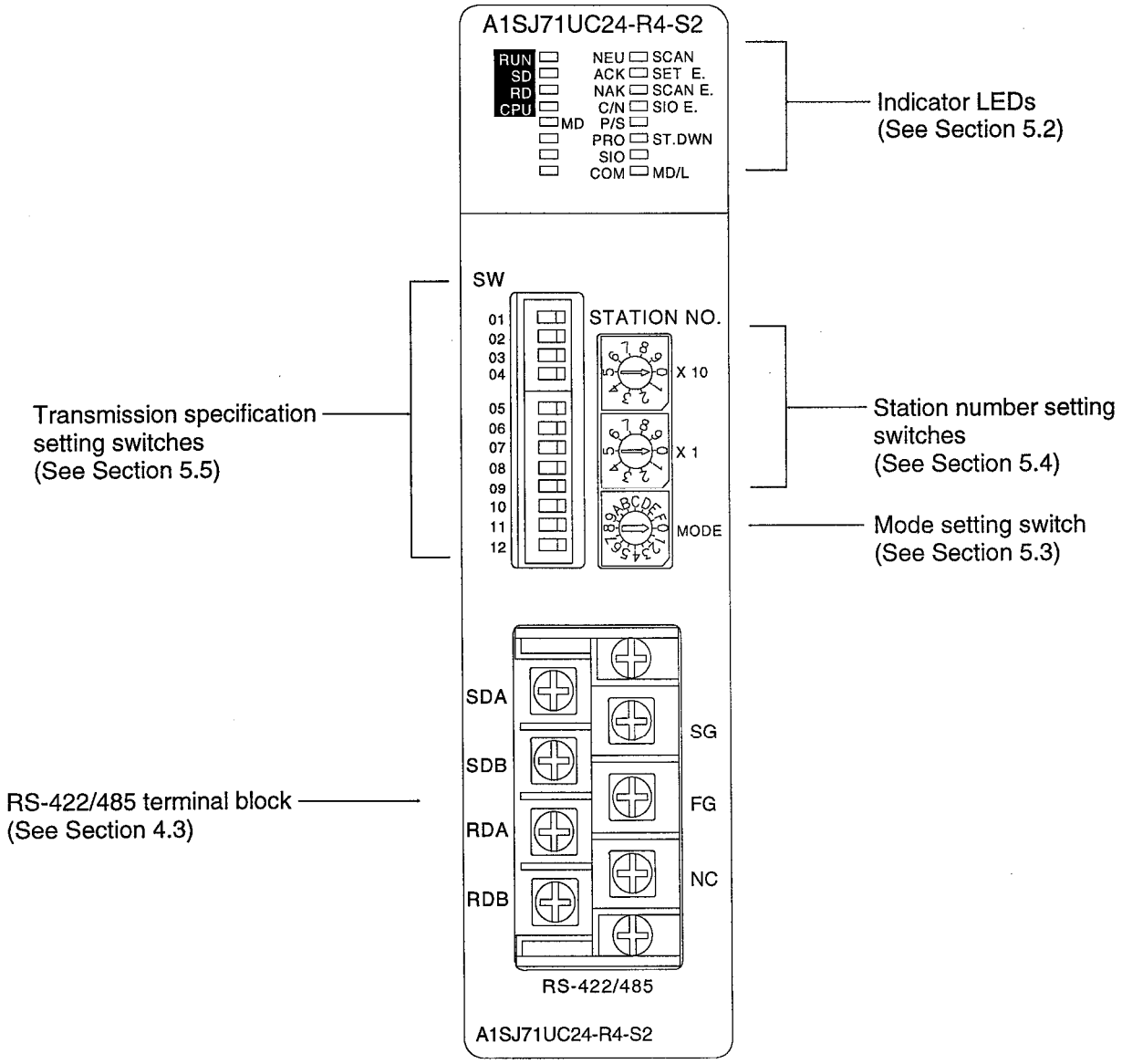
(1) AJ71UC24-S2



(2) A1SJ71UC24-R2-S2



(3) A1SJ71UC24-R4-S2



5.2 Indicator LEDs

The indicator LEDs on the upper part of the front face of the C24-S2 indicate operation statuses, link transmission and reception statuses, and error details. The meanings of the ON and OFF states differ according to the LED.

(1) AJ71UC24-S2

LED No.	LED	Meaning of LED Display	LED ON	LED OFF	Initial Status of LED
0	RUN	Normal run	Normal	Error	ON
1	2-SD	RS-232C transmitting	Flashes during data transmission		OFF
2	2-RD	RS-232C receiving	Flashes during data reception		
3	Not used				
4	2-NEU	Not used			
5	2-ACK	RS-232C ACK	After sending ACK	After sending NAK	
6	2-NAK	RS-232C NAK	After sending NAK	After sending ACK	
7	4-NEU	Not used			
8	4-ACK	RS-422/485 ACK	After sending ACK	After sending NAK	
9	4-NAK	RS-422/485 NAK	After sending NAK	After sending ACK	
10	4-SD	RS-422/485 transmission status	Flashes during data transmission		
11	4-RD	RS-422/485 received data status	Flashes during data reception		
12	Not used				
13					
14					
15					
16	2-C / N	Result of RS-232C and PC CPU communications	*1	Normal	
17	2-P / S	RS-232C parity, CRC/LRC error	Parity CRC/LRC error		
18	2-PRO	RS-232C protocol error	Communications protocol error		
19	2-SIO	RS-232C SIO error	Overrun, framing error		
20	4-C / N	Result of RS422/485 and PC CPU communications	*1		
21	4-P / S	RS-422/485 parity, CRC/LRC error	Parity, CRC/LRC error		
22	4-PRO	RS-422/485 protocol error	Communications protocol error		
23	4-SIO	RS-422/485 SIO error	Overrun, framing error		
24	Not used				
25	CPU R/W	Communications with PC CPU	Flashes during communication with PC CPU (ON when not communicating)		ON
26	COM	Not used			OFF
27	M.D.M				
28	M.L.M				

LED No.	LED	Meaning of LED Display	Status of LED							Initial Status of LED
		Baud rate (BPS)	300	600	1200	2400	4800	9600	19200	
29	B0	Baud rate status	OFF	ON	OFF	ON	OFF	ON	OFF	*2
30	B1		OFF	OFF	ON	ON	OFF	OFF	ON	
31	B2		OFF	OFF	OFF	OFF	ON	ON	ON	

*1 Illegal access attempted from the C24-S2 while the PC CPU is in theRUN status (e.g., writing while the program is being run).

Alternatively, access to the PC CPU is not normal.

*2 Depends on the settings of the transmission specification setting switches (see Section 5.5).

(2) A1SJ71UC24-R2-S2

A1SJ71UC24-R4-S2

LED No.	LED	Meaning of LED Display	LED ON	LED OFF	Initial Status LED
0	RUN	Normal run	Normal	Error	ON
1	SD	Transmitting	Flashes during data transmission		OFF
2	RD	Receiving	Flashes during data reception		
3	CPU	Communications with PC CPU	Flashes during communications with PC CPU		ON
4	MD	Not used			OFF
5	Not used				
6					
7					
8	NEU	Not used			
9	ACK	ACK	After sending ACK	After sending ACK	
10	NAK	NAK	After sending NAK	After sending NAK	
11	C / N	Result of PC CPU communications	*1	Normal	
12	P / S	Parity, CRC/LRC error	Parity error, CRC/LRC error		
13	PRO	Protocol error	Communication protocol error		
14	SIO	SIO error	Overrun, framing error		
15	COM	Not used			

*1 Illegal access attempted from the C24-S2 while the PC CPU is in the RUN status (e.g., writing while the program is being run).
Alternatively, access to the PC CPU is not normal.

5.3 Mode Setting Switch

Used to select the connector used for communication in conformance with the MODBUS protocol.

Mode Setting Switch Number		Setting Datails	
		RS-232C Side	RS-422/485 Side
0	*1	MODBUS protocol	Unusable
1	*2	Unusable	MODBUS protocol
2	*3	MODBUS protocol	MODBUS protocol
3		Unusable	
4			
5			
6			
7			
8			
9			
A			
B			
C		Unusable	
D		Unusable	
E			
F		For self-loopback test	

*1 Used when only RS-232C is connected to the master station(1:1).

*2 Used when only RS-422/485 is connected to the master station. The data sent by the master station is received by the C24-S2 specified in the message.

*3 Mode used when both the RS-232C and RS-422/485 interfaces are used in conjunction. The data sent by the master station is received by the C24-S2 specified in the message.

Note:

- The transmission specifications for RS-232C and RS422/485 are the same.
- If using both RS-232C and RS422/485 modes, but not simultaneously, set "0 or 1".
- If the mode is set to "2" and there is an interface to which no external device is connected, noise will enter the system from that interface and normal operation will not be possible. To solve this problem,set "0 or 1".
- Example settings for each system configuration are given in Section 3.2
- When using an A1SJ71UC24-R2-S2, modes "1" and "2" cannot be used.
- When using an A1SJ71UC24-R4-S2, modes "0" and "2" cannot be used.

5.4 Station Number Setting Switch

A station number is a number set for a C24-S2 module so that, when performing data link operations using C24-S2 modules, the C24-S2 module that the MODBUS master station is to communicate with can be set.
Set station numbers in the range 1 to 99, ensuring that no number is duplicated in the system.
Note that, since the A1SJ71UC24-R2-S2 has no station number setting switch, all received data is assumed to be destined for it.

5.5 Transmission Specification Setting Switches

These switches are used to set the transmission specifications, main channel, terminal resistors, etc.

(1) AJ71UC24-S2

<table>
<tr><th rowspan="2">Switch</th><th rowspan="2">Setting Item</th><th colspan="2">Switch Position</th><th rowspan="2">Remarks</th></tr>
<tr><th>ON</th><th>OFF</th></tr>
<tr><td>SW11</td><td>Main channel setting</td><td>——</td><td>RS-232C (fixed)</td><td>Only valid when mode "2" set</td></tr>
<tr><td>SW12</td><td>Transmission mode setting</td><td>RTU (8 bits)</td><td>ASCII (7 bits)</td><td></td></tr>
<tr><td colspan="5">
<table>
<tr><td>Baud rate</td><td>300</td><td>600</td><td>1200</td><td>2400</td><td>4800</td><td>9600</td><td>19200</td><td>Unusable</td></tr>
<tr><td>SW13</td><td rowspan="3">Transmission speed setting</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>SW14</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
<tr><td>SW15</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
</table>
</td></tr>
<tr><td>SW16</td><td>Parity bit present/absent setting</td><td>Present</td><td>Absent</td><td></td></tr>
<tr><td>SW17</td><td>Even/odd parity setting</td><td>Even</td><td>Odd</td><td></td></tr>
<tr><td>SW18</td><td>Stop bit setting</td><td>2 stop bits</td><td>1 stop bit</td><td></td></tr>
<tr><td>SW21</td><td>Not used</td><td>——</td><td>——</td><td></td></tr>
<tr><td>SW22</td><td>Write during RUN enabled/disabled</td><td>Enabled</td><td>Disabled</td><td></td></tr>
<tr><td>SW23</td><td>Not used</td><td>(fixed)</td><td>——</td><td></td></tr>
<tr><td>SW24</td><td>Not used</td><td>——</td><td>——</td><td></td></tr>
</table>

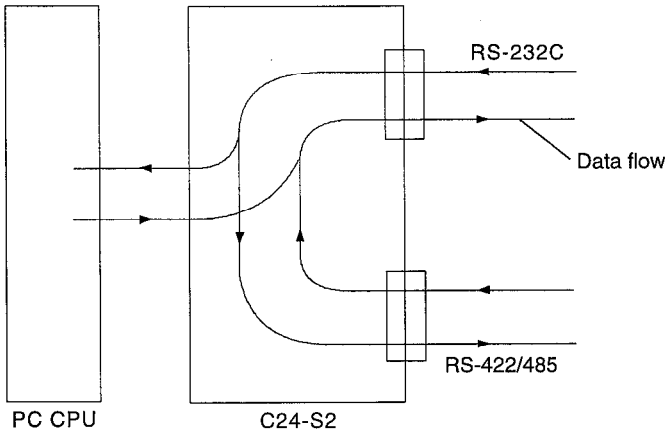
(2) A1SJ71UC24-R2-S2
A1SJ71UC24-R4-S2

<table>
<tr><th rowspan="2">Switch</th><th rowspan="2">Setting Item</th><th colspan="2">Switch Position</th><th rowspan="2">Remarks</th></tr>
<tr><th>ON</th><th>OFF</th></tr>
<tr><td>SW01</td><td>Not used</td><td>——</td><td>——</td><td></td></tr>
<tr><td>SW02</td><td>Not used</td><td>(fixed)</td><td>——</td><td></td></tr>
<tr><td>SW03</td><td>Not used</td><td>——</td><td>——</td><td></td></tr>
<tr><td>SW04</td><td>Write during RUN enabled/disabled setting</td><td>Enabled</td><td>Disabled</td><td></td></tr>
<tr><td colspan="5">
<table>
<tr><td>Baud rate</td><td>300</td><td>600</td><td>1200</td><td>2400</td><td>4800</td><td>9600</td><td>19200</td><td>Unusable</td></tr>
<tr><td>SW05</td><td rowspan="3">Transmission speed setting</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>SW06</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
<tr><td>SW07</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
</table>
</td></tr>
<tr><td>SW08</td><td>Transmission mode setting</td><td>RTU(8 bits)</td><td>ASCII(7 bits)</td><td></td></tr>
<tr><td>SW09</td><td>Parity bit present/absent setting</td><td>Present</td><td>Absent</td><td></td></tr>
<tr><td>SW10</td><td>Even/odd parity setting</td><td>Even</td><td>Odd</td><td></td></tr>
<tr><td>SW11</td><td>Stop bit setting</td><td>2 stop bits</td><td>1 stop bit</td><td></td></tr>
<tr><td>SW12</td><td>Not used</td><td>——</td><td>——</td><td></td></tr>
</table>

5.5.1 Main channel setting

The main channel set with SW11 of the DIP switches indicates the connector (interface) to which the MODBUS master station is connected.The main channel setting is fixed as RS-232C (SW11: OFF). Note that the main channel setting is only valid when the mode setting switch is set to "2".

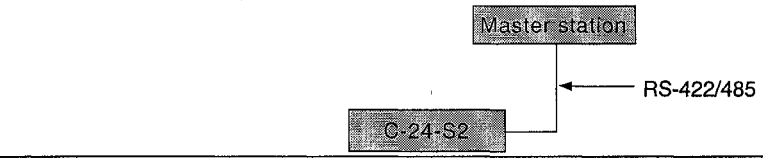
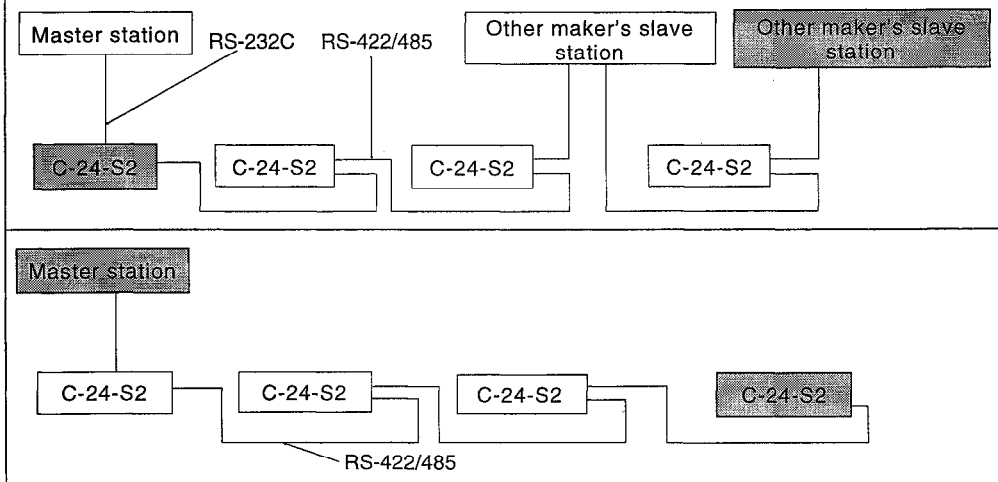
The flow of data in accordance with the main channel setting is such that data received through the main channel is automatically transmitted through the sub-channel and data received through the sub-channel is automatically transmitted through the main channel.
When a processing request is made from another station to the host station, only data received through the main channel is regarded as valid, and the C24-S2 executes the requested processing and transmits the processing result through the main channel.



Situation when the main channel is RS-232C

5.5.2 Terminal resistor connections

For connections via the RS-422/485 interface, connect a terminal resistor to both ends of the connected stations.
A connection example is shown below.

MODBUS Master Station / Slave Station Ratio	System Configuration Example
1 : 1	
1 : n	

Terminal resistor must be set

Terminal resistor not required

6. SPECIFICATIONS FOR INTERFACE WITH THE PC CPU

6.1 I/O Signals for the PC CPU

(1) Input signals (C24-S2→PC CPU)

The input signals occupy the 16 points from Xn0 to XnF: all of these are switched ON and OFF by the C24-S2.

Input Signal	Signal Name	Details	Remarks
Xn0	RS-232C communication error	Comes ON when there is a parity error, communication protocol error, etc.at the RS-232C side.	*1
Xn1	RS-422/485 communication error	Comes ON when there is a parity error, communication protocol error, etc., at the RS-422/485 side.	*2
Xn2 to Xn6	———	Unusable	
Xn7	Ready signal	Comes ON when the C24-S2 is ready after the PC CPU has started up.	
Xn8	Parameter error	Comes ON when there is an error in the device allocation parameters	
Xn9 to XnC	———	Unusable	
XnD	Watchdog timer error	Comes ON when a C24-S2 watchdog timer error occurs.	
XnE, XnF	———	Unusable	

*1 Cannot be used with A1SJ71UC24-R4-S2

*2 Cannot be used with A1SJ71UC24-R2-S2

(2) Output signals (PC CPU→C24-S2)

The output signals occupy the 16 points from Y $_{(n+1)}$0 to Y $_{(n+1)}$ F: all of these are switched ON and OFF by the sequence program.

Input Signal	Signal Name	Details	Remarks
Y $_{(n+1)}$ 0	RS-232C communication error cancel	Requests switching OFF of LED for communication error at the RS-232C side	*1
Y $_{(n+1)}$ 1	RS-422/485 communication error cancel	Requests switching OFF of LED for communication error at the RS-422/485 side	*2
Y $_{(n+1)}$ 2 to Y $_{(n+1)}$ 6	———	Unusable	
Y $_{(n+1)}$ 7	Parameter change request	Requests a change in the device allocation parameters	
Y $_{(n+1)}$ 8 to Y $_{(n+1)}$ F	———	Unusable	

*1 Cannot be used with A1SJ71UC24-R4-S2

*2 Cannot be used with A1SJ71UC24-R2-S2

6.2 Buffer Memory

The buffer memory is a memory area of the C24-S2 used to store the control information etc. required for data exchanges between the MODBUS master station and PC CPU.
The buffer memory is configured with 16 bits per address.

Address	Buffer Memory Address Name			Default Value
0H	Mode setting status storage area			*1
1H	Station number setting status storage area		*4	*2
2H	RS-232C error response code storage area		*3	0
3H	RS-232C error detail code storage area		*3	0
4H	RS-422/485 error response code storage area		*4	0
5H	RS-422/485 detail response code storage area		*4	0
6H	RS-232C error LED display status storage area		*3	0
7H	RS-422/485 error LED display status storage area		*4	0
8H	RS-232C error LED OFF request storage area		*3	0
9H	RS-422/485 error LED OFF request storage area		*4	0
AH	Error status read device No. storage area	Device code	*5	0CH (12)
BH		Device No.	*5	0
CH	Optional function (computer link function) function code change request storage area			46H (70)
D to FH	Vacant area			0
10H to 23H	Allocation for window for coils		*6	*5
24H to 2FH	Vacant area			0
30H to 43H	Allocation for window for latch registers		*6	*5
44H to DEFH	User area			0
DFO to DFFH	Unusable			0

*1 The value set with the mode setting switch is stored.

*2 The value set with the station number setting switches is stored.

*3 Cannot be used with A1SJ71UC24-R4-S2

*4 Cannot be used with A1SJ71UC24-R2-S2

*5 See Section 6.4.

*6 Valid when using MODBUS standard functions

Note:

- The area comprising addresses 44H to DEFH can be used as required by the user. It is the area used to execute data exchanges using the buffer memory read and write commands (optional function).

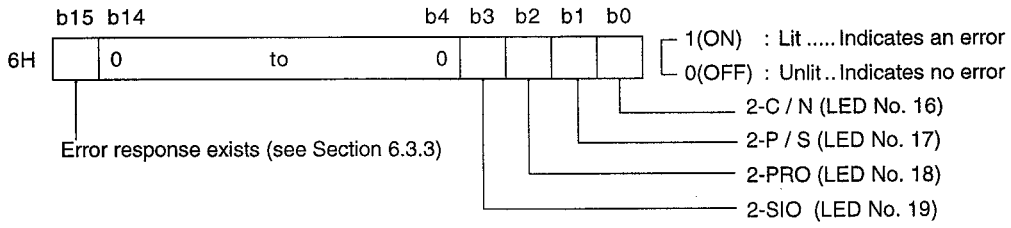
6.3 Reading Transmission Error Information

This section describes the error information and error LED ON/OFF statuses stored in the buffer memory, and the method for switching off LEDs that are ON.

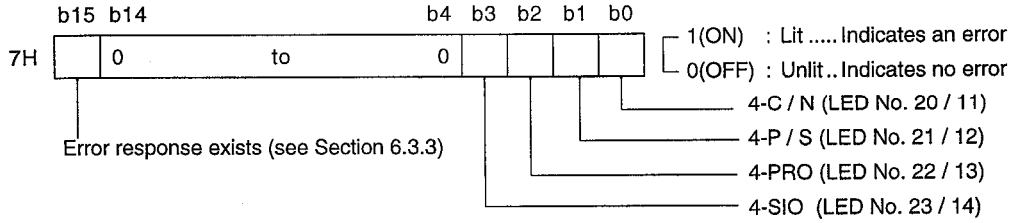
6.3.1 Reading error LED display statuses

The error LED ON/OFF statuses are stored in addresses 6/7H of the buffer memory as shown below.

(1) RS-232C



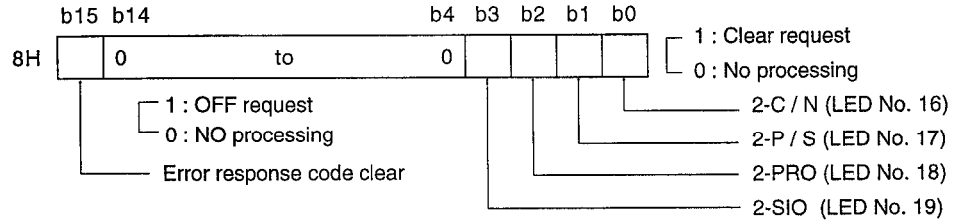
(2) RS-422/485



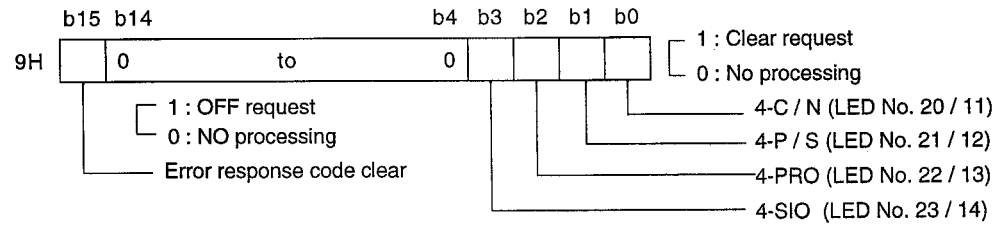
6.3.2 Error LED OFF request

When an error LED comes ON, it will remain ON even after the status has returned to normal.
However, an error LED that is ON can be switched OFF by writing a "1" to the corresponding bit in the OFF request area (address 8/9H) of the buffer memory to switch on the OFF request Y (Y $_{(n+1)}$ 0 / Y $_{(n+1)}$ 1).

(1) RS-232C



(2) RS-422/485



6.3.3 Reading error response codes

If there is error data in an enquiry message from the MODBUS master station, or an error occurs in communication with the PC CPU, the error response code is stored in buffer memory address 2/4H and this error response code is appended to the response message and returned to the MODBUS master station.
When an error occurs, the communication error signal, X, (Xn0/Xn1) comes ON and bit 15 of the error LED display status storage area changes to "1". The stored error response code can be cleared by writing "1" to bit 15 of the error LED OFF request area, causing the write OFF request signal, Y, (Y (n+1) 0/Y (n+1) 1) to come ON.

(1) Error response code list

Error Response Code	Name	Details
1H	Function code error	Function code cannot be confirmed.
2H	Data address error	The address (reference number) in the data field cannot be processed by the slave.
3H	Data value error	The data value in the data field cannot be processed by the slave.
4H	Device-related error	Error in communication with PC CPU

In addition, error detail codes are stored at buffer memory address 3/5H.

(2) Error detail code list

Error detail code	Meaning	Error detail code	Meaning
00H	Error No. for NAK from CPU	60H	Window setting error
		61H	Device designation error (larger than 9999)
2FH		62H	Device code error in window
~ ~	Reserved	63H	Device No. + device designation overflow
~ ~		64H	Outside device No. + device specification range
40H	Function code error	65H	Extension file register request made to A1CPU
41H	PC number error	66H	Number of points over limit
42H	CPU watchdog time out error	67H	ON/OFF data error (other than 0000/FF00H)
~ ~	Reserved	68H	Not possible during RUN
48H	Number of 232C receive data over limit	69H	Number of bytes error
49H	Number of 422 receive data over limit	6AH	Extension file register block No. error
4AH	232C receive data format error	~	~ Reserved
4BH	422 receive data format error		
~ ~	Reserved		
50H	CPU response data error		
51H	CPU response request code error		
52H	Loopback diagnosis data error		
53H	Option subcode error		
54H	Monitor data not registered		
55H	No subprogram capacity		
56H	Inapplicable CPU used (when writing a sequence or microcomputer program)		
57H	Y No. error		
58H	Diagnosis code or function code error		
~ ~	Reserved		

6.3.4 Setting error status read device numbers

Eight specified coils read in accordance with a message incorporating function code 07H can be assigned. The devices that can be set are Y, M, B, F, T, and C devices only, and the head coil of eight consecutive coils is assigned in buffer memory addresses AH (device code) and BH (device number).
For details on coil device codes and device numbers, see Section 6.4.

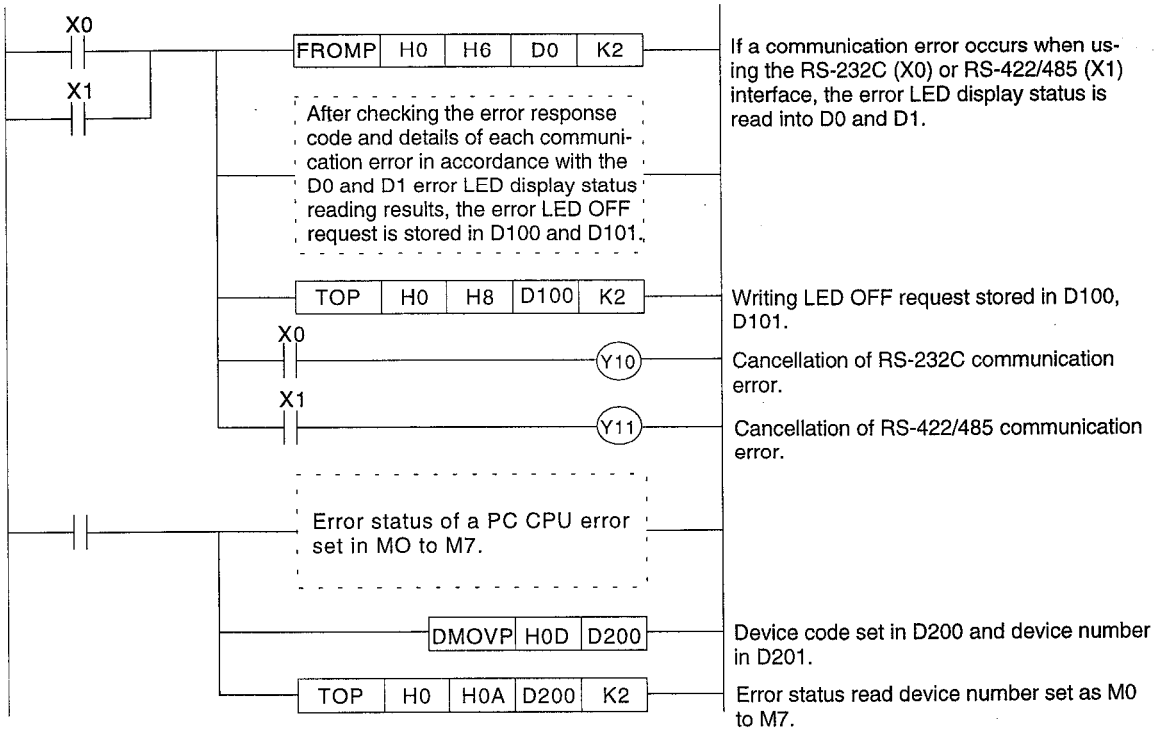
6.3.5 Changing optional function (computer link function) function codes

The function code set in a message when using the optional functions can be changed. The range of function codes that can be set is 65 to 72 and the function code is set in buffer memory address BH.

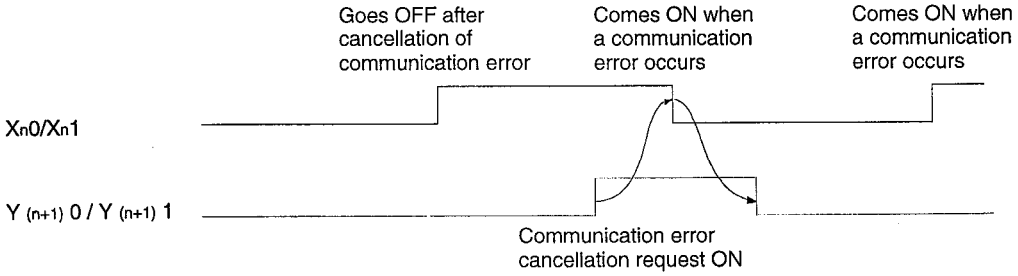
6.3.6 Example program for reading transmission error information

(1) Program example

This examples assumes that the C24-S2 is loaded in slot 0 of the main base unit.



(2) Communication error I/O (X/Y) ON/OFF timing



Note:

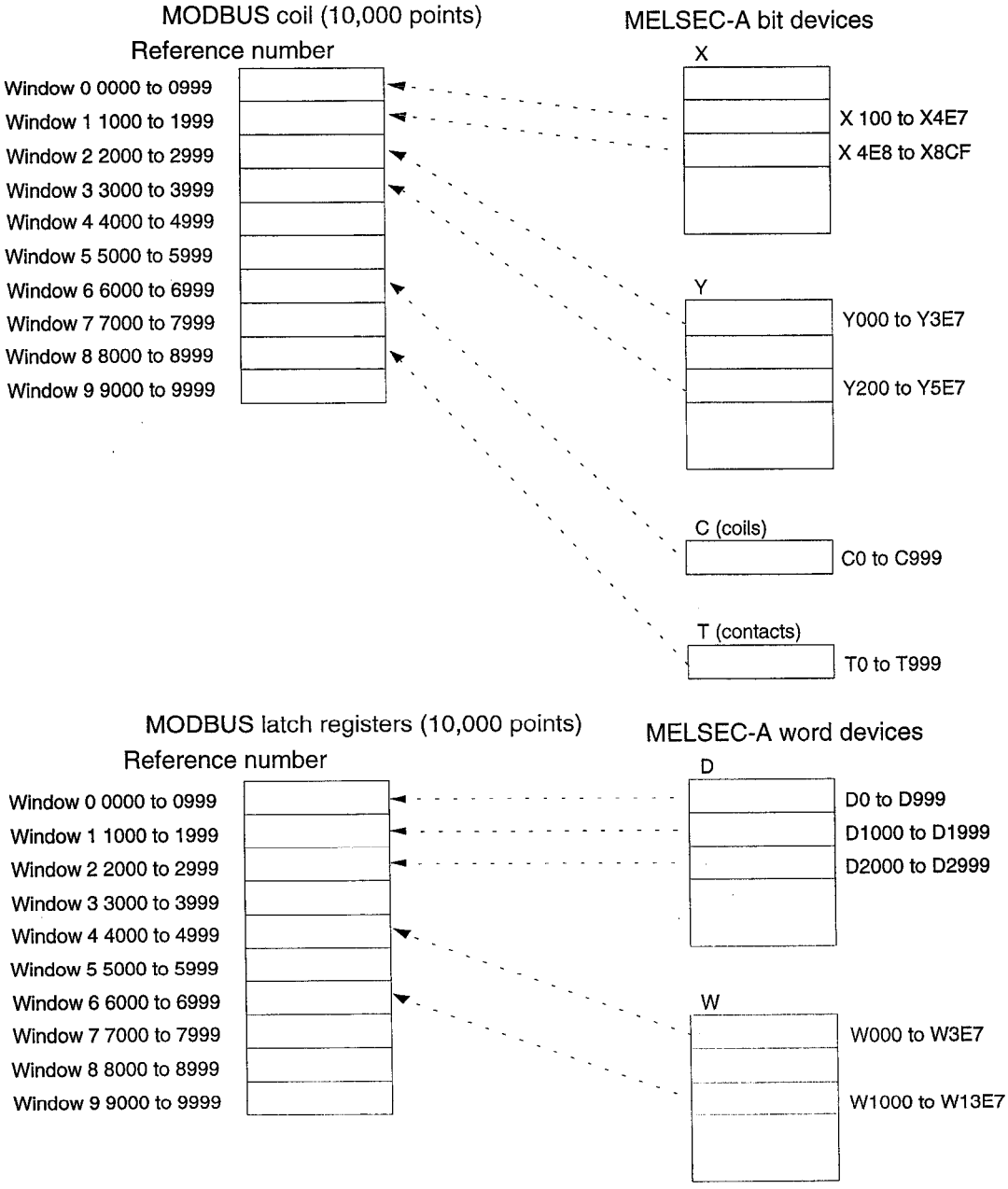
- If, after an attempt is made to eliminate the cause of the communication error while the communication error cancellation request Y is ON, the cause of the communication error remains or the communication error occurs again, X is switched OFF, and then back ON after checking that Y has gone OFF.

6.4 Device Allocations

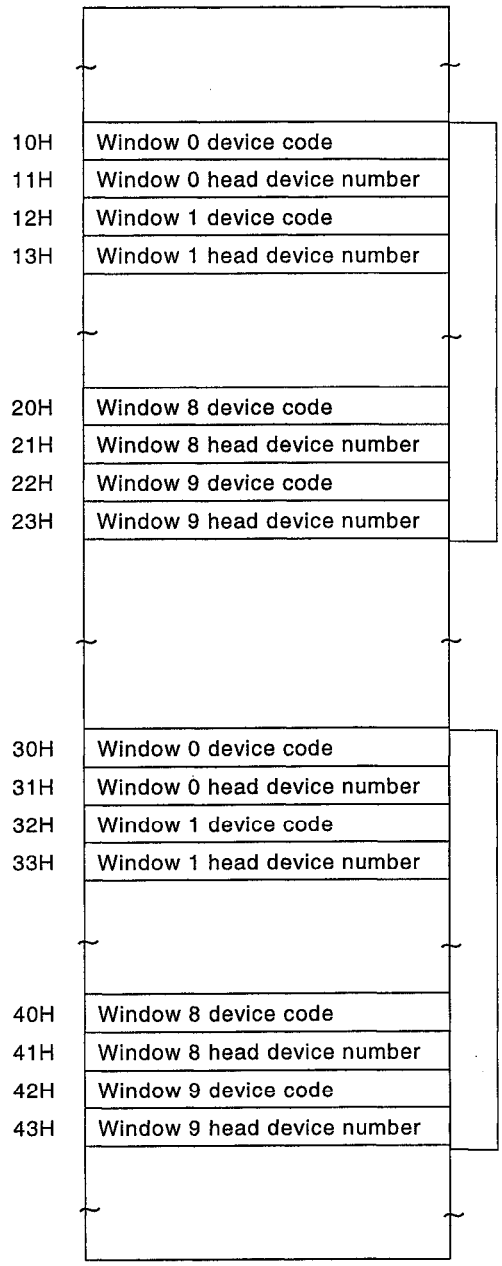
The device designations for device reading and writing during execution of MODBUS standard functions are made in accordance with the device designation and buffer memory allocation in the enquiry message.

6.4.1 Allocation outline

The MODBUS coils or latch registers are divided into windows comprising 1000 points each, and MELSEC-A bit devices or word devices can be allocated without restriction to each window in 1,000 point units.



6.4.2 Allocation method



(1) Device codes

No allocation	:	0H
D	:	1H
Special D	:	2H
W	:	3H
R	:	4H
T (present value)	:	5H
T (contact)	:	6H
T (coil)	:	7H
C (present value)	:	8H
C (contact)	:	9H
C (coil)	:	AH
X	:	BH
Y	:	CH
M	:	DH
Special M	:	EH
B	:	FH
F	:	10H

(2) Device numbers

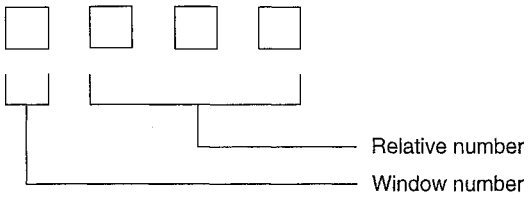
D	:	0 to 1FFFH
Special D	:	0 to 00FFH
W	:	0 to 1FFFH
R	:	0 to 1FFFH
T (present value)	:	0 to 07FFH
T (contact)	:	0 to 07FFH
T (coil)	:	0 to 07FFH
C (present value)	:	0 to 03FFH
C (contact)	:	0 to 03FFH
C (coil)	:	0 to 03FFH
X	:	0 to 1FFFH
Y	:	0 to 1FFFH
M	:	0 to 1FFFH
Special M	:	0 to 00FFH
B	:	0 to 1FFFH
F	:	0 to 00FFH

Note:

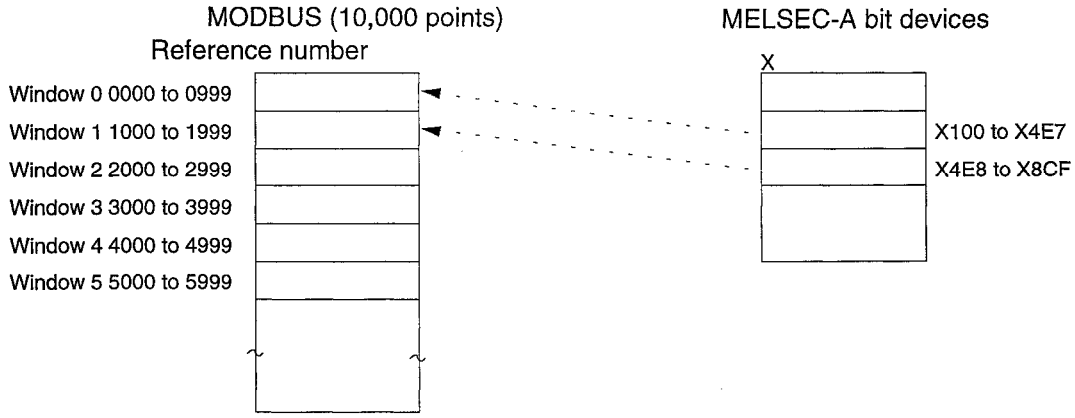
- When the power is switched ON the default allocations are made, but these can be changed by switching $Y_{(n+1)}$ 7 ON after writing allocation data to the buffer memory.
- It only possible to set bit devices in windows for coils, and word devices in windows for latch registers.

6.4.3 Device designations

Devices are designated by specifying the window to which the relevant device is allocated and the number of devices from the head device number, in a four- digit decimal number.



Example:
To read X200 when the buffer memory window allocations are made as indicated in the figure below, "0256" should be specified as the device designation in the enquiry message, since X200 is the 256th allocation in window 0.

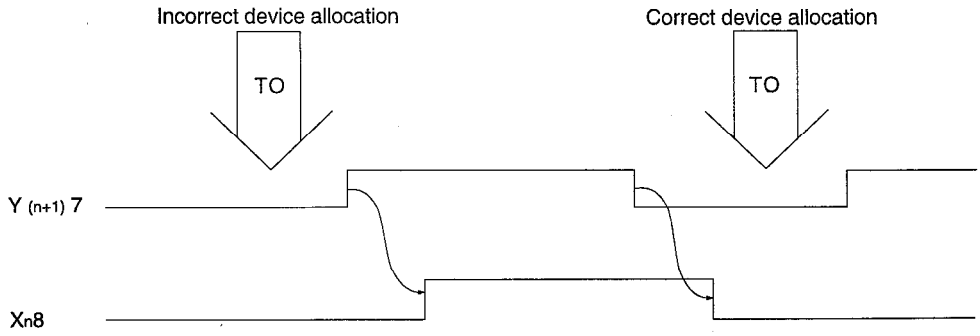


6.4.4 Device default allocations

The allocations made when the power is switched on are shown below.

	Coil		Latch Registers	
Window 0	X	0000 to 03E7	D	0000 to 0999
1	Y	0000 to 03E7	D	1000 to 1999
2	M	0000 to 0999		
3	M	1000 to 1999		
4	T (contact)	0000 to 0999	T (present value)	0000 to 0999
5	T (coil)	0000 to 0999	C (present value)	0000 to 0999
6	C (contact)	0000 to 0999		
7	C (coil)	0000 to 0999		
8	B	0000 to 03E7	W	0000 to 03E7
9	Special M	0000 to 0255	Special D	0000 to 0255

6.4.5 Device allocation I/O (X/Y) ON/OFF timing



Note:

- When an incorrect device allocation is made, the allocation data is ignored and - if there is a device read/write request - a NAK is returned.
- Regardless of the parameter settings, R allocations will be checked as follows: 0 K points in the case of A1 systems, 4 K points in the case of A2 systems, and 8 K points in the case of A3 systems.

7. MODBUS STANDARD FUNCTIONS

The MODBUS standard functions are the functions featured as standard, under function codes 0 to 21, in MODBUS systems used with the 184/384, 484, and 584 controllers made by MODICON.
The C24-S2 supports these functions with applicable CPUs, and communicates the relevant data between the MODBUS master station and the PC CPU.
Details of the MODBUS standard functions and the various message formats (RTU mode only) are presented below.

7.1 MODBUS Standard Function List

Function Code	Function	Processing Details	Supported by C24-S2
00	———	———	———
01	READ COIL STATUS	Obtains the current status (ON/OFF) of a group of logical coils.	○
02	READ INPUT STATUS	Obtains the current status (ON/OFF) of a group of discrete inputs.	×
03	READ HOLDING REGISTERS	Obtains the binary value currently stored in one or more latched registers.	○
04	READ INPUT REGISTERS	Obtains the binary value currently stored in one or more input registers.	×
05	FORCE SINGLE COIL	Changes the status of a logical coil to ON or OFF.	○
06	PRESET SINGLE REGISTERS	Writes a specified binary value to a latched register.	○
07	READ EXCEPTION STATUS	Obtains the statuses (ON/OFF) of eight internal coils at addresses in the controller. The user logic can be used to program these coils to indicate the statuses of slave stations. Short message length ensures rapid status reading.	○
08	LOOPBACK DIAGNOSTIC TEST	The diagnosis test message is sent to slave stations to evaluate transmission processing.	○
09	PROGRAM-484 ONLY	Enables the master station to execute programming panel simulation processing and PC slave logic changes.	×
10	POOL PROGRAM COMPLETE-484 ONLY	Enables other slave stations to communicate with the master station even when it is occupied with a long program task at a particular slave station. The slaves are cyclically pooled to determine whether or not program execution has been completed or not. Terminated after a message including a single function code 9 is sent.	×
11	FETCH EVENT COUNTER COMMUNICATIONS	Enables the master station to determine whether or not the operation was successfully completed when a communication error (particularly one related to a command or response) occurs after sending one query.	○
12	FETCH EVENT COMMUNICATIONS EVENT LOG	Returns to the master station the communication event log, which includes information on each of the MODBUS transactions of the slave stations. If a transaction was not completed, the log indicates the error that occurred.	○

Supported : ○
Not supported : ×

Function code	Function	Processing Details	Supported by C24-S2
13	PROGRAM-184/384, 484, 584	Enables the master station to execute programming panel simulation processing and PC slave logic changes.	
14	POOL PROGRAM COMPLETE-184/384, 484, 584	Enables other slave stations to communicate with the master station even when it is occupied with a long program task at a particular slave station. The slaves are cyclically pooled to determine whether or not program execution has been completed or not. Terminated after a message including a single function code 13 is sent.	
15	FORCE MULTIPLE COILS	Changes the ON or OFF statuses of a defined consecutive sequence of logical coils.	○
16	FORCE MULTIPLE REGISTERS	Writes a specified binary value to a consecutive sequence of latched registers.	○
17	REPORT SLAVE I. D.	Enables the master station to determine the type of the slave whose address is specified and the running status of the slave.	○
18	PROGRAM-884&Micro 84	Enables the master station to execute programming panel simulation processing and PC slave logic changes.	
19	RESET COMMUNICATIONS LINK	Resetting a slave in order to investigate the status after the occurrence of an error from which recovery was not possible.	
20	READ GENERAL REFERENCE-584 ONLY	Display of information contained in expansion memory files.	○
21	WRITE GENERAL REFERENCE-584 ONLY	Registration and changing of information contained in expansion memory files.	○

Supported : ○

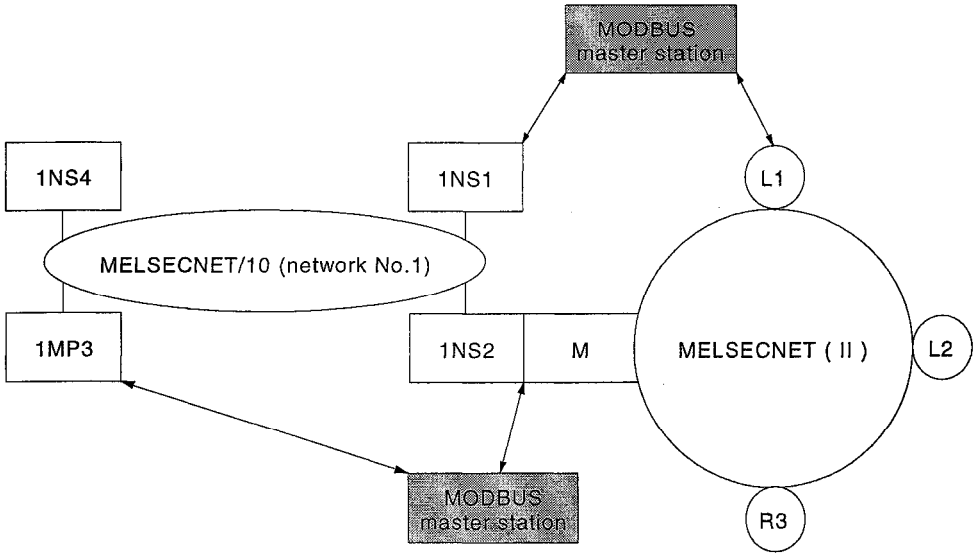
Not supported : ×

Note:

- If a message containing a function code between 1 and 21 that is not supported is received, or if a message containing a function code outside the range 1 to 21 and not supported as an optional function is received, the C24-S2 sends a "NAK" to the MODBUS master station.
- Broadcast communication can only be used with function codes 5, 6, 15, and 16.

7.2 Access Range

The access range for MODBUS standard functions is such that the MODBUS master station can access directly only a PC CPU mounted on the same base as a C24-S2.



1MP3 : Master station (station No.3)
1NS1 : Normal station (station No.1)
1NS2 : Normal station (station No.2)
1NS4 : Normal station (station No.4)
M : Master station
L1 : Local station 1
L2 : Local station 2
R3 : Remote station 3

PC CPU on the Same Base as the C24-S2 Connected to the MODBUS Master Station	1MP3	1NS1	1NS4	1NS2 / M	L1	L2	R3
1MP3	○						
1NS1		○					
1NS2 / M			×	○			×
L1					○		

○ : Direct access possible
: Direct access not possible

7.3 Device Read/Write

This function is used to read data from, and write data to, the device memory of the PC CPU on which the C24-S2 is mounted.

7.3.1 Device memory read/write function list

Function Code	Function	Number of Points Processed in One Communication	PC CPU Status			Remarks
			STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
01	READ COIL STATUS	256 points	○	○	○	
03	READ HOLDING REGISTERS	64 points	○	○	○	
05	FORCE SINGLE COIL	1 point	○	○	×	
06	PRESET SINGLE REGISTERS16	1 point	○	○	×	
15	FORCE MULTIPLE COILS	160 points	○	○	×	
16	FORCE MULTIPLE REGISTERS	64 points	○	○	×	

○ : Can be executed
× : Cannot be executed

7.3.2 Device range

The devices specified in messages must be specified within the ranges indicated in the table below for the applicable CPU of the C24-S2. For the method for specifying devices, see Section 6.4.3.

MODBUS Device Type			C24-S2 Device Type	
Device	Attribute	Reference Number	Device	Reference Number *1
Coil	R / W	0****	Y	Y0 to 1FFFH (8192 points)
			X	X0 to 1FFFH (8192 points)
			B	B0 to 1FFFH (8192 points)
			M	M0 to 8191 (8192 points)
			F	F0 to 2047 (2048 points)
			T (Coil)	T0 to 2047 (2048 points)
			T (Contact)	T0 to 2047 (2048 points)
			C (Coil)	C0 to 1023 (1024 points)
			C (Contact)	C0 to 1023 (1024 points)
			Special M	M9000 to 9255 (256 points)
Input	R	1****	———	———
Input register	R	3****	———	———
Holding register	R / W	4****	D	D0 to 8191 (8192 points)
			W	W0 to 1FFFH (8192 points)
			R	R0 to 8191 (8192 points)
			T (present value)	T0 to 2047 (2048 points)
			C (present value)	C0 to 1023 (1024 points)
			Special D	D9000 to 9255 (256 points)

*1 The reference numbers given in the table indicate the maximum range used by the applicable CPU: the ranges used will differ according to the CPU.

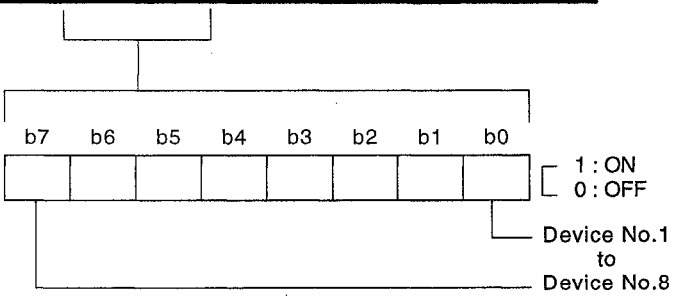
7.3.3 READ COIL STATUS

(1) Query message format

Address	Function code (01H)	Device designation		Number of points read		Error check field
		(H)	(L)	(H)	(L)	

(2) Response message format

Address	Function code (01H)	Number of bytes read (n)	Read data No.1	.....	Read data No.n	Error check field



7.3.4 READ HOLDING REGISTERS

(1) Query message format

Address	Function code (03H)	Device designation		Number of points read		Error check field
		(H)	(L)	(H)	(L)	

(2) Response message format

Address	Function code (03H)	Number of bytes read (nx2)	Read data No.1		.....	Read data No.n		Error check field
			(H)	(L)		(H)	(L)	

7.3.5 FORCE SINGLE COIL

(1) Query message format

Address	Function code (05H)	Device designation		ON/OFF data		Error check field
		(H)	(L)	(H)	(L)	

FF00H : ON
0000H : OFF

(2) Response message format

Address	Function code (05H)	Device designation		ON/OFF data		Error check field
		(H)	(L)	(H)	(L)	

7.3.6 PRESET SINGLE REGISTERS

(1) Query message format

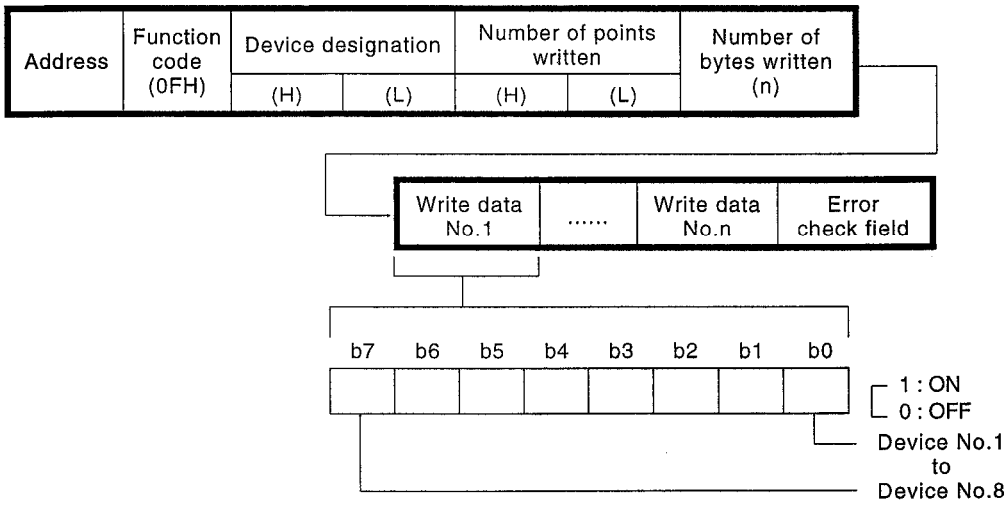
Address	Function code (06H)	Device designation		Write data		Error check field
		(H)	(L)	(H)	(L)	

(2) Response message format

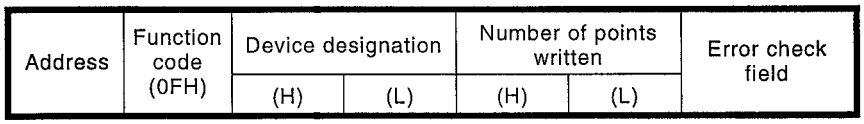
Address	Function code (06H)	Device designation		Write data		Error check field
		(H)	(L)	(H)	(L)	

7.3.7 FORCE MULTIPLE COILS

(1) Query message format

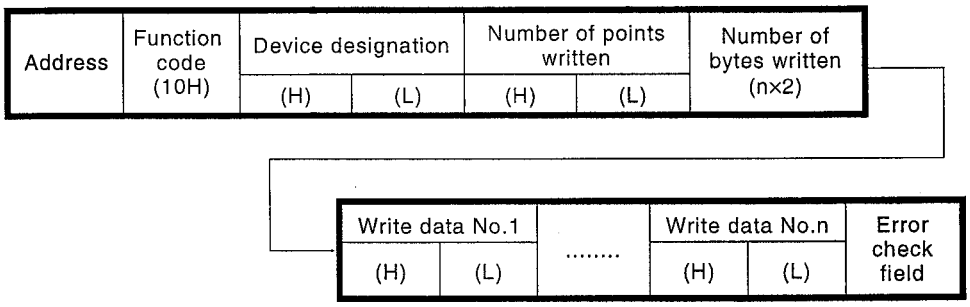


(2) Responce message format

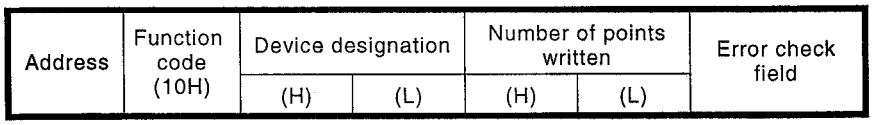


7.3.8 FORCE MULTIPLE REGISTERS

(1) Query message format



(2) Response message format



7.4 READ EXCEPTION STATUS

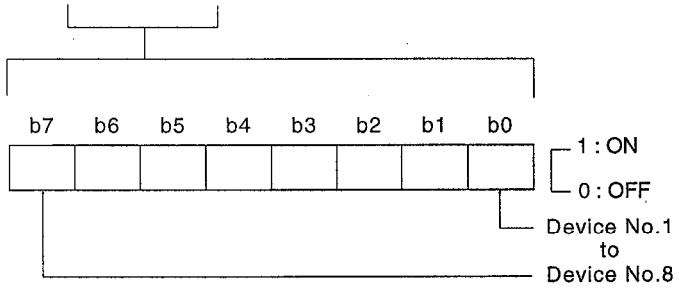
This function is used to read the status of eight coils in the PC CPU. The C24-S2 reads the status of Y0 to 7 of the PC CPU on the same base. The user can set control information (battery status, etc.) for these coils by using a sequence program.

(1) Query message format

Address	Function code (07H)	Error check field

(2) Response message format

Address	Function code (07H)	Coil data	Error check field



Note:

- Y0 to 7 is the default: it is possible to change this setting. (See Section 6.3.4.)

7.5 LOOPBACK DIAGNOSTIC TEST

This function is used to obtain the contents of diagnosis registers and information that is useful for the analysis of communication errors, in accordance with the diagnosis code and data for operations in the data field.

7.5.1 List of loopback test functions

Diagnosis Code	Processing Details	Remarks
00	Return Query Date	
01	Restart Comm Option-no response	
02	Return Diagnostic Register	
03	Change input Delimiter Character	
04	Force Slave to Listen only Mode	
05 to 09	Reserve	
10	Clear Counters and Diagnostic Register	
11	Return Bus Message Count	
12	Return Bus CRC Error Count	
13	Return Bus Exception Error Count	
14	Return Slave Message Count	
15	Return Slave No Response Count	
16	Return Slave NAK Count	
17	Return Slave Busy Count	
18	Return Bus Character Overrun Count	
19	Return Overrun Error Count	
20	Clear Overrun Error Count and Flag	

7.5.2 Return Query Data

Returns the query message without alteration as the response message.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	00H	Arbitrary data	Arbitrary data	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	00H	Arbitrary data	Arbitrary data	

7.5.3 Restart Comm Option-no response

When the port is reset (on returning from the listen only mode (LOM) to the online mode), all counters (for number of messages, etc.) are cleared. In addition, if "error continuation" (FF00H) is specified, the communication event log is also cleared.
When the listen only mode is effective, no response message is returned.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	01H	(H)	(L)	

Normal : 0000H
Error continuation :FF00H

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	01H	(H)	(L)	

7.5.4 Return Diagnostic Register

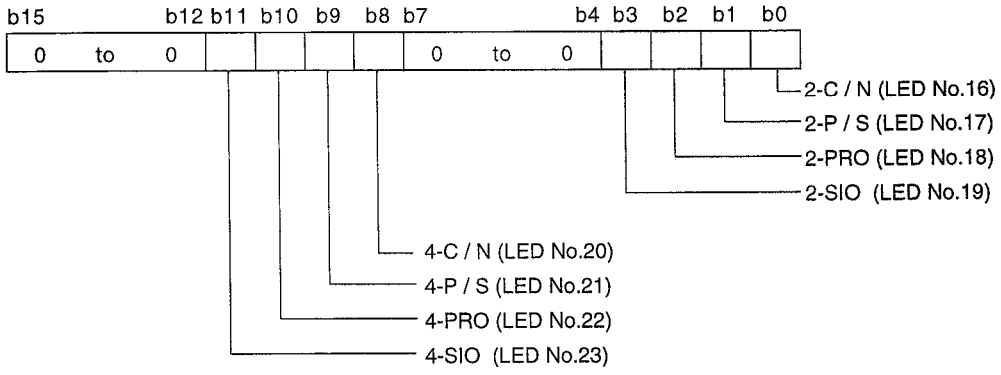
Returns the data in the diagnostic register.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	02H	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	02H	(H)	(L)	



7.5.5 Change Input Delimiter Character

Specifies the character designated in the data field for use in place of the delimiter character LF in ASCII messages.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	03H	CHAR	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	03H	CHAR	00H	

<<Caution>>

In a system configuration in which a main channel setting is made and sequential communication is executed, either change the delimiter character using "broadcast send", or change the station for which the main channel is set last.

7.5.6 Force Slave to Listen Only Mode

Changes the slave status to the listen only mode (LOM). No processing is executed, and no response message is returned, in response to subsequent query messages.
The only type of quety that is recognized and processed in the listen only mode is the "Restart Comm Option-no response" command (function code 08H, diagnosis code 01H).

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	04H	00H	00H	

(2) Response message format

None

7.5.7 Clear Counters and Diagnostic Register

Clears all counters (for number of messages, etc.) and diagnostic registers (also switches off LEDs, etc.).

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0AH	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0AH	00H	00H	

7.5.8 Return Bus Message Count

Returns the number of messages processed at the MODBUS slave interface (C24-S2) whose address is specified since the last time a restart was executed or the power was switched ON.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0BH	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0BH	(H)	(L)	

Number of messages

7.5.9 Return Bus CRC Error Count

Returns the number of CRC errors detected at the MODBUS slave interface (C24-S2) whose address is specified since the last time a restart was executed or the power was switched ON.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0CH	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0CH	(H)	(L)	

Number of CRC errors

7.5.10 Return Bus Exception Error Count

Returns the number of error codes returned by the MODBUS slave interface (C24-S2) whose address is specified since the last time a restart was executed or the power was switched ON.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0DH	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0DH	(H)	(L)	

Number of error codes

7.5.11 Return Slave Message Count

Returns the number of messages addressed to the PC since the last time a restart was executed or the power was switched ON.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0EH	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0EH	(H)	(L)	

Number of messages

7.5.12 Return Slave No Response Count

Returns the number of times faults have occurred on responding to the interface module (C24-S2) connected to the PC since the last time a restart was executed or the power was switched ON at the MODBUS slave whose address is specified.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0FH	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	0FH	(H)	(L)	

Number of on response events

7.5.13 Return Slave NAK Count

Returns the number of NAK responses returned to the MODBUS slave interface module (C24-S2) whose address is specified by the connected PC since the last time a restart was executed, the counter was cleared, or the power was switched ON.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	10H	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	10H	(H)	(L)	

Number of NAK responses

7.5.14 Return Slave Busy Count

Returns the number of BUSY responses returned to the MODBUS slave interface module (C24-S2) whose address is specified by the connected PC since the last time a restart was executed, the counter was cleared, or the power was switched ON.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	11H	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	11H	(H)	(L)	

Number of BUSY responses

7.5.15 Return Bus Character Overrun Count

Returns the number of messages that could not be processed because characters were lost: either because transmission was too fast to record the characters up to UART, or because of hardware malfunction.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	12H	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	12H	(H)	(L)	

Number of overruns

7.5.16 Return Overrun Error Count

Returns the number of MODBUS messages that could not be processed by MODBUS IOP due to character overrun error.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	13H	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	13H	(H)	(L)	

Number of overrun errors

7.5.17 Clear Overrun Error Count and Flag

Clears the overrun error count and flag.

(1) Query message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	14H	00H	00H	

(2) Response message format

Address	Function code (08H)	Diagnosis code		Data field		Error check field
		00H	14H	00H	00H	

7.6 Fetch Event Counter Communications/Fetch Communications Event Log

This function is used to obtain information including the number of messages sent from the master station in which queries to a particular slave station were made, the number of normal processings, and the current BUSY status.

7.6.1 FETCH EVENT COUNTER COMMUNICATIONS

Returns the processing status of program commands (not supported), and the number of messages that have been processed normally, as an event counter.

(1) Query message format

Address	Function code (0BH)	Error Check field

(2) Response message format

Address	Function code (0BH)	Processing status		Event counter		Error check field
		00H	00H	(H)	(L)	

7.6.2 FETCH COMMUNICATIONS EVENT LOG

Returns the processing status of program commands (not supported), and the number of messages that have been processed normally, as an event counter; and the number of messages and a maximum of 64 bytes of event data.

(1) Query message format

Address	Function code (0CH)	Error Check field

(2) Response message format

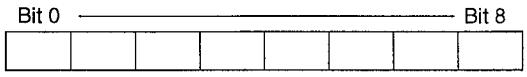
Address	Function code (0CH)	Number of bytes (n+6)	Processing status		Event counter		Number of messages	
			00H	00H	(H)	(L)	(H)	(L)

Event counter No.1	.....	Event counter No.n	Error Check field

7.6.2.1 Event data

Event data is one byte of information that corresponds to a communications processing or a specific internal processing. It is stored in a cyclic memory area (ring buffer).

The arrangement of bits in this byte is shown below



A) When received by a slave: The query message is stored on receipt.

Bit 0 - 0
Bit 1 - Set on occurrence of communications error
Bit 2 - 0
Bit 3 - 0
Bit 4 - Set on occurrence of an overrun error
Bit 5 - Set in the listen only mode
Bit 6 - Set when broadcast communication is executed
Bit 7 - 1

B) When transmitted by a slave: Stored on completion of processing and response

Bit 0 - Set when error codes 1 to 3 are returned
Bit 1 - Set when error code 4 is returned
Bit 2 - 0
Bit 3 - 0
Bit 4 - 0
Bit 5 - Set in the listen only mode
Bit 6 - 1
Bit 7 - 0

C) When the listen only mode is registered: Stored each time the listen only mode is registered

Bit 0 - 0
Bit 1 - 0
Bit 2 - 1
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 0
Bit 7 - 0
(20H)

D) When communication is restarted: Stored each time the error continuation mode

Bit 0 - 0
Bit 1 - 0
Bit 2 - 0
Bit 3 - 0
Bit 4 - 0
Bit 5 - 0
Bit 6 - 0
Bit 7 - 0

7.7 REPORT SLAVE I.D

This function is used to obtain the type and RUN status of the PC CPU mounted on the same base as the C24-S2.

(1) Query message format

Address	Function code (11H)	Error Check field

(2) Response message format

Address	Function code (11H)	Number of bytes (02H)	CPU type	RUN status	Error check field

RUN status
- 00H : STOP, PAUSE
- FFH : RUN, STEP RUN

CPU type
- A1H : A1CPU, A1NCPU
- A2H : A2CPU, A2NCPU, A2NCPU-S1, A2SCPU, A2SCPU-S1, A1SCPU-S1
- A3H : A3CPU, A3NCPU, A73CPU
- A4H : A3HCPU, A3MCPU
- 92H : A2ACPU
- 93H : A2ACPU-S1
- 94H : A3ACPU
- 98H : A0J2HCPU, A1SCPU, A1SJCPU
- 9AH : A52GCPU
- 82H : A2UCPU, A2ASCPU
- 83H : A2UCPU-S1, A2ASCPU-S1
- 84H : A3UCPU, AJ72LP25, AJ72BR15
- 85H : A4UCPU

7.8 Read General Reference/Write General Reference

This function uses the unused area in the user memory area of the PC CPU mounted on the same base as the C24-S2 as an extension file register for read/write operations.
The block number and a relative reference number in the range 0 to 81 to 8191 are specified for the read or write operation in the query message. The block numbers that can be specified depend on the type of memory cassette and the parameter settings of the PC CPU.

Function Code	Function	Number of Points Processed in One Communication	PC CPU Status			Remarks
			STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
14H	READ GENERAL REFERENCE	20 points *1	○	○	○	
15H	WRITE GENERAL REFERENCE	10 points *2	○	○	×	

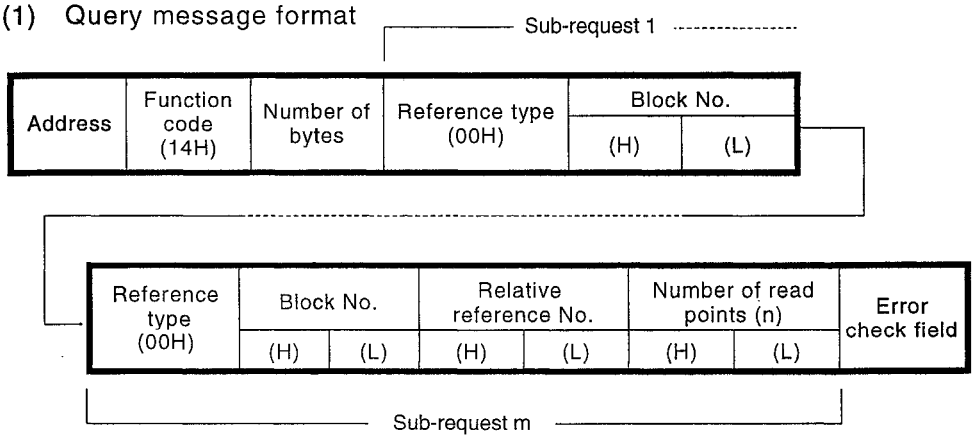
*1 Total points read in all sub-requests

*2 Total points written in all sub-requests

7.8.1 READ GENERAL REFERENCE -584 ONLY

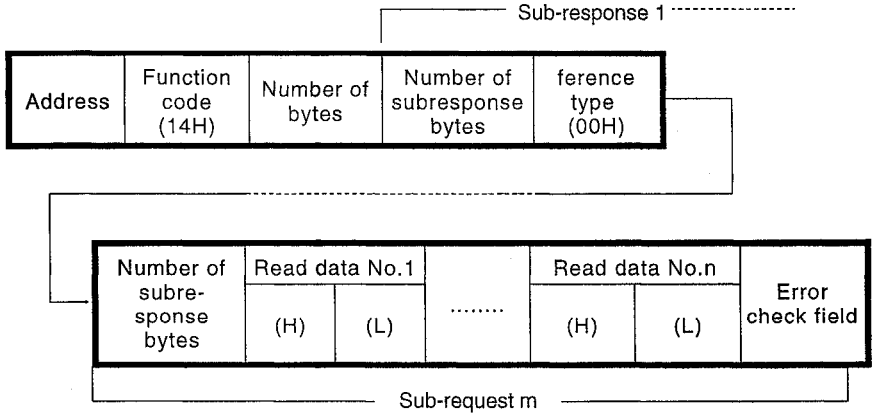
Reads extension file registers.

(1) Query message format



Number of bytes = number of sub-requests (m)×7

(2) Response message format

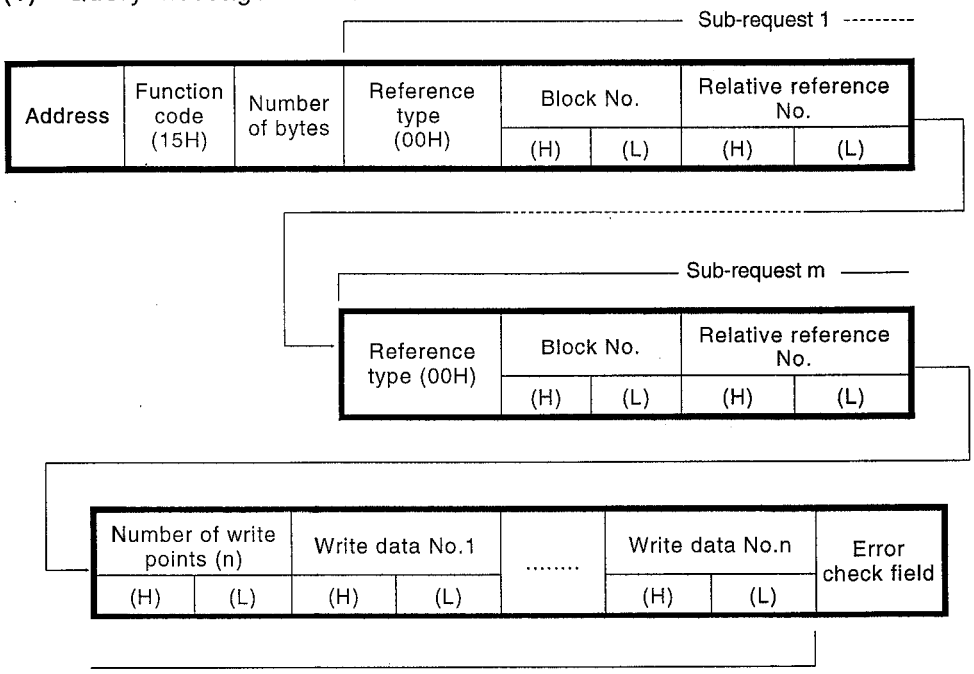


Number of bytes = total of numbers of bytes for all sub-responses
Number of sub-response bytes = number of write points × 2 + 1

7.8.2 WRITE GENERAL REFERENCE -584 ONLY

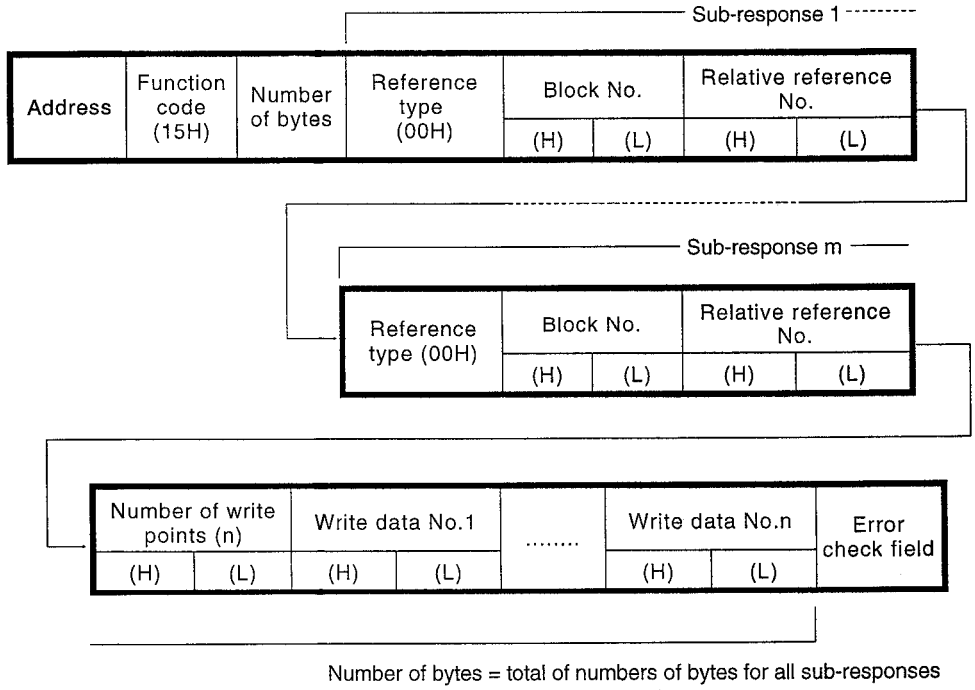
Writes to extension file registers.

(1) Query message format



Number of bytes = total of numbers of bytes for all sub-requests
Sub-request = number of write points × 2 + 7

(2) Response message format

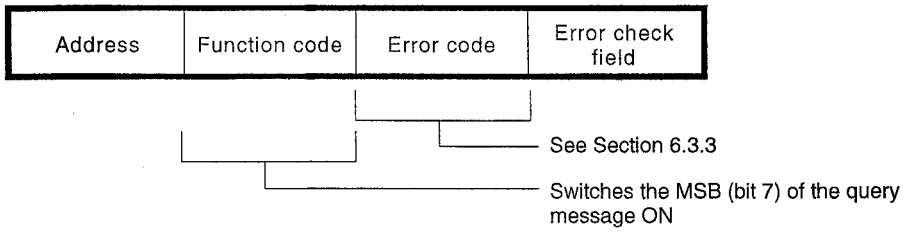


Number of bytes = total of numbers of bytes for all sub-responses
Sub-response = number of write points × 2 + 7

7.9 NAK

If there is data that cannot be processed in the query message, or if an error occurs when communicating with the PC CPU, a NAK message is returned to the MODBUS master station.

(1) Response message format



8. OPTIONAL FUNCTIONS (COMPUTER LINK FUNCTION)

The MODBUS system reserves function codes 65 to 75 for use with functions set by the user and the optional functions can therefore be supported by using this range.
The optional functions of the C24-S2 provide the system with computer link functions (option code 70) which are not supported by the MODBUS standard functions. These additional functions enable the control and monitoring of PC CPU operation statuses, and the communication of data and programs with PC CPUs.
The various message formats when using the optional functions (RTU mode only) are tabled below.

8.1 Computer Link Function List

Function			Processing Details	Remarks
Device memory	Batch read	Bit units	Reads bit devices (such as X, Y, and M) in units of 1device.	
		Word units	Reads bit devices (such as X, Y, and M) in units of 16 devices.	
			Reads word devices (such as D, R, T, C, etc.) in units of 1 device.	
	Batch write	Bit units	Writes bit devices (such as X, Y, and M) in units of 1 device.	
		Word units	Writes bit devices(such as X, Y, and M) in units of 16 devices.	
			Writes word devices (such as D, R, T, C, etc.) in units of 1 device.	
	Test (random write)	Bit units	Specifies bit devices (such as X, Y,and M) and device numbers in units of 1 device at random and sets/resets the device.	
		Word units	Specifies bit devices (such as X, Y, and M) and device numbers in units of 16 devices at random and sets/resets the device.	
			Specifies word devices (D, R, T, C, etc.) and device numbers in units of 1 device at random and writes to the devices.	
	Monitor data entry	Bit units	Sets bit devices to be monitored (such as X, Y, and M) in units of 1 device.	
		Word units	Sets bit devices to be monitored (such as X, Y, and M) in units of 16 devices.	
			Sets word devices to be monitored (such as D, R, T, and C) in units of 1 device.	
	Monitor	Bit units	Monitors devices for which monitor data entry has been executed.	
		Word units		
Extension file register	Batch read		Reads extension file registers (R) in units of 1 register.	
	Batch write		Writes extension file registers (R) in units of 1 register.	
	Test (random write)		Specifies random extension file registers (R) by specifying block No. and deviceNo. and writes to them.	
	Monitor data entry		Sets extension registers (R) to be monitored in units of 1 register.	
	Monitor		Monitors extension registers (R) for which monitor data entry has been executed.	
Buffer memory	Batch read		Reads data in the C24-S2 buffer memory.	
	Batch write		Writes data to the C24-S2 buffer memory.	

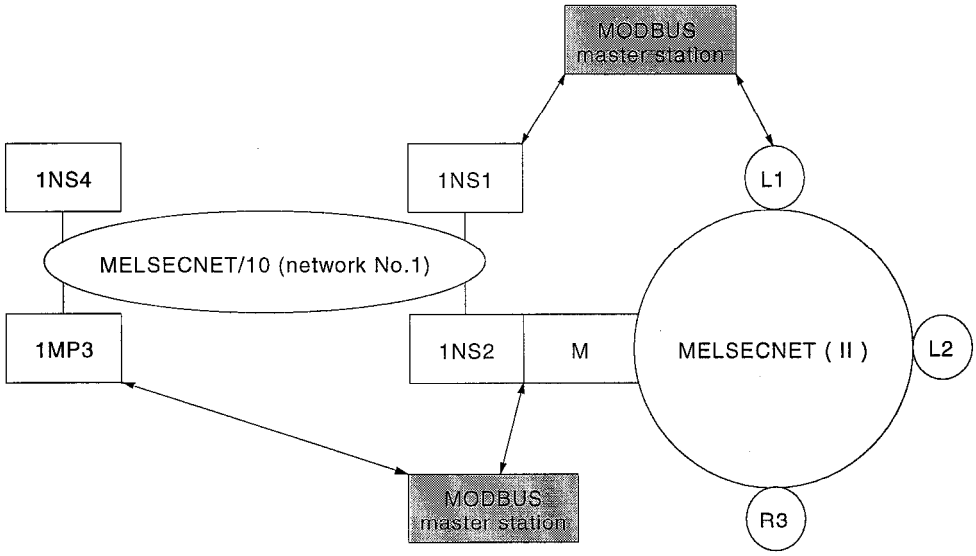
Function				Processing Details	Remarks
Special function module buffer memory	Batch read			Reads the contents of the special function module buffer memory.	
	Batch write			Writes data to the special function module buffer memory.	
Sequence program	Batch read	Main	T/C set value	Reads T/C set values used in main sequence programs.	
			Other than T/C set	Reads main sequence programs.	
		Sub	T/C set value	Reads T/C set values used in subsequence programs.	
			Other than T/C set	Reads subsequence programs.	
	Batch write	Main	T/C set value	Writes T/C set values used in main sequence programs	
			Other than T/C set	Writes main sequence programs.	
		Sub	T/C set value	Writes T/C set values used in subsequence programs.	
			Other than T/C set	Writes subsequence programs.	
Microcomputer program	Batch read		Main	Reads main microcomputer programs.	
			Sub	Reads submicrocomputer programs.	
	Batch write		Main	Writes main microcomputer programs.	
			Sub	Writes submicrocomputer programs.	
Comment	Batch read			Reads comment data.	
	Batch write			Writes comment data.	
Parameter	Batch read			Reads parameters from the PC CPU.	
	Batch write			Writes parameters to the PC CPU.	
	Analysis request			Causes the PC CPU to acknowledge and check rewritten parameters.	
PC CPU	Remote RUN			Requests remote RUN of the PC CPU.	
	Remote STOP			Requests remote STOP of the PC CPU.	
	PC CPU read			Reads the type of PC CPU: A1N, A2N, A3N, A3H.	
Loopback test				Echoes unchanged characters back to the MODBUS master station.	
Real address	Batch read			Reads PC CPU memory data using real addresses.	Not released
	Batch write			Writes PC CPU memory data using real addresses.	

Note:

- The default function code for the optional functions (computer link function) is 70 but this can be changed within the range of 65 to 75. (See Section 6.3.5.)
- Broadcast communication can only be used with subcodes 2, 3, 4, and 5.

8.2 Access Range

The access range for the optional functions (computer link function) is such that the MODBUS master station can directly access the PC CPU mounted on the same base as the C24-S2 and other stations of the host network by designating the station number in the network (0 to 64: other stations, FFH: self station) as the PC number.



1MP3 : Master station (station No.3)
1NS1 : Normal station (station No.1)
1NS2 : Normal station (station No.2)
1NS4 : Normal station (station No.4)

M : Master station
L1 : Local station 1
L2 : Local station 2
R3 : Remote station 3

PC CPU on the Same Base as the C24-S2 Connected to the MODBUS Master Station	1MP3	1NS1	1NS4	1NS2 / M	L1	L2	R3
1MP3	○	○	○	○	×	×	×
1NS1	○	○	○*1	○ *1	×	×	×
1NS2 / M *2	○	○*1	○*1	○	○	○	○
L1		×	×	○	○		×

○ : Direct access possible
× : Direct access not possible

*1 See *3 in the table below.

*2 If the 1NS2/M PC CPU is an AnUCPU, the host network is determined in accordance with the valid station number when accessing other stations set in the parameters.

System Name	Mounted PC CPU	Station Accessed
MELSECNET (II) MELSECNET / B	Master station	Local station Remote I/O station
	Local station	Master station
MELSECNET / 10	Control station	Normal station (AnN/AnA/AnUCPU)
	Master station	Remote I/O station
	Normal station (AnN/AnA/AnUCPU)	Control station
		Normal station *3 (Only when normal station to left is AnUCPU)
	Remote I/O station	Master station

8.3 Device Memory Read/Write

This function reads data from, and writes data to, the PC CPU device memory.

8.3.1 Device memory read/write function list

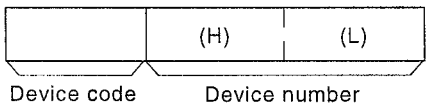
Sub code	Function			Number of Points Processed in One Communication	PC CPUStatus			Remarks
					STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
00	Batch read	Bit units		256 points	○	○	○	
01		Word units	Bit	32 words (512 points)				
			Word	64 points				
02	Batch write	Bit units		160 points	○	○		
03		Word units	Bit	10 words (160 points)				
			Word	64 points				
04	Test (random write)	Bit units		20 points	○	○		
05		Word units	Bit	10 words (160 points)				
			Word	10 points				
06	Monitor data entry	Bit units		40 points	○	○	○	
07		Word units	Bit	20 words (320 points)				
			Word	20 points				
08	Monitor	Bit units		———	○	○	○	
09		Word units						

○ : Can be executed

: Cannot be executed

8.3.2 Device ranges

As shown in the figure below, device settings for reading from or writing to the device memory are made by specifying a device code (1 byte) and a device number (2 bytes).

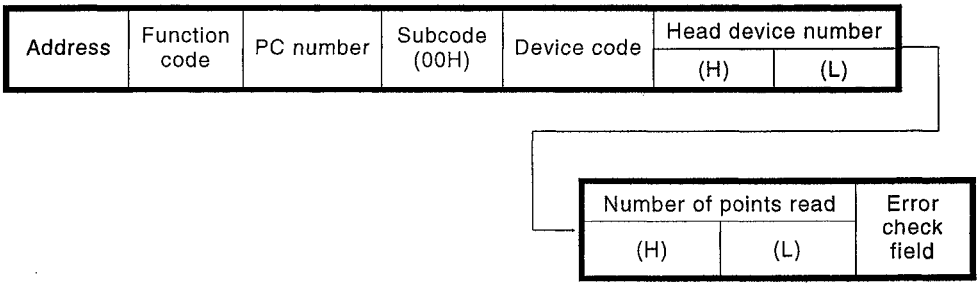


Device		Device Code	Device No.	Device Code + Device No.
Data registers		1	D0 to 8191	010000 to 018191
		2	D9000 to 9255	029000 to 029255
Link registers		3	W0 to 1FFFH	030000 to 031FFF
File registers		4	R0 to 8191	040000 to 048191
Timers	(present value)	5	T0 to 2047	050000 to 052047
	(contact)	6	T0 to 2047	060000 to 062047
	(coil)	7	T0 to 2047	070000 to 072047

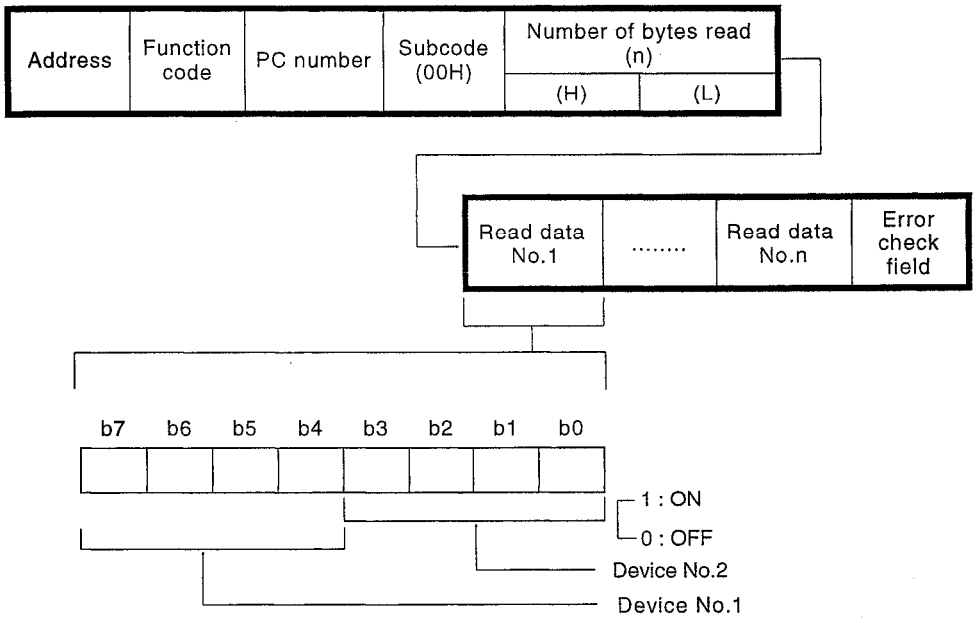
Device		Device Code	Device No.	Device Code + Device No.
Counters	(present value)	8	C0 to 1023	080000 to 081023
	(contact)	9	C0 to 1023	090000 to 091023
	(coil)	A	C0 to 1023	0A0000 to 0A1023
Inputs		B	X0 to 1FFFH	0B0000 to 0B1FFF
Outputs		C	Y0 to 1FFFH	0C0000 to 0C1FFF
Internal relays		D	M (L, S) 0 to 8191	0D0000 to 0D8191
		E	M9000 to 9255	0E9000 to 0E9255
Link relays		F	B0 to 1FFFH	0F0000 to 0F1FFF
Annunciators		10	F0 to 2047	100000 to 102047

8.3.3 Device memory batch reading in bit units

(1) Query message format

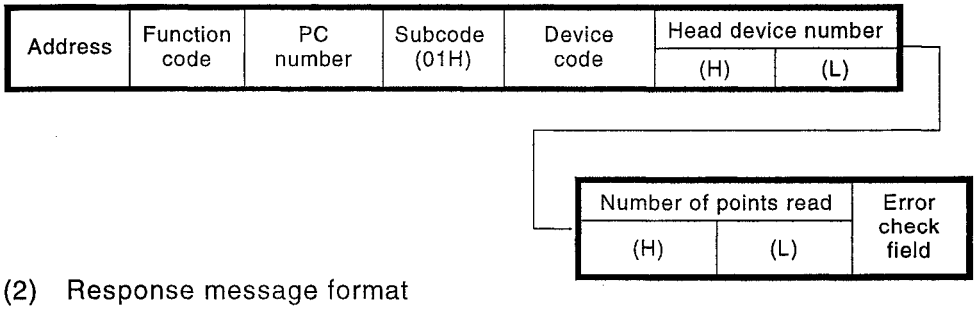


(2) Response message format

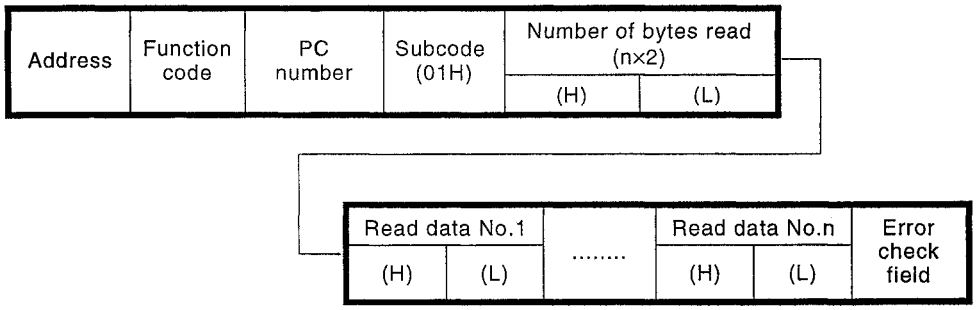


8.3.4 Device memory batch reading in word units

(1) Query message format

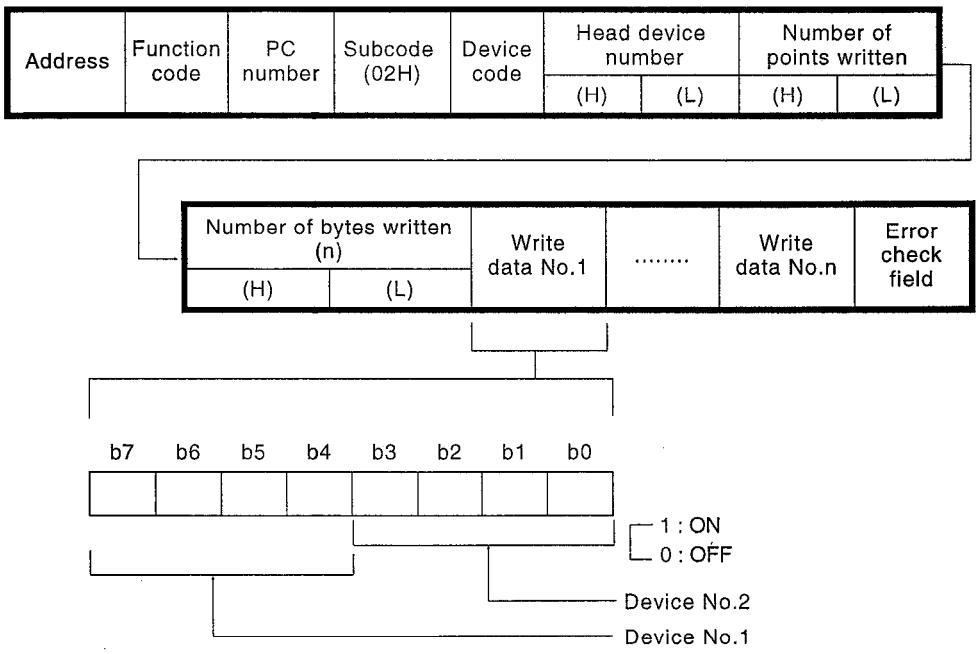


(2) Response message format

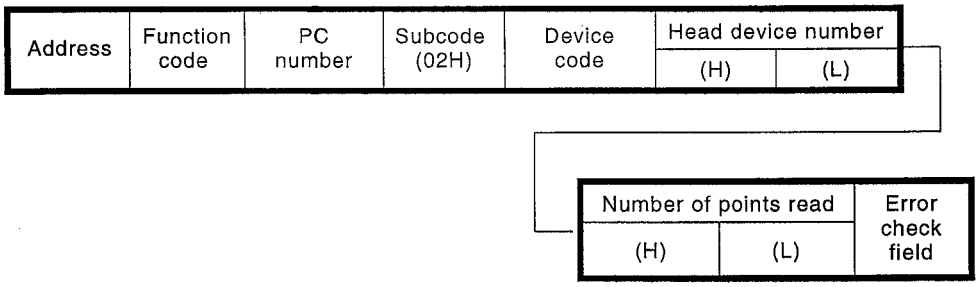


8.3.5 Device memory batch writing in bit units

(1) Query message format

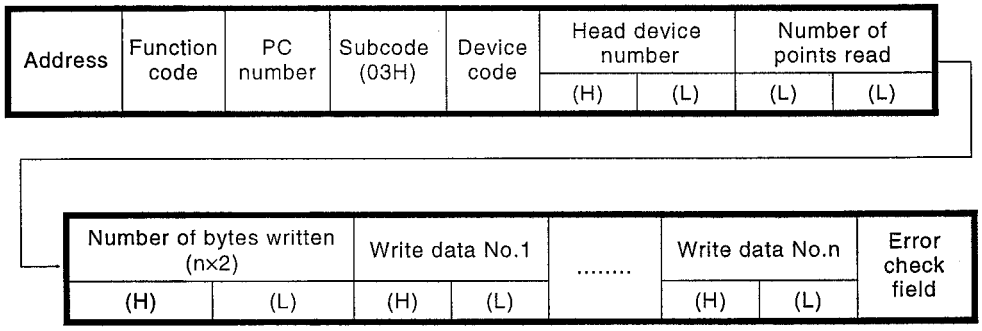


(2) Response message format

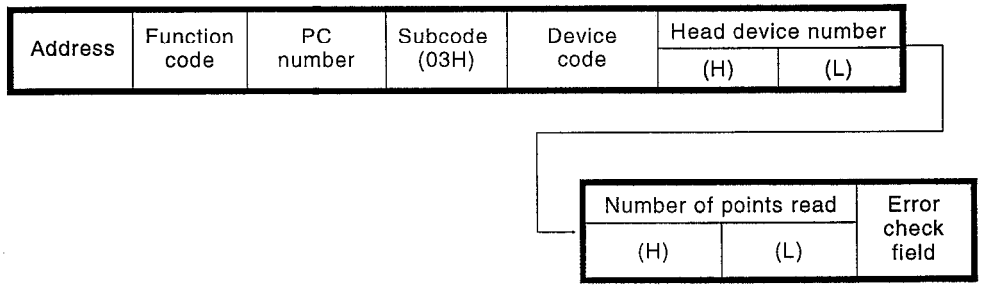


8.3.6 Device memory batch writing in wrod units

(1) Query message format

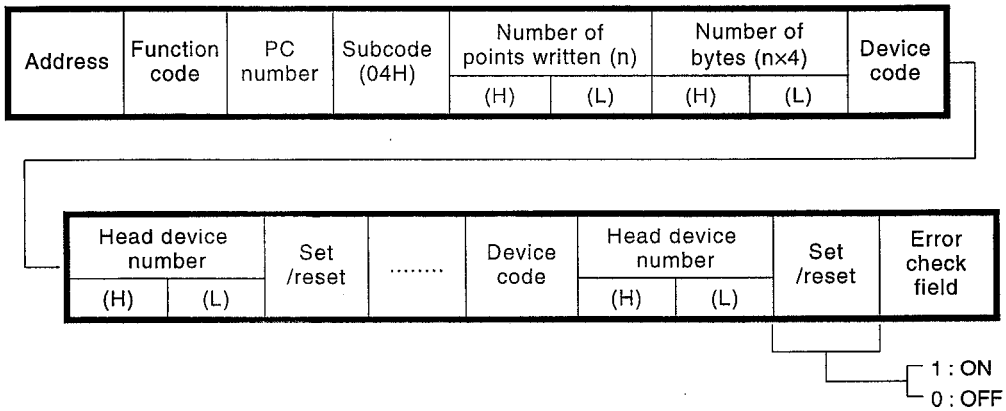


(2) Response message format

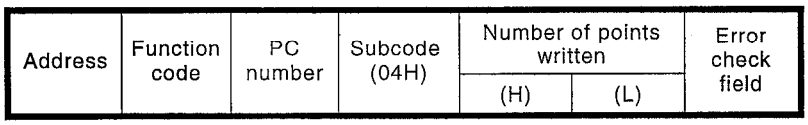


8.3.7 Device memory test in bit units (random write)

(1) Query message format

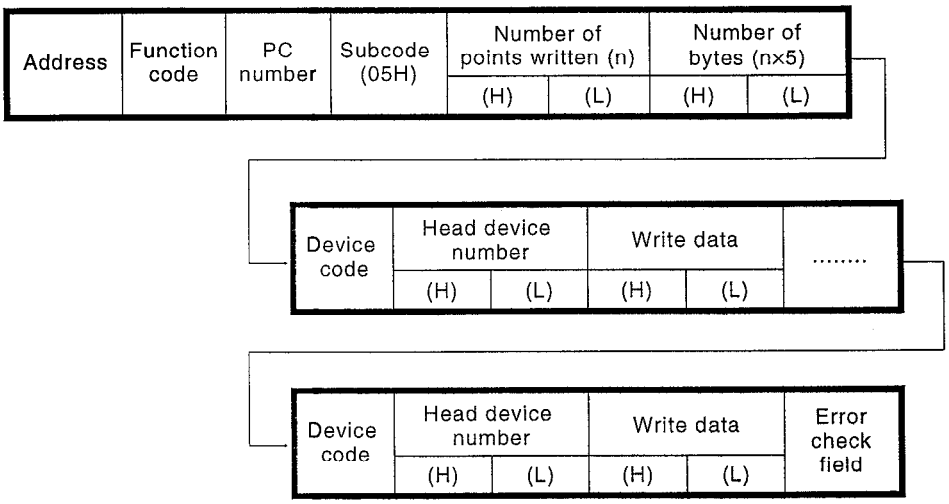


(2) Response message format

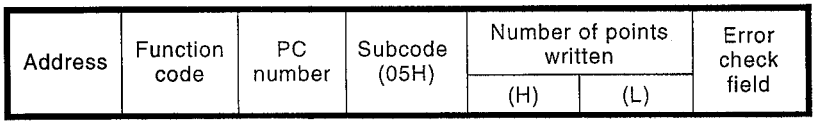


8.3.8 Device memory test in word units (random write)

(1) Query message format

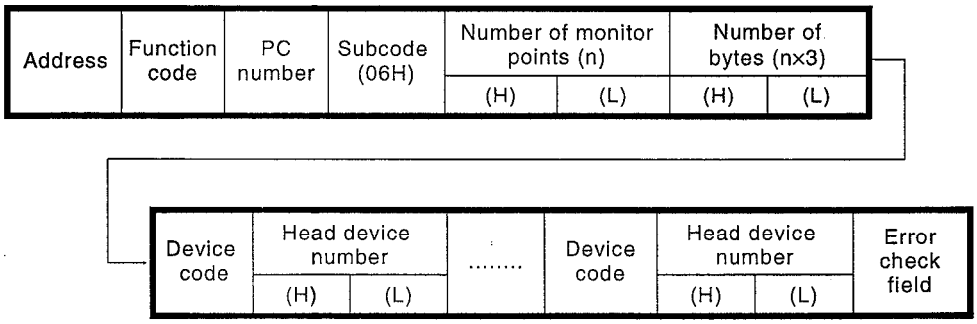


(2) Response message format

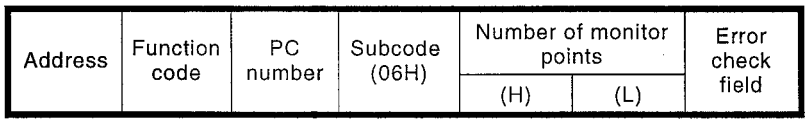


8.3.9 Device memory monitor data entry in bit units

(1) Query message format

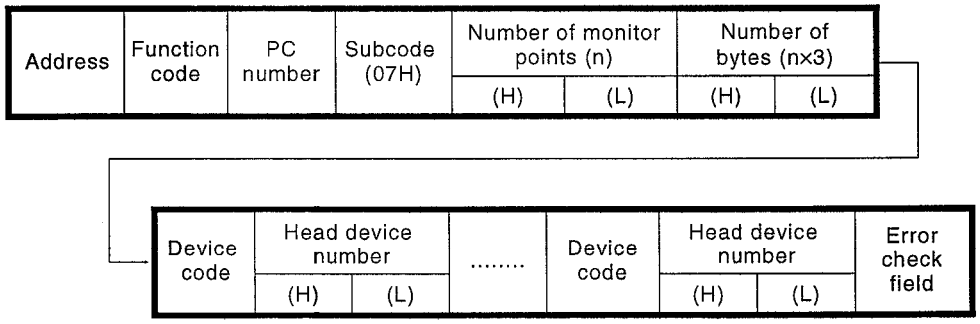


(2) Response message format

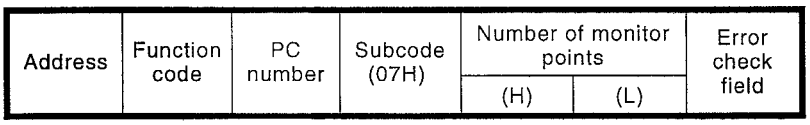


8.3.10 Device memory monitor data entry in word units

(1) Query message format



(2) Response message format



8.3.11 Device memory monitoring in bit units

(1) Query message format

Address	Function code	PC number	Subcode (08H)	Error check field

(2) Response message format

Address	Function code	PC number	Subcode (08H)	Number of monitor bytes (n)	
				(H)	(L)

Monitor data No.1	.....	Monitor data No.n	Error check field

b7	b6	b5	b4	b3	b2	b1	b0

1 : ON
0 : OFF

Device No.2

Device No.1

8.3.12 Device memory monitoring in word units

(1) Query message format

Address	Function code	PC number	Subcode (09H)	Error check field

(2) Response message format

Address	Function code	PC number	Subcode (09H)	Number of monitor bytes (n×2)	
				(H)	(L)

Monitor data No.1		.....	Monitor data No.n		Error check field
(H)	(L)		(H)	(L)	

8.4 Extension File Register Read/Write

Extension file registers are free areas of the PC CPU user memory that are used as file registers. They store the necessary data for, and operation results of, various types of data processing executed using software packages and extension file dedicated instructions.

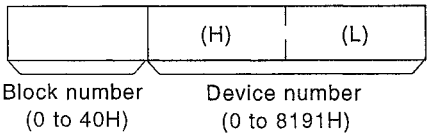
8.4.1 Extension file register read/write function list

Sub code	Function	Number of Points Processed in One Communication	PC CPU Status			Remarks
			STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
17H	Batch read	64 points	○	○	○	
18H	Batch write	64 points	○	○		
19H	Test (random write)	10 points	○	○		
1AH	Monitor data entry	20 points	○	○	○	
1BH	Monitor	———	○	○	○	

○: Can be executed
: Cannot be executed

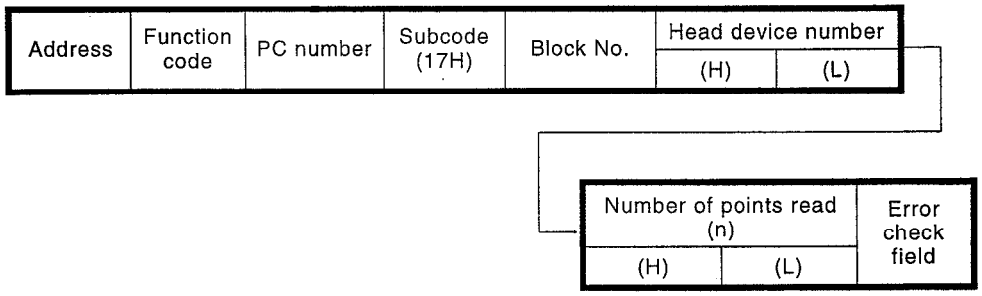
8.4.2 Extension file register addresses

Extension file registers are organized in blocks with block numbers 0 to n (the value for n differs according to the memory cassette; the highest value is 64). Block No.0 has a number of points designated in the PC CPU parameters, and blocks No.1 to n each have 8192 register points.
Addresses are specified by specifying a block number (1 byte) and a device number (2 bytes).

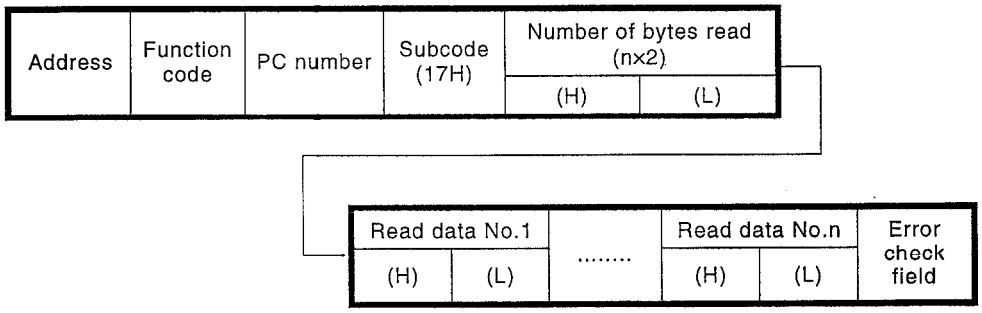


8.4.3 Extension file register batch read

(1) Query message format

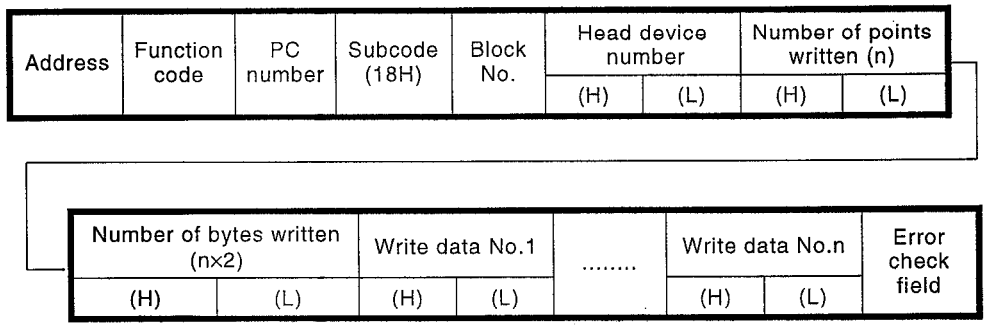


(2) Response message format

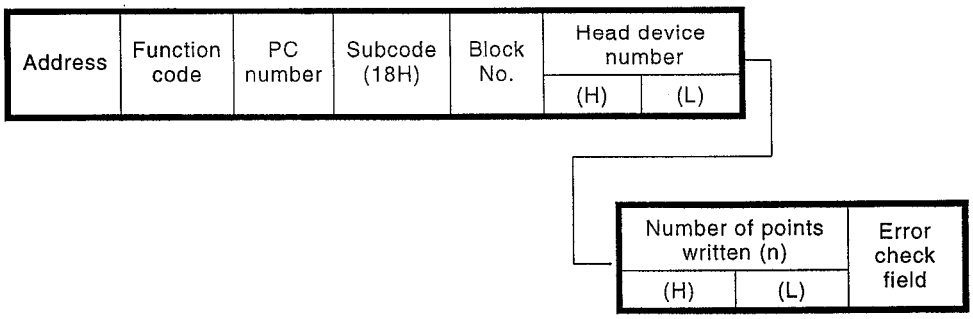


8.4.4 Extension file register batch write

(1) Query message format

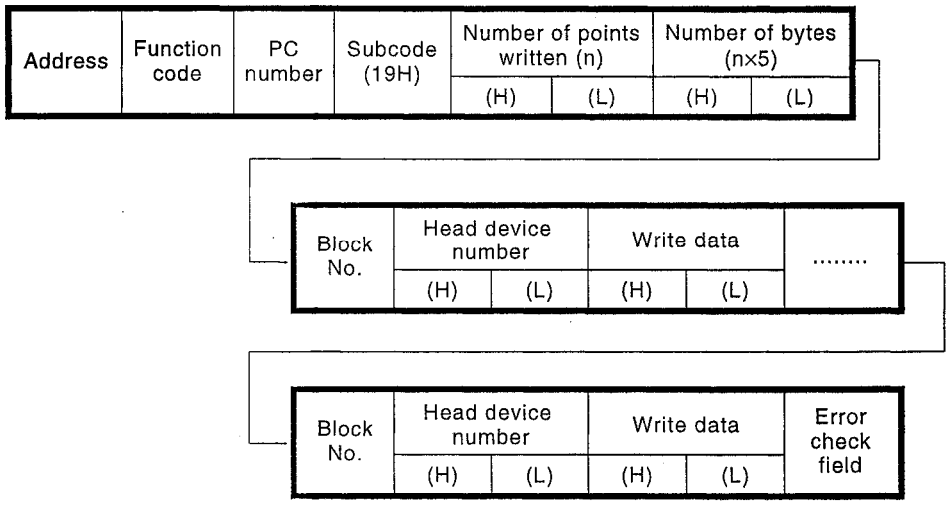


(2) Response message format

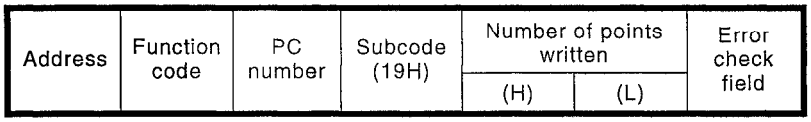


8.4.5 Extension file register test (random write)

(1) Query message format

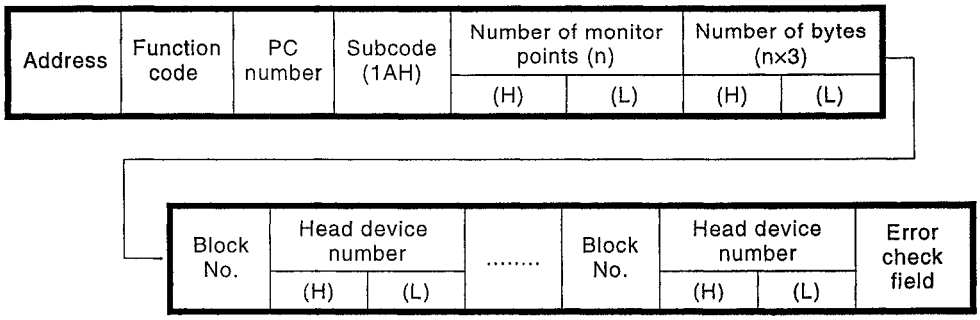


(2) Response message format

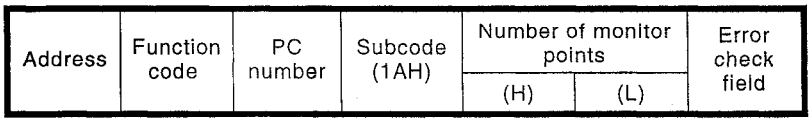


8.4.6 Extension file register monitor data entry

(1) Query message format



(2) Response message format



8.4.7 Extension file register monitoring

(1) Query message format

Address	Function code	PC number	Subcode (1BH)	Error check field

(2) Response message format

Address	Function code	PC number	Subcode (1BH)	Number of monitor bytes (n×2)	
				(H)	(L)

Monitor data No.1		.....	Monitor data No.n		Error check field
(H)	(L)		(H)	(L)	

8.5 Buffer Memory Read/Write

This function reads data from, and writes data to, the C24-S2 buffer memory.

8.5.1 Buffer memory read/write function list

Sub code	Function	Number of Points Processed in One Communication	PC CPU Status			Remarks
			STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
22H	Batch read	64 points	○	○	○	
23H	Batch write					

○ : Can be executed

× : Cannot be executed

8.5.2 Reading from the buffer memory

(1) Query message format

Address	Function code	PC number	Subcode (22H)	Head address		
				(higher)	(middle)	(lower)

Read word length		Error check field
(H)	(L)	

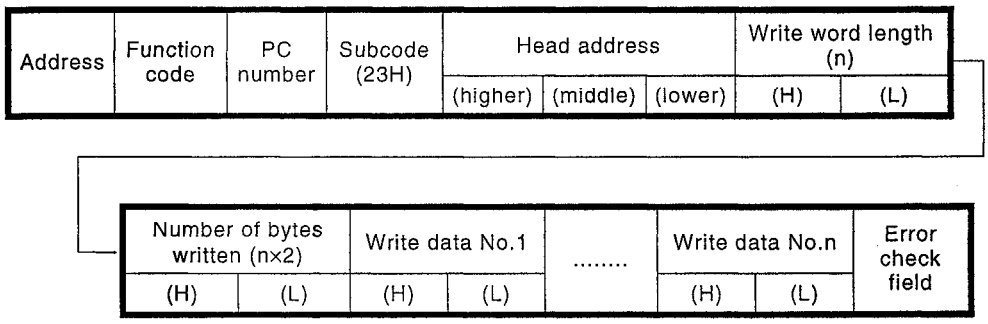
(2) Response message format

Address	Function code	PC number	Subcode (22H)	Number of bytes read (n×2)	
				(H)	(L)

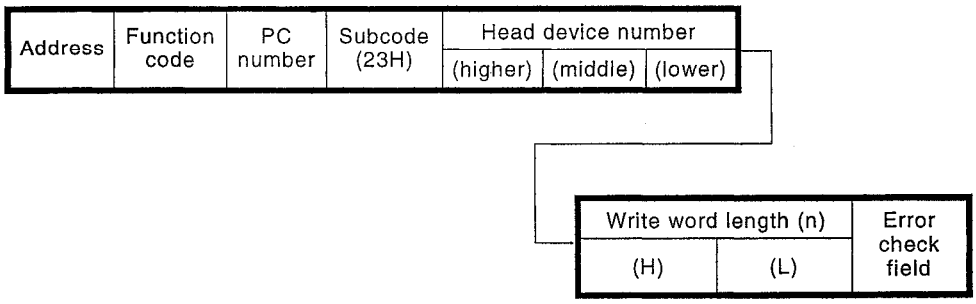
Read data No.1		.....	Read data No.n		Error check field
(H)	(L)		(H)	(L)	

8.5.3 Writing to the buffer memory

(1) Query message format



(2) Response message format



8.6 Special Function Module Buffer Memory Read/Write

This function reads data from, and writes data to, the buffer memory area of a special function module.

8.6.1 Special function module buffer memory read/write function list

Sub code	Function	Number of Points Processed in One Communication	PC CPU Status			Remarks
			STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
0EH	Batch read	128 bytes (64 words)	○	○	○	
0FH	Batch write		○	○		

○ : Can be executed
: Cannot be executed

8.6.2 Reading from the special function module buffer memory

(1) Query message format

Address	Function code	PC number	Subcode (0EH)	Head address		
				(higher)	(middle)	(lower)

Special function module No.		Read word length (n)		Error check field
(H)	(L)	(H)	(L)	

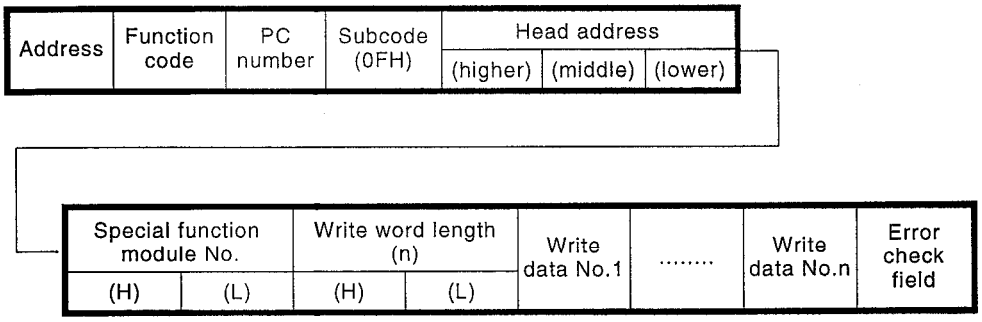
(2) Response message format

Address	Function code	PC number	Subcode (0EH)	Special function module No.		Read byte length (n)	
				(H)	(L)	(H)	(L)

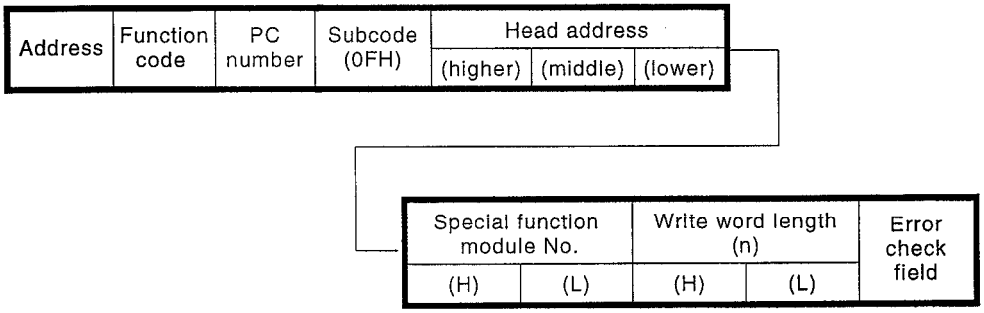
Read data No.1	.....	Read data No.n	Error check field

8.6.3 Writing to the special function module buffer memory

(1) Query message format



(2) Response message format



8.7 Reading and Writing Sequence Programs

This function is used to read and write the sequence program for a PC CPU.

8.7.1 Sequence program read/write function list

Sub code	Function			Number of Points Processed in One Communication	PC CPU Status			Remarks
					STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
0AH	Batch read	Main	T/C set value	64 points	○	○	○	
			Other than T/C set value	64 steps				
0BH		Sub	T/C set value	64 points	○	○	○	
			Other than T/C set value	64 steps				
0CH	Batch write	Main	T/C set value	64 points	○	○	×	
			Other than T/C set value	64 steps	○	○ *1	×	
0DH		Sub	T/C set value	64 points	○	○	×	
			Other than T/C set value	64 steps	○	○ *1		

○ : Can be executed
× : Cannot be executed

*1 Write during program RUN is possible when all the following conditions are met.

1) The PC CPU must be an A3, A3N, A3H, A3M, A73, A3A, A3U, or A4U.
2) The program written cannot be the one being run. (If the main program is being run, the subprograms called from the main program cannot be written either).
3) The PC CPU special relay must be in one of the following statuses.
   (a) M9051 (signal flow switching contact) : OFF (A3CPU only)
   (b) M9051 (CHG instruction execution disable) : ON

8.7.2 Designation of the head step

The addresses indicated in the table below can be specified for "sequence program" and "T/C set value".

Sequence Program, T/C Set Value		Head Step Designation
T/C set value	T0 set value	FE00H
	T1 set value	FE01H
	to	to
	T255 set value	FEFFH
	C0 set value	FF00H
	C1 set value	FF01H
	to	to
	C255 set value	FFFFH
Sequence program	Step 0	0000H
	Step 1	0001H
	to	to
	Step 30718 (30K)	77FEH

8.7.3 Main sequence program batch read

(1) Query message format

Address	Function code	PC No.	Subcode (0AH)	Head step		Number of steps		Error check field
				(H)	(L)	(H)	(L)	

(2) Response message format

Address	Function code	PC No.	Subcode (0AH)	Number of bytes read (n×2)	
				(H)	(L)

Read data No.1		.....	Read data No.n		Error check field
(H)	(L)		(H)	(L)	

8.7.4 Subsequence program batch read

(1) Query message format

Address	Function code	PC No.	Subcode (0BH)	Head step		Number of steps		Error check field
				(H)	(L)	(H)	(L)	

(2) Response message format

Address	Function code	PC No.	Subcode (0BH)	Number of bytes read (n×2)	
				(H)	(L)

Read data No.1		.....	Read data No.n		Error check field
(H)	(L)		(H)	(L)	

8.7.5 Main message format

(1) Query message format

Address	Function code	PC number	Subcode (0CH)	Head step		Number of steps (n)	
				(H)	(L)	(H)	(L)

Number of bytes written (n×2)		Write data No.1		.....	Write data No.n		Error check field
(H)	(L)	(H)	(L)		(H)	(L)	

(2) Response message format

Address	Function code	PC No.	Subcode (0CH)	Head step		Number of steps (n)		Error check field
				(H)	(L)	(H)	(L)	

8.7.6 Subsequence program batch read

(1) Query message format

Address	Function code	PC number	Subcode (0DH)	Head step		Number of steps (n)	
				(H)	(L)	(H)	(L)

Number of bytes written (n×2)		Write data No.1		.....	Write data No.n		Error check field
(H)	(L)	(H)	(L)		(H)	(L)	

(2) Response message format

Address	Function code	PC No.	Subcode (0DH)	Head step		Number of steps (n)		Error check field
				(H)	(L)	(H)	(L)	

8.8 Reading and Writing Microcomputer

This function is used to read and write microcomputer programs for a PC CPU.

8.8.1 Microcomputer program read/write function list

Sub code	Function		Number of Points Processed in One Communication	PC CPU Status			Remarks
				STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
1EH	Batch read	Main	128 bytes	○	○	○	
1FH		Sub					
20H	Batch write	Main	128 bytes	○	○ *1	×	
21H		Sub					

○: Can be executed
×: Cannot be executed

*1 Write during program RUN is possible when all the following conditions are met.

1)The PC CPU must be an A3, A3N, A3H, A3M,or A73

2)The program written cannot be the one being run. (If the main program is being run, the subprograms called from the main program cannot be written either.)

3)The PC CPU special relay must be in one of the following statuses.

(a) M9051 (signal flow switching contact) : OFF (A3CPU only)

(b) M9051 (CHG instruction execution disable) : ON

8.8.2 Microcomputer program addresses

The range of addresses that can be specified with each CPU type are indicated below.

CPU Model	Microcomputer Program Capacity	Microcomputer Program Addresses
A0J2HCPU A1SJCPU (S3) A1SJHCPU A1SCPU (S1) A1SHCPU	Max. 14 Kbytes	0000H to 37FEH
A1NCPU	Max. 10 Kbytes	0000H to 27FEH
A2SCPU (S1) A2SHCPU (S1) A2CPU (S1) A2NCPU (S1)	Max. 26 Kbytes	0000H to 67FEH
A3CPU, A3NCPU A3HCPU, A3MCPU A73CPU	Max. 58 Kbytes for both main and sub	0000H to E7FEH

8.8.3 Main microcomputer program batch read

(1) Query message format

Address	Function code	PC number	Subcode (1EH)	Head step		Number of bytes read (n)		Error check field
				(H)	(L)	(H)	(L)	

(2) Response message format

Address	Function code	PC number	Subcode (1EH)	Number of bytes read (n)	
				(H)	(L)

Read data No.1	.....	Read data No.n	Error check field

8.8.4 Sub microcomputer program batch read

(1) Query message format

Address	Function code	PC number	Subcode (1FH)	Head step		Number of bytes read (n)		Error check field
				(H)	(L)	(H)	(L)	

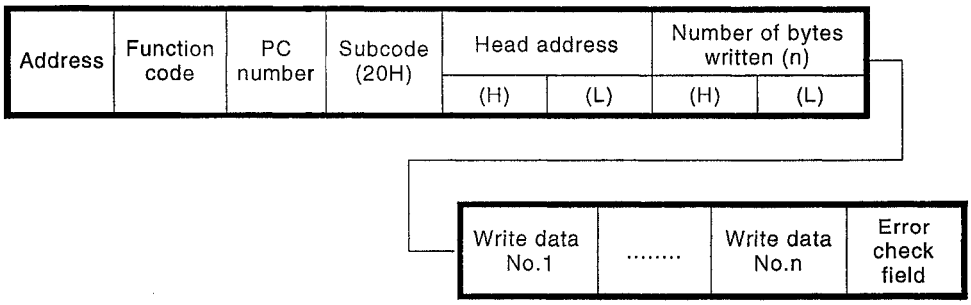
(2) Response message format

Address	Function code	PC number	Subcode (1FH)	Number of bytes read (n)	
				(H)	(L)

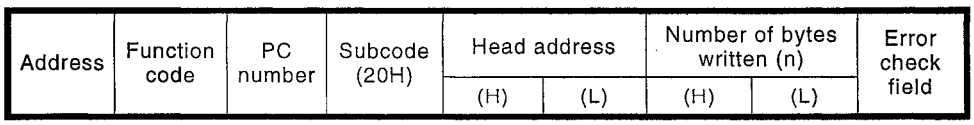
Read data No.1	.....	Read data No.n	Error check field

8.8.5 Main microcomputer program batch write

(1) Query message format

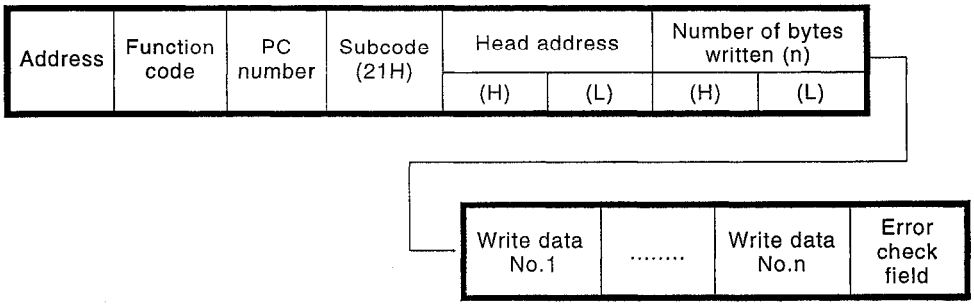


(2) Response message format

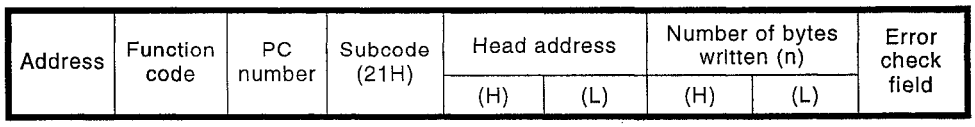


8.8.6 Sub microcomputer program batch write

(1) Query message format



(2) Response message format



8.9 Comment Memory Read/Write

This function is used to read data from, and write data to, the comment memory of the PC CPU.

8.9.1 Comment memory read/write function list

Sub code	Function	Number of Points Processed in One Communication	PC CPU Status			Remarks
			STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
1CH	Batch read	128 bytes	○	○	○	
1DH	Batch write	128 bytes	○	○	×	

○ : Can be executed
: Cannot be executed

Note:

- The comment data storage area is managed by using relative addresses, with the head address taken to be 00H. The comment memory has a maximum capacity of 64 Kbytes and the address range for comment data is determined by the capacity set in the parameters.

8.9.2 Comment memory batch read

(1) Query message format

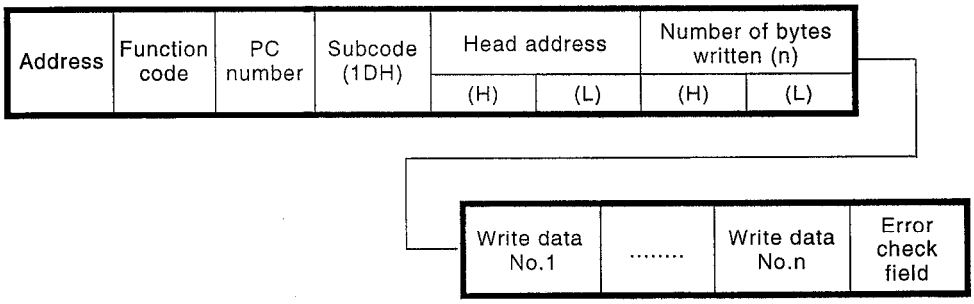
Address	Function code	PC number	Subcode (1CH)	Head step		Number of bytes read (n)		Error check field
				(H)	(L)	(H)	(L)	

(2) Response message format

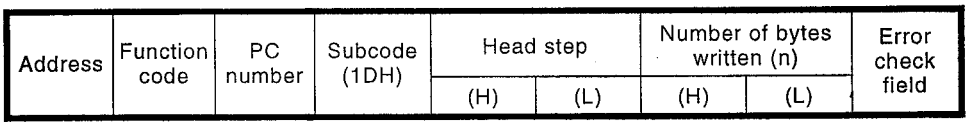
Address	Function code	PC number	Subcode (1CH)	Number of bytes read (n)		Read data No.1	.....	Read data No.n	Error check field
				(H)	(L)				

8.9.3 Comment memory batch write

(1) Query message format



(2) Response message format



8.10 Parameter Memory Read/Write

This function is used to read the contents of the PC CPU parameter memory, and to write data to the parameter memory.

8.10.1 Comment memory read/write function list

Sub code	Function	Number of Points Processed in One Communication	PC CPU Status			Remarks
			STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
10H	Batch read	128 bytes	○	○	○	
11H	Batch write	128 bytes	○		×	
12H	Analysis request		○	×	×	

○ : Can be executed
× : Cannot be executed

Note:

- The parameter memory area has a capacity of 3 Kbytes, with an address range from 0 to 0BFFH.

8.10.2 Parameter memory batch read

(1) Query message format

Address	Function code	PC number	Subcode (10H)	Parameter head address		
				(higher)	(middle)	(lower)

Number of bytes read (n)		Error check field
(H)	(L)	

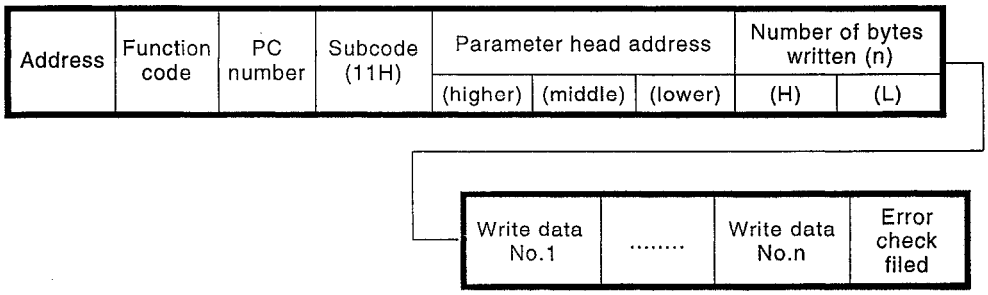
(2) Response message format

Address	Function code	PC number	Subcode (10H)	Number of bytes read (n)	
				(H)	(L)

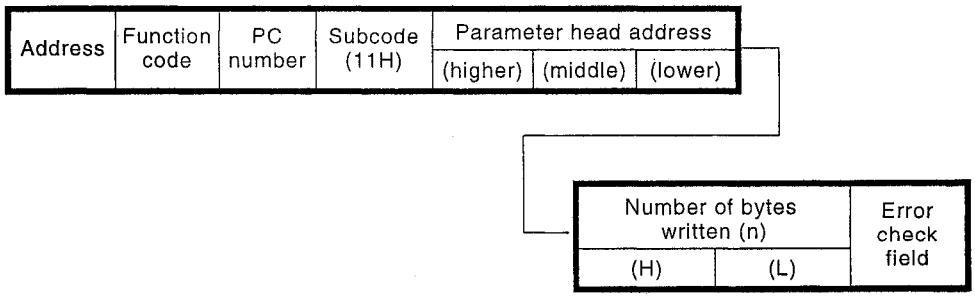
Read data No.1	.....	Read data No.n	Error check field

8.10.3 Parameter memory batch write

(1) Query message format

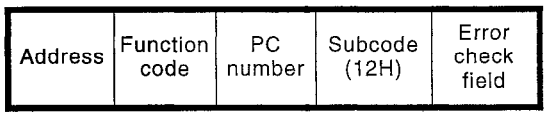


(2) Response message format

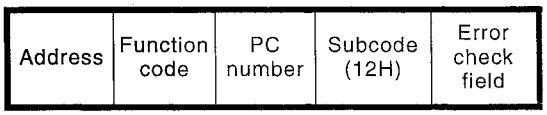


8.10.4 Parameter memory analysis request

(1) Query message format



(2) Response message format



8.11 PC CPU Remote RUN/STOP, CPU Type Read

These functions are used to set the PC CPU in the RUN or STOP status remotely from the MODBUS master station, and to read the PC CPU type.

8.11.1 Remote RUN/STOP and CPU type read function list

Sub code	Function	Number of Points Processed in One Communication	PC CPU Status			Remarks
			STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
13H	Remote RUN		○	○	○	
14H	Remote STOP		○	○	○	
15H	PC type read		○	○	○	

○ : Can be executed

× : Cannot be executed

8.11.2 Remote RUN/STop control details

The status of the PC CPU is determined as shown in the table below by the combination of the remote RUN/STOP request from the MODBUS master station and the position of the RUN/STOP key switch on the front face of the PC CPU.

		Position of Key Switch on Front Face of PC CPU			
		RUN	STOP	PAUSE	STEP-RUN
Designation from MODBUS master station	Remote RUN	RUN	STOP	PAUSE	STEP-RUN
	Remote STOP	STOP	STOP	STOP	STOP

Note:

- If the relevant PC CPU has already been set in the remote STOP status by, for example, another computer, it will not go into the remote RUN status even if the remote RUN function is executed.
- When the remote RUN function is executed, as shown in the table below, the status of special relays M9016 and M9017 determines whether the RUN status becomes effective after the data memory has been cleared.

8.11.3 Remote RUN

(1) Query message format

Address	Function code	PC number	Subcode (13H)	Error check field

(2) Response message format

Address	Function code	PC number	Subcode (13H)	Error check field

8.11.4 Remote STOP

(1) Query message format

Address	Function code	PC number	Subcode (14H)	Error check field

(2) Response message format

Address	Function code	PC number	Subcode (14H)	Error check field

8.11.5 PC CPU type read

(1) Query message format

Address	Function code	PC number	Subcode (15H)	Error check field

(2) Response message format

Address	Function code	PC number	Subcode (15H)	PC type	Error check field

8.11.6 PC CPU type and read data

PC CPU Type	Reading Result	PC CPU Type	Reading Result
A1CPU, A1NCPU	A1H	A0J2HCPU, A1SCPU, A1SJCPU	98H
A2CPU, A2CPU-S1, A2NCPU, A2NCPU-S1, A1SCPU-S1, A2SCPU, A2SCPU-S1	A2H	A52GCPU	9AH
A3CPU, A3NCPU, A73CPU	A3H	A2UCPU, A2ASCPU	82H
A3HCPU, A3MCPU	A4H	A2UCPU-S1, A2ASCPU-S1	83H
A2ACPU	92H	A3UCPU, AJ72LP25, AJ72BR15	84H
A2ACPU-S1	93H	A4UCPU	85H
A3ACPU	94H	Q2ASCPU, Q2ASHCPU Q2ACPU	92H
A1SJHCPU, A1SHCPU	A3H	Q2ASCPU-S1, Q2ASHCPU-S1 Q2ACPU-S1	93H
A2SHCPU, A2SHCPU-S1	A3H	Q3ACPU	94H
A2USHCPU-S1	84H	Q4ACPU, Q4ARCPU	94H

8.12 Loopback Test

This function is used to test whether or not communication between the MODBUS master station and C24-S2 is normal, by echoing back characters received from the MODBUS master station without changing them.

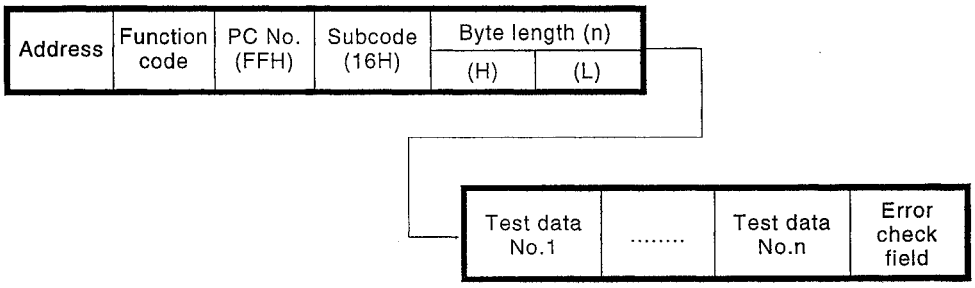
8.12.1 Loopback test function list

Sub code	Function	Number of Points Processed in One Communication	PC CPU Status			Remarks
			STOP	"Write during RUN" Enabled	"Write during RUN" Disabled	
16H	Loopback test	254 bytes	○	○	○	

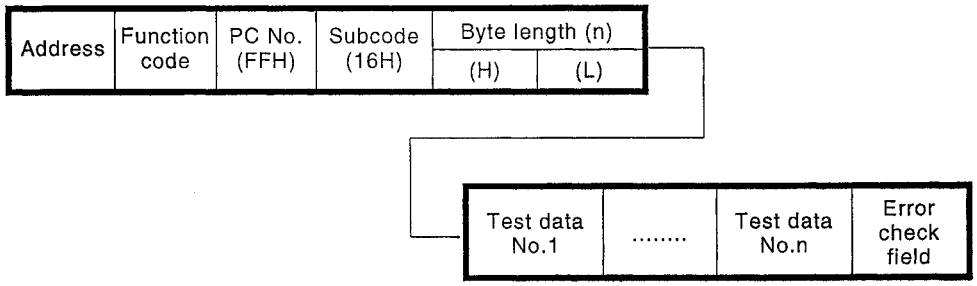
○ : Can be executed

× : Cannot be executed

(1) Query message format



(2) Response message format



9. SELF-LOOPBACK TEST

The self-loopback test function is used to check that the C24-S2 is operating normally as an isolated unit, without connecting it to the MODBUS master station. This function is selected by setting the mode setting switch to "F".

9.1 AJ71UC24-S2 Self-Loopback Test

9.1.1 Procedure to carry out the self-loopback test

The procedure to carry out the self-loopback test is as follows.

Step 1 Connect the cables
Connect the cables to the RS-232C and RS-422/485 connectors as shown below.

RS-232C Cable Connections

C24-S2		Cable Connections
Signal Name	Pin Number	
FG	1	
SD	2	
RD	3	
RS	4	
CS	5	
DSR	6	
SG	7	
CD	8	
DTR	20	

RS-422/485 Cable Connections

C24-S2	Cable Connections
Signal Name	
SDA	
SDB	
RDA	
RDB	
SG	
FG	

Step 2 Set the mode setting switch
Set the mode setting switch to "F" to select the self-loopback test.

Step 3 Execute the self-loopback test

(1) Turn the PC CPU power supply ON or reset the PC CPU.
The C24-S2 turns ON the ready signal (Xn7), and the test automatically starts.

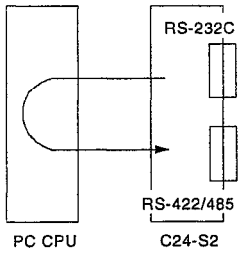
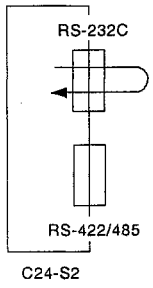
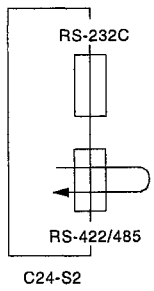
(2) Check sequence
Checks are executed in the following order:
1) PC CPU communications check
2) RS-232C communications check
3) RS-422/485 communications check
The checks are then repeated.

(3) Check the LED display status, as described in Section 9.1.2.
Normal ..... Go to step (4) to end the test.
Error ..... Correct the error and repeat the self-loopback test.

(4) When the checks are completed:
1) Turn the power supply OFF.
2) Disconnect the cables. Connect the cables for communication with the MODBUS master station.
3) Change the setting of the mode setting switch ("0" to "2").

9.1.2 Self-loopback test operations

The check operations in the self-loopback test, the LED indications when normal and in the event of an error, etc., are shown in the table below.

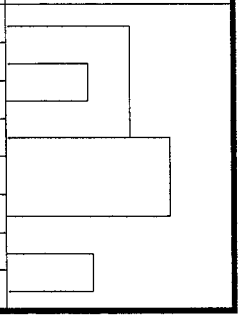
Check Items	Check Descriptions	Normal Indicator LED Status		Error Indicator LED Status		Remarks
PC CPU communication check	After writing data to special register D9072, the C24-S2 reads and verifies it. If the data matches, the data is changed and the procedure is repeated. If the data does not match, an error is indicated.	2-C/N (LED No.16)	OFF	2-C/N (LED No.16)	ON	
		PC CPU R/W (LED No.25)	Flashing			
RS-232C communications check	Checks if data sent from the RS-232C interface of the C24-S2 is correctly received by the same interface. If normal, the C24-S2 changes the data and the procedure is repeated. If not normal, an error is indicated. An error is indicated if no cable is connected.	2-SIO (LED No.19)	OFF	2-SIO (LED No.19)	ON	
		2-SD (LED No.1)	Flashing			
		2-RD (LED No.2)				
RS-422/485 communications check	Checks if data sent from the RS-422/485 interface of the C24-S2 is correctly received by the same interface. If normal, the C24-S2 changes the data and the procedure is repeated. if not normal, an error is indicated. An error is indicated if no cable is connected	4-SIO (LED No.23)	OFF	4-SIO (LED No.23)	ON	
		4-SD (LED No.10)	Flashing			
		4-RD (LED No.11)				

9.2 A1SJ71UC24-R2-S2 Self-Loopback Test

9.2.1 Procedure to carry out the self-loopback test

The procedure to carry out the self-loopback test is as follows.

Step 1 Connect the cables
Connect the cables to the RS-232C connectors as shown below.

C24-S2		Cable Connections
Signal Name	Pin Number	
CD	1	
RD	2	
SD	3	
DTR	4	
SG	5	
DSR	6	
RS	7	
CS	8	

Step 2 Set the mode setting switch
Set the mode setting switch to "F" to select the self-loopback test.

Step 3 Execute the self-loopback test

(1) Turn the PC CPU power supply ON or reset the PC CPU.
The C24-S2 turns ON the ready signal (Xn7), and the test automatically starts.

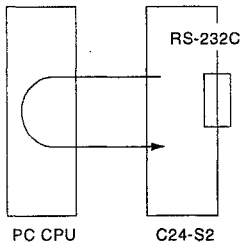
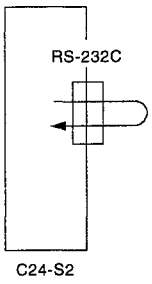
(2) Check sequence
Checks are executed in the following order:
1) PC CPU communications check
2) RS-232C communications check
The checks are then repeated.

(3) Check the LED display status, as described in Section 9.2.2.
Normal.....Go to step (4) to end the test.
Error ..... Correct the error and repeat the self-loopback test.

(4) When the checks are completed:
1) Turn the power supply OFF.
2) Disconnect the cables. Connect the cables for communication with the MODBUS master station.
3) Change the setting of the mode setting switch ("0").

9.2.2 Self-loopback test operations

The check operations in the self-loopback test, the LED indications when normal and in the event of an error, etc., are shown in the table below.

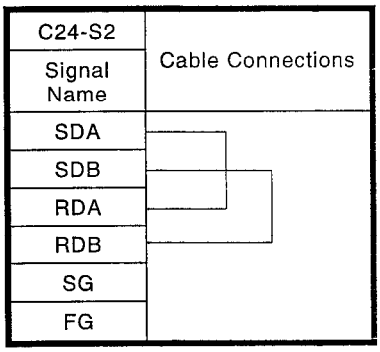
Check Items	Check Descriptions	Normal Indicator LED Status		Error Indicator LED Status		Remarks
PC CPU communication check	After writing data to special register D9072, the C24-S2 reads and verifies it. If the data matches, the data is changed and the procedure is repeated. If the data does not match, an error is indicated.	C/N (LED No.11)	OFF	C/N (LED No.11)	ON	
		CPU (LED No.3)	Flashing			
RS-232C communications check	Checks if data sent from the RS-232C interface of the C24-S2 is correctly received by the same interface. If normal, the C24-S2 changes the data and the procedure is repeated. If not normal, an error is indicated. An error is indicated if no cable is connected.	SIO (LED No.14)	OFF	SIO (LED No.14)	ON	
		SD (LED No.1)	Flashing			
		RD (LED No.2)				

9.3 A1SJ71UC24-R4-S2 Self-Loopback Test

9.3.1 Procedure to carry out the self-loopback test

The procedure to carry out the self-loopback test is as follows.

Step 1 Connect the cables
Connect the cables to the RS-422/485 terminal block as shown below.



Step 2 Set the mode setting switch
Set the mode setting switch to "F" to select the self-loopback test.

Step 3 Execute the self-loopback test

(1) Turn the PC CPU power supply ON or reset the PC CPU.
The C24-S2 turns ON the ready signal (Xn7), and the test automatically starts.

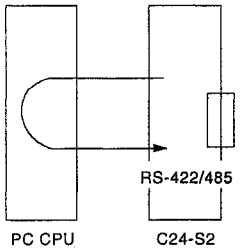
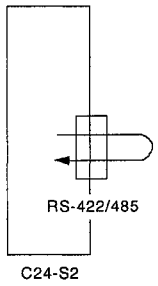
(2) Check sequence
Checks are executed in the following order:
1) PC CPU communications check
2) RS-422/485 communications check
The checks are then repeated.

(3) Check the LED display status, as described in Section 9.1.2.
Normal.....Go to step (4) to end the test.
Error ..... Correct the error and repeat the self-loopback test.

(4) When the checks are completed:
1) Turn the power supply OFF.
2) Disconnect the cables. Connect the cables for communication with the MODBUS master station.
3) Change the setting of the mode setting switch ("1").

9.3.2 Self-loopback test operations

The check operations in the self-loopback test, the LED indications when normal and in the event of an error, etc., are shown in the table below.

Check Items	Check Descriptions	Normal Indicator LED Status		Error Indicator LED Status		Remarks
PC CPU communication check	After writing data to special register D9072, the C24-S2 reads and verifies it. If the data matches, the data is changed and the procedure is repeated. If the data does not match, an error is indicated.	C/N (LED No.11)	OFF	C/N (LED No.11)	ON	
		CPU (LED No.3)	Flashing			
RS-422/485 communications check	Checks if data sent from the RS-422/485 interface of the C24-S2 is correctly received by the same interface. If normal, the C24-S2 changes the data and the procedure is repeated. if not normal, an error is indicated. An error is indicated if no cable is connected	SIO (LED No.14)	OFF	SIO (LED No.14)	ON	
		SD (LED No.1)	Flashing			
		RD (LED No.2)				

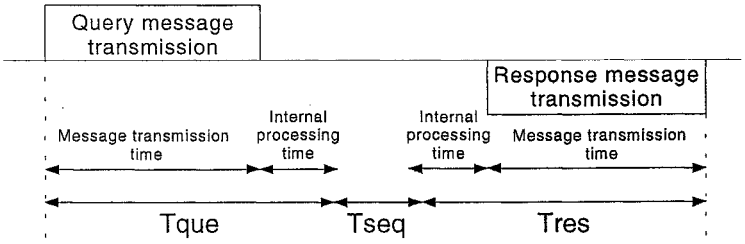
10. PROCESSING TIME

10.1 Transmission Delay Time

The transmission delay time is the time lapse between the transmission of a query message from the MODBUS master station and the reception of a response message.

MODBUS
master station

C24-S2



Transmission delay time (T) = Tque + Tseq + Tres

T que (query message processing time) = Query message transmission time ((number of bytes × number of bits in one character)/baud rate × 1000 ms) + C24-S2 internal processing time (approx. 2 ms + number of bytes × 3μs) *1

T seq (PC CPU processing time) = Sequence scan time × n times *2

T res (response message processing time) = Response message transmission time ((number of bytes × number of bits in one character)/baud rate × 1000 ms) + C24-S2 internal processing time (approx. 2 ms + number of bytes × 3μs) *1

*1 46μs in the ASCII mode

*2 For the number of accesses determined in accordance with the type of query message request, see the APPENDIX.

10.1.1 Calculation examples

(1) The transmission delay time when 256 points are read in the RTU mode by using the MODBUS standard function "read coil status" is calculated below.
The transmission specifications are assumed to be as follows: parity bit exists (odd), stop bit = 1 bit, transmission speed = 19200 bps. The PC CPU scan time is assumed to be 100 ms.

1) Query message format

Address	Function code (01H)	Device designation		Number of points read		Error check field
		(H)	(L)	(01H)	(00H)	

2) Response message format

Address	Function code (01H)	Number of bytes read (32)	Read data No.1	.....	Read data No.32	Error check field

T que (query message processing time) = Query message transmission time ((number of bytes × number of bits in one character)/baud rate × 1000 ms) + C24-S2 internal processing time (approx. 2 ms + number of bytes × 3μs)
= Query message transmission time ((7 × 11) / 19200 × 1000ms) + C24-S2 internal processing time (2 ms + 7 X 3μs)
= 4.01 ms + 2 ms + 0.02 ms
= 6.03 ms

T seq (PC CPU processing time) = Sequence scan time × n times
= 100 ms × 1 time
= 100 ms

T res (response message processing time) = Response message transmission time ((number of bytes × number of bits in one character)/baud rate × 1000 ms) + C24-S2 internal processing time (approx. 2 ms + number of bytes × 3μs)
= Response message transmission time ((36 × 11)/19200 × 1000 ms) + C24-S2 internal processing time (2 ms + 36 × 3μs)
= 20.63 ms + 2 ms + 0.11 ms
= 22.74 ms

Transmission delay time (T) = Tque + Tseq + Tres
= 6.03 ms + 100 ms + 22.74 ms
= 128.77 ms

(2) The transmission delay time when the MODBUS standard function "force single coil" is executed in the ASCII mode is calculated below. The transmission specifications are assumed to be as follows: parity bit exists (odd), stop bit = 1 bit, transmission speed = 19200 bps. The PC CPU scan time is assumed to be 100 ms.

1) Query message format

Address	Function code (05H)	Device designation		ON/OFF data		Error check field
		(H)	(L)	(H)	(L)	

2) Response message format

Address	Function code (05H)	Device No.		ON/OFF data		Error check field
		(H)	(L)	(H)	(L)	

Note:

- In the actual message format, there are two bytes of ASCII code between the address and the error check field, and a colon preceding the address and carriage return (CR) and line feed (LF) characters after the error check field are used as the synchronization characters.

T que (query message proccessing time) = Query message transmission time ((number of bytes × numberof bits in one character)/baud rate × 1000 ms) + C24-S2 internal processing time (approx. 2 ms + number of bytes × 46μs)

= Query message transmission time ((17 × 10)/19200 × 1000 ms + C24-S2 internal processing time (2 ms + 7 × 46μs)

= 8.85 ms + 2 ms + 0.32 ms

11.17 ms

T seq (PC CPU processing time) = Sequence scan time × n times

= 100 ms × 1 time

= 100 ms (1 time: If "disabled during RUN" is set)

T res (response message processing time) = Response message transmission time ((number of bytes × number of bits in one character)/baud rate × 1000 ms) + C24-S2 internal processing time (approx. 2 ms + number of bytes × 3μs)

= Response message transmission time ((17 × 10)/19200 × 1000 ms + C24-S2 internal processing time (2 ms + 7 × 46μs)

= 8.85 ms + 2 ms + 0.32 ms

= 11.17 ms

Transmission delay time (T) = Tque + Tseq + Tres
= 11.17 ms + 100 ms + 11.17 ms
= 122.34 ms

11. HANDLING PRECAUTIONS

(1) C24-S2 station numbers can be set in the range 1 to 99, and a maximum of 32 stations can be set on one RS-422/485 line.
Station numbers cannot be duplicated within the same system.

(2) The transmission specifications must be the same for all stations on the same line.

(3) Since the A1SJ71UC24-R2-S2 has no station number setting switch, it judges all received data to be destined for it.

(4) Dedicated commands for C24 cannot be used, and it is not possible to register the model name in I/O allocation.

APPENDIX

If the PC CPU is in the RUN status when it receives a request from the C24-S2, the request is processed after execution of the END instruction. The intervening times added to the scan time and the number of scans required for processing are indicated below.

(1) MODBUS standard functions

Item	Itervening Time [ms] (Extension of Scan Time)					Number of Scans Required for Processing
	A0J2H, A1S, AnN	A3H	AnA	AnU	Access Data Unit	
READ COIL STATUS	0.76 ms	0.57 ms	1.38 ms	1.95 ms	256 devices	1 scan
READ HOLDING REGISTERS	1.13 ms	0.81 ms	2.42 ms	3.51 ms	64 devices	1 scan devices (2 scans for "R" devices only)
FORCE SINGLE COIL	1.13 ms	0.94 ms	1.06 ms	1.65 ms	1 device	2 scans (1 scan when "enableduring RUN" is set)
PRESET SINGLE REGISTERS	1.13 ms	0.84 ms	2.60 ms	3.90 ms	1 device	2 scans (1 scan when "enableduring RUN" is set [excluding R])
READ EXCEPTION STATUS	——	——	——	——	——	1 scan
LOOPBACK DIAGNOSTICTEST	——	——	——	——	——	——
FETCH EVENT COUNTER COMMUNICATIONS	——	——	——	——	——	——
FETCH COMMUNICATIONS EVENT LOG	——	——	——	——	——	——
FORCE MULTIPLE COILS	1.13 ms	0.94 ms	1.06 ms	1.65 ms	160 devices	2 scans (1 scan when devices "enable during RUN" is set)
FORCE MULTIPLE REGISTERS	1.13 ms	0.84 ms	2.60 ms	3.90 ms	64 devices	2 scans (1 scan when "enable during RUN" is set [excluding R])
REPORT SLAVE I.D.	——	——	——	——	——	1 scan
READ GENERAL REFERENCE	1.27 ms	0.76 ms	2.42 ms	5.00 ms	64 devices	2 scans
WRITE GENERAL REFERENCE	1.27 ms	0.76 ms	2.60 ms	5.40 ms	64 devices	2 scans

(2) Optional functions (data link function)

Item			Itervening Time [ms] (Extension of Scan Time)					Number of Scans Required for Processing
			A0J2H, A1S, AnN	A3H	AnA	AnU	Access Data Unit	
Device memory	Batch read	Bit units	0.76 ms	0.57 ms	1.38 ms	1.95 ms	256 devices	1 scan (2 scans for device "R" only)
		Word devices	1.13 ms	0.81 ms	2.42 ms	3.51 ms	64 devices	
	Batch write	Bit units	1.13 ms	0.94 ms	1.06 ms	1.65 ms	160 devices	2 scans (1 scan when "enable during RUN" is set [excluding R])
		Word devices	1.13 ms	0.84 ms	2.60 ms	3.90 ms	64 devices	
	Test (random write)	Bit units	1.13 ms	0.90 ms	1.06 ms	1.55 ms	20 devices	2 scans (1 scan when "enable during RUN" is set [excluding R])
		Word devices	1.13 ms	0.90 ms	1.06 ms	0.95 ms	10 devices	
	Monitor data entry	Bit units	——	——	——	——	——	——
		Word devices						1 scan for device "R" only
	Monitor	Bit units	2.02 ms	0.93 ms	1.46 ms	0.70 ms	40 devices	1 scan
		Word devices	2.08 ms	0.96 ms	1.47 ms	0.70 ms	20 devices	
Extension file register	Batch read		1.27 ms	0.76 ms	2.42 ms	5.00 ms	64 devices	2 scans
	Batch write		1.27 ms	0.76 ms	2.60 ms	5.40 ms	64 devices	
	Test (random write)		1.31 ms	0.87 ms	0.97 ms	1.75 ms	10 devices	2 scans
	Monitor data entry		——	——	——	——	——	1 scan
	Monitor		1.75 ms	0.98 ms	1.42 ms	0.85 ms	20 devices	
Buffer memory	Batch read		——	——	——	——	——	——
	Batch write							
Special function module buffer memory	Batch read		FROM instruction + processing time	FROM instruction + processing time	FROM instruction + processing time	FROM instruction + processing time	128 bytes	1 scan
	Batch write		1.13 ms	0.81 ms	0.75 ms	1.20 ms		2 scans (1 scan when "enable during RUN" is set)
Sequence program	Batch read	Main	1.20 ms	0.78 ms	0.70 ms	1.10 ms	64 steps	1 scan
		Sub	1.20 ms	0.84 ms	0.70 ms	1.05 ms		
	Batch write	Main	1.35 ms	0.75 ms	0.70 ms	0.75 ms		2 scans
		Sub	1.70 ms	0.76 ms	0.70 ms	1.45 ms		
Micro computer program	Batch read	Main	1.35 ms	0.76 ms	——	——	128 bytes	2 scans
		Sub	1.35 ms	0.76 ms				
	Batch write	Main	1.35 ms	0.73 ms				
		Sub	1.53 ms	0.73 ms				
Comment	Batch read		1.35 ms	0.76 ms	2.42 ms	4.90 ms	128 bytes	2 scans
	Batch write		1.53 ms	0.73 ms	2.60 ms	5.35 ms		
Parameter	Batch read		0.68 ms	0.50 ms	2.42 ms	4.95 ms	128 bytes	2 scans
	Batch write		——	——	——	——	——	
	Analysis request							
PC CPU	Remote RUN		——	——	——	——	——	1 scan
	Remote STOP		——	——	——	——	——	
	PC type read		——	——	——	——	——	
Loopback test			——	——	——	——	——	——

IMPORTANT

(1) Design the configuration of a system to provide an external protective or safety inter locking circuit for the PCs.

(2) The components on the printed circuit boards will be damaged by static electricity, so avoid handling them directly. If it is necessary to handle them take the following precautions.

(a) Ground human body and work bench.

(b) Do not touch the conductive areas of the printed circuit board and its electrical parts with any non-grounded tools etc.

Under no circumstances will Mitsubishi Electric be liable or responsible for any consequential damage that may arise as a result of the installation or use of this equipment.

All examples and diagrams shown in this manual are intended only as an aid to understanding the text, not to guarantee operation. Mistubishi Electric will accept no responsibility for actual use of the product based on these lillustrative examples.

Owing to the very great variety in possible applications of this equipment, you must satisfy yourself as to its suitability for your specific application.

Serial communication compatible with MODBUS
type AJ71UC24-S2/A1SJ71UC24-R2-S2/A1SJ71UC24-R4-S2

User's Manual

MODEL	MODBUS-U-E
MODEL CODE	13J806
IB(NA)-66583-B(9911)MEE	

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